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Instruction Manual

Model EC2000 Controller



(NEMA 1 Enclosure Version Shown)

EC-2000 Software Version 1.26
Hardware Version 0512

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Section 1 - GENERAL THEORY OF OPERATION

In general, an eddy current drive systems consist of a prime mover (AC induction motor, usually a NEMA B type), an AC motor starter, the eddy current coupling, a speed feedback device and a controller with an operator interface. The sketch below depicts the standard type of control scheme normally used with Dynamatic eddy current drives.

Dynamatic typically does not provide the motor starting equipment; these are optional and a matter of the customer's preference. Normally all else is supplied: the integral motor, eddy current clutch, tach generator and the separate electronic control.

The drive system is relatively simple; the AC motor is started under no load and allowed to reach full speed before the controller is energized. The output of the control is determined by reference setting and feedback magnitude with drive speed and torque being based on the operational mode and load requirements. Speed control mode with tach feedback will regulate within 0.5% of set speed, while approximately 5% regulation is possible in torque mode using the internal clutch current loop as feedback. Preset speeds, jog, thread and external reference inputs are available as standard parameter selections with the EC2000 control.

The EC2000 uses microprocessor technology to provide a flexible low noise control for today's high tech industrial environment. It provides setup and programming via a digital keypad and an easy to read alphanumeric display; drive parameters may be programmed and displayed by the customer to activate the many built-in features.

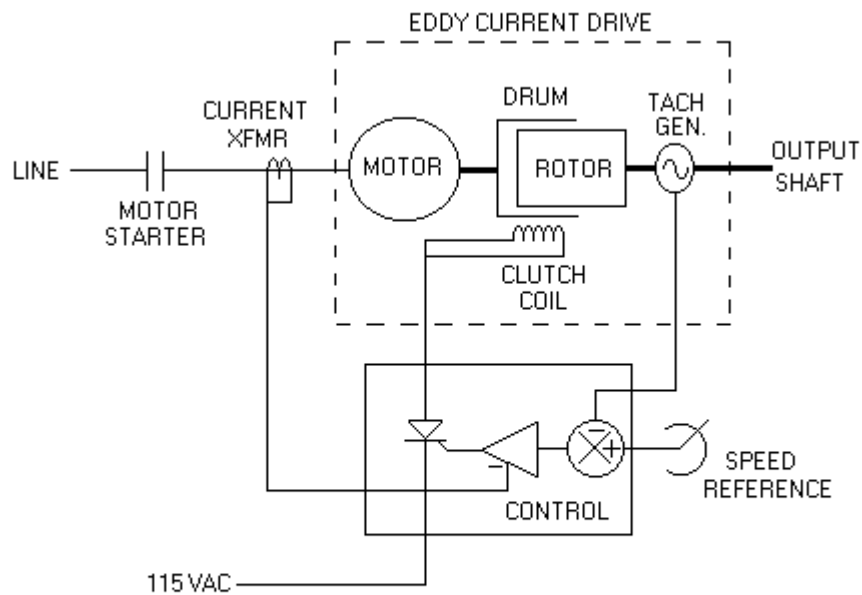


Figure 1: Eddy Current Drive / Control Block Diagram

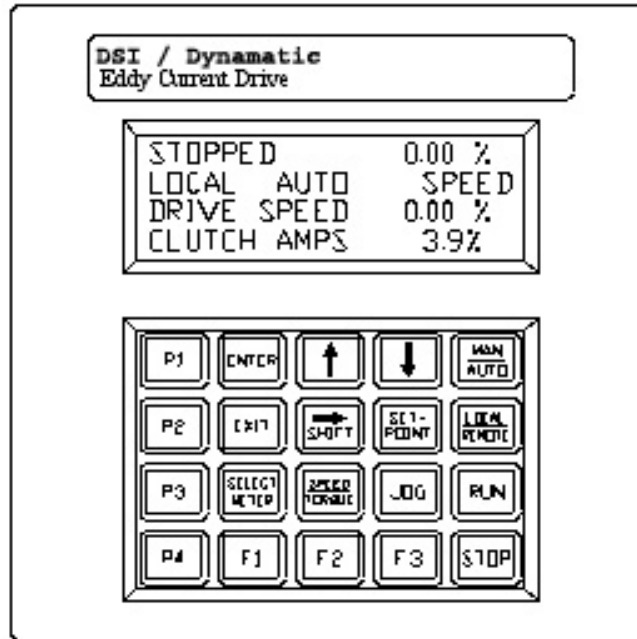


Figure 2: EC2000 Keypad / Display

Section 2 - SPECIFICATIONS

The EC2000 Control is offered in panel mount, NEMA 1 and NEMA 12 versions. The standard EC-2000 control has 45 or 90VDC maximum voltage output with current capabilities up to 8 amps. An RS232 serial communications port for connection to a PC will be available in the future.

The user may select from these control types: speed, torque (current), or external. An adjustable brake current regulator is also standard. Speed regulation is provided using a G-2 tachometer or digital pulse pickup located on the EC mechanical unit. True current regulation results from using an isolated internally generated current feedback signal. Use of the external control scheme, such as Dancer Position, requires a customer supplied DC feedback signal.

Features:

True current feedback control with isolated electronic measurement of coil current, voltage forcing (45 coils only), and inversion for fast response, 115VAC power input to allow running on standard lighting circuits, surface mount components to minimize PCB "real estate", combination LED "power on" with indication of the +/- 12V supplies being within range, simple and rugged linear power supplies for reliable, noise free operation and a back-lit, super-twist liquid crystal four-line display with soft touch keypad. NEMA 4 rated.

The output of the EC2000 is fuse protected against short circuits or shorts to ground. If 115VAC is not available and/or additional line noise suppression is desired, an isolation transformer may be used; no center-tap is required.

2.1 Power Input/Output:

Input voltage: 115VAC, $\pm 10\%$, 50/60Hz, no center tap required
Input line current: 8.0A RMS at 8.0A DC output. Maximum Output rating: 8.0A at 90VDC,
Inversion and field forcing available to 90VDC
Run Contact: (N.O.) 115VAC or 24V DC at 5A (Resistive), 150VA pilot duty
Programable F relay 2A @ 115 VAC

Load Regulation: -0.25% load change from 25% to full load
Line Regulation: $\pm 1\%$ of rated speed for $\pm 10\%$ change in line voltage

Thermal Drift $\pm .05\%$ of rated speed per $^{\circ}\text{C}$
Linearity $\pm 2\%$ of maximum rated speed

Minimum Regulated Speed: 25 RPM
Linear Acceleration and Deceleration range: 1% to 200% of top speed per second

Fuses 10 A, 250VAC

2.2 Environmental Ratings:

Operating temperature range: 0° to 40°C (enclosed or panel mount)
Storage temperature: -10° to 75°C maximum
Humidity: 95% non-condensing
Elevation: to 1500 meters without derating

2.3 Electrical Noise: The control is immune to showering arc noise as specified by NEMA 519 test procedures. Operation will not be affected by a 5 watt, 2-way radio transmission with the enclosure door closed. Noise Immunity and Radiation: The controller complies with FCC, part 15B, of federal regulation #47 as a Class A digital device when operated in a defined enclosure and installed in accordance with our instructions; third party verification is required. EMI Susceptibility: The controller will comply with IEC 801(1984)-3, class 2. The controller will operate without fault or disturbance under the specified level of radiated EMI (Performance Criteria 1).**Mechanical Characteristics****2.4 Enclosures:** NEMA 1 standard.
NEMA 4, NEMA 12 and Panel Mount optional.**2.5 Weight Panel Mount controller - 5 pounds.**
NEMA 4 Enclosed - 115VAC no isolation transformer - 18 pounds.
NEMA 12 Enclosed -115VAC no isolation transformer - 22 pounds.**2.6 Dimensions:** Main Board - 8.5"H x 9.25"W x 2.25"D
Keypad - 4.875"H x 4.875"W x 1.375"D
NEMA 1 Enclosure - 14.00"H x 15.125"W x 7.34"D
NEMA 12 Enclosure - 24.00"H x 16.00"W x 7.00 "D**2.7 Packaging:** All Controls will be packaged in a cardboard shipping container. Enclosed versions will include the keypad mounted on the door of the enclosure. For keypad panel mount versions, the keypad will be packaged separately including mounting hardware. Panel mounts without keypads will be programmed for external control at the factory. Final programming will be the responsibility of the customer. Any damage to packaging discovered during receiving must be reported promptly to the carrier.

- 2.8 Reliability: The MTBF (mean time between failures) is 50,000 hours minimum calculated. Field failure rates should be less than 1% in 36 months. An actual MTBF will be reported when available.
- 2.9 Codes and Standards: The controller is designed to conform to the currently accepted standards for industrial electronic controls; consult the factory for details on applicable markings.
- 2.10 Hardware Description and Miscellaneous Information: The power PCB 15-1201-1 is mounted on six standoffs with # 6-32 screws. Piggybacked on this board is the logic board assembly 15-1200-1, the interconnect is via a 40-pin ribbon cable. The third major control element is the keypad/display which is mounted either on the enclosure door or is shipped loose for mounting by the customer. The keypad cable consists of a pair of wires for the power supply and a shielded pair for serial data; it connects to the logic board at PL2. A latching resistor is chassis or panel mounted and plugged into the power board. Two terminal blocks at the bottom of the power board comprise all of the customer connections with the exception of optional communication interfaces or connections to Relay Mod(s), if used. The right hand "power" terminal block, TB1, is for input and output power, run relay and fault contacts, and G2 Generator connections. As with our other controls, the EC2000 has separate brake terminals for adjustable (programmable) braking when in "Stop". External references, operator elements, current transformer, pulse pickups and follower signals connect to TB2.

Most of the modifications are built into the software; consult Section 8 on programming and the appropriate parameters to implement them.

The panel mount version of this control is available for customer mounting within an existing enclosure with the keypad (if used) either bracket mounted or enclosure door mounted. The maximum length for the keypad cable is 6' and the wires should be at least AWG 26; it is advised to keep the cable as short as possible.

The customer is responsible for operator element and other control input wiring. All signal input connections should be made with shielded cable, grounded (to common) at the control end only. The control may be operated solely from the keypad, if desired.

Two communication interfaces and a Two Relay Modification are available for use with the control. The control can accommodate up to five relay outputs (F relay plus two mods); further details follow in this manual. When the controller is shipped with a modification board, a separate instruction sheet is provided that includes the mounting and wiring instructions as well as the schematic and connection diagrams for the complete controller.

Pages 13, 14 and 15 of this manual contain connection diagrams and Sections 5 and 8 contain information for operational modifications; note that parameter programming will be required to activate the mods

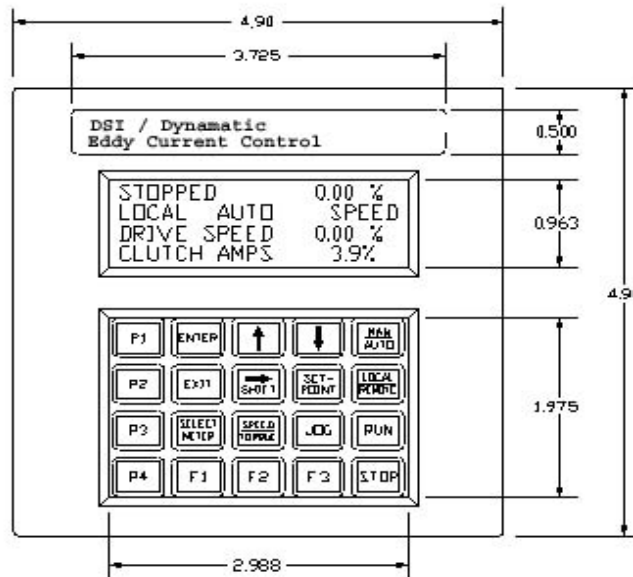


Figure 3: Keypad Dimensions (inches)

Section 3 - GENERAL OPERATION MODE AND INPUT/OUTPUT INFORMATION

Four control modes will be available and selectable from the keypad:

- Speed Control
- Torque (current) Control
- Speed/Torque
- External Control

Other modes of operation can also be provided, some of which are dependent on the control type selected:

- Local/Remote
- Jogging
- Manual/Follower-tachometer or low signal
- Two Wire or Three Wire Start/Stop
- Preset Set points
- PLC Run
- Auto Restart on power
- Auto Restart after Fault
- Adjustable Braking
- Coast to Stop.
- Ramp Control (separate rates)
- Loss of Follower
- Torque Limit (requires optional CT)
- User Process Units
- Forward / Reverse Speed Control

3.1 Input/Output Connections:

Most inputs/outputs will be provided via terminal blocks (sometimes abbreviated "TB"). Some functions may be programmed to be controlled by either a terminal block input, by the keypad, or both.

Analog Inputs

3.2 Reference Voltage (Set point):

This input, when programmed, determines the desired speed or torque. Programming usually configures this input as a 0-10 volt analog signal from a remote pot or a programmable controller, computer or other source.

3.3 Auto Reference Signal (Follower Input) (Set point):

This input provides the drive reference when in the Auto Mode. Parameters are used to scale this signal. The follower signal is isolated and input level jumper selectable for either 4-20ma or 0-10VDC.

3.4 Motor Current Feedback Input (For Torque limit):

This signal is to be used by the Torque Limit function, motor amps display and other control functions. Software and hardware are used to scale this signal. This function requires the use of either a Dynamatic 15-203-3 or 15-18-* standard current transformer. 0-5 VAC.

3.5 Four Speed Feedback Inputs (selectable):

These inputs are used by the control: (one of two) to close the speed loop and as an indication of output speed and, (one of two) as a follower signal. Programming will allow the user to scale these signals as necessary and jumpers are used to select between the different types (on different terminals) of feedback. A +12V supply terminal is also provided for customer use if the speed feedback source requires it.

3.6 External Process Feedback Input (selectable):

This is an analog feedback input for use by the logic when the "External" control type is selected. It will be used for specialized control schemes such as dancer position, etc. 0-10VDC or 0-5 VDC selectable, isolated.

3.7 Clutch Current Feedback:

This is an internal signal used by the processor for current control logic, stability purposes and the clutch amps or "percent excitation" display. Software and hardware settings must be made (and be in agreement) to scale this signal based on coil rating.

3.8 Brake Current Feedback:

This is the same as for the clutch above, but is separate and only for the brake output.

Discrete Digital Inputs

3.9 These are defined as inputs from customer supplied switches or hardware contacts (not solid state) wired to the terminal block. All the inputs listed are available, but may not all be used at the same time. Usage is dependent on the control type and functions selected; the Control Mode will automatically program the inputs to the necessary function. Programming will also direct some operator functions to be controlled by either the terminal block or keypad, for instance, "Local/Remote". Other inputs:

- | | | |
|--------------|----------------------------------|---------------|
| E-Stop | Preset 1/2 | E-Stop - N.C. |
| Stop - N.C. | Preset 3/4 | |
| Start - N.O. | Manual/Auto N.O. | |
| Jog - N.O. | Speed/Torque | |
| PLC Run N.O. | Speed/Torque Control Mode Select | |

Analog Outputs

- 3.10 Programmable Analog Outputs (2). These signals are intended for customer use. All of the outputs listed are available, but only two at the same time and the selection may be dependent upon the control type selected. The output level is selectable from 0-10VDC or 4-20ma (minimum load 500 ohms), isolated. Select outputs from:

Motor Amps	Drive Output Speed (rpm)
Process	Clutch Amps
Feedback	Brake Amps
Reference	Setpoint
Drive Output Speed (rpm)	Setpoint Deviation

- 3.12 Run Signal (or "Drive Run" signal): Normally open E relay contact rated 2A, 115VAC.
- 3.13 F Relay (Fault Output): Form C contact rated 2A, 115VAC. Fault indication was the intended use for this relay output, however it may be reprogrammed for the other conditions listed under 3.14. As a fault relay, it is energized in the non-faulted condition and drops out on any fault.
- 3.14 Four (4) User Programmable Relays: (Option) Either 2 or 4 relays (two per mod board). Each relay has (2) Form C Contacts rated 2 Amp, 115VAC. The use of the relay mod(s) requires an optional external 12VDC power supply. Each relay may be programmed as status indicator, trip on or trip off relay function. The relays can indicate any of the following conditions:

Speed Mode	Run
Torque Mode	Run 0
External Mode	Coasting
Local Mode	Jogging
Remote Mode	Fault
Manual Mode	Restart
Auto Mode	Torque Limit
Stopped	At Set point
Stopping	Loss of Follower
E-Stop	Loss of Feedback

- 3.15 Keypad/Display: The EC2000 keypad/display unit is used for monitoring and setup of the drive. This unit is usually mounted on the enclosure door or remotely up to 6 ft from the control. All customer adjustments may be made using the keypad/display unit. Future optional PC software will also allow setup and monitoring of the drive (protocol only). The keypad has dedicated command keys as well as scrolling and programmable presets. A user friendly, multi-line alphanumeric LCD gives written prompts in English. Each control may use only one keypad and the keypad may be removed and the control run without it. The keypad display unit allows the user to set up the drive using about 14 convenient parameter "menus" of variables. The control will automatically display the parameters that are appropriate to the selected modes or mods. Some parameters will require the drive be stopped before a change can be entered. Access to certain commands and parameters may be denied by locking the keypad with a password.

Section 4 - INSTALLATION

- 4.0 Location: In an effort to reduce costs and minimize enclosure volume, the EC2000 standard enclosure is a modified NEMA 1 with hidden, drip-proof air vents, intended for inside use only, and requiring a relatively clean and dry environment. If this cannot be provided, an alternative method of mounting the control should be arranged. Remember that evidence of condensation caused corrosion or substantial dirt build up on failed circuit boards will invalidate the warranty. The area selected should have an ambient temperature of 40°C (104°F) or less, and have at least 12" of clearance above and below the enclosure so that the cooling air will not be impeded. Mounting surfaces with substantial vibration or mechanical shock must be avoided.

Knockouts are provided for conduit entrances at the top and bottom of the enclosure. Remember that the area selected for mounting should be convenient for reading the display and entering command or parameter changes on the keypad.

The mounting surface for the control should be flat; refer to the outline dimension print or use the enclosure to make a paper template for hole locations. Use ¼ - 20 hardware for mounting; be sure to leave enough room to the left of the enclosure so that the door can be fully opened (see the dimension drawing for minimum left side clearance).

- 4.1 Wiring: This basic instruction manual and modification instruction sheets includes connection diagrams (see pages 13 – 15), which are in simplified block form with the terminal blocks shown, numbered and lettered exactly as they appear on the controller. The devices that may have to be wired are shown graphically on the diagram with the heavy solid lines representing the wire connections.

Since the drive uses a standard AC induction motor, it must be connected with the proper branch circuit protection, motor starter and overload devices (not normally supplied as a part of the control package). The minimum requirements are specified in the National Electrical Code and other local regulations may also apply. If there are any questions, consult with the supplier of the equipment or the local code authorities.

Wire size, the number of conductors in a conduit or the NEC and other applicable local regulations also specify raceway and grounding techniques; it is important to meet the minimum requirements of these codes. Consult the nameplate on your drive for full load current at the line voltage you will be connected to. Controller 115VAC input wiring current capacity is equal to the output rating for the EC2000 control; in most cases, the minimum conductor size allowed by code will suffice. To avoid stray signal interference, do not run the signal wires in the same conduit as the power wiring and note that is necessary to use shielded conductors for the generator leads and all signal wiring, both for runs to the controller and to any other devices that may be used. The shielded conductor should be a twisted, insulated pair with a continuous metallic shield and an outer insulation. It is generally accepted that the best practice is to ground the shields only at the control end to avoid making "ground loops". Be sure to tape or otherwise insulate exposed shielding which could short to other conductors or terminals. The generator leads need not be shielded if the run is short, up to 15' or so, and is either in a separated conduit or dressed away from power wiring. If shielded cable is used for the generator leads, it may be run in the same conduit with the other drive wires.

After pulling the proper size conductors, connect each terminal at the drive to the corresponding controller terminal of the same designation. For example, C1 at the drive unit should be connected to terminal C1 at the controller. Be sure to properly strip the wires so that the insulation is not crimped under the terminals or that excessive bare wire is showing. Also make sure that no strands of wire are outside the terminal where they may short out. When all wiring is completed, recheck all connections again to insure they are correct and that each is tight. Once you have assured yourself that the wiring is exactly as shown on the connection diagram, you may proceed to the next step.

4.3 Hardware Programming: There are a number of programmable jumpers and other devices that must be set properly in order to be able to run the EC2000.

E-stop jumper: Check terminals 31 and 32 on TB2, either normally closed pushbuttons (in series) or a wire jumper must be installed between these points for the control to run.

Remote normal stop terminal: TB2-24, also must either be wired to a remote normally closed pushbutton (to COM TB2-22) or a wire jumper must be installed in order to run. This is because all “Stop” inputs to the logic are always active for safety purposes.

Trim pots: R4 is a factory set + 5V adjustment; do not change the setting unless the + 5V is out of range. R111 is the Torque Limit gain adjustment, which is covered under setup for that function.

Programmable Jumpers:

J2 and J4: These two jumpers have similar purposes; J4 is for speed control to select between tach generator feedback (“B” position) at G1 and G2 on TB1 or pulse pickup speed feedback connected to TB2-2 (“A”). J2 is for the same selection of inputs for tach follower.

J3: This is set in “A” for ± 20V process feedback; “B” is for ± 5 or ± 10V. The feedback may be of either polarity because the process feedback circuit includes an absolute value function.

J5 and J6: Are used to correctly scale the clutch and brake current feedbacks for the logic/software. “B” position is for 8A, the maximum control rating. Since there are many clutches and brakes that are rated at or less than 5.5A, the feedbacks may be scaled to be 100% at 5.5A for better resolution by selecting position “A”. These jumpers must be in agreement with the “Control Rating” parameters.

J9 and J10: Are for analog follower operation type and gain selection and are covered by the section dealing with follower setup.

J11 and J13 Are for selecting the standard controller 5.5 & 8.0 amps (Position A, both jumpers) or high power controls 16 to 100 Amp (Position B, both jumpers). J11 controls the LEM current feedback and J13 Controls the out put gating Circuit. These jumpers are set at the factory. See the High Power control Manual for more information.

SW2 Torque Limit Programming: If the torque limit function is to be used, a properly sized motor current transformer must be wired to terminals TB2-14 and 15. SW2 is then set based on the motor full load current rating per the Table 1 on page 12. Gain pot R111 adjustment and calibration is covered in Section 5-20. For further detailed information refer to the EC2000 Parameter List, Section 6.

Table 1: SW2 Programming vs. I XFMR Assembly

CURRENT XFMR ASSEMBLY	RATED MOTOR CURRENT	SW2				TRANSFORMER LEAD CONNECTIONS
		CONT ACTS				
		1	2	3	4	
15-203-3	0 – 3A	X	X	X	X	Tape Orange Lead (Not Used)
	3 – 4 ^A	X	O	O	O	
	4 – 5 ^A	O	O	X	O	
	5 – 10 ^A	O	O	O	X	
	10 – 20 ^A	X	X	X	X	Connect Orange and Black Leads Together
	20 – 35 ^A	X	O	O	O	
	35 – 50 ^A	O	O	X	O	
	50 – 70 ^A	O	O	O	X	
15-18-*	60 – 190 ^A	X	X	X	X	

X = Indicates closed contact; O = Open

Table 2: Drive Tach Generator and Pulse Pick Up -- Pulses/Rev. (PPR) (or Pole Pairs)

Drive	PPR
Obselete Drives ACM's	10
AS-14 / 25 – Fractional "FD"	12
Salient Pole Drives	14
AS-27 / AT-320	16
Salient Pole Drives	24
VT-320 P-base, AT-360, AT-440	30
Pulse Pickup, Gear	30,60,120,180

Pulse pick-ups: The pulse counts naturally are dependent on the gear used, with the most common being 60 tooth (60 PPR).

EC2000 Set Up				
	Speed	Torque	Speed / Torque	External
Process Units	Choices are: Percent RPM User	Percent only	Choices are: Percent RPM User	Choices are: Percent RPM User
Feedback Source	Automatically set to speed, parameter is locked	Automatically set to clutch current, parameter is locked	Automatically set to speed when speed is selected, clutch current when torque is selected. Locked.	Choices are: Speed External
Select Input 1/2 Function	Parameter is enabled and displayed	Parameter is enabled and displayed	Parameter is disabled and not displayed	Parameter is enabled and displayed
Preset Command Source	Parameter is enabled and displayed	Parameter is enabled and displayed	Parameter is enabled and displayed	Parameter is enabled and displayed
Speed / Torque key	Key is not functional	Key is not functional	Key is functional	Key is not functional

Table 3

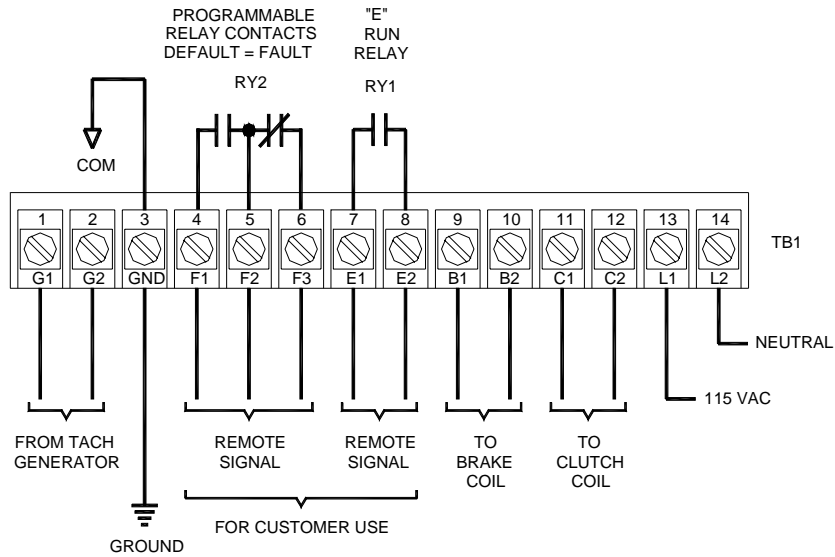


Figure 4: Customer Power Terminal Block Connections

NOTE: START AND JOG CONTACTS ARE ACTIVE ONLY DURING "REMOTE" OPERATION.

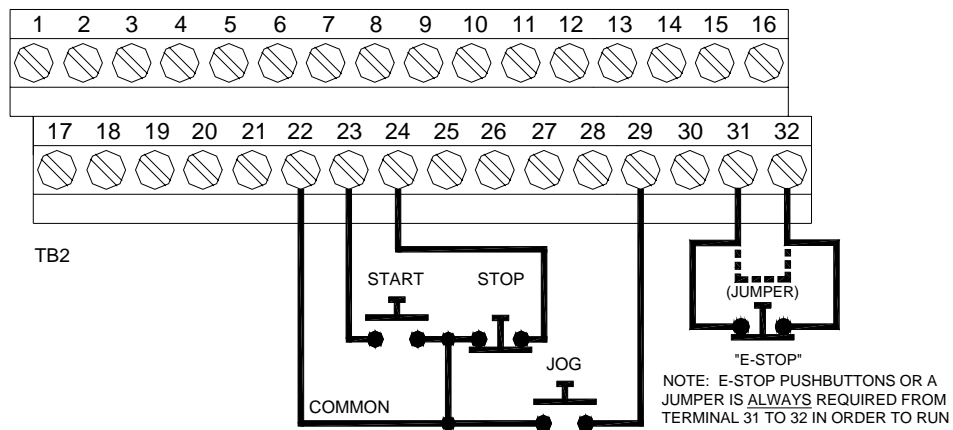


Figure 5: Three Wire Start / Stop Connections with Jog Pushbutton For two wire control, jumper 22 & 23 and toggle 22 & 24.

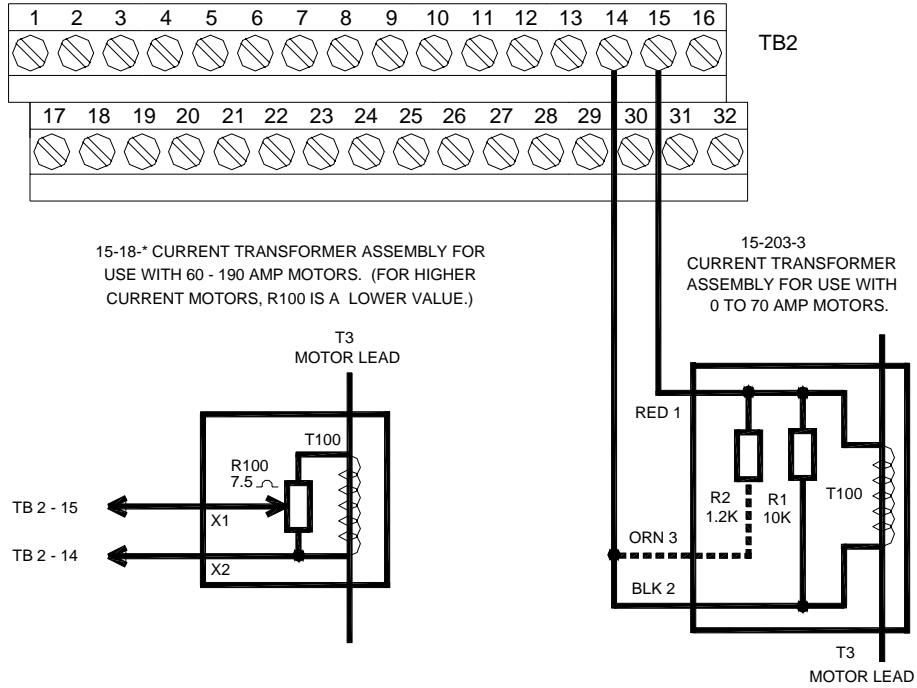
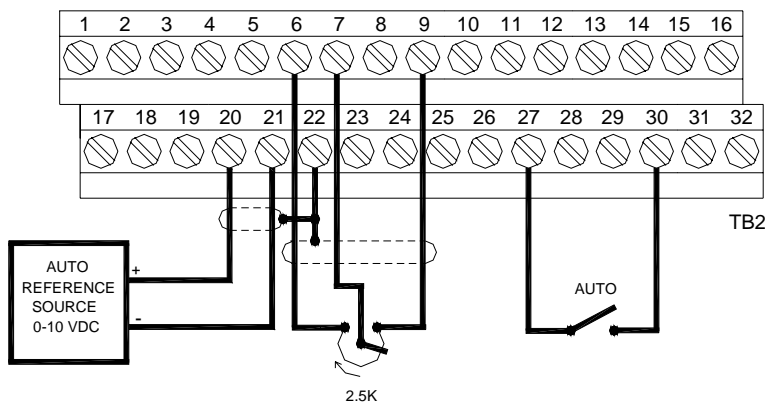


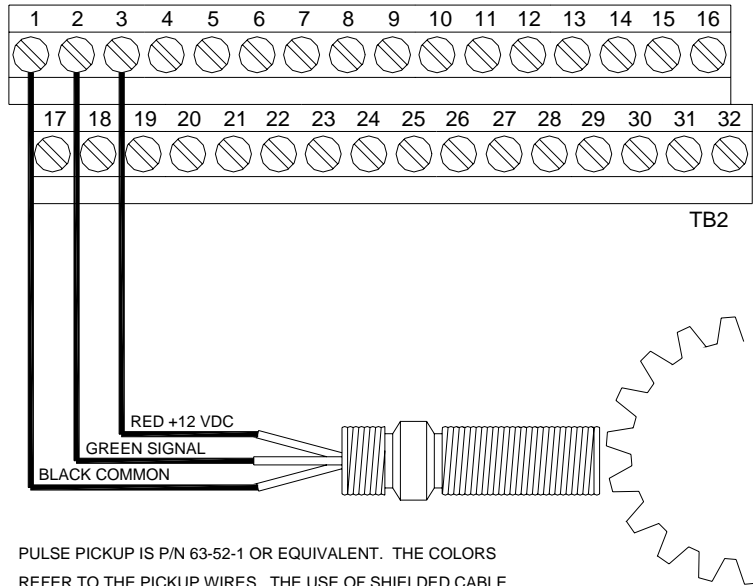
Figure 6: Torque Limit and Motor Current Indication Connections



NOTE: AUTO/MANUAL OPERATION MUST BE SET ON KEYPAD.

Figure 7: Follower Auto Signal and Pot Connections

SPEED FEEDBACK OPTION: ZERO VELOCITY HALL EFFECT PULSE PICKUP
NOTE: SET J4 ON THE POWER PCB TO THE "A" POSITION.



PULSE PICKUP IS P/N 63-52-1 OR EQUIVALENT. THE COLORS REFER TO THE PICKUP WIRES. THE USE OF SHIELDED CABLE IS RECOMMENDED.

Figure 8: Pulse Pickup Connection Details

NOTE: 0 - 10V OR 4 - 20MA (MAX) OUTPUTS ARE DETERMINED BY THE VALUE OF THE LOAD TERMINATIONS.

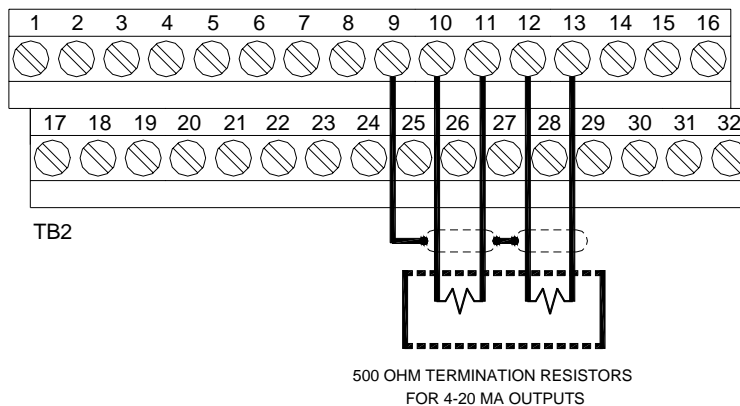


Figure 9: Analog Output Connections

Section 5 - INITIAL CONTROLLER SETUP

This section covers in detail the fundamental programming required to optimize the operation of the EC2000 control on your drive; Section 8 covers some of the more specialized features. Since we realize that the average person does not have the patience in the beginning to wade through all of the fine aspects, please go to Section 9 "Quick Startup" for nearly instant gratification. Once familiarized and desiring other features or optimization, then consult Sections 5 and 8. Although the information is presented roughly in order of the menus and parameters, sometimes it is given in order of apparent importance to the operation. Obviously what is important will be different for every application, and so we apologize if it becomes necessary to hop around to find your topics.

5.1 PROGRAMMING CONTROL TYPE AND DRIVE CHARACTERISTICS:

To enable the control to operate properly, minimal information about the application and the eddy current drive must be entered. The "A CONTROL SETUP" menu is used to enter the required information as follows: (Note: if the mechanical unit is equipped with a brake, also see the "D BRAK PERFORMANCE", Section 5.5 for additional set up requirements.)

Enter control type:

The parameter "1 CONTROL TYPE"

Select from "SPEED", "TORQUE", "SPD/TRQ", or "EXTERNAL"; the default is speed control. This parameter automatically selects the correct feedback source. The EC2000 control is designed to use speed feedback, coil current or an external analog signal source, which is the "process feedback". The selected control mode may also change the default performance gains; if Speed is selected, the feedback source is defined by the "Speed Feedback Scale" parameter, and if torque is selected, the (current) feedback is provided internally from the power board. At the same time, it disables the speed feedback parameters and automatically displays "Clutch Current" as the feedback. If external is selected, a separate analog signal connected to the terminal block is used as defined by the External Feedback parameters. If "SPD/TRQ" mode is selected, then the control type is selected via the terminal block input or Keypad "Speed/Torque" key and the "Input 1/2 Function" parameter is not displayed since these inputs are replaced by the speed/torque command inputs. If the "SPD/TRQ" selection is not made, the "Speed/Torque" key on the keypad is not functional and the "Control Type" source parameter is not displayed. This information is summarized in Table 3 on page 12.

Now enter the controller current rating:

The parameter "2 CONTRLR CURRENT" is used to select the output range of the controller. The choices are 5.5 or 8.0 amps. Choose the lowest value above or equal to the coil rating of the EC unit being used. Note: Jumper J5 (and J6 for the brake) on the power PCB must be in the correct position for the current level setting. Position A = 5.5 Amps, B = 8 Amps.

Next the EC coil rating must be entered:

The parameter "3 CLUTCH COIL RATING" is used to enter the coil rating. Locate the coil current rating on the nameplate of the mechanical unit and enter this value. Note that the value should be equal to or less than the controller rating (Parameter 2) entered.

Determine if the coil current limit to be used will be less than rated:

The parameter "4 CLUTCH CURNT LIM" is to set the coil current limit to a value equal to or less than it's rating. Limiting the coil current to less than rated reduces the amount of torque; in some applications this may be desirable, however for most applications this parameter should be set the same value as the clutch coil rating.

Set the speed feedback frequency:

The parameter "5 TACH PULSES/REV" is used to set this rate. In most applications, the AC generator located inside the mechanical unit, is used to provide the speed feedback signal. Alternatively, an external generator or pulse pick up may be used. If the generator PPR rate is unknown, check Table 2 on page 12 to see if your drive size is listed or check the nameplate on newer units; it may also be obtained by consulting the factory. If an external generator or pickup is used, enter the PPR rate. The available choices are: 10, 12, 14, 16, 24, 30, 60, 120 and 180. If none of the choices are correct the clutch scale factor may be used. Use the closest choice and multiply by the percentage (eg 50% = 0.5 so $16 \times .5 = 8$ pulses per rev) to accommodate the actual pulses of your unit. Note: Jumper J4 on the power board must be in the correct position; if an AC tach generator is used, wire to terminals TB1-1 and 2 (G1 and G2) on the power PCB, and set the jumper to the "B" position. If a pulse pickup is used, wire to TB2-1 (COM), TB2-2 (sig.) and TB2-3 (+12V) and set the jumper in the "A" position.

Enter the clutch speed range:

The parameter "6 CLUTCH MIN RPM" sets the low speed thermal rating (from unit nameplate) if any. Slower speeds are possible, but may require reduced torque. The parameter "7 CLUTCH MAX RPM" is used to set the max speed of the clutch (again from nameplate). These two parameters set the limits for the max and min process. **IMPORTANT:** The min and max clutch rpm parameters set the overall speed range limits for drive operation. The correct values are essential for drive thermal protection particularly in applications requiring rated torque at slow speeds and it also ensures the EC2000 control will remain in regulation at high speed applications. If application speed or full load torque is required outside nameplate capacity, consult the factory.

CAUTION: Clutch min and max RPM parameters affect the range and setting of other parameters (i.e. min/max process and preset parameters) and may cause other parameters to be automatically rescaled. Always set these parameters first and then reset or verify the other parameters before continuing.

The motor current rating must now be entered:

The parameters "8 MTR FULL LOAD A" and "9 MTR NO LOAD AMPS" are used to scale the motor current signal for proper operation and are necessary only if the torque limit mode of operation is to be used. The rated motor amps are listed on the nameplate of the motor; the no load motor amps must be measured. For more information see the section about torque limit.

Select the stopping mode:

The parameter "10 COAST ENABLE" is selected if it is desired to allow the output to coast or to have a controlled rate of stopping. The usual stopping mode is linear decel (default) so that if coast to stop is desired, it must be selected. For more information see Section 5.14 about "Coast to Stop".

Enter the control mode to be used:

The parameter "11 LOCAL/REM EN" is used to select the local or remote control mode. This determines if the control is to be operated from the keypad, externally wired switches or both. The factory default is for keypad operation. This feature is not required for most applications and is shipped disabled. For more information see Section 5.9 about local/remote operation.

Filter values found under this menu normally should be left at the defaults; consult the factory before changing. "12 FILTER 1" affects the inner current loop feedback signal only (clutch amps). The default for this parameter is 16 (min filtering). "13 FILTER 2" affects the outer loop. In speed control mode it filters speed feedback and in external control it filters the process feedback signal, the default being zero (no filtering). These parameters are not "stop" protected so they may be changed while running.

Explanation of the memory reset function:

This is a command function that resets all parameters to the factory default settings stored in memory. The parameter "14 MEMORY RESET EN" is used to execute this function. Memory can also be reset from the terminals if the controller will not boot up due to a firmware upgrade or parameter error. Open 31 & 32 (e-stop), Open 22 & 24 & (stop) Close 22 & 29.(jog). Cycle power. Defaults will load.

CAUTION: Enabling this command will change all stored parameters back to their factory defaults! For detailed information, see Section 8.8 about this feature.

Enter Reverse Control Enable / Disable.

Disable is default. Enable is used to control downwards in speed instead of upwards. Rarely used. Centrifuges usually require reverse control.

Enter Current Feedback Scaling.

Default is 100%. Adjust after start up if current display is inaccurate. Raise number to increase reading. Only a small adjustment should be necessary.

Enter the Pulse Feedback Scaling.

Default is 100%. Allows the control to be adjusted for pulserates not included in Tach / Pulse Revs Item 5 above. Set Tach / Pulse Revs to nearest unit 10, 12, 14 ect and adjust upward or downward until accurate display reading is obtained.

The following is a brief example of how to set control parameters with application data given:

AS 20 hp unit with the following nameplate ratings: min rpm 440, max rpm 1660, clutch amps hot 4.18A and motor amps 27.5 @ 460V. The application is to be speed control with a decel ramp required on stopping. Local/Remote operation is not needed. Set the following parameters in the "A CONTROL SETUP" menu:

- 1 CONTROL TYPE set to "SPEED"
- 2 CONTROL CURRENT set to "5.5A"
- 3 CLUTCH COIL RATING set to "4.18A"
- 4 CLUTCH CURNT LIMIT set to "4.18A"
- 5 TACH PULSES/REV set to "12"
- 6 CLUTCH MAX RPM set to "1660 rpm"
- 7 CLUTCH MIN RPM set to "440 rpm"
- 8 MTR FULL LOAD A set to "27.5A"
- 9 MTR NO LOAD AMPS set from measured value or table value
- 10 COAST ENABLE left in "DISABLE"
- 11 LOCAL/REM ENABLE set to "DISABLE"
- 12 FILTER 1 left at "16"
- 13 FILTER 2 left at "0"
- 14 MEMORY REST left on DISABLE
- 15 REVERSE CONTROL left on DISABLE

- 16 CLUTCH CURRENT SCALE left at 100%
- 17 CLUTCH PPR FDB SCALE left at 100%

All else may be left at the factory default settings for the initial running tests.

5.2 SET POINT RANGE:

PROCESS UNITS: These parameters should be set up after the “CONTROL SETUP” parameters but before any other parameters because they may affect the values displayed as well as the min/max ranges for other setup and display parameters. If the “Control Type” parameter is set to speed control, the choices are “PERCENT, RPM or USER UNITS” with percent as the default; if RPM is selected, the base speed motor rpm is used as the default and upper limit for the “MAXIMUM PROCESS” parameter (see attached chart). If torque control is selected, percent is the only choice with maximum process of 100% and a min of 0%. If “EXTERNAL” is used, the choices are “PERCENT” or “USER UNITS” with percent as the default. If “PERCENT” is selected, 100% is the maximum process value and 0 is the minimum. If “USER” is selected, see user unit scaling below.

USER UNITS: If “USER” process units are selected, the following parameters are displayed (hidden otherwise); that will also be used to calculate the “MAXIMUM PROCESS” parameter using the motor base speed value. In “USER UNITS”, select the most appropriate alphanumeric characters using the keypad arrow keys and ENTER key, i.e. RPM, FPM, SPM and so on. In “USER DECIMAL PNT” the decimal point is then set to 0, 1, 2 or 3 to arrive at the correct display. For the “MAX USER VALUE”, enter the number of user units that correspond to the desired top drive speed. See Section 5.18 for further details.

The min and max clutch rpm parameters set the overall speed range limits for drive operation by setting the limits for the MIN and MAX PROCESS parameters. The MIN and MAX PROCESS parameters set the range for many other parameters.

MAXIMUM PROCESS sets the highest output speed from the drive and the range of adjustment. This parameter is automatically determined by the software based on the “CONTROL TYPE” and “USER” unit parameters. Note: If “USER” units are selected, values must be entered in the user units menu before the max process can be set. The output is then in the selected process units with the default being 100% of the set process maximum (this corresponds to the max clutch setting which remains in rpm).

Control Type	Process Units	Max Range of Adjustment/Units
Speed	Percent	0-100%
	Rpm	0-base speed (rpm)
Torque	Percent	0-100%
Spd/Trq	Percent	0-100%
User	Programmed	0 to user scale max @ MAX CLUTCH RPM in process units

“MINIMUM PROCESS” sets the minimum output process from the drive with the range of adjustment being from zero to the value determined by the “MAXIMUM PROCESS” parameter value, the default being 0%.

Example 1: The CLUTCH MIN RPM is 440 rpm and the CLUTCH MAX RPM is 1660 and process units are in RPM. The parameter ranges are as follows:

1. MIN PROCESS - May be 440 rpm to MAX PROCESS value range; set to 440 rpm.
2. MAX PROCESS - From MIN PROCESS value to 1660rpm range; set to 1660 rpm.
3. PRESET 1 - Between the 440 rpm to 1660 rpm speeds.

Example 2: Same speed range as Example 1, but the process units are changed to PERCENT. 26.5% is 440/1160 rpm. The parameter ranges are as follows:

1. MIN PROCESS - 26.5% to MAX PROCESS value range, set to 26.5%
2. MAX PROCESS - MIN PROCESS value to 100% range, set to 100%
3. PRESET 1 - Between 26.5% and 100%.

Example 3: Same speed range as example 1, but the process units are changed to SPM with a user value parameter of 15 and decimal parameter of 3. The max process is 15 SPM (1660 rpm) and min process of 3.975 SPM (440rpm). The parameter ranges are as follows:

1. MIN PROCESS - 3.975 SPM to MAX PROCESS value range, set to 3.975SPM.
2. MAX PROCESS - MIN PROCESS value to 100% range, set to 15 SPM.
3. PRESET 1 - Between 3.975 SPM and 15 SPM.

Also note that the MIN PROCESS value cannot be set below its minimum range unless the CLUTCH MIN RPM parameter is first lowered. Similarly the MAX PROCESS value cannot be set above its range unless the CLUTCH MAX RPM parameter is increased. CAUTION: When changing the MIN or MAX CLUTCH RPM values beyond nameplate values, it may be necessary to derate in order to avoid damage to the EC mechanical unit. Consult the factory if further information is required on derating. The jog set point is not affected by the MIN PROCESS or MIN CLUTCH RPM parameters since jog is not a continuous operation.

5.3 CLCH PERFORMANCE: These parameters fine-tune the response of the (PID) control loops. If performance is satisfactory, it should not be necessary to change the preset, general purpose values, which are in percent. These default values may automatically change depending upon which control mode is selected.

CURR PROP GAIN
CURR INTGRL GAIN
CURR DIFF GAIN

SPEED PROP GAIN
SPEED INTGRL GAIN
SPEED DIFF GAIN

Eddy current drives are not particularly stable and well behaved if there is no shaft load, so make sure the drive is installed on the machine and a reasonable amount of load is present, if possible, before evaluating stability. The defaults for the PID parameters under "B CLCH PERFORMANCE" are the most usual settings for the average application. If instability occurs, try increasing the "6 SPEED DIFF GAIN" gradually to see if the performance is improved; if not, next try slowly reducing "5 SPED INTGRL GAIN". The integral gain should not go to zero because it will not react properly with load changes. "4 SPEED PROP GAIN" may also be reduced; it will not allow values less than 1%. On all of these adjustments, if performance becomes noticeably worse, adjust the parameter in the opposite direction (increase rather than decrease, for instance). If after these adjustments performance is still unsatisfactory, contact the factory.

Also under this menu are the torque limit parameters, which are not used unless a motor current transformer is supplied and wired. Be sure to set SW2 on the power board per Table 1 on page 12 and enter the desired level of motor current limit under "7 TORQUE LIMIT". Then, adjust R111 on the power board while using a clamp on ammeter to calibrate the torque limit. This should be done as close to the desired limit level as possible because the current metering scheme is not linear. "TRQL PROP GAIN" and "TRQL INTGRL GAIN" are used to adjust the stability of operation but only when actually in torque limit; they have no effect during normal operation.

- 5.4 ACCEL/DECEL STUP. The following parameters determine the set point ramp times: "NORMAL ACCEL RATE" is used to enter the desired ramp rate for manual operation; similarly, "NORMAL DECEL RATE" is also for manual only. "AUTO ACCEL RATE" and "AUTO DECEL RATE" are only for auto mode, and finally "JOG ACCEL RATE" and "JOG DECEL RATE" naturally is only for jog mode of operation. These parameters set the rate from 0 to max process in percent per second with the range being .25% to 250%. The default is 10% except for the jog parameters, which are 100%. The jog parameters are not displayed in either torque or external mode.
- 5.5 BRAKE PERFORMANCE. These parameters set up the adjustable braking option, which will put a programmed value of voltage on the brake coil when the E relay drops out. PID parameters may be adjusted to improve the stability of the brake current similar to the clutch current PID parameters above.

Check to insure the hardware settings have been made before entering the "D BRAK PERFORMANCE" menu for programming as follows:

Brake set up jumpers: The EC2000 is capable of two levels of current and up to 90VDC; check that Jumper J6 on the power PCB is in the correct position (equal to or greater than the brake current rating).

Position A = 5.5 Amps, Position B = 8 Amps

Braking must be enabled by setting the "ADJ BRAKING ENABL" parameter to "ENABLE" and entering an appropriate level using the "ADJ BRAKE AMPS" parameter.

The braking performance is adjusted if necessary using the PID parameters, "BRAKE PROP GAIN", "BRAKE INTGRL GAIN", and "BRAKE DIFF GAIN".

Example: AS unit, 20 hp with an eddy current brake is required to quickly slow the process when a stop command is given. (The brake current rating is obtained from the drive nameplate).

Set the following parameters in the D BRAK PERFORMANCE menu:

- 1 BRAK COIL RATING set to 3.8A (rated)
- 2 ADJ BRAKING ENABL set to ENABLE
- 3 ADJ BRAKE AMPS set to 3A
- 4 BRAKE PROP GAIN set to 30%
- 5 BRAKE INTGRL GAIN set to 10%
- 6 BRAKE DIFF GAIN set to 10%

Now change "3 ADJ BRAKE AMPS" to higher values for faster stopping, lower for slower.

- 5.6 STOPPING COMMANDS:
The drive may be stopped by many different methods. Keypad, pushbuttons, interlocks, faults, are among the ways to stop the drive. All stop command methods are active at all times:

- The keypad Stop key
- From the keypad, when the JOG key is released
- A remote Stop pushbutton (three wire control)
- Releasing a remote JOG pushbutton (three wire control)
- From a remote manually operated switch (2 wire control)
- From a remote automatic contact (2 wire control PLC)
- From the E-stop input
- Drive fault

5.7 STARTING THE DRIVE:

A start command may be issued through any of the ways listed below. Before a particular method will work, the drive must be wired and programmed correctly. Control logic and circuits also will vary according to how each method is implemented. A standard control is preset from the factory to operate from the keypad only. Start command methods:

From the keypad START key

From the keypad JOG key

From a remote START pushbutton (three wire control)

From a remote JOG pushbutton (three wire control)

From a remote manually operated switch (2-wire control)

From a remote automatic contact (2-wire control PLC)

Automatically when power is applied (auto restart)

Automatically after a fault has occurred (auto restart)

NOTE: The drive will not start if the stop input (TB2-24), is open, the ESTOP interlock (TB2-31) is open or the drive is in a “fault” condition.

The “START SOURCE” is item 7 under the “SOURCE SELECT” menu and determines whether the drive start commands will be executed from either the start key on the keypad or from a start switch wired to TB2. If the “11 LOCAL/REM ENABLE” is disabled and the “START SOURCE” is set to “KEYPAD”, only the “START” key on the keypad will be active; if “TERM”, then only remote start switches will be active. If both local (keypad) and remote (external switch) are to be used, local/remote has to be enabled and the “START SOURCE” must be set to “TERM”. If the start source is left in “KEYPAD” it dominates and only the keypad start button will be active regardless of local/remote condition.

There are two distinct terminal start/stop methods; three wire start/stop and two wire or “PLC” run. To use either method, the start source has to be set to “TERM”. If PLC run is to be used, the “PLC RUN ENABLE” parameter is set to enable; this allows the drive to be started and stopped by an external contact wired to TB2.

Note: If “PLC RUN ENABLE” is set to enable, the normal TB2-23 start input is inactive.

PLC run may be used if the start source is set to “TERM” and:

1. The “PLC RUN” parameter is set to enable and the “LOCAL/REMOTE EN” parameter is set to disable, or
2. Both the “PLC RUN” parameter and the “LOCAL/REMOTE EN” parameter are set to enable, and the unit is in remote mode.

If the PLC contact is closed before switching from local to remote, the unit will not start until the PLC contact is opened and then closed again. If the unit is already running when the transition from local to remote is made, the control will stop and may only be restarted by cycling the PLC contact.

Using the “PLC AUTO START” parameter may defeat this PLC start protection. If this parameter is set to enable, the unit will automatically start when the transition from local to remote is made or will continue to run if already running (see Section 8.2).

The following examples assume correct wiring per the connection diagrams:

Example 1: From the keypad start key only:

Set the following parameters, in the "K SOURCE SELECT" menu: "7 START SOURCE" to keypad and in the "A CONTROL SETUP" menu: "11 LOCAL/REM ENABLE" to disable.

Example 2: From a remote start pushbutton (three wire control) only:

Set the following parameters, in the "K SOURCE SELECT" menu: "7 START SOURCE" to term and in the "A CONTROL SETUP" menu: "11 LOCAL/REM ENABLE" to disable.

Example 3: From a remote start/stop switch (two wire control variation on three wire input) only:

Set the following parameters, in the "K SOURCE SELECT" menu: "7 START SOURCE" to term and in the "A CONTROL SETUP" menu: "11 LOCAL/REM ENABLE" to disable. The start terminal TB2-23 must be jumpered to common and the stop terminal TB2-24 switched.

Example 4: From a remote PLC contact (two wire control) only:

Set the following parameters, in the "K SOURCE SELECT" menu: "4 PLC RUN ENABLE" to enable, "7 START SOURCE" to term and in the "A CONTROL SETUP" menu: "11 LOCAL/REM ENABLE" to disable.

Example 5: From the keypad start key when in the "Local" mode and a remote start pushbutton when in "Remote" mode:

Set the following parameters in the "K SOURCE SELECT" menu: "7 START SOURCE" to term and in the "A CONTROL SETUP" menu: "11 LOCAL/REM ENABLE" to enable.

Example 6: From the keypad start key when in the "Local" mode and a remote PLC contact when in "remote" mode. The PLC contact must be open when change from "Local" to "Remote" is made. If the drive is running when mode change is made, the drive will stop:

Set the following parameters in the "K SOURCE SELECT" menu: "4 PLC RUN ENABLE" to enable, "7 START SOURCE" to term and in the "A CONTROL SETUP" menu: "11 LOCAL/REM ENABLE" to enable.

Example 7: From the keypad start key when in the "Local" mode and a remote PLC contact when in "Remote" mode. The PLC contact may be closed when change from "Local to Remote" is made. If the drive is running when mode change is made, the drive will continue to run:

Set the following parameters in the "K SOURCE SELECT" menu: "3 PLC AUTOSTART" to enable, "4 PLC RUN ENABLE" to enable, "7 START SOURCE" to term and in the "A CONTROL SETUP" menu: "11 LOCAL/REM ENABLE" to enable.

5.8 JOG FUNCTION:

Jog is a momentary run function at a preset jog speed reference. When jog is commanded, the drive will start and accelerate to the jog set point and remain there as long as the jog pushbutton is pressed. When the Jog pushbutton is released, the output will stop after a deceleration to zero. The drive will remain ready for about five seconds after a jog command is removed. During this time the output contactor remains picked up and "JOG" is displayed on the alphanumeric display and the drive output is inhibited during this period. This is to give a faster drive response to a jog commands by not having to pull the contactor in each time the jog button is pushed.

Set "JOG SOURCE", item 2 under "SOURCE SELECT"; proper jog operation is also dependent upon the state of the "LOCAL/REM ENABLE". If the "LOCAL/REM ENABLE" is set to disable and the "JOG SOURCE" is set to keypad, the jog command can only be executed from the "JOG" key on the keypad; when it is set to TERM, it may only be executed from the terminal block. If the "LOCAL/REM ENABLE" is set to ENABLE and the "JOG SOURCE" is set to TERM, the source of the jog command is automatically switched between the terminal block and keypad when the

local/remote mode is changed on the keypad. If the "JOG SOURCE" is set to keypad, the source of the jog command is not switched when the Local/Remote mode is changed and remains active only from the keypad.

Example 1: Jog is to be commanded from the keypad only, and jog speed is 200 rpm:

Set the following parameters in the "K SOURCE SELECT" menu: "2 JOG SOURCE" to keypad, and in the "L PROCESS SETUP" menu, "7 JOG SET POINT" to 200 rpm (in process units).

Example 2: Jog is to be commanded from the terminal block only; jog speed is 200 rpm:

Set the following parameters in the "A CONTROL SETUP" menu, "11 LOCAL/REM" to disable, in the "K SOURCE SELECT" menu, "2 JOG SOURCE" to term and in the "L PROCESS SETUP" menu, "7 JOG SET POINT" to 200 rpm (in process units).

Example 3: Jog is to be commanded from either the keypad or the terminal block dependant on local or remote mode; jog speed is 200 rpm.

Set the following parameters in the "A CONTROL SETUP" menu, "11 LOCAL/REM" to enable, in the "K SOURCE SELECT" menu, "2 JOG SOURCE" to term and in the "L PROCESS SETUP" menu, "7 JOG SET POINT" to 200 rpm (in process units).

Other useful jog information:

1. Jog is not available in torque control or external control, and jog parameters are not displayed in these modes; the jog key on the keypad and the jog input on TB are not functional.
2. Relay outputs may be used to indicate the jog mode, see relay output section.
3. A status display on the keypad indicates the jog operation. The control logic provides a number of automatic protection features when using the jog mode, as listed below:
 - a. The Jog mode can only be selected when the drive is in manual mode.
 - b. The Jog mode may not be entered while in Run.
 - c. When the drive is in the Jog mode, the Jog speed reference overrides all other speed references including Auto.
4. Jog speed will be determined by the parameter "JOG SET POINT" and accel and decel rates as set by the parameters "JOG ACCEL and JOG DECEL".
5. Jog units are determined by the "PROCESS UNITS" parameter.
6. An external Jog pot is not available.
7. The jog speed range is limited by the MAX PROCESS parameter but is not affected by the "MIN PROCESS" or "MIN CLUTCH RPM" because jogging is not intended as a continuous operation.
8. If the "JOG SOURCE" parameter is set to keypad, the jog function will always be activated by the jog key on the keypad and not from the terminal block, even if the local/remote function is enabled.

5.9 LOCAL/REMOTE OPERATION:

The EC2000 has two modes of operation, LOCAL or REMOTE. The local/remote mode selection determines the source of the START, JOG, and MANUAL/AUTO, PRESET(s) 1-4 and SPD/TORQUE commands. Each command has a dedicated key on the keypad and a terminal block input for remote wired switches and pushbuttons.

In local mode, the above commands are executed only from the keypad and in remote mode the commands are executed via elements wired to the terminal block inputs.

As a safety feature, the local/remote command may be executed only from the keypad. In order to switch between the two modes by using the LOCAL/REMOTE key on the keypad, the "LOCAL/REMOTE ENABLE" parameter must be set to "enable". If the local/remote command is disabled, the source for each command can be set individually.

Start Command:

- 1.If local/remote is enabled and start source is set to terminal; when in local, the keypad RUN key starts the drive and the TB (terminal block) start inputs are disabled. When in remote, the start input on the TB starts the drive. The start input could be either the start input TB2-23 or the PLC run input TB2-28 (depending on if the PLC run function is enabled) and the keypad RUN key is disabled.
- 2.If local/remote is enabled and start source is set to keypad; when in local or remote, the keypad RUN key starts the drive; the TB start inputs are disabled.

Speed/Torque Command:

- 1.If local/remote is enabled and control type source is set to terminal; when in local, the keypad SPD/TRQ key selects the control type and the TB input is disabled. When in remote, the control type input at TB2-25 selects the control type and the keypad SPD/TRQ key is disabled.
- 2.If local/remote is enabled and control type source is set to Keypad; hen in local or remote, the keypad SPD/TRQ key selects the control type and the TB input is disabled.

Manual/Auto Command:

- 1.If local/remote is enabled and auto/man source is set to terminal; when in local, the keypad MAN/AUTO key selects the mode and the terminal block auto input is disabled; in remote, the auto input at TB2-30 sets the mode and the keypad MAN/AUTO key is disabled.
- 2.If local/remote is enabled and auto/man source is set to keypad; when in local or remote, the keypad MAN/AUTO key selects the mode and the TB auto input is disabled.

Preset Commands:

- 1.If the control type is SPEED, TORQUE, or EXTERNAL, and if local/remote is enabled and preset source is set to terminal; in local, the keypad P1, P2, P3, and P4 keys select the set point and the TB inputs are disabled. In remote, the preset inputs at TB2-25 and TB2-26 select the set point and the keypad P1, P2, P3 and P4 keys are disabled.
- 2.If local/remote is enabled and Preset source is set to Keypad; in local or remote, the keypad P1, P2, P3, and P4 keys select the set point and the TB inputs are disabled.
- 3.If the control type is SPD/TRQ, and if local/remote is enabled (preset parameter is not displayed in spd/trq mode) in local or remote, the keypad P1, P2, P3, and P4 keys select the set point and the TB inputs are disabled.

Automatic protection features when using the Local/Remote mode:

If the drive is running in the Local mode when the Remote command is executed, the drive will perform a normal stop before changing modes. If the drive is equipped with a PLC Run input and the PLC Auto Start (PLC AS) logical is enabled, the drive will start (or remain running) when the transition from the Local mode to the Remote mode is made, and the PLC Run contact is closed. If the drive is operating in Remote and in the Auto mode, and the local command is executed, the Manual mode is automatically selected. If the Auto mode is required in local operation, then the Auto command must be executed after the control has been switched from Remote to Local operation. Refer to Manual and Auto commands for more information. If the drive is running in the remote mode when the Local command is executed, the drive will stop. The Start key on the keypad must be pressed to restart the drive. If the drive is equipped with a PLC Run input, the "PLC AUTOSTART" does not affect operation in the Local mode.

Other useful information:

Relay outputs to indicate the local or remote modes can be set up; see the relay output section. A status display on the keypad indicates the local/remote operation. Speed/Torque selection from the terminal block is available and the parameter is displayed only if the control type parameter is set to "SPD/TRQ". If Speed/Torque control is selected, presets 1-4 are not available from the terminal blocks as these terminal inputs are redefined as speed/ torque inputs, (the speed/torque source parameter in the source menu must also be set to "term").

5.10 SET POINT/REFERENCE:

The set point can originate from many different paths, both digital and analog paths and is dependent on the control mode. The set point is applied to a "ramp generator" to become the "reference". The ramp generator uses the accel/decel parameters to compute the reference value. The "set point" value is always shown on the top line of the display and "reference" value can be displayed by the using the meter select functions "REFERENCE"; both are in process units. If the set point is adjusted beyond these levels the reference will be clamped. "MIN PROCESS" and "MAX PROCESS" limit the set point levels under any conditions.

The ramp rates are set by parameters located in the "C. ACCEL/DECL STUP" menu. In the Manual mode, the parameters "NORM ACCELERATION" and "NORM DECELERATION" are used, in the Auto mode, "AUTO ACCELERATION" and "AUTO DECELERATION" serve. For Jog mode, the parameters "JOG ACCELERATION" and "JOG DECELERATION" are used. All of the rates are adjustable between 0.25 and 250% per second.

The EC2000 has the capability of accepting a set point signal from a "manual" or an "automatic" source. The logic provides MANUAL and AUTO commands to switch between these sources. In the manual mode the drive receives an analog reference from an external speed pot or from one of the preset speeds or a directly set reference ("SET POINT" operation from the keypad). The auto command uses an external analog reference from the follower input. The logic also provides a "loss of follower signal" function, which can be used to provide the set point if the follower signal becomes disconnected.

5.11 MANUAL SET POINT AND SET POINT MODE OPERATION:

In the manual mode, one of the following set point sources is used:

1) An external 0-10V max analog signal from a potentiometer wired to the terminal block. This source may be selected by setting parameter "Preset1 Source" to "Pot"; an on-board +9V supply is provided. The pot voltage is profiled by parameters, which will locate two points on the (straight line) curve by defining the minimum and maximum voltages and the minimum and maximum set points that correspond.

Example: The signal from the pot is 0-9VDC where 1V and below represents 500 rpm, and 9 volts and above represents 1600 rpm. Control mode is "Speed" and Process units are in rpm.

Set the following parameter in the "K SOURCE SELECT" menu, "6 PRESET 1 SOURCE" to pot. Set the following parameters in the "J POTENTIOMETER SETUP" menu,

- 1 POT MIN to 500 rpm (in process units)
- 2 POT MAXIMUM 1600 rpm (in process units)
- 3 POT MINIMUM REF to 010.0%
- 4 POT MAXIMUM REF to 090.0%

When the drive is in manual mode, the process should change from 500 to 1600 rpm when the 1-9V signal from the pot is applied. The set point displayed on the keypad should be 500 to 1600 rpm; the speed will not go below 500 or above 1600.

Other useful information:

- a. If the "PRESET1 SOURCE" parameter is set to pot, the set point key on the keypad is not functional.
- b. The range of the "POT MIN" and "POT MAX" parameters is limited by the min and max process parameters.
- c. The ramp is determined by the "NORM ACCEL RATE" and "NORM DECEL RATE" parameters.

2) SET POINT MODE: Modify the set point directly by using the "SET POINT" and arrow keys on the keypad. When in the set point mode, the set point value flashes as an indication; then the set point value may be modified up or down by using the corresponding arrow keys. When the set point key is pressed, the set point value will begin to flash; use the up/down arrows to adjust value to 1600 RPM. Push the set point key to exit the mode.

Other useful information:

- a. The pot is not functional if "PRESET 1 SOURCE" is set to keypad. If it is set to pot and preset 1 is entered, the set point key on the keypad will not adjust the set point because the set point is being provided by the pot. However if presets 2, 3 or 4 have been entered, and the set point key is pressed you will be able to modify the set point.
Remember, to go back to the pot set point, Preset 1 must be pushed.
- b. The set point adjustment range is limited by the MIN and MAX PROCESS parameters.
- c. The ramp is determined by the NORM ACCEL/DECEL parameters.

5.12 PRESET SOURCE: This parameter determines the source of the preset commands, which may be executed from either the preset keys on the keypad or from switches wired to the terminal block. The selection of the preset source is also dependent on the state of the Local/Remote enable. If "LOCAL/REM" is disabled, and "PRESET SOURCE" is set to keypad, then the preset commands will always be executed from the keypad and the terminal block inputs will not function. Similarly, if the source parameter is set to "TERM", then the commands will always be executed from remote switches wired to the terminal blocks and the keypad presets will not be functional. If "LOCAL/REM" is enabled, and "PRESET SOURCE" is set to keypad, then the preset commands will always be executed from the keypad and the terminal inputs will not function regardless of the Local/Remote mode state. However, if the source parameter is set to "TERM", then the commands will switch between the keypad and terminal block when the "LOCAL/REM" state is changed. PRESET SOURCE is not displayed when the SPD/TRQ control mode is selected because the presets are then redefined as speed/torque inputs only. You may program four set points in the "L PROCESS" menu items 3 to 6 which will be activated by using one of the preset keys or external contacts as described above (remember "PRESET 1

SOURCE” must be set to keypad to use all four). The terminal preset command is determined by the following inputs:

	SPD1	SPD2	SPD3	SPD4
TB2 - 25 input	low	low	high	high
TB2 - 26 input	low	high	low	high

Example 1: Control mode is Speed and Process units are in rpm. Preset command by the keypad keys only. P1 is set at 500 rpm, P2 at 550 rpm, P3 at 600 rpm and P4 at 650 rpm. Terminal block selection and the remote pot are not used.

Set the following parameters in the “K SOURCE SELECT” menu, “5 PRESET SOURCE” to keypad and “6 PRESET 1 SOURCE” to keypad.

Set the following parameters in the “L PROCESS” menu,

- 3 PRESET 1 to 500 rpm (in process units)
- 4 PRESET 2 to 550 rpm (in process units)
- 5 PRESET 3 to 600 rpm (in process units)
- 6 PRESET 4 to 650 rpm (in process units)

Example 2: Use the same presets as Example 1, but Presets are commanded at the terminal block only. The preset keys and the remote pot are not used.

Set the following parameters in the “K SOURCE SELECT” menu, “5 PRESET SOURCE” to term, and “6 PRESET 1 SOURCE” to keypad.

Set the following parameters in the “L PROCESS” menu,

- 3 PRESET 1 to 500 rpm (in process units)
- 4 PRESET 2 to 550 rpm (in process units)
- 5 PRESET 3 to 600 rpm (in process units)
- 6 PRESET 4 to 650 rpm (in process units)

Example 3: Control mode is Speed and Process units are in rpm. Preset inputs commanded at the terminal block only. The remote pot is used for P1 and P2 is set at 550 rpm, P3 at 600 rpm and P4 at 650 rpm set point. The preset keys on the keypad are not used.

Set the following parameter in the “A CONTROL SETUP” menu, “11 LOCAL/REM” to disable.

Set the following parameters in the “K SOURCE SELECT” menu, “5 PRESET SOURCE” to term and “6 PRESET 1 SOURCE” to pot.

Set the following parameters in the “L PROCESS” menu,

- 3 PRESET 1 (not used)
- 4 PRESET 2 to 550 rpm (in process units)
- 5 PRESET 3 to 600 rpm (in process units)
- 6 PRESET 4 to 650 RPM (in process units)

Example 4: Preset commands by the keypad only. The remote pot is used for P1, P2 is at 550 rpm, P3 at 600rpm and P4 at 650 rpm set point. Terminal block speed selection is not used.

Set the following parameters in the “K SOURCE SELECT” menu, “5 PRESET SOURCE” to keypad and “6 PRESET 1 SOURCE” to pot.

Set the following parameters in the "L PROCESS" menu,

- 3 PRESET 1 (not used)
- 4 PRESET 2 to 550 rpm (in process units)
- 5 PRESET 3 to 600 rpm (in process units)
- 6 PRESET 4 to 650 rpm (in process units)

Example 5: Preset commands by the keypad only when in local mode and by the terminal block when in remote. The remote pot is used for P1, P2 is set at 550 rpm, P3 at 600 rpm and 650 rpm set point. Terminal block speed selection is not used.

Set the following parameter in the "A CONTROL SETUP" menu, "11 LOCAL/REM" to enable. Set the following parameters in the "K SOURCE SELECT" menu, "5 PRESET SOURCE" to term and "6 PRESET 1 SOURCE" to pot.

Set the following parameters in the "L PROCESS" menu,

- 3 PRESET 1 (not used)
- 4 PRESET 2 to 550 rpm (in process units)
- 5 PRESET 3 to 600 rpm (in process units)
- 6 PRESET 4 to 650 rpm (in process units)

Other useful information:

1. Relay outputs to indicate the manual, auto or jog modes may be set up. See the relay output section.
2. Preset commands from the terminal block are not available if the control type is set to SPD/TRQ because the terminal block inputs are then used for switching these functions; the preset keys on the keypad are still functional.
3. When set to "keypad", the preset set point level can be overridden at anytime by pressing the SET POINT key and using the arrows to adjust the level. This is not true in the "terminal" mode or if the parameter "Preset 1 Source" is set to "Pot".
4. If the Preset 1 Source parameter is changed, the preset 1 command must be executed by either pressing the P1 button on the keypad or by closing the appropriate switch wired to the terminal block. (Dependent on set up.)
5. The ramp is determined by the NORM ACCEL/DECEL parameters.
6. The range of the PRESET parameters is limited by the MIN and MAX PROCESS parameters.
7. In the torque and external modes, the PRESET 1 - 4 values are retained despite the mode which was selected or when they were set.
8. In the torque and external modes, the process units are always in percent.
9. If the PRESET SOURCE parameter is set to keypad, the preset functions will always be activated by the keys on the keypad and not from the terminal block, even if the local/remote function is enabled.

5.13 FOLLOWER SETUP AND AUTO MODE SET POINT SOURCE

The follower parameters scale the auto input signal; the (DC) signal can be either voltage or current depending on hardware jumpers, the default is for a 4-20ma current signal. As with the pot input signal explained above, there are four parameters to define two points on the set point/follower signal curve. "FOLLOWER MINIMUM" and "FOLLOWER MAXIMUM" are the set points for speed or torque, while "FOLLOWER MIN REF" and "FOLLOWER MAX REF" set the corresponding follower signal values in %. The default value for "FOLLOWER MIN REF" is 20% because the usual 4-20ma signal input usually requires zero output at 4ma. Again the minimum and maximum set point values are bounded by the process limits set elsewhere.

MANUAL/AUTO COMMAND SOURCE: This parameter sets the source of the MAN/AUTO command. This command may be executed from either the "MAN/AUTO" key on the keypad or from a switch wired to the terminal block. The selection of the "AUTO/MAN SOURCE" command is also dependent on the state of the "LOCAL/REM ENABLE" command parameter. If the "LOCAL/REM ENABLE" parameter is set to "DISABLE" and the "AUTO/MAN SOURCE" is set to keypad, the MAN/AUTO command can only be executed from the keypad; when it is set to "TERM" it can only be executed from the terminal block. If the "LOCAL/REM ENABLE" parameter is set to "ENABLE" and the "AUTO/MAN SOURCE" is set to "TERM", the source of the MAN/AUTO command is automatically switched between the terminal block and the keypad when the LOCAL/REMOTE key on the keypad is actuated. If the "AUTO/MAN SOURCE" command source is set to "KEYPAD", the source of the MAN/AUTO command is not switched between the terminal block and keypad when the LOCAL/REMOTE mode is changed; it remains active only from the keypad.

Determine where the manual/auto command comes from (keypad, terminal block, or both)

Example 1: Man/Auto is to be commanded from the keypad only.

Set the following parameter in the "K SOURCE SELECT" menu, "1 MAN/AUTO SOURCE" to keypad.

Example 2: Man/Auto is to be commanded from the terminal block only.

Set the following parameter in the "A CONTROL SETUP" menu, "11 LOCAL/REM" to disable and set the following parameter in the "K SOURCE SELECT" menu, "1 MAN/AUTO SOURCE" to term.

Example 3: Man/Auto is to be commanded from either the keypad or the terminal block dependant on local or remote mode.

Set the following parameter in the "A CONTROL SETUP" menu, "11 LOCAL/REM" to enable and set the following parameter in the "K SOURCE SELECT" menu, "1 MAN/AUTO SOURCE" to term.

Other useful information:

- 1.If the man/auto source parameter is set to keypad, the command function will always be activated by the man/auto key on the keypad and not from the terminal block even if the local/remote function is enabled.
- 2.Relay outputs to indicate the manual, auto, local, and remotes modes can be set up. See relay output section.

Auto Signal Scaling

The type and range of the applied auto signal must be known as well as the desired process range ratio. The power PCB can accept voltage signals of 0-10, 0-5V and current signals of 4-20, 8-40ma on TB2-20 / 21. Jumpers J9 and J10 set the follower signal type:

0-10V	J9 in "A" and J10 in "A"
0-5V	J9 in "A" and J10 in "B"
4-20ma	J9 in "B" and J10 in "B"
8-40ma	J9 in "B" and J10 in "A"

Example 1: Control mode is Speed and Process units are in rpm. The auto signal is 0-10VDC where zero represents 500 rpm speed and 10 volts represents 1600 rpm speed. Lost of follower option is not required.

Set jumpers J9 and J10 on PCB to correct settings for 0-10V, J9 in "A" and J10 in "A" and set the following parameters in the "E FOLLOWER SETUP" menu:

- 1 FOLLOWER MINIMUM to 500 rpm (in process units)
- 2 FOLLOWER MAXIMUM to 1600rpm (in process units)
- 3 FOLLOWER MIN REF to 000.0%
- 4 FOLLOWER MAX REF to 100.0%
- 5 FOLLOWER LOST LEVEL to 000.0%

When the drive is in auto mode, the process should change from 500-1600 rpm when the 0-10 VDC auto signal is applied. The set point displayed should be 500-1600 rpm.

Example 2: Control mode is Speed and Process units are in rpm. The auto signal is 4-20ma, where 4ma represents 600 rpm and 20ma represents 1200 rpm. Lost of follower option is not required.

Set jumpers J9 and J10 on PCB to correct settings for 4-20ma, J9 and J10 both in "B" and set the following parameters in the "E FOLLOWER SETUP" menu:

- 1 FOLLOWER MINIMUM to 600 rpm (in process units)
- 2 FOLLOWER MAXIMUM to 1200 rpm (in process units)
- 3 FOLLOWER MIN REF to 020.0%
- 4 FOLLOWER MAX REF to 100.0%
- 5 FOLLOWER LOST LEVEL to 000.0%

When the drive is in auto mode, the process should change from 600 to 1200 rpm when the 4-20ma-auto signal is applied. The set point displayed should be 600 to 1200 rpm. Signals less than 4ma will be clamped at 600 rpm and signals above 20ma will be clamped at 1200 rpm.

Other Useful information:

1. When auto mode is selected, the status display changes from "MANUAL" to "AUTO".
2. An output relay can be setup to indicate when the drive is in auto or manual modes. See relay output section.
3. In auto mode, the ramp is determined by the auto accel/decel parameters.
4. See Section 8.3 for loss of follower signal option programming.
5. See local/remote section for more information.

5.14 COAST TO STOP:

"Coast to stop" is a feature that bypasses the programmed decel rate while stopping. If enabled, when a stop command is issued, the output is inhibited immediately and the output contactor drops out; the drive output shaft will then coast to a stop. If coast to stop is to be used, select the "A. CONTROL SETUP" menu and set parameter "10 COAST ENABLE" to "ENABLE". When the stop command is given, the drive status display will show "COASTING" until the output speed sensed by the tach is at zero, then the status display will change to "STOPPED".

If this feature is selected, it also works in the jog mode. When the jog button is released, the drive will coast to stop.

5.15 ESTOP MODE:

All remote Estop buttons must be hard wired in series to TB2-31. Upon E-stop command, "ESTOP" is annunciated on the display and the reference is switched to zero. When clutch current reaches a preset low value (in less than 0.5 sec.) the E relay drops out. To restart, the E-stop switches must all be closed, then press the STOP key or pushbutton to reset the control. The display will change to "STOP" and the drive may now be restarted.

Other Useful Information:

- 1.If two wire control is employed, the run contact must be opened to clear the E-stop and then closed again to restart the drive.
- 2.The drive will not auto restart after an E-stop, the E-stop must be cleared and then the drive must be restarted manually.

5.16 FAULT MODE:

If the EC2000 logic senses a fault, the control is programmed to stop immediately. The output to the coil is inhibited and the output relay drops out. The control will display the fault and the drive will coast to zero speed. Exception: The over speed and under speed faults may be programmed to announce the fault but not stop the drive (see details below). The following conditions may be monitored and used to set fault conditions by entering the "M. FAULT" menu and enabling the corresponding parameters:

- 1."1 COIL OPEN FLT EN" Open clutch coil fault; when the control senses no current when voltage is applied, it will fault and display "COIL FLT".
- 2."2 SPD FDBK FLT EN" Speed feedback is not present fault; when the control is in the run mode with a reference applied, after a time delay set by the "3. FDBK TEST DELAY" parameter, the fault will be set and the display reads "FDBK FLT".
- 3."4 KEYPAD FLT ENABLE" Keypad fault: if the keypad connection is lost, the drive will fault and show a "KPAD FLT" (when the keypad is reconnected).
- 4."5 OVERSPD FLT EN" Over speed fault: if the drive speeds exceed a set limit, as defined by the parameter "7 OVERSPEED TRIP", the fault is set. The over speed condition must be present for a preset time period before the fault occurs as defined by parameter "10 SPEED TRIP TIME". It is optional as to whether the drive is shut down when a fault is sensed (as other faults do) or the drive to continues to run. Parameter "6 OVSPD FT ACTION" determines whether the drive will stop or continue to run when an over speed condition is sensed; if "STOP", the drive will stop and if it is set to "RUN", the drive will continue to run. The status display will show "OVSPD FLT".
- 5."8 UNDERSP FLT EN" The under speed fault: is very similar to the over speed fault above. The trip level is set by "7 UNDERSPEED TRIP" and the time period for the under speed condition to exist before the fault occurs is set by "10 SPEED TRIP TIME". This feature also has the option to shut down the drive when a fault is sensed or to continue to run and this is set by Parameter "9 UNSPD FT ACTION". When the under speed fault occurs, the status display will show "UDSP FLT".

Other Useful Information:

1. The F relay and any other relay driver outputs (if programmed) will de-energize on a fault. The start command must be toggled (press stop button or toggle remote switch) to clear the fault and restart the drive.
2. The auto restart option may be used to restart the drive after a fault unless the fault was due to an E-stop.
3. The over speed and under speed trips are always based on output speed of the drive (rpm units) regardless of what the process units have been defined as. The parameter "10 SPEED TRIP TIME" is used for both faults.

5.17 UNITS:

When speed control is selected, the units displayed by the keypad may be defined to be the same as the actual production or “process units;” this can make it easier to understand the operation and to perform drive setup.

Since speed is the controlling factor, the process units displayed can be in PERCENT of speed, actual RPM or some other ratio desired by the USER. See user unit section for more information. The parameter “1 PROCESS UNITS” is used to select from RPM, PERCENT, or USER defined units.

Example 1: Max clutch parameter set to 1660 rpm; the control mode is Speed. The user wants 1660 rpm output speed to display 100% on the keypad.

Set the following parameters in the “H UNITS” menu, 1 PROCESS UNITS to “PERCENT”

Drive Rpm	Displayed
1660	100.0%
830	50%
415	25%

Other useful information:

- 1.If torque control is selected, the units displayed may only be in percent of coil current. The “H UNITS” menu is not displayed.
- 2.If Speed/Torque control is selected, the display may be rpm, percent or user units and the “H UNITS” menu is displayed while operating in speed control only.
- 3.If the External mode is selected, the process units displayed may only be in percent of process feedback and the “H UNITS” menu is not displayed.

5.18 USER UNITS:

If “USER” was selected for the PROCESS UNIT parameter, the unit value may be scaled and the identification abbreviation displayed by the keypad may be changed to other common names (i.e. fpm, spm etc.) by using the following parameters:

The “USER UNITS” parameter is used to select the legend in the keypad display. The choices are: RPM, RPS, RPH, CPM, CPS, CPH, FPM, FPS, FPH, SPM, SPS, SPH, XPM, XPS, XPH.

The “USER DECIMAL PNT” parameter is used to set the position of the decimal point in the display; (leading zeros will be suppressed) the choices are:

- 0 - No decimal (29999)
- 1 - One decimal place (2999.9)
- 2 - Two decimal places (299.99)
- 3 - Three decimal places (29.999)

The “MAX USER VALUE” parameter is used to scale the highest user units’ value displayed which will correspond to CLUTCH MAX RPM, the maximum being 29999.

Example 1: CLUTCH MAX RPM parameter is set to 1660 rpm, speed control mode and process units are in rpm. It is desired that at 1660 rpm drive speed the display will read 150.0 SPM.

Set the following parameters in the “H UNITS” menu:

- 1 PROCESS UNITS to USER
- 2 USER UNITS to SPM
- 3 USER DECIMAL PT to 1

4 MAX USER VALUE to 150

Drive RPM	Displayed
1660	150.0 SPM
830	75.0 SPM
414	37.5 SPM

Example 2: CLUTCH MAX RPM parameter is set to 1660 rpm, speed control mode and process units are in rpm. The user wants 1660 rpm drive speed to read 3000 FPM on the display.

Set the following parameters in the "H UNITS" menu:

- 1 PROCESS UNITS to USER
- 2 USER UNITS to FPM
- 3 USER DECIMAL PT to 0
- 4 MAX USER VALUE to 300

Drive RPM	Displayed
1660	3000 FPM
830	1500 FPM
415	0750 FPM

Remember, the parameters USER UNITS, USER DECIMAL PT and MAX USER VALUE are only displayed if the process unit parameter is set to "USER".

5.19 CONTROL TYPE OPERATION

The EC2000 internal regulators provide for speed, current and external control types. Speed control requires the use of a drive internal AC generator, a system (external) AC generator or an external pulse pickup. Torque or current control, utilizes an internal current feedback signal derived from the clutch coil current. External control uses 0-10Vdc external transducer signals such as from a torque transducer or a dancer operated pot.

The following lists features or actions that automatically happen when a control type is selected by the parameter "1 CONTROL TYPE" in the setup menu:

All Types:

1. Local/remote function is available from keypad by using local/remote key if programmed.
2. Manual auto function available from terminal or keypad as programmed.
3. Auto restart function available if programmed.
4. Analog output function available if programmed.
5. Relay output function available if programmed.
6. Presets from keypad are available if programmed.
7. Presets from terminal block depending on mode selected and if programmed.
8. The drive speed indication (meter) is always in RPM regardless of control type or the process units selected; for this indication a speed feedback signal is required although it may not be necessary for control.
9. The torque limit control loop is active in all types, however it is usually only used with speed control.
10. The filter parameter "Filter 1" is displayed and active for the clutch current feedback.
11. All faults sources are available in all types, programmed:

- Coil open Fault
- Speed Feedback Fault
- Keypad Fault

Overseed Fault
Underspeed Fault

Note that speed feedback is required for feedback and over/under speed faults. If speed feedback is not used, then those faults should be disabled.

Speed Control Type:

In the Speed control mode the EC2000 regulates by controlling the clutch current based on the outer speed feedback loop. If **Reverse Control** is enabled the speed loop action is reversed causing the output to rise when the speed is above set point. Default Process units for speed control is in RPM, but other process units can be selected. See the "UNITS" section. The following parameters control the speed and current regulators:

B CLCH PERFORMANCE menu:
1 CURR PROP GAIN
2 CURR INTGRL GAIN
3 CURRENT DIFF GAIN
4 SPEED PROP GAIN
5 SPEED INTGRL GAIN
6 SPEED DIFF GAIN

Example 1: The units are set to percent and the maximum clutch speed of 1660 rpm was set by parameter "7 CLUTCH MAX RPM" in the "A CONTROL SETUP" menu, so that 100% is 1660rpm. Therefore a drive set point of 50% would cause the control to regulate at 50% rated speed or 830 rpm.

Example 2: If the clutch speed were 1750 rpm as set by parameter "7 CLUTCH MAX RPM" in the "A CONTROL SETUP" menu, then 100% would be 1750 rpm. Therefore a drive set point of 50% would cause the control to regulate at 50% rated speed or 875 rpm.

Other useful information about speed control:

1. Control loops used are current and speed. If reverse control is enabled the speed loop action is reversed.
2. The feedback variable is speed and is displayed in process units.
3. The Min and Max process range is defined by the parameters for min and max clutch rpm. 100% process equals the max clutch rpm value and so the process parameters cannot be set outside this range without changing the min/max clutch variables. The preset and jog speed defaults are specific values for speed control; changing any of these parameter while in speed control will not affect the existing parameter values for torque or external control.
4. The jog function is active and all jog parameters are displayed. Jog may be commanded from the keypad or terminal block as programmed.
5. The speed/torque key not functional.
6. The process feedback menu is not displayed.
7. The filter parameter "Filter 2" is used with the speed feedback signal.

Torque Control Type:

In the Torque control mode the EC2000 regulates by controlling the clutch current, because torque is proportional to current; the drive speed is not controlled. Process units for torque control are in percent of coil current. The following is a list of parameters that controls the current regulator:

B CLCH PERFORMANCE menu:

- 1 CURR PROP GAIN
- 2 CURR INTGRL GAIN
- 3 CURRENT DIFF GAIN

Example 1: If the coil rating were 3 amps as set by parameter "3 CLUTCH COIL RATING" under the "A CONTROL SETUP" menu, 100% would be 3 amps. Therefore a drive set point of 10% would cause the control to regulate at 10% rated coil current or 0.3 amps.

Example 2: With the coil rating parameter "3 CLUTCH COIL RATING" in the "A CONTROL SETUP" menu set at 5 amps, (100%), then a drive set point of 50% would cause the control to regulate at 50% rated coil current or 2.5 amps. Other Useful Information about Torque Control:

1. The control loops use clutch current only.
2. The feedback variable is clutch amps, and is displayed in %.
3. The units menu is not displayed.
4. A unique set of ranges, and default values all in percentages are used for the Process menu parameters. The min process parameter may be set from 0 to the max process parameter; the max process parameter range is from min process to 100% (clutch amps). The defaults for the presets specific values for torque control. Changing any of these parameter values while in torque control will not change the existing corresponding parameter values for speed or external control.
5. The jog function is disabled and no jog parameters are displayed. The jog key and the jog TB input are not functional.
6. The speed/torque key not functional.
7. The process feedback menu not displayed.
8. The filter parameter "Filter 2" is not used.

Speed/Torque Control Type

This mode allows for switching instantly between speed and torque control types. The control type parameter in the control set up menu is set to SPD/TRQ. The type is then selected manually by using the speed/torque key on the keypad or a switch wired to the terminal block or both (if local/remote is enabled). All other rules hold true as outlined above based on which control type is active with the following exceptions:

1. The preset source parameter is replaced by a control type source parameter.
2. The Speed/Torque key is functional if programmed, based on the control type source parameter and local/remote operation.
3. Presets from terminal block are not available because it is used for speed/torque selection; the remaining TB input is not used. Presets are available from the keypad.

External Control Type

In External Control mode, a separate outer control loop is added that uses the process feedback to ultimately control torque. The Process units for the external control mode are in % of the process. The following is a list of parameters that controls the speed and current regulators:

- B CLCH PERFORMANCE menu:
- 1 CURR PROP GAIN
 - 2 CURR INTGRL GAIN
 - 3 CURRENT DIFF GAIN

- I PROCESS FEEDBACK menu:
- 2. EXTN F/B REF MIN
 - 3. EXTN F/B REF MAX
 - 4. EXTN F/B MIN

- 5. EXTN F/B MAX
- 6. PROCESS PROP GAIN
- 7. PROCESS INTGRL GAIN
- 8. PROCESS DIFF GAIN

Additional circuitry is provided on the power board to allow a separate process feedback signal to be used. This circuitry is intended to be used for torque transducers or dancer operated pots and is provided with a wide range of input levels; it will also accept changing polarities. The J3 jumper for external feedback scaling must be set properly as follows:

Vin (to COM)	TB2-4	TB2-5	J3
0 to +/-5V	X	COM	B
0 to +/-10V	X	N.C.	B
0 to +/-20V	X	N.C.	A

X = Connection; N.C. = No connection (connect other input signal wire to COM).

Other Useful Information about External Control:

1. The control loops are “current” and “external” (external control loop gains are determined by the parameters in the process feedback menu).
2. The feedback variable is the external process feedback signal, displayed in percent
3. The units menu is not displayed because process units are always in percent.
4. A unique set of ranges, and default values are used for the Process menu parameters. The Min process parameter range is defined as 0 to max process parameter and the Max process parameter range is defined by min process to 100% of process feedback. The process feedback menu determines feedback scaling and the defaults for the presets are set to specific values for external control. Changing any of the external parameter values will not affect the existing parameter values for torque or speed control.
5. The jog function is disabled and the jog set point and parameters are not displayed. Neither the jog key nor the jog TB inputs are functional.
6. The speed/torque key is nonfunctional.
7. The process feedback menu is displayed (to scale the feedback signal and set gains).
8. The parameter “Filter 2” is displayed and is applied to the process feedback signal.

5.20 TORQUE LIMIT:

Certain variable speed applications can present unlimited or excessive torque requirements to the drive, which could overload the motor. The most common example is very high inertia machines such as stamping presses. The torque limit mode of operation provides an “override” feedback signal to limit the induction motor torque, and therefore current, to a preset maximum level. Thus, motor breakdown torque is avoided during conditions such as drive output shaft “lockup”, or the period when large system inertia is being accelerated. Since the torque level is adjustable between 60 and 250%, precise control of the acceleration rate versus maximum motor current can be achieved. Torque limit requires the use of an external motor current transformer connected to TB2-14 and 15. It is also necessary to set SW2 correctly for the combination of rated motor current and the current transformer connection used (see Table 1 on page 12) the gain trim pot **R111** on the power board must be adjusted in conjunction with a clamp-on ammeter to calibrate the motor current display. It is advised to make this calibration near the area of the desired limit because the sensing method is nonlinear over large ranges. 150% motor amps during the punch is a safe value to start at and will provide a safe operating setup range for the control and the press. The parameters for setting torque limit level and stability are located under “B CLCH PERFORMANCE”. Note that the PI gain constants are only active while the control is actually in the outer “torque limit” loop control These limit values are based on the calibration or **R111**:

7 TORQUE LIMIT

8 TRQL PROP GAIN
9 TRQL INTGRL GAIN

5.21 PASSWORD PROTECTION

The EC2000 has a simple password that prevents most parameters from being accidentally changed from the keypad. The password is enabled by pressing the F1, F2, and F3 keys on the keypad in succession; the status display will then briefly flash "PW ENABLED". With the password enabled, critical process parameters may no longer be changed by keypad entry, although all parameters may still be viewed. In order to disable the password, repeat the F1, F2, F3 sequence and the status display will now flash "PW DISABLED"; and once again, all parameters may be modified. The Parameter List (Section 6) shows which parameters are password protected.

5.22 PARAMETER CHANGE PROTECTION WHILE RUNNING

Certain parameters may not be changed while the drive is running in order to protect personnel and machinery from unsafe operation. This safety feature is always present and those parameters, which may only be changed when the drive is stopped, are indicated on the Parameter List (Section 6).

5.23 KEYPAD STATUS DISPLAY

The EC2000 is provided with a keypad/display unit used for monitoring and setup of the drive. This unit is either mounted on the controller enclosure door or remotely up to 10 ft from the control. The keypad is normally supplied loose for customer mounting, with panel mount versions of the EC2000.

All customer adjustments may be conveniently made using the keypad/display unit. The keypad has dedicated command keys and a four line alphanumeric display with prompts in plain English. Only one keypad per drive may be used but one keypad can be used to control multiple drives because it may be removed if the drive is to be controlled from pots and switches wired to the terminal block. In order to extend the lifetime of the display backlight, it is programmed to go off after several minutes during which no key has been operated. The LCD display is legible in normal room lighting and the backlight turns back on as soon as any key is pressed, including the blue (normally unused) function keys.

Monitor Mode

When in the monitor mode (as opposed to program mode), the keypad displays the following information: The top line shows the drive "status" and the "set point" value, including the process units. The status may be:

STOPPED	The drive is stopped and the E relay is de-energized.
FDBK FLT	The drive faulted because the speed feedback signal was lost; E relay de-energized.
COIL OPN FLT	The clutch coil is open or disconnected; E relay de-energized.
STOPPING	The drive stop command has been received and is decelerating; E relay energized.
ESTOP	The ESTOP input is (or was) open; E relay de-energized.
RUN	The drive is in run state; E relay energized.
RUN0	The drive is in run state, the reference is zero; E relay energized.

COASTING	The drive is coasting to zero speed; E relay de-energized.
JOG	The drive is in jog mode at zero speed, waiting for next jog command; E relay energized.
JOGGING	The drive is in jog mode at jog speed; E relay energized.
RSTART	The drive auto restart is in progress; E relay de-energized.
TRQ LIM	The drive is in torque limit and continues to run but at reduced speed.
FOL LOST	The drive is in loss of follower mode because the auto signal dipped below the trip level. The drive continues to run but at a predetermined reference.
COIL FLT	Coil voltage was applied but no current was measured.
FDBK FLT	After a period of run time, no speed feedback voltage was detected.
OVERSPEED FLT	The drive speed went above the trip level; it continues to run or will shut down depending how it was set up.
UNDERSPEED FLT	The drive speed went below the trip level; the action is the same as for overspeed fault.

The set point has six digits, (XXXXXX) which are used as required (leading zeros are suppressed). Other characters may be selected for the three digit units display, see Section 5.19 USER UNITS. (Note that the default RPM and %, (non-USER units), are referenced directly to the drive output shaft speed.)

The second line is used to display the control modes; the left six digits display:

LOCAL	The local/remote feature is enabled and the drive is in Local mode. The start key on keypad is active and other keys may be active depending on set up.
REMOTE	The same as above for "LOCAL", with the drive in remote mode.
(no display)	The local/remote feature is disabled. Start may be from keypad or terminal block input depending on set up.

The center six digits display:

MANUAL	The drive set point is manually set with either keypad or a pot.
AUTO	The drive set point comes from the follower input.

The right six digits display:

SPEED	Speed control, either straight speed or speed portion of "SPD/TRQ mode.
TORQUE	Torque control mode.

EXTERN	External mode (external process control)
The third and fourth lines display drive conditions (meter):	
REFERENCE	Displays the current reference value in process units.
MOTOR AMPS	This display will give an indication of motor current if a current transformer is used. It should be calibrated (gain pot R111 on the power board) for the rated or most important current of interest as the linearity error increases over the entire range.
CLUTCH AMPS	Displays the clutch current in amps or percent.
BRAKE AMPS	Displays the brake current.
FEEDBACK	This meter display depends on the type of control mode currently being used; in speed mode the meter displays the speed feedback value determined from the tach input. The units displayed are "PROCESS UNITS" as programmed under the "UNITS" menu, that is, rpm, percent or user units. In torque mode the meter will display the clutch current feedback value displayed in percent. In external mode the meter will display the external process feedback value in percent. The external feedback signal arrives at TB2-4 and 5.
DRIVE SPEED	Displays the drive output speed in rpm, (must have tach generator input).

Setup Mode

When in the setup mode, (push "ENTER") the keypad displays a menu structure to make it easier to program. Each menu has a letter and a name. When the desired menu is displayed, push "ENTER" again to view or change the numbered settable parameters. Note that if a menu is not applicable, such as "H UNITS" when in external mode (percent only) it will not appear in order to avoid confusion. Similarly, inappropriate parameters are not displayed. Menus:

A	CONTROL SETUP	Parameters related to the control, the mechanical unit (motor, eddy current clutch and brake if any) and applications.
B	CLCH PERFORMANCE	Clutch PID performance parameters and torque limit.
C	ACCEL/DECEL STUP	Linear accel and decel ramp parameters.
D	BRAK PERFORMANCE	Brake setup and PID performance parameters.
E	FOLLOWER SETUP	Parameters for the auto follower mode.
F	ANALOG OUTPUT	Programming parameters for the two analog outputs.
G	RELAY OUTPUT	Parameters for the five relay outputs.
H	UNITS	Contains parameters for the display units.
I	PROCESS FEEDBACK	Parameters used for the external control mode.
J	POTENTIOMTR STUP	Scaling parameters related to the external pot.
K	SOURCE SELECT	To determine various command sources.
L	PROCESS	Parameters for min/max process, preset and jog set point.
M	FAULT	Setup parameters to activate drive faults.
N	AUTO RESTART	Parameters required for setup of the auto restart feature.


Section 6 - PARAMETER LIST

 Note ->  Code Explanation:

- A) "Control Parameter may be changed only when stopped;"
 B) "Parameter is password protected."


Code	"A"	"B"
0	no	no
1	no	yes
2	yes	yes

CONTROL SETUP menu


PARAMETER		RANGE	DEFAULT
1. CONTROL TYPE	2	SPD, TRQ, SPD/TRQ, EXT.	SPEED
*2. CONTRLR CURRENT	2	5.5, 8.0,16,24,32,50,64,80,100	5.5 A
3. CLUTCH COIL RATING	2	00.0 to CONTRLR CURRENT	5.5 A
4. CLUTCH CURNT LIM	2	00.0 to CLUTCH COIL RATING	5.5 A
5. TACH PULSES/REV	2	10,12,14,16,24,30,60,120,180 ppr	12 ppr
6. CLUTCH MIN RPM	2	0-3600	440 rpm
7. CLUTCH MAX RPM	2	0-3600	1660 rpm
8. MTR NO LOAD AMPS	2	000.0 to MTR FULL LOAD A	000.0 A
9. MTR FULL LOAD A	2	000.0 to 250.0 A	250.0 A
10. COAST ENABLE	2	ENABLE/DISABLE	DISABLE
11. LOCAL/REM ENABLE	2	ENABLE/DISABLE	DISABLE
12. FILTER 1	1	16-64	16
13. FILTER 2	1	0-16	0
14. MEMORY RESET EN	2	NO/YES	NO
15. REVERSE CONTROL EN	2	ENABLE/DISABLE	DISABLE
16. CLUTCH CUR SCALE	1	0-2500%	100%
17. CLUTCH PPR SCALE	1	0-2500%	100%

Note: Menu# 2 Controller Current, 16,24,32,50,64,80 & 100 Amp settings are not used on the standard control.

B. CLUTCH PERFORMANCE menu

PARAMETER		RANGE	DEFAULT
1. CURR PROP GAIN	1	0001.0-100.0%	100.0%
2. CURR INTGRL GAIN	1	000.0-100.0%	050.0%
3. CURRNT DIFF GAIN	1	000.0-100.0%	000.0%
4. SPEED PROP GAIN	1	0001.0-1000.0%	020.0%
5. SPED INTGRL GAIN	1	000.0-100.0%	020.0%
6. SPEED DIFF GAIN	1	000.0-100.0%	000.0%
7. TORQUE LIMIT	1	060.0% to 250.0%	250.0%
8. TRQL PROP GAIN	1	001.0-100.0%	010.0%
9. TRQL INTGRL GAIN	1	000.0-100.0%	010.0%

C. ACCEL / DECEL SETUP menu

PARAMETER		RANGE	DEFAULT
1. NORM ACCEL RATE	1	000.25 – 250.0 % /sec	010.0%/sec
2. NORM DECEL RATE	1	000.25 - 250 .0% /sec	010.0%/sec
3. AUTO ACCEL RATE	1	000.25 – 250.0 % /sec	010.0%/sec
4. AUTO DECEL RATE	1	000.25 – 250.0 % /sec	010.0%/sec

- *5. **JOG ACCEL RATE** 1 000.25 – 250.0 % /sec 100.0%/sec
 *6. **JOG DECEL RATE** 1 000.25 – 250.0 % /sec 100.0%/sec

* The JOG parameters are not displayed in torque or external control.

D. BRAKE PERFORMANCE menu

PARAMETER		RANGE	DEFAULT
1. BRAK COIL RATING	2	00.0 to CONTRLR CURRENT	05.5 A
2. ADJ BRAKING ENABL	2	ENABLE/DISABLE	DISABLE
3. ADJ BRAKE AMPS	1	000.0 to 100.0% of BRAKE RATING	00.0 A
4. BRAKE PROP GAIN	1	001.0-100.0%	030.0%
5. BRAK INTGRL GAIN	1	000.0-100.0%	010.0%
6. BRAKE DIFF GAIN	1	000.0-100.0%	000.0%

E. FOLLOWER SETUP menu

PARAMETER		RANGE	DEFAULT
1. FOLLOWER MINIMUM	1	MIN PROCESS to FOLL MAX	0440 RPM
2. FOLLOWER MAXIMUM	1	FOLL MIN to MAX PROCESS	1660 RPM
3. FOLLOWER MIN REF	1	0 to FOLLOWER MAX REF	020.0%
4. FOLLOWER MAX REF	1	FOLLOWER MIN REF to 100%	100.0%
5. FOLLOWER LOST LEVEL	1	0 to 100%	000.0%
6. FOLLOWER LOST STPT	1	Follower Min to FOLL MAX	0440 RPM
7. FOLLWR LOST FLAG	1	FLSET/LAST	FLSET

F. ANALOG OUTPUT menu

PARAMETER		RANGE	DEFAULT
1. ANALOG 1 SELECT	1	NONE, DRIVE SPEED, REF, SET POINT, MOTOR AMPS, CLUT AMPS, BRAK AMPS, FEEDBACK	NONE
*2. ANA 1 MIN SIGNAL	1	000.0 –ANA1 MAX SIGNAL	000.0%
*3. ANA 1 MAX SIGNAL	1	ANA1 MIN SIGNAL –100.0%	100.0%
*4. ANA 1 MIN OUTPUT	1	000.0 to ANA 1 MAX OUTPUT	000.0%
*5. ANA 1 MAX OUTPUT	1	ANA 1 MIN OUTPUT to 100%	100.0%
6. ANALOG 2 SELECT	1	NONE, DRIVE SPEED, REF, SET POINT, MOTOR AMPS, CLUT AMPS, BRAK AMPS, FEEDBACK	NONE
*7. ANA 2 MIN SIGNAL	1	000.0 –ANA 2 MAX SIGNAL	000.0%
*8. ANA 2 MAX SIGNAL	1	ANA 2 MIN SIGNAL –100.0%	100.0%
*9. ANA 2 MIN OUTPUT	1	000.0 to ANA 2 MAX OUTPUT	000.0%
*10. ANA 2 MAX OUTPUT	1	ANA 2 MIN OUTPUT to 100%	100.0%

*These parameters are NOT displayed if the ANALOG# SELECT parameter is set to "NONE".

G. RELAY OUTPUT menu

PARAMETER		RANGE	DEFAULT
1. F RELAY	1	NONE, STATUS, TRIP ON, TRIP OFF	STATUS
STATUS	1	NONE, SPD MODE, TRQ MODE, EXT MODE, LOCAL, REMOTE, MANUAL, AUTO, STOPPED, STOPPING, ESTOP, RUN, RUN0, COASTING, JOGGING, FAULT, RESTART, TRQ LIM, AT SETPNT, FOL LOST, FB LOST	FAULT
TRIP ON	1	NONE, SET POINT, DEV+, DEV-, SPEED, MTR AMPS, CLUT AMPS, BRAK AMPS,	NONE
SET POINT	1	000.0 to MAX PROCESS	000 RPM
DEVIATION+	1	000.0 to MAX PROCESS	000 RPM
DEVIATION-	1	000.0 to MAX PROCESS	000 RPM
SPEED	1	000.0 to MAX PROCESS	000 RPM
MTR AMPS	1	000.0 to 250.0% of MTR FULL LOAD A	0 AMP
CLUT AMPS	1	000.0 to 100.0% of CLUTCH RATING	0 A
BRAK AMPS	1	0 to 100.0% of BRAK COIL RATING	0 A
TRIP OFF	1	NONE, SETPOINT, DEV+, DEV- SPEED, MTR AMPS, CLUT AMPS, BRAK AMPS,	NONE
SET POINT	1	000.0 to MAX PROCESS	000 RPM
DEVIATION+	1	000.0 to MAX PROCESS	000 RPM
DEVIATION-	1	000.0 to MAX PROCESS	000 RPM
SPEED	1	000.0 to MAX PROCESS	000 RPM
MTR AMPS	1	000.0 to 250.0% of MTR FULL LOAD A	0 A
CLUT AMPS	1	000.0 to 100.0% of CLUTCH RATING	0 A
BRAK AMPS	1	0 to 100.0% of BRAK COIL RATING	0 A
2. RELAY 1*	1	NONE, STATUS, TRIP ON, TRIP OFF	NONE
Same as F RELAY, see above.			
3. RELAY 2*	1	NONE, STATUS, TRIP ON, TRIP OFF	NONE
Same as F RELAY, see above.			
4. RELAY 3*	1	NONE, STATUS, TRIP ON, TRIP OFF	NONE
Same as F RELAY, see above.			
5. RELAY 4*	1	NONE, STATUS, TRIP ON, TRIP OFF	NONE
Same as F RELAY, see above.			

*Note that Relays 1 – 4 require the use of externally connected Dual Relay mod boards.

H. UNITS menu

*This menu is displayed only if SPEED control is selected.

PARAMETER		RANGE	DEFAULT
1. PROCESS UNITS	2	RPM/USER/PERCENT	RPM
*2. USER UNITS	2	RPM, RPS, RPH, CPM, CPS, CPH, FPM, FPS, FPH, SPM, SPS, SPH, XPM, XPS, XPH	RPM
*3. USER DECIMAL PNT	2	0-3	0
*4. MAX USER VALUE	2	0-29999	00000

*Displayed only if process units is set to "USER".

* I. PROCESS FEEDBACK menu

*Displayed only if the CONTROL TYPE parameter in the Control Setup menu is "EXTERNAL".

PARAMETER		RANGE	DEFAULT
1. EXTN F/B REF MIN	1	000.0 TO EXTN F/B REF MAX	000.0%
2. EXTN F/B REF MAX	1	EXTN F/B REF MAX TO 100.0%	100.0%
3. EXTERNAL F/B MIN	1	MIN PROCESS TO EXTN F/B MAX	000.0%
4. EXTERNAL F/B MAX	1	EXTN F/B MIN TO MAX PROCESS	100.0%
5. PROCESS PROP GAIN	1	1-1000%	0100.0%
5. PROCESS INTR GAIN	1	0-100%	050.0%
7. PROCESS DIFF GAIN	1	0-100%	000.0%

J. POTENTIOMETER SETUP menu

PARAMETER		RANGE	DEFAULT
1. POT MINIMUM	1	MIN PROCESS to POT MAXIMUM	440.0 RPM
2. POT MAXIMUM	1	POT MINIMUM to MAX PROCESS	1660 RPM
3. POT MINIMUM REF	1	0 to POT MAXIMUM REF parameter	000.0%
4. POT MAXIMUM REF	1	POT MINIMUM REF to 100%	090.0%

K. SOURCE SELECT menu

PARAMETER		RANGE	DEFAULT
1. AUTO/MAN SOURCE	2	TERM/KYPD	KEYPAD
*2. JOG SOURCE	2	TERM/KYPD	KEYPAD
3. PLC AUTOSTART	2	ENABLE/DISABLE	DISABLE
4. PLC RUN ENABLE	2	ENABLE/DISABLE	DISABLE
**5. PRESET SOURCE	2	KYPAD/TERM	KEYPAD
6. PRESET 1 SOURCE	2	KYPAD/POT	KEYPAD
7. START SOURCE	2	KYPAD/TERM	KEYPAD

* Jog source parameter is shown only when "SPEED" mode is selected.

** When SPD/TRQ control mode is selected, the following parameter replaces Item 5, However the parameter preset source can still be used. It must be set prior to the spd/torq parameter.

5. **CONTROL TYPE SRC** 2 KYPAD/TERM KEYPAD

L. PROCESS menu

If in SPEED control (default):

PARAMETER		RANGE	DEFAULT
1. MINIMUM PROCESS	2	CL MIN SPD% -- MAX PROCESS	0440 rpm
2. MAXIMUM PROCESS	2	MIN PROCESS -- 100% CL MAX SPD	1660 rpm
3. PRESET 1	2	MIN PROCESS – MAX PROCESS	500 rpm
4. PRESET 2	2	MIN PROCESS – MAX PROCESS	550 rpm
5. PRESET 3	2	MIN PROCESS – MAX PROCESS	600 rpm
6. PRESET 4	2	MIN PROCESS – MAX PROCESS	650 rpm
*7. JOG SET POINT	2	0 – MAXIMUM PROCESS	50 rpm

*The jog set point may be set below the min process/min clutch rpm

If TORQUE control is selected:

PARAMETER		RANGE	DEFAULT
1. MINIMUM PROCESS	2	0% -MAXIMUM PROCESS	0%
2. MAXIMUM PROCESS	2	MIN --100% CL RATING	100%
3. PRESET 1	2	MIN – MAX PROCESS	10%
4. PRESET 2	2	MIN – MAX PROCESS	20%
5. PRESET 3	2	MIN – MAX PROCESS	30%
6. PRESET 4	2	MIN – MAX PROCESS	40%

The jog function is not available in TORQUE or EXTERNAL control.

If EXTERNAL control is selected:

PARAMETER		RANGE	DEFAULT
1. MINIMUM PROCESS	2	0% -MAXIMUM PROCESS	0%
2. MAXIMUM PROCESS	2	MIN --100% PROCESS FDBK	100%
3. PRESET 1	2	MIN – MAX PROCESS	10%
4. PRESET 2	2	MIN – MAX PROCESS	20%
5. PRESET 3	2	MIN – MAX PROCESS	30%
6. PRESET 4	2	MIN – MAX PROCESS	40%

M. FAULT menu

PARAMETER		RANGE	DEFAULT
1. COIL OPEN FLT EN	2	ENABLE/DISABLE	ENABLE
2. SPD FDBK FLT EN	2	ENABLE/DISABLE	ENABLE
3. FLT TEST DELAY	2	0-30 sec	10 sec
4. KEYPAD FLT ENABLE	2	ENABLE/DISABLE	ENABLE
5. OVERSPD FLT EN	2	ENABLE/DISABLE	DISABLE
6. OVSPD FLT ACTION	2	STOP/RUN	STOP
7. OVERSPEED TRIP	2	0-110% of max clutch rpm	1826 rpm
8. UNDERSP FLT EN	2	ENABLE/DISABLE	DISABLE

9. UNSPD FLT ACTION	2	STOP/RUN	STOP
10. UNDERSPEED TRIP	2	0-110% of max clutch rpm	000.0 RPM
11. SPEED TRIP TIME	2	0-1000	0010 SEC

N. AUTO RESTART menu

<u>PARAMETER</u>	<u>🔒</u>	<u>RANGE</u>	<u>DEFAULT</u>
1. RESTART POWER EN	2	ENABLE/DISABLE	DISABLE
2. RESTART FAULT EN	2	ENABLE/DISABLE	DISABLE
3. START DELAY – PWR	2	000 to 600 seconds	010 sec
4. START DELAY – FLT	2	000 to 600 seconds	010 sec
5. MAX FAULT RETRYs	2	0 to 10	3
6. RESTART TIMER	2	60 to 600	60 sec

METER SELECT menu

Access by pressing “SELECT METER” key; then use the up/down arrows go to meter 1 or 2, then “ENTER”.

<u>PARAMETER</u>	<u>🔒</u>	<u>RANGE</u>	<u>DEFAULT</u>
METER 1 SELECT	0	REFERENCE, MOTOR AMPS, CLUTCH AMPS, BRAKE AMPS, FEEDBACK, DRIVE SPEED	REFERENCE
METER 2 SELECT	0	REFERENCE, MOTOR AMPS, CLUTCH AMPS, BRAKE AMPS, FEEDBACK, DRIVE SPEED	DRIVE SPEED

Section 7 - TROUBLESHOOTING GUIDE

In general, eddy current drives are relatively simple devices for which a few meter readings will point out the problem area. The mechanical drive is repairable and supported by 90 authorized service centers located all over the 48 states and the control elements, keypad and circuit boards, are available through our network of distributors also located all over the country. In the event of trouble, some of the more common symptoms are listed below along with suggested remedial action:

7.1 **Unit runs at top speed only - No control:**

Check the setting of Fault parameter "2 SPD FDBK FLT EN"; is this parameter enabled? If not, enable it to let the control confirm feedback loss. A meter may be used to check the G1, G2 wires back to the drive. If the wires appear okay, check for generator voltage right at the drive, it should be 45 to 60VAC at top speed. If this voltage is low or missing the drive will have to be sent out for repair.

Check the Control setup for control type (for instance Speed or Torque mode), in Torque control speed is a function of the load not the pot setting. Re-adjust as needed; note that the feedback fault should be disabled in this mode.

See if the drive still runs at top speed with the control de-energized or with a clutch wire disconnected; if so, it is due to a failed pilot bearing or foreign matter jammed between the rotor and drum. In this case, send the drive out for repair. If not, the power board may have shorted output devices and should be repaired or replaced.

7.2 **The fuses are blown:**

Disconnect the clutch leads C1 and C2 and read them with an ohmmeter; compare the reading with the nameplate resistance. Note that a cold coil will read 10 to 20% lower than nameplate and that if there are slip rings and brushes; it is more difficult to read (if possible, read directly on the slip rings). If the reading is substantially lower than the rating or is a short circuit, check again at the junction box to eliminate any wiring shorts. If it is still too low the drive will have to be sent out for coil replacement.

Try another set of fuses with the clutch leads disconnected. If they blow again, the power board will have to be repaired or replaced.

Double check the clutch current rating and current limit parameters.

7.3 **The speed range is limited--can't reach minimum speed or maximum speed:**

Check the settings for clutch minimum and maximum RPM parameters and also check the min and max process values; the speed range may have been purposely limited. If so, determine why by checking the application.

Measure the clutch coil current and compare with the rating; see if the current limit is set properly to rated current.

If torque limit is being used, check the calibration and parameter settings; torque limit works by slowing the drive when the motor current threshold is exceeded.

Check the tach PPR setting; readjust parameter if needed.

7.4 **The speed pot does not work:**

Check the potentiometer is wiring and the scaling parameter.

- Verify that the control is in the manual mode because the pot will only work in manual.
Is Preset #1 source parameter set to pot?
- 7.5 **The control will not "start":**
Stop input TB2-24 or the Estop interlock TB2-31 is open; both must be jumpered or wired via pushbuttons to common.
- The control is in a faulted condition. Toggle the Stop input to clear fault; be sure to assess the reason for the fault having occurred.
- Verify that the start mode and parameter setup is correct for the desired mode(s) of operation: keypad, 2 wire, 3 wire, PLC Run and Local/Remote.
- 7.6 **The control will run but not jog; no fault is displayed:**
Verify that the jog mode and parameter setup is correct and remember the remote jog pushbutton is wired (between TB2-29 and common TB2-27), that Local/Remote must be enabled and local mode selected for the keypad jog key to function.
- Jog is not functional in torque or external control mode.
- Check to make sure the control is not in auto mode where jog is not operational.
- 7.7 **Unstable Speed:**
Eddy current drives are not particularly stable and well behaved if there is no shaft load, so make sure the drive is installed on the machine and a reasonable amount of load is present, if possible, before evaluating stability. The defaults for the PID parameters under "B CLCH PERFORMANCE" are the most usual settings for the average application. If instability occurs, try increasing the "6 SPEED DIFF GAIN" gradually to see if the performance is improved; if not, next try slowly reducing "5 SPED INTGRL GAIN". The integral gain should not go to zero because it will not react properly with load changes. "4 SPEED PROP GAIN" may also be reduced; it will not allow values less than 1%. On all of these adjustments, if performance becomes noticeably worse, adjust the parameter in the opposite direction (increase rather than decrease, for instance). If after these adjustments performance is still unsatisfactory, contact the factory.
- 7.8 **The control will not linear decelerate upon stop command:**
The "10 COAST ENABLE" under "A CONTROL SETUP" must be disabled.
- Check the setting of "2 NORM DECEL RATE" parameter under the "C ACCEL/DECEL STUP" menu. The rate must be set such that decel time exceeds coast to stop time. Remember that larger rate numbers result in faster accel/decel times.
- 7.9 **The Local/Remote key doesn't function:**
For any key which does not work check to see if the function is disabled or if there is an overriding or conflicting condition. Check the appropriate enable parameters. Swap keypads if necessary to eliminate the possibility of a bad key.
- 7.10 **The display is blank:**
Check the keypad display cable at both ends to see that it is seated properly and not offset. Note that if the plug is accidentally inserted backward, a new keypad will be required.
- Is the power on? Check the green LED on the power board which indicates power on and the + and -12V supplies are within range.
- Check the display power supply voltage on the logic board, PL2-1(+) to 6(-); it is an unregulated DC voltage $11.5 \pm 1V$. (Be careful not to short the pins to any other components.) If this voltage

is missing, it is likely a bad power board where the supply originates, and if it is okay, swap keypads to determine a possible faulty display.

7.11 **Other faults and suggested action:**

Coil Open Fault. Check the coil with an ohmmeter, comparing to the nameplate resistance. If the meter reads open, check at the drive junction box to eliminate possible broken wiring. If there are slip rings and brushes, check to see that the brushes are seated properly and are not excessively worn; the slip rings should be shiny and free of oil or other contamination. If the clutch coil is open, the drive will have to be removed and sent out to have a new coil installed.

Keypad Fault: Check the keypad cable; swap with a known good keypad or disable the fault.

Overspeed Fault: Determine the cause of the overspeed; are the overspeed trip level and other control speed programming parameters set correctly? Was the overspeed condition independently confirmed? If the mechanical unit has a jam condition it may be due to a bad pilot bearing or extraneous material build up in the drive, which will require cleaning out.

Underspeed Fault: As with the overspeed, first confirm the existence of the condition, then find the cause and eliminate it. Is the drive is overloaded and/or going into torque limit? Another possible cause is current limit if it is set too low.

Note: The fault menu and conditions are merely troubleshooting aids. "No fault" operation is possible as it is with any other eddy current control. If this is desired, just enter the "M FAULT" menu and disable faults as desired. **CAUTION: The "SPD FDBK FAULT EN" is intended to prevent runaway conditions due to loss of speed feedback; if an unsafe condition may result with overspeed, do not disable this fault.** If there are questions or if additional assistance is required, please contact the factory.

Section 8 - MODIFICATION PROGRAMMING AND OTHER FEATURES

8.1 PROCESS FEEDBACK SOURCE. Select "1 CONTROL TYPE", "EXTERNAL". This parameter selects the process feedback source. When External is selected, the feedback is defined by the "I PROCESS FEEDBACK" scaling parameters. The Following parameters are only displayed under "I PROCESS FEEDBACK" only when "EXTERNAL" is selected as the control type:

1. EXTN F/B REF MIN 0 to external feedback ref. max
2. EXTN F/B REF MAX external feedback ref. Max to 100.0%
3. EXTN F/B MIN min process to external feedback max
4. EXTN F/B MAX external feedback min to max process
5. PROCESS PROP GAIN 1-1000%
5. PROCESS INTGRL GAIN 0-100%
7. PROCESS DIFF GAIN 0-100%

8.2 PLC AUTOSTART. This parameter activates the PLC start input on TB1. If set to "ENABLE", the level of the signal determines if the drive will be started or stopped (high or low). If in "DISABLE", the input signal must change from low to high to imply a RUN command. This parameter is necessary primarily when using the Local/Remote from the keypad because it allows the drive to automatically start if the PLC input is high when going from local to remote, otherwise it would require the PLC input to toggle before the drive would start.

8.3 LOSS OF FOLLOWER SIGNAL. The parameter, "FOLLWER LOST LEVEL", sets the level of follower signal that below which, it will be considered lost. If the signal falls below the selected level the drive will do one of two things as set in the "FOLLWR LOST FLAG" parameter; it will either hold at the present set point (LAST), or change the set point (FLSET) to the value entered in the "FOLLOW LOST STPT" parameter. Once a loss of follower condition has occurred, the drive must be stopped to restore normal follower operation. The loss of follower option is disabled by setting the level parameter at 0%. The follower lost parameters are active only in auto mode; it is helpful to set a relay output to alert to the loss of follower condition.
Other Useful Information:

1. The loss of follower feature is disabled by setting "FOLLOWER LOST LEVEL" to 000.0%.
2. Relay outputs to indicate a loss of follower status can be set up. See relay output section.
3. Note that when the loss of follower condition exists, the status display changes to "FOL LOST" and the set point goes to the "follower lost set point".

Loss of Follower option setup:

Determine the point at which a loss of follower condition will be considered to exist and what action is desired when this occurs.

Example 1: Using a 2-10 volt auto signal. If the follower signal falls to or below 10%, (1V or less), the drive is to sense this and set a relay output and run at 500 rpm.

Set the following parameters in the "E FOLLOWER SETUP" menu:

- 6 FOLLOWER LOST LEVEL to 010.0%
- 7 FOLLOWER LOST STPT to 500rpm (in process units)
- 8 FOLLWR LOST FLAG to FLSET

Set the following parameter in the “G RELAY OUTPUT” menu, “2 RELAY 1” set to “STATUS”, “FOL LOST”.

Example 2: Using a 4-20ma-auto signal. If the follower signal falls below 4ma, the drive is to sense this and set a relay output and run at 700 rpm.

Set the following parameters in the “E FOLLOWER SETUP” menu,

- 6 FOLLOWER LOST LEVEL to 020.0%
- 7 FOLLOWER LOST STPT to 700 rpm (in process units)
- 8 FOLLWR LOST FLAG to FLSET

Set the following parameter in the “G RELAY OUTPUT” menu, “2 RELAY 1” set to “STATUS”, “FOL LOST”.

- 8.4 ANALOG OUTPUTS. The drive has two analog outputs, which can be either voltage or current signals depending on the load connected. If 4-20ma output is desired, a minimum 500 ohm load should be connected; for voltage output, higher resistances should be used such as 1 to 10K ohm. ANALOG 1 SELECT is Channel 1 and ANALOG 2 SELECT is Channel 2; the choices for output are identical. Note that if the hardware is set up for 0-20ma with the min signal set for 20% and the max signal set for 100%, then this channel should never output less than 4ma (20% of 20ma) or more than 20ma (100% of 20ma). Using the scaling parameters located in the “F ANALOG OUTPUT” menu, both signals can be set up to indicate the drive processes listed below. The output level is buffered but non-isolated. Select outputs from:

- NONE (no output)
- DRIVE SPEED (rpm)
- REFERENCE (process units)
- SET POINT (process units)
- MOTOR AMPS (CT required)
- CLUTCH AMPS
- BRAKE AMPS
- FEEDBACK (process feedback units)

The following parameters are used to program the minimum and maximum value as well as the percent of full analog output range for each signal:

- ANA 1(or 2) MIN SIGNAL
- ANA 1(2) MAX SIGNAL
- ANA 1(2) MIN OUTPUT
- ANA 1(2) MAX OUTPUT

The method used for scaling is similar to that used for the speed pot and follower inputs on the drive where two points on the curve are described by the above four points. The min and max signals are given in percentage from 0 to 100% and the output is expressed in RPM, AMPS or whatever the selected signal units are displayed as. All of these signal outputs are for customer use and are available assuming the signal exists, for instance, motor amps requires the use of an optional current transformer.

- 8.5 RELAY OUTPUTS. The drive has 4 relay driver outputs and one on-board “F” relay that can be setup to indicate status or be used for on/off trip functions. All of the outputs and the F relay have the same setup choices. “STATUS” is used to indicate drive condition status, the “TRIP ON” function energizes above the programmable trip point and “TRIP OFF” de-energizes the relay above the trip point.

The following table lists the relay output functions, which may be programmed; the relay driver outputs at the RLY connector are open collector and are pulled low for an active signal. The parameters for these outputs are located in the "G RELAY OUTPUT" menu; where the five

outputs are listed:

- 1 F RELAY
- 2 RELAY1
- 3 RELAY2
- 4 RELAY3
- 5 RELAY4

Each of the outputs has the identical command set below:

NONE - No function, relay remains de-energized at all times.

STATUS - The relay condition changes when:

- NONE - (relay will not function)
- SPD MODE - the control is in speed mode
- TRQ MODE - is in torque mode
- EXT MODE - is in external mode
- LOCAL - local mode is selected
- REMOTE - remote mode is selected
- MANUAL - manual mode is selected
- AUTO - auto mode is selected
- STOPPED - the drive is stopped
- STOPPING - while the drive is stopping
- ESTOP - an E-stop condition exists
- RUN - the drive is running
- RUN0 - the drive is in Run mode but there is no set point reference
- COASTING - the drive is coasting
- JOGGING - the drive is in Jog mode
- FAULT- the drive is faulted
- RESTART - the drive is in restart mode
- TRQ LIM - the drive is in torque limit
- AT SETPNT - the drive is at set point
- FOL LOST - the follower signal is lost (auto mode only)
- FB LOST- speed feedback is lost

These conditions may be programmed to determine relay action when the given status condition changes; when the item is selected with the ENTER key, the appropriate value entry line is presented so that the trip point may be set:

TRIP ON - The relay is normally de-energized and energizes when:

- SET POINT - the set point is at or above a programmed value
- REFERENCE - the reference is at/above set value
- FEEDBACK - the feedback is at/above set value
- SPEED - the drive speed is at/above set value
- MTR AMPS - the motor amps are at/above set value
- CLUT AMPS - the clutch amps are at/above set value
- BRAK AMPS - the brake amps are at/above set value

TRIP OFF - The same as above except that the relay is normally energized and will de-energize when the programmed value is reached or exceeded.

- 8.6 AUTO RESTART. The EC2000 has two Automatic Start features. They are 1. Automatic start upon application of power and, 2. Automatic restart after a fault. Both functions will automatically start the drive without any operator action, and each function can be used independently in conjunction with each other; both require specific operator start control schemes and have several software parameters that have to be set for proper operation. These parameters are located under menu "N. AUTO RESTART".

The "auto restart after a fault" feature has a maximum attempt limit. If this limit is reached, the drive will cease start attempts and will display the last fault. The attempt counter is reset after a period of time the unit has run without a fault. There is no attempt limit on the application of power function. Once the features are enabled and the other conditions are met, the actions described below occur:

AUTO RESTART UPON LINE POWER APPLICATION

When line power is applied, the logic performs a power up routine. When that is complete, there is a time delay before the drive starts set by the parameter "3 START DELAY-PWR". During this delay the keypad will display "RESTART", and after the delay time the control will attempt a normal start.

AUTO RESTART AFTER A FAULT

If a fault occurs while the drive is running, the keypad display will show the fault type for a few seconds and then waits for a period of time determined by the parameter "4 START DELAY FLT". During this delay, the keypad will display "RESTART", and after the time delay the drive will attempt a normal start. If another fault occurs, the process is repeated. Each restart attempt increments a counter until the limit set by the "5 MAX FAULT RETRYS" parameter is reached, after which the restart function is inhibited. If on the last allowed try, a fault occurs, the display will show the fault until it is cleared.

The start attempts counter is cleared if the drive has not faulted for a period of time set by "6. RESTART TIMER" parameter; the range is 60 to 600 seconds with the default being 60 seconds. The start attempts counter is also cleared when the unit is in a stop condition.

Before either of the auto start functions can be used, they must be enabled. The parameters "1 RESTART POWER EN" for auto start upon application of power and "2 RESTART FAULT EN" for auto restart after fault must be set to ENABLE. Auto start functions are only active if a two wire stop/start control scheme is used; three wire control is not allowed.

- 1.The control must be in remote mode if local/remote mode is enabled. If local/remote is not enabled, the start source must be set to "term" (terminal).
- 2.The Stop input (TB2-24) must be connected to common.
- 3.The Start input (TB2-23) (see below) must be also be low.

The EC2000 has two modes of starting, local mode is defined as the start command (source) from the keypad; remote mode is when the start command comes from a contact wired to the power PCB terminal block. Both modes may be active, but only one mode can be used at a time (determined by the Local/Remote command). Local (keypad) mode is considered three wire control and the remote mode may be either three or two wire control depending on how the contacts are wired. For auto restart all of the software and hardware requirements (as outlined in the previous sections) must be correct, and the drive must be in the remote mode of operation with the proper start/stop commands present at the terminal block.

The auto start function will be canceled if any one of the follow items occurs:

- 1.The start input opens.
- 2.The stop input opens.
- 3.A stop key on the keypad is pressed.

4. The drive mode is changed from remote to local.
5. The Estop interlock opens.

Note: The above items do not disable the auto start function; they only cancel auto restart at that time. The next time the drive is started, the function (if conditions are met) will be active. If the auto start option is not to be used anymore, change the enable parameter back to "disable".

Auto Restart Relay Outputs. In general, two relay outputs can be used with the auto restart function, "FAULT" and "RESTART". FAULT status indicates when the drive is faulted. With auto restart after a fault "enabled", the fault output is only active after the last start attempt. For instance, if the number of attempts were set to three, the fault indication would not be given until fault number four. RESTART Status indicates when the drive is the time delay condition before a restart attempt. This output is a pulsed at a 2 Hz frequency when active, in order to provide a flashing (display) indication of the impending restart. If the start delay parameter were set to 10 seconds, the output will pulse (flash) for ten seconds.

Other useful information:

1. If the drive faults while stopping or coasting, it will not auto restart.
2. If the drive faults while E-stopping, it will not auto restart.
3. Auto start will not work with the Jog function because jog is considered three wire control. If the drive faults while jogging, it will not auto restart.
4. After the drive finishes its power up sequence, no fault condition may exist if the "start on applied power" feature is to function.

8.7 MEMORY RESET FEATURE

The EC2000 logic uses PROM memory to provide flexibility. Upon power up or reset of the drive the parameters values and states will be the same as when the drive was last powered.

Included in PROM memory is a set of parameter values called "defaults". In the event that the processor memory was to be corrupted, or the need was felt to start over on programming, the default values are available. The "MEMORY RESET EN" command located in the "A CONTROL SETUP" menu will reset all parameters to the default values. Operation is as follows:

Scroll to parameter "14 MEMORY RESET EN" in the Control setup menu (Shortcut—push "down arrow" because it is the last item in the menu!) and press enter. The second part of the last line of the display will show "NO". Either arrow key will change it to "YES".

If YES is selected, then the "ENTER" key must be pushed to execute the memory reset command after which the first part of the last line of the display will change to "YES". Note that the parameter values will remain unchanged until the next time the power is cycled. (It may be changed back to "NO" as long as power is not removed, if a change of mind occurs.) When power is cycled, the unit will display "LOADING DEFAULTS" for a few seconds. This indicates to the user that the defaults are loaded and all previously changed settings have been reset. Refer to the parameter listing for the default parameter values loaded.

It is also possible to reset memory through the use of the terminals in the event that the control will not boot up due to software upgrade or programming error. To use this function open terminals 30 & 31 (Emergency Stop), open terminals 22 & 24 (Stop) and jumper terminals 22 & 29 (Jog). Cycle power. The control will display "LOADING DEFAULTS" and the factory defaults will be restored. Note: all programming data will be lost.

- ## 8.8 DISPLAY VARIABLES.
- In addition to the normally displayed speed or torque, the user may also monitor many other process items by using the SELECT METER and selecting the desired items for display. Regardless of the control type selected (speed, torque, external), the output speed

of the EC drive can be displayed if the mechanical unit if the internal tach generator is wired.
Programmable items:

REFERENCE
MOTOR AMPS
CLUTCH AMPS
BRAKE AMPS
FEEDBACK
DRIVE SPD

- 8.10 Operation without a KEYPAD/DISPLAY. This mode of operation is possible, although it will still be necessary to have a keypad available for programming and also to monitor operation if desired. Note: It is advised to power down the control when plugging or unplugging the keypad cable to prevent damage; also be sure to avoid damage not covered by the warranty, which will occur if the plug is reversed. The following parameters should be set and the operation monitored before removing the keypad:
1. Enter the fault menu and disable item 4, keypad fault. Consider setting items 1 – 3 to “disable” since the faults will not be displayed, there may be confusion if the control faults (E relay drops out) without indication.
 2. Since the keypad is not to be used for operational commands, terminal block connections to a speed pot(s) and start/stop switches must be made.
 3. The pot parameters will have to be programmed in “J POTENTIOMTR STUP”.
 4. Several parameters under “K SOURCE SELECT” now have to be set; “5 PRESET SOURCE” has to be “TERM”, “6 PRESET 1 SOURCE” must be set to “POT” and “7 START SOURCE” to “TERM”.

Section 9 - QUICK STARTUP

Once the drive and controller has been wired, the following is the minimum setup that is required to operate the drive:

- 9.1 Choose remote or local operation from the keypad. If no keypad is present, external control has been preprogrammed and the operation requires operator controls, Run and Stop pushbuttons and a Speed potentiometer or external reference. The balance of this section assumes a keypad/display is available at least for startup programming.
- 9.2 The control type must be selected from the following choices (menu/parameter "A 1"):
 - A.) Speed
 - B.) Torque (current) control
 - C.) Speed/Torque
 - D.) External Control
- 9.3 The controller current output must now be set. The parameter is "A 2" and is used to set the output rating of the controller. Use 5.5A unless the mechanical unit coil is rated between 5.5 and 8 amps (then select 8A). Note: The jumper J5 must also be positioned correctly, "A" for 5.5A or "B" for 8.0A.
- 9.4 Set the coil rating using the actual value from the motor nameplate in "A 3; this value is to be equal to or less than "A 2 CONTROL CURRENT".
- 9.5 The "A 4" CLUTCH CURRENT LIMIT is designed to limit output from the control, which will then limit torque. Unless full time current/torque limiting is desired, this parameter should be set to the "A 3" value.
- 9.6 The internal tach generator or pulse pickup frequency must be entered in "A 5 TACH PULSES/REV" and the number to be set is the pulse per revolution. The most common generator pulse rate is 12, but the larger units use other values. If a pickup is used, the limit is 180 PPR. The unit value can also be scaled by use of the clutch scale factor in the A MENU (Control Setup) Note: The jumper J4 on the power PCB must be set to "A" for pulse pickup (TB1(com), TB2(Signal) and TB3(+12 Volts)) or to "B" for tach generator input.
- 9.7 The clutch speed range is set by setting the minimum and maximum RPM in parameters "A 6" and "A 7". These will be set to nameplate minimum and maximum RPM's to keep the mechanical unit within its design thermal operating and regulated control ranges.
- 9.8 Stopping mode programming. The parameter "A 10 COAST ENABLE" is used to choose the coast function. If a controlled decel stop is selected, it will require that the decel time be set longer than the normal coast to stop time, unless a brake is used, then the decel time will be controllable to any desired value within the limits of the braking torque.
- 9.9 Now decide if Local/ Remote operation is to be used; Local/Remote may be enabled by using parameter "A 11 LOCAL/REM ENABLE". It is best to enable this to be sure which mode the control is in. If you are planning to run from the terminals (remote) go to Menu K Source Select and set Items 1 Auto/Man Source = kpad , 2 Jog Source = term, 5 Preset Source = term, 6 preset 1 Source = pot & 7 Start Source = term. Now, the control will need a start/stop circuit on terminals 22, 23, & 24. It will need a potentiometer on terminals 6,7 & 9. for manual mode and a voltage or current on the auto input, terms 20 & 21. See figures 5 & 7 for detailed wiring. The user can switch from aut to manual with the keypad. If you are planning to run from the keypad, then set items 1,2,5,6,7 above all to keypad. Terminals 22,24 must have a jumper for this as the stop circuit is always active. Note, for the auto or manual inputs to work, the control must be in remote mode. Once set the control will remember it's operating mode even if power is removed.

9.10 Should the control programming become corrupted or if it is desired to start over, it is possible to reset the control to the default settings. To do this, go into the programming mode item “A 14 MEMORY RESET EN”, and set it to “YES”. WARNING: If you change your mind, be sure to reset the “A 14” parameter back to “NO” before turning off the power. Exit the programming mode and remove power from the control for 10 seconds; this will reset the parameters to their default settings upon power up and all of the “tailored” parameters required for running the particular system will have to be re-entered. It is also possible to reset the control to factory defaults through use of the terminals. This could be necessary in the event the controller will not boot up due to a software upgrade or a programming error. To enable the terminal reset, open terminals 30 & 31 (Emergency Stop), open terminals 22 & 24 (Stop) and jumper terminals 22 & 29 (Jog). Then cycle power. The control will reload factory defaults, so all programming data will be lost.

Table 4: Power Board Programmable Jumpers

JUMPER	PARAMETER	POSITION “A”	POSITION “B”
J2	Follower Operation	Pulse Pickup (TB2-17)	Tach. Generator (TB2-18 to 19)
J3	Process Feedback	0 TO ±20VDC	0 TO ± 5, ±10V
J4	Speed Control Feedback	Pulse Pickup (TB2-2)	Tach. Generator (TB1, G1 & G2)
J5	Clutch Current Feedback Scaling	5.5 AMP (or less) Output	8 Amp Output
J6	Brake Current Feedback Scaling	5.5 AMP (or less) Output	8 Amp Output
J11	Clutch LEM Feedback	Standard Control On Board LEM's	High Power Control Off Board LEM's
J13	Clutch Gating Circuit	Standard Control On Board Pulse XFMR	High Power Control Off Board Pulse XFMR

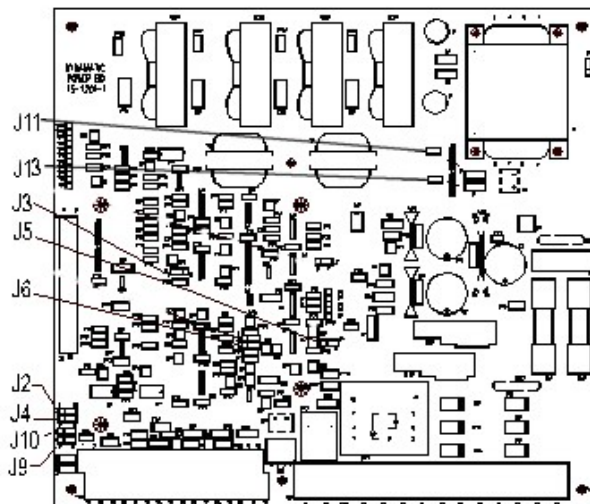


Figure 10: Location of Jumpers on the Power Board
 Note that Jumpers J3 and J6 are located under the logic circuit board, if it is installed.

Table 5: Process Feedback Signal Programming

For Special Uses Only, (such as Dancer Position)

SIGNAL	JUMPER	
	J9	J10
0 –10 VDC	A	A
0 -5 VDC	A	B
4 – 20 maDC	B	B
8 – 40 maDC	B	A

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