



VG10 & GP10

Technical Q & A



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Note: The descriptions of the products in this document are for promotion purposes. Read respective Instruction Manual for actual use of the products.

I. BASIC INFORMATION AND CONCEPTS

1-1 What is the development background?

- ◆ In recent years, the demand for more powerful material handling machines working under heavy loads, and the growing need for more energy-savings for fans and pumps, has prompted the need for inverters offering higher performance and enhanced functionality. Requirements such as reduced noise and harmonics, ease of use, full protection and maintenance functions, support of systematization, and compliance with International Standards are now being placed on inverters as well. The VG10 and GP10 Series inverters fully satisfy these needs and surpass many competitive offerings.

1-2 What is the product concept?

The VG10 and GP10 Series was designed to:

- ◆ Greatly improve basic performance (including starting torque and low-speed operation) and to set a new industry standard.
- ◆ Reduce motor noise, suppress harmonics, and enhance automatic energy-saving functions for a more environmentally conscious product.
- ◆ Strengthen systemization by providing MODBUS RTU via and RS485 port as standard, supporting various bus interfaces, and expanding the HP range.
- ◆ Improve operability, protection functions, and maintenance functions to facilitate ease-of-use.
- ◆ Support various International Standards for globalization.
- ◆ Utilization of the latest IGBT and micro processor technologies.
- ◆ Have prices flexibly set according to the market.

1-3 How different are the VG10 and GP10?

- ◆ The VG10 is designed for a constant torque load and for use with high performance industrial machinery. The GP10 is a dual rated designed for general purpose applications, including both variable torque and constant torque.
- ◆ The capacity range of the VG10 is 1/4 to 600HP and that of the GP10 is 7.5 to 800HP.
- ◆ The overload capability of the VG10 is 150% one minute; that of the GP10 is 110% one minute or 150% one minute.
- ◆ The maximum output frequency of the VG10 is 400 Hz; that of the GP10 is 120 Hz.
- ◆ The starting torque of the VG10 is 200% or more: that of the GP10 is 100% or more.
- ◆ The GP10 does not support droop control, torque control, PG (Pulse Generator) feedback control, or synchronized operation, while the VG10 does.
- ◆ The GP10 is now available in NEMA 1, NEMA 12 and NEMA 4.

1-4 What market does the VG10 target, and what applications are the VG10 suitable for?

- ◆ The VG10 can be used in high performance industrial applications.
- ◆ The VG10 is ideally suited for use with material handling machines, lifting applications, automated parking garage, textile machines, agitators, printing presses, winders, metal processing and machine tools, abrasive machines, extruders, chemical machinery, woodworking equipment, and other constant torque load applications where the high performance of dynamic torque-vector control can be best seen.

1-5 What market does the GP10 target, and what applications are the GP10 suitable for?

- ◆ The GP10 is an inverter designed for general purpose applications.
- ◆ The GP10 is dual rated to perform variable torque applications, such as fans and pumps.
- ◆ The constant torque rated GP10 is suitable for conveyor belts, centrifugal mixers, surface winders and other general purpose applications, where precise speed or torque is not required.

II. REPLACEMENT

2-1 Does conversion to the VG10 and GP10 require a process design change?

- ◆ Its replacement is very easy because the installation dimensions are almost the same for most models.
- ◆ Utilize the CAD Drawing files for documentation changes.
- ◆ Utilize the parameter cross reference document for set-up.

2-2 We are satisfied with the FP5/GP5 and VG5, and do not intend to replace it. What advantages are offered by conversion?

- ◆ Encourage customers to review the VG10 & GP10 for performance, features, and cost and recommend up-grading.
- ◆ The advantages vary depending on your actual application, but the advantages for general industrial machinery are as follows:
 - (1) An improved Keypad panel supporting six languages, with a copy function is a standard feature.
 - (2) Improved auto tuning function. Static tuning (no spinning motor/loaded) and on-line tuning.
 - (3) Soft switching technology to reduce RFI/EMI and eliminate output filters.
 - (4) The starting torque is higher.
 - (5) A Modbus RTU communication function is standard.
 - (6) Acceleration and deceleration response is greatly improved.
 - (7) Smoother rotation in the low-speed range.
- ◆ Replacement enhances machine functions and performance and reduces overall cost.

2-3 Are the terminal symbols the same as those of the FP5/GP5 & VG5?

The symbols are basically the same, but some changes were made to support global markets:

- ◆ The input power terminals. For the VG10 and GP10, the terminals have been changed to L1/R, L2/S, and L3/T (in consideration of export). The 2HP and higher models of the VG10 and GP10 are equipped with input terminals (R0 and T0) for auxiliary control power as standard. The R0, T0 inputs were not available on the FP5/GP5 and VG5.
- ◆ The VG10 and GP10 have 35 control terminals; the FP5/GP5 had 18 terminals and the VG5 had 25.
- ◆ The VG10 and GP10 now have the exact same terminal layout and designation.

2-4 Are the external dimensions the same as those of the FP5/GP5 & VG5?

- ◆ The dimensions are approximately the same as those of the FP5/GP5 & VG5 for 30 HP and below. However, some models may differ slightly. For 40HP and above the VG10 and GP10 models are smaller.

2-5 Can a system using vector control with PG on Yaskawa's G5 be replaced with the vector control with PG in the VG10?

- ◆ Yes, it can. Carefully check the application and specifications, however.
- ◆ The following is a comparison of significant performance.
- ◆ The VG10 does not have case capability. This is implemented in the AD10 product.
- ◆ The VG10 has a max. frequency of 400 Hz. Refer to factory for high speed applications.

Model	Speed control accuracy	Speed control range	Speed response	Torque control	Zero-speed hold torque
VG10 vector control with PG	+/-0.02%	1:1200	40Hz or higher	Good	150% (short time)
Yaskawa's G5 vector control with PG	+/-0.02%	1:1000	30Hz	Good	150% (short time)

2-6 The overload capability of the GP10 is 110% for one minute. Is that lower than the rating of the FP5 variable torque output?

- ◆ In catalogs and specification sheets the overload capability is written as 110% for one minute for the GP10, and 120% one minute for the FP5 (VT). Changes in the IEC standard require different reporting, but there is no difference in the actual overload capability in usage between the GP10 and FP5 (VT). REview motor nameplate current versus unit ratings to assess actual drive's operating and overload capability.

2-7 Why is the vibration value (catalog value) less than that of the FP5/GP5 and VG5?

- ◆ The values are not less but merely represented in a style conforming to the IEC standard. The actual value is the same as that of the FP5/GP5 and VG5.

2-8 What is the input voltage rating?

- ◆ On all Series 10 Drives input voltage ratings are based on 480V +10% (max voltage 528Vac). Most drives in the industry are rated 460V input.

2-9 Can we use option cards with the VG10 and GP10 that we use with the FP5/GP5 and VG5?

- ◆ No.

III. FUNCTION AND PERFORMANCE

3-1 What is dynamic torque-vector control?

- ◆ Dynamic torque vector control is our unique control method which achieves dynamic characteristics by making full use of advanced sensorless vector control power electronics technology. This method instantaneously calculates output according to load conditions using one of the fastest CPUs in the industry to extract maximum motor torque and control voltage and current vectors at the optimum values.
- ◆ For details and differences between competitors' methods, see Q3-7 and Q3-8.

3-2 What is the Vector-distributed Pulse-width Modulation (PWM) control method?

- ◆ The vector distributed PWM is a control method that converts motor noise into a more comfortable sound. By modulating the frequency of the carrier used in the sine wave Pulse-width Modulation (PWM) control method, the noise produced is less metallic in tone.

3-3 What is IGBT soft switching?

- ◆ IGBT soft switching is a control method that reduces the DV/DT (voltage rate of change with respect to time) of inverter output, which reduces the generated noise which helps reduce transient voltage levels appearing at the motor. The result is 20% reduction in switching losses, reduced EMI/RFI and 50% reduction in DV/DT levels. See the soft switching technical paper for more details.

3-4 In what cases should we use static tuning, and in what cases should we use dynamic tuning?

- ◆ Dynamic tuning is the function to use to obtain optimum control when using another manufacturer's motor. In this situation, automatic tuning must be performed beforehand to establish the correct motor parameters when control of the following is used: Automatic torque, slip compensation, dynamic torque-vector control, vector control with PG, torque limiting, torque control, flying start, droop control, automatic energy-saving, input open-phase, calculated torque value monitoring, and on-load factor monitoring.
- ◆ Static tuning should be performed only when it is not possible to uncouple the load for the motor.

3-5 What is "on-line" tuning?

- ◆ On-line tuning should be performed when very precise speed or torque control is required.
- ◆ On-line tuning continuously monitors the motor characteristics. When the characteristics change due to temperature, the motor's parameters are automatically changed to reflect the new motor characteristics.

3-6 How many control methods are available?

- ◆ One of three control methods can be selected: V/Hz control, dynamic torque-vector control, or flux vector control with PG (VG10 only).

3-7 How different are these three control methods?

(1) V/Hz Control

- ◆ The magnetic flux and (torque) current needed to drive the motor and load are set manually by using a torque boost setting. Slip compensation can be used additionally, according to the load.
- ◆ Being independent of the motor and load parameters, this method has wide, general-purpose application and achieves stable operation in steady state. When the torque boost setting does not match the load, however, insufficient torque or over-excitation may result.
- ◆ The control range is one-tenth the base frequency to 120/400 Hz. However, when a frequency command is suddenly changed, great changes in torque and rotation speed result.

(2) Dynamic torque-vector control (sensorless vector control)

- ◆ The magnetic flux and (torque) current needed to drive the motor and load are adjusted automatically.
- ◆ In this method, even when a frequency command is suddenly changed, the torque limiting function maintains proper motor torque and suppresses any changes to torque and speed. This suppression is based on the secondary flux of the motor, while the exciting current remains fixed to the correct value regardless of the load. Even under a varying load, speed control maintains virtually constant motor speed.

- (3) Flux Vector control with PG (VG10 only)
- ◆ Motor current is divided into exciting current and torque current (orthogonal to it) for independent control.
 - ◆ This method enables high-performance speed and torque control that achieves fast response, linearity, and stability.
 - ◆ Even when the speed command or load varies, torque and rotation speed are stable.
 - ◆ This method features a control range of zero speed to 120 Hz.

3-8 What is the maximum frequency of the Series 10 Drives?

- ◆ The VG10 and PC10 are capable of 400Hz operation, while the GP10 is limited to 120Hz maximum frequency.

3-9 What are the main differences among the various types of competing sensorless vector controls?

- ◆ The VG10 achieves the highest level of control in the industry as shown below:

	Saftronics VG10	Mitsubishi's A500	Yaskawa's G5
Control Name	Dynamic torque-vector control	Advanced flux vector control	Current vector control
Control Type	Voltage Type	Voltage type	Current type
Control Method	<u>The voltage vector is controlled to optimize the secondary flux</u> for extracting maximum motor torque regardless of whether the motor is in a steady state (constant-speed operation) or transient state (accelerating, decelerating, at impact load).	<u>The voltage vector is controlled to optimize the primary flux of the motor.</u> Control focusing on the primary flux has one drawback: control of braking is difficult.	<u>The current vector is controlled to optimize the secondary flux of the motor.</u> The method has a drawback: many adjustment parameters are required for correct control. This method is also inferior to dynamix torque-vector control in terms of response becasu

3-10 Can flying start (speed search) be performed regardless of the duration of power outage?

- ◆ Yes, it can.
- ◆ In this case, set the starting characteristics (H09) of the function codes to active (1 or 2).

3-11 Can flying start (speed search) be performed from reverse rotation?

- ◆ Yes, it can.
- ◆ Detection of the motor current phase enables smooth operation regardless of the direction of rotation.

3-12 Can droop control be used for contact stoppage control?

- ◆ Droop control may be effective in the low-speed range, but we recommend a torque limiting function for contact stoppage control.

3-13 Can we use the inputs for pre-set speeds for anything else?

- ◆ 8-stage frequency can be set by using three multistage frequency selections (SS1, SS2, and SS4) among nine digital input terminals (X1 to X9). The other six terminals can be used to set other functions. The flexibility of the X input terminals is a main feature of the GP10 and VG10.

3-14 Can the products be applied to single-phase power?

- ◆ These products are typically for 3-phase power, but 3-phase 230V can also be applied to single-phase power (230V). Note that single-phase power can only be used at up to a load of about 50% of the inverter rating because the products are equipped with an input open-phase protection function.

3-15 Can the VG10 and GP10 be operated in DC common bus systems?

- ◆ Yes, it can be done by connecting the DC power supply to the P (+) and N (-) terminals. However, we recommend the usage of the AC reactor (ACR), because current imbalance may occur.
- ◆ The 30 kW or higher rated models support common bus systems by switching the cooling fan power input to the auxiliary power input terminals. However, an AC power supply must be connected to the auxiliary power input terminals (RO and TO) to drive the cooling fan.

3-16 Is torque control supported?

- ◆ Torque control can be performed by selecting vector control with PG and setting torque control (function code H18) to a torque command at terminal 12, VG10 products only.

3-17 Are a braking transistor and braking resistor included?

- ◆ The VG10 10HP or lower and GP10VT 15HP or lower rated models include a braking transistor.
- ◆ The VG10 10HP or lower rated models include a braking resistor. However, when a larger braking force is required, remove the built-in braking resistor and connect an external braking resistor.
- ◆ The GP10 contains no internal braking resistor.

3-18 What measures have been taken against the effects of noise when a high carrier frequency is set?

- ◆ The DV/DT reduction due to IGBT soft switching, the low-noise control power supply system using half-resonance-type control, and the use of the vector-distributed Pulse-width Modulation (PWM) control method have greatly reduced the effects of noise on sensors and other peripheral devices.

IV. OPERATION, SETUP, AND CONNECTION

4-1 Do the drives accept single phase input?

- ◆ The drives are capable of single phase input with a 50% de-rate factor and with the single phase input connected L1 and L3. (Use a 5Hp motor with a 10Hp drive)

4-2 How do we switch between V/Hz control and dynamic torque-vector control?

- ◆ All that must be changed is the function code F42 setting from Inactive (0) to Active (1). The value preset at factory shipment (initialized value) is inactive (operation by V/Hz control).

4-3 Why is dynamic torque-vector control preset (inactive) at factory shipment though it is a sales point of the VG10 (and GP10)?

- ◆ The concept is to have the VG10 “operational” right out of the box for any motor. Because a special, unknown motor may actually be used, V/Hz mode is the default. When a standard motor is used, we recommend changing the setting of dynamic torque-vector control to operate.

4-4 What is the difference in starting characteristics “1: Active” and “2: Active” (H09)?

- ◆ In the “1” operation, catching a spinning motor is only possible if the motor is restarted after a momentary power failure.
- ◆ In the “2” operation, catching a spinning motor is performed at start-up.
- ◆ If stop to start operation is repeated frequently, catching a spinning motor at start-up degrades the response of the start-up. This is why we provide “1: Active” and “2: Active” separately.

4-5 Which starting characteristic (H09) “1: Active” and “2: Active” is selected when starting characteristics selection (STM) for the digital input signals is turned on?

- ◆ As follows under a normal starting characteristics (H09) setting:

Set Value	At Startup	Restart after momentary power failure	Switching from line to inverter
0	Inactive	Inactive	Inactive
1	Inactive	Active	Active
2	Active	Active	Active

- ◆ When starting characteristics selection (STM) of the digital input signals is turned on, all cases are set to operate as shown below.

Set Value	At Startup	Restart after momentary power failure	Switching from service to inverter
0	Active	Active	Active
1	Active	Active	Active
2	Active	Active	Active

4-6 Can we perform droop control, torque control, PID control, and automatic energy-saving operation under dynamic torque-vector control?

- ◆ Yes, except for automatic energy-saving operation, as indicated below.

	At V/Hz Control	At Dynamic torque-vector control	At the vector control with PG
Slip compensation control	P	P	P
Drooping control	P	P	P
Torque control	P	P	P
PID control	P	P	P
Automatic energy-saving control	P	N	N







4-7 Can we switch between Keypad operation and external signal operation from the keypad when data protection is set (F00: 1)?

- ◆ The setting cannot be changed from the keypad under this condition because the data protection function has priority.

4-8 Can we switch between jogging operation and normal operation from the Keypad when data protection is set (F00: 1)?

- ◆ The setting cannot be changed from the keypad under this condition because data protection has priority.




4-9 We cannot change the setting (from 0 to 1) for data protection (F00)

- ◆ The setting can only be changed by pressing two keys on the keypad at the same time. This prevents data from being easily changed and prevent accidental data destruction.
- ◆ From 0 to 1: Press the  and  keys at the same time to change the value from 0 to 1, then press the  key to confirm the value.
- ◆ From 1 to 0: Press the  and  keys at the same time to change the value from 1 to 0, then press the  key to confirm the value.

4-10 What turns the internal cooling fan on and off ?

- ◆ The internal cooling fan turns on at an internal temperature of 70°C or higher and will continue to run until the drive temperature drops below 70°C for 10 minutes, then the internal cooling fan will shut down.

4-11 We cannot change the setting (from 0 to 1) for data initialization (H03)

- ◆ The setting can only be changed by pressing two keys on the Keypad panel at the same time. This prevents data from being changed easily and prevents accidental data destruction.
- ◆ From 0 to 1: Press the  and  keys at the same time to change the value from 0 to 1, then press the  key to initialize all data.
- ◆ When initialization ends, the set value automatically returns to 0.

4-12 Even after the motor sound (F27) setting is changed, the motor sound remains the same.

- ◆ First change the carrier frequency (F26) setting to 7kHz or lower. When a higher value is set, the actual motor sound cannot be changed even though the F27 data can be changed.

4-13 Can data be changed from the Keypad when the digital input write-enable command (WE-KP) is not set?

- ◆ Data can be changed when WE-KP is on.
- ◆ Data can also be changed when the write-enable command (WE-KP) is not assigned to a digital input terminal.

4-14 What happens when a torque control signal is input from terminal 12 and torque control cancellation (Hz/TRQ) is turned on from a digital input terminal?

- ◆ Torque control cancellation from the digital input terminal has priority, and frequency input is accepted.

4-15 Can you disable PID mode?

- ◆ Yes, by using a digital input (x1-X9) programmed for PID cancellation. When the input is activated, the drive disables the PID loop and then uses the keypad (frequency reference) to change the speed of the motor.

4-16 What problem occurs when the tap (U1 and U2) is incorrectly switched between 460V and 230V?

- ◆ Inverter operation cannot be guaranteed because the allowable usage range of the contactor has been exceeded.
- ◆ Immediate destruction of the inverter does not occur.

4-17 What causes Er7 to be displayed during automatic tuning?

- ◆ During automatic tuning, Er7 is displayed when the STOP key is pressed from the keypad or when a BX (coast-to-stop) command is issued from the digital input terminal.

4-18 The PG2 card is connected, but there are no Option functions (O01) in the programming section.

- ◆ If the encoder is mis-wired, the drive will not recognize the option cards and will not supply the O functions. Or if the INT/EXT power supply switch is set to external (EXT) and no external power supply is used, the drive will not recognize the option card.

4-19 Is there any function that cannot be copied by using the copy function?

- ◆ The following seven functions cannot be copied:
 - ◆ Data protection (F00)
 - ◆ Motor 1 capacity (P02)
 - ◆ Motor 1 automatic tuning (P04)
 - ◆ Data initialization (H03)
 - ◆ RS485 station address (H31)
 - ◆ Motor 2 capacity (A11)
 - ◆ Motor 2 automatic tuning (A13)

4-19 Do any of the drives have a copy/read keypad standard?

- ◆ GP10 and VG10 Keypads are copy/read, the PC10 is not a copy/read keypad.

4-20 Are there any restrictions on using the copy function?

- ◆ Copying cannot be performed if data protection is enabled (F00 is 1) or during inverter operation.
- ◆ Also, as indicated below, copying can only be performed between models of the same capacity or type (230V or 460V) in the same series (G or P).

Example

1	230V 5HP <u>VG10</u>	230V 5HP <u>GP10</u>	Copying not allowed.
2	<u>230V</u> 5HP VG10	<u>460V</u> 5HP VG10	Copying not allowed.
3	230V <u>5HP</u> VG10	230V <u>7.5HP</u> VG10	Copying not allowed.
4	230V 5HP VG10	230V 5HP VG10	Copying allowed.

V. MAINTENANCE

5-1 How do we use the life expiration notification function?

- ◆ Display the life expiration judgement guide for limited-life parts of the inverter from the maintenance information (measurement of main circuit capacitor capacitance, life of electrolytic capacitor on control PC board, and life of cooling fan) on the keypad to monitor maintenance needs in advance.
- ◆ The guide for life expiration judgement based on maintenance information is as follows:

Part	Judgement criteria
Main circuit capacitor	85% or lower of the initial value
Electrolytic capacitor on control PC board	61,000 hours
Cooling Fan (ambient temperatur 40oC)	40,000 hours for 5HP or lower rated models, 25,000 hours for 7.5 or higher rated models

- ◆ For specific values and the method of checking, refer to the instruction manual.

5-2 What is the minimum time unit for operating the cooling fan?

- ◆ An hour is the minimum unit. Operation under an hour is not added to the cooling fan operation time. Therefore, when the cooling fan operates for 0.5 hour and repeats 0.5-hour operation after a stop, the accumulated operation time is 0 hour, not one hour.

5-3 What does the I_{max} measure in the maintenance menu?

- ◆ The I_{max} measures the peak current of the drive since the drive has been running. The I_{max} value resets to 0 after a power outage.

5-4 What determines the capacitor capacity in the maintenance menu?

- ◆ When the drive is turned off, the drive measures the discharge time of the DC bus capacitors to determine the capacity left on the capacitor.

5-5 Why does the fan have more operating hours than the capacitors?

- ◆ The fan time is actual running time, on the capacitor, however, is a temperature coefficient. Example: If the temperature is low, the coefficient is low. With an increase of temperature the coefficient number becomes higher.