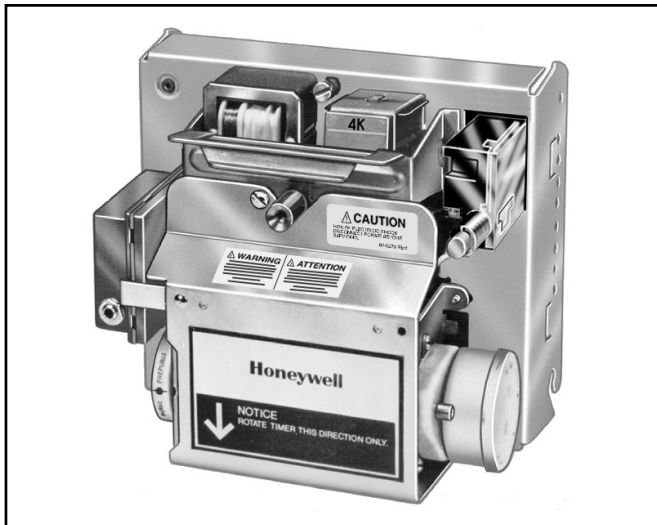


## R4140L Flame Safeguard Programming Controls

### PRODUCT DATA



### APPLICATION

The R4140L 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.
- **With auxiliary equipment,** also complies with Industrial Risk Insurers (formerly FIA) recommended good practices for single-burner boilers.
- The R4140 directly replaces the R4150 for most applications and mounts on the same Q520A Wiring Subbase.
- Low-high-low proven 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.
- R7427C 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.
- R7427B 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 high fire position of the firing rate motor near the start of prepurge, and low fire position before starting ignition trials.
- Provisions for connecting preignition interlocks to prove the proper conditions for startup, and for a combustion airflow switch to prove airflow throughout the operating cycle.
- All models have four-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 before and during prepurge; if a flame (or a condition simulating a flame) is detected, ignition trials cannot be started and safety shutdown occurs.
- Safety shutdown also occurs on (1) opening of a preignition interlock during prepurge, (2) opening of a lockout interlock (such as loss of air, or low or high fuel pressure) after 14 seconds, (3) failure to ignite the pilot, (4) failure to light the main burner, (5) loss of flame during the Run period, or (6) failure in the flame detection system (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

### Models:

R4140L 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.

### IMPORTANT

The specifications given in this publication do not include normal manufacturing tolerances. Therefore, this unit may not match the listed specifications. 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.

Table 1. Models Available.

Model	With Cover <sup>a</sup>	Timer Cycle (sec)	Prepurge <sup>b</sup> (seconds)	Early Spark Termination <sup>c</sup>	Flame-Establishing Period (seconds)		Postpurge (seconds)	Interlock Circuits	Firing Rate Switching Circuit
					Pilot <sup>d</sup>	Main Burner (Field Selectable) <sup>d</sup>			
R4140L1014	No	120	60	No	10	10 or 15	16	Preignition, lockout (including airflow switch), high fire, and low fire	4-wire (common, high fire, low fire, modulate)
R4140L1030 <sup>e</sup>	No	120	60	Yes	10	10 or 15	16		
R4140L1105	No	120	60	Yes	10	10 or 15	16		
R4140L1147	No	120	60	Yes	10	10, 15, or 30	15		

<sup>a</sup> 139695B Cover with reset button; heavy duty, metal cover for outside panel mounting.

<sup>b</sup> Extended proven high fire prepurge capability per Industrial Risk Insurers (formerly FIA) provided by auxiliary timer contact connected in series with and between the high fire switch and terminal 15.

NOTE: All external timers must be listed or component recognized by authorities having jurisdiction, for the specific purpose for which they are used.

<sup>c</sup> Early spark termination available on terminal 18 (five-second ignition and five-second pilot only).

<sup>d</sup> If used for direct spark ignition (oil or gas), the flame-establishing period is ten seconds.

<sup>e</sup> On the R4140L1030, the timer *cannot* be rotated manually.

### Interlock Circuits:

Preignition Interlocks—Must be closed to start programmer. If interlocks open during prepurge (after 14 seconds), ignition trials cannot be started and safety shutdown occurs.

Lockout Interlocks—Must be closed (airflow must be proven, fuel pressure must not be too low or too high) within 14 seconds after startup or ignition trials cannot be started. Interlocks must remain closed through the

run period or the automatic fuel valves de-energize and safety shutdown occurs.

High Fire Interlock—Timer stops at ten seconds until high fire proving switch closes, indicating damper is open.

Low Fire Interlock—Timer stops at 51 seconds (52 seconds for the R4140L1030) until low fire proving switch closes, indicating the damper is closed prior to ignition.

## 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

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Scarborough, Ontario M1V 4Z9.

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 before and during prepurge. If the flame relay 2K pulls in before 57.5 seconds, 2K1 opens, relay 3K drops out, ignition trials cannot be started, and safety shutdown occurs.

**Safety Shutdown**—Ignition transformer and all automatic fuel valves are de-energized. 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 standby position (zero seconds). The lockout switch must be manually reset to restart the system.

Safety Shutdown occurs on:

- Opening of a preignition interlock during prepurge (after 14 seconds).
- Opening of a lockout interlock (loss of air, low or high fuel pressure, etc.) after 14 seconds.
- Detection of a flame (or a condition simulating a flame) before or during prepurge until 57.5 seconds.
- 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.

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 the output terminals): 18 watts 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	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 or valves using a total of 1150 VA locked rotor (inrush), 460 VA to open, and 250 VA to hold or Motorized valve(s) using a total of 1500 VA locked rotor (inrush), 600 VA to open, and 250 VA to hold
8	Motor Burner (Blower)	9.8A full load, 58.8 amp 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 0.42 = 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 Lockout Interlocks (including airflow switch)	Ignition transformer, pilot valve, and main fuel valve(s)
Preignition Interlocks (all models except the R4140L1030)	Programmer relays 1K, 3K, and 4K (12 watts max)
Preignition Interlocks on the R4140L1030	Ignition transformer and pilot valve

**Ambient Operating Temperature Ratings:**

Minimum: Minus 40°F (minus 40°C).  
Maximum:

Programmer Mounting Position	
Standard Vertical (With Handle Up)	Any Other
+130°F (+54°C)	+125°F (+52°C)

**Storage Temperature Ratings:**

-60°F to +150°F (-51°C to +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.

**Flame Detection System (Ordered Separately):**

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

**Table 4. 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 <sup>a</sup> : C7004, C7007, C7011. Complete assemblies: C7005, C7008, C7009, Q179.
			R7247A, R7247B <sup>b</sup>	2 to 4 sec	Oil	Rectifying Photocells <sup>c</sup>	C7003, C7010. C7013, C7014.
		Dynamic Self-Check	R7247B <sup>b</sup>	2 to 4 sec	Gas, Oil, Coal	Ultraviolet (Purple Peeper)	C7012A or C.
			R7247C <sup>d</sup>	2 to 4 sec	Gas	Rectifying Flame Rods	Holders <sup>a</sup> :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 <sup>b</sup>	2 to 4 sec			
Ultraviolet	Purple	No	R7249A	2 to 4 sec	Gas, Oil	Ultraviolet (Minipeeper)	C7027, C7035, C7044.
	Blue	Dynamic Self-Check	R7476A <sup>d</sup>	2 to 4 sec	Gas, Oil, Coal	Ultraviolet (Adjustable Sensitivity)	C7076.

<sup>a</sup> Order Flame Rod separately; see instructions for the holder.

<sup>b</sup> Circuitry tests the Flame Signal Amplifier at least 150 times a minute during burner operation and shuts down the burner if the amplifier fails.

<sup>c</sup> Use only Honeywell part no. 38316 Photocell.

<sup>d</sup> 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.

**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. MP68; Guide No. MCCZ2.

Canadian Standards Association Certified: File No. LR1620.

Factory Mutual Approved: Report No. 24181.

Industrial Risk Insurers (Formerly FIA): Approvable.

**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).

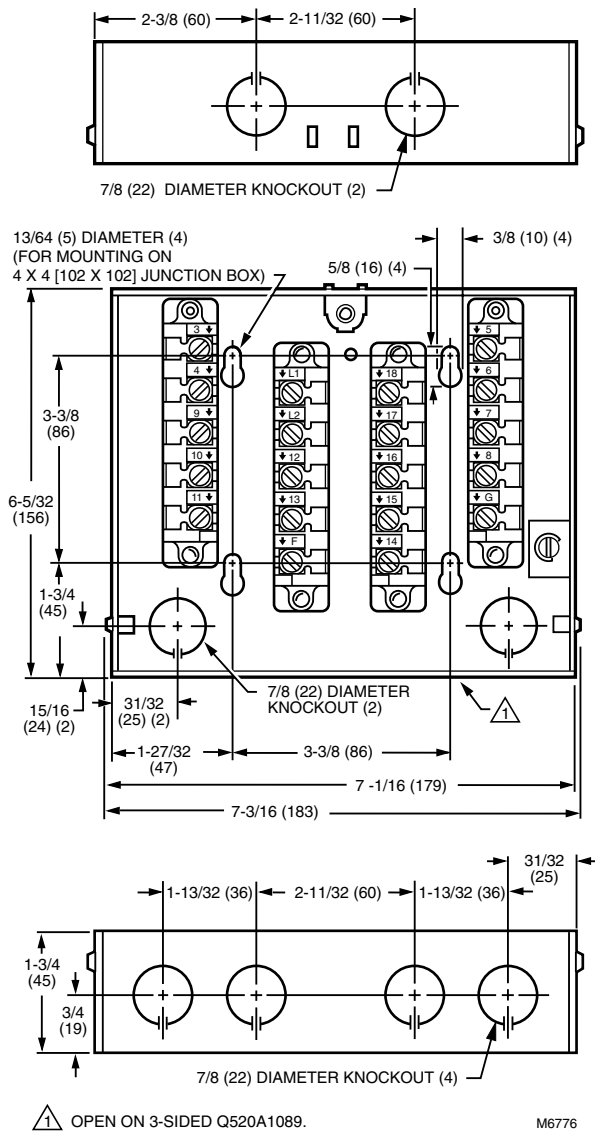
123514B Flame Simulator (for use with R7249A Ultraviolet Amplifiers).

139695C (Series 1 and 2); Cover with reset button; heavy duty, metal cover for outside panel mounting.

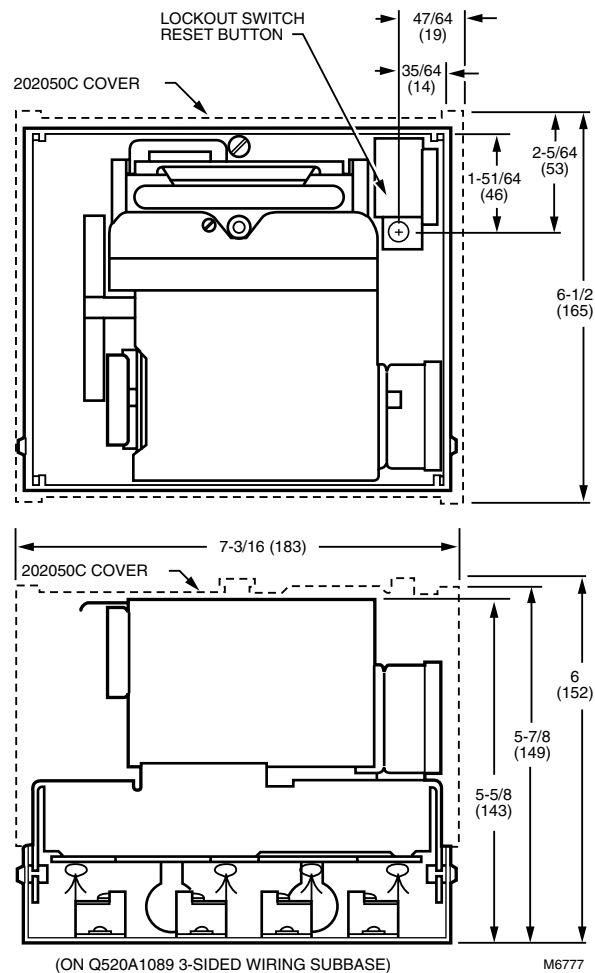
202050C (Series 3); Cover with reset button; heavy duty, metal cover for outside panel mounting.

- 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 25,000 volts or
- 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 or

- 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 (177°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.



**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).**

# OPERATION

## R4140L1014

Fig. 3 below 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.

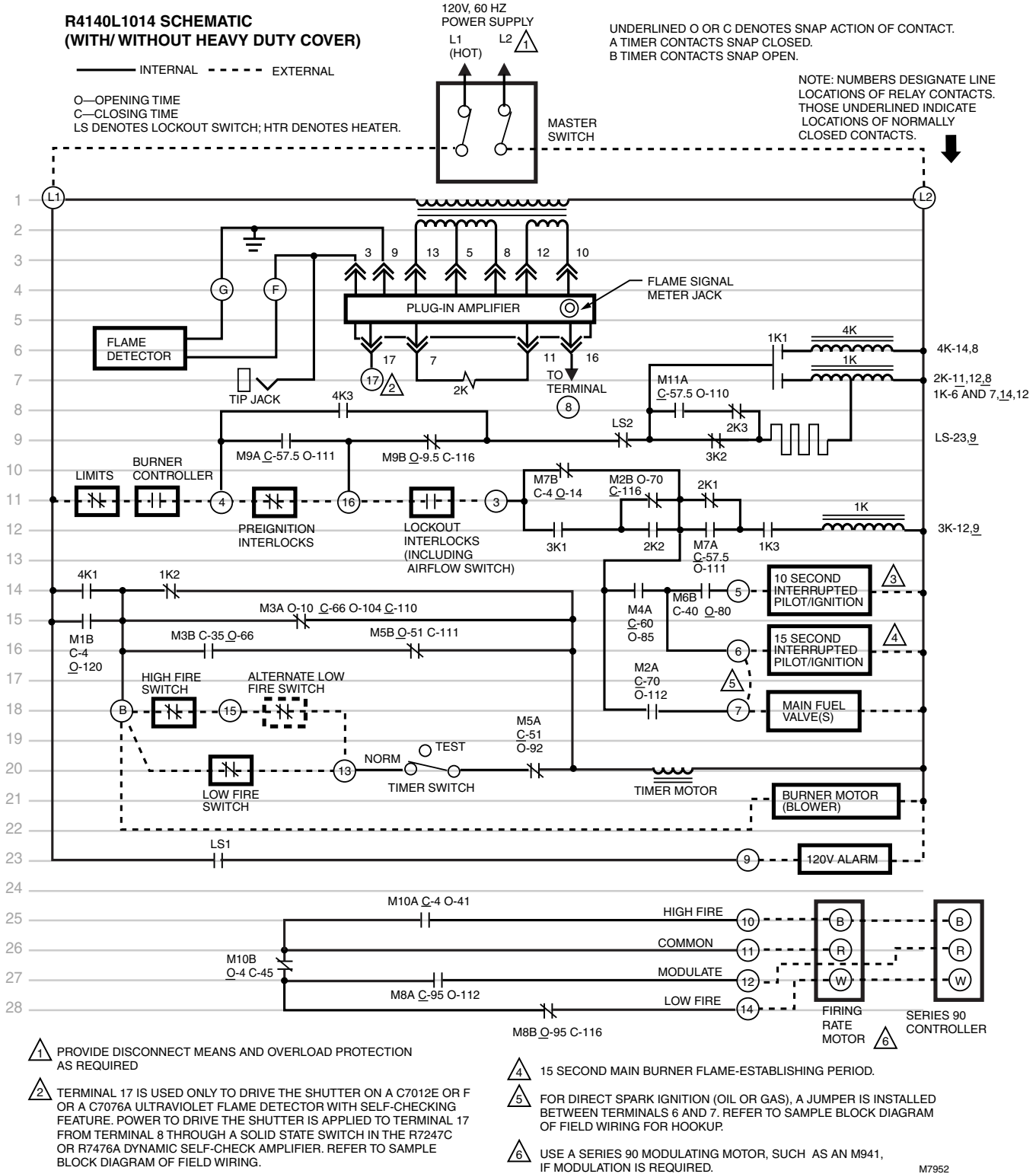


Fig. 3. Simplified schematic diagram of the R4140L1014 Programmers.

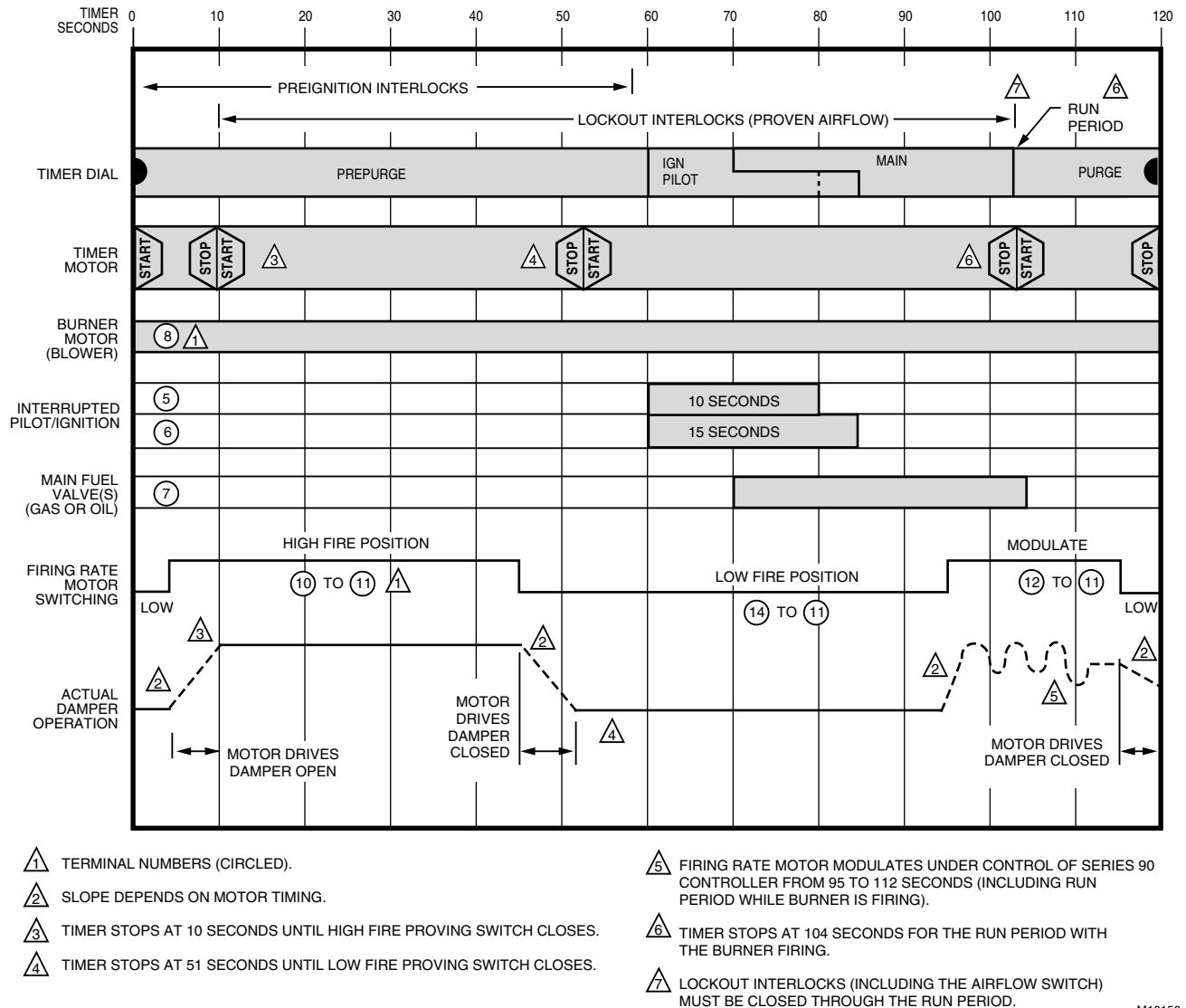


Fig. 4. Simplified Timer Sequence for R4140L1014 Programmer.

M10150

## Step-by-Step Operation (R4140L1014)

### Start and Prepurge

- 0 seconds—on a call for heat, the burner controller contacts close. If the limits and preignition interlocks are closed, relay 1K pulls in through M9B, LS2, 3K2, and the LS HTR (lockout switch heater—thus proving its continuity).
  - 1K1 closes; relay 4K pulls in and the LS HTR starts heating (through 1K1 and 3K2); 1K3 closes.
  - 4K1 closes and 1K2 opens; the timer motor starts (through 4K1 and M3A); power is applied to terminal 8, starting the burner motor (blower).
  - 4K3 closes; 1K and 4K stay pulled in through the run period unless safety shutdown occurs or a limit opens.
  - prepurge begins.
- 4 seconds—M10A closes, M10B opens; the firing rate motor drives toward high fire position (open).
  - M1B closes, bypassing 4K1; the timer can complete its revolution if safety shutdown occurs or a limit opens.

- M7B closes; when the lockout interlocks close (including the airflow switch and fuel pressure switches, if used), relay 3K pulls in (through M7B, 2K1, and 1K3).
  - 3K1 closes, bypassing M7B.
  - 3K2 opens; the LS HTR stops heating.
  - If a flame (or a condition simulating a flame) is detected before or during prepurge (until 57.5 seconds), 2K pulls in, 2K1 opens, relay 3K drops out, 3K2 closes, the LS HTR heats, and safety shutdown occurs.
- 10 seconds—M3A opens; timer stops until the high fire proving switch closes.
- 14 seconds—M7B opens; preignition interlocks must stay closed through prepurge, and lockout interlocks must stay closed continuously (airflow must be proven) through the run period, or relay 3K drops out.
  - If 3K drops out after 14 seconds:
    - 3K1 opens; ignition trials cannot be started, or fuel valves are de-energized if burner is already firing; 3K cannot pull in again until the next cycle.
    - 3K2 closes; lockout switch heater begins heating; safety shutdown occurs in approximately one-half minute.

- 35 seconds—M3B closes, bypassing the high fire switch.
- 45 seconds—M10B closes; firing rate motor drives toward low fire position (closed).
- 51 seconds—MSA closes, MSB 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, bypassing 2K1 in preparation for ignition trials; a flame can now be detected without causing safety shutdown.
  - M9A closes, bypassing the preignition interlocks.
  - M11A closes; the LS HTR starts heating (through 1K1, M11A, and 2K3).

### 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, 2K pulls in, 2K3 opens and the LS HTR stops heating; 2K1 opens and 2K2 closes.
- 66 seconds—M3A closes, bypassing the high fire switch, low fire switch, and timer switch.
- 70 seconds—M2B opens; pilot or ignition trial ends; a flame must be detected by this time (2K pulled in and 2K2 closed) or pilot/ignition is de-energized, relay 3K drops out, and safety shutdown occurs.
  - M2A closes; power is applied to terminal 7, energizing the main fuel valve(s).
- 80 seconds—M6B opens; ten second interrupted pilot/

- ignition (terminal 5) is de-energized.
- 85 seconds—M4A opens; 15 second interrupted pilot/ignition (terminal 6) is de-energized.
- 95 seconds—M8A closes, M8B opens; firing rate motor is released to modulate under control of the Series 90 Controller.
- 104 seconds—M3A 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; 1K, 3K, and 4K relays drop out; main fuel valve(s) (terminal 7) is 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.

### R4140L1030

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.



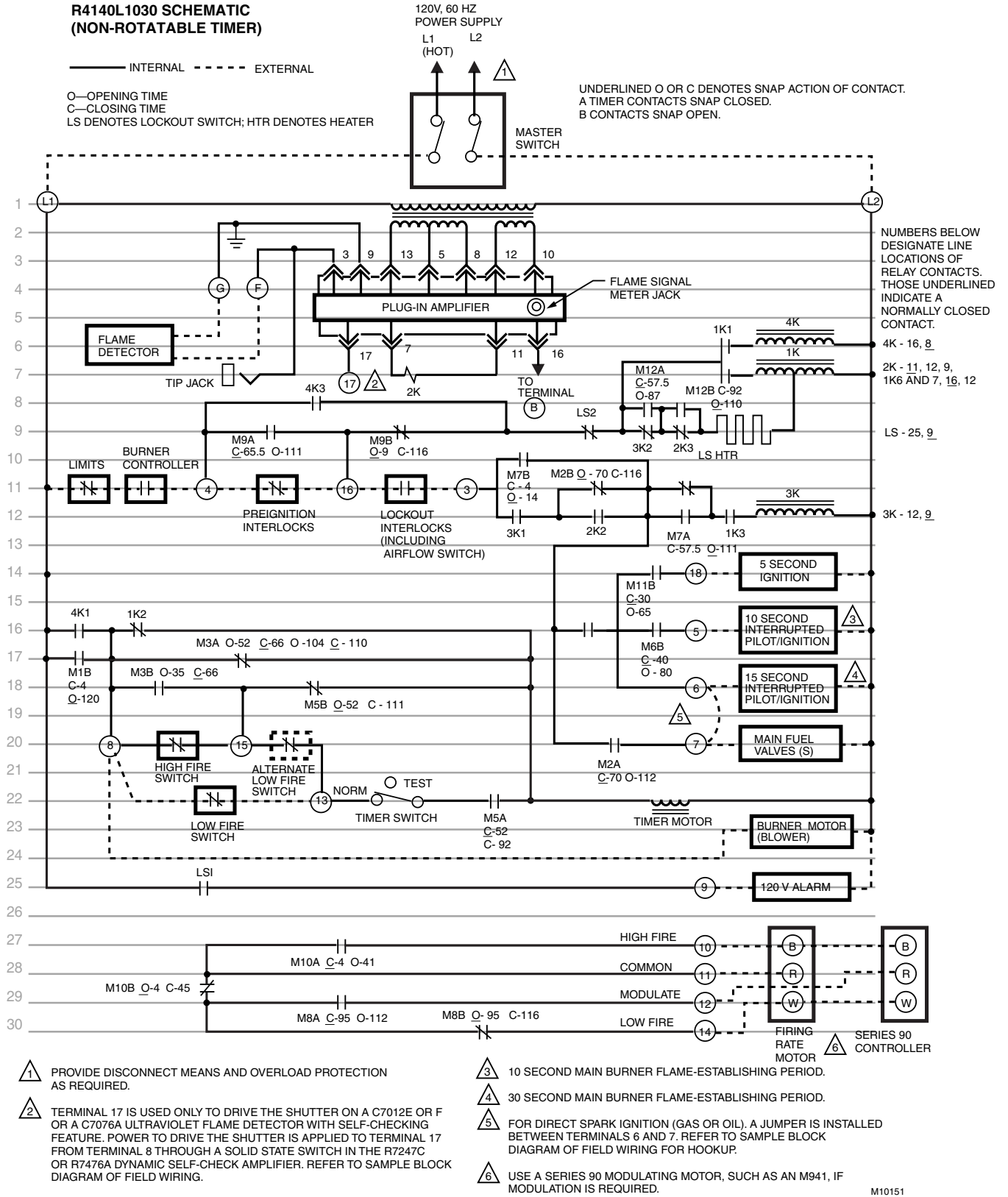


Fig. 5. Simplified schematic diagram of the R4140L1030 Programmer.

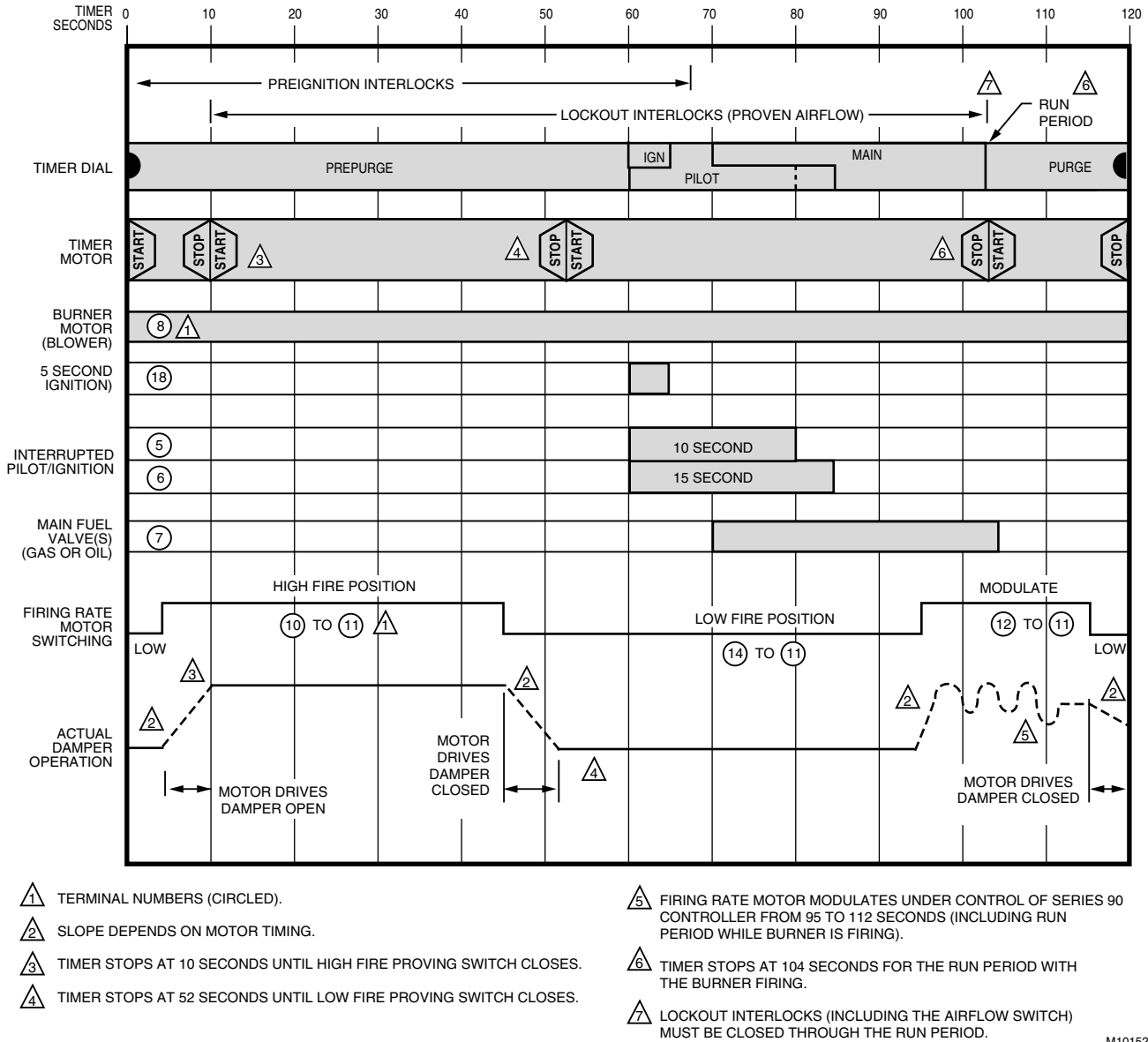


Fig. 6. Timer sequence for R4140L1030 Programmer.

M10152

## Step-by-Step Operation (R4140L1030 with Nonrotatable Timer)

### Start and Prepurge

- 0 seconds—On a call for heat, the burner controller contacts close. If the limits and preignition interlocks are closed, and a flame or flame simulating condition is not detected (2K not energized), relay 1K pulls in through M9B, LS2, 3K2, 2K3, and the LS HTR (lockout switch heater—thus proving its continuity).
- 1K1 closes; relay 4K pulls in and the LS HTR starts heating (through 1K1, 3K2, and 2K3); 1K3 closes.
  - 4K1 closes and 1K2 opens; the timer motor starts (through 4K1 and M3A); power is applied to terminal 8, starting the burner motor (blower).
  - 4K3 closes; 1K and 4K stay pulled in through the run period unless safety shutdown occurs or a limit opens.

- Prepurge begins.
- 4 seconds—M10A closes, M10B opens; the firing rate motor drives toward high fire position (open).
- M1B closes, bypassing 4K1; the timer can complete its revolution if safety shutdown occurs or a limit opens.
- M7B closes; when the lockout interlocks close (including the airflow switch and fuel pressure switches, if used), relay 3K pulls in (through M7B, 2K1, and 1K3).
  - 3K1 closes, bypassing M7B.
  - 3K2 opens; the LS HTR stops heating.
  - If a flame (or a condition simulating a flame) is detected before or during prepurge (until 57.5 seconds), 2K pulls in, 2K1 opens, relay 3K drops out, and safety shutdown occurs.
- 10 seconds—M3A opens; timer stops until the high fire proving switch closes.

14 seconds—M7B opens; preignition interlocks must stay closed through prepurge, and lockout interlocks must stay closed continuously (airflow must be proven) through the run period, or relay 3K drops out.

— If 3K drops out after 14 seconds:

- 3K1 opens; ignition trials cannot be started, or fuel valves de-energize if burner is already firing; 3K cannot pull in again until the next cycle.
- 3K2 closes; lockout switch heater begins heating and safety shutdown occurs in approximately one-half minute,

35 seconds—M3B closes, bypassing the high fire switch.

45 seconds—M10B closes; firing rate motor drives toward low fire position (closed).

52 seconds—MSA closes, MSB 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, bypassing 2K1 in preparation for ignition trials; a flame can now be detected without causing safety shutdown,

— M12A closes; the LS HTR starts heating (through 1K1, M12A, and 2K3).

### 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, 2K pulls in, 2K3 opens, and the LS HTR stops heating; 2K1 opens and 2K2 closes.

65 seconds—M11B opens; 5 second ignition (terminal 18) de-energizes (pilot only until 70 seconds).

66 seconds—M3A closes, bypassing the high fire switch, low fire switch, and timer switch.

66.5 seconds—M9A closes, bypassing the preignition interlocks.

70 seconds—M2B opens; pilot or ignition trial ends; a flame must be detected by this time (2K pulled in and 2K2 closed) or pilot/ignition de-energizes, relay 3K drops out, and safety shutdown occurs.

— M2A closes; power is applied to terminal 7, energizing the main fuel valve(s).

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.

95 seconds—M8A closes, M8B opens; firing rate motor is released to modulate under control of the Series 90 Controller.

104 seconds—M3A 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; 1K, 3K, and 4K relays drop out; 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.

# R4140L1147

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

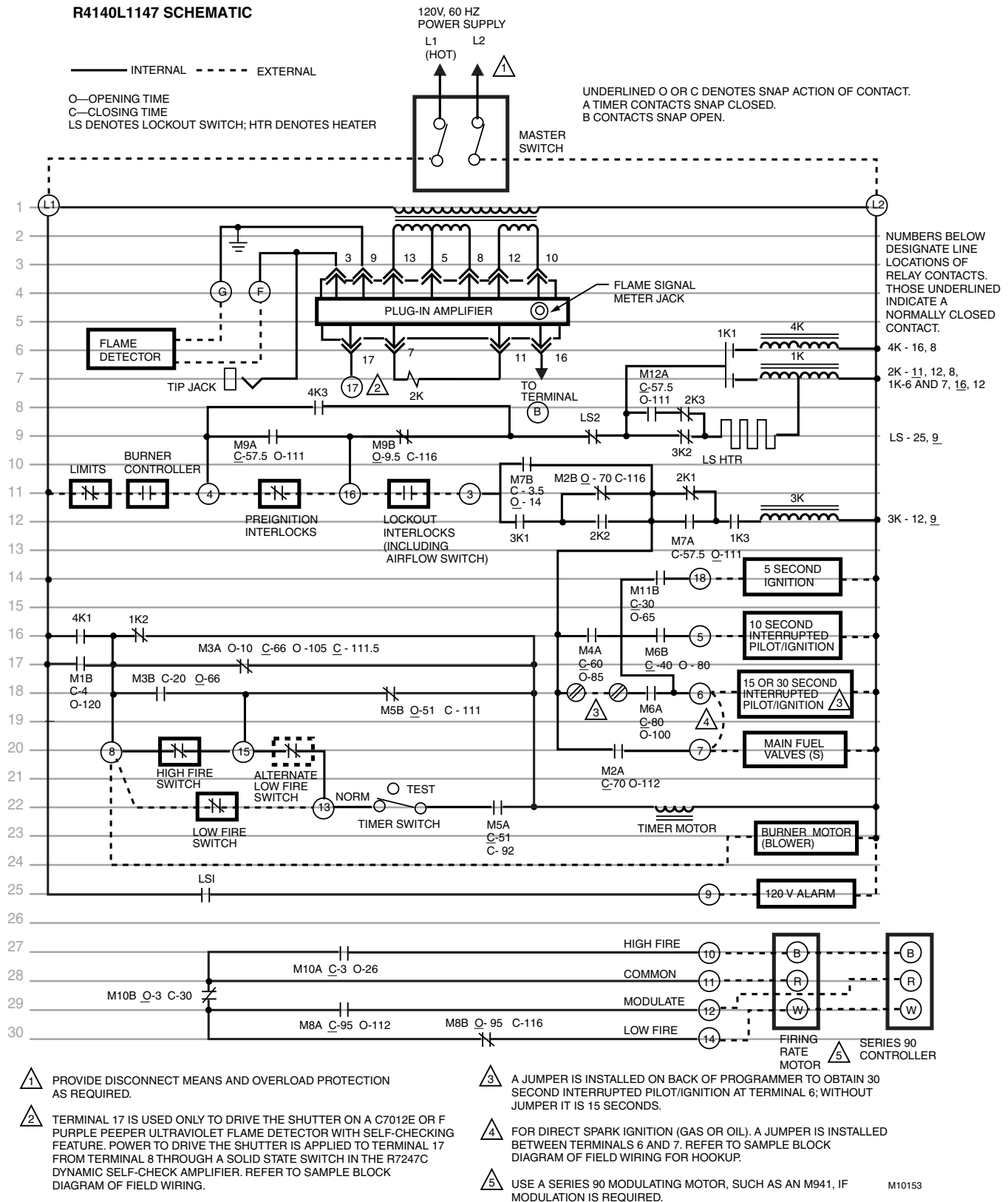


Fig. 7. Simplified schematic diagram of the R4140L1147 Programmer.

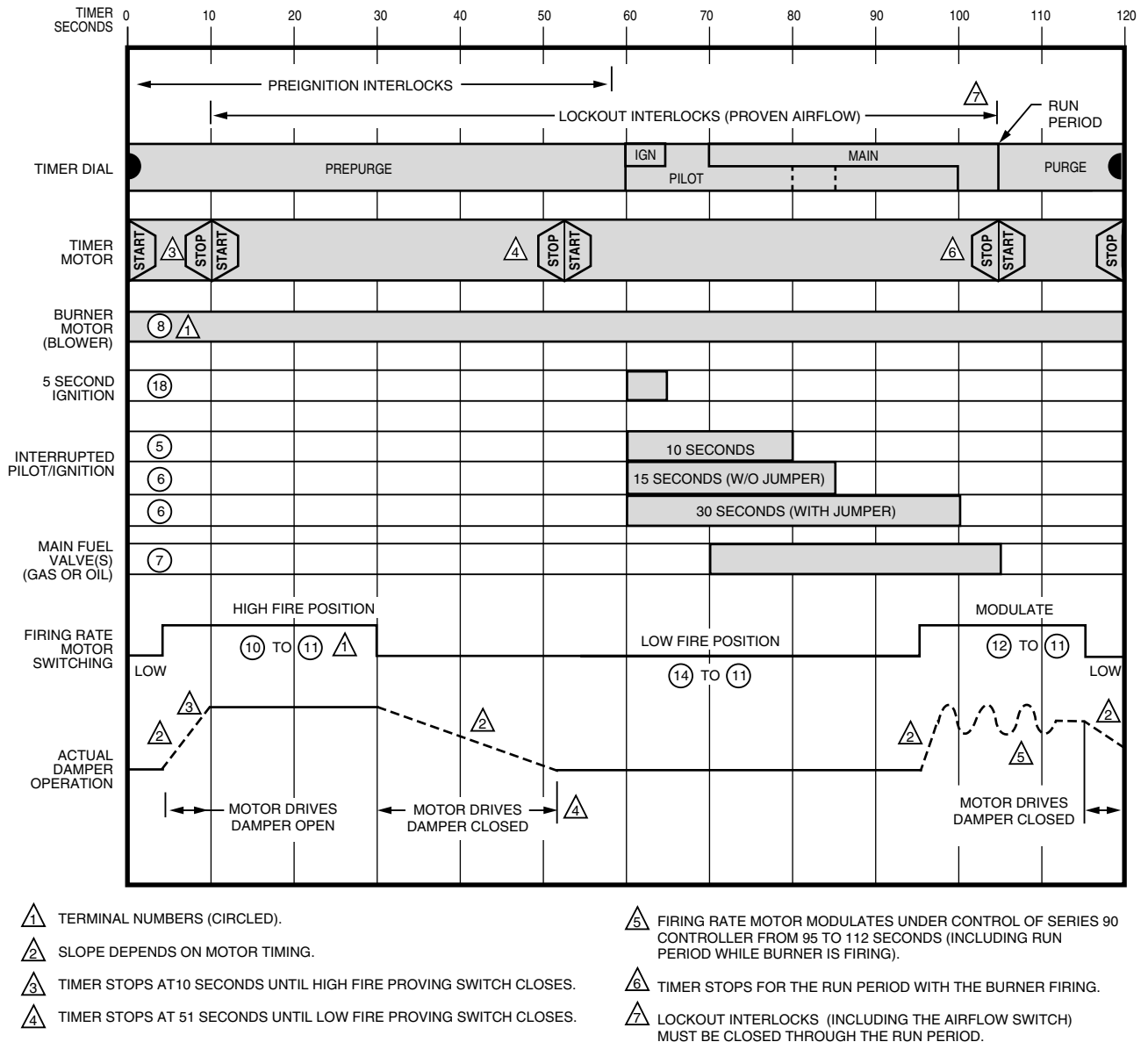


Fig. 8. Timer Sequence for R4140L1147 Programmer.

M11061

## Step-by-Step Operation (R4140L1147)

### Start and Prepurge

- 0 seconds—On a call for heat, the burner controller contacts close. If the limits and preignition interlocks are closed, relay 1K pulls in through M9B, LS2, 3K2, and the LS HTR (lockout switch heater—thus proving its continuity).
  - 1K1 closes; relay 4K pulls in and the LS HTR starts heating (through 1K1 and 3K2); 1K3 closes.
  - 4K1 closes and 1K2 opens; the timer motor starts (through M3A); power is applied to terminal 8, starting the burner motor (blower). Prepurge begins.
  - 4K3 closes; 1K and 4K stays pulled in through the run period unless safety shutdown occurs or a limit opens.
- 3 seconds—M10A closes, M10B opens; the firing rate motor drives damper toward the high fire position (open).

- 3.5 seconds—M7B closes; when the lockout interlocks close (including the airflow switch and fuel pressure switches, if used), relay 3K pulls in (through M7B, 2K1, and 1K3).
  - 3K1 closes, bypassing M7B.
  - 3K2 opens; the LS HTR stops heating.
  - If a flame (or a condition simulating a flame) is detected before or during prepurge (until 57.5 seconds), 2K pulls in, 2K1 opens, relay 3K drops out, 3K2 closes, the LS HTR heats, and safety shutdown occurs.
- 4 seconds—M1B closes, bypassing 4K1; the timer can complete its revolution if safety shutdown occurs or a limit opens.
- 10 seconds—M3A opens; timer stops until the high fire proving switch closes.
- 14 seconds—M7B opens; preignition interlocks must stay closed through prepurge, and lockout interlocks must stay closed continuously (airflow must be proven) through the run period, or relay 3K drops out.

- If 3K drops out after 14 seconds:
  - 3K1 opens; ignition trials cannot be started, or fuel valves are de-energized if burner is already firing; 3K cannot pull in again until the next cycle.
  - 3K2 closes; lockout switch heater begins heating; safety shutdown occurs in approximately half a minute.

- 20 seconds—M3B closes, bypassing the high fire switch.
- 30 seconds—M10B closes; firing rate motor drives toward low fire position (closed).
- 51 seconds—M5A closes, M5B 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, bypassing 2K1 in preparation for ignition trials; flame can now be detected without causing safety shutdown.
  - M9A closes, bypassing the preignition interlocks.
  - M12A closes; the LS HTR starts heating (through 1K1, M12A, and 2K3).

### 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 flame is detected, 2K pulls in, 2K3 opens, and the LS HTR stops heating; 2K1 opens and 2K2 closes.
- 65 seconds—M11B opens, 5 second ignition (terminal 18) is de-energized (5 second pilot only until 70 seconds).
- 66 seconds—M3A closes, bypassing the high fire switch, low fire switch, and timer switch.
- 70 seconds—M2B opens; pilot or ignition trial ends; flame must be detected by this time (2K pulled in and 2K2 closed) or pilot/ignition is de-energized, relay 3K drops out, and safety shutdown occurs.

- M2A closes; power is applied to terminal 7, energizing the main fuel valve(s).
- 80 seconds—M6B opens; 10 second interrupted pilot/ignition (terminal 5) is de-energized.
- 85 seconds—M4A opens; 15 second interrupted pilot/ignition (terminal 6) is de-energized if jumper was *not* installed on back of programmer.
- 95 seconds—M8A closes, M8B opens; firing rate motor is released to modulate under control of Series 90 Controller.
- 100 seconds—M6A opens; 30 second interrupted pilot/ignition (terminal 6) is de-energized if jumper was installed on back of programmer.
- 106 seconds—M3A opens; timer stops with the system in the run condition.

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

- 105 seconds—When the operating setpoint is reached, the burner controller contacts open; 1K, 3K, and 4K relays drop out; main fuel valve(s) (terminal 7) is 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.

### R4140L1105

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.

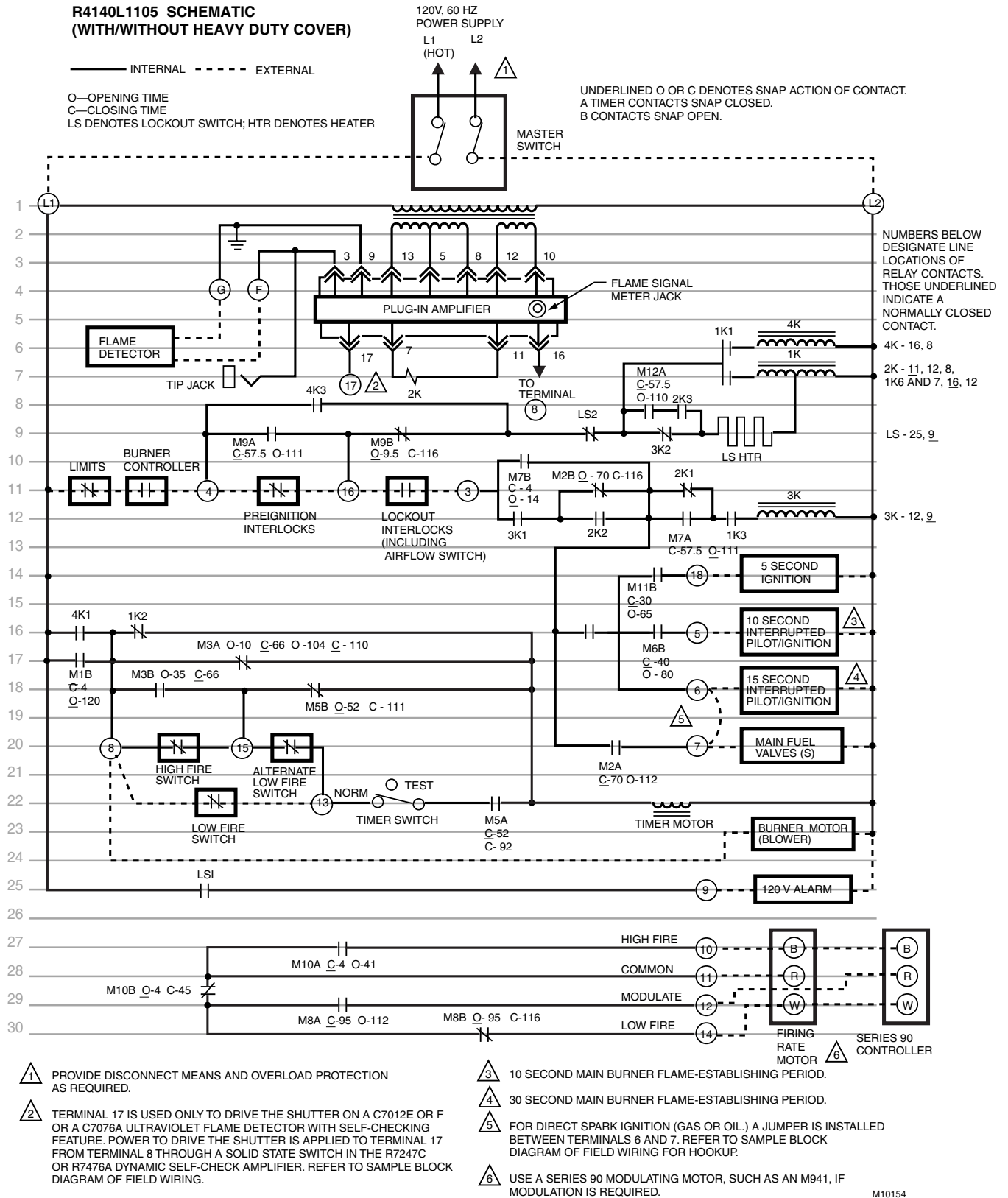
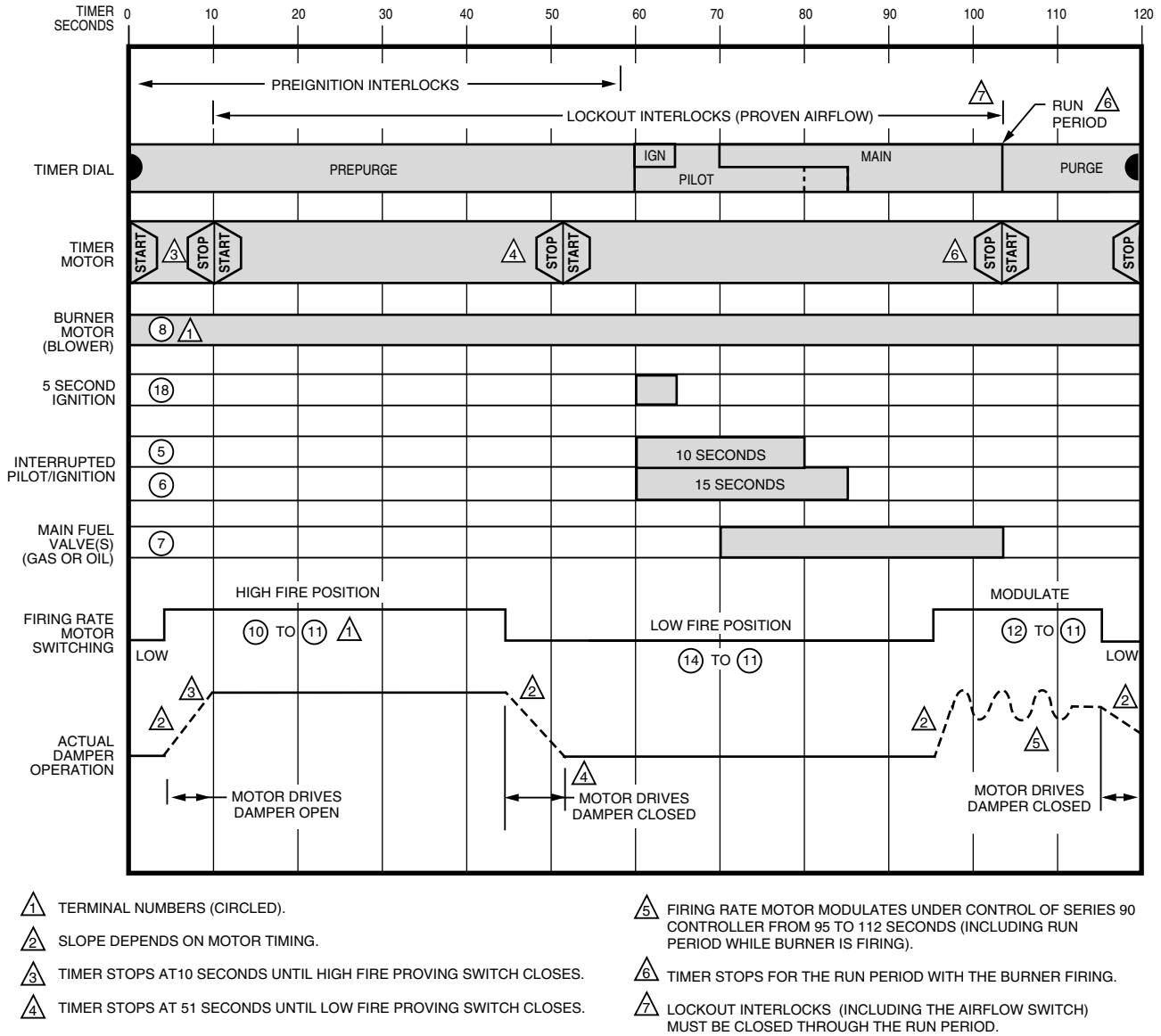


Fig. 9. Simplified schematic diagram of the R4140L1105 Programmer.



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Fig. 10. Timer sequence for R4140L1105 Programmer.

## Step-by-Step Operation (R4140L1105) Start and Prepurge

0 seconds—on a call for heat, the burner controller contacts close. If the limits and preignition interlocks are closed, relay 1K pulls in through M9B, LS2, 3K2, and the LS HTR (lockout switch heater—thus proving its continuity).

- 1K1 closes; relay 4K pulls in and the LS HTR starts heating (through 1K1 and 3K2); 1K3 closes.
- 4K1 closes and 1K2 opens; the timer motor starts (through 4K1 and M3A); power is applied to terminal 8, starting the burner motor (blower).
- 4K3 closes; 1K and 4K stay pulled in through the run period unless safety shutdown occurs or a limit opens.
- Prepurge begins.

4 seconds—M10A closes, M10B opens; the firing rate motor drives toward high fire position (open).  
 — M1B closes, bypassing 4K1; the timer can complete its revolution if safety shutdown occurs or a limit opens.

- M7B closes; when the lockout interlocks close (including the airflow switch and fuel pressure switches, if used), relay 3K pulls in (through M7B, 2K1, and 1K3).
  - 3K1 closes, bypassing M7B.
  - 3K2 opens; the LS HTR stops heating.
  - If a flame (or a condition simulating a flame) is detected before or during prepurge (until 57.5 seconds), 2K pulls in, 2K1 opens, relay 3K drops out, 3K2 closes, the LS HTR heats, and safety shutdown occurs.

10 seconds—M3A opens; timer stops until the high fire proving switch closes.



- 14 seconds—M7B opens; preignition interlocks must stay closed through prepurge, and lockout interlocks must stay closed continuously (airflow must be proven) through the run period, or relay 3K drops out.
- If 3K drops out after 14 seconds:
- 3K1 opens; ignition trials cannot be started, or fuel valves are de-energized if burner is already firing; 3K cannot pull in again until the next cycle.
  - 3K2 closes; lockout switch heater begins heating; safety shutdown occurs in approximately one-half minute.
- 35 seconds—M3B closes, bypassing the high fire switch.
- 45 seconds—M10B closes; firing rate motor drives toward low fire position (closed).
- 51 seconds—M5A closes; M5B 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, bypassing 2K1 in preparation for ignition trials; a flame can now be detected without causing safety shutdown.
- M9A closes, bypassing the preignition interlocks.
- M12A closes; the LS HTR starts heating (through 1K1, M12A, and 2K3).

### 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, 2K pulls in, 2K3 opens, and the LS HTR stops heating; 2K1 opens and 2K2 closes.

- 65 seconds—M11B opens; 5 second ignition (terminal 18) is de-energized (pilot only until 70 seconds).
- 66 seconds—M3A closes, bypassing the high fire switch, low fire switch, and timer switch.
- 70 seconds—M2B opens; pilot or ignition trial ends; a flame must be detected by this time (2K pulled in and 2K2 closed) or pilot/ignition de-energizes, relay 3K drops out, and safety shutdown occurs.
- M2A closes; power is applied to terminal 7, energizing the main fuel valve(s).
- 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.
- 95 seconds—M8A closes, M8B opens; firing rate motor is released to modulate under control of the Series 90 Controller.
- 104 seconds—M3A 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; 1K, 3K, and 4K relays drop out; main fuel valve(s) (terminal 7) is 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.

**WIRING**

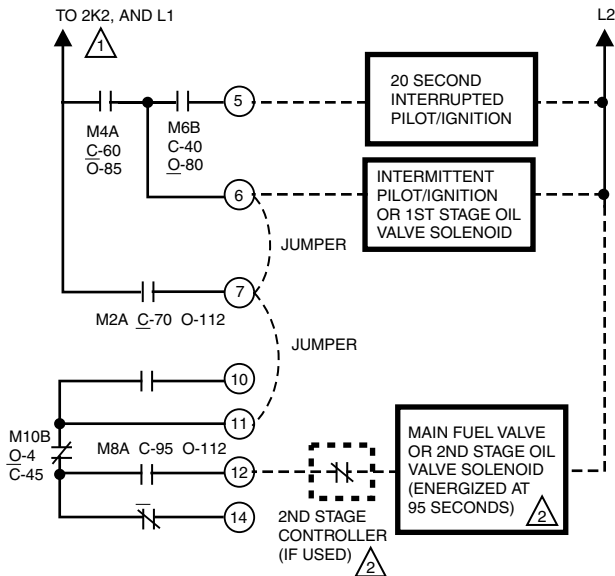
**⚠ CAUTION**

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).

**Optional Hookups for Intermittent Pilot/Ignition or 2-Stage Switching (Nonmodulating Oil Burners)**

An R4140L can be used to provide an intermittent pilot/ignition function or 2-stage switching for an oil burner, if modulation of the firing rate is not required. See Fig. 12 for the R4140L Programmer sample block diagram. Refer to Fig. 11 for the wiring changes necessary, and make these changes in the field wiring to the Q520A Wiring Subbase.

**R4140L PARTIAL SCHEMATIC**



⚠ REFER TO SCHEMATIC DIAGRAMS FOR COMPLETE INTERNAL WIRING AND CONTACT SWITCHING.

⚠ IF A 2ND STAGE CONTROLLER IS USED, THE 2ND STAGE OIL VALVE SOLENOID IS NOT ENERGIZED UNTIL THE 2ND STAGE CONTROLLER CONTACTS CLOSE.

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**Fig. 11. Field wiring changes (dashed) to provide intermittent pilot/ignition or 2-stage switching for a nonmodulating oil burner.**

1. Remove all wiring from terminals 5, 6, 7, 10, 11, 12, and 14.
2. Install a jumper wire between terminals 6 and 7.
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

5. terminals 6 and L2 (for intermittent ignition).
5. 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.
6. For 2-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.

For a description of the ignition trials for this hookup, see Fig. 13 and the Step-by-Step Operation section.

**Step-by-Step Operation Intermittent Pilot/Ignition or 2-Stage Switching (Nonmodulating Oil Burner)**

**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.

**Ignition Trials**

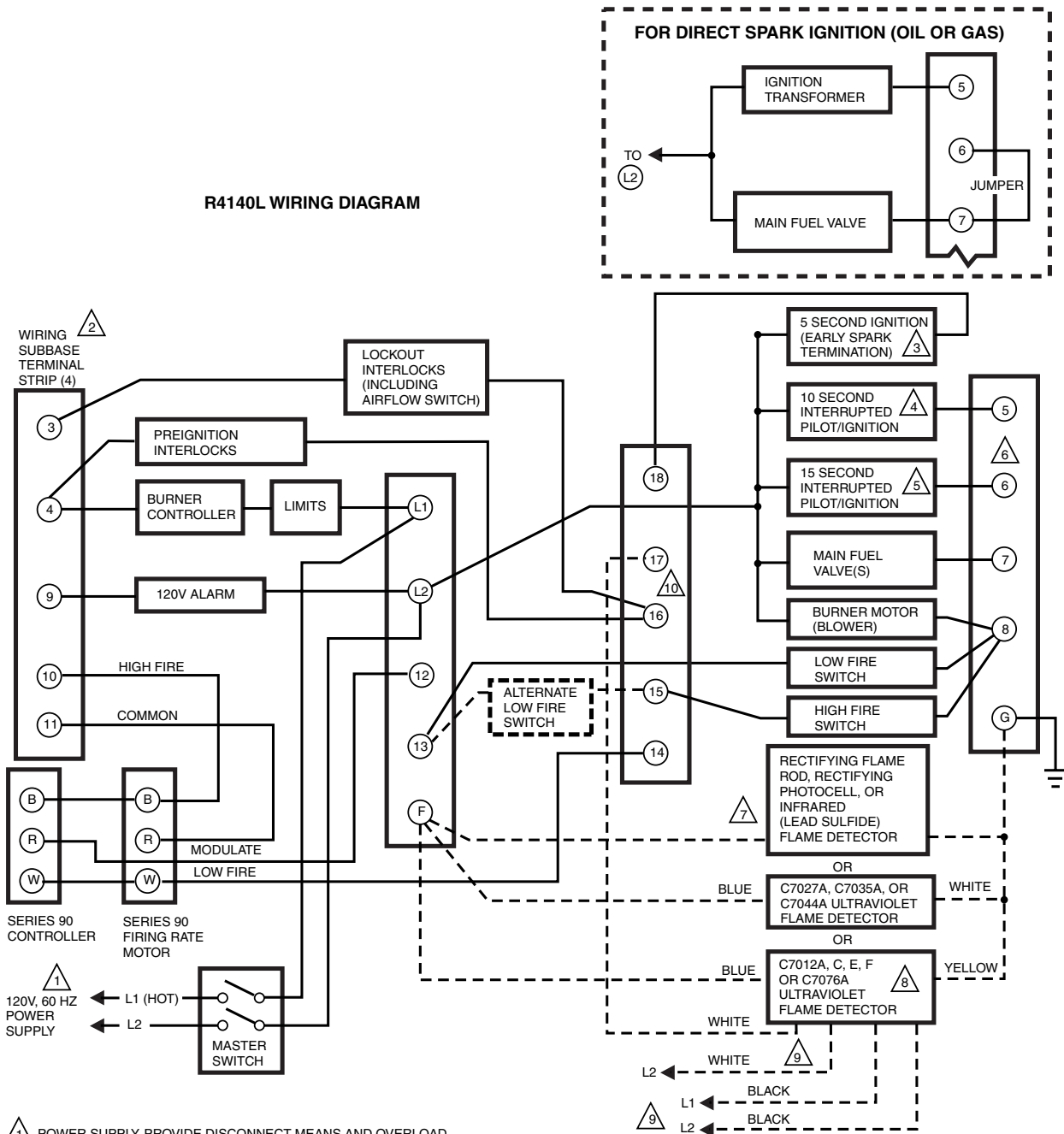
- 60 seconds—M4A closes; power is applied to terminals 5 and 6, energizing the ignition transformer and pilot valve (or first stage oil valve solenoid, if using 2-stage switching).
  - When a flame is detected, 2K pulls in, 2K3 opens, and the LS HTR stops heating; 2K1 opens and 2K2 closes.
- 70 seconds—M2B opens; pilot or ignition trial ends; a flame must be detected by this time (2K pulled in and 2K2 closed) or relay 3K drops out and safety shutdown occurs.
  - M2A closes; power is applied to terminal 7, maintaining power at terminals 6 and 11 (through the jumpers) until the run period concludes.
- 80 seconds—M6B opens; 20 second interrupted pilot/ignition (terminal 5) is de-energized.
- 95 seconds—M8A closes; power is applied to terminal 12, energizing the main fuel valve (or second stage oil valve solenoid, if using 2-stage switching).

NOTE: If using 2-stage switching with a second stage controller, the second stage oil valve solenoid is energized only when there is a demand for more heat and the second stage controller contacts close.

104 seconds—M3A opens; timer stops with the system in the run condition.

NOTE: Intermittent pilot/ignition and all fuel valves and solenoids (terminals 6 and 12) are de-energized when the run period concludes and the main burner controller contacts open.

R4140L WIRING DIAGRAM

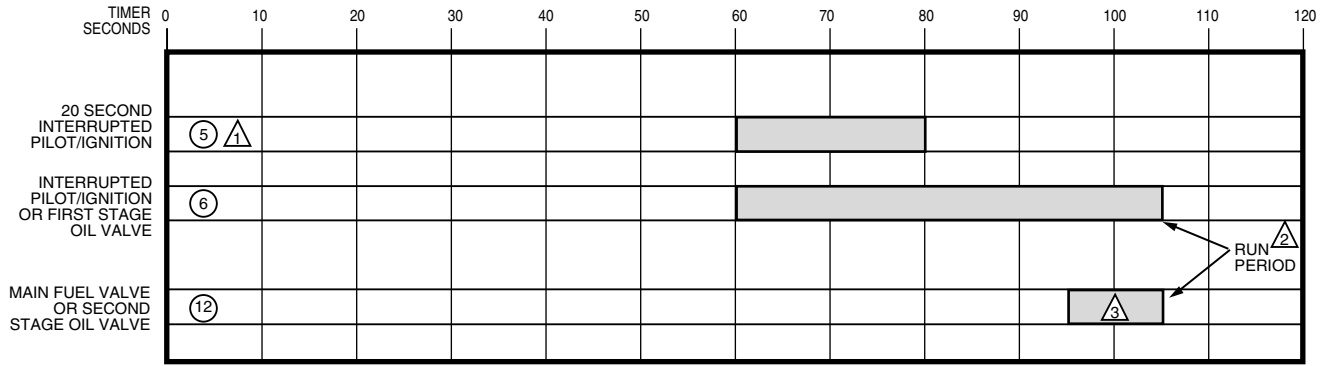


- 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 USE ALL NEC CLASS 1 WIRING.
- 3 5 SECOND IGNITION IS AVAILABLE ONLY ON THE R4140L1030, R4140L1105 AND R4140L1147 MODELS.
- 4 10 SECOND MAIN BURNER FLAME-ESTABLISHING PERIOD.
- 5 FOR 30 SECOND INTERRUPTED PILOT/IGNITION, INSTALL JUMPER (IN 4074B2V BAG ASSEMBLY) ON BACK OF PROGRAMMER BETWEEN SCREW TERMINALS LABELED "JUMPER TO EXTEND MAIN IGNITION TRIAL." 15 SECOND MBFEP ON ALL OTHER MODELS.
- 6 FOR DIRECT SPARK IGNITION (OIL OR GAS) CONNECT THE IGNITION TRANSFORMER AND MAIN FUEL VALVE(S) AS SHOWN IN INSET.
- 7 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.)
- 8 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 C7012A, F MODELS WITH ELECTRON TUBES; 60-2398 FOR C7012A,C,E,F SOLID STATE MODELS; 95-8269 FOR THE C7076A.)
- 9 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.
- 10 TERMINAL 17 IS USED ONLY FOR THE SHUTTER ON SELF-CHECKING C7012E,F OR C7076A FLAME DETECTORS.

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Fig. 12. Sample block diagram of field wiring for the R4140L Programmers.

# R4140L FLAME SAFEGUARD PROGRAMMING CONTROLS



① TERMINAL NUMBERS (CIRCLED).

② TIMER STOPS FOR THE RUN PERIOD WITH THE BURNER FIRING.

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

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**Fig. 13. Partial timer sequence for R4140L Programmer optional hookups.**

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

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