

# FR-A700 Variable Frequency Drive

World-class FA Products

**Support  
Vector Control**

## Highest level in your hand



**SPEED  
UP**



Comprehensive functions to guarantee faster production cycles with outstanding speed constancy and dynamic performance

**INTELLIGENT  
DESIGN**



Many key components with 10-year design guarantee a long service life

**MORE  
FLEXIBILITY**



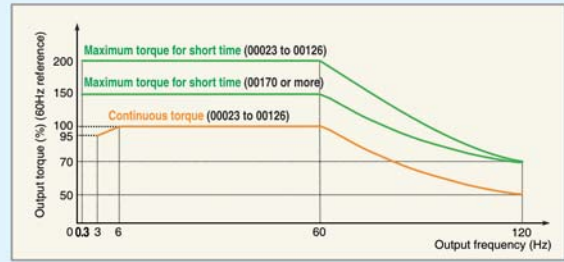
PLC inside as standard

## (1) Exhibit best performance of the general-purpose motor (real sensorless vector control)

High accuracy/fast response speed operation by the vector control can be performed with a general-purpose motor without encoder.

- Maximum of **200%** high torque can be generated at an ultra low speed of **0.3Hz** (Type 00023 to 00126).
- **Speed Control**  
**Speed control range**      **1:200** (0.3Hz to 60Hz driving only)  
**Speed response**            **120rad/s**
- **Torque Control**  
**Torque control range**      **1:20**  
**Absolute torque accuracy**   **± 20%**

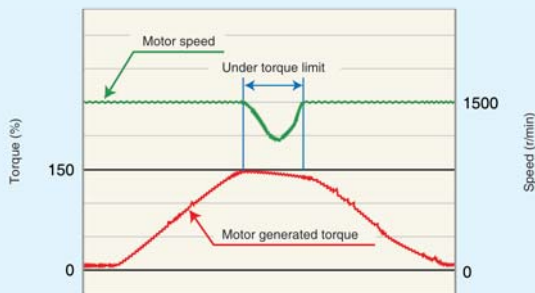
\* Since torque control can not be performed in the low speed regeneration region and at a low speed with light load, use the vector control with encoder.



Example of torque characteristic under real sensorless vector control

### 1. Torque limit function

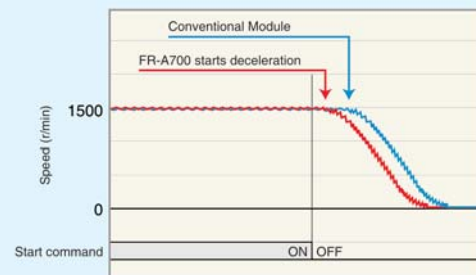
Torque limit function is effective to prevent machine from damage (Grinding machine tools etc.) against the sudden torque disturbance.



Example of torque limit characteristic

### 2. Input response time reduced

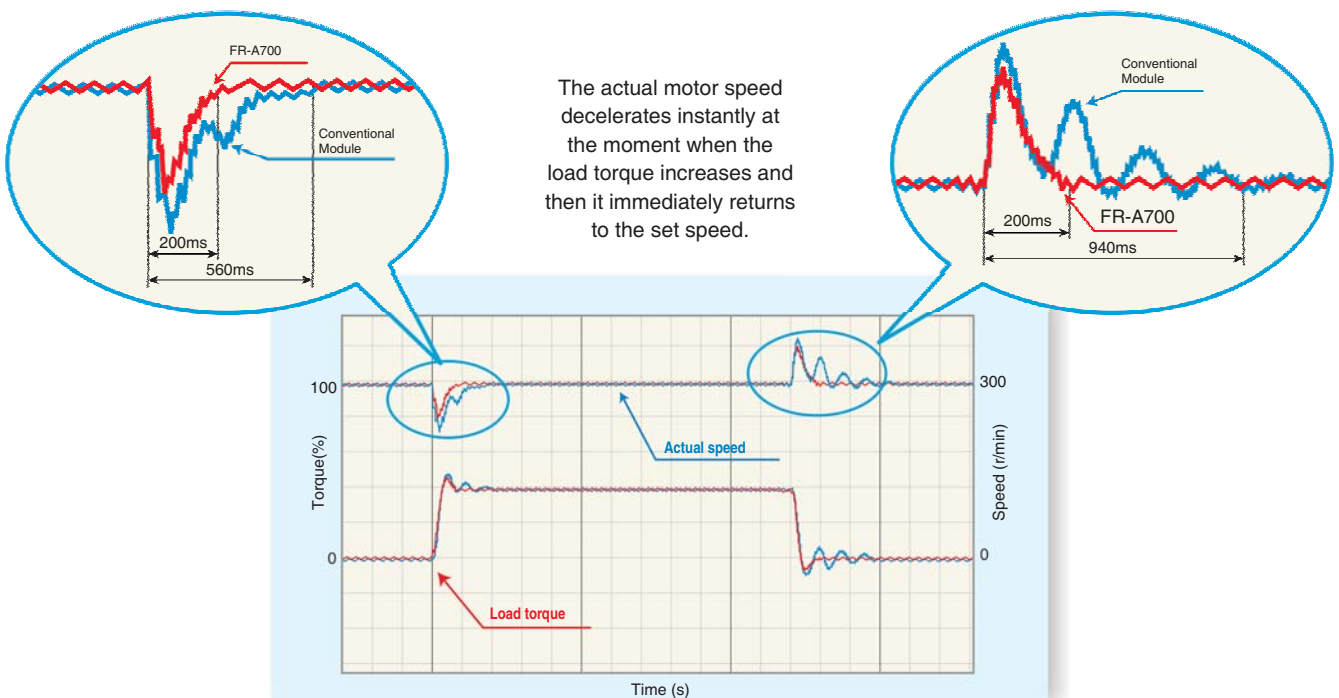
The delay to the input command has been minimized. The response time has been reduced to half as compared to the conventional model. It is suitable for cycle-operation applications.



Example of input command signal response characteristic

### 3. Quick response to fluctuating load

Torque response level to the sudden load fluctuation has been greatly improved as compared to the conventional model. The motor speed variation is minimized to maintain a constant speed. It is suitable for a sawmill machine, etc.



Example of actual speed variation when a load is instantaneously applied  
 FR-A700 series under real sensorless vector control  
 conventional series under advanced magnetic flux vector control



## (2) Higher accuracy operation with encoder (vector control)

Vector control operation can be performed using a motor with encoder<sup>\*1</sup>. Torque control/position control<sup>\*2</sup> as well as fast response/high accuracy speed control (zero speed control, servo lock) can be realized with the inverter.

<sup>\*1</sup> A plug-in option for encoder feed back control (FR-A7AP) is necessary.

<sup>\*2</sup> Only a pulse train+code system is employed for pulse command system when performing position control with an inverter and the FR-A7AP. The maximum pulse input is 100kpps.

### ■ Speed control

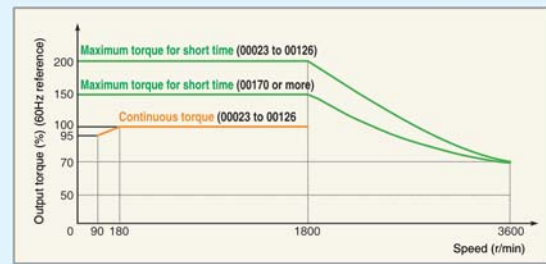
**Speed control range** 1:1500 (both driving/regeneration<sup>\*3</sup>)  
**Speed variation rate** ± 0.01% (100% means 3000r/min)  
**Speed response** 300rad/s (with model adaptive speed control)

<sup>\*3</sup> Regeneration unit (option) is necessary for regeneration

### ■ Torque control

**Torque control range** 1:50  
**Absolute torque accuracy** ± 10%<sup>\*4</sup>  
**Repeated torque accuracy** ± 5%<sup>\*4</sup>

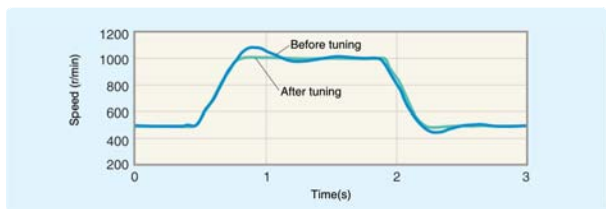
<sup>\*4</sup> Online auto tuning (with adaptive magnetic flux observer)



Example of torque characteristics under vector control

### 1. Easy gain tuning

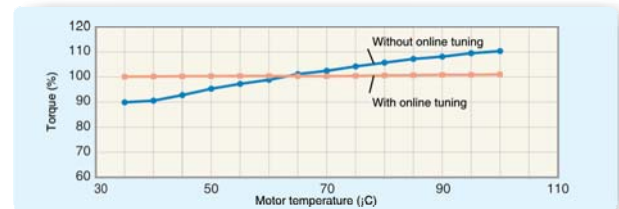
Since the load inertia of the motor is automatically estimated online to calculate the optimum speed control gain and position loop gain.



Comparison of the speed accuracy before and after the load inertia estimation

### 2. Online auto tuning

Online auto tune feature compensated for motor temperature. This operation is appropriate for applications such as a winder/printing machine (tension control) which is controlled by torque.



Example of motor temperature-torque characteristics

## (3) V/F control and advanced magnetic flux vector control operations available

Since V/F control and advanced magnetic flux vector control operations are also available, you can replace the conventional model without anxiety with the inverter.



### •Complement: list of functions according to driving control method

Control Method	Speed Control	Torque Control	Position Control	Speed Control Range	Speed Response	Applied Motor
V/F	○	×	×	1:10 (6 to 60Hz : Driving)	10 to 20rad/s	General-purpose motor (without encoder)
Advanced magnetic flux vector	○	×	×	1:120 (0.5~60Hz : Driving)	20 to 30rad/s	General-purpose motor (without encoder)
Real sensorless vector	○	○	×	1:200 (0.3~60Hz : Driving)	120rad/s	General-purpose motor (without encoder)
Vector (FR-A7AP is necessary)	○ (zero speed control, servo lock)	○	○ <sup>*5</sup>	1:1500 (0.04~60Hz Both driving/regeneration) <sup>*6</sup>	300rad/s	General-purpose motor (with encoder) Dedicated motor

<sup>\*5</sup> Only a pulse train+code method is employed for pulse command method when performing position control with an inverter and the FR-A7AP. The maximum pulse input is 100kpps.

<sup>\*6</sup> Regeneration unit (option) is necessary for regeneration

## 2 Built in PLC function



The FR-A700 also has an integrated PLC function that gives the customer the ability to adapt the FR-A700's performance to his individual needs. Because of this, many small applications can now be completely

handled by the FR-A700 inverter without any other control device. Programming the PLC function is simple and easy when using Mitsubishi's GX Developer programming software.

## 3 Improved Usability with Full of Useful Functions



- More advanced auto tuning
- Enhanced PID function-dancer control
- Power failure deceleration stop function/original operation continuation at instantaneous power-failure
- Regeneration avoidance function

- Built-in brake transistor (Type 00023 to 00620 built-in brake resistor)
- Pulse train input
- Enhanced I/O function
- Multiple Overload rating
- Traverse function



## 4 Long Life Components and Life Check Function

### (1) Further extended components life

- The life of a newly developed cooling fan has been extended to 10 years of design life<sup>\*1</sup>. The life of the cooling fan is further extended with ON/OFF control of the cooling fan.
- Longevity of capacitor was achieved with the adoption of a design life of 10 years<sup>\*1,2</sup>.  
(A capacitor with specification of 5000 hours at 105 °C ambient temperature is adapted.)

<sup>\*1</sup> Ambient temperature : annual average 40°C (free from corrosive gas, flammable gas, oil mist, dust and dirt).

Since the design life is a calculated value, it is not a guaranteed value.

<sup>\*2</sup> Output current: equivalent to rating current of the Mitsubishi standard motor (4 poles).

#### ■ Life indication of life components

Components	Life Guideline of the FR-A700	Guideline of JEMA <sup>*3</sup>
Cooling fan	10 years	2 to 3 years
Main circuit smoothing capacitor	10 years	5 years
Printed board smoothing capacitor	10 years	5 years

<sup>\*3</sup> Excerpts from "Periodic check of the transistorized inverter" of JEMA (Japan Electrical Manufacturer's Association).

### (2) State of the art longevity diagnostic method

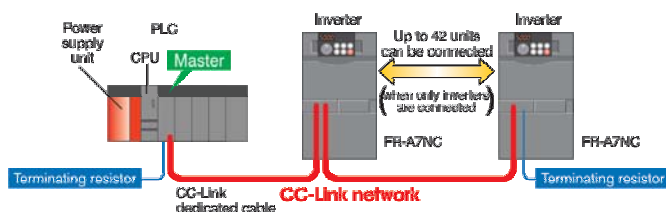
- Degrees of deterioration of main circuit capacitor, control circuit capacitor or inrush current limit circuit can be monitored.
- Since a parts life alarm can be output<sup>\*4</sup> by self-diagnosis, troubles can be avoided.

<sup>\*4</sup> Any one of main circuit capacitor, control circuit capacitor, inrush current limit circuit and cooling fan reaches the output level, an alarm is output.  
For the main circuit capacitor, the capacitor capacity needs to be measured during A stop by setting parameter.

## 5 Network Connection as You Desired

### (1) Compatible with the CC-Link communication (option)

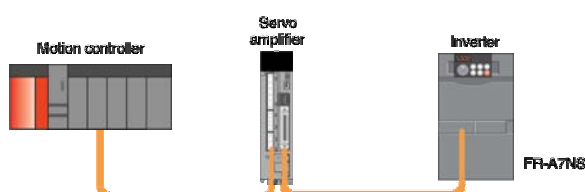
The inverter can be connected to the Mitsubishi PLC (Q, QnA, A series, etc.) through the CC-Link. It is compatible with the CCLink



### (2) Compatible with SSCNETIII (option) (available soon)

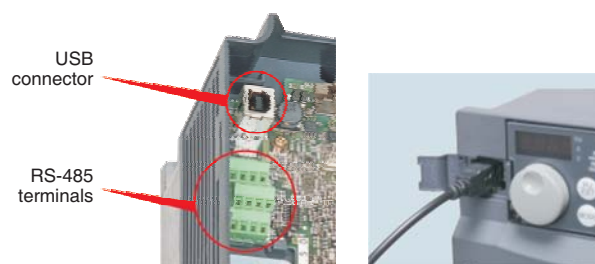
The inverter can be connected to Mitsubishi motion controller through the SSCNETIII. The SSCNETIII employs a high-speed synchronous serial communication system and is appropriate for the synchronous operation.

(SSCNET...Servo System Controller Network)



### (3) RS-485 and USB connection

- The RS-485 terminals are equipped as standard in addition to the PU connector.
- You can make RS-485 communication with the operation panel or parameter unit connected to the PU connector.
- Since the inverter can be connected to the network with terminals, multi-drop connection is also easily done.
- Modbus-RTU (Binary) protocol has been added for communications in addition to the conventional Mitsubishi inverter protocol (computer link).
- As a USB connector (USB1.1B connector) is standard equipped, communication with a personnel computer can be made with a USB cable only.
- Using the RS-485 terminal or USB connector, you can make communication by the FR-Configurator (setup S/W).



### (4) Corresponds to major networks overseas

The inverter can be connected with networks such as Device-NET™, PROFIBUS-DP, LONWORKS, EtherNet (available soon), SSCNETIII and CANopen when communication options are used.

LONWORKS is a registered trademark of Echelon Corporation and DeviceNet is of ODVA. Other company and product names herein are the trademarks of their respective owners.

## 5 Free of Environmental Worries

### (1) Reduction of electromagnetic noise (built-in EMC filter)

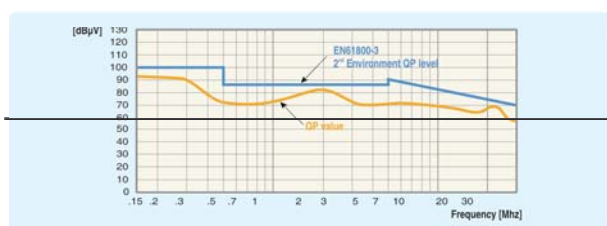
- Reduction of noise generated from the inverter was achieved with adoption of a new technology (low-noise of switching power, low noise of inverter element).
- Because of the newly developed built-in noise filter (EMC filter), the inverter itself can comply with the EMC Directive (2nd Environment<sup>3</sup>). (To make the EMC filter of the inverter valid<sup>1</sup>, set ON/OFF connector<sup>2</sup> to ON.)



<sup>1</sup> Leakage current will increase when the EMC filter is selected.

<sup>2</sup> Since the leakage current when using the EMC filter for the 200V class 0.4K and 0.75K is small, the filter is always valid (setting connector is not provided).

<sup>3</sup> Refer to the EMC installation manual for compliance conditions.



	Capacitive Filter (Radio noise filter)	Zero-phase Reactor (Line noise filter)	DC Reactor
Type 01160 or less	Standard (built-in)	Standard (built-in)	Option (sell separately)
Type 01800 or more	Standard (built-in)	Option (sell separately)	Standard (provided)

### (2) Measures against harmonic leakage current

- A compact AC reactor (FR-HAL) and a DC reactor (FR-HEL), which limit harmonics current flowing into the power supply and improve the power factor, are available as options. (For the 75K or more, a DC reactor is supplied as standard.)



- A high power factor converter (FR-HC, MT-HC) for effective suppressions of power-supply harmonics (conversion coefficient: K5=0) can be connected.

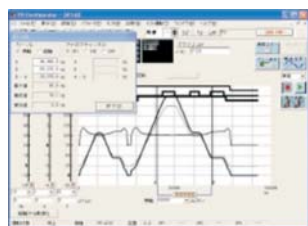
### (3) Equipped with inrush current suppression circuit

- Because of the built-in inrush current limit circuit, the current at power on can be restricted.

## 7 Simple Operation and Easy Maintenance

### (1) Easy maintenance with FR-Configurator (Option)

- Parameter management (parameter setting, file storage, printing) is easy.
- Maintenance and setup of the inverter can be done from a personal computer connected with USB.
- Mechanical resonance is easily avoided with machine analyzer function.
- Parameter setting after replacement of the FRA500 series can be made with a parameter automatic conversion function.



### (2) Operation panel with the popular setting dial

- Possible to copy parameters with operation panel. Parameter setting values are stored in the operation panel and optional parameter unit (FR-PU07).
- Operation is easy with the setting dial.



Example of  
parameter change

PU/EXT operation  
mode example

- Operation panel is detachable and can be installed on the enclosure surface. (cable connector option is required)
- PU/EXT (operation mode) can be switched with a single touch.
- A dial/key operation lock function prevents operational errors.



### (3) New type parameter unit FR-PU07 (option)

- An operation panel can be removed and a parameter unit can be connected.
- Setting such as direct input method with a numeric keypad, operation status indication, and help function are usable.
- Eight languages can be displayed.
- Parameter setting values of a maximum of three inverters can be stored.
- Since a battery pack type (available soon) is connectable, parameter setting and parameter copy can be performed without powering on the inverter.



### (4) Easy replacement with the cooling fan cassette

- Cooling fans are provided on top of the inverter.
- Cooling fans can be replaced without disconnecting main circuit wires.



### (5) Removable terminal block

A removable terminal block was adapted. (The terminal block of the FR-A700 series is compatible with that of the FR-A500 series. Note that some functions of the FR-A700 series are restricted when using the terminal block of the FR-A500 series. Note that the wiring cover is not compatible.)

## Rating

Series			FR-A740														
			00023	00038	00052	00083	00126	00170	00250	00310	00380	00470	00620	00770	00930	01160	
Output	Rated motor capacity (KW) <sup>*1</sup>	120% overload capacity	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	
		150% overload capacity	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	
		200% overload capacity	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	
	Rated current <sup>*3</sup>	120% overload capacity	2.3	3.8	5.2	8.3	12.6	17	25	31	38	47	62	77	93	116	
		150% overload capacity	2.1	3.5	4.8	7.6	11.5	16	23	29	35	43	57	70	85	106	
		200% overload capacity	1.5	2.5	4	6	9	12	17	23	31	38	44	57	71	86	
	Output capacity (KVA) <sup>*2</sup>	120% overload capacity	1.8	2.9	4	6.3	9.6	13	19.1	23.6	29	35.8	47.3	58.7	70.9	88.4	
		150% overload capacity	1.6	2.7	3.7	5.8	8.8	12.2	17.5	22.1	26.7	32.8	43.4	53.3	64.8	80.8	
		200% overload capacity	1.1	1.9	3	4.6	6.9	9.1	13	17.5	23.6	29	33.5	43.4	54.1	65.5	
	Overload current rating <sup>*4</sup>	120% overload capacity	110% of rated current capacity for 60 s; 120% for 3 s <sup>*9</sup>														
		150% overload capacity	120% of rated current capacity for 60 s; 150% for 3 s <sup>*10</sup>														
		200% overload capacity	150% of rated current capacity for 60 s; 200% for 3 s <sup>*10</sup>														
Voltage <sup>*5</sup>			3 Phase AC , 0 V to power supply voltage														
Frequency range			0.2 - 400 Hz														
Control method			Soft PWM control / high carrier frequency control ( Selectable from among V/f control, advance magnetic flux vector control, real sensorless vector control, and close loop vector control )														
Regenerative braking torque			100% torque / 2% ED <sup>6</sup>										20% torque continuous <sup>*6</sup>		20% torque continuous		
Input	Power supply voltage		Three phase 380 - 480V 50Hz/60Hz ( -15% / +10% )														
	Voltage range		323 - 528V at 50Hz/60Hz														
	Power supply frequency		50 / 60 HZ ( ± 5% )														
	Rated input capacity (KVA) <sup>*7</sup>	120% overload capacity	2.5	4.5	5.5	9	12	17	20	28	34	41	52	66	80	100	
		150% overload capacity	2.1	4	4.8	8	11.5	16	20	27	32	37	47	60	73	91	
200% overload capacity		1.5	2.5	4.5	5.5	9	12	17	20	28	34	41	52	66	80		
Others	Cooling		Self cooling				Fan cooling										
	Protective structure		IP20 <sup>*8</sup>														
	Dimension in mm ( W*H*D )		150*260*140				220*260*170		220*300*190		250*400*190		325*550*195		435*550*250		
	Approximate mass ( Kg )		3.8	3.8	3.8	3.8	3.8	7.1	7.1	7.5	7.5	13	13	23	35	35	

Series			FR-A740																			
			01800	02160	02600	03250	03610	04320	04810	05470	06100	06830	07700	08660	09620	10940	12120					
Output	Rated motor capacity (KW) <sup>*1</sup>	120% overload capacity	90	110	132	160	185	220	250	280	315	355	400	450	500	550	630					
		150% overload capacity	75	90	110	132	160	185	220	250	280	315	355	400	450	500	560					
		200% overload capacity	55	75	90	110	132	160	185	220	250	280	315	355	400	450	500					
	Rated current <sup>*3</sup>	120% overload capacity	180	216	260	325	361	432	481	547	610	683	770	866	962	1094	1212					
		150% overload capacity	144	180	216	260	325	361	432	481	547	610	683	770	866	962	1094					
		200% overload capacity	110	144	180	216	260	325	361	432	481	547	610	683	770	866	962					
	Output capacity (KVA) <sup>*2</sup>	120% overload capacity	137	165	198	248	275	329	367	417	465	521	587	660	733	834	924					
		150% overload capacity	110	137	165	198	248	275	329	367	417	465	521	587	660	733	834					
		200% overload capacity	100	110	137	165	198	248	275	329	367	417	465	521	587	660	733					
	Overload current	120% overload capacity 150% overload capacity 200% overload capacity	110% of rated current capacity for 60 s; 120% for 3 s <sup>*9</sup> 120% of rated current capacity for 60 s; 150% for 3 s <sup>*10</sup> 150% of rated current capacity for 60 s; 200% for 3 s <sup>*10</sup>																			
	Voltage <sup>*5</sup>		3 Phase AC , 0 V to power supply voltage																			
	Frequency range		0.2 - 400 Hz																			
Control method		Soft PWM control / high carrier frequency control ( Selectable from among V/f control, advance magnetic flux vector control, real sensorless vector control, and close loop vector control )																				
Regenerative braking torque		20% torque / continuous 60% torque / continuous      10% torque / continuous																				
Input	Power supply voltage	Three phase 380 - 480V 50Hz/60Hz ( -15% / +10% )																				
	Voltage range	323 - 528V at 50Hz/60Hz																				
	Power supply frequency	50 / 60 HZ ( ± 5% )																				
	Rated input capacity (KVA) <sup>*7</sup>	120% overload capacity 150% overload capacity 200% overload capacity	37	165	198	247	275	329	366	416	464	520	586	660	733	833	924					
Others	Cooling	Fan cooling																				
	Protective structure	IP00																				
	Dimension in mm ( W*H*D )	435*550*250			465*620*300			465*740*360			498*1010*380			680*1010*380			790*1330*440			995*1580*440		
	Approximate mass ( Kg )	37	50	57	72	72	110	110	175	175	175	260	260	370	370	370						

### Remarks

- The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.
- The rated output capacity indicated assumes that the output voltage is 440 V.
- The % value of the overload current rating indicates the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the inverter and motor to return to or below the temperature under 100% load.
- The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range. However, the pulse voltage value of the inverter output side voltage remains unchanged at about  $\sqrt{2}$  that of power supply.
- With high duty brake resistor, the 00023 to 00250 & 00310 to 00620 will achieve the performance of 100% torque / 10%ED & 100% torque / 6% ED respectively.
- The power supply capacities varies with the value of the power supply side inverter impedance ( including those of the input reactor and cables ).
- When the hook of the inverter front cover is cut off for installation of plug-in option, the inverter changes to an open type (IP00).
- FR-DU07 : IP40 ( except for the PU connector)
- Max. ambient temperature 40° C - Inverse time characteristics.
- Max. ambient temperature 50° C - Inverse time characteristics.

### • Details of Factory Supplied DC Link Chokes

Application (Inverter)	DC reactor	Dimensions in mm			weight Kg	Application (Inverter)	DC reactor	Dimensions in mm			weight Kg
		W	H	D				W	H	D	
FR-A740-01800-IN	FR-HEL-H90K	150	340	190	20	FR-A740-06100-IN	FR-HEL-H315K	210	495	250	42
FR-A740-02160-IN	FR-HEL-H110K	150	340	195	22	FR-A740-06830-IN	FR-HEL-H355K	210	495	250	46
FR-A740-02600-IN	FR-HEL-H132K	175	405	200	26	FR-A740-07700-IN	FR-HEL-H400K	235	500 ±10%	250	50
FR-A740-03250-IN	FR-HEL-H160K	175	405	205	28	FR-A740-08660-IN	FR-HEL-H450K	240	500 ±10%	270	57
FR-A740-03610-IN	FR-HEL-H185K	175	405	240	29	FR-A740-09520-IN	FR-HEL-H500K	-	345	455	67
FR-A740-04320-IN	FR-HEL-H220K	175	405	240	30	FR-A740-10940-IN	FR-HEL-H560K	-	360	460	85
FR-A740-04810-IN	FR-HEL-H250K	190	440	250	35	FR-A740-12120-IN	FR-HEL-H630K	-	360	460	95
FR-A740-05470-IN	FR-HEL-H280K	190	440	255	38						

### • Brake resistor specifications 400V Class

Model	Resistance	Power
	Ohm	W*
FR-A740-00023-IN	1200	45
FR-A740-00038-IN	700	75
FR-A740-00052-IN	350	115
FR-A740-00083-IN	250	120
FR-A740-00126-IN	150	155
FR-A740-00170-IN	110	185
FR-A740-00250-IN	75	340
FR-A740-00310-IN	52	1000
FR-A740-00380/00470-IN	36	1500
FR-A740-00620-IN	26	2200

\* Wattage rating will change with respect to brake duty & brake torque

## Common specifications

FR-A740			Description
Control Specifications	Control method		Soft-PWM control/high carrier frequency PWM control (selectable from among V/F control, advanced magnetic flux vector control and real sensorless vector control) / vector control <sup>*1</sup>
	Frequency setting resolution	Analog input	0.015 Hz / 0-50 Hz (terminal 2, 4:0-10 V / 12 bit) 0.03 Hz / 0-50 Hz (terminal 2, 4:0-5 V / 11 bit, 0-20mA / 11 bit, terminal 1: -10~+10V / 12 bit) 0.06 Hz / 0-50 Hz (terminal 1:0~±V / 11 bit)
		Digital Input	0.01 Hz
	Frequency accuracy		±0.2 % of the maximum output frequency (temperature range 25° ± 10°C) via analog input; ±0.01 % of the set output frequency (via digital input)
	Voltage / frequency characteristics		Base frequency adjustable from 0 to 400 Hz; selection between constant torque, variable torque or optional flexible 5-point V/f characteristics
	Starting torque		200 % 0.3 Hz (00023 to 00126), 150 % 0.3 Hz (00170 or more) (under real sensorless vector control or vector control)
	Torque boost		Manual torque boost
	Acceleration / deceleration time		0;0.1 to 3600s (can be set individually), linear or S-pattern acceleration/deceleration mode, backlash measures acceleration/deceleration can be selected.
	Acceleration / deceleration characteristics		Linear or S-form course, user selectable
	DC injection brake		Operating frequency (0-120 Hz), operating time (0-10 s) and operating voltage (0-30 %) can be set individually. The DC brake can also be activated via the digital input
	Stall prevention operation level		Operation current level can be set (0 to 220 % adjustable), whether to use the function or not can be selected
	Motor protection		Electronic motor protection relay (rated current user adjustable)
	Torque limit level		Torque limit value can be set (0 to 400 % variable)
Control signals for operation	Frequency setting values	Analog input	Terminal 2, 4:0-5 V DC, 0-10 V DC, 0/4-20 mA Terminal 1:0~±5 V DC, 0~±10V DC
		Digital Input	Input using the setting dial of the operation panel or parameter unit Four-digit BCD or 16 bit binary (when used with option FR-A7AX)
	Start signal		Available individually for forward rotation and reverse rotation. Start signal automatic self-holding input (3-wire input) can be selected.
	Input signals	Common	Any of 12 signals can be selected using parameters 178 to 189 (input terminal function selection): from among multi speed selection, remote setting, stop-on-contact, second function selection, third function selection, terminal 4 input selection, JOG operation selection, selection of automatic restart after instantaneous power failure, flying start, external thermal relay input, inverter operation enable signal (FR-HC/FR-CV connection), FR-HC connection (instantaneous power failure detection), PU operation/external inter lock signal, external DC injection brake operation start, PID control enable terminal, brake opening completion signal, PU operation/external operation switchover, load pattern selection forward rotation reverse rotation boost, V/F switching, load torque high-speed frequency, S-pattern acceleration / deceleration C switchover, pre-excitation, output stop, start self-holding selection, control mode changing, torque limit selection, star-time tuning start external input, torque bias selection, 1, 2*, P/PI control switchover, forward rotation command, reverse rotation command, inverter reset, PTC thermistor input, PID forward reverse operation switchover, PU-NET operation switchover, NET-external operation switchover, and command source switchover
		Pulse train input	100 kpps
	Output signals	Operating status	Any of 7 signals can be selected using parameter 190 to 196 (output terminal function selection): from among inverter running, up-to frequency, instantaneous power failure / undervoltage, overload warning, output frequency (speed) detection, second output frequency (speed) detection, third output frequency (speed) detection, regenerative brake prealarm, electronic thermal relay function pre-alarm, PU operation mode, inverter operation ready, output current detection, zero current detection, PID lower limit, PID upper limit, PID forward rotation reverse rotation output, commercial power supply-inverter switchover MC1, commercial power supply-inverter switchover MC2, commercial power supply-inverter switchover MC3, orientation completion*, brake opening request, fan fault output, heatsink overheat pre-alarm, inverter running / start command on, deceleration at an instantaneous power failure, PID control activated, during retry, PID output interruption, life alarm, alarm output 1, 2, 3 (power-off signal), power savings average value update timing, current average monitor, maintenance timer alarm, remote output, forward rotation output*, reverse rotation output*, low speed output, torque detection, regenerative status output*, start-time tuning completion, in-position completion*, minor failure output and alarm output. Open collector output (5 point), relay output (2 points) and alarm code of the inverter can be output (4 bit) from the open collector
		When using the FR-A7AY, FR-A7AR option	In addition to the above operating modes parameters 313-319 (function selection for the additional 7 output terminals) can also be used to assign the following four signals: control circuit capacitor life, main circuit capacitor life, cooling fan life, inrush current limit circuit life (Only positive logic can be set for extension terminals of the FR-A7AR)
		Analog output	You can select any signals using Pr. 54 CA and Pr. 158 AM terminal function selection (analog output) from among output frequency, motor current (steady or peak value), output voltage, frequency setting, operation speed, motor torque, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, motor excitation current, reference voltage output, motor load factor, power saving effect, regenerative brake duty, PID set point, PID measured value, motor output, torque command, torque current command, and torque monitor.
Display	Control unit display (FR-PU07/FR-DU07)	Operating state	Output frequency, motor current (steady or peak value), output voltage, frequency setting, running speed, motor torque, overload, converter output voltage (steady or peak value), electronic thermal relay function load factor, input power, output power, load meter, motor excitation current, cumulative energization time, actual operation time, motor load factor, cumulative power, energy saving effect, cumulative saving power, regenerative brake duty, PID set point, PID measured value, PID deviation, inverter I/O terminal monitor, input terminal option monitor*, output terminal option monitor*, option fitting status*, terminal assignment status*, torque command, torque current command, feed back pulse*, motor output
		Alarm definition	Alarm definition is displayed when the protective function is activated, the output voltage/current/frequency/cumulative energization time right before the protection function was activated and the past 8 alarm definitions are stored.
		Interactive guidance	Operation guide/trouble shooting with a help function*3.
Environment	Ambient Temperature		-10°C to +50°C (non-freezing)
	Ambient humidity		90%RH maximum (non-condensing)
	Storage temperature **		-20°C to +65°C
	Atmosphere		Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
	Altitude/vibration		Maximum 1000m above sea level, 5.9m/s <sup>2</sup> or less *5 (conforms to JIS C 60068-2-6)

\*1. Only when the option (FR-A7AP) is mounted

\*2. Can be displayed only on the operation panel (FR-DU07).

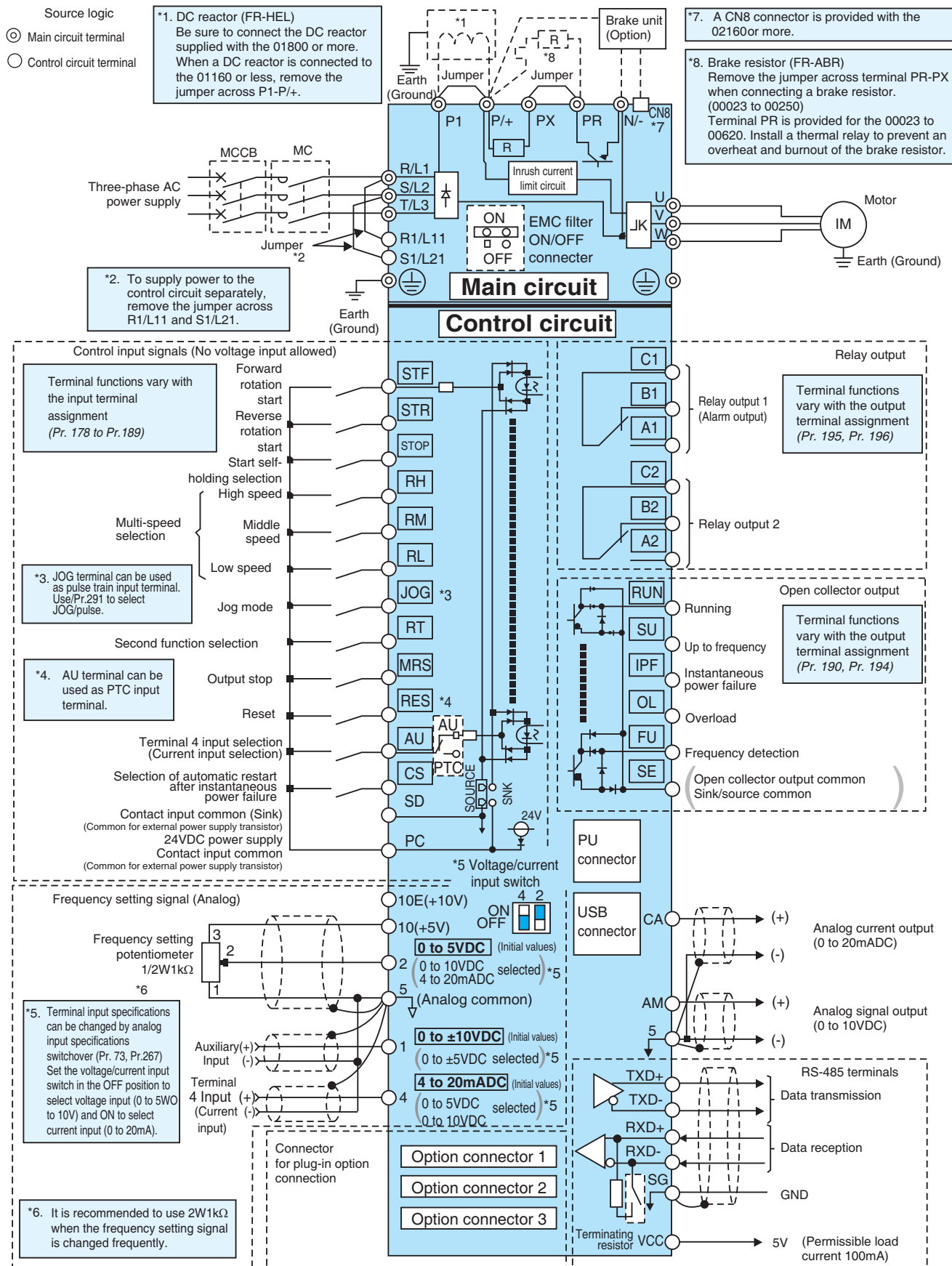
\*3. Can be displayed only on the parameter unit (FR-PU07/FR-PU04).

\*4. Temperature applicable for a short period in transit, etc.

\*5. 2.9m/s<sup>2</sup> or less for the 160K or more.



## Terminal Connection Diagram



### CAUTION

- To prevent a malfunction caused by noise, separate the signal cables more than 10cm from the power cables.
- Be sure to earth (ground) the inverter and motor before use.
- This connection diagram assumes that the control circuit is source logic (initial setting). Refer to the instruction manual for the connection in the case of sink logic.



## Terminal Assignment of Main Circuit & Signal Terminals

Function	Terminal	Designation	Description
Main circuit connection	L1, L2, L3,	Mains supply connection	Mains power supply of the inverters (380-480 V AC, 50/60 Hz)
	P/+, PR	Brake resistor connection	An optional brake resistor (FR-ABR) can be connected across these terminals. The PR terminal is provided only for type 00023 - 00620.
	P/+, N/-	Brake unit connection	A brake unit (FR-BU and BU,MT-BU5), power regeneration common converter (FR-CV) or regeneration common converter (MT-RC) and high power factor converter (FR-HC, MT-HC) can be connected to these terminals.
	P/+,P1	DC reactor connection	For type 00023 - 01160 a DC reactor can be connected to these terminals. (For 01800 or above a DC reactor is supplied as standard)
	PR, PX	Built-in brake circuit connection	When the jumper is connected across terminals PR and PX (initial status), the built-in brake reactor circuit is valid. The PX terminal is provided only for type 00023 - 00250.
	U, V, W	Motor connection	Voltage output of the inverter (3-phase, 0 V up to power supply voltage, 0.5-400 Hz)
	L11, L21	Power supply for control circuit	To use external power for the control circuit connect the mains power to L11/L21 (and remove jumpers L1 and L2)
	CN8	Ext. brake transistor control	Control connection for the MT-BU5 external brake module
Control connection (programmable)		PE	Protective earth connection of inverter
	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 according to the combination of the RH, RM and RL signals
	JOG	Jog mode selection	The JOG mode is selected, if a signal is applied to this terminal (factory setting). The start signals STF and STR determine the rotation direction.
		Pulse train input	The JOG terminal can be used as pulse train input terminal (parameter 291 setting needs to be changed)
	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	The 0/4-20mA signal on terminal 4 is enabled by a signal on the AU terminal
		PTC input	If you connect a PTC temperature sensor you must assign the PTC signal to the AU terminal and set the slide switch on the control circuit board to the PTC position.
	CS	Automatic restart after instantaneous power failure	The inverter restarts automatically after a power failure, if a signal is applied to the terminal CS
Common	SD	Reference potential (0V) for the PC terminal (24V)	When "sink" control logic is selected by setting the control signal jumper a specific control function is triggered when the corresponding control terminal is connected to the PC terminal. When "source" control logic is selected and you are using external 24V power you must connect the 0V of the external power supply to terminal SD. The SD terminal is isolated from the terminals 5 and SE with optocouplers.
	PC	24 V DC output	Internal power supply 24 V DC/0, 1 A output
Setting value specification	10 E	Voltage output for potentiometer	Output voltage 10 V DC. Max. output current 10 mA Recommended potentiometer: 1 k $\Omega$ , 2 W linear
	10		Output voltage 5 V DC Max. output current 10 mA. Recommended potentiometer: 1k $\Omega$ , 2 W linear
	2	Input for frequency setting value signal	The setting value 0 to 5 V DC (or 0-10 V, 0/4-20mA) is applied to this terminal. You can switch between voltage and current setpoint values with parameter 73. The input resistance is 10k $\Omega$
	5	Frequency setting common and analog outputs	Terminal 5 provides the common reference potential (0V) for all analog set point values and for the analog output signals CA (current) and AM (voltage). The terminal is isolated from the digital circuit's reference potential (SD). This terminal should not be grounded
	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- $\pm$ 10 V DC. The input resistance is 10k $\Omega$
	4	Input for setting value signal	The setting value 0/4-20 mA or 0-10 V is applied to this terminal. You can switch between voltage and current setpoint values with parameter 267. The input resistance is 250 $\Omega$ . The current setting value is enabled via terminal function AU.
Signal output (programmable)	A1, B1, C1	Potential free relay output 1 (Alarm)	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 pick up. The maximum contact load is 200 V AC/0.3 A or 30 V DC/0.3 A
	A2, B2, C2	Potential free relay output 2	Any of the available 42 output signals can be used as the output driver. The maximum contact load is 230V AC /0.3 A or 30 V DC / 0.3A.
	RUN	Signal output for motor operation	The output is switched low, if the inverter output frequency is equal to or higher than the starting frequency. The output is switched high, if no frequency is output or the DC brake is in operation.
	SU	Signal output for frequency setting value/current value comparison	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.
	IPF	Signal output for instantaneous power failure	The output is switched low for a temporary power failure within a range of 15ms $\leq$ t <sub>PF</sub> $\leq$ 100ms or for under voltage.
	OL	Signal output for overload alarm	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.
	FU	Signal output for monitoring output frequency	The output is switched low once the output frequency exceeds a value preset in parameter 42(or 43). Otherwise the FU output is switched high.
	SE	Reference potential for signal outputs	The potential that is switched via open collector outputs RUN, SU,OL,IPF and FU is connected to this terminal.
	CA	Analog signal output 0-20 mA DC	One of 18 monitoring function can be selected, e.g. external frequency output. CA and AM output can be used simultaneously. The function are determined by parameters.
	AM	Analog signal output 0-10 V DC (1mA)	
Interface	-	PU connector	A parameter unit can be connected. Communications via RS485 I/O standard: RS485, Mult-Drop operation, 4,800-38,400 Baud (overall length: 500m)
	-	RS 484 terminal (via RS485 terminal)	Communications via RS485 I/O standard: RS485, Mult-Drop operation, 300-38, 400 Baud (overall length: 500m)
	-	USB connector	This USB interface is used to connect the inverter to a personal computer(conforms to USB1.1)

## Option List

Name			Type	Applications, Specifications, etc.	Applicable Inverter	
Plug-in Type	Vector control		FR-A7AP	Vector control with encoder can be performed.	Shared among all models	
	Orientation/encoder			The main spindle can be stopped at a fixed position (orientation) in combination with a pulse encoder. The motor speed is sent back and the speed is maintained constant.		
	16-bit digital input		FR-A7AX	<ul style="list-style-type: none"><li>This input interface sets the high frequency accuracy of the inverter using an external BCD or binary digital signal.</li><li>BCD code 3 digits (maximum 9990)</li><li>BCD code 4 digits (maximum 9999)</li><li>Binary 12 bits (maximum FFFH)</li><li>Binary 16 bits (maximum FFFFH)</li></ul>		
	Digital output Extension analog output			FR-A7AY		<ul style="list-style-type: none"><li>Output signals provided with the inverter as standard are selected to output from the open collector.</li><li>This option adds 2 different signals that can be monitored at the terminals AM0 and AM1, such as the output frequency, output voltage and output current.</li><li>20mADC or 10VDC meter can be connected.</li></ul>
			Relay output			FR-A7AR
	Communication	CC-Link		FR-A7NC		<ul style="list-style-type: none"><li>This option allows the inverter to be operated or monitored or the parameter setting to be changed from a computer or PLC.</li></ul> *For the FR-A7NC (CC-Link), the above operations can be done from the PLC only.
		LONWORKS		FR-A7NL		
		DeviceNet		FR-A7ND		
PROFIBUS-DP		FR-A7NP				
Stand-alone Shared	Parameter unit (8 languages)		FR-PU07 / FR-PU04		Interactive parameter unit with LCD display	Shared among all models
	Parameter unit connection cable		FR-CB20		Cable for connection of operation panel or parameter unit □ indicates a cable length. (1m, 3m, 5m)	
	Operation panel connection connector		FR-ADP		Connector to connect the operation panel (FR-DU07) and connection cable	
	Cable for encoder Mitsubishi vector control dedicated motor (SF-V5RU)		FR-V7CBL		Connection cable for the inverter and encoder for Mitsubishi vector control dedicated motor (SF-V5RU). □ indicates a cable length. (1m, 3m, 5m)	
	Heatsink protrusion attachment		FR-A7CN01 to 11		The inverter heatsink section can be protruded outside of the rear of the enclosure.	FR-A720-1.5K to 90K FR-A740-0.4K to 132K According to capacities
	Intercompatibility attachment		FR-AAT24		Attachment for replacing with the A700 series using the installation holes of the FR-A500 series.	FR-A740-11K, 15K
			FR-A5AT		Attachment for replacing with the FR-A700 series using the installation holes of the FR-A100<Excellent> and FR-A200<Excellent>	According to capacities
	AC reactor		FR-HAL		For harmonic suppression measures and improvement of inverter input power factor (total power factor approx. 88%)	According to capacities
	DC reactor		FR-HEL		For harmonic suppression measures and improvement of inverter input power factor (total power factor approx. 93%)	Compatible with the 55K or less
	Line noise filter		FR-BSF01 FR- BLF		For line noise reduction	Shared among al models
	High-duty brake resistor		FR-ABR		For improvement of braking capability of the built-in brake of the inverter	Compatible with the 22K or less
	Brake unit Resistor unit		FR-BU2 FR-BR		For increasing the braking capability of the inverter (for high-inertia load or negative load) Brake unit and resistor unit are used in combination	Compatible with the 55K or less
Connected as per capacity						
Stand-alone Shared	Power regeneration common Converter Stand-alone reactor dedicated for the FR-CV		FR-CV FR-CVL		Unit which can return motor-generated braking energy back to the power supply in common converter system	Compatible with the 55K or less
	Power regeneration converter		MT- RC		Energy saving type high performance brake unit which can regenerate the braking energy generated by the motor to the power supply.	Compatible with the 75K or more
	High power factor converter		FR-HC		The high power factor converter switches the converter section on/off to reshape an input current waveform into a sine wave, greatly suppressing harmonics. (Used in combination with the standard accessory.)	Compatible with the 55K or less
			MT-HC			Compatible with the 75K or more
	Surge voltage suppression filter		FR-ASF		Filter for suppressing surge voltage on motor	Compatible with the 400V class 55K or less
	Sine wave filter	Reactor	MT- BSL (-HC)		Reduce the motor noise during inverter driving Use in combination with a reactor and a capacitor	Compatible with the 75K or more
Capacitor		MT- BSC				

## Protective Functions

	Function Name	Display
Error Message *2	Operation panel lock	HOLD
	Parameter write error	Er 1 to Er 4
	Copy operation error	rEr 1 to rEr 4
	Error	Err.
Warnings *3	Stall prevention (overcurrent)	OL
	Stall prevention (overvoltage)	oL
	Regenerative brake prealarm	rb
	Electronic thermal relay function prealarm	rH
	PU stop	PS
	Maintenance signal output	nr
	Parameter copy	CP
	Speed limit display (output during speed limit)	SL
Minor Failure *4	Fan fault	Fn
Major failures *5	Overcurrent shut-off during acceleration	EOC1
	Overcurrent shut-off during constant speed	EOC2
	Overcurrent shut-off during deceleration or stop	EOC3
	Regenerative overvoltage shut-off during acceleration	EOv1
	Regenerative overvoltage shut-off during constant speed	EOv2
	Regenerative overvoltage shut-off during deceleration or stop	EOv3
	Inverter overload shut-off (Electronic thermal relay Function) *1	ErHr
	Motor overload shut-off (Electronic thermal relay Function) *1	ErHn
	Fin overheat	EFIn
	Instantaneous power failure protection	E1PF
	Undervoltage protection	EUvF
	Input phase failure	E1LF
	Stall prevention	EDLF
	Brake transistor alarm detection	E. bE
	Output side earth (ground) fault overcurrent protection	E. GF
	Output phase failure protection	E. LF
	External thermal relay operation *6	EDHr
	PTC thermistor operation	EPFC
	Option alarm	EDPr
	Communication option alarm	EDP3

	Function Name	Display
Major failures *5	Option alarm	E. 1 to E. 3
	Parameter storage device alarm	E. PE
	PU disconnection	EPUE
	Retry count excess	ErEr
	Parameter storage device alarm	EPE2
	CPU error	E. 61 to E. 71/ECPU
	Operation panel power supply short circuit RS-485 terminals power supply short circuit	ECrE
	24VDC power output short Circuit	EP24
	Output current detection value excess	ECdO
	Inrush resistor overheat	E1OH
	Communication alarm (inverter)	ESEr
	Analog input error	ERIE
	Overspeed occurrence *7	EOS
	Speed deviation excess detection *7	EOSd
	Open cable detection *7	EECr
	Position error large *7	E. Od
	Brake sequence error	Enb1 to Enb7
	Encoder phase error *7	EEP
	Internal circuit error	E. 13
	USB error	EUSb
	Opposite rotation deceleration alarm	E. 11

- \*1. Resetting the inverter initializes the internal thermal integrated data of the electronic thermal relay function.
- \*2. The error message shows an operational error. The inverter output is not shut off.
- \*3. Warnings are messages given before major failures occur. The inverter output is not shut-off.
- \*4. Minor failure warns the operator of failures with output signals. The inverter output is not shut-off.
- \*5. When major failures occur, the protective functions are activated to shut-off the inverter output and output the alarms.
- \*6. The external thermal operates only when the OH signal is set in Pr.178 to Pr.189 (input terminal function selection).
- \*7. Appears when the FR-A7AP (option) is fitted.



Textile



Automotive



Pharma



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