AC Drive Parameters

Contents of this Chapter...

DURAPULSE Parameter Summary

Parameters available only in later firmware versions of *DURAPULSE* AC drives

Some parameters and settings are available only in later firmware versions of *DURAPULSE* AC drives. Check parameter P9.39 to determine the firmware version of your *DURAPULSE* drive.

Parameters and settings available only with firmware v1.02 and higher:

- P6.30
- P9.39

Parameters and settings available only with firmware v1.04 and higher:

- P3.02~P3.10 settings 19, 20
- P3.11~P3.14 setting 16
- P3.31
- P4.13
- P4.14
- P4.15
- P4.16
- P4.17
- P4.18
- P7.27 settings 02, 03
- P7.28

Parameters and settings available only with firmware v1.05 and higher:

- P2.09
- P2.10 settings 04, 05
- P4.13 default = 06
- P6.37

Parameter Summary				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
Motor Parameters				
P0.00	Motor Nameplate Voltage	230V class: 200/208/220/230/240 460V class: 380/400/415/440/460/480	240 480	
P0.01	Motor Nameplate Amps	Drive Rated Amps x 0.4 to 1.0	Drive Rated Amps x 1.0	
P0.02	Motor Base Frequency	50/60/400	60	
P0.03	Motor Base RPM	375 to 24,000 rpm	1750	
P0.04	Motor Maximum RPM (Max operation Freq., AI1 and AI2 100% value)	P0.03 to 24,000 rpm	P0.03	
P0.05	Motor Auto Tune	00 Disable 01 Enable P0.06 only 02 Enable P0.06 and P0.07	00	
P0.06	Motor Line to Line Resistance R1	00 to 65535 mΩ	00	
P0.07	Motor No-Load Current	Drive Rated Amps x 0.0 to 0.9 (Amps)	Drive Rated Amps x 0.4	

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Parameter Summary				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
Ramp Parameters				
P1.00	Stop Methods	00: Ramp to Stop 01: Coast to Stop	00	
◆ **P1.01**	Acceleration Time 1	0.1 to 600.0s (must be > 1s to be effective)	10.0	
◆ **P1.02**	Deceleration Time 1	0.1 to 600.0s (must be > 1s to be effective)	30.0	
P1.03	Accel S-curve	0 to 7	00	
P1.04	Decel S-curve	0 to 7	00	
◆ **P1.05**	Acceleration Time 2	0.1 to 600.0s (must be > 1s to be effective)	10.0	
◆ **P1.06**	Deceleration Time 2	0.1 to 600.0s (must be > 1s to be effective)	30.0	
P1.07	Select method to use 2nd Accel/Decel	00: RMP2 from DI terminal 01: Transition Frequencies P1.08 & P1.09	00	
P1.08	Accel 1 to Accel 2 frequency transition	0.0 to 400.0 Hz	0.0	
P1.09	Decel 2 to Decel 1 frequency transition	0.0 to 400.0 Hz	0.0	
P1.10	Skip Frequency 1	0.0 to 400.0 Hz	0.0	
P1.11	Skip Frequency 2	0.0 to 400.0 Hz	0.0	
P1.12	Skip Frequency 3	0.0 to 400.0 Hz	0.0	
P1.13	Skip Frequency 4	0.0 to 400.0 Hz	0.0	
P1.14	Skip Frequency 5	0.0 to 400.0 Hz	0.0	
P1.17	Skip Frequency Band	0.0 to 20.0 Hz	0.0	
P1.18	DC Injection Current Level	00 to 100 %	00	
P1.20	DC Injection during Start-up	0.0 to 5.0 sec	0.0	
P1.21	DC Injection during Stopping	0.0 to 25.0 sec	0.0	
P1.22	Start-point for DC Injection	0.0 to 60.0 Hz	0.0	

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◆ Parameter can be set during RUN Mode.

Parameter Summary (continued)				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
Volts/Hertz Parameters				
P2.00	Volts/Hertz Settings	00: General Purpose 01: High Starting Torque 02: Fans and Pumps 03: Custom	00	
◆ **P2.01**	Slip Compensation	0.0 to 10.0	0.0 (V/Hz mode) 1.0 (Vector mode)	
◆ **P2.02**	Auto-torque Boost	00 to 10	00	
◆ **P2.03**	Torque Compensation Time Constant	00 to 10 sec	0.05	
P2.04	Mid-point Frequency	0.1 to 400 Hz	0.5	
P2.05	Mid-point Voltage	230V class: 0.1 to 240V 460V class: 0.1 to 480V	5.0 10.0	
P2.06	Min. Output Frequency	0.1 to 20.0 Hz	0.5	
P2.07	Min. Output Voltage	230V class: 0.1 to 50V 460V class: 0.1 to 100V	5.0 10.0	
P2.08	PWM Carrier Frequency	01 to 15 kHz 01 to 15 kHz 01 to 09 kHz 01 to 06 kHz	1–5hp = 15 7.5–25hp = 9 30–60hp = 6 75–100hp = 6	
◆ **P2.09**	Slip Compensation Time Constant	0.05 to 10.00 sec	0.10	
P2.10	Control Mode	00: V/Hz without encoder feedback 01: V/Hz with encoder feedback 02: Sensorless Vector without encoder feedback 03: Sensorless Vector with encoder feedback 04: V/Hz with encoder feedback & high-speed regulation 05: Sensorless Vector with encoder feedback & high-speed regulation	00	
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Parameter Summary (continued)				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
Digital Parameters				
P3.00	Source of Operation Command	00: Operation determined by digital keypad 01: Operation determined by external control terminals; keypad STOP is enabled 02: Operation determined by external control terminals; keypad STOP is disabled 03: Operation determined by RS-485 interface; keypad STOP is enabled 04: Operation determined by RS-485 interface; keypad STOP is disabled	00	
P3.01	Multi-function Input Terminals (DI1 - DI2)	00: DI1 - FWD / STOP, DI2 - REV / STOP 01: DI1 - RUN / STOP, DI2 - REV / FWD 02: DI1 - RUN momentary (N.O.) DI2 - REV / FWD DI3 - STOP momentary (N.C.)	00	
P3.02	Multi-function Input DI3	00: External Fault (N.O.) 01: External Fault (N.C.) 02: External Reset 03: Multi-Speed Bit 1 04: Multi-Speed Bit 2 05: Multi-Speed Bit 3 06: Multi-Speed Bit 4 07: Manual Keyboard Control 08: Reserved 09: Jog 10: External Base Block (N.O.) 11: External Base Block (N.C.) 12: Second Accel/Decel Time 13: Speed Hold 14: Increase Speed 15: Decrease Speed 16: Reset Speed to Zero 17: PID Disable (N.O.) 18: PID Disable (N.C.) 19: 1st/2nd Source Select (N.O.) 20: 1st/2nd Source Select (N.C.) 99: Input Disable	00	
P3.03	Multi-function Input DI4		03	
P3.04	Multi-function Input DI5		04	
P3.05	Multi-function Input DI6		05	
P3.06	Multi-function Input DI7		06	
P3.07	Multi-function Input DI8		09	
P3.08	Multi-function Input DI9		02	
P3.09	Multi-function Input DI10		12	
P3.10	Multi-function Input DI11		10	

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Parameter Summary (continued)				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
Digital Parameters (continued)				
P3.11	Multi-Function Output Terminal 1 (Relay Output)	00: AC Drive Running 01: AC Drive Fault 02: At Speed 03: Zero Speed 04: Above Desired Frequency (P3.16) 05: Below Desired Frequency (P3.16) 06: At Maximum Speed (P0.04) 07: Over Torque detected (P6.08) 08: Above Desired Current (P3.17) 09: Below Desired Current(P3.17) 10: PID Deviation Alarm 11: Heatsink Overheat Warning (OH1) 12: Soft Braking Signal 13: Above Desired Frequency 2 (P3.20) 14: Below Desired Frequency 2 (P3.20) 15: Encoder Loss 16: PID Feedback Loss Warning	00	
P3.12	Multi-Function Output Terminal 2 (DO1)		01	
P3.13	Multi-Function Output Terminal 3 (DO2)		02	
P3.14	Multi-Function Output Terminal 4 (DO3)		03	
◆ **P3.16**	Desired Frequency	0.0 to 400.0 Hz	0.0	
◆ **P3.17**	Desired Current	0.0 to <Drive Rated Amps>	0.0	
◆ **P3.18**	PID Deviation Level	1.0 to 50.0 %	10.0	
◆ **P3.19**	PID Deviation Time	0.1 to 300.0 sec	5.0	
◆ **P3.20**	Desired Frequency 2	0.0 to 400.0 Hz	0.0	
◆ **P3.30**	Frequency Output (FO) Scaling Factor	1 to 20	1	
P3.31	2nd Source of Operation Command	00: Operation determined by digital keypad 01: Operation determined by external control terminals; keypad STOP is enabled 02: Operation determined by external control terminals; keypad STOP is disabled 03: Operation determined by RS-485 interface; keypad STOP is enabled 04: Operation determined by RS-485 interface; keypad STOP is disabled	0	
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Parameter Summary (continued)				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
Analog Parameters				
P4.00	Source of Frequency Command	01: Frequency determined by digital keypad up/down 02: Frequency determined by 0 to +10V input on AI1 terminal 03: Frequency determined by 4 to 20 mA input on AI2 terminal 04: Frequency determined by 0 to 20 mA input on AI2 terminal 05: Frequency determined by RS-485 communication interface 06: Frequency determined by -10V to +10V input on (AI3) terminal	01	
◆ **P4.01**	Analog Input Offset Polarity	00: No Offset 01: Positive Offset 02: Negative Offset	00	
◆ **P4.02**	Analog Input Offset	0.0 to 100.0%	0.0	
◆ **P4.03**	Analog Input Gain	0.0 to 300.0%	100.0	
P4.04	Analog Input Reverse Motion Enable	00: Forward Motion Only 01: Reverse Motion Enable	00	
P4.05	Loss of AI2 Signal (4-20 mA)	00: Decelerate to 0Hz 01: Stop immediately and display error code "External Fault" 02: Continue operation by the last frequency command	00	
◆ **P4.11**	Analog Output Signal	00: Frequency Hz 01: Current A 02: PV	00	
◆ **P4.12**	Analog Output Gain	00 to 200%	100	
P4.13	2nd Source of Frequency Command	same settings as for P4.00	06	
◆ **P4.14**	2nd Analog Input Offset Polarity	same settings as for P4.01	00	
◆ **P4.15**	2nd Analog Input Offset	0.0 to 100.0%	0.0 (float)	
◆ **P4.16**	2nd Analog Input Gain	0.0 to 300.0%	100.0 (float)	
◆ **P4.17**	Trim Frequency Reference	0.0 to 400.0 Hz	0.0 (float)	
◆ **P4.18**	Trim Mode Select	00: Disable Trim function 01: 1st source frequency + 2nd source freq 02: 1st source frequency - 2nd source freq 03: Speed Command + Trim Frequency Reference (P4.17) 04: Speed Command - Trim Frequency Reference (P4.17)	00	
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Parameter Summary (continued)				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
Presets Parameters				
◆ **P5.00**	Jog Speed	0.0 to 400.0 Hz	6.0	
◆ **P5.01**	Multi-Speed 1	0.0 to 400.0 Hz	0.0	
◆ **P5.02**	Multi-Speed 2	0.0 to 400.0 Hz	0.0	
◆ **P5.03**	Multi-Speed 3	0.0 to 400.0 Hz	0.0	
◆ **P5.04**	Multi-Speed 4	0.0 to 400.0 Hz	0.0	
◆ **P5.05**	Multi-Speed 5	0.0 to 400.0 Hz	0.0	
◆ **P5.06**	Multi-Speed 6	0.0 to 400.0 Hz	0.0	
◆ **P5.07**	Multi-Speed 7	0.0 to 400.0 Hz	0.0	
◆ **P5.08**	Multi-Speed 8	0.0 to 400.0 Hz	0.0	
◆ **P5.09**	Multi-Speed 9	0.0 to 400.0 Hz	0.0	
◆ **P5.10**	Multi-Speed 10	0.0 to 400.0 Hz	0.0	
◆ **P5.11**	Multi-Speed 11	0.0 to 400.0 Hz	0.0	
◆ **P5.12**	Multi-Speed 12	0.0 to 400.0 Hz	0.0	
◆ **P5.13**	Multi-Speed 13	0.0 to 400.0 Hz	0.0	
◆ **P5.14**	Multi-Speed 14	0.0 to 400.0 Hz	0.0	
◆ **P5.15**	Multi-Speed 15	0.0 to 400.0 Hz	0.0	

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◆ Parameter can be set during RUN Mode.

Parameter Summary (continued)				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
Protection Parameters				
P6.00	Electronic Thermal Overload Relay	00: Inverter/Vector Duty Motors 01: Fan Cooled Standard Motors 02: Inactive	00	
P6.01	Auto Restart after Fault	00 to 10	00	
P6.02	Momentary Power Loss	00: Stop operation after momentary power loss 01: Continue operation after momentary power loss, speed search from Speed Reference 02: Continue operation after momentary power loss, speed search from Minimum Speed	00	
P6.03	Reverse Operation Inhibit	00: Enable Reverse Operation 01: Disable Reverse Operation	00	
P6.04	Auto Voltage Regulation	00: AVR enabled 01: AVR disabled 02: AVR disabled during decel 03: AVR disabled during stop	00	
P6.05	Over-Voltage Stall Prevention	00: Enable Over-voltage Stall Prevention 01: Disable Over-voltage Stall Prevention	00	
P6.06	Auto Adjustable Accel/Decel	00: Linear Accel/Decel 01: Auto Accel, Linear Decel 02: Linear Accel, Auto Decel 03: Auto Accel/Decel 04: Auto Accel/Decel Stall Prevention (limited by P1.01, P1.02, P1.05 and P1.06)	00	
P6.07	Over-Torque Detection Mode	00: Disabled 01: Enabled during constant speed operation 02: Enabled during acceleration	00	
P6.08	Over-Torque Detection Level	30 to 200%	150	
P6.09	Over-Torque Detection Time	0.1 to 10.0	0.1	
P6.10	Over-Current Stall Prevention during Acceleration	20 to 200% 00: Disable	150	
P6.11	Over-Current Stall Prevention during Operation	20 to 200%	150	
P6.12	Maximum Allowable Power Loss Time	0.3 to 5.0 sec	2.0	
P6.13	Base-Block Time for Speed Search	0.3 to 5.0 sec	0.5	
P6.14	Maximum Speed Search Current Level	30 to 200%	150	

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Parameter Summary (continued)				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
Protection Parameters (continued)				
P6.15	Upper Bound of Output Frequency	0.1 to 400 Hz	400	
P6.16	Lower Bound of Output Frequency	0.0 to 400 Hz	0.0	
P6.17	Over-Voltage Stall Prevention Level	230V series - 330.0V to 450.0V 460V series - 600.0V to 900.0V	390.0 780.0	
P6.18	Braking Voltage Level	230V series - 370.0V to 450.0V 460V series - 740.0V to 900.0V	380.0 760.0	
P6.30	Line Start Lockout	00: Enable Line Start Lockout 01: Disable Line Start Lockout	00	
P6.31	Present Fault Record	00: No Fault occurred 01: Over-current (oc) 02: Over-voltage (ov) 03: Over-temperature 04: Overload (oL) 05: Thermal Overload (oL1) 06: Over-Torque (oL2) 07: External Fault (EF) 08: CPU failure 1 (CF1) 09: CPU failure 2 (CF2) 10: CPU failure 3 (CF3) 11: Hardware Protection Failure (HPF) 12: Over-current during accel (OCA) 13: Over-current during decel (OCd) 14: Over-current during steady state (OCn) 15:Ground fault or fuse failure (GFF) 17: Input power 3-phase loss 19: Auto Ramp Fault 20: Parameters Locked 21: PID Feedback loss (FbE) 22: Encoder Feedback Loss 23: Output Shorted (OCC) 24: Momentary Power Loss	00	
P6.32	Second Most Recent Fault Record		00	
P6.33	Third Most Recent Fault Record		00	
P6.34	Fourth Most Recent Fault Record		00	
P6.35	Fifth Most Recent Fault Record		00	
P6.36	Sixth Most Recent Fault Record		00	
◆ **P6.37**	Hunting Gain	0 to 1000	0	

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◆ Parameter can be set during RUN Mode.

Parameter Summary (continued)				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
PID Parameters				
P7.00	Input Terminal for PID Feedback	00: Inhibit PID operation 01: Forward-acting (heating loop) PID feedback, PV from AI1 (0 to + 10V) 02: Forward-acting (heating loop) PID feedback, PV from AI2 (4 to 20 mA) 03: Reverse-acting (cooling loop) PID feedback, PV from AI1 (0 to +10V) 04: Reverse-acting (cooling loop) PID feedback, PV from AI2 (4 to 20 mA)	00	
P7.01	PV 100% Value	0.0 to 999	100.0	
P7.02	PID Setpoint Source	00: Keypad 01: Serial Communications 02: AI1 (0 to +10V) 03: AI2 (4 to 20mA)	02	
◆ **P7.03**	PID Feedback Gain	00 to 300.0%	100	
◆ **P7.04**	PID Setpoint Offset Polarity	00: No Offset 01: Positive Offset 02: Negative Offset	00	
◆ **P7.05**	PID Setpoint Offset	0.0 to 100.0%	0.0	
◆ **P7.06**	PID Setpoint Gain	0.0 to 300.0%	100	
◆ **P7.10**	Keypad PID Setpoint	0.0 to 999	0.0	
◆ **P7.11**	PID Multi-setpoint 1	0.0 to 999	0.0	
◆ **P7.12**	PID Multi-setpoint 2	0.0 to 999	0.0	
◆ **P7.13**	PID Multi-setpoint 3	0.0 to 999	0.0	
◆ **P7.14**	PID Multi-setpoint 4	0.0 to 999	0.0	
◆ **P7.15**	PID Multi-setpoint 5	0.0 to 999	0.0	
◆ **P7.16**	PID Multi-setpoint 6	0.0 to 999	0.0	
◆ **P7.17**	PID Multi-setpoint 7	0.0 to 999	0.0	
◆ **P7.20**	Proportional Control	0.0 to 10.0	1.0	
◆ **P7.21**	Integral Control	0.00 to 100.0 sec	1.00	
◆ **P7.22**	Derivative Control	0.00 to 1.00 sec	0.00	
P7.23	Upper Bound for Integral Control	00 to 100%	100	
P7.24	Derivative Filter Time Constant	0.0 to 2.5 sec	0.0	
P7.25	PID Output Frequency Limit	00 to 110%	100	
P7.26	Feedback Signal Detection Time	0.0 to 3600 sec.	60	
P7.27	PID Feedback Loss	00: Warn and AC Drive Stop 01: Warn and continue operation 02: Warn and continue at last frequency 03: Warn and continue at Preset Speed (P7.28)	00	
◆ **P7.28**	PID Feedback Loss Preset Speed	0.0 to 400.0 Hz	0.0	

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Parameter Summary (continued)				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
Display Parameters				
◆ **P8.00**	User Defined Display Function	00: Output Frequency (Hz) 01: Motor Speed (rpm) 02: Scaled Frequency 03: Output Current (A) 04: Motor Load (%) 05: Output Voltage (V) 06: DC Bus Voltage (V) 07: PID Setpoint 08: PID Feedback (PV) 09: Frequency Setpoint	00	
◆ **P8.01**	Frequency Scale Factor	0.01 to 160.0	1.0	
◆ **P8.02**	Backlight Timer	00: Timer Enable (1 min light off) 01:Timer Disable	00	

Communications Parameters				
P9.00	Communication Address	01 to 254	01	
P9.01	Transmission Speed	00: 4800 baud 01: 9600 baud 02: 19200 baud 03: 38400 baud	01	
P9.02	Communication Protocol	00: MODBUS ASCII mode 7 data bits, no parity, 2 stop bits 01: MODBUS ASCII mode 7 data bits, even parity, 1 stop bit 02: MODBUS ASCII mode 7 data bits, odd parity, 1 stop bit 03: MODBUS RTU mode 8 data bits, no parity, 2 stop bits 04: MODBUS RTU mode 8 data bits, even parity, 1 stop bit 05: MODBUS RTU mode 8 data bits, odd parity, 1 stop bit	00	
P9.03	Transmission Fault Treatment	00: Display fault and continue operating 01: Display fault and RAMP to stop 02: Display fault and COAST to stop 03: No fault displayed and continue operating	00	
P9.04	Time Out Detection	00: Disable 01: Enable	00	
P9.05	Time Out Duration	0.1 to 60.0 seconds	0.5	
◆ **P9.07**	Parameter Lock	00: All parameters can be set and read 01: All parameters are read-only	00	
P9.08	**Restore to Default**	**99: Restores all parameters to factory defaults**	00	

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◆ Parameter can be set during RUN Mode.

Parameter Summary (continued)				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
Communications Parameters (continued)				
◆ **P9.11**	Block Transfer Parameter 1	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.12**	Block Transfer Parameter 2	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.13**	Block Transfer Parameter 3	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.14**	Block Transfer Parameter 4	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.15**	Block Transfer Parameter 5	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.16**	Block Transfer Parameter 6	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.17**	Block Transfer Parameter 7	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.18**	Block Transfer Parameter 8	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.19**	Block Transfer Parameter 9	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.20**	Block Transfer Parameter 10	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.21**	Block Transfer Parameter 11	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.22**	Block Transfer Parameter 12	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.23**	Block Transfer Parameter 13	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.24**	Block Transfer Parameter 14	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.25**	Block Transfer Parameter 15	P0.00 to P8.02, P9.99	P9.99	
◆ **P9.26**	Serial Comm Speed Reference	0.0 to 400.0 Hz	60.0	
◆ **P9.27**	Serial Comm RUN Command	00: Stop 01: Run	00	
◆ **P9.28**	Serial Comm Direction Command	00: Forward 01: Reverse	00	
◆ **P9.29**	Serial Comm External Fault	00: No fault 01: External fault	00	
◆ **P9.30**	Serial Comm Fault Reset	00: No action 01: Fault Reset	00	
◆ **P9.31**	Serial Comm JOG Command	00: Stop 01: Jog	00	
P9.39	Firmware Version	#.##	#.##	
◆ **P9.40**	Parameter Copy	00: Disable Copy Keypad Function 01: Enable Copy Keypad Function	00	
P9.41	GS Series Number	01: GS1 02: GS2 03: GS3 04: GS4	##	
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◆ Parameter can be set during RUN Mode.				

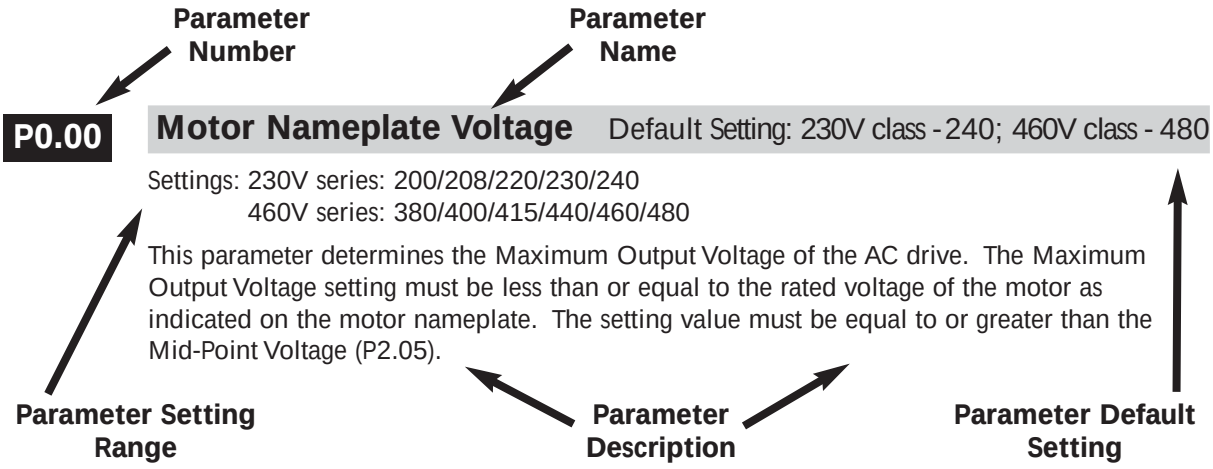
Parameter Summary (continued)				
Parameter *	**Description**	**Range***	**Default Setting**	**User Setting**
Communications Parameters (continued)				
P9.42	Manufacturer Model Information	00: GS3-21P0 (230V 3ph 1.0hp) 01: GS3-22P0 (230V 3ph 2.0hp) 02: GS3-23P0 (230V 3ph 3.0hp) 03: GS3-25P0 (230V 3ph 5.0hp) 04 :GS3-27P5 (230V 3ph 7.5hp) 05: GS3-2010 (230V 3ph 10hp) 06: GS3-2015 (230V 3ph 15hp) 07: GS3-2020 (230V 3ph 20hp) 08: GS3-2025 (230V 3ph 25hp) 09: GS3-2030 (230V 3ph 30hp) 10: GS3-2040 (230V 3ph 40hp) 11: GS3-2050 (230V 3ph 50hp) 12: GS3-41P0 (460V 3ph 1.0hp) 13: GS3-42P0 (460V 3ph 2.0hp) 14: GS3-43P0 (460V 3ph 3.0hp) 15: GS3-45P0 (460V 3ph 5.0hp) 16: GS3-47P5 (460V 3ph 7.5hp) 17: GS3-4010 (460V 3ph 10hp) 18: GS3-4015 (460V 3ph 15hp) 19: GS3-4020 (460V 3ph 20hp) 20: GS3-4025 (460V 3ph 25hp) 21: GS3-4030 (460V 3ph 30hp) 22: GS3-4040 (460V 3ph 40hp) 23: GS3-4050 (460V 3ph 50hp) 24: GS3-4060 (460V 3ph 60hp) 25: GS3-4075 (460V 3ph 75hp) 26: GS3-4100 (460V 3ph 100hp)	##	N/A

Encoder Feedback Parameters				
P10.00	Encoder Pulses per Revolution	01 to 20000	1024	
P10.01	Encoder Type Input	00: Disable 01: Single Phase 02: Quadrature, FWD - CCW 03: Quadrature, FWD - CW	00	
◆ **P10.02**	Proportional Control	0.0 to 10.0	1.0	
◆ **P10.03**	Integral Control	0.00 to 100.00 sec	1.00	
P10.04	Encoder Control Output Limit	0.0 to 20.0%	7.5	
P10.05	Encoder Loss Detection	00: Warn and continue operation 01: Warn and RAMP to stop 02: Warn and COAST to stop	00	

***** Some parameters and settings are available only in later firmware versions of *DURAPULSE* drives. Refer to the beginning of this "*DURAPULSE* Parameter Summary" section for more information.

◆ Parameter can be set during RUN Mode.

Detailed Parameter Listings



If the ◆ symbol is found next to the parameter name, the parameter can be edited when the AC drive is in RUN Mode.

Motor Parameters

P0.00 **Motor Nameplate Voltage** Default Setting: 230V class - 240 / 460V class - 480

Settings: 230V series: 200/208/220/230/240
460V series: 380/400/415/440/460/480

This parameter determines the Maximum Output Voltage of the AC drive. The Maximum Output Voltage setting must be less than or equal to the rated voltage of the motor as indicated on the motor nameplate. The setting value must be equal to or greater than the Mid-Point Voltage (P2.05).

P0.01 **Motor Nameplate Amps** Default Setting: Drive Rating (A)

Range: Drive Rated Amps x 0.4 to Drive Rated Amps x 1.0

This parameter sets the output current to the motor, and is used by the drive to set the motor overload protection. Set this parameter value to the full load current listed on the motor nameplate. (Also refer to P6.00 to set overload current type.)

P0.02 **Motor Base Frequency** Default Setting 60

Range: 50/60/400

This parameter should be set to the base frequency of the motor as indicated on the motor nameplate. Motor Base Frequency determines the volts per hertz ratio.

P0.03 Motor Base RPM

Default Setting: 1750

Range: 375 to 24,000 RPM

- This value should be set according to rated Base RPM of the motor as indicated on the motor nameplate.

P0.04 Motor Maximum RPM

Default Setting: P0.03

Range: P0.03 to 24,000 rpm

- This value should be set according to the desired maximum speed of the motor. This value should not exceed the motor's maximum rated speed.

Warning: The Motor Maximum RPM parameter (P0.04) should never exceed the maximum RPM rating for the motor you are using. If this information is not readily available, consult your motor manufacturer.

- This value cannot be set lower than Motor Base RPM (P0.03).

This parameter, along with P0.02 and P0.03, determines the Maximum Output Frequency of the AC Drive. The Maximum Output Frequency can be calculated as follows:

$$\textbf{Max. Output Frequency} = \left(\frac{\text{Maximum Speed (P 0.04)}}{\text{Base Speed (P 0.03)}}\right) \text{x Base Frequency (P 0.02)}$$

- If an output limit based on Maximum Output Frequency is desired, use the following equation to determine the corresponding value for Motor Maximum RPM:

$$\textbf{Motor Maximum RPM} = \left(\frac{\text{Max. Output Frequency}}{\text{Motor Base Frequency (P 0.02)}}\right) \text{x Motor Base RPM (P 0.03)}$$

P0.05 Motor Auto Tune

Default Setting: 00

Settings: 00 Disable
01 Enable P0.06 only (R1)
02 Enable P0.06 and P0.07 (R1 + No-load Test)

- Auto-tuning is required only for Sensorless Vector Control Modes (P2.10 = 02, 03, 05).

Do NOT set auto-tuning without a motor connected. Also, do NOT set auto-tuning with any mechanical load connected to the motor output shaft.

The unit will auto detect when you press the RUN key after this parameter is set to 01 or 02. When set to 01, the unit will auto detect only the motor R1 line to line resistance value (P0.06); manually enter the motor no-load current in P0.07. When set to 02, the values of both P0.06 and P0.07 will be filled in automatically.

Refer to the "Auto-Tune Procedure" subsection of chapter 3 for step-by-step auto-tuning instructions.

P0.06 Motor Line-to-Line Resistance R1

Default: 00

Range: 00 to 65535 milliohm

The motor auto detection feature will set this parameter. The user may also set this parameter without using P0.05. Some motor manufacturers list this value on the motor nameplate.

P0.07 Motor No-Load Current

Default: Drive Rated Amps x 0.4

Range: Drive Rated Amps x 0.0 to 0.9 (Amps)

The rated current of the AC drive is regarded as 100%. The setting of the motor no-load current will affect the slip compensation. The setting value must be less than the Motor Rated Current (P0.01).

Ramp Parameters

P1.00 Stop Methods

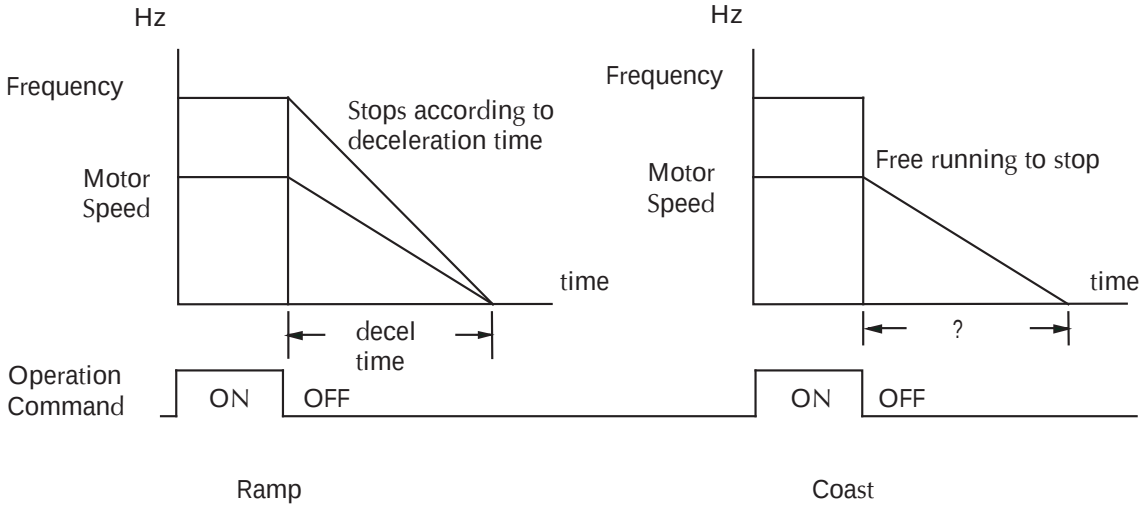
Default Setting: 00

Range: 00 Ramp to Stop
01 Coast to stop

This parameter determines how the motor is stopped when the AC drive receives a valid stop command.

- Ramp: The AC drive decelerates the motor to Minimum Output Frequency (P2.06) and then stops according to the deceleration time set in P1.02 or P1.06.
- Coast: The AC drive stops output instantly upon command, and the motor free runs until it comes to a complete stop.

The drive application or system requirements will determine which stop method is needed.



P1.01 ◆ Acceleration Time 1

Default Setting: 10 sec

Range: 0.1 to 600 sec

This parameter is used to determine the time required for the AC drive to ramp from 0 to its Maximum Motor RPM (P0.04). The rate is linear unless S-Curve is "Enabled" (P1.03 > 0).

P1.02 ◆ Deceleration Time 1

Default Setting: 30 sec

Range: 0.1 to 600 sec

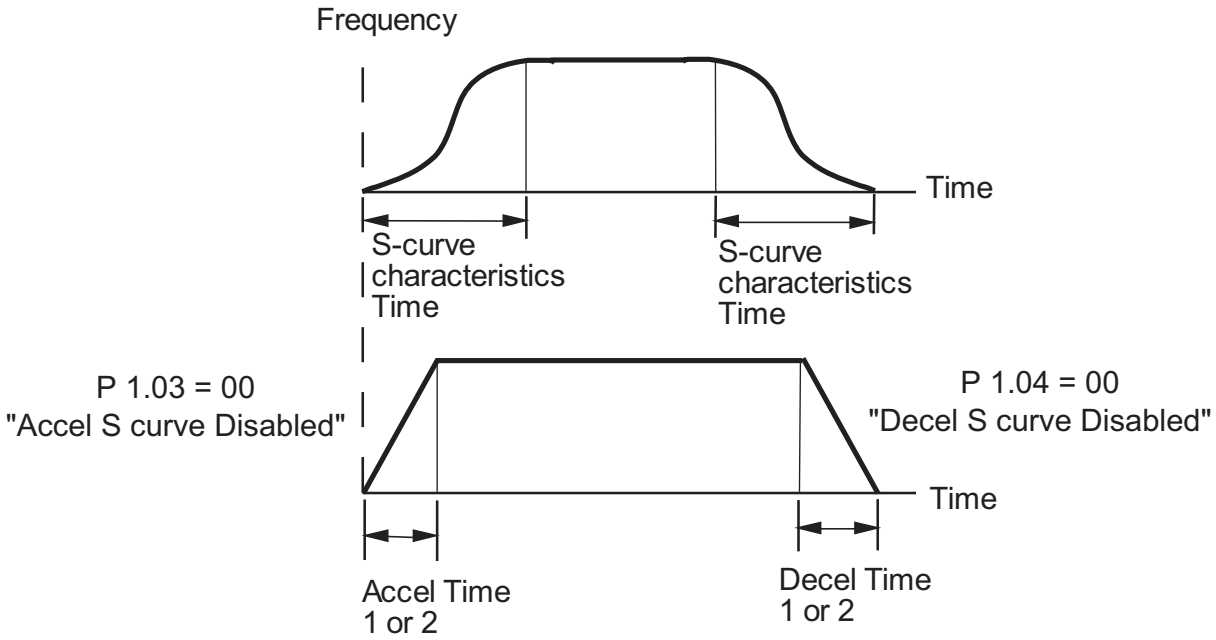
This parameter is used to determine the time required for the AC drive to decelerate from the Maximum Motor RPM (P0.04) down to 0Hz. The rate is linear unless S-Curve is "Enabled" (P1.04 > 0).

P1.03 Accel S-Curve

Default Setting: 00

Range: 00 to 07

This parameter is used whenever the motor and load need to be accelerated more smoothly. The Accel S-Curve may be set from 0 to 7 to select the desired acceleration S Curve.



S-curves can only be seen when the motor is loaded. Static testing will result in no noticeable change on tuning software (i.e. GSoft).

Accel / Decel times 1 and 2 are applied to S-curve calculations.

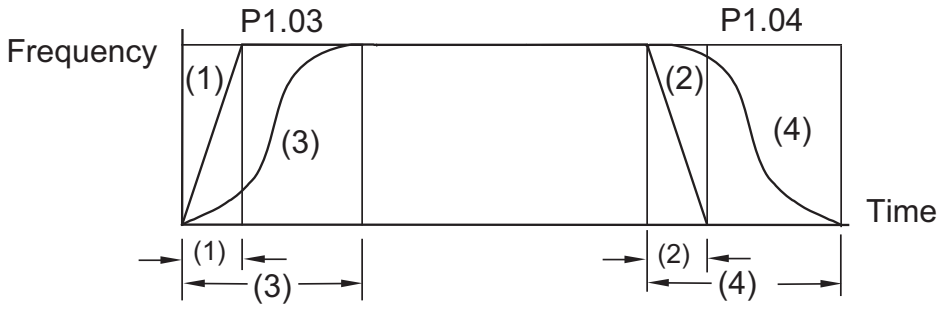
P1.04 Decel S-Curve

Default Setting: 00

Range: 00 to 07

This parameter is used whenever the motor and load need to be decelerated more smoothly. The Decel S-Curve may be set from 00 to 07 to select the desired deceleration S-Curve.

From the diagram shown below, the original setting accel/decel time will be for reference when the function of the S-curve is enabled. The actual accel/decel time will be determined based on the S-curve selected (1 to 7).



S curve is disabled in (1), (2)
P1.03 sets S curve for (3)
P1.04 sets S curve for (4)

P1.05 ◆ Acceleration Time 2

Default Setting: 10.0

Range: 0.1 to 600 sec

The Second Acceleration Time determines the time for the AC drive to accelerate from 0 RPM to Maximum Motor RPM (P0.04). Acceleration Time 2 (P1.05) can be selected using a multi-function input terminal or frequency transition (P1.07).

P1.06 ◆ Deceleration Time 2

Default Setting: 30 sec

Range: 0.1 to 600 sec

The Second Deceleration Time determines the time for the AC drive to decelerate from Maximum Motor RPM (P0.04) to 0 RPM. Deceleration Time 2 (P1.06) can be selected using a multi-function input terminal or frequency transition (P1.07).

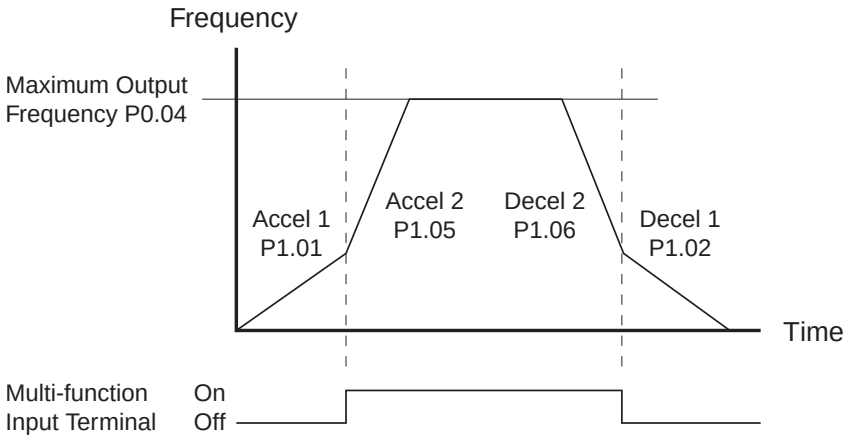
P1.07 Select Method for 2nd Accel/Decel

Default Setting: 00

Range: 00: Second Accel/Decel from terminal
01: Frequency Transitions P1.08 & P1.09

The second set of acceleration and deceleration times P1.05 and P1.06 can be selected either with a multi-function input terminal programmed to Second Accel/Decel, or by the values of the transition frequencies P1.08 and P1.09.

Second Accel/Decel Times selected with Multi-Function Input Terminal



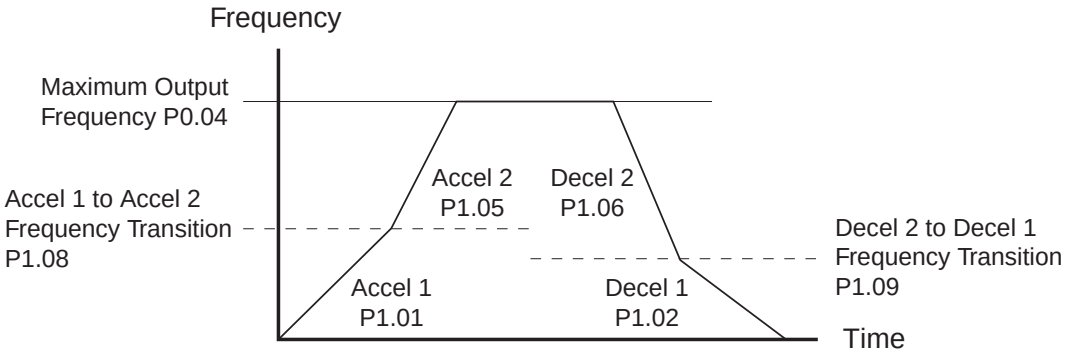
P1.08 Accel 1 to Accel 2 Frequency Transition

Default Setting: 0.0

Range: 0.0 to 400.0 Hz

This parameter sets the frequency at which the AC drive changes acceleration rate from Acceleration Time 1 (P1.01) to Acceleration Time 2 (P1.05).

Second Accel/Decel Times selected with Frequency Transition



P1.09 Decel 2 to Decel 1 Frequency Transition

Default Setting: 0.0

Range: 0.0 to 400.0 Hz

This parameter sets the frequency at which the AC drive changes deceleration rate from Deceleration Time 2 (P1.06) to Deceleration Time 1 (P1.02).

P1.10 **Skip Frequency 1** Default Setting: 0.0

Range: 0.0 to 400.0Hz

P1.11 **Skip Frequency 2** Default Setting: 0.0

Range: 0.0 to 400.0Hz

P1.12 **Skip Frequency 3** Default Setting: 0.0

Range: 0.0 to 400.0 Hz

- P1.10, P1.11, and P1.12 determine the location of the frequency bands that will be skipped during AC drive operation.

P1.13 **Skip Frequency 4** Default Setting: 0.0

Range: 0.0 to 400.0 Hz

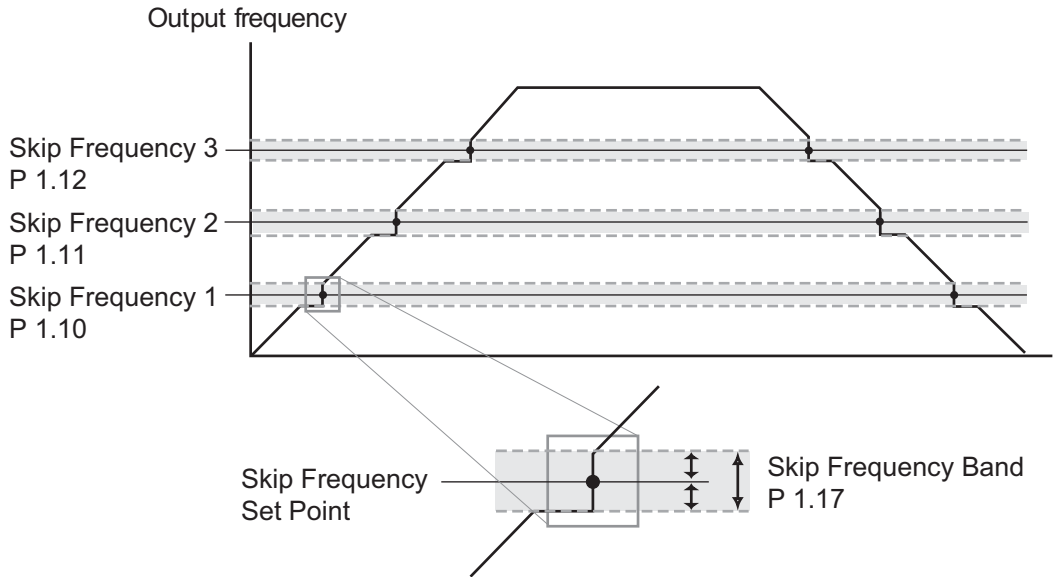
P1.14 **Skip Frequency 5** Default Setting: 0.0

Range: 0.0 to 400.0 Hz

P1.17 **Skip Frequency Band** Default Setting: 0.0

Range: 0.0 to 20.0 Hz

This parameter determines the frequency band for a given Skip Frequency (P1.10, P1.11, or P1.12). Half of the Skip Frequency Band is above the Skip Frequency and the other half is below. Programming this parameter to 0.0 disables all skip frequencies.



P1.18 DC Injection Current Level

Default Setting: 00

Range: 00 to 100%

This parameter determines the amount of DC Braking Current applied to the motor during start-up and stopping. When setting DC Braking Current, please note that 100% is equal to the rated current of the drive. It is recommended to start with a low DC Braking Current Level and then increase until proper holding torque has been attained.

P1.20 DC Injection during Start-up

Default Setting: 0.0

Range: 0.0 to 5.0 sec

This parameter determines the duration of time that the DC Braking Current will be applied to the motor during the AC drive start-up. DC Braking will be applied for the time set in this parameter until the Minimum Frequency is reached during acceleration.

P1.21 DC Injection during Stopping

Default Setting: 0.0

Range: 0.0 to 25.0 sec

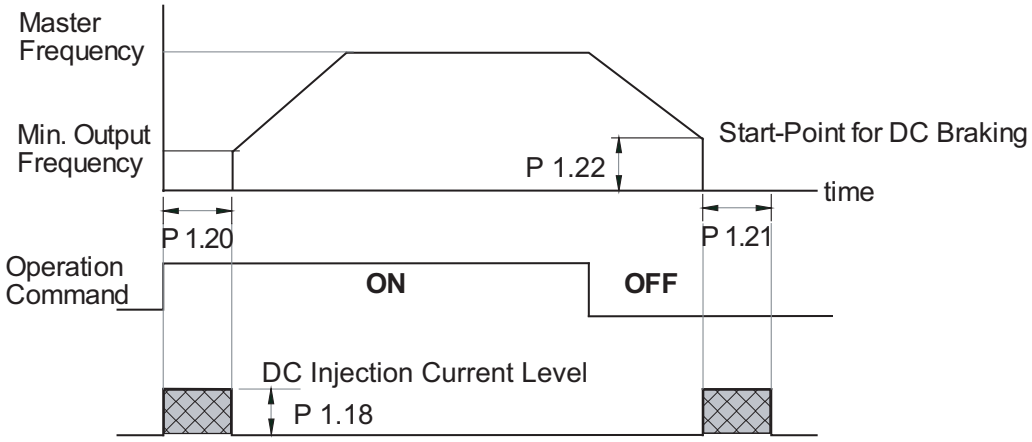
This parameter determines the duration of time that the DC braking voltage will be applied to the motor during stopping. If stopping with DC Braking is desired, then P1.00 must be set to Ramp to Stop (00).

P1.22 Start-point for DC Injection

Default Setting: 0.0

Range: 0.0 to 60.0 Hz

This parameter determines the frequency when DC Braking will begin during deceleration.



Volts/Hertz Parameters

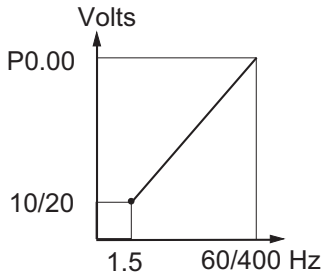
P2.00 **Volts/Hertz Settings** Default Setting: 0.0

Settings:

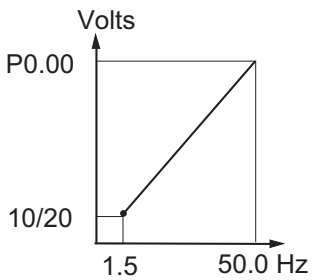
00	General Purpose (constant torque)
01	High Starting Torque
02	Fans and Pumps (variable torque)
03	Custom

P2.04 through P2.07 are only used when the Volts/Hertz parameter (P2.00) is set to 03.

00: General Purpose

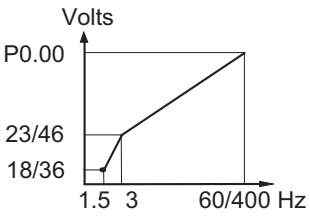


60/400Hz Base Frequency

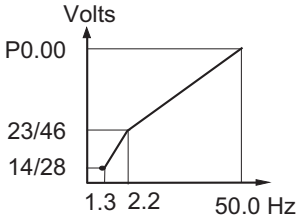


50Hz Base Frequency

01: High Starting Torque

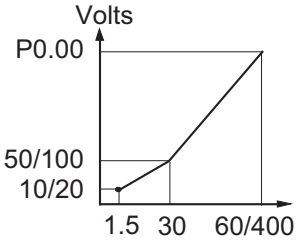


60/400Hz Base Frequency

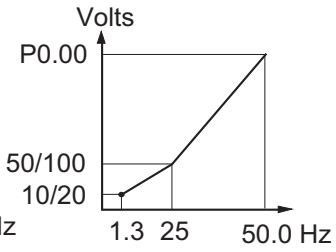


50Hz Base Frequency

02: Fans and Pumps

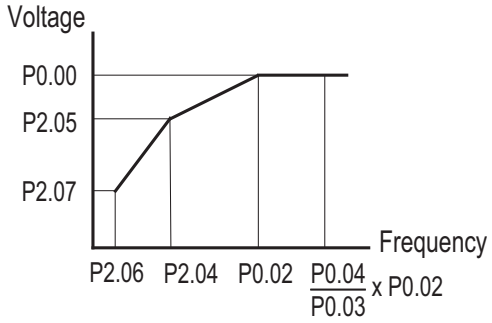


60/400Hz Base Frequency



50Hz Base Frequency

03: Custom



A custom curve can be applied for nonstandard motors.

Example:

These settings keep the V/Hz ratio at 380/300 for a motor rated 380V, 18000 rpm, 300 Hz:

P0.00 = 460V or 400V
P0.02 = 400 Hz
P2.00 = 03
P2.04 = 300 Hz
P2.05 = 380V
P2.06 = 1.5 Hz
P2.07 = 20V
P6.15 = 300 Hz

P2.01 ◆ Slip Compensation

Default Setting: V/Hz mode: 0.0 / Vector mode: 1.0

Range: 0.0 to 10.0

This parameter can be used to partially compensate for the slip inherent in asynchronous three phase AC induction motors. An increase in load on the motor will result in an increase in slip within the motor. When this parameter is set above zero, the drive automatically increases the output frequency as the load increases. The higher the parameter setting, the more aggressively the drive increases the output frequency. The drive compares the actual output current to the values of P0.01 (Motor Nameplate Amps) and P0.07 (Motor No-Load Current) in order to determine the required output frequency increase.

The proper setting for P2.01 is determined by trial and error. Correct settings of P0.01, P0.07, and P2.09 (if applicable) are important for proper operation of this slip compensation feature.

P2.02 ◆ Auto-torque Boost

Default Setting: 00

Range: 00 to 10

This parameter functions similarly to the High Starting Torque setting of the V/Hz Settings parameter (P2.00 = 01), except that this parameter (P2.02) uses less current. The High Starting Torque setting of P2.00 boosts starting torque by increasing current at every start beyond what is required to move the load. However, P2.02 Auto-torque Boost increases the current only as required to move the load. The proper setting for P2.02 is determined by trial and error.

- This parameter only applies in V/Hz mode.

P2.03 Torque Compensation Time Constant

Default Setting: 0.05

Range: 00 to 10 sec

This parameter is essentially a low-pass filter which affects how Auto-Torque Boost (P2.02) is applied. When this parameter is set to zero, Auto-Torque Boost is applied instantaneously. When this parameter is set greater than zero, Auto-Torque Boost is applied gradually over the time period set by this parameter.

P2.04 through P2.07 are used only when the Volts/Hertz parameter (P2.00) is set to 03. If trying to set when P2.00 is not 03, "ERR" will result.

P2.04 Mid-point Frequency

Default Setting: 1.5

Range: 0.1 to 400 Hz

This parameter sets the Mid-Point Frequency of V/F curve. With this setting, the V/F ratio between Minimum Frequency and Mid-Point frequency can be determined.

This parameter must be greater than or equal to the Minimum Output Frequency (P2.06) and less than or equal to the Maximum Voltage Frequency (P0.02). This parameter is used only when the Volts/Hertz Settings parameter (P2.00) is set to 03, custom.

P2.05 Mid-point Voltage

Default Setting: 230V class: 10.0 / 460V class: 20.0

Range: 230V class: 0.1 to 240V
460V class: 0.1 to 480V

This parameter sets the Mid-Point Voltage of any V/F curve. With this setting, the V/F ratio between Minimum Frequency and Mid-Point Frequency can be determined.

This parameter must be greater than or equal to the Minimum Output Voltage (P2.07) and less than or equal to the Maximum Output Voltage (P0.00). This parameter is used only when the Volts/Hertz Settings parameter (P2.00) is set to 03, custom.

P2.06 Minimum Output Frequency

Default Setting: 1.5

Range: 0.1 to 20.0 Hz

This parameter sets the Minimum Output Frequency of the AC drive.

This parameter must be less than or equal to the Mid-Point Frequency (P2.04). This parameter is used only when the Volts/Hertz Settings parameter (P2.00) is set to 03, custom.

P2.07 Minimum Output Voltage

Default Setting: 230V class: 10.0 / 460V class: 20.0

Range: 230V class: 0.1 to 50V
460V class: 0.1 to 100V

This parameter sets the Minimum Output Voltage of the AC drive.

This parameter must be equal to or less than Mid-Point Voltage (P2.05). This parameter is used only when the Volts/Hertz Settings parameter (P2.00) is set to 03, custom.

P2.08 PWM Carrier Frequency

Default Settings: 15/09/06/06

Range: 1 to 5 hp; 01 to 15 kHz — Default Setting: 15
7.5 to 25 hp; 01 to 15 kHz — 09
30 to 60 hp; 01 to 09 kHz — 06
75 to 100 hp, 01 to 06 kHz — 06

This parameter sets the carrier frequency of PWM (Pulse-Width Modulated) output.

- In the table below, we see that the carrier frequency of PWM output has a significant influence on the electromagnetic noise, leakage current and heat dissipation of the AC drive, and the acoustic noise to the motor.

Carrier Frequency	Acoustic Noise	Electromagnetic Noise, Leakage Current	Heat Dissipation
1kHz	significant	minimal	minimal
15kHz	minimal	moderate	moderate

P2.09 Slip Compensation Time Constant

Default Setting: 0.10

Range: 0.05 to 10.00 sec

This parameter is usually applied to heavy-load applications in which the motor speed is changed frequently. It acts as a damper for P2.01, Slip Compensation, which changes the output frequency to compensate for motor slip due to heavy loads. Frequent speed changes can cause system vibration, and P2.09 can be adjusted while monitoring drive/motor operation to reduce that vibration.

Increasing P2.09 slows the Slip Compensation response (loosens speed regulation).

Decreasing P2.09 speeds the Slip Compensation response (tightens speed regulation).

- This parameter is enabled only in the “high-speed regulation” control modes; (P2.10 = 04 or 05).
- This parameter is available only with AC drive firmware v1.05 or higher. Refer to P9.39 to determine the drive’s firmware version.

P2.10 Control Mode

Default: 00

Range: 00: V/Hz without encoder feedback
01: V/Hz with encoder feedback
02: Sensorless Vector without encoder feedback
03: Sensorless Vector with encoder feedback
04: V/Hz with encoder feedback and high-speed regulation
05: Sensorless Vector with encoder feedback and high-speed regulation

This parameter determines the control method of the AC drive.

The V/Hz modes (00, 01, & 04) are the basic control modes.

The Sensorless Vector modes (02, 03, & 05) allow improved torque performance at very low speeds and improved speed regulation. These modes require Auto-Tuning per P0.05 in order to match the characteristics of the particular motor being used.

The encoder feedback settings (01, 03, 04, & 05) require the installation of an optional GS3-FB feedback card in order for the drive to read the encoder signal from the motor. (Refer to Appendix A of this manual for more information regarding the GS3-FB.)

The high-speed regulation settings (04 & 05) enable two other parameters which can be used to reduce system vibration:
Slip Compensation Time Constant (P2.09) and Hunting Gain (P6.37).

Digital Parameters

P3.00 Source of Operation Command — Default Setting: 00

Settings:

00	Operation Determined by Digital Keypad
01	Operation determined by external control terminals. Keypad STOP is enabled.
02	Operation determined by external control terminals. Keypad STOP is disabled.
03	Operation determined by communication interface. Keypad STOP is enabled.
04	Operation determined by communication interface. Keypad STOP is disabled.

This parameter sets the input source for the AC drive operation commands. Refer to P3.01 to P3.10 for more details.

P3.01 Multi-Function Input Terminals (DI1-DI2) — Default Setting: 00

Settings:

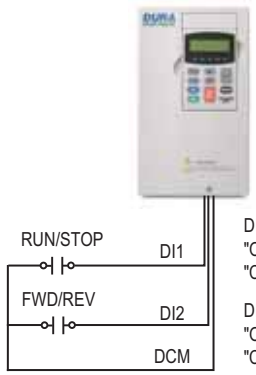
00	DI1 - FWD/STOP DI2 - REV/STOP
01	DI1 - RUN/STOP DI2 - REV/FWD
02	DI1 - RUN (used with momentary N.O. contact) DI2 - REV/FWD DI3 - STOP (used with momentary N.C. contact)

Multi-function Input Terminals DI1 and DI2 do not have separate parameter designations. DI1 and DI2 must be used in conjunction with each other to operate two and three wire control.

P3.01: Setting 00

DI1	DI2	Result
OFF	OFF	STOP
ON	OFF	FWD
OFF	ON	REV
ON	ON	STOP

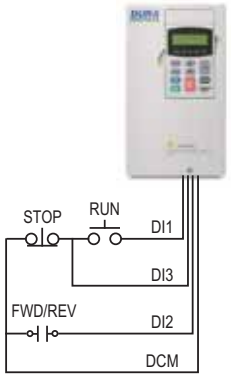
P3.01: Setting 01



DI1- RUN/STOP select
"Open" : Stop
"Close" : Run

DI2- FWD/REV select
"Open" : FWD
"Close" : REV

P3.01: Setting 02



DI1- RUN command
Latching input (N.O.)
Runs from momentary contact closure

DI2- FWD/REV select
"Open" : FWD
"Close" : REV

DI3- STOP command
Latching input (N.C.)
Stops from momentary contact opening

P3.02	**Multi-Function Input (DI3)**	Default Setting: 00
P3.03	**Multi-Function Input (DI4)**	Default Setting: 03
P3.04	**Multi-Function Input (DI5)**	Default Setting: 04
P3.05	**Multi-Function Input (DI6)**	Default Setting: 05
P3.06	**Multi-Function Input (DI7)**	Default Setting: 06
P3.07	**Multi-Function Input (DI8)**	Default Setting: 09
P3.08	**Multi-Function Input (DI9)**	Default Setting: 02
P3.09	**Multi-Function Input (DI10)**	Default Setting: 12
P3.10	**Multi-Function Input (DI11)**	Default Setting: 10

Settings for P3.02 to P3.10:

00	**External Fault (N.O.)
01	**External Fault (N.C.)
02	External Reset
03	Multi-Speed Bit 1 / PID Setpoint Bit 1
04	Multi-Speed Bit 2 / PID Setpoint Bit 2
05	Multi-Speed Bit 3 / PID Setpoint Bit 3
06	Multi-Speed Bit 4
07	Manual Keypad Control
08	Reserved
09	Jog
10	External Base Block (N.O.)
11	External Base Block (N.C.)
12	Second Accel/Decel Time
13	Speed Hold (P4.00 must be set to 01.)
14	***Increase Speed (P4.00 must be set to 01.)
15	***Decrease Speed (P4.00 must be set to 01.)
16	Reset Speed to Zero (P4.00 must be set to 01.)
17	PID Disable (N.O.)
18	PID Disable (N.C.)
*19	1st/2nd Source Select (N.O.)
*20	1st/2nd Source Select (N.C.)
99	Input Disable

** Parameter setting available only with firmware v1.04 or higher (refer to P9.39)*

*** Use either setting 00 or 01, but not both. Use interposing relays if more contacts are needed.*

**** Accel / Decel times must be more than one second in order for Increase (14) and Decrease (15) Speed settings to work efficiently.*

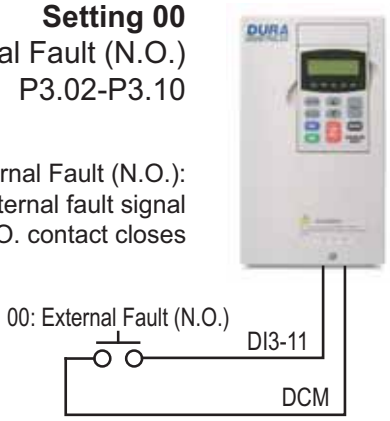
Setting Explanations for Parameters P3.02 through P3.10

Settings 00 and 01: External Fault (N.O. & N.C.)

When an External Fault input signal is received, the AC drive output will turn off, the drive will display the words "External Fault" on the LED Display, and the motor will Coast to Stop. To resume normal operation, the external fault must be cleared, and the drive must be reset. (The drive can be reset from the STOP/RESET key on the keypad, or from a contact wired to a digital input set for function 02, External Reset.)

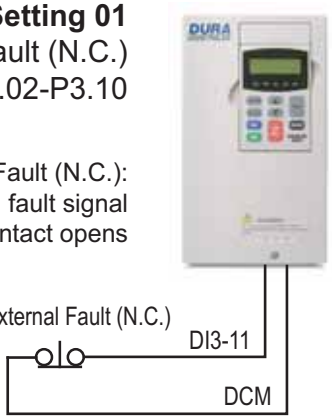
Setting 00
External Fault (N.O.)
P3.02-P3.10

External Fault (N.O.):
Drive receives external fault signal
when N.O. contact closes



Setting 01
External Fault (N.C.)
P3.02-P3.10

External Fault (N.C.):
Drive receives external fault signal
when N.C. contact opens



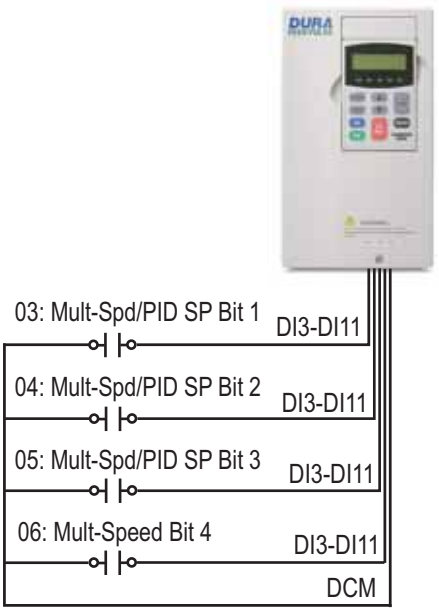
- Use either setting 00 or 01, but not both. Use interposing relays if more contacts are needed.

Setting 02: External Reset

An External Reset has the same function as the STOP/RESET key on the digital keypad. Use an External Reset to reset the drive after a fault.

Settings 03, 04, and 05: PID Setpoint Bits 1, 2, 3
Settings 03, 04, 05 and 06: Multi-Speed Bits 1, 2, 3 and 4

The four Multi-Speed Bits are used to select the multi-speed settings defined by parameters P5.01 to P5.15. The first three of these bits can also be used to select a PID setpoint, if PID is enabled (P7.00 ≠ 0.)



Multi-Speed / PID SP				Speed Selection	PID SP Selection
Bit 4	Bit 3	Bit 2	Bit 1		
OFF	OFF	OFF	OFF	P4.00	P7.02
OFF	OFF	OFF	ON	P5.01: Spd 1	P7.11: SP 1
OFF	OFF	ON	OFF	P5.02: Spd 2	P7.12: SP 2
OFF	OFF	ON	ON	P5.03: Spd 3	P7.13: SP 3
OFF	ON	OFF	OFF	P5.04: Spd 4	P7.14: SP 4
OFF	ON	OFF	ON	P5.05: Spd 5	P7.15: SP 5
OFF	ON	ON	OFF	P5.06: Spd 6	P7.16: SP 6
OFF	ON	ON	ON	P5.07: Spd 7	P7.17: SP 7
ON	OFF	OFF	OFF	P5.08: Spd 8	-
ON	OFF	OFF	ON	P5.09: Spd 9	-
ON	OFF	ON	OFF	P5.10: Spd 10	-
ON	OFF	ON	ON	P5.11: Spd 11	-
ON	ON	OFF	OFF	P5.12: Spd 12	-
ON	ON	OFF	ON	P5.13: Spd 13	-
ON	ON	ON	OFF	P5.14: Spd 14	-
ON	ON	ON	ON	P5.15: Spd 15	-

In order to use the Multi-Speed settings, P5.01 - P5.15 must be set.
In order to use the Multi-PID SPs, P7.11 - P7.17 must be set, and P7.00 ≠ 0.

When all Multi-Speed inputs are off, the AC drive reverts back to the Command Frequency (P4.00). When all PID Multi-Setpoint inputs are off, the AC drive reverts back to the PID Setpoint Source (P7.02).

Setting 07

This setting is used to temporarily switch to the keypad RUN and STOP buttons as the source of the operation command for run and stop functions. It does NOT change the source of the frequency command for the speed reference. Useful for troubleshooting.

Setting 09: Jog Command

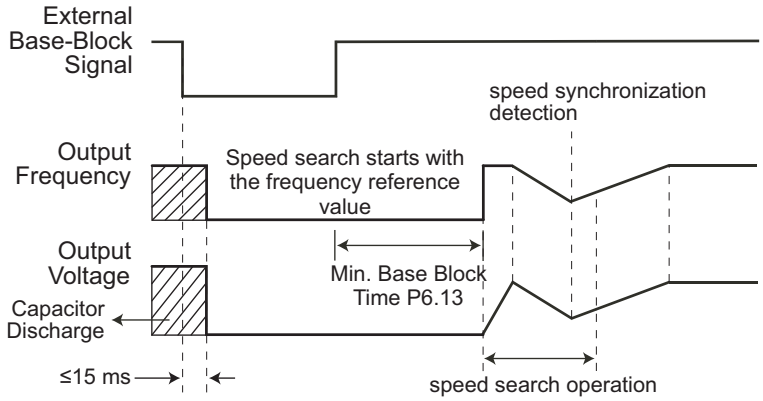
This setting configures a Multi-function Input Terminal to run the motor at a preset speed only while the Jog Input is activated. Set the Jog Speed in P5.00. The Jog function can be used in combination with a FWD/REV signal (P3.01 = 01 or 02) to Jog in forward or reverse directions.

The drive must be stopped to initiate this command. The Jog Command cannot be used simultaneously with an active FWD/STOP, REV/STOP, or RUN/STOP command.

Settings 10 and 11: External Base Block (N.O.) and External Base Block (N.C.)

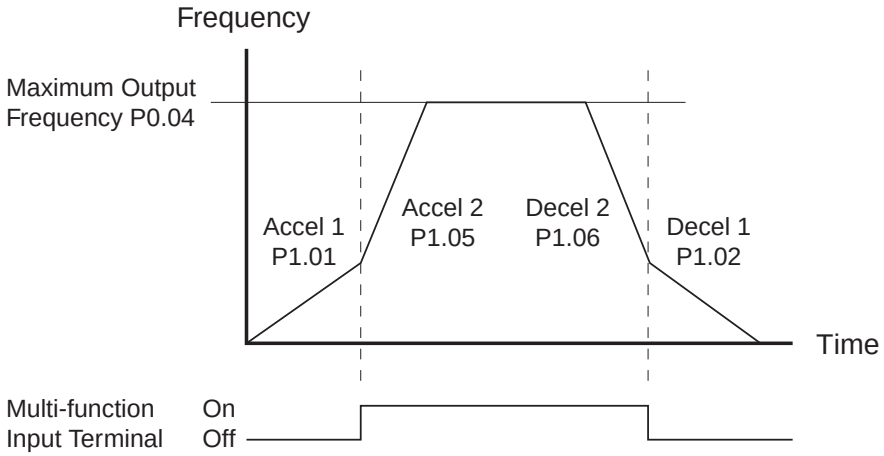
Value 10 is for a normally open (N.O) input, and value 11 is for a normally closed (N.C.) input.

When an External Base Block is activated, the LCD display reads "EXT.BASE-BLOCK," the AC drive stops all output, and the motor will free run. When the External Base Block is deactivated, the AC drive will start the speed search function and synchronize with the motor speed. The AC drive will then accelerate to the Master Frequency.



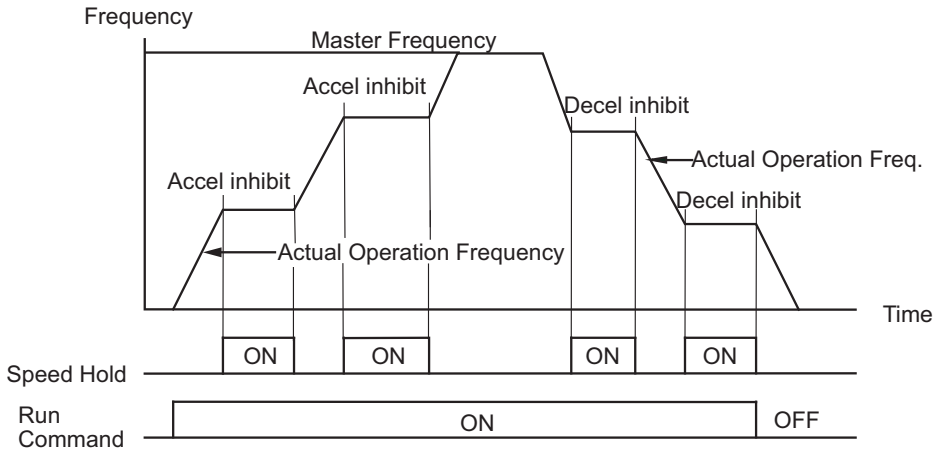
Setting 12: Second Accel/Decel Time

Multi-function Input Terminals DI3~DI11 can be set to select between Accel/Decel times 1 and 2. Parameters P1.01 and P1.02 set Accel 1 and Decel 1 times. Parameters P1.05 and P1.06 set Accel 2 and Decel 2 times.



Setting 13: Speed Hold

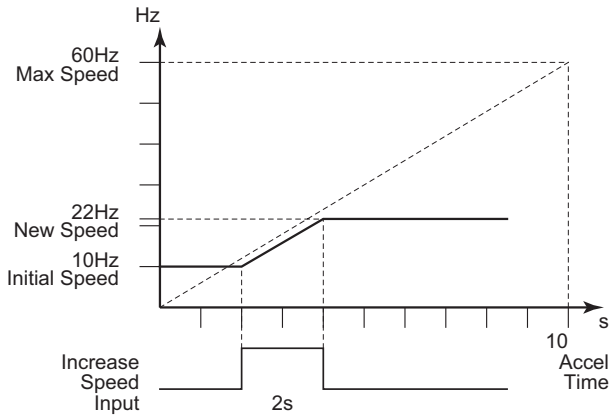
When the Speed Hold command is received, the drive acceleration or deceleration is stopped and the drive maintains a constant speed.



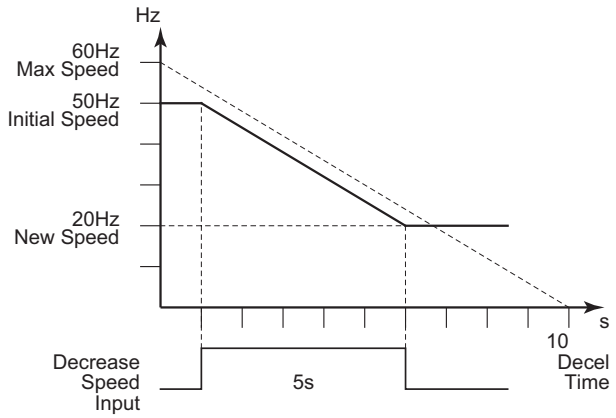
Settings 14 and 15: Increase and Decrease Speed (Electronic Motor Operated Potentiometer)

Settings 14 and 15 allow the Multi-function terminals to be used to increase or decrease speed. As long as the DI terminal is activated, the speed reference will continuously increase or decrease using the acceleration and deceleration ramp settings.

- Increase Speed rate of change = P0.04(Hz) / P1.01(s)
- Decrease Speed rate of change = P0.04(Hz) / P1.02(s)
- Example:
  For P0.04 = 60Hz; P1.01 = P1.02 = 10s; rate of change = 60Hz/10s = 6Hz/s



Speed Increase = (2s)(6Hz/s) = 12Hz
New Speed = 10Hz + 12Hz = 22Hz



Speed Decrease = (5s)(6Hz/s) = 30Hz
New Speed = 50Hz - 30Hz = 20Hz

- *In order to use these settings, P4.00 must be set to 01.*
- *Accel / Decel times must be more than one second to work efficiently.*

Setting 16: Reset Speed to Zero

This setting allows a Multi-function input terminal to reset the drive output frequency to zero.

Settings 17 and 18: PID Disable (N.O) and (N.C.)

Settings 17 and 18 set the Multi-function terminals to disable PID operation.

Settings 19* and 20*: 1st/2nd Source Select (N.O.) and (N.C.)

The AC drive runs from the (1st) Source of Operation Command (P3.00) and the (1st) Source of Frequency Command (P4.00) if the 1st/2nd Source Select signal is inactive.

The AC drive runs from the 2nd Source of Operation Command (P3.31) and the 2nd Source of Frequency Command (P4.13) if the 1st/2nd Source Select signal is active.

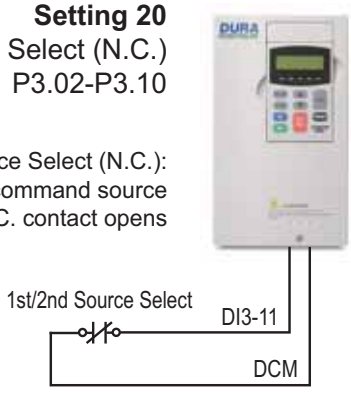
- Among other uses, these two settings allow the drive operation to be switched back and forth between local and remote control.

Setting 19
1st/2nd Source Select (N.O.)
P3.02-P3.10

1st/2nd Source Select (N.O.):
Drive selects the 2nd command source when N.O. contact closes

Setting 20
1st/2nd Source Select (N.C.)
P3.02-P3.10

1st/2nd Source Select (N.C.):
Drive selects the 2nd command source when N.C. contact opens



** Parameter settings 19 and 20 are available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version.*

Setting 99: Multi-Function Input Disable

Setting a Multi-Function Input to 99 will disable that input. The purpose of this function is to provide isolation for unused Multi-Function Input Terminals. Any unused terminals should be programmed to 99 to make sure they have no effect on drive operation.

Any unused terminals should be programmed to 99 to make sure they have no effect on drive operation.

P3.11 **Multi-Function Output Terminal 1 (Relay Output)** Default Setting: 00

P3.12 **Multi-Function Output Terminal 2 (DO1)** Default Setting: 01

P3.13 **Multi-Function Output Terminal 3 (DO2)** Default Setting: 02

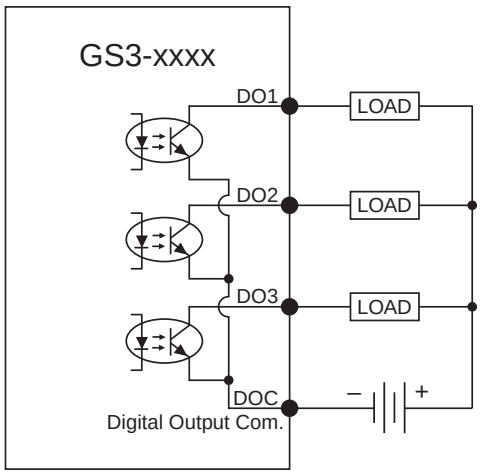
P3.14 **Multi-Function Output Terminal 4 (DO3)** Default Setting: 03

Settings for P3.11 - P3.14:

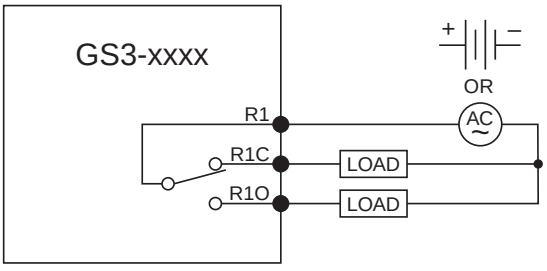
00	AC Drive Running
01	AC Drive Fault
02	At Speed
03	Zero Speed
04	Above Desired Frequency (P3.16)
05	Below Desired Frequency (P3.16)
06	At Maximum Speed (P0.02)
07	Over Torque Detected
08	Above Desired Current (P3.17)
09	Below Desired Current (P3.17)
10	PID Deviation Alarm (P3.18 and P3.19)
11	Heatsink Overheat Warning (OH)
12	Soft Braking Signal
13	Above Desired Frequency 2 (P3.20)
14	Below Desired Frequency 2 (P3.20)
15	Encoder Loss
*16	PID Feedback Loss Warning

** - Parameter setting available only with firmware v1.04 or higher (refer to P9.39)*

Wiring Diagram for
DO1, DO2, DO3, DOC
(Digital Outputs)



Wiring Diagram for
R1, R1C, R1O
(Relay Output)



Setting Explanations for Parameters P3.11 through P3.14

Setting 00: AC Drive Running — The terminal will be activated when there is an output from the drive.

Setting 01: AC Drive Fault — The terminal will be activated when one of the faults listed under parameters P6.31 through P6.36 occurs.

Setting 02: At Speed — The terminal will be activated when the AC drive attains the Command Frequency (P4.00).

Setting 03: Zero Speed — The output will be activated when Command Frequency (P4.00) is lower than the Minimum Output Frequency (P2.06).

Setting 04: Above Desired Frequency — The output will be activated when the AC drive is above the Desired Frequency (P3.16).

Setting 05: Below Desired Frequency — The output will be activated when the AC drive is below the Desired Frequency (P3.16).

Setting 06: At Maximum Speed — The output will be activated when the AC drive reaches Motor Maximum RPM (P0.04).

Setting 07: Over Torque Detected — The output will be activated when the AC drive reaches the Over-torque Detection Level (P6.08) and exceeds this level for a time greater than the Over-torque Detection Time (P6.09).

Setting 08: Above Desired Current — The output will be activated when the AC drive is above the Desired Current (P3.17).

Setting 09: Below Desired Current — The output will be activated when the AC drive is below the Desired Current (P3.17).

Setting 10: PID Deviation Alarm — The output will be activated when the AC drive exceeds the PID Deviation Level (P3.18) for longer than the PID Deviation Time (P3.19).

Setting 11: Heatsink Overheat Warning (OH) — The output will be activated when the heatsink overheats.The function will be activated as follows: Temperature range: 1 ~ 15HP, >90°C (194°F) ON; <90°C (194°F) OFF. Above 15HP: >80°C (176°F) ON; <80°C (176°F) OFF

Setting 12: Soft Braking Signal — If DC Bus voltage is greater than the braking voltage level set in parameter P6.18 (Braking Voltage level), then any output configured for function 12 will change state.

Setting 13: Above Desired Frequency 2 — The output will be activated when the AC drive is above the Desired Frequency.(P3.20)

Setting 14: Below Desired Frequency — The output will be activated when the AC drive is below the Desired Frequency. (P3.20)

Setting 15: Encoder Loss — The output will be activated when the AC drive experiences loss of the encoder signal.

Setting *16: PID Feedback Loss Warning — The output will be activated when the AC drive experiences loss of a 4 to 20 mA PID Feedback signal.

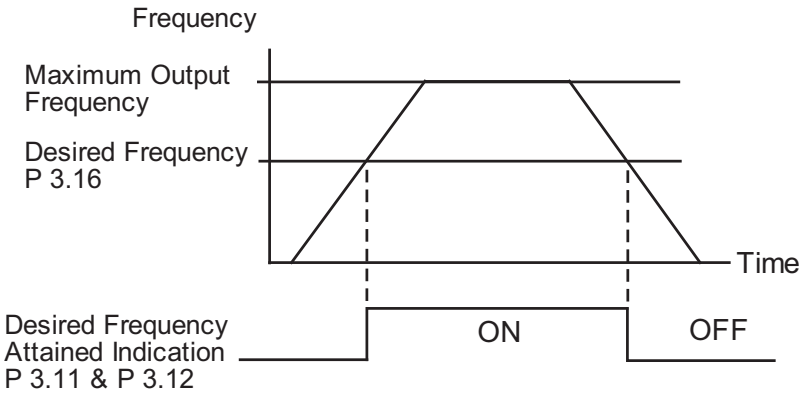
** - Parameter setting available only with firmware v1.04 or higher (refer to P9.39)*

P3.16 ◆ Desired Frequency

Default Setting: 0.0

Range: 0.0 to 400.0 Hz

- If a Multi-function output terminal is set to function as Desired Frequency Attained (P3.11 or P3.12 = 04 or 05), then the output will be activated when the programmed frequency is attained.



P3.17 ◆ Desired Current

Default Setting: 0.0

Range: 0.0 to <Drive Rated Amps>

P3.18 ◆ PID Deviation Level

Default Setting: 10.0

Range: 1.0 to 50.0%

If a Multi-function Output terminal is set to PID Deviation Alarm (RO, DO1-DO3 setting = 10), then the output will be activated when the amount of deviation between the SP (set point) and PV (process variable) in the PID loop constantly exceeds the threshold set by this parameter for the period of time set by P3.19. This is defined in percentage of PV Value (see P7.01).

- This parameter is used in conjunction with P3.19, PID Deviation Time.

P3.19 ◆ PID Deviation Time

Default Setting: 5.0

Range: 0.1 to 300.0 sec

If a Multi-function Output terminal is set to PID Deviation Alarm (RO, DO1-DO3 setting = 10), then the output will be activated when the amount of deviation between the SP (set point) and PV (process variable) in the PID loop constantly exceeds the threshold set by P3.18 for the period of time set by this parameter.

- This parameter is used in conjunction with P3.18, PID Deviation Level.

P3.20 ◆ Desired Frequency 2

Default Setting: 0.0

Range: 0.0 to 400.0 Hz

P3.30 ◆ Frequency Output (FO) Scaling Factor

Default Setting: 1

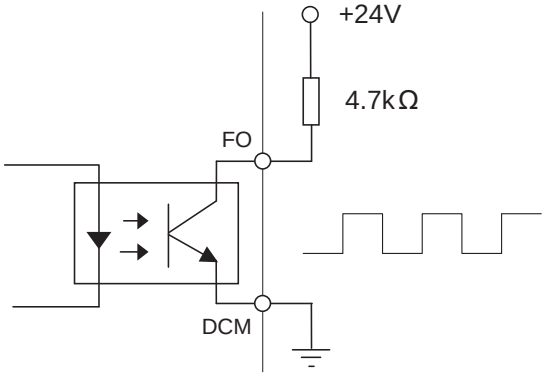
Range: 1 to 20

This parameter determines the scaling factor that is used to scale the frequency at the Digital Frequency Output terminals (FO-DCM). The number of output pulses per second is equal to the AC drive output frequency multiplied by P3.30. (Pulse per second = actual output frequency x P3.30).

Example 1: When drive frequency is 60.0 Hz and P3.30 = 10;
60.0 Hz x 10 = 600.0 Hz;
Frequency of FO's outputted square wave is 600.0 Hz

Example 2: When drive output frequency = 400.0 Hz and P3.30 = 20
400.0Hz x 20 = 8kHz;
FO's output frequency is 8kHz.

FO is an open collector circuit. Square wave is generated, for example, by sending +24V through a 4.7 kΩ resistor as shown in the diagram below.



P3.31 2nd Source of Operation Command

Default Setting: 00

Settings:

00	Operation Determined by Digital Keypad
01	Operation determined by external control terminals. Keypad STOP is enabled.
02	Operation determined by external control terminals. Keypad STOP is disabled.
03	Operation determined by RS-485 communication interface. Keypad STOP is enabled.
04	Operation determined by RS-485 communication interface. Keypad STOP is disabled.

This parameter sets the second input source for the AC drive operation command.

- Select the 1st or 2nd sources with a Digital Input and the appropriate parameter settings for P3.02 through P3.10.
- This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version.

Analog Parameters

P4.00 Source of Frequency Command

Default Setting: 01

Settings:

01	Frequency determined by digital keypad up/down.
02*	Frequency determined by 0 to +10V input (including remote potentiometer) on AI1 terminal.
03	Frequency determined by 4 to 20 mA input on AI2 terminal.
04	Frequency determined by 0 to 20 mA input on AI2 terminal.
05	Frequency determined by RS-485 communication interface.
06	Frequency determined by -10V to +10V input on AI3 terminal.

This parameter sets the input source for the AC drive frequency command.

** In order to set P4.00 = 02, you must first change the value of P4.13 to some value other than two (02) in order to avoid the "Error: Duplicate Function" error message. (P4.13 default value is 02)*

P4.01 ◆ Analog Input Offset Polarity

Default Setting: 00

Settings:

00	Offset disabled
01	Positive Offset
02	Negative Offset

This parameter sets the analog input bias frequency to be positive or negative.

- The Analog Input Offset calculation will also define the Analog Input Offset Polarity. Refer to the note following P4.02.
- P4.01 to P4.04 are used when the source of frequency command is an analog input signal (0 to +10V, -10 to +10V, 0 to 20 mA, or 4 to 20 mA).

P4.02 ◆ Analog Input Offset

Default Setting: 0.0

Range: 0.0 to 100%

This parameter provides a frequency offset for an analog input.

- Use the equation below to determine the Analog Input Offset. For this equation, you will need to know the necessary Minimum Frequency References and Maximum Output Frequency needed for your application.

$$\textbf{Analog Offset \%} = \left(\frac{\text{Min. Frequency Reference}}{\text{Maximum Output Frequency}} \right) \times 100$$

The result of the Analog Input Offset calculation will also define the Analog Input Offset Polarity (P4.01). A positive answer means you should have a positive offset. A negative answer means you should have a negative offset.

- P4.01 to P4.04 are used when the source of frequency command is an analog input signal (0 to +10V, -10 to +10V, 0 to 20 mA, or 4 to 20 mA).

P4.03 ◆ Analog Input Gain

Default Setting: 100.0

Range: 0.0 to 300.0%

This parameter sets the ratio of analog input vs frequency output.

- Use the equation below to calculate the Analog Input Gain. For this equation, you will need to know the minimum and maximum set-point frequencies needed for your application.

$$\text{Analog Gain \%} = \left(\frac{\text{Max. Frequency Reference} - \text{Min. Frequency Reference}}{\text{Maximum Output Frequency}} \right) \times 100$$

- P4.01 to P4.04 are used when the source of frequency command is an analog input signal (0 to +10V, -10 to +10V, 0 to 20 mA, or 4 to 20 mA).

P4.04 Analog Input Reverse Motion Enable

Default Setting: 00

Range: 00 Forward Motion Only
01 Reverse Motion Enable

- P4.01 to P4.04 are used when the source of frequency command is an analog input signal (0 to +10V, -10 to +10V, 0 to 20 mA, or 4 to 20 mA).

P4.05 Loss of AI2 Signal (4-20mA)

Default Setting: 00

Range: 00 - Decelerate to 0Hz
01 - Stop immediately and display “EF”.
02 - Continue operation by the last frequency command

This parameter determines the operation of the drive when the ACI frequency command is lost.

P4.11 ◆ Analog Output Signal

Default Setting: 00

Range: 00 - Frequency Hz
01 - Current A
02 - PV

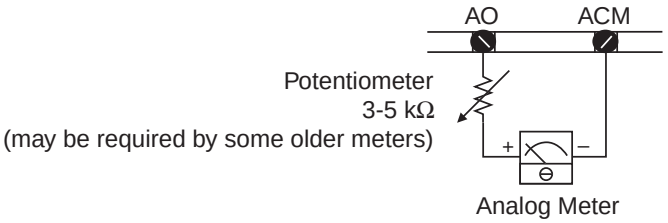
This parameter configures the 0-10V AO output to indicate either output Frequency, output Current, or the PID Process Variable.

P4.12 ◆ Analog Output Gain

Default Setting: 100

Range: 00 to 200%

This parameter sets the voltage range of the analog output signal on output terminal AO.



- When P4.11 is set to 00, the analog output voltage is directly proportional to the output frequency of the AC drive. With the factory setting of 100%, the Maximum Output Frequency of the AC drive corresponds to +10VDC analog voltage output. (The actual voltage is about +10VDC, and can be adjusted by P4.12)
- When P4.11 is set to 01, the analog output voltage is directly proportional to the output current of the AC drive. With the factory setting of 100%, the 2.5 times rated current of the AC drive corresponds to +10 VDC analog voltage output. (The actual voltage is about +10 VDC, and can be adjusted by P4.12).

Note: Any type of voltmeter can be used. If the meter reads full scale at a voltage less than 10 volts, then P4.12 should be set by the following formula:

P4.12 = (meter full scale voltage ÷ 10) × 100%

For Example: When using the meter with full scale of 5 Volts, adjust P4.12 to 50%.

P4.13 2nd Source of Frequency Command

Default Setting: 06

Settings:

01*	Frequency determined by digital keypad up/down.
02	Frequency determined by 0 to +10V input on AI1 terminal.
03	Frequency determined by 4 to 20 mA input on AI2 terminal.
04	Frequency determined by 0 to 20 mA input on AI2 terminal.
05	Frequency determined by RS-485 communication interface.
06	Frequency determined by -10V ~ +10V input on AI3 terminal.

This parameter sets the second input source for the AC drive frequency command.

- Select the 1st or 2nd sources with a Digital Input and the appropriate parameter settings for P3.02 through P3.10.
- This parameter is available only with AC drive firmware v1.04 or higher.
  Default setting = 02 for firmware v1.04.
  Default setting = 06 for firmware v1.05 and higher.
  Refer to P9.39 to determine the drive's firmware version.

** In order to set P4.13 = 01, you must first change the value of P4.00 to some value other than one (01) in order to avoid the "Error: Duplicate Function" error message. (P4.00 default value is 01)*

P4.14 ◆ 2nd Analog Input Offset Polarity

Default Setting: 00

Settings:

00	Offset disabled
01	Positive Offset
02	Negative Offset

This parameter sets the analog input 2nd bias frequency to be positive or negative.

- Select the 1st or 2nd sources with a Digital Input and the appropriate parameter settings for P3.02 through P3.10.
- The 2nd Analog Input Offset calculation will also define the 2nd Analog Input Offset Polarity. Refer to the note following P4.15.
- This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version

P4.15 ◆ 2nd Analog Input Offset

Default Setting: 0.0

Range: 0.0 to 100%

This parameter provides a frequency offset for a second analog input.

- Select the 1st or 2nd sources with a Digital Input and the appropriate parameter settings for P3.02 through P3.10.
- Use the equation below to determine the Analog Input Offset. For this equation, you will need to know the necessary Minimum Frequency References and Maximum Output Frequency needed for your application.

$$\textbf{Analog Offset \%} = \left(\frac{\text{Min. Frequency Reference}}{\text{Maximum Output Frequency}} \right) \times 100$$

The result of the 2nd Analog Input Offset calculation will also define the Analog 2nd Input Offset Polarity (P4.14). A positive answer means you should have a positive offset. A negative answer means you should have a negative offset.

- This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version.

P4.16 ◆ 2nd Analog Input Gain

Default Setting: 100.0

Range: 0.0 to 300.0%

This parameter sets the ratio of the second analog input vs frequency output.

- Select the 1st or 2nd sources with a Digital Input and the appropriate parameter settings for P3.02 through P3.10.
- Use the equation below to calculate the Analog Input Gain. For this equation, you will need to know the minimum and maximum set-point frequencies needed for your application.

$$\text{Analog Gain \%} = \left(\frac{\text{Max. Frequency Reference} - \text{Min. Frequency Reference}}{\text{Maximum Output Frequency}} \right) \times 100$$

- This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version.

P4.17 ◆ Trim Reference Frequency

Default Setting: 00

Range: 0.0 to 400.0 Hz

This parameter determines a set frequency to add to or subtract from the selected Frequency Command (P4.00 or P4.13) to produce a modified actual frequency command. The setting of P4.18 determines whether P4.17 adds to or subtracts from the Frequency Command.

- This parameter is active only if P4.18 is set to 03 or 04.
- This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version.

Effects of P4.17 on Actual Frequency Command		
Source of Frequency Command	**Trim Mode Select P4.18 Setting**	**Actual Frequency Command**
P4.00	03	P4.00 + P4.17
	04	P4.00 - P4.17
P4.13	03	P4.13 + P4.17
	04	P4.13 - P4.17

P4.18 ◆ Trim Mode Select

Default Setting: 00

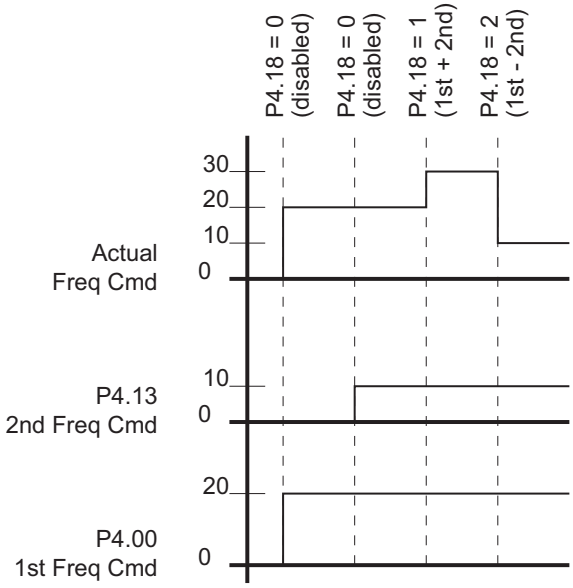
Settings:

00	Disable Trim Function
01	1st Frequency Command (P4.00) + 2nd Frequency Command (P4.13)
02	1st Frequency Command (P4.00) - 2nd Frequency Command (P4.13)
03	Frequency Command (P4.00 or P4.13) + Trim Ref Frequency (P4.17)
04	Frequency Command (P4.00 or P4.13) - Trim Ref Frequency (P4.17)

This parameter determines how the Frequency Command is modified by the Trim Frequency to produce the modified actual frequency command.

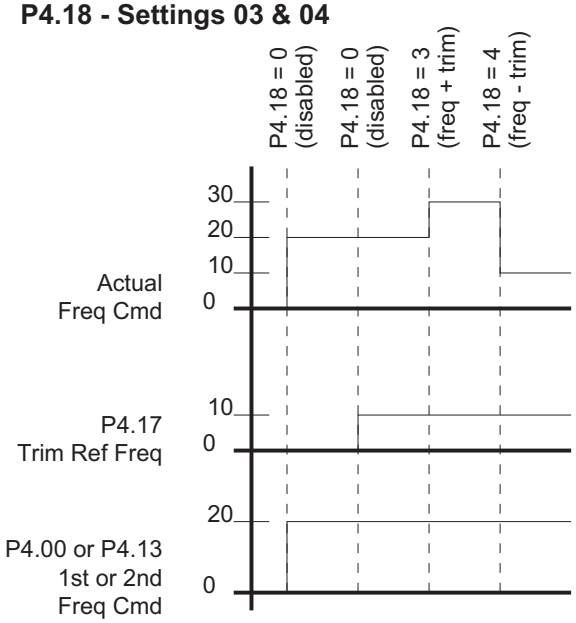
- For parameter settings 03 and 04, the Trim Frequency modifies whichever primary Frequency Command is selected as active by the digital input controlled by P3.02~P3.10 settings 19 or 20.
- This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version.

P4.18 - Settings 01 & 02



NOTE: P4.00 & P4.13 values shown also include any effects of P4.01~P4.04 and P4.14~P4.16. These seven additional parameters affect frequency commands only from the analog inputs. They do not affect keypad or RS-485 frequency commands.

P4.18 - Settings 03 & 04



NOTE: P4.00 & P4.13 values shown also include any effects of P4.01~P4.04 and P4.14~P4.16. These seven additional parameters affect frequency commands only from the analog inputs. They do not affect keypad or RS-485 frequency commands.

Analog Input Parameter Examples

Refer to the following equations and examples for changing the ratio of the analog input signal relative to the output frequency of the drive.

Use the equations below when calculating the values for the Maximum Output Frequency, Analog Input Offset, Analog Input Gain, and the Mid-point Frequency.

A) **Maximum Output Frequency** =
(P0.04 Maximum Speed / P0.03 Base Speed) x P0.02 Base Frequency

The Maximum Output Frequency is not a parameter setting, but is needed in order to calculate the Analog Gain. The default Maximum Output Frequency for the DURAPULSE drive is 60Hz. If parameters P0.02, P0.03, or P0.04 are changed, then the Maximum Output Frequency will change.

B) **Analog Offset %** =
(Minimum Frequency Reference / Maximum Output Frequency) x 100

C) **Analog Gain %** =
((Max Freq Reference - Min Freq Reference) / Max Output Frequency) x 100

D) **Mid-point Frequency** =
((Max Freq Reference - Min Freq Reference) / 2) + Min Freq Reference

The Mid-point Frequency calculation shows the frequency reference of the drive when the potentiometer or other analog input device is at its mid-point.

Example 1: Standard Operation

This example illustrates the default operation of the drive. The example is given to further illustrate the use of the analog calculations. The full range of the analog input signal corresponds to the full forward frequency range of the AC drive.

- Minimum Frequency Reference = 0Hz
- Maximum Frequency Reference = 60 Hz

Calculations

A) **Max Output Frequency** = (1750 rpm / 1750 rpm) x 60 Hz = **60 Hz**

B) **Analog Offset %** = (0Hz / 60 Hz) x 100 = **0%**

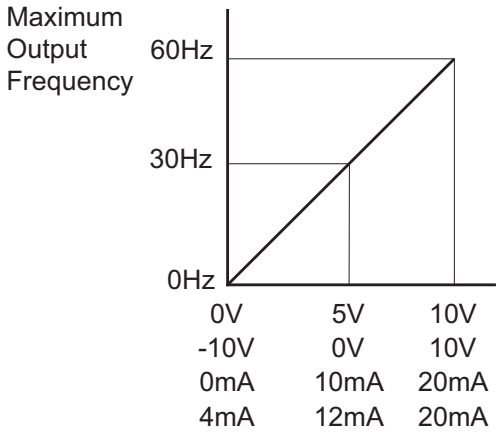
C) **Analog Gain %** = ((60 Hz – 0Hz) / 60 Hz) x 100 = **100%**

D) **Mid-point Frequency** = ((60 Hz – 0Hz) / 2) + 0Hz = **30 Hz**

Parameter Settings

P4.01: 00 (default) – Offset disabled
P4.02: 00 (default) – 0% Analog Input Offset
P4.03: 100 (default) – 100% Analog Input Gain
P4.04: 00 (default) – Forward Motion Only

Results



Example 2: Standard Operation with Increased Maximum Output Frequency

This example illustrates how to run the motor faster than its base speed. For this purpose, the only required parameter change is P0.04, Motor Maximum RPM. (Motors produce reduced output torque when running above their base speed.)

WARNING: The Motor Maximum RPM parameter (P0.04) should never exceed the maximum speed rating for the motor you are using. If this information is not readily available, consult your motor manufacturer.

The analog input adjustment parameters P4.01 through P4.04 can remain defaulted, as determined by the analog input calculations shown below. The increased Maximum Output Frequency can be obtained regardless of whether the Source of Frequency Command is an analog input or one of the other sources, such as the keypad, RS-485 communication interface, jog, or multi-speed settings.

- Minimum Frequency Reference = 0Hz
- Maximum Frequency Reference = 70 Hz
- Motor Maximum RPM = 2042 rpm

Calculations

A) **Max Output Frequency** = (2042 rpm / 1750 rpm) x 60 Hz = **70 Hz**

B) **Analog Offset %** = (0Hz / 70 Hz) x 100 = **0%**

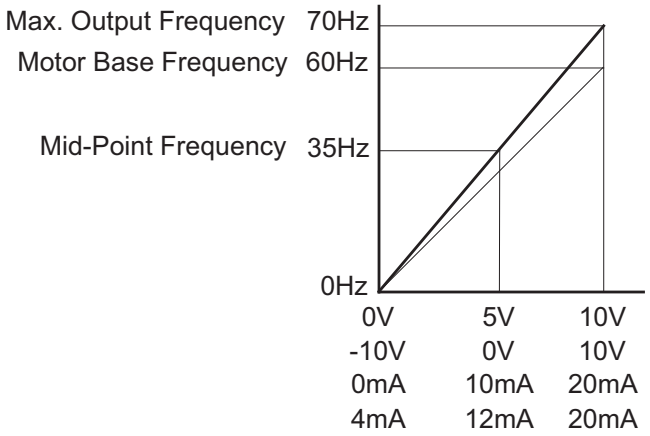
C) **Analog Gain %** = ((70 Hz – 0Hz) / 70 Hz) x 100 = **100%**

D) **Mid-point Frequency** = ((70 Hz – 0Hz) / 2) + 0Hz = **35 Hz**

Parameter Settings

P0.04: 2042 – Motor Maximum RPM
P4.01: 00 (default) – Offset disabled
P4.02: 00 (default) – 0% Analog Input Offset
P4.03: 100 (default) – 100% Analog Input Gain
P4.04: 00 (default) – Forward Motion Only

Results



Example 3: Positive Offset

In this example, the Analog Input will have a positive offset while still using the full scale of the potentiometer or other analog signal device. When the analog signal is at its lowest value (0V, 0mA, or 4mA), the set-point frequency will be at 10Hz. When analog signal is at its maximum value (10V or 20mA), the set-point frequency will be 60 Hz.

- Minimum Frequency Reference = 10 Hz
- Maximum Frequency Reference = 60 Hz

Calculations

A) **Max Output Frequency** = (1750 rpm / 1750 rpm) x 60 Hz = **60 Hz**

B) **Analog Offset %** = (10 Hz / 60 Hz) x 100 = **16.7%**

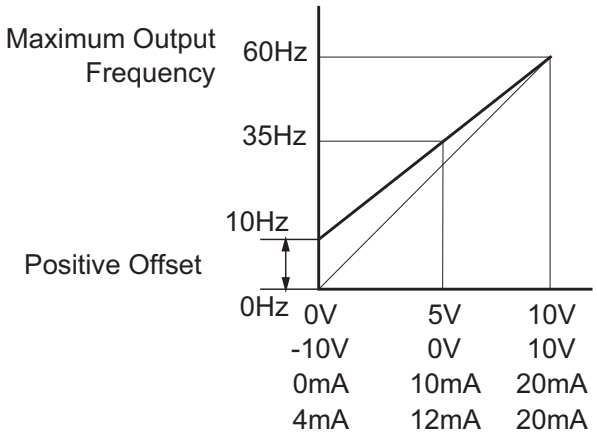
C) **Analog Gain %** = ((60 Hz – 10 Hz) / 60 Hz) x 100 = **83.3%**

D) **Mid-point Frequency** = ((60 Hz – 10 Hz) / 2) + 10 Hz = **35 Hz**

Parameter Settings

P4.01: 01 – Positive Input Offset Polarity
P4.02: 16.7 – 16.7% Analog Input Offset
P4.03: 83.3 – 83.3% Analog Input Gain
P4.04: 00 (default) – Forward Motion Only

Results



Example 4: Forward and Reverse Operation

In this example, the potentiometer (or other analog signal device) is programmed to run a motor full-speed in both forward and reverse directions. The frequency reference will be 0Hz when the potentiometer is positioned at mid-point of its scale. Parameter P4.04 must be set to enable reverse motion.

When calculating the values for the Analog Input using reverse motion, the reverse frequency reference should be shown using a negative (-) number. Pay special attention to signs (+/-) for values representing reverse motion.

- Minimum Frequency Reference = -60 Hz (reverse)
- Maximum Frequency Reference = 60 Hz

Calculations

A) **Max Output Frequency** = (1750 rpm / 1750 rpm) x 60 Hz = **60 Hz**

B) **Analog Offset %** = (-60 Hz / 60 Hz) x 100 = **-100%**

The negative (-) value for the Analog Offset % shows that a negative offset is needed for P4.01.

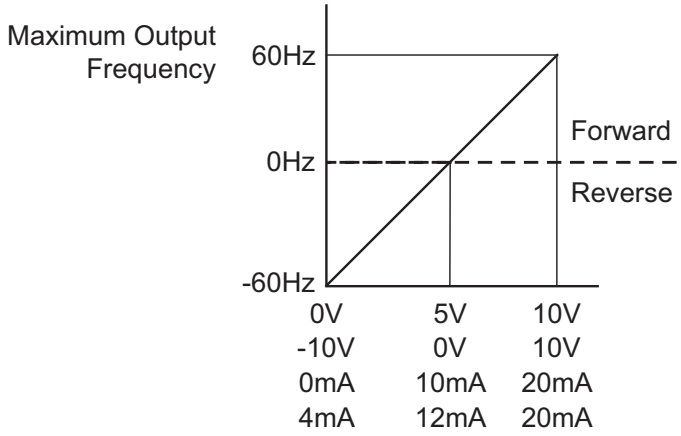
C) **Analog Gain %** = ((60 Hz – (-60 Hz)) / 60 Hz) x 100 = **200%**

D) **Mid-point Frequency** = ((60 Hz – (-60 Hz)) / 2) + (-60 Hz) = **0Hz**

Parameter Settings

P4.01: 02 – Negative Input Offset Polarity
P4.02: 100 – 100% Analog Input Offset
P4.03: 200 – 200% Analog Input Gain
P4.04: 01 – Reverse Motion Enable

Results



Example 5: Forward Run/Reverse Jog

This example shows an application in which the drive runs full-speed forward and jogs in reverse. The full scale of the potentiometer (or other analog signal device) will be used.

When calculating the values for the Analog Input using reverse motion, the reverse frequency reference should be shown using a negative (-) number. Pay special attention to signs (+/-) for values representing reverse motion.

- Minimum Frequency Reference = -15 Hz (reverse)
- Maximum Frequency Reference = 60 Hz

Calculations

A) **Max Output Frequency** = (1750 rpm / 1750 rpm) x 60 Hz = **60 Hz**

B) **Analog Offset %** = (-15 Hz / 60 Hz) x 100 = **-25%**

The negative (-) value for the Analog Offset % shows that a negative offset is needed for P4.01.

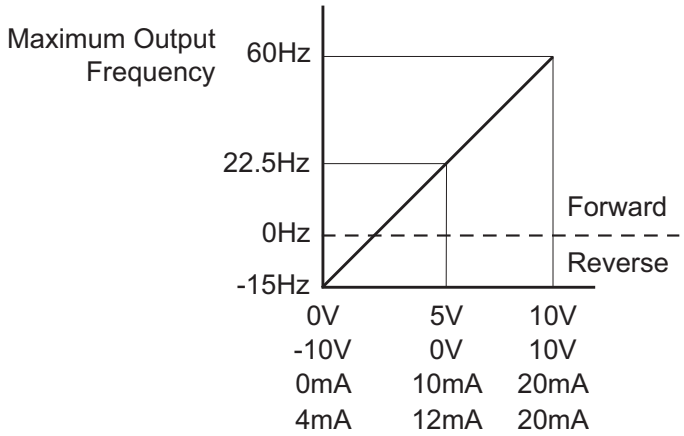
C) **Analog Gain %** = ((60 Hz – 15 Hz) / 60 Hz) x 100 = **125%**

D) **Mid-point Frequency** = ((60 Hz – (-15 Hz)) / 2) + (-15 Hz) = **22.5 Hz**

Parameter Settings

P4.01: 02 – Negative Input Offset Polarity
P4.02: 25 – 25% Analog Input Offset
P4.03: 125 – 125% Analog Input Gain
P4.04: 01 – Reverse Motion Enable

Results



Example 6: Reduced Analog Gain

This example shows how to limit the Maximum Frequency Reference by reducing the Analog Input Gain. When the Analog Input is at its maximum value (10V or 20mA), the set-point frequency will be 50Hz. However, this reduced maximum frequency applies only to an Analog Input Source of Frequncy Command. The Maximum Output Frequency can still can still go to 60 Hz if controlled from the Keypad, RS-485 interface, Jog Command, or Multi-Speed settings.

- Minimum Frequency Reference = 0Hz
- Maximum Frequency Reference = 50 Hz

Calculations

A) **Max Output Frequency** = (1750 rpm / 1750 rpm) x 60 Hz = **60 Hz**

B) **Analog Offset %** = (0Hz / 50 Hz) x 100 = **0%**

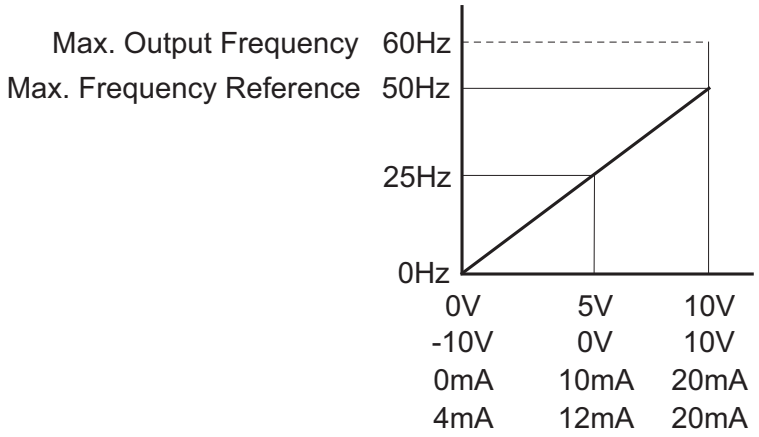
C) **Analog Gain %** = ((50 Hz – 0Hz) / 60 Hz) x 100 = **83.3%**

D) **Mid-point Frequency** = ((50 Hz – 0Hz) / 2) + 0Hz = **25 Hz**

Parameter Settings

P4.01: 00 (default) – Offset disabled
P4.02: 00 (default) – 0% Analog Input Offset
P4.03: 71.4 – 71.4% Analog Input Gain
P4.04: 00 (default) – Forward Motion Only

Results



Example 7: Positive Offset with Reduced Analog Gain

This example illustrates how to provide a positive offset of the Analog Input, while using the full scale of the potentiometer or other analog device. At the same time, the Maximum Frequency Reference is limited by reducing the Analog Input Gain.

When the analog signal is at its lowest value, the set-point frequency will be at 11.5Hz. When the analog signal is at its maximum value, the set-point frequency will be 39.6Hz.

- Minimum Frequency Reference = 11.5 Hz
- Maximum Frequency Reference = 39.6 Hz

Calculations

A) **Max Output Frequency** = (1750 rpm / 1750 rpm) x 60 Hz = **60 Hz**

B) **Analog Offset %** = (11.5 Hz / 60 Hz) x 100 = **19.2%**

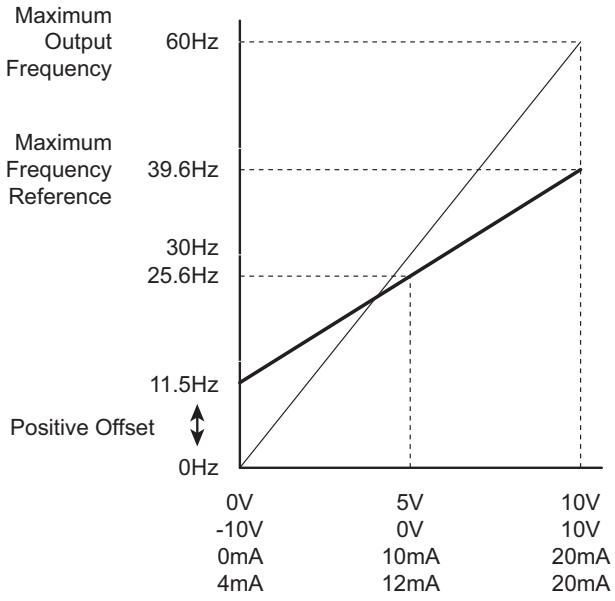
C) **Analog Gain %** = ((39.6 – 11.5) / 60) x 100 = **46.8%**

D) **Mid-point Frequency** = ((39.6 – 11.5) / 2) + 11.5 = **25.6 Hz**

Parameter Settings

P4.01: 01 – Positive Analog Input Offset Polarity
P4.02: 19.2 – 19.2% Analog Input Offset
P4.03: 46.8 – 46.8% Analog Input Gain
P4.04: 00 (default) – Forward Motion Only

Results



Example 8: Trim Mode

This example illustrates using the drive in Trim Mode with a Trim Reference Frequency

- Minimum Frequency Reference = 0Hz
- Maximum Frequency Reference = 45 Hz
- Output Frequency = Frequency Command - Trim Reference Frequency

Calculations

A) **Max Output Frequency** = (1750 rpm / 1750 rpm) x 60 Hz = **60 Hz**

B) **Analog Offset %** = (0Hz / 60 Hz) x 100 = **0%**

C) **Analog Gain %** = ((60 Hz – 0Hz) / 60 Hz) x 100 = **100%**

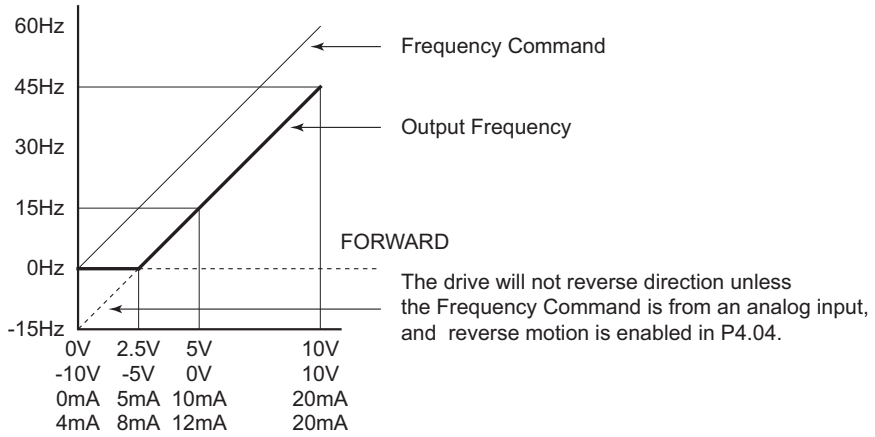
D) **Mid-point Frequency** = ((60 Hz – 0Hz) / 2) + 0Hz = **30 Hz**

- **Actual Output Frequency$_{P4.18=04}$ = Freq Command – Trim Ref Freq**

Parameter Settings

P4.01: 00 (default) – Offset disabled
P4.02: 00 (default) – 0% Analog Input Offset
P4.03: 100 (default) – 100% Analog Input Gain
P4.04: 00 (default) – Forward Motion Only
P4.17: 15 – Trim Reference Frequency = 15 Hz
P4.18: 04 – Output Frequency = Frequency Command - Trim Reference Frequency

Results



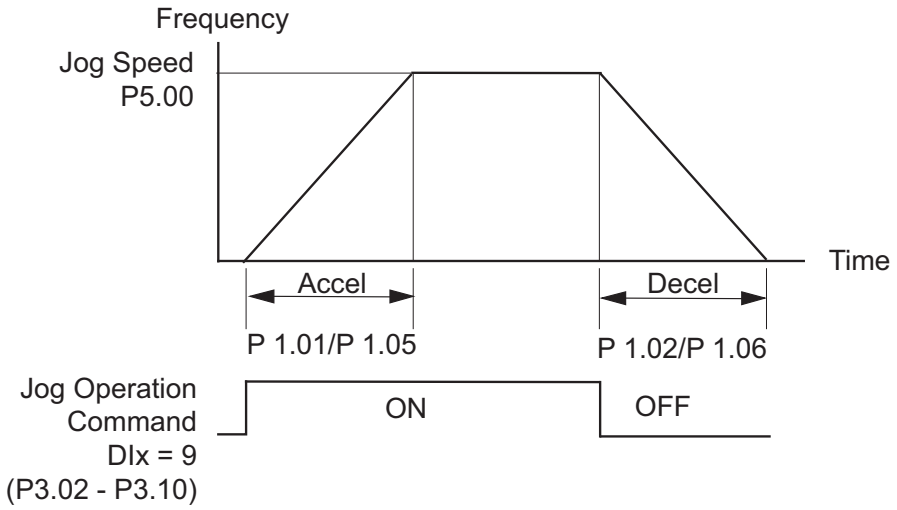
Presets Parameters

P5.00 ◆ **Jog Speed** Default Setting: 6.0

Range: 0.0 to 400.0 Hz

This parameter sets the speed for the Jog Command.

- The Jog Command is selected by a Multi-Function Input Terminal (P3.02 to P3.10) set to the Jog Command function (09).
- Acceleration and deceleration times apply to the Jog Speed



The Jog function can be used in conjunction with the direction signal (FWD/REV; P3.01 = 01 or 02) to Jog in forward and reverse directions.

The drive must be stopped to initiate this command. The Jog command cannot be used simultaneously with an active FWD/STOP, REV/STOP, or RUN/STOP command.

P5.01	◆ **Multi-Speed 1**	Default Setting: 0.0
P5.02	◆ **Multi-Speed 2**	Default Setting: 0.0
P5.03	◆ **Multi-Speed 3**	Default Setting: 0.0
P5.04	◆ **Multi-Speed 4**	Default Setting: 0.0
P5.05	◆ **Multi-Speed 5**	Default Setting: 0.0
P5.06	◆ **Multi-Speed 6**	Default Setting: 0.0
P5.07	◆ **Multi-Speed 7**	Default Setting: 0.0
P5.08	◆ **Multi-Speed 8**	Default Setting: 0.0
P5.09	◆ **Multi-Speed 9**	Default Setting: 0.0
P5.10	◆ **Multi-Speed 10**	Default Setting: 0.0
P5.11	◆ **Multi-Speed 11**	Default Setting: 0.0
P5.12	◆ **Multi-Speed 12**	Default Setting: 0.0
P5.13	◆ **Multi-Speed 13**	Default Setting: 0.0
P5.14	◆ **Multi-Speed 14**	Default Setting: 0.0
P5.15	◆ **Multi-Speed 15**	Default Setting: 0.0

Range for P5.01~P5.15: 0.0 to 400.0 Hz

The Multi-Function Input Terminals (refer to P3.02 to P3.10) are used to select one of the AC drive preset Multi-speeds. The speeds (frequencies) are determined by the settings of P5.01 to P5.15.

When all multi-speed inputs are off, the AC drive reverts back to the Command Frequency (P4.00).

Multi-Speed Bits				Speed Selection
Bit 4	Bit 3	Bit 2	Bit 1	
OFF	OFF	OFF	OFF	P4.00: Source of Frequency
OFF	OFF	OFF	ON	P5.01: Multi-Speed 1
OFF	OFF	ON	OFF	P5.02: Multi-Speed 2
OFF	OFF	ON	ON	P5.03: Multi-Speed 3
OFF	ON	OFF	OFF	P5.04: Multi-Speed 4
OFF	ON	OFF	ON	P5.05: Multi-Speed 5
OFF	ON	ON	OFF	P5.06: Multi-Speed 6
OFF	ON	ON	ON	P5.07: Multi-Speed 7

Multi-Speed Bits				Speed Selection
Bit 4	Bit 3	Bit 2	Bit 1	
ON	OFF	OFF	OFF	P5.08: Multi-Speed 8
ON	OFF	OFF	ON	P5.09: Multi-Speed 9
ON	OFF	ON	OFF	P5.10: Multi-Speed 10
ON	OFF	ON	ON	P5.11: Multi-Speed 11
ON	ON	OFF	OFF	P5.12: Multi-Speed 12
ON	ON	OFF	ON	P5.13: Multi-Speed 13
ON	ON	ON	OFF	P5.14: Multi-Speed 14
ON	ON	ON	ON	P5.15: Multi-Speed 15

Protection Parameters

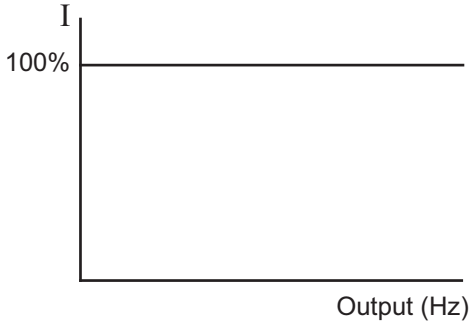
P6.00 Electronic Thermal Overload Relay

Default Setting: 00

Settings:

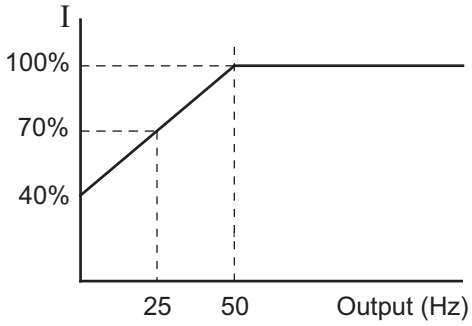
00 Constant Torque (Recommended **for inverter/vector duty motors**)

Use this setting when using the drives with motors designed specifically for AC drive outputs and for running at low speeds with high currents. Motor currents will be 100% throughout the speed range, and can be up to 150% for one minute.



01 Variable Torque (Recommended **for fan-cooled standard motors**)

Use this setting when using the drives with motors which are NOT designed specifically for AC drive outputs. Motors with shaft mounted fans offer poor cooling at low speeds, therefore the output can be derated at lower output frequencies. This derated current is for protecting the motor at lower speeds.



The output current is derated as follows:

- I_{output} (%) = [f_{output} (Hz) x 1.2 %/Hz] + 40%

Example:
If the rated motor current is 10A, and the output frequency is 25Hz, the derating will be 70%, and the overload will be 10.5A (150%) for one minute.

- I_{output} (%) = [(25Hz) (1.2 %/Hz)] + 40% = 70%
- 10A x 70% = 7A
- 7A x 150% = 10.5A

02 Inactive

This parameter determines the drive's motor overload protection characteristic. The Variable Torque setting (01) allows less motor current at lower speeds than does the Constant Torque setting (00).

P6.01 Auto Restart after Fault

Default Setting: 00

Range: 00 to 10

After fault occurs (allowable faults: over-current OC, over-voltage OV), the AC drive can be reset/restarted automatically up to 10 times. Setting this parameter to 0 will disable the reset/restart operation after any fault has occurred. When enabled, the AC drive will restart with speed search, which starts at the previous Frequency. To set the fault recovery time after a fault, please see (P6.13) base-block time for speed search.

P6.02 Momentary Power Loss

Default Setting: 00

Settings:

00	Stop operation after momentary power loss.
01	Continue operation after momentary power loss; speed search from Speed Reference.
02	Continue operation after momentary power loss; speed search from Minimum Speed.

This parameter will only work if the Source of Operation (P3.00) is set to something other than 00 (Operation determined by digital keypad).

P6.03 Reverse Operation Inhibit

Default Setting: 00

Settings:

00	Enable Reverse Operation
01	Disable Reverse Operation

This parameter determines whether the AC Motor Drive can operate in the reverse direction.

P6.04 Auto Voltage Regulation

Default Setting: 00

Settings:

00	AVR enabled
01	AVR disabled
02	AVR disabled during decel
03	AVR disabled during stop

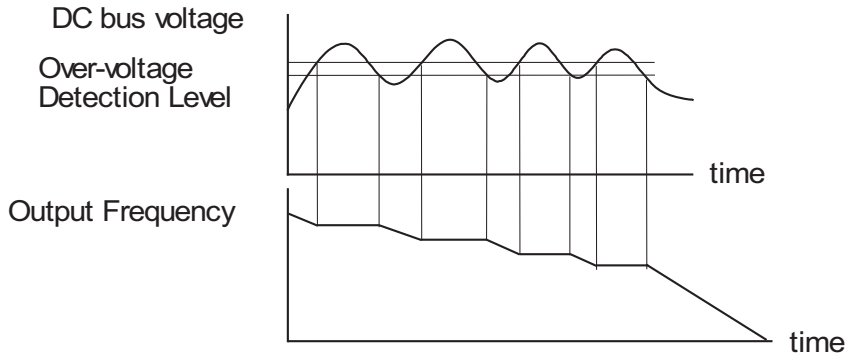
- AVR function automatically regulates the AC drive output voltage to the Maximum Output Voltage (P0.00). For instance, if P0.00 is set at 200 VAC and the input voltage is at 200V to 264VAC, then the Maximum Output Voltage will automatically be regulated to 200 VAC.
- Without AVR function, the Maximum Output Voltage may vary between 180V to 264VAC, due to the input voltage varying between 180V to 264 VAC.
- Selecting program value 2 enables the AVR function and also disables the AVR function during deceleration. This offers a quicker deceleration.

P6.05 Over-Voltage Stall Prevention

Default Setting: 00

Range: 00 Enable Over-voltage Stall Prevention
01 Disable Over-voltage Stall Prevention

During deceleration, the AC drive DC bus voltage may exceed its Maximum Allowable Value due to motor regeneration. When this function is enabled, the AC drive will stop decelerating, and maintain a constant output frequency. The drive will resume deceleration when the voltage drops below the factory-preset value.



With moderate inertial loads, over-voltage during deceleration will not occur. For applications with high inertia loads, the AC drive will automatically extend the deceleration time. If deceleration time is critical for the application, a dynamic braking resistor should be used. ***Set this parameter to 01 (disable) when using a dynamic braking resistor.***

P6.06 Auto Adjustable Accel/Decel

Default Setting: 00

Settings:

00	Linear Accel/Decel
01	Auto Accel, Linear Decel
02	Linear Accel, Auto Decel
03	Auto Accel/Decel
04	Auto Accel/Decel Stall Prevention

If the auto accel/decel is selected, the AC drive will accel/decel in the fastest and smoothest means possible by automatically adjusting the time of accel/decel.

This parameter provides five modes to choose:

- 00 Linear Acceleration and deceleration (operation by P1.01, P1.02 or P1.05, P1.06 acceleration/deceleration time).
- 01 Automatic acceleration, linear deceleration (Operation by automatic acceleration time, P1.02 or P1.06 deceleration time).
- 02 Linear acceleration and automatic deceleration (Operation by automatic acceleration time, P1.01 or P1.05 acceleration time).
- 03 Automatic acceleration, deceleration (Operation by AC drive auto adjustable control).
- 04 Auto acceleration, deceleration. The auto accel/decel will not be quicker than the settings for acceleration (P1.01 or P1.05) or deceleration (P1.02 or P1.06). The operation is specific to preventing a stall.

P6.07 Over-Torque Detection Mode

Default Setting: 00

Settings:

00	Disabled
01	Enabled during constant speed operation
02	Enabled during acceleration

P6.08 Over-Torque Detection Level

Default Setting: 150

Range: 30 to 200%

- A setting of 100% is proportional to the Rated Output Current of the drive.
- This parameter sets the Over-Torque Detection level in 1% increments. (The AC drive rated current is equal to 100%.)

P6.09 Over-Torque Detection Time

Default Setting: 0.1

Range: 0.1 to 10.0

This parameter sets the Over-Torque Detection Time in units of 0.1 seconds.

P6.10 **Over-current Stall Prevention during Acceleration** Default Setting: 150

Range: 20 to 200%

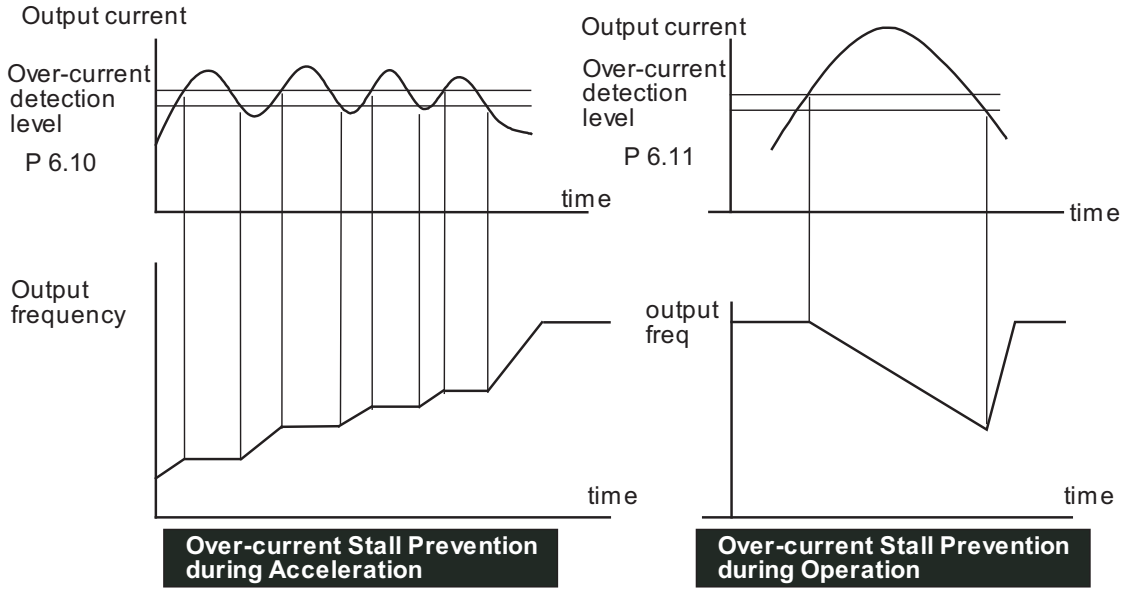
A setting of 100% is equal to the Rated Output Current of the drive.

Under certain conditions, the AC drive output current may increase abruptly, and exceed the value specified by P6.10 This is commonly caused by rapid acceleration or excessive load on the motor. When this function is enabled, the AC drive will stop accelerating and maintain a constant output frequency. The AC drive will only resume acceleration when the current drops below the maximum value.

P6.11 **Over-current Stall Prevention during Operation** Default Setting: 150

Range: 20 to 200%

During steady-state operation with motor load rapidly increasing, the AC drive output current may exceed the limit specified in P6.11. When this occurs, the output frequency will decrease to maintain a constant motor speed. The drive will accelerate to the steady-state output frequency only when the output current drops below the level specified by P6.11.



Over-current Stall Prevention during Acceleration

Over-current Stall Prevention during Operation

P6.12 Maximum Allowable Power Loss Time

Default Setting: 2.0

Range: 0.3 to 5.0 sec

During a power loss, if the power loss time is less than the time defined by this parameter, the AC drive will resume operation. If the Maximum Allowable Power Loss Time is exceeded, the AC drive output is turned off.

P6.13 Base-Block Time for Speed Search

Default Setting: 0.5

Range: 0.3 to 5.0 sec

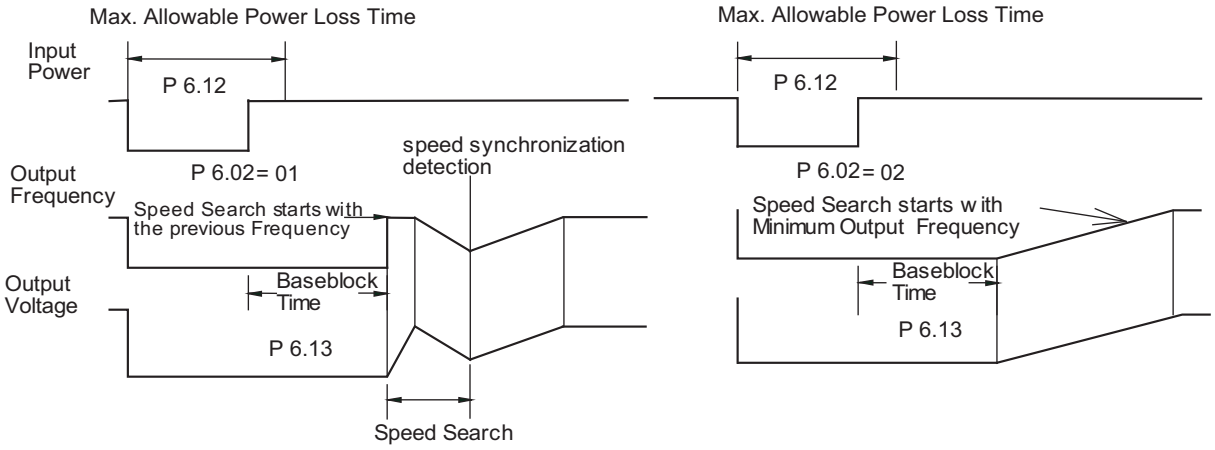
- When a momentary power loss is detected, the AC drive turns off for a specified time interval determined by P6.13 before resuming operation. This time interval is called Base-Block. This parameter should be set to a value where the residual output voltage due to regeneration is nearly zero, before the drive resumes operation.
- This parameter also determines the searching time when performing external Base-Block and Fault Reset (P6.01).

P6.14 Maximum Speed Search Current Level

Default Setting: 150

Range: 30 to 200%

Following a power failure, the AC drive will start its speed search operation only if the output current is greater than the value determined by P6.14. When the output current is less than that of P6.14, the AC drive output frequency is at a "speed synchronization point". The drive will start to accelerate or decelerate back to the operating frequency at which it was running prior to the power failure.



P6.15 Upper Bound of Output Frequency

Default Setting: 400

Range: 0.1 to 400 Hz

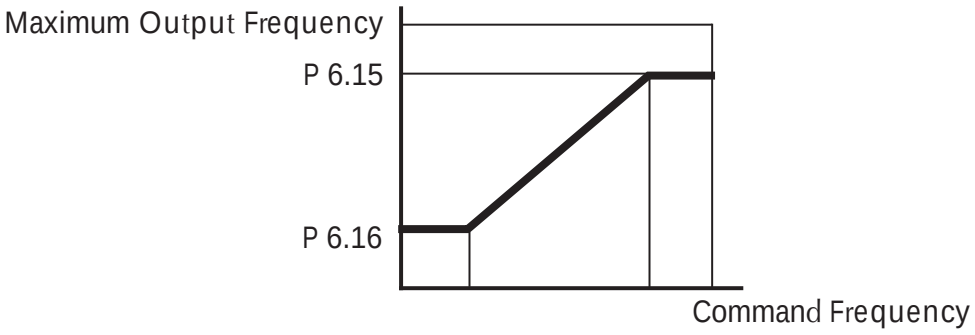
- The Upper/Lower Bound of Output Frequency is to prevent operation error and machine damage.
- This parameter must be equal to or greater than the Lower Bound of Output Frequency (P6.16).
- If the Upper Bound of Output Frequency is 50Hz and the Maximum Output Frequency is 60 Hz, then any Command Frequency above 50 Hz will generate a 50 Hz output from the drive.
- The Output Frequency is also limited by the Motor Maximum RPM (P0.04).

P6.16 Lower Bound of Output Frequency

Default Setting: 0.0

Range: 0.0 to 400 Hz

- The Upper/Lower Bound of Output Frequency is to prevent operation error and machine damage.
- This parameter must be equal to or less than the Upper Bound of Output Frequency (P6.15).
- If the Lower Bound of Output Frequency is 10 Hz, and the Minimum Output Frequency (P2.06) is set at 1.0 Hz, then any Command Frequency between 1-10 Hz will generate a 10 Hz output from the drive.
- The Upper/Lower Bound of Output Frequency is to prevent operation error and machine damage.



If the reference frequency is less than 0.5 Hz, then this parameter setting is disabled.

P6.17 Over-Voltage Stall Prevention Level

Default: 230V series = 390.0V
Default: 460V series = 780.0V

Range: 230V Series - 330.0V to 450.0V
460V Series - 600.0V to 900.0V

When drive is running, if the DC bus voltage exceeds Over-Voltage Stall level (P6.17), the AC drive will start over-voltage stall prevention.

P6.18 Braking Voltage Level

Default: 230V series = 380.0V
Default: 460V series = 760.0V

Range: 230V Series - 370.0V to 450.0V
460V Series - 740.0V to 900.0V

This parameter establishes the Dynamic Braking Voltage level threshold based on the DC Bus voltage. With the drive running and with DC Bus voltage above the braking level threshold, the braking transistor internal to the drive is gated ON, connecting the external braking resistor across the DC Bus to dissipate the excess voltage as heat.

P6.30 Line Start Lockout

Default Setting: 00

Settings:

00	Enable Line Start Lockout
01	Disable Line Start Lockout

When this parameter is enabled, the AC Drive will not start the motor when powered up with a RUN command already applied. The drive must see the RUN command change from STOP to RUN before it will start.

When this parameter is disabled, the AC Drive will start the motor when powered up with a RUN command already applied.

- This parameter is available only with AC drive firmware v1.02 or higher. Refer to P9.39 to determine the drive's firmware version.

P6.31	**Present Fault Record**	Default Setting: 00
P6.32	**Second Most Recent Fault Record**	Default Setting: 00
P6.33	**Third Most Recent Fault Record**	Default Setting: 00
P6.34	**Fourth Most Recent Fault Record**	Default Setting: 00
P6.35	**Fifth Most Recent Fault Record**	Default Setting: 00
P6.36	**Sixth Most Recent Fault Record**	Default Setting: 00

Settings for P6.31 - P6.36:

00	No Fault occurred
01	Over-current (oc)
02	Over-voltage (ov)
03	Over-temperature (oH)
04	Overload (oL)
05	Thermal Overload (oL1)
06	Over-Torque (oL2)
07	External Fault (EF)
08	CPU failure 1 (CF1)
09	CPU failure 2 (CF2)
10	CPU failure 3 (CF3)
11	Hardware Protection Failure (HPF)
12	Over-current during accel (OCA)
13	Over-current during decel (OCd)
14	Over-current during steady state (OCn)
15	Ground fault or fuse failure (GFF)
17	Input Power 3 phase loss
19	Auto Ramp Fault
20	Parameters Locked
21	PID Feedback Loss
22	Encoder Feedback Loss
23	Output Shorted(OCC)
24	Momentary Power Loss

P6.37	**Hunting Gain**	Default Setting: 0

Range: 0 to 1000

This parameter can help control frequency oscillation of motors (if needed). If system vibration is encountered due to drive frequency hunting, reduce the vibration by adjusting this parameter while monitoring drive/motor operation.

- This parameter is enabled only in the “high-speed regulation” control modes; (P2.10 = 04 or 05).
- This parameter is available only with AC drive firmware v1.05 or higher. Refer to P9.39 to determine the drive’s firmware version.

PID Parameters

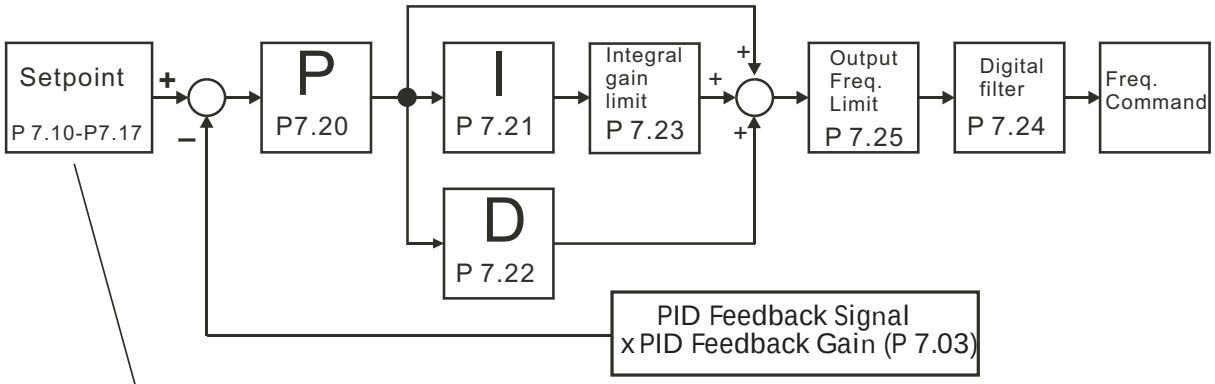
P7.00 Input Terminal for PID Feedback

Default Setting: 00

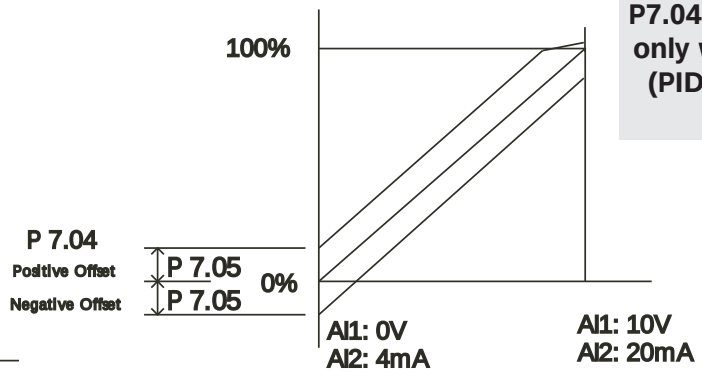
Settings:

00	Inhibit PID operation.
01	Forward-acting (heating loop) PID feedback, PV from AI1 (0 to +10V)
02	Forward-acting (heating loop) PID feedback, PV from AI2 (4 to 20 mA)
03	Reverse-acting (cooling loop) PID feedback, PV from AI1 (0 to +10V)
04	Reverse-acting (cooling loop) PID feedback, PV from AI2 (4 to 20 mA)

Basic PID Loop Diagram:



PID Setpoint x PID Setpoint Gain (P 7.06) + PID Setpoint Offset (P 7.05)



P7.04 thru P7.06 are used only when P7.02 = 2 or 3 (PID Setpoint Source is AI1 or AI2).

P7.01 **PV 100% Value** Default Setting: 100.0

Range: 0.0 to 999

This parameter should be set to the value corresponding to the 100% value of the process variable (PV). The setting for P7.01 cannot be less than any setting for P7.10 to P7.17.

The setting for PV 100% value (P7.01) cannot be set less than any value set for P7.10 to P7.17. If you are unable to reduce P7.01 to the desired value, check parameters P7.10 to P7.17, and reduce these values accordingly.

P7.02 **PID Setpoint Source** Default Setting: 02

Settings:

00	Keypad
01	Serial Communications*
02	AI1 (0 to 10V)
03	AI2 (4 to 20mA)

The user may change the display to PID setpoint by changing P8.00 to 07 on the keypad.

** Serial communication PID setpoint uses P7.10 memory address:*
Hexadecimal - 070A, MODBUS Decimal - 41803, Octal - V3412.

P7.03 ◆ **PID Feedback Gain** Default: 100

Range: 00 to 300.0%

P7.04 ◆ **PID Setpoint Offset Polarity** Default: 00

Settings:

00	No Offset
01	Positive Offset
02	Negative Offset

This parameter functions similarly to P4.01, Analog Input Offset Polarity.

- This parameter only affects analog inputs AI1 and AI2. It does not affect AI3.

P7.05 ◆ **PID Setpoint Offset** Default: 0.0

Range: 0.0 to 100.0%

This parameter functions similarly to P4.02, Analog Input Offset.

- This parameter only affects analog inputs AI1 and AI2. It does not affect AI3.

P7.06 ◆ **PID Setpoint Gain** Default: 100

Range: 0.0 to 300.0%

This parameter functions similarly to P4.03, Analog Input Gain.

- This parameter only affects analog inputs AI1 and AI2. It does not affect AI3.

P7.10 ◆ **Keypad PID Setpoint** Default Setting: 0.0

Range: 0.0 to 999

This parameter is used for serial communication PID setpoints.

Serial communication PID setpoint uses P7.10 memory address: Hexadecimal - 070A, MODBUS Decimal - 41803, Octal - V3412.

The setting for P7.10 cannot exceed the setting for P7.01.

P7.11 ◆ **PID Multi-setpoint 1** Default Setting: 0.0

P7.12 ◆ **PID Multi-setpoint 2** Default Setting: 0.0

P7.13 ◆ **PID Multi-setpoint 3** Default Setting: 0.0

P7.14 ◆ **PID Multi-setpoint 4** Default Setting: 0.0

P7.15 ◆ **PID Multi-setpoint 5** Default Setting: 0.0

P7.16 ◆ **PID Multi-setpoint 6** Default Setting: 0.0

P7.17 ◆ **PID Multi-setpoint 7** Default Setting: 0.0

Range for P7.11-P7.17: 0.0 to 999 Default Setting: 0.0

The Multi-Function Input Terminals DI3 to DI11 (P3.02 to P3.10) are used to select one of the PID Multi-Setpoints. The SPs are determined by P7.11 to P7.17.

1) *In order to use the Multi-PID SPs, P7.11 - P7.17 must be set, and P7.00 ≠ 0.*
2) *The settings for P7.11 through P7.17 cannot exceed the setting for P7.01.*
3) *When all PID Multi-Setpoint inputs are off, the AC drive reverts to the PID Setpoint Source (P7.02).*

Multi-PID SP Bits			PID SP Selection
Bit 3	Bit 2	Bit 1	
OFF	OFF	OFF	P7.02
OFF	OFF	ON	P7.11: SP 1
OFF	ON	OFF	P7.12: SP 2
OFF	ON	ON	P7.13: SP 3
ON	OFF	OFF	P7.14: SP 4
ON	OFF	ON	P7.15: SP 5
ON	ON	OFF	P7.16: SP 6
ON	ON	ON	P7.17: SP 7

P7.20 ◆ Proportional Control (P)

Default Setting: 1.0

Range: 0.0 to 10.0

The first parameter of PID control is Proportional Control (P). For a given process, if the Proportional Value is set too low, the control action will be too sluggish. If the Proportional value is set too high, the control action will be unstable (erratic).

Set the Integral Control (I) and Derivative Control (D) to zero (0). Begin tuning the process with a low Proportional Value, and increase the Proportional value until the system goes unstable (erratic). When instability is reached, reduce the Proportional Value slightly until the system becomes stable (smaller values reduce system Gain). Stability can be tested by moving between two wide-spread setpoint values.

With 10% deviation and P=1, then PX 10% = Control Output. For example, if the speed of a motor is dragged down 10% due to a load increase, a corrective speed signal increase of 10% is generated. In a perfect world, this increase in speed command should bring the motor speed back to normal.

P7.21 ◆ Integral Control (I)

Default Setting: 1.00

Range: 0.00 to 100.0 sec (0.00 disable)

Using only the Proportional Control, the corrective action may not increase fast enough or the setpoint may never be reached because of system losses. The Integral Control is used to generate additional corrective action.

When tuning, begin with a large Integral value and reduce the value until the system goes unstable (erratic). When instability is reached, increase the Integral value slightly until the system becomes stable and the desired setpoint value is reached.

P7.22 ◆ Derivative Control (D)

Default Setting: 0.00

Range: 0.00 to 1.00 sec

If the control output is too sluggish after the Proportional Control (P) and Integral Control (I) values are set, Derivative Control (D) may be required. Begin with a high Derivative value and reduce the value to the point of system instability. Then increase the Derivative value until the control output regains stability. Stability can be tested by moving between two wide-spread setpoint values.

P7.23 Upper Bound for Integral Control

Default Setting: 100

Range: 00 to 100%

- This parameter defines an upper boundary or limit for the integral gain (I) and therefore limits the Master Frequency. Use the formula below to calculate the Integral upper limit.
- The formula is: Integral upper limit = (Maximum Output Frequency) x P7.23. This parameter can limit the Maximum Output Frequency.

$$\textbf{Max. Output Frequency} = \left(\frac{\text{Maximum Speed (P 0.04)}}{\text{Base Speed (P 0.03)}}\right) \text{x Base Frequency (P 0.02)}$$

P7.24 Derivative Filter Time Constant

Default Setting: 0.0

Range: 0.0 to 2.5 sec

To avoid amplification of measured noise in the controller output, a derivative digital filter is inserted. This filter helps smooth oscillations. Larger values for P7.24 provide more smoothing.

P7.25 PID Output Frequency Limit

Default Setting: 100

Range: 00 to 110%

This parameter defines the percentage of output frequency limit during the PID control. The formula is Output Frequency Limit = (Maximum Output Frequency) x P7.25. This parameter will limit the Maximum Output Frequency.

$$\textbf{Max. Output Frequency} = \left(\frac{\text{Maximum Speed (P 0.04)}}{\text{Base Speed (P 0.03)}}\right) \text{x Base Frequency (P 0.02)}$$

P7.26 Feedback Signal Loss Detection Time

Default Setting: 60

Range: 0.0 to 3600 sec

This parameter defines how long the PID Feedback signal is lost before an error is generated. Setting this parameter to 0.0 disables the PID Feedback loss timer. When the feedback signal is lost, the PID Feedback loss timer starts timing. When the timer value is greater than the setting value of P7.26, the PID Feedback Loss warning will activate as set in P7.27. The display shows "PID FBACK LOSS", meaning a feedback abnormality is detected. When the signal is corrected, the warning message "PID FBACK LOSS" will automatically be corrected if a PV signal is still present. If no signal is present, then the screen must be manually reset.

P7.27 PID Feedback Loss Operation

Default Setting: 00

Settings:

00	Warn and AC Drive Stop
01	Warn and Continue Operation
*02	Warn and Continue at Last Frequency
*03	Warn and Continue Preset Speed set in P7.28

* - Parameter setting available only with firmware v1.04 or higher (refer to P9.39)

This parameter sets the operation of the drive when there is a loss of the PID feedback signal.

P7.28 PID Feedback Loss Preset Speed

Default Setting: 0.0

Range: 0 to 400.0 Hz

This parameter sets the speed of operation of the drive when there is a loss of the PID feedback signal, and P7.27 is set to 03.

- This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version.

Display Parameters

P8.00 ◆ User Defined Display Function

Default Setting: 00

Settings:

00	Output Frequency (Hz)
01	Motor Speed (rpm)
02	Scaled Frequency
03	Output Current (A)
04	Motor Load (%)
05	Output Voltage (V)
06	DC Bus Voltage (V)
07	PID Setpoint
08	PID Feedback (PV)
09	Frequency Setpoint

P8.01 ◆ Frequency Scale Factor

Default Setting: 1.0

Range: 0.01 to 160.0

This parameter can be used to multiply the display unit by a scaling factor so that the display will represent some other user desired unit. For example, the user may want to scale the drive display to represent ft/min for a motor that is driving a conveyor.

The coefficient K determines the multiplying factor for the user-defined unit.

- The display value is calculated as follows:

  Display value = output frequency x K

- The display window is only capable of showing four digits, but P8.01 can be used to create larger numbers. The display window uses decimal points to signify numbers up to five digits as explained below:

DISPLAY	***NUMBER REPRESENTED***
9999	The absence of a decimal point indicates a four digit integer.
999.9	A single decimal point between the middle and the right-most numbers is a true decimal point; it separates ones and tenths as in “300.5 (three hundred and one-half).
9999.	A single decimal point after the right-most number is not a true decimal point; instead it indicates that a zero follows the right-most numbers. For example, the number 12340 would be displayed as “1234.”.

P8.02 ◆ Backlight Timer

Default Setting: 00

Settings:

00	Timer Enable (1 min light off)
01	Timer Disable

This parameter is used to enable or disable the backlight timer.

Communications Parameters

P9.00 Communication Address

Default Setting: 01

Range: 01 to 254

If the AC drive is controlled by serial communication, the communication address must be set via this parameter.

P9.01 Transmission Speed

Default Setting: 01

Settings:

00	4800 baud data transmission speed
01	9600 baud data transmission speed
02	19200 baud data transmission speed
03	38400 baud data transmission speed

This parameter is used to set the transmission speed between the computer and AC drive. Users can set parameters and control the operation of the AC drive via the RS-485 serial interface of a personal computer.

P9.02 Communication Protocol

Default Setting: 00

Settings:

00	MODBUS ASCII mode	<7 data bits, no parity, 2 stop bits>
01	MODBUS ASCII mode	<7 data bits, even parity, 1 stop bit>
02	MODBUS ASCII mode	<7 data bits, odd parity, 1 stop bit>
03	MODBUS RTU mode	<8 data bits, no parity, 2 stop bits>
04	MODBUS RTU mode	<8 data bits, even parity, 1 stop bit>
05	MODBUS RTU mode	<8 data bits, odd parity, 1 stop bit>

Each *DURAPULSE* AC drive has a pre-assigned communication address specified by P9.00. The master computer or PLC then controls each AC drive according to its communication address. *DURAPULSE* drives can be set up to communicate on Modbus networks using one of the following modes: ASCII (American Standard Code for Information Interchange), or RTU (Remote Terminal Unit). Users can select the desired mode along with the serial port communications protocol using the settings above.

P9.03 Transmission Fault Treatment

Default Setting: 00

Settings:

00	Display fault and continue operating
01	Display fault and RAMP to stop
02	Display fault and COAST to stop
03	No fault displayed and continue operating

This parameter is used to detect an error and take appropriate action.

P9.04 Time Out Detection

Default Setting: 00

Settings:

00	Disable
01	Enable

When this parameter is set to 01, the communications Time Out Detection is Enabled. If a delay in communications for more than the Time Out Duration (P9.05) is detected, the action selected by the Transmission Fault Treatment (P9.03) will be used.

P9.05 Time Out Duration

Default Setting: 0.5

Range: 0.1 to 60.0 seconds

P9.07 ◆ Parameter Lock

Default Setting: 00

Settings:

00	All parameters can be set and read
01	All parameters are read-only

P9.08 Restore to Default

Default Setting: 00

Settings: 0 or 99

•• Setting 99 restores all parameters to factory defaults. ••

P9.11	◆ **Block Transfer Parameter 1**	Default Setting: P9.99
P9.12	◆ **Block Transfer Parameter 2**	Default Setting: P9.99
P9.13	◆ **Block Transfer Parameter 3**	Default Setting: P9.99
P9.14	◆ **Block Transfer Parameter 4**	Default Setting: P9.99
P9.15	◆ **Block Transfer Parameter 5**	Default Setting: P9.99
P9.16	◆ **Block Transfer Parameter 6**	Default Setting: P9.99
P9.17	◆ **Block Transfer Parameter 7**	Default Setting: P9.99
P9.18	◆ **Block Transfer Parameter 8**	Default Setting: P9.99
P9.19	◆ **Block Transfer Parameter 9**	Default Setting: P9.99
P9.20	◆ **Block Transfer Parameter 10**	Default Setting: P9.99
P9.21	◆ **Block Transfer Parameter 11**	Default Setting: P9.99
P9.22	◆ **Block Transfer Parameter 12**	Default Setting: P9.99
P9.23	◆ **Block Transfer Parameter 13**	Default Setting: P9.99
P9.24	◆ **Block Transfer Parameter 14**	Default Setting: P9.99
P9.25	◆ **Block Transfer Parameter 15**	Default Setting: P9.99

Range for Block Transfer Parameters (P9.11-P9.25): P0.00 to P8.02, P9.99

The sequential block transfer parameters (P9.11 through P9.25) allow you to "group" various miscellaneous non-sequential parameters, so that only one PLC programming write instruction is required to update those parameters, instead of three separate write instructions.

- Example:
  Writing directly to three non-sequential parameters P1.00, P1.02, and P1.04 requires three separate write instructions from the PLC. However, those drive parameters can be updated with only one PLC write instruction to the sequential transfer blocks P9.11 through P9.13; if P9.11 is set to P1.00, P9.12 is set to P1.02, and P9.13 is set to P1.04.
- Setting P9.99 (default) disables the Block Transfer Parameter.

P9.26 ◆ **Serial Comm Speed Reference** Default Setting: 60.0

Range: 0.0 to 400.0 Hz [16-bit binary (HEX) format]

This parameter is used to set the Frequency Command when the AC drive is controlled by communication interface.

In order for this parameter to function, the Source of Frequency Command (P4.00) must be set to 05.

P9.27 ◆ **Serial Comm RUN Command** Default Setting: 00

Settings:

00	Stop
01	Run

- Do not write both RUN (P9.27) & JOG (P9.31) Commands in the same write instruction. Use separate write instructions from the master computer or PLC.

In order for this parameter to function, the Source of Operation Command (P3.00) must be set to 03 or 04.

P9.28 ◆ **Serial Comm Direction Command** Default Setting: 00

Settings:

00	Forward
01	Reverse

P9.29 ◆ **Serial Comm External Fault** Default Setting: 00

Settings:

00	No action
01	External fault

P9.30 ◆ **Serial Comm Fault Reset** Default Setting: 00

Settings:

00	No action
01	Fault Reset

P9.31 ◆ **Serial Comm JOG Command** Default Setting: 00

Settings:

00	Stop
01	Jog

- Do not write both RUN (P9.27) & JOG (P9.31) Commands in the same write instruction. Use separate write instructions from the master computer or PLC.

P9.39 **Firmware Version** Default Setting: ##

Settings: Factory Set, Read Only

- This parameter is available only with AC drive firmware v1.02 or higher.

P9.40 ◆ Parameter Copy

Default Setting: 00

Settings:

00	DISABLE Copy Keypad Function
01	ENABLE Copy Keypad Function

This parameter is used to upload or download information to the drive.

P9.41 GS Series Number

Default Setting: ##

Settings

01	GS1
02	GS3
03	GS3
04	GS4

P9.42 Manufacturer Model Information

Default Setting: ##

Settings

00	GS3-21P0 (230V / 3ph / 1.0 hp)
01	GS3-22P0 (230V / 3ph / 2.0 hp)
02	GS3-23P0 (230V / 3ph / 3.0 hp)
03	GS3-25P0 (230V / 3ph / 5.0 hp)
04	GS3-27P5 (230V / 3ph / 7.5 hp)
05	GS3-2010 (230V / 3ph / 10 hp)
06	GS3-2015 (230V / 3ph / 15 hp)
07	GS3-2020 (230V / 3ph / 20 hp)
08	GS3-2025 (230V / 3ph / 25 hp)
09	GS3-2030 (230V / 3ph / 30 hp)
10	GS3-2040 (230V / 3ph / 40 hp)
11	GS3-2050 (230V / 3ph / 50 hp)
12	GS3-41P0 (460V / 3ph / 1.0 hp)
13	GS3-42P0 (460V / 3ph / 2.0 hp)
14	GS3-43P0 (460V / 3ph / 3.0 hp)
15	GS3-45P0 (460V / 3ph / 5.0 hp)
16	GS3-47P5 (460V / 3ph / 7.5 hp)
17	GS3-4010 (460V / 3ph / 10 hp)
18	GS3-4015 (460V / 3ph / 15 hp)
19	GS3-4020 (460V / 3ph / 20 hp)
20	GS3-4025 (460V / 3ph / 25 hp)
21	GS3-4030 (460V / 3ph / 30 hp)
22	GS3-4040 (460V / 3ph / 40 hp)
23	GS3-4050 (460V / 3ph / 50 hp)
24	GS3-4060 (460V / 3ph / 60 hp)
25	GS3-4075 (460V / 3ph / 75 hp)
26	GS3-4100 (460V / 3ph / 100 hp)

Encoder Feedback Parameters

P10.00 Encoder Pulses Per Revolution — Default 1024

Range: 01 to 20000

An encoder is used as a transducer to feed back the motor speed, and this parameter defines the number of pulses for each cycle of the PI control.

P10.01 Encoder Type Input — Default: 00

Range:

00	Disable
01	Single Phase
02	Quadrature, FWD - CCW
03	Quadrature, FWD - CW

This parameter is used to specify encoder signal type. Settings 02 and 03 are used to distinguish motor rotation in relation to the quadrature type encoder signal. Error message "ENC SIGNAL ERROR" will come up if motor rotation does not match quadrature settings.

The diagram on the following page shows the output control relationship of P10.02, P10.03 and P10.04.

P10.02 ◆ Proportional Control — Default: 1.0

Range: 0.0 to 10.0

This parameter specifies proportional control and associated gain (I) used for vector control with encoder feedback (P2.10 = 03). As part of the drive's control algorithm, the most recent feedback signal is multiplied on each scan by the scaling factor set by this parameter.

P10.03 ◆ Integral Control — Default: 1.00

Range: 0.00 to 100.00 sec

This parameter specifies integral control and associated gain (I) used for vector control with encoder feedback (P2.10 = 03). The drive calculates a running integral, or summation, of the feedback signal over the time period set by this parameter. This summation, rather than the most recent feedback signal, is used in the control algorithm. Integral control "smoothes" the effect of radical changes in the feedback signal.

P10.04 Encoder Control Output Limit

Default: 7.5

Range: 0.0 to 20.0%

This parameter limits the amount of correction by the encoder proportional and integral controls (P10.02 & P10.03) on the output frequency when controlling speed. It can limit the maximum output frequency, and is defined in percent of maximum output frequency.

P10.05 Encoder Loss Detection

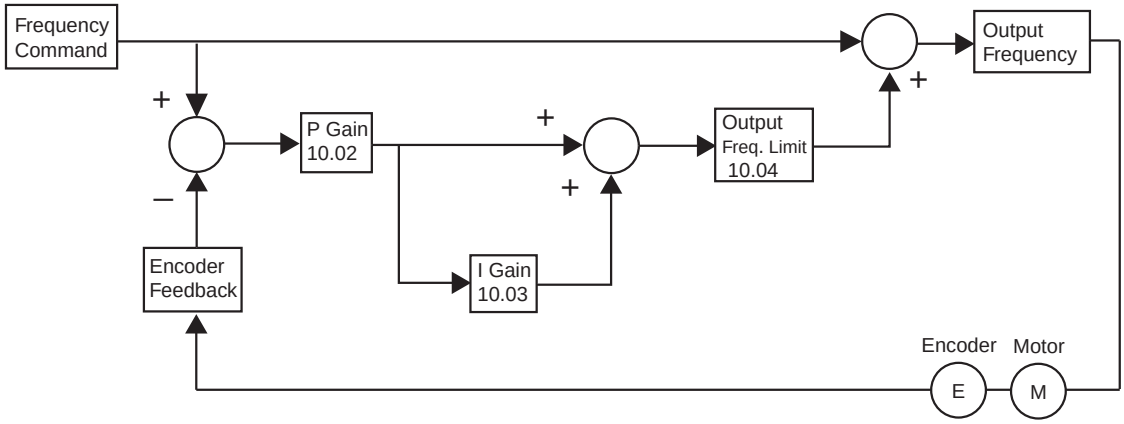
Default: 00

Settings:

00	Warn and continue operation
01	Warn and RAMP to stop
02	Warn and COAST to stop

This parameter governs the response of the drive to the feedback signals, such as the analog or encoder pulse signals, when they are performing abnormally.

Closed Loop Tuning Diagram (P10.02, P10.03, P10.04)



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