

Medium Voltage 3-Level IGBT Drive

FRENIC4800VM6

6.6~26.4 MVA (3.3 kV)



AC Adjustable Speed Drive

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

Large-capacity IGBT inverter

This drivable and regenerative IGBT inverter can be used for 4-quadrant operation such as rolling mills.

A single unit of inverter has capacity of 6.6 MVA (3.3 kV) and up to four units can be combined in a multiplex configuration for capacity of 26.4 MVA (3.3 kV).

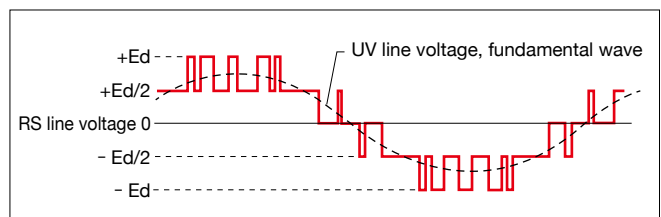
Adoption of a water-cooling system

The efficient water-cooling system for IGBT modules can take the inverter large capacity with downsizing. This can reduce air-conditioning capacity of electric power equipment room.

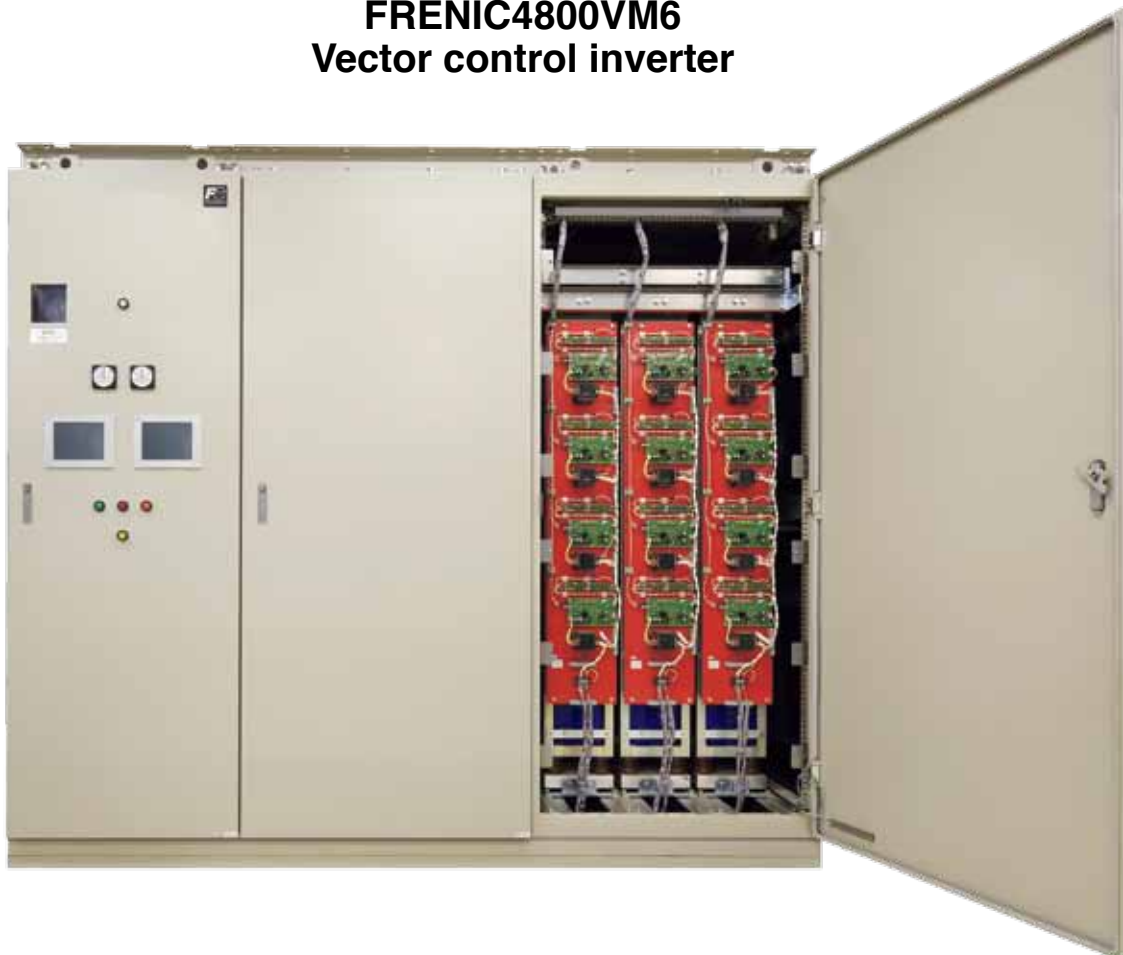
3-level PWM inverter

The 3-level PWM control reduces the output harmonics of the inverter and torque pulsation of the motor, thus minimizing adverse effect on the motors and rolling mills etc..

Output voltage waveform of 3-level inverter



FRENIC4800VM6 Vector control inverter



High-performance

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.

Power supply harmonic current reduction and power factor $\cong 1$

The 3-level PWM converter can provide minimize power line harmonics and equalizing power factor nearly to 1. This reduces power supply capacity.

Large LCD touch panel

Use of an 8.4-inch programmable display provides excellent visibility and operability. Various operations such as setting, running, monitoring and maintenance are available from the programmable display.

Wide choice of plant control functions

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

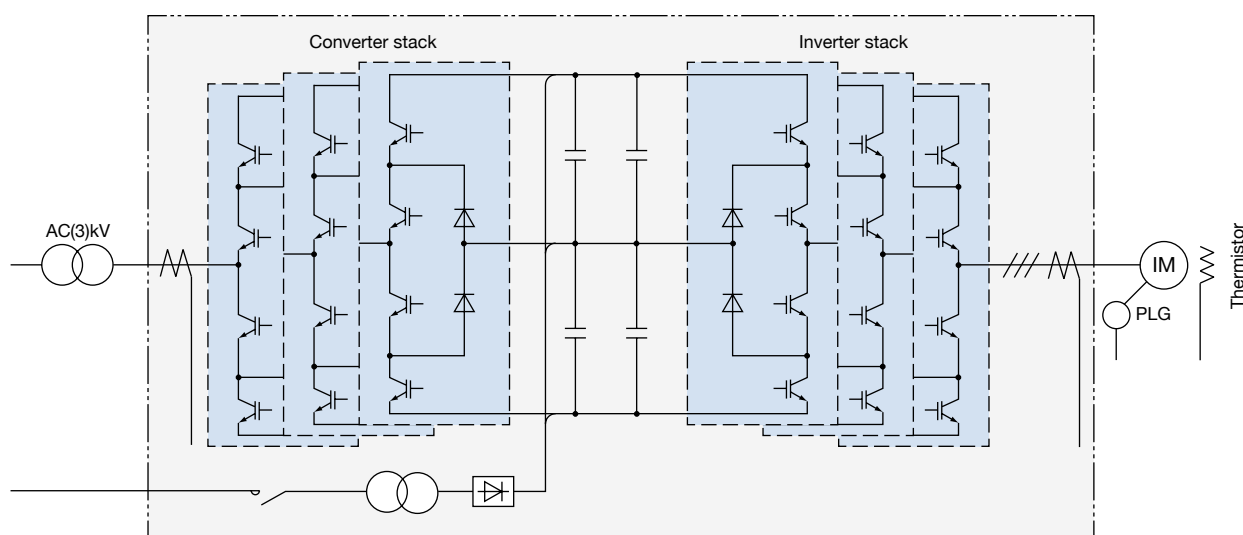
Connectable to different transmission lines (option)

Connectable with a PLC or other high level controller at high speed and less wiring link. 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)

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

Main circuit arrangement



Specifications

VM6

Specifications

(*): Option

Type	FRENIC4800VM6	
Main circuit system	Voltage-type IGBT sine wave PWM inverter	
Output voltage	3-phase, 3.3 kV AC	
Rated capacity	6.6 MVA	
Overload capability	150% for 1 min	
Control power supply	3-phase, 200/220 V - 15 to +10%	
Control function	Start/stop	Key operation Transmission link operation
	Key operation	LCD, Loader (*)
	Transmission link operation	T-link (*), SX bus (*), PROFIBUS-DP (*)
	Contact input	Built-in 20 points (14 points selectable: X1 to X14)
	Speed setting	Various transmission links, External signals, LCD, Loader (*) key operation
	Operation status signal	• Relay output built-in 9 points (6 points selectable (Y1 to Y6)) • Transistor output built-in 3 points (3 points selectable (Y7 to Y9)) • Analog output (built-in 4 points + externally mounted 4 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.
	LCD	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), Chart display
Protection	Analog output	
	Analog output of arbitrary control data	
	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 6000 V DC
	Undervoltage	On detecting undervoltage of DC intermediate voltage, inverter stops.
	Overheat	Protects the inverter by detecting the temperature of the cooling water (pure water)
	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	Water leakage detection	Leakage of cooling water (pure water) is detected by a leakage sensor(*)
	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 1000 m
	Vibration	4.9 m/s ² 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: Stores and displays control data of 225 points for the past two 1 ms sampling.

Low-speed trace: Stores and displays control data of 225 points for the past two 200 ms sampling.

(*2): To be supplied by the customer.

Type	FRENIC4800VM6	
Motor control system	Vector control	
Function	Drive motor	Induction machine, Synchronous machine
	Speed control	ASR fixed cycle 5 ms
	Vector control	Maximum speed
		100 Hz on inverter output frequency basis
		Control range
		1: 1000
	Speed control accuracy	±0.01% of the maximum speed
		PG frequency
	Torque accuracy	100 kHz or lower
		±5% of the rated torque
Control function	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
	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 control	Torque drooping characteristics according to the speed. A fixed drooping type or speed command proportional type.
		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
Maintenance function	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
Maintenance function	Remaining service life monitoring	Replacement timing of limited-life components such as electrolytic capacitors and cooling fans is announced.

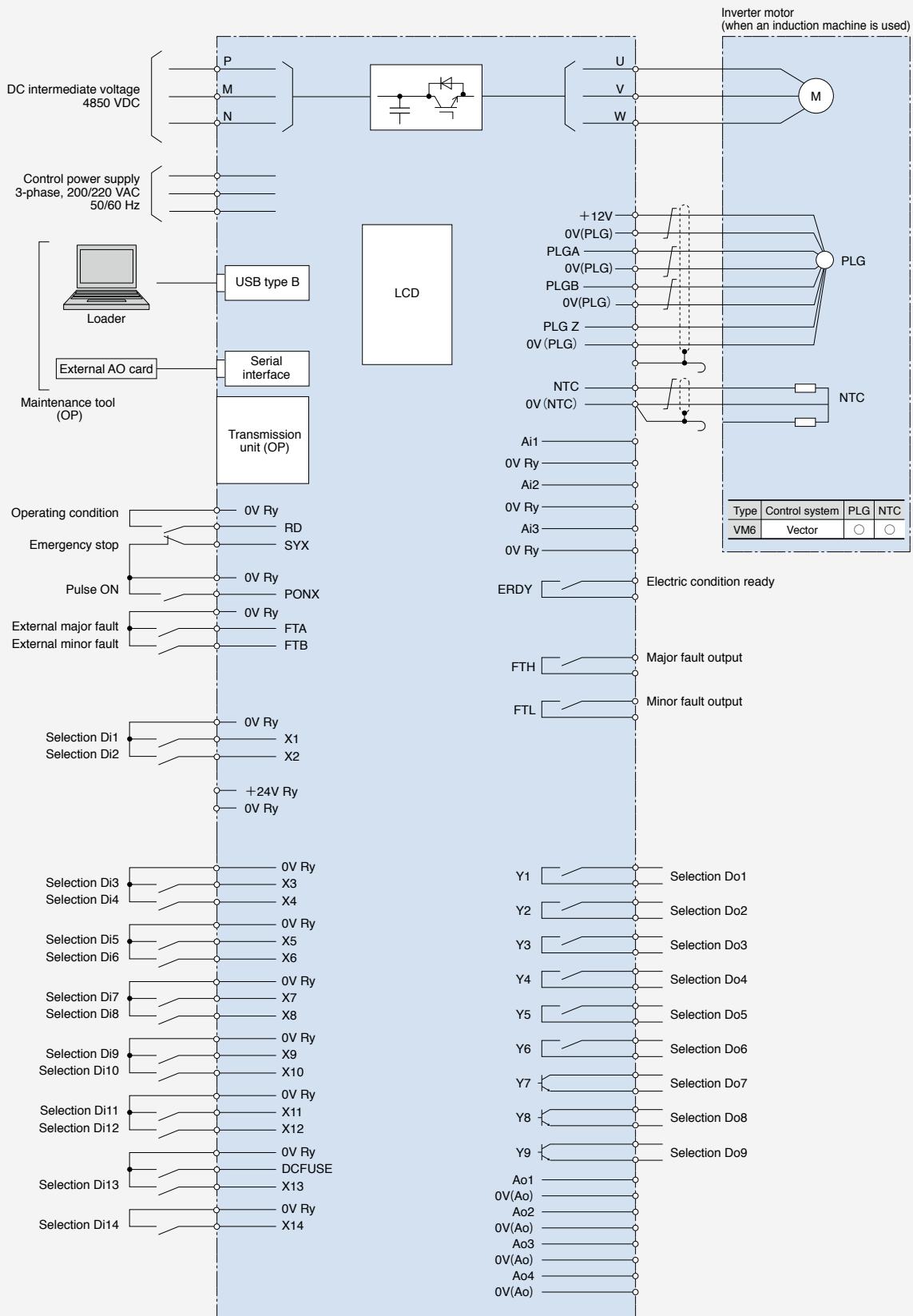
Cooling water

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

Transmission card

Card name	Use
T-link card	Connects the inverter with the host PLC via 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

Standard interface VM6

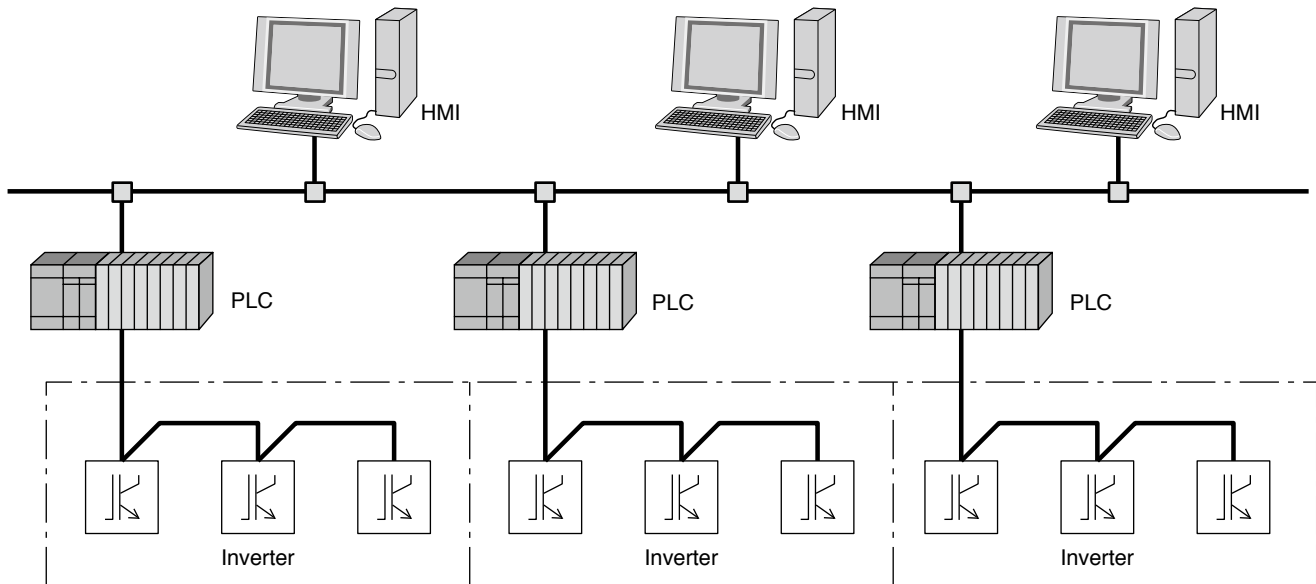


(OP): Option

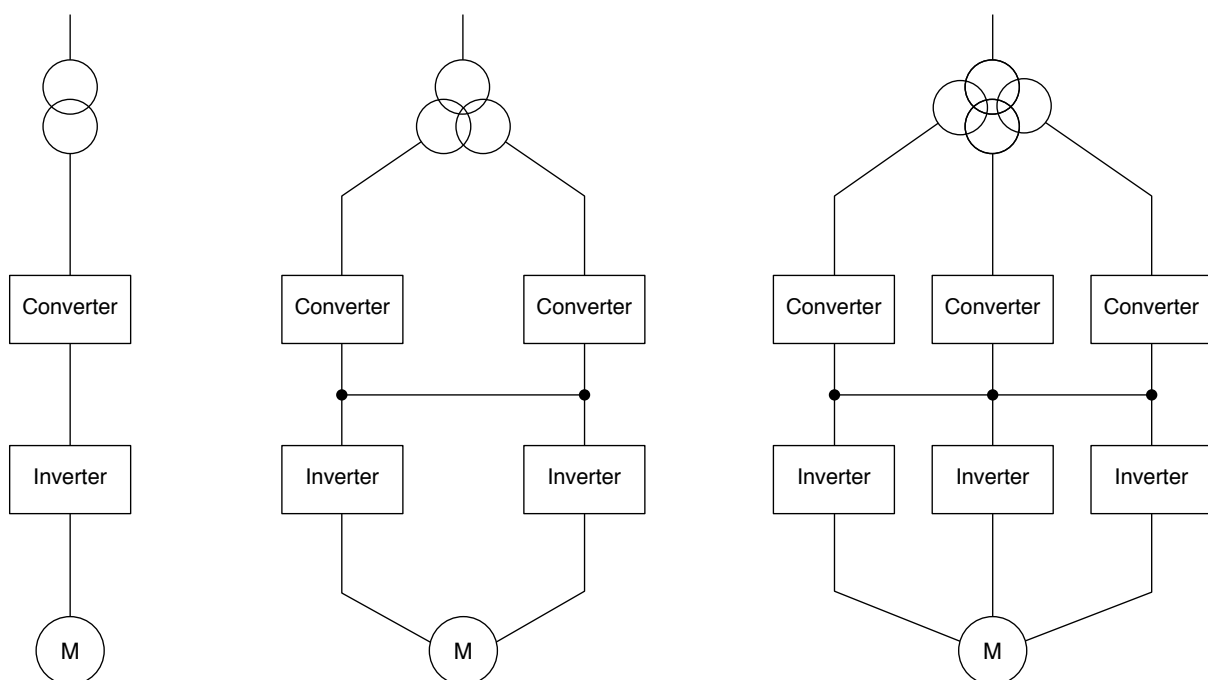
Example of system configuration and single-line diagram

VM6

System configuration



Single-line diagram



Data setting and monitoring (programmable display) VM6

8.4-inch programmable displays

The 8.4-inch programmable displays provide excellent visibility and operability, enabling easy data setting, running operation, monitoring and maintenance. There are two programmable display units: one for the converter and one for the inverter.



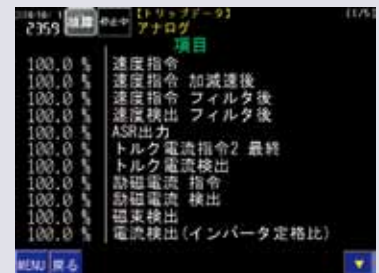
Setting screen

Used for confirming and changing the parameters.



Monitor screen

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



Trip data screen

Displays internal data at the time of a fault occurrence, enabling the situation at the time of the fault to be assessed.



Data input/output (Dio) screen

Displays the status of the external input and output terminal.



Auxiliary screen

Various support screens can be used.



Internal data screen

Displays internal data (instantaneous values).



Fault history screen

Displays the factors, occurrence date, and time of the past 100 faults, in order of occurrence, enabling the past fault history to be confirmed. Touching the number on the far left displays guidance on the fault description, cause, and action to be taken.



Displays various support screens.

Enable to check the status of each startup condition.

Basic inverter capacity and bank units, dimensions

VM6

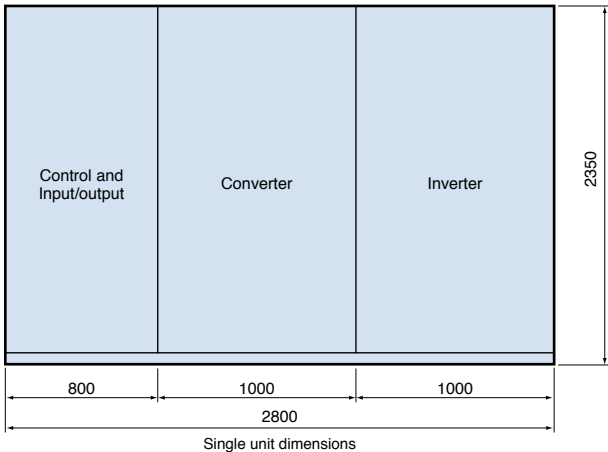
Basic inverter capacity and bank units

Composition (unit quantity)		1	2 multiplex	3 multiplex	4 multiplex
Converter capacity [MW]		6.0	12.0	18.0	24.0
Inverter	Capacity [MVA] *1	6.6	13.2	19.8	26.4
	Current [A]	1151	1151×2	1151×3	1151×4
Overload capability		150% for 1 min			
Approx. mass [kg] *2		4500	9000	13500	18000

(*1): Output voltage; 3.3 kV AC
 (*2): Mass of the converter and inverter combined (excluding water cooler)

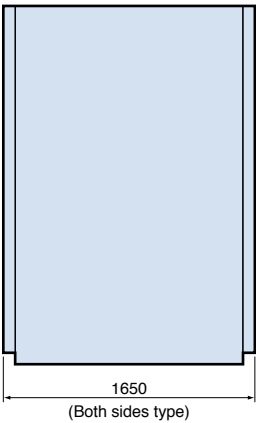
Dimensions [Unit: mm]

Inverter panel



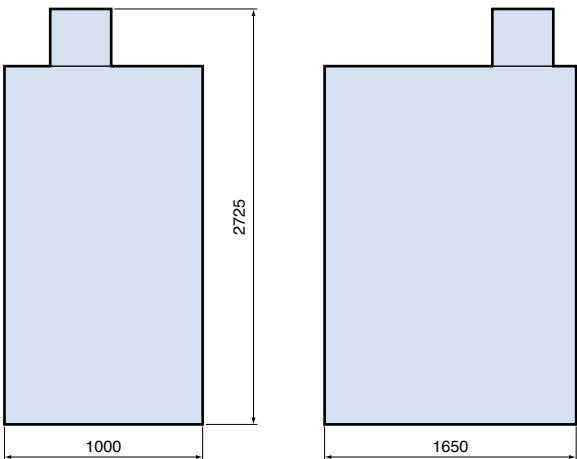
Dimensions of 2-multiplex structure: 2800×2=5600
 Dimensions of 3-multiplex structure: 2800×3=8400
 Dimensions of 4-multiplex structure: 2800×4=11200

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

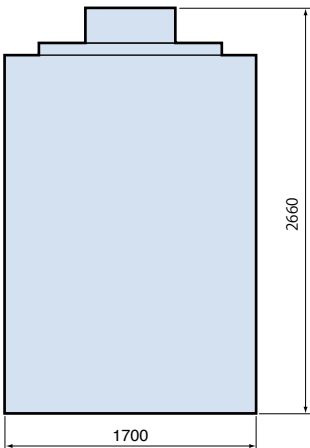


Maintenance space
 Front: 1600 or more
 Rear: 600 or more
 Ceiling height of the electric room: 2550 or higher

Water-cooling unit (Single unit)



Synchronous motor exciter panel (Reference example)



Maintenance tool (option)

VM6

PC loader (FLOAD V8 for Windows)

Maintenance and adjustment can be performed using the programmable display on the panel surface, but a PC loader is also available as an optional maintenance and adjustment tool.

- **Main functions of FLOAD V8 for Windows**

- Trace-back data

Upon fault occurrence, the waveform data of the speed, current and other major items and bit on/off statuses are registered together with the cause. You can proceed to analysis of error circumstances, quick action and recovery. Details of up to 4 of the latest error occurrences can be retained. High-speed (1 ms sampling) and low-speed (200 ms 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 managed on a PC. It is also possible to compare the parameters of the inverter and 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 4 faults are saved. Up to 30 causes per 1 fault are indicated together with the time and date of occurrence.

- **Fault history display**

Fault history display
Displays the fault occurrence history for the past 100 faults, including the date and time of the occurrence.

- **Fault guidance**

The cause of a fault and the recovery procedure can be confirmed from the fault factor read in from the controller.

- **Test run operation**

The loader can start and stop of the inverter easily on the "operation status display".

- **Multi-window display**

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

- **Printing**

Reports can be printed using Microsoft Excel. In addition, data saved in Excel files can be viewed even in environments where a PC loader is not installed.

- **Chart display**

The following two types of chart display are available, and both charts enable high-speed sampling at a maximum of 1 ms.

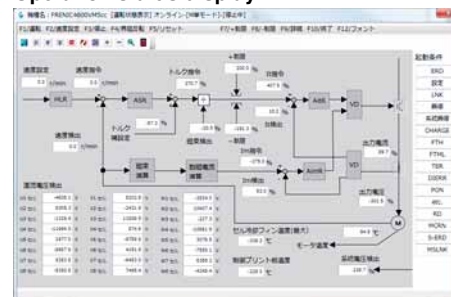
Real-time chart: Data is accumulated on the personal computer and the waveform is displayed in real time.

Historical chart: Data is accumulated on the controller. Monitoring data synchronized with the control software can be accumulated. Data can be accumulated regardless of the connection of a loader.

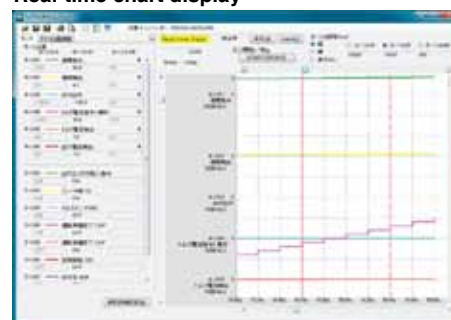
Control parameter display



Operation status display



Real-time chart display



External AO card (type: RGGW1AAU-0070E)

Inverter internal data (signal selection out of about 120 data) can be outputted by 4 channels in ± 10 V of analog voltage.

They are isolated from the inverter.

Special lifter

The inverter stack can be replaced by a small number of person by use of special lifter.

Maintenance tool (option) VM6

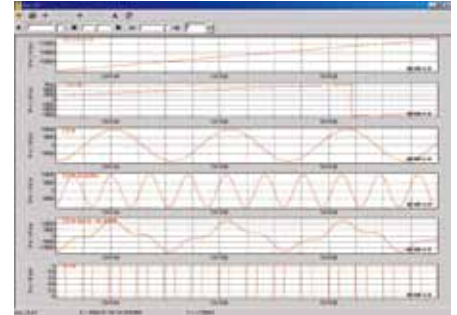
f(s)NISDAS (*)

The inverter monitoring can be centralized at high speed.

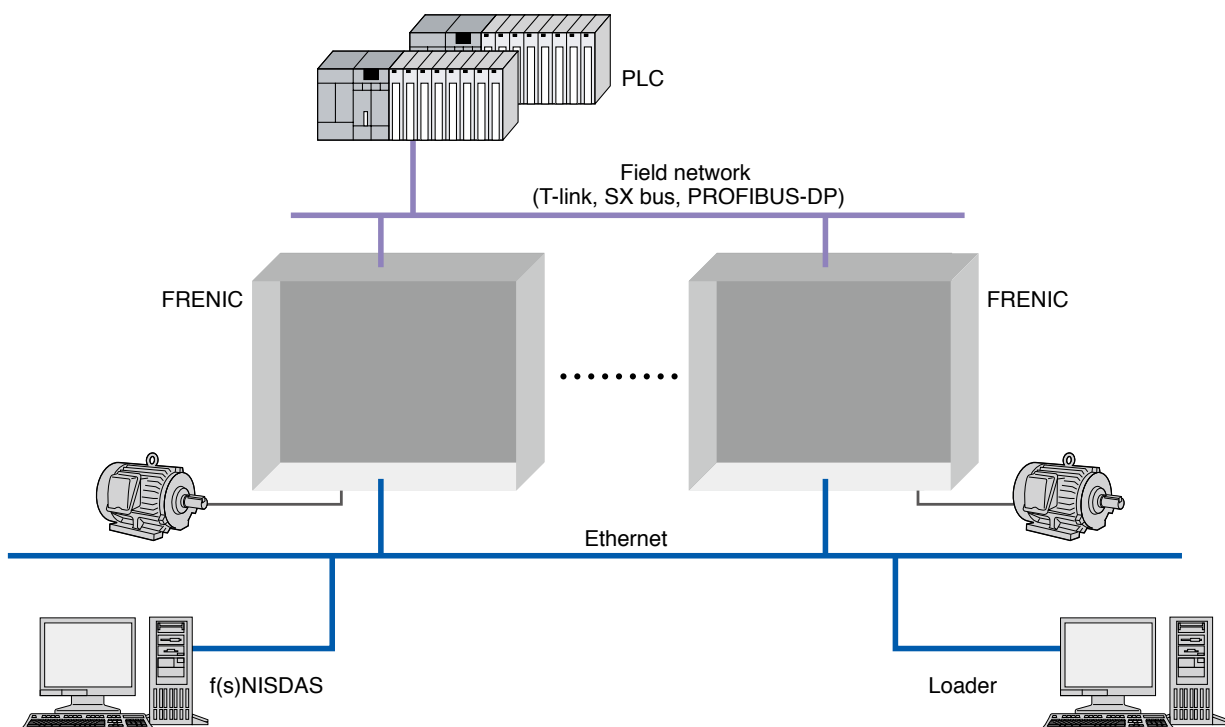
- **Main features**

- 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.

(*): f(s)NISDAS: Using open-**N**etwork & **I**.T., based on **S**X, **D**iagnosis and **A**nalysis **S**ystem



Example of system configuration



Adjustable speed drives of Fuji Electric group VM6

Adjustable speed drives of Fuji Electric group

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 4400VM6	Large-capacity vector controlled inverter • The capacity of FRENIC4000 series units has been increased due to 3-level control.	800			8000	
	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	3300				26000
	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	
	FRENIC-VG	High-performance vector controlled inverter	200 400		90 kW 800 kW		
For general industry (low-voltage)	FRENIC-MEGA	High-performance V/f controlled inverter	200 400		90 kW 630 kW		
	FRENIC-ECO	V/f controlled inverter for fans and pumps	200 400		110 kW 560 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 Altitude: m
Provision of air conditioning:			Limit on carrying-in:		

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