Installation & Operating Manual

GOV+ Speed Governor for PLC

Form GOV+ IOM 12-16

altronic
HOERBIGER Engine Solutions

1.0 PLC+ Function-Specific I/O Modules

1.1 The PLC+ product line was developed by Altronic to allow easy integration of engine/compressor/generator function specific I/O through Ethernet to industry standard PLCs. The PLC+ Modules are designed to seamlessly deliver efficient, hazardous area approved, cost-effective I/O functions that are not normally available by off-the-shelf PLC hardware.

1.2 The PLC+ modules were designed with Rockwell Automation Control Logix and Compact Logix controllers in mind. EtherNet/IP implemented in the PLC+ Modules, along with Modbus/TCP allow seamless communication over Ethernet to Rockwell Automation PLCs as well as a wide range of other industrial PLCs.

1.3 The PLC+ Modules are based upon taking a time tested Altronic designed and tested specialty I/O function such as analog and digital I/O, vibration, detonation, speed, and others and marrying it to a communications board packaged in a rugged, cost effective shock and dust-resistant package.

WARNING: Deviation from this installation/operating manual may lead to improper operation of the Moduled machine, which could cause personal injury to operators or other nearby personnel.

CAUTION: The GOV+ Speed Governor is certified for use in Class I, Division 2, Groups C & D hazardous locations when installed in accordance with these instructions.

The input leads connected to this device operate at a low voltage and power level and MUST NOT CONTACT any external voltage source. Damage to the system will result from connection between the low voltage leads and the ignition system or any AC or DC power source above 36 Vdc.

WARNING: The GOV+ must be configured prior to use.

2.0 GOV+ Description

2.1 The GOV+ Electronic Speed Governor is a module in the PLC+ product line. It provides closed loop speed control of an engine by controlling an actuator. It can communicate to PLC's to monitor and control processes via Ethernet/IP or Modbus TCP. The speed input pulse can come from magnetic, Hall-effect, or other types of active pickups. A configurable 4-20mA or 0-10V analog output signal can be used to control an actuator position to control the speed. The desired run speed setpoint can be set by an internal configurable RPM value or adjusted by a 4-20mA input signal or a potentiometer. The GOV+ has the following startup logic: ready, purging, starting, warmup, and running. The GOV+ has three adjustable warm-up ramps with configurable ramp speed in rpm/sec with hold timers. The GOV+ can also accept a discrete signal from an engine temperature switch for engine warmup control.

2.2 The GOV+ is designed for use as a component of a PLC+ Control Panel, or as a stand-alone product. PLC+ panels use one or more such devices for engine control and monitoring. The GOV+ has an on-board web page that can be used to configure and monitor stand-alone applications. The Ethernet port allows the monitored values to be communicated to a PC, PLC, or other communications device using either Modbus/TCP or EtherNet/IP protocol. These values can be displayed on an HMI display and compared to user adjustable setpoint levels for sequencing, and/or alarm and shutdown

2.3 The GOV+ is housed in a 4.5" x 4.25" rugged anodized aluminum case. It mounts on a DIN rail using the DIN-rail-clip on the back of the unit. Pluggable Phoenix Contact-type connectors with push-in spring-cage connectors are used for connections. A standard RJ45 connector is used for Ethernet communications. The power requirement is 10 to 32Vdc, 0.6Amp max

2.4 For proper operation, these instructions must be adhered to strictly.

3.0 Mounting

WARNING: This Module is OPEN type equipment that must be used within a suitable enclosure.

3.1 Mount the GOV+ inside a control panel or to a suitable flat surface. A DIN-rail-mounting-clip on the back of the unit is used to mount the unit on a standard 35mm DIN rail. When mounting the Module to the DIN rail, angle the top of the unit towards the rail and slide the top of the clip over the top of the rail. Firmly push the unit towards the rail until it snaps into place. To remove, grasp the Module firmly on the top of the unit and apply downward pressure to compress the latch spring. Rock the bottom of the unit away from the rail.

4.0 Wiring and Description (SEE WIRING DIAGRAMS)

4.1 GENERAL

Take care not to damage the insulation and take precautions against damage from vibration, abrasion or liquids in conduits. Never run sensor, low voltage power, current loop, communications, or output switch wires in the same conduit as the ignition wiring or other high energy wiring such as AC line power, etc. Keep wires at least 12 inches away from all high voltage wiring.

Keep secondary wires to spark plugs and other high voltage wiring at least 12 inches (205mm) away from low voltage wiring to the GOV+.

NOTE: Altronic HIGHLY RECOMMENDS the use of resistor spark plugs and/or spark plug leads with all digital instrumentation as a means of reducing the impact of RFI (radio frequency interference) on operation.

4.2 POWER WIRING (DC+), (DC-)

Connect the power input wires to terminals (DC+) and (DC-); power requirement is 10 to 32Vdc, 0.5 Amp typical when using a voltage actuator, and 0.2 Amp when using a 4-20mA actuator. Connect the minus terminal (DC-) to panel ground, which must be the same as the ground on the connected device. The GOV+ must be powered from a Class 2 power supply. It is recommended that the current from the power supply to the GOV+ be limited through a properly sized surge tolerant fuse or electronic breaker.

WARNING: DO NOT connect the minus terminal directly to AN IGNITION SYSTEM COMMON COIL GROUND ON THE ENGINE.

4.3 SPEED INPUT (RPM IN)

The GOV+ uses a speed voltage signal on the (RPM IN) terminals to acquire the speed of the engine. The (RPM IN) inputs are isolated from DC-. Use the (GT) and (COM) terminals to connect a pickup to the (RPM IN) input for the speed signal.

- MAGNETIC PICK-UP — Connect the two wires from the 691118 series or similar magnetic pick-up to the GOV+ at terminals GT and COM using cable assembly 693104 series.
- HALL-EFFECT PICK-UP — Connect the three wires from the 791050 series Hall-effect pick-up to the Module at terminals GT, COM, and a +5 volt source using cable assembly 593 050 series. Connect pick-up cable wire B to a +5V supply, wire A to terminal GT, and wire C to terminal COM (minus). In addition, a 10,000-ohm pull-up resistor must be placed across the +5V supply to GT of the Module.

WARNING: Do not disconnect equipment in Div. 2 environment unless power is switched off or the area is known to be non-hazardous.

Please be aware that the GOV+ is optimized to receive evenly spaced input pulses. The calculated RPM may be unsteady or read improperly for unevenly spaced input pulses.

4.4 SPEED OUTPUT

The RPM OUT can be used as a speed signal output. A conditioned amplified square wave output speed signal equal in frequency to the RPM IN signal is available on the (RPM OUT) terminals. The amplitude of the signal is proportional to the voltage supplied on the VCC and GND terminals. Connect the speed output wires to the terminals marked (RPM OUT). The output signal is isolated from DC minus. The output is open drain thus allowing for any output voltage between 3 and 30 volts. The output does not require an external pull-up resistor, a 1K ohm pull-up resistor is provided internally. Max sink current is 15mA. Connect a supply voltage of the desired output voltage in the range of 3 to 30 Vdc to terminals VCC and GND. The conditioned output signal is on terminals OUT and GND.

4.5 OUTPUT SWITCHES

The GOV+ contains both an alarm and fault output. The alarm output activates output switch number 1. The fault output activates output switch number 2. Each output switch turns ON/OFF to switch COM. These switches are solid state, form C (N/O and N/C) break-before-make contacts and are isolated from the power supply. Switch 1 is closed with the absence of power and switch 2 is open with the absence of power. The switches are rated at 32Vdc, 200mA and the N/O switch has a unique internal overload current protection circuit. If an overload occurs, the internal circuitry limits current to safe levels. When the overload is removed, the relay resumes its normal ON characteristics. These switches can be wired to engine management systems, an Altronic annunciator system or to pilot duty relays as shown by the wiring diagrams.

NOTE: If the engine is shut down in a routine manner (without opening Din2, the permissive input or by a GOV+ fault) Din2 will not need to be toggled for a restart.

- Alarm – The alarm output (SW1) can be enabled or disabled, set for latching or non-latching, and be set for shelf or failsafe. In addition the following can

trigger an alarm condition:

1. Alarm on Voltage out-of-range: (range 10 to 32 VDC)
2. Alarm on Governor Limit: (can not reach target RPM)
3. Alarm on Braking: (sudden decrease in load, set by breaking percentage)
4. Alarm on Underspeed (no latch): (active below setpoint, clears above setpoint)
5. Alarm on Remote Speed OOR: (If remote speed control is enabled and input is below 2mA or greater than 22mA)

- Fault – The fault output (SW2) is always active and cannot be shut off. A fault condition will trip output switch number 2. Output switch number 2 is a normally closed switch that opens for a fault condition. It is highly recommended to connect a safety shutdown device to SW2 for safety purposes. Conditions that will trip the fault switch are:
  1. An overspeed condition (configured overspeed value in general setup)
  2. An Actuator Fault
     a. A voltage outside of the Actuator Output Voltage of 0 – 10V
     b. An over current or over temperature condition of the voltage Actuator driver
     c. A loss of actuator driver supply voltage (12V)
     d. Less than 12 volt input voltage when using Voltage actuator output
     e. An open current loop or high loop impedance when configured for current loop control
  3. An internal watchdog fault

4.6 DISCRETE INPUTS (Din1), (Din2)

There are two discrete inputs on the GOV+, Din1(+) and Din2(+). They both have internal pull-ups. Din1 can be configured for active low or active high. Din2 is not configurable and is active low (active when grounded to DC-).

(Din1) Warmup/Cooldown - Discrete input Din1 can be used to select a pre-configured speed for use during a warmup or cooldown period. The Warmup/cooldown feature can be enabled or disabled by the onboard web page or by the Modbus bit. When enabled the Target RPM, Acticve High or Low, and the Ramp rate must be configured.

Din1 can be configured to be active either high or low. Din 1 contains an internal pullup resistor. When configured as active low, close input Din1 to DC- to go to the pre-configured speed. When configured as active high, open input Din1 from DC- to go to the pre-configured speed.

(Din2) Stop/Run permissive - Discrete input Din2 is used as a permissive input to the Speed Governor. Discrete input Din2 must be grounded to DC- for governor control operation. If Din2 is not grounded the system will not start up. If Din2 goes open at any time when the GOV+ is active the Actuator Output will go to the 0% open position. If configured for voltage, 0 volts; or if configured for 4-20mA out, the current will go to the zero speed loop value configured. For stand-alone operation, if a fault occurs, Din2 must be momentarily opened then closed again before startup. If connected to a PC or PLC the stop/run bit must be toggled. The GOV+ stop/run command can be initiated in any of three ways:

1. By toggling the Din2 terminal open then closed
2. By sending a reset command via communications
3. By activating the “clear” button on the Monitor web page (next to “Stopped”)

4.7 ANALOG INPUTS (Ain1), (Ain2)

There are two analog inputs on the GOV+, Ain1(+) and Ain2(+). They each have 200 ohm receiving resistors on their inputs. Ain1 can be used for a speed control input, and Ain2 is not currently used for a governing function.

(Ain1) Remote Speed Control Input – The speed control input can be used to

remotely adjust the engine speed. The desired remote speed range is configured in the GOV+. The Speed range value is the desired normal speed range of the engine under load. The remote speed input can be from either a 4-20mA current loop input or a potentiometer. See wiring diagram section of manual.

As a note, the desired speed setpoint value can also be set internally by setting the Local Speed Control value. The local speed setpoint can be set via the on-board web page (Local Speed Control RPM), or by a PC/PLC sending the speed register value to the GOV+, Modbus register 40007.

4.8 RJ45 ETHERNET COMMUNICATIONS

The GOV+ can communicate to other instruments, PCs, or PLCs via the Ethernet communications port. Use data grade Category 5E Shielded Twisted Pair (STP) or Unshielded Twisted-Pair (UTP) cable that has a 100Ω characteristic impedance that meets the EIA/TIA Category Five (CAT-5) wire specifications. Max wire length is 100 meters/325 feet.

NOTE: The use of Category 5E STP cable (Shielded Twisted Pair) with shielded RJ45 plug connectors is strongly recommended for installations in harsh industrial environments and/or in the presence of strong electrical fields.

4.9 RS485 SERIAL PORT

The GOV+ has a RS485 slave port for communication to PC's, PLC's and other master Modbus RTU enabled controllers over RS485. Use a two-conductor shielded cable of fine gauge stranded wire and connect the wires to the terminals labeled A and B. Make the connection to the device A to A(-) and B to B(+). If required connect the shield to the slave device only.

4.10 ACTUATOR OUT

The actuator output governs the speed of the engine by the control of a throttle actuator that controls the amount of air or air/fuel mixture delivered to the gaseous-fueled engine. The GOV+ controls the actuator opening with the choice of either voltage (0 to 10V) or current loop actuator (4 to 20mA) or (0 to 24mA) control. Note: current loop control can be either forward or reverse acting.

Voltage Control – Voltage control output from the GOV+ is used to interface to an electric voltage controlled actuator (a voice coil). Output voltage from the voltage control is from 0 to 10 VDC with a max current of 0.5A. Wire the actuator to terminals ACT OUT (V) terminals (+) and (-).

Current Loop Control – The GOV+ has a (4-20mA or 0-24mA) current loop output for the control of a current loop controlled actuator. Typical Actuators are Altronic AGV5 Gas Control Valve, Throttle body actuators, and other devices commonly used in governor control. It can be configured for forward or reverse acting. The current loop output is accessible through the (ACT OUT 4-20mA) and (DC-) terminals. The output is protected against open and short circuits. A 250 ohm loop resistor can be used over the entire supply voltage range from 12 to 36 Vdc. The maximum load resistance that can be tolerated in the loop is determined by the supply voltage. When using the maximum rated loop resistor of 500 ohms with a desired full scale loop output of 20 mA, the supply voltage must be between 15 and 36 VDC. At 12 VDC supply voltage, the maximum load resistor for 20mA loop output current is 350 ohms. Refer to the wiring diagrams for typical hook-up

4.11 HAZARDOUS AREA OPERATION

The GOV+ is CSA certified for CLASS I, DIVISION 2, GROUPS C & D areas as a component only and is required to be installed in a suitable enclosure where the suitability of the combination is subject to the local inspection authority having jurisdiction. The power connections to the GOV+ must be in accordance with the National Electrical Code and in Canada, the Canadian Electrical Code. In addition, the following requirements must be met:

1. **Run the sensor wires leaving the panel in a separate conduit from all other wiring and keep them separate throughout the installation.**
2. **Power, input, and output wiring must have a grade of insulation capable of withstanding an AC voltage of 500 volts RMS.**
3. **In general, run wires in separate conduits and junction boxes from high voltage wires such as ignition, fuel valve, and other high voltage wiring**.

5.0 Front Panel LED Indicators

5.1 **POWER** – When the unit is powered, the green "POWER" LED will be on.

5.2 **STATUS** – The status indicator is multi-purpose. It contains several "blink" patterns.

- EtherNet/IP communications mode – one long, one short blink at 1/4-second rate
- Modbus/TCP communications mode – short blinks at 1/4 second rate
- "wink" mode – steady short blinks at 1/8 second rate for the selected time

5.3 **ETHERNET** – The Ethernet port contains two LED's that are built into the RJ45 connector. The green LINK LED will be on solid if the Ethernet port has successfully established a connection. The yellow RX/TX light signals network activity.

5.4 **RX/TX** – The RS485 serial port has two activity LED indicators, one for transmit (TX), one for receive (RX). These LED's will blink indicating activity on the RS485 bus.

5.5 **OUTPUT SWITCH INDICATORS** – Each of the built-in output switches (SW1 and SW2) have an LED indicator. The LED turns on when the switch is activated.

6.0 Protocols

6.1 The PLC+ Modules support EtherNet/IP (Ethernet Industrial Protocol) and Modbus/TCP (Modbus over TCP/IP).

6.2 EtherNet/IP – EtherNet/IP is a communication protocol developed and used by Rockwell Automation for use in their Allen Bradley brand PLCs. It is managed by Open DeviceNet Vendors Association (ODVA) (www.odva.org) and is designed for use in process control and other industrial automation applications. Some other vendors using EtherNet/IP are Omron, Schneider Electric, Harting, Phoenix Contact, Opto 22, Wago Corporation, and Yaskawa. EtherNet/IP uses objects to communicate to and from the PLC+ Modules and the PLC. An object model is a collection of related data values and common elements of the PLC+ Module. The object model is listed at the end of this manual.

6.3 Modbus/TCP – Modbus/TCP is Modbus over Ethernet. It is very similar to Modbus RTU. The Modbus registers are the same. The memory map of the Modbus registers are listed toward the end of this manual.

7.0 EDS File (Electronic Data Sheet)

7.1 The EDS file is used for GOV+ Module configuration and to commission it on an EtherNet/IP network. It is an ASCII text file that describes the Modules' device type, product revision, and its configurable parameters on the EtherNet/IP network.

7.2 An EDS file for the GOV+ can be found enclosed on the media with this document and on the Altronic ftp site; it may also be downloaded from the onboard web page.

8.0 Embedded Web Server

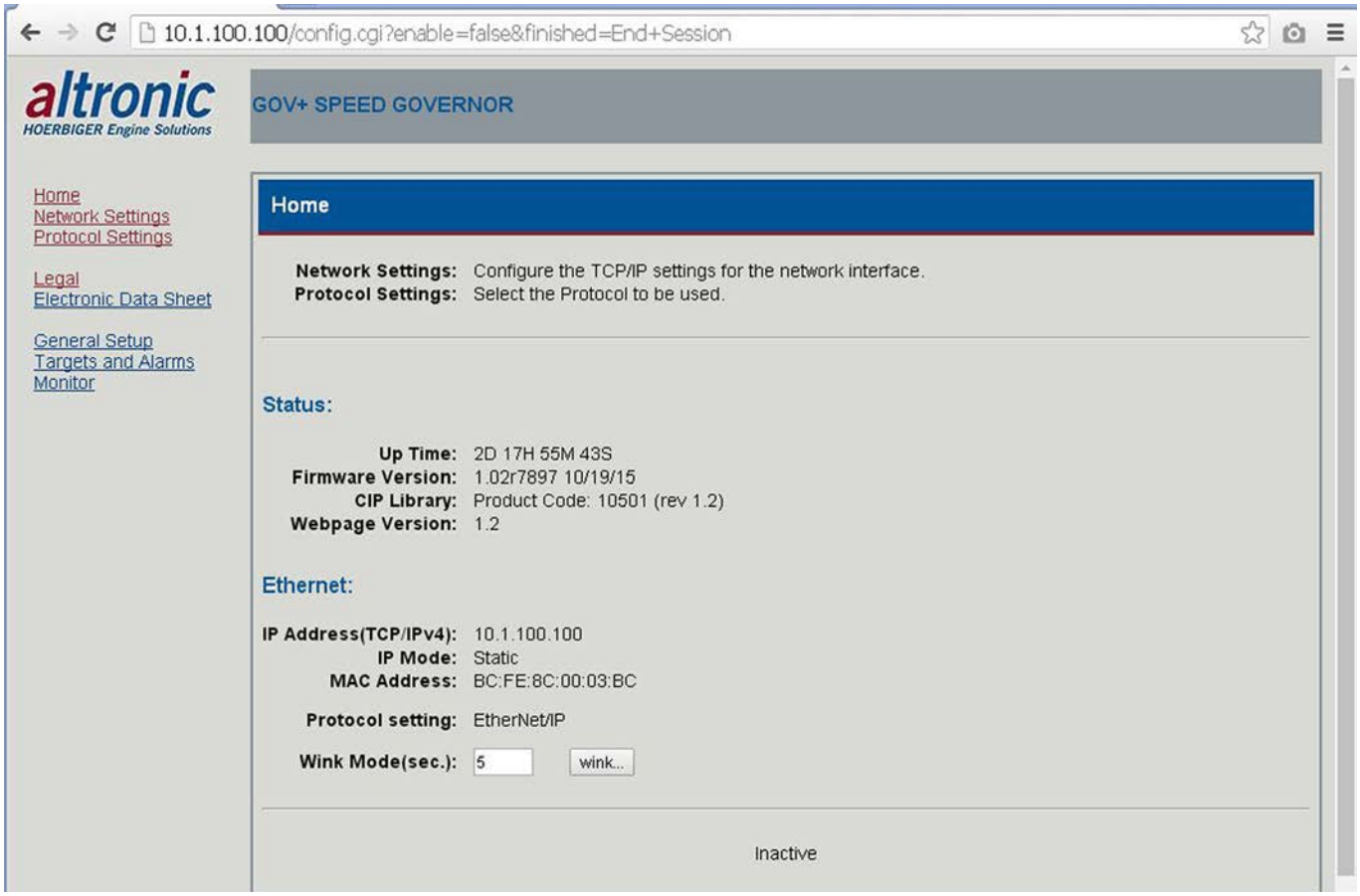
8.1 The GOV+ Module has a built-in web server that allows it to be configured and Monitored. The embedded web server can be used to view and configure the network settings, the protocol settings, configure, and monitor the Module. For connection details see wiring diagrams at the end of this manual.

8.2 The PLC+ Modules support Auto MDI/MDI-X crossover. A straight-through Ethernet cable may be used to connect the PC to the PLC+ Module. A straight-through connection through an Ethernet switch or hub on a network may also be used.

NOTE: The default parameters are:
Static IP Address: 10.1.100.100
Subnet Mask:255.255.255.0
Protocol Setting: EtherNet/IP

8.3 Once connected and powered, open your web browser and type the IP address assigned to the Module in the “Address” bar; http://10.1.100.100 for example. The Modules home page will be displayed.

8.4 Home Page – The Home Page will show the current firmware version, Network Settings, Protocol Settings and allows execution of the “Wink” mode.



Default Settings are shown

Status:

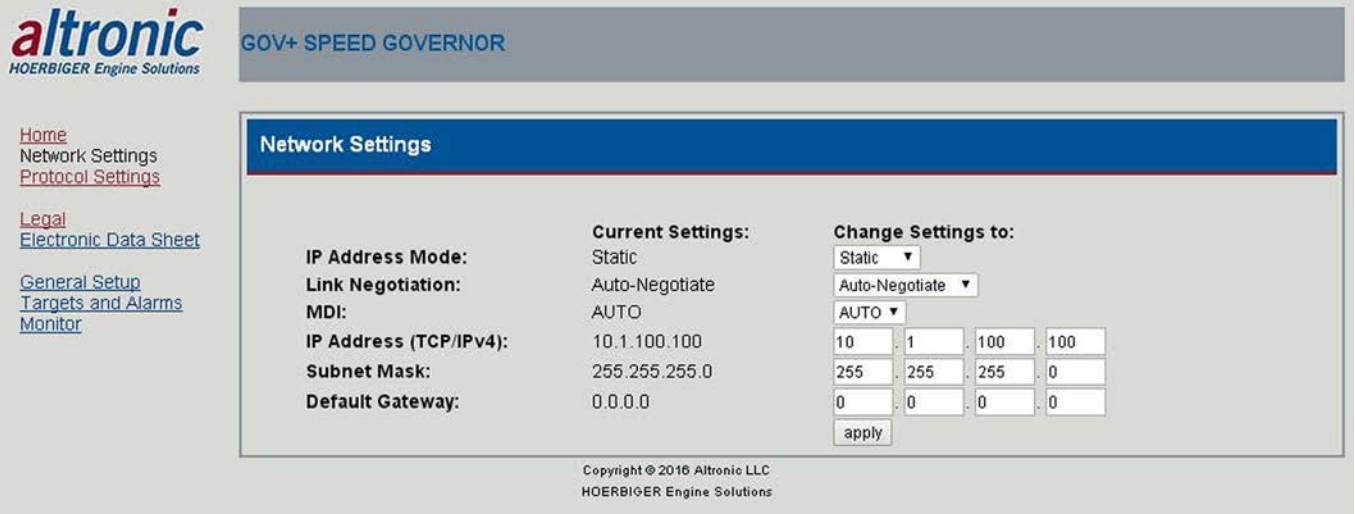
- Up Time – the time between power cycles.
- Firmware Version – the revision level and the date it was compiled.
- CIP Library – the personality code of the product and rev level.
- Webpage Version – the revision level of the webpage.

Ethernet:

- IP Address – a node identification number for the device on the network. The current IP address is shown.
- IP Mode – shows the current Static, DHCP, BootP, or AutoIP IP address assignment type.
- MAC Address – the unique Hardware identifier of the Monitor assigned by the factory.
- Protocol Setting – Shows the current protocol; either EtherNet/IP or Modbus/TCP.
- Wink Mode – used to identify a Module in the network. When the wink mode is commanded, the “STATUS” LED on the Module with the displayed IP address will blink with short blinks at a rate of 1/8 second. This can be used by the integrator or technician to identify which unit is being talked to. The number of seconds the unit will “wink” for can be selected from 1 to 60 seconds.

9.0 Network Settings

9.1 Select the Network Settings page to change the network settings for this Monitor. Press the apply button to save the new settings. The following network settings can be selected.



Default settings are shown

IP Address Mode:

- Static – A Static IP Address is a fixed IP Address for the Monitor.
- DHCP, AutoIP, BOOTP – Dynamic Host Configuration Protocol (DHCP), link-local address (AutoIP), Bootstrap Protocol (BOOTP) are network discovery protocols that allow the Module to be automatically discovered on the network and be assigned the necessary information like an IP address, Subnet Mask, and Gateway by a server connected to the network to allow communication on the network.
- Link Negotiation – Auto-Negotiate, 100 Full Duplex, 100 Half Duplex, 10 Full Duplex, 10 Half Duplex. Auto negotiation chooses the highest performance transmission mode the network supports.
- MDI – A Medium Dependent Interface (MDI), Auto, MDI, MDI-X, is the physical and electrical selection. Auto detects if the connection would require a crossover connection and automatically selects for the correct connection.
- IP Address – The IP Address is an identification number assigned to a device. The PLC+ Modules are set to a default IP address of 10.1.100.100 when received. See section 9.3 on how to return the IP address to the default setting.
- Subnet Mask – A Subnet Mask is used to distinguish between the host portion of the IP address and the network.
- Default Gateway – The Default Gateway is the node on the network that facilitates communication with other networks. The default gateway setting is optional. For networks that do not have a gateway, this should be set to 0.0.0.0.

9.2 DEFAULT NETWORK SETTINGS — The GOV+ Module is shipped with default network settings to allow the integrator to start at known settings. The following are the default Network Settings:

- IP Address Mode: Static
- Link Negotion: Auto-Negotiate
- MDI: Auto
- IP Address: 10.1.100.100
- Subnet Mask: 255.255.255.0
- Default Gateway: 0.0.0.0

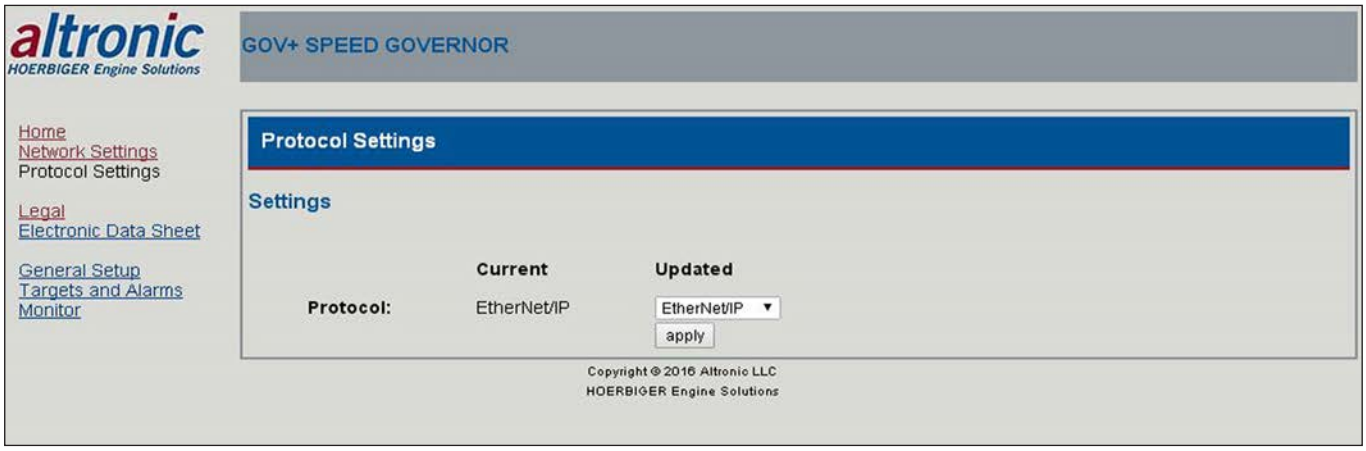
9.3 The Module can, at any time, be returned to the default network settings.

1. Power the Module
2. Locate the small hole on the bottom of the Module in line with the Ethernet connector.
3. Unwrap a paper clip. Insert the end into the hole to activate the reset switch. The switch has tactile feedback. Press and hold the switch on for 5 seconds.
4. Observe the Status LED indicator on the front panel; after a few seconds it will blink in rapid succession indicating the network settings have returned to the default configuration.
5. Open your web browser and type the default IP address into the "Address" bar: http://10.1.100.100. The monitor home page will be displayed. The network settings on the PC may need to be reconfigured in order to communicate with the device.

10.0 Protocol Settings

10.1 Select the Protocol Settings page to change the protocol for this Module. The selections are EtherNet/IP or Modbus/TCP. Press the apply button to save the new settings.

NOTE: The Protocol setting is not affected by the reset switch and will remain the same.



11.0 Configuring the Speed Governor

11.1 In addition to the network and protocol settings the GOV+ operating parameters can also be configured using the onboard web page. The web page is divided up by the following sections:

NOTE: The GOV+ Speed Governor Module must be configured prior to use.

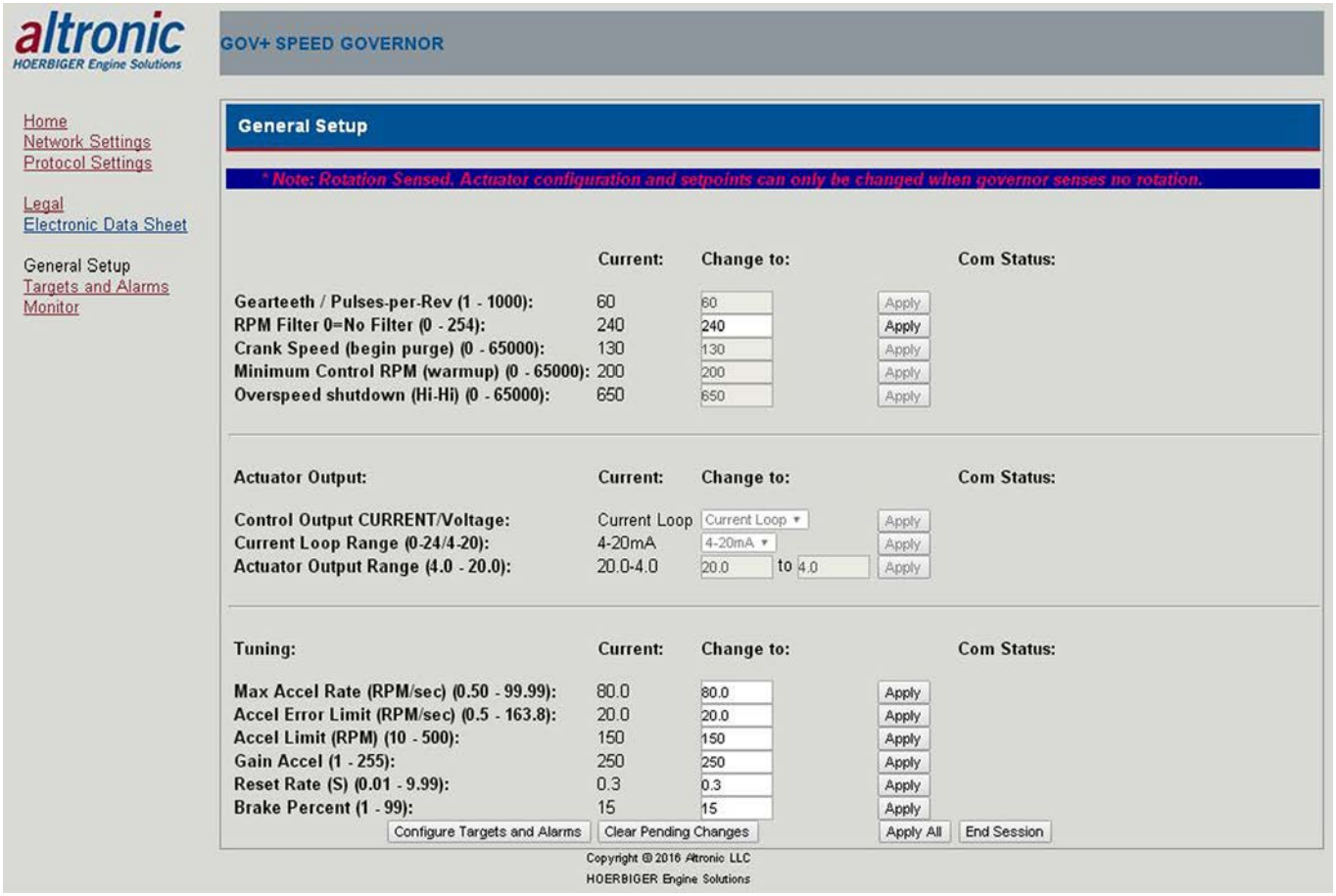
- General Setup
  - — Speed input configuration
  - — Actuator output configuration
  - — PID Tuning parameters
- Targets and Alarms
  - — Stop/Run control
  - — Start Configuration
  - — Warmup Timers (1-3)
  - — Remote Target RPM (activated by Ain2)
  - — Warmup/Cooldown (activated by Din1)
  - — Alarm Output
  - — Map Alarm
- Monitor
  - — Engine RPM, Actuator Position, System Status

NOTE: It is best to configure the General Setup parameters (except for the Tuning parameters) before the Targets and Alarms parameters. Some of the values from the General Setup are used as range values for the Targets and Alarm parameters.

To change a setting, type the required value in the “Change to:” box. The line will highlight yellow. This indicates a change is pending. The yellow highlight will go away when “Apply” is selected indicating the new value is saved to the Monitor. The configuration parameters are described below. Each configuration parameter value must be carefully chosen.

NOTE: Gear teeth, Crank Speed, Minimum Control RPM, Overspeed Shutdown, and Actuator configuration can only be changed when the Speed Governor senses no rotation.

12.0 General Setup Page



12.1 GEAR TEETH/PULSES-PER-REV

The gear teeth or pulses per revolution sets the number of pulses the Governor Module is expected to see in one revolution. Set the PPR to 360 for a 360 tooth gear mounted on the crankshaft of an engine. The range is 1 to 1000.

12.2 RPM FILTER

The RPM filter is used to stabilize the RPM reading for a changing input. The filter is an adjustable dynamic software filter that can be set from 0 to 254. 0 being no filter, 254 being max filtering. A good starting filter value is 240.

12.3 CRANK SPEED (begin purge)

The Crank Speed (begin purge) setpoint is the speed at which the purge cycle commences (if enabled). Set the Crank Speed setpoint below the normal crank speed of the engine.

12.4 MINIMUM CONTROL RPM

The Minimum Control RPM is the speed at which the engine is self-sustaining; no longer requires the starter for rotation. Upon reaching the minimum control RPM the GOV+ transitions from start control to RPM control and it will commence ramping to the warmup timer 1-3 configured RPM (if they are enabled), otherwise it will go to the configured speed control setpoint RPM. The configured Minimum Control RPM value should be greater than the fastest cranking RPM and less than the Warmup or minimum RUN RPM.

12.5 OVERSPEED SHUTDOWN (HI-HI)
If the engine speed RPM exceeds the configured overspeed setpoint value, the Speed Governor will go to 0% actuator position and output switch SW2 will activate. The 0% actuator position and the faulted output switch position will remain until the start sequence is reinitiated. The start sequence can be iniated by either momentarily opening the permissive switch on Din2, or by sending the reset command via communications, or by pressing the "clear" button on the Monitor page of the onboard website.

THE OVERSPEED SHUTDOWN IN THE GOV+ SHOULD NOT BE USED AS THE PRIMARY OVERSPEED SHUTDOWN. IT IS MEANT AS A REDUNDANT SHUTDOWN DEVICE ONLY.

12.6 Actuator Output Configuration – The Actuator Output can be configured for either current loop or voltage control of the actuator.

12.7 CURRENT LOOP MODE – When current loop actuator output control is selected, the complete current loop range can be either 0 to 24mA or 4 to 20mA. The actuator output can be set to any value within the selected current loop range. A reverse acting actuator can be configured by entering a larger value in the first box and a smaller value in the second box.

12.8 VOLTAGE MODE – When Voltage actuator output control is selected the voltage range for the actuator output is 0 to 10 volts. The voltage output range can be any value within the range. The voltage actuator output cannot be configured for reverse acting.

12.9 Tuning parameter configuration – The Speed Governor can be tuned by these configuration settings.

The GOV+ uses a proprietary approach to engine speed control which has been optimized for gas fueled engines. Typical Speed Governors, when applied to gas engines, use a dual loop or dual rate approach to avoid problems in RPM control caused by the difference in engine behavior between unloaded and loaded conditions. When the gas engine is unloaded it often suffers from misfire. When a gas engine misfires, the torque produced by the cylinder which was intended to fire disappears regardless of the amount of fuel being delivered. The Governor, which after all is only sensing the engine RPM, will naturally try to increase the fueling rate of the engine because the speed is dropping. When an engine is misfiring, however, the next firing will often occur normally, causing a speed increase even without the Governor increasing the fueling rate. When fueling after the misfire is increased by the Governor, as normally occurs, the next firing causes much more acceleration than intended, so that the RPM is quickly above the desired value. This occurs even though the engine was below the setpoint value as a result of the misfire, only a single firing earlier.

Unfortunately, when the engine is unloaded, almost every firing (regardless of the fueling rate) has the potential to increase engine speed significantly. Additionally, because the engine is unloaded, the forces available to cause deceleration of the engine are at a minimum. The combination of these effects result in the poor speed stability of the engine when unloaded and a tendency to overspeed. Conversely, when a gas engine is loaded, forces acting in a manner to decelerate the engine are at a maximum and the firing of every cylinder at the current fueling rate is normally required just to maintain the engine RPM. When the engine is fully loaded, the forces available to cause the engine to accelerate are at a minimum. Loaded engines therefore are inclined to droop in speed or lug when experiencing a load increase.

In order to moderate these effects, the Altronic GOV+ monitors the acceleration and deceleration of the engine at all times, and depending upon the magnitude of the RPM error from the setpoint and a set of user-tuned variables, calculates a currently desired acceleration or deceleration rate. The desired rate of acceleration or deceleration for a given engine is the same for different load conditions, but the fueling adjustment needed to cause the desired rate change when loaded or unloaded is quite different. By comparing the measured acceleration to that which is desired for a given RPM error, the GOV can implement a fueling change

based upon the likelihood of its actually being needed to achieve the RPM setpoint in a timely manner. This operating philosophy allows for a common set of tuning variables to control both an unloaded and a loaded engine.

12.10 MAX ACCELERATION RATE (RPM/sec) – Max Accel Rate determines the maximum desired acceleration or deceleration target rate at which to seek the target RPM. Higher values will cause the Governor to seek the target speed at a faster rate. The actual acceleration target is established ratio-metrically from Max Accel Rate based on the RPM error. As RPM error would go from Accel Limit RPM to zero, the acceleration target would go from Max Accel Rate to zero. The recommend value of 40.00 RPM/SEC has been observed to work best on most engines. The range of this setting should be limited between 5 and 50 RPM/SEC.

12.11 ACCELERATION ERROR LIMIT (RPM/sec) – Accel Error Limit is used to limit the magnitude of observed engine acceleration that is used in the calculation of acceleration error. Decreasing the value results in less derivative control action, while increasing the value results in more. The acceleration limit range is .5 to 163.8 RPM per seconds. Set this value at 50% of Max Accel Rate for best balanced control response.

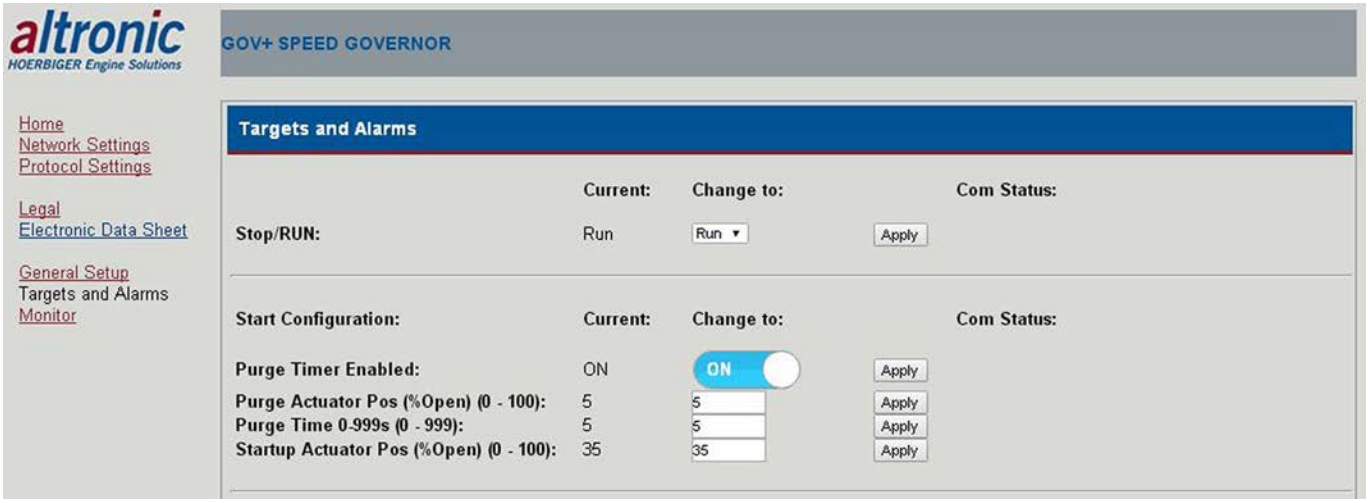
12.12 ACCELERATION LIMIT (RPM) – Accel Limit is used to limit the magnitude of RPM error used in the governor control logic. It provides a means to deliver aggressive control response when RPM error is small by limiting the error input signal when RPM error is large. The control output response will increase proportionally to the size of the error until the magnitude of the error is limited by Accel Limit. The acceleration limit range is 10 to 500 RPM. The recommended value of 40 has been observed to work best on most engines. Limit the range of this setting between 20 and 60.

12.13 GAIN ACCELERATION - The Gain Accel setting determines the response of the Governor to the error in acceleration and speed which has been computed for the last revolution based on the above settings. Higher values cause a faster actuator response, lower values cause a slower actuator response to acceleration errors. Each step between 1 and 255 produces an effective 2% change in the control gain. Typical values are 50 to 150. Higher gain values are typical for engines of larger horsepowers and operating pressures.

12.14 RESET RATE (S) - Reset Rate for acceleration control determines the time to integrate the full proportional response of the system in seconds (0.01 to 9.99). The Reset Rate determines how often changes occur; the smaller the number the quicker the response, the larger the number the slower the response. Adjust this value to compensate for fuel manifold volume and flow rates. Larger manifolds tend to require longer reset rates while higher flow applications may require a shorter reset rate. Typical values are 0.10 to 1.00.

12.15 BRAKE PERCENT - If actual engine speed is above the speed setpoint by more than 15% of (Overspeed minus Setpoint), then aggressive actions to reduce the engine speed are enabled. The recommend value is 15% and it is adjustable from 1% to 99%.

13.0 Targets and Alarms



13.1 STOP/RUN – The Stop/Run function is used when running to direct the actuator output to 0% position. This input can be triggered by the web page or by a PLC.

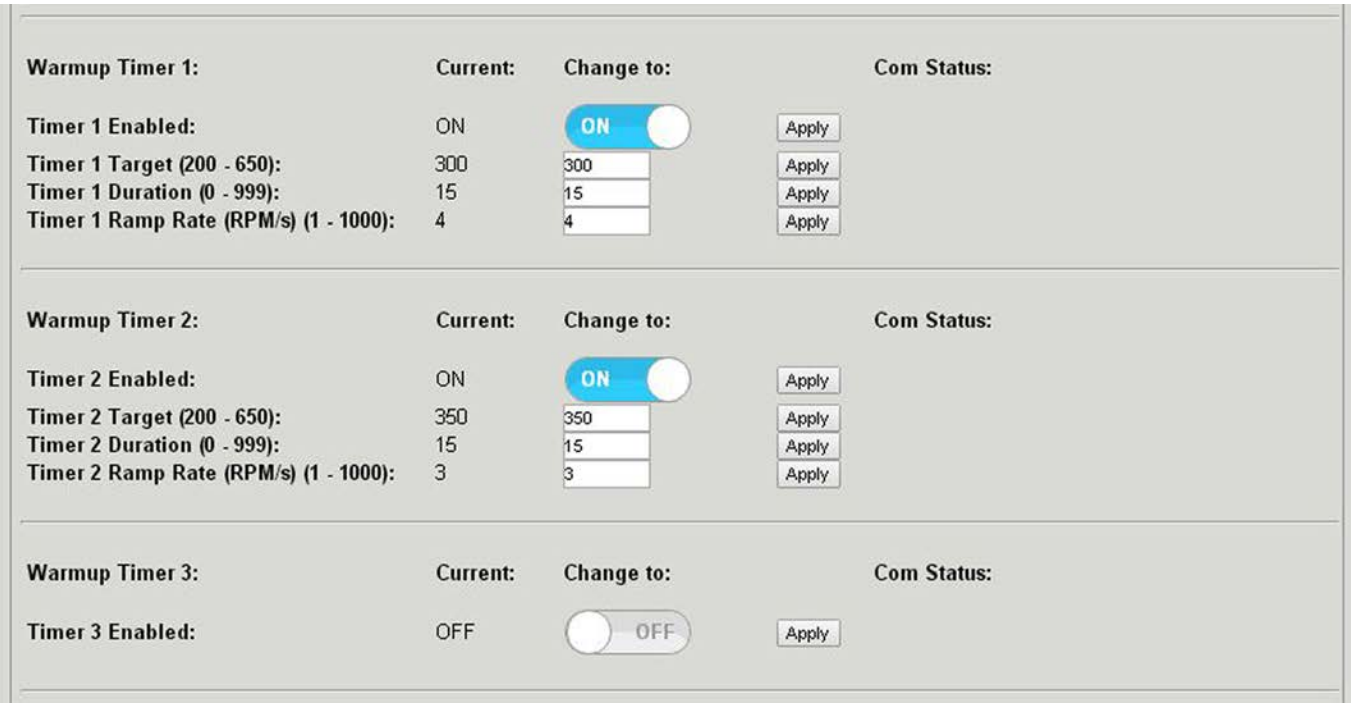
13.2 START CONFIGURATION – Used to configure the actuator position and duration during purge and to configure the desired actuator position for startup.

13.3 PURGE TIMER ENABLED – Can be configured to be used for the application (set to ON) or disabled (OFF). Note: the Startup Actuator Position is still available if the purge timer is set to off.

13.4 PURGE ACTUATOR POSITION (% Open) – Insert the desired actuator position, percent open, during the purge cycle. Range is 0 to 100% open.

13.5 PURGE TIME (seconds) – Enter the desired purge cycle time in seconds. The actuator will remain at the actuator purge position for the set purge time. Range is 0 to 999 seconds.

13.6 STARTUP ACTUATOR POSITION (% Open) – Set the desired start position of the actuator to enable the engine to start. The actuator will go to this position upon timeout of the purge timer and remain there until the minimum control RPM is reached. Once the minimum control rpm (section 12.4) is reached the warmup sequence commences. The range is 0 to 100%. Note that the Startup Actuator Position can be continuously written to when used with a PLC. This can allow for different throttle positions for engine start.



13.7 WARMUP TIMERS
There are three warmup timers, Timers 1 – 3. The warmup timers can be used to set the RPM to fixed values before the load is applied. The warmup period will last for the duration timer value configured for each timer and use each timers' configured ramp rate to reach the timers' target RPM. Upon completion of each timer the RPM will progress to the next warmup timer. If no warmup timers remain the speed will progress to the load target run speed. The timer sequence follows the timers in progression from 1 to 3. Each timer can be enabled or disabled and configured independantly.

13.8 TIMER X ENABLED – Each timer can be individually configured to be used for the application (set to ON) or disabled (OFF).

13.9 TIMER X TARGET (RPM) – Insert the desired target RPM for the respective timer. The GOV+ will use the ramp rate configured to reach the configured warmup target RPM. The RPM range is derived from two previously set configuration values; the minimum RPM from the Minimum Control RPM and the maximum RPM from the configured Overspeed Shutdown setpoint.

13.10 TIMER X DURATION (seconds) – Once the warmup timer x RPM is reached the RPM will remain at that RPM for the timer x duration.

13.11 TIMER X RAMP RATE (RPM/s) – The ramp rate is used to accelerate the engine speed to the target RPM at the configured ramp rate.

13.12 REMOTE SPEED CONTROL (Ain1)
Remote Speed Control Input is used when an external speed control setpoint is desired. The external control input is Ain1 on the GOV+. The max input range is 0 to 24mA or 0 to 5 volts. Run range is from 2mA to 22mA. External control can be from a potentiometer, an Altronic 581602 Manual Timing Box, or other sources. Please note that Ain1 has an internal 200 ohm shunt resistor on its input.

13.13 REMOTE SPEED CONTROL ENABLE – When remote speed control is desired for the application enable remote speed control(set to ON) or when not desired disable (set to OFF).

13.14 REMOTE SPEED Range – The Remote Speed Range Input RPM Range is the desired adjustment range of the remote input speed control device. For example if the desired lower value is 700 RPM and the desired upper value is 900 RPM the GOV+ will allow adjustment in that range only. Note that the max allowable range comes from previous selected values that are part of the General Setup configurables. The lower value comes from the Minimum Control RPM and the upper value comes from the Overspeed Setpoint value.

13.15 REMOTE FILTER – The Remote Filter is used to stabilize the input from a changing input. The filter is an adjustable dynamic software filter that can be set from 0 to 254. 0 being no filter, 254 being max filter. A good starting filter value is 240.

13.16 LOCAL SPEED CONTROL RPM – The local speed control RPM is dual function.
When the Remote Speed Control is turned off the GOV+ uses the Local Speed Control value as its Speed Control Setpoint. The local speed control uses the Ramp to Local Speed (RPM/s) for the ramp rate.

When the Remote Speed Control is turned on and if the input goes beyond its range (below 2mA or above 22mA) the GOV+ will go to the value configured in the Local Speed Control setpoint. If configured to Alarm, an alarm will be triggered and switch #1 will turn on indicating Remote Speed Out of Range. See: Map Alarm section below.

13.17 RAMP TO LOCAL SPEED (RPM/s) – The Ramp to Local Speed rate is used to accelerate the engine speed to the target RPM at the configured rate.

13.18 WARMUP/COOLDOWN (Activated by DIN1)
The Warmup/Cooldown is activated by input Din1. Din1 is a discrete input that is pulled up to 3.3 volts internally by a 10K resistor. It requires a dry contact for operation. It can be configured to be active either closed or open. If Din1 is enabled and if Din1 is activated, the GOV+ will attempt to control the engine to the warmup/cooldown setpoint.

The Warmup/Cooldown function can be used in several different means.

a. The Warmup/Cooldown can be used in place of Warmup timers 1-3 if the requirement is to warm up the engine until a temperature is reached, for example using oil temperature. An oil temperature contact can be used; when the oil temperature is below the desired oil temperature the engine will run at the configure warm up speed. When the oil is determined to be at proper run temperature, the oil switch will close its contact transferring control to the engine run speed control setpoint.
b. The Warmup/Cooldown can be used for a cool down sequence. The warm up timers 1-3 can be used for warm up. If cooldown mode is desired, Din1 can be activated at any time and the GOV+ will advance to the configured cool down speed value. The engine speed will remain at the cooldown setpoint until the engine is shut down and Din1 is deactivated.

13.19 ALARM OUTPUT AND MAP ALARM - There are two output switches, switch 1 is used as the Alarm Output. The alarm output can be used as a notification of several conditions. Those conditions are listed below. Switch 1 can be set to be enabled or disabled, latching or non-latching, and shelf or failsafe.

13.20 ALARM SWITCH ENABLED – Alarm switch 1 can be enabled (ON) or set to off. When set to off, sw1 will not change states.

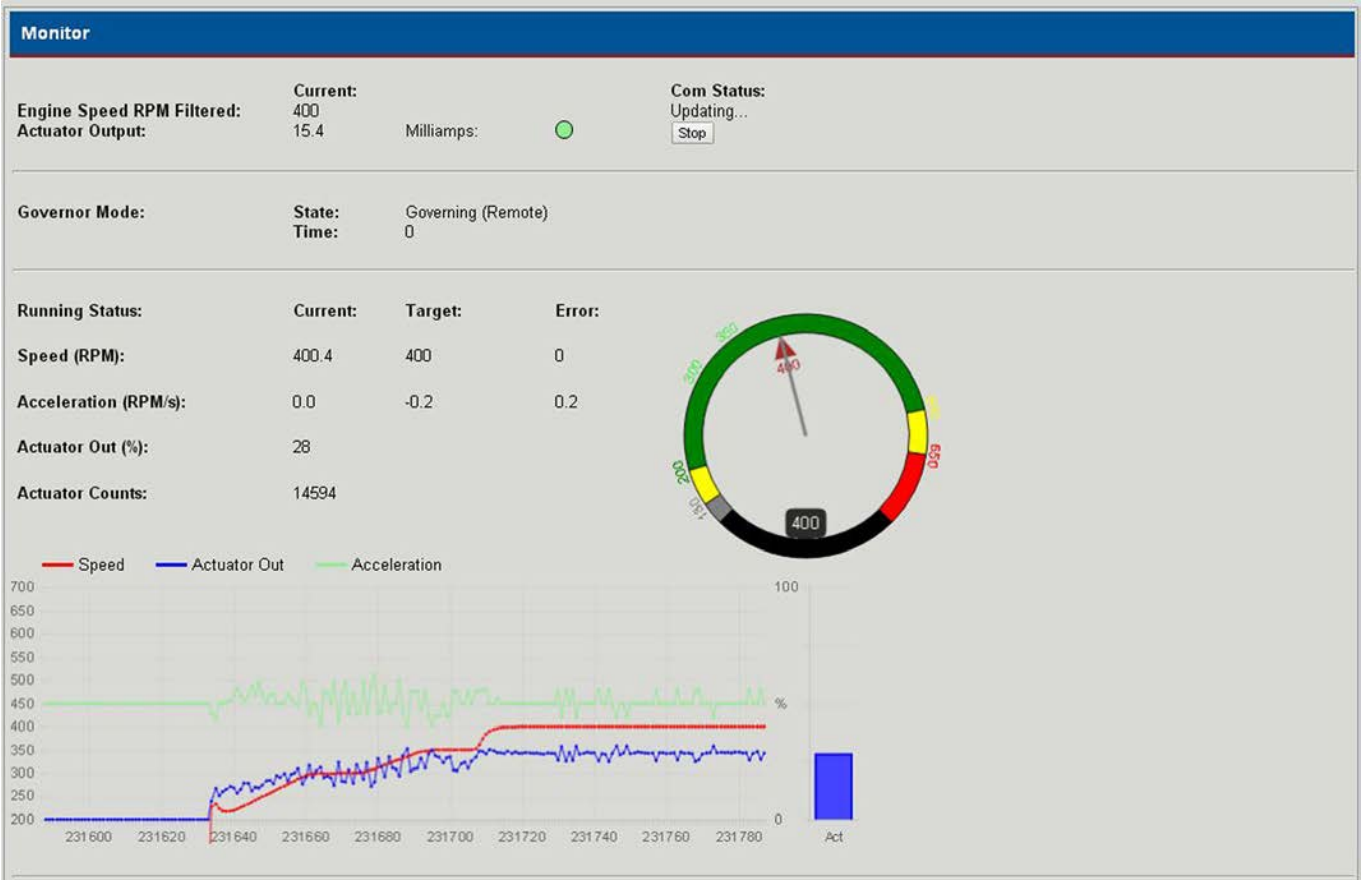
13.21 ALARM SWITCH LATCHING – In non-latching mode, the output switch changes state when the alarm comes out of violation. In latching mode, a reset event is required to clear the switches from the tripped state. Unpowered state switch 1 is closed.

13.22 ALARM SWITCH FAILSAFE - Shelf state is when the outputs are in the same condition with no faults as when unpowered; failsafe is when they are opposite.

13.23 MAP ALARM – Switch 1 can be mapped to the following conditions. It can be mapped to one, two, etc, or all of them.

a. Alarm on Voltage out-of-range
b. Alarm on Governor Limit
c. Alarm on Braking
d. Alarm on Underspeed (no latch)
e. Alarm on Remote Speed OOR

14.0 Monitor



14.1 The Monitor page data can be used to commission and view the status of the GOV+. The monitor page data can be viewed on a PC via the on-board web page or on a HMI mounted in the panel. Values under the "Current" column show the current status for each function. Where applicable, target values are the desired values and the error values are the difference between the two. "Com Status" will show "updating..." when data is being updated.

The definition of each indicator is as follows:

Gray — not active or below setpoint
Green — active or occurring
Yellow — alarm or caution
Red — fault or shutdown

The following functions and their conditions can be viewed.

14.2 ENGINE SPEED RPM FILTERED
Shows the current filtered engine speed.

14.3 ACTUATOR OUTPUT

a. The current actuator output value is shown along with the units.
b. Units of measure for the actuator. If in current loop out mode, milliamps; if in voltage out mode, volts.
c. The status indicator will show green when the actuator output is in compliance. The status indicator will show red, if when in current mode, the loop opens, or in voltage mode, an overcurrent condition occurs.

14.4 STOP BUTTON
Can be used to halt actuator control and place the actuator in the 0% open position.

14.5 GOVERNOR MODE

STATE – Shows the current state of the GOV+ system.

a. Stopped – Permissive input (Din2) is open or a fault condition is occurring
b. Ready – System is reset and ready to start, no rotation is sensed
c. Rotating – Engine is being cranked
d. Starting – Starting shows if purging is disabled
e. Purging – In the purging state
f. Warmup 1, 2, 3 – In one of the warmup modes
g. Governing – Governing (Local) Controlling to the internal desired speed control setpoint value

   Governing (Remote) Controlling to the remote speed control setpoint value (input from Ain1)

TIME – Time will show the warmup timer countdown values. When the timers expire, "Not Met" will display indicating that the system is ramping to the next setpoint via the ramp rate configured and has not yet reached it.

14.6 RUNNING STATUS:

The running status shows the current value, the target value, and the error value for each parameter. The parameters are Speed (RPM), Acceleration (RPM/s), and Actuator out (%).

a. Current – The actual value being read at that time.
b. Target – The target value is the desired setpoint value that the GOV+ is trying to attain.
c. Error – The error is the difference between the current and target values.

14.7 GAUGE

The gauge shows the current RPM. The configured setpoints are shown on the perimeter of the gauge. The states of the GOV+ are color coded to easily see the configured RPM ranges from stop through overspeed.

a. Stop – Black
b. Purge – Gray
c. Yellow – Start
d. Light Green – Warmup
e. Green – Run Speed
f. Yellow – Run to overspeed
g. Red - Overspeed

14.8 GRAPH

The monitor page displays a running time graph of the Speed (red), Actuator Out (blue), and the Acceleration (green). The graph is updated in one second intervals. The RPM is shown on the left of the graph and the actuator is shown on the right of the graph. The speed range is from the configured minimum control RPM to Overspeed RPM. The actuator range shows 0 to 100% open.

15.0 Monitor Page, GOV+ System Status Indicators and Description

The indicators visually show the status of various parameters of the GOV+ system. Some of the diagnostics have two states, green and gray, others have more states that include yellow and red. Generally the colors have the following meanings:

- Green – OK
- Gray – not active
- Yellow – Alarm condition
- Red – Stopped or fault condition

NOTE: If the external current loop value is below 2mA or above 22mA the Target (RPM) label value will show "Low" or "High".

15.1 Remote Speed Control (A1)

a. Current (mA): – This is the current read on the analog input A1.

b. Target (RPM): – This is the target RPM value set by the external current loop or potentiometer control.

15.2 System Voltages – The supply voltage and the actuator voltage (voltage to the actuator driver) are displayed. The status will show "Ok" if the input voltage is within 12 to 35 volts.

15.3 System Status – The diagnostic bits are used to view the GOV+ System Status.

a. Warmup/Cooldown Input Status – Indicates the GOV+ system is in the Warmup/ Cooldown mode; (Din1) input is open or closed

b. Permissive Input Not Grounded – Indicates if the permissive input is not grounded (Din2).

c. Any Mapped Alarm Active (SW1) – Indicates if any of the mapped alarm conditions are occurring.
d. Shutdown Switch Closed (SW2) – Indicates if output switch SW2 is closed for run or open for shutdown
e. Fault (Any) – Indicates if any faults are occurring.
f. Actuator Power Supply Faulted – Indicates if the internal - voltage out actuator switch - has drive voltage above 12.5 volts.

15.5 Governor Status – The diagnostic bits are used to view the GOV+ operation status.

a. Engine Rotating – Indicates that the input pickup signal senses rotation
b. Speed Under Control RPM – Indicates that the RPM sensed is below the configured Minimum Control RPM
c. Speed above Crank RPM (Act En) – Indicates that the actuator is above the configured crank speed
d. Purge Timer Active – Indicates that the GOV+ is in purge mode
e. Governor Active – Indicates that the speed sensed is above the configured Minimum Control RPM
f. Warmup Timer 1 Active – Indicates that the GOV+ is turned on and in warmup timer 1 mode
g. Warmup Timer 2 Active – Indicates that the GOV+ is in warmup timer 2 mode
h. Warmup Timer 3 Active – Indicates that the GOV+ is in warmup timer 3 mode
i. Remote Speed Control (Ain1) – Indicates that there is a valid current between 2mA and 22mA on the Ain1input
j. Warmup Cooldown Active (Din1) – Indicates that the GOV+ is in Warmup/ Cooldown mode.

Note: The indicators and bits for Warmup timers 1-3, if configured on, will be on until each of them time out.

15.6 Upon a stop condition, either by a fault condition from the GOV+ or a stop command from either the external permissive switch or the stop command bit, the GOV+ takes a snapshot of the current GOV+ conditions. This allows the user to determine what caused the shutdown. The diagnostic information is available from the Monitor screen of the onboard website. The diagnostic bits are also available through communications. Note that a normal controlled shutdown does not trigger the diagnostic stop data.

15.7 When a fault stop condition occurs the “Fault (Any)” indicator will turn red and “Retrieve Stop Data” will be displayed. Select “Retrieve Stop Data” to view a snap shot of the data upon a GOV+ stop command or a fault stop condition.

15.8 Using the Clear button – The Clear button can be used to clear or reset the fault stop condition(s). This will clear the faults in the GOV+ and allow the engine to be restarted.

15.9 Using the Unlatch button – The Unlatch button can be used to unlatch or reset the alarm output switch SW1 if set to latching in the Alarm output configuration. If the alarm output switch is set to Non-Latching the alarm output switch will self-clear.

15.10 Stop Conditions – The indicators are latched in the state that they were in for a fault stop or forced stop condition. Gray indicates the condition was not occurring, yellow indicates an alarm condition was occurring, and red indicates a fault condition during a GOV+ stop command or a fault stop condition.

a. Fault (Any) – indicates the permissive opened or the stop bit was activated
b. Permissive Input not Grounded - indicates the permissive switch opened (Din2) or the stop bit was activated
c. Remote Stop Requested – The stop command was initiated by either a PC or PLC
d. Actuator Output Fault – A fault occurred on the configured actuator output signal type (voltage or current).
e. Overspeed Fault – The RPM sensed was over the configured overspeed setpoint

15.11 Stop Data – A snapshot of the analog values are displayed for a GOV+ stop command or a fault stop condition. The Current value, Target value and Error between the two are displayed.

a. Speed – Shows the RPM read, target RPM, and the difference when the fault occurred
b. Acceleration - Shows the acceleration read, target acceleration, and the difference when the fault occurred
c. Actuator out – Shows the actuator position in percent and either the current or voltage when the fault occurred

15.12 Stop State - The indicators are latched in the state that they were in for a fault stop or forced stop condition. Gray indicates the condition was not occurring, green indicates it was functioning properly, and yellow indicates an alarm condition during a GOV+ stop command or a fault stop condition.

a. Alarm Out Active – Indicates that an alarm condition was occurring during the capture
b. Actuator Status – Indicates that the actuator was in control mode during the capture

c. Purging Timer Active – Indicates that the System was in the purge state during the capture
d. Governing – Indicates that the System was in the governing state during the capture
e. Braking – Indicates that braking was active during the capture
f. Max Authority – Indicates that the Actuator was at 100% open during the capture
g. Speed Under Control RPM – Indicates that the RPM sensed was below the configured minimum control RPM during the capture
h. Warmup Timer 1 Active – Indicates that the System was in the Timer 1 state during the capture
i. Warmup Timer 2 Active – Indicates that the System was in the Timer 2 state during the capture
j. Warmup Timer 3 Active – Indicates that the System was in the Timer 3 state during the capture
k. Remote Speed Control Active – Indicates that the remote speed control was active during the capture
l. Warmup/Cooldown Active – Indicates that the System was in the Warmup/Cooldown mode during the capture
m. Target Met – Indicates that the RPM target was met during the capture
n. Supply Voltage OOR – Indicates that the System voltage was outside of the range of 10V to 32V during the capture
o. Actuator Voltage OOR – Indicates that the internal supply voltage to the actuator is below 12.5 volts during the capture. Applicable when configured for voltage actuator mode

16.0 EtherNet/IP and Modbus/TCP

16.1 The GOV+ Speed Governor Module is part of a system designed to easily interface to popular PLCs, SCADA systems and computers. The GOV+ has two user-selectable communication protocols, EtherNet/IP and Modbus/TCP. The built-in WEB SERVER is used to select the protocol. See section 13.0 PROTOCOL SETTINGS to select the protocol.

16.2 EtherNet/IP – Ethernet Industrial Protocol is Ethernet combined with an industrial application layer protocol targeted to industrial PLCs. The EtherNet/IP protocol is used by Allen Bradley in their Compact Logix and Control Logix PLCs. The EtherNet/IP is used in many other PLC manufacturers as well.

16.3 The data for EtherNet/IP is arranged as a collection of objects. Objects divide the functionality of a device into logically related subsets. This collection of related data values and common elements of the device make up its object model.

17.0 EtherNet/IP Object Models

17.1 The following Objects are used in the GOV+.

OBJECT (ID)	TYPE
Identity (01h)	Required
Message Router (02h)	Required
Assembly (04h)	Device-specific
Connection Manager (06h)	Required
TCP Object (F5h)	Required
Ethernet Link Object (F6h)	Required
QoS (48h)	Pre-defined
Parameter (0Fh)	Pre-defined
Parameter Group (10h)	Pre-defined
Group (12h)	Pre-defined
File (37h)	Pre-defined
config (6Dh)	Vendor Specific
status (6Eh)	Vendor Specific

17.2 **Identity Object (01h – 1 instance)**
The identity object provides identification of, and general information about, the GOV+.

ATTR ID	NAME	DATA TYPE	DATA VALUE	Access RULE
Class Attributes				
1	Revision	UINT	1	GET
Instance Attributes				
1	Vendor Number	UINT	1250_{DEC}	GET
2	Device Type, Generic	UINT	$2b_{HEX}$	GET
3	Product Code Number	UINT	$27DA_{HEX}$	GET
4	Product Major Revision Product Minor Revision	USINT USINT	02 30	GET
5	Status Word (see definition below)	WORD	See Below	GET
6	Product Serial Number (unit mac address)	UDINT	Unique 32 Bit Val	GET
7	Product Name Structure of: Product Name Size Product Name String	 USINT USINT[0-32]	 7 “GOVPlus”	GET

Status Word

Bit	Bit = 0	Bit = 1
0	No I/O Connection	I/O Connection Allocated
1-15	Unused	Unused

Common Services

SVC CODE	IMPLEMENTED FOR		SERVICE NAME
	CLASS LEVEL	INSTANCE LEVEL	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single

Common Services (continued)			
05_{HEX}	No	Yes	Reset

Reset Service Code

SVC CODE	CLASS	INSTANCE	DATA[1]	DESCRIPTION
05h	01h	01h	00h	Force software reset.
05h	01h	01h	01h	Reload factory settings and reset.

[1] This device requires that the attribute be left blank and that the valve be entered in the data field.

17.3 Message Router Object (02h)

The message router object provides a messaging connection point through which a client may address a service to any object class or instance residing in the GOV+.

The GOV+ has no supported attributes.

17.4 Assembly Object (04h)

The Assembly Object binds attributes of multiple objects, which allows data to or from each object to be sent or received over a single connection. Assembly objects can be used to bind input data or output data. The terms "input" and "output" are defined from the network's point of view. An input will produce data on the network and an output will consume data from the network.

ATTR ID	NAME	DATA TYPE	DATA VALUE	ACCESS RULE
Class Attributes				
1	Revision	UINT	1	GET
2	Max Instance	UINT	255	GET
Instance 64H Attributes (Input Instance 1)				
3	Input Data (T->O)	INT[12]	See below	GET
Instance 65H Attributes (Output Instance 1)				
3	Output Data (O->T)	INT[4]	See below	SET
Instance 66H Attributes (Configuration Instance)				
3	Configuration (CFG)	SINT[48]	See below	SET
Instance FDH Attributes (Output Only Instance)				
This instance allows clients to produce output data without monitoring the input data.				
Instance FEH Attributes (Input only Instance)				
This instance allows clients to control the input without providing output data.				
Instance FFH Attributes (Heartbeat Instance – Listen Only)				
This instance allows clients to monitor input data without providing output data.				
Common Services				

SVC CODE	IMPLEMENTED FOR		SERVICE NAME
	CLASS LEVEL	INSTANCE LEVEL	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
05_{HEX}	No	Yes	Reset

17.5 Input Assembly Data "Target to Originator" (T->O)

INDEX	NAME	EQUIV MODBUS REGISTER
0.0	Reserved	10001
0.1	Reserved	10002

INDEX	NAME	EQUIV MODBUS REGISTER
0.2	CPU Supply Low	10003
0.3	CPU Supply High	10004
0.4	Analog Supply Low	10005
0.5	Analog Supply High	10006
0.6	Actuator Drive Voltage Low	10007
0.7	Actuator Drive Voltage High	10008
0.8	Supply Voltage Low	10009
0.9	Supply Voltage High	10010
0.10	Auxiliary Input 2 Signal Low	10011
0.11	Auxiliary Input 2 Signal High	10012
0.12	Reserved	10013
0.13	Reserved	10014
0.14	Demand Input Signal Low	10015
0.15	Demand Input Signal High	10016
1.0	Cooldown Input Status	10017
1.1	Permissive Input not Grounded	10018
1.2	Current Loop Open Detected	10019
1.3	SW1 Enabled (echo)	10020
1.4	SW1 Latching (echo)	10021
1.5	SW1 Failsafe (echo)	10022
1.6	Reserved	10023
1.7	Engine Rotating	10024
1.8	Alarm Output Activated	10025
1.9	Shutdown Output Closed	10026
1.10	Auxiliary Output out-of-range	10027
1.11	Target Met	10028
1.12	Reserved	10029
1.13	Reserved	10030
1.14	Actuator Drive Voltage Active	10031
1.15	Actuator Drive Voltage Fault	10032
2.0	Braking	10033
2.1	Watchdog Failure Detected	10034
2.2	Calibration Mode Enabled	10035
2.3	Reserved	10036
2. 4	Actuator Output Enabled	10037
2.5	Governing	10038
2.6	Timer 1 Active	10039
2.7	Timer 2 Active	10040
2.8	Timer 3 Active	10041
2.9	Purge timer Acvtive	10042
2.10	Warmup/Cooldown Active	10043
2.11	Governor Max Authority Reached	10044
2.12	Demand Target Active	10045
2.13	PLC Setpoint Active	10046
2.14	Actuator Drive Voltage OK	10047

INDEX	NAME	EQUIV MODBUS REGISTER
2.15	Reserved	10048
3.0	Auxiliary Output Alarm	10049
3.1	Actuator Output Faulted	10050
3.2	Overspeed Fault	10051
3.3	Speed Below Governing	10052
3.4	Stopped	10053
3.5	Remote Stop Requested	10054
3.6 Thru 3.15	Reserved	10055 Thru 10064
4	State Time (now) [1]	30006
5		
6,7	Engine Acceleration 1	30007
8,9	Speed (Filtered) 2	30008
10,11	Speed (Unfiltered) 1	30009
12,13	Demand Input (Ain1) 1	30010
14,15	Aux Input (Ain2) 1	30011
16,17	Current Loop Output 1	30012
18,19	Voltage Output 1	30013
20,21	Supply Voltage 1	30014
22,23	Actuator Drive Voltage 1	30015
24,25	Analog Supply Voltage 1	30016
26,27	CPU Voltage 1	30017
28,29	Output Voltage Sensed 1	30021
30,31	Target RPM from Demand Input 2	30019
32	% CPU Usage (approximate)	30018
33	Governor State	30020
34,35	Speed target now 1	30026
36,37	Acceleration Target now 1	30028
38,39	Acceleration Error now 1	30029
40	RPM Error	30027
41	Actuator Position Output	30025
42,43	Actuator Counts now 2	30024
44 Thru 47	Reserved	30031 Thru 30032
48	Communications Status	***
49	Reserved	***
50,51	Auxiliary Output Echo Back 1	40065

[1] Actual value is a REAL and can be copied to a corresponding UDT
[2] Actual value is a DINT and can be copied to a corresponding UDT

17.6 Output Assembly Data "Originator to Target" (O->T)

INDEX	NAME	MIN	MAX	DEFAULT	EQUIV MODBUS REG
0,1	Target RPM 2	0	65000	0	40066
2	Starting Actuator Position	0	100	50	40048
3	Status Control	-32768	32767	0	***
0.0	Governor Enabled	0	1	0	00017
0.1 Thru 0.12	Reserved	0	1	0	00018 Thru 00029
0.13	Alarm Output Failsafe	0	1	0	00030
0.14	Alarm Output Latching	0	1	0	00031
0.15	Alarm Output Enabled	0	1	0	00032
5	Reserved	0	1	0	***
6,7	Auxiliary Output 1	0	1	0	***
8,9	Reserved 2	0	1	0	***
10,11	Reserved 2	0	1	0	***

[1] Actual value is a REAL and can be copied to a corresponding UDT
[2] Actual value is a DINT and can be copied to a corresponding UDT

17.7 Configuration Assembly Data

INDEX	NAME	MIN	MAX	DEFAULT	EQUIV MODBUS REG
0.0 Thru 0.7	Reserved (Bits)			0	00001 thru 00008
1.0 Thru 1.3	Reserved			0	00009 Thru 00012
1.4	Current Loop 0-24/4-20			0	00013
1.5	Control Output Current loop/Voltage			0	00014
1.6	Reserved			0	00015
1.7	Reserved			0	00016
2.0	Timer 1 Enabled			0	00033
2.1	Timer 2 Enabled			0	00034
2.2	Timer 3 Enabled			0	00035
2.3	Warmup/Cooldown (DI1) Enabled			0	00036
2.4	Warmup/Cooldown (DI1) Active			0	00037
2.5	Demand (Ain1) Enabled			0	00038
2.6	Purge Timer Enabled			0	00039
2.7	Reserved			0	00040
3.0	Alarm on Supply out-of-range			0	00041
3.1	Alarm on Aux Output Failure			0	00042
3.2	Alarm on Governor Limit			0	00043
3.3	Alarm on Braking			0	00044
3.4	Alarm on Underspeed			0	00045
3.5	Alarm on Remote Speed out-of-range			0	00046
3.6	Alarm on Ain2 out-of-range			0	00047
3.7	Reserved			0	00048

INDEX	NAME	MIN	MAX	DEFAULT	EQUIV MODBUS REG
4	RPM Filter	0	254	240	40005
5					
6	Gear Teeth [3]	1	1000	360	40009
7					
8	Start Speed [2,3]	0	65000	150	40006
9					
10					
11					
12	Crank Speed [2,3]	0	65000	50	40045
13					
14					
15					
16	Overspeed [2,3]	0	65000	2000	40008
17					
18					
19					
20	Warmup Target 1 [2]	0	65000	0	40049
21					
22					
23					
24	Warmup 1 Ramp Rate	1	1000	50	40053
25					
26	Warmup 1 Duration	0	999	0	40019
27					
28	Warmup Target 2 [2]	0	65000	0	40050
29					
30					
31					
32	Warmup 2 Ramp Rate	1	1000	50	40054
33					
34	Warmup 2 Duration	0	999	0	40020
35					
36	Warmup Target 3 [2]	0	65000	0	40051
37					
38					
39					
40	Warmup 3 Ramp Rate	1	1000	50	40055
41					
42	Warmup 3 Duration	0	999	0	40021
43					

INDEX	NAME	MIN	MAX	DEFAULT	EQUIV MODBUS REG
44	Cooldown Target [2]	0	65000	0	40052
45					
46					
47					
48	Cooldown Ramp Rate	1	1000	50	40056
49					
50	Purge Time	0	999	5	40046
51					
52	Purge Actuator Position	0	100	0	40047
53					
54	Acceleration Limit	1	500	30	40026
55					
56	Acceleration Gain	1	255	180	40027
57					
58	Brake Percent	1	99	15	40029
59					
60	Max Acceleration Rate [1]	0.5	99.99	20	40024
61					
62					
63					
64	Acceleration Error Limit [1]	0.5	168.83	20	40025
65					
66					
67					
68	Reset Rate [1]	0.01	9.99	0.3	40026
69					
70					
71					
72	Remote RPM @4mA Input [2]	0	65000	0	40043
73					
74					
75					
76	Remote RPM @20mA Input [2]	0	65000	0	40044
77					
78					
79					
80	Remote Demand RPM Filter	0	254	245	40014
81					
82	Ramp to Operating Target	1	1000	50	40057
83					

INDEX	NAME	MIN	MAX	DEFAULT	EQUIV MODBUS REG
84	Actuator Output at 0% [1,3]	Depends on actuator Configuration			40034
85					
86					
87					
88	Actuator Output at 100% [1,3]	Depends on actuator Configuration			40035
89					
90					
91					

Actual values are INT unless otherwise specified and can be copied to a corresponding UDT
[1] Actual value is a REAL and can be copied to a corresponding UDT
[2] Actual value is a DINT and can be copied to a corresponding UDT
[3] This can't be sent while engine is rotating

17.8 Connection Manager Object (O6h)

This object is used for connection and connectionless communication, including establishing connections across multiple subnets.

17.9 TCP/IP Interface Object (F5h – 1 instance)

The TCP/IP Interface Object provides the mechanism to configure a device's TCP/IP network interface. Examples of configurable items include the device's IP Address, Network Mask, and Gateway Address.

ATTR ID	NAME	DATA TYPE	DATA VALUE	Access RULE
Class Attributes				
1	Revision	UINT	1	GET
Instance Attributes				
1	Status[1]	DWORD	1	GET
2	Configuration Capability[2]	UINT[]	5	GET
3	Configuration Control[3]		0	GET
4	Physical Link Object[4]-			GET
	A Structure of:			
	Path Size	UINT	2	
	Path	Array of WORD	20F6H.. 2401H	
5	Interface Configuration[5]			GET
	A Structure of:			
	IP Address	UDINT	0	
	Network Mask	UDINT	0	
	Gateway Address	UDINT	0	
	Name Server	UDINT	0	
	Name Server 2	UDINT	0	
	Domain Name Size	UINT	0	
	Domain Name	STRING	0	
6	Host Name[6]			GET
	A Structure of:			
	Host Name Size	UINT	0	
	Host Name	STRING	0	

Common Services			
SVC CODE	IMPLEMENTED FOR		
	CLASS LEVEL	INSTANCE LEVEL	SERVICE NAME
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
10_{HEX}	No	Yes	Set_Attribute_Single

[1] See section 5-3.2.2.1 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on this attribute.
[2] See section 5-3.2.2.2 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on this attribute.
[3] See section 5-3.2.2.3 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on this attribute.
[4] See section 5-3.2.2.4 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on this attribute.
[5] See section 5-3.2.2.5 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on this attribute.
[6] See section 5-3.2.2.6 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on this attribute.

17.10 EtherNet Link Object (F6h – 1 instance)

The Ethernet Link Object maintains link-specific counters and status information for an IEEE 802.3 communications interface.

ATTR ID	NAME	DATA TYPE	DATA VALUE	ACCESS RULE
Class Attributes				
1	Revision	UINT	1	GET
Instance Attributes				
1	Interface Speed[1]	UDINT	100 (default)	GET
2	Interface Flags[2]	DWORD	3 (default)	GET
3	Physical Address[3]	USINT Array[6]	0 default)	GET

Common Services			
SVC CODE	IMPLEMENTED FOR		
	CLASS LEVEL	INSTANCE LEVEL	SERVICE NAME
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single

[1] See section 5-4.2.2.2 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on this attribute.
[2] See section 5-4.2.2.1 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on this attribute.
[3] See section 5-4.2.2.3 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on this attribute.

17.11 QoS Object (48h – 1 instance)

The QoS Object provides a means to configure certain QoS-related behaviors in EtherNet/IP devices.

ATTR ID	NAME	DATA TYPE	DATA VALUE	ACCESS RULE
Class Attributes				
1	Revision	UINT	1	GET
Instance Attributes				
4	DSCP Urgent	USINT	[1]	GET/SET
5	DSCP Scheduled	USINT	[1]	GET/SET
6	DSCP High	USINT	[1]	GET/SET
7	DSCP Low	USINT	[1]	GET/SET
8	DSCP Explicit	USINT	[1]	GET/SET

Common Services			
SVC CODE	IMPLEMENTED FOR		
	CLASS LEVEL	INSTANCE LEVEL	SERVICE NAME
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
10_{HEX}	No	Yes	Get_Attribute_Single

[1] See section 5-6.4.2 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on these attributes.

17.12 Parameter Object (0Fh – 208 instances)

The parameter object along with the parameter group and group objects provide an alternate path to the data provided by the vendor specific objects: "config" and "status".

ATTR ID	NAME	DATA TYPE	DATA VALUE	ACCESS RULE
Class Attributes				
1	Revision	UINT	1	GET
2	Max Instance ID	UINT	30	GET
3	Number of Instances	UINT	30	GET
4	Attribute List	UINT,UINT[]	15,[7-21]	GET
5	Service List	UINT,UINT[]	1,[1]	GET
6	Max Object Attribute ID	UINT	9	GET
7	Max Instance Attribute ID	UINT	21	GET
8	Parameter Class Descriptor	WORD	0000000000001011b	GET
9	Configuration Assembly Instance	UINT	0	GET
Instance Attributes				
1	Parameter Value	[data type]	See Tables below	GET/SET
2	Link Path Size	USINT		GET
3	Link Path	Packed EPATH		GET
4	Descriptor	WORD	[1]	GET
5	Data Type	USINT	Refer to referenced data	GET
6	Data Size	USINT		GET
7	Parameter Name String	SHORT_STRING	*Same as "Tag" for referenced item*	GET
8	Units String	SHORT_STRING	*Same as "Tag" for referenced item*	GET
9	Help String	SHORT_STRING	*Same as Get_Label service for referenced item*	GET
10	Minimum Value	[data type]	Refer to referenced data	GET
11	Maximum Value	[data type]		GET
12	Default Value	[data type]		GET
13	Scaling Multiplier	UINT	1	GET
14	Scaling Divisor	UINT	1	GET
15	Scaling Base	UINT	1	GET
16	Scaling Offset	INT	0	GET
17	Multiplier Link	UINT	0	GET
18	Divisor Link	UINT	0	GET
19	Base Link	UINT	0	GET

ATTR ID	NAME	DATA TYPE	DATA VALUE	ACCESS RULE
20	Offset Link	UINT	0	GET
21	Decimal Precision	USINT	0	GET

Common Services

SVC CODE	IMPLEMENTED FOR		SERVICE NAME
	CLASS LEVEL	INSTANCE LEVEL	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
10_{HEX}	No	Yes	Get_Attribute_Single
01_{HEX}	No	Yes	Get_Attribute_All

17.13 **"Config" Object Parameter Mapping (Group Instance 1)**
Instance (Parameter Group Instance)

Attribute	1 (1)
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15

Attribute	1 (1)
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
25	25
26	26
27	27
28	28
29	29
30	30

Attribute	1 (1)
31	31
32	32
33	33
34	34
35	35
36	36
37	37
38	38
39	39
40	40
41	41
42	42
43	43
44	44
45	45

Attribute	1 (1)
46	46
47	47
48	48
49	49
50	50
51	51

17.14 **"Status" Object Parameter Mapping (Group Instance 2)**
Instance (Parameter Group Instance)

Attribute	1 (2)
1	52
2	53
3	54
4	55
5	56
6	57
7	58
8	59
9	60
10	61
11	62
12	63

Attribute	1 (2)
13	64
14	65
15	66
16	67
17	68
18	69
19	70
20	71
21	72
22	73
23	74
24	75

Attribute	1 (2)
25	76
26	77
27	78

17.15 **Parameter Group Object (10h – 41 instances)**
The parameter object along with the parameter group and group objects provide an alternate path to the data provided by the vendor specific objects: “Sensor”, “Speed”, and “Log”.

ATTR ID	NAME	DATA TYPE	DATA VALUE	ACCESS RULE
Class Attributes				
1	Revision	UINT	1	GET
2	Max Instance ID	UINT	1	GET
3	Number of Instances	UINT	1	GET
4	Attribute List	UINT,UINT[]	0	GET
5	Service List	UINT,UINT[]	1,[1]	GET
6	Max Object Attribute ID	UINT	6	GET
Instance Attributes				
1	Group Name String	SHORT_STRING	Object name and instance index if applicable: “config” or “status”	GET
2	Number of members in group	UINT	Refer to tables above	GET
3	Parameter Instance of first member	UINT		GET
4-n	Parameter Instance of n^{th} member	UINT		GET

Common Services

SVC CODE	IMPLEMENTED FOR		
	CLASS LEVEL	INSTANCE LEVEL	SERVICE NAME
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
01_{HEX}	No	Yes	Get_Attribute_All

17.16 **Group Object (12h – 2 instances)**
The parameter object along with the parameter group and group objects provide an alternate path to the data provided by the vendor specific objects: “Sensor”, “Speed”, and “Log”.

ATTR ID	NAME	DATA TYPE	DATA VALUE	ACCESS RULE
Class Attributes				
1	Revision	UINT	1	GET
2	Max Instance ID	UINT	1	GET
3	Number of Instances	UINT	1	GET
4	Attribute List	UINT,UINT[]	6,[1-4,6-7]	GET
5	Service List	UINT,UINT[]	1,[1]	GET
6	Max Object Attribute ID	UINT	7	GET
7	Max Instance Attribute ID	UINT	7	GET
Instance Attributes				
1	Number of Attributes	USINT	See tables above	GET
2	Attribute List	USINT[]		GET
3	Number of bound instances	USINT		GET
4	Binding	Array of: UINT: Class ID UINT: Instance ID		GET
6	Owner Vendor ID	UINT	1250	GET

ATTR ID	NAME	DATA TYPE	DATA VALUE	ACCESS RULE
7	Owner – Serial Number	UDINT	This device's serial number (see Identity Object)	GET

Common Services

SVC CODE	IMPLEMENTED FOR		SERVICE NAME
	CLASS LEVEL	INSTANCE LEVEL	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
01_{HEX}	No	Yes	Get_Attribute_All

17.17 **File Object (37h – 2 instances)**
The file object allows easy access to the device EDS and icon files from within a PLC control environment.

ATTR ID	NAME	DATA TYPE	DATA VALUE	ACCESS RULE
Class Attributes				
1	Revision	UINT	1	GET
2	Max Instance ID	UINT	201	GET
3	Number of Instances	UINT	2	GET
4	Attribute List	UINT,UINT[]	1,[11]	GET
5	Service List	UINT,UINT[]	1,[77]	GET
6	Max Object Attribute ID	UINT	32	GET
7	Max Instance Attribute ID	UINT	11	GET
32	Directory	Array of: UINT: Instance Number STRINGI: Instance_Name STRINGI: File_Name	[{200, (ENG)"EDS and Icon Files", (ENG)"EDS.txt"}, {201, (ENG)"Related EDS and Icon Files", (ENG)"EDSCollection.gz"}]	GET
Instance C8H Attributes (EDS file)				
1	State[2]	USINT	2 (Default – Loaded)	GET
2	Instance Name	STRINGI	(ENG)"EDS and Icon Files"	GET
3	Instance Format Version	UINT	1	GET
4	File Name	STRINGI	(ENG)"EDS.txt"	GET
5	File Revision	USINT: Major_Revision USINT: Minor_Revision	0[1] 3	GET
6	File Size	UDINT	8292[1]	GET
7	File Checksum	INT	-20137[1]	GET
8	Invocation Method	USINT	255	GET
9	File Save Parameters	BYTE	00000000b	GET
10	File Type[3]	USINT	1	GET
11	File Encoding Format[4]	USINT	0	GET
Instance C9H Attributes (Icon file)				
1	State[2]	USINT	2 (Default – Loaded)	GET
2	Instance Name	STRINGI	(ENG)"Related EDS and Icon Files"	GET
3	Instance Format Version	UINT	1	GET
4	File Name	STRINGI	(ENG)"EDSCollection.gz"	GET

ATTR ID	NAME	DATA TYPE	DATA VALUE	ACCESS RULE
5	File Revision	USINT: Major_Revision USINT: Minor_Revision	0[1] 8	GET
6	File Size	UDINT	433[1]	GET
7	File Checksum	INT	10478[1]	GET
8	Invocation Method	USINT	255	GET
9	File Save Parameters	BYTE	00000000b	GET
10	File Type[3]	USINT	1	GET
11	File Encoding Format[4]	USINT	1 (compressed)	GET

Common Services

SVC CODE	IMPLEMENTED FOR		SERVICE NAME
	CLASS LEVEL	INSTANCE LEVEL	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
01_{HEX}	No	Yes	Get_Attribute_All
$4B_{HEX}$	No	Yes	Init_Upload
$4D_{HEX}$	No	Yes	Init_Partial_Read
$4F_{HEX}$	No	Yes	Upload

[1] These values are subject to change without notice.
[2] See section 5-42.2 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on this attribute.
[3] See section 5-42.2 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on this attribute.
[4] See section 5-42.8 of "Volume 2: EtherNet/IP Adaptation of CIP™" from ODVA for more details on this attribute.

17.18 Config Object (6Dh – 1 instance)

The Speed Object gives access to the configuration and run-time parameters.

ATTR ID	NAME	DATA TYPE	DATA VALUE (MIN)	DATA VALUE (MAX)	ACCESS RULE
Class Attributes					
1	Revision	UINT	1		GET
2	Max Instance ID	UINT	1		GET
3	Number of Instances	UINT	1		GET
4	Attribute List	UINT,UINT[]	18,[1-18]		GET
5	Service List	UINT,UINT[]	5,[14,16,1,2,76]		GET
6	Max Object Attribute ID	UINT	7		GET
7	Max Instance Attribute ID	UINT	51		GET
Instance Attributes					
1	Current Loop/Voltage Output	BOOL	0	1	GET/SET
2	Current Loop Limit	BOOL	0	1	GET/SET
3	Reserved	BOOL	0	1	GET/SET
4	Switch 1 Enabled	BOOL	0	1	GET/SET
5	Switch 1 Latching	BOOL	0	1	GET/SET
6	Switch 1 Failsafe	BOOL	0	1	GET/SET
7	Stop	BOOL	0	1	GET/SET
8	Warmup Timer 1 Enable	BOOL	0	1	GET/SET
9	Warmup Timer 2 Enable	BOOL	0	1	GET/SET

ATTR ID	NAME	DATA TYPE	DATA VALUE (MIN)	DATA VALUE (MAX)	ACCESS RULE
10	Warmup Timer 3 Enable	BOOL	0	1	GET/SET
11	Cooldown Enable	BOOL	0	1	GET/SET
12	Cooldown Active High	BOOL	0	1	GET/SET
13	Demand Input Enable	BOOL	0	1	GET/SET
14	Purge Timer Enable	BOOL	0	1	GET/SET
15	Alarm on Supply out-of-range	BOOL	0	1	GET/SET
16	Alarm on Auxiliary Output Failure	BOOL	0	1	GET/SET
17	Alarm on Max-Authority	BOOL	0	1	GET/SET
18	Alarm on Braking	BOOL	0	1	GET/SET
19	Alarm on Underspeed	BOOL	0	1	GET/SET
20	Alarm on Demand out-of-range	BOOL	0	1	GET/SET
21	Alarm on Auxiliary Input out-of-range	BOOL	0	1	GET/SET
22	Gearteeth	UINT	0	1000	GET/SET
23	RPM Filter	UINT	0	254	GET/SET
24	Start RPM	UINT	0	65000	GET/SET
25	Crank RPM	UINT	0	999	GET/SET
26	Overspeed RPM	UINT	0	999	GET/SET
27	Actuator output at 0% *1000	UINT	0	24000	GET/SET
28	Actuator output at 100% *1000	UINT	0	24000	GET/SET
29	Purge Delay	UINT	0	999	GET/SET
30	Purge Actuator Position	UINT	0	999	GET/SET
31	Max Acceleration Rate *100	UINT	50	999	GET/SET
32	Max Acceleration Error Limit *100	UINT	50	16383	GET/SET
33	Acceleration Limit RPM	UINT	10	500	GET/SET
34	Gain	UINT	1	255	GET/SET
35	Reset Rate *100	UINT	1	999	GET/SET
36	Braking Percentage	UINT	1	99	GET/SET
37	Warmup 1 Target	UINT	0	65000	GET/SET
38	Warmup 1 Ramp Rate	UINT	1	1000	GET/SET
39	Warmup 1 Duration	UINT	0	999	GET/SET
40	Warmup 2 Target	UINT	0	65000	GET/SET
41	Warmup 2 Ramp Rate	UINT	1	1000	GET/SET
42	Warmup 2 Duration	UINT	0	999	GET/SET
43	Warmup 3 Target	UINT	0	65000	GET/SET
44	Warmup 3 Ramp Rate	UINT	1	1000	GET/SET
45	Warmup 3 Duration	UINT	0	999	GET/SET
46	Cooldown Target	UINT	0	65000	GET/SET
47	Ramp to Cooldown Target	UINT	1	1000	GET/SET
48	RPM Target @4mA Demand	UINT	0	65000	GET/SET

ATTR ID	NAME	DATA TYPE	DATA VALUE (MIN)	DATA VALUE (MAX)	ACCESS RULE
49	RPM Target @20mA Demand	UINT	0	65000	GET/SET
50	Demand Input Filter	UINT	0	254	GET/SET
51	Ramp to Operating Target	UINT	1	1000	GET/SET

Common Services

SVC CODE	IMPLEMENTED FOR		SERVICE NAME
	CLASS LEVEL	INSTANCE LEVEL	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
10_{HEX}	No	Yes	Set_Attribute_Single
01_{HEX}	No	Yes	Get_Attribute_All
02_{HEX}	No	Yes	Set_Attribute_All
$4C_{HEX}$	No	Yes	Get_Label

Service Description for "Get_Label" (4CH)
The "Get_Label" service provides a simple, human readable, description of the data point in question. This service is roughly equivalent to the "Read Label (fn 101, 102, 103, and 104)" service available through Modbus. The request must specify the Attribute ID for which the label is to be read and returns a STRINGI containing the label.

17.19 **Status Object (6Eh – 1 instance)**
The Status Object gives access to the configuration and run-time parameters.

ATTR ID	NAME	DATA TYPE	DATA VALUE (MIN)	DATA VALUE (MAX)	ACCESS RULE
Class Attributes					
1	Revision	UINT	1		GET
2	Max Instance ID	UINT	1		GET
3	Number of Instances	UINT	1		GET
4	Attribute List	UINT,UINT[]	18,[1-18]		GET
5	Service List	UINT,UINT[]	5,[14,16,1,2,76]		GET
6	Max Object Attribute ID	UINT	7		GET
7	Max Instance Attribute ID	UINT	27		GET
Instance Attributes					
1	w1_active	BOOL	0	1	GET
2	w2_active	BOOL	0	1	GET
3	w3_active	BOOL	0	1	GET
4	cd_active	BOOL	0	1	GET
5	dmd_active	BOOL	0	1	GET
6	purging	BOOL	0	1	GET
7	actuator	BOOL	0	1	GET
8	governing	BOOL	0	1	GET
9	braking	BOOL	0	1	GET
10	max_auth	BOOL	0	1	GET
11	met	BOOL	0	1	GET
12	underspeed	BOOL	0	1	GET

ATTR ID	NAME	DATA TYPE	DATA VALUE (MIN)	DATA VALUE (MAX)	ACCESS RULE
13	alarm	BOOL	0	1	GET
14	V24Problem	BOOL	0	1	GET
15	V10Problem	BOOL	0	1	GET
16	VCPUProblem	BOOL	0	1	GET
17	act_out	UINT	0	100	GET
18	target	UINT	0	65000	GET
19	reserved1	UINT	0	0	GET
20	rpm	UINT	0	65000	GET
21	reserved2	UINT	0	0	GET
22	accel	UINT	-32768	32767	GET
23	rpm_err	UINT	-32768	32767	GET
24	acc_target	UINT	-32768	32767	GET
25	acc_err	UINT	-32768	32767	GET
26	act_pos	UINT	0	51200	GET
27	reserved3	UINT	0	0	GET

Common Services

SVC CODE	IMPLEMENTED FOR		SERVICE NAME
	CLASS LEVEL	INSTANCE LEVEL	
$0E_{HEX}$	Yes	Yes	Get_Attribute_Single
01_{HEX}	No	Yes	Get_Attribute_All
$4C_{HEX}$	No	Yes	Get_Label
$4B_{HEX}$	No	Yes	Key_Command

Service Description for "Get_Label" (4CH)
The "Get_Label" service provides a simple, human readable, description of the data point in question. This service is roughly equivalent to the "Read Label (fn 101, 102, 103, and 104)" service available through Modbus. The request must specify the Attribute ID for which the label is to be read and returns a STRINGI containing the label.

Service Description for "Key_Command" (4BH)
The "Key_Command" service provides a method for sending discrete commands to the module. These commands can be used to reset the device state machine, clear, or acknowledge alarms. It provides easy access to anything that requires momentary or event based access. This service provides similar access to the device as the 40068 and 40069 Modbus registers. When using this service, the attribute should be omitted. The message payload is an array as follows:

Index	Data	Data Type
0	Key Command Number	SINT
1	Key Command Compliment[1]	SINT
2	Key Command Argument 1	SINT
3	Key Command Argument 2	SINT

[1] This value is a bitwise inversion of index 0

18.0 Modbus/TCP

Modbus/TCP is Modbus over Ethernet. The registers are listed below.

Location	Label	0	1	Default
Read/Write bits				
00000's	Global Functions			
00001 thru 00012	Reserved			0
00013	Current Loop Range (0-24/4-20)	4-20	0-24	0
00014	Control Output CURRENT/Voltage	Voltage	CURRENT	0
00015 00016	Reserved			0
00017	Stop/RUN	Stop	RUN	0
00018 thru 00029	Reserved			0
00030	Alarm Switch Failsafe	Shelf	FAILSAFE	0
00031	Alarm Switch Latching	Non-Latching	LATCHING	0
00032	Alarm Switch Enabled	Off	ENABLED	0
00033	Timer 1 Enabled	Off	ENABLED	0
00034	Timer 2 Enabled	Off	ENABLED	0
00035	Timer 3 Enabled	Off	ENABLED	0
00036	DIN1 Input Enabled	no	yes	0
00037	DIN1 Input Active HIGH/Low	low	HIGH	0
00038	Remote Speed Control Enable	Off	ENABLED	0
00039	Purge Timer Enabled	Off	ENABLED	0
00040	RESERVED			0
00041	Alarm on Voltage out-of-range	no	yes	0
00042	Alarm on Aux Output failure	no	yes	0
00043	Alarm on Governor Limit	no	yes	0
00044	Alarm on Braking	no	yes	0
00045	Alarm on Underspeed (no latch)	no	yes	0
00046	Alarm on Remote Speed OOR	no	yes	0
00047	Alarm on Aux Loop out-of-range	no	yes	0
00048 thru 00064	RESERVED			0

Location	Label
Read only bits	
10000's	Global Functions
10001	RESERVED
10002	RESERVED
10003	3.3V Power Supply Low
10004	3.3V Power Supply High
10005	5V Power Supply Low
10006	5V Power Supply High
10007	Actuator Power Supply Low
10008	Actuator Power Supply High
10009	24V Power Supply Low
10010	24V Power Supply High
10011	Auxiliary ma Signal Low
10012	Auxiliary ma Signal High
10013	RESERVED
10014	RESERVED
10015	Demand (ma) Signal Low
10016	Demand (ma) Signal High
10017	Warmup/ Cooldown Input Status
10018	Permissive Input Not Grounded
10019	Current Loop Open
10020 - 10023	RESERVED
10024	Engine Rotating
10025	Any Mapped Alarm Active (SW1)
10026	Shutdown Switch Closed (SW2)
10027	Auxiliary Output Out of Range
10028	Target Met
10029	RESERVED
10030	RESERVED
10031	Voltage Output Active
10032	Actuator Power Supply Faulted
10033	Braking
10034	RESERVED
10035	Factory Calibration Enabled
10036	Watchdog Send Inhibit
10037	Speed Above Crank RPM (Act En)
10038	Governor Active
10039	Warmup Timer 1 Active
10040	Warmup Timer 2 Active
10041	Warmup Timer 3 Active
10042	Purge Timer Active
10043	Warmup/Cooldown Active (DIN1)

Location	Label
Read only bits	
10000's	Global Functions
10044	Governer Max Authority Reached
10045	Remote Speed Control (AIN1)
10046	PLC Setpoint Active
10047	Voltage Driver Output On
10048	RESERVED
10049	Auxiliary Output Alarm
10050	Actuator Output Fault
10051	Overspeed Fault
10052	Speed Under Control RPM
10053	Fault (Any)
10054	Remote Stop Requested
10055 thru 10064	RESERVED
Note:	Registers 10065 thru 10080 are captured for a fault stop or forced stop condition
10065	Warmup Timer 1 Active
10066	Warmup Timer 2 Active
10067	Warmup Timer 3 Active
10068	Warmup/Cooldown Active
10069	Remote Speed Ctrl Active
10070	Purging Timer Active
10071	Actuator Status
10072	Governing
10073	Braking
10074	Max Authority
10075	Target Met
10076	Speed Under Control RPM
10077	Alarm Out Active
10078	Supply Voltage OOR
10079	Actuator Voltage OOR
10080	CPU Supply out-of-range

Location	Label
Read only bits	
30000's	Global Functions
30001	mirror of inputs 10016-10001
30002	mirror of inputs 10032-10017
30003	mirror of inputs 10048-10033
30004	mirror of inputs 10064-10049
30005	mirror of inputs 10080-10065
30006	Current state timer S * 10
30007	Engine Acceleration RPM/sec
30008	Engine Speed RPM Filtered
30009	Engine Speed RPM*10 NOW
30010	Demand Signal Input
30011	Aux Signal Input
30012	Current Loop Output
30013	Voltage Output
30014	GOV VOLTAGE 24V volts *10
30015	GOV VOLTAGE 12.5V volts *10
30016	GOV VOLTAGE 5.0V volts *10
30017	GOV VOLTAGE 3.3V volts *10
30018	%CPU Usage (approximate)
30019	Demand Target RPM
30020	Governer State (Enumerated)
30021	GOV VOut Sense volts*10
30022	RESERVED
30023	RESERVED
30024	Actuator Counts NOW
30025	Actuator Position Output
30026	Speed target NOW
30027	RPM error (rpm-sp) NOW RPM
30028	Acceleration Target NOW
30029	Acceleration error NOW
30030	RESERVED
30031	RESERVED
30032	RESERVED
30033	Stop: Actuator Output
30034	Stop: Speed (Inst)
30035	Stop: Acceleration
30036	Stop: Target
30037	Stop: RPM Error
30038	Stop: Acceleration Target

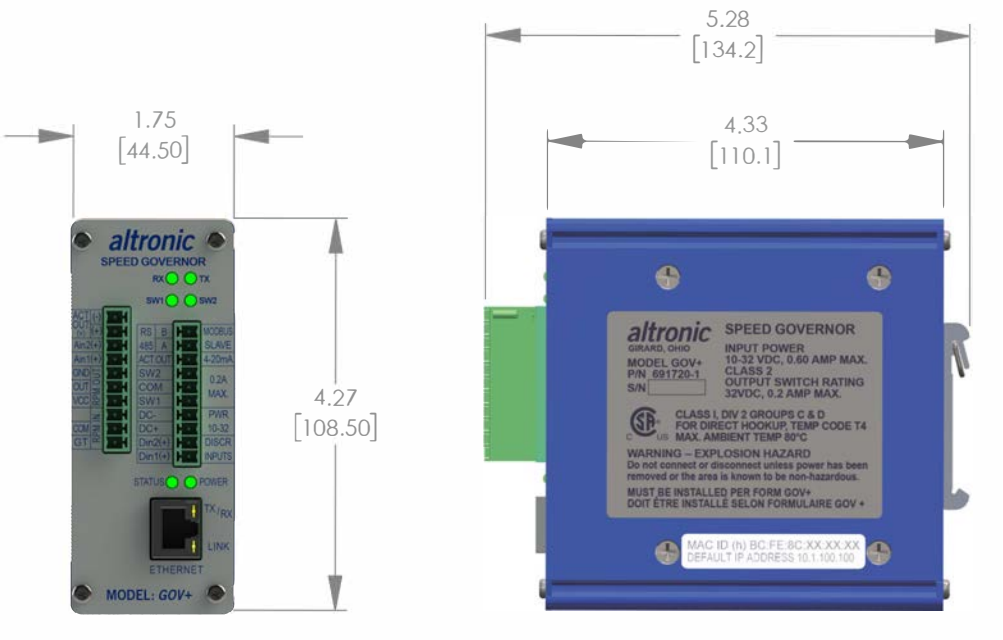
Location	Label
Read only bits	
30000's	Global Functions
30039	Stop: Acceleration error
30040	Stop: Actuator Position Output
30041 thru 30088	RESERVED

Location	Label	Min	Max	Default	Notes
Read/Write bytes					
40000's	Global Functions				
40001	mirror of coils 00016-00001	00000	65535	00000	
40002	mirror of coils 00032-00017	00000	65535	00000	
40003	mirror of coils 00048-00033	00000	65535	00000	
40004	mirror of coils 00064-00049	00000	65535	00000	
40005	RPM Filter	0	254	240	
40006	Minimum Control RPM (warmup)	0	65000	150	
40007	Local Speed Control RPM	0	65000	800	
40008	Overspeed shutdown (Hi-Hi)	0	65000	2000	Cannot be changed while rotating
40009	Gearteeth / Pulses-per-Rev	1	1000	360	Cannot be changed while rotating
40010	KReloadDivider:KToothDly	1	1000	360	Cannot be changed while rotating
40011	KTimeDly	1	255	3	Cannot be changed while rotating
40012	RPM_LB:ACC_LB	257	7681	6401	Cannot be changed while rotating
40013	RESERVED				
40014	Remote Filter 0=No Filter	0	254	240	
40015	AUX Dampener 0-254 0=No Filter	0	254	0	
40016	Default Damp 0-254 0=No Filter	0	254	0	
40017	RESERVED				
40018	RESERVED				
40019	Timer 1 Duration	0	999	0	
40020	Timer 2 Duration	0	999	0	
40021	Timer 3 Duration	0	999	0	
40022	RESERVED				
40023	RESERVED				
40024	Max Accel Rate (RPM/sec)	50	9999	2000	
40025	Accel Error Limit (RPM/sec)	50	16383	2000	
40026	Accel Limit (RPM)	10	500	30	
40027	Gain Accel	1	255	180	
40028	Reset Rate (S)	1	999	40	
40029	Brake Percent	1	99	15	
40030	Voltage Cal .5V (AD cnts)	0	4095	205	
40031	Voltage Cal 8.0V (AD cnts)	0	4095	3276	
40032	Current Loop Cal 20mA(AD cnts)	0	65535	54613	
40033	Current Loop Cal 4mA (AD cnts)	0	65535	10923	
40034	Actuator Output at 0% Open	0	24000	500	
40035	Actuator Output at 100% Open	0	24000	8000	
40036	RESERVED				
40037	RESERVED				
40038	DACO Dampener 0-254 0=NoFilter	0	254	0	
40039	Modbus Baudrate 300-38400	300	57600	9600	
40040	Modbus Node ID (1-248)	1	248	2	
40041	RESERVED				

Location	Label	Min	Max	Default	Notes
Read/Write bytes					
40000's	Global Functions				
40042	RESERVED				
40043	Remote Input RPM @4mA	0	65000	0	
40044	Remote Input RPM @20mA	0	65000	0	
40045	Crank Speed (begin purge)	0	65000	5	
40046	Purge Time 0-999s	0	999	5	
40047	Purge Actuator Pos (%Open)	0	100	0	
40048	Startup Actuator Pos (%Open)	0	100	50	
40049	Timer 1 Target	0	65000	0	
40050	Timer 2 Target	0	65000	0	
40051	Timer 3 Target	0	65000	0	
40052	DIN1 Input Target	0	65000	0	
40053	Timer 1 Ramp Rate (RPM/s)	1	1000	50	
40054	Timer 2 Ramp Rate (RPM/s)	1	1000	50	
40055	Timer 3 Ramp Rate (RPM/s)	1	1000	50	
40056	DIN1 Ramp Rate (RPM/s)	1	1000	50	
40057	Ramp to Local Speed (RPM/s)	1	1000	50	
40058 thru 40064	Reserved				
40065	Auxiliary Output Value	0	65535	0	
40066	Target RPM	0	65000	0	
40067	RESERVED				
40068	Key Command Argument	0	65535	0	
40069	Key Command	0	65535	0	
40070 thru 40083	RESERVED				

FIGURES SECTION:

FIGURE 1. MOUNTING DIMENSIONS AND SPECIFICATIONS



SPECIFICATIONS:

POWER REQUIRED: DC POWER 10-32VDC, 0.60 AMP. MAX.

AMBIENT TEMPERATURE RANGE: -40°C TO 80°C (-40°F TO 176°F)

ENCLOSURE: EXTRUDED ALUMINUM, NEMA TYPE 1

MOUNTING: MOUNTS TO 35MM DIN RAILS

SPEED INPUT: PULSES FROM MAGNETIC PICKUPS, HALL-EFFECT SENSORS

INPUT FREQUENCY RANGE: 1HZ TO 100KHZ

RANGE: 0 TO 3,000 RPM

UPDATE RATE: 30 MILLISECONDS

I/O AND POWER CONNECTIONS: PLUGGABLE, PUSH-IN, SPRING-CAGE

COMMUNICATION PROTOCOLS: MODBUS/TCP, ETHERNET/IP

MODULE CONFIGURATION: BUILT-IN WEB PAGES OR MODBUS

CONNECTOR, ETHERNET PORT: SHIELDED RJ45 SOCKET

NETWORK WIRING INTERFACE: AUTO MDI/MDIX

CONNECTIONS: UP TO 5 CONNECTIONS

DATA RATE: AUTO SENSED 10/100 Mbps

ADDRESS: AUTO IP, BOOT P, STATIC

LED INDICATORS: POWER, STATUS, LINK, RX/TX, SW1, SW2

ANALOG INPUTS: 2 EA., 0-20MA OR 0-5V

DISCRETE INPUTS: 2 EA., INTERNAL PULL UP TO 3.3V

VOLTAGE OUTPUT: 0 TO 10V, 0.5 AMP MAX.

CURRENT LOOP OUTPUT: 4-20MA FORWARD OR REVERSE ACTING

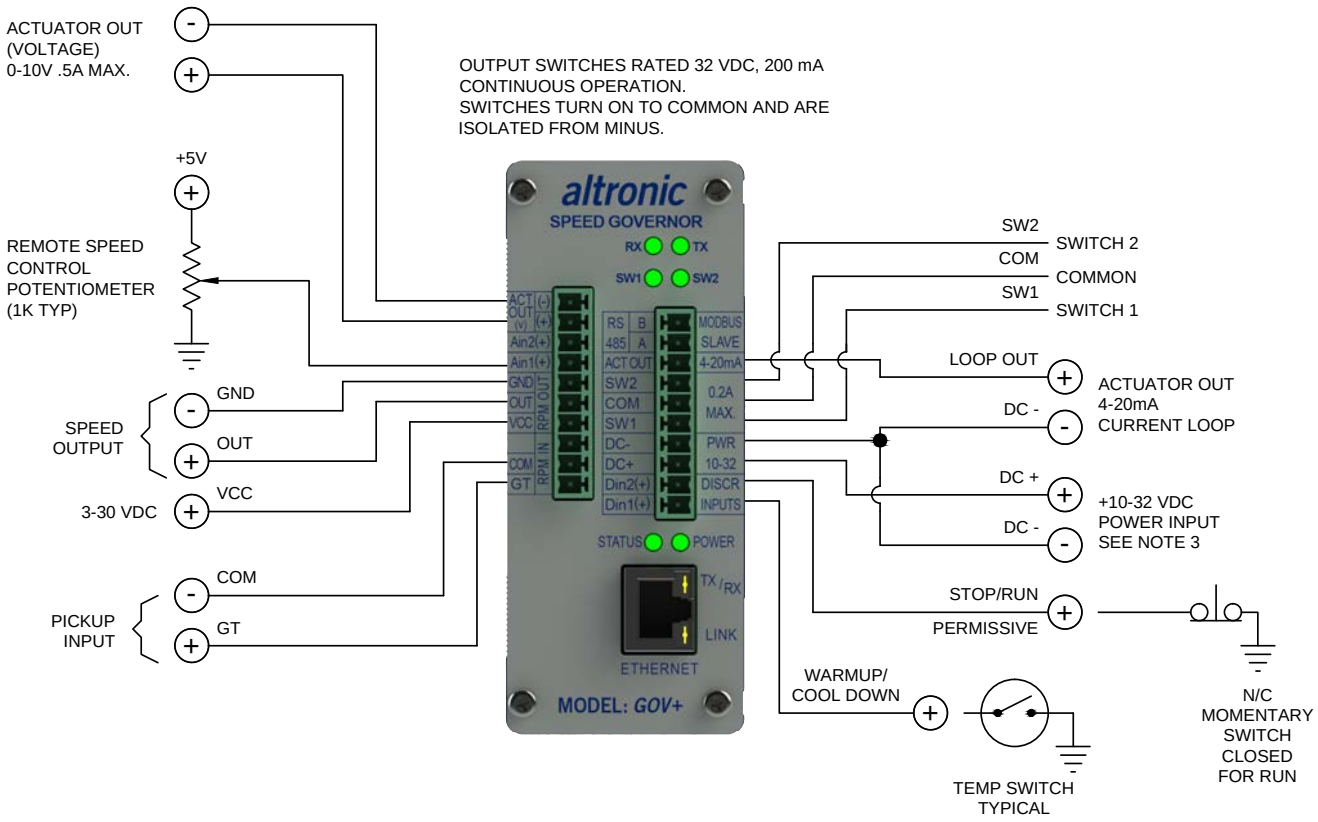
OUTPUT SWITCH: TWO PROGRAMMABLE, SOLID STATE SWITCHES, RATED 32VDC, 0.2 AMP CONTINUOUS, OPTICALLY ISOLATED FROM POWER SUPPLY.

SWITCH 1 CONFIGURATIONS: NC/NO, FAILSAFE/SHELF

SWITCH 2: N/O, FAILSAFE (CLOSED FOR RUN)

HAZARDOUS AREA CLASSIFICATION: CLASS I, DIV. 2, GROUPS C & D CERTIFIED FOR DIRECT HOOKUP, TEMP CODE T4, MAX. AMBIENT TEMP. 80°C.

FIGURE 2. GENERAL ELECTRICAL CONNECTIONS



NOTES:

1. DIN 2 (PERMISSIVE) INPUT MUST BE CLOSED (GROUNDED) FOR GOVERNOR CONTROL OPERATION.
   IF AT ANY TIME DURING OPERATION DIN 2 GOES OPEN THE ACTUATOR WILL GO TO 0% OPEN POSITION.
   IF A GOV+ FAULT OCCURS DIN 2 MUST BE MOMENTARILY OPENED AND CLOSED AGAIN BEFORE STARTUP.

2. ANALOG INPUTS AIN 1+ AND AIN 2+ CONTAIN INTERNAL 200Ω SENSING RESISTORS TO GROUND.

3. MAX CURRENT DRAIN WITH 4-20mA ACTUATOR .25A
   MAX CURRENT DRAIN WITH 0-10V VOLTAGE ACTUATOR .60A

FIGURE 3A. WIRING DIAGRAM – MAGNETIC PICKUP INPUT

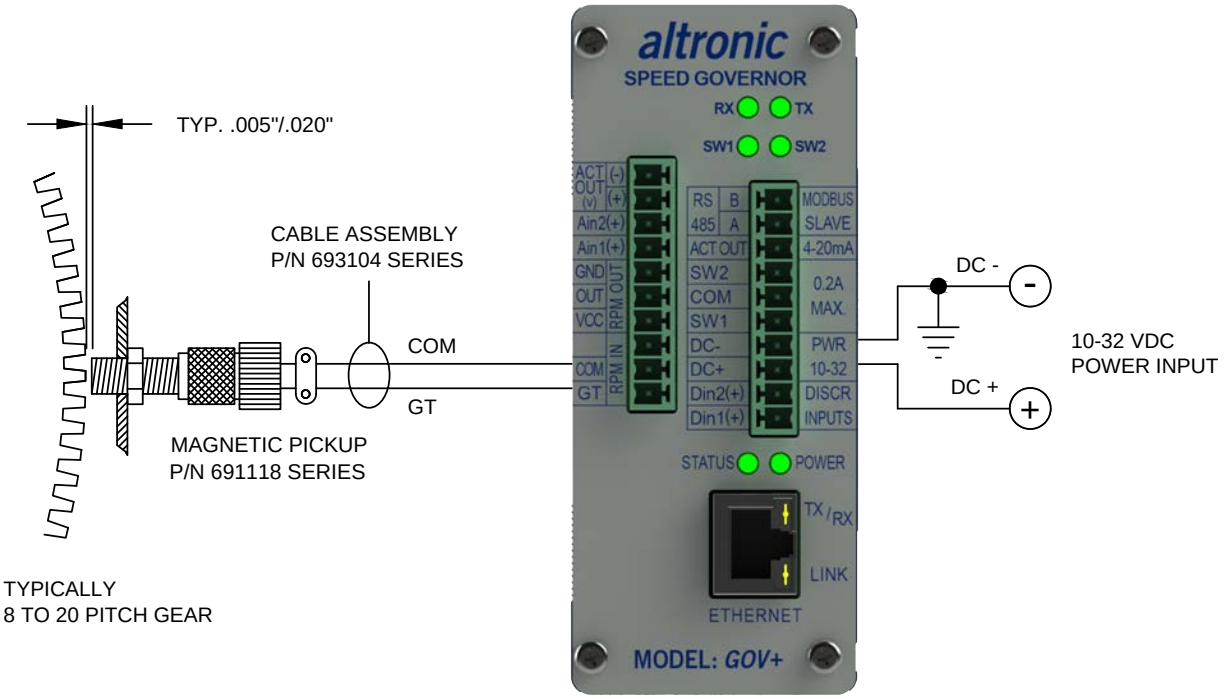


FIGURE 3B. WIRING DIAGRAM – HALL-EFFECT PICKUP INPUT

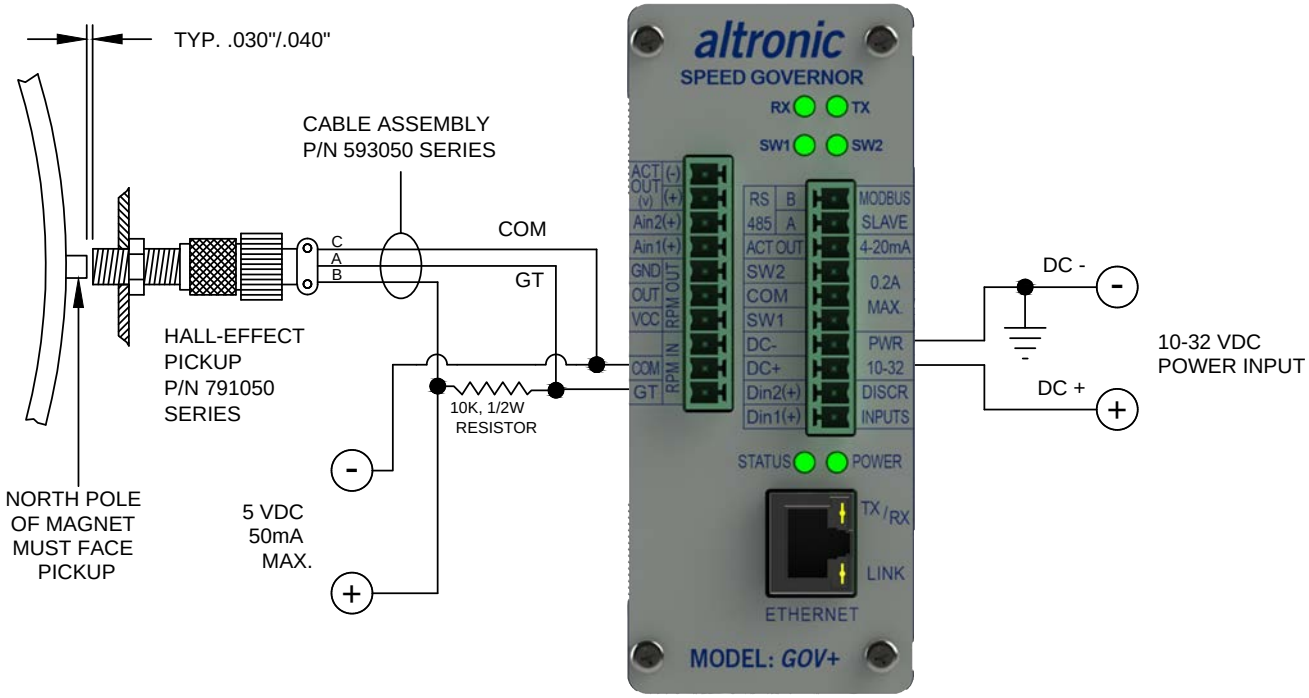
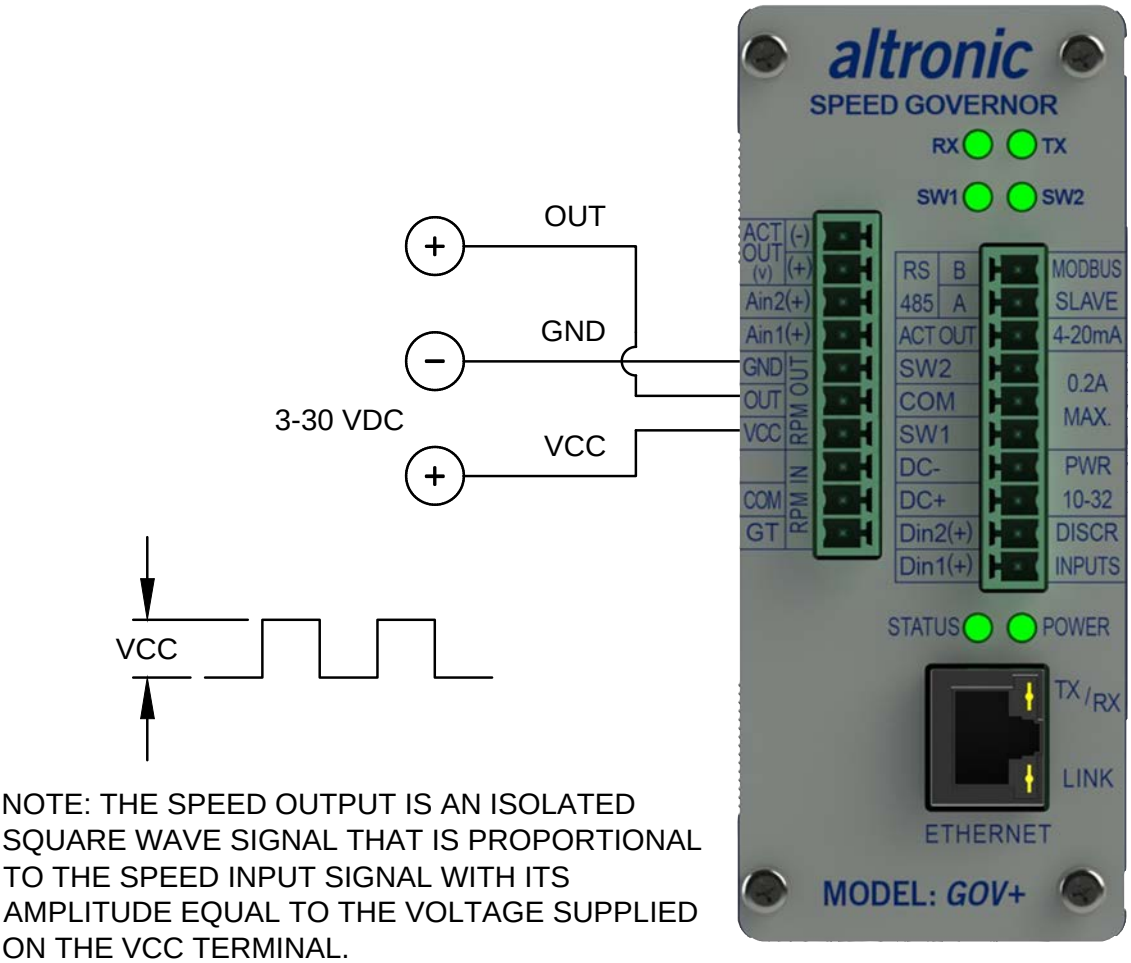


FIGURE 4. WIRING DIAGRAM – SPEED SIGNAL REPEATER OUTPUT



NOTE: THE SPEED OUTPUT IS AN ISOLATED SQUARE WAVE SIGNAL THAT IS PROPORTIONAL TO THE SPEED INPUT SIGNAL WITH ITS AMPLITUDE EQUAL TO THE VOLTAGE SUPPLIED ON THE VCC TERMINAL.

FIGURE 5A. WIRING DIAGRAM – ACTUATOR, CURRENT LOOP

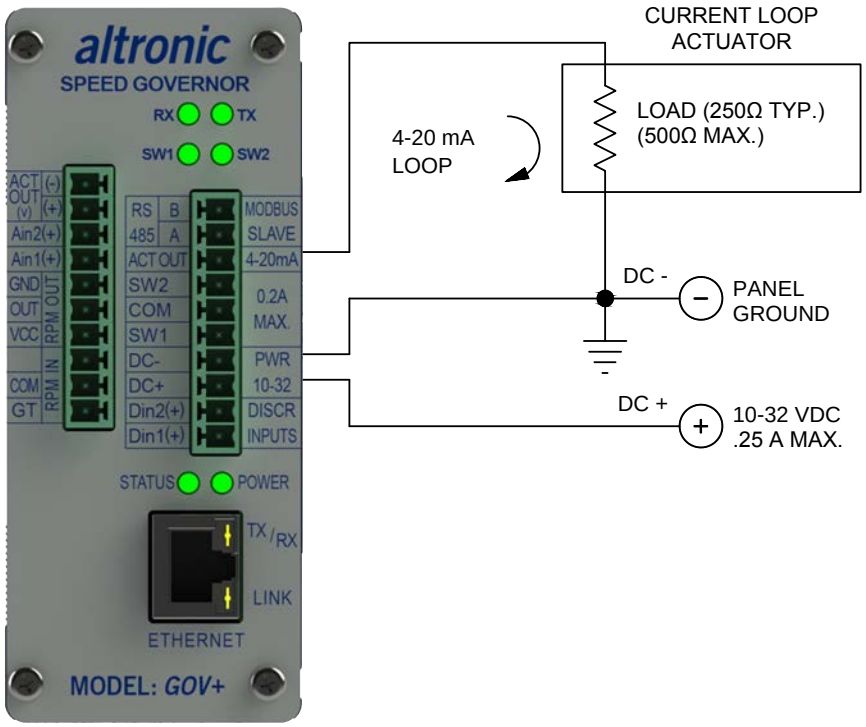


FIGURE 5B. WIRING DIAGRAM – ACTUATOR, VOLTAGE

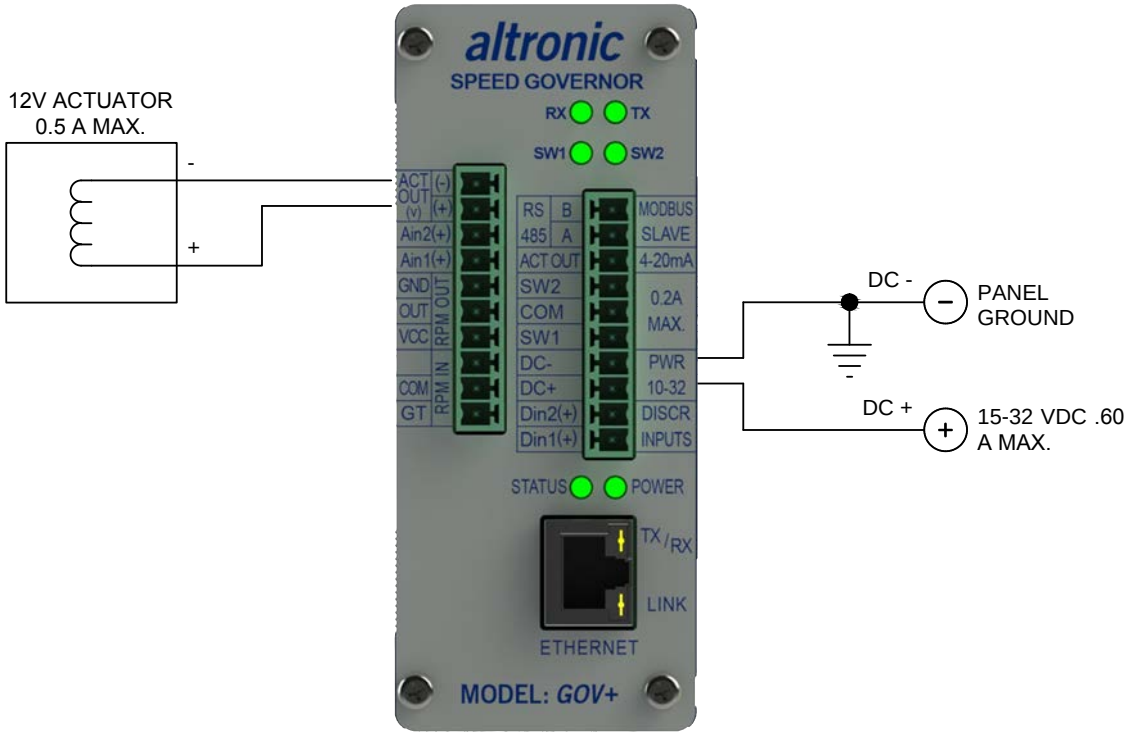
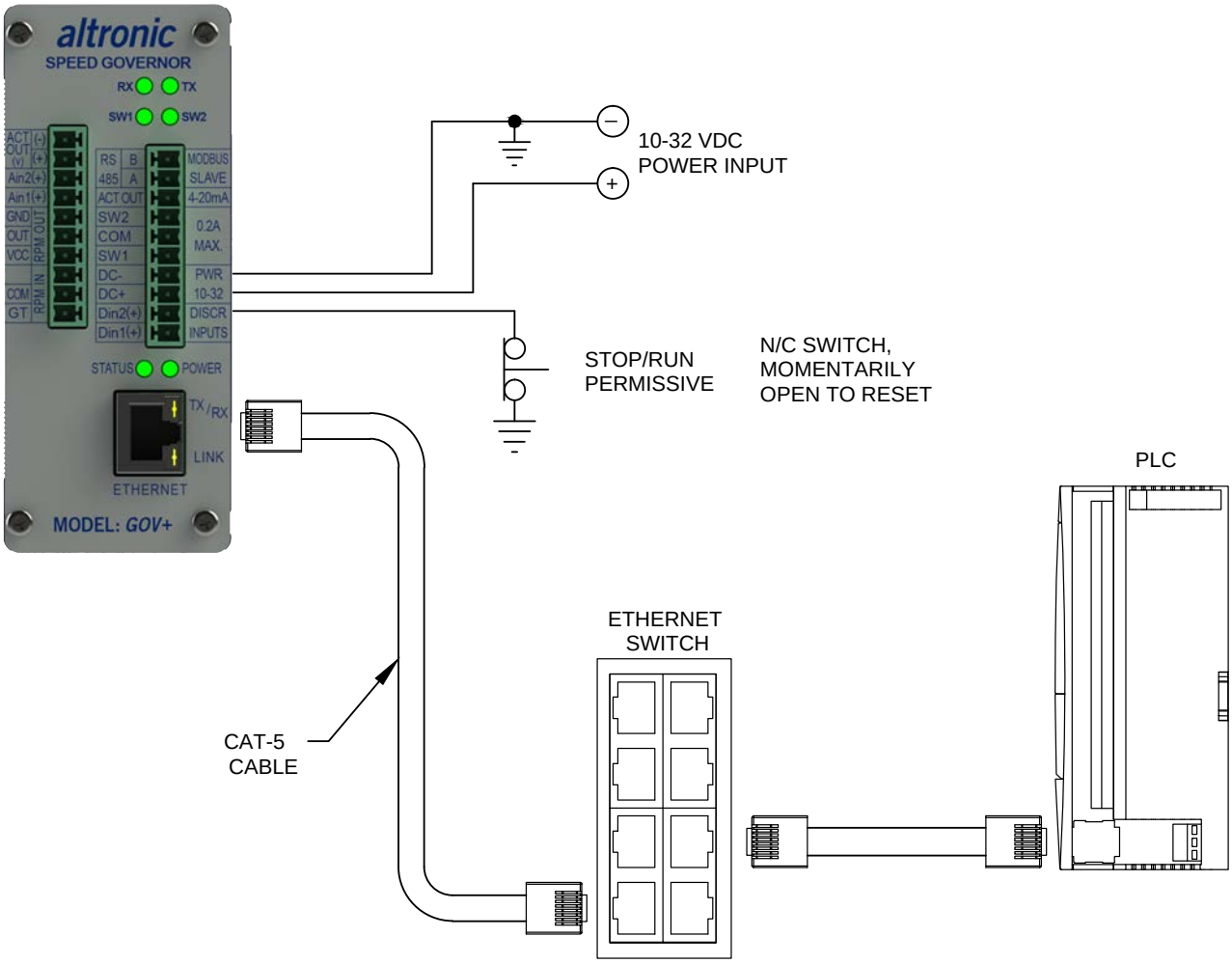


FIGURE 6. WIRING DIAGRAM – ETHERNET SWITCH



NOTES:

1. POWER WIRING,
   MUST BE POWERED FROM A CLASS 2 POWER SUPPLY. IT IS RECOMMENDED THAT THE CURRENT FROM THE POWER SUPPLY TO THE MODULE BE LIMITED THROUGH A PROPERLY SIZED SURGE TOLERANT FUSE OR ELECTRONIC BREAKER.

2. RJ45 ETHERNET COMMUNICATIONS WIRING,
   USE DATA GRADE CATEGORY 5E SHIELDED TWISTED-PAIR (STP) OR UNSHIELDED TWISTED-PAIR (UTP) CABLE THAT HAS A 100Ω CHARACTERISTIC IMPEDANCE THAT MEETS THE EIA/TIA CATEGORY FIVE (CAT-5) WIRE SPECIFICATIONS. MAX. WIRE LENGTH IS 100 METERS/325 FEET.