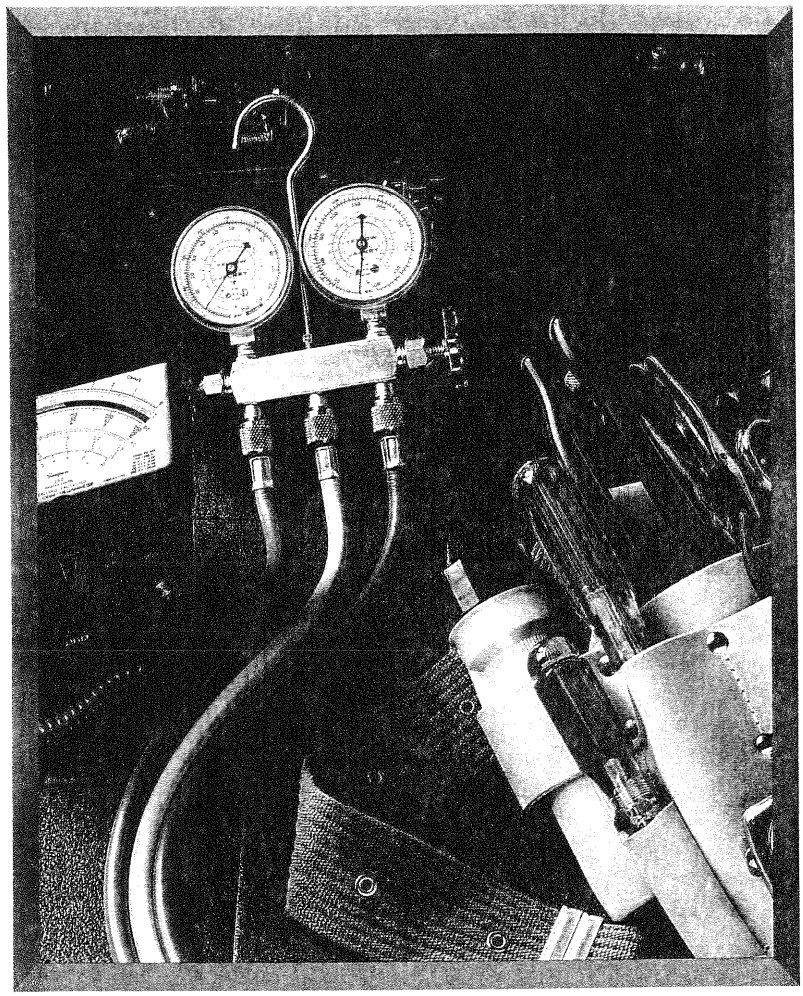
TECH SERVICE



YAC "IGC" BOARD

INTEGRATED GAS UNIT CONTROLLER

FAMILIARIZATION • ELECTRICAL OPERATING SEQUENCE • DIAGNOSTIC FEATURES

"IGC"

INTEGRATED GAS UNIT CONTROLLER

The contents of the IGC Service Training Packaged Program, Catalog No. 020-513, are: (53) 35mm slides and this workbook (Catalog No. 020-512).

TABLE OF CONTENTS

Section Title	Slide No.	Page No.
Introduction and Safety	1 - 7	1
Familiarization	8 - 22	2
Electrical Operating Sequence	23 - 37	8
Diagnostic Features	38 - 53	14
Quiz		20
Appendix		22
Quiz Key		29

Objectives-
Upon completion of this training program, you will have a better understanding of the IGC (Integrated Gas Unit Controller) and how to troubleshoot and service units containing it.

Presentation Instructions-
1. Obtain necessary audio-visual equipment, air conditioning equipment, handout materials and program workbooks for each participant.
2. Distribute and review handout materials (see suggested list of handout materials below).
3. Read the workbook in its entirety. Use the slides to highlight topics of importance. Review quiz using slide/page references noted in the Quiz Key.
4. Distributors may obtain Certificates of Achievement through Literature Distribution.

Note: For Classroom Instructors, check slide orientation of wiring diagram slides before loading in slide tray. These slides are in a vertical format.

Handout Materials/Additional Training Materials- (Available through Literature Distribution.)
1. Installation, Operation, and Start-Up Instructions for applicable gas-fired unit.
2. This workbook.

Self Instruction-
When using this program for self instruction, read the workbook in its entirety and complete the quiz. Quiz answers with paragraph references are located in the Quiz Key.

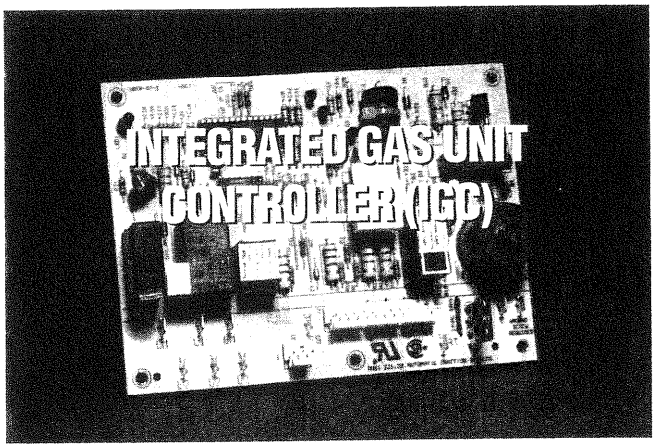
INTEGRATED GAS UNIT CONTROLLER TRAINING PROGRAM

- Introduction and Safety
- Familiarization
- Electrical Operating Sequence
- Diagnostic Features

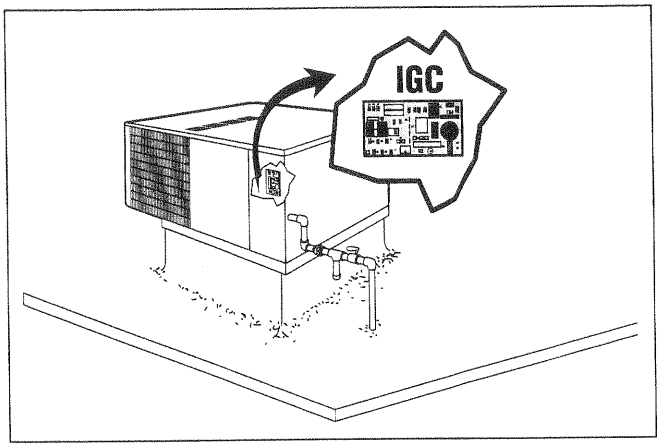
1. This program provides information on the new Integrated Gas Unit Controller (IGC) board, which is the latest electronic circuit board for control of gas-fired rooftop equipment.

The program is divided into four parts:

- Introduction and Safety
- Familiarization
- Electrical Operating Sequence
- Diagnostic Features



2. The IGC is a circuit board designed to control combustion functions and blower motor timing. It ignites, maintains, and checks burner flame in rooftop units from 1 1/2 to 100 tons of capacity. The board also has a diagnostic feature that displays error codes for identifying heating system problems should they occur.



3. The IGC responds to inputs from any 24-volt central control or heating-cooling thermostat*. This sophisticated control board makes the control of rooftop units more reliable. It also simplifies rooftop unit troubleshooting through its built-in diagnostic function.

Before we move into the program, however, let's take a moment to talk about safety.

* It is not recommended to use thermostats that draw power from the unit for their operation. Refer to the product literature for the correct thermostats to use.

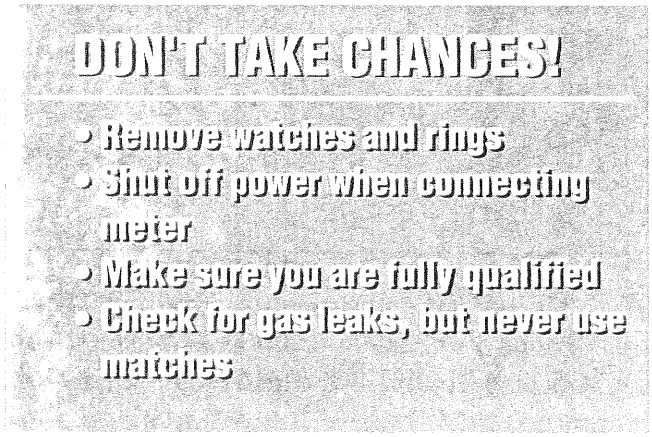
SAFETY

- Watch out for pressurized, rotating, or "hot" components
- Open, lock, and tag disconnects
- Be extremely careful when troubleshooting live components
- Follow prescribed safety precautions

4. **Remember!** Safety is a very important part of your job. Working on air conditioning, refrigeration, or heating systems means working on components that are pressurized, rotating, and either thermally or electrically HOT. Be careful!

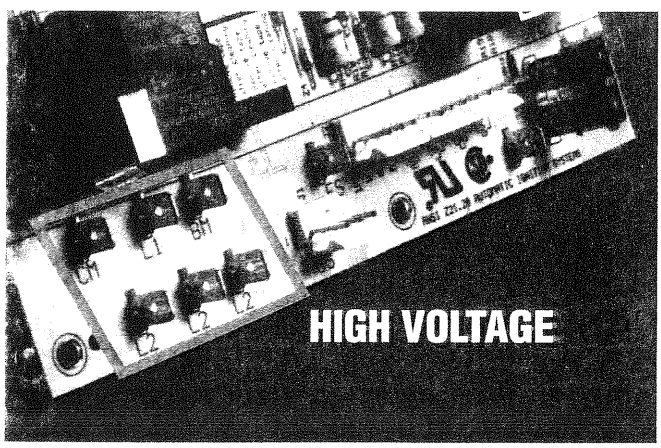
Before performing electrical service, shut off all power; open, lock and tag all disconnects. Use

extreme caution when troubleshooting live electrical components. Follow all safety procedures shown in printed instructions.

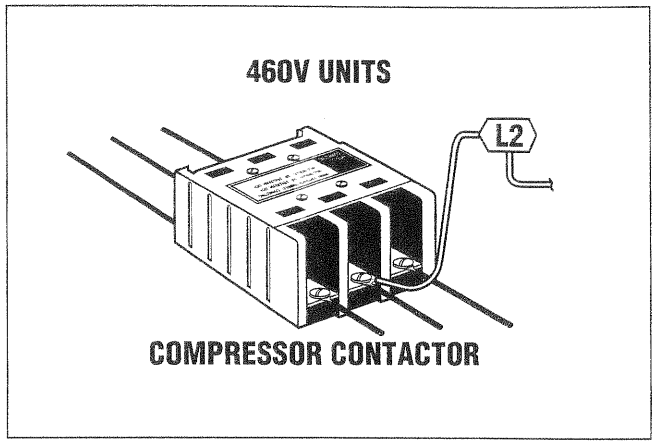


5. DON'T TAKE CHANCES!

- Remove watch and rings before performing electrical troubleshooting.
- Shut power off before placing electrical meter alligator clips on component terminals.
- Only qualified technicians should perform service on air conditioning equipment.
- Gas leaks are dangerous. Always check for leaks with a soapy water solution prior to firing the burners. Never use a match or open flame to check for gas leaks.

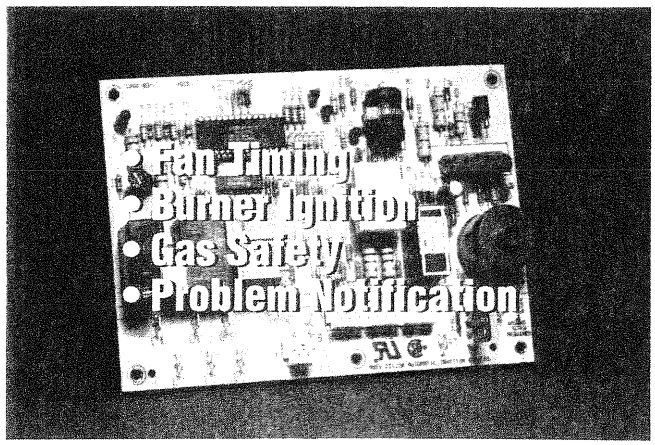


6. When working on the IGC, keep in mind that, unlike some control boards, the IGC contains high voltage circuits as well as the usual 24-volt circuits. Therefore, special care is necessary when working on or near the IGC board with power applied.



7. There are 208/230-volt and 460-volt versions of the IGC. The 208/230 version has an L2 connection on the board; the 460-volt version does not. A lead from the compressor contactor supplies the L2 voltage.

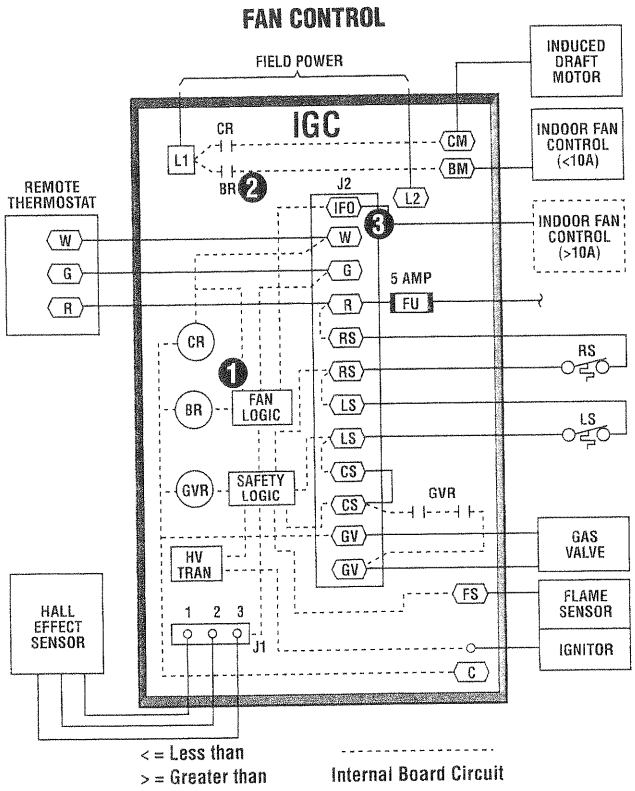
FAMILIARIZATION



8. The IGC is designed to perform four basic tasks:

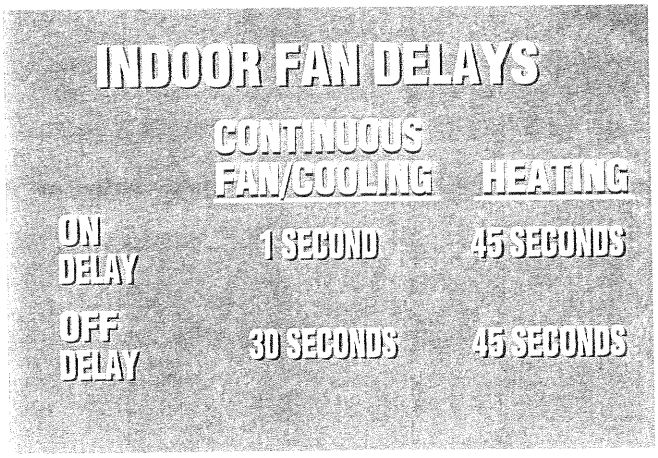
- Timed control of indoor fan functions
- Ignition of burners
- Safe and efficient control of heating operation
- System status and error codes via a light emitting diode (LED)

In this section, we will discuss how the board performs these tasks.



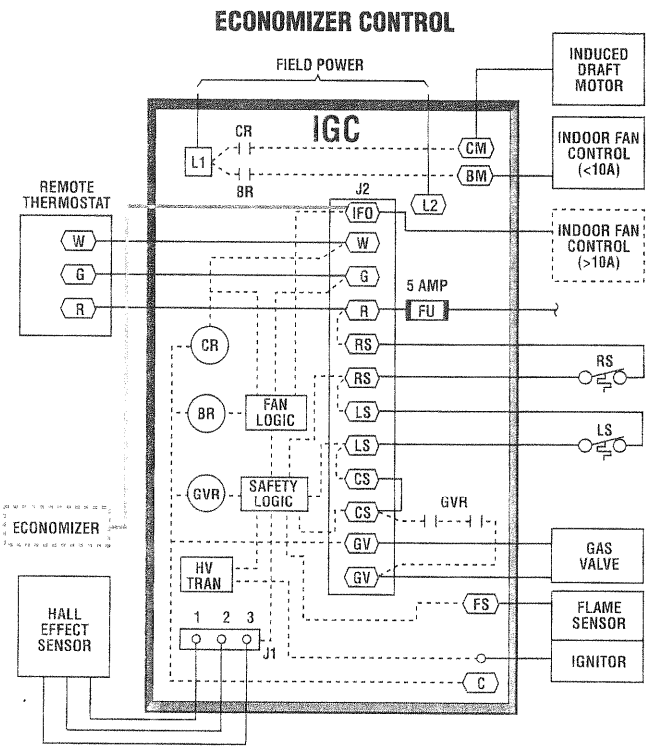
9. The fan logic, at 1, controls the timing of the indoor fan, also known as the blower, by controlling on-board blower relay BR contacts, at 2, or an external fan contactor for the larger size units. The blower relay can handle blower motors drawing up to 10 amps. If the unit being controlled uses a larger blower, the IGC will control the unit's indoor fan contactor through terminal IFO, at 3, on J2. More about this in the Operating Sequence Section.

NOTE: In this program, the wiring schematic dotted lines represent logic and circuits within the board and the solid lines represent wiring to and from the board.

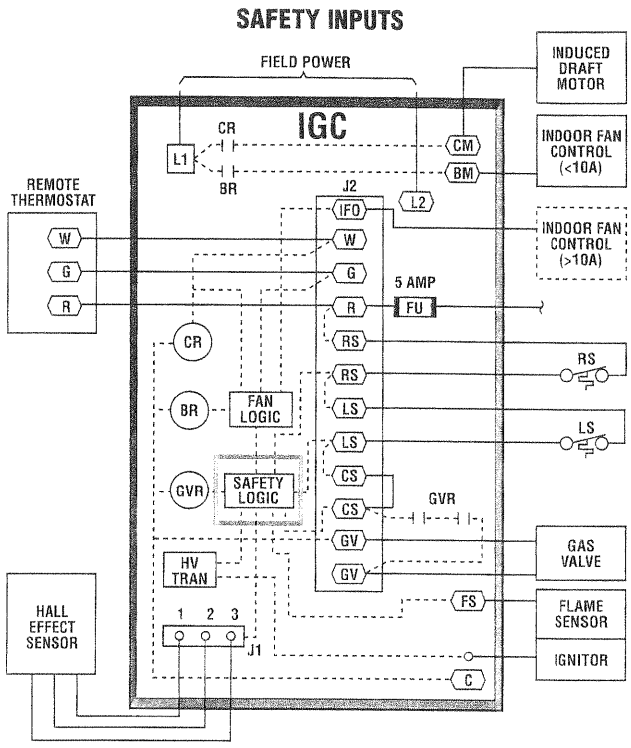


10. In the cooling mode, the fan logic activates the blower one second after the thermostat calls for cooling. This prevents the blower motor from starting at the same instant as the compressor motor(s) and outdoor fan motor(s). When the cooling thermostat opens, there is a 30-second delay before the blower shuts off, in order to take advantage of residual cooling capacity in the system. The continuous fan mode also has a 1-second on delay and a 30-second off delay.

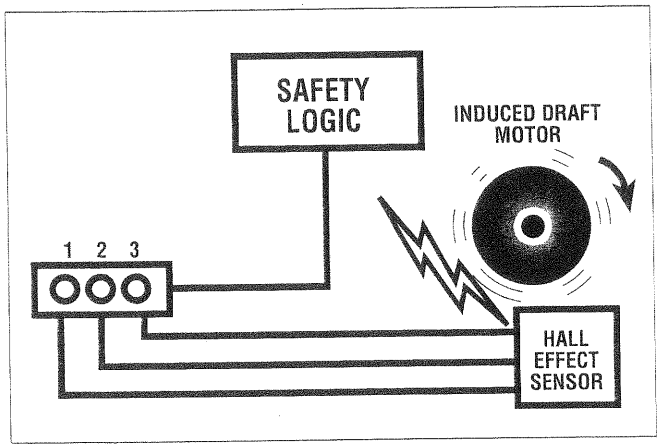
In the heating mode, the fan logic imposes blower start-up and shutoff delays of 45 seconds in normal operation. The delay in start-up prevents supplying cold air to the conditioned space and the delay in shutoff takes advantage of residual heating capacity in the system.



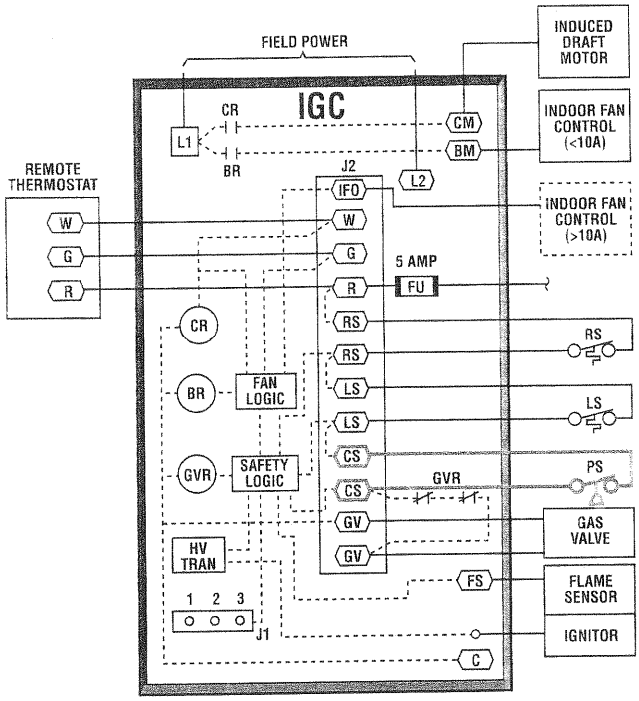
11. If the unit is equipped with an economizer, the IGC fan logic sends a signal through J2 terminal IFO to tell the economizer when the blower is on.



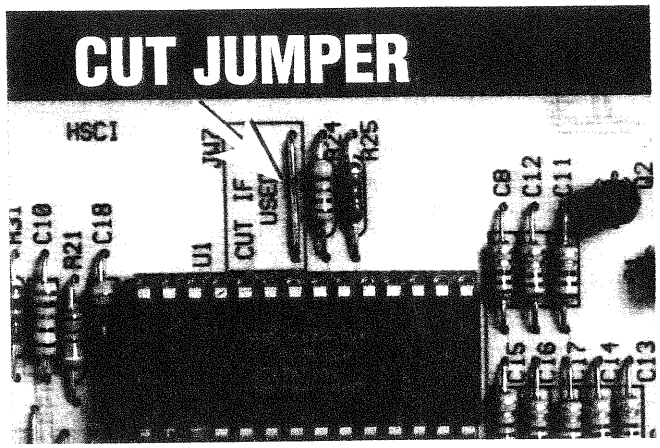
12. The safety logic receives inputs from the unit's rollout switch, limit switch, flame sensor, and the IGC fan logic. It also receives an input from the device used to prove operation of the induced draft motor, which can be either a pressure switch, centrifugal switch, or Hall Effect sensor. In this program we will use the Hall Effect sensor.



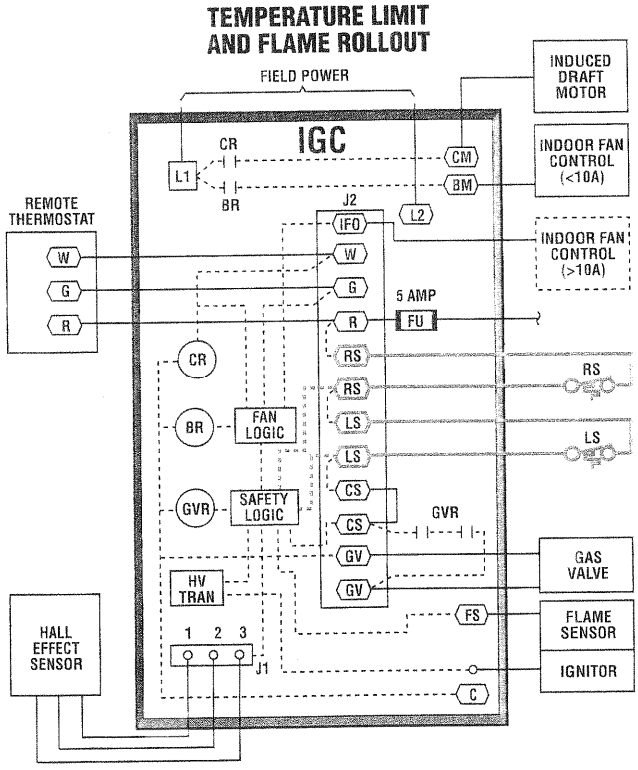
13. The Hall Effect sensor is a magnetic device mounted on the induced draft motor. As long as the motor is turning at the required speed, the sensor produces an induced current which signals the safety logic that the induced draft fan is running at the required speed.



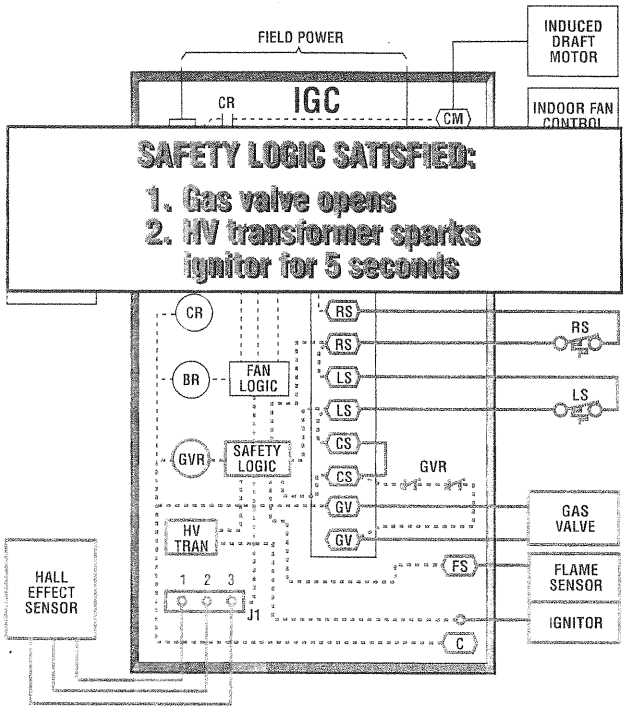
14. If the unit uses a pressure switch or centrifugal switch to prove the induced draft motor, the switch will be connected to terminal CS on J2 and will thus be in series with the other safety switches. On such units, the jumper across the CS terminals will be removed when the switch is installed.



15. When a pressure switch or centrifugal switch is used, the jumper shown here must be cut. A cut jumper will signal the IGC that a pressure switch or centrifugal switch is to be used in place of a Hall Effect sensor.



16. Terminals RS and LS on J2 connect the IGC safety logic to the unit's rollout and limit switches. If either switch opens, the safety logic shuts off the gas flow and energizes the unit's blower and induced draft fan to cool and purge the heat exchangers. In the event of a flame rollout the IGC also locks out the unit.



17. When the safety logic is receiving all the necessary inputs from the safety switches, fan logic, and induced draft motor sensor, it will open the gas valve and start the gas flow.

At the same time, the high voltage transformer, enabled by the safety logic, will send a 10,000 volt spark to the ignitor for five seconds to ignite the gas.

NUISANCE TRIP COMPENSATION

BLOWER-ON DELAY = ELAPSED DELAY - 5 SECONDS

BLOWER-OFF DELAY = CURRENT DELAY + 15 SECONDS (UP TO 3 MINUTES)

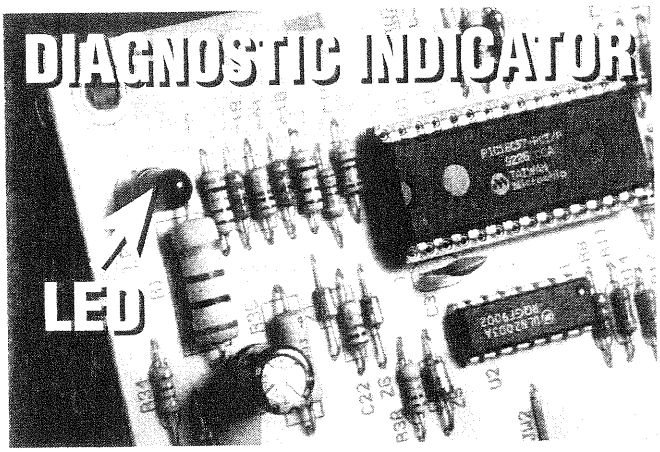
18. One of the important features of the IGC is its ability to compensate for nuisance trips of the limit switch. If the limit switch is tripping during the blower-on delay period, the IGC fan logic subtracts 5 seconds from the elapsed delay time, and the result becomes the new blower-on delay.

For example, assume the unit tripped on the limit switch 30 seconds into the blower-on delay. When re-ignition occurs, the new fan delay will be 25 seconds.

Similarly, if the limit switch opens within 10 minutes after the heating thermostat opens, 15 seconds will be added to the next blower-off delay, up to a maximum of 3 minutes.

For example, if the limit switch tripped 5 minutes after gas shutoff, the blower will remain on for 60 seconds (vs. 45) on the next heating cycle.

These automatic blower-delay modifications remain in effect until the power source is reset.



19. A light emitting diode (LED) on the IGC provides an indication when there is a fault in the unit or in the control itself. The LED remains on when the unit is operating normally and remains off when there is a major malfunction such as a loss of 24-volt power.

ERROR CODE DESCRIPTION FOR CONTROL BOARD

LED INDICATION	ERROR MODE
ON	NORMAL OPERATION
OFF	HARDWARE FAILURE
1 FLASH	FAN ON/OFF DELAY MODIFIED
2 FLASHES	LIMIT SWITCH FAULT
3 FLASHES	FLAME SENSE FAULT
4 FLASHES	4 CONSECUTIVE LIMIT SWITCH FAULTS
5 FLASHES	IGNITION LOCKOUT FAULT
6 FLASHES	INDUCED DRAFT MOTOR FAULT
7 FLASHES	ROLLOUT SWITCH FAULT
8 FLASHES	INTERNAL CONTROL FAULT

NOTE: -WHEN W1 IS ENERGIZED THE BURNERS WILL REMAIN ON FOR A MINIMUM OF 60 SECONDS.
-IF MORE THAN ONE ERROR MODE EXISTS THEY WILL BE DISPLAYED ON THE LED IN SEQUENCE.

Fault Directory Label

20. A flashing LED indicates that a specific failure has been detected, as determined by the number of flashes between intervals. This label can then be used to determine where the fault is. For example, if the LED is flashing eight times between 3-second intervals, it means there is a failure of the IGC board itself.

The diagnostic features of the IGC board are discussed in more detail later in the program. Also, an Error Code Description Chart, Table II, in the back of this workbook provides a summary of the fault messages and their probable causes and corrective actions.

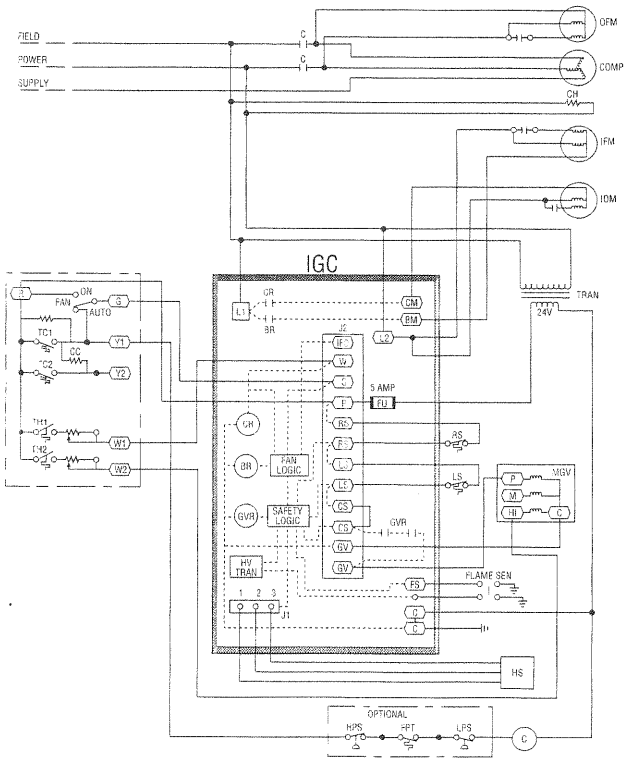
21. A 5-amp, automotive-type fuse on the IGC provides overcurrent protection for the remote thermostat and the secondary of the 24-volt transformer.

REVIEW

- Safety Practices
- IGC Features
- Fan Control
- Burner Ignition and Safety Controls
- Diagnostic Features

22. That concludes the Introduction and Familiarization sections. In these first two sections, we have covered safety practices, IGC features, fan control, burner ignition and safety controls, and diagnostic features. In the next section, we will cover the electrical operating sequence of a typical heating-cooling unit under the control of the IGC.

ELECTRICAL OPERATING SEQUENCE



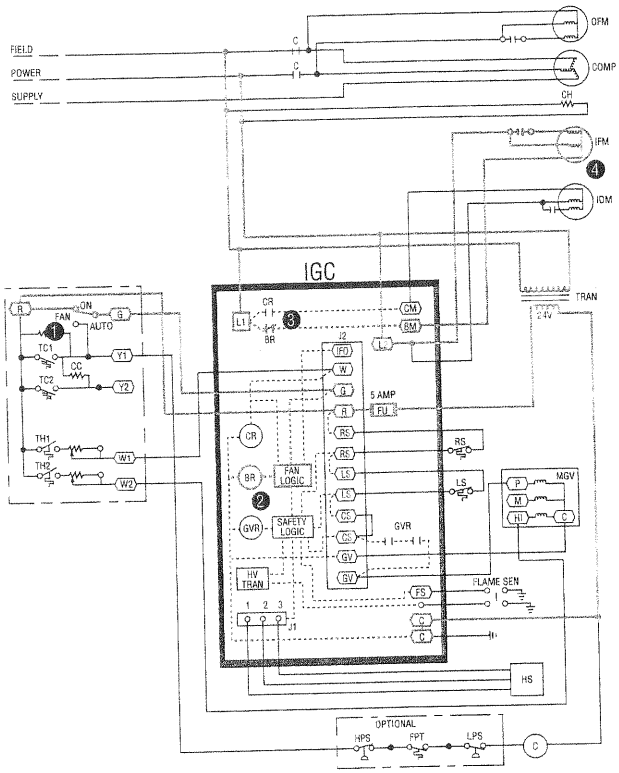
23. For our discussion, we have selected a typical heating and cooling unit with 208/230-volt three-phase power, a 24-volt thermostat, IGC board, and a high heat gas valve. Also note that this unit's indoor fan motor draws less than 10 amps, so the IFM will be controlled by BR contacts.

Refer to the following legend for an explanation of the abbreviations used to identify components on the schematic diagram. In our explanation of the electrical operating sequence we are using a simplified version of the wiring schematic. Refer to the back of the workbook for an actual diagram and to Table I for a Sequence of Operation Summary.

LEGEND

BR	Blower Relay
C	Contactor
COMP	Compressor
CR	Combustion Relay
FLAME SEN	Flame Sensor
FPT	Freeze-up Protection Thermostat
FU	Fuse (5 amp)
GVR	Gas Valve Relay
HS	Hall Effect Sensor
HPS	High Pressure Switch
HV TRAN	High Voltage Transformer
IDM	Induced Draft Motor
IFM	Indoor Fan Motor
IGC	Integrated Gas Unit Controller
LS	Limit Switch
LPS	Low Pressure Switch
MGV	Main Gas Valve
OFM	Outdoor Fan Motor
RS	Rollout Switch
TC1	Thermostat Cooling Switch 1
TC2	Thermostat Cooling Switch 2
TH1	Thermostat Heat Switch 1
TH2	Thermostat Heat Switch 2
TRAN	Transformer

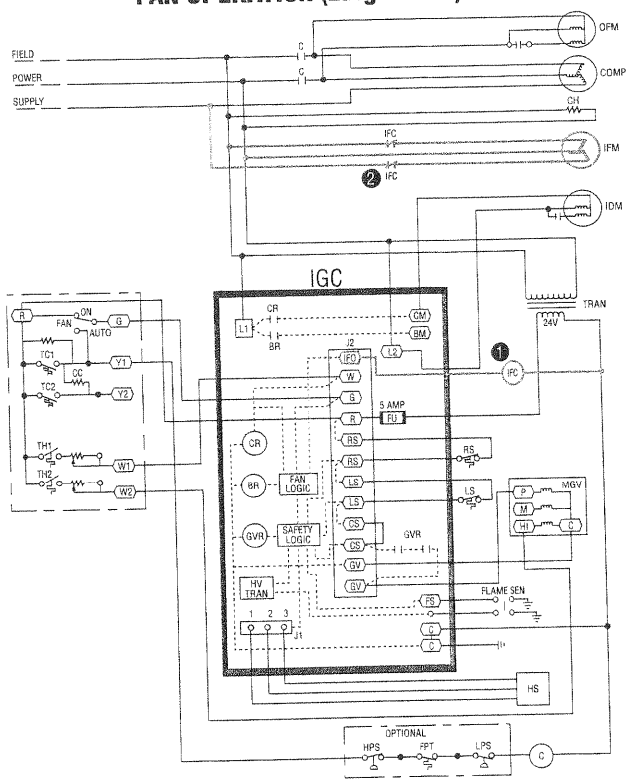
FAN OPERATION (Small Units)



24. With the power on and the overcurrent protection closed, there is a path through J2-R to supply 24 volts to the thermostat and FAN switch. If the FAN switch, at 1, is set to ON, the indoor fan operates continuously. This switch provides a path through J2-G to the fan logic and blower relay BR, at 2, will be energized.

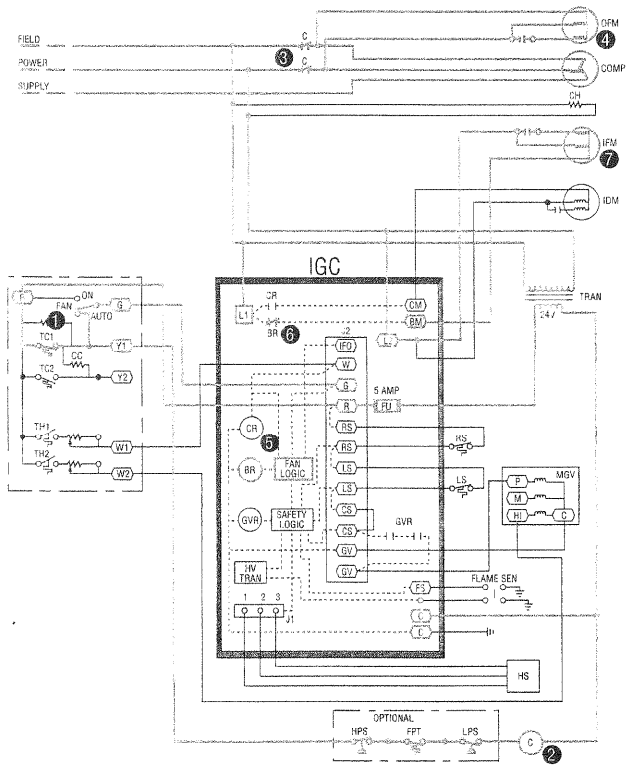
The BR contacts, at 3, close, completing the current path to the indoor fan motor, at 4. The indoor fan motor will start after a 1-second delay and will run as long as the FAN switch is in the ON position. If the FAN switch is set to AUTO, the delays described in the Familiarization section will apply.

FAN OPERATION (Large Units)



25. In larger units, the indoor fan contactor (IFC) contacts control the operation of the indoor fan motor, as shown here. The fan logic energizes indoor fan contactor IFC, at 1. Two sets of normally open IFC contacts, at 2, in the power circuit close to start the indoor fan motor. The on and off fan delays for the large units are the same as those for the small units.

COOLING



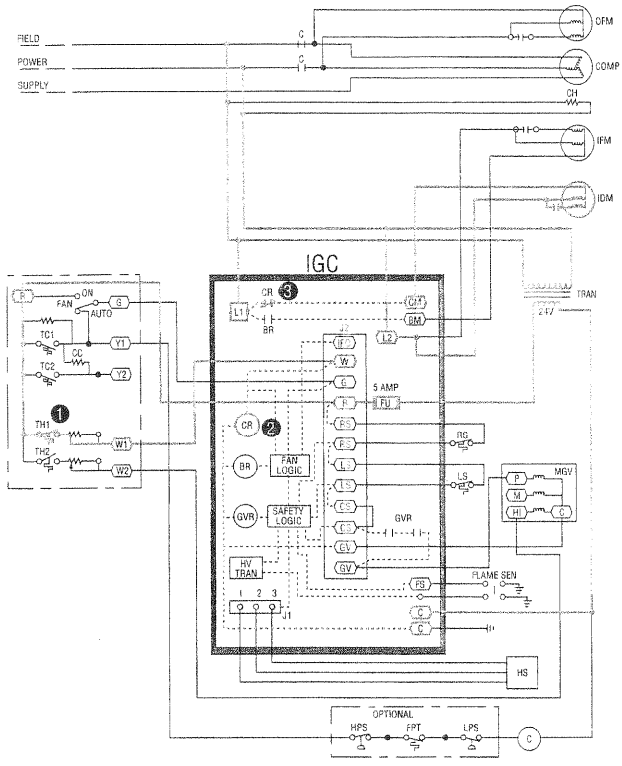
26. In the cooling mode, cooling thermostat TC1, at 1, closes on a call for cooling. This completes a path through Y1 to the compressor contactor C, at 2, assuming that all safety devices in the path are closed.

When C energizes, the C contacts in the power circuit, at 3, close to activate the compressor and outdoor fan motor OFM, at 4.

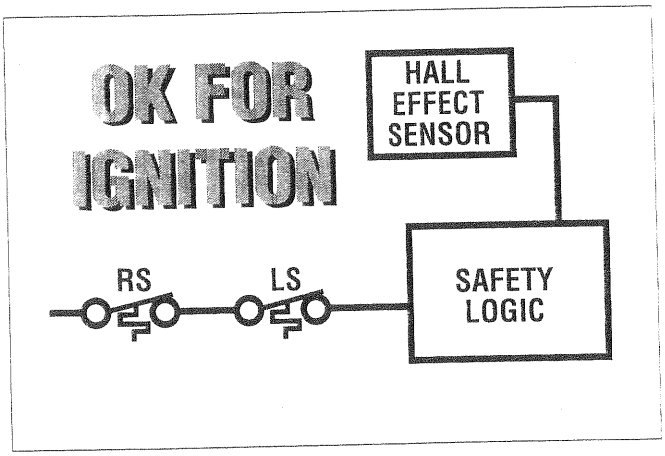
Since the FAN switch is set to AUTO, a signal is sent through G to the fan logic, at 5, which creates a one-second delay to allow for voltage stabilization and then energizes the blower relay BR. This closes the normally open BR contacts, at 6, and the indoor fan motor, at 7, starts.

The compressor and fan motors will run until the temperature of the room air is below the thermostat setting. When TC1 opens, it de-energizes the compressor and OFM, but the fan logic runs the IFM for an additional 30 seconds to take advantage of residual cooling capacity in the system.

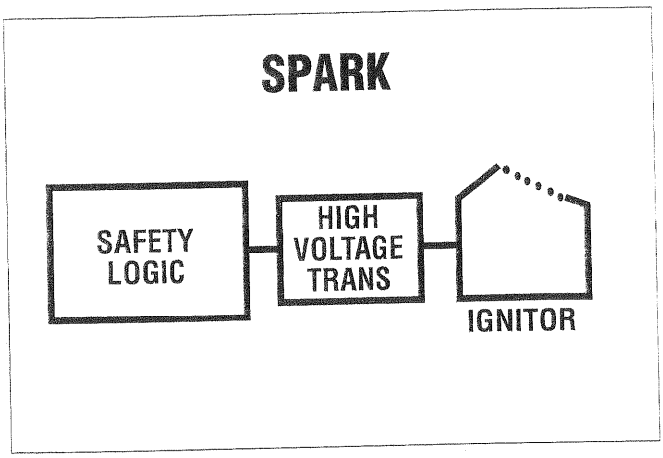
HEATING – IDM ENERGIZED



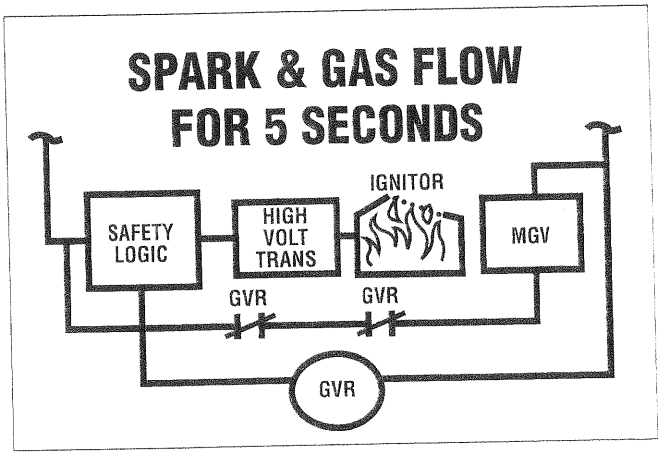
27. When there is a call for heating, the TH1 thermostat switch, at 1, closes to provide a path through terminal W to combustion relay CR, at 2. This energizes the induced draft motor (IDM) by closing the set of normally open CR contacts, at 3.



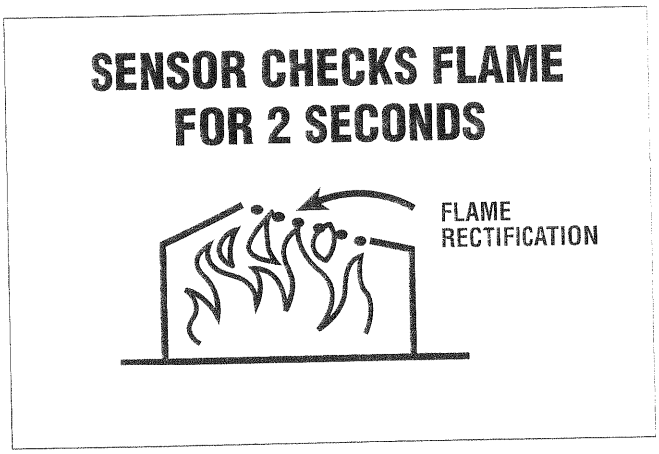
28. The IDM reduces the pressure in the flue collector box by drawing air and/or combustion by-products through the heat exchangers. When the IDM is running, the Hall Effect sensor (in this case) signals the safety logic. If the limit and rollout switches are closed, the safety logic will initiate the ignition sequence.



29. The safety logic signals the high voltage transformer to create a high voltage spark for 5 seconds. This is a 10,000-volt spark, so be careful when troubleshooting in this area.



30. At the same time, the safety logic energizes the gas valve relay and its two N.O. contacts close to open the gas valve and light the burners. The contacts are wired in series so that a welded contact cannot result in an open gas valve. The gas and spark continue for 5 seconds.



31. The molecules of burning gas flowing between the burner and sensor become ionized and capable of conducting electrical current. A pulsating direct current signals the safety logic when the flame is stable and strong. For the IGC to sense a stable, strong flame, .2 microamp is needed. The flame is sensed for 2 seconds to make the "go" or "no go" decision. This process is known as *flame rectification.*

FLAME SENSING

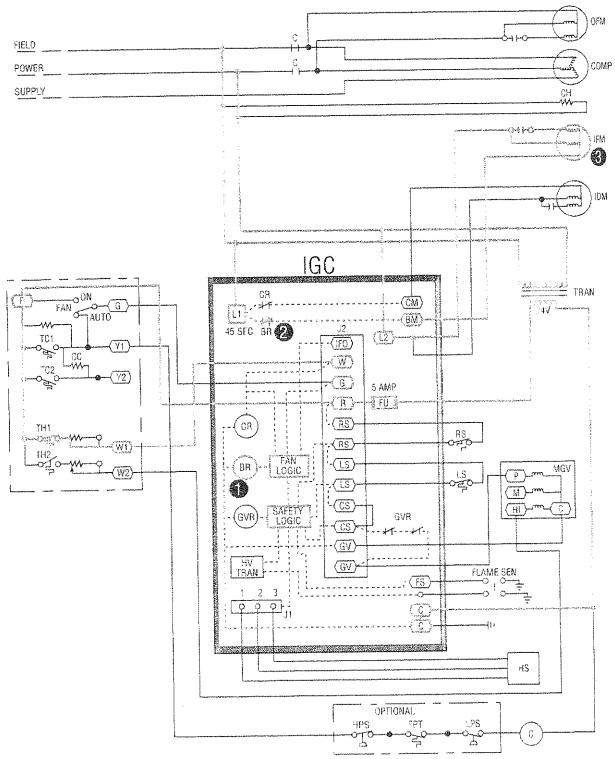
- STRONG FLAME: Spark Stopped
- WEAK FLAME: 5 Sec. Spark
  2 Sec. Proof
  20 Sec. Purge

Up To 15 Min. (33 Tries)

32. If the flame is strong, the high voltage spark will stop and the flame will continue to burn. As the flame burns, it is monitored by the flame sensor for the purpose of re-ignition if the flame should go out.

If the flame is weak, the IGC's safety logic will shut down the MGV after a 5-second spark and a 2-second proof of flame, for a total of a 7-second ignition attempt. A 20-second purge of the heat exchanger is then initiated after which another burner ignition is attempted. *This cycle can continue for 15 minutes, resulting in 33 attempts to light. If there is no ignition within the 15-minute period, the unit will lock out.* To reset a lockout condition, open the unit disconnect to break the voltage for a few seconds, then close the disconnect.

HEATING – BLOWER ENERGIZED



33. Forty-five seconds after the burners ignite, the safety logic signals the fan logic to energize the blower relay BR, at 1, closing the BR contacts, at 2, and energizing the indoor fan motor, at 3. As described in the Familiarization section, if the limit switch opens prior to the fan coming on, 5 seconds are subtracted from the fan delay. For example, if the limit switch trips after 38 seconds, on a relight the fan delay time is reduced to 33 seconds.

If the space temperature continues to fall while the unit is operating, and the unit is equipped with a two-stage gas valve – as in this unit – the high fire solenoid of the gas valve (HI) will be energized. As the temperature rises, TH2 will open and the unit will continue to heat on TH1 until the thermostat is satisfied, at which time the unit will shut down.

TH1 SATISFIED:

- IDM Stops
- Safety Logic Shuts Off Gas Valve

34. When the heating thermostat TH1 is satisfied, it opens, causing the inducer motor to stop and the safety logic to interrupt the voltage to the gas valve relay. The main gas valve solenoid drops out, shutting off the flow of gas.

BLOWER-OFF DELAY

- 45 SEC. BLOWER SHUTOFF DELAY
- DELAY EXTENDED BY 15 SECONDS FOR EACH LIMIT SWITCH TRIP
- MAXIMUM DELAY: 3 MINUTES

35. The fan logic keeps the blower relay energized for 45 seconds to remove the residual heat from the heat exchangers. If the limit switch opens within 10 minutes after the heating thermostat is satisfied, the OFF delay will be extended by 15 seconds on the next cycle. If the limit switch continues to open, the OFF delay can be extended up to 3 minutes, as described in the Familiarization section.

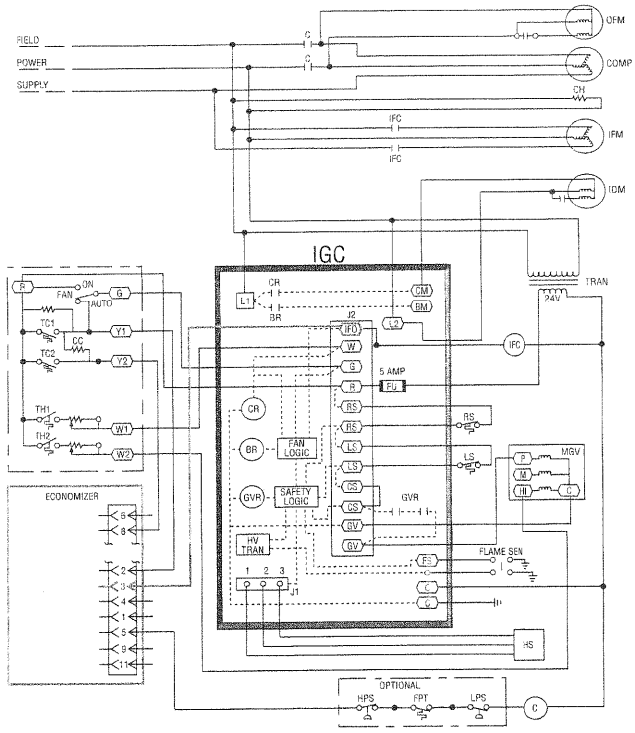
After the fan stops, the unit goes into standby, awaiting a call for heating or cooling.

ONE MINUTE LOCK-ON PREVENTS THERMOSTAT "JIGGLE"

- Furnace Runs For At Least 1 Minute After Call For Heat

36. To prevent "thermostat jiggle," any call for heat (W) is locked on for a minimum of 60 seconds. Even if W is energized for only 1 second, the furnace will run for 60 seconds. This prevents the short cycling problems sometimes present with mercury-switch thermostats.

ECONOMIZER CONTROL



37. If the unit is equipped with an economizer, the fan logic signals the economizer through terminal IFO of J2 when the fan is running. The compressor contactor circuit is also routed through the economizer.

DIAGNOSTIC FEATURES

- CHECK LED BEFORE OPENING DISCONNECT
- REMOVE EXTERNAL ACCESS PANEL AND OBSERVE LED
- OPEN DISCONNECT BEFORE CONDUCTING ANY FURTHER WORK

38. This section provides an overview of the diagnostic capabilities built into the IGC. All diagnostic messages are provided by an LED on the IGC board. To obtain access in order to view the LED, follow these steps.

NOTE: Do NOT open the disconnect switch before checking the LED.

Step 1. Remove the electrical access panel. Be careful of any exposed wiring, terminals, and rotating fans.

Step 2. Observe the LED and note any error code being flashed.

Step 3. Open the electrical disconnect switch before conducting any further work. Opening the disconnect switch breaks the lockout and resets the unit. Any error codes will be canceled.

— CAUTION —

As with any electronic control, the IGC board can be damaged by electrostatic discharges. Before handling the IGC board, always touch the metal of the unit to discharge any static electricity your body may have accumulated.

LED CONSTANT *ON*

= NORMAL OPERATION

LED *OFF*

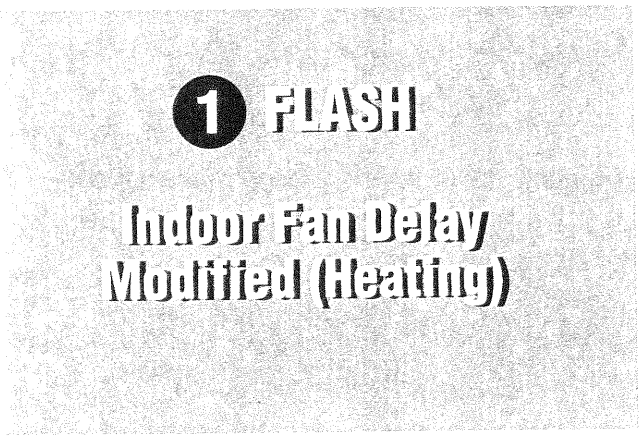
= PROBABLE LOSS OF 24V

39. If the unit is operating normally, the LED will be on constantly.

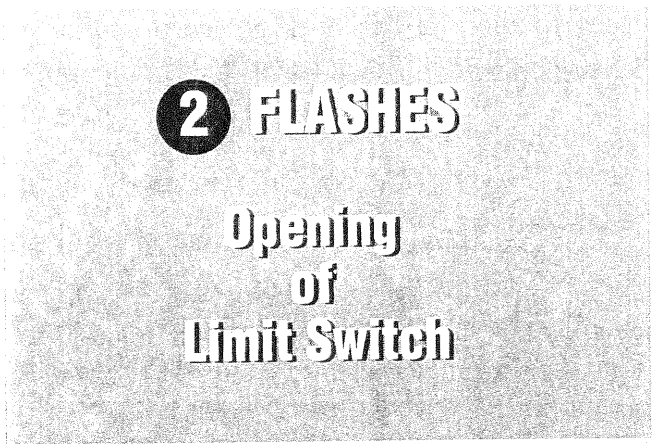
If there is a hardware failure such as no power, open fuse, faulty transformer, or bad PC board, the LED will be off. **DO NOT** replace the board until you have verified all possible causes of power loss.

All other error messages are communicated by a flashing LED.

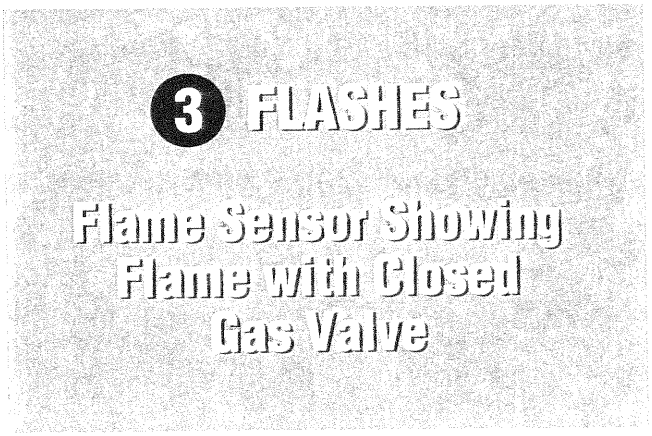
NOTE: All flashing messages are followed by a 3-second pause.



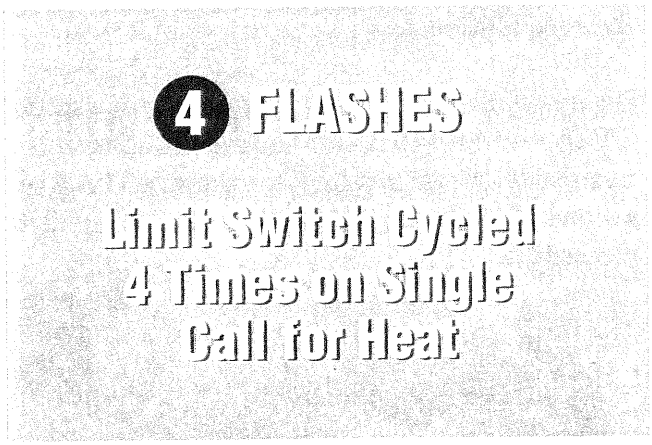
40. INDOOR FAN "TIME ON" IN HEATING HAS BEEN MODIFIED – If the limit switch has opened and the indoor fan ON time has been modified, the LED will flash once. This time modification will stay in effect until the 24-volt control voltage is reset by opening the disconnect switch. The cause for this condition should be investigated and corrected. One obvious cause would be a shortage of air flow.



41. LIMIT SWITCH OPENS DUE TO HIGH TEMPERATURE – Opening of the limit switch breaks the circuit to the gas valve and the LED will flash twice. When the limit switch opens and then resets, the unit will go through the re-ignition sequence and the alarm will be canceled.



42. FLAME SENSOR INDICATING FLAME – If the flame sensor is faulty and indicates a flame without the gas valve being open, an alarm of 3 flashes will be visible. If the fault clears, the unit will go back into heating operation, but the error code will remain in effect until power is reset.



43. FOUR CONSECUTIVE LIMIT SWITCH FAULTS – A code of 4 flashes indicates that the unit cycled on the limit switch four times during the same call for heat, causing the unit to lock out. This usually indicates that there is a blockage in the supply or return ducts, or that the indoor fan motor belt needs adjustment or replacing.

5 FLASHES

Ignition Lockout

44. IGNITION SEQUENCE AND LOCKOUT – No ignition in 15 minutes will result in a lockout and a message of 5 flashes will be seen. If the control voltage is reset at the thermostat the timer will reset to zero (allowing another 15-minute ignition attempt) but the error code of 5 flashes will remain. As with other lockout faults, opening the disconnect and breaking the voltage for a few seconds cancels the coded flashing.

If a loss of flame occurs for one quarter of a second (.25 second) after the flame has been established, the board will attempt to relight the flame within .8 of a second. The time periods for re-ignition will be repeated.

6 FLASHES

Induced Draft Motor Fault

45. INDUCED DRAFT MOTOR FAULT – If there is 24 volts at W for more than 60 seconds and the control board does not receive a signal from the Hall Effect sensor that the induced draft motor is running, a fault will be declared, as indicated by 6 flashes of the LED. The board will not allow ignition until the induced draft motor is running.

If ignition has occurred and it appears that the induced draft motor has stopped, the gas valve will be de-energized until the Hall Effect sensor indicates rotation. If this does not occur within 60 seconds, a fault is declared and the board locks out.

The combustion relay will remain energized and if the Hall Effect sensor indicates rotation, an attempt at re-ignition will be made.

If the input to W is broken by opening the disconnect, a reset takes place and the error code clears; however, the induced draft motor status will be tested again on the next call for heat.

7 FLASHES

Opening of Rollout Switch

46. OPENING OF THE ROLLOUT SWITCH – The rollout switch protects against flame "backing" out of the heat exchangers for any reason. If the rollout switch trips, a code of 7 flashes will be initiated and the unit will lock out.

An investigation should be made to see why the rollout switch opened. Some common causes of flame rollout are inadequate combustion air, over-fired burners, and blocked heat exchangers.

8 FLASHES

Hardware or Software Fault

PROBABLE IGC FAULT

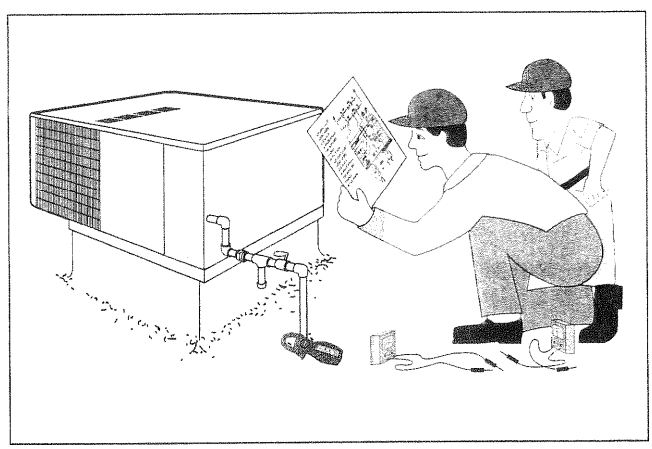
47. CONTROL HARDWARE OR SOFTWARE FAULT – If a fault develops in the control hardware or software, a lockout will occur and a code of 8 flashes will be indicated. If resetting the disconnect does not clear the problem, replace the board.

More Than One Fault: ALL Applicable Codes Will Flash

48. Should more than one fault exist, any applicable codes will be displayed in numerical order.

For instance, if a limit switch fault and a rollout switch fault both happened, the LED would display 2 flashes and a 3-second pause, 7 flashes and a 3-second pause, 2 flashes and a 3-second pause, 7 flashes and a 3-second pause and so on.

TROUBLESHOOTING



49. Keep in mind that the IGC diagnostic function only identifies system problems which might include the IGC board itself and that it does not resolve these problems. To resolve any problems, the service technician must apply standard troubleshooting and service techniques, such as checking the supply voltage, "hopscotching" the power or control circuits, checking system components, and other commonly used service methods.

50. It should be noted that the majority of problems occur outside the electronic control area.

No cooling problem can be blamed on the IGC as long as the indoor fan motor runs.

With any heating problem, you must look for an open switch, a bad transformer, loss of power, loose connections, and all the things that you looked for in a system with electro-mechanical contacts or another type of control board.

Lack of return air, dirty filters, low gas pressure, poor flame characteristics, and other problems still apply. Refer to the Heating Troubleshooting Chart, Table III, in the back of this workbook for information on isolating and correcting faults.

51. Remember to observe the display shown by the LED before opening the disconnect, so that any coded message is not canceled.

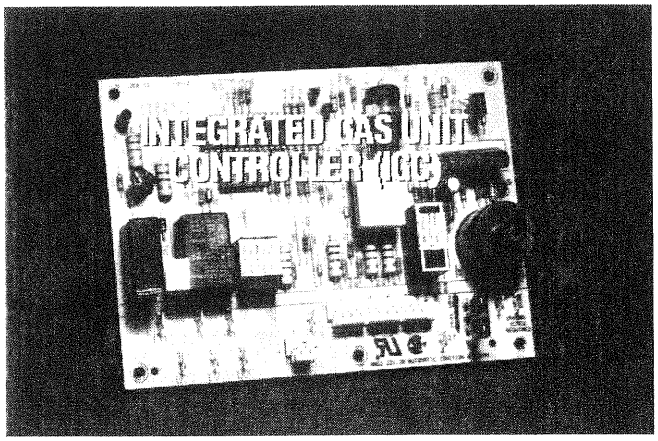
SUMMARY

REVIEW

- IGC Features
- IGC Inputs and Outputs
- Safety
- Fan Control, Ignition and Gas Safety Functions
- Operating Modes and Sequences
- Diagnostic Features
- Troubleshooting

52. In this program, we covered:

- IGC features.
- The safety aspects of troubleshooting the board and the unit.
- The functions of ignition, flame monitoring, and checking for safe operation, as well as control of the blower motor.
- The operation of a rooftop unit in fan-only, cooling, and heating modes.
- Built-in diagnostic capabilities.
- Hints on troubleshooting.



53. That concludes our program on the Integrated Gas Unit Controller. The insight you have gained from this program should help you understand and troubleshoot units containing an IGC. Reviewing the tables in the appendix provides an overview of sequence of operation, diagnostic codes, and troubleshooting.

Now, test your knowledge by completing the Quiz which follows. Review those areas that need additional attention.

QUIZ

1. True or False? The IGC board includes both high voltage and low voltage circuits.

2. The basic tasks of the IGC include _____.
   a. timed control of indoor fan functions
   b. ignition of the burners
   c. safe and efficient control of heating operation
   d. all of the above

3. The status of the system is related by _____.
   a. a light emitting diode
   b. two flashing light bulbs
   c. a buzzer
   d. a computer screen

4. The IGC boards have blower relay (BR) contacts which _____.
   a. control the operation of smaller indoor fan motors
   b. change the speed of operation
   c. protect the compressor
   d. over-ride the limit switch

5. True or False? The indoor fan "on" and "off" time delays are the same for both cooling and heating modes.

6. True or False? The Hall Effect sensor signals the safety logic that the induced draft fan is running at the required speed.

7. True or False? When a Hall Effect sensor is used, a jumper is connected between the CS terminals on the IGC board.

8. If the limit switch opens prior to the blower starting, the IGC _____.
   a. locks out the burner
   b. locks out the compressor
   c. subtracts 5 seconds from the elapsed delay time on the next blower-on delay
   d. goes into standby mode

9. A _____-amp fuse on the IGC provides overcurrent protection for the remote thermostat and 24-volt transformer.
   a. 2
   b. 3
   c. 5
   d. 10

10. The job of the induced draft motor (IDM) is to reduce the pressure in the _____.
    a. return air
    b. room air
    c. flue collector box
    d. low side

11. *Flame rectification* is a term which means that _____.

    a. the flame is weak
    b. the flame conducts electrical energy to the safety logic showing the strength of the flame
    c. a lockout is apparent
    d. the disconnect switch must be opened

12. The ignition cycle for a weak flame condition is _____.

    a. 5-second spark, 2-second flame proving, 20-second purge, and another ignition try
    b. 10 seconds on and 10 seconds off
    c. 5 seconds on and 10 minutes off
    d. none of the above

13. The IGC has a feature which prevents "jiggling," or short cycling, of the thermostat. Once there is a call for heat, the unit will run for a minimum of _____.

    a. 60 seconds
    b. 30 seconds
    c. 15 seconds
    d. 3 minutes

14. You should shut off the disconnect _____.

    a. when you get to the job
    b. only after observing the LED to determine unit status
    c. when actually working on the unit
    d. both b and c

15. True or False? The IGC will indicate when a high supply temperature condition has occurred.

16. A loss of flame for a quarter second initiates _____.

    a. a lockout
    b. an attempt to relight within .8 of a second
    c. opening of the rollout switch
    d. opening of the limit switch

17. True or False? If the IGC board locks out for an ignition or induced draft motor problem, the lockout can be broken by interrupting the high voltage.

18. If more than one fault exists, the LED on the IGC displays _____.

    a. error codes in numerical order
    b. the first error code only
    c. 10 flashes and a 3-second pause
    d. 15 flashes and a 3-second pause

19. True or False? The IGC board can be adjusted to correct a dirty yellow flame.

20. True or False? If you have no gas at the burners, you should check the gas supply, gas valve, flame sensor, and use a flame simulator before replacing the IGC board.

APPENDIX

Contents:

- Integrated Gas Unit Controller (IGC) Board - Photo
- Table I - Sequence of Operation Summary
- Table II - Error Code Description
- Table III - Heating Troubleshooting Chart
- Wiring Diagrams

Integrated Gas Unit Controller (IGC) Board

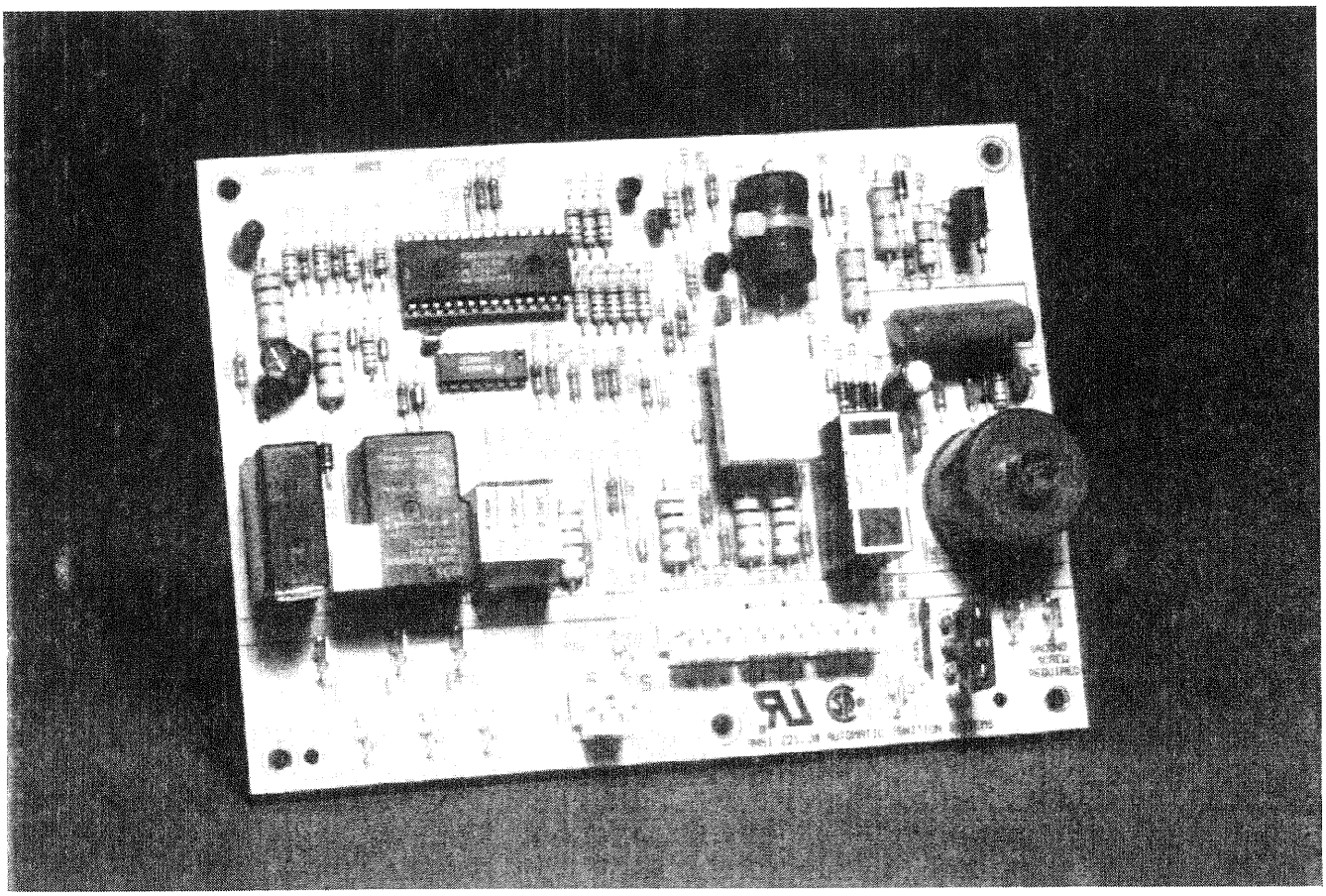


Table I - Sequence of Operation Summary

SEQUENCE OF OPERATION	TROUBLESHOOTING COMMENTS
1. **Call for heat from thermostat brings control voltage to W on J2.**	Upon a call for heat, 24V should be measured at connector J2 pin W on the IGC. If not check the following: 1) all thermostat connections, 2) 24V connections in unit, 3) check LED for error codes. NOTE: To prevent thermostat "jiggle," a call for heat is locked on for 60 seconds from the initial call to W. To terminate, open the unit disconnect and reset power.
2. **Induced Draft Motor (IDM) is energized.**	The call for heat energizes the combustion relay on the IGC, closing the contacts between terminals L1 & CM on the IGC. The speed of the motor is checked by a Hall Effect sensor on the motor. The board reads this sensor and continues the ignition process if the motor is up to speed. If the induced draft motor does not start, check for line voltage between CM and L2 (C13 on 460V units). Replace unit disconnect fuses if necessary.
3. **Main Gas Valve (MGV) is energized, ignition electrode sparks (5 seconds), flame sensor proves flame (2 seconds).**	When the IGC has proof that the induced draft motor is operating properly and the limit and rollout switches are closed, it will begin an ignition sequence. If no sparking occurs at this point, check: 1) for error codes on the LED or 2) for problems with the high voltage ignitor or ignition wire (proper gaps, connections, shorts, etc.).
4. **Burners light.**	If the unit is sparking but the burners do not ignite, the unit is not getting gas. Check: 1) the manual gas valve (turn on), 2) the gas line pressure to unit, 3) that the gas lines have been thoroughly purged of air, and 4) for 24 volts between terminals 1 & 2 (or P & C) on MGV.
5. **45 seconds after initial 7 second flame sense period, the Indoor Fan Motor (IFM) is energized.**	The default indoor fan on delay is 45 seconds. If the indoor fan does not come on after this delay, check: 1) that the indoor fan motor is properly wired as per the unit label diagram, 2) the indoor fan is rotating in the correct direction, and 3) that the motor has not gone out on thermal overload (allow time for motor to cool and overload to reset).
6. **The unit continues to operate with burners lit and combustion and indoor fan motors energized as long as the call for heat (W1) is present. If the conditioned space temperature continues to fall while the unit is in operation, and the unit is equipped with a two-stage gas valve, the high fire solenoid of the gas valve (W2) will be energized. When W2 is satisfied, TH2 will open and the unit will again operate on W1.**	As long as a call for heat is present, the unit should run continuously without interruption. If this is not the case, check: 1) that there is sufficient air flow through the unit and it is not cycling on the limit switch (possible causes: blocked inlet/outlet, dirty filters, etc.) and 2) the LED for error messages.
7. **When the call for heat has been satisfied, the main gas valve and combustion motor are de-energized by the opening of TH1.**	If the burners do not shut off after the call for heat has ended, 1) check LED for error codes and 2) unit may be locked into heating for 60 seconds to prevent short cycling from thermostat "jiggle."
8. **45 seconds after the call for heat is satisfied, the indoor fan motor is de-energized.**	If the indoor fan continues to operate after 45 seconds, check: 1) that the thermostat is not in the continuous fan mode and 2) the LED for error codes. If the LED is displaying 1 flash it could mean that the indoor fan off delay has been modified. If the unit limit switch is cycling within 10 minutes after a call for heat, the indoor fan off delay can be extended up to 3 minutes.

Table II - Error Code Description

LED	INDICATIONS & EXPLANATIONS
On	Normal operation.
Off	Hardware failure - check: 5 amp fuse on IGC, power to unit (all legs), 24V circuit breaker, transformer (note that units without a 24V circuit breaker have an internal overload in the 24-volt transformer. If this overload trips, allow 10 minutes for it to reset). If power is OK change the board.
1 Flash	Modified indoor fan on or off delay - this is not to be considered an error. The IGC has the ability to change the fan on delay or off delay from the default value of 45 seconds. If the unit detects abnormal limit switch cycling, the on delay can be reduced to 0 seconds, and the off delay extended to 180 seconds. Resetting the unit power will restore the default delay settings.
2 Flashes	Limit fault switch - this indicates that the high temperature limit switch is open. The unit will not operate in heating until the switch (automatically) resets. If this condition continues, 1) check the operation of the indoor fan motor (proper rotation, belt, etc.), 2) insure that the outlet air temperature agrees with the published rise range on the unit name plate.
3 Flashes	Flame sensor fault - indicates that the IGC sensed flame when flame should not have been present. NOTE: This message is retained by the IGC until power is reset to the unit.
4 Flashes	4 consecutive limit switch trips - indicates that during a single call for heat the limit switch cycled 4 times. The probable cause for this problem is inadequate air flow through the unit. Check: 1) the operation of the indoor fan motor (proper rotation, belt, etc.), 2) insure that the outlet air temperature agrees with the published rise range on the unit name plate.
5 Flashes	Ignition lockout - indicates that the unit unsuccessfully attempted ignition for 15 minutes. Check: 1) ignition and flame sensor electrode spacing, gaps, etc., 2) that flame sensor and ignition wires are properly terminated and not shorting to ground, and 3) that the unit is getting the proper amount of gas.
6 Flashes	Induced draft motor fault - indicates that the IGC does not sense that the induced draft motor is operating. If the motor is not operating, insure that the motor is getting the proper voltage. If the motor is in fact operating, check that the speed sensor plug from the motor is properly connected to the IGC at terminal J2, and is wired as follows: PIN 1 - white, PIN 2 - red, PIN 3 - black.
7 Flashes	Rollout switch fault - indicates that the rollout switch has opened. NOTE: The rollout switch will automatically reset but the IGC will continue to lock out the unit until the unit disconnect is reset. Check: 1) that the induced draft blower wheel is properly secured to the motor shaft, 2) rollout switch wiring, and 3) gas valve operation.
8 Flashes	Internal control fault - if error code is not cleared by resetting the unit power, replace the IGC.

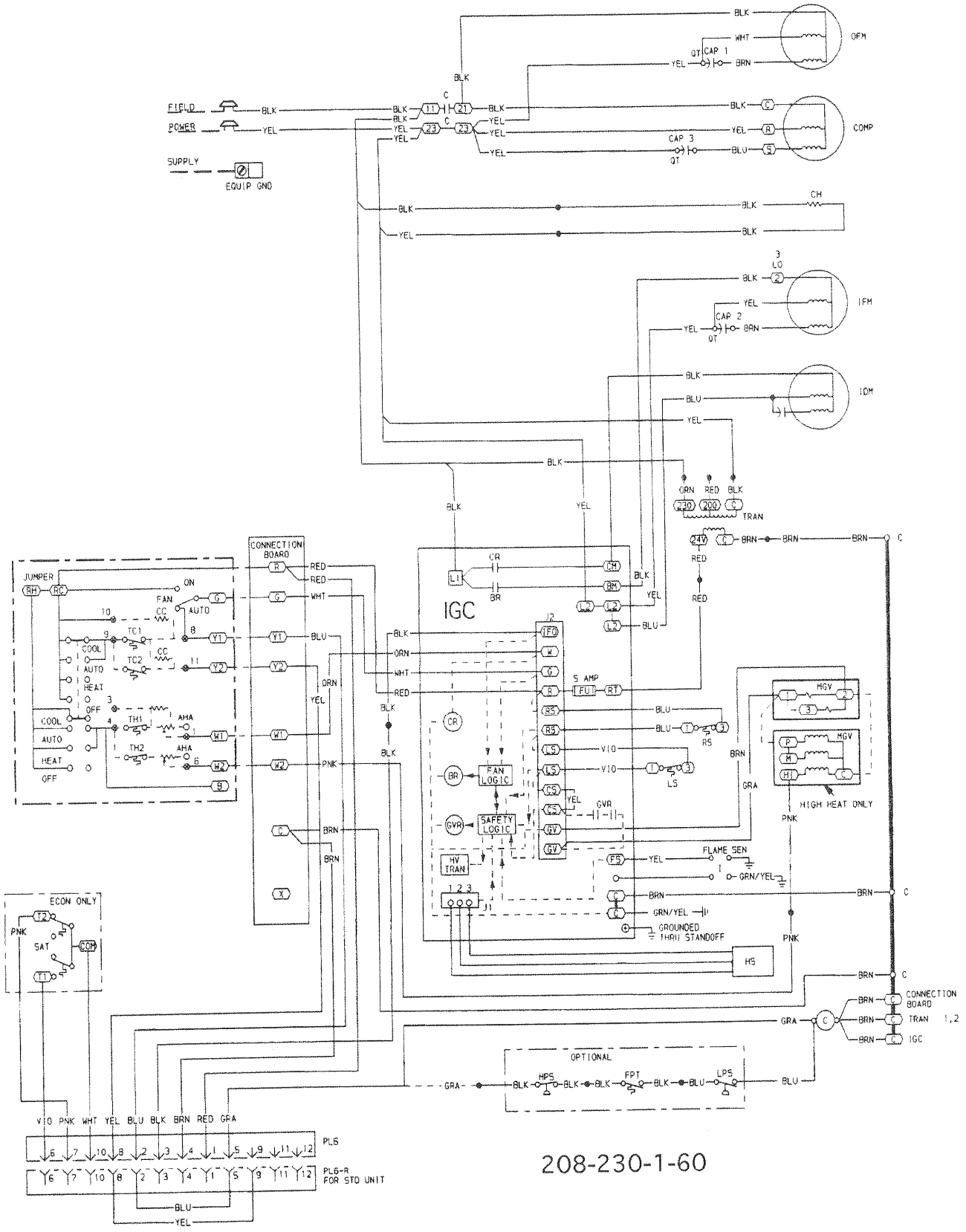
NOTES: 1) Multiple error codes will be displayed consecutively.
2) If using the error codes to troubleshoot the unit, allow several minutes for the codes to register.
3) Resetting the power will clear the IGC of all error codes.

Table III - Heating Troubleshooting Chart

SYMPTOM	CAUSE	REMEDY
Burners will not ignite.	Water in gas line	Drain - install drip leg.
	No power	Check power supply, fuses, wiring, or circuit breaker.
	No 24V power supply to control circuit	Check transformer - replace if necessary.
	Miswired or loose connections	Check all wiring & wirenut connections.
	Dirty yellow flame	Adjust air.
	Burned-out heat anticipator in Thermostat	Replace Thermostat.
	No gas at main burners	1. Check gas source. 2. Check gas valve. 3. Check flame sensor for proper operation. 4. Use flame simulator. 5. Do all of the above before replacing IGC.
	Broken thermostat wire	Run continuity check.
Inadequate heating.	Dirty air filter	Clean/replace filter as necessary.
	Gas input too low	Check gas pressure at manifold. Clock gas meter for input. If too low, increase manifold pressure, or replace with correct orifices.
	Unit undersized for application	Replace with proper unit or add additional unit.
	Restricted air flow	Clean/replace filter/remove restriction.
	Blower speed too low	Use faster speed tap or install optional blower.
	Limit switch cycles main burners	Dirty air filters - clean/replace. Registers closed, restricted ductwork - open or remove restriction. Check heat anticipator setting on thermostat, readjust.
Poor flame characteristics.	Incomplete combustion results in: - Aldehyde odors - Carbon Monoxide - Sooting flame-floating flame	Check screws around flue outlets and tighten burner compartment. Lack of combustion air. Cracked heat exchanger - replace.
Burners do not shut off.	Unit is in 60-second "lock on" period (thermostat "jiggle")	Wait for heating lock on period to expire or turn off power to unit.

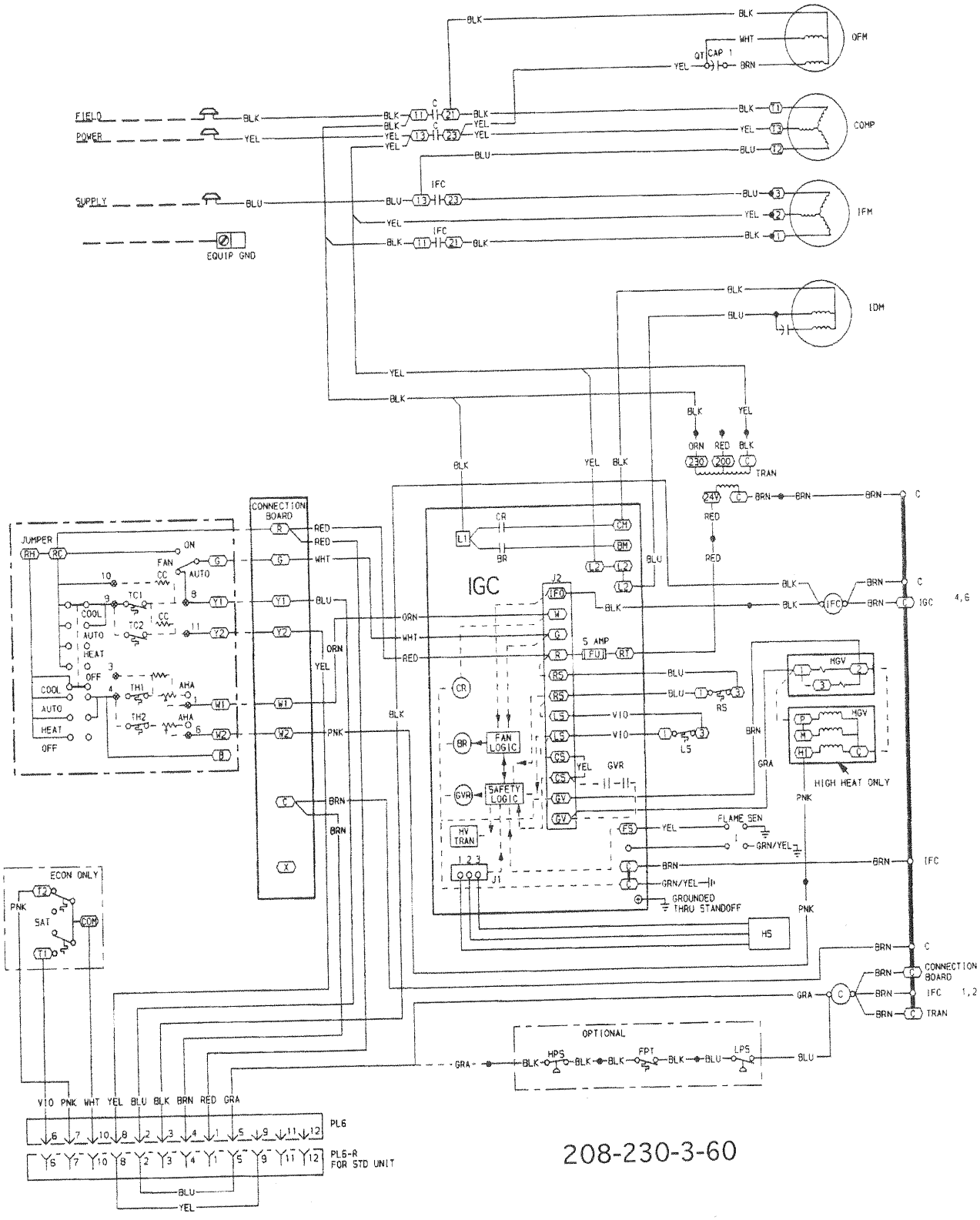
Small Units (Blower < 10 Amps)

TYPICAL SCHEMATIC



Large Units (Blower > 10 Amps)

TYPICAL SCHEMATIC



QUIZ KEY

Answers		Paragraph	Page
1.	True	6	2
2.	d	8	2
3.	a	8	2
4.	a	9	3
5.	False	10	3
6.	True	12, 13, 28	4, 5, 11
7.	True	14	5
8.	c	18	6
9.	c	21	7
10.	c	28	11
11.	b	31	11
12.	a	32	12
13.	a	36	13
14.	d	38	14
15.	True	41	15
16.	b	44	16
17.	True	44, 45	16
18.	a	48	17
19.	False	Appendix, Table III	26
20.	True	Appendix, Table III	26

GT54-01A

Carrier Corporation • Syracuse, NY

Printed in U.S.A.

020-512