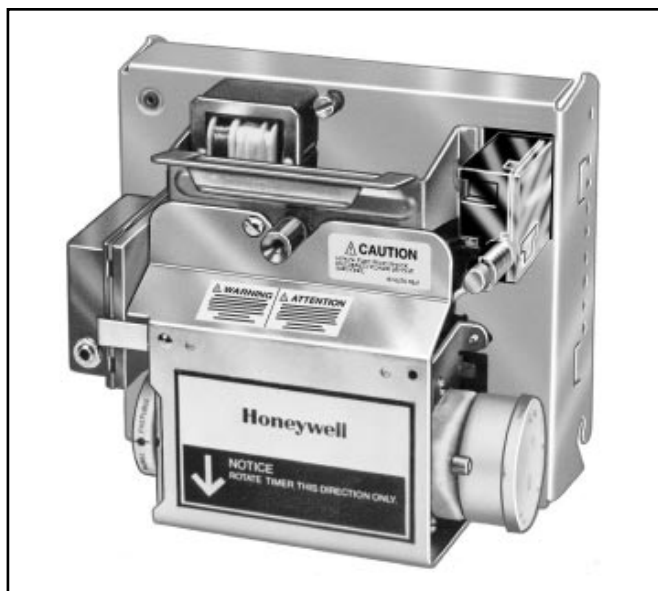


R4140G Flame Safeguard Programming Controls

PRODUCT DATA



APPLICATION

The R4140G Flame Safeguard Programmers provide flameout protection plus automatic sequencing of the burner motor (blower), firing rate motor, ignition, pilot valve, and main fuel valve(s) for commercial and industrial burners using gas, oil, coal, or a combination of fuels.

FEATURES

- Approvals: Underwriters Laboratories Inc. listed or component recognized, Canadian Standards Association certified, and Factory Mutual approved for automatic fired burners.
- The R4140 directly replaces the R4150 for most applications and mounts on the same Q520A Wiring Subbase.
- Low-high-low purge programmers.
- Field selectable main burner flame-establishing period.
- Early spark termination (five-second ignition and five-second pilot only) available on some models.
- Plug-in, solid state, flame signal amplifiers are color-coded and interchangeable to allow the use of any type of flame detector-flame rod, photocell, infrared detector, or ultraviolet detector.
- Amplifier capability includes three standard models, three Dynamic Self-Check models, and one Dynamic Ampli-Check® model.

- R7247C or R7476A Dynamic Self-Check Amplifier, when used with an ultraviolet flame detector with a self-checking shutter (R7247C with a C7012E or F; R7476A with a C7076), tests all electronic components in the flame detection system (amplifier and detector) 60 to 240 times a minute during burner operation and shuts down the burner if the detection system fails.
- R7247B Dynamic Self-Check Amplifier, when used with a rectifying flame rod (which is considered fail-safe), or R7248B Dynamic Ampli-Check Amplifier, when used with a C7015A Infrared (lead sulfide) Flame Detector, tests the flame signal amplifier at least 150 times a minute during burner operation and shuts down the burner if the amplifier fails.
- All models feature capability of proving low fire position of the firing rate motor before starting ignition trials.
- Provisions for connecting preignition or start interlocks (depending on model) to prove the proper conditions for startup, and for a combustion airflow switch to prove airflow throughout the operating cycle.
- All models have 4-wire firing rate switching circuitry—firing rate can be modulated while the burner is firing, and the firing rate motor can be driven to both low and high fire positions during prepurge.
- Safe start check at startup and during prepurge. If flame relay 2K is holding in at startup, the programmer cannot be started. If a flame (or a condition simulating a flame) is detected during prepurge, ignition trials cannot be started and the programmer recycles.
- Safety shutdown occurs on failure to ignite the pilot or main burner, on loss of flame during the Run period, or if the flame detection system fails (if a self-checking system is used).
- All relays are visible, labeled, and easily accessible.
- Alarm terminal is available to operate an external, line voltage alarm on safety shutdown.

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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:

R4140G Flame Safeguard Programming Controls—Flame Safeguard protection and sequencing controls for use on gas, oil, coal, or combination burners. See Table 1 for models available.

Interlock Circuits:

- Start Interlocks (R4140G1049, G1056, G1064, G1114, G1122, G1148 and G1171)—System controls must be in proper positions or programmer will not start.
- Preignition Interlocks (R4140G1007, G1015, and G1106)—Must be closed to start programmer. Prevent ignition trials if interlocks open during prepurge; timer recycles the programmer and system restarts if condition is self-correcting.
- Running Interlocks (all models)—Must be closed (airflow must be proven, fuel pressure must not be too low or too high) within 9.5 seconds after startup or ignition trials cannot be started. Running interlocks must remain closed through the Run period or the automatic fuel valves de-energize, the burner flame(s) goes out, and the timer recycles the programmer.
- Low Fire Interlock (all models)—Timer stops at 52 seconds until low fire proving switch closes, indicating damper is closed prior to ignition.

Table 1. Models Available.

Model	With Cover ^a	Timer Cycle (sec)	Prepurge (sec)	Early Spark Termination ^b	Flame-Establishing Period (sec)		Postpurge (sec)	Interlock Circuits	Firing Rate Switching Circuit
					Pilot ^c	Main Burner (Field Selectable) ^c			
R4140G1007	Yes	120	60	No	10	10 or 30	16	Preignition, Running (including Airflow Switch) and Low Fire	4-wire common, high fire, low-fire, modulate)
R4140G1015	No								
R4140G1106	No	120	60	No	10	10 or 15	16		
R4140G1049	No	120	60	Yes	10	10 or 30	16	Start, Running (including Airflow Switch) and Low Fire	
R4140G1056	Yes	120	60	Yes	10	10 or intermittent	16		
R4140G1064	No	120	60	Yes	10	10 or intermittent	16	Airflow Switch) and Low Fire	
R4140G1114	No	180	70	Yes	10	10, 30, or 60	25		
R4140G1122	No	180	70	Yes	10	10, 30 or 60	25		
R4140G1148	No	120	60	Yes	10	10 or 15	16		
R4140G1171	No	180	70	Yes	10	10 or 15	25		

^a 202050C Cover with reset button; heavy duty, metal cover for outside panel mounting.

^b Early spark termination available on terminal 18 (5 second ignition and 5 second pilot only).

^c If used for direct spark ignition (oil or gas), the flame-establishing period is 10 seconds.

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number or specify order number. Order separately:

1. Flame detection system (amplifier and matching flame detector). See Table 4.
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 Home and Building Control Sales Office (check white pages of your phone directory).
2. Home and Building Control Customer Logistics
Honeywell Inc., 1885 Douglas Drive North
Minneapolis, Minnesota 55422-4386 (612) 951-1000

In Canada—Honeywell Limited/Honeywell Limitée, 155 Gordon Baker Road, North York, Ontario M2H 2C9.
International Sales and Service 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.

Safety Features:

Safe Start Check—For the presence of a flame (or a condition simulating a flame) provided at startup and during prepurge. If the flame relay 2K is pulled in at startup, 2K2 is open and the programmer cannot be started. If the flame relay 2K pulls in during prepurge (before 57.5 seconds), 2K2 opens, relay 1K drops out, and ignition trials cannot be started. Instead, the timer completes its revolution and stops at the standby position (zero seconds). If the flame relay 2K drops out by the end of the cycle, the programmer restarts the system.

Safety Shutdown—Ignition transformer and all automatic fuel valves de-energize. The lockout switch trips and locks out the programmer. If used, the external alarm is energized. The timer completes its revolution and locks up at the stand-by position (zero seconds). The lockout switch must be manually reset to restart the system.

Safety Shutdown occurs on:

- Failure to ignite the pilot (or first stage burner if using direct spark ignition).
- Failure to light the main burner (unless monitoring an intermittent pilot).
- Loss of flame during the Run period.
- Failure in the flame detection system (if a self-checking system is used, see Table 4).

Flame Failure Response Time—2 to 4 seconds.

Lockout Switch Timing—30 seconds (nominal).

Electrical Ratings:

Voltage and Frequency: 120 Vac (102V minimum to 132V maximum), 50/60 Hz.

R4140G1114: 240 Vac, 60 Hz.

R4140G1122: 208 Vac, 60 Hz.

NOTE: Use of a 50 Hz power supply lengthens the sequence timings by a factor of 1.2.

Power Consumption (With No Loads Connected to Output Terminals): 13W maximum.

Maximum Total Connected Load: 2000 VA.

Terminal Ratings:

See Table 2.

Table 2. Terminal Ratings.

Terminal	Typical Load	Maximum Rating at 120 Vac, 60 Hz
5 or 6	Ignition Transformer/Pilot Valve/First Stage Fuel Valve	4.5A ignition and 50 VA pilot duty or 2.5A ignition and 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(s) 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)	9.8A full load, 58.8A locked rotor (inrush)
9	120V Alarm	75 VA pilot duty
10, 11, 12, and 14	Firing Rate (damper) Motor Contacts	50 VA pilot duty
18 (if available)	Ignition Transformer	4.5A ignition

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

EXAMPLE: Pilot duty rating = 50 VA.

At 120V, running current is:

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

Maximum allowable inrush is ten times 0.42A = 4.2A.

Interlock Ratings:

See Table 3.

Table 3. 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).
Start or Preignition Interlocks	Programmer relay 1K (5W max).

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 (subbase ordered separately).

Dimensions:

See Fig. 1 and 2.

Weight (Without Plug-in Flame Signal Amplifier and 202050C Cover):

4 lb, 12 oz (2.15 kg).

Flame Detection System (Ordered Separately):

Plug-in Flame Signal Amplifier and matching Flame Detector; see Table 4.

Approvals:

Underwriters Laboratories Inc. Listed Section of Primary Safety Control (120V Models With Covers): File No. MP268; Guide No. MCCZ.

Underwriters Laboratories Inc. Component Recognized (120V Models Without Covers): File No. MP268; Guide No. MCCZ2.

Canadian Standards Association Certified: File No. LR1620.

Factory Mutual Approved: Report No. 24180.

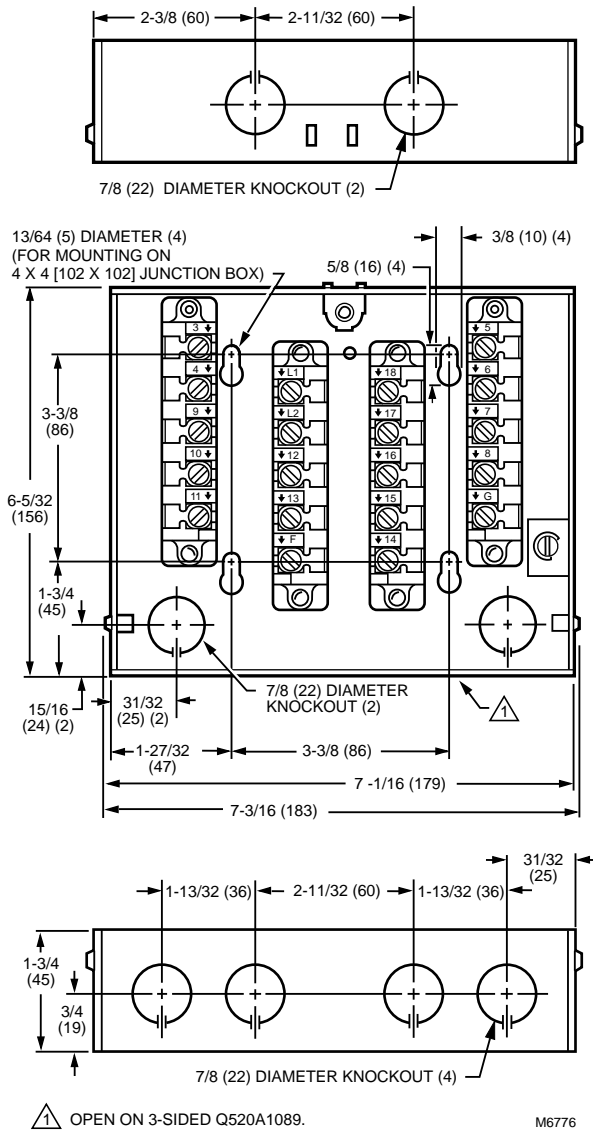


Fig. 1. Mounting dimensions of the Q520A wiring subbase in in. (mm).

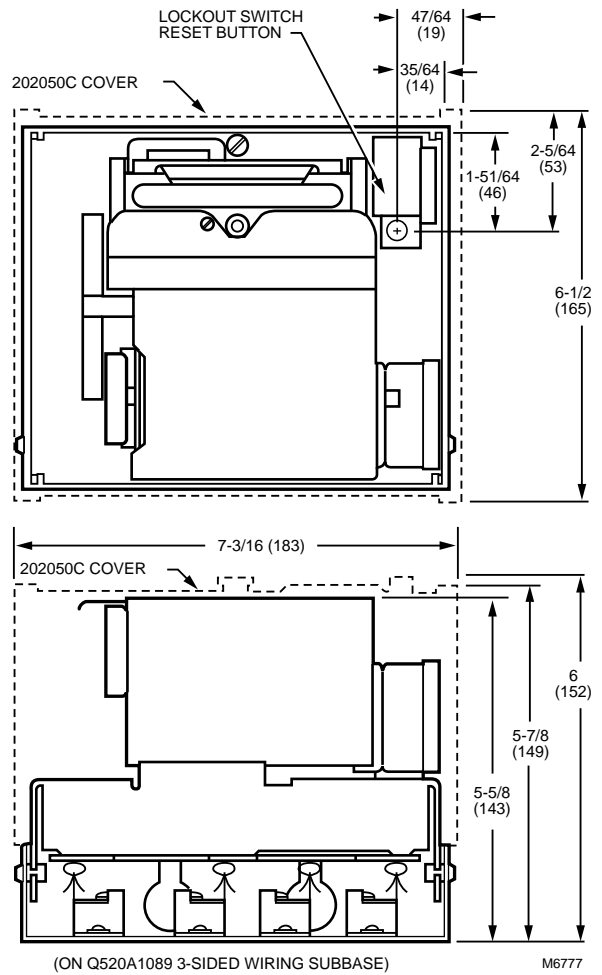


Fig. 2. Mounting dimensions of the R4140 Programmer on the Q520A wiring subbase in in. (mm).

Accessories:

- W136A Test Meter (includes 117053 Meter Connector Plug); has SPL position with damping for testing self-checking flame detection systems.
- 117053 Meter Connector Plug (for older W136A models).
- 123514A Flame Simulator (for use with R7247A Rectification Amplifiers).
- 123514B Flame Simulator (for use with R7249A Ultraviolet Amplifiers).
- 139695C (Series 1 and 2) Cover with reset button; heavy duty, metal cover for outside panel mounting.
- 202050C (Series 3) Cover with reset button; heavy duty, metal cover for outside panel mounting.
- 118760B (Series 1 and 2) Remote Reset Cover; heavy duty, metal cover with remote reset assembly; 120V, 60 Hz solenoid.
- 202051B (Series 3) Remote Reset Cover; heavy duty, metal cover with remote reset assembly; 120V, 60 Hz solenoid.
- R1061012 Ignition Cable; for ignition installations in a high temperature environment; rated at 350°F (177°C) for continuous duty, and up to 500°F (260°C) for intermittent use; tested to 25,000V.

- R1298020 Cable; for flame detector (F lead-wire) installations in a high temperature environment; rated up to 400°F (204°C) for continuous duty; tested for operation up to 600V and breakdown up to 7500V.
- R1239001 High Tension Ignition Cable; for ignition installations in a contaminating environment; very resistant to severe conditions of oil, heat, and corona, and tested to withstand high voltages up to 25,000V rms in a salt bath for one minute without breakdown; rated at 200°F (93°C) for continuous duty, and up to 350°F (197°C) for intermittent use.
- Q624A Solid State Spark Generator; prevents detection of ignition spark when properly applied with flame detection systems using C7027, C7035, or C7044 Minipeeper Ultraviolet Flame Detectors. For use only with gas pilots.
- FSP5004 Tester; provides a quick operational check of most R4140 Flame Safeguard Programming Controls.
- Q520E1002 Service Tool; allows any of the programmer terminals to be monitored while the programmer is operating.

Table 4. Flame Detection Systems

NOTE: Neither the R414G1114 or the R4140G1122 can be used with the C7012E or F Purple Peeper Ultraviolet Flame Detector and with the R7247C Dynamic Self-Check Amplifier.

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	Holder ^a : C7004, C7007, C7011. Complete assemblies: C7005, C7008, C7009, Q179.
			R7247A, R7247B ^b	2 to 4 sec	Oil	Rectifying Photocells ^c	C7003, C7010, C7013, C7014.
		Dynamic Self-Check	R7147B ^b	2 to 4 sec	Gas	Ultraviolet (Purple Peeper)	C7012A or C.
			R7247C ^d	2 to 4 sec	Gas, Oil, Coal	Rectifying Flame Rods	Holder ^a : C7004, C7007, C7011. Complete Assemblies: C7005, C7008, C7009, Q179.
Infrared	Red	No	R7248A	2 to 4 sec	Gas, Oil, Coal	Infrared (Lead Sulfide)	C7015.
		Dynamic Ampli-Check [®]	R7248B ^b	2 to 4 sec	Gas, Oil, Coal	Infrared (Lead Sulfide)	C7015.
Ultraviolet	Purple	No	R7249A	2 to 4 sec	Gas, Oil	Ultraviolet (Minipeeper)	C7027, C7035, C7044.
	Blue	Dynamic Self-Check	R7476A ^d	2 to 4 sec	Gas, Oil, Coal	Ultraviolet (Adjustable Sensitivity)	C7076.

^a Order flame rod separately; see Instructions for the holder.

^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 Use only Honeywell part no. 38316 Photocell.

^d Circuitry tests all electronic components in the flame detection system (amplifier and detector) 60 to 240 times a minute during burner operation and shuts down the burner if the detection system fails.

OPERATION

Models with Preignition Interlocks

Fig. 3 shows all contacts in the standby position (zero seconds). The opening and closing times are shown adjacent

to each timer contact. Refer to Fig. 4 and the Step-by-Step Operation section.

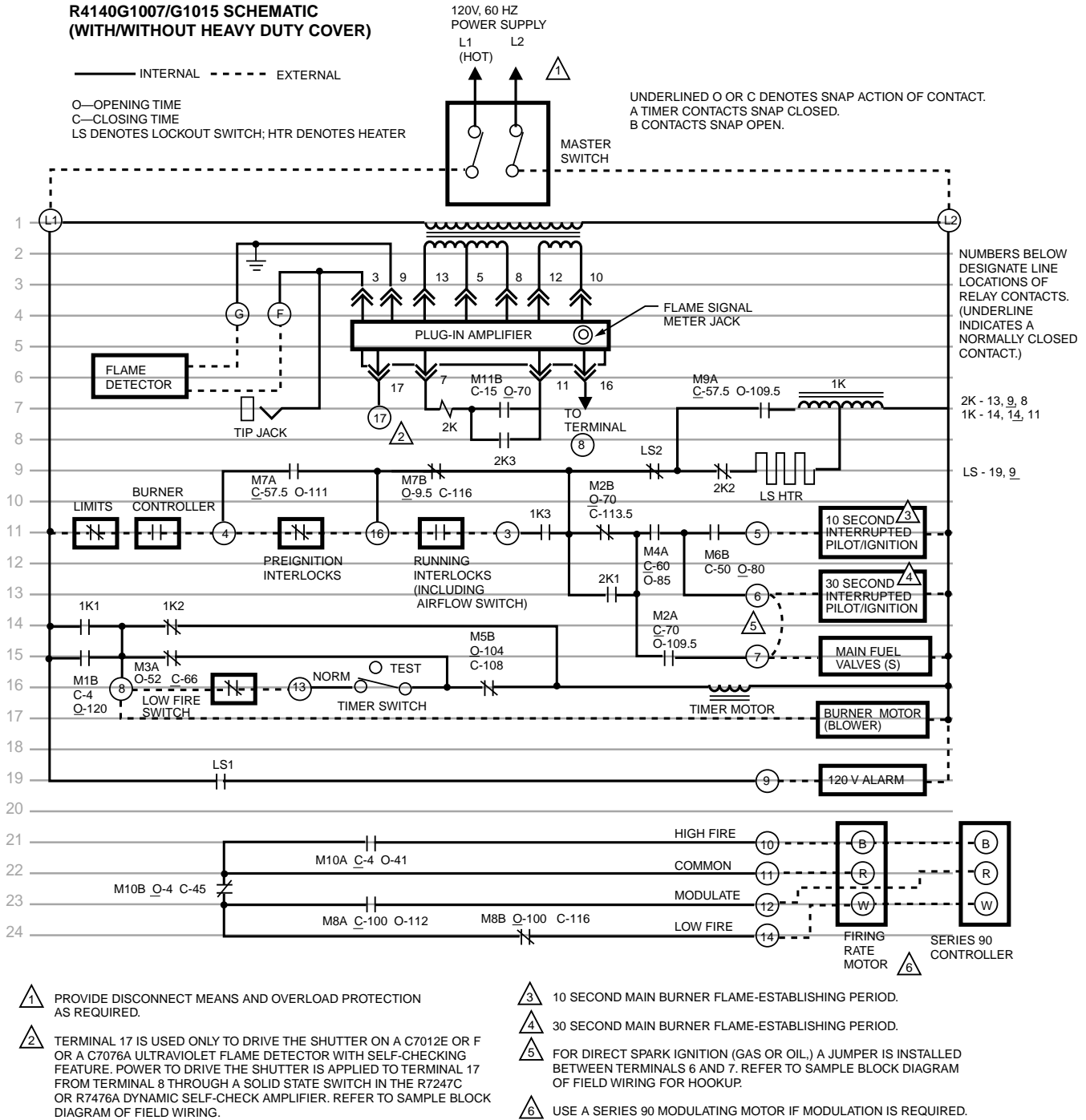


Fig. 3. Simplified schematic diagram of R4140G1015 Programmer.

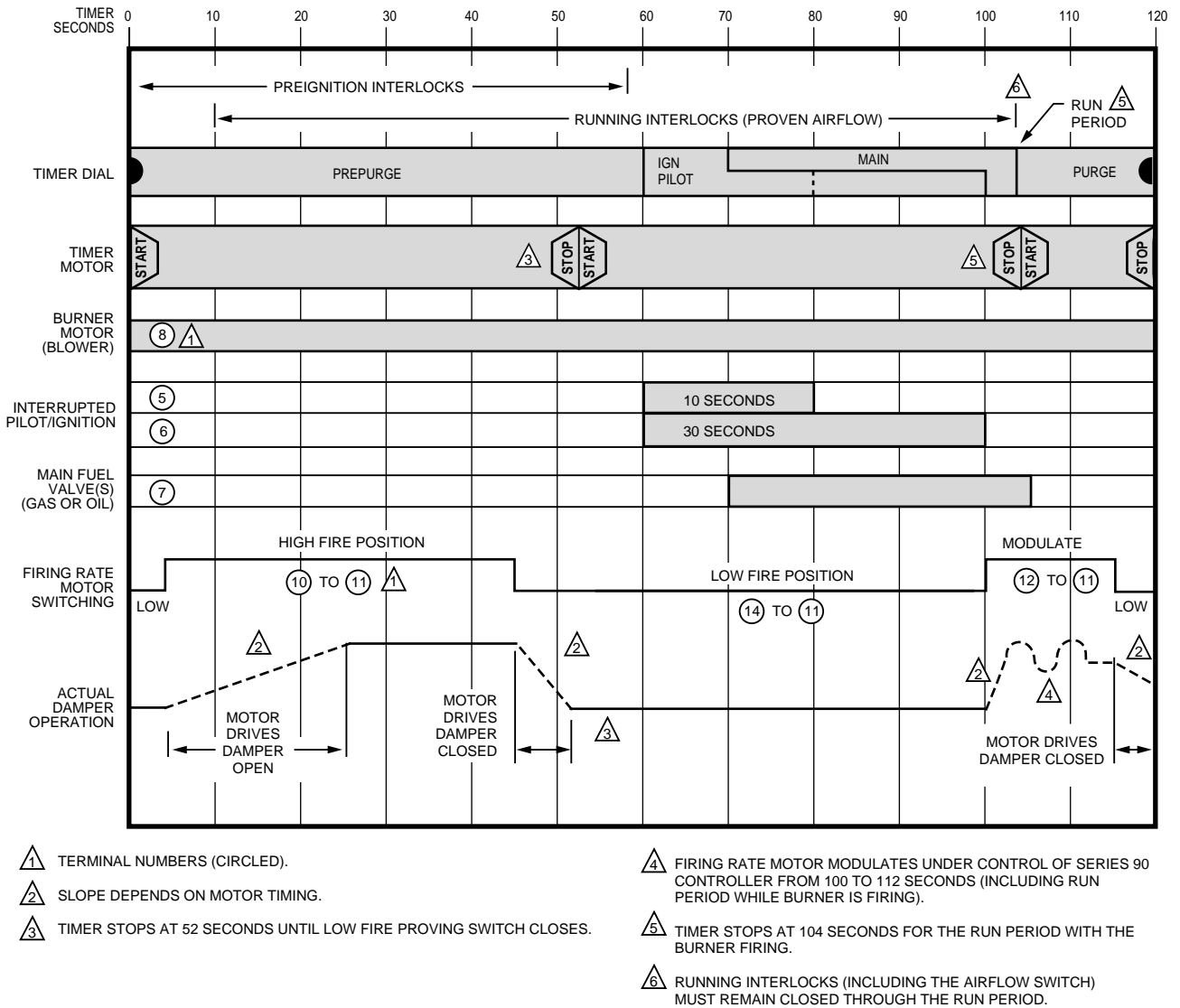


Fig. 4. Timer sequence for R4140G1015 Programmer.

Step-By-Step Operation (R4140G1015)

Start And Prepurge

- 0 seconds—On a call for heat, the burner controller contacts close. If the limits and preignition interlocks are closed and flame relay 2K is not holding in, relay 1K pulls in through M7B, LS2, 2K2, and the LS HTR (lockout switch heater—thus proving its continuity).
 - 1K1 closes and 1K2 opens, timer motor starts (through 1K1, M3A, and M5B), power is applied to terminal 8, starting the burner motor (blower); 1K3 closes.
 - Prepurge begins.
- 4 seconds—M10A closes, M10B opens; firing rate motor drives toward high fire position (open).
 - M1B closes, bypassing 1K1; the timer can complete its revolution if shutdown occurs.
- 9.5 seconds—M7B opens; running interlocks must close (airflow must be proven) or 1K drops out, 1K3 opens,

- and ignition trials cannot be started. Running interlocks must remain closed through the Run period or the system shuts down; the timer completes its revolution and recycles the programmer.
- 15 seconds—M11B closes; flame relay 2K can pull in if a flame (or a condition simulating a flame) is detected. If detected during prepurge (until 57.5 seconds), 2K pulls in, 2K2 opens, 1K drops out, and the system shuts down; the timer completes its revolution and recycles the programmer (if 2K dropped out).
- 45 seconds—M10B closes; firing rate motor drives toward low fire position (closed).
- 52 seconds—M3A opens; timer stops until the low fire proving switch closes; timer can be stopped by opening the timer switch (until 66 seconds when M3A closes again).
- 57.5 seconds—M9A closes; the LS HTR (lockout switch heater) begins heating in preparation for ignition trials.
 - M7A closes, bypassing the preignition interlocks.

Ignition Trials

- 60 seconds—M4A closes; power is applied to terminals 5 and 6, energizing the ignition transformer and pilot valve (or main fuel valve(s) on terminal 7 if using direct spark ignition).
 - When a flame is detected, relay 2K pulls in, 2K2 opens, and the LS HTR stops heating; 2K1 and 2K3 close.
- 66 seconds—M3A closes, bypassing the low fire switch and the timer switch.
- 70 seconds—M2B opens; pilot or ignition trial ends; a flame must be detected by this time (2K pulled in and 2K1 closed) or safety shutdown occurs and the lockout switch trips.
 - M2A closes; power is applied to terminal 7, energizing the main fuel valve(s).
 - M11B opens; prevents 2K from pulling in after this time.
- 80 seconds—M6B opens; 10 second interrupted pilot/ignition (terminal 5) is de-energized.
- 100 seconds—M4A opens; 30 second interrupted pilot/ignition (terminal 6) is de-energized.
 - M8A closes, M8B opens; firing rate motor is released to modulate under control of the Series 90 Controller.
- 104 seconds—M5B opens; timer stops with the system in the Run condition.

Run Period (Burner is Firing)

Postpurge And Stop

- 104 seconds—When the operating setpoint is reached, the burner controller contacts open; relay 1K and the main fuel valve(s) (terminal 7) de-energize.
 - 1K2 closes; timer motor starts; postpurge begins.
 - When the flame goes out, relay 2K drops out.
- 112 seconds—M8A opens; firing rate motor stops modulating under control of the Series 90 Controller.
- 116 seconds—M8B closes; firing rate motor drives toward low fire position (closed).
- 120 seconds—M1B opens; timer and burner motor stop; cycle ends.

Fig. 5 shows all contacts in the standby position (zero seconds). The opening and closing times are shown adjacent to each timer contact. Refer to Fig. 6 and the Step-by-Step Operation section.

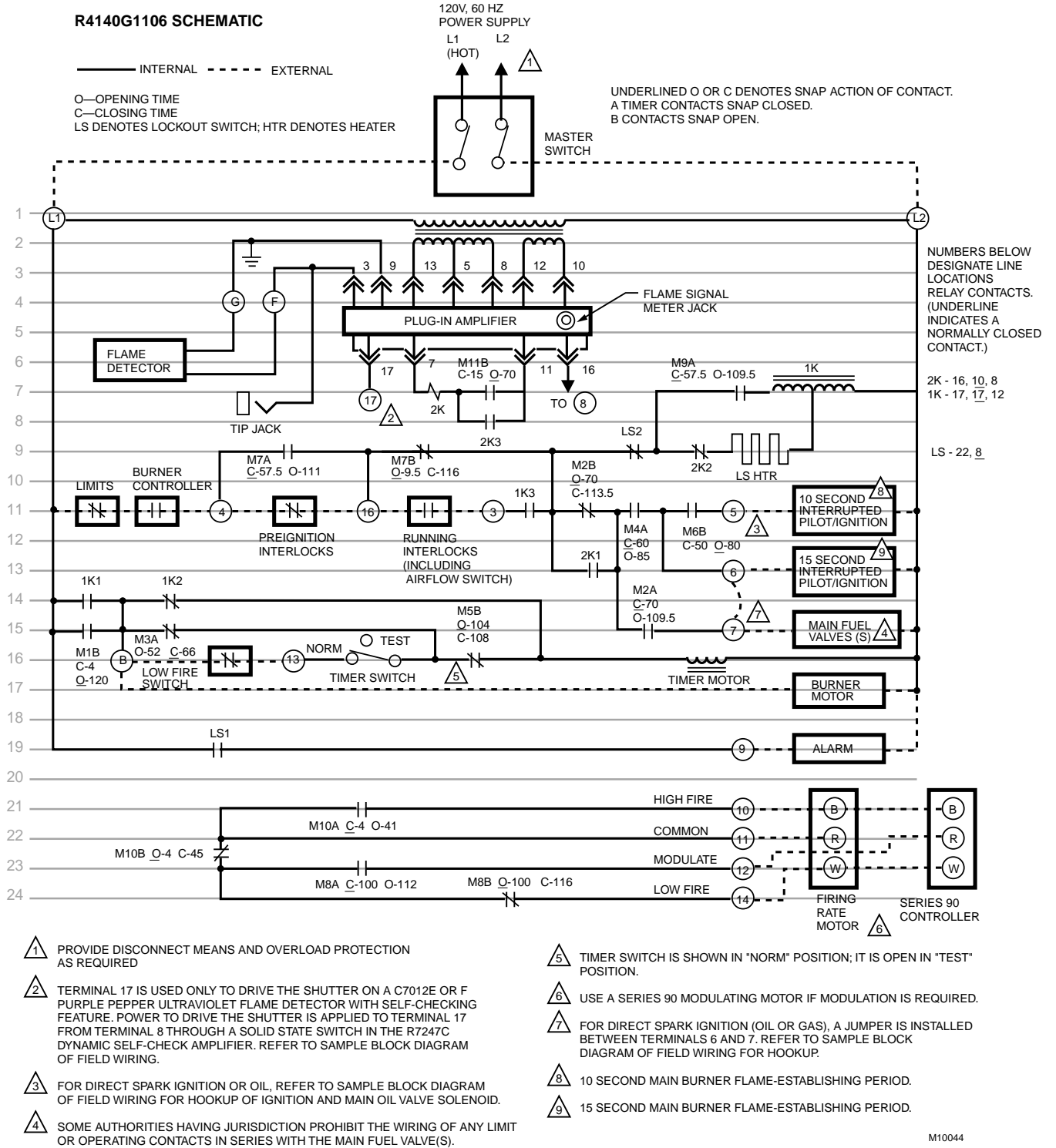


Fig. 5. Simplified schematic diagram of R4140G1106 Programmer.

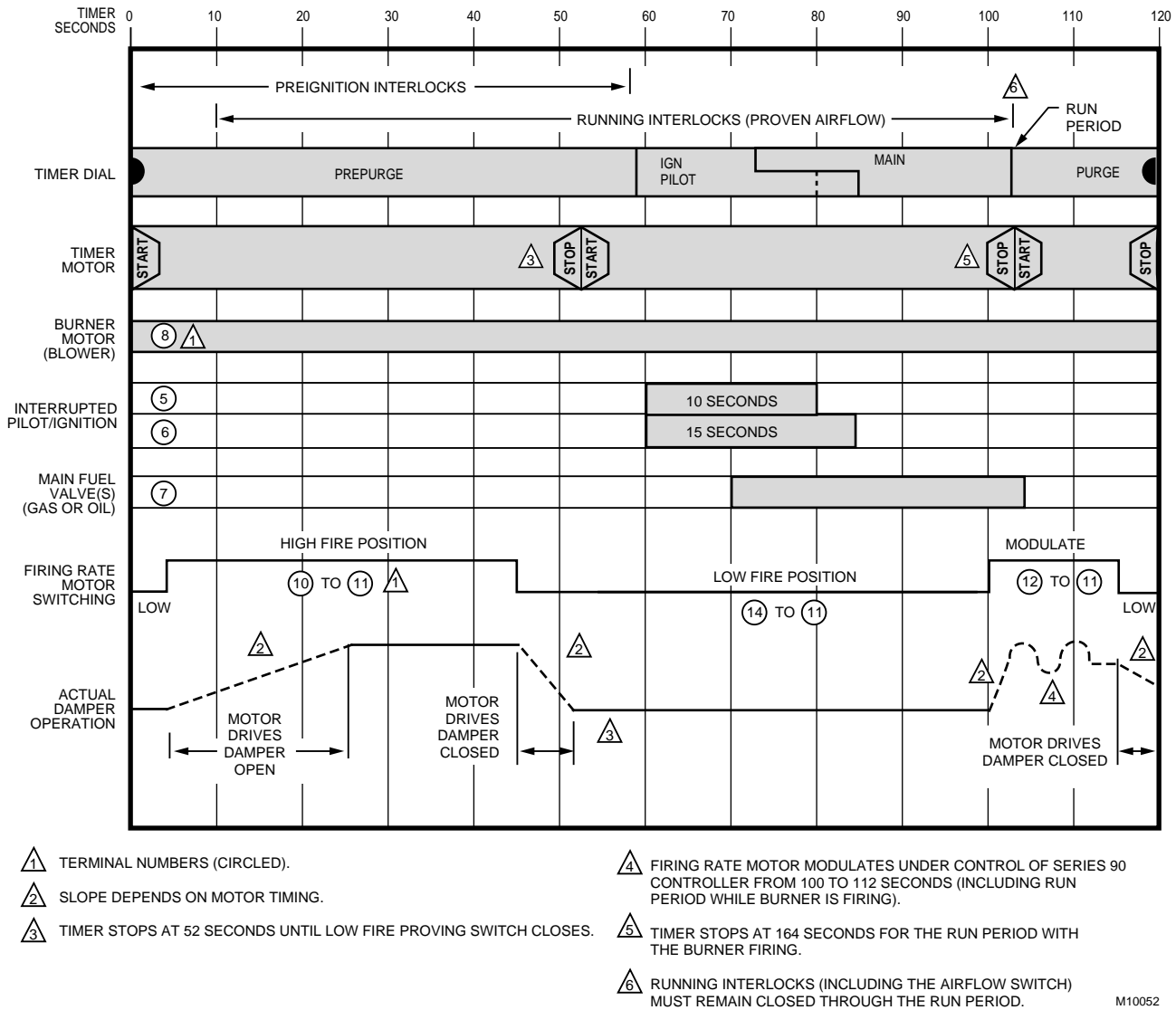


Fig. 6. Timer sequence for R4140G1106 Programmer.

Step-By-Step Operation (R4140G1106)

Start and Prepurge

- 0 seconds—On a call for heat, the burner controller contacts close. If the limits and preignition interlocks are closed and flame relay 2K is not holding in, relay 1K pulls in through M7B, LS2, 2K2, and the LS HTR (lockout switch heater—thus proving its continuity).
 - 1K1 closes and 1K2 opens; timer motor starts (through 1K1, M3A, and M5B); power is applied to terminal 8, starting the burner motor (blower); 1K3 closes.
 - Prepurge begins.
- 4 seconds—M10A closes, M10B opens; firing rate motor drives toward high fire position (open).
 - M1B closes, bypassing 1K1; the timer can complete its revolution if shutdown occurs.
- 9.5 seconds—M7B opens; running interlocks must be closed (airflow must be proven) or 1K drops out, 1K3 opens, and ignition trials cannot be started. Running interlocks must remain closed through the Run period

- or the system shuts down; the timer completes its revolution and recycles the programmer.
- 15 seconds—M11B closes; flame relay 2K can pull in if a flame (or a condition simulating a flame) is detected. If detected during prepurge (until 57.5 seconds), 2K pulls in, 2K2 opens, 1K drops out, and the system shuts down; the timer completes its revolution and recycles the programmer (if 2K dropped out).
- 45 seconds—M10B closes; firing rate motor drives toward low fire position (closed).
- 52 seconds—M3A opens; timer stops until the low fire proving switch closes; timer can be stopped by opening the timer switch (until 66 seconds when M3A closes again).
- 57.5 seconds—M9A closes; the LS HTR (lockout switch heater) begins heating in preparation for ignition trials.
 - M7A closes, bypassing the preignition interlocks.

Ignition Trials

- 60 seconds—M4A closes; power is applied to terminals 5 and 6, energizing the ignition transformer and pilot valve (or main fuel valve(s) on terminal 7 if using direct spark ignition).
- When a flame is detected, relay 2K pulls in, 2K2 opens, and the LS HTR stops heating; 2K1 and 2K3 close.
- 66 seconds—M3A closes, bypassing the low fire switch and the timer switch.
- 70 seconds—M2B opens; pilot or ignition trial ends; a flame must be detected by this time (2K pulled in and 2K1 closed) or safety shutdown occurs and the lockout switch trips.
- M2A closes; power is applied to terminal 7, energizing the main fuel valves(s).
 - M11B opens; prevents 2K from pulling in after this time.
- 80 seconds—M6B opens; 10 second interrupted pilot/ignition (terminal 5) de-energizes.
- 85 seconds—M4A opens; 15 second interrupted pilot/ignition (terminal 6) de-energizes.
- 100 seconds—M8A closes, M8B opens; firing rate motor is released to modulate under control of the Series 90 Controller.
- 104 seconds—M5B opens; timer stops with the system in the run condition.

Run Period (Burner is Firing)**Postpurge and Stop**

- 104 seconds—When the operating setpoint is reached, the burner controller contacts open; relay 1K and the main fuel valve(s) (terminal 7) are de-energized.
- 1K2 closes; timer motor starts; postpurge begins.
 - When the flame goes out, relay 2K drops out.
- 112 seconds—M8A opens; firing rate motor stops modulating under control of the Series 90 Controller.
- 116 seconds—M8B closes; firing rate motor drives toward low fire position (closed).
- 120 seconds—M1B opens; timer and burner motor stop; cycle ends.

Models with Start Interlocks

Fig. 7 shows all contacts in the standby position (zero seconds). The opening and closing times are shown adjacent to each timer contact. Refer to Fig. 8 and the Step-by-Step Operation section.

R4140G FLAME SAFEGUARD PROGRAMMING CONTROLS

R4140G1049 SCHEMATIC (WITH/WITHOUT HEAVY DUTY COVER)

— INTERNAL - - - - EXTERNAL

O—OPENING TIME
C—CLOSING TIME
LS DENOTES LOCKOUT SWITCH; HTR DENOTES HEATER

UNDERLINED O OR C DENOTES SNAP ACTION OF CONTACT.
A TIMER CONTACTS SNAP CLOSED.
B CONTACTS SNAP OPEN.

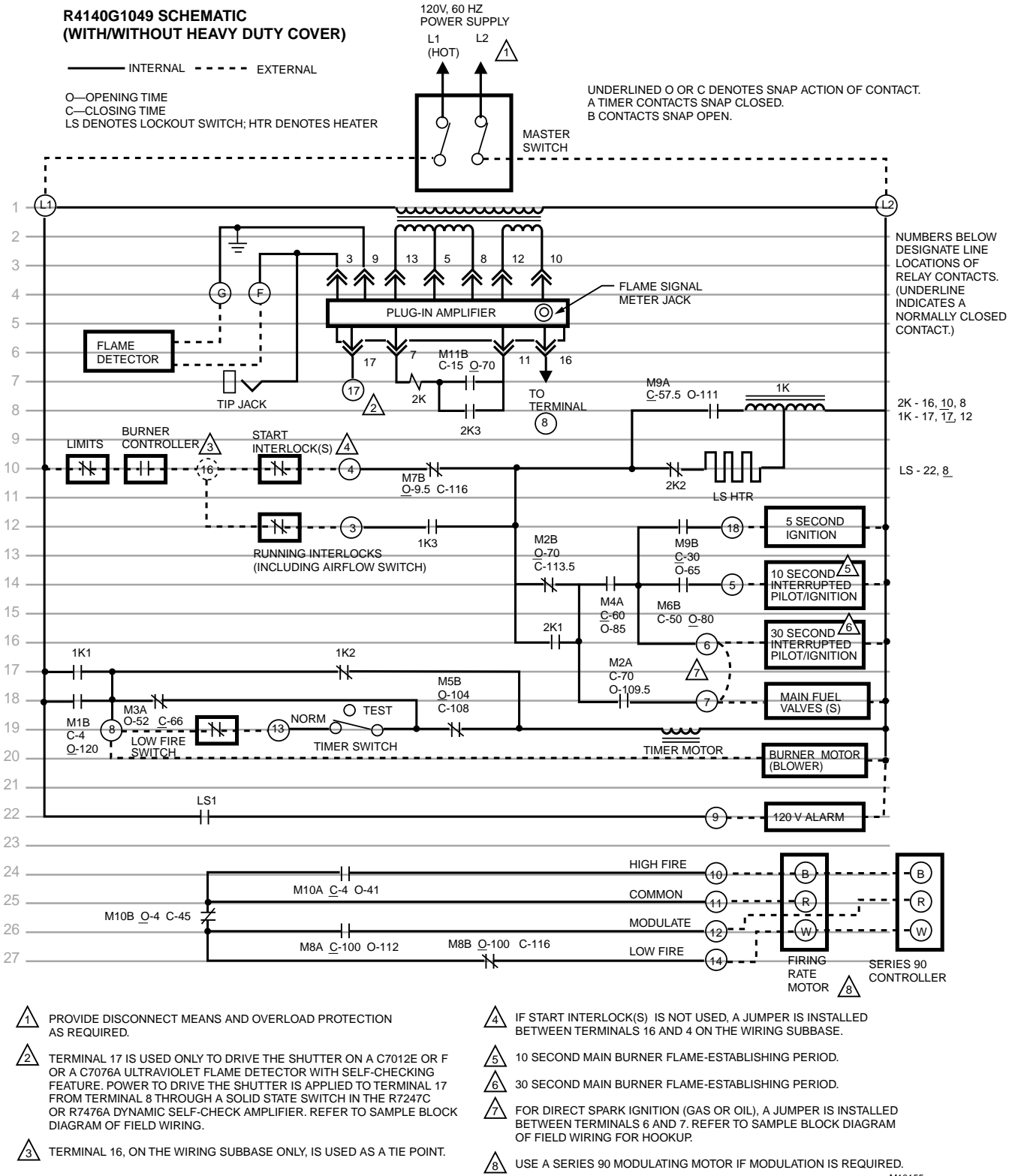
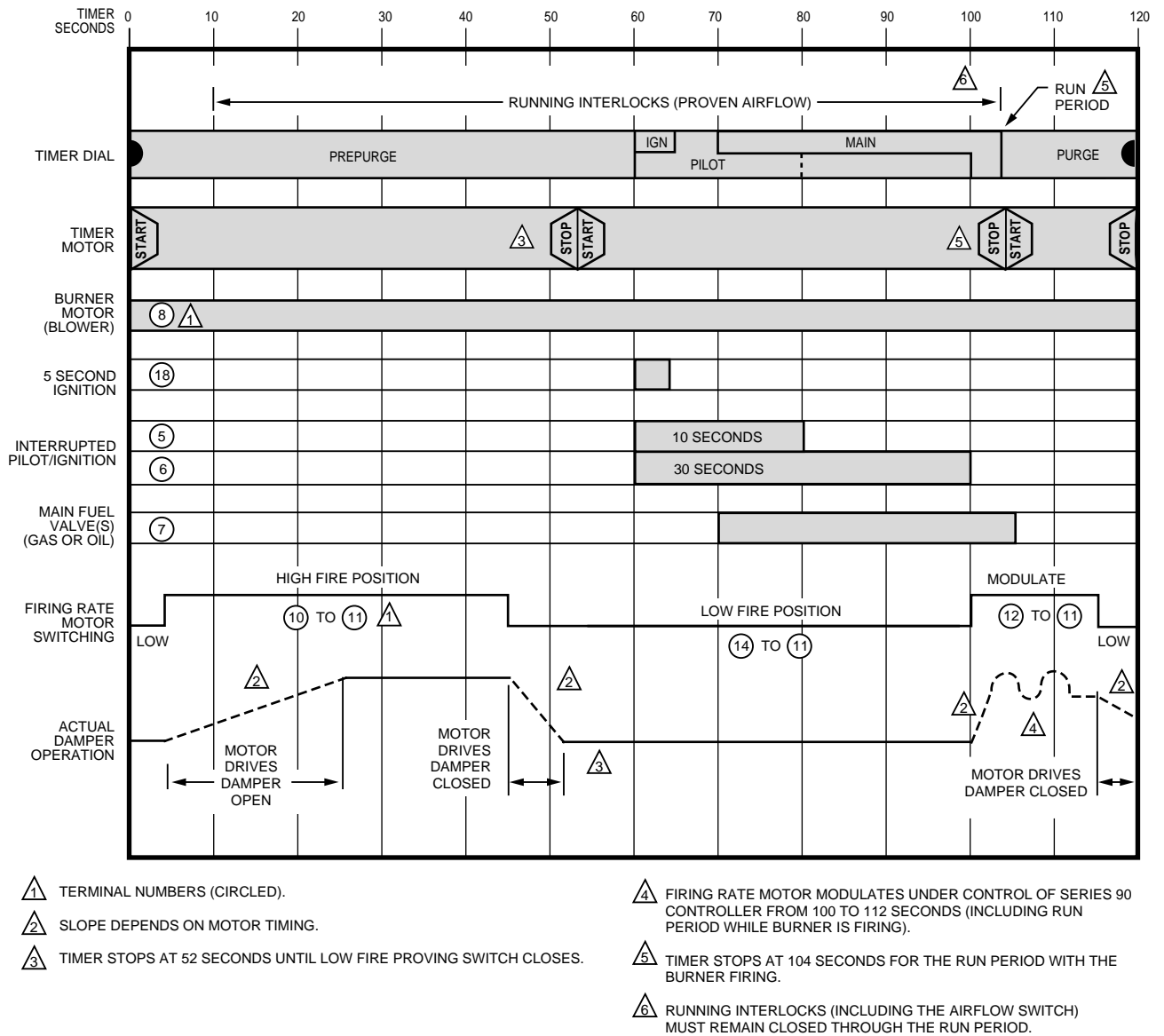


Fig. 7. Simplified schematic diagram of R4140G1049 Programmer.



M10055

Fig. 8. Timer sequence for R4140G1049 Programmer.

Step-By-Step Operation (R4140G1049)

Start and Prepurge

- 0 seconds—On a call for heat, the burner controller contacts close. If the limits and start interlock(s) are closed and flame relay 2K is not holding in, relay 1K pulls in through M7B, 2K2, the LS HTR (lockout switch heater—thus proving its continuity), and LS2.
 - 1K1 closes and 1K2 opens; timer motor starts (through 1K1, M3A, and M5B); power is applied to terminal 8, starting the burner motor (blower); 1K3 closes.
 - Prepurge begins.
- 4 seconds—M10A closes, M10B opens; firing rate motor drives toward high fire position (open).
 - M1B closes, bypassing 1K1; the timer can complete its revolution if shutdown occurs.
- 9.5 seconds—M7B opens; running interlocks must be closed (airflow must be proven) or 1K drops out, 1K3 opens, and ignition trials cannot be started. Running

- interlocks must remain closed through the Run period or the system shuts down; the timer completes its revolution and recycles the programmer.
- 15 seconds—M11B closes; flame relay 2K pulls in if a flame (or a condition simulating a flame) is detected. If detected during prepurge (until 57.5 seconds), 2K pulls in, 2K2 opens, 1K drops out, and the system shuts down; the timer completes its revolution and recycles the programmer (if 2K dropped out).
- 45 seconds—M10B closes; firing rate motor drives toward low fire position (closed).
- 52 seconds—M3A opens; timer stops until the low fire proving switch closes; timer can be stopped by opening the timer switch (until 66 seconds when M3A closes again).
- 57.5 seconds—M7A closes; the LS HTR (lockout switch heater) begins heating in preparation for ignition trials.

Ignition Trials

- 60 seconds—M4A closes; power is applied to terminals 18, 5, and 6, energizing the ignition transformer and pilot valve (or main fuel valve(s) on terminal 7 if using direct spark ignition).
- When a flame is detected, relay 2K pulls in, 2K2 opens, and the LS HTR stops heating; 2K1 and 2K3 close.
- 65 seconds—M9B opens; 5 second ignition (terminal 18) is de-energizes (pilot only until 70 seconds).
- 66 seconds—M3A closes, bypassing the low fire switch and the timer switch.
- 70 seconds—M2B opens; pilot or ignition trial ends; a flame must be detected by this time (2K pulled in and 2K1 closed) or safety shutdown occurs and the lockout switch trips.
- M2A closes; power is applied to terminal 7, energizing the main fuel valve(s).
 - M11B opens; prevents 2K from pulling in after this time.
- 80 seconds—M6B opens; 10 second interrupted pilot/ignition (terminal 5) de-energizes.
- 100 seconds—M4A opens; 30 second interrupted pilot/ignition (terminal 6) de-energizes.
- M8A closes, M8B opens; firing rate motor is released to modulate under control of the Series 90 Controller.
- 104 seconds—M5B opens; timer stops with the system in the run condition.

Run Period (Burner is Firing)

Postpurge and Stop

- 104 seconds—When the operating setpoint is reached, the burner controller contacts open; relay 1K and the main fuel valve(s) (terminal 7) de-energize.
- 1K2 closes; timer motor starts; postpurge begins.
 - When the flame goes out, relay 2K drops out.
- 112 seconds—M8A opens; firing rate motor stops modulating under control of the Series 90 Controller.
- 116 seconds—M8B closes; firing rate motor drives toward low fire position (closed).
- 120 seconds—M1B opens; timer and burner motor stop; cycle ends.

Fig. 9 shows all contacts in the standby position (zero seconds). The opening and closing times are shown adjacent to each timer contact. Refer to Fig. 10 and the Step-by-Step Operation section.

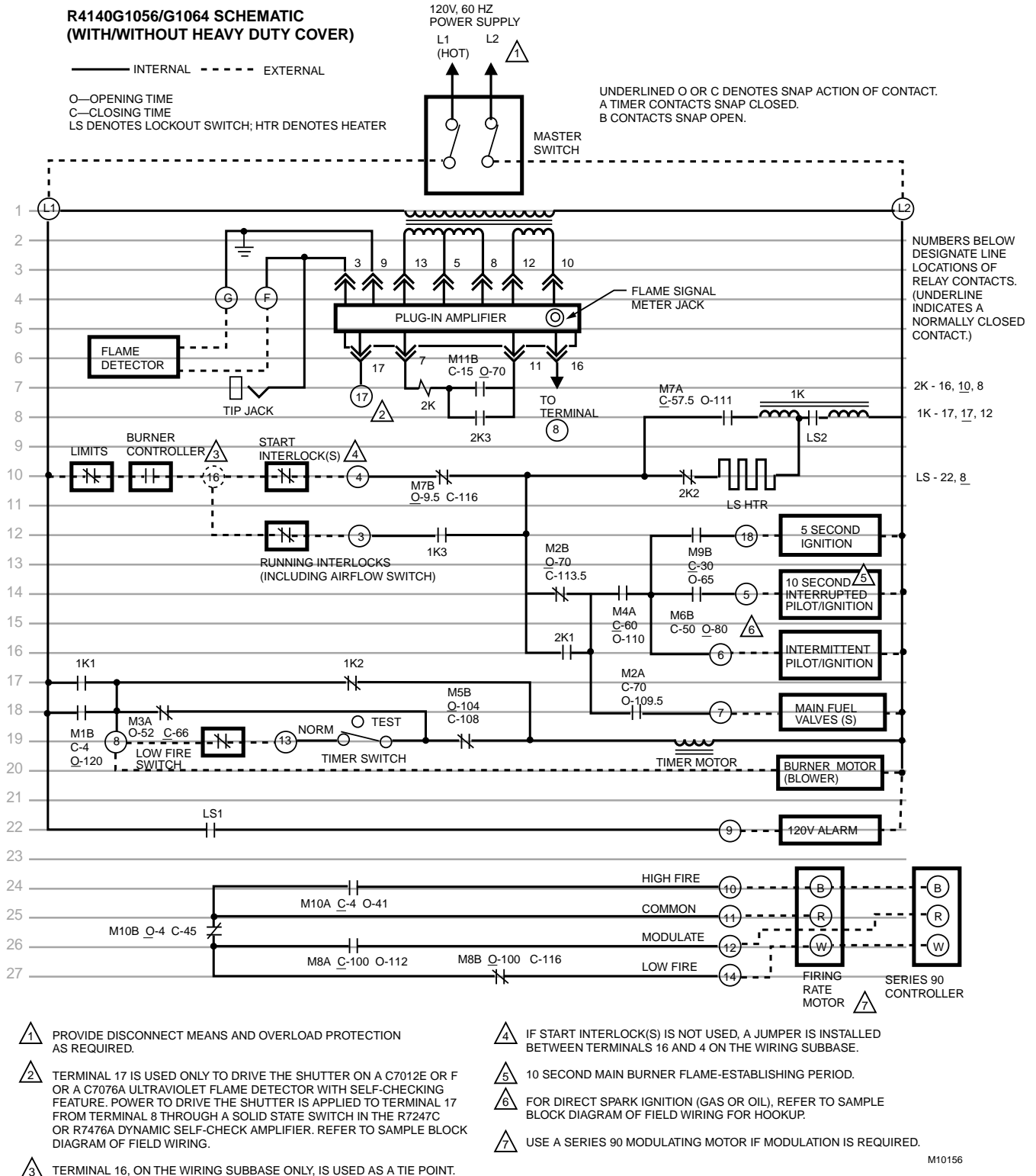


Fig. 9. Simplified schematic diagram of the R4140G1056 and R4140G1064 Programmers.

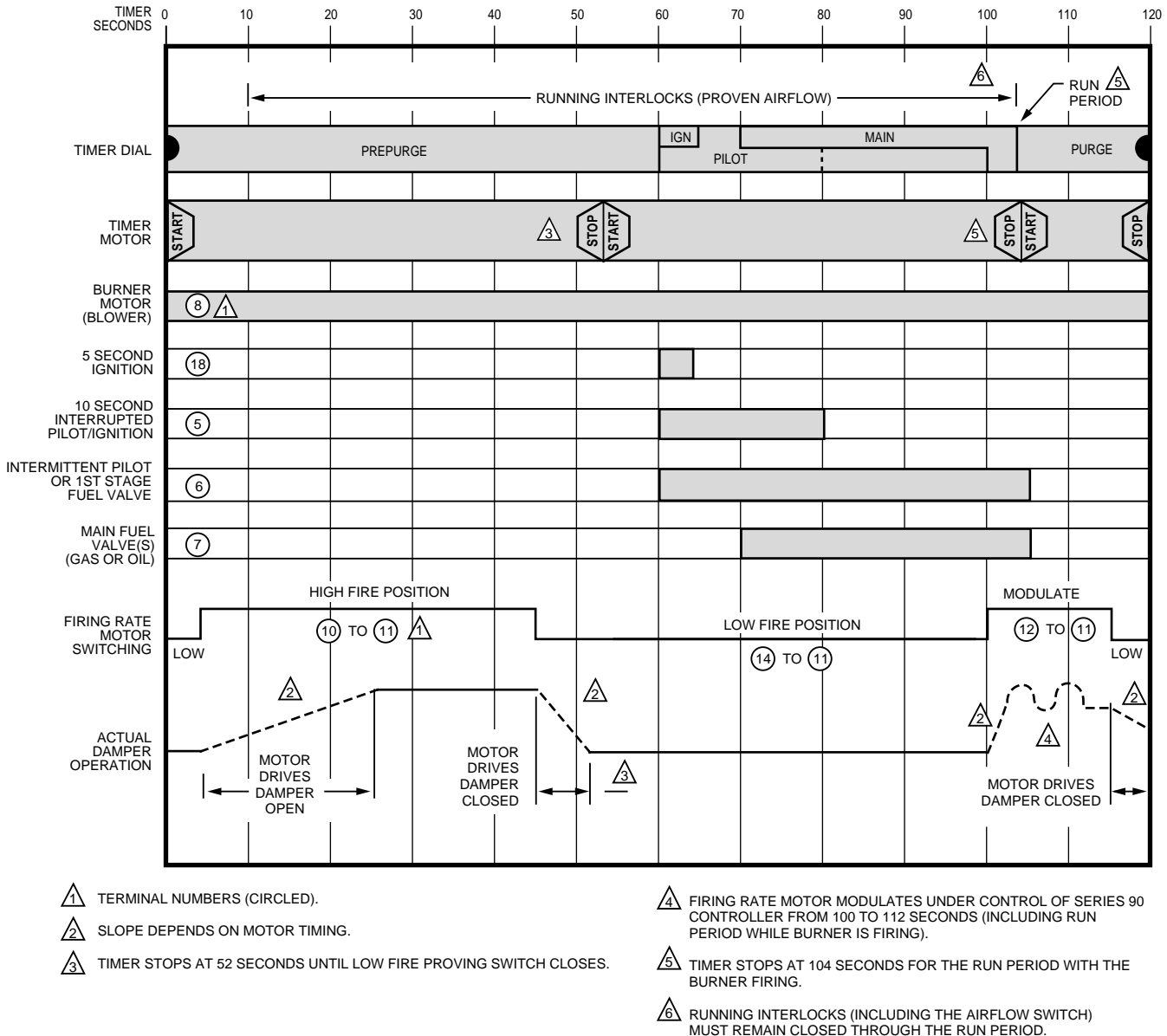


Fig. 10. Timer sequence for R4140G1056 and R4140G1064 Programmers.

M10056

Step-By-Step Operation (R4140G1056 and R4140G1064)

Start and Prepurge

- 0 seconds—On a call for heat, the burner controller contacts close. If the limits and start interlock(s) are closed and flame relay 2K is not holding in, relay 1K pulls in through M7B, 2K2, the LS HTR (lockout switch heater—thus proving its continuity), and LS2.
 - 1K1 closes and 1K2 opens; timer motor starts (through 1K1, M3A, and M5B); power is applied to terminal 8, starting the burner motor (blower); 1K3 closes.
 - Prepurge begins.
- 4 seconds—M10A closes, M10B opens; firing rate motor drives toward high fire position (open).
 - M1B closes, bypassing 1K1; the timer can complete its revolution if shutdown occurs.
- 9.5 seconds—M7B opens; running interlocks must be closed (airflow must be proven) or 1K drops out, 1K3

- opens, and ignition trials cannot be started. Running interlocks must remain closed through the Run period or the system shuts down; the timer completes its revolution and recycles the programmer.
- 15 seconds—M11B closes; flame relay 2K can pull in if a flame (or a condition simulating a flame) is detected. If detected during prepurge (until 57.5 seconds), 2K pulls in, 2K2 opens, 1K drops out, and the system shuts down; the timer completes its revolution and recycles the programmer (if 2K dropped out).
- 45 seconds—M10B closes; firing rate motor drives toward low fire position (closed).
- 52 seconds—M3A opens; timer stops until the low fire proving switch closes; timer can be stopped by opening the timer switch (until 66 seconds when M3A closes again).
- 57.5 seconds—M7A closes; the LS HTR (lockout switch heater) begins heating in preparation for ignition trials.

Ignition Trials

- 60 seconds—M4A closes; power is applied to terminals 18, 5, and 6, energizing the ignition transformer and pilot valve (or first stage fuel valve when using direct spark ignition).
- When a flame is detected, relay 2K pulls in, 2K2 opens, and the LS HTR stops heating; 2K1 and 2K3 close.
- 65 seconds—M9B opens; 5 second ignition (terminal 18) de-energizes (pilot only until 70 seconds).
- 66 seconds—M3A closes, bypassing the low fire switch and the timer switch.
- 70 seconds—M2B opens; pilot or ignition trial ends; a flame must be detected by this time (2K pulled in and 2K1 closed) or safety shutdown occurs and the lockout switch trips.
- M2A closes; power is applied to terminal 7, energizing the main fuel valve(s).
 - M11B opens; prevents 2K from pulling in after this time.
- 80 seconds—M6B opens; 10 second interrupted pilot/ignition (terminal 5) de-energizes.
- 100 seconds—M8A closes, M8B opens; firing rate motor is released to modulate under control of the Series 90 Controller.
- 104 seconds—M5B opens; timer stops with the system in the run condition.

Run Period (Burner is Firing)**Postpurge and Stop**

- 104 seconds—When the operating setpoint is reached, the burner controller contacts open; relay 1K, intermittent pilot or first stage fuel valve (terminal 6), and the main fuel valve(s) (terminal 7) de-energize.
- 1K2 closes; timer motor starts; postpurge begins.
 - When the flame goes out, relay 2K drops out.
- 112 seconds—M8A opens; firing rate motor stops modulating under control of the Series 90 Controller.
- 116 seconds—M8B closes; firing rate motor drives toward low fire position (closed).
- 120 seconds—M1B opens; timer and burner motor stop; cycle ends.

Fig. 11 shows all contacts in the standby position (zero seconds). The opening and closing times are shown adjacent to each timer contact. Refer to Fig. 12 and the Step-by-Step Operation section.

R4140G FLAME SAFEGUARD PROGRAMMING CONTROLS

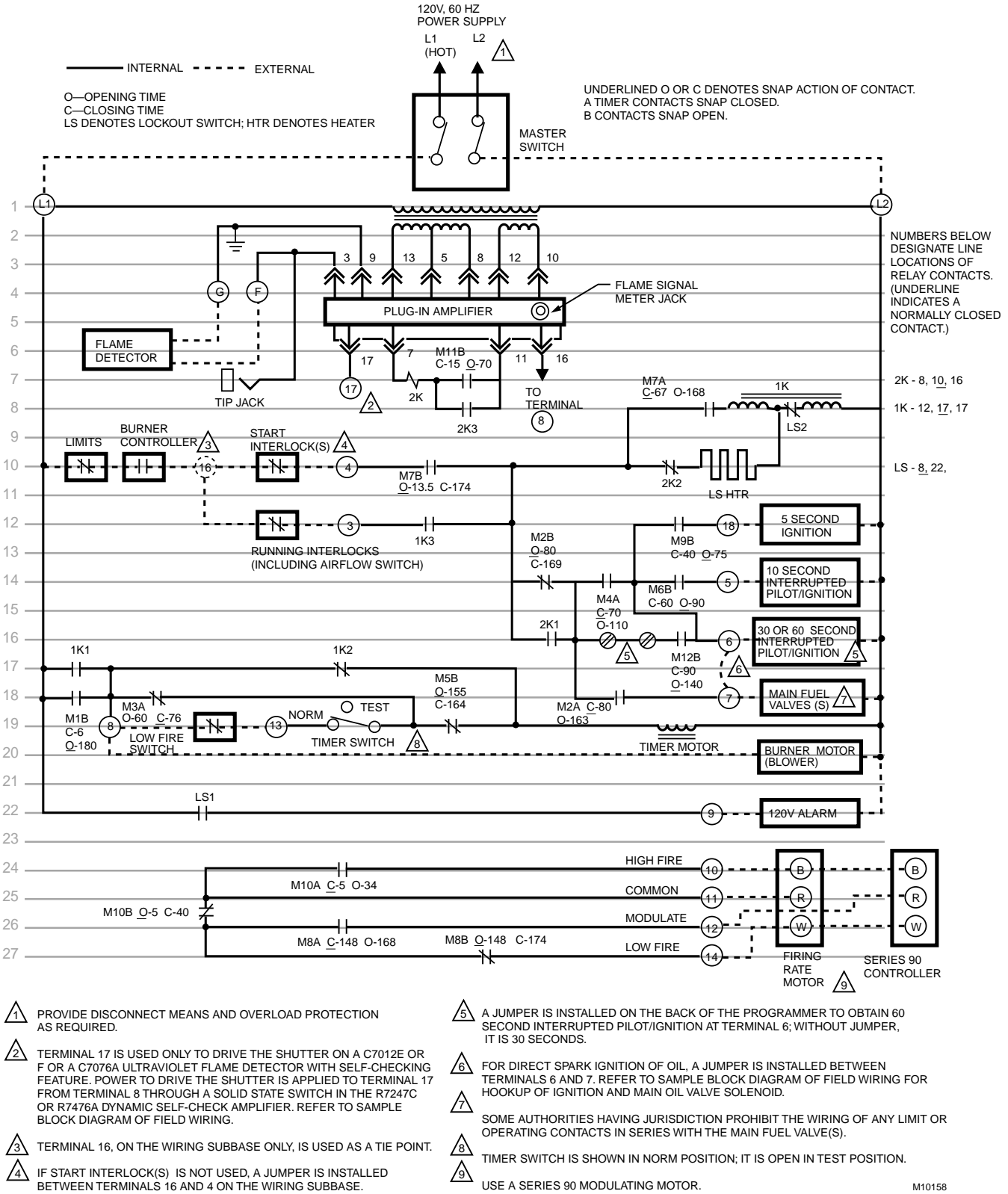


Fig. 11. Simplified schematic diagram of R4140G1171, R4140G1122 and R4140G1114 Programmers.

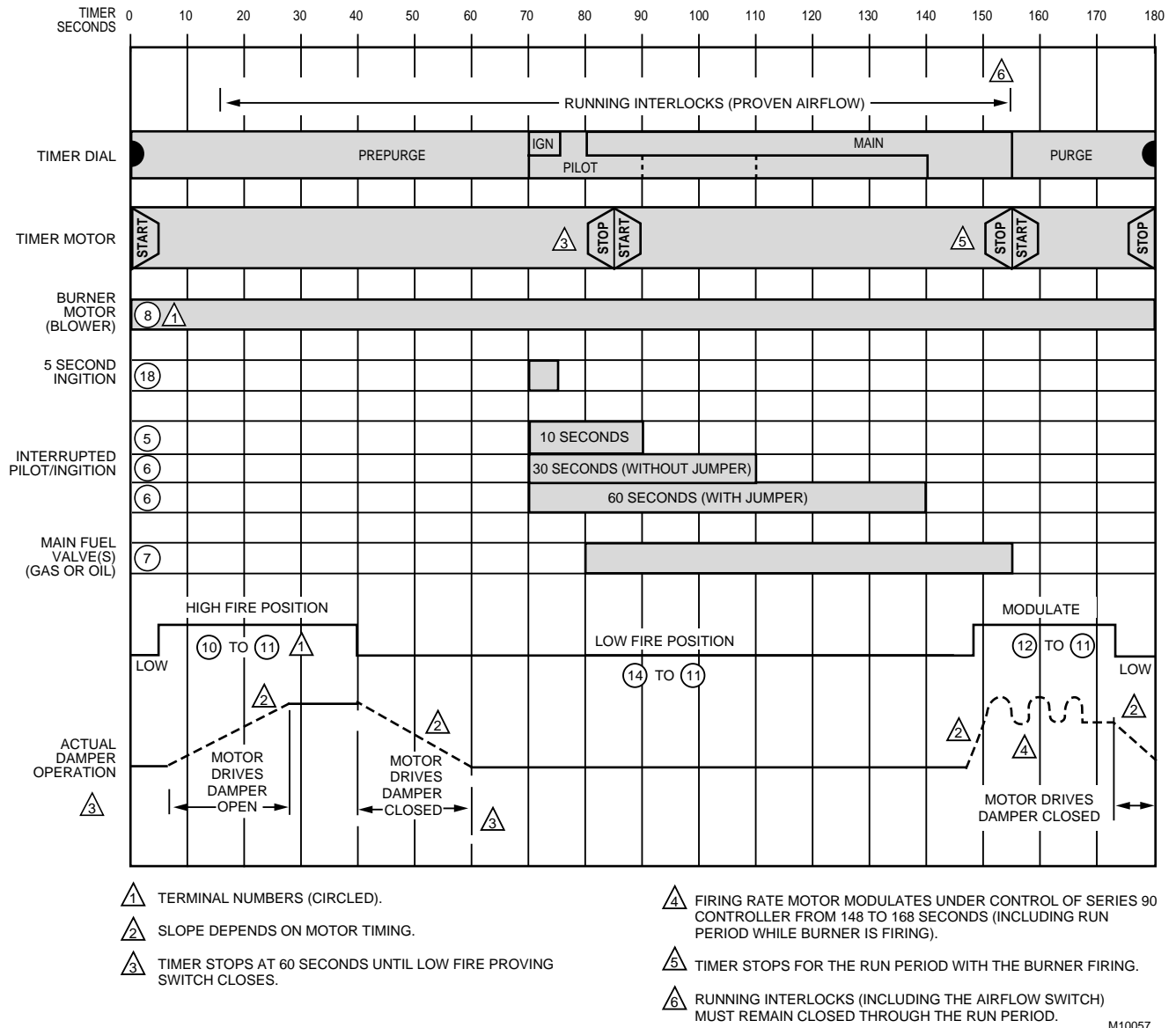


Fig. 12. Timer sequence for R4140G1171, R4140G1122 and R4140G1114 Programmers.

Step-By-Step Operation (R4140G1171, R4140G1122 and R4140G1114)

Start and Prepurge

- 0 seconds—On a call for heat, the burner controller contacts close. If the limits and start interlock(s) are closed, relay 1K pulls in through M7B, 2K2, the LS HTR (lockout switch heater—thus proving its continuity), and LS2.
 - 1K1 closes and 1K2 opens; timer starts (through M3A and M5B); power is applied to terminal 8, starting the burner motor (blower); 1K3 closes.
 - Prepurge begins.
- 5 seconds—M10A closes, M10B opens; firing rate motor drives toward high fire position (open).
- 6 seconds—M1B closes, bypassing 1K1; the timer completes its revolution if shutdown occurs.
- 10 seconds—M11B closes; flame relay 2K can pull in if a flame (or a condition simulating a flame) is detected. If detected during prepurge (until 67 seconds), 2K pulls in, 2K2 opens, 1K drops out, and the system shuts

- down; the timer completes its revolution and recycles the programmer.
- 13.5 seconds—M7B opens; running interlocks must be closed (airflow must be proven) or 1K drops out, 1K3 opens, and ignition trials cannot be started. Running interlocks must remain closed through the Run period or the system shuts down; the timer completes its revolution and recycles the programmer.
- 40 seconds—M10B closes; firing rate motor drives toward low fire position (closed).
- 60 seconds—M3A opens; timer stops until the low fire proving switch closes; timer can be stopped by opening the timer switch (until 76 seconds when M3A closes again).
- 67 seconds—M7A closes; the LS HTR (lockout switch heater) begins heating in preparation for ignition trials.

Ignition Trials

- 70 seconds—M4A closes; power is applied to terminals 18, 5 and 6, energizing the ignition transformer and pilot valve (and terminal 7, main oil valve solenoid, if using direct spark ignition of oil).
 - When flame is detected, relay 2K pulls in, 2K2 opens, and the LS HTR stops heating; 2K1 and 2K3 close.
- 75 seconds—M9B opens; 5 second ignition (terminals 18) de-energizes (pilot only until 80 seconds).
- 76 seconds—M3A closes, bypassing the low fire switch and the timer switch.
- 80 seconds—M2B opens; pilot or ignition trial ends; flame must be detected by this time (2K pulled in and 2K1 closed) or safety shutdown occurs and the lockout switch trips.
 - M2A closes; power is applied to terminal 7, energizing the main fuel valve(s).
 - M11B opens; prevents 2K from pulling in after this time.
- 90 seconds—M6B opens; 10 second interrupted pilot/ignition (terminal 5) de-energizes.
- 110 seconds—M4A opens; 30 second interrupted pilot/ignition (terminal 6) de-energizes if jumper was *not* installed on back of programmer.
- 140 seconds—M12B opens; 60 second interrupted pilot/ignition (terminal 6) de-energizes if jumper was installed on back of programmer.

- 148 seconds—M8A closes, M8B opens; firing rate motor is released to modulate under control of the Series 90 Controller.
- 155 seconds—M5B opens; timer stops with the system in the Run condition.

Run Period (Burner is Firing)

Postpurge and Stop

- 155 seconds—When the operating setpoint is reached, the burner controller contacts open; relay 1K and the main fuel valve(s) (terminal 7) de-energizes.
 - 1K2 closes; timer motor starts; postpurge begins.
 - When flame goes out, relay 2K drops out.
- 168 seconds—M8A opens; firing rate motor stops modulating under control of the Series 90 Controller.
- 174 seconds—M8B closes; firing rate motor drives toward low fire position (closed).
- 180 seconds—M1B opens; timer and burner motor stop; cycle ends.

Fig. 13 shows all contacts in the standby position (zero seconds). The opening and closing times are shown adjacent to each timer contact. Refer to Fig. 14 and the Step-by-Step Operation section.

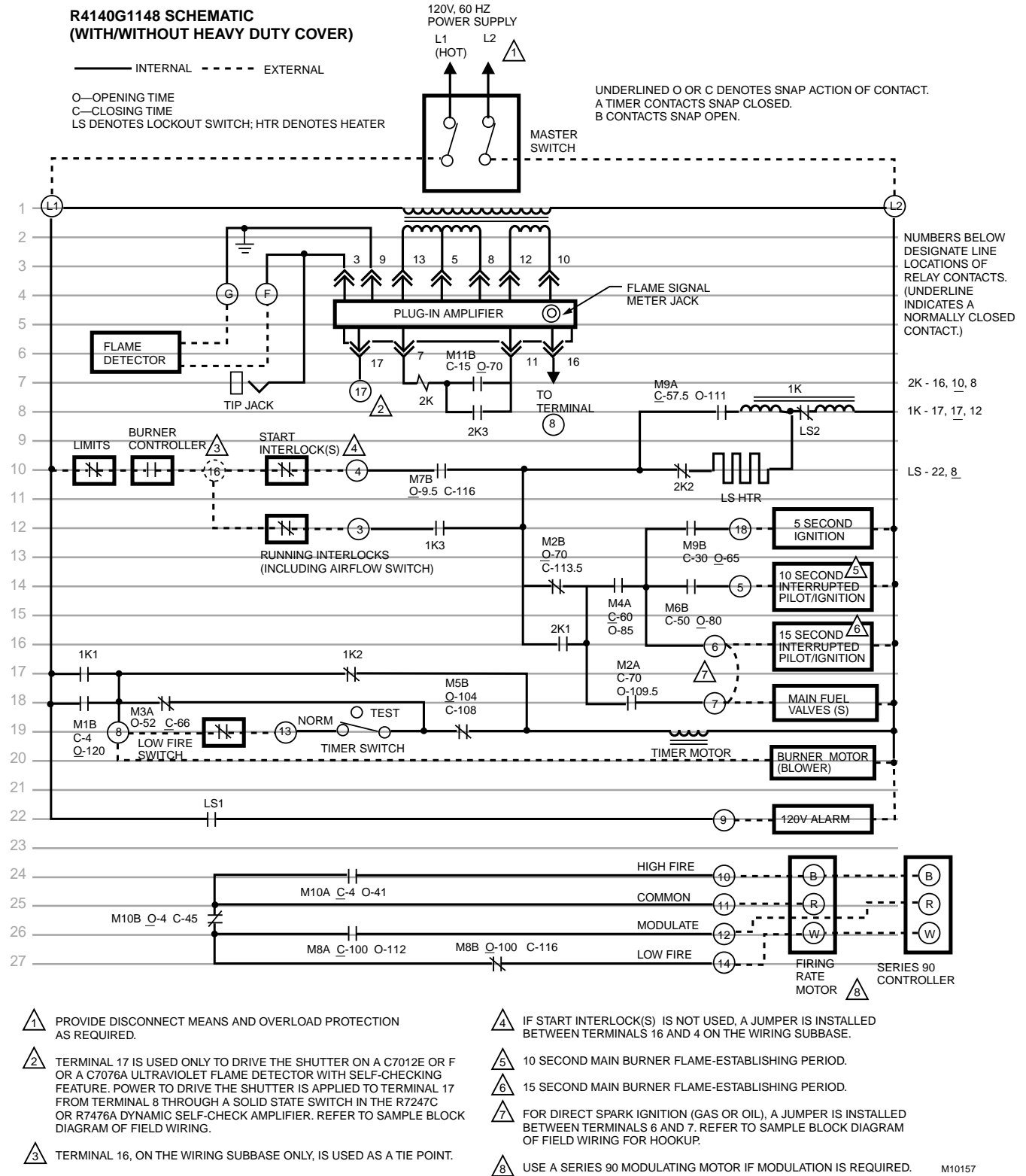
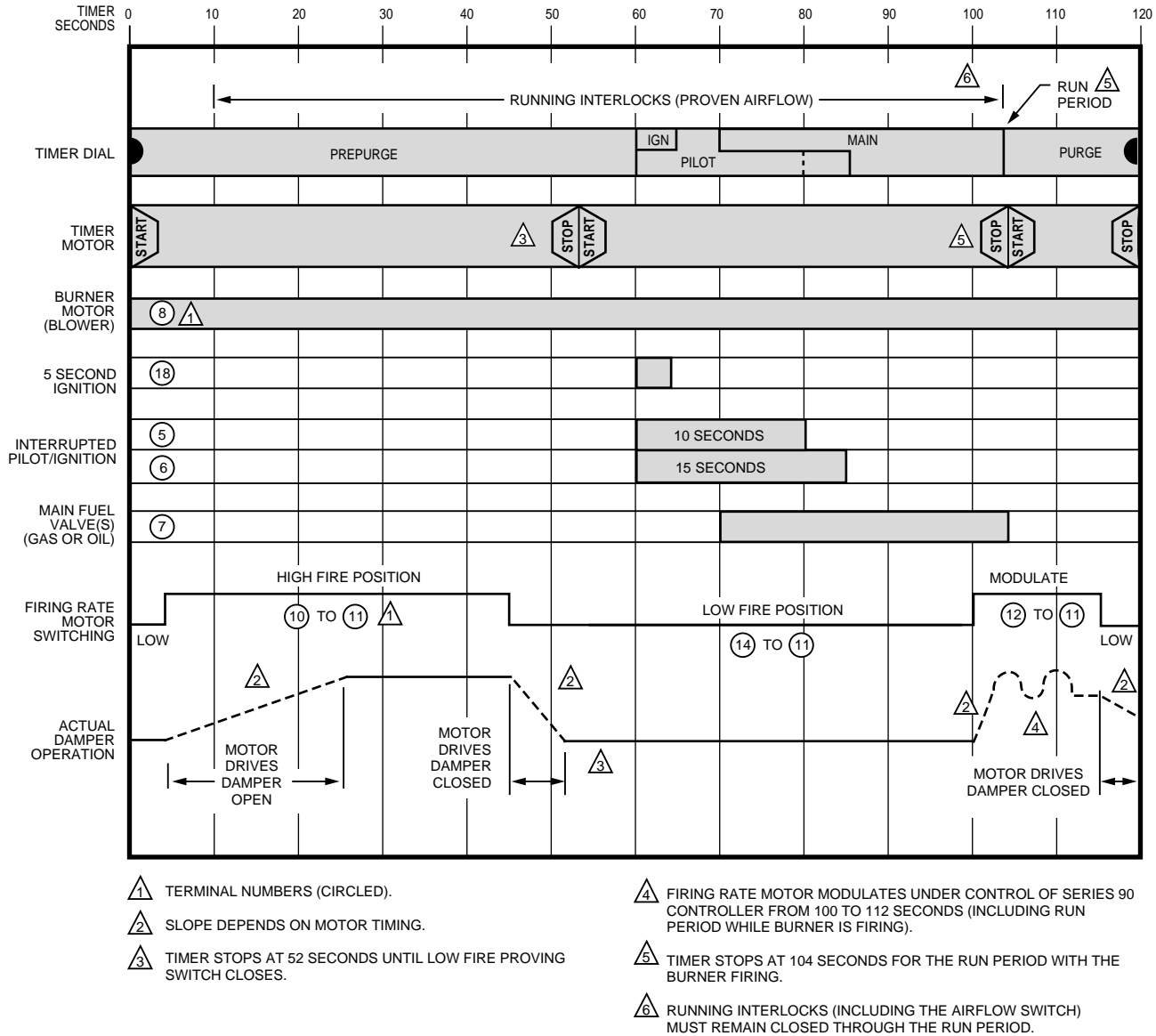


Fig. 13. Simplified schematic diagram of R4140G1148 Programmer.



M10058

Fig. 14. Timer sequence for R4140G1148 Programmer.

Step-By-Step Operation (R4140G1148)

Start and Prepurge

- 0 seconds—On a call for heat, the burner controller contacts close. If the limits and start interlock(s) are closed and flame relay 2K is not holding in, relay 1K pulls in through M7B, 2K2, the LS HTR (lockout switch heater—thus proving its continuity), and LS2.
 - 1K1 closes and 1K2 opens; timer motor starts (through 1K1, M3A, and M5B); power is applied to terminal 8, starting the burner motor (blower); 1K3 closes.
 - Prepurge begins.
- 4 seconds—M10A closes, M10B opens; firing rate motor drives toward high fire position (open).
 - M1B closes, bypassing 1K1; the timer can complete its revolution if shutdown occurs.
- 9.5 seconds—M7B opens; running interlocks must be closed (airflow must be proven) or 1K drops out, 1K3 opens, and ignition trials cannot be started. Running

- interlocks must remain closed through the Run period or the system shuts down; the timer completes its revolution and recycles the programmer.
- 15 seconds—M11B closes; flame relay 2K can pull in if a flame (or a condition simulating a flame) is detected. If detected during prepurge (until 57.5 seconds), 2K pulls in, 2K2 opens, 1K drops out, and the system shuts down; the timer completes its revolution and recycles the programmer (if 2K drops out).
- 45 seconds—M10B closes; firing rate motor drives toward low fire position (closed).
- 52 seconds—M3A opens; timer stops until the low fire proving switch closes; timer can be stopped by opening the timer switch (until 66 seconds when M3A closes again).
- 57.5 seconds—M7A closes; the LS HTR (lockout switch heater) begins heating in preparation for ignition trials.

Ignition Trials

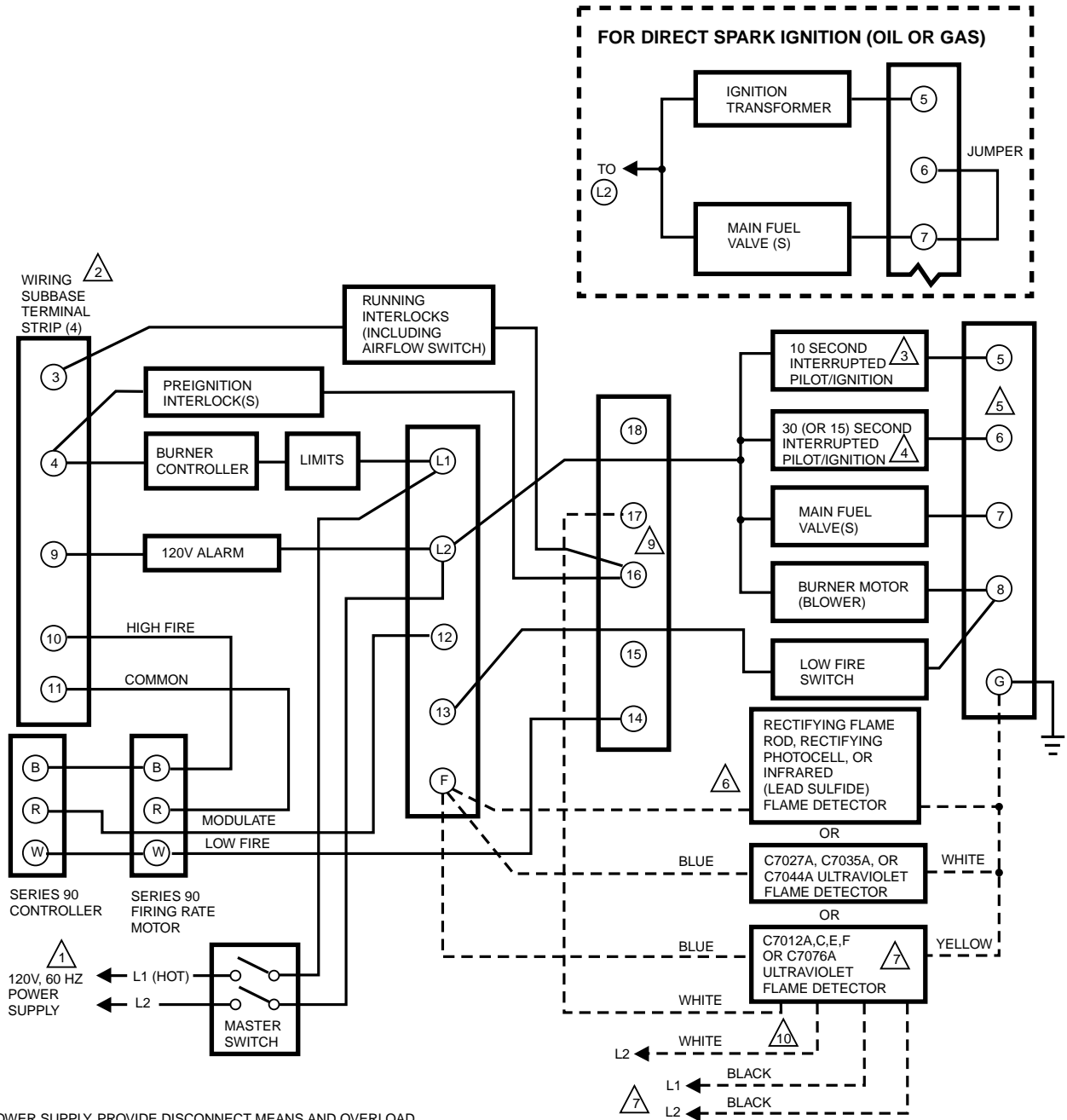
- 60 seconds—M4A closes; power is applied to terminals 18, 5 and 6, energizing the ignition transformer and pilot valve (or main fuel valve(s) on terminal 7 if using direct spark ignition).
- When a flame is detected, relay 2K pulls in, 2K2 opens, and the LS HTR stops heating; 2K1 and 2K3 close.
- 65 seconds—M9B opens; 5 second ignition (terminal 18) de-energizes (pilot only until 70 seconds).
- 66 seconds—M3A closes, bypassing the low fire switch and the timer switch.
- 70 seconds—M2B opens; pilot or ignition trial ends; a flame must be detected by this time (2K pulled in and 2K1 closed) or safety shutdown occurs and the lockout switch trips.
- M2A closes; power is applied to terminal 7, energizing the main fuel valve(s).
 - M11B opens; prevents 2K from pulling in after this time.
- 80 seconds—M6B opens; 10 second interrupted pilot/ignition (terminal 5) de-energizes.
- 85 seconds—M4A opens; 15 second interrupted pilot/ignition (terminal 6) de-energizes.
- 100 seconds—M8A closes, M8B opens; firing rate motor is released to modulate under control of the Series 90 Controller.
- 104 seconds—M5B opens; timer stops with the system in the run condition.

Run Period (Burner is Firing)**Postpurge and Stop**

- 104 seconds—When the operating setpoint is reached, the burner controller contacts open; relay 1K and the main fuel valve(s) (terminal 7) de-energizes.
- 1K2 closes; timer motor starts; postpurge begins.
 - When the flame goes out, relay 2K drops out.
- 112 seconds—M8A opens; firing rate motor stops modulating under control of the Series 90 Controller.
- 116 seconds—M8B closes; firing rate motor drives toward low fire position (closed).
- 120 seconds—M1B opens; timer and burner motor stop; cycle ends.

WIRING (FIG. 15 AND 16)**CAUTION**

1. Disconnect power supply before beginning wiring to prevent electrical shock and equipment damage.
2. Wiring must comply with all applicable local electrical codes, ordinances, and regulations.
3. All wiring must be NEC Class 1 (line voltage).

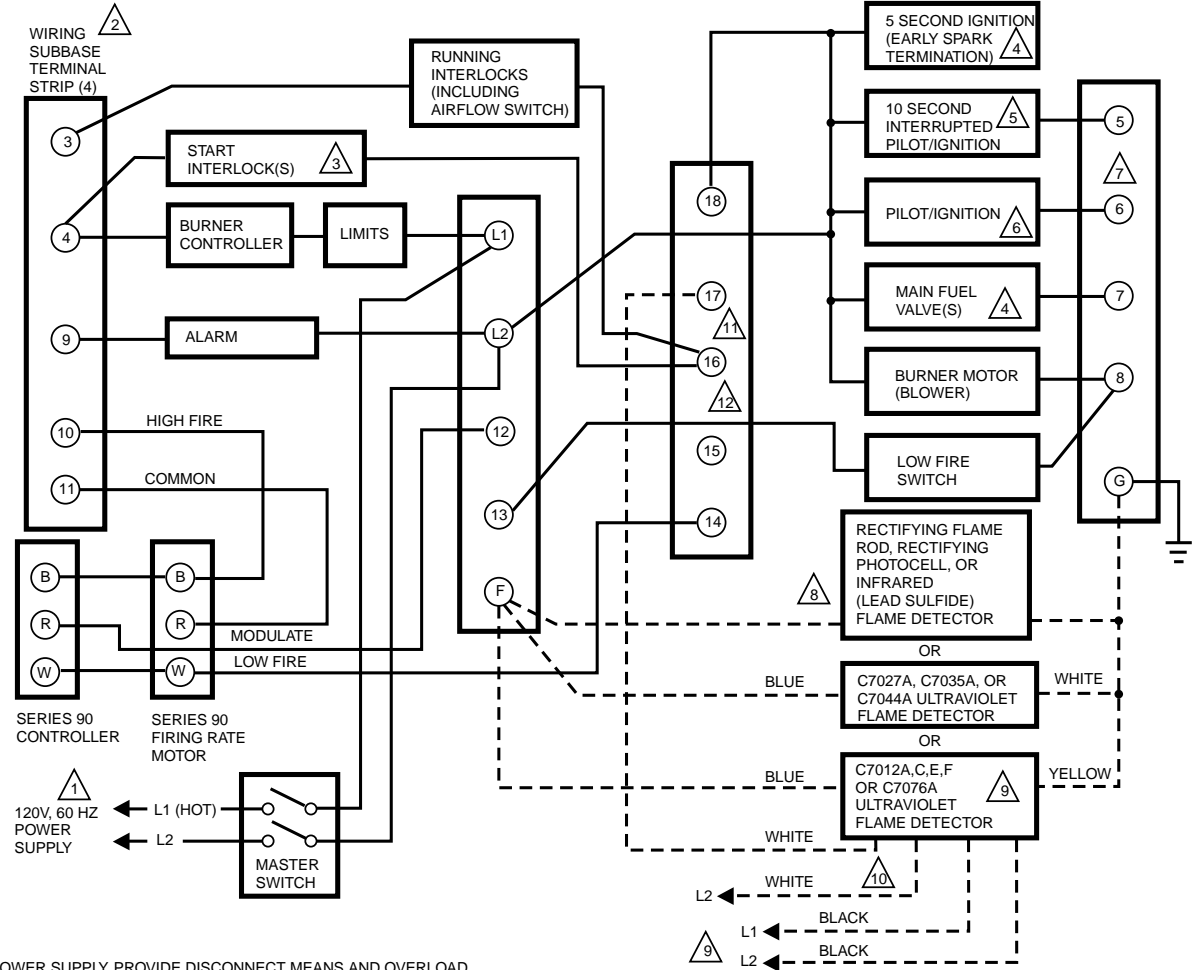
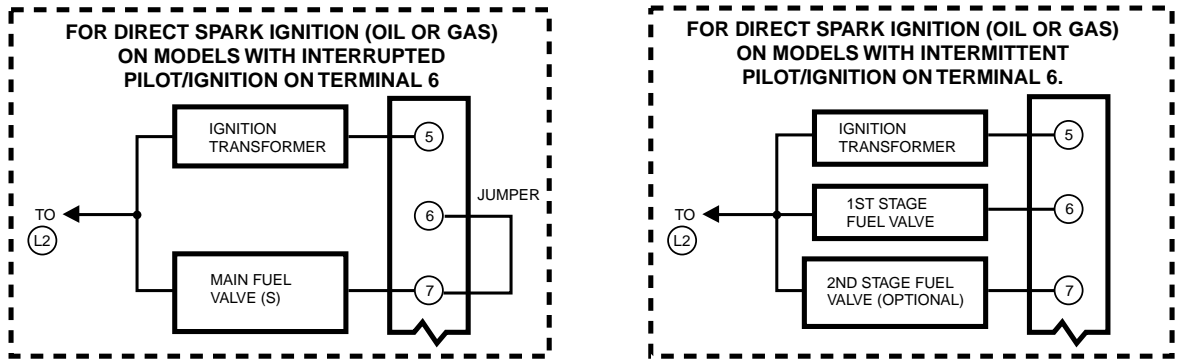


- 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 USE ALL NEC CLASS 1 WIRING.
- 3 10 SECOND MAIN BURNER FLAME-ESTABLISHING PERIOD.
- 4 30 SECOND MAIN BURNER FLAME-ESTABLISHING PERIOD (MBFEP) ON THE R4140G1007 and R4140G1015 MODELS; 15 SECOND MBFEP ON THE R4140G1106 MODEL.
- 5 FOR DIRECT SPARK IGNITION (OIL OR GAS) CONNECT THE IGNITION TRANSFORMER AND FUEL VALVE(S) AS SHOWN IN THE INSET.
- 6 FOR THE C7015A INFRARED (LEAD SULFIDE) FLAME DETECTOR, EITHER LEADWIRE CAN BE CONNECTED TO THE F TERMINAL. RUN THE C7015A LEADWIRES ALONE IN CONDUIT ALL THE WAY TO THE WIRING SUBBASE AND GROUND THE CONDUIT AT THE SUBBASE. (REFER TO PUBLICATION 60-2306 FOR DETAILED INSTRUCTIONS.)

- 7 C7012 OR C7076 MUST BE RATED FOR 120 V, 60Hz. TWO DETECTORS WITH THE SAME MODEL NUMBER CAN BE WIRED IN PARALLEL TO THE SAME TERMINALS. C7076A DOES NOT HAVE LEADWIRES. (FOR INSTRUCTIONS, SEE FORM NUMBERS: 60-2046 FOR C7012A,C MODELS WITH ELECTRON TUBES; 60-2044 FOR C7012E,F MODELS WITH ELECTRON TUBES; 60-2398 FOR C7012A,C,E,F SOLID STATE MODELS; 95-8269 FOR THE C7076A.)
- 8 WHITE SHUTTER LEADWIRES ARE ONLY ON THE C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTORS WITH SELF-CHECKING FEATURE; C7076A ADJUSTABLE SENSITIVITY ULTRAVIOLET FLAME DETECTORS DO NOT HAVE LEADWIRES.
- 9 TERMINAL 17 IS USED ONLY FOR THE SHUTTER ON SELF-CHECKING C7012E,F OR C7076A FLAME DETECTORS.

M10131

Fig. 15. Sample block diagram of field wiring for R4140G1007, R4140G1015 and R4140G1106 Programmers.



- 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 USE ALL NEC CLASS 1 WIRING.
- 3 IF START INTERLOCK(S) IS NOT USED, INSTALL A JUMPER BETWEEN TERMINALS 4 AND 16.
- 4 5 SECOND IGNITION IS AVAILABLE ONLY ON THE R4140G1049, G1056, G1064, G1114, G1122, G1148, AND G1171 MODELS.
- 5 10 SECOND MAIN BURNER FLAME-ESTABLISHING PERIOD. ON R4140G114, G1122, G1171 FOR 60 SECOND INTERRUPTED PILOT IGNITION, INSTALL JUMPER (IN 4074B2V BAG ASSEMBLY) ON BACK OF PROGRAMMER BETWEEN SCREW TERMINALS LABELED "JUMPER TO EXTEND MAIN IGNITION TRIAL."
- 6 30 SECOND INTERRUPTED PILOT/IGNITION (30 SECOND MAIN BURNER FLAME-ESTABLISHING PERIOD, MBFEP) ON THE R4140 AND R4140G1049, G1114, G1122, G1171, 15 SECOND INTERRUPTED PILOT/IGNITION (15 SECOND MBFEP) ON THE R4140G1148. INTERMITTENT PILOT/IGNITION ON THE R4140G1056, AND R4140G1064.
- 7 FOR DIRECT SPARK IGNITION (OIL OR GAS) CONNECT THE IGNITION TRANSFORMER AND FUEL VALVE(S) AS SHOWN IN THE APPROPRIATE INSET.

- 8 FOR THE C7015A INFRARED (LEAD SULFIDE) FLAME DETECTOR, EITHER LEADWIRE CAN BE CONNECTED TO THE F TERMINAL. RUN THE C7015A LEADWIRES ALONE IN CONDUIT ALL THE WAY TO THE WIRING SUBBASE AND GROUND THE CONDUIT AT THE SUBBASE. (REFER TO PUBLICATION 60-2306 FOR DETAILED INSTRUCTIONS.)
- 9 C7012 OR C7076 MUST BE RATED FOR 120V, 60HZ. TWO DETECTORS WITH THE SAME MODEL NUMBER CAN BE WIRED IN PARALLEL TO THE SAME TERMINALS. C7076A DOES NOT HAVE LEADWIRES. (FOR INSTRUCTIONS SEE FORM NUMBERS; 60-2046 FOR C7012A, C MODELS WITH ELECTRON TUBES; 60-2044 FOR C7012E,F MODELS WITH ELECTRON TUBES; 60-2398 FOR C7012A,C,E,F SOLID STATE MODELS; 95-8269 FOR THE C7076A.) C7012E,F UV FLAME DETECTORS WITH SELF CHECKING FEATURE CANNOT BE USED WITH THE R4140G1122 OR R4140G1114.
- 10 WHITE SHUTTER LEADWIRES ARE ONLY ON THE C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTORS WITH SELF-CHECKING FEATURE; C7076A ADJUSTABLE SENSITIVITY ULTRAVIOLET FLAME DETECTOR DO NOT HAVE LEADWIRES.
- 11 TERMINAL 17 IS USED ONLY FOR THE SHUTTER ON SELF-CHECKING C7012E,F OR C7076A FLAME DETECTORS.
- 12 TERMINAL 16 IS USED ONLY AS A TIE POINT.

Fig. 16. Sample block diagram of field wiring for R4140G1049, R4140G1056, R4140G1064, R4140G1114, R4140G1122, R4140G1148 and R4140G1171 Programmers.

Optional Hookups for Two-Stage Switching or Intermittent Pilot/Ignition (Nonmodulating Oil Burners)

If modulation of the firing rate is not required, an R4140G can be used to provide two-stage switching for an oil burner; also, an R4140G with interrupted pilot/ignition on terminal 6 can be wired to provide an intermittent pilot/ignition. Refer to Fig. 17 for the necessary wiring changes and make these changes in the field wiring to the Q520A Wiring Subbase.

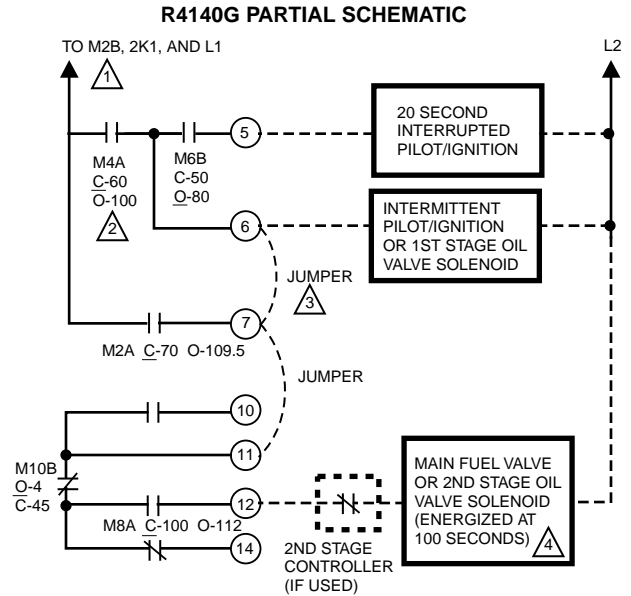
- 1 Remove all wiring from terminals 5,6,7,10,11, 12, and 14.
- 2 Install a jumper wire between terminals 6 and 7.
(If using an R4140G1056 or R4140G1064, this jumper is not necessary.)
- 3 Install a jumper wire between terminals 7 and 11.
- 4 Connect the ignition transformer between terminals 5 and L2 (for 20 second interrupted ignition), or between terminals 6 and L2 (for intermittent ignition).
- 5 For two-stage switching:
 - a. Connect the first stage oil valve solenoid between terminals 6 and L2.
 - b. Connect the second stage controller (if used) and second stage oil valve solenoid in series between terminals 12 and L2.
- 6 For an intermittent pilot:
 - a. Connect the intermittent pilot between terminals 6 and L2.
 - b. Connect the main fuel valve between terminals 12 and L2.

IMPORTANT

The fuel valve or solenoid connected to terminal 12 must not exceed the electrical rating of terminal 7.

NOTE: The maximum Pilot or First Stage Flame-Establishing Period is ten seconds.

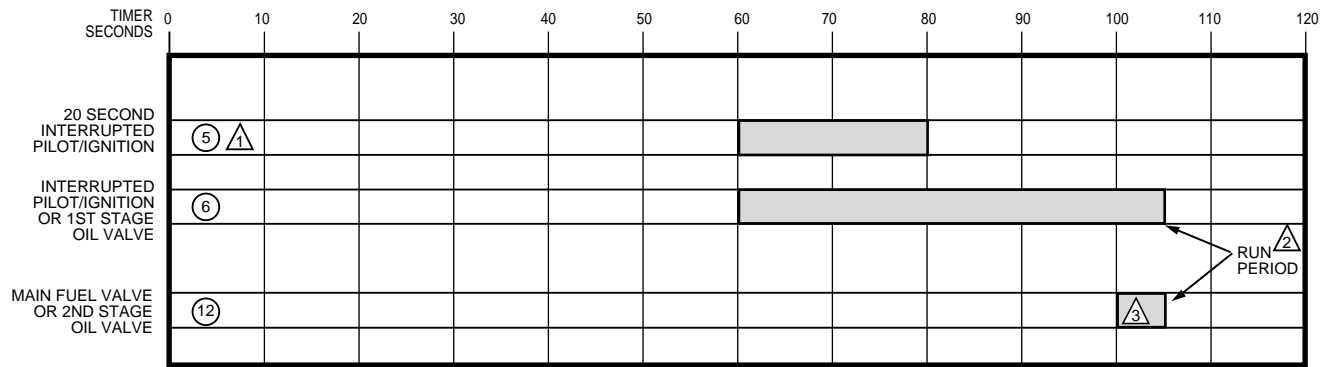
For a description of the Ignition Trials for this hookup, refer to Fig. 18 and the Step-by-Step Operation section.



- 1 REFER TO SCHEMATIC DIAGRAMS FOR COMPLETE INTERNAL WIRING AND CONTACT SWITCHING.
- 2 M4A O-85 ON THE R4140G1106, AND R4140G1148; O-110 ON THE R4140G1056, R4140G1064, R4140G1114, R4140G1122, AND R4140G1171.
- 3 JUMPER IS NOT NECESSARY TO OBTAIN INTERMITTENT PILOT/IGNITION ON THE R4140G1056, OR R4140G1064; THESE MODELS PROVIDE INTERMITTENT PILOT/IGNITION ON TERMINAL 6.
- 4 IF A 2ND STAGE CONTROLLER IS USED, THE 2ND STAGE OIL VALVE SOLENOID IS NOT ENERGIZED UNTIL THE 2ND STAGE CONTROLLER CONTACTS CLOSE.

M10060

Fig. 17. Field wiring changes (dashed) to provide two-stage switching or intermittent pilot/ignition for a nonmodulating oil burner.



△ 1 TERMINAL NUMBERS (CIRCLED).

△ 2 TIMER STOPS AT 104 SECONDS FOR THE RUN PERIOD WITH THE BURNER FIRING.

△ 3 IF A 2ND STAGE CONTROLLER IS USED, THE 2ND STAGE OIL VALVE IS ENERGIZED ONLY WHEN THERE IS A DEMAND FOR MORE HEAT AND THE 2ND STAGE CONTROLLER CONTACTS CLOSE.

M110061

Fig. 18. Partial timer sequence for optional hookups of R4140G Programmers.

Step-By-Step Operation (for Two-Stage Switching or Intermittent Pilot/ Ignition of a Nonmodulating Oil Burner)

Ignition Trials

60 seconds—M4A closes; power is applied to terminals 5 and 6, energizing the ignition transformer and pilot valve (or first stage oil valve solenoid when using two-stage switching).

— When a flame is detected, 2K pulls in, 2K2 opens, and the LS HTR stops heating; 2K1 and 2K3 close.

70 second—M2B opens; pilot or ignition trial ends; a flame must be detected by this time (2K pulled in and 2K1 closed) or safety shutdown occurs and the lockout switch trips.

— M2A closes; power is applied to terminal 7, maintaining power at terminals 6 and 11 (through the jumpers) until the Run period is completed.

80 seconds—M6B opens; 20 second interrupted pilot/ignition (terminal 5) de-energizes.

100 seconds—M8A closes; power is applied to terminal 12, energizing the main fuel valve (or second stage oil valve solenoid when using two-stage switching).

NOTE: If using two-stage switching with a second stage controller, the second stage oil valve solenoid energizes only when there is a demand for more heat and the second stage controller contacts close.

104 seconds—M5B opens; timer stops with the system in the run condition.

NOTE: Intermittent pilot/ignition and all fuel valves and solenoids (terminals 6 and 12) de-energize when the Run period is complete and the main burner controller contacts open.

For complete installation, checkout, troubleshooting, and service information, refer to form 60-0770.

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