Conic Systems Inc.

INSTRUCTION MANUAL
FOR
DATATRAN
D2653
HYDROSTATIC
TRANSMISSION
CONTROLLER

FOR TECHNICAL OR SALES ASSISTANCE
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GENERAL DESCRIPTION:

The Datatran Labs, Inc. model series D2653 will provide the user with a complete high performance, adjustable speed hydrostatic transmission control system, on a single circuit board assembly. It is designed to be used in industrial applications where both the pump and the motor are equipped with an electrical displacement control that can be varied to obtain the required operating speed range. The output signal to the pump displacement controller is bipolar, therefore providing bidirectional operation without the need for any additional interface devices.

The hydrostatic transmission controller is an extremely accurate bipolar linear current amplifier, when it is operated in the open loop mode, it is capable of maintaining the preset output within 1% as the input voltage, ambient temperature and load impedance are varied over the specified range. Speed regulation can be improved, in the closed loop mode, to better then 1/10% with the addition of a suitable velocity feedback transducer.

The controller is supplied as a single, industrial grade modular circuit board assembly with a terminal block for external connections. The circuit board is solder masked and conformal coated. The basic controller includes a regulated bipolar reference supply as well as the devices required to set the pump and motor null position, gain and maximum output. In addition, a phase control adjustment is included to set the motor crossover point. The motor bias may be arranged to either increase or decrease the displacement control valve signal with an increase in the input command signal. All of the user adjustment controls are multiple turn potentiometers that are clearly marked on the board. Operation is directly from the 115 VAC or 230 VAC power line or a bipolar 18 to 30 volt DC power supply. The output is capable of supplying a maximum of 200 ma. of current to the pump and motor displacement control valves.

The controller can be ordered with optional features. These include linear acceleration and deceleration control as well as built in dither generator modules for both the pump and the motor. The linear acceleration and deceleration option provides four adjustable ramp controls. These are used to set the forward and reverse acceleration and deceleration times. The ramp times are adjustable from 1 second to 250 seconds in three overlapping ranges. Also included is a lockout circuit that will provide a smooth transition from one direction to the other at the preset ramp rates, independent of the rate of change of the input command signal. The dither generator is supplied with controls to set both the amplitude and frequency of the dither signal to the servovalve coils.

The controller is designed to accept a bipolar analog input signal that is internally decoded to produce the required output speed and direction of rotation. This command signal can be obtained from the internal reference with a potentiometer or generated externally with suitable signal conditioning amplifiers. Bipolar input signals of 5 or 10 volts are standard. For unidirectional applications the controller will accept and follow a 4 to 20 ma. current input. For closed loop operation, a scaling circuit with adjustable gain has been included so that commonly available analog, velocity transducers can be interfaced with a minimum of external parts.

All of the external power and signal connections are made to a single barrier type terminal block supplied with #6-32 wire clamping screws. The various options and operating modes are selected with multiple position pin headers, thus the controller can be configured for a number of applications without the need to solder or remove any components. The hydrostatic transmission controller will provide the user with a simple, reliable method of generating the signals required for a complete variable speed drive system. The wide range of options allows the user to quickly assemble a custom speed control system for a specific application within a minimum amount of time at a reasonable cost.

INSTALLATION INSTRUCTIONS:

Once the equipment has been removed from the shipping container, inspect the unit to determine if any of the components have been loosened or damaged during shipment and storage. In the event that any items are damaged, missing or should loose parts be discovered, they must be repaired or replaced before proceeding with the installation.

In the event that the equipment is not to be used for a period of time it should be stored in the shipping carton. The storage area must be dry and protected. Severe humidity or temperature, vibration and dirt are adverse conditions that can be injurious to the equipment and must be avoided.

The location selected for mounting the equipment should be of the same nature as that selected for storage. The temperature should be such that the ambient does not rise above 55 degrees C. Note, that 55 degrees C is the maximum ambient surrounding the components inside the controller when it is operating at

INSTALLATION INSTRUCTIONS, CON'T:

maximum load. Due to component dissipation it may be necessary to force cooling air through the equipment if the plant temperature approaches 55 degrees C. In the event that forced air cooling is required, always install a good filter in the inlet stream ahead of the controller.

All *electrical* connections *to the controller must be made in strict conformance with the connection diagram supplied and all applicable electrical and fire codes.* Should conflicts occur between the connection diagrams and the local codes, Datatran's engineering department should be consulted prior to proceeding with the installation.

It is recommended that the system common (0 volt line) be operated at earth ground potential. This will provide the highest immunity to any electrical noise as well as the maximum safety for the operator. The system common terminal is clearly marked on the board connection drawings included in this manual. This point should be run directly to the plant earth ground with a wire no smaller then that used to connect the power line to the equipment. Connections to the hydrostatic transmission controller should be in conduit separate from all other plant wiring for optimum performance and reliable operation in the high electrical noise environment typical in most industrial operations. This is particularly true for external command and feedback signal input lines.

Where shielded cable is called for on the connection diagram, expose the shield on the controller end only**.** If this cable is spliced at any point along its run be sure that the shield splice is covered and not grounded at any point along the run. Shielded cable should be in separate signal conduits only. They should not be run parallel to non signal conduits. If any signal conduits must cross non signal wires they should do so at an angle between 45 and 90 degrees.

All of the connections to the transmission controller should be clearly marked and installed in conduit where possible. The importance of proper wire routing can not be overstressed; time spent on this operation is well worth it and will eliminate a number of possible problems and associated expense that can occur from improper connections during the operation of the equipment.

! ! ! ! ! WARNING ! ! ! ! !

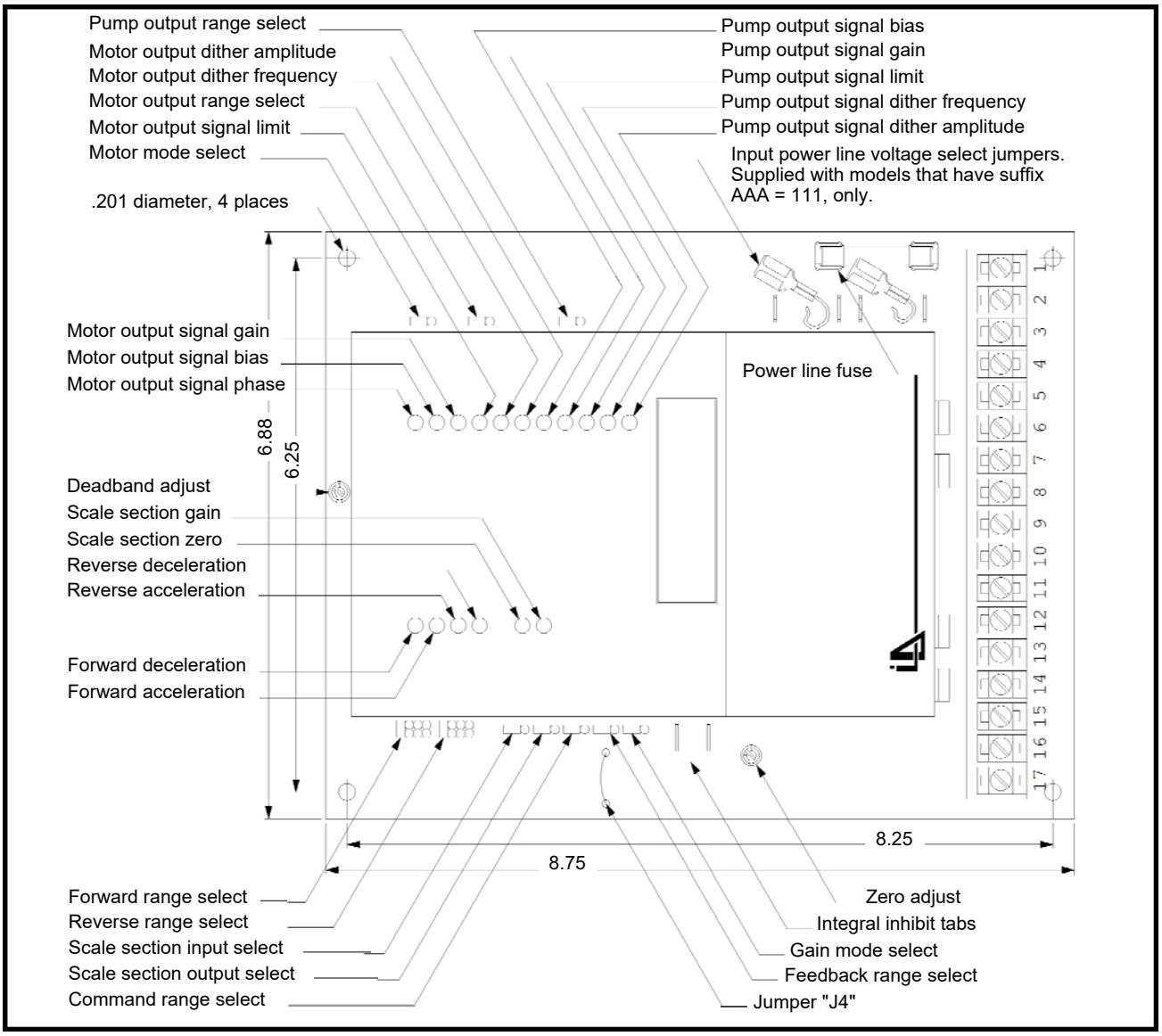
All AC powered hydrostatic transmission controllers are transformer isolated from the AC power line. No additional signal isolation is supplied. DC powered units do not provide any isolation. All external speed command, feedback transducer or additional inputs must be referenced to the drive controller system common (0 volts). It is extremely important that all of these signals have a single common or earth ground connection.

The output signal from the hydrostatic transmission controller to the pump and motor electrical displacement control valves must be floating. Do not ground any of the wires running to the pump or motor electrical displacement control valves. Grounded connections to the electrical displacement control valves may cause the hydrostatic transmission controller to drive the displacement controllers to their maximum outputs.

Multiple grounds or common connections that differ in electrical potential may cause high current flows resulting in fire and/or permanent damage to the transmission controller as well as other devices connected to the system.

The transmission controller enclosure must be connected directly to the plant earth ground prior to applying power to the system. For operator safety, all ungrounded equipment should be clearly marked as such.

OUTLINE DIMENSIONS:



EXTERNAL WIRING REQUIREMENTS:

All external wiring shall be located in conduit or raceways. All shielded wiring must be located in it's own separate signal conduit. In general, all shielded wire should have the shield exposed and connected on one end only, as shown on the interconnection drawings. All of the power line or supply and earth ground connections to the drive controller circuit board can be made with 18 AWG or larger. Signal and output wires may be 20 AWG. All signal command input and feedback wiring should be twisted and shielded.

All external non-shielded wires should be of stranded copper with thermoplastic (PVC) insulation, rated for 600 volts and 90 degrees C. minimum. All external, multiconductor shielded cables should be of stranded copper with a foil shield and thermoplastic (PVC) insulation, rated for a minimum of 300 volts at 80 degrees C. The wire and cable ratings listed are the minimum. The user is expected to show a bit of common sense in the selection of the external interconnection wires, the voltage rating, current capacity and operating temperature must be suitable for the specific application. *All wires must be selected and installed as specified in the local electrical and fire codes.*

The user should supply a suitable disconnect with short circuit protection in the branch circuit feeding the hydrostatic transmission controller.

POWER LINE FUSE REQUIREMENTS:

All 115 volt or 230 volt AC power line input models (suffix AAA =111 or 231) are supplied with a fuse, mounted on the circuit board and located in series with the connection to terminal number 1. This fuse is

POWER LINE FUSE REQUIREMENTS, CON'T:

rated for 1 amp for 115 volt models and for .5 amps for 230 volt models. Both fuses are specified at 250 volts. In the event that the power line connection to terminal number 2 is not connected to the system earth ground, the user should install an external fuse in series with this connection, equal in size to the internal fuse mounted on the board.

All controllers with suffix AAA = 111 are shipped from the factory set up to operate from a 115 VAC power line. They are fused at 1 amp. If 230 VAC operation is selected the user must replace the fuse with a .5 amp slo-blo device, rated 250 volts minimum. In the event that the power line connection is not connected to the system earth ground, the user should install a fuse in series with this connection that is rated the same as the internal fuse mounted on the circuit board.

All 18 to 30 volt DC powered models (suffix AAA = 180) are not supplied with any fuses on the circuit board. In this case the power supply connections to terminal numbers 1 and 2 should be protected by a fast blowing fuse in series with each wire. Fuses should be no larger than 1 amp. The user should note that on DC powered models, a blown fuse in one of the input power supply connections may cause the drive controller to provide a maximum output signal to the pump displacement controller.

All external fuses should be equal to the Littelfuse series 312 (type 3AG, at 250 volts). Terminal number 3 is internally connected to the chassis and the system common (0 volt). It is recommended that this terminal be connected directly to the plant earth ground with a number 18 AWG or larger wire.

Do ***not*** install ***fuses in any conductor that is connected to the system earth ground.***

DISPLACEMENT CONTROL VALVE REQUIREMENTS:

The hydrostatic transmission controller is designed to provide a current signal to electrical displacement control valves that require up to 200 ma. The maximum voltage that the controller will deliver to the valve coil is 10 volts DC.

The maximum impedance of the displacement control valve can be calculated from the formulas below.

Z(load max.) = 10 / Maximum coil current Z(load min.) = 10 ohms.

The pump and motor output range jumper should be set to match the displacement control valve current requirements as closely as possible.

EXTERNAL COMMAND SIGNAL POTENTIOMETER:

This device should have a value between 1000 and 10000 ohms. It should be rated for a minimum of .5 watts and have a linear taper. For the highest immunity to electrical noise, the wires to this device should be shielded.

Best results will be obtained when the command potentiometer is rated at 5000 ohms.

EXTERNAL VOLTAGE COMMAND SIGNALS:

Unless the scale section is used, this signal must be either 5 or 10 volts DC full scale. The "COMMAND INPUT" range jumper on the board should be set to match the maximum input signal. Reversing applications require a bipolar input signal. The wires to the external voltage command signal should be shielded.

Input signals between 1 and 100 volts DC can be used if they are connected to the scale section of the controller. The input command signal should be capable of driving a 100K ohm load at its maximum value. The "SCALE INPUT" jumper must be set to the "VOL" position for voltage operation.

EXTERNAL CURRENT COMMAND SIGNALS:

The hydrostatic transmission controller will follow a 4 to 20 ma signal. This signal must be run through the scale section prior to being applied to the command input terminals. The "SCALE INPUT" jumper must be set to the "CUR" position for current operation. This optional input allows unidirectional operation only.

VELOCITY FEEDBACK TRANSDUCER SIGNALS:

The external velocity transducer is connected to the driven element and must return a voltage signal that is proportional to speed. This device is used for closed loop operation only. The output signal from the transducer must be of the same magnitude but *opposite in polarity* to the command signal. The "FEEDBACK

VELOCITY FEEDBACK TRANSDUCER SIGNALS, CON'T:

INPUT" range jumper on the board should be set to match the maximum transducer voltage.

Transducers with outputs between 1 and 100 volts DC can be used if they are connected to the scale section of the controller. The "SCALE INPUT" jumper must be set to the "VOL" position for voltage operation. The output from the scale section is selected with the "SCALE OUTPUT" jumper to be either of the same or opposite polarity as the transducer input. The transducer must be capable of driving a 100K ohm load at maximum input.

The output ***signal from the transducer must be opposite in polarity to the command signal.***

USER ADJUSTMENTS:

The devices listed below are multiturn potentiometers, their location and function is shown on the nameplate located on the controller's cover as well as the drawing on page number 3 of this manual.

PUMP GAIN: Adjusts the amount of current delivered to the pump displacement control valve for a given amount of command signal in open loop mode. Controls stability of the pump output in closed loop mode. Clockwise rotation will increase the amount of coil current for a given input signal.

PUMP BIAS: Adjusts the amount of current delivered to the pump displacement control valve when the input command signal is zero. Rotation from the center position will provide either a positive or negative bias current.

PUMP LIMIT: Sets the maximum amount of current that can be delivered to the pump displacement control valve. Clockwise rotation will increase the maximum amount of coil current.

PUMP FREQ: Sets the frequency of the dither signal applied to the pump displacement control valve. Clockwise rotation will increase the dither frequency. The dither generator frequency can be measured at the test point marked "TP3" Supplied only if the optional dither generator module was ordered.

PUMP AMPL: Sets the magnitude of the dither signal applied to the pump displacement control valve. Clockwise rotation will increase the amount of dither current. Supplied only if the optional dither generator module was ordered.

MOTOR GAIN: Adjusts the amount of current delivered to the motor displacement control valve for a given amount of command signal in open loop mode. Controls stability of the motor output in closed loop mode. Clockwise rotation will increase the amount of coil current for a given input signal.

MOTOR BIAS: Adjusts the amount of current delivered to the motor displacement control valve when the input command signal is zero. Rotation from the center position will provide either a positive or negative bias current.

MOTOR LIMIT: Sets the maximum amount of current that can be delivered to the motor displacement control valve. Clockwise rotation will increase the maximum amount of coil current.

MOTOR FREQ: Sets the frequency of the dither signal applied to the motor displacement control valve. Clockwise rotation will increase the dither frequency. The dither generator frequency can be measured at the test point marked "TP3" Supplied only if the optional dither generator module was ordered.

MOTOR AMPL: Sets the magnitude of the dither signal applied to the motor displacement control valve. Clockwise rotation will increase the amount of dither current. Supplied only if the optional dither generator module was ordered.

PHASE ADJUSTMENT: Determines the value of the input command signal required to start the output to the motor displacement control valve. Clockwise rotation will increase the start point. This point is the same for either positive or negative input signals.

FORWARD ACCEL: Sets the acceleration time when the input command signal is increased from a lower to a higher *positive* voltage. C'clockwise rotation will increase the ramp time. Supplied only if the optional ramp generator module was ordered.

FORWARD DECEL: Sets the deceleration time when the input command signal is reduced from a *positive* voltage towards zero. C'clockwise rotation will increase the ramp time. Supplied only if the optional ramp generator module was ordered.

REVERSE ACCEL: Sets the acceleration time when the input command signal is increased from a lower to a higher *negative* voltage. C'clockwise rotation will increase the ramp time. Supplied only if the optional ramp generator module was ordered.

REVERSE DECEL: Sets the deceleration time when the input command signal is reduced from a

USER ADJUSTMENTS, CON'T:

negative voltage towards zero. C'clockwise rotation will increase the ramp time. Supplied only if the optional ramp generator module was ordered.

SCALE GAIN: Determines the gain of the scale section. Clockwise rotation will increase the amount of output for a given input signal.

SCALE ZERO: Used to set the scale section output signal to zero when the scale input signal is at its minimum value. Rotation from the center position will provide either a positive or negative bias current.

SUPPLEMENTARY ADJUSTMENTS:

The devices listed below are single turn potentiometers that are located on the circuit board. They are preset and sealed at the factory prior to shipment. They do not normally require any additional adjustment by the user. The function of these devices is included for reference only. The devices are marked on the component side of the circuit board.

INTEGRATOR ZERO: Sets the output of the integrator to zero volts with both terminal numbers 12 and 13 connected to the system common (0 volt) potential at terminal number 11. The integrator output can be measured at the "INT INHIBIT" tab located closest to the "ZERO" adjustment potentiometer. The "GAIN MODE" select jumper should be removed when adjusting this device.

DEADBAND ADJUST: Sets the amount of command input signal required to produce an output signal to the pump displacement control valve. This control is supplied only if the optional linear acceleration and deceleration ramp control module is ordered. It will prevent the output from changing polarity until the internal ramp has passed thru zero. The current deadband voltage can be measured at the test point marked "TP3"
on the circuit board.

MODE SELECT JUMPERS:

These devices are two (2) position pin headers, their location and function is shown on the nameplate located on the controller's cover as well as the drawing on page number 2 of this manual.

COMMAND INPUT: Selects the magnitude of the command input signal. "LO" position is 5 volts maximum. "HI" position is 10 volts maximum.

FEEDBACK INPUT: Selects the magnitude of the feedback signal. "LO" position is 5 volts maximum. "HI" position is 10 volts maximum.

PUMP OUTPUT RANGE: Selects the maximum current that can be delivered to the pump displacement control valve. "LO" position is 50 or 100 ma. maximum. "HI" position is 100 or 200 ma. maximum. The 50-100 or 100-200 ranges depend upon the model number supplied. Refer to the Specification and Part number identification sections of this manual for additional information.

MOTOR OUTPUT RANGE: Selects the maximum current that can be delivered to the pump displacement control valve. "LO" position is 50 or 100 ma. maximum. "HI" position is 100 or 200 ma. maximum. The 50-100 or 100-200 ranges depend upon the model number supplied. Refer to the Specification and Part number identification sections of this manual for additional information.

MOTOR OPERATING MODE: Selects the motor displacement control valve operating mode. "NOR" position will increase the current to the displacement control valve as the input signal is increased. "REV" position will decrease the current to the motor displacement control valve as the input signal is increased.

The **"**NOR" position should be selected for motors that are biased to maximum displacement when zero current is applied to the displacement control valve. The "REV" position should be selected only if the motor displacement is biased to it's minimum value with zero current flowing through the displacement control valve.

GAIN MODE: Selects the amplifier operating mode. "PRO" position is proportional gain. "INT" position is integral gain. Use the integral mode for closed loop, velocity feedback operation only.

SCALE INPUT: Selects the type of input signal to the scale section. "VOL" position accepts inputs from 1 to 100 VDC maximum. "CUR" position is designed to accept a 4 to 20 ma. current signal.

MODE SELECT JUMPERS, CON'T:

Either signal will produce a 10 VDC maximum output.

SCALE OUTPUT: Selects the polarity of the output signal from the scale section. "NON" position produces an output signal of the same polarity as the input. "INV" position produces an output of the opposite polarity from the input signal.

The devices described below are four (4) position pin headers, their location and function is shown on the nameplate located on the controller's cover as well as the drawing on page number 3 of this manual. These devices are supplied only if the optional linear acceleration and deceleration ramp generator module was ordered.

FORWARD RANGE: Selects the acceleration and deceleration time range when the command input signal is at a *positive* voltage. "HI" position is 25 to 250 seconds. "MID" position is 5 to 50 seconds. "LO" position is 1 to 10 seconds. "DIS" position will inhibit the linear ramp function. The acceleration times are separately adjustable within the selected range.

REVERSE RANGE: Selects the acceleration and deceleration time range when the command input signal is at a *negative* voltage. "HI" position is 25 to 250 seconds. "MID" position is 5 to 50 seconds. "LO" position is 1 to 10 seconds. "DIS" position will inhibit the linear ramp function. The acceleration times are separately adjustable within the selected range.

INHIBIT TABS FUNCTION:

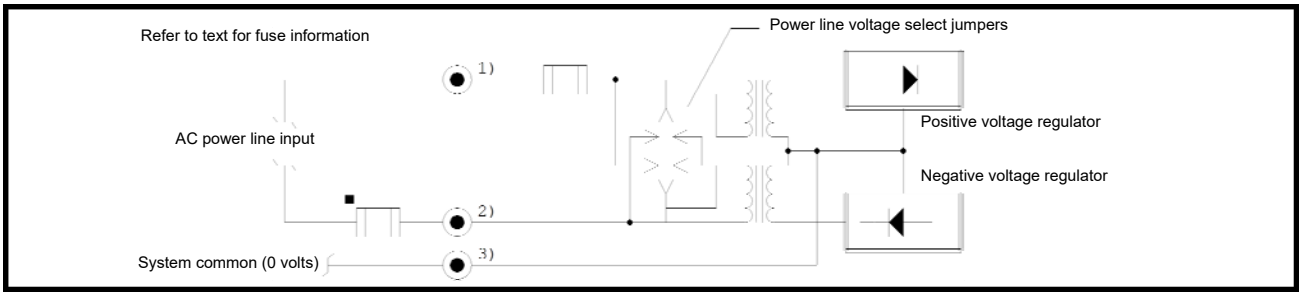
These 1/4 inch male quick connect tabs are generally used only in closed loop velocity feedback applications with integral gain. When they are shorted to each other the output from the internal integrator is forced to zero. This will prevent the amplifier from generating a false output signal due to mismatched or noisy input signals when the command is set to zero. During normal operation, there should be no connection between the two tabs. These tabs must be left unconnected for all open loop applications.

AC POWER LINE VOLTAGE SELECT JUMPERS:

All hydrostatic transmission controllers with suffix AAA = 111 are designed to operate from *either 115 or 230 volt AC power lines*. Prior to applying the AC input power to this model, the user must position the voltage select jumpers for the proper line voltage. The location of these jumpers is marked on the circuit board as well as the installation drawing on page number 3 of this manual.

For 115 volt AC power line operation, connect the two wires with the female connectors to the adjacent male tab marked "115" For 230 volt AC power line operation, connect the two wires with the female connector to the adjacent male tabs marked "230". These jumpers are located above the controller's terminal block and next to the power line fuse. Set both jumpers to match the nominal power line input, either 115 VAC or 230 VAC.

EXTERNAL POWER SUPPLY CONNECTIONS, AC INPUT MODELS



The external fuse shown in series with the connection to terminal number 2 should *not be installed* if this line is connected to the system earth ground.

Note that all hydrostatic transmission controllers with suffix AAA = 111 will operate from both 115 and 230 volt AC power lines. ***The line voltage select jumpers must be placed in the correct position prior to applying AC power to these models.***

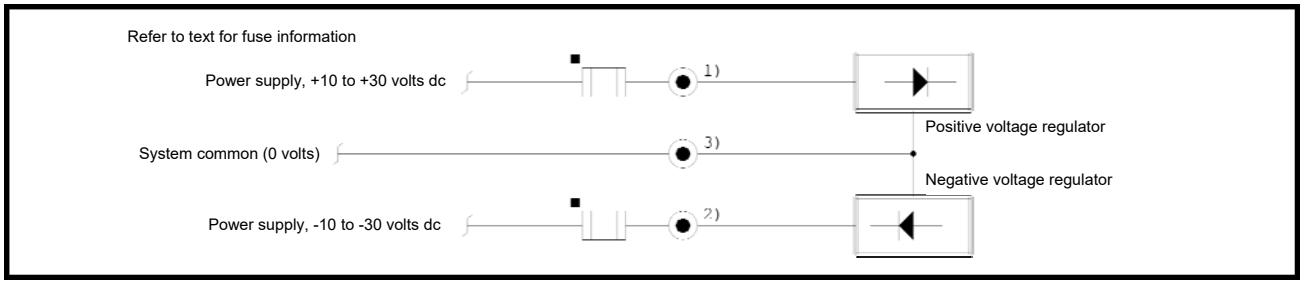
Controllers with suffix AAA = 231 operate on 230 volts AC only. No line voltage selection is required for these models and the power line voltage input select jumpers are not supplied.

EXTERNAL POWER SUPPLY CONNECTIONS, AC INPUT MODELS, CON'T

! ! ! ! ! CAUTION ! ! ! ! !

Improper connection of the input power line voltage selection jumpers may cause irreparable damage to the hydrostatic transmission controller.

EXTERNAL POWER SUPPLY CONNECTIONS, DC INPUT MODELS



The fuses shown in the connections to terminal numbers 1 and 2 are not required if the user's external power supply includes the necessary short circuit protection devices.

Do not ***install fuses in any conductor that is connected to the system earth ground.***

The minimum input power supply voltage for controllers with suffix AAA = 180 is plus and minus 18 volts DC. The maximum input power supply voltage is plus and minus 30 volts DC. For best operation the plus and minus power supply voltages should be within 2 volts of each other.

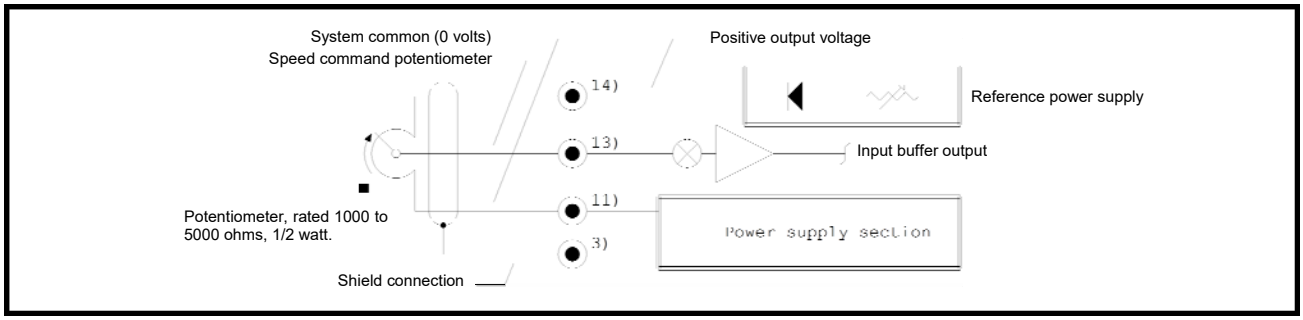
EXTERNAL COMMAND SIGNAL WIRING OPTIONS:

For maximum application flexibility, the hydrostatic transmission controller is designed to operate from a number of different input command signal sources. The user should select the correct wiring for a specific application from the choices given in the figures below.

The user should be aware of the fact that on models with the linear acceleration and deceleration ramp control option, that the input signal applied to terminal number 13 is the signal that is acted on by the ramps. This signal must be the input command signal. For unidirectional operation with positive input signals the "REVERSE" ramp controls will have no effect on the output.

Should the feedback signal be connected to terminal number 13 and passed thru the linear ramp section, in most cases it will be impossible to adjust the drive controller for stable operation. *Do not wire the feedback signal thru the ramp generator section.*

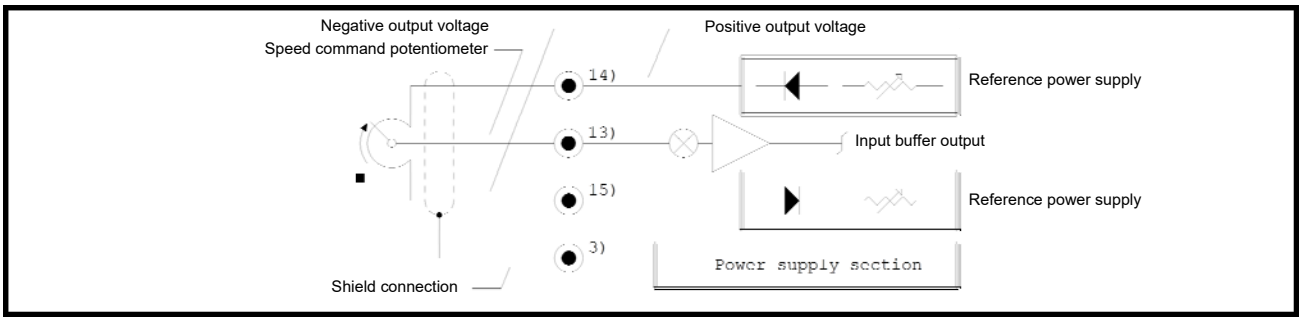
EXTERNAL COMMAND SIGNAL FROM A POTENTIOMETER, UNIDIRECTIONAL OPERATION:



The figure above illustrates the connections between the external command potentiometer and the hydrostatic transmission controller to provide unidirectional (non-reversing) operation. The internal reference power supply is used to supply a positive command voltage. The "COMMAND INPUT" jumper should be placed in the "LO" position.

Rotation of the potentiometer wiper in the direction shown by the arrow will cause the speed of the drive to increase.

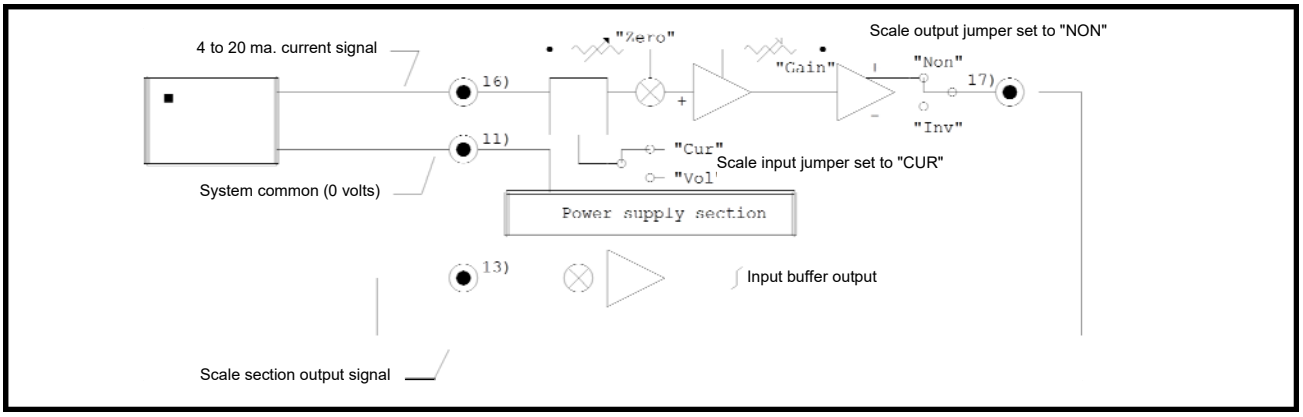
EXTERNAL COMMAND SIGNAL FROM A POTENTIOMETER, BIDIRECTIONAL OPERATION:



The figure above illustrates the connections between the external command potentiometer and the hydrostatic transmission controller to provide bidirectional (reversing) operation. The internal reference power supply is used to supply a bipolar command voltage. The "COMMAND INPUT" jumper should be placed in the "LO" position.

Clockwise rotation of the potentiometer wiper from the center position will cause the drive speed to increase in the forward direction. C'clockwise rotation of the potentiometer wiper from the center position will cause the drive speed to increase in the reverse direction. When the potentiometer wiper is centered the drive will be stopped.

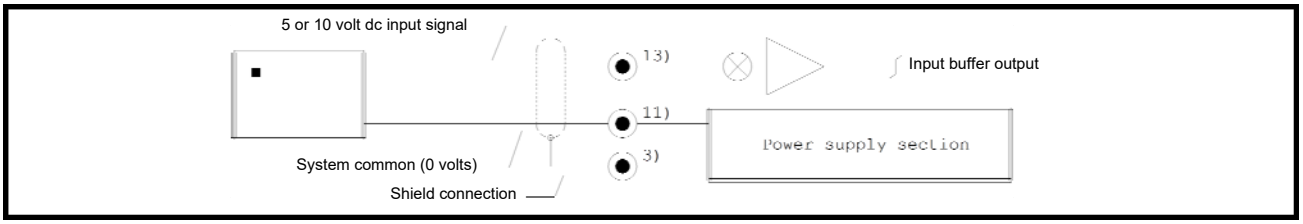
EXTERNAL COMMAND SIGNAL FROM A 4 TO 20 MA. CURRENT SOURCE, UNIDIRECTIONAL OPERATION:



The figure above illustrates the connections required for unidirectional operation with the command signal generated from a 4 to 20 ma. current source. Current signals are converted to voltage inputs at the scale section by passing them thru a 47 ohm resistor to the system common (0 volts). The voltage offset generated by the minimum 4 ma. signal should be removed with the "SCALE ZERO" adjustment. Once this is accomplished, the input signal should be increased to 20 ma. and the "SCALE GAIN" adjusted to produce the correct input signal voltage at terminal number 17, as set by the "COMMAND INPUT" mode select jumper.

The input current signal must be capable of sourcing 4 to 20 ma. into 47 ohms (.188 to .94 volts) connected to the system common (0 volts). The hydrostatic transmission controller does not provide signal isolation.

EXTERNAL COMMAND SIGNAL FROM A LOW VOLTAGE (5 OR 10 VDC) SOURCE:



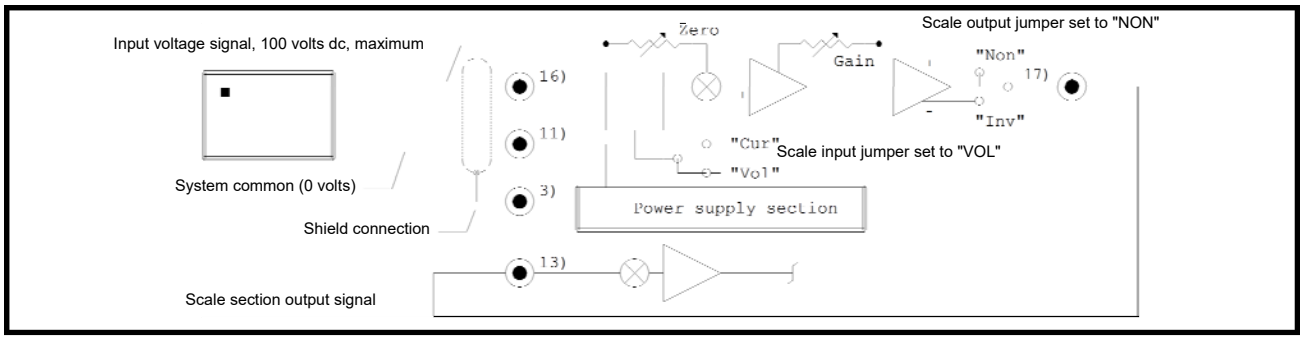
The figure above illustrates the connections required for both unidirectional and bidirectional operation with the command signal generated from a 5 or 10 volt DC source. The output speed will increase in the forward direction as the input voltage is made more positive. A negative going increase in the input voltage will

EXTERNAL COMMAND SIGNAL FROM A LOW VOLTAGE (5 OR 10 VDC) SOURCE, CON'T:

cause the output speed to increase in the reverse direction. With the input voltage command signal at zero volts the output will be stopped.

The "COMMAND INPUT" mode select jumper should be set to the "LO" position for full scale input command signals equal to +/- 5 volts DC or the "HI" position for full scale input command signals of +/- 10

EXTERNAL COMMAND SIGNAL FROM A HIGH VOLTAGE (100 VDC MAXIMUM) SOURCE



The figure above illustrates the connections required for both unidirectional and bidirectional operation with the command signal generated from a 100 volt (maximum) DC source. The output speed will increase in the forward direction as the input voltage is made more positive. A negative going increase in the input voltage will cause the output speed to increase in the reverse direction. With the input voltage command signal at zero volts the output will be stopped.

The command voltage should be set to it's minimum value, than the "SCALE ZERO" adjustment used to set the voltage at terminal number 17 to zero. Once this is accomplished, the input signal should be increased to it's maximum and the "SCALE GAIN" adjusted to produce the correct input signal voltage at terminal number 17, as set by the "COMMAND INPUT" mode select jumper.

The "COMMAND INPUT" mode select jumper should be set to the "LO" position for full scale input command signals equal to +/- 5 volts DC or the "HI" position for full scale input command signals of +/- 10

EXTERNAL VELOCITY FEEDBACK TRANSDUCER WIRING OPTIONS:

The hydrostatic transmission controllers speed regulation can be improved by the addition of a signal proportional to the driven elements speed and direction. In operation, this signal is compared to the input command signal and the controllers output adjusted in a manner such as to reduce any difference between the two signals to zero.

The improvement in speed regulation is obtained at the cost of reduced output signal stability and is directly related to the quality of the feedback signal supplied by the external velocity transducer. The hydrostatic transmission controller expects this feedback signal to be a voltage that is equal in magnitude to the command signal but opposite in polarity. For bidirectional operation the transducer signal polarity must reverse with a polarity change of the input command signal. A loss of feedback signal or a signal of the wrong polarity will cause the drive to operate at it's maximum speed only.

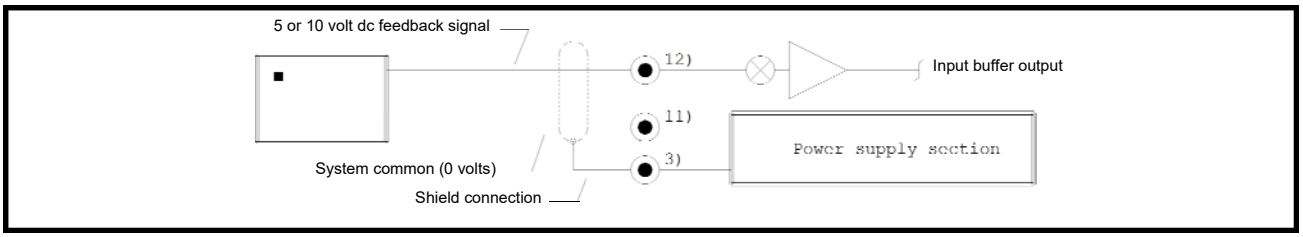
A feedback signal of 5 or 10 volts DC can be applied directly to the controllers feedback input terminal number 12. Signals of up to 100 volts DC maximum can be used, but must be processed by the scale section first.

Do not apply the feedback signal to terminal number 13 if the optional linear acceleration and deceleration ramp control module is supplied. In most cases the drive will be impossible to stabilize should the feedback signal response be less than the command signal.

The feedback transducer must provide a linear, ripple free signal DC voltage signal to terminal number 12. In most cases, a rectified and filtered signal from an AC tachometer will not provide adequate performance. In most cases the drive response will be non-linear and may become unstable at low speeds. AC tachometers are inexpensive, however due to their poor output signal characteristics their use as feedback devices to the hydrostatic drive controller is not advised.

The user should select the correct feedback transducer wiring for a specific application from the choices given in the figures on the next page of this manual.

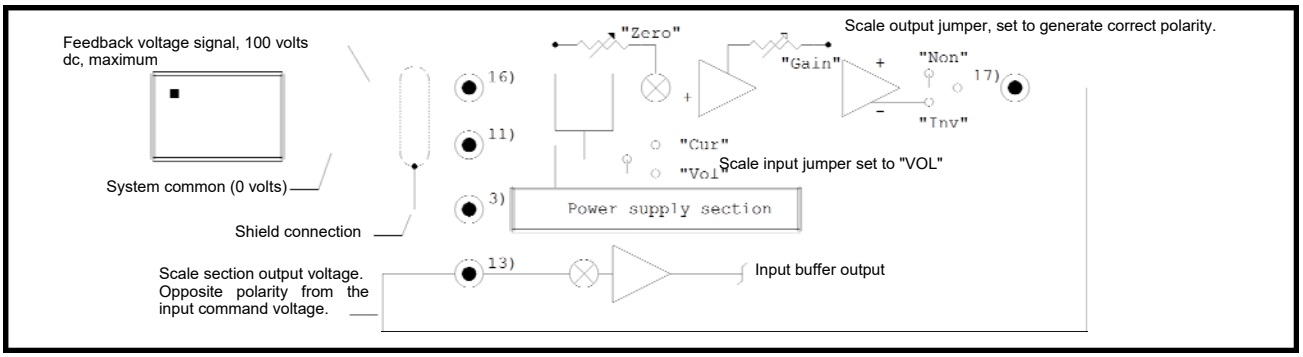
EXTERNAL FEEDBACK SIGNAL FROM A LOW VOLTAGE (5 OR 10 VDC) SOURCE:



The figure above illustrates the connections required for both unidirectional and bidirectional operation with the velocity feedback signal generated from a 5 or 10 volt DC source.

The "FEEDBACK INPUT" mode select jumper should be set to the "LO" position for full scale input feedback signals equal to +/- 5 volts DC or the "HI" position for full scale input command signals of +/- 10 volts DC.

EXTERNAL FEEDBACK SIGNAL FROM A HIGH VOLTAGE (100 VDC MAXIMUM) SOURCE:



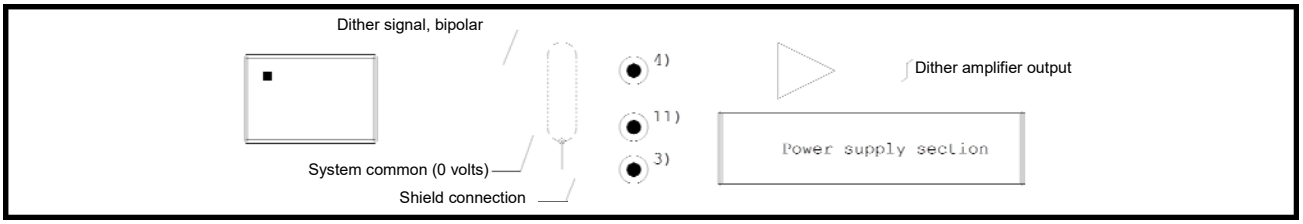
The figure above illustrates the connections required for both unidirectional and bidirectional operation with the command signal generated from a 100 volt (maximum) DC source.

The wire between terminal number 13 and terminal number 17 should not be installed during the setup process described below.

With the drive stopped or the feedback transducer disconnected, the "SCALE ZERO" adjustment should be used to set the voltage at terminal number 17 to zero. Once this is accomplished, the input command signal should be increased to it's maximum and the drive adjusted to operate at it's maximum speed, with the feedback transducer connected to the driven element. The "SCALE GAIN" should be adjusted to set the voltage at terminal number 17 exactly equal in magnitude to the command voltage at terminal number 12.

The "FEEDBACK INPUT" mode select jumper should be set to the "LO" position for full scale input feedback signals equal to +/- 5 volts DC or the "HI" position for full scale input command signals of +/- 10 volts DC. The "SCALE OUTPUT" mode select jumper should be set so that the feedback voltage at terminal number 17 is opposite in polarity to the command voltage at terminal number 12.

OPTIONAL EXTERNAL PUMP DITHER SIGNAL CONNECTIONS:

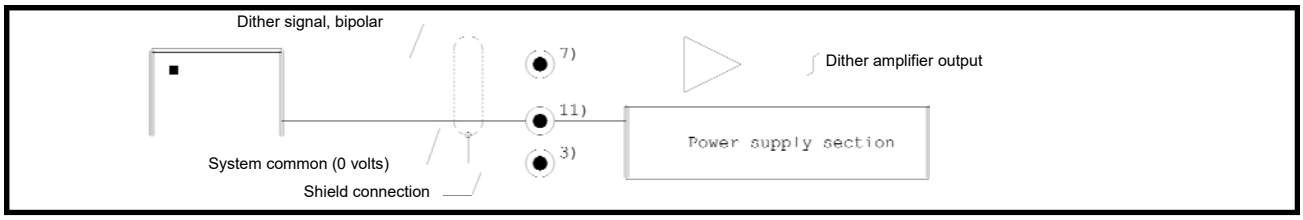


The addition of a dither signal as shown above will generally improve the hydrostatic drive's regulation and response time. The magnitude and frequency of the optional dither signal should be obtained from the pump displacement controller manufactures data sheet.

The dither signal is applied directly to the controller's pump output amplifier section., accordingly it is not affected by the gain setting. This input may also be used as for a external voltage bias signal.

The external dither signal connections shown above should be used only if the optional dither generator module was not ordered. Do not apply both internal and external dither signals to the pump displacement controller.

OPTIONAL EXTERNAL MOTOR DITHER SIGNAL CONNECTIONS:

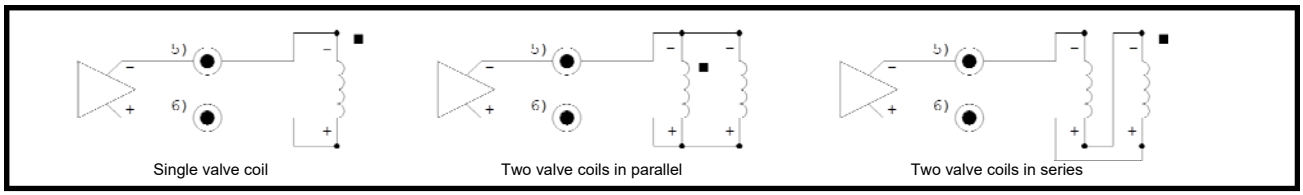


The addition of a dither signal as shown above will generally improve the hydrostatic drive's regulation and response time. The magnitude and frequency of the optional dither signal should be obtained from the pump displacement controller manufactures data sheet.

The dither signal is applied directly to the controller's motor output amplifier section., accordingly it is not affected by the gain setting. This input may also be used as for a external voltage bias signal.

The external dither signal connections shown above should be used only if the optional dither generator module was not ordered. Do not apply both internal and external dither signals to the pump displacement controller.

EXTERNAL CONNECTIONS TO THE PUMP DISPLACEMENT CONTROL VALVE:



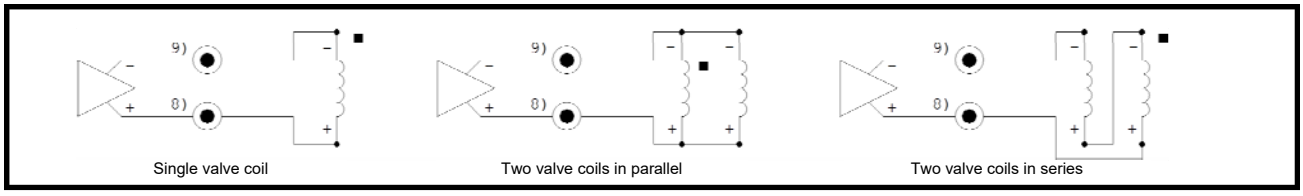
The pump displacement controller should be connected to the hydrostatic transmission controller in accordance with the drawing above. The polarity shown is with a positive input command signal. Signal current flow will be in the opposite direction when the input command signal is negative.

The maximum pump displacement controller coil current should be matched as closely as possible to the hydrostatic transmission controllers rated output. With multiple coil pump displacement controllers, the preferred connection is with both of the coils connected in parallel

The user should note that the pump displacement controller impedance and the current required for full stroke will change with the selected coil connections. Most displacement controller's will have a combination of either series or parallel connections that are suitable for use with the hydrostatic transmission controller output signal. The rated displacement control valve current and coil impedance can be obtained from the manufactures data sheets for the specific valve. User's with questions should contact Datatran's technical support department for application assistance.

Connections to the pump displacement controller need not be shielded. They must be made exactly as shown above. The pump displacement control valve coil should *not be grounded or connected to the system common* (0 volts). A grounded connection may cause the drive to operate at top speed in one direction and not rotate at all in the other.

EXTERNAL CONNECTIONS TO THE MOTOR DISPLACEMENT CONTROL VALVE:



The motor displacement controller should be connected to the hydrostatic transmission controller in accordance with the drawing above. The polarity shown is with either a positive or negative input command signal. Signal current flow to the motor displacement controller is always in the direction shown.

The maximum motor displacement controller coil current should be matched as closely as possible to the hydrostatic transmission controllers rated output. With multiple coil motor displacement controllers, the preferred connection is with both of the coils connected in parallel

The user should note that the motor displacement controller impedance and the current required for full stroke will change with the selected coil connections. Most displacement controller's will have a combination of either series or parallel connections that are suitable for use with the hydrostatic transmission controller

EXTERNAL CONNECTIONS TO THE MOTOR DISPLACEMENT CONTROL VALVE, CON'T:

output signal. The rated displacement control valve current and coil impedance can be obtained from the manufactures data sheets for the specific valve. User's with questions should contact Datatran's technical support department for application assistance.

Connections to the motor displacement controller need not be shielded. They must be made exactly as shown above. The motor displacement control valve coil should *not be grounded or connected to the system common* (0 volts). A grounded connection will force the motor to the displacement equal to maximum motor displacement control valve current flow.

OPERATION WITH VOLTAGE SIGNALS OTHER THAN 5 OR 10 VOLTS:

The hydrostatic transmission controller is capable of operating with external voltage command and feedback signals other then the standard 5 or 10 volts DC without the use of the scale section. In this mode the signal should be applied to terminal number 10. The common (0 volt) side of this external signal must be connected to terminal number 11. A external resistor must be placed in series with the signal line to terminal number 10. The value of this resistor should be calculated using the formula below:

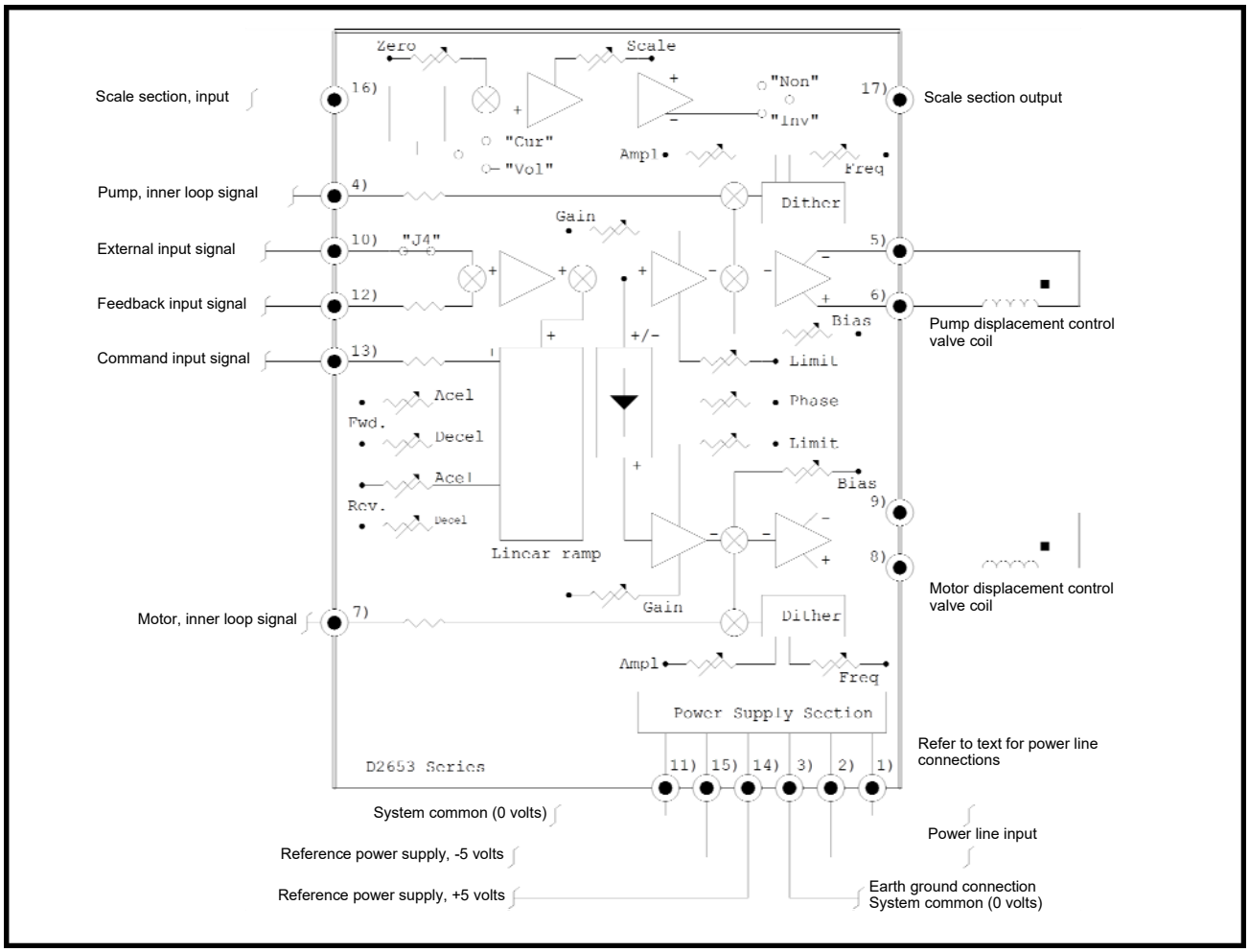
R(external) = External signal voltage * 20000

The resistor selected should be rated at 1/4 watt or more and maintain a stable value as the operating temperature changes. Resistors that change in value with temperature will cause the drive controller's output to vary in direct proportion to their change.

The calculated resistor value allows the external signal to be summed with the standard inputs and used as a multiple command input or feedback voltage. In this mode of operation the signal scale network is available for other uses. The output gain relationships are unchanged and remain as noted in the Specifications section. Input signals applied to terminal number 10 bypass the optional linear acceleration and deceleration ramp control module.

The required series resistor may be located external to the controller or jumper "J4" can be removed and the resistor installed in its place. If the resistor is installed, by the user, in place of "J4" the soldering iron used should be rated for no more than 25 watts.

FUNCTIONAL DIAGRAM:



The functional drawing in the figure above illustrates the signal flow and polarity as well as the interconnections between the signal processing modules supplied on the hydrostatic transmission controller.

! ! ! ! ! WARNING ! ! ! ! !

The input power line select jumpers are not shown in the functional drawing above. All dual voltage AC line powered models must have these line voltage select jumpers set for the correct power line voltage input prior to applying power to the hydrostatic transmission controller.

The user should carefully examine the logic, signal flow and polarities shown in the functional diagram prior to installation. Incorrect external wiring connections may damage the controller or produce unpredictable

STARTUP AND CALIBRATION INSTRUCTIONS:

When the hydrostatic transmission controller is first installed, or should it be modified in the field, the unit must be adjusted to the user's requirements. This calibration procedure is discussed below. The location of the devices referenced can be identified from the installation drawing shown on page number 3 of this manual.

The startup and tuning instructions below are described in a number of simple steps. They should be followed in sequence. Although, the number of operations shown may appear to make the process a complicated affair, this is not the case. If you take them step by step, the startup and tuning will proceed quickly. Do not proceed with any step unless you fully understand the operation that is being described and the desired results. In the event that you are confused or require clarification of a specific operation, you should contact Datatran's technical support department for assistance.

! ! ! ! ! WARNING ! ! ! ! !

The tuning instructions in the next section are for use by qualified service personnel only. You must be trained to startup electronic drive systems, have read and understand the warnings in this manual and all supporting literature, prior to proceeding.

Line voltage will exist on the equipment at any time the power line is connected. In addition, the process drive may rotate at high speed or oscillate during the tuning process.

The hydrostatic drive controller and any test equipment connected to it during the startup process may not be grounded. A high voltage potential with respect to earth ground may exist at any time the power line is connected.

To avoid possible injury or death do not attempt to tune or service this equipment unless you have been properly trained to do so.

1) Remove the AC or DC input power from the controller.

2) Inspect the wiring and option jumper select positions. Be positive that everything agrees with the expected mode of operation before proceeding with the calibration process. If closed loop operation is being used disconnect the feedback signal and set the "GAIN MODE" option jumper to the "PRO" position.

3) Make sure that the "INT INHIBIT" tabs are not shorted. They must be open for the drive controller to operate.

4) Set the "PUMP GAIN" and "MOTOR GAIN" potentiometers to their c'clockwise position (twenty five turns).

5) Set the "PUMP LIMIT" and "MOTOR LIMIT" potentiometers to their clockwise position (twenty five turns).

6) Turn the "PUMP BIAS" and "MOTOR BIAS" potentiometers c'clockwise twenty five turns than back clockwise approximately 12 turns.

7) If the optional dither generator modules are supplied, set the "PUMP AMPL" and "MOTOR AMPLY" potentiometers to their c'clockwise position (twenty five turns). This will inhibit the dither signals.

8) If a dither signal is applied externally to terminal numbers 4 and/or 7, remove the wire(s) connected to these terminals.

9) If the optional linear acceleration and deceleration ramp module is supplied, place the "FORWARD RANGE" and "REVERSE RANGE" select jumpers in the "DIS" positions. This will inhibit the ramps.

10) Set the "FORWARD" and "REVERSE ACCEL" and "DECEL" controls to the clockwise position (twenty five turns). This will produce the fastest ramp times.

11) If the command input signal is wired through the scale section the following steps must be done. If the scale section is not used proceed directly to step 17.

12) Disconnect the wire between terminal number 13 and terminal number 17. Connect a DC voltmeter between terminal numbers 3 and 17. Terminal number 3 is the system common (0 volt) connection.

13) Apply AC or DC input power to the controller. ***Do not start the pump prime mover at this time.***

14) Set the command input signal to it's minimum value. Adjust the "SCALE ZERO" potentiometer to produce zero output on terminal number 17.

STARTUP AND CALIBRATION INSTRUCTIONS, CON'T:

15) Set the command input signal to it's maximum value. Adjust the "SCALE GAIN" potentiometer to produce the desired full scale input signal on terminal number 17, as selected by the "COMMAND INPUT" jumper, at the scale circuit output.

16) Remove the AC or DC input power from the controller and reconnect the wire between terminal number 13 and terminal number 17.

17) Apply AC or DC input power to the controller. ***Do not start the pump prime mover drive at this point.***

18) Set the command input signal to it's minimum value (zero input).

19) Set the "PUMP BIAS" potentiometer to deliver zero current to the pump displacement control valve.

20) For normal motor operation, maximum motor displacement with zero current to the control valve, set the "MOTOR BIAS" potentiometer to deliver zero current to the motor displacement control valve.

OR

For reversed motor operation, minimum motor displacement with zero current to the control valve, Set the "MOTOR BIAS" potentiometer to force the motor to it's maximum displacement value.

21) Start the pump drive prime mover. Observe the pump flow. If it is not zero, adjust the mechanical null on the pump electrical displacement control valve until zero flow is observed.

22) Set the command input signal to it's maximum value. The pump flow should be less than maximum.

23) Adjust the "PUMP GAIN" potentiometer until the required maximum pump flow is observed.

24) Adjust the "PUMP LIMIT" potentiometer until the output flow from the pump starts to decrease, then turn it back clockwise about one half turn.

25) Set the command input signal to the value where the motor displacement should start to decrease. If this value is zero, set the "PHASE" potentiometer to it's c'clockwise position and skip to step number 27.

26) Adjust the "PHASE" potentiometer until the output speed of the motor starts to increase, than turn it back in the opposite direction about one half turn.

27) Set the command input signal to the value where maximum motor speed is required. This will normally be equal to the maximum command signal value.

28) Adjust the "MOTOR GAIN" potentiometer until the maximum motor speed is observed.

29) For normal motor operation, maximum displacement with zero current to the control valve, adjust the "MOTOR LIMIT" potentiometer until the current to the motor displacement control valve starts to *decrease*, than turn it back clockwise about one half turn.

OR

For reversed motor operation, minimum motor displacement with zero current to the control valve, adjust the "MOTOR LIMIT" potentiometer until the current to the motor displacement control valve starts to *increase,* than turn it back clockwise about one half turn.

30) If the optional dither modules are supplied, slowly turn the "PUMP AMPL" and the "MOTOR AMPL" potentiometers clockwise approximately twelve turns. This will deliver a dither signal of approximately 10% of the controllers maximum rated output to both the pump and motor. This setting will be adequate for the majority of applications. Should a more precise dither current setting be required, the user should contact Datatran's technical support department for specific instructions.

    If the pump or motor should start to oscillate during the dither current adjustment, the appropriate "PUMP AMPL" or "MOTOR AMPL" potentiometer should be turned back c'clockwise until stable operation is obtained.

31) If the dither signal is generated externally. Reconnect the wire(s) to terminal number 4 and/or 7 and apply a 10 volt peak to peak square wave. Signals applied to terminal number 4 are for the pump dither, signal on terminal number 7 are for the motor. This will deliver a dither signal of approximately 10% of the controllers maximum rated output. This setting will be adequate for the majority of applications.

STARTUP AND CALIBRATION INSTRUCTIONS, CON'T:

Should a more precise dither current setting be required, the user should contact Datatran's technical support department for specific instructions.

If the pump or motor should start to oscillate when the dither signal is applied, the amplitude of this signal must be reduced until stable operation is obtained.

32) If the optional linear acceleration and deceleration ramp module is installed, set the "FORWARD RANGE" and "REVERSE RANGE" select jumpers to the desired time range.

Vary the input command signal from one end of it's range to the other while adjusting the appropriate "ACCELERATION" and "DECELERATION" controls until the desired response is observed.

33) This completes the open loop adjustment, cycle the command input signal over its entire range and check for smooth operation under all input signal conditions. If the system is to be operated with closed loop velocity feedback proceed with step 34, if not proceed to step 50.

34) Set the input signal to zero, allow the drive to stop and then remove the AC or DC input power from the controller. Do not stop the pump prime mover. ***The drive will rotate in the following steps.***

! ! ! ! ! CAUTION ! ! ! ! !

The hydrostatic transmission controller described in this instruction manual is designed to be applied by experienced user's in both open and closed loop applications.

Although each individual component in a system may function perfectly by itself, once they are interconnected, closed loop operations can sometimes be difficult or in extreme cases impossible to stabilize.

The type of external load, it's location, the process control element gain as well as the system time constants and electrical noise all contribute to the stability considerations in any closed loop application.

Due to the numerous external factors acting upon the controller, Datatran is not able to guarantee that satisfactory operation can be obtained in all closed loop applications.

35) If the velocity feedback signal is wired through the scale section the following steps must be done. If the scale section is not used proceed directly to step 42.

36) Connect the feedback transducer to the controller in accordance with the correct connection diagram. Disconnect the wire between terminal number 12 and terminal number 17. Connect a DC voltmeter between terminal numbers 3 and 17. Terminal number 3 is the system common (0 volt) connection.

37) Turn the "SCALE GAIN" potentiometer all the way c'clockwise (twenty five turns).

38) Apply AC or DC input power to the controller, with the command input signal at zero and the feedback transducer stationary, adjust the "SCALE ZERO" potentiometer to produce zero output on terminal number 17.

39) Set the command input signal to maximum and allow the drive to accelerate to it's maximum speed. Adjust the "SCALE GAIN" potentiometer so that the output from the scale circuit is exactly equal to the input signal in magnitude but opposite in polarity.

The polarity of the voltage output signal on terminal number 17 can be reversed by changing the current position of the "SCALE OUT" mode select jumper.

40) Set the command input signal to zero and check the scale output voltage on terminal number 17. It should be zero and the drive should be stopped. If the output is not zero repeat steps 38 and 39 until the correct range is obtained.

41) Remove the AC power from the controller and connect the scale circuit output to the feedback signal input terminal number 12.

42) Set the "GAIN MODE" option select jumper to the "INT" position. Any jumpers between the "INT INHIBIT" tabs must be removed for the drive to run.

STARTUP AND CALIBRATION INSTRUCTIONS, CON'T:

43) Apply the AC or DC input power to the controller and slowly increase the command input signal. If the controller goes to maximum output with a small input signal, remove the AC or DC input power and reverse the feedback transducer polarity. Reapply the AC or DC input power and try again.

44) Set the command input signal to about one half of it's maximum.

45) Slowly, adjust the "PUMP GAIN" potentiometer until the output to the pump electrical displacement control valve starts to become unstable, at this point reduce the "PUMP GAIN" setting until stable operation is observed. Adjust the command signal until the motor is operating at approximately one half of its displacement range.

46) If necessary, increase the command input signal until the signal to the motor displacement control valve is approximately one half of it's maximum.

47) Slowly, adjust the "MOTOR GAIN" potentiometer until the output to the motor electrical displacement control valve starts to become unstable, at this point reduce the "MOTOR GAIN" setting until stable operation is observed.

48) Adjust the command input signal over it's entire range and observe the pump output. If any hunting or instability of the output occurs, the "PUMP GAIN" and "MOTOR GAIN" controls must be adjusted to produce stable operation at all times. In the event that the system can't be stabilized with a reasonable gain setting it is recommended that Datatran's engineering department be consulted for specific application assistance.

THE OUTPUT SPEED MUST BE STABLE UNDER ALL CONDITIONS!

Any process that oscillates or rings in an uncontrolled manner is not only not working, it may damage the equipment or cause injury to personnel.. If you are forced to choose between regulation and stability, always set the process for stable operation.

49) On closed loop applications, it is strongly recommended that a contact be closed across the "INT INHIBIT" contacts at any time the drive is to remain at zero speed. This will prevent unwanted rotation due to mismatched feedback or noisy input signals.

50) Set the command input signal to zero and remove the AC or DC input power from the controller.

51) Shut off the pump drive and remove any test equipment used in the calibration procedure.

This completes the startup and calibration procedure. The hydrostatic transmission controller is now ready for operation.

SPECIFICATIONS:

AC INPUT POWER SUPPLY VOLTAGE:	205 to 250 VAC with suffix AAA = 231
	105 to 130 VAC or 205 to 250 VAC with suffix AAA = 111
All ac line powered models will operate with line frequencies from 47 to 62 Hz.	

AC INPUT POWER REQUIREMENT:	20 VA maximum with both outputs at 200 ma.

DC INPUT POWER SUPPLY VOLTAGE:	+/- 18 volts minimum with suffix AAA = 180
The maximum power supply voltage for all dc input models is +/- 30 volts. The power supply must deliver a minimum of 75 ma. plus the displacement controllers maximum coil current.	

RATED OUTPUT VOLTAGE:	Plus and minus 10 volts dc, maximum.

SPECIFICATIONS, CON'T:

RATED OUTPUT CURRENT:	High range, 100 ma. Low range, 50 ma. maximum with suffix CCC = 101. High range, 200 ma. Low range, 100 ma. maximum with suffix CCC = 201.

OUTPUT CURRENT SIGNAL STABILITY AND DRIFT:	Better than 1% with inner loop current feedback and unity gain.

MAXIMUM LOAD IMPEDANCE:	High range, 100 ohms. Low range 200 ohms maximum at rated current with suffix CCC = 101. High range, 50 ohms. Low range, 100 ohms maximum at rated current with suffix CCC = 201.

The minimum load impedance shall not be less than 10 ohms under any operating condition.

REFERENCE OUTPUT VOLTAGE AND CURRENT:	Plus and minus 5 volts dc at 5 ma. maximum.

RATED INPUT COMMAND SIGNAL:	High range, 10 volts. Low range, 5 volts. All signals are bipolar. Current range, 4 to 20 ma, unipolar.

Command input signals up to 100 volts can be applied to the scale section input.

RATED FEEDBACK SIGNAL:	High range, 10 volts. Low range, 5 volts. All signals are bipolar.

Feedback input signals up to 100 volts can be applied to the scale section input.

SIGNAL INPUT IMPEDANCE: Signal and feedback. High range, 200K ohms. Low range, 100K ohms at terminal numbers 12 and 13. Inner loop, 20K ohms at terminal number 4. Scale input set for voltage input, 100K ohms at terminal number 16. Scale section set for current input, 47.5 ohms at terminal number 16.

ACCELERATION AND DECELERATION RAMP TIMES:

Range select jumpers set to:	Low range (LO):	1 second (fast) to 10 seconds (slow).
	Mid range (MID):	5 seconds (fast) to 50 seconds (slow).
	High Range (HI):	25 seconds (fast) to 250 seconds (slow).

The acceleration and deceleration rates are separately adjustable within the selected range.

Time ranges shown are for a 100% step change of the input signal. Range tolerance is plus and minus 20% of the values shown.

PROPORTIONAL GAIN ADJUSTMENT RANGE:	High range in and out, 200% ma./volt, maximum.
	High range in, Low range out, 200% ma./volt, maximum.
	Low range in, High range out, 400% ma./volt, maximum.
	Low range in and out, 400% ma./volt, maximum.

The minimum proportional gain settings are 1/40 of the values listed above.

SCALE SECTION GAIN ADJUSTMENT RANGE:	1/10 minimum to 10 maximum, volts per volt.

DITHER AMPLITUDE ADJUSTMENT RANGE:	0% to 20% of the rated output current.

SPECIFICATIONS, CON'T:

INTEGRAL GAIN ADJUSTMENT RANGE: High range in and out, 212% ma./sec./volt, maximum.

High range in, Low range out, 212% ma./sec./volt, maximum.

Low range in, High range out, 425% ma./sec./volt, maximum.

Low range in and out, 425% ma./sec./volt, maximum.

The minimum integral gain setting is 1/40 of the values listed above.

DITHER FREQUENCY ADJUSTMENT RANGE: 100 Hz. minimum to 1000 Hz. maximum.

The dither frequency is preset at the factory, prior to shipment, to 400 Hz.

PHASE CONTROL ADJUSTMENT RANGE: 0% to 100% of the rated input voltage.

The phase setpoint is the command signal value where the motor output signal will start to change.

BIAS OR ZERO CONTROL ADJUSTMENT RANGE: . 0% to 100% of the rated output current.

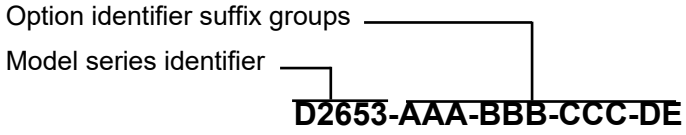
FIXED INNER LOOP GAIN: High output range, 4 ma./volt. Low output range, 2 ma./volt, with suffix CCC = 101..

High output range, 8 ma./volt. Low output range, 4 ma./volt, with suffix CCC = 201.

OPERATING TEMPERATURE: - 20 degrees to + 55 degrees C..

PART NUMBER IDENTIFICATION:

All hydrostatic transmission controllers utilize the same basic model series identifier number. This number is modified with a suffix to indicate a particular combination of options. The format for the complete part number is illustrated in the example below:



PART NUMBER SUFFIX GROUP EXPLANATION	
SUFFIX	**DESCRIPTION**
AAA	Minimum power supply voltage
BBB	Maximum input signal voltage
CCC	Maximum output current to valve coil
D	Factory installed option identifier number 1
E	Factory installed option identifier number 2

Parts shipped from the factory will have the correct alphanumeric option identifier in place of the suffix letters indicated in the table above.

ORDERING INFORMATION:

Purchase orders must include a complete part number. Refer to the D2653 model series selection sheet for a complete listing of all available models.

A number of modifications are available for this unit. Some of the most common options include special input and output signal ranges, operation at temperatures between -55 and +100 degrees C, gain and stability adjustment changes as well as special OEM versions. Most of these modifications can be accomplished at little or no additional cost. Interested user's are invited to contact Datatran Labs, Inc. for a quotation pertaining to any special options that they may require.

DS2653 issued 7/11/2006, replaces 11/1/2001

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