Rexroth
Bosch Group

Generator Speed Controller

RA 29977/07.05 1/8
Replaces: 09.95

Model GSC 1

Series 2X

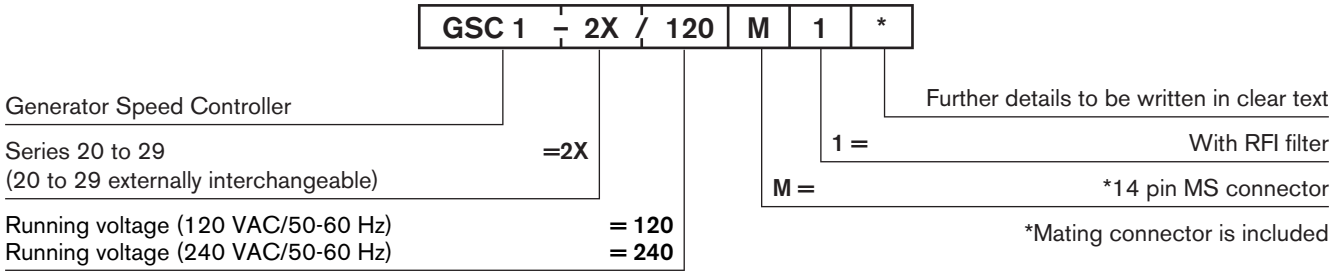
Description

- Self contained controller for driving electrical power generators with a hydrostatic transmission
- 16 Bit microprocessor based controller
- 50 or 60 hertz generator operation
- Tunable PID controller to accommodate a wide range of pump/motor/generator combinations
- Fault safety shutdown
- Simple machine interface
- Mechanical and electrical "plug-in" compatability with the Rexroth GSC1-1X controller

Features

- Internal alpha–numeric display and keypad for setup and diagnostics
- Menu based setup
- Descriptive display of faults
- Accepts a wide range of battery voltages
- 120 or 240 volt AC generator operation, 50 or 60 Hz
- Start/Stop external control with momentary pushbuttons and standard 3 wire circuit
- Generator safety shutdown for under/over frequency and generator output over voltage
- External LED indicators for Generator Run and Fault
- Frequency accuracy +/– 0.5 Hz
- Fine frequency trim
- Uses battery voltage for starting and generator power during running
- Self contained in water resistant enclosure with interface connector
- Requires only 2 wires to pump
- Radio frequency interference (RFI) filter for high-noise environments

Ordering details



Functional description

The Rexroth GSC-2X generator speed controller provides constant drive speed for an AC power generator. Generator speed is controlled to provide accurate frequency independent of changes in load and power take-off (PTO) drive speed. The controller operates by modulating the stroke of a Rexroth A4V transmission pump, with proportional solenoid control. The pump is typically driven by a diesel engine PTO. The pump flow hydraulically drives a fixed displacement Rexroth A2F hydraulic motor which is coupled to the AC generator. The generator speed feedback is by means of a magnetic pulse pickup, or by the generator's output frequency. If a magnetic pickup is used, a fan blade or toothed wheel normally provides a pulse signal to the magnetic pickup. If the generator frequency is used as the speed feedback, the magnetic pickup can optionally be used to provide drive (diesel) RPM to the controller. This provides a feedforward control signal to improve response time to PTO speed changes.

Power for the controller is provided in two ways. During starting, available engine battery voltage, in the range of 10 to 35 volts DC, is used to provide power to start the drive. Once the generator is running at sufficient speed, the AC output from the generator supplies the running power to the controller. Generator outputs of 120 or 240 volts AC can be accommodated. The voltage range is configured at the factory and must be specified on the order.

The generator drive can be started and stopped remotely with a momentary pushbutton control circuit. For safety considerations, the stop pushbutton uses a normally closed circuit, so that interruption of the stop circuit will cause generator shutdown. During starting, the generator speed is ramped up to proper running speed, at a preset ramp rate. When speed is reached the controller is enabled. If the stop circuit is interrupted, the generator is ramped to a controlled stop. The controller also contains a temperature sensor that is used to measure ambient temperature. A startup mode can be selected that allows the generator starting conditions to be dynamically altered as a function of temperature. Lengthened ramp up time and altered starting PID tuning parameters can be selected as cold startup options. This mode provides compensation for changes in the hydraulic fluid viscosity, as well as providing slower startups to allow time for warm oil to circulate through the hydrostatic loop.

Controller operation

When DC power is applied to the GSC controller, the microcontroller is activated and performs a power on self-test (POST). All parameters are then read from the EEPROM parameter storage memory. The control inputs are active at this time. Any error detected at this time, such as a parameter memory error or POST error, will be displayed on the internal readout.

When the Start input is activated, several conditions must be met before the generator will start. There must be no errors that would prevent a startup, such as a memory error. Additionally the DC battery voltage must be over 9.4 volts to enable a start. Finally the Stop input must be on (closed circuit) to start the generator drive.

If the above criteria is met, the controller will supply current to the A4V proportional solenoid to drive the pump on stroke. The ramp up rate (stroke rate), minimum and maximum proportional solenoid currents, as well as the proportional solenoid PWM frequency are set as parameters in the controller.

As the pump strokes and the generator starts rotating, the generator speed is measured by the controller. This speed signal comes from a predetermined option of either a pulse pickup or the AC voltage out of the generator. If a pulse pickup is used for generator speed feedback, the controller can be set to accept 1 to 200 pulses per revolution, corresponding to a nominal speed of 1800 RPM (1500 RPM in 50 hertz mode). As the pump stroke is increased, a check is made by the controller to determine that the feedback signal is present. If no speed feedback signal is detected, the controller causes a shutdown of the start sequence and a FEEDBACK FAIL fault is displayed.

If feedback is present, the pump stroke is increased until the measured generator speed (frequency) is near the desired setpoint. At this point the closed loop PI controller is activated and takes over control of the pump stroke. The transition from ramp up to closed loop is smooth and shock free. The controller then regulates the pump stroke to maintain the generator rotational speed at the desired setpoint. The speed setpoint can be set to a nominal value of 50 or 60 hertz, with a +/- 10 hertz fine frequency trim from the setpoint. The measured speed is constantly compared with the setpoint and differences between these two values results in direct and time based corrections to the pump stroke. As a result, the generator is driven at a constant speed as load and pump input RPM changes.

While running, the generator speed and generator output voltage are monitored and compared to preset limits. If the generator speed varies from the setpoint by the preset value, a fault shutdown of the generator occurs, and the fault is displayed on the controller's display. The frequency fault can be disabled, if desired. The AC voltage into the controller is also measured and compared to a setpoint. If the AC voltage from the generator exceeds a preset limit, an overvoltage shutdown fault occurs, and the fault is displayed. The overvoltage fault can be disabled, if desired. The response time of the overvoltage fault can be selected between slow and fast response, to match the response time of the generator regulator, and to prevent false shutdown tripping.

If the stop input is opened (no signal), the speed controller is shut down and the pump stroke, and thus the generator speed, is ramped down to a stop.

Two additional modes of operation are provided. If generator AC frequency is used as the controller feedback, the pulse pickup input can be used to measure the PTO or prime mover speed, for feedforward control. In this mode of operation, changes in PTO speed cause a direct change in pump stroke, rather than generator speed error causing the correction. This results in quicker response to PTO speed changes. The feedforward compensation can be adjusted with a parameter in the controller. A manual mode is also provided. In the manual mode, the pump stroke is ramped to a preset value when the start circuit is activated. This mode provides no corrections from any feedback signal and is intended as a troubleshooting and diagnostic tool. Manual mode can also be used as a "drop dead" mode of operation, if hardware failures prevent normal operation. Varying the stroke value or the PTO speed is necessary to set the correct generator drive RPM.

In cold starting conditions, the drive system performance may be affected by changes in the hydraulic fluid viscosity, as well as changes in other mechanical components. To compensate for these variations, the ambient temperature at the controller is measured. The measured temperature can be used to modulate the controller's speed control tuning parameters, as a function of temperature. As the controller self heats, the parameters are slowly returned to normal running values. During this time the hydraulic and mechanical components are also warming as the generator is run. There is also a provision to slow the starting ramp up rate as a function of temperature. This feature allows the hydrostatic transmission to be started slowly, allowing the oil to warm the loop as the system slowly accelerates. Starting ramp rates of over 4 minutes can be selected.

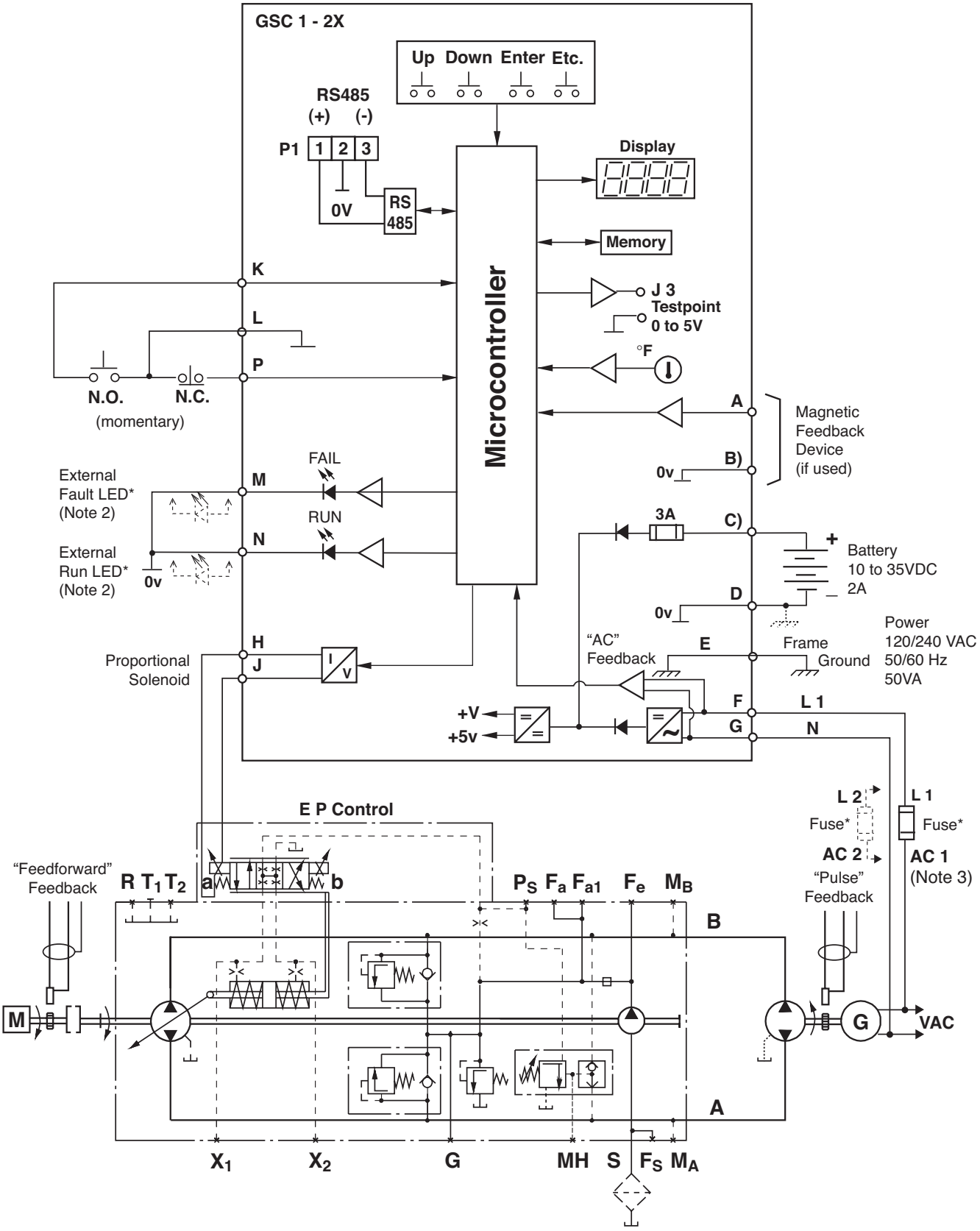
The controller contains other features to assist in set up and maintenance of the generator system. The controller's display can be selected to display system information when the generator is running. Generator AC frequency, generator AC output voltage, DC battery input voltage, ambient temperature and pump stroke proportional solenoid current can be displayed on the controller's display. Additionally, an analog output signal is provided for connection to an oscilloscope, chart recorder or data measurement system. The analog output can be selected in the controller to indicate frequency error, magnified frequency error (error X 10), speed controller output, proportional error correction, integral error correction, proportional solenoid command value, proportional solenoid actual current and generator speed feedback. The output can be changed at the controller and is always present. A communications port is also available at the controller for remote diagnostics and setup.

CAUTION: Instability may occur with generators exhibiting harmonic distortion. "AC" feedback will not work with generators that have significant distortion of the AC sine wave. Use "Pulse" feedback unless performance is proven satisfactory with your generator and "AC" feedback.

Technical data

Power supply	Starting	VDC	+ 10 to 35, negative ground 2 Amp maximum
	Running	VAC	120 to 240, 50/60 Hz ± 10% 50 VA maximum
Output Drive		A	Up to 2.5 maximum to drive A4V pump solenoid, current controlled, Pulse Width Modulation 80 to 250 Hz
Frequency control range		Hz	50 or 60 ±0.5 Hz (±10 Hz adjustment)
Load response			15 kw load step, ±1% Hz error, recovery to steady state typical
Speed			Input change of 1000 rpm/sec. cause max of ±3 Hz frequency change, recovery to steady state
START/STOP change response		sec.	Start/stop in 1 sec. typical. Settle to stable speed ≤ 2 sec.
START/STOP circuit requirements			3 wire, 12 VDC control, optically isolated inputs, 15 mA max.
Frequency shutdown		Hz	Selectable up to 30 Hz deviation
Overvoltage shutdown		VAC	Selectable 0–300
Pulse pickup input		VAC	5 to 30 any non-monotonic waveshape
LED output		mA	10 nominal, short circuit proof
Setup interface			Alpha-numeric display, 4-character, red LED 4 pushbuttons – up, down, enter, escape
Communications port			RS-485, 19,200 baud
Enclosure			NEMA 12, screw cover plate
Ambient temperature		°C (°F)	–18 to 60 (0 to 140)
Connector	Multiturn	M	Type GSC… /M MS3102E22 - 19P Mating connector MS3106E22 - 19S
Size (approximately)		mm (in)	235 x 159 x 99 (9.25 x 6.25 x 3.50)
Weight (approximately)		kg (lbs.)	4.54 (10)
Mounting position			Optional

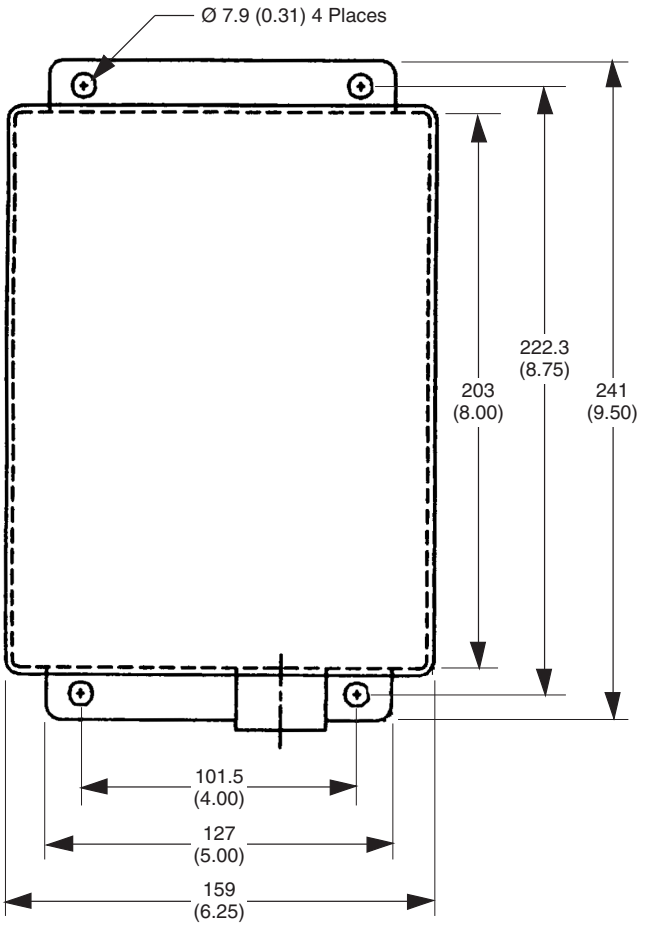
Generator speed controller block diagram

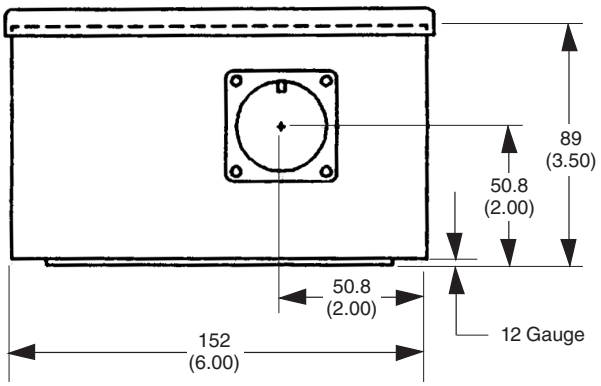


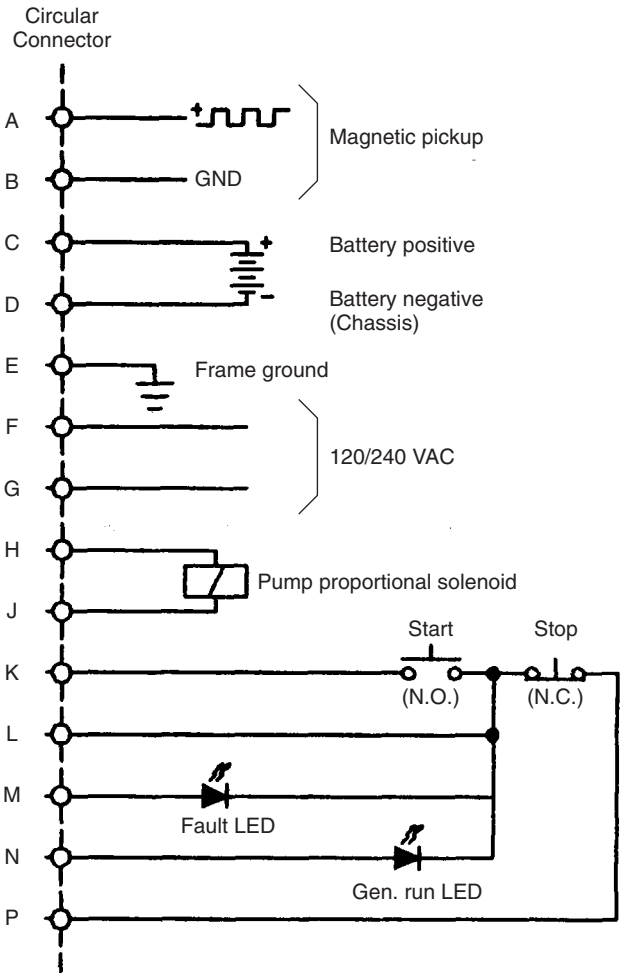
Notes:

1) * Items are customer supplied
2) Install external LED or jumper to 0V
3) Dual element, time delay fuse recommended for 240 VAC
4) Do not connect or disconnect when circuit is energized

Unit dimensions, MS and KPSE connectors: dimensions in mm (inches)

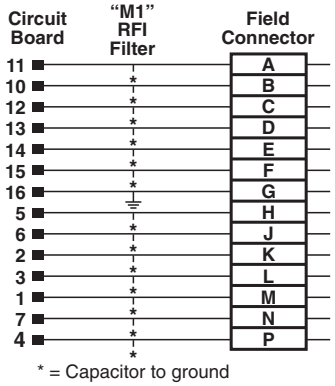






Type	Box receptacle	Mating connector
GSC… /M	MS3102E22-19P	MS3106E22-19S

Mating connector is supplied.



Notes

Notes

Bosch Rexroth Corp.
Industrial Hydraulics
2315 City Line Road
Bethlehem, PA 18017-2131
USA
Telephone (610) 684-8300
Facsimile (610) 694-8467
www.boschrexroth-us.com