

Guardian®

Load Sensing Module Specification and Instruction Guide



WARNING

To ensure proper protection against drowning due to full body entrapment on suction inlets (drains), follow these instructions for proper installation, calibration, testing and troubleshooting. Leave these instructions with the owner, and pass these instructions on to any new owner.

Guardian[®] Table of Contents

Safety Information.....	2
Overview.....	4
Set Up.....	5
Basic Operation	5
Startup Lockout Time	6
Calibration	6
Test of Proper Calibration.....	7
Reset.....	8
Bypass Mode.....	9
Operating Faults	10
Self Check Faults	12
LED Indicators.....	13
Specifications	13
Technical Support Question and Answer.....	15

Important Safety Information

Drain Suction Hazards

There are five types of entrapment hazards associated with underwater suction outlets (drains) in pools and spas:

1. Body entrapment:

In some pool configurations, if a person's body covers the drain, the person can be trapped by suction, leading to drowning.

2. Hair entrapment:

If long hair is pulled into some drains by the flowing water, it can become knotted or snagged, trapping the swimmer underwater and leading to drowning.

3. Mechanical entrapment:

Small items or body parts (e.g., jewelry, swimsuit, hair decorations, fingers, toes or knuckles) can be caught in some drains or drain covers, trapping the swimmer underwater and leading to drowning.

4. Limb entrapment:

Arms or legs can become trapped in uncovered drains, leading to drowning.

5. Evisceration/disembowelment:

If a person sits on some drains, the suction can pull the lower intestine out of the rectum, causing irreversible damage.

Safety Vacuum Release System

This motor is equipped with a Safety Vacuum Release System (SVRS), which **helps prevent body entrapment only**. The SVRS turns off the pump and releases the suction if this occurs.

The **SVRS does NOT protect against the other four types of entrapment**: hair entanglement, mechanical entrapment, limb entrapment and evisceration/disembowelment.

Important Safety Information *(continued)*

Safety Vacuum Release System *(continued)*

To get proper protection from body entrapment:

- **Install the motor in the circulation system properly**
Remove all check valves and hydrostatic valves from the circulation system (confirm that this will not damage other components of the pool). Be sure that every circulating pump is equipped with SVRS.
- **Calibrate and test the unit**
The SVRS must be calibrated for the pool and tested monthly.
- **Keep swimmers out of the pool when SVRS is not active**
The SVRS is disabled during the 3-minute startup lockout time, during calibration and when it is in bypass mode.

Drain Covers

Proper drain covers can help protect against all five entrapment hazards. **SVRS is not a substitute for proper drain covers.** All drains should be equipped with covers that are in good condition. Use suction fittings marked with the text “ASME A112.19.8 2007,” a 12” x 12” or larger drain grate, or an approved channel drain system at each suction or drain outlet.

Consult Local Codes and Ordinances

Local codes and ordinances may require additional or different forms of protection against drain hazards, as well as other important safety requirements.

Instruct Pool Users About Drain Safety

Even with SVRS, be sure that people, particularly children, do not play or swim near suction fittings (drains), and never stick fingers, toes or body parts into them. Tell anyone with long hair to stay away from drains and to pin their hair up or wear a bathing cap.

Overview

The Guardian® load sensing electronic module is an accessory to a pool pump motor. It is permanently attached to the motor and is used to protect the motor and pump from damage. It can also be used as a Safety Vacuum Release System (SVRS) for pools and spas.

The load sensing module will turn the pool pump motor off if the input power to the motor is too low, indicating either a lack of fluid flow, or a dry running pump. It will also turn the motor off if the input power gets too high, indicating excessive load on the pump. The module will also shut the pump motor off if input current is too high, indicating a locked rotor or blocked pump impeller condition.



Operation of the Guardian® Module

Guardian® Set Up

The Guardian® module is permanently mounted and wired to the motor. All necessary electrical connections are made at the factory.

- 1) Disconnect all power to the motor and pump system.
- 2) Remove pump and motor assembly.
- 3) Disassemble pump and motor.
- 4) Install Guardian® motor to the pump assembly and install a new pump seal.
- 5) Make certain all valves and filters are in the normal operating position.
- 6) Apply power to Guardian® to calibrate. Once unit is calibrated the green LED will remain on.
- 7) Test Guardian® to insure proper relief of a full suction blockage.

Basic Operation

While the pool pump is running, the Guardian® module monitors pump motor input power. If the motor input power drops rapidly from its normal running condition value (indicating a possible blockage event), the Guardian will fault and the pump motor will be turned off. When faulted, the red LED on the end of the Guardian module will flash fault code 31.

The module also monitors motor input power to verify that it is within +25% to -25% of its normal running value. If the input power deviates outside this window for more than 1 second, the Guardian will fault, the motor will be turned off, and the red LED on the end of the Guardian module will flash fault code 11 or 12. If either of the out of window power conditions does not last for at least one second, however, the fault condition will not be latched, and the motor will continue to run.

After four minutes, the Guardian will automatically attempt to restart the motor. After the 3 minute Startup Lockout period, or if the circuit senses that the pump is primed, the unit will once again start monitoring motor input power. If conditions are still not normal, the unit will fault out again.

Note: It is important to keep skimmers and drains free of debris to prevent the Guardian from nuisance tripping.

Startup Lockout Time

When starting a pool pump, there is often air in the plumbing system. If the volume of air is large, it can take a minute or two to fully evacuate the air in the system and prime the pump. To keep the Guardian® module from detecting a low input power condition (lack of flow) a Startup Lockout period is employed. When the Guardian is powered up, it will ignore the motor power input for up to 3 minutes before it starts to monitor the motor operating conditions. While the Guardian module is in this Startup Lockout state, the green LED on the end of the enclosure will flash.

If the pump primes faster than the 3 minute limit, the Guardian circuitry will detect this and immediately go into Run mode. When in Run mode, the green LED on the end of the enclosure will be on.

⚠ WARNING Do not allow swimmers in the pool while Guardian® is in Startup Lockout state. Guardian® does not protect against drowning due to body entrapment when in Startup Lockout state.

Calibration

Because every pool is different, the Guardian® SVRS device must be field adjusted to site-specific hydraulic conditions. Once installed, the system shall be tested by simulating an entrapment event as outlined in the test of proper calibration section of this manual.

⚠ WARNING Do not allow swimmers in the pool until calibration and testing are complete. Guardian® may not protect against drowning due to body entrapment if it is not properly calibrated.

The Guardian unit will automatically calibrate after running through the 3 minute Startup Lockout period for the first time. When calibrating the unit, it is important to make sure that the pump is fully primed, and that all valves and filters are in their normal operating conditions. If there is an in-floor cleaning system in the pool, it is best

Operation of the Guardian® Module

Calibration *(continued)*

to have the return flow valves adjusted so that the cleaner is off. Also make sure that there are no leaves or other obstructions on the pool drains. All of these things will result in the pump motor input power being at its normal operating value.

During the three minute Startup Lockout time, the green and red LEDs will flash alternately. The alternate flashing LEDs indicates that the Guardian unit is in Auto-Calibrate mode. At the end of the three minute priming period, the Guardian will automatically calibrate and go into Run mode (green LED on).

If for some reason the pump is not yet fully primed, let the Guardian fault out. Cycle input power and press the Reset button as discussed on the following page.

Note: It is important that the pump be fully primed and running at normal conditions when the Guardian motor calibrates.

Note: For two speed motors, the Guardian must be calibrated at both operating speeds. It is recommended that the Guardian be calibrated at both speeds when the motor is initially installed on the pool, so that the installer can observe the pump and verify that it is operating at normal conditions during the calibration process.

Test of Proper Calibration

Upon completing the installation of a Guardian® equipped motor to the pump and pool plumbing, and after calibration is complete, the manufacturer recommends that the system be tested by simulating an entrapment event. A ball, butterfly, or sliding gate valve shall be installed within 2 feet upstream from the SVRS protected pump (between the pump and the protected suction outlet), or a test mat shall be used to cover the suction outlet to simulate an entrapment event. There shall be three simulated entrapment tests conducted to verify proper calibration and operation of the device.

The motor and the pump should shutdown in less than 3 seconds after the simulated suction event (mat on drain or valve closing). The red LED on the end of the Guardian module should be flashing fault code 31. Remove the blockage from the drain or open the valve. Wait 4 minutes and the Guardian will attempt to restart the motor. Manual reset will restart the motor as well. To manually reset, switch power to the motor off, wait for 10 seconds with the power off, and then switch the power back on. It is recommended that this test be performed monthly to assure no changes have occurred in the calibration of the pool system.

Note: A. O. Smith does not recommend testing the safety function of the Guardian with a pump inlet valve. Covering the pool sump with a mat ensures that the entire pool plumbing system from pump to drain is tested.

If the Guardian unit does not shut down the motor and pump in less than 3 seconds, the unit should be Reset. Please refer to the Reset section of the installation guide below.

Check valves and hydrostatic valves shall not be used in suction systems protected by SVRS devices.

⚠ WARNING The presence of a check valve has been shown in the suction plumbing has been shown to prolong the high vacuum present at the drain, even though the drain is protected by an SVRS device.

Reset

If for some reason it becomes necessary to reset the calibration of the Guardian® module (change in plumbing or other pool conditions), press the button next to the red LED on the end of the enclosure and hold it down for at least three seconds. Please note that this function is **only active during the first three minutes of operation** after power is applied to a Guardian motor.

Pushing the button will erase the calibration settings and the motor will stop. Manual reset is required to resume motor operation. To reset, switch power to the motor off, wait for 10 seconds with the power off, and then switch the motor power back on. The unit will now go through a new Calibration sequence as was discussed previously.

Operation of the Guardian® Module

Reset *(continued)*

Once the unit is Reset, the unit will then calibrate to the new load point once power is applied to the unit. The blockage test should be repeated once the unit has completed the calibration and is operating with a solid green LED illuminated.

Bypass Mode

It may be necessary to defeat the Guardian® motor input power monitoring functions during unusual operating conditions in the pool. This might include hand wand vacuuming the pool, back flushing of filters, replacement of filters, or clearing a large volume of air from the pool plumbing system.

⚠ WARNING Do not allow swimmers in the pool while Guardian® is in bypass mode. Guardian does not protect against drowning due to body entrapment when in bypass mode.

To enter Bypass mode, press and hold the Bypass mode button for at least three seconds. The Bypass mode button is located next to the green LED on the enclosure. The Guardian will respond by starting to flash the red and green LEDs together. Bypass mode will last for 30 minutes, or until the Bypass mode button is pushed for at least three seconds a second time. If at any time while in Bypass mode the power is cycled off, the Bypass mode button will need to be pressed again once the power is returned to resume Bypass mode.

Bypass mode can be entered anytime the Guardian motor is powered. If the Bypass mode button is pushed while the Guardian is calibrating, the Guardian will continue to complete the Calibration process, and then proceed directly to Bypass mode.

Note: The installer must reset and re-calibrate the Guardian motor when proper operation of the pool is attained. The Guardian calibrated while the pool was being started up and it is likely that poor or improper calibration values were captured.

If the Guardian motor is faulted when the Bypass Mode button is pressed and held for 3 seconds, the motor will restart, and after initialization will go directly to Bypass Mode.

Operating Faults

If a fault occurs while the Guardian motor is running, the motor will be turned off and the red LED on the Guardian enclosure will flash out a code. The pattern of the flashes is: blink the tens digit, short pause, blink the ones digit, short pause, solid red LED for three seconds and repeat. For example, fault 14 would be: 1 blink, short pause, 4 blinks, short pause, red LED for 3 seconds and repeat. The faults and codes are:

• Motor input power too low	code	11
• Motor input power too high	code	12
• Motor current too high.....	code	13
• Pump failed to prime.....	code	14
• Power line voltage too low	code	15
• Guardian temperature too high	code	16
• Motor power too low to calibrate	code	17
• Power line frequency wrong	code	18
• Poor motor power factor.....	code	19
• Sudden change in motor input power (possible blockage event).....	code	31
• Power line voltage too high.....	code	34
• Ambient temperature too low.....	code	35
• Circuit power supply fault	code	36
• Bypass mode switch is stuck.....	code	41
• Motor current too low	code	45

After 4 minutes, the Guardian will automatically attempt to re-start the motor. After the 3 minute Startup Lockout period, or if the circuitry senses that the pump is primed, the Guardian will once again start monitoring motor input power. If conditions are still not normal, the unit will fault again.

Operation of the Guardian® Module

For the following faults, the Guardian will attempt to restart 4 times:

- Motor input power too low code 11
- Pump failed to prime code 14
- Sudden change in motor input power (possible blockage event) code 31

The four fault limit is programmed in for safety reasons and to prevent dry running the pump for an extended period of time. After the fourth attempt, the Guardian will go to Lockup mode. Once in Lockup mode, manual reset is required to resume motor operation. To reset, switch power to the motor off, wait for 10 seconds with the power off, and then switch the power back on.

If the motor runs normally for at least 9 minutes when the Guardian returns to Run mode, the fault counter will be reset back to zero. This means that it will now take 4 new power too low, failed to prime, or sudden change in power faults to reach Lockup mode again.

Self Check Faults

The Guardian performs a self test of its electronic circuits on startup. If upon application of power to the Guardian motor, the Guardian immediately goes to the fault condition, it is likely a failure of one of these circuits. To reset, switch power to the motor off, wait for 10 seconds with the power off, and then switch the motor power back on. If the fault will still not clear, the Guardian motor will need to be replaced.

The self check faults include:

- Circuit power supply fault code 36
- Motor control relays stuck codes 42, 43, 44, or 55
- Motor current sense circuitry not working..... codes 45 or 46
- Microprocessor fault solid red LED
- Line voltage sense circuitry not working..... codes 48, 49, 53 or 54
- Motor power factor sense not working..... codes 55 or 56
- Software fault codes 57 or 58

LED Indicator Map

Green LED	Red LED	Operating Mode
On	Off	Run Mode
Flashing	Off	Startup Lockout Mode
Off	Flashing Code	Fault Mode
Alternate Flashing	Alternate Flashing	Calibration Mode
Flashing Together	Flashing Together	Bypass Mode
On	Flashing	Reset Mode (cycle power to restart motor)

Guardian® Load Sensing Module Specifications

Input Power

Voltage	102 to 130 vac rms single phase (low voltage connected) 195 to 250 vac rms single phase (high voltage connected)
Frequency	58 to 62 hertz **
Power Consumption	5 watts maximum (Guardian only)
Line Loss Ride Through	20 milliseconds minimum

****Note:** 50 Hz operation will result in incorrect timing. The Guardian is rated for only 60 Hz operation at the present time.

Environment

Operating Temperature Range	14 to 122 °F (-10 to 50°C)
Storage Temperature Range	-15 to 150 °F (-25 to 65°C)
Humidity	10 to 95% non-condensing
Altitude	5000 feet maximum (de-rate max operating temperature 2°F (1°C) per 1000 feet above 5000 feet)
Shock / Vibration	1G maximum (any axis)

Enclosure

Length	5.4 inches
Width	3.5 inches
Depth	2.6 inches
Weight	1 pound
Other	Drip and splash proof

Other

UL / CSA Compliance	Tested to UL 60730-1A
FCC Compliance	Tested to CISPR11 Class B
SVRS Compliance	Tested to ASME 112-19.17-2002

Technical Support Question and Answer

Service: If you need service for your Guardian® pump motor, you will receive the most prompt service if you contact the company that did the original installation or a local service company that handles swimming pool and spa equipment.

Symptom:

My Guardian® equipped motor starts and runs for three or four seconds and then shuts itself off again. If I cycle power to the motor it does the same thing again. The motor makes a loud humming noise when I do this.

Possible Problem:

The motor is configured for the wrong input power line voltage.

The motor rotor or pump impeller is jammed.

Power line wiring is insufficient for the motor load.

The Guardian® equipped motor is calibrated to the wrong motor load point.

Solution

Verify what the line voltage to the pool pump motor is with an AC voltage meter. If the line voltage is in the range of 110 to 120 volts, the motor should be configured for low voltage. If the line voltage is in the range of 208 to 240 volts, it should be configured for high voltage. Change the motor configuration with the voltage selector switch, or by moving wires on the motor terminal board as necessary.

Remove power from the motor, and then remove the rear cover from the motor. Verify that the motor shaft turns freely by inserting a screwdriver into the slot on the end of the shaft, or by gently turning on the governor switch assembly with your hand. If the motor shaft does not turn freely, it will be necessary to separate the pump and the motor so that it can be determined which of the two is binding. If the motor is binding, it will need to be returned. If the pump is binding, verify that the pump parts were all assembled correctly, and that all parts are in good condition.

Measure the voltage on the motor terminal board with an AC voltage meter when power is applied and the motor is making the humming sound. If the voltage sags below 85 volts for 115 volt systems, or below 190 volts for 240 volt systems, there is too much resistance in the wiring to the motor to start the motor reliably. A stronger electrical supply to the pump motor will need to be provided.

Follow the instructions in the Reset section of this manual.

Technical Support Question and Answer

Symptom:

When I plug the hose to my suction cleaner in, the Guardian® equipped motor faults out.

Possible Problem:

Air in the cleaner hose is being drawn into the pump. This causes the pump to temporarily lose prime. The Guardian detects this and shuts the pump off.

My Guardian equipped motor used to run fine, but now seems to fault a lot.

Skimmer basket, strainer basket, or main drain in pool is plugged with debris.

Filter needs to be cleaned.

Not enough water in pool to cover the skimmer.

Diverter valve(s) that choose return lines from pool to pump are in wrong position.

Solution

Use the water flow from the return line to the pool to chase the air out of the suction cleaner hose before plugging it in. This will keep the pump from losing prime when you plug the hose in.

The Guardian motor will attempt to restart in 4 minutes. You can also manually reset the Guardian motor by switching power to the motor off, waiting for 10 seconds with the power off, and then switching the motor power back on. The Guardian will then restart the pump and try for three minutes to re-establish pump prime. This is usually enough time to clear the air out of the lines and return to normal operating conditions.

Verify that the baskets and drains are clear and clean if necessary.

Check the pressure gauge on the filter. If the pressure has gone up more than 10 PSI from where it was when the filter was clean, the water flow through the system may be reduced enough to cause the Guardian® to fault. Clean the filter if necessary. If the filter is a sand type filter, back-flush if necessary.

Pump is drawing air into the system because the skimmer is not covered in water. The air causes the pump to partially lose prime and this causes the Guardian to fault out. Add water to the pool.

Check to verify that diverter valve(s) are in the position that they were when the Guardian was first installed and calibrated. Return valve(s) to the original position if necessary. If it is desired to operate the pool with a new valve position as the “new” normal position, recalibrate the Guardian. Instructions on how to do this are located in the Reset section of this manual.

Technical Support Question and Answer

Symptom:

My two-speed pump runs OK on high speed, but faults on low speed after running several hours.

Possible Problem:

Leak in plumbing system is causing pump to lose prime. In high speed mode the pump moves enough water to absorb the air being leaked into the system. In low speed mode, however, the water flow is reduced to the point where the air bubbles accumulate in the strainer basket. Eventually the air bubble becomes large enough that the pump loses prime.

The Guardian® runs for less than one second when power is applied and then quits. A flashing red LED is displayed.

Failed relay on the Guardian board. Each time the motor is powered up, the electronics checks the motor control relays to verify that they are working properly. If one of the relays is stuck shut, the motor will run for 1/2 to 1 second before the Guardian electronics realizes that something is wrong and turns the motor off. The fault codes for failed relays are 42, 43, 44 or 55.

Solution

Check to see that the strainer basket cover is tight, and that the gasket is in good condition. Check the diverter valve(s) to make sure that it is in good condition and that the seals in it are in good condition. Check any unions in the piping system for proper fit up and that the O-ring seal is in good condition.

The Guardian® equipped motor will need to be replaced.

Technical Support Question and Answer

Symptom:

My Guardian® equipped motor nuisance trips (and has never run correctly).

Possible Problem:

The Guardian mis-calibrated when system was first set up

Air leak in the pool plumbing system.

Pump/motor is too large for pool plumbing system.

Suction release valve of mechanical type SVRS not adjusted correctly.

Solution

Sometimes the pump has a hard time clearing all the air from the pool return lines in the three minute window allowed by the Guardian® to do this. If this seems to be the case, follow the instructions in the Reset section of this manual.

Check the water flow in the strainer basket of the pool pump. If there is a heavy flow of air bubbles in the water, or if the strainer basket never fills with water, there may be an air leak in the suction side plumbing to the pump. Check to see that the strainer basket cover is tight, and that the gasket is in good condition. Check the diverter valve(s) to make sure that it is in good condition and that the seals in it are in good condition. Check any unions in the piping system for proper fit and that the O-ring seal is in good condition. Check for cracked pipes.

Check the water flow in the strainer basket of the pool pump for a heavy flow of air bubbles in the water. How does the pump sound? If it is making lots of noise, similar to the sound of a car tire on a gravel road, the pump is cavitating. These are signs that the pump is trying to move more water than the pool plumbing is capable of delivering. Common causes of plumbing flow restrictions are long runs of small diameter pipe, too many elbows or valves, or the pump being located too high above the water level of the pool. If a change to the plumbing cannot be made to rectify the limit to water flow, the best solution would be to try a smaller pump/motor combination. **Note:** Consult a pool professional to verify that proper pool circulation is maintained with a smaller motor and pump.

If a mechanical type suction release valve is located upstream of the pump, it may be bleeding air into the system. Adjust the release setting on the valve to keep a tighter seal during normal running conditions.

Note: If any adjustment is made to the SVRS device protecting a pool, its proper operation should be verified before allowing swimmers back in the pool. See the operator's manual for the SVRS device in question for the proper procedure on how to do this.

Technical Support Question and Answer

Symptom:

When I apply power to my pump motor, the Guardian® immediately displays a flashing red LED. The motor doesn't even attempt to start.

Possible Problem:

Voltage applied to the motor is out of the allowable operation range. Fault codes for improper voltage are 15 or 34.

Temperature of the Guardian electronics is too low (fault code 35). The rated temperature of operation for the Guardian and pump motor is from 14°F (-10°C) to 122°F (50°C).

Internal fault in the electronics. Please see fault code chart on page 12 of this manual.

When the power is applied to my Guardian equipped motor, it runs for about 10 seconds and then stops. A flashing red LED is displayed.

The Bypass mode button is stuck (fault code 41).

Solution

Measure the voltage on the motor terminal board with an AC voltage meter when power is applied. If the voltage is not between 102 and 130 volts for 115 volt systems, or between 195 and 250 volts for 240 volt systems, the supply voltage is outside the allowable range for the motor. Check the voltage at other locations in the house to see if they are within normal limits. If other circuits are OK, inspect the wiring of the pool pump branch circuit. If all the house voltages are out of limits, contact the local power utility.

If the temperature is around 14°F (-10°C), the pump may be in danger of freezing up. If the pool water is heated and just the pump motor is cold, a method of keeping the Guardian® and motor at a more moderate temperature will need to be provided.

If voltage and temperature issues can be discarded, it is likely an internal fault in the Guardian electronics that is causing the problem. The motor will need to be replaced.

With the power to the motor off, try pushing the Bypass mode button several times. Also wiggle the rubber actuator back and forth in the housing a little as occasionally the button gets hung up in the housing. Re-apply power to the motor to see if this clears the problem. If not, the motor will need to be replaced.

Technical Support Question and Answer

Symptom:

Since I installed the Guardian motor on my pool, I sometimes find the heater faulted out and not heating the pool.

Possible Problem:

Some pool heaters do not automatically reset after there has been an interruption of water flow. If the Guardian detected a fault (such as a power line voltage sag for instance) and shut the pump off, the heater would fault from lack of flow shortly after. The Guardian motor would automatically reset after 4 minutes. The heater may remain in the faulted state, however.

Solution

See if the heater has the option to auto-reset after a fault. Put the heater in this mode. If the heater is not capable of this mode of operation, another heater or control scheme should be considered.

The Pool Motor...

with a built in

Safety Vacuum Release System (SVRS)



www.aosmithmotors.com

531 N. Fourth St. • Tipp City, OH 45371 • Tel: (937) 667-2431