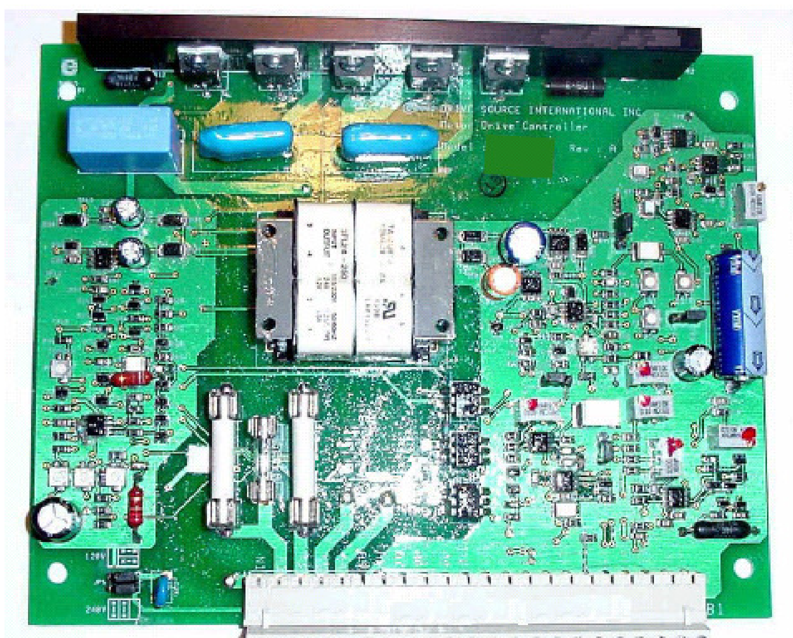
**Model DSI-700**
**Universal Eddy-Current Controller**

# Instruction Manual

**(Revision 2.0, March 15, 2007)**

Part Number IM-150700-0701



**7900 Durand Avenue, PO Box 0361**
**Sturtevant, WI USA 53177**
**Toll Free: (800) 548-2169 (Mon thru Fri – 8 AM to 4 PM CST)**
**Email:** drivesourse1@yahoo.com
**24 hours Service: (262) 499-0437**
**Application Engineering * Quality Products * Total Solutions**

# TABLE OF CONTENTS

# GENERAL INFORMATION

## Introduction

This instruction manual contains the necessary information required for the normal installation, operation, and maintenance of the **Model DSI-700** eddy current controller. Please make it available to all maintenance and operating personnel.

The **DSI-700** is a quality, high performance controller capable of providing excitation for the ***Dynamatic*** **Ajusto-Spede** eddy current drives, as well as those manufactured by others. The **DSI-700** may be used with drives ranging from the fractional hp **FAS** line of drives from 1/4- to 1.5-Hp, the complete **AS** line of integral motor-clutch drives from 1- through 40-Hp, as well as the full line of **AT** drives through 200-Hp.

Instructions provided in this manual are arranged in their normal order of use. Beginning with general information on warranty, safety, training, equipment handling, receiving and damage claims, and storage, it gives brief information about system description, specifications, installation, start-up and various adjustments, maintenance and trouble shooting. These instructions do not cover or describe any modification that may be used with the controller, but they do address each and every adjustment and/or user-accessible function of the controller. In the case of special or modified controllers, use this instruction manual in conjunction with any specific schematic, prints or instructions supplied with your specific controller. Special 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 operation or maintenance of this controller, please refer them immediately to:

**Customer Service Department**
**Drive Source International, Inc.**
**7900 Durand Avenue**
**Sturtevant, WI 53177**
**Phone is (262) 554-7977**
**FAX is (262) 554-7041**

## Contents Of Package

The DSI-700 controller is shipped in packaging designed to withstand normal shipping and handling conditions for electronic circuit boards. The following are the contents of the shipping box:

* DSI-700 Universal Eddy-Current controller circuit Board with mating socket wrapped in bubble pack.
* Small Plastic bag with four (4) mounting screws, (4) stand-offs, and a service label.
* Instruction Manual

Contact Drive Source International immediately if any one of the items mentioned above is missing.

## Warranty

Your new Model **DSI-700** controller is covered by a 1-year warranty against any manufacturing defect in either material or workmanship. If the control unit fails within the 1-year warranty period, please return the controller to our Electronics Repair Service facility in Sturtevant, Wisconsin for warranty repair or exchange. Your controller will either be repaired or replaced with a fully reconditioned controller. Shipping charges both ways are your responsibility. For further assistance, you may also contact the Customer Service Department at:

**DRIVE SOURCE INTERNATIONAL INC.**
**7900 Durand Avenue**
**Sturtevant, WI 53177 USA**
**Telephone: (262) 554-7977 or (800) 548-2169**
**Fax: (262) 554-7041**

**Safety Considerations**

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 correct procedures that meet the requirements of all applicable safety codes. The wiring must be in accordance with the National Electric Code and all other local codes and regulations. Means should be in place to protect operating and maintenance personnel from moving machine parts as well as high voltage. Refer to OSHA rules and regulations, paragraph 1910.219, for guards on mechanical power transmission apparatus. Please carefully heed these safety instructions.

**Earth Grounding of Equipment**

For safety of equipment and personnel the drive (motor and clutch) frame should be connected to earth ground using a green insulated wire or bare copper conductor of proper size (refer to the National Electric Code). The DSI-700 printed circuit board should also be connected to earth ground. To accomplish this, connect an AWG 16 Ga. green wire to one (and only one) of the following circuit common terminals: A5, A9, or A12. **Do not ground any other terminal**.

**Warning Labels**

DANGER, WARNING, CAUTION and special INSTRUCTION labels should be provided on the equipment to remind the operator of the hazards that exist. Know your equipment to properly handle, operate or service it. The following definitions apply to labels and are used as references in this instruction manual.

Definitions:

**DANGER**: It is used where an immediate hazard exists. Failure to follow instructions could be fatal!

**WARNING**: It means a possibility of injury to personnel, but not as severe as a Danger Warning.

**CAUTION**: It is used to warn of potential hazards and unsafe practices.

**INSTRUCTION Labels** and **Notes** are used when a need exists for special instructions related to safety, proper operation, or maintenance.

## Training

Please make these instructions available to your operating and maintenance personnel. Training programs are an essential part of safe and correct operation, and provide the know-how necessary to obtain top performance from your equipment. The technical staff at **Drive Source International, Inc.** recognizes this fact and is capable of conducting training schools to educate your plant personnel in safe maintenance and operating procedures. Special training schools structured around your specific equipment can be arranged in our plant or at your facility. These may be scheduled by calling our Customer Service Department. There is a nominal fee for this service.

## Equipment Handling

The **DSI-700** controller weighs just over a pound 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 board, although ruggedly built, consists of various components, some of which are delicate and susceptible to damage. The circuit board does contain CMOS components that may be susceptible to electrostatic damage. The controller should be kept in the protective anti-static packaging until it is needed, and then it should be handled at an anti-static work station, using personnel grounding straps and proper attire.

## Receiving and Damage Claims

The **DSI-700** controller has 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 the shipment be carefully inspected upon delivery to ensure that no items were lost or that no damage 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. If you require assistance in settling your claim with the carrier, contact your Drive Source International representative. You will need the unit model number, serial number, and the purchase order number for identification purposes.

## Storage

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

Ambient temperature should not exceed 40-degrees C. (104-degrees F.) on a continuous basis, or 71-degrees C. (160-degrees, F.) on an intermittent basis. The minimum temperature must remain above freezing and above the dew point of the ambient air (non-condensing). High temperature, corrosive atmospheres, and moisture are detrimental to controller equipment.

## Long Term Storage

The manufacturer's warranty covers repair or replacement of the controller for defects in materials and/or workmanship. It does not cover degradation or damage that occurs during storage.

Some examples of deterioration due to storage are:

1. Corrosion of terminals and contacts.
2. Breakdown of electrolytic capacitors.
3. Moisture absorption within insulations and non-hermetic components.

## Removal from Storage

Before returning the controller to service after long-term 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 any condensation exists, the transformers will require thorough drying. Dampness alters the impedance characteristics of film and composition type resistors, degrading the performance of the controller. Corrosion is an important factor. Inspect terminals, plugs, sockets, and contacts for signs of any corrosion. If detected, cleaning will be necessary. Before applying power, make sure all connections are tight.

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

## Construction

The **DSI-700** is offered in an Original Equipment Manufacturer (O.E.M.) package as a basic, central control unit to provide maximum performance at the lowest price. It features single circuit board construction with integral heat dissipater for the power components. Only the topside of the circuit board is populated, using hybrid surface-mount as well as through-hole technologies.

## System Description

The **DSI-700** is a solid-state controller compatible with a variety of eddy-current adjustable speed drives. This versatile controller features the simple set-up of analog circuitry, and employs the time-tested surge and overload capability of the thyristor-controlled power converter. Each unit is fully tested and adjusted at the factory for nominal performance. This allows the user to connect and operate the controller, out of the box, with a minimum of adjustments.

## Theory of Operation: The Eddy Current Drive

In the basic form, the eddy current drive consists of an AC motor and an electrically controlled magnetic clutch. The eddy current clutch is composed of an input drum which is driven by the motor at constant speed, and an output rotor, usually positioned concentrically within the drum. Both members are constructed of magnetically soft iron (low carbon steel), supported by ball and/or roller bearings, and free to rotate independently of each other, separated by a small air gap. Control is imparted by means of an electrical field coil, which is strategically positioned to allow magnetic coupling between the input and output members of the clutch. The eddy current brake operates in a similar manner, except that the “drum” member remains stationary.

In a motor, a time-variant magnetic field is generated in the air gap at the poles by means of the current flowing in the windings, the field reversals being accomplished by an alternating current in the AC motor, or by means of brushes and the electro-mechanical commutator in the DC motor.

The eddy current clutch acts as a rotating transformer similar to a motor. In the eddy current clutch, a static DC current produces a magnetic field in the air gap, coupling the rotating input drum and the output rotor. The pole geometry of the coupled output member imprints a pattern of alternating magnetic domains on the drum. Flux reversals are established in the field by virtue of the speed differential between the input and output members, generating eddy currents. A current of high magnitude is generated in the rotating drum, which appears as a single turn secondary winding. This current regenerates the magnetic field, producing a radial coupling force, dragging the output member along. The torque developed herein is essentially proportional to the coil current.

## Theory of Operation: Closed Loop Control Systems

A typical closed loop control system is depicted below in Figure 1.

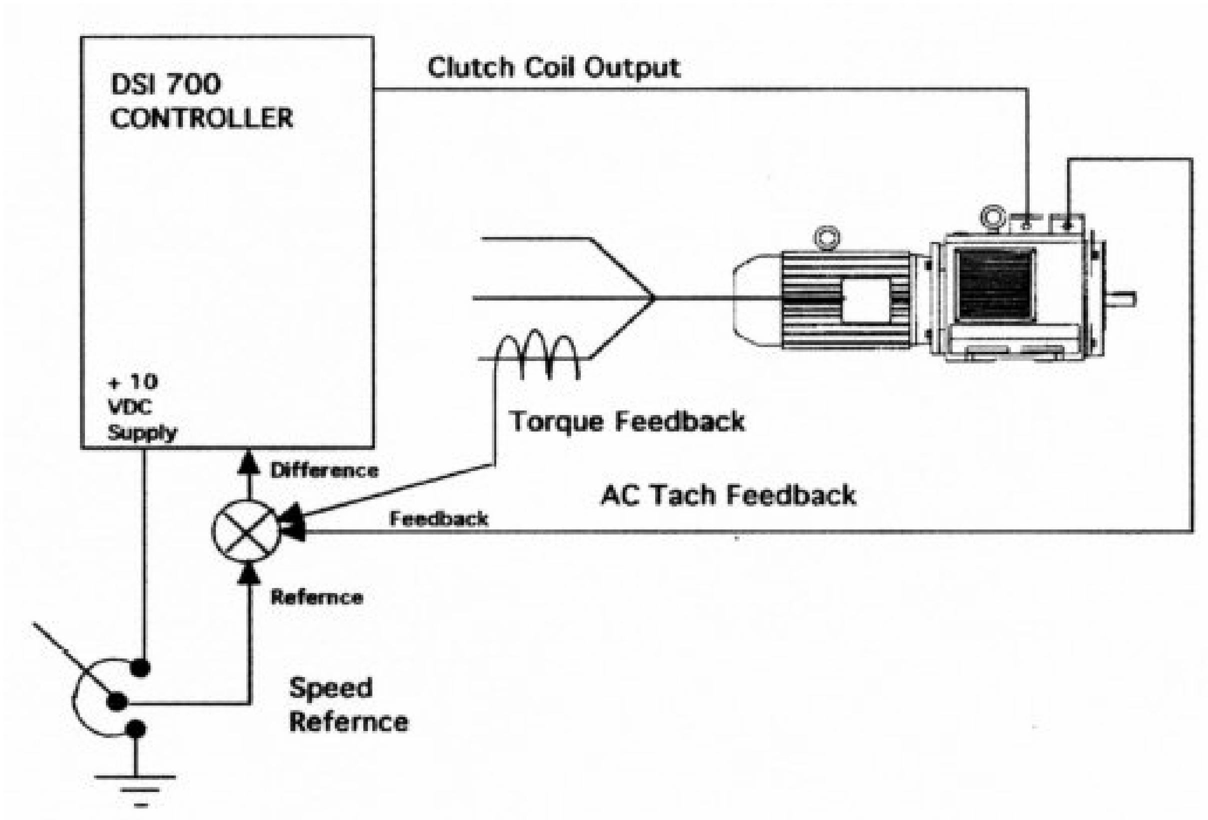



**Figure 1 Typical Closed Loop Control System**

This control system employs closed-loop feedback control techniques to linearize and stabilize the performance characteristics of the machine. In the basic speed control system, the **speed reference signal** is the **COMMAND** that drives a high gain **summing amplifier** that in turn, provides the drive current to the clutch field coil. This clutch current produces a magnetic coupling between the constantly rotating drum and the output rotor. The resulting torque causes the output shaft to rotate; this **output speed** being the **CONTROLLED QUANTITY**.

A tachometer generator is internally coupled to the output shaft, and produces an AC voltage proportional to the speed, at a frequency that is also proportional to the output speed. This AC signal is a **MEASURE OF THE CONTROLLED QUANTITY**, and is fed back to the summing amplifier where it is compared to the **COMMAND** signal. The difference between the speed reference and the feedback signal is the **ERROR** signal which causes the clutch current to increase if the output speed is lower than, or decrease if the output speed is higher than the speed set reference signal.

Not shown in Figure 1 is an adjustable inner clutch current feedback loop that is employed in the DSI-700 for improving or tuning the response of a wide variety of machine characteristics.

In the **DSI-700**, the **frequency** of the tach-generator is converted to a DC signal for comparison with the speed reference. By using the tach frequency rather than the voltage, the non-linearity introduced by the diode bridge rectifier is eliminated. Also, since the conversion is handled at a higher frequency, less filtering is required in this scheme, providing better phase margin for control stability. Frequency feedback also improves control performance by eliminating the differences or variations in the generator output voltage from machine to machine.

**Mounting the DSI-700 Controller**

The front cover page shows the DSI-700 in the normal vertical mounting plane. The board may be rotated ninety degrees, or mounted in the horizontal plane without impairing the natural convection cooling characteristics. Care should be taken, however, to provide sufficient headroom above the PCB that might impede proper air flow, or to avoid mounting the controller PCB above other heat-generating components. Adequate ventilation inside the control panel enclosure will prevent premature failure due to heat build-up.

The controller may be mounted to a substrate panel using four (4) standoff insulators and screws (provided). Mounting dimensions are shown below in Figure 2.

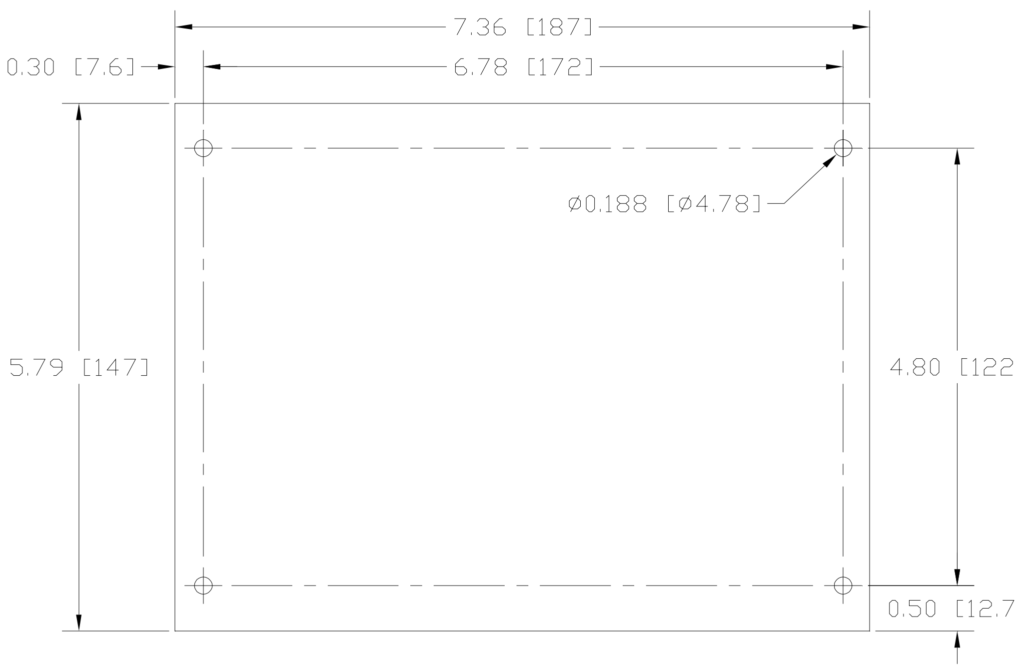



**Figure 2    DSI-700 Mounting Dimensions**

## Terminal Connections

The DSI-700 controller is supplied with a quick connect-disconnect terminal block. The terminal designations are given below in Figure 3.

The DSI-700 was designed to be directly interchangeable with controllers manufactured by others, such as the Torspec 5001TCP. The terminal pin-out and the mounting dimensions are identical, although the DSI-700 has a smaller overall footprint, and provision has been made for a current transformer. Operating specifications and performance are similar.

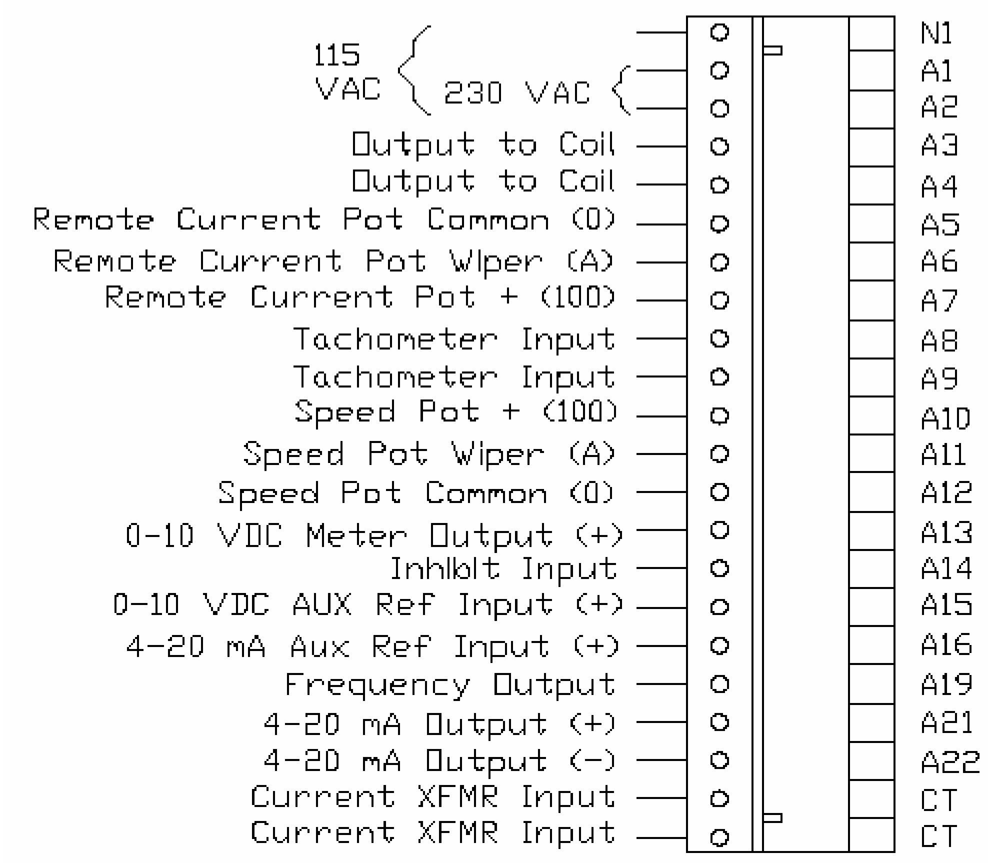



**Figure 3 DSI-700 Terminal Layout**

Figure 4, below, displays the location of the potentiometer adjustments, test points, and other components to assist the operator in setup or trouble shooting.

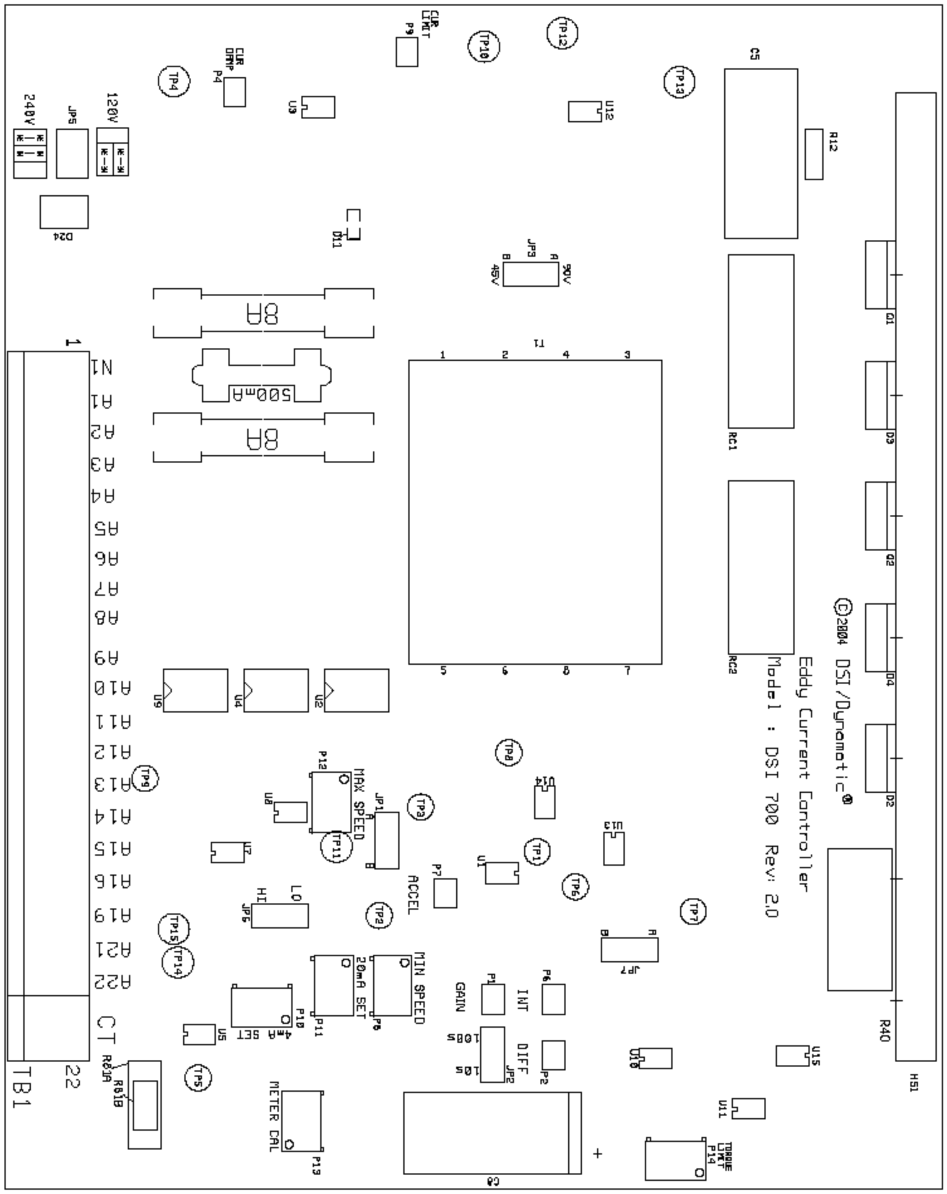



**Figure 4 DSI-700Test Points and Adjustments**

## DSI-700 POWER INPUT JUMPER SETTINGS

### Line Input Voltage

**FAILURE TO CHECK THE SUPPLY VOLTAGE MAINS AND CONFIGURE THE CONTROL FOR PROPER INPUT AND OUTPUT VOLTAGE MAY RESULT IN IMPROPER OPERATION OR DAMAGE TO THE CONTROLLER AND/OR MACHINE.**

The **DSI-700** may be set up for 120- or 240-VAC input. The controller is configured for the proper input voltages with two (2) header shunts (jumpers) at **JP5**. The output voltage is a function of the line input voltage. The jumper configuration is shown on the circuit board at the location of **JP5** in the lower left hand corner.

With the shunts in the **120V** position, the input voltage is 120-VAC with a resulting output of 0- to 45-volts DC or 0- to 90-volts DC, the range being selected by the jumper at header JP3 . Connect the high line to terminal **A2** and the neutral line to terminal **N1**. The maximum coil voltage may be reduced to values below 90-V by adjusting the **CUR LIMIT** potentiometer, **P9** for the desired voltage limit. Please see the section on controller set-up and adjustment beginning on page 20.

With the shunts in the **240V** position, the input voltage is 240-VAC with a resulting output of 0- to 90-volts DC or 0- to 180-volts DC, depending on the selection of jumper JP3. Connect the 240V lines to terminals **A1** and **A2**. **DO NOT USE TERMINAL "N1" WHEN USING THE 240-VOLT INPUT.** The maximum coil voltage may be reduced to values below 180-V by adjusting the **CUR LIMIT** potentiometer, **P9** for the desired voltage limit. Please see the section on controller set-up and adjustment beginning on page 20.

Care must be exercised in sizing the clutch coil to the controller. When using the CUR LIMIT pot, P9, for operation below the rated output voltage, the user is cautioned to insure that the maximum controller output rating of 5.6-amps DC is never exceeded. Failure to follow this advice may lead to blown fuses or permanent damage to the controller.

**ALL DSI-700 CONTROLLERS ARE CONFIGURED AND TESTED AT THE FACTORY FOR 120-VAC INPUT AND 90-VDC OUTPUT**

# PRELIMINARY SETUP
# (No Power Applied to DSI-700)

## OTHER JUMPER OPTIONS

**Acceleration Time:**

DSI-700 has two (2) acceleration ranges. The **10-second range** is selected when the header shunt is applied in the **10S** (right-hand) position at header **JP2**, and the **100-second range** is selected when the shunt is applied in the **100S** (left-hand) position. The speed input signal conditioning may be defeated by removing the range shunt entirely. This may be advantageous when operating in the remote signal mode (Terminal A15) where the response of the drive must follow the input signal directly without the delay of an acceleration circuit.

**Deceleration Time:**

Controlled deceleration times are provided by header, **JP1**. Log deceleration time is achieved at the same rate as the acceleration time with the header shunt in the **A** (left-hand) position at header, **JP1**. Placing the shunt in the **B** (right-hand) position at **JP1** provides for a quick deceleration time by rapidly discharging the acceleration capacitors.

**Max Speed Range:**

Header **JP6** sets the max speed range of the drive. Select the **LO** (upper) speed position for 4-pole motors (1800-rpm) or the **HI** (lower) speed position for 2-pole motors (3600-rpm).

**Torque Limit:** **(Separate Current Transformer Required)**

A motor protection circuit is provided in the **DSI-700** controller to limit the torque produced by the motor by monitoring the motor line current. This feature is useful in metal stamping press applications where the large inertia of the flywheel would stall the motor during start-up. Torque Limit is accomplished by means of an external current transformer (purchased separately) that is connected to the "**CT**" terminals on the input terminal block. This signal is conditioned and compared to the internal reference as set by the **TORQUE LIMIT** pot, **P14**. The on-board torque limit reference is selected by placing the header shunt in the **A** (upper) position at header, **JP7**.

Although the **B** (lower) position at header **JP7** provides for an external potentiometer at the input terminal block, this external reference controls the **maximum clutch coil current or voltage**, similar to the on-board **CUR LIMIT** pot, **P9**, not the motor current. It is essentially a remote, off-board **CUR LIMIT** adjustment. Please see "Other DSI-700 Features" beginning on page 23.

**Motor protection is provided only by using the on-board Torque Limit reference pot, P14 with the JP7 jumper in the UPPER position**.

**Torque Limit Range:**

The DSI-700 provides motor protection by limiting the current to the clutch by monitoring the motor current. As the board is configured, motor currents up to 150-Amperes can be controlled. It may be necessary to pass the motor lead through the center of the current transformer more than once to achieve the proper protection on smaller motors. Use the following table to determine the number of turns through the center of the current transformer for the corresponding maximum motor amps. Note: A "turn" is defined as a pass through the hole in the transformer, such that a single wire passing once through the center of the transformer is one turn. A wire passing through, looping once around the outside of the transformer and through the center again is two turns. The following data is valid when using current transformer part number **15-203-3**.

**TABLE NO. 1**

**CURRENT TRANSFORMER PRIMARY TURNS AND WIRE SIZE**

| MAX WIRE SIZE | MAX AMPS CONTINUOUS | MAX AMPS OVERLOAD | # OF TURNS THROUGH CT |
|---|---|---|---|
| 4 | 95 | 50 – 150 | 1 |
| 6 | 75 | 25 – 75 | 2 |
| 8 | 50 | 16 – 50 | 3 |
| 10 | 38 | 12 – 38 | 4 |
| 14 | 25 | 8 – 25 | 6 |
| 16 | 18 | 6 – 18 | 8 |
| 16 ** | 7.1 ** | 2.3 – 7.1 ** | 1** |
| 16 ** | 3.5 ** | 1.2 – 3.5 ** | 2 ** |
| 16 ** | 2.3 ** | 0.75 – 2.3 ** | 3 ** |
| 16 ** | 1.8 ** | 0.6 – 1.8 ** | 4 ** |

**NOTE:** * **Wire size shown is for 90-degree, C insulation at max. continuous current.**

** **For maximum current ratings of 7.1-Amperes or less, the USER MUST REMOVE the 2.7-ohm resistor, R-81A, by cutting the resistor leads close to the circuit board. This resistor is located directly above the right-hand end of the 22-pin connector. Discard the resistor.**

**NOTE: If the maximum required overload motor current exceeds 150-amperes, please contact the factory for alternate current transformer assemblies.**

The following table provides approximate motor full-load line currents with respect to input voltage for a variety of drives which may be used with this controller. This information may be useful when applying the current transformer for the **TORQUE LIMIT** function.

**TABLE NO. 2**

**TYPICAL MOTOR FULL LOAD CURRENTS**

| HP | 208-V | 230-V | 460-V | 575-V |
|---|---|---|---|---|
| 0.50 HP | 2.0 A | 1.7 A | 0.9 A | 0.8 A |
| 0.75 HP | 2.8 A | 2.9 A | 1.5 A | 1.1 A |
| 1.0 HP | 3.2 A | 3.6 A | 1.8 A | 1.4 A |
| 1.5 HP | 5.6 A | 4.9 A | 2.5 A | 2.1 A |
| 2 HP | 7.4 A | 6.4 A | 3.2 A | 2.7 A |
| 3 HP | 10.8 A | 9.4 A | 4.7 A | 3.9 A |
| 5 HP | 16.6 A | 14.4 A | 7.2 A | 5.8 A |
| 7.5 HP | 25 A | 22 A | 11 A | 9 A |
| 10 HP | 31 A | 27 A | 14 A | 11 A |
| 15 HP | 45 A | 39 A | 20 A | 16 A |
| 20 HP | 59 A | 51 A | 26 A | 21 A |
| 25 HP | 75 A | 65 A | 33 A | 26 A |
| 30 HP | 87 A | 76 A | 38 A | 30 A |
| 40 HP | 116 A | 101 A | 51 A | 40 A |
| 50 HP | 150 A | 124 A | 62 A | 50 A |
| 60 HP | 174 A | 152 A | 75 A | 60 A |
| 75 HP | 225 A | 195 A | 92 A | 73 A |
| 100 HP | 300 A | 247 A | 118 A | 95 A |
| 125 HP | - | 293 A | 147 A | 117 A |

## DETERMINING THE MAXIMUM CURRENT

The value of motor current that will activate the **TORQUE LIMIT** circuit is usually determined by the application. If maximum utilization of the motor's power is to be realized, the motor current should be allowed to reach at least rated motor amps, either as given in the chart above, or as read from the motor nameplate.

There are times when the motor may be overloaded by a nominal amount for a few seconds, such as when accelerating the flywheel during start up of a stamping press, or breaking loose an extruder screw as the material becomes plastic. In such a case, the overload may be allowed to reach 50% (150% rated amps) or more for a period of several seconds.

As configured, the DSI-700 will allow a maximum current of:

Maximum Current = 150 / T amperes

Where: T is the number of turns passing through the current transformer.

This current may be adjusted to almost zero with the on-board **TORQUE LIMIT** pot, **P14**.

Implementation of the Torque Limit function is demonstrated in the two following examples. In the first application, assume that the drive operates a conveyor where the normal load seldom exceeds 80%. It is determined that the Torque Limit will be set at 100-% of rated motor current.

**Example 1:** Given: 10-hp motor operating from 230-VAC, 3-phase line
Nameplate indicates voltage is 460/230 ACV
FLA rating 13.3/26.6 ACA

For this dual voltage motor, the lower current rating is for 460-volt operation, the higher current rating is for operation from 230-VAC. The maximum current will then be 100-% FLA or 26.6-amps.

According to Table 1, two, three, or four turns through the current transformer will accommodate a current of 26.6-amps. The smallest wire within the range should be used. Using four turns of #10 or #12 wire, the maximum current that can be obtained will be:

Maximum Current = 150 / T = 150 / 4 = 37.5 amps

which is (37.5 / 26.6 = 1.41) or 141% rated motor current. Use the **Torque Limit** pot, **P14**, to adjust the current limit point up or down to 26.6-amps.

Since the motor amps can be adjusted down to almost zero, this task could also have been accomplished with only two turns through the current transformer. In that case:

Maximum Current = 150 / T = 150 / 2 = 75.0-amps

This corresponds to (75 / 26.6 = 2.82) or 282% of rated amps. This will work just as well, but care must be taken to properly adjust the **Torque Limit** pot**, P14**, down so that the motor current begins to limit at 26.6-amperes. A better choice would be three or four turns.

**Example 2:** Given: A motor with no nameplate, although it is known that the motor is wound for 460-volts, and is rated at 75-hp at 1750-rpm.

This drive is to be used on a metal stamping press, operating from the 460-volt AC mains. It is determined that the acceleration time to get the flywheel up to speed is about seven seconds if the motor can be allowed to operate at 50% overload, or 150% of rated full load current. Since the press is started only two or three times a day, the motor should be able to handle this overload for the short duty cycle without degradation.

Table 2, indicates that a 75-hp motor operating at 460-VAC will have a full load current rating of 92-amperes. The maximum overload current will be 150% or (1.5)(92) = 138-amperes. Table 1 indicates that one turn of #4 wire through the current transformer can carry the continuous 92-full load amps, and that 138-amps in overload can also be accommodated. This will result in:

Maximum Current = 150 / T = 150 / 1 = 150 amps

which is (150 / 92 = 1.63) or 163% rated motor current. Use the **Torque Limit** pot, **P14**, to adjust the current limit point up or down to 138-amps.

In a case such as this, the acceleration time to bring the flywheel up to speed is not critical, so the Torque Limit could be set lower, perhaps to 125%, at the expense of increasing the acceleration time by only another second or two.

Figure 5, below, demonstrates typical connections for the various DSI-700 functions.

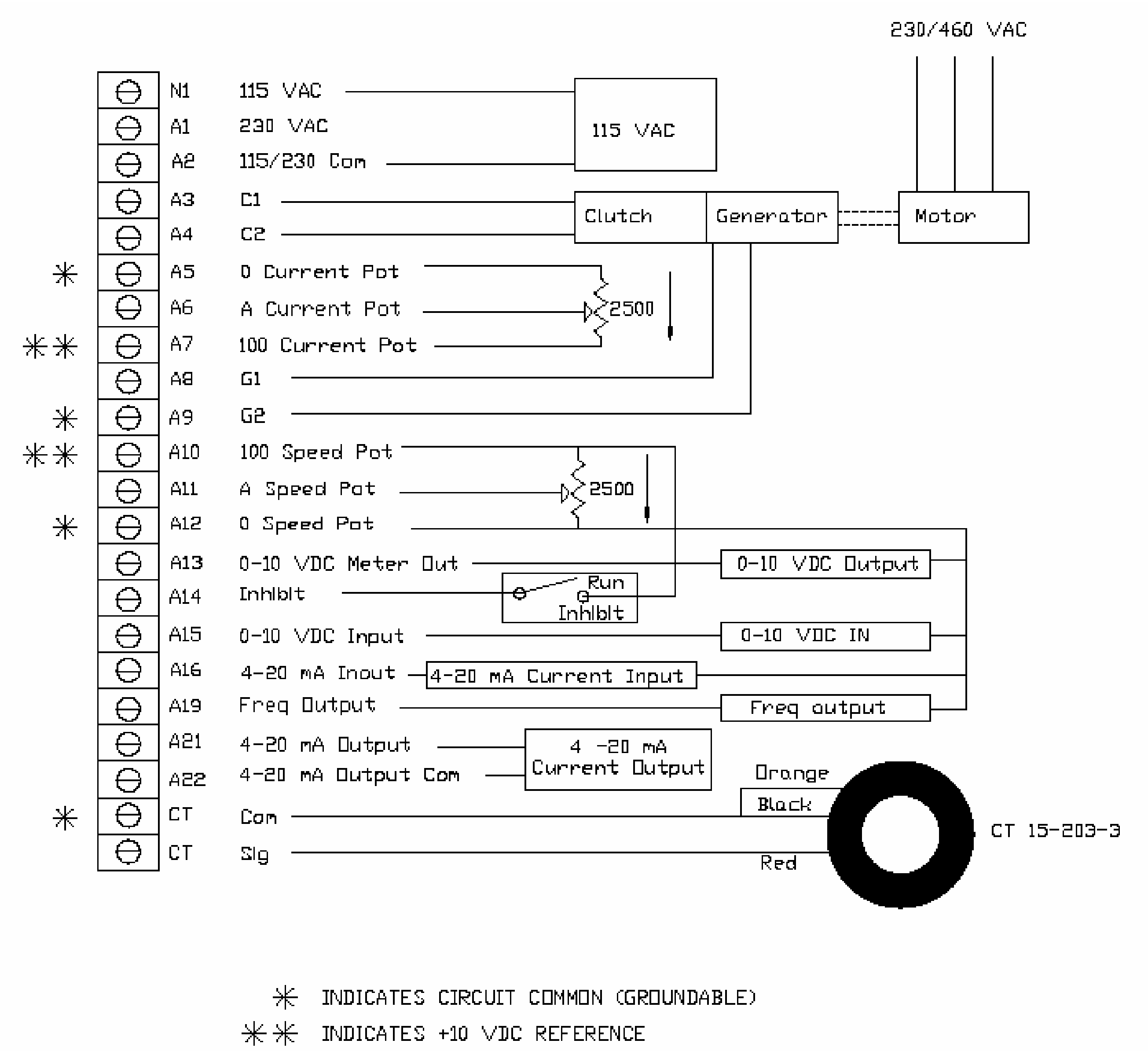



**Figure 5 Typical DSI-700 Connection Diagram**

## = = = PLEASE NOTE = = =

## <u>Before proceeding</u>

Determine proper motor rotation by momentarily "bumping" the motor with **NO** power being applied to the DSI-700 controller. If the direction of rotation is **incorrect**, disconnect the power to the motor and interchange any two motor power supply leads to reverse the motor direction.

## DSI – 700 CONTROLLER SET-UP ADJUSTMENT
## (WITH POWER APPLIED TO THE CONTROLLER)

All DSI-700 controllers are operated at the factory on a fully instrumented test stand employing a typical motor/clutch drive with an electrically adjustable load. The controllers are adjusted during final test, and can generally be operated, out of the box, without further adjustment. Different operating modes or special applications may require adjustment of some parameters.

## Factory Calibrations

**The following adjustments have been calibrated at the factory, and should require no further adjustment:**

| POT | DESIGNATION | FUNCTION | FACTORY SETTING |
|---|---|---|---|
| **P10** | **4-mA SET** | Speed current signal output offset | AS REQUIRED |
| **P11** | **20-mA SET** | Speed current signal output span | AS REQUIRED |
| **P13** | **METER CAL** | Speed voltage signal output span | AS REQUIRED |

## Factory Settings

**The following adjustments have been set at the factory, but may require readjustment to achieve proper response or stability in some instances:**

| POT | DESIGNATION | FUNCTION | FACTORY SETTING |
|---|---|---|---|
| **P1** | **GAIN** | Speed loop gain control | 0% CW |
| **P2** | **DIF** | Speed differential gain control | 100% CW |
| **P4** | **CUR DAMP** | Current loop gain control | 50% CW |
| **P6** | **INT** | Speed integral gain control | 25% CW |
| **P9** | **CUR LIMIT** | Clutch coil current (voltage) limit control | 100% CW |

## User Adjustments

**The following adjustments have been set at the factory, but specific machine conditions may require readjustment to achieve proper or desired operation:**

| POT | DESIGNATION | FUNCTION |
|---|---|---|
| **P7** | **Accel Rate** | This adjustment provides for setting the acceleration to a specific rate within the 10-second or 100-second range as set by the jumper at header **JP2**. Turning the adjustment CW increases the rate (faster), while a CCW setting will decrease the rate, slowing down the acceleration time. **This adjustment is factory set at 100% CW for highest acceleration rate.** |
| **P8** | **Min. Speed** | Turn the external **main drive speed pot** to 0% (full CCW). Set the **Min. Speed** pot, **P8**, for zero volts on the clutch coil or no shaft rotation. Alternately, the **Min. Speed** may be set to a higher speed if the application so requires. **This adjustment is factory set as required for no shaft rotation.**<br><br>When using the 4- to 20-milliamp remote signal input, the 4-ma minimum loop current will have to be offset. **Min. Speed** pot, **P8**, should be adjusted to produce the required minimum speed. |
| **P12** | **Max. Speed** | Turn the external **main drive speed pot** to 100% (full CW). Adjust the **Max. Speed** pot, **P12**, to the desired maximum speed. It may be necessary to repeat adjustments of **P8** and **P12** as they tend to interact. **This adjustment is factory set as required.** |
| **P14** | **TORQUE LIMIT** | This adjustment is functional only when an external current transformer is used with the DSI-700 controller. The coupled torque can be controlled to almost zero by turning **P14** fully CCW. Consequently, turning the pot fully CW will allow the clutch to produce higher torque, allowing the motor to operate at full load or beyond. Adjust the **TORQUE LIMIT** pot, **P14**, for the desired limiting point by observing the motor line current with a clamp-on ammeter. **This adjustment is set at approximately 2/3 max allowable motor current.** |
| **JP3** | **VOLTAGE RANGE** | This jumper function enables the user to select the output voltage range of the controller. Jumper JP3 is in the “90V” position when the DSI-700 is shipped from the factory. Please see **“OTHER FEATURES”** on page 24 for details. |

## SPECIFICATIONS

### Physical Details

Width: 7.36 inches (187 millimeters)

| | | |
|---|---|---|
| Height: | 5.79 inches | (147 millimeters) |
| Depth: | 1.18 inches | (30 millimeters) |
| Net Weight: | 1.00 pounds | (454 grams) |

**Input Characteristics**

| | |
|---|---|
| Supply Voltage | 120-VAC or 240-VAC, +/-10% |
| Line Frequency | 50/60-Hz |
| Tach Generator Frequency | 10 - 720 Hz |
| Tach Generator Voltage | 3 volts, peak-to-peak minimum |

**Output Characteristics**

| | |
|---|---|
| Output Voltage @ 115-VAC Input | 0-45 VDC, 0-90 VDC, Selectable |
| Output Voltage @ 230-VAC Input | 0-90 VDC, 0-180 VDC, Selectable |
| Output Current | 5.6 Amps, Full Voltage Output |
| | 4.0 Amps, Half Voltage output |
| Speed output signal (voltage) | 0-10VDC |
| Speed output signal (current) | 4-20MA (500 ohms max. resistance) |

**Regulation**

| | | |
|---|---|---|
| Line Voltage Change: 10% | 0.1% @ 1600-rpm | (1.5-rpm typical) |
| Load Change: 25% - 100% | 1.0% @ 1600-rpm | (15-rpm typical) |

**Run Speed Potentiometer**

| | |
|---|---|
| Standard 2 Watt Molded Carbon Potentiometer | 1000 - 5000 ohms |

**Temperature**

| | | |
|---|---|---|
| Ambient Air, Operating | 32 to 104-degrees, F. | (0 to 40-degrees, C.) |
| Ambient Air, Storage, Non-Condensing | -4 to 158-degrees, F. | (-20 to 70-degrees, C.) |

## OTHER DSI-700 FEATURES

### OUTPUT SIGNALS

**0-10 VDC (10 ma max. load)**

This isolated voltage output signal is available at terminals **A13(+)** and **A12(-)**. It can be used to drive a speed indicator or used as a “follower” reference signal to control a “slave” drive. Adjustment is provided by the Meter Cal. **(P13)** pot.

**4ma-20ma DC (500 ohm or less resistance)**

This isolated current output signal is available at terminals **A21(+) and A22(-).** It can be used to drive a 4-20 ma DC speed indicator or used as a “follower” signal to control a “slave” drive. Adjustment of the 4-ma offset is affected by the 4-mA **(P10)** pot, while the 20-ma span adjustment is made using the 20-mA **(P11)** pot.

**Frequency Output**

This isolated output signal corresponds to the tachometer generator feedback. It is a buffered square wave which may be used for driving time-based speed indicators, or a digital reference follower for a slave drive.

## INPUT SIGNALS

Alternate speed reference signals can be used to control the DSI-700 controller in place of a speed setting pot. This would typically be used when the DSI-700 is required to “follow” another drive or process controller. To use these input signals, the jumper (shunt) at header, **JP1,** should be in the **(A)** position (no connection), and the jumper (shunt) at header, **JP2**, should be removed altogether (no capacitor selected).

**0-10 VDC SIGNAL**

Connect this remote signal to terminals **A15** (+) and **A12** (-).

**4-20 MA DC CURRENT SIGNAL**

Again, connect this remote signal to terminals **A15** (+) and **A12** (-). Also, connect a jumper between terminals A15 and A16 to provide the 20-ma load resistor.

## OTHER FEATURES

**Inhibit Input**

An inhibit input is provided at terminal **A14** for the purpose of bringing the controller to a “stop” condition while maintaining power to the control. Tying the **INHIBIT** input at terminal **A14** to the **+10 VDC** reference source available at terminal **A7** or **A10** will activate the inhibit function by discharging the acceleration capacitors in the reference circuit, and clamping the output of the phase shifter. Removing the reference voltage to the **INHIBIT** input will cause the inhibit function to turn off, returning the controller to what ever normal "run" condition existed before the inhibit was invoked.

**External Current Limit Control**

On page 13, the function of the **CUR LIMIT** adjustment, **P9**, was described as a "voltage limit" control. This is accomplished by essentially clamping the output of the phase shifter such that the output voltage of the controller no longer increases for any further increase in the input reference voltage signal.

This function can be achieved with an external control potentiometer connected to terminals **A5, A6, and A7** as shown in Figure 3 on Page 11, as well as Figure 5 on page 19. The jumper at header, **JP7**, must be in the (lower) **B** position as described on page 14.

The operating range on this adjustment is "touchy", full control being achieved over a small range of the pot. If this remote function is desired, better control can be achieved with the use of range limiting resistors in both the top and bottom legs of the control pot.

**Selectable Output Voltage Range**

A header, JP3, is provided with a jumper to provide for selecting the output voltage range of 0- to 45-VDC or 0- to 90-VDC when operating at 120-VAC input. This is accomplished by modifying the power converter to provide only half the power in the lower range, rather than limiting the phase-up angle. This power reduction method is preferred because the system gain remains constant, preserving the stability of the drive. When operating at 240-VAC input, the jumper may be used to select 0-to 90-VDC or 0- to 180-VDC output.

## FUNCTIONAL SCHEMATIC DIAGRAM

**TO FACILITATE JUMPER PLACEMENT AND PARAMETER ADJUSTMENTS, A FUNCTIONAL SCHEMATIC DIAGRAM FOLLOWS ON PAGE 25.**

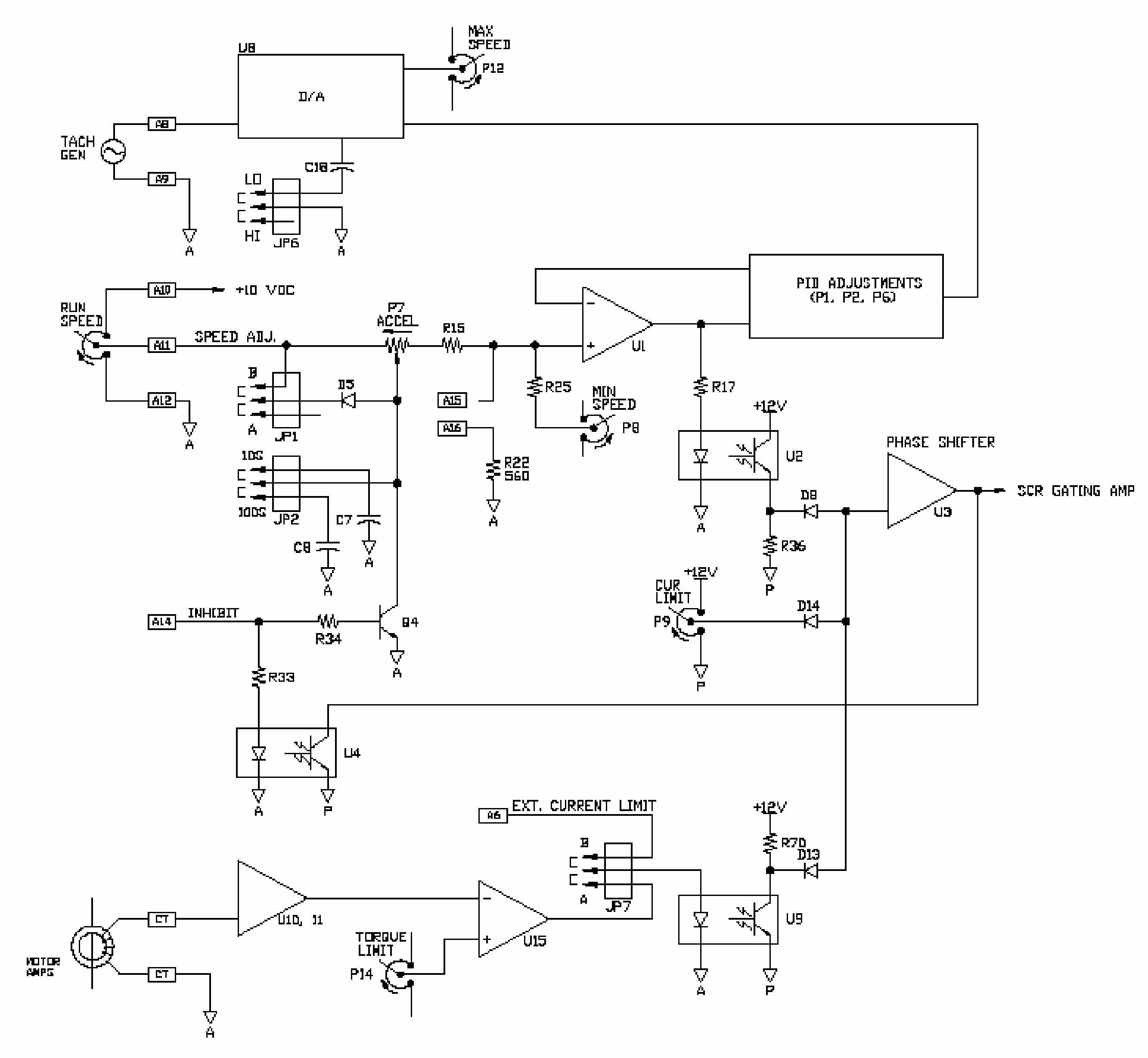



**Figure 6. Functional Schematic Diagram**

## TROUBLE SHOOTING

Component failure or other problems are always possible with circuit boards. This section of the manual is provided to assist in finding the fault and making repairs. Our design philosophy is based on assembly replacement. Trying to repair a failed printed circuit board is not economical when the cost of labor and down time is compared with the cost of PCB replacement. Therefore, this manual limits trouble shooting to sub-assembly level. Only qualified personnel acquainted with safety procedures should service this equipment.

1. Check that all plugs and jumpers are in the proper position before turning power "ON".

2. Check that the fuses are in place and are intact.

3. Check that the clutch and feedback generator leads are connected properly to the controller. Refer to the connection diagrams on page 11 or 19. The mechanical drive and the DSI-700 control panel should be connected to earth ground. (Refer to Equipment Grounding section of this instruction manual).

## IF THE DRIVE WILL NOT RUN

1. Check the incoming power supply, 120VAC or 240VAC, with a voltmeter to verify that power is being supplied to the motor and DSI-700 controller.

2. Blowing of fuses may occur during any short circuit or overload condition. With the motor and controller disconnected from the power source, check fuses F1 and F2 (8 amp) and F3 (500 ma). If fuses are open, replace the fuses with the same type and value. Re-apply power to the motor and controller.

3. If a fuse blows on a cold start, there may be a short or ground in the clutch coil or lead wires. Disconnect both leads at the controller terminal strip (A3 and A4), and measure the resistance of the coil and resistance of the coil to ground. Check the clutch nameplate or instruction manual for the proper coil resistance. In general, the coil resistance should lie in a range of 16- to 100-ohms. Resistance to ground should be about 20 megohms. When using a megger, make sure both coil leads are **disconnected** from the controller. If a short or open coil is detected, machine repair will be necessary. Please contact the DSI/Dynamatic factory for repair assistance.

4. Disconnect the run speed pot lead from terminal A10. Connect a DC voltmeter to terminals A10(+) and A12(-). With power applied to the DSI-700 controller, a reading of approximately 10 VDC should be observed. If the voltage differs from 10 VDC significantly, replace the DSI-700 controller. Otherwise, reconnect the wire to terminal A10.

5. Connect a DC voltmeter between terminals A11(+) and A12(-). With power applied to the controller, rotate the speed setting potentiometer from “0” to “100%”, observing that the speed reference voltage follows between “0” and “+10” volts, DC. Refer to page 11 or 19 for the proper connections.

6. Check the **CUR LIMIT** pot, **P9**. Normal setting for this adjustment is 100% CW. Although the control operates at reduced output at lower settings, the controller will not run at all if this adjustment is at or nearly at the fully CCW setting.

**<u>IF THE DRIVE RUNS ONLY AT FULL SPEED</u>**

7. Connect a DC voltmeter between terminals **A11**(+) and **A12**(-). With power applied to the controller, rotate the speed setting potentiometer from “0” to “100%”, observing that the speed reference voltage follows between “0” and “+10” volts, DC. Refer to page 11 or 19 for the proper connections.

8. Check the position of the jumper at header **JP6**. This should be in the **LO** position for 4-pole (1800-rpm) motors, and in the **HI** position for 2-pole (3600-rpm ) motors.

9. Check the setting of the **MAX SPEED** pot, **P12**. Try adjusting the pot down (CCW) to adjust the drive speed.

10. Check for a proper tachometer feedback signal by checking the **FREQ OUT** signal at **TP5** or terminals **A19** and **A12** for a square wave output proportional to the speed. The tach generator input may also be checked by reading at least 5-volts peak-to-peak (AC) at the generator input terminals, **A8** and **A9**. If a zero or near zero voltage reading is observed, the problem may be a faulty tach generator in the mechanical drive. Check for broken or shorted connections between the clutch and controller.

11. Check the control output voltage between **A3** and **A4**. If proper tach feedback was observed above in step 10, **AND** the controller output is zero or near zero, the clutch may be physically locked up, and the mechanical unit should be checked for proper operation.

**<u>IF THE DRIVE HUNTS (SPEED WILL NOT STABILIZE)</u>**

12. Check the settings for adjustments **P1, P2, P4, and P6** as given on page 20 for factory settings. One at a time, try readjusting each of these pots in an effort to affect an improvement in stability. The following suggestions can be offered:

13. **CUR DAMPING** pot, **P4**, should generally be set between 40% CW and 60% CW for clutch coils that are rated close to 5 amperes, while a setting of 100% CW may be used for coils having a rating of less than 3 amperes. Increasing the CW rotation of **P4** will generally improve stability.

14. The **GAIN** pot, **P1**, is used to increase the overall loop gain, thereby improving regulation. However, as the gain is increased, the tendency for instability also increases. Keep this adjustment fully CCW unless your application demands better regulation.

15. The **DIF** pot, **P2**, controls the differential speed damping. Generally, increasing this adjustment CW will tend to slow and dampen the response, while decreasing the adjustment (CCW) will cause the response to quicken, but increase overshoot.

16. The **INT** pot, **P6**, controls the bandwidth of the difference amplifier and will generally slow the response as the adjustment is advanced CW and quicken the response with CCW adjustment. Increasing this adjustment CW can reduce beat frequencies between the power line and the tach generator output.

**RENEWAL PARTS AND SERVICE**

Other than fuses, the DSI-700 has no user serviceable parts. It is suggested that customers stock an extra DSI-700 circuit board and replacement fuses to minimize down time. Only the user can evaluate the cost of down time compared to the cost of stocking spares. If you need help in establishing stock levels, consult your local Authorized Distributor or Drive Source International Customer Service.

Drive Source International maintains a repair Service Department that works on a time and material basis. Controllers may be returned for repair or replacement through DSI's repair and exchange program. However, the company will not accept replacement boards that are cracked, foil damaged, field modified or burned.  All replacement boards or assemblies will carry a full one-year factory warranty. Additional warranty coverage is available for an additional charge. Contact Drive Source International 's Customer Service department for more information.

# DRIVE SOURCE INTERNATIONAL, INC.

*Innovators in **DYNAMATIC®** Drives since 1931*

## EDDY CURRENT DRIVES
## EDDY CURRENT CONTROLLERS
## INVERTERS – SPARE PARTS

**AT Ajusto-Spede® Drives 1-200 HP**

**AS Ajusto-Spede Drives® 0.75 - 40 HP**

**Fractional HP Ajusto-Spede® Drives 0.25 -1.5 HP**

**Matched Controllers for Ajusto-Spede® Drives**

**Air & Liquid Cooled Brakes, 5-100 HP Dissipation**

**Liquid Cooled Heavy Duty Couplings & Brakes, 75-4000 HP**

**Universal Eddy Current Controllers up to 200 HP Controllers**

**Digital CES Press Controllers & Drives**

**PDC 2000 Electronic Press Controllers**

**High Efficiency Motors up to 500 HP**

**Specialty AC Motors**

**Yaskawa Inverters**

dSi Dynamatic®

7900 Durand Avenue, P.O. Box 0361
Sturtevant, WI USA 53177
Toll Free: (800) 548-2169 (Mon thru Fri – 8 am to 4 pm CST)
Email: drivesource1@yahoo.com
24 Hours Service: (262) 499-0437

*Applications Engineering ¤ Quality Products ¤ Total Solutions*