OT960/980/OT980L

Electric Powered Actuator and Driver

Installation and Operation Manual

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Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others.To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

1. Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).

2. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as Synthetics.

3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cup holders, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, and plastic ash trays) away from the control, the modules, and the work area as much as possible.

4. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:

- Do not touch any part of the PCB except the edges.
- Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
- When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Chapter 1.

General Information

The OT960, OT980 and OT980L drivers convert either a 0–200 mA or 4–20 mA control signal from a OT2115 electronic control into a specific actuator Position.

The OT2115 drivers require a separate electrical supply of 20–32 Vdc. The supply must be capable of supplying a sustained 10 A and a peak 20 A for up to two seconds for both the OT960, OT980 and OT980L drivers.

The OT960 actuator provides up to 8Nm of work to move the fuel setting lever on the engine. The OT980 actuator provides up to 16Nm of work to move the fuel setting lever on the engine. The OT980L actuator provides up to 26Nm of work. The actuators rotate 75 degrees, and they have position feedback.

Figures 1-1 through 1-2 show the control outline drawings, and Figure 1-3 is the plant wiring diagram.

Engine stability and response are set by the controlling device, not by the actuator and driver. Follow the instructions for the controlling device while setting up the engine control system.

Actuator Model	Work Output	Max Output	Max work deeger
OT960	4 Nm	8Nm	75
OT980	8Nm	16Nm	75
OT980L	15Nm	30Nm	75

Table 1-1. Actuator Specifications

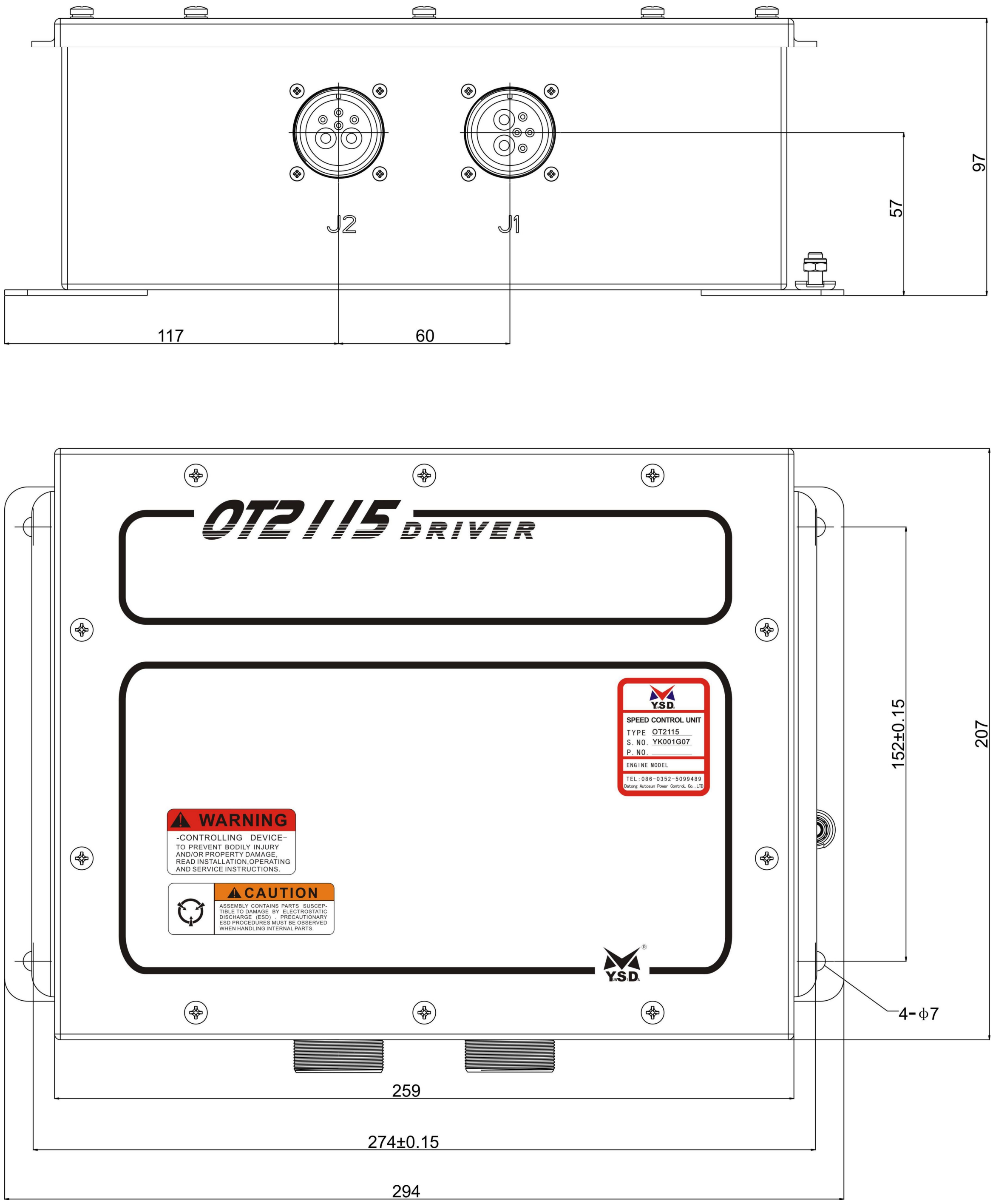
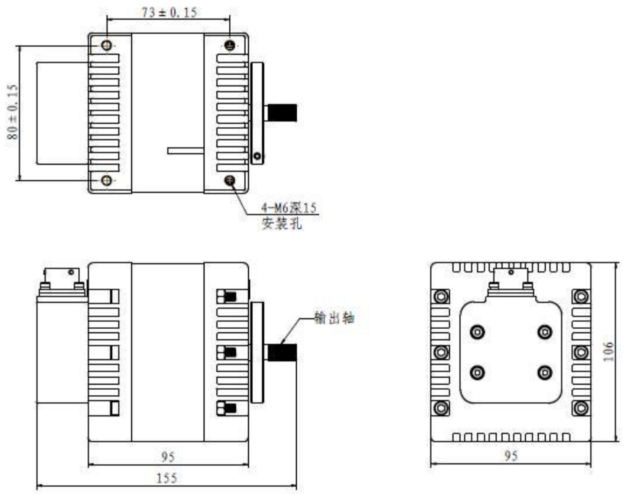
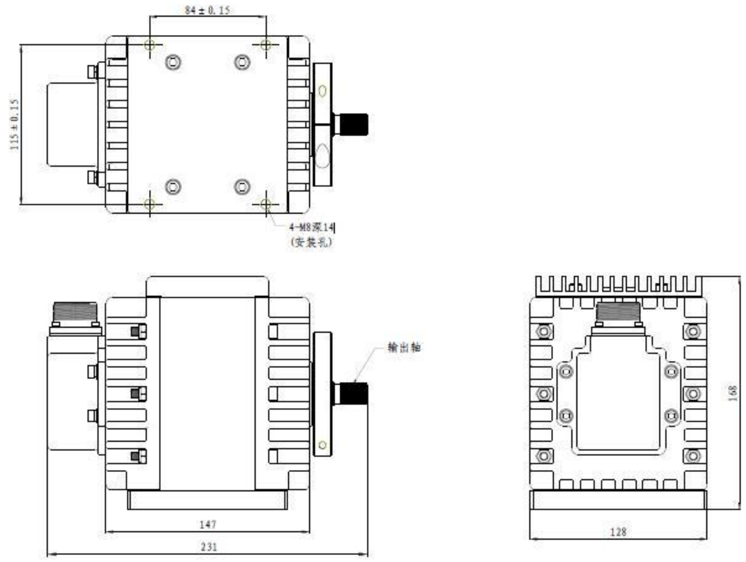


Figure 1-1. Drier Outline Drawing

OT960



OT980



OT980L

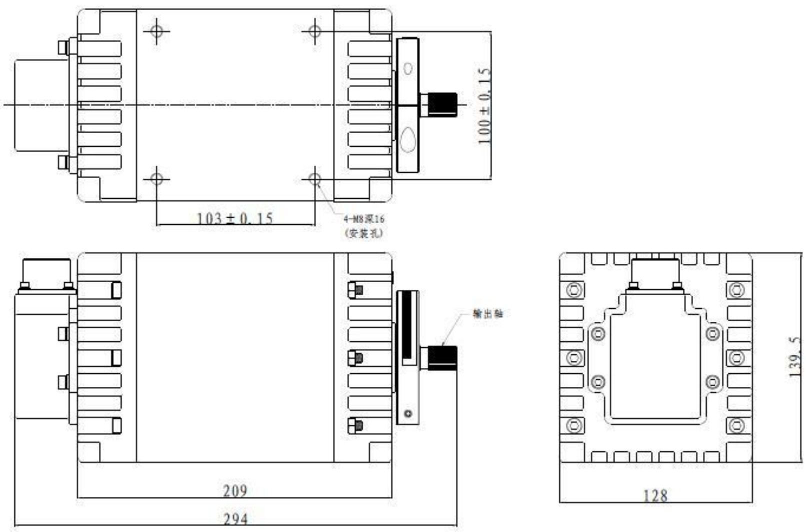


Figure 1-2. Actuator Outline Drawing

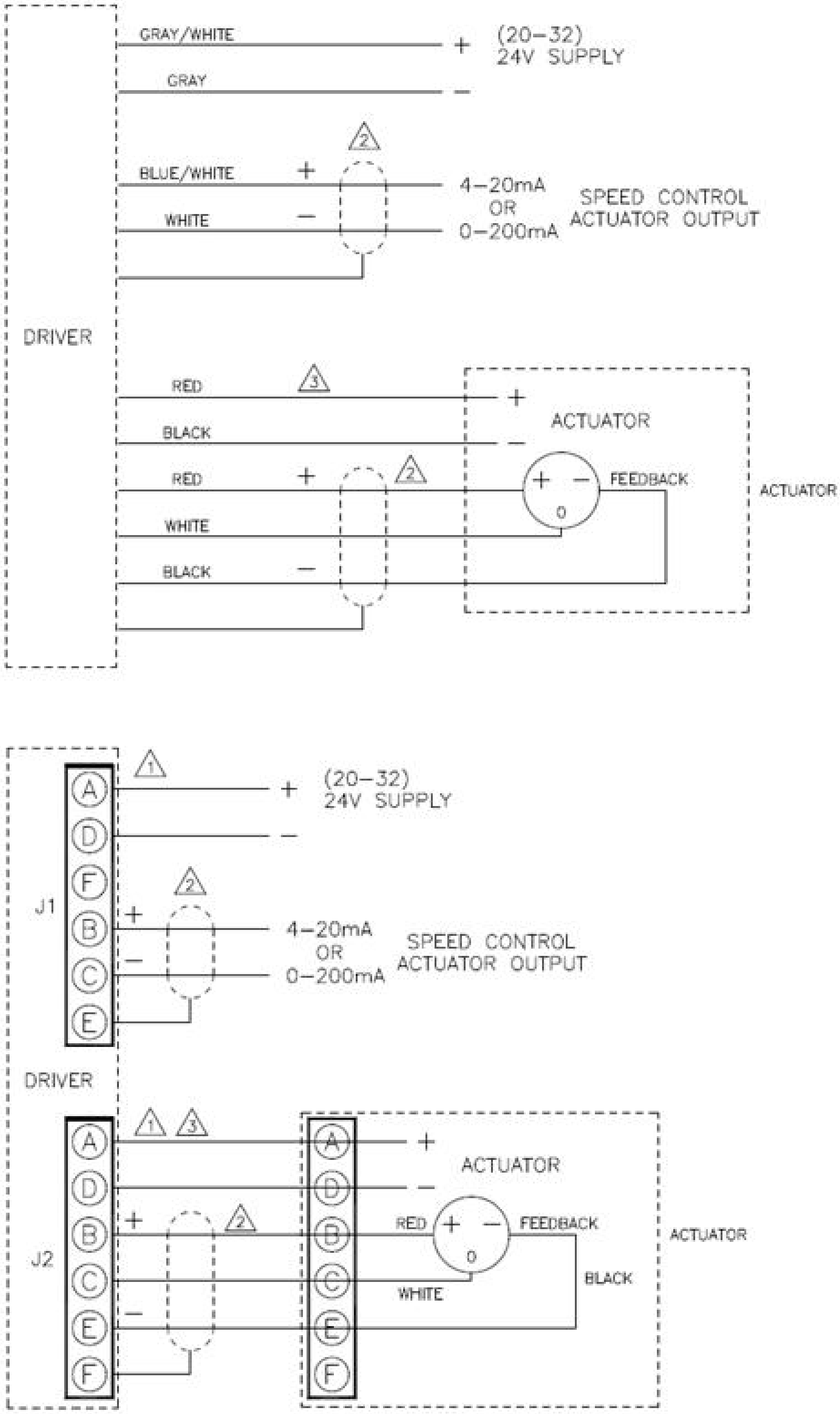


Figure1-3. Plant Wiring Diagram

Chapter 2.
Description of Operation

Introduction

The OT2115 control system functions by receiving a current signal from a electronic governor. The system then sends a pulse width modulated (PWM) current (–20 A to +20 A) signal to the actuator, modified by signals from a position feedback, velocity, and current sensor from the actuator (see Figure 2-1).

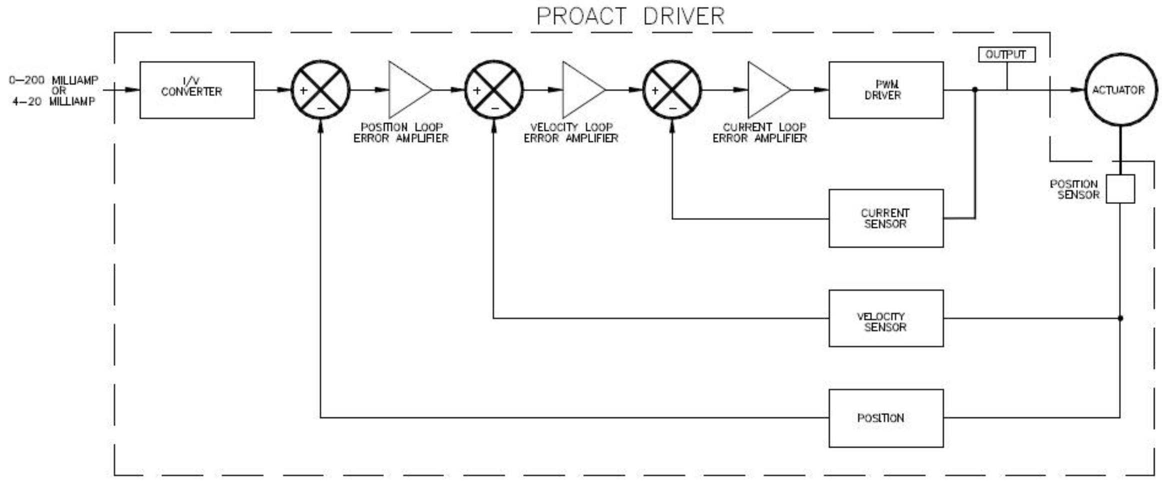


Figure 2-1. Functional Block Diagram

Electronic Circuits

All circuits in the driver are solid state and are not serviceable in the field. The printed circuit board is manufactured by YUNSIDA to provide maximum tolerance to temperature and vibration.

Three potentiometers, accessible when the cover of the driver box is removed, provide all adjustments to the driver system.

A 25-turn potentiometer (Offset) adjusts the actuator position with a minimum input signal from the speed control.

A 25-turn pot (Span) adjusts how far the actuator travels when the speed control signal varies from minimum to maximum. This pot adjusts the maximum position of the actuator. The Span adjustment range is approximately 40 degrees to 75 degrees.

The Span and Offset adjustments are interrelated. The adjustments may need to be repeated until the desired actuator travel is achieved.

A one-turn pot (ACT. BANDWIDTH) adjusts how quickly the actuator responds to a change in signal from the speed control (bandwidth 2–9 Hz).

4–20 mA Output Models

Units which provide a 4–20 mA output proportional to actuator position have two additional 25-turn potentiometers (Position Span and Position Offset). These potentiometers adjust the 4–20 mA output to correspond to minimum and maximum positions of the actuator. The Position Offset adjusts the output at minimum position to be 4 mA. The Position Span adjusts how much the output changes with a given actuator position change and is used to adjust the maximum output current. The adjustments are interrelated and may need to be repeated until the desired output is achieved.

Actuator Position Signal

The feedback device is located on the closed shaft of the actuator. The device is a rotary transducer which changes resistance proportional to the location of the shaft. The device is a non-contacting unit, thereby eliminating most wear problems. The feedback voltage is approximately 2 Vdc at 0° and 3 Vdc at 75° (measured from 0 to –).

Actuator

The rotary design of the actuators gives 75 degrees of shaft rotation to position fuel controls. The actuators apply torque in both directions. Torque is proportional to the current supplied to the actuator by the driver.

The actuator uses sealed bearings, eliminating the need for maintenance. The feedback mechanism attaches to the end of the rotor not being used to control the engine. The device is enclosed in a Ryton housing and is sealed against the elements. Avoid pressure washing the actuator.

An inertia disc is installed on the actuator output shaft. The disc is necessary for stable actuator operation with light, low-friction linkages. Do not remove the disc.

Chapter 3.

Installation

Driver Installation

Mounting

The driver box is designed to operate within a temperature range of –40 to +70 °C .

Mount the driver in a location with space for adjustment and wiring access. Do not expose the driver to sources of radiant heat such as exhaust manifolds or turbochargers. Mount the driver close enough to the actuator and battery to meet the wire-length requirements (see wiring instructions in this chapter).

The driver will generate some heat, so surfaces must be open to normal air movement. No special ventilation is required. The driver must be bolted to a heat sink of a minimum 0.4 m² of 3 mm mild steel.

Ideally the driver should be mounted flush to the metal side of a control cabinet, protected from the weather and high humidity, and close to the engine being controlled. Do not install the driver directly on the engine. The location should provide protection from high-voltage or high-current devices, or devices which produce electromagnetic interference. After initial adjustments are completed, access to the driver will not be required for normal engine operation.

Actuator Installation

Thermal

The actuators are designed for installation on the engine. The actuators will generate heat, especially when stalled or during other conditions requiring maximum torque output. Maximum operating temperature for either the OT960/OT980/OT980L actuator is 100 °C .

The installer must consider the heat conductivity of the installation bracket, and the operating temperature of the ultimate heat sink to which the bracket will be attached. Generally the heat transfer abilities of aluminum and low-carbon steel are better than those of high-carbon steel or stainless steel.

Uninhibited air flow over the heat-exchanger fins on the side of the actuators will help control possible heat problems. Keep the fins as clean as possible to improve heat transfer. Do NOT paint the fins, since this will reduce the heat transfer efficiency.

Fuel Position Stops

Diesel Stops—Diesel installations will generally use the fuel system minimum and maximum position stops. Diesel engine racks are normally designed to provide the minimum and maximum stops without binding.

The actuator's stops must not prevent the actuator from driving the fuel linkage to the minimum and maximum positions. The linkage should be designed to use as much actuator travel as possible, without preventing minimum and maximum fuel positions (see Figure 3-1).

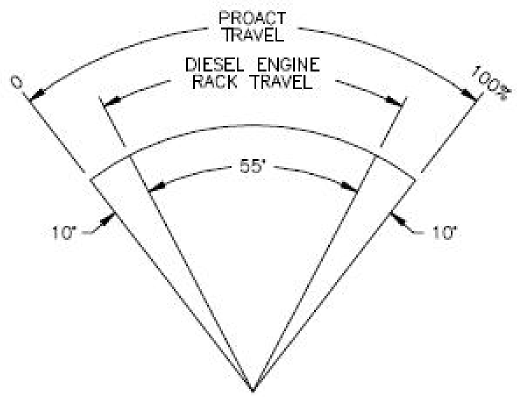


Figure 3-1. Diesel Engine Travel Stops

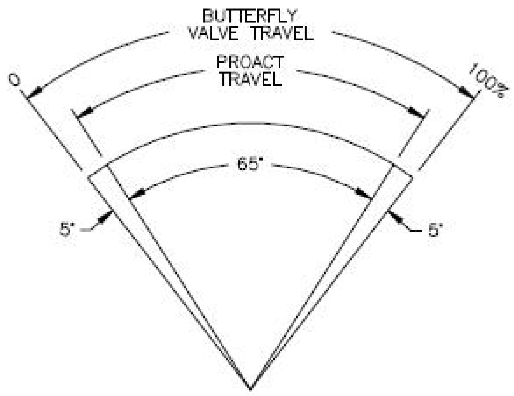


Figure 3-2. Use Travel Stops for Carburetors

Gas Engine Stops—Butterfly valves in carburetors will often bind if rotated too far toward minimum or maximum. For this reason, the stops in the actuator should be used at both minimum and maximum positions. Note that the stops will allow up to 3 degrees of additional rotation in both directions during impact (see Figure 3-2).

The engine must always shut down when the actuator is at the minimum stop.

Actuator Bracket

The actuator may be installed on a bracket which attaches to the base with four M8x1.25 screws with a minimum engagement of 16 mm . The actuator may be mounted in any attitude. The actuator is weatherproof and resistant to the corrosive effects of water and salt water. Avoid pressure washing near the shaft seals.

The OT960 actuator weighs 5 kg ,The OT980 actuator weighs 13.5 kg , and the OT980L actuator weighs 19.5 kg. The bracket and attaching hardware must be designed to hold the weight and to withstand the vibration associated with engine mounting. The bracket must also be designed to provide a heat sink (heat transfer) from the actuator to the engine block. Figure 3-3 provides an illustration of the mounting bracket.

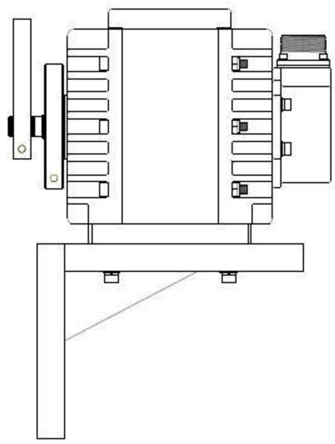


Figure 3-3. Example of Actuator Bracket

[When mounting on the bottom of the actuator, torque the attaching bolts to 17 to 18 Nm.]

Linkage

Proper design and installation of the linkage from the actuator to the engine is necessary if the unit is to give good control. Do not remove the inertia disk from the output shaft. It is necessary to achieve steady-state control with low external inertia loads.

Make sure that the actuator has ample work capacity to control the fuel supply under maximum load conditions.

Manually stroke the fuel-control linkage from stop to stop as if the actuator were moving it. The linkage must move freely, without friction, and without backlash. Lubricate or replace worn linkage or fuel control parts as required.

A light loading spring to minimum fuel is included in the actuator. A positive shutdown is necessary in the event of a loss of power to the actuator/driver.

OT960 actuator stops are designed to absorb 0.5 J of kinetic energy with 3 degrees overtravel. OT980 actuator stops are designed to absorb 1.1 J of kinetic energy with 3 degrees overtravel. OT980L actuator stops are designed to absorb 2.3 J of kinetic energy with 3 degrees of overtravel. If the actuator travel stops are used, the linkage must be designed to allow this 3 degree overrun.

The link connecting the actuator lever to the fuel-control lever must be short and stiff enough to prevent flexing when the engine is running.

Adjust the location of the rod end on the lever to achieve the desired rotation of the actuator shaft between minimum and maximum positions. (Use as much of the 75° rotation as possible, at least 60°.) To increase the amount of rotation, move the rod end closer to the actuator shaft or farther away from the shaft controlling fuel flow. To decrease the amount of rotation used, move the rod end farther from the actuator shaft or closer to the shaft controlling fuel flow.

Electrical Connections

External wiring connections and shielding requirements for a typical control installation are shown in the plant wiring diagram (see Figure 1-3).

Use 8, 6, or 4 mm² (8, 10, or 12 AWG) wire throughout the OT series circuit. The total distance from the battery to the driver and from the driver to the actuator must not exceed the maximum wire length indicated in the following formula: one-half the battery-wire length plus the actuator wire length must be less than or equal to 12.2 m.

For example:

actuator wire length (4 mm²)	**battery wire length (4 mm²)**
3.1 m max.	18.2 m max.
6.1 m max.	12.2 m max.
9.1 m max.	6.2 m max.

Actuator wire lengths may be multiplied by 1.6 for 6 mm² wire.

Actuator wire lengths may be multiplied by 2.5 for 8 mm² wire.

Shielded Wiring

All shielded cable must be twisted conductor pairs. Do not attempt to tin the braided shield. All signal lines should be shielded to prevent picking up stray signals from adjacent equipment. Connect the shields to the correct pins on the driver connector or wiring. Do not connect shields to the actuator ground. Wire exposed beyond the shield should be as short as possible, not exceeding 50 mm. The other end of the shields must be left open and insulated from any other conductor. DO NOT run shielded signal wires along with other wires carrying large currents.

Where shielded cable is required, cut the cable to the desired length and prepare the cable as instructed below.

1. Strip outer insulation from BOTH ENDS, exposing the braided or spiral wrapped shield. DO NOT CUT THE SHIELD.

2. Using a sharp, pointed tool, carefully spread the strands of the shield.

3. Pull the inner conductor(s) out of the shield. If the shield is the braided type, twist it to prevent fraying.

4. Remove 6 mm of insulation from the inner conductors.

The shield must be considered as a separate circuit when wiring the system. The shield must be carried through connectors without interruption.

Installations with severe electromagnetic interference (EMI) may require additional shielding precautions.

Failure to provide shielding can produce future conditions which are difficult to diagnose. Proper shielding at the time of installation is required to assure satisfactory operation of the OT series control system.

Power Supply

Power supply output must be low impedance (for example, directly from batteries).

Run an insulated wire directly from the positive (+) battery terminal and negative (–) battery terminal to the correct connection on the driver (see Figure 3-4). Run a second insulated wire directly from the negative (–) terminal of the battery to the driver. Neither of these connections needs to be shielded.

Run the power leads directly from the power source to the control. DO NOT POWER OTHER DEVICES WITH LEADS COMMON TO THE CONTROL (see Figure 3-4). For controls with MS type connector (controls and actuators), connect the positive (line) to terminal J1-A and negative (common) to terminal J1- D. For controls with conduit fittings and wires (controls and actuators), connect the positive (line) to the gray/white wire. Connect the negative (–) terminal to the gray wire. If the power source is a battery, be sure the system includes an alternator or other battery-charging device.

When the engine is shut down, the driver powers the actuator into the minimum stop. If the battery charging system is off when the engine is shut down, this will cause the battery to be drained. In this case, the power must be turned off with a switch or relay. Any such switch or relay must be interlocking to prevent starting the engine when power to the actuator is shut off.

WARNING	**Do not remove power from the driver for normal shutdown procedures. All actuator position commands should come from the control unit, through the driver, to the actuator. Engine overspeed is possible if power is removed from the driver while the engine is running.**

NOTECE	**To prevent possible damage to the control, or poor control performance resulting from ground loop problems, follow these instructions.**

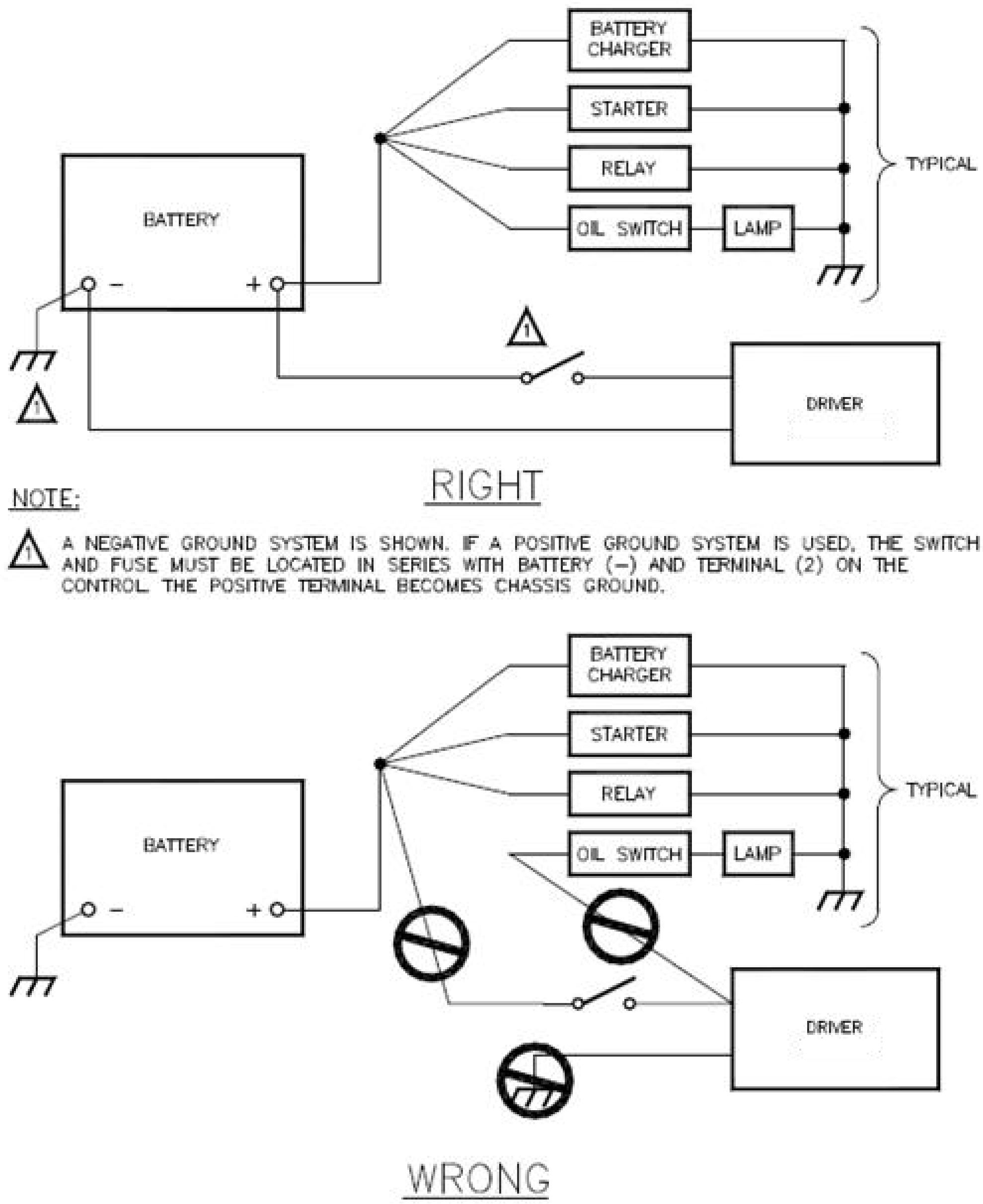


Figure 3-4. Wiring to Power Supply

Driver Adjustments

It is important to set up the driver in the order that follows. See Figure 3-5 for the location of potentiometers on the driver box.

NOTECE	**Always hold onto the side of the control box with one hand while making an adjustment with the other hand. This prevents possible static damage to parts.** **Use an insulated screwdriver to make adjustments. Extensive damage is possible if the high voltages present inside the box are shorted to elements on the board.**

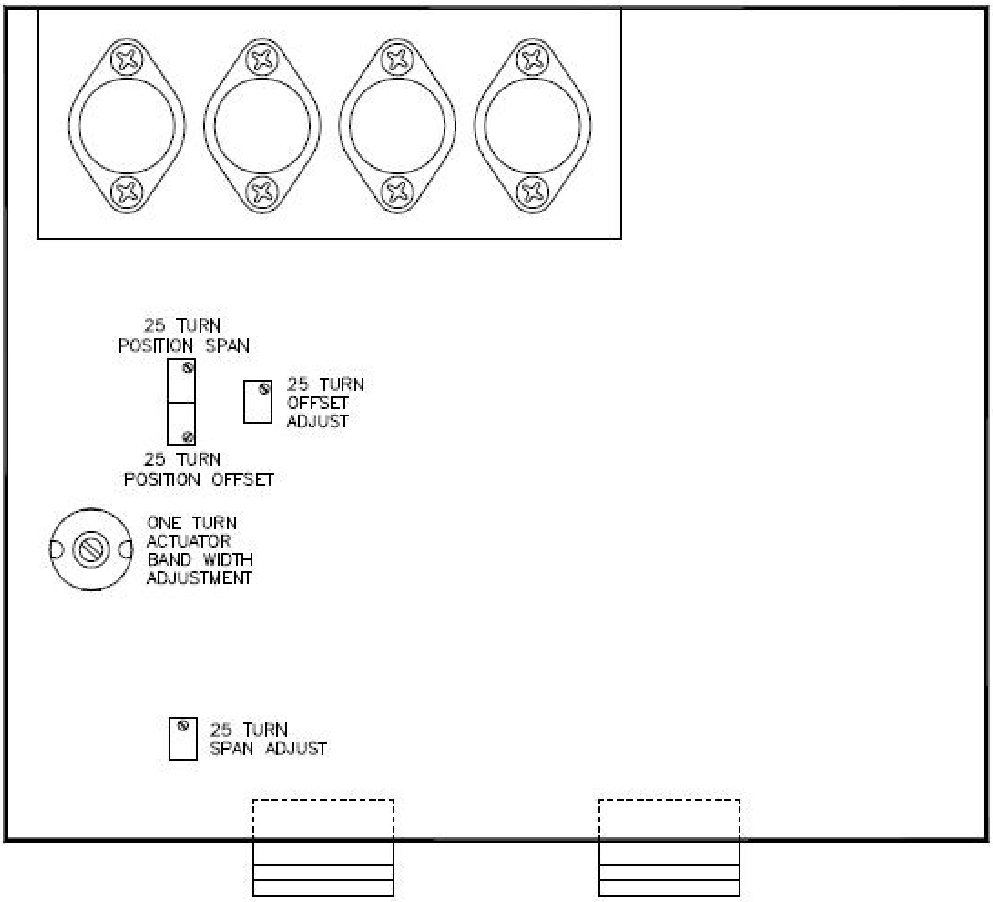


Figure 3-5. Driver Adjustment Locations

Actuator Travel

The driver's span and offset adjustments normally don't need to be changed unless you experience difficulty getting the actuator to travel full stroke. The following graphs define the relationship between command signal (0–200 mA or 4–20 mA) and actuator position. If the characteristic falls outside of the tolerance limits, adjust span and offset as required with the goal to get the characteristic midway between the tolerance limits.

To set up the driver and actuator, power up the system with the actuator disconnected from the linkage but with the inertia disk in place. DO NOT START THE ENGINE AT THIS TIME.

Vary the current into the mA input to the driver and observe actuator angle. Adjust span and offset to achieve the desired relationship (see Figure 3-6). Failure to make this adjustment correctly may result in the inability to shut off fuel or the inability to reach full fuel position. After this adjustment is made, re-install linkage, coupling, etc., to the engine.

This procedure must be repeated whenever the actuator or driver is changed. The Offset and Range pots are both located on the printed circuit board inside the driver box. The Offset and Range pots are each 25-turn. Both turn clockwise to increase the position of the actuator output for a given input to the driver. See Chapter 2 for the adjustment procedure.

The actuator position feedback sensor is factory set and should not be adjusted.

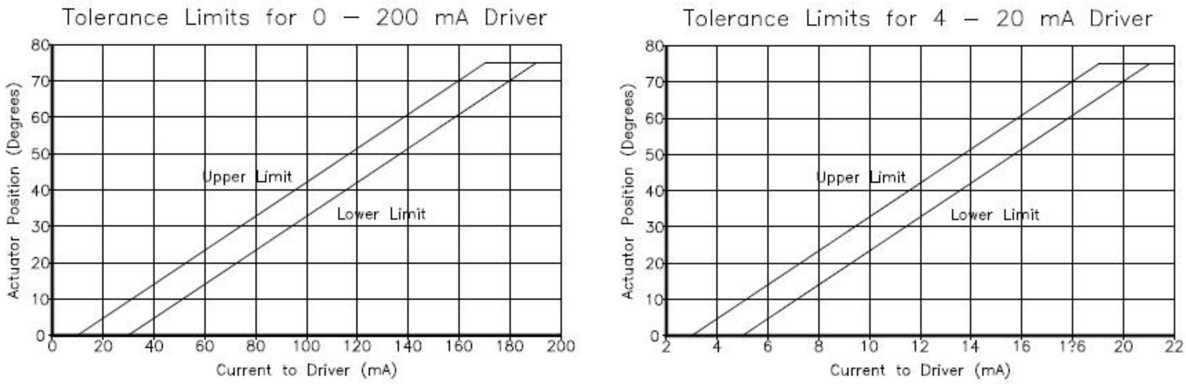


Figure 3-6. Tolerance Limits in Driver Setup

Chapter 4.
Troubleshooting

Introduction

Improper engine operation is often the result of factors other than governor operation. This chapter gives tips about engine problems which can resemble governor problems. Make sure the engine is operating correctly before making any changes in the governor.

Attempting to correct engine or load problems with untimely governor adjustment can make problems worse.

If possible, isolate the governor from the engine to determine if the problem is with the governor and not with the engine or the load on the engine.

Governor faults are usually caused by problems in the installation or the linkage between the actuator and the engine. Carefully review all the wiring connections, the power supply, and the linkage before making any adjustments to the actuator or driver. Always check the fuel-control linkage from stop to stop as if the actuator were moving it. The linkage must move freely without friction and without backlash. Some fuel controls will present problems at particular fuel or rack positions because of a hesitation or binding in the linkage.

Fuel supply and injector conditions can also present problems which resemble governor problems.

On spark-ignited engines, distributor, coil, points, and timing problems can all cause improper operations which may resemble faulty governor control.

Linkage and Actuator Stroke

Use as much of the 75 degrees of actuator stroke as possible. Carefully follow the guidelines in the Driver Adjustments section of Chapter 3 in making linkage arrangements. Using less than optimum actuator movement will make stability more difficult, and will make the actuator more sensitive to external loading forces and friction.

OT960/OT980/980L Actuator/Driver Specifications

Driver Box

Operating Temperature Range	–40 to +70 °C
Storage Temperature Range	–55 to +105 °C
Humidity	95% at 38 °C
Shock	2G
Power Supply	20 to 32 Vdc (24 Vdc nominal)
Current Requirements	10 A sustained 20 A available for two seconds

Actuator

Operating Temperature Range	–40 to +100 °C
Storage Temperature Range	–55 to +125 °C
Shock	2G
Vibration	500Hz

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