690+ Series 3-in-1 Controller – 220-240 VAC ±10%; 50-60 Hz ±5%

FRAME SIZE	B	C	D	E	F	G	H	J
Dimensions	233 x 171 x 181 9.1 x 6.9 x 7.1	348 x 201 x 208 13.7 x 7.9 x 8.1	453 x 252 x 245 17.8 x 9.9 x 9.6	668 x 257 x 312 26.3 x 10.1 x 12.1	720 x 257 x 349 28.9 x 10.1 x 27.5			
Weight (Kg/Lb.)	4.3 / 9.5	9.3 / 20	17.4 / 38	22.5 / 50	29 / 64			
Encl. Protection	NEMA 1				IP20			
Mounting Options	Panel							
Supply	Three-Phase[1]	Three-Phase						
VARIABLE TORQUE DUTY								
HP	0.5 – 5	10 – 15	20 – 25	40	50 – 75			
kW	0.37 – 3.7	7.5 – 11	15 – 18	30	37 – 55			
Current	2.3 – 16	28 – 42	54 – 68	104	130 – 192			
CONSTANT TORQUE DUTY								
HP	0.5 – 5	7.5 – 10	15 – 25	30	40 – 60			
kW	0.37 – 3.7	5.5 – 7.5	11 – 18	22	30 – 45			
Current	2.3 – 16	22 – 28	42 – 68	80	104 – 154			

OPTIONS AND TECHNICAL SPECIFICATIONS

Keypad Type	6901 – Standard remote mountable, does not hold configuration 6051 – Optional remote mountable, will hold configuration
Built-in Choke	None / DC / AC
Built-in Brake Switch	Standard / Optional
Internal EMC Filter[2]	Optional / None (External option only)
System Board	Factory installed option only – provides 5 additional digital inputs/outputs, 2 encoder and 2 high speed marker inputs, and 12-bit analog input resolution
Ambient	Constant Torque: 0-45°C (32-113°F) (40°C (104°F) as NEMA 1); derate 2% per °C to 50°C (122°F) maximum Variable Torque: 0-40°C (32-104°F) (35°C (95°F) as NEMA 1); derate 2% per °C to 50°C (122°F) maximum
Altitude	1000m (3280 ft.) ASL; derate 1% per 100m (328 ft.) above 1000m (3280 ft.) to 5000m (16400 ft.) max.
Overload	Constant Torque: 150% for 60 seconds, 180% for 0.5 seconds Variable Torque: 115% for 10 seconds
Output Frequency	Open-loop – 1000 Hz, Sensorless vector – 120 Hz, Vector – 300 Hz
Analog Inputs	Two voltage or current configurable; 10 bit at 10ms Voltage modes: 0 – 10, 2 – 10, 0 – 5, 1 – 5, -10 – 10, 0 – 20 VDC Two voltage only configurable Current modes: 0 – 20, 4 – 20, 20 – 4, 20 – 0 mA
Analog Outputs	One voltage* or current configurable; 10 bit at 10ms Voltage modes: 0 – 10, 2 – 10, 0 – 5, 1 – 5, -10 – 10 VDC Two voltage only configurable Current modes: 0 – 20, 4 – 20, 20 – 4, 20 – 0 mA *Does not support -10 – 10 VDC mode
Digital Inputs	Seven 24 VDC; 7.5ma at 24 VDC; 10ms; configurable
Relay Output	Three configurable for 250 VAC maximum, 3A resistive load maximum; 10ms
Encoder Input	Requires encoder feedback option or systems board option
Thermistor Input	Isolated

STANDARDS (SEE PRODUCT MANUAL FOR INSTALLATION REQUIREMENTS TO MEET REQUIRED STANDARDS)

UL & cUL (Canada)	Listed component under UL508C (industrial control equipment)
EMC Standards	EN50081-1 (1992) EN50081-2 (1993) EN50082-1 (1997) EN61800-3 (1997) EN61000-6-2 (1999)
CE	EN50178 (1998) and EMC standards (when used as stand-alone equipment) EN60204-1 and EMC standards (when used as part of other equipment)

SOFTWARE AND COMMUNICATIONS

Setup	Configuration using the keypad or software (DSELite) of all function blocks
Communication	P3 programming port included
Techbox Options	Link, Profibus, DeviceNet, ControlNet, CanOpen, LonWorks, Ethernet IP, Ethernet Modbus TCP, ModbusPlus and Serial (Modbus RTU/EI Bisynch)

[1] Single-phase supply option available for Frame B drives through 2 Hp at 230 VAC.

[2] All drives meet the CE Drive Specific Standard, filter required only to meet Class A or B.

690+ Series 3-in-1 Controller – 380-460 VAC ±10%; 50-60 Hz ±5%

FRAME SIZE	B	C	D	E	F	G	H	J
Dimensions	233 x 171 x 181 9.1 x 6.9 x 7.1	348 x 201 x 208 13.7 x 7.9 x 8.1	453 x 252 x 245 17.8 x 9.9 x 9.6	668 x 257 x 312 26.3 x 10.1 x 12.1	720 x 257 x 349 28.9 x 10.1 x 27.5	1042 x 456 x 465 41 x 17.9 x 18.3	1177 x 572 x 465 46.3 x 22.5 x 18.3	1288 x 677 x 465 50.7 x 26.6 x 18.3
Weight (Kg/Lb.)	4.3 / 9.5	9.3 / 20	17.4 / 38	22.5 / 50	29 / 64	108 / 238	138 / 304	176 / 387
Encl. Protection	NEMA 1				IP20	Open Chassis		
Mounting Options	Panel							
Supply	Three-Phase							
VARIABLE TORQUE DUTY								
HP	1 – 10	15 – 25	30 – 50	60 – 75	100 – 150	200 – 300	350 – 450	550
kW	0.75 – 6	11 – 18	22 – 37	45 – 55	75 – 91	132 – 200	220 – 300	315
Current	2.5 – 14	27 – 34	45 – 65	87 – 105	125 – 180	260 – 361	420 – 545	650
CONSTANT TORQUE DUTY								
HP	1 – 10	10 – 20	25 – 40	50 – 60	75 – 150	175 – 250	300 – 400	500
kW	0.75 – 6	7.5 – 15	18 – 30	37 – 45	55 – 91	110 – 160	180 – 250	280
Current	2.5 – 14	21 – 27	38 – 52	73 – 87	105 – 180	216 – 316	361 – 480	590

OPTIONS AND TECHNICAL SPECIFICATIONS

Keypad Type	6901 – Standard remote mountable, does not hold configuration 6051 – Optional remote mountable, will hold configuration
Built-in Choke	None / DC / AC / External AC
Built-in Brake Switch	Standard / Optional
Internal EMC Filter[3]	Optional / None (External option only)
System Board	Factory installed option only – provides 5 additional digital, 2 encoder, and 2 high speed marker inputs and 12-bit analog input resolution
Ambient	Constant Torque: 0-45°C (32-113°F) (40°C (104°F) as NEMA 1) Variable Torque: 0-40°C (32-104°F) (35°C (95°F) as NEMA 1) Derate 2% per °C to 50°C (122°F) maximum / 0-40°C (32-104°F); Derate 2% per °C to 50°C (122°F) maximum
Altitude	1000m (3280 ft.) ASL; derate 1% per 100m (328 ft.) above 1000m (3280 ft.) to 5000m (16400 ft.) max.
Overload	Constant Torque: 150% for 60 seconds, 180% for 0.5 seconds Variable Torque: 110% for 60 seconds / Constant Torque: 150% for 60 seconds Variable Torque: 110% for 10 seconds
Output Frequency	Open-loop – 1000 Hz, Sensorless vector – 120 Hz, Vector – 300 Hz
Analog Inputs	Two voltage or current configurable; 10 bit at 10ms Two voltage only configurable / Voltage modes: 0 – 10, 2 – 10, 0 – 5, 1 – 5, -10 – 10, 0 – 20 VDC Current modes: 0 – 20, 4 – 20, 20 – 4, 20 – 0 mA
Analog Outputs	One voltage* or current configurable; 10 bit at 10ms Two voltage only configurable / Voltage modes: 0 – 10, 2 – 10, 0 – 5, 1 – 5, -10 – 10 VDC Current modes: 0 – 20, 4 – 20, 20 – 4, 20 – 0 mA *Does not support -10 – 10 VDC mode
Digital Inputs	Seven 24 VDC; 7.5ma at 24 VDC; 10ms; configurable
Relay Output	Three configurable for 250 VAC maximum, 3A resistive load maximum; 10ms
Encoder Input	Requires encoder feedback option or systems board option
Thermistor Input	Isolated

STANDARDS (SEE PRODUCT MANUAL FOR INSTALLATION REQUIREMENTS TO MEET REQUIRED STANDARDS)

UL & cUL (Canada)	Listed component under UL508C (industrial control equipment)
EMC Standards	EN50081-1 (1992) EN50081-2 (1993) EN50082-1 (1997) EN61800-3 (1997) EN61000-6-2 (1999)
CE	EN50178 (1998) and EMC standards (when used as stand-alone equipment) EN60204-1 and EMC standards (when used as part of other equipment)

SOFTWARE AND COMMUNICATIONS

Setup	Configuration using the keypad or software (DSELite) of all function blocks
Communication	P3 programming port included
Techbox Options	Link, Profibus, DeviceNet, ControlNet, CanOpen, LonWorks, Ethernet IP, Ethernet Modbus TCP, ModbusPlus and Serial (Modbus RTU/EI Bisynch)

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[3] All drives meet the CE Drive Specific Standard, filter required only to meet Class A or B.

General Information

Q.　How can the 690+ be configured?

A.　The 690+ can be configured using the 6901 HMI or the software DSELite.

Q.　What are the modes of operation for the 690+?

A.　The special modes are V/Hz , Sensorless Vector and Closed-Loop Flux Vector Control.

>　Note: V/Hz is for general purpose and variable torque applications.

>　Sensorless Vector is suitable for any general purpose and moderate performance applications.

>　Closed-Loop Flux Vector is for high performance applications such as converting, spindles and lathes, extruders, web tension controls and historically DC applications.

Q.　What SSD Drives does the 690+ replace?

A.　The 690+ replaces the 605, 584SV, and 620 Vector product lines.

Q.　Can a 690+ perform electronic line shafting like a 620L?

A.　Yes, the master drive needs an encoder feedback option and the follower drive requires a Systems Board option.

Q.　Are there any differences between common bussing a 690+ compared to a 620 drive?

A.　No, remember the application requires interlocks and fusing for drive protection.

Q.　What is common bussing?

A.　Common bussing is tying the DC bus of AC drives together to allow regenerating and motoring drives to share energy.

Q.　Where can I receive the programming and On Line software DSELite ?

A.　Visit http://www.ssddrives.com/usa then go to the *Resource Center / Software Downloads.*

Q.　What options can be added to the 690+?

A.　Speed Feedback, Communications, Remote mounting kit for the keypad, EMC compliant filters, and Systems Expansion Module are options for the 690+.

Q.　What are the types of Speed Feedback for the 690+?

A.　The Speed feedback option for the 690+ is Encoder.

Q.　What are the Communication options for the 690+?

A.　The 690+ has Communication Techboxes for Link, Profibus, DeviceNet, ControlNet, CanOpen, LonWorks, Ethernet IP, Ethernet Modbus TCP, ModbusPlus and Serial (Modbus RTU/EI Bisynch).

Q.　**What setup Macros are available for the 690+?**

A.　The 690+ has macros including a factory default, Raise/Lower, PID, Preset Speed, and Speed Programmed Winder.

Q.　What is the Systems Board for the 690+?

A.　The Systems Board is a PCB containing five additional configurable Digital I/O, four high resolution (12-bit) analog inputs, two encoder inputs, and two high speed register mark inputs for registration and electronic line shafting.

>　Note: The Systems Expansion board reroutes the hardwire analog inputs through a **High** resolution processor, but does not add additional analog inputs.

Q.　Is the keypad detachable during operation?

A.　Only if the drive is being controlled through the remote terminal connections.

If you have questions, please call the Product Support Group at (704) 588-3246.

Q. What are the communication settings for the P3 Port on a 690+?

A. The baud rate is 19200.

Q. How many Analog Inputs are on a 690+?

A. The 690+ has four analog inputs: two configurable to receive ±10VDC, 0-20V, 0-20mA, or 4-20mA and two configurable receive ±10VDC, 0-20V. All analog inputs have 10-bit resolution (plus sign bit). The inputs are scanned approximately every 10 milli-seconds.

   Note: The resolution for the analog input can be increased to 12 bit by adding a Systems Board option.

Q. How many Analog Outputs are on a 690+?

A. The 690+ has three configurable analog outputs: two to output ±10VDC, and one to output 0-10V, 0-20mA, 4-20mA. The outputs are scanned approximately every 10 milli-seconds. The analog outputs have 10-bit resolution (plus sign bit).

Q. How many Digital Inputs are on a 690+?

A. The 690+ has eight digital inputs, seven configurable, all rated at +24VDC, 100mA. The inputs are sampled approximately every 10 milli-seconds.

Q. How many Digital Outputs are on a 690+?

A. The 690+ has three volt free digital output contacts. They are configurable and rated at 3A @ 230Vac.

   Note: A System Board option provides the drive with five extra Digital I/O.

If you have questions, please call the Product Support Group at (704) 588-3246.

Inputs and Outputs

Q. How many analog inputs are on a 690+?

A. The 690+ has four analog inputs: two configurable to receive ±10VDC, 0-20V, 0-20mA, or 4-20mA and two configurable receive ±10VDC, 0-20V. All analog inputs have 10-bit resolution (plus sign bit). The inputs are scanned approximately every 10 milli-seconds.

   Note: The resolution for the analog input can be increased to 12 bit by adding a systems expansion PCB.

Q. How many analog outputs are on a 690+?

A. The 690+ has three configurable analog outputs: two to output ±10VDC, and one to output 0-10V, 0-20mA, 4-20mA. The outputs are scanned approximately every 10 milli-seconds. The analog outputs have 10-bit resolution (plus sign bit).

Q. How many digital inputs are on a 690+?

A. The 690+ has eight digital inputs, seven configurable, all rated at +24VDC, 100mA. The inputs are sampled approximately every 10 milli-seconds.

Q. How many digital outputs are on a 690+?

A. The 690+ has three volt free digital output contacts. They are configurable and rated at 3A @ 230Vac.

   Note: A system expansion PCB provides the drive with five extra digital in/outputs.

Specifications

Q. What are the reference power supplies available to terminal connections on the 690+?

A. The 690+ has ±10 VDC and +24 VDC supplies available to terminal connections.

Q. What is the current overload rating for the 690+ drive?

A. The 690+ has an overload rating of 150% for 60 seconds and 180% for 1 second.

Q. What are the minimum and maximum 3-phase input voltage ratings?

A. The 690+ voltage rating is 220-240VAC (±10%) single or three phase or 380-460VAC (±10%) three phase.

Q. What is the output rating?

A. The output rating is 0-480Hz.

Q. What is the operating temperature for the 690+?

A. The 690+ temperature rating is 0°C to 45°C (32°F-113°F).

   Note: The drive has to be derated linearly 1% per degree centigrade from 45°C (113°F) up to a maximum of 50°C (122°F).

Q. What is the maximum operating altitude for the 690+?

A. The maximum drive operating altitude is 5000m (16400 ft).

   Note: The drive has to be derated linearly 1% per 100 meters above 1000m.

Q. What standards do the 690+ meet?

A. The 690+ meets the CE, UL, c-UL, ECN50081-1, and ECN50082-2 standards.

If you have questions, please call the Product Support Group at (704) 588-3246.

690+ Rating Tables

220-240 (±10%) VAC Supplies – Single Phase

Part Number	Constant Torque Ratings		Frame Size
	Hp	Output Current (A)	
690+0001/230	1	2.5	B
690+0002/230	2	4.5	B
690+0003/230	3	5.5	B
690+0005/230	5	9.5	B

380-460 (±10%) VAC Supplies – Three Phase

Part Number	Constant Torque Ratings		Quadratic (Fan) Torque Ratings		Frame Size
	Hp	Output Current (A)	Hp	Output Current (A)	
690+0001/460/1BN	1	2.5	-	-	B
690+0002/460/1BN	2	4.5	-	-	B
690+0003/460/1BN	3	5.5	-	-	B
690+0005/460/1BN	5	9.5	-	-	B
690+0007/460/1BN	7.5	12	10	16	C
690+0010/460/1BN	10	16	15	23	C
690+0015/460/1BN	15	23	20	31	C
690+0020/460/1BN	20	31	25	38	D
690+0025/460/1BN	25	38	30	45	D
690+0030/460/1BN	30	45	40	59	D
690+0040/460/1BN	40	59	50	73	E
690+0050/460/1BN	50	73	60	87	E
690+0060/460/1BN	60	87	75	105	E
690+0075/460/1BN	75	105	100	145	F
690+0100/460/1BN	100	145	125	165	F

Note: The part numbers listed above are for ordering a standard configuration drive.

Change the last three values in the part number to select a special drive hardware configuration.

Enclosure::   **C**- Chassis (IP20 only)   **1**- NEMA 1 (IP20 and falling dirt protection (UL Type 1)

Brake Module:: **N**-NONE   **B**-INSTALLED

Option Card::   **N**-NONE   **S**-System board installed

Example: 690+0005/460/1BS is for a 690+, 5Hp, 460VAC, with a Nema 1 cover, w/Brake, and systems expansion PCB.

If you have questions, please call the Product Support Group at (704) 588-3246.

Objective

690+ Phase Control

The 690+ drive version 2 or greater firmware supports Phase Control with the use of the Encoder Function blocks.

Phase Control or Phase Lock, sometimes referred to as electronic lineshaft or electronic gearbox, is a position trim of a slave drive speed to maintain the relative position between the master and slave shafts or a precision ratio between the two shafts. The slave speed demand comprises the Master speed demand and the position trim from a counter of the accumulated differences between the Master and Slave encoders.

Equipment

690+ drive equipped with the "Systems Board" option, an external 24 VDC power supply to power the Systems Board, a Reference Encoder Input from a Master encoder, a Slave encoder which will be mounted to the 690+ Slave motor and the software DSELite. The "Systems Board" option is required to do Phase Control.

Systems Board

The Systems Board is an option board that is fitted to the 690+ drives and provides the following features: Master Encoder Input, Slave Encoder Input, Retransmit Slave Encoder Output, adds 5 Configurable Digital I/O (Inputs or Outputs) and increased Analog Input resolution, 12bit plus sign.

Description of the 690+ System Blocks

ENCODER SPEED 1

This block provides the 'feed forward' speed demand from the Reference / Master encoder. This is the Master/Reference encoder signal, that the Slave drive will follow.

Source: Selects either the Master or Slave encoder "hardware" input for the speed reference. The signal is generated from the Systems Board, terminal connector "B" for the *Master* encoder. For this application select *Master.*

Lines: Set this to match the PPR (Pulses Per Revolution) of the Master encoder.

Invert: Inverts the polarity of the speed output . Do not use. (swap encoder wires to invert polarity)

Max Speed: Sets the RPM of the Master encoder which will equal 100% at the *Speed* output of this block.

Filter Time: Sets the time constant of the speed filter. Useful for removing ripple on the reference encoder; but, any filter will produce a transient lag in the speed signal which will cause a following error during acceleration or deceleration. Set to zero to remove filter. The default value of 0.5s or less would be a typical value.

Speed: Encoder *Speed* output, connect to PHASE CONTROL::SPEED INPUT for this application. This output will have a range of 0 to 100% Speed, where 100% will be the Master Encoder max speed.

If you have questions, please call the Product Support Group at (704) 588-3246.

PHASE CONFIGURE

Slave Cnt Source: Selects either the TechBox or System Board Slave encoder, for the *Slave* input to the counter. For this application, set it to *Slave Encoder.* The *Slave Encoder* input will be taken from terminal block "C" of the Systems Board.

Speed Loop Speed feedback: Selects either the Encoder TechBox or System Board Slave / Feedback encoder as the speed feedback for the 690+ drive. For this application, select *Slave Encoder.* The encoder input will be taken from terminal block "C" of the Systems Board.

> **Note**: The encoder TechBox is not required for speed feedback when the System Board is used.

Counts Per Unit: Normalizes the encoder counts, e.g. if the encoder is 2048ppr, counting rising and falling edges on A & B inputs, it produces 2048*4 counts in every rev. Setting the Counts per unit to 8192 produces a position value of 1.00 per rev. Set this parameter to 4 times the encoder ppr.

1 ms Cycle Rate: . In drive firmware version 5, setting this to True boosts the execution rate of the phase loop to 1ms, thus improving response. For drive firmware version 5, this parameter is usually set to False.

Max Speed: This scales the speed feed forward for Phase Inch, Phase Move and Phase Register. For this application, this parameter is connected to the *Max Speed* in the *Setpoint Scale* block.

Master Scale A & Master Scale B: These are used to scale the Master encoder input. A is the multiplier and B the divider. E.g. In this example, if the Master encoder is 1024ppr and the Slave encoder 5000pp and the requirement is for 1:1 phase lock, set the *Master Scale A* to 5000 (representing the Slave encoder) and *Master Scale B* to 1024 (representing the Master encoder) so that one revolution of the master encoder produces the same number of counts as the Slave. Set these parameters accordingly to match the Master and Slave encoders ppr.

Master Position: Diagnostic output in encoder counts from the master quadrature encoder. This is the raw counter value and will wrap around from maximum positive to maximum negative through 0, if the counter overflows. With the *Counts per Unit* set to 8192, and with 1 revolution of the encoder, the *Master Position* would be 8192.

Slave Position: Same as the *Master Position*, except for the slave encoder.

Fault: This is a general error flag. The phase accumulator is 32bit. I f the *Position Error* counter exceeds the 32bit register, the *Overflow* flag will be set and the phase information will be lost.

PHASE CONTROL

The Phase Control includes the position counter, feed forward speed demand and gearing.

Speed Input: This is the input for the Master Speed demand. For this application this Speed Input is connected to the ENCODER SPEED 1::SPEED.

Gearing A and Gearing B: These scale both the Master Speed and the Master Count for ratioing the Slave speed to the Master speed. A is the multiplier and B the divider. If this ratio is 1:1, the Slave will follow the Master exactly. If Gearing A=100 and Gearing B = 50, the ratio is (100/50) = 2. Thus the slave will run at 2x speed of the master. If Gearing A=1100 and Gearing B = 1000, the ratio is (1100/1000) = 1.1 Thus the slave will operate at 10% faster speed, then the master. Use Integer numbers for Gearing A&B.

If you have questions, please call the Product Support Group at (704) 588-3246.

Position Enable: Enables the position counter, disabling resets the Phase CONTROL::OUTPUT to zero. This parameter is usually connected to a Digital Input or to *Running* parameter in the *Sequence Logic block*.

Output: Output of the position counter scaled by *Output Scale* and sign set by *Invert Output.* This Output is the error between the Master encoder and Slave encoder pulses. If the *Counts Per Unit* in *Phase Configure* is set to 8192, for 1 revolution of the encoder, the *Output* will be 1.00. When the system is running in a steady state condition the *Output* should be hovering around zero if the system is set up properly.

Speed Output: Master encoder speed demand scaled by *Gearing A & Gearing B*.

Master Position: Master position scaled in encoder counts. If the *Counts Per Unit* in *Phase Configure* is set to 8192, for 1 revolution of the Master encoder, the *Master Position* will be 1.00

Master Position INT: Position error in actual counts. If the *Counts Per Unit* in *Phase Configure* is set to 8192, for 1 revolution of the encoder, the *Master Position INT* will be 8192.

Position Error: Normalized position error in encoder units. If the *Counts Per Unit* in *Phase Configure* is set to 8192, for 1 revolution of the encoder, *Position Error* will be 1.00

PHASE PID

This is a dedicated PID for the Phase Control. It includes a Feed forward (*Feed Fwd*) input and Scaling (*Feed Forward Gain*) for the Master Speed demand. The *Limit* can be used to set the trim range, it operates only on the PID output. The *P Gain* and *I Gain* should be set much higher than usual as the normalized position error typically reduces the gain by a factor of 10 to 100. The *Integral* can be disabled by setting the *I Gain* to zero. Without *Integral* the speed will be correct but with a possible position error. Integral control will provide zero position error in steady state.

Output: This is the feed forward speed demand and it should be connected to the *Speed Trim* in the *Reference* block in drive firmware version 4 & 5. This *Output* will generate a 0 to 100% speed demand to the drive. The *Speed Trim* input will accept a speed signal to 100% and it will bypass all of the ramps in the drive.

PID Output: Output of the PID without the feed forward. No connection is made to this parameter. In firmware version 4 & 5, an internal connection is made from this parameter to the *Speed Loop // Phase Input*.

Enable PID: Globally resets the PID output and *Integral* term when false. This parameter must be true for the PID to operate. This parameter should be connected to PHASE CONTROL::POSITION ENABLE for this application.

If you have questions, please call the Product Support Group at (704) 588-3246.

Different Types of Phase Configure Applications

PHASE CONTROL WITH FIXED 1:1 RATIO

This is the simplest phase control configuration. The master encoder is driven by the previous section   and the slave drive section follows in phase.

In this example, the master encoder has 5000 pulses per revolution and the slave encoder has 2048 pulses per revolution.
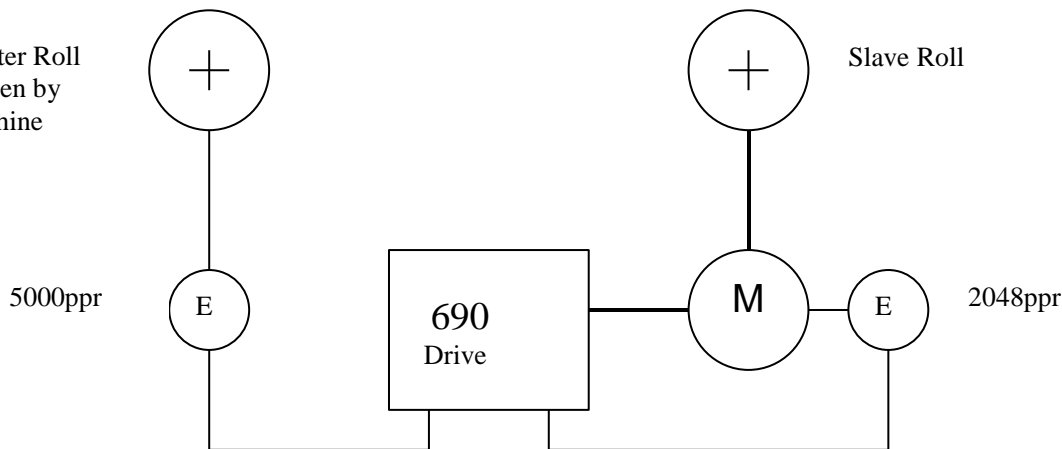
Phase Configure block

 The *Counts Per Unit* sets the global scaling of position setpoint and feedback. It is 4 times the ppr of the slave encoder for 1 revolution of the slave encoder. This is because there are 2 edges (1 rising and 1 falling) from both A and B inputs of a quadrature encoder. Thus since the slave encoder has 2048 pulses / revolution, the counts Per Unit will be set to (4*2048) = 8192.

Max Speed block: Set to 1800 rpm the same as the Drive *Max Speed* in the *Quick Set* up menu.

Master Scale A and *Master Scale B,* provide the same counts per unit for the master position. The master encoder counts are scaled by Master Scale A & B, where A is the multiplier and B is the divisor. Set *Master Scale A* to the slave encoders ppr. Set *Master Scale B* to the master encoders ppr.

Encoder Speed 1 block

This provides the feed forward speed demand.

Source Set to *Master Encoder*

Lines Set to 5000

Max Speed Set to1800 rpm which will equal 100% at the *Speed* out of this block.

Phase Control block

Set *Gearing A & B* so both are1000 for 1:1 ratio.

If you have questions, please call the Product Support Group at (704) 588-3246.

PHASE CONTROL WITH FIXED RATIO OTHER THAN 1:1

This is a more typical case where the master encoder is directly connected to a roll turning at a low speed and the slave has a pulley ratio to increase the motor speed. The slave roll must rotate in phase with the master.

The 17 and 53 tooth pulleys give a ratio of 53/17 = 3.117647…
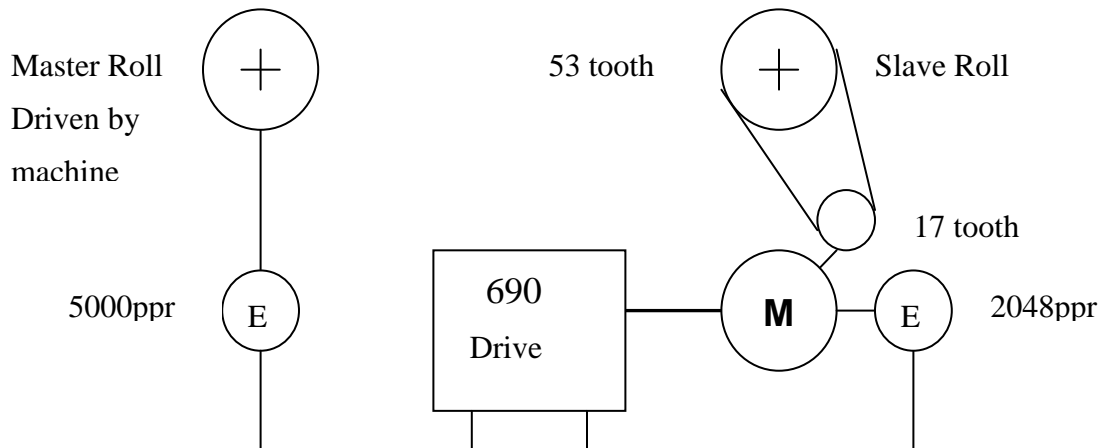
Phase Configure block

Integer ratios must be used which can easily be achieved by setting *Gearing A* = 53 and *Gearing B* = 17

If the Gearing is not an Integer ratio, i.e. Gearing A = 31176 and gearing B =10000, the speed will be correct within the drive resolution but the slave will slowly move out of phase with the master because the ratio is not exact. If this, for example were a print section following a main press with a compensator for register control, the compensator would slowly move and eventually reach the end of its travel.

Max Speed: Set to 1800 rpm the same as the Drive *Max Speed* in the *Quick Set* up menu.

Encoder Speed 1 block

This provides the feed forward speed demand.

Source Set to *Master Encoder*

Lines Set to 5000

Max Speed Set to1800 rpm.

If the Master Roll speed is 500 rpm the Slave Roll must run at 500*53/17 = 1559 rpm.

Checking the speed feedforward:

Encoder Speed 1 O/P is 500/1800*100 = 27.78%, multiplied by the gearing of 53/17 = 86.6% of 1800 = 1559rpm.

If you have questions, please call the Product Support Group at (704) 588-3246.

Procedure

1. Determine which version of the 690+ drive firmware is being used. Different versions have different connections and set up parameters.

2. Using DSELite, open a "default*.690" template, which matches the drive firmware version. Configure this template per the different versions as shown in FIGURE 3x.

3. In the PHASE CONFIGURE block set SLAVE CNT SOURCE & SPD LOOP SPD FBK to SLAVE ENCODER. This will use the Slave Encoder Feedback from the Systems Board terminal "C" block. Enter the required data for the PHASE CONFIGURE block. I.e. Counts Per Unit, Max Speed, Master Scale A and Master Scale B. See page 2 for information on this block.

4. In the ENCODER SPEED 1 block, set SOURCE to MASTER ENCODER. Enter the LINES and the MAX SPEED data.

5. Using DSELite download the template to the 690+ Slave drive. When installing this template make sure that PARTIAL INSTALL is performed under the COMMAND menu. Do NOT do a COMMAND::FULL INSTALL.

6. Connect the (Feedback) Slave Encoder to terminal block "C" on the Systems Board, as shown in FIGURE 2. This is the encoder that is mounted to the Slave drive motor. See FIGURE 2.

7. Connect the (Master) Reference Encoder to terminal block "B" of the Systems Board.

8. Connect an External 24 VDC power supply to the Systems Board, as shown in FIGURE 2. An external 24Vdc, 1 amp power supply is required for the systems board to operate and supply the digital I/O and encoder power supply at maximum loading.

9. Set up the slave drive via the 690+ MMI keypad (motor data, max speed, encoder data & etc) using the QUICK SETUP menu. Also set the CONTROL MODE for VOLTS / HZ and the VIEW LEVEL to ADVANCED.

10. Run the Slave drive in the Local Mode via the MMI Keypad on the drive and in the forward direction. Verify that the Slave motor is rotating in the correct direction as required for the application. If the motor rotation is wrong, swap any 2 motor leads. Run the motor up to100% speed to make sure that max speed can be obtained.

11. Run the drive in the Local Mode via the MMI Keypad with a speed SETPOINT of 50%. Make sure the drive is operating in the forward direction. (The right hand arrow > LED will be illuminated). Go to the menu SETUP: MOTOR CONTROL::FEEDBACKS::ENCODER FBK %. Verify that there is a valid number in this ENCODER FBK % window. I.e.: If the Speed Demand of the drive is 50%, the ENCODER FEEDBACK % should be 50%.Also verify that the polarity of this number is positive. If it is NOT positive, reconnect the encoder wiring to make it positive. **Do NOT change the parameter ENCODER INVERT. This parameter must be FALSE for the Phase Control to operate properly.**

12. Set the CONTROL MODE to CLOSED LOOP VEC and perform an Autotune. When finished save the parameters in the drive.

Phase Control setup procedure:

13. In the Slave drive, set the ENCODER SPEED 1::MAX SPEED to 0. (Record the original MAX SPEED value which will be needed in step 16). Also set the SYSTEM BOARD::PHASE PID ::LIMIT to 100%.

14. Run the Master drive or the piece of equipment that the "controls / turns" the Master / Reference encoder. Run this Master Encoder at 10% speed.

If you have questions, please call the Product Support Group at (704) 588-3246.

15. Run the Slave drive in the remote mode and enable the SYSTEM BOARD:: POSITION CONTROL::POSITION ENABLE. Verify that the Slave drive motor is operating in the correct direction and is under control. If the Slave motor is rotating in the wrong direction, change the Master / Reference Encoder wiring on terminal strip B, and repeat this step. **Do *NOT* change the PHASE CONTROL:: INVERT OUTPUT to change rotation of the motor.**

16. Monitor the parameter DIAGNOSTIC::TOTAL SPD DMD %, it should be 10% and a positive number.

17. Slowly increase the speed of the Master / Reference encoder up to 100% speed. The Slave drive should now be running a 100%. Monitor the DIAGNOSTIC::TOTAL SPD DMD %. It should be 100%. Verify that the Slave drive is operating at 100% speed. If it is not, there is a set up problem, possibly with GEARING A or GEARING B set up, in the Phase Control block. If the slave drive is not operating at 100% speed, do not proceed any further until this problem is resolved.

18. Stop the Master and Slave drive. In the Slave drive, set the PHASE PID::LIMIT to 0.(record the original value)

19. In the Slave drive, set the ENCODER SPEED CALC 1::MAX SPEED from 0 to the correct max speed for the application which was recorded in step 13.

20. Run the Master drive or the piece of equipment that the "controls / turns" the Master / Reference encoder. Run this Master Encoder at 10% speed.

21. Run the Slave drive in the remote mode and enable the POSITION CONTROL::POSITION ENABLE. Verify that the Slave drive motor is operating in the correct direction. Go to DIAGNOSTIC::TOTAL SPD %, it should be 10% and a positive number. If it is not the ENCODER SPEED CALC 1::MAX SPEED may be incorrect

22. Slowly increase the speed of the Master / Reference encoder up to 100% speed. The Slave drive should now be running a 100%. Go to DIAGNOSTIC::TOTAL SPD DMD %, it should be 100% and a positive number. Verify that the Slave drive is operating at 100% speed. Stop the Master & Slave drives.

23. Set the PHASE PID::LIMIT to the original value (recorded in step 15).Typically this value is in the range of 3 to 10%.

24. Run the Slave drive and monitor the PHASE PID::PID OUTPUT. This PID OUTPUT is the trim signal and it should be a very small number or dithering around zero, if the drive is set up properly,

    Phase Tuning procedure: This procedure is optional, but to optimize the drive speed loop and phase loop it should be performed.

25. The Phase Tuning function block can now be used to optimize the drive speed loop. To set up the Speed Loop:

a) Disable the phase loop by setting the: PHASE CONTROL::GEARING A to 0.0. Record the original value of GEARING A as it needs to be re entered in step 22e.

b) In the PHASE TUNING block, set PERIOD to1.0s, SPEED OFFSET to 10% and set ENABLE SPEED to True.

c) Monitor speed feedback with an oscilloscope via an Analog Output.

d) Start the drive in the remote mode. Make sure that the PHASE CONTROL:: POSITION ENABLE is True. The speed will step between 0 and 10%. Adjust the MOTOR CONTROL::SPEED LOOP :: SPEED PROP GAIN & SPEED INT. TIME for optimum response. A typical value for the Prop Gain is 75 -90 and a typical value for the Int. Time is 75 to 200ms.

e) Stop the drive, set PHASE TUNING::ENABLE SPEED to false and set the PHASE CONTROL::GEARING A to the correct value which was recorded in step 22a.

If you have questions, please call the Product Support Group at (704) 588-3246.

26. The Phase Tuning function block can now be used to optimize the drive Phase loop. To Set up the Phase Loop:

a) Disable the phase loop by setting the: PHASE CONTROL::GEARING A to 0. Record the original value of GEARING A as it needs to be re entered in step 23e.

b) Monitor SLAVE POSITION in the PHASE CONTROL block with an oscilloscope, via an Analog Output (set the Analog Output Scale to 300% for more scale).

c) Set the PHASE TUNING block set, PERIOD to 4s, PHASE OFFSET to 0.3, and ENABLE PHASE to True.

d) Start the drive in the remote mode. Make sure that the PHASE CONTROL:: POSITION ENABLE is TRUE. The motor should step forward and backwards 1/3 or a revolution. Adjust the PHASE PID || P GAIN and I GAIN for optimum response. With a square wave phase input, there will be no effective speed feedforward, so only small Phase Offsets should be used. A typical value for the P GAIN would be 30 to 75 and the I GAIN between 5 to 10.

e) Stop the drive, set the ENABLE PHASE to False, and restore GEARING A to the original value that was recorded in step 23a and save the drive parameters.

27. The drive is now optimized for Phase Control.
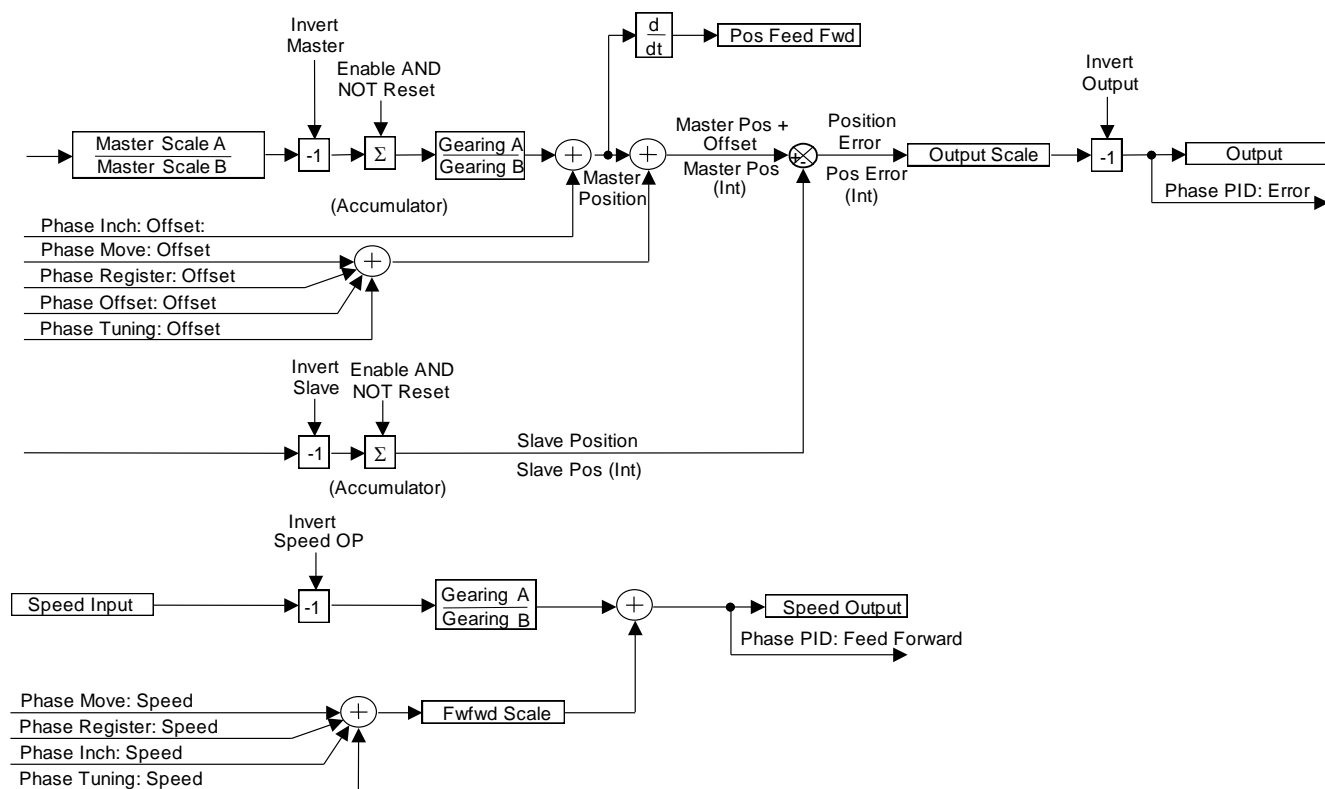
Phase Control internal diagram

Figure 1

If you have questions, please call the Product Support Group at (704) 588-3246.

Switch Settings

SW1 \ SW2	OFF	ON
OFF	24V	18V
ON	12V	5V
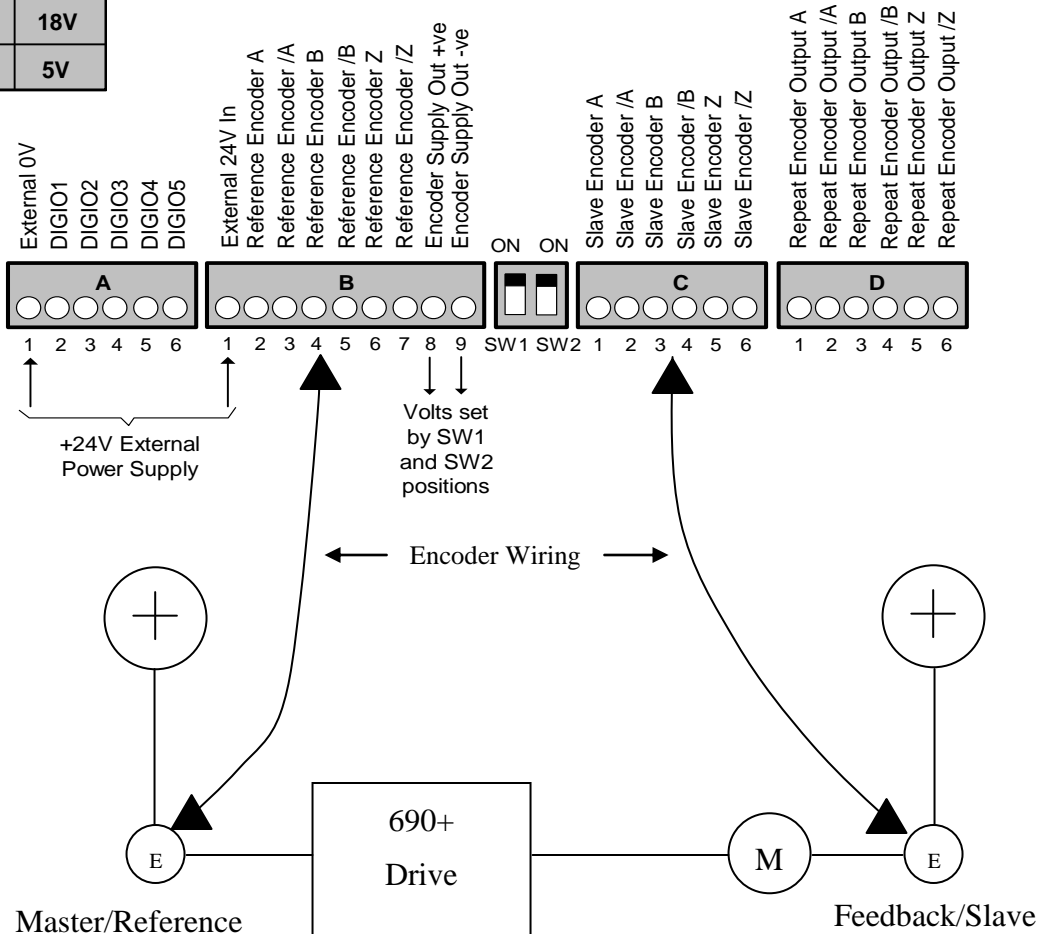
Figure 2 – Wiring Diagram

If you have questions, please call the Product Support Group at (704) 588-3246.

Phase Control Configuration for firmware version 5.x drive
Figure 3
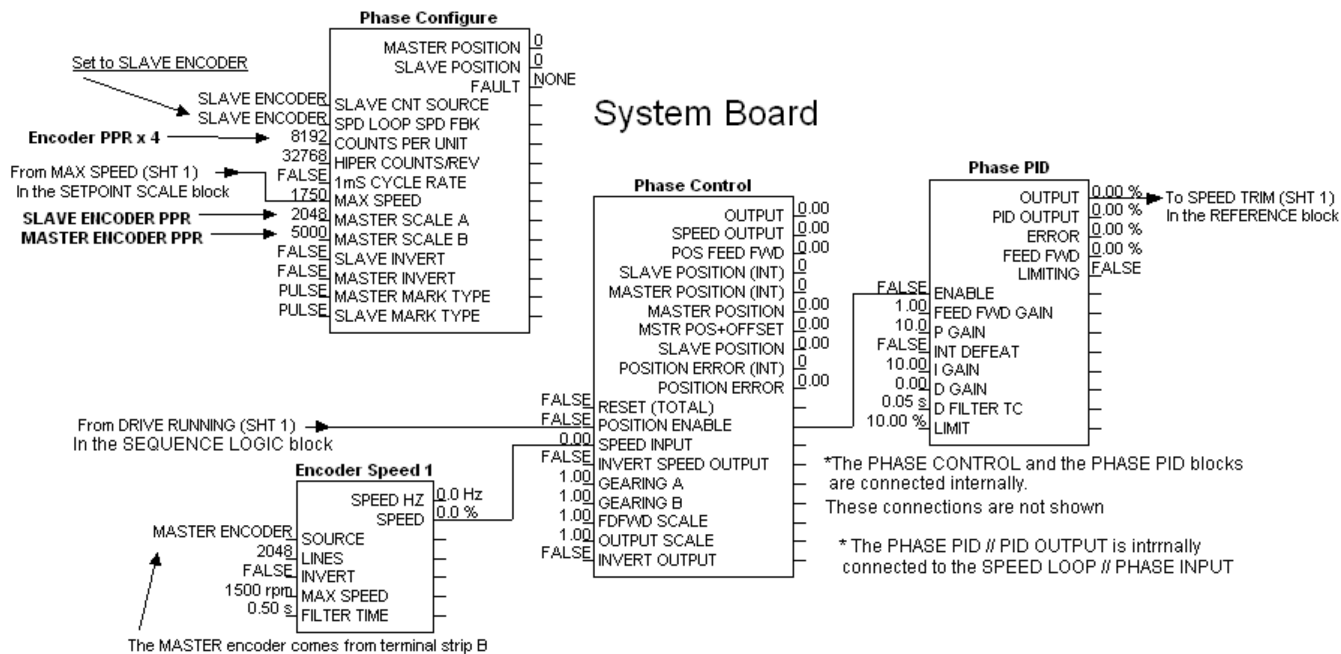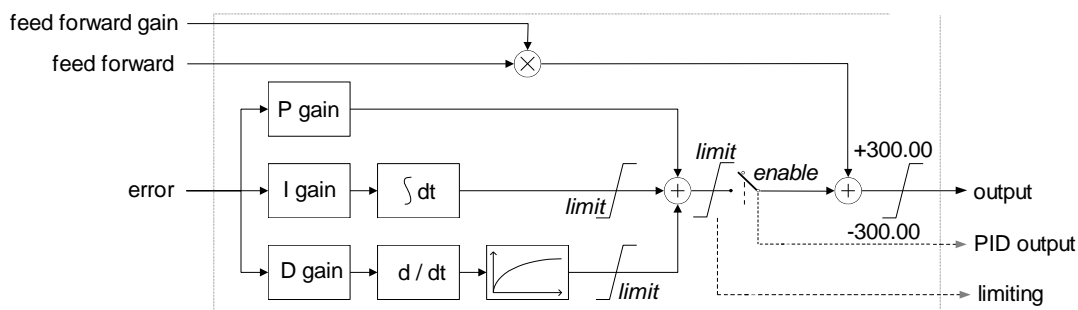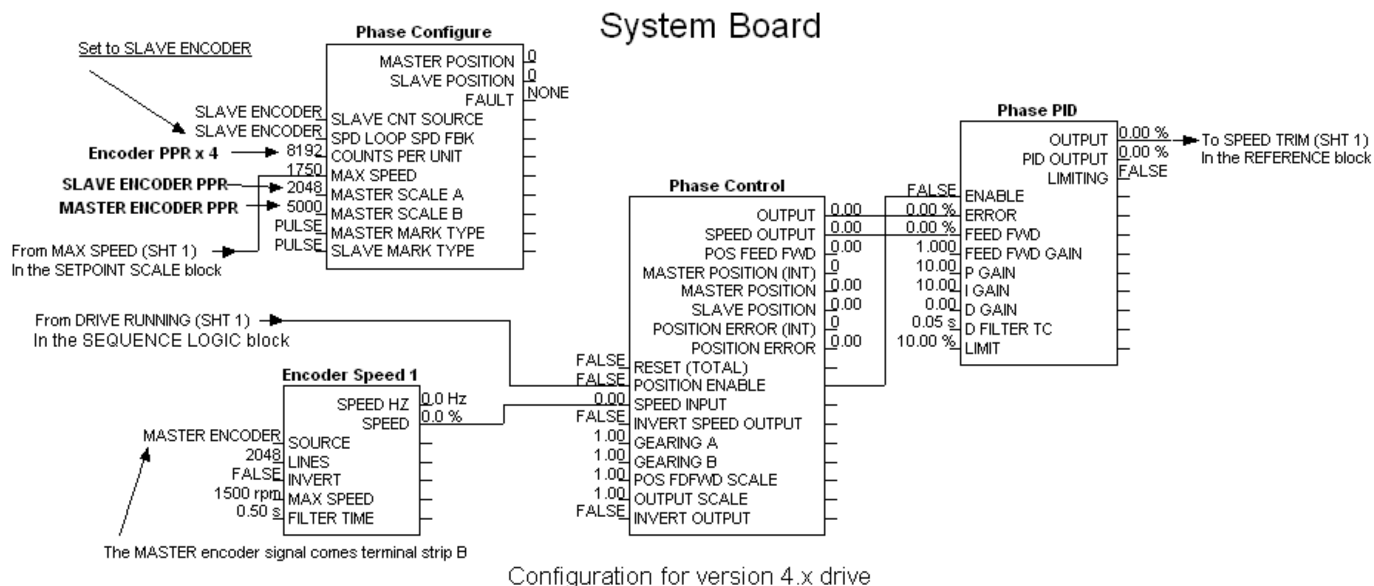

Configuration for version 5.x drive
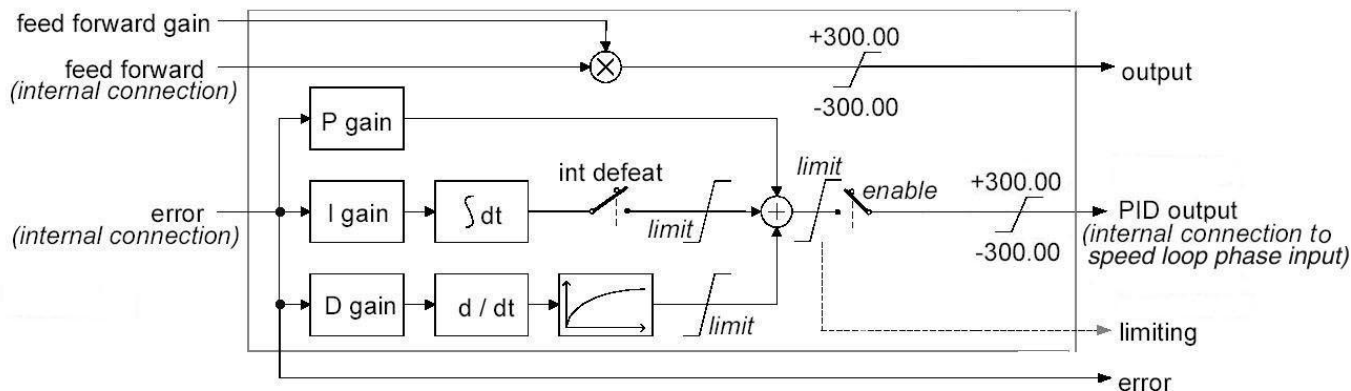
Phase PID **internal block diagram for firmware version 5.x drive**

If you have questions, please call the Product Support Group at (704) 588-3246.

Phase Control Configuration for firmware version 4.x drive

Figure 3

Configuration for version 4.x drive

Phase PID **internal block diagram for firmware version 4.x drive**

If you have questions, please call the Product Support Group at (704) 588-3246.

Objective

Provide details to configure the 690+ drive for dual Jog speeds.

Equipment

690+ drive and a computer with the software DSELite

Procedure

1. Launch DSELite.

2. Under **File::New**, open the default configuration of the drive you have, (example: default5.690). Ensure that the name on the lower left corner matches the drive you are working on.

3. Using DSELite and using a free *Digital Input* and a *Value Function* block, configure the template as shown below.

4. Enter in the desired jog speeds into the *Value Func* block.

0 VDC on Digital Input = uses *Value Fun / Input A* jog speed
24 VDC on Digital Input = uses *Value Fun / Input B* jog speed
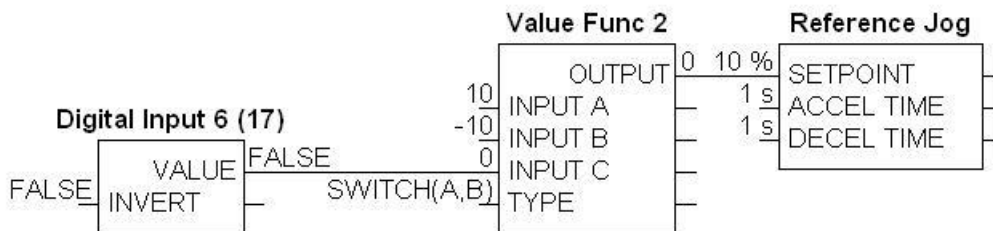
Note: The Digital Input will toggle the *Value Function / Input C* to select between the values set at Input A or Input B for the Jog Speed.

If you have questions, please call the Product Support Group at (704) 588-3246.

Objective

How to configure the 690+ drive to obtain a Footage Counter for version 5 firmware.

The 690+ firmware version 5 supports the *Position bock*, which is used for the footage counter in this application note.

A Footage Counter can be configured in the drive which can turn on a Digital Output at a certain predefined distance or an Analog Output can be configured to measure distance.

Equipment

690+ drive with firmware version 5 and with an encoder feedback and the software DSELite. For 690+ firmware version 4 or less, see the second portion of this application note.

NOTE: The drive is not required to have the optional Systems Board, to support the Footage Counter, but an encoder is required along with the HTTL Speed Feedback TechBox at a minimum. If the Systems Board is used, the HTTL Speed Feedback TechBox is not required.

Description of the function blocks for firmware version 5.x

Phase Configure block:

Slave Count Source: Selects either the Encoder Techbox or System Board Slave encoder for the Slave input to the counter. Leave in the *Slave Encoder* mode.

Speed Loop Speed feedback: Selects either the Encoder Techbox or System Board Slave encoder (terminal strip B) as the speed feedback for the 690.

The remaining *Phase Configure* blocks have no effect with this application.

Position block

Reset: Resets the *Scaled Output* and *Output (INT)* to the *Preset* value when set to True.

Preset: The value which the *Scaled Output* is set when *Reset* is set to True.

Limit: A limit that clamps the *Scaled Output*. The *Scaled Output* can not be greater than *Limit*. The range of this parameter is 0 to 32767.00

Counts Per Unit: Normalizes the encoder counts, e.g. if the encoder is 2048ppr, counting rising and falling edges on A & B inputs, it produces 2048*4 counts in every rev. Setting the *Counts per unit* to 8192 produces a *Scaled Output* of 1.0 per rev. The range of this parameter is –2,147,483,647 to 2,147,483,647.

Scaled Position (Output): An *Output* scaled such that 1.0 = actual encoder counts / *Counts Per Unit.* The range of this *Scaled* Position *Output* is 0 to 32767.00

Output (INT) : The number of encoder counts since the block was last *Reset*. This *Output* is persistent, thus it is saved on a power down.

If you have questions, please call the Product Support Group at (704) 588-3246.

Procedure / Theory of Operation.

1. Set the *Phase Configure::Slave Encoder* parameter to select if the encoder is connected to either an Encoder Techbox or a Systems Slave Board (located at terminal strip B).

2. Set the *Position::Counts Per Unit*. If the encoder is 2048 pulse per revolution, counting rising and falling edges on A & B inputs, it produces 2048*4 counts in   every rev. Thus 2048 * 4 = 8192. Setting the *Counts per unit* to 8192 produces *Scaled Position* of 1.0 for every encoder revolution. To obtain more range, increase this *Counts Per Unit.*

    a. Example A: If the *Position::Counts Per Unit* is set to 8,192,000 the encoder would have to rotate 1,000 revolutions to obtain a *Scaled Position* of 1.0   I.E. (8,192,000 / 8192 =1,000)

    b. In Example A above, the encoder would have to rotate 10,000 revolutions to obtain a *Scaled Position* of 10.0

    c. In Example A above, the encoder would have to rotate 100,000 revolutions to obtain a *Scaled Position* of 100.0

    d. Example B: If the *Position::Counts Per Unit* is set to 1,6384,000 the encoder would have to rotate 2,000 revolutions to obtain a *Scaled Position* of 1.0   I.E. (1,6384,000 / 8192 =2,000)

    e. In Example B above, the encoder would have to rotate 20,000 revolutions to obtain a *Scaled Position* of 10.0

    f. In Example B above, the encoder would have to rotate 200,000 revolutions to obtain a *Scaled Position* of 100.0

3. The Analog Out can be scaled so an *Scaled Position* of 100 will equal 10VDC on this *Analog Output*. The *Analog Output / Scale* also can be adjusted to the application.

4. The Digital Output can be used to indicate when a certain distance has been traveled. The *Value Func* block '*type*' is set for 'A>=B'. When the *Scaled Output* value exceeds the 'Input B' adjustable parameter, the Digital Output will activate.

If you have questions, please call the Product Support Group at (704) 588-3246.
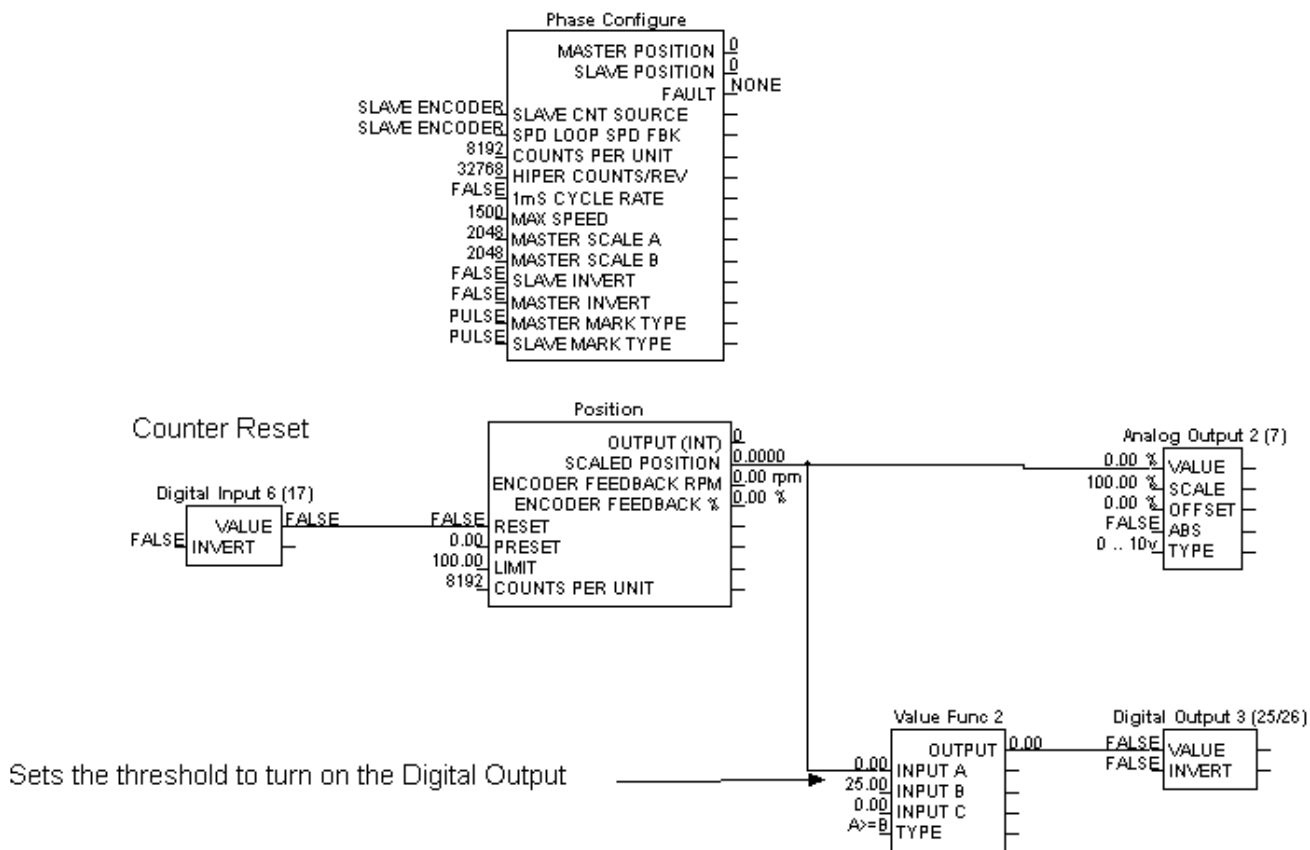
Footage Counter configuration for a 690+ firmware version 5 drive.

If you have questions, please call the Product Support Group at (704) 588-3246.

Objective

How to configure the 690+ drive to obtain a Footage Counter for firmware version 4 or less.

A Footage Counter can be configured in the drive which can turn on a Digital Output at a certain predefined distance or an Analog Output can be configured to measure distance.

Equipment

690+ drive with an encoder feedback and the software DSELite.

NOTE: The drive is not required to have the optional Systems Board, to support the Footage Counter, but an encoder is required along with the HTTL Speed Feedback TechBox at a minimum. If the Systems Board is used, the HTTL Speed Feedback TechBox is not required.

Description of the function blocks.

Phase Configure:

Slave Count Source: Selects either the TechBox or System Board Slave encoder for the Slave input to the counter. If using a Systems Board, set this parameter to *Slave Encoder.* If using a TechBox Speed Feedback device, set this parameter to *TB Encoder*.

Speed Loop Speed feedback: Selects either the TechBox or System Board Slave encoder as the speed feedback for the 690+. If using a Systems Board, set this parameter to *Slave Encoder.* If using a TechBox Speed Feedback device, set this parameter to *TB Encoder*.

Counts Per Unit: Normalises the encoder counts, e.g. if the encoder is 2048ppr, counting rising and falling edges on A & B inputs, it produces 2048*4 counts in every rev. Setting the Counts per unit to 8192 produces a *Phase Control::Output* of 1.00 per rev.

The remaining *Phase Configure* blocks have no effect with this application

Phase Control

Position Enable: Enables the position counter. This parameter must be set to TRUE, for the Footage Counter to count. This parameter can be connected to a Digital Input to enable. When this parameter goes False, all counts will be reset to 0 and the *Phase Control::Output* will reset to 0.

Reset (Total): This resets the *Output*. This must be set to False to count.

Output: Output of the position counter scaled by *Output Scale*.

*Output Scale::*Scales the *Output.* The range is 0.01 to 300.00

Invert Output:: Inverts the *Output.* If the Output goes negative, enable this parameter.

The remaining *Phase Control* blocks have no effect with this application

If you have questions, please call the Product Support Group at (704) 588-3246.

Procedure / Theory of Operation.

1. Configure the 690+ as shown below, using DSELite
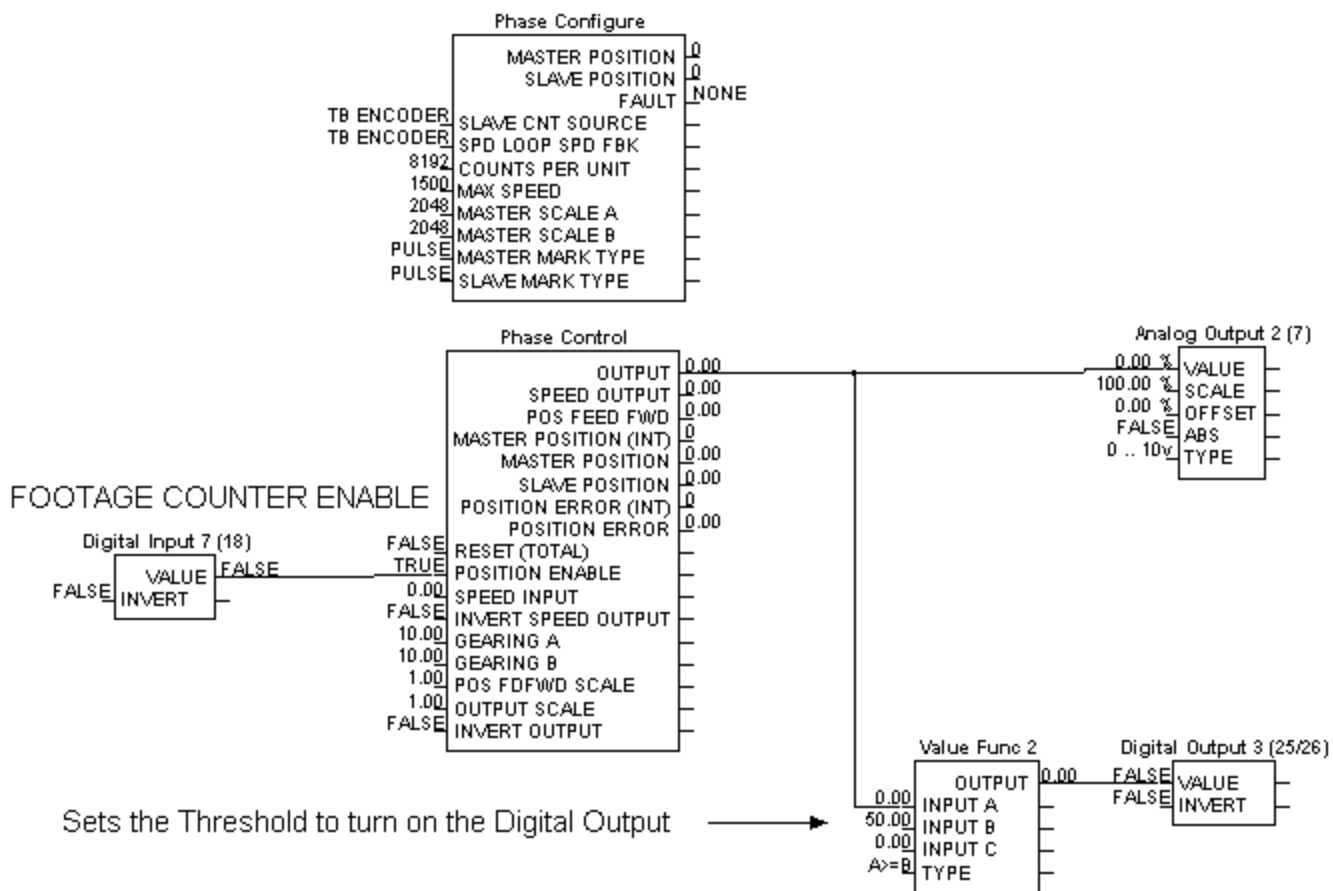
2. Connect the encoder to the drive either by using the HTTL Speed Feedback TechBox or the optional Systems Board. Set *Phase Configure::Speed Loop Speed Feedback* to match which device is being used.

If you have questions, please call the Product Support Group at (704) 588-3246.

3. Set the *Counts Per Unit* in the Phase Configure block. If the encoder is 2048 pulses per revolution, set this parameter to 4 times this number. Thus 2048 * 4 = 8192 *Counts Per Unit.*

4. If the *Phase Control::Output Scale* is set to 1.0, for every revolution of the encoder, the *OUTPUT* will display 1.00. Thus for 100 revolutions of the encoder, the *Output* would display 100.00

5. The Output Scale can be adjusted to scale the *Output*. If the *Output Scale* is set to 0.01 in the above example, it would take 10,000 revolutions for the *Output* to display 1.0

6. If more range is needed, the *Counts Per Unit* can be used. If the *Counts Per Unit* were doubled and set to 16384 (8192*2), for 1 revolution of the encoder, the *Output* will be 0.5

7. If the *Phase Control::Output* is connect to an *Analog Out*, for a *Phase Control::Output* of 100, the *Analog Output* voltage would be 10VDC. For a *Phase Control::Output* of 50, the *Analog Output* voltage would be 5VDC. The *Analog Output::Scale* can also be used scale the *Analog Output.*

8. A *Digtal Ouput* can be configured to turn on, at a predefined distance. Connect the *Phase Control::Output* to a *Value Function* block *Input A,* set the *Value Function::Type* to "*A>=B*". Set *Input B* to the value that the *Digital Output* is to "turn on". This is a compare function. If *Input A* is "greater or equal to" *Input B*, the *Output* of the *Value Function* block will change to TRUE, thus "turning on" the Digital Output.

If you have questions, please call the Product Support Group at (704) 588-3246.
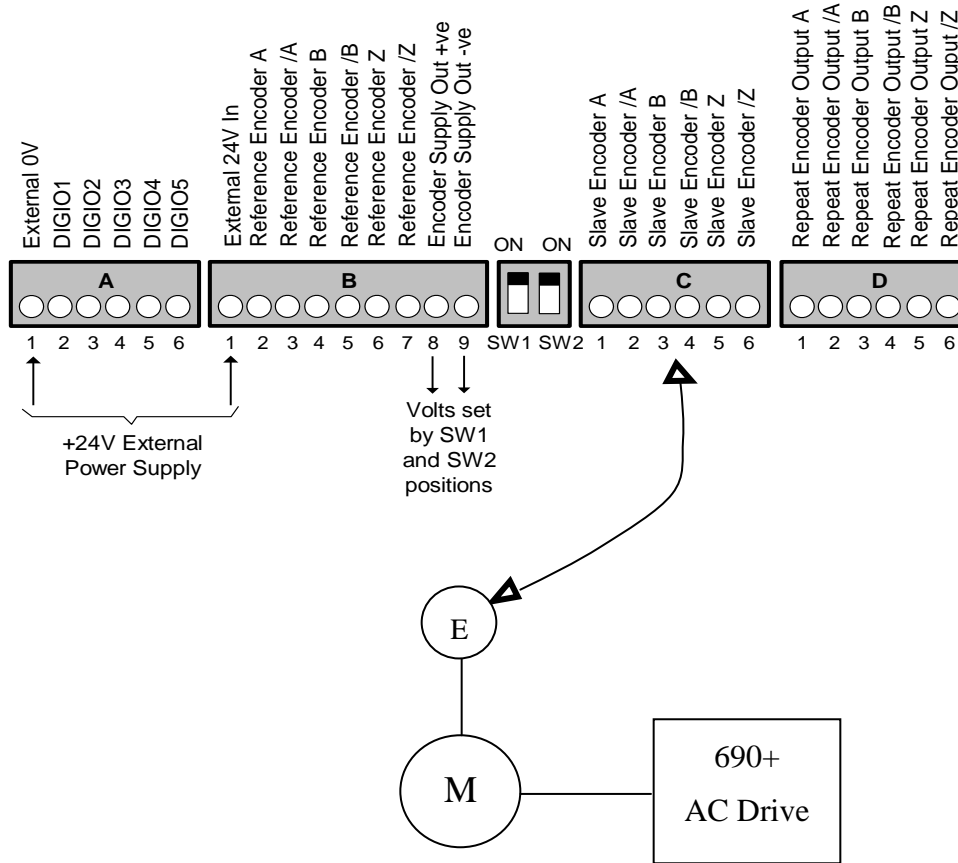
Objective

Provide details to configure the 690+ drive with encoder feedback using a Systems Board.

Equipment

690+ drive equipped with a "Systems Board" option, motor with a feedback (Slave) encoder

Note: The "Systems Board" is an option added to the drive.

Procedure

Note: Reference the switch settings of SW1 and SW2 on the Systems Board to the diagram
below to determine the output voltage to the encoder.

Switch Settings

SW1 \ SW2	OFF	ON
OFF	24V	18V
ON	12V	5V

If you have questions, please call the Product Support Group at (704) 588-3246.

1. Connect an external 24Vdc Supply to the Systems Board.

    Note: An external 0V and 24V dc (±10%) 1A power supply is required for the board to operate and supply the digital I/O and encoder power supply at maximum loading.

2. Connect the encoder wiring to the "Slave Encoder" position (Terminal C) on the Systems Board.

3. Set the Phase Configure::SPD LOOP SPD FBK to "Slave Encoder".

    Note: Below is a default DSELite template diagram. The Phase Configure block is contained on page 5 of 6.
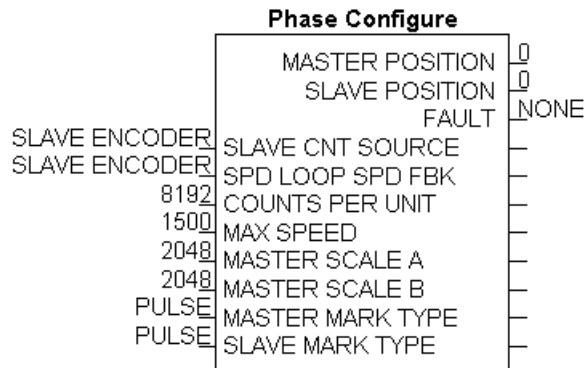
Note: Below is the MMI diagram.
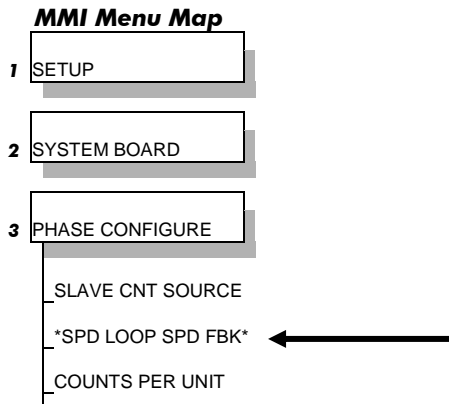
    Note: Remember to perform a "Parameter Save" on the 690+ drive.

If you have questions, please call the Product Support Group at (704) 588-3246.

Objective

To configure the 690+ drive to obtain a *Phase Move*

The 690+ firmware version 2 or greater supports the *Phase Move*. The *Phase Move* is a simple trapezoidal relative move, to the master (it is added to the speed demand). It acts on each rising edge of the *Enable* input. The slave shaft is moved a fixed distance at a rate given by the *Velocity* parameter. A move must be completed before a new move will be registered. See Figure 2 for a Functional Description.

Equipment

690+ drive with firmware version 2 or greater operating in the Closed Loop Vector mode and the software DSELite.

NOTE: The drive is not required to have the optional Systems Board, to support the *Phase Move*, but an encoder on the feedback motor is required along with the HTTL Speed Feedback TechBox at a minimum. If the Systems Board is used, the HTTL Speed Feedback TechBox is not required.

Description of the 690+ System Blocks for firmware version 5.x

Phase Move block**:**

Enable: If the function block is not already *Active, Enable* starts the *Phase Move* operation when going from False to True. Setting the *Enable* to False while a move is *Active,* will not abort the operation. This parameter is interlocked with the *Phase Control* block, thus *Phase Control / Position Enable* must be True **before** the *Phase Move / Enable* goes True. To abort the *Phase Move* once the operation starts, set *Phase Control / Reset* to True. When this is done, all *Phase Move* data will be lost.

Distance*: Sets the coarse distance (in motor revolutions) that the move command, will add to the phase loop. The range of this parameter is 3000.0 to – 3000.0 (motor revolutions). A negative (-) distance indicates that the motor will rotate reverse.

Distance Fine*: Additional *Distance* to allow fine control of position. The range is 1.0000 to –1.0000

Velocity*: The maximum velocity at which the distance is added to the phase loop. *Velocity* is a % of the *Max Speed* parameter. Thus if *Max Speed* = 1800 RPM and *Velocity* = 90%, the actual Velocity = 1800 x 0.9 =1620 rpm.

Acceleration*: The acceleration at which the distance is added to the phase loop.
Acceleration = (100 / desired acceleration time in seconds). I.E. acceleration of 20 = 100 / 5 seconds desired

Distance Left: Diagnostic showing the distance remaining before the move is complete.

Active: Will be True when the *Distance Left* is none zero.

*NOTE: Do not change these parameters while a *Move* is *Active*. The block may not respond as expected.

Phase Configure block:

Slave Count Source: Selects, "where the 'source' for the counter blocks comes from", either the HTTL Encoder Speed Feedback Techbox or System Board (terminal strip B). Select accordingly.

Speed Loop Speed Fbk: Selects where the speed feedback for the 690+ comes from, either the HTTL Encoder Speed Feedback Techbox or System Board Slave encoder (terminal strip B). Select accordingly.

Max Speed: This parameter must be connected to *Max Speed* in the *Setpoint Scale* block.

If you have questions, please call the Product Support Group at (704) 588-3246.

Counts Per unit: Normalizes the encoder counts, e.g. if the encoder is 2048ppr, counting rising and falling edges on A & B inputs, it produces 2048*4 counts in every rev. Setting the Counts per unit to 8192 produces a position value of 1.00 per rev. Set this parameter to 4 times the encoder ppr.

The remaining *Phase Configure* blocks have no effect with this application.
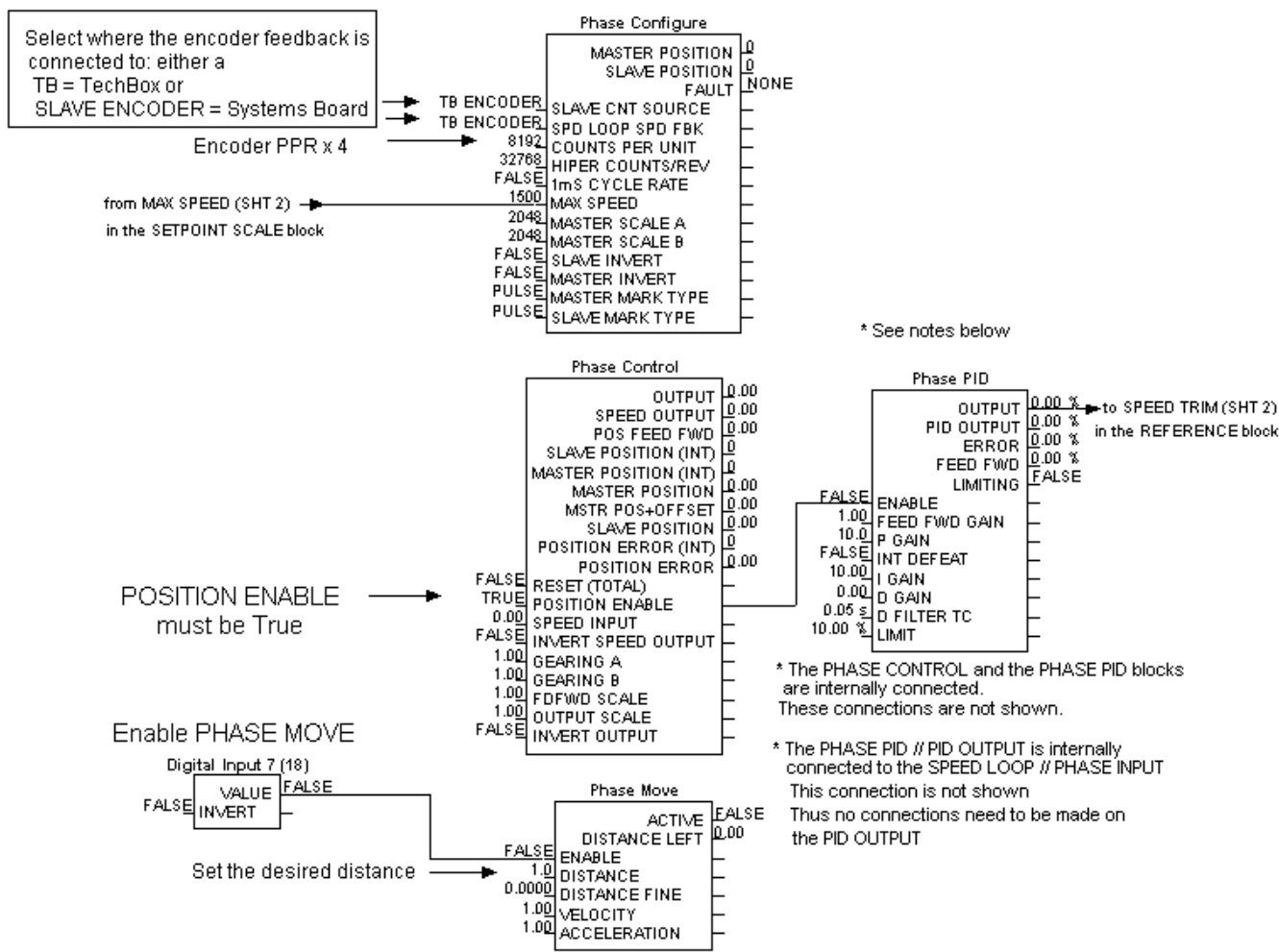
Phase Control block:

Position Enable: Enables the accumulator portion of this block. If set False, the accumulator is to zero and any phase data is reset. This parameter must be set True before *Phase Move / Enable* is set True. This parameter is interlocked with the *Phase Move / Enable* parameter. The *Position Enable* must be True **before** the *Phase Move / Enable* is set True.

Reset (Total): A Total reset of the Speed Output and the Output (Phase Loop). When a reset is performed, all phase data will be lost. This parameter must be False to calculate an output.

Procedure / Theory of Operation:

1. Using ConfigEd Lite, configure the drive to match the template as shown in Figure 1.

2. In the *Phase Configure* block, make sure that *Slave Cnt Source* and *Sped Loop Spd Fbk* parameters are set correctly. If using a TechBox for the motor encoder feedback, select these 2 parameters for *TB Encoder*. If using a Systems Board for the motor encoder feedback and the feedback encoder is connected to terminal strip B, set these parameters for *Slave Encoder*.

3. Use the *690+ Quick Start* (HA4700631) guide to set up the drive and Autotune the drive in the Closed Loop Vector mode.

4. Set the desired *Distance, Velocity & Acceleration* values, in the *Phase Move* block.

    a) Example: If the *Distance* is set to 1.0, the motor will rotate 1 revolution when the *Phase Move / Enable* is set True.

    b) Example: If the *Distance* is set to 100.0, the motor will rotate 100.0 revolutions when the *Phase Move / Enable* is set True.

    c) Example: If the *Distance* is set to -100.0, the motor will rotate -100.0 revolutions (reverse motor rotation) when the *Phase Move / Enable* is set True

5. Start the 690+ drive. (Enable *Run Forward*). Make sure that *Phase Control / Position Enable* is True and the *Phase Control / Reset (Total)* is False. When *Phase Move / Enable* goes True, the *Phase Move / Active* becomes True, the motor will rotate at the values set in the *Phase Move* block. The *Phase Move / Distance Left* will count toward 0. When the operation is completed, the *Phase Move / Active* becomes False and the value added to the Speed Loop from these blocks will be 0.

    a. **NOTE**: If the motor continues to rotate after the *Phase Move* has completed, there may be a polarity issue. If this is the case, try changing *Phase Control / Invert Output* from False to True.

6. Once the *Phase Move / Enable* goes True, the Move will complete the operation even though the *Enable* goes False.

7. For optimum performance, the Speed Loop and the Phase Loop should be tuned. See Application Note 3405, which explains the 'Phase Tuning Procedure', page number7.
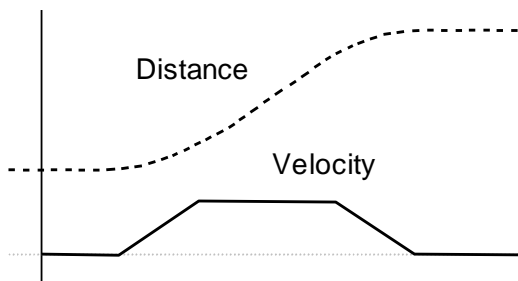
If you have questions, please call the Product Support Group at (704) 588-3246.

Configuration for drive firmware version 5.x

Figure 1

Distance

Velocity

Functional Description of a Phase Move

Figure 2

If you have questions, please call the Product Support Group at (704) 588-3246.

Objective

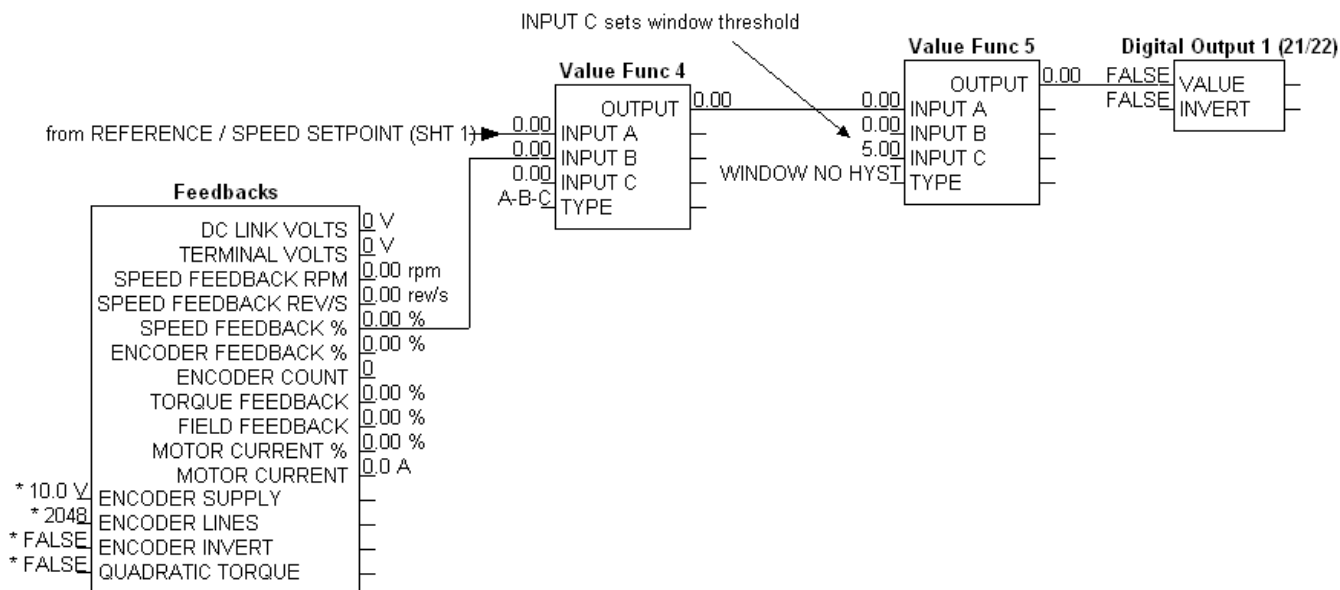Provide details to configure an Up To Speed indication on the 690+ drive.

Equipment

690+ AC Drive, computer with DSELite.

Procedure

1. Launch DSELite on the computer.

2. Under **File::New**, open the default configuration of the drive you have, (example: default5.690). Ensure that the name on the lower left corner matches the drive you are working on.

3. Connect the blocks as shown below

4. Set *Value Func* 4:: *Type* to *A-B-C*

5. Set *Value Func* 5:: *Type* to *WINDOW NO HYST*

6. Set *Value Func* 5:: *INPUT C* for the desired "window threshold" to turn on the Digital Ouput.

   Note: If the *Value Func* 5:: *INPUT C* "window threshold" is 5% and *SPEED SETPOINT* is 50%, the *Digital Output* will be True when *Feedbacks::SPEED FEEDBACK* is between 45 and 55%. Adjust accordingly.

   If the *Value Func* 5:: *INPUT C* "window threshold" is 2% and *SPEED SETPOINT* is 50%, the *Digital Output* will be True when *Feedbacks::SPEED FEEDBACK* is between 48 and 51%.

If you have questions, please call the Product Support Group at (704) 588-3246.

Objective

Provide details to display a parameter on the keypad on the 690+ drive.

Equipment

690+ AC Drive, computer with DSE Lite (> v.2.xx) installed. (2.19 as of this writing)

Procedure

1) Launch DSE Lite on the computer. For details, see DSE Lite manual HA471486U001

2) Under **File::New**, open the default configuration of the drive you have, (example: default5.690). Ensure that the name on the lower left corner matches the drive you are working on.

3) Select the parameter to be displayed. For this application note we will use Torque Feedback. (Parameter number 70).

4) Locate the Operator Menus (sheet 6 of 8). Select the desired Operator Menu (1 through 32). We will select Operator Menu 6.

5) Open this function block. Enter the desired parameter number to be displayed in the Parameter entry area of the block. Operator Menu 6::Parameter to the desire tag number.
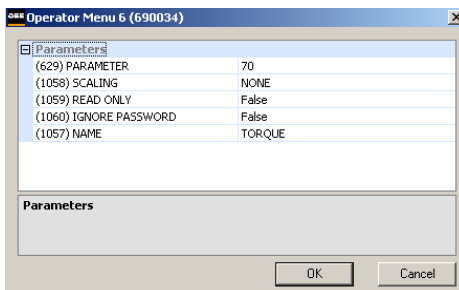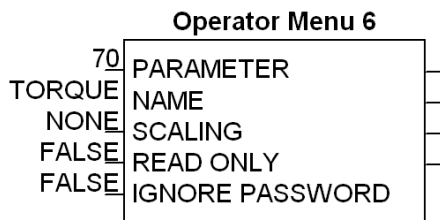

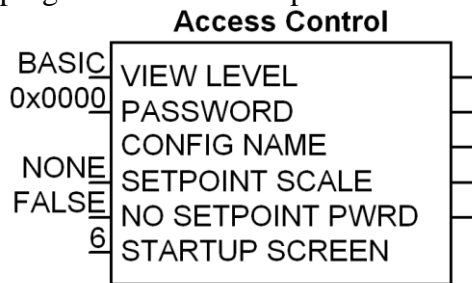6) If desired enter a name in the space provided Operator Menu 6::Name.

If you have questions, please call the Product Support Group at (704) 588-3246.

a) If the Name is left blank the parameter name will appear the same as in the HMI.

Operator Menu 6

```
          70 | PARAMETER        —
      TORQUE | NAME             —
        NONE | SCALING          —
       FALSE | READ ONLY        —
       FALSE | IGNORE PASSWORD
```

7) Scaling can be done such that one could make the HMI appear in desired units. (FPM, GPM, MPM…) This is done with the help of one of four Display Scale function blocks.

8) The Operator Menu can be set for Read only and not allow any changes to the displayed parameter.

9) A Password can be set for the Operator Menu to restrict write access to the displayed parameter.

10) If desired Operator Menu 6 can be programmed to be the default display on power up and the first to appear in the Operator Menu. Access Control: Start-Up Screen to 6.

11) After downloading the DSE program. The desired parameter should be displayed on the HMI. If the

Access Control

```
       BASIC | VIEW LEVEL        —
      0x0000 | PASSWORD          —
             | CONFIG NAME       —
        NONE | SETPOINT SCALE    —
       FALSE | NO SETPOINT PWRD  —
           6 | STARTUP SCREEN
```

drive displays the Welcome Screen then press the "M" twice to view the desired parameter.

If you have questions, please call the Product Support Group at (704) 588-3246.

Objective

To provide details on how to configure the 690+ Slave drive to Load Share with a 690+ Master drive.

Equipment

690+ drives and the software DSELite.

Procedure

1. For the drives operating in the _Closed Loop Vector_ mode, configure the 690+ Master Drive so the parameters SPEED DEMAND and TORQUE DEMAND are connected to Analog Outputs. These outputs will be connected to the Slave Drive, Analog Inputs. See Figure 1.

2. For the drives operating in the open loop _V / Hz_ mode, configure the 690+ Master Drive so the parameters SPEED DEMAND and MOTOR CURRENT % are connected to Analog Outputs. These outputs will be connected to the Slave Drive, Analog Inputs. See Figure 2.

3. Configure the 690+ Slave Drive according to the configuration shown below.

4. Make sure both drives are properly Autotuned if operating in the Closed Loop Vector mode.

5. Adjust the PID block accordingly.
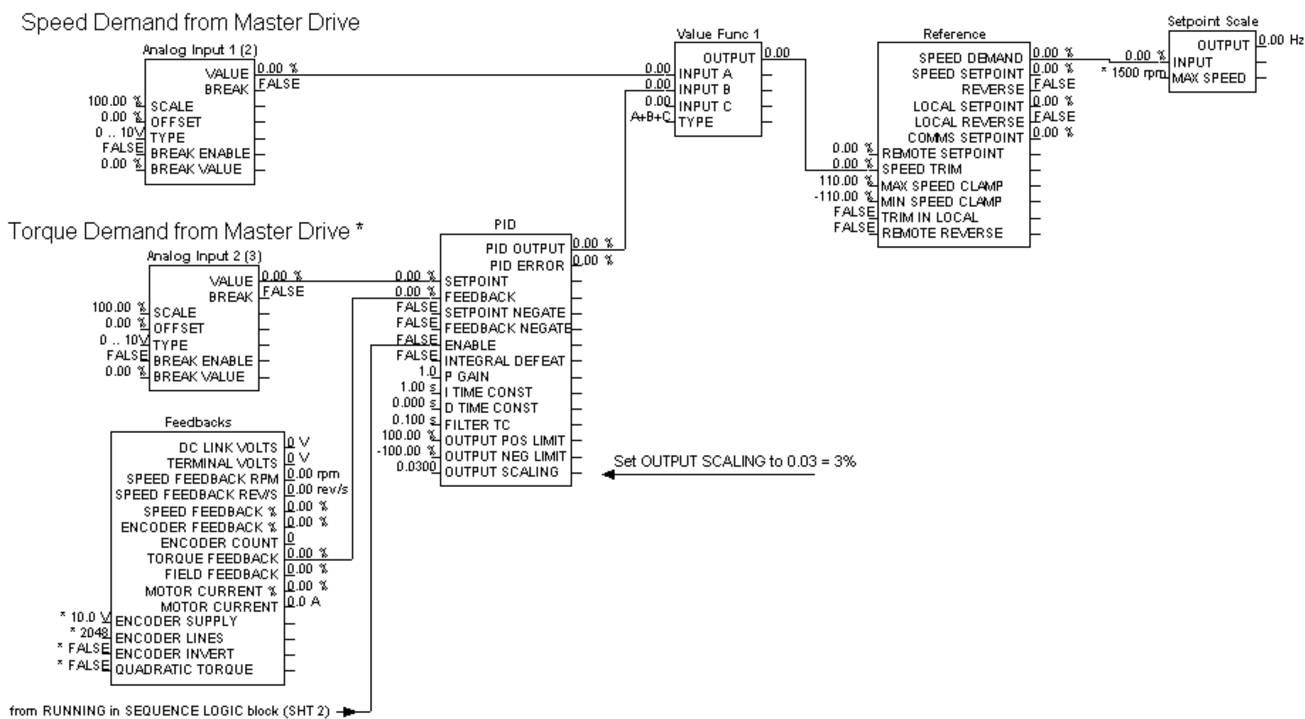
Figure 1.   DSELite configuration for the 690+ Slave drive operating in the Closed Loop Vector Mode

If you have questions, please call the Product Support Group at (704) 602-6062.
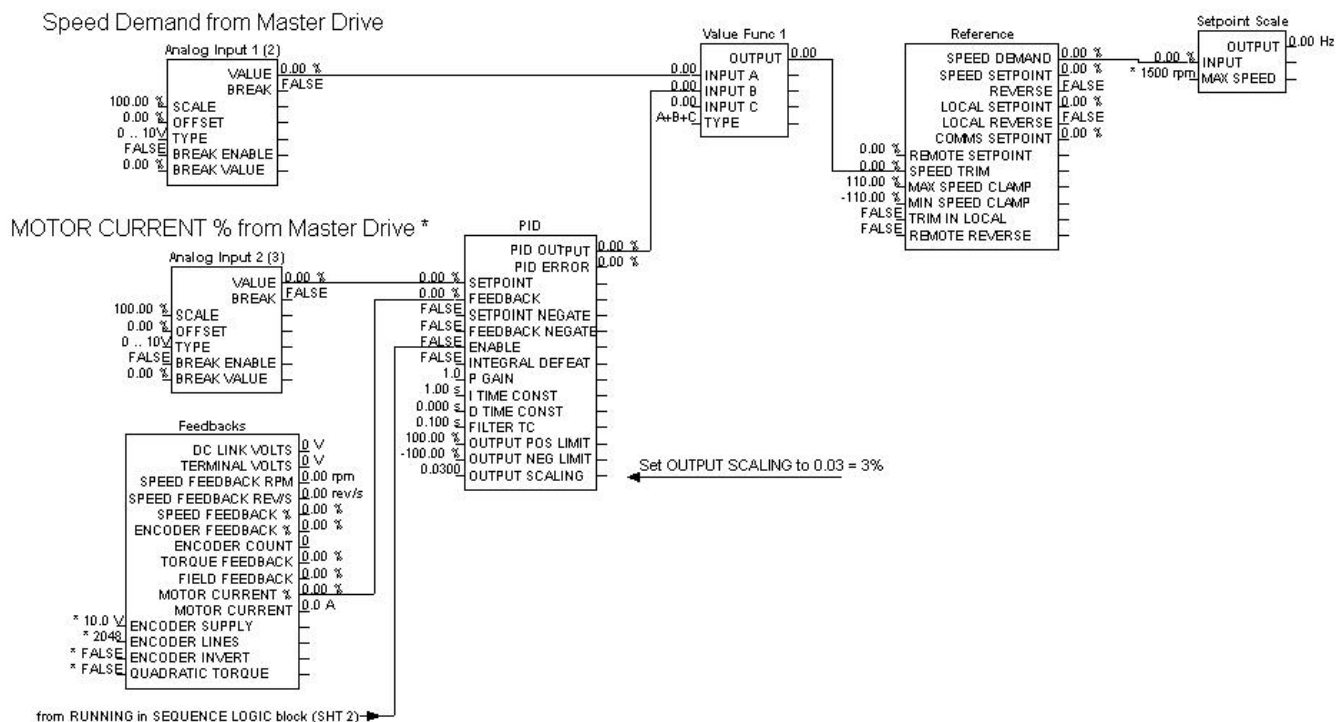
Figure 2. DSELite configuration for the 690+ Slave drive operating in the V /Hz Mode

If you have questions, please call the Product Support Group at (704) 602-6062.

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Application Note

Common Bussing AC Drives
APP-AC-03

For 650 and 690+ series drives

Introduction

On occasion, one or more drives in a system may be absorbing power from the machine and pumping it back into the drive. This condition is called regeneration. This occurs when motors are being "overhauled" (mechanically pulled at a speed faster than their setpoint) or when the drive and motor are "holding back" their speed to provide desired tension, as in the case of unwind stands.

The typical pulse width modulated AC drive is not designed for regenerating power back into the three phase supply lines, so all energy absorbed from the motor goes into the capacitor bank, resulting in increased DC bus voltage inside the drive. When equipped with a standard duty braking module and resistor, the drive is capable of dissipating only short-term energy, typically a few seconds at a time. It is possible to specify a braking module and resistor to dissipate this energy continuously, by taking into consideration the maximum current capacity of the brake switch, the duty cycle and the resulting wattage rating of the resistor. In either case, energy dissipated in a braking resistor is energy wasted.

This regenerative energy can be absorbed by other motoring drives if the drives are connected in a common DC bus configuration. If all the drives on a given line are connected in a common bus configuration, there is no need for other dissipation techniques, (even though some sections may always be in continuous regeneration), since the net power flow into any machine is positive. Braking modules and resistors may be required to dissipate short-term regenerative energy only when the system performs a fast or emergency stop.

If only part of the machine is fitted with AC drives, the situation is slightly more complex. With a good understanding of the application, one can determine the motoring and regenerative requirements for each section driven by the AC drive. Under worst case conditions, if the net flow of power is still into the common-bussed drive sections, there is no need for additional dissipation methods. If it is not, an appropriately sized braking module or even a line regenerative unit should be considered.

Common Bus Scheme

There are several ways of implementing a common bus scheme. Considerations for precharge on power up, independent drive control, drive faults, load sharing and input circuit protection, must be addressed. The scheme illustrated in Figure 1 is recommended and used by SSD Drives in our factory built systems.

The features of this scheme are:

- A complete drive is used
- No need for separate rectifier, precharge scheme, capacitor bank and inverter modules
- Each drive can be individually removed from the common bus without affecting the system
- Interlocked contactor to put the drive onto the common bus
- High speed fuses to protect the drive capacitors on the common bus

Guidelines

All drives on a common bus must be powered from the same three-phase AC supply.

Ordering the Drive

The standard drive is used for a common bus scheme. No special options required.

Line Protection

(CB in the figure)
If using a circuit breaker as the mains protection, order one with an auxiliary contact. This circuit breaker needs to be used for interlocking the DC contactor. Refer to the drive instruction manual for sizing and specifying circuit breakers.

Line fuses

If using fuses as the mains protection, order ones with blown-fuse microswitches. These fuses need to be used for interlocking the DC contactor. Refer to the drive instruction manual for sizing and specifying line fuses.

Line Reactor

(LR in the figure)
A line reactor is required for this common bus scheme. Use a standard line reactor rated at 3% impedance for the HP rating of that section, such as the MTE RL series.

Drive Healthy Relay

(DH in the figure)
The Drive Healthy relay should have a 24VDC coil powered by the drive and is energized when the drive is in a healthy state. See the drive instruction manual for connection information. It is used for interlocking the DC bus contactor, so that in the event of a fault, the drive is removed from the common bus.

DC Bus Fuses

(FU in the figure)
Use 2 semiconductor fuses, rated 700VDC, such as the Bussman FWP series, or Ferraz-Shawmut A70P series. The current rating of these fuses depends upon the expected motoring or regenerative energy for that section. When in doubt, size them for 125% of rated drive current.

DC Bus Contactor

(DCC contacts in the figure)
Use a 2-pole DC contactor rated for 650VDC, such as the ABB EHDB series. The current capacity of this contactor depends upon the expected regenerative energy for that section. When in doubt, size it for 120% of the rated drive current.

Interlocking the DC Bus Contactor

(DCC coil in the figure)
The coil of the DC bus contactor should be energized only if the three-phase AC power is on AND the drive is healthy. This can be done by connecting the circuit breaker auxiliary and drive healthy relay contacts in series with the contactor coil, as shown in Figure 1. When a 'Drive Isolate' or 'Coast Stop' relay is present, its contact may be inserted into the interlock, if desired, to provide an extra permissive.

Dynamic Braking

(DBR in the figure)
If the entire system is on a common bus, the only net regenerative energy produced will be during fast or emergency stopping of the line. It is only at this time that an alternative short-term dissipation method is necessary. Braking modules and resistors should be used strategically under these conditions:

- When in doubt, use braking on all the drives
- When a drive is not the largest in its frame size, the braking module may be capable of more than the power rating of the section. For braking module capability, refer to "Current Rating" in the Dynamic Braking section of the drive instruction manual.

- If there is one drive that is significantly larger than the rest, it is often sufficient to put a braking resistor on that drive alone, taking into consideration that it would be able to absorb and dissipate enough energy to stop the entire system, in the event of a fast stop.

Caution
If every drive does not have a brake, it is important that the large drives have the braking resistors rather than the small ones, so that the braking modules inside the small drives do not have to absorb the total regenerative energy from the common DC bus.

Caution
Do not connect a braking resistor to a drive that is not equipped with a braking module. Serious component damage could occur.

Dynamic Braking Protection
(MCP in the figure)
Ensure that the braking resistor and wire are protected by a motor circuit protector rated at 110% of the continuous current rating of the resistor(s). Use SquareD GV2 series, or equivalent. Route the braking wire through all three poles, as shown in the sketch, to provide DC breaking capability. An auxiliary contact may be used to annunciate an alarm, if a trip should occur.

To Braking Resistor

To alarm

To alarm

From Drive
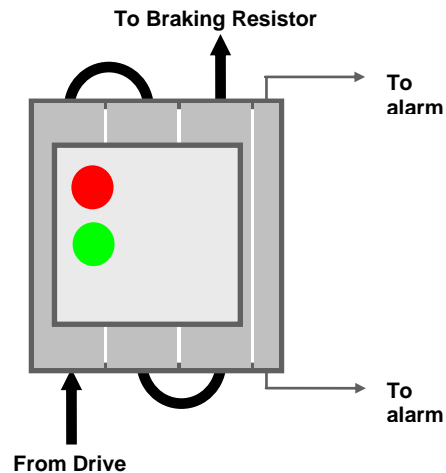
Parameter Change
Disable Slew Rate Limit in the 690+ when used in a common bus configuration. The parameter may be found under Setup/Motor Control/Slew Rate Limit/Enable. Set it to FALSE.
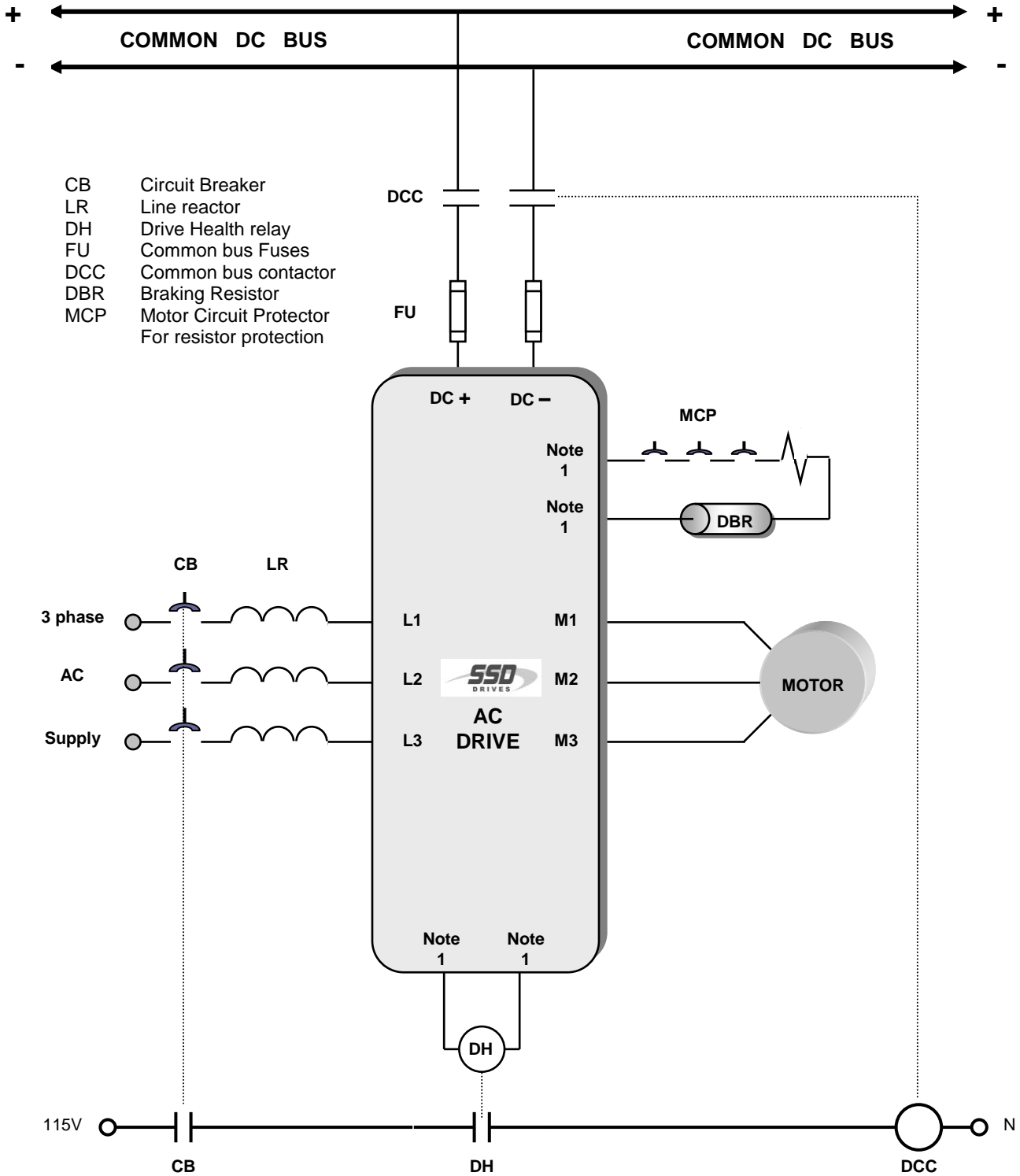
Other Dissipation Methods

Large Braking Module
If specifying braking resistors and modules for individual drives gets very involved, a third party braking module sized for the entire common bus may serve as an alternate solution. This module connects across the DC bus and has a threshold that should be adjusted to 740VDC for a 460V system. When the DC bus voltage exceeds this threshold, the module turns on and dissipates excess energy into a resistor bank. Contact SSD Drives' Product Support Group for details.

Line Regenerative Unit
When only a section of the machine has common bussed AC drives, it is possible that the common bus may need to absorb regenerative energy for extended periods. A Line Regenerative Unit may be specified under these circumstances, if the amount of energy to be absorbed exceeds the steady state rating of the braking modules and resistors. This unit connects across the DC bus and the AC supply and conducts when a threshold voltage is exceeded, pumping the excess energy back into the lines. Contact SSD Drives' Product Support Group for details.

Figure 1

CB	Circuit Breaker
LR	Line reactor
DH	Drive Health relay
FU	Common bus Fuses
DCC	Common bus contactor
DBR	Braking Resistor
MCP	Motor Circuit Protector
	For resistor protection

COMMON DC BUS **COMMON DC BUS**

DCC

FU

DC + DC −

Note 1 MCP

Note 1 DBR

CB LR

3 phase L1 M1

AC L2 M2 MOTOR

Supply L3 M3

AC DRIVE

Note 1 Note 1

DH

115V CB DH DCC N

NOTE 1: Refer to the drive instruction manual for terminal designations for that drive