

# **FRENIC4800VM5**

**3kV-output 3-level Inverter**



**FRENIC4800VM5**

***AC Adjustable Speed Drive***

# Large-capacity, High-accuracy and High-performance IGBT 3kV-output 3-level PWM Inverter

## Large-capacity IGBT inverter

The drivable/regenerative IGBT inverter used for the rolling mills, etc. achieves a single bank capacity of 6.2MVA (3.1kV), 2.4 times that of our conventional units.

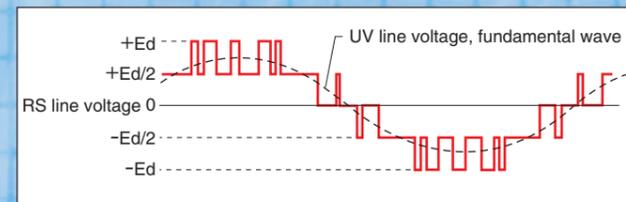
## Adoption of a water-cooling system

Based on efficient water-cooling of the IGBT device, large capacity and downsizing have been achieved. The air-conditioning capacity of the electric room can also be reduced.

## 3-level PWM inverter

The 3-level PWM control reduces the output harmonics and torque pulsation of the inverter, thus minimizing their adverse effect on the motors and other machines.

### Output voltage waveform of 3-level inverter



## Adoption of large-capacity general-purpose IGBT modules

The adoption of large-capacity general-purpose IGBT modules enables high control response, low loss, and a simplified inverter control circuit.

## Reduction of harmonic current on power supply side

The PWM converter with power line harmonics and power factor approximately equal to 0 and 1 respectively minimizes the power supply capacity.

## Touch panel equipped with a liquid crystal display<sup>(\*)</sup> (LCD)

Setting, running, monitoring and maintenance functions are all adjustable from the touch panel, equipped with a LCD on the unit front. The LCD displays various data as well as key operational guidance on the bottom, thus facilitating operation.

(\*): Available in both Japanese and English (switchable)

## Wide choice of plant control functions

Based on previous operational experiences in different plants to date, various control functions useful for plant control are provided.

## Connectable to different transmission lines (option)

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

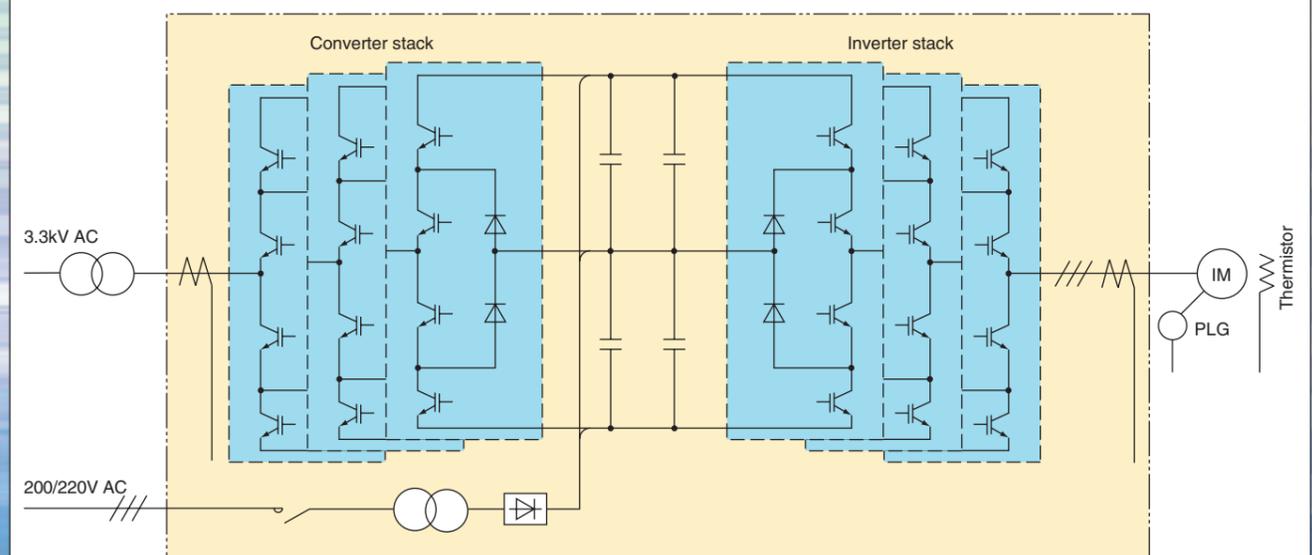
## Enhanced support tools (option)

Analog output for chart, PC loader, web-based remote monitoring, a high speed data acquisition system and other support tools are enhanced.

## FRENIC4800VM5 Vector control inverter



## Main circuit arrangement



### Specifications

(\*): Option

Type	FRENIC4800VM5		
Main circuit system	Voltage-type IGBT sine wave PWM inverter		
Output voltage	3-phase, 3.1kV AC		
Rated capacity	6.2MVA		
Overload capability	150% for 1min		
Control power supply	3-phase, 200/220V - 15 to +10%		
Control function	Start/stop	Touch panel, Loader (*)	
	Key operation	T-link (*), SX bus (*), PROFIBUS-DP (*)	
	Transmission link operation		
	Contact input	Built-in 12 points + 4 points (*) (2 points selectable X1, X2)	
	Speed setting	Various transmission links, External signals, Touch panel, Loader (*) key operation	
	Operation status signal	• Relay output (built-in 9 points + 8 points (*)) 3 points selectable (Y1, Y2, Y3) • Analog output (built-in 4 points + externally mounted 4 points (*) + built-in 2 points (*))	
	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	
	Loader (*)	Setting item, Startup conditions, Control data digital display, Fault cause display, Fault trace data display (*1)	
Analog output	Analog output of arbitrary control data		
Charge lamp	Comes on when residual voltage (200V DC or larger) is in the main circuit.		
Protection	Protection level	Classified into the following 5 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 600V 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"	
	Environment	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		Water-cooling type	
Cooling water (*2)		Industrial water, at 35°C or lower	
Altitude		Up to 1000m	
Vibration		4.9m/s <sup>2</sup> or lower (at 10 to 50Hz)	
Storage (ambient temp.)	- 5 to +40°C		
Applicable standard	JEC-2410 (JIS, JEM, etc.)		

Note: (\*1) High-speed trace: Stores and displays control data of 225 points for the past two 1ms sampling.  
Low-speed trace: Stores and displays control data of 225 points for the past two 200ms sampling.  
(\*2) To be supplied by the customer

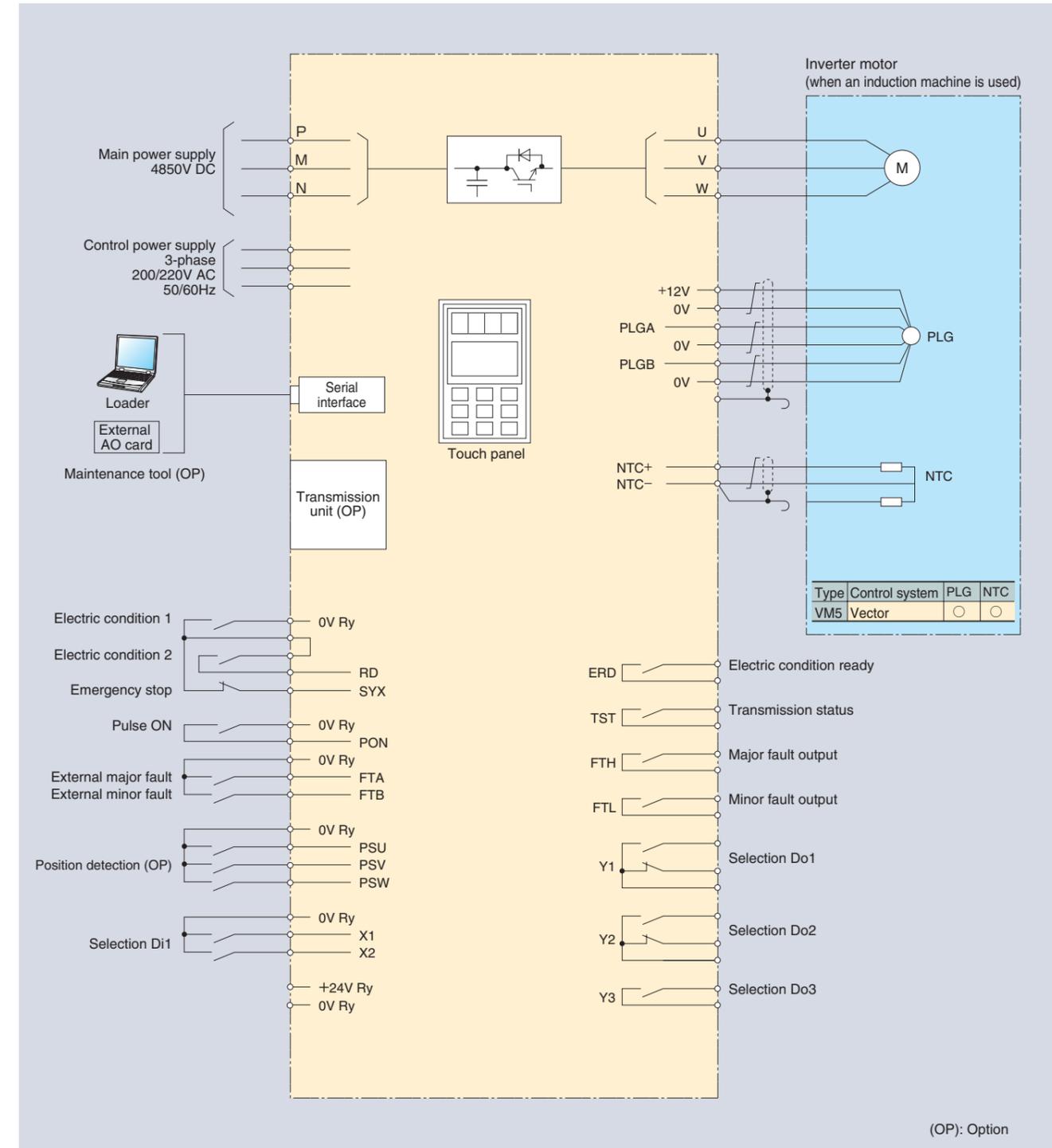
Type	FRENIC4800VM5	
Motor control system	Vector control	
Drive motor	Induction machine, Synchronous machine	
Speed control	ASR fixed cycle 1ms	
Vector control	Maximum speed	60Hz on inverter output frequency basis
	Control range	1:1000
	Speed control accuracy	±0.01% of the maximum speed
	PG frequency	100kHz or lower
Control function	Torque accuracy	±5% of the rated torque
	Setting resolution	±0.005% of the max. speed (20000d/100%)
	Acceleration/deceleration time	0 to 550.00s Linear (break point) acceleration/deceleration Acceleration/deceleration settable by transmission 2 types of deceleration for emergency stop
	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 (2 types of transmission) Mechanical loss torque is compensated by polygonal approximation with set value (forward/reverse: 14 points)
	Torque bias	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	

#### Cooling water

Kind	Industrial water
Inlet temperature	5 to 35°C
Flow volume	280L/min
Temperature rise	4K

#### Transmission card

Card name	Use
DSM card	Connects the inverter with the host PLC via T-link (D-line also allowed)
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

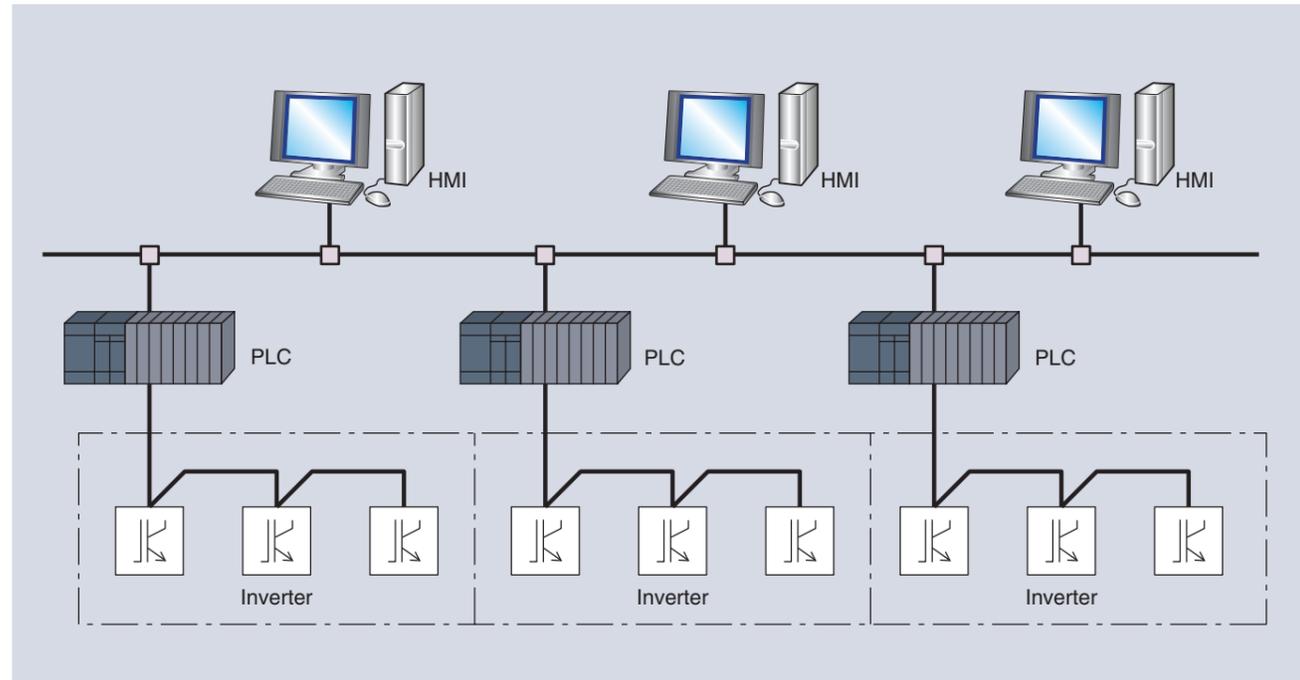


(OP): Option

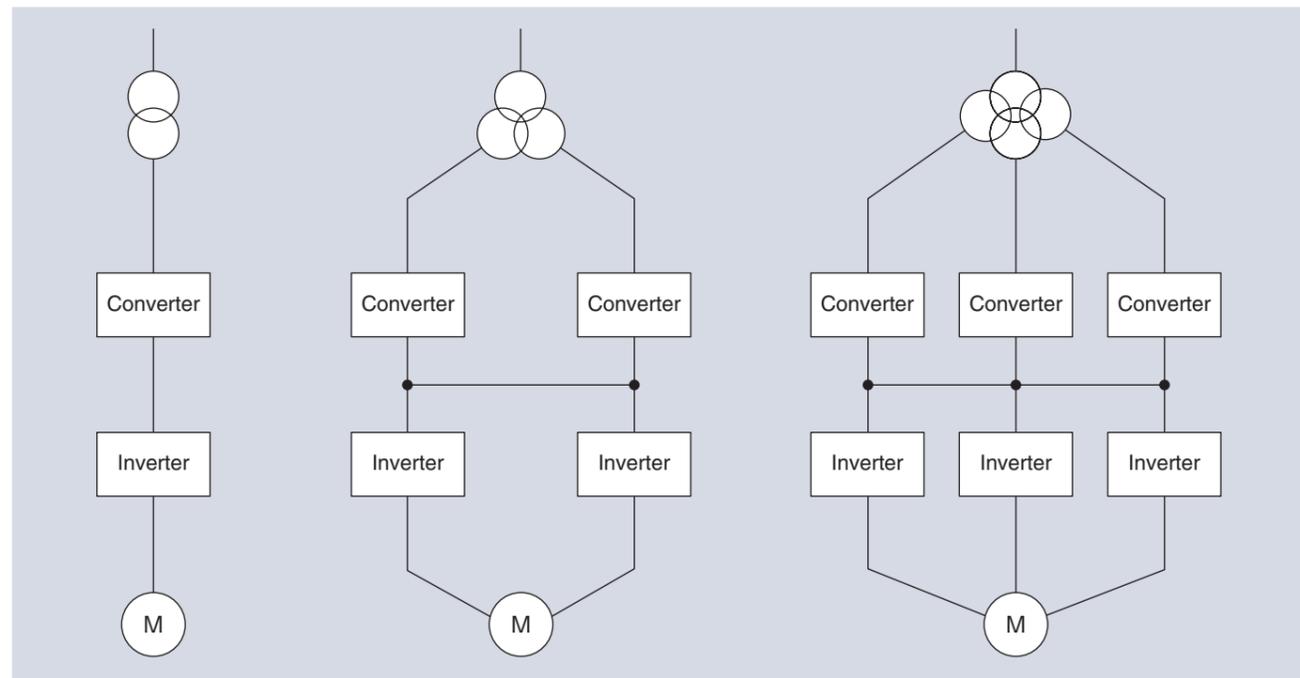
# Example of system configuration and single-line diagram

VM5

## System configuration



## Single-line diagram



# Data setting and monitoring (dedicated touch panel)

VM5

The touch panel equipped with a LCD displays a lot of information, and facilitates the functions of data setting, running operation and monitoring. On the bottom of the LCD, key operational guidance appears, allowing you to perform almost all operations without referring to the instruction manual.

### Up and down keys

Used for changing the Data Indication Nos. and the data setting values.

### Program key

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

### Shift key (digit shift)

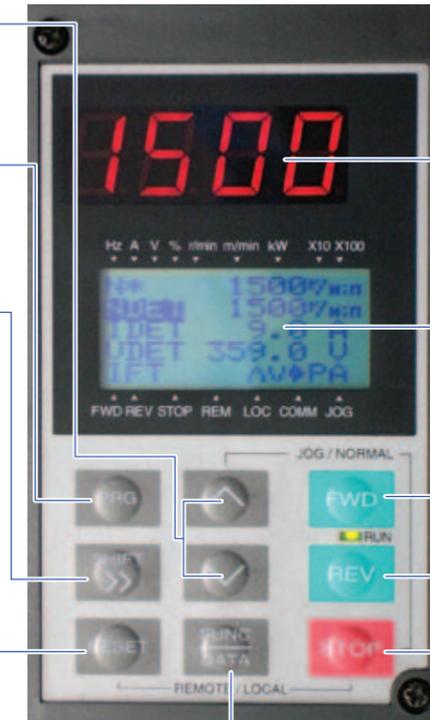
Used to move the cursor from one digit to another in order to change data.

### Reset key

When normal:  
Assigned to "return" and "cancel" functions.  
Returns to the previous layer.  
At tripping:  
Releases the stop status due to tripping.

### Function/data selection key

Assigned to "enter" and "OK" functions.



### LED monitor (4 digits)

Displays the number of revolutions (changeable). Any of 8 different data indicated on the LCD on the monitor screen can be selected arbitrarily. At tripping: "Err" blinks automatically, alerting you to the trip.

### LCD monitor

Displays various information, including operational, set and fault data over a maximum of 5 lines × 13 characters. Operational guidance appears on the bottom. On tripping, the trip data automatically appears.

### Normal, reverse and stop keys

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

### Example of actual screen display

The monitor screen (default screen after turning on power) continually displays all of the current running statuses: speed command, detection, output current, output voltage and key operational guidance.

## Use of touch panel

Menu	Description	No. of items
Initial	Monitor screen: Current, voltage and frequency display	Selected out of 2 pictures
M01	Parameter setting reference and change	About 350
M02	Di/Do bit on/off status reference	7 pictures
M03	Ai/Ao voltage reference	2 pictures
M04	Inverter internal data display	About 90
M05	Transmission, sent/received data reference	About 60
M06	Inverter start, stop operation	1 picture
M07	Inverter startup condition on/off reference	2 pictures
M08	Latest fault code (simultaneous occurrence) reference	Up to 20
M09	Error history reference	Latest 40
M10	Inverter inside data reference on trip	About 20
M11	Present time setting, operating time reference, parameter setting control, liquid crystal concentration adjustment, etc.	About 10 pictures

## Introduction of some functions

### ●M09: Error history

Displays a chronological record of the past 40 faults with the causes and the time and date of occurrence, thereby allowing you to trace back errors.

### ●M10: Trip data display

Displays internal data sampling values and bit data on/off, allowing you to know the fault circumstances.

### ●M11: Save of parameter settings, load, and comparison

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

# Basic inverter capacity and bank units, dimensions

VM5

## Basic inverter capacity and bank units

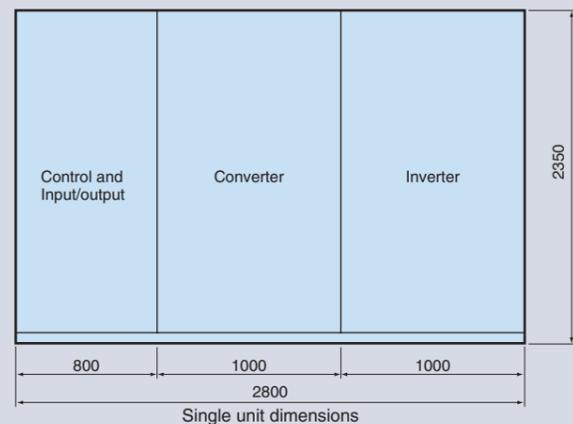
Composition (unit quantity)	1	2 multiplex	3 multiplex	4 multiplex	
Converter capacity [MW]	5.2	10.4	15.6	20.8	
Inverter	Capacity [MVA] (*1)	6.2	12.4	18.6	24.8
	Current [A]	1151	1151×2	1151×3	1151×4
Overload capability	150% for 1min				
Approx. mass [kg] (*2)	4000	8000	12000	16000	

(\*1): Output voltage: 3.1kV AC

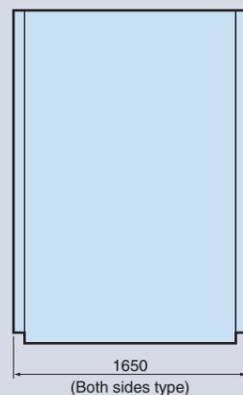
(\*2): Mass of the converter and inverter combined (excluding water cooler)

## Dimensions

### Inverter panel



[Unit: mm]

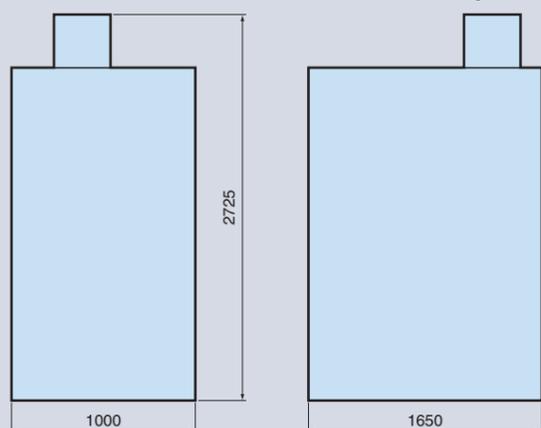


Maintenance space  
Front: 1500 or more  
Rear: 600 or more  
Ceiling height of the electric room: 2550 or higher

Dimensions of 2-multiplex structure: 2800×2=5600  
Dimensions of 3-multiplex structure: 2800×3=8400  
Dimensions of 4-multiplex structure: 2800×4=11200

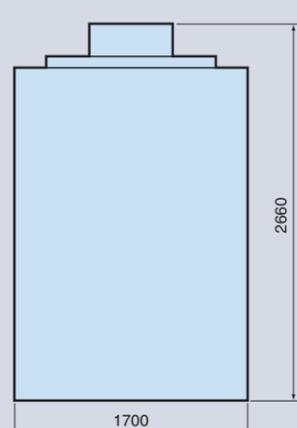
Structure: Self-standing enclosed-type panel  
Finish color: JEM standard Munsell 5Y7/1 (semi-gloss)

### Water-cooling unit



[Unit: mm]

### Synchronous motor exciter panel



[Unit: mm]

# Maintenance tool (option)

VM5

## PC loader (FLOAD for Windows)

Although maintenance and adjustment can be performed from the touch panel mounted on the panel face, an optional PC loader is available as a maintenance/adjustment tool. The PC loader installed in a notebook PC, has better operability and visibility than the touch panel. The trace-back data is useful for locating any fault trip.

### 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.

High-speed (1ms sampling) and low-speed (200ms sampling) trace data are acquired at the same time.

#### 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 2 faults with up to 20 causes each are indicated together with the time and date of occurrence.

#### 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

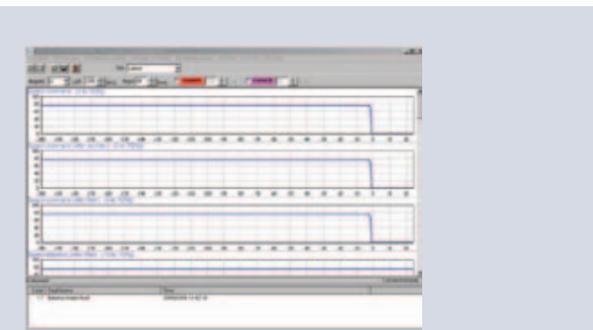
Several window indications can be displayed on a single screen, thereby allowing you to simultaneously monitor multiple information sources.

## External AO card (type: RGGW1AAU-0070D)

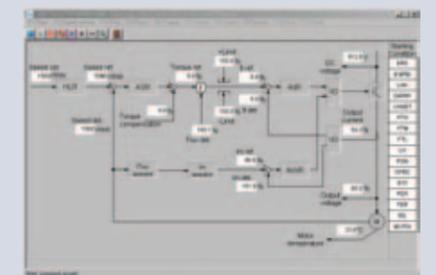
Inverter internal data (signal selection out of about 60 data) can be outputted by 4 channels in  $\pm 10V$  of analog voltage. They are isolated from the inverter.

## Special lifter

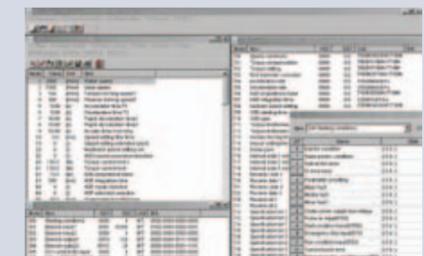
The inverter can be replaced by a small number of persons.



Trace-back data (inverter waveform at fault) window



Running status window



Multi-window display

# Maintenance tool (option)

VM5

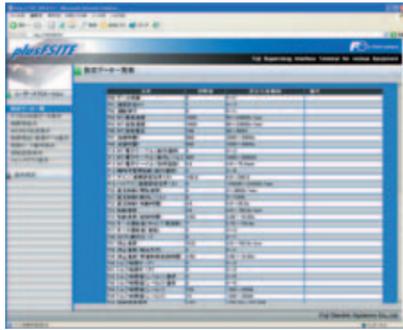
## plusFSITE (\*1) (Field Web adapter)

This adapter enables users to carry out remote monitoring of inverters promptly and easily with their own personal computers without using a dedicated system.

### Main features

- Web server function  
Inverters can be monitored from the browser of a personal computer. (Display screen can be changed if requested.)
- Mail sending function  
Actions can be reported periodically from inverters. Upon fault occurrence, mail, including trace-back data, is transmitted.
- Applicable to the FRENIC4800VM5 and other Fuji Electric products.

(\*1): plusFSITE: Fuji Supervising Interface Terminal for various Equipment



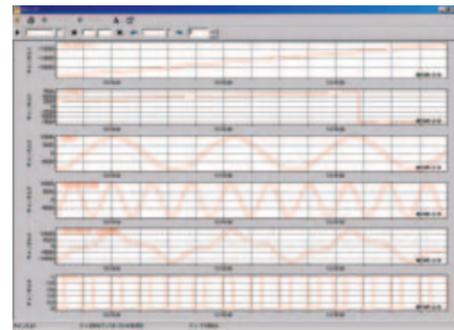
## f(s)NISDAS (\*2)

The inverter monitoring can be centralized at high speed.

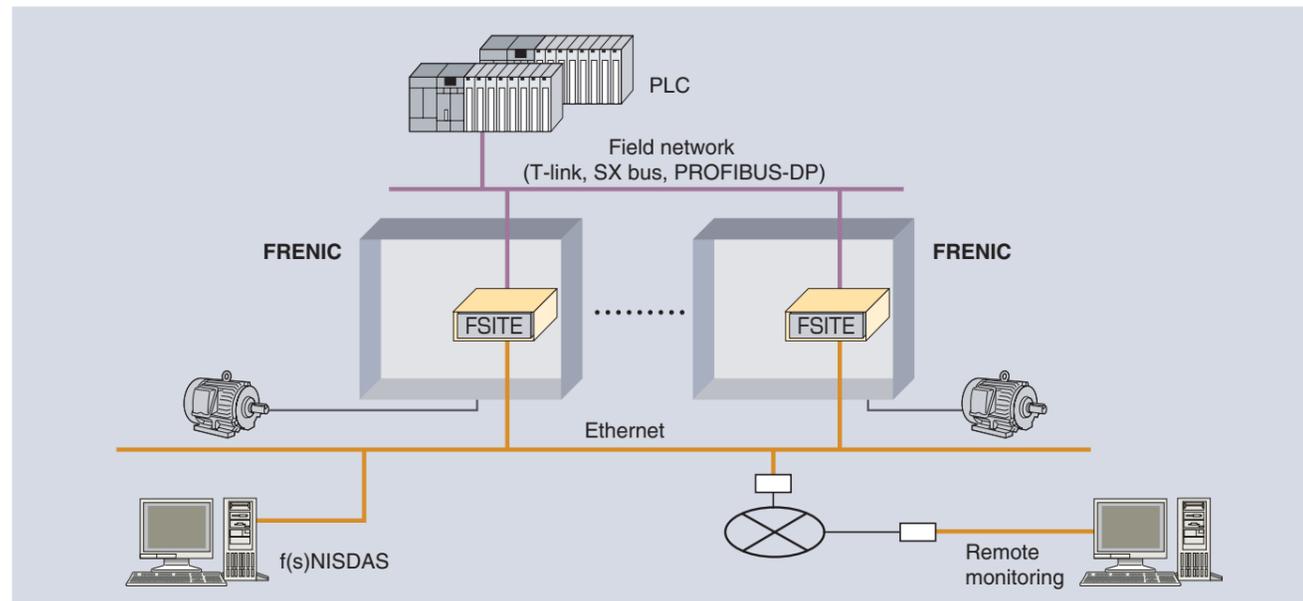
### Main features

- Real time monitoring  
Inverter data can be sampled every 10ms (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.

(\*2): f(s)NISDAS: Using open-Network & I.T., based on SX, Diagnosis and Analysis System



## Example of system configuration



# Adjustable speed drives of Fuji Electric group

VM5

Application	Series	Features	Output voltage [V]	Capacity range [kVA]			
				10	100	1000	10000
For plant	FRENIC 4000VM5	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	5400			
	FRENIC 4000FM5	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 4400VM5	Large-capacity vector controlled inverter • The capacity of FRENIC4000 series units has been increased due to 3-level control.	800	6000			
	FRENIC 4400FM5	Large-capacity V/f controlled inverter • The capacity of FRENIC4000 series units has been increased due to 3-level control.	800	2000			
	FRENIC 4700VM5	Medium-voltage large-capacity vector controlled inverter • The capacity of FRENIC4000 series units has been increased thanks to the series-connected device and 3-level control.	3440	7800			
	FRENIC 4800VM5	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	3100	24000			
	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	75kW 150kW			
For general industry (medium-voltage)	FRENIC 4600FM5	Medium-voltage direct-output inverter • 3.3/6.6kV IGBT inverter • Variable speed operation of medium-voltage motors saves energy. • Circuit configuration and control are well designed for power supplies and motors.	3300 6600	3750 7500			
	FRENIC 4600FM5e	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.	3300 6600 10000	5200 10500 5300			
For general industry (low-voltage)	FRENIC 5000VG7S	High-performance vector controlled inverter	200 400	90kW 800kW			
	FRENIC-MEGA	High-performance V/f controlled inverter	200 400	90kW 630kW			
	FRENIC-ECO	V/f controlled inverter for fans and pumps	200 400	110kW 560kW			

# Ordering information

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

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

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** Fuji Electric Co., Ltd.**

Gate City Ohsaki, East Tower, 11-2, Osaki 1-chome, Shinagawa-ku, Tokyo 141-0032, Japan  
Phone : (03)5435-7111

Internet address : <http://www.fujielectric.co.jp>

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