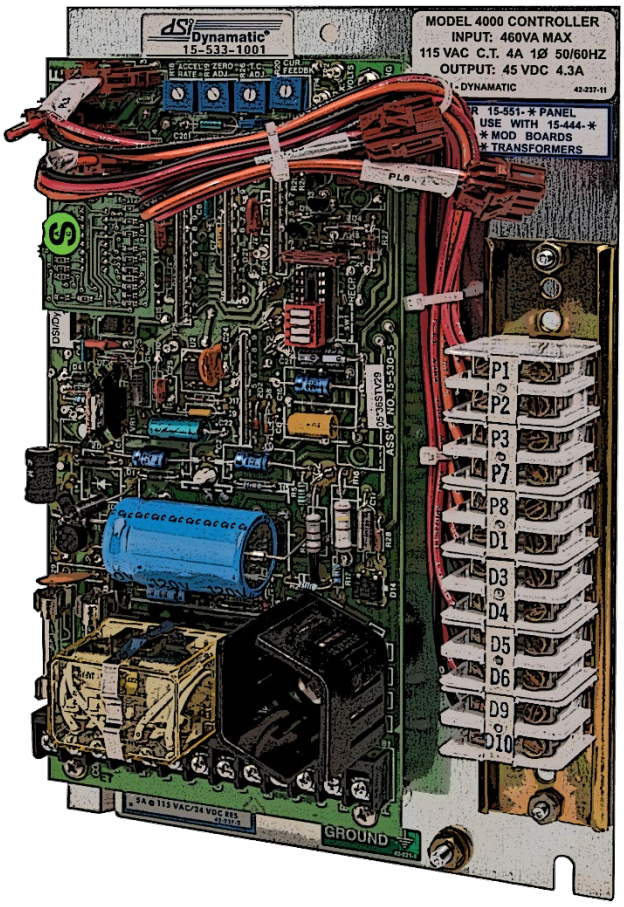
Dynamatic®
DRIVE SOURCE INTERNATIONAL, INC.

Model 4000 and 4050 Controllers

Instruction Manual

Part Number IM-130006-9801



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Section 1

General Information

Introduction

This instruction manual contains the necessary information required for normal installation, operation and maintenance of the Model 4000 and 4050 Eddy Current Controllers. Please make it available to all maintenance and operating personnel.

The Model 4000 and 4050 Eddy Current Controllers are high quality performance controllers capable of operating Dynamatic Ajusto-Spede drives. The 4000 controller can be used with the Fractional Drives (.5 HP thru 1.5 HP), AS-14 thru AS-25 (.75 HP thru 20 HP) and the AT-140 thru AT-280 (1 HP thru 50 HP) The 4050 Controller can be used with the fractional Drives (.5 HP thru 1.5 HP), AS-14 thru AS-27 (.75 HP thru 40 HP), AT-140 thru AT-440 (1 HP thru 200 HP) and the AS-705 Air Cooled Brake

The Model 4000 and 4050 controllers are available in panel mount configurations designed for use in a customer's enclosure or they may be supplied in their own enclosure. Operator's elements are provided by Dynamatic at the customer's request. Wiring of these elements is the customer's responsibility.

The controllers' flexible design allows them to be programmed by use of a Dip switch for wither speed or torque control. They can be used with any combination of the basic controller and one of the modifications, providing the interconnection is completed according to the schematic and connection diagrams provided. Any combination of modifications or use of a modification not designed for the controllers is not authorized.

Instructions provided in this manual are arranged in their normal order of use. Beginning with general information, the instructions proceed from receiving, handling and storage, through installation, start-up and adjustments to maintenance and trouble shooting. Written as a guide, these instructions do not cover or describe each detail or modification in the controller. Use this instruction manual in conjunction with any specific schematic, prints or instructions supplied with your controller. Certified drawings shall take precedence over printed instruction material if a difference in content occurs.

While every effort has been made to provide a complete and accurate manual, there is no substitute for trained, qualified personnel to handle unusual situations. If any questions arise regarding the operation or maintenance of this controller, please refer them immediately to Dynamatic Customer Service at 262-554-7977.

Safety

With any electronic or electrical rotating equipment, potential safety hazards are present and require safeguards for proper use. This equipment must be installed properly, using safe procedures that meet the requirements of all applicable safety codes. The wiring must be in accordance with the National Electrical Code and all other local codes and regulations. Shaft guards, as well as protection for operating and maintenance personnel against high voltage and moving machine parts, is essential. Refer to OSHA rules and regulations, paragraph 1910.219, for guards on mechanical power transmission apparatus. Pleases heed these safety instructions.

DANGER, WARNING, CAUTION and special *INSTRUCTION* labels are applied to the equipment to remind you of the hazards the exist. Know your equipment before handling or working on it.

DANGER… is used where an immediate hazard exists. Failure to follow instructions could be fatal

WARING… means a possibility of injury to personnel, but not as severe as a Danger Warning.

CAUTION… is used to warn of potential hazards and unsafe practices.

INSTRUCTION… labels and notes are used when there is a need for special instructions related to safety, proper operation or maintenance.

Training

Training programs are an essential part of safe and correct operation. Training provides the know-how necessary to obtain top performance from your equipment. Dynamatic recognizes this fact and conducts training schools to educate your plant personnel in safe maintenance and operating procedures. There is a nominal charge for this service. Contact customer service at 262-554-7977 to set up a date.

Receiving and Damage Claims

The Model 4000 and 4050 controllers have been operated and tested at the factory prior to shipment. Specific test procedures are followed to assure the quality of your controller. Carrier approved packing methods assure safe shipment to your plant. Shipment is made F.O.B. from our factory, with the carrier assuming responsibility for your unit. Therefore, it is essential that you carefully inspect the shipment upon delivery to ensure that no damage or lost items have occurred in transit, Loss or damage is covered by the carrier, not by the product warranty. File a claim immediately with the carrier if any damage or loss is found. Should you require assistance in settling your claim with the carrier, contact Dynamatic. You will need the unit model number, serial number and your purchase order number for identification.

Warranty

Your new Model 4000 or 4050 controller is covered by a one-year warranty against any manufacturing defect in either material or workmanship. Should the controller fail with in the one-year warranty period, contact Dynamatic for a return material authorization (RMA) form. Fill in all required information on the form and return the form with the controller to our Repair Service Department in Sturtevant, Wisconsin for warranty repair or exchange. Your controller will either be repaired or replaced with a preciously repaired exchange controller. Freight charges both ways are your responsibility.

Handling

Then Model 4000 and 4050 controllers weigh only a few pounds and can be hand carried safely. Do not drop or subject the controller to shock or vibration. Do not stack heavy material on the controller. The printed circuit boards and other components may be mounted on an open panel making the controller very accessible to damage

Storage

Store the controller in a clean dry location with a non-corrosive atmosphere protected from sudden temperature changes, high levels of moisture, shock and vibration. Electrical components are delicate and easily damaged; provide adequate protection for them.

Ambient temperature should not exceed 25°C (77°F) on a continuous basis or 40°C (104°F) on an intermittent basis. The minimum temperature must remain above freezing and the dew point of ambient air. High temperature, corrosive atmosphere and moisture are detrimental to controller equipment.

Long Term Storage

The manufacturer's warranty covers repair or replacement of defective materials and rectification of faulty workmanship. It does not cover damage and deterioration that transpire during the storage period.

Some examples of deterioration due to storage are:

1. Corrosion of terminals and contacts
2. Breakdown of electrolytic capacitors
3. Moisture absorption within insulation and composition resistors.

These are not manufacturer's defects and will not be covered by the warranty policy. Refer questions to the Field Service Department in Sturtevant Wisconsin.

Removal from Storage

Before returning the controller to service after long time storage, it will be necessary to carefully inspect it for any signs of damage or deterioration. Correct any deficiency. Carefully inspect the controller for signs of moisture, especially with respect to transformers and composition resistors. If moist, the transformer will require thorough drying. Damp resistors will change impedance and affect performance of the controller; they should be replaced.

Corrosion is an important factor. Inspect terminals, plugs, sockets and contacts for signs of corrosion. If detected, cleaning will be necessary.

Before applying power, make sure all connections are tight.

These procedures are given only as recommendations offered to aid our customers in preserving stored equipment. We cannot guarantee stored equipment, even if all suggestions are followed; damage or deterioration may still occur. Equipment storage is not covered by warranty.

Numbering System

The numbering system for electrical component and assembly part numbers contains some useful data which could be of value to the technician working with or trouble shooting the controller. The number is twelve digits, arranged in a two-six-four-digit sequence with the groups separated by dashes. As an example, one printed circuit board part number is 15-000530-0006. This twelve-digit number is the complete number as recognized by the computer. Frequently, the number is abbreviated by dropping zeros, i.e.., 15-530-6. The number printed on the board and in the technical instruction material is the abbreviated form. However, the actual bill of material and order paper work for the board would use the complete number.

The first two digits of the part number identifies the parts category. As in the precious example, the 15 designates an assembly. The following table lists the complete category listing and assigned numbers used as the first two digits of the part number.

Category Number and Descriptions

14	Alarms	35	Generators	56	Shock Mountings
15	Assemblies	36	Hardware	57	Solenoids
16	Bearings	37	Instruments	58	Switches
17	Blocks	38	Insulators and Insulations	59	Servo mechanisms
18	Blowers	39	Lights & Fixtures	60	Terminals
19	Brackets	40	Motors	61	Thermal devices (excluding motor starter heaters)
20	Cables	41	Motor starters & Controls	62	Timers
21	Cams & Gears, cam Switch assemblies	42	Nameplates	63	Transducers
22	Cans	43	Operating mechanism (breakers)	64	Transformers, chokes
23	Capacitors	44	Operator panels	65	Tube sockets
24	Chassis	45	Panels	66	Valves
25	Circuit Breakers	46	Phase Shifters	67	Wires
26	Coils & Coil Assemblies	47	Photoelectrical	68	Wiring Ducts
27	Connectors, plugs, sockets	48	Plates	69	Tubes
28	Control units & parts	49	Potentiometers	70	Insulated Mounting Boards
29	Counters	50	Power Converters	71	
30	Dial plates & knobs	51	Reactors	72	Master bills of material
31	Enclosures	52	Regulators	73	Engineering Data Sheets
32	Fuses & Fuses Holders	53	Relays & Contactors	74	
33	Filters (radio interference)	54	Resistors	75	Reworked Assemblies
34	Gaskets & Gasket Materials	55	Semi-conductors		

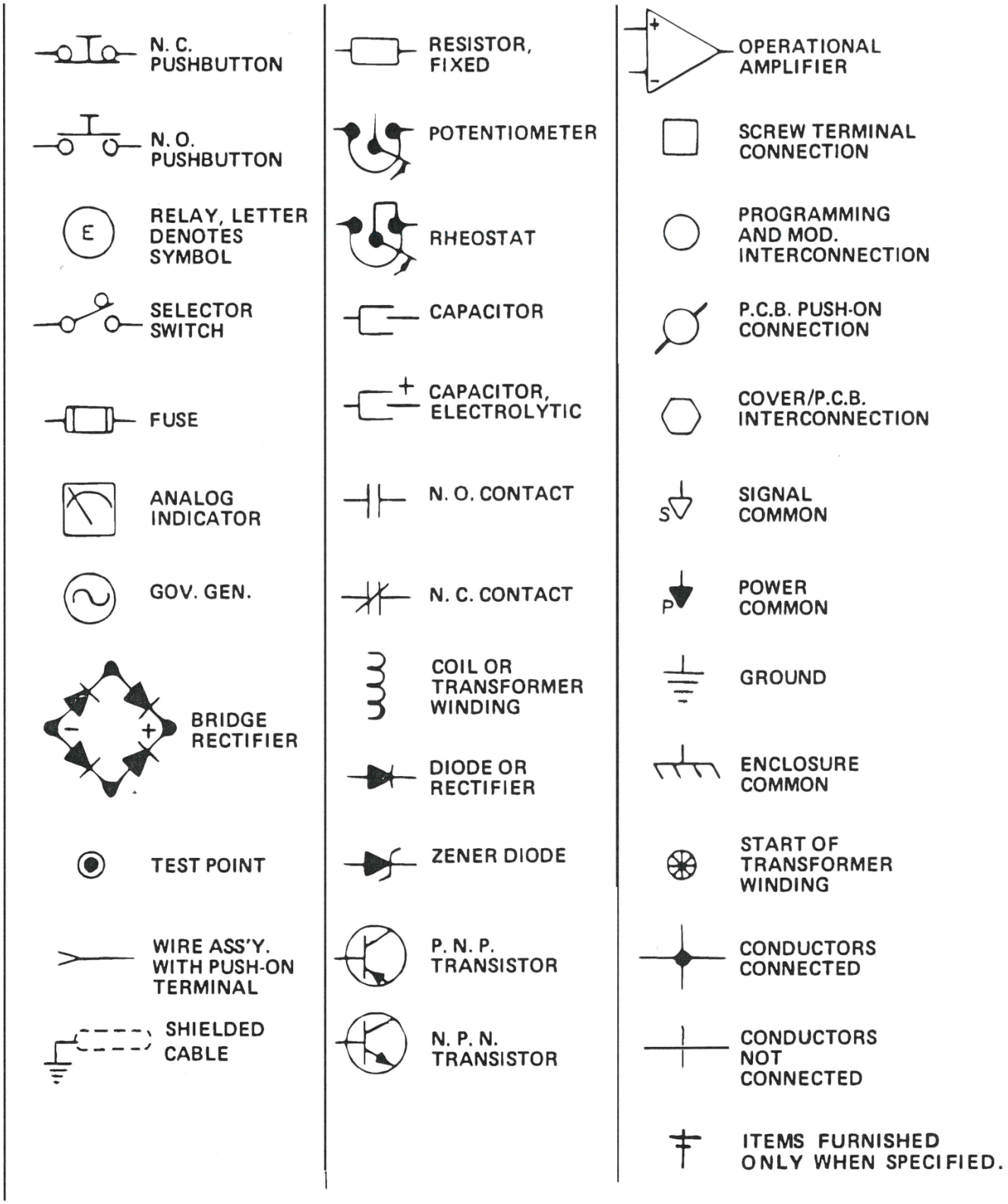
The middle six digits describe a basic type of part, such as physical or electrical characteristics of a group or family of parts. As an example, a resistor family of ½ watt carbon resistors has the number 000045. The part number of on specific resistor in this family is 54-000045-0102.

Category	Part Name	Parameter Described
23	Capacitor	Capacitance
32	Fuses	Ampere Rating
49	Potentiometer	Resistance
54	Resistors	Resistance
55	Power diodes & SCR’s	Peak Reverse Voltage

The last four digits describe a specific part within the family and may be assigned in numerical sequence or may describe the specific part value. The following table lists those part categories where the last four digits have a significant meaning to the technician.

Last 4 Digits	Numeric Value
2593	.025
2592	.25
2591	2.5
0250	25
0251	250
0252	2500
0253	25000

Symbols used in Illustrations



Section 2

4000 and 4050 Controller Description

The Model 4000 and 4050 controllers are available as a panel mount or in an enclosure. They are solid state eddy-current controllers employing an integrated circuit design with a transistorized out-put. The 4050 is designed to provide a higher current output, 8 amps at 45 volts, so it can be used on AC drives up through 200 HP. The output of the 4000 controller is 0 to 45 Vdc rated at 0 to 4.3 amps and can be used on drives up to 20 HP. Descriptions of other features available on these controllers follow. The adjustable time constant circuit matches the controller to the time constant of the mechanical unit. An LED Set-up Indicator circuit enables the maximum speed and minimum bias to be set visually by means of an "onboard" light emitting diode, in most cases eliminating the need for a meter. Because the requirements for damping increase with higher horsepower drives and higher inertia, the velocity damping ranges on the Model 4000 and 4050 controllers have been extended to approximately twice that of the original Model 4000 controller. Current feedback damping is available for customers who require this type of response. The output of each controller is short circuit proof, which includes the following conditions:

1. Shorting of terminal C1 to C2
2. Shorting of terminal B1 to B2
3. Shorting of terminals C1 or C2 to earth ground
4. Shorting of terminals B1 or B2 to earth ground

If any of these events occur, the controller shall be completely self-protecting without damage to any of its internal components. Input power for the controller is supplied from a 115 Vac transformer winding in the drive's ac motor. A separately mounted 115 Vac transformer is Also available if required. Pushbutton operation by a Run relay is standard; also, the Run relay has an extra set of NO (Normally Open) contacts available for customer's use.

Numerous safety features protect the Model 4000 and 4050 controllers and associated equipment from possible damage due to drive overloads, loss of power, transients and other electrical or mechanical failures. All trim potentiometers are sealed.

Specifications

Input Voltage	115 Vac, CT. +20%, -10%, 50/60 Hz
Input Current	
Model 4000	4 Aac rms
Model 4050	7 Aac rms
Output Voltage	45 Vdc nominal at either terminals C1 or C2 (clutch) or B1 and B2 (brake)
Output Current	
Model 4000	4.3 Adc continuous
Model 4050	8 Adc continuous
Extra Run Relay Contact (NO)	115 Vac, or 24 Vdc, 5A resistive, 150 V. pilot duty

Load Regulation	-0.5% of maximum rated speed for no load to 100% load change
Line Regulation	±0.1% of rated speed for ±10% input line voltage change
Thermal Drift	±0.05% of rated speed per degree C. (or ±0.03% per degree F.)
Linearity	±2% of maximum rate speed, reference voltage to speed
Min Regulated Speed	50 rpm
Zero Adjust Range	0 to 15% of rated speed
Linear Accel Range	3 to 80 seconds
Fuses FU1, FU2	
Model 4000	4 A, 250 Vac
Model 4050	10 A, 250 Vac
Ambient	0°- 40°C. (32°- 104°F.) Cast enclosure Model 4000 only 0°- 65° (32° - 148° F.) Panel mount Model 4050
Mounting	
Model 4000	NEMA 13 or open panel
Model 4050	NEMA 13 or open panel

Basic Controller Assembly

The main PCB (15-530-5/6) is mounted to the panel by four standoffs. A support standoff is located in the middle of the board (foil side). See Figure 3-1 for proper insertion of this standoff. A ground stud is provided for grounding the enclosure/panel to an existing enclosure. A 13-position terminal block across one end of the main PCB is provided for connections to the mechanical unit. Near the center, along one side of the board, is a 16-pin receptacle (RECP1) into which is plugged a 4 pole, 8 pin Dip switch. This Dip switch is removed and replaced with a 16-pin plug and mod interconnect ribbon cable when a modification PCB is used. Three additional options are built into each main PCB assembly: Linear Acceleration, Fixed Brake and basic Torque Control. The customer may elect to use one or more of these optional features. The Dip switch on the main PCB connects the acceleration circuit. Terminals B1 & B2 are provided for the brake option; a set of NO contacts is wired to terminals D7 and D8 for customer use. This set of contacts is normally open when the controller Run relay is deenergized and can be used to operate a spring set brake.

The Model 4000 and 4050 controllers are available for customer mounting within an existing enclosure, however they are also available in their own enclosure when specified.

The customer is required to wire his own operator's elements to the panel mount version of the controller.

When the controller is to be used with a modification PCB, the instruction sheet provided with the board contains the mounting instructions for the modification board, plug wiring information, schematic diagram, and the connection diagram for the complete controller.

Modification PCB's

Modification printed circuit boards for these controllers are 3.5" by 3.9" or 4.5" by 3.9". Any one modification board may be used with the main PCB as required. The following list includes the twelve basic types of modification boards available with the Model 4000 and 4050 controllers. Tables 2-1 through 2-5 list the 21 to 23 different types of controllers available for each.

Description	Part Number
Tachometer Follower PCB	15-444-1
Torque Limit PCB	15-444-2
Alternate Speed PCB	15-444-3
Adjustable Brake PCB	15-444-4
Torque/Speed PCB	15-444-5
Dancer Position PCB	15-444-7
Instrument Sig. Follower PCB	15-446-1/5
Mutuatrol PCB (used only with drives thru 20 HP)	15-446-2
Variable Air Volume PCB	15-446-3/102
Linear Accel/Decel PCB	15-446-4

Packaging Options

The Model 4000 and 4050 controllers are available in the following packaging options:

The Standard Enclosed 4000 Controllers: (assembly numbers 15-551-10**) are complete controllers with the operator's elements located in the cover of the NEMA 13 enclosure.

The Panel Mount 4000 Controllers: (assembly numbers 15-533-10**) are intended to be mounted in the customer's enclosure. A remote operator's station is required for this controller version.

The Panel Mount 4050 Controllers: (assembly numbers 15-539-00**) are intended to be counted in the customer's enclosure. A remote operator's station is required for this controller version.

The Standard Enclosed 4050 Controllers: (assembly numbers 15-553-00**) are complete controllers mounted in a NEMA 13 enclosure. A remote operator's station is required for this controller version.

** Model number, 01 through 26.

Table 2-1 Standard Enclosed Model 4000 Controller

Model 4000 Controller Type	Final Assembly	Mod. Board	Pos 1.	Pos. 2.	Pos. 3	Pos. 4	Pos. 5	Options
Basic Speed Control	15-551-1001		Stop	Start		Run Speed		Fixed Brake Linear Accel
Speed w Adj Brake	15-551-1002	15-44-4	Stop	Start		Run Speed		Linear Accel
Speed w Jog @ Run Speed	15-551-1003		Stop	Start	Jog/Run	Run Speed		Fixed Brake Linear Accel
Speed w/ Adj. Brake & Jog @ Run Speed	15-551-1004	15-444-4	Stop	Start	Jog/Run	Run Speed		Linear Accel
Speed w/ Adj Jog	15-551-1005	15-444-3	Stop	Start	Jog/Run	Run Speed		Fixed Brake Linear Accel
Speed w/ Threading Int.	15-551-1006	15-444-3	Stop	Start	Thread/Run	Run Speed		Fixed Brake Linear Accel
Speed w/ Threading Ext.	15-551-1007	15-444-3	Stop	Start	Thread/Run	Run Speed	Thread Speed	Fixed Brake Linear Accel
Speed w Cascade (Auto/Manual)	15-551-1008	15-444-3	Stop	Start	Auto/ Manual	Man. Speed	Ratio	Fixed Brake Linear Accel
Speed w/ Tach Follower (Auto/Man)	15-551-1009	15-444-1	Stop	Start	Auto/ Manual	Man. Speed	Ratio	Fixed Brake Linear Accel
Speed w/ Low Signal Follower Int. Ratio (Auto/Man)	15-551-1010	15-446-1/5	Stop	Start	Auto/ Manual	Man. Speed		Fixed Brake Linear Accel
Speed w/ Low Signal Follower Ext Ratio (Auto/Man)	15-551-1011	15-446-1/5	Stop	Start	Auto/ Manual	Man. Speed	Ratio	Fixed Brake Linear Accel
Torque Control	15-551-1012		Stop	Start		Run Speed		Fixed Brake
Speed/Torque	15-551-1013	15-444-5	Stop	Start	Thread/Run	Run Speed	Torque	Fixed Brake Linear Accel
Speed w/ Torque Limit	15-551-1014	15-444-2	Stop	Start		Run Speed		Fixed Brake Linear Accel
Speed w Torque Limit & Jog @ Run Speed	15-551-1015	15-444-2	Stop	Start		Dancer Pos		Fixed Brake Linear Accel
Mutuatrol	15-551-1017	15-446-2	Stop	Start		Run Speed		Linear Accel
Mutuatrol w Jog @ Run Speed	15-551-1018	15-446-2	Stop	Start	Jog/Run	Run Speed		Linear Accel
Speed w/ Variable Air Volume (Auto/Manual w/o Run Stop	15-551-1023	15-446-3/102	Stop	Start	Auto/ Manual	Man. Speed		Fixed Brake
Speed w/ Variable Air Volume (Auto/Manual w Run Stop	15-551-1024	15-446-3/102	Stop	Start	Auto/ Manual	Man. Speed		Fixed Brake
Speed w Linear Accel/Decel	15-551-1025	15-446-4	Stop	Start		Run Speed		Fixed Brake
Speed w Linear Accel/Decel & Adjustable Jog	15-551-1026	15-446-4	Stop	Start	Jog/Run	Run Speed		Fixed Brake

Table 2-2 Panel Mounted 4000 Controllers

Model 4000 Controller Type	Final Assembly	Mod. Board	Pos 1.	Pos. 2.	Pos. 3	Pos. 4	Pos. 5	Options
Basic Speed Control	15-533-1001		Stop	Start		Run Speed		Fixed Brake Linear Accel
Speed w Adj Brake	15-533-1002	15-44-4	Stop	Start		Run Speed		Linear Accel
Speed w Jog @ Run Speed	15-533-1003		Stop	Start	Jog/Run	Run Speed		Fixed Brake Linear Accel
Speed w/ Adj. Brake & Jog @ Run Speed	15-533-1004	15-444-4	Stop	Start	Jog/Run	Run Speed		Linear Accel
Speed w/ Adj Jog	15-533-1005	15-444-3	Stop	Start	Jog/Run	Run Speed		Fixed Brake Linear Accel
Speed w/ Threading Int.	15-533-1006	15-444-3	Stop	Start	Thread/Run	Run Speed		Fixed Brake Linear Accel
Speed w/ Threading Ext.	15-533-1007	15-444-3	Stop	Start	Thread/Run	Run Speed	Thread Speed	Fixed Brake Linear Accel
Speed w Cascade (Auto/Manual)	15-533-1008	15-444-3	Stop	Start	Auto/ Manual	Man. Speed	Ratio	Fixed Brake Linear Accel
Speed w/ Tach Follower (Auto/Man)	15-533-1009	15-444-1	Stop	Start	Auto/ Manual	Man. Speed	Ratio	Fixed Brake Linear Accel
Speed w/ Low Signal Follower Int. Ratio (Auto/Man)	15-533-1010	15-446-1/5	Stop	Start	Auto/ Manual	Man. Speed		Fixed Brake Linear Accel
Speed w/ Low Signal Follower Ext Ratio (Auto/Man)	15-533-1001	15-446-1/5	Stop	Start	Auto/ Manual	Man. Speed	Ratio	Fixed Brake Linear Accel
Torque Control	15-533-1012		Stop	Start		Run Speed		Fixed Brake
Speed/Torque	15-533-1013	15-444-5	Stop	Start	Torque/Speed	Run Speed	Torque	Fixed Brake Linear Accel
Speed w/ Torque Limit	15-533-1014	15-444-2	Stop	Start		Run Speed		Fixed Brake Linear Accel
Speed w Torque Limit & Jog @ Run Speed	15-533-1015	15-444-2	Stop	Start	Jog/Run	Dancer Pos		Fixed Brake Linear Accel
Dancer Position	15-533-1016	15-444-7						
Mutuatrol	15-533-1017	15-446-2	Stop	Start		Run Speed		Linear Accel
Mutuatrol w Jog @ Run Speed	15-533-1018	15-446-2	Stop	Start	Jog/Run	Run Speed		Linear Accel
Speed w/ Torque Limit Shock Mount	15-533-1019	See IM-11005-8300						
Speed w Torque Limit w Minimum Speed Pot	15-533-1020	See IM-11005-8300						
Speed w/ Variable Air Volume (Auto/Manual)	15-533-1021	15-446-3/102	Stop	Start	Auto/ Manual	Man. Speed		Fixed Brake
Speed w Linear Accel/Decel	15-533-1025	15-446-4	Stop	Start		Run Speed		Fixed Brake
Speed w Linear Accel/Decel & Adjustable Jog	15-533-1025	15-446-4	Stop	Start	Jog/Run	Run Speed		Fixed Brake

Table 2-3 Panel Mounted 4050 Controllers

Model 4050 Controller Type	Final Assembly	Mod. Board	Pos 1.	Pos. 2.	Pos. 3	Pos. 4	Pos. 5	Options
Basic Speed Control	15-539-0001		Stop	Start		Run Speed		Fixed Brake Linear Accel
Speed w Adj Brake	15-539-0002	15-44-4	Stop	Start		Run Speed		Linear Accel
Speed w Jog @ Run Speed	15-539-0003		Stop	Start	Jog/Run	Run Speed		Fixed Brake Linear Accel
Speed w/ Adj. Brake & Jog @ Run Speed	15-539-0004	15-444-4	Stop	Start	Jog/Run	Run Speed		Linear Accel
Speed w/ Adj Jog	15-539-0005	15-444-3	Stop	Start	Jog/Run	Run Speed		Fixed Brake Linear Accel
Speed w/ Threading Int.	15-539-0006	15-444-3	Stop	Start	Thread/Run	Run Speed		Fixed Brake Linear Accel
Speed w/ Threading Ext.	15-539-0007	15-444-3	Stop	Start	Thread/Run	Run Speed	Thread Speed	Fixed Brake Linear Accel
Speed w Cascade (Auto/Manual)	15-539-0008	15-444-3	Stop	Start	Auto/ Manual	Man. Speed	Ratio	Fixed Brake Linear Accel
Speed w/ Tach Follower (Auto/Man)	15-539-0009	15-444-1	Stop	Start	Auto/ Manual	Man. Speed	Ratio	Fixed Brake Linear Accel
Speed w/ Low Signal Follower Int. Ratio (Auto/Man)	15-539-0010	15-446-1/5	Stop	Start	Auto/ Manual	Man. Speed		Fixed Brake Linear Accel
Speed w/ Low Signal Follower Ext Ratio (Auto/Man)	15-539-0011	15-446-1/5	Stop	Start	Auto/ Manual	Man. Speed	Ratio	Fixed Brake Linear Accel
Torque Control	15-539-0012		Stop	Start		Torque		Fixed Brake
Speed/Torque	15-539-0013	15-444-5	Stop	Start	Torque/Speed	Run Speed	Torque	Fixed Brake Linear Accel
Speed w/ Torque Limit	15-539-0014	15-444-2	Stop	Start		Run Speed		Fixed Brake Linear Accel
Speed w Torque Limit & Jog @ Run Speed	15-539-0015	15-444-2	Stop	Start	Jog/Run	Run Speed		Fixed Brake Linear Accel
Dancer Position	15-539-0016	15-444-7	Stop	Start		Dancer Pos		Fixed Brake Linear Accel
Mutuatrol	15-539-0017	15-446-2	Stop	Start		Run Speed		Linear Accel
Mutuatrol w Jog @ Run Speed	15-539-0018	15-446-2	Stop	Start	Jog/Run	Run Speed		Linear Accel
Speed w/ Torque Limit Shock Mount	15-539-0019	See IM-11005-8300						
Speed w Torque Limit w Minimum Speed Pot	15-539-0020	See IM-11005-8300						
Speed w Linear Accel/Decel	15-539-0025	15-446-4	Stop	Start		Run Speed		Fixed Brake
Speed w Linear Accel/Decel & Adjustable Jog	15-539-0025	15-446-4	Stop	Start	Jog/Run	Run Speed		Fixed Brake

Table 2-4 NEMA 13 Enclosure 4050 Controllers

Model 4050 Controller Type	Final Assembly	Mod. Board	Pos 1.	Pos. 2.	Pos. 3	Pos. 4	Pos. 5	Options
Basic Speed Control	15-553-0001		Stop	Start		Run Speed		Fixed Brake Linear Accel
Speed w Adj Brake	15-553-0002	15-44-4	Stop	Start		Run Speed		Linear Accel
Speed w Jog @ Run Speed	15-553-0003		Stop	Start	Jog/Run	Run Speed		Fixed Brake Linear Accel
Speed w/ Adj. Brake & Jog @ Run Speed	15-553-0004	15-444-4	Stop	Start	Jog/Run	Run Speed		Linear Accel
Speed w/ Adj Jog	15-553-0005	15-444-3	Stop	Start	Jog/Run	Run Speed		Fixed Brake Linear Accel
Speed w/ Threading Int.	15-553-0006	15-444-3	Stop	Start	Thread/Run	Run Speed		Fixed Brake Linear Accel
Speed w/ Threading Ext.	15-553-0007	15-444-3	Stop	Start	Thread/Run	Run Speed	Thread Speed	Fixed Brake Linear Accel
Speed w Cascade (Auto/Manual)	15-553-0008	15-444-3	Stop	Start	Auto/ Manual	Man. Speed	Ratio	Fixed Brake Linear Accel
Speed w/ Tach Follower (Auto/Man)	15-553-0009	15-444-1	Stop	Start	Auto/ Manual	Man. Speed	Ratio	Fixed Brake Linear Accel
Speed w/ Low Signal Follower Int. Ratio (Auto/Man)	15-553-0010	15-446-1/5	Stop	Start	Auto/ Manual	Man. Speed		Fixed Brake Linear Accel
Speed w/ Low Signal Follower Ext Ratio (Auto/Man)	15-553-0011	15-446-1/5	Stop	Start	Auto/ Manual	Man. Speed	Ratio	Fixed Brake Linear Accel
Torque Control	15-553-0012		Stop	Start		Torque		Fixed Brake
Speed/Torque	15-553-0013	15-444-5	Stop	Start	Torque/Speed	Run Speed	Torque	Fixed Brake Linear Accel
Speed w/ Torque Limit	15-553-0014	15-444-2	Stop	Start		Run Speed		Fixed Brake Linear Accel
Speed w Torque Limit & Jog @ Run Speed	15-553-0015	15-444-2	Stop	Start	Jog/Run	Run Speed		Fixed Brake Linear Accel
Dancer Position	15-553-0016	15-444-7	Stop	Start		Dancer Pos		Fixed Brake Linear Accel
Mutuatrol	15-533-0017	15-446-2	Stop	Start		Run Speed		Linear Accel
Mutuatrol w Jog @ Run Speed	15-533-0018	15-446-2	Stop	Start	Jog/Run	Run Speed		Linear Accel
Speed with Variable Air Volume (Auto/Manual)	15-533-0021	15-446-3/102	Stop	Start	Auto/ Manual	Man. Speed		Fixed Brake
Speed w Linear Accel/Decel	15-533-0025	15-446-4	Stop	Start		Run Speed		Fixed Brake
Speed w Linear Accel/Decel & Adjustable Jog	15-533-0025	15-446-4	Stop	Start	Jog/Run	Run Speed		Fixed Brake

Section 3

Assembly

This section describes the procedure for assembling the basic Model 4000 and 4050 controllers or modifying an existing controller with one of the 12 available modification boards that make up the 4000 and 4050 system. If you have purchased a complete controller, this section can be passed over and you may proceed with the next section, covering installation.

Identification

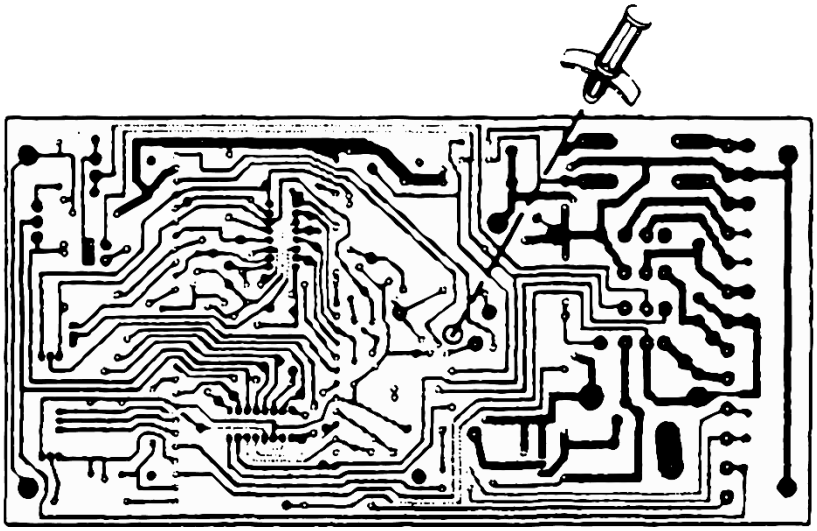
Before beginning to assemble or change your Model 4000 or 4050 controller, identify the type of final assembly you need. All standard options to your controller are listed in Section 2, Tables 2-1 through 2-4. These tables describe each modification, give the final assembly number and list the part numbers of sub-assemblies required to make the modification. Refer to the Instruction Sheet included with the modification PCB and this basic instruction manual for the necessary wiring instructions. The Instruction Sheet will carry the final assembly part number of your controller.

Main Printed Circuit Board Support

When mounting the main PCB to your controller panel or enclosure, it will be necessary to insert a center support standoff on the main board to add stability. The following instructions are provided to help you this task. Insert a support standoff into the hole on the back side (foil side) of the board as shown in Figure 3-1. Position tabs between soldered leads so the standoff may be seated properly to allow the locking tips to lock. Then mount the printed circuit board to the panel with the four mounting screws that are furnished.

Caution: Do not push on components when inserting standoff or damage may result.

Figure 3-1 15-263-14 Support Standoff Kit



Insert support standoff into hole on back side (foil side) of board as shown. Position tabs between soldered leads so that standoff may be seated properly to allow locking tips to lock.

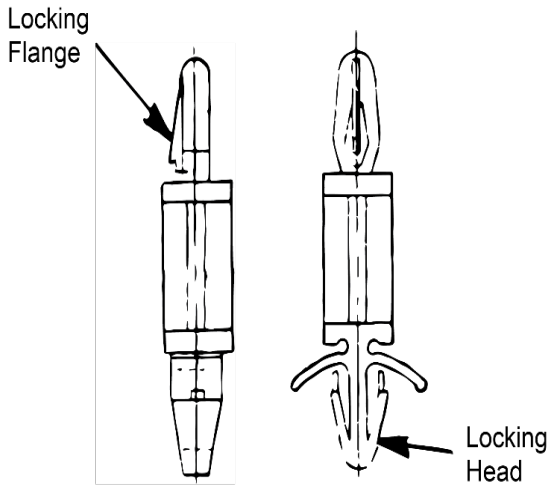
Caution: Do not push parts on component side when inserting standoff or damage may result

Modification PCB

When a modification PCB assembly is required, we suggest you install this board according to the following procedure:

1. Place the main PCB in front of you with the long dimension in a horizontal position and the terminal strip to the left.
2. Locate the dual in-line, 4 position Dip switch plugged into receptacle RECP 1 on the main PCB assembly. RECP 1 is 2.5” from the right edge and 1.0” from the bottom edge of the board.
3. Remove the Dip switch by pulling it straight out of the receptacle. Save the switch for some future use. Then, peel the adhesive-backed label off the other half of RECP 1.
4. Four nylon standoffs are supplied with each modification PCB assembly. Locate the four 0.188” diameter holes in the main PCB assembly. Refer to your assembly illustration for the location of these holes. Insert the arrow type locking head of a standoff into each of the holes in the main PCB assembly and press them in. The tabs will snap out to lock the standoffs permanently in position. Replacement standoffs are available by ordering the standoff kit assembly, 15-263-16, which contains four standoffs

   Figure 3-2: Modification PCB Standoff



5. Hold the modification PCB assembly over the standoffs with the ribbon connector toward you, which should be over RECP 1 receptacle. 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. These pins are easily bent. To remove this connector, pull straight up on the body of the plug. Do not pull on the ribbon itself.

6. Align the holes in the modification PCB assembly over the standoffs and press over the tapered posts until the locking flanges snap out to lock the board in position. To remove the board, squeeze the locking flanges in with your fingers and lift off the board.

Wiring

In the standard NEMA 13 version, with the operator's control elements mounted in the door, the operator's elements are completely wired. Wiring of the operator's elements to the panel mount version of the controller is through a 12-position terminal block, located on the right side of the panel. All connections to this terminal block must be wired as shown on the connection diagram. The terminal block is supplied with a marking strip identifying each terminal, P1 through D10. The inner side of the terminal block is supplied with a prewired harness, complete with plugs of different sizes and configurations, to aid in wiring your controller. These plugs are clearly identified by wire markers (PL2, PL3, etc.) and are to be inserted in the main PCB or modification board's matching receptacles (RECP 2, RECP 3, etc.) Plugs supplied with the harness will allow you to modify your controller into any one of the available types. Any plug(s) that you are not instructed to use for your specific controller should be taped to the panel and out of the way. The plugs include spring latches at opposite sides that fit inside molded catches in the receptacle body.

Align and insert them into the receptacle. Note the groove(s) in one side of the plug and raided key(s) on the receptacle to ensure proper alignment. For modified controllers refer to the specific instruction sheet for your controller for complete plug wiring information.

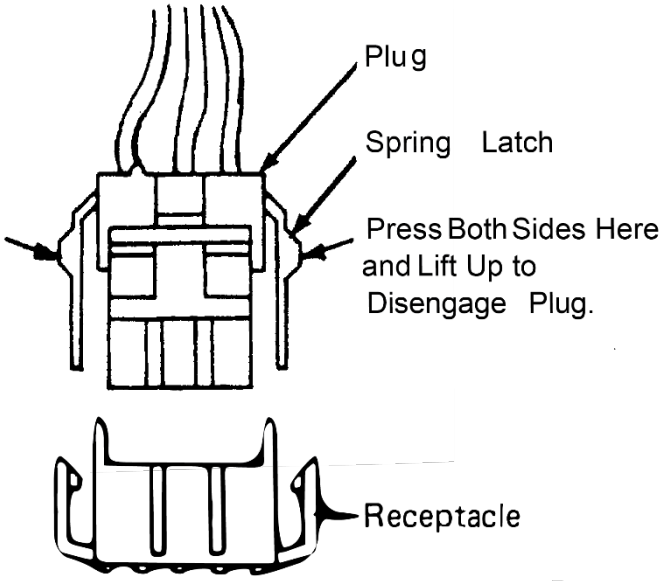


Figure 3-3 Wiring Harness Plug & Receptacle

Section 4

Installation

Location

The standard NEMA 13 4000 controllers are in an oil tight enclosure, which permits mounting in relatively dusty environments. The controller components generate heat during operation, raising the temperature inside the enclosure. Since the enclosure is sealed, the heat is trapped inside. To prevent the internal temperature from reaching a destructive level, the enclosure was designed with enough surface area to radiate the heat generated by the controller, even when the ambient is 40°C (104°F). Since the design is based on using the enclosure surface as a radiator, do not mount the controller on a heated surface or directly adjacent to other enclosures which will block free air movement around the controller. Keep the controller clean to allow for natural radiation.

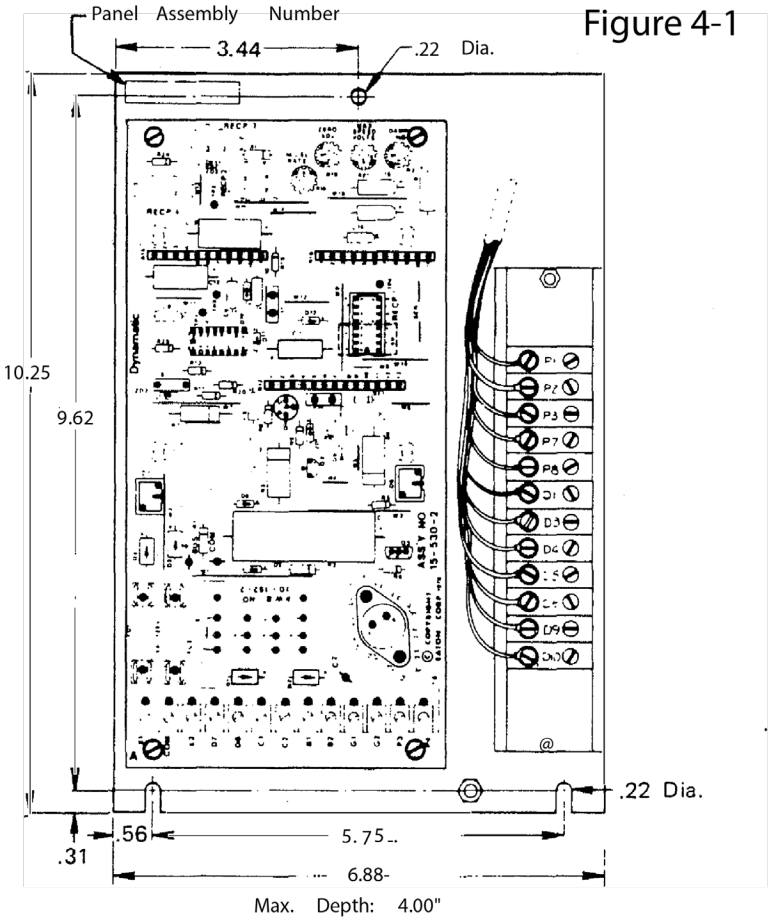


Figure 4-1

The controller enclosure, intended for indoor use, provides protection from lint, dust, seepage, external condensation, water, oil and coolant spray. We recommend that the conduit and wiring to the controller be tightly sealed at the entry point of the enclosure with a suitable compound to safeguard against entry of liquid via the conduit. Areas with vibration and repeated shock should be avoided. If you must locate the controller in a severe or abnormal environment, consult with your local Dynamatic sales representative.

Mounting Panel Mounted Model 4000 and 4050 Controllers

The Model 4000 and 4050 panel mount controllers should be mounted with the main PCB terminal block toward the bottom of your enclosure. The minimum depth required for the controller is 4”. You may use the controller as a template or use the outline dimension print in Figure 4-1 (panel) to locate the required mounting holes. The mounting screws should be No. 1 such as 10-24 or 10-32.

Mounting an Input Transformer

A suitable location should be selected for installing the transformer. Figure 4-2 includes mounting dimensions. Orient the transformer for ready access to primary and secondary terminals, which are clearly marked. Using adequate size hardware,

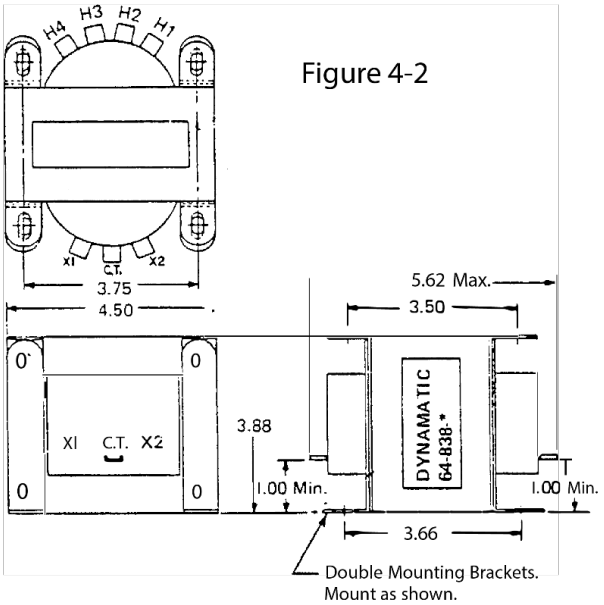


Figure 4-2

secure the transformer in place. Check transformer input and out-put requirements before wiring it to the input supply and to the controller.

Wiring

This basic instruction manual and modification instruction sheets contain the connection and schematic diagrams. The connection diagrams are in simplified block form. The large rectangular box in the center of the diagram represents the controller enclosure or panel, with the terminal strips shown, numbered and lettered exactly as they appear on the actual controller. The rotating unit's electrical devices that must be wired are shown graphically on the left side of the connection diagram. The connections to the drive and controller are shown by the solid lines drawn between to terminal points of each. The heavy solid lines represent a raceway or conduit run.

Staring at the top left of the connection diagram, note the dotted box, labeled "disconnect device and motor starter". This dotted line indicates these items are not included in the Model 4000 and 4050 controller packages. Since the drives uses a standard ac induction motor, it must be connected with the proper branch circuit protection, motor starter and overload devices. The minimum requirements are specified in the National Electrical Code; other local regulations may also apply. If a question exists, consult with the supplier of the equipment or contact Dynamatic at 262-554-7977.

Wire size, number of conductors in a conduit or raceway and grounding are also specified by the National Electrical Code and other applicable local regulations. Make sure you meet minimum requirements of these codes. Consult the nameplate of the drive for full load current at the voltage you are using. Controller input wiring should be sized to carry 115 Vac at 4 amps for the 4000 controller and 7 amps for the 4050 controllers. The dc output to the coils is 45 Vdc at 8 amps for Model 4050 controllers and 45 Vdc at 4.3 amps for Model 4000 controllers. All other controller wiring is 5 amps or less. In most cases, the minimum conductor size allowed by code will be adequate. To avoid stray signal interference, do not run the reference signal interconnection wires in the same conduit a s the power wiring.

Note, it is necessary to use shielded conductors for the generator leads, both for runs to the controller and to any tachometer indicator that may be used. The shielded conductor should be twisted, insulated

pair of conductors having a continuous metallic shield around the twisted pair with an insulating jacket over the shield. At the generator and indicator ends, cut back the shield as required to expose enough lead to make the connection, Then, tape the exposed shield so that it does not ground at that point. On the controller panel, strip off enough of the outer jacket to expose several inches of shield, Unwrap or unbraid the shield ground connection cannot make contact with the terminals at the terminal strip. Shielded cable should have the shield grounded at on end only. When shielded cable is used, the generator leads may be run in the same conduit as the other conductors. You may prefer to not use shielded cable and is so, you must run the generator leads in separate conduit with no other conductors. Keep wire length as short as possible.

After pulling the proper size conductors, connect each terminal at the drive to a controller terminal at the drive to a controller terminal having the same number or letters. As an example, C1 at the drive unit should be connected to terminal C1 at the controller. A screwdriver with a blade width not exceeding 1/8" should be used to loosen each terminal screw. With the terminal screw tight, back it out four (4) full turns. Route the conductor neatly to the terminal, mark the length at a point that just reaches the back-insulating barrier, cut off and then strip to expose 5/16". Insert the exposed conductor under the clamp below the screw head and tighten. After tightening, check to make sure no strand(s) of wire are curled to short out the conductor.

When all wiring is completed, recheck all connections again to make sure they are correct, that each is tight, and no exposed strands can short out at any point. Once you have assured yourself that the wiring is exactly as shown on the connection diagram, you may proceed to the next step—programming the controller

Programming Dip Switch

The basic controller contains at least one switch; when used with some modifications, two switches must be placed in the proper switch positions for the type of control action required. Each connection diagram contains a table with the switch positions. Compare this drawing with your unit to check the contact positions.

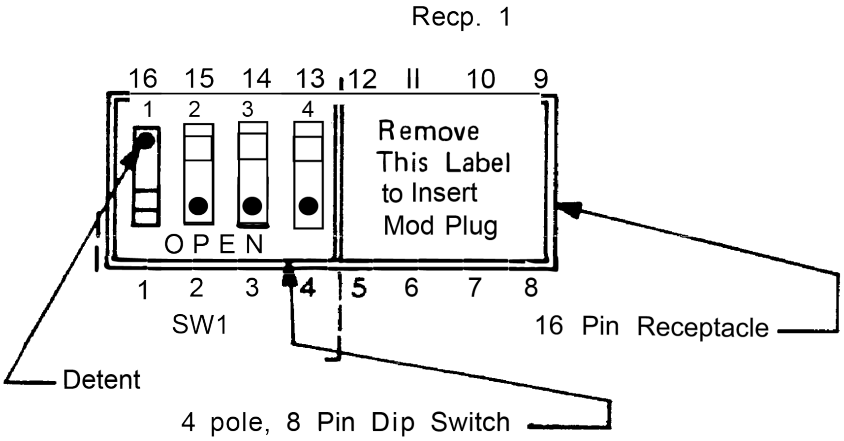


Figure 4-3

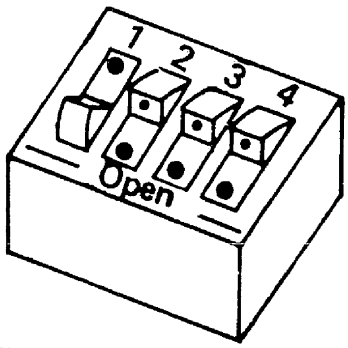


Figure 4-4

Switch 1 is Shown Closed; All Others are Shown Open.

The main PCB assembly uses to Dip switch (SW 1) in all cases where no modification PCB assembly is used. When looking at the board, with the terminal block to the left, you will see a 4 pole, 8 pin switch plugged into the left half of the receptacle (RECP1). The switch *must* be in this position. Figure 4-3 shows the switch in the proper position. The switch poles have a rocker action. Contact 1 is on the left. If the controller programming chart on the connection diagram calls for contact 1 to be in the *CLOSED* position, place a pencil point in the switch rocker detent on the side opposite *OPEN* and press down to a position flush with the top of SW 1. The *OPEN* side of contact 1 is now up. Refer to the controller programming chart on the connection diagram for your controller and program each contact of each switch per the chart.

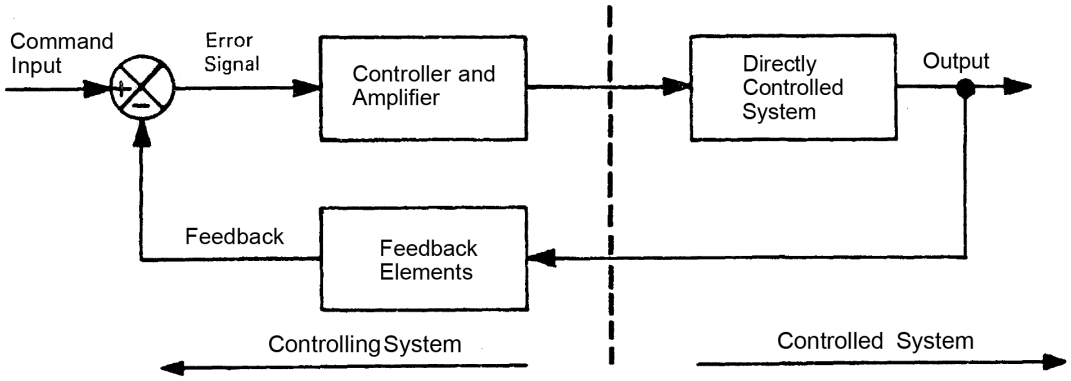
Section 5

Operation

The Model 4000 and 4050 controllers are easy to operate. However, a more detailed knowledge of the controller's functions will help you obtain the best possible performance. Knowing now they work will help you trouble shoot any problems that may arise. Before applying power to the controller please read these operating instructions carefully.

Basic Controller Theory

These are closed loop controllers. The output is measured, fed back and compared to the command input. Whenever the feedback differs from the command, an error proportional to the difference is generated. The resultant error is used to increase or decrease the output until it is equal to the command input. A simplified closed loop block diagram is shown in Figure 5-1.



Simple Closed Loop System

Figure 5-1

A closed loop system consists of two parts, the controlling and the controlled systems. In the case of this description, the controlling system is the Model 4000 or 4050 controller and the controlled system is the eddy-current drive. The command input is a 0 to 9.1 Vdc signal, adjusted and set by the operator when he turns the Run Speed potentiometer. The feedback signal is obtained from the tachometer generator* driven from the output shaft of the drive. The feedback voltage is directly proportional to speed. Whenever the command signal is greater than the feedback, a positive error exists. The drive is not running fast enough, and the positive error signal turns on the amplifier, increasing the clutch coil excitation. The reverse is true when the feedback exceeds the command. This indicates the drive is running too fast and the controller is turned down. When the drive speed is at or near the desired speed, the difference between the command input and the feedback is very small, resulting in a small

error signal. At this point the controller is regulating and adjusting the drive excitation to bring the speed to the set point. Any sudden load change would change the drive speed, change feedback voltage, increase the error signal and result in a change in drive excitation to correct for the load change. In actual operation, the voltage across the clutch coil is constantly varying to compensate for load changes.

**If an external tach generator is employed, it should be capable of producing 40 to 60 Volts and 5 milliamperes at 100% speed for a unit with standard speed control.*

The model 4000 and 4050 are somewhat more complex than the preceding explanation, in that two feedback loops are connected. Both speed (velocity) feedback and clutch voltage (current analog) feedback are used. In the speed control mode of operation, the velocity feedback is used to provide the shaft speed intelligence described above, and the current feedback is used for damping and stability. The main PCB assembly, which contains this circuitry, is also capable of torque control. By opening the voltage feedback path, the controller will now regulate to control clutch coil voltage instead of speed. This type of controller is frequently used with a take-up or spooler drive where voltage (torque) is proportional to web tension and speed varies with the diameter of the roll

A block diagram for the basic speed controller version of the Model 4000 and 4050 is shown in Figure 5-2.

To operate the basic speed control version of the model 4000 and 4050 controllers, three operator control devices are required: Stop and Start pushbuttons and a Run Speed potentiometer (these operator controls are standard with the cast enclosures version but are not supplied with the other versions unless specified). The Start pushbutton energizes the E relay, which holds itself in through a holding contact. At the same time, the E relay opens the brake output and connects the clutch coil. The operator can then set the drive speed by turning the Run Speed potentiometer to a reference position on the knob corresponding to the percent of maximum speed desired. The velocity feedback signal from the tachometer generator causes the controller to regulate and hold the proper speed. To stop the controller, the operator depresses the Stop pushbutton. The E relay drops out, disconnecting the clutch coil and connection any brake that may be used.

Linear Acceleration Option

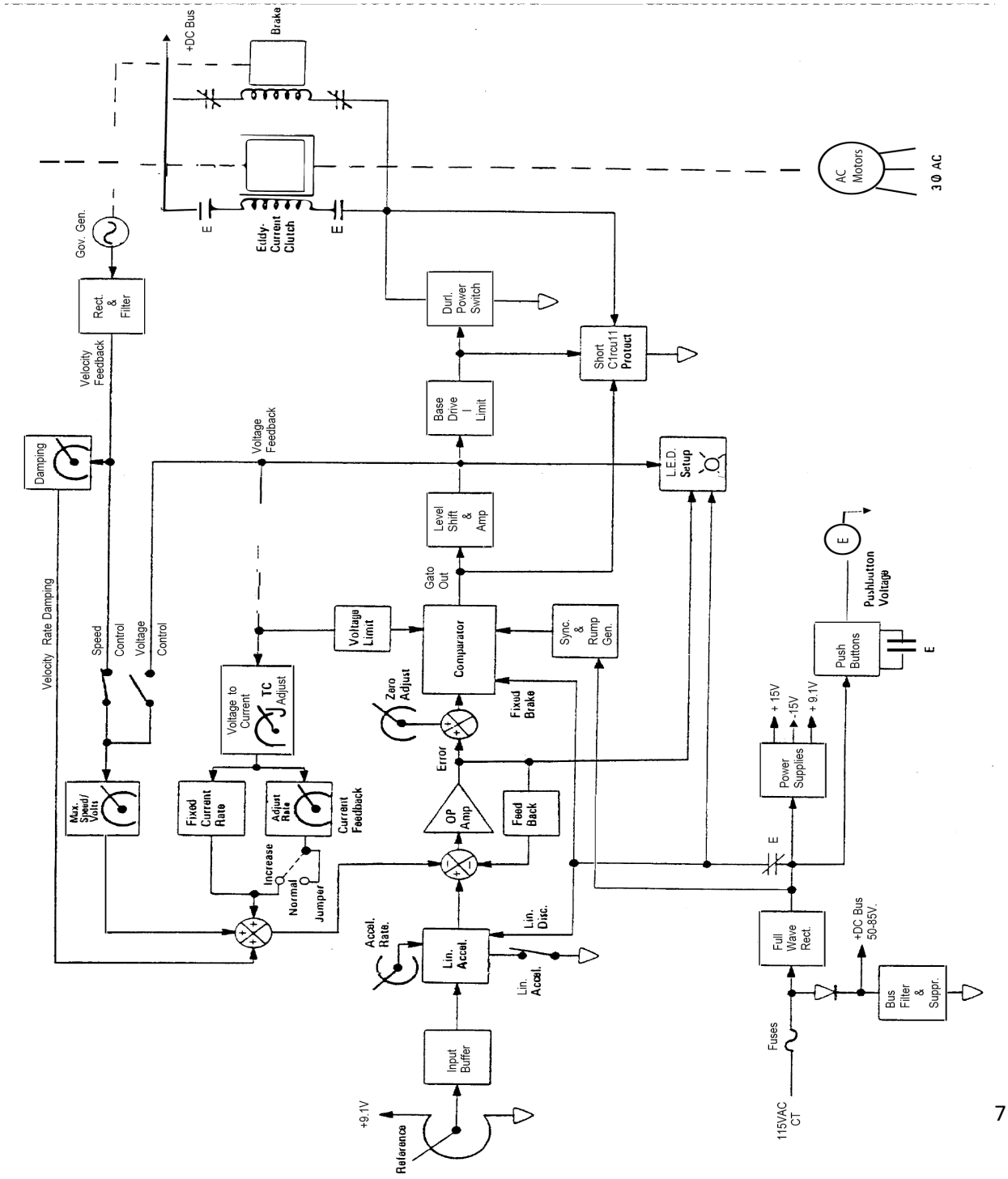
One of the optional features included in the Model 4000 and 4050 controllers is the on-board linear acceleration circuit. With the components mounted on the main PCB assembly, the circuit can be easily connected or disconnected by the Dip switch.

The purpose of linear acceleration is to slow down response to a change in command. Without linear acceleration control, the drive will respond to operator speed adjustments very quickly, limited only by the torque capacity of the drive. With the linear acceleration circuit, the output response of the controller is held to a linear rate of change with respect to time. The circuit is adjustable from a nominal 3 to 90 seconds. When set at the minimum acceleration rate the drive will take at least 80 seconds to accelerate from zero to full speed, following a linear ramp. When less than full speed is set, the time to reach that speed is proportionally less. The controller programming chart on the connection diagram shows how the circuit should be programmed.

Fixed Brake Option

A fixed brake option is available on all Model 4000 and 4050 controllers not using the adjustable brake modification. When the controller is stopped, the E relay de-energizes, connecting the brake coil to terminals B1 and B2. The 4050 controller is capable pf putting out 45 Vdc, 8 amps continuous at these terminals. The 4000 controller is capable of 4.3 amps continuous at this voltage. An electrically applied brake is required, such as the eddy current brake or electromagnetic friction brake. No adjustment of the brake excitation is available, unless you install an external resistor in series with the brake coil to limit the voltage across the brake.

Figure 5-2: Model 4000/4050 Controller Block Diagram



Spring Set Brake Option

All Model 4000 and 4050 controller configurations provide a normally open (NO) relay contact from the E relay, wired to terminals D7 and D8. This contact is open whenever the controller is stopped and is rated 115 Vac or 24 Vdc, 5 amps resistive load, 150 VA pilot duty. If a spring set brake is not used the E relay contact is available for any customer use within its rating.

Adjustable Brake Modification, 15-444-4

There are application in which a certain drive output deceleration is required. The deceleration is a function of braking torque and brake coil excitation. A modification PCB, Assembly 15-444-4, can be added to the basic controller to provide a means of adjusting the brake coil voltage to any value less than 45 volts.

The Brake Adjust potentiometer R6 is located on the modification PCB. The speed Reference potentiometer R5 is connected to the modification PCB by means of a 'plug in" connector PL3. All main connections between the modification PCB and main PCB are made with a 'ribbon cable" connector. Two "on-board" relays (BR1 and BR2) provide the necessary internal switching. When the controller is operating, the brake circuit is disconnected. However, when the Stop push button is depressed the relays de-energize, connect the brake coil and apply the controller output to the brake.

Alternate Speed Modification, 15-444-3

Several of the controller configurations in the Model 4000 and 4050 systems use the Alternate Speed modification. The following listing is in order in which they appear in Tables 2-1 through 2-4 in Section 2:

Assembly Numbers	Modification Operating Feature
15-5**-0005/1005	Adjustable Jog
15-5**-0006/1006	Threading (internal)
15-5**-0007/1007	Threading (external)
15-5**-0008/1008	Auto/Manual Cascade

These modifications provide a convenient means for applying two different speed references ('Run Speed" and "Alternate Speed) to the Model 4000 and 4050 controllers. Either speed reference can be applied with or without linear acceleration. The Run Speed potentiometer R5 is connected to the modification PCB by means of a "plug-in" connector. There is an "on-board" potentiometer provided for the Alternate Speed Reference R3 or an external potentiometer can be used. It also would be connected to the modification PCB by means of a "plug-in" connector. Interconnections are made between the modification PCB's and the main PCB by "ribbon cables" connectors. Switch SW8 is now used for the acceleration circuit. Two "on-board" K relays are used to select either the Run Speed potentiometer or the Alternate Speed Potentiometer. Alternate Speed Can be any second speed, such as Jog or Thread, or can be the Ratio Speed in a cascaded drive. The word "cascade" is used to describe a combination of two to for "slave" controllers (Model 4000 and 4050) connected to the same Run Speed potentiometer. Only the Master Controller supplies the 9.1-volt reference voltage. In "cascade", all drives receive the same reference and will control to the same command signal. The Ratio potentiometers on the individual slave controls are used to adjust the speed of the slave drives with respect to the master.

Tach Follower Modification, 15-444-1

The Tach Follower modification assembly is used to control or set the speed of the drive connected to the Model 4000 or 4050 controller as commanded by another (remote) ac tachometer generator driven by some other drive or machine section.

This modification allows a drive to follow the speed of another machine at some proportionate ratio, e.g., 1:1, 2:1, etc. Basically, this is accomplished by first producing a dc analog voltage of the master speed by means of rectifying and filtering the output of the master ac tachometer generator of the master ac tachometer generator and then dividing the voltage with the Ratio potentiometer to produce a suitable reference voltage range for the Follower. This type of operation is termed the “Automatic Follower Mode”. The remote generator should be capable of producing between 40 and 60 Vac at 100% generator speed. The Ratio potentiometer permits you to trim the speed when in the automatic mode.

The follower drive can also be placed in the manual mode, so its speed is set by an external Speed potentiometer. In this latter mode, linear or standard acceleration can be selected.

The external Ratio potentiometer and the Manual Speed potentiometer are connected to the modification PCB by means of “plug-in” connectors. Interconnections are made between the modification PCB and the main PCB by means of a ‘ribbon cable” connector.

Low signal Follower Modification 15-446-1/5/101

The Low Signal Follower modification circuit accepts a transducer output signal (current or voltage) and conditions it to produce a dc reference voltage for the Model 4000 and 4050 controllers. The circuit is adjusted so that a specific linear drive speed range is obtained for a given transducer output range.

This implies that an instrument or process controller having an output of 10 to 50 ma, or other low-level output, is being used to command the speed of the Model 4000 and 4050 controllers. This modification PCB assembly mounts on the main PCB assembly and connects to it by a ribbon connection just like the other modifications. On-board relays K1 and K2 switch between Auto and Manual operation. As in the Tach Follower circuit, you have complete manual control when switched to manual, or automatic operation when the instrument controller is providing the input command signal. An internal Ratio potentiometer or an external one is available. Switched SW8 and 9 are used to program the modification for five different input signal levels. A programming chart is included on the connection diagram for these switches

Torque/Speed Modification, 15-444-5

With this modification added to the main PCB a means is provided to externally select wither Speed control or Torque Control (Voltage Control).

The main PCB assembly contains the necessary circuits to permit the board to be set up for wither speed control or torque control, but not both. The limit is primarily due to the single Max Speed/Volts feedback adjustment on the board, which is used by both circuits. The Torque/Speed modification PCB includes a second feedback potentiometer, labeled Max Torque, plus the two relays (K1 and K2) required to do the switching. When you select the Torque position on the Torque/Speed selector switch, you program the controller for torque control operation. When the switch is turned to Speed, the speed control circuits are effective. Linear Acceleration may be used only I the Speed position, if desired.

Torque Limit Modification, 15-444-2

For some applications of variable speed drives, it is necessary to limit the torque available to a machine in order to prevent damage to the machine itself or its process. The adjustment range is from 50 to 150% of rated motor torque.

Used in conjunction with Model 4000 and 4050 controllers, the Torque Limit modification provides an "override" feedback signal which indirectly limits the induction motor torque (current) to a preset maximum value.

The input to the modification is a motor current feedback signal from a current transformer on one of the motor lines. The current transformer assembly (15-203-3 or 15-18-*) includes the current transformer and the required load resistor in a package for mounting by the customer. The motor current signal is rectified, filtered and then fed to the Difference Amplifier. When it exceeds the Torque Limit reference, a negative feedback signal is sent to the Model 4000 and 4050 controllers. The controller is "phased" back to the point where the clutch excitation is such that the torque reflected to the motor remains at the pre-set value of Torque Limit potentiometer R19 located on the modification PCB.

The torque limit response can generally be adjusted from underdamped to overdamped by the Torque Limit Damping potentiometer R18 on the modification PCB. Also, in special applications with very high load inertias, additional velocity damping is available by using the HI Damping pot.

The Linear acceleration option can be utilized by closing SW2 on the modification board. With the switch open, acceleration is limited only by the torque limit circuit.

Dancer Position Modification, 15-444-7

The Dancer Position modification converts the standard Model 4000 and 4050 controllers into a Dancer Position control system. The Feedback signal to the controller is the voltage from a Dancer Operated potentiometer rather than from the shaft mounted tachometer generator (rpm). The steady state position of the "dancer" is controlled by automatically adjusting the torque of the drive to maintain the Dancer in the desired (preset) position. This results in a match between the velocity (FPM) of material entering the dancer loop and the velocity (FPM) leaving the loop.

It is important to understand that the drive and controller do not regulate the tension on the material. The tension is determined by the effective force of the dancer assembly on the loop of material.

The modification circuit includes a supplementary+ Clutch Current Bandpass Filter circuit and a Position Rate circuit to provide the lead compensation necessary for stability. The circuit gains are adjustable so that the dynamic response of a specific system can be "tuned" via Velocity Damping and Current Damping adjustments. A Bias potentiometer is included to compensate for operational amplifier offset voltage. These 3 adjustments are located on the modification PCB.

Linear Acceleration option is available by closing SW2 on the modification boards.

**Function of full load motor current*
+ to that already on the main PCB

Figure 5-3: Model 4000 Controller Schematic with 15-530-5 Main Assembly

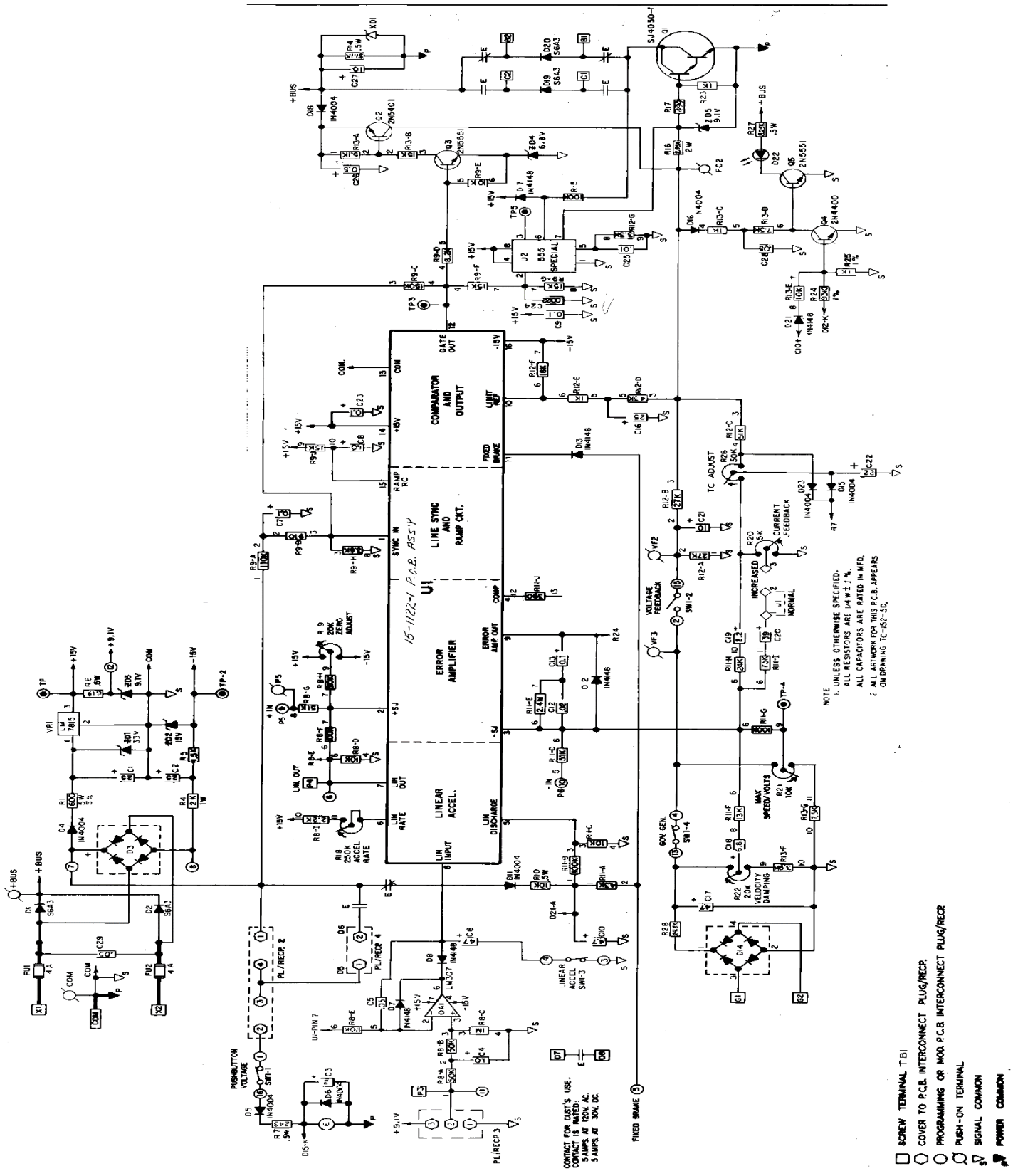
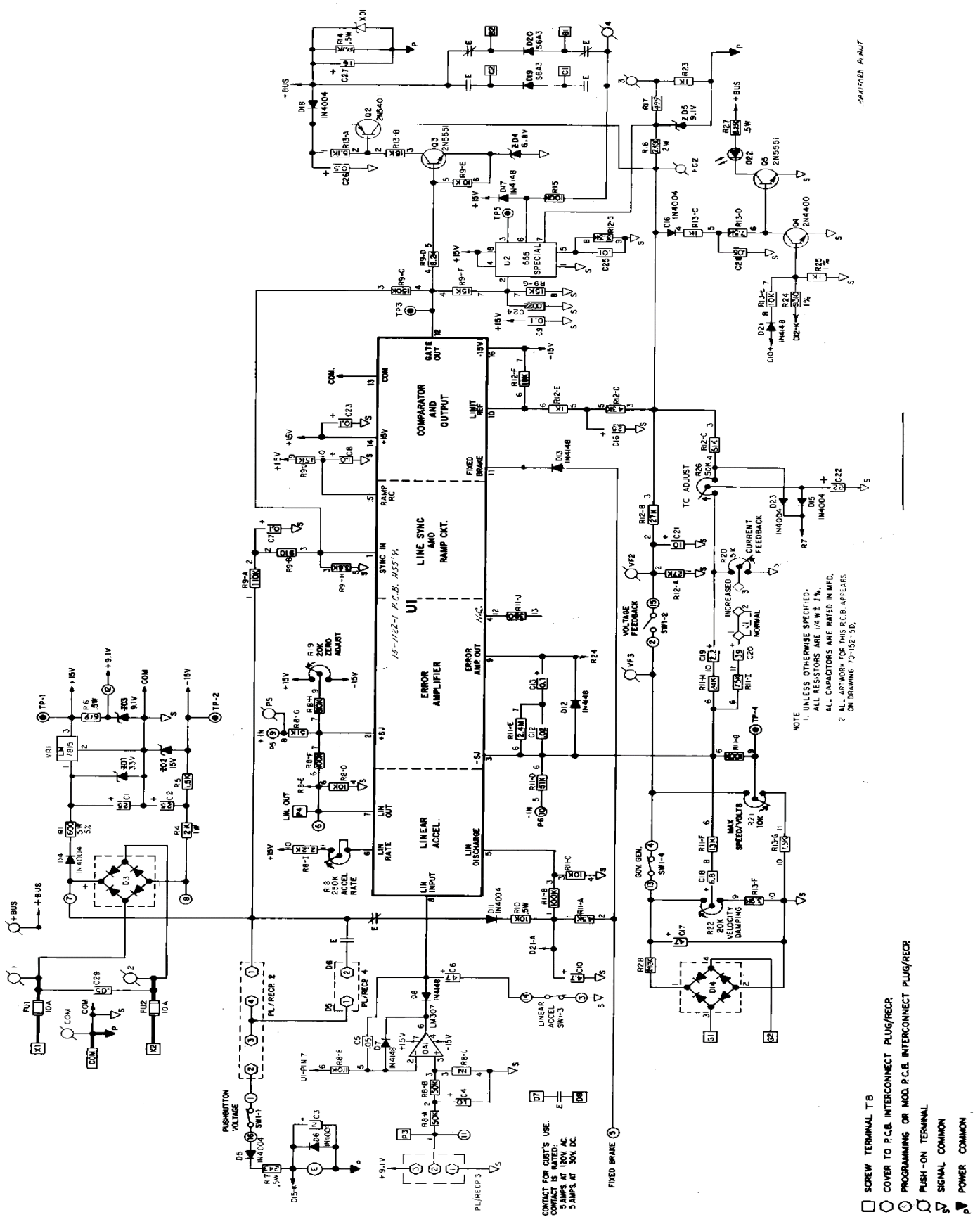


Figure 5-4: Model 4050 Controller Schematic with 15-530-6 Main PCB Assembly



Mutuatrol® Modification, 15-446-2

The Mutuatrol modification assembly is used to control the operation of a clutch and brake on the same drive, regulate the speed and provide proportional braking when the drive is decelerating for stopping. Clutch excitation occurs when the feedback voltage is less than the reference. The deadband at which the drive crosses over from clutch operation to brake operation is called separation. As the separation decreases, overlap begins to occur. A very slight amount of overlap may be desirable to eliminate the deadband between clutch and brake operation.

Variable Air Volume Modification (VAV), 15-446-3/102

This modification circuit accepts and translates an air pressure input signal into a voltage reference for the Model 4000 and 4050 controllers. The circuit is designed to provide the full output speed range with a 0 to 15 psi input air signal for PCB 15-444-3, and 0 to 30 psi input air signal for PCB 15-446-102. Separate means are provided for ensuring zero volts output with 0 psi input and for setting a minimum speed up to 50% of rated speed.

This modification can be used in Auto or Manual as determined by an external switch. In manual speed operation, speed selection is set by an external potentiometer.

Linear Accel/Decel Modification, 15-446-4

This modification circuit provides linear acceleration and deceleration independently adjustable between 3 and 90 seconds. The linear Accel/Decel action is initiated by input reference changes; a fast ramp down to zero occurs when the controller's Stop button is pushed. This modification also has an adjustable Jog Speed without Linear Accel/Decel, activated by an external contact closure. The Linear Accel/Decel modification may serve as the master reference for up to eight cascaded systems when using Alternate Speed (15-444-3) mods with 25k Ratio pots.

Section 6

Start-Up and Adjustments

This section of the manual is intended to assist you in placing Model 4000 or 4050 controllers into service. Before turning on the power please read these instructions carefully.

Although the controller has been tested and inspected at the factory the following series of Power Off tests must be completed before turning power on to the controller. After completing these tests, refer to the Power On test and proceed to the start-up and adjustment procedure for your specific controller. The adjustment procedures given in Section 6 apply only to controllers without a modification PCB. Controllers requiring a modification PCB. Controllers requiring a modification PCB have their own instruction sheets with a detailed start-up procedure for that specific application. These instruction sheets are listed below.

Model 4000 Panel Assembly	Model 4050 Panel Assembly	Control Description	Instructions Required
15-533-1001	15-539-0001	Basic Speed Control	IS-000539-0001A
15-533-1002	15-539-0002	Speed w/Adj Brake	IS-000539-0002A
15-533-1003	15-539-0003	Speed w/Jog at Run Speed	IS-000539-0003A
15-533-1004	15-539-0004	Speed w/Adj Brake 7 Jog at Run Speed	IS-000539-0004A
15-533-1005	15-539-0005	Speed w/Adj Jog	IS-000539-0005A
15-533-1006	15-539-0006	Speed w/Threading Int.	IS-000539-0006A
15-533-1007	15-539-0007	Speed w/Threading Ext.	IS-000539-0007A
15-533-1008	15-539-0008	Speed w/Cascade (Auto/Man)	IS-000539-0008A
15-533-1009	15-539-0009	Speed w/ Tach Follower (Auto/Man)	IS-000539-0009A
15-533-1010	15-539-0010	Speed w/Low Signal Follower Int. Ratio (Auto/Manual)	IS-000539-0010B
15-533-1011	15-539-0011	Speed w/Low Signal Follower Ext. Ratio (Auto/Manual)	IS-000539-0011B
15-533-1012	15-539-0012	Torque Control	IS-000539-0012A
15-533-1013	15-539-0013	Speed/Torque	IS-000539-0013A
15-533-1014	15-539-0014	Speed with Torque Limit	IS-000539-0014A
15-533-1015	15-539-0015	Speed with Torque Limit and Jog at Run Speed	IS-000539-0015A
15-533-1016	15-539-0016	Dancer Position	IS-000539-0016A

15-533-1017	15-539-0017	Mutuatrol	IS-000539-0017A
15-533-1018	15-539-0018	Mutuatrol w/Jog at Run Speed	IS-000540-0018A
15-533-1019	15-539-0019	Speed w/Min Speed & Torque Limit-shock Mount-Panel Mount Only	IM-110005-8400
15-533-1020	15-539-0020	Speed w/min Speed-Shock Mount Panel Only	IM-110005-8400
15-533-1021	15-540-0021	Speed w/V.A.V. (Auto/Manual)	IS-000540-0021A
15-533-1025	15-539-0025	Speed w/Linear Accel/Decel	IS-000539-0025A

*On the Model 4000 controller: 15-533-10** is the assembly number for panel assembly controller. 15-551-10** is the assembly number for NEMA 13 Enclosure Controls.

On the Model 4050 controller: 15-539-00 is the assembly number for panel assembly controllers. 15-553-00** is the assembly number for NEMA 13 Enclosure Controls.

Tools Required

To simplify the start-up and adjustment procedure for the Model 4000/4050 controllers, they are equipped with an LED (light emitting diode). This LED enables the operator to set Maximum Speed and Zero adjust with the use of only a small screwdriver. No other tools are required for start-up; however, a multimeter, ammeter and stroboscope are desirable to obtain exact settings. The controller will be hot when you are working on it; make sure your tools are well insulated. Do not switch meter scales or ranges when the probes are connected to the controller.

Power Off Tests

Before starting the ac motor or applying power to the controller, make the following visual inspections and continuity checks. The disconnect switch should be locked out.

Caution: Alert all personnel in the area that the machine is being checked out and should be considered running. Do not work alone. Rotating machinery and above-ground electrical potentials can be hazardous. Your life may depend on prompt help, someone capable of stopping the machine and disconnecting the ac power. Know where the Stop push button and disconnect switch are located.

1. Visually inspect the machine and drive. Are they safe to operate and are all required guards and safety devices installed and checked out?
2. Visually inspect all electrical connections. Make sure they are all tight and not grounded or shorted. Look for individual strands that may be sticking out of a lug or from a terminal.
3. Visually inspect each control plug to make sure it is plugged into the right receptacle and is locked in place. Check the connection diagram if there is a question.
4. Visually inspect the PCB switch(s) for programming. The connection diagram includes the programming chart.

5. Disconnect the clutch (C1 & C2) and brake (B1 & B2) leads from the controller terminal strip. Using an ohmmeter, check resistance between each lead and ground, and all other leads for shorts. If a brake is not used, check to ensure that the leads are not inadvertently shorting out inside of the drive.

Power on Tests

Do not apply power until this procedure instructs you to do so. Follow the instructions; each step has a purpose.

1. Check to make sure the machine is ready to be started and all personnel in the area are alerted. The drive should remain uncoupled from the load during initial start-up.
2. Prepare to start the ac motor portion of the drive to check the direction of rotation. If the machine can be damaged by reverse rotation, temporarily disconnect the output shaft. Checking rotation is best done by having two people involved, one to operate the pushbuttons and the other to watch the drive. Turn ON the ac power to the motor. Do not start the controller.
3. Bump the motor by starting and quickly stopping the motor. While the motor is coasting to a stop, look into one of the large louvered air discharge grilles located on either side of the drive. Observe the direction of rotation of the motor rotor and drum assembly. If rotation is not correct, turn OFF the ac power and reverse any two of the three motor leads (T1, T2, T3).
4. With ac power ON, start the ac motor. Do not start the controller. Let the ac motor run and observe its operation. Listen for any abnormal noise and feel for excessive vibration. The clutch portion of the drive should not be energized. With the output shaft disconnected, or with machines having very little friction, the output shaft may turn over slowly. This is caused by windage and bearing drag and is normal. Excessive torque at the output shaft is an indication of mechanical problems. If any defect is detected, shut down immediately and correct the problem. If the output shaft was disconnected in step 2, turn OFF the ac power and reconnect the shaft and replace the guards. Then turn on the ac power and restart the ac motor.
5. AC power is connected to the controller when the ac motor is running, either from the isolation transformer winding in the motor or from a separate isolation transformer connected to the load side of the motor starter. If you have installed a disconnect device in the controller ac input leads, close it at this time. Start the controller by pressing the Start pushbutton located on the operator's control panel. Turn the Run Speed potentiometer up (CW) until the output shaft begins to turn. Controllers with Auto/Manual switching should be in the Manual position. Torque controllers should be switched to the Torque position if they have Torque/Speed switching. The torque potentiometer should then be turned up (CW). If the drive output shaft turns when the potentiometer is turned up, turn the potentiometer back to zero (Full CCW) and proceed to step 6. Should the drive fail to run, turn to the Trouble Shooting section of this manual. The fault may be a simple wiring error, blown fuse or incorrect positioning of a plug or switch contact.
6. Check out the operation of the machine before making any controller adjustments. Turn up the Run Speed potentiometer (Torque potentiometer on Torque controls) and run the machine at some safe, reasonable speed. Carefully check all parts of the machine to make sure it is

functioning properly and that it is safe to continue. Stop the drive, turn OFF the ac power and make any connections that are necessary. When ready, proceed to the Adjustment Procedure.

Set-Up of Main PCB Assembly

This procedure is applicable to all Model 4000 and 4050 controllers. After reading this section, refer to the Instruction Sheet for your controller and follow the steps in the order provided. In each case the objective is to adjust the main PCB assembly first and then set up any modification that may be used. Six adjustments are found on the main PCB assembly. They are Zero Adjust, Maximum Speed/Volt, Linear Acceleration Rate, Velocity Damping, TC Adjust and Current Feedback. The six are grouped together at the edge of the board opposite the terminal strip. The name is silk-screened next to the adjustment to prevent error in selection. Each is a single turn potentiometer are adjusted at the factory during test to provide optimum performance on our test drive. However, some minor variations exist between drives, due to manufacturing tolerances, which may make it necessary to reset the adjustments.

Basic Speed Control

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 and 15-530-6
   Note: The board number is determined by which model controller you have either Model 4000 or 4050
   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 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/ACS/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		75%

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

Mechanical Unit Model Numbers		TC Adjust Setting
AC/ACM/ACS/PD/VT	AS/AT/AE/VT/EC	

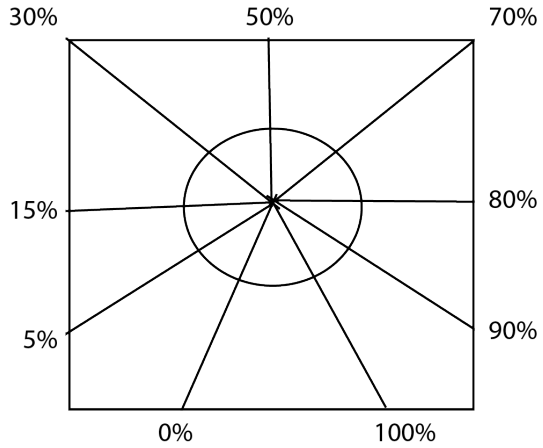
Fractional Hp (FHP)		
FHP/181/182		0%
184/186/214	14/18/112/132/140/180	15%
216/254/253/280	21/160/210	30%
320/360/440	25/27/180/225/250/280	100%

f. Set the Current Feedback potentiometer R20 to 0% (Full CCW)
g. Set the programming switches and jumper as indicated in the controller programming chart on the connection diagram

*Typical product number stamped on mechanical unit nameplate:

1. A1-100214-1053 specific mechanical model is AC-214

2. A1-100210-0003 specific mechanical model is EC-21



Trimpot Illustration Figure 6-1

Adjustment Procedure: *Caution: To avoid personal injury or damage to the test equipment remove power before connection or disconnecting test equipment.*

LED Set-Up

Since it is not always convenient to use a meter to monitor clutch voltage while setting up an eddy current controller, a light-emitting diode (LED) is included to provide a visual indication. The LED enables the operator to set Maximum Speed and Zero Adjust with only a small screwdriver.

Conditions: The Run Speed pot is at 0%. Aero Adjust is at 0%

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 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 obtained. 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 set-up 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 indicated that the speed of the drive is in the regulating range of the controller. The clutch voltage 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 will vary with different sized 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 de-energized (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) a cross 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 the 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 maximum 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. Trimpot Illustration Figure 6-1 to facilitate the setting of this control. Sufficient range has been provided for drive sizes from fractional trough 30 hp for the 4000 controller and up to 200 hp for the 4050 controller. Set your TC Control appropriately for your individual drive size, as shown in the Preliminary adjustments on page 33.

Setting are not critical and so may be "tuned" for each drive. High inertia application can benefit from higher than normal setting.

7. *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 80 seconds. When set at the slowed acceleration rate, the drive will take 80 seconds to accelerate from zero to full rated speed, following a linear ramp. When less than full speed is set, the time required to reach top speed is proportionally less.

4000/4050 Controller Response Date

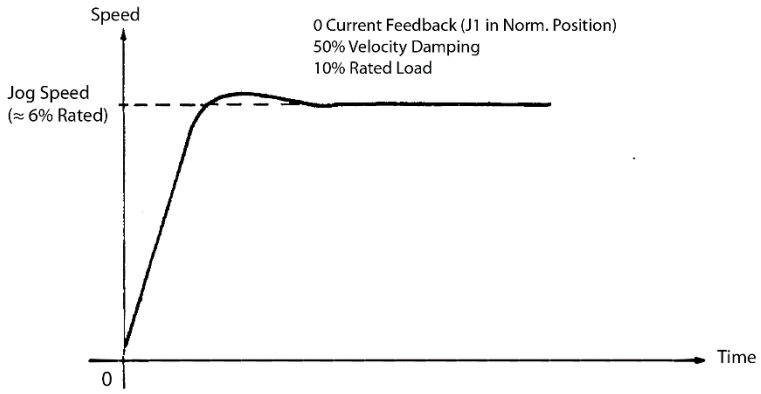


Figure 6-2 Curve No. 1

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

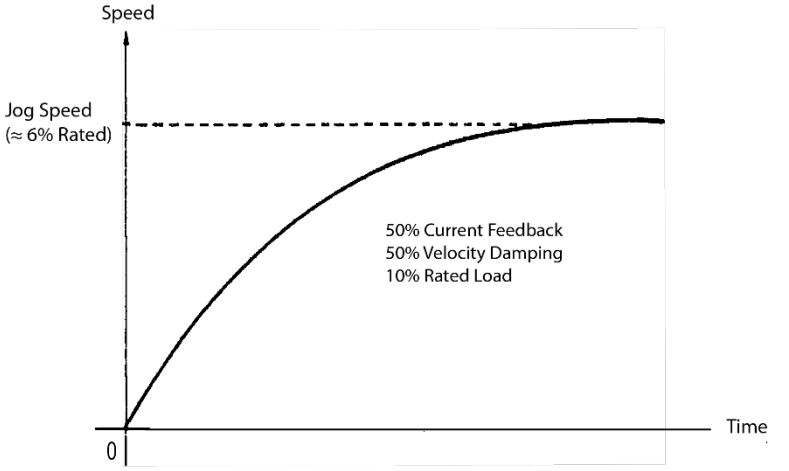


Figure 6-3 Curve No. 2

Note: Use current feedback in normal running mode may result in some overshoot. See Curve #4

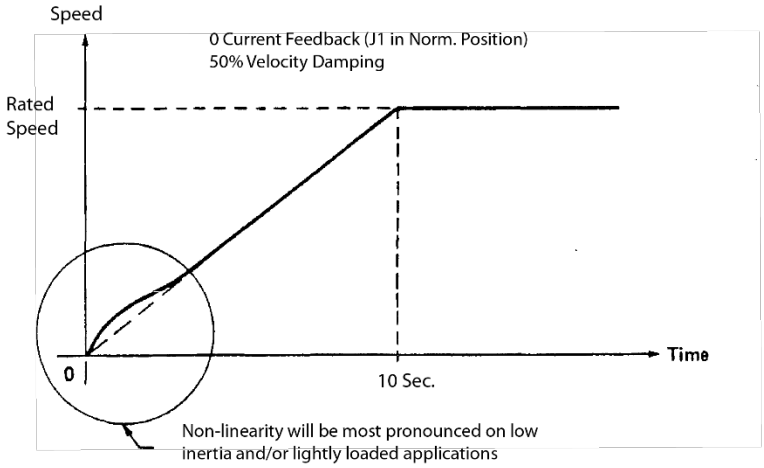


Figure 6-4 Curve No. 3

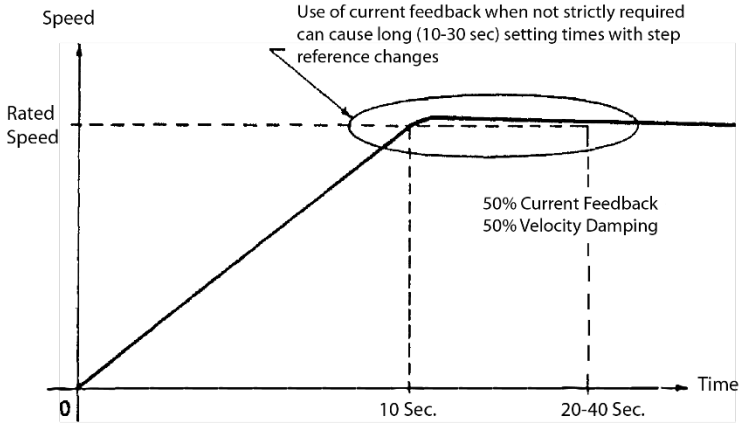


Figure 6-5 Curve No. 4

<u>To set the Accel Rate:</u> 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.

8. *Velocity Damping R22-* Velocity damping is the main type of damping used on the Model 4000 and 4050 controllers. This damping signal is derived from the speed feedback (governor generator) voltage is a dc voltage that functions primarily as the negative feedback signal. The significant advantage to using a velocity derivative damping signal is that a speed (velocity) damping signal detects speed changes, and speed is the quantity being controlled. This results in a more accurate and faster response to

both load and reference changes than would result from the use of current damping.

The Velocity Damping setting specified under Preliminary Adjustments is a good stating point and will result in satisfactory performance for most applications. This pot is used to match the controller's response (drive response is a function of the clutch coil time constant and the system inertia) The Proper setting for this adjustment depends on the drive size and total load inertia Unusually high or low inertia loads may require further adjustment of the Velocity Damping pot to obtain optimum system response. This must be done on a trail and error basis. If instability (speed control becomes erratic) occurs at any setting increase (turn CW) slightly until the speed becomes stable.

9. *Current Feedback, R20-* **** Normal operation will not require use of this potentiometer.*** However, there are some low inertia, light load, linear acceleration applications that may benefit from the improved low-end linearity that results from using current feedback damping. Certain applications are best met with a negative current feedback response which is slower in settling and less likely to overshoot at low rpms. These types of drive applications require the addition of current feedback to the velocity damping to obtain the desired performance. These applications primarily include slowing the responses at a low Jog/Inch speeds and maximizing the linearity on linear acceleration. The current feedback is normally not in the circuit. It is connected by changing the jumper J1 from the normal to the Increased position. J1 is located near the top of the main Model 4000 or 4050 printed circuit board.

   **The Current Feedback is a derivative signal, not a direct, proportional feedback signal.*

   The current feedback should be used in addition to, but not in place of, the velocity damping. For most applications some velocity damping is required for best response. A minimum setting of the Velocity Damping adjustment of 50% is recommended when used with current feedback.

   Typical response curves for low speed Jog/Inch and Linear Acceleration with and without current back are shown to demonstrate their effect on the drive's performance. The linear acceleration curves are typical of both the on-board and separate circuits.

10. For Speed Control with Jog: stop the controller, set the Run Speed pot to some slow speed and set the Run/Jog switch to Jog. Push the Start pushbutton; the drive will run at the selected slow speed as long as the Start pushbutton is depressed.

11. Check motor current to make sure the motor is operating within its rating. If motor current exceeds the nameplate rating, shut it down and correct the problems. This completes the adjustment procedure.

Basic Torque Control (Used when speed control is not used)

It is important to note that 100% torque is not 100% clutch coil voltage, as that amount of excitation will always overload the drive motor. Set maximum torque to not exceed full load motor current.

Refer to IS-000539-0012A, for the Basic Torque Control set-up procedure.

Section 7

Maintenance and Trouble Shooting

Maintenance

Very little maintenance is required to keep the Model 4000 and 4050 controllers in service. Periodically, we suggest that you check the controller to make sure all terminal screws and other connections are tight. Look for signs of trouble, such as burn spots on the boards, loose parts, worn out switches or pushbuttons and any other abnormal condition. Correct any deficiency found. If you have a question, consult the Dynamatic office at 262-554-7977.

The relays in the controller have a definite life, as do the potentiometers and switches. They are designed for many years of average use, but your operation may call for more frequent switching. Therefore, we suggest you stock replacements based on your type of operation. If you need help in deciding which parts to stock, our Customer Service Department will help you. A recommended spare parts list is included in the Instruction Sheets for your specific controller. This list is based on average conditions.

Trouble Shooting

The possibility of component failures or other problems always exists. This section of the manual is provided to assist you in finding the fault and making repairs. Our design philosophy is based on assembly replacement. Trying to find a failed part on a printed circuit board is not economical when you compare the cost of labor and down time with the cost of a replacement PCB assembly. Therefore, this manual limit trouble shooting to the sub-assembly level. Check the obvious first. Are the plugs and switches in the right position and is the power ON?

The Model 4000 and 4050 controllers are short circuit proof for the following conditions:

- Shorting of terminal C1 to C2
- Shorting of terminal B1 to B2
- Shorting of terminals C1 or C2 to earth ground
- Shorting of terminals B1 or B2 to earth ground

Should any of these conditions occur the controller is self-protecting and damage or degradation to any controller internal components will not happen. Blowing of fuses FU1 & FU2 may occur with some short circuit conditions. Mechanical drive & control panel are assumed to be at earth ground.

CAUTION: Turn OFF ac power to the motor and controller before making tests, except when voltage measurements are necessary. Only qualified personnel acquainted with safety procedures should service this equipment.

If the drive will not run:

We suggest you make these tests to check out the Model 4000 and 4050 controllers:

1. With ac power removed, set your multimeter on the 250 Vac range. Measure controller terminals X1 and X2. With power, OFF you should read zero volts. Do not proceed until a zero reading is obtained. Then pull fuses FU1 and FU2 (main PCB assembly) and check for blown fuses. Replace if required and re-install FU1 and FU2 in the controller.
2. Turn ON the ac power and start the motor. Use the meter, set on the 250 Vac range, to check for 115 Vac at terminals X1 and X2. Also check X1 to COM and X2 to COM for 57.5 Vac (nominal voltage based on 115 Vac input). If voltage is not found at these terminals, trace the problem back to the voltage source and correct it.
3. With ac power to the controller ON, remove the meter and switch to the 10Vdc range. Connect the positive lead to the 100% end of the Run Speed potentiometer (Torque on the basic Torque Control) and the negative lead to the zero end. When looking at the back of the potentiometer, with the terminals down, the 100% end is at the left and zero end on the right; you should read approximately 9 Vdc. If 9 Vdc is not obtained, replace the main PCB assembly.
4. With ac power ON, connect the meter (10 Vdc) leads to terminals P3 and COM (P3 is positive). You are now measuring the output of the Run Speed potentiometer (Torque on the basic Torque Control). Controllers with the selector switches on the cover should have the switch in the Run, Manual or Speed position. Turn the Run Speed potentiometer from zero to 100% (Full CW). The meter should indicate a voltage swing from 0 to 9 Vdc. If you do not observe this voltage at P3, check or replace the potentiometer, the E relay or the main PCB assembly, one at a time.
5. Connect the meter, set on the 250 Vdc range, to Power Bus (+) and COM (-). These points are push-on connector terminals located on the main PCB assembly near the E relay. With ac power ON, you should read 45 to 80 Vdc. With a brake coil connected (Fixed Brake) it will be approximately 50 Vdc. Without a brake coil it will be approximately 80 Vdc. If voltage is not present, replace the main PCB assembly.
6. Leave the power ON. Connect the meter to terminals B2 (positive and B1 (negative). A brake voltage of 45 Vdc should be observed with a brake coil connected (Fixed Brake). Without a brake coil connected this voltage will be approximately 80 Vdc. If an Adjustable Brake modification is included, and the brake coil is connected, the voltage measured may be between 0 to 45 Vdc, as set by the Brake Adj potentiometer. If no voltage is present, the problem could be in wither board. Replace them one at a time.
7. If the correct voltages are found in steps 1 through 6, and the drive still will not run, connect the meter across C2 (positive) and C1 (negative). Start the controller and turn the Run Speed potentiometer to 100% (Full CW). If clutch voltage between 0 and 45 Vdc is not observed, replace the main PCB assembly. If voltage is found the problem is not in the controller. Check the wiring to the drive, the brushes and slip rings (if any) and the clutch coil.

If the drive runs at full speed:

We suggest the following:

1. With the drive running, set your multimeter, on the 250 Vac range, on terminals G1 and G2. At full speed, the generator voltage should be in the 40 to 65 Vac range. If no voltage is found, the

problem is in the tach generator or the leads to the controller. If the voltage is present, check the Max Speed adjustments; and If that has no effect, replace the main PCB assembly.
Note: No generator is connected to the basic Torque control. If that drive runs only at full torque, replace the main PCB assembly. Controllers with alternate speed or follower type controllers should be checked in the Run, Manual or Speed mode of operation.

2. Mechanical problems, such as a failed bearing or plugged air gap, can cause the unit to run at full speed. Stopping the controller will not have any effect on the drive. It will run whenever the motor is running. If a fuse blows on a cold start, there may be a short or ground in the coil lead wires. Disconnect both leads at the controller terminal strip (C1 & C2) and check the resistance of the coil and resistance to ground. Check the drive's nameplate or instruction manual for the coil resistance. Resistance to ground should be about 20 megohms. When using a megger, make sure both coil leads are disconnected from the controller. Do not megger any portion of the controller.

   If the drive is erratic or hunts, we suggest you check for loose connections, proper brush seating and good slip ring surface (if used) and load pulsations that can reflect erratic load to the controller. If no external cause is found, replace the main PCB assembly.

Renewal Parts and Service

Renewal parts for the Model 4000 and 4050 controllers are stocked by Dynamatic. We suggest you stock renewal parts to minimize down time. You alone can evaluate the cost of down time compared to the cost of stocking spares. If you need help in establishing stock levels, consult Dynamatic. The Instruction Sheets for your individual controller contain a list of recommended spares, based on average requirements.

Warranty controller failure will be handled by replacement. Technical assistance is always available over the telephone, and field service engineers are available for start-up, trouble shooting and training seminars at the published rates. Service Engineers are located at the factory, in major industrial areas and in some other countries. Contact Dynamatic 262-554-7977.

Instruction Sheet

IS-000539-0001A

15-533-1001 Panel Mount 4000 (4.3 Controller)
15-535-1001 Standard Enclosure 4000 (4.3 A Controller)
15-536-1001 Blank Cover 4000 (4.3 A Controller)
15-539-0001 Panel Mount 4050 (8 A Controller)
15-540-0001 Standard Enclosure 4050 (8 A Controller)

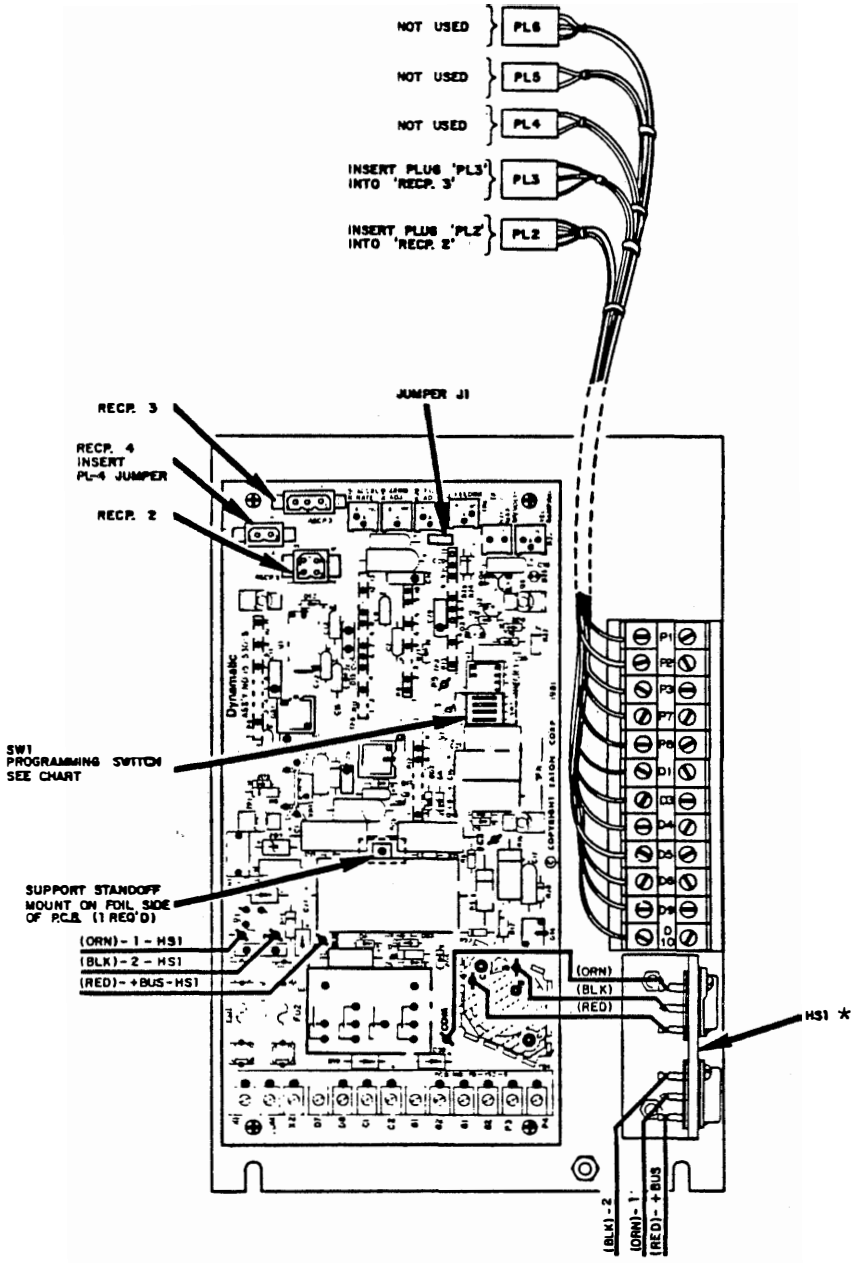
Dynamatic

MODEL 4000 AND 4050 WITH BASIC SPEED CONTROL

These instructions relate specifically to the Model 4000 and 4050 controllers assembled for basic Speed Control. Connection diagram, schematic diagram, switch programming, plug wiring connections, 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 these instructions for complete installation, operation and maintenance instructions.

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

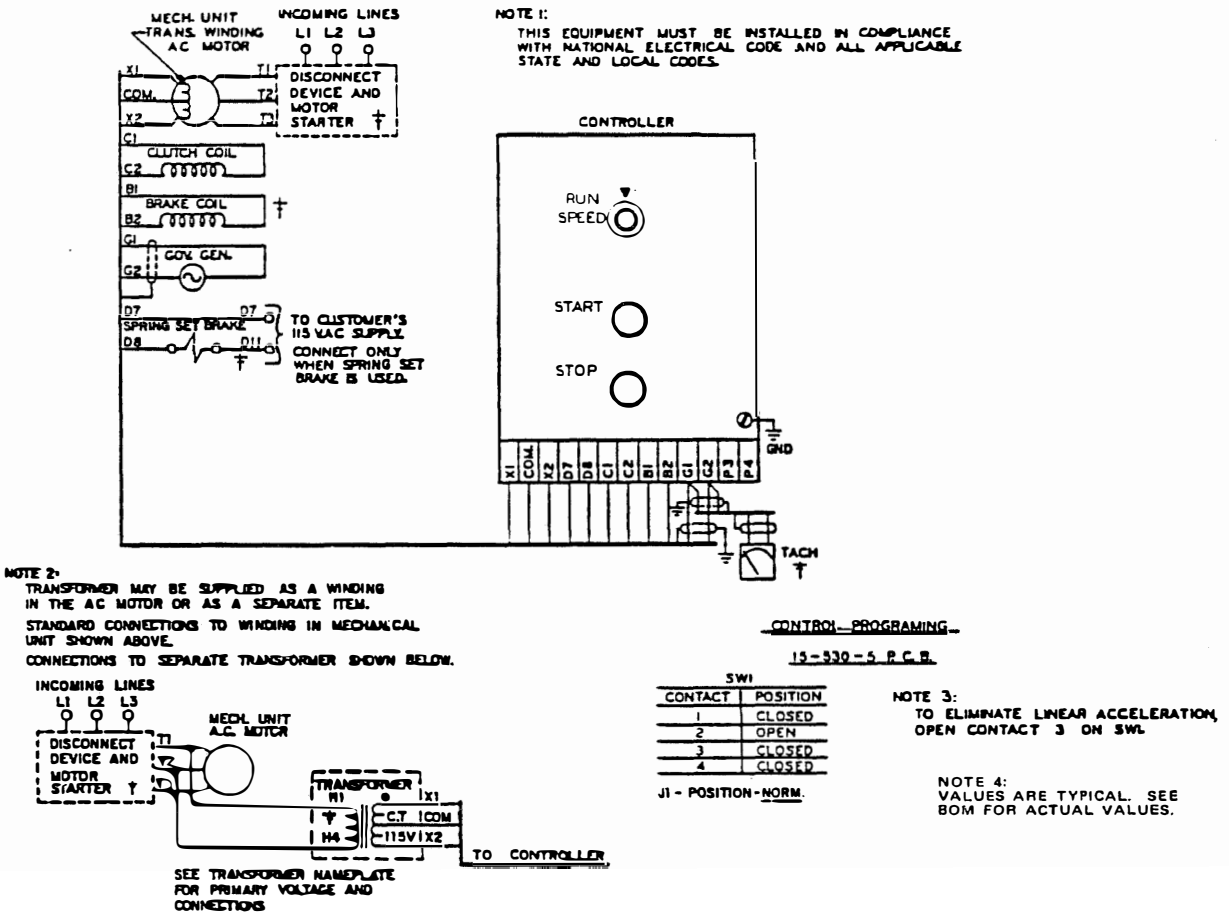
*Heat sink assembly, HS1, and its wiring are not supplied on Model 4000 controllers. The parts are mounted on the 15-530-5 main 4000 board.



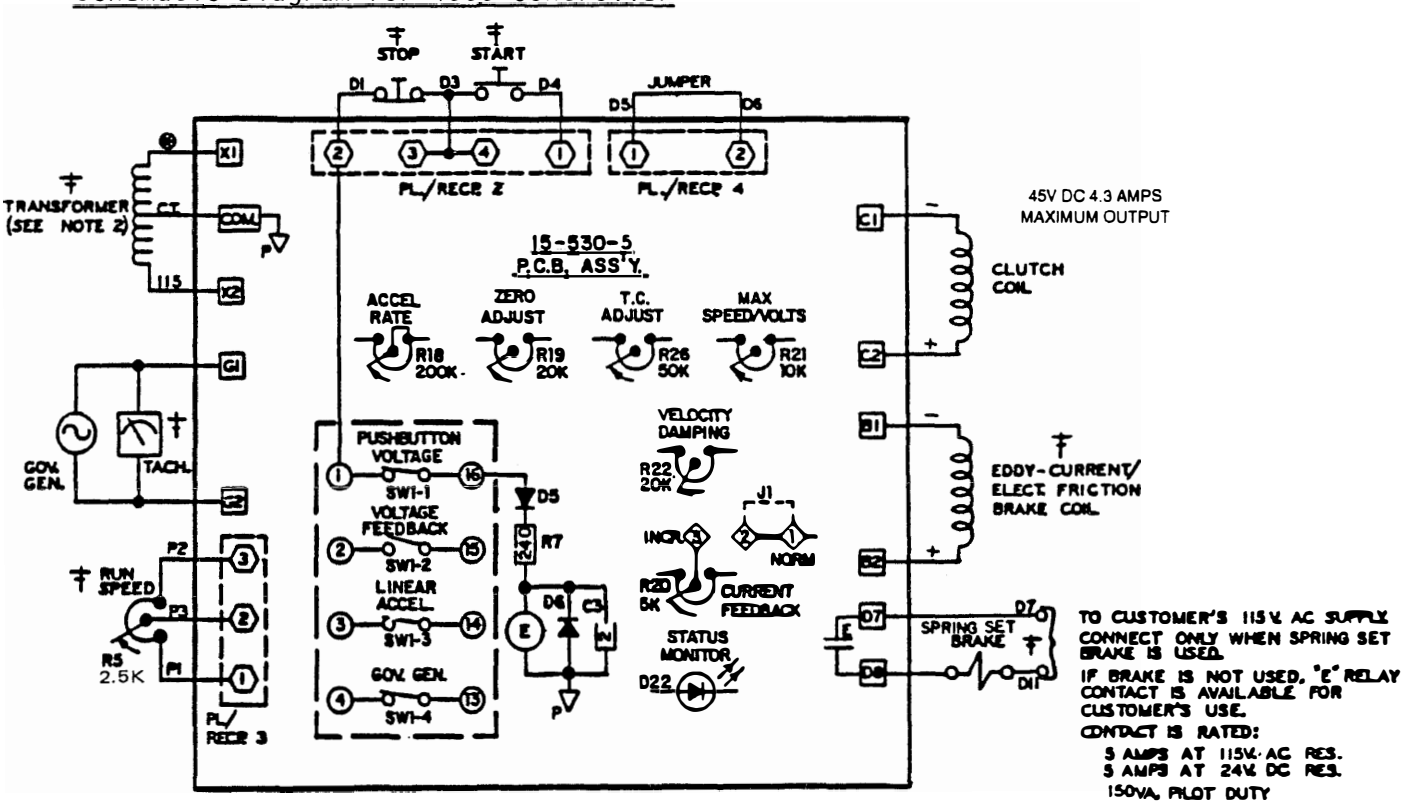
Standard Model 4050 Controller Panel

Dynamatic®
DRIVE SOURCE INTERNATIONAL, INC.
7900 Durand Avenue, Bdlg 3
Sturtevant, WI 53177, USA

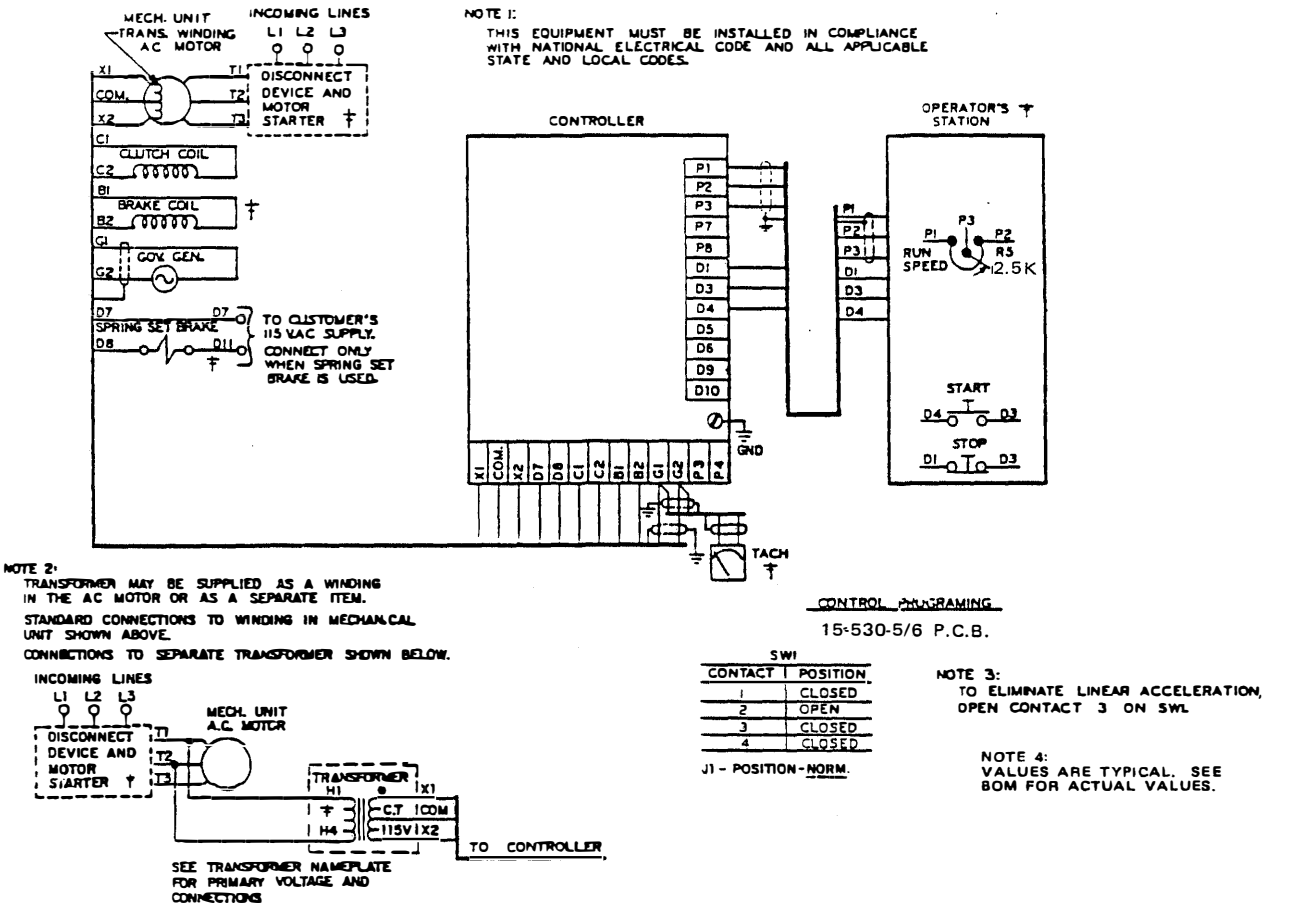
Connection Diagram for Standard Cast Enclosure 4000 Controller



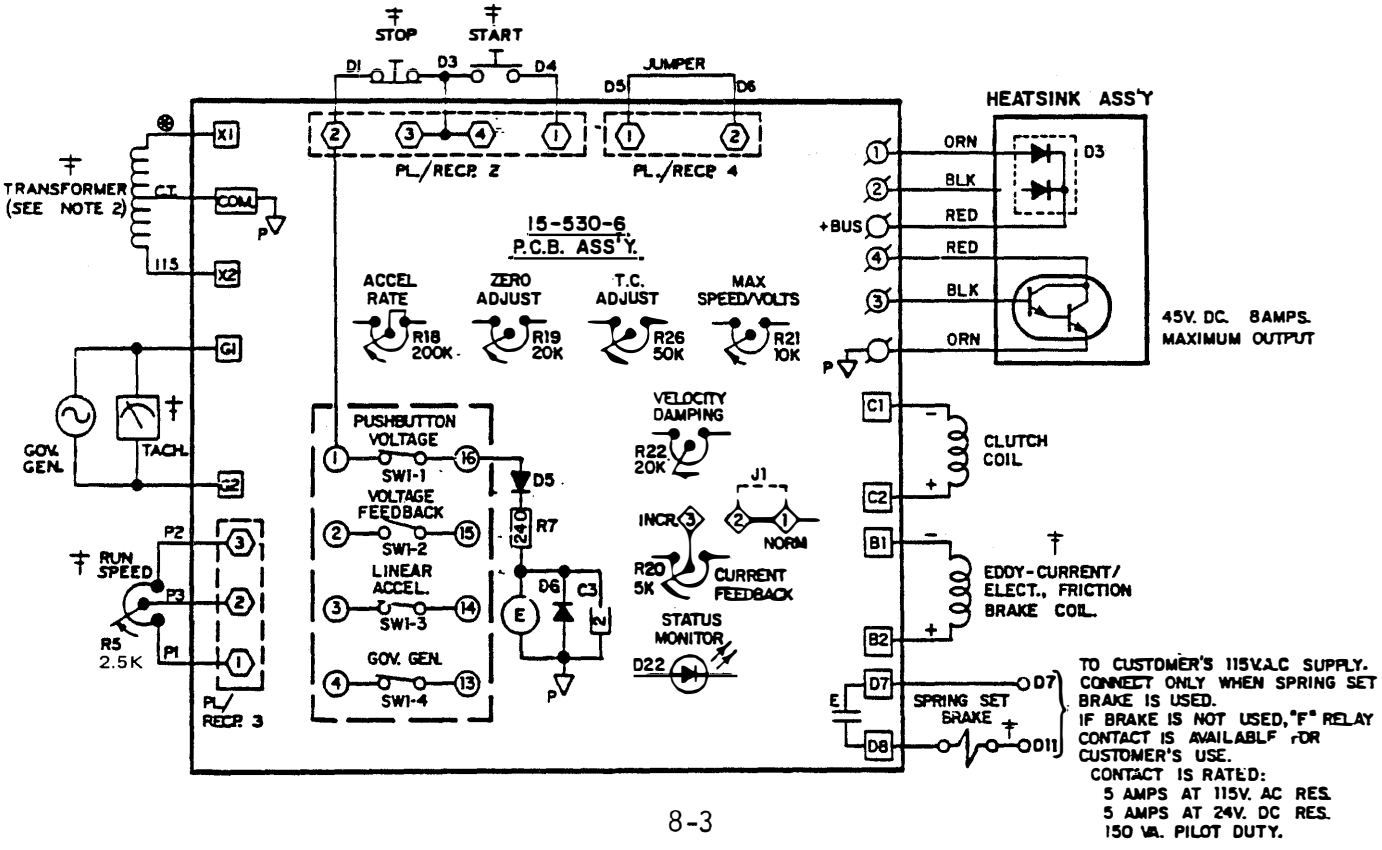
Schematic Diagram for 4000 Controller



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



Schematic Diagram for 4050 Controller



Visual Inspection

1. Before proceeding to the Preliminary Adjustments, check the controller for any damage that may have occurred during shipment, such as loose connections and damaged wire or components.

2. Check all interconnecting wires for conformance to connection diagram and schematic as supplied in this instruction sheet.

3. Check the Operator's controls (which are supplied by customer) to see if they are connected properly per the connection diagram. This includes the Run Speed pot R5 and the Start and Stop pushbutton controls.

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).

Mechanical Unit Model Numbers		Velocity Damping Setting
AC/ACM/ACS/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		75%

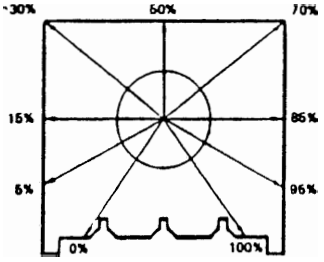
   d. Set the Velocity Damping potentiometer R22 as follows (see trimpot illustration):
   e. Set the Time Constant (TC) Adjust potentiometer R26 as follows (see trimpot illustration):

Mechanical Unit Model Numbers		TC Adjust Setting
AC/ACM/ACS/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%

*Typical product number stamped on mechanical unit nameplate:

1) A1-100214-1053, specific mechanical model is AC-214.
2) A1-100210-0003, specific mechanical model is EC-21.

   f. Set the Current Feedback potentiometer R20 to 0% (Full CCW).
   g. Set the programming switches and jumper as indicated in the controller programming chart on the connection diagram.



TRIMPOT ILLUSTRATION

Adjustment Procedure

CAUTION: To avoid personal injury or damage to the test equipment remove power before connecting or disconnecting test equipment.

The Model 4000 & 4050 controllers contain an LED status monitor which provides a visual means of setting the maximum speed and minimum bias. 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 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 set up 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 witha 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.

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 a nominal 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 accelepate from zero to full speed. Adjust the Accel Rate potentiometer R18 CCW for a slower accel rate, or CW for a faster accel rate.

*See Section 6 of this manual for a detailed description of this adjustment.

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 on 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. This completes the adjustment procedure.

*See Section 6 of this manual for a detailed description of this adjustment.

Renewal Parts List for 4000 & 4050 Basic Speed Controllers

Qty	Part Number	Description	Legend
		MODEL 4000 CONTROLLERS	
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
15-533-1001 PANEL MOUNT			
1	15-530-0005	Main PCB (Refer to PCB parts list above).	
15-535-1001 STANDARD ENCLOSURE			
1	15-530-0005	Main PCB (Refer to PCB parts list above).	
1	15-531-1001	Base assembly	
1	15-532-0001	Cover assembly (Basic)	
* 1	15-529-0001	Pushbutton assembly	PB1,2
* 1	15-529-0003	Speed pot	R5
15-536-1001 BLANK COVER			
1	15-530-0005	Main PCB (Refer to PCB parts list above).	
1	15-531-1001	Base assembly	
1	15-532-0000	Cover assembly (blank)	
		MODEL 4050 CONTROLLERS	
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
15-539-0001 PANEL MOUNT			
1	15-530-0006	Main PCB (Refer to PCB parts list above).	
1	15-529-0019	Heat sink assembly, incl. Q1 & D3	
15-540-0001 STANDARD ENCLOSURE			
1	15-539-0001	Basic Panel assembly (Refer to panel mount parts list above).	

* denotes minimum spare parts.
** denotes suggested spares when downtime is critical.

Instruction Sheet

IS-000539-0003A

15-533-1003 Panel Mount 4000 (4.3 Controller)
15-535-1003 Standard Enclosure 4000 (4.3 A Controller)
15-536-1003 Blank Cover 4000 (4.3 A Controller)
15-539-0003 Panel Mount 4050 (8 A Controller)
15-540-0003 Standard Enclosure 4050 (8 A Controller)

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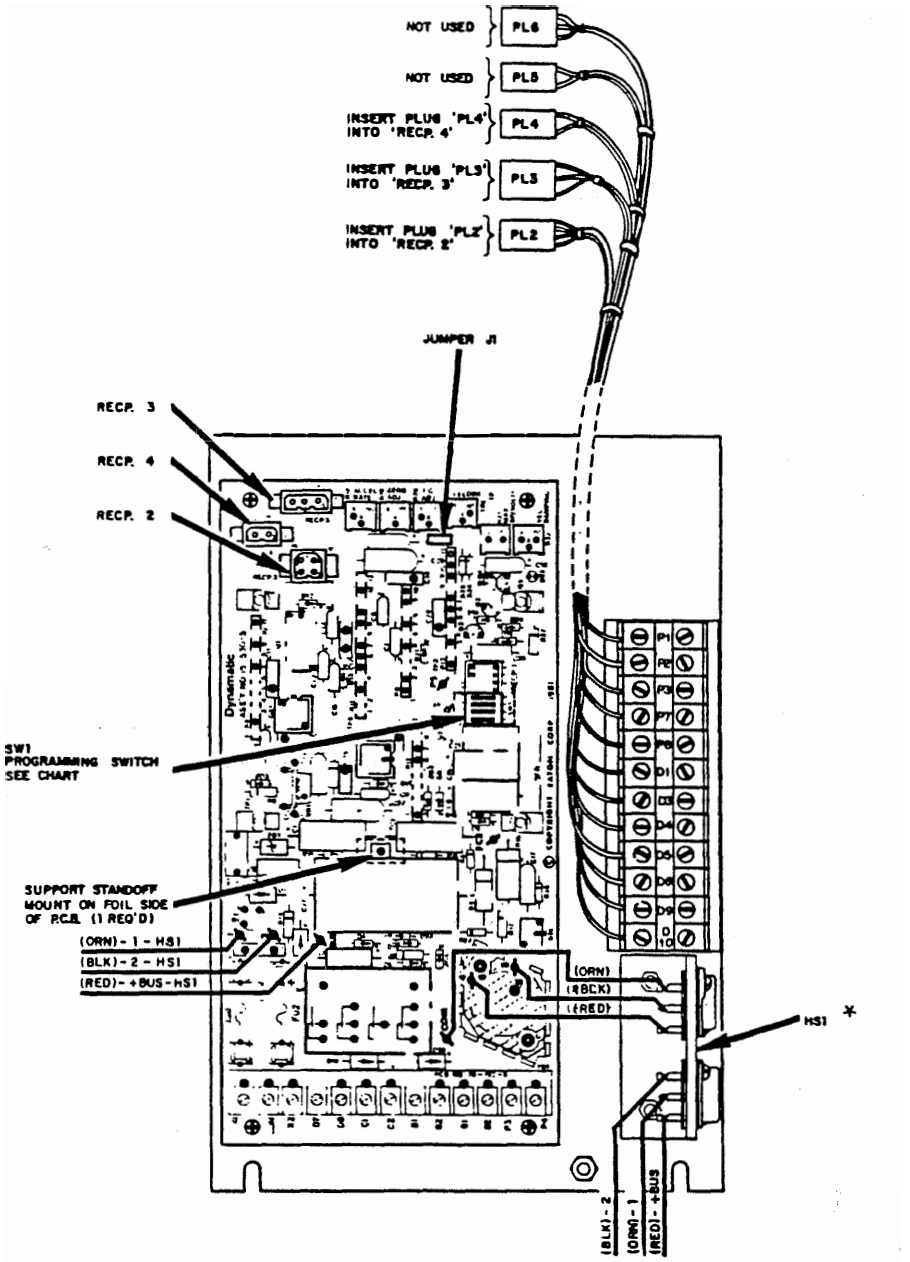
MODEL 4000 AND 4050 WITH JOG AT RUN SPEED

These instructions relate specifically to the Model 4000 and 4050 Controllers assembled for Speed Control trol with Jog at Run Speed modification. Connection diagram, schematic diagram, switch programming, plug wiring connections, 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 these instructions for complete installation, operation and maintenance instructions.

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

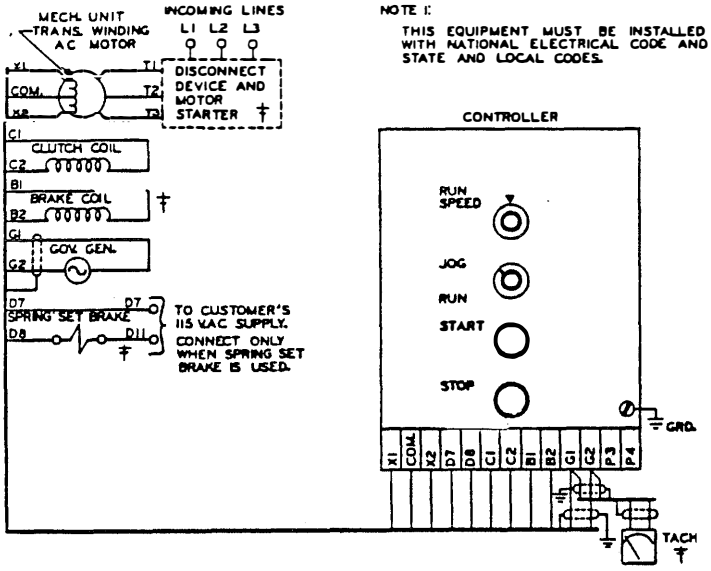
*Heat sink assembly, HS1, and its wiring are not supplied on Model 4000 controllers. The parts are mounted on the 15-530-5 main 4000 board.



4050 Controller Panel with Jog at Run Speed

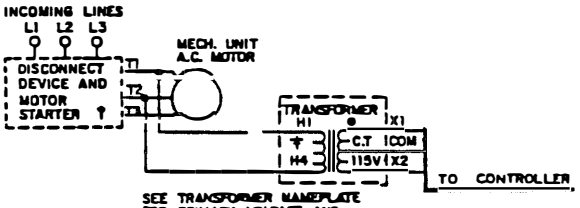
Dynamatic®
DRIVE SOURCE INTERNATIONAL, INC.
7900 Durand Avenue, Bdlg 3
Sturtevant, WI 53177, USA

Connection Diagram for Standard Cast Enclosure 4000 Controller



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 SHOWN ABOVE.
CONNECTIONS TO SEPARATE TRANSFORMER SHOWN BELOW.



CONTROL PROGRAMING
15-530-5 P.C.B.

SW1

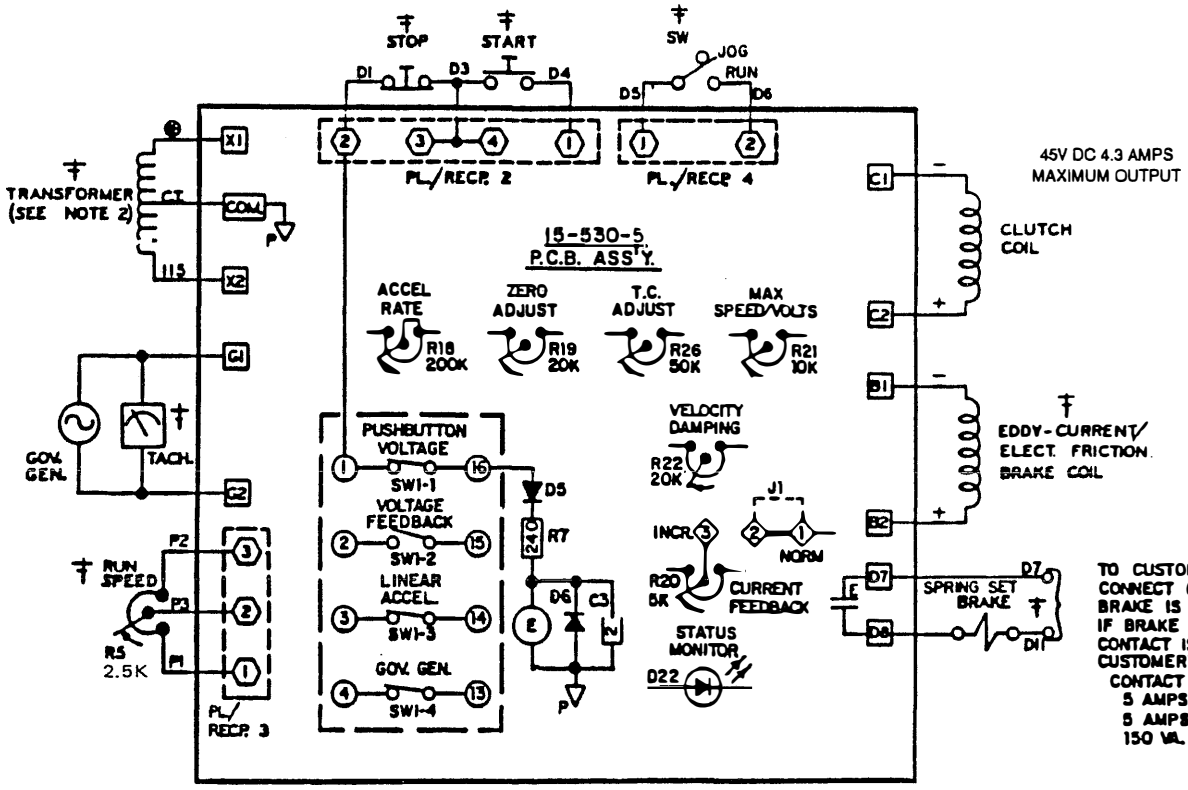
CONTACT	POSITION
1	CLOSED
2	OPEN
3	CLOSED
4	CLOSED

J1 - POSITION - NORM.

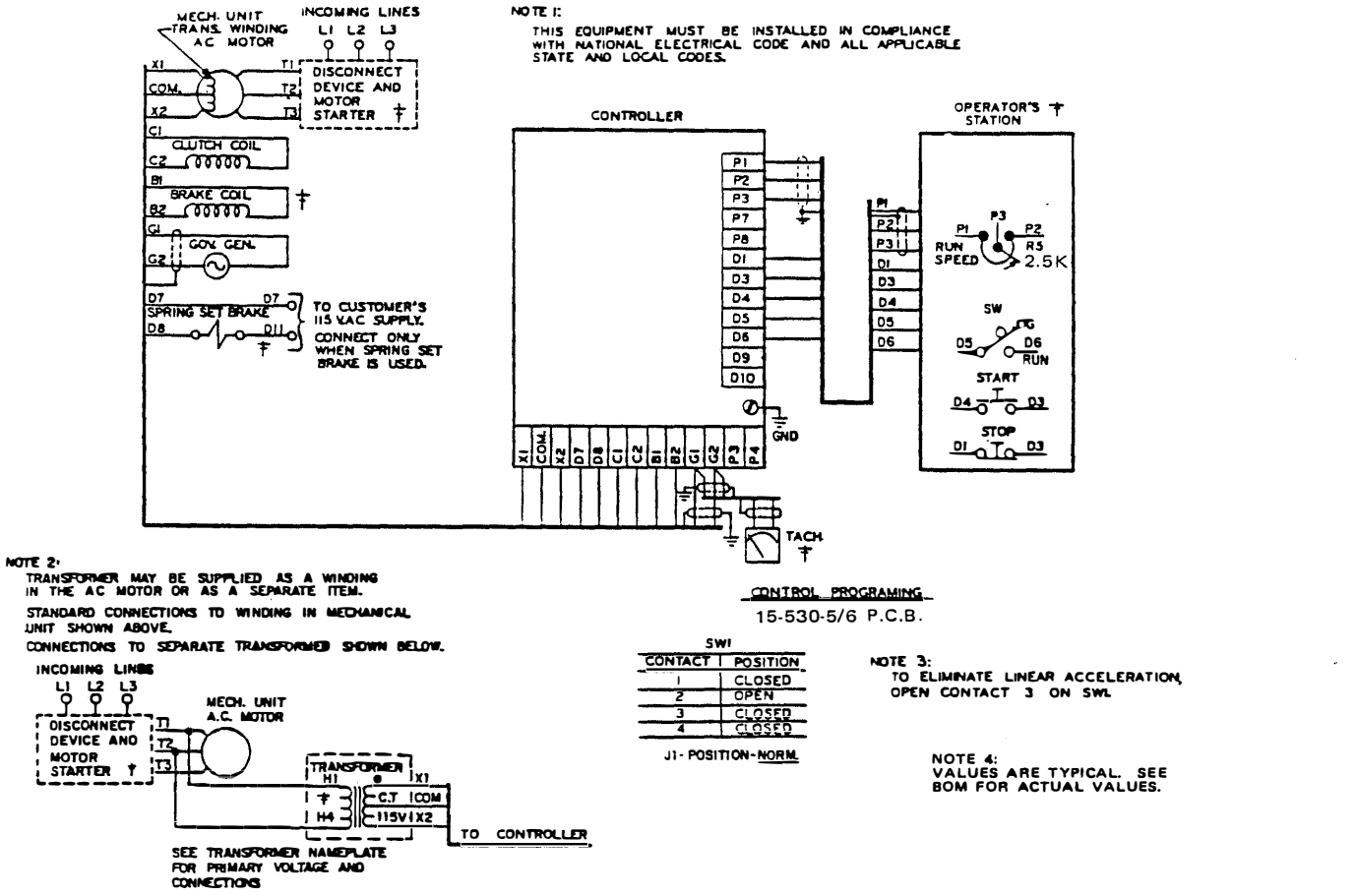
NOTE 3:
TO ELIMINATE LINEAR ACCELERATION, OPEN CONTACT 3 ON SW1.

NOTE 4:
VALUES ARE TYPICAL. SEE BOM FOR ACTUAL VALUES.

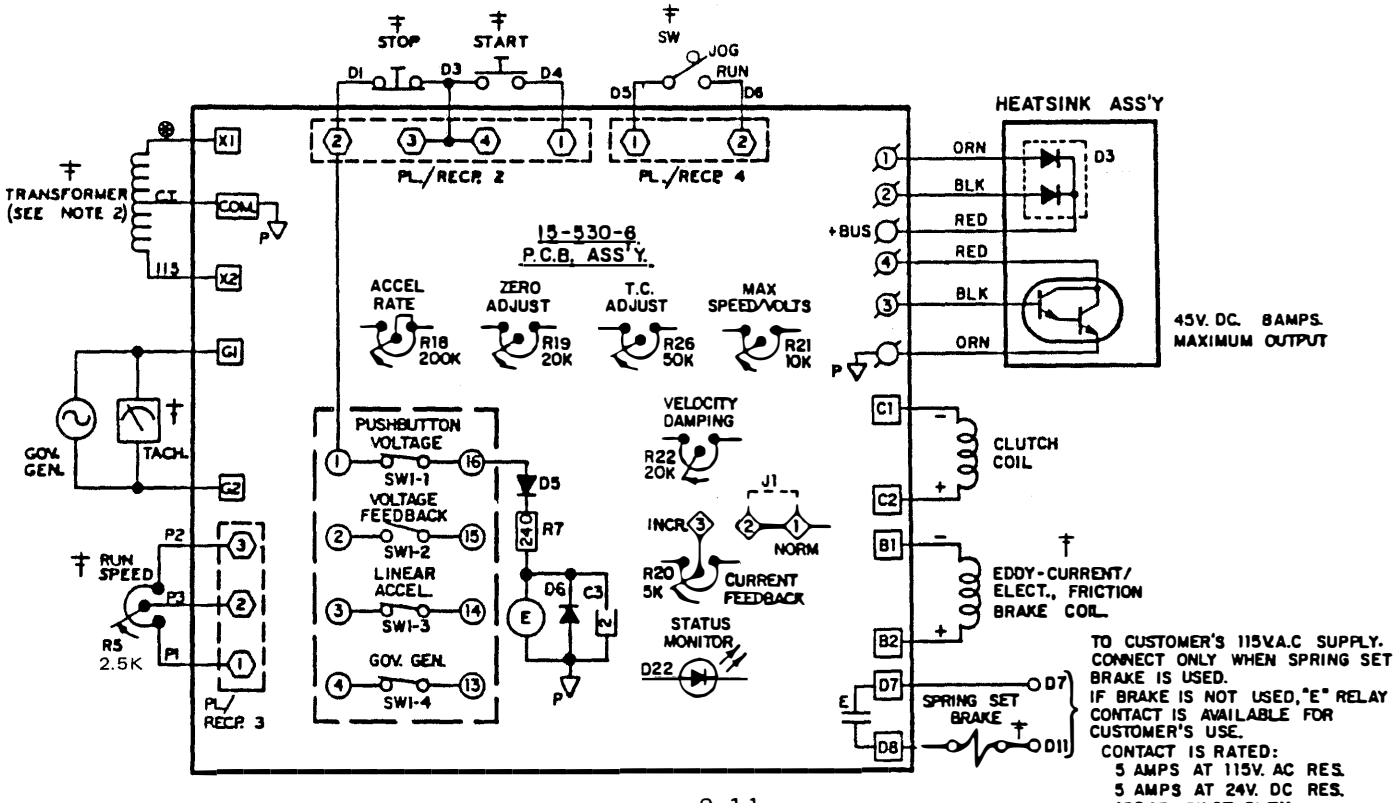
Schematic Diagram for 4000 Controller



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



Schematic Diagram for 4050 Controller



Visual Inspection

1. Before proceeding to the preliminary adjustments, check the controller for any damage that may have occurred during shipment, such as loose connections and damaged wire or components.

2. Check all interconnecting wires for conformance to connection diagram and schematic as supplied in this instruction sheet.

3. Check the Operator's controls (which are supplied by customer) to see if they are connected properly per the connection diagram. This includes the Run Speed pot R5, Run/Jog selector switch and the Start and Stop pushbutton controls.

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. Set the Run/Jog selector switch to the Run position.
   c. 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 rotentiometer R19 to 0% (Full CCW).

Mechanical Unit Model Numbers		Velocity Damping Setting
AC/ACM/ACS/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		75%

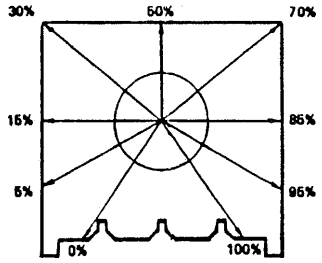
   c. Set the Max Speed/Volts potentiometer R21 to 0% (Full CCW).
   d. Set the Velocity Damping potentiometer R22 as follows (see trimpot illustration):
   e. Set the Time Constant (TC) Adjust potentiometer R26 as follows (see trimpot illustration):

Mechanical Unit Model Numbers		TC Adjust Setting
AC/ACM/ACS/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%

*Typical product number stamped on mechanical unit nameplate:

1) A1-100214-1053, specific mechanical model is AC-214.
2) A1-100210-0003, specific mechanical model is EC-21.

   f. Set the Current Feedback potentiometer R20 to 0% (Full CCW).
   g. Set the programming switches and jumper as indicated in the controller programming chart on the connection diagram.



TRIMPOT ILLUSTRATION

Adjustment Procedure

CAUTION: To avoid personal injury or damage 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 minimum bias. 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 set up 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 application are best met within a negative current feedback response which is slower in settling and less likely to overshoot at low rpm's. There ar some low inertia, light load, linea acceleration applications that may also benefit with better low end linearity from 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.

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 a nominal 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 in both Run and Jog modes by setting the programming switches as indicated o the programming chart on the connection diagram.

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

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 fulction of the clutch coil time constant and system inertia). The proper setting for this adjustment depends on 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. This completes the adjustment procedure.

*See Section 6 of this manual for a detailed description of this adjustment.

Renewal Parts List for 4000 and 4050 Controllers with Jog at Run Speed

Qty	Part Number	Description	Legend
		MODEL 4000 CONTROLLERS	
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
15-533-1003 PANEL MOUNT			
1	15-530-0005	Main PCB (Refer to PCB parts list above).	
15-535-1003 STANDARD ENCLOSURE			
1	15-530-0005	Main PCB (Refer to PCB parts list above).	
1	15-531-1001	Base assembly	
1	15-532-0002	Cover assembly (Jog at Run Speed)	
* 1	15-529-0001	Pushbutton assembly	PB1,2
* 1	15-529-0003	Speed pot	R5
1	15-529-0005	1 Selector switch assy.	SW4
15-536-1003 BLANK COVER			
1	15-530-0005	Main PCB (Refer to PCB parts list above).	
1	15-531-1001	Base assembly	
1	15-532-0000	Cover assembly (blank)	
		MODEL 4050 CONTROLLERS	
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
15-539-0003 PANEL MOUNT			
1	15-530-0006	Main PCB (Refer to PCB parts list above).	
1	15-529-0019	Heat sink assembly, incl. Q1 & D3	
15-540-0003 STANDARD ENCLOSURE			
1	12-007-0017	Enclosure parts	
1	15-539-0003	Panel assembly (Refer to Panel Mount parts list above.)	

* denotes minimum spare parts.
** denotes suggested spares when downtime is critical.

Instruction Sheet

IS-000539-0012A

15-533-1012 Panel Mount 4000 (4.3 Controller)
15-535-1012 Standard Enclosure 4000 (4.3 A Controller)
15-536-1012 Blank Cover 4000 (4.3 A Controller)
15-539-0012 Panel Mount 4050 (8 A Controller)
15-540-0012 Standard Enclosure 4050 (8 A Controller)

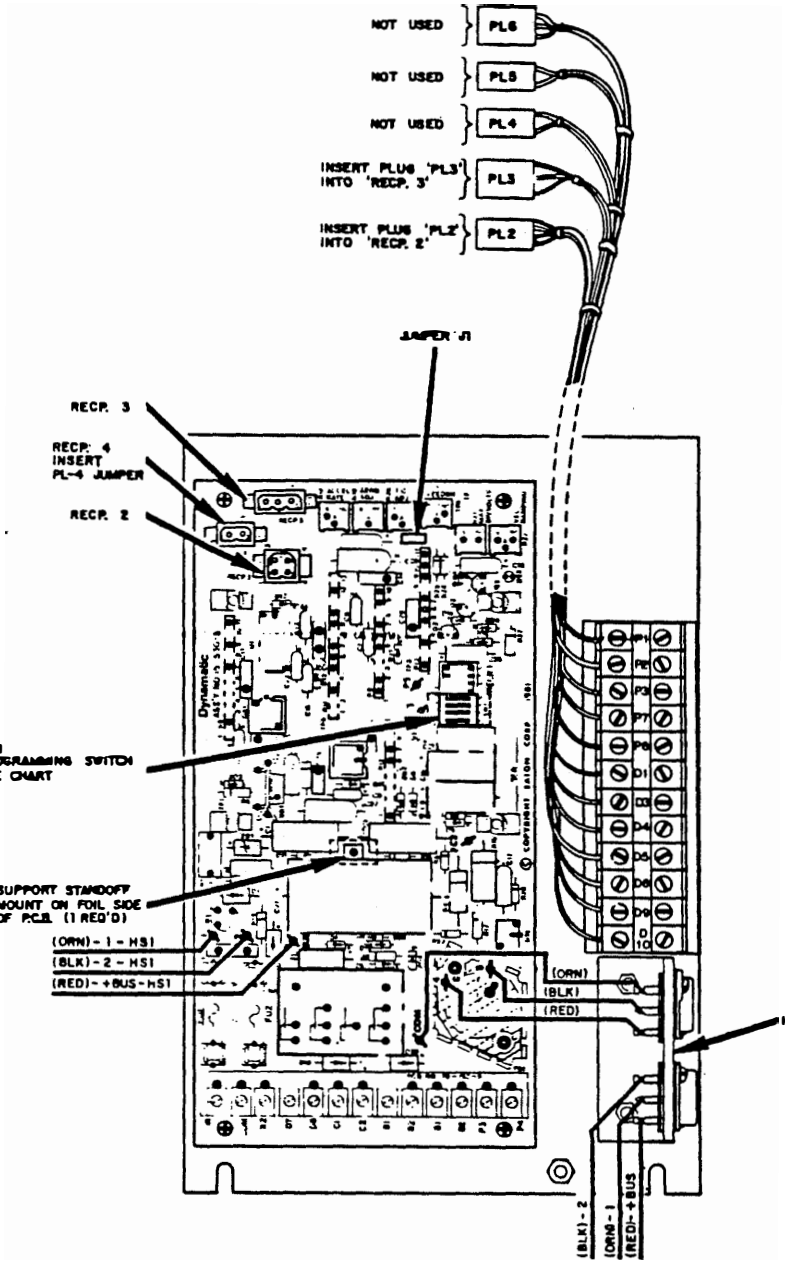
Dynamatic

MODEL 4000 AND 4050 WITH BASIC TORQUE CONTROL

These instructions relate specifically to the Model 4000 and 4050 controllers assembled for Basic Torque Control. Connection diagram, schematic diagram, switch programming, plug wiring connections, 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 these instructions for complete installation, operation and maintenance instructions.

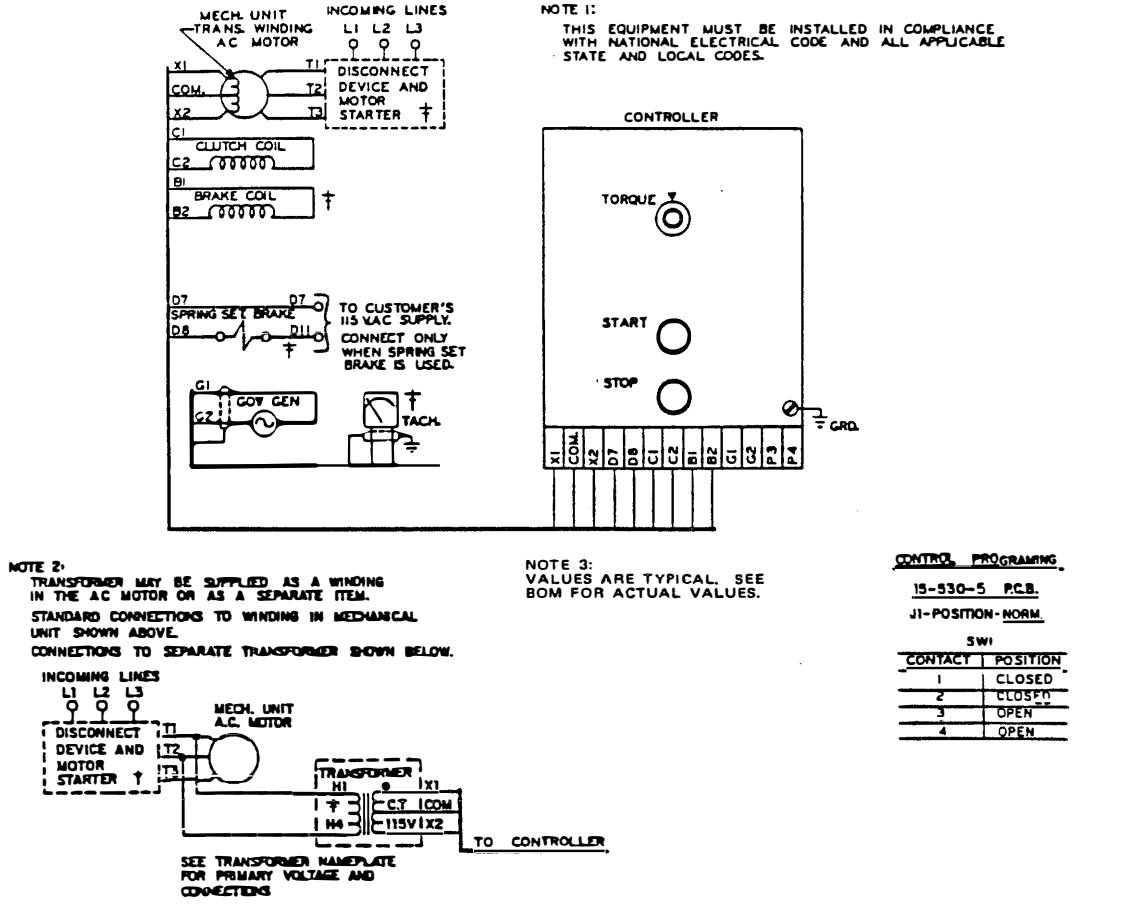
CAUTION: Above ground electrical potentials can be hazardous. Always disconnect electrical power before working on the controller.

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

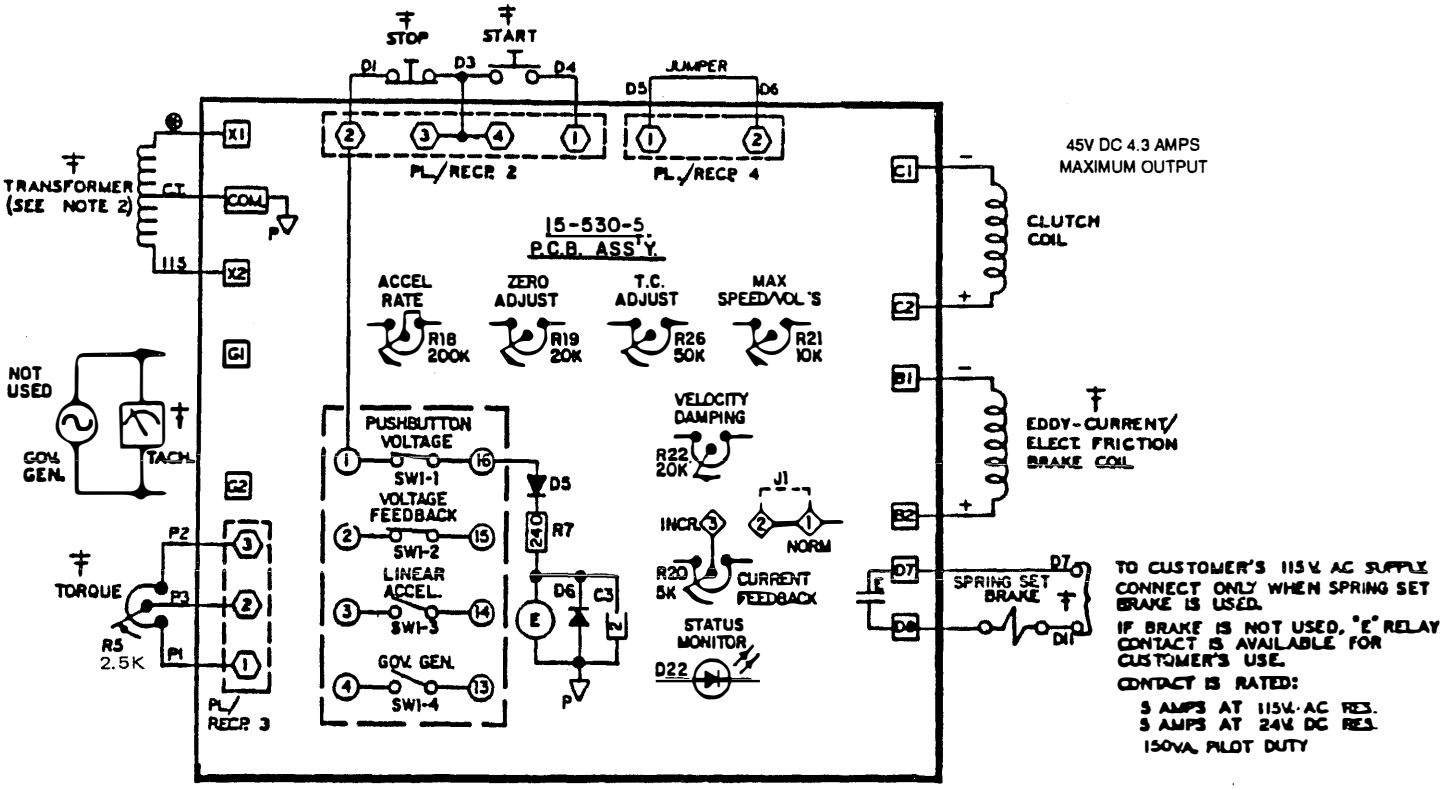


Model 4050 Controller Panel with Basic Torque Control

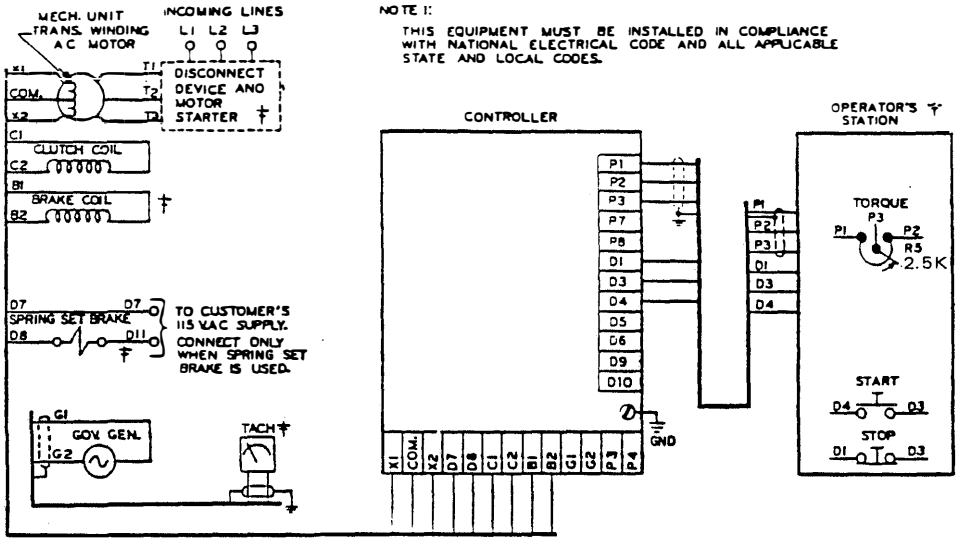
Connection Diagram for Standard Cast Enclosure 4000 Controller



Schematic Diagram for 4000 Controller

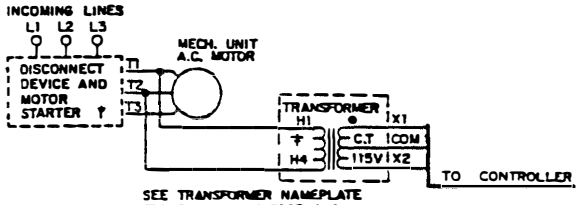


Connection Diagram for 4000 Panel Mount/Blank Cover and 4050 Panel Mount Controllers



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 SHOWN ABOVE.
CONNECTIONS TO SEPARATE TRANSFORMER SHOWN BELOW.



NOTE 3:
VALUES ARE TYPICAL. SEE BOM FOR ACTUAL VALUES.

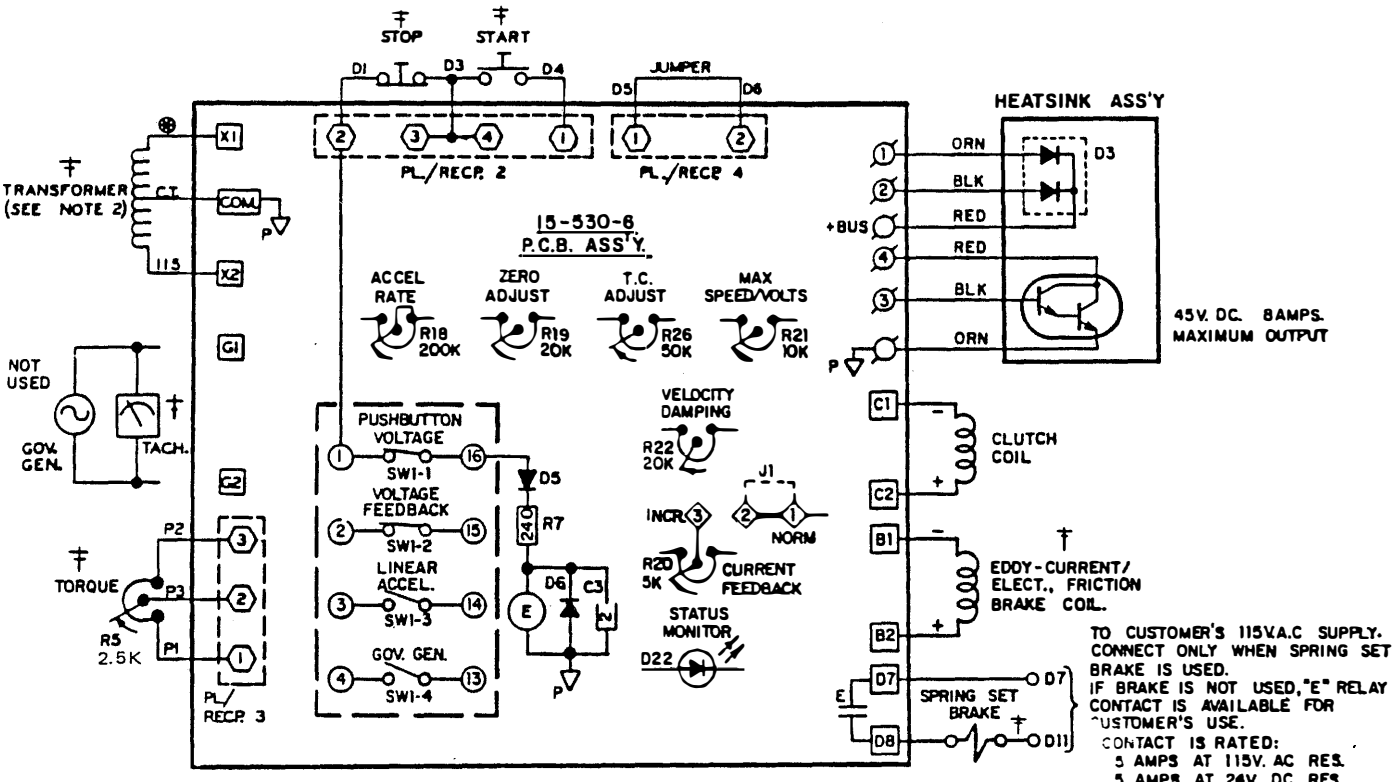
CONTROL PROGRAMING
15-530-5/6 P.C.B.

J1-POSITION-NORM.

SW1

CONTACT	POSITION
1	CLOSED
2	CLOSED
3	OPEN
4	OPEN

Schematic Diagram for 4050 Controller



Visual Inspection

1. Before proceeding to the preliminary adjustments, check the controller for any damage that may have occurred during shipment, such as loose connections and damaged wire or components.

2. Check all interconnecting wires for conformance to connection diagram and schematic as supplied in this instruction sheet.

3. Check the Operator's controls (which are supplied by customer) to see if they are connected properly per the connection diagram. This includes the Operator Torque pot R5 and the Start and Stop pushbutton controls.

Preliminary Adjustments

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

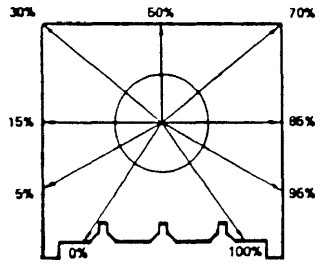
1. Operator Controls (supplied by customer unless specified)

   a. Set the Torque 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 to 0% (Full CCW).
   e. Set the Time Constant (TC) Adjust R26 to 0% (Full CCW).
   f. Set the Current Feedback potentiometer R20 to 0% (Full CCW).
   g. Set the programming switches and jumper as indicated in the controller programming chart on the connection diagram.



TRIMPOT ILLUSTRATION

Adjustment Procedure

CAUTION: To avoid personal injury or damage 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 minimum bias. This LED set up along with an alternate method is given below.

1. Install an ac ammeter in one of the ac motor leads to monitor motor current. This meter should be used to monitor motor current during all of the following set steps to ensure that the motor is not overloaded. The rated full load current of the ac motor is shown on the nameplate on the motor. This value should not be exceeded during normal operation. If it is, the Max Speed/Volts adjustment should be reduced.

2. Turn ON the power to the drive and start the ac motor.

3. Start the controller with the Start pushbutton. Note the location of the Stop pushbutton.

4. 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 torque or some minimum torque greater than zero, as required by the machine operating requirements.

a. For zero torque: 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 torque greater than zero, the LED cannot be used. Turn the Zero Adjust potentiometer CW until the desired torque is attained.

5. MAX SPEED/VOLTS R21 - This adjustment can be set to limit drive torque to its maximum or to a lower torque as required by the machine process. An LED status monitor has been provided on the main board to allow you to set the maximum torque without the use of a voltmeter. However, an alternate method of set up using a voltmeter is given also.

   MAX SPEED/VOLTS R21 with LED monitor Set the Torque 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 drive is operating in the regulating range of the controller. The clutch voltage should drop below 45V.

   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 approximate maximum torque with a voltmeter: connect a voltmeter (50 Vdc scale) across terminals C1 and C2. Turn the Torque 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 a reading of 45V is obtained. This is the point of maximum torque.

   b. To set a torque that is less than maximum torque: turn the Torque 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 torque is indicated.

6. Important Note - 100% torque is not 100% coil voltage. That amount of excitation will always overload the drive. After the above steps using the LED or voltmeter have been completed, the drive should be operated through its entire range to be sure the motor current does not exceed the full load nameplate rating as described in step 1 above. Also, make sure that the drive thermal limit is not exceeded at the lower output speeds.

7. No adjustment is required for the Accel Rate R18, Velocity Damping R22, TC Adjust R26 or Current Feedback R20 potentiometers on Torque controllers. This completes the adjustment procedure.

Renewal Parts List for Standard 4000 and 4050 Controllers with Basic Torque Control

Qty	Part Number	Description	Legend
		MODEL 4000 CONTROLLERS	
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
15-533-1012 PANEL MOUNT			
1	15-530-0005	Main PCB (Refer to PCB parts list above).	
15-535-1012 STANDARD ENCLOSURE			
1	15-530-0005	Main PCB (Refer to PCB parts list above).	
1	15-531-1001	Base assembly	
1	15-532-0008	Cover assembly (Torque)	
* 1	15-529-0001	Pushbutton assembly	PB1,2
* 1	15-529-0003	Speed pot	R5
15-536-1012 BLANK COVER			
1	15-530-0005	Main PCB (Refer to PCB parts list above).	
1	15-531-1001	Base assembly	
1	15-532-0000	Cover assembly (blank)	
		MODEL 4050 CONTROLLERS	
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
15-539-0012 PANEL MOUNT			
1	15-530-0006	Main PCB (Refer to PCB parts list above).	
* 1	15-444-0007	Dancer Position PCB assembly	
1	15-529-0019	Heat sink assembly, incl. Q1 & D3	
15-540-0012 STANDARD ENCLOSURE			
1	15-539-0012	Panel assembly (Refer to Panel Mount parts list above.)	

* denotes minimum spare parts.
** denotes suggested spares when downtime is critical.

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