FORTRUST®

Analogue Speed Governors

C2002

Features andBenefits

- Speed Ramping from Idle to Operating Speed
- Starting Fuel Control for lower engine exhaust emissions
- A unique actuator power drive circuit

The **C2002** speed control unit is an all electronic device designed to control engine speed with last and precise response to transient load changes. This closed loop control, when connected to a proportional electric actuator and supplied with a magnetic speed Sensor signal, will control a wide variety of engines in an isochronous or droop mode. It is designed for high reliability and built ruggedly to withstand the engine environment.

Simplicity of installation and adjustment was foremost in the design. Non-interacting performance controls allow near optimum response to be easily obtained.

The primary features of the C2002 speed control unit are the engine STARTING FUEL and SPEED RAMPING adjustments. The use of these features will minimize engine exhaust smoke experienced prior to attaining engine operation speed.
Other features include adjustable droop and idle operation, inputs for accessories used in multi-engine or special applications, protection against reverse battery voltage, transient voltages, accidental short circuit of the actuator and fail safe design in the event et loss of speed sensor signal or battery supply.

The C2002 speed control unit is compatible with all FORTRUST ® proportional actuators . When the C2002 speed control unit is used with an A100C-W Series electric actuator, the DROOP adjustment range will be less due to this actuator's low current demand.

C2002

Description

Engine speed information for the speed control unit is usually received from a magnetic speed sensor.
Any other signal generating device may be used provided the generated frequency is proportional to engine speed and meets the voltage input and frequency range specification.
The speed sensor is typically mounted in close proximity to an engine driven ferrous gear, usually the engine ring gear. As the teeth of the gear pass the magnetic sensor, a signal is generated which is proportional to enginespeed.

Signal strength must be within the range of the input amplifier.
An amplitude of 0.5 to 120 volts RMS is required to allow the unit to function within is design specifications.
The speed signal is applied lo Terminals 3 and4 of the speed control unit.
Between these terminals there is an input impedance of over 33,000 ohms.
Terminal 4 is internally connected to Terminal5, battery negative.
Only one end of the shielded cable should be connected.

When a speed sensor signal is received by the controller, the signal is amplified and shaped by an internal circuit to provide an analog speed signal.
If the speed sensor monitor does not detect a speed a sensor signal, the output circuit of the speed control unit will turn off all current to the actuator.

A summing circuit receives the speed sensor signal along with the speed adjust set point input.
The speed range has a ratio of 8:1 and is adjusted with a 25 turn potentiometer.
The output from the summing circuit is the input to the dynamic Control Section of the speed control unit.
The dynamic control circuit, of which the gain and stability adjustments are part, has control function that will provide isochronous and stable performance for most engine types and fuel systems.

The speed control unit circuit is influenced by the gain and stability performance adjustments.
The governor system sensitivity is increased with clockwise rotation of the gain adjustment.
The gain adjustment has a range of 33:1.
The stability adjustment, when advanced clockwise, increases the time rate of response of the governor system to match the various time constants of a wide Variety of engines.

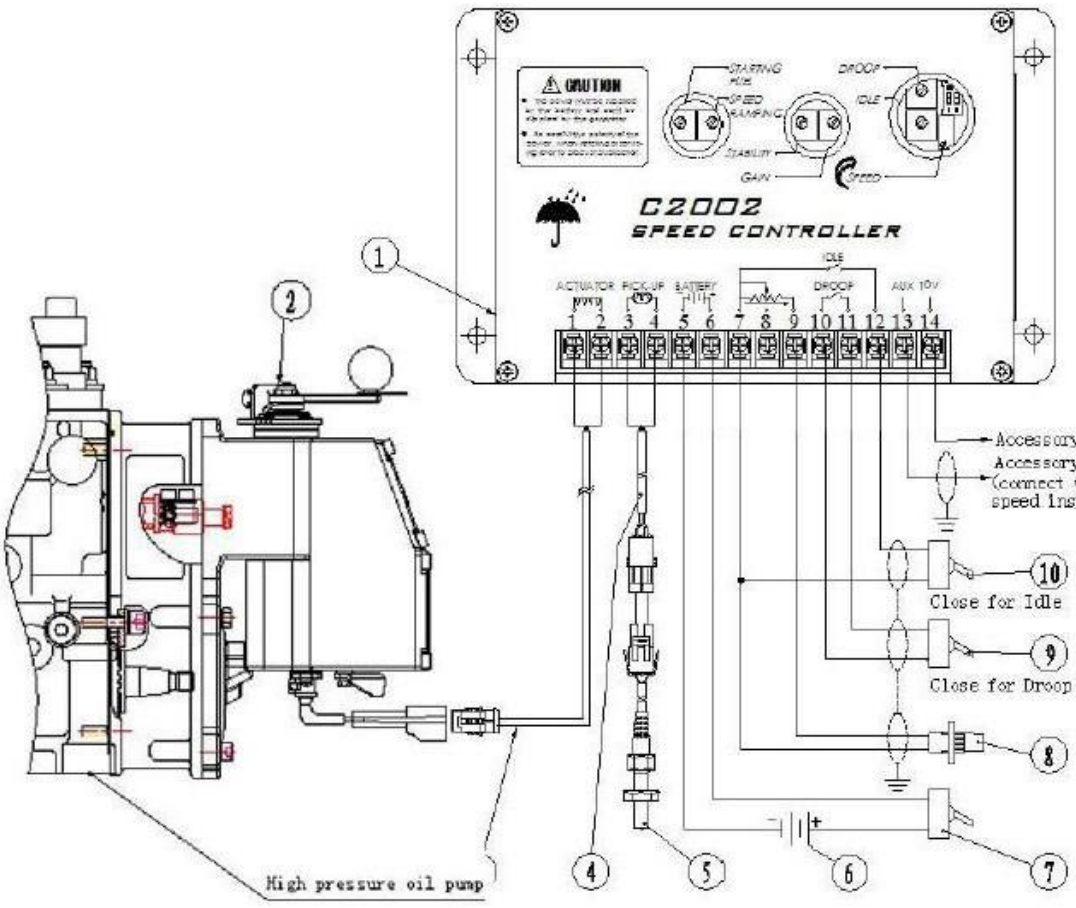
The speed control unit is a P I D device, the “D”, derivative portion can be varied when required. (See Instability section)
During the engine cranking cycle, STARTING FUEL can be adjusted from an almost closed, to a nearly full fuel position.
Once the engine has started, the speed control point is determined, first by the IDLE speed set point and the SPEED RAMPING circuit.
After engine speed ramping has been completed, the engine will be at its governed operating speed.
At the desired governed engine speed, the actuator will be energized with sufficient current to maintain the desired engine speed, independent of load(isochronous operation).

The output circuit provides switching current at a frequency of about 500 Hz. to drive the actuator.
Since the switching frequency is well beyond the natural frequency of the actuator, there is no visible motion of the actuator output shaft.
Switching the output transistors reduces its internal power dissipation for efficient power control.
The output circuit can provide current of up to 10 amps continuous at 25°C for 12 and 24 VDC battery systems.
The actuator responds to the average current to position the engine fuel control lever.

In standard operation, the speed control unit performance is isochronous.
Droop governing can be selected by connecting terminals 10 and 11 and the percent of droop governing can be varied with the droop adjustment control.
The droop range can be decreased by connecting Terminals 7 and 8.

The speed control unit has several performance and protection features which enhance the governor system.
A speed anticipation circuit minimizes speed overshoot on engine start-up or when large increments of load are applied to the engine.
Engine idle speed can be remotely selected and is adjustable.
Accessory inputs to achieve variable speed operation and multi-engine control can be accepted by the C2002 speed control unit from FORTRUST ® FPSS 7800 intelligent terminal automatic paralleling and GEC7520 gen-set paralleling controller.
Protection against reverse battery voltage and transient voltages is provided.
The design is fail-safe In the event of loss of speed sensor signal or battery supply.

Figure 1: Sytem Wiring/Outline



No.	Component Name
1	Speed control unit
2	Electromagnetic Actuator
3	Actuator cable
4	Sensor cable
5	Magnetic pick-up
6	Battery
7	Switch of the power
8	Trimming potentiometer
9	Droop switch
10	Idle/speed switch

C2002 Speed Control Units

Specification

Performance

Isochronous Operation/Steady State Stability.....
.....± 0.25% or better
Speed Range/Governor..... 1K-7.5KHz continuous
Speed Drift with Temperature.....± 1% Maximum
Idle Adjust CW.....60% of setspeed
Idle Adjust CCW..... Less than 1200 Hz.
Droop Range.....1 - 5% regulation*
Droop Adj. Max.(K-L Jumpered).....
.....400 Hz, ± 75 Hz. per 1.0 A change
Droop Adj. Min. (K-L ,Jumpered).....
.....15 Hz., ± 6 Hz. per 1.0 A change
Speed Trim Range.....± 200 Hz.
Remote Variable Speed Range.....
Terminal sensitivity.....500 - 7.5 Hz. or any part thereof
J.....100 Hz., ± 15 Hz / Volt @ 5.0 K Impedance
L.....735 Hz., ± 50 Hz / Volt @ 65 K Impedance
N..... 145 Hz.,± 10 Hz/ Volt @ 1 Meg. Impedance
P.....10 VDC Supply @ 20 ma Max.

* Droop is based on a speed sensor frequency of 4000 Hz. and an actuator current change of 1 amp from no load to full toad. Applications with high- er speed sensor signals will experience less percentage of droop. Applications with more actuator current change will experience higher percentages of droop. See droop description for specific details on operation of droop ranges.
** Protected against reverse voltage by a series diode. A 15 amp fuse must be installed in the positive battery lead.
*** Protected against short circuit to actuator (shuts off current to actuator), unit automatically turns back on when short is removed.

Environmental

Ambient Operating Temperature Range.....
.....-40° to +180 °F (-40° to +85°C)
Relative Humidity..... upto 95%
Art Surface Finishes.....
.....Fungus Proof and Corrosion Resistant

Input Power

Supply.....12 or 24 VDC Battery Systems
.....(Transient and Reverse Voltage Protected)**
Polarity.....Negative Ground (Case Isolated)
Power Consumption.....
.....50 ma continuous plus actuator current
Actuator Current Range @ 77°F (25°C)-(Inductive Load).....
.....Min. 2.5 Amps
.....Max.10Amps continuous***
Speed Sensor Signal..... .0.5-120 Volts RMS

Reliability

Vibration.....1G @ 20-100 Hz.
Testing.....100% Functionally Tested

Physical

Dimensions.....See Outline (FIGURE 1)
Weight..... 1.2 lbs(545 grams)
Mounting..... Any Position. Vertical Preferred

FORTRUST®

Analogue Speed Governors

C2006

■A Two Element Speed Switch (overspeed sensing and crank termination)

■Speed Ramping from Idle to Operating Speed

■Starting Fuel Control for lower engine exhaust emissions

■A unique actuator power drive circuit

The C2006 speed control unit is designed to precisely Control engine speed and provide fast precise response to transient engine loads.

This speed control is intended to be used with all FORTRUST® Actuators . A complete closed loop control system is formed with the addition of a magnetic pickup signal sensing engine speed and 24 Volt DC power.

Other standard features include; adjustable Droop, Accessory inputs for Load Sharing, Variable Speed Governing, protection against reverse battery voltage and transient volt- ages, and a fail safe design in the event of loss of speed signal or battery supply.

FORTRUST®

Analogue Speed Governors

C2006

Description

Engine speed information for the speed control unit is usually received from a magnetic speed sensor which is mounted in close proximity to the engine driven flywheel ring gear.
As teeth pass the pickup, a signal is generated which is proportional to engine speed.
The strength of this signal must be in the range of 0.5 - 50 VRMS.
When the speed signal is low or absent, the output from the controller will be shut off.

Speed Setting is via the 25 turn SPEED potentiometer in the controller.
The settingofthisadjustment determinestheoperating speed of the engine.

Performance Adjustments are provided tomatch and optimize the controller to specific engine characteristics.
The basic control is e PID type with continuous adjustments for the Gain (P) and Stability (I), and DIP switches to adjust the Dead Time Compensation (D).
In Addition, a special circuit is included for applications with resonant drive trains.
Switch SW1, C2 compensates for this situation.

A Two Element Speed Switch is incorporated in the unit for overspeed sensing and crank termination.
These independent monitors have set points with limited adjustable ranges.
Relay outputs (6 AMP) are available to operate crank termination circuits and fuel or air shutoff devices.

Droop Operation isavailablebyaddingaswitchacross Terminals 10 and 11.
Droop is proportional to actuator current changes, from zero to maximum engine power.

Idle Operation can be obtained by adding a switch across Terminals 7 and 12.
The Idle speed is adjustable over a wide range.

Smooth Speed Ramping is provided automatically during each engine startup.
Once the engine speed has reached the crank termination setting, ramping automatically takes place unless the idle switch is closed.
The speed ramping will raise the engine speed to the operating speed set point.
The ramp time acceleration rate is adjustable.

Start Fuel Limiting results in lower emissions from the engine during the starting and the run up cycle by reducing excess fuel to the engine.
The STARTING FUEL adjustment will allow the actuator current to set the starting fuel.
Once the engine has started and passed the cranking termination point, it is controlled by the fuel ramping circuit until the speed ramping takes over and smooth acceleration results.

For generator set applications, the C2006 Series speed control unit from FORTRUST ® FPSS 7800 intelligent terminal automatic paralleling and GEC7520 gen-set paralleling controller.
With the use of other interfaces and control devices, the C2006 Series can be used in a wide variety of industrial engine applications.

Application and Installation Information

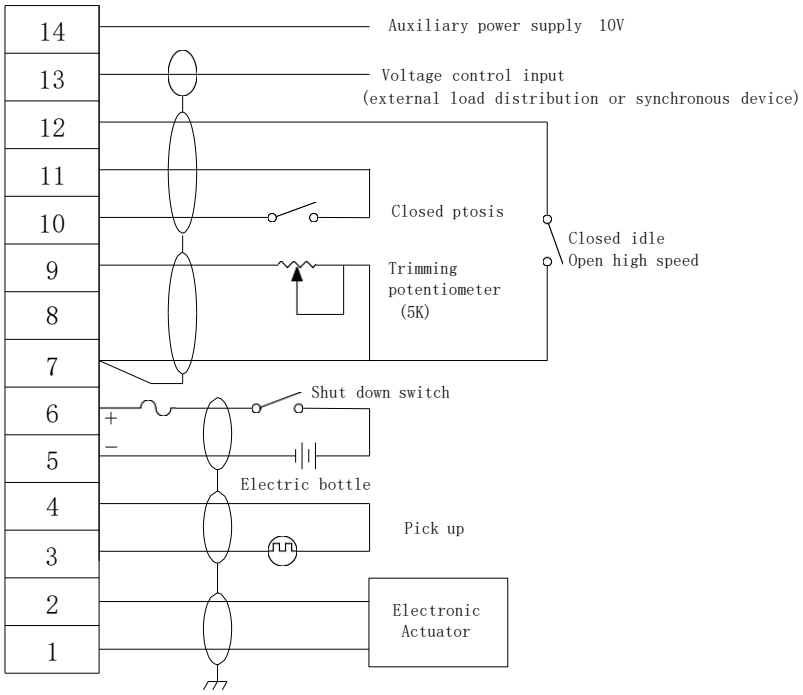
The C2006 Series speed control unit is rugged enough to be placed in a control cabinet or engine mounted enclosure with other dedicated control equipment.
The circuit board is conformally coated to seal out moisture and resist vibration.
If water, mist or condensation can come in contact with the controller, it should be mountedvertically.
This will allow any accumulated fluids to drain away from the speed control unit.

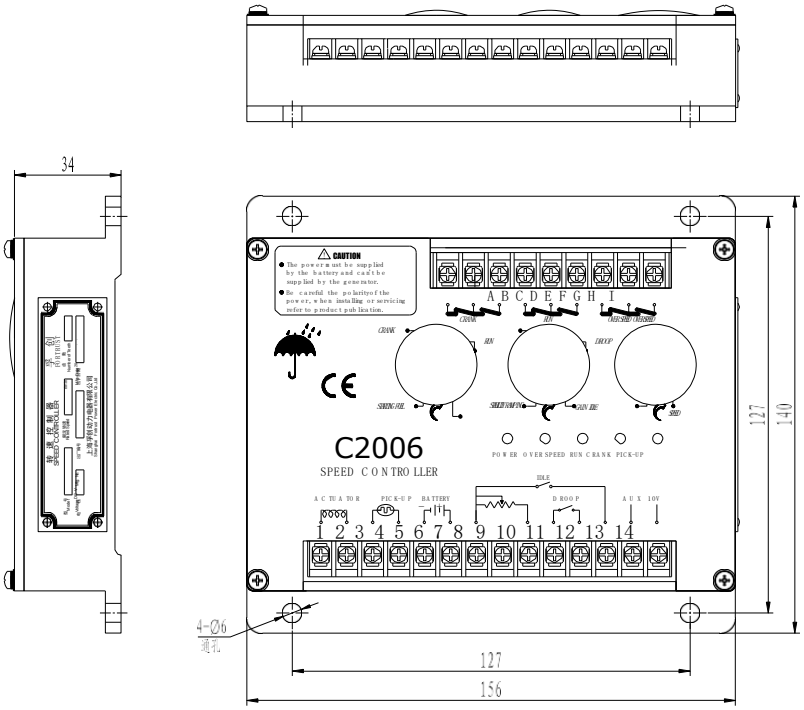
Warning

An overspeed shutdown device, independent of this controller, should be provided to prevent loss of engine control which may cause personal injury or equipment damage.
Do not rely exclusively on deenerization of the governor system actuator to prevent overspeed.
A secondary shutoff device such as a fuel or air solenoid should be used.

Diagram 1. System Wiring/Outline

C2006





FORTRUST®

Analogue Speed Governors

C2006 Series Speed Control Unit

C2006.....StandardUnit, 24Voltoperation
C2006-12.....12 Volt operation

Specifications

Performance

Isochronous.....± 0.25% orbettor
Operating Speed Range.....1K - 7.5 Hzcontinuous
Speed Drift with Temperature..... ± 1% maximum
Idle Speed Adjust Range.....25 – 85% ofrated speed
Droop Range.....Adjustable from 0-5% for
..... a1.5actuatorcurrentchange
Speed Trim Range.....±200 Hz
Remote VariableSpeed Range.....25to100% ofratedspeed
Speed Ramp Time
Acceleration adjustment range.....266Hz/Secto1300Hz/Sec
Decelerationadjustmentrange..... 250Hz/Secto1000Hz/Sec
Starting Fuel Adjustment
0 - 1.5A..... 120, 175, 225, 275 Actuators/SW2-7 "OFF"
0.3 - 4A..... 2000 Aduator/SW2-7 "ON"
0verspeed Set Point.....2400 Hzto8300 Hz
Crank TerminationSet Point..... 200 Hzt0 2050 Hz
Terminal Sensitivity
H..... ..-105 Hz,±15 Hz/Volt@ 5KImpedance
M.....-130 Hz, ±15 Hz/Volt @ 1 MImpedance
K..... ..-685 Hz, ±40 Hz/Volt @ 225 K Impedance
N.....+1000Hz,±50Hz/Volt@8KImpedance

Environmental

Ambient 0perating Range.....-40° to +85°C (-40° to +185°F)
RelativeHumidity(Noncondensing)..... upto 95%
All Surface Finishes..... Fungusproofandcorrosionresistant

Input Power – Nominal Ratings

DC Supply..... 24±20%VDCbatterysystems
.....(transient and reverse voltage protected)
Maximum Continuous DCSupply Voltage..... 32 Volts
Polarity.....Negative ground(caseisolated)
Power Consumption (Engine Stopped).....
.....100 MA (No actuatorcurrent)
Speed Signal Range..... .0.5-50 VAC
Maximum Actuator Current .....
.....Internally limited to 9 A continuous
Maximum Current, Speed Switch Contact (Terminals 1-6).....
.....6 Amps

Reliability

Vibration..... 1 G @ 20-100 Hz
Shock.....10G(11ms)
Testing..... 100% functionally tested

Physical

Dimensions.....See FIGURE 1
Wiring Diagram and Outline (page X)
Weight..... 2.0 lbs (0.91grams)
Mounting.....Any position, vertical preferred

FORTRUST®

Electric Actuator

A800C-W

Features and Benefits

- Mountson thepump in place of mechanical governor
- Capable of controlling pumps on engines up to 8-cyl.
- Sealed to protect linkage and electromechanical components
- Connects directly to the fuel rack bellows
- Includes manual shut-off mechanism
- Compact size, fast response
- Cost effective design
- Feedback position available

The Integral Electric Actuator for Diesel Pumps

The A800C-W electric actuator is designed to mount directly to inline fuel injection pumps, with a right hand rack in place of the mechanical governor. An optional external fuel shut off lever is provided to manually override the actuator's control. Also provided, as standard equipment, is an adjustable internal maximum fuel limit.
The A800C-W Electric Actuator can control fuel pumps up to 8 cylinders. The actuator was designed with two isolated chambers. The upper chamber is wet with oil and contains the connection to the fuel rack and an optional manual shut off mechanism. The sealed lower chamber contains the electromagnetic components.

Preparing the fuel injection pump

If the fuel injection pump is equipped with a mechanical governor, it must be removed. FORTRUST® recommends that this modification be performed by a qualified fuel injection service facility. The following procedure lists the general steps required to remove the mechanical governor.

NOTE: Be prepared to collect the oil that will be released from the mechanical governor.

1. Remove the rear housing from the mechanical governor and disconnect the governor linkage from the pump fuel rack. Remove the flyweight assembly. A special tool is required.
2. Remove the intermediate governor housing. This leaves only the rack and camshaft protruding from the pump.
3. Install the adapterplateto provide thetransition required from the actuator to the mounting holes formerly held by the governor housing. This plate must have countersunk holes for the mounting screws

Warning

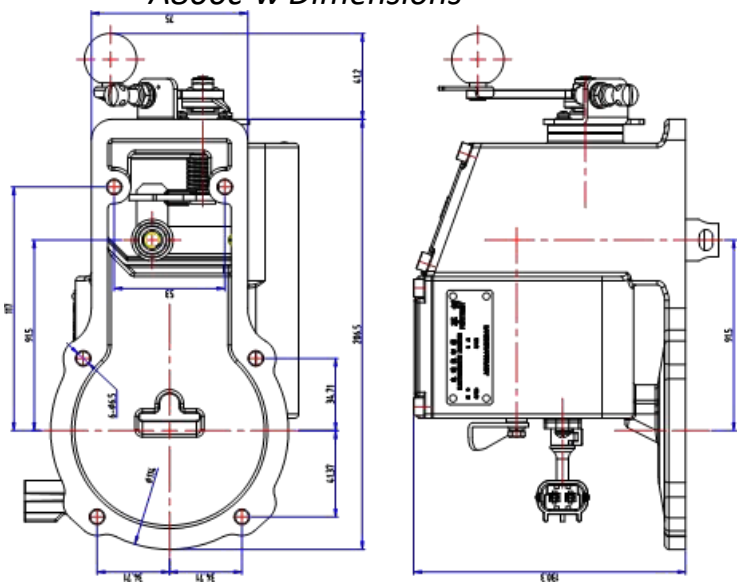
Setting high fuel levels may cause the maximum fuel adjustment screw to hit the inside of the top cover, which can change the minimum fuel position. This could lead to a dangerous condition. When setting fuel levels above 17mm of rack travel, ensure that the adjustment screw does not contact the cover at minimum fuel position.

With the fuel pump operating on the engine, the maximum fuel setting screw can be adjusted to provide specific horse- power.

Caution

The engine should be equipped with an independent shut down device to prevent overspeed which can cause equip- ment damage or personal injury.

A800c-w Dimensions



Specification

Performance

Force..... 6.2 lbs(27.5N)
Operating Stroke..... 0.80 in(21mm)
ResponseTime (10-90% 2-19mm).....35 MSEC
Internal Sealing Pressure..... 2 bar (29 psi)

Electrical Power Input

Operating Voltage.....12 VDC or 24 VDC
Coil Resistance..... 12 VDCVersion- 1.7+/-0.2 OHMS
.....24 VDC Version- 7.2+/-0.5 OHMS
Nominal Operating Current..... 12 VDC Version- 4.0 A
.....24 VDC Version- 2.0 A
Maximum Current.....12 VDC Version- 5.8 A
.....24 VDCVersion- 3.1 A

Environmental

OperatingTemperature.....-40° to+200°F(-40° to+95°C)
Relative Humidity..... Upto 100%
Shock..... 20g @11msec
Vibration..... 20g, 20-500Hz
Agency..... RoHSCompliant

Physical

Dimensions..... See Figure 2-1
Weight.....4.75lbs.(2.2kg)
Mounting..... adapterplate

NOTICED:FORTRUST® has able to provide differentadapter plate for different fuel pump following customer's requirements.

FORTRUST®

Electric Actuator

A900C-W

- Feedback possible
- Mounts Directly on Bosch ‘P’ and ‘RP 21’,ZEXELFuel Injection Pumps in Place of a Mechanical Governor*
- Ableto Control Up to 16 Cylinder Pumps
- Outstanding Reliability- No Sliding Parts, Completely Sealed
- Connects Directly to the Fuel Rack Bellows
- Includes Manual Rack Return Mechanism
- Position Feedback Transducer & Heavy Duty Bearing Retention OptionsAvailable
- Optimum Performance for Inline Pumps

Integrated Pump Mounted Electric Actuator

The A900 Electric Actuator is designed to mount directly on Bosch ‘P’ and ‘RP 21’ ZEXELFuel Injection Pumps in place of the mechanical governor. When the A900 is installed on the fuel pump, an integral high performance fuel control system without external linkages or brackets results. An external fuel rack return lever is provided to manually override the actuator’s control. Also provided is an adjustable internal maximum fuel limit for calibration.

The A900, a second generation design that is more powerful than its predecessor, is able to control up to 16 cylinder pump-arrangements. The actuator was designed with two isolated chambers that eliminates the possibility of any magnetic particles collecting and jamming the actuator. The upper chamber, which contains spray-oil, houses the actuator linkage and the lower chamber houses the electro-magnetic components. The A900 typically outlasts the life of a diesel engine’s.

FORTRUST® has a complete line of Camshaft Bearing Retainer Kits available for the A900 to ensure an appropriate fit and prevent leakage. The A900 Actuator can also be installed on Bosch ‘MW” and ‘A’ Pumps. For the most common A900’s variations and kits available see TABLE 1.

FORTRUST®

Electric Actuator

A900

Actuator Variations Available	
P/N	**Description**
EC-1300	Mating Connector
Associated kits	
FP-900-3000-MT	Adaptor Kit - Bosch 'P' 3000 Pump
FP-900-7001-MT	Adaptor Kit - Bosch 'P' 7000 Pump
FP-900 -1	Adaptor Kit - Bosch RP21 Pump
NOTICED:FORTRUST® has able to provide differentadapter plate for different fuel pump following customer's requirements.	

Table 1.

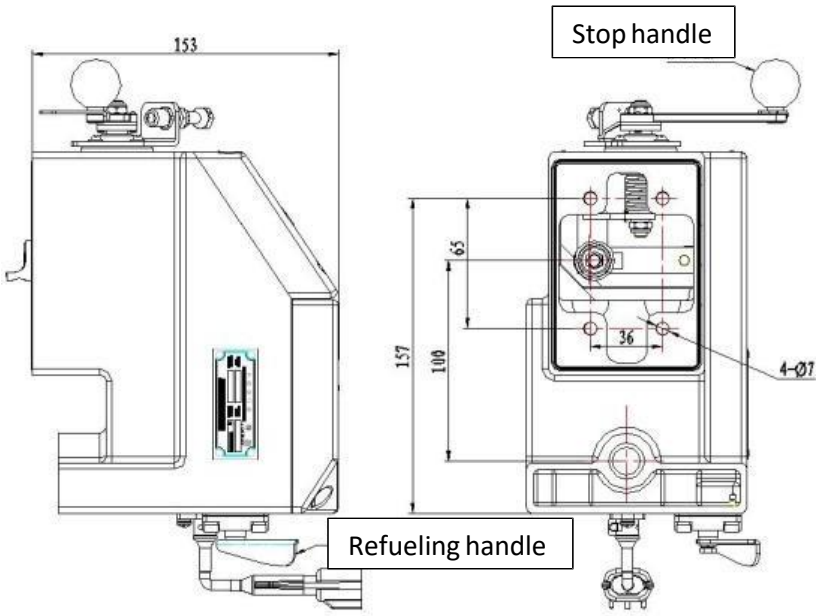
Description

The actuator is an electromagnetic servo device which can be integrated into a closed loop control system.
An engine control system can be described as follows.
An electrical signal is generated by a magnetic speed sensor which is proportional to engine speed.
This signal is sent into the electronic speed control unit which compares it to the preset engine speed setting.
If the magnetic speed sensor signal and the preset engine speed setting are not equal, a change in current from the speed control unit to the actuator will change the magnetic force in the actuator.

The rotation of the actuator shaft will then adjust the fuel to the engine and cause the engine speed to be equal to the preset engine speed setting.
Shaftrotationisproportionaltotheamountofactuator current and counterbalanced by the internal spring.

Since the design has no sliding parts and is totally sealed, outstanding reliability results.
A single compression spring is used to improve reliability.
No maintenance is necessary

Outline Drawing 1.



FORTRUST®

Electric Actuator

Specification

A900

Performance

Force.....13.2lb.max(58.7 N)
Operating Stroke.....0.79 in max (20mm)

Input Power

Operating..... 12 or 24 VDC
Normal Operating Current..... 3A at 12 VDC
..... 1.5A at 24 VDC
Maximum Current(Continuous)..... 9A at 12 VDC
..... 4.5A at 24 VDC

Environment

Operating Temperature Range.....-40°to +185°F (-40°to -85°C)
Relative Humidity..... upto 100%
All Surface Finishes.....
.....Fungus Proof and Corrosion Resistant

Physical

Dimensions.....See Diagram 1.
Weight..... 11 lb.(4.9 kg)
Mounting.....Directly on 'RP 21', 'P' 3000 and
.....'P' 7000 Bosch fuel injection pumps in
.....place of the mechanicalgovernor.
..... Requires camshaft bearing retainer kit.

Reliability
Testing.....100%

Mating Hardware

Connectors..... EC-1300 // EC-1000

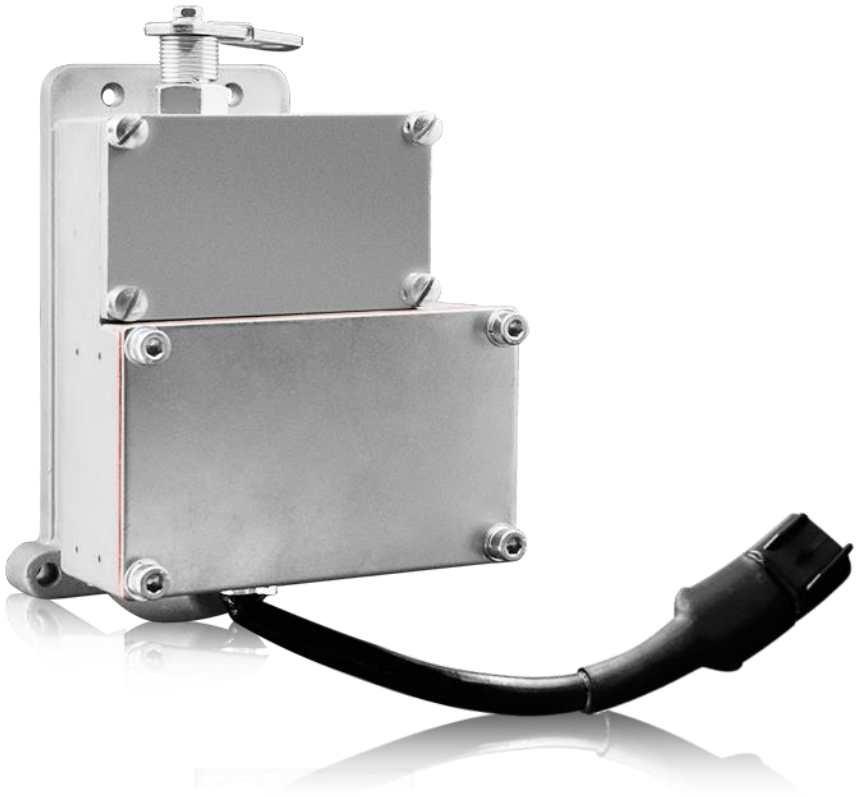
FORTRUST®

Electric Actuator

A08C-W1

Features and Benefits

- Mounts on the pump in place of mechanical governor
- Capable of controlling pumps on engines up to 6-cyl.
- Sealed to protect linkage and electromechanical components
- Connects directly to the fuel rack bellows
- Includes manual shut-off mechanism
- Compact size, fast response
- Cost effective design
- Feedback position available



The Integral Electric Actuator for Diesel Pumps

The A08C-W1 electric actuator is designed to mount directly to inline fuel injection pumps, with a right hand rack in place of the mechanical governor. An optional external
fuel shut off lever is provided to manually override the actuator's control. Also provided, as standard equipment, is an adjustable internal maximum fuel limit.
TheA08C-W1 Electric Actuator can control fuel pumps up to 6 cylinders. The actuator was designed with two isolated chambers. The upper chamber is wet with oil and contains the connection to the fuel rack and an optional manual shut off mechanism. The sealed lower chamber contains the electromagnetic components.

Preparing the fuel injection pump

If the fuel injection pump is equipped with a mechanical governor, it must be removed. FORTRUST® recommends that this modification be performed by a qualified fuel injection service facility. The following procedure lists the general steps required to remove the mechanical governor.
NOTE: Be prepared to collect the oil that will be released from the mechanical governor.

1. Remove the rear housing from the mechanical governor and disconnect the governor linkage from the pump fuel rack. Remove the flyweight assembly. A special tool is required.
2. Remove the intermediate governor housing. This leaves only the rack and camshaft protruding from the pump.
3. Install the adapterplateto provide thetransition required from the actuator to the mounting holes formerly held by the governor housing. This plate must have countersunk holes for the mounting screws.

Installing the Actuator

1. Slip the spring seat Nr:20 over the fuel rack and press it into the seat hole of the fuel pump (Refer to Illustration 1-1); and put return spring Nr:19 onto the fuel rack, and push them into the spring seat of the fuel pump. Support thereturnspringwithpartNr:17, Nr:16, Nr:9 and Nr:10 of the connecting screw rod, and apply Loctite 243 onto flat round-headed M5x10 boltNr:18 and firmly tighten them on the fuel rack with 3.5 Nm torque. Note that the tab of the manual stop plate must face upward.

2. Remove the small cover plate Nr:2 and sealing ring Nr:4 of the actuator. Clean both mating end surfaces between the actuator and the fuel pump. onto two pieces Takethe two M6x20 Allen screws Nr:6 and put on spring washer Nr:7 and plain washer Nr:11 and insert them into the two installation holes on the upper cavity of the actuator and apply Loctite 243 to the two M6x20. Insert the sealing ring Nr:8 into the sealing groove on the end surface of the actuator(Refer to Illustration 1-1 and Illustration 1-4), then carefully slide the actuator over the fuel rack through the upper chamber with the two M6x20 aligning with the mounting screw holes of the fuel pump; use the allen key with ball head into the upper cavityNr:24, and align the screws M6x20 Nr:6 and tighten with 5.5 Nm torque in sequence;

3. Carefully loosen bolt Nr:28 and nut Nr:25 to install the bearing so the bolt holding the bearing can freely move in the adjustment groove of the lever (Refer to Illustration 1-2); Turn the lever Nr:24 outward, until the armature touches the large cover plate Nr:14 and is kept in this position; move bearing assembly Nr:26 inward and press until the bearing touches the fuel rack screw Nr:10, continue pushing so the fuel rack is moving from stop fuel inward approx.: 1 – 2 mm. With this position kept, tighten bolt Nr:28 and nut Nr:25 with a torque of 3.5 Nm. The fuel rack is now released and the stop position is within the armature in order to prevent the fuel elements from damage.

4. Check the installation of the entire assembly, and ensure that all the bolts are tightened correctly. Push and pull the fuel lever and ensure it moves freely. Push the fuel rack lever to max position and make sure that the fuel rack is pushed back with the stop lever Nr:5 to full sop position.

5. The fuel lever Nr:24 is equipped with a max. fuel limit screw Nr:22, which is used to set the maximum fuel supply to the fuel pump. By adjusting this bolt, the maximum movement position for fuel lever is set and will limit the fuel rack position to max fuel.

NOTE: When installed, the cover must not hit the internal operating lever or the maximum fuel adjustment screw. Torque the cover screws to 2-3 NM. Check for any oil leaks. Lock-wire the lower screws for tamper resistance.

Warning

Setting high fuel levels may cause the maximum fuel adjustment screw to hit the inside of the top cover, which can change the minimum fuel position. This could lead to a dangerous condition. When setting fuel levels above 17mm of rack travel, ensure that the adjustment screw does not contact the cover at minimum fuel position.

With the fuel pump operating on the engine, the maximum fuel setting screw can be adjusted to provide specific horsepower.

Caution

The engine should be equipped with an independent shut down device to prevent overspeed which can cause equipment damage or personal injury.

Selection Chart

	12V	24V	w/ Shutoff	w/o Shutoff	w/ Mating Conn	w/o Mating Conn
A08C-W1-12	*		*			*
A08C-W1-24		*	*			*

Table A

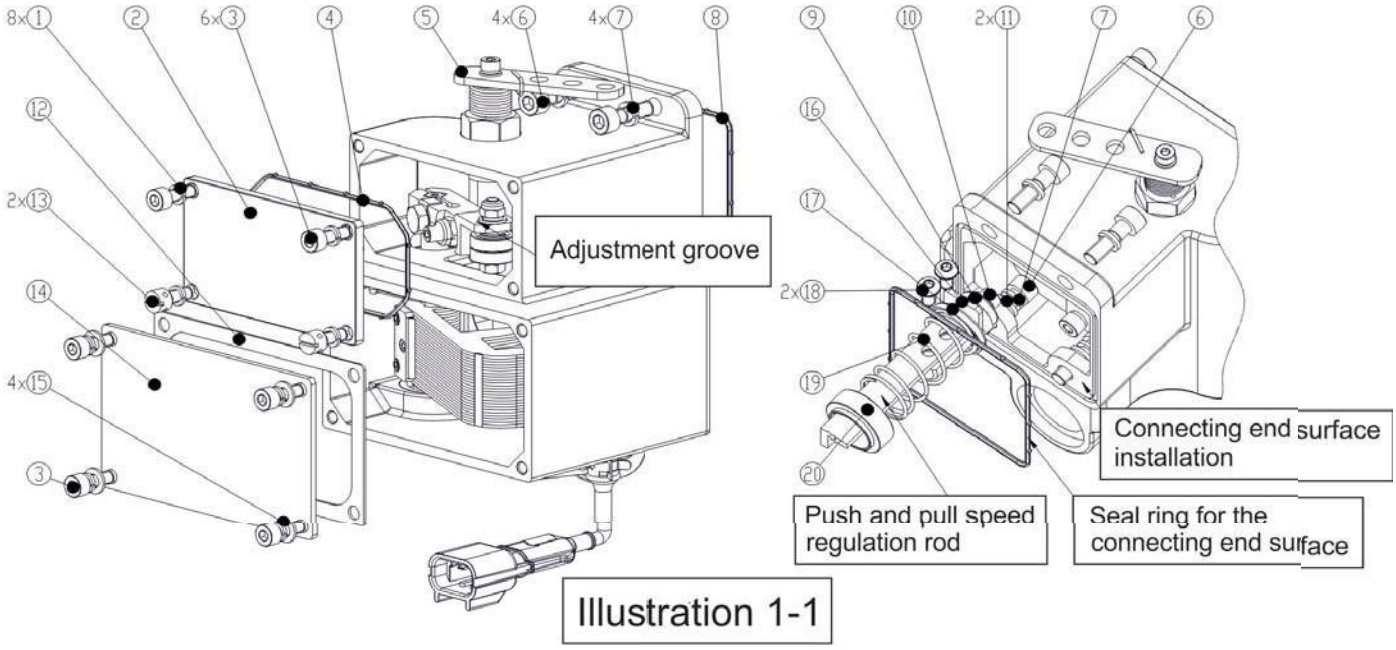


Illustration 1-1

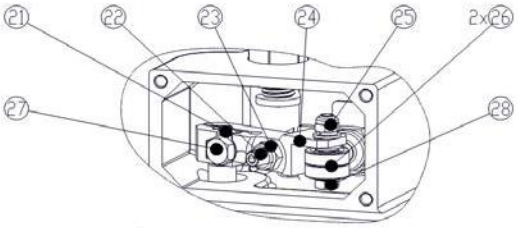


Illustration 1-2

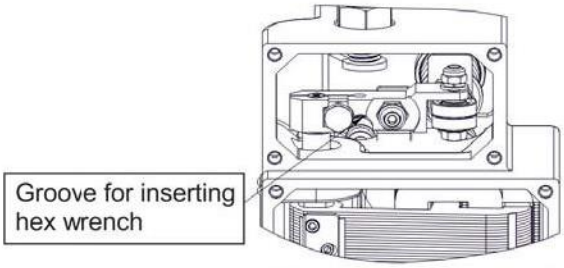


Illustration 1-3

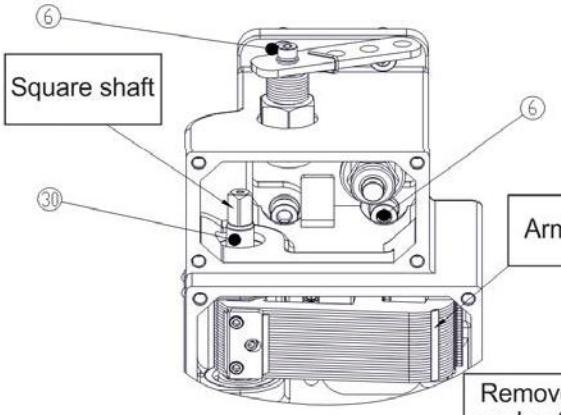


Illustration 1-4

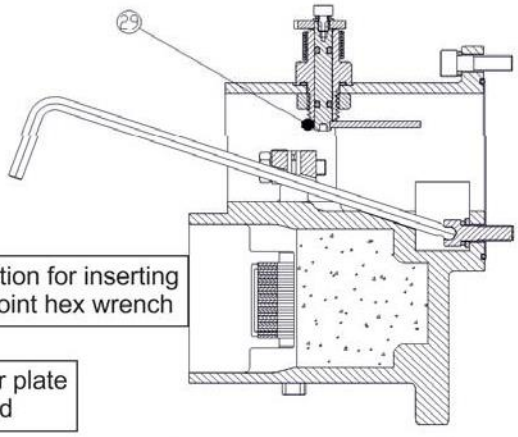
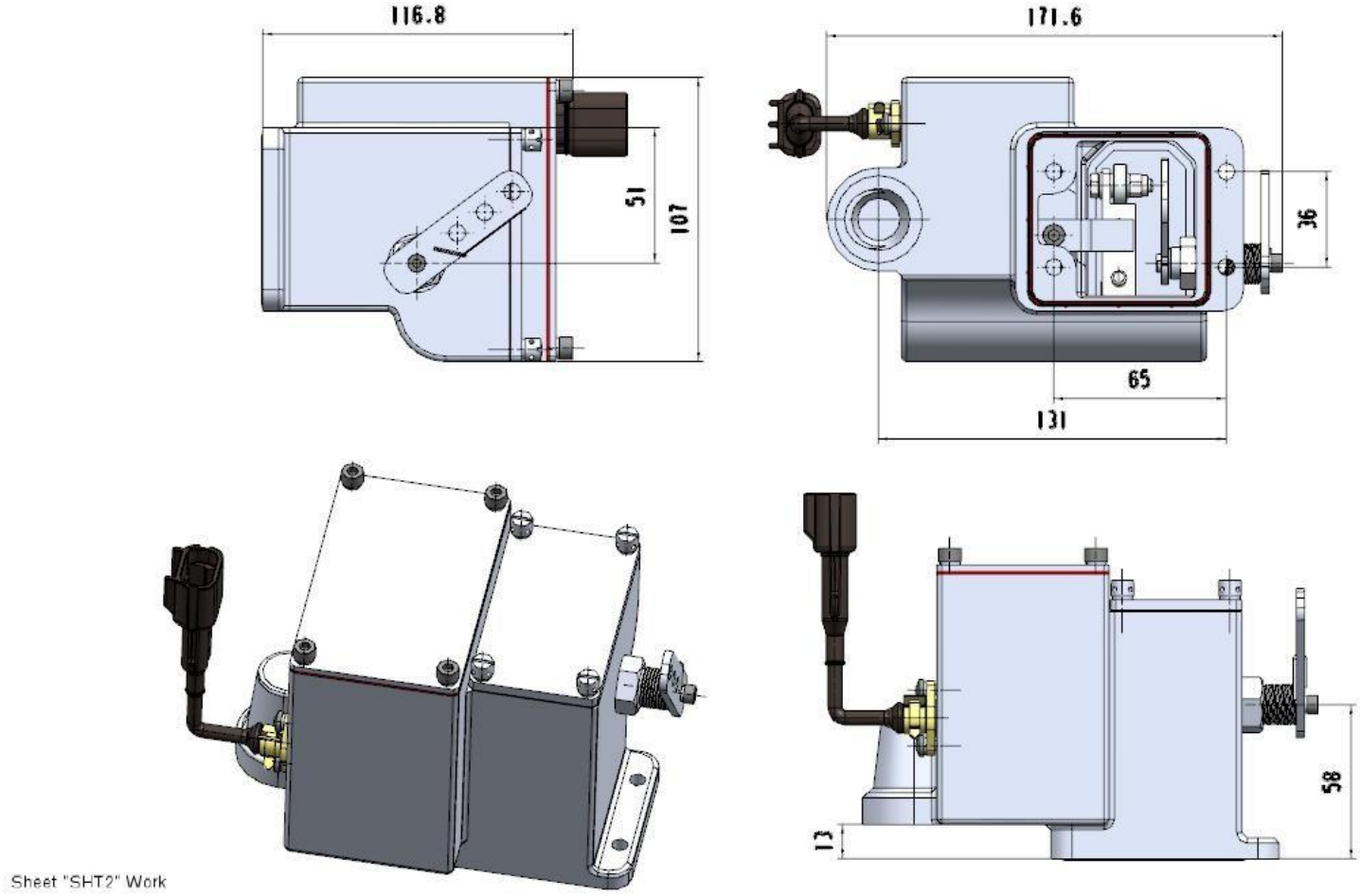


Illustration 1-5

FORTRUST®

Electric Actuator

A08C-W1 Dimensions



Specification

Performance

Force..... 6.2 lbs (27.5N)
Operating Stroke..... 0.80 in(21mm)
ResponseTime (10-90% 2-19mm).....35 MSEC
Internal Sealing Pressure..... 2 bar (29 psi)

Electrical Power Input

Operating Voltage..... 12 VDC or 24 VDC
Coil Resistance..... 12 VDCVersion- 1.7+/-0.2 OHMS
.....24 VDC Version- 7.2+/-0.5 OHMS
Nominal Operating Current..... 12 VDC Version- 4.0 A
.....24 VDC Version- 2.0 A
Maximum Current.....12 VDC Version- 5.8 A
.....24 VDCVersion- 3.1 A

Environmental

Operating Temperature.....-40° to+200°F(-40° to+95°C)
Relative Humidity..... Upto 100%
Shock..... 20g @11msec
Vibration..... 20g, 20-500Hz
Agency..... RoHSCompliant

Physical

Dimensions..... See Figure 2-1
Weight.....4.75lbs.(2.2kg)
Mounting..... adapterplate

NOTICED:FORTRUST® has able to provide differentadapter plate for different fuel pump following customer's requirements.

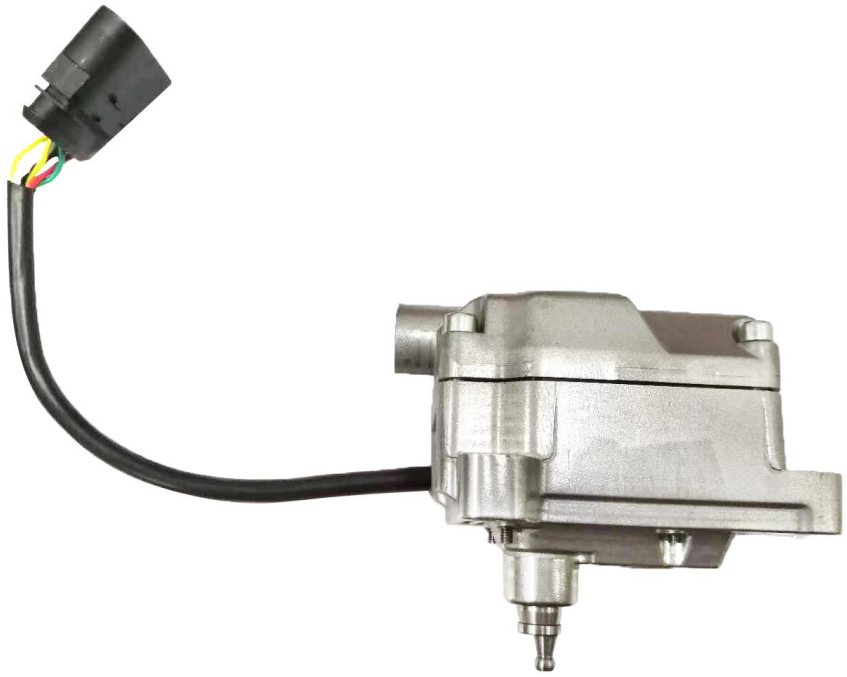
FORTRUST®

Electric Actuator

A03C-F Series

Features and Benefits

- Doule closed loop control with position feedback sensor
- A Low Cost Integral Actuator
- Proven Electromechanical Design with High Reliability
- Easy Installation with Minimal Setup Time
- Fast Response
- Environmentally Sealed, All Metal Design
- Increased Operational Integrity and Security



The Integral Electric Actuator for the Stanadyne DB-Fuel Pumps

This integral actuator is an electromagnetic servo device which, when installed becomes part of a closed loop fuel control system.

This system can be described as follows:
Electrical pulses, generated by the magnetic speed sensor, are directly proportional to the engine speed.
These pulses are transmitted to the speed control unit, which will compare the real-time pulses to the preset engine speed setting.
If the real-time pulses differ from the preset speed setting, the speed control unit will deviate the current to the electric actuator in an amount proportional to the difference. This deviation in current will cause the actuator shaft to rotate thus adjusting engine speed to match the preset engine speed setting.

Since there are no sliding parts in the A03C-F Series electric actuator and the unit is sealed, outstanding reliability and no maintenance are the resulting qualities.

FORTRUST®

Electric Actuator

A03C-F Series

Introduction

The A03C-FSeries integral Actuator is designed to mount directly to Stanadyne "D" Series fuel injection pumps. When the A03C-F Series electric actuator is installed on the fuel pump, an Integral high performance fuel control system results. No external linka- ges or brackets are required and no extra Stanadyne parts are needed. In addition, when the governor system is de-energized, the A03C-F series electric actuator provides the function of a fuel shut off solenoid. FORTRUST®employs its field proven electro- mechanical design which provides proportional actuator movement based on actuator coil current.

The A03C-F Series actuator is simple to install. It conveniently replaces the fuel injection pump mechanical governor cover to achieve an integrated proportional servo fuel control package.

System Description

The actuator is an electromagnetic servo device which can be integrated into double closed loops fuel control system.One sigal is come from position sensor with inside actuator for measure the fuel pump's sliding sleeve's postion,then feedback the signal to the speed contrl unit.An engine speed control system can be described a follows. Electrical signals are generated by a magnetic speed sensor which are proportional to engine speed. The signal is sent into the electronic speed control unit which compares it to the preset engine speed setting. If the magnetic speed sensor signal and the preset engine speed setting are not equal, a change in current from the speed control unit to the actuator will change the magnetic force to the actuator. The rotation of the actuator shaft will then adjust the fuel deli- very to the engine which will result in adjusting the engine speed to be equal to the preset engine speed setting. Shaft rotation is proportional to the amount of actuator current and counterbalanced by the actuator's return spring.

Doule closed loop design is more accurately meanwhile reduce the diesel engine fuel consumption,make the diesel engine runs more smooth and more stability.

Since the design has no sliding parts and Is sealed, outstanding-reliability results. No maintenance is required.

Warning:

An Overspeed shutdown device, independent of the governor system, should be provided to prevent loss of engine control, which may cause personal injury or equipment damage.

Installation

Preparing the Fuel Pump

Before the fuel Injection pump's Governor Cover can be removed and replaced by the A03C-F Series electric actuator, It is important for the outside of the pump to be clean. If necessary, remove any dirt with a solvent. This will prevent contaminates from entering the pump. The cleaning solvent as well as fuel oil can be collected by placing a suitable container underneath this pump.

1. Disconnect the pump's Electric Shutoff Solenoid wire from its connection point on the pump's Governor Cover. This wire connection is no longer necessary and it can be eliminated at its source.
2. Remove the Fuel Return Line from the Fuel Return Line Connector.
3. Remove the three (3) Governor Cover Screws. These will be replaced by mounting screws provided with the A03C-F Series actuator.
4. Remove the Governor Cover assembly with care, to insure that no dirt is allowed to enter the fuel injection pump.
5. Remove the Fuel Return Line Connector and the Gasket from the Governor Cover Assembly. Save the Fuel Return Line Connector and Gasket for later assembly use with A03C-F Series electricactuator.

Installung the Actuator

1. Re-Install the straight Fuel Return Line Connector and original pump Gasket to the A03C-F Series electric actuator.
2. Position the A03C-FSeries electric actuator on the fuel injection pump with the tall end of the electric actuator tilted slightly upward.
3. Slide the A103C-F Series electric actuator toward the rear (injector) end of the fuel injection pump until the actuators's U shaped coupler engaged the pump's Governor Linkage Hook. Alter engagement has been made, align the mounting holes between the electric actuator and the fuel injection pump.

CAUTION: Improper engagement of the actuator coupler to the pump's Governor Linkage Hook can cause an engine overspeed condition.

4. Securely fasten the A03C-F Series electric actuator to the fuel injection pump, using the (3) screws provided with the actuator.
5. Re-attach the Return Fuel Line to the Fuel Return Line Connector sealed on the A03C-F Series electric actuator.

Fuel Injection Pump Set-Up

Prior to starting the engine, the pump's shut off lever, throttle lever and mechanical governor must be set, to insure compatibility with the electronic governor.

1. Secure the shut off lever in the "On Fuel" position, If the Stanadyne pump is equipped with one.
2. Lock the throttle lever in the High Idle fuel setting position. This setting should be 10-12% above the desired governor speed.
3. Adjust the pump's mechanical governor Droop by turning the Droop Adjusting Screw counterclockwise (CCW) until it stops. Then turn It clockwise (CW) two turns. This adjustment will provide compatibility between the mechanical governor and the electronic governor. See Diagram outline drawing.
4. Purge the air in the fuel by removing the alien head plug located on top of the actuator.

Wiring

The A03C-F Series is designed to have a dedicated coil for use in the 12 VDC operation and another dedicated coil for 24 VDC operation. These actuators are respectively identified as A03C-F-12 and A03C-F-24.
The output from the selected VEC2800-F speed control unit is connected to the A03C-F Series actuator using the FORTRUST® cable harness . See the specific speed control unit literature for wiringinformation.

Troubleshooting

If the governor system falls to operate and the actuator is suspected to be the problem, make the following tests:

Measure Coil Resistance		**Measure Coil isolation**
10 ohms	12 VDC	>1 M ohm to ground
7.5 ohms	24 VDC	

Remove actuator cover and manually move the actuator through its range by depressing the actuator's armature. Energize the actuator to full fuel (follow steps in control unit publication). No binding or sticking should occur.
If the actuator passes these tests, the problem is elsewhere in the governor system. Refer to the speed control unit trouble shooting publication.

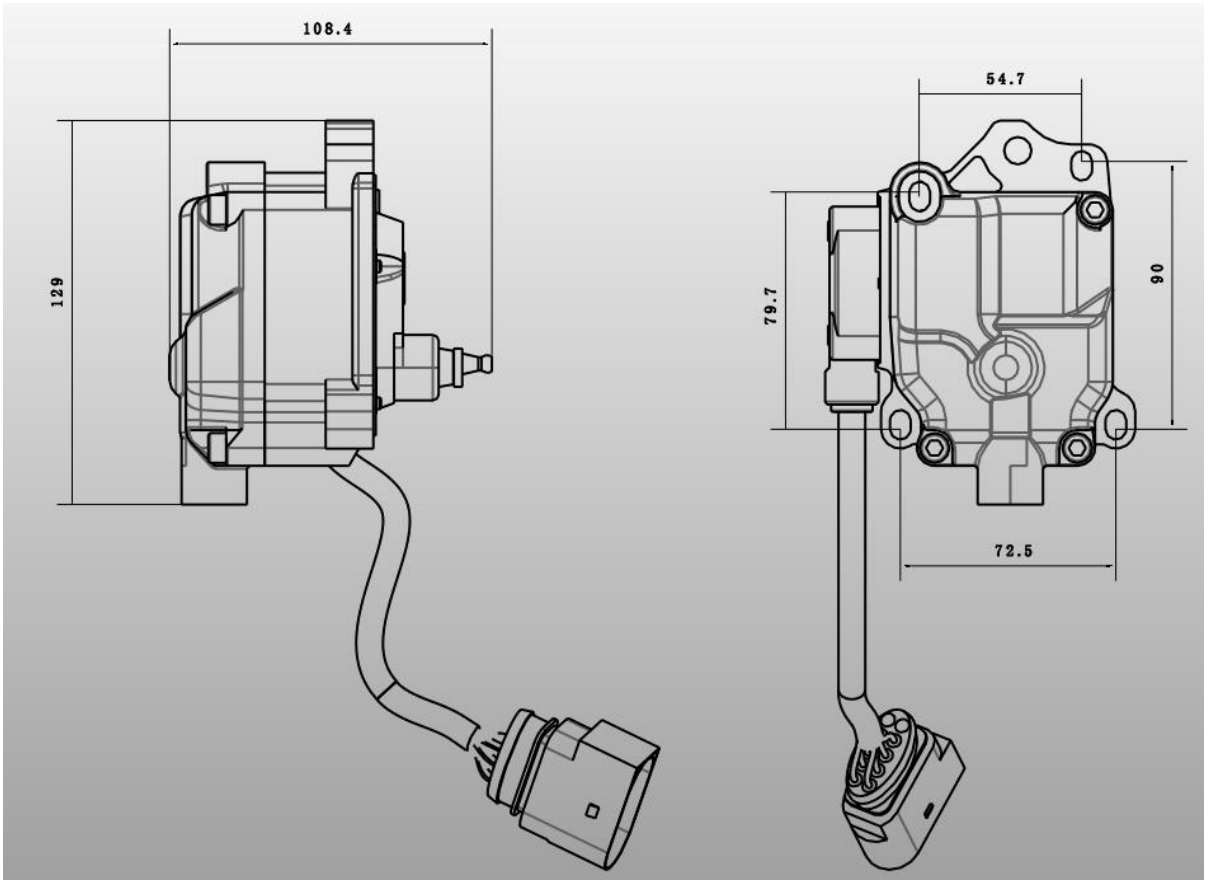
Specifications

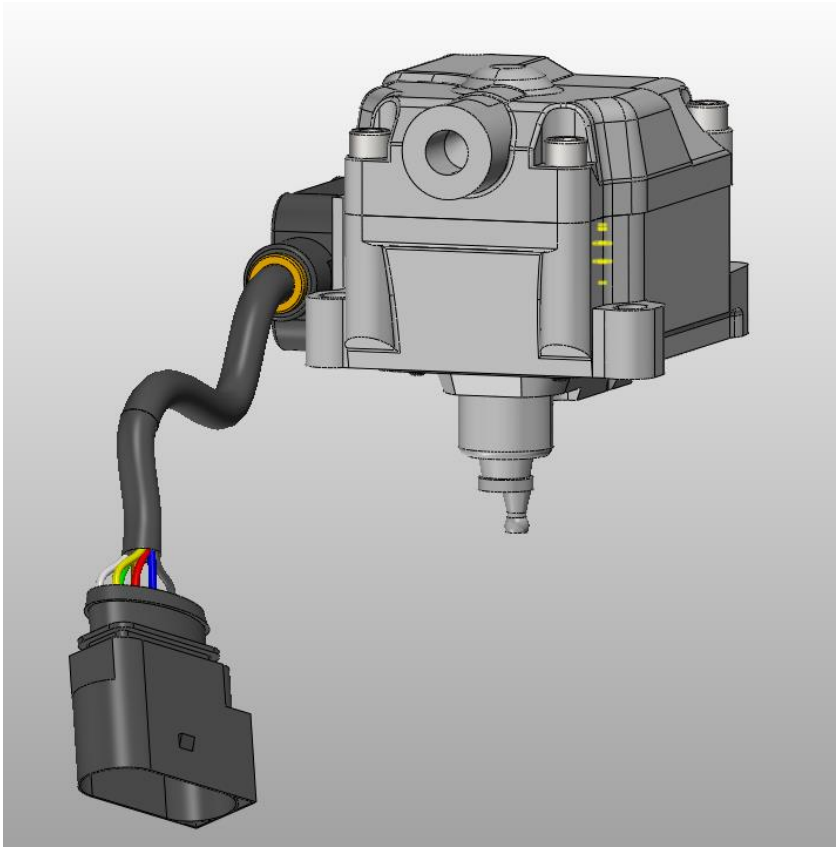
Power Input
Operating Voltage(Dedicated Coil)..... 12 or 24 VDC available
Nominal Operating Current..... 1.9 A at 12 VDC
..... 1.5 A at 24VDC
Maximum Current(Continuous)..... 2.7 A at 12 VDC
..... 9 A at 24 VDC
Environmental
Operating Temperature Range..... -40°to+180°F(-40'°to+85°C)
Relative Humidity..... upto100%
All Surface Finishes..... Fungus Proof and Corrosion Resistant
Physical
Dimensions.....See outline drawing
Weight..... 2.2 lbs (1 Kg.)
Mounting.....Directly on STANADYNE "D" Series fuel injection pumps
Reliability
Testing..... All Units 100% Tested

FORTRUST®

Electric Actuator

Outline Drawing





FORTRUST®

Electric Actuator

A02A-WXZ

A02A-WXZ

Features and Benefits

- A Low Cost Integral Actuator
- Proven Electromechanical Design with High Reliability
- Easy Installation with Minimal Setup Time
- Fast Response
- Environmentally Sealed, All Metal Design
- Increased Operational Integrity and Security

The Integral Electric Actuator for the Delphi DPG / DP210G Pumps

This integral actuator is an electromagnetic servo device which, when installed becomes part of a closed loop fuel control system.

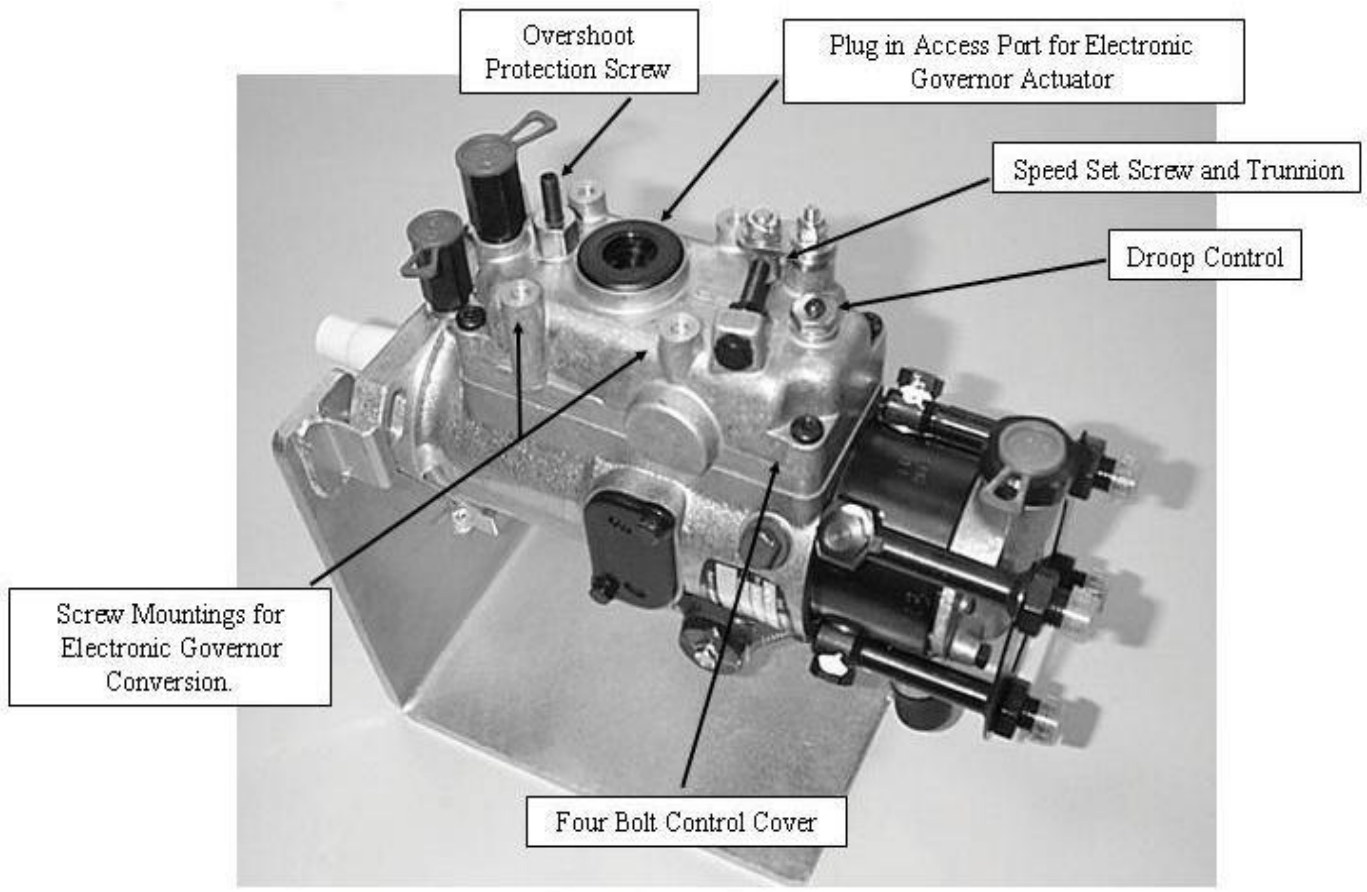
This system can be described as follows:
Electrical pulses, generated by the magnetic speed sensor, are directly proportional to the engine speed.
These pulses are transmitted to the speed control unit, which will compare the real-time pulses to the preset engine speed setting.
If the real-time pulses differ from the preset speed setting, the speed control unit will deviate the current to the electric actuator in an amount proportional to the difference.
This deviation in current will cause the actuator shaft to rotate thus adjusting engine speed to match the preset engine speed setting.

Since there are no sliding parts in the A02A-WZ Series electric actuator and the unit is sealed, outstanding reliability and no maintenance are the resulting qualities.

Wiring

The A02A-WXZ Series Electric Actuator is designed in either a 12Vdc or 24Vdc version. These actuator models are identified in Chart A. You must be sure that the actuator voltage matches the battery supply voltage when ordering.

An actuator cable harness is used to connect the A02A-WXZ Series actuator to the selected FORTRUST ®speed control unit. There are no polarity connections from the speed control unit to the actuator which need to be observed.
For more information on additional wiring, see literature specific to the speed control unit being used.



Warning:
An Overspeed shutdown device, independent of the governor system, should be provided to prevent loss of engine control, which may cause personal injury or equipment damage.

Preparing the Fuel Pump

Note: Before starting this procedure, make sure that the upper surface of the pump is clean of all dirt and grime. The following procedure will then assist you with installing your new A02A-WXZ Series electric actuator.

Step 1
The Overshoot Protection Screw may have to be replaced with a shorter screw. A 10mm M6 screw is recommended. This will provide the adequate clearance needed to install the A02A-WXZ Series actuator.

Step 2
To adjust the Droop Control, loosen the locking-bolt and turn the Droop Control Allen Screw clockwise, but do not force or over-tighten, until it cannot be turned any further. Then adjust the Allen Screw in a counter-clockwise direction one and half turns and tighten locknut.

Checking for Physical Obstruction
Remove the actuator from the pump. Hold the actuator with the lever side down. Manually move the actuator's shaft through its entire range of motion by depressing the actuator lever. You should NOT feel any binding or sticking. Energize the actuator to full fuel (follow steps in speed control publication) while observing the movement of the lever. The actuatorshould operate smoothly throughoutits entire stroke without any interruptions in motion.
If the A02A-WXZ Series actuator passes these tests, the problem is likely elsewhere in the speed control unit, speed sensor or fuel system. Refer to the speed control unit troubleshooting publication or fuel pumpinformation.

Specification

Power Input
Operating Voltage(Dedicated Coil)..... 12 or 24Vdc Available
Nominal Operating Current.....1.9A @12Vdc
.....or 1.5A @ 24Vdc
Maximum Current(Continuous)..... 2.7A @12Vdc
.....or 1.9A @ 24Vdc

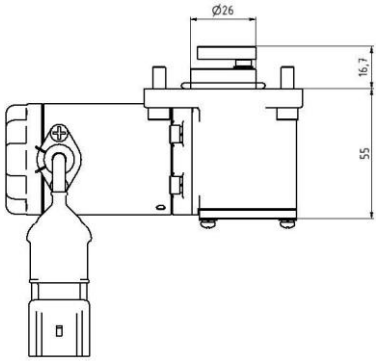
Environmental
Operating Temperature Range.....-40° to 180°F
.....(-40° to 85°C)
Relative Humidity..... Upto100%

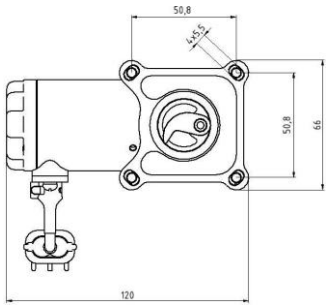
Physical
Dimensions..... See Diagram 1
Weight..... 2 lbs.
Mounting..... Directly to Delphi Type DPG / DP210G

Reliability
Testing.....All Units 100% Tested

Mating Hardware
- The actuator comes with mounting hardware and O-ring.
- The actuator does not come with mating connector.
- Wiring Harness: Provide with actuator

Diagram 1





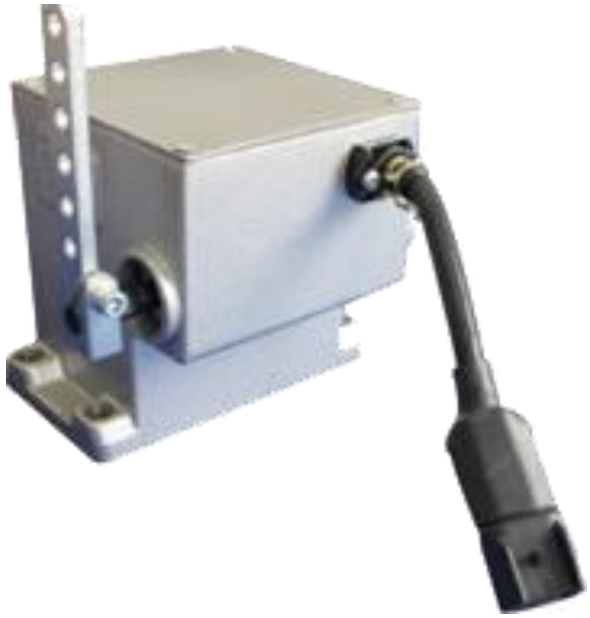
FORTRUST®

Electric Actuator

A3B Series

Features and Benefits

- Easy Installation
- Universal Design
- Internal Return Spring
- Rapid Response to Transient
- Multiple Mounting Positions
- Maintenance Free
- Proven Reliability



The Integral Electric Actuator for external use

The A3B Series electric actuator is a rotary output, linear torque, proportional servo. This electromechanical actuator is typically used as an engine fuel control positioning device. An internal spring provides fail safe operation by forcing the actuator to the fuel shut off position when the actuator is de-energized. This design combines fast operation, multi voltage usage, wider rotation angles, and proven reliability. The actuator can operate directly from 12 and 24 volt batterysupplies.

The speed of operation of the actuator is typically faster than competitive units, thus it provides more stable and rapid response to transientconditions.

Applications include most block pumps, with or without mechanical governors, distributor type pumps, and medium sized carbureted engines. The 25 degrees of rotation expands the application to a wider variety of engines.

FORTRUST®

Electric Actuator

A3B Series

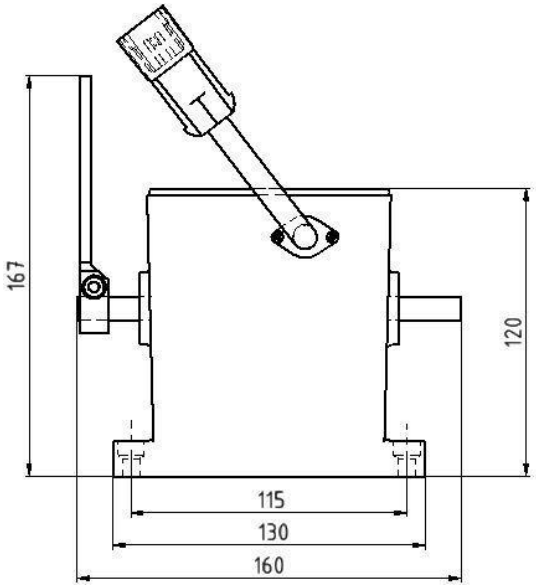
Description

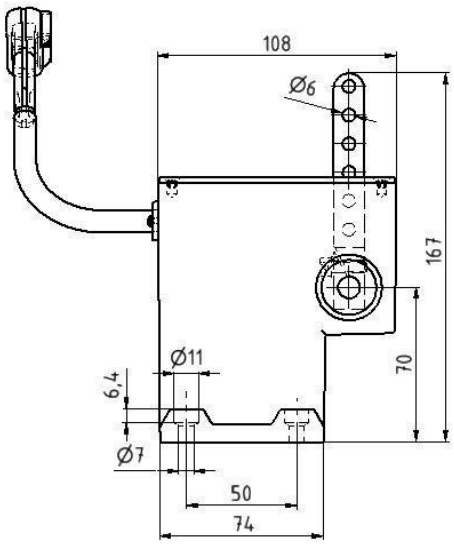
The actuator is an electromagnetic servo device which can be integrated into a closed loop control system. An engine control system can be described as follows. An electrical signal is generated by a magnetic speed sensor which is proportional to engine speed. This signal is sent to the electronic speed control unit which compares it to the preset engine speed setting. If the magnetic Speed sensor signal and the preset engine speed setting are not equal, a change in current from the speed control unit to the actuator will change the magnetic force in the actuator.

The rotation of the actuator shaft will then adjust the fuel to the engine to cause the engine speed to be equal to the preset engine speed setting. Shaft rotation is proportional to the amount of actuator current and counterbalanced by the internal spring.

Since the design has no sliding parts and is totally sealed, outstanding reliability is achieved. A single compression spring is used to improve reliability. No maintenance is necessary.

Diagram 1





Specification

Performance

Available Torque.....Max 2.2 lb-ft (2.7 Nm)
Maximum Operating Shaft Angular Travel.....
.....25 ±1 degree CW/CCW

Power Input

Operating voltage.....12, 24VDC
Normal Operating Current.....3 A at 12 VDC
.....1.5 A at 24 VDC
Maximum Current-Continuously Rated..... 8 A at 12 VDC
... .4 A at 24 VDC

Environmental

Ambient Temperature.....-65°F to 200°F (-54°C to +95°C)

Relative Humidity..... upto100%
All Surface Finishes. Fungus proof and corrosion resistance

Physical

Dimensions..... See Diagram 1
Weight.....8.25 lb. (3.75 kg)

Reliability

Vibration.....up to 20G, 50-500 Hz
Testing..... 100% Test

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