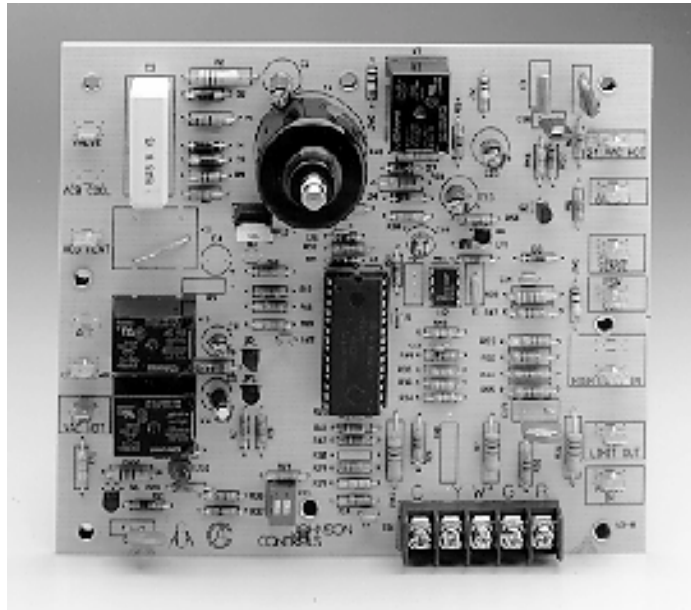


G861 Series Integrated Function Direct Spark Ignition Control



**Figure 1: G861 Integrated Function
Direct Spark Ignition Control**

Application

The G861 is a microprocessor-based, 100% shutoff, direct spark, and remote flame sense, integrated function ignition control. The G861 responds to inputs from the thermostat, high limit switch, pressure switch, and flame sensor. It provides outputs for timing and sequencing of the main gas valve, induced draft motor, circulator/blower, and spark igniter.

The G861 utilizes quick-connect terminals for all off board connections, except thermostat inputs and spark output. The thermostat inputs are connected to a terminal strip with screw terminals and the spark output is connected by a rajah, spike, or 1/4 in. male tab-type spark connector.

All G861 applications must use redundant gas valves and the pressure switch must carry main valve current. Any application over 117 kW (400,000 Btu/hr) must be approved in advance by Johnson Controls Application Engineering.

Table 1: Specifications

Ignition Type	Direct
Ignition Source	High voltage spark, capacitive discharge
High Voltage Cable Length	1,220 mm (48 in.) maximum
Flame Detection Means	Flame rectification
Flame Detection Types	Remote sensing
Minimum Flame Current Flame Threshold Current (I_{TH}) Insufficient Flame Marginal Flame Good Flame	0.250 microampere \pm 25% Flame current $< I_{TH}$ $I_{TH} < \text{flame current} < 4 \times I_{TH}$ Flame current $> 4 \times I_{TH}$
Flame Failure Response Time	0.8 second @ 0.500 microampere flame current
Spark Gap	3.17 mm (0.125 in.) nominal
Ignition Trials	3
Ignition Trial Time	7, 8, 10, or 11 seconds*
Prepurge Time	0, 10, or 30 seconds*
Postpurge	15, 30, or 45 seconds*
Interpurge	10 seconds*
Automatic Retry Delay Period	60 minutes*
Flameout Recycles	16 including the initial ignition trial
Circulator/Blower “On Delay”	30 seconds*
Circulator/Blower “Off Delay”	90, 120, 180, or 240 seconds*
Power Requirements	Line Voltage 120 VAC, 50/60 Hz Control: 24 VAC, 50/60 Hz, nominal Operation Current: 0.3A @ 24 VAC
Contact Rating	Main Valve: 2A continuous at 24 VAC, 5A inrush Inducer: 2A continuous, 120 VAC Blower: 1/3 hp (7.20 FLA), 125 VAC
Ambient Operating and Storage Temperature	-40 to 70°C (-40 to 160°F)
Humidity	95% RH non-condensing
Wiring Connections	Spark: Spike, rajah, or 1/4 in. male tab
Types of Gas	Natural, Liquefied Petroleum (LP), manufactured, mixed, or LP gas-air mixture
Packaging	Bulk pack supplied to original equipment manufacturer (individual pack optional).
Bulk Pack Quantity	24
Bulk Pack Weight	8 kg (18 lb)
Agency Listing	CSA (AGA/CGA) Certificate Number 11250-7
Specification Standards	ANSI Standard Z21.20 CSA C22.2-No. 199

*Timings listed are for 60 Hz operations. Timings increase by 20% under 50 Hz operation.

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

Refer to the G861 Product Bulletin (LIT-4350440) for necessary information on operating and performance specifications of this product.

**Operating
Mode
Definitions**

The following conditions occur in normal control operation:

- *Prepurge*--Initial time delay between thermostat contact closure and trial for ignition.
- *Trial-for-Ignition Time*--Maximum time period that the main gas valve and igniter energizes in an attempt to light the main burner.
- *Interpurge*--Time period between trials for ignition when both the gas valve and ignition source turn off and the inducer is on, allowing unburned gas to escape before a succeeding trial can occur. (Retry takes place only if proper ignition did not occur during the previous trial and if total trials are less than three.)
- *Run*--Main gas valve remains energized after a successful ignition trial.
- *Circulator/Blower "On Delay"*--Fixed time delay after the flame is sensed until the circulator/blower is energized.
- *Circulator/Blower "Off Delay"*--Field selectable time delay after the thermostat contacts open when the circulator/blower remains energized.
- *Postpurge*--Time delay after the thermostat is satisfied when the inducer remains energized.

**Normal
Sequence of
Operation****Call for Heat**

Figure 2 illustrates the sequence of operation of the G861 control.

Upon receiving a call for heat from the system thermostat, the G861 follows this normal sequence of operation:

1. *Pressure Switch Detection*--The control checks the inducer pressure switch to ensure that it is open.
2. *Prepurge*--The control energizes the inducer motor and verifies that the pressure switch closes.
3. *Pressure Switch Detection*--The control checks the pressure switch to ensure that it remains closed during the prepurge period.
4. *Trial for Ignition*--The control simultaneously energizes the spark igniter and gas valve in an attempt to light the main burner. During the trial time, the igniter is energized until flame is detected or until the trial for ignition is complete, whichever occurs first.
5. *Run*--If main burner flame is sensed up to the last 0.5 second of the trial, the gas valve and inducer remain energized for the duration of the heat call. The circulator/blower is energized after a 30-second blower "on delay" time and remains energized for the duration of the heat call.
6. *Postpurge*--Once the thermostat is satisfied, the gas valve is de-energized and the inducer remains energized until the postpurge period ends. The circulator/blower remains energized until the selected blower "off delay" time has elapsed.

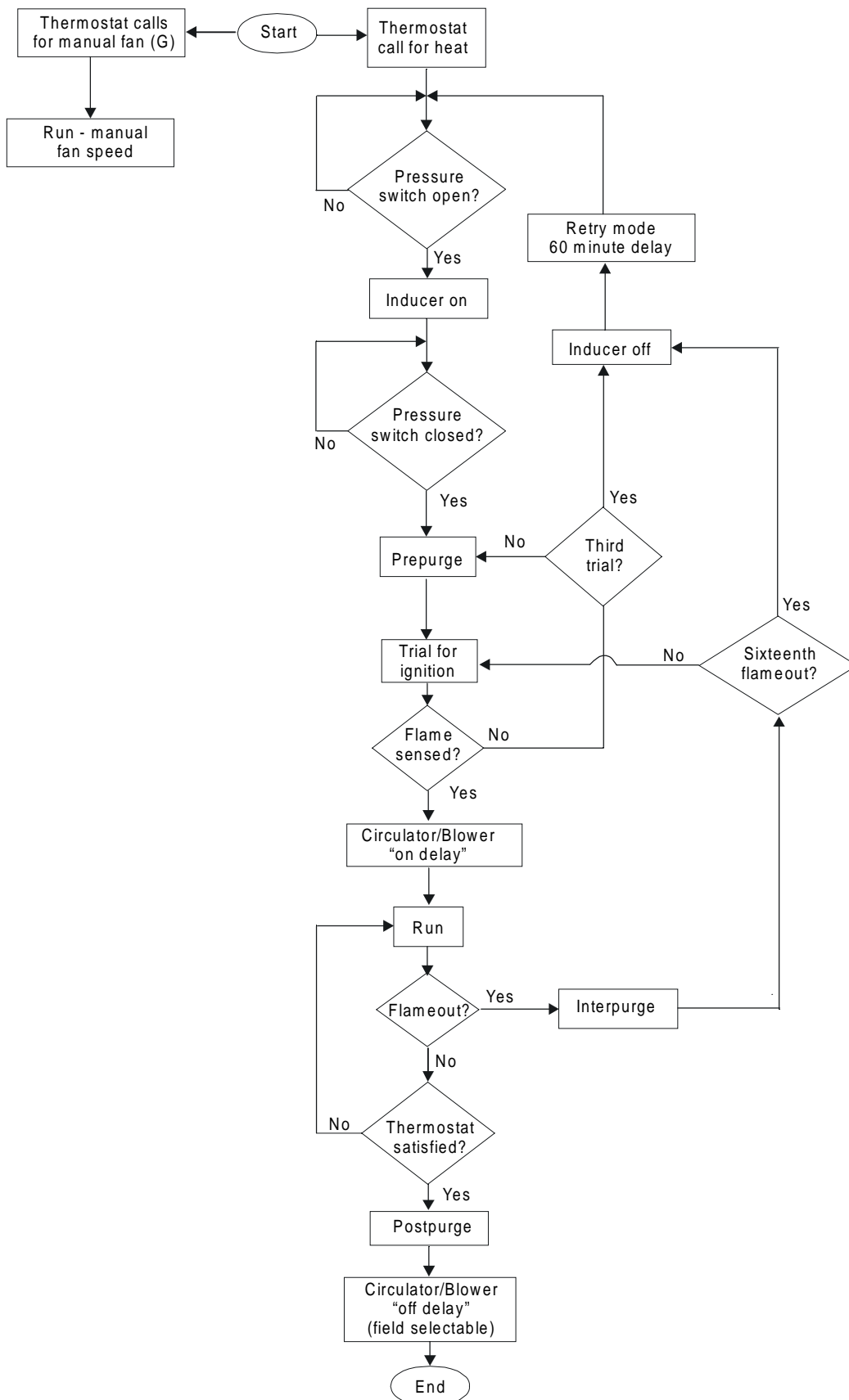


Figure 2: G861 Sequence of Operation

Call for Manual Fan

Upon receiving a call for continuous manual fan, the G861 energizes the circulator/blower motor at medium fan speed. The continuous fan on request is immediately overridden by a call for heat.

Abnormal System Operation

The G861 offers the following responses based on abnormal system operation.

Pressure Switch Detection

A pressure switch within the appliance provides proof of combustion air flow. During a heating cycle, the G861 control responds to the state of this switch in the following ways:

- At the beginning of the heating cycle, if the pressure switch is not open before the inducer is energized, the control will wait for the switch to open for as long as the call for heat is present. The G861 control LED (Light-Emitting Diode) will blink with a flash code of 3 while waiting for the pressure switch to open.
- If the pressure switch does not close after the inducer has been energized for 8 seconds, the control will keep the inducer energized and the LED will blink with a flash code of 3 until the pressure switch closes or the call for heat is removed.
- If the pressure switch opens any time after the G861 control has begun the trial for ignition, the control will immediately de-energize the gas valve. If the pressure switch fault occurs after the flame is sensed, the circulator/blower will run for 90 seconds, the inducer motor will remain energized, and the control will go into the Pressure Switch Open Fault state. During this time, the LED will blink with a flash code of 3. As long as the call for heat is still present, the control will continue to wait for the pressure switch to close before resuming the heating cycle. If the pressure switch fails three times with no more than 30 seconds between successive faults, the control will go to PSWFLT1 and PSWFLT 2 state with an LED flash code of 3.

Undesired Flame

If a flame is present at power up, the G861 allows the flame to extinguish within 10 seconds. If this occurs, the normal sequence of operation continues. If the flame is still present after 10 seconds, the G861 goes into flame lockout. If flame is present any other time it should not be, the G861 goes into flame lockout after a 10-second delay.

During the flame lockout, the inducer motor and the circulator/blower remain energized, and the main valve is de-energized. The G861 control LED flashes with a duty cycle of 1/2 second On, 1/2 second Off for five flashes with a longer Off time before repeating the series. The control remains in this state until the main power is cycled.

Failure to Sense Flame Within Trial Period

If a flame is not sensed by the end of the trial-for-ignition period, the gas valve is de-energized, the inducer remains energized through the 10-second interpurge period, and another trial for ignition begins. If a flame is not sensed before the end of the third trial, the control proceeds to a 60-minute retry delay period, where all outputs are de-energized, before resetting itself. During the 60-minute retry delay period, the LED will blink with a flash code of 2.

A “manual fan” call from the thermostat during the 60-minute retry will run the circulator/blower at medium speed.

Flameout

If the main burner flame is established and then lost, the gas valve is de-energized and the inducer and circulator/blower run through a 10-second interpurge. Once the interpurge period expires, the control initiates another trial for ignition.

After the sixteenth flameout in any given heating cycle, the control proceeds to a 60-minute retry delay period, where all outputs are de-energized. A “manual fan” call from the thermostat will run the circulator/blower at medium speed. During the 60-minute retry delay period, the LED will blink with a flash code of 2.

A “manual fan” call from the thermostat during the 60-minute retry will run the circulator/blower at medium speed.

Interrupted Thermostat

The G861 offers the following responses to the two possible interrupted thermostat situations:

- If the call for heat is removed before the gas valve is energized, the G861 will de-energize all outputs and return to the Off state.
- If the call for heat is removed any time after the gas valve is energized, the gas valve and spark igniter (if energized) are de-energized, the inducer motor will run through the postpurge period, and the circulator/blower will run for the selected blower “off delay” time.

High Limit Switch

The high limit switch is monitored whenever a call for heat is present. Any time the switch opens, the gas valve and igniter are de-energized, and the inducer and circulator/blower run continuously. When the switch is reset, the inducer and circulator/blower run for 180 seconds before the control returns to normal operation. Whenever the high limit switch is open while the call for heat is present, the control LED will blink with a flash code of 4.

Installation and Wiring

IMPORTANT: This technical bulletin is intended as a guide for qualified personnel installing or servicing Johnson Controls products. Carefully follow all instructions in this sheet and all instruction on the appliance. Limit repairs, adjustments, and servicing to the operations listed in this sheet or on the appliance.



WARNING: **Fire or Explosion Hazard.** Avoid serious injury by carefully following precautions in this sheet and all instructions on the appliance. Limit repairs, adjustments, and servicing to the operations listed in this sheet or on the appliance.



WARNING: **Fire or Explosion Hazard.** If the control is installed in an area that is exposed to water (dripping, spraying, rain, etc.), it must be protected. If the control has been exposed to water in any way, do not use it.

Mounting



WARNING: **Shock Hazard.** Avoid electrical shock and equipment damage. Disconnect the electrical power and turn off the gas before wiring the control into the circuit.

Choose a location that provides the shortest, direct cable route to the spark igniter and flame sensor. Easy access to the terminals is desired for wiring and servicing. The G861 may be mounted in any position. Mount the control on a grounded metal surface with No. 8 machine or No. 6 sheet metal screws.



CAUTION: **Equipment Damage Hazard.** Do not mount the control where it will be exposed to direct infrared radiation from the main burner or to temperatures in excess of the maximum product temperature rating.

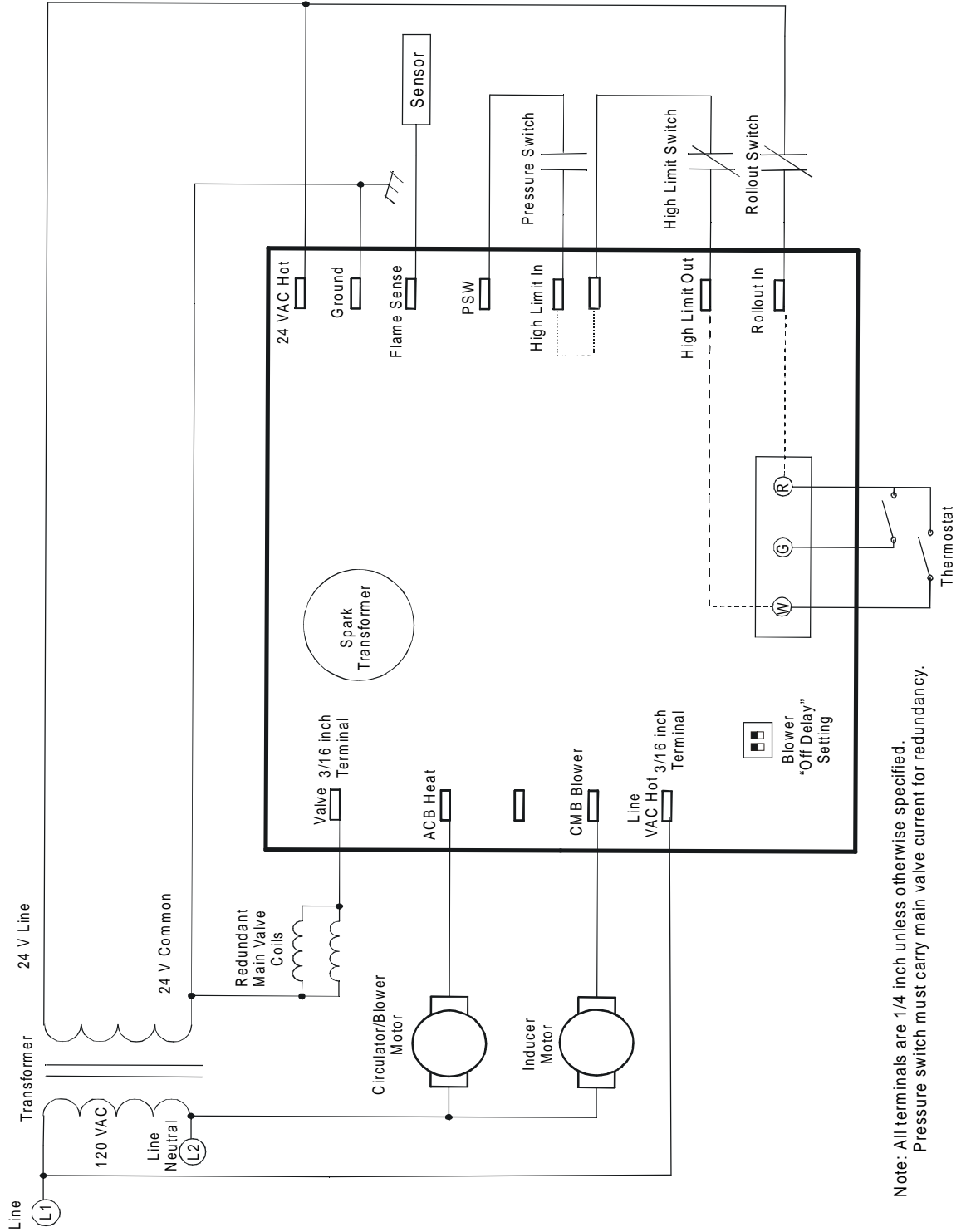
Electrical Connections



CAUTION: **Equipment Damage Hazard.** Connect the high voltage cable to the spark transformer terminal and spark igniter before applying power to the control.

Check the voltage rating marked on the control and ensure it is suited to the application. Use an NEC Class 2 transformer to provide 24 VAC under maximum load, including the valve. A transformer having excessive primary impedance due to poor coupling will affect the ignition potential.

Refer to Figure 3 for the G861 wiring diagram. All wiring should be in accordance with the National Electrical Code (NEC) and all other local codes and regulations. The high voltage spark transformer cable must not be in continuous contact with a metal surface. Use standoff insulators. Ensure that the flame sensor wire and high voltage spark transformer cable are separated from one another by a minimum distance of 6.35 mm (1/4 in.) and are not wrapped around any pipe, other wiring, or accessories.



Note: All terminals are 1/4 inch unless otherwise specified.
 Pressure switch must carry main valve current for redundancy.

Figure 3: G861 Terminal Interface Wiring Diagram

**Checkout and
Startup
Procedures**



WARNING: Fire or Explosion Hazard. Avoid personal injury or property damage by making sure the control functions properly and there are no gas leaks. Follow this checkout and startup procedure before leaving the installation.

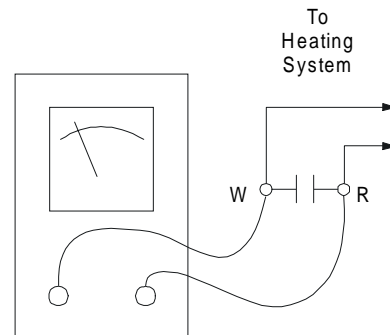
Make sure all components function properly by performing the following shutoff test:

1. With the gas and thermostat off, turn on power to the appliance.
2. Turn the thermostat to a high setting and verify that the control goes through the operating sequence to a shutoff condition.
Note: The burner will not light because the gas is off.
3. Turn the thermostat off.
4. Turn gas on and purge gas lines of all air.
5. Check for gas leaks on all pipe joints upstream of the gas valve with a soap solution.
6. Turn the thermostat to a high setting and verify successful ignition and a normal run condition for at least three minutes.
7. Check for gas leaks on all pipe joints downstream of the gas valve with a soap solution.
8. Turn the thermostat down for at least 30 seconds, and then back up again. Verify successful ignition at least three times before leaving the installation.

**Thermostat
Heat
Anticipator
Settings**

The thermostat anticipator setting is normally equal to the ignition system current draw, plus that of the main valve.

Due to variations in appliance wiring and valves, it is advisable to measure the actual current draw of the heating system at the thermostat location. Measuring this current can be accomplished by opening the thermostat contacts (lowering the setpoint) and installing an AC ammeter across the terminals, or by using a clamp-on ammeter with a 10-turn multiplier attached to the terminals. See Figure 4.



AC Ammeter Low Scale Setting

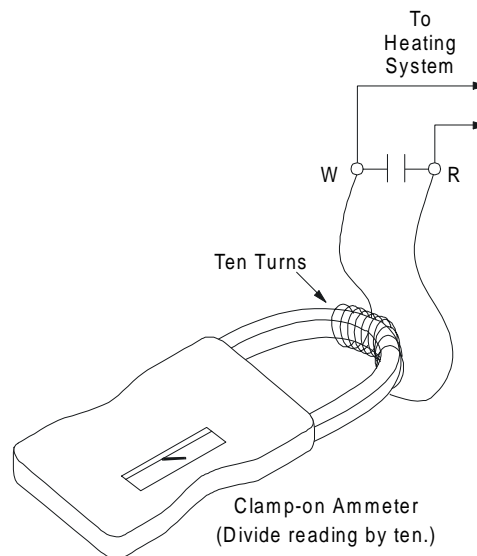


Figure 4: Measuring the Thermostat Current

**Service
Procedures**


If the system does not function properly, check the following:

- Are all mechanical and electrical connections tight?
- Is the system wired correctly?
- Is gas inlet pressure per manufacturer's specifications?
- Is the system powered?
- Is the thermostat calling for heat?

Flash Codes**Table 2: LED Flash Code Summary**

Flash Code	Flash Code Description
Slow Flash	Normal operation, no call for heat
Fast Flash	Normal operation, call for heat
Flash Two	Failed to detect or sustain flame
Flash Three	Pressure switch open or closed
Flash Four	High limit open
Flash Five	Flame sensed and gas valve not energized
Steady On	Internal failure (microcontroller self-check failure)

**Repairs and
Replacement**

 CAUTION: Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

Do not attempt field repairs to the ignition control. Use only an exact or recommended replacement control. For a replacement control or accessories, contact the original equipment manufacturer or the nearest Johnson Control distributor.



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