Fuji Electric

Innovating Energy Technology

Industrial Drives

FRENIC-GS Series

24E1-E-0180b

Bringing together Fuji Electric's industry-leading technology and developed know-how through numerous experiences.
Next-generation drives that deliver high precision and high functionality by combining superior control and monitoring performance

FRENIC-GS Series

Industrial drives offering the industry's highest class of performance, functionality, and safety

Compact design

Large capacity up to 650 kVA in a slim structure that contributes to space savings

The PWM converter and inverter feature a slim stack structure suitable for panel mounting and replacement, while achieving a maximum capacity of 650 kVA. Up to 12 stacks of 25 kVA or less can be housed per panel, contributing to space savings in the electrical room.

Control performance

High-speed, high-precision control performance contributes to improving product quality and productivity

It has a speed response of 100 Hz, torque control accuracy of ±3% (when using a dedicated motor), and two types of observers, and contributes to improving product quality and productivity through its high-speed, high-precision control.

Safety features

Top-level safety features that contribute to improving safety in manufacturing facilities

Comes standard with STO (Safe Torque Off) safety performance that meets safety certification levels SIL3 (IEC/EN 61800-5-2) and PL e (ISO/EN 13849-1) to contribute to improved safety in manufacturing facilities. Options cards can be installed to support SS1, SLS, and SBC.

Monitoring function

Stabilizes production and promotes DX with excellent monitoring functions.

Comes standard with Ethernet as the information LAN, and is also the first of its kind to support OPC UA. Contributes to stable production and promotes DX (Digital Transformation) of systems without degrading drive control performance by industry-leading monitoring functions that separates the information LAN and control LAN.

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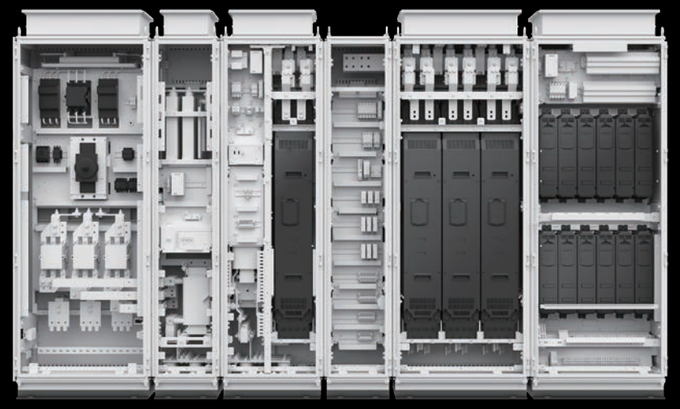
FRENIC-GS configuration

Inverter panel

Configuration
- Slim stack shape
- Adjusts panel width according to the number of housed stacks

Features
- Enables multi-drive configuration with DC link
- Capable of transferring energy between DC buses
- Facilitates construction of large-capacity systems
- Improves maintainability



Filter panel

Configuration
- Compact housing of reactors and capacitors in the panel
- Bus bar system for all inputs and outputs of main power

Features
- Reduces loss by eliminating filter resistance
- Common filters for multiple converters

PWM converter panel

Configuration
- Slim stack shape
- Capable of housing booster reactor in the same panel
- Bus bar system for all inputs and outputs of main power

Features
- Facilitates construction of large-capacity systems
- Improves maintainability
- Capable of using transmission to monitor status

*In addition to PWM converter panels, diode converter panels and regenerative converter panels are also available.

*In addition to the above, we also offer a braking unit for use with braking resistors and a lineup of DC-DC converters for use with batteries. Please contact us for details.

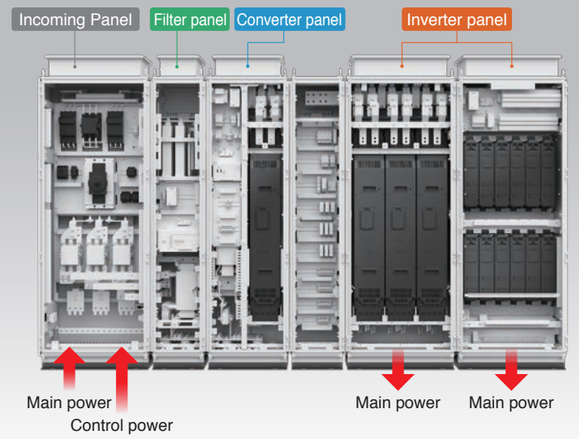
The industry's highest level of stack capacity. Compact design contributes to space savings and cost reduction

Pursues streamlining to realize significant compactness.

Reduces the number of devices and external cables by thoroughly streamlining the expansion of stack capacity and optimizing equipment configuration. Reduces installation costs and saves space.

Minimizes installation costs by reducing external cables

■ Panel layout example

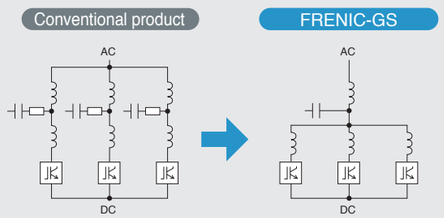


■ Main power and control power between adjacent panels are connected by bus bar.
■ No longer need external main power cables through incoming panel to inverter panel due to bus bar system.
Minimizes installation costs by reducing external cables.
■ Control power cables only inputs to Incoming panel. No longer need external control power cables through incoming panel to inverter panel due to bus bar system.
Minimizes installation costs by reducing external control power cables.

Realizes space savings by optimizing the equipment configuration (PWM converter to filter)

■ Reduces the number of devices by using common filters when PWM converters are connected in parallel
■ Reduces loss by eliminating filter resistance

Filter configuration when PWM converters are connected in parallel



Saves space through the industry's highest level of compactness

Improved stack cooling structure provides the industry's highest level of stack output.
Achieves the industry's highest level of housing efficiency by adopting an optimized design and offering panel widths according to the number of housed stacks.

Expands stack output through an improved cooling structure

■ 400 V series inverter
* At 440 V of rated output voltage

FRENIC-VG	FRENIC-GS
Max. 445 kVA (585 A)	Max. 650 kVA (853 A)

46% expansion

■ 690 V series inverter
* At 690 V of rated output voltage

FRENIC-VG	FRENIC-GS
Max. 550 kVA (460 A)	Max. 650 kVA (544 A)

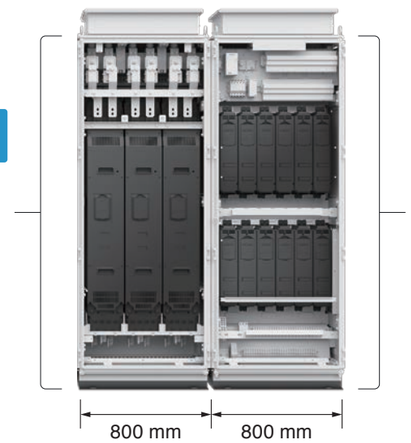
18% expansion

Contributes to space savings through the industry's highest housing efficiency

■ For 400 V series inverters, 10-25 kVA stacks and 40-69 kVA stacks can be housed in the same panel, thereby reducing the number required panels.

[Number of inverter stacks housed (for W800 panel)]

Capable of mounting up to 3 stacks
(Stack capacity)
400 V: 80 to 650 kVA
690 V：75 to 650 kVA



Capable of mounting up to 12 stacks
(Stack capacity)
400 V: 10 to 25 kVA

Capable of mounting up to 6 stacks
(Stack capacity)
400 V: 40 to 69 kVA
690 V: 37 to 60 kVA

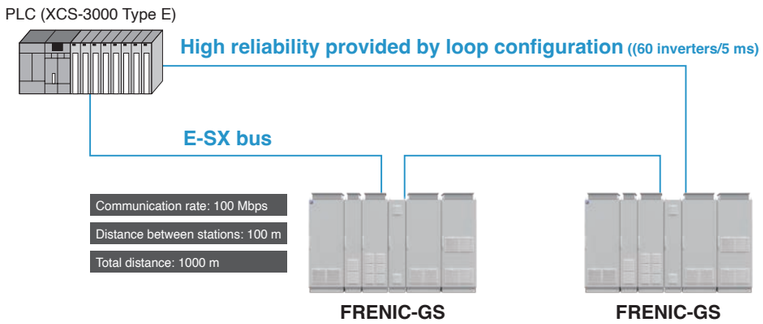
Control performance

Industry-leading high-speed, high-precision control performance contributes to improving product quality and productivity

Contributes to improved quality and productivity using a high-speed and high-precision E-SX bus

FRENIC-GS can be connected to the PLC (XCS-3000 Type E, SPH3000MG, SPH3000MM controllers) via the ultra high-speed E-SX bus. This bus makes it possible to support devices that require higher speeds and precision motion control. In addition, when used in combination with the XCS-3000 Type E controller, a network loop can be constructed, and if a disconnection should occur in one place, operation can continue.

■ Loop configuration



■ Bus configuration

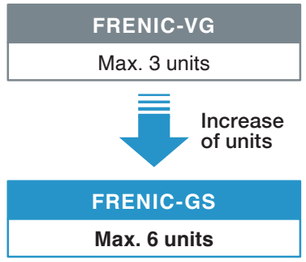
■ E-SX bus specification

Item	Specifications	
	Bus mode specification	Loop mode specification
Bus communication rate	100 Mbps	
Bus distance (between stations/total distance)	100 m/1 km	
Optical line	Yes	
Continuous system operation when one disconnection occurs	Yes Station dropout	Yes No station dropout
I/O capacity	4,096 words	
Refresh performance	512 words/1 ms	
Tact fluctuation	±1 µsec	
Synchronization between stations	±1 µsec Between a maximum of 32 axes on the same bus	
Tact cycle setting range	0.25 to 10 ms	0.5 to 10 ms

Improved control performance expands the number of direct parallel connections

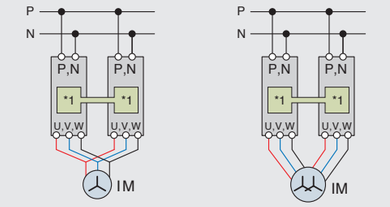
High-speed communication between CPUs increases the number of possible connections for inverters and PWM converters.

■ Number of direct parallel connections



*Up to six inverters and six PWM converters
*Up to six inverters in parallel for multi-winding motors
*1 When using a direct parallel connection, current derating is required according to the number of connected units. Please contact us for details.

Inverter parallel connection systems



Safety features

Industry's best-in-class safety features contribute to improved worksite safety

Achieves even more safe and reliable stoppages by improving the level of functional safety standards

The standard STO (Safe Torque Off) safety function has been improved to achieve more safe and reliable stoppages

■ ISO/EN 13849-1 *1

■ IEC/EN 61800-5-2 *1

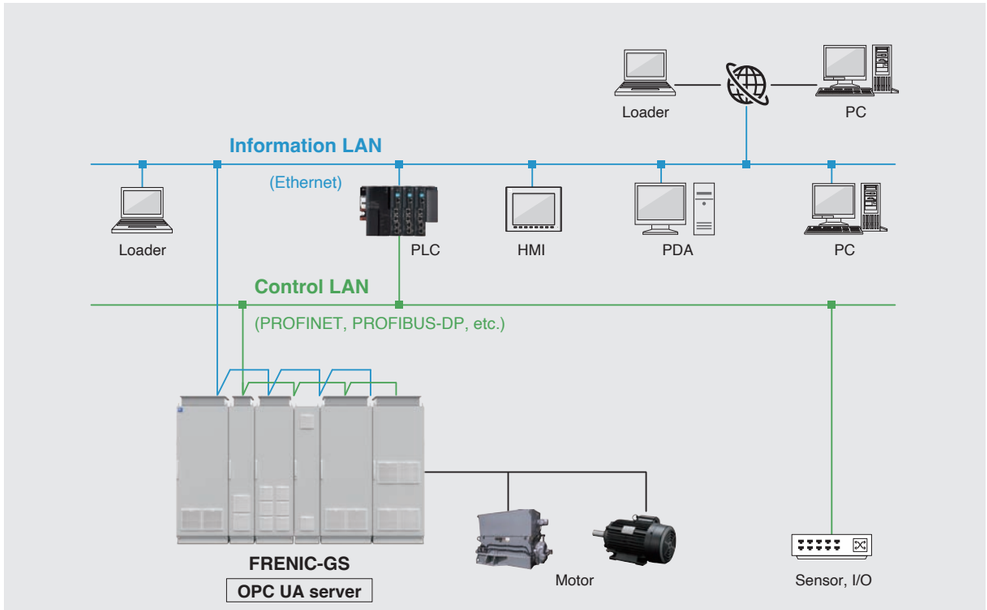
*1 Coming soon
*Options cards can be installed to support SS1, SLS, and SBC (Coming soon).

Monitoring function

Industry-leading monitoring functions promote DX and help stabilize production

Separates the information LAN from the control LAN to achieve both high-speed, high-precision control and a large amount of data monitoring. Promotes DX in production facilities and contributes to stabilizing production

Capable of transmitting a large amount of data (operation history, power, speed, torque, etc.) to PCs and analyzers over an information LAN regardless of the control LAN (control cycle), enabling long-term trend analysis and simulation.



- Separation of information LAN and control LAN promotes DX in production facilities without compromising drive control performance.
- Ethernet comes standard as the information LAN
- Mounted OPC UA server*1 on drive ahead of other companies
- Enhanced predictive maintenance and failure detection functions such as IGBT life expectancy prediction and motor malfunction detection*2

*1 Optional
*2 Some functions are achieved by the drive unit alone, while others are achieved in combination with a PLC, etc.

Other features

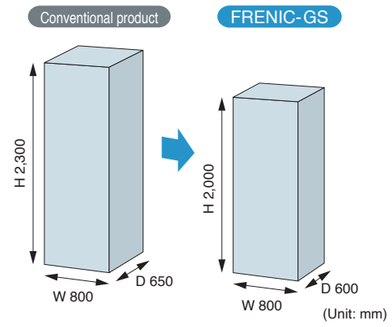
Facilitates installation and operation with a lineup that complies with standards and market needs

Easy to install and flexibly operate through in compliance with international standards and an extensive product lineup.

- Panels can comply with IEC, CE, UL, and NK
  *The input voltage is 600 V for the UL/cUL compliant 690 V series.
- The standard size of the panel is H2,000 × D600. Can be transported in standard containers
  *Standardizes W800, W600, and W400 panel widths
- Supports PROFINET, the world's most popular industrial Ethernet
  *Supports PROFIBUS, E-SX bus, T-Link
- Expanded lineup of 690 V series in low voltage category at IEC

Facilitates installation and operation by using industry-standardized panel dimensions

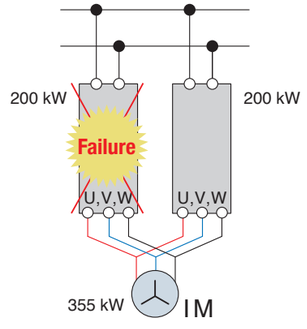
- Adopting standard panel dimensions makes it easy to replace the drive panels of other companies
- Reduced panel height improves visibility during maintenance and inspection



Reduced capacity operation allows continued operation even in the unlikely event of a breakdown

If a stack fails in case of direct parallel connection, the operation continues with lower output power using the stacks that have not failed.

* To start the reduced capacity operation, consideration is needed to the switch over operation of PG signals or motor constants and sequence circuit.
* Direct parallel connection is available for the same stack model.



Example) If one inverter fails when 200 kW × 2 inverters are driving a 355 kW motor, the operation can continue with the 200 kW inverter (capacity of one inverter).

Main fields of application

Cranes

■ Space savings in electric rooms

Slim stack shape enables downsizing of electrical rooms

■ Stable operation

By connecting multiple stacks in parallel, even if one stack fails, operation can continue with reduced capacity operation.

Cement

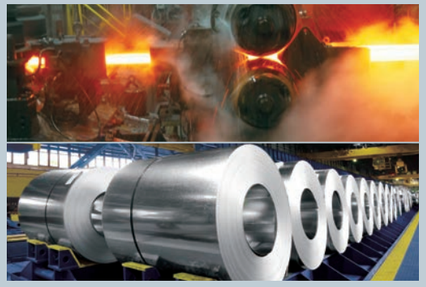
■ Stable operation

Achieves stable operation through high-speed control response even to high kiln starting torque and load fluctuations.

■ System response

Highly accurate load sharing control for twin drive type kilns, overload calculations and overload alarms specific to kiln equipment are achieved by combining with a controller.

Steel



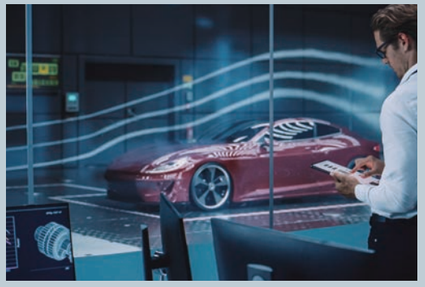
■ Energy savings

The DC distribution system enables energy transfer between driving and braking operations, and reduces the capacity of the common converter by taking into account the load factor of each motor.

■ Observer control (FOSC)

Reduces the speed jump when material is removed, shortens recovery time, and shortens rolling pitch

Automotive testing machines



■ High-speed response control

Supports high-speed rotation and high-response torque control for engine and transmission tests

■ System response

Capable of supporting systems in combination with controllers, such as functions that simulate vehicle body inertia for brake test equipment

Press machines

■ Position control

The press position is controlled based on the instantaneous position command given by the host CNC. High-response control contributes to shortened operation cycles

■ Precise synchronized control

Larger machines are driven by multiple motors to increase thrust. Capable of precise synchronous control of multiple inverters/motors using a high-speed bus system

Papermaking

■ Tension control

Improved tension-type winding control performance through high-precision torque control
Improved step-type winding control performance through high-speed response speed control

■ System response

Achieves constant tension control using a controller that performs winding diameter calculations, etc.

Shiphandling winches

■ High reliability and tension control

Sensorless torque control even at extremely low speeds. Achieves stable drive even in wave-induced load fluctuations

■ Energy savings

The DC distribution system enables energy transfer between driving and braking operations, and reduces the capacity of the common converter by taking into account the load factor of each motor.

Mining

■ Remote monitoring

Separated control and information LANs enable remote monitoring of equipment distributed over long distances.

■ Stable operation

By connecting multiple stacks in parallel, even if one stack fails, operation can continue with reduced capacity operation.

Wide lineup of products

Inverters and PWM converters

3-phase 400 V series: Up to 3,000 kW
3-phase 690 V series: Up to 3,000 kW

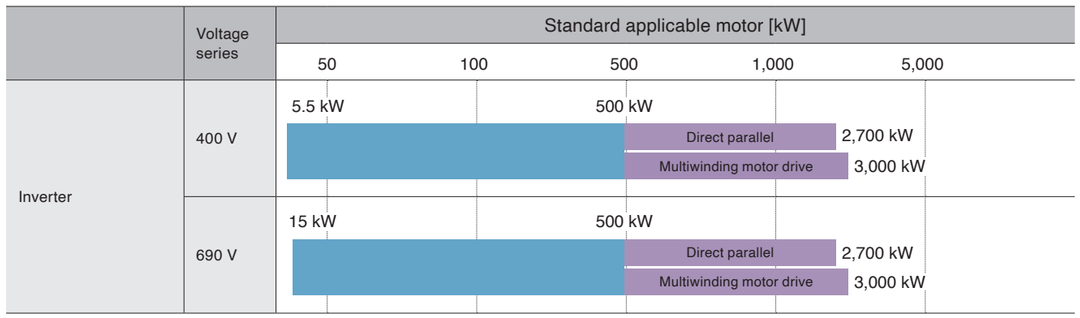
Diode converter

3-phase 400 V series: Up to 3,200 kW
3-phase 690 V series: Up to 6,000 kW

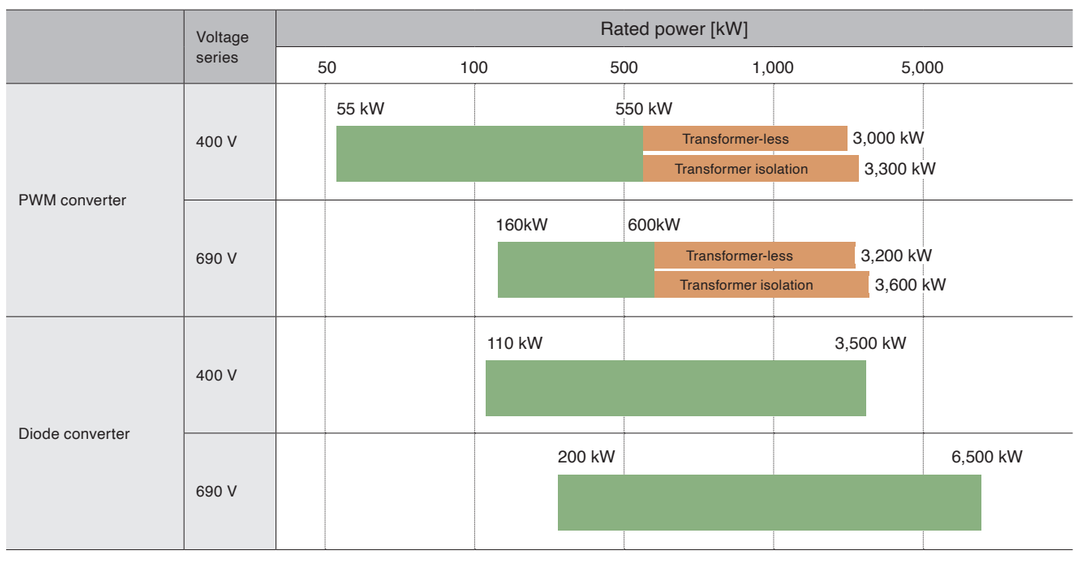
Inverter
Product lineup
Capacity expansion (parallel operation)

Converter
Product lineup
Capacity expansion (parallel operation)

Inverter



Converter



Common panel specifications

Item	Specifications
Installation location	Indoor
Atmosphere	No corrosive gas, flammable gas, dust, oil mist (pollution level 2 (IEC60664-1)) No locations with significant salt content (0.01 mg/cm^2 or less per year) No direct sunlight
Ambient temperature	0 to 40°C *40 to 50°C requires derating (as a panel)
Relative humidity	5 to 95% (no condensation)
Cooling method	Forced air-cooled system *1
Altitude	1000 m or less *2
Vibration	4.9 m/s^2 (10 to 50 Hz)
Noise	80 dB or less
Protective structure	IP20, IP22, IP32 *3
Cable inlet	Main circuit: Lower part of panel Control circuit: Lower part of panel
Paint color	RAL 7035 (leather tone)

*1: Some panels are naturally air-cooled
*2: When installing at an altitude of 1,000 m or more, reduce the output current based on the altitude as shown in the “Altitude-based output current reduction ratio” below. For 2001 to 3000 m, the insulation class of the control circuit needs to be changed from reinforced insulation to basic insulation.
*3: Options

Altitude-based output current reduction ratio

Altitude	Output current reduction ratio
1,000 m or less	1.00
1,000 to 1,500 m	0.97
1,500 to 2,000 m	0.95
2,000 to 2,500 m	0.91
2,500 to 3,000 m	0.88

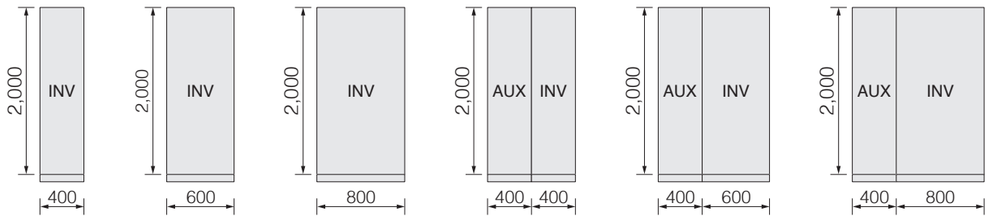
Inverter specifications

400 V series inverter stack specifications

Type FRN-GS1M□-4		0013	0020	0033	0053	0091	0105	0158	0210	0315	0420	0630	0853
Rated capacity [kVA] *1 *2		10	15	25	40	70	80	120	160	240	320	480	650
Rated current [A]		13.1	19.7	32.8	52.5	91.0	105	158	210	315	420	630	853
Overload rating		Rated current 150%–1 min.											
Output voltage		0 to 0.71 × inverter DC input voltage *Stack unit only											
Standard applied motor output [kW]		5.5	7.5	15	22	37	55	75	110	200	250	355	500
Power supply voltage	Main power	Refer to the PWM converter specifications											
	Control power supply	Single phase 380 to 480 V, 50/60 Hz											
	Voltage/frequency variation	Voltage: -15 to +10%, Frequency: -5 to +5%											
Carrier frequency [kHz]		2											
Approx. mass [kg]		7.5		7.8	19		38		39	106	108	119	128
Approximate dimensions W × H × D [mm]		110 × 500 × 262			220 × 505 × 320		220 × 866 × 400			220 × 1,400 × 550			
Protective structure (IEC 60529)		IP00											
Cooling method		Air-cooled											
Maximum number of housed stacks (Approx. mass) /per panel	Dimensions (1)	4 *3 (260kg)			2 *3 (330kg)		1 (240kg)			-			
	Dimensions (2)	8 *3 (380kg)			4 *3 (490kg)		2 (340kg)			-			
	Dimensions (3)	12 *3 (420kg)			6 *3 (550kg)		3 (390kg)			-			
	Dimensions (4)	-			-		-			1 *4 (550kg)			
	Dimensions (5)	-			-		-			2 *4 (720kg)			
	Dimensions (6)	-			-		-			3 *4 (840kg)			

*1: Maximum capacity (1,852) kVA
*2: Shown when the rated output voltage is 440 V.
*3: Stacks with different dimensions can also be housed in the same inverter panel.
*4: The auxiliary panel corresponds to one panel (W400) even when two inverter panels are being utilized. *Please contact us for details.

Dimensions (1) Dimensions (2) Dimensions (3) Dimensions (4) Dimensions (5) Dimensions (6)



(Unit: mm)

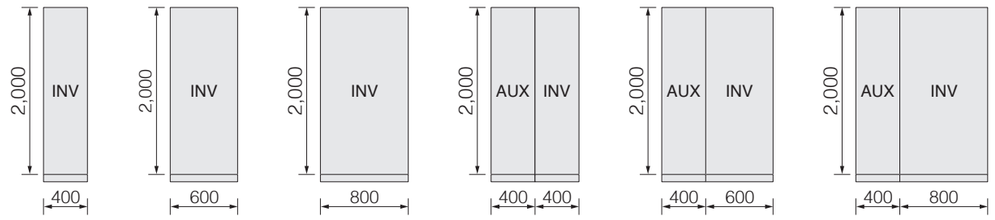
*INV: Inverter panel
AUX: Auxiliary panel
*All depth dimensions (D) are 600 mm
*Height dimensions (H) not include the base, exhaust box of top face and etc.

690 V series inverter stack specifications

Type FRN-GS1M□-69		0031	0050	0063	0117	0167	0234	0335	0452	0544
Rated capacity [kVA] *1 *2		37	60	75	140	200	280	400	540	650
Rated current [A]		31.0	50.2	62.8	117	167	234	335	452	544
Overload rating		Rated current 150%–1 min.								
Output voltage		0 to 0.71 × inverter DC input voltage *Stack unit only								
Standard applied motor output [kW]		15	37	55	110	160	220	315	400	500
Power supply voltage	Main power	Refer to the PWM converter specifications								
	Control power supply	Single phase 575 to 690 V, 50/60 Hz								
	Fan power supply	-		3-phase 380 to 440 V, 50/60 Hz						
	Voltage/frequency variation	Voltage: -10 to +15%, Frequency: –5 to +5%								
Carrier frequency [kHz]		2								
Approx. mass [kg]		18	19	37	38	100	107	107	119	120
Approximate dimensions W × H × D [mm]		220 × 505 × 320		220 × 866 × 400		220 × 1,400 × 550				
Protective structure (IEC 60529)		IP00								
Cooling method		Air-cooled								
Maximum number of housed stacks (Approx. mass) /per panel	Dimensions (1)	2 (330kg)		-		-				
	Dimensions (2)	4 (490kg)		-		-				
	Dimensions (3)	6 (550kg)		-		-				
	Dimensions (4)	-		1 *3 (420kg)		1*3 (590kg)				
	Dimensions (5)	-		2 *3 (530kg)		2*3 (760kg)				
	Dimensions (6)	-		3 *3 (580kg)		3*3 (880kg)				

*1: Maximum capacity (1,852) kVA
*2: Shown when the rated output voltage is 690 V.
*3: The auxiliary panel corresponds to one panel (W400) even when two inverter panels are being utilized. *Please contact us for details.

Dimensions (1) Dimensions (2) Dimensions (3) Dimensions (4) Dimensions (5) Dimensions (6)

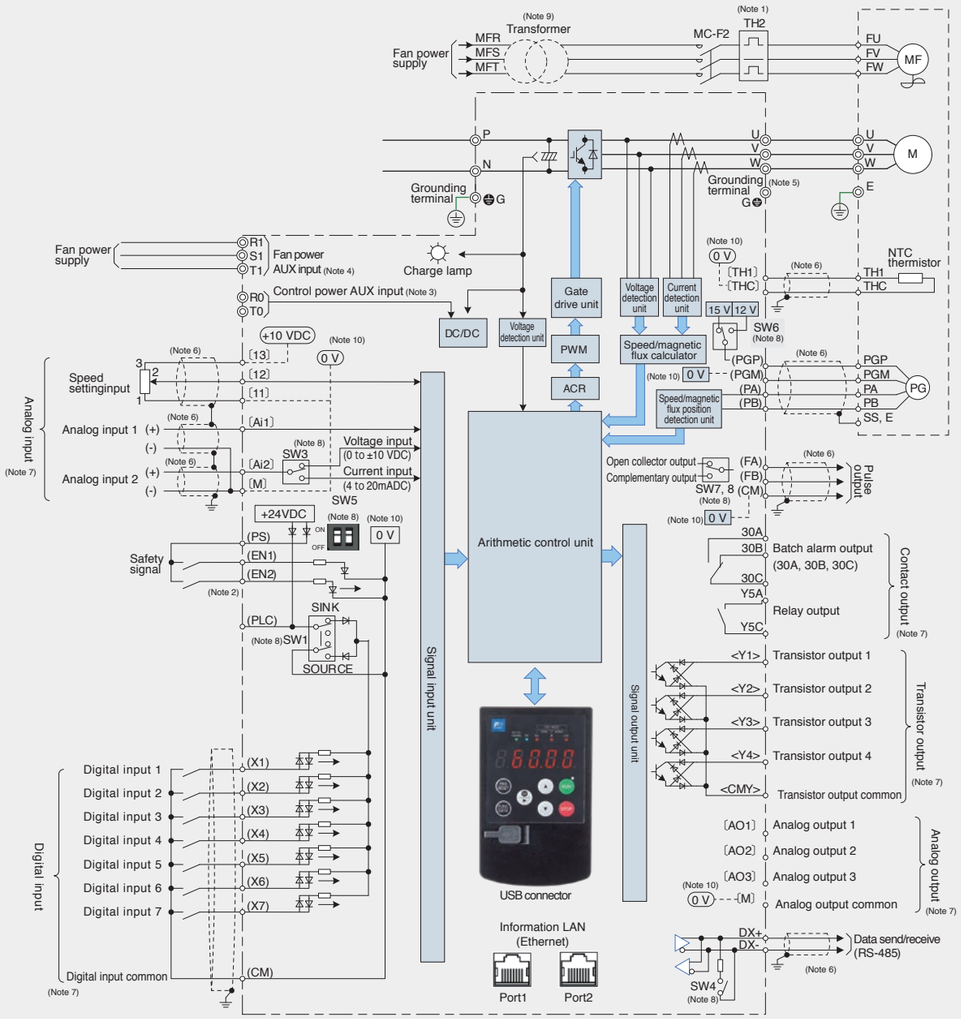


(Unit: mm)

*INV: Inverter panel
AUX: Auxiliary panel
*All depth dimensions (D) are 600 mm
*Height dimensions (H) not include the base, exhaust box of top face and etc.

Inverter specifications

Inverter basic wiring diagram



(Note 1) Trip the molded case circuit breaker (MCCB) or magnetic contactor (MC) with the auxiliary contact (manual recovery) of the thermal overload relay.
(Note 2) The safety function terminals [EN1] and [EN2] are enabled by factory default. When not using these terminal functions, be sure to turn ON the SW5 (2-pole switch) on the control PCB.
(Note 3) Connect the terminals to the power supply when you want to preserve the batch alarm signal during protective function activation (even when the main power of the inverter has been cut off), or when you want to continuously display the keypad.
(Note 4) The 690 V series product has a terminal for the fan power supply, so connect the power supply.
(Note 5) This terminal is for grounding the motor. To suppress inverter noise, it is recommended to ground the motor at this terminal.
(Note 6) For ⋮ wiring, use stranded or shielded wire. The shielded wire should be grounded, but if it is subject to a large amount of external inductive noise, you may be able to reduce the effect of noise by connecting it to 0V ([M], [11], [THC]) or 0V ([CM]). When possible, separate it from the main circuit wiring and do not put it in the same duct. (The recommended distance is 10 cm or more.) If they intersect, ensure that they are approximately orthogonal to the main circuit wiring. If the PG signal is subject to significant external inductive noise, we recommend inserting ACL-40C.
(Note 7) The functions listed in the terminals [X1] - [X7] (digital input), [Y1] - [Y4] (transistor output), [Y5A/C] (contact output), [AO1] - [AO3] (analog output), and [Ai1] - [Ai2] (analog input) indicate the functions assigned as factory default.
(Note 8) This is a changeover switch on the control PCB.
(Note 9) The voltage of the motor's cooling fan differs for each motor. Prepare a transformer if necessary.
(Note 10) 0V ([M], [11], [THC]), and 0V ([CM]) are insulated inside the inverter.

Common inverter specifications

Item				Specifications
Control specifications	Motor control method	For induction motors		High-speed sensor-equipped vector control High-speed sensorless vector control V/f control
		For synchronous motors		High-speed sensor-equipped (including magnetic position sensor) vector control
		Test mode		Operation simulation mode
Induction motor control specifications	High-speed sensor-equipped vector control	Settings Resolution	Speed setting	Analog setting: 0.005% of the maximum speed Digital setting: 0.005% of the maximum speed
			Torque setting Torque current setting	0.01% of rated torque
		Control accuracy	Speed	Analog setting: ±0.1% (25 ±10°C) of maximum speed Digital setting: ±0.005% (-10 to 40°C) of the maximum speed
			Torque	3% of rated torque (for dedicated motor)
		Control response	Speed	100 Hz
		Maximum speed		150 Hz during inverter output frequency conversion
		Speed control range		1: 1500 1 r/min to 1,500 r/min to maximum speed when the base speed is 1,500 r/min (when the number of PG pulses is 1024 P/R) 1:6 (constant torque region: constant output region)
	High-speed sensorless vector control	Settings Resolution	Speed setting	Analog setting: 0.005% of the maximum speed Digital setting: 0.005% of the maximum speed
			Torque setting Torque current setting	0.01% of rated torque
		Control accuracy	Speed	Analog setting: ±0.1% (25 ±10°C) of maximum speed Digital setting: ±0.1% (-10 to 40°C) of the maximum speed
			Torque	±5% of rated torque
		Control response	Speed	20 Hz
		Maximum speed		150 Hz during inverter output frequency conversion
		Speed control range		1:250 6 r/min to 1,500 r/min to maximum speed when the base speed is 1,500 r/min 1:4 (constant torque region: constant output region)
	V/f control	Setting resolution		Analog setting: 0.005% of the maximum speed Digital setting: 0.005% of the maximum speed
		Output frequency control accuracy		Analog setting: ±0.2% (25 ±10°C) of maximum output frequency Digital setting: ±0.01% (-10 to 40°C) of maximum output frequency
		Maximum frequency		150 Hz
		Control range		0.2 to 150 Hz 1:4 (constant torque region: constant output region)
Synchronous motor control specifications	High-speed sensor-equipped vector control	Settings Resolution	Speed setting	Analog setting: 0.005% of the maximum speed Digital setting: 0.005% of the maximum speed
			Torque setting	0.01% of rated torque
		Precision control	Speed	Analog setting: ±0.1% (25 ±10°C) of maximum speed Digital setting: ±0.005% (-10 to 40°C) of the maximum speed
			Torque	3% of rated torque (for dedicated motor)
		Response control	Speed	100 Hz
		Maximum speed		150 Hz during inverter output frequency conversion

Inverter specifications

Common inverter specifications

Item			Specifications
Synchronous motor control specifications	High-speed sensor-equipped vector control	Speed control range	1:1500 (when the number of PG pulses is 1024 P/R) When the base speed is 1,500 r/min, 1 r/min to 1,500 r/min to maximum speed
Control functions	Operation		Key operation: RUN via RUN key (forward/reverse), STOP via STOP key Input signals: forward command, reverse command, free run command, reset input, multi-step speed command selection, etc.
	Speed setting		Key operations: Setting via ▲/▼ keys Setting resistor: Can be set using variable resistor (3 terminals: 1 to 5 kΩ) Analog signals : Can be set at 0 to ±10 V, 4 to 20 mA UP/DOWN control : While the external signal (DI signal) is ON, speed can be controlled so as to increase (UP signal) or decrease (DOWN signal) Multi-step speed command: Can select operations up to 15 steps by combining 4 external signals (DI signals). Digital signals : When using an option card, can set via “16 bit parallel signal” Serial link operation : RS-485 as standard, but can be set according to various optional communication features Jogging operation : Can be activated by selecting jogging mode and using the RUN key, or FWD or REV terminal
	Speed detection		The receive frequency will differ depending on the speed detector used.

PG interface used		Speed detector	Receive frequency
Induction motor	Main unit PG interface	Complementary PG	100 kHz/Max
	OPC-PG	Open collector PG	
	OPC-PG2	Line driver PG	500 kHz/Max
Synchronous motor	OPC-PMPG2	Line driver PG (With magnetic pole position function)	100 kHz/Max

Control functions	Speed control	Performs PI operations with a feedforward term. Control constant switching: Can perform control constant switching using an external signal.
	Operation status signal	Transistor output signals: in operation, speed reached, speed detected, overload forecast, torque limited, etc. Analog signals: motor speed, output voltage, torque, load factor, etc.
	Acceleration/deceleration time	0.01 to 3,600 s (4 types of acceleration/deceleration modes can be independently set and selected using external signals) (Can select S-curve acceleration/deceleration in addition to linear acceleration/deceleration)
	Speed setting gain	Can set the proportionality between the analog speed setting and the motor speed from 0 to 200%.
	Jump speed	Can set 3 operation points and 1 jump width point.
	Pick-up operation	Enables switching to inverter operation without stopping the running motor (effective for speed-sensor-equipped/sensorless vector control)
	Instantaneous power failure restart	Automatic restart setting allows inverter restart without stopping motor
	Slip compensation control	Compensates for the load-dependent decrease in speed and provides stable operation. (During induction motor V/f control)
	Droop control	Enables control with speed droop characteristics (disabled during V/f control)
	Torque limit	Limits torque below the preset limit (Can select from 4 quadrant equivalence, driving, individual braking, etc.). Can set the limit value using analog setting or external signal (2-step).
	Torque control	Analog setting: (0 to ±10 V)/0 to ±150% (up to 300% with gain adjustment) Digital setting: When using an option card, can set via “16 bit parallel signal”
	PID control	Enables PID control with analog input
	Cooling fan ON/OFF control	Stops the cooling fan when the motor is stopped and the temperature is low to extend the life and reduce the noise of the cooling fan
	Toggle monitoring control function	Enables monitoring of properly functioning communication between the host device (PLC) and the inverter
	Torque biasing function	Internal setting (3 steps) by combining fixed value (1 step, with polarity switching function according to the motor rotation direction) and external signal (DI signal) Can use analog setting (with hold function)

Common inverter specifications

Item			Specifications
Control functions	Motor selection function		Can be switched by combining 3 types of motor selections (F79) or an external signal (DI signal)
	Temperature detection		NTC thermistor (Fuji Electric equivalent specifications) PT 100 Ω PTC thermistor (trip level corresponds to parameter setting) (used for motor overheat protection only)
	PG detection circuit self-diagnosis function		Performs self-diagnosis of the detection circuit for pulse encoder input signals (PA, PB).
	Load-compensating control function		Improves the operating efficiency of equipment by calculating the maximum lifting speed for the loads of vertical conveyors, etc.
	Multiplex systems	Multi-winding motor drive function	Optional: Use OPC-GS-SI. Maximum multiplexing: 6 units Control specifications : Capable of high-speed sensor-equipped vector control only
		Direct parallel connection method	Optional: Use OPC-GS-SI. Maximum multiplexing: 4 units There are restrictions on usage conditions such as output wire length.
	UP/DOWN function		Enables speed setting by combining UP command, DOWN command, and zero clear command with an external signal (DI signal)
	Shutdown operation selection function		3 types of stop functions, STOP 1, 2, 3
	PG pulse output function		Outputs input pulses such as motor PG signals at fixed or arbitrary frequency divisions. Enables switching between open collector and complementary (same voltage as PGP terminal) using the stack's internal switch setting
	Observer function		Load disturbance observer and load vibration suppression observer
	Offline tuning		Performs rotating, non-rotating type and motor constant tuning
	Online tuning		Online tuning to compensate for motor constant temperature variation
	Position control function		Standard function: Servo lock, built-in transmitter circuit position control Optional: OPC-PG2: For line driver type pulse command input OPC-PG: For open collector type pulse command input
	Pulse train and synchronous operation function		Optional: OPC-PG2: For line driver type pulse command input OPC-PG: For open collector type pulse command input
Display and setting	Keypad	Indicator	7-segment LED
		In operation/stopped	• Speed detection value • Torque current command value • Power consumption (motor output) • DC intermediate voltage • Load rotation speed • PID output value • Ai adjustment value (Ai2) • Motor temperature • Operation time • Speed command value • Torque command value • Output current • Magnetic flux command value • PID command value • Ai adjustment value (12) • Option monitor 1 to 6 • Cooling fin temperature • Output frequency • Torque calculation value • Output voltage • Magnetic flux calculation value • PID feedback value • Ai adjustment value (Ai1) • Digital input/output signal existence • Load factor • Motor cumulative operation time/number of starts (by motor), etc.
		At setting	Displays name and data
		At alarm	Alarm cause display • EF (ground fault) • Er3 (CPU error) • Er6 (Operation procedure error) • Er9 (Speed mismatch) • OC (Overcurrent) • OH3 (Overheat in stack) • OL2 (Overload in motor 2) • OS (Overspeed) • Err (Simulated failure) • ErH (Hardware error) • dO (Excessive position deviation) • ArF (Toggle error) • FTC (External medium failure) • IFA (Inverter panel fan failure) • MCb (Output breaker error) • ArC (Resolver setting error) • Er1 (memory error) • Er4 (Network error) • Er7 (Output wiring error) • dLU (DC undervoltage) • OH1 (Fin overheat) • OH4 (Overheat in motor) • OL3 (Overload in motor 3) • dOU (DC overvoltage) • OPL (Output open phase detection) • Erb (Optical netwark error) • LOC (Startup congestion) • FTA (External major failure) • HCT (External current sensor error) • MFA (Motor fan failure) • MCM (Output contactor error) • Ard (Inter-option communication error) • Er2 (keypad communication error) • Er5 (RS-485 error) • Er8 (A/D converter error) • nrb (NTC thermistor disconnection) • OH2 (External failure) • OL1 (Overload in motor 1) • OLU (Overload in stack) • PG (PG disconnection) • dFA (DC fan lock) • ECF (Functional safety circuit abnormality) • ArE (E-SX error) • FTb (External minor failure) • IGS (IGBT short-circuit failure) • EFA (External fan power supply failure) • Arb (SI mounted error)
		In operation or at alarm	Stores the latest and past 255 alarm codes and the latest and past 4 alarm details. Saves and displays the date and time of the alarm occurrence with the calendar and clock display functions (Accuracy: ±27 seconds/month (Ta = 25°C)) Retention period: 7 days or more (Ambient temperature 25°C)

Inverter specifications

Common inverter specifications

Item			Specifications
Display and setting	Loader	Historical trace	Reads the sampling data stored in the inverter and displays it graphically. Sampling time: 50 µs to 1 s
		Real-time trace	Reads data from the inverter in real time and displays it graphically. Sampling time: 1 ms to 1 s
		Traceback	Reads the sampling data stored in the inverter at the time of an alarm and displays it graphically. Sampling: 62.5 µs to 1s (However, other than some signals such as current can be used for sampling over 500 µs.) Sampling data retention period: 7 days or more (ambient temperature 25 °C)
		Operation monitor	Capable of I/O monitoring, system monitoring, alarm history monitoring, etc.
		Function code setting	You can check the setting status of the function code. It can also be edited, transferred, compared, and initialized.
	Charge lamp		Lights up while power is supplied to the inverter. Lights up even when only the control power supply is used.
Maintainability	Common		• Displays and records accumulated time for the main circuit and control power supply capacitor life and cooling fan operation time. • Records and displays inverter operation time • Records and displays previous 1-hour maximum output current values and maximum internal inverter temperatures
Control LAN			PROFINET (RT), PROFIBUS-DP, E-SX Bus, SX Bus, T-Link, CC-Link
Information LAN			Ethernet 100/10Base UDP
Input		DI	STO (EN1、EN2: 2 ch) / Freely configurable: 7 ch; AI: ±10 V: 2 ch, ±10 V/4–20 mA: 1 ch
Output		DO	Freely configurable: 5 ch (transistor: 4, relay: 1); AO: ±10 V: 3 ch
Communication	RS-485		This is an input terminal for connecting a computer and programmable controller, etc. via RS-485 communication.
	USB		This is a USB connector (mini-B specification) for connecting to a computer. Capable of editing, transferring and verifying function codes and monitoring various statuses using the inverter support loader
Safety features	Standard functions	Stop function	Safe Torque Off (STO) • This function immediately shuts off the torque (cuts off the output) of the motor by stopping the output transistor of the inverter via hardware when the external digital input signal (EN1 terminal or EN2 terminal) is turned OFF.
Product standard	Conforming standards		U.S. and Canada safety standards UL/cUL (UL61800-5-1, Edition 1, 2012/C22.2 No.274-17.2017) *1 Machine command EN ISO 13849-1, Cat.3/PL:e IEC/EN 60204-1, stop category 0 IEC/EN 61508-1 to -2 SIL3 IEC/EN 61800-5-2 SIL 3 (STO) Low-voltage command IEC/EN 61800-5-1 Over Voltage Category 3 EMC Directive IEC/EN 61800-3, IEC/EN 61326-3-1 (Emissions) EMC filter (optional): Category C3 (Immunity) Second environment (Industrial)

*1: The input voltage is 600 V for the UL/cUL compliant 3-phase 690 V series.

Structure and environment

Item		Specifications	
Installation environment	Installation location	Indoor	
	Atmosphere	No corrosive gas, flammable gas, dust, oil mist (pollution level 2 (IEC60664-1)) No locations with significant salt content (0.01 mg/cm^2 or less per year), no direct sunlight	
	Ambient temperature	-10 to +40°C (14 to 104°F)	
	Ambient humidity	5 to 95% RH (no condensation)	
	Altitude	1,000 m or less *1	
	Vibration	Compliant standard IEC61800-2 Amplitude 0.3 mm: 2 to 9 Hz 1 m/s^2: 9 to 200 Hz	Standards conformity IEC 61800-5-1 Amplitude 0.075 mm: 10 to less than 57 Hz 1G: 57 to 150 Hz
	Storage temperature	-25 to +70°C (during transport) -25 to +65°C (during temporary storage)	
	Storage humidity	5 to 95% RH (no condensation)	

*1: When installing at an altitude of 1,000 m or more, reduce the output current based on the altitude as shown in the “Altitude-based output current reduction ratio” above. For 2,001 to 3,000 m, the insulation class of the control circuit needs to be changed from reinforced insulation to basic insulation.or 2,001 to 3,000 m, the insulation class of the control circuit needs to be changed from reinforced insulation to basic insulation.

Altitude-based output current reduction ratio

Altitude	Output current reduction ratio
1,000 m or less	1.00
1,000 to 1,500m	0.97
1,500 to 2,000m	0.95
2,000 to 2,500m	0.91
2,500 to 3,000m	0.88

Terminal features

Terminal symbol		Name	Specifications
Main circuit	U, V, W	Inverter output terminal	Connects the 3-phase motor.
	P (+), N (–)	Main DC input terminal	Used for DC bus connection. Connects to the output terminals P (+) and N (-) of the diode rectifier or PWM converter.
	R0, T0	Auxiliary control power input	Connects the same AC power supply as the main circuit as a backup for the control circuit power supply.
	R1, S1, T1	Auxiliary fan power input	Used as power supply input for the cooling fan inside the inverter.
	⏚ G	Grounding	Grounding terminals of the inverter.
Analog input	13	Power supply for variable resistor	Used as power supply for speed potentiometer (variable resistance: 1 to 5 kΩ). 10 V DC 10 mA Max.
	12	Setting voltage input	Sets the speed according to the external analog input voltage command value. Reversible operation with ± signal: 0 to ±10 V DC / 0 to max. speed
	Ai1 to 2	Analog input 1 to 2	**0**: Input signal off [OFF] **1**: Auxiliary speed setting 1 [AUX-N1] **2**: Auxiliary speed setting 2 [AUX-N2] **3**: Torque limit (level 1) [TL-REF1] **4**: Torque limit (level 2) [TL-REF2] **5**: Torque bias reference [TB-REF] **6**: Torque command [T-REF] **7**: Torque current command [IT-REF] **8**: Creep speed 1 in UP/DOWN setting [CRP-N1] **9**: Creep speed 2 in UP/DOWN setting [CRP-N2] **10**: Magnetic-flux command [MF-REF] **11**: Line speed detection [LINE-N] **12**: Motor temperature [M-TMP] **13**: Speed override [N-OR] **14**: Universal Ai [U-AI] **15**: PID feedback value 1 [PID-FB1] **16**: PID command value [PID-REF] **17**: PID correction gain [PID-G] **25**: Speed main setting [N-REFV] **26**: Current input speed setting [N-REFC] **27**: PID feedback value 2 [PID-FB2] * Ai2 can be switched over between voltage input and current input using the internal switch setting. However, only the “speed setting” is available for the current input.
	11, M	Analog I/O common	This is a common terminal for analog I/O signals.
Digital input	X1 to X7	Digital input 1 to 7	**00, 01, 02, 03**: Multistep speed selection (step 1 to 15) [00: SS1, 01: SS2, 02: SS4, 03: SS8] **04, 05**: ASR, ACC/DEC selection (4 steps) [04: RT1, 05: RT2] **06**: Self maintenance selection [HLD] **07**: Free run command [BX] **08**: Alarm reset [RST] **09**: External alarm [THR] **10**: Jogging operation [JOG] **11**: Speed setting N2/Speed setting N1 [N2/N1] **12**: Motor M2 selection [M-CH2] **13**: Motor M3 selection [M-CH3] **14**: DC braking command [DCBRK] **15**: ACC/DEC clear to zero command [CLR] **16**: Creep speed switching in UP/DOWN setting [CRP-N2/N1] **17**: UP command in UP/DOWN setting [UP] **18**: DOWN command in UP/DOWN setting [DOWN] **19**: Write enable for keypad (data can be changed) [WE-KP] **20**: PID control cancel [KP/PID] **21**: Inverse mode change over [IVS] **22**: Interlock signal for 52-2 [IL] **23**: Write enable through link [WE-LK] **24**: Operation selection through link [LE] **25**: Universal DI [U-DI] **26**: Pick up start mode [STM] **27**: Synchronous run command [SYC] **28**: Zero speed locking command [LOCK] **29**: Pre-exciting command [EXITE] **30**: Speed command limit cancel [N-LIM] **31**: H41 (torque command) cancel [H41-CCL] **32**: H42 (torque current command) cancel [H42-CCL] **33**: H43 (magnetic-flux command) cancel [H43-CCL] **34**: F40 (torque limit mode 1) cancel [F40-CCL] **35**: Torque limit (selection of level 1 or level 2) [TL2/TL1] **36**: Bypass [BPS] **37, 38**: Torque bias command 1/2 [37: TB1, 38: TB2] **39**: Droop selection [DROOP] **40**: Ai1 zero hold [ZH-AI1] **41**: Ai2 zero hold [ZH-AI2] **42**: Ai3 zero hold [ZH-AI3] **43**: Ai4 zero hold [ZH-AI4] **44**: Reverse Ai1 polarity [REV-AI1] **45**: Reverse Ai2 polarity [REV-AI2] **46**: Reverse Ai3 polarity [REV-AI3] **47**: Reverse Ai4 polarity [REV-AI4] **48**: PID command inverse selection [PID-INV] **49**: PG alarm cancel [PG-CCL] **50**: Undervoltage cancel [LU-CCL] **51**: Ai torque bias hold [H-TB] **52**: STOP1 (The motor stops with standard deceleration time) [SOPT1] **53**: STOP2 (The motor decelerates and stops with deceleration time 4) [STOP2] **54**: STOP3 (The motor stops with torque limit) [STOP3] **55**: DI data latch [DI] **57**: Multiplex system cancel [MT-CCL] **58-67**: Custom Di1-10 [C-DI1 to C-DI10] **68**: Load compensating parameter selection [AN-P2/1] **69**: PID clear [PID-CCL] **70**: Enable PID FF component [PID-FF] **71**: Speed limit calculation completion reset signal [NL-RST] **72**: Toggle signal 1 [TGL1] **73**: Toggle signal 2 [TGL2] **74**: Simulated external fault [ERR] **75**: NTC thermistor alarm cancel [NTC-CCL] **76**: Lifetime early warning cancel [LF-CCL] **77**: MCRN answer back [MCRNX] **78**: PID feedback changeover signal [PID-1/2] **79**: PID torque bias selection [TB-PID] **80**: Converter SS [CSSX] **81**: External electrical conditions [RD] **82**: Start conditions [STRD] **83**: Link error operation continuation signal [LK-D] **84**: External major fault [FTA] **85**: External medium fault [FTC] **86**: External minor fault [FTB] **87**: Emergency stop [SYX] **88**: Running conditions [RDX] **89**: Link command enabled [L-EDIT] **90**: Output contactor answer back [MCMX] **91**: Output breaker answer back [MCBX] **92**: Output contactor preparation conditions [MCMRD] **93**: Pulse on signal [PON] **94**: Output contactor ON command [MCM-ON] **95**: All external conditions ON [ALLON] **96**: Motor fan failure [MFAN] **97**: Inverter panel fan failure [IFAN] **98**: Run command [RUN] **99**: Forward command [FWD] **100**: Reverse command [REV] **101**: Read position detect command [RPDC] **102**: MCST answer back [MCSTX] **103**: Current limit 2 selection [ITL2] **120**: Speed matching level switching [NAG-LVL] **121**: Multiplex master switching [MT-MST]
	CM	Digital input common	Digital input signal common terminal
	PLC	PLC signal power supply	Connects the PLC output signal power supply. It can also be used as a load power supply to connect to the transistor output. +24 V (22 to 27 V) max. 100 mA
	EN, EN2	Safety function input terminal	When the EN1-PS terminal or the EN2-PS terminal is open, the switching element of the inverter main circuit is turned OFF and the PS output is cut off.
	PS		

Inverter specifications

Terminal features

Terminal symbol		Name	Specifications
Analog output	AO1 to 3	Analog output 1 to 3	**00**: Speed detection (speedometer, single runout) [N-FB1+] **01**: Speed detection (speedometer, double runout) [F-FB1±] **02**: Speed setting 2 (before acceleration/deceleration calculation) [N-REF2] **03**: Speed setting 4 (ASR input) [N-REF4] **04**: Speed detection [N-FB2±] **05**: Line speed detection [LINE-N±] **06**: Torque current command (torque ammeter, double runout) [IT-REF±] **07**: Torque current command (torque ammeter, single runout) [IT-REF+] **08**: Torque command (torque meter, double runout) [T-REF±] **09**: Torque command (torque meter, single runout) [T-REF+] **10**: Motor current RMS value [I-AC] **11**: Motor voltage RMS value [V-AC] **12**: Power consumption (motor output) [PWR] **13**: DC intermediate voltage [V-DC] **14**: +10 V output test [P10] **15**: -10 V output test [N10] **16**: Motor temperature [TMP-M] **30**: Universal AO [U-AO] **31-37**: Custom Ao1-7 [C-A01 to C-A07] **39**: Magnetic pole position signal [SMP] **40**: PID output value [PID-OUT]
	M	Analog I/O common	This is a common terminal for analog I/O signals.
Digital output	30A, 30B, 30C	Batch alarm output	Outputs the non-voltage contact signal (1C) when the inverter stops the alarm. Alarm output setting can be switched between alarm output during excitation and alarm output during non-excitation.
	Y1 to 4	Transistor output 1 to 4	**00**: Running [RUN] **01**: With speed [N-EX] **02**: Speed match 1 [N-AG1] **03**: Speed reached [N-AR] **04, 05, 06**: Speed detection 1/2/3 [04: N-DT1, **05**: N-DT2, 06: N-DT3] **07**: Undervoltage stoppage in progress [LU] **08**: Torque polarity detection (braking/driving) [B/D] **09**: Torque braking in progress [TL] **10, 11**: Torque detection 1/2 [10: T-DT1, 11: T-DT2] **12**: Keypad running [KP] **13**: Stoppage in progress [STOP] **14**: Run ready [RDY] **15**: Magnetic-flux detection signal [MF-DT] **16**: Motor M2 selection status [SW-M2] **17**: Motor M3 selection status [SW-M3] **18**: Brake release signal [BRK] **19**: Alarm indication 1 [AL1] **20**: Alarm indication 2 [AL2] **21**: Alarm indication 4 [AL4] **22**: Alarm indication 8 [AL8] **23**: Cooling fan running [FAN] **24**: Reset function running [TRY] **25**: Universal DO [U-DO] **26**: Cooling fin overheat forecast [INV-OH] **27**: Synchronous control complete [SY-C] **28**: Lifetime early warning [LIFE] **29**: Under acceleration [U-ACC] **30**: Under deceleration [U-DCC] **31**: Stack overload early warning [INV-OL] **32**: Motor overheat early warning [M-OH] **33**: Motor overload early warning [M-OL] **35**: Link transmission error [LK-ERR] **36**: Load adaptive control under limiting [ANL] **37**: Load adaptive control under calculating [ANC] **38**: Analog torque bias hold in progress [TBH] **39-48**: Custom Do1-10 [C-DO1 to C-DO10] **51**: Multiplex system communication establishment in progress [MTS] **52**: Multiplex system cancellation response [MEC-AB] **53**: Multiplex system master selection [MSS] **54**: Multiplex system local fault [AL-SF] **55**: Communication error stoppage in progress [LES] **56**: Batch alarm [ALM] **57**: Minor fault [L-ALM] **58**: Maintenance forecast [MNT] **60**: DC fan locked [DCFL] **61**: Speed match 2 [N-AG2] **62**: Speed match 3 [N-AG3] **63**: Axial flow fan stop signal [MFAN] **64**: Arbitrarily assigned RDY [AS-RDY] **66**: Droop selection response [DSAB] **67**: Answerback to cancellation of torque command/torque current command [TCL-C] **68**: Answerback to cancellation of torque limiter mode 1 [F40-AB] **71**: 73 input command [PRT-73] **72**: Y-terminal test output ON [Y-ON] **73**: Y-terminal test output OFF [Y-OFF] **78**: Electrical conditions ready [ERD] **79**: Ready for operation [COP] **80**: EN terminal detection circuit error [DECF] **81**: EN terminal OFF [ENOFF] **82**: Safety function running [SF-RUN] **83**: Motor stopped by safety function [SF-STP] **84**: STO under testing [SF-TST] **87**: Transmission status [TST] **88**: Brake release [SS] **89**: ASR ON [ASR] **90**: Brake release and pulse ON [SSPON] **91**: Synchronous 1 input [SY1] **92**: Main contactor input [MCRN] **93**: Output contactor input command [MCM] **94**: Initial charging contactor input [MCST] **95**: MCRN command & with answer [MCRNA] **96**: Major fault [FTH] **97**: Major fault 1 [FTH1] **98**: Major fault 2 [FTH2] **99**: Medium fault [FTM] **100**: After medium fault timer [FTMT] **101**: Minor fault 1 [FTL1] **102**: Minor fault 2 [FTL2] **103**: Read position detect [PRDT] **121**: Torque detection signal 3 [T-DT3] **122**: M1 magnetic flux detection signal [MF-DTM1] **123**: M2 magnetic flux detection signal [MF-DTM2] **124**: M3 magnetic flux detection signal [MF-DTM3] **125**: M1 brake release signal [BRK-M1] **126**: M2 brake release signal [BRK-M2] **127**: M3 brake release signal [BRK-M3]
	Y5A Y5C	Relay output	
Communication specifications	General communication specifications		Operation information, operation status, function code monitoring function (polling) FWD, REV, RST, X1-X7 control and function code setting function (selecting) are available.
	DX+, DX-	RS-485 (built in as standard)	Communication is possible with a PC or PLC. (Fuji standard and RTU protocols are supported)
	T-Link (option card)		The OPC-GS-TL option enables T-Link communication with the MICREX-F or SX T-Link module.
	CC-Link (option card)		The OPC-GS-CCL option allows connection with a CC-link master device.
	SX bus (option card)		The OPC-VG1-SX option allows connection with MICREX-SX via the SX bus.
	E-SX bus (option card)		The OPC-VG1-ESX option allows connection with MICREX-SX via the E-SX bus.
	Optical communications (optional)		The OPC-GS-SI option enables load sharing control of parallel multiplexed systems.
Speed detection	PA, PB	Pulse generator 2-phase signal input	Terminals for connecting the 2-phase signal of pulse generator.
	PGP, PGM	Pulse generator power supply	+15 V DC pulse generator power supply (can be switched to +12 V).
	FA, FB	Pulse generator output	Outputs pulse encoder signal with a frequency that can be divided by a configurable ratio (set by function code). Open collector and complimentary (same voltage as PGP terminal) can be switched.
	CM	Pulse generator output common	Common terminals to FA and FB
Temperature detection	TH1, THC	NTC thermistor and PTC thermistor connection	Motor temperature can be detected with the NTC and the PTC thermistors. For the PTC thermistor, the motor overheat protection level can be set by the function code (E32).

PWM converter specifications

Features

■ Complies with harmonic suppression guidelines to prevent damage to electrical equipment

PWM control produces sinusoidal current on the power supply side, significantly reducing harmonic current. By combining it with an inverter, it can treat the conversion coefficient Ki of the “Guidelines for Harmonics Suppression Measures for Consumers Receiving Electricity at High Voltage or Special High Voltage” issued by the Agency for Natural Resources and Energy of METI as “0” (that is, no harmonic generation) in order to prevent damage to other electrical equipment.

■ Reduces power supply equipment capacities and enables space savings

Power factor control allows current to flow in phase with the power supply phase voltage, allowing operation at a power factor of ≈ 1. As a result, compared to diode converters, it contributes to reducing transformer capacities and equipment sizes, while also achieving space savings for facilities.

■ Realizes energy savings by significantly increasing power supply regeneration capacity

Energy is saved during regeneration because all regenerated energy from high-frequency acceleration/deceleration operations, elevators, etc. is regenerated to the power supply side. Moreover, since the current waveform during regeneration is also a sine wave, there is no need to worry about problems affecting the power supply system.
Continuous regeneration rating 100%
One-minute regeneration rating 150%

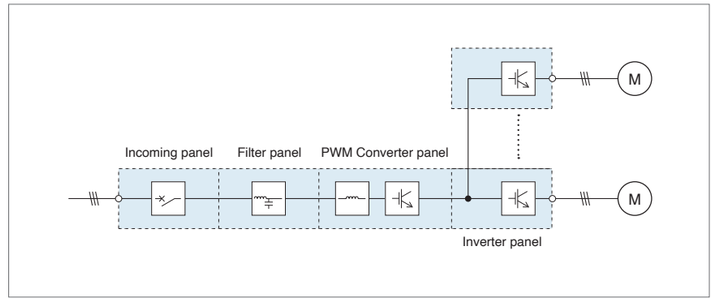
■ Improves safety with enhanced protection and maintenance functions

Traceback (optional) facilitates failure analysis.
(1)The dedicated keypad display allows operators to retrieve the contents of the past 10 alarms, making it easy to analyze the cause of alarms and take countermeasures.
(2) In the event of an instantaneous power failure, the gate is shut off, enabling rapid continuous operation after power restoration.
(3)Predictive signals such as overload, fin overheating, and life expectancy reduce the risk of shutdowns by alerting operators before the converter trips.

■ Improved convenience through full network support

Supports PROFINET, PROFIBUS, SX bus, E-SX bus, T-Link, and CC-Link.

■ PWM converter basic connection diagram



PWM converter specifications

400 V series PWM converter stack specifications

Type FRN-GS1P□-40		0105	0210	0315	0420	0630	0853
Rated power [kW]		67	135	203	270	406	550
Required power capacity [kVA] *2 *1		73	146	219	291	437	591
Overload rating		150%-1 min. of rated output					
Output voltage		640 to 710 V DC (variable according to input voltage)					
Power supply voltage	Main power	3-phase 380 to 440 V/50 Hz, 380 to 460 V/60 Hz					
	Control power supply	Single phase 380 to 480 V, 50/60 Hz					
	Voltage/frequency variation	Voltage: -15 to +10%, Frequency: -5 to +5%, Voltage phase imbalance ratio: within 2%					
Carrier frequency [kHz]		2.5					
Approx. mass [kg]		38	39	106	108	119	128
Approximate dimensions W × H × D [mm]		220 × 866 × 400		220 × 1,400 × 550			
Protective structure (IEC 60529)		IP00					
Cooling method		Air-cooled					

*1: Shown when the input voltage is 400 V. *2: Maximum capacity (3,900) kVA

690 V series PWM converter stack specifications

Type FRN-GS1P□-69		0167	0234	0335	0452	0544
Rated power [kW]		186	261	372	502	605
Required power capacity [kVA] *2 *1		200	280	400	540	650
Overload rating		150%-1 min. of rated output				
Output voltage [V]		895 to 1,073 V DC (variable according to input voltage)				
Power supply voltage	Main power	3-phase 660 to 690 V, 50/60 Hz, 3-phase 575 to 600 V, 50/60 Hz (with capacity reduction)				
	Control power supply	Single phase 575 to 690 V, 50/60 Hz				
	Fan power supply	Single phase 380 to 440 V, 50/60 Hz				
	Voltage/frequency variation	Voltage: -15 to +10%, Frequency: -5 to +5%, Voltage phase imbalance ratio: within 2%				
Carrier frequency [kHz]		2.5				
Approx. mass [kg]		100	107		119	120
Approx. dimensions W × H × D [mm]		220 × 1,400 × 550				
Protective structure (IEC 60529)		IP00				
Cooling system		Air-cooled				

*1: Shown when the input voltage is 690 V. *2: Maximum capacity (3,864) kVA

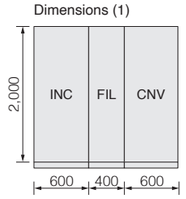
400 V series PWM converter panel specifications (including incoming panel and filter panel)

Rated input current [A]	105	210	315	420	630	853	630 × 2	853 × 2	853 × 3	853 × 2 × 2	853 × 3 × 2
Rated output [kW]	67	135	203	270	406	550	406 × 2	550 × 2	550 × 3	550 × 2 × 2	550 × 3 × 2
Required power capacity [kVA]	73	146	219	291	437	591	874	1,182	1,773	2,364	3,546
Approx. dimensions W [mm] (incoming panel + converter panel)	1,200	1,200	1,600	1,600	1,800	1,800	2,800	2,800	3,600	5,000	7,600
Approx. mass [kg]	800	800	1,200	1,200	1,300	1,400	2,200	2,200	2,900	4,000	6,000
Approx. dimensions W [mm] (incoming panel + filter panel + converter panel)	1,600	1,600	2,000	2,000	2,200	2,200	3,400	3,400	4,200	6,200	8,800
Approx. mass [kg]	1,000	1,100	1,400	1,500	1,600	1,700	2,600	2,700	3,700	5,200	7,400
Dimensions	(1)	(1)	(2)	(2)	(3)	(3)	(4)	(4)	(5)	(6)	(7)

690 V series PWM converter panel specifications (including incoming panel and filter panel)

Rated input current [A]	167	234	335	452	544	452 × 2	544 × 2	544 × 3	544 × 2 × 2	544 × 3 × 2
Rated output [kW] (at 690 V)	186	261	372	502	605	502 × 2	605 × 2	605 × 3	605 × 2 × 2	605 × 3 × 2
Required power capacity [kVA] (at 690 V)	200	280	400	540	650	1,080	1,300	1,950	2,600	3,900
Approx. dimensions W [mm] (incoming panel + converter panel)	1,600	1,600	1,600	1,800	1,800	2,800	2,800	3,600	5,000	7,600
Approx. mass [kg]	1,000	1,100	1,200	1,300	1,400	2,200	2,300	3,000	4,100	6,200
Approx. dimensions W [mm] (incoming panel + filter panel + converter panel)	2,000	2,000	2,000	2,200	2,200	3,400	3,400	4,200	6,200	8,800
Approx. mass [kg]	1,300	1,400	1,500	1,600	1,700	2,700	2,800	3,700	5,400	7,500
Dimensions	(2)	(2)	(2)	(3)	(3)	(4)	(4)	(5)	(6)	(7)

Dimensions (1)



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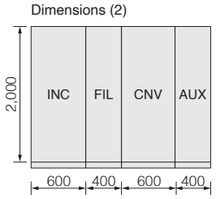
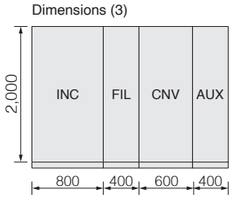


Dimensions (3)



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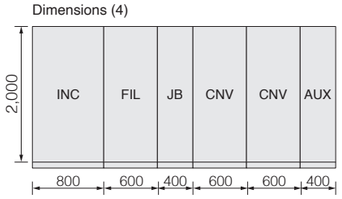
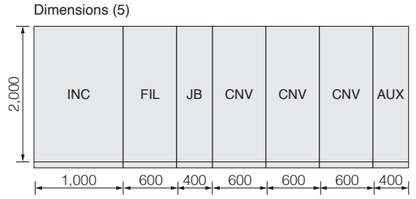
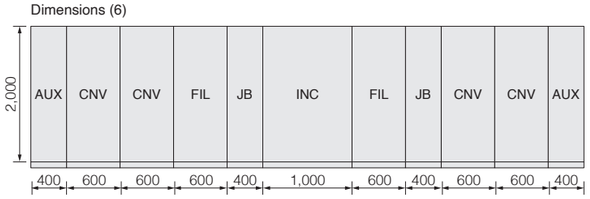


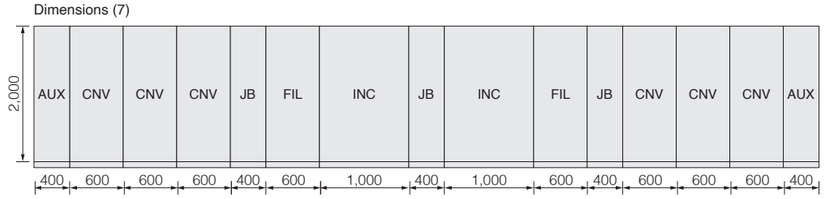
Dimensions (5)



Dimensions (6)



Dimensions (7)



*INC: Incoming panel
FIL: Filter panel
CNV: Converter panel
AUX: Auxiliary panel
JB: Junction box

*All depth dimensions (D) are 600 (mm)
*Height dimensions (H) not include the base, exhaust box of top face and etc.

(Unit: mm)

PMW converter common specifications

PMW converter common specifications

Item			Specifications		
Control specifications	Control method		AVR control with AC ACR minor		
	Input power factor		0.99 or more (at 100% load) *1 (excluding multiplex operation)		
	Input harmonic current		Capable of setting conversion factor ki = 0 according to METI's guidelines for harmonic suppression measures		
	Carrier frequency		2.5 kHz fixed		
Control function	Operation		Performs rectification when power is turned ON. The operation signal (digital input from the terminal block or run command from communication) starts the boost operation and gets the run operation ready.		
	Operation status signal		During operation, power running, regeneration, run ready, batch failure, etc.		
	Instantaneous stop restart		During instantaneous power failure, the converter is able to stop at the undervoltage level and then restart when power is restored.		
	Cooling fan ON/OFF control		Stops the cooling fan when the converter is stopped and the temperature is low, enabling extended cooling fan life and reduced cooling fan noise.		
	Multiplex system	Transformer isolation type parallel system	Option: Uses OPC-GS-SI. Max. multiplexing: 6 converters require isolation transformer input		
		Transformer isolation-less parallel system	Option: Uses OPC-GS-SI. Max. multiplexing: 4 units		
Display and settings	Keypad	Display	7-segment LED		
		Running/setting	・Input power, input current RMS value, input voltage RMS value, DC intermediate voltage, and power supply frequency ・Digital I/O signal presence ・Cooling fin temperature ・Load factor ・Operation time		
		At setting	Displays name and data		
		At alarm	Display of alarm cause ・EF (Ground fault) ・Er1 (Memory error) ・Er3 (CPU error) ・Er4 (Network error) ・Er5 (RS-485 communication error) ・Er6 (Operation procedure error) ・Er8 (A/D converter error) ・Erb (Optical network error) ・dLU (DC undervoltage) ・OC (Overcurrent) ・OH1 (Fin overheat) ・OH2 (External fault) ・OH3 (Stack internal overheating) ・OLU (Stack overload) ・dOU (DC overvoltage) ・ECF (Functional safety circuit abnormality) ・ErH (Hardware error) ・Err (Simulated fault) ・dFA (DC fan lock) ・Arb (SI mounted error) ・Ard (Inter-option communication error) ・FTA (External major fault) ・FTC (External medium fault) ・HCT (External current sensor error) ・IGS (IGBT short circuit fault) ・ACF (AC fuse blown) ・AOU (AC overvoltage) ・ALU (AC undervoltage) ・ACE (AC input current error) ・LPU (Input open loss) ・FrE (Synchronous power frequency error) ・OHF (Filter stack overheat) ・MCS (Initial charging contactor error) ・ST (Initial charging congestion) ・OLS (Device overload) ・MCA (MCAC contactor error) ・MCr (Main circuit contactor error) ・FTb (External minor failure) ・CFA (Converter panel fan failure) ・FFA (Filter panel fan failure) ・EFA (External fan power supply failure)		
		Alarm history	Stores the most recent and past alarm codes (255 instances) and the most recent and past 4 alarm details. The calendar/clock display function saves and displays the date and time of the alarm (accuracy: ± 27 seconds/month (Ta = 25°C)). Retention period: 7 days or more (ambient temperature 25°C)		
	Loader *2	Historical trace	Loads sampling data stored in the converter to display a graph. Sampling time: 62.5 us to 1 s		
		Real-time trace	Loads data from the converter on a real-time basis to display a graph. Sampling time: 1 ms to 1 s		
		Trace back	Loads sampling data stored in the converter at an alarm to display a graph. Sampling: 100 µs to 1s (However, other than some signals such as current can be used for sampling over 800 µs.) Sampling data retention period: 7 days or more (ambient temperature 25 °C)		
		Operation monitor	Includes the I/O monitor, system monitor, alarm history monitor, etc.		
		Function code setting	Function code setting states can be checked. Also enables editing, transferring, comparing, and initialization.		
	Charge lamp		Lit when the power is being supplied to the converter body. It will not light up with control power only.		
Maintenance	Common functions		・Displays and records accumulated time for the main circuit and control power supply's capacitor life and cooling fan operation time. ・Displays and records converter operation time. ・Displays and records the maximum input current, maximum power, and maximum converter internal temperature for the past hour.		
Control LAN			PROFINET (RT), PROFIBUS-DP, E-SX Bus, SX Bus, T-Link ,CC-Link		
Infomation LAN			Ethernet 100/10Base UDP		
Input			DI	Freely configurable: 7 ch	AO	±10 V: 3 ch
Output			DO	Freely configurable: 5 ch (transistor; 4, relay: 1)		
Communication	RS-485		RS-485 communication allows you to connect a computer or programmable controller to set and refer to function codes.		
	USB		This is a USB connector (mini B type) for connecting to a computer. Use the converter support loader to edit, transfer, and verify function codes, monitor the various statuses of the converter, and perform other operations.		
Product standard	Standards conformity		US and Canada Safety Standard UL/cUL (UL61800-5-1, Edition 1, 2012/C22.2 No.274-17.2017)*3 Low Voltage Directive IEC/EN 61800-5-1 Over Voltage Category 3 EMC Directive IEC/EN 61800-3, (Emission) EMC filter (Option): Category C3 (Immunity): Second environment (Industrial)		

*1: When the power supply voltage is 420 V or higher and the load operation is 50% or higher, the power factor of the power supply will be reduced to about 0.95. (Only during regenerative operation)
*2: Download the loader software from FeLibrary, our dedicated website for downloads.
*3: The input voltage is 600 V for the UL/cUL compliant 3-phase 690 V series.

Structure and environment

Item		Specifications	
Installation environmen	Installation location	Indoor	
	Atmosphere	No corrosive gas, flammable gas, dust, oil mist (pollution level 2 (IEC60664-1)) No locations with significant salt content (0.01 mg/cm^2 or less per year) No direct sunlight	
	Ambient temperature	-10 to +40°C (14 to 104°F)	
	Ambient humidity	5 to 95% RH (no condensation)	
	Altitude	1,000 m or less *1	
	Vibration	Compliant standards IEC61800-2 Amplitude 0.3 mm: 2 to 9 Hz 1 m/s^2: 9 to 200 Hz	Standards conformity IEC61800-5-1 Amplitude 0.075 mm: 10 to less than 57 Hz 1G: 57 to 150 Hz
	Storage temperature	-25 to +70°C (during transport) -25 to +65°C (during temporary storage)	
	Storage humidity	5 to 95% RH (no condensation)	

*1: When installing at an altitude of 1,000 m or more, reduce the output current based on the altitude as shown in the "Altitude-based output current reduction ratio" above. For 2,001 to 3,000 m, the insulation class of the control circuit needs to be changed from reinforced insulation to basic insulation.

Altitude-based output current reduction ratio

Altitude	Output current reduction ratio
1,000 m or less	1.00
1,000 to 1,500m	0.97
1,500 to 2,000m	0.95
2,000 to 2,500m	0.91
2,500 to 3,000m	0.88

Terminal functions

Terminal symbol		Terminal name	Specifications
Main circuit	L1/R, L2/S, L3/T	Main power input	Connects to a 3-phase power supply using a dedicated filter circuit.
	P(+), N(-)	Converter output	Connects to inverter power input terminals P(+) and N(-).
	E(G)	Ground terminal	This is the ground terminal for the converter chassis (case).
	R0, T0	Control power AUX input	Connects the backup terminal of the control power supply to the same power supply system as the main circuit power supply.
	R1, S1, T1	Fan power supply	This is the connection terminal for the fan power supply. 690 V series only.
	Ri, Si, Ti	Synchronous power input for voltage detection	Connects to the power supply side of the dedicated filter via a voltage detection terminal used for internal control of the converter.
Input signa	X1 to X7	Digital input 1 to 7	**0**: External alarm [THR], **1**: Current limit cancel [LMT_CCL], **2**: 73 answer-back [73ANS], **3**: Current limit switch [I-LIM], **4-13**: Custom Di1-10 [C-DI1 to C-DI10], **14**: Universal DI [U-DI], **15**: AC fuse burnout [ACF], **16**:RHF overheat alarm [RHF-OH], **17**: Parallel system cancellation [MT-CCL], **18**: Generator/commercial power switch [SW-GEN], **19**: Alarm reset [RST], **20**: Run command [RUN], **21**: External electrical condition [ERDX], **22**: All external conditions ON [ALLON], **23**: Ground fault detection [GND], **24**: Main circuit breaker answer back [MCRN-ANS], **25**: Initial charging contactor answer back [MCST-ANS], **26**: MCAC answer back [MCAC-ANS], **27**:Converter panel fan failure [CNV-FAN], **28**: Filter panel fan failure [FLT-FAN], **29**: External major fault [FTA], **30**: External medium fault [FTC], **31**: External minor fault [FTB], **32**: External simulation [ERR], **33**: LPV alarm mask signal [LPU-CCL], **34**: Di-STOP [RD], **35**: Power breaker abnormality [ICB], **36**: Life prediction cancel [LF-CCL], **37**: Link command reflection enable [L-EDIT]
	CM	Digital input common	Common terminal of the digital input signal
	PLC	PLC signal power supply	Connects the PLC output signal power supply. It can also be used as a load power supply to connect to the transistor output. +24 V (22 to 27 V) max. 100 mA
Output signal	30A, 30B, 30C	Batch output alarm	Outputs the non-voltage contact signal (1C) when the PWM converter stops the alarm. Alarm output setting can be switched between alarm output during excitation and alarm output during non-excitation.
	Y1 to Y4	Transistor output 1 to 4	**0**: In operation [RUN], **1**: Ready for operation [RDY], **2**: Undergoing power supply current limiting [IL], **3**: Life expectancy forecast [LIFE], **4**: Cooling fin overheat forecast [PRE-OH], **5**: Overload forecast [PRE-OL], **6**: Working [DRV], **7**: Regenerating [REG], **8**: Current limit forecast [CUR], **9**: Instantaneous power failure restart [U-RES], **10**: Undergoing power supply frequency synchronization [SY-HZ], **11**: Alarm content 1 [AL1], **12**: Alarm content 2 [AL2], **13**: Alarm content 4 [AL4], **14**: DC fan lock [DCFL], **15-24**: Custom Do 1-10 [C-DO1 to C-DO10], **25**: Universal DO [U-DO], **26**: Minor failure [L-ALM], **27**: Cooling fan in operation [FAN], **28**: Multiplex system communication establishment [MTS], **29**: Multiplex system cancel response [MEC-AB], **30**: Multiplex system master selected [MSS], **31**: Multiplex system local station failure [AL-SF], **32**: Batch alarm [ALM], **33**: Y-terminal test output ON [Y-ON], **34**: Y-terminal test output OFF [Y-OFF], **36**: Reset function running [TRY], **37**: Major fault [FTH], **38**: Major fault 1 [FTH1], **39**: Major fault 2 [FTH2], **40**: Medium fault [FTM], **41**: After medium fault timer [FTMT], **42**: Minor fault 1 [FTL1], **43**: Minor fault 2 [FTL2], **44**: Electrical condition complete [ERD], **45**: Initial charge contactor command [MCSTY], **46**: Main circuit breaker command [MCRNY], **47**: MCRN command & answerback [MCRN], **48**: Ground fault detection [GNDY], **51**: MCAC command [MCAC], **52**: Device overload current alarm [OLSOP], **53**: Converter overload current alarm [OLCOP], **54**: Overload current alarm [OLOP], **55**: Di fault [DIERR], **56**: Undervoltage detected [UV], **59**: Synchronous power drop [ACUV], **60**: AC input abnormality [ACERR], **61**: PLL operating [PLLOP], **62**: Synchronous power phase abnormality [PHASE], **63**: Synchronous power overvoltage [ACOV], **64**: Arbitrarily assigned RDY [AS-RDY], **67**: Transmission status [TST], **68**: Transmission operation command [ST], **69**: Overvoltage fault [OV], **70**: Alarm reset [RST], **71**: Control device temperature alarm [OTDDC], **72**: Pulse on preparation complete [PONX], **73**: Di ERD [ERDX], **74**: Di ~STOP(RD) [RD], **75**: MCRN answerback [MCRNX], **76**: Di operation command [DI-ST], **77**: Initial charge blinking signal [INI-B], **78**: COPX [COPX], **79**: Initial charging [INI-C]
	Y5A, Y5C	Relay output	
	A01 to A03	Analog output 1 to 3	**0**: Input power [PWR], **1**: Input current RMS value [I-AC], **2**: Input voltage RMS value [V-AC], **3**: DC Intermediate voltage [V-DC], **4**: Power frequency [FREQ], **5**: +10 V test [P10], **6**: -10 V test [N10], **12-18**: Custom-AO1-7 [C-AO1 to C-AO7], **19**: Universal AO [U-AO], **30**: Device overload remaining [OLS-REM], **31**: Stack overload remaining [OLU-REM], **40**: Heat sink temperature [TMP-F], **41**: Internal air temperature [TMP-I], **44**: Main circuit capacitor lifetime [TIME], **45**: Main Circuit capacitor remaining life [TIME-REM], **46**: Main circuit capacitor threshold [TIME-LEV], **47**: Printed circuit board capacitor lifetime [TCAP], **48**: Printed circuit board capacitor remaining life [TCAP-REM], **49**: Printed circuit board capacitor threshold [TCAP-LEV], **50**: Cooling fan lifetime [TFAN], **51**: Cooling fan remaining Life [TFAN-REM], **52**: Cooling fan threshold [TFAN-LEV] *Do not select 7 11, 20 29, 32 39, or 42 43.
	M	Analog output common	Common terminal for analog output signals
	73A, 73C	Charging resistor turn-on relay output	External charging resistor turn-on relay (73) control output
Communication specifications	General communication specifications		Operation information, operation status, function code monitoring function (polling) RUN, RST, X1-X7 control and function code setting function (selecting) are available.
	DX+, DX-	RS-485 (built in as standard)	Communication is possible with a PC or PLC. (Fuji standard and RTU protocols are supported)
	T-Link (option card)		The OPC-GS-TL option enables T-Link communication with the MICREX-F or SX T-Link module.
	CC-Link (option card)		The OPC-GS-CCL option allows connection with a CC-link master device.
	SX bus (option card)		The OPC-VG1-SX option allows connection with MICREX-SX via the SX bus.
	E-SX bus (option card)		The OPC-VG1-ESX option allows connection with MICREX-SX via the E-SX bus.
	Optical communications (optional)		The OPC-GS-SI option enables load sharing control of parallel multiplexed systems.

Diode converter specifications

Features

■ Enables construction of large-capacity systems with full range of applicable capacities

Enables construction of large-capacity systems by connecting diode converters in parallel. Meets a wider range of needs.

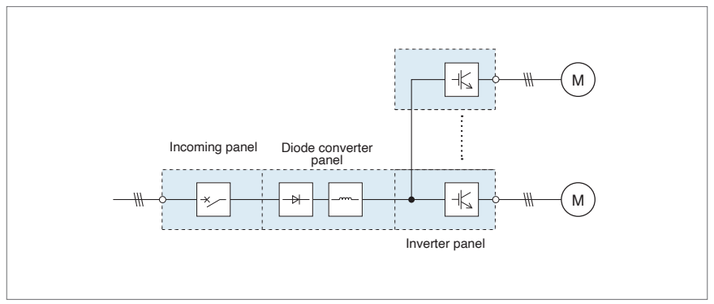
■ Reduces harmonic current and prevents problems in electrical equipment

Includes a DC reactor as standard to reduce harmonic current. Since the DC reactor is built into the panel, there is no need for external line work. Moreover, it can be combined with a power transformer to achieve 12-phase rectification to further reduce harmonic current. Prevents unexpected problems with electrical equipment.

■ Ensures energy savings during regeneration using a regenerative converter

Available with optional (externally mounted) braking unit and braking resistor. Also, it can be combined with a regenerative converter to regenerate energy on the power supply side. It saves energy during regeneration.

■ Diode converter basic wiring diagram



400V series diode converter panel specifications

Rated input current [A]		206	375	751	1,502	3,004	6,008
Rating output [kW] *1		127	231	462	927	1,854	3,709
Required power capacity [kVA] *1		144	261	521	1,041	2,082	4,163
Overload-rating		rated output 150%-1 min					
Output voltage [V]		513 to 679 V DC (varies depending on input voltage and load)					
Power supply voltage	Main power	Three-phase, 380 to 440 V/50 Hz, 380 to 480 V/60 Hz					
	Control power	Single-phase 200 to 220 V/50 Hz, 200 to 230 V/60 Hz					
	Fan power supply	Single-phase, 200 to 220 V/50 Hz, 200 to 230 V/60 Hz					
	Voltage/frequency variation	Voltage: +10 to -15% (phase imbalance ratio: within 2%) Frequency wavenumber: +5% to -5%					
Approx. mass [kg]		TBD					
Approx. dimensionsW × H × D [mm]		(1)			(2)	(3)	(4)
Protective structure		IP32					
Cooling method		Air-cooled					

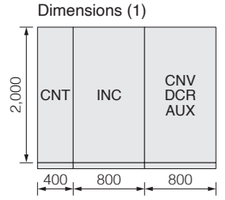
*1: Indicates a supply voltage of 400 V.
*2: The specifications are subject to change due to ongoing development.

690V series diode converter panel specifications

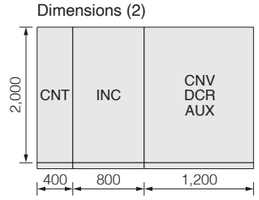
Rated input current [A]		206	375	751	1,502	3,004	6,008
Rating output [kW] *1		219	398	797	1,627	3,254	6,508
Required power capacity [kVA] *1		248	450	899	1,797	3,591	7,182
Overload-rating		rated output 150%-1 min					
Output voltage [V]		776 to 976 V DC (varies depending on input voltage and load)					
Power supply voltage	Main power	Three-phase, 575 to 690 V / 50 Hz, 60 Hz					
	Control power	Single-phase 200 to 220 V/50 Hz, 200 to 230 V/60 Hz					
	Fan power supply	Single-phase, 200 to 220 V/50 Hz, 200 to 230 V/60 Hz					
	Voltage/frequency variation	Voltage: +10 to -15% (phase imbalance ratio: within 2%) Frequency wavenumber: +5% to -5%					
Approx. mass [kg]		TBD					
Approx. dimensionsW × H × D [mm]		(1)			(2)	(3)	(4)
Protective structure		IP32					
Cooling method		Air-cooled					

*1: Indicates a supply voltage of 690 V.
*2: The specifications are subject to change due to ongoing development.

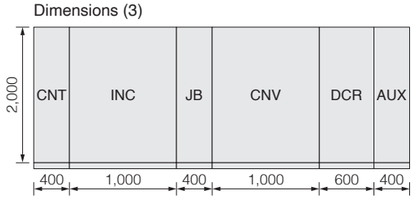
Dimensions (1)



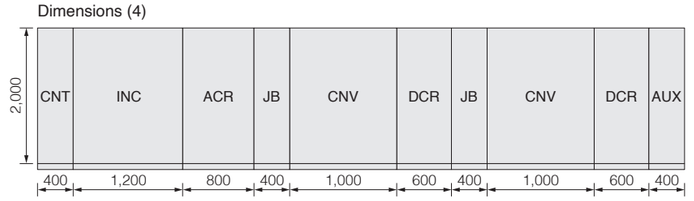
Dimensions (2)



Dimensions (3)



Dimensions (4)



*CNT: Control panel
INC: Incoming panel
ACR: AC reactor panel
JB: Junction box
CNV: Di converter panel
DCR: DC reactor panel
AUX: Auxiliary panel

*All depth dimensions (D) are 600 (mm)
*Height dimensions (H) not include the base, exhaust box of top face and etc.

(Unit: mm)

Data setting and monitoring (dedicated keypad display)

Use the keypad to start and stop the inverter, display various data, set function code data, check I/O, and display maintenance and alarm information.

Name and function overview

Classification	Display and keys	Overview of functionality
Data display	8.8.8.8.8.	This is a 5-digit, 7-segment LED monitor. It displays the following information for each operation mode. ■ In operation mode : Operation information (output frequency, output current, output voltage, etc.) Switches to status display when operation is different from normal. Switches to medium failure or minor failure display when a medium failure or minor failure occurs. ■ In program mode : Menu, function code, function code data, etc. ■ In alarm mode : Alarm code indicating the cause of the protection function's activation
Key operation	PRG RESET	Switches the operation mode. ■ In operation mode : Pressing this key will switch it to program mode. ■ In program mode : Pressing this key will switch it to operation mode. ■ In alarm mode : After clearing the alarm cause, pressing this key will switch it to the operation mode deactivated by the alarm.
	FUNC DATA	Performs the following operations: ■ In operation mode : Switches the operation state monitoring items (output frequency, output current, output voltage, etc.). ■ In program mode : Displays function code and establishes the data. ■ In alarm mode : Switches the display of the alarm detailed information.
	RUN *1	Starts the motor operation. (When the keypad is being operated)
	STOP *1	Stops the motor operation. (When the keypad is being operated)
	▲ / ▼	Used to select the setting items displayed on the LED monitor or change the function code data.
	M	■ In operation mode: Does not operate. ■ Program mode During menu display: Proceeds to the next menu number. During function code display : Advances the display number in steps of 10. During numerical setting: Moves the cursor digit to the right. ■ In alarm mode: Advances the alarm detailed information number in steps of 10.
LED display	RUN (green)	Lights up when the inverter/PWM converter is running.
	KEYPAD CONTROL*1 (Green)	Lights up when the RUN key on the keypad is enabled as an operation command. However, in program mode or alarm mode, no operation is possible even if this LED is lit. It blinks every second in local mode.
	M (Blue)	Lights when the displayed data is a negative number.
	Unit LED (3 red LEDs)	Hz, A, kW, r/min, m/min: Displays the unit when monitoring the operating status in operation mode via a combination of three LEDs.
		PRG. MODE: Two LEDs on the left and right will light up when you transition to program mode. (●Hz ●A ●kW)
USB port	USB	Capable of connecting to a PC with a USB cable. The connector type is mini-B.

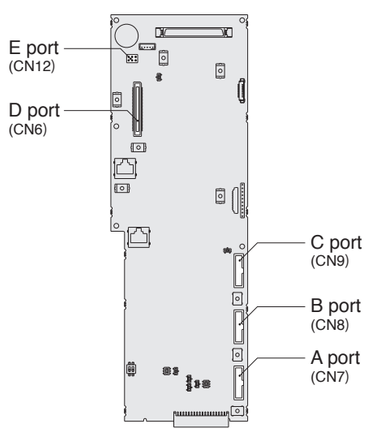
*1: Only usable for inverter run/stop

Options

Option cards

Classification	Accessories	Model	Specifications	Available ports	Re-marks
Interface expansion	Analog interface card	OPC-AIO	Analog voltage inputs: 1 (0 to 10 V); Current inputs: 1 (4 to 20 mA or 0 to 20 mA) Analog voltage outputs: 1 (0 to ±10 V); Current outputs: 1 (4 to 20 mA)	A, B, or C	
	Digital interface card	OPC-DI	Digital inputs: 16	A, B, or C	
	Digital interface card	OPC-DO	Digital outputs: 8	A, B, or C	
	Relay output interface card	OPC-RY	Relay outputs: 2 circuits (supports up to 4 relay output circuits when 2 interface cards are installed)	A or B	
	Resistance temperature detector input card	OPC-PT	Resistance temperature detector Pt1000	A, B, or C	Coming soon
Encoder connection*1	PG interface card	OPC-PG	Pulse input circuit system 2 (open collector/complementary type)	C	
	PG interface card	OPC-PG2	Pulse input circuit system 1 (5 V line driver type)	C	
	PG interface card for synchronous motor drive	OPC-PMPG2	Pulse input circuits system 1 (5 V line driver type) magnetic pole position detection U, V, W	Uses B and C	Coming soon
	Resolver interface card	OPC-G1-RES		Uses B and C	
Communication extensions*2	T-Link communication card	OPC-GS-TL	Data link between PLC (MICREX-SX) and inverter	A or C	
	DeviceNet communication card	OPC-GS-DEV	Data link between PLC (DeviceNet) and inverter	A, B, or C	Coming soon
	CC-Link communication card	OPC-GS-CCL	Data link between PLC (CC-Link) and inverter	A or C	
	OPC-UA communication card	OPC-GS-UA	Data link via OPC-UA specification	A or C	Coming soon
	SX bus communication card	OPC-VG1-SX	Data link between PLC (MICREX-SX)*3 and inverter over SX bus	D	
	ESX bus communication card	OPC-VG1-ESX	Data link between PLC (MICREX-SX)*3 and inverter over E-SX bus	D	
	PROFINET communication card	OPC-VG1-PNET	Data link between PLC (PROFINET) and inverter	D	
	PROFIBUS-DP communication card	OPC-GS-PSB	Data link between PLC (PROFIBUS-DP) and inverter	D	
Optical communication extensions	Optical communication card	OPC-GS-SI	For multiplexed connections	E	
Functional safety*1	Functional safety card	Coming soon		Use of A and B	Coming soon

*1: Cannot be mounted on the PWM converter.
*2: Only one option card can be installed as a communication extension.
*3: The version of the programming support tool SX-Programmer Expert (D300win) must be Expert Version 3.7.5.23 or higher.



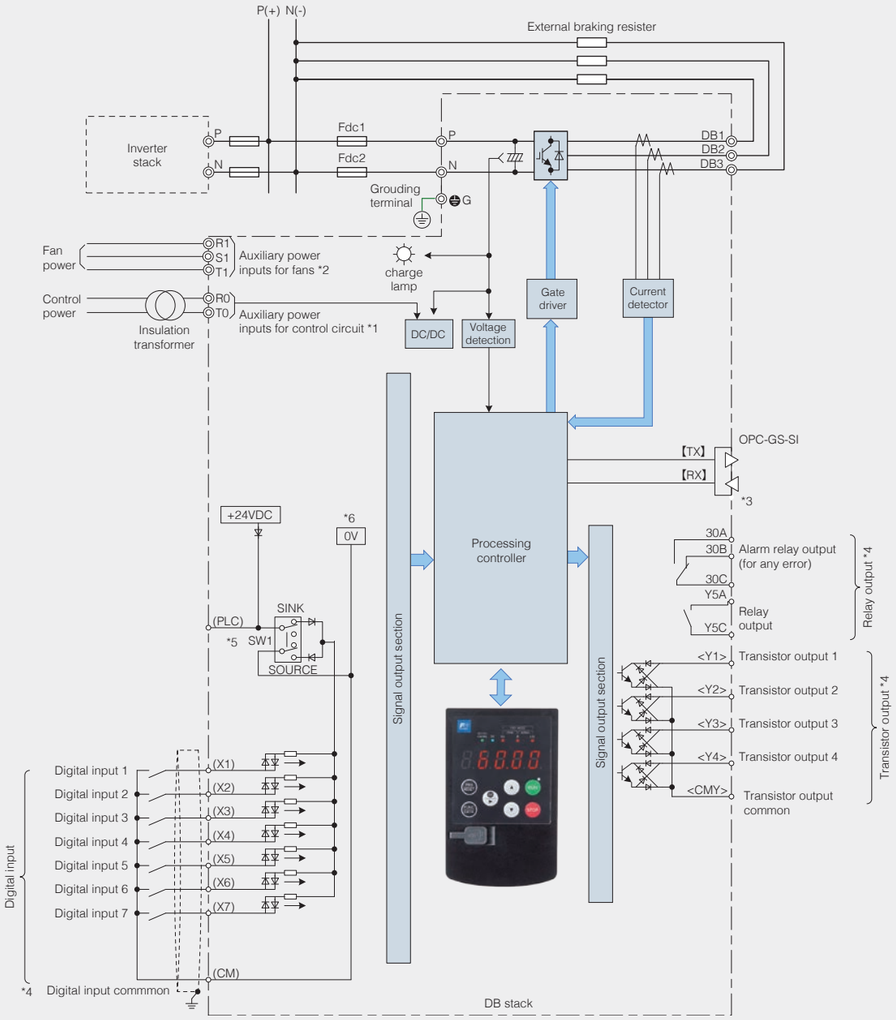
Options

DB stack specifications

Item		Specifications	
Type *3		FRN-GS1B560C-40	FRN-GS1B600C-69
Output ratings	Rated output capacity	560 kW	600 kW
	Maximum rated braking power	150 % - 1 min	
	Braking duty cycle	100 %ED (continuously) *2	
	Rated current *1	306 A × 3	224 A × 3
Input ratings	Auxiliary control power input: Phase, voltage, frequency	Single-phase, 380 to 480 V, 50 Hz/60 Hz	Single-phase, 575 to 690 V, 50 Hz/60 Hz
	Auxiliary fan power input: Phase, voltage, frequency	-	3phase, 380 to 440 V, 50/60 Hz
	Allowable voltage/frequency	Voltage: +10 to -15%, Frequency: +5 to -5%	
	Rated voltage	DC513-DC710V	DC776-DC1073V
	Rated current	917 A	671 A
Minimum connection resistance *1		2.0 Ω × 3	4.0 Ω × 3
Operating voltage		DC758 V	1,093 V
Approx. mass (kg)		119	130
Enclosure		IP00 open type	

*1: Three sets of external braking resistor are used, and it connects with DB1, DB2, and DB3 between DC link bus N bars.
*2: Continuous braking is possible at the rated braking power.
*3: Salt-proof models have XS at the end of the type number.

DB stack basic wiring diagram



*1: Using a PWM converter for the connection, insert an insulation transformer or auxiliary B contact (normally-closed) of a power side magnetic contactor. If you are using an ungrounded power supply, you will need to install an isolation transformer.
*2: The 690V series has a fan power terminal, so please connect the power supply to it.
*3: If you use two or three DB stacks, you will need an optical communication card (model: OPC-GS-SI). An optical cable (5m) is included as standard with this card.
*4: The functions of terminals [X1] to [X7] (digital inputs), terminals [Y1] to [Y4] (transistor outputs), and terminals [Y5A/C] (relay outputs) are assigned at the factory.
*5: Slide switches on the control printed circuit board (control PCB).
*6: (0V) ([CM]) is insulated inside the inverter.

Options

DB stack common specifications

Item			Specifications
Control functions	Multiplex systems		Optional: Use OPC-GS-SI. Maximum multiplexing: 3 units There are restrictions on usage conditions such as the length of the wire between the inverter stack and the DB stack.
Display and setting	Keypad	Indicator	7-segment LED
		At setting	Displays name and data
		At alarm	**00**: DC fuse blown [DCF], **01**: DC fan lock [Dfa], **02**: Memory error [Er1], **03**: CPU error [Er3], **04**: Operation procedure error [Er6], **05**: Optical communication error [Erb], **06**: Overcurrent [OC], **07**: Fin overheat [OH1], **08**: DB stack internal overheating [OH3], **09**: DC overvoltage [dOV], **10**: Functional safety circuit abnormality [ECF], **11**: Hardware error [ErH], **12**: Simulated fault [Err], **13**: Current sensor error [HCT], **14**: Outdoor air fan power supply failure [Efa]
		In operation or at alarm	Stores the latest and past 255 alarm codes and the latest and past 4 alarm details. Saves and displays the date and time of the alarm occurrence with the calendar and clock display functions(Accuracy:±27 seconds/month (Ta=25°C)) Retention period: 7 days or more (Ambient temperature 25°C)

Structure and environment

Item	Specifications	
Site location	Indoors	
Atmosphere	No corrosive gases, flammable gases, dust, or oil mist (Pollution level 2 (IEC60664-1)). The atmosphere can contain a small amount of salt. (0.01 mg/cm^2 or less per year). No direct sunlight.	
Ambient temperature	-10 to + 40°C	
Relative humidity	5 to 95 % (No condensation)	
Altitude	Less than 1,000 m If the altitude is 1,000 to 3,000 m, output current derating is required. If the altitude is 2,001 to 3,000 m, the insulation level of the control circuits lowers from the reinforced insulation to the basic insulation.	
Vibration	Compliant to the standard IEC61800-2 Amplitude 0.3 mm : 2 to less than 9 Hz 1 m/s^2 : 9 to 200 Hz	Compliant to the standard IEC61800-5-1 Amplitude 0.075 mm : 10 to less than 57 Hz 1 G : 57 to 150 Hz
Storage temperature	-25 to + 70°C (during transport), -25 to + 65°C (during temporary storage)	
Storage humidity	5 to 95 % RH (no condensation)	

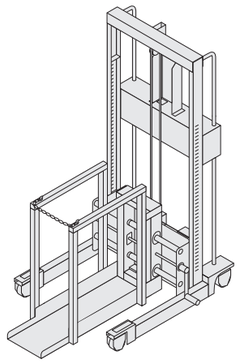
Terminal features

Terminal symbol		Name	Specifications
Main circuit	P(+), N(-)	Inverter P(+)-N(-) line connecting terminal	Connects the P(+)-N(-) line of inverter.
	DB1, DB2, DB3	External braking resistor connecting terminal	Three sets of external braking resistor are used, and it connects with DB1, DB2, and DB3 between DC link bus N bars.
	⏚ G	Grounding for DB stack	Grounding terminals of the DB stack.
	R0, T0	Auxiliary power inputs for control circuit	Connect the same AC power lines as the main power input for a backup of the control circuit power supply.
	R1, S1, T1	Auxiliary power inputs for fans	Power terminals for AC cooling fans.
Digital input	X2	Digital input 2	Switching the [X2] – [CM] from OFF to ON cancels the alarm relay output and restart operation while the protective function is active.
	CM	Digital input common	The common terminal for digital input signals.
Transistor output	Y1	Transistor output 1	Turns ON when DB is in driving state.
	Y2	Transistor output 2	
	Y3	Transistor output 3	
	Y4	Transistor output 4	
	CMY	Transistor output common	Common terminal for transistor output signals.
Relay output	Y5A, Y5C	Relay output	Turns ON when the DB stack is ready for the operation.
	30A, 30B, 30C	Alarm relay output (for any error)	Outputs a contact signal (relay contact, 1C) when the protective function stops the DB stack. Contact rating: 250 VAC, 0.3 A, cos ϕ = 0.3

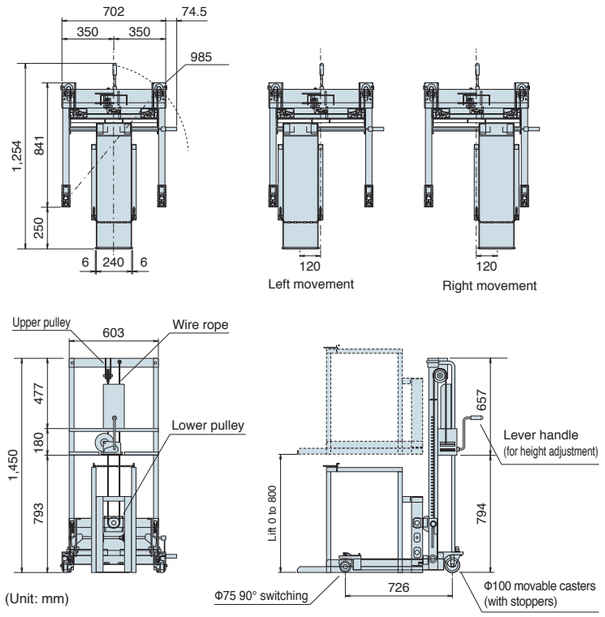
Options

Hand lifter (LFT-VG1)

Used when replacing inverter and PWM converter stacks.
Stack receptacles can be adjusted vertically and horizontally to match the stack position in the panel.



■Mountable stack range
- Inverters: FRN-GS1M0105-40 to
  : FRN-GS1M0063-69 to
- PWM converters: FRN-GS1P0105-40 to
  : FRN-GS1P0167-69 to



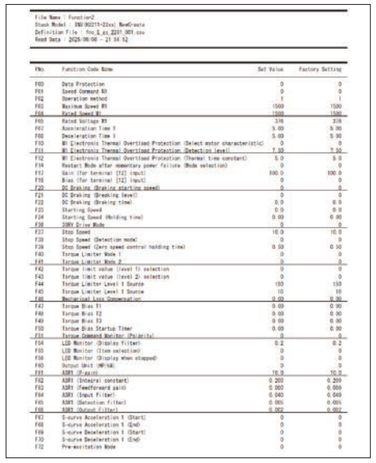
PC loader (GS LOADER)

An optional PC loader is available for inverter and PWM converter offline verification of maintenance data and management of the control parameters.

Main functions

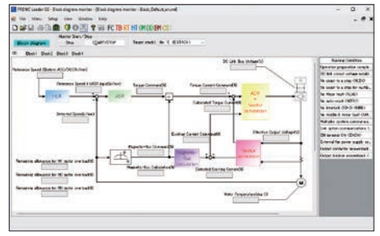
- **Traceback data**
  When a failure occurs, key waveform data such as speed and current and the past 4 occurrences of bit ON/OFF data are stored to enable analysis of failures and facilitate prompt countermeasures and recovery. High-speed traces (sampling 1 ms) and low-speed traces (sampling 200 ms) can be captured simultaneously.
- **Setting, changing, displaying, and saving control parameters**
  Since control parameters can be saved and modified on PCs with user-specified file names and comments, operators can manage the control parameters of inverters on their PCs. In addition, operators can also compare the parameters on their PCs with inverters.
- **Operation status displays**
  The present inverter operation status can be checked at a glance using block diagram, real value, and internal data displays.
- **Failure cause display**
  It displays up to 4 failures and 30 failure factors per failure, including the date and time of occurrence.

■ Control parameter display

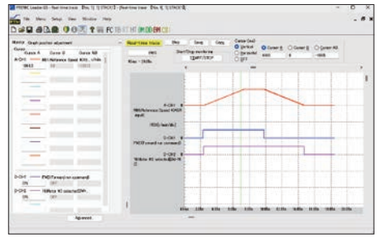


- **Failure history display**
  It displays the failure and occurrence history for the past 100 incidents, including the date and time of occurrence.
- **Failure guidance**
  The causes of failures and methods for recovery operations can be confirmed using failure factors read from the control unit.
- **Commissioning**
  It is easy to run or stop the unit while viewing the inverter status on the “Operation status display screen” from the loader.
- **Multi-window display**
  Multiple windows can be displayed on a single screen allowing operators to monitor multiple pieces of information at the same time.
- **Printing**
  Capable of printing in report format. In addition, by saving the data as a CSV file, you can view the data even in an environment where a PC loader is not installed.
- **Chart display**
  Capable of displaying two types of charts.
  Real-time charts: Data is stored in the PC. It displays waveforms in real time.
  Historical charts: Data is stored in the controller. It can store monitoring data synchronized with the control software. It can store data with or without a loader connection.

■ Operation status display



■ Real-time chart display



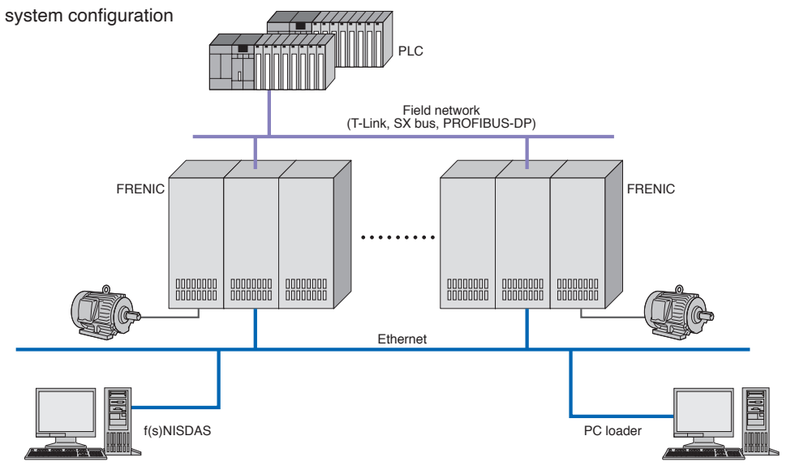
f(s)NISDAS

Capable of high-speed centralized monitoring of inverter equipment.

Key features

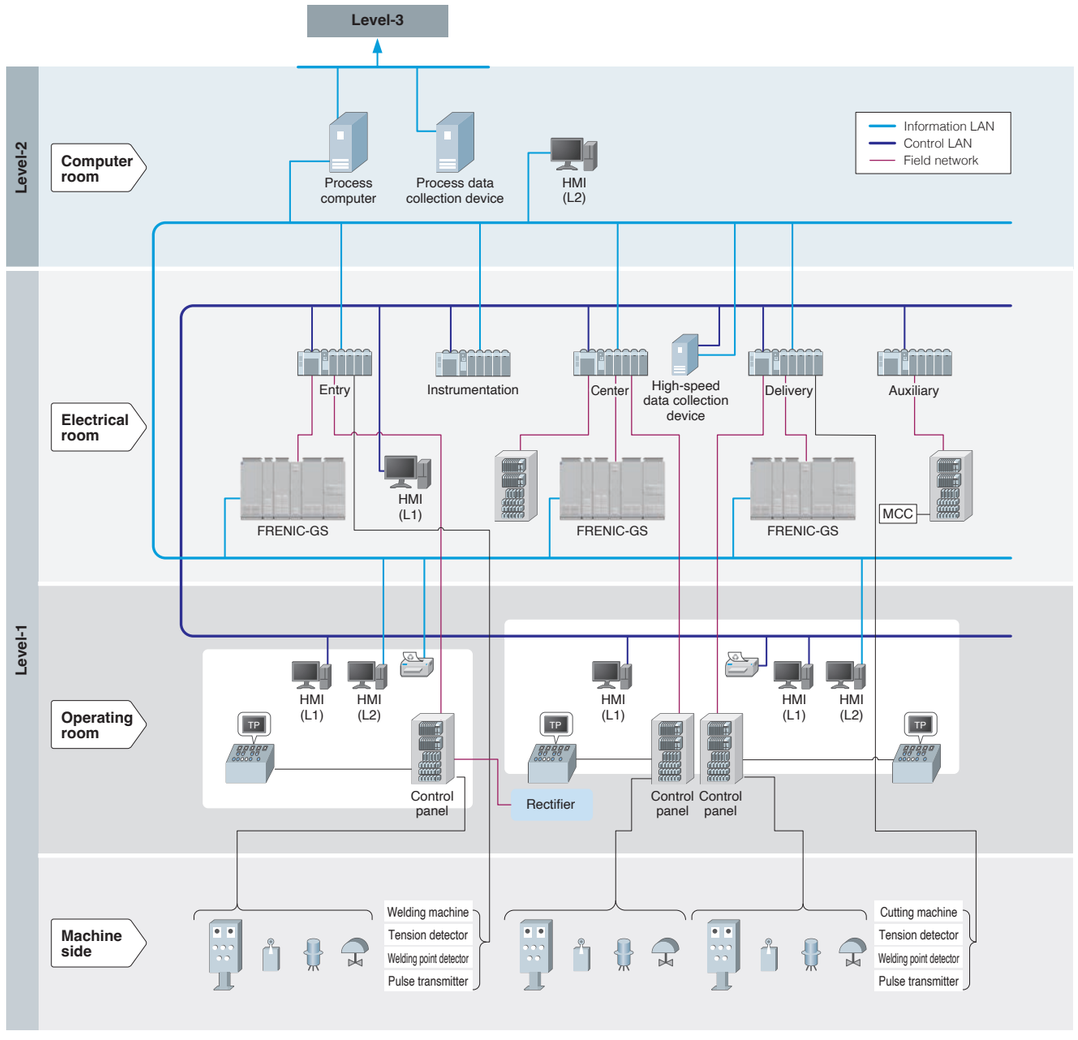
- **Real-time monitoring**
  Capable of collecting inverter device data at 10 ms sampling.
  (Up to 32 units can simultaneously collect data)
- **Traceback data collection**
  Capable of collecting traceback data stored in inverters.
- **PLC internal data collection**
  Capable of collecting the internal data of Fuji general purpose PLCs (MICREX-SX).

■ Example of system configuration



System solutions

In addition to inverter panels, we offer total system solutions including power receiving, HMI, and control panels.



Variable speed control devices

Applications	Series name	Features	Output voltage	Capacity range [kVA] (10 / 100 / 1,000 / 10,000)
For plant	FRENIC 4000VM6	Industrial vector control inverter • Applies high-performance vector control to achieve high-speed response, high-precision, and wide-range high-speed control • DC distribution type enables highly efficient plant and factory operations	400	5,400
	FRENIC 4000FM6	Industrial V/f control inverter • Capable of high-precision frequency control for fan pumps and group-driven motors • DC distribution type enables highly efficient plant and factory operations	400	900
	FRENIC 4400VM6	Large-capacity vector control inverter • Higher capacity FRENIC4000 Series with 3-level control	850	8,400
	FRENIC 4800VM6	High-voltage water-cooled large-capacity vector control inverter • Higher capacity FRENIC4000 Series with 3-level control • Equipment miniaturization via water cooling	3,300	26,400
	LEONIC-M700	Industrial thyristor Leonard • Large-capacity thyristor Leonard for various control applications	DC220 DC440 DC750	• • •
	LEONIC-M Compact	Unit type DC machine controller • Compact thyristor Leonard designed for updates from analog controllers	DC220 DC440	75 kW 450 kW
For general industry (high-voltage)	FRENIC 4600FM6e	High-voltage direct output inverter (for fans and pumps) • Compact dimensions • Achieves energy savings by operating high-voltage motors at variable speeds • Utilizes power supply and motor-friendly circuit configuration and control	3,300 6,600	5,200 5,720
For general industry (low-voltage)	FRENIC-VG	High-performance vector control inverter	200 400 690	90 kW 800 kW 90 kW 450 kW
	FRENIC-MEGA	High-performance multifunctional inverter	200 400	90 kW 630 kW

Inquiries

When placing an order or making an inquiry, please provide the following information.

1. Applications

2. Load machine specifications
1) Name
2) Torque characteristics (squared reduction, constant torque, constant power)
3) Moment of inertia J ☐ kg-m^2 (motor shaft conversion)
4) O/L ☐ %

3. Input specifications
1) Rated voltage ☐ V ± ☐ %
2) Rated frequency ☐ Hz ± ☐ %
3) Control power supply 3-phase 4-wire 200 V -50/60 Hz, 220 V -50/60 Hz

4. Drive motor
1) Motor type ☐ (Existing or newly installed)
2) Rating
Output ☐ kW, poles ☐ P, voltage ☐ kV,
Frequency ☐ Hz, rotational speed ☐ r/min,
Rated current ☐ A

5. Rotational speed control range ☐ r/min to ☐ r/min

6. Ambient condition
1) Indoor use 2) Humidity 3) Temperature 4) Altitude
5) Air conditioning availability Yes / No 6) Installation restrictions

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