

***OWNER'S INSTALLATION  
AND OPERATING  
MANUAL***

**SV3000  
AC Flux Vector  
Special Application  
Shaft-Lock Software**

Detailed changes to software programs are introduced frequently. Please ensure this manual refers to the software version you are using.

For your safety and for proper operation, please take time to carefully read all instructions before installing and operating this unit.

LIM 55394-REV. G 6/01

**Danaher MOTION  
Engineered Systems Center**

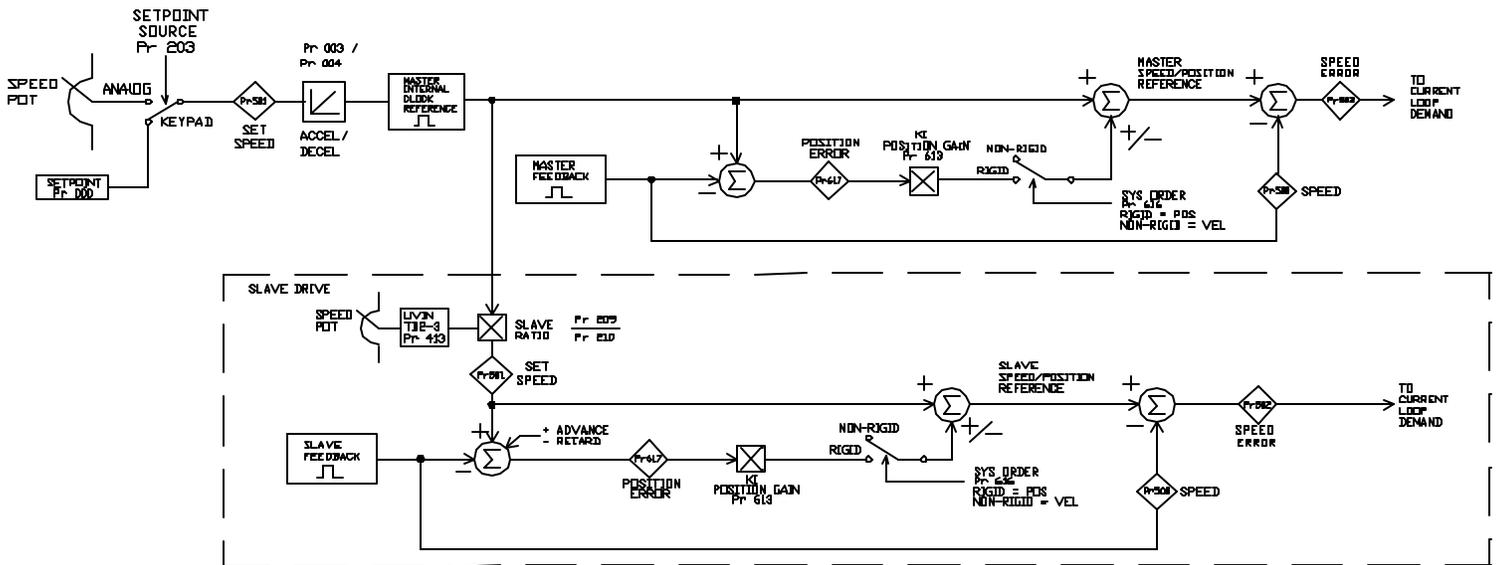
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## Introduction

This manual is intended to supplement the SV3000 Owner's Installation And Operating manual for units with Position and Speed Lock software option SV3999-5 installed. It is important to note that it is mandatory that 1) both the master and follower drives include shaft lock software option, and 2) all drives are enhanced performance, with encoders on each motor. The Shaft-Lock for SV3000 software operates on the algorithm shown in the following flow diagram.



There are some significant differences between units with and without the Digital Shaft Lock software. The primary differences are the tuning procedure which is slightly different from the generic tune test and a few additional programming parameters and options. The programming and operation differences are compared as followed:

**SHAFT-LOCK PARAMETER COMPARISONS**

**Parameters Related To Shaft-Lock Operation**

Parameter Number	Shaft Lock Software	Generic Software
P207	FOLLOWER ADV RET	ON DELAY
P208	ADV RET PLS	AD DELAY
P613	KI	INV DIR
P616	SYS ORDER	SET T
P617	POSITION ERROR	HMASK

**Shaft Lock Parameter Descriptions**

P207 FOLLOWER ADV RET

Enables and disables the follower drive advance and retard control.

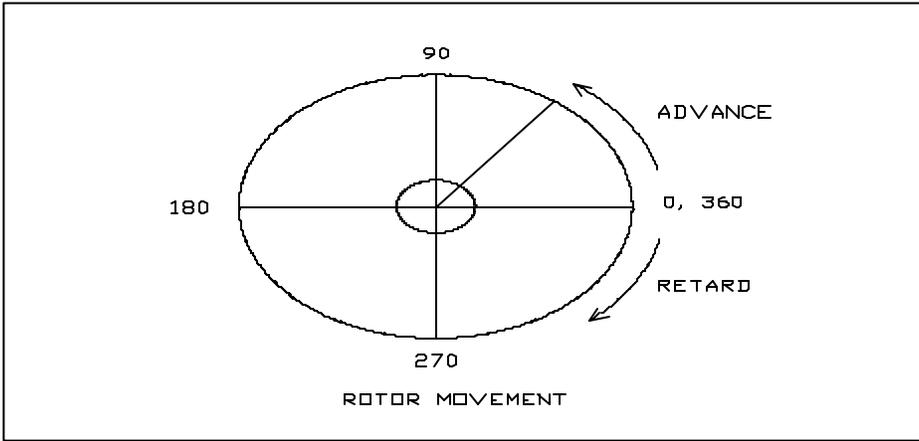
**D(isable) :**

If set to D(isable), the follower drive advance and retard control is disabled.

**EKP (Keypad Control):**

If set to EKP and the drive is in follower mode (“ RUN MODE “ (P201) is set to SSPEED and “SLAVE SOURCE “ (P206) is set to SCI).

- ? The up arrow keys advance the follower relative to the master; the down arrow keys retard the follower relative to the master.
- ? Every time a single arrow key is pressed, the follower will advance or retard x number of pulses relative to the master. The number of pulses is set in parameter P208 (ADV RET PLS). Every time a double arrow key is pressed, the follower drive will advance or retard 10 x (P208) pulses relative to the master.



**EPS (Terminal Control) :**

If set to EPS and the drive is in follower mode, the parallel digital inputs (TB1 pins 14, 16, 17, and 18) and/or the serial command addresses 905, 935, 936, and 937 control the follower drive’s advance and retard. Every

time one of the digital inputs is connected to LOGIC COMMON (TB1 pins 11 or 21) or every time a 1 is written to the serial command addresses, the drive will advance or retard relative to the master drive. The logic table can be seen below.

<u>Digital Inputs (tied to LOGIC COMMON)</u>	<u>Serial CMD (1 written to)</u>	<u>Function</u>	<u>Amount of Shift (Encoder pulses relative to master)</u>
TB1-14	905	Advance	10 x P208
TB1-16	937	Advance	x P208
TB1-17	936	Retard	x P208
TB1-18	935	Retard	10 x P208

#### ADV RET PLS P208

“ADV RET PLS” defines the smallest number of encoder pulses the follower drive will advance or delay relative to the master drive each time a shift is requested from the keypad, digital inputs, or serial command addresses. For example, if “ADV RET PLS “ is set to a 1, “SLAV ADV RET“ (P207) is set to EKP, and the drive is in Follower Mode, the follower drive will advance encoder pulse relative to the master when the single up arrow key is pressed. When the double down arrow is pressed, the follower drive will retard 10 encoder pulses.

#### KI (P613)

The integral tuning gain of the PID controller. This gain is set to zero when “SYS ORDER” (P616) is set to VEL(ocity). When “SYS ORDER” is set to POS(ition), the value of KI is automatically calculated based upon “SYS GAIN” (P602) and “SYS WN” (P601).

#### SYS ORDER (P616)

“SYS(tem) ORDER” determines how the control loop regulates torque to correct for following error.

##### **VEL(ocity):** (Non-Rigid Lock)

Sets the control loop for velocity regulation. There is a gradual increase in torque as you move the shaft (degree of shaft movement approximately equals torque).

##### **POS(ition):** (Rigid Lock)

Sets the control loop for position regulation. This serves as an extra integrator. Given an error in relative shaft position (follower relative to master), the follower drive will go to full torque output to compensate.

#### POSITION ERROR (P617)

A Read-Only parameter that displays the position error in encoder pulse units. By reading the position errors in both the Master and the Follower drives, the actual position error between the two can be acquired by taking the difference between the two readings.

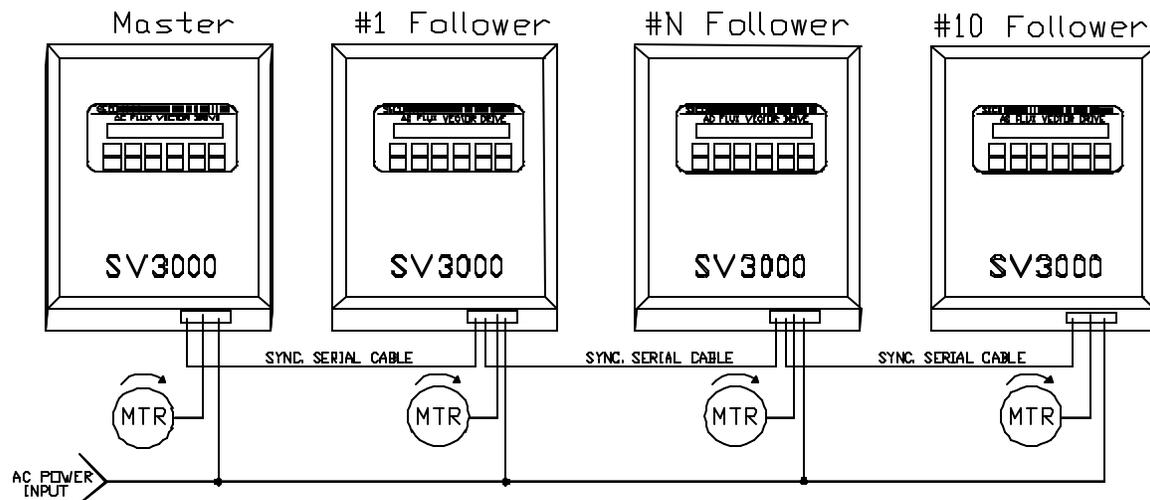
## **SETTING UP THE SHAFT-LOCK SOFTWARE**

# Quick Start Guide

## SV3000 APPLICATION

### 1. Master/Follower Using Synchronous Serial

#### 2. Introduction:



#### 3. Features:

- ? Using synchronous serial, a master drive can control up to 10 follower drives,
- ? Master drive can set speed with KEYPAD, SPEED POT, or analog input (0-10V, 0-20mA, or 4-20mA)
- ? The master sends start/stop and digital speed commands to the followers over the SCI(Synchronous Serial) network
- ? SCI network: Master start and stop the followers, if the master trips all follower drives stop.

**If one of the follower drives stops locally or trips, the master and all other followers continue to run.**

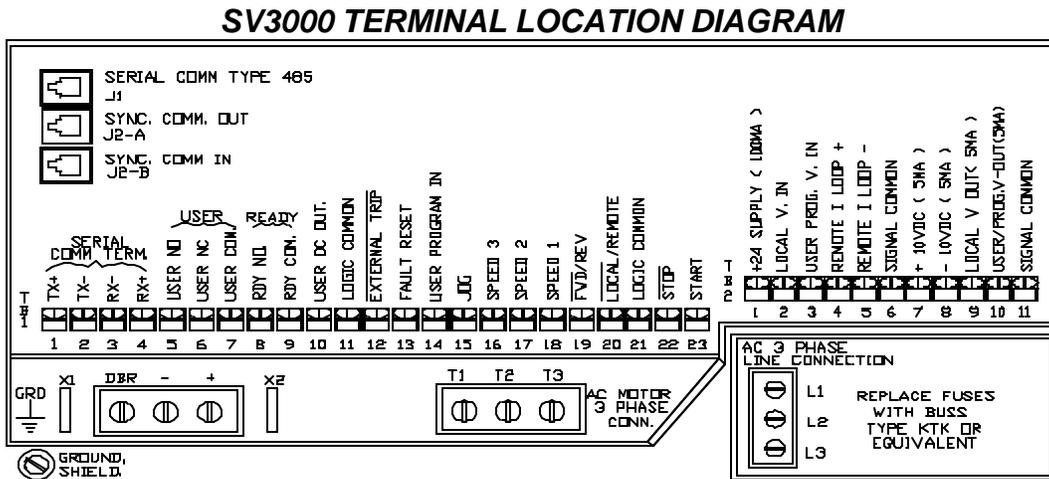
#### 4. Safety and Installation:

Installation instructions are specified in **Section 2** of SV3000 manual.

**BEFORE APPLYING POWER, VERIFY THAT THE PROPER VOLTAGE SUPPLY IS AVAILABLE FOR THE DRIVE (PER THE DRIVE'S SPECIFICATIONS). FAILURE TO DO THIS CAN RESULT IN EQUIPMENT DAMAGE AND PERSONAL INJURY.**

**5. Application of Master/Follower With Trim Pot:**

Here is the overall view of the control terminal connections for the SV3000, for more information about the control terminal locations and definitions refer to **section 2.12** of the SV 3000 manual. Note: Power Connections below are shown per 1-15 HP/460 VAC. For higher HP drives please refer to the SV3000 manual.



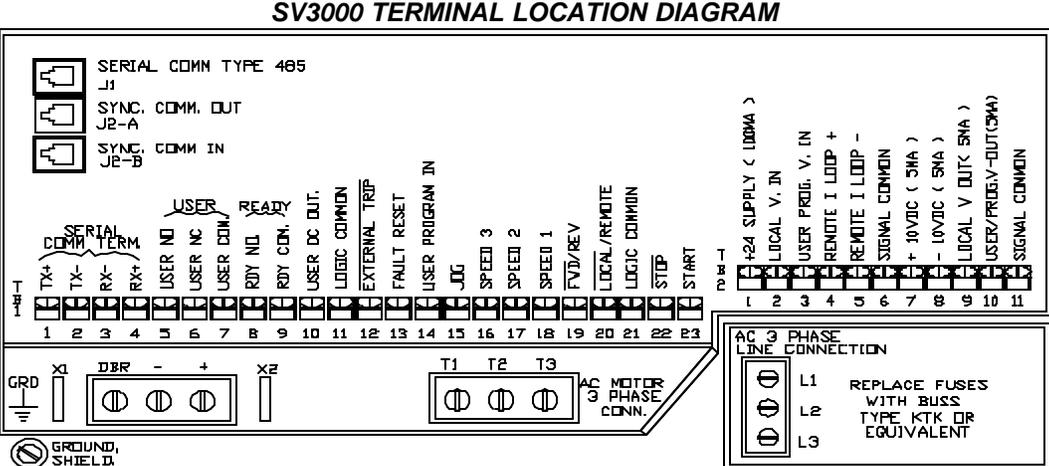
Connect the synchronous serial communication cable of a master to the follower. Using a length of **RJ11 phone cable** (Refer to Modular Cable Assemblies, Section 6) connect **J2-A** of master drive to **J2-B** of the follower drive. If you are using multiple follower drives, connect **J2-A** of the first follower drive to **J2-B** of the second follower drive. Repeat the connections if the third and fourth drives are used. Note: it is recommended that the cables used in the synchronous serial connections are purchased from factory. Cables provided by factory are designed to provide correct impedance matching and noise immunity.

The logic common connections on **TB1-11** must also be connected from the master drive to all follower drives. This logic common connection improves noise immunity.

After the synchronous cables (RJ11 cable) are connected, remove **R15** and **R16** of the follower drives except for the last follower drive. These two resistors are located on logic board. They are located on posts for easy removal. The master drive can be started or stopped via **KEYPAD** or **TERMINALS** (TB1-21, TB1-22, TB1-23). If you want to stop the master drive from the terminal strips then connect the terminals as shown in **Figure 1** on the following page.

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### Control Terminal Connections for Master / Follower with SV3000.

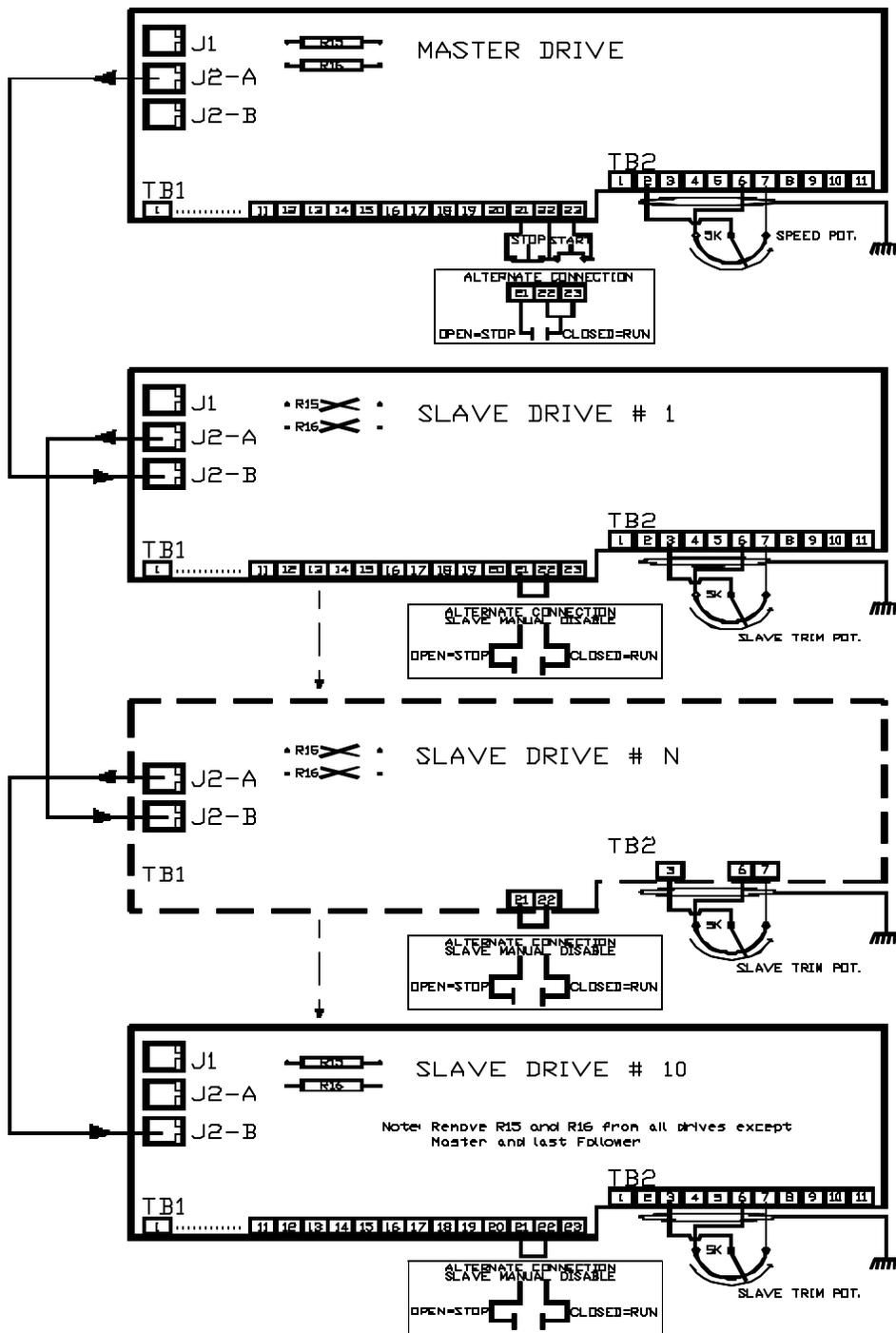


Figure 1. Terminal Connection of Master / Follower

6. Cable Assembly

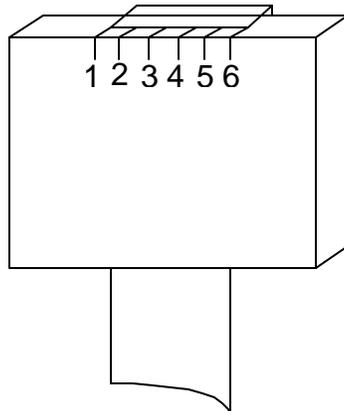
# MODULAR CABLE(RJ11) ASSEMBLIES

## DIGI-IKEY STYLE 2 : REVERSE



(WHT) 1	.....	1
(BK) 2	.....	2
(R) 3	.....	3
(G) 4	.....	4
(Y) 5	.....	5
(BL) 6	.....	6

### FRONT VIEW

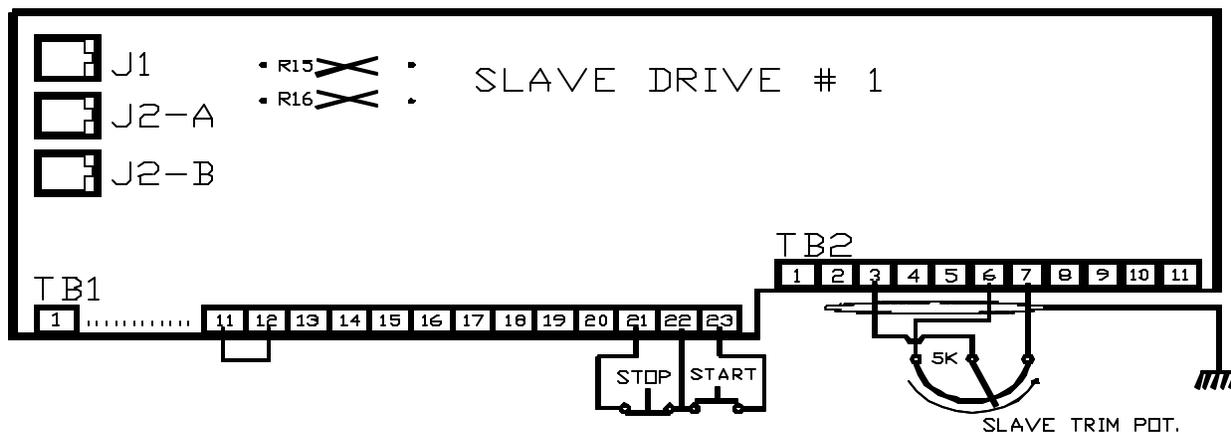


APPROVED VENDOR DIGI-KEY IDC MODULAR CABLE		SECO
PART NUMBER	DESCRIPTION	PART NUMBER
H2662-07-ND	7' CABLE WITH CONNECTORS REVERSED	PAS2022-07
H2662-14-ND	14' CABLE WITH CONNECTORS REVERSED	PAS2022-14
H2662-25-ND	25' CABLE WITH CONNECTORS REVERSED	PAS2022-24

Note: Cannot use a standard 4 pin R.111 Phone

## 7. Trim Pot Connections (Analog Ratio Adjustment)

If the ratio of the follower drives needs to be adjusted, the trim pots can be connected as shown below.



After the installation and wiring are properly connected, all the drives need to be tuned. Note that the tuning procedure in the Shaft Lock software is slightly different than the one described in the SV3000 Installation and Owner's Manual. See the **AC Tune Test** portion of this manual for details.

## 8. Setting Parameters for Master/Follower Operation with KEYPAD

### 8.1 Setting Parameters for Master Drive:

After the drive has been tuned, go to menu P2XX

**Pr201** should be **M SPEED**

**Pr205** set to **SEND**.

The master drive can be stopped using either DECEL or COAST. To set this stop mode, go to **Pr202** and set to either **DECEL** or **COAST**.

**DECEL:** The followers' "Stop mode" should be set to **Coast**. This assures all of the followers will stop at the same time as the master. When the master is stopped, all the followers will decelerate to a stop (while under power). "Set T" (Pr616) can be used to force all of the drives to turn off simultaneously.

If the master drive trips, all drives (master and followers) will coast to a stop.

**COAST:** The master and all followers will coast to a stop.

**Notice:** If one of the follower drives has tripped, that follower cannot be reset from the master drive.

## 8.2 Setting Parameters for Follower Drive:

After the drives have been tuned, and as an example, you want the follower drive to run at half the speed of the master drive then first go to menu P2XX. Set:

**Pr201** to **S SPEED**  
**Pr203** to **ANALOG**  
**Pr205** to **RECEIVE**  
**Pr206** to **SCI**  
**Pr209** to **1000**  
**Pr210** to **2000**

$$\begin{aligned}\text{Overall Speed Ratio} &= \text{RATIO NUM}(\mathbf{Pr209})/\text{RATIO DEN}(\mathbf{Pr210}) \\ &= 1000/2000 \\ &= 0.5\end{aligned}$$

The above settings will allow the follower drive to run at 50% of the speed of the master. Note that larger numbers can be used for greater resolution (i.e. 5000/5000), however, the overall gain will be affected. The 12 bit resolution is limited to a 2 to 1 ratio or maximum speed.

Suppose (using the example above) the follower speed is set to 50% of the master speed and the application requires a ? 10% on the follower speed. **Notice:** The trim pot should already be connected as shown in the diagram : **Trim Pot Connections**. Go to menu P4XX and set the parameters of the follower drive as follows:

**Pr413** to **P209**  
**Pr414** to **+10%**  
**Pr415** to **-10%**  
**Pr416** to **TRIM**

### Parameter Pr207 (ON DEL) and Pr208 (AD DEL)

**ON DEL** is a readout of the minimum delay after the drive is given a start command and before the drive is commanded to change speed. The delay is necessary to give the field flux in the motor time to build up before the motor is commanded to change speed. The value is a read-only and cannot be changed. ON DEL varies with MTR AMPS (P300), I field (Pr606), SLIP FREQ (Pr607) and whether or not an encoder is being used.

**AD DEL** allows additional time delay to be added after the drive is given a start command and before the drive is commanded to change speed. The total delay after the drives are started and before the drive commanded to move is ON DEL + AD DEL.

**AD DEL** is useful when using a synchronous serial master/follower set up and all drives need to start simultaneously. The master should not tell the followers to move until all the followers are ready.

To ensure this:

1. Set **Pr208** (AD DEL) in **follower** drive(s) to zero
2. Check **Pr207** (ON DEL) in all **followers** and find the **largest value**.
3. Set **Pr208** (AD DEL) in master so that:

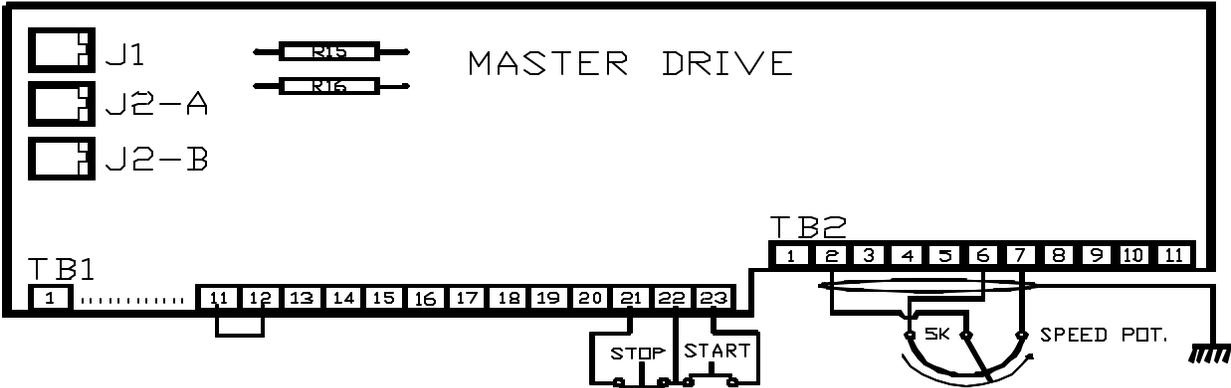
$$\text{Pr207 (in master) + Pr208 (in master) = Largest Pr207 (in follower)}$$
*Do not set Pr208 (ON DEL) in master < 0*

After the follower settings are completed, the follower drive will follow the master digital reference signal with the ratio set using the trim pot. Note that the master is given a start command and through the sync. serial logic the master starts the followers.

If the speed of the master drive is to be controlled by a speed pot, analog input from 0-10 volts, 0-20 milli-amps, or 4-20 milli-amps, then the following connections and parameter settings should be made.

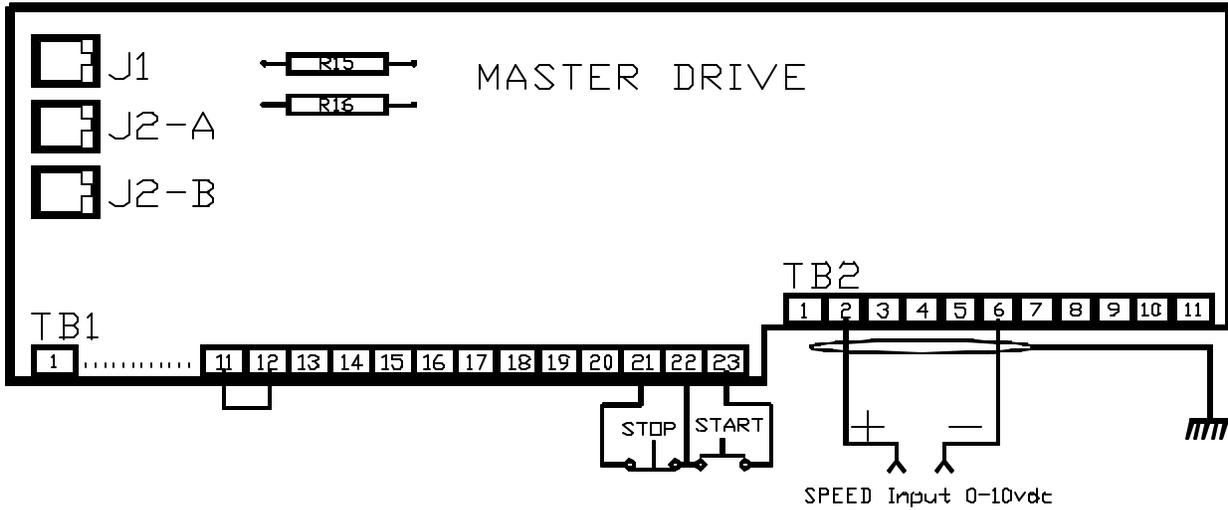
**9. Operating the master drive speed using speed pot**

Connect a 2K to 10 K pot on the terminal of **TB2** of the master drive as shown and go to menu P2XX of the master drive. Set **Pr203 to ANALOG**.



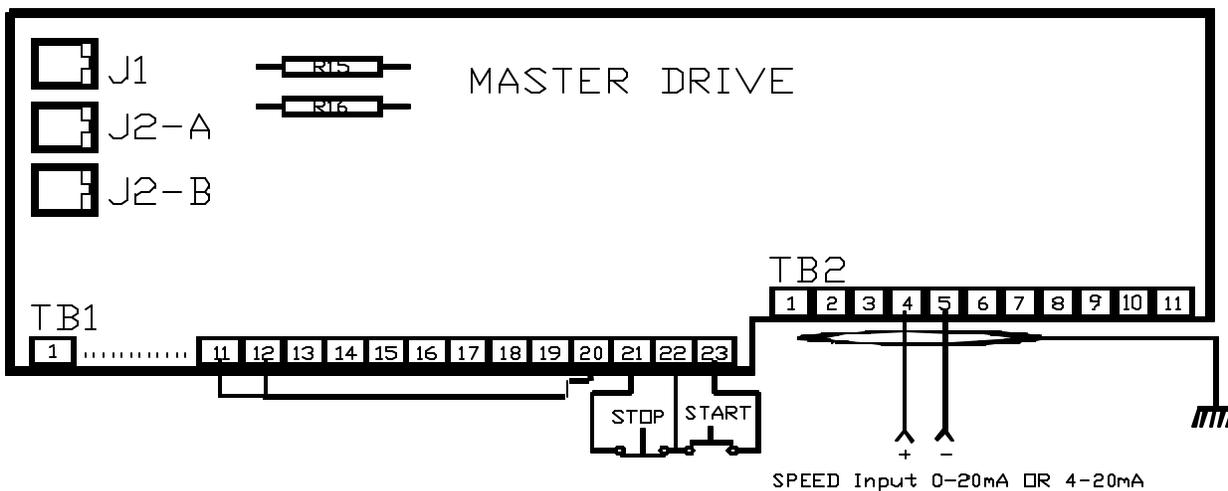
### 10. Operating the master drive speed using analog from 0-10V

Connect the following terminals (TB1 and TB2) as shown below and go to menu P2XX of the master drive. Set **Pr203** to **ANALOG**.



### 11. Operating the master drive speed using analog from 0-20mA or 4-20mA.

Connect the following terminals (TB1 and TB2) as shown below and go to menu P2XX and P4XX of the master drive. Set **Pr203** to **ANALOG**. If the speed setpoint 0-20mA, then set **Pr410** to **NOM 0-20**. If the speed setpoint 4-20mA, then set **Pr410** to **NOM 4-20**.



## **ADDITIONAL PARAMETER COMPARISONS**

### **Parameters NOT related to Shaft-Lock Operation**

Parameter Number	Shaft Lock Software	Generic Software
P209	ON DEL	RATIO NUM
P210	AD DEL	RATIO DEN
P211	RATIO NUM	SPINNING MOTOR
P212	RATIO DEN	S RAMP
P213	SPINNING MOTOR	F R MODE
P214	S RAMP	INJ BRAKE TIME
P215	SRAMP M	INJ BRAKE I
P216	F R MODE	TRIP RESTARTS
P217	INJBRAKE TIME	RESTART TIME
P218	INJBRAKE I	BUS REG
P219	TRIP RESTARTS	LANGUAGE
P220	RESTART TIME	SET USER DEFLT
P221	BUS REG	DEFLT THIS MENU
P222	RUN ENABLE	DEFLT ALL FACT
P223	START INIT	DEFLT ALL USER
P224	LANGUAGE	-
P225	SET USER DEFLT	-
P226	DEFLT MENU	-
P227	DEFLT ALL FACT	-
P228	DEFLT ALL USER	-
P617	INVERT (INV DIR)	H MASK
P616	SET T	S MASK
P617	H MASK	LOWPASS FREQ
P618	S MASK	NOTCH FREQ
P619	LOWPASS FREQ	OPEN LOOP
P620	NOTCH FREQ	DZ STATE
P621	OPEN LOOP	-
P622	DZ STATE	-

A number of SHAFT LOCK software parameters have additional choices as described below.

PARAMETER NUMBER (SHAFT LOCK)	FUNCTION	ADDITIONAL CHOICES	
P317	MDROP MODE	M D, M E	
P404	L OFFSET	INVERSE	
P410	R OFFSET	INVERSE	
P413	USER VIN	LOCA, REMO	
P423	USER VOUT	P599	FACTORY USE ONLY
P426		FREEZE BCD	
P427, P430	USER RELAY, USER OUT	FWDFD, REVFD, FAULT, FWD, REV, FWDON, REVON, TQLIM, RUN, MSPED, SSPED, TORQ, LOCAL, REMOT, JOG, USIN, ATSPD, WDT	

### **Additional Parameter Descriptions**

#### **SRAMP M (P215)**

##### **“ SRAMP M “ = POSITION :**

If the drive is in the middle of accelerating and it is requested to decelerate, it will start to decelerate immediately, even though this requires an infinite jerk. Under normal conditions, the requested jerk rate is maintained. If the drive is in the middle of decelerating and it is requested to accelerate, it will start to accelerate immediately, even though this requires an infinite jerk. Under normal conditions, the requested jerk rate is maintained. This setting is desirable if the application is trying to position the drive from a limit switch. If the drive hits the limit switch telling it to stop while it is still accelerating, it will start to decelerate immediately. This will cause the drive to stop short of the normal position - the normal position being the stopping point when the drive hit the switch at speed. If “ SRAMP M “ = ALWAYS, the drive would stop long of the normal stopping position. This setting may also be desirable if it is unacceptable for the drive to continue to accelerate after being told to decelerate.

##### **“ SRAMP M “ = ALWAYS**

If the drive is in the middle of accelerating and it is requested to decelerate, it will continue to accelerate as required to maintain the requested jerk limiting. When the acceleration drops to zero, it will start to decelerate. If the drive is in the middle of decelerating and it is requested to accelerate, it will continue to decelerate as required to maintain the requested jerk limiting. When the deceleration drops to zero, it will start to accelerate. This setting is desirable if the drive is not being positioned off of a limit switch and it is important to maintain the jerk limit.

#### **Run Enable P222**

##### **“ Run Enable “ = STOP :**

1. The “ Start ” input (TB1-23) is closed momentarily to start the drive. The “Run Enable” input (TB1-22) is opened momentarily, the drive is stopped. The drive stops according to “STOP MODE” (P202).
2. The “Jog” input (TB1-15) is closed to jog the drive and opened to stop the drive. If the “ Run Enable “ input is opened momentarily, the drive is stopped. The drive stops according to “STOP MODE” (P202).

3. The drive can also be jogged by using the “Start” input (“START INIT” (P223) = OFF). Use the keypad to select “JOG”. Maintain the “Start” and “Run Enable” inputs to jog the drive.
4. The “Run Enable” and “Start” inputs can be tied together for a two-wire start/stop. Use of the “Jog” input with a two-wire start/stop is not recommended because the running speed could inadvertently be selected should the “Jog” input fail to close or if it closes later than the “Start” input.
5. The drive cannot be started serially (asynchronously or synchronously) or from the keypad if the “Run Enable” input is open.

**“RUN ENABLE” = COAST:**

1. When the “Run Enable” input (TB1-22) is opened momentarily, the drive will coast to a stop regardless of “STOP MODE” (P202).
2. The “Start” input (TB1-23) must be maintained to keep the drive running. When the “Start” input is opened, the drive will stop according to “STOP MODE” (P202). When the “Start” input is closed, the drive will start backing up.
3. The “Jog” input must be maintained to keep the drive jogging. When the “Jog” input is opened, the drive stop according to “STOP MODE” (P202).
4. The drive cannot be started serially (asynchronously or synchronously) or from the keypad if the “Run Enable” input is open. When the “Start” input is open, the drive can not be started serially (asynchronously or synchronously) or from the keypad. It can be jogged from the keypad, however.
5. Use of a two-wire start/stop is not recommended since the “Run Enable” input must close at least 0.010 seconds before the “Start” input to ensure the drive starts.
6. It is recommended that “START INIT” (P223) be set to ON when “Run Enable” is set to COAST.

**“START INIT” = ON**

When the drive is started, all functions are initialized according to the digital inputs.

**“START INIT” = OFF**

When the “Start” input is closed, the drive will go to running speed if the “Jog” input is open. The “Jog” input should always be open since it is not recommended that the “Jog” and “Start” inputs be closed at the same time. Should the “Jog” input be closed when the “Start” input is first closed, the drive will go to Jog Speed.

**START INIT (P223)**

The “Reverse” input (TB1-19), “Jog” input (TB1-15), “Remote” input (TB1-20), and “User” input (TB1-14) are edge sensitive. The “Reverse” input selects “reverse” at the rising edge of being closed and “forward” at the rising edge of being opened. The “Jog” input selects “jog” at the rising edge of being closed and “not jog” at the rising edge of being opened. The “Remote” input selects “remote” at the rising edge of being closed and “local” at the rising edge of being opened. The “User” input selects “user input” at the rising edge of being closed and “not user input” at the rising edge of being opened. This allows the keypad or serial command to set the drive state opposite to that of the inputs. If “START INIT” is set to ON, these states will be initialized according to the inputs when the drive is started using the “Jog” or “Start” input (TB1-23) as described below :

**“START INIT” = ON:**

For most applications, “START INIT” should be set ON.

1. When the drive is started by closing the “Start” input (TB1-23), “forward”/“reverse”, “jog”/“not jog”, “local”/“remote”, and “user in”/“not user in” are initialized according to the “Reverse” input (TB1-19), “Jog” input (TB1-15), “Remote” input (TB1-20), and “USER” input (TB1-14).
2. When the drive is started by closing the “Jog” input (TB1-15), “forward”/“reverse”, “local”/“remote”, and “user in”/“not user in” are initialized according to the “Reverse” input (TB1-19), “Remote” (TB1-20), and “User” input (TB1-14).

**“START INIT” = OFF and “RUN ENABLE” = COAST:**

This combination of settings is not generally recommended. When “RUN ENABLE” is set to COAST, “START INIT” should be set to ON.

When the “Start” input is closed, the drive will go to running speed if the “Jog” input is open. The “Jog” input should always be open since it is not recommended that the “Jog” and “Start” inputs be closed at the same time.

Should the “Jog” input be closed when the “Start” input is first closed, the drive will go to jog speed.

The “forward”/“reverse”, “local”/“remote”, and “user in”/“not user in” state used when the drive is started with the “Jog” or “Start” input is the last state selected, not necessarily the level of the “Reverse”, “Remote”, and “User” inputs.

**“START INIT” = OFF and “RUN ENABLE” = STOP :**

The “forward”/“reverse”, “jog”/“not jog”, “local”/“remote”, and “user in”/“not user in” state used when the drive is started with the “Jog” or “Start” input is the last state selected, not necessarily the level of the “Reverse”, “Remote”, “Jog”, and “User” inputs. This combination of settings could be useful when some functions are controlled by the keypad or serially while the remaining functions are controlled by the digital inputs.

Examples :

Serial controls “local”/“remote”, but the “Start” and “Run Enable” digital inputs are used to start and stop the drive. The keypad is used to select “jog”/“not jog”, but the “Start” and “Run Enable” digital inputs are used to start and stop the drive.

MDROP MODE (P317)

“MDROP MODE” can be set to E, D, M E, or M D. The M E and M D settings enable a monitor mode at the asynchronous serial port. The monitor is for factory use only. For customer use, set “MDROP MODE” to E or D.

**“MDROP MODE” = E:**

1. Multiple drives can be connected together to communicate with the host computer.
2. The SV3000 will tri-state its transmitter when it is not transmitting.
3. The monitor mode is disabled.

**“MDROP MODE” = D:**

1. Only one drive is allowed in the network to communicate with the host computer.
2. The SV3000 will keep its transmitter line driver on all the time.
3. The monitor mode is disabled.

**“MDROP MODE” = M E:**

1. Multiple drives can be connected together to communicate with the host computer.
2. The SV3000 will tri-state its transmitter when it is not transmitting.
3. The monitor mode is enabled.

**“MDROP MODE” = M D:**

1. Only one drive is allowed in the network to communicate with the host computer.
2. The SV3000 will keep its transmitter line driver on all the time.
3. The monitor mode is enabled.

L OFFSET (P404) = INVERSE

**INVERSE and DONE:**

After the “Local Cmd” (TB2-2) voltage input is calibrated, change “L OFFSET” to INVERSE invert the input. For non-inverted inputs, “ L OFFSET “ is set to DONE.

**INVERSE and “DIR CONTROL” is UNI(polar):**

Maximum voltage (nominally 10 V) selects minimum speed (for example, 0 rpm) or zero torque in Torque Mode. Nominally, zero volts selects maximum speed (for example, 1800 rpm) or maximum torque in Torque Mode.

**INVERSE and “DIR CONTROL” is BIP (olar):**

Maximum voltage (nominally 10 V) selects minimum speed (for example, -1800 rpm) or maximum negative torque in Torque Mode. Nominally, zero volts selects zero speed or zero torque in Torque Mode. Minimum voltage (nominally -10 V) selects maximum speed (for example, 1800 rpm) or maximum torque in Torque Mode.

R OFFSET (P410)= INVERSE

**INVERSE and DONE:**

After the “Remote Cmd” (TB2-4 and TB2-5) analog current input is calibrated, change “R OFFSET” to “ INVERSE “ to invert the input. For a non-inverted input, “R OFFSET” is set to “DONE”. When the input is inverted, maximum current (nominally 20 mA) selects minimum speed (for example, 0 rpm) or zero torque in Torque Mode. Nominally, zero current (0 mA or 4 mA) selects maximum speed (for example, 1800 rpm) or maximum torque in Torque Mode.

USER VIN (P413)

**USER VIN= LOCA**

When “ User Vin” is set to LOCA, the “User Vin” voltage input adjusts the gain of the “Local Cmd” voltage input (TB2-2). The gain is adjusted in Master Mode and Follower Mode. No effect occurs in Torque Mode.

**USER VIN=REMO**

When “User Vin” is set to REMO, the “User Vin” voltage input adjusts the gain of the “Remote Cmd” current input (TB2-4 and TB2-5). The gain is adjusted in Master Mode and Follower Mode. No effect occurs in Torque Mode.

UIN (P426) =FREEZE BCD:

When the “User” digital input (TB1-14) is set, the BCD inputs (TB1-16, TB1-17, and TB1-18) are held or frozen. The idea is to change the BCD inputs while they are being held, then open the “ User” input when it is time to change to the new settings.

USER RELAY P427, UR CLR P430

**Parameter setting FWDFD**

The output sets or clears as shown below:

Output set

drive feedback velocity > “SET” and drive is on (current flowing in motor)

Output clear

drive feedback velocity < “CLR” or drive is off

If the value is between “SET” and “CLR” and the drive is on, the output stays in its last state. “SET” and “CLR” are in [ENG] units.

**Parameter setting REVFD**

The output sets or clears as shown below:

Output set

drive feedback velocity < - “SET” and drive is on (current flowing in motor)

Output clear

drive feedback velocity >- "CLR" or drive is off

If the value is between - "SET" and - "CLR" and the drive is on, the output stays in its last state. "SET" and "CLR" are in [ENG] units.

### All Parameter Settings

- ? The number of decimal places displayed is automatically determined by the parameter selected in "USER RELAY" or "USER OUT".
- ? The program forces "UR SET" to be greater than or equal to "UR CLR". When changing "UR SET", the program may automatically change "UR CLR"; when changing "UR CLR", the program may automatically change "UR SET".

The program forces "UO SET" to be greater than or equal to "UO CLR". When changing "UO SET", the program may automatically change "UO CLR"; when changing "UO CLR", the program may automatically change "UO SET".

### Function Settings

<u>Setting</u>	<u>Description</u>
MTRON	Output set immediately when the drive is turned on (current starts to flow in 0.10 seconds + "AD DEL" (P210)). It clears when the drive is turned off (current in the motor is stopped).
FAULT	Output is set when drive is faulted. Output is set even if drive will be auto restarting.
FWD	Output is set when forward is selected. Drive could be running reverse.
REV	Output set when reverse is selected. Drive could be running forward.
FWDON	Output set when forward is selected, the drive is on (current to motor), and drive is being commanded to a speed greater than or equal to 0.
RECON	Output set when reverse is selected, the drive is on (current to motor), and drive is being commanded to a speed less than or equal to 0.
TQLIM	Output is set when drive is at "MAX F TORQ" (P306), "MAX R TORQ" (P307), "MAX F BRAKE" (P308), or "MAX R BRAKE" (P309) limits.
RUN	Output set when the drive has been started. Cleared when drive has been stopped (although the drive may be still decelerating to a stop).
MSPED	Output set when drive is in Master Speed Mode.
SSPED	Output set when drive is in Follower Speed Mode.
TORQ	Output set when drive is in Torque Mode.
LOCAL	Output set when local speed source is selected, even if local speed source is not presently being used.
REMOT	Output set when remote speed source is selected, even if remote speed source is not presently being used.
JOG	Output set when Jog Mode is selected.
USEIN	Output set when "User" input is selected.
ATSPD	Output set when drive is on and at speed.
WDT	Output toggles set and clear at 25 Hertz.

## TUNING PROCEDURE

As previously noted, the SHAFT-LOCK software is slightly different from the generic tune test. The SHAFT-LOCK tune test is described in the following pages.

### **AC Tune Test**

Through the majority of the tune test, the shaft lock software is the same as the generic. However, there are a few differences. Most notably, the Slip Test provides a no move or move test choice. This determines whether the motor moves or not while calculating the slip. Another major difference is in the System Gain Test. In the shaft lock software, the System Gain Test will ask whether or not the drive has dynamic braking resistors. Details are provided in the following pages. Also in the System Gain Test is the prompt for Test Torque %. In the generic software this prompt appears in the initialization of the AC Tune Test.

The AC Tune Test automatically determines the drive, motor, and load parameters necessary to operate the drive in your system. It is comprised of a number of subtests that interrogate the motor and load to calculate the field current, leakage, motor slip frequency, motor stator resistance, number of motor poles, and system gain. If an encoder is being used, the test will determine the size of the encoder and the correct encoder and motor phasing. The AC Tune Test can be run in its entirety, or each of the individual subtests can be run or bypassed independently using the "Down Arrow" key when a bypass is desired.

### **When Manual Tuning is Required**

While the AC Tune Test will accommodate most applications, the procedure may not optimally tune the drive in a small number of cases. Certain applications, in particular, may dictate that some degree of manual tuning may be done.

Before proceeding with the AC Tune Test, the following questions should be taken into consideration:

#### **Does the load pull on the drive when at rest?**

If the load pulls on the drive when the drive is at rest (such as in a crane application), portions of the AC Tune Test will not be valid. Use the test to determine stator resistance and slip, but skip over the field current and system gain tests. Calculate those values manually using the formulas in the owner's installation and operating manual under "Manual Tuning".

#### **Are there limitations on how far the load can travel?**

The AC Tune Test may cause the load to overtravel its limits in either direction. Use the test to determine stator resistance and slip, but skip over the field current and system gain tests. Calculate those values manually using the formulas in the owner's installation and operating manual under 'Manual Tuning.'

#### **Are there restrictions on which direction the load can travel?**

If the load cannot travel freely in both directions, the AC Tune Test should be run initially with the load uncoupled. If an encoder is being used, the test will determine the correct phasing. If an encoder is not being used, you will have to phase the motor after the test has run. The motor can then be coupled and the test can be done again.

#### **To Run the AC Tune Test:**

**CAUTION !!!!!!!**

If you are not certain that the AC Tune Test can be run **safely** while coupled to the load, it is recommended that you first run the test while uncoupled. This will allow you to become familiar with the test under safe conditions.

### 1. Have the following basic data ready

The AC Tune Test will ask you to set the following basic data, most of which can be found on the nameplate of the motor. The test will allow you to accept the default values or edit them as required.

#### **Motor current** ("MTR AMPS")

The nameplate motor current, in Amperes. This value defaults to the drive's rating for a constant-torque application.

#### **Motor voltage** ("MTR VOLTS")

The nameplate motor voltage. This value defaults to the drive's rated line voltage (230 V or 460 V) and need not be changed if your motor is rated the same as the input supply.

#### **Motor frequency** ("MTR FREQ")

Enter name plate motor frequency. Normally 50 or 60 Hertz.

#### **Motor speed** ("MTR RPM")

The nameplate speed of the motor in RPM. The default value is 1,780 rpm. Note that this is not the synchronous speed but rather the rotor speed at rated load or base speed.

#### **Motor poles** ("MTR POLES")

The number of motor poles. This value is calculated from the "MTR RPM" and **'MTR FREQ' values**. Under rare circumstances, the calculated motor poles may be incorrect. In this case, the correct value should be entered each time the **AC** Tune Test is run.

#### **Test motor speed** ("TEST RPM")

The motor speed used during the PG size and field current tests. The value should be no larger than the lower of the motor nameplate rating and the maximum operating speed of the load. The default value is 400 rpm. Normally 400 rpm is a satisfactory value.

#### **Test acceleration time** ("TEST ACC")

The acceleration time during the PG size and field current tests. The default value is 1.0 second.

### 2. Transducer or Transducerless

The value in "MOTOR PPR" (P604) determines whether the drive will run closed loop with an encoder as feedback or open-loop with no feedback device. If "MOTOR PPR" is zero, the test will be ran open loop whether there is an encoder board or not. If "MOTOR PPR" is nonzero, then an encoder board and encoder feedback signal are expected. Whenever "MOTOR PPR" is changed from zero to a nonzero number or vice versa, power to the drive must be cycled. Be sure to wait for the screen to go blank before turning the power back on.

If an encoder is used in the system, the correct PG size should be entered in "MOTOR PPR" (P604) before the AC Tune Test is run.

If a marker pulse is provided, the AC Tune Test will determine the PG size, even if wrong size is entered in 'MOTOR PPR', the PG size may be off plus or minus one, however. If the correct PG size is entered, the AC Tune

Test will verify the PG size. If the size is correct, it will leave "MOTOR PPR" alone.

### **Test acceleration time ("TEST ACC")**

The acceleration time during the PG size and field current tests. The default value is 1.0 second.

## **2. Transducer or Transducerless**

The value in "MOTOR PPR" (P604) determines whether the drive will run closed loop with an encoder as feedback or open-loop with no feedback device. If "MOTOR PPR" is zero, the test will be ran open loop whether there is an encoder board or not. If "MOTOR PPR" is nonzero, then an encoder board and encoder feedback signal are expected. Whenever "MOTOR PPR" is changed from zero to a nonzero number or vice versa, power to the drive must be cycled. Be sure to wait for the screen to go blank before turning the power back on.

If an encoder is used in the system, the correct PG size should be entered in "MOTOR PPR" (P604) before the AC Tune Test is run.

If a marker pulse is provided, the AC Tune Test will determine the PG size, even if wrong size is entered in 'MOTOR PPR', the PG size may be off plus or minus one, however. If the correct PG size is entered, the AC Tune

Test will verify the PG size. If the size is correct, it will leave "MOTOR PPR" alone.

Check "MOTOR PPR" and enter the appropriate value. Cycle power if necessary.

## **3. Run the AC Tune Test**

Before running the AC Tune Test, make sure the drive output contactor is closed. Any drive output contactor must remain closed throughout the AC Tune Test. If there is a motor brake on, it should be released.

Change "AC TUNE" (P600) to E(nable) and press the "Edit" key to begin the test. The test will prompt you as your input or authorization to proceed is required.

The flow of the test is outlined in the charts on the following pages. Your input is required only for the steps highlighted in solid black. Follow the screens as shown and press the appropriate keys when requested.

### **NOTE:**

**To abort the test at any time and turn the drive off,**

Press the 'Status/Menu' key or open 'No External Fault' input.

**To continue with the indicated test,** press the "Edit" key

**To skip over the indicated test,** press the DOWN arrow key

### **CAUTION !!!!!!!**

Portions of the AC Tune Test will drive the motor with torque commands. The motor must be able to move freely in both directions. Use extreme caution to avoid any possibility of injury or equipment damage.

### **Marker Pulse**

If an encoder is used, the test will ask whether a marker pulse (MAKR) is used or not. If no marker is used, the PG size cannot be determined.

Press ^ if MAKR Press v if No MK
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### **Slip Test with a PG**

If an encoder is used, there is a choice of two slip tests.

If move press ^ No move press v
------------------------------------

#### *No Move Test*

If the No Move Test is selected, the slip is determined without moving

#### *Move Test*

If the Move Test is selected, the initial slip is determined without moving the motor. Thereafter, the drive is accelerated to 5/6 of base frequency, then decelerated slowly to zero speed. (Dynamic braking resistors are not used during deceleration, so there is no danger of them overheating.) This cycle is repeated using a different slip value each time until the best slip value is found. If the initial slip was far off, many iterations will occur. This test will determine a better slip than the No Move test.

The Move Test will work under load as long as the load does not pull on the drive and the load is not so great as to stall the motor or prevent it from reaching speed. If the motor continues running at a constant speed, press the "STOP" key. If the AC Tune Test exits, then reduce the load and repeat the test. If the test does not exit, simply wait until the drive coasts to a stop (back-light will be flashing), then press the "Edit" key as prompted to stop the flashing back-light and restart the drive. The Move Test will work fine with the load uncoupled since the correct slip is independent of the load.

Under rare circumstances, the drive may shut off as it is decelerated (back-light will flash). In this case, simply wait until it coasts to a stop, then press the "Edit" key as prompted. This will stop the flashing back-light and restart the drive. The test will continue without harm even if it shuts off every time it decelerates.

### **Slip Test without a PG**

If an encoder is not used, the only option is a No Move Test. The slip value determined is good for transducer-less operation.

### **System Gain**

The System Gain Test will ask you for the following basic data. The test will allow you to accept the default values or edit them as required.

Edit to Test System Gain
-----------------------------

The System Gain test will work under load as long as the load does not pull on the drive and the load is not so great as to stall the motor or prevent it from reaching speed. If the motor continues running at a constant speed, press the 'STOP' key. If the AC Tune Test exits, then reduce the load or increase Test Torque, then repeat the test.

When the System Gain Test is run, the drive is accelerated at Test Torque up to Max RPM, then decelerated at -Test Torque to zero speed. This reduces the distance traveled by the drive. If there are no dynamic braking resistors, the drive will most likely trip.

*Without DB (v selected)*

When the System Gain Test is run, the drive is accelerated at 60% of Test Torque up to Max RPM, then decelerated slowly. The drive is accelerated again at 100% of Test Torque, then decelerated slowly. This option can be selected even if the drive has dynamic braking resistors.

Under rare circumstances, the drive may shut off as it is decelerated (backlight will flash). In this case, simply wait until it coasts to a stop and press the “STOP” key on the keypad.

**Phase the Motor**

If you are using an encoder, the test is complete. If you are not using an encoder, you may have to re-phase the motor. During the field current portion of the parameter test, you were asked to note the direction the motor was rotating; the drive considers this direction to be forward. If that direction is not forward for your application, set “INVERT” (P617) to invert the direction of rotation manually as follows:

To invert motor direction:

<b>If “INVERT” (P617) is :</b>	<b>Change to :</b>
PGN MTN 0	PGI MTI 3
PGI MTI 3	PGN MTN 0
PGN MTI 1	PGN MTN 2
PGI MTN 2	PGN MTI 1

This simulates reversing the motor direction by swapping any two of the motor stator leads (U, V, and W) and potentially two encoder channels which was required in the past. Since this can now be done in the software, re-wiring your motor or encoder is not necessary.

**Checkout**

Your drive should now be tuned to the motor and the load. To verify that tuning has been successful:

**1. Return to the operator menus**

Press the “Prog” key to return to the operator menus.

**2. Run the drive**

Enter a speed setpoint. Run or jog the drive to verify proper operation.

If “SETPT” is the selected setpoint, the drive speed can be adjusted from the Speed Menu shown below using the arrow keys:

SP0:        1800 RPM stopped
---------------------------------

**NOTE:** In a small number of cases, the drive may not tune optimally using the automatic tuning procedures. In these instances, manual tuning of the drive may be necessary. Refer to the owner's installation and operating manual under the ‘Manual Tuning’ section for instructions.

**Application Setup**

The factory default values are normally sufficient to minimally operate the drive from the keypad, but the remaining parameters must be configured for your application. **(Do not forget that the tune procedure must occur before setting the drive up for the application!)**

1. Familiarize yourself with the drive parameters.
2. Enter the appropriate values in all Main, Preset, Setup, Drive, Terminal, and Tune menu parameters.

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