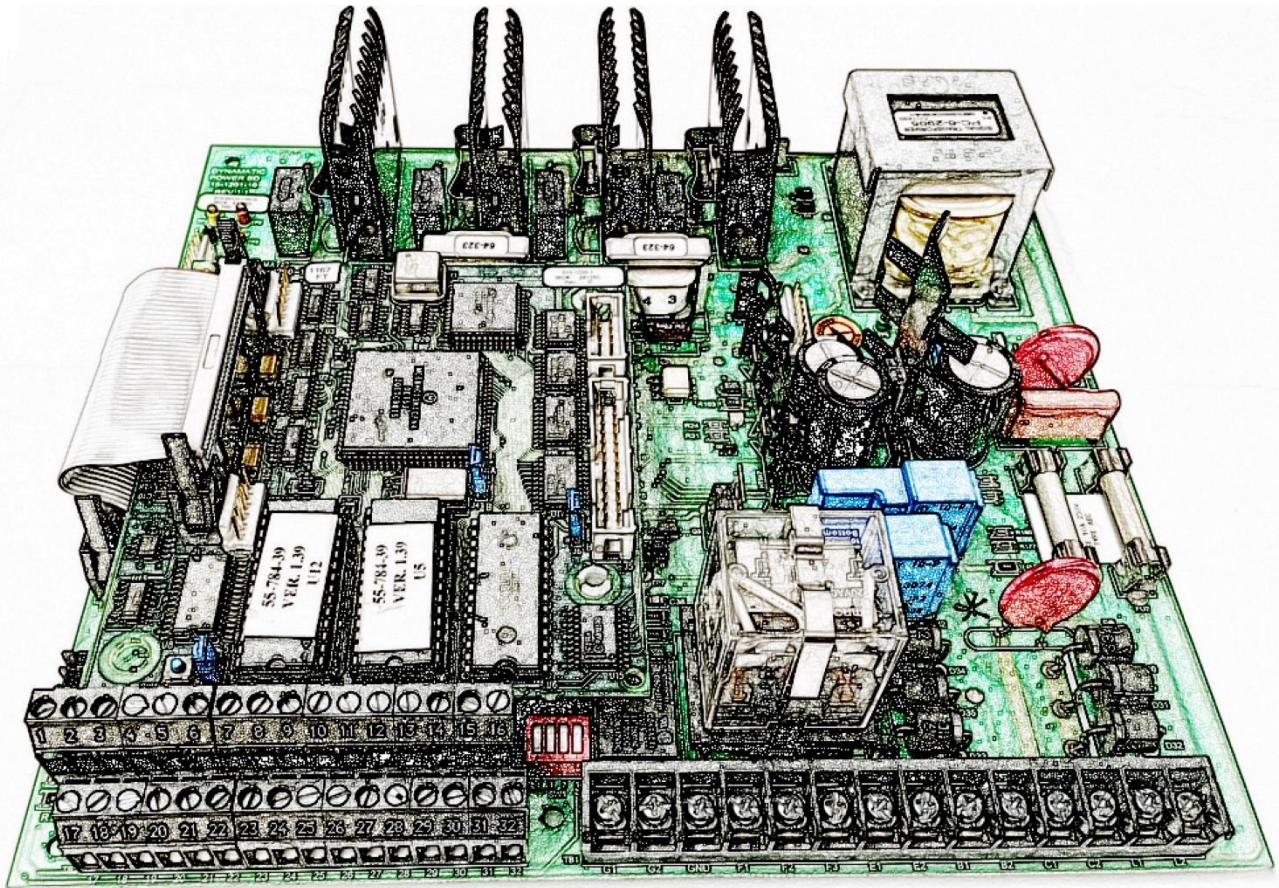


# **Dynatomic<sup>®</sup>**

DRIVE SOURCE INTERNATIONAL, INC.

## **EC 2000**

### **Instruction Manual**



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## Section 1 - THEORY OF OPERATION

The Dynamatic® Eddy Current drive system consists of a prime mover (AC induction motor), an AC motor starter (optional and not provided), the Eddy Current coupling, a speed feedback device (tachometer generator) and a controller with an operator interface.

The AC motor is started under no load and allowed to reach full speed before the controller is energized (motor starter not included). 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 tachometer 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 EC 2000 control.

The EC 2000 uses digital technology to provide a flexible, low noise control for today's high tech industrial environment. It provides setup and programming via a keypad with a user friendly alphanumeric display; drive parameters may be programmed and displayed by the customer to activate the many built-in features.

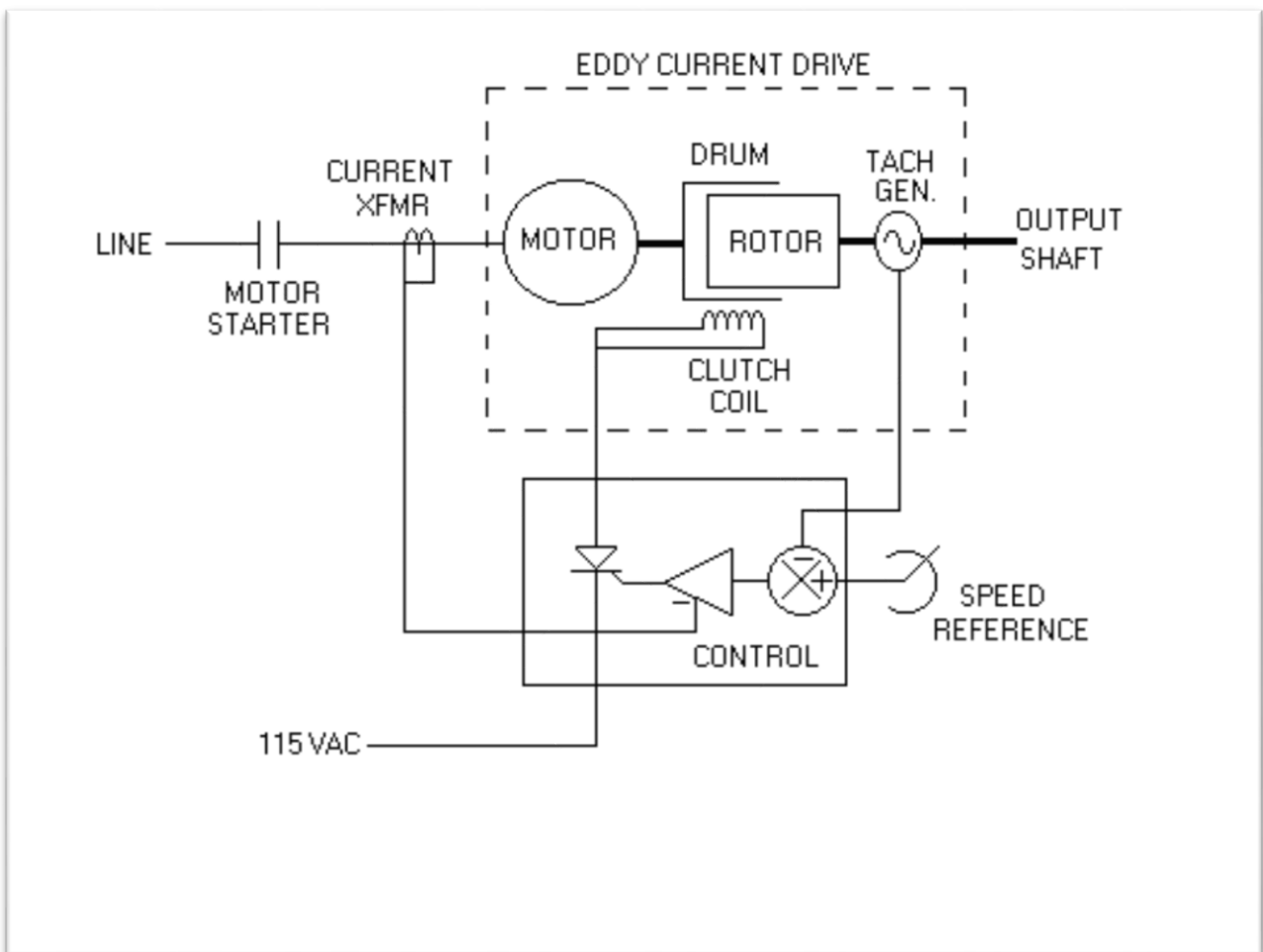
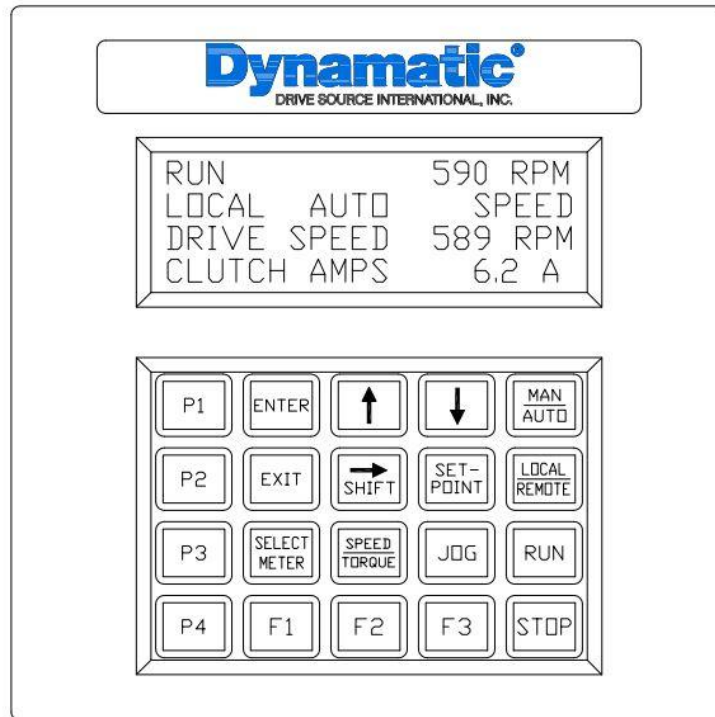


Figure 1: Eddy Current Drive & Control Block Diagram



**Figure 2: EC 2000 Keypad Display**

## SECTION 2 – SPECIFICATIONS

### 2.1 Features

- Eddy current drive digital controller
- Available in panel and NEMA enclosed configurations
- Adjustable output voltage from 0 – 90VDC
- Up to 8 amps output (see **EC 2000 – HP** models for higher voltage or current outputs)
- Ethernet IP add-on available
- Speed (AC tachometer generator or speed pickup) or torque (clutch current) feedback permissible
- Adjustable brake current output
- Controllable via potentiometer, follower signal (0-10V, 4-20mA), or the keypad
- 115VAC standard power input
- Digital, noise free operation
- Fuse and MOV protected
- Back-lit LCD with keypad user interface
- Programmable analog and relay outputs for different speeds/states and monitoring.
- Recorded and displayed faults

### 2.2 Power and Load Ratings

- Input voltage: 115VAC, 50/60Hz
- Input Line Current: 8.0A RMS
- Output: 8.0A DC Output at 90VDC MAX
- Inversion and field forcing available to 90VDC
- “Run” Relay (SPST): 115 VAC or 24 VDC at 5A (Resistive); 150VA Pilot Duty
- Programmable “F” Relay (SPDT): 2A @ 115 VAC
- Load Regulation: -0.25% load change from 25% to full load
- Line Regulation: +/- 1% of rated speed for +/-10% change in line voltage
- Thermal Drift: +/- 0.05% of rated speed per °C
- Linearity: +/- 2% of maximum rated speed
- Minimum Regulated Speed: 25 RPM
- Linear Acceleration/Deceleration Range: 1% - 200% of top speed/sec

### 2.3 Electrical Protection

- Fuses: 10A, 250VAC, Type ABC
- Metal Oxide Varistors
  - 240V, 10kA
  - Used on both input and output

## **2.4 Environmental Ratings**

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

## **2.5 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: Complies with IEC 801(1984)-3, class 2. It operates without fault or disturbance under the specified level of radiated EMI (Performance Criteria 1).

## **2.6 Enclosures**

- Available in NEMA Type 1 (Dynamatic Part Number: 015-002000-0300)
- Other enclosures available upon request (lead times may vary)

## **2.7 Weight**

- Panel Mounted Controller: 8.3 lbs. (base unit)
- 460/230VAC : 120VAC transformer: 24 lbs. (panel mounted)

## **2.8 Dimensions (see Figures 3-6)**

- Main Board: Main Board - 8.5"H x 9.25"W x 2.25"D
- Panel Mounted (Standard):
- Keypad: 4.875"H x 4.875"W x 1.375"D

## **2.9 Reliability**

- Mean Time Between Failures: 50,000 hours

## **2.10 Codes and Standards**

- National Electrical Code (NEC) compliant



## **SECTION 3 – CONTROL OPERATION MODES**

### **3.1 Control Modes**

- Speed (AC Tachometer Generator or Pulse Pickup)
- Torque (Current Feedback)
- Speed/Torque (switchable)

### **3.2 Other Modes of Operation**

- Local/Remote
  - Allows the user to switch between keypad use and externally wired devices
- Jog
- Manual/Auto
  - Allows the use to switch between an automatic signal (i.e. 4-20mA or 0-10V) and the control potentiometer
- 2 or 3 wire start/stop
- Four Preset Setpoints
  - Programmable through the keypad
- PLC Run
- Auto Start on Power
- Auto Restart after fault
- Adjustable Braking
- Coast to Stop
- Ramp Control
- Loss of Follower
- Torque Limit
  - Requires motor current transformer
- User Process Units
- Forward/Reverse Speed Control
- ESTOP (TB2-31 and 32 are not closed)

## **SECTION 4 – Inputs/Outputs**

### **4.1 Analog Inputs**

- Potentiometer/Reference Voltage
  - Used for setpoints
- Automatic Signal
  - 0-10V, 0-5V, 4-20mA, 8-40mA
  - Used for setpoints
- Motor Current Feedback (AC)
- Speed Feedback

### **4.2 Digital Inputs**

- E-Stop (Normally closed)
- Stop (Normally closed)
- Start (Normally open)
- Jog (Normally open)
- PLC Run (Normally open)
- Preset 1 or 2
- Preset 3 or 4
- Manual/Auto
- Speed/Torque

### **4.3 Analog Outputs**

- 2 x Programmable 0-10V/4-20mA Outputs (minimum 500 Ohm load required for 4-20mA)
  - Motor Amps
  - Process
  - Feedback
  - Clutch Amps
  - Drive Speed
  - Set Point
  - Brake Amps
  - Set Point Deviation

#### 4.4 Digital Outputs

- Run Relay (Normally open)
  - 2A, 115VAC
- Programmable “F” Relay (SPDT)
  - Speed Mode
  - Torque Mode
  - Local Mode
  - Manual Mode
  - Auto Mode
  - Stopped
  - Stopping
  - E-Stop
  - Run
  - Run 0
  - Coasting
  - Jogging
  - Fault
  - Restart
  - Torque Limit
  - At Set Point
  - Loss of Follower
  - Loss of Feedback
- 4 x Programmable +12VDC Relays (Logic)
  - Female pin header needed (6 position, 2.54 mm pitch)
  - Same programming functions as “F” relay

SECTION 5 – INSTALLATION

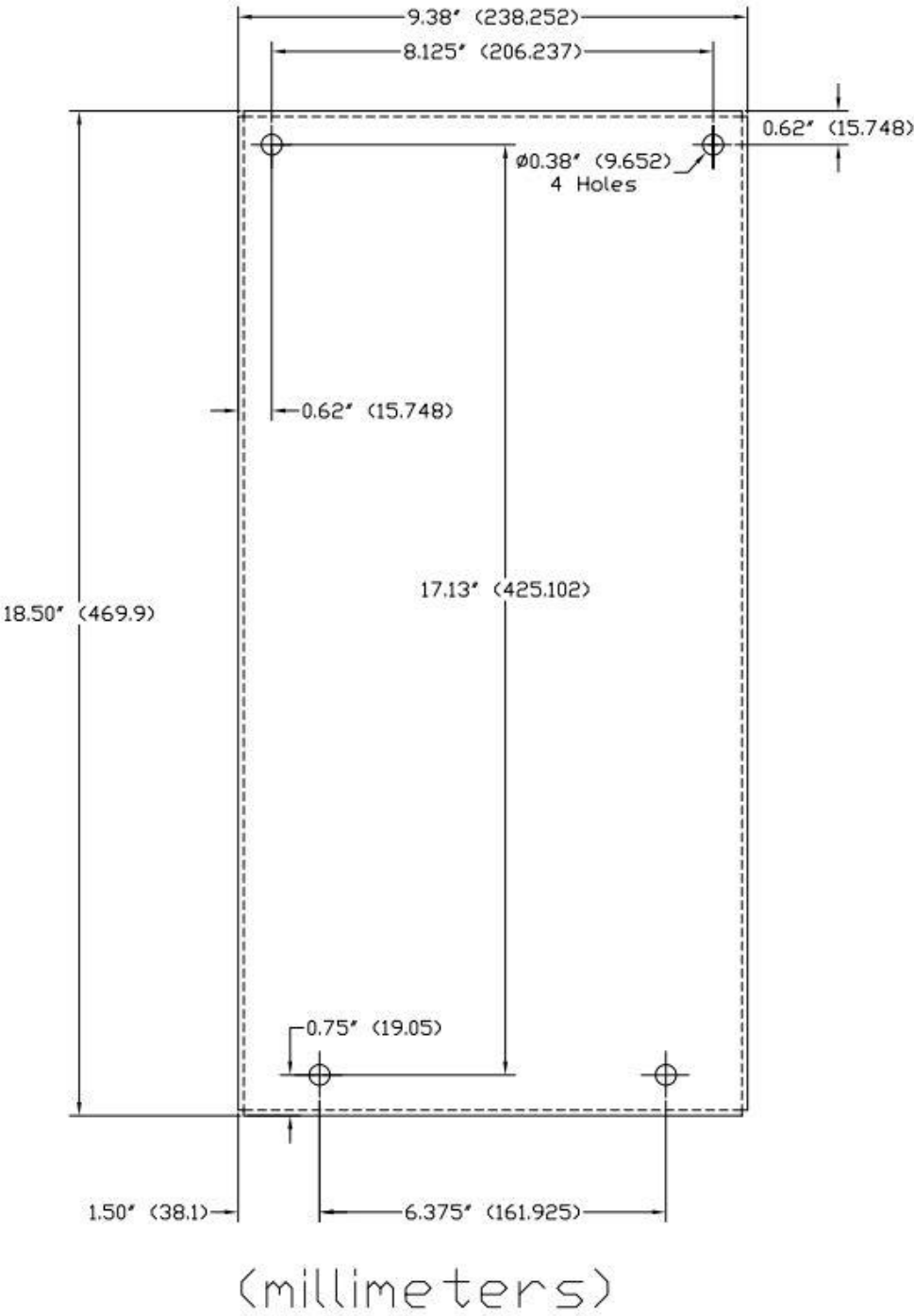
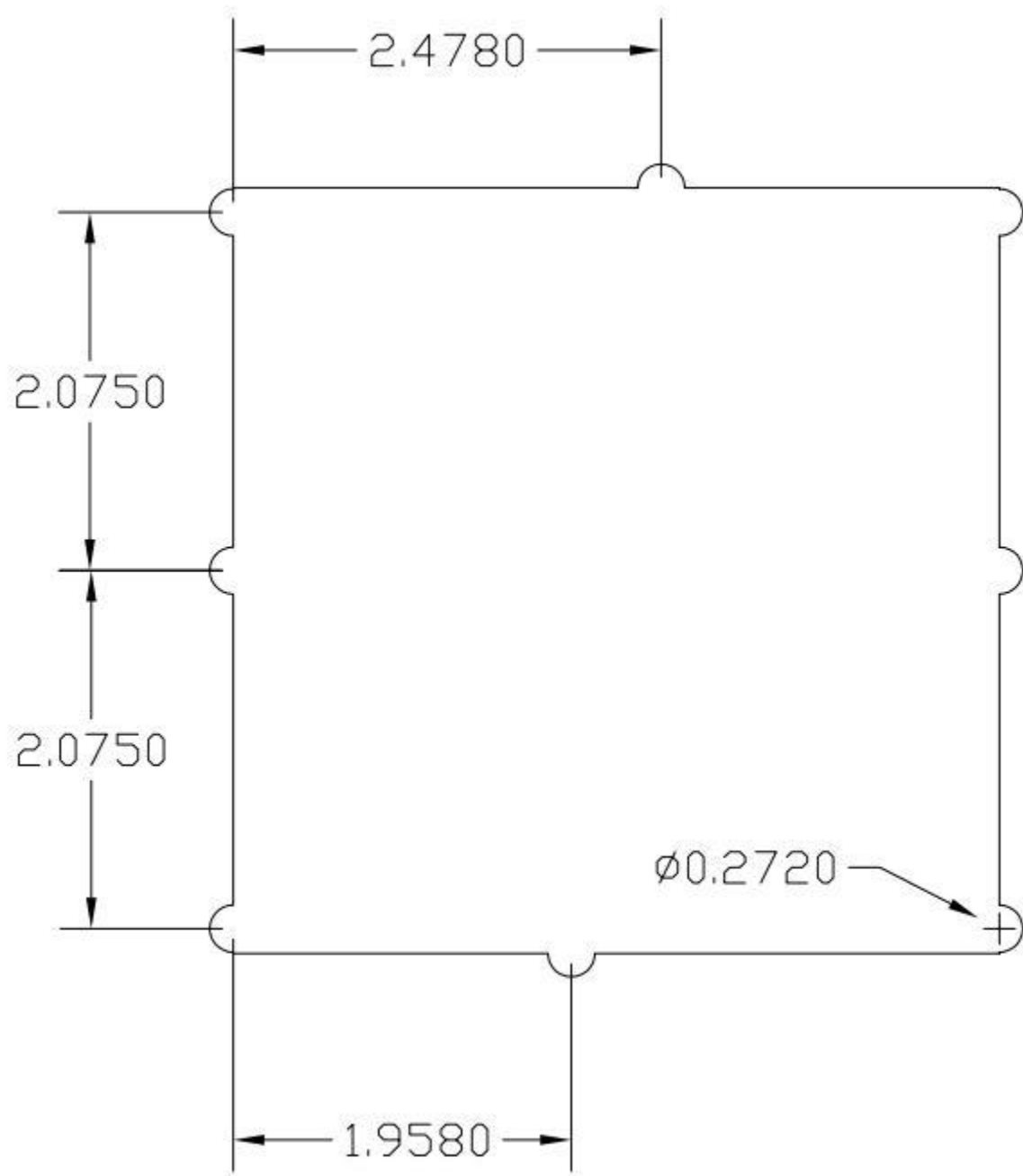


Figure 3: Standard Panel Dimensions (Not to scale)



**Figure 4: Keypad Cutout Template (to Scale, Inches)**

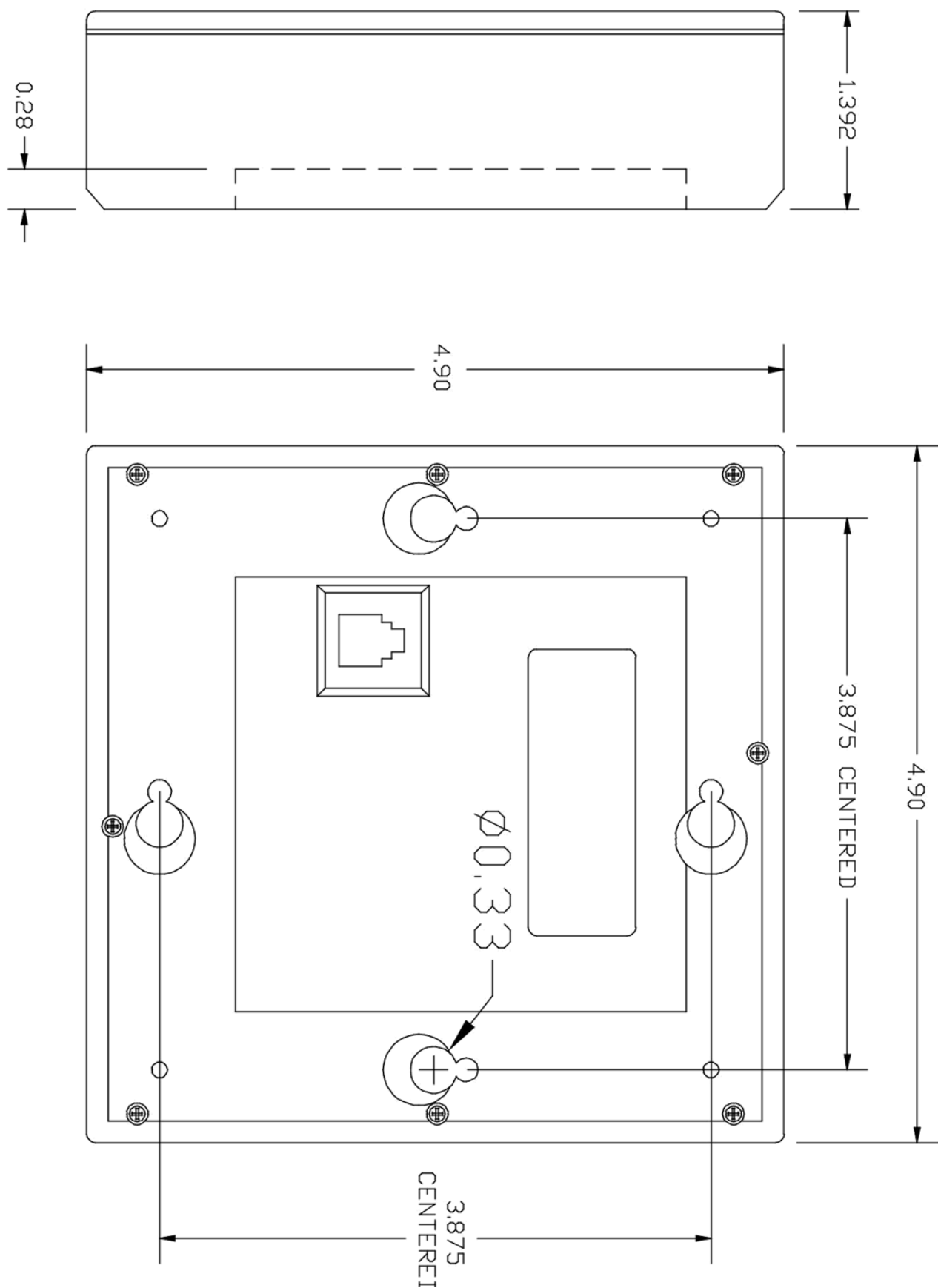
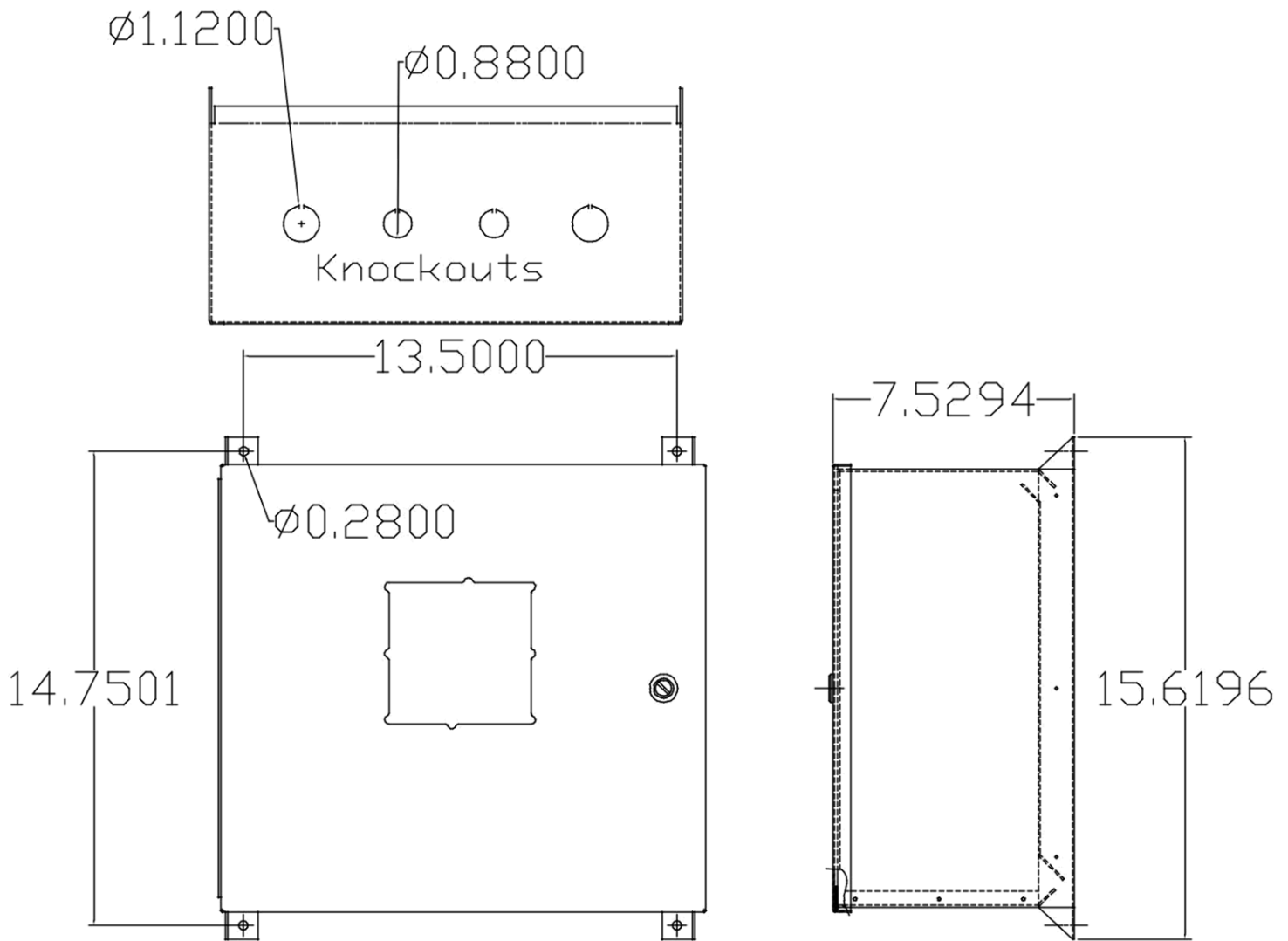


Figure 5: Keypad Dimensions (to Scale)



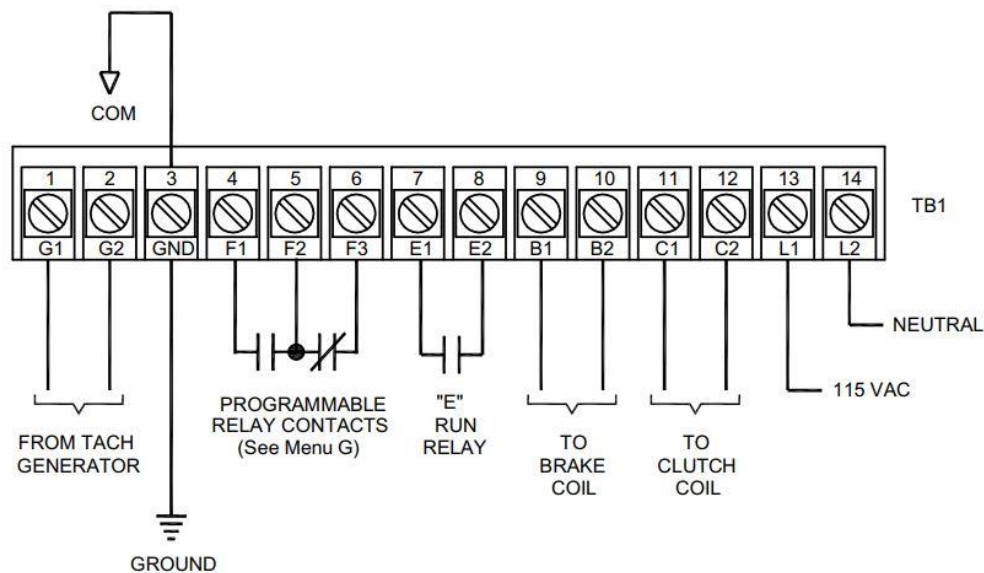
*Figure 6: Standard NEMA Rated Enclosure Dimensions (Not to Scale)*

## 5.1 Mounting Hardware

- Standard Panel
  - $\frac{1}{4}$ " - 20 Bolts, Flat Washers, Lock Washers (Not included)
- Standard Enclosure
  - $\frac{1}{4}$ " - 20 Bolts, Flat Washers, Lock Washers (Not included)
- Keypad
  - Included

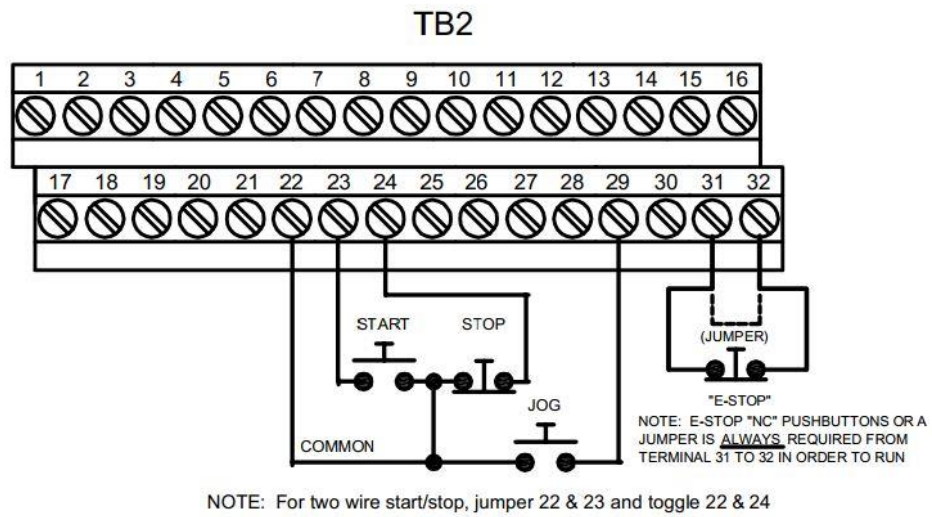
## 5.2 Wiring

- Dynamatic recommends adhering to the National Fire Protection Association's "NFPA 70: National Electrical Code" codes and standards for proper branch protection, SCCR ratings, and ampacity ratings.
  - <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70>
- Terminal Block Tightening Torque
  - "TB" : 25 lb-in.
  - "TB1" : 8.8 lb-in.
  - "TB2" : 6 lb-in.

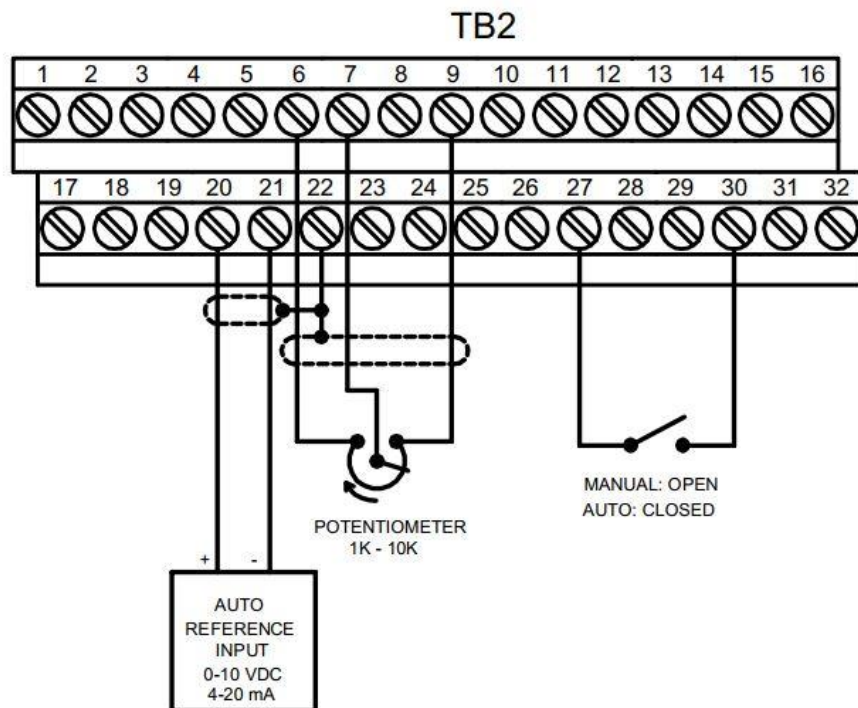


*Figure 7: "TB1" Terminal Block*

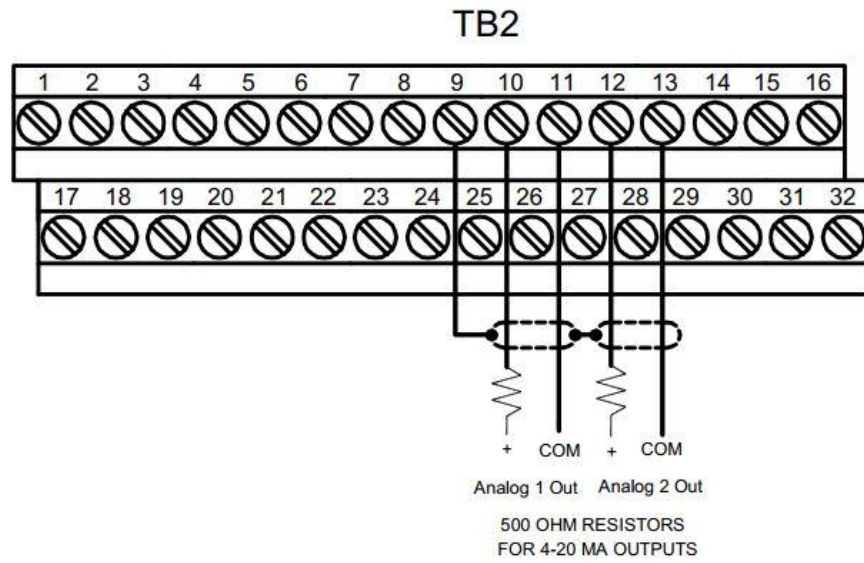




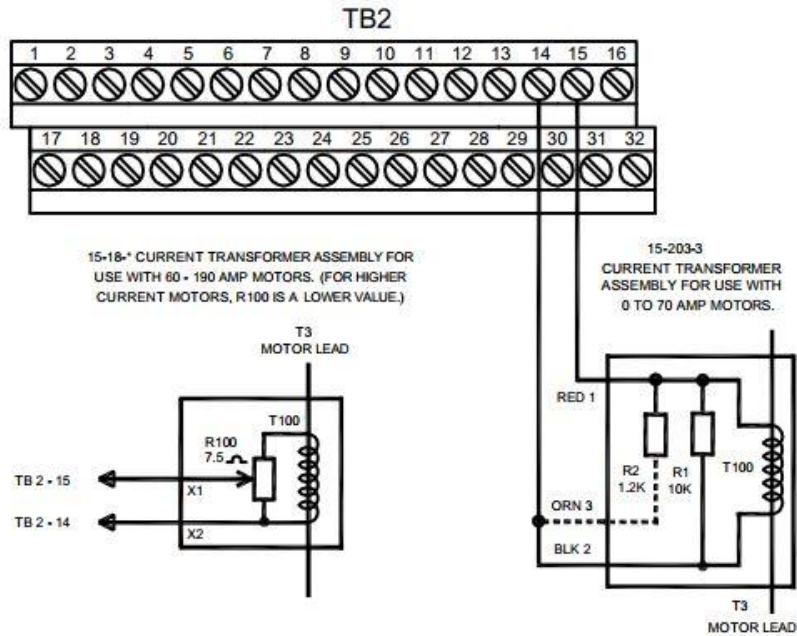
*Figure 8: Start/Stop/Jog & E-STOP Wiring*



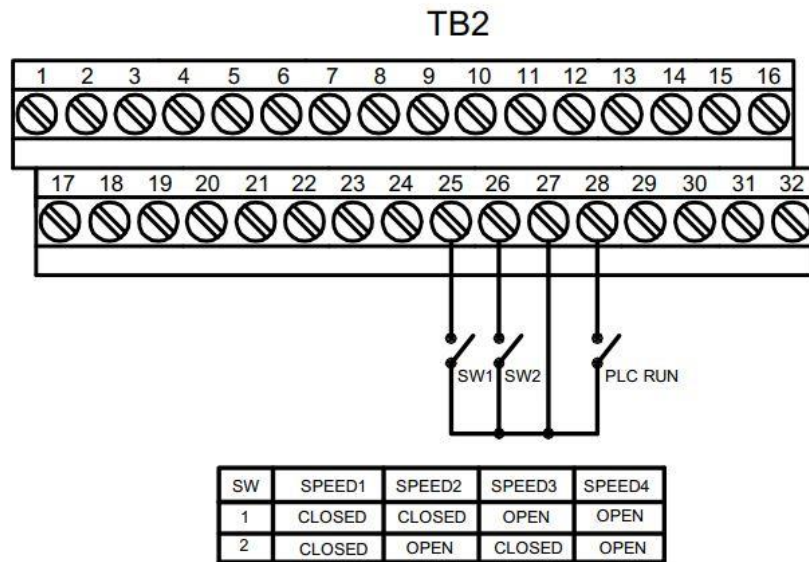
*Figure 9: Setpoint Reference & Manual/Auto Mode Wiring*



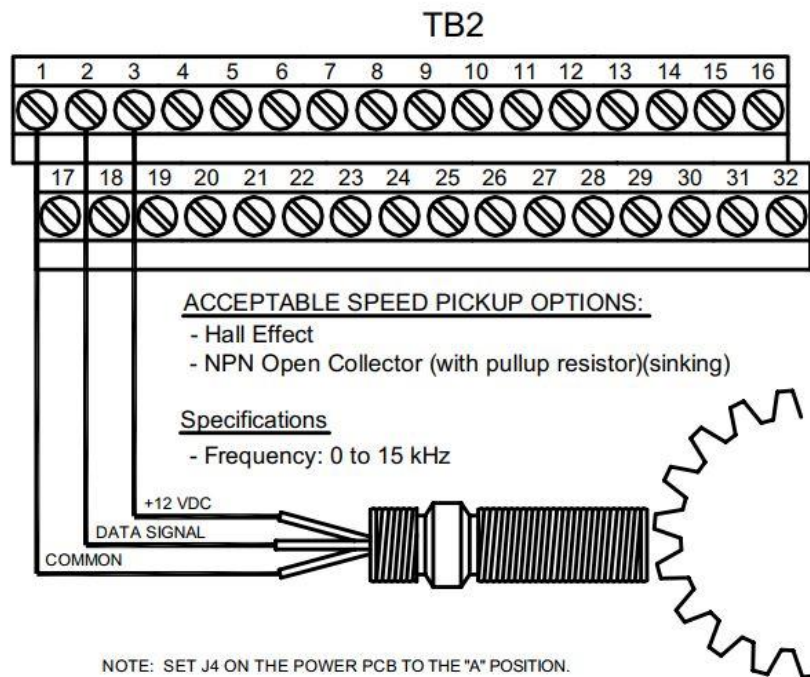
*Figure 10: Programmable Analog Outputs Wiring*



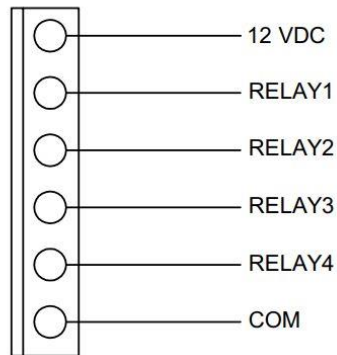
*Figure 11: Current Transformer Wiring for Torque Limiting*



*Figure 12: Preset Speeds & PLC Run Wiring*



*Figure 13: Speed Pickup Wiring*



## PL-RLY

(6 position, 2.54 mm pitch female pin header required)

*Figure 14: Relay 1-4 Connection Diagram*

### 5.3 Hardware Setup

- There are several 3 contact male pin headers on the board with a jumper either occupying the center and left pins (position A) or the center and right pins (position B). Below is a list of jumper settings for the EC 2000. All jumpers not listed should be left in the default position.

*Table 1: EC 2000 Jumper Settings*

Jumper	Parameter	Position A	Position B
J2	Follower Operation	Pulse Pickup	Tachometer Generator
J4	Speed Control Feedback	Pulse Pickup (TB2: 1,2,3)	Tachometer Generator (TB1: G1/G2)
J5	Clutch Current Scaling	5.5A Max	8A Max
J6	Brake Current Scaling	5.5A Max	8A Max

**Table 2: Follower Setpoint Jumper Settings**

Signal	Jumper	
	J9	J10
0 – 10 VDC	A	A
0 – 5 VDC	A	B
4 – 20 mA (DC)	B	B
8 – 40 mA (DC)	B	A

- To properly utilize motor torque limiting with the EC 2000, the red dip switch “SW1” must be set in conjunction with a current transformer. Below is a table with “SW1” contact configurations with Dynamatic® approved current transformers.
- To fine tune the scaling of the motor amps for torque limiting, adjust R111.

**Table 3: Torque Limiting SW1 Settings**

Current Transformer Assembly	Rated Motor Current	SW1 Contacts				Transformer Lead Connections
		1	2	3	4	
15-203-3	0 – 3A	X	X	X	X	Orange Lead NOT Used
	3 – 4A	X	O	O	O	
	4 – 5A	O	O	X	O	
	5 – 10A	O	O	O	X	
	10 – 20A	X	X	X	X	Connect Orange and Black Leads
	20 – 35A	X	O	O	O	
	35 – 50A	O	O	X	O	
	50 – 70A	O	O	O	X	
15-203-*	55 – 500A	X	X	X	X	

X = Indicates closed contact; O = Open

\* Use 15-203-125 for 55-125A, 15-203-250 for 110-250A, and 15-203-500 for 220-500A

## SECTION 6 – KEYPAD

- The EC 2000 can be either controlled via the keypad or from external pilot device, but initial programming must be done with the keypad.
- The keypad is plugged into the “PL2-KEYPAD” male pin header on 15-1200-1.
- Dynamatic® part number: 037-000544-0100 (Keypad with 10ft cable)
  - Other cable sizes available upon request

*Table 4: Keypad Button Descriptions*

Key	Function	Notes
P1	Preset 1	Set in Menu L, “Process”
P2	Preset 2	Set in Menu L, “Process”
P3	Preset 3	Set in Menu L, “Process”
P4	Preset 4	Set in Menu L, “Process”
ENTER	Allows user into a menu or submenu; confirms value change	
EXIT	Allows user to back out of a menu or submenu.	
SELECT METER	User changes displayed meters (Meter 1 or Meter 2) on bottom two lines of the keypad.	Meter options include: Reference, Motor Amps, Clutch Amps, Brake Amps, Feedback, and Drive Speed.
F1/F2/F3	Successive pushing locks or unlocks the keypad	“Locked” does not allow changing of parameters
↑	Allows user to cycle through menus or values in ascending order	
→ Shift	Allows user to change between individual digits	
↓	Allows user to cycle through menus or values in descending order	
SET- POINT	Reference point for speed or torque control	
<u>SPEED</u> TORQUE	Switches between speed or torque control	
JOG	Momentary run function at a preset reference	
<u>MAN</u> AUTO	Switches between “Manual” and “Automatic” mode	“Manual” refers to the use of a potentiometer for speed/torque reference, while “Automatic” refers to the use of a follower input such as 0-10V or 4-20mA .
<u>LOCAL</u> REMOTE	Switches between “Local” and “Remote” mode	“Local” mode is for operation from the keypad, while “Remote” mode is for operation from external pilot devices. Only available to toggle if enabled in Menu A, Parameter 12.
RUN	Starts the control	Will only work in “Local” mode
STOP	Stops the control	The control can either be programmed to stop the control via the keypad or external push button (See Menu K).

## SECTION 7 – PROGRAMMING

### 7.1 Menu A: Control Setup

#### 1. CONTROL TYPE

- Speed (default)
  - *Uses the AC Tachometer Feedback for speed feedback and control.*
- Torque
  - *Clutch coil voltage is regulated. This is frequently used for take-up or spooler applications where torque is proportional to tension and speed varies with the diameter of the roll.*
- Spd/Trq
  - *The control type is selected via the terminal block input or the “Speed/Torque” keypad button.*

#### 2. CONTRLR CURRENT

*Select the output range of the controller. Choose the closest value to the coil rating for scaling purposes.*

- 5.5 Amps
- 8 Amps

#### 3. CLUT COIL RATING

*Locate the clutch coil rating on the nameplate of the mechanical unit and enter it. The value should be equal or less than the previous parameter (2. Controller Current).*

#### 4. CLUTCH CURNT LIM

*Enter the coil current limit, which is equal to or less than the clutch coil rating. Note, limiting the coil current to less than its rated value will reduce the amount of torque.*

#### 5. TACH PULSES/REV

*Set the speed feedback frequency for the AC tachometer generator based on what mechanical unit you have. See the table, below. For finer tuning, see Menu A, Parameter 20.*

**Table 5: Mechanical Unit Tach Pulses/REV Setting**

DRIVE	PPR
Obsolete Drives ACM's	10
AS-14 / 25 – Fractional “FD”	12
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

6. TORQ PULSES/REV

*Sets an alternate pulses per revolution rate (PPR) for applications that use more than one transducer. To enable this rate, enable Menu A. Parameter 18 and close TB2-25.*

7. CLUTCH MIN RPM

*The minimum speed for the clutch.*

8. CLUTCH MAX RPM

*The maximum speed of the clutch. Please note that proper minimum and maximum values are necessary for safe and proper use of the drive.*

9. MTR NO LOAD AMPS

*The no load amp setting for the motor for proper scaling and torque limiting. Consult the nameplate on the drive for the correct value. Only used if a current transformer is being used to measure the motor amps.*

10. MTR FL. LOAD AMP

*The full load amp setting for the motor for proper scaling and torque limiting. Consult the nameplate on the drive for the correct value. Only used if a current transformer is being used to measure the motor amps.*

11. COAST ENABLE

*Allows for bypassing of the deceleration rate by dropping out the output and allowing the shaft to coast to a stop.*

- ENABLE
- DISABLE (default)

12. LOCAL/REM ENABLE

*Allows user to switch between local and remote mode on the keypad. Local corresponds to functions done on the keypad, while remote corresponds to functions done external to the keypad (TB2).*

- ENABLE (default)
- DISABLE

13. CURRENT FILTER 1

*Adjusts the inner current loop feedback signal (clutch amps) (Default: 16).*



#### 14. SPEED FILTER AVER

*Allows for taking an average of the speed feedback readings. This is primarily used for non-standard speed feedback configurations, noise affected configurations, or heavy loads not getting up to speed in a timely manner (Default: 0).*

#### 15. SPEED FILTER CLAMP

*Limits the amount of speed feedback readings done by the EC 2000. This is primarily used for non-standard speed feedback configurations, noise affected configurations, or heavy loads not getting up to speed in a timely manner (Default: 0).*

#### 16. MEMORY RESET EN

*Allows the user to reset the stored parameters back to the factory defaults upon powering or resetting the device (pressing the SW1 button on the 15-1200-1 logic board).*

- YES
- NO (default)

*Note: Parameters can also be reset back to factory defaults by placing a jumper between terminals 32 and 29 on TB2, while also removing all other connections on TB2.*

#### 17. REVERSE SETPOINT

*Allows the user to use a setpoint reference signal in reverse. For example, if a potentiometer normally gives a full voltage signal to give a maximum speed reference, enabling this parameter would tell the control to give a minimum speed reference with a full voltage signal from that potentiometer.*

- ENABLE
- DISABLE (default)

#### 18. REVERSE CONTROL

*Sometimes used in centrifuge applications, this allows the user to control the drive to go "down" instead of "up."*

- ENABLE
- DISABLE (default)

#### 19. REV CONTRL REM

*Allows the user to switch the controller from forward to reverse in conjunction with TB2-25 being closed to common and "REVERSE CONTROL" being enabled.*

- ENABLE
- DISABLE (default)

#### 20. CLOSED LOOP TORQUE

*Allows the user to use the setting in Menu A, Parameter 6 (TORQ PULSES/REV) instead of Menu A, Parameter 5. Note, this must be used in conjunction with TB2-25 being closed to common.*

- ENABLE
- DISABLE (default)

#### 21. CLUTCH CUR SCALE

*Used to adjust the difference between the actual clutch current (measured with a DC clamp on meter) and the current reading of the EC 2000. If the keypad displayed clutch current is less than measured, increase the percentage, and vice-versa (Default: 100%).*

#### 22. CLUTCH PPR SCALE

*Used to fine tune the Menu A, Parameter 5 (TACH PULSES/REV) speed feedback rate (Default: 100%). This is typically used for nonstandard or pulse pickup units.*

#### 23. TORQ PPR SCALE

*Used to fine tune the Menu A, Parameter 6 (TORQ PULSES/REV) alternate feedback rate (Default: 100%). This is typically used for nonstandard or pulse pickup units.*

#### 24. PULSE MAX FREQ

*Used to scale the pulse follower input when "PULSE" is selected for "PRESET 1" in Menu K (SOURCE SELECT). Default: 100.*

#### 25. BOOT START DELAY

*Delays the boot up sequence of the EC 2000. This is used for more unstable power supplies (Default: 0 sec).*

## 26. CONTRLR BAUD RATE

*Changes the BAUD rate (how fast data is sent over a serial line) of the control data transfer.*

- 4800
- 9600 (default)
- 19200
- 38400

## 27. DATA XMIT ENABLE

*Allows the user to enable or disable data transmission.*

- ENABLE
- DISABLE (default)

## 7.2 Menu B: CLCH PERFORMANCE

*This is for adjusting the clutch performance using an internal proportional-integral-derivative feedback loop (PID). Dynamatic recommends only adjusting the speed feedback parameters 4, 5, and 6. Dynamatic recommends trying to keep parameter 6 as low as possible (as high DIFF values can cause a control speed to run away over time) and adjust parameters 4 and 5 until stable results are achieved.*

1. CURR PROP GAIN
2. CURR INTGRL GAIN
3. CURRENT DIFF GAIN
4. SPEED PROP GAIN

*The minimum speed for the clutch. Proportional control is the amount of response to an incorrect speed and is proportional to the amount of error. For example, if you are driving a car, and you want to be going 40 mph, but you drop below that, you hit the gas pedal to accelerate until you hit 40 mph again.*

5. SPED INTGRL GAIN

*Integral control is a constant summation of error from the setpoint and provides feedback proportional to the total rather than the error. While proportional control deals with a large difference in target and actual speed, and derivative control deals with sudden changes, integral control deals with small errors.*

6. SPEED DIFF GAIN

*Derivative control compensates for sudden changes in speed. For example, if you are driving at 40 mph, but now you are on a hilly road. If you hit a large hill, the speed will drop fairly quickly, but you press the gas pedal again to bring it back up. But you probably applied a lot more gas than what was needed to counteract that sudden and drastic drop in speed. Default: 0%*

7. ENABLE CURRENT LOOP

*The EC 2000 has two PID loops (as seen in the previous parameters), speed and current, where the speed PID loop is fed into the current PID loop. This parameter allows the user to disable the current PID loop. This is typically used as last resort in performance stabilization.*

- ENABLE (default)
- DISABLE

8. TORQUE LIMIT

*The percentage of motor amps allowed until the torque limit fault is enabled. Default: 250%*

9. TRQL PROP GAIN

*The proportional gain control of the torque limit.*

10. TRQL INTGRL GAIN

*The integral gain control torque limit.*

**7.3 Menu C: ACCEL/DECEL SETUP**

1. Normal Accel Rate (Default: 10%)
2. Normal Decel Rate (Default: 10%)
3. Auto Accel Rate (Default: 10%)
4. Auto Decel Rate (Default: 10%)
5. Jog Accel Rate (Default: 100%)
6. Jog Decel Rate (Default: 100%)

**7.4 Menu D: BRAKE PERFORMANCE**

*Allows to user to adjust the brake output (TB1 – B1/B2). Note, the brake will enable when the clutch drops out. For simultaneous clutch and brake output, a “Mutuatrol” modification is required (please consult Dynamatic).*

1. Brake Coil Rating

*Enter the brake current rating found on the nameplate.*

2. Adj Braking Enable

- ENABLE
- DISABLE

3. Adj Brake Amps

*Set the amount of brake amps to apply. Note, the higher the current, the quicker the braking.*

4. Brake Prop Gain
5. Brake Integral Gain
6. Brake Diff Gain

## 7.5 Menu E: FOLLOWER SETUP

*The follower is the automatic signal (Auto Mode) that acts as a setpoint reference instead of a potentiometer. Typically, this signal comes from a SCADA or PLC system. The EC 2000 accepts 0-10V, 0-5V, 4-20mA, or 8-40mA signals.*

1. Follower Minimum
2. Follower Maximum
3. Follower Min Ref

*The minimum reference point. For example, a 4-20mA signal would set the minimum reference at 20% for 4mA at zero output (20% of 20mA is 4mA).*

4. Follower Max Ref
5. Follower Lost Level

*If the follower signal is lost or drops below a certain value due to an external failure, the user can program the EC 2000 to run at a specific speed. This parameter allows the user to set the level at which to activate this.*

6. FOLLOWER LOST STPT

*The setpoint at which the drive will run at if the follower hits the lost level setting.*

7. FOLLWR LOST FLAG

*Allows the user to choose which setpoint is enabled when the follower is lost. Choosing FLSET will refer to the value set in "FOLLOWER LOST STPT", while choosing LAST will take the last known setpoint and keep it there.*

- FLSET (Default)
- LAST

## 7.6 Menu F: ANALOG OUTPUTS

*The EC 2000 can output two different analog values based on a variety of statuses or setpoints. Note that for a 4-20mA or 8-40mA output, proper programming and a 500 Ohm resistor should be connected (See Figure 10).*

### 1. ANALOG 1 SELECT

*Select which status, range, or setpoint will have an analog output. For example, selecting DRIVE SPD will output an analog range (0-10V, 0-5V, 4-20mA, 8-40mA) based on the drive speed of the unit. For example, if you have set the control to output a 0-10V signal, your maximum speed setting is 1600 RPM, and your drive is running at 800 RPM, you will see an output of 5V. The same options are available for ANALOG 2 SELECT.*

- DRIVE SPD
- REFERENCE
- SETPOINT
- MTR AMPS
- CLUT AMPS
- BRAK AMPS
- FEEDBACK
- NONE

### 2. ANA 1 MIN SIGNAL

*If desiring to output a 4-20mA signal, set this value to 20% (20% of 20 is 4).*

3. ANA 1 MAX SIGNAL
4. ANA 1 MIN OUTPUT
5. ANA 1 MAX OUTPUT
6. ANALOG 2 SELECT
7. ANA 2 MIN SIGNAL
8. ANA 2 MAX SIGNAL
9. ANA 2 MIN OUTPUT
10. ANA 2 MAX OUTPT

## 7.7 Menu G: RELAY OUTPUT

### 1. F RELAY

*The F Relay corresponds to TB1- F1/F2/F3 (see Figure 7). Trip ON means the relay is normally deenergized, TRIP OFF means the relay is normally energized. TRIP ON and TRIP OFF have the same options.*

- NONE
- STATUS
  - RESTART (drive is in restart mode)
  - TRQ LIM (torque limit reached)
  - AT SETPNT (drive is at the setpoint)
  - FOL LOST (follower/automatic signal is lost)
  - FB LOST (speed feedback is lost)
  - SPD MODE (control is in speed mode)
  - TRQ MODE (control is in torque mode)
  - LOCAL (local mode is selected)
  - REMOTE (remote mode is selected)
  - MANUAL (manual mode is selected)
  - AUTO (auto mode is selected)
  - STOPPED (drive is stopped)
  - STOPPING drive is stopping)
  - ESTOP (estop contact is open)
  - RUN (drive is running)
  - RUN0 (drive is running, but there is no setpoint reference)
  - COASTING (drive is coasting)
  - JOGGING (drive is in jog mode)
  - FAULT (fault condition exists) (default)
- TRIP ON
  - MTR AMPS
  - CLUT AMPS
  - BRAK AMPS
  - SETPOINT
  - DEV+ (deviation above the setpoint)
  - DEV- (deviation below the setpoint)
  - SPEED
- TRIP OFF

### 2. RELAY1

*“RELAY1” – “RELAY4” are 12VDC logic output relays. See Figure 13.*

- 3. RELAY2
- 4. RELAY3
- 5. RELAY4



## 7.8 Menu H: UNITS

### 1. PROCESS UNITS

- RPM (default)
- PERCENT (used for torque mode)
- USER

*USER can be selected to display speed in something other than RPM. If chosen, Parameters 2-4 are opened for changing. If not, Parameter 1 is the only one that is open.*

### 2. USER UNITS

- RPM (revolutions per minute)
- RPS (revolutions per second)
- RPH (revolutions per hour)
- CPM (cycles per minute)
- CPS (cycles per second)
- CPH (cycles per hour)
- FPM (feet per minute)
- FPS (feet per second)
- FPH (feet per hour)
- SPM (strokes per minute)
- SPS (strokes per second)
- SPH (strokes per hour)
- XPM (x per minute)
- XPS (x per second)
- XPH (x per hour)

### 3. USER DECIMAL PNT

- 0 (no decimal)
- 1 (one decimal)
- 2 (two decimal)
- 3 (three decimal)

### 4. MAX USER VALUE

*Enter the number of user units that corresponds with the top process speed. For example, if the maximum press speed is 40 SPM, the MAX USER VALUE will be 40.0 (USER DECIMAL PNT will be 1).*

## 7.9 Menu J: POTENTIOMTR SETUP

*The setup menu if an external potentiometer is used for a setpoint reference.*

1. POT MINIMUM
2. POT MAXIMUM
3. POT MINIMUM REF
4. POT MAXIMUM REF

## 7.10 Menu K: SOURCE SELECT

*The setup menu for run, jog, presets, stop, start, and setpoint reference modes. "TERM" refers to devices attached to TB2, "KEYPAD" refers to operation from the Keypad. Remember, for external devices to be functional, the control must be in "REMOTE."*

1. AUTO/MAN SOURCE
  - TERM
  - KEYPAD

2. JOG SOURCE
  - TERM
  - KEYPAD

3. PLC AUTOSTART

*Allows the user to automatically start the control using the PLC start input terminals (TB2-28 and TB2-27) instead of the normal start terminal of TB2-23. By enabling and closing TB2-28 and TB2-27, the drive will automatically start upon power up. Note: the next parameter, "PLC RUN ENABLE", must be enabled as well.*

- ENABLE
- DISABLE (default)

4. PLC RUN ENABLE

*Allows the user to start or stop the drive based on the PLC start input terminals of TB2-28 and TB2-27.*

- ENABLE
- DISABLE (default)

## 5. PRESET SOURCE

*Allows the user to change between P1,P2,P3, and P4 on the keypad or through TB2 (see Figure 12). Note: the user changes the programmed presets in “Menu L: PROCESS”.*

- TERM
- KEYPAD

## 6. PRESET 1 SOURCE

*Allow the user to change what “P1” corresponds to. For example, “P1” can be set to “POT”, but by being in “LOCAL” and “MANUAL” mode, one can use P2, P2, and P3 from the keypad, but have the external potentiometer be enabled when “P1” is selected. “PULSE” corresponds to “TB2-17”, which is the Follower Pulse Pickup Input.*

- POT
- PULSE
- KEYPAD

## 7. MAN START SOURCE

*Allows the user to change how the control starts in “MANUAL” mode.*

- TERM
- KEYPAD

## 8. AUTO START SOURCE

*Allows the user to change how the control starts in “AUTO” mode.*

- SERIAL (for use with the ethernet IP add on)
- TERM (default)

## 9. AUTO SETPNT SRC

*Allows the user to change which setpoint reference is used.*

- SERIAL (for use with the ethernet IP add on)
- TERM (default)

## 10. STOP SOURCE

*Allows the user to change how to stop the control.*

- TERM (external stop button via TB2)
- TERM&KPD (external stop button and keypad)

## 7.11 Menu L: PROCESS

*Match minimum and maximum values to previously set values for minimum/maximum speed.*

1. MINIMUM PROCESS
2. MAXIMUM PROCESS
3. PRESET 1

*The setpoint for "P1".*

4. PRESET 2
5. PRESET 3
6. PRESET 4
7. JOG SETPOINT

*The setpoint for "JOG".*

## 7.12 Menu M: FAULT

1. CURRENT FAULT

*Allows the user to see the current fault (read only).*

2. PRIOR FAULT #1

*Allows the user to see the previous fault (read only).*

3. PRIOR FAULT #2

*Allows the user to see the second previous fault (read only).*

4. PRIOR FAULT #3

*Allows the user to see the third previous fault (read only).*

5. PRIOR FAULT #4

*Allows the user to see the fourth previous fault (read only).*

6. CLEAR FAULT

*If enabled, the control will clear the fault history.*

- ENABLE
- DISABLE (default)

#### 7. COIL OPEN FLT EN

*If enabled, the control will fault if there is no detected clutch current when the output voltage is applied.*

- ENABLE (default)
- DISABLE

#### 8. SPD FDBK FLT EN

*If enabled, the control will fault if there is no detected speed feedback signal (ie AC Tachometer Generator) when the control is trying to run at a set speed.*

- ENABLE (default)
- DISABLE

#### 9. FLT TEST DELAY

*The time between the when the fault is sensed and when the fault is indicated. (default: 10 sec).*

#### 10. KEYPAD FLT ENABLE

*If enabled, the control will fault if the keypad is disconnected.*

- ENABLE
- DISABLE (default)

#### 11. OVERSPD FLT EN

*If enabled, the control will fault if the speed set by parameter 7: OVERSPEED TRIP is reached.*

- ENABLE
- DISABLE (default)

#### 12. OVSPD FLT ACTION

- RUN (keeps running if an overspeed occurs)
- STOP (stops if an overspeed occurs)

#### 13. OVERSPEED TRIP

*The overspeed threshold setpoint.*

#### 14. UNDERSP FLT EN

*If enabled, the control will fault if the speed set by parameter 10: UNDERSPEED TRIP is reached.*

- ENABLE
- DISABLE (default)

#### 15. UNDSPD FLT ACTION

- RUN (keeps running if an overspeed occurs)
- STOP (stops if an overspeed occurs)

#### 16. UNDERSPEED TRIP

*The underspeed threshold setpoint.*

#### 17. SPEED TRIP TIME

*The amount of time allowable for the drive to be underspeed or overspeed.*

### 7.13 Menu N: AUTO RESTART

#### 1. RESTART POWER EN

*If enabled, the control will start and enter run mode right after power is applied.*

- ENABLE
- DISABLE (default)

#### 2. RESTART FAULT EN

*If enabled, the control will restart and enter run mode again after a fault.*

- ENABLE
- DISABLE (default)

#### 3. START DELAY- PWR

*The delay timer for auto start on power up (default: 10 sec)*

#### 4. START DELAY- FLT

*The delay timer for auto start after a fault (default: 10 sec).*

#### 5. MAX FAULT RETRYS

*The number of attempts allowed to restart after a fault.*

#### 6. RESTART TIMER

*The timer that determines when to clear the start attempts counter. For example, if the parameter was set to 60 sec, then the drive will have to run for 60 seconds before the start attempts are cleared.*

## **SECTION 8– TROUBLESHOOTING**

### **8.1 CONTROL WILL NOT “RUN” or “START”**

- Verify there is a normally closed button or jumper between TB2-22 and TB2-24.
- Double check your control modes such as “LOCAL” and “REMOTE”.
- Check the “MENU K: SOURCE SELECT” to make sure the proper start sources are programmed.

### **8.2 NO OUTPUT**

- Verify you have a setpoint programmed. The setpoint is the top right line of the display.
- Verify the control says “RUN” on the top left line of the keypad. If it says “RUN0”, then there is no setpoint reference.
- Disconnect the clutch coil leads from the EC 2000 (C1 and C2). Try to run the control with a setpoint and measure the DC voltage on the TB1-C1 and C2 (where the clutch coil leads were just connected). A high DC voltage should be obtained (over 90VDC). If not, contact Dynamatic for a replacement board. If there is a voltage on those terminals, measure the resistance of the clutch coil and compare to the value on the drive nameplate as it could be a defective clutch coil.
- Check if Jumpers 11 and 13 are in the “A” position on the circuit board.

### **8.3 DRIVE RUNS AT FULL SPEED**

- Measure the AC Tachometer Voltage on TB1-G1 and G2. One should see a voltage anywhere from 30VAC to 60VAC. If no voltage is measured, verify the control is in the proper feedback mode (speed, torque, etc) or replace the AC Tachometer Generator inside the drive. If an AC voltage is indeed measured, check the mechanical unit to see if there is a lockup between the drum and rotor. If your clutch rotates at full speed without the control being in “RUN” mode, then there is a lockup between the motor and the clutch.
- Verify the “TACH PULSES/REV” setting in MENU A is correct.

### **8.4 FUSES BLOW**

- Verify the EC 2000 is not underrated for the mechanical unit.
- Verify the right voltage is being applied at TB1-L1 and L2 (115VAC).
- Check to see if the clutch coil or brake coil is shorted.
- Verify incoming power is properly grounded.
- Disconnect the clutch and brake leads and try to power the control, if the fuses blow again, the EC 2000 needs to be replaced if incoming power is assumed to be proper.

### **8.5 CANNOT CHANGE ANY SETTINGS**

- Press F1, F2, and F3 on the keypad successively to unlock the keypad for access.
- Try resetting the EC 2000 by pressing “SW1” on the 15-1200-1 board or by removing all TB2 wires and placing a jumper between TB2-32 and TB2-29, then applying power.



## **8.6 FOLLOWER OR POTENTIOMETER SIGNAL NOT CHANGING SETPOINT**

- Verify the control is in the right mode. “AUTO” mode corresponds to an automatic follower signal. “REMOTE” mode corresponds to a signal that is external to the keypad.
- Check to see if any external connections into TB2 are improperly grounded. Recheck the wiring diagrams seen in Figures 8 through 13. If multiple signals are wired into TB2, try disconnecting signals one by one to eliminate possible issues.
- Verify the signals are present at TB2.

## **8.7 UNSTABLE SPEED**

- Adjust the PID loop parameters in Menu B.

## **8.8 SPEED ON DISPLAY IS DIFFERENT THAN ACTUAL SPEED**

- Verify that the Tach Pulses/REV setting in Menu A, Parameter 5 matches your mechanical unit. If unknown, try another setting and see if the displayed speed is closer to the actual speed.

## **8.9 SCREEN IS FROZEN AND/OR HAS UNFAMILIAR CONTENT**

- Try resetting the EC 2000 either by pushing “SW1” on the 15-1200-1 board or by removing all TB2 connections and placing a jumper between TB2-32 and TB2-29.

## **8.10 SCREEN IS LIT, BUT NOTHING IS DISPLAYED**

- Try resetting the EC 2000. If the issues persists, check to see if the keypad cable is inserted correctly or not damaged.

## **8.11 LOCAL/REMOTE KEY DOES NOT WORK**

- Check to see if “LOCAL/REM ENABLE” is enabled in Menu A, Parameter 12.

## **8.12 DRIVE SLOWER THAN DESIRED**

- Check to see if the clutch current limits are properly set in Menu A, Parameter 4.

## SECTION 9 – ETHERNET IP AND SERIAL COMMUNICATIONS

The latest major change to the EC 2000 is the implementation of serial communications on the EC 2000 control. The capabilities offered are allowing complete control of the EC 2000 thru its serial port along with data acquisition. The system can read and write all 105 of the parameters, read and monitor data from the control such as speed, clutch current, feedback, and communicate with any device that can transmit and receive data over a serial port.

### 9.1 DATA TRANSCIVING ORGANIZATION

*NOTE: ASCII(0) = 30, ASCII(1) = 31, ASCII(8) = 38*

- One Byte Hex Header Block
  - 7e “~” Command Follows
- One Byte ASCII Command
  - 30 “0” 30 = read, 31 = write
- Two Byte ASCII Menu Number
  - 3031 “01” Menu Number 1 = A, 2 = B, etc.
- Two Byte ASCII Item Number
  - 3038 “08” Menu Item Number
- Five Byte ASCII Parameter
  - 3030303031 “00001”

### 9.2 READ AND WRITE REQUESTS

- 7e30303130383030303031 (reads data in Menu A, Parameter 8)
- 7e30303130383031363630 (controller response indicating the speed is 1660 RPM)
- 7e31303130383031303030 (writes data “1000” to Menu A, Parameter 8).
- 7e31303130383031303030 (controller response indicating the speed is 1000 RPM)

### 9.3 NOTES

- When reading values, the 5 byte parameter values do not matter, but five bytes must be sent.
- When writing data, the five bytes are written to the parameter menu and item specified.
- When writing parameters the data is reread and returned.
- If the parameter doesn’t exist “20000” will be returned as the parameter. The highest normal value is “10000”.
- If something else goes wrong on reading, “20001” will be returned. On writing: “20002”.
- The controller will enforce parameter limits, so values higher or lower than the limits will not be allowed. However, the parameter will switch to the closest value possible and that value will be reported back and set.
- Additional items may be added.

## 9.4 DATA ACQUISITION

*Table 6: Ethernet IP/Serial Data Acquisition*

Item #1	Drive Speed in %	0 to 10000	
Item #2	Drive Speed In RPM	0 to Max RPM	
Item #3	Reference	0 to 10000	
Item #4	Set Point	0 to 10000	
Item #5	Motor Amps (XFMR)	0 to 250	
Item #6	Clutch Amps (LEM)	0 to 250	
Item #7	Brake Amps (LEM)	0 to 250	
Item #8	Analog Input Pot or 4-20 mA	0 to 250	
Item #9	Drive Status "tb_in_a"	16 bit	Jog; PLC RUN; PRESET 1/2; Auto/Man; E-Stop
Item #10	Drive Status "key_in_a"	16 bit	Keypad Button Status
Item #11	Drive Status "db_in_a"	16 bit	Program Status; Source Selects; etc.
Item #12	Drive Status "db_in_b"	16 bit	Faults; Presets; Status
Item #13	Drive Status "state_a"	16 bit	Drive State On Off; Local / Remote; Etc.
Item #14	Drive Status "state_b"	16 bit	Drive Commands: Stop Run Jog Fault, etc.
Item #15	Drive Status "state_c"	16 bit	Keypad Run & Stop Presets; Pot.
Item #16	Drive Status "misc_in_a"	16 bit	Fault Listing
Item #17	Software Version	5 byte	

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