

DC-link 3-level Inverter

FRENIC4400VM6



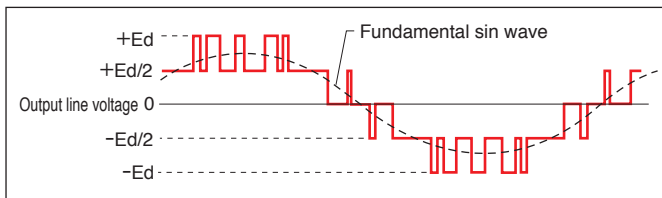
AC Adjustable Speed Drive

High-accuracy and High-performance IGBT 3-level PWM Inverter

3-level PWM inverter

The 3-level PWM control enables an output voltage of 850 V AC, and a single unit of inverter can have a rated capacity of 2,100 kVA. Furthermore, the 3-level PWM inverter is capable of reducing the output harmonic currents and motor torque pulsation. Therefore, it can reduce the bad effect on the motor and machine side mechanism.

Output voltage waveform of 3-level inverter



IGBT utilized

This inverter has achieved a quick response, low-loss and simplification of the inverter control circuit due to the use of an IGBT (insulated-gate bipolar transistor).

Reduction of harmonic currents on power supply side

The adoption of a diode converter of 12-pulse rectification method permits reduction of the harmonic currents on the power supply side.

Power factor $\cong 1$ at power supply side

A PWM converter can also be utilized to achieve a power factor $\cong 1$ at power supply side.

FRENIC4400VM6 Vector control inverter FRENIC4400FM6 V/F control inverter



Note: Photograph shows the equipment with the optional LCD mounted.

Touch panel controller with a liquid crystal display^{Note} (LCD)

Setting, running, monitoring and maintenance functions are all adjustable from the touch panel controller with a LCD.

The LCD displays various data and operational guidance on the bottom of the screen. A large LCD display touch panel can also be used. (option)

Note: Available in both Japanese and English (switchable)

Enhanced support tools^(option)

Extensive support tools include analog output for wave plots, PC loader, and high-speed data acquisition system.

Connectable to various transmission lines^(option)

Connectable with PLCs or other high order controllers at high speed and with limited wiring. In addition to Fuji's original T-link, SX bus, and E-SX bus, PROFIBUS-DP, which is a typical open bus, is usable.

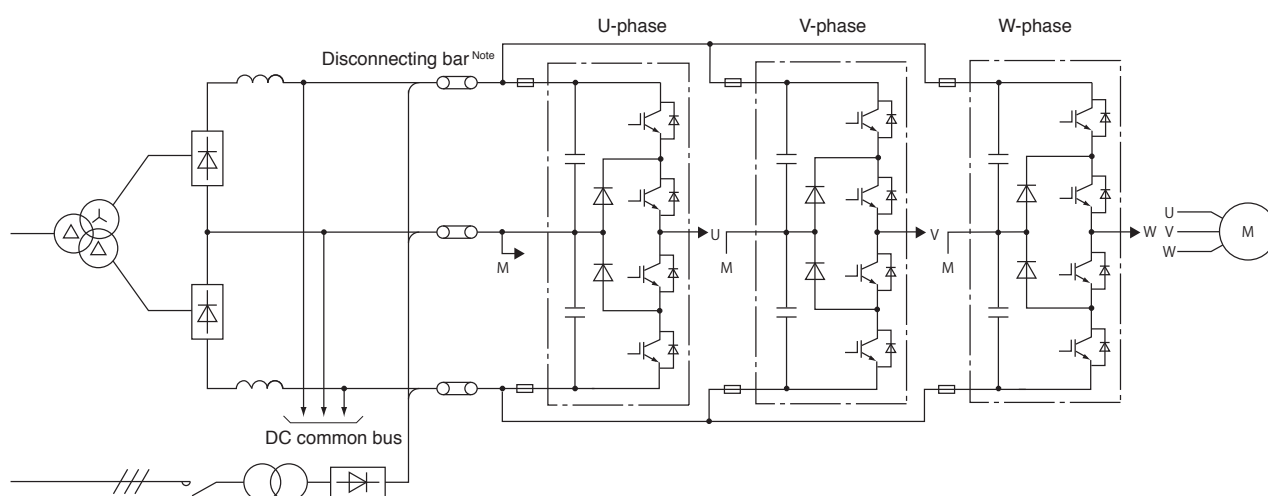
Wide choice of plant automation control functions

Based on our achievement of plant automation systems for many different kinds of manufacturing plants, various cutting edge automation control functions are available for recent plant automation systems.

High efficiency operation enabled by DC-link system

Power running energy and regenerative energy are transmitted and received via a common DC bus for high efficiency plant operation.

Main circuit arrangement



Note: Disconnecting switch is option.

Specifications

VM6

Common specifications

Note: Option

Type		FRENIC4400VM6		
Main circuit system		Voltage-type IGBT sine wave PWM inverter		
Output voltage		3-phase, 850 V AC		
Overload capability		150% for 1min		
Control power supply		3-phase, 200/220 V -15 to +10%		
Control function	Start/stop	Key operation	Touch panel, Loader ^{Note} , LCD ^{Note}	
		External signal	Contact input, Analog input (±10V)	
		Transmission link operation	T-link ^{Note} , SX bus ^{Note} , E-SX bus ^{Note} , PROFIBUS-DP ^{Note}	
	Contact input		Built-in 20 points (14 points selectable, X1 to X14)	
	Speed setting		Various transmission links, External signals, Touch panel, LCD ^{Note} Loader ^{Note} key operation	
	Operation status signal		• Built-in relay output: 9 points (6 points selectable, Y1 to Y6) • Built-in transistor output: 3 points (3 points selectable, Y7 to Y9) • Analog output (4 built-in points + 4 externally mounted points^{Note})	
	Rotating motor pickup		The rotating motor is picked up in inverter operation (SY0).	
	Restart after momentary power failure		Inverter is restarted without stopping the motor.	
	Touch panel		Each constant setting, Startup conditions, Control data digital display, Fault cause display, Fault point data display	
	LCD ^{Note}		Each constant setting, Startup conditions, Control data digital display, Fault cause display, Fault point data display	
	Loader ^{Note}		Setting item, Startup conditions, Control data digital display, Fault cause display, Fault trace data display ^{Note 1} Chart display	
	Analog output		Analog output of arbitrary control data	
Charge lamp		Comes on when residual voltage (25 V DC or larger) is in the main circuit.		
Protection	Protection level		Classified into the following 4 levels. • Major fault 1, 2: Trips instantly. • Medium fault: Quickly decelerates and trips to stop after the set time has elapsed. • Minor fault 1: Cannot be restarted once it is stopped. • Minor fault 2: Display only	
	Overvoltage		Actuated when the DC main circuit voltage exceeds 1,580 V DC	
	Undervoltage		On detecting undervoltage of DC intermediate voltage, inverter stops.	
	Overheat		Protects the inverter by detecting the temperature of the heat sink inside the inverter.	
	Short-circuit		Detected by “overcurrent.”	
	Overcurrent		Actuated when the output current peak value exceeds the overcurrent level (fixed).	
	Ground fault		By the operation of the converter side ground fault detection relay, inverter stops.	
	Motor		Protected by electronic thermal function and temperature detection. “Overload”, “Motor overheat”, “Startup congestion”, “Overspeed”	
	Environ-ment	Installation location		Indoors, Free from corrosive gas, inflammable gas, dust, or explosive gas
		Ambient temp.		0 to +40 °C
Ambient humidity		20 to 90% RH (no condensation)		
Cooling method		Forced air-cooled system		
Altitude		Up to 1000 m		
Vibration		4.9 m/s² or lower (at 10 to 50 Hz)		
Storage (ambient temp.)		- 5 to +40 °C		
Applicable standard		JEC-2410 (JIS, JEM, etc.)		

Note 1) High-speed trace: Saves and displays 225 points of control data for the past four 1 ms samplings.
 Low-speed trace: Saves and displays 225 points of control data for the past four 200 ms samplings.

Individual specifications

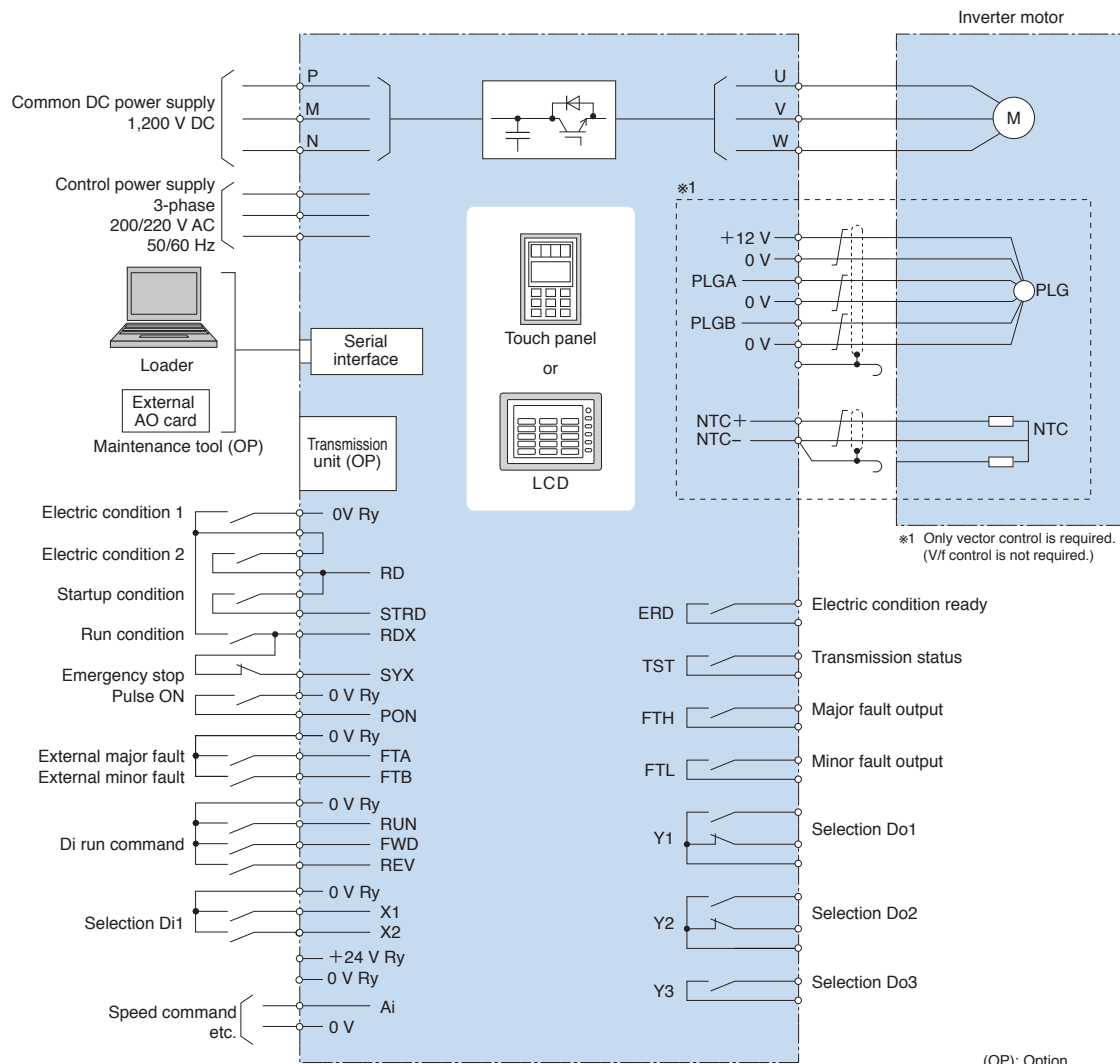
Type	FRENIC4400VM6		
Motor control system	Vector control		
Function	Speed control	ASR fixed cycle 5 ms or 1 ms	
	Vector control	Maximum speed	100 Hz on inverter output frequency basis
		Control range	1:1000
		Control response	25 Hz (mechanical systems not included)
		Speed control accuracy	±0.01% of the maximum speed
		PG frequency	100 kHz or lower
		Torque accuracy	±5% of the rated torque
	Setting resolution	±0.005% of the max. speed (20000d/100%)	
	Acceleration/deceleration time	0 to 550.00 s Linear (break point) acceleration/deceleration Acceleration/deceleration settable by transmission 2 types of deceleration for emergency stop	
	Control function	Multiplex winding motor driving	Up to 12 windings (4 multiplexing) without the output reactor
		Start/stop operation selection	The timing for releasing the brake or starting ASR can be controlled by 3 different signals (SY1, 2 and 3 by transmission)
		Droop control	Torque drooping characteristics according to the speed. A fixed drooping type or speed command proportional type.
		Torque control	Torque limit (2 types of transmission) Torque compensation (Transmission 2 types) Mechanical loss torque is compensated by polygonal approximation with set value (forward/reverse: 14 points)
		Torque bias	Analog torque setting, Transmission torque setting (2 lines), Mechanical loss pattern, etc.
		Observer	Load disturbance observer Vibration suppression observer
		Acceleration/ deceleration forcing	Upon calculating the acceleration/deceleration torque based on the moment of inertia J and acceleration
		Backlash correction	Corrects backlash during mechanical drive by several motors
Higher setting		Sets the speed higher than normal to cope with load impact	
ω2 lock		Applies an electromagnetic brake during excitation to prevent the motor from needless rotation	
di/dt limitation		Limits the gradient of the torque current command	

Transmission options

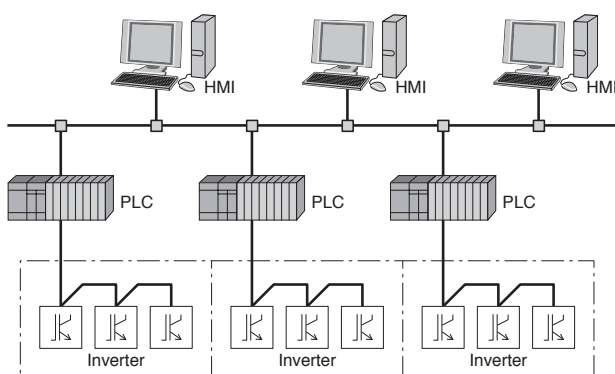
Card name	Use
T-link card	Connects the inverter with the host PLC T-link
SX bus card	Connects the inverter with the host PLC via SX bus
PSB card	Connects the inverter with the host PLC via PROFIBUS-DP
E-SX bus card	Connects the inverter with the host PLC via E-SX bus

Standard Interface/System Configuration/ Single-line Diagram VM6

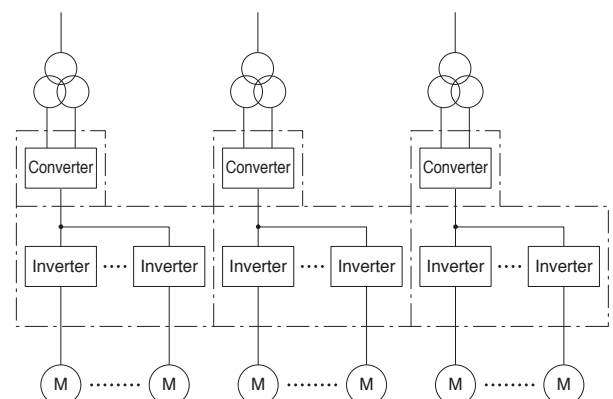
Standard Interface



Example of system configuration



Single-line diagram



Data setting and monitoring

(VM6 touch panel with LCD and programmable display)

Touch panel with LCD

The touch panel with LCD displays appropriate information, and can easily be used to set data, and operate and monitor the equipment.

The display language can be switched between Japanese and English.

Key operation guidance is displayed at the bottom line of the LCD, and most operations can be performed without referring to the instruction manual.

LED (sign + 4 digits)

Displays the number of revolutions (changeable).
Any of 8 different data indicated on the LCD on the monitor screen (default screen) can be selected arbitrarily.
When tripped:
“Err” blinks automatically, alerting you to the trip.

Program key

Reverts to the monitor screen (default screen) from any screen.

Shift key (digit shift)

Used to move the cursor from one digit to another in order to change data.

Reset key

When normal: Assigned to “return” and “cancel” functions. Returns to the previous layer.
When tripped: Releases the stop status due to tripping.



LCD

Displays various information such as operation, setting and fault data in up to 5 lines × 13 characters.
When tripped: The display automatically switches to trip data.

Up and down keys

Used to change the data display numbers and data setting values.

Normal, reverse and stop keys

The operation can be started or stopped on the touch panel.

Help key

When normal: Changes to the key operation guidance screen that can be used on the current screen.
On key operation guidance screen: Returns to the previous screen.

Function and data selection key

Assigned to “enter” and “OK” functions.

Example of actual screen display

The monitor screen (default screen after turning on power) displays the rotational speed commands, detection, output current, and output voltage on one screen enabling you to see the current operating status at a glance.

Use of touch panel

Menu	Description
initial	Monitor screen: current, voltage and frequency display
M01	Parameter setting reference and change
M02	Di/Do bit on/off status reference
M03	Ai/Ao voltage reference
M04	Inverter internal data display
M05	Transmission, sent/received data reference
M06	Inverter start and stop operation
M07	Inverter startup condition on/off reference
M08	Latest fault code (simultaneous occurrence) reference
M09	Fault history reference
M10	Inverter internal data reference when tripped
M11	Present time setting, operating time reference, parameter setting control, LCD concentration adjustment, etc.

Introduction of some functions

● M09 fault history

Displays a chronological record of the past 100 faults with the causes and the time and date of occurrence, enabling you to trace back the faults

● M10 trip data display

Displays internal data sampling values and bit data on/off when a fault occurs, enabling you to know the fault circumstances.

● M11 Saving, loading, and comparing setting parameters

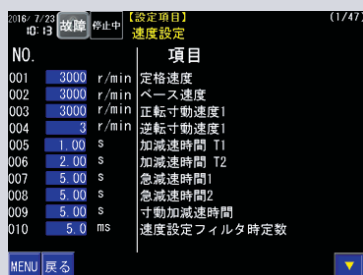
Inverter parameter settings can be saved in batch into nonvolatile memory using the touch panel.

The settings are retained when the power is turned off.

The saved data can also be loaded to the inverter. Current inverter settings and values saved on the touch panel can be compared with each other.

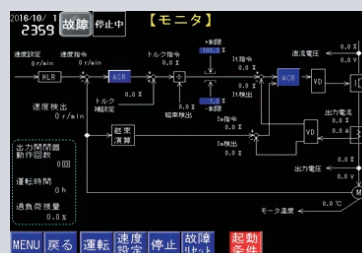
8.4 inch programmable display (Large LCD) (option)

The 8.4 inch programmable display unit features excellent visibility and operability, making data setting, operation, monitoring and maintenance easy to perform. The converter and inverter each have a programmable display unit.



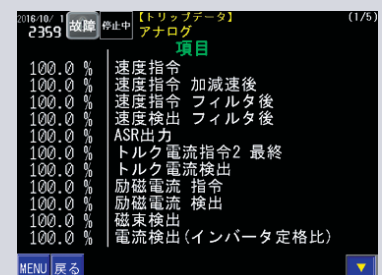
Setting screen

Parameters can be checked and changed from this screen.



Monitor screen

Various command values and detection values are displayed in a simplified control block diagram. The inverter can be started and stopped from this screen.



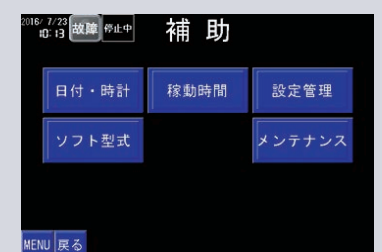
Trip data screen

Internal data when a fault occurs is displayed, making it possible to determine the state when the fault occurred.



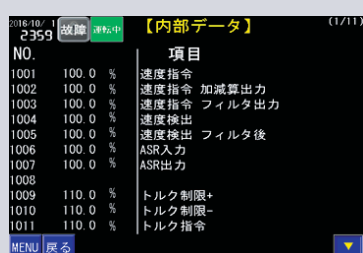
Dio screen

Displays the status of the external input and output terminals.



Auxiliary screen

Various support screens are accessible from this screen.



Internal data screen

Internal data (instantaneous values) are displayed.



Fault history screen

The past 100 fault factors, occurrence date and time in order of occurrence can be displayed, and the past fault occurrence history can be displayed by going back in time. By touching the number on the far left of the screen, guidance on the fault content, causes, and actions will be displayed.



Start condition screen

The screen enables a check of whether or not the individual start conditions are satisfied.

Inverter application and dimensions

VM6

Capacity and series

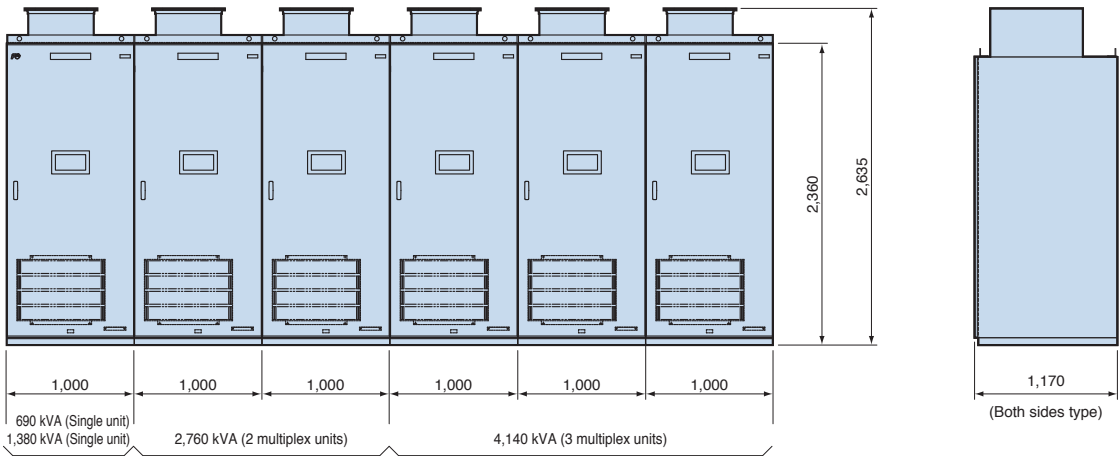
Capacity [kVA]	690	1,380	2,100	2,760	4,200	4,140	6,300
Composition (unit quantity) ^{Note}	1			2 multiplex		3 multiplex	
Current [A]	469	938	1,443	938×2	1,443×2	938×3	1,443×3
Overload capability	150% for 1min						
Approx. mass [kg]	1,500	1,500	3,000	3,000	6,000	4,500	9,000

Note: Available maximum unit is 4 multiplex.

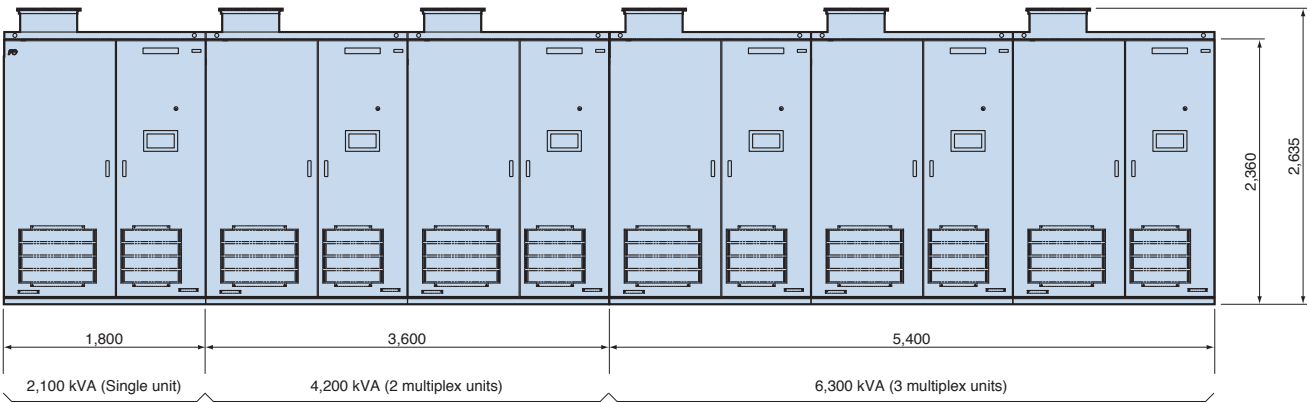
Dimensions [Unit: mm]

Inverter panel (when diode converter is used)

690 kVA / 1,380 kVA



2,100 kVA



Inverter panel: Self-standing, enclosed type
 Finish color: JEM standard Munsell 5Y7/1 (semi-gloss) for internal and external

Converter specifications and dimensions

VM6

For the converter connected to the inverter, when regeneration is not required, use a diode converter. When the regeneration side capacity can be reduced with respect to the drive side, use a combination of a diode converter + a PWM regenerative converter. If regenerative capacity equivalent to the drive side is required, use a PWM converter.

Specifications, dimensions and masses

Diode converter

Rated output capacity [kW] (at 1,200 V DC output)	Rated current [A]	Input			Output		Dimensions W×D×H [mm]	Approx. mass [kg]
		Frequency	Voltage	Control power supply	Voltage	Overload capacity		
3,300	2,750	50/60 Hz ±5%	2 systems of 3-phase, 460 V±10%	3-phase, 200/220 V -15 to +10%	1,200 V DC ±10% (depends on input voltage)	150% for 1min	1,100×1,170×2,635	1,500
5,940	4,950						2,200×1,170×2,635	3,000

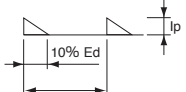
Note 1: Diode converter of capacity over 5,940kW can also be produced. Please contact us for details.

PWM converter

Rated output capacity [kW]	Rated current [A] (AC side)	Input			Output		Dimensions W×D×H [mm]	Approx. mass [kg]
		Frequency	Voltage	Control power supply	Voltage	Overload capacity		
500 (unit capacity)	469	50/60 Hz ±5%	3-phase, 800 V ±10%	3-phase, 200/220 V -15 to +10%	1,250 V DC	150% for 1min	1,500×1,170×2,635	2,000
1,100 (unit capacity)	938						1,500×1,170×2,635	2,000
1,100×2 (2 multiplex)	938×2						2,500×1,170×2,635	3,500
1,100×3 (3 multiplex)	938×3						3,500×1,170×2,635	5,000
1,700 (unit capacity)	1,443						2,300×1,170×2,635	3,500
1,700×2 (2 multiplex)	1,443×2						4,100×1,170×2,635	6,500
1,700×3 (3 multiplex)	1,443×3						5,900×1,170×2,635	9,500

Note 2: Dimensions of PWM converter panels are same as those of inverter panels shown on P8. (However, the width is wider than that of the inverter panels for ensuring the space for the initial charging circuit, by 500 mm for control initial charging system and by 800 mm for the main circuit initial charging system.)

PWM regenerative converter

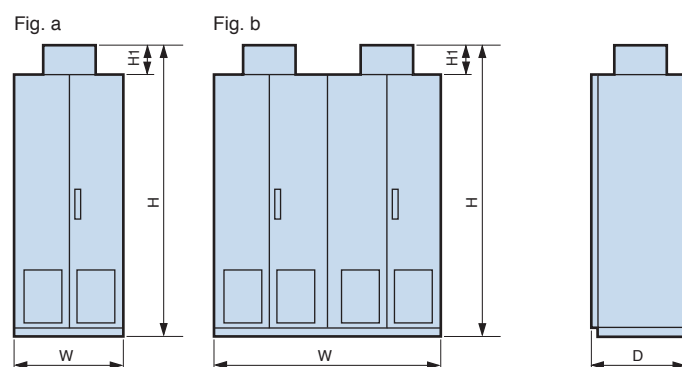
Peak regenerative amount [kW]	Max. current	Rated reguration	Regenerative voltage	Dimensions W×D×H [mm]	Approx. mass [kg]
725 (unit capacity)	703		3-phase, 460V	1,500×1,170×2,635	2,000
1,450 (unit capacity) ^{Note 4}	1,407			1,500×1,170×2,635	2,000
2,200 (unit capacity) ^{Note 4}	2,165			2,300×1,170×2,635	3,500

Note 3: Dimensions of PWM regenerative converter panels are same as those of inverter panels shown on P8. (However, the width is wider than that of the inverter panels for ensuring the space for the initial charging circuit, by 500 mm for control initial charging system and by 800 mm for the main circuit initial charging system.)

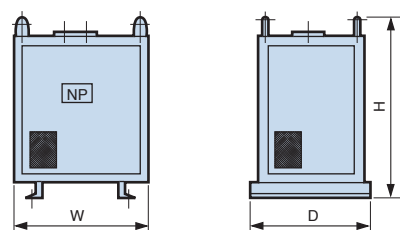
Note 4: Multiplex support is possible.

Dimensions

Diode converter panel



Diode converter panel: Self-standing, enclosed type
Finish color: Munsell 5Y7/1 for internal and external



Separately installed DCL
(for diode converter)
Separately installed ACL
(for PWM converter)
Separately installed Tr
(for regenerative converter)

Diode DC power supply current rank [A]	Dimensions [mm]			Fig.	Approx. mass [kg]
	W	D	H		
2,750	1,100	1,170	2,635	a	1,500
4,950	2,200			b	3,000

Dimensions of DCL

Diode DC power supply current rank [A]	Dimensions [mm]			Approx. mass [kg]
	W	D	H	
2,750	800	1,300	1,200	600
4,950	1,300	1,300	1,200	900

Note: 2 units of DCL are required per converter, as DCL's are good for 3 levels.

Dimensions of ACL

Rated output capacity [kW]	Dimensions [mm]			Approx. mass [kg]
	W	D	H	
550	Contact us			Contact us
1,100	900	900	1,200	800
1,700	1,100	1,200	1,300	1,200

Note: An ACL is good for a unit PWM converter.

Dimensions of Tr

Peak regenerative amount [kW]	Dimensions [mm]			Approx. mass [kg]
	W	D	H	
725	Contact us			Contact us
1,450	1,200	1,000	1,600	1,700
2,200	1,600	1,000	2,100	2,500

Note: A Tr is good for a unit regenerative converter.

Inverter application and dimensions

VM6

PC loader (FLOAD8 for Windows)

An optional PC loader is available for offline checking of maintenance data and managing control parameters.

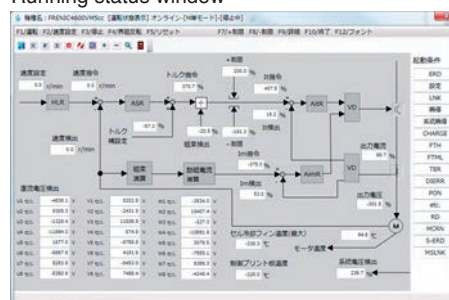
Main functions of FLOAD for Windows

- Trace-back data**
 Upon fault occurrence, the cause as well as the waveform data and bit on/off statuses of the speed, current and other major items are registered. You can proceed to analysis of error circumstances, quick action and recovery. Details of up to 2 of the latest error occurrences can be retained.
- Control parameter setting, change, display and storage**
 Control parameter settings can be saved with arbitrary filenames and comments and changed on a PC. Thus, the inverter control parameters can be controlled on a PC.
- Running status display**
 Current inverter running statuses can be viewed at a glance thanks to the block diagram, actual value and internal data indications.
- Fault cause display**
 Up to 1 faults with up to 30 causes each are indicated together with the time and date of occurrence.
- Fault history display**
 Displays the time and date of a fault occurrence together with a fault history of the past 100 faults.
- Fault guidance**
 The cause of a fault and the recovery method can be checked from the failure factor that is read in from the controller.
- Test run operation**
 The loader facilitates easy start and stop of the inverter while its statuses are displayed on the "running status indication screen".
- Multi-window display**
 Several window indications can be displayed on a single screen, thereby allowing you to simultaneously monitor multiple information sources.
- Printing**
 Printing is possible in document formats used by Microsoft Excel. In addition, you can refer to data even in environments where a PC loader is not installed by saving the data as an Excel file.
- Chart display**
 Two types of chart display are possible, and both charts support high-speed sampling at a maximum of 1 ms.
 Real-time chart: Data is collected by the personal computer, and the waveform is displayed in real time.
 Historical chart: Data is collected by the controller, and monitoring data can be synchronized with the control software. Data collection is possible even without a loader connected.

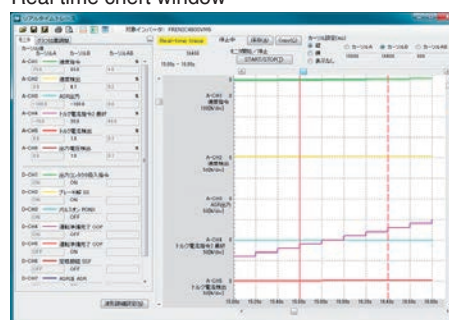
Control parameter window

パラメータ番号	パラメータ名	単位	初期値	設定値	読み出し値	コメント
1	電源電圧	V	220	220	220	
2	電源周波数	Hz	50	50	50	
3	電流制限値	A	10	10	10	
4	電圧制限値	V	100	100	100	
5	電圧制限値	V	100	100	100	
6	電圧制限値	V	100	100	100	
7	電圧制限値	V	100	100	100	
8	電圧制限値	V	100	100	100	
9	電圧制限値	V	100	100	100	
10	電圧制限値	V	100	100	100	
11	電圧制限値	V	100	100	100	
12	電圧制限値	V	100	100	100	
13	電圧制限値	V	100	100	100	
14	電圧制限値	V	100	100	100	
15	電圧制限値	V	100	100	100	
16	電圧制限値	V	100	100	100	
17	電圧制限値	V	100	100	100	
18	電圧制限値	V	100	100	100	
19	電圧制限値	V	100	100	100	
20	電圧制限値	V	100	100	100	
21	電圧制限値	V	100	100	100	
22	電圧制限値	V	100	100	100	
23	電圧制限値	V	100	100	100	
24	電圧制限値	V	100	100	100	
25	電圧制限値	V	100	100	100	
26	電圧制限値	V	100	100	100	
27	電圧制限値	V	100	100	100	
28	電圧制限値	V	100	100	100	
29	電圧制限値	V	100	100	100	
30	電圧制限値	V	100	100	100	

Running status window



Real time chart window



External AO card (type: RGGW1AAU0070G)

Inverter internal data (signal selection out of about 120 data) can be outputted by 4 channels in $\pm 10V$ of analog voltage. They are isolated from the inverter.

Special lifter

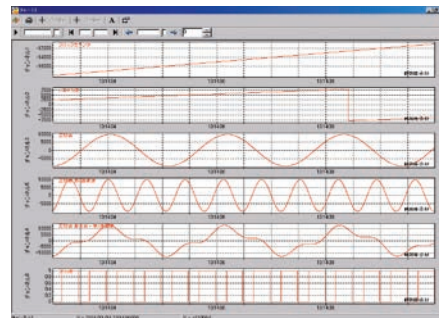
The inverter can be replaced by a small number of persons.

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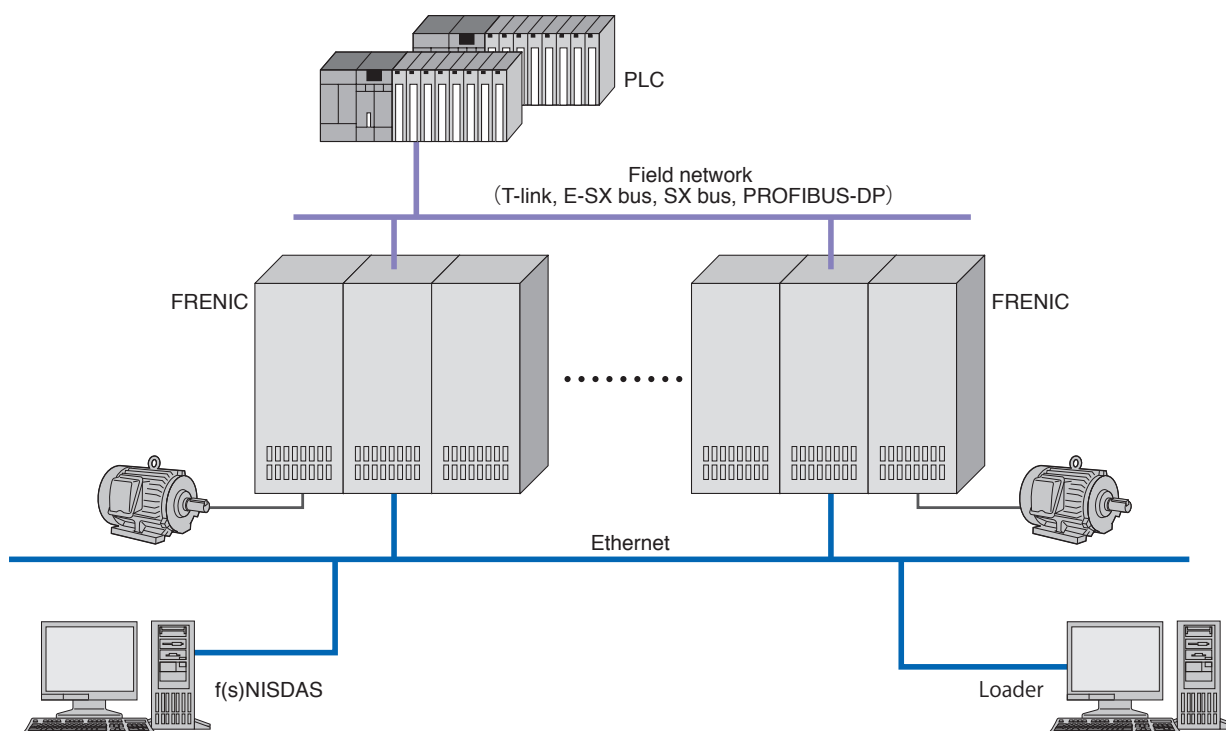
The inverter monitoring can be centralized at high speed.

Main features

- **Real time monitoring**
Inverter data can be sampled every 10 ms (for up to 32 inverters simultaneously).
- **Trace-back data acquisition**
Trace-back data stored in the inverter can be acquired.
- **PLC internal data acquisition**
Fuji general-purpose PLC (MICREX-SX) internal data can be acquired.



Example of system configuration



Adjustable speed drives of Fuji Electric group

Application	Series	Features	Output voltage [V]	Capacity range [kVA]			
				10	100	1,000	10,000
For plant	FRENIC 4000VM6	Vector controlled inverter for plants • High-performance vector control system for quick response, high-accuracy and wide range speed control. • The DC-link system allows highly efficient plant operation.	400			5,400	
	FRENIC 4000FM6	V/f controlled inverter for plants • Frequency of fan, pump and group-driven motors can be controlled accurately. • The DC-link system allows highly efficient plant operation.	400		900		
	FRENIC-GS	Vector controlled inverter for plants • Large capacity up to 650 kVA in a slim structure that contributes to space savings • High-speed, high-precision control performance contributes to improving product quality and productivity • Top-level safety features that contribute to improving safety in manufacturing facilities • Stabilizes production and promotes DX with excellent monitoring functions	400 690			3,900 3,900	
	FRENIC 4400VM6	Large-capacity vector controlled inverter • The capacity of FRENIC4000 series units has been increased due to 3-level control.	800			8,400	
	FRENIC 4800VM6	Medium-voltage, water-cooling, large-capacity and vector controlled inverter • The capacity of FRENIC4000 series units has been increased due to 3-level control. • Downsizing achieved by adopting a water-cooling system	3,100				26,400
	LEONIC-M700	Thyristor converter for plants • Large-capacity thyristor converter for various types of control	220 DC 440 DC 750 DC			...	
	LEONIC-M Compact	Unit-type DC motor controller • Compact thyristor controller equipment intended for update from analog controller also	220 DC 440 DC	75 kW 450 kW			
For general industry (medium-voltage)	FRENIC 4600FM6e	Medium-voltage direct-output inverter (for fans and pumps) • Compact • Variable speed operation of medium-voltage motors saves energy. • Circuit configuration and control are well designed for power supplies and motors.	3,300 6,600			5,200 5,720	
For general industry (low-voltage)	FRENIC-VG	High-performance vector controlled inverter	200 400 690	90 kW 800 kW 90 kW	450 kW		
	FRENIC-MEGA	High-performance V/f controlled inverter	200 400	90 kW 630 kW			

Ordering information

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

Application of inverter				Remarks:	
Load machine specifications					
Name:					
Load torque characteristics: ☐ Square-law speed ☐ Constant torque ☐ Constant output					
Moment of load inertia after conversion into motor shaft (J):				kg · m ²	
Overload: %					
Input specifications					
Rated voltage:		V ± %	Rated frequency:		Hz ± %
Control power source:		-phase, -wire, V,	Hz		
Driven motor					
Motor specifications: ☐ Squirrel-cage rotor ☐ () , ☐ Existing ☐ New installation					
Rating	Output:	kW	No. of poles:	Voltage:	kV
	Frequency:	Hz	Speed:	Current:	A
Speed control					
Control range:		r/min to	r/min		
Rotational/frequency setting method					
Ambient conditions					
Installation location: Indoor		Humidity:	%RH	Temperature:	°C
Provision of air conditioning:		Limit on carrying-in:			

Note: All company names, product names, and service names contained herein are acknowledged to be the trademarks or registered trademarks of their respective companies.

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