

# Dynamatic

## Introduction

These instructions relate specifically to the following Model 4000 and 4050 controllers which are assembled for Speed Control with the Torque Limit modification.

### Model 4000, 4.3 Amp Controllers:

- 15-533-1014 Panel Mount
- 15-535-1014 Standard Enclosure
- 15-536-1014 Blank Cover

### Model 4050, 8 Amp Controllers:

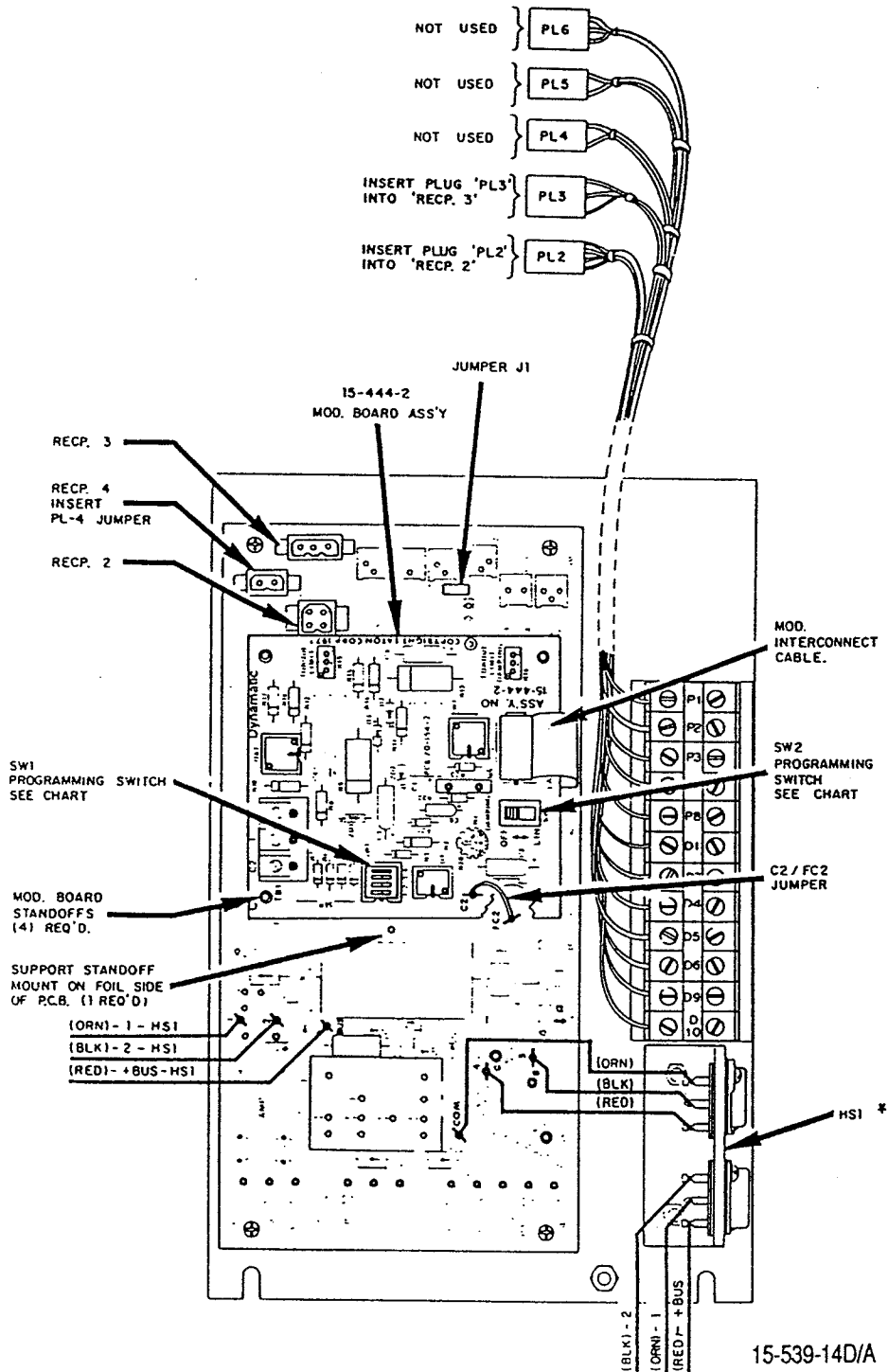
- 15-539-0014 Panel Mount
- 15-540-0014 Standard Enclosure

Connection diagram, schematic diagram, switch programming, plug wiring connection, adjustment procedure and recommended spare parts list for these specific assemblies are contained in this instruction sheet. Any differences between these two controllers are clearly noted.

Use instruction manual IM-130006-83XX with this instruction sheet for complete installation, operation and maintenance instructions.

**CAUTION:** Above ground electrical potentials can be hazardous. Always disconnect electrical power before working on the controller.

\* Heat sink assembly, HS1, and its wiring apply only to the Model 4050 controllers. These parts are not supplied on Model 4000 controllers. The parts are mounted on the 15-530-5 main 4000 board.



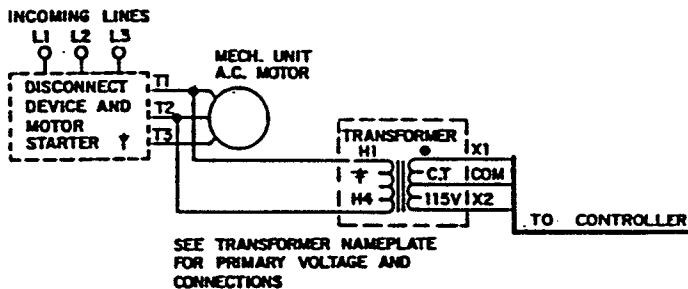
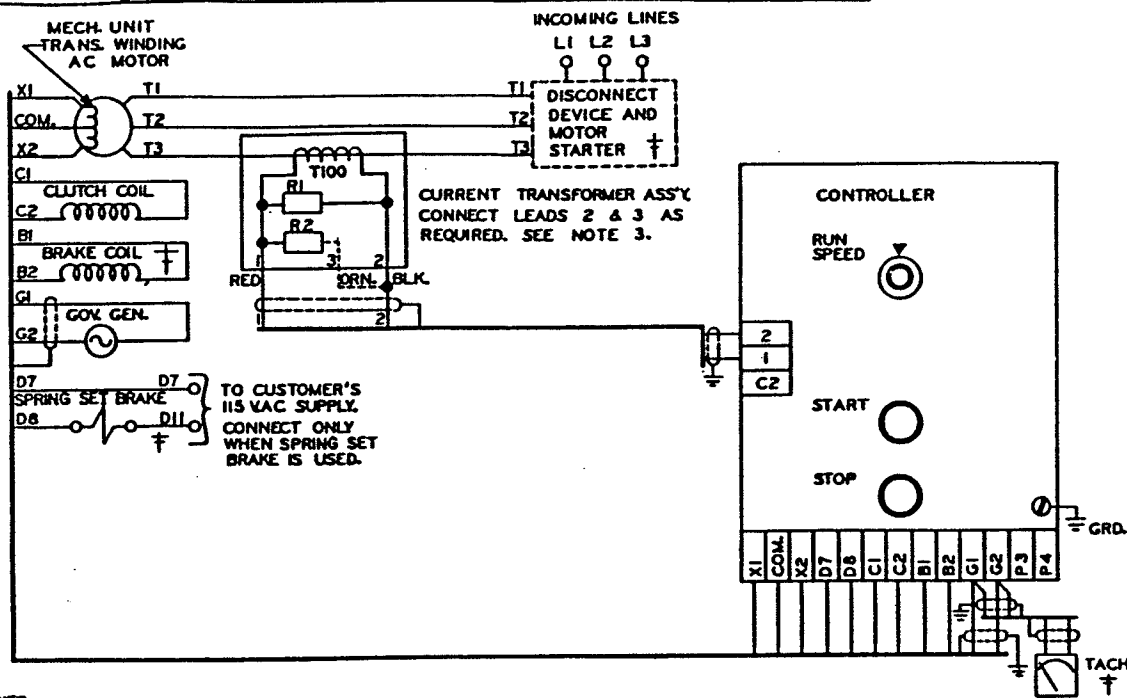
Model 4050 Controller Panel with Modification Board 15-444-2  
Torque Limit

15-539-14D/A



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# Connection Diagram for Standard Cast Enclosure 4000 Controller



**CONTROL PROGRAMMING**  
 15-530-5/6 P.C.B.  
 J1-POSITION-NORM

**15-444-2 P.C.B.**

SW1-PROGRAMMED FOR MOTOR CURRENTS OF 0 TO 3AMPS. FOR ALTERNATE MOTOR CURRENTS SEE TABLE 1.

SW2-POSITION - L IN TO ELIMINATE LINEAR ACCELERATION, PUT SW2 IN 'OFF' POSITION

TABLE 1

CURRENT TRANSFORMER ASSEMBLY	RATED MOTOR CURRENT	SW1 - CONTACTS				INPUT IMPEDANCE	TRANSFORMER LEAD CONNECTIONS
		1	2	3	4		
15-203-3	0 - 3A	x	x	x	x	27K	TAPE LEAD No. 3 (ORN) SEPARATELY
	3 - 4A	x	o	o	o	40K	
	4 - 5A	o	o	x	o	59K	
	5 - 10A	o	o	o	x	82K	CONNECT LEAD No. 3, (ORN) TO LEAD No. 2, (BLK)
	10 - 20A	x	x	x	x	27K	
	20 - 35A	x	o	o	o	40K	
	35 - 50A	o	o	x	o	59K	
50 - 70A	o	o	o	x	82K		
15-18-K	60 - 190A	x	x	x	x	27K	

x - INDICATES CLOSED CONTACT.  
 o - INDICATES OPEN CONTACT.

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**Note 1:**

This equipment must be installed in compliance with National Electrical code and all applicable state and local codes.

**Note 2:**

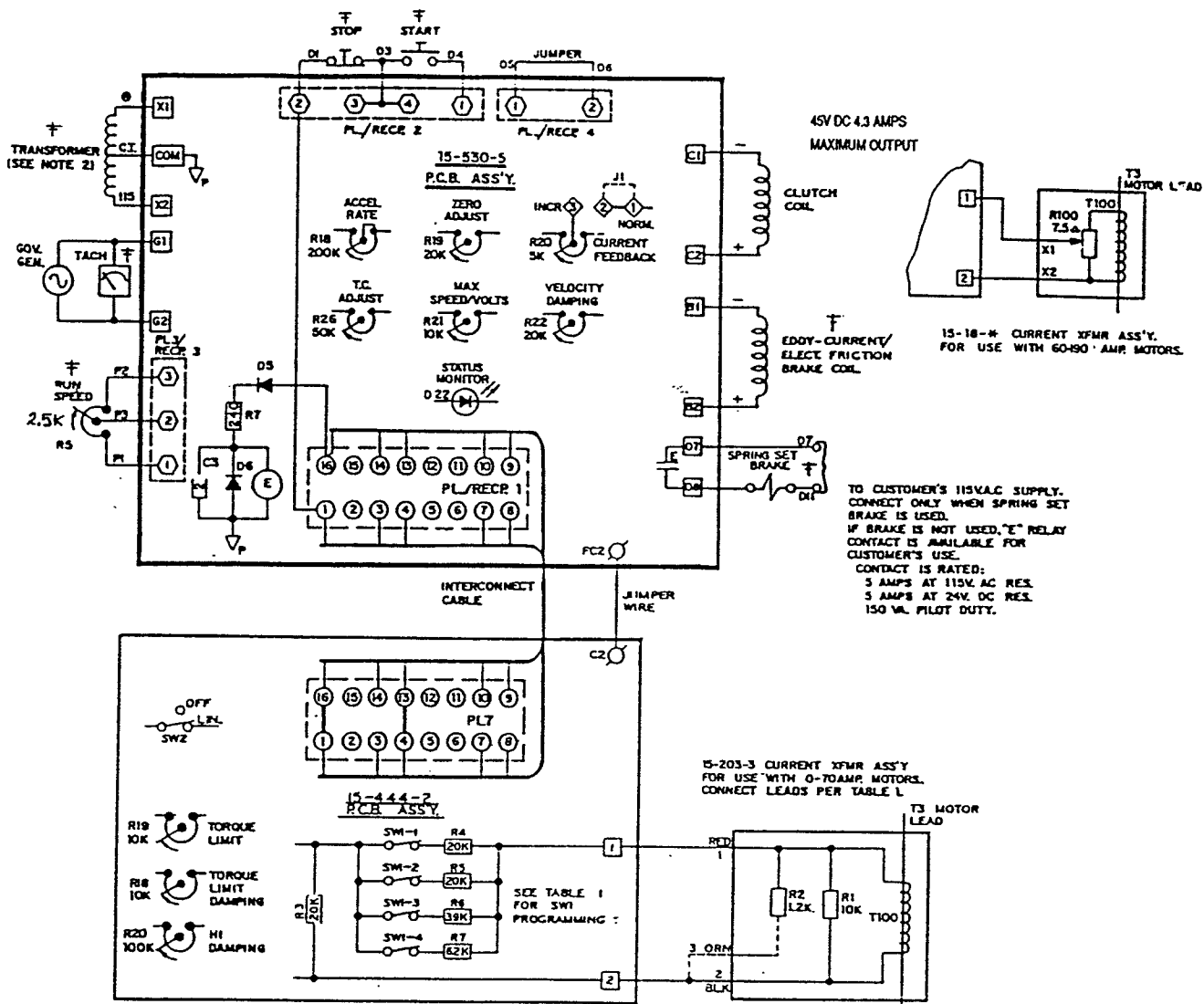
Transformer may be supplied as a winding in the ac motor or as a separate item. Standard connections to winding in mechanical unit and to separate transformer are both shown above.

**Note 3:**

Values shown are typical. See BOM for actual values.

- Programming and Mod. interconnect plug/recp.
- Operator's station and PCB interconnect plug/recp.
- Screw terminal
- ⤴ Signal common
- ⤴ Power common
- ‡ Items furnished only when specified

# Schematic Diagram for 4000 Controller

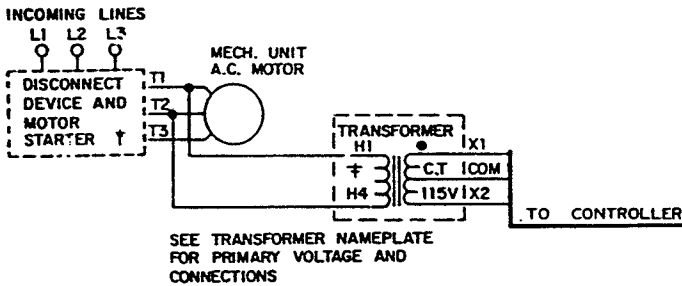
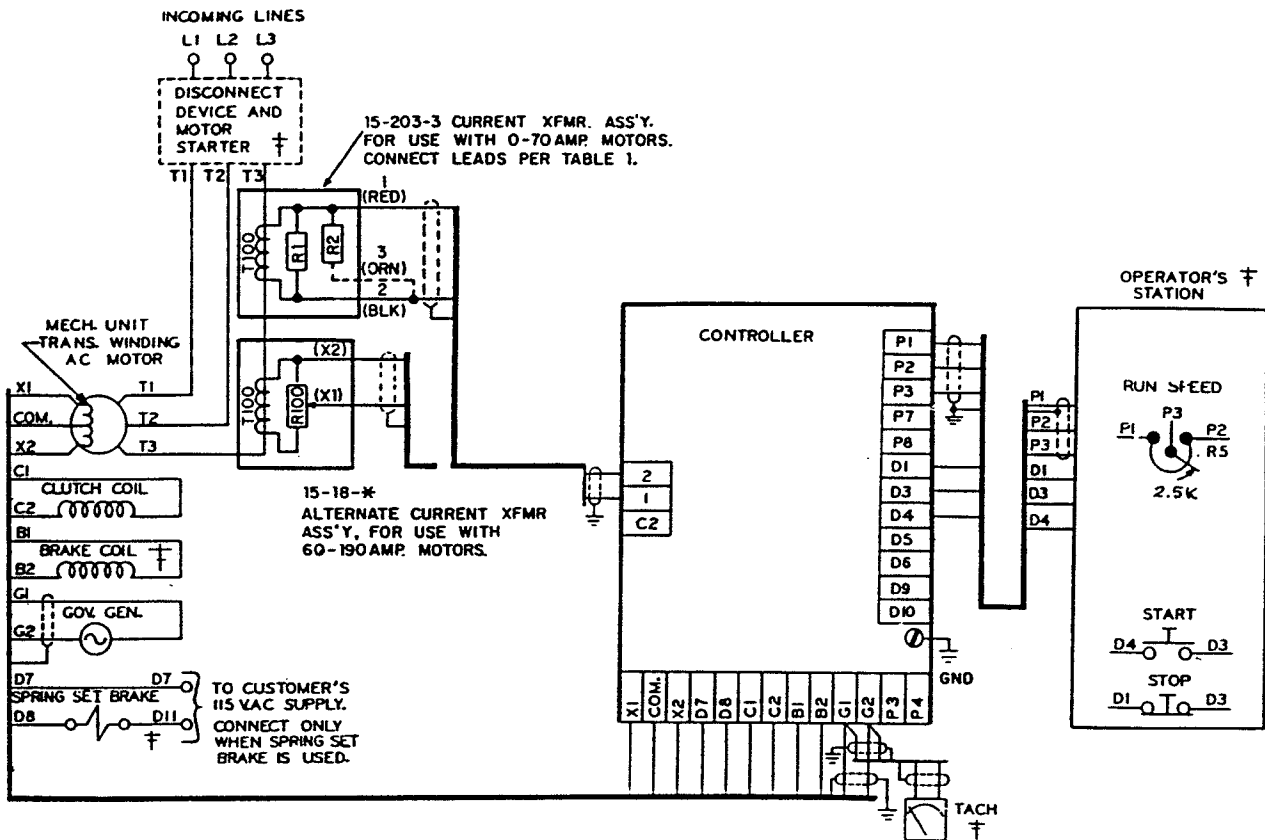


## Modification PCB Mounting

If you have purchased a complete controller this section may be passed over and you may proceed to General Description.

- Place the Main PCB in front of you with the long dimension in a horizontal position and the terminal strip to the left.
- Remove the DIP switch by pulling it straight out of the receptacle, RECP 1. Then, peel the adhesive-backed label off the other half of RECP 1.
- Insert the arrow-type locking head of the four nylon stand-offs supplied into the four 0.188" diameter holes in the main PCB and press in. The tabs will snap out to lock the stand-offs permanently in position.
- Hold the modification PCB assembly over the stand-offs with the ribbon connector toward you and insert the ribbon connector plug into RECP 1. Be careful to see that all 16 pins are started properly into the receptacle before pressing the plug in.
- Align the holes in the modification PCB assembly over the stand-offs and press over the tapered posts until the locking flanges snap out to lock the board in position.

# Connection Diagram for 4000 Panel Mount/Blank Cover and 4050 Controllers



SEE TRANSFORMER NAMEPLATE FOR PRIMARY VOLTAGE AND CONNECTIONS

**CONTROL PROGRAMING**

15-530-5/6 P.C.B.

J1-POSITION-NORM.

**15-444-2 P.C.B.:**

SW1-PROGRAMMED FOR MOTOR CURRENTS OF 0 TO 3AMPS. FOR ALTERNATE MOTOR CURRENTS SEE TABLE 1.

SW2-POSITION - LIN. TO ELIMINATE LINEAR ACCELERATION, PUT SW2 IN "OFF" POSITION

TABLE 1

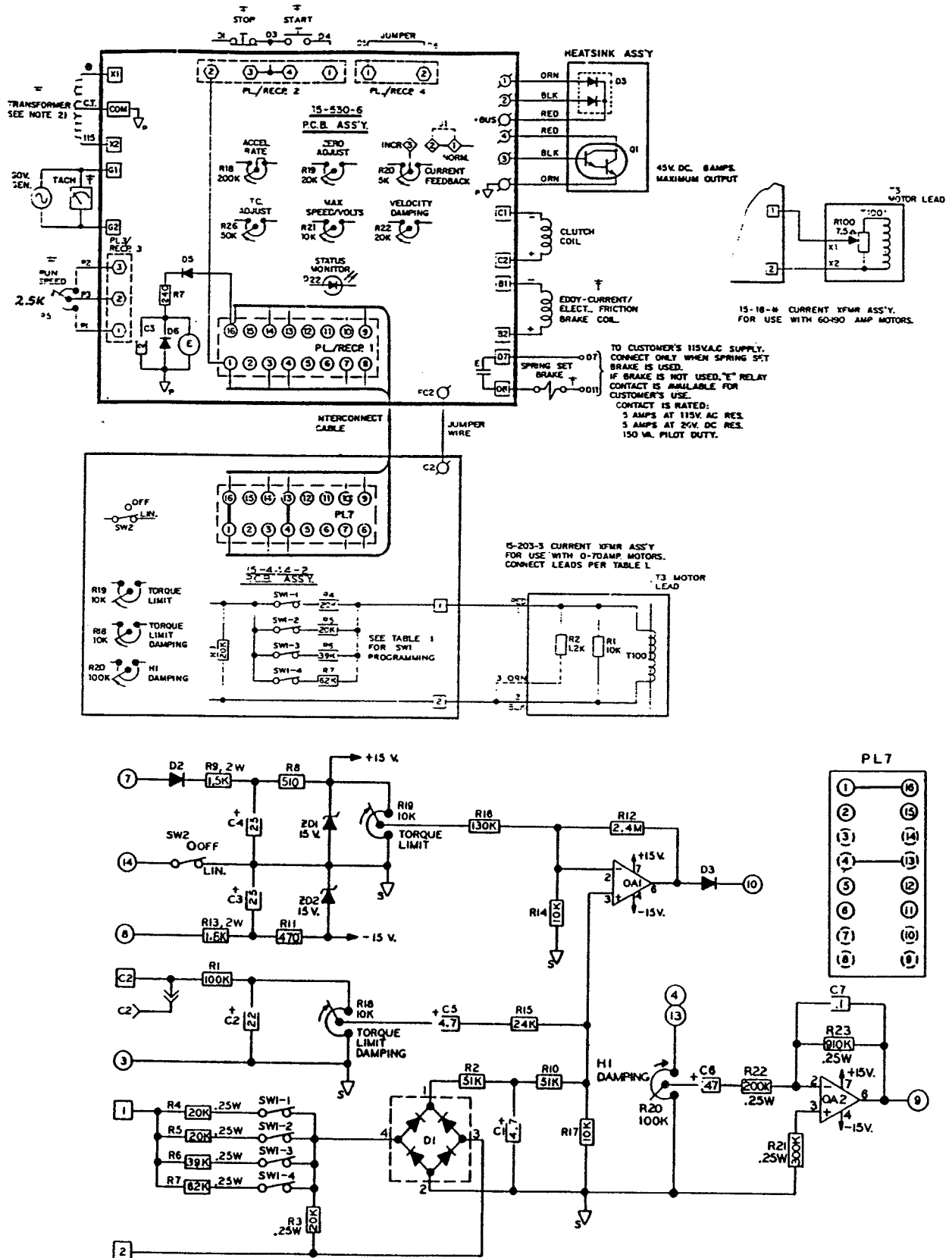
CURRENT TRANSFORMER ASSEMBLY	RATED MOTOR CURRENT	SW1 CONTACTS				INPUT IMPEDANCE	TRANSFORMER LEAD CONNECTIONS
		1	2	3	4		
15-203-3	0 - 3A	x	x	x	x	27K	TAPE LEAD No. 3 (ORN) SEPARATELY
	3 - 4A	x	o	o	o	40K	
	4 - 5A	o	o	x	o	59K	
	5 - 10A	o	o	o	x	82K	CONNECT LEAD No. 3, (ORN) TO LEAD No. 2, (BLK)
	10 - 20A	x	x	x	x	27K	
	20 - 35A	x	o	o	o	40K	
15-18-*	35 - 50A	o	o	x	o	59K	CONNECT LEAD No. 3, (ORN) TO LEAD No. 2, (BLK)
	50 - 70A	o	o	o	x	82K	
	60 - 190A	x	x	x	x	27K	

x - INDICATES CLOSED CONTACT.  
o - INDICATES OPEN CONTACT.

See page 2 for notes and description of symbols.

ED-56814/A

# Schematic Diagram for 4050 Controller



Torque Limit Modification PCB 15-444-2

## General Description

For some variable speed drive applications it is necessary to limit the torque available to a machine in order to prevent damage to the machine itself or its process. The Torque Limit modification provides an "override" feedback signal which indirectly limits the induction motor torque (current) to a preset maximum value. This limit can be used to prevent the motor breakover torque from being reached during a condition such as drive output shaft "lock-up" or the period when a large system inertia is being accelerated. The adjustment range is from 50 to 150% of rated motor torque.

## Preliminary Adjustments

Perform the following preliminary adjustments (with no power applied to the controller).

1. Operator Controls (supplied by customer unless specified)
  - a. Set the Run Speed potentiometer R5 to 0% (Full CCW).
  - b. Note location of Start and Stop pushbuttons.
2. Main PCB 15-530-5 or 15-530-6

The pots used are screwdriver adjust, single turn pots. Do not use a screwdriver with a blade width exceeding 1/8 inch.

- a. Set the Accel Rate potentiometer R18 to 100% (Full CW).
- b. Set the Zero Adjust potentiometer R19 to 0% (Full CCW).
- c. Set the Max Speed/Volts potentiometer R21 to 0% (Full CCW).
- d. Set the Velocity Damping potentiometer R22 as follows (see trimpot illustration):

Mechanical Unit Model Numbers		Velocity Damping Setting
AC/ACM/WACS/PD/VT Fractional Hp (FHP)	AS/AT/AE/VT/EC	
Fractional Hp	14/112/140	0%
181/182/184/186	18/21/132/160/180/210	50%
214/216/254/256	25/27/180/225/250/280	75%
280/320/360/440	320/360/440	75%

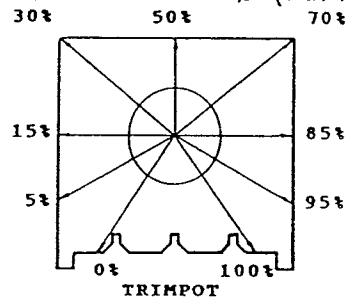
- e. Set the Time Constant (TC) Adjust potentiometer R26 as follows (see trimpot illustration):

Mechanical Unit Model Numbers		TC Adjust Setting
AC/ACM/WACS/PD/VT Fractional Hp (FHP)	AS/AT/AE/VT/EC	
FHP/181/182		0%
184/186/214	14/18/112/132/140/180	15%
216/254/256/280	21/160/210	30%
320/360/440	25/27/180/225/250/280	100%
	320/360/440	100%

\*Typical product number stamped on mechanical unit nameplate:

- 1) A1-100214-0053, specific mechanical model is AC-214.
- 2) B2-100210-0008, specific mechanical model is AS-21.

- f. Set the Current Feedback potentiometer R20 to 0% (Full CCW).



TRIMPOT ILLUSTRATION

3. Torque Limit Mod PCB 15-444-2
  - a. Set the Torque Limit Damping potentiometer R18 at 50% CW.
  - b. Set the Torque Limit potentiometer R19 at 50% CW (this setting is approximately 150% of rated motor torque).
  - c. Set HI Damping potentiometer R20 to 0% (Full CCW).
  - d. Check the drive nameplate for motor hp, voltage and current ratings. Set the Programming switches and jumpers as indicated in Table 1 on the connection diagram for your rated motor current.
4. Place a clamp-on ammeter on one lead of the ac motor.

## Adjustment Procedure

CAUTION: To avoid personal injury or dam-

age to the test equipment remove power before connecting or disconnecting test equipment.

The Model 4000 and 4050 controllers contain an LED status monitor which provides a visual means of setting the maximum speed and zero adjust. This LED set up along with an alternate method is given below.

1. Turn ON the power to the drive and start the ac motor.
2. Start the controller with the Start pushbutton. Note the location of the Stop pushbutton.
3. ZERO ADJUST R19 with LED monitor - Slowly increase the Zero Adjust Potentiometer R19 CW while monitoring the LED, D22. When controller output is turned ON or clutch voltage is turned ON (or the drive shaft begins to rotate), the LED should start flashing. Now just back off slowly until the flashing stops.

ZERO ADJUST R19, Alternate Method - This adjustment can be set to provide zero rpm or some minimum speed greater than zero, as required by the machine operating requirements.

- a. For zero rpm, turn the Zero Adjust potentiometer R19 CW until the output shaft just begins to turn. Then, back off on the control until the output shaft just stops turning. Stop and start the controller a few times to be sure the drive shaft does not rotate.
  - b. For a minimum speed greater than zero, the LED cannot be used. Turn the Zero Adjust potentiometer CW until the desired speed is attained. For an accurate setting use a tachometer or stroboscope.
4. MAX SPEED/VOLTS R21 - This adjustment can be set to limit drive speed to its rated maximum or to a slower

speed as required by the machine process. An LED status monitor has been provided on the main board to allow you to set the maximum speed without the use of a tachometer, stroboscope or voltmeter. However, an alternate method of setup using this equipment is given to set the maximum speed point. The tachometer or stroboscope will give an accurate rpm setting while the use of a voltmeter will give only an approximate speed setting. This is because the voltmeter is measuring generator voltage instead of actual output rpm.

MAX SPEED/VOLTS R21 with LED monitor  
Set the Run Speed potentiometer R5 at 100% (Full CW). The drive should be loaded for best results. Set the Max Speed/Volts potentiometer R21 at 100% (Full CW). CAUTION: drive will go to top speed. The LED should be out when the drive is at top speed. With the LED out, slowly turn the Max Speed/Volts potentiometer R21 CCW until the LED lights. This indicates that the speed of the drive is in the regulating range of the controller. The clutch voltage should drop below 45V. This will be approximately the maximum rated speed of the drive. The maximum speed point setting will vary with different mechanical units.

There are two other conditions for which the LED will be out besides the drive being set for zero speed, or running wide open above the regulating range. These are whenever the "E" relay is deenergized (the drive is stopped), or due to a wiring error, ground or some malfunction of the controller itself.

MAX SPEED/VOLTS R21, Alternate Methods -

- a. To set maximum rated speed with a tach or stroboscope: turn the Run Speed potentiometer R5 to 100% (Full CW). Allow the drive to accelerate to full speed,

turn the Max Speed/Volts pot CW until the rated speed indicated is the same as the speed listed on the nameplate of the mechanical unit.

- b. To set approximate maximum speed with a voltmeter connect a voltmeter (60 Vac scale) across terminals G1 and G2. Turn the Run Speed pot R5 to 100% (Full CW). Allow the drive to accelerate to full speed. With the drive at full speed, turn the Max Speed/Volts pot CW until the meter reading ceases to rise. Back off the adjustment (CCW) until the meter reading just begins to drop. This is the point of maximum speed.
  - c. To set a maximum speed that is less than rated maximum speed requires the use of a tachometer or stroboscope indicator. This cannot be accomplished with the LED status monitor. Turn the Run Speed potentiometer to 100% (Full CW). Allow the drive to accelerate to full speed. With the drive at full speed, slowly increase Max Speed/Volts potentiometer setting CW until the desired speed is indicated.
5. Since there may be some interaction between the Zero Adjust and the Max Speed/Volts, particularly if the minimum speed is other than zero, repeat steps 3 and 4 until the desired speeds are obtained for both the zero and max positions of the Run Speed pot.
  6. TIME CONSTANT (TC) ADJUST R26 - The TC Adjust is used to set current feedback by using coil voltage and a variable RC combination to simulate the different coil time constants of various size drives. A trimpot illustration is provided to facilitate the setting of this control. Sufficient range has been provided for drive sizes from fractional through 20 hp for the 4000 controller and up

to 125 hp for the 4050 controller. Set your TC control appropriately for your individual drive size as shown in Preliminary Adjustments. Settings are not critical and so may be "tuned" for each drive. High inertia applications can benefit from a higher than normal setting.

7. CURRENT FEEDBACK R20\* - Normal operation will not require use of this potentiometer. Certain applications are best met with a negative current feedback response which is slower in settling and less likely to overshoot at low rpm's. There are some low inertia, light load, linear acceleration applications that may also benefit from improved low end linearity with current feedback damping. If you have one of these applications, remove Jumper J1 from the Normal position and place it in the Increased position. Adjust Current Feedback R20 as required to obtain desired drive response.

\*See basic 4000/4050 manual for a more detailed description of this adjustment.

8. ACCEL RATE R18 - The purpose of Linear Acceleration is to slow down drive response to an increase in command. Without Linear Accel control, the drive will respond to operator speed adjustments very quickly, limited only by the torque capacity of the drive. With the Linear Accel circuit, the output of the controller is linear with respect to time. This circuit is adjustable from 3 to 90 seconds. When set at the slowest acceleration rate, the drive will take 90 seconds to accelerate from zero to rated speed, following a linear ramp. When less than rated speed is set, this time required to reach top speed is proportionally less.

The Linear Acceleration circuit may be activated or deactivated by setting the programming switches as indicated on the programming chart on the connection diagram.



To set the Accel Rate: stop the controller with the Stop pushbutton. Turn the Run Speed potentiometer to 100% (Full CW). With the drive at a complete stop, push the Start pushbutton, and time the interval required for the drive to accelerate from zero to full speed. Adjust the Accel Rate potentiometer R18 CCW for a slower accel rate, or CW for a faster accel rate.

NOTE:

Only the Acceleration Rate is adjustable. The response of the controller to a reduced command is instantaneous. The response of the drive to a decrease in command is a function of drive system load and inertia.

9. VELOCITY DAMPING R22\* - This potentiometer is used to match the controller response to the drive response (drive response is a function of the clutch coil time constant and system inertia). The proper setting for this adjustment depends upon the drive size and total load inertia.

See Preliminary Adjustments. If instability (speed control becomes erratic) occurs at any setting increase (turn CW) slightly until the speed becomes stable.

\*See basic 4000/4050 manual for a more detailed description of this adjustment.

10. HI DAMPING R20 - This pot is located on the Torque Limit modification board. It is used for applications, such as stamping presses, where the load inertia is greater than 5 to 10 times the drive inertia. In these cases turn the Velocity Damping pot R22 on the main board to zero (Full CCW). Now adjust the HI Damping pot R20 on the modification board until the proper response is achieved (neither oscillatory nor sluggish). If however, maximum CW is attained and the system remains oscillatory,

further damping may be obtained from R22 on the main board. The main PCB Velocity Damping pot R22 has about 75% of the damping range that the HI Damping pot R20 has on the modification board. However, they may be used in combination on high inertia applications where increased damping is required.

11. Torque Limit PCB 15-444-2 (Normal Load)

- a. Apply a normal load on the mechanical unit driven by the clutch.
- b. Monitor the motor current. Since current is proportional to torque, check your nameplate for the rated motor current to determine the desired torque limit. Example - if your drive is rated at 10 amps, and you want to limit the torque (150% of 10 amperes is 15 amperes), start the drive and note the maximum current on the ac ammeter during acceleration. If the current is less than 150% of rated motor torque, increase the Torque Limit setting R19 CW. If the current rating is too high, decrease the Torque Limit setting CCW. Stop the unit and repeat the Start Up. Check on the ac ammeter during acceleration. If the motor current during acceleration never reaches 150% of rated motor current, increase the load and repeat current monitoring.
- c. When the clutch is being torque limited, decrease the setting of the Torque Damping potentiometer R18 CCW until instability (hunting) develops. Then increase the setting CW until stability is attained. Recheck the Torque Limit setting as described in step 10b and readjust if necessary.

12. Torque Limit PCB 15-444-2 (If normal load cannot be applied)

- a. Apply a load to the motor and note the motor current (IR) (a load of 50% of full load or more is desirable).
- b. Check the motor nameplate for full load current (IF) of the motor.
- c. Connect a voltmeter across terminals 1 and 2 and measure the voltage (VR) at a motor current of IR.
- d. Calculate what the voltage would be across terminals 1 and 2 at full load:

$$VF = \frac{(VR) \times (IF)}{IR}$$

VF = Current x fmr output voltage at full load

VR = Current x fmr output voltage at reduced load

IF = Motor current at full load

IR = Motor current at reduced load

- e. Disconnect the leads to terminals 1 and 2 on 15-444-2 Modification board and connect a variac.
- f. Adjust the variac for VF and adjust the Torque Limit pot until the output speed of the drive just begins to decrease. Increasing the output of the variac slightly will cause the speed of the drive to decrease sharply. When making this adjustment DO NOT exceed 75 volts out of the variac.
- g) Torque Limit Damping - Follow the procedure outlined in step 11c. Load must be applied and the circuit must be limiting torque to make this adjustment.

Renewal Parts List for 4000 and 4050 Controllers with Torque Limit

Qty	Part Number	Description	Legend
MODEL 4000 CONTROLLERS			
<hr/>			
15-530-0005 MAIN PCB ASSEMBLY**			
1	27-123-0001	Mini-jumper	J1
* 2	32-018-4091	Fuse, 4 Amp, 250 V	FU1,2
* 1	53-398-0001	Relay, 4pdt, plug-in	E
15-533-1014 PANEL MOUNT			
1	15-530-0005	Main PCB (Refer to PCB parts list above.)	
* 1	15-444-0002	Torque Limit PCB assembly	
4	36-298-0010	Circuit board support	
15-535-1014 STANDARD ENCLOSURE			
1	15-530-0005	Main PCB (Refer to PCB parts list above.)	
* 1	15-444-0002	Torque Limit PCB assembly	
1	15-531-1001	Base assembly	
1	15-532-0001	Cover assembly (Basic)	
1	12-007-0003	Cover, 1 knob	
* 1	15-529-0001	Pushbutton assembly	PB1,2
* 1	15-529-0003	Speed pot	R5
4	36-298-0010	Circuit board support	
15-536-1014 BLANK COVER			
1	15-530-0005	Main PCB (Refer to PCB parts list above.)	
* 1	15-444-0002	Torque Limit PCB assembly	
1	15-531-1001	Base assembly	
1	15-532-0000	Cover assembly (blank)	
4	36-298-0010	Circuit board support	

MODEL 4050 CONTROLLERS

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15-530-0006 MAIN PCB ASSEMBLY**			
1	27-123-0001	Mini-jumper	J1
* 2	32-028-0100	Fuse, 10 Amp, 250 V	FU1,2
* 1	53-398-0001	Relay, 4pdt, plug-in	E
15-539-0014 PANEL MOUNT			
1	15-530-0006	Main PCB (Refer to PCB parts list above.)	
* 1	15-444-0002	Torque Limit PCB assembly	
1	15-529-0019	Heat sink assembly, incl. Q1 & D3	
4	36-298-0010	Circuit board support	
15-540-0014 STANDARD ENCLOSURE			
1	15-539-0014	Panel assembly (Refer to Panel Mount parts list above.)	

\* denotes minimum spare parts.

\*\* denotes suggested spares when downtime is critical.