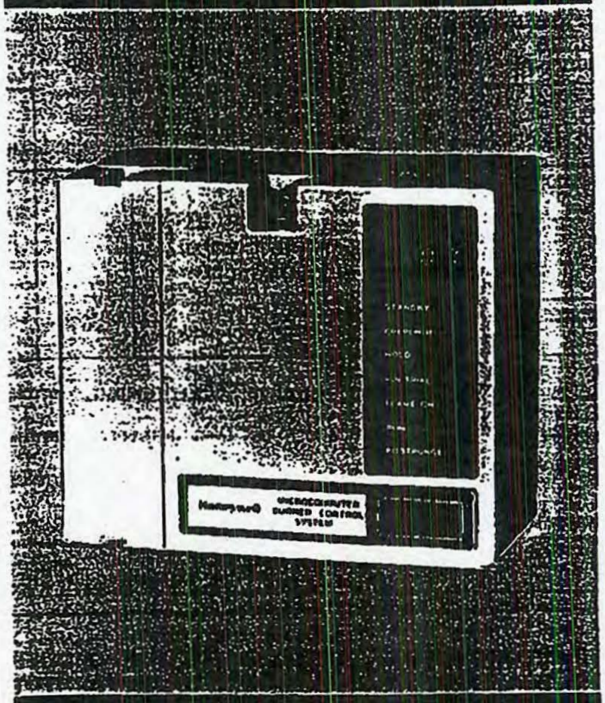
Honeywell

MICROCOMPUTER BURNER CONTROL SYSTEM



BC7000 'BLUE CHIP'

THE BC7000 "BLUE CHIP" IS AN INTELLIGENT MICRO-COMPUTER BASED INTEGRATED CONTROL SYSTEM FOR AUTOMATICALLY FIRED GAS, OIL, COAL, OR COMBINATION FUEL SINGLE BURNER APPLICATIONS. ITS PRINCIPLE CONTROL AND LOGIC ELEMENT IS A

HIGH RELIABILITY MICROCOMPUTER THAT IS PRO-GRAMMED TO PROVIDE LEVELS OF SAFETY, FUNC-TIONAL CAPABILITY, AND FEATURES BEYOND THE CAPACITY OF CONVENTIONAL ELECTROMECHANICAL OR DISCRETE SOLID STATE CONTROLS.

FUNCTIONS PROVIDED BY THE BC7000 "BLUE CHIP" BURNER CONTROL SYSTEM INCLUDE: AUTOMATIC BURNER SEQUENCING, FLAME SUPERVISION, STATUS INDICATION, FIRST-OUT ANNUNCIATION, SELF-DIAGNOSTICS, AND *ENERGY CONSERVATION.*

- Dynamic Self Check provisions continuously monitor system performance to ensure proper operation.
- Safety features include:
  - Dynamic Self Check Logic
  - Expanded Safe Start Check
  - Dynamic Input Check
  - Closed Loop Output Check
  - High Fire Purge Switch Test
  - Low Fire Start Switch Test
  - Tamper resistant timing and logic
- First-out Annunciation and System Diagnostics pro-vided by numeric display. Service Codes as well as the time in cycle are alternately displayed.
- Fault Codes isolate the cause of a safety shutdown. Hold Codes identify the cause of a failure to start or proceed in the burner control sequence.
- LED Sequence Status lights provide positive visual in-formation regarding program position and alarm status.
- Energy saving features reduce unneccessary purge re-lated heat losses.
- BC7000 Universal System Chassis will provide any standard burner program sequence, timing, and features with appropriate plug-in PM720 Program Module.
- System chassis accepts any of seven standard solid state plug-in flame emplifiers.
- Triple Function Test Switch halts the aequence at the end of prepurge, during pilot trial, and drives the firing rate to low fire during run cycle.
- Interlock circuits are "de-bounced" to reduce nuisance shutdowns due to intermittant/bouncing limit switches.
- Upgrades the R4140 and R4150 in most applications. Mounts on the same Q520A wiring subbase.
- Microcomputer technology provides dependable, long term operation.

H.K.
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Form Number 60-2529—1

SPECIFICATIONS

MODELS: BC7000L Microcomputer Burner Control System features a universal chassis with the burner sequencing and interlock circuits determined by the PM720 Plug-in Program Module.

Table I lists the PM720G,L, and M Program Modules that are available.

ELECTRICAL RATINGS:

Voltage and Frequency: 120 Vac (+10, −15%), 60 Hz (±4%).

Power Consumption (no loads connected to the output terminals): BC7000—25 W maximum.

TABLE I—PM720 MODELS AVAILABLE

PM720	PREPURGE TIMING (sec)	EARLY SPARK TERMINATION	FLAME ESTABLISHING PERIOD (sec) PILOT	FLAME ESTABLISHING PERIOD (sec) MAIN	POST-PURGE TIMING (sec)	INTERLOCK CIRCUITS	FIRING RATE CIRCUIT	ENERGY SAVING PREPURGE (ESP)
L1030	30	Yes	10	10 or 15	15	Preignition, Lockout, Low Fire, High Fire	4-Wire Modulating	
L2004								Yes
G2005	40	Yes	10	10 or 15/30 (2)	15	Preignition, Running Low Fire	4-Wire Modulating	
G2013				10 or Intermittent				
M2002	30/90 (1)	Yes	10	10 or Intermittent	15	Preignition, Running Low Fire	2-Wire Isolated ON-OFF-ON Contacts	
M2036	30/7 (3)					Preignition, Running	None	

(1) 90 seconds; 30 seconds if terminal 15 is jumpered to terminal 8.

(2) 15 seconds; 30 seconds if terminal 15 is jumpered to terminal 8.

(3) 30 seconds; 7 seconds if terminal 15 is jumpered to terminal 8.

ORDERING INFORMATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALER OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER, OR SPECIFY—

1. **BC7000L1000 Universal System Chassis.**
2. **Desired PM720G,L,or M Program Module.**

ORDER SEPARATELY

1. **Flame signal amplifier and matching flame detector. See Table IV.**
2. **Q520A1121 or Q520A1089 Wiring Subbase.**
3. **Accessories, if desired.**

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:

1. **YOUR LOCAL HONEYWELL RESIDENTIAL SALES OFFICE (CHECK WHITE PAGES OF PHONE DIRECTORY.**
2. **RESIDENTIAL DIVISION CUSTOMER SERVICE**
   HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH
   MINNEAPOLIS, MINNESOTA 55422-4386 (612)542-7500

   (IN CANADA—HONEYWELL LIMITED/HONEYWELL LIMITEE, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO M1P 2V9) INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.

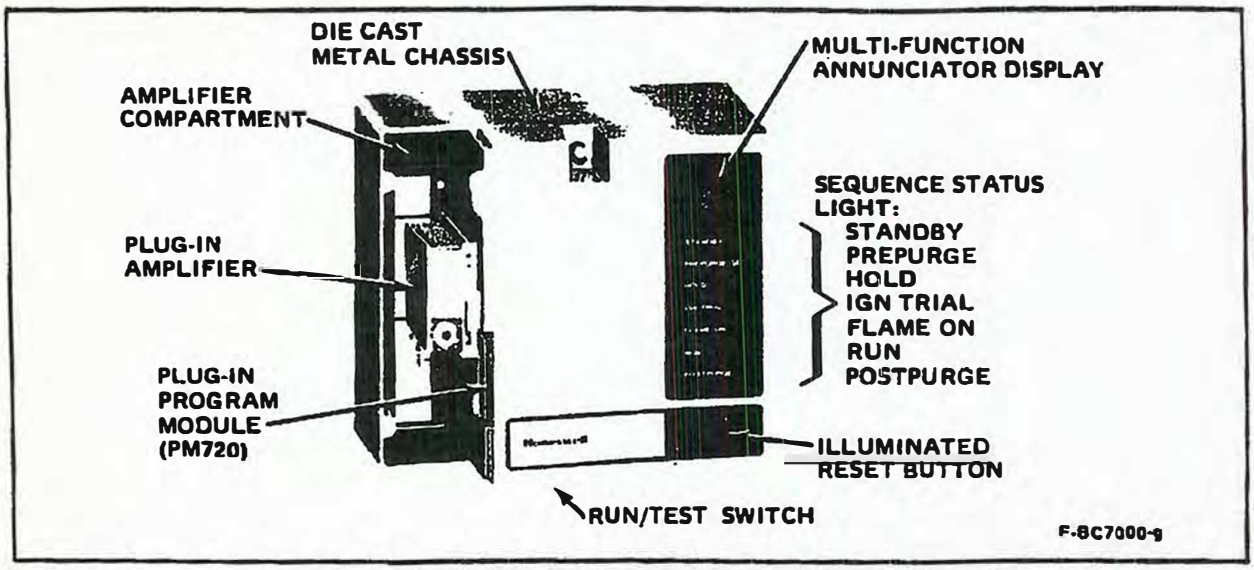

FIG. 1—BC7000 MICROCOPUTER BURNER CONTROL SYSTEM.

TABLE II—TERMINAL RATINGS

TERMINAL	TYPICAL LOAD	MAXIMUM RATING AT 120 Vac, 60 Hz
5	Ignition Transformer/ Pilot Valve	4.5 A ignition and 50 VA pilot duty OR 2.5 A ignition and 75 VA pilot duty
6	Interrupted Ignition Transformer/ Pilot Valve	
	Intermittent Pilot Valve/ 1st Stage Fuel Valve	75 VA pilot duty
7	Main Fuel Valve(s) (solenoid/ motorized/ diaphragm) and Vent Valve if required	250 VA pilot duty OR 65 VA pilot duty in parallel with motorized valve or valves using a total of 1150 VA locked rotor (inrush), 460 VA to open, and 250 VA to hold OR Motorized valve(s) using a total of 1500 VA locked rotor (inrush), 600 VA to open, and 250 VA to hold
8	Burner Motor (blower)	9.8 A full load, 58.8 A locked rotor (inrush)
9	120 V Alarm	75 VA pilot duty
10, 11, 12 and 14	Firing Rate (damper) Motor Contacts	75 VA pilot duty
18 (if available)	Ignition Transformer	4.5 A ignition

Maximum Total Connected Load—1800 VA

NOTE: Allowable inrush can be up to 10 times the pilot duty rating.

EXAMPLE—Pilot duty rating = 50 VA.
At 120 V, running current is

$$\frac{50}{120} = 0.42 \text{ A.}$$

Maximum allowable inrush is
10 times 0.42 = 4.2 A.

TABLE III—INTERLOCK RATINGS

INTERLOCKS	REQUIREMENTS Must be able to carry and break current to:
Limits, Burner Controller, and Running Interlocks (including airflow switch).	Ignition transformer, pilot valve, and main fuel valve(s).

AMBIENT OPERATING TEMPERATURE RATING:
Wall mounted: 32 F to 130 F [0 C to 55 C].
Horizontal mounting: 32 F to 125 F [0 C to 53 C].

STORAGE TEMPERATURE RATING: -30 F to +150 F [-34 C to +66 C].

MOUNTING: 4-sided Q520A1121 or 3-sided Q520A1089 Wiring Subbase (order separately).

DIMENSIONS: See Figs. 2 and 3.

WEIGHT: 8 lb. [3.6 kg].

FLAME DETECTION SYSTEM (order separately): Plug-in Flame Signal Amplifier and matching Flame Detector; see Table IV.

TABLE IV—FLAME DETECTION SYSTEMS

PLUG-IN FLAME SIGNAL AMPLIFIERS					APPLICABLE FLAME DETECTORS		
TYPE	COLOR	SELF-CHECKING	MODEL	FLAME FAILURE RESPONSE TIME	FUEL	TYPE	MODELS
RECTIFICATION	GREEN	NO	R7247A	2 TO 4 SEC	GAS	RECTIFYING FLAME RODS	HOLDERS[c]: C7004, C7007, C7011. COMPLETE ASSEMBLIES: C7005, C7008, C7009, Q179.
			R7247A, R7247B[b]	2 TO 4 SEC	OIL	RECTIFYING PHOTOCELLS[d]	C7003, C7010, C7013, C7014.
					GAS, OIL, COAL	ULTRAVIOLET (PURPLE PEEPER)	C7012A OR C.
		DYNAMIC SELF CHECK	R7247B[b]	2 TO 4 SEC	GAS	RECTIFYING FLAME RODS	HOLDERS[c]: C7004, C7007, C7011. COMPLETE ASSEMBLIES: C7005, C7008, C7009, Q179.
			R7247C[a]	2 TO 4 SEC	GAS, OIL, COAL	ULTRAVIOLET (PURPLE PEEPER)	C7012E OR F.
INFRARED	RED	NO	R7248A	2 TO 4 SEC	GAS, OIL, COAL	INFRARED (LEAD SULFIDE)	C7015.
		DYNAMIC AMPLI-CHECK	R7248B[b]	2 TO 4 SEC			
ULTRAVIOLET	PURPLE	NO	R7249A	2 TO 4 SEC	GAS, OIL	ULTRAVIOLET (MINIPEEPER)	C7027, C7035, C7044.
	BLUE	DYNAMIC SELF CHECK	R7476A[a]	2 TO 4 SEC	GAS, OIL, COAL	ULTRAVIOLET (ADJUSTABLE SENSITIVITY)	C7076.

[a]CIRCUITRY TESTS ALL ELECTRONIC COMPONENTS IN THE FLAME DETECTION SYSTEM (AMPLIFIER AND DETECTOR) 60 TO 120 TIMES A MINUTE DURING BURNER OPERATION AND SHUTS DOWN THE BURNER IF THE DETECTION SYSTEM FAILS.

[b]CIRCUITRY TESTS THE FLAME SIGNAL AMPLIFIER AT LEAST 150 TIMES A MINUTE DURING BURNER OPERATION AND SHUTS DOWN THE BURNER IF THE AMPLIFIER FAILS.

[c]ORDER FLAME ROD SEPARATELY; SEE INSTRUCTION SHEET FOR THE HOLDER.

[d]USE HONEYWELL PHOTOCELL, PART NO. 38316, ONLY.

3899-M

APPROVAL BODIES:

UNDERWRITERS LABORATORIES INC. LISTED SECTION OF PRIMARY SAFETY CONTROL: File No. MH11790; Guide No. MCCZ.

CANADIAN STANDARDS ASSOCIATION CERTIFIED: LR1620-520.

FACTORY MUTUAL APPROVED (When used with PM720L Program Module): Report No. J.I. 1F6A1.AF.

INDUSTRIAL RISK INSURERS (formerly F.I.A.) Approvable.

ACCESSORIES:

1. W136A Test Meter (includes 196146 Meter Connector Plug); has SPL position with damping for testing self-checking flame detection systems.

2. 196146 Meter Connector Plug (for older W136A models).

3. 123514A Flame Simulator (for use with R7247A rectification amplifiers).

4. 123514B Flame Simulator (for use with R7249A ultraviolet amplifiers).

5. R1061012 Ignition Cable for ignition installations in high temperature environment; rated at 350 F [177 C] for continuous duty, and up to 500 F [260 C] for intermittent use; tested to 20,000 V RMS.

6. R1298020 Cable for flame detector ("F" leadwire) installations in a high temperature environment; rated up to 400 F [204 C] for continuous duty; tested for operation up to 600 V and breakdown up to 7500 V.

7. R1239001 High Tension Ignition Cable for ignition installations in a contaminating environment; very resistant to severe conditions of oil, heat, and corona. Tested to withstand high voltages up to 25,000 V RMS in a salt bath for 1 minute without breakdown. Rated at 200 F [93 C] for continuous duty, and up to 350 F [177 C] for intermittent use.

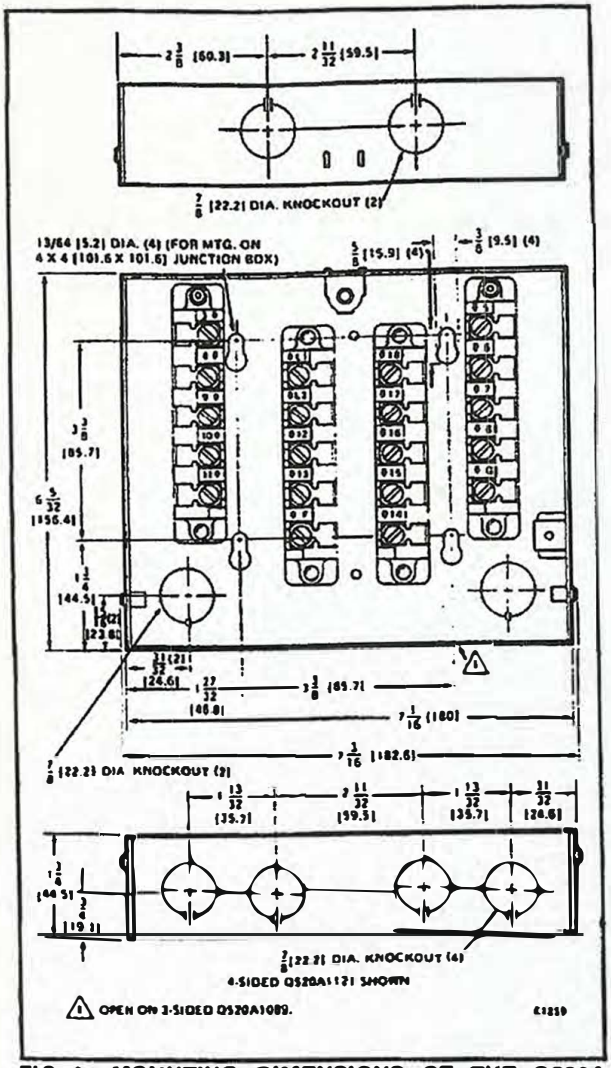

FIG. 2—MOUNTING DIMENSIONS OF THE Q520A SUBBASE IN in. [mm SHOWN IN BRACKETS].

8. Q624A Solid State Spark Generator; prevents detection of ignition spark when properly applied with flame detection systems using the C7027, C7035, or C7044 Minipeeper Ultraviolet Flame Detectors. For use with gas pilots only.

9. Q520E1002 Service Tool allows all of the programmer terminals to be monitored while the programmer is operating.

10. FSP5004 R4150/R4140/BC7000 Tester provides a quick operational check of the BC7000 Microcomputer Burner Control System.

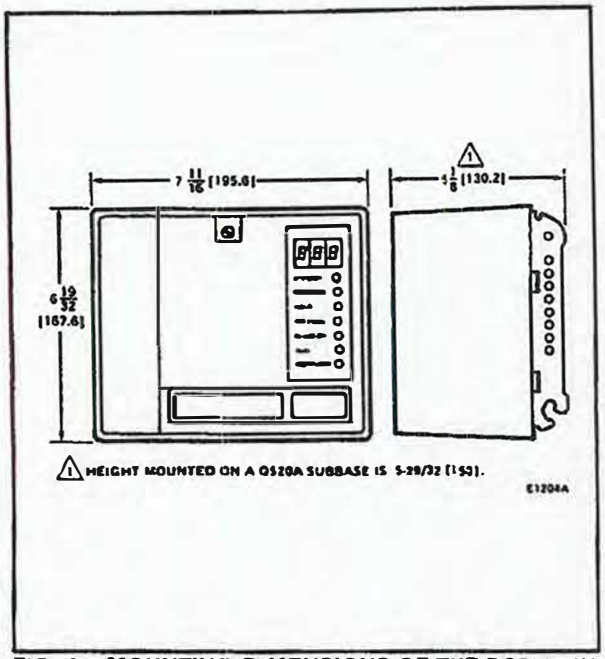

FIG. 3—MOUNTING DIMENSIONS OF THE BC7000 IN in. [mm SHOWN IN BRACKETS].

PRINCIPAL TECHNICAL FEATURES

The BC7000 Microcomputer Burner Control System performs all customary flame safeguard functions while providing significant advancements in the areas of safety, annunciation, self-dianostics and energy conservation.

SAFETY PROGRAMS

Since combustion safety is the main task of the BC7000 Microcomputer Burner Control System, 60% of the running time of the microcomputer is devoted to doing 15 different but overlapping safety routines. More than 400 safety checks are performed every second that the BC7000 is in operation to check the performance of the total Burner Control System (microcomputer operation, program memory and execution, timing functions, input signals, logic operations, and output commands). This assures that the BC7000 is able to do its fundamental combustion safeguard task with the highest degree of safety available.

SAFETY SHUTDOWN (Lockout) OCCURS IF:

(All BC7000L/PM720 Combinations)

1. A flame signal is present continuously for more than 30 seconds during standby (F70).
2. A preignition interlock is open continuously for 30 seconds immediately after the burner controller closes (F03).
3. The low fire start switch fails to close within 2 minutes and 15 seconds (30 minutes for the PM720L1030) when the firing rate motor is commanded toward the low fire position at the end of prepurge (F11). Not applicable for PM720M2010.
4. The pilot (or first stage oil burner) fails to ignite (F30).
5. The main flame (except with intermittent pilot) fails to ignite (F40).
6. The contacts for the interlocks, limits, and controllers are recurrently intermittent (F81, F82, F83, F84, F85, F86, F87).
7. The powerline frequency deviates from 60 Hz (F97).
8. The program module malfunctions or is improperly positioned (F90).
9. The safety critical load terminals are improperly wired (F99).
10. An internal failure of the BC7000 (F99).
11. The flame detection system fails (F99).

(BC7000L with a PM720L)

1. Flame signal detected after the first 10 seconds during prepurge (F00).
2. The high fire purge switch fails to close within 2 minutes and 15 seconds (30 minutes for the PM720L1030) after the firing rate motor is commanded to drive to the high fire position at the start of prepurge (F01).
3. A preignition interlock opens during the prepurge period (F03).
4. Flame signal is detected during the low fire hold (F10).
5. A lockout interlock opens during the prepurge (after 10 seconds), ignition, or run period (F04, F14, F34, F44, F54).

(BC7000 with a PM720G or M)

1. Flame signal is present continuously for more than 30 seconds during the prepurge period (F00).
2. A preignition interlock is open continuously for 30 seconds during the prepurge period (F03) or during the low fire hold period (F13).
3. Flame signal is continuously detected for 30 seconds during the low fire hold prior to the ignition trials (F10). Does not apply to PM720M2010.
4. A running interlock opens and remains open for 30 seconds during the prepurge, ignition, or run period (F04, F14, F34, F44, F54).

Safety shutdown (lockout) has occurred when the reset switch is illuminated and a fault code is displayed. The alarm (if used) is energized 10 seconds after safety shutdown.

SAFETY PROVISIONS

DYNAMIC SELF-CHECK SAFETY CIRCUIT

The principal safety provision of the BC7000 Microcomputer Burner Control System is its Dynamic Self Check Safety Circuit: a totally independent multi-element safety circuit that supervises microcomputer performance to ensure its proper operation. The microcomputer tests itself and its associated hardware with comprehensive safety routines. Any malfunction will either be detected by the microcoputer to cause a safety shutdown or cause the Dynamic Safety Relay to de-energize ALL safety critical loads.

EXPANDED SAFE START CHECK

The conventional safe start check is expanded to include a flame signal check during standby (off-cycle) and a preignition output circuit check.

—Off-Cycle (Standby) Flame Signal Check is a provision that monitors the status of the flame detection subsystem (flame detector and amplifier). If a flame simulating condition as a result of marginal or faulty flame detection components (or actual flame) exists, a hold code will be displayed and system startup will be prevented. If the condition continues for more than 30 seconds, a lockout will occur and be annunciated.

—Preignition Output Circuit Check makes sure that all safety critical loads (valves, and ignition terminals) are de-energized just before the ignition trial. At the end of prepurge (before entering the ignition trial sequence) the Dynamic Safety Relay (1K1) is energized and the ignitor, pilot valve, and main valve terminals are immediately checked for the de-energized condition. A safety shutdown will occur if any of these terminals are energized.

CIRCUIT STATUS MONITORING

—Dynamic Input Check examines all system input circuits at the load terminals to assure system capability to recognize the true status of external controls, limits, and interlocks. This self-check is accomplished thousands of times every minute. If any input fails the test, the microcomputer will execute a safety shutdown and annunciate the appropriate fault code.

—Closed Loop Logic Test verifies the integrity of all safety critical output circuits (terminals 5, 6, 7, and 18). An immediate safety shutdown is executed if these loads are not properly operated.

—Dynamic Safety Relay Test checks the ability of the 1K1 relay to open and close. During prepurge (with power to terminal 3) the circuit status monitor immediately "downstream" of 1K1 is checked to verify the de-energized state. At the end of prepurge (but before ignition trials) the Dynamic Safety Relay is energized and both the upstream and downstream circuit status monitors are checked. A miscompare will result in a safety shutdown.

HIGH FIRE PURGE AND LOW FIRE START SWITCH TESTS

—**High Fire Purge Switch Test (PM720L)** examines the purge position interlock switch at the moment the firing rate motor is commanded to the high fire position. If the switch is bypassed, welded, or otherwise prematurely closed, the system will automatically add 30 seconds to allow the firing rate motor additional drive time to reach or near the open damper position before starting the purge timing. Otherwise purge timing starts when the high fire switch closes.

—**Low Fire Start Switch Test** examines the low fire start switch at the moment prepurge is over. If the switch is bypassed, welded, or otherwise prematurely closed, the system will automatically add 30 seconds to allow the firing rate motor additional time to reach or near the low fire start position prior to ignition trials. Otherwise ignition trials start after the low fire switch closes.

SUPERVISED LOW FIRE START

The low fire start switch is monitored before entering the ignition trial and during the last 5 seconds of the trial for pilot flame.

VERIFIED SPARK TERMINATION

The ignition terminal is monitored to assure early spark termination (5 seconds ignition and pilot and 5 seconds "pilot only").

TAMPER RESISTANCE

All safety and logic timings are inaccessible and cannot be altered or defeated.

MANDATORY PURGE

If lockout occurs after the initiation of ignition trials (or at any time during the sequence that the fuel valves may have been energized) a mandatory postpurge period is imposed.

FIRST-OUT ANNUNCIATION AND SELF-DIAGNOSTICS

Control and burner system startup, troubleshooting, and repair are aided through integral BC7000 Burner Control System first-out annunciation and self-diagnostic functions.

—**First-out Annunciation** reports the cause of a safety shutdown (with a Fault code) or identifies the cause of a failure to start or continue in the burner control sequence (with a Hold code). All field input circuits are monitored, including the flame signal amplifier and firing rate position switches. The system distinguishes seven modes of flame failure and detects and annunciates difficult-to-find intermittents caused by bouncing or marginal limits and interlocks.

—**The Multi-function Annunciator Display** shows the elapsed time during prepurge, ignition trials, and postpurge sequences. As an additional service aide it provides the time in sequence if a safety shutdown occurs during a timed period (the hold/fault code and time are alternately displayed).

—**Self Diagnostics** add to the first-out annunciation by allowing the BC7000 Microcomputer Burner Control System to distinguish between field (external device) and internal (system related) problems. Faults associated with either the flame detection subsystem, plug-in program module, or the system chassis are isolated and reported by the Multi-function Annunciator Display (see the BC7000 Annunciation and Diagnostic Codes, page 27).

—**Sequence Status Lights** (LEDs) provide positive visual indication of the program sequence: STANDBY (power on), PREPURGE, HOLD, IGN TRIAL, FLAME ON, RUN, POSTPURGE, and, through the illuminated reset switch, Safety Shutdown (lockout).

ENERGY CONSERVATION

Unnecessary and wasteful purge related heat losses are significantly reduced by the program intelligence of the BC7000 Microcomputer Burner Control System.

—**Energy Saving Prepurge (ESP)**, exclusive to some PM720L sequences, prevents blower operation at startup until the damper reaches the purge position (high fire purge switch closed). This prepurge sequence change saves approximately 300,000 Btuh per boiler horsepower annually on cycling boilers in typical heating applications.

—**Energy Saving Intelligence** terminates burner/blower operation and energizes the alarm circuit whenever the high fire purge switch (PM720L model), the low fire start switch (all models except PM720M2010), or the running interlocks (PM720G,M models) fail to close after a sufficient time delay.

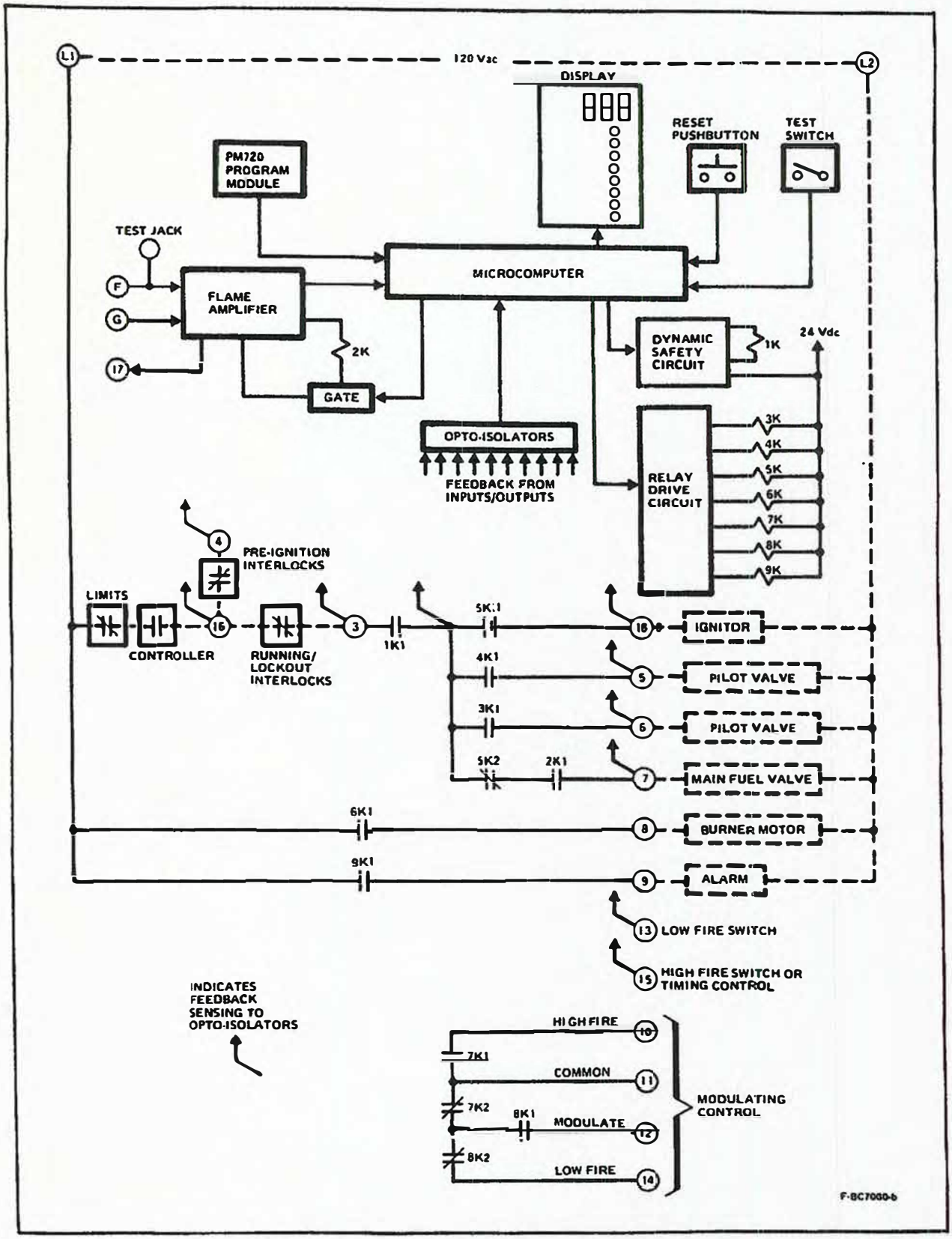

FIG. 4—INTERNAL BLOCK DIAGRAM OF THE BC7000L/PM720L2004. SEE FIGS. 5-10 FOR DETAILED WIRING INSTRUCTIONS.

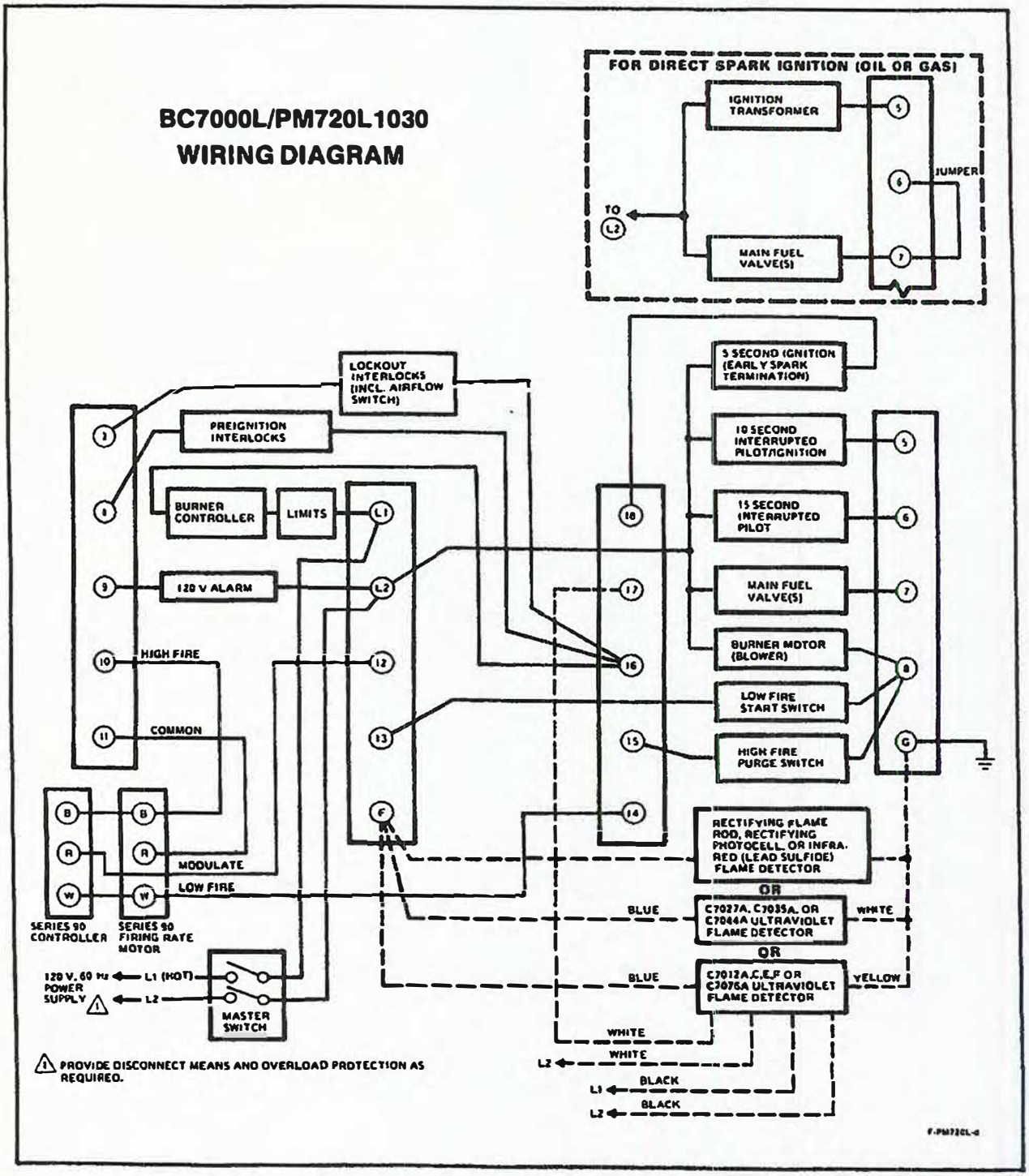

FIG. 5—WIRING THE BC7000L FOR USE WITH THE PM720L1030 PROGRAM MODULE.

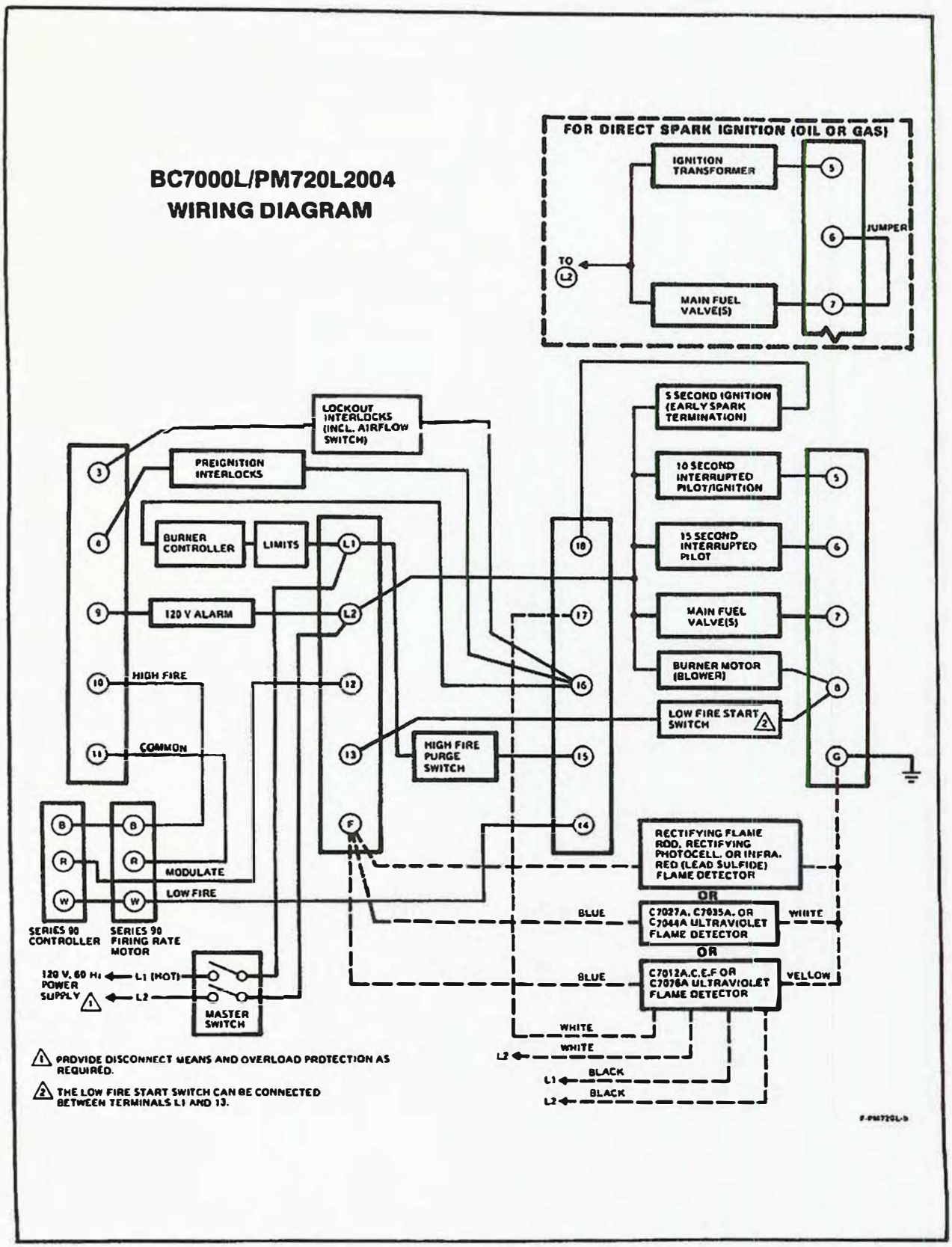

FIG. 6—WIRING THE BC7000L FOR USE WITH THE PM720L2004 PROGRAM MODULE.

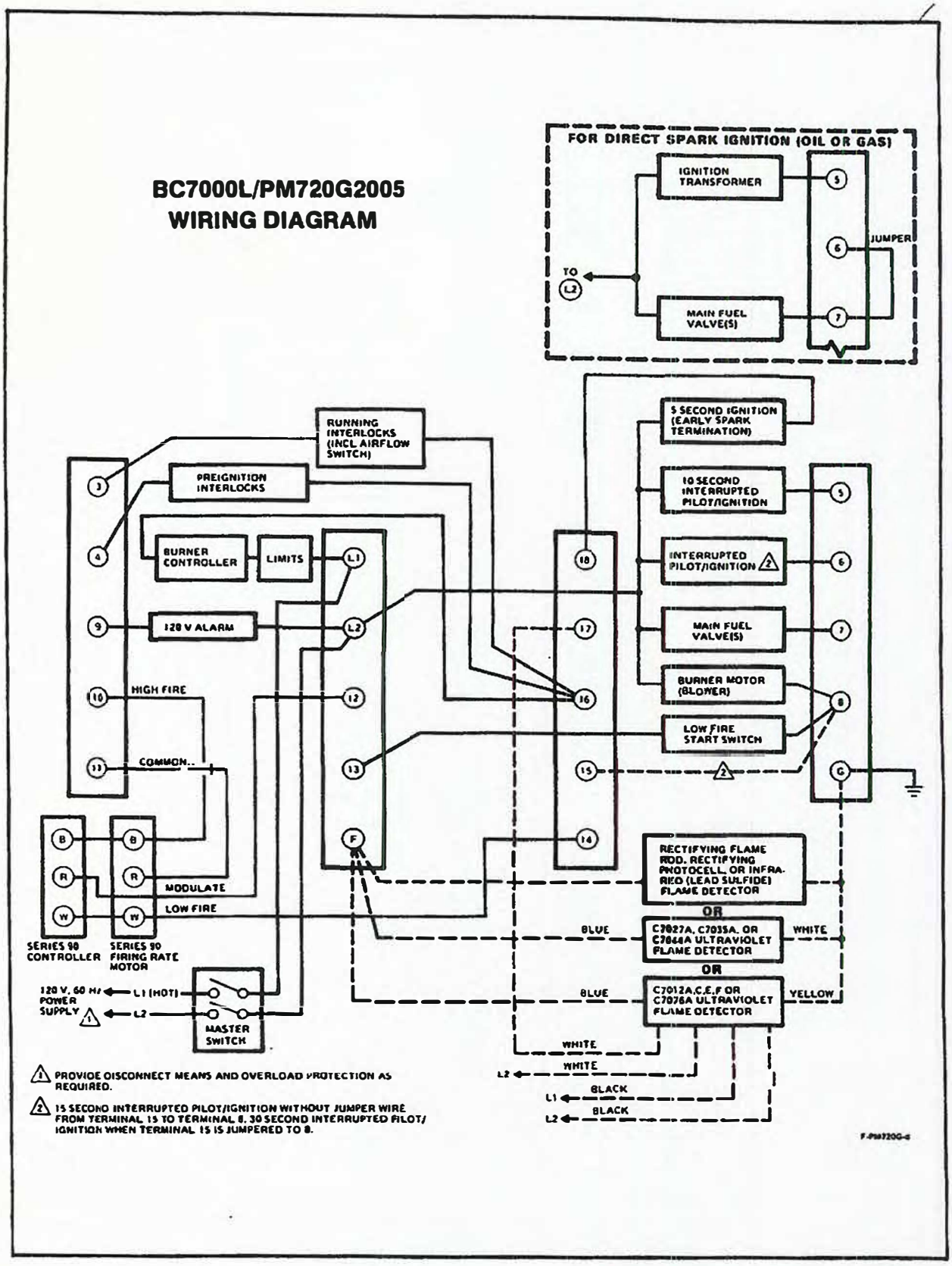

FIG. 7—WIRING THE BC7000L FOR USE WITH THE PM720G2005 PROGRAM MODULE.

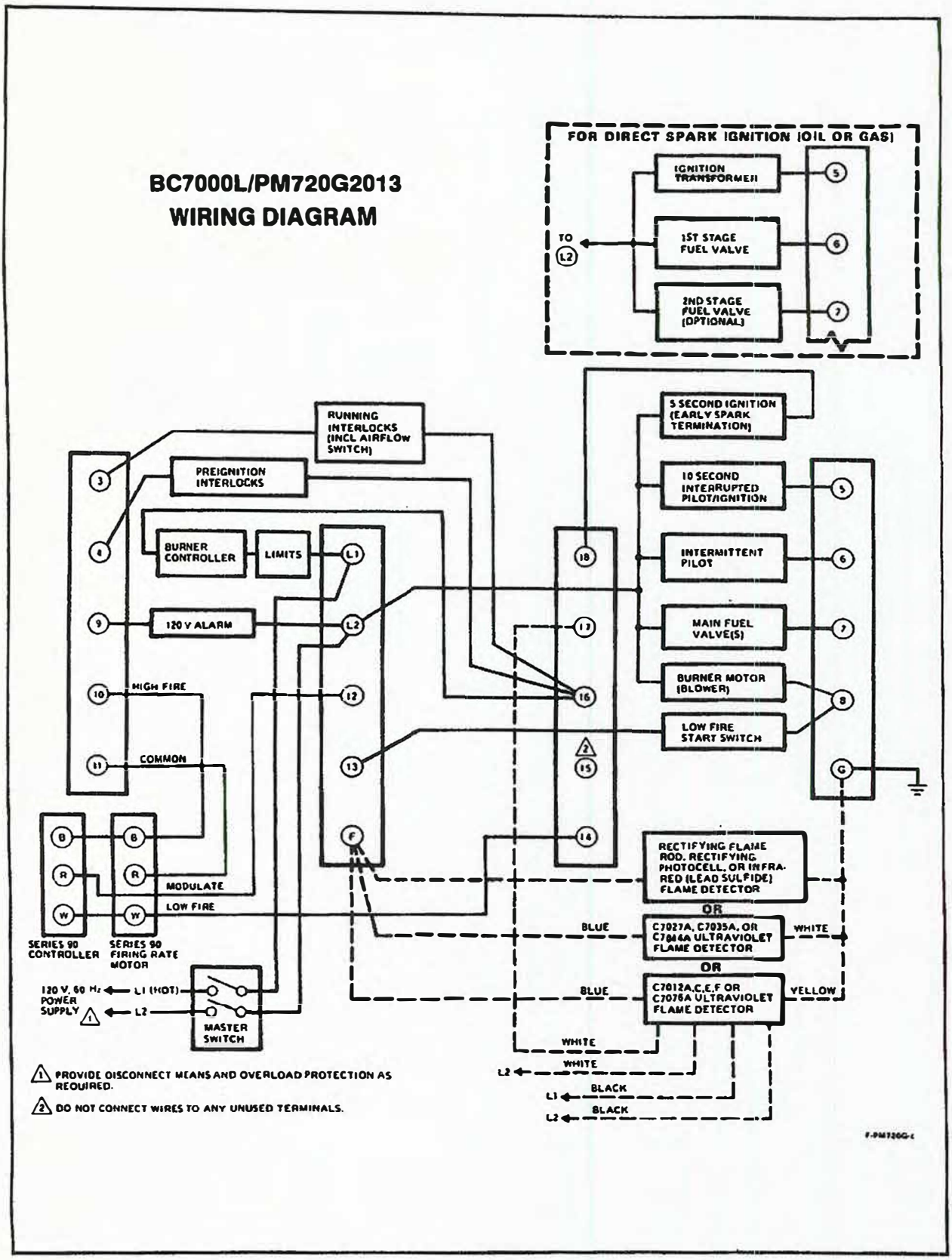

FIG. 8—WIRING THE BC7000L FOR USE WITH THE PM720G2013 PROGRAM MODULE.

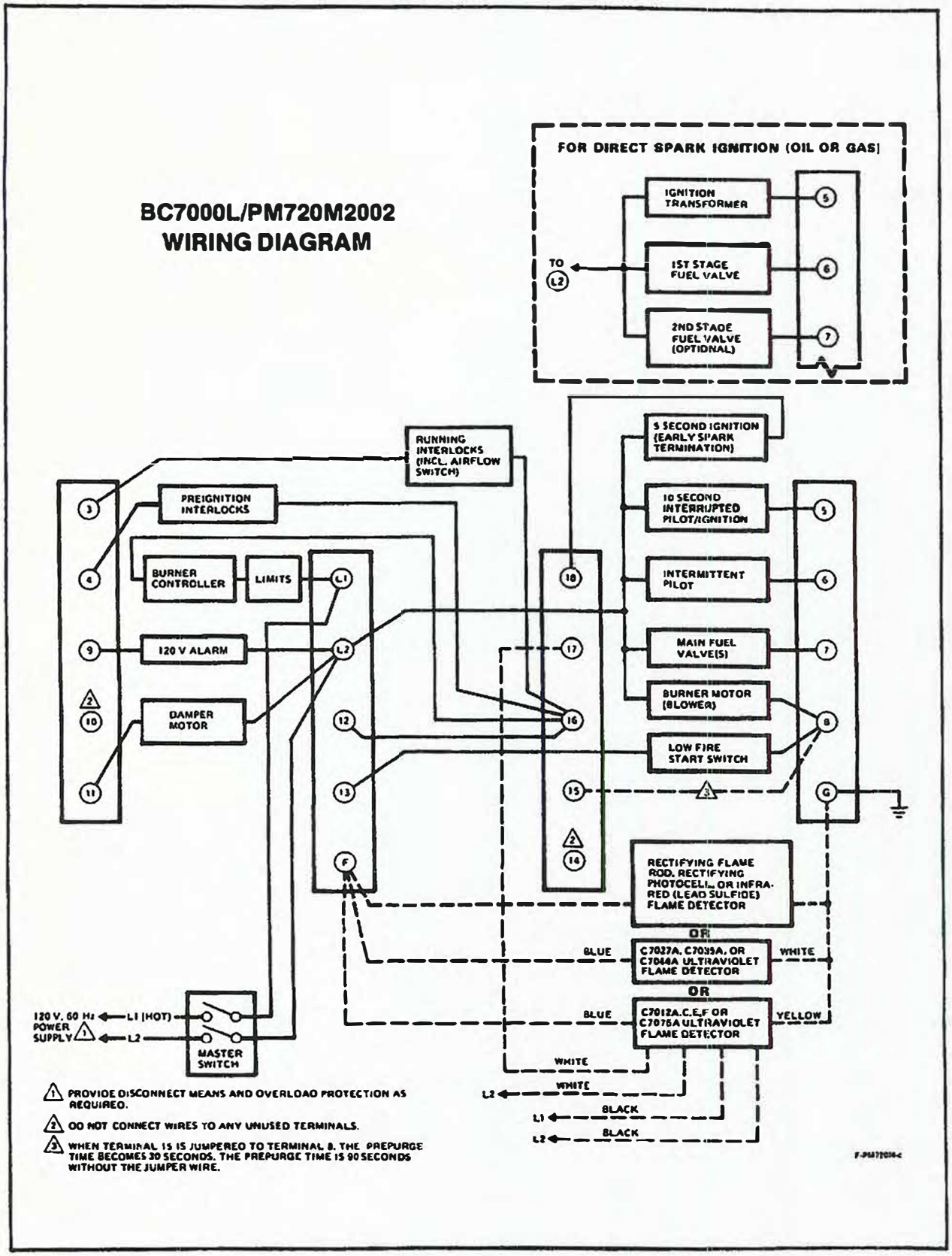

FIG. 9—WIRING THE BC7000L FOR USE WITH THE PM720M2002 PROGRAM MODULE.

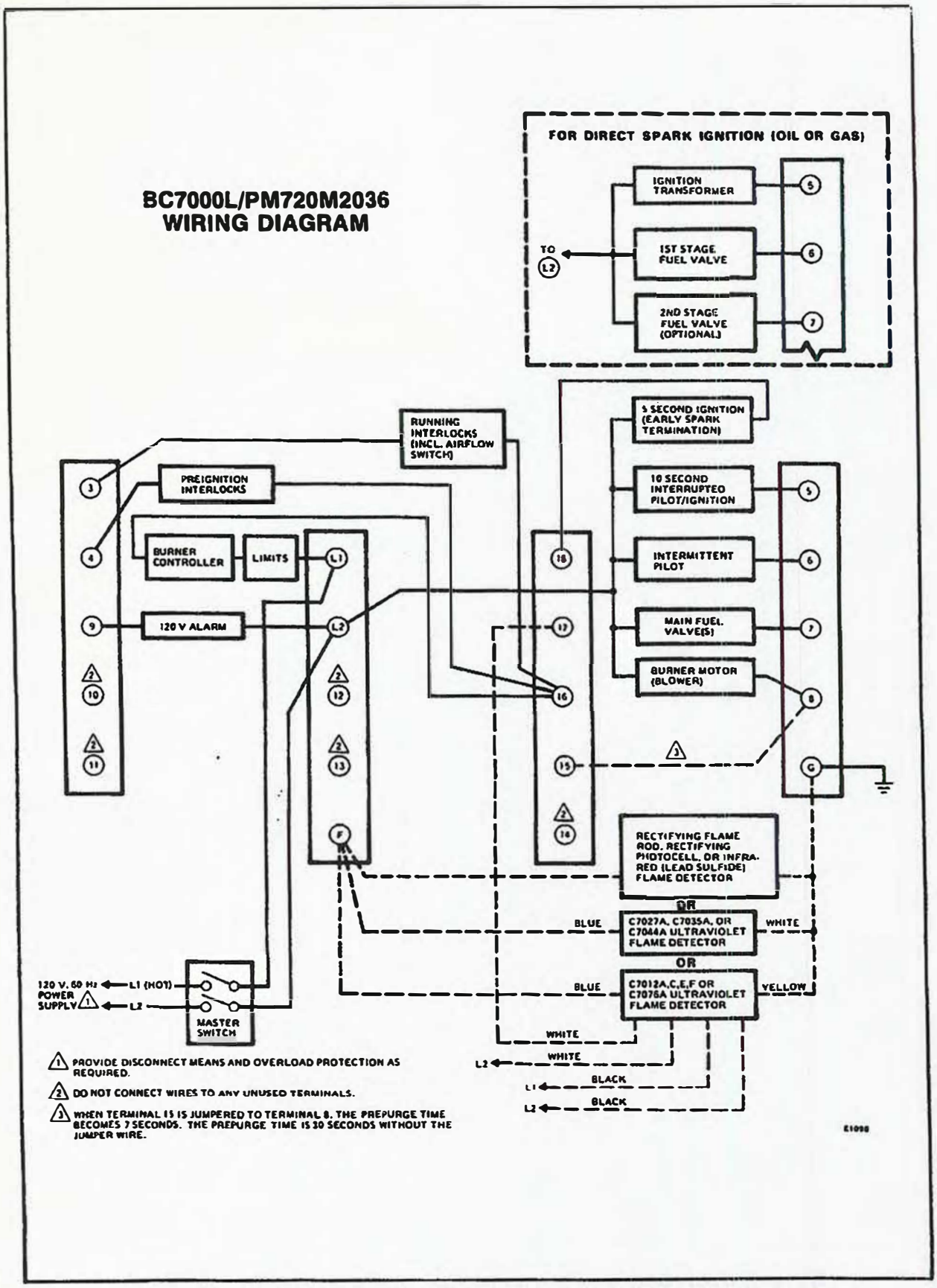

FIG. 10—WIRING THE BC7000L FOR USE WITH THE PM720M2010 PROGRAM MODULE.

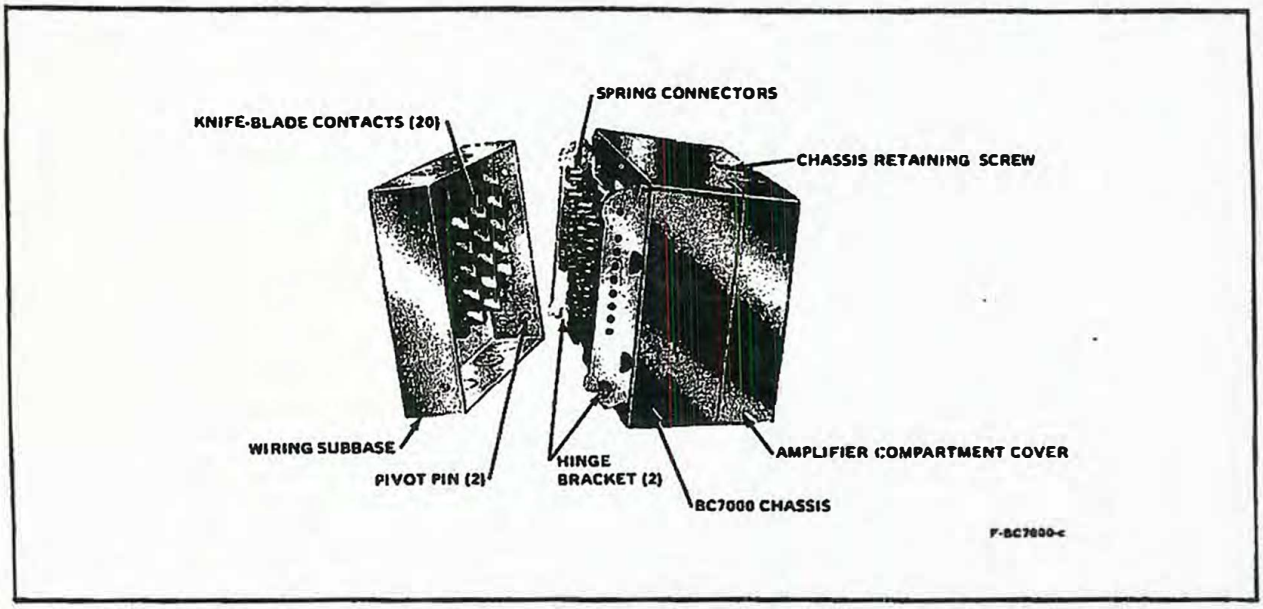

FIG. 11—MOUNTING THE BC7000 MICROCOMPUTER BURNER CONTROL SYSTEM ON THE SUBBASE.

INSTALLING THE BC7000 (Fig. 11)

1. Open the master switch.

2. Make sure no subbase wiring is projecting beyond the terminal blocks. Tuck wiring in against the back of the subbase so it does not interfere with the contacts.

3. Engage the chassis hinge brackets with the pivot pins at the bottom of the subbase.

4. Swing the chassis inward until the spring connectors engage the knife-blade contacts. Push until the contacts are fully engaged.

5. Tighten the chassis retaining screw securely.

PM720 PROGRAM MODULE

The plug-in program module contains all of the logic instructions which determine the operating sequence of the BC7000 system. This allows one universal chassis to perform any standard burner program. All that need be changed is the program module and subbase wiring. Table I (page 2) gives specific sequence data on the individual program modules available and Figs. 5-10 show the specific wiring hookups.

INSTALLING THE PM720 PROGRAM MODULE (Fig. 12)

1. Remove the amplifier compartment cover.

2. Remove the flame signal amplifier, if present.

3. Insert the program module into the opening in the side of the amplifier compartment (see Fig. 12). NOTE THAT THE MODULE IS KEYED.

4. Reinstall the flame signal amplifier.

5. Reinstall the amplifier compartment cover.

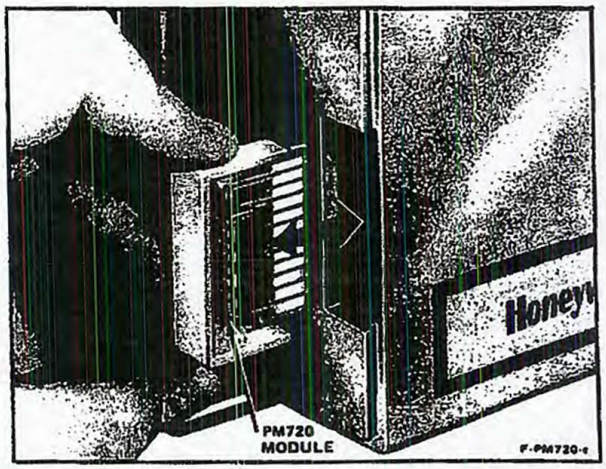

FIG. 12—INSTALLING THE PM720 PROGRAM MODULE IN THE BC7000 MICROCOMPUTER BURNER CONTROL SYSTEM.

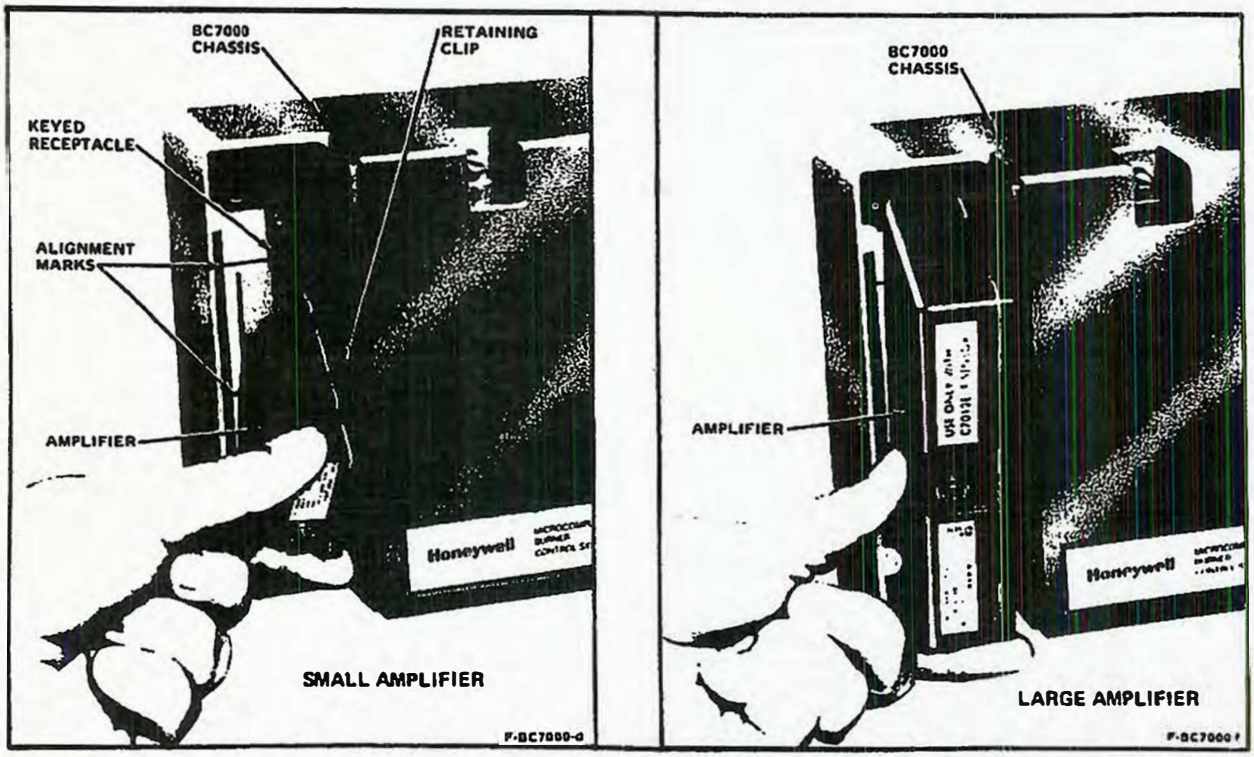

FIG. 13—INSTALLING THE PLUG-IN FLAME SIGNAL AMPLIFIER.

INSTALLING THE PLUG-IN FLAME SIGNAL AMPLIFIER (Fig. 13)

1. Remove the amplifier compartment cover.

2. Grasp the flame signal amplifier with the monogram toward the outside face of the amplifier compartment. Align the circuit board with the keyed receptacle in the BC7000 chassis. NOTE: If you are installing a small amplifier, align its ends with the 2 lines alongside the receptacle on the BC7000 chassis.

3. Push the flame signal amplifier into the keyed receptacle until the circuit board is fully inserted and slide it under the holddown clip. Make sure the amplifier is securely in place.

4. Replace the amplifier cover.

USE OF THE RUN/TEST SWITCH (Fig. 1)

The RUN/TEST switch is located on the side of the BC7000 Microcomputer Burner Control System chassis.

The RUN/TEST switch performs the following functions in the operating cycle:

1. The RUN/TEST switch will stop the sequence in the PREPURGE, at low fire, just before ignition trials (if it is in the TEST position prior to this point). Stopping the system at this point allows adjustment of the firing rate motor and damper linkages.

2. The RUN/TEST switch will stop the sequence during the first 8 seconds of the PILOT IGNITION trial. This allows testing for spark pickup when the system is used with an ultraviolet sensor. When stopped in this position it is possible to perform the pilot turndown test. A BC7000 internal flame-out timer is activated that will cause a safety shutdown if the pilot flame signal is lost for 30 seconds.

3. If the RUN/TEST switch is thrown to the TEST position during the BURNER RUN period of the cycle, the BC7000 commands the firing rate motor to drive to the low fire position. This is useful for holding at low fire for cold startup (as recommended by most boiler manufacturers).

NOTE: When the BC7000 is switched to the TEST mode, it will stop and hold at the next RUN/TEST switch test point in the operating sequence until the RUN/TEST switch is returned to the RUN position. MAKE SURE THAT THIS SWITCH IS IN THE RUN POSITION BEFORE LEAVING THE INSTALLATION.

FLAME SIGNAL MEASUREMENT (Fig. 14 and Table VI)

ALL INSTALLATIONS

Measure the flame signal at the appropriate times defined in the following checkout tests. Read the flame signal in microamps at the meter jack on the plug-in flame signal amplifier.

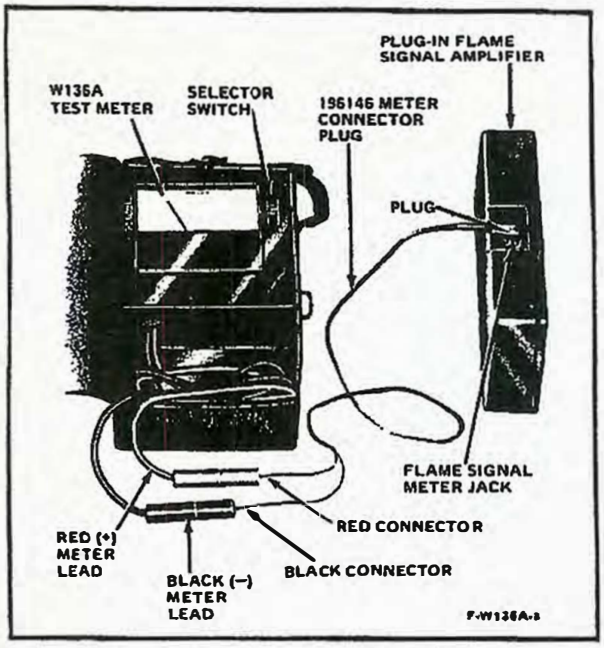

FIG. 14—MEASURING THE FLAME SIGNAL.

1. Use a Honeywell W136A Test Meter. (If a W136A is not available, a microammeter with a 0 to 25 microamp dc range and overload protection to 300 microamps may be used.

CAUTION

Flame currents in excess of 200 microamps may be measured on BC7000 models using the R7247 (Green) Amplifiers.

If a cold BC7000 is installed in a warm area, condensate forms inside the BC7000 chassis. This condition may cause the excessive flame currents. However, this false flame signal does not adversely affect the performance of the BC7000 or the flame detector and will clear itself when the moisture dries out.

2. Set the selector switch on the test meter to:
   25uA—for all standard amplifiers (R7247A, R7248A, and R7249A) or for an R7248B Dynamic Ampli-Check Infrared Amplifier,

   OR

   SPL—for an R7247B or C or an R7476A Dynamic Self Check Amplifier. (If the test meter is not a W136A, shunt the 0 to 25 microamp dc range with a 50 microfarad capacitor.)

3. Use a 196146 Meter Connector Plug. (It may be ordered separately.) Connect its RED plug-in tip to the RED (+) meter lead and its BLACK plug-in tip to the BLACK (-) meter lead.

4. Insert the grey plug into the flame signal meter jack and allow a few seconds for the meter reading to stabilize.

5. Read the average *stable* current. For an R7247B or C or an R7476A Dynamic Self Check Amplifier, disregard the peaks due to self-checking operation. The red flame-indicating lamp on a self-checking amplifier should blink—
   - —about 2-1/2 to 4 times a second on an R7247B.
   - —about 1 to 2 times a second on an R7247C or R7476A.
   - —at the same rate that the flame is flickering (may be as high as 20 times a second) on an R7248B.

If the lamp is ON or OFF continuously while reading the flame signal, replace the amplifier.

6. The meter reading must be as specified in Table VI after all tests have been completed and all adjustments have been made.

If the signal is unstable or less than the minimum acceptable current, check the flame detector installation and circuitry.

1. Check the supply voltage at terminals L1-L2 on the wiring subbase. Make sure the master switch is closed, connections are correct, and the power supply is of the correct voltage and frequency.
2. Check the detector wiring for defects, including—
   - —incorrect connections.
   - —wrong type or size of wire.
   - —deteriorated wire.
   - —open circuits.
   - —short circuits.
   - —leakage paths caused by moisture, soot, or accumulated dirt.
3. For a flame rod, make sure—
   - —there is enough ground area.
   - —the flame rod is located in the flame properly.
   - —temperature at the flame rod insulator is no greater than 500 F [260 C].
   - —ignition interference is not present (see Ignition Interference Test in this section).
4. For all other detectors, clean the detector lens, filter, viewing window, and inside of the sighting pipe (as applicable).
5. For a C7012A,C,E, or F Purple Peeper Ultraviolet Flame Detector, replace the 113236 and 115330 Electron Tubes (unless the detector is a solid state model).
6. With the burner running, check the temperature at the detector. If it exceeds the detector's maximum rated temperature—
   - —add additional insulation between the wall of the combustion chamber and the detector,
   - —add a shield or screen to reflect radiated heat away from the detector, or
   - —add cooling. (Refer to Sighting Pipe Ventilation in the instruction sheet for the detector.)
7. Make sure that the flame adjustment is not too lean.
8. Make sure the detector is sighting the flame properly.
9. If necessary, resight or reposition the detector.

If you cannot obtain proper operation, replace the plug-in amplifier. If you still cannot obtain proper operation, replace the flame detector.

TABLE VI—FLAME SIGNAL

FLAME DETECTOR	FLAME SIGNAL AMPLIFIER	MINIMUM ACCEPTABLE STEADY CURRENT[a] (MICROAMPERES)	MAXIMUM CURRENT EXPECTED (MICROAMPERES)
RECTIFYING FLAME ROD	R7247A (GREEN)	2	5[g]
	R7247B (GREEN; SELF CHECK)[c]	1-1/4	2-1/2[g]
RECTIFYING PHOTOCELL	R7247A (GREEN)	2	5[b,g]
	R7247B (GREEN; SELF CHECK)[c]	1-1/4	2-1/2[g]
C7012A,C ULTRAVIOLET (PURPLE PEEPER)	R7247A (GREEN)	2	6[g]
	R7247B (GREEN; SELF CHECK)[c]	2	4[g]
C7012E,F ULTRAVIOLET (PURPLE PEEPER)[d]	R7247C (GREEN; SELF CHECK)[d]	2[e]	7
C7015A INFRARED (LEAD SULFIDE CELL)	R7248A (RED)	2-1/4[f]	5
	R7248B (RED; AMPLI-CHECK)[c]	3-1/2[f]	5
C7027A, C7035A, OR C7044A ULTRAVIOLET (MINIPEEPER)	R7249A (PURPLE)	3-1/2	7-1/2
C7076A ULTRAVIOLET (ADJUSTABLE SENSITIVITY)[e]	R7476A (BLUE; SELF CHECK)[d]	2-1/2[e]	5-1/2

[a]THIS MINIMUM OR STRONGER SIGNAL SHOULD EASILY BE OBTAINED IF THE DETECTOR IS CORRECTLY INSTALLED AND POSITIONED TO SENSE FLAME PROPERLY. THIS CURRENT MUST BE OBTAINED BEFORE COMPLETING CHECKOUT.

[b]DO NOT PERMIT SIGNAL TO EXCEED 5 MICRDAMPERES AS IT WOULD SHORTEN PHOTOCELL LIFE. REDUCE SIGNAL BY USE OF ORIFICE PLATES (APERTURE DISCS) OR FILTERS AS NECESSARY.

[c]IF USING AN R7247B OR AN R7248B, CIRCUITRY TESTS THE FLAME SIGNAL AMPLIFIER AT LEAST 150 TIMES A MINUTE DURING BURNER OPERATION AND SHUTS DOWN THE BURNER IF THE AMPLIFIER FAILS.

[d]IF USING AN R7247C OR AN R7476A, CIRCUITRY TESTS ALL ELECTRONIC COMPONENTS IN THE FLAME DETECTION SYSTEM (AMPLIFIER AND DETECTOR) 60 TO 120 TIMES A MINUTE DURING BURNER OPERATION AND SHUTS DOWN THE BURNER IF THE DETECTION SYSTEM FAILS.

[e]SHUTTER OPERATION OF THE C7012E OR F OR C7076A CAUSES FLUCTUATIONS IN THE CURRENT READING. READ THE AVERAGE STABLE CURRENT, DISREGARDING THE PEAKS.

[f]THE LEAD SULFIDE CELLS ARE AVAILABE IN 4 RANGES OF SENSITIVITY: 104662A (RED MARKING), LOWEST; 104662B (YELLOW MARKING), MEDIUM; 104662C (GREEN MARKING), HIGH; 104662D (WHITE MARKING), HIGHEST SENSITIVITY. IF A SUFFICIENTLY STRONG SIGNAL CANNOT OTHERWISE BE OBTAINED, TRY A DIFFERENT CELL OF THE SAME RANGE. IF NECESSARY, SUBSTITUTE A CELL OF HIGHER SENSITIVITY.

[g]FLAME CURRENTS IN EXCESS OF 200 MICROAMPS MAY BE MEASURED ON R7247 (GREEN) AMPLIFIERS USED WITH THE BC7000. THIS CONDITION IS CAUSED BY CONDENSATION INSIDE THE BC7000 CHASSIS. IT MAY OCCUR IF A COLD BC7000 IS MOUNTED IN A WARM AREA. THIS FALSE FLAME READING DOES NOT AFFECT THE PERFORMANCE OF THE BC7000 OR FLAME SENSOR AND WILL CLEAR ITSELF WHEN THE CONDENSATION DRIES OUT.

F-BC7000-e

INITIAL LIGHTOFF CHECK FOR PROVED PILOT

ALL INSTALLATIONS USING A PILOT

Perform this check on all installations using a pilot. It should immediately follow the preliminary inspection.

NOTE: Low fuel pressure limits, if used, *could be open*. If so bypass them with jumpers during this check.

1. Open the master switch.
2. Make sure the manual main fuel shutoff valve(s) is (are) closed. Open the manual pilot shutoff valve. (If the pilot takeoff is downstream from the manual main fuel shutoff valve, make sure the main fuel is shut off just upstream from the burner inlet, or disconnect power from the automatic main fuel valve[s].)
3. Close the master switch and start the system with a call for heat (raise the set point of the burner controller). The program sequence should start.
4. Let the sequence advance through PREPURGE. When the IGN TRIAL light comes on, spark should occur and the pilot should ignite. If it ignites, proceed to step 7.
5. If the pilot flame is not established in 10 seconds, safety shutdown will occur. Let the sequence complete its cycle.
6. Reset the lockout switch, and let the system recycle once. If the pilot still does not ignite, make the following ignition/pilot adjustments:
   a. *Open the master switch* and remove the BC7000 from the subbase.
   b. On the subbase, jumper terminal L1 to the ignition terminal (5, 6, or 18). Refer to the appropriate wiring diagram to determine the proper terminal. Disconnect the leadwire to the pilot valve if it is connected to the same terminal.
   c. Close the master switch to energize the ignition transformer only.
   d. If the ignition spark is not strong and continuous, *open the master switch* and adjust the ignition electrode spark gap setting to the manufacturer's recommendation.
   e. Make sure the ignition electrodes are clean.
   f. Close the master switch and observe the spark.
   g. Once a continuous spark is obtained, *open* the *master switch* and add a jumper on the subbase from terminal L1 to the pilot terminal (5 or 6). Reconnect the leadwire from the pilot valve if it was disconnected in b.
   h. Close the master switch to energize both the ignition transformer and the pilot valve.

i. If the pilot does not ignite and if the ignition spark is still continuous, adjust the pilot gas pressure regulator until a pilot is established.
j. When the pilot ignites properly and stays ignited, *open the master switch and remove the jumper(s)* from terminals L1-5, L1-6, or L1-18 of the subbase.
k. Check for adequate bleeding of the fuel line.
l. Reinstall the BC7000 on the subbase and close the master switch.

7. When the pilot ignites, measure the flame signal. If necessary, adjust the flame or detector to give a proper flame signal.

8. Recycle the system to recheck lightoff and the pilot flame signal.

9. When the RUN light comes on make sure the automatic main fuel valve(s) is (are) open; then *smoothly* open the manual main fuel shutoff valve (and manually opened safety shutoff valve, if used) and watch for main burner flame ignition. When the main burner flame is established, proceed to step 14.

NOTE: This step requires 2 people—one to open the manual valve(s) and one to watch for ignition.

10. If the main burner flame is not established within 5 seconds, or within the normal lightoff time specified by the burner manufacturer, *close the manual main fuel shutoff valve(s) and open the master switch.*

11. Wait about 3 minutes. Close the master switch, and let the BC7000 recycle to the main flame ignition trial period. *Smoothly* open the manual fuel shutoff valve(s) and try lightoff again. The first attempt may have been required to purge the lines and bring sufficient fuel to the burner.

NOTE: This step requires 2 people—one to open the manual valve(s) and one to watch for ignition.

12. If the main burner flame is not established within 5 seconds, or within the normal lightoff time specified by the burner manufacturer, *close the manual main fuel shutoff valve(s) and open the master switch.* Check all burner adjustments.

13. Repeat steps 11 through 13 to establish the main burner flame. Then proceed to step 14.

14. When the main burner flame is established, the sequence will stay in RUN. Make burner adjustments for flame stability and input rating.

15. Shut down the system by lowering the set point of the burner controller. *Make sure the main burner flame goes out. If using an intermittent pilot, make sure the pilot flame goes out. Make sure all automatic fuel valves close.*

16. *If used, remove the bypass jumpers from the low fuel pressure limits.*

17. Restart the system by raising the set point of the burner controller. Observe that the pilot is established during IGN TRIAL, and the main burner flame during IGN TRIAL, within the normal lightoff time specified by the burner manufacturer.

18. Measure the flame signal. Continue to check for the proper signal (Table VI) through the RUN period. Check the signal at both high and low firing rate positions and while modulating, if applicable.

19. Run the burner through another sequence, observing the flame signal for—
—pilot alone (unless using direct spark ignition),
—pilot and main burner flame together, and
—main burner flame alone (unless monitoring an intermittent pilot).
Also, observe the time to light the main burner.

20. Make sure all readings are in the required ranges before proceeding.

INITIAL LIGHTOFF CHECK FOR DIRECT SPARK IGNITION OF OIL

OIL BURNERS NOT USING A PILOT

This check applies for oil burners not using a pilot. It should immediately follow the preliminary inspection. Refer to the appropriate sample block diagram of field wiring in this specification sheet for the hookup of the ignition transformer and fuel valve(s).

NOTE: Low fuel pressure limits, if used, *could be open.* If so, bypass them with jumpers during this check.

1. Open the master switch.

2. Complete the normal "ready-to-fire" checkout of the oil supply and equipment as recommended by the burner manufacturer.

3. Close all manual fuel shutoff valves. Check that the automatic fuel valves are closed. *Make sure oil is not entering the combustion chamber.*

4. Close the master switch and start the system with a call for heat (raise the set point of the burner controller). The program sequence should start.

5. Let the sequence advance through PREPURGE. When the IGN TRIAL light comes on, watch for ignition spark and listen for the click of the 1st stage oil solenoid.

6. Let the program sequence complete its cycle.

7. Open the manual fuel shutoff valves.

8. Reset the lockout switch and recycle the program through PREPURGE.

9. When the IGN TRIAL light comes on, watch for the 1st stage burner flame to be established. If it is, proceed to step 15.

10. If the 1st stage burner flame is not established within 5 seconds, or within the normal lightoff time specified by the burner manufacturer, *close the manual fuel shutoff valves, and open the master switch.*

11. Purge the combustion chamber to remove any unburned oil; then check all burner adjustments.

12. Wait about 3 minutes. Close the master switch, open the manual fuel shutoff valves, and try lightoff again. The first attempt may have been required to purge the lines and bring sufficient oil to the burner.

13. If the 1st stage burner flame is not established within 5 seconds, or within the normal lightoff time specified by the burner manufacturer, *close the manual fuel shutoff valves.*

14. If necessary, repeat steps 11 through 13 to establish the 1st stage burner flame. Then proceed to step 15.

15. When the 1st stage burner flame is established, the sequence will advance to RUN. Make burner adjustments for flame stability and input rating. *If a 2nd stage is used, make sure the automatic 2nd stage oil valve has opened.*

16. Shut down the system by lowering the set point of the burner controller. *Make sure the burner flame goes out and all automatic oil valves close.*

17. *If used, remove the bypass jumpers from the low fuel pressure limits.*

18. *If a 2nd stage is used,* check the lightoff as follows. Otherwise proceed to step 19.

a. Open the manual 2nd stage oil valve.
b. Restart the system by raising the set point of the burner controller.
c. When the 1st stage burner flame is established, watch for the automatic 2nd stage oil valve to open. Observe that the 2nd stage lights off properly.
d. Make burner adjustments for flame stability and input rating.
e. Shut down the system by lowering the set point of the burner controller. *Make sure the burner flames go out and all automatic oil valves close.*
f. Proceed to step 19.

19. Restart the system by raising the set point of the burner controller. Observe that the burner flame is established during IGN TRIAL, within the normal lightoff time specified by the burner manufacturer.

20. Measure the flame signal. Continue to check for the proper signal (Table VI) into the RUN period. Check the signal at both high and low firing rate positions and while modulating, if applicable. Any pulsating or unsteady readings will require further adjustments.

21. Make sure all readings are in the required ranges before proceeding.

PILOT TURNDOWN TEST

ALL INSTALLATIONS USING A PILOT

Perform this check on all installations using a pilot. The purpose of this test is to ensure that the main burner can be lighted by the smallest pilot flame that will hold in the 2K (flame) relay (FLAME ON light on). Clean the flame detector(s) to ensure that it will detect the smallest acceptable pilot flame.

NOTE: Low fuel pressure limits, if used, *could be open.* If so, bypass them with jumpers during this test.

1. Open the master switch.
2. Close the manual main fuel shutoff valve(s).
3. Connect a manometer (or pressure gauge) to measure pilot gas pressure during the turndown test.
4. Open the manual pilot shutoff valve.
5. Close the master switch and start the system with a call for heat (raise the set point of the burner controller). The program sequence should start, and prepurge should begin.
6. When the IGN TRIAL light comes on, set the RUN/TEST switch to TEST position to stop the sequence. The FLAME ON light will come on when the pilot ignites.

NOTE: If the sequence does not stop, reset the system and make sure you set the RUN/TEST switch as soon as the beginning of the IGN. TRIAL light comes on.

IMPORTANT

You have 8 seconds to stop the sequence after the start of ignition.

7. Turn the pilot pressure down very slowly, reading the manometer (or gauge) as it drops. Stop instantly when the FLAME ON light goes out. Note the pressure at the dropout point. The pilot is at the turndown position. Immediately, turn up the pilot pressure until the FLAME ON light comes on again.

NOTE: With the sequence stopped at this point, the BC7000 will lockout and flash F35 if there is no flame for 30 seconds.

8. Repeat step 7 to verify the pilot gas pressure reading at the exact point the FLAME ON light goes out.
9. Increase the pilot pressure immediately until the FLAME ON light comes on, and then turn it down slowly to obtain a pressure reading just above the dropout point.
10. Set the RUN/TEST switch in the RUN position and let the sequence proceed. At 10 seconds into the ignition trial period (display shows "10"), make sure the automatic main fuel valve(s) opens; then *smoothly* open the manual main fuel shutoff valve (and manually opened safety shutoff valve, if used) and watch for main burner ignition. If the main burner flame is established, proceed to step 18.

NOTE: This step requires 2 people—one to open the manual valve(s) and one to watch for ignition.

11. If the main burner flame is not established within 5 seconds, or within the normal lightoff time specified by the burner manufacturer, *close the manual main fuel shutoff valve(s) and open the master switch.*
12. Purge the combustion chamber to remove any unburned fuel; check all burner adjustments.
13. Wait about 3 minutes. Close the master switch, and let the program sequence go to RUN. Repeat steps 10 and 11 (try lightoff once more).
14. If the second attempt is unsuccessful, adjust the flame detector position so that a larger pilot is required to cause the FLAME ON light to come on. This may require relocating the flame detector to sense further out on the pilot flame, or adding an orifice plate.
15. Measure the pilot flame signal after adjusting the flame detector to make sure it is stable and above the minimum (see Table VI).
16. Repeat steps 5 through 16 until the main burner positively lights with the pilot flame just causing the FLAME ON light to remain on.

17. Repeat the lightoff of the main burner several times (steps 5 through 10) with the pilot at turndown.

18. When the main burner lights reliably with the pilot at turndown, disconnect the manometer (or gauge) and turn the pilot up to normal.

19. *If used, remove the bypass jumpers from the low fuel pressure limits.*

20. Run the system through another cycle to check for normal operation.

IGNITION INTERFERENCE TEST

ALL FLAME RODS

Test to make certain that a false signal from a spark ignition system is not superimposed on the flame signal.

Ignition interference can subtract from (decrease) or add to (increase) the flame signal. If it decreases the flame signal enough, it will cause safety shutdown. If it increases the flame signal, it could cause the FLAME ON light to come on when the true flame signal is below the minimum acceptable value.

TEST

Start the burner and measure the flame signal with both ignition and pilot (or main burner) on, and then with the pilot (or main burner) only. Any significant difference (greater than 1/2 microamp) indicates ignition interference.

TO ELIMINATE IGNITION INTERFERENCE

1. Make sure there is enough ground area.
2. Be sure the ignition electrode and the flame rod are on opposite sides of the ground area.
3. Check for correct spacing on the ignition electrode:

   6,000 V systems—1/16 to 3/32 in. [1.6 to 2.4 mm].
   10,000 V systems—1/8 in. [3.2 mm].

4. Make sure the leadwires from the flame rod and ignition electrode are not too close together anywhere.
5. Replace any deteriorated leadwires.
6. If the problem cannot be eliminated, you may have to change to an ultraviolet flame detection system.

HOT REFRACTORY SATURATION TEST

ALL INFRARED DETECTORS

Test to make certain that radiation from hot refractory does not mask the flickering radiation of the flame itself.

Start the burner and monitor the flame signal during the warmup period. A decrease in signal strength as the refractory heats up indicates hot refractory saturation. If saturation is extreme, the FLAME ON light will go out and the system will shut down as though a flame failure has occurred.

If hot refractory saturation occurs, the condition must be corrected. Add an orifice plate ahead of the cell to restrict the viewing area. If this doesn't work, resight the detector at a cooler, more distant background. You can also try lengthening the sighting pipe or decreasing the pipe size (diameter). Continue adjustments until hot refractory saturation is eliminated.

HOT REFRACTORY HOLD-IN TEST

RECTIFYING PHOTOCELLS OR INFRARED DETECTORS

Test to make certain that hot refractory will not cause the FLAME ON light to remain on after the burner flame goes out. This condition would delay response to flame failure and also would prevent a system restart as long as hot refractory is detected.

First check the plug-in flame signal amplifier by starting a burner cycle. As soon as the BC7000 stops in the RUN period, lower the set point of the burner controller to shut down the burner while the refractory is still at a low temperature. Measure the time it takes for the FLAME ON light to go out after the flame goes out. If this takes more than 4 seconds, open the master switch and replace the amplifier.

To check rectifying photocells for hot refractory hold-in, operate the burner until the refractory reaches its maximum temperature. Then terminate the firing cycle. (Lower the set point of the burner controller, or set the fuel selector switch to OFF. Do not open the master switch.) Visually observe when the burner flame goes out. After the flame goes out, measure the time it takes for the FLAME ON light to go out. If this takes more than 4 seconds, the photocell is sensing hot refractory. This condition must be corrected as described in the last paragraph of this test.

Infrared (lead sulfide) detectors can respond to infrared rays emitted by a hot refractory, even when the refractory has visibly ceased to glow. Infrared radiation from a hot refractory is steady, whereas radiation from a flame has a flickering characteristic. The infrared detection system responds only to a flickering infrared radiation; it can reject a steady signal from hot refractory. The refractory's steady signal can be made to fluctuate if it is reflected, bent, or blocked by smoke or fuel mist within the combustion chamber. Care must be taken when applying an infrared system to ensure its response.

To check infrared (lead sulfide) detectors for hot refractory hold-in, operate the burner until the refractory reaches its maximum temperature. If the installation has a multifuel burner, burn the *heavier* fuel, which is most likely to reflect, bend, or obscure the hot refractory's steady infrared radiation. (Burn a solid instead of a liquid, or a liquid instead of a gas.) When the maximum refractory temperature is reached, close *all* manual fuel shutoff valves, or open the electrical circuits of *all* automatic fuel valves. Visually observe when the burner flame goes out. After the flame goes out, measure the time it takes for the FLAME ON light to go out. If this takes more than 4 seconds, the infrared detector is sensing hot refractory. Immediately terminate the firing cycle. (Lower the set point of the burner controller, or set the fuel selector switch to OFF. Do not open the master switch.)

NOTE: Some burners continue to purge their oil lines between the valve(s) and nozzle(s) even though the fuel valve(s) is (are) closed. Termination of the firing cycle (instead of opening the master switch) will allow purging of the combustion chamber, if available. This will reduce a buildup of fuel vapors in the combustion chamber caused by oil line purging.

If the detector is sensing hot refractory, the condition must be corrected. Add an orifice plate ahead of the cell to restrict the viewing area of the detector. If this doesn't work, resight the detector at a cooler, more distant part of the combustion chamber. While resighting the detector, keep in mind that it must also sight the flame properly. For an infrared detector, you can also try lengthening the sighting pipe or decreasing the pipe size (diameter). For details, refer to the C7015A Instruction sheet, form 60-2306. Continue adjustments until hot refractory hold-in is eliminated.

ULTRAVIOLET RESPONSE TESTS

ALL ULTRAVIOLET DETECTORS

IGNITION SPARK RESPONSE TEST

Test to make certain that ignition spark is not actuating the FLAME ON light.

1. Close the pilot and main burner manual fuel shutoff valves.
2. Start the burner and run through the ignition period. Ignition spark should occur, but the FLAME ON light must not come on. The flame signal should not be more than 1/4 microamp.
3. If the FLAME ON light does come on, resight the detector farther out from the spark, or away from possible reflection. It may be necessary to construct a barrier to block the ignition spark from the detector's view. Continue adjustments until the flame signal due to ignition spark is less than 1/4 microamp.

NOTE: Honeywell's Q624A Solid State Spark Generator will prevent detection of ignition spark when properly applied with flame detection systems using C7027, C7035, or C7044 Minipeeper Ultraviolet Flame Detectors. The Q624A is for use only with gas pilots.

RESPONSE TO OTHER ULTRAVIOLET SOURCES

Some sources of artificial light produce small amounts of ultraviolet radiation. Under certain conditions, an ultraviolet detector will respond to them as if it is sensing a flame. DO NOT USE AN ARTIFICIAL LIGHT SOURCE TO CHECK THE RESPONSE OF AN ULTRAVIOLET DETECTOR. To check for proper detector operation, flame failure response tests should be conducted under all operating conditions.

FLAME SIGNAL WITH HOT COMBUSTION CHAMBER

ALL INSTALLATIONS

With all initial startup tests and burner adjustments completed, operate the burner until the combustion chamber is at maximum expected temperature. (Observe the burner manufacturer's warmup instructions.) Recycle the burner under these hot conditions and measure the flame signal. Check the pilot alone, the main burner flame alone, and both together (unless monitoring only the pilot flame when using an intermittent pilot, or only the main burner flame when using direct spark ignition). Check the signal at both high and low firing rate positions and while modulating, if applicable.

Also check the flame failure response time. Lower the set point of the burner controller and observe the time it takes for the FLAME ON light to go out (this should be within 4 seconds).

If the flame signal is too low or unsteady, check the flame detector temperature. Relocate the detector if the temperature is too high. If necessary, realign the sighting to obtain the proper signal and response time. If the response time is still too slow, replace the plug-in flame signal amplifier. If the detector is relocated or resighted, or the amplifier is replaced, repeat all required checkout tests.

IMPORTANT

Repeat ALL required CHECKOUT tests after all adjustments have been completed. ALL tests must be satisfied with the flame detector(s) in FINAL position.

BC7000 SYSTEM ANNUNCIATION AND DIAGNOSTIC CODES

The following codes are used to annunciate and diagnose system problems.

For complete system troubleshooting and operating instructions, see form 65-0014, BC7000 Microcomputer Burner Control System Detailed Operating Sequences, System Annunciation, Diagnostics, and Troubleshooting.

SYSTEM HOLD CODES

H70 – FLAME SIGNAL DURING STANDBY
H73 – OPEN PRE-IGNITION INTERLOCK
H74 – OPEN RUNNING INTERLOCK

SYSTEM FAULT/LOCKOUT CODES

F00 – FALSE FLAME SIGNAL DURING PREPURGE
F01 – HIGH FIRE PURGE SWITCH FAULT
F03 – PRE-IGNITION INTERLOCK OPENED DURING PREPURGE
F04 – LOCKOUT/RUNNING INTERLOCK OPENED DURING PREPURGE
F10 – FALSE FLAME SIGNAL DURING LOW FIRE HOLD
F11 – LOW FIRE START SWITCH FAULT
F13 – PRE-IGNITION INTERLOCK OPENED DURING LOW FIRE HOLD
F14 – LOCKOUT/RUNNING INTERLOCK OPENED DURING LOW FIRE HOLD
F30 – PILOT (FIRST STAGE OIL) FLAME FAILURE
F31 – LOW FIRE START SWITCH OPENED DURING PILOT TRIAL
F34 – LOCKOUT/RUNNING INTERLOCK OPENED DURING PILOT TRIAL
F35 – PILOT FLAME FAILURE IN TEST MODE
F40 – MAIN FLAME FAILED TO IGNITE
F44 – LOCKOUT/RUNNING INTERLOCK OPENED DURING MAIN FLAME TRIAL
F50 – FLAME FAILURE DURING RUN PERIOD
F54 – LOCKOUT/RUNNING INTERLOCK OPENED DURING RUN PERIOD
F70 – FALSE FLAME SIGNAL DURING STANDBY
F73 – PRE-IGNITION INTERLOCK FAILED TO CLOSE
F81 – INTERMITTENT (BOUNCING) PRE-IGNITION INTERLOCK
F82, F83, F85, F86, F87 – INTERMITTENT (BOUNCING) BURNER CONTROLLER/LIMIT
F84 – INTERMITTENT (BOUNCING) LOCKOUT/RUNNING INTERLOCK
F90 – PROGRAM MODULE FAULT
F97 – SYNCHRONIZATION (LINE FREQUENCY) FAULT
F99 – INTERNAL CIRCUIT FAULT

HONEYWELL BC 7000 SYSTEM
ANNUNCIATION AND DIAGNOSTIC CODES

CODE	SYSTEM HOLD
H70	FLAME SIGNAL DURING STANDBY
H73	OPEN PRE-IGNITION INTERLOCK
H74	OPEN RUNNING INTERLOCK

CODE	SYSTEM FAULT/LOCKOUT
F00	FALSE FLAME SIGNAL DURING PREPURGE
F01	HIGH FIRE PROVING SWITCH FAULT
F03	PRE-IGNITION INTERLOCK OPENED DURING PREPURGE
F04	LOCKOUT/RUNNING INTERLOCK OPENED DURING PREPURGE
F10	FALSE FLAME SIGNAL DURING LOW FIRE HOLD
F11	LOW FIRE PROVING SWITCH FAULT
F13	PRE-IGNITION INTERLOCK OPENED DURING LOW FIRE HOLD
F14	LOCKOUT/RUNNING INTERLOCK OPENED DURING LOW FIRE HOLD
F30	PILOT (First stage oil) FLAME FAILURE
F31	LOW FIRE PROVING SWITCH FAULT DURING PILOT TRIAL
F34	LOCKOUT/RUNNING INTERLOCK OPENED DURING PILOT FLAME TRIAL
F35	PILOT FLAME FAILURE IN TEST MODE
F40	MAIN FLAME FAILED TO IGNITE
F44	LOCKOUT/RUNNING INTERLOCK OPENED DURING MAIN FLAME TRIAL
F50	FLAME FAILURE DURING RUN PERIOD
F54	LOCKOUT/RUNNING INTERLOCK OPENED DURING RUN PERIOD
F70	FALSE FLAME SIGNAL DURING STANDBY
F73	PRE-IGNITION INTERLOCK FAILED TO CLOSE
F81	INTERMITTENT (Bouncing) PRE-IGNITION INTERLOCK
F84	INTERMITTENT (Bouncing) LOCKOUT/RUNNING INTERLOCK
F82, F83, F85, F86, F87	INTERMITTENT (Bouncing) BURNER CONTROLLER/LIMIT
F90	PROGRAM MODULE FAULT
F97	SYNCHRONIZATION (Line frequency) FAULT
F99	MISWIRED SUBBASE OR INTERNAL FAULT
OTHERS	CONSULT SPEC. SHEET 65-0014 FOR ALL OTHER CODES.

For further information refer to:

BC 7000 INSTALLATION & INSTRUCTION SHEET 60-2529.