Troubleshooting

This chapter provides information to guide you in troubleshooting the PowerFlex DC drive. Included is a listing and description of drive faults (with possible solutions, when applicable) and alarms.

Faults and Alarms

A fault is a condition that always stops the drive and prevents it from starting until the fault condition is corrected. There are two fault types.

Type	Description	
①	User Configurable	This type of fault allows you to configure the drive's response to the condition that caused the error. • When configured for a fault, the drive will be stopped, the error condition will be annunciated on the HIM or a via digital output (if programmed) and the drive will not be allowed to start until the fault condition is corrected. • When configured for an alarm, the error condition will be annunciated on the HIM or via a digital output (if programmed) and the drive will continue to run and/or be allowed to start. • When configured for ignore or disabled, the error condition will not be recognized by the drive or be indicated on the HIM or via a programmed digital output.
②	Non-Configurable	This type of fault is always enabled and will cause the drive to stop running in order to protect the drive and/or motor from damage. In some cases, drive or motor repair may be required. The cause of the fault must be corrected before the fault can be cleared (via a fault reset using the HIM or programmed digital input). The fault will be reset on power up after repair.

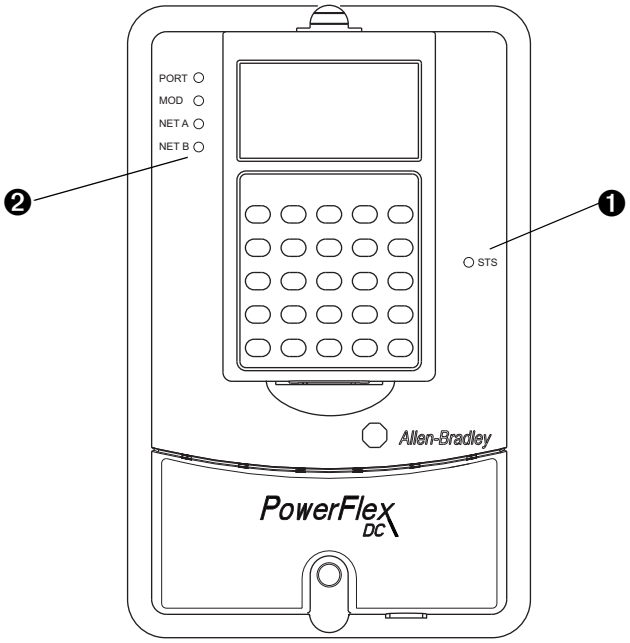
An alarm indicates a drive error condition that does not stop the drive, but may prevent it from starting. There are two types of alarms.

Type	Description	
①	User Configurable	This type of alarm indicates a drive error condition but does not stop the drive from starting or running. However, if this type of alarm is left uncorrected, a fault condition may eventually occur.
②	Non-Configurable	This type of alarm is always enabled and will prevent the drive from starting until the alarm condition is corrected.

Drive Status

The condition or state of your drive is constantly monitored. Any changes will be indicated through the LEDs and/or the HIM (if present).

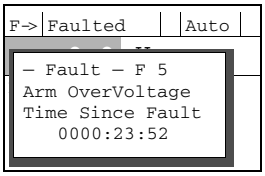
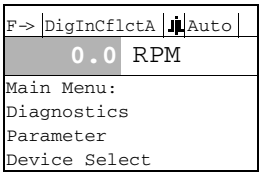
Figure 4.1 Drive Status Indicators



#	Name	Color	State	Description
❶	STS (Status)	Green	Flashing	Drive ready, but not running and no faults are present.
			Steady	Drive running, no faults are present.
		Yellow	Flashing, Drive Stopped	A condition exists that is preventing the drive from starting. Check parameters 1403 [Start Inhibits] and/or 1380 [Drive Alarm 1].
			Flashing, Drive Running	An intermittent type 1 alarm condition is occurring. Check parameter 1380 [Drive Alarm 1]. Refer to Fault Descriptions on page 4-4 and/or Alarm Descriptions on page 4-7.
			Steady, Drive Running	A continuous type 1 alarm condition exists. Check parameter 1380 [Drive Alarm 1]. Refer to Fault Descriptions on page 4-4 and/or Alarm Descriptions on page 4-7.
		Red	Flashing	A fault has occurred. Check [Fault x Code] or view the Fault Queue on the HIM. Refer to Fault Descriptions on page 4-4.
			Steady	A non-resettable, non-configurable fault has occurred. Check [Fault x Code] or view the Fault Queue on the HIM. Refer to Fault Descriptions on page 4-4.
❷	PORT	Refer to the Communication Adapter User Manual.		Status of DPI port internal communications (if present).
	MOD			Status of communications module (when installed).
	NET A			Status of network (if connected).
	NET B			Status of secondary network (if connected).

HIM Indication

The LCD HIM also provides visual notification of a fault or alarm condition.

Condition	Display
The drive is indicating a fault. The LCD HIM immediately reports the fault condition by displaying the following: • "Faulted" appears in the status line • Fault number • Fault name • Time that has passed since the fault occurred Press "Esc" to regain HIM control.	
The drive is indicating an alarm. The LCD HIM immediately reports the alarm condition by displaying the following: • Alarm name • Alarm bell graphic	

Manually Clearing Faults

Step	Key(s)
1. Press "Esc" to acknowledge the fault. The fault information will be removed so that you can use the HIM.	
2. Address the condition that caused the fault. The cause must be corrected before the fault can be cleared.	
3. After corrective action has been taken, clear the fault by **one** of these methods. • Press "Stop" • Cycle drive power • Set parameter 1347 [Fault Clear] to 1 "Clear Faults" • "Clear Faults" on the HIM Diagnostic menu	

Fault Descriptions

Table 4.A Fault Types, Descriptions and Actions

Fault	No.	Type[1]	Description	Action
AC Undervoltage	4	①	There is an undervoltage on the power circuit. Possible causes include:	
			• Par 481 [UnderVolt Thresh] is set incorrectly (possibly set to 400V when the drive is rated for 230V input power).	Set Par 481 [UnderVolt Thresh] correctly and then reset the drive via Par 1347 [Fault Clear].
			• The incoming voltage to the power terminals (U/V/W) of the drive is too low due to: • The AC input voltage is too low • There are poor cable connections (e.g. terminals on contactor, choke, filter, etc., is not properly connected).	• Verify AC input power level. • Check all connections.
			• The incoming voltage to the control power terminals (U2, V2) is too low due to: • The AC input voltage is too low • There are poor cable connections. • The fuse(s) on the Switching Power Supply circuit board have blown.	• Verify AC input power level. • Check all connections. • Check and replace the fuse(s) if necessary.
			• The line fuses have tripped. • The AC input voltage dips or there is a high disturbance in the supply voltage.	1. Remove power from the drive. 2. Eliminate AC input voltage dips and/or disturbances. 3. Replace any blown fuses.
Arm Overvoltage	5	①	There is an overvoltage on the armature circuit. Possible causes include:	
			• Par 175 [Rated Motor Volt] is set too low.	Set Par 175 [Rated Motor Volt] correctly.
			• The drive is not configured to use field weakening, but the motor can only reach the set speed when the drive is in field weakening mode.	Check the value of Par 469 [Field Mode Sel] and set accordingly.
			Note: Configure with Par 203 [OverVolt Flt Cfg].	
Auxiliary Input	2	①	An auxiliary input interlock is open or a voltage (+15 - 30 V) or reference signal is missing for the digital input set to 14 “Aux Fault”. Note: Configure with Par 354 [Aux Inp Flt Cfg].	Check the remote wiring.
Drive Overload	64	②	Drive Rating of 150% for 1 minute or 200% for 3 seconds has been exceeded	Reduce the load or extend the acceleration time.
Dsp Error	132	②	A non-resettable software error exists on the Control board.	Cycle power to the drive. If the problem persists, replace the Control board.
EEPROM Error	100	②	There was a problem saving parameter values or there has been a control board change. Note: When this fault occurs, the parameters will be reset to the default settings.	1. Reset the fault. 2. If this fault occurs again, cycle power to the drive. 3. If the problem persists, replace the Control board.
Encoder Loss	91	①	The drive is not receiving a speed feedback signal. Possible causes include:	
			• The conductors of the feedback signal have been interrupted.	Current from one or more of the feedback device wires is not reaching the drive. Check the feedback device wiring.
			• One or several encoder channels are missing (conductor interruption, no encoder power supply).	Check the encoder connections and power supply.
			Note: Configure with Par 478 [Spd Loss Flt Cfg].	
Fld Current Loss	6	①	The field current is too low. Possible causes include:	
			• The field current regulator is currently not enabled.	Enable the field current regulator via Par 497 [Field Reg Enable].
			• The conductors in the field circuit have been interrupted.	Check the motor field wiring. Measure the resistance of the motor and verify that it matches motor nameplate data.
			• The field fuses are currently open.	Check the field fuses and replace as necessary.
			Note: Configure with Par 473 [FldLoss Flt Cfg].	

Fault	No.	Type[1]	Description	Action
Hardware Fault	130	②	A non-resettable hardware error has occurred.	Cycle power to the drive. If the problem persists, replace the Control board.
Heatsink OvrTemp	8	②	The heatsink temperature is too high Possible causes include:	
			• The surrounding air temperature is too high.	Lower the surrounding air temperature.
			• The drive's cooling fans have failed (drives > 110 A).	Check the fan fuses and fans. If the fan fuses have failed, replace the fuses. The fans have failed, replace the fans.
			• The heatsink is dirty.	Clean the heatsink.
Interrupt Error	131	②	A non-resettable software error has occurred in the main application.	Report this error to the manufacturer.
Main Contactor	10	②	One of the following has occurred: • The Main and/or Dynamic Brake (DB) contactor failed to open or close in the proper amount of time. • A digital input and/or relay output 1 is incorrectly wired and/or configured. • Wiring to a digital input configured for contactor has opened.	• Check all contactor wiring and drive jumpers. Repair or replace the contactor(s) if the problem(s) persist. • Check the digital input and/or relay output 1 (terminals 35 and 36) wiring and configuration using Pars 1391 [ContactorControl], 1392 [Relay Out 1 Sel] and [Digital Inx Sel]. Refer to Using Contactors on page 1-9 for more information.
Motor Over Temp	16	①	The motor has exceeded its temperature rating (as signaled by the thermistor connected to the drive terminals 78 and 79). Possible causes include:	
			• The motor does not have a thermistor and there is no resistor between terminals 78 and 79 on the drive.	Refer to Thermistors and Thermal Switches on page 1-21 for configuration information.
			• The cable between the thermistor connection on the motor and terminals 78 and 79 on the drive has been broken.	Check and repair any damage to or loss of connection of the thermistor cables between the motor and drive.

			• The overheating of the motor may have been caused by one of the following:
			  • The Load cycle is too extreme.
			  • The surrounding air temperature at the site of motor is too high.
			  • The motor has an external fan and the fan failed.
			  • The motor does not have an external fan and the load is too large at low speeds. The cooling effect of the internal fan on the motor shaft is too low for this load cycle.
				Reduce the load.
				Reduce the surrounding air temperature.
				Replace the motor fan.
				Reduce the load cycle or fit the motor with an external fan.

			Note: Configure with Par 365 [OverTemp Flt Cfg].	
No Fault	0	–	There are currently no faults in the drive.	Informational only.
Overcurrent	13	①	An overcurrent has occurred in the motor circuit. Possible causes include:	
			• There is a short-circuit or ground fault at the output of the drive.	Verify the armature circuit wiring is correct.
			• The current regulator was not properly fine tuned.	Refer to Tune the Current Regulator: on page 2-8.
			• The value of Par 584 [OverCurrent Thr] is too low.	Increase the value of Par 584 [OverCurrent Thr] accordingly.
Overspeed	25	②	The Encoder/Tachometer feedback indicated a speed that is more than 10% above the value in Par 2 [Maximum Speed].	Remove the excessive load or overhauling conditions or increase the value of Par 2 [Maximum Speed].
Params Defaulted	48	②	User parameters have been reset to their default values.	Informational only.
Port 1-5 Adapter	71 - 75	②	The communications card has a fault.	Check the DPI device event queue and corresponding fault information for the device.

Fault	No.	Type[1]	Description	Action
Port 1-5 DPI Loss	81 - 85	②	The DPI port stopped communicating.	1. Check the HIM connection. 2. If adapter was not intentionally disconnected, check the wiring to the port. Replace the wiring, port expander, adapters, Control Board or complete drive as required. 3. If an adapter was intentionally disconnected and the bit for that adapter in Par 591 [Logic Mask] is set to "1", this fault will occur. To disable this fault, set the appropriate bit in [Logic Mask] for the adapter to "0."
Power Failure	3	②	There is a fault in the 24V Control board supply - the voltage is below the permitted value. In most cases the cause is in the external I/O wiring.	• Pull the plug-in I/O terminal blocks out of the control circuit board and reset the drive via 1347 [Fault Clear]. If there are no other faults, check the I/O wiring for a short-circuit including the cable shielding. • Check fuses F1 and F2 located on the Switching Power Supply circuit board (frame A size drives only have one fuse - F1). Replace as necessary.* • Check varistor fuses F1, F2, and F3 on the Pulse Transformer or Transient Noise Filter circuit boards for Frame C size drives. Replace as necessary.* • If this fault occurs again, an internal fault may be present. Contact your Rockwell Automation sales office. *Note: Refer to Control Power Circuit Protection Fuses on page A-14 for fuse sizing information.
			ATTENTION: Remove power from the drive before removing the I/O terminal blocks and/or fuses.	
STune Aborted	62	②	The speed regulator auto tuning procedure has been stopped by the user.	Informational only.
STune CurLimit	59	②	The value of Par 1048 [Autotune Cur Lim] for auto tuning the speed regulator is set too high.	Decrease the value of Par 1048 [Autotune Cur Lim] and repeat the auto tune procedure.
STune FrictionLo	60	②	The friction value attained during the auto tuning procedure is zero or lower than the control precision limit.	Decrease the value of Par 1048 [Autotune Cur Lim] and repeat the auto tune procedure.
STune LoadHi	58	②	The loading torque value is too high at zero speed to complete the speed regulator auto tuning procedure.	Decrease the load torque, where applicable, and repeat the auto tune procedure.
STune Overspeed	56	②	The measured motor speed is too high during the speed regulator auto tuning procedure.	Decrease the value of Par 1048 [Autotune Cur Lim] and repeat the auto tune procedure.
STune Stalled	57	②	The drive stalled during the speed regulator auto tuning procedure.	Increase the value of Par 1048 [Autotune Cur Lim] and repeat the auto tune procedure.
STune Timeout	61	②	The speed regulator auto tuning procedure did not complete within the available time.	Verify the value in Par 1048 [Autotune Cur Lim]. If this value is set to low, the motor will not be able to reach a maximum speed of 33% of the lower of the values in Par 45 [Max Ref Speed] or Par 3 [Max Speed Fwd] or Par 4 [Max Speed Rev] and not be able to complete the test. Set these values appropriately and repeat the auto tuning procedure.
Sustained Curr	70	②	The motor CEMF is too high or the line voltage is too low.	• Check the line voltage and frequency. • Check the motor brushes and connections. • Check the Main and DB Contactor connections if present. • Verify that there are no overhauling loads present.

[1] See page 4-1 for a description of fault types.

Table 4.B Fault Cross Reference by Number

No.(1)	Fault	No.(1)	Fault
2	Auxiliary Input	64	Drive Overload
3	Power Failure	70	Sustained Curr
4	AC Undervoltage	71 - 75	Port 1 Adaptor
5	Arm Overvoltage		Port 2 Adaptor
6	Fld Current Loss		Port 3 Adaptor
8	Heatsink OvrTemp		Port 4 Adaptor
10	Main Contactor		Port 5 Adaptor
13	Over Current	81 - 85	Port 1 DPI Loss
16	Motor Over Temp		Port 2 DPI Loss
25	Overspeed		Port 3 DPI Loss
56	STune Overspeed		Port 4 DPI Loss
57	STune Stalled		Port 5 DPI Loss
58	STune LoadHi	91	Encoder Loss
59	STune CurLimit	100	EEPROM Error
60	STune FrictionLo	130	Hardware Fault
61	STune Timeout	131	Interrupt Error
62	STune Aborted	132	Dsp Error

(1) Fault numbers not listed are reserved for future use.

Clearing Alarms

Alarms are automatically cleared when the condition that caused the alarm is no longer present.

Alarm Descriptions

The status of the alarms can be viewed in 1380 [Drive Alarm 1].

Table 4.C Alarm Descriptions and Actions

Alarm	Type	Description
AnalogCflct	②	More than one of the drive's reference inputs (Pars 70, 75 and 80 [Anlg Inx Sel], Pars 1323-1327 [DPI Px Select], or Par 1021 [Encoder Out Sel]) are set to "Speed Ref A" or "Speed Ref B". This alarm takes precedence over the "EncoderCflct" alarm when both are present. Refer to Figure C.1 or Speed Reference Selection on page D-5 for a graphical representation of the drive's reference selections.
Arm Overvoltage	①	There is a possible overvoltage on the armature circuit or Par 175 [Rated Motor Volt] is set too low for the application. Refer to the "Arm Overvoltage" fault description on page 4-4 for more information.
Auxiliary Input	①	An auxiliary input interlock is open or a voltage (+15 - 30 V) or reference signal is missing for the digital input set to 14 "Aux Fault". Refer to the "Auxiliary Input" fault description on page 4-4 for more information.
BipolarCflct	②	Par 1322 [Direction Mode] is set to "Bipolar" or "Reverse Dis" and one or more of the following digital input functions is configured: "Fwd/Reverse," "Run Forward," "Run Reverse," "Jog Forward" or "Jog Reverse."

<table>
<tr><th>Alarm</th><th>Type</th><th>Description</th></tr>
<tr><td>CntactrCflct</td><td>②</td><td>Contactor input functions are in conflict:
• When Par 1391 [ContactorControl] is set to “None”, both relay outputs (Pars 1392 [Relay Out 1 Sel] and 629 [Relay Out 2 Sel] and all digital inputs ([Digital Inx Sel]) cannot be set to “Contactor” or “ContactorDB”.
• With [ContactorControl] set to “Contactor”, one relay output and one digital input must be set to “Contactor”. No output can be defined as “ContactorDB”.
• With [ContactorControl] set to “Contactor+DB”, both relay outputs and one digital input must be set to “Contactor”, “ContactorDB” and “Contactor”, respectively.
Because any relay output can be configured as contactor or DB control and any digital input as contactor status, care must be taken to correctly wire the terminal blocks to match the parameter selections.</td></tr>
<tr><td>DigInCflctA</td><td>②</td><td>Digital input functions are in conflict. Combinations marked with a “ ” will cause an alarm.
<table><tr><th></th><th>Acc2/Dec2</th><th>Accel 2</th><th>Decel 2</th><th>Jog 1/2</th><th>Jog Fwd</th><th>Jog Rev</th><th>Fwd/Rev</th></tr><tr><td>Acc2/Dec2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Accel 2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Decel 2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Jog 1/2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Jog Fwd</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Jog Rev</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Fwd/Rev</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>DigInCflctB</td><td>②</td><td>One of the following digital input conflicts exists:
• A digital Start input has been configured without a Stop input
• None of the digital inputs are configured for “Enable”
• Other digital input functions are in conflict. Combinations that conflict are marked with a “ ” and will cause an alarm.
<table><tr><th></th><th>Start</th><th>Stop-CF</th><th>Run</th><th>Run Fwd</th><th>Run Rev</th><th>Jog 1/2</th><th>Jog Fwd</th><th>Jog Rev</th><th>Fwd/Rev</th></tr><tr><td>Start</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Stop-CF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Run</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Run Fwd</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Run Rev</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Jog 1/2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Jog Fwd</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Jog Rev</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Fwd/Rev</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>DigInCflctC</td><td>②</td><td>More than one physical input has been configured to the same input function. Multiple configurations are not allowed for the following input functions.
Forward/Reverse, Run Reverse, Run Forward
Jog Forward, Jog Reverse, Speed Select 1
Speed Select 2, Speed Select 3, Acc2 / Dec2
Accel 2, Decel 2, Run</td></tr>
<tr><td>Encoder Loss</td><td>①</td><td>The drive is not receiving a speed feedback signal from the encoder. Refer to the “Encoder Loss” fault description on page 4-4 for more information.</td></tr>
<tr><td>EncoderCflct</td><td>②</td><td>One of the following has occurred:
• Par 414 [Fdbk Device Type] is set to 1 “Encoder” and Par 1021 [Encoder Out Sel] is not set to 0 “Off”. If you are using an encoder, set Par 1021 [Encoder Out Sel] to 0 “Off”.
• More than one of the following parameters contains the same value: Pars 1021 [Encoder Out Sel], 70, 75 and 80 [Anlg Inx Sel], and/or 1323 - 1327 [DPI Px Select].</td></tr>
<tr><td>Fld Current Loss</td><td>①</td><td>The field current is too low. Refer to the “Fld Current Loss” fault description on page 4-4 for more information.</td></tr>
</table>

Alarm	Type	Description
Motor Over Temp	①	The motor has exceeded its temperature rating (as signaled by the thermistor connected to the drive terminals 78 and 79). Refer to the “Motor Over Temp” fault description on page 4-5 for more information.
Start At PowerUp	①	Par 1344 [Start At Powerup] is enabled. The drive may start at any time after drive power up and the time specified in Par 1345 [Powerup Delay] has elapsed.

Common Drive Symptoms and Corrective Actions

Drive will not start

Drive Symptom	Action

An external “Start” command was issued, but the drive does not start.	• Verify that no faults or alarms are displayed. If a fault or alarm is displayed, follow the corrective action provided (refer to Fault Descriptions on page 4-4 or Alarm Descriptions on page 4-7).
	• The external wiring to the programmed Start terminal block connection is missing.
	  • Verify that +24V DC is present at terminal block connection.
	  • Verify that 24V Supply Common is connected between terminals 18 and 16.
	  • Verify that the configuration for Pars 133-144 [Digital Inx Sel] matches the switch wiring.

The drive is not in a "Ready" state, is not “Enabled” or a “Stop” is asserted.	Check the Enable and Stop inputs. Verify that the wiring is correct (refer to I/O Wiring Examples on page 1-33).
External AC Input or DC Output contactor, if used, has not closed.	If using an AC Input contactor: • Verify that the drive is "Ready", then verify that the required coil voltage is present at terminals 35 and 36 (Relay Output 1). If the coil voltage is present at terminals 35 or 36, then verify that proper voltage is at the AC Input contactor coil. • Inspect the contactor for mechanical problems. • Verify that Par 1391 [ContactorControl] is set properly. • Verify that the contactor and/or auxiliary contact is properly wired to a digital input on the drive and that the appropriate digital input selection parameter (133-144 [Digital Inx Sel]) is set to 31 “Contactor”. • Verify that parameter 1392 [Relay Out 1 Sel] is set to 25 “Contactor”. If using an external DC Output contactor: • Verify that the drive is "Ready", then verify that the required coil voltage is present at terminals 35 and 36 (Relay Output 1). If the coil voltage is present at terminals 35 or 36, then verify that the proper voltage is at the DC Output contactor coil. • Inspect the contactor for mechanical problems. • Verify that parameter 1391 [ContactorControl] is set properly. • Verify that the contactor and/or auxiliary contact is properly wired to a digital input on the drive and that the appropriate digital input selection parameter (133-144 [Digital Inx Sel]) is set to 31 “Contactor”. • Verify that parameter 1392 [Relay Out 1 Sel] is set to 25 “Contactor”.

Drive Symptom	Action
The external DB resistor contactor, if used, has not closed.	• Verify that the drive is "Ready", then verify that the required coil voltage is present at terminals 75 and 76 (Relay Output 2). If the coil voltage is present at terminals 75 or 76, then verify that proper voltage is at the DB contactor coil. • Inspect contactor for mechanical problems. • Verify that parameter 1391 [ContactorControl] is set properly. • Verify that the auxiliary contacts for the AC Input or DC Output contactor and DB contactor are properly wired in series to a digital input on the drive. • Verify that the appropriate digital input selection parameter (133-144 [Digital Inx Sel]) is set to 31 “Contactor”. • Verify that parameter 629 [Relay Out 2 Sel] is set to 24 “ContactorDB”.
The drive starts from the HIM but will not start from the terminal block.	Check masks for Terminal Block control (see parameters 591 [Logic Mask] and 592 [Start Mask]).

Drive starts but motor does not turn and no armature current.

Drive Symptom	Action
The drive starts but there is no armature current and the motor does not respond to a speed signal.	• Verify the wiring to the analog input(s) selected for speed reference (refer to I/O Wiring Examples on page 1-33). • Verify the setting(s) of switch S9 and Par 71 [Anlg In1 Config]; or S10 and Par 76 [Anlg In2 Config]; or S11 and Par 81 [Anlg In3 Config] (refer to DIP Switch and Jumper Settings on page 1-28). • Verify the speed selection digital input(s) and the respective input terminal voltage(s), if used. • Verify the analog input(s) voltage(s) displayed in parameters 1404 [Analog In1 Value], 1405 [Analog In2 Value] or 1406 [Analog In3 Value].
The drive starts and armature current is present but the motor does not turn.	• The Load may be too great for the motor and drive. • Remove the load from the motor and test for motor rotation. If the motor rotates, then verify that the measured armature current, using an in-line current meter or DC clamp on meter, equals the armature current feedback value displayed in parameters 200 [Arm Current] and 199 [Arm Current Pct]. Increase the value of parameter 7 [Current Limit], 8 [Current Lim Pos] or 9 [Current Lim Neg]. • Verify that the measured motor field current, using an in-line current meter or DC clamp on meter, equals the feedback value displayed in parameter 351 [Field Current]. • Verify that the motor nameplate value equals the value displayed in parameter 280 [Nom Mtr Field Amps]. • Measure the DC voltage supplied to the motor field. Verify that the value of parameter 374 [Drv Fld Brdg Cur] equals the setting of DIP Switch S14. • If the motor does not rotate with the load removed, check the motor. • Verify that parameter 353 [Zero Torque] is not enabled.

The motor does not reach commanded speed.

Drive Symptom	Action
The drive starts and the motor turns but does reach the commanded speed.	The load may be too great for the motor and drive. • Remove the load from the motor and test for the correct commanded speed. If the motor reaches the commanded speed, then verify that the measured armature current, using an in-line current meter or DC clamp on meter, equals the armature current feedback value displayed in parameters 200 [Arm Current] and 199 [Arm Current Pct]. Increase the value of parameter 7 [Current Limit], 8 [Current Lim Pos] or 9 [Current Lim Neg]. • Verify that the measured motor field current, using an in-line current meter or DC clamp on meter, equals the feedback value displayed in parameter 351 [Field Current]. If the motor does not achieve commanded speed continue with following tests: • Check the speed parameter limits: parameters 2 [Maximum Speed], 3 [Max Speed Fwd], 4 [Max Speed Rev] and 122 [Spd Feedback]. • Check the analog voltage input and speed reference values: parameters 1404 [Analog In1 Value], 1405 [Analog In2 Value], 44 [Speed Ref A], 48 [Speed Ref B] • Check the setting of switch S9 and parameter 71 [Anlg In1 Config], S10 and 76 [Anlg In2 Config] or S11 and 81 [Anlg In3 Config]. • Tune the analog input(s) using parameters 259-261 [Anlg Inx Tune] with the potentiometer set at max. • The encoder pulse per revolution (PPR) parameter (169 [Encoder PPR]) value is too high. • The DC Tach Scaling is incorrect or the jumpers are not properly set. Check parameter 562 [Anlg Tach Gain] and check the setting of the DC Analog Tachometer DIP Switch S4 (see Figure 1.30 on page 1-30).

The motor is turning the wrong direction.

Drive Symptom	Action
The motor is rotating in the wrong direction.	The motor is incorrectly wired. • Change the armature or field connections to the drive.

ATTENTION: If the motor is turning the wrong direction and the drive is using an encoder or DC analog tachometer for feedback and the speed feedback is correct, then the feedback wiring must be changed. If using an encoder, then two encoder connections must be reversed (A with A-Not or B with B-Not). If using a DC analog tachometer, then the tachometer leads must be reversed.

	• The Polarity of the analog speed reference signal is incorrect for the required direction.

The motor reaches maximum speed immediately.

Drive Symptom	Action
The motor accelerates to maximum speed and cannot be controlled.	Check the analog input voltage and speed reference values: • Parameters 1404 [Analog In1 Value], 1405 [Analog In2 Value], 44 [Speed Ref A] and 48 [Speed Ref B] • Check the setting of switch S9 and parameter 71 [Anlg In1 Config], S10 and 76 [Anlg In2 Config] or S11 and 81 [Anlg In3 Config]. The feedback device, encoder or DC analog tachometer is not connected, incorrectly connected or has failed. • Change parameter 414 [Fdbk Device Type] to 3 “Armature” to test the encoder or DC analog tachometer feedback.

Testpoint Codes and Functions

Select a testpoint with Par 1381 [TestPoint Sel]. Values can be viewed with Par 1382 [TestPoint Data].

No.(1)	Description	Values		
		Minimum	Maximum	Default
566	Rx count	0	65535	0
567	Tx count			
568	BusLoss count			
569	Port 1 Timeout			
570	Port 2 Timeout			
571	Port 3 Timeout			
572	Port 4 Timeout			
573	Port 5 Timeout			
574	Port 6 Timeout			

(1) Enter in [TestPoint Sel].

Control Board Testpoints:

Test Point	Function	Test Point	Function
XY20	Monitors (± 10VDC) the [Anlg Outx Sel] parameter values (using this test point, set all of the [Anlg Outx Sel] parameters to the variable that must be measured)	XY17	Output current signal (0.61 V = nominal drive output current)
XY10	Reference point	XY18	Reference point

Supplemental Drive Information

Specifications

Category	Specification	
Agency Certification	c UL us	According to file E59272 for the series of the approved devices.
	The drive is also designed to meet the following specifications: NFPA 70 - US National Electrical Code	

Category	Specification	
Drive Type	Full Wave Regen, 6 Pulse, Regulated Field Supply	
Protection	Heat Sink Thermistor:	Monitored by microprocessor overtemp trip
	Drive Overcurrent Trip Software Overcurrent Trip: Hardware Overcurrent Trip:	 200% of rated current (typical) 220-300% of rated current (dependent on drive rating)
	Line transients:	Up to 2000 volts peak per IEC 6100-4-5
	Control Logic Noise Immunity:	Showering arc transients up to 1500V peak
	Power Ride-Thru:	15 milliseconds at full load
	Logic Control Ride-Thru:	0.5 seconds minimum, 2 seconds typical
	Ground Fault Trip:	Phase-to-ground on drive output
	Short Circuit Trip:	Phase-to-phase on drive output
Environment (1)	Altitude:	1000 m (3300 ft) max. without derating. De-rate output power by 1.2% for every 100 meters (328ft) above 1000 meters (3300ft).
	Maximum Surrounding Air Temperature IP20, NEMA Type Open:	0 to 50 degrees C (32 to 122 degrees F), typical.
	Storage Temp. (all const.):	–25 to 55 degrees C (–13 to 131 degrees F)
	Atmosphere:	**Important:** Drive **must not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.
	Relative Humidity:	Operating: 5 to 85% non-condensing Storage: 5 - 95% non-condensing
	Shock:	15G peak for 11ms duration (±1.0 ms)
	Vibration:	0.152 mm (0.006 in.) displacement, 1G peak

(1) PowerFlex DC drives must be installed in a Pollution Degree 2 environment.

Category	Specification			
Drive Type	Full Wave Regen, 6 Pulse, Regulated Field Supply			
Electrical	Input Voltages:	230 to 480V AC +/- 10%, 3 Phase		
	Input Frequency:	50/60 Hz +/- 5%		
	Armature Output Voltage:	Two Quadrant Drives	Four Quadrant Drives	
		260V DC @ 230V AC 470V DC @ 400V AC 530V DC @ 440V AC 560V DC @ 460V AC 580V DC @ 480V AC	240V DC @ 230V AC 420V DC @ 400V AC 460V DC @ 440V AC 480V DC @ 460V AC 500V DC @ 480V AC	
	Output Horsepower (Cont.)	1.5 to 150 HP @ 230V AC 2 to 400 HP @ 460V AC		
	Output Current:	4.1 to 667A		
	Overload Capability:	100% rated continuous current 150% rated current for one minute then fault 200% rated current for three seconds then fault		
	Field Output Voltage	200V DC @ 230V AC 310V DC @ 400V AC 360V DC @ 460V AC Maximum field output voltage is 0.85 x AC input line voltage.		
	Controller Current Overload:	150% rated current for one minute 200% rated current for three seconds		
	Max. Short Circuit Ratings:	Input Voltage:	Converter Size:	Short Circuit Rating:
		230V AC	7A -180 A	5,000 A
			218 - 521 A	10,000 A
		460V AC	4.1 - 86 A	5,000 A
			100 - 330 A	10,000 A
			412 - 667 A	18,000 A
Control	Speed Regulation:*	All operating modes: Max. speed: 8000 rpm Digital reference resolution: 0.25 rpm Analog reference resolution: ≥ 0.25 rpm		
		with Digital Incremental Encoder 1000: 1 rpm, bi-directional Performance Accuracy 0.02% typical		
		with DC Analog Tachometer 100: 1 rpm DC tach bi-directional Performance accuracy 0.1%		
		with Armature Feedback 500: 1 rpm 5 rad/sec bandwidth		
		*Subject to motor specs, current loop tuning.		
	Torque Regulation	Resolution: 1:2000		
		Performance accuracy: 0.2% typical		
		Field regulation: 1:500		

Category	Specification	
Feedback Devices	Encoder	Type: Incremental, dual channel, two channel optional (with jumper), differential (recommended) or single-ended
		Input Voltage: Configurable for +2.5V - 5.2V (switch S21 in ENC_5 position) or +5.4V - 15.2V (switch S21 in ENC_12 position)
		Input Current: 4.5 mA / 6.8 - 10.9 mA each channel
		Quadrature: 90° ± 27° @ 25° C
		Duty cycle: 50% ± 10% Source/Sink capable
		Pulses Per Revolution: 150 to 9999
		Maximum Frequency: 150 kHz
		Maximum Cable Length: Shielded, 150m (0.75 mm^2), 125m (0.5 mm^2), 55m (0.22 mm^2)
	DC Analog Tachometer	Input Voltage: 22.7, 45.4, 90.7, 181.6, & 302.9V max.
		Input Current: 8 mA full scale
		Maximum Cable Length: Shielded, depends on the installation, typical 150m.
Inputs	Analog Inputs	Three configurable, isolated, differential
		±10V, 0-10V, 0-20mA or 4-20mA.
	Digital Inputs	Eight standard configurable, four additional configurable with the I/O Expansion circuit board.
		Max Voltage +30V DC input, 200mA (total current draw is the sum of encoder power, digital outputs and any other loads connected to terminal 19)
Outputs	Analog Outputs	Two standard configurable, two additional configurable with the I/O Expansion circuit board.
		± 10V, 5mA, bipolar (current is not bipolar)
	Digital Outputs	Four standard configurable, four additional configurable with the I/O Expansion circuit board.
		+ 30V, 50mA
	Relay Outputs	Two configurable, N.O. contacts
		Max. 250V AC, 1A AC1

IP20 (NEMA UL/Type Open) Watts Loss

Watts loss data shown below is based on the rated current of the drive.

Important: For drives with 230V input, rated 150 hp / 521 amps, the cooling fans must be powered by an external 230V 50/60 Hz power supply at terminals U3 & V3.

Frame	Drive Current Rating Code[1]		Total Watts Loss (W)	Fans		
	@ 230V	@ 460V		Voltage (V)	Rated Current (A)	Air Capacity (m^3/h)
A	7P0	4P1	131	–	–	–
	9P0	6P0				
	012	010				
	020	014				
	–	019				
	029	027	186	–	–	–
	038	035	254	Internal power supply		80
	055	045				
	–	052				
	073	073	408			160
	093	086	476			160
	110	–				
	–	100	553			160
	–	129				
B	146	167	781			320
	180	–				
	218	207	939			320
	265	250	1038			320
	–	330	1248			320
	360	412	1693			680
	434	–				
C	521	495	2143	230	0.75	1050
	–	667	2590	230	0.75	1050

(1) Refer to Catalog Number Explanation on page Preface-4, positions 8-10 for corresponding drive HP rating, armature amp rating and field amp rating.

Communication Configurations

Typical Programmable Controller Configurations

Important: If block transfers are programmed to continuously write information to the drive, care must be taken to properly format the block transfer. If attribute 10 is selected for the block transfer, values will be written only to RAM and will not be saved by the drive. This is the preferred attribute for continuous transfers. If attribute 9 is selected, each program scan will complete a write to the drives non-volatile memory (EEprom). Since the EEprom has a fixed number of allowed writes, continuous block transfers will quickly damage the EEprom. Do Not assign attribute 9 to continuous block transfers. Refer to the individual communications adapter User Manual for additional details.

Logic Command/Status Words

Refer to parameter 1328 [Drive Logic Rslt] for more information.

Figure A.1 Logic Command Word

Logic Bits															Command	Description
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
															x	Stop(1)	0 = Not Stop 1 = Stop
														x		Start(1)(2)	0 = Not Start 1 = Start
													x			Jog	0 = Not Jog 1 = Jog
												x				Clear Faults	0 = Not Clear Faults 1 = Clear Faults
										x	x					Direction	00 = No Command 01 = Forward Command 10 = Reverse Command 11 = Hold Present Direction
									x							Local Control	0 = No Local Control 1 = Local Control
								x								MOP Increment	0 = Not Increment 1 = Increment
						x	x									Accel Rate	00 = No Command 01 = Use Accel Time 1 10 = Use Accel Time 2 11 = Use Present Time
				x	x											Decel Rate	00 = No Command 01 = Use Decel Time 1 10 = Use Decel Time 2 11 = Use Present Time
	x	x	x													Reference Select(3)	000 = No Command 001 = Ref. 1 (Spd Ref A) 010 = Ref. 2 (Spd Ref B) 011 = Ref. 3 (Preset Spd 3) 100 = Ref. 4 (Preset Spd 4) 101 = Ref. 5 (Preset Spd 5) 110 = Ref. 6 (Preset Spd 6) 111 = Ref. 7 (Preset Spd 7)
x																MOP Decrement	0 = Not Decrement 1 = Decrement

(1) A “0 = Not Stop” condition (logic 0) must first be present before a “1 = Start” condition will start the drive. The Start command acts as a momentary Start command. A “1” will start the drive, but returning to “0” will not stop the drive.

(2) This Start will not function if a digital input (parameters 131- 144) is programmed for 2-Wire Control (option 5 “Run”, 6 “Run Forward” or 7 “Run Reverse”).

(3) This Reference Select will not function if a digital input (parameters 131- 144) is programmed for “Speed Sel 1, 2 or 3” (option 17, 18 or 19). Note that Reference Selection is “Exclusive Ownership” see [Reference Owner] on page 3-58.

Figure A.2 Logic Status Word

Logic Bits															Status	Description
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
															x	Ready	0 = Not Ready 1 = Ready
														x		Active	0 = Not Active 1 = Active
													x			Command Direction	0 = Reverse 1 = Forward
												x				Actual Direction	0 = Reverse 1 = Forward
											x					Accel	0 = Not Accelerating 1 = Accelerating
										x						Decel	0 = Not Decelerating 1 = Decelerating
									x							Alarm	0 = No Alarm 1 = Alarm
								x								Fault	0 = No Fault 1 = Fault
							x									At Speed	0 = Not At Reference 1 = At Reference
				x	x	x										Local Control [1]	000 = Port 0 (TB) 001 = Port 1 010 = Port 2 011 = Port 3 100 = Port 4 101 = Port 5 110 = Reserved 111 = No Local
x	x	x	x													Reference Source	0000 = Spd Ref A Auto 0001 = Spd Ref B Auto 0010 = Preset Spd 2 Auto 0011 = Preset Spd 3 Auto 0100 = Preset Spd 4 Auto 0101 = Preset Spd 5 Auto 0110 = Preset Spd 6 Auto 0111 = Preset Spd 7 Auto 1000 = Term Blk Manual 1001 = DPI 1 Manual 1010 = DPI 2 Manual 1011 = DPI 3 Manual 1100 = DPI 4 Manual 1101 = DPI 5 Manual 1110 = Reserved 1111 = Jog Ref

(1) Refer to Masks & Owners on page 3-57 for further information.

Drive Power Circuit Protection

The tables on the following pages provide drive ratings and the recommended fuses for protecting the armature and field circuits. Externally mounted fuses (as indicated in Figure A.3 on page A-7) must be sourced separately when installing the drive. Internally mounted fuses are provided with the drive.

Frame A and B Fuse Information

Figure A.3 Frame A and B Fuse Table Designations

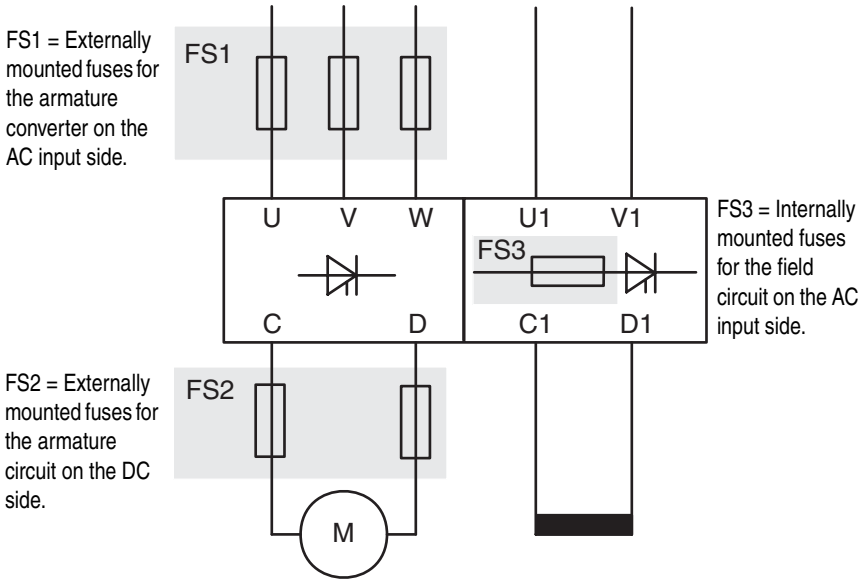


Table A.A 230V AC Input Frame A and B - Recommended Armature Converter AC Input Line Fuses

Frame	Drive Current Rating Code	DC Amps	AC Line Amps	Fuse Code FS1 (See Figure A.3 above)					
				Bussmann				Ferraz Shawmut (Gould Shawmut)	
				Ferrule FWP Type	Ferrule Fuse Block	North American FWP Type	North American Fuse Block	Ferrule A70QS Type	North American A70P / A70QS Type
A	7P0	7	5.7	FWP-10A14F	CH143D	FWP-10B	–	A70QS10-14F	A70P10-4
	9P0	9	7.4	FWP-15A14F		FWP-15B	–	A70QS16-14F	A70P15-4
	012	12	9.8	FWP-20A14F		FWP-20B	–	A70QS20-14F	A70P20-4
	020	20	16	FWP-32A14F		FWP-35B	–	A70QS32-14F	A70QS35-4
	029	29	24	FWP-50A22F	CH223D	FWP-50B	–	A70QS50-22F	A70QS50-4
	038	38	31	FWP-63A22F		FWP-60B	–	A70QS63-22F	A70QS60-4
	055	55	45	FWP-100A22F		FWP-90B	–	A70QS100-22F	A70QS90-4
	073	73	60	–	–	FWP-125A	ST14	–	A70QS125-4K
	093	93	76	–	–	FWP-150A		–	A70QS150-4K
	110	110	90	–	–	FWP-175A		–	A70QS175-4K
B	146	146	119	–	–	FWP-250A		–	A70QS250-4
	180	180	147	–	–	FWP-300A		–	A70QS300-4
	218	218	178	–	–	FWP-350A		–	A70QS350-4
	265	265	217	–	–	FWP-450A	ST38-72612	–	A70QS450-4
	360	360	294	–	–	FWP-600A		–	A70QS600-4K
	434	434	355	–	–	FWP-700A		–	A70QS700-4

Table A.B 460V AC Input Frame A and B - Recommended Armature Converter AC Input Line Fuses

Frame	Drive Current Rating Code	DC Amps	AC Line Amps	Fuse Code FS1 (See Figure A.3 on page A-7)					
				Bussmann				Ferraz Shawmut (Gould Shawmut)	
				Ferrule FWP Type	Ferrule Fuse Block	North American FWP Type	North American Fuse Block	Ferrule A70QS Type	North American A70P / A70QS Type
A	4P1	4.1	3.3	FWP-10A14F	CH143D	FWP-10B	–	A70QS10-14F	A70P10-4
	6P0	6	4.9	FWP-10A14F		FWP-10B	–	A70QS10-14F	A70P10-4
	010	10	8.2	FWP-20A14F		FWP-20B	–	A70QS20-14F	A70P25-4
	014	14	11.4	FWP-25A14F		FWP-25B	–	A70QS25-14F	A70P25-4
	019	19	15.5	FWP-30A14F		FWP-30B	–	A70QS32-14F	A70P30-4
	027	37	22.1	FWP-50A22F	CH223D	FWP-50B	–	A70QS50-22F	A70QS50-4
	035	35	28.6	FWP-63A22F		FWP-60B	–	A70QS63-22F	A70QS60-4
	045	45	36.8	FWP-80A22F		FWP-80B	–	A70QS80-22F	A70QS80-4
	052	52	42.5	FWP-100A22F		FWP-90B	–	A70QS100-22F	A70QS90-4
	073	73	59.6	–	–	FWP-125A	ST14	–	A70QS125-4K
	086	86	70.3	–	–	FWP-150A		–	A70QS150-4K
	100	100	81.7	–	–	FWP-175A		–	A70QS175-4K
	129	129	105.4	–	–	FWP-200A		–	A70QS200-4K
B	167	167	136.4	–	–	FWP-300A		–	A70QS300-4
	207	207	169.1	–	–	FWP-350A		–	A70QS350-4
	250	250	204.3	–	–	FWP-400A	ST38-72612	–	A70QS400-4
	330	330	269.6	–	–	FWP-600A		–	A70QS600-4K
	412	412	336.6	–	–	FWP-700A		–	A70QS700-4

Table A.C 230V AC Input Frame A and B - Recommended Armature DC Output Fuses

Frame	Drive Current Rating Code	DC Amps	AC Line Amps	Fuse Code FS2[1] (See Figure A.3 on page A-7)					
				Bussmann				Ferraz Shawmut (Gould Shawmut)	
				Ferrule FWP Type	Ferrule Fuse Block	North American FWP Type	North American Fuse Block	Ferrule A70QS Type	North American A70P / A70QS Type
A	7P0	7	5.7	FWP-15A14F	CH142D	FWP-15B	–	A70QS16-14F	A70P15-4
	9P0	9	7.4	FWP-20A14F		FWP-20B	–	A70QS20-14F	A70P20-4
	012	12	9.8	FWP-25A14F		FWP-25B	–	A70QS25-14F	A70P25-4
	020	20	16	FWP-40A14F		FWP-40B	–	A70QS40-14F	A70QS40-4
	029	29	24	FWP-63A22F	CH222D	FWP-60B	–	A70QS63-22F	A70QS60-4
	038	38	31	FWP-80A22F		FWP-80B	–	A70QS80-22F	A70QS80-4
	055	55	45	–	–	FWP-125A	ST14	–	A70QS125-4K
	073	73	60	–	–	FWP-150A		–	A70QS150-4K
	093	93	76	–	–	FWP-200A		–	A70QS200-4K
	110	110	90	–	–	FWP-225A		–	A70QS250-4
B	146	146	119	–	–	FWP-300A		–	A70QS300-4
	180	180	147	–	–	FWP-350A			A70QS350-4
	218	218	178	–	–	FWP-450A	ST38-72612	–	A70QS450-4
	265	265	217	–	–	FWP-600A		–	A70QS600-4K
	360	360	294	–	–	FWP-700A		–	A70QS700-4
	434	434	355	–	–	FWP-900A	–	–	A70P900-4

(1) Required on four quadrant drives only, highly recommended on two quadrant drives.

Table A.D 460V AC Input Frame A and B - Recommended Armature DC Output Fuses

Frame	Drive Current Rating Code	DC Amps	AC Line Amps	Fuse Code FS2[1] (See Figure A.3 on page A-7)					
				Bussmann				Ferraz Shawmut (Gould Shawmut)	
				Ferrule FWP Type	Ferrule Fuse Block	North American FWP Type	North American Fuse Block	Ferrule A70QS Type	North American A70P / A70QS Type
A	4P1	4.1	3.3	FWP-10A14F	CH142D	FWP-10B	–	A70QS10-14F	A70P10-4
	6P0	6	4.9	FWP-15A14F		FWP-15B	–	A70QS16-14F	A70P15-4
	010	10	8.2	FWP-20A14F		FWP-20B	–	A70QS20-14F	A70P20-4
	014	14	11.4	FWP-30A14F		FWP-30B	–	A70QS32-14F	A70P30-4
	019	19	15.5	FWP-40A14F		FWP-40B	–	A70QS40-14F	A70QS40-4
	027	37	22.1	FWP-63A22F	CH222D	FWP-60B	–	A70QS63-22F	A70QS60-4
	035	35	28.6	FWP-80A22F		FWP-70B	–	A70QS80-22F	A70QS70-4
	045	45	36.8	FWP-100A22F		FWP-90B	–	–	A70QS90-4
	052	52	42.5	FWP-100A22F		FWP-100B	–	–	A70QS100-4
	073	73	59.6	–	–	FWP-150A	ST14	–	A70QS150-4K
	086	86	70.3	–	–	FWP-175A		–	A70QS175-4K
	100	100	81.7	–	–	FWP-200A		–	A70QS200-4K
	129	129	105.4	–	–	FWP-250A		–	A70QS250-4
B	167	167	136.4	–	–	FWP-350A		–	A70QS350-4
	207	207	169.1	–	–	FWP-400A		–	A70QS400-4
	250	250	204.3	–	–	FWP-500A	ST38-72612	–	A70QS500-4K
	330	330	269.6	–	–	FWP-700A		–	A70QS700-4
	412	412	336.6	–	–	FWP-800A		–	A70QS800-4

(1) Required on four quadrant drives only, highly recommended on two quadrant drives.

Table A.E 230V AC Input Frame A and B - Recommended Field Circuit Fuses

Frame	Drive Current Rating Code	Field Amps	Type	Fuse Code FS3[1] (See Figure A.4 on page A-10 and Figure A.5 on page A-11 for location)	
				Bussmann	Ferraz Shawmut (Gould Shawmut)
A	7P0	10	6 x 32 mm	FWH-016A6F	E085450
	9P0				E085451
	012				E085452
	020				E085453
	029				E085454
	038				E085455
	055				E085456
	073	14			E085457
	093				E085458
	110				E085459
B	146	20	10 x 38 mm	FWC-25A10F	A60Q25-2
	180				A60Q25-3
	218				A60Q25-4
	265				A60Q25-5
	360				A60Q25-6
	434				A60Q25-7

(1) Internal fuses - provided with the drive.

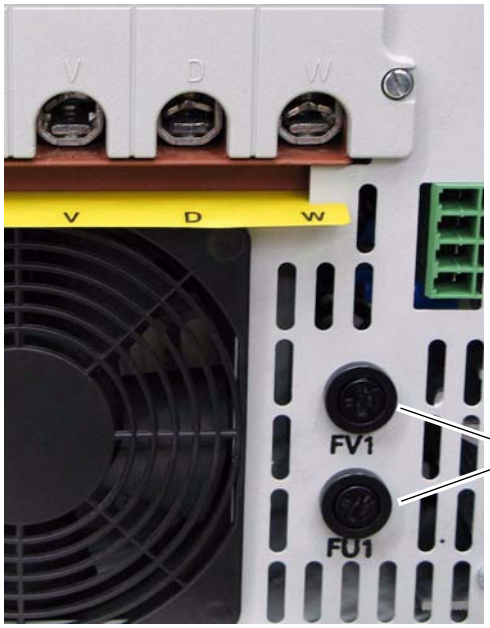
Table A.F 460V AC Input Frame A and B - Recommended Field Circuit Fuses

Frame	Drive Current Rating Code	Field Amps	Type	Fuse Code FS3[1] (See Figure A.4 below and Figure A.5 on page A-11 for location)	
				Bussmann	Ferraz Shawmut (Gould Shawmut)
A	4P1	10	6 x 32 mm	FWH-016A6F	E085449
	6P0				E085450
	010				E085451
	014				E085452
	019				E085453
	027				E085454
	035				E085455
	045				E085456
	052				E085457
	073	14			E085458
	086				E085459
	100				E085460
	129				E085461
B	167	20	10 x 38 mm	FWC-25A10F	A60Q25-2
	207				A60Q25-3
	250				A60Q25-4
	330				A60Q25-5
	412				A60Q25-6

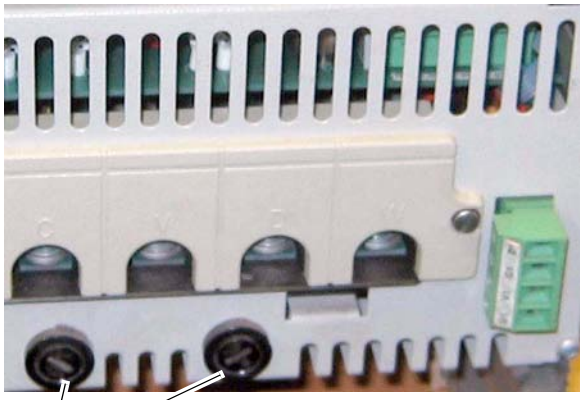
(1) Internal fuses - provided with the drive.

Figure A.4 Frame A Field Circuit Fuses Location

Bottom View of Drive with Fan



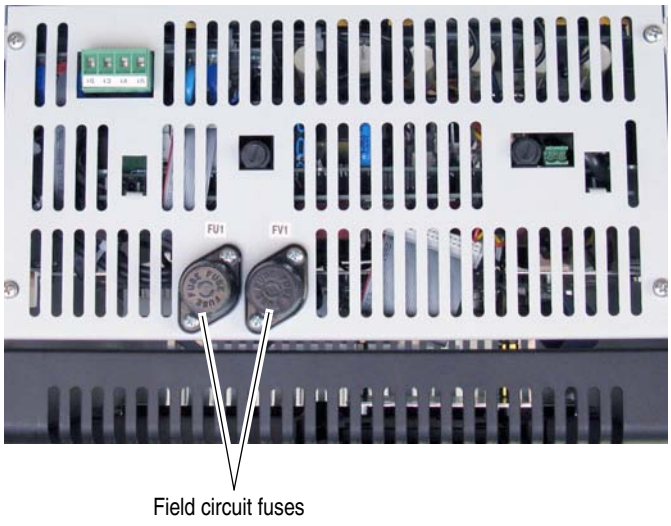
Bottom View of Drive without Fan



Field circuit fuses

Figure A.5 Frame B Field Circuit Fuses Location

Top View of Drive



Frame C Fuse Information

All AC input fuses for armature and field circuit protection are internally mounted and provided with frame C PowerFlex DC drives with 230V AC input and a current rating of 521A and 460V AC input and a current rating of 495A and 667A.

Figure A.6 Frame C Fuse Table Designations

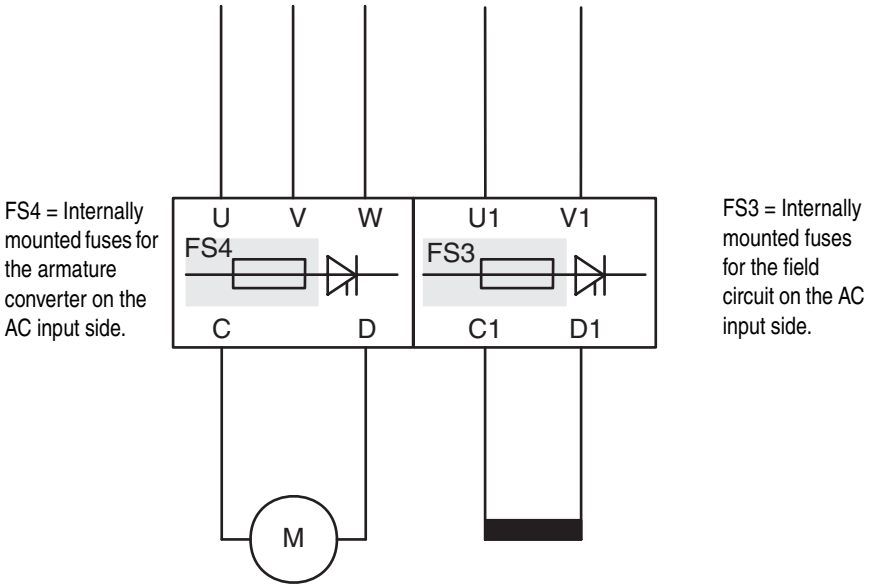


Table A.G 230V AC Input Frame C - Recommended Field Circuit Fuses

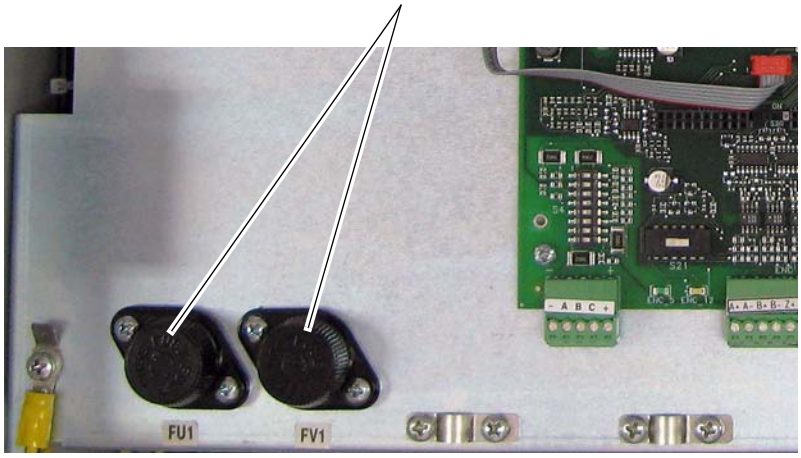
Drive Current Rating Code	Field Amps	Type	Fuse Code FS3 (See Figure A.6 on page A-11 and Figure A.7 below for location)	
			Bussmann	Ferraz Shawmut (Gould Shawmut)
521	20	10 x 38 mm	FWC-25A10F	A60Q25-8

Table A.H 460V AC Input Frame C - Recommended Field Circuit Fuses

Drive Current Rating Code	Field Amps	Type	Fuse Code FS3 (See Figure A.6 on page A-11 and Figure A.7 below for location)	
			Bussmann	Ferraz Shawmut (Gould Shawmut)
495	20	10 x 38 mm	FWC-25A10F	A60Q25-7
667				A60Q25-8

Figure A.7 Frame C Field Circuit Fuse Location

Field circuit fuses are located on the Control EMI shield, which holds the Control board.



Note: Drive shown with front covers removed.

Table A.I 230V AC Input Frame C - Recommended AC Input Line Fuses

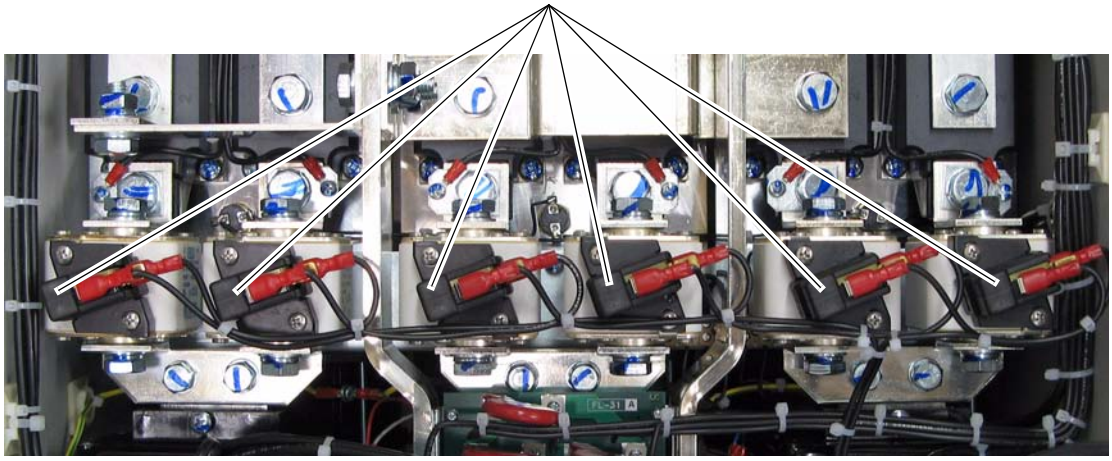
Drive Current Rating Code	DC Amps	AC Line Amps	**Fuse Code FS4** (See Figure A.6 on page A-11 and Figure A.8 below for location)	
			Bussmann	**Ferraz Shawmut (Gould Shawmut)**
			Square Body - Flush End Contact	
521	521	426	170M5466 + switch 170H0069	PC32UD69V1000TF + switch MS3-V1-5BS

Table A.J 460V AC Input Frame C - Recommended AC Input Line Fuses

Drive Current Rating Code	DC Amps	AC Line Amps	**Fuse Code FS4** (See Figure A.6 on page A-11 and Figure A.8 below for location)	
			Bussmann	**Ferraz Shawmut (Gould Shawmut)**
			Square Body - Flush End Contact	
495	495	404.4	170M5464 + switch 170H0069	PC32UD69V800TF + switch MS3-V1-5BS
667	667	544.9	170M5466 + switch 170H0069	PC32UD69V1000TF + switch MS3-V1-5BS

Figure A.8 Frame C - AC Input Line Fuse Location

AC Input fuses and switches are located on the bus bars behind the Control EMI shield, which holds the Control board.



Note: Drive shown with front covers removed and Control EMI shield lowered.

Control Power Circuit Protection Fuses

The following fuses are used to protect the Switching Power Supply circuit and the MOVs on the Pulse Transformer circuit board or Transient Noise Filter circuit board (frame C drives only).

Frame	Designation	Fuses for	Fuse	Mounted on
A	F1	+ 24V	1 A, 250 V slow 0.2"x0.8" (5x20mm)	Switching Power Supply circuit board
B and C	F1	+ 24V	3 A, 250 V slow 0.2"x0.8" (5x20mm)	Switching Power Supply circuit board
	F2	Main section	2.5 A, 250 V fast 0.2"x0.8" (5x20mm)	
B and C	F1/F2/F3	Varistors	4 A, 500 V fast 0.24"x1.3" (6x32mm)	Pulse Transformer circuit board
C				Transient Noise Filter circuit board

Figure A.9 Frame A Switching Power Supply Fuse Location

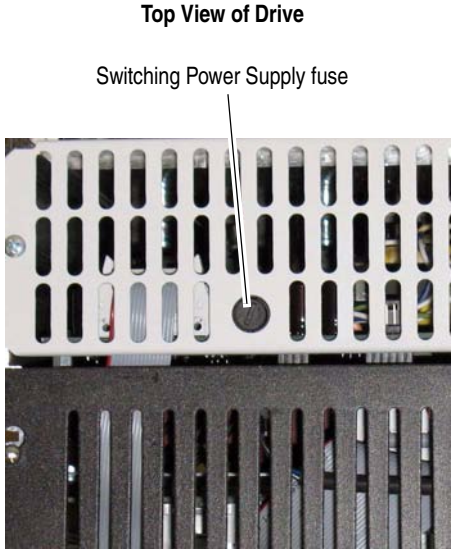


Figure A.10 Frame B Switching Power Supply Fuse Location

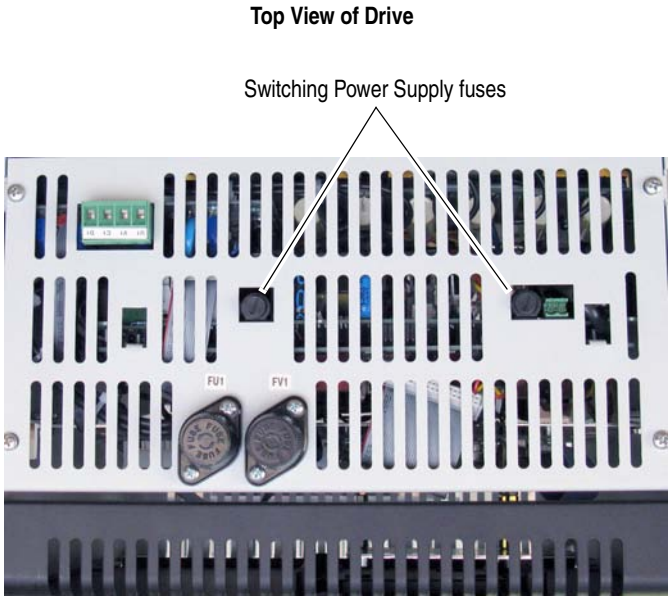
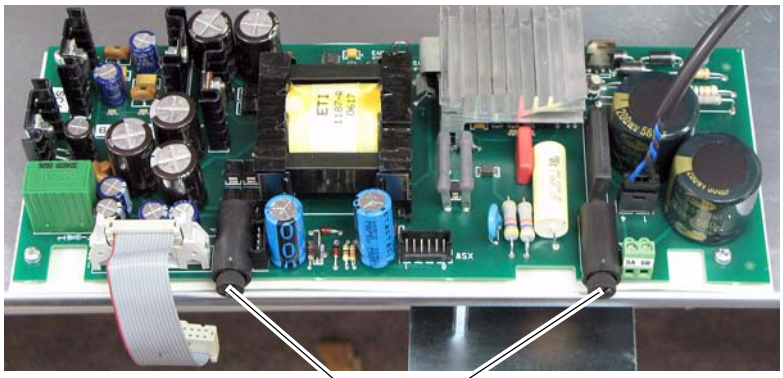


Figure A.11 Frame C Switching Power Supply Fuse Location



Fuses are located on the Switching Power Supply circuit board (SW-2) on the back of the Control EMI shield, which holds the Control board.

AC Input Line Reactors and AC Input Contactors

If a DC Contactor is used, an AC Input contactor is not needed.

Table A.K 230V AC Input, Regenerative Drives

Drive Cat. No.	DC Amps	AC Line Amps	HP	IP00 (Open Style) Line Reactor Cat No.	Line Reactor kW (HP)	AC Input Contactor Cat. No.
20P-41AB7P0	7	5.7	1.5	1321-3R8-A	.75 (1)	100-C12D10
20P-41AB9P0	9	7.4	2	1321-3R12-A	1.49 (2)	100-C12D10
20P-41AB012	12	9.8	3	1321-3R18-A	0.75-3.7 (1-5)	100-C12D10
20P-41AB020	20	16	5	1321-3R18-A	0.75-3.7 (1-5)	100-C23D10
20P-41AB029	29	24	7.5	1321-3R55-A	5.5-11 (7.5-15)	100-C30D10
20P-41AB038	38	31	10	1321-3R55-A	5.5-11 (7.5-15)	100-C37D10
20P-41AB055	55	45	15	1321-3R55-A	5.5-11 (7.5-15)	100-C60D10
20P-41AB073	73	60	20	1321-3R80-A	15 (20)	100-C60D10
20P-41AB093	93	76	25	1321-3R100-A	18.5-22 (25-30)	100-C85D10
20P-41AB110	110	90	30	1321-3R100-A	18.5-22 (25-30)	100-D110D11
20P-41AB146	146	119	40	1321-3R160-A	30-37 (40-50)	100-D140D11
20P-41AB180	180	147	50	1321-3R160-A	30-37 (40-50)	100-D180D11
20P-41AB218	218	178	60	1321-3RB250-A	45-56 (60-75)	100-D180D11
20P-41AB265	265	217	75	1321-3RB250-A	45-56 (60-75)	100-D250ED11
20P-41AB360	360	294	100	1321-3RB320-A	75 (100)	100-D300ED11
20P-41AB434	434	355	125	1321-3RB400-A	93 (125)	100-D420ED11
20P-41AB521	521	426	150	1321-3R500-A	112 (150)	100-D630ED11

Table A.L 230V AC Input, Non-Regenerative Drives

Drive Cat. No.	DC Amps	AC Line Amps	HP	IP00 (Open Style) Line Reactor Cat No.	Line Reactor kW (HP)	AC Input Contactor Cat. No.
20P-21AB7P0	7	5.7	1.5	1321-3R8-A	.75 (1)	100-C12D10
20P-21AB9P0	9	7.4	2	1321-3R12-A	1.49 (2)	100-C12D10
20P-21AB012	12	9.8	3	1321-3R18-A	0.75-3.7 (1-5)	100-C12D10
20P-21AB020	20	16	5	1321-3R18-A	0.75-3.7 (1-5)	100-C23D10
20P-21AB029	29	24	7.5	1321-3R55-A	5.5-11 (7.5-15)	100-C30D10
20P-21AB038	38	31	10	1321-3R55-A	5.5-11 (7.5-15)	100-C37D10
20P-21AB055	55	45	15	1321-3R55-A	5.5-11 (7.5-15)	100-C60D10
20P-21AB073	73	60	20	1321-3R80-A	15 (20)	100-C60D10
20P-21AB093	93	76	25	1321-3R100-A	18.5-22 (25-30)	100-C85D10
20P-21AB110	110	90	30	1321-3R100-A	18.5-22 (25-30)	100-D110D11
20P-21AB146	146	119	40	1321-3R160-A	30-37 (40-50)	100-D140D11
20P-21AB180	180	147	50	1321-3R160-A	30-37 (40-50)	100-D180D11
20P-21AB218	218	178	60	1321-3RB250-A	45-56 (60-75)	100-D180D11
20P-21AB265	265	217	75	1321-3RB250-A	45-56 (60-75)	100-D250ED11
20P-21AB360	360	294	100	1321-3RB320-A	75 (100)	100-D300ED11
20P-21AB434	434	355	125	1321-3RB400-A	93 (125)	100-D420ED11
20P-21AB521	521	426	150	1321-3R500-A	112 (150)	100-D630ED11

Table A.M 460V AC Input, Regenerative Drives

Drive Cat. No.	DC Amps	AC Line Amps	HP	IP00 (Open Style) Line Reactor Cat No.	Line Reactor kW (HP)	AC Input Contactor Cat. No.
20P-41AD4P1	4.1	3.3	2	1321-3R4-A	.55 (.75)	100-C12D10
20P-41AD6P0	6	4.9	3	1321-3R8-A	.75 (1)	100-C12D10
20P-41AD010	10	8.2	5	1321-3R18-B	1.5-7.5 (2-10)	100-C12D10
20P-41AD014	14	11.4	7.5	1321-3R18-B	1.5-7.5 (2-10)	100-C12D10
20P-41AD019	19	15.5	10	1321-3R18-B	1.5-7.5 (2-10)	100-C23D10
20P-41AD027	27	22.1	15	1321-3R55-B	11-22 (15-30)	100-C23D10
20P-41AD035	35	28.6	20	1321-3R55-B	11-22 (15-30)	100-C30D10
20P-41AD045	45	36.8	25	1321-3R55-B	11-22 (15-30)	100-C37D10
20P-41AD052	52	42.5	30	1321-3R55-B	11-22 (15-30)	100-C43D10
20P-41AD073	73	59.6	40	1321-3R80-B	30 (40)	100-C60D10
20P-41AD086	86	70.3	50	1321-3R100-B	37-45 (50-60)	100-C85D10
20P-41AD100	100	81.7	60	1321-3R100-B	37-45 (50-60)	100-C85D10
20P-41AD129	129	105.4	75	1321-3R160-B	56-75 (75-100)	100-D110D11
20P-41AD167	167	136.4	100	1321-3R160-B	56-75 (75-100)	100-D140D11
20P-41AD207	207	169.1	125	1321-3RB250-B	93-112 (125-150)	100-D180D11
20P-41AD250	250	204.3	150	1321-3RB250-B	93-112 (125-150)	100-D210ED11
20P-41AD330	330	269.6	200	1321-3RB320-B	149 (200)	100-D300ED11
20P-41AD412	412	336.6	250	1321-3RB400-B	186.4 (250)	100-D420ED11
20P-41AD495	495	404.4	300	1321-3R500-B	223.7 (300)	100-D420ED11
20P-41AD667	667	544.9	400	1321-3R600-B	298.3 (400)	100-D630ED11

Table A.N 460V AC Input, Non-Regenerative Drives

Drive Cat. No.	DC Amps	AC Line Amps	HP	IP00 (Open Style) Line Reactor Cat No.	Line Reactor kW (HP)	AC Input Contactor Cat. No.
20P-21AD4P1	4.1	3.3	2	1321-3R4-A	.55 (.75)	100-C12D10
20P-21AD6P0	6	4.9	3	1321-3R8-A	.75 (1)	100-C12D10
20P-21AD010	10	8.2	5	1321-3R18-B	1.5-7.5 (2-10)	100-C12D10
20P-21AD014	14	11.4	7.5	1321-3R18-B	1.5-7.5 (2-10)	100-C12D10
20P-21AD019	19	15.5	10	1321-3R18-B	1.5-7.5 (2-10)	100-C23D10
20P-21AD027	27	22.1	15	1321-3R55-B	11-22 (15-30)	100-C23D10
20P-21AD035	35	28.6	20	1321-3R55-B	11-22 (15-30)	100-C30D10
20P-21AD045	45	36.8	25	1321-3R55-B	11-22 (15-30)	100-C37D10
20P-21AD052	52	42.5	30	1321-3R55-B	11-22 (15-30)	100-C43D10
20P-21AD073	73	59.6	40	1321-3R80-B	30 (40)	100-C60D10
20P-21AD086	86	70.3	50	1321-3R100-B	37-45 (50-60)	100-C85D10
20P-21AD100	100	81.7	60	1321-3R100-B	37-45 (50-60)	100-C85D10
20P-21AD129	129	105.4	75	1321-3R160-B	56-75 (75-100)	100-D110D11
20P-21AD167	167	136.4	100	1321-3R160-B	56-75 (75-100)	100-D140D11
20P-21AD207	207	169.1	125	1321-3RB250-B	93-112 (125-150)	100-D180D11
20P-21AD250	250	204.3	150	1321-3RB250-B	93-112 (125-150)	100-D210ED11
20P-21AD330	330	269.6	200	1321-3RB320-B	149 (200)	100-D300ED11
20P-21AD412	412	336.6	250	1321-3RB400-B	186.4 (250)	100-D420ED11
20P-21AD495	495	404.4	300	1321-3R500-B	223.7 (300)	100-D420ED11
20P-21AD667	667	544.9	400	1321-3R600-B	298.3 (400)	100-D630ED11

DC Output Contactors and Dynamic Brake Resistor Kits

Table A.O 230V AC Input, Regenerative Drives

Drive Cat. No.	DC Amps	AC Line Amps	HP	Dynamic Brake Resistor Kit Cat. No.	Armature Voltage (Volts)	DB Resistor Size (ohms)	DB Resistor Size (Watts)	Brake Amps Required	DC Loop Contactor Cat. No.(3)	DC Contactor Crimp Lugs Cat. No.
20P-41AB7P0	7	5.7	1.5	1370-DBL62	240	20	420	12.00	1370-DC56	1370-LG40
20P-41AB9P0	9	7.4	2	1370-DBL63	240	20	420	12.00	1370-DC56	1370-LG40
20P-41AB012	12	9.8	3	1370-DBL64	240	15	420	16.00	1370-DC56	1370-LG40
20P-41AB020	20	16	5	1370-DBL65	240	8.6	420	27.91	1370-DC56	1370-LG40
20P-41AB029	29	24	7.5	1370-DBL66	240	6	345	40.00	1370-DC56	1370-LG40
20P-41AB038	38	31	10	1370-DBL67	240	5	330	48.00	1370-DC56	1370-LG40
20P-41AB055	55	45	15	1370-DBL68	240	3.5	385	68.57	1370-DC56	1370-LG56
20P-41AB073	73	60	20	1370-DBL69	240	2.6	385	92.31	1370-DC110	1370-LG92
20P-41AB093	93	76	25	1370-DBL70	240	2	330	120.00	1370-DC110	1370-LG92
20P-41AB110	110	90	30	1370-DBL71	240	2	330	120.00	1370-DC110	1370-LG110
20P-41AB146	146	119	40	1370-DBL72	240	0.7	280	342.86	1370-DC180	1370-LG160
20P-41AB180	180	147	50	1370-DBL73	240	0.5	365	480.00	1370-DC180	1370-LG180
20P-41AB218	218	178	60	1370-DBL74	240	0.5	365	480.00	1370-DC280	1370-LG228
20P-41AB265	265	217	75	1370-DBL75	240	2	330	120.00	1370-DC280	1370-LG268
20P-41AB360	360	294	100	1370-DBL76	240	1.4	290	171.43	1370-DC360	(5)
20P-41AB434	434	355	125	(1)	240	0.5	1458	651	(4)	(5)
20P-41AB521	521	426	150	(2)	240	0.322	6221	781	(4)	(5)

(1) Qty 4-CUTLER-HAMMER_G3AP50 Two in series, two in parallel. Must be sourced separately from drive.
(2) HUBBELL_Y139W322GB - Must be sourced separately from drive.
(3) Coil voltage = 115V AC, 50/60Hz.
(4) ABB_EHDB520C2P-1L - ABB Contactor for drives with no Dynamic Brake. ABB_EHDB520C-1L - ABB Contactor for drives with Dynamic Brake. Must be sourced separately from drive.
(5) Wire and Lug size dependant on Cabinet dims and local codes. Parallel solutions available.

Table A.P 230V AC Input, Non-Regenerative Drives

Drive Cat. No.	DC Amps	AC Line Amps	HP	Dynamic Brake Resistor Kit Cat. No.	Armature Voltage (Volts)	DB Resistor Size (ohms)	DB Resistor Size (Watts)	Brake Amps Required	DC Loop Contactor Cat. No.(3)	DC Contactor Crimp Lugs Cat. No.
20P-21AB7P0	7	5.7	1.5	1370-DBL62	240	20	420	12.00	1370-DC56	1370-LG40
20P-21AB9P0	9	7.4	2	1370-DBL63	240	20	420	12.00	1370-DC56	1370-LG40
20P-21AB012	12	9.8	3	1370-DBL64	240	15	420	16.00	1370-DC56	1370-LG40
20P-21AB020	20	16	5	1370-DBL65	240	8.6	420	27.91	1370-DC56	1370-LG40
20P-21AB029	29	24	7.5	1370-DBL66	240	6	345	40.00	1370-DC56	1370-LG40
20P-21AB038	38	31	10	1370-DBL67	240	5	330	48.00	1370-DC56	1370-LG40
20P-21AB055	55	45	15	1370-DBL68	240	3.5	385	68.57	1370-DC56	1370-LG56
20P-21AB073	73	60	20	1370-DBL69	240	2.6	385	92.31	1370-DC110	1370-LG92
20P-21AB093	93	76	25	1370-DBL70	240	2	330	120.00	1370-DC110	1370-LG92
20P-21AB110	110	90	30	1370-DBL71	240	2	330	120.00	1370-DC110	1370-LG110
20P-21AB146	146	119	40	1370-DBL72	240	0.7	280	342.86	1370-DC180	1370-LG160
20P-21AB180	180	147	50	1370-DBL73	240	0.5	365	480.00	1370-DC180	1370-LG180
20P-21AB218	218	178	60	1370-DBL74	240	0.5	365	480.00	1370-DC280	1370-LG228
20P-21AB265	265	217	75	1370-DBL75	240	2	330	120.00	1370-DC280	1370-LG268
20P-21AB360	360	294	100	1370-DBL76	240	1.4	290	171.43	1370-DC360	(5)
20P-21AB434	434	355	125	(1)	240	0.5	1458	–	(4)	(5)
20P-21AB521	521	426	150	(2)	240	0.322	6221	–	(4)	(5)

(1) Qty 4-CUTLER-HAMMER_G3AP50 Two in series, two in parallel. Must be sourced separately from drive.
(2) HUBBELL_Y139W322GB - Must be sourced separately from drive.
(3) Coil voltage = 115V AC, 50/60Hz.
(4) ABB_EHDB520C2P-1L - ABB Contactor for drives with no Dynamic Brake. ABB_EHDB520C-1L - ABB Contactor for drives with Dynamic Brake. Must be sourced separately from drive.
(5) Wire and Lug size dependant on Cabinet dims and local codes. Parallel solutions available.

Table A.Q 460V AC Input, Regenerative Drives

Drive Cat. No.	DC Amps	AC Line Amps	HP	Dynamic Brake Resistor Kit Cat. No.	Armature Voltage (Volts)	DB Resistor Size (ohms)	DB Resistor Size (Watts)	Brake Amps Required	DC Loop Contactor Cat. No.(4)	DC Contactor Crimp Lugs Cat. No.
20P-41AD4P1	4.1	3.3	2	1370-DBH63	500	81	255	6.17	1370-DC56	1370-LG40
20P-41AD6P0	6	4.9	3	1370-DBH64	500	62	245	8.06	1370-DC56	1370-LG40
20P-41AD010	10	8.2	5	1370-DBH65	500	45	245	11.11	1370-DC56	1370-LG40
20P-41AD014	14	11.4	7.5	1370-DBH66	500	27	350	18.52	1370-DC56	1370-LG40
20P-41AD019	19	15.5	10	1370-DBH67	500	20	420	25.00	1370-DC56	1370-LG40
20P-41AD027	27	22.1	15	1370-DBH68	500	12	405	41.67	1370-DC56	1370-LG40
20P-41AD035	35	28.6	20	1370-DBH69	500	5	330	100.00	1370-DC56	1370-LG40
20P-41AD045	45	36.8	25	1370-DBH70	500	4.5	330	111.11	1370-DC56	1370-LG52
20P-41AD052	52	42.5	30	1370-DBH71	500	3.5	385	142.86	1370-DC56	1370-LG52
20P-41AD073	73	59.6	40	1370-DBH72	500	2.6	345	192.31	1370-DC110	1370-LG92
20P-41AD086	86	70.3	50	1370-DBH73	500	2	345	250.00	1370-DC110	1370-LG92
20P-41AD100	100	81.7	60	1370-DBH74	500	2	345	250.00	1370-DC110	1370-LG110
20P-41AD129	129	105.4	75	1370-DBH75	500	1	270	500.00	1370-DC180	1370-LG140
20P-41AD167	167	136.4	100	1370-DBH76	500	0.7	280	714.29	1370-DC180	1370-LG180
20P-41AD207	207	169.1	125	1370-DBH77	500	0.7	280	714.29	1370-DC280	1370-LG228
20P-41AD250	250	204.3	150	1370-DBH78	500	0.5	365	1000.00	1370-DC280	1370-LG268
20P-41AD330	330	269.6	200	1370-DBH79	500	0.7	280	714.29	1370-DC360	(8)
20P-41AD412	412	336.6	250	(1)	500	0.808	7292	–	(5)	(8)
20P-41AD495	495	404.4	300	(2)	500	0.595	6069	–	(6)	(8)
20P-41AD667	667	544.9	400	(3)	500	0.542	6439	–	(7)	(8)

(1) HUBBELL_Y95W808GB - Must be sourced separately from drive.
(2) HUBBELL_Y101W595GB - Must be sourced separately from drive.
(3) HUBBELL_Y109W542GB - Must be sourced separately from drive.
(4) Coil voltage = 115V AC, 50/60Hz.
(5) ABB_EHDB520C2P-1L - ABB contactor for drives with no dynamic brake. ABB_EHDB520C-1L - ABB contactor for drives with a dynamic brake. Must be sourced separately from drive.
(6) ABB_EHDB650C2P-1L - ABB contactor for drives with no dynamic brake. ABB_EHDB650C-1L - ABB contactor for drives with a dynamic brake. Must be sourced separately from drive.
(7) ABB_EHDB800C2P-1L - ABB contactor for drives with no dynamic brake. ABB_EHDB800C-1L - ABB contactor for drives with a dynamic brake. Must be sourced separately from drive.
(8) Wire and Lug size dependant on Cabinet dims and local codes. Parallel solutions available.

Table A.R 460V AC Input, Non-Regenerative Drives

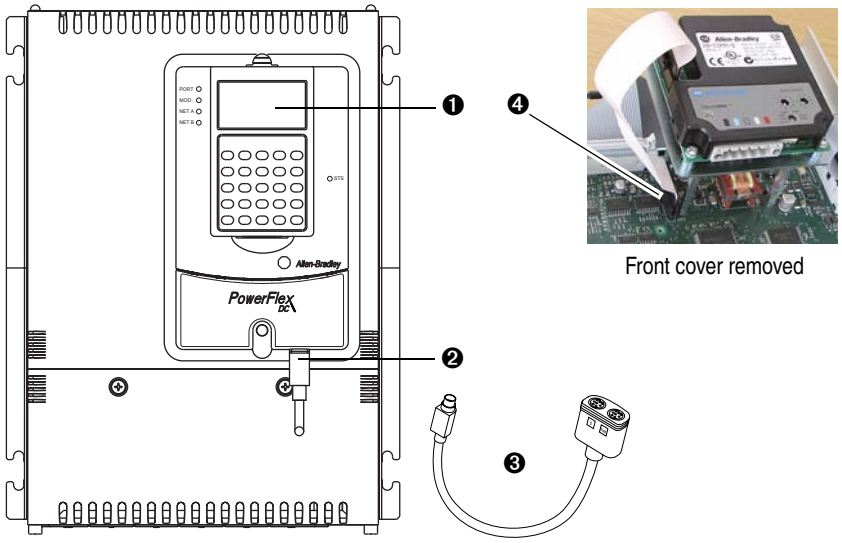
Drive Cat. No.	DC Amps	AC Line Amps	HP	Dynamic Brake Resistor Kit Cat. No.	Armature Voltage (Volts)	DB Resistor Size (ohms)	DB Resistor Size (Watts)	Brake Amps Required	DC Loop Contactor Cat. No.(4)	DC Contactor Crimp Lugs Cat. No.
20P-21AD4P1	4.1	3.3	2	1370-DBH63	500	81	255	6.17	1370-DC56	1370-LG40
20P-21AD6P0	6	4.9	3	1370-DBH64	500	62	245	8.06	1370-DC56	1370-LG40
20P-21AD010	10	8.2	5	1370-DBH65	500	45	245	11.11	1370-DC56	1370-LG40
20P-21AD014	14	11.4	7.5	1370-DBH66	500	27	350	18.52	1370-DC56	1370-LG40
20P-21AD019	19	15.5	10	1370-DBH67	500	20	420	25.00	1370-DC56	1370-LG40
20P-21AD027	27	22.1	15	1370-DBH68	500	12	405	41.67	1370-DC56	1370-LG40
20P-21AD035	35	28.6	20	1370-DBH69	500	5	330	100.00	1370-DC56	1370-LG40
20P-21AD045	45	36.8	25	1370-DBH70	500	4.5	330	111.11	1370-DC56	1370-LG52
20P-21AD052	52	42.5	30	1370-DBH71	500	3.5	385	142.86	1370-DC56	1370-LG52
20P-21AD073	73	59.6	40	1370-DBH72	500	2.6	345	192.31	1370-DC110	1370-LG92
20P-21AD086	86	70.3	50	1370-DBH73	500	2	345	250.00	1370-DC110	1370-LG92
20P-21AD100	100	81.7	60	1370-DBH74	500	2	345	250.00	1370-DC110	1370-LG110
20P-21AD129	129	105.4	75	1370-DBH75	500	1	270	500.00	1370-DC180	1370-LG140
20P-21AD167	167	136.4	100	1370-DBH76	500	0.7	280	714.29	1370-DC180	1370-LG180
20P-21AD207	207	169.1	125	1370-DBH77	500	0.7	280	714.29	1370-DC280	1370-LG228
20P-21AD250	250	204.3	150	1370-DBH78	500	0.5	365	1000.00	1370-DC280	1370-LG268
20P-21AD330	330	269.6	200	1370-DBH79	500	0.7	280	714.29	1370-DC360	(8)
20P-21AD412	412	336.6	250	(1)	500	0.808	7292	–	(5)	(8)
20P-21AD495	495	404.4	300	(2)	500	0.595	6069	–	(6)	(8)
20P-21AD667	667	544.9	400	(3)	500	0.542	6439	–	(7)	(8)

(1) HUBBELL_Y95W808GB - Must be sourced separately from drive.
(2) HUBBELL_Y101W595GB - Must be sourced separately from drive.
(3) HUBBELL_Y109W542GB - Must be sourced separately from drive.
(4) Coil voltage = 115V AC, 50/60Hz.
(5) ABB_EHDB520C2P-1L - ABB contactor for drives with no dynamic brake. ABB_EHDB520C-1L - ABB contactor for drives with a dynamic brake. Must be sourced separately from drive.
(6) ABB_EHDB650C2P-1L - ABB contactor for drives with no dynamic brake. ABB_EHDB650C-1L - ABB contactor for drives with a dynamic brake. Must be sourced separately from drive.
(7) ABB_EHDB800C2P-1L - ABB contactor for drives with no dynamic brake. ABB_EHDB800C-1L - ABB contactor for drives with a dynamic brake. Must be sourced separately from drive.
(8) Wire and Lug size dependant on Cabinet dims and local codes. Parallel solutions available.

HIM Overview

External and Internal Connections

The PowerFlex DC drive provides a number of cable connection points for the HIM (Frame A shown).



Front cover removed

No.	Connector	Description
❶	DPI Port 1	HIM connection when installed in cover.
❷	DPI Port 2	Cable connection for handheld and remote options.
❸	DPI Port 3 or 2	Splitter cable connected to DPI Port 2 provides additional port.
❹	DPI Port 5	Cable connection for communications adapter.

LCD Display Elements

Display	Description
F-> Power Loss Auto 0.0 RPM Main Menu: Diagnostics Parameter Device Select	Direction | Drive Status | Alarm | Auto/Man | Information Commanded or Output Speed or Current Programming / Monitoring / Troubleshooting

The top line of the HIM display can be configured with parameter 1321 [DPI Fdbk Select].

ALT Functions

To use an ALT function, press the ALT key, release it, then press the programming key associated with the function printed on the HIM above the key:

Table B.A ALT Key Functions

Press the ALT Key and then ...		Performs this function ...
ALT	S.M.A.R.T. Esc	Displays the S.M.A.R.T. list screen. See Using the S.M.A.R.T. List Screen below for more information.
	View Sel	Allows the selection of how parameters will be viewed or detailed information about a parameter or component.
	Lang ▲	Displays the language selection screen (Not available on the PowerFlex DC drive).
	Auto / Man ▼	Switches between Auto and Manual Modes.
	Remove ↵	Allows HIM removal without causing a fault if the HIM is not the last controlling device and does not have Manual control of the drive.
	Exp .	Allows value to be entered as an exponent (Not available on the PowerFlex DC drive).
	Param # +/–	Allows entry of a parameter number for viewing/editing.

Using the S.M.A.R.T. List Screen

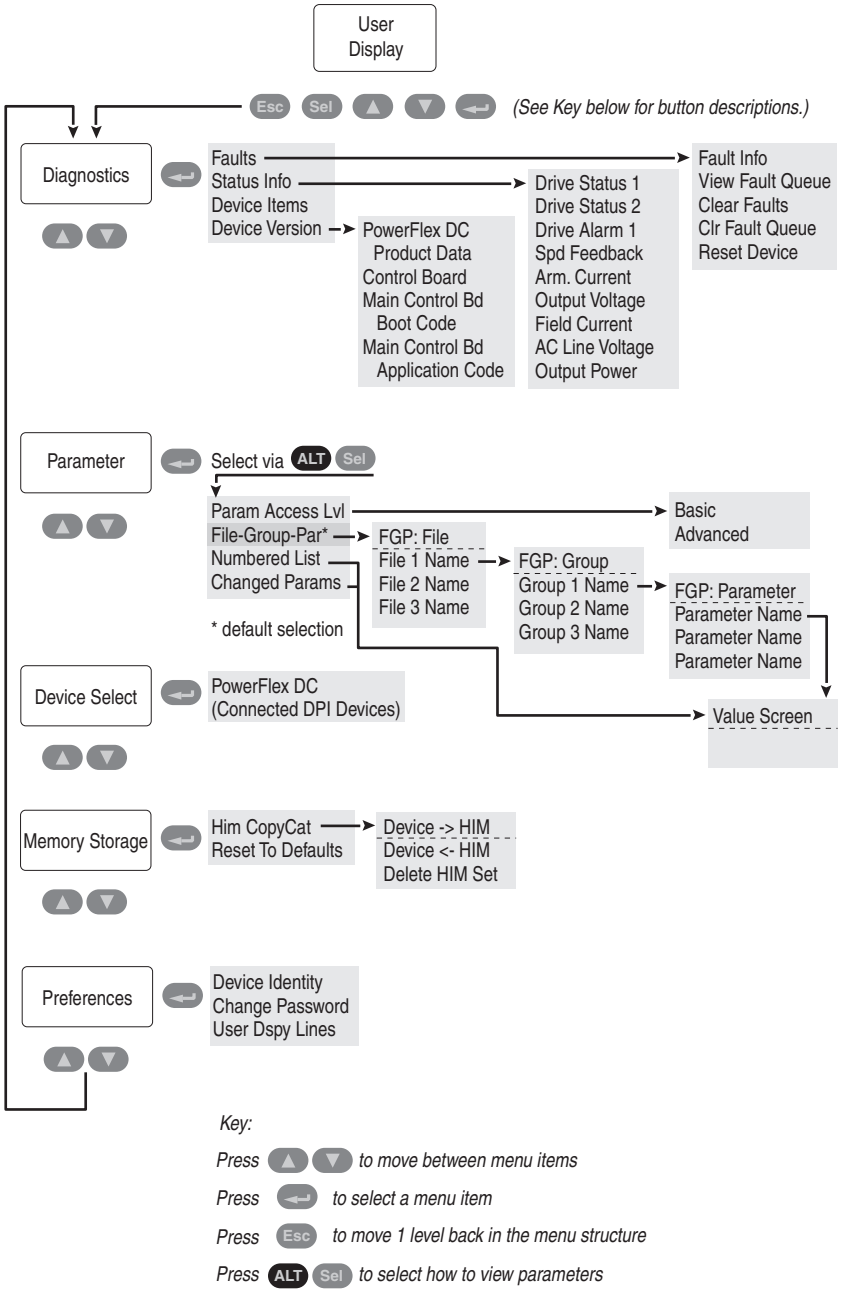
During drive start up, most applications require changes to only a few parameters. The LCD HIM provides the S.M.A.R.T. list screen which contains the most commonly changed parameters, including the following:

Parameter Name / Number	Description
[Max Ref Speed] (45)	The nameplate base motor speed.
[Rated Motor Volt] (175)	The maximum armature voltage of the drive output.
[Nom Mtr Arm Amps] (179)	Corresponds to 100% of the current limit.
[Nom Mtr Fld Amps] (280)	Rated motor nameplate field current.
[Anlg In1 Sel] (70)	Selects the parameter to which a value will be written from analog input 1 (default = “Speed Ref A”)
[Maximum Speed] (2)	Defines the maximum speed of the drive.
[Current Limit] (7)	Symmetrical current limit for both current directions for four quadrant drives, expressed as a percentage of the value in parameter 179 [Nom Mtr Arm Amps].
[Accel Time 1] (660)	Sets the rate of acceleration for Ramp 0.
[Fdbk Device Type] (414)	The source of speed feedback.

If your application requires additional parameter set up and tuning, refer to Drive Start Up on page 2-1 for detailed instructions.

Menu Structure

Figure B.1 HIM Menu Structure



Diagnostics Menu

When a fault trips the drive, use this menu to access detailed data about the drive.

Option	Description
Faults	View fault queue or fault information, clear faults or reset drive.
Status Info	View parameters that display status information about the drive.
Device Items	View statistics associated with DPI Communications.
Device Version	View the firmware version and hardware series of components.

Parameter Menu

Use this menu to view and edit parameters for the drive. When you enter the the Parameter menu, by default the File–Group–Parameter view is displayed. To access other views for the Parameter menu, with "Parameter" highlighted in the Main menu, press Alt then Sel (View), select the desired view in the list and press Enter. The following selections are available:

Option	Description
Param Access Lvl	Displays parameter 211 [Param Access Level]. The PowerFlex DC drive is initially set to the Basic Parameter view. To view all parameters, set parameter 211 [Param Access Lvl] to option 1 “Advanced”.
File-Group-Par (FGP)	Displays all parameters in a File - Group - Parameter structure. This simplifies programming by grouping parameters that are used for similar functions.
Numbered List	Displays all parameters in numerical order.
Changed Params	Displays the most recently changed parameter. You can scroll through the list of all changed parameters to the least recently changed. The new and default values are listed for each parameter.

Refer to Viewing and Editing Parameters on page B-5 for more information.

Device Select Menu

Use this menu to access parameters in connected peripheral devices.

Memory Storage Menu

Drive data can be saved to, or recalled from, HIM sets.
HIM sets are files stored in permanent nonvolatile HIM memory.

Option	Description
HIM Copycat Device -> HIM Device <- HIM	Save data to a HIM set, load data from a HIM set to active drive memory or delete a HIM set.
Reset To Defaults	Restore the drive to its factory-default settings.

Preferences Menu

The HIM and drive have features that you can customize.

Option	Description
Drive Identity	Add text to identify the drive.
User Dspy Lines	Select the display, parameter, scale and text for the User Display. The User Display is two lines of user-defined data that appears when the HIM is not being used for programming.

Viewing and Editing Parameters

LCD HIM

Step	Key(s)	Example Displays
1. In the Main Menu, press the Up Arrow or Down Arrow to scroll to "Parameter."	▲ or ▼	
2. Press Enter. "FGP File" appears on the top line and the first three files appear below it.	↵	FGP: File Monitor Motor Control Speed Command
3. Press the Up Arrow or Down Arrow to scroll through the files.	▲ or ▼	
4. Press Enter to select a file. The groups in the file are displayed under it.	↵	FGP: Group Motor Data Field Config Torq Attributes
5. Repeat steps 3 and 4 to select a group and then a parameter. The parameter value screen will appear.	↵	FGP: Parameter Field Reg Enable Fld Economy En Field Mode Sel
6. Press Enter to edit the parameter.	▲ or ▼	FGP: Par 499 Fld Economy En 1 Enabled
7. Press the Up Arrow or Down Arrow to change the value. If desired, press Sel to move from digit to digit, letter to letter, or bit to bit. The digit or bit that you can change will be highlighted.	Sel ↵	
8. Press Enter to save the value. If you want to cancel a change, press Esc.	▲ or ▼ Esc	FGP: Par 499 Fld Economy En 0 Disabled
9. Press the Up Arrow or Down Arrow to scroll through the parameters in the group, or press Esc to return to the group list.		

Numeric Keypad Shortcut

If using a HIM with a numeric keypad, press the ALT key and the +/– key to access the parameter by typing its number.

Removing/Installing the HIM

The HIM can be removed or installed while the drive is powered.

Important: HIM removal is only permissible in Auto mode. If the HIM is removed while in Manual mode or the HIM is the only remaining control device, a fault will occur.

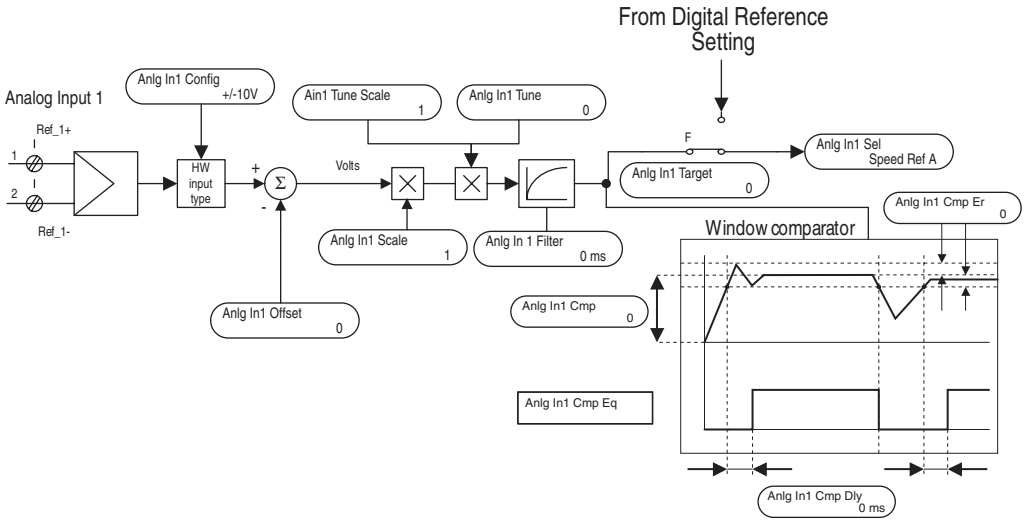
Step	Key(s)	Example Displays
To remove the HIM . . . 1. Press ALT and then Enter (Remove). The Remove HIM confirmation screen appears.	ALT + ↵	Remove Op Intrfc: Press Enter to Disconnect Op Intrfc? (Port 1 Control)
2. Press Enter to confirm that you want to remove the HIM.		
3. Remove the HIM from the drive.		
To install HIM . . . 1. Insert into drive or connect cable.		

Notes:

Application Notes

Analog Input Configuration

The analog inputs default to ±10V. To configure the analog inputs for 0-10V, set parameters [Anlg Inx Config] to 1, “0-10V”. To configure the analog inputs for a current signal, set parameters [Anlg Inx Config] to 2, “0 - 20mA” or 3, “4 to 20mA”. In addition, switches S9, S10 and S11 must be properly configured (refer to Table 1.M on page 1-29 for more information).



Refer to the “Analog Inputs / Outputs & Mapping” block diagram on page D-4 for more information.

Example 1:

The speed reference value of a drive is defined with an external voltage of 5V. With this value the drive should reach the maximum allowable speed set in Par 45 [Max Ref Speed]. Enter a scaling factor of 2 in [Anlg Inx Scale] to scale the input voltage from 5V to 10V.

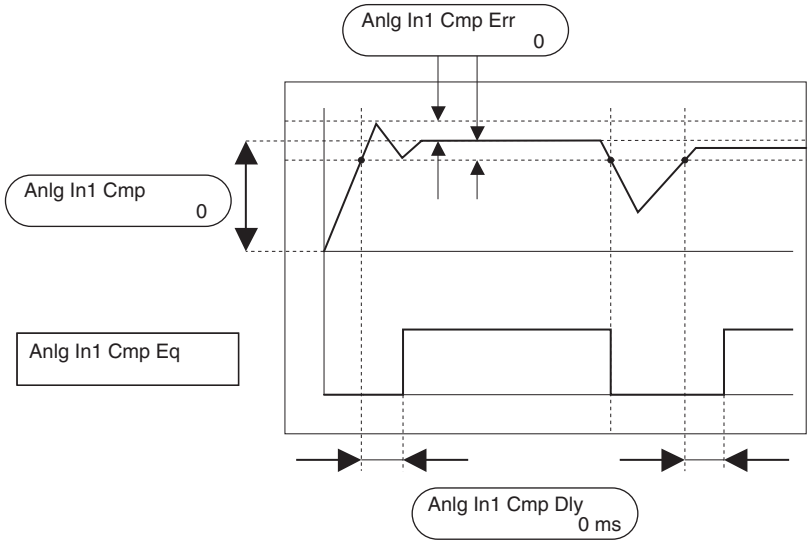
Example 2:

An external analog reference reaches a maximum value of 9.8V. Enter a scaling factor of 1.020 in [Anlg Inx Scale] to scale the maximum voltage from 9.8V to 10V.

The same result could be obtained via parameter [Anlgx Tune Scale], by entering the values of the appropriate parameters via the HIM. The maximum possible analog value (in this case 9.8V) would have to be present at the terminal with a positive polarity.

Analog Input Signal Comparison

This feature provides an indication via the HIM or a digital output when the signal of analog input 1 has reached a limit above or below a set reference point.



Calculations used to determine Pars1042 [Anlg In1 Cmp] and 1043 [Anlg In1 Cmp Err]:

- [Anlg In1 Cmp] = (comparison value) x 10000 / (max. reference value)
- [Anlg In1 Cmp Err] = (tolerance value) x 10000 / (max. reference value)

Example 1:

An application requires an indication via a digital output that the motor speed is within 100 RPMs of 700 RPM.

- Par 45 [Max Ref Speed] = 1500 RPM (maximum reference value)
- For Analog Input 1, 10V or 20mA sets the maximum value of Par 44 [Speed Ref A] = Par 45 [Max Ref Speed]

Configure the following:

- Set Par 70 [Anlg In1 Sel] = “Speed Ref A”
- Set [Digital Outx Sel] = “Input1 Cmp” (Par 1045 [Anlg In1 Cmp Eq])
- Set Par 1042 [Anlg In1 Cmp] = 4667 (700 x 10000 / 1500)
- Set Par 1043 [Anlg In1 Cmp Err] = 666 (100 x 10000 / 1500)
- Par 1045 [Anlg In1 Cmp Eq] = “1” (high) when the signal on Analog Input 1 is within the range specified in Par 1043 [Anlg In1 Cmp Err]. Par 1045 [Anlg In1 Cmp Eq] = “0” (low) when the signal on Analog Input 1 is outside the range specified in Par 1043 [Anlg In1 Cmp Err].

Example 2:

An application requires an indication via a digital output that the output current is within ±2% of 50% of the maximum current limit.

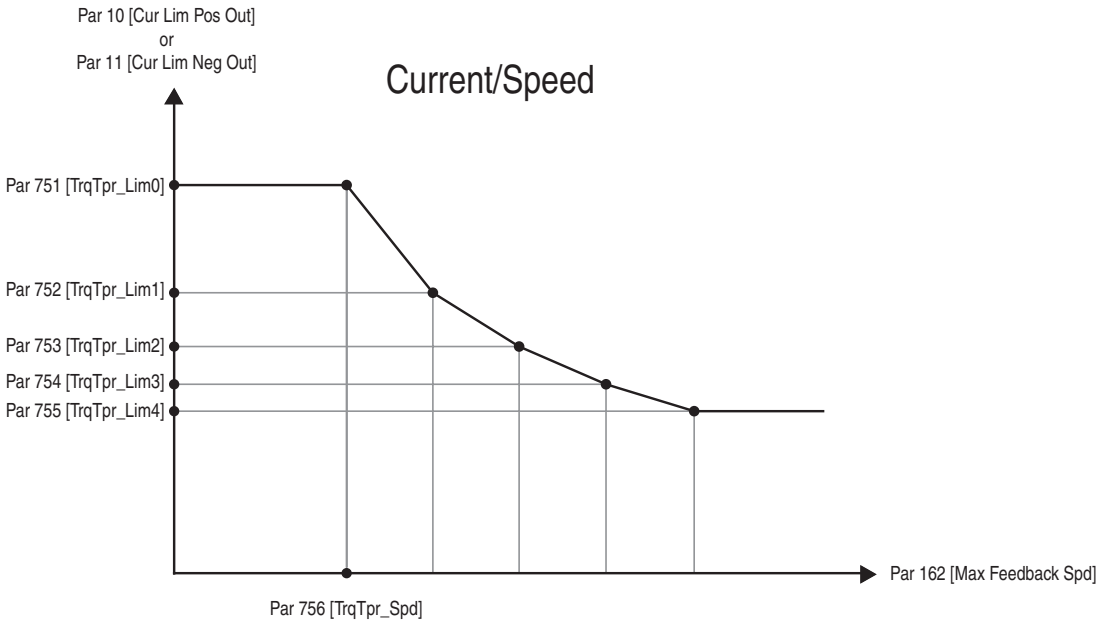
- Par 7 [Current Limit] = 100% (maximum reference value)
- For Analog Input 1, 10V or 20mA sets the maximum value = Par 7 [Current Limit]

Configure the following:

- Set Par 70 [Anlg In1 Sel] = “Pos Cur Lim”
- Set [Digital Outx Sel] = “Input1 Cmp” (Par 1045 [Anlg In1 Cmp Eq])
- Set Par 1042 [Anlg In1 Cmp] = 5000 (50 x 10000 / 100)
- Set Par 1043 [Anlg In1 Cmp Err] = 200 (2 x 10000 / 100)

Current / Speed Curve

The current/speed curve function allows you to establish a current limit lower than the standard current limits of the drive (specified in parameters 8 [Current Lim Pos] and 9 [Current Lim Neg]) and reduce the output current (torque) of the drive through a defined curve of five equally divided set points as the speed increases based on a threshold speed, effectively reducing torque.



- Enable the current/speed curve function by setting parameter 750 [TrqTpr_Enable] to 1 “Enabled”.
- Set the current limit (for both directions of rotation in four quadrant drives) in parameter 751 [TrqTpr_Lim0]. The value specified in this parameter overrides the value of parameters 8 [Current Lim Pos] and 9 [Current Lim Neg].
- Set the threshold speed at which current (torque) reduction begins in parameter 756 [TrqTpr_Spd].
- Set the first reduced current limit in parameter 752 [TrqTpr_Lim1]. The value defined in this parameter must be less than the value in parameter 751 [TrqTpr_Lim0] and greater than the values in parameters 753 [TrqTpr_Lim2], 754 [TrqTpr_Lim3] and 755 [TrqTpr_Lim4].
- Set the second, third and final reduced current limits in parameters 753 [TrqTpr_Lim2], 754 [TrqTpr_Lim3] and 755 [TrqTpr_Lim4], respectively. The value of each subsequent parameter must be less than the previous parameter’s value. The drive will maintain the value specified in parameter 755 [TrqTpr_Lim4] up to the value set in parameter 162 [Max Feedback Spd].

Droop Compensation

The Droop function is used when the current must be balanced between two drives. A typical situation is when two motors are mechanically coupled and must run at the same speed. If, because of differences in the drive's speed regulators, one of the motors runs at a higher speed, it will be overloaded and the second motor will function, essentially, as a brake.

The Droop function allows you to overcome this difference by adding a load compensation component to the speed reference, which is proportional to the actual load differences of the drives.

For Example:

Master Drive:
[Anlg In1 Sel] = "Speed Ref A"
[Anlg Out1 Sel] = "Torque Ref"

Slave Drive:
[Anlg In1 Sel] = "Speed Ref A"
[Anlg In2 Sel] = "Load Comp"
[Enable Droop] = "Enabled"
[Droop Percent] = 5%
[Droop Filter] = 100 ms
[Droop Limit] = 1000

PID Function

The PID function is used to increase or reduce the reference signal output to the speed or current regulator of the drive. The PID function can be used for nip-roll, winder/unwinder, roll doctor/salvage machine, pump and extruder pressure control and extruder temperature control applications. (Refer to the complete "PID Control" block diagram on page D-17.)

Examples are included below for configuring the following applications:

- Speed winder with a load cell and tension control
  - Line speed signal (see Configure a Line Speed Signal on page C-6)
  - Closed loop dancer / load cell feedback (see Configure the Feedback Signal in the Follower Drive(s) on page C-7)
  - Tension set point (see Configure the Tension Set Point Signal in the Follower Drive(s) on page C-9)
- Torque winder with a load cell and tension control
  - Line speed signal (see Configure a Line Speed Signal on page C-6)
  - Closed loop dancer / load cell feedback (see Configure the Feedback Signal in the Follower Drive(s) on page C-7)
  - Tension set point (see Configure the Tension Set Point Signal in the Follower Drive(s) on page C-9)

Configure a Line Speed Signal

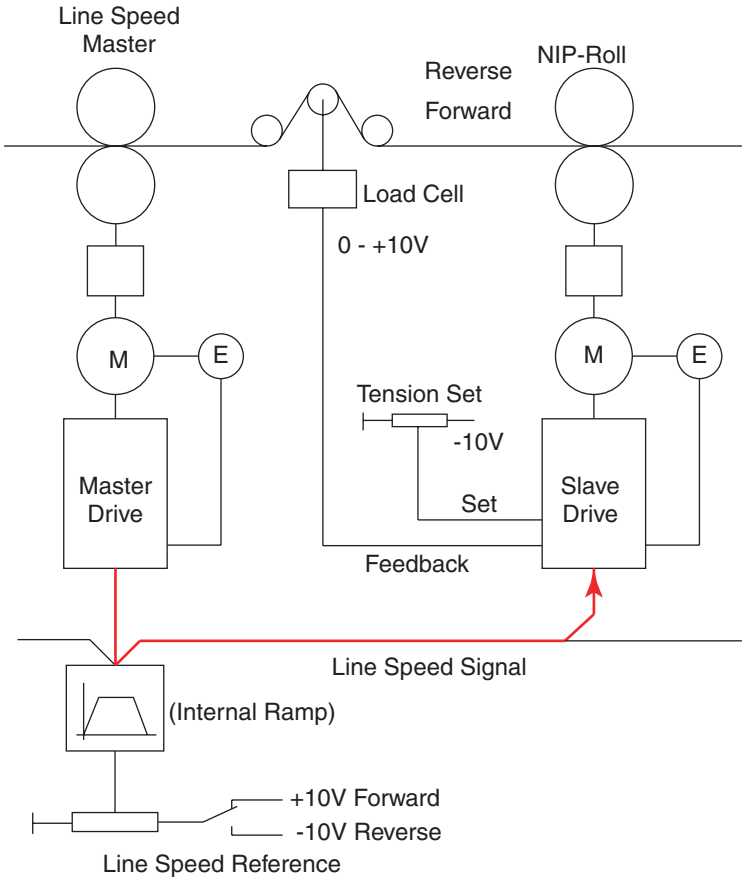
The line speed signal is the main reference for the speed or current regulator in the follower drive(s).

In the Master drive:

- Configure an analog output for the main speed reference (1 “Spd Ref Out”)

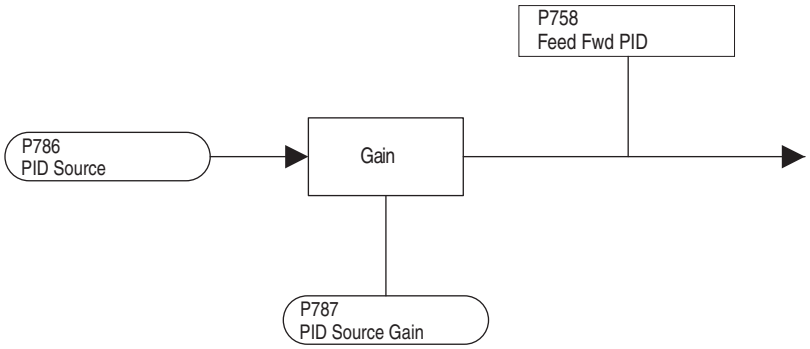
In the Follower drive:

- Set Par 80 [Anlg In3 Sel] to 12 “UserDefined0”
- Set Par 786 [PID Source] to 8695 (503 + 8192). “503” = the parameter number to which the signal from analog input 3 is sent (Par 503 [UserDefined0]), and “8192” is a drive internal fixed offset value.



In addition you can configure the following:

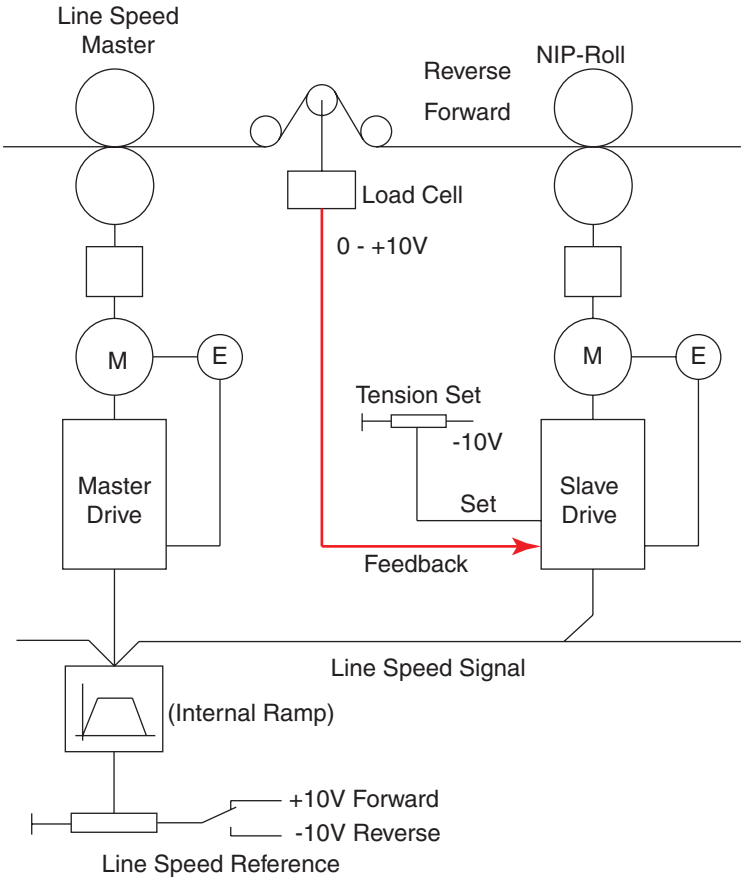
- Enter the gain for the feed-forward signal in Par 787 [PID Source Gain]
- Monitor the feed-forward signal after the gain is applied in Par 758 [Feed Fwd PID]



Configure the Feedback Signal in the Follower Drive(s)

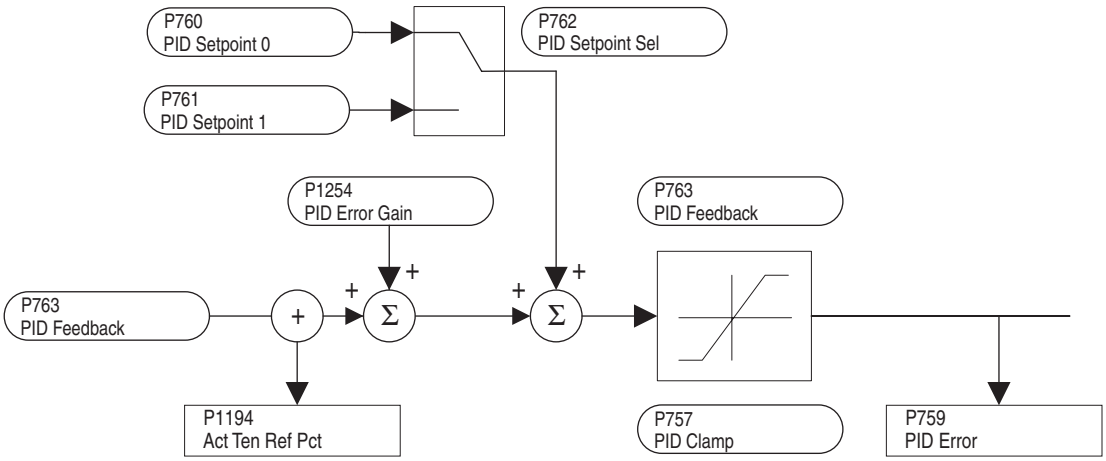
The feedback signal originates from a load cell or a closed loop dancer and is input to the drive via an analog input (typically analog input 1, due to the ability to filter this signal).

- Set Par 70 [Anlg In1 Sel] to 19 “PID Feedback”.



In addition you can configure the following:

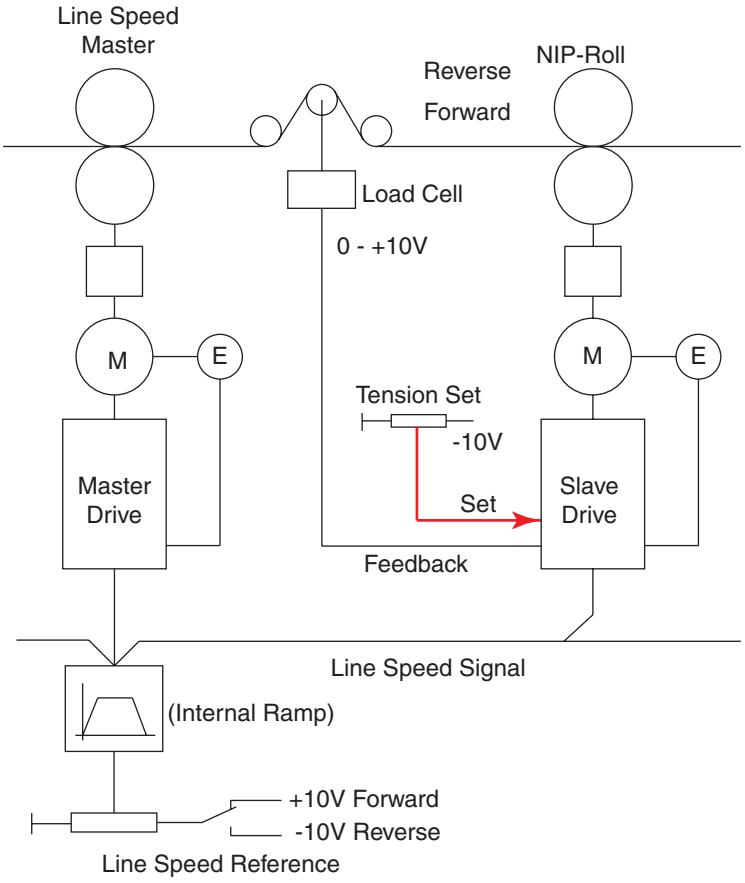
- Par 763 [PID Feedback] contains the raw feedback counts from the analog input signal received from the transducer position (dancer) or tension (load cell)
- Monitor the tension set point for a torque winder application in Par 1194 [Act Ten Ref Pct]
- Configure the PID feedback gain in Par 1254 [PID Error Gain]
- Limit the PID correction error using Par 757 [PID Clamp]
- Monitor the actual error input to the PI and PD blocks in Par 759 [PID Error]



Configure the Tension Set Point Signal in the Follower Drive(s)

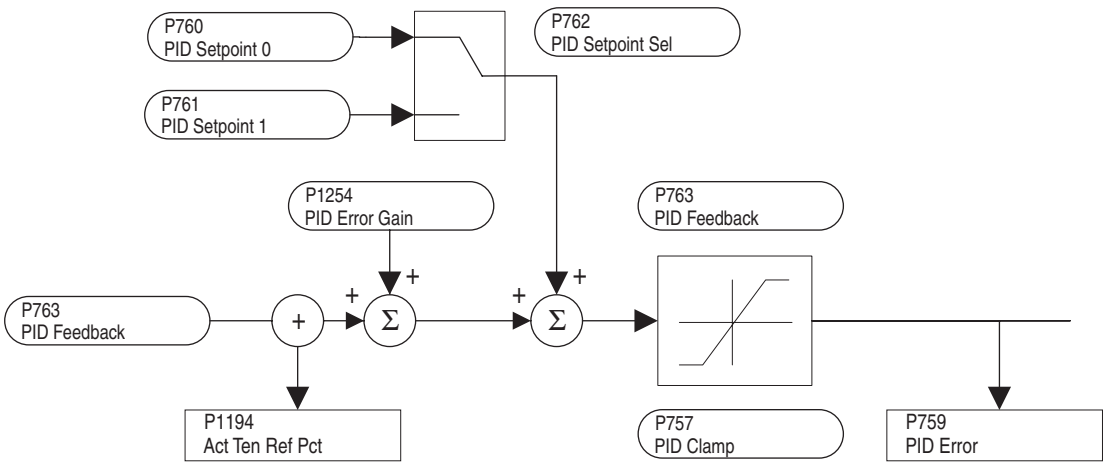
Configure the initial tension for the application in the Follower drive(s):

- Set Par 75 [Anlg In2 Sel] to 17 “PID Setpt 0”



In addition, configure the following in the Follower drive(s):

- Verify that Par 762 [PID Setpoint Sel] is set to 0 “Setpoint 0”



Reference Control

The drive speed command can be obtained from a number of different sources. The source is determined by drive programming and the condition of the digital inputs configured as speed selects, a digital input configured for “Auto/Manual” or Reference Select bits of a command word (see Communication Configurations on page A-4 for more information).

“Auto” Speed Sources

The default auto source for a command reference (all speed select digital inputs open or not programmed) is analog input 1 configured for “Speed Ref A” (parameter 44 [Speed Ref A]). If any of the speed select digital inputs are closed, the drive will use other parameters as the auto speed command source.

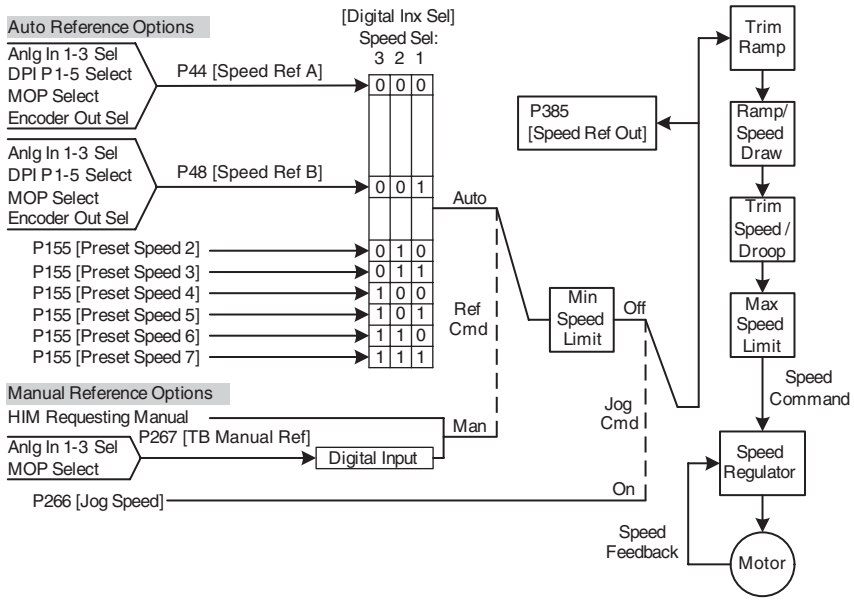
“Manual” Speed Sources

The manual source for speed command to the drive is either the HIM requesting manual control (see ALT Functions on page B-2) or the control terminal block (analog input or MOP) if a digital input is programmed to “Auto/Manual”.

Changing Speed Sources

The selection of the active speed reference can be made through the digital inputs, DPI command, Jog button or Auto/Manual HIM operation.

Figure C.1 Speed Reference Selection Chart



Torque Reference Source

The torque reference can only be supplied by an analog input, the HIM, or a network reference. Switching between available sources while the drive is running is not available. Digital inputs programmed as “Speed Sel 1, 2, 3” and the HIM Auto/Manual function (see above) do not affect the active torque reference. The HIM, however, cannot acquire Manual Reference control while it is configured to supply the torque reference.

Auto/Manual Examples

PLC = Auto, HIM = Manual

A process is run by a PLC when in Auto mode and requires manual control from the HIM during set-up. The speed reference is issued by the PLC through a communications module installed in the drive (Port 5). Therefore, parameter 1327 [DPI P5 Select] is set to “Speed Ref A” with the drive running from the Auto source.

Acquire Manual Control

- Press ALT then Auto/Man on the HIM. When the HIM acquires manual control, the drive speed command comes from the HIM speed control keys.

Release to Auto Control

- Press ALT then Auto/Man on the HIM again. When the HIM releases manual control, the drive speed command returns to the PLC.

PLC = Auto, Terminal Block = Manual

A process is run by a PLC when in Auto mode and requires manual control from an analog potentiometer wired to the drive terminal block. The auto speed reference is issued by the PLC through a communications module installed in the drive (Port 5). Therefore, parameter 1327 [DPI P5 Select] is set to “Speed Ref A” with the drive running from the Auto source. Since the Manual speed reference is issued by analog input 2, parameter 75 [Anlg in2 Sel] is set to “TB Man Ref”. The value of analog input 2 can be viewed in parameter 267 [TB Manual Ref]. To switch between Auto and Manual, parameter 136 [Digital In4 Sel] is set to “Auto/ Manual”.

Acquire Manual Control

- Close the digital input. With the input closed, the speed command comes from the pot.

Release to Auto Control

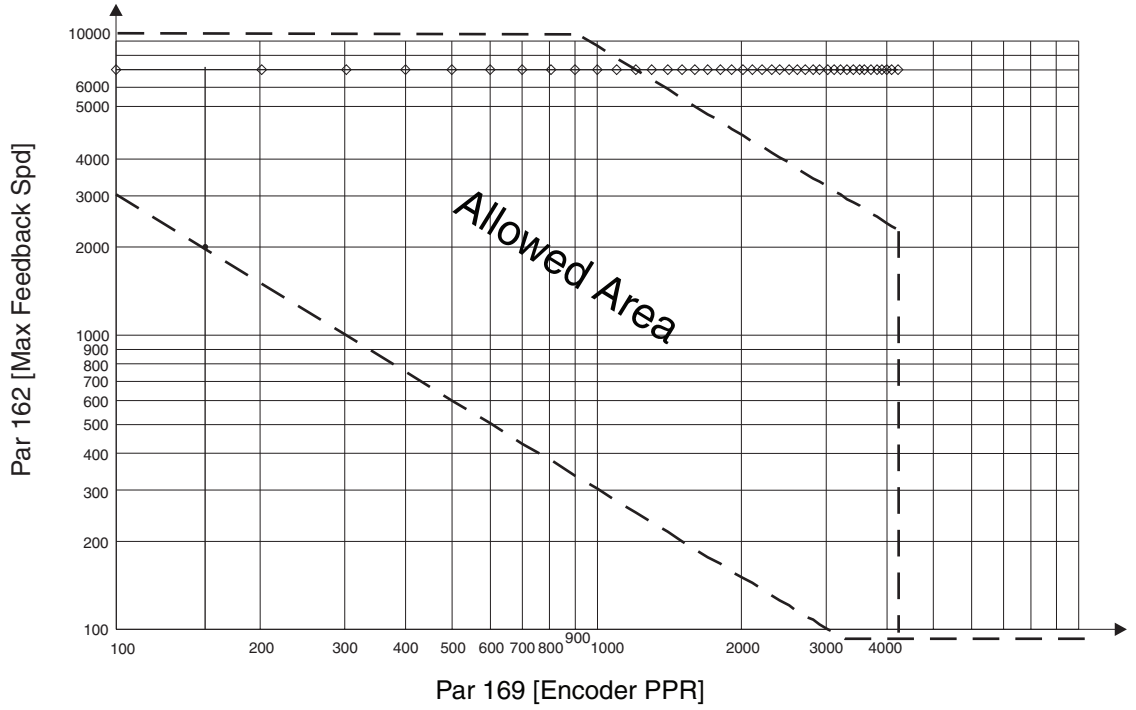
- Open the digital input. With the input open, the speed command returns to the PLC.

Auto/Manual Notes

1. Manual control is exclusive. If a HIM or Terminal Block takes manual control, no other device can take manual control until the controlling device releases control.
2. If a HIM has manual control and power is removed from the drive, the drive will return to Auto mode when power is reapplied.

Speed Feedback

The value of parameters 169 [Encoder PPR] and 162 [Max Feedback Spd] must be inside the allowed area shown in the figure below regardless of the value selected in Par 414 [Fdbk Device Type].



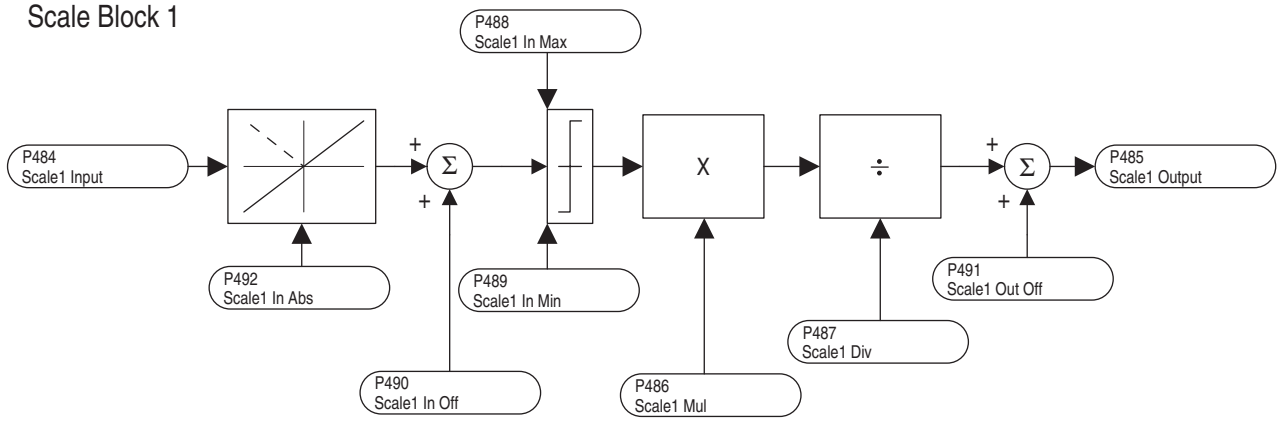
Scale Blocks

The Scale Blocks function allows you to link or rescale dissimilar parameter types (e.g., integer vs. real) though multiply, divide, maximum and minimum limits, input and output offsets and absolute value functions. There are six individually configurable Scale Blocks. A representative block diagram is shown below.

Important: The Scale Blocks functions are executed sequentially in the background, which can cause a delay in processing data between the input and output values. The amount of delay is dependant on the application.

The following rules apply to Scale Blocks:

- All input [Scalex Input] and output [Scalex Output] values are specified as a parameter number (not parameter values).
- Both Sink (read/write) and Source (read only) parameters can be used as input values ([Scalex Input]).
- Only Sink (read/write) parameters can be used as the output value ([Scalex Output]).
- Configuration parameters (parameters that can only be changed while the drive is stopped) can be used as the output value ([Scalex Output]). However, any value written to a configuration parameter will not take effect in the drive until it is stopped.
- The output value is truncated to a whole number when different parameter types are used (e.g., a real input value of 54.97% becomes an integer output value of 54 RPM).
- Dividing by zero (0) does not cause an error, but will result in an output value of zero (0).
- Turning off (setting = “0”) the input parameter or changing the output parameter number does not reset or change the original output value (i.e., the output parameter remains at the last value written).



Linking Parameters Via the Scale Block Parameters

Most parameter values are entered directly by the user. However, certain parameters can be "linked," via the Scale Block parameters, so the value of one parameter becomes the value of another.

For example, the value of an analog input 1, parameter 70 [Anlg In1 Sel], can be linked to parameter 660 [Accel Time 1]. In order to do so:

- Set parameter 70 [Anlg In1 Sel] to 12 "UserDefined0".
- Set parameter 484 [Scale1 Input] to "503" (the parameter number of [UserDefined0]).
- Set parameter 485 [Scale1 Output] to "660" (the parameter number of [Accel Time 1]).

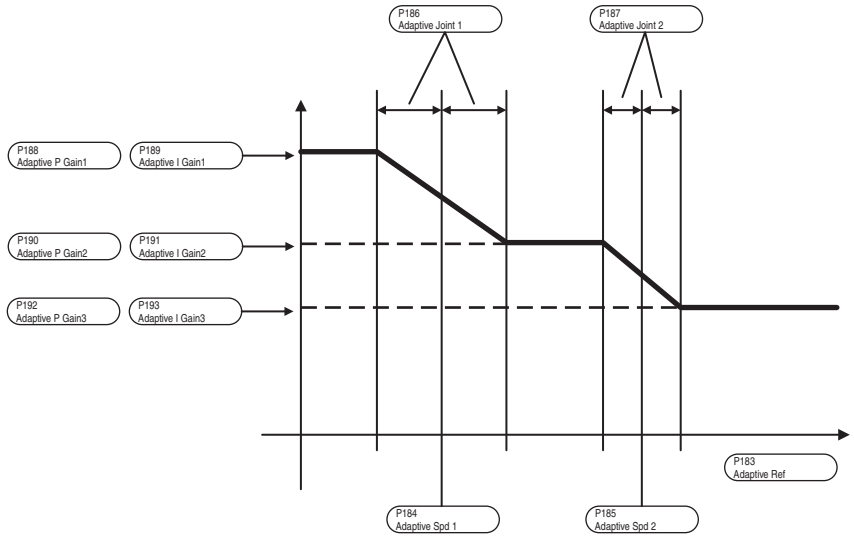
In this way, rather than entering an acceleration time directly (via HIM), the link allows the value to change by varying the analog signal. This can provide additional flexibility for certain applications. This functionality should be tested for the desired response before applying to an application.

Speed Regulation Functions

The PowerFlex DC Digital drive provides a flexible speed regulator circuit that can be adapted to the requirements of a variety of applications. The drive is set to PI regulation by default.

Adaptive Speed Regulator

The adaptive speed regulator function enables different gains of the speed regulator depending on the speed reference or another variable (adaptive reference). This allows optimum adaptation of the speed regulator to the specific application.



The adaptive speed regulator is enabled with parameter 181 [Adaptive Spd En] = “1 Enabled”. Normally the gain depends on the speed of the drive. It can, however, vary according to a variable defined in parameter 183 [Adap Ref]. The type of regulation used is selected in parameter 182 [Adaptive Reg Typ]; 0 = “Speed”, or 1 = “Adaptive Ref”.

Parameters 184 [Adaptive Spd 1] and 185 [Adaptive Spd 2] are used to define the three ranges that may have different gains. A parameter set can be defined for each of these ranges, with each set containing an individually definable P and I component (i.e., Pars 188 [Adaptive P Gain1] and 189 [Adaptive I Gain1], 190 [Adaptive P Gain2] and 191 [Adaptive I Gain2], and 192 [Adaptive P Gain3] and 193 [Adaptive I Gain3]). When the adaptive speed regulator is enabled, the first set of parameters is active until the speed specified in Par 184 [Adaptive Spd 1] or Par 183 [Adap Ref] is reached.

Parameters 186 [Adaptive Joint 1] and 187 [Adaptive Joint 2] ensure a smooth transition between the different parameter sets. The fields must be defined so that [Adaptive Joint 1] and [Adaptive Joint 2] do not overlap.

When the adaptive speed regulator is enabled, parameters 87 [Spd Reg Kp] and [Spd Reg Ki] parameters have no effect on the speed regulator. They do, however, retain their value and are active when the adaptive speed regulator is disabled.

Configuring the Adaptive Speed Regulator

- Set Par 181 [Adaptive Spd En] = “1 Enabled”
- If the gain must be changed on the basis of units other than the drive’s speed reference, set Par 182 [Adaptive Reg Typ] = 1 “Adaptive Ref”. The adaptive reference is provided to the drive as an analog value via an analog input. For this reason Par 183 [Adaptive Ref] must be assigned to an analog input. The other possibility is to enter the value of Par 183 [Adaptive Ref] via the HIM. In this case the an analog input is not necessary.
- Enter the appropriate values in Par 184 [Adaptive Spd 1] and Par 185 [Adaptive Spd 2] to define the three speed ranges. Values are expressed as a percentage of Par 45 [Max Ref Speed] and the maximum value of Par 183 [Adaptive Ref].
- When Par 182 [Adaptive Reg Typ] = 0 “Speed”, tuning is completed via Fine Tuning the Regulators on page C-22. In this case the following points must be taken into consideration:
  - The value entered in Par 61 [TstGen Offset] must be at the low end of the speed range to be tuned, but is also outside the range set in Par [Adaptive Joint x].

  - Enter the step value in Par 60 [TstGen Amplitude], so that the speed remains inside the range to be tuned.
  - The optimization is carried out separately for each range and the parameters of the regulator are set for each range with Pars [Adaptive P Gainx] and [Adaptive I Gainx].
  - After the optimization of the different phases review the entire speed range. By changing the value of [Adaptive Joint x] it is possible to reduce the instabilities present in the transients during the changes from one range to the other. Increasing the values transients are slighter.

- When Par 182 [Adaptive Reg Typ] = 1 “Adaptive Ref”, tuning is application specific.
- When the speed zero logic (see page C-19) is disabled (factory default setting) and the drive is disabled, the gains of the speed regulator are active. These are set via Pars 188 [Adaptive P Gain1] and 189 [Adaptive I Gain1]. When the speed zero logic is enabled, the values set when the motor is stopped are valid.

Speed Up Function

The Speed-up function is used to avoid oscillations in the presence of loads with a high moment of inertia. When this function is enabled (default value of 0 “Speed Up” in Par 1016 [SpdFuncSelect]), a D (derivative) value is added to the speed feedback circuit, which allows you to increase the integral gain of the speed regulator. It is also useful in the case of cyclical non-constant loads on the motor (e.g., cams). The feedback applied to the speed regulator is made of two components:

- the motor speed
- the output signal from the Speed Up function

Figure C.2 Speed-Up function inactive
Oscillation during a speed change due to a high moment of inertia.
Top: Par 122 [Spd Feedback]
Bottom: Par 199 [Arm Current Pct]

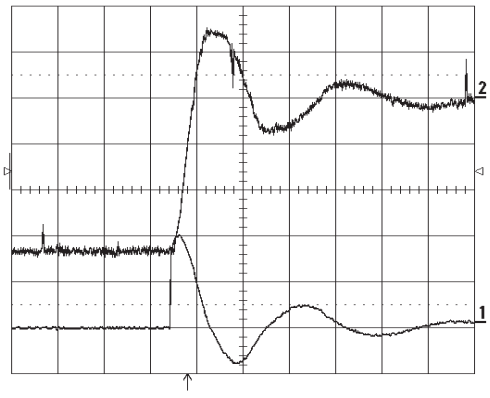
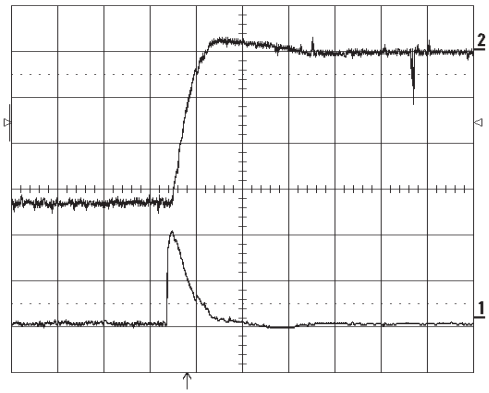


Figure C.3 Speed-up function active
The same drive with Speed-up function active.
Top: Par 122 [Spd Feedback]
Bottom: Par 199 [Arm Current Pct]



Parameters used in the example:

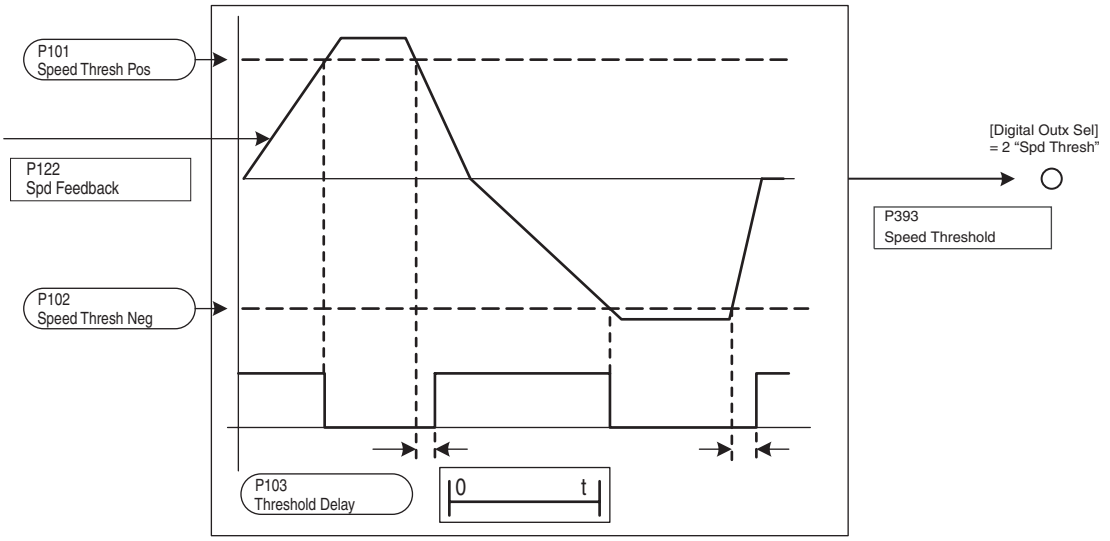
- Par 445 [Speed Up Gain Pct] = 50 %
- Par 446 [Speed Up Base] = 14 rpm/ms
- Par 447 [Speed Up Filter] = 20 ms

Speed Threshold Indicators

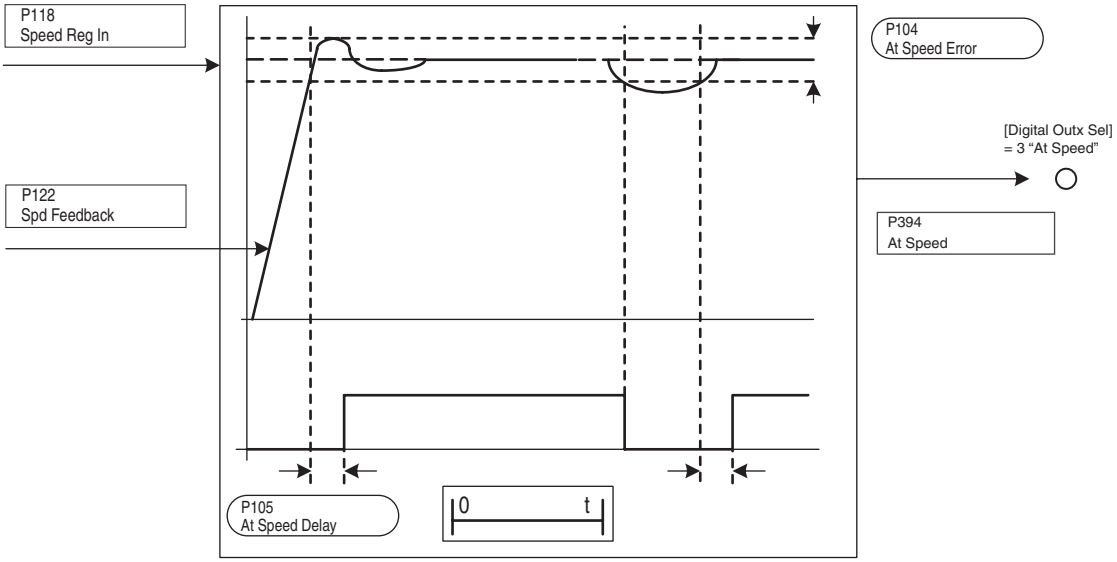
There are two speed threshold functions available that can be programmed via a digital output to provide indication of when the drive has exceeded certain set points.

Par 393 [Speed Threshold] displays whether the speed of the drive is above or below a set speed for clockwise and counter-clockwise rotation. Set the threshold speed for clockwise rotation in Par 101 [Spd Thresh Pos] and set

the threshold speed for counter-clockwise rotation in Par 102 [Speed Thresh Neg]. You can specify a delay time before indication that the speed has fallen below the threshold values in Par 103 [Threshold Delay]. Par 393 [Speed Threshold] can be assigned to a digital output. A digital output so assigned will only change state at the clockwise (positive) speed threshold.



Par 394 [At Speed] indicates whether or not the speed of the drive corresponds to the set speed reference (specified in Par 118 [Speed Reg In]) before the speed regulator and the ramp reference (if enabled) are applied. The speed above and below the speed reference at which indication will occur is set in Par 104 [At Speed Error]. You can specify a delay time before indication that the speed reference is within the range set in Par 104 [At Speed Error] will occur using Par 105 [At Speed Delay]. Par 394 [At Speed] can be assigned to a digital output.



Speed Zero Function

The Speed Zero Logic determines the behavior of the drive when the motor is at zero speed. Refer to the Speed Adaptive and Speed Zero Logic block diagram on page D-12.

Configuring the Speed Zero Logic

It is possible to avoid drive creep when the motor is at zero speed by disabling the Integral section of the Speed regulator. By default, the output of the Integral portion of the Speed regulator is disabled (Par 123 [Spd Zero I En] = 0 “Disabled”).

Important: If the speed regulator is disabled, the motor cannot receive a load when it is stopped. Therefore this function is not suitable for all applications!

Disable the output of the P gain of the Speed regulator by setting Par 126 [Spd Zero P Gain] to one of the following settings:

- If the speed reference is above the value set in Par 106 [Ref Zero Level]: Set Par 124 [Spd Ref Zero En] = 1 “Enabled”
- If the speed reference and/or the reaction are above the value set in Par 106 [Ref Zero Level], set Par 124 [Spd Ref Zero En] = 0 “Disabled”

Par 124 [Spd Ref Zero En] is active only when Par 125 [Spd Zero P En] = 1 “Enabled”.

Set the P gain for zero speed:

- If the P gain corresponds to the value set in Par 126 [Spd Zero P Gain], then set Par 125 [Spd Zero P En] = 1 “Enabled”
- If the P gain corresponds to the normal P gain, then set Par 125 [Spd Zero P En] = 0 “Disabled”

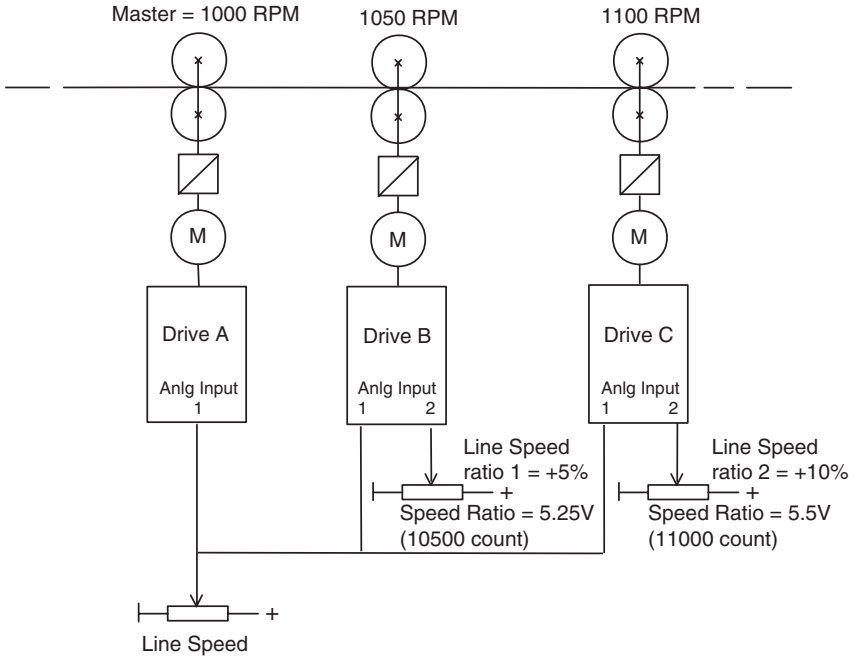
The P gain at zero speed is set via Par 126 [Spd Zero P Gain] when Par 125 [Spd Zero P En] = 1 “Enabled”.

The threshold for the recognition of zero speed is determined by the value in Par 106 [Ref Zero Level].

Speed Draw Function

The Speed Draw function can be used to apply a configurable speed ratio (set in Par 1017 [Speed Ratio]) to the main speed reference of the drive. This function is useful in a multi-drive system where a proportional speed increase between the motors is required. The range of parameter 1017 [Speed Ratio] can be set between 0 and 32767 if written in digital form, or can be set from 0 to 20000 (0 to +10V) if assigned via an analog input. The resulting speed value can be viewed in Par 1018 [Speed Draw Out] via an analog output.

Figure C.4 Speed Draw Example



Speed Draw Example Configuration

Drive A:

- Set parameter 70 [Anlg In1 Sel] to 4 “Trim Speed”

Drive B:

- Set parameter 70 [Anlg In1 Sel] to 4 “Trim Speed”
- Set parameter 75 [Anlg In2 Sel] to 22 “Speed Ratio”
- Set parameter 1017 [Speed Ratio] to 10500

Drive C:

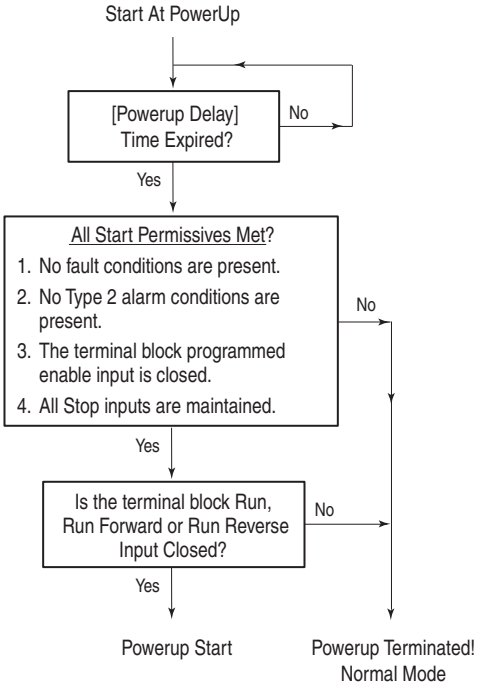
- Set parameter 70 [Anlg In1 Sel] to 4 “Trim Speed”
- Set parameter 75 [Anlg In2 Sel] to 22 “Speed Ratio”
- Set parameter 1017 [Speed Ratio] to 11000

Start At Powerup

The “Start At Powerup” function allows you to automatically resume running at commanded speed after drive input power is restored, a run command is issued and all of the start permissive conditions indicated in the diagram below are met. To enable this feature, parameter 1344 [Start At Powerup] must be set to 1 “Enable”.

ATTENTION: Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

In addition, A delay time of up to 10800 seconds (3 hours) can be programmed in parameter 1345 [Powerup Delay]. An automatic drive restart is not possible before the delay time has expired. If a “Start”, “Run” or “Stop” command is asserted before the time in this parameter expires, the “Start At Powerup” function will be aborted.



During the time specified in parameter 1345 [Powerup Delay], the alarm indicator “” is displayed on the HIM and bit 12 “PwrUp Start” of parameter 380 [Drive Status 1] is set to “1”.

Fine Tuning the Regulators

The PowerFlex DC drive control regulators have predefined values meant to provide consistent drive performance without performing any further configuration, with the exception of the armature current regulator, which must always be tuned. When the armature current regulator has been tuned to meet the requirements of the application, the fine tuning procedures for the other regulators are not necessary. However, the fine tuning procedures can be used to optimize the output and control features of the drive.

The drive contains the following regulation circuits:

- Armature current regulator - The auto tuning procedure is run via Par 452 [CurrReg Autotune]. Refer to Chapter 2 - Drive Start Up.
- Field current regulator:
  - A manual procedure to adjust the armature inductance when the autotune steps yielded a value outside the recommended setting. Refer to Manually Adjusting the Current Regulator Tune Settings on page C-22.
  - A fine tuning procedure is available below. Refer to Fine Tuning the Field Current Regulator on page C-23.
- Speed regulator - A fine tuning procedure is available below. Refer to Fine Tuning the Speed Regulator on page C-26.
- Armature voltage regulator - A fine tuning procedure is available below. Refer to Fine Tuning the Voltage Regulator in the Field Converter on page C-28.

The fine tuning procedures are included below. In order to obtain a step function, the internal “Test generator” is used. The goal of the fine tuning procedures is to obtain an optimal step response. For example, it is recommended that you directly measure the step response for the field current regulator.

The analog output can be connected to the terminal strip, with a sampling rate of two milliseconds.

Using the Test Generator

The “Test Generator” function creates signals with a rectangular wave form based on a specific frequency and amplitude. The frequency and amplitude can be added to a configurable offset value, if needed. Par 58 [TstGen Output] determines which regulator input signal (reference) is active; torque current, field, ramp, or speed.

Manually Adjusting the Current Regulator Tune Settings

During the current regulator auto tuning test the value of Par 587 [I Reg Error] displays. This parameter is used to determine whether the current regulator is correctly tuned. The value should be as near to zero as possible, but values between -40 and +40 are acceptable. Any changes to the resulting

value are made in Par 454 [Arm Inductance] in order to fine tune the speed regulator and set Par 587 [I Reg Error] to an acceptable value.

- ❏ If the value of Par 587 [I Reg Error] is positive, increase the value of Par 454 [Arm Inductance].
- ❏ If the value of Par 587 [I Reg Error] is negative, decrease the value of Par 454 [Arm Inductance].

Fine Tuning the Field Current Regulator

Important: In most cases motors with a direct current and an independent excitation work with a constant field (Par 469 [Field Mode Sel] = 0 “Base Speed”). In this case it is not necessary to optimize the field current or armature voltage regulators.

The procedure below is used for drives that use constant torque and power (mixed armature and field regulation). In these cases it is necessary to configure the field converter according to this method.

Important: Do not issue a “Start” command to the drive during the field current regulator fine tuning procedure.

Follow the procedure below to fine tune and optimize the field current regulator:

1. Configure the following parameters:
   - ❏ Set Par 467 [Max Fld Curr Pct] = 100% of the field rated current of the connected motor
   - ❏ Set Par 468 [Min Fld Curr Pct] = 0
   - ❏ Set Par 91 [Fld Reg Kp] = 0.00
   - ❏ Set Par 92 [Fld Reg Ki] = 0.00
2. Measure the field current using an analog output by setting:
   - ❏ Par 66 [Anlg Out1 Sel] = 18 “Fld Current”
   - ❏ Par 67 [Anlg Out2 Sel] = 24 “Field Ref”
3. Configure the following parameters:
   - ❏ Set Par 497 [Field Reg Enable] = 1 “Enabled” (default)
   - ❏ Set Par 469 [Field Mode Sel] = 1 “Field Weaken”
   - ❏ Set Par 498 [Force Min Field] = 1 “Enabled”

4. Configure the following Test Generator parameters:

   - ❑ Set Par 58 [TstGen Output] = 3 “Field Ref”
   - ❑ Set Par 60 [TstGen Amplitude] = 70% of the field rated current of the motor (this setting allows the system overshoot).

5. Increase the value of the Par 91 [Fld Reg Kp] until the overshoot of the field current (displayed in Par 234 [Fld Current Pct]) is lower than 4%.

6. Increase the value of Par 92 [Fld Reg Ki] until the overshoot is higher than 4%. Then, decrease the value of this parameter until it becomes slightly lower than 4%.

Important: Because of the relatively high field time constant, the rising speed of the field current is limited. The rising time with optimal tuning conditions could be up to 100 milliseconds.

7. Set Par 58 [TstGen Output] = 0 “NotConnected”.

8. Set Par 498 [Force Min Field] = 0 “Disabled”.

9. Set Par 468 [Min Fld Curr Pct] to the desired value.

10. Configure the analog outputs according to your application needs.

Field Current Regulator Tuning Examples

Figure C.5 Increase in the field current with oscillation
Non-optimal response of the regulator.
Top: Par 500 [Field Ref Pct]
Bottom: Par 234 [Fld Current Pct]

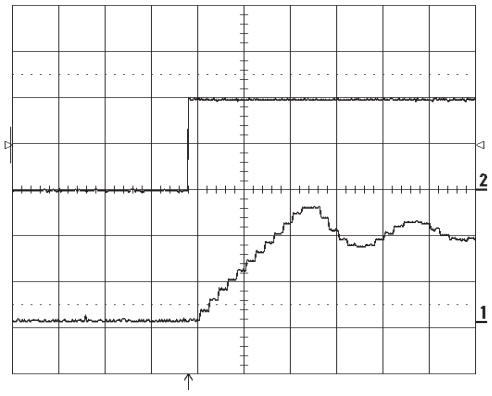


Figure C.6 Too high of a time constant on the field
The reduction of the field current depends on the field time constant. Therefore, the regulator has no influence on the flux current.
Top: Par 500 [Field Ref Pct]
Bottom: Par 234 [Fld Current Pct]

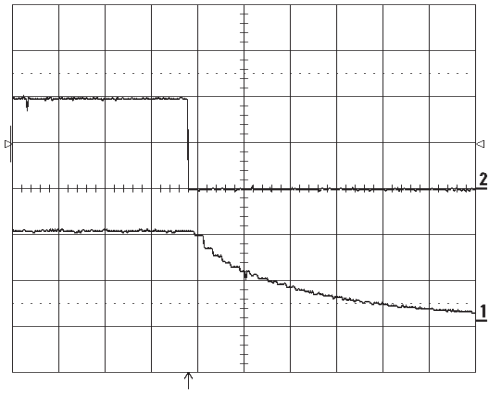
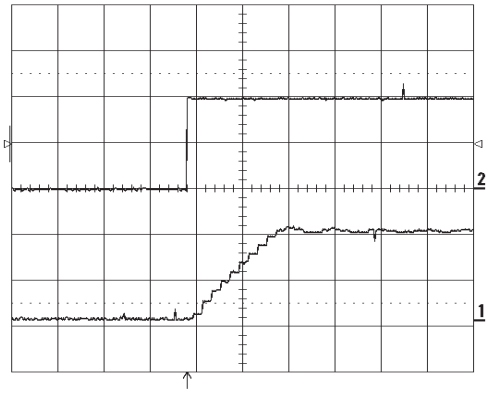


Figure C.7 Increase in the field current without oscillation
This graph, as compared to the graph in Figure C.5, shows an increase in [Fld Reg Kp] from 2% to 10% with [Fld Reg Ki] = 5%.
Top: Par 500 [Field Ref Pct]
Bottom: Par 234 [Fld Current Pct]



Fine Tuning the Speed Regulator

Follow the procedure below to fine tune and optimize the speed regulator:

1. Configure the following Test Generator parameters:
   - ❏ Set Par 58 [TstGen Output] = 4 “Ramp Ref”
   - ❏ Set Par 59 [TstGen Frequency] = 0.2 Hz
   - ❏ Set Par 60 [TstGen Amplitude] = 10 %
   - ❏ Set Par 61 [TstGen Offset] = 10 %
2. Measure the results on analog outputs 1 and 2 by setting:
   - ❏ Par 66 [Anlg Out1 Sel] = 8 “Spd Reg Out”
   - ❏ Par 67 [Anlg Out2 Sel] = 13 “Motor Curr”.
3. Set Par 660 [Accel Time 1] = 1 sec.
4. Set Par 87 [Spd Reg Kp] = 0.00
5. 88 [Spd Reg Ki] = 0.00
6. Start the drive.
7. Increase the value of Par 87 [Spd Reg Kp] until the overshoot is lower than 4% with the shortest possible acceleration or deceleration time.
8. Increase the value of Par 88 [Spd Reg Ki] until the overshoot is higher than 4%. Then, decrease the value of this parameter until its value becomes slightly lower than 4%.
9. Stop the drive.
10. Set Par 58 [TstGen Output] = 0 “NotConnected”.

Important: When the “Bypass” function is enabled (Par 458 [SpdReg FB Bypass] = 1 “Enabled”) the drive is automatically switched to armature feedback when a “Speed fbk loss” fault occurs due to an encoder or tachometer feedback loss. In this case, you must repeat steps 1 - 9 of the “Fine Tuning the Speed Regulator” procedure when the fault has been cleared. After an automatic switch to armature feedback, the speed regulator works with Pars 459 [SpdReg Kp Bypass] and 460 [SpdReg Ki Bypass] and the D (derivative) part of the speed regulator is automatically excluded.

When it is necessary to have different gains for the speed regulator above the speed range, you can utilize the adaptive speed regulator. For further information about this function refer to the Adaptive Speed Regulator block diagram page C-14.

[Spd Reg Kp] and [Spd Reg Ki] curves

Figure C.8 [Spd Reg Kp] too low
Top: Par 122 [Spd Feedback]
Bottom: Par 199 [Arm Current Pct]

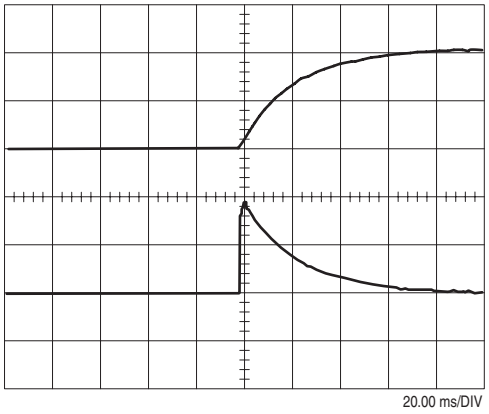


Figure C.9 [Spd Reg Kp] too high
Top: Par 122 [Spd Feedback]
Bottom: Par 199 [Arm Current Pct]

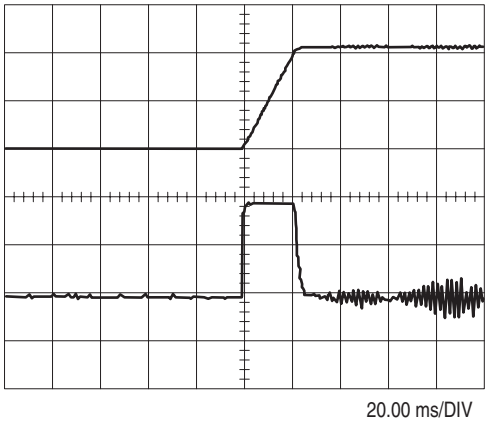


Figure C.10 [Spd Reg Ki] too high
Top: Par 122 [Spd Feedback]
Bottom: Par 199 [Arm Current Pct]

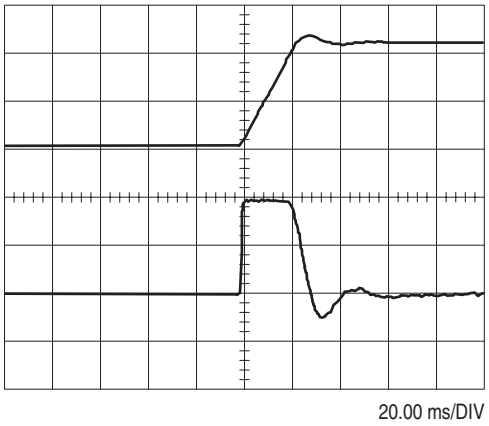
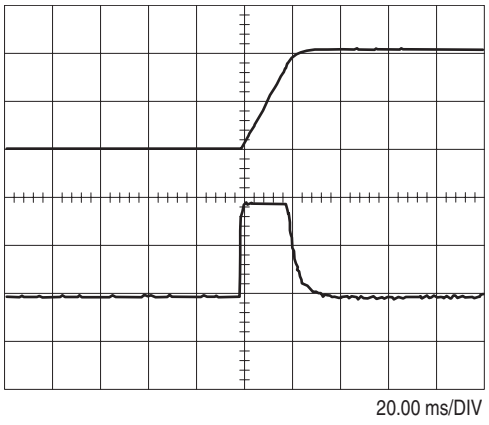


Figure C.11 [Spd Reg Ki] correct
Top: Par 122 [Spd Feedback]
Bottom: Par 199 [Arm Current Pct]



Fine Tuning the Voltage Regulator in the Field Converter

Important: In most cases, DC motors with independent excitation, work with a constant field (Par 469 [Field Mode Sel] = 0 “Base Speed”). In this case it is not necessary to optimize the regulator of the field current and the regulator of the armature voltage.

When field weakening occurs, the voltage regulator keeps the armature voltage at a constant level. The critical point for this regulator is at the beginning of field weakening, because with the saturation of the motor field the system requires more consistent changes in the field current in order to carry out a flux change. Tune the regulator so that the armature voltage undergoes very small changes.

Important: Before the optimization of the voltage regulator, the speed and field current regulators must have already been tuned. Refer to Tune the Current Regulator: on page 2-8 and Fine Tuning the Field Current Regulator on page C-23.

1. Configure the following Test Generator parameters:
   - ❏ Set Par 58 [TstGen Output] = 4 “Ramp Ref”
   - ❏ Set Par 59 [TstGen Frequency] = 0.2 Hz
   - ❏ Set Par 60 [TstGen Amplitude] = 10 %
   - ❏ Set Par 61 [TstGen Offset] = to the switching point from the armature to the field regulation. For example: If Par 162 [Max Feedback Spd] = 2000 rpm, field weakening starts at 1500 rpm. Therefore, set Par 61 [TstGen Offset] = 75 %.
2. Measure the field current and the armature voltage using analog outputs 1 and 2, by setting:
   - ❏ Par 66 [Anlg Out1 Sel] = 18 “Fld Current”
   - ❏ Par 67 [Anlg Out2 Sel] = 14 “Motor Volts”
3. Start the drive.
4. Check the armature voltage via analog output 2. After a possible short oscillation, the voltage should remain constant. Refer to the Field Voltage Regulator examples below. You can change the Proportional and Integral gains of the Field Voltage regulator via Pars 493 [Arm Volt Kp] and 494 [Arm Volt Ki].
5. Stop the drive.
6. Set Par 58 [TstGen Output] = 0 “NotConnected”.

Field Voltage Regulator Tuning Examples

Figure C.12 Field voltage oscillation
Oscillation after a speed change where [Arm Volt Kp] = 10% and [Arm Volt Ki] = 80%.
Top: Par 234 [Fld Current Pct]
Bottom: Par 233 [Output Voltage]

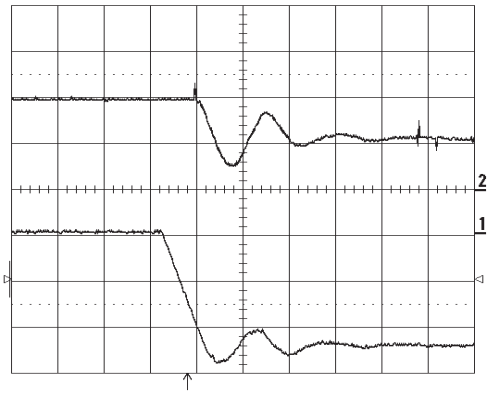


Figure C.13 Too small of a gain
The armature voltage increases where [Arm Volt Kp] = 3% and [Arm Volt Ki] = 5%.
Top: Par 234 [Fld Current Pct]
Bottom: Par 233 [Output Voltage]

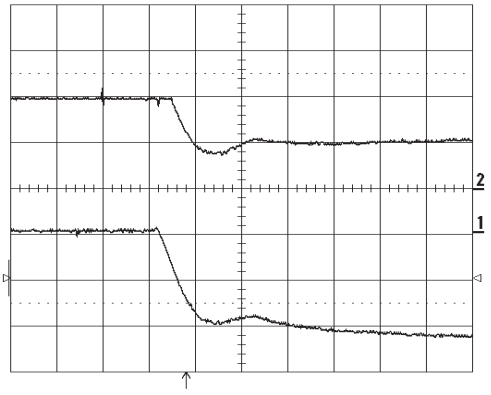
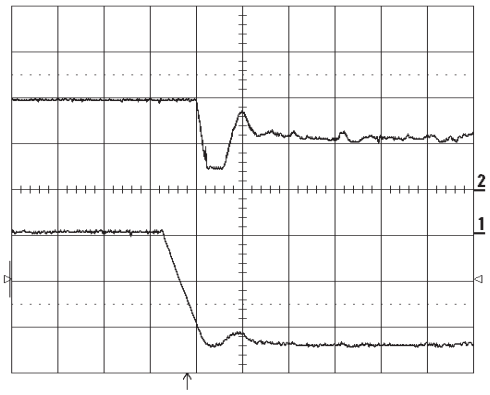


Figure C.14 Optimal field regulation
After a short transient, the field current and armature voltage are constant. [Arm Volt Kp] = 40%, [Arm Volt Ki] = 5%.
Top: Par 234 [Fld Current Pct]
Bottom: Par 233 [Output Voltage]



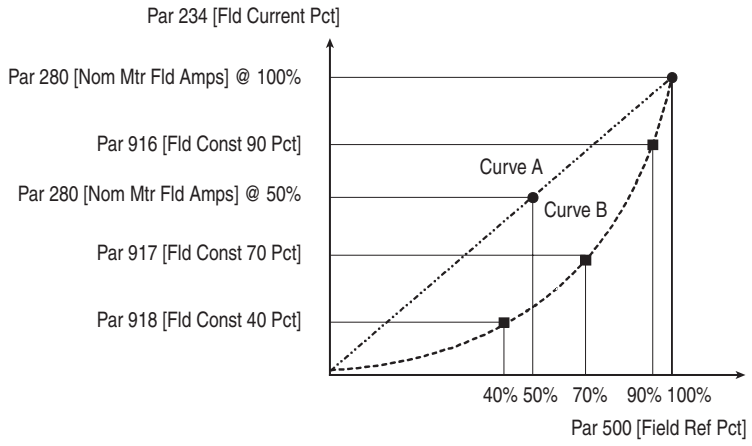
Tuning the Field Current Curve

The function of the field current curve is to control the actual motor flux and, subsequently, motor torque if the field goes into an overvoltage condition. Figure C.15 below illustrates the relationship between flux and flux current when the field current curve is defined versus not defined.

Important: Complete the procedures in the order listed below when tuning the field current curve:

- Field current regulator. Refer to Fine Tuning the Field Current Regulator on page C-23.
- Field current curve tuning (Flux / if curve)
- Voltage regulator in the field converter. Refer to Fine Tuning the Voltage Regulator in the Field Converter on page C-28.

Figure C.15 Curve Conversion Flux/Current



Examples:

- Curve A - If the default settings of the drive are retained, the flux current to flux reference will remain linear when the value of Par 500 [Field Ref Pct] changes. E.g.,
  - If Par 467 [Max Fld Curr Pct] / Par 500 [Field Ref Pct] = 100%, then Par 234 [Fld Current Pct] / Par 500 [Field Ref Pct] = Par 280 [Nom Mtr Fld Amps]
  - If Par 467 [Max Fld Curr Pct] / Par 500 [Field Ref Pct] = 50%, then Par 234 [Fld Current Pct] / Par 500 [Field Ref Pct] = 50% of Par 280 [Nom Mtr Fld Amps]
- Curve B - If the field current curve fine tuning procedure is completed, the flux current to flux reference curve will follow a curve determined by the real flux percentage of Par 500 [Field Ref Pct] necessary to determine the circulation of the field current for the connected system. Refer to the Current Regulator block diagram on page D-13.

Field Current Curve Tuning Procedure:

1. Reset the field current curve by setting Par 920 [Reset Fld Curve] to “1”.
2. Configure the following parameters:
   - ❏ Enter the percentage (100%) of the maximum motor nameplate rated armature voltage in Par 921 [Out Volt Level]
   - ❏ Set Par 469 [Field Mode Sel] = 0 “Base Speed”
   - ❏ Set Par 467 [Max Fld Curr Pct] = 100%

3. Start the drive.

4. Increase the motor speed until the value (electromotive force) displayed in Par 233 [Output Voltage] corresponds to the value previously set in Par 175 [Rated Motor Volt].

5. Decrease the value of Par 467 [Max Fld Curr Pct] until the value displayed in Par 233 [Output Voltage] is equal to 90% of Par 175 [Rated Motor Volt]. When you have reached this value, read the value displayed in Par 234 [Fld Current Pct] and enter the value into Par 918 [Fld Const 90 Pct].

6. Decrease the value of Par 467 [Max Fld Curr Pct] until the value displayed in Par 233 [Output Voltage] is equal to 70% of Par 175 [Rated Motor Volt]. When you have reached this value, read the value displayed in Par 234 [Fld Current Pct] and enter the value into Par 917 [Fld Const 70 Pct].

7. Decrease the value of Par 467 [Max Fld Curr Pct] until the value displayed in Par 233 [Output Voltage] is equal to 40% of Par 175 [Rated Motor Volt]. When you have reached this value, read the value displayed in Par 234 [Fld Current Pct] and enter the value into Par 916 [Fld Const 40 Pct].

8. Stop the drive.

9. Set the desired method of field control in Par 469 [Field Mode Sel] (0 “Base Speed” or 1 “Field Weaken”)

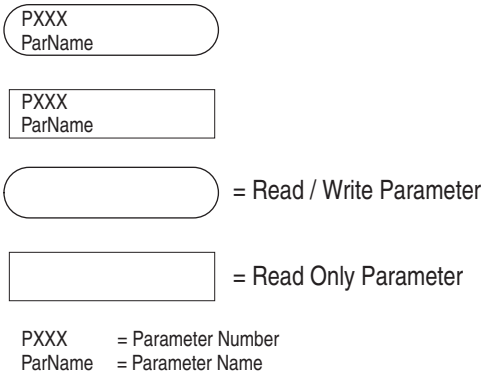
10. Reset the value of 467 [Max Fld Curr Pct] to 100%.

If you change the value of Par 175 [Rated Motor Volt] or par 280 [Nom Mtr Fld Amps], the field current curve will need to be re-tuned.

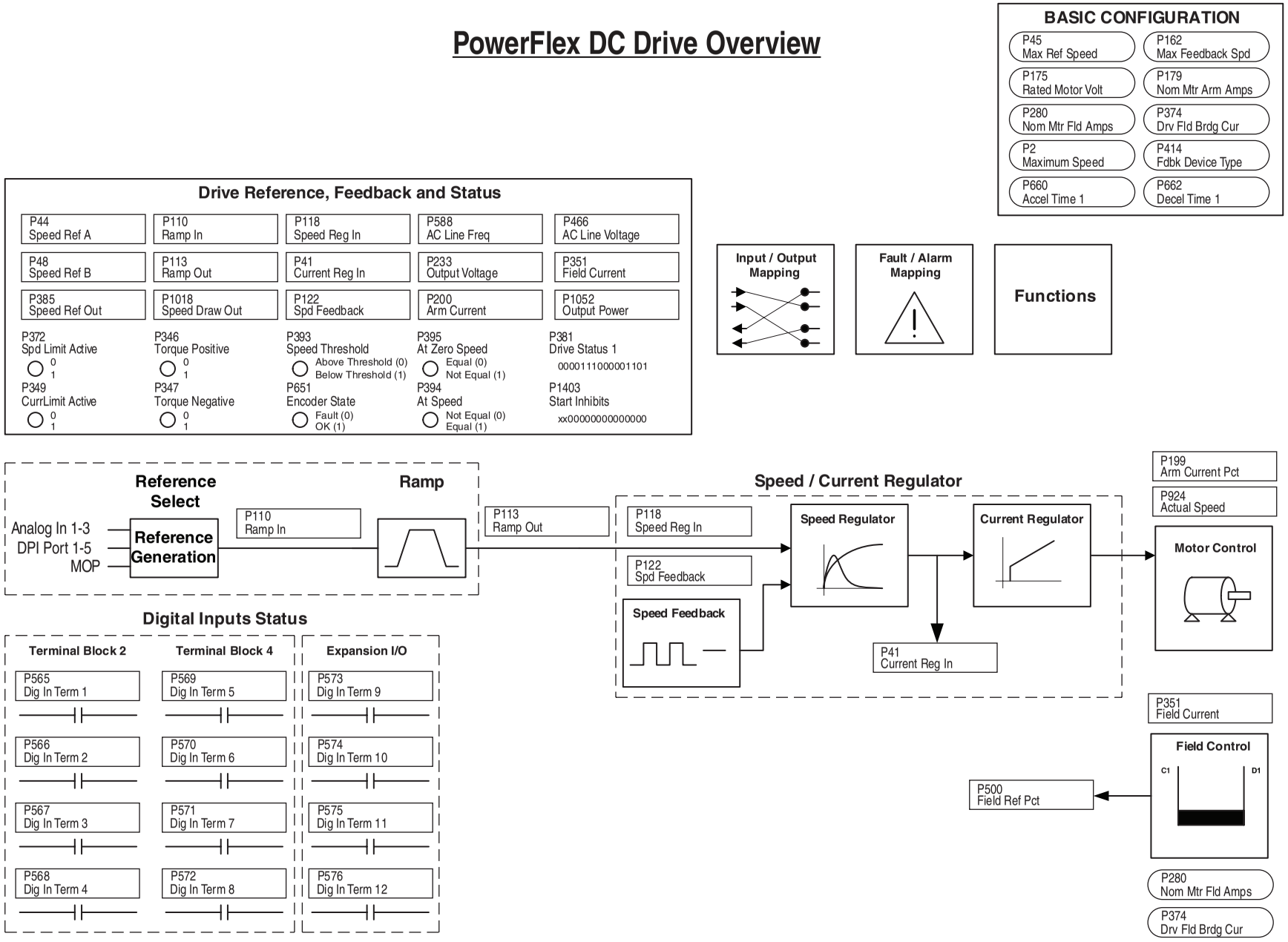
Control Block Diagrams

Diagram Conventions

Examples:



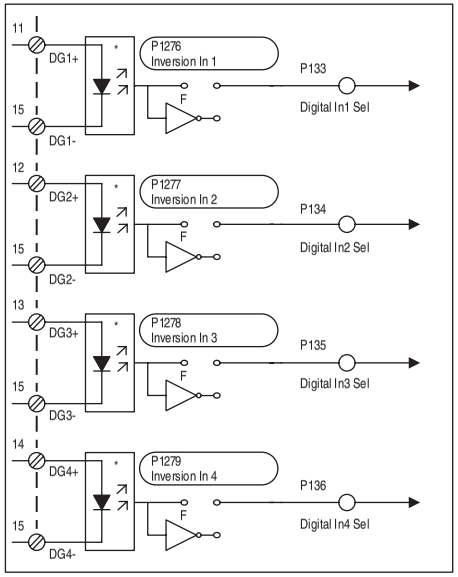
PowerFlex DC Drive Overview



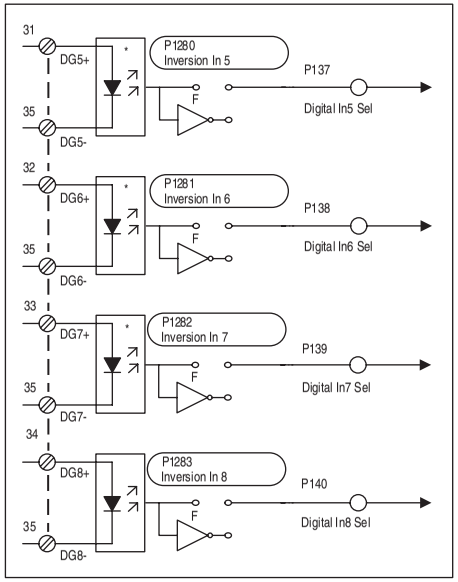
Digital Inputs/Outputs
Standard and Expansion I/O

Digital Inputs

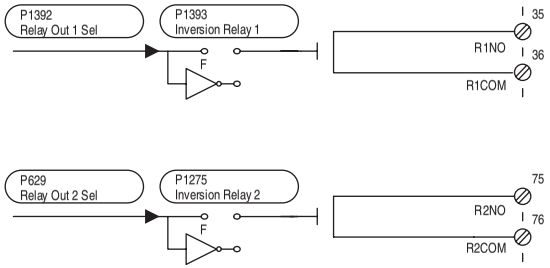
Terminal Block 2



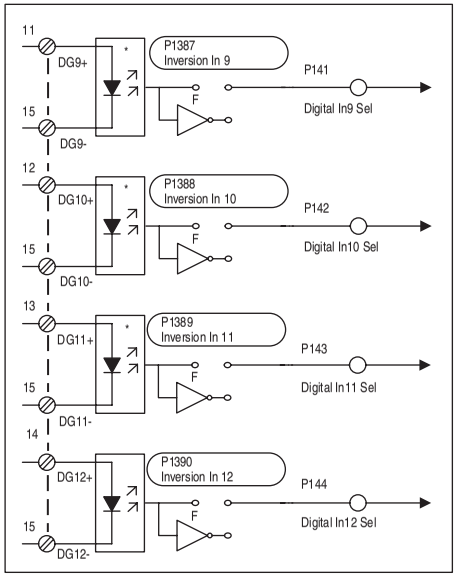
Terminal Block 4



Drive Relay Outputs

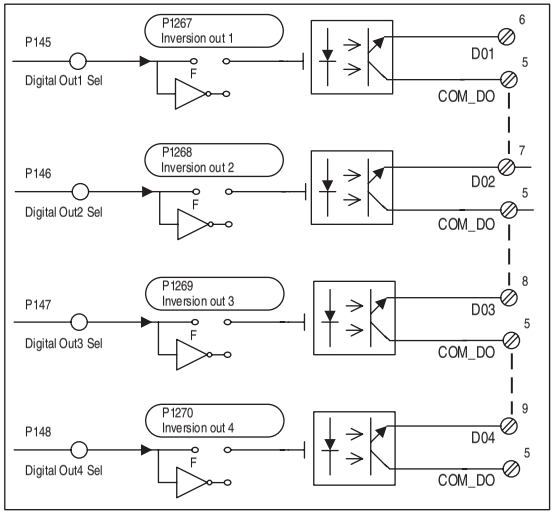


Expansion Digital Inputs (Optional)

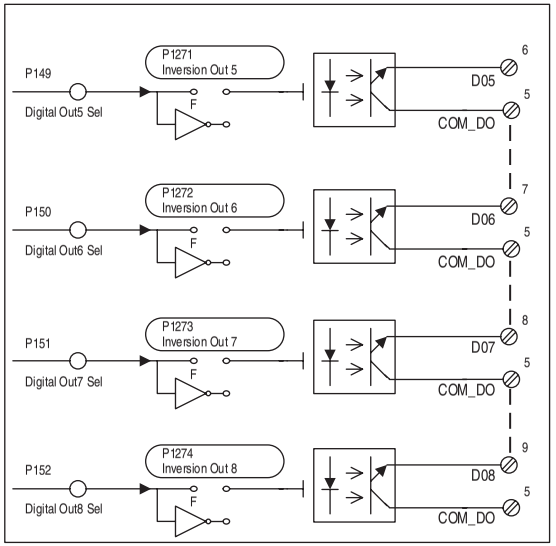


Digital Outputs

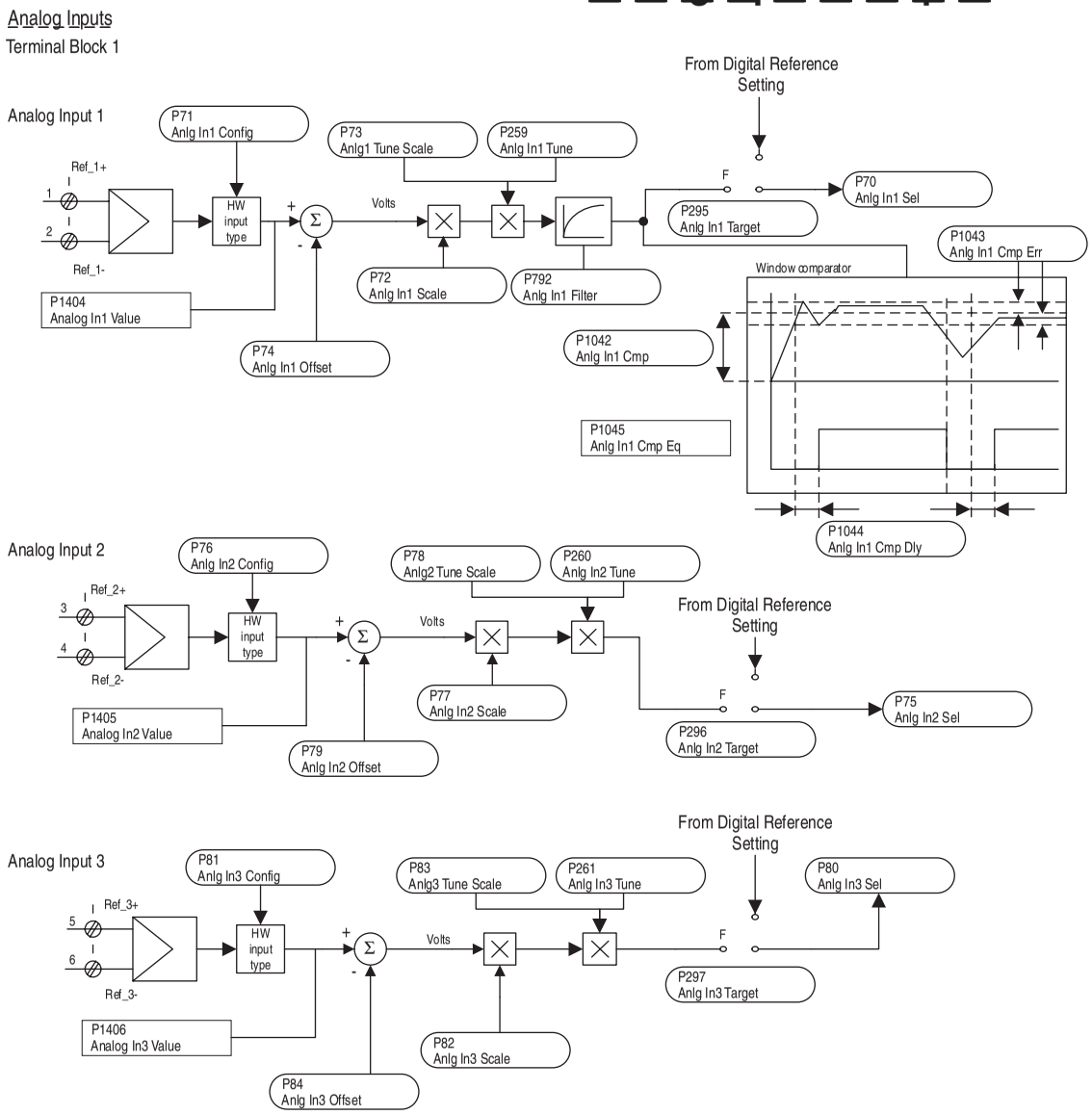
Terminal Block 3

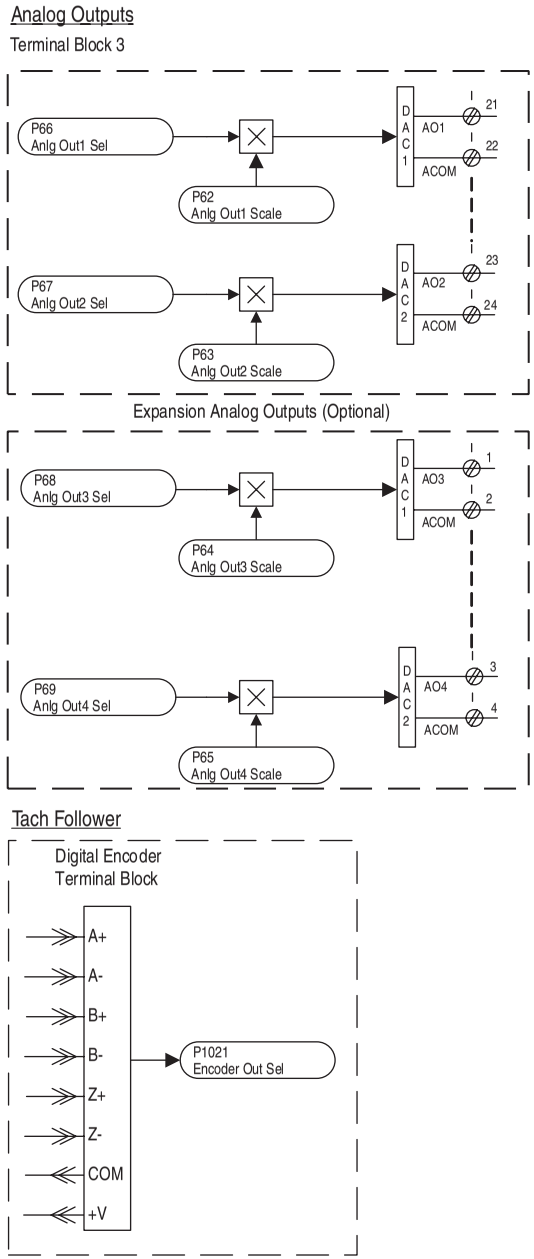


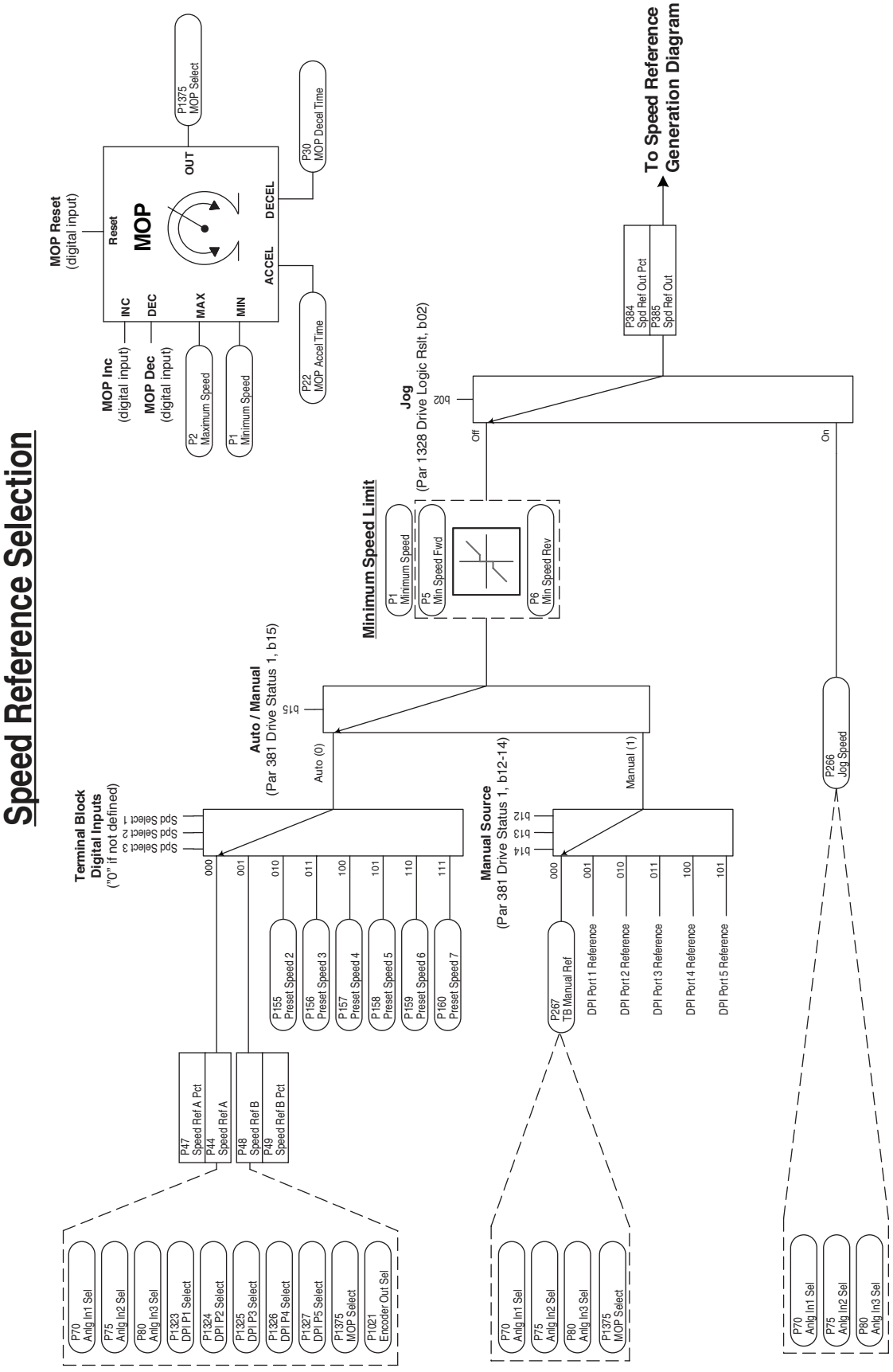
Expansion Digital Outputs (Optional)



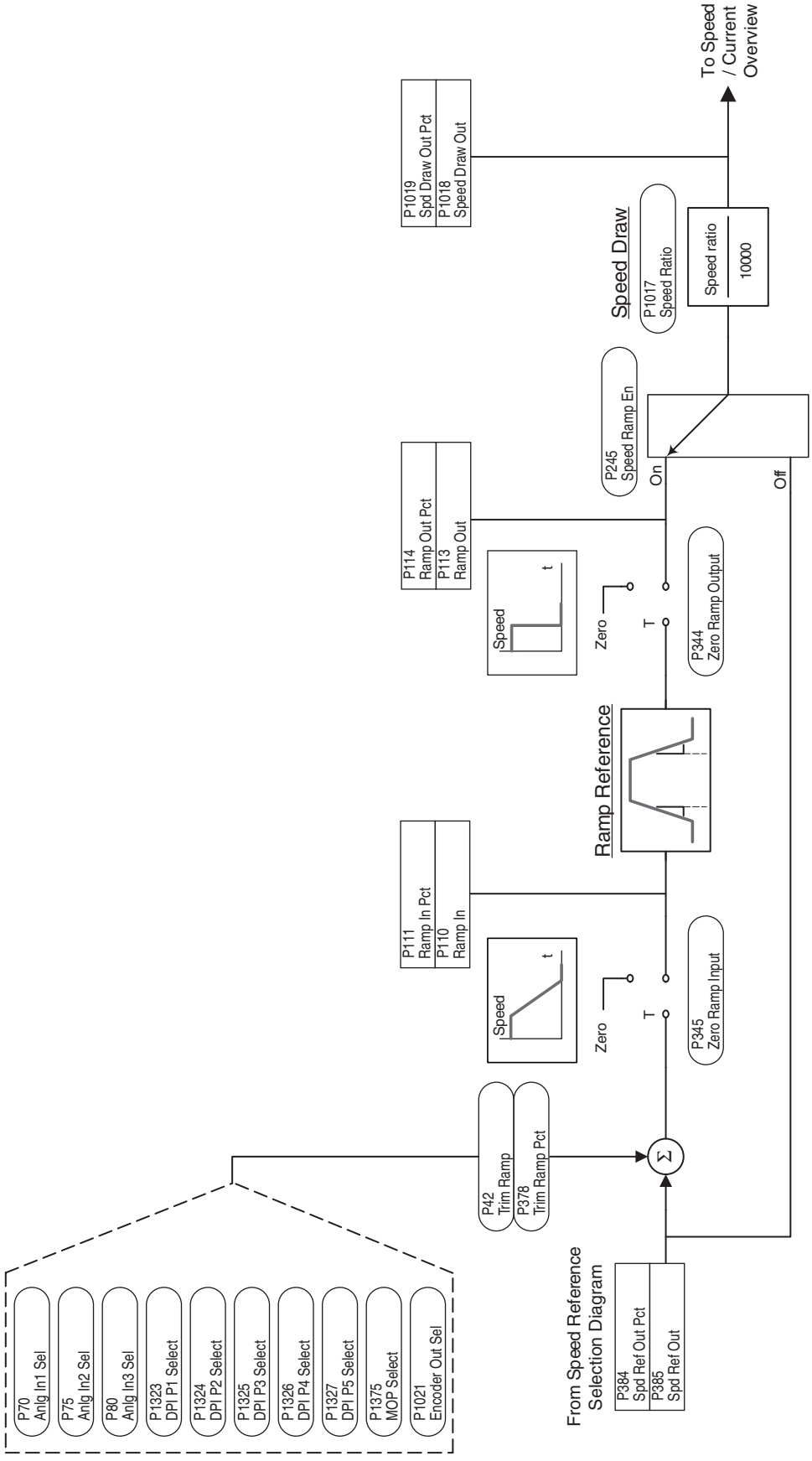
Analog Inputs / Outputs



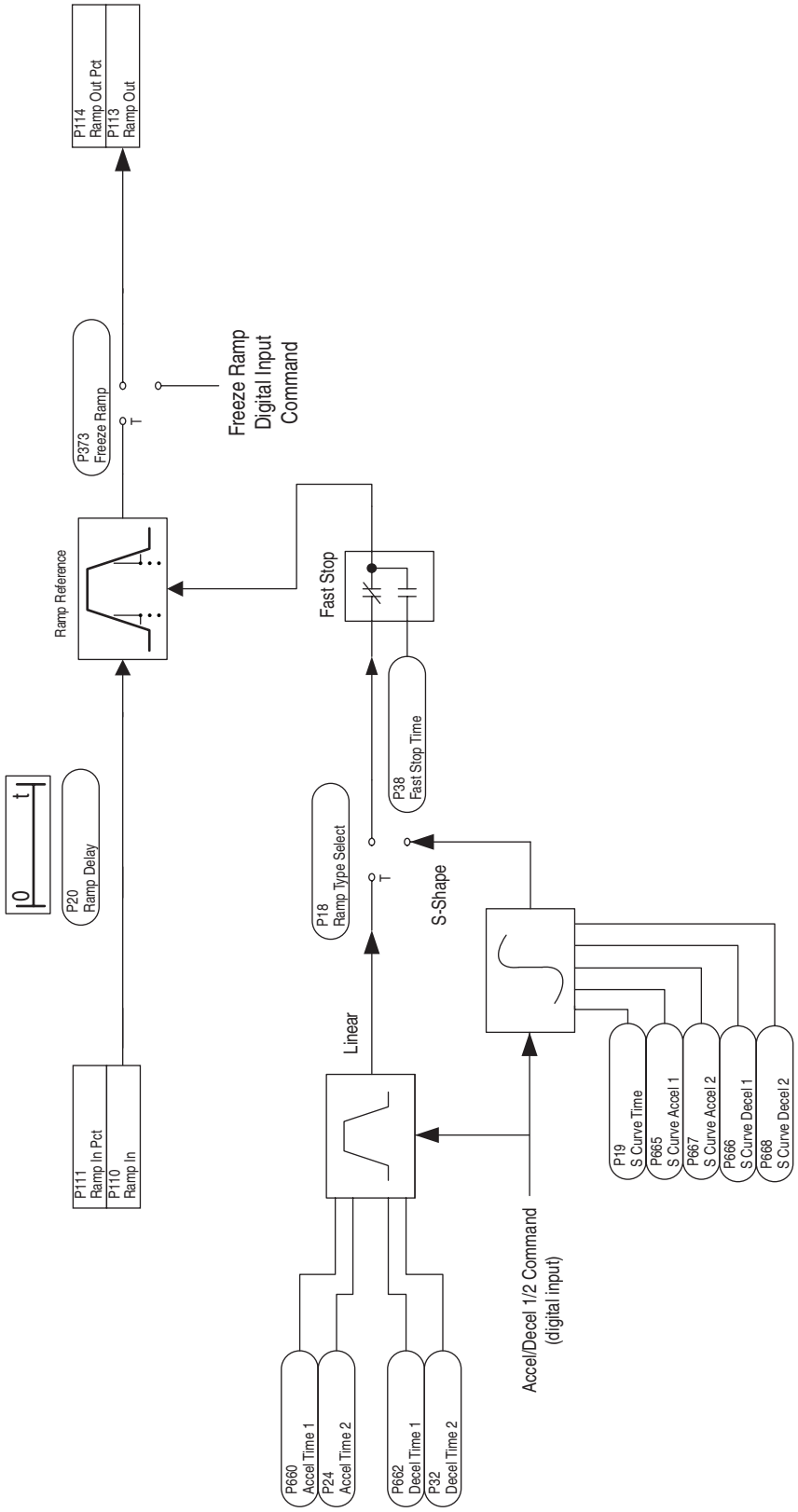



Speed Reference Selection
MOP Reset
(digital input)
Reset
MOP
INC
DEC
MAX
MIN
ACCEL
DECEL
OUT
P1375
MOP Select
P30
MOP Decel Time
P22
MOP Accel Time
MOP Inc
(digital input)
MOP Dec
(digital input)
P2
Maximum Speed
P1
Minimum Speed
To Speed Reference
Generation Diagram
P384
Spd Ref Out Pct
P385
Spd Ref Out
Jog
(Par 1328 Drive Logic Rslt, b02)
b02
Off
On
Minimum Speed Limit
P1
Minimum Speed
P5
Min Speed Fwd
P6
Min Speed Rev
Auto / Manual
(Par 381 Drive Status 1, b15)
b15
Auto (0)
Manual (1)
Terminal Block
Digital Inputs
("0" if not defined)
Spd Select 1
Spd Select 2
Spd Select 3
000
001
010
011
100
101
110
111
P155
Preset Speed 2
P156
Preset Speed 3
P157
Preset Speed 4
P158
Preset Speed 5
P159
Preset Speed 6
P160
Preset Speed 7
P47
Speed Ref A Pct
P44
Speed Ref A
P48
Speed Ref B
P49
Speed Ref B Pct
Manual Source
(Par 381 Drive Status 1, b12-14)
b12
b13
b14
000
001
010
011
100
101
P267
TB Manual Ref
DPI Port 1 Reference
DPI Port 2 Reference
DPI Port 3 Reference
DPI Port 4 Reference
DPI Port 5 Reference
P266
Jog Speed
P70
Anlg In1 Sel
P75
Anlg In2 Sel
P80
Anlg In3 Sel
P1323
DPI P1 Select
P1324
DPI P2 Select
P1325
DPI P3 Select
P1326
DPI P4 Select
P1327
DPI P5 Select
P1375
MOP Select
P1021
Encoder Out Sel
P70
Anlg In1 Sel
P75
Anlg In2 Sel
P80
Anlg In3 Sel
P1375
MOP Select
P70
Anlg In1 Sel
P75
Anlg In2 Sel
P80
Anlg In3 Sel

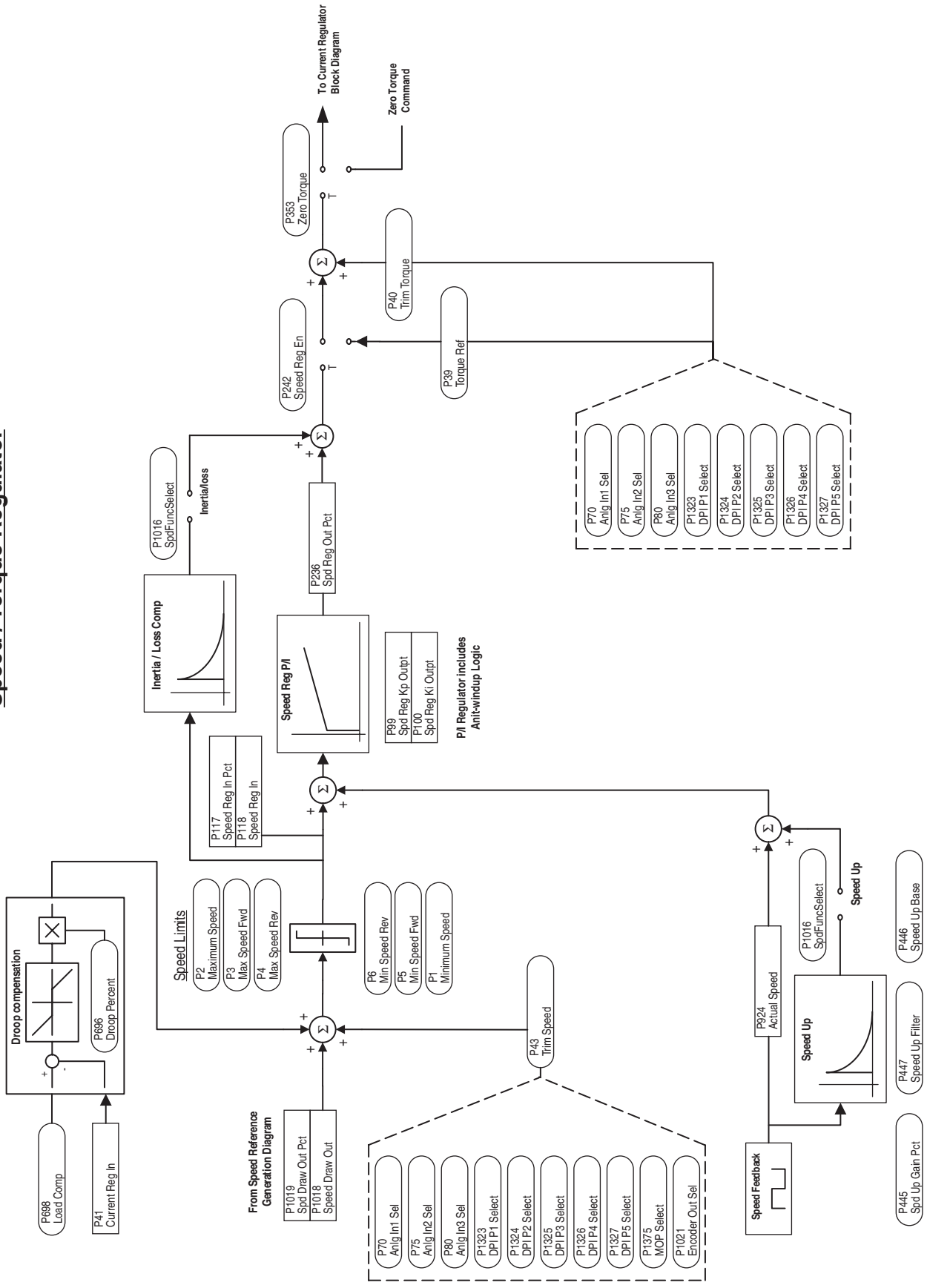
Speed Reference Generation



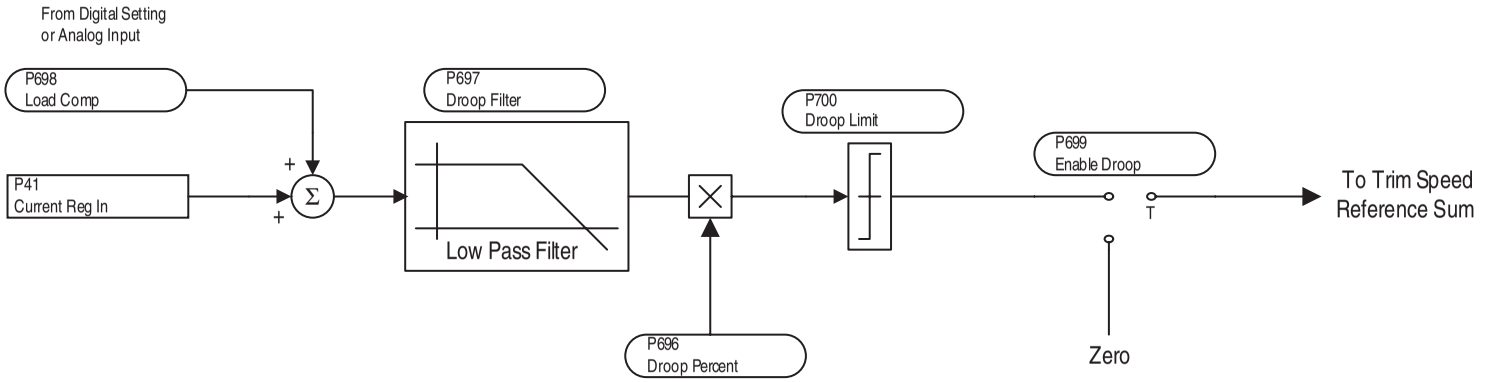
Ramp Reference Block



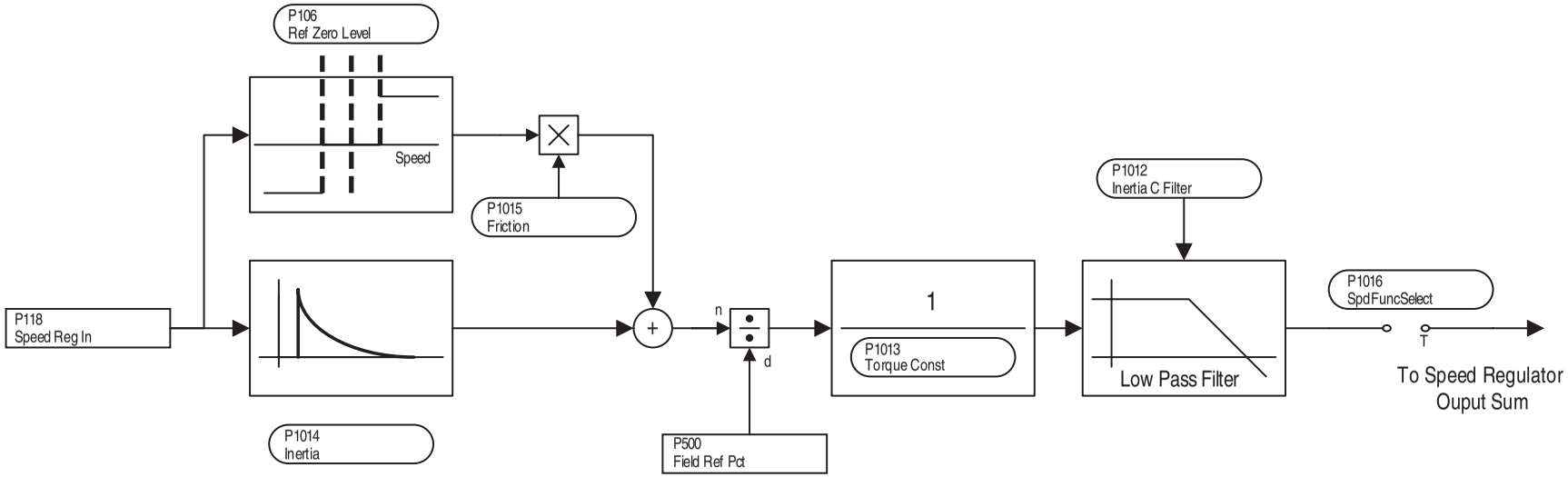
Speed / Torque Regulator



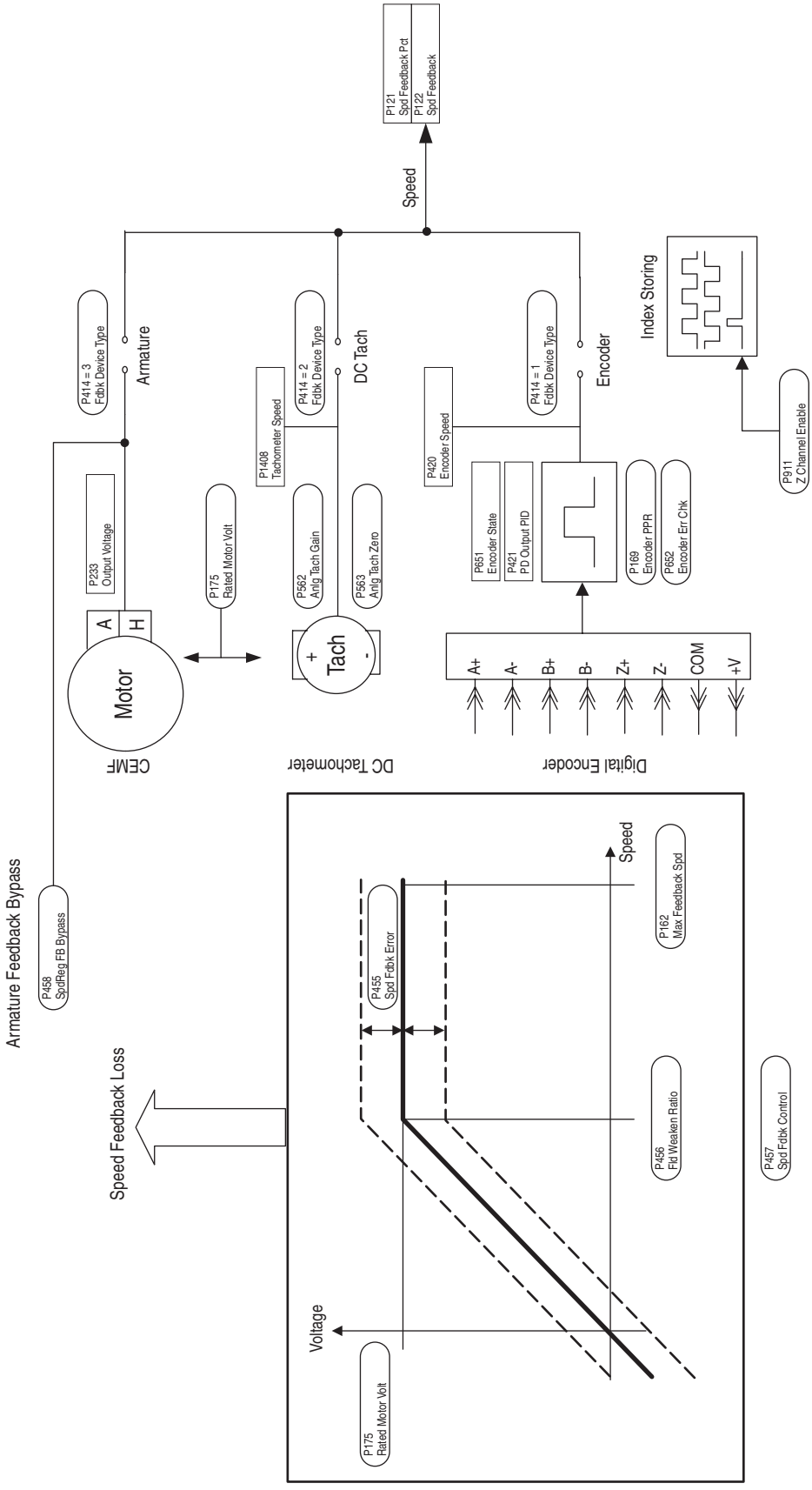
Droop Compensation



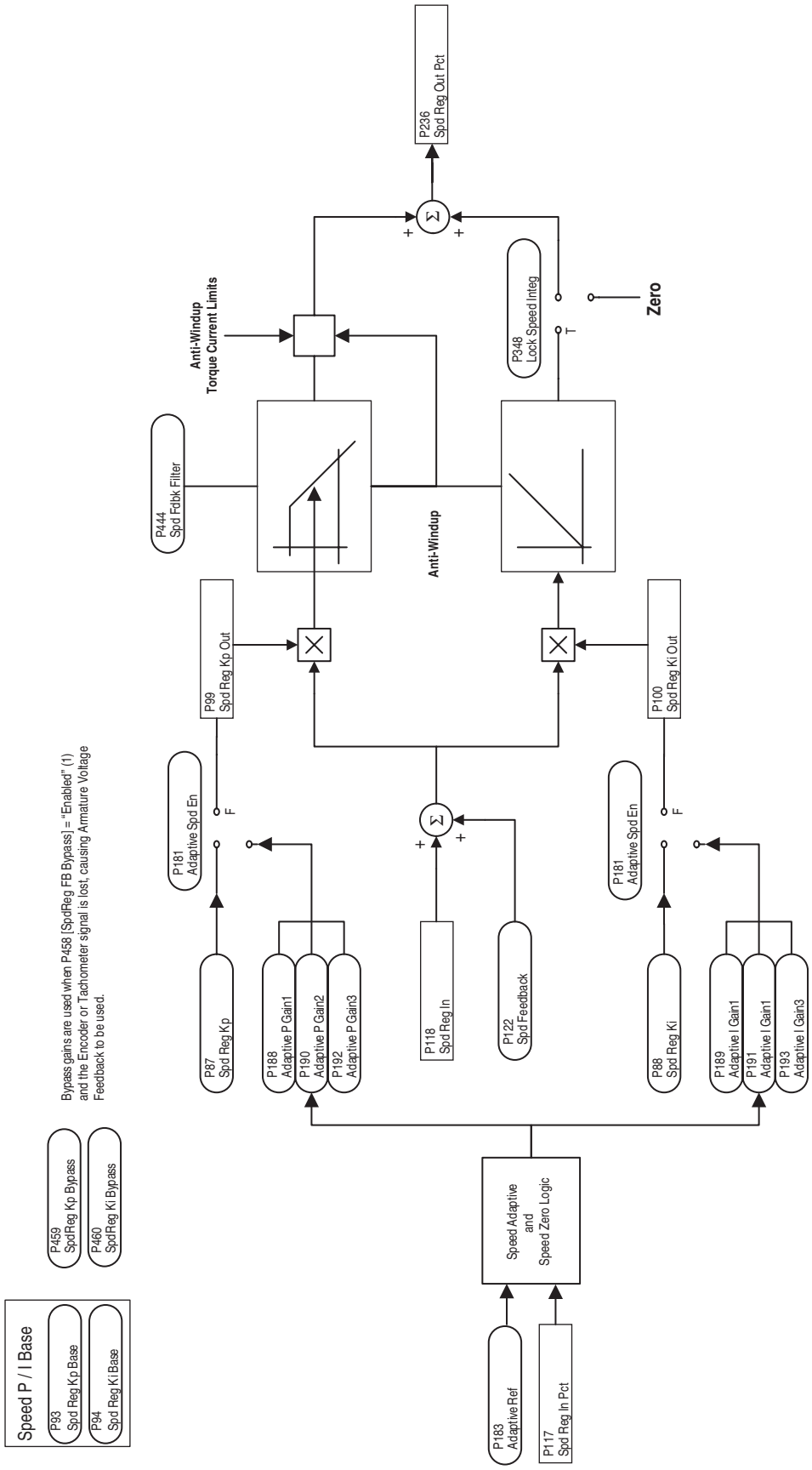
Inertia / Loss Compensation

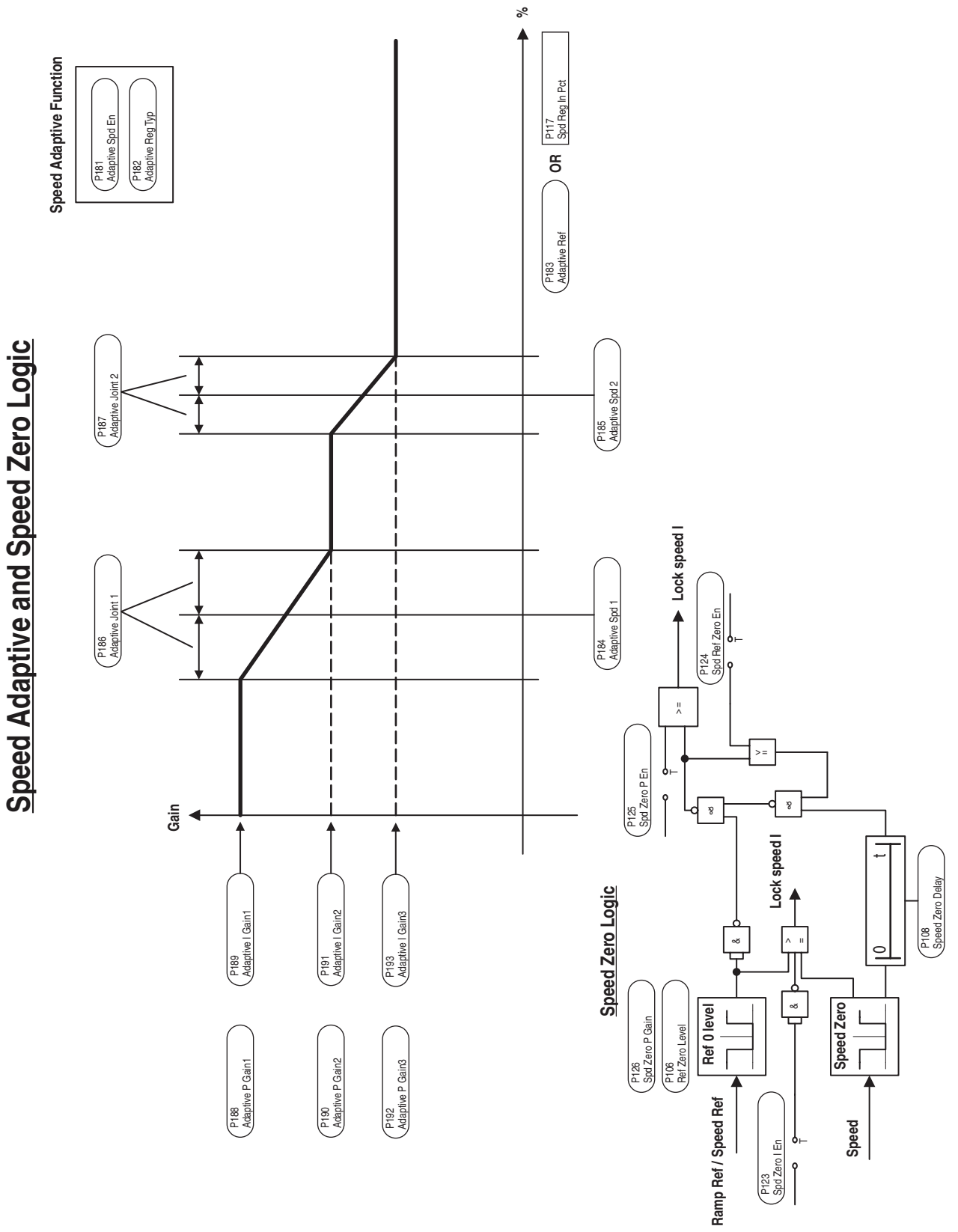


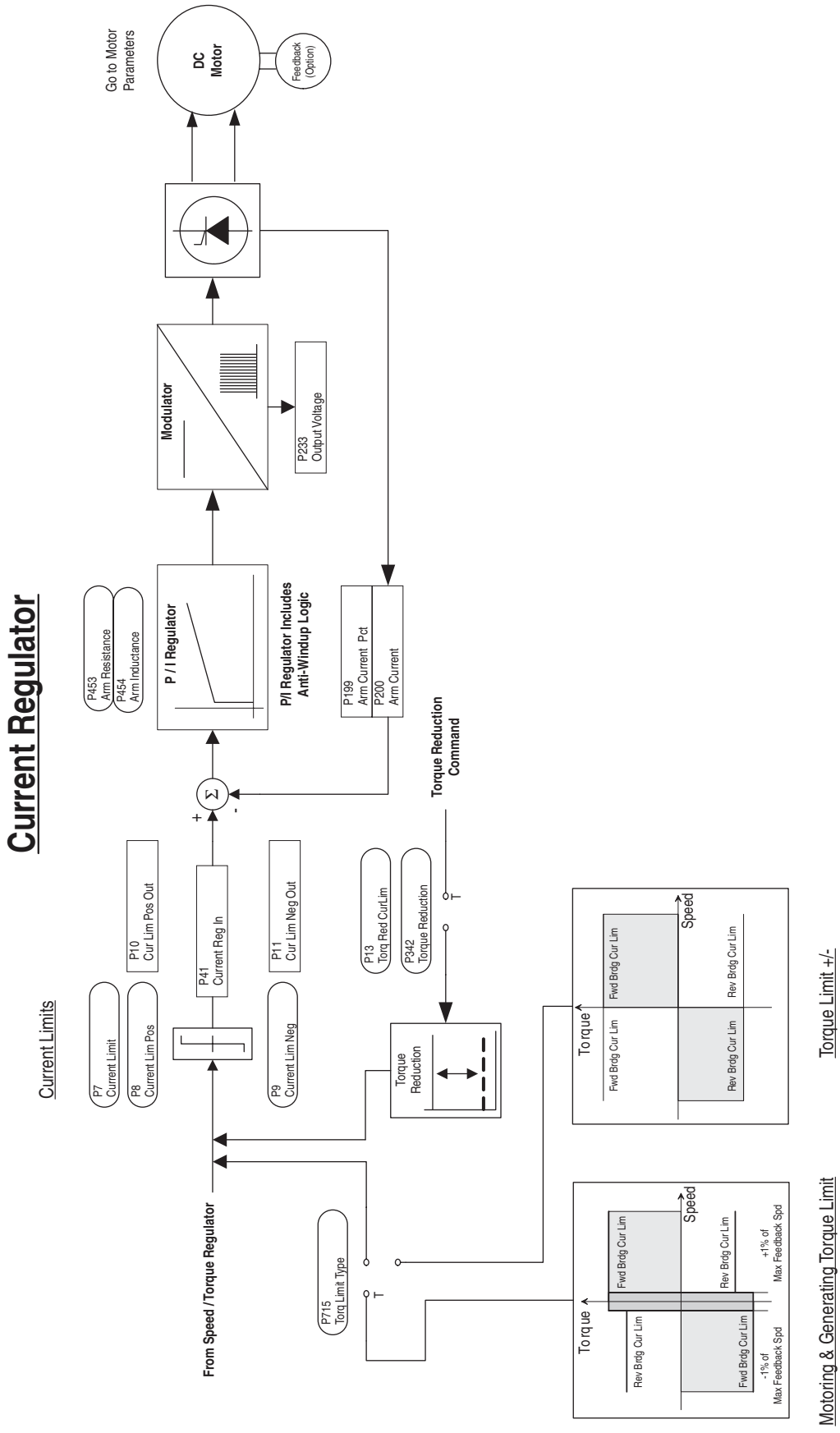
Speed Feedback



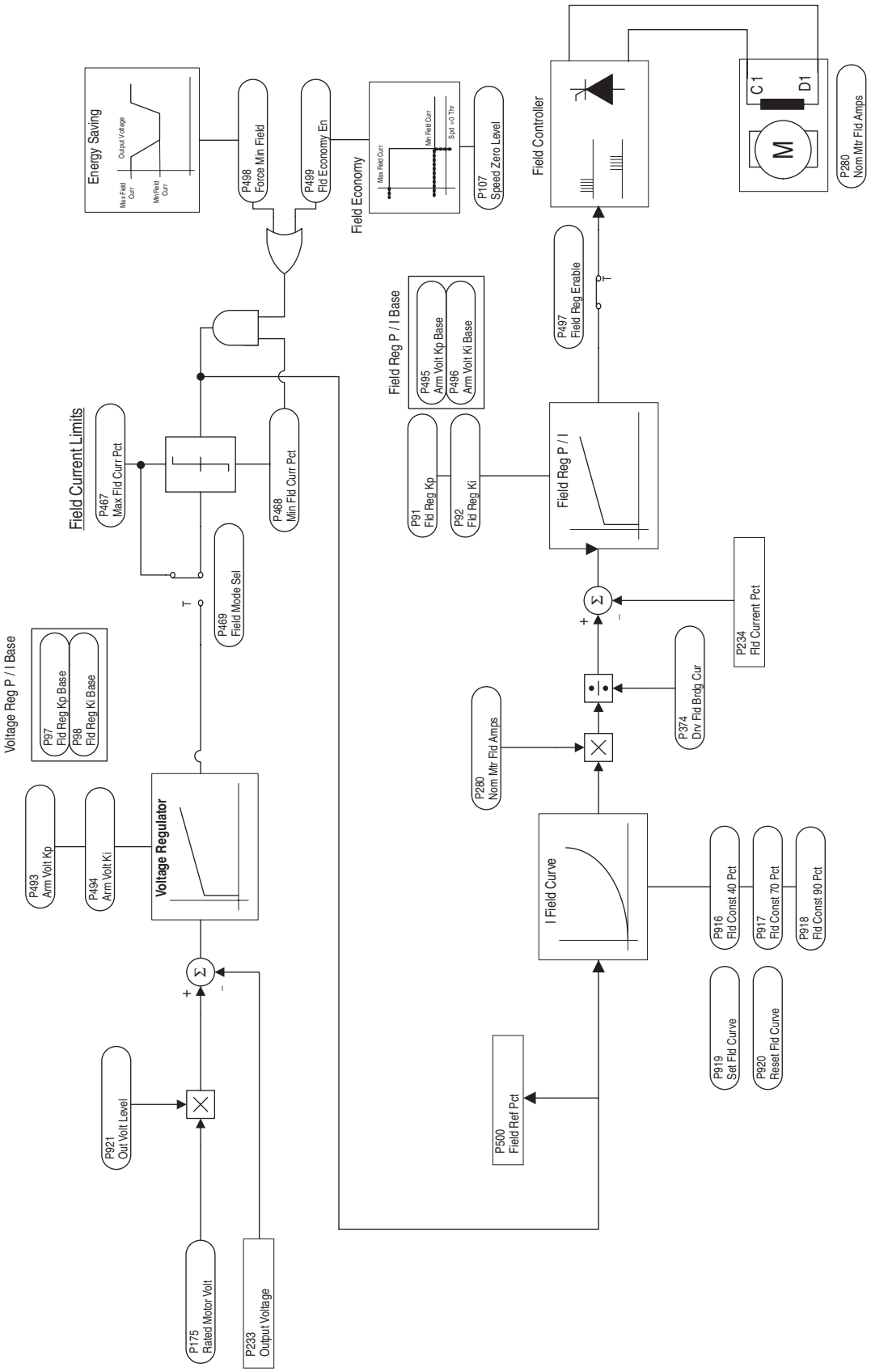
Speed Regulator PI Block



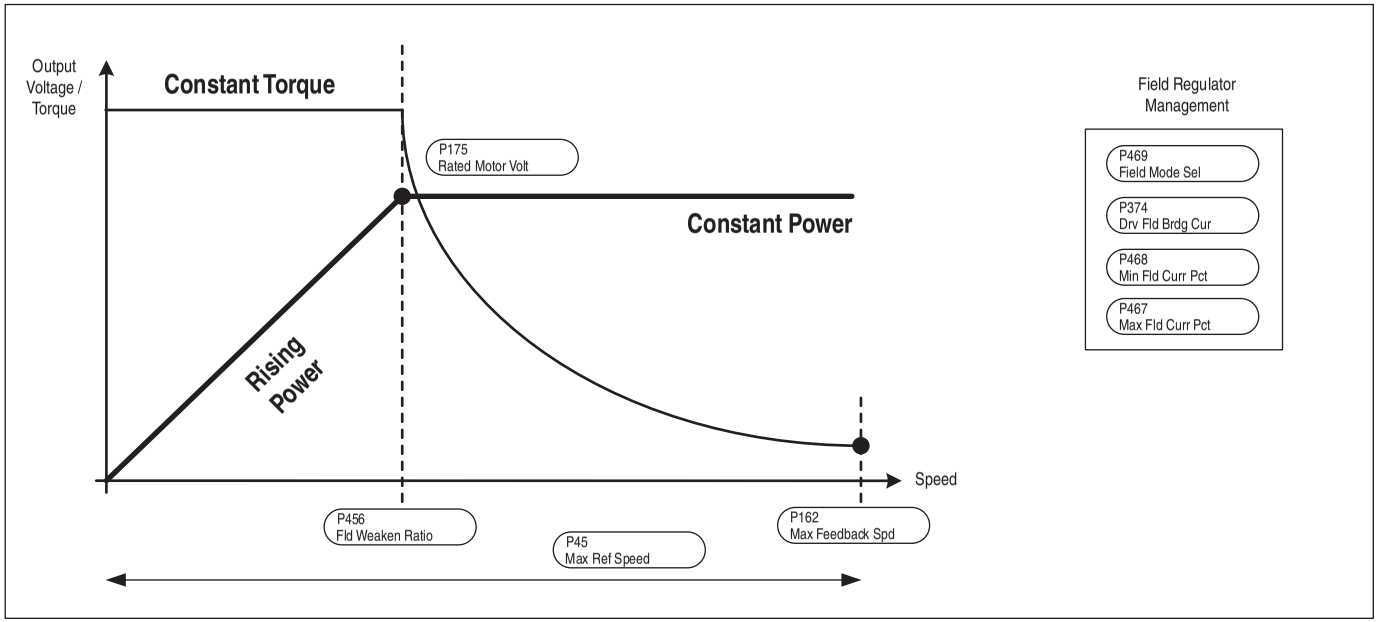

Speed Adaptive and Speed Zero Logic
Speed Adaptive Function
P181 Adaptive Spd En
P182 Adaptive Reg Typ
P117 Spd Reg In Pct
OR
P183 Adaptive Ref
%
Gain
P186 Adaptive Joint 1
P187 Adaptive Joint 2
P184 Adaptive Spd 1
P185 Adaptive Spd 2
P189 Adaptive I Gain1
P191 Adaptive I Gain2
P193 Adaptive I Gain3
P188 Adaptive P Gain1
P190 Adaptive P Gain2
P192 Adaptive P Gain3
Speed Zero Logic
P125 Spd Zero P En
P124 Spd Ref Zero En
Lock speed I
P126 Spd Zero P Gain
P106 Ref Zero Level
Ref 0 level
Lock speed I
Ramp Ref / Speed Ref
P123 Spd Zero I En
Speed Zero
Speed
P108 Speed Zero Delay

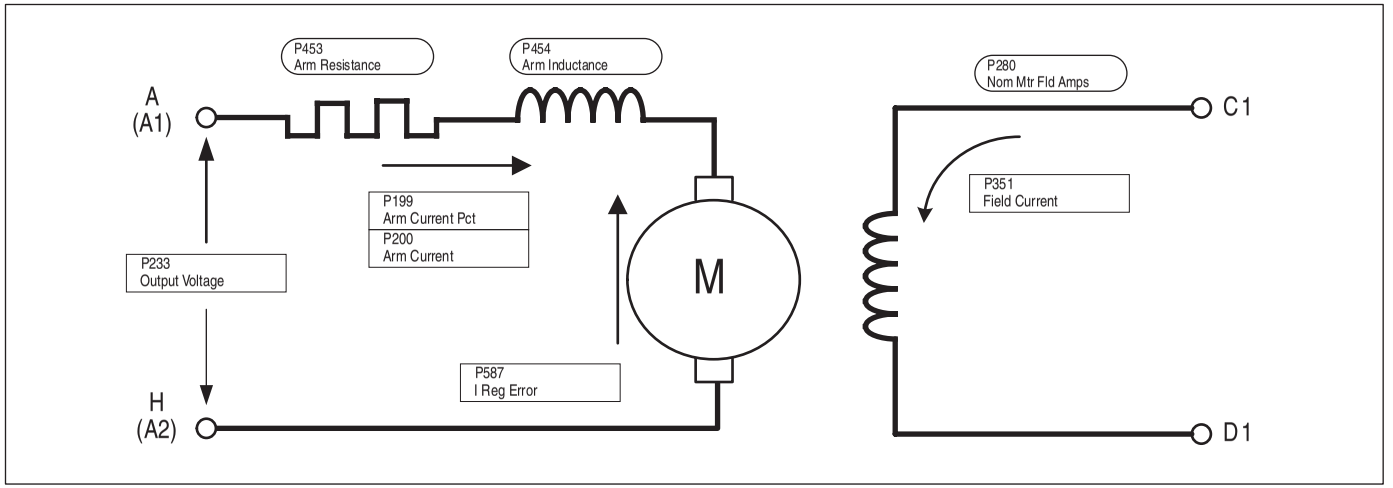

Current Regulator
Current Limits
P7
Current Limit
P8
Current Lim Pos
P10
Cur Lim Pos Out
P41
Current Reg In
P11
Cur Lim Neg Out
P9
Current Lim Neg
P13
Torq Red CurLim
P342
Torque Reduction
Torque Reduction
Command
From Speed / Torque Regulator
P715
Torq Limit Type
T
Torque Reduction
P453
Arm Resistance
P454
Arm Inductance
P / I Regulator
P/I Regulator Includes
Anti-Windup Logic
P199
Arm Current Pct
P200
Arm Current
Modulator
P233
Output Voltage
Go to Motor
Parameters
DC
Motor
Feedback
(Option)
Torque
Speed
Fwd Brdg Cur Lim
Rev Brdg Cur Lim
Torque Limit +/-
Motoring & Generating Torque Limit
+1% of
Max Feedback Spd
-1% of
Max Feedback Spd

Field Current Regulator

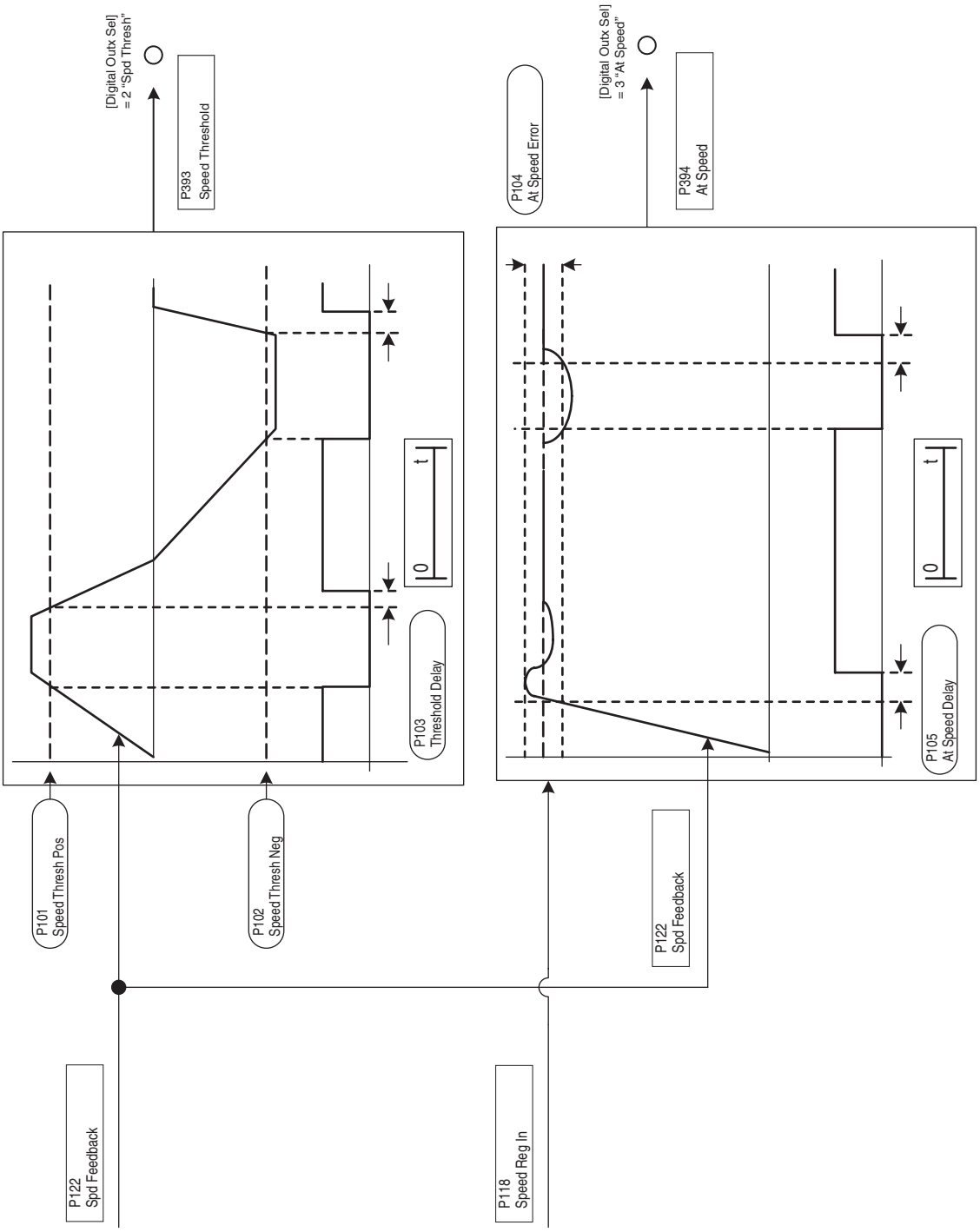


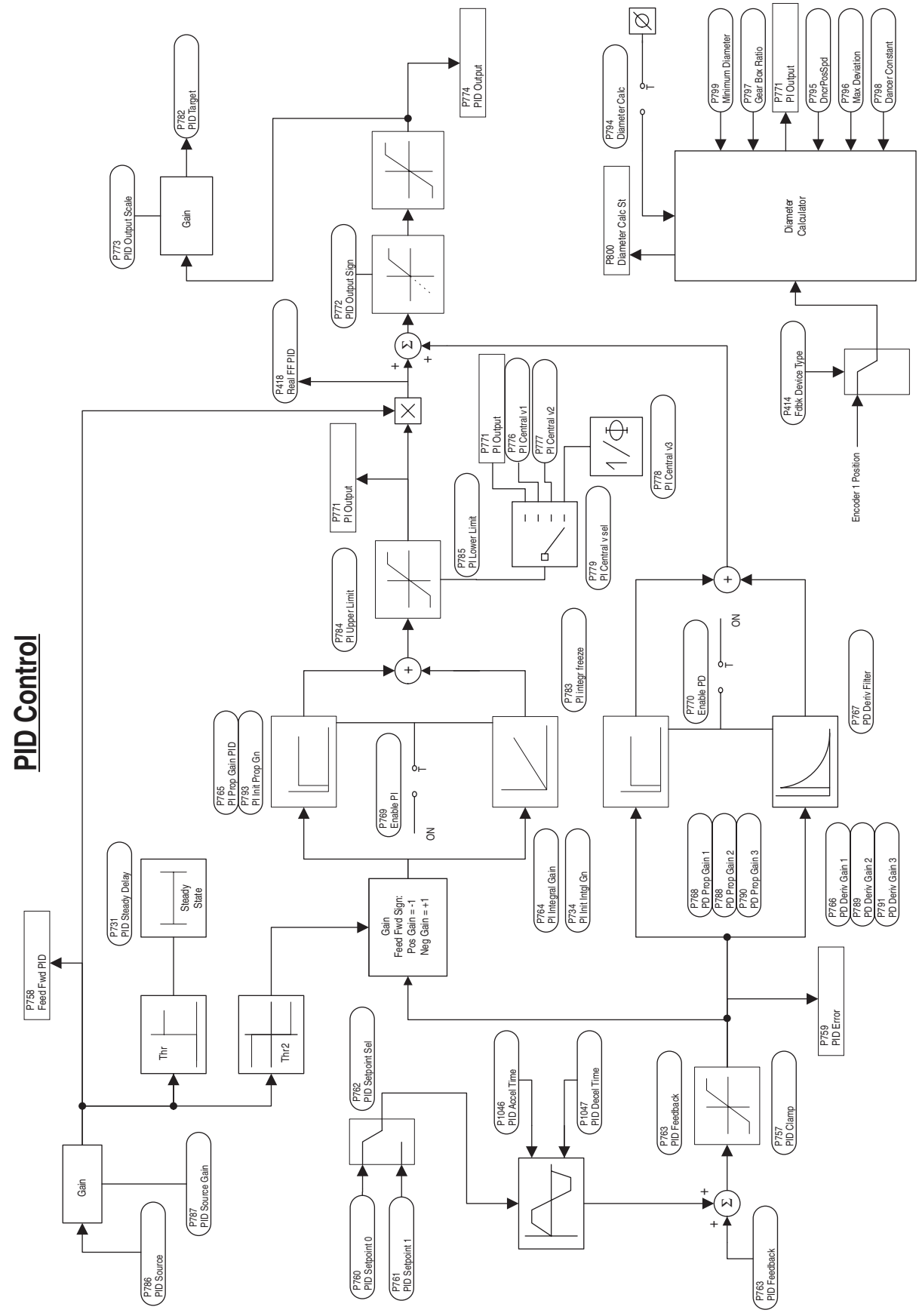
Motor Parameters





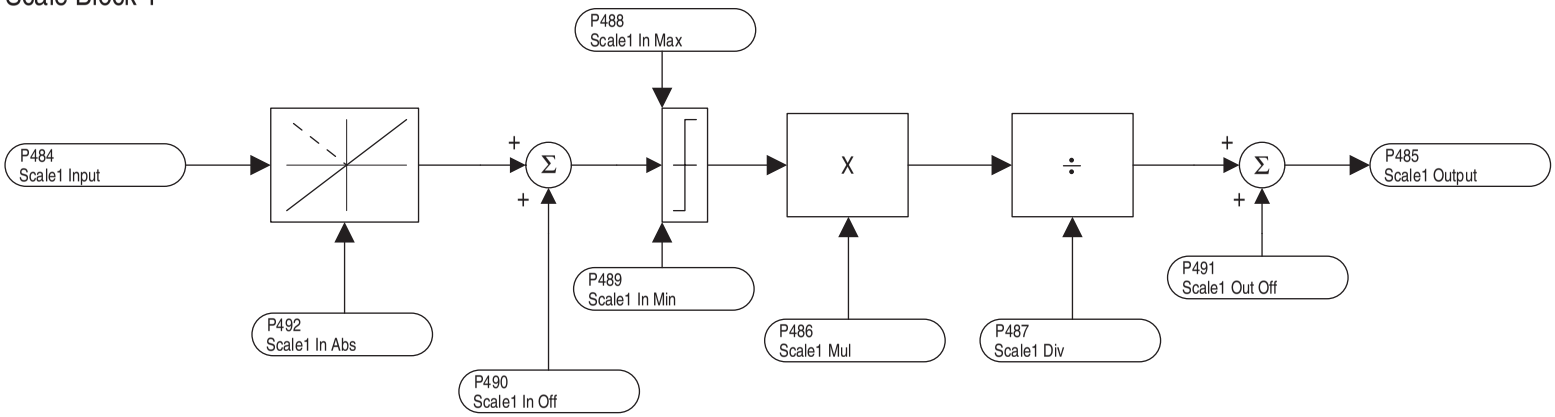
Speed Threshold / Speed Control



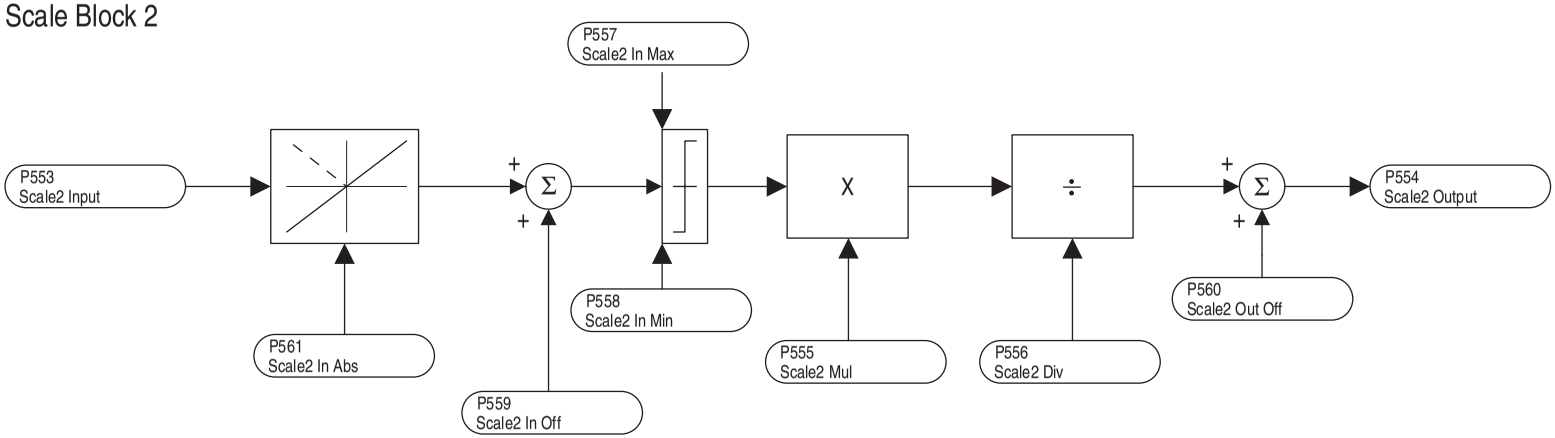

PID Control
P758 Feed Fwd PID
P731 PID Steady Delay
Steady State
Thr
Thr2
Gain
P786 PID Source
P787 PID Source Gain
Gain Feed Fwd Sign: Pos Gain = -1 Neg Gain = +1
P762 PID Setpoint Sel
P760 PID Setpoint 0
P761 PID Setpoint 1
P1046 PID Accel Time
P1047 PID Decel Time
P763 PID Feedback
P757 PID Clamp
P759 PID Error
P765 PI Prop Gain PID
P793 PI Init Prop Gn
P769 Enable PI
ON
P764 PI Integral Gain
P734 PI Init Intgl Gn
P783 PI Integr freeze
P784 PI Upper Limit
P785 PI Lower Limit
P771 PI Output
P776 PI Central v1
P777 PI Central v2
P778 PI Central v3
P779 PI Central V sel
P418 Real FF PID
P772 PID Output Sign
P773 PID Output Scale
Gain
P782 PID Target
P774 PID Output
P770 Enable PD
ON
P767 PD Deriv Filter
P768 PD Prop Gain 1
P788 PD Prop Gain 2
P790 PD Prop Gain 3
P766 PD Deriv Gain 1
P789 PD Deriv Gain 2
P791 PD Deriv Gain 3
P794 Diameter Calc
P800 Diameter Calc St
Diameter Calculator
P799 Minimum Diameter
P797 Gear Box Ratio
P771 PI Output
P795 DncrPosSpd
P796 Max Deviation
P798 Dancer Constant
P414 Fdbk Device Type
Encoder 1 Position

Scale Blocks

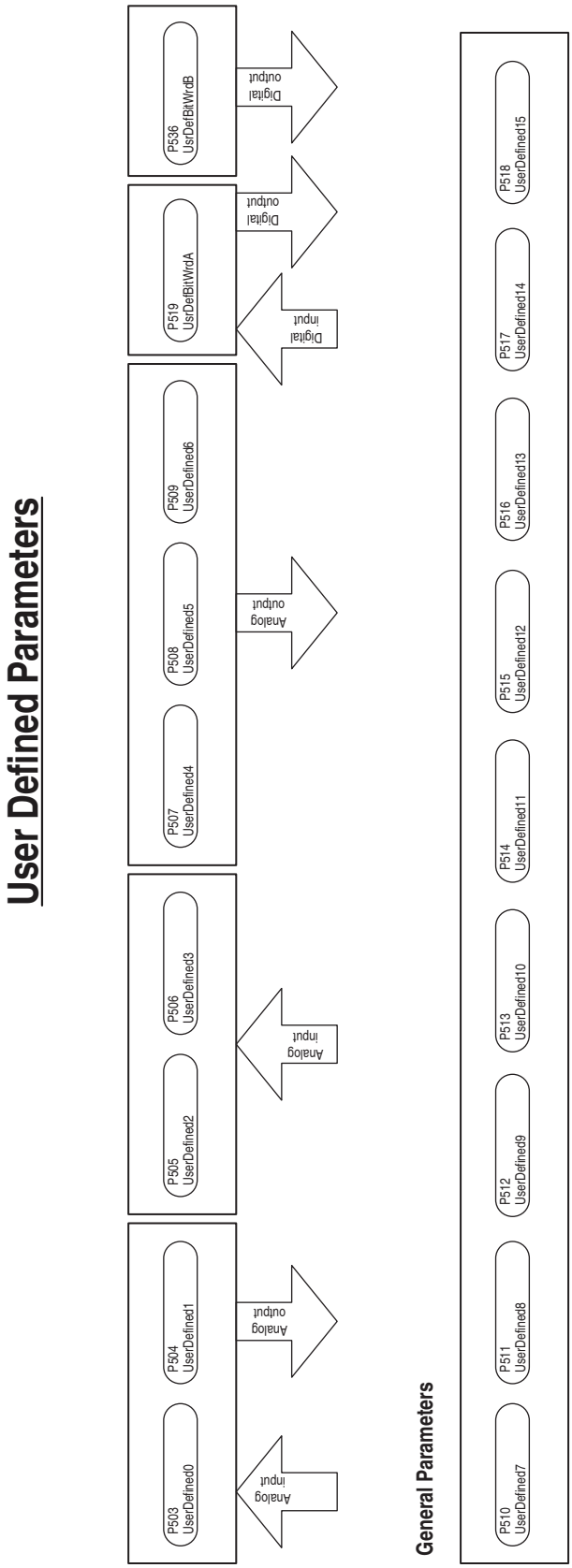
Scale Block 1

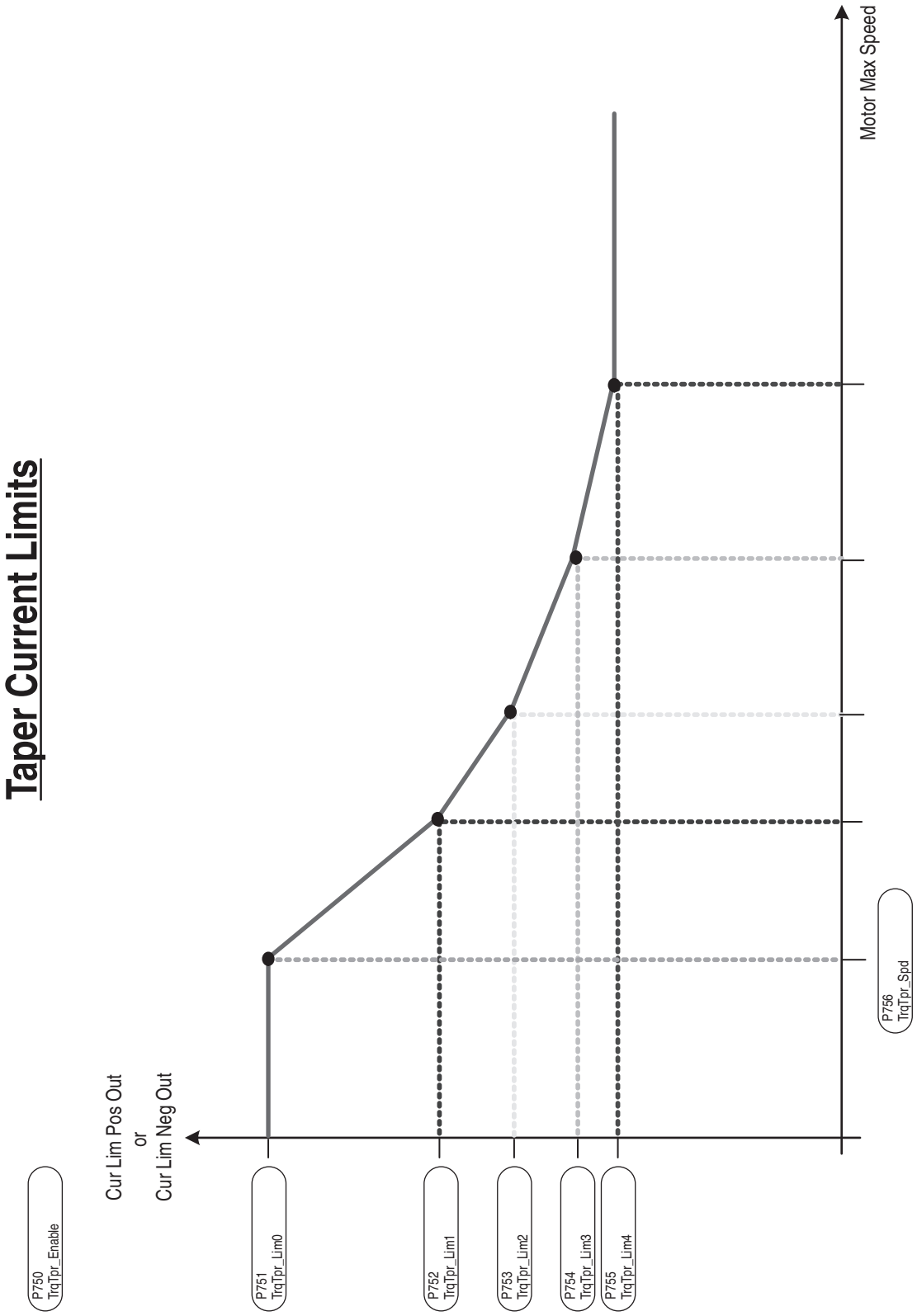


Scale Block 2

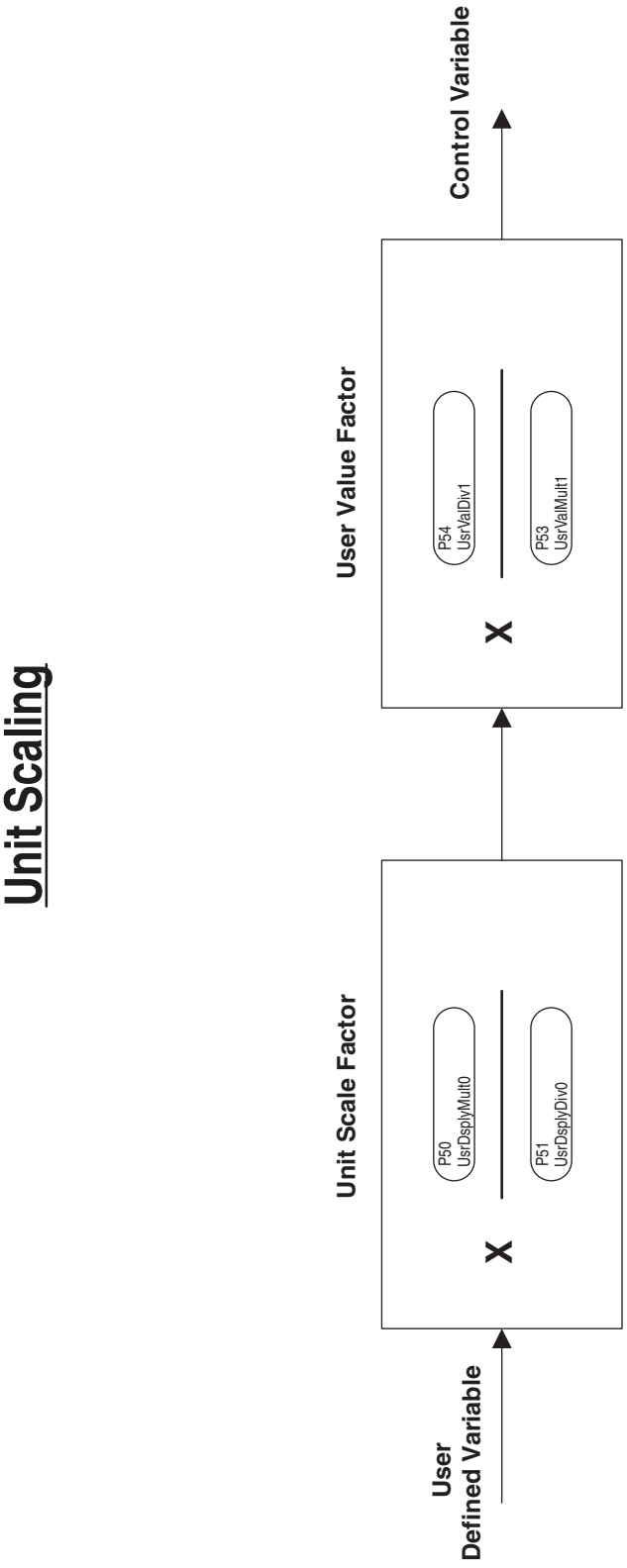


Note: Up to six scale blocks are available. Scale blocks 3-6 follow the same flow as scale blocks 1 and 2, shown here.

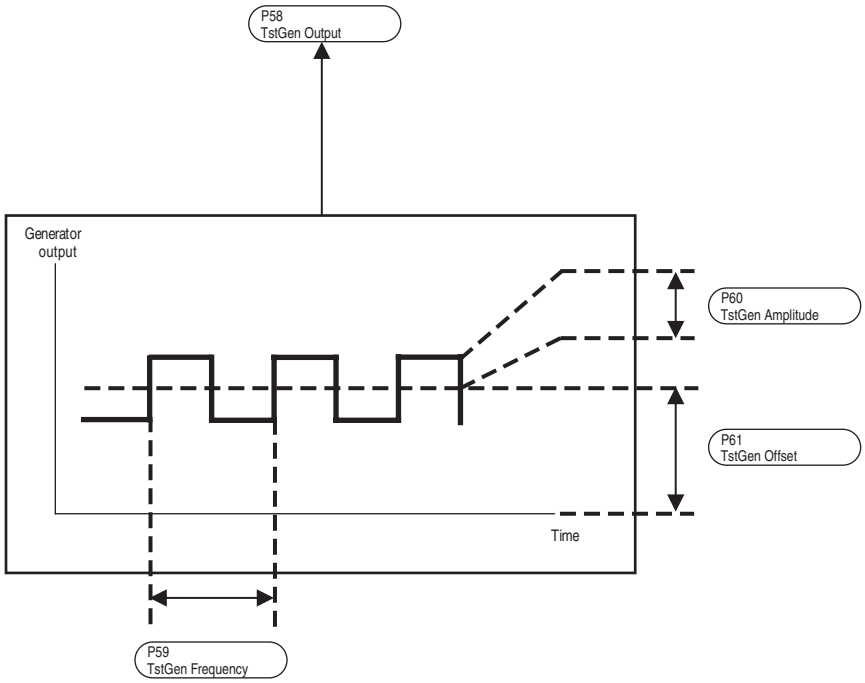

User Defined Parameters
P503 UserDefined0
P504 UserDefined1
Analog input
Analog output
P505 UserDefined2
P506 UserDefined3
Analog input
Analog output
P507 UserDefined4
P508 UserDefined5
P509 UserDefined6
Digital input
Digital output
P519 UsrDefBitWrdA
Digital output
P536 UsrDefBitWrdB
General Parameters
P510 UserDefined7
P511 UserDefined8
P512 UserDefined9
P513 UserDefined10
P514 UserDefined11
P515 UserDefined12
P516 UserDefined13
P517 UserDefined14
P518 UserDefined15


Taper Current Limits
P750
TrqTpr_Enable
Cur Lim Pos Out
or
Cur Lim Neg Out
P751
TrqTpr_Lim0
P752
TrqTpr_Lim1
P753
TrqTpr_Lim2
P754
TrqTpr_Lim3
P755
TrqTpr_Lim4
Motor Max Speed
P756
TrqTpr_Spd

Unit Scaling



Test Generator



Multi Speed

P400 Spd Select 0	P401 Spd Select 1	P402 Spd Select 2	Reference
0	0	0	P44 Speed Ref A
1	0	0	P48 Speed Ref B
0	1	0	P155 Preset Speed 2
1	1	0	P156 Preset Speed 3
0	0	1	P157 Preset Speed 4
1	0	1	P158 Preset Speed 5
0	1	1	P159 Preset Speed 6
1	1	1	P160 Preset Speed 7

Fault/Alarm Mapping

"Arm Overvoltage" (F5)

P203
OverVolt Flt Cfg

0 = "Ignore"
1 = "Alarm"
2 = "Fault"

"Fld Current Loss" (F6)

P473
FldLoss Flt Cfg

0 = "Ignore"
1 = "Alarm"
2 = "Fault"

"Auxiliary Input" (F2)

P354
Aux Inp Flt Cfg

1 = "Alarm"
2 = "Fault"
3 = "Quick Stop"
4 = "Normal Stop"
5 = "CurrLim Stop"

"Encoder Loss" (F91)

P478
Spd Loss Flt Cfg

1 = "Alarm"
2 = "Fault"

"Motor Over Temp" (F16)

P365
OverTemp Flt Cfg

0 = "Ignore"
1 = "Alarm"
2 = "Fault"
3 = "Quick Stop"
4 = "Normal Stop"
5 = "CurrLim Stop"

Installing a Communication Adapter

Communication Adapter Kits

The following Communication Adapter kits are available for use with the PowerFlex® DC drive:

Comm Option	Catalog Number
BACnet® MS/TP RS-485 Communication Adapter	20-COMM-B
ControlNet™ Communication Adapter (Coax)	20-COMM-C
DeviceNet™ Communication Adapter	20-COMM-D
EtherNet/IP™ Communication Adapter	20-COMM-E
HVAC Communication Adapter	20-COMM-H
Interbus™ Communication Adapter	20-COMM-I
LonWorks™ Communication Adapter	20-COMM-L
PROFIBUS™ DP Communication Adapter	20-COMM-P
ControlNet™ Communication Adapter (Fiber)	20-COMM-Q
Remote I/O Communication Adapter	20-COMM-R
RS-485 DF1 Communication Adapter	20-COMM-S
External Comms Power Supply	20-XCOMMAC-PS1
DPI External Communications Kit	20-XCOMMDC-BASE
External DPI I/O Option Board(1)	20-XCOMMIO-OPT1
Compact I/O to DPI/SCANport Module	1769-SM1
Serial Null Modem Adapter	1203-SNM
Smart Self-powered Serial Converter (RS-232) includes 1203-SFC and 1202-C10 Cables	1203-SSS
Universal Serial Bus™ (USB) Converter includes 2m USB, 20-HIM-H10 & 22-HIM-H10 Cables	1203-USB

(1) For use only with External DPI Communications Kits 20-XCOMM-DC-BASE.

What The Communication Adapter Kit Includes

- Communication Adapter module w/captive screws
- Internal Interface cable
- Communication Adapter User Manual
- Additional components, based on the option selected

Tools That You Need

- Phillips® screwdriver

Phillips® is a registered trademark of Phillips Screw Company.

Safety Precautions

ATTENTION: Only qualified personnel familiar with drives, power products and associated machinery should plan or implement the installation, start-up, configuration and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

ATTENTION: To avoid an electric shock hazard, ensure that all power to the drive has been removed before performing the following.

ATTENTION: This drive contains **ESD** (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference A-B publication 8000-4.5.2, "Guarding Against Electrostatic Damage" or any other applicable ESD protection handbook.

Installing the Communication Adapter Module in the Drive

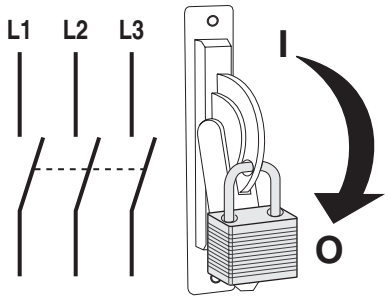
Follow these steps to install a communication adapter module:

ATTENTION: Remove power before making or breaking cable connections. When you remove or insert a cable connector with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine motion
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.

1. Remove and lock-out all incoming power to the drive.

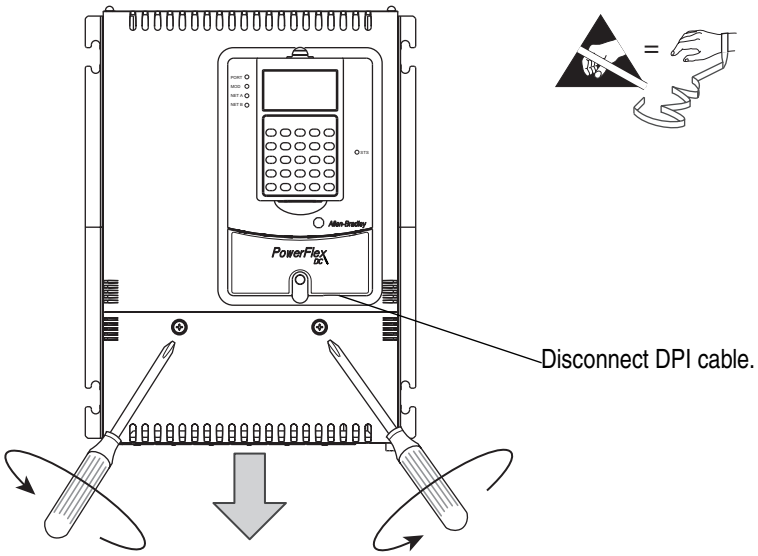


2. Disconnect the DPI cable from the HIM on the drive.

3. Remove the bottom cover from the drive:

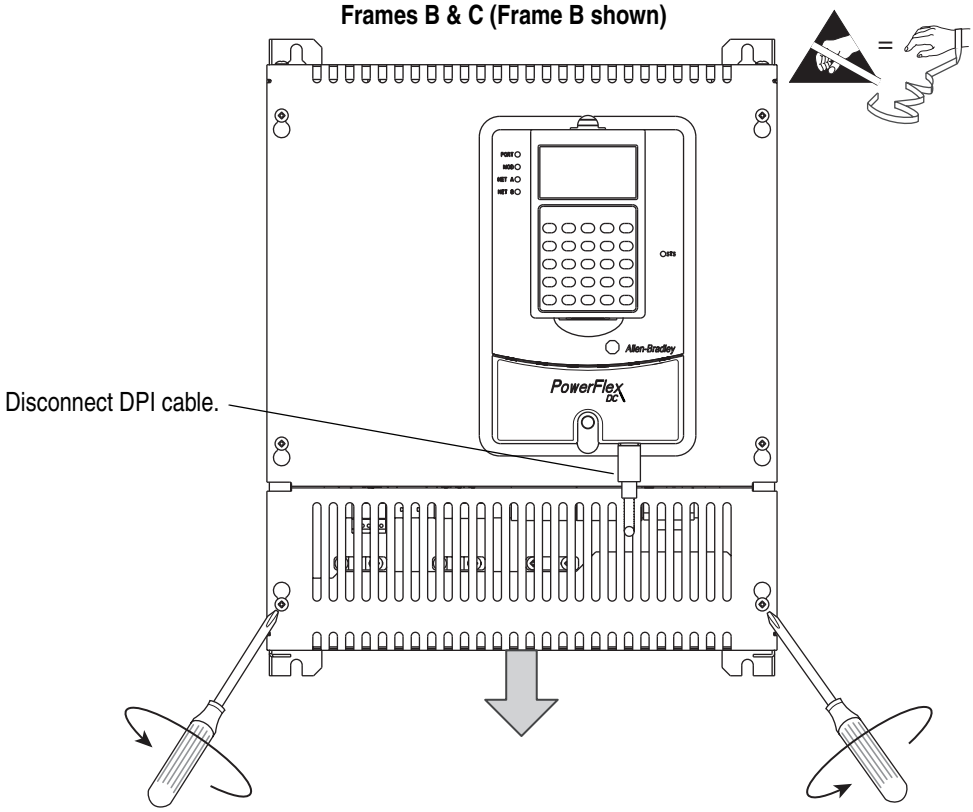
a. On frame A drives, remove the screws that secure the bottom cover to the drive, then slide the cover down and off the drive chassis.

Frame A



b. On frame B and C drives, loosen, but do not remove, the screws that secure the bottom cover to the drive, then slide the cover down and off the drive chassis.

Frames B & C (Frame B shown)

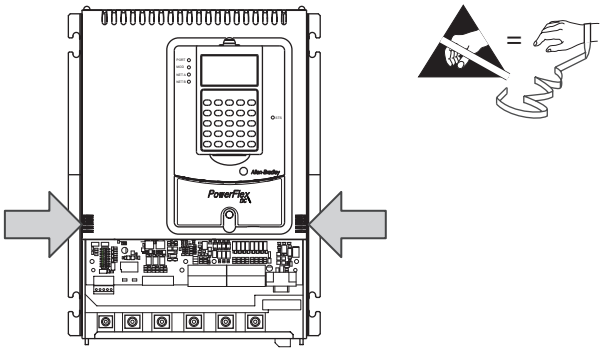


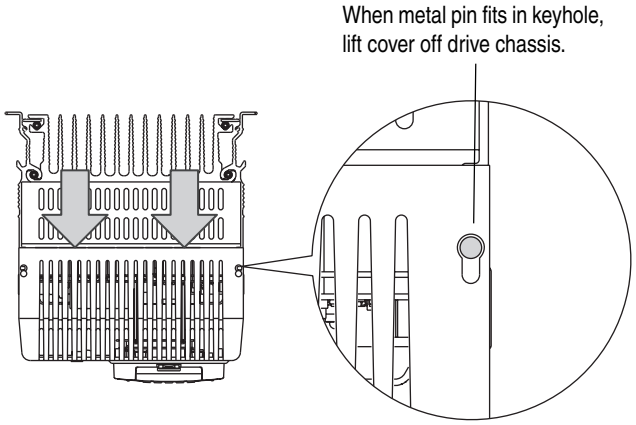
4. Remove the top cover from the drive:

   a. For frame A drives, press in on the sides at the bottom edge of the top cover and at the same time pull the cover toward you to pull it partially off the drive chassis. Next, at the top of the drive, pull the cover forward, away from the drive, until the pins fit in the keyhole in the top of the cover, then carefully lift the cover off of the drive chassis.

   Important: The HIM assembly is connected via a cable to the Control board and therefore will not pull free from the drive until disconnected. See page E-6 for instructions.

Frame A

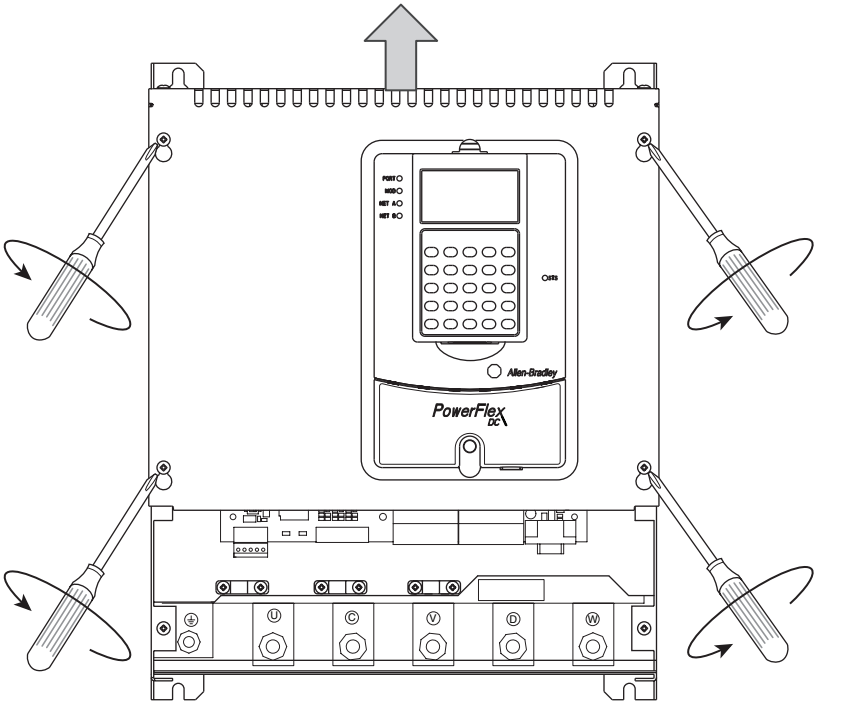




b. On frame B and C drives, loosen, but do not remove, the screws that secure the top cover to the drive, then slide the cover up and off the drive chassis.

Important: The HIM assembly is connected via a cable to the Control board and therefore will not pull free from the drive until disconnected. See page E-6 for instructions.

Frames B & C (Frame B shown)



5. Disconnect the HIM Communication cable from the connector on the upper right corner of the Control board and set the cover aside.

All Frames (Frame A shown)

6. Secure and ground the Communication Adapter to the EMI Shield on the drive using the four captive screws.

   Important: All screws must be tightened, because the adapter is grounded through a screw to the EMI shield. Recommended tightening torque is 0.9 N-m (8 lb.-in.).

7. Connect the Internal Interface cable to the DPI connectors on the Control board and the communication Adapter board.

8. Refer to the Adapter's User Manual for network connection, commissioning, and configuration information.

9. Install the HIM Communication cable in reverse order or removal.

10. Install the drive covers in reverse order of removal.

Notes:

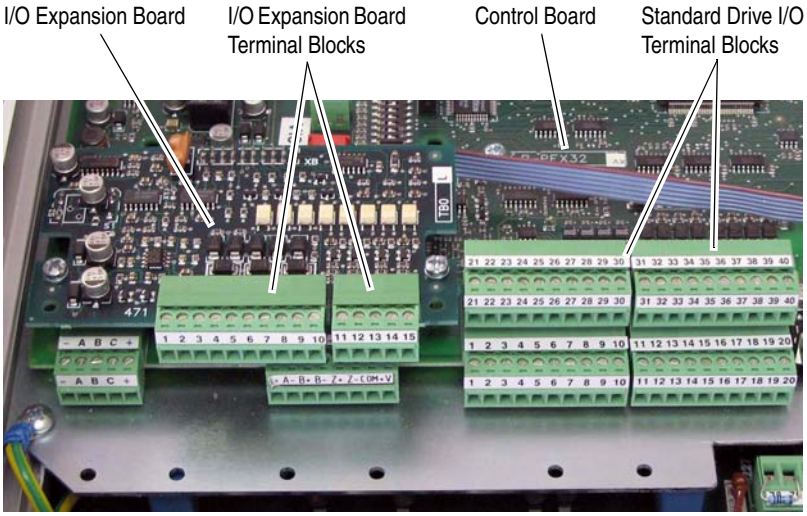
Optional Analog and Digital I/O Expansion Circuit Board

What This Option Board Provides

The optional I/O Expansion circuit board[1] is mounted on the Control board of the drive and provides these additional I/O signals:

- Four (4) Digital Inputs
- Four (4) Digital Outputs
- Two (2) Analog Outputs

Figure F.1 I/O Expansion Board Mounting Location



I/O Expansion Board Wiring

Table F.A Recommended Signal Wire Size

Wire Type and Size			Tightening Torque
Flexible (mm^2)	multi-core (mm^2)	AWG	N-m (lb.-in.)
0.14 - 1.5	0.14 - 1.5	28-16	0.4 (3.5)

A 75 x 2.5 x 0.4 mm (3.0 x 0.1 x 0.02 in.) flathead screwdriver is recommended for connecting wire to the terminal block inputs. Strip the ends of the cables to a length of 6.5 mm (0.26 in.).

Important: To improve the noise immunity it is recommended that you connect the common of the outputs (terminals 2, 4, 5 and 15 of the I/O Expansion board) with the ground (terminal 10 or 20) on the standard I/O terminal blocks on the Control board. If this is not possible, these terminals must be grounded by means of a 0.1 µf/250V capacitor.

(1) The Analog and Digital I/O Expansion circuit board is not factory installed.

Table F.B I/O Expansion Board Terminal Block 1 Designations

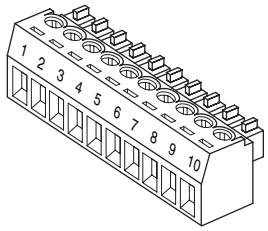
	No.	Signal	Description
	1	Analog Output 3 (+)	±10V, 5mA maximum
	2	Analog Output 3 (–)	
	3	Analog Output 4 (+)	±10V, 5mA maximum
	4	Analog Output 4 (–)	
	5	Digital Output Common	
	6	Digital Output 5 (+)	Max volt. +30V, max cur. 50mA
	7	Digital Output 6 (+)	
	8	Digital Output 7 (+)	
	9	Digital Output 8 (+)	
	10	+24VDC	Drive supplied power for Digital Outputs. Max volt. +30V, max. cur. 80mA.

Table F.C I/O Expansion Board Terminal Block 2 Designations

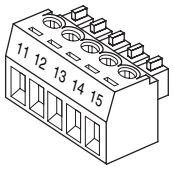
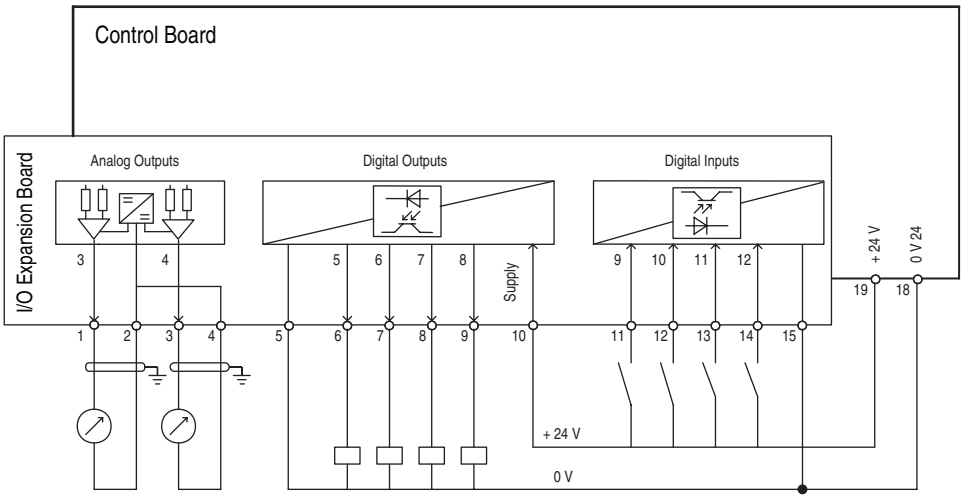
	No.	Signal	Description
	11	Digital Input 9	Max volt. +30V, max cur. 15V/3.2mA, 24V/ 5mA, and 30V/6.4mA.
	12	Digital Input 10	
	13	Digital Input 11	
	14	Digital Input 12	
	15	Digital Input Common	

Figure F.2 I/O Expansion Board Wiring Diagram



Optional 115V AC to 24V DC I/O Converter Circuit Board

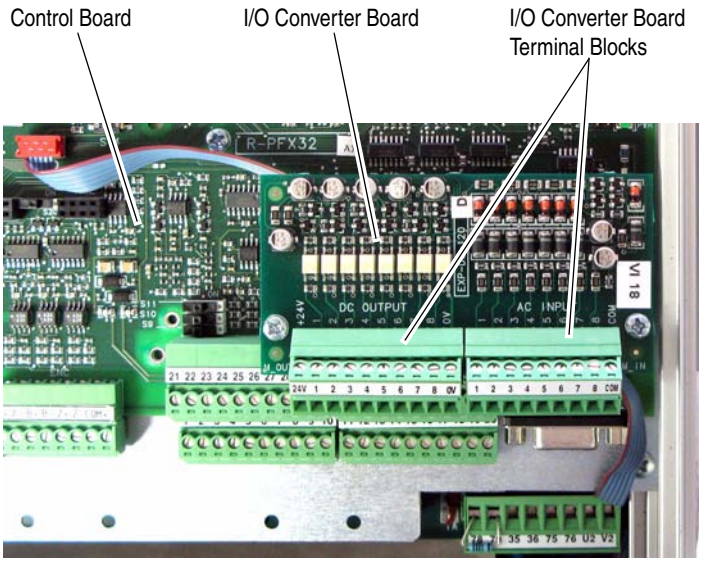
What This Option Board Provides

The 115V AC to 24V DC I/O Converter circuit board[1] allows you to convert 115V AC digital input signals to 24V DC digital input signals in order to interface with the standard digital I/O terminal blocks on the PowerFlex DC drive Control board.

The card consists of:

- Eight (8) opto isolated 115V AC digital inputs
- Eight (8) interface outputs for the digital inputs on Control board of the drive[2]
- Two (2) input terminals for the 24V DC power supply voltage

Figure G.1 115V AC to 24V DC I/O Converter Circuit Board Mounting Location



(1) The 115V AC to 24V DC I/O Converter circuit board is not factory installed.

(2) If more than eight 115V AC digital input signals require conversion to 24V DC (i.e., the optional PowerFlex DC drive I/O Expansion circuit board is used - see Appendix F), a second Converter board is required and must be sourced and wired independently from the 115V AC to 24V DC I/O Converter board mounted on the Control board and be mounted in an appropriate enclosure external to the PowerFlex DC drive enclosure.

I/O Converter Board Wiring

Table G.A Recommended Signal Wire Size

Wire Type and Size			Tightening Torque
Flexible (mm^2)	multi-core (mm^2)	AWG	N-m (lb.-in.)
0.14 - 1.5	0.14 - 1.5	28-16	0.4 (3.5)

A 75 x 2.5 x 0.4 mm (3.0 x 0.1 x 0.02 in.) flathead screwdriver is recommended for connecting wire to the terminal block inputs. Strip the ends of the cables to a length of 6.5 mm (0.26 in.).

Table G.B I/O Converter Board M_IN Terminal Block Designations

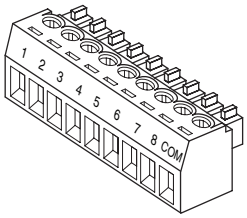
	No.	Signal	Description
	1	Digital Input 1	Rated input voltage:115V AC ±10% 50 - 60Hz. ON input voltage: 115V AC ±10% OFF input voltage: 0 - 70V AC ON input current: 4 - 5.5mA
	2	Digital Input 2	
	3	Digital Input 3	
	4	Digital Input 4	
	5	Digital Input 5	
	6	Digital Input 6	
	7	Digital Input 7	
	8	Digital Input 8	
	Com	Digital Input Common	

Table G.C I/O Converter Board M_OUT Terminal Block Designations

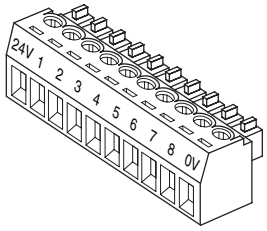
	No.	Signal	Description
	24V	+24VDC Supply	24V DC ±10%, 40mA power supply. Max. load 120mA. Supply power can be provided by the +24V DC supply on the Control board I/O (terminal 19 - see Figure G.2 on page G-3) or an external source (see Figure G.3 on page G-3).
	1	Digital Output 1	Output type: Open collector, PNP type with 15kohm pull-down Output current: 10mA max. Delay time hw OFF to ON: 5ms (typ.) Delay time hw ON to OFF: 50ms (typ.)
	2	Digital Output 2	
	3	Digital Output 3	
	4	Digital Output 4	
	5	Digital Output 5	
	6	Digital Output 6	
	7	Digital Output 7	
	8	Digital Output 8	
	0V	24V Common	Common for the power supply. • If an internal supply is used, this terminal must be wired to the digital input common (terminal 16 or 35) on the Control board I/O. See Figure G.2 on page G-3. • If an external supply is used, this terminal must be wired to the external 24V DC supply common and the digital input common (terminal 16 or 35) on the Control board I/O. See Figure G.3 on page G-3.

Figure G.2 I/O Converter Board with Internal Supply Wiring Diagram

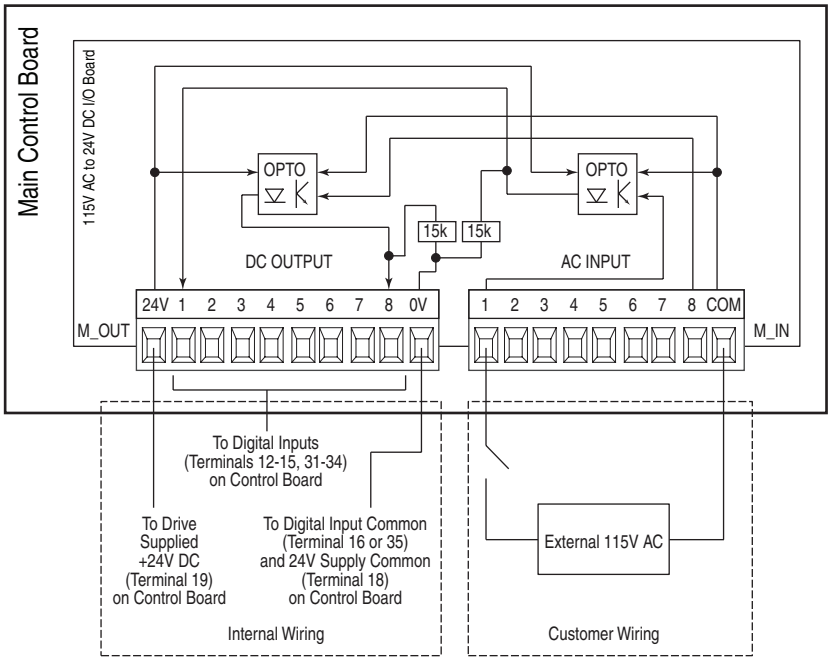
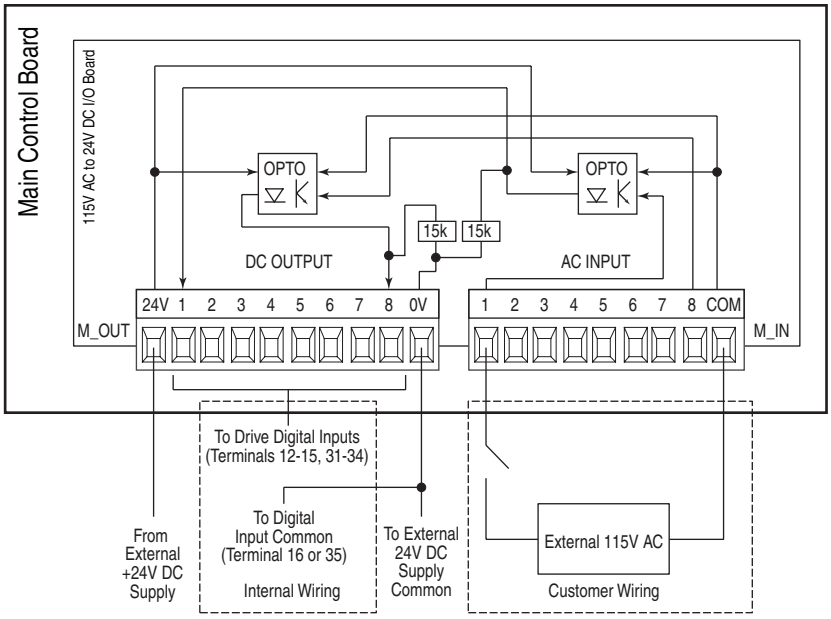


Figure G.3 I/O Converter Board with External Supply Wiring Diagram



Notes:

Numerics

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V

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Z

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