Group P10.xx Details – Speed Feedback Control Parameters

In this parameter group the following abbreviations are used:

- *ASR - Adjust Speed Regulator*
- *AMR - Active Magnetic Regulator*
- *PG - Pulse Generator*

Parameters P10.00 - P10.21 are used for setting up a pulse generator signal into the GS20(X) drive.

The DI7 mulitfunction input will accept a pulse generator signal with a maximum frequency of 33kHz. This signal can be configured as an encoder feedback device from a motor (PG) or as a speed command signal to the drive (PG2) from another device.

DI7 (PG) uses pulse time to calculate the motor frequency. The Encoder PPR (pulse per revolution) and Motor RPM will affect the operating frequency range. Normal encoder PPR values are 512, 1024, 2048, etc. To calculate the operating frequency of an application, use this formula:

(Max Motor RPM x Encoder PPR) / 60 seconds = Pulses/Sec

Choose an encoder PPR value that will generate less than 33,000 pulses/sec for use with the DI7 input.

NOTE: For GS20, VF+PG is only single-phase input and will not know if it's REV or FWD.

The following table summarizes the parameter configuration for the PG and PG2 application. See the detailed parameter descriptions for more information.

Parameter	***Pulse Generator (PG)*** (Use for Motor Encoder Feedback)	***Pulse Generator 2 (PG2)*** (Use for Pulse Input Frequency Reference)	***Description***
	Parameter Setting		
P00.04	--	22	View Input Frequency value on keypad display (optional)
P00.11	1	--	Speed Control Mode (IMVFPG mode only)
P00.20	--	4	Auto Mode Only
P00.30	--	4	Manual Mode Only
P02.07	0	0	DI7 input config
P03.20	--	19	Analog Output to send PG2 signal to another device (optional)
P10.00	5	5	Selects Pulse Input for use
P10.01	PPR	PPR	Defines Pulses per revolution of device
P10.02	5	0	Encoder input type (PG only)
P10.04	1-65535	--	Electrical Gearing Load Side A1 (PG)
P10.05	1-65535	--	Electrical Gearing Motor Side B1 (PG)
P10.06	1-65535	--	Electrical Gearing Load Side A2 (PG)
P10.07	1-65535	--	Electrical Gearing Motor Side B2 (PG)
P10.10	0-120%	--	Encoder Stall Level (PG)
P10.11	0-2.0 sec	--	Encoder Stall Time (PG)
P10.12	0, 1, or 2	--	Encoder Stall Action (PG)
P10.13	0-50%	--	Encoder Slip Range (PG)
P10.14	0-10 sec	--	Encoder Slip Detection Time (PG)
P10.15	0, 1, or 2	--	Encoder Stall and Slip Error Action (PG)
P10.16	0	5	Set PG2 Pulse Input Type
P10.17	--	1-65535	PG2 Electrical Gear A
P10.18	--	1-65535	PG2 Electrical Gear B
P10.21	--	1-65535 sec	PG2 Low Pass Filter Time

		Type	Hex Addr	Dec Addr
P10.00	**Encoder Type Selection**	R/W	0A00	42561
Range/Units (Format: 16-bit binary)		Default		
0: Disabled 5: Pulse input (DI7)		0		

When you use DI7 single-phase pulse input (PG2), you must use it with P10.00=5 and P00.20=4, P02.07=0, and P10.16=5.

When you use DI7 single-phase pulse input as speed feedback (PG), you must use it with P02.07=0, P10.00=5, and P10.02=5. The drive calculates the DI7 single-phase pulse input speed when the control mode is IMVFPG.

The GS20(X) does not support the full position control pulse command input function.

		Type	Hex Addr	Dec Addr
P10.01	**Encoder Pulses per Revolution**	R/W	0A01	42562
Range/Units (Format: 16-bit unsigned)		Default		
1–20000		600		

P10.01 sets the encoder pulses per revolution (PPR). It is a feedback control signal source when using PG (pulse generator) for DI7. The encoder sets the number of pulses for the motor rotating through one rotation. The A/B phase cycle generates the pulse number.

- *This setting is also the encoder resolution. The speed control is more accurate with higher resolution.*
- *If you set this parameter incorrectly, it may cause motor stall, drive over-current, or a magnetic pole origin detection error for the PM motor in closed-loop control. When using the PM motor, you must perform the magnetic pole origin detection (P05.00 = 13) again if you modify the content of this parameter.*

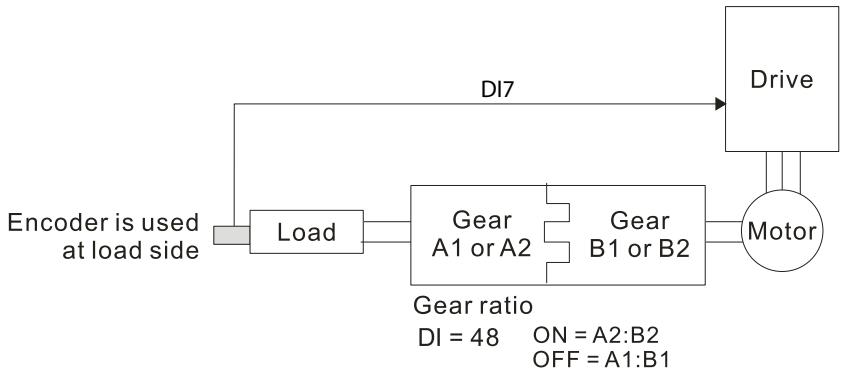
		Type	Hex Addr	Dec Addr
P10.02	**Encoder Input Type Setting (PG)**	R/W	0A02	42563
Range/Units (Format: 16-bit binary)		Default		
0: Disable 5: Single-phase input (DI7)		0		

P10.02 sets the DI7 Pulse input as an encoder feedback device from the motor (PG).

To use this parameter, P10.00=5 and P10.16=0 are required.

		Type	Hex Addr	Dec Addr
P10.04	**Electrical Gear at Load Side A1**	♦R/W	0A04	42565
P10.05	**Electrical Gear at Motor Side B1**	♦R/W	0A05	42566
P10.06	**Electrical Gear at Load Side A2**	♦R/W	0A06	42567
P10.07	**Electrical Gear at Motor Side B2**	♦R/W	0A07	42568
Range/Units (Format: 16-bit unsigned)		Default		
1–65535		100		

Use P10.04–P10.07 with the multi-function input terminal setting 48 to switch to P10.04– P10.05 or P10.06–P10.07, as shown in the diagram below.



		Type	Hex Addr	Dec Addr
P10.10	**Encoder Stall Level**	♦R/W	0A0A	42571
Range/Units (Format: 16-bit unsigned)		*Default*		
0–120% (0: Disable)		115		

P10.10 determines the maximum encoder feedback signal allowed before a fault occurs; the maximum operation frequency P01.00 = 100%.

		Type	Hex Addr	Dec Addr
P10.11	**Detection Time of Encoder Stall**	♦R/W	0A0B	42572
Range/Units (Format: 16-bit unsigned)		*Default*		
0.0–2.0 sec.		0.1		

		Type	Hex Addr	Dec Addr
P10.12	**Encoder Stall Action**	♦R/W	0A0C	42573
Range/Units (Format: 16-bit binary)		*Default*		
0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop		2		

When the drive output frequency exceeds the encoder stall level (P10.10), the drive starts to count the time. When the error time exceeds the encoder stall detection time (P10.11), the drive implements the encoder stall action.

		Type	Hex Addr	Dec Addr
P10.13	**Encoder Slip Range**	♦R/W	0A0D	42574
Range/Units (Format: 16-bit unsigned)		*Default*		
0–50% (0: Disable)		50		

		Type	Hex Addr	Dec Addr
P10.14	**Detection Time of Encoder Slip**	♦R/W	0A0E	42575
Range/Units (Format: 16-bit unsigned)		*Default*		
0.0–10.0 sec.		0.5		

		Type	Hex Addr	Dec Addr
P10.15	**Encoder Stall and Slip Error Action**	♦R/W	0A0F	42576
Range/Units (Format: 16-bit binary)		*Default*		
0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop		2		

P10.15 acts on the settings for P10.13–P10.14:

When the value of (rotation speed – motor frequency) exceeds the P10.13 setting, and the detection time exceeds P10.14; the drive starts to count the time. If the detection time exceeds P10.14, the encoder feedback signal error occurs.

		Type	Hex Addr	Dec Addr
P10.16	**Pulse Input Type Setting (PG2)**	♦R/W	0A10	42577
Range/Units (Format: 16-bit binary)		*Default*		
0: Disabled 5: Single-phase input (DI7)		0		

P10.16 sets the DI7 Pulse input as a pulse generator input for frequency reference (PG2).

When P10.16=5, you cannot set P10.02 to 5: Single-phase input (DI7) for closed-loop control.

The setting steps when using the DI7 single-phase pulse input as the frequency command:

1) Set P00.20=4: Pulse input without direction command
2) Set P02.07=0
3) Set P10.00=5: Pulse input (DI7)
4) Set P10.01 to motor pulses per revolution (PPR)
5) Set P10.16=5: Single-phase input (DI7)
6) Set P00.04=22 (Pulse input frequency) to verify if the pulse input frequency is correct.

		Type	Hex Addr	Dec Addr
P10.17	**PG2 Electrical Gear A**	♦R/W	0A11	42578
P10.18	**PG2 Electrical Gear B**	♦R/W	0A12	42579
Range/Units (Format: 16-bit unsigned)		*Default*		
1–65535		100		

Rotation speed = pulse frequency / encoder pulses (P10.01) * electrical gear A / electrical gear B.

		Type	Hex Addr	Dec Addr
P10.21	**PG2 Pulse Input Speed Command Low Pass Filter Time**	♦R/W	0A15	42582
Range/Units (Format: 16-bit binary)		*Default*		
0.000–65.535 sec.		0.100		

When you set P00.20 to 4, the system treats the pulse command as a Frequency command. Use this parameter to suppress the speed command jump.

Parameters P10.24 - P10.53 are for configuring the speed and torque control loop characteristics. These parameters are only applicable to certain speed control modes (P00.11). See function block diagrams under P00.11 on page 4–58 for a visual representation of how the parameters interact.

		Type	Hex Addr	Dec Addr
P10.24	**FOC Function Control**	♦R/W	0A18	42585
Range/Units (Format: 16-bit unsigned)		*Default*		
0–65535		0		

FOC (Field Oriented Control) is the highest accuracy speed control mode of the drive, set by P00.11=5: IMFOC sensorless mode. This parameter configures the optional settings of FOC.

bit	Description
0	ASR controller under torque control. 0: use PI as ASR; 1: use P as ASR
1–10	N/A
11	Activates the DC brake when executing the zero torque command. 0: ON; 1: OFF
12	FOC sensorless mode with crossing zero means the speed goes from negative to positive or positive to negative (forward to reverse direction or reverse to forward direction). 0: determined by the stator frequency; 1: determined by the speed command
13	N/A
14	N/A
15	Direction control in open-loop torque 0: Switch ON direction control; 1: Switch OFF direction control

Only bit = 0 is used for closed-loop; other bits are used for open-loop.

Set the bits as needed in binary format. Then convert to decimal for parameter entry on drive keypad, or Hex for parameter entry on optional GS4-KPD.

This parameter is only active when P00.11=5: IMFOC sensorless mode. See function block diagrams under P00.11 on page 4–58.

		Type	Hex Addr	Dec Addr
P10.25	**FOC Bandwidth for Speed Observer**	♦R/W	0A19	42586
Range/Units (Format: 16-bit unsigned)		*Default*		
20.0–100.0 Hz		40.0		

Setting the speed observer to a higher bandwidth could shorten the speed response time but creates greater noise interference during the speed observation.

This parameter is only active when P00.11=5: IMFOC Sensorless mode. See Function diagram under P00.11 on page 4–58.

		Type	Hex Addr	Dec Addr
P10.26	**FOC Minimum Stator Frequency**	♦R/W	0A1A	42587
Range/Units (Format: 16-bit unsigned)		*Default*		
0.0–10.0% fN		2.0		

P10.26 sets the stator frequency lower limit in operation status. This setting ensures the stability and accuracy of observer and avoids interferences from voltage, current and motor parameters. fN is the motor rated frequency.

This parameter is only active when P00.11=5: IMFOC Sensorless mode. See Function diagram under P00.11 on page 4–58.

P10.27	FOC Low Pass Filter Time Constant	Type	Hex Addr	Dec Addr
		♦R/W	0A1B	42588
Range/Units (Format: 16-bit unsigned)		Default		
1–1000 ms		50		

P10.27 sets the low pass filter time constant of a flux observer at start-up. If you cannot activate the motor during high speed operation, lower the setting for this parameter.

P10.28	FOC Gain for Excitation Current Rise Time	Type	Hex Addr	Dec Addr
		♦R/W	0A1C	42589
Range/Units (Format: 16-bit unsigned)		Default		
33–100% Tr		100		

P10.28 sets the drive's excitation current rise time when it activates in open-loop torque mode. When the drive's activation time is too long in torque mode, adjust this parameter to a shorter time value. Tr is the rotor time constant.

P10.29	Upper Limit of Frequency Deviation	Type	Hex Addr	Dec Addr
		♦R/W	0A1D	42590
Range/Units (Format: 16-bit unsigned)		Default		
0.00–200.00 Hz		20.00		

P10.29 limits the maximum frequency deviation.

This parameter is only applicable when P00.11=IMVFPG, using input DI7 as the PG (encoder).

If you set this parameter too high, an abnormal feedback malfunction occurs.

If the application needs a higher setting for P10.29, note that a higher setting results in larger motor slip, which causes a PG Error (PGF3, PGF4). In this case, you can set P10.10 and P10.13 to 0 to disable PGF3 and PGF4 detection, but you must make sure the DI7 wiring and application are correct; otherwise, it may lose the instant PG protection. Setting P10.29 too high is not commonly done.

P10.31	I/F Mode, Current Command	Type	Hex Addr	Dec Addr
		♦R/W	0A1F	42592
Range/Units (Format: 16-bit unsigned)		Default		
0–150% rated current of the motor		40		

P10.31 is only applicable to PM motors with P00.11= 2: PMSVC. See Function diagram under P00.11 on page 4–58.

P10.31 sets the current command for the drive in the low speed area (low speed area: Frequency command < P10.39). When the motor stalls on heavy duty start-up or forward/reverse with load, increase the parameter value. If the inrush current is too high and causes oc stall, then decrease the parameter value.

P10.32	PM Sensorless Speed Estimator Bandwidth	Type	Hex Addr	Dec Addr
		♦R/W	0A20	42593
Range/Units (Format: 16-bit unsigned)		Default		
0.00–600.00 Hz		5.00		

P10.32 is only applicable to PM motors with P00.11= 2: PMSVC. See Function diagram under P00.11 on page 4–58.

P10.32 sets the speed estimator bandwidth. Adjust the parameter to influence the stability and the accuracy of the motor speed.

If there is low frequency vibration (the waveform is similar to a sine wave) during the process, then increase the bandwidth. If there is high frequency vibration (the waveform shows extreme vibration and is like a spur), then decrease the bandwidth.

		Type	Hex Addr	Dec Addr
P10.34	**PM Sensorless Speed Estimator Low-pass Filter Gain**	♦R/W	0A22	42595
Range/Units (Format: 16-bit unsigned)		Default		
0.00–655.35		1.00		

P10.34 is only applicable to PM motors with P00.11= 2: PMSVC. See Function diagram under P00.11 on page 4–58.

P10.34 influences the response speed of the speed estimator.

If there is low frequency vibration (the waveform is similar to a sine wave) during the process, then increase the gain. If there is high frequency vibration (the waveform shows extreme vibration and is like a spur), then decrease the gain.

		Type	Hex Addr	Dec Addr
P10.35	**AMR (Kp) Gain**	♦R/W	0A23	42596
Range/Units (Format: 16-bit unsigned)		Default		
0.00–3.00		1.00		

		Type	Hex Addr	Dec Addr
P10.36	**AMR (Ki) Gain**	♦R/W	0A24	42597
Range/Units (Format: 16-bit unsigned)		Default		
0.00–3.00		0.20		

The AMR parameters P10.35 and P10.36 are only active when P00.11= 5: IMFOC Sensorless mode. See Function diagram under P00.11 on page 4–58.

Active Magnetic Regulator (AMR) Kp/Ki, affects the response of magnetic regulation in the low magnetic area.

If entering the low magnetic area and the input voltage (or DC BUS) plummets (e.g. an unstable power net causes instant insufficient voltage, or a sudden load that makes DC BUS drop), which causes the ACR diverge and oc, then increase the gain. If the Id value of a spur creates large noise in high-frequency output current, decrease the gain to reduce noise. Decreasing the gain will slow down the response.

		Type	Hex Addr	Dec Addr
P10.39	**Frequency Point to Switch from I/F Mode to PM Sensorless Mode**	♦R/W	0A27	42600
Range/Units (Format: 16-bit unsigned)		Default		
0.00–599.00 Hz		20.00		

P10.39 sets the frequency for the switch point from low frequency to high frequency. This parameter is only applicable to PM motors with P00.11=2: PMSVC.

Due to the weak back-EMF in the low frequency area, PM sensorless mode cannot estimate the accurate speed and position of the rotor. Thus, using I/F mode control is more suitable. In the medium-to-high frequency area, PM sensorless can accurately estimate the back-EMF, stabilizes and controls the motor with lower current.

If the switch point is too low and PM sensorless mode operates at a too low frequency, the motor does not generate enough back-EMF to let the speed estimator measure the right position and speed of the rotor, and causes stall and oc when running at the switch point frequency.

If the switch point is too high, the drive easily runs in the frequency area of the I/F mode for a long time, which generates a larger current and will not save energy. (If the current for P10.31 is too high, the high switch point makes the drive continue to output with the setting value for P10.31.)

		Type	Hex Addr	Dec Addr
P10.42	**Initial Angle Detection Pulse Value**	♦R/W	0A2A	42603
Range/Units (Format: 16-bit unsigned)		Default		
0.0–3.0		1.0		

P10.42 is only applicable to SPM motors with P00.11=2:PMSVC. See Function diagram under P00.11 on page 4–58.

P10.42 is only active when P10.53=3:Pulse Injection.

The angle detection is fixed to 3: Use the pulse injection method to start. The parameter influences the value of the pulse during the angle detection. The larger the pulse, the higher the accuracy of rotor's position. A larger pulse might cause oc.

Increase the parameter when the running direction and the command are opposite during start-up. If oc occurs at start-up, then decrease the parameter.

Refer to Adjustment & Application for detailed motor adjustment procedure.

		Type	Hex Addr	Dec Addr
P10.49	**Zero Voltage Time during Start-up**	♦R/W	0A31	42610
Range/Units (Format: 16-bit unsigned)		Default		
0.000–60.000 sec.		0.000		

P10.49 is valid only when the setting of P07.12 (Speed Tracking during Start-up) = 0.

When the motor is in static state at start-up, this increases the accuracy when estimating angles. In order to put the motor in static state, set the drive three-phase output to the motor to 0V. The P10.49 setting time is the length of time for three-phase output at 0 V.

It is possible that even when you apply this parameter, the motor cannot go in to the static state because of inertia or some external force. If the motor does not go into a complete static state in 0.2 seconds, increase this setting value appropriately.

If P10.49 is set too high, the start-up time is longer. If it is too low, then the braking performance is weak.

		Type	Hex Addr	Dec Addr
P10.51	**Injection Frequency**	♦R/W	0A33	42612
Range/Units (Format: 16-bit unsigned)		Default		
0–1200 Hz		500		

P10.51 is a high frequency injection command in PM SVC control mode, and usually you do not need to adjust it. But if a motor's rated frequency (for example, 400Hz) is too close to the frequency setting for this parameter (that is, the default of 500Hz), it affects the accuracy of the angle detection. Refer to the setting for P01.01 before you adjust this parameter.

- *If the setting value for P00.17 is lower than P10.51*10, then increase the frequency of the carrier frequency.*
- *P10.51 is valid only when P10.53 = 2.*

		Type	Hex Addr	Dec Addr
P10.52	**Injection Magnitude**	♦R/W	0A34	42613
Range/Units (Format: 16-bit unsigned)		Default		
120V / 230V series: 100.0 V 460V series: 200.0 V 575V series: 200.0 V Note: The setting range varies depending on the voltage.		15.0 / 30.0 / 37.5		

P10.52 is the magnitude command for the high frequency injection signal in PM SVC control mode.

Increasing the parameter can increase the accuracy of the angle estimation, but the electromagnetic noise might be louder if the setting value is too high.

- *The system uses this parameter when the motor's parameter is "Auto". This parameter influences the angle estimation accuracy.*
- *When the ratio of the salient pole (Lq / Ld) is lower, increase P10.52 to make the angle detection accurate.*
- *P10.52 is valid only when P10.53 = 2.*

		Type	Hex Addr	Dec Addr
P10.53	***Angle Detection Method***	♦R/W	0A35	42614
Range/Units (Format: 16-bit binary)		*Default*		
0: Disabled 1: Force attracting the rotor to zero degrees 2: High frequency injection 3: Pulse injection		0		

Set P10.53 = 2 for IPM; set to 3 for SPM. If these settings cause problems, then set the parameter to 1.