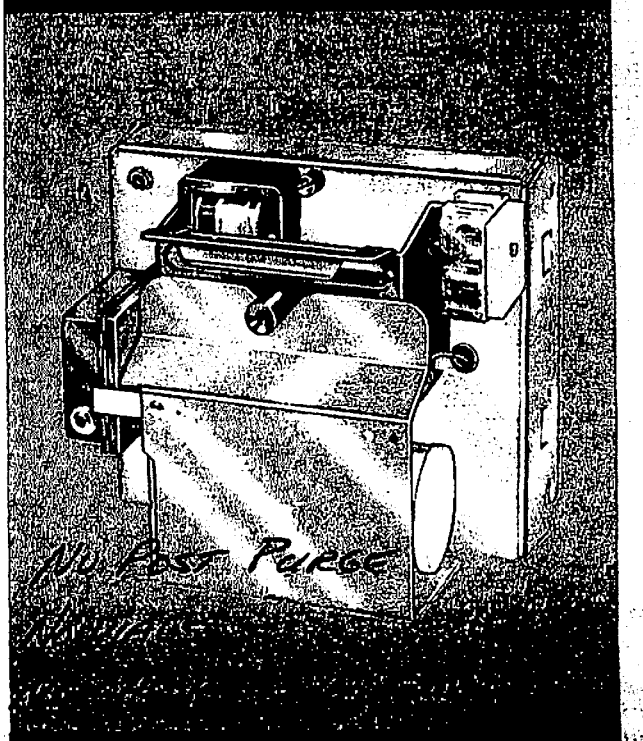
Honeywell

FLAME SAFEGUARD PROGRAMMING CONTROL



R4140Y

THE R4140Y FLAME SAFEGUARD PROGRAMMER PROVIDES FLAMEOUT PROTECTION PLUS AUTOMATIC SEQUENCING OF THE BURNER MOTOR, IGNITION, PILOT VALVE, AND MAIN FUEL VALVE(S) FOR COMMERCIAL AND INDUSTRIAL GAS, OIL, COAL, OR COMBINATION BURNERS.

- Approval: Underwriters Laboratories Inc. listed or component recognized. Factory Mutual approved for automatic fired burners.
- The R4140Y functionally replaces R4795A or D for most applications.
- Separate models provide 7, 30, 60, or 90 second prepurge time.

  Every model provides Intermittent Pilot.
- Includes terminals for connection of an airflow switch to prove airflow from the beginning of the prepurge period all the way through the run period.
- Safe start check before and during prepurge. If a flame (or a condition simulating a flame) is detected before or at startup, the programmer cannot be started; if it is detected during prepurge, ignition trials cannot be started and the programmer will recycle.
- Safety shutdown will occur on failure to ignite the pilot or 1st stage oil burner, or on loss of flame during the run period.
- On safety shutdown, the lockout switch will trip; it must be manually reset to restore operation.
- Solid state, color-coded, plug-in flame signal amplifier capability includes 3 standard models for use with rectification, infrared, or ultraviolet flame detectors; 1 Dynamic Self Check model for use with rectifying flame rods, rectifying photocells, or C7012A or C Purple Peeper Ultraviolet Flame Detectors; and 1 Dynamic Ampli-Check model for use with infrared (lead sulfide) flame detectors.
- A Dynamic Self Check or Dynamic Ampli-Check flame signal amplifier will test all of its own electronic components many times a minute during burner operation, and will shut down the burner if the amplifier fails.
- Recommended minimum flame signal (in microamps) is stamped on each amplifier.
- Meter jack, located on amplifier, provides means of plugging in microammeter to measure flame signal with system in operation.
- All relays are visible and labeled.
- Programmer plugs into standard Q520A Wiring Subbase.
- Alarm terminal is available to operate an external line voltage alarm on safety shutdown.

Form Number 60-2480—1

H.K.
REV. 4-80 (.34)

SEE BACK COVER FOR TABLE OF CONTENTS

SPECIFICATIONS

IMPORTANT

THE SPECIFICATIONS GIVEN IN THIS PUBLICATION DO NOT INCLUDE NORMAL MANUFACTURING TOLERANCES. THEREFORE, THIS UNIT MAY NOT MATCH THE LISTED SPECIFICATIONS EXACTLY. ALSO, THIS PRODUCT IS TESTED AND CALIBRATED UNDER CLOSELY CONTROLLED CONDITIONS, AND SOME MINOR DIFFERENCES IN PERFORMANCE CAN BE EXPECTED IF THOSE CONDITIONS ARE CHANGED.

MODELS: R4140Y Flame Safeguard Programming Controls–flame safeguard protection and sequencing controls for use on gas, oil, coal, or combination burners. See Table I for models available.

TABLE I–MODELS AVAILABLE

MODEL	WITH COVER[a]	TIMER CYCLE (sec)	PREPURGE (SECONDS)	FLAME-ESTABLISHING PERIOD (sec)
R4140Y1005	Yes	30	7	10
R4140Y1013	Yes	30	7	4
R4140Y1021	BA Yes 40	90	30	10
R4140Y1039	BB Yes 40	90	30	4
BE R4140Y1047	BE Yes 30	120	60	10
R4140Y1054	Yes	120	60	4
BE R4140Y1062	Yes 30	120	90	10
R4140Y1070	Yes	120	90	4

[a]Heavy duty, metal cover with reset button for outside panel mounting.

(continued on page 3)

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. Order number.

ORDER SEPARATELY–

1. Flame detection system (amplifier and matching flame detector). See Table IV.
2. Q520A1089 or Q520A1121 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 YOUR PHONE DIRECTORY).
2. RESIDENTIAL GROUP CUSTOMER SERVICE
   HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH
   MINNEAPOLIS, MINNESOTA 55422 (612) 542-7500

   (IN CANADA–HONEYWELL CONTROLS LIMITED, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO)
   INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.

INTERLOCK CIRCUIT:

Airflow Switch–Contacts must close when airflow is proven to start programmer sequence. Contacts must stay closed (airflow must remain proven) through prepurge, ignition trials, and the run period. If contacts open, burner motor, ignition transformer, and fuel valve terminals are de-energized, and programmer recycles.

SAFETY FEATURES:

Safe Start Check–for the presence of a flame (or a condition simulating a flame), provided before and during prepurge. If the flame relay 2K is pulled in at startup, the programmer cannot be started. If the flame relay 2K pulls in during prepurge, ignition trials cannot be started. Instead, the timer will complete its revolution. If the flame relay has dropped out by the end of the cycle, the programmer will start its sequence.

Safety Shutdown–Ignition transformer and all fuel valves are de-energized. The lockout switch trips and locks out the programmer. If used, the external alarm is energized. The lockout switch must be manually reset to restart the system.

Safety Shutdown Occurs on–

1. Failure to ignite the pilot or 1st stage oil burner.
2. Loss of flame during the run period.

Flame Failure Response Time–2 to 4 seconds.

Lockout Switch Timing–30 seconds (nominal).

ELECTRICAL RATINGS:

Voltage and Frequency–120 Vac (102 V minimum to 132 V maximum), 50/60 Hz.
NOTE: Use of a 50 Hz power supply will lengthen the sequence timings by a factor of 1.2.
Power Consumption (with no loads connected to the output terminals)–13 W maximum.
Maximum Total Connected Load–2000 VA.

TABLE II–TERMINAL RATINGS

TERMINAL	TYPICAL LOAD	MAXIMUM RATING AT 120 Vac, 60 Hz
5	Ignition Transformer	4.5 amp ignition & 50 VA pilot duty OR 2.5 amp ignition & 75 VA pilot duty
6	Intermittent Pilot Valve or 1st Stage Oil Valve	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
7	Main Gas Valve or 2nd Stage Oil Valve (Solenoid/ Motorized/ Diaphragm) and Vent Valve if required	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	9.8 amp full load, 58.8 amp locked rotor (inrush)
9	120 V Alarm	75 VA pilot duty

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
$\frac{50}{120} = 0.42$ 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 Airflow Switch	Burner motor, ignition transformer, and pilot valve (or 1st stage oil valve), simultaneously. Also, burner motor, pilot valve (or 1st stage oil valve), and main gas valve (or 2nd stage oil valve), simultaneously.

AMBIENT OPERATING TEMPERATURE RATINGS:
Minimum–minus 40 F [minus 40 C].
Maximum–

PROGRAMMER MOUNTING POSITION	
STANDARD VERTICAL (with handle up)	ANY OTHER
+150 F [+66 C]	+135 F [+57 C]

STORAGE TEMPERATURE RATINGS: minus 60 F to plus 150 F [minus 51 C to plus 66 C].

MOUNTING: 3-sided Q520A1089 Wiring Subbase, or 4-sided Q520A1121 Wiring Subbase; both have 20 knife-blade contacts (order subbase separately).

DIMENSIONS: See Figs. 1 and 2.

WEIGHT (without plug-in flame signal amplifier): With heavy duty, metal cover–7 lb [3.18 kg].

RECOMMENDED LIMITS: L404A; L604A,L; L4006A,C,E; L4008A,E,F; L6006A,B–These controllers have been tested by Underwriters Laboratories Inc. for *breaking* loads only, at 120V ac, for the total rating of 9.8 amps full load, plus 360 VA ignition, plus 250 VA pilot duty.

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[b]: C7004, C7007, C7011. Complete Assemblies: C7005, C7008, C7009, Q179.
		DYNAMIC SELF CHECK[a]	R7247B		Oil	Rectifying Photocells[c]	C7003, C7010, C7013, C7014.
					Gas, Oil, Coal	Ultraviolet (Purple Peeper)	C7012A or C.
Infrared	Red	No	R7248A	2 to 4 sec	Gas, Oil, Coal	Infrared (lead sulfide)	C7015.
		DYNAMIC AMPLI-CHECK[a]	R7248B				
Ultraviolet	Purple	No	R7249A	2 to 4 sec	Gas, Oil	Ultraviolet (Minipeeper)	C7027, C7035.

[a]Circuitry tests the flame signal amplifier many times a minute during burner operation and shuts down the burner if the amplifier fails.

[b]Order flame rod separately; see instruction sheet for the holder.

[c]Use Honeywell 38316 Photocell only.

APPROVALS:

UNDERWRITERS LABORATORIES INC. LISTED–Models with 30, 60, or 90 second prepurge times; File No. MP268, Guide No. MCCZ.

UNDERWRITERS LABORATORIES INC. COMPONENT RECOGNIZED–Models with 7 second prepurge time; File No. MP268, Guide No. MCCZ2.

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

FACTORY MUTUAL APPROVED: Report No. JIOE4AGAF.

ACCESSORIES:

1. W136A Test Meter (includes 117053 Meter Connector Plug).

2. 117053 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. Q624A Solid State Spark Generator; prevents detection of ignition spark when properly applied with flame detection systems using C7027 or C7035 Minipeeper Ultraviolet Flame Detectors. For use only with gas pilots.

6. FSP5004 Tester; provides a quick operational check of most R4140 Flame Safeguard Programming Controls.

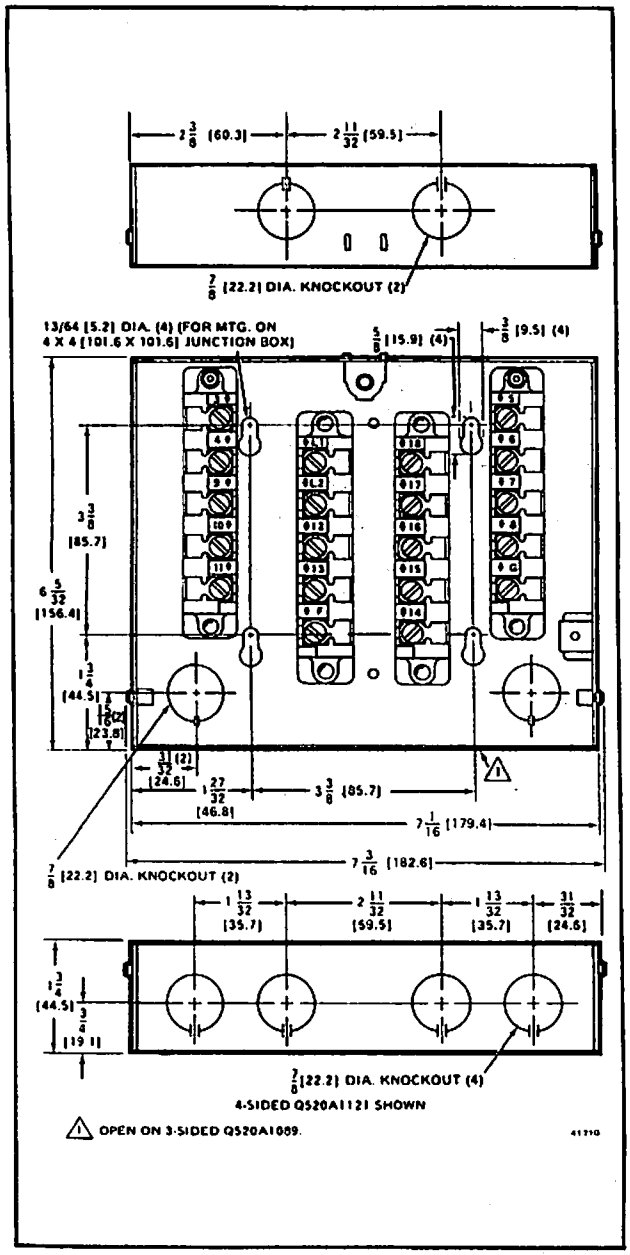


FIG. 1–MOUNTING DIMENSIONS OF THE Q520A WIRING SUBBASE, IN in. [mm SHOWN IN BRACKETS].

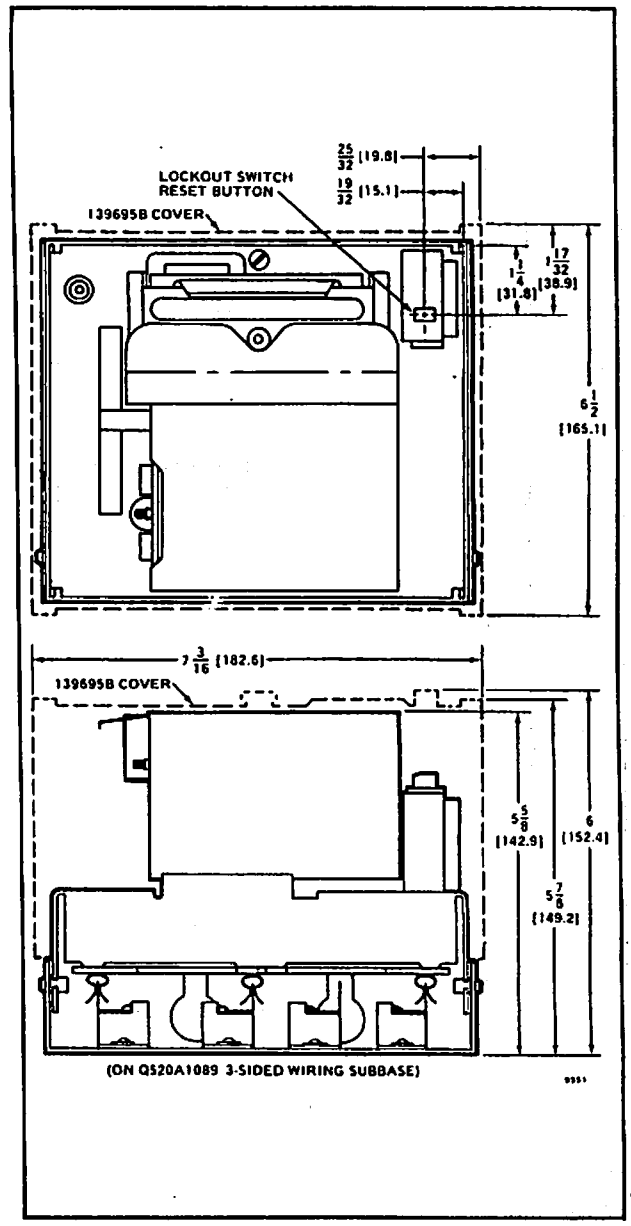
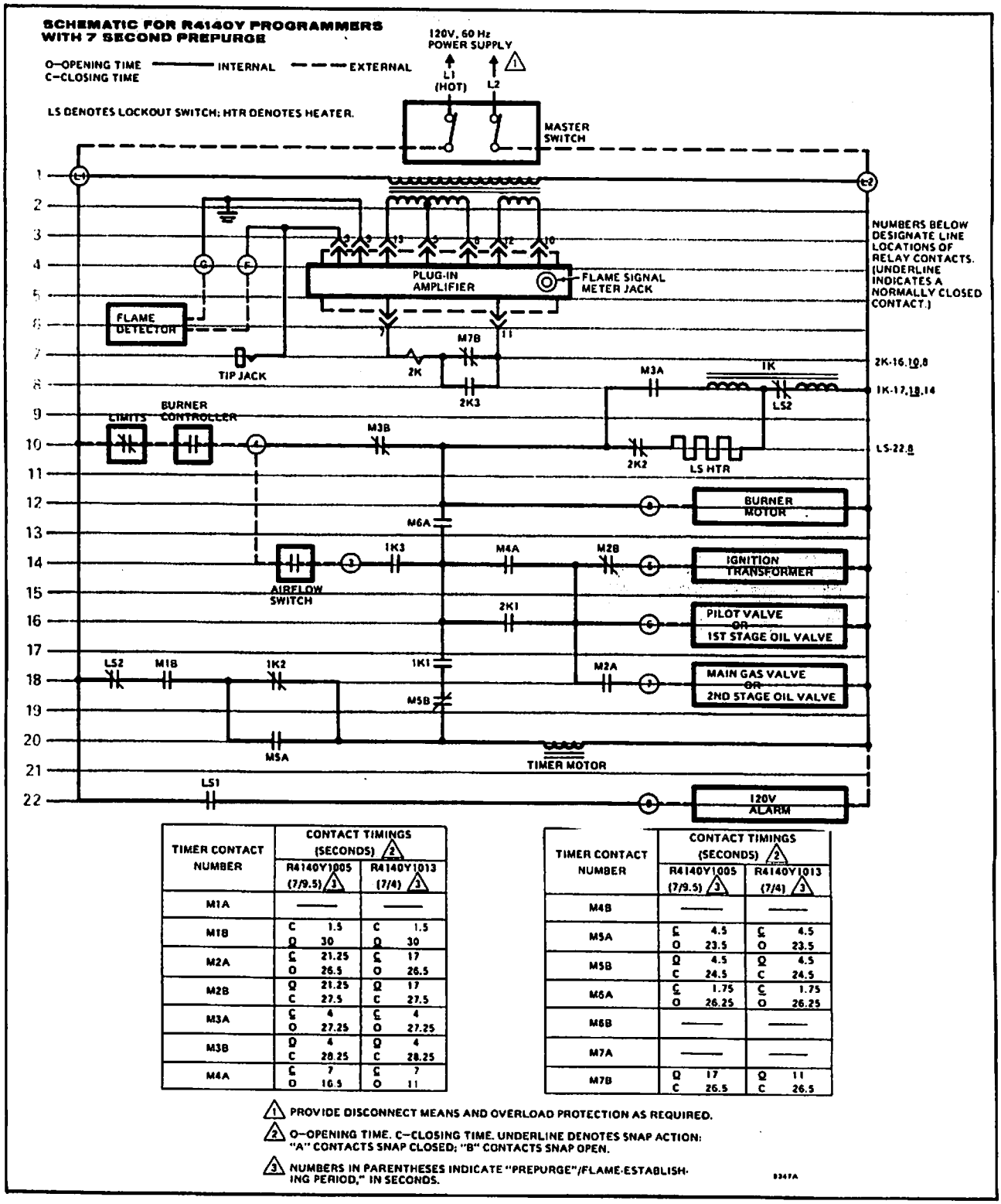


FIG. 2–MOUNTING DIMENSIONS OF THE R4140 PROGRAMMER ON THE Q520A WIRING SUBBASE, IN in. [mm SHOWN IN BRACKETS].

OPERATION

The schematic below shows all contacts in the standby position (zero seconds). The opening and closing times are given in the table below the schematic. Refer to Fig. 4, the Timer Sequence Chart, and Table V, Step-By-Step Operation, on the facing page.



TIMER CONTACT NUMBER	CONTACT TIMINGS (SECONDS) ⚠2 R4140Y1005 (7/9.5) ⚠3	R4140Y1013 (7/4) ⚠3
M1A	——	——
M1B	C 1.5 O 30	C 1.5 O 30
M2A	C 21.25 O 26.5	C 17 O 26.5
M2B	O 21.25 C 27.5	O 17 C 27.5
M3A	C 4 O 27.25	C 4 O 27.25
M3B	O 4 C 28.25	O 4 C 28.25
M4A	C 7 O 10.5	C 7 O 11

TIMER CONTACT NUMBER	CONTACT TIMINGS (SECONDS) ⚠2 R4140Y1005 (7/9.5) ⚠3	R4140Y1013 (7/4) ⚠3
M4B	——	——
M5A	C 4.5 O 23.5	C 4.5 O 23.5
M5B	O 4.5 C 24.5	O 4.5 C 24.5
M6A	C 1.75 O 26.25	C 1.75 O 26.25
M6B	——	——
M7A	——	——
M7B	O 17 C 26.5	O 11 C 26.5

⚠1 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

⚠2 O–OPENING TIME. C–CLOSING TIME. UNDERLINE DENOTES SNAP ACTION: "A" CONTACTS SNAP CLOSED; "B" CONTACTS SNAP OPEN.

⚠3 NUMBERS IN PARENTHESES INDICATE "PREPURGE"/FLAME-ESTABLISHING PERIOD," IN SECONDS.

8347A

FIG. 3–SIMPLIFIED SCHEMATIC DIAGRAM OF THE R4140Y1005 AND R4140Y1013 PROGRAMMERS (WITH 7 SECOND PREPURGE).

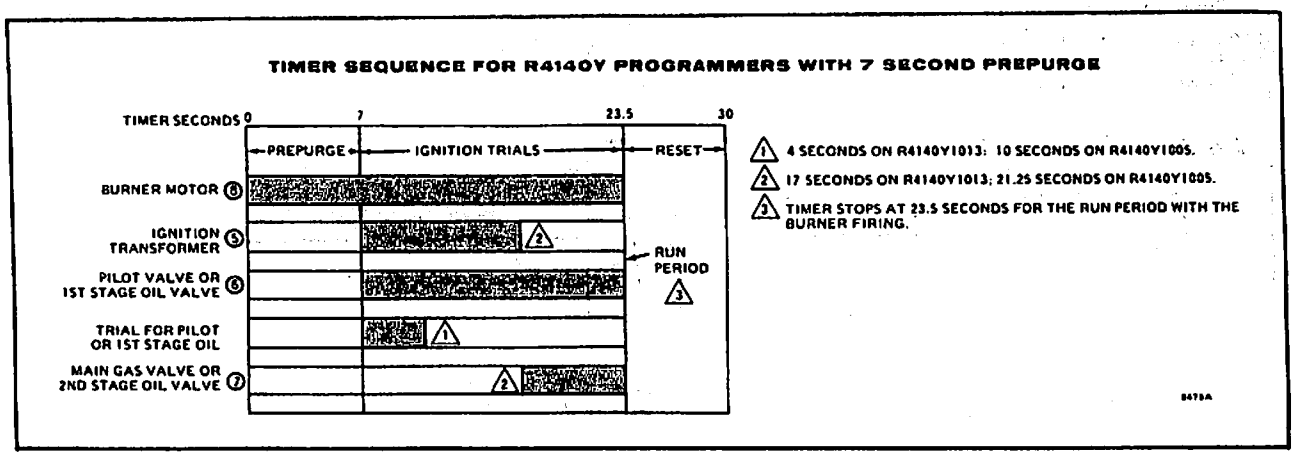


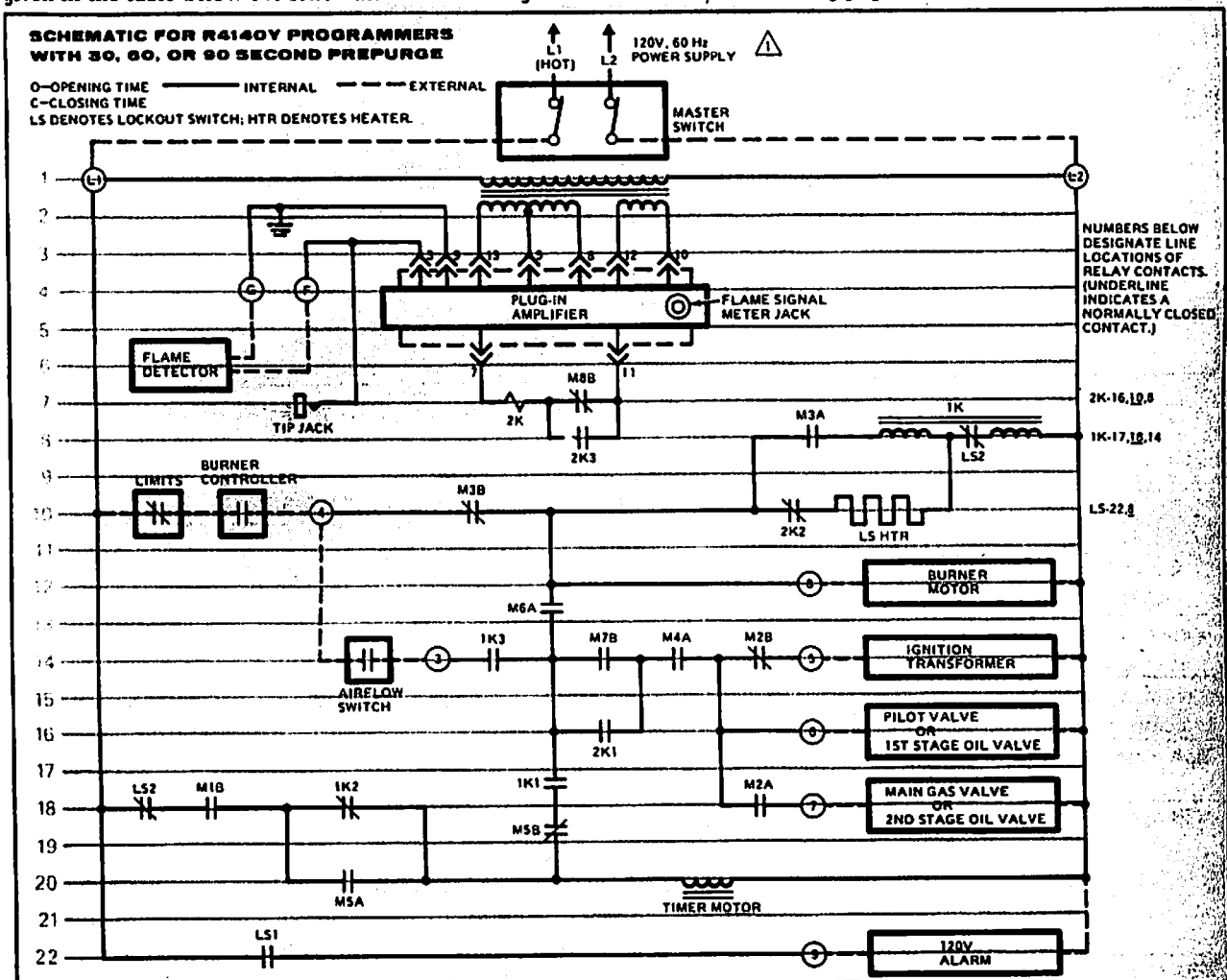
FIG. 4–TIMER SEQUENCE CHART FOR THE R4140Y1005 AND R4140Y1013 PROGRAMMERS.

TABLE V–STEP-BY-STEP OPERATION OF R4140Y PROGRAMMERS WITH 7 SECOND PREPURGE

TIMER CONTACT ACTION	TIMER SECONDS		OPERATION
	R4140Y1005 (7/10)[a]	R4140Y1013 (7/4)[a]	
Burner controller contacts close	0	0	Burner motor (terminal 8) is energized (through M3B). Relay 1K pulls in (through M3B, 2K2, LS HTR, and LS2).
Airflow switch contacts close	0	0	Timer motor is energized (through airlow switch, 1K3, 1K1, and M5B). Prepurge begins.
M6A closes	1.75	1.75	Bypasses airflow switch until M3B opens. Timer motor is now energized through M3B, M6A, 1K1, and M5B.
M3B opens	4	4	Relay 1K cannot pull in after this time. Airflow switch contacts must stay closed during prepurge, ignition trials, and the run period, or relay 1K will drop out; the burner motor (terminal 8), ignition transformer (terminal 5), and fuel valves (terminals 6 and 7) will be de-energized; and the programmer will recycle.
M3A closes	4	4	Lockout switch heater (LS HTR) starts heating (through M3A and 2K2).
M5A closes and M5B opens	4.5	4.5	Timer motor is now energized through M1B and M5A.
M4A closes	7	7	Ignition trials start. Ignition transformer (terminal 5) and pilot valve or 1st stage oil valve (terminal 6) are energized (through airflow switch, 1K3, M4A, and M2B). When a flame is detected, relay 2K pulls in, 2K2 opens, and the LS HTR stops heating; 2K1 and 2K3 close.
M4A opens	16.5	11	Flame-establishing period ends. A flame must be detected by this time (2K pulled in and 2K1 closed) or ignition transformer (terminal 5) and pilot valve or 1st stage oil valve (terminal 6) will be de-energized, and safety shutdown will occur.
M7B opens	17	11	Prevents relay 2K from pulling in after this time.
M2B opens and M2A closes	21.25	17	Ignition transformer (terminal 5) is de-energized. Main gas valve or 2nd stage oil valve (terminal 7) is energized.
M5A opens	23.5	23.5	Timer stops with the system in the "run" condition.
Burner controller contacts open	23.5+	23.5+	End of run period; operating set point has been reached. Burner motor (terminal 8) and fuel valves (terminals 6 and 7) are de-energized. Relay 1K drops out; 1K2 closes, starting the timer motor.
M1B opens	30	30	Timer motor is de-energized; timer stops in standby position (zero seconds). End of operational cycle.

[a]Numbers in parentheses indicate "Prepurge/Flame-Establishing Period," in seconds.

The schematic below shows all contacts in the standby position (zero seconds). The opening and closing times are given in the table below the schematic. Refer to Fig. 6 and Table VI on the facing page.



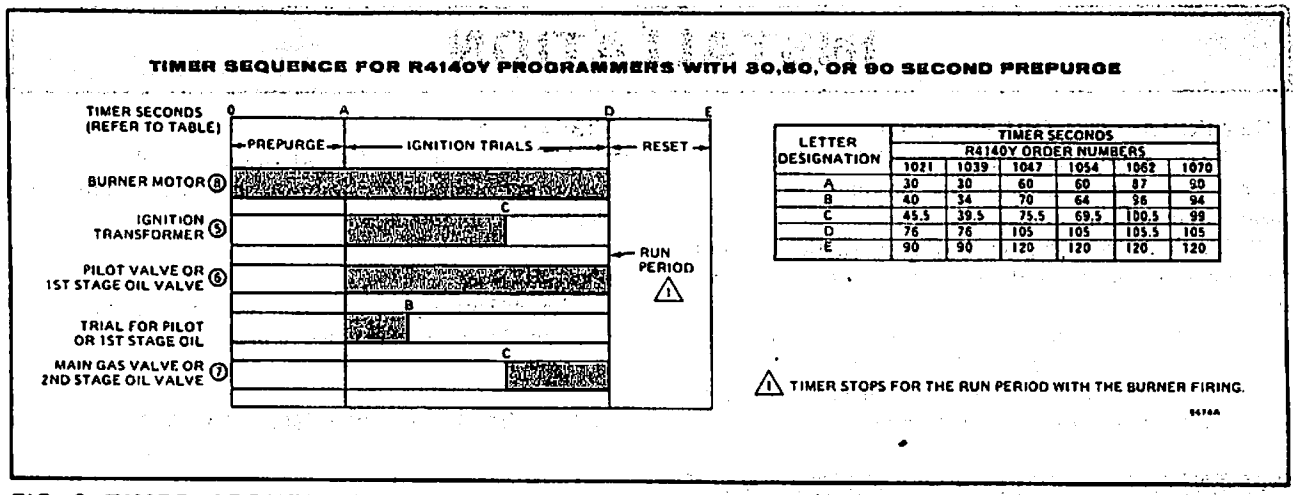
TIMER CONTACT NUMBER	CONTACT TIMINGS (SECONDS) 2					
	R4140Y1021 (30/10) 3	R4140Y1039 (30/4) 3	R4140Y1047 (60/10) 3	R4140Y1054 (60/4) 3	R4140Y1062 (87/9) 3	R4140Y1070 (90/4) 3
M1A	—	—	—	—	—	—
M1B	C 2.75 O 90	C 2.75 O 90	C 3 O 120	C 3 O 120	C 3 O 120	C 3 O 120
M2A	C 45.5 O 85	C 39.5 O 85	C 75.5 O 115	C 69.5 O 115	C 100.5 O 115	C 99 O 115
M2B	O 45.5 C 88	O 39.5 C 88	O 75.5 C 119	O 69.5 C 119	O 100.5 C 119	O 99 C 119
M3A	C 27.5 O 82.75	C 27.5 O 82.75	C 57.5 O 111.5	C 57.5 O 111.5	C 83 O 111.5	C 86 O 111.5
M3B	O 10 C 86.5	O 10 C 86.5	O 11.5 C 116.5	O 11.5 C 116.5	O 11.5 C 116.5	O 11.5 C 116.5
M4A	C 30 O 82	C 30 O 82	C 60 O 113	C 60 O 113	C 87 O 113	C 90 O 113
M4B	—	—	—	—	—	—
M5A	C 10 O 76	C 10 O 76	C 20 O 105	C 20 O 105	C 20 O 105.5	C 20 O 105
M5B	O 10 C 79	O 10 C 79	O 20 C 109	O 20 C 109	O 20 C 109.5	O 20 C 109
M6A	C 7 O 82	C 7 O 82	C 8 O 115	C 8 O 115	C 8 O 115	C 8 O 115
M6B	—	—	—	—	—	—
M7A	—	—	—	—	—	—
M7B	C 20 O 40	C 14 O 34	C 50 O 70	C 40 O 64	C 75 O 96	C 71 O 94
M8A	—	—	—	—	—	—
M8B	O 40 C 83	O 34 C 83	O 70 C 113	O 64 C 113	O 97 C 113	O 94 C 113

1 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 O—OPENING TIME. C—CLOSING TIME. UNDERLINE DENOTES SNAP ACTION; "A" CONTACTS SNAP CLOSED; "B" CONTACTS SNAP OPEN.

3 NUMBERS IN PARENTHESES INDICATE "PREPURGE"/"FLAME-ESTABLISHING PERIOD," IN SECONDS.

FIG. 5—SIMPLIFIED SCHEMATIC DIAGRAM OF THE R4140Y1021, R4140Y1039, R4140Y1047, R4140Y1054, R4140Y1062, AND R4140Y1070 PROGRAMMERS (with 30, 60, or 90 second prepurge).



LETTER DESIGNATION	TIMER SECONDS R4140Y ORDER NUMBERS					
	1021	1039	1047	1054	1062	1070
A	30	30	60	60	87	90
B	40	34	70	64	96	94
C	45.5	39.5	75.5	69.5	100.5	99
D	76	76	105	105	105.5	105
E	90	90	120	120	120	120

FIG. 6–TIMER SEQUENCE CHART FOR THE R4140Y1021, R4140Y1039, R4140Y1047, R4140Y1054, R4140Y1062, AND R4140Y1070 PROGRAMMERS.

TABLE VI–STEP-BY-STEP OPERATION OF R4140Y PROGRAMMERS WITH 30, 60, OR 90 SECOND PREPURGE

TIMER CONTACT ACTION	TIMER SECONDS R4140Y ORDER NUMBERS						OPERATION
	1021 (30/10)[a]	1039 (30/4)[a]	1047 (60/10)[a]	1054 (60/4)[a]	1062 (90/10)[a]	1070 (90/4)[a]	
Burner controller contacts close	0	0	0	0	0	0	Burner motor (terminal 8) is energized (through M3B). Relay 1K pulls in (through M3B, 2K2, LS HTR, and LS2).
Airflow switch contacts close	0	0	0	0	0	0	Timer motor is energized (through airflow switch, 1K3, 1K1, and M5B). Prepurge begins.
M6A closes	7	7	8	8	8	8	Bypasses airflow switch until M3B opens. Timer motor is now energized through M3B, M6A, 1K1, and M5B.
M3B opens	10	10	11.5	11.5	11.5	11.5	Relay 1K cannot pull in after this time. Airflow switch contacts must stay closed during prepurge, ignition trials, and the run period, or relay 1K will drop out; the burner motor (terminal 8), ignition transformer (terminal 5), and fuel valves (terminals 6 and 7) will be de-energized; and the programmer will recycle.
M5A closes and M5B opens	10	10	20	20	20	20	Timer motor is now energized through M1B and M5A.
M3A closes	27.5	27.5	57.5	57.5	83	86	Lockout switch heater (LS HTR) starts heating (through M3A and 2K2).
M4A closes	30	30	60	60	87	90	Ignition trials start. Ignition transformer (terminal 5) and pilot valve or 1st stage oil valve (terminal 6) are energized (through airflow switch, 1K3, M7B, M4A, and M2B). When a flame is detected, relay 2K pulls in, 2K2 opens, and the LS HTR stops heating; 2K1 and 2K3 close.
M7B opens	40	34	70	64	96	94	Flame-establishing period ends. A flame must be detected by this time (2K pulled in and 2K1 closed) or ignition transformer (terminal 5) and pilot valve or 1st stage oil valve (terminal 6) will be de-energized, and safety shutdown will occur.
M8B opens	40	34	70	64	97	94	Prevents relay 2K from pulling in after this time.
M2B opens and M2A closes	45.5	39.5	75.5	69.5	100.5	99	Ignition transformer (terminal 5) is de-energized. Main gas valve or 2nd stage oil valve (terminal 7) is energized.
M5A opens	76	76	105	105	105.5	105	Timer stops with the system in the "run" condition.
Burner controller contacts open	76+	76+	105+	105+	105.5+	105+	End of run period; operating set point has been reached. Burner motor (terminal 8) and fuel valves (terminals 6 and 7) are de-energized. Relay 1K drops out; 1K2 closes, starting the timer motor.
M1B opens	90	90	120	120	120	120	Timer motor is de-energized; timer stops in standby position (zero seconds). End of operational cycle.

[a]Numbers in parentheses indicate "Prepurge/Flame-Establishing Period," in seconds.

INSTALLATION

WHEN INSTALLING THIS PRODUCT . . .

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

CAUTION

1. Disconnect power supply before beginning installation to prevent electrical shock and equipment damage.
2. All wiring must comply with all applicable local electrical codes, ordinances, and regulations.
3. All wiring must be NEC Class 1 (line voltage).
4. Loads connected to the control terminals must not exceed those listed on the R4140 label or in the SPECIFICATIONS section.
5. Limits and interlocks must be rated to carry and break current to the ignition transformer, pilot valve, and main fuel valve(s) simultaneously.
6. All external timers must be listed or component recognized by authorities having jurisdiction, for the specific purpose for which they are used.

IMPORTANT

For on-off gas-fired systems, some authorities having jurisdiction prohibit the wiring of any limit or operating contacts in series between the flame safeguard control and the main fuel valve(s).

Use applicable installation instructions provided by the burner manufacturer in addition to the corresponding instructions given here. Before putting the system into service, check out the installation using the procedures in the CHECKOUT section of this sheet, and any others stipulated by the burner manufacturer.

LOCATION

TEMPERATURE

Install the R4140 where the surrounding temperatures will remain within the Ambient Operating Temperature Ratings in the SPECIFICATIONS section.

HUMIDITY

Install the R4140 where the relative humidity never reaches the saturation point. Condensation of moisture on the R4140 may cause enough leakage to short the flame signal to ground and thus prevent the burner from starting.

VIBRATION

Do not install the R4140 where it could be subject to extreme vibration. Vibration shortens the life of the electronic components.

WEATHER

The R4140 is not designed to be weathertight. If it is installed outdoors, it must be protected.

MOUNTING THE WIRING SUBBASE

See Figs. 1 and 2 for installation dimensions.

1. The subbase can be mounted in any position except horizontally with the knife-blade contacts pointing down. The standard vertical position (shown in Fig. 8) is recommended. Any other position decreases the maximum ambient temperature rating.
2. Select the location on a wall or instrument panel. (The Q520A Subbase may be mounted directly in the customer's cabinet.) Be sure to allow clearances for servicing and for removal of the R4140.

IMPORTANT

Do not mount the wiring subbase horizontally with the knife-blade contacts pointing down.

3. For surface mounting, use the back of the subbase as a template to mark the 4 screw locations. Drill the pilot holes.
4. Insert the mounting screws and tighten them securely.

WIRING TO SUBBASE (FIG. 7)

CAUTION

Make sure the wiring to terminal 7 does not touch any other terminal, especially terminal 8.

1. All wiring must comply with all applicable electrical codes, ordinances, and regulations. Use NEC Class 1 (line voltage) wiring.
2. *For normal installations*, use moisture-resistant No. 14 wire suitable for at least 194 F [90 C].
3. *For high temperature installations*, use moisture-resistant No. 14 wire, selected for a temperature rating above the maximum operating temperature, for all but the ignition and flame detector "F" leadwires.
   a. *For the ignition*, use *Honeywell Spec. No.* R1061012 Ignition Cable or equivalent. (This wire is rated at 350 F [177 C] for continuous duty, and up to 500 F [260 C] for intermittent use. It has been tested to 25,000 volts.)
   b. *For the flame detector "F" leadwire*, use Honeywell Spec. No. R1298020 or equivalent. (This wire is rated up to 400 F [204 C] for continuous duty. It is tested for operation up to 600 volts and breakdown up to 7500 volts.)

IMPORTANT

Do not run high voltage ignition transformer wires in the same conduit with the flame detector wiring.

4. *For ignition installations in a contaminating environment*, use Honeywell Spec. No. R1239001 High Tension Ignition Cable or equivalent. (This wire is very resistant to severe conditions of oil, heat, and corona, and is tested to withstand high voltages up to 25,000 volts RMS in a salt bath for 1 minute without breakdown. It is rated at 200 F [93 C] for continuous duty, and up to 350 F [177 C] for intermittent use.)

5. Refer to Fig. 7 for typical field wiring connections. Follow the burner manufacturer's wiring diagram if provided.

6. Make sure the loads do not exceed the terminal ratings. Refer to the label on the R4140 or to the Terminal Ratings in the SPECIFICATIONS section.

7. *Check the power supply circuit.* The voltage and frequency must match those of the R4140. Do not connect the R4140 to a circuit which is subject to line voltage variations, such as would occur with on-off switching of heavy loads. A separate power supply circuit may be required for the flame safeguard control. Add required disconnect means and overload protection.

8. Check all wiring circuits and complete the STATIC CHECKOUT (Table VII) before installing the R4140.

INSTALLING THE FLAME DETECTOR

Proper flame detector installation is the basis of a safe and reliable flame safeguard installation. Refer to the instructions packed with the flame detector and to the burner manufacturer's instructions. Follow the instructions carefully to make the best possible application of the flame detector.

Keep the flame signal leadwires from the flame detector to the wiring subbase as short as possible. Capacitance increases with leadwire length, reducing the signal strength. The maximum permissible leadwire length depends on the type of flame detector, leadwire, and conduit. *The ultimate limiting factor in flame signal leadwire length is the signal current.* Refer to Table VIII in the CHECKOUT section.

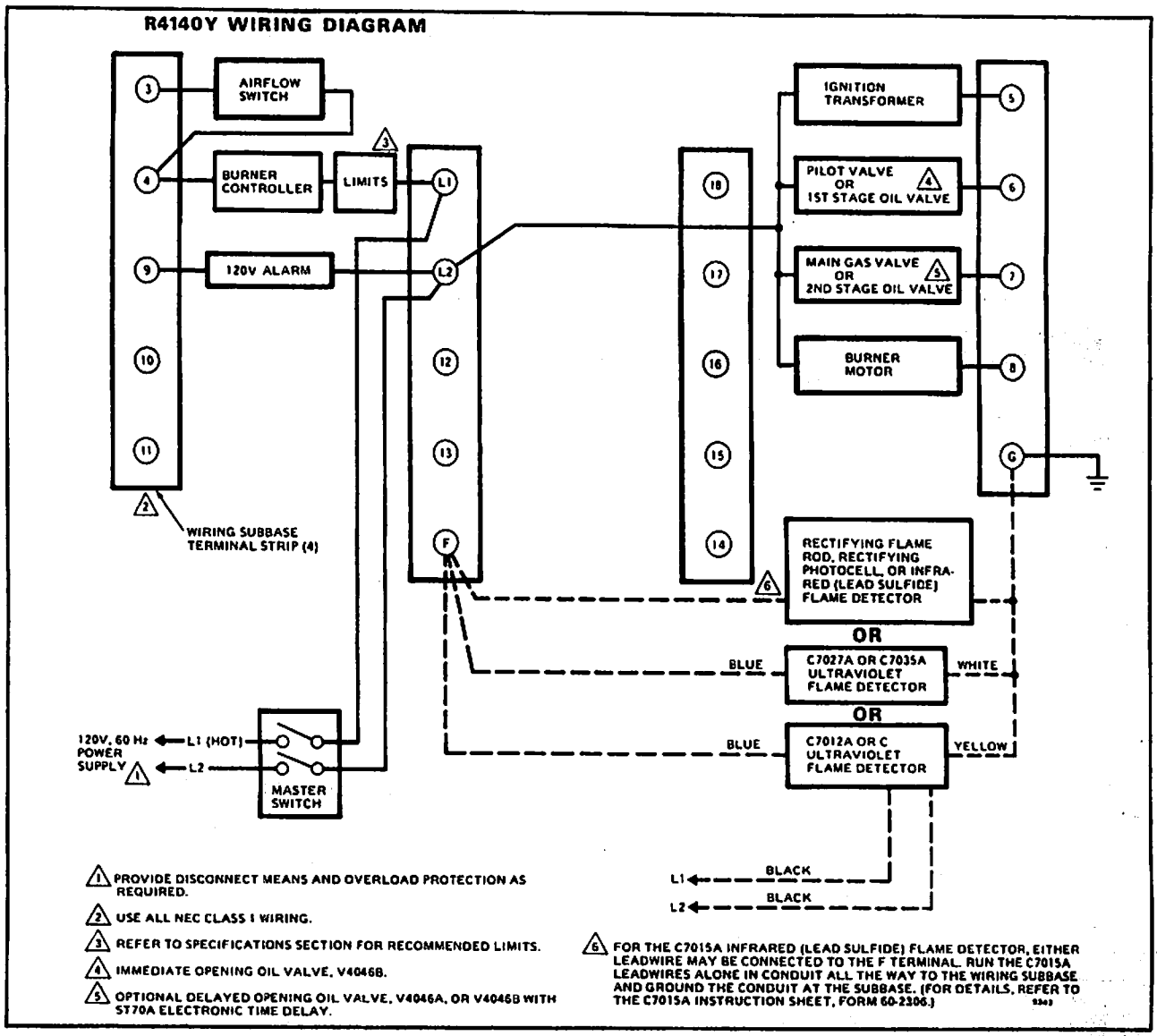


FIG. 7—SAMPLE BLOCK DIAGRAM OF FIELD WIRING FOR THE R4140Y PROGRAMMERS.

STATIC CHECKOUT (Table VII)

CAUTION

1. Use utmost care while performing these tests; line voltage is present on most subbase terminals when power is on.
2. Open the master switch before installing or removing a test jumper.
3. Be sure to remove the test jumper after completing each test before continuing to the next test.
4. Replace all external devices not operating properly. Do not bypass external devices.
5. Close all manual fuel shutoff valves before starting these tests.

After checking all wiring circuits, perform this checkout *before* installing the programmer on the subbase. These tests ensure that the Q520A Wiring Subbase is wired correctly, and that the external controllers, limits, interlocks, actuators, valves, transformers, motors, and other devices are operating properly.

EQUIPMENT REQUIRED

1. Voltmeter (W136A or equivalent)–set on 0 to 300 Vac scale.
2. Jumper wire–No. 14 wire, insulated, 12 in. [304.8 mm] long, with alligator clips at both ends.

GENERAL INSTRUCTIONS

1. Perform all tests in Table VII below, in the order listed.
2. Make sure all manual fuel shutoff valves are closed.
3. Raise the set point of the burner controller to simulate a call for heat.
4. For each test, open the master switch and install the jumper wire between the subbase wiring terminals listed under TEST JUMPER.
5. Close the master switch before observing operation.
6. Read the voltage between the subbase wiring terminals listed under VOLTMETER.
7. If there is no voltage or operation is abnormal, check the circuits and external devices as described in the last column.
8. Check all wiring in the circuits for correct connections, tight terminal screws, correct wire, and proper wiring techniques. Replace all worn or incorrectly sized wires.
9. Replace faulty controllers, limits, interlocks, actuators, valves, transformers, motors, and other devices, as required.
10. Normal operation must be obtained for each required test before continuing the checkout.
11. Be sure to remove the test jumper after completing each test before continuing to the next test.

TABLE VII–STATIC TESTS OF EXTERNAL DEVICES

TEST NO.	TEST JUMPER	VOLT-METER	NORMAL OPERATION	IF OPERATION IS ABNORMAL, CHECK THE ITEMS LISTED BELOW
	CAUTION Make sure all manual fuel shutoff valves are closed.			
1	None	L1-L2	Line voltage at terminal L1.	1. Master switch is closed. 2. Power is connected to the master switch. 3. Overload protection (fuse, circuit breaker, etc.) has not opened the power line.
2	None	4-L2	Line voltage at terminal 4.	**IMPORTANT** Low fuel pressure limits, if used, *could be open.* Bypass them with jumpers for the rest of the Static Tests (if required). 1. Limits are closed. If open, determine cause(s) and correct the condition(s). 2. Burner controller contacts are closed (call for heat).
3	L1-8	3-L2	1. Burner motor (fan or blower) starts. 2. Line voltage at terminal 3 within 12 seconds.	1. Burner motor circuit: a. Manual switch of burner motor is closed. b. Burner motor power supply, overload protection, and starter are okay. c. Burner motor is okay. 2. Airflow switch is closed.
	WARNING Make sure all manual fuel shutoff valves are closed.			

(Table VII, continued)

TEST NO.	TEST JUMPER	VOLT-METER	NORMAL OPERATION	IF OPERATION IS ABNORMAL, CHECK THE ITEMS LISTED BELOW
4	L1-5	–	Ignition spark.	1. Watch for spark or listen for buzz. a. Ignition electrodes are clean. b. Ignition transformer is okay.
5	L1-6	–	Automatic pilot valve or 1st stage oil valve opens.	1. Listen for click or feel head of valve for activation. a. Actuator (if used) is okay. b. Valve is okay.
	WARNING Make sure all manual fuel shutoff valves are closed.			
6	L1-7	–	Automatic main gas valve or 2nd stage oil valve opens.	1. Listen for and observe operation of the main fuel valve and actuator. 2. Valve and actuator are okay.
7	L1-9	–	Alarm (if used) turns on.	1. Alarm is okay.
	CAUTION Upon completing these tests, open the master switch and remove all *test jumpers* from the subbase terminals. Also remove bypass jumpers from the low fuel pressure limits (if used).			

INSTALLING THE PROGRAMMER (Fig. 8)

1. Open the master switch.
2. Make sure no subbase wiring is projecting out beyond the terminal blocks. Tuck wiring in against the back of the subbase so it does not interfere with the contacts.
3. Grasp the handle of the programmer chassis and 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 in until the contacts are fully engaged.
5. Tighten the chassis retaining screw securely.

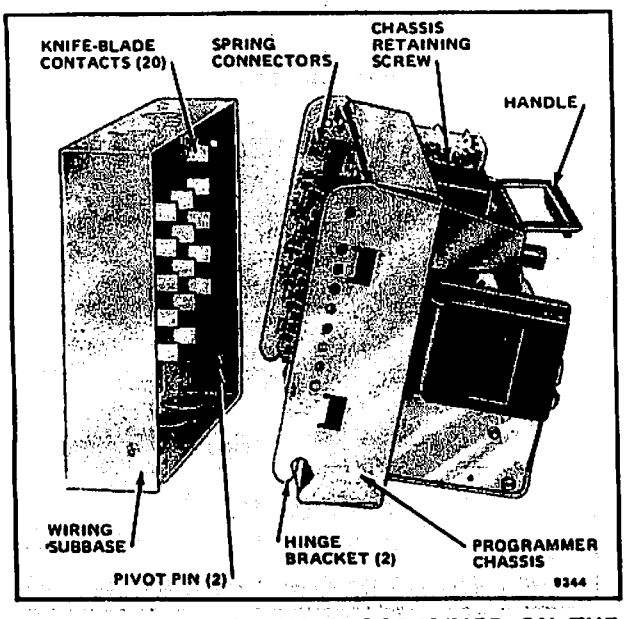


FIG. 8–MOUNTING THE PROGRAMMER ON THE SUBBASE.

REMOVING THE PROGRAMMER

1. Open the master switch.
2. Loosen the chassis retaining screw.
3. Pull outward on the handle.
4. Disengage the chassis hinge brackets from the subbase pivot pins.

REMOVING AND REPLACING THE RELAY/TIMER COVER (FIG. 9)

CAUTION

If the programmer is mounted on the subbase, open the master switch before removing or replacing the relay/timer cover.

The relay/timer cover must be removed to install a plug-in flame signal amplifier, to observe relay and timer operation, or to inspect contacts.

REMOVING THE COVER

1. Grasp the relay/timer cover and squeeze until the V-notch on the cover slides free of the stud on the handle.
2. Rotate the cover down and out to disengage the 2 tabs from the slot in the bottom of the programmer chassis.
3. Pull the cover out.

REPLACING THE COVER

1. Insert the 2 tabs on the bottom of the cover between the timer and the programmer chassis and engage them with the slot in the bottom of the chassis. Make sure the tabs are not jammed in the slot.
2. Rotate the cover up and in so the V-notch slides along the stud on the handle. If the cover does not rotate easily, the tabs are jammed.

(continued on next page)

3. Make sure the spring clip on the cover fits over the plug-in amplifier.

4. Push in on the cover until the V-notch snaps into place on the stud.

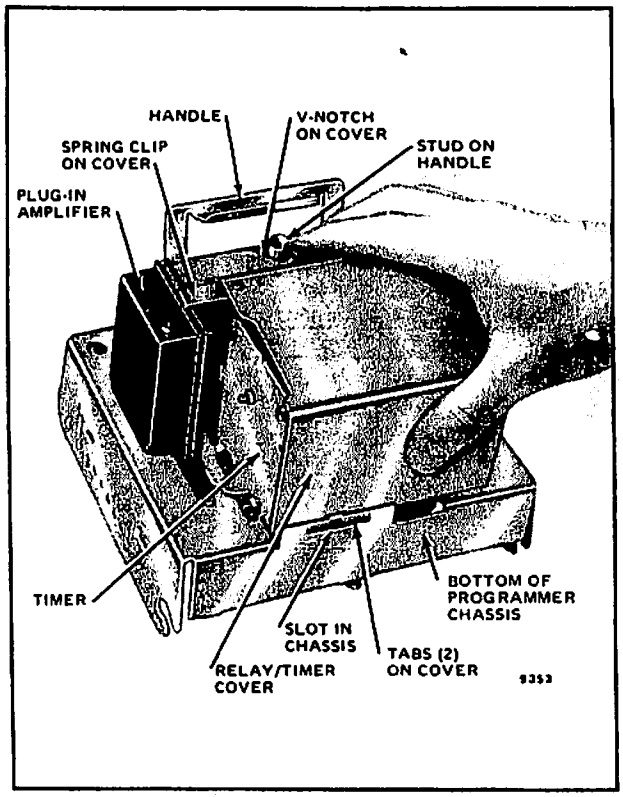


FIG. 9—REMOVING AND REPLACING THE RELAY/TIMER COVER.

INSTALLING A PLUG-IN FLAME SIGNAL AMPLIFIER (Fig. 10)

1. Remove the relay/timer cover.

2. Make sure the amplifier nameplate is on the outside. Then align the circuit board with the keyed receptacle on the programmer.

NOTE: If you are installing a small amplifier, align its ends with the 2 scribe marks alongside the receptacle on the programmer.

3. Push in the amplifier until the circuit board is fully inserted into the receptacle.

4. Make sure the amplifier is firmly in place; then replace the relay/timer cover. Make sure the spring clip on the cover fits over the amplifier.

NOTE: For further information about self-checking amplifiers, refer to the R7247B instruction sheet, form 60-2358, or to the R7248B instruction sheet, form 60-2357, packed with the amplifier.

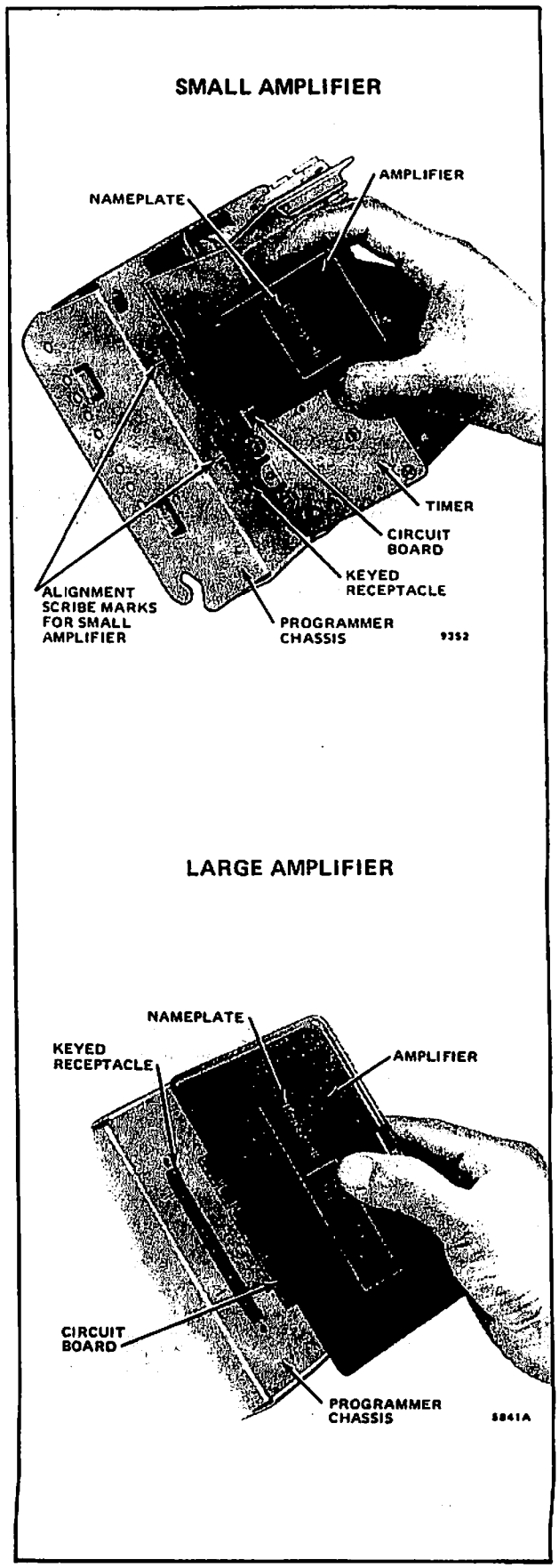


FIG. 10—INSTALLING A PLUG-IN FLAME SIGNAL AMPLIFIER.

CHECKOUT

WARNING

Do not allow fuel to accumulate in the combustion chamber. If fuel is allowed to enter the chamber for longer than a few seconds without igniting, an explosive mixture could result. Do not exceed the normal lightoff time specified by the burner manufacturer; close the manual fuel shutoff valves if the flame is not burning at the end of the specified time.

CAUTION

1. Use utmost care while testing the programmer; line voltage is present on most contacts when power is on.
2. Open the master switch before removing the programmer from the subbase, before reinstalling the programmer, before installing or removing any jumpers, and before making any adjustments.
3. Make sure all manual fuel shutoff valves are closed before starting the initial lightoff.
4. If low fuel pressure limits are bypassed for any of the tests, make sure you remove the jumpers from these limits before putting the system into service.
5. Do not put the system into service until you have satisfactorily completed all applicable tests described in this CHECKOUT section and any others required by the burner manufacturer.

IMPORTANT

a. If the system fails to perform properly, note the point at which trouble occurs and refer to the TROUBLESHOOTING section.
b. Before you reset the lockout switch, wait at least 1 minute to allow the heater to cool.
c. Repeat ALL required Checkout tests after all adjustments have been made. ALL tests must be satisfied with the flame detector(s) in its FINAL position.

EQUIPMENT REQUIRED

1. Voltmeter (Honeywell W136A or equivalent)–with 0 to 300 Vac scale.
2. Microammeter (Honeywell W136A or equivalent)–with 0 to 25 microamp range and SPL scale with damping.
3. Meter connector plug–Part No. 117053 or equivalent.
4. Jumper wires (2)–No. 14 wire, insulated, 12 in. [304.8 mm] long, with alligator clips at both ends.
5. Watch or clock–with second hand.
6. Manometer (or pressure gauge)–to measure pilot gas pressure.
7. Thermometer or thermocouple–to measure temperature at the flame detector(s).
8. Orifice plates (aperture discs) or filters–as necessary to adjust sensitivity of flame detector(s).

CHECKOUT SUMMARY

The following list summarizes the checkout tests required for each type of installation. Instructions for each test are included in this section; also consult the burner installation instructions.

- Preliminary Inspection–all installations.
- Flame Signal Measurement–all installations.
- Initial Lightoff Check for Direct Spark Ignition of Oil–oil burners not using a pilot.
- Ignition Interference Test–all installations using flame rods.
- Hot Refractory Hold-in Test–all installations using rectifying photocells or infrared (lead sulfide) flame detectors.
- Safety Shutdown Tests–all installations.

Refer to Fig. 7 for terminal locations, and to Fig. 11 for locations of component parts.

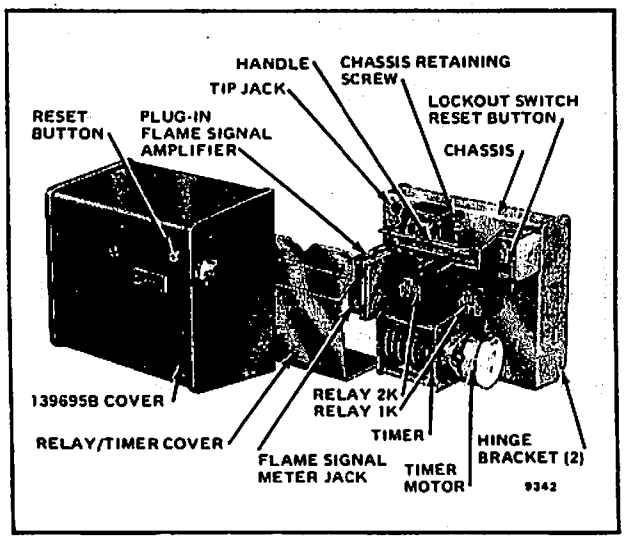


FIG. 11–COMPONENTS OF THE R4140Y PROGRAMMER.

PRELIMINARY INSPECTION (ALL INSTALLATIONS)

Perform this inspection to avoid common problems. Make certain that:

1. Wiring connections are correct and all terminal screws are tight.
2. Flame detector(s) is clean, and it is installed and positioned properly. Consult the appropriate instruction sheet.
3. Correct combination of amplifier and flame detector(s) is used. Refer to Table IV in the SPECIFICATIONS section.

(continued on next page)

4. Voltage rating of the flame detector(s) matches the power supply of the R4140.

5. Spring clip on relay/timer cover is holding the plug-in flame signal amplifier securely in the receptacle.

6. Burner is completely installed and ready to fire (consult burner manufacturer's instructions); fuel lines are purged of air.

7. Combustion chamber and flues are clear of fuel and fuel vapor.

8. Power is connected to the system disconnect switch (master switch).

9. Lockout switch is reset (push in lockout switch reset button, Fig. 11).

10. All limits and interlocks are reset.

FLAME SIGNAL MEASUREMENT (Fig. 12) (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.

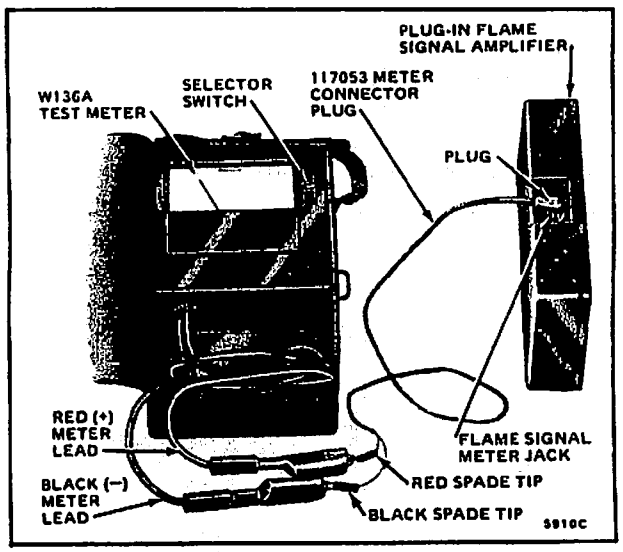


FIG. 12–MEASURING THE FLAME SIGNAL.

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

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

   OR

   SPL–for an R7247B Dynamic Self Check Rectification 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 117053 Meter Connector Plug. (It may be ordered separately.) Connect its RED spade tip to the RED (+) meter lead and its BLACK spade tip to the BLACK (–) meter lead.

4. Insert the 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 Dynamic Self Check Rectification 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.
   –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 VIII after all tests have been completed and all adjustments have been made.

TABLE VIII–FLAME SIGNAL

FLAME DETECTOR	FLAME SIGNAL AMPLIFIER	MINIMUM ACCEPTABLE STEADY CURRENT[a] (microamperes)	MAXIMUM CURRENT EXPECTED (microamperes)
Rectifying Flame Rod	R7247A (Green)	2	5
	R7247B (Green; Self Check)[c]	1-1/4	2-1/2
Rectifying Photocell	R7247A (Green)	2	5[b]
	R7247B (Green; Self Check)[c]	1-1/4	2-1/2
C7012A,C Ultraviolet (Purple Peeper)	R7247A (Green)	2	6
	R7247B (Green; Self Check)[c]	2	4
C7015A Infrared (lead sulfide cell)	R7248A (Red)	2-1/4[d]	5
	R7248B (Red; Ampli-Check)[c]	3-1/2[d]	5
C7027A or C7035A Ultraviolet (Minipeeper)	R7249A (Purple)	3-1/2	7-1/2

[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 microamperes 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 many times a minute during burner operation and shuts down the burner if the amplifier fails.

[d]The lead sulfide cells are available in 4 ranges of sensitivity: 104662A (red), lowest; 104662B (yellow), medium; 104662C (green), high; 104662D (white), 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.

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.
2. Check the detector wiring for defects, including–
   –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 sighting pipe (as applicable).
5. For a C7012A or C Purple Peeper Ultraviolet Flame Detector, replace the 113236 and 115330 Electron Tubes (unless the detector is a solid state model).
6. Check that the temperature at the detector does not exceed its maximum rated temperature.
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.

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.

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

1. Complete the normal "ready-to-fire" checkout of the oil supply and equipment as recommended by the burner manufacturer.
2. Close all manual fuel shutoff valves. Check that the automatic fuel valves are closed. *Make sure oil is not entering the combustion chamber.*
3. Close the master switch and start the system with a call for heat (raise the set point of the burner controller). The burner motor (blower) should run, the programmer timer should start, and prepurge should begin.
4. When prepurge is over, watch for ignition spark and listen for the click of the 1st stage oil solenoid. (If spark does not occur or the 1st stage oil valve does not open, refer to steps 3 through 6 for Symptom E in Table IX in the TROUBLESHOOTING section.)
5. Let the programmer complete its revolution and stop.

(continued on next page)

6. Open the manual 1st stage shutoff valve.

7. Reset the lockout switch and recycle the programmer.

8. When prepurge is over, watch for the 1st stage burner flame to be established. If it is, proceed to step 14.

9. If the 1st stage burner flame is not established within the normal lightoff time specified by the burner manufacturer, *close the manual 1st stage shutoff valve and open the master switch.*

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

11. Wait about 3 minutes. Close the master switch, open the manual 1st stage shutoff valve, and try lightoff again. The first attempt may have been required to purge the lines and bring sufficient oil to the burner.

12. If the 1st stage burner flame is not established within the normal lightoff time specified by the burner manufacturer, *close the manual 1st stage shutoff valve and open the master switch.*

13. If necessary, repeat steps 10 through 12 to establish the 1st stage burner flame. Then proceed to step 14.

14. When the 1st stage burner flame is established, 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.*

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

16. *If a 2nd stage is used,* check the lightoff as follows. Otherwise proceed to step 17.

   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 17.

17. Restart the system by raising the set point of the burner controller. Observe that the burner flame(s) is established within the normal lightoff time specified by the burner manufacturer.

18. Measure the flame signal. Continue to check for the proper signal (Table VIII) into the run period after the timer stops. Any pulsating or unsteady readings will require further adjustments.

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

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 (relay 2K will not pull in and the programmer will act as though the pilot or 1st stage oil burner has not been ignited). If it increases the flame signal, it could cause relay 2K to pull in 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 1st stage oil burner) on, and then with the pilot (or 1st stage oil 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 HOLD-IN TEST (rectifying photocells or infrared detectors)

Test to make certain that hot refractory will not cause flame relay 2K to stay pulled-in 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 programmer stops for 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 relay 2K to drop out after the flame goes out. (Watch or listen to the flame relay to determine when it drops out.) If the flame relay fails to drop out within 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 relay 2K to drop out. (Watch or listen to the flame relay to determine when it drops out.) If the flame relay fails to drop out within 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 flame only.

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 relay 2K to drop out. (Watch or listen to the flame relay to determine when it drops out.) If the flame relay fails to drop out within 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 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.

IMPORTANT

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

SAFETY SHUTDOWN TESTS (all installations)

Perform these tests at the end of Checkout after all other tests have been completed.

Safety shutdown should occur upon (1) failure to ignite the pilot or 1st stage oil burner, and (2) loss of flame during the run period.

On safety shutdown, the lockout switch should trip (pop out) and lock out the programmer. The ignition, burner motor, and fuel valve terminals should be de-energized. If used, the external alarm should turn on. The lockout switch must be manually reset to restart the system. The timer should complete its revolution and start a new cycle.

1. *Failure to Ignite Pilot or 1st Stage Oil Burner*
   a. Close *all* manual fuel shutoff valves; this includes the manual pilot shutoff valve (or manual 1st stage oil valve) and the manual main gas shutoff valve (or manual 2nd stage oil valve).
   b. Make sure all interlocks are closed, and reset the lockout switch, if tripped.
   c. Close the master switch.
   d. Start the system with a call for heat (raise the set point of the burner controller).
   e. Ignition spark should occur, and the automatic pilot valve (or 1st stage oil valve) should be energized, but the pilot (or 1st stage oil burner) cannot ignite. No flame is detected so relay 2K cannot pull in.
   f. Safety shutdown should occur about half a minute after ignition spark occurs.
2. *Loss of Flame During the Run Period*
   a. Open *all* manual fuel shutoff valves; this includes the manual pilot shutoff valve (or manual 1st stage oil valve) and the manual main gas shutoff valve (or manual 2nd stage oil valve).
   b. Reset the lockout switch.
   c. Start the system. Startup should be normal; the pilot (or 1st stage oil burner) and the main gas burner (or 2nd stage oil burner) should light normally.
   d. After the timer stops for the run period with the burners firing, close all manual fuel shutoff valves to extinguish the burner flames.
   e. Relay 2K should drop out within 4 seconds after the burner flames go out.
   f. Safety shutdown should occur about half a minute after 2K drops out.

IMPORTANT

1. If the lockout switch fails to trip and shut down the system on any of these tests, replace the programmer and rerun all Checkout tests from the beginning.
2. When all Checkout tests have been completed, reset all controller set points to the desired values.

CAUTION

If low fuel pressure limits have been bypassed for any of the tests in this Checkout section, make sure you remove the jumpers from these limits before putting the system into service.

TROUBLESHOOTING

CAUTION

1. Close *all* manual fuel shutoff valves as soon as trouble occurs.
2. Use utmost care while troubleshooting the programmer; line voltage is present on most contacts when power is on.
3. Open the master switch before removing or replacing the relay/timer cover, before removing the programmer from the subbase, before reinstalling the programmer, before installing or removing any test jumpers, before making any adjustments, and before replacing any devices.
4. Replace all external devices not operating properly. Do not bypass external devices.
5. Make sure you remove all test jumpers from the subbase when troubleshooting is completed.
6. Replace the relay/timer cover upon completion of troubleshooting.

EQUIPMENT REQUIRED

1. Voltmeter (Honeywell W136A or equivalent)–with 0 to 300 Vac scale.

2. Microammeter (Honeywell W136A or equivalent)–with 0 to 25 microamp range and SPL scale with damping.

3. Meter connector plug–Part No. 117053 or equivalent.

4. 123514A Flame Simulator–for use with R7247A Rectification Flame Signal Amplifiers (green).

5. 123514B Flame Simulator–for use with R7249A Ultraviolet Flame Signal Amplifiers (purple).

6. Jumper wires (2)–No. 14 wire, insulated, 12 in. [304.8 mm] long, with alligator clips at both ends.

7. Shorting wire–10 in. [254.0 mm] long, insulated, with 3/4 in. [19.1 mm] of insulation removed from each end; for simulating flame with an R7248A Infrared Flame Signal Amplifier (red).

8. Watch or clock–with second hand.

9. Manometer (or pressure gauge)–to measure pilot gas pressure.

10. Thermometer or thermocouple–to measure temperature at the flame detector.

11. Orifice plates (aperture discs) or filters–as necessary to adjust sensitivity of flame detector(s).

PRELIMINARY CHECK (Fig. 13)

Open the master switch before performing this check. Eliminate the possibility of trouble being caused by poor contact of the spring connectors on the back of the programmer. Ensure that they are properly aligned and have the proper tension. They should be tight enough so that it is necessary to force a dime between the contacts. If a dime slips through, press the connector together gently with your finger tips–do not use pliers.

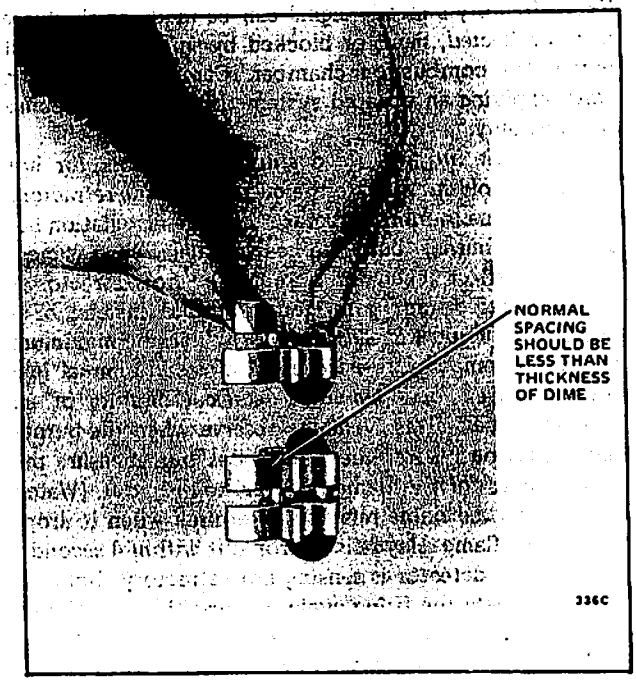


FIG. 13–ADJUSTING THE SPRING CONNECTORS.

TROUBLESHOOTING PROCEDURES

Refer to the Step-By-Step Operation for the appropriate R4140Y model in the OPERATION section of this instruction sheet. Observe the operation carefully to determine at what point the trouble occurs. Then refer to Table IX and follow the procedure outlined.

Refer to Figs. 17 and 18 for location of relay and timer contacts. Access to the contacts may be gained by removing the relay/timer cover (Fig. 9).

IMPORTANT

a. Blackened M2B, M4A, or M7B timer contacts are due to normal deposits of impurities caused by breaking an inductive load (ignition transformer). Tests on returned programmers have shown that the deposits are not heavy enough to cause ignition failure. Determine *exactly* at what point in the operating sequence the trouble occurs and follow the applicable troubleshooting procedure carefully.

b. If, after completing an applicable troubleshooting procedure, proper operation still cannot be obtained, replace the programmer (except the amplifier, unless noted).

c. At the completion of troubleshooting, be sure to perform *all* applicable tests in the CHECK-OUT section of this instruction sheet.

TABLE IX–TROUBLESHOOTING CHART

SYMPTOM	TEST	POSSIBLE CAUSE/CORRECTION
A. ON A CALL FOR HEAT, PROGRAMMER WON'T START. (RELAY 1K DOES NOT PULL IN.)	1. Check lockout switch. 2. Check relay 2K. 3. Open master switch, remove programmer from subbase, close master switch, and check for line voltage between the following terminals on the subbase: a. L1 to L2. b. 4 to L2. 4. Open master switch, reinstall programmer on subbase, and close master switch.	1. If lockout switch is popped out, reset it. 2. If relay 2K is holding in, perform the Flame Relay (2K) Hold-In Check immediately following this table. 3. If there is no voltage, check that: a. Line voltage power is connected to master switch, master switch is closed, and overload protection (fuse, circuit breaker, or similar device) has not opened power line. b. Limits and burner controller contacts are closed. If a limit is open, determine cause(s) and correct condition(s) before proceeding. 4. If relay 1K still does not pull in, replace programmer.
B. RELAY 1K PULLS IN, BUT BURNER MOTOR DOES NOT START.	1. Check manual switch for burner motor. 2. Check external burner motor circuits. 3. Check motor power supply, motor overload protection, and motor starter. 4. Check burner motor.	1. Make sure switch is closed. 2. Make sure circuits are wired correctly; replace deteriorated leadwires. 3. Replace devices if they are not operating properly. 4. Replace burner motor if it is not operating properly.
C. BURNER MOTOR STARTS, BUT TIMER DOES NOT START.	1. Check that airflow switch contacts are closed.	1. Replace airflow switch if it is not operating properly.
D. TIMER STARTS, BUT SYSTEM SHUTS DOWN (ANYTIME DURING PREPURGE, IGNITION TRIALS, OR THE RUN PERIOD) AND PROGRAMMER RECYCLES TO STANDBY POSITION (ZERO SECONDS).	1. Check that all limits are closed. 2. Check that the airflow switch contacts are closed.	1. If a limit is open, determine cause(s) and correct condition(s). 2. Make sure that there is airflow. If not: a. Check burner motor; replace if necessary. b. Check airflow switch; replace if necessary.
E. PILOT OR 1ST STAGE OIL BURNER DOES NOT IGNITE. (SAFETY SHUTDOWN OCCURS.)	1. *Close all manual main fuel shutoff valves immediately*, and let programmer complete its revolution. 2. Reset lockout switch and let programmer run through another cycle. 3. If pilot or 1st stage oil burner still does not ignite, close *all* manual fuel shutoff valves, open master switch, and remove programmer from subbase. 4. Check operation of ignition transformer: Jumper terminals L1-5 on subbase and close master switch. Watch for spark or listen for buzz. 5. Check operation of pilot valve or 1st stage oil valve: Open master switch, jumper terminals L1-6 on subbase, and close master switch. Listen for click or feel head of valve for activation. 6. Open master switch, remove test jumpers from subbase, and reinstall programmer on subbase. 7. Open manual pilot shutoff valve or manual 1st stage oil valve, reset lockout switch, close master switch, and recycle programmer.	1. Make sure that: a. Manual pilot shutoff valve or manual 1st stage oil valve is open. b. Fuel is available. c. Fuel lines are not plugged. 2. If pilot or 1st stage oil flame is established, operation is okay; discontinue tests and open manual main fuel shutoff valves. 3. Make sure that: a. Ignition electrodes are clean. b. External circuits are wired correctly; replace deteriorated leadwires. 4. If ignition spark is not strong and continuous, open master switch and adjust ignition electrode spark gap setting to manufacturer's recommendation. If a strong, continuous spark still cannot be obtained, replace ignition transformer. 5. If valve or actuator is not operating properly, replace it. 6. No action. 7. If pilot or 1st stage oil flame is still not established, replace programmer.

(continued on next page)

(TABLE IX, continued)

SYMPTOM	TEST	POSSIBLE CAUSE/CORRECTION
F. PILOT OR 1ST STAGE OIL BURNER IGNITES, BUT RELAY 2K DOES NOT PULL IN. (SAFETY SHUTDOWN OCCURS.)	1. *Close all manual fuel shutoff valves immediately*, and let programmer complete its revolution. 2. Perform the Flame Signal Check following this table on the next page.	1. No action. 2. Follow instructions in Flame Signal Check.
G. PILOT OR 1ST STAGE OIL BURNER IGNITES AND RELAY 2K PULLS IN, BUT MAIN GAS BURNER OR 2ND STAGE OIL BURNER DOES NOT LIGHT.	1. Shut down system (lower burner controller set point) and check manual main gas shutoff valve or manual 2nd stage oil valve. 2. Raise set point and let programmer run through another cycle. 3. If main gas burner or 2nd stage oil burner still does not light, close *all* manual fuel shutoff valves, open master switch, and remove programmer from subbase. 4. Check operation of main gas valve or 2nd stage oil valve: Open master switch, jumper terminals L1-7 on subbase, and close master switch. Listen for and observe operation of the valve and actuator. 5. Open master switch, remove test jumper from subbase, and reinstall programmer on subbase. 6. Open all manual fuel shutoff valves, close master switch, and recycle programmer.	1. Make sure that: a. Manual valve is open. b. Fuel is available. c. Fuel lines are not plugged. d. Air and fuel supplies are adjusted for the correct air-fuel ratio. 2. If main gas flame or 2nd stage oil flame is established, operation is okay; discontinue tests. 3. Make sure that external circuits are wired correctly; replace deteriorated leadwires. 4. If valve or actuator is not operating properly, replace it. 5. No action. 6. If main gas flame or 2nd stage oil flame is still not established, replace programmer.
H. SHUTDOWN OCCURS DURING RUN PERIOD.	1. *Close all manual fuel shutoff valves immediately*, let programmer complete its revolution, open master switch, and check the lockout switch on the programmer. 2. If the lockout switch has *not* tripped (if the reset button has *not* popped out): a. Check that all limits are closed. b. Check that the airflow switch contacts are closed. 3. If the lockout switch *has* tripped (if the reset button *has* popped out): a. Check the flame detection system. b. If flame detection system is okay, check fuel lines and automatic fuel valves.	1. No action. 2. Follow steps a and b. a. If a limit is open, determine cause(s) and correct condition(s). b. Make sure that there is airflow. If not— —check burner motor; replace if necessary. —check airflow switch; replace if necessary. 3. Follow steps a and b. a. Perform the Flame Signal Check following this table on the next page. b. Clean fuel lines; replace valves and actuators if defective. (Refer to applicable procedures for Symptoms E and G.)
J. TIMER DOES NOT COMPLETE ITS REVOLUTION AFTER OPERATING SET POINT HAS BEEN REACHED.	1. Check that the burner controller contacts are open.	1. If burner controller is not operating properly, replace it.
K. BURNER MOTOR KEEPS RUNNING AT END OF CYCLE.	1. Check burner motor starter. 2. Check external burner motor circuits.	1. If starter is mechanically stuck, repair it or replace it. 2. Make sure circuits are wired correctly; replace deteriorated leadwires.
L. RELAY 2K STAYS IN AT END OF CYCLE. (PROGRAMMER CANNOT START NEW CYCLE.)	1. Perform the Flame Relay (2K) Hold-In Check immediately following this table.	1. Follow instructions in the Flame Relay (2K) Hold-In Check.
M. EXTERNAL ALARM (IF USED) DOES NOT GO ON WHEN SAFETY SHUTDOWN OCCURS.	1. Check external alarm circuits. 2. Check the alarm.	1. Make sure circuits are wired correctly; replace deteriorated leadwires. 2. If alarm is not operating properly, replace it.

FLAME RELAY (2K) HOLD-IN CHECK

1. Check that the pilot and main gas burner flames (or 1st and 2nd stage oil flames) are out. If a flame is still burning, check the external wiring and operation of the automatic valves and actuators. Replace them if they are defective.

2. If the flame detector is a rectifying photocell or infrared (lead sulfide) detector, perform the Hot Refractory Hold-in Test in the CHECKOUT section.

3. If the plug-in flame signal amplifier is an R7247B Dynamic Self Check Amplifier (green) or an R7248A or B Infrared Amplifier (red), open the master switch and install a new amplifier.

4. If the plug-in flame signal amplifier is an R7247A Rectification Amplifier (green) or an R7249A Ultraviolet Amplifier (purple), momentarily short the tip jack to the programmer chassis (Fig. 14). If this does not cause relay 2K to drop out, open the master switch and install a new amplifier.

5. Check the external wiring and operation of the flame detector (see step 9 of the Flame Signal Check which follows). Replace if faulty.

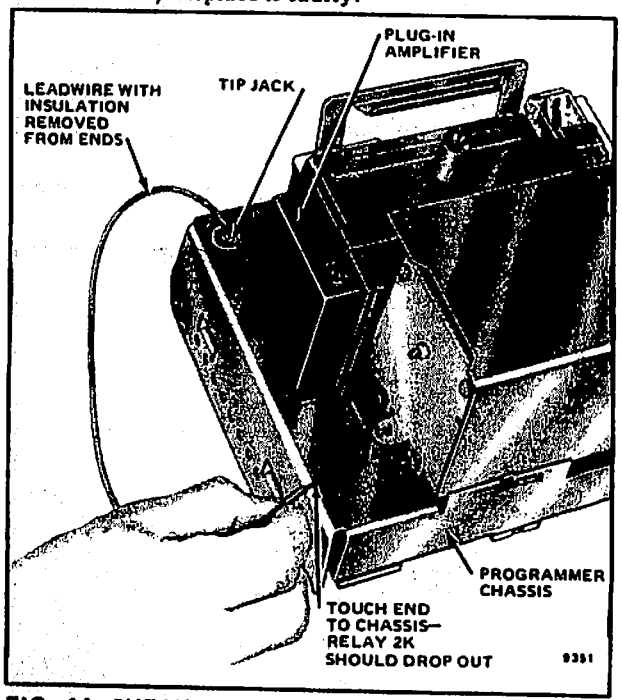


FIG. 14—CHECKING THE PLUG-IN FLAME SIGNAL AMPLIFIER FOR 2K HOLD-IN (R7247A or R7249A only).

FLAME SIGNAL CHECK

IMPORTANT

If the flame relay 2K does not pull in when the pilot (or 1st stage oil burner) ignites, or if safety shutdown occurs during the run period, perform this check. The flame detector, plug-in flame signal amplifier, and flame relay 2K form a flame detection system which can be disabled by failure of any of the components.

1. Open the master switch and plug a microammeter into the meter jack on the plug-in amplifier (Fig. 12).

2. *Make sure the manual main gas shutoff valve (or manual 2nd stage oil valve) is closed.* Open the manual pilot shutoff valve (or manual 1st stage oil valve).

3. Reset the lockout switch and close the master switch to start the programmer.

4. When the pilot (or 1st stage oil burner) ignites, measure the flame signal as described in Flame Signal Measurement in the CHECKOUT section. If the signal is unstable or weak, check the flame detector installation and circuitry as instructed.

5. Recycle the programmer and measure the flame signal again to obtain a good reading. If the flame signal is unstable or less than the minimum acceptable value listed in Table VIII, proceed to step 7. Otherwise, continue with step 6.

6. If the flame signal is stable and above the minimum acceptable value listed in Table VIII, either the amplifier or the programmer is faulty.

   a. Let the programmer complete its revolution and open the master switch.
   b. Replace the plug-in amplifier with a new one of the same part number.
   c. Reset the lockout switch, close the master switch, recycle the programmer, and measure the flame signal again.
   d. If the flame signal is okay but relay 2K still does not pull in, replace the programmer. (Keep the plug-in amplifiers.)

7. The procedure in this step depends on the model of the plug-in flame signal amplifier used.

   a. All self-checking models:
      R7247B Dynamic Self Check Rectification Amplifier (green)—used with rectifying flame rods, rectifying photocells, or C7012A or C Purple Peeper Ultraviolet Flame Detectors.
      R7248B Dynamic Ampli-Check Infrared Amplifier (red)—used with C7015A Infrared (lead sulfide) Flame Detectors.
      (1) Let the programmer complete its revolution and open the master switch.
      (2) Replace the plug-in amplifier with a new one of the same part number.
      (3) Wait a minute and reset the lockout switch.
      (4) Close the master switch to start the programmer.
      (5) When the pilot (or 1st stage oil burner) is ignited, relay 2K should pull in.
      (6) If relay 2K pulls in, operation is normal. Omit steps 8 and 9 and perform all applicable tests in the CHECKOUT section.
      (7) If relay 2K does not pull in, either the flame detector or the programmer is faulty.
      —Install the original amplifier.
      —Check the flame detector and its circuit as described in step 9.
      —If the problem still exists, replace the programmer.
   b. All standard models (R7247A, R7248A, and R7249A).
      (1) Let the programmer complete its revolution.
      (2) Open the master switch and remove the programmer from the subbase.

(continued on next page)

(3) Remove the flame detector leadwire from terminal F on the subbase. *Be sure the leadwire does not touch anything after removal.*
(4) Reinstall the programmer on the subbase.
(5) Turn down the set point so the burner controller contacts will stay open.
(6) Proceed to the following instructions for the appropriate amplifier.

c. R7247A Rectification Amplifier (green)–used with rectifying flame rods, rectifying photocells, or C7012A or C Purple Peeper Ultraviolet Flame Detectors.
(1) Complete step 7.b.
(2) Close the master switch.
(3) Plug the probe of a 123514A Flame Simulator into the tip jack on the front of the programmer chassis (Fig. 15).
(4) Hold the plug (lead end) of the simulator against the programmer chassis. Relay 2K should pull in and stay in while the plug is in contact with the chassis.
(5) If relay 2K pulls in, the trouble is in the flame detector or its circuitry outside the programmer. Proceed to steps 8 and 9.
(6) If relay 2K does not pull in, open the master switch.
(7) Replace the plug-in amplifier with a new one of the same part number.
(8) Close the master switch and repeat (4).
(9) If relay 2K pulls in, restore the programmer to operating condition as instructed in step 8 on the next page.
(10) If relay 2K still does not pull in, replace the programmer.

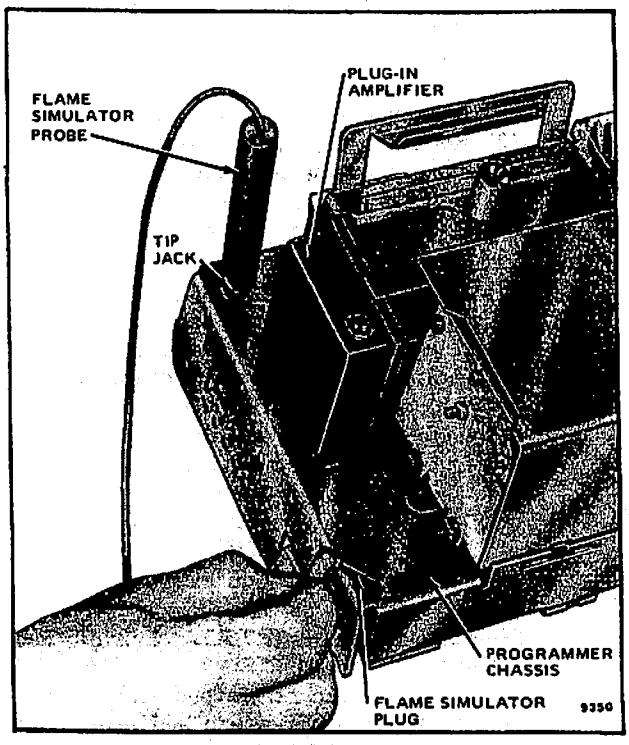


FIG. 15–USING A FLAME SIMULATOR.

d. R7248A Infrared Amplifier (red)–used with C7015A Infrared (lead sulfide) Flame Detectors.
(1) Complete step 7.b.
(2) Remove the plug-in infrared amplifier.
(3) Remove 3/4 in. [19.1 mm] of insulation from each end of a 10 in. [254.0 mm] length of insulated wire. Plug one end of this wire into the tip jack on the front of the programmer chassis (Fig. 16).
(4) Reinstall the plug-in amplifier and close the master switch.
(5) Tap the free end of the wire against the programmer chassis at a rapid frequency (about 2 times a second) to simulate flame. Relay 2K should pull in and stay in while flame is simulated.
(6) If relay 2K pulls in, the trouble is in the flame detector or its circuitry outside the programmer. Proceed to steps 8 and 9.
(7) If relay 2K does not pull in, open the master switch.
(8) Replace the plug-in amplifier with a new one of the same part number.
(9) Close the master switch and repeat (5).
(10) If relay 2K pulls in, restore the programmer to operating condition as instructed in step 8 on the next page.
(11) If relay 2K still does not pull in, replace the programmer.

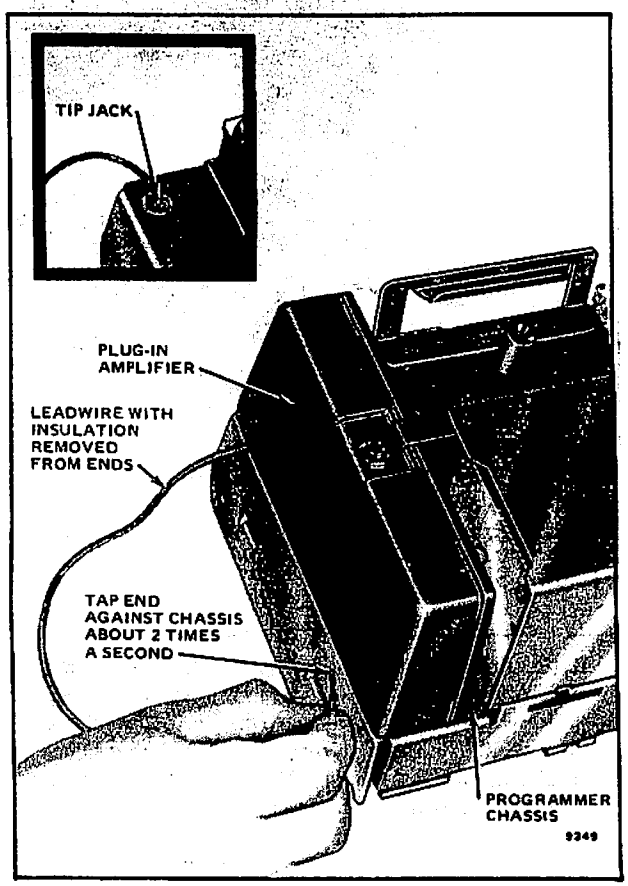


FIG. 16–SIMULATING FLAME FOR AN INFRARED AMPLIFIER.

e. R7249A Ultraviolet Amplifier (purple)–used with C7027A or C7035A Minipeeper Ultraviolet Flame Detectors.
–Follow the same procedure as described in 7.c for an R7247A Rectification Amplifier, except substitute a 123514B Flame Simulator in (3).

8. Restore the programmer to operating condition as follows:
a. Open the master switch and remove the programmer from the subbase.
b. Reconnect the flame detector leadwire to terminal F on the subbase.
c. Reinstall the programmer on the subbase and reset the lockout switch.
d. Reset the burner controller set point to the desired value.

9. Check the flame detector and its circuitry outside the programmer as follows:
a. Check the detector wiring for defects, including–
–wrong type or size of wire.
–deteriorated wire.
–open circuits.
–short circuits.
–leakage paths caused by moisture, soot, or accumulated dirt.
b. 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 the CHECKOUT section).
c. For all other detectors, clean the detector lens, filter, viewing window, and sighting pipe (as applicable).
d. For a C7012A or C Purple Peeper Ultraviolet Flame Detector, replace the 113236 and 115330 Electron Tubes (unless the detector is a solid state model).
e. Check that the temperature at the detector does not exceed its maximum rated temperature.
f. Make sure that the flame adjustment is not too lean.
g. Make sure the detector is sighting the flame properly.
h. If necessary, resight or reposition the detector.
i. If trouble persists, replace the detector. (Open the master switch before replacing the flame detector.)

IMPORTANT

If you make any changes in the flame detection system (including the plug-in amplifier), repeat ALL required tests in the CHECKOUT section of this instruction sheet.

SERVICE INFORMATION

CAUTION

1. Only qualified service technicians should attempt to service or repair flame safeguard controls and burner systems.
2. Open the master switch before removing the relay/timer cover or before cleaning contacts. Line voltage may be present on most contacts when power is on. If cleaning is necessary, be sure to replace the relay/timer cover.

SCHEDULED INSPECTION AND MAINTENANCE

A schedule should be set up and followed for periodic inspection and maintenance, including the burner and all other controls as well as the programmer. Include the following in that schedule.

1. Always keep the burner and fuel mixture adjusted according to the burner manufacturer's recommendations.

2. Clean the flame detector lens, filter, viewing window, and sighting pipe (as applicable).

3. Check the flame signal (Table VIII) using a Honeywell W136A Test Meter, or equivalent (and a 117053 Meter Connector Plug if needed).

4. If using a C7012A or C Purple Peeper Ultraviolet Flame Detector, replace the 113236 and 115330 Electron Tubes annually (unless the detector is a solid state model). These tubes are tested by Honeywell to ensure reliability and safety. DO NOT REPLACE THESE TUBES WITH COMMERCIAL SUBSTITUTES.

CONTACT CLEANING

Field cleaning of relay or timer contacts is *not recommended*. If they must be cleaned, use *only* Honeywell pressurized contact cleaner, Part No. 132569. Honeywell's chemical analysis laboratory has found this cleaner to be acceptable for this task. Directions for using this cleaner are printed on the can.

(continued on next page)

IMPORTANT

1. Do not clean contacts unless absolutely necessary.
2. Use only Honeywell contact cleaner, Part No. 132569. Do not use any other type of contact cleaner.
3. Use utmost care to avoid bending the contacts or changing their specifications or configuration in any way.
4. Do not use an abrasive or a burnishing tool to clean contacts.
5. Do not use hard paper, such as a business card, to clean contacts.

Do not use other types of contact cleaners. Honeywell's chemical analysis laboratory tested other pressurized type contact cleaners but did not approve them for these reasons:

1. The solvents could deteriorate plastic parts and wire insulation.
2. The cleaners leave an oily residue which will collect dust and dirt. The residue will also break down to form various carbonaceous products. Either result will cause early contact failure.

Do not use an abrasive (sand paper stick, file, etc.) or a burnishing tool to clean contacts. Its use can cause early contact failure for these reasons:

1. Some relay and timer contacts are plated with gold for increased reliability. Burnishing can quickly remove the plating.
2. The radii or points of the contacts are designed with specific shapes to best serve the intended functions of the contacts. Burnishing can rapidly alter these contact configurations.
3. Use of an abrasive loosens fine particles of the contact material which adhere to the surface of the contact, thus increasing its resistance.
4. Contact specifications (contact pressures, press-back, and gaps) are carefully controlled during manufacturing to ensure maximum contact life. Burnishing can easily change these specifications.

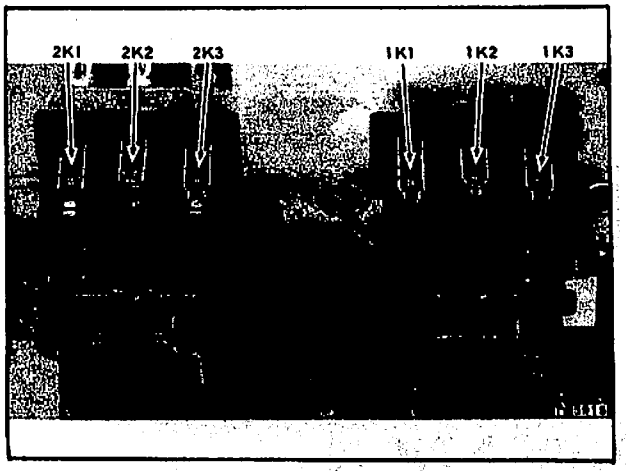


FIG. 17—LOCATION OF RELAY CONTACTS (front view).

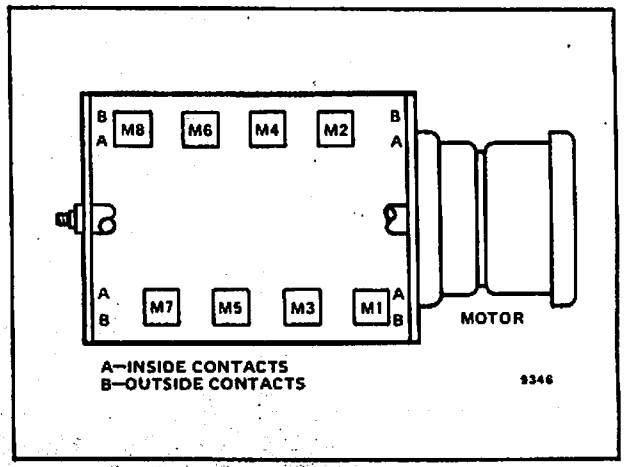


FIG. 18—LOCATION OF TIMER CONTACTS (front view).

TABLE OF CONTENTS

Dear Customer,

We welcome your comments and suggestions for improving this publication. Your assistance is greatly appreciated and will enable us to provide better technical information for you.

Please send your comments and suggestions to:
Honeywell Inc.
Honeywell Plaza
Minneapolis, Minnesota 55408
ATTN: Publications Supervisor MN12-3247

HONEYWELL MINNEAPOLIS, MN 55408 INTERNATIONAL Sales Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.

PRINTED IN U.S.A.