

805-7 Press Synchronization Module

Installation and Operating Manual

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Press Synch

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1 INTRODUCTION

The 805-7 Press Synchronization Module is available as an option for the OmniLink 805 Operator Terminal. Its purpose is to synchronize the operation of two separate presses so that they stroke as closely as possible as if they were mechanically tied together. One press is designated as the “master” and the other as the “slave”. Before stroking, the module will compare the speeds reported from the press drives and set the slave drive command to a value that results in the same speed as the master drive. This allows the presses to start stroking at very nearly the same speed. Once stroking has started, the module compares the difference in crank angle between the two presses and adjusts the slave speed to drive that difference as closely as possible to zero. The module receives crank angle from the existing Link controls over a high speed serial bus and requires no other resolvers to operate.

1.1 Features

- The Module provides two analog inputs for the master press and two analog inputs for the slave press. These inputs can be set for 0 to 10 volts or 4 to 20 ma input signals. The slave also has two 0 to 10 volt analog outputs. The master side and the slave side are isolated from each other and the OT805 operator terminal. No separate isolation devices are necessary to tie them to the motor drives.
- 4 digital inputs and 4 solid state relay outputs are included for various interfacing signals to and from the presses and/or automation. Each digital input and solid state relay output is independently isolated.
- The crankshaft angle from the master and slave presses is supplied to the module via high speed serial bus from supported Link equipment on the presses. No additional resolvers are needed. Supported Link equipment includes the System 5000 Press Control, the System 5100 Press Control, and the OmniLink II Automation Control. Any position dependent parameters are entered directly into the module and require no external cam switches.

1.2 Specifications

Size:	5.0” wide, 4.0” high (circuit board installs in OmniLink 805 Operator Terminal)
Input Power:	Supplied from OmniLink 805 Operator Terminal
Analog Inputs:	Switch selectable 0 to 10 volts or 4 to 20 milliamps
Analog Outputs:	0 to 10 volt, 15 milliamps max load
Digital Inputs:	12 VDC minimum to guarantee turn on, 135 VAC max
SS Relay Outputs:	300 Volts AC or DC, 0.13 Amps, 1 microamp off state leakage

2 DEFINITIONS AND TERMINOLOGY

This section will give some background and explain the meaning of various settings and readings in the module. It is strongly recommended that this section be read in order to use the module effectively!

2.1 “Master” Press

The “master” press is the press that sets the overall speed of the process. The press synchronization module does not set or adjust the speed of this press, but instead uses the speed of the “master” as a reference to determine how to adjust the speed of the “slave” press.

2.2 “Slave” Press

The “slave” press speed is controlled by the press synchronization module based on the speed set for the system by the “master” press.

2.3 Crank Speed

The crank speed is the speed calculated by the press synchronization module by looking at the resolver readings taken from the press while it is stroking. This speed will usually fluctuate through the stroke as the press slows down while doing work and speeds up as energy is restored by the motor through the stroke.

2.4 Drive Volts and Drive Speed

Motor drives that are compatible with this module must be able to report the current stroking speed of the press based on the flywheel speed. The drive will typically do this with a 0 to 10 volt output or a 4 to 20 milliamp output. If a 4 to 20 milliamp output is used, it is converted by the module to a voltage by using a precision resistor (engaged by a switch) in the analog input circuit of the module. By using calibration settings, the press synchronization module converts this output from the drive to a value in strokes per minute (the drive speed). The drive voltage should settle to a steady value before the press begins stroking, but will usually fluctuate through the stroke as the press slows down while doing work and speeds up as energy is restored by the motor through the stroke.

2.5 Command Volts and Command Speed

The speed at which the motor drive will cause the press to run is determined by the command signal sent to the drive. This signal is usually 0 to 10 volts but may in some cases be 4 to 20 milliamps. The press synchronization module can output 0 to 10 volts for the slave drive command signal. A converter must be used if the slave drive needs a 4 to 20 milliamp signal. The module can read 0 to 10 volts or 4 to 20 milliamps for the master press command signal input. The module does not output a master drive signal (unless master slew rate limited pass-through is used, see section 4.4.3), but reads the same signal that is sent to the master drive in order to properly control the slave press speed when stroking.

3 OPERATION

3.1 Main Screen

The main screen shown in Figure 1 provides a broad overview of the operation and status of the synchronization system. The information presented in this screen allows the operator to determine how well the master and slave press are synchronized and what synchronization mode, if any, is active.

When the presses are not stroking but are both “ready to synchronize”, the module will be in speed synchronization mode. This mode will attempt to drive the slave press drive output to a value that will match the speed reported from the master drive as closely as possible.

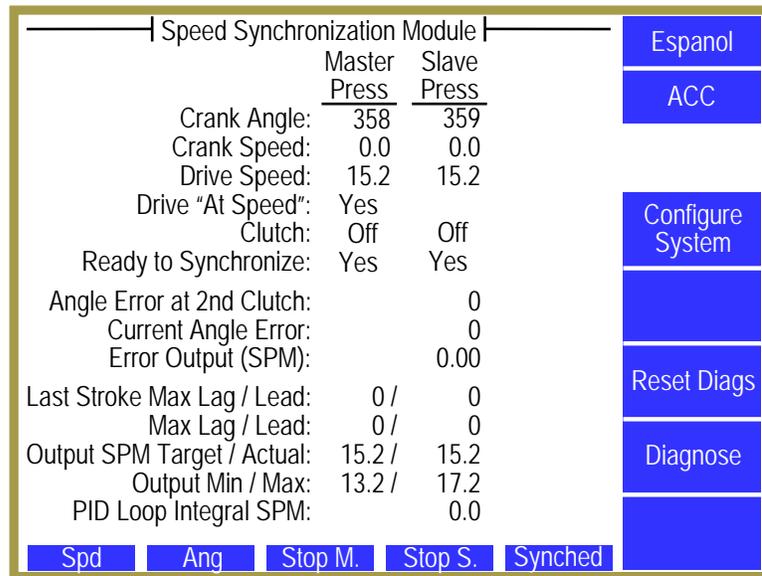


Figure 1: Main Screen

Once both presses are stroking, the module uses the angular difference between the presses to determine what output to send to the slave drive in order to drive the angular difference as closely as possible to 0.

The row of blue indicators shown along the bottom of the screen in Figure 1 tells the operator which of several conditions are active. Though all of the indicators are shown in the figure for illustration, they will not all be “on” at the same time.

The elements of this screen are:

- Crank Angle*** The current crankshaft angles reported for the master and slave presses.
- Crank Speed*** This is the current actual speed of the master and slave crankshafts. This will be 0 when the presses are not actually stroking. While stroking, these values will typically fluctuate somewhat as the press slows down while doing work and speeds back up as the motor replaces the lost energy in the flywheel.
- Drive Speed*** These are the equivalent stroking speeds the flywheels are turning at as reported by the motor drives for the master and slaves presses. In speed synchronization mode the slave drive output is adjusted to make the slave drive speed match the master drive speed.
- Drive “At Speed”*** An output from the master press drive can optionally be used to tell the module that the master drive has arrived at its set speed. If not used, this will always show “yes”. If used, the “Synched” output will not turn on if the master drive is not “At Speed”.

<i>Clutch</i>	This shows the state of the master and slave clutches. If “On” then the press should be stroking.
<i>Ready to Synchronize</i>	This indicates whether the press has reported that it is ready to synchronize with the other press. Depending on configuration (see section 4.7.1), this can come from mode status through the high speed serial link or from digital inputs on the module that can be driven by other automation or even manually.
<i>Angle Error at 2nd Clutch</i>	In some cases the slave press may need to be started a little before or a little after the master press in order to compensate for different starting characteristics such as clutch engagement time. This line shows the initial angular difference between the slave press and the master press a user configurable amount of time (see section 4.2.7) after both presses have started. Ideally, this number would be 0. This diagnostic allows the user to find the time delay necessary to minimize the initial angle difference. A negative number indicates the slave is behind the master, and a positive number indicates the slave is ahead of the master.
<i>Current Angle Error</i>	This is the current angle difference between the slave press and the master press when they are stroking (this number will always be 0 when the presses are not running even if they are at different angles). This number may change throughout the stroke as one press slows down more than the other as it does work.
<i>Error Output (SPM)</i>	This shows the current SPM error signal generated from the current angular difference multiplied by the “Error Angle Gain” (see section 4.3.5). This is largely a diagnostic value generated for telephone support and is not directly used by the system.
<i>Last Stroke Max Lag / Lead</i>	These two numbers show the maximum lag and lead of the slave press relative to the master press for the last complete stroke. Unless the loads on the presses are nearly identical (as well as the presses themselves), these numbers should not be expected to be 0 as one press will slow down more during the stroke than the other.
<i>Max Lag / Lead</i>	These two numbers show the maximum lag and lead of the slave press relative to the master press since the last time the Reset Diags softkey was pressed. Use this to determine the maximum angle difference for multiple strokes.
<i>Output SPM Target / Actual</i>	This shows the target and actual output to the slave drive in SPM. The difference between the target and the actual value is that the actual value “chases” the target value at a maximum slew rate set in the configuration area (see section 4.4.2). This prevents large jumps in output value which could destabilize the speed control.
<i>Output Min / Max</i>	The slave drive output is only allowed to vary a certain amount from the master command signal. This amount is set in the configuration area (see section 4.4.1). This line shows the minimum and maximum values that the slave drive output is allowed to take under the current conditions.

<i>PID Loop Integral SPM</i>	This shows the amount of PID integral loop “windup” in SPM for the slave drive output loop. This is primarily for telephone support purposes for the rare circumstance in which an integral gain factor is used.
<i>“Spd” Indicator</i>	When the blue “Spd” indicator is showing at the bottom of the screen, the module is in speed synchronization mode. This should be the case when both presses are stopped, both presses show “Ready to Synchronize”, and “Drive at Speed” shows “Yes”. In this mode the module will adjust the slave drive output to try to match the master press drive speed.
<i>“Ang” Indicator</i>	When the blue “Ang” indicator is showing at the bottom of the screen, the module is in angle synchronization mode. This will be the case when both presses are stroking, both presses show “Ready to Synchronize”, and “Drive at Speed” shows “Yes”. In this mode the module will adjust the slave drive output to try to make the angular difference between the master and slave presses go to 0.
<i>“Stop M”. Indicator</i>	When the blue “Stop M.” indicator is showing at the bottom of the screen, the module has asserted a stop to the master press. This will be the case when the master press is “Ready to Synchronize” but the slave is not. This prevents the master from stroking in a synchronized mode when the slave is not ready to go.
<i>“Stop S”. Indicator</i>	When the blue “Stop S.” indicator is showing at the bottom of the screen, the module has asserted a stop to the slave press. This will be the case when the slave press is “Ready to Synchronize” but the master is not. This prevents the slave from stroking in a synchronized mode when the master is not ready to go.
<i>“Synched”. Indicator</i>	When the blue “Synched.” indicator is showing at the bottom of the screen, the module has asserted that the master and slave press are in synchronization. The presses are considered to be in synchronization in the “Spd” mode when the drive speeds are within the “Speed Synch Tolerance” (see section 4.2.5). The presses are considered to be in synchronization in the “Ang” mode when the presses are stroking and the angle difference is within the “Angle Synch Tolerance”.
<i>Configure System Softkey</i>	This softkey brings up the system configuration screens. The system configuration area is where parameters that control the system are set up. Note that it is only present when the RUN/PROG key switch is in the PROG position. In addition, the system configuration code is required to gain access to these screens. See section 4 for more information.
<i>Reset Diags Softkey</i>	Pressing this softkey will reset the “Max Lead / Lag” diagnostic values.
<i>Diagnose Softkey</i>	This softkey will bring up some additional diagnostic screens. See section 3.2 for details.

3.2 Diagnostic Screens

The diagnostic screens allow for troubleshooting of the system. By isolating problems to a particular area, time can be saved when some part of the system is working incorrectly. Not only do these screens allow for troubleshooting the synchronization module, but calibration modes are available that allow both digital and analog outputs to be set to specific values to aid in troubleshooting external equipment as well.

3.2.1 Main Diagnostic Screen

Press the Diagnose softkey in the Main screen (shown in Figure 1) to display the main diagnostic screen shown in Figure 2.

Master Recv Count (CAN1):	84365465	Espanol
Master Recv Count/Sec (CAN1):	2499	ACC
Slave Recv Count (CAN2):	83435456	Diagnose
Slave Recv Count/Sec (CAN2):	2500	
Speed Error at Checkpoint (SPM):	0.00	
Angle Error at Checkpoint:	0	
Error Speed Target (SPM):	0.00	Digital I/O
Error Speed Actual (SPM):	0.00	Analog I/O
		Exit

Figure 2: Main Diagnostic Screen

The elements of this screen are:

<i>Master Recv Count (CAN1)</i>	This is the message count from the CAN1 port (the CAN port on the main OIT logic board). While the press connected to this port is powered up, the count should continually increase.
<i>Master Recv Count/Sec (CAN1)</i>	This is the number of message per second being received from the CAN1 port. It should be at least 2450 while the press connected to this port is powered up.
<i>Slave Recv Count (CAN2)</i>	This is the message count from the CAN2 port (the CAN port on the 805-7 option board). While the press connected to this port is powered up, the count should continually increase.
<i>Slave Recv Count/Sec (CAN2)</i>	This is the number of message per second being received from the CAN2 port. It should be at least 2450 while the press connected to this port is powered up.
<i>Speed Error at Checkpoint (SPM)</i>	This shows the speed difference between the slave press and the master press at the last error checkpoint. If this number is negative then the slave press was slower than the master; if positive then the slave press was faster than the master.
<i>Angle Error at Checkpoint</i>	This shows the angle difference between the slave press and the master press at the last error checkpoint. If this number is negative then the slave press was lagging the master; if positive then the slave press leading the master.

Error Speed Target (SPM)

This is the additional target speed over the base speed setting of the slave drive that the system has set at the last error checkpoint in order to try to make the angular difference between the presses go to 0. It can be positive or negative.

Error Speed Actual (SPM)

This is the actual error speed being applied to the system. It will go to the error speed target but limited by the error slew rate limit as set in the configuration (see section 4.3.2).

Digital I/O Softkey

This softkey brings up the digital input and output diagnostic screen.

Analog I/O Softkey

This softkey brings up the analog input and output diagnostic screen.

3.2.2 Digital I/O Diagnostic Screen

As shown in Figure 3, the Digital I/O diagnostic screen shows details about the state of the digital inputs and outputs of the module. To get to this screen, press the Digital I/O softkey in the main diagnostic screen as seen in Figure 2.

Each of the four digital inputs is shown in the upper portion of this screen. There are two rows of information for each input. Values to the right of the “R:” indicate the “raw” state of the input without debounce applied. Each input has a programmable “turn on” and “turn off” debounce value set in the configuration area (see section 4.8). The values to the right of the “D:” show the debounced state of the input. Digital input 4 is not currently used by the module but its state is still shown. It may be used in future implementation of the synchronization software.

Digital Inputs			Espanol
	State	On Count	
Master Ready to Sync (Input D1A/B)	R: On D: On	R: 1 D: 1	ACC
Slave Ready to Sync (Input D2A/B)	R: On D: On	R: 1 D: 1	Diagnose
Master Drive At Speed (Input D3A/B)	R: On D: On	R: 1 D: 1	
Digital Input 4 (Input D4A/B)	R: Off D: Off	R: 0 D: 0	
Digital Outputs			
Master Press Stop (Output O1A/B)		On	Enter Cal. Mode
Slave Press Stop (Output O2A/B)		On	
Presses Synchronized (Output O3A/B)		On	
Digital Output 4 (Output O4A/B)		Off	
			Exit

Figure 3: Digital I/O Diagnostic Screen

These two views of the input can be used to diagnose intermittent connections or improperly functioning relay outputs that are driving the inputs. The “State” column shows whether the input is on or off. The “On Count” column shown how many times the input has turned on. This is especially useful to detect conditions where the input is very briefly dropping out. Note that the “raw” and “debounced” count values will not always be the same - and in fact probably will not be if driven by an electromechanical relay contact and debounce is used.

The digital outputs are show in the bottom portion of the screen with a simple “On” or “Off” state. Digital Output 4 is not currently used by the module but may be used in future implementation of the synchronization software.

The Enter Cal. Mode softkey puts the outputs in a special mode that allows the operator to manually toggle them on and off for diagnostic purposes. This is especially useful for checking the end-to-end connection of these outputs to whatever automation is using them.

The Enter Cal. Mode softkey will only be displayed when the RUN/PROG key is in the PROG position. When pressed, a screen will appear asking for a configuration code. After the code is properly entered, the calibration mode will become active and the screen will look like Figure 4. When the calibration mode is first entered, all outputs will be set to “Off”.

Digital Inputs				Espanol
	State	On Count		
Master Ready to Sync (Input D1A/B)	R: On D: On	R: 1 D: 1		ACC
Slave Ready to Sync (Input D2A/B)	R: On D: On	R: 1 D: 1		Diagnose
Master Drive At Speed (Input D3A/B)	R: On D: On	R: 1 D: 1		
Digital Input 4 (Input D4A/B)	R: Off D: Off	R: 0 D: 0		
Digital Outputs				Espanol
Master Press Stop (Output O1A/B)		Off		Exit Cal. Mode
Slave Press Stop (Output O2A/B)		Off		
Presses Synchronized (Output O3A/B)		Off		
Digital Output 4 (Output O4A/B)		Off		
Toggle O1A/B	Toggle O2A/B	Toggle O3A/B	Toggle O4A/B	Exit

Figure 4: Digital I/O Diagnostic Screen in Cal Mode



WARNING: Make sure the effects the outputs will have on the system as a whole are understood before entering this mode. Depending on the logic employed by automation within the system, it is possible that changing the state of these outputs may result in operation of various parts of the system, up to and including the stroking of the presses themselves.

In this mode, pressing the “Toggle” buttons at the bottom of the screen will change the respective output from “On” to “Off” or “Off” to “On”.

3.2.3 Analog I/O Diagnostic Screen

As shown in Figure 5, the Analog I/O diagnostic screen shows details about the state of the analog inputs and outputs of the module. To get to this screen, press the Analog I/O softkey in the main diagnostic screen as seen in Figure 2.

Each of the four analog inputs is shown in the top portion of this screen. For each input the current ADC (analog to digital converter) value and input voltage is shown. For the “drive in” inputs, the press stroking SPM that the voltage represents is also shown. Note that the SPM will only be accurate if the Calibration Settings for those inputs are properly configured (see section 4.6).

Analog Inputs				Espanol
	ADC	Volts	SPM	
Slave Drive In (SI1)	2085	5.117	15.2	ACC
Slave Local Command In (SI2)	0	0.000		
Master Drive In (MI1)	2068	5.099	15.2	Diagnose
Master Command In (MI2)	2075	5.117		
Analog Outputs				Espanol
	DAC	Volts	SPM	
Slave Drive Command Out (SO1)	2083	5.104	15.2	
Master Drive Command Out (SO2)	2091	5.111		Enter Cal. Mode
				Exit

Figure 5: Analog I/O Diagnostic Screen

To verify that the module hardware reading these inputs is functioning correctly, a simple voltmeter can be used to verify that the displayed voltage is within 1 or 2 percent of the actual voltage. When checking these voltages, always use the “common” that is on the same connector as the input. The master and slave inputs are isolated from each other and from the system ground. When checking SI1 or SI2, use SCM for the common. When checking MI1 or MI2, use MCM for the common. Using other ground points for the system will result in invalid readings. The ADC readings for each input are generally not useful to the operator, but may be helpful for Link to use in telephone support.

The analog outputs for the module are shown in bottom portion of the screen. There are only two outputs and both of them use the slave side isolation even though SO2 is used for the master drive command if the slew rate limited master passthrough function is used. If SO2 is used, an external isolation amplifier must be provided between this output and the master drive.

Each output shows the current DAC (digital to analog converter) value and the voltage being output. For the “Slave Drive Command Out” output, the press stroking SPM that the voltage represents is also shown. Note that the SPM will only be accurate if the Calibration Settings for this output is properly configured (see section 4.6).

To verify that the module hardware for these outputs is functioning correctly, a simple voltmeter can be used to verify that the displayed voltage is within 1 or 2 percent of the actual voltage. If the reading does not agree, disconnect the wires from the connector and take the reading again. If the reading is now correct, then it is likely that the output is shorted or excessively loaded. Each output can drive about 15 milliamps. The outputs won’t be damaged by a short circuit to ground, but can be damaged by excessive voltage.

The Enter Cal. Mode softkey puts the outputs in a special mode that allows the operator to manually set the voltage for diagnostic purposes. This is especially useful for checking the end-to-end connection of these outputs to the drives using them.

The Enter Cal. Mode softkey will only be displayed when the RUN/PROG key is in the PROG position. When pressed, a screen will appear asking for a configuration code. After the code is properly entered, the calibration mode will become active and the screen will look like Figure 6. When the calibration mode is first entered, both outputs will be set to 0 volts.

Analog Inputs				Espanol
	ADC	Volts	SPM	ACC
Slave Drive In (SI1):	2085	5.117	15.2	Diagnose
Slave Local Command In (SI2):	0	0.000		
Master Drive In (MI1):	2068	5.099	15.2	
Master Command In (MI2):	2075	5.117		
Analog Outputs				
	DAC	Volts	SPM	Exit Cal. Mode
Slave Drive Command Out (SO1)	816	2.000	10.0	
Master Drive Command Out (SO2)	1227	2.999		Exit

Figure 6: Analog I/O Diagnostic Screen in Cal Mode

WARNING:



Make sure the effects the outputs will have on the system as a whole are understood before entering this mode. As these outputs are typically used to set the motor speed, depending on how the drives are configured it may be possible to enter a voltage that would result in excessive and/or dangerous flywheel speeds.

In this mode, pressing inside the blue bordered DAC or Volts boxes will allow the operator to enter a DAC value or voltage for the output.

4 CONFIGURATION

4.1 The Main Configuration Screen

The configuration screens of the synchronization module are accessed by selecting the **Configure System** softkey in the main screen (see Figure 1 on page 6) with the RUN/PROG switch in the PROG position. The operator terminal will request entry of the configuration access code and upon correct entry will provide the configuration menu shown in Figure 7.

This screen provides access to the individual configuration screens discussed in the following sections.

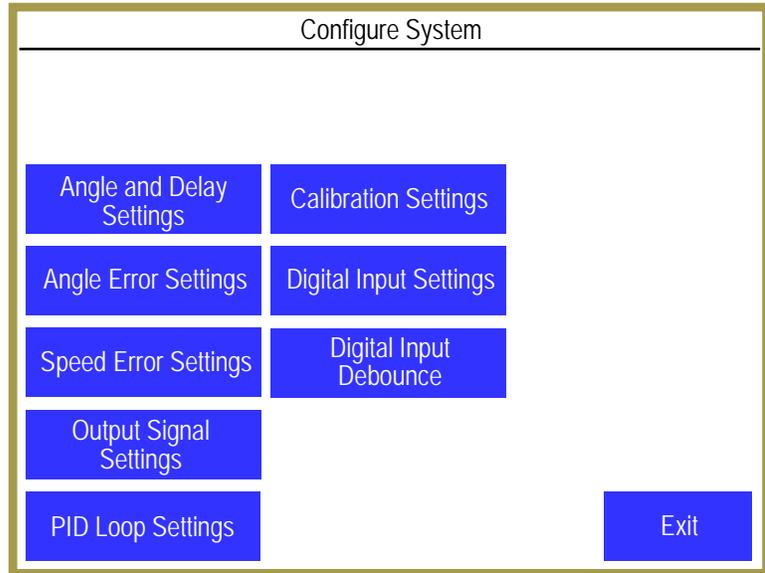


Figure 7: Main Configuration Screen

4.2 The Angle and Delay Settings Configuration Screen

Press the **Angle and Delay Settings** softkey in the main configuration screen as shown in Figure 7 to display the screen shown in Figure 8.

The following sections describe the settings in this screen.

4.2.1 Slave Press Angle Difference

This is the angle that the slave press will try to maintain relative to the master press during stroking. For the presses to operate in “lock step” this would be set to 0. In some applications, it may be necessary to operate the slave so many degrees leading or lagging the master. For instance, if this was set to 45 degrees lagging, the synchronization module would adjust the slave drive output in such a way as to cause the slave to be at 315 degrees when the master was at 0 degrees while stroking. Note that the initial difference would have to be managed by whatever automation was starting the presses as they will still stop at top. Using the diagnostics provided by this module, an appropriate delay in starting the slave press can be determined to start it 45 degrees behind the master. Once stroking, the module will maintain that difference.

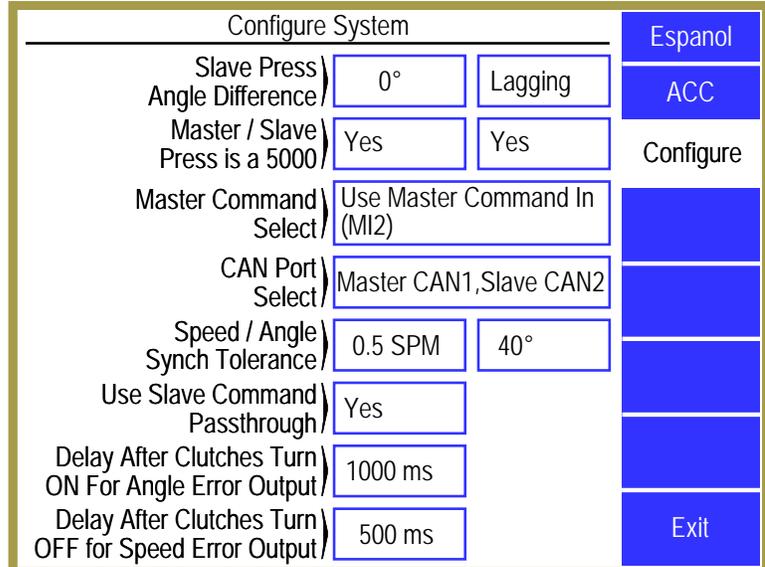


Figure 8: Angle and Delay Settings Configuration Screen

4.2.2 Master/Slave Press is a 5000

For System 5000 press controls, a slight difference in handling the information coming over the high speed serial bus is necessary. These settings tell the module to apply that difference if the system it is talking to is a System 5000.

4.2.3 Master Command Select

The master command that the module uses to synchronize the slave speed to the master speed can be set to either “Use Master Command In (MI2)” or “Use Master Drive In (MI1)”. This should typically be set to “Use Master Command In (MI2)” as the master drive in voltage may vary under stroking conditions.

4.2.4 CAN Port Select

The module has to know which CAN port is connected to the master and which CAN port is connected to the slave in order to properly function. This setting can be either “Master CAN1, Slave CAN2” or “Master CAN2, Slave CAN1”. CAN1 is the port on the main OIT logic board and CAN2 is the port on the 805-7 option module.

4.2.5 Speed / Angle Synch Tolerance

The “Synched” digital output is controlled by the two tolerance values set for this parameter.

In the initial speed synchronization mode before stroking starts, the “Synched” output will not be set unless the speed difference between the master and slave press is less than the speed tolerance.

After stroking starts, the “Synched” output will not stay set unless the angle difference between the master and slave press is less than the angle tolerance.

4.2.6 Use Slave Command Passthrough

Slave Command Passthrough is an optional feature that allows the slave press to set its own speed when it is NOT “Ready to Synch”. If this parameter is set to “Yes”, then when the slave press is NOT “Ready to Synch”, the voltage from SI2 (Slave Local Command In) will be reproduced at SO2 (Slave Drive Command Out). This allows slave local control of its own speed in setup modes or any other condition where it may be necessary. If this parameter is set to “No” then the slave will follow the master press speed at all times.

4.2.7 Delay After Clutches Turn ON for Angle Error Output

This parameter controls how the synchronization module handles the transition from speed synchronization mode to angle synchronization mode when the presses start stroking. The presses may have different starting characteristics because of clutch, tooling, or other machine characteristics. Once the 1st clutch turns on, the speed command to the slave press is frozen where it is. After the second clutch turns on a timer starts and when it exceeds this parameter, the system switches over to angle synchronization mode. It will then start to check the angle difference at the “Error Check Angle” and make adjustments based on that.

4.2.8 Delay After Clutches Turn OFF for Speed Error Output

This parameter controls how the synchronization module handles the transition from angle synchronization mode to speed synchronization mode when the presses stop stroking. Once the 1st clutch turns off, the speed command to the slave press is frozen where it is. After the second clutch turns off a timer starts and when it exceeds this parameter, the system switches over to speed synchronization mode.

4.3 The Angle Error Settings Configuration Screen

Press the **Angle Error Settings** softkey in the main configuration screen as shown in Figure 7 to display the screen shown in Figure 9. This screen has parameters that primarily affect the behavior of the module when in the angle synchronization mode (during stroking)

The following sections describe the settings in this screen.

4.3.1 Error Maximum SPM

Regardless of the “Error Speed Loop Gain” and angle difference between the two presses, the system will not allow a speed correction factor larger than this parameter. This prevents wild changes in speed should some error condition occur.

4.3.2 Error Neg / Pos Slew Rate Limit

An error SPM (a correction factor) is calculated at the “Error Check Angle” or after the “Error Speed Interval” depending on the “Error Signal Method” selected. The negative and positive slew rate limits set here are applied to the correction factor so that the speed change requested will be gradually applied. Because most presses can speed up faster than they slow down, the positive and negative slew rate can be set independently.

4.3.3 Error Speed Loop Gain

This parameter sets how much of the calculated speed correction factor will be applied to the slave drive command output each time it is calculated. This value should always be less than 1. Smaller values will result in more gradual changes will help to minimize overshoot.

4.3.4 Error Signal Method

This parameter determines which of three methods will be applied to generate a correction speed while the presses are stroking.

The screenshot shows the 'Configure System' screen with the following settings:

Configure System		Espanol	
Error Maximum SPM	0.7	ACC	
Error Neg / Pos Slew Rate Limit (SPM/sec)	0.50	0.50	Configure
Error Speed Loop Gain	0.40		
Error Signal Method	Check at Angle		
Error Angle Gain (SPM/Deg)	0.004		
Error Check Angle	340°		
Error Speed Interval (msecs)	500		
Bottom Start / End Angle	100°	260°	Exit

Figure 9: Angle Error Settings Configuration Screen

“Check at Angle” - This checks the angle difference at the angle specified by the “Error Check Angle”. In addition, an SPM difference is calculated. The error angle is multiplied by the “Error Angle Gain” to calculate a desired SPM correction to close the gap. The correction is compared to the current SPM difference to come up with the actual correction factor. The correction factor is then multiplied by the “Error Speed Loop Gain” and then applied to the slave drive command output. Note that when the slave press passes the “Error Check Angle”, at least “Error Speed Interval” milliseconds must have passed or the system will wait until it passes the check angle again to make the calculation.

“Timed” - This works like “Check at Angle” except that the check is made purely when “Error Speed Interval” milliseconds have elapsed. This means that the check will generally be made at a variety of angles. Since the presses slow down and speed up through the stroke as work is done and energy replaced by the motor, this can result in a poorer “lock in” than the “Check at Angle” method. In some cases with extremely slow presses, however, it may result in a lower maximum angle difference at startup since it will start making corrections sooner.

“Timed (exclude bottom)” - This is same as timed except that if the “Error Speed Interval” expires while the press is at bottom (as defined by the “Bottom Start / End Angle” parameters), it will wait until the press is not at the bottom before running the correction calculation. This may result in less variation due to changing press speed as work is done as the most variation will usually be at the bottom.

In general, the “Check at Angle” should be tried first.

4.3.5 Error Angle Gain

This parameter controls how “hard” the system will make a correction based on the angle difference while the presses are stroking. This parameter is in SPM per degree of difference. The bigger this number, the more correction will be applied for a given angle difference. If this parameter is made too large, the system may become uncontrollable.

4.3.6 Error Check Angle

This parameter is used when the “Error Signal Method” is set to “Check at Angle”. This is the angle at which the angle error will be checked while the presses are stroking. It can be set anywhere, but somewhere around 340 degrees will probably work well for most applications.

4.3.7 Error Speed Interval

This parameter determines how often the angle difference is checked when the presses are stroking and the “Error Signal Method” is set to one of the “Timed” methods. It also serves as a minimum time when the method is set to “Check at Angle”. It should probably not be set smaller than about 500 milliseconds as this can affect the accuracy of the SPM difference calculation. A good place to start when using the “Timed” methods is about 1000 milliseconds. When using “Check at Angle” 500 milliseconds would be reasonable.

4.3.8 Bottom Start / End Angle

These parameters define where “bottom” is when the “Error Signal Method” is set to “Timed (exclude bottom)”

4.4 The Output Signal Settings Configuration Screen

Press the Output Signal Settings softkey in the main configuration screen as shown in Figure 7 to display the screen shown in Figure 10.

The following sections describe the settings in this screen.

4.4.1 Slave Output Maximum SPM Difference

This limits the output to the slave drive to be the master SPM setting plus or minus this amount. In error conditions, this will prevent the slave drive from getting an unreasonable speed command.

4.4.2 Slave Output Negative and Positive Slew Rate Limits

These two parameters set limits on how fast the command signal to the slave drive can change. This can help in ensuring slow, controlled changes to the system.

4.4.3 Master Passthrough Negative and Positive Slew Rate Limits

If the master command passthrough capability is used, this limits how fast the master drive command can change. This would typically be used when the production process must be “ramped up” in speed after stroking has started. In order to keep the master and slave presses synchronized, the speed change should be made gradually. These limits are applied to the “Master Command In (MI2)” signal and the slew rate limited signal is output on “Master Drive Command Out (SO2)”. Note that this output uses the slave drive common, and therefore an external isolation amplifier MUST be used between the module output and the master drive.

The screenshot shows a configuration screen titled "Configure System". On the right side, there is a vertical menu with buttons for "Español", "ACC", "Configure", and "Exit". The main area contains several settings, each with a text label and a numeric input field:

Setting	Value
Slave Output Maximum SPM Difference	3
Slave Output Negative Slew Rate Limit (SPM/sec)	0.50
Slave Output Positive Slew Rate Limit (SPM/sec)	1.00
Master Passthrough Neg. Slew Rate Limit (SPM/sec)	0.25
Master Passthrough Pos. Slew Rate Limit (SPM/sec)	0.25

Figure 10: Output Signal Settings Configuration Screen

4.5 The PID Loop Settings Configuration Screen

Press the PID Loop Settings softkey in the main configuration screen as shown in Figure 7 to display the screen shown in Figure 11.

The PID Loop settings apply to the slave drive output. This is primarily to drive the “lock in” of the slave speed to the master speed before stroking starts. It can also be used to accommodate poorly tuned motor drives that would otherwise overshoot or undershoot when sudden changes in the speed command voltage are applied.

The following sections describe the settings in this screen.

Configure System		Espanol
PID Loop Proportional Gain	0.010	ACC
PID Loop Integral Gain	0.0000	Configure
PID Loop Derivative Gain	0.200	
PID Loop Integral Limit (SPM)	2	
PID Run Interval (msec)	80	
		Exit

Figure 11: PID Loop Settings Configuration Screen

4.5.1 PID Loop Proportional Gain

This is the gain applied to the difference between the command and the current speed feedback. This should usually be far less than 1. 0.01 is a reasonable starting value. Using too large a value will cause oscillation of the speed command. Too small and the response will become very sluggish.

4.5.2 PID Loop Integral Gain

This gain should not typically be used in this application and is set to 0. It has been left as a parameter in case some other application or special circumstance requires it.

4.5.3 PID Loop Derivative Gain

This gain is applied based on the rate of change in the output signal. A reasonable starting value is 0.200. Too large a value can result in instability of the output.

4.5.4 PID Loop Integral Limit

This limits how much of the integral term is allowed to “build up” if any integral gain is used. It has no effect if the integral gain is 0 (which is typical).

4.5.5 PID Run Interval

This controls how often the PID calculations run. 80 milliseconds should be a reasonable value for most applications.

4.6 The Calibration Settings Configuration Screen

Press the Calibration Settings softkey in the main configuration screen as shown in Figure 7 to display the screen shown in Figure 12.

The calibration screen contains parameters that allow the module to map voltages from the master and slave drives to the strokes per minute run rate that those voltages represent. This means that the master and slave drives do not have to use the same voltages for the same speed in order for the module to handle them.

The system needs two points for each input or output voltage corresponding to a low and a high SPM to do this conversion.

	SPM	Drive Volts	Command Volts	Espanol
Master Low Speed	14.5	4.756	4.739	ACC
Master High Speed	19.8	6.488	6.464	Configure
Slave Low Speed	15.0	7.380	7.299	
Slave High Speed	20.0	9.812	9.749	
Master Drive In (MI1):		4.415		Enter Cal. Mode
Master Command In (MI2):		4.390		
Slave Drive In (SI1):		7.647		
Master Crank Speed:		0.0	0.0	
Slave Crank Speed:		0.0	0.0	Exit

Figure 12: Calibration Settings Configuration Screen

The information shown at the bottom of the screen gives the necessary information to complete the calibration.

To calibrate the master side:

- 1) Set the master press to run at or near the lowest production SPM that will be used.
- 2) Wait until the “Master Drive In (MI1)” and “Master Command In (MI2)” voltages displayed below the calibration settings settle to a stable value. Once they have, enter those voltages in the “Master Low Speed” row Drive and Command Volts parameters.
- 3) Without changing the speed command, run the master press in continuous mode. The first number to the right of “Master Crank Speed” near the bottom of the screen is the current crank speed and will probably fluctuate through the stroke to some degree. The second number to the right of “Master Crank Speed” is a high precision 4 stroke running average of the master press speed. Wait at least 5 or 6 strokes and when the reading has settled to a stable value, enter that value in the “Master Low Speed” SPM parameter (you will need to stop the press first).
- 4) Now set the press to run at or near the highest production SPM that will be used.
- 5) Wait until the “Master Drive In (MI1)” and “Master Command In (MI2)” voltages displayed below the calibration settings settle to a stable value. Once they have, enter those voltages in the “Master High Speed” row Drive and Command Volts parameters.
- 6) Without changing the speed command, run the master press in continuous mode. Wait at least 5 or 6 strokes and when the high precision SPM reading has settled to a stable value, enter that value in the “Master High Speed” SPM parameter (you will need to stop the press first).

To calibrate the slave side we need to put this screen in calibration mode. Since the module controls the command voltage to the slave drive, calibration mode allows the user to directly enter a voltage that will be sent to it.

When pressed, the Enter Cal. Mode softkey will cause the screen to look like Figure 13. When the calibration mode is first entered, the slave output will be set to 0 volts. In this mode, pressing inside the blue bordered Slave Drive Command (SO1) Volts box will allow the operator to enter a voltage for output to the slave drive.

	SPM	Drive Volts	Command Volts	Espanol
Master Low Speed	14.5	4.756	4.739	ACC
Master High Speed	19.8	6.488	6.464	Configure
Slave Low Speed	15.0	7.380	7.299	
Slave High Speed	20.0	9.812	9.749	
Master Drive In (MI1):		4.415		Exit Cal. Mode
Master Command In (MI2):		4.390		
Slave Drive In (SI1):		2.003		
Master Crank Speed:		0.0	0.0	
Slave Crank Speed:		0.0	0.0	
Slave Drive Command (SO1) Volts		2.000		Exit

Figure 13: Calibration Settings Configuration Screen in Cal. Mode



WARNING: Make sure the effects the output will have on the system as a whole are understood before entering this mode. As this output is typically used to set the motor speed, depending on how the drive is configured it may be possible to enter a voltage that would result in excessive and/or dangerous flywheel speed.

To calibrate the slave side:

- 1) Enter calibration mode as described above.
- 2) Enter a voltage in the “Slave Drive Command (SO1) Volts” parameter that results in the slave running at or near to the lowest SPM that will be used in production.
- 3) Run the slave press in continuous mode. The first number to the right of “Slave Crank Speed” near the bottom of the screen is the current crank speed and will probably fluctuate through the stroke to some degree. The second number to the right of “Slave Crank Speed” is a high precision 4 stroke running average of the slave press speed. Wait at least 5 or 6 strokes and when the reading has settled to a stable value, enter that value in the “Slave Low Speed” SPM parameter (you will need to stop the press first). If the initial value of “Slave Drive Command Volts” did not result in the desired speed, just change it and repeat this step.
- 4) With the slave press stopped, wait for the “Slave Drive In (SI1)” reading to stabilize to a steady value. Enter this value in the “Drive Volts” column of the “Slave Low Speed” row. Also enter the “Slave Drive Command Volts” into the “Command Volts” column of the “Slave Low Speed” row.
- 5) Now enter a voltage in the “Slave Drive Command (SO1) Volts” parameter that results in the slave running at or near to the highest SPM that will be used in production.

- 6) Run the slave press in continuous mode. Wait at least 5 or 6 strokes and when the precision SPM reading has settled to a stable value, enter that value in the “Slave High Speed” SPM parameter (you will need to stop the press first). If the initial value of “Slave Drive Command Volts” did not result in the desired speed, just change it and repeat this step.
- 7) With the slave press stopped, wait for the “Slave Drive In (SI1)” reading to stabilize to a steady value. Enter this value in the “Drive Volts” column of the “Slave High Speed” row. Also enter the “Slave Drive Command Volts” into the “Command Volts” column of the “Slave High Speed” row.
- 8) Exit the calibration mode by pressing the Exit Cal. Mode softkey.

4.7 The Digital Input Settings Configuration Screen

Press the Digital Input Settings softkey in the main configuration screen as shown in Figure 7 to display the screen shown in Figure 14.

The following sections describe the settings in this screen.

4.7.1 “Ready to Synchronize” Signal

The signals from the master and slave presses that tell the module they are ready to synchronize can come from one of two places:

User Master/Slave Ready Inputs - This selection causes the module to use the D1A/B and D2A/B digital inputs for the ready signals. These inputs must be driven by means external to the module, such as keyed selector switches, PLC, or other automation.

User “Setup Mode” Internal Flags - This selection causes the module to use internal information from the high speed serial busses connected to the master and slave presses for the ready signals. If the master or slave signals that it is in setup mode, then it is NOT ready to synchronize. Otherwise it IS ready to synchronize.

4.7.2 Use “Master Drive At Speed” Input

The synchronization module can optionally check an “At Speed” output from the master drive. If enabled, then master drive must report that it has reached its set speed before the module will turn on the “Synched” output. If set to “No”, then the master drive is always considered to be “At Speed”.

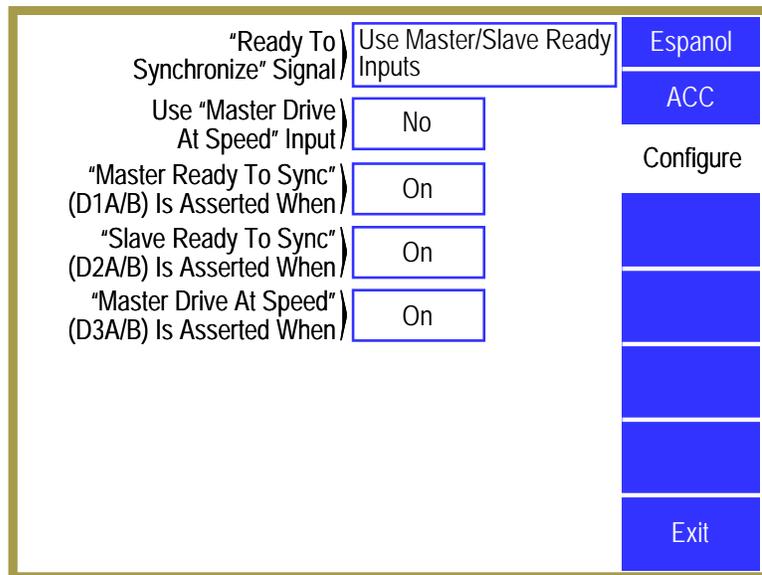


Figure 14: Digital Input Settings Configuration Screen

4.7.3 Input Assertion Settings

The three “XXX is Asserted When” settings control what the module considers to be an active or asserted level on an input. For example, when ““Master Drive At Speed” (D3A/B) Is Asserted When” is set to “On”, then master drive is recognized as “At Speed” when the input is on (has a voltage applied to it). If this parameter was instead set to “Off”, then the drive would be recognized as “At Speed” when the input was NOT turned on. This allows some flexibility when connecting the module to various systems.

4.8 The Digital Input Debounce Configuration Screen

Press the Digital Input Debounce softkey in the main configuration screen as shown in Figure 7 to display the screen shown in Figure 15.

This screen allows setting the on and off debounce times for each digital input in order to accommodate electromechanical relay or switch contact bounce. The “Input “On” Debounce Time” is the time the input must be continuously “On” before it is treated by the system as “On”. Likewise the “Input “Off” Debounce Time” is the amount of time the input must stay continuously “Off” before the system treats it as “Off”.

	Input “On” Debounce Time	Input “Off” Debounce Time	Espanol
Master Ready to Sync (Input D1A/B)	100 ms	100 ms	ACC
Slave Ready to Sync (Input D2A/B)	100 ms	100 ms	Configure
Master Drive At Speed (Input D3A/B)	100 ms	100 ms	
Digital Input 4 (Input D4A/B)	100 ms	100 ms	
			Exit

Figure 15: Digital Input Debounce Configuration Screen

If necessary, these can also be used to implement time delays for the system. For instance, if it was necessary for a 3 second delay to occur from the time the slave press “Ready To Synch” signal is generated by the automation and stroking, then the input “On” debounce time for that input could be set to 3000 milliseconds.

5 INSTALLATION

The 805-7 synchronization module can be used ONLY with the OmniLink 805 Operator Terminal. The board is installed directly into the operator terminal.

5.1 Mounting the Board

If the press synchronization module was not installed at the factory, it will need to be installed into the OmniLink 805 Operator Terminal (OIT).

The board mounting location is shown in Figure 16 highlighted in yellow. Five 6-32 X 1/4" screws with lock washers are required to mount the board to the indicated mounting standoffs. Also note the indicated board connector in the figure. The 805-7 mating connector must line up correctly with this connector. If the mounting holes do not seem to line up correctly after plugging in the board, remove the board and correct the alignment.

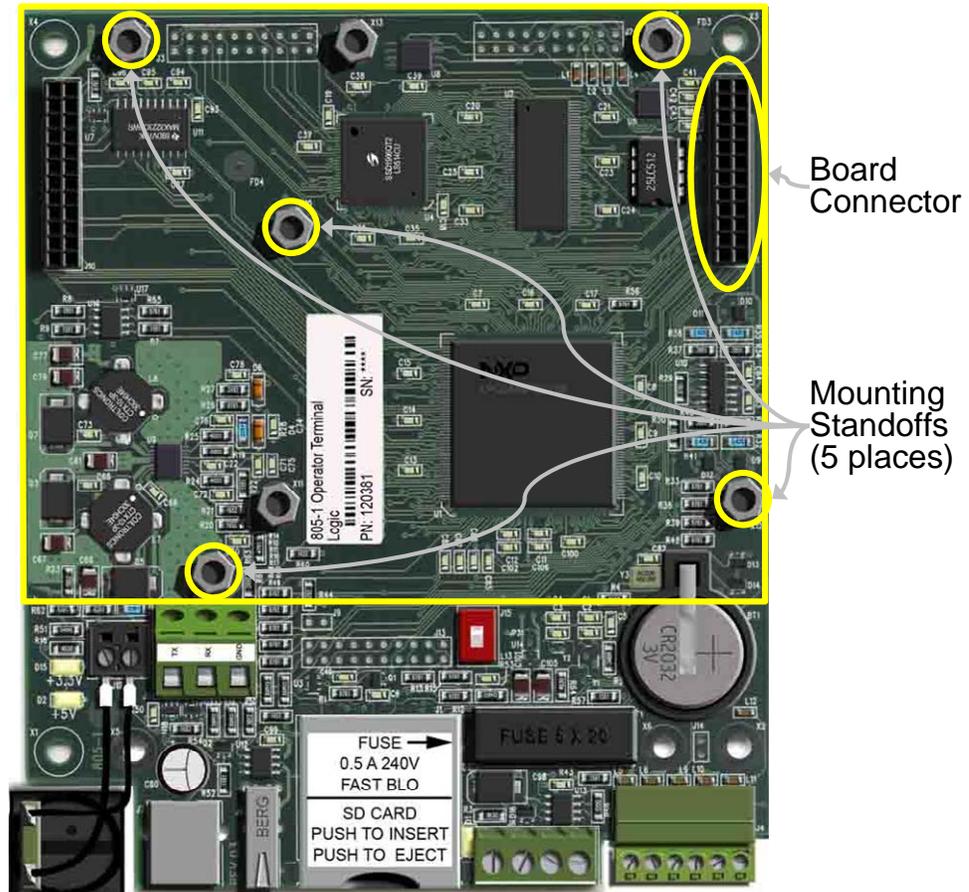


Figure 16: Mounting Location of Board in the OIT

5.2 Digital Inputs

There are four digital inputs on the module, with the functions described in the configuration section. These inputs are each individually isolated. A single input is labeled with an A and a B side – for example, input 1 consists of two terminals: D1A and D1B. These terminals go to a bidirectional opto-coupler so there is not set polarity. When driving the input with 24 volts, D1A could be common and D1B 24 volts (or vice versa with D1B tied to common and D1A at 24 volts). The inputs are meant to driven with 24 volts DC or 120 volts AC, but any voltage between 12 volts and 135 volts will work.

5.3 Solid State Relay Outputs

There are four solid state relay outputs on the module, with the functions described in the configuration section. A single output has an A and a B side – for example, output 1 consists of two terminals: O1A

and O1B. These outputs are bidirectional, AC or DC, and can generally be treated as if they were a standard normally open relay contact with the following characteristics:

- Rated for 300 Volts AC or DC
- Rated for 0.13 Amps of current
- 1 microamp of off state leakage
- About 25 Ohms of resistance when on

If more voltage or current capability is needed, or if more contacts are needed for a given output to drive multiple devices, then the solid state relay output can be used to drive an external electromechanical or solid state relay with the appropriate characteristics.

5.4 Analog Inputs

There are four analog inputs on the synchronization module – two for the master press, and two for the slave press. Some motor drives require isolated inputs and outputs to drive them, so the synchronization module separately isolates the slave press signals and the master press signals from each other and from the OT805 operator terminal. The slave press signals are referenced to SCM (slave common) and the master press signals are referenced to MCM (master common). Each of these inputs can read from 0 to 10 volts or from 0 to 20 milliamps. A dipswitch near each input selects whether that input will read voltage or current and will need to be set based on the motor drive output.

5.5 Analog Outputs

There are two analog outputs on the synchronization module slave press connector. Some motor drives require isolated inputs and outputs to drive them, so the synchronization module isolates the slave press signals from the master press signals and the OT805 operator terminal. The slave press output signals are referenced to SCM (slave common). Each of these outputs is 0 to 10 volts. If a drive needs 4 to 20 milliamps then a converter must be used. Also, when SO2 is used for the optional master passthrough function, it must be run through an isolation amplifier in order to reference it to the master common.