P-K COMPACT® (02/28/2013)
1004905931 - Warren Amuract, Love, & Colton Trap

P-K COMPACT
TEMPERATURE CONTROL
EQUIPMENT GUIDE

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HARSCO INDUSTRIAL
Patterson-Kelley

P-K COMPACT®

Temperature Control

Equipment Guide

To be used in conjunction with the latest editions of:
P-K COMPACT® Semi-Instantaneous Water Heater I&OM
P-K COMPACT® Supplemental Equipment Guide

Harsco Industrial, Patterson-Kelley
100 Burson Street
East Stroudsburg, PA 18301
Telephone: (570) 476-7261
Toll Free: (877) 728-5351
Facsimile: (570) 476-7247
www.harscopk.com

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AmurAct Actuator
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PRODUCT OVERVIEW

The AmurAct actuator is a fast stroking industrial electric actuator mated to four different series of industrial control valves ranging in size from ½" to 4" depending on series and profile. The new generation of Motors covered in this IOM allow the user to select either a linear stem lift or a non-linear stem lift by means of a dipswitch. Linear stem lift is the factory default dipswitch selection. Linear stem lift means the stem position is linear with respect to the input signal. For example if the valve is closed with a 0% input signal, the valve will be at 25% Stroke with a 25% input signal, at 50% Stroke with a 50% input signal, at 75% Stroke with a 75% input signal, and at 100% Stroke with a 100% input signal. Linear stem lift preserves the inherent flow characteristic of the valve.

When non-linear stem lift is selected the actuator has an ever gain changing stroke curve that accelerates in the last half of the stroke and is relatively slow on startup. Extreme gain changes as present in the Non- liner configuration are difficult for a control system to manage. If an application's turndown requirements are only 3:1 to 5:1 for example such that a valve could be sized to only operate from 50% to 100% of stroke, some level of speed of response can be achieved in the Non-linear configuration. Otherwise, in all other circumstances, the Linear Stem Lift (factory default) will be the desired setting.

In either case, correct control valve sizing is critical to good operation. See individual product specifications for details on the control valve assemblies and Cv tables. This document will focus on the installation, operation, and maintenance of the actuator portion only.

APPLICATIONS & KEY FEATURES

This product serves a variety of applications very well but is particularly well suited to semi-instantaneous water heaters, heat exchangers and coils where response times to load changes are expected to be handled in two to three seconds. With the High Temperature LE linkage option, thermal fluids, superheated steam and high temperature hot water are safely served. With the NEMA 4X Option, many hose down and outdoor applications are possible.

** Enerdrive® Failsafe System for Fail Close or Open (selectable)*

** Full Range of AC and DC Voltage Supplies Available*

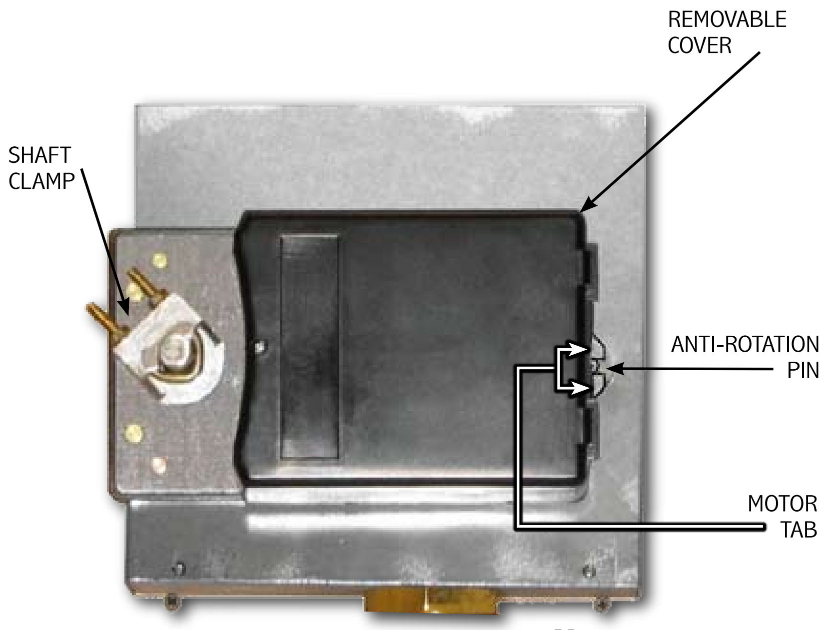
** Universal Input (Voltage or Milliamp) and pushbutton stroke calibration*

** All Stainless Steel Linkage Construction with maintenance free Oilite® bearings*

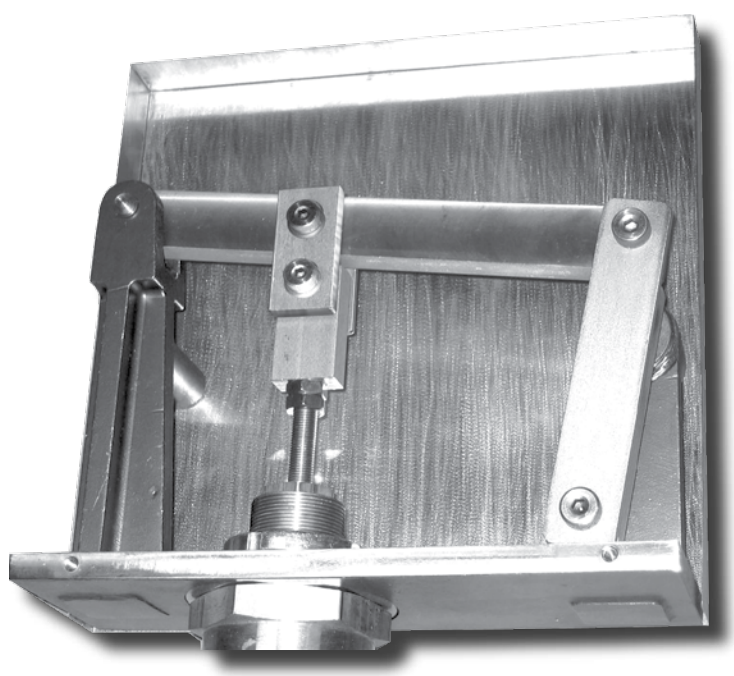
DESCRIPTION

The AmurAct actuation system is comprised of two principal components. The first is an electrical/electronic motor, which produces torque (rotational force) and applies it to the input shaft of the second component, the AmurAct linkage. The linkage converts rotary force and motion to linear force and motion to operate the reciprocating stem of an attached globe-style valve. The photos below show the two components and identify important parts.

VIEW OF STANDARD LINKAGE (LS) ASSEMBLY



Motor



AmurAct Linkage

in the fail-safe locked position

THEORY OF OPERATION

Refer to page 2 and below for identification and location of components and parts.

Four AmurAct **MOTORS** are available: the F3 and F5 produce 120 pound-inches of torque and the F4 and F6 produce 240 pound-inches. A **MOTOR** is selected according to the valve type and size, the differential pressure against which the valve must operate, and the power source that is available. Consult Product Specifications for additional information on motor selection.

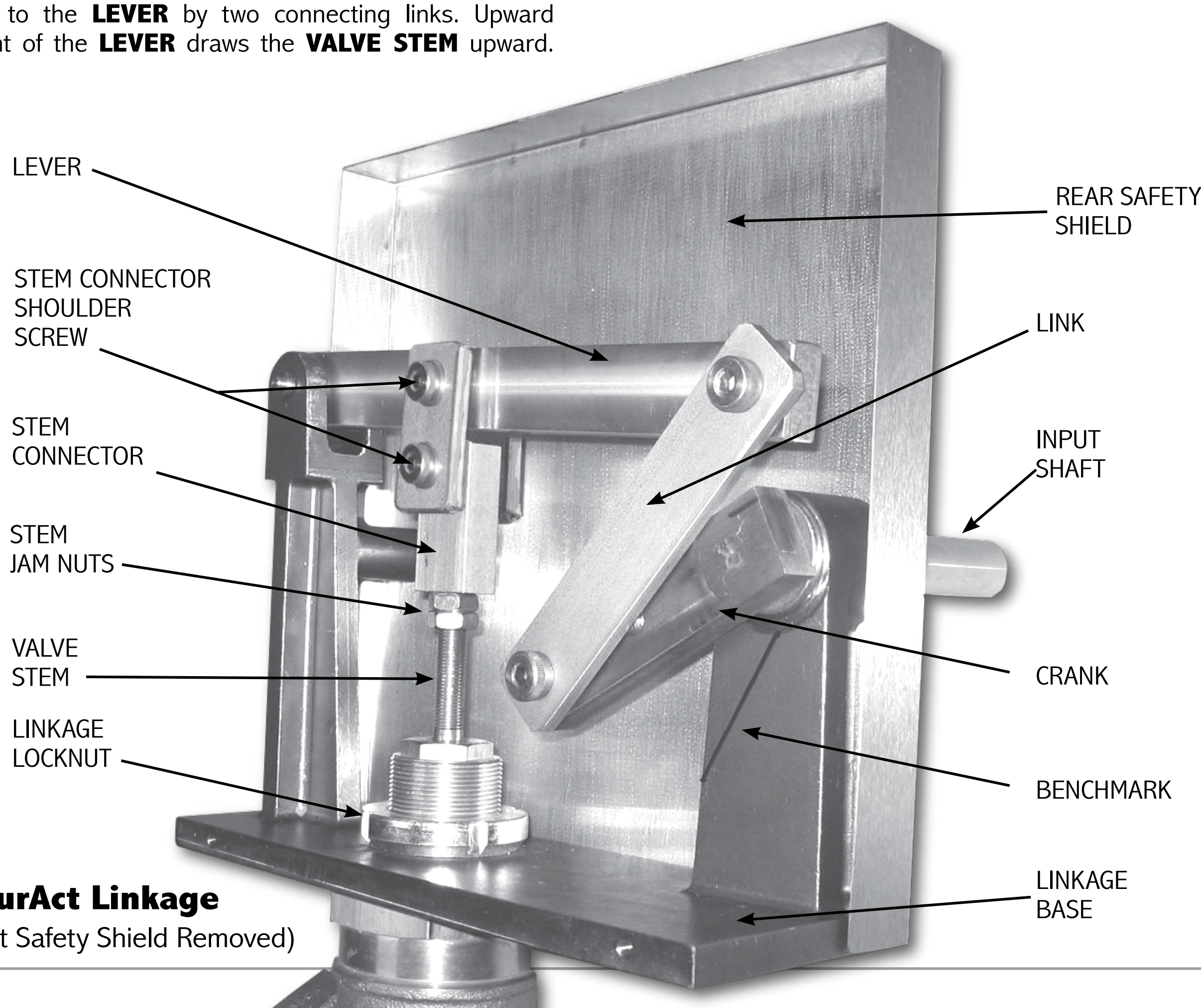
Each motor contains an internal *Enerdrive®* energy source to run the motor to a fail-safe valve position if operating power is lost. An advanced AutoStroke feature apportions the control signal over the actual range of valve movement for increased accuracy; and provides "soft stops" at both ends of travel to extend operating life. See page 6 for location of the Reset/Autostroke pushbutton.

The **MOTOR** applies rotary motion and rotational force to the **INPUT SHAFT** of the AmurAct **LINKAGE** by means of the **SHAFT CLAMP**. The **CRANK** is welded to the **INPUT SHAFT** and rotates with it. Clockwise **CRANK** rotation is translated by the **LINK** and causes the **LEVER** to rotate counterclockwise (upward) about the fixed pivot at its left end (as shown below).

A **STEM CONNECTOR** is threaded onto the valve stem and attached to the **LEVER** by two connecting links. Upward movement of the **LEVER** draws the **VALVE STEM** upward. The articulated link connection reduces side loading on the valve stem packing. Raising the stem of a two-way valve opens it. Raising the stem of a three-way valve opens the lower (L) port and shuts the upper (U) port. When the **MOTOR** reverses direction, the lever is drawn downward and the valve stem is pushed downward, reversing the control valve action.

When the AmurAct linkage has been calibrated, the **BENCHMARK** indicates the position of the **CRANK** when the valve plug makes contact with the valve seat. Further counterclockwise rotation of the **CRANK** exerts seating force onto the valve plug to produce very tight closure. On a two-way valve with ¾" stem travel, motion stops when the **CRANK** and **LINK** are aligned with each other, perpendicular to the **LEVER**. This is the lockup position, and is maintained by the AmurAct linkage without sustained **MOTOR** torque.

Factory default settings call for an increasing 2-10 volt or 4-20 mAdc signal to open the control valve. Therefore, loss or interruption of the control signal will cause the two-way valve to shut, or the lower (L) port of a three-way valve to shut. Similarly, loss of operating power will activate the Enerdrive fail-safe system to drive the AmurAct linkage to the fail-safe position. Upon restoration of operating power, AmurAct returns to normal operation after the Enerdrive fail-safe energy source is fully recharged, typically 30 seconds or less ... with no operator action required.



AmurAct Linkage
(front Safety Shield Removed)

STOP

READ THE SAFETY PRECAUTIONS BEFORE PROCEEDING!

SAFETY PRECAUTIONS
READ THIS PAGE BEFORE PROCEEDING!

1. **Good engineering practice** dictates that isolation valves must be installed in inlet and outlet piping connected to the AmurAct control valve. A means should be provided to de-pressurize line media trapped between them when they are shut. Pressure can cause the valve stem and any attached mechanism to move with force, posing a threat to safety. Setup and an operational check of AmurAct actuation should be completed before piping is pressurized.

2. Potentially **hazardous voltages** may be present inside the AmurAct motor. Exercise caution when removing its cover.

3. When connecting high voltage wiring (115 or 230 volts AC) to the AmurAct motor, connect the **green case grounding lead**, located inside the motor, to the ground wire of the power supply cable. This will reduce the danger of electrical shock.

4. Before removing a motor, the linkage **must be stabilized** by installing a small C-clamp onto the Crank/Link as illustrated in procedures that follow. The C-clamp must remain in place until the motor clamp is securely fastened to the linkage input shaft.

5. **Do not de-clutch the AmurAct motor** <u>w/o first explicitly following all instructions on page 10.</u> If the goal is to only manually stoke the valve and not remove the motor, you must first follow steps 1 -5 of this procedure and when finished perform the Auto-Calibration procedure on page 9. Failure to remove power AND de-energize the Enerdrive system first, prior to de-clutching the motor will result in permanent motor damage and **void the warranty.**

6. Both parts of the **Safety Shield must be in place** before energizing AmurAct or pressurizing piping.

7. Exercise extreme caution when working on exposed AmurAct linkage parts. The geometric relationships of linkage parts and their ranges of motion can **harm or sever fingers**.

8. Before adjusting the AmurAct valve stem connection, position the linkage so the plug is **not against a valve seat.** The valve stem must never be turned while the plug is in contact with the valve seat, because **seating surfaces will be damaged** and tight valve closure will no longer be achieved! Detailed procedures follow on pages 10-15.

9. **Contact the factory at (610) 317-0800** before attempting to reconfigure or reposition an AmurAct actuator. Improperly rotating the linkage on the valve bonnet adversely affects linkage calibration, can result in seat damage and/or operational failure; and **will void warranty coverage**.

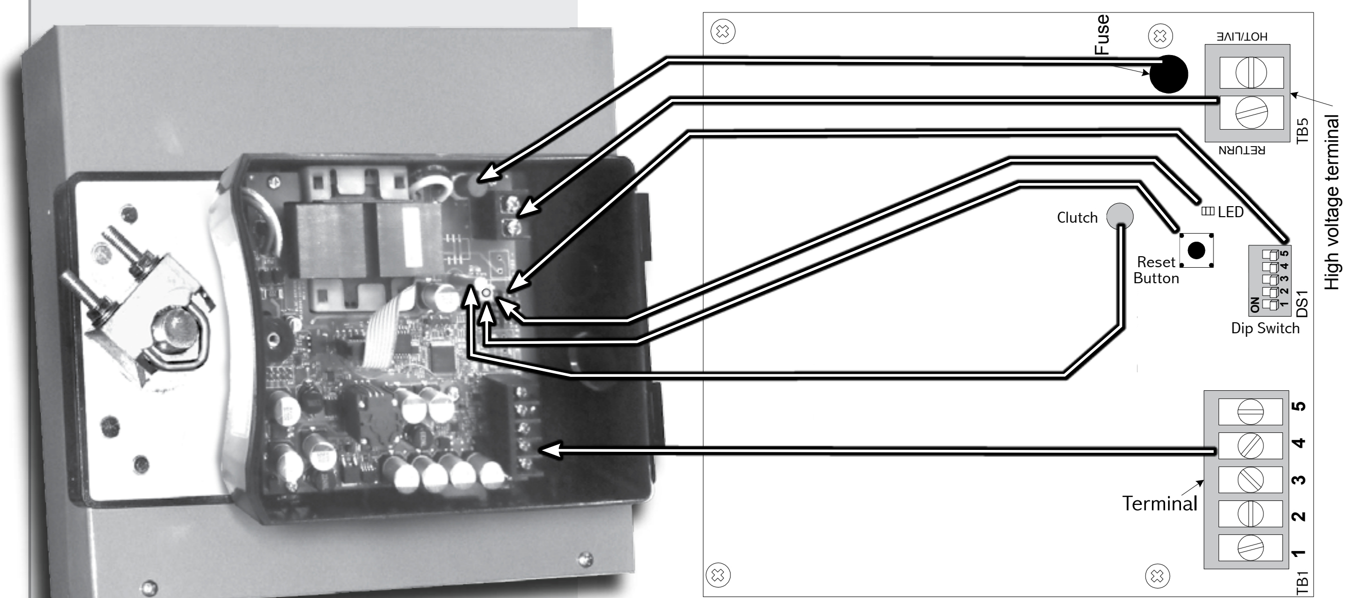
10. Follow instructions to initiate the motor's **Autostroke calibration cycle** each time AmurAct is placed into service following any extended shutdown, adjustment or maintenance. Failure to do so can cause inaccuracy of control and premature failure of the motor.
(See Page 9)

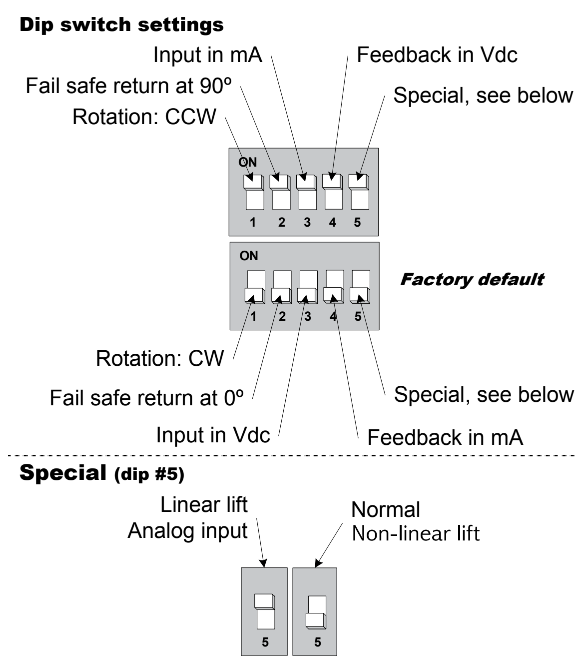
Contact the factory at (610) 317-0800 before attempting to reconfigure or reposition an AmurAct actuator.

Improperly rotating the linkage on the valve bonnet adversely affects linkage calibration, can result in seat damage and/or operational failure; and **will void warranty coverage**.

WIRING AND STARTING AN AMURACT CONTROL VALVE.

This applies to all AmurAct models. Remove the screw from the black motor cover and refer to the following circuit board diagrams for the designated terminations and switches. Field wiring should be of sufficient size and insulation rating to be in accordance with local codes, ordinances and standards for safety. The motor draws 30VA (either model) at full load, while start up power consumption is 50VA. The Power Supply wires if not specified should be a minimum of 18 AWG and at that gauge should not exceed 100 ft. from the transformer. For longer lengths, use 16 AWG wire. The input signal and feedback may use standard instrument wire of 24 or 26 AWG. Do not use rigid conduit.





* Fuse is a Littelfuse®

part number 3720315041

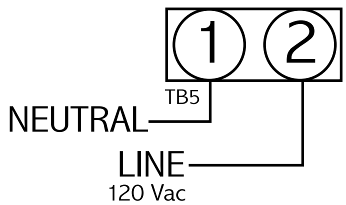
315 mA
Slow Blow with
T41 terminations

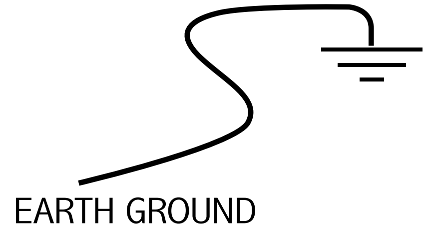
WIRING SUPPLY, SIGNAL AND FEEDBACK

SUPPLY VOLTAGE

F3 & F4 MOTORS

120 VAC (SINGLE-PHASE 50/60 HZ)



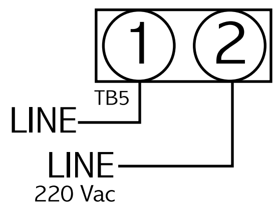


Locate the green case-grounding wire inside the motor case and connect it to the earth ground lead from the power source. Connect the neutral (typically white) wire to terminal one (1) on terminal block TB5. Connect the "hot" (typically black) wire to terminal two (2).

F5 & F6 MOTORS

220 VAC (SINGLE-PHASE 50/60 HZ)

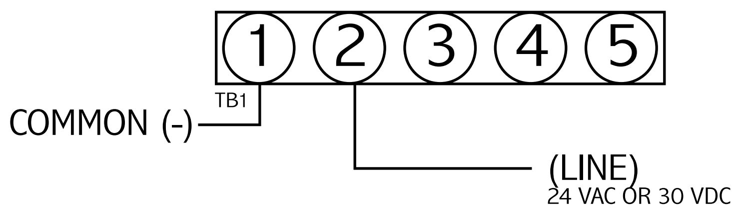
Locate the green case-grounding wire inside the motor case and connect it to the earth ground lead from the power source. Connect one "hot" wire to each of the two terminals on terminal block TB5.



F3 & F4 MOTORS

24 VAC OR 30 VDC

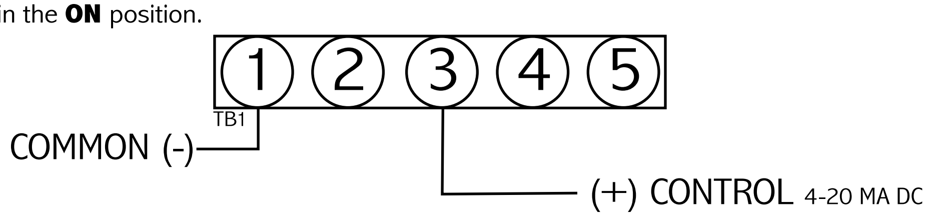
(24 VDC - W / Special Considerations)



If the actuator is to be powered by 24 VAC or 30 VDC, connect the negative or common wire to terminal ONE (1) and the positive (or "hot" wire) to Terminal TWO (2) on TB1. When powered by (24 VDC, Special Consideration) voltage, motor torque will be reduced by approximately 10% which will reduce close off capability. Contact the factory for questions.

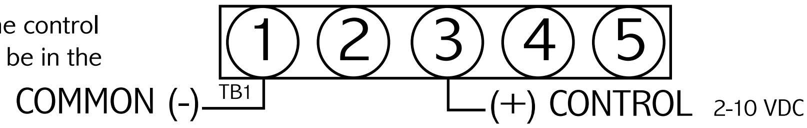
CONTROL SIGNAL - Current (milliamp) <DEFAULT>

If the control signal is 4 - 20 mA, connect the control wires to TB1 as shown below.
Dipswitch #3 **MUST** be in the **ON** position.



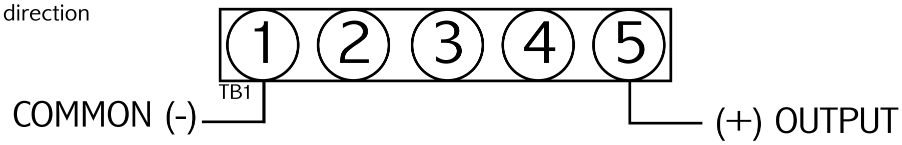
CONTROL SIGNAL - Voltage

If the control signal is 2 - 10 Vdc, connect the control wires to TB1 as shown. Dipswitch #3 **MUST** be in the **OFF** position.



FEEDBACK SIGNAL

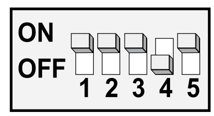
This signal is an output signal and not required for operation. The sole function is to provide a verified feedback signal that is proportional to rotation. The actuator can be set to provide a 4-20 mA feedback signal (factory default) or a 2-10 Vdc feedback signal. For 4-20 mA feedback dipswitch #4 must be in the OFF position. For 2-10 Vdc feedback, dipswitch #4 must be in the ON position. Connect the feedback wires to TB1 as shown below. If the actuator is set for CCW rotation on increasing signal (factory default) and the actuator is at 90º rotation (facing the motor) the feedback will be 4 mA or 2 Vdc, at 45 degrees rotation the feedback will be 12 mA or 6 Vdc and at 0º rotation (facing the motor) the feedback will be 20 mA or 10 Vdc. If the actuator is set for CW rotation on increasing signal the direction of the feedback signal will be reversed.



CONFIGURATION OF DIPSWITCHES:

FACTORY DEFAULT CONFIGURATION OF THE FIVE DIPSWITCHES IS SHOWN BELOW.

DIPSWITCHES



Switch #1: Action & Signal Loss
Switch #2: Power Fail
Switch #3: Signal
Switch #4: Feedback
Switch #5: Linearization

Switch #1 **Factory default - ON** An increasing control signal causes the valve stem to drive up, opening a two-way valve, or opening the L (lower) port and closing the U (upper) port of a three-way valve. The valve stem will drive down upon loss of signal. When Switch 1 is in the OFF position an increasing control signal causes the valve stem to drive down, closing a two-way valve, or closing the L (lower) port and opening the U (upper) port of a three way valve. The valve stem will drive up upon loss of signal.

Switch #2 **Factory default - ON** Upon loss of power the Enerdrive® circuit will drive the valve stem down, closing a two-way valve, or closing the L (lower) port and opening the U (upper) port of a three-way valve. When Switch #2 is in the OFF position, upon loss of power the Enerdrive® circuit will drive the valve stem up, opening a two-way valve or opening the L (Lower) port and closing the U (upper) port of a three-way valve.

Switch #3 **Factory default - ON** The motor will accept a 4-20 mAdc control signal connected to terminals 1(-) and 3(+) on terminal block 1. When Switch #3 is in the OFF position the motor will accept a 2-10 vdc signal.

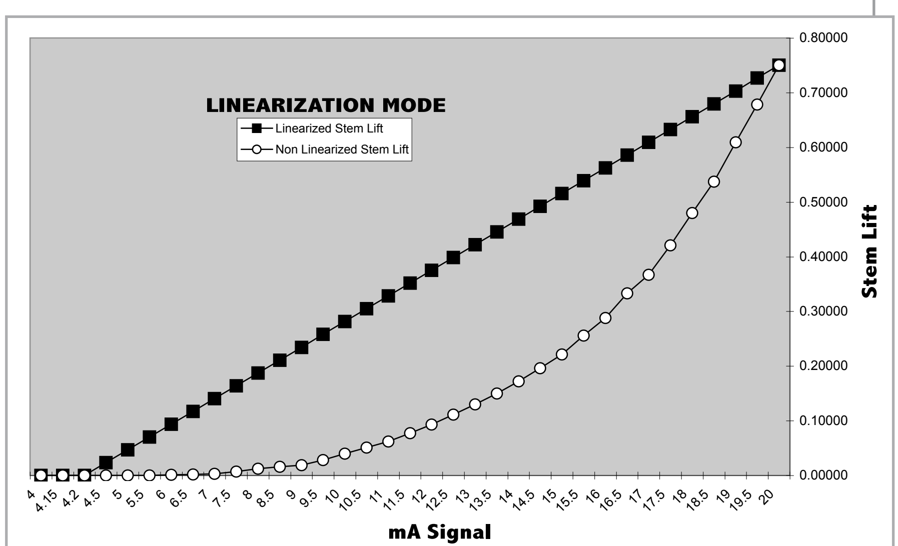
Switch #4 **Factory default - OFF** The motor will provide a 4-20 mAdc feedback output at terminals 1(-) and 5(+) on terminal block 1. When Switch #4 is in the ON position the motor will provide a 2-10 vdc output.

Switch #5 **Factory default - ON** This establishes a linear relationship between the control signal and valve stem lift. When Switch #5 is in the OFF position a "non-linear" relationship is established between the control signal and valve stem lift.

Placing dipswitch #5 in its ON (Linearizing) position accomplishes several objectives that may be helpful in specific control valve installations. One result is that the entire input signal range is applied to modulating the valve opening. Only at the very end of the signal range does the AmurAct linkage drive into lockup. Another result is that the inherent characteristic of the control valve is preserved. "Linearizing" operation can provide linear flow control when using a valve having linear trim.

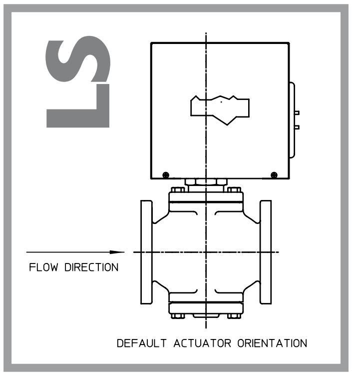
Placing dipswitch #5 on its OFF (Non-Linear) position causes the valve stem to rise very slowly in the beginning of its stroke, and to rise increasingly rapidly as the valve opens. This mode uses the first 25% of the control signal to move the linkage into and out of lockup. "Non-Linear" operation may be useful when additional control is needed at low flow rates, and additional response is required for changes in higher flow rates.

Selection of the linearization mode (dipswitch #5) can be made during operation, and dipswitch #5 should be left in the position that produces the better system control result.

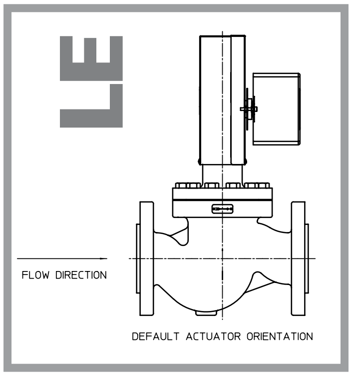


INITIAL STARTUP AND OPERATION

STANDARD LINKAGE



EXTENDED LINKAGE



1. After verifying that line isolation valves are shut, that wiring connections and motor switches are properly positioned, and AmurAct linkage safety covers are in place, apply power to the motor. Observe that the led light remains lit for 30 seconds. After the led goes off, indicating that the Enerdrive capacitors are sufficiently charged, press and release the small RESET pushbutton beside the led (see page 6 for location). The motor and valve will run through a slow-speed calibration cycle, and then stop.

Initiate this **AUTOSTROKE CALIBRATION CYCLE** each time AmurAct is placed into service following an intentional shutdown, adjustment or maintenance. It apportions the input signal over the actual range of valve stem movement for maximum accuracy of control, and provides "soft stops" at both ends of travel to reduce gear impact and extend motor life. Failure to do so can result in inaccuracy of control and premature failure of the motor.

The 30-second pause occurs each time power is applied to the motor, and allows the motor to recall its internal settings. No operator action is needed to return to fully automatic operation following a power outage. The Enerdrive fail-safe energy supply is fully restored within one minute after power is restored.

2. Apply a control signal and observe that the control valve responds correctly by opening with an increasing signal and closing with a decreasing signal (This is with the default setting). Install the motor cover.

3. Fail-safe operation can be tested at any time by interrupting power to the motor. Recall that there is up to a 30-second delay after power is restored.

4. With power and control signal applied, slowly and carefully open the isolation valves. Observe that the controller and control valve have control of the process before leaving the area.

TO RE-ORIENT THE AMURACT ON THE VALVE

CONSULT FACTORY

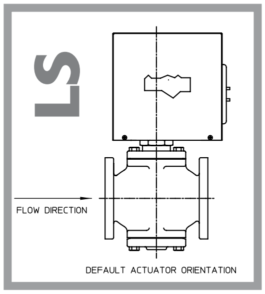
IF IT IS NECESSARY TO RE-POSITION AMURACT ON THE VALVE CALL THE FACTORY AT 610-317-0800 FOR PROCEDURAL ASSISTANCE.

FAILURE TO DO SO WILL VOID THE WARRANTY COVERAGE.

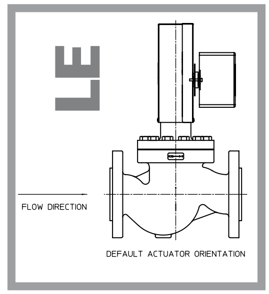
TO RE-ORIENT THE AMURACT ON THE VALVE CONSULT FACTORY

IF IT IS NECESSARY TO RE-POSITION AMURACT ON THE VALVE CALL THE FACTORY AT 610-317-0800 FOR PROCEDURAL ASSISTANCE. FAILURE TO DO SO WILL VOID THE WARRANTY COVERAGE.

STANDARD VS HIGH TEMPERATURE LINKAGE



The AmurAct is available with two versions of Linkage. The standard version or LS linkage has the motor situated directly behind the linkage assembly with the AmurAct actuator unit oriented parallel to the pipeline This configuration of the linkage is suitable for process fluids up to 250F (steam to 15 PSIG) when the pipeline and valve are not insulated, or up to 340F (steam to 100 PSIG) when the pipeline and valve are insulated.



For higher temperature applications or for when insulation is not available the higher temperature linkage can be used. This is capable of operating up to the valve rated temperature, without regard to insulation. For temperatures above 500F this may require the use of the optional extension bonnet as well. In this version, the motor is oriented 180° away from the standard orientation, and the entire assembly is mounted perpendicular to the valve and pipeline, avoiding convected heat from the valve and process piping, ensuring safe, reliable operation.

REMOVING AN AMURACT MOTOR

CAUTION!

DO NOT DE-CLUTCH THE ACTUATOR WHEN POWER IS ON. IRREPARABLE DAMAGE TO THE GEAR TRAIN WILL OCCUR!

1 Shut the isolation valves both upstream and downstream of the AmurAct control valve. If the control valve is not isolated, line pressure can open the valve and move the linkage when the motor is removed.

2 Turn off power to the motor and controller.

3 Remove the black motor cover and dissipate Enerdrive energy by cycling dipswitch #2 in 20-second intervals until the motor no longer runs. Return dipswitch #2 to its ON position (Fail Shut).

4 Remove the front safety shield by removing the two screws from the lower edge of the AmurAct linkage.

5 De-clutch the motor by depressing the brass pin located in the center of the circuit board as shown on page 6 and manually rotate the CRANK to its counter-clockwise end of travel position, as defined in specific linkage calibration procedures. Install a c-clamp to hold the CRANK in that position.

6 If the same motor is to be reinstalled, proceed to step 7. If it is to be replaced, label field wires for reconnection, then disconnect and remove them.

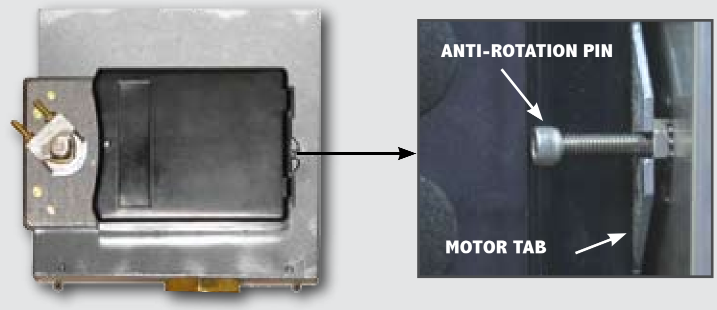
7 Loosen the two 10 mm hex nut on the motor output clamp u-bolt. This is best done with a long socket or box end wrench. Nuts are very tight. (It may also be necessary to loosen the kep nut and loosen or remove the anti-rotation screw located at the foot of the motor.)

8 Remove the motor. Review linkage calibration on pages 13-15 to verify linkage is calibrated and valve stem nuts are tight.

MOTOR INSTALLATION AND CALIBRATION

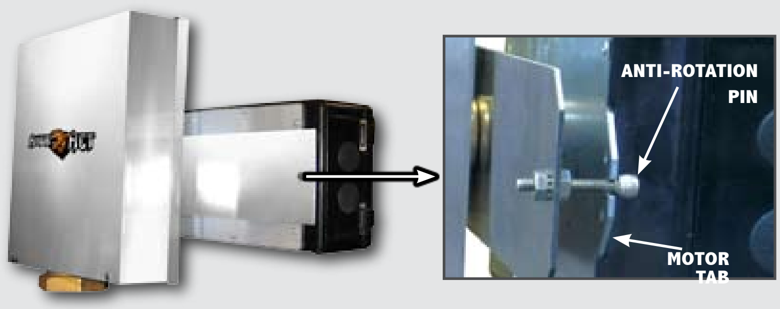
1. Slide the motor output clamp over the linkage shaft; then install the anti-rotation screw, securing it with its locking nut. **THE ANTI-ROTATION SCREW TO THE MOTOR TAB SHOULD HAVE SOME PLAY. SEE BELOW.**

STANDARD (LS) LINKAGE



An anti-rotation pin engages a slotted tab at the foot of the motor to allow alignment of the motor as its' shaft clamp rotates. The pin (screw) threads into a boss on the linkage base and is retained by a locking nut. Note that the slotted motor tab rests and moves freely on the threads.

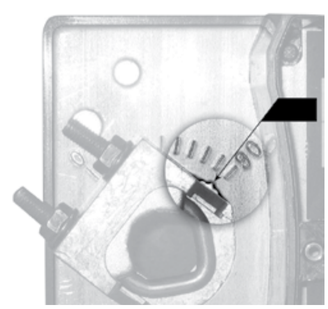
HIGH TEMPERATURE (LE) LINKAGE



An anti-rotation pin engages a slotted tab at the foot of the motor to allow alignment of the motor as its' shaft clamp rotates. The pin (screw) passes through the "Hi-Temp Motor Mounting Bracket, and is retained by "KEP" nuts on either side of the sheet metal. Note the positions of the parts and that the slotted motor tab rests and moves freely on the threads.

2. To calibrate the motor output, remove the black cover, declutch the gear train and manually rotate the output clamp as follows:

> On a two-way valve, rotate the clamp fully clockwise until the pointer stops at the 90-degree position. Release the clutch pushbutton to engage the clamp at that position.
>
> On a three-way valve, note that the 90-degree rotation scale is divided into ten percent graduations. Rotate the clamp clockwise until the pointer is midway between the 90-degree and adjacent graduation marks. Release the clutch to engage the clamp at that position.



3-Way Valve

3. Apply moderate pressure to minimize the gap between the motor and safety shield, and tighten the two 10 mm hex nut to 150 lb. in. torque. Use of a 6 pt deep well socket wrench is recommended. Apply force gradually, as sudden, or impact force may damage the u-bolt.

4. Remove the c-clamp installed during the motor removal procedure.

5. Connect field wiring and re-start the control valve as instructed in pages 6 through 9. Remember to press the reset/auto-stroke push-button before applying a control signal.

REMOVING/INSTALLING/CALIBRATING AN AMURACT LINKAGE

There are currently three ways in which AmurAct linkages are employed. It is necessary to identify which version is applicable before proceeding.

VERSION A: Two-way valves with ¾" stem travel. This applies to all two-way AmurAct control valves, with the exception of:

VERSION B: Two-way valves with 1 1/8" stem travel, currently limited to the 4" Type 20 and 23.

VERSION C: Three-way valves with ¾" stem travel. This applies to all three-way valves currently listed in the AmurAct product line.

While the difference between ¾" (A) and 1 1/8" (B) stem travels is accounted for by linkage calibration, the three-way linkage (C) is mechanically distinct as well as being calibrated differently.

REMOVING AN AmurAct LINKAGE (all versions)

1. After the motor has been removed according to instructions on page 10, and with the line isolation valves securely shut, remove the c-clamp from the crank and base. Manually rotate the crank clockwise to release stem force.

2. Remove the lower shoulder screw, nut and washer from the stem connector. Remember to retain all removed parts for reassembly.

3. Using a drift pin or blunt chisel and striking hammer, loosen and remove the large nut that secures the linkage base to the threaded valve bonnet. Lift the entire AmurAct linkage assembly from the bonnet. Store it safely for re-use.

NOTE

Care must be taken to avoid rotating the valve plug while it is in contact with the valve seat to avoid damaging the valve's seating surfaces.

4. If the valve is to be re-packed, hold the jam nuts and remove the stem connector. Measure and record the distance from the top of the jam nuts to the end of the valve stem. This will facilitate re-assembly. Loosen and remove the jam nuts.

INSTALLING AN AmurAct LINKAGE (all versions)

1. Loosely install the valve stem jam nuts to the dimension recorded earlier, or ½" from the end of the valve stem.

2. Thread the stem connector onto the stem into loose contact with the top jam nut.

3. Lower the linkage assembly over the valve stem and bonnet then slide the bonnet nut over the connector and loosely thread the nut onto the threaded bonnet until it contacts the linkage base.

4. Rotate the linkage base to the desired orientation and tighten the bonnet nut using a drift pin or blunt chisel and striking hammer to ensure that it is securely fastened.

5. Rotate the stem connector so the stem connector links can straddle it. Rotate the crank until the link bearings align with the stem connector opening and install the shoulder screw and washers. Tighten the nut securely.

6. The linkage is ready to be calibrated in accordance with instructions specific to the linkage version (see definitions above).

WARNING

The valve stem must be raised when making stem connector adjustments. Do not turn or rotate the valve stem while the valve plug is in contact with the valve seat. "Grinding" contact will damage the mating surfaces, adversely affect shut-off capability.

CALIBRATING THE AMURACT LINKAGE

OVERVIEW: Calibration of the AmurAct linkage is accomplished by adjusting effective stem length so the linkage crank is precisely aligned with a benchmark when the valve plug contacts the valve seat. Precision is necessary, because the remaining crank travel determines how much force will be applied to the valve plug to achieve tight shutoff. Minor maladjustment can result in major loss of shutoff capability or overstressing of linkage and valve components. AmurAct performance is directly related to the accuracy of its' calibration. Calibration of each version is different from the others, read and understand the entire procedure before adjusting anything. Call our factory with any questions.

Version A: two-way AmurAct control valves having ¾" stem travel (all two-way valves except the 4" Type 20 and 23).

1. Beginning with a linkage properly oriented, securely fastened to the valve bonnet and loosely assembled to the valve stem, manually operate the linkage to raise the valve stem. Observe the benchmark scribed into the front face of the crank support column.

2. Gently lower the valve stem and note the position of the crank relative to the benchmark when the plug makes contact with the valve seat. Exert just enough force on the crank to take up any looseness in the linkage pivots.

3. Lower and tighten the two stem nuts together. This provides a means to grip and rotate the valve stem after lifting the plug from its' seat, to thread the stem **into** or **out of** the stem connector. Threading the stem **into** the connector shortens the assembly and allows the crank to move further counterclockwise. Threading the stem **out of** the connector lengthens the assembly, allowing less counterclockwise rotation. Perform this sensitive **into** or **out of** adjustment until the crank stops 2 to 3 degrees **PAST** the benchmark. REPEAT THE POSITION CHECK IN STEP 2 AFTER EACH ADJUSTMENT.

4. Carefully loosen the stem nuts from each other and move the upper nut upward into contact with the stem connector block. Using a second wrench to keep the block from rotating, tighten the nut securely against the block. This tightening will lengthen the stem connection assembly and allow less crank rotation to the plug/seat contact point.

NOTE that the valve stem and plug have been raised prior to turning the stem.

5. Repeat step 2. If the crank stops PRECISELY at the benchmark (denoting proper calibration), tighten the second stem nut against the first, then repeat step 2 once more.

6. If the crank does not stop precisely at the benchmark after completing step 5, repeat this procedure from step 3, appropriately lengthening or shortening the stem assembly in SMALL INCREMENTS.

7. After precise calibration is complete, push the crank firmly against its support column to fully extend the linkage input shaft. Install a small c-clamp onto the crank and link and draw the two together into alignment with each other. This is the end-of-travel position of the calibrated linkage and full seating force is now present on the valve plug. LEAVE THE CLAMP IN PLACE UNTIL MOTOR INSTALLATION IS COMPLETE.

8. Calibrate and install the motor as instructed on Page 11 of this manual. The proper motor calibration point for this version is 90 degrees as indicated on the motor shaft clamp position scale. Remember to press the motor RESET pushbutton after installation and calibration are complete and the motor is energized, but before the system is placed into service.

BENCHMARK

CALIBRATED

END-OF-TRAVEL

WARNING
The valve stem must be raised when making stem connector adjustments. Do not turn or rotate the valve stem while the valve plug is in contact with the valve seat. "Grinding" contact will damage the mating surfaces, adversely affect shut-off capability.

OVERVIEW: Calibration of the AmurAct linkage is accomplished by adjusting effective stem length so the linkage crank is precisely aligned with a benchmark when the valve plug contacts the valve seat. Precision is necessary, because the remaining crank travel determines how much force will be applied to the valve plug to achieve tight shutoff. Minor maladjustment can result in major loss of shutoff capability or overstressing of linkage and valve components. AmurAct performance is directly related to the accuracy of its' calibration. Calibration of each version is different from the others, read and understand the entire procedure before adjusting anything. Call our factory with any questions.

Version B: two-way AmurAct control valves having 1 1/8" stem travel. 4" Type 20 and 23.

1. Beginning with a linkage properly oriented, securely fastened to the valve bonnet and loosely assembled to the valve stem, manually operate the linkage to raise the valve stem. Observe that there are **TWO benchmarks** scribed into the front face of the crank support column.

2. Gently lower the valve stem and note the position of the crank relative to **benchmark #1** when the plug makes contact with the valve seat. Exert just enough force on the crank to take up any looseness in the linkage pivots.

3. Lower and tighten the two stem nuts together. This provides a means to grip and rotate the valve stem after lifting the plug from its' seat, to thread the stem **into** or **out of** the stem connector. Threading the stem into the connector shortens the assembly and allows the crank to move further counterclockwise. Threading the stem **out of** the connector lengthens the assembly, allowing less counterclockwise rotation. Perform this sensitive into or out of adjustment until the crank stops 2 to 3 degrees **PAST benchmark #1**. REPEAT THE POSITION CHECK IN STEP 2 AFTER EACH ADJUSTMENT.

NOTE that the valve stem and plug have been raised prior to turning the stem.

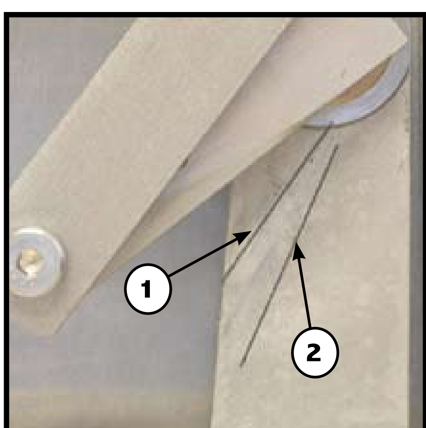
4. Carefully loosen the stem nuts from each other and move the upper nut upward into contact with the stem connector block. Using a second wrench to keep the block from rotating, tighten the nut securely against the block. This tightening will lengthen the stem connection assembly and allow less crank rotation to the plug/seat contact point.

5. Repeat step 2 (above). If the crank stops PRECISELY at benchmark #1 (denoting proper calibration), tighten the second stem nut against the first, THEN REPEAT STEP 2 ONCE MORE.

6. If the crank does not stop **precisely** at the benchmark after completing step 5, repeat this procedure from step 3, appropriately lengthening or shortening the stem assembly in small increments.

7. After precise calibration is complete, push the crank firmly against its support column to fully extend the linkage input shaft. Install a clamp onto the lower end of the crank and the crank support column. Draw the crank toward the column until it aligns with the **#2 benchmark**. This is the end-of-travel position of the calibrated linkage and full seating force is now present on the valve plug. Leave the clamp in place until motor installation is complete.

8. Calibrate and install the motor as instructed on Page 11 of this manual. The proper motor calibration point for this version is 90 degrees as indicated on the motor shaft clamp position scale. Remember to press the motor RESET pushbutton after installation and calibration are complete and the motor is energized, but before the system is placed into service.



BENCHMARKS

CALIBRATED

END-OF-TRAVEL

OVERVIEW: Calibration of the AmurAct linkage is accomplished by adjusting effective stem length so the linkage crank is precisely aligned with a benchmark when the valve plug contacts the valve seat. Precision is necessary, because the remaining crank travel determines how much force will be applied to the valve plug to achieve tight shutoff. Minor maladjustment can result in major loss of shutoff capability or overstressing of linkage and valve components. AmurAct performance is directly related to the accuracy of its' calibration. Calibration of each version is different from the others, read and understand the entire procedure before adjusting anything. Call our factory with any questions.

WARNING

The valve stem must be raised when making stem connector adjustments. Do not turn or rotate the valve stem while the valve plug is in contact with the valve seat. "Grinding" contact will damage the mating surfaces, adversely affect shut-off capability.

Version C: three-way AmurAct control valves having 3/4" stem travel. Small (1/2"-1") AMB-30 valves have stem travel = 9/16".

1. Beginning with a linkage properly oriented, securely fastened to the valve bonnet and loosely assembled to the valve stem, manually operate the linkage to raise the valve stem. Observe the benchmark scribed into the front face of the crank support column.

2. Gently lower the valve stem and note the position of the crank relative to the benchmark when the plug makes contact with the valve seat. Exert just enough force on the crank to take up any looseness in the linkage pivots.

3. Lower and tighten the two stem nuts together. This provides a means to grip and rotate the valve stem after lifting the plug from its' seat, to thread the stem **into** or **out of** the stem connector. Threading the stem **into** the connector shortens the assembly and allows the crank to move further counterclockwise. Threading the stem **out of** the connector lengthens the assembly, allowing less counterclockwise rotation. Perform this sensitive into or out of adjustment until the crank stops 2 to 3 degrees PAST the benchmark. REPEAT THE POSITION CHECK IN STEP 2 AFTER EACH ADJUSTMENT.

NOTE that the valve stem and plug have been raised prior to turning the stem.

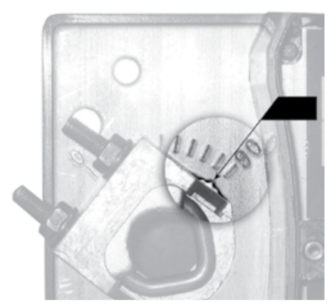
4. Carefully loosen the stem nuts from each other and move the upper nut upward into contact with the stem connector block. Using a second wrench to keep the block from rotating, tighten the nut securely against the block. This tightening will lengthen the stem connection assembly and allow less crank rotation to the plug/seat contact point.

5. Repeat step 2 (above). If the crank stops **PRECISELY** at the benchmark (denoting proper calibration), tighten the second stem nut against the first, then repeat step 2 once more.

6. If the crank does not stop **PRECISELY** at the benchmark after completing step 5, repeat this procedure from step 3, appropriately lengthening or shortening the stem assembly in small increments.

7. After precise calibration is complete, push the crank firmly against its support column to fully extend the linkage input shaft.

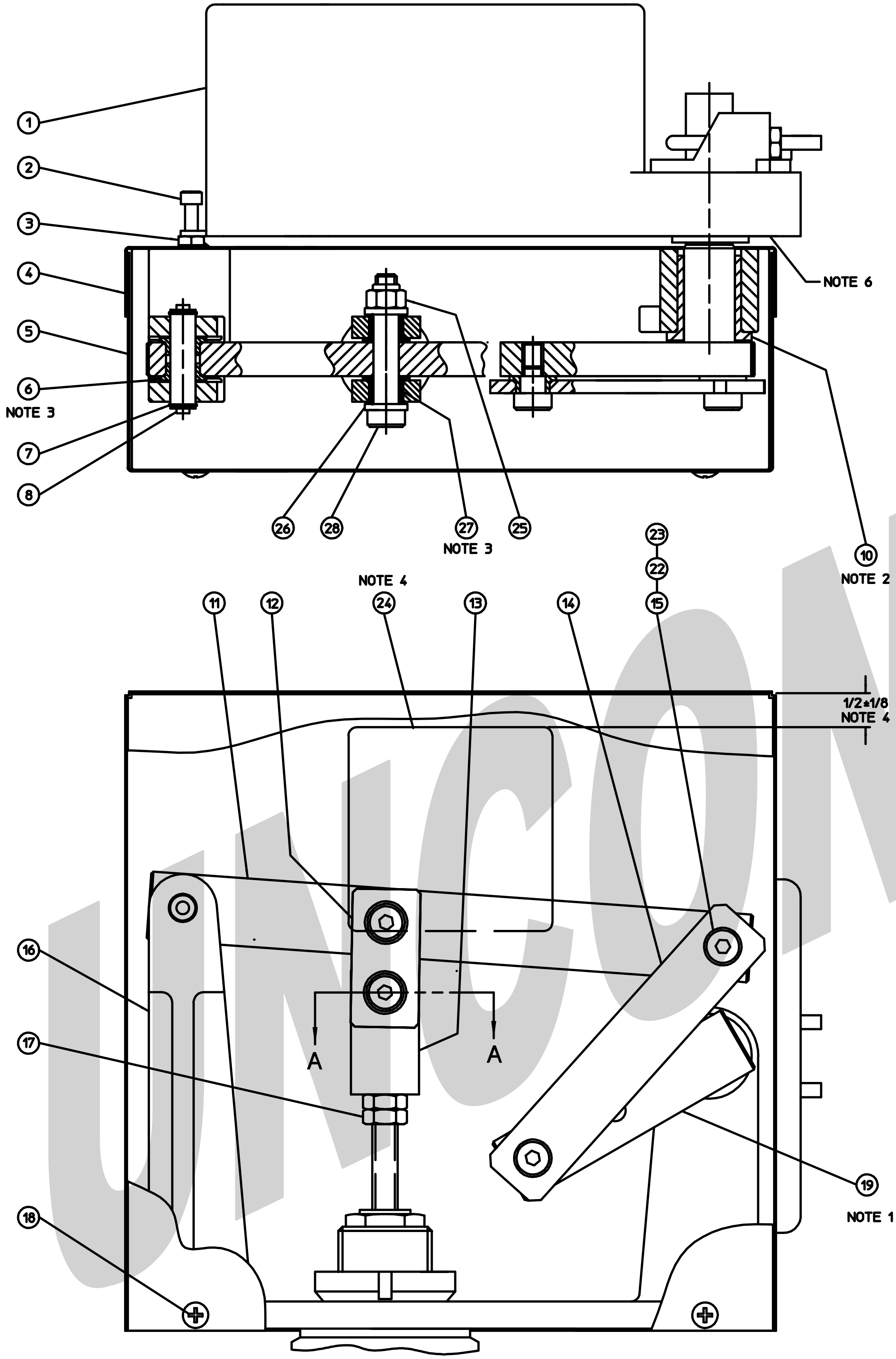
8. Calibrate and install the motor as instructed on Page 11 of this manual. The proper motor calibration point for this version is approximately 85 degrees as indicated on the motor clamp position scale. The remaining motor travel exerts valve close-off force. Remember to press the motor RESET pushbutton after installation and calibration are complete and the motor is energized, but before the system is placed into service.



3-Way Valve

BENCHMARK

CALIBRATED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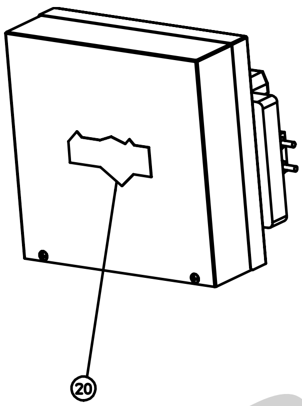
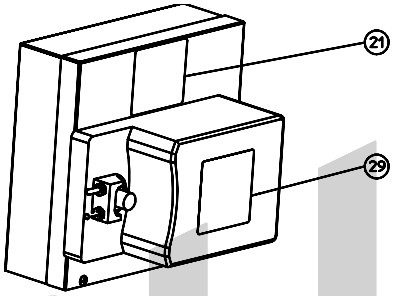
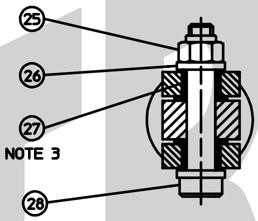
NOTE 1

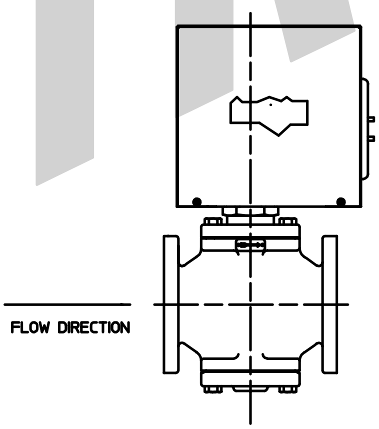
C	REDRAWN WITH CHANGE ECN 2519	BLB 4/22/10	







SECTION A–A



DEFAULT ACTUATOR ORIENTATION

7) RECORD MOTOR DATE ON PICK TICKET.
6) WRITE S/N ON METAL BOTTOM OF MOTOR BEFORE MOUNTING.
5) TIGHTEN ALL TERMINAL SCREWS AFTER TESTING, BEFORE SHIPPING.
4) LOCATE WARNING LABEL AS SHOWN. CENTRALLY LOCATE HORIZONTALLY ON INSIDE OF REAR COVER.
3) PRESS IN BEARINGS USING TOOL B6150032. INSTALLED BEARING ID SHALL BE Ø.3750 - .3761.
2) PRESS IN BEARING USING TOOL B6150024. INSTALLED BEARING ID SHALL BE Ø.7500 - .7511.
1) THE CRANK ARM IS INITIALLY SET UP AT DIFFERENT ANGLES DEPENDING ON THE VALVE TRAVEL. SEE WORK INSTRUCTION WI10006 FOR DETAILS ON SETTING UP THE LINKAGE.

NOTES:

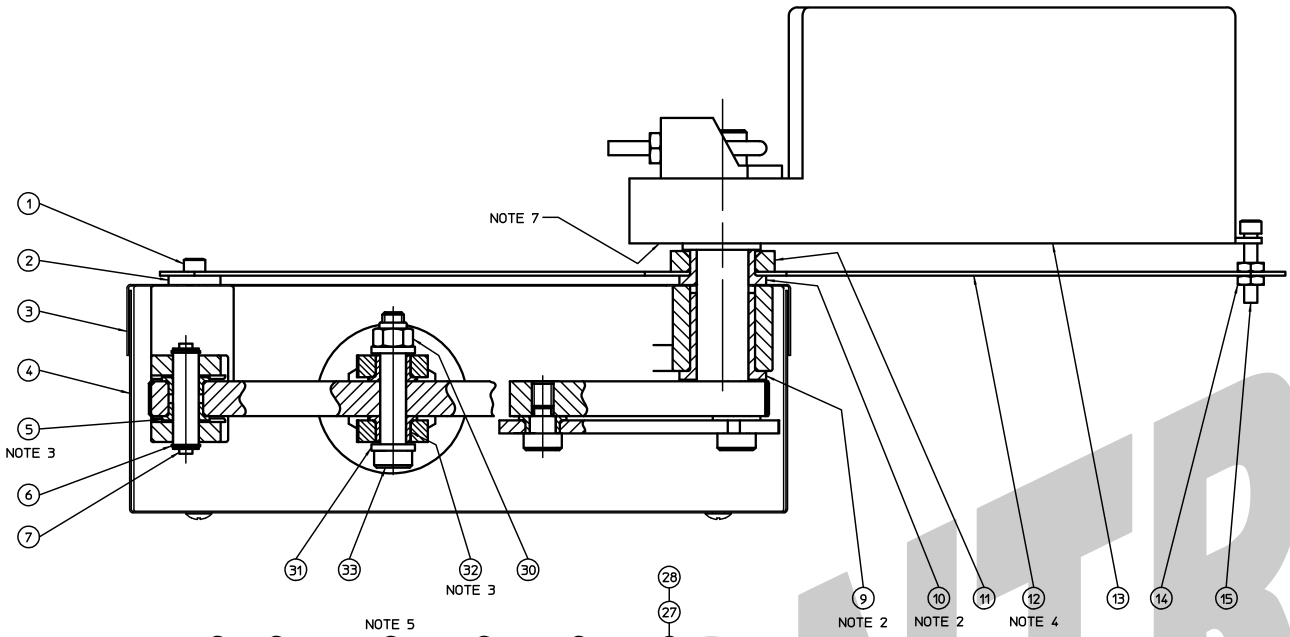
ITEM	QTY	PART NO	DESCRIPTION	MATL SPEC
29	1	B1670070	MOTOR REMOVAL & LINKAGE RE-ORIENTATION WARNING LABEL	LAMINATED PAPER W/ ADHESISE
28	2	05106724	.375 x 1.500 LG SOCKET HD SHOULDER SCREW	300 SERIES ST STL
27	4	B1060063	3/8 ID x 3/8 LG SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
26	4	B2060007	.385 ID x .627 OD x .093 THK FLAT WASHER	300 SERIES ST STL
25	2	01505708	5/16-18 SELF LOCKING NUT	300 SERIES ST STL
24	1	B1670067	AMURACT WARNING LABEL	ALUMINUM FOIL W/ ADHESIVE
23	A/R	A0940027	LOCTITE 272	
22	A/R	A0940038	LOCTITE PRIMER T	
21	1	B1670059	AMURACT SERIAL PLATE	ALUM FOIL W/ ADHESIVE
20	1	B1670060	AMURACT BADGE	PLASTIC W/ ADHESIVE
19	1	B1900071	CRANK ARM ASSEMBLY 2 WAY	304 ST STL ASTM A276 OR A479
18	4	04396706	8-32 x 3/8 CROSS RECESSED TRUSS HD MACHINE SCREW	300 SERIES ST STL
17	2	01806709	3/8-24 HEX JAMNUT	18-8 ST STL
16	1	D1899935-01	BASE 1 3/8 DIAMETER BONNET	CAST ST STL ASTM A351 CF8
15	2	05106704	.375 x .250 LG SOCKET HD SHOULDER SCREW	300 SERIES ST STL
14	1	B1900080	CONNECTING LINK SUBASSEMBLY	ST STL & BRONZE
13	1	B1900079	STEM CONNECTOR NS1 INTERFACE	304 ST STL ASTM A276 OR A479
12	2	B1909952	STEM CONNECTOR LINK	300 SERIES ST STL
11	1	B1900072	ROCKER ARM	304 ST STL ASTM A276 OR A479
10	1	B1060061	3/4 ID SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
8	1	B1900077-01	ROCKER ARM PIN	303 ST STL ASTM A582
7	2	C0200004-01	RETAINING RING	TYPE 302 ST STL
6	2	B1060060	3/8 ID x 1/4 LG SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
5	1	D1580033-01	FRONT COVER	300 SERIES ST STL
4	1	D1580032-01	REAR COVER	300 SERIES ST STL
3	1	02297799	10-32 KEP NUT	300 SERIES ST STL
2	1	01297716	10-32 x 1 SOCKET HEAD CAPSCREW	ST STL ASTM F837
1	1	PER SALES ORDER	MOTOR	

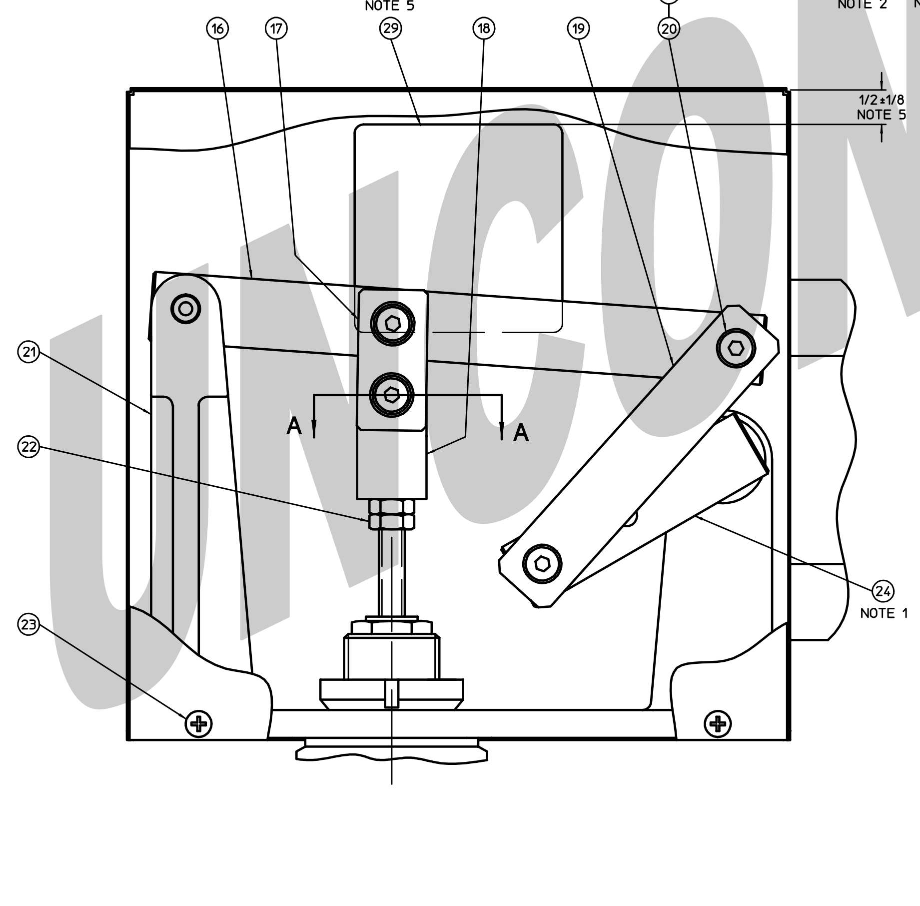
UNLESS OTHERWISE SPECIFIED: DECIMAL .XX ± DECIMAL .XXX ± FRACTION ± ANGLE ±
THIRD ANGLE PROJECTION
NEXT ASSEMBLY
ALL DIMENSIONS ARE IN INCHES
MATERIAL: SEE TABLE
TREATMENT
FINISH
DRAWN: BLB DATE: 6/14/07
CHECKED
APPROVED

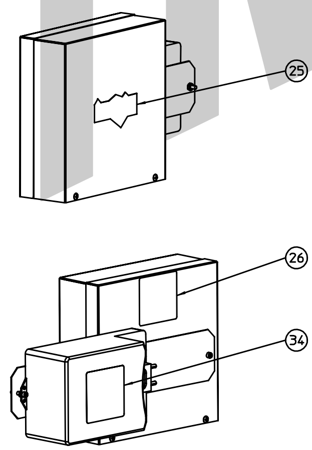
WARREN CONTROLS INCORPORATED
BETHLEHEM, PENNSYLVANIA 18020-8010

AMURACT ACTUATOR ASSEMBLY
2 WAY LOW TEMP NS1 INTERFACE

SIZE: D | FSCM NO: 03847 | DWG NO: D3400007 | REV: C





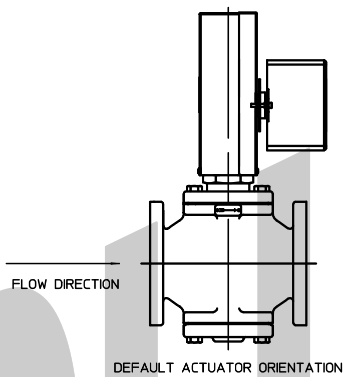


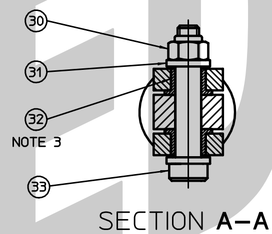
8) RECORD MOTOR DATE ON PICK TICKET.
7) WRITE S/N ON METAL BOTTOM OF MOTOR BEFORE MOUNTING.
6) TIGHTEN ALL TERMINAL SCREWS AFTER TESTING, BEFORE SHIPPING.
5) LOCATE WARNING LABEL AS SHOWN. CENTRALLY LOCATE HORIZONTALLY ON INSIDE OF REAR COVER.
4) BRACKET IS ASYMMETRICAL. SLOTTED HOLE IS FOR FASTENER, ITEM 1.
3) PRESS IN BEARINGS USING TOOL B6150032. INSTALLED BEARING ID SHALL BE Ø.3750 - .3761.
2) PRESS IN BEARING USING TOOL B6150024. INSTALLED BEARING ID SHALL BE Ø.7500 - .7511.
1) THE CRANK ARM IS INITIALLY SET UP AT DIFFERENT ANGLES DEPENDING ON THE VALVE TRAVEL. SEE WORK INSTRUCTION WI10006 FOR DETAILS ON SETTING UP THE LINKAGE.

NOTES:

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
B	REDRAWN WITH CHANGE ECN 2519	BLB 4/22/10	
C	ECN 2524	DGS 5-12-10	





ITEM	QTY	PART NO	DESCRIPTION	MATL SPEC
34	1	B1670070	MOTOR REMOVAL & LINKAGE RE-ORIENTATION WARNING LABEL	LAMINATED PAPER W/ ADHESIVE
33	2	05106724	.375 x 1.500 LG SOCKET HD SHOULDER SCREW	300 SERIES ST STL
32	4	B1060063	3/8 ID x 3/8 LG SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
31	4	B2060007	.385 ID x .627 OD x .093 THK FLAT WASHER	300 SERIES ST STL
30	2	01505708	5/16-18 SELF LOCKING NUT	300 SERIES ST STL
29	1	B1670067	AMURACT WARNING LABEL	ALUMINUM FOIL W/ ADHESIVE
28	A/R	A0940027	LOCTITE 272	
27	A/R	A0940038	LOCTITE PRIMER T	
26	1	B1670059	AMURACT SERIAL PLATE	ALUM FOIL W/ ADHESIVE
25	1	B1670060	AMURACT BADGE	PLASTIC W/ ADHESIVE
24	1	B1900071	CRANK ARM ASSEMBLY 2-WAY	304 ST STL ASTM A276 OR A479
23	4	04396706	8-32 x 3/8 CROSS RECESSED TRUSS HD MACHINE SCREW	300 SERIES ST STL
22	2	01806709	3/8-24 HEX JAMNUT	18-8 ST STL
21	1	D1899935-01	BASE 1 3/8 DIAMETER BONNET	CAST ST STL ASTM A351 CF8
20	2	05106704	.375 x .250 LG SOCKET HD SHOULDER SCREW	300 SERIES ST STL
19	1	B1900080	CONNECTING LINK SUBASSEMBLY	ST STL & BRONZE
18	1	B1900079	STEM CONNECTOR 3/8-24 FOR NS1 & HD1 INTERFACE	304 ST STL ASTM A276 OR A479
17	2	B1909952	STEM CONNECTOR LINK	300 SERIES ST STL
16	1	B1900072	ROCKER ARM	304 ST STL ASTM A276 OR A479
15	1	01297716	10-32 x 1 LG SOCKET HEAD CAPSCREW	ST STL ASTM F837
14	2	02297799	10-32 KEP NUT	300 SERIES ST STL
13	1	PER SALES ORDER	MOTOR	
12	1	D1899977-01	HI-TEMP MOTOR MOUNTING BRACKET	300 SERIES ST STL
11	1	B1800056-01	MOUNTING BRACKET BEARING COLLAR	ST STL ASTM A582 OR A479
10	1	B1060062	3/4 ID x 1/2 LG SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
9	1	B1060061	3/4 ID x 1 1/4 LG SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
7	1	B1900077-01	ROCKER ARM PIN	303 ST STL ASTM A582
6	2	C0200004-01	RETAINING RING	TYPE 302 ST STL
5	2	B1060060	3/8 ID x 1/4 LG SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
4	1	D1580033-01	FRONT COVER	300 SERIES ST STL
3	1	D1580032-01	REAR COVER	300 SERIES ST STL
2	1	B1910088	MOUNTING BRACKET SPACER	300 SERIES ST STL
1	1	01297708	10-32 x 1/2 LG SOCKET HEAD CAPSCREW	ST STL ASTM F837

UNLESS OTHERWISE SPECIFIED:
DECIMAL .XX ± DECIMAL .XXX ±
FRACTION ± ANGLE ±
THIRD ANGLE PROJECTION
NEXT ASSEMBLY
ALL DIMENSIONS ARE IN INCHES

MATERIAL: SEE TABLE
TREATMENT
FINISH

DRAWN: BLB DATE: 9/4/07
CHECKED
APPROVED

WARREN CONTROLS INCORPORATED
BETHLEHEM, PENNSYLVANIA 18020-8010

AMURACT ACTUATOR ASSEMBLY 2 WAY
HI TEMP NS1 INTERFACE

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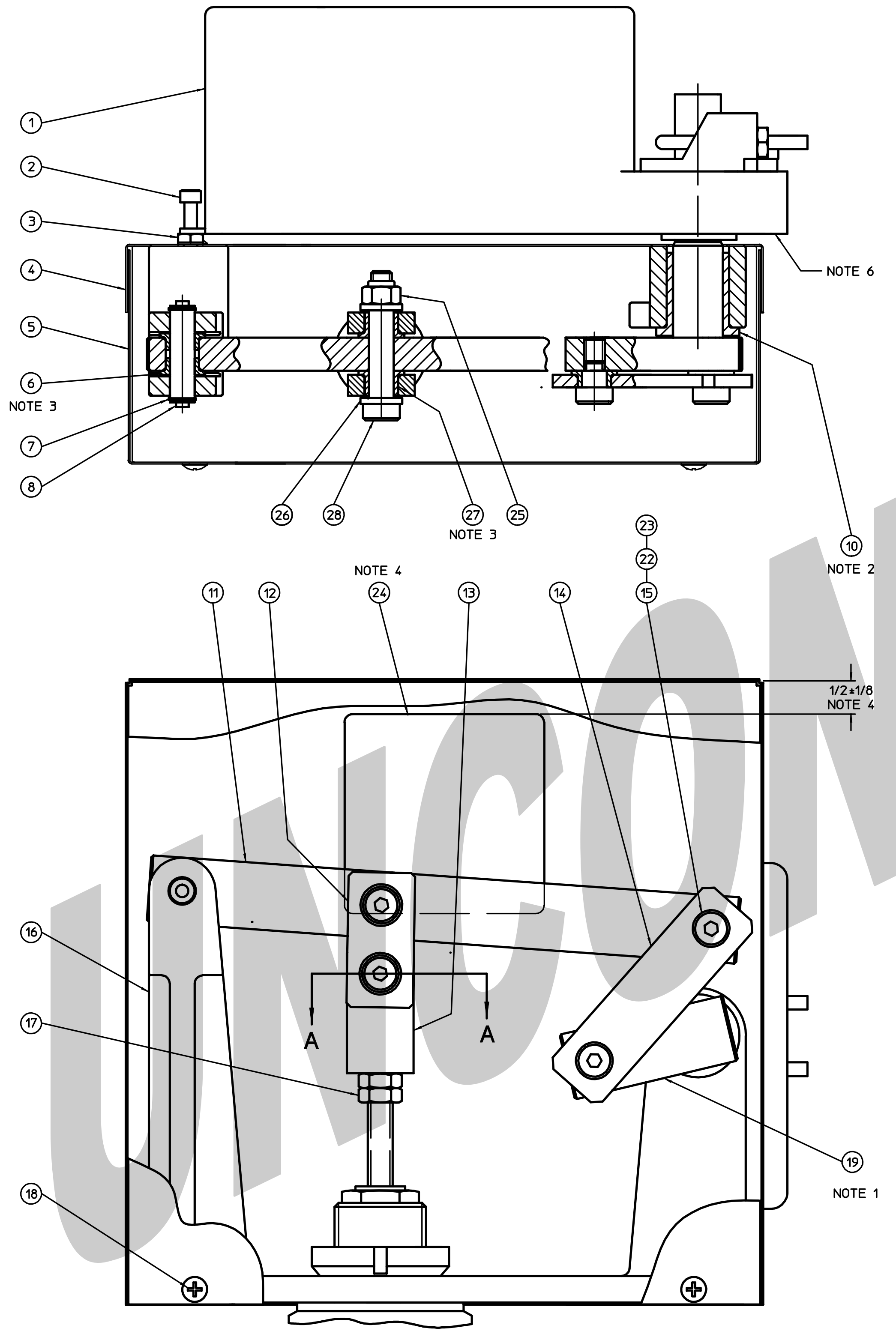
SCALE: FULL WT SHEET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REV	DESCRIPTION	DATE	APPROVED
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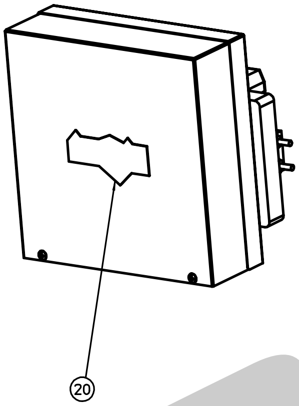
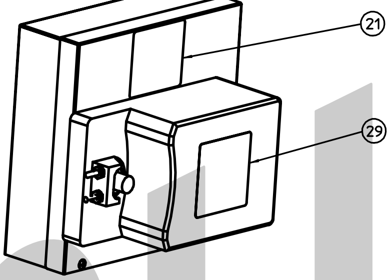
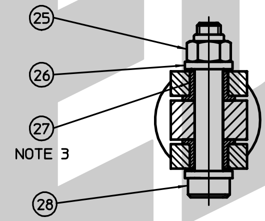
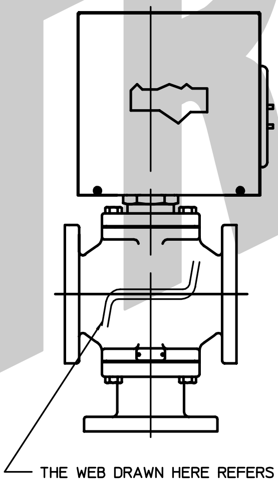






SECTION A-A



THE WEB DRAWN HERE REFERS TO THE ACTUAL WEB INSIDE OF THE BODY AND NOT TO ANY IMAGE OF THE WEB CAST ON THE OUTSIDE OF THE BODY.

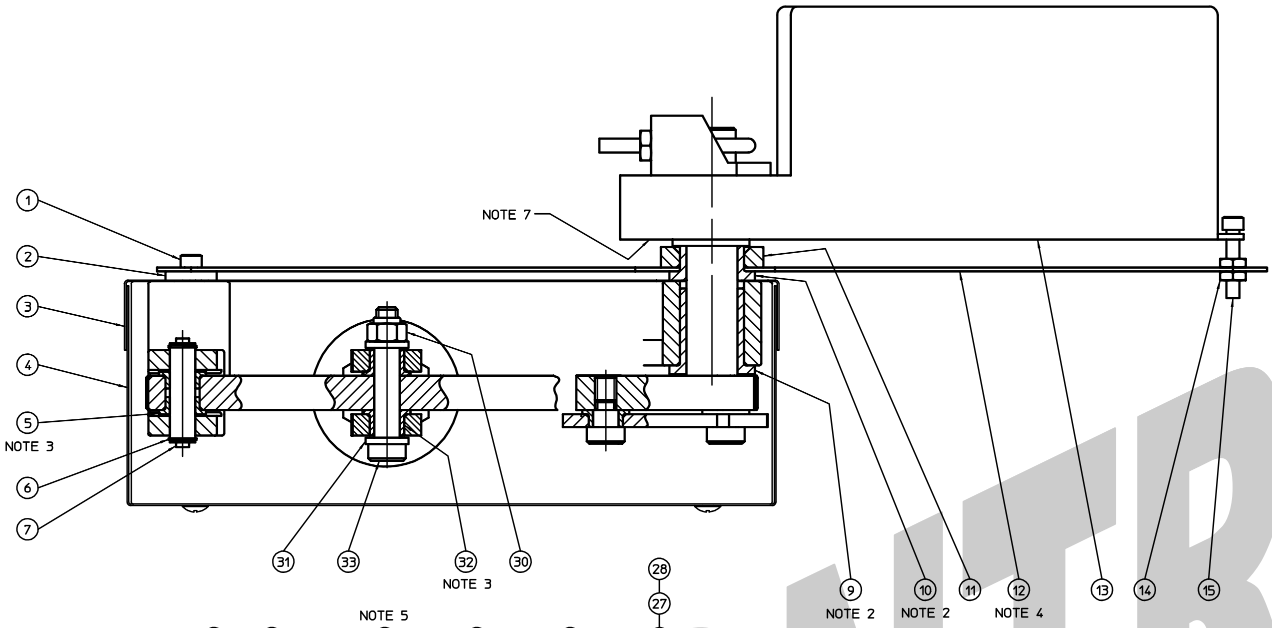
DEFAULT ACTUATOR ORIENTATION

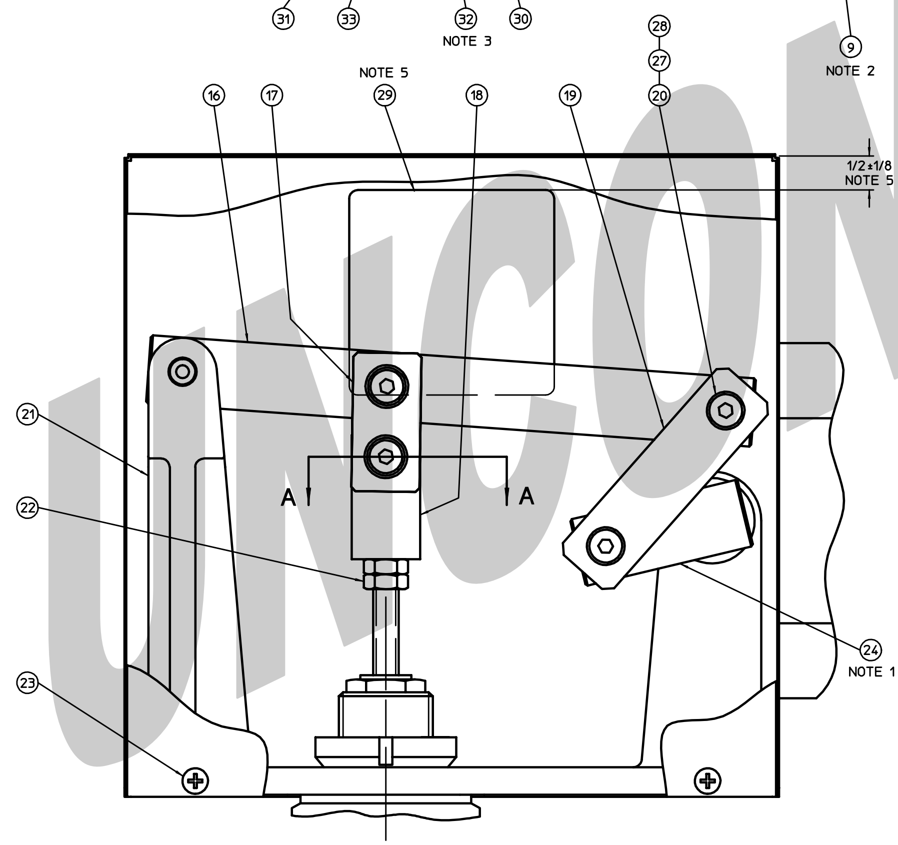
ITEM	QTY	PART NO	DESCRIPTION	MATL SPEC
29	1	B1670070	MOTOR REMOVAL & LINKAGE RE-ORIENTATION WARNING LABEL	LAMINATED PAPER W/ ADHESIVE
28	2	05106724	.375 x 1.500 LG SOCKET HD SHOULDER SCREW	300 SERIES ST STL
27	4	B1060063	3/8 ID x 3/8 LG SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
26	4	B2060007	.385 ID x .627 OD x .093 THK FLAT WASHER	300 SERIES ST STL
25	2	01505708	5/16-18 SELF LOCKING NUT	300 SERIES ST STL
24	1	B1670067	AMURACT WARNING LABEL	ALUMINUM FOIL W/ ADHESIVE
23	A/R	A0940027	LOCTITE 272	
22	A/R	A0940038	LOCTITE PRIMER T	
21	1	B1670059	AMURACT SERIAL PLATE	ALUM FOIL W/ ADHESIVE
20	1	B1670060	AMURACT BADGE	PLASTIC W/ ADHESIVE
19	1	B1900081	CRANK ARM ASSEMBLY 3 WAY	304 ST STL ASTM A276 OR A479
18	4	04396706	8-32 x 3/8 CROSS RECESSED TRUSS HD MACHINE SCREW	300 SERIES ST STL
17	2	01806709	3/8-24 HEX JAMNUT	18-8 ST STL
16	1	D1899935-01	BASE 1 3/8 DIAMETER BONNET	CAST ST STL ASTM A351 CF8
15	2	05106704	.375 x .250 LG SOCKET HD SHOULDER SCREW	300 SERIES ST STL
14	1	B1900083	CONNECTING LINK SUBASSEMBLY 3 WAY	ST STL & BRONZE
13	1	B1900079	STEM CONNECTOR NS1 INTERFACE	304 ST STL ASTM A276 OR A479
12	2	B1909952	STEM CONNECTOR LINK	300 SERIES ST STL
11	1	B1900072	ROCKER ARM	304 ST STL ASTM A276 OR A479
10	1	B1060061	3/4 ID SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
8	1	B1900077-01	ROCKER ARM PIN	303 ST STL ASTM A582
7	2	C0200004-01	RETAINING RING	TYPE 302 ST STL
6	2	B1060060	3/8 ID x 1/4 LG SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
5	1	D1580033-01	FRONT COVER	300 SERIES ST STL
4	1	D1580032-01	REAR COVER	300 SERIES ST STL
3	1	02297799	10-32 KEP NUT	300 SERIES ST STL
2	1	01297716	10-32 x 1 SOCKET HEAD CAPSCREW	ST STL ASTM F837
1	1	PER SALES ORDER	MOTOR	

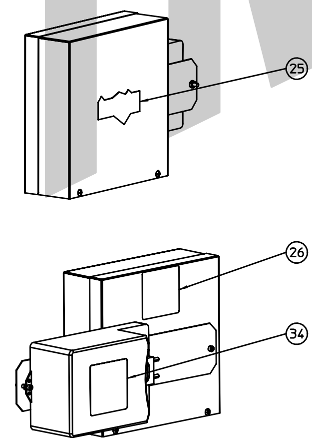
UNLESS OTHERWISE SPECIFIED: DECIMAL .XX ± DECIMAL .XXX ± FRACTION ± ANGLE ±	MATERIAL SEE TABLE	DRAWN BLB DATE 10/2/07	WARREN CONTROLS INCORPORATED BETHLEHEM, PENNSYLVANIA 18020-8010
THIRD ANGLE PROJECTION	TREATMENT	CHECKED	AMURACT ACTUATOR ASSEMBLY 3 WAY LOW TEMP NS1 INTERFACE
NEXT ASSEMBLY / ALL DIMENSIONS ARE IN INCHES	FINISH	APPROVED	SIZE D FSCM NO 03847 DWG NO D3400014 REV A

NOTES:

1) THE CRANK ARM IS INITIALLY SET UP AT DIFFERENT ANGLES DEPENDING ON THE VALVE TRAVEL. SEE WORK INSTRUCTION WI10006 FOR DETAILS ON SETTING UP THE LINKAGE.
2) PRESS IN BEARING USING TOOL B6150024. INSTALLED BEARING ID SHALL BE Ø.7500 - .7511.
3) PRESS IN BEARINGS USING TOOL B6150032. INSTALLED BEARING ID SHALL BE Ø.3750 - .3761.
4) LOCATE WARNING LABEL AS SHOWN. CENTRALLY LOCATE HORIZONTALLY ON INSIDE OF REAR COVER.
5) TIGHTEN ALL TERMINAL SCREWS AFTER TESTING, BEFORE SHIPPING.
6) WRITE S/N ON METAL BOTTOM OF MOTOR BEFORE MOUNTING.
7) RECORD MOTOR DATE ON PICK TICKET.



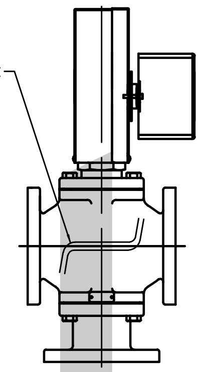




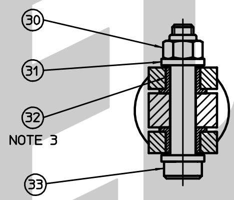
8) RECORD MOTOR DATE ON PICK TICKET.
7) WRITE S/N ON METAL BOTTOM OF MOTOR BEFORE MOUNTING.
6) TIGHTEN ALL TERMINAL SCREWS AFTER TESTING, BEFORE SHIPPING.
5) LOCATE WARNING LABEL AS SHOWN. CENTRALLY LOCATE HORIZONTALLY ON INSIDE OF REAR COVER.
4) BRACKET IS ASYMMETRICAL. SLOTTED HOLE IS FOR FASTENER, ITEM 1.
3) PRESS IN BEARINGS USING TOOL B6150032. INSTALLED BEARING ID SHALL BE Ø.3750 - .3761.
2) PRESS IN BEARING USING TOOL B6150024. INSTALLED BEARING ID SHALL BE Ø.7500 - .7511.
1) THE CRANK ARM IS INITIALLY SET UP AT DIFFERENT ANGLES DEPENDING ON THE VALVE TRAVEL. SEE WORK INSTRUCTION WI10006 FOR DETAILS ON SETTING UP THE LINKAGE.
NOTES:

REV	DESCRIPTION	DATE	APPROVED
B	REDRAWN WITH CHANGE ECN 2519	BLB 4/23/10	
C	ECN 2524	DGS 5-12-10	

THE WEB DRAWN HERE REFERS TO THE ACTUAL WEB INSIDE OF THE BODY AND NOT TO ANY IMAGE OF THE WEB CAST ON THE OUTSIDE OF THE BODY.



DEFAULT ACTUATOR ORIENTATION



SECTION **A–A**

ITEM	QTY	PART NO	DESCRIPTION	MATL SPEC
34	1	B1670070	MOTOR REMOVAL & LINKAGE RE-ORIENTATION WARNING LABEL	LAMINATED PAPER W/ ADHESIVE
33	2	05106724	.375 x 1.500 LG SOCKET HD SHOULDER SCREW	300 SERIES ST STL
32	4	B1060063	3/8 ID x 3/8 LG SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
31	4	B2060007	.385 ID x .627 OD x .093 THK FLAT WASHER	300 SERIES ST STL
30	2	01505708	5/16-18 SELF LOCKING NUT	300 SERIES ST STL
29	1	B1670067	AMURACT WARNING LABEL	ALUMINUM FOIL W/ ADHESIVE
28	A/R	A0940027	LOCTITE 272	
27	A/R	A0940038	LOCTITE PRIMER T	
26	1	B1670059	AMURACT SERIAL PLATE	ALUM FOIL W/ ADHESIVE
25	1	B1670060	AMURACT BADGE	PLASTIC W/ ADHESIVE
24	1	B1900081	CRANK ARM ASSEMBLY 3-WAY	304 ST STL ASTM A276 OR A479
23	4	04396706	8-32 x 3/8 CROSS RECESSED TRUSS HD MACHINE SCREW	300 SERIES ST STL
22	2	01806709	3/8-24 HEX JAMNUT	18-8 ST STL
21	1	D1899935-01	BASE 1 3/8 DIAMETER BONNET	CAST ST STL ASTM A351 CF8
20	2	05106704	.375 x .250 LG SOCKET HD SHOULDER SCREW	300 SERIES ST STL
19	1	B1900083	CONNECTING LINK SUBASSEMBLY 3 WAY	ST STL & BRONZE
18	1	B1900079	STEM CONNECTOR 3/8-24 FOR NS1 & HD1 INTERFACE	304 ST STL ASTM A276 OR A479
17	2	B1909952	STEM CONNECTOR LINK	300 SERIES ST STL
16	1	B1900072	ROCKER ARM	304 ST STL ASTM A276 OR A479
15	1	01297716	10-32 x 1 LG SOCKET HEAD CAPSCREW	ST STL ASTM F837
14	2	02297799	10-32 KEP NUT	300 SERIES ST STL
13	1	PER SALES ORDER	MOTOR	
12	1	D1899977-01	HI-TEMP MOTOR MOUNTING BRACKET	300 SERIES ST STL
11	1	B1800056-01	MOUNTING BRACKET BEARING COLLAR	ST STL ASTM A582 OR A479
10	1	B1060062	3/4 ID x 1/2 LG SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
9	1	B1060061	3/4 ID x 1 1/4 LG SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
7	1	B1900077-01	ROCKER ARM PIN	303 ST STL ASTM A582
6	2	C0200004-01	RETAINING RING	TYPE 302 ST STL
5	2	B1060060	3/8 ID x 1/4 LG SELF LUBRICATING FLANGED BEARING	POWDER METAL BRONZE
4	1	D1580033-01	FRONT COVER	300 SERIES ST STL
3	1	D1580032-01	REAR COVER	300 SERIES ST STL
2	1	B1910088	MOUNTING BRACKET SPACER	300 SERIES ST STL
1	1	01297708	10-32 x 1/2 LG SOCKET HEAD CAPSCREW	ST STL ASTM F837

UNLESS OTHERWISE SPECIFIED: DECIMAL .XX ± DECIMAL .XXX ± FRACTION ± ANGLE ±

THIRD ANGLE PROJECTION

NEXT ASSEMBLY — ALL DIMENSIONS ARE IN INCHES

MATERIAL: SEE TABLE

TREATMENT

FINISH

DRAWN: BLB — DATE: 10/2/07

CHECKED

APPROVED

WARREN CONTROLS INCORPORATED
BETHLEHEM, PENNSYLVANIA 18020-8010

AMURACT ACTUATOR ASSEMBLY 3 WAY
HI TEMP NS1 INTERFACE

SIZE: D — FSCM NO: 03847 — DWG NO: D3400015 — REV: C

SCALE: FULL — WT — SHEET

TROUBLESHOOTING

A. No valve movement:

1. Check that operating power and signal are present at the motor terminals.

2. Check fuse for continuity. Shut the isolation valves and then press the Reset push button. Observe that the valve travels fully open then shut.

3. Review WIRING AND STARTING (pages 6-9) to confirm wiring and switch positioning.

4. Remember to press the Reset pushbutton to perform the AutoStroke calibration cycle. It will optimize performance and maximize motor life.

B. Valve and Motor are "out of sync" ie: the linkage or motor do not both reach their ends of travel, or they arrive at different times.

1. Check for indication of slippage between the motor output clamp and the linkage input shaft. If slipping is detected, the linkage and motor must be re-calibrated. See pages 11-15 as necessary to review both procedures. Pay close attention to tightening the two 10 mm hex nut on the motor output clamp, and remember to press the Reset pushbutton to perform the Autostroke calibration cycle. It will optimize performance and maximize motor life.

C. After extensive usage, valve closure tightness appears to have diminished.

1.Remove the motor (see page 11) and then perform LINKAGE CALIBRATION (see pages 12-15) and MOTOR CALIBRATION (see page 11). This will restore seat-closing force to its original high value, correcting for normal linkage wear.

2. Remember to press the Reset pushbutton to perform the Autostroke calibration cycle. It will optimize performance and maximize motor life.

D. For more information or advice, contact your Warren Controls sales representative, or our factory at (610) 317-0800.

OPERATING TIPS

AmurAct control valves are designed to operate for extended periods of time without maintenance or operator action.

1. No operator action is needed after a power outage sends AmurAct into its fail-safe position. It will resume normal operation when power is restored. Recall that nothing happens until completion of the Enerdrive recharging process. It will then respond to a control signal input.

2. Initiate the motor's AutoStroke calibration cycle each time AmurAct is placed into service following any intentional shutdown, adjustment, calibration or maintenance. Failure to do so can cause inaccuracy of control and premature failure of the motor.

3. Fail-safe operation can be verified at any time by interrupting the normal power supply.

4. Improper calibration of the electric controller by others may cause the control valve to "hunt", causing abnormal wear and premature failure.

NOTES

1. Linkage Model **LS** at factory is aligned with the pipe center line. It is specified when line media are **below 250 deg. F., or 340 deg. F.** when the valve body is insulated.

2. Linkage Model **LE** must be installed perpendicular to the pipe center line. It is specified when line media flowing through un-insulated valves **exceed 250 deg. F., or 340 deg. F.** through insulated valves. **The 180-degree offset anti-rotation tailpiece must also be installed.**

3. Actuators **F3, F4, F5 and F6** are similar in appearance. The label on **F3 & F5** states that output torque is **120 lb. in**., and **F4 & F6** states **240 lb. in.**

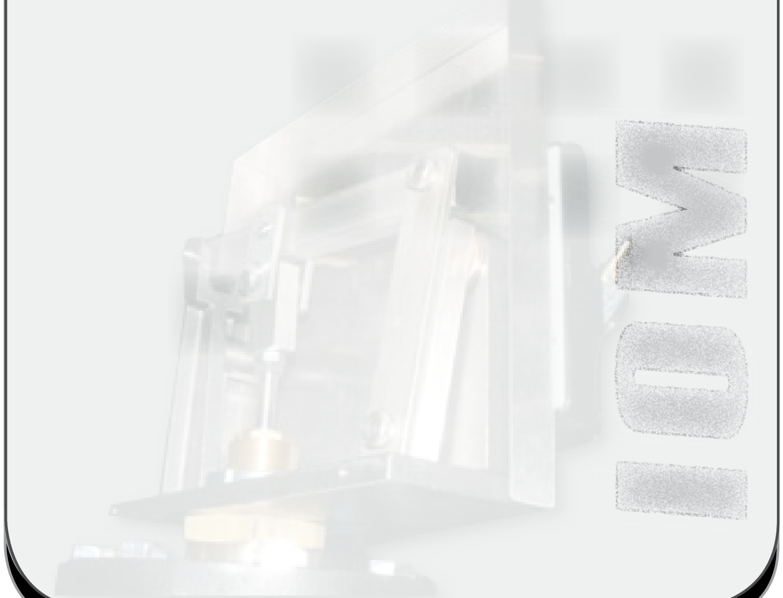
4. Split-ranging, or two-stage (two valve) control can be accomplished in the linearized operating mode. **Call the factory for additional instructions.**

NOTES

A VETERAN OWNED, PRIVATELY HELD, SMALL BUSINESS

AmurAct Actuator Linkage and Motor

IOM AA Rev. G 0411



WARREN CONTROLS

2600 Emrick Blvd • Bethlehem, PA 18020 • USA

800-922-0085 • www.warrencontrols.com

92500060 RevG

Bulletin E-90-BPC

Series 4B, 8B, 16B and 32B Microprocessor Based Temperature Process Control

Specifications - Installation and Operating Instructions

LOVE CONTROLS DIVISION
DWYER INSTRUMENTS INC.
P.O. BOX 338 - MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000 www.love-controls.com
Fax: 219/872-9057 e-mail:love@love-controls.com

MODEL NUMBER IDENTIFICATION

32B —

OUTPUT 1
2 = Voltage Pulse
3 = Relay
5 = Current
6 = Linear Voltage

OUTPUT 2
2 = Voltage Pulse
3 = Relay

16B — OPTIONS

OUTPUT 1
2 = Voltage Pulse
3 = Relay
5 = Current
6 = Linear Voltage

OUTPUT 2
2 = Voltage Pulse
3 = Relay

OPTIONS
Blank = none
1 = Event input
2 = Current Transformer

4B — OPTIONS

OUTPUT 1
2 = Voltage Pulse
3 = Relay
5 = Current
6 = Linear Voltage

OUTPUT 2
2 = Voltage Pulse
3 = Relay

OPTIONS
Blank = none
1 = Event input
2 = Current Transformer

8B — OPTIONS

OUTPUT 1
2 = Voltage Pulse
3 = Relay
5 = Current
6 = Linear Voltage

OUTPUT 2
2 = Voltage Pulse
3 = Relay

OPTIONS
Blank = none
1 = Event input
2 = Current Transformer

GETTING STARTED

1. Install the control as described on page 4.

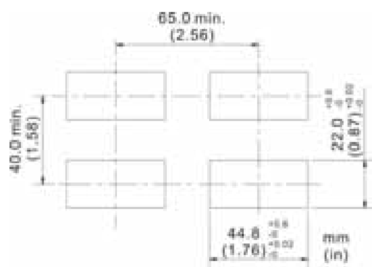
2. Wire your control following the instructions on pages 6-7. Please read the Precautions section located at the end of this manual before wiring the control.

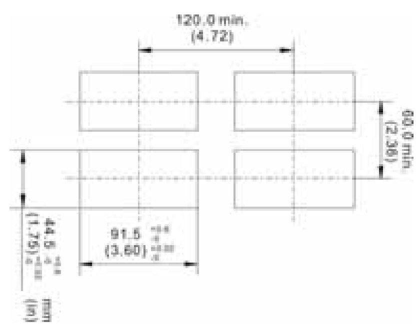
3. For best results when programming changes are necessary, make all changes to the Initial Setting mode (Pages 20-22) before making changes to the Regulation Mode (Pages 17-19) or Operation Mode (Pages 15-16). If any error messages occur, check the Diagnostic Error Message Section (Page 26) for assistance.

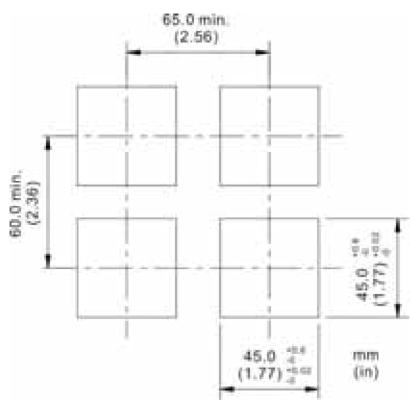
INSTALLATION
Mount the instrument in a location that will not be subject to excessive temperature, shock, or vibration. All models are designed for mounting in an enclosed panel.

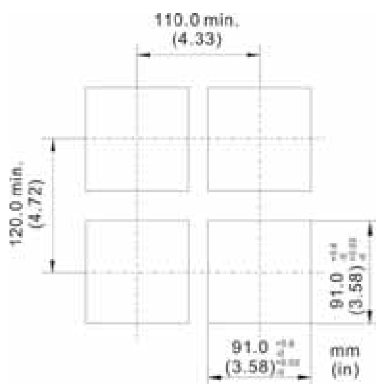
Select the position desired for the instrument on the panel. Prepare the panel by cutting and deburring the required opening per the panel cut out dimensions listed below. Follow the mounting instructions listed on page 5. Lastly, wire the controller per the appropriate wiring diagram listed on page 6.

PANEL CUTOUT DIMENSIONS









MOUNTING METHOD

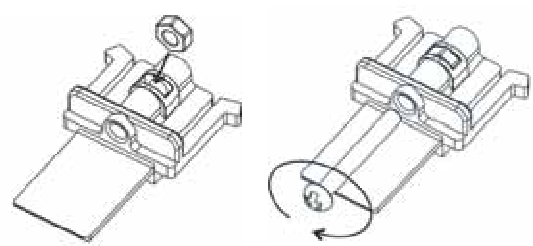
Step 1: From the front of the panel, slide the controller housing through the cut out. The housing gasket should be against the housing flange before installing.

Step 2: Insert the mounting brackets into the mounting grooves on the top and bottom of the controller (16B, 8B, and 4B). For the 32B, slide the mounting collar over the housing from the rear of the panel.

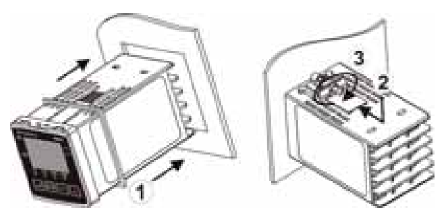
Step 3: Push the mounting brackets forward until the bracket stops at the panel wall.

Step 4: Insert and tighten the screws on the bracket to secure the controller in place. (The screw torque should be 0.8 kgf-cm).

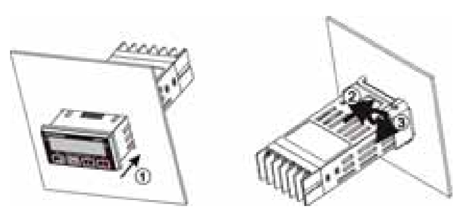
Mounting Bracket Installation



16B/4B/8B Mounting Method



32 Mounting Method



WIRING

Do not run thermocouple or other class 2 wiring in the same conduit as power leads. Use only the type of thermocouple or RTD probe for which the control has been programmed. Maintain separation between wiring of sensor, auxiliary in or out, and other wiring. See the Initial Setting Menu for input selection.

For thermocouple input always use extension leads of the same type designated for your thermocouple.

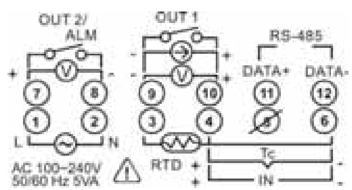
For supply connections use No. 16 AWG or larger wires rated for at least 75° C. Use conductors only. All line voltage output circuits must have a common disconnect and be connected to the same pole of the disconnect.

Input wiring for thermocouple, current, and RTD; and output wiring for current 14 VDC is rated CLASS 2.

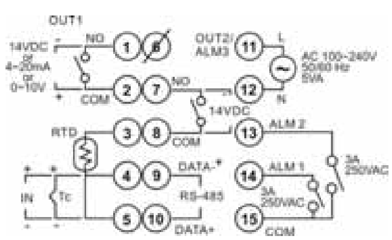
Control wiring as show below:

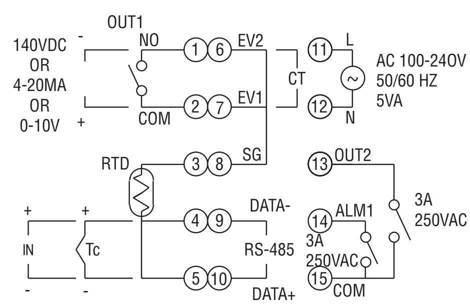
Terminal Identification

32B



16B

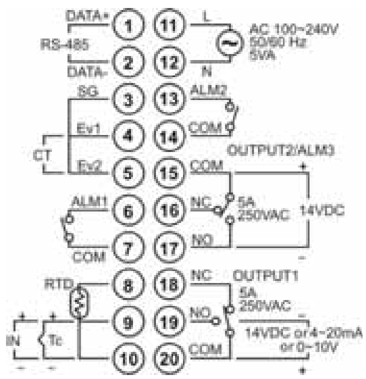




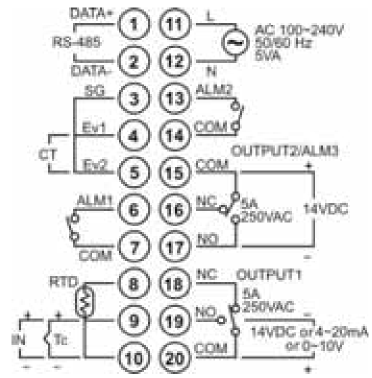
No Event / CT Input **Event / CT Input**

Terminal Identification (Continued)

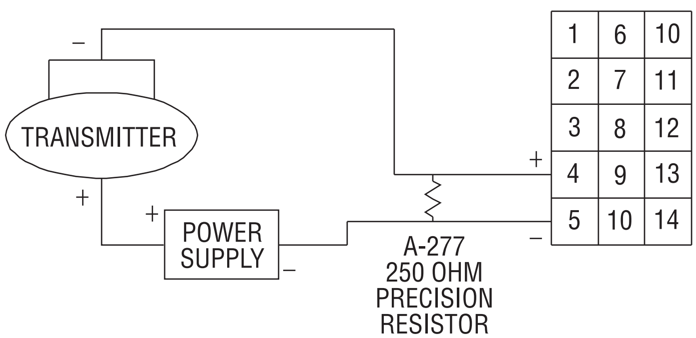
4B



8B



Wiring for 4 to 20 mA Transmitter Inputs



Note: 16B terminal layout used in above example. Use appropriate terminal layout for selected controller.

FRONT KEY FUNCTIONS

Key functions are as follows:

INDEX: Pressing the INDEX key advances the display to the next menu item.

UP ARROW: Increments a value or changes a menu item. If pressed during the Operation Mode, the set point value will be increased.

DOWN ARROW: Decrements a value or changes a menu item. If pressed during the **Operation Mode**, the set point value will be decreased.

ENTER: Stores the value or item change. If not pressed, the previously stored value or item will be retained. When pressed during the **Operation Mode**, the controller switches to the **Regulation Mode**. If held for more than 3 seconds during the **Operation Mode**, the controller switches to the **Initial Setting Mode**. If pressed during the **Regulation Mode** or **Initial Setting Mode**, the controller will return to the **Operation Mode**.

SECURITY FEATURES

The B series controller has two built in security lock settings to prevent unauthorized personnel from changing parameter settings. These parameters are set in the **Operation Mode**.

The LoC1 setting affects all parameters in the controller. If LoC1 setting is enabled, the operator will have to unlock the controller to make any changes to the controller's parameters.

The LoC2 setting affects all parameters except the set point. If LoC2 setting is enabled, the only parameter that the operator will be able to change is the set point. In order to change any other parameters, the operator will have to unlock the control before making a change.

In order to unlock the control, the operator must depress the ENTER and INDEX key simultaneously.

CONTROL OPERATION DESCRIPTION

The HOME display is the normal display while the control is operating. If no errors or functions are active, the HOME display will indicate the Process Variable (the temperature, pressure, flow, %RH, etc.) that is being measured on the top display and the Set Variable on the bottom display.

Items that can change the HOME display are the Ramp and Soak function and any error messages. Descriptions of these special displays follow.

If the Ramp and Soak feature is active, then bottom display will show the current execution pattern and current execution step. The UP and DOWN arrows can be pressed to change the bottom display to show the Set Point (SP) of the current execution step or the Time Remaining (r-ti) of the current execution step. After changing the bottom display to either the Time Remaining or the Set Point, the ENTER key must be pressed to display the values.

Error Messages are shown on page 26.

OPTIONS

Event Input

When the controller is ordered with the Event Input Option (See page 3 for ordering information), two event inputs are available. The event input is triggered by contact closure between event 1 (EV1) or event (EV2) contact terminal and signal ground (SG) contact terminal.

Event 1 controls the output operation of the control. When the event 1 contact terminals are open, the output is active. When the event 1 contact terminals are closed, the output is de-activated. The outputs can also be controlled via the Run/Stop parameter using the front keypad or by using the RS-485 communications.

Event 2 allows the user to switch between two temperature set points. Each temperature set point has independent control parameters.

Current Transformer Alarm Function

The current transformer option allows the user to have an alarm contact trigger due to a loss of current or a surge in current to the control output. When using the current transformer input, the desired alarm contact should be set to alarm type 13 in the Initial Setting Menu (Page 21). The current transformer should be wired according to the appropriate wiring diagram on page 6 and page 7. The high and low alarm set points can be set from 0.5 to 30 Amps. The display resolution is 0.1 Amps and the accuracy is ±0.5 Amps with the included current transformer.

Heating, Cooling or Dual Loop Control

Temperature Control can be achieved by either heating or cooling. In the B series controllers, heating and cooling can be operated simultaneously using Dual Loop Output Control to maintain a temperature set point. When Dual Loop Output Control is used, control outputs must be connecting to the heating and cooling devices. Please refer to the following for the operation of each setting.

Control Modes are selected by changing the S-HC parameter in the Initial Setting Mode.

Select HEAt, for heating or reverse acting control for output 1. If selected, output 2 will become alarm 3.

Select CooL, for cooling or direct acting control for output 1. If selected, output 2 will become alarm 3.

Select H1C2 or C1H2 for Dual Loop Output Control for output 1 and 2. If H1C2 is selected, output 1 would be fore heating or reverse acting control and output 2 would be for cooling or direct acting control. If C1H2 is selected, output 1 would be for cooling or direct acting control and output 2 would be for heating or reverse acting control.

Setting the control mode to PID when the controller is set for Dual Loop Output Control Activates the Proportional Band Coefficient (CoEF) parameter and the Dead Band (dead) parameter.

The Proportional Band Coefficient (CoEF) sets the Proportional band value for Output 2 based on the Proportional band of output 1. The Proportional Band of Output 2 would be equal to the Proportional Band (Pn) of Output 1 multiplied by the Proportional Band Coefficient (CoEF). The Integral Time (in) and the Derivative Time (dn) will be the same for both Outputs.

The Dead Band (dEAd) parameter sets an area in which the heating and cooling outputs are operating at 0% on. The Dead Band is centered on the Set Point in Dual Loop Output Control mode. Please see the Dead Band illustrated on page 19.

RAMP/SOAK PROGRAMMING AND OPERATION

The ramp/soak feature offers a great deal of flexibility by allowing changes in the set point to be made over a predetermined period of time.

Theory of Operation

The B series controls offer a very simple approach to programming a ramp function. Rather than requiring the operation to calculate an approach rate (usually in degrees per minutes), the B series does the calculation internally. Thus, the operator only needs to program the target set point and the time desired to reach that point. When the ramp segment is executed by the control, it calculates the ramp required to move the process from the starting value (current PV) to the desired value (programmed SP) in the time allowed.

Soaks (or dwells) are ramp segments where the target set point is the same as the beginning process value. This allows for multistage ramps without wasting intermediate soak steps. Care must be taken, however, that the process does actually reach the soak value before the soak time starts. If not, the next segment will calculate a slope from the starting PV to the target SP. Depending on your process requirements, this difference may be important. Make sure to test any program for desired results before running production material.

Do not operate auto-tuning while a ramp function is operating. The ramp function will prevent self tune from operating properly. Make sure that all tuning is set up before operating ramp/soak.

Program Setup

All of the programming for the Ramp/Soak function is done in the Initial Setting Mode. You may wish to work out your program on paper before going into the programmer menu sequence.

In the Initial Setting Mode, go to the Control Mode (CtrL) parameter. Set the parameter to ProG. Press INDEX to the Pattern Editing parameter (PAtn). Use the arrows to select the desired pattern to edit. By setting the Pattern Editing parameter to off, pressing the INDEX key brings up the next parameter in the Initial Setting mode. The Ramp and Soak function is supported by 8 different patterns (pattern numbers 0 to 7). Each pattern contains 8 steps (step numbers 0 to 7) for set point and execution times, one link pattern (Linn) parameter, one cycle parameter (CyCn), and one actual step parameter (PSYn).

The default of step 0 in pattern 0 is a soak function. The control should be programmed to reach the Set Point (SV) temperature, X, after the execution time, T. The unit will control the process temperature (PV) to reach temperature X and the keep the temperature at temperature X. The execution time T is determined by the execution time (ti00) for step number 0. The target set point (SP00) for step number 0 should equal the Set Point (SV) temperature.

After the first step, program SP01 and ti01 through SP07 and ti07 for the first pattern. The target set point value (SP0n) is in actual units just like your Set Point (SV). If the control is set for temperature, then the target set point displays are in temperature. If the control is programmed for some other engineering unit, the target set point displays will be set in that unit. The target execution time (ti0n) is in units of time, (hh.mm). The step parameters will be followed by the Actual Step parameter, Cycle parameter, and the Link parameter for each pattern.

The Actual Step parameter (PSYn) sets the last executable step for the current pattern. For example, if the Actual Step parameter is set to 2 for pattern 0, then the program will only run steps 0, 1, and 2 for pattern 0.

The Cycle parameter (CyCn) determines how many times the current pattern is repeated. For example, if the Cycle parameter for pattern 0 is set to 2, the steps in pattern 0 will be repeated twice before moving on to the next pattern.

The Link parameter (Linn) assigns the next pattern for the program to execute. For example, if the Link parameter is set to 3 for pattern 0, the program will skip patterns 1 and 2 and start executing pattern 3 after pattern 0 is complete. If the Link parameter is set to oFF, the program will stop after executing the current pattern and the temperature will be maintained at the set point of the last step executed.

Execution
The execution of the ramp and soak feature is initiated through the Run/Stop parameter, (r-S) in the Operation Mode. The Run/Stop parameter has four possible values.

If the Run/Stop parameter is set to rUn, the program will start to execute in order from step 0 of the start pattern.

If the Run/Stop parameter is set to Program Stop (PStP), the program will stop and maintain the temperature of the last set point before the program was halted. When the Run/Stop parameter is restarted, the program will restart and execute from step 0 of the start pattern. The start pattern selection (Ptrn) is only available when the Run/Stop parameter is set to Program Stop.

If the Run/Stop parameter is set to Program Hold (PHod), the program will be paused and the temperature will be maintained at the set point temperature that was active prior to the program hold. Once the Run/Stop parameter is set back to run, the program will follow the step before the hold and start to execute through the rest of the program.

Display
During ramp and soak program control, the SV default display is P-XX, where P indicates the current execution pattern and XX indicates the display item to Set Point Value (SP) or Residual Time (r-ti). The Set Point Value will display the temperature set point of the current execution step in the SV display. The Residual Time will display the remaining time of the current execution step in the SV display. After selecting the Set Point Value or Residual Time, the ENTER key must be pressed to accept the display change.

PROGRAMMING AND OPERATION FOR PID

Theory of Operation

The PID method of control is based on the individual tuning of proportional band values, integral time values, and derivative time values to help a unit automatically compensate for changes in a control system. The proportional band is the range around the set point in which the control's proportioning takes place. The control increases or decreases the output proportionately to the process temperature's deviation from the set point. The integral time eliminates undershoot and overshoot of the set point by adjusting the proportioning control based on the amount of deviation from the set point during steady state operation. The derivative time eliminates undershoot and overshoot by adjusting the proportioning control based on the rate of rise or fall of the process temperature. The integral deviation offset correction (ioFn) improves the speed in which the process value reaches the set point value. If this parameter is set to zero, the output will be zero when the process value is equal to the set point value. If the integral time parameter is used only to eliminate steady state error, it may take a long time to reach the set point because it needs time to accumulate the error. This parameter defines the default output level on start up. When the integral time is set at 0, then the proportional derivative offset correction (PdofF) would replace the integral deviation offset correction, but serves the same function.

Program Set Up

In order to use the PID function in the B series controllers, the Control Mode will have to be set to PID in the Initial Setting Menu. After changing the Control Mode, the PID parameters can be accessed in the Regulation Menu. The PID parameters can either be programmed manually or they can be set by the controller using the auto tune function. The auto tune will use trial and error to tune the PID parameters to give the control the most precise control. Since the time to accurately tune the control may differ depending on the process, the controller can also be manually tuned to known PID values prior to running auto tune. The Run/Stop parameter must be set to run in order to start auto tuning.

The B series controller has four user-defined profiles (PID0 to PID3) of PID values along with an auto selection function (PID4). Each set of PID values includes a set point value (Svn), proportional band (Pn), integral time (in), derivative time (dn), and integral deviation setting (iofn). If PID4 is selected, the controller will pick which set of user defined parameters to use based on how close the set point value of the profile is to the current process value.

DESCRIPTION OF MENU STRUCTURE

The programming for the controller is broken down into three menus (Operation, Regulation, and Initial Setting). Upon normal operation, control will be in the Operation Menu.

OPERATION MENU

Pressing the INDEX key will cycle through the below menu items. The parameter will be displayed in the top display, while its value will be displayed in the bottom display, except for the set point which is displayed in the bottom display on the Home Display. The UP and DOWN arrows change the values of the parameters. The ENTER key must be pressed after any changes.

1234	Adjust the set point value - Can be any numerical value between the upper and lower limit of the temperature range.
r-S	Select Run - Stop Output Control.
rUn	Activates outputs and Starts Ramp/Soak.
StoP	De-activates outputs and Stops Ramp/Soak.
PStP	Halts Ramp/Soak program, outputs remain active. Only available during ramp/soak operation. Program restarts at Step 0 of Start Pattern.
PHod	Pauses Ramp/Soak program, outputs remain active. Only available during ramp/soak operation. Program restarts at step prior to program being held.
Ptrn	Set Start pattern for Ramp/Soak. Only available when r - S set to PStP.
SP	Number of digits to the right of the decimal. Decimal Point Position can be set for all Inputs except for B, S, and R type thermocouples.
AL1H	Alarm 1 High Set Point. May not appear depending on ALA1 setting in Initial Setting Menu.

AL1L — Alarm 1 Low Set Point. May not appear depending on ALA1 setting in Initial Setting Menu.

AL2H — Alarm 2 High Set Point. May not appear depending on ALA2 setting in Initial Setting Menu.

AL2L — Alarm 2 Low Set Point. May not appear depending on ALA2 setting in Initial Setting Menu.

AL3H — Alarm 3 High Set Point. May not appear depending on ALA3 setting in Initial Setting Menu.

AL3L — Alarm 3 Low Set Point. May not appear depending on ALA3 setting in Initial Setting Menu.

LoC — Set front panel security lock.
- LOC1 — Lock all settings.
- LOC2 — Lock all settings except the set point.

oUt1 — Display the % output value for output 1. In manual mode, this value can be changed using the up and down arrows.

oUt2 — Display the % output value for output 2. In manual mode, this value can be changed using the up and down arrows.

REGULATION MENU

Press the ENTER key while at the Home Display in order to access the Regulation Menu. Pressing the INDEX key will cycle through the below menu items. The parameter will be displayed in the top display, while its value will be displayed in the bottom display. The UP and DOWN arrows change the values of the parameters. The ENTER key must be pressed after any changes.

AT — Auto Tune. The controller will evaluate the process and select the PID values to maintain good control. Only available when the control mode is set to PID.

- on — Start learning the process. After the process has been learned the menu will revert to oFF.
- oFF — Disables Auto Tune.

Pidn — Selection of PID profile. The controller can store up to 4 PID profiles. The top display will show the PID profile and the bottom display will show the target set value for that profile. When Pid4 is selected, the controller will automatically select which PID profile to use based on the target set values. Only available when control mode is set to PID. See Programming and Operation of PID function for more information. (n = 0 to 4)

- Svn — Target Set Value associated with each PID Profile. (n = 0 to 3).
- Pn — Proportional Band Setting associated with each PID Profile. (n =0 to 3).
- in — Integral time (reset time) associated with each PID Profile. (n = 0 to 3).
- dn — Derivative time (rate time) associated with each PID Profile. (n = 0 - 3).
- ioFn — Integral Deviation Offset Correction associated with each PID Profile. (n = 0 to 4)

CtS

PD Offset Correction Setting. only available when control mode is set to PID and integral time = 0. See Programming and Operation of PID function for moving information.

Heating Hysteresis (Differential) Setting. Sets the value for the amount of difference between the turn off point (set point) and the turn on point. Figure A shows the output behavior for a heating (reverse acting) application. Only available when control mode set to on/off control.

Cooling Hysteresis (Differential) Setting. Sets the value for the amount of difference between the turn off point (set point) and the turn on point. Figure A shows the output behavior for a cooling (direct acting) application. Only available when control mode set to on/off control.

HtPd

CLPd

HCPd

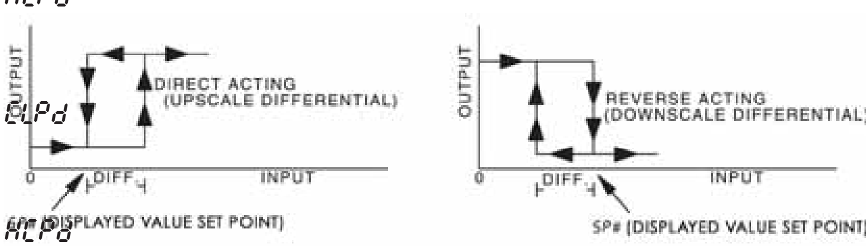


Figure A: Output behavior for Heating/Cooling On/Off Applications

Heating Control Cycle Setting. Defines the duration for one output period or cycle for output 1. Only available when control mode is set to PID or ProG and Output 1 is set for heating.

Cooling Control Cycle Setting. Defines the duration for one output period or cycle for output 1. Only available when control mode is set to PID or ProG and Output 1 is set for cooling.

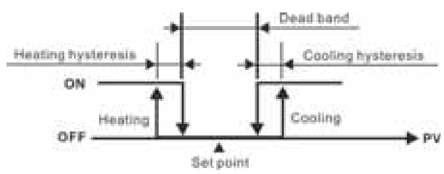
Control Cycle setting for output 2. Defines the duration for one output period or cycle for output 2. Only available when control mode is set to PID and Dual Loop Output Control.

CoEF

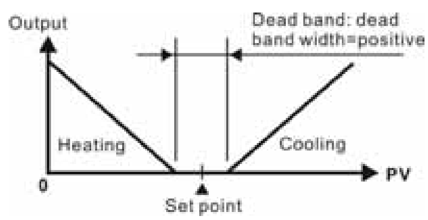
Proportional Band Coefficient. Sets the value of the proportional band for output 2. The proportional band of output 2 is equal to the proportional band of output 1 multiplied by the proportional band coefficient. This parameter is only available when the control mode is set to PID and Dual Loop Output Control.

dEAd

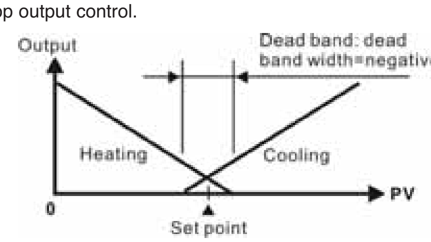
Dead Band. The zone centered on the set point in which the control is thought to be at the desired set level. The outputs will be turned off at this point unless there is an integral deviation offset or the dead band is negative. This parameter is only shown when the control is set to Dual Loop Output Control.



Output operation of ON/OFF control during dual loop output control.



PID control Dead Band is positive.



PID control, Dead Band is negative.

Figure B: Output Operation during dual loop control

tPoF

Process Temperature Offset. This feature allows the input value to be changed to agree with an external reference or to compensate for sensor error.

Crh

Analog Output High Limit: Sets the actual upper limit of the analog output when the control's output is operating at 100%. Only available for analog output models.

CrLo

Analog Output Low Limit. Sets the actual lower limit of the analog output when the control's output is operating at 0%. Only available for analog output models.

INITIAL SETTING MENU

Press and hold the ENTER key for at least 3 seconds while at the Home Display in order to access the Initial Setting Menu. Pressing the INDEX key will cycle through the below menu items. The parameter will be displayed in the top display, while its value will be displayed in the bottom display. The UP and DOWN arrows change the values of the parameters. The ENTER key must be pressed after any changes.

InPt — Input Selection. Select one of the following input types from the below table. For Current inputs, a 250 Ohm Resistor must be wired across the input terminals.

Input Temperature Sensor Type	LED Display	Temperature Range
Thermocouple TXK type	c	-328 ~ 1472°F (-200 ~ 800°C)
Thermocouple U type	U	-328 ~ 932°F (-200 ~ 500°C)
Thermocouple L type	L	-328 ~ 1562°F (-200 ~ 850°C)
Thermocouple B type	b	212 ~ 3272°F (100 ~ 1800°C)
Thermocouple S type	S	32 ~ 3092°F (0 ~ 1700°C)
Thermocouple R type	r	32 ~ 3092°F (0 ~ 1700°C)
Thermocouple N type	n	-328 ~ 2372°F (-200 ~ 1300°C)
Thermocouple E type	E	32 ~ 1112°F (0 ~ 600°C)
Thermocouple T type	t	-328 ~ 752°F (-200 ~ 400°C)
Thermocouple J type	J	-148 ~ 2192°F (-100 ~ 1200°C)
Thermocouple K type		-328 ~ 2372°F (-200 ~ 1300°C)
Platinum Resistance (Pt100)	Pt	-328 ~ 1112°F (-200 ~ 600°C)
Platinum Resistance (JPt100)	JPt	-4 ~ 752°F (-20 ~ 400°C)
0~50mV Analog Input	u	-999 ~ 9999
0V ~ 10V Analog Input	u 10	-999 ~ 9999
0V ~ 5V Analog Input	u5	-999 ~ 9999
4 ~ 20mA Analog Input	A4	-999 ~ 9999
0~20mA Analog Input	A0	-999 ~ 9999

tPUn — Temperature Units. This parameter is only available for thermocouple or RTD inputs.

tP-H — Scale Hight Limit. Sets the upper limit of the temperature range. If the process temperature exceeds this setting, the display will flash an error code.

tP-L — Scale Low Limit. Sets the lower limit of the temperature range. If the process temperature exceeds this setting, the display will flash an error code.

CtrL Control Mode. Select method of control operation. Can be set to PID, On-Off, Manual, or Ramp/Soak Programming.

PAtn Ramp/Soak Pattern Selection. Allows user to select which of the 8 ramp/soak patterns to program. Each pattern has 8 steps which gives a total of 64 possible steps in a single program. When finished programming all ramp and soak patterns, the parameter should be set to off. (n = 0 to 7)

- **SPnY** Segment Set Point for pattern n and step y. For example the first step of the first pattern would be SP00. The last step would be SP77. (n = 0 to 7, y = 0 to 7)

- **tinY** Segment Time for pattern n and step y. For example the first step of the first pattern would be ti00. The last step would be Ti77. The value of this parameter will be in HH:MM. (n = 0 to 7, y = 0 to 7)

- **PSYn** Last Step for pattern n. Sets the last step that will be performed in the current pattern. (n = 0 to 7)

- **CYCn** Pattern Loop Setting for pattern n. Sets the number of times that the current pattern will be repeated. (n = 0 to 7)

- **Linn** Pattern Link for pattern n. Sets the next pattern that will be performed after the current pattern. When set to off, the program will end and maintain last set point. (n = to 7)

S-HC Heat/Cool Selection. Assigns output 1 and output 2 to be either heat or cool.

HEAt = Output 1 = Heating
CooL = Output 1 = Cooling
H1C2 = Output 1 = Heating; Output 2 = Cooling
H2C1 = Output 1 = Cooling; Output 2 = Heating

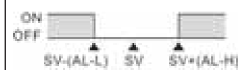
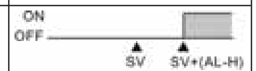
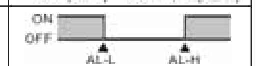
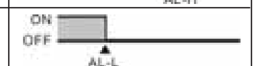
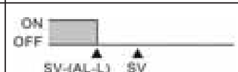
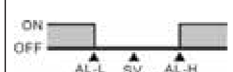
ALA1 Alarm 1 Setting. Sets operation for Alarm 1. Please see selection on Alarm Outputs for description of the outputs.

ALA2 Alarm 2 Setting. Sets operation for Alarm 2. Please see selection on Alarm Outputs for description of the outputs.

ALA3 Alarm 3 Setting. Sets operation for Alarm 3. Please see selection on Alarm Outputs for description of the outputs. (not available for Dual Loop Output Control)

SALA	System Alarm Setting. Selects which of the alarm outputs is used if a system alarm occurs. The system alarms would be an input error or a process control failure. This feature can be disabled by turning this parameter to oFF.
CoSH	Communications Write Function Feature. Allows parameters to be changed via the RS-485 communications. Setting to oFF prevents any changes from remote users.
C-SL	Protocol Selection: Select whether to communicate using ASCII or RTU Protocol. This value must match the protocol used by the host computer.
C-no	Controller Address: Set from 1 to 247. This value must match the controller address used by the host computer.
LEn	Communication Data Length. Choose either 7 or 8. This value must match the communication data length of the host computer.
PrtY	Communication Parity Bit. Set this value to even, odd, or none. This value must match the communication parity bit of the host computer.
StoP	Communication Stop Bit. Set this value to 1 or 2. This value must match the communication stop bit of the host computer.

Alarm Output Configuration and Operation Table.

Set Value	Alarm Type	Alarm Output Operation
0	Alarm function disabled	Output is OFF
1	Deviation upper- and lower-limit: This alarm output operates when PV value is higher than the setting value SV+(AL-H) or lower than the setting value SV-(AL-L).	
2	Deviation upper-limit: This alarm output operates when PV value is higher than the setting value SV+(AL-H).	
3	Deviation lower-limit: This alarm output operates when PV value is lower than the setting value SV-(AL-L).	
4	Reverse deviation upper- and lower-limit: This alarm output operates when PV value is in the range of the setting value SV+(AL-H) and the setting value SV-(AL-L).	
5	Absolute value upper- and lower-limit: This alarm output operates when PV value is higher than the setting value AL-H or lower than the setting value AL-L.	
6	Absolute value upper-limit: This alarm output operates when PV value is higher than the setting value AL-H.	
7	Absolute value lower-limit: This alarm output operates when PV value is lower than the setting value AL-L.	
8	Deviation upper- and lower-limit with standby sequence: This alarm output operates when PV value reaches set point (SV value)and the value is higher than the setting value SV+(AL-H) or lower than the setting value SV-(AL-L).	
9	Deviation upper-limit with standby sequence: This alarm output operates when PV value reaches set point (SV value) and the reached value is higher than the setting value SV+(AL-H).	
10	Deviation lower-limit with standby sequence: This alarm output operates when PV value reaches the set point (SV value) and the reached value is lower than the setting value SV-(AL-L).	
11	Hysteresis upper-limit alarm output: This alarm output operates if PV value is higher than the setting value SV+(AL-H). This alarm output is OFF when PV value is lower than the setting value SV+(AL-L).	
12	Hysteresis lower-limit alarm output: This alarm output operates if PV value is lower than the setting value SV-(AL-H). This alarm output is OFF when PV value is higher than the setting value SV-(AL-L).	
13	CT alarm output: This alarm operates when the current measured by transformer (CT) is lower than AL-L or higher than AL-H (This alarm output is available only for the controller with current transformer).	
14	When program control is end status, alarm output is ON.	
15	When RAMP UP status happens to PID program control, alarm output is ON.	
16	When RAMP DOWN status happens to PID program control, alarm output is ON.	
17	When SOAK status happens to PID program control, alarm output is ON.	
18	When RUN status happens to PID program control, alarm output is ON.	

(Note: AL-H and AL-L include AL1H, AL2H, AL3H and AL1L, AL2L, AL3L)

Communication Register List

1. Supporting transmission speed: 2400, 4800, 9600, 19200, 38400 bps.
2. Non-supported formats: 7, N, 1 or 8, O, 2 or 8, E, 2.
3. Communication protocol: Modus (ASCII or RTU).
4. Function code: 03H to read the contents of register (Max. 8 words). 06H to write 1 (one) word into register. 02H to read the bits data (Max. 16 bits). 05H to write 1 (one) bit into register.
5. Address and Content of Data Register:

Address	Content	Explanation
1000H	Process value (PV)	Measuring unit is 0.1, updated one time in 0.4 second. The following reading value display indicates error occurs: 8002H : Initial process (Temperature value is not got yet) 8003H : Temperature sensor is not connected 8004H : Temperature sensor input error 8006H : Cannot get temperature value, ADC input error 8007H : Memory read/write error
1001H	Set point (SV)	Unit is 0.1, oC or oF
1002H	Upper-limit of temperature range	The data content should not be higher than the temperature range
1003H	Lower-limit of temperature range	The data content should not be lower than the temperature range
1004H	Input temperature sensor type	Please refer to the contents of the “Temperature Sensor Type and Temperature Range” for detail
1005H	Control method	0: PID, 1: ON/OFF, 2: manual tuning, 3: PID program control
1006H	Heating/Cooling control selection	0: Heating, 1: Cooling, 2: Heating/Cooling, 3: Cooling/Heating
1007H	1st group of Heating/Cooling control cycle	0~99, 0:0.5 sec
1008H	2nd group of Heating/Cooling control cycle	0~99, 0:0.5 sec
1009H	PB Proportional band	0.1 ~ 999.9
100AH	Ti Integral time	0~9999
100BH	Td Derivative time	0~9999
100CH	Integration default 0~100%, unit is 0.1%	
100DH	Proportional control offset error value, when Ti = 0	0~100%, unit is 0.1%
100EH	The setting of COEF when Dual Loop output control are used	0.01 ~ 99.99
100FH	The setting of Dead band when Dual Loop output control are used	-999 ~ 9999
1010H	Hysteresis setting value of the 1st output group	0 ~ 9999
1011H	Hysteresis setting value of the 2nd output group	0 ~ 9999
1012H	Output value read and write of Output 1	Unit is 0.1%, write operation is valid under manual tuning mode only.
1013H	Output value read and write of Output 2	Unit is 0.1%, write operation is valid under manual tuning mode only.
1014H	Upper-limit regulation of analog linear output	1 Unit = 2.8uA(Current Output) = 1.3mV(Linear Voltage Output)
1015H	Lower-limit regulation of analog linear output	1 Unit = 2.8uA(Current Output) = 1.3mV(Linear Voltage Output)
1016H	Temperature regulation value	-999~+999, unit: 0.1
1017H	Analog decimal setting	0 ~ 3
101CH	PID parameter selection	0~4
101DH	SV value corresponded to PID value	Only valid within available range, unit: 0.1 scale
1020H	Alarm 1 type	Please refer to the contents of the “Alarm Outputs” for detail
1021H	Alarm 2 type	Please refer to the contents of the “Alarm Outputs” for detail
1022H	Alarm 3 type	Please refer to the contents of the “Alarm Outputs” for detail
1023H	System alarm setting	0 : None (default), 1~3 : Set Alarm 1 to Alarm 3
1024H	Upper-limit alarm 1	Please refer to the contents of the “Alarm Outputs” for detail
1025H	Lower-limit alarm 1	Please refer to the contents of the “Alarm Outputs” for detail

Address	Content	Explanation
1026H	Upper-limit alarm 2	Please refer to the contents of the “Alarm Outputs” for detail
1027H	Lower-limit alarm 2	Please refer to the contents of the “Alarm Outputs” for detail
1028H	Upper-limit alarm 3	Please refer to the contents of the “Alarm Outputs” for detail
1029H	Lower-limit alarm 3	Please refer to the contents of the “Alarm Outputs” for detail
102AH	Read LED status	b0 : Alm3, b1: Alm2, b2: F, b3: _, b4: Alm1, b5: OUT2, b6: OUT1, b7: AT
102BH	Read push button status	b0 : Set, b1 : Select, b2 : Up, b3 : Down. 0 is to push
102CH	Setting lock status	0 : Normal, 1 : All setting lock, 11 : Lock others than SV value
102FH	Software version	V1.00 indicates 0x100
1030H	Start pattern number	0 ~ 7
1040H~ 1047H	Actual step number setting inside the correspond pattern	0 ~ 7 = N, indicate that this pattern is executed from step 0 to step N
1050H~ 1057H	Cycle number for repeating the execution of the correspond pattern	0 ~ 99 indicate that this pattern has been executed for 1 ~ 100 times
1060H~ 1067H	Link pattern number setting of the correspond pattern	0 ~ 8, 8 indicates the program end. 0~7 indicates the next execution pattern number after executing the current pattern
2000H~ 203FH	Pattern 0~7 temperature set point setting Pattern 0 temperature is set to 2000H~2007H	-999 ~ 9999
2080H~ 20BFH	Pattern 0~7 execution time setting Pattern 0 time is set to 2080H~2087H	Time 0 ~ 900 (1 minute per scale)

6. Address and Content of Bit Register: (First bit of reading will put into LSB, Write data = FF00H for bit set, 0000H for bit clear)

DIAGNOSTIC ERROR MESSAGES

Display Error Messages

Display		Description	Action Required
PV	b150	Display on Start Up	No Action Required
SV	rr		
PV	No	No Input Probe Connection	Verify that sensor is wired to proper terminals. Next, check that the controller is programmed for the correct input type. Most commonly seen when controller is programmed for a RTD, while a thermocouple is connected.
SV	Cont		
PV	Err	Input Error	Verify that the input is wired to the proper terminals. Next check to see if the input type is set to the proper value. Most commonly seen when controller is programmed for a 4 to 20 mA input and 0 to 20 mA signal is wired to the controller.
SV	inPt		
PV	2001	Process Value Flashes when outside of range	Input signals may normally go above or below range limits. If not check input and correct the process temperature or increase temperature range limits using tP-H and tP-L.
SV	0.0		
PV	Err	Error EEPROM	Attempt to reset the factory default settings using the instructions in the next section. If still has error, call customer service for a return goods authorization number to have the controller evaluated at the factory.
SV	Pron		

Communication Error Messages

Error Status 102EH/4750H	**PV read back 1000H/4700H**	**Error Status**
0001H	N/A	PV Unstable
0002H	8002H	Re-initialize, no temperature at this time
0003H	8003H	Input sensor did not connect
0004H	8004H	Input Signal Error
0005H	N/A	Over Input Range
0006H	8006H	ADC fail
0007H	N/A	EEPROM read/write error

Reset Factory Default Settings

Note: Resetting Factory Default Settings erases all of the values entered by the user. Record any necessary settings before proceeding.

Warning: Erasing the user entered values may result in a safety hazard and system malfunction.

The following instructions will reset the controller to the original factory default settings.

Step 1. Press the INDEX KEY while at the Home Display until the controller reads LoC in the process display. Use the UP arrow to select LoC1. Press the ENTER KEY to save this value.

Step 2. Press and hold the UP and DOWN arrows simultaneously for one second. Upon releasing the buttons, the display will read SHou in the PV display and oFF in the SV display.

Step 3. Press the INDEX key once and the controller will read PASS in the PV display and a 4321 in the SV display. Adjust the value in the SV display to 1357 using the UP and DOWN arrows. Press the ENTER KEY to save the value.

Step 4. Cycle the power on the controller. Upon power up, all of the user set values have been erased.

SPECIFICATIONS

Input Voltage	100 to 240VAC 50/60Hz.
Operation Voltage Range	85% to 110% of rated voltage.
Power Consumption	5VA max.
Memory Protection	EEPROM 4K bit (non-volatile memory (number of writes: 1000,000)).
Display Method	2 line x 4 character 7-segment LED display Process value (PV): Red color, Set point (SV): Green color.
Sensor Type	Thermocouple: K, J, T, E, N, R, S, B, L, U, TXK.
	3-wire platinum RTD: Pt100, JPt100.
	Analog input 0~5V, 0~10V, 0~20mA, 0~50mV.
Control Mode	PID, ON/OFF, Manual or PID program control (Ramp/Soak control).
Control Output	Relay output: SPDT (SPST: 1/16 DIN and 1/32 DIN size), Max. load 250VAC, 5A resistive load.
	Voltage pulse output: DC 14V, Max. output current 40mA.
	Current output: DC 4~20mA output (Load resistance: Max. 600Ω).
	Linear voltage output: 0~5V, 0~10V *(B Series only).
Display Accuracy	0 or 1 digit to the right of the decimal point (selectable).
Sampling Range	Analog input: 150 msec/per scan Thermocouple or Platinum RTD: 400 msec/per scan.
RS-485 Communication	MODBUS® ASCII/RTU communication protocol.
Vibration Resistance	10 to 55Hz, 10m/s^2 for 10 min, each in X, Y and Z directions.
Shock Resistance	Max. 300m/s^2, 3 times in each 3 axes, 6 directions.
Ambient Temperature	32°F to 122°F (0°C to +50°C).
Storage Temperature	-4°F to 150°F (-20°C to +65°C).
Altitude	2000m or less.
Relative Humidity	35% tp 80% (non-condensing).

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Thermocouple Type and Temperature Range		
Input Temperature Sensor Type	**LED Display**	**Temperature Range**
Thermocouple TXK type	tXK	-328 ~ 1472°F (-200 ~ 800°C)
Thermocouple U type	U	-328 ~ 932°F (-200 ~ 500°C)
Thermocouple L type	L	-328 ~ 1562°F (-200 ~ 850°C)
Thermocouple B type	b	-212 ~ 3272°F (-100 ~ 1800°C)
Thermocouple S type	S	-32 ~ 3092°F (0 ~ 1700°C)
Thermocouple R type	r	-32 ~ 3092°F (0 ~ 1700°C)
Thermocouple N type	n	-328 ~ 2372°F (-200 ~ 1300°C)
Thermocouple E type	E	-32 ~ 1112°F (0 ~ 600°C)
Thermocouple T type	t	-328 ~ 752°F (-200 ~ 400°C)
Thermocouple J type	J	-148 ~ 2192°F (-100 ~ 1200°C)
Thermocouple K type	K	-328 ~ 2372°F (-200 ~ 1300°C)
RTD Type and Temperature Range		
Input Temperature Sensor Type	**LED Display**	**Temperature Range**
Platinum Resistance (Pt100)	Pt	-328 ~ 1472°F (-200 ~ 800°C)
Platinum Resistance (JPt100)	JPt	-4 ~ 752°F (-20 ~ 400°C)
Voltage Input Type and Input Range		
Voltage Input Range	**LED DIsplay**	**Temperature Range**
0~50mV Analog Input	mV	-999 ~ 9999
0V ~ 10V Analog Input	V10	-999 ~ 9999
0V ~ 5V Analog Input	V5	-999 ~ 9999
Current Input Type and Input Range		
Current Input Type	**LED Display**	**Temperature Range**
4 ~ 20mA Analog Input	mA4	-999 ~ 9999
0~20mA Analog Input	mA0	-999 ~ 9999

PRECAUTIONS

DANGER! Caution! Electric Shock!

1. Do not touch the AC terminals while the power is supplied to the controller to prevent an electric shock.
2. Make sure power is disconnected while checking the unit inside.
3. The symbol ⧈ indicates that this Controller is protected throughout by DOUBLE INSULATION or REINFORCED INSULATION (equivalent to Class II of IEC 536).

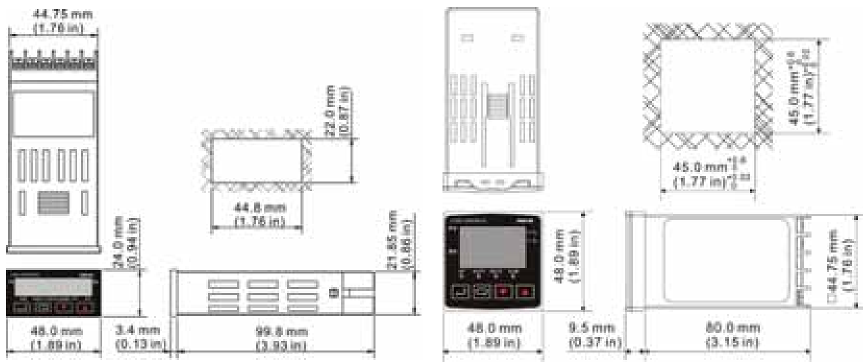
WARNING!

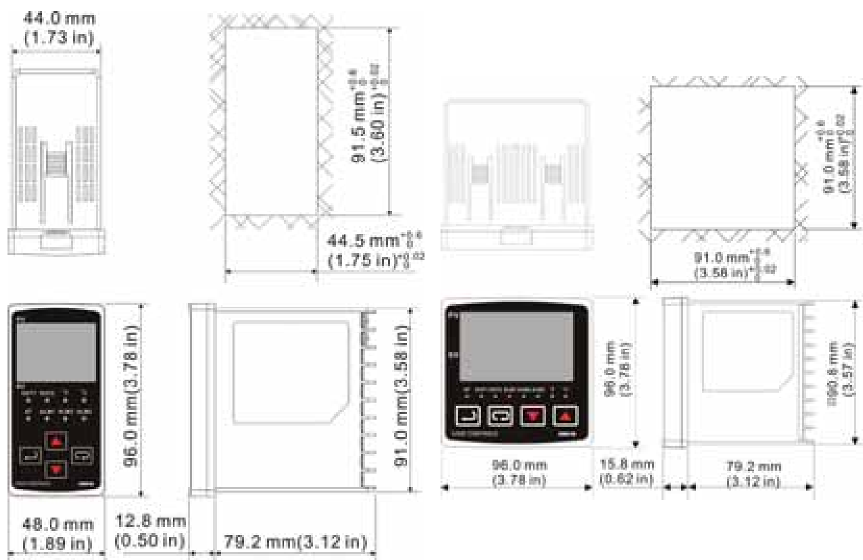
Mount the controller in a location that will not be subject to excessive temperature, shock, or vibration. All models are designed for mounting in an enclosed panel.

1. Always use recommended solder-less terminals: Fork terminals with isolation (M3 screw, width is 7.0mm (6.0mm for 32B Series), hole diameter 3.2mm). Screw size: M3 x 6.5 (With 6.8 x 6.8 square washer). Screw size for 32B Series: M3 x 4.5 (With 6.0 x 6.0 square washer). Recommended tightening torque: 0.4 N.m (4kgf.cm). Applicable wire: Solid/twisted wire of 2 mm^2, 12AWG to 24AWG. Please be sure to tighten them properly.
2. Do not allow dust or foreign objects to fall inside the controller to prevent it from malfunctioning.
3. Never modify or disassemble the controller.
4. Do not connect anything to the “No used” terminals.
5. Make sure all wires are connected to the correct polarity of terminals.
6. Do not install and/or use the controller in places subject to: Dust or corrosive gases and liquid, high humidity and high radiation, vibration and shock, high voltage and high frequency.
7. Power must be off when wiring and changing a temperature sensor.
8. Be sure to use compensating wires that match the thermocouple types when extending or connecting the thermocouple wires.
9. Please use wires with resistance when extending or connecting a platinum resistance sensor (RTD).
10. Please keep the wire as short as possible when wiring a platinum resistance sensor (RTD) to the controller and please route power wires as far as possible from load wires to prevent interference and induce noise.
11. This controller is an open-type unit and must be placed in an enclosure away from high temperature, humidity, dripping water, corrosive materials, airborne dust and electric shock or vibration.
12. Please make sure power cables and signals from instruments are all installed properly before energizing the controller, otherwise serious damage may occur.
13. Please do not use acid or alkaline liquids for cleaning. Please use a soft, dry cloth to clean the controller.
14. Wait at least one minute after power is disconnected to allow capacitors to discharge, and please do not touch any internal circuit within this period.
15. This instrument is not furnished with a power switch or fuse. Therefore, if a fuse or power switch is required, install the protection close to the instrument. Recommended fuse rating: Rated voltage 250 V, Rated current 1 A. Fuse type: Time-lag fuse.
16. Note: This controller does not provide overcurrent protection. Use of the product requires that suitable overcurrent protection device(s) must be added to ensure compliance with all relevant electrical standards and codes. (Rated 250 V, 15 Amps max). A suitable disconnecting device should be provided near the controller in the end-use installation.

External Dimensions

Dimensions are in millimeter (inch)





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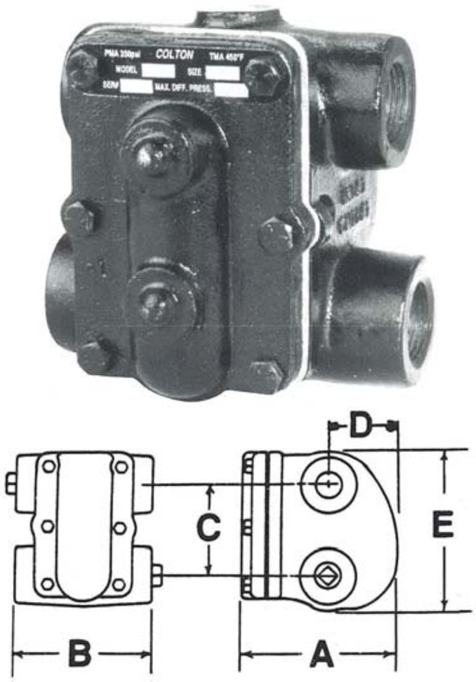
LOVE CONTROLS DIVISION
DWYER INSTRUMENTS INC.
P.O. BOX 338 - MICHIGAN CITY, INDIANA 46361, U.S.A.

Phone: 219/879-8000 www.love-controls.com
Fax: 219/872-9057 e-mail:love@love-controls.com

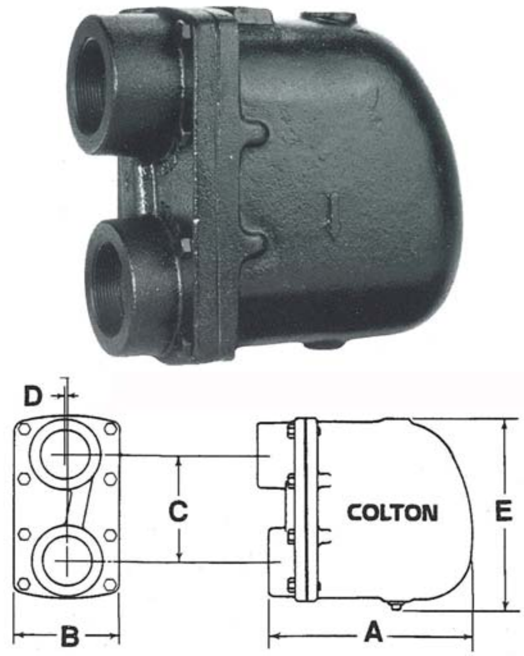
NOTES:

FLOAT AND THERMOSTATIC STEAM TRAPS – FTX/FTC Series

COLTON INDUSTRIES



FTX SERIES
3/4" and 1" All Ranges
1-1/4" 15 psi and 30 psi only



FTC SERIES
1-1/2" and 2" All Ranges
1-1/4" 75 psi and 125 psi only

CONSTRUCTION

Colton float and thermostatic steam traps are compact, of rugged design, and with easy access to all interior parts. The body is cast with two inlet and two outlet pipe connections that permit four combinations of pipe hook-ups for all types of applications *. All working parts are stainless steel and attached to the cover casting

* Except the 1-1/4" FTC-075, FTC-125 and all 1-1/2" and 2" models which are piped through the cover

RATINGS

PMD (maximum differential pressure):	See model selection
TMO (maximum operating temperature):	Saturated steam
temperature at operating pressure	
PMA (maximum allowable pressure):	250 psi
TMA (maximum allowable temperature):	450°F

MATERIALS

Part	Description
Cover	Cast Iron, ASTM-A278 Class 30
Body	Cast Iron, ASTM-A278 Class 30
Mechanism	Stainless Steel
Air Vent	Stainless Steel
Float	Stainless Steel
Gasket	Non-Asbestos Fiber
Cover Bolts	Steel, Grade 5
Plug	Cast Iron, ASTM-A278 Class 30

DIMENSIONS AND WEIGHTS

SIZE		MODELS	DIMENSIONS										WEIGHT	
			A		B		C		D		E			
mm	in		mm	in	mm	in	mm	in	mm	in	mm	in	kg	lbs
20	3/4	FTX-015, 030, 075, 125	152	6	146	5-3/4	86	3-3/8	76	3	152	6	6.35	14
25	1	FTX-015, 030, 075, 125	152	6	146	5-3/4	86	3-3/8	76	3	152	6	6.35	14
32	1-1/4	FTX-015, 030	152	6	146	5-3/4	86	3-3/8	76	3	152	6	6.35	14
32	1-1/4	FTC-075, 125	213	8-3/8	111	4-3/8	78	3-1/16	15	19/32	206	8-1/8	7	15.5
40	1-1/2	FTC-015, 030, 075, 125	213	8-3/8	111	4-3/8	78	3-1/16	15	19/32	206	8-1/8	7	15.5
50	2	FTC-015, 030, 075, 125	255	10-1/16	127	5	125	4-15/16	3	1/8	225	8-7/8	12	26.5

FLOAT AND THERMOSTATIC STEAM TRAPS – FTX/FTC Series

COLTON INDUSTRIES

CAPACITIES (SHEMA) – Lbs. condensate per hour

Pipe Size	Model No.	Pressure Differential (PSIG)						
		1/4	1/2	1	2	5	10	15
3/4	FTX-015	70	100	140	200	210	220	230
1	FTX-015	175	250	350	500	525	550	575
1-1/4	FTX-015	425	600	850	1200	1260	1320	1380
1-1/2	FTC-015	850	1200	1700	2400	2520	2640	2760
2	FTC-015	1775	2500	3550	5000	5250	5500	5750

Note On Capacity: Low pressure float & thermostatic capacities are in accordance with standards adopted by the Steam Heating Manufacturers Association (SHEMA) providing for the continuous elimination of air when the trap is operating at its maximum rating. No safety factor need be applied. *Actual capacities are significantly greater than SHEMA rating indicates*

CAPACITIES (Gross) – Lbs. condensate per hour

Pipe Size	Model No.	Pressure Differential (PSIG)														
		1/4	1/2	1	2	5	10	15	20	25	30	40	50	75	100	125
3/4	FTX-015	385	490	670	905	1075	1450	1650	—	—	—	—	—	—	—	—
1	FTX-015	385	490	670	905	1075	1450	1650	—	—	—	—	—	—	—	—
1-1/4	FTX -015	630	808	1029	1302	1880	2780	3005	—	—	—	—	—	—	—	—
1-1/2	FTC-015	1155	1785	2520	3465	5250	6930	7980	—	—	—	—	—	—	—	—
2	FTC-015	2415	2940	3780	4883	7245	9450	11445	—	—	—	—	—	—	—	—
3/4	FTX -030	293	387	513	683	900	1050	1235	1425	1540	1650	—	—	—	—	—
1	FTX -030	293	387	513	683	900	1050	1235	1425	1540	1650	—	—	—	—	—
1-1/4	FTX -030	394	525	725	956	1260	1575	1764	1890	2350	2700	—	—	—	—	—
1-1/2	FTC -030	1050	1365	1785	2415	3570	4830	5775	6300	6930	7350	—	—	—	—	—
2	FTC -030	1365	1890	2625	3570	5460	7140	8190	9030	9765	10500	—	—	—	—	—
3/4	FTX -075	240	300	420	505	630	725	820	905	980	1020	1190	1345	1645	—	—
1	FTX -075	240	300	420	505	630	725	820	905	980	1020	1190	1345	1645	—	—
1-1/4	FTC -075	535	720	970	1300	1910	2660	3050	3400	3750	4000	4390	4750	5420	—	—
1-1/2	FTC -075	535	720	970	1300	1910	2660	3050	3400	3750	4000	4390	4750	5420	—	—
2	FTC -075	893	1155	1575	2100	3225	4358	4987	5460	5775	6090	6720	7140	8085	—	—
3/4	FTX -125	225	285	350	385	455	500	535	600	650	720	850	1010	1275	1505	1640
1	FTX -125	225	285	350	385	455	500	535	600	650	720	850	1010	1275	1505	1640
1-1/4	FTC -125	380	510	675	880	1310	1700	2065	2315	2550	2710	3035	3225	3790	4200	4480
1-1/2	FTC -125	380	510	675	880	1310	1700	2065	2315	2550	2710	3035	3225	3790	4200	4480
2	FTC -125	578	709	924	1286	2048	2730	3150	3413	3675	3990	4410	4850	5775	6405	6930

Note On Capacity: Trap capacities are based on continuous discharge at steam temperature. Significantly greater capacities are realized when condensate temperature is below saturated steam temperature. Appropriate safety factors should be applied to the ratings

Note: FLOAT TRAPS are available for those applications where draining liquid is the only requirement of the trap. In those instances the thermostatic air vent is replaced by a solid plug. To order, use the previous model numbers with the prefix “FAX” or “FAC” instead of “FTX” or “FTC”. All pipe sizes and pressure ratings are available.

NOTES:

Other fine products from Harsco Industrial Patterson-Kelley

P-K MACH® condensing boiler, including dual fuel and outdoor models

P-K MODU-FIRE® forced draft boiler

P-K THERMIFIC® gas fired water heating boiler

P-K GEMINI® dual fuel boiler

P-K WEATHERMASTER® outdoor boiler

P-K DURATION® condensing indirect water heating system

P-K fabricated systems

P-K MACH® 'n' Roll™ water heating system

P-K CONTROL-FLO 500™ storage water heater