VG7

System Application Drive

A highly efficient and effective global inverter with the functions and capabilities for all your needs.

The Industry's Best Control Capability

- The multiple control methods are vector control, sensorless vector control, V/f control and vector control for synchronous motors.
- Vector control with dedicated motors have attained the industry's best control capabilities such as; speed control accuracy of +/- 0.005%, speed response of 100Hz, current response of 800 Hz and torque control accuracy (linearity) of +/- 3%.

A Wealth of Integrated Functions

- The tuning function has been enhanced to optimally control different motors.
- Load vibration suppressing observer and load adaptive control functions are built in motors.
- Position control functions, such as zero speed locking control, have been upgraded.
- Position synchronization control using pulse train input is available as an option.
- Orientation control is available as an option.

System Integration

- UPAC, the optional card incorporating user-programmable functions, enables user-original system configuration and construction. Dedicated package software products are also available.
- The RS485 Modbus communication function is provided as standard and T-Link Fiber Optic communications are available as an option.
- Inverter support loader for Windows is supplied to facilitate function code setting and storing.

Global Products

- A standard product that conforms to UL/cUL and CE marking, allowing unification of devices and machines made at home and abroad.
- The KEYPAD panel is set for 8 languages as standard to make exporting simple.
- Various field bus options are available.

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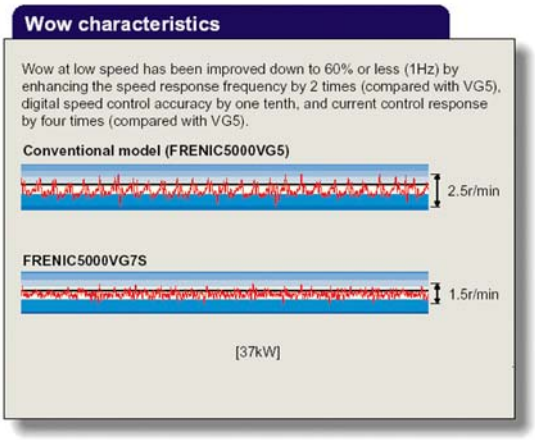
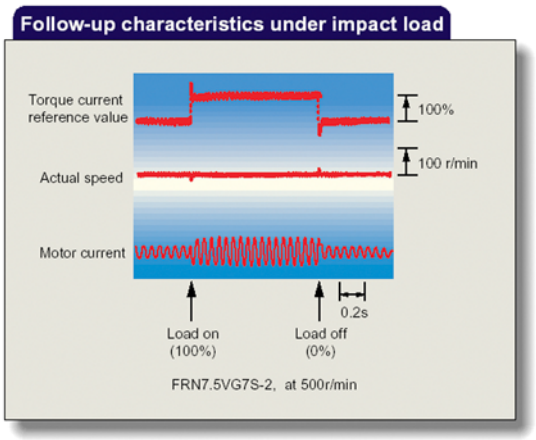
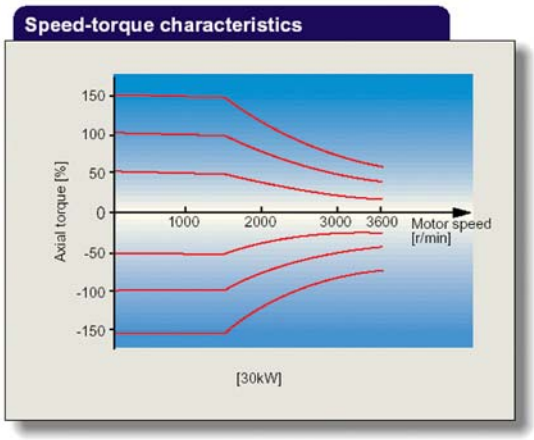
Drives for every industry

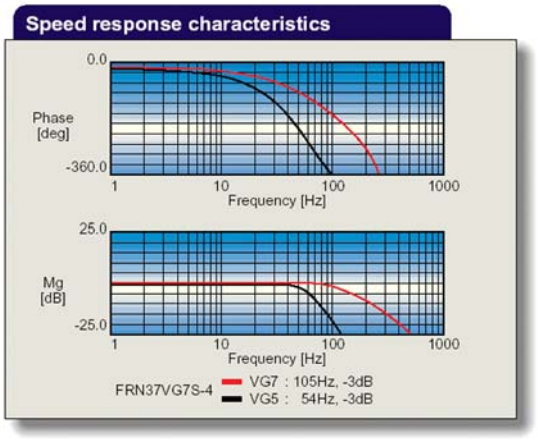
The Industry's Best Control Capability

- Speed control accuracy of ±0.005% (tested with a dedicated motor with PG under vector control: one half compared to our standard model).
- Speed response of 100Hz (tested with a dedicated motor with PG under vector control: two times compared to our standard model).
- Current response of 800Hz (tested with a dedicated motor with PG under vector control: four times compared to our standard model).
- Torque control accuracy (linearity) of ±3%.









A wide range of capacity/flexible applications

- A standard product that meets three specifications.
- Simple system construction based on a single specification with a capacity range from 0.75kW to 400kW.

Specification Type	Overload	Main Application	Carrier Frequency
CT	150%	Constant torque applications	High frequency
VT	110%	Variable torque applications	Low frequency
HT	200% / 170%	Vertical transfer applications	High frequency

The Industry's Best Control Capability

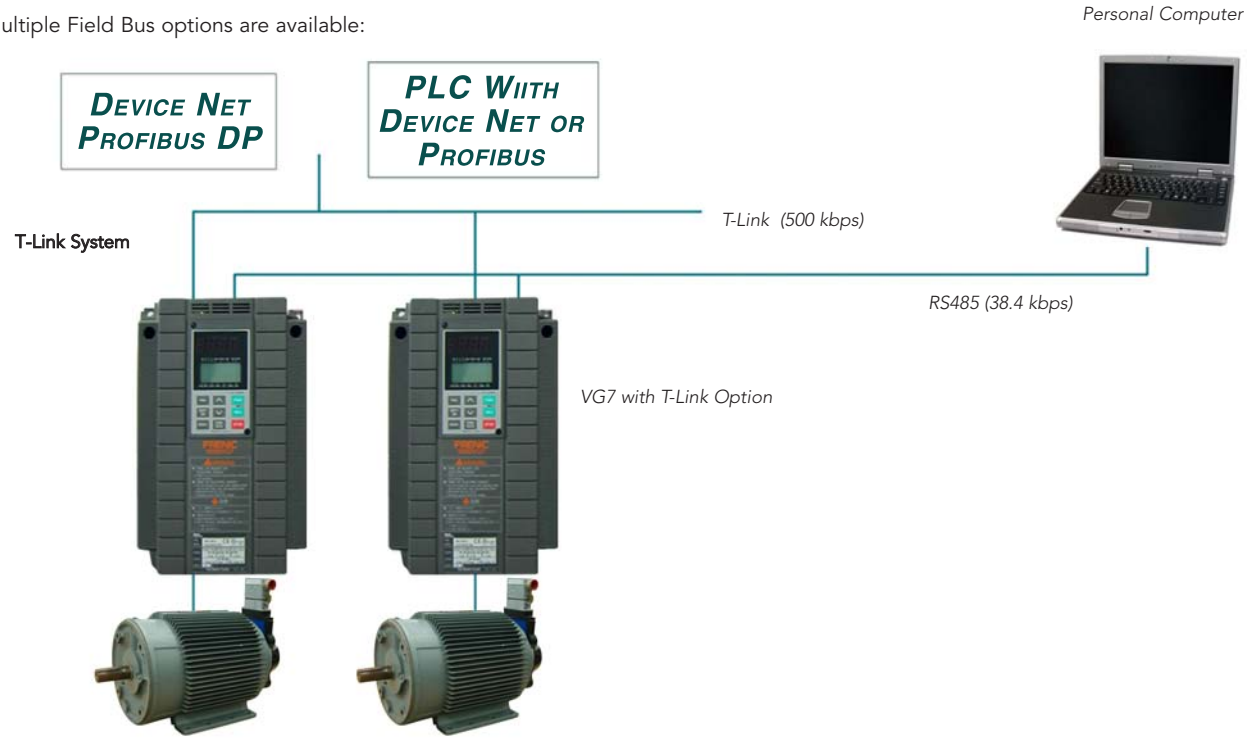
Built-in User-Programmable Functions (UPAC Card)

VG7

- User can personalize inverter control and terminal functions with the optional UPAC (User Programmable Application Card).
- Dedicated package software products for tension control, dancer control, winder control, and position control.

Exhanced Networking Capability

- RS485 Modbus communication is standard.
- Fiber Optic based T-Link (500kbps) is optional for drive to drive communications.
- Multiple Field Bus options are available:



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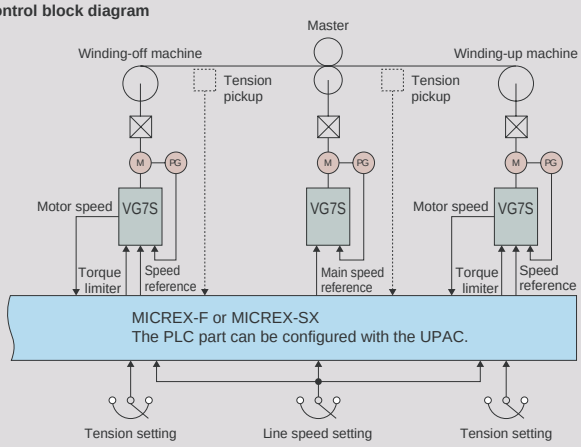
Winding-up and winding-off machines

The following diagram shows simplified tension control for winding-up / off machines (torque reference open loop).

Control block diagram



Torque reference is obtained from

Torque = Tension X Winding diameter

Using winding diameter calculation by PLC since tension reference cannot be input directly into the inverter.

1 Winding diameter calculation

Fuji's PLC calculates winding diameter by reading the line speed and motor speed of the winding-up machine. The winding diameter of winding-off machines is calculated from the line speed and motor speed of the winding-off machine.

2 Torque control

Torque is set, based on the following limitations because applying reference torque values corresponding to tension references directly into inverters may increase motor speed to the overspeed (OS) alarm level if there is breakage.

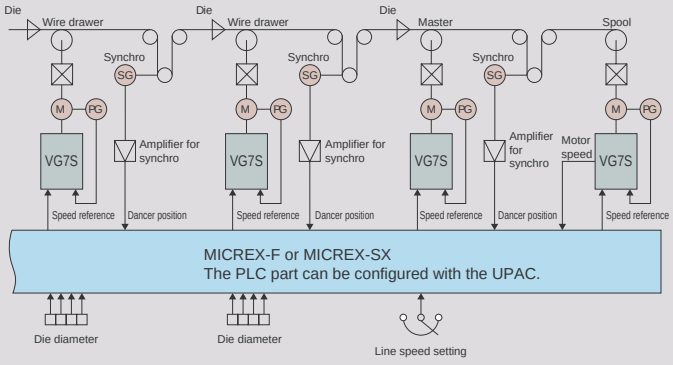
Speed reference ····· Speed reference higher than the speed of the motor is given to the winding-up device. Speed reference lower than the speed of the motor (or 0 [r/min]) is given to the winding-off device.

Torque limiter ····· Since inverters try to provide maximum torque with the speed references above, the PLC commands torque values corresponding to tension reference as torque limiter values.

Closed-loop control is also possible by employing tension pickups and inputting actual tensions into the PLC.

Wire drawing line

Control block diagram



1 Die diameter calculation

Different types of drawings are conducted on the same wire drawing line and die diameters vary according to wire. Employing Fuji's PLC and entering diameters as digital values after setting reduction ratios in the mechanical system and motor speed enables high-precision speed setting to skip readjusting when dies are changed.

2 Winding diameter calculation

The reference speed is provided such that the peripheral speed of a spool remains constant by reading in the line speed and the motor speed while the diameter of the spool continuously changes.

3 Dancer control

Dancer control prevents lines from breaking due to differences in tensions among drawing machines and keeps the tensions constant. Dancer roll positions are set such that tensions among drawing machines are balanced when dancer rolls are at sensor positions. The PLC detects the movement of dancer rolls from tension imbalances and corrects the speeds to return the dancer rolls to sensor positions. A PID controller for adjusting dancer roll positions is integrated into the PLC.

Application Examples

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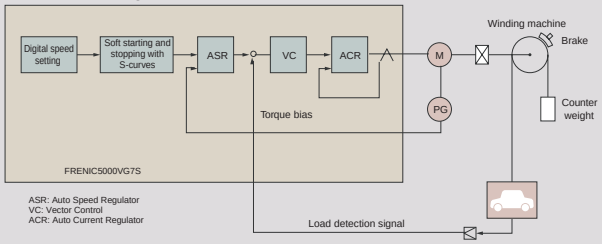
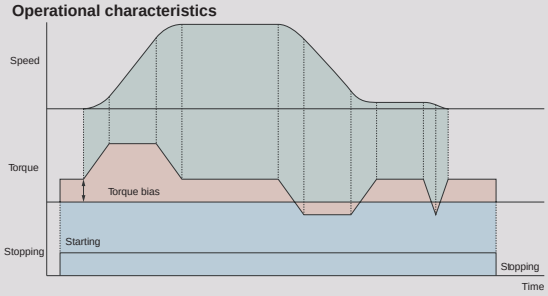
Multi-storied parking facility

FRENICS5000VG7 can build an optimal systems for a multi-storied parking facility.

Control block diagram



Operational characteristics



1 15-step digital speed setting

Digital settings reduce fluctuations on starting and stopping at zero-speed operations.

2 Multiple S-curves

Smooth acceleration and deceleration is achieved.

3 200% or more maximum torque

Attains 200% of maximum torque using HT.

4 Torque bias function

The torque detection signal drastically reduces rollbacks at starting.

5 Load adaptive control

Load adaptive control allows for stepless variable double-speed control at light load.

Crane

1 Combination of vector control and sensorless vector control

Vector control inverters with sensors are applied to hoisting and elevating devices which require large starting torque and quick response while general-purpose motors and sensorless inverters are applied to traversing and traveling devices.

2 PWM converter application

PWM converters drastically reduce harmonic current in power lines. Energy saving is achieved by supplying regenerative energy to power lines on winding-down or decelerating operations and utilizing the regenerative energy of individual inverter section (for example: applying regenerative energy from traverse to drive energy of elevating up/down) while providing a common DC power supply to inverters for traversing, elevating, and traveling devices.

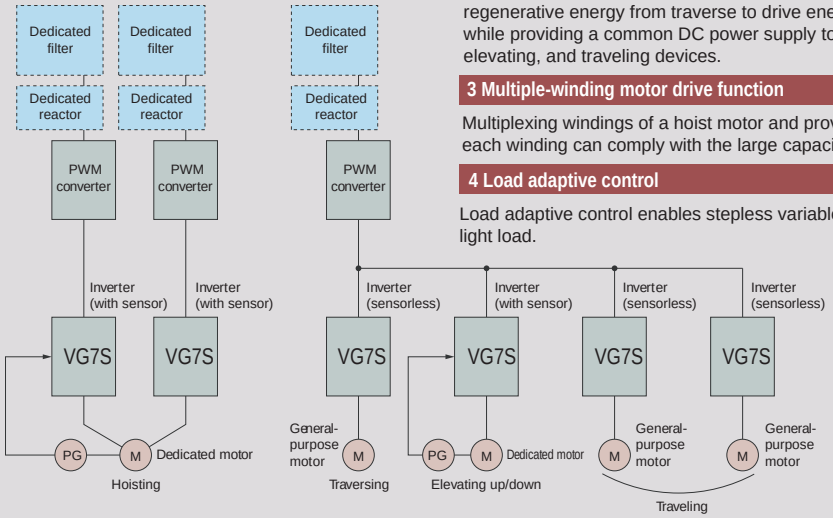
3 Multiple-winding motor drive function

Multiplexing windings of a hoist motor and providing an inverter with each winding can comply with the large capacity system.

4 Load adaptive control

Load adaptive control enables stepless variable double-speed control at light load.

Crane system configuration



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Standard Specifications

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CT use (for constant torque, overload capability: 150% - 1 min.)

Three-phase 230V series

Type FRN☐VG7S-2		0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Nominal applied motor [kW]		0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Rated capacity [kVA] (*1)		1.9	3.0	4.1	6.8	10	14	18	24	28	34	44	55	68	81	107	131
Rated current (Continuous)		5	8	11	18	27	37	49	63	74	90	116	145	180	215	283	346
(1min.)		7.5	12	16.5	27	40.5	55.5	73.5	94.5	111	135	174	217.5	270	333	441	519
Input ratings	Phase, Voltage, Frequency	3-phase 200 to 230V, 50Hz/60Hz								3-phase 200 to 220V/50Hz, 200 to 230V/60Hz (*2)							
	Voltage/frequency variation	Voltage:+10 to -15%, Frequency: +5 to -5%, Voltage unbalance: 2% or less (*3)															
	Momentary voltage dip capability (*4)	When voltage drops from the rated voltage, the inverter will continue operation if the voltage is more than 165V. If the voltage is less than 165V, the inverter can be operated for 15 ms.															
	Rated current [A] with DCR) (*7)	3.1	5.7	8.3	14.0	19.7	26.9	39.0	54.0	66.2	78.8	109	135	163	199	272	327
	without DCR)	6.4	11.1	16.1	25.5	40.8	52.6	76.9	98.5	117	136	168	204	243	291	—	—
	Required power supply capacity [kVA] (*5)	1.1	2.0	2.9	4.9	6.9	9.4	14	19	23	28	38	47	57	69	95	114
Braking method/braking torque		Braking resistor discharge control: 150% braking torque, separately installed braking resistor (option), separately installed braking unit (option for 75W or more)															
Carrier frequency [kHz] (*6)		0.75 to 15														0.75 to 10	
Mass [kg]		7	7	7	8	8	8	12.5	12.5	25	25	30	37	46	48	70	115
Enclosure		Up to 15kW: IP20, 18.5kW or over: IP00 (IP20: option)															

*1) Inverter output capacity [kVA] at 220V.
*2) Order individually for 200 to 230V/50Hz.
*3) Use a DC REACTOR if the voltage unbalance exceeds 2% (this is the same as for FUJI's conventional models).
Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V] x 67
*4) Tested at the standard load condition (85% load of nominal applied motor) prescribed by JEMA,
*5) When power-factor correcting DC REACTOR is used. (Optional for 55kW or less model)
*6) The inverter may automaticlaly reduce carrier frequency in accordance with ambient temperature or output current in order to protect itself.
*7) This value is obtained by using a FUJI original calculation method.
*8) Use the function code F80 to switch between CT, VT, and HT uses.
*9) Not EN standard conformed.

Three-phase 460V series

Type FRN☐VG7S-4		3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	280	315	355	400
Nomianl applied motor [kW]		3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	280	315	355	400
Rated capacity [kVA] (*1)		6.8	10	14	18	24	29	34	45	57	69	85	114	134	160	192	231	287	316	396	445	495	563
Rated current (Continuous)		9.0	13.5	18.5	24.5	32.0	39.0	45.0	60.0	75.0	91.0	112	150	176	210	253	304	377	415	520	585	650	740
(1min.)		13.5	20.0	27.5	36.5	48.0	58.5	67.5	90.0	113	137	168	225	264	315	360	456	566	623	780	878	975	1110
Input ratings	Phase, Voltage, Frequency (*1)	3-phase 380 to 480V,50Hz/60Hz					3-phase 380 to 440V/50Hz, 380 to 480V/60Hz (*8)																
	Voltage/frequency variation	Voltage:+10 to -15%, Frequency: +5% to -5%, Voltage unbalance: 2% or less (*2)																					
	Momentary voltage dip capability (*3)	When voltage drops from the rated voltage, the inverter will continue operation if the voltage is more than 165V. If the voltage is less than 310V, the inverter can be operated for 15 ms.																					
	Rated current [A] with DCR) (*6)	7.1	10	13.5	19.8	26.8	33.2	39.3	54	67	81	100	134	160	196	232	282	352	385	491	552	624	704
	without DCR)	14.9	21.5	27.9	39.1	50.3	59.9	69.3	86	104	124	150	—	—	—	—	—	—	—	—	—	—	—
	Required power supply capacity [kVA] (*4)	5.0	7.0	9.4	14	19	24	28	38	47	57	70	93	111	136	161	196	244	267	341	383	432	488
Braking method/braking torque		Braking resistor discharge control: 150% braking torque, separately installed braking resistor (option), separately installed braking unit (option for 132W or more)																					
Carrier frequency [kHz] (*5)		0.75 to 15											0.75 to 10										
Mass [kg]		8	8	8	12.5	12.5	25	25	30	35	40	41	50	72	72	100	100	140	140	250	250	300	360
Enclosure		Up to 15kW: IP20, 18.5kW or over: IP00 (IP20:option)																					

*1) Inverter output capacity [kVA] at 440V.
*2) Use a DC REACTOR if the voltage unbalance exceeds 2% (this is the same as for FUJI's conventional models).
Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V] x 67
*3) Tested at the standard load condition (85% load of nominal applied motor) prescribed by JEMA.
*4) When power-factor correcting DC REACTOR is used. (Optional for 55kW or less model)
*5) The inverter may automaticlaly reduce carrier frequency in accordance with ambient temperature or output current in order to protect itself.
*6) This value is obtained by using a FUJI original calculation method.
*7) Use the function code F80 to switch between CT, VT, and HT uses.
*8) When the input voltage is 380 to 398V/50Hz or 380 to 430V/60Hz, a connector inside the inverter must be switched.
*9) The inverter for 18.5kW motor does not conform to EN standards. If a standard-compliant model is required, select the inverter for 22kW.

Common Specifications

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Item			Explanation
Main circuit type			Voltage type IGBT sinusoidal PWM inverter
Motor control method			Vector control Sensorless vector control V/F control Vector control (synchronous motor) Simulated operation mode
Speed control	Maximum speed		200Hz in terms of inverter output frequency 2P:12000r/min 4P:6000r/min 6P:4000r/min where PG frequency is 100kHz or less 400Hz for V/F control
	Control range	Vector control	1:1000 (Min. speed, base speed: 15 to 1500 r/min in terms of 4P with PG of 1024P/R) 1:4 (Constant torque range, constant output range)
		Sensorless control V/f control	1:100 (Min. speed, base speed: 15 to 1500 r/min in terms of 4P) 1:4 (Constant torque range, constant output range)
	Control response	Vector control	100Hz (max.)
		Sensorless control	20Hz (max.)
	Control accuracy	Vector control	Analog setting:±0.1% of max. speed (25±10˚C) Digital setting:±0.005% of max. speed (-10 to +50˚C)
		Sensorless control	Analog setting:±0.5% of max. speed (25±10˚C) Digital setting:±0.5% of max. speed (-10 to +50˚C)
	Setting resolution		0.005% of max. speed
Control	Operation method		KEYPAD operation: FWD or REV key, STOP key Digital input signal operation: FWD or REV command, Coast-to-stop command, reset input, multistep speed selection command, etc.
	Speed setting		KEYPAD operation: ∧ or ∨ key External potentiometer: three terminals, 1 to 5k Analog input: 0 to ±10V UP/DOWN control: Speed increases when UP signal (DI) is ON, and decreases when DOWN signal (DI) is ON. Multistep speed: Up to 15 different speeds can be selected by combining four external input signals (DI). Digital signal: Setting with an option card's 16-bit parallel signal Serial link operation: RS485 (standard). Setting through different communication options is possible. Jogging operation: FWD or REV key, FWD or REV terminals in jogging mode.
	Running status signal		Transistor output: Inverter running, Speed equivalence, Speed detection, inverter overload early warning, torque limiting, etc. Analog output: Motor speed, Output voltage, Torque, Load factor, etc.
	Acceleration/Deceleration time		0.01 to 3600s (4 independent settings for acceleration and deceleration selectable with external signals) (S-curve acceleration/deceleration in addition to linear acceleration/deceleration)
	Gain for speed setting		Sets the proportional relationship between analog speed setting and motor speed in the range of 0 to 200%.
	Jump speed		Jump speed (3 points) and jump hysteresis width (1 point) can be set.
	Rotating motor pick up (Flying start)		A rotating motor can be smoothly picked up by the inverter without stopping. (Vector control and sensorless vector control).
	Auto-restart after momentary power failure		Automatic restart is available without stopping the motor after a momentary power failure.
	Slip compensation		Compensates for the decrease of speed due to load and realizes stable operation (V/f control).
	Droop control		The motor speed droops in proportion to output torque.
	Torque limiting		Limits the torque to predetermined values (selectable from "common to 4 quadrants", "independent driving and braking", etc.) Analog and external signal (2 steps) settings are available (vector control and sensorless vector control).
	PID control		PID control with analog input
	Fan stop operation		Stops the cooling fan at low temperatures to reduce noise.
	Torque bias		Can be set using a fixed value (1 step, with polarity change in accord with motor rotating direction), internal setting (3 steps) by combination of external signals (DI signals), and analog setting (with holding function).
	Speed limiting		Same limit to FWD/REV rotation, upper and lower limits, and individual limits to FWD/REV rotation. Speed limit usable even in torque control mode.
	Motor selection		Select from three types.
	Multiple winding motor drive		Optional
	UP/DOWN control		Speed can be set with external (DI signals); combination of UP command, DOWN command, and zero clear command.
	Stop function		Three types of stopping functions, STOP 1, 2 and 3
	PG pulse output		Divides PG signal for output.
	Observer		Suppresses load disturbances and vibrations.
	Position control		Optional
	Synchronized operation		Optional

Common Specifications

VG7

Function	Description	LED monitor	Related function code
DB resistor overheating	When the built-in braking resistor overheats, the inverter stops discharging and running. Function codes E35 to 37 corresponding to the resistor (built-in/external) must be set.	dbH	E35-37
DC fuse blown	When a fuse at the main DC circuit blows due to a short-circuit in the IGBT circuit, the inverter stops operation.	dCF	
Ground fault	Activated by a ground fault in the inverter output circuit. Connect a separate earth-leakage protective relay or an earth-leakage circuit breaker for accident prevention such as human damage and fire.	EF	
Excessive position deviation	Activated when the position deviation between the reference and the detected values exceeds the function code o18 "Excessive deviation value" in sunchronized operation. The option code "o" becomes valid and is displayed on the KEYPAD panel after installing options.	dO	o18
Memory error	Activated when a fault such as "write error" occurs in the memory.	Er 1	
KEYPAD panel communication error	Activated if a communication error is detected between the inverter control circuit and the KEYPAD panel when the start/stop command from the KEYPAD is valid (function ode F02=0). NOTE: KEYPAD panel communication error does not indicate the alarm display and issue the alarm relay output when the inverter is operated by external signal input or the link function. The inverter continues operating.	Er2	F02
CPU error	Activated when a CPU error occurs due to noise.	Er3	
Network error	Activated if a communication error occurs due to noise when the inverter is operated through T-Link, SX bus or field bus.	Er4	o30,31
RS485 communication error	Activated if: The function code H32 is set to 0 to 2, or a disconnection continues for more than the specified period of 0.1 to 60.0 with the function code H38.	Er5	H32,H33,H38
Operation procedure error	Activated if multiple network options (T-Link, SX bus, and field bus) are installed. Though you can install multiple SI, DI and PG options, this error is issued if the two SW settings are identical.	Er6	
Output wiring error	Activated when the measured data are out of the motor characteristic data range during executing tuning or the wires are not connected in the inverter output circuit.	Er7	H01,H71
A/D converter error	Activated ed when an error occurs in the A/D converter circuit.	Er8	
Speed disagreement	Activated when the deviation between the speed reference (speed setting) and the motor speed (detected speed, predicted speed) becomes excessive.	Er9	
UPAC error	Activated on a hardware fault in the UPAC option or a communication error between the inverter control circuit and the UPAC option.	ErA	
Inter-inverter communication error	Activated if a communication error occurs in inter-inverter communiction over the optical option or simplified RS485.	Erb	
IPM error	Actuated if IPM self-shutoff function is triggered by excessive current or overheat.	IPE	
Input phase loss	The inverter is protected from being damaged due to input phase loss.	Lin	
Undervoltage	Activated if the DC link circuit voltage decreases to the undervoltage level due to a reduction in the supply voltage. The alarm output is not issued when the DC link circuit voltage decreases and the "function code F14" is set to "3 to 5". • Undervoltage detection level: 230V series: 186V DC, 460V series 371V DC.	LU	F14
NTC thermistor disconnection	Activated if the thermistor dircuit is disconnected when the application of NTC thermistors to corresponding motors (M 1, 2, 3) is specified with the function codes P30, A31 and A47.	nrb	P30,A31,A47
Overcurrent	Activated if the momentary value of the inverter output current exceeds the overcurrent detection level due to a short-circuit or ground fault.	OC	
Overheating at heat sink	Activated if the temperature of the heat sink to cool the rectifier diodes and the IGBTs increases due to cooling fan stoppage.	OH1	
External alarm	The inverter stops on receiving the external alarm signal (THR). It is activated by a terminal signal when the control circuit terminals (THR assignment) are connected to alarm terminals of external devices such as a braking unit or a braking resistor.	OH2	E01-E14
Inverter internal overheat	Activated if the ambient temperature of the control PC board increases due to poor ventilation of the inverter.	OH3	
Motor overheat	Activated if the detected temperature of the built-in NTC thermistor for motor temperature detection exceeds the data of the "function code E30 Motor overheat protection".	OH4	E30,E31
Motor 1 overload	Activated when the motor 1 current (inverter output current) exceeds the operation level set by "function code F11".	OL1	F11
Motor 2 overload	Activated when the motor 2 current (inverter output current) exceeds the operation level set by "function code A33".	OL2	A33
Motor 3 overload	Activated when the motor 3 current (inverter output current) exceeds the operation level set by "function code A49".	OL3	A49
Inverter unit overload	Activated if the output current exceeds the overload characteristic of the inverse time characteristic.	OLU	
Overspeed	Activated if the motor speed (detected speed value/predicted speed value) exceeds 120% of the specified value by the function code "maximum speed".	OS	F03,A06,A40
Overvoltage	Activated if the DC link circuit voltage exceeds the overvoltage level due to an increase of supply voltage or regenerative braking current from the motor. However, the inverter cannot be protected from excessive voltage (high voltage, for example) supplied by mistake. • Overvoltage detection level: 230V series: 400V DC, 460V series: 800V DC	OU	
PG error	Activated when the pulse generator terminal PA/PB circuits are disconnected. It is not activated when the sensorless control or the V/f control is selected.	PG	
Charging circuit error	Activated if the bypass circuit of the DC link circuit is not formed (the magnetic contactor for the charging circuit bypass is not closed) two minutes after power is supplied.	PbF	

NOTES:

All protective functions are reset automatically of the control power voltage decreases to where maintaining the operation of the inverter control circuit is impossible.
Fault history data is stored for the last ten trips.
Stoppage due to a protective function can be reset by the RST key of the KEYPAD or turning OFF and then ON between the X terminal (RST assigning) and the CM. This action is invalid if the cause of an alarm is not found and resolved.
In addition to these protective functions, there can be further protective from surge voltage by connecting surge suppressors to the main circuit power terminals (L1/R, L2/S, L3/T) and the auxiliary control power terminals (R0, T0).

Common Specifications

VG7

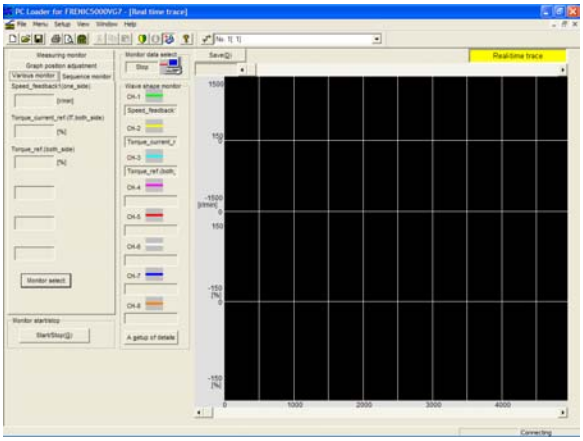
Item		Explanation
Indication	**Running/Stopping**	• Detected speed value • Speed reference value • Output frequency • Torque current reference value • Torque reference value • Torque calculation value • Motor output • Output current • Output voltage • DC link circuit voltage • Magnetic-flux reference value • Magnetic-flux calculation value • Load shaft speed • PID reference value • PID feedback value • PID output value • Ai adjusted value (12) • Ai adjusted value (Ai1) • Ai adjusted value (Ai2) • Ai adjusted value (Ai3) • Ai adjusted value (Ai4) • Optional monitor 1 • Optional monitor 2 • Optional monitor 3 • Optional monitor 4 • Optional monitor 5 • Optional monitor 6 • Presence of digital input/output signal • Motor temperature • Heat sink temperature • Load factor • Operation time, etc.
	Programming	Displays function codes, names, and data. Multi-language display: English, French, Spanish, German, Italian, Chinese, Korean and Japanese.
	Trip mode	Displays the following trip codes: dbH Overheat at the DB circuit · dCF DC fuse blown · EF Ground fault · P9 PG error Er1 Memory error · Er2 Keypad panel communication · dO Excessive position deviation · Er4 Network error Er5 RS485 error · Er6 Operation procedure error · Er3 CPU error · Er8 A/D converter error Er9 Speed disagreement · ErA UPAC error · Er7 Output wiring error · IPE IPM error Lin Input phase loss · LU Undervoltage · Erb Inter-inverter communication error · OC Overcurrent OH1 Overheat at heat sink · OH2 External alaerm input · nrb NTC thermistor disconnection · OH4 Motor overheat OL1 Motor 1 overload · OL2 Motor 2 overload · OH3 Inverter internal overheat · OLU Inverter unit overload OS Overspeed · OU Overvoltage · OL3 Motor 3 overload · PbF Charging circuit error
	Running/Trip mode	Stores and displays data for the last ten trips. Stores and displays the detailed cause of the last trip.
	Charge lamp	ON when there is residual voltage in the main circuit capacitors.
Protection	**Overload**	Protects the inverter by electronic thermal overload relay and the detection of inverter temperature.
	Overvoltage	Detects DC link circuit overvoltage and stops the inverter.
	Incoming surge	Protects the inverter from surge voltage between the main circuit power lines and the ground.
	Undervoltage	Detects DC link circuit undervoltage and stops the inverter.
	Overheat	Stops the inverter by detecting the inverter internal temperature.
	Short-circuit	Protects the inverter from overcurrent due to a short-circuit in the output circuit.
	Ground fault	Protects the inverter from overcurrent due to a ground fault in the output circuit.
	Motor protection	Protects the motor with NTC thermistor and PTC thermistor. Protects the motor with electronic thermal overload relay. Overload early warning: Overload early wanring can be issued at a predetermiend level before stopping the inverter. (The electronic thermal overload relay and the overload early warning can be set for motor 1 to 3 individually)
	DB resistor overheating	• Protects through internal functions of the inverter. • For the optional DB resitor, an external alarm signal issued from the built-in temperature sensor stops the inverter.
	Input phase loss	Protects the inverter from damage due to input phase loss.
	Output phase loss	Detects impedance imbalance in the output circuit and issues an alarm (under tuning operation).
	Retry	Sets the retry numbers and retry waiting time for stoppage due to an alarm (only for OV, OC, LU, OH1, OH3, OLU, OL, dbH).
Conditions	**Installation location**	Indoor use only. Free from corrosive and flammable gases, dusts, and direct sunlight.
	Ambient temperature	–10˚C to +50˚C
	Ambient humidity	5 to 95%RH (no condensing)
	Altitude	3000m or less, with some power derating from 1,001 to 3,000m.
	Vibration	Amplitude: 3mm at 2 to 9Hz, 9.8m/s² at 9 to 20Hz. 2m/s² at 20 to 55Hz (2m/s² at 9 to 55Hz for 90kW or over), 1m/s² at 55 to 200Hz
	Storage temperature	–25˚C to +55˚C
	Storage humidity	5 to 95%RH
Maintenance	**Main circuit capacitor life**	Life judgment function installed
	Common functions	• Displays and records accumulated time for capacitor life and cooling fan operation time in the control power. • Displays and records inverter operation time. • Displays and records the maximum output current and the maximum internal temperature for the past one year.
RS485		Provided as standard.

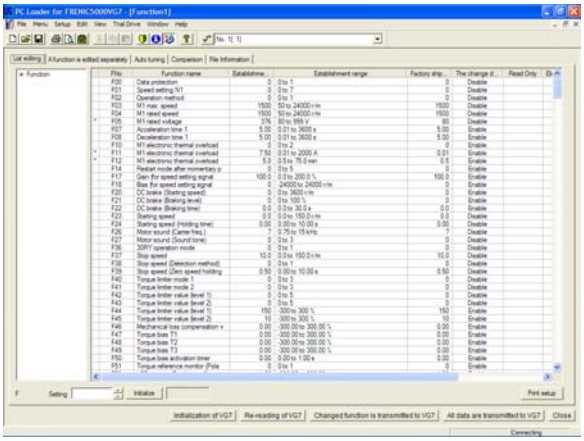
SAFTRONICS

Windows Based Software Tool

VG7

An inverter support loader for Windows is available as an option to facilitate function code setting.





Enhanced Built-in Functions

- Improved tuning function
  Motor parameters can be tuned while the motor is stopped.
- Built-in observer function for load vibration suppresstion
- Equipped with load adaptive control function
  Stepless variable double-speed control is possible at low speed.
- Increased position control
  Zero-speed locking control is possible.
- Position synchronizing control with pulse train input is possible as an option.
- Orientation control is possible as an option.
- Vector control is applicable to two types of motors. Also, V/f control is applicable to the third motor.
- Built-in braking unit
  Built-in braking unit for 55kW or smaller models (230V series) and for 110kW or smaller models\(460V series) allows for downsizing machines and devices.

	Input	Output
Analog	3 points	3 points
Digital	11 points	6 points

- 23 I/O terminal points
- Built-in PG feedback card
  Both 12V and 15V voltage inputs are accepted; can handle line drivers as an option.

Upgraded Maintenance/Protective Functions

- I/O terminal checking function
- Main circuit capacitor life judgment
- Inverter load factor measure
- Records and displays accumulated operation time
- Displays operating conditions such as output voltage, heat sink temperature and calculated torque value
- Detailed data is recorded on the inverter trip
- Setting the thermal time constant of the electronic thermal overload relay makes differnt motors applicable.
- Standard protective function against input phase loss. Protects the inverter from damage caused by power line disconnection
- Motor protection with PTC thermistor
- Equipped with terminals for connecting DC reactor that can suppress harmonics.

Interactive Keypad Panel for Simple Operation

- Standard copy function
  Easily copies function code data to other inverters.
- Remote operation capability
  The KEYPAD panel is detachable for remote operation using an optional cable.
- Standard language operation (English, German, French, Italian, Spanish, Chinese, Korean and Japanese)
- Jogging operation from the KEYPAD panel or with input from an external signal
- Switching between KEYPAD operations (LOCAL) and external signal input operations (REMOTE) using the KEYPAD panel

Software Application Examples VG7

Application for Rotary Positioning

1 Positioning (orientation) control of a rotary axis

Installation of orentation package software in the UPAC card provides sophisticated function and high performance positioning (orientation) for applications requiring positioning in rotary axes of machine tools, testing machines and processing machines.
UPAC card is equipped with a user program, so that the user can build or modify an original system.

2 Selection of applicable pulse according to requirements of stopping accuracy

The pulse count of the position detection pulse encoder can be selected from seven types according to the requirements of the stopping accuracy of the mechanical axis: 128, 256, 512, 1024, 2048, 4096, 8192.

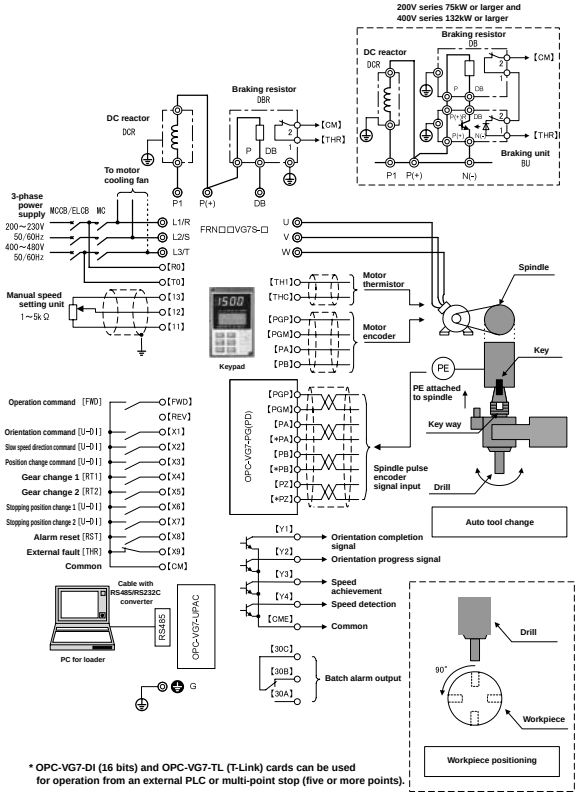
3 Wide variety of capacity ranges and applications

Because the same specificataion covers 0.75kW to 400kW, system construction is easy even for a large capacity machine. Also useful for a replacement of a DC-driven machine tool.

4 Simple adjustment

Because inverter parameters are used to gain adjustment, slow speed, stopping position and so on, data check, entry and change can be made easily at the keypad or PC loader.
various pieces of data such as the stopping position reference value, Z-phase-based spindle position and psotion deviation can be checked at the option monitor (LED) of the keypad.

Wiring Diagram and System Configuration



Function Setting Value (Recommended)

Function code	Name		Factory setting	Recommended setting value	Remarks
E01	X terminal function selection	X1	0: Multistep speed selection [SS1]	25: Universal DI [U-DI]	Orientation command
E02		X2	1: Multistep speed selection [SS2]	25: Universal DI [U-DI]	Slow speed direction command
E03		X3	2: Multistep speed selection [SS4]	25: Universal DI [U-DI]	Position change command
E04		X4	3: Multistep speed selection [SS8]	4: ASR and ACC/DEC time selection [RT1]	Gear change 1
E05		X5	4: ASR and ACC/DEC time selection [RT1]	5: ASR and ACC/DEC time selection [RT1]	Gear change 2
E06		X6	5: ASR and ACC/DEC time selection [RT2]	25: Universal DI [U-DI]	Stopping position change 1
E07		X7	7: Coast-to-stop command [BX]	25: Universal DI [U-DI]	Stopping position change 2
E14	X terminal function normally open / close		0000 0: Normally open 1: Normally closed	0100: X9 terminal normally closed	Enter according to the specifications of external alarm signal actions.
E15	Y terminal function selection	Y1	1: Speed existence signal [N-EX]	25: Universal DI [U-DI]	Orientation completion signal
E16		Y2	2: Speed agreement signal [N-AG]	25: Universal DI [U-DI]	Orientation progress signal
o05	PG (PD) option setting		0: Built-in PG	1: PG (PD) option	The spindle pulse encoder signal is supplied to the PG (PD) card.
o38	UPAC option setting		0: UPAC stop	1: UPAC start	Specify starting / stopping of UPAC option.
U01 (U64)	ORT version data		0: Inactive	13 (Ó Óversion)	The version data of the UPAC software is displayed.
U02	Direction of rotation of ORT from stopping state		0: Inactive	0: Random access to target position 1: In external slow speed direction	Enter settings according to the specifications of the coupled machine.
U03	ORT stopping mode selection		0: Inactive	0: Stopping at shortest time 1: Stopping without boosting	
U04	Control input selection		0: Inactive	0: Internal contact valid (X1 to X3) 1: DIOB card input valid 2: S05 (communication passage setting) valid	
U05	ORT completion width		0: Inactive	0 to 511 pulses	
U06	Completion width after ORT stoppage		0: Inactive	0 to 511 pulses	
U07	ORT completion signal ON-timer		0: Inactive	0 to 10.00s	
U08	ORT completion signal OFF-timer		0: Inactive	0 to 10.00s	
U09	Pulse encoder selection		0: Inactive	-3: 128 P/R encoder -2: 256 P/R encoder -1: 512 P/R encoder 0: 1024 P/R encoder 1: 2048 P/R encoder 2: 4096 P/R encoder 3: 8192 P/R encoder	
U10 to U13	Slow speed 1 to 4		0: Inactive	0 to 1000r/min	Changed with acceleration / deceleration selection [RT1, RT2]
U14 to U17	ORT gain 1 to 4		0: Inactive	0 to 100.0 times	
U20 to U23	Stopping position setting 1 to 4		0: Inactive	0 to 32768 Enter four times the encoder resolution.	Changed with change of stopping position 1 and 2.
U24	Speed detection selection		0: Inactive	0: Built-in PG (PA, PB), PG (SD) card valid 1: PG (PD) card valid	Enter according to the specifications of the coupled machine.

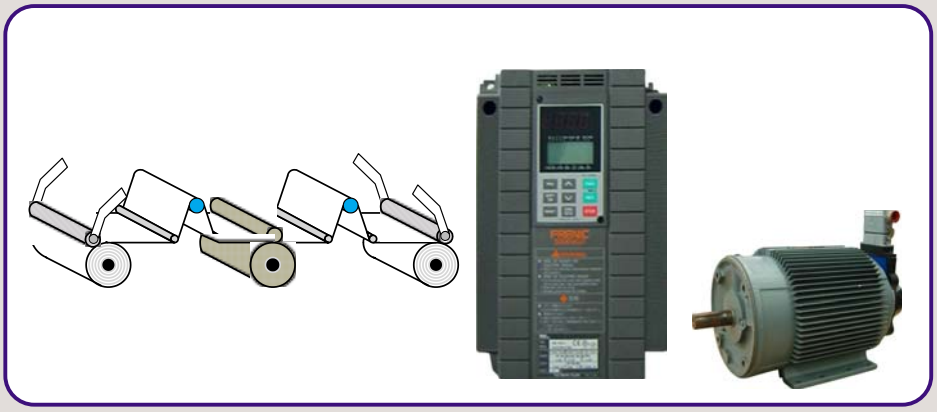
(Note) In addition to the above, basic functions (such as the maximum speed, acceleration/deceleration time, motor constant, etc.) must be specified.

SAFTRONICS

Software Application Examples

VG7

Application CTCW Winding Control (Tension Control)



1 Constant-tension torque control through detection of tension

For general winding applications such as the printing machine and slitter line requiring tension control, packaged software for tension control can be installed in the UPAC card to realize sophisticated function, high-performance tension control through tension pickup detection.
Because UPAC is equipped with a user programming function, an original system can be configured or modified by the user.

2 Built-in winding diameter calculation function

The inverter automatically calculates the current winding diameter, based on the line speed command and the winder motor speed.

3 Advanced control functions

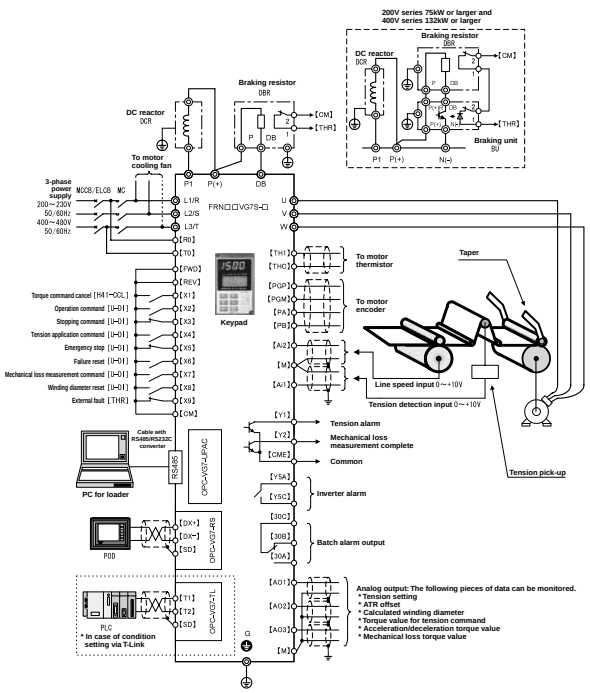
Various functions such as those listed below are provided.

1. Tension setting, taper setting, various condition setting, interface with POD or PLC (with separate option card for interface)
2. Automatically sampling of mechanical loss torque through automatic measurement of mechanical loss
3. Tension taper output function

4 Simple adjustment

Because inverter parameters are used for adjustment of the PID constant, mechanical loss compensation, and acceleration/decelration torque compensation, data check, entry and change are made easily at the keypad or PC loader.

Wiring Diagram and System Configuration



Function Setting Value (Recommended)

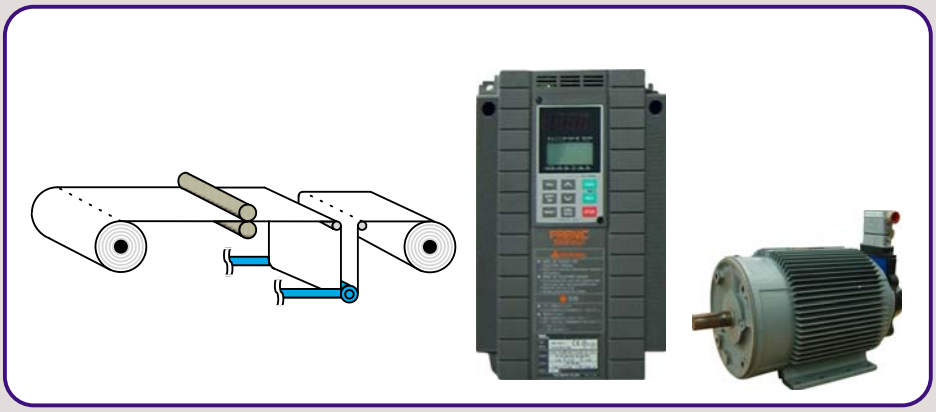
Function code	Name	F	actory setting	Recommended setting value	Remarks
E01	X terminal function	X1	0: Multistep speed selection [SS1]	31: Torque command cancel [CCL]	
E02		X2	1: Multistep speed selection [SS2]	25: Universal DI [U-DI]	Operation command
E03		X3	2: Multistep speed selection [SS4]	25: Universal DI [U-DI]	Stopping command
E04		X4	3: Multistep speed selection [SS8]	25: Universal DI [U-DI]	Tension application command
E05		X5	4: Acceleration / deceleration selection [RT1]	25: Universal DI [U-DI]	Emergency stop
E06		X6	5: Acceleration / deceleration selection [RT2]	25: Universal DI [U-DI]	Failure reset
E07		X7	7: Coast-to-stop command [BX]	25: Universal DI [U-DI]	Mechanical loss measurement command
E08		X8	8: Alarm reset [RST]	25: Universal DI [U-DI]	Winding diameter reset
E09		X9	9: External fault [THR]	9: External fault [THR]	
E15	Y terminal function	Y1	1: Speed existence signal [N-EX]	25: Universal DO [U-DO]	Tension alarm
E16		Y2	2: Speed agreement signal [N-AG]	25: Universal DO [U-DO]	Mechanical measurement complete
E17		Y3	3: Speed equivalent [N-AR]	1: Speed presence [N-EX]	
E18		Y4	4: Speed detection 1 [N-DT1]	4: Speed detection 1 [N-DT1]	
E19		Y5	14: Operation ready output [RDY]	25: Universal DO [U-DO]	Inverter alarm
E49	Ai function selection	Ai1	0: Input signal shut [OFF]	14: Universal Ai [U-AI]	Tension detection input
E50		Ai2	0: Input signal shut [OFF]	14: Universal Ai [U-AI]	Line speed input
E69	Ao function selection	Ao1	1: Speed detection 1 [N-FB1]	30: Universal Ao [U-AO]	Selection from six types of data pieces with U51 to U53
E70		Ao2	6: Torque current command [IT-RBF]	30: Universal Ao [U-AO]	
E71		Ao3	3: Speed setting [N-REF4]	30: Universal Ao [U-AO]	
o38	UPAC option setting		0: UPAC stop	1: UPAC start	Specify starting / stopping of UPAC option
U01	Stall tension setting		0: Inactive	Enter the tension setting at stall.	
U02	Operation tension setting		0: Inactive	Enter the tension setting at operation.	
U03	Material thickness		0: Inactive	Enter the material thickness in [mm].	
U04	Material width		0: Inactive	Enter the material width in [mm].	
U05	Upper tension limit (alarm level)		0: Inactive	A signal for stopping line operation is issued if these settings are exceeded.	
U06	Lower tension limit (alarm level)		0: Inactive		
U07	Winding diameter (initial value)		0: Inactive	Enter the initial winding diameter.	
U08	Material mass		0: Inactive	Enter the mass per $1m^3$ in [kg].	
U09	Linear taper setting		0: Inactive	Enter the taper-related values. Refer to the specification for details.	
U10	Two-point taper setting		0: Inactive		
U11	Two-point taper diameter setting		0: Inactive		
U16	PID control method selection		0: Inactive	Fixed at ÒØÓ	
U17 to U21	ATR control constant setting (At constant speed)		0: Inactive	Enter the PID constant of ATR (Automatic Tension Regulator) and the upper and lower limit values.	
U22 to U26	ATR control constant setting (at line acceleration / deceleration)		0: Inactive		
U27	Maximum line speed		0: Inactive	Enter for line speed scale conversion.	
U28	Maximum diameter		0: Inactive	Enter for winding diameter scale conversion.	
U29	Upper ATR limit value (at stall)		0: Inactive	Enter the upper and lower limit values of the ATR correction. (At stall)	
U30	Lower ATR limit value (at stall)		0: Inactive		
U31	Minimum speed		0: Inactive	Minimum speed of winding motor	
U64	ORT version data		0: Inactive	Ò1100 Ó (Ò Òversion)	The version data of the UPAC software is displayed.

(Note) In addition to the above, basic functions (such as the acceleration/deceleration time and motor parameter) must be specified.
U codes other than those listed above include the tension conditions (U12 to U15), ATR control timings (U44 and U56 to U61), acceleration/deceleration compensation (U33 to U42, U45, U46, U48, U62 and U63), and AO monitor output selection (U51 to U53). Refer to the tension control packaged software specification for data entry.

Software Application Examples

VG7

Application Speed Winding Control (Dancer Position Control)



1 Speed control through detection of dancer roll position

- For applications requiring speed control of the winder and feeder such as printing machines, wire drawing machines and pulp production lines, packaged software for dancer control can be installed in the UPAC card to provide sophisticated function, high-performance speed control through detection of the dancer roll position.
- Because UPAC is equipped with a user programming function, an original system can be configured or modified by the user.

2 Built-in winding diameter calculation function

The inverter automatically calculates the current winding diameter, based on the line speed command and the winder (feeder) motor speed.

3 Advanced control functions

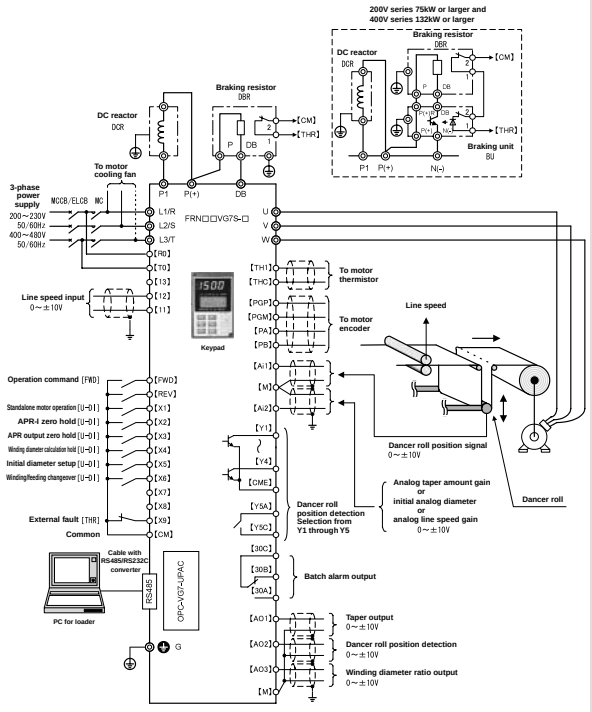
Various functions such as those listed below are provided.

1. Dancer roll position control gain and speed control gain for winding diameter, I constant changeover
2. Common control for winding and feeding (support for reverse mill)
3. Tension taper output function

4 Simple adjustment

- Because inverter parameters are used for gain adjustment, data check, entry and change can be made easily at the keypad or PC loader.
- Various pieces of data such as the calculated winding diameter, line speed, dancer roll position and correction can be checked at the option monitor (LED) of the keypad.

Wiring Diagram and System Configuration



Function Setting Value (Recommended)

Function code	Name	F	actory setting	Recommended setting value	Remarks
F01	Speed setting N1		0: Keypad	2: Analog input (0 to +10V)	Enter ÒÓÔ the maximum winding motor speed is adjusted.
F02	Operation method		0: KEYPAD operation	1: External signal	
F03	M1 Maximum speed		1500r/min	Enter the motor speed causing U01 Ömaximum line speedÓ at U02 Ómin imum winding diameter.Ó	
E01	X terminal function	X1	0: Multistep speed selection [SS1]	25: Universal DI [U-DI]	Standalone motor operation
E02		X2	1: Multistep speed selection [SS2]	25: Universal DI [U-DI]	APR-I zero hold
E03		X3	2: Multistep speed selection [SS4]	25: Universal DI [U-DI]	APR output zero hold
E04		X4	3: Multistep speed selection [SS8]	25: Universal DI [U-DI]	Winding diameter calculation hold
E05		X5	4: Acceleration / deceleration selection [RT1]	25: Universal DI [U-DI]	Initial diameter setup
E06		X6	5: Acceleration / deceleration selection [RT2]	25: Universal DI [U-DI]	Winding/feeding changeover
E09		X9	9: External fault [THR]	9: External fault [THR]	
E14	X terminal function normally open / close		0000 0: Normally open 1: Normally closed	0010: X9 terminal normally closed	X9 (external fault) is configured as a normally closed terminal.
E15	Y terminal function	Y1	1: Speed existence signal [N-EX]	The Y terminal selected with U54 is assigned for 25: universal DI [U-DI].	Dancer roll position detection
E16		Y2	2: Speed agreement signal [N-AG]		
E17		Y3	3: Speed equivalent [N-AR]		
E18		Y4	4: Speed detection 1 [N-DT1]		
E19		Y5	14: Operation ready output [RDY]		
E49	Ai function selection	Ai1	0: Input signal shutoff [OFF]	14: Universal Ai [U-AI]	Dancer roll position signal
E50		Ai2	0: Input signal shutoff [OFF]	14: Universal Ai [U-AI]	Signal selection with U42
E69	Ao function selection	Ao1	1: Speed detection 1 [N-FB1	30: Universal Ao [U-AO]	Taper output
E70		Ao2	6: Torque current command]ITREF	30: Universal Ao [U-AO]	Dancer roll position detection
E71		Ao3	3: Speed setting 4 [N-REF4]	30: Universal Ao [U-AO]	Winding diameter ratio output
o38	UPAC option setting		0: UPAC stop	1: UPAC start	Specify starting / stopping of UPAC option.
U01	Maximum line speed		0: Inactive	Enter the maximum line speed (m/min).	
U02	Minimum winding diameter (DS)		0: Inactive	Enter the minimum winding diameter causing the maximum motor speed.	
U03	Maximum winding diameter(DL)		0: Inactive	Enter the maximum winding diameter.	
U04	Material length		0: Inactive	Refer to the specification for details.	
U05	Dancer roll position voltage loose limit (tension limit)		0: Inactive	Enter the voltage (in mV) of Ai1 input at the loose / tight limit of the dancer roll position.	
U06	Dancer roll position voltage tight limit (deflection limit)		0: Inactive		
U07	Taper starting winding diameter		0: Inactive	Enter for taper output operation.	
U08	Taper amount		0: Inactive		
U09	Line speed offset		0: Inactive	Adjust the line speed input in the range from 0 to +/-10V.	
U10	Line speed gain		0: Inactive		
U11	Intermediate winding diameter		0: Inactive	Enter the intermediate winding diameter.	
U12 to U17	APR-P gain		0: Inactive	Enter the gain for each mode of the winding diameters (maximum, intermediate and minimum), line speeds (during constant operation and acceleration / deceleration).	
U18	APR-I gain		0: Inactive		Integration invalid with ÒÓÒ
U19	APR-D gain		0: Inactive		Differentiation invalid with ÒÓÒ
U20 to U22	ASR-P gain		0: Inactive	Enter the gain for each mode of the winding diameters (maximum, intermediate and minimum).	
U23 to U25	ASR-I		0: Inactive	Enter the I constant for each mode of the winding diameters (maximum, intermediate and minimum).	
U64	ORT version data		0: Inactive	Ò1100 Ó (Ò Ó: version)	The version data of the UPAC software is displayed.

SAFTRONICS

External Dimensions

VG7

Fig. A (Internal mounting type)

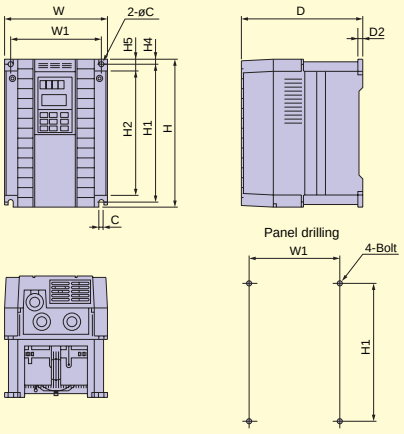
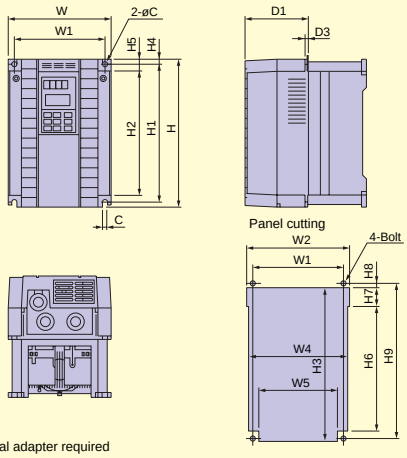


Fig. B (External cooling type)



Note: Optional adapter required

Fig. C (Internal mounting types)

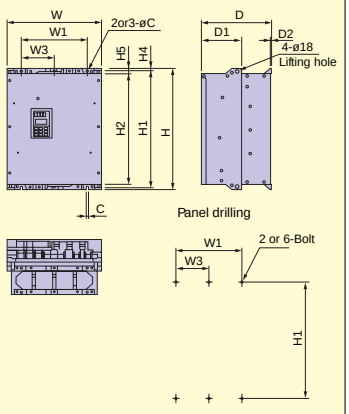
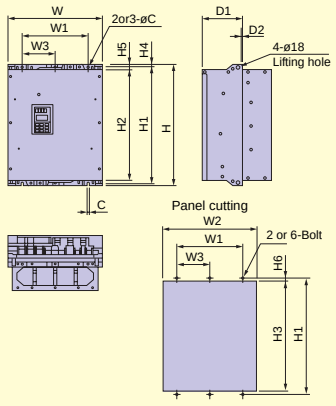


Fig. D (External cooling types)



KEYPAD panel (Common to all models)

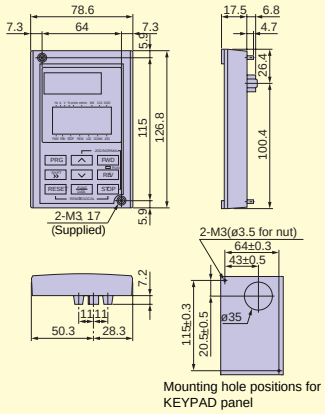
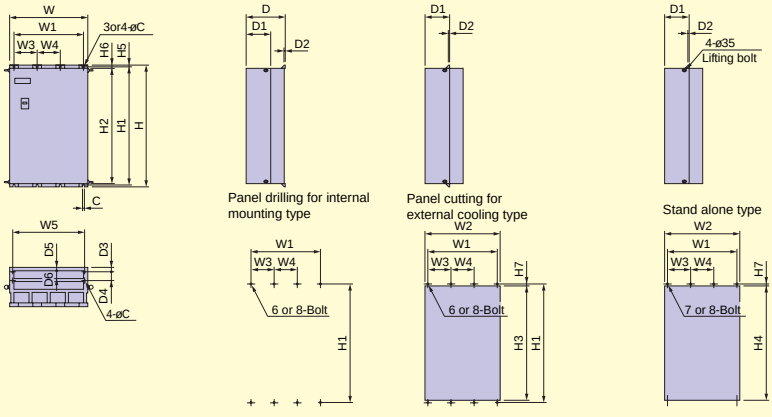


Fig. E (Type common to internal mounting, external cooling, and stand alone)



External Dimensions

VG7

230V series

Nominal applied motor [kW]	Inverter type	Fig.	Dimensions [mm]																						Approx. mass [kg]
			W	W1	W2	W3	W4	W5	H	H1	H2	H3	H4	H5	H6	H7	H8	H9	D	D1	D2	D3	C	Mtg. bolt	
0.75	FRN0.75VG7S-2	A	205	181	207	–	197	159	300	278	255	314	11	21	253.5	39	8	315	245	125	10	7	10	M8	8
1.5	FRN1.5VG7S-2																								
2.2	FRN2.2VG7S-2	B																							
3.7	FRN3.7VG7S-2																								
5.5	FRN5.5VG7S-2																								
7.5	FRN7.5VG7S-2																								
11	FRN11VG7S-2		250	226	252		242	202	380	358	335	394			333.5			395							12.5
15	FRN15VG7S-2																								
18.5	FRN18.5VG7S-2	C	340	240	326	–	–	–	480	460	430	442	12	25	9	–	–	–	255	145	4	–	10	M8	25
22	FRN22VG7S-2																								
30	FRN30VG7S-2	D							550	530	500	512													30
37	FRN37VG7S-2		375	275	361				615	595	565	577							270						37
45	FRN45VG7S-2								740	720	690	702													46
55	FRN55VG7S-2																								48
75	FRN75VG7S-2		530	430	510				750	720	685	695	15.5	32.5	12.5				285	145			15	M12	70
90	FRN90VG7S-2		680	580	660	265			880	850	815	825							360	220					115

460V series

Nominal applied motor [kW]	Inverter type	Fig.	Dimensions [mm]																								Approx. mass [kg]
			W	W1	W2	W3	W4	W5	H	H1	H2	H3	H4	H5	H6	H7	H8	H9	D	D1	D2	D3	D4	D5	D6	C	Mtg. bolt	
3.7	FRN3.7VG7S-4	A	205	181	207	–	197	159	300	278	255	314	11	21	253.5	39	8	315	245	125	10	7	–	–	–	10	M8	8
5.5	FRN5.5VG7S-4																											
7.5	FRN7.5VG7S-4	B																										
11	FRN11VG7S-4		250	226	252		242	202	380	358	335	394			333.5			395										12.5
15	FRN15VG7S-4																											
18.5	FRN18.5VG7S-4	C	340	240	326	–	–	–	480	460	430	442	12	25	9	–	–	–	255	145	4	–	–	–	–	10	M8	25
22	FRN22VG7S-4																											
30	FRN30VG7S-4	D							550	530	500	512																30
37	FRN37VG7S-4		375	275	361														270									35
45	FRN45VG7S-4								675	655	625	637																40
55	FRN55VG7S-4																											41
75	FRN75VG7S-4								740	720	690	702																50
90	FRN90VG7S-4		530	430	510				740	710	675	685	15.5	32.5	12.5				315	175						15	M12	72
110	FRN110VG7S-4																											
132	FRN132VG7S-4								1000	970	935	945							360	220								100
160	FRN160VG7S-4																											
200	FRN200VG7S-4		680	580	660	290																						140
220	FRN220VG7S-4																											
280	FRN280VG7S-4	E	680	580	660	290	–	610	1400	1370	1330	1340	1335	15.5	3.5	14.5	–	–	450	285	6.4	50	100	35	115	15	M12	250
315	FRN315G7S-4																											
355	FRN355VG7S-4		880	780	860	260	260	810																				360
400	FRN400VG7S-4																											

NOTE: Since the DC REACTOR for power-factor correction is equipped with inverter unit (supplied for external installation) of 75W or more as standard, reserve installation space outside of the unit.

Mounting adapter for external cooling (optional for models of 15kW or less)

Option type	Applicable inverter type
PBVG7-7.5	FRN0.75VG7S-2 to FRN7.5VG7S-2 FRN3.7VG7S-4 to FRN7.5VG7S-4
PBVG7-15	FRN11VG7S-2, FRN15VG7S-2 FRN11VG7S-4, FRN15VG7S-4

Since the 18.5kW or larger model can be modified to external cooling type by replacing the mounting bracket, the adapter is not required.

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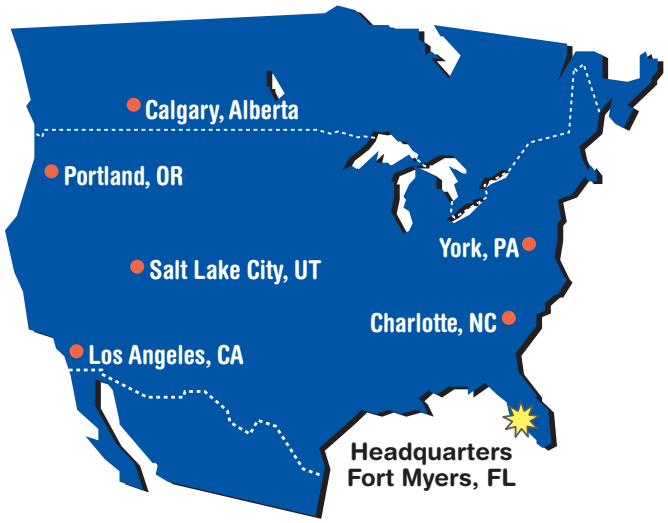

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