Jordan CONTROLS

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By: Engineering Dept.

INSTALLATION AND OPERATING INSTRUCTIONS FOR AD-7700 AMPLIFIERS

Due to wide variations in the terminal numbering of actuator products, actual wiring of this device should follow the wiring drawing supplied with the unit.

Jordan Controls, Inc. • 5607 West Douglas Avenue • Milwaukee Wisconsin 53218
Phone: 414/461-9200 • Fax: 414/461-1024 • E-Mail: jordan@jordancontrols.com • Website: www.jordancontrols.com

I. Description

The AD-7700 series amplifiers are Pulse-Width-Modulated dc servo amplifiers with an integral power supply, current transmitter and limit signals that fit inside Jordan Controls 1100 series actuators. Operating from either 115 Vac, 230 Vac, or 24 Vdc the two AD-7700 models provide closed loop control with many common current and voltage command signals. Discrete control is also provided to allow manual or remote control outside the actuator. The servo amplifier is made up of two boards, the power supply and logic amplifier board.

The amplifier board plugs into the supply, and has the following features:

- Servo or manual control selection
- Command input selection with loss of signal lock-in-place or preset position modes
- Increase/decrease manual control, exclusive OR input logic active low operation, also used for end of travel stop
- Four Adjustable Electronic Limit signals based on pot position
- Motor speed control loop, no tach required, based on armature reaction also with dynamic RPM motor brake control
- Torque control, variable current to motor
- Isolated loop powered 4 to 20 mA transmitter reading pot position
- Light emitting diode annunciation of motor drive, loss of signal and limit signal operation
- Reverse servo operation, selects operating direction to ends of travel

The power section of the AD-7700 series amplifiers consists of two different boards depending upon the model; a transformer 115/230 Vac supply or a 24 Vdc board. Each unit is input fused. The dc board is made utilizing the same PCB as the ac unit without the transformer. Both boards produce: (V1) 24 Vdc motor supply, +15 Vdc high filtered analog supply and (V2) noncritical +15 Vdc.

II. Models

AD-7710: Amplifier and 120 Vac power supply
Input power: 120 Vac, ±10%, 50/60 Hz, 0.5 A

AD-7720: Amplifier and dc supply
Input power: +24 Vdc, ±10%, 4.5 A

III. Specifications

(All measurements with respect to terminal 11, GND)

Input Resistance:

4 to 20 mA command	480 to 260 ohms
0 to 10 Vdc command	Greater than 10 thousand ohms

Manual Input:

P4-13	[INC] active LOW	sink 5 mA min (yellow LED)
P4-14	[DEC] active LOW	sink 5 mA min (green LED)

NOTE: Two active lows will always stop the motor. Used as override stop or end of travel limit. See wiring diagrams

P4-12	[AUTO] active LOW	sink 1 mA min

Feedback Resistance: 1 K ohm
Voltage across feedback pot: +2 Vdc lo
+15 Vdc hi

4 to 20 mA input command:

Loss of signal threshold	1.5 mA
Lock in place and Preset range	4.0 mA to 20.0 mA

Gain:
AD-7700 12 turn pot adjustment
10 to 100 V/V (standard)
Speed Loop: 0 to 100% of rated actuator speed (adjustable).

Limit Signal Circuitry:
Four adjustable voltage comparators connected to uncommitted optoisolators that may be used to signal external systems or stop motor movement when limit point on feedback pot is reached. One limit circuit is required, for each limit position.

Isolation	5000 Vrms
Breakdown voltage "Vbr CEO"	40 Vdc
Load current "If"	15 ma dc
Saturation voltage Vsat @ 15 ma	2 Vdc

Isolated 4-20 mA transmitter

Load	800 ohm max
Loop Supply	12 to 36 Vdc

Loop powered optically isolated transmitter using pulse width modulation to convert the servo feedback pot position to 4 to 20 mA external loop control. The transmitter may be set for 4-20 mA output over the full feedback travel down to 20% full travel.

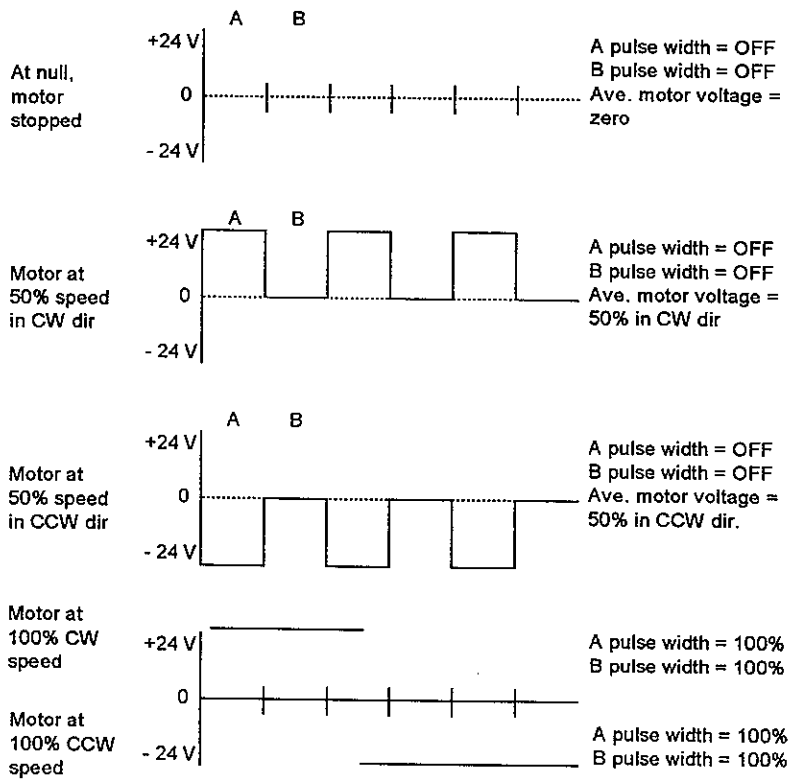
Output: Peak current rating to motor 4.5 A
Amplifier max continuous rating 2.0 A @ 24 Vdc
Pulse-Width-Modulated freq 22.0 KHZ (nominal)

Adjustments:
1) Hi setpoint
2) Low setpoint
3) LOS setpoint
4) Torque (motor current
5) Max motor speed
6) Deadband
7) LS1 limit signal
8) LS2 limit signal
9) LS3 limit signal
10) LS4 limit signal
11) Xmtr 4 mA setpoint
12) Xmtr 20 mA setpoint

Environment:
Operating temp (Outside actuator ambient)
AD-7700 inside 1140 series 0 to 55°C
AD-7700 inside 1180 series 0 to 45°C
(With optional heater down to - 40°C)
Humidity To 85% @ 25°C
Mounting position Any

Power Supply
Input power AD-7710
120 Vac, 0.5 A, 50/60 Hz
Output V1 +28 Vdc, 3.0A
Output V2 +15 Vdc, 150 mA
Output +15 +15 Vdc, 150 mA
Line regulation +28 Vdc +5%
+15 Vdc +1%
Load regulation +28 Vdc +15%
+15 Vdc +1%
Input under-voltage threshold AD-7710
108 Vac
Input over-voltage threshold AD-7710
132 Vac

DC board : AD-7720
Input power +24 Vdc, 4.5 A
Output V1 +24 Vdc, 4.8 A
Output V2 +15 Vdc, 150 mA
Output +15 +15 Vdc, 150 mA
Line regulation +24 Vdc same as input
+15 Vdc +1%
Load regulation +24 Vdc same as input
+15 Vdc +1%
Input power range +22 Vdc to +26 Vdc



IV. Theory of Operation

A. General

The AD-7700 series amplifiers are proportional pulse-width-modulated (PWM) dc servo amplifiers. The output motor voltage across P1-1 and P1-2 is proportional to the difference between the command and feedback voltage with max duty cycle established by the motor speed loop and the motor current setting. The wave forms below show the PM motor armature voltage under different motor conditions at max motor speed and current settings.

B. Motor Speed Control

This circuit maintains the motor running RPM during loading in auto or manual operation. A speed loop control compares the speed setting against motor electronic tach circuit speed, derived from motor armature reaction, and corrects for RPM changes.

C. Motor Braking

A dynamic braking circuit has been included to rapidly stop the motor by applying a controlled short circuit through the driver across the armature leads. At the time the stop command is sent motor speed is measured to determine the kinetic energy in the motor. (Too much energy will burnout the driver if a short is fully applied to the spinning motor.) A pulse width modulated short increases as the speed drops, a full short at zero speed helps the motor hold position.

D. Actuator Automatic Shutdown Under Locked Rotor Conditions

The AD-7700 has a motor protection circuit that will limit current to the motor under any conditions to control torque to the load. If the actuator is stopped or jammed by external forces, the motor will draw limited current. The amplifier limits this peak maximum current to 4.5 A, but the motor cannot withstand this 2.5 A continuously. After approximately 2 minutes at 4.5 A, the amplifier drive circuitry will thermally shut off the outputs to the motor. The drive will reset after the jam is removed and the amp cools.

V. Installation

A. Mounting

The amplifier mounting dimensions are completely defined on the Jordan Controls installation drawing shipped with your unit.

B. Wiring

For specific wiring prints for your unit, refer to wiring print shipped with your unit. Use 18 AWG for all power leads and 22 AWG shielded twisted pair for command input. Ground shield to terminal P4-11 only, do not ground other end of shield.

C. Fusing

Fusing is provided internally for the amplifier. A 2 ampere slow-blow fuse is included.

D. Start Up and Calibration

The AD-7700 amplifier and actuator combination was set-up and calibrated at the factory. Upon initial receipt of the amplifier/actuator follow this procedure:

1. Connect power leads to P1-1 and P1-2 of the power supply. Set input voltage switch to the line level being used.
2. Connect the command signal P4-17 & P4-16 for voltage P4-16 & P4-15 for current.
3. End of travel control is wired per the wiring diagrams specified for your unit. to set these locations position the output unpowered or manually first to the low point, set LS1 (R76) DS1 to just come on, then the high point, LS2 (R77) DS2 to just come on. During normal operation as a limit point is reached both DS5 and DS6 will both com on indication a stopped condition. For high current switched outputs mechanical switches may be setup by rotating the cams to the limit points.
4. After the minimum and maximum actuator limit positions are determined, set the following amplifier adjustments as required.
5. Normal or reverse acting servo operation: Select this switch if you desire to swap the location of the command set points, limit signal settings will not be affected.

E. Adjustments

The following adjustments are used to tune the amplifier/actuator loop and give the best possible actuator response for a given command signal.

Gain

Sensitivity and loop stability may be tailored to the type of motor gearing and feedback specific to the unit. Higher ratio multi turn units will require higher gain for optimum performance. Quarter turn high output actuators will required a careful balance of gain and deadband adjustments to maintain stability through the various load requirements.

Deadband

Deadband is an adjustable zone around the null point that the motor is stopped electronically. Auto servo positioning stability and sensitivity may be adjusted with (R12). Clockwise rotation opens the deadband window. Indication of activity outside the deadband are seen in the green and yellow LEDS.

Hi and Low Setpoints

Hi and Low trim potentiometers are needed to set the actuator's minimum and maximum positions for a given command signal. Adjust the low setpoint (R19) on the amplifier board to the desired minimum actuator position. Set the command signal to maximum, and adjust the Hi setpoint (R18) to obtain the desired maximum position. Verify both settings, changing HI setting does not affect the LO but any corrections to the LO will shift the HI the same amount.

Speed

the speed potentiometer (R11) was set at the factory for the maximum output voltage of 24 Vdc. Adjusting this trimpot CCW will reduce the actuator's full speed for manual or auto operation..

4 to 20 mA Loss of Signal Preset Position Adjustment

If you have a 4 to 20 mA command signal, and this signal is removed, the actuator will lock-in-place or go to a preset position depending upon the switch position (SW1-8) and adjust of LOS set (R17). The actuator will position itself as you adjust (R17). Now by using (R17), position the actuator where you want it if you should lose the 4 to 20 mA command signal. Reconnect the removed wire and the actuator will again follow the command.

4 to 20 mA Loss of Signal Threshold Adjustment

The loss of signal threshold does not need to be adjusted. During loss of signal a LED will light for an open circuit 4-20 mA input or a voltage command loss (open circuit).

VI. Troubleshooting

A. General

The AD-7700 series amplifiers are designed for ease of repair. All the boards that make up the AD-7700 plug into each other for modular replacement. A system block diagram is shown on page 6.

B. Identification of Board Replacement

This section will aid the qualified service technician to determine which board is in need of repair. Model AD-7700, has two boards: main amplifier and the power supply board.

1. Power supply checks :
   a. check condition of input wire and fuse
   b. check proper line voltage selection 230 volts will blow the fuse if in the 115 position
   c. visually inspect for damage or burned parts
   d. meter check:
      V1= 24 Vdc
      V2= 15 Vdc
      +15= 15 Vdc
   e. If supply levels are incorrect replace this assembly

2. Logic amplifier board functional verification:
   a. Check manual operation of motor INC, DEC with SW1-7 open (up) and P4-12 is also open. Verify limit operation. See wiring diagram for proper motor phasing.
   b. Vary motor speed by turning the motor speed pot counter clockwise then clockwise in manual mode.
   c. Change motor torque by acting on the motor current limit pot in the manual mode. The acceleration time may change as the current is reduced. See that at minimum current the output can be stalled.

2. Logic amplifier board functional verification cont:
    d. Connect a voltage or current transmitter and observe LOS light. Light is out for a valid transmitter connection. Check SW1 is set to match the transmitter type.
    e. Confirm the feedback pot phasing matches the wiring diagram.
    f. Disable the motor lifting on motor lead. Apply the command and verify changes in yellow and green LEDs as the null point is approached from either direction, both lights are out inside the deadband.
    g. The feedback transmitter may be checked by applying a remote supply with load and monitoring the loop current as the feedback pot moved. Check that wiring is per the diagram and be sure the remote loop supply is properly connected.
    h. In the event that the logic amplifier board response is inconsistent with the preceding functional verification or appears burned or physically damaged, replace the entire circuit board.

C. Repair

If any of the boards are found to be defective, please contact the Jordan Controls service department.