

FR-A 500

Frequency Inverter

Installation Manual

FR-A 540 EC

FR-A 540L-G EC

About this Manual

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

If you have any questions concerning the programming and operation of the equipment described in this manual, please contact your relevant sales office or department (refer to back of cover).

Current information and answers to frequently asked questions are also available through the Internet (www.mitsubishi-automation.com).

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

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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-A series are only intended for the specific applications explicitly described in this manual. Please take care to observe all the installation and operating parameters specified in the manual. The design, manufacturing, testing and documentation of these products have all been carried out in strict accordance with the relevant safety standards. Under normal circumstances the products described here do not constitute a potential source of injury to persons or property provided that you precisely observe the instructions and safety information provided for proper system design, installation and operation. However, unqualified modification of the hardware or software or failure to observe the warnings on the product and in this manual can result in serious personal injury and/or damage to property. Only accessories specifically approved by MITSUBISHI ELECTRIC may be used with the frequency inverters FR-A 540 EC and FR-A 540L-G 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-A 500 frequency inverters, which should be sufficient to enable experienced users to install and configure the inverter. For further information on the functions and parametrization please refer to the Instruction Manual of the frequency inverter FR-A 500. This Installation Manual is intended exclusively as an installation and setup guide and a brief reference. It does not replace the main product manual.

1.1 General Description

The inverters of the FR-A 540 EC series are available with outputs from 0.4kW to 55kW. The higher power range from 75kW to 450kW is covered by the inverters of the FR-A 540 L-G EC series. All devices are designed for the connection to 3~ 380 to 480V (50/60Hz). The output frequency ranges from 0.2 to 400Hz.

Features of the frequency inverters

- Communication ability and networking
For the integration in an automation plant a serial interface RS485 is included as standard equipment. Through this interface up to 32 inverters can be linked up. Open communications with standardised industrial bus systems as Profibus/DP, DeviceNet, CC-Link, CAN Open, or Modbus Plus can be realised easily via optional interface cards.
- Compatibility with a lot of new applications
 - PID Control
The inverter can be used to exercise process control, e.g. flow rate for pumps
 - Stop function selection (terminal MRS)
This function is used to select the stopping method (deceleration to a stop or coasting).
 - Brake sequence function
 - 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
- Optimised drive characteristics
 - Advanced magnetic flux vector control with auto tuning
The advanced magnetic flux vector control with auto tuning ensures a stable torque even at ultra low speed.

2 Specifications

2.1 Model Specifications FR-A 540

Type		FR-A 540																
		0.4 k	0.75 k	1.5 k	2.2 k	3.7 k	5.5 k	7.5 k	11 k	15 k	18.5 k	22 k	30 k	37 k	45 k	55 k		
Output	Rated motor capacity [kW] ①	150% Overload capacity ①	0.75	1.1	2.2	3.0	4.0	7.5	11	15	18.5	22	30	37	45	55	75	
		200% Overload capacity ②	0.4	0.75	1.5	2.2	4.0	5.5	7.5	11	15	18.5	22	30	37	45	55	
	Rated current [A]	150% Overload capacity ①	I ₁₅₀	2.7	4.5	7.4	10	14	21	32	44	59	65	81	107	144	162	207
			I ₁₂₀	2.2	3.6	5.9	8	11	17	25	35	47	52	65	85	115	130	166
			I _{rated}	1.8	3	4.9	7	9.5	14	21	29	39	43	54	71	96	108	138
		200% Overload capacity ②	I ₁₅₀	3	5	8	12	18	24	34	46	62	76	86	114	142	172	220
			I ₁₂₀	2.3	3.8	6	9	14	18	26	35	47	57	65	86	107	129	165
			I _{rated}	1.5	2.5	4	6	9	12	17	23	31	38	43	57	71	86	110
	Rated output capacity [kVA]	150% Overload capacity ①	1.3	2.3	3.7	5.1	6.9	10.6	16.0	22.1	25.7	32.8	41.1	54.1	73.1	82.3	105	
		200% Overload capacity ②	1.1	1.9	3	4.6	6.9	9.1	13	17.5	23.6	29	32.8	43.4	54	65	84	
	Overload capacity ②	①	150% of rated motor capacity for 0.5s; 120% for 1min (max. ambiente temperature 40°C, max. carrier frequency < 2kHz); typical e.g. for pumps, fans and extruders															
		②	200% of rated motor capacity for 0.5s; 150% for 1min (max. ambiente temperature 50°C); typical e.g. for cranes and stone breakers															
Rated input AC voltage ③		3-phase, 0V up to power supply voltage ⑦																
Frequency range		0.2–400Hz																
Regenerative braking torque		Max. 100% / 5s 2% ED							Braking internal converter supported. External brake unit connectable									
Control method		Advanced flux vector control with online auto tuning of motor data or V/f control																
Modulation control		Sine elevated PWM, Soft PWM																
Carrier frequency		0.7–14.5kHz (user adjustable)																
Input	Power supply voltage		3-phase, 380–480V AC, –15 % / +10 %															
	Permissible AC voltage fluctuation		323–528V AC bei 50 / 60Hz															
	Power supply frequency		50 / 60Hz ± 5%															
	Rated input capacity [kVA] ④	150% Overload capacity ①	1.8	3	5.4	6.1	9	14	20	26	36	41	51	66	90	100	126	
200% Overload capacity ②		1.5	2.5	4.5	5.5	9	12	17	20	28	34	41	52	66	80	100		
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	0.01Hz															
	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 400Hz; constant torque or variable torque selectable; optional flexible flexible 5-Point-V/f-characteristics															
Starting torque		150% / 0.5Hz (for advanced vector control)																

Please observe the notes on page 10!

Type		FR-A 540														
		0.4 k	0.75 k	1.5 k	2.2 k	3.7 k	5.5 k	7.5 k	11 k	15 k	18.5 k	22 k	30 k	37 k	45 k	55 k
Control specifications	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 torque boost														
	Stall prevention	Response threshold 0–200%, 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 input	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 15 speed settings can be selected (each speed can be preset from 0 to 400Hz). 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													
		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, frequency reached, instantaneous power failure (undervoltage), frequency detection, 2nd frequency detection, 3rd frequency detection, in PU operation, overload warning, regenerative brake pre-alarm, electronic thermal relay pre-alarm, zero current detection, output current detection, PID lower limit, PID upper limit, PID forward run, PID reverse run, commercial power supply-inverter switchover MC1-2-3, operation ready, brake release request, fan trouble, overheat fan 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, motor torque, converter output voltage (constant or peak value), regenerative brake duty, electronic thermal relay load rate, input power, output power, load meter, motor excitation current, pulse train output (1440Hz/full scale), or analog output (0–10V DC).													
	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, motor torque, overload, converter output voltage (constant or peak value), electronic thermal relay load rate, input power, output power, load meter, motor excitation current, cumulative power ON time, current operation time, cumulative power, regenerative brake duty, 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													

Please observe the notes on page 10!

Type		FR-A 540														
		0.4 k	0.75 k	1.5 k	2.2 k	3.7 k	5.5 k	7.5 k	11 k	15 k	18.5 k	22 k	30 k	37 k	45 k	55 k
Protection	Functions	Overcurrent cutoff (during acceleration, deceleration, constant speed), regenerative overvoltage cutoff, undervoltage, instantaneous power failure, overload cutoff (electronic thermal relay), brake transistor error ^⑤ , ground fault overcurrent, output short circuit, overheating of main circuit, stall prevention, overload warning, brake transistor overheating, fin overheating, fan error, option error, parameter error, PU connection error, output of group error message via relay contact (220V AC / 0.3A; 30V DC / 0.3A).														
	Protective structure	IP 20 ^⑧										IP 00				
Environment	Ambient temperature in operation	-10°C to +50°C (non freezing) (For selection of the overload capacity of 150% the max. temperature is 40°C)														
	Storage temperature ^④	-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. After that derate by 3% for every extra 500m up to 2500m (91%)														
	Vibration resistance	Max. 0.6g														
Cooling	Self-cooling					Fan-cooling										
Weight (kg)	3.5	3.5	3.5	3.5	3.5	6.0	6.0	13.0	13.0	13.0	13.0	24.0	35.0	35.0	36.0	

NOTES

Special notes referring to the table:

- ① At 150% rating a maximum ambient temperature of 40°C is allowed and the PWM carrier frequency must be less than 2kHz.
- ② The overload capacity indicated in % is the ratio of the overload current to the inverter's rated current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
- ③ The maximum output voltage cannot exceed the power supply voltage. The maximum output voltage may be set as desired below the power supply voltage.
- ④ The power supply capacity changes with the values of the power supply side inverter impedances (including those of the input reactor and cables).
- ⑤ The brake transistor alarm is only provided for inverters with a capacity between 0.4 k to 7.5 k that are equipped with a built-in brake circuit.
- ⑥ Temperature applicable for a short period in transit, etc.
- ⑦ It is not possible to connect single-phase motors in general.
- ⑧ The protective structure changes to IP 00 when an inboard option is fitted after removal of the option wiring port cover.

2.2 Model Specifications FR-A 540L-G

Type		FR-A 540L										
		G75 k	G90 k	G110 k	G132 k	G160 k	G220 k	G280 k	G375 k	G450 k		
Output	Rated motor capacity [kW] ①	120% Overload capacity ①	—	132	160	220	250	315	400	530	530	
		150% Overload capacity ②	90	110	132	185	220	280	375	450	530	
		200% Overload capacity ③	75	90	110	132	160	220	280	375	450	
	Rated current [A] ②	120% Overload capacity ①	I ₁₂₀	—	312	362	518	572	732	900	1212	1212
			I ₁₁₀	—	286	332	475	525	671	825	1111	1111
			I _{rated}	—	260	302	432	477	610	750	1010	1010
		150% Overload capacity ②	I ₁₅₀	270	324	390	542	648	821	1083	1299	1515
			I ₁₂₀	216	259	312	433	518	656	866	1039	1212
			I _{rated}	180	216	260	361	432	547	722	866	1010
		200% Overload capacity ③	I ₂₀₀	288	360	432	520	650	864	1094	1444	1732
			I ₁₅₀	216	270	324	390	488	648	821	1083	1299
			I _{rated}	144	180	216	260	325	432	547	722	866
	Rated output capacity [kVA]	120% Overload capacity ①	—	198	230	329	364	465	572	770	770	
		150% Overload capacity ②	137	165	198	275	329	417	550	660	770	
		200% Overload capacity ③	110	137	165	198	248	329	417	550	660	
	Overload capacity ③	①	120% of rated motor capacity 0.5s; 110% for 1min (max. ambiente temperature 40°C); typical e.g. for pumps and fans									
		②	150% of rated motor capacity for 0.5s; 120% für 1min (max. ambiente temperature 50°C); typical e.g. for pumps, fans and extruders									
		③	200% of rated motor capacity for 0.5s; 150% für 1min (max. ambiente temperature 50°C); typical e.g. for cranes and stone breakers									
	Voltage ^④		3-phase 0V up to power supply voltage ^⑦									
Frequency range		0.2–400Hz										
Control method		Advanced flux vector control with online auto tuning of motor data or V/f control										
Modulation control		Sine elevated PWM, Soft PWM										
Carrier frequency		0.7kHz / 1kHz / 2.5kHz (user adjustable) to 5kHz										
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] ⑤	120% Overload capacity ①	—	198	230	329	364	465	572	770	770	
150% Overload capacity ②		137	165	198	275	329	417	550	660	770		
200% Overload capacity ③		110	137	165	198	248	329	417	550	660		
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	0.01Hz									
	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 400Hz; constant torque or variable torque selectable; optional flexible 5-Point-V/f-characteristics									
Starting torque		150% / 0.5Hz (for advanced vector contro)										

Please observe the notes on page 13!

Type		FR-A 540L								
		G75 k	G90 k	G110 k	G132 k	G160 k	G220 k	G280 k	G375 k	G450 k
Control specifications	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 torque boost								
	Stall prevention	Response threshold 0–200%							Response threshold 0–150%	
		User adjustable								
Motor protection	Electronic motor protection relay (rated current user adjustable)									
Controlsignals for operation	Frequency setting values	Analog input	0–5V DC, 0–10V DC, 0–±10V DC, 0/4–20mA							
		Digital input	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 15 speed settings can be selected (each speed can be preset from 0 to 400Hz). 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							
		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, frequency reached, instantaneous power failure (undervoltage), frequency detection, 2nd frequency detection, 3rd frequency detection, in PU operation, overload warning, regenerative brake pre-alarm, electronic thermal relay pre-alarm, zero current detection, output current detection, PID lower limit, PID upper limit, PID forward run, PID reverse run, commercial power supply-inverter switchover MC1-2-3, operation ready, brake release request, 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, motor torque, converter output voltage (constant or peak value) regenerative brake duty, electronic thermal relay load rate, input power, output power, load meter and motor excitation current, pulse train output (1440Hz/full scale), or analog output (0–10V DC)							
	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, motor torque, overload, converter output voltage (constant or peak value), electronic thermal relay load rate, input power, output power, load meter, motor excitation current, cumulative power ON time, current operation time, cumulative power, regenerative brake duty, 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							

Please observe the notes on page 13!

Type		FR-A 540L							
		G75 k	G90 k	G110 k	G132 k	G160 k	G220 k	G280 k	G375 k
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, main circuit error, output of group error message via relay contact (220V AC / 0.3 A; 30V DC / 0.3A).							
	Protective structure	IP 00							
Environment	Ambient temperature	-10°C to +50°C (non freezing)						200% and 150% overload capacity: -10°C to +50°C 120% overload capacity: -10°C to +40°C (non freezing)	
	Storage temperature ⑥	-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)	57	66	66	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, a maximum ambient temperature of 40°C and a PWM carrier frequency of less than 1kHz.
- ② The rating 120% is available with serial marking "type 2" only (shipping from 02.2003).
- ③ The overload capacity indicated in % is the ratio of the overload current to the inverter's rated current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
- ④ The maximum output voltage cannot exceed the power supply voltage. The maximum output voltage may be set as desired below the power supply voltage.
- ⑤ The power supply capacity changes with the values of the power supply side inverter impedances (including those of the input reactor and cables).
- ⑥ Temperature applicable for a short period in transit, etc.
- ⑦ It not possible to connect single-phase motors in general.

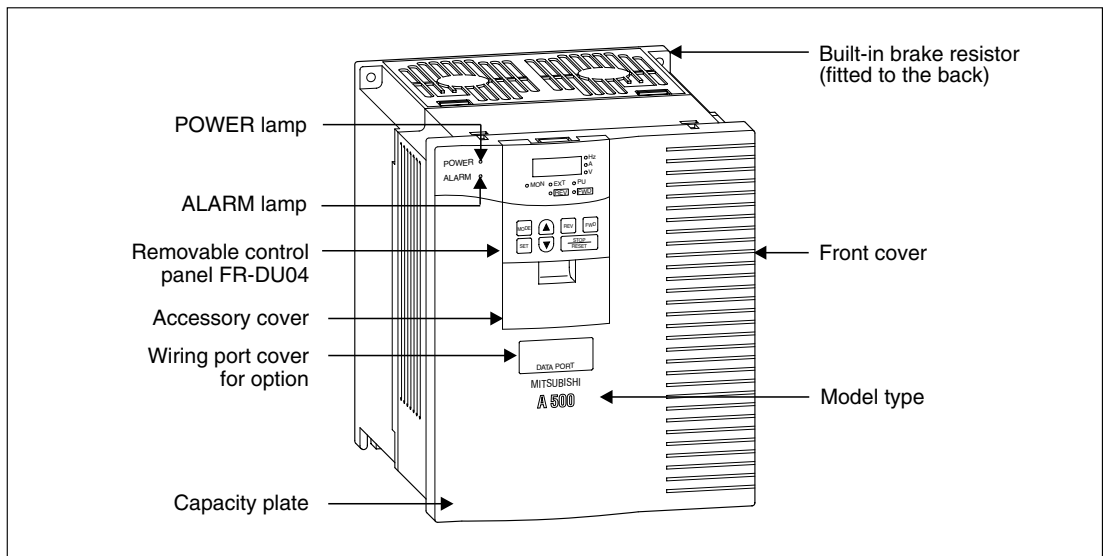
3 Appearance and Structure

3.1 Description of the Case

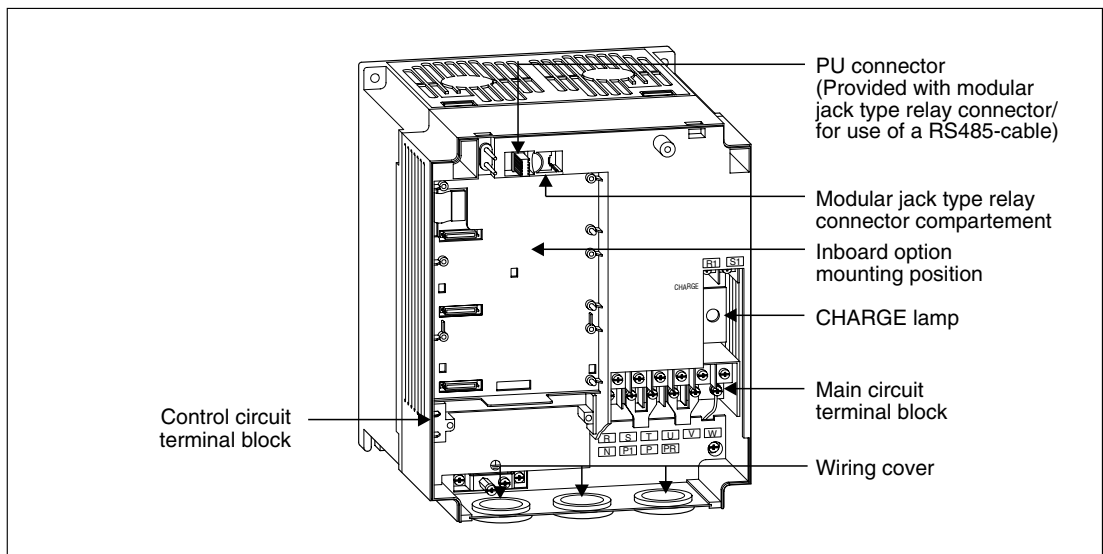
3.1.1 Model Type FR-A 540

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

Frequency inverter FR-A 540 EC with front cover



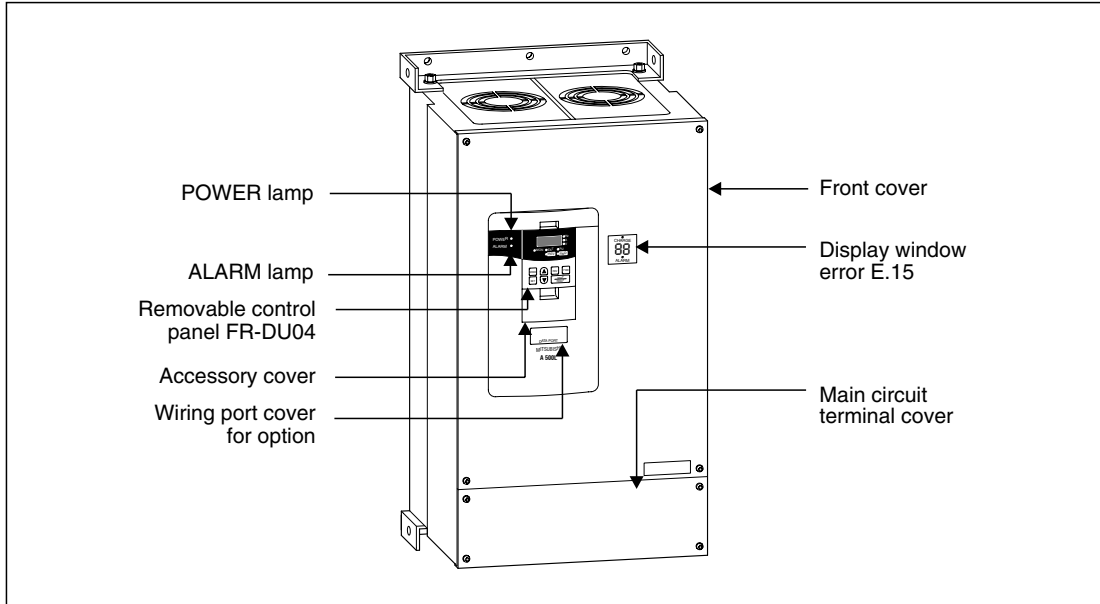
Frequency inverter FR-A 540 EC without front cover



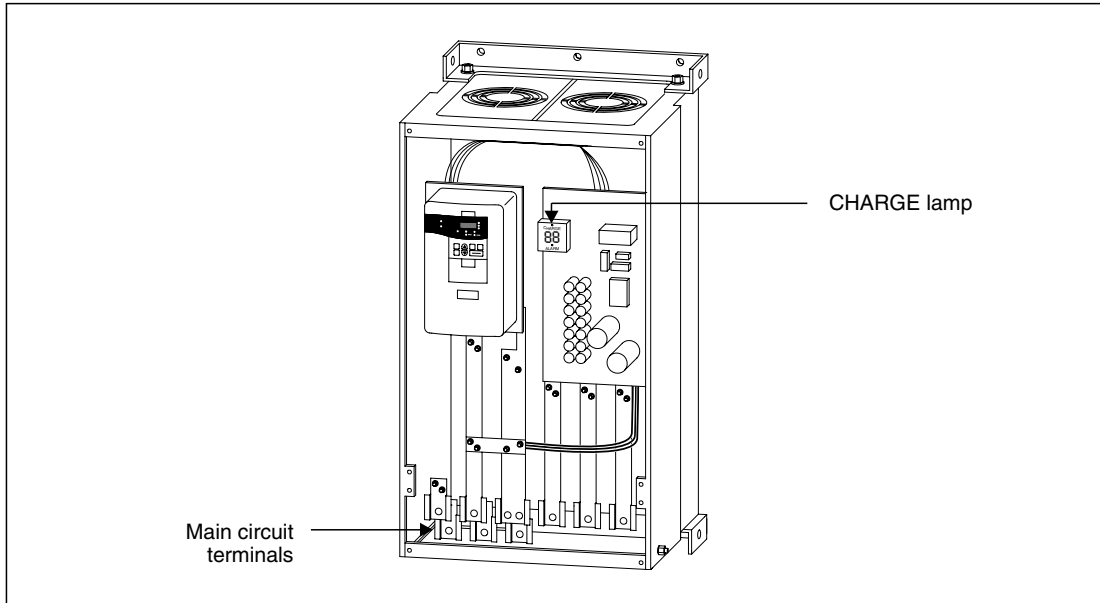
3.1.2 Model Type FR-A 540L-G

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

Frequency inverter FR-A 540L-G EC with front cover



Frequency inverter FR-A 540L-G EC without front cover

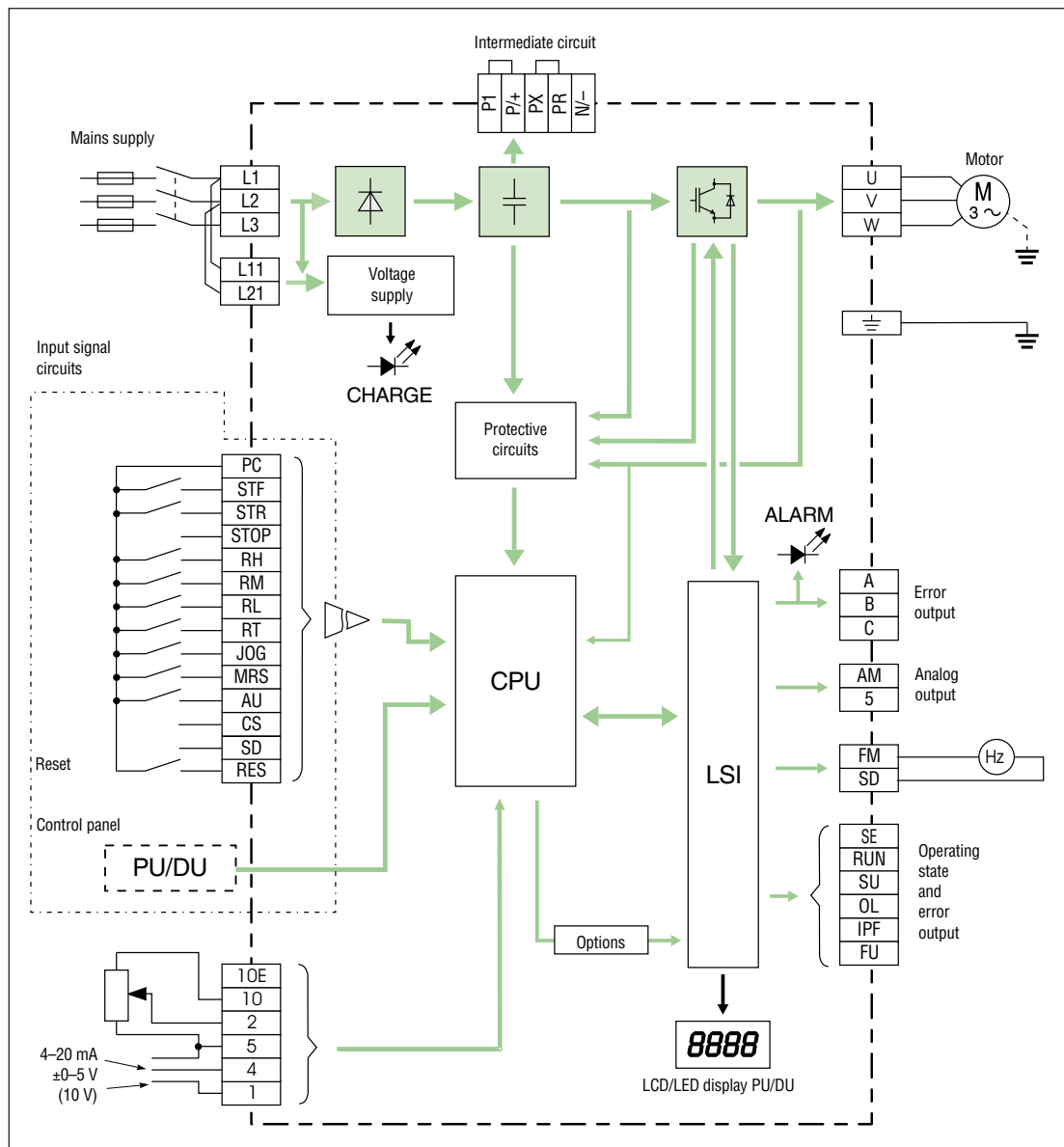


4 Wiring

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 and if a DC choke coil is used (see also section 4.2.1). The PX and PR connections are only available in models FR-A 540-0.4 k through 7.5 k.

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.*

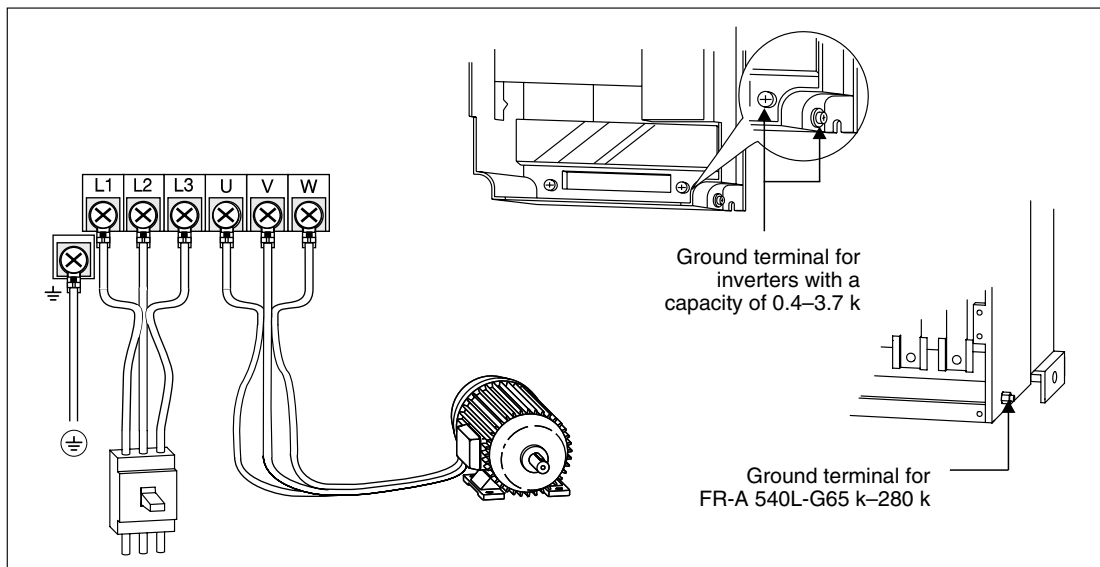
4.2.1 Mains, Motor and Ground Terminal Connections

The terminal blocks for connection of the frequency inverter can be accessed by removing the front cover (FR-A 540) or the terminal block cover (FR-A 540L-G). 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.

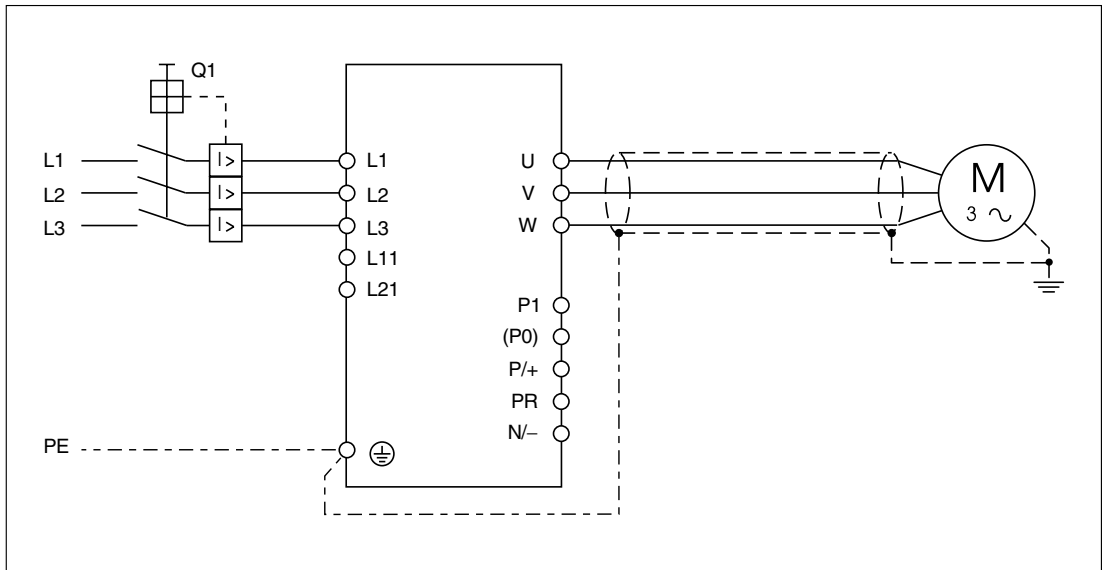
NOTE

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 300m for the 0.4 k capacity inverter and 500m from 0.75 k upwards.

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/-.
	P/+, PR	Optional external brake resistor connection	An optional external brake resistor can be connected to the terminals P/+ and PR. Disconnect the jumper from terminals PR and PX before (FR-A 540-0.4 k to 7.5 k only).
	P1, P/+ (P0, P1)	DC choke coil connection	An optional choke coil can be connected to the terminals P1 and P/+ (up to 280 k) or between P0 and P1 (375 k to 450 k) respectively. For all FR-A 540L-G inverters the supplied choke coil has to be installed to the mentioned terminals
	U, V, W	Motor connection	Voltage output of the inverter (3-phase, 0V up to power supply voltage, 0.2–400Hz)
	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.

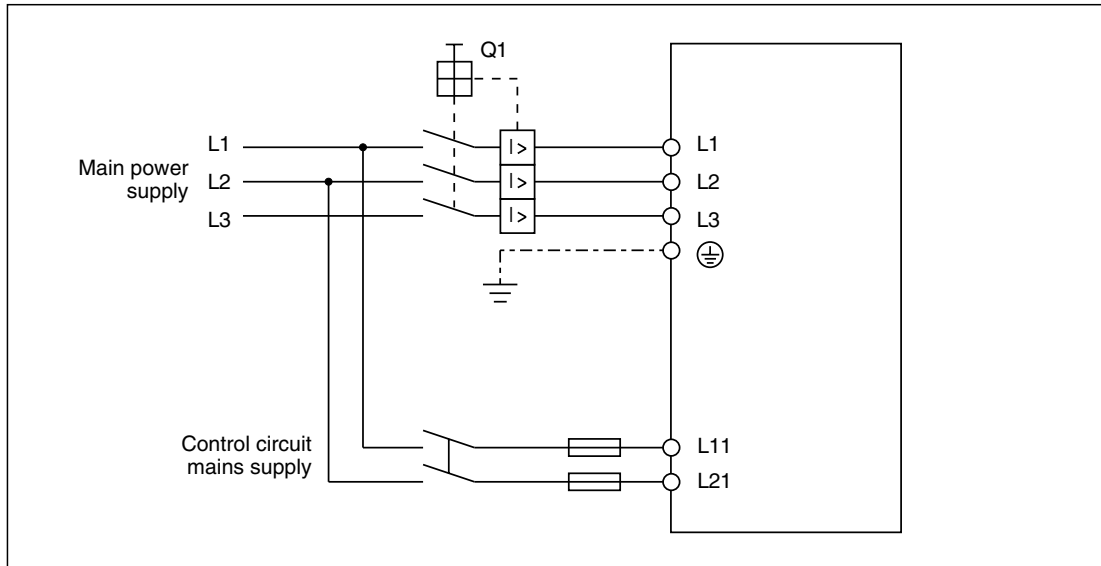


CAUTION:

For the frequency inverters FR-A540L-G75 k to 280 k the enclosed DC choke coil always has to be connected to the terminals P1 and P(+). For the inverters FR-A540L-G375 k/450 k it has to be connected to the terminals P0 and P1.

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.

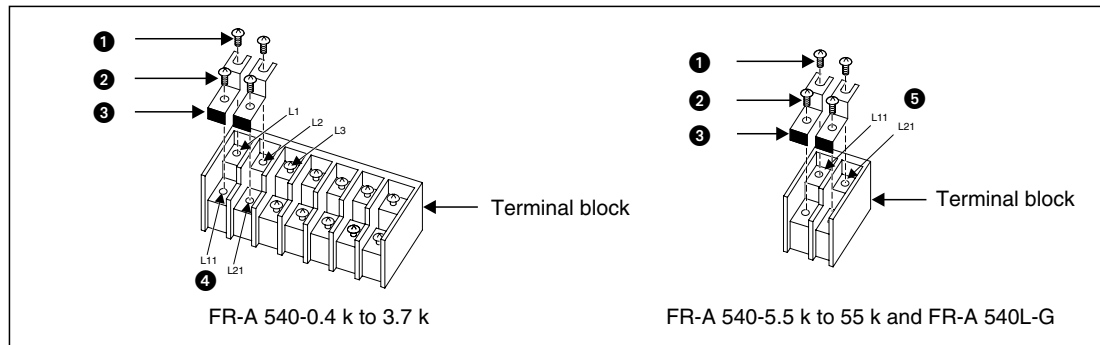


CAUTION:

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

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 cables for control circuits for the inverters FR-A 540-0.4 k to 3.7 k to the lower ④, and for the inverters FR-A 540-5.5 k to 55 k and FR-A 540L-G to the upper terminals ⑤ (L11 and L21).

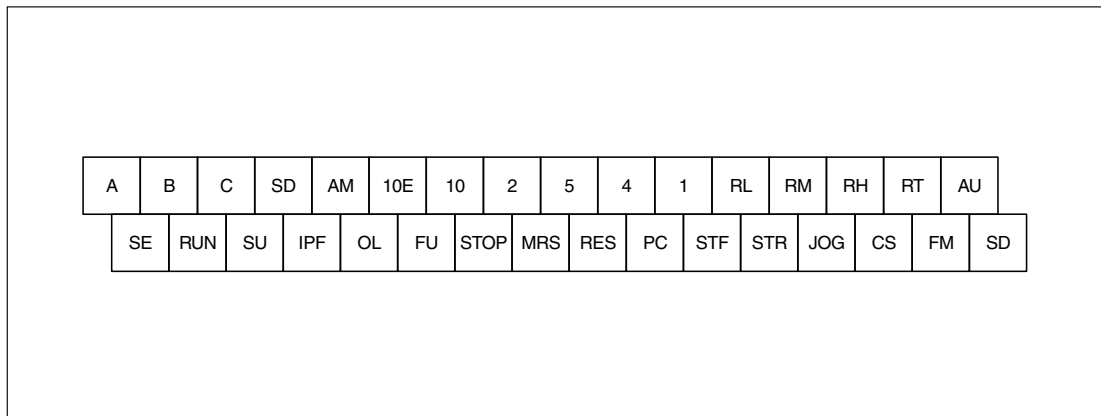


CAUTION:

The power supply cables must not be connected to the lower terminals for the 5.5 k to 55 k capacity frequency inverters and the inverter FR-A 540L-G. Otherwise the inverter may be damaged.

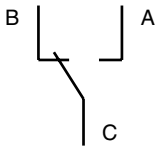
4.3 Wiring of the Control Circuit

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-A 540L-G375 k and G450 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 ($t > 0.1s$).
	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.

	Terminal	Terminal name	Description
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	24V DC/0.1A output With negative logic and control via open collector transistors (e.g. a PLC) the positive pole of an external power source must be connected to the PC terminal. With positive logic the PC terminal is used as a common reference for the control inputs. This means that when positive logic is selected (default setting of the EC units) the corresponding control function is activated by connecting its terminal to the PC terminal.
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 10 mA 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 10k 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 terminal 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 voltage range is preset to 0– \pm 10V DC. The input resistance 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.

	Terminal	Terminal name	Description
Signal outputs	A, B, C	Potential free alarm output	<p>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.</p>  <p>The maximum contact load is 230V / 0.3A AC or 30V / 0.3A DC.</p>
	RUN	Signal output for motor operation (open collector)	<p>The output is switched low, if the inverter output frequency is equal to the starting frequency. The output is switched high, if no frequency is output or the DC brake is in operation.</p>
	SU	Signal output for frequency setting value / current value comparison (open collector)	<p>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) approaches the frequency setting value (determined by the setting value signal) within a preset range of tolerance (parameter 41).</p>
	IPF	Signal output for instantaneous power failure (open collector)	<p>The output is switched low for a temporary power failure within a range of $15\text{ms} \leq t_{IPF} \leq 100\text{ms}$ or for undervoltage.</p>
	OL	Signal output for overload alarm (open collector)	<p>The OL is switched low, if the output current of the inverter exceeds the current limit preset in parameter 22 and the stall prevention is activated. If the output current of the inverter falls below the current limit preset in parameter 22, the signal at the OL output is switched high.</p>
	FU	Signal output for monitoring output frequency (open collector)	<p>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.</p>
	SE	Reference potential for signal outputs	<p>Reference potential for the signals RUN, SU, OL, IPF, and FU. This terminal is isolated from the reference potential of the control circuit SD.</p>
	FM	Pulse output	<p>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.</p> <p>The functions are determined by parameters. Either a moving coil gauge (measuring range: 1mA) or a pulse counter with an initial setting of 1440 pulses/s at 50Hz output frequency.</p>
	AM	Analog output	<p>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.</p> <p>The functions are determined by parameters. A DC voltmeter can be connected. The max. output voltage is 10V, the max. current is 1mA.</p>
	—	Connection of control panel (RS485)	<p>Communications via RS485 I/O standard: RS485, Multi-Drop operation, max. 19200 Baud, Overall length max. 500m</p>

**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 (only on models up to 280 k)/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

Function	Parameter	Meaning	Setting range		Default setting	
			FR-A 540	FR-A 540L-G	FR-A 540	FR-A 540L-G
Basic functions	0	Torque boost (manual) ①	0–30%		6% / 4% / 3% / 2% ⑧	1%
	1	Maximum frequency	0–120Hz	0–60Hz	120Hz	60Hz
	2	Minimum frequency	0–120Hz		0Hz	
	3	Base frequency	0–400Hz		50Hz	
	4	Multi-speed setting (high speed) ②	0–400Hz		60Hz	
	5	Multi-speed setting (middle speed) ②	0–400Hz		30Hz	
	6	Multi-speed setting (low speed) ②	0–400Hz		10Hz	
	7	Acceleration time	0–360s / 0–3600s		5s / 15s ⑤	15s
	8	Deceleration time	0–360s / 0–3600s		5s / 15s ⑤	15s
9	Electronic thermal overload relay	0–500A	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%		4% / 2% ⑤	1%
	13	Starting frequency	0–60Hz		0.5Hz	
	14	Load pattern selection ①	0–5		0	
	15	JOG frequency	0–400Hz		5Hz	
	16	JOG acceleration / deceleration time	0–360s / 0–3600s		0.5s	
	17	MRS input selection	0 / 2		0	
	18	High-speed max. frequency	120–400Hz	0–400Hz	120Hz	60Hz
	19	Base frequency voltage ①	0–1000V / 8888 / 9999		8888	
	20	Acceleration / deceleration reference frequency	1–400Hz		50Hz	
	21	Acceleration / deceleration time increments	0 / 1		0	
	22	Stall prevention operation level ②	0–200% / 9999		150%	150% (M = const) 120% (M ~ n ²) ⑩
	23	Stall prevention operation at double speed	0–200 % / 9999		9999	

Function	Parameter	Meaning	Setting range		Default setting	
			FR-A 540	FR-A 540L-G	FR-A 540	FR-A 540L-G
Standard operation functions	24	Multi-speed setting (speed 4) ⑦	0–400Hz / 9999		9999	
	25	Multi-speed setting (speed 5) ⑦	0–400Hz / 9999		9999	
	26	Multi-speed setting (speed 6) ⑦	0–400Hz / 9999		9999	
	27	Multi-speed setting (speed 7) ⑦	0–400Hz / 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	
	31	Frequency jump 1A	0–400Hz / 9999		9999	
	32	Frequency jump 1B	0–400Hz / 9999		9999	
	33	Frequency jump 2A	0–400Hz / 9999		9999	
	34	Frequency jump 2B	0–400Hz / 9999		9999	
	35	Frequency jump 3A	0–400Hz / 9999		9999	
	36	Frequency jump 3B	0–400Hz / 9999		9999	
	37	Speed display	0 / 1–9998		0	
Output terminal functions	41	Up-to-frequency sensitivity	0–100%		10%	
	42	Output frequency detection	0–400Hz		6Hz	
	43	Output frequency detection for reverse rotation	0–400Hz / 9999		9999	
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 ①	0–30% / 9999		9999	
	47	Second V/F (base frequency) ①	0–400Hz / 9999		9999	
	48	Second stall prevention operation current	0–200%		150%	150% (M = const) 120% (M ~ n ²) ⑧
	49	Second stall prevention operation frequency	0–400Hz / 9999		0Hz	
	50	Second output frequency detection	0–400Hz		30Hz	
Display functions	52	DU/PU main display data selection ⑦	0 / 5–14 / 17 / 18 / 20 / 23 / 24 / 25 / 100		0	
	53	PU level display data selection ⑦	0–3 / 5–14 / 17 / 18		1	
	54	FM terminal function selection ⑦	1–3 / 5–14 / 17 / 18 / 21		1	
	55	Frequency monitoring reference ⑦	0–400Hz		50Hz	
	56	Current monitoring reference ⑦	0–500A	0–3600A	Rated current	
Automatic restart functions	57	Restart coasting time	0–5s / 9999	0–30s / 9999	9999	
	58	Restart cushion time	0–60s		1s	
Additional function	59	Remote setting function selection	0 / 1 / 2		0	

Function	Parameter	Meaning	Setting range		Default setting	
			FR-A 540	FR-A 540L-G	FR-A 540	FR-A 540L-G
Operation selection functions	60	Intelligent mode selection	0-8		0	
	61	Reference I for intelligent mode	0-500A / 9999	0-3600A / 9999	9999	
	62	Reference I for intelligent mode (acceleration)	0-200% / 9999		9999	
	63	Reference I for intelligent mode (deceleration)	0-200% / 9999		9999	
	64	Starting frequency for elevator mode	0-10Hz / 9999		9999	
	65	Retry selection	0-5		0	
	66	Stall prevention operation reduction starting frequency	0-400Hz		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	0-15% / 0-30% / 0% ^②	0-100%	0%	
	71	Applied motor	0-8 / 13-18		0	
	72	PWM frequency selection ^⑦	0-15	0-5 / 17 ^⑧	2	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 ^⑦	0-3 / 14-17	0-3 / 14-17 / 100-117	14	
	76	Alarm code output selection	0 / 1 / 2 / 3		0	
	77	Parameter write disable selection ^⑦	0 / 1 / 2		0	
	78	Reverse rotation prevention selection	0 / 1 / 2		0	
79	Operation mode selection	0-8		0		
Motor constants	80	Motor capacity	0.4-55kW / 9999	0-3600kW / 9999	9999	
	81	Number of motor poles	2 / 4 / 6 / 12 / 14 / 16 / 9999		9999	
	82	Motor excitation current ^③	0- / 9999		9999	
	83	Rated motor voltage	0-1000V		400V	
	84	Rated motor frequency	50-120Hz		50Hz	
	89	Speed control gain	0-200%		100%	
	90	Motor constant R1 ^③	0- / 9999		9999	
	91	Motor constant R2 ^③	0- / 9999		9999	
	92	Motor constant L1 ^③	0- / 9999		9999	
	93	Motor constant L2 ^③	0- / 9999		9999	
	94	Motor constant X ^③	0- / 9999		9999	
	95	Online auto tuning selection	0 / 1		0	
96	Auto tuning setting / status	0 / 1 / 101		0		

Function	Parameter	Meaning	Setting range		Default setting	
			FR-A 540	FR-A 540L-G	FR-A 540	FR-A 540L-G
5-point flexible V/f characteristics	100	V/F1 (first frequency) ①	0–400Hz / 9999		9999	
	101	V/F1 (first frequency voltage) ①	0–1000V		0	
	102	V/F2 (second frequency) ①	0–400Hz / 9999		9999	
	103	V/F2 (second frequency voltage) ①	0–1000V		0	
	104	V/F3 (third frequency) ①	0–400Hz / 9999		9999	
	105	V/F3 (third frequency voltage) ①	0–1000V		0	
	106	V/F4 (fourth frequency) ①	0–400 Hz / 9999		9999	
	107	V/F4 (fourth frequency voltage) ①	0–1000V		0	
	108	V/F5 (fifth frequency) ①	0–400Hz / 9999		9999	
	109	V/F5 (fifth frequency voltage) ①	0–1000V		0	
Third functions	110	Third acceleration / deceleration time	0–360s / 0–3600s / 9999		9999	
	111	Third deceleration time	0–360s / 0–3600s / 9999		9999	
	112	Third torque boost ①	0–30% / 9999		9999	
	113	Third V/F (base frequency) ①	0–400Hz / 9999		9999	
	114	Third stall prevention operation current	0–200%		150 %	150% (M = const) 120% (M ~ n ²) ②
	115	Third stall prevention operation frequency	0–400Hz		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 control	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%	
Commercial power supply-inverter switch-over	135	Commercial power supply-inverter switch-over sequence output terminal selection MC switch-over interlock time	0 / 1		0	
	136	MC switch-over interlock time	0–100s		1s	
	137	Start waiting time	0–100s		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	
			FR-A 540	FR-A 540L-G	FR-A 540	FR-A 540L-G
Backlash	140	Backlash acceleration stopping frequency ④	0–400Hz		1Hz	
	141	Backlash acceleration stopping time ④	0–360s		0.5s	
	142	Backlash deceleration stopping frequency ④	0–400Hz		1Hz	
	143	Backlash deceleration stopping time ④	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	0–200%		150%	150% (M = const) 120% (M ~ n ²) ⑩
	149	Stall prevention level at 10V input	0–200%		200%	200% (M = const) 150% (M ~ n ²) ⑩
Current detection	150	Output current detection level	0–200%		150%	150% (M = const) 120% (M ~ n ²) ⑩
	151	Output current detection period	0–10s		0	
	152	Zero current detection level	0–200%		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	0–25 s / 9999		0	
	158	AM terminal function selection	1–3 / 5–14 / 17 / 18 / 21		1	
Additional function	160	User group read selection ⑦	0 / 1 / 10 / 11		0	
Automatic restart after instantaneous power failure	162	Automatic restart after instantaneous failure selection	0 / 1	0 / 1 / 2 / 10	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	0–200%		150%	150% (M = const) 120% (M ~ n ²) ⑩
Initial monitor	170	Watt-hour meter clear	0		0	
	171	Actual operation hour meter clear	0		0	

Function	Parameter	Meaning	Setting range		Default setting	
			FR-A 540	FR-A 540L-G	FR-A 540	FR-A 540L-G
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 function selection	180	RL terminal function selection	0–99 / 9999		0	
	181	RM terminal function selection	0–99 / 9999		1	
	182	RH terminal function selection	0–99 / 9999		2	
	183	RT terminal function selection	0–99 / 9999		3	
	184	AU terminal function selection	0–99 / 9999		4	
	185	JOG terminal function selection	0–99 / 9999 ^②		5	
	186	CS terminal function selection	0–99 / 9999		6	
	190	RUN terminal function selection	0–199 / 9999		0	
	191	SU terminal function selection	0–199 / 9999		1	
	192	IPF terminal function selection	0–199 / 9999		2	
	193	OL terminal function selection	0–199 / 9999		3	
	194	FU terminal function selection	0–199 / 9999		4	
195	ABC terminal function selection	0–199 / 9999		99		
Additional function	199	User initial value setting	0–999 / 9999		0	
Pro-grammed operations	200	Programmed operation minute / second selection	0/2: minute, second 1/3: hour, minute		0	
	201 – 230	Program set	0–2: rotation direction 0–400 / 9999: frequency 0–99:59: time		0 9999 0	
	231	Timer setting	0–99:59		0	
Multi-speed operations	232	Multi-speed setting (speed 8) ^②	0–400Hz / 9999		9999	
	233	Multi-speed setting (speed 9) ^②	0–400Hz / 9999		9999	
	234	Multi-speed setting (speed 10) ^②	0–400Hz / 9999		9999	
	235	Multi-speed setting (speed 11) ^②	0–400Hz / 9999		9999	
	236	Multi-speed setting (speed 12) ^②	0–400Hz / 9999		9999	
	237	Multi-speed setting (speed 13) ^②	0–400Hz / 9999		9999	
	238	Multi-speed setting (speed 14) ^②	0–400Hz / 9999		9999	
Auxiliary functions	239	Multi-speed setting (speed 15) ^②	0–400Hz / 9999		9999	
	240	Soft-PWM setting	0 / 1		1	
Stop selection function	244	Cooling fan operation selection	0 / 1		0	
	250	Stop selection	0–100s / 9999		9999	

Function	Parameter	Meaning	Setting range		Default setting	
			FR-A 540	FR-A 540L-G	FR-A 540	FR-A 540L-G
Supplementary functions	251	Output phase failure protection selection	0 / 1		1	
	252	Override bias	0–200%		50%	
	253	Override gain	0–200%		150%	
Power failure stop function	261	Power failure stop selection	0 / 1		0	
	262	Subtracted frequency at deceleration start	0–20Hz		3Hz	
	263	Subtracted starting frequency	0–120Hz / 9999		50Hz	
	264	Power failure deceleration time 1	0–3600s		5s	
	265	Power failure deceleration time 2	0–3600 / 9999		9999	
	266	Power failure deceleration time switch-over frequency	0–400Hz		50Hz	
Function selection	270	Stop on contact / load high-speed frequency control selection	0 / 1 / 2 / 3		0	
High-speed frequency control	271	High-speed setting maximum current ⑦	0–200%		50%	
	272	Mid-speed setting minimum current ⑦	0–200%		100%	
	273	Current averaging range ⑦	0–400Hz / 9999		9999	
	274	Current averaging filter time constant ⑦	1–4000		16	
Stop on contact	275	Stop-on-contact exciting current low-speed multiplying factor ④	0–1000% / 9999		9999	
	276	Stop-on-contact PWM carrier frequency ④	0–15 / 9999	0 / 1 / 2 / 9999	9999	
Brake sequence functions	278	Brake opening frequency ②	0–30Hz		3Hz	
	279	Brake opening current ②	0–200%		130%	
	280	Brake opening current detection time ②	0–2s		0.3s	
	281	Brake operation time at start ②	0–5s		0.3s	
	282	Brake operation frequency ②	0–30Hz		6Hz	
	283	Brake operation time at stop ②	0–5 s		0.3 s	
	284	Deceleration detection function selection ②	0 / 1		0	
Droop-control	285	Over-speed detection frequency	0–30Hz / 9999		9999	
	286	Droop gain	0–100%		0%	
Parameter options	287	Droop filter time constant	0.00–1.00s		0.3s	
	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	

Function	Parameter	Meaning	Setting range		Default setting		
			FR-A 540	FR-A 540L-G	FR-A 540	FR-A 540L-G	
Parameter options	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		
	Communication	331	Station number	0–31		0	
		332	Communication speed	3 / 6 / 12 / 24 / 48 / 96 / 192		96	
333		Stop bit 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		
338		Operation command write	0 / 1		0		
Supplementary function	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		
	342	E ² PROM write yes/no	0 / 1	—	0	—	

Function	Parameter	Meaning	Setting range		Default setting	
			FR-A 540	FR-A 540L-G	FR-A 540	FR-A 540L-G
Parameter options	350	Stop position command selection	0 / 1 / 9999		9999	
	351	Orientation speed	0–30Hz		2Hz	
	352	Creep speed	0–10Hz		0.5Hz	
	353	Creep select position	0–16383		511	
	354	Position loop select position	0–8191		96	
	355	DC dynamic braking start position	0–255		5	
	356	Internal stop position command	0–16383		0	
	357	In-position zone	0–255		5	
	358	Servo torque selection	0–13		1	
	359	PLG rotation direction	0 / 1		1	
	360	12-bit data selection	0 / 1 / 2–127		0	
	361	Position shift	0–16383		0	
	362	Position loop gain	1–10		1	
	363	In-position signal output delay time	0–5s		0.5s	
	364	PLG stop check time	0–5s		0.5s	
	365	Orientation time limit	0–60s / 9999		9999	
	366	Recheck time	0–5s / 9999		9999	
	367	Speed feedback range	0–400 Hz / 9999		9999	
	368	Feedback gain	0–100		1	
	369	PLG pulse count	0–4096		1024	
	370	Control mode selection	0 / 1 / 2		0	
	371	Torque characteristic selection	0 / 1		1	
	372	Speed control P gain	0–200%		100%	
	373	Speed control I gain	0–200%		20%	
	374	Overspeed detection level	0–400Hz		120Hz	
	375	Servo lock gain	0–150		20	
	376	Wire break detection selection ⑩	0 / 1	—	0	—
	380	Acceleration S pattern 1	0–50%		0%	
	381	Deceleration S pattern 1	0–50%		0%	
	382	Acceleration S pattern 2	0–50%		0%	
	383	Deceleration S pattern 2	0–50%		0%	
	384	Input pulse F division ratio	0–250		0	
385	Zero-input pulse frequency	0–400Hz		0		
386	Maximum-input pulse frequency	0–400Hz		50Hz		

Function	Parameter	Meaning	Setting range		Default setting	
			FR-A 540	FR-A 540L-G	FR-A 540	FR-A 540L-G
Parameter options	500	Communication error recognition waiting time ^⑩	0–999.8s	—	0	—
	501	Communication error occurrence count display ^⑩	0	—	0	—
	502	Error time stop mode selection ^⑩	0 / 1 / 2	—	0	—
Supplementary functions	570	CT / VT selection	—	0 / 1 / 2 / 10 ^⑬	—	0
	571	Start holding time	—	0–10s / 9999	—	9999
Calibration functions	900	FM terminal calibration	Calibration range ^⑦		—	
	901	AM terminal calibration	Calibration range ^⑦		—	
	902	Frequency setting voltage bias	0–60Hz / [0–10V]		0Hz / [0V]	
	903	Frequency setting voltage gain	1–400Hz / [0–10V]		50Hz / [5V]	
	904	Frequency setting current bias	0–60Hz / [0–20mA]		0Hz / [4mA]	
	905	Frequency setting current gain	1–400Hz / [0–20mA]		50Hz / [20mA]	
Additional functions	990	Buzzer control	0 / 1		1	
	991	LCD contrast	0–63		53	

Remarks on the table:

- ① The parameter setting is ignored, if the advanced flux vector control is activated.
- ② Can only be set, if parameters 80 and 81 do not equal 9999 and parameter 60 is set to the value 7 or 8.
- ③ Can only be accessed, if parameters 80 and 81 do not equal 9999 and parameter 77 is set to the value 801.
- ④ Can only be accessed, if parameters 80 and 81 do not equal 9999 and parameter 270 is set to the value 1 or 3.
- ⑤ The setting values depend on the corresponding capacity class of inverter.
- ⑥ Can only be accessed, if parameter 29 is set to the value 3.
- ⑦ Can even be set even if the inverter is running and if parameter 77 is set to the value 0.
- ⑧ The setting values depend on the corresponding capacity class of inverter. Sub-division of capacity classes: (0.4 k) / (1.5–3.7 k) / (5.5 k–7.5 k) / (11 k).
- ⑨ The setting values depend on the corresponding capacity class of inverter. Sub-division of capacity classes: (0.4 k–1.5 k) / (2.2–7.5 k) / (\geq 11 k).
- ⑩ The setting depends on the value of parameter 570.
- ⑪ Valid for the frequency inverters FR-A 540 EC for firmware version 7392 and higher.
- ⑫ This terminal is connected internally for the frequency inverters FR-A 540L-G375 k and G450 k and cannot be used by the customer.
- ⑬ The setting values depend on the corresponding inverter version.

6 Protective Functions

6.1 Error Messages and Remedies

Error Message		Meaning	Description	Remedy
Control Panel FR-PU04	Control Panel FR-DU04			
OC Du- ring Acc	<i>E.O.C 1</i>	Overcurrent 1 (acceleration)	A) The output current of the inverter has reached or exceeded 200% of the rated current during acceleration, deceleration, or at constant speed. B) The temperature of the main circuits of the inverter rises rapidly.	The cause for the activation of the protective function is a short circuit or a ground fault across the main outputs, an exceeding moment of inertia of the load (GD ²), too short acceleration/ deceleration time presets, restart during a motor idling phase, operation of a motor with an exceeding capacity. Overheating due to insufficient cooling (defective cooling fan or choked heat sink).
Stedy Spd OC	<i>E.O.C 2</i>	Overcurrent 2 (const. speed)		
OC Du- ring Dec	<i>E.O.C 3</i>	Overcurrent 3 (deceleration)		
OV Du- ring Acc	<i>E.O.V 1</i>	Overvoltage 1 (acceleration)	The converter voltage has increased highly due to regenerative energy. The overvoltage limit was exceeded during acceleration, deceleration, or at constant speed.	In most cases the protective function is activated due to a too short deceleration time preset or a regenerative overload. Remedy by increasing the deceleration time of connecting an external brake unit. An overvoltage in the mains power supply activates this protective function as well.
Stedy Spd OV	<i>E.O.V 2</i>	Overvoltage 2 (const. speed)		
OV Du- ring Dec	<i>E.O.V 3</i>	Overvoltage 3 (deceleration)		
Motor Overload	<i>E.S.H 1</i>	Overload (motor)	The electronic overload protection for the motor or inverter was activated.	Decrease the motor load to avoid an activation.
Inv. Over load	<i>E.S.H 2</i>	Overload (inverter)	The electronic motor protection switch continually detects the motor current and the output frequency of the inverter. If a self-cooling motor operates over a long period at low speed but high torque, the motor is thermally overloaded and the protective function is activated. If several motors are operated by one inverter the motor protection switch will not operate properly. In this case deactivate the motor protection and replace it by external protection switches.	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.
Fan Failure	<i>F_n</i>	Fan fault ①	The cooling fan does not operate according to the setting in parameter 244.	Replace cooling fan.
Br. Cct. Fault	<i>E_bE</i>	Brake transistor failure ①	A) The integrated brake transistor does not operate properly. B) Possibly, a thermal overload occurred.	Check the relative operating time of the brake resistor. In case of thermal difficulties use an external brake resistor or an inverter of higher capacity.
Ground Fault	<i>EDF</i>	Ground failure	An overcurrent occurred due to a ground failure upon the inverter output (load).	Check load connections (motor circuit).
OH Fault	<i>EDHF</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) shut 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>EDPF</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.
Option slot alarm	<i>EDP1</i> to <i>EDP3</i>	Option slot alarm	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.

Error Message		Meaning	Description	Remedy
Control Panel FR-PU04	Control Panel FR-DU04			
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>ECPU</i>	CPU error	Scan time of CPU was exceeded.	Restart the inverter. Contact the customer service if the error occurs again.
Error 1 Error 3	<i>E. 1</i> to <i>E. 3</i>	Option fault ④	The inverter output is stopped if a contact fault occurs at the connector between the inverter and the communication option, or if a fault of the communication option itself, etc. occurs. The numbers 1 to 3 indicate the slot numbers.	Check the installation and all connections of the option board. Contact the customer service if the error occurs again.
Error 6 Error 7	<i>E. 6</i> <i>E. 7</i>	CPU error ②④	Communication error with the built-in CPU.	Restart the inverter. Contact the customer service if the error occurs again.
—	<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>ECFE</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.
E.MB1 E.MB7	<i>ENb 1</i> to <i>ENb 7</i>	Brake sequence error	This function stops the inverter output if a sequence error occurs during the use of the brake sequence function (Pr. 278 to Pr. 285)	Check the parameters 278 to 285.
E.OSd	<i>E.OSd</i>	Excessive speed deviation detection ④	The motor speed is increased or decreased due to load, etc. during vector control which is executed with the FR-A5AP option.	Check for sudden load change.
E.ECT	<i>E.ECT</i>	Wire break detection ④	The encoder signal is turned off during orientation, PLG feedback or vector control which is executed with the FR-A5AP option.	Check for encoder signal wire break.
—	<i>PS</i>	Inverter was stopped via control panel	STOP key on the control panel was pressed during external operating mode.	Check the parameter 77.

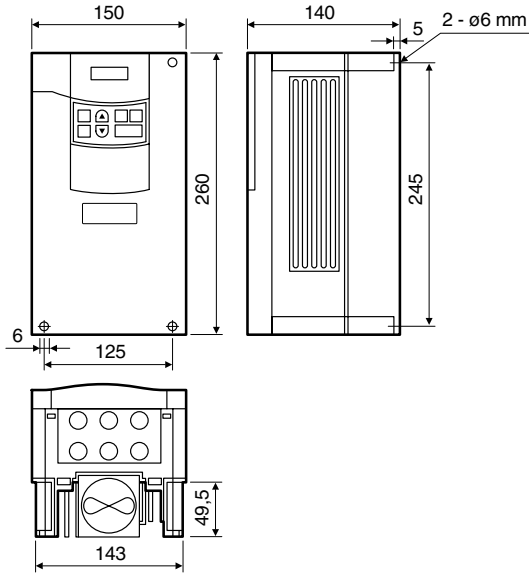
Error Message		Meaning	Description	Remedy
Control Panel FR-PU04	Control Panel FR-DU04			
—	<i>rb</i>	Brake resistor overload	The brake resistor must exchange too much energy.	Increase the brake time.
—	<i>rh</i>	Load too large? Sudden acceleration?	The load is too large or the operating speed too high.	Reduce the load or the operating speed.
—	<i>OL</i>	Motor run under overload? Sudden deceleration? oL: Overvoltage OL: Overcurrent	The load is too large or the brake frequency too high.	Reduce the load or the brake frequency.
—	<i>Error</i>	Error ^{① ②}	CPU error This message appears for about 3s during the communication check that follows an inverter reset.	Please contact your nearest MITSUBISHI ELECTRIC representative if the error occurs repeatedly.
E.14	<i>E.14</i>	DC circuit short circuited ^③	The inverter output is stopped after a short circuit occurred	Remove the short circuit and replace the DC fuse.
E.15	<i>E.15</i>	Main circuit failure ^⑤	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 ^④	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 These error messages are valid only for FR-A 540-0.4 k to 55 k EC inverters.
- ② These error messages are valid only for FR-A 540L-G75 k to 280 k EC inverters.
- ③ These error messages are valid only for FR-A 540L-G375 k and 450 k EC inverters.
- ④ These error messages are valid only for FR-A 540-0.4 k to 55 k EC inverters for firmware version 7392J and higher.
- ⑤ The error message E.15 is valid only for FR-A 540L-G75 k to 450 k EC inverters. Refer to the instruction manual of the frequency inverter for a detailed description of the error message.

7 Dimensions

7.1 Inverter Type FR-A 540

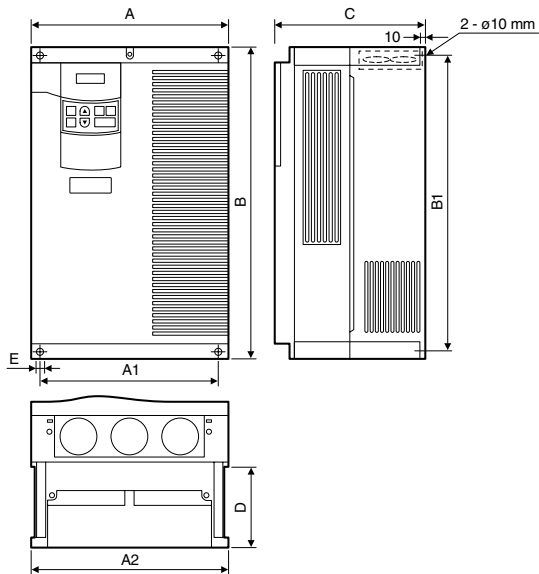
7.1.1 Capacity Classes 0.4 k to 3.7 k



Unit: mm

NOTE | The inverters FR-A 540 EC-0.4 k to 1.5 k do not have a built-in fan.

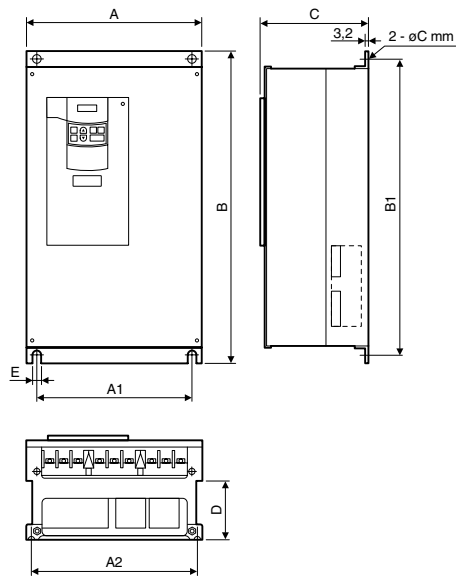
7.1.2 Capacity Classes 5.5 k to 22 k



Unit: mm

Type	A	A1	A2	B	B1	C	D	E
FR-A 540-5.5 k / 7.5 k	220	195	211	260	245	170	86.5	6
FR-A 540-11 k / 15 k / 18.5 k / 22 k	250	230	242	400	380	190	101.5	10

7.1.3 Capacity Classes 30 k to 55 k

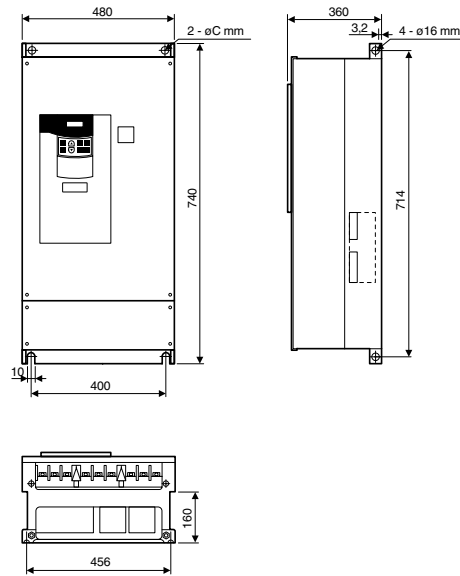


Unit: mm

Type	A	A1	A2	B	B1	C	D	E
FR-A 540-30 k	340	270	320	550	530	195	71.5	10
FR-A 540-37 k / 45 k / 55 k	450	380	430	550	525	250	154	12

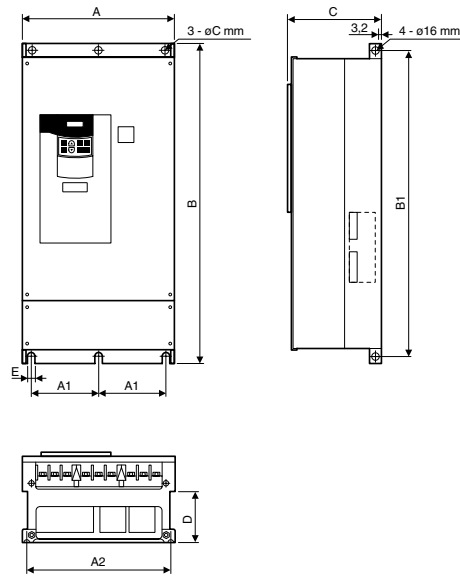
7.2 Inverter Type FR-A 540L-G

7.2.1 Capacity Classes G75 k to G110 k



Unit: mm

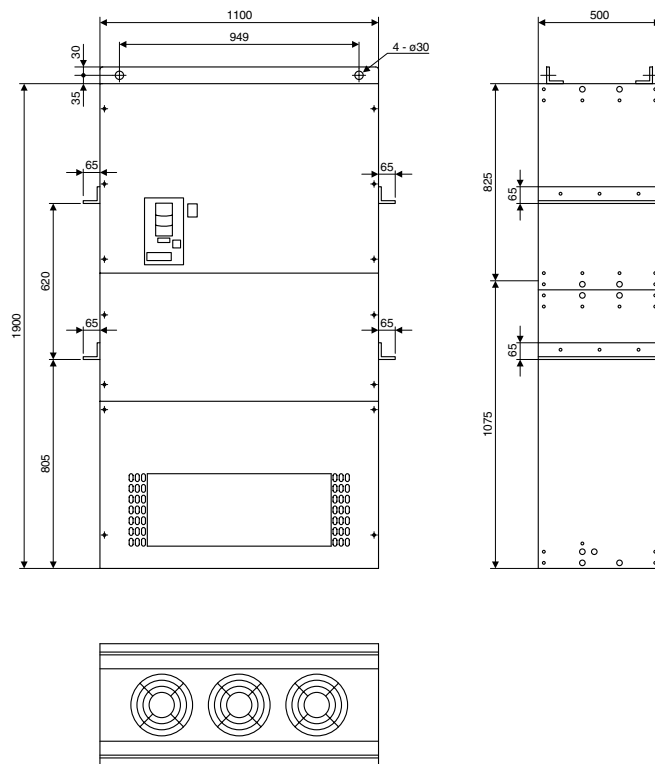
7.2.2 Capacity Classes G132 k to G280 k



Unit: mm

Type	A	A1	A2	B	B1	C	D	E
FR-A 540L-G132 k / G160 k	498	200	474	1010	984	380	185	10
FR-A 540L-G220 k	680	300	656	1010	984	380	185	10
FR-A 540L-G280 k	790	315	766	1330	1300	440	196	12

7.2.3 Capacity Classes G375 k and G450 k



Unit: mm

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