



S9100D Integrated Furnace Control

INSTALLATION INSTRUCTIONS

APPLICATION

The S9100D Integrated Furnace Control (IFC) is used in high efficiency gas-fired warm air furnaces with an induced draft burner (IDB), direct spark ignition, and a flame rectification circuit to confirm flame presence.

The S9100D provides:

- Control of one or two circulating fan speeds (based on appliance requirements) plus continuous fan option, in response to a standard thermostat.
- Main burner ignition via direct spark generated on board.
- Appliance operation/safety requirements controlled via microprocessor. Microprocessor/software safety requirements are as defined by Resideo and stated applicable standards.
- Monitoring of system pressure switch and high temperature limit functions.
- Control of inducer, gas valve, circulating fan, EAC output, safety input status, user-selected blower off delays and established internal operating sequence.
- LED system status and diagnostic indication.
- EnviraCOM™ communication capability to enable local and/or remote system status, diagnostics, and troubleshooting.

Two models are provided. One model controls unit heaters using a single speed circulating fan (heat only model). The second model controls a two-speed circulating fan for other appliances that must support heating and cooling (heat/cool model).

The S9100D Integrated Furnace Control is intended for residential natural or liquid propane furnaces only. Other applications require Resideo Automation and Control Solutions Design Engineering review and written approval. Contact your Resideo Sales Representative for assistance.

SPECIFICATIONS

Control Voltage: 18–30 VAC 50/60 Hz

Control Power Consumption Maximum: 12VA* + Gas Valve

* 12 VA includes Thermostat Anticipator current, relay drive current, etc. during a call for heat.

Thermostat Anticipator Setting: 100mA.

Gas Control:

Any 24 Vac redundant gas control rated at 1.5A or less. Resideo VR8205 recommended.

Cooling Contactor:

Any 24 Vac contactor rated at 1.0A or less.

Induced Draft Blower:

2.5FLA/5LRA @ 115VAC

1.25FLA/2.5LRA @ 240VAC

Indoor Blower Load:

12FLA/16LRA @ 115VAC

6FLA/8LRA @ 240VAC

Humidifier:

1A resistive load @ 120VAC

Electronic Air Cleaner:

1A resistive load @ 120VAC

APPROVED TIMINGS RANGE*

Prepurge: 2 to 60 seconds

Trial for Ignition: 4 to 20 seconds

Interpurge: 5 to 60 seconds

Postpurge: 2 to 60 seconds

Auto Reset Delay: 60 minutes

Recycle Time: 5 to 60 seconds

Flame Failure Response Time: 2 seconds max at 1.0uA

Indoor Fan-On Delay:

Heat: 30 seconds.

Cool: 5 to 7 seconds.

Indoor Fan-Off Delay:

Heat: 45 to 160 seconds.

Cool: 30, 60 seconds.

* Contact Resideo Sales Representative for specific model and available timings.



INSTALLATION

When Installing This PRODUCT...

- 1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
- 2. Check the ratings given in these instructions to make sure the integrated furnace control is suitable for your application.
- 3. Installer must be a trained, experienced service technician.
- 4. After installation is complete, check out operation as provided in these instructions.

 WARNING

Fire or Explosion Hazard.
Can cause severe injury, death or property damage.

- 1. The integrated furnace control can malfunction if it gets wet, leading to accumulation of explosive gas.
 - Never install where water can flood, drip or condense on the control.
 - Never try to use an integrated furnace control that has been wet—replace it.
- 2. Liquefied petroleum (LP) gas is heavier than air and will not naturally vent upward.
 - Do not operate electric switches, lights, or appliances until you are sure the appliance area is free of gas.

 WARNING

Electrical Shock Hazard.
Can cause severe injury, death or property damage.

Disconnect power supply before beginning wiring to prevent electrical shock or equipment damage.

 CAUTION

Equipment Damage Hazard.
Water can cause equipment damage or malfunction.

If furnace control must be mounted near water or moisture, provide suitable waterproof enclosure.

Location

The integrated furnace control is mounted inside the furnace wiring compartment. The location must provide:

- Access to the field wiring terminals.
- Operating ambient temperatures between minus 40°F and plus 150°F (minus 40°C and plus 66°C), except temperatures to 170°F (77°C) are acceptable for occasional brief periods.
- Relative humidity below 95% noncondensing.
- Protection from water, steam or corrosive chemicals that are used to clean the appliance.
- Protection from dripping water, such as from an overfilled humidifier or from condensation.
- Protection from dust or grease accumulation.
- A barrier between line and low voltage field wiring terminals.

Mounting

Select a location close enough to the burner to allow a short direct cable route to the igniter. the integrated furnace control can be mounted in any position. Line voltage wiring terminals must be in an enclosure separate from the low voltage field wiring terminals. The unit is designed to snap into predrilled holes in the mounting surface.

Wiring

 WARNING

Electrical Shock Hazard.
Can cause severe injury, death or property damage.

Disconnect the power supply before making wiring connections to prevent electrical shock or equipment damage.

Check the wiring diagrams furnished by the appliance manufacturer, if available, for circuits differing from the general hookup shown. Carefully follow any special instructions affecting the general procedures outlined below.

IMPORTANT

- 1. The common ground required for the S9100D and the main burner must be supplied through the plug connected to the P1 receptacle on the board.
- 2. Make sure the transformer has adequate VA. To determine the total VA requirement, add the maximum current draws of all devices in the control circuit, including the furnace control and the gas control and multiply by 24. The result is the minimum transformer VA rating. Use a Class II transformer if replacement is required.

All wiring must comply with local codes and ordinances. See Table 1 and Fig. 1 for typical connections, but refer to furnace manufacturer instructions, if available.

Table 1.

Installation	Voltage	Terminal Type	Connects S9100D to:
Factory	120 Vac	1/4 in. male quick-connects	Indoor blower motor, system transformer primary, 120 Vac power supply, igniter and induced draft blower motor.
	24 Vac	9-pin AMP Mate-N-Loc receptacle	Pressure switch, gas control and limits. Also supplies common ground between burner and S9100D flame sense rod.
		1/4 in. male quick-connect	Transformer secondary.
Field	120 Vac	1/4 in. male quick-connects	Humidifier and electronic air cleaner.
	24 Vac	Screw terminals	Thermostat.
	24 Vac	E-COM 3-pin connector	Another EnviraCOM enabled device

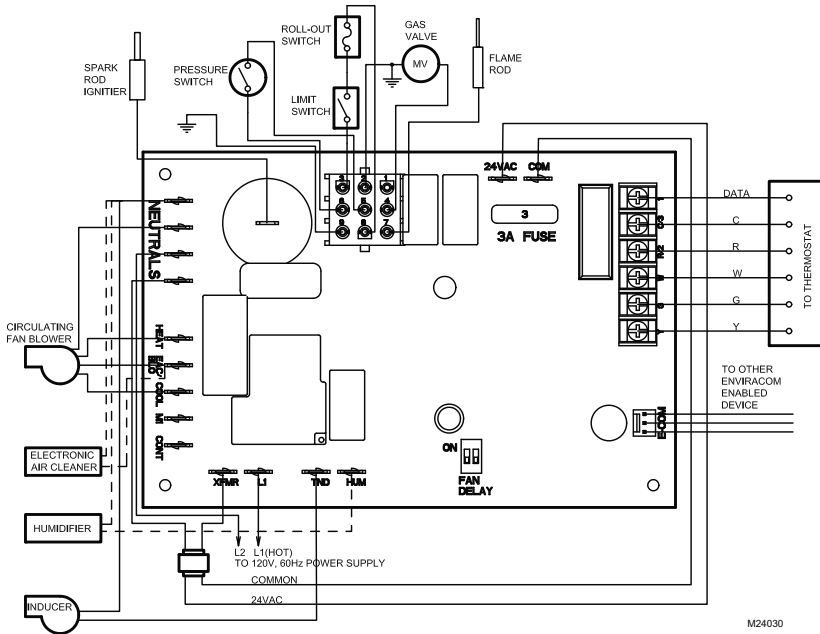


Fig. 1. Typical wiring connections to S9100D Integrated Furnace Control.

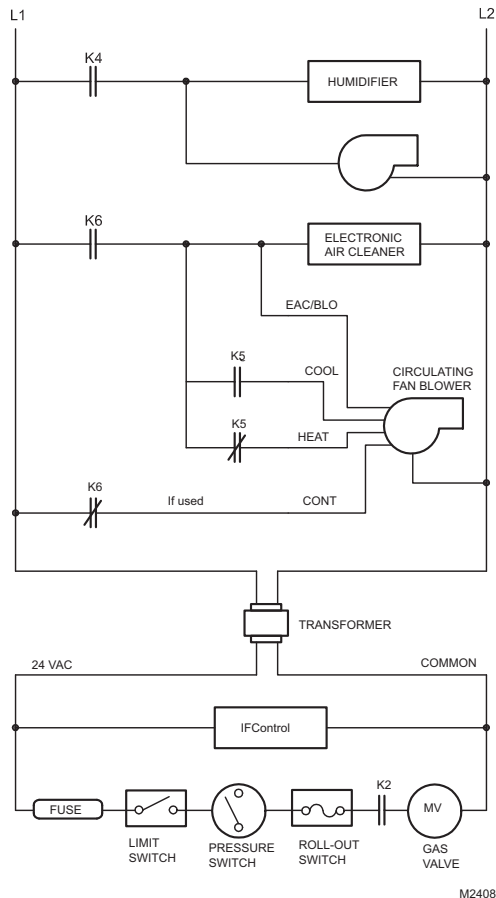


Fig. 2. Ladder diagram of S9100D Integrated Furnace Control.

SETTINGS AND ADJUSTMENTS

Thermostat Anticipator

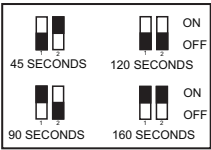
Set the heat anticipator in the thermostat to 0.1A. Thermostat current is constant throughout the heating cycle.

Fan Off Timing

The fan off delay timing is factory-set at 120 seconds. To change it, first disconnect the power, then set the switches according to Table 2 and Fig. 3.

Table 2.

Fan Off Delay Timer	SW1	SW2
120 seconds (factory setting)	Off	Off
90 seconds	On	Off
45 seconds	Off	On
160 seconds	On	On



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Fig. 3. Fan off delay time switches.

CHECKOUT

Check out the control system:

- At initial installation of the appliance.
- As part of regular maintenance procedures.
- As the first step in troubleshooting.
- Any time work is done on the system.

Use the following procedures only for the integrated furnace control; see individual component instructions for additional checkout procedures.

Check Normal Operation

1. Turn on power to the appliance and reset the furnace control by turning the thermostat to its lowest setting and waiting five seconds.
2. Set the thermostat to call for heat. Make sure the integrated furnace control sequences the system as indicated in Fig. 4.
3. Set the thermostat below the room temperature to end the call for heat. The burner should go out; the induced draft fan should provide postpurge time according to the model (5, 45 seconds); and after a delay time, the indoor fan should stop.

Normal Heat cycle

Call for Heat

The IFC is not allowed to initiate new heating cycle if the heat speed off delay is in progress (no matter if the indoor blower runs on heat or cool speed). The control stays in Idle until the heat off delay period expires.

The thermostat calls for heat by energizing the "W" terminal. The control checks to see the limit switch is closed and pressure switch is open. If the limit switch is open, the control responds as defined in the Limit Switch Circuit Operation section. If the pressure switch is closed for 5 seconds, the control will flash the proper error code and wait indefinitely for the pressure switch to open. If the pressure switch is open, the control proceeds to pre-purge.

Pre-purge

The control energizes the induced draft motor and waits for the pressure switch to close. If the pressure switch does not close within 30 seconds of the inducer being energized, the proper error code will flash. The inducer runs until the pressure switch closes or the call for heat is removed. If the pressure switch closes, the error code is reset and the ignition sequence continues.

When the pressure switch is proven closed, the control begins the pre-purge time. If flame is present any time while in pre-purge, the pre-purge time is restarted. If flame is present long enough to cause lockout, the control responds.

The control runs the inducer for the pre-purge time, then proceeds to the ignition trial period.

Ignition Trial

The control energizes the spark and gas valve solenoids. The inducer remains energized. Any time flame is sensed above the Spark Off level, spark is turned off. If flame drops below the Flame Lost level during ignition trial, spark turns back on. The control monitors flame level for the entire Ignition Trial time. If, at the end of Ignition Trial, flame is sensed above the Run level, the control proceeds to the heat blower on delay. If flame is not sensed above

the Run level at the end of Ignition Trial, the control de-energizes the gas valve and proceeds with ignition retries (see Ignition Retry below).

Heat Speed On Delay

The control waits for the specified time after the start of Ignition Trial, and then energizes the indoor blower heat speed. The gas valve and inducer remain energized. The control proceeds to Run mode.

Run

Control inputs are continuously monitored to ensure limit and pressure switches are closed, flame is established, and the thermostat call for heat remains. When the thermostat call for heat is removed, the control de-energizes the gas valve and begins post-purge and blower off delay timing.

If the control is in the run mode for 1 hour, the retry and recycle counter is cleared.

Post Purge

The Inducer output remains on for the selected post-purge period after the thermostat is satisfied.

Heat Speed Off Delay

The control waits for a field-selectable time after the call for heat is ended and de-energizes the indoor blower heat speed. A label on the control identifies switch settings and the timings available. One delay time is factory set by Resideo.

Abnormal Heat cycle

Interrupted Thermostat call for heat

If the thermostat demand for heat is removed while inducer was not on the control returns back to idle.

If the thermostat demand for heat is removed before the flame is recognized, while inducer was on the control will run the inducer for the post purge period and de-energize all outputs.

If the thermostat demand for heat is removed after successful ignition (i.e. the control entered Heat Fan On Delay or Run states), the control will de-energize the gas valve, run the induced draft motor through a post purge, and run the indoor blower motor on heat speed for the selected delay off time.

Ignition Retry

If flame is not established on the first Ignition Trial period, the control de-energizes the gas valve and the inducer remains energized for the inter-purge period. The spark and gas valve are then re-energized and the control initiates another trial for ignition.

If flame is not established on the second trial for ignition, the control de-energizes the gas valve, energizes the indoor blower on heat speed, and the induced draft motor remains energized. The indoor blower is shut off after the longest selectable blower delay time. When the indoor blower de-energizes, the spark and gas valve are re-energized and the control initiates another trial for ignition.

If flame is not established on the third Ignition Trial period, the control de-energizes the gas valve and the inducer remains energized for the inter-purge period. The control then re-energizes the gas valve and spark and initiates another trial for ignition.

If flame is not established on the fourth Ignition Trial (initial try + 3 retries), the control de-energizes the gas valve, runs inducer for the established post purge and goes into soft lockout. The proper LED diagnostic flashes during the selected time before auto reset from soft lockout.

Ignition Re-cycle

If flame is established and maintained during Ignition Trial period and then flame is subsequently lost, the control de-energizes the gas valve within 2 seconds, the induced draft motor continues to run, and the control begins timing the inter-purge delay. The control energizes (or keeps energized) the indoor blower motor on heat speed for the selected delay off time.

When the inter-purge delay is over, the gas valve and spark are re-energized, and the control initiates another ignition activation period. The control will cycle up to 5 flame losses (4 re-cycles) within a single call for heat before going to soft lockout. The proper LED diagnostic will flash during the auto reset delay before reset from soft lockout.

Limit Switch Circuit Operation

The limit switch circuit is ignored unless a call for heat is present (W energized) and the control is not in soft lockout. If the limit switch circuit is open, a call for heat is present and the control is not in soft lockout, it de-energizes the gas valve and runs the indoor blower motor on heat speed, and runs the induced draft motor.

When the switch re-closes or the call for heat is lost, the control runs the induced draft motor through post-purge and runs the indoor blower through the selected fan off delay. The control will return to normal operation after the blower off delay is completed.

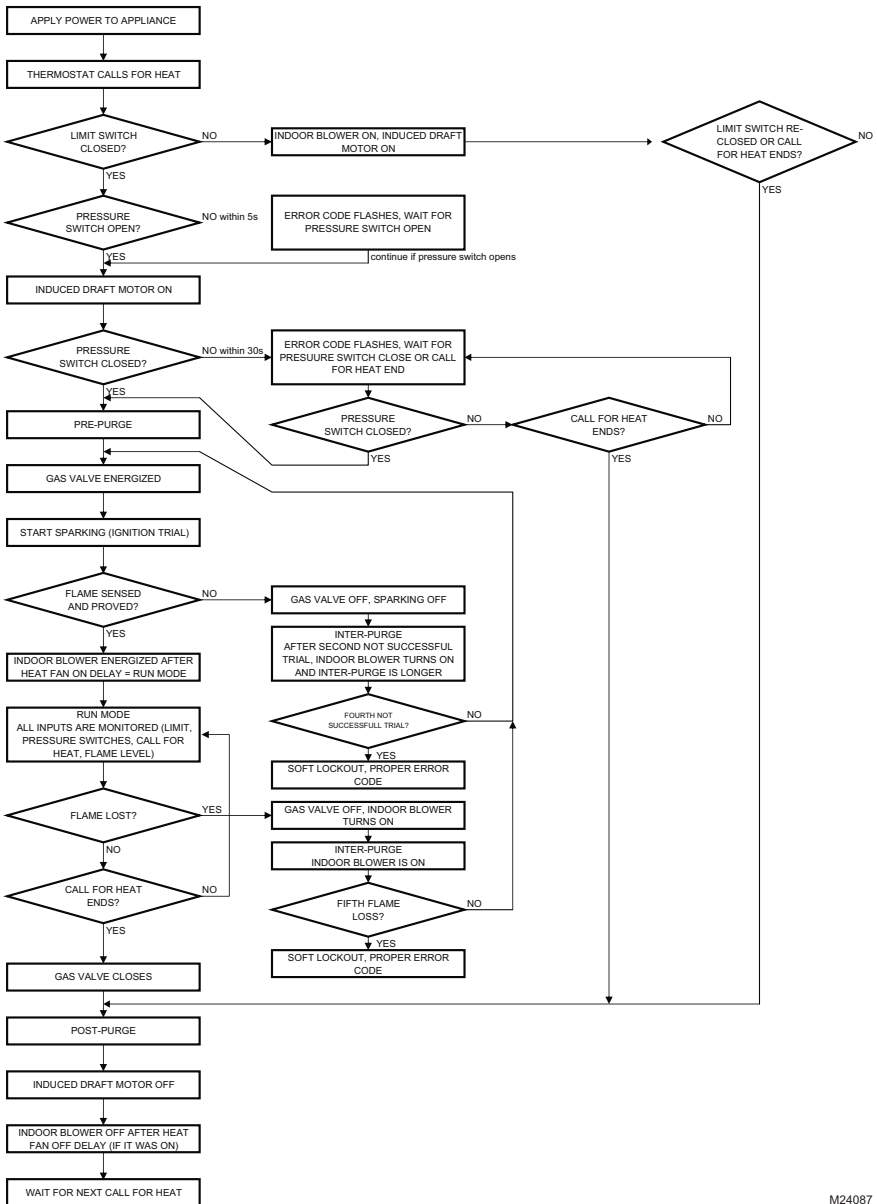
Pressure switch

If the pressure switch opens during prepurge before the Ignition Trial period, the induced draft motor will run through the pressure switch recognition delay (2 seconds). If the pressure switch is still open, the control will re-start pressure switch proving sequence if the call for heat still exists.

Pressure switch opening for less than 2 seconds during the Ignition Trial period will not interrupt the heat cycle. (Gas valve will de-energize while the pressure switch is open).

If the pressure switch opens during run mode, the pressure switch will de-energize the gas valve. If flame is lost before the end of the 2-second pressure switch recognition delay, the control will respond to the loss of flame. If the pressure switch remains open for 2 seconds and flame remains, the control de-energizes the gas valve, the induced draft motor runs through post-purge, and the indoor blower runs on heat speed through the selected fan off delay. When the fan off delay is over, the indoor blower is de-energized and a heat cycle is begun if the call for heat still exists.

If pressure switch opens during Interpurge for longer than pressure switch recognition delay (2 seconds) the control proceeds to post-purge.



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Fig. 4. S9100D IFC sequence on normal heating cycle.

Check Safety Shutoff Operation

1. Shut off the gas supply at the manual gas valve ahead of the appliance.
2. Set the thermostat to call for heat. System should operate as indicated in Fig. 4
3. Following lockout, open the manual gas valve and make sure no gas is flowing to the burner.

TROUBLESHOOTING



WARNING

Fire, Explosion, or Electrical Shock Hazard.
Can cause severe injury, death or property damage.
Do not attempt to modify the physical or electrical characteristics of this device in any way. Replace it if troubleshooting indicates a malfunction.

IMPORTANT

- 1. The status codes outlined in Table 3 are a general guide. Follow appliance manufacturer service instructions when available.
- 2. Take all meter readings within the trial for ignition period. After the ignition period ends, before continuing, reset the system by turning down the thermostat for at least five seconds but for less than 20 seconds.
- 3. If any component does not function properly, make sure it is correctly installed and wired before replacing it.
- 4. Static discharge can damage the integrated furnace control. Touch the metal surface to discharge static electricity before touching the furnace control.

- 5. The integrated furnace control cannot be repaired. If it malfunctions, replace it.
- 6. Only trained, experienced service technicians should service integrated furnace control systems. Perform the checkout steps listed in the Checkout system before beginning any troubleshooting procedure. After troubleshooting, check out the system again to be sure it is operating normally.

The integrated furnace control has three LED:

- **STATUS**
 - Control powered (without call for Heat): short flashing (once in 4 seconds)
 - Call for heat, normal operation: heartbeat (alternating between full and reduced brightness every 1/2 second)
 - Special code for failure diagnostics
- **FLAME**
 - Flame signal at least 1 µA above run level: LED is ON solid
 - Flame signal between Normal and Flame lost level: flashing every half second
 - Flame signal under Flame Lost level: LED is OFF solid
- **E-COM**
 - EnviraCOM communication is indicated

LED codes are mapped in Table 3.

Table 3. Status LED Codes.

Pattern	Status
Short Flashing	Control powered (without call for Heat)
Heartbeat	Call for heat: normal operation
2	PS closed when should be open (after time delay) - PS failed closed
3	PS open when should be closed (after time delay) - PS failed open
4	Limit circuit open
5	Flame sensed out of sequence - flame still present
6 + 1	Softlockout: Failed to light during four ignition trials
6 + 2	Softlockout: Limit circuit opened during run (recycle counter is at its maximum)
6 + 3	Softlockout: PS opened during run; did not reclose within 2 seconds (flame lost and recycle is at its maximum)
6 + 4	Softlockout: Flame failed during run; from other than already mentioned reason (recycle is at its maximum)
6 + 5	Softlockout: Flame sensed out of sequence and is gone now
7 + 1	Lockout: Bad fuse detected (Serviceman should replace the fuse)
7 + 2	Lockout: Low voltage on 24VAC input (Serviceman should check transformer voltage)
7 + 3	Lockout: EnviraCOM bus/circuit fault (Serviceman should switch the power off, unplug EnviraCOM connector and switch back on. If error doesn't appear again till 5 minutes, there is a problem on external EnviraCOM bus, IFC is O.K.)
7 + 4	Lockout: Gas Valve Fault (Serviceman should perform Soft reset. If there is no reaction then manual power reset. Gas valve relay is either welded or failed open or gas valve is connected improperly. If error is reported again and non-IFC valve stuff are O.K., IFC must be replaced)
7 + 5	Lockout: Internal Hardware Error detected (IFC must be replaced if error appears again after power-up)

When 7 + Y code is to be flashed and more than one error is present simultaneously, the most critical one shall be flashed (advanced part of the code is sorted in the way, that higher number means more critical error).

NOTE: Because one error can cause detection of another one, the serviceman should check also all lower priority faults than the one which is being flashed.



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69-1830-05 M.S. Rev. 06-20 | Printed in United States