7800 SERIES
RM7888A Relay Module

The Honeywell RM7888A Relay Module is a microprocessor based, integrated burner control for industrial process semiautomatically fired gas, oil, coal, or combination fuels for single and multiple burner industrial applications. The RM7888A requires a Relay Module, Subbase and Amplifier for operation. Options include Personal Computer Interface, Keyboard Display Module, DATA CONTROLBUS MODULE™, Remote Display Mounting, First-Out Expanded Annunciator and COMBUSTION SYSTEM MANAGER™ software. The RM7888 intended use is in conjunction with a master system control. The master system control determines the purge timing and confirms air supply and air flow.

The RM7888A is programmed to provide a level of safety, functional capability and features beyond the capability of conventional controls.

The basic functions of the RM7888 include automatic burner startup sequencing, five user selectable operating (run) sequences, four line voltage sequence control inputs (commonly controlled with a Programmable Logic Controller [PLC]), flame supervision, system status indication, system or self-diagnostics and troubleshooting.

■ Safety features:
— Closed loop logic test.
— Dynamic input check.
— Dynamic safety relay test.
— Dynamic self-check logic.
— Expanded safe-start check.
— Internal hardware status monitoring.
— Tamper resistant timing and logic.
■ Access for external electrical voltage checks.
■ Application flexibility.
■ Communication interface capability.
■ First-out annunciation and system diagnostics are provided by 2 row by 20 column Vacuum Fluorescent Display (VFD) located on the Keyboard Display Module.
■ First-out expanded annunciation with 26 light emitting diodes (LEDs) for limits and interlocks (optional).
■ Five sequence information LEDs.
■ Interchangeable plug-in flame amplifiers.
■ Local or remote annunciation of RM7888A operation and fault information.
■ Dependable, long-term operation provided by microcomputer technology.
■ Nonvolatile memory for retaining history files and sequencing status after loss of power.
■ Remote reset capability (optional).
■ Burner controller data:
— Sequence status.
— Sequence time.
— Hold status.
— Lockout/alarm status.
— Flame signal strength.
— Expanded annunciator status.
— Total hours of operation.

— Total cycles of operation.
— Fault history of six most recent faults:
  • Cycles of operation at the time of the fault.
  • Expanded annunciator data at the time of the fault.
  • Fault message and code.
  • Hours of operation at the time of the fault.
  • Sequence status at the time of the fault.
  • Sequence time at the time of the fault.
— Diagnostic information:
  • Device type.
  • Flame amplifier type.
  • Flame failure response time.
  • Manufacturing code.
  • On/Off status of all line voltage digital inputs.
  • Software revision and version of RM7888A via S7800 Keyboard Display Module.
  • Status of configuration jumpers.

CONTENTS

Specifications

ELECTRICAL RATINGS (see Table 1):
Voltage and Frequency: 120 Vac (+10/-15%), 50 or 60 Hz (±10%) [operating frequency determined by model number selection].
Keyboard Display Module: 13.0 Vdc peak full wave rectified (+20/-15%).
Power Dissipation:
RM7888A: 10W maximum.
Display Module: 3W maximum.
Maximum Total Connected Load: 2000 VA.
Fusing: Total Connected Load: 20A maximum, type FRN or equivalent.
ENVIRONMENTAL RATINGS:
Ambient Temperature:
Operating: -40° F to +140° F [-40° C to +60° C].
Storage: -40° F to + 150° F [-40° C to +66° C].

Humidity:
85% relative humidity continuous, noncondensing.
Vibration:
0.5G environment.
DIMENSIONS: See Figs. 1, 2, 3.
WEIGHT:
RM7888A: 1 pound, 10 ounces [737 grams], unpacked.
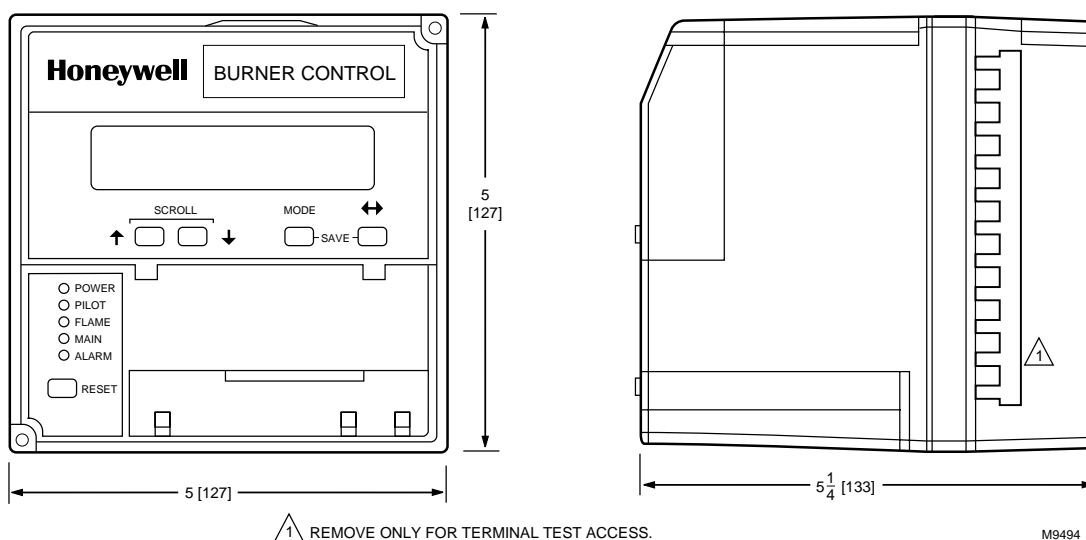Keyboard Display Module: 4 ounces [113 grams], unpacked.
APPROVAL BODIES:
Underwriters Laboratories Inc. component recognized.
Canadian Standards Association certified.
Factory Mutual approved.

Fig. 1—Mounting dimensions of the RM7888A Relay Module and Q7800A Subbase in in. [mm].

⚠1 REMOVE ONLY FOR TERMINAL TEST ACCESS.

M9494

Ordering Information

When purchasing replacement and modernization products from your 7800 SERIES distributor, refer to the TRADELINE® Catalog for complete ordering number.

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 Satisfaction
Honeywell Inc., 1885 Douglas Drive North
Minneapolis, Minnesota 55422-4386 (612) 951-1000

In Canada—Honeywell Limited/Honeywell Limitée, 740 Ellesmere Road, Scarborough, Ontario M1P 2V9 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.

Fig. 2—Mounting dimensions of the RM7888A Relay Module and Q7800B Subbase in in. [mm].

⚠1 REMOVE ONLY FOR TERMINAL TEST ACCESS.

M9493
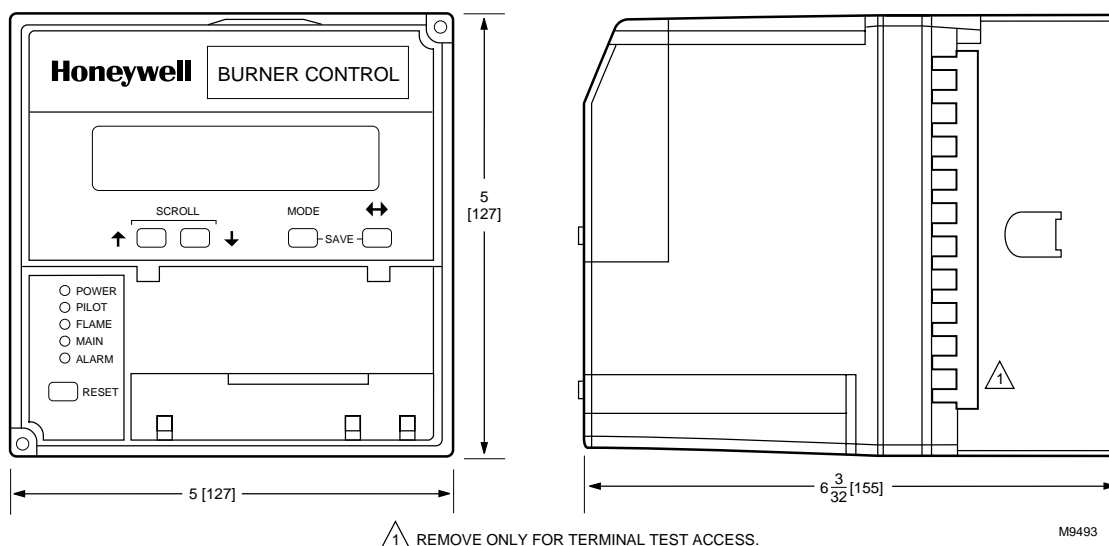
NOTE: The RM7888 is a component of a larger overall combustion safety system for industrial-burner applications. Due to the custom design nature inherent in industrial-burner control systems, the system designer/integrator has responsibility for the overall combustion system safety and system approval. **Separate appliance or site approval may also be required.** The RM7888 serves as a system component that provides control and flame safety monitoring for an individual burner.

MOUNTING:
   Q7800A1005 for panel mount or Q7800B1003 for wall or burner mount.
ACCESSORIES:
   Required for Operation:
   Plug-in Flame Signal Amplifier (see Table 2).
   Optional:
   ControlBus 5-Wire Electrical Connector— part number 203541.
   COMBUSTION SYSTEM MANAGER™ (CSM™)—part number ZM7850A1001.
   Communications Interface Base Unit— part number Q7700A1014.
   Communications Interface ControlBus Module— part number QS7800A1001.
   DATA CONTROLBUS MODULE™— part number S7810A1009.
   Expanded Annunciator—part number S7830A1005.
   Flame Simulators:
       Rectifying—part number 123514A.
       Ultraviolet—part number 203659.
   Keyboard Display Module—part number S7800A1001.
   Remote Reset Module—part number S7820A1007.
   Remote Display Mounting Brackets— part numbers 203765, 205321B, 204718A,B.

Remote Display Power Supply (13 Vdc) Plug-in— part number 203968A.
Sixty-inch Extension Cable Assembly— part number 221818A.
Tester—part number A78001002.

Fig. 3—Mounting dimensions of the Keyboard Display Module in in. [mm].

M5002B
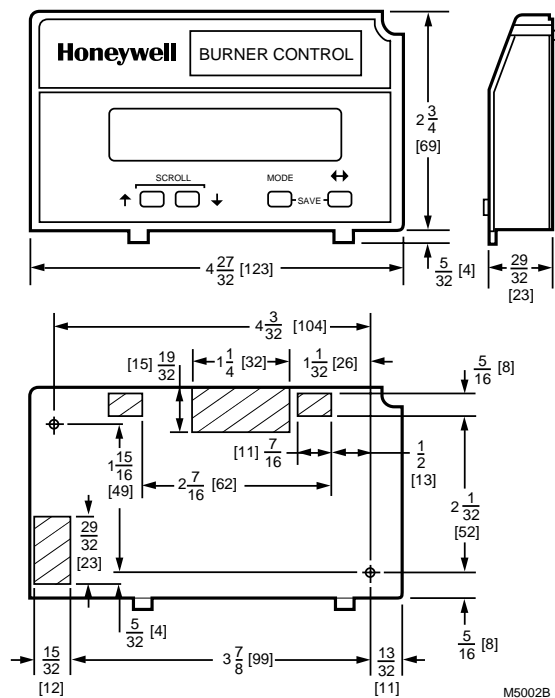
TABLE 1—TERMINAL RATINGS.

Terminal Number	Description	Ratings
G	Flame Sensor Ground[1]	60 to 220 Vac, current limited.
Earth G	Earth Ground[1]	—
L2(N)	Line Voltage Common	—
3	Alarm	120 Vac, 1A pilot duty.
4	Line Voltage Supply (L1)	120 Vac (+10/-15%), 50/60 Hz (±10%)[2,5]
5	Air Valve	120 Vac, 9.8A FL, 58.8A LR (inrush).
6	Special Function 1	120 Vac, 1 mA.
7	Limits Complete	120 Vac, 9A.
8	Pilot Valve	120 Vac, 4.5A and 50 VA pilot duty[3].
9	Main Fuel Valve	120 Vac, 2A pilot duty[4].
10	Ignition	120 Vac, 4.5A Ignition[3].
F(11)	Flame Sensor	60 to 220 Vac, current limited.
12(B)	Firing Rate High Fire	120 Vac, 75 VA Pilot Duty.
13(R)	Firing Rate Common	120 Vac, 75 VA Pilot Duty.
14(W)	Firing Rate Low Fire	120 Vac, 75 VA Pilot Duty.
15	Firing Rate Modulate	120 Vac, 75 VA Pilot Duty.
16	Unused	—
17	Special Function 2	120 Vac, 1 mA.
18	@Low Fire Input	120 Vac, 1 mA.
19	Special Function 3	120 Vac, 1 mA.
20	Special Function 4	120 Vac, 1 mA.
21	Flame Proven	120 Vac, 2A pilot duty.
22	Shutter	120 Vac, 0.5A.

[1] The RM7888 must have an earth ground providing a connection between the subbase and the control panel or the burner. The earth ground wire must be capable of conducting the current to blow the 20A fuse (or breaker) in event of an internal short circuit. The RM7888 needs a low impedance ground connection to the equipment frame which, in turn, needs a low impedance connection to earth ground. For a ground path to be low impedance at RF frequencies, the connection must be made with minimum length conductors having maximum surface areas. Wide straps or brackets are preferred rather than leadwires. Be careful to make sure that mechanically tightened joints along the ground path, such as pipe or conduit threads or surfaces held together with fasteners, are free of nonconductive coatings and are protected against mating surface corrosion.

[2] 2000 VA maximum connected load to RM7888A Assembly.

[3] Can also be 120 Vac, 1A pilot duty.

[4] Can also be 65 VA pilot duty with motorized valve, 1150 VA inrush, 460 VA open, 250 VA hold.

[5] Operating frequency chosen by RM7888A selection.

IMPORTANT: *A Flame Detection System that must be ordered separately is required for operation. To select your Plug-in Flame Signal Amplifier and applicable Flame Detector, see Table 2.*

TABLE 2—FLAME DETECTION SYSTEMS (FIGS. 4, 5, 6).

Plug-In Flame Signal Amplifiers				Applicable Flame Detectors			
Type	Color	Self-Checking	Model	Flame Failure Response Time	Fuel	Type	Models
Rectification	Green	No	R7847A	0.8 or 3 sec	Gas	Rectifying Flame Rod Holders[a]	C7004, C7007, C7011, Complete Assemblies: C7008, C7009, Q179.
		No	R7847A	0.8 or 3 sec	Oil	Rectifying Photocell[b]	C7003, C7010, C7013, C7014.
		No	R7847A	3 sec	Gas, oil, coal	Ultraviolet (Purple Peeper)	C7012A,C[c]
		Dynamic Amplicheck™	R7847B[d]	0.8 or 3 sec	Gas	Rectifying Flame Rod Holders[a]	C7004, C7007, C7011. Complete Assemblies: C7008, C7009, Q179.
		Dynamic Amplicheck™	R7847B[d]	0.8 or 3 sec	Oil	Rectifying Photocell	C7003, C7010, C7013, C7014.
		Dynamic Amplicheck™	R7847B[d]	3 sec	Gas, oil, coal	Ultraviolet (Purple Peeper)	C7012A,C[c].
		Dynamic Self-Check	R7847C[e]	3 sec	Gas, oil, coal	Ultraviolet (Purple Peeper)	C7012E,F.
Infrared	Red	No	R7848A	3 sec	Gas, oil, coal	Infrared (Lead Sulfide)	C7015.
		Dynamic Amplicheck™	R7848B[b]	3 sec	Gas, oil, coal	Infrared (Lead Sulfide)	C7015.
Ultraviolet	Purple	No	R7849A	0.8 or 3 sec	Gas, oil	Ultraviolet (Minipeeper)	C7027, C7035, C7044[c].
		Dynamic Amplicheck™	R7849B[d]	0.8 or 3 sec	Gas, oil	Ultraviolet (Minipeeper)	C7027, C7035, C7044[c].
	Blue	Dynamic Self-Check	R7886[e]	3 sec	Gas, oil, coal	Ultraviolet (Adjustable sensitivity)	C7076A, D.

[a] Order flame rod separately; see holder instructions.
[b] Use only Honeywell Photocell, part number 38316.
[c] Circuitry tests the flame signal amplifier at least 12 times a minute during burner operation and shuts down the burner if the amplifier fails.
[c] *CAUTION:* Ultraviolet radiation sensing tubes have a life expectancy of 40,000 hours of continuous use within the flame detector's specified ambient temperature and voltage ratings. A worn-out ultraviolet radiation sensing tube results in failure of the UV sensor to properly discriminate between flame conditions.

The C7012A,C, the C7027A, C7035A and C7044A Flame Detectors should only be used on burners that cycle on/off periodically or, in the absence of cycling, are periodically checked for proper operation.

Recommended industry standards for the frequency of sensor checks, either through cycling (employing safe-start check methods) or periodic maintenance, vary between once every ten seconds and once every week, depending on the standard used and the application needs.

Consult the equipment manufacturer or the governing standard for recommendations about frequency of checks.

Controls that incorporate safe-start checks, and sensors with controls that employ constant checking means are available from Honeywell. See your Honeywell representative for specific information.
[d] Circuitry tests all electronic components in the flame detection system (amplifier and detector) 12 times a minute during burner operation and shuts down the burner if the detection system fails.

Fig. 4—Rectification detectors.

IGNITION
ELECTRODE
(Q179C ONLY)

FLAME ROD

CERAMIC
INSULATORS

$1\frac{21}{32}$
[42]

$1\frac{13}{32}$
[36]

TARGET

$3\frac{1}{8}$
[79]

$\frac{3}{8}$[10]

$1\frac{1}{16}$
[27]

1 [25]

$\frac{1}{2}$ [13]

$\frac{3}{32}$ [2]

$\frac{25}{32}$
[20]

$\frac{25}{32}$
[20]

$\frac{17}{32}$
[14]

$2\frac{25}{32}$ [62]

$\frac{11}{16}$
[18]

BRACKET

THREADED
MOUNTING
HOLES (2)–
10-32 UNF   M1983

Q179

MOUNTING FLANGE

3/4–14 NPT

$7\frac{7}{32}$ [183]

$3\frac{3}{4}$
[95]

$5\frac{1}{8}$
[130]

$3\frac{7}{16}$
[87]

1/2–14 NPSM

LEADWIRES

FACEPLATE

$5\frac{1}{4}$ [133]

M1962A

C7012A,C,E,F

2
[51]

$1\frac{1}{4}$ [32]

$1\frac{5}{16}$ [33]

$\frac{5}{16}$ [8]

C7013A

$\frac{13}{16}$ [21]
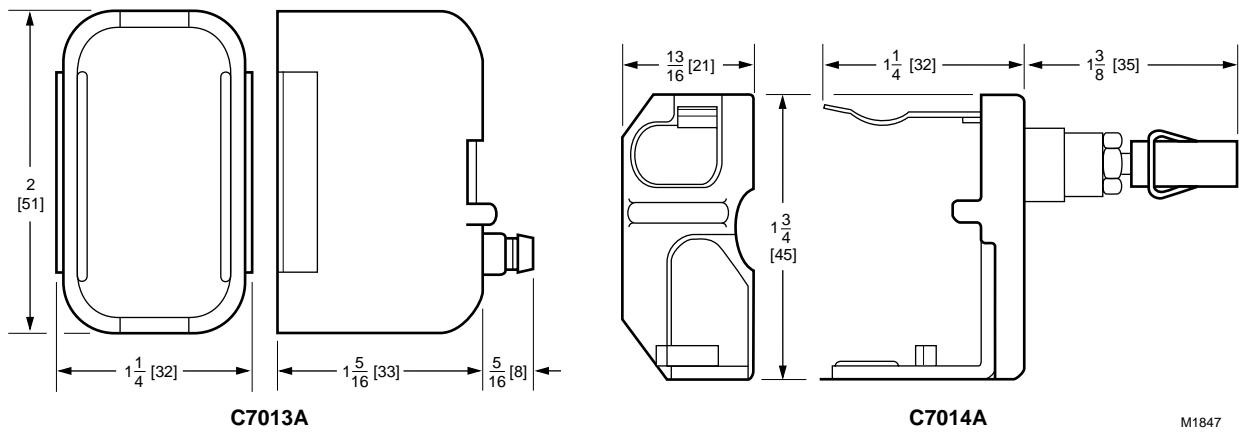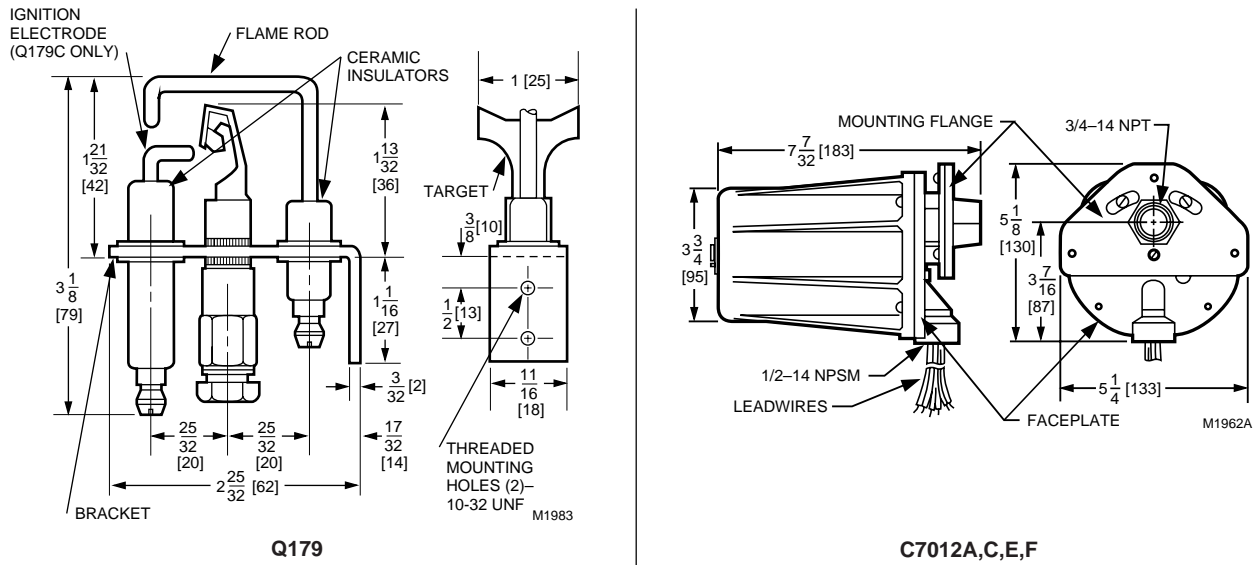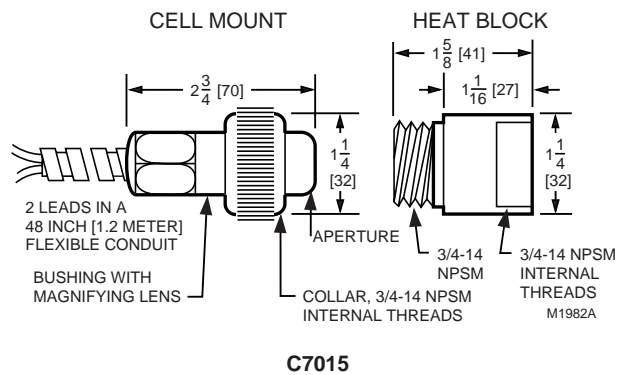
$1\frac{1}{4}$ [32]

$1\frac{3}{8}$ [35]

$1\frac{3}{4}$
[45]

C7014A   M1847

Fig. 5—Infrared detector.

CELL MOUNT

HEAT BLOCK

$2\frac{3}{4}$ [70]

$1\frac{5}{8}$ [41]

$1\frac{1}{16}$ [27]

$1\frac{1}{4}$
[32]

$1\frac{1}{4}$
[32]

2 LEADS IN A
48 INCH [1.2 METER]
FLEXIBLE CONDUIT

BUSHING WITH
MAGNIFYING LENS

APERTURE

COLLAR, 3/4-14 NPSM
INTERNAL THREADS

3/4-14
NPSM

3/4-14 NPSM
INTERNAL
THREADS

M1982A

C7015

Fig. 6—Ultraviolet detectors (minipeepers).

4 [102]

$3\frac{1}{2}$ [89]

6 FOOT [1.83 METER] LEADWIRES (2) /1\

$1\frac{1}{16}$ [27]

/2\

COLLAR WITH 1/2-14 NPSM INTERNAL THREADS
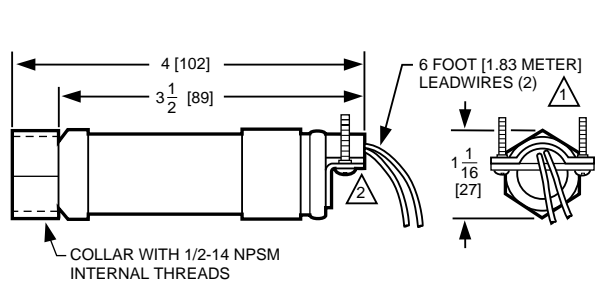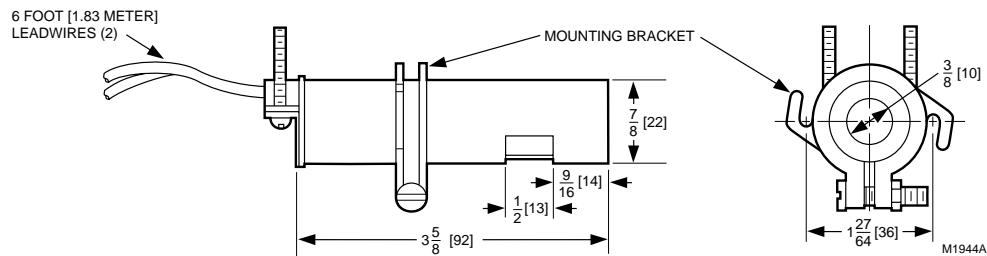
/1\ MODEL AVAILABLE WITH 24 FOOT [7.32 METER] LEADWIRES.

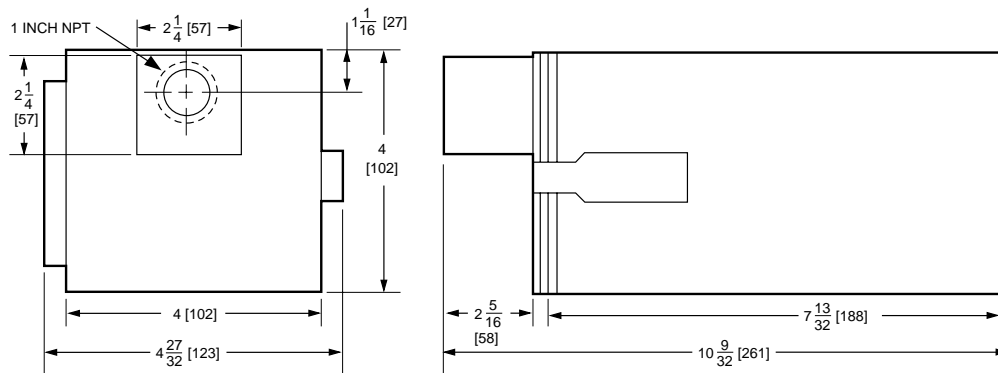/2\ MODELS AVAILABLE WITH SPUD CONNECTOR (1/2-14 NPSM INTERNAL THREADS) INSTEAD OF CLAMP TYPE CONNECTOR.

M1943A

C7027

$4\frac{1}{8}$ [105]

COLLAR WITH 1–11-1/2 NPSM INTERNAL THREADS /1\

2 [51]

$1\frac{3}{16}$ [30]

1/2-14 NPSM INTERNAL THREADS /2\

$1\frac{1}{2}$ [38]

$\frac{31}{32}$ [25]

$2\frac{5}{8}$ [67]

INSERTION DEPTH

6 FOOT [1.83 METER] LEADWIRES (2) /3\
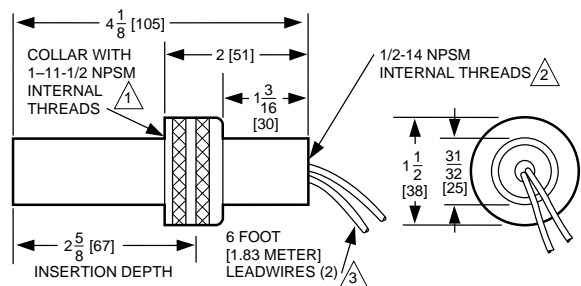
/1\ DIN APPROVED C7035A1064 HAS 1-11 BSP.P1 INTERNAL THREADS.

/2\ DIN APPROVED C7035A1064 HAS 1/2-14 BSP-F INTERNAL THREADS.

/3\ MODEL AVAILABLE WITH 12 FOOT [3.66 METER] LEADWIRES.

M1945A

C7035

6 FOOT [1.83 METER] LEADWIRES (2)

MOUNTING BRACKET

$\frac{3}{8}$ [10]

$\frac{7}{8}$ [22]

$\frac{9}{16}$ [14]

$\frac{1}{2}$ [13]

$3\frac{5}{8}$ [92]

$1\frac{27}{64}$ [36]

M1944A

C7044

1 INCH NPT

$2\frac{1}{4}$ [57]

$1\frac{1}{16}$ [27]

$2\frac{1}{4}$ [57]

4 [102]

4 [102]

$4\frac{27}{32}$ [123]

$2\frac{5}{16}$ [58]

$7\frac{13}{32}$ [188]

$10\frac{9}{32}$ [261]

$\frac{3}{4}$ [19]

7/8 [22] OPENING FOR 1/2-INCH CONDUIT

$\frac{29}{32}$ [23]

$1\frac{19}{32}$ [41]

3/8 INCH NPT

/1\ ALLOW 9 INCHES [228 MILLIMETERS] CLEARANCE TO SWING OUT THE DETECTOR FOR LENS CLEANING OR SERVICING.

$2\frac{11}{16}$ [68]

$7\frac{5}{8}$ [194]

M5083A

C7076A

Fig. 6—Ultraviolet detectors *(Continued).*
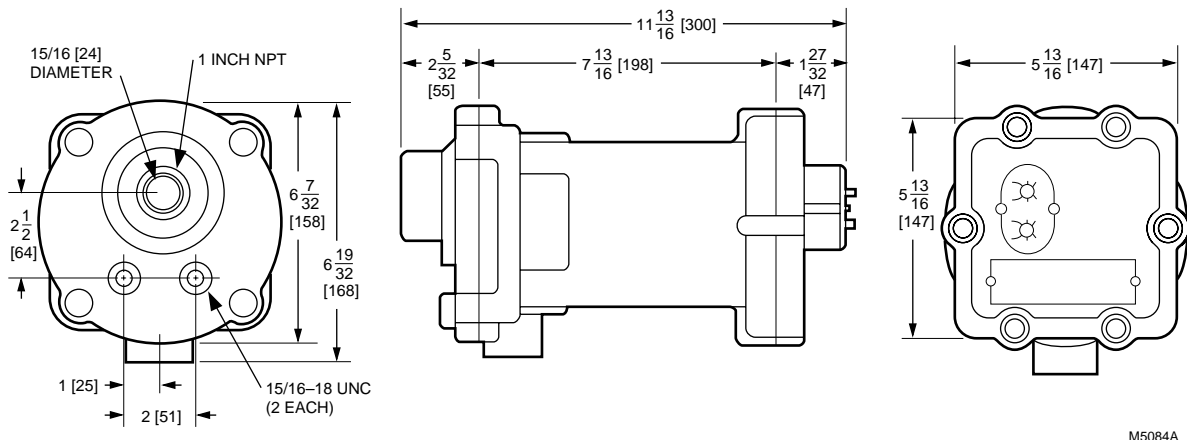
C7076D

Sequence timing for RM7888A Relay Module operation are listed in Table 3.

TABLE 3—SEQUENCE TIMING FOR OPERATION.

RM7888A Sequence	Initiate	Standby	Purge	Pilot Flame Establishing Period (PFEP)	Main Flame Establishing Period (MFEP)	Pilot Relight	Run
Pilot: PV Return	10 seconds	*	**	10 seconds	15 seconds	5 sec to infinity	*
Pilot: MV Lo Fire	10 seconds	*	**	10 seconds	15 seconds	—	*
DSI Normal	10 seconds	*	**	4 seconds	—	—	*
DSI High/Low Stepfire	10 seconds	*	**	4 seconds	—	—	*
DSI On/Off Stepfire	10 seconds	*	**	4 seconds	—	—	*

  * STANDBY and RUN can be an infinite time period.
** PURGE will be determined by the system master controller.

Principal Technical Features

The RM7888A provides customary flame safeguard functions while providing significant advancements in the areas of safety, annunciation and system diagnostics.

SAFETY SHUTDOWN (LOCKOUT) OCCURS IF:
1. INITIATE Period
    a. Configuration jumper was changed (after 200 hours).
    b. AC line power errors, see Operation section.
    c. Four minute INITIATE period is exceeded.
2. STANDBY Period
    a. Flame signal is present after 40 seconds.
    b. Pilot valve/1st stage main valve terminal is energized.
    c. Main valve terminal is energized.
    d. Internal system fault.
    e. Flame detected during the last two seconds.
    f. Limits Complete is not energized after 120 seconds.

g. Hold @Low Fire Switch is not energized after eight minutes of hold.
    h. Flame Proven terminal energized.
    i. Ignition terminal energized.
    j. Configuration jumpers select is illegal (during last two seconds).
3. PILOT FLAME ESTABLISHING Period (PFEP) (Pilot Configuration)
    a. Pilot/1st stage main valve terminal is not energized.
    b. No flame is present at end of PFEP.
    c. Internal system fault.
    d. Main valve terminal is energized.
    e. Limits Complete is not energized.
    f. @Low Fire is not energized.
    g. Ignition terminal is not energized for the first ten seconds of PFEP.

   h. Ignition terminal is energized after the first ten seconds of PFEP.

   i. Flame Proven terminal is energized for the first ten seconds of PFEP.

   j. Flame Proven terminal is not energized at the end of PFEP.

   k. Special Function 2 is not energized after eight minutes (Pilot Configuration).

3. MAIN FLAME ESTABLISHING Period.

   a. Pilot is energized.

   b. Pilot/1st stage main valve terminal is not energized.

   c. Main valve terminal is not energized.

   d. No flame present.

   e. Internal system fault.

   f. @Low Fire switch is not energized.

   g. Ignition terminal is energized.

   h. Flame Proven is not energized.

   i. Limits Complete is not energized.

   j. Special Function 2 is not energized.

   k. Special Function 3 is not energized.

4. RUN Period

   a. No flame present.

   b. Flame Proven is not energized.

   c. Internal system fault.

   d. Ignition terminal is energized.

   e. Pilot terminal is energized (Pilot configuration).

   f. Pilot terminal/main valve first stage is not energized (DSI configuration).

   g. Limits Complete is not energized.

   h. Main valve is not energized.

5. Anytime the configuration jumpers are changed while the RM7888A is powered.

6. PILOT RELIGHT

   a. Limits Complete is de-energized.

   b. Special Function 2 is not energized.

   c. Special Function 3 is not energized.

   d. Ignition, pilot, or main is not energized.

   e. Low Fire is not energized.

   f. Flame failure.

   g. Ignition terminal not energized.

   h. Flame Proven is not energized.

7. WAIT FOR LOW OFF FOR 5 SECONDS

   a. Limits Complete is not energized.

   b. Special Function 2 is not energized.

   c. Flame failure.

   d. Ignition energized.

   e. Main energized.

   f. Flame Proven not energized.

   g. Pilot not energized.

8. DRIVE TO LOW

   a. Limits Complete is not energized.

   b. Special Function 2 is not energized

   c. Flame failure.

   d. Ignition energized.

   e. Main energized.

   f. Flame Proven is not energized.

Safety Provisions

INTERNAL HARDWARE STATUS MONITORING

The RM7888A analyzes the integrity of the configuration jumper and internal hardware. The POWER LED blinks every four seconds to signify an internal hardware check.

CLOSED LOOP LOGIC TEST

The test verifies the integrity of all safety critical loads (terminals 8, 9, 10 and 21). If the loads are not energized properly, for example, the main valve terminal is powered during purge, the RM7888A will lockout on a safety shutdown. The RM7888A must react to input changes but avoid the occurrence of nuisance shutdown events. Signal conditioning is applied to line voltage inputs to verify proper op-eration in the presence of normal electrical line noise such as transient high voltage spikes or short periods of line dropout. Signal conditioning is tolerant of synchronous noise (line noise events that occur at the same time during each line cycle).

DYNAMIC FLAME AMPLIFIER AND SHUTTER CHECK

Self-checking circuitry tests all electronic components in the flame detection system and amplifier 12 times per minute and shuts down the RM7888A if the detection system fails.

DYNAMIC AMPLICHECK™

Dynamic Amplicheck™ circuitry tests the flame signal amplifier during burner operation and shuts down RM7888A if the flame amplifier fails.

DYNAMIC INPUT CHECK

All system input circuits are examined to make sure that the RM7888A is capable of recognizing the true status of external controls, limits and interlocks. If any input fails this test, a safety shutdown occurs and the fault is annunciated.

DYNAMIC SAFETY RELAY TEST

Checks the ability of the dynamic safety relay contacts to open and close. Verifies that the safety critical loads (terminals 8, 9, 10 and 21) can be de-energized, as required, by the Dynamic Self-Check logic.

DYNAMIC SELF-CHECK SAFETY CIRCUIT

The microcomputer tests itself and related hardware, and at the same time, the safety relay system tests the microcomputer operation. If a microcomputer or safety relay failure occurs and does not allow proper execution of the self-check routine, safety shutdown occurs and all safety critical loads will be de-energized.

EXPANDED SAFE-START CHECK

The conventional safe-start check, which prevents burner start-up if flame is indicated at start-up, is expanded to include a flame signal check during STANDBY, a safety critical load check, a Limits Complete check, and an @Low Fire check.

OFF CYCLE (STANDBY) FLAME
SIGNAL CHECK

The flame detection subsystem (flame detector and amplifier) is monitored during STANDBY. If a flame simulating condition or an actual flame exists for 40 seconds in STANDBY, a safety shutdown occurs and startup is prevented. If the flame signal exists at any time after 40 seconds during STANDBY, a safety shutdown occurs and is annunciated.

- A shutter-check amplifier and self-checking detector are energized continuously during STANDBY and the last two seconds of STANDBY. If a flame exists, a safety shutdown will occur.
- An Amplicheck™ Amplifier is energized continually through STANDBY to detect any possibility of a runaway detector or a flame. If either situation happens, a safety shutdown will occur.
- A standard amplifier is energized continually through STANDBY to detect any possibility of a runaway detector or a flame. If either situation happens, a safety shutdown will occur.

TAMPER RESISTANT TIMING AND LOGIC

Safety and logic timings are inaccessible and cannot be altered or defeated.

ALARM OPERATION

This output will supply power to the system master and/or an external alarm indicator such as a bell or buzzer. The alarm is turned on anytime a lockout has occurred and the lockout condition has not been cleared. The alarm output is also turned on when the reset button is pressed and held for more than four seconds. The status of this output is not monitored by the relay module.

FIRST-OUT ANNUNCIATION AND
SELF-DIAGNOSTICS

Sequence Status Lights (LEDs) provide positive visual indication of the program sequence: POWER, PILOT, FLAME, MAIN and ALARM. The green POWER LED blinks every four seconds, signifying that the RM7888A hardware is running correctly.

Optional Multi-function Keyboard Display Module shows elapsed time during PILOT IGNITION and MAIN IGNITION. As an additional troubleshooting aid, it provides sequence timing, diagnostic information, historical information and expanded annunciator information when a safety shutdown or hold or normal operation occurs.

First-out Annunciation reports the cause of a safety shutdown or identifies the cause of a failure to start or continue the burner control sequence with an English text and numbered code via the Keyboard Display Module. It monitors all field input circuits, including the flame signal amplifier and output circuits. The system distinguishes modes of failure and detects and annunciates difficult-to-find intermittent failures.

Self-diagnostics add to the First-out Annunciation by allowing the RM7888A to distinguish between field (external device) and internal (system related) problems. Faults associated within the flame detection subsystem or the RM7888A are isolated and reported by the optional Keyboard Display Module. See Table 15, Hold and Fault Message Summary, or the 7800 SERIES System Annunciation Diagnostics and Troubleshooting, form 65-0118.

INTERLOCK REQUIREMENTS

The following interlock inputs are provided.

Limits Complete (Terminal 7)

This input provides an indication of the status of an interlock string. If this input is energized, it is permissible to operate through a burner sequence. The burner sequence does not leave the Standby state if the Limits Complete signal is de-energized. If this input becomes de-energized after leaving the Standby state, one or more interlocks are open and the burner sequence is either recycled or a lockout occurs as defined for the particular burner state.

@Low Fire (Terminal 18)

This input will provide an indication of the low firing rate position. If this input is energized, the motor position is assumed by the relay module to be at the Low Fire position; otherwise, the motor position cannot be determined if this input is de-energized.

This signal is readable in any burner operating state without regard to the status of the special function signals or the Limits Complete signal. The RM7888 does not perform a test to assure that the Low Fire input signal becomes energized when the High Fire motor control is commanded. For example, the RM7888 will not detect a Low Fire input that is jumpered or continuously energized without regard to the actual motor position.

The High Fire position is not confirmed by a separate high fire input at the RM7888. The system master control is responsible for the High Fire proving and purging of the combustion unit.

Installation

⚠ *WARNING*

FIRE OR EXPLOSION HAZARD CAN CAUSE PROPERTY DAMAGE, SEVERE INJURY, OR DEATH.
To prevent possible hazardous burner operation, perform verification of safety requirements each time a control is installed on a burner.

WHEN INSTALLING THIS PRODUCT...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.

2. Check the ratings given in the instructions and marked on the product to make sure the product is suitable for your application.

3. Installer must be a trained, experienced, flame safeguard service technician.

4. After installation is complete, check out the product operation as provided in these instructions.

⚠ *CAUTION*

To prevent electrical shock and equipment damage, disconnect the power supply before beginning installation. More than one power supply disconnect may be involved.

1. To prevent electrical shock and equipment damage, disconnect the power supply before beginning installation. More than one power supply disconnect may be involved.

2. Wiring connections for the RM7888A are unique; therefore, refer to Fig. 7 or the correct specifications for proper subbase wiring.

3. Wiring must comply with all applicable codes, ordinances and regulations.

4. Wiring, where required, must comply with NEC Class 1 (Line Voltage) wiring.

5. Loads connected to the RM7888A must not exceed those listed on the RM7888A label or the specifications (see Table 1).

6. Limits and interlocks must be rated to carry and break current simultaneously to the ignition transformer, pilot valve, and main fuel valve(s).

7. All external timers must be listed or component recognized by authorities who have jurisdiction for the specific application.

IMPORTANT:
1. *For on-off gas-fired systems, some authorities who have jurisdiction prohibit the wiring of any limit or operating contacts in series between the flame safeguard control and the main fuel valve(s).*
2. *Two detectors can be connected in parallel, with the exception of infrared detectors (C7015).*

3. *This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class B computing device of part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference, in which case the users, at their own expense, may be required to take whatever measures are required to correct this interference.*
4. *This digital apparatus does not exceed the Class B limits for radio noise of digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.*
5. *RM7888A cannot be connected in parallel without isolation circuits to isolate input and output circuits.*

HUMIDITY
Install the RM7888A where the relative humidity never reaches the saturation point. The RM7888A is designed to operate in a continuous, noncondensing moisture environment with a maximum 85 percent relative humidity. Condensing moisture can cause a shutdown.

VIBRATION
Do not install RM7888A where it could be subjected to vibration in excess of 0.5G continuous maximum vibration.

WEATHER
The RM7888A is not designed to be weather tight. If installed outdoors, the RM7888A must be protected by an approved weather-tight enclosure.

MOUNTING WIRING SUBBASE

NOTE: For installation dimensions, see Figs 1 or 2.

1. Mount the subbase in any position except horizontally with the bifurcated contacts pointing down. The standard vertical position is recommended. Any other position decreases the maximum ambient temperature rating.

2. Select a location on a wall, burner or in an electrical panel. The Q7800 can be mounted directly in the control cabinet. Be sure to allow adequate clearance for servicing, installation, access and removal of RM7888A, dust cover, flame amplifier, flame amplifier signal voltage probes, electrical signal voltage probes and electrical field connections.

3. For surface mounting, use the back of the subbase as a template to mark the four screw locations. Drill the pilot holes.

4. Mount the subbase securely using four No. 6 screws.

Wiring

1. a. For the internal block diagram of the RM7888A, see Fig. 7. For proper subbase wiring, refer to Figs. 8 and 9.

   b. For proper subbase wiring, refer to Fig. 8 .

   c. For proper remote wiring of the Keyboard Display Module; refer to Fig. 9 or 10; or to the Specifications for the Keyboard Display Module (65-0090), Communication Interface Base Unit (63-2278), DATA CONTROLBUS MODULE™ (65-0091), or Extension Cable Assembly (65-0131).

2. Disconnect the power supply from the main disconnect before beginning installation to prevent electrical shock and equipment damage. More than one disconnect may be involved.

3. All wiring must comply with all appropriate electrical codes, ordinances and regulations. Wiring, where required, must comply with NEC Class 1 wiring.
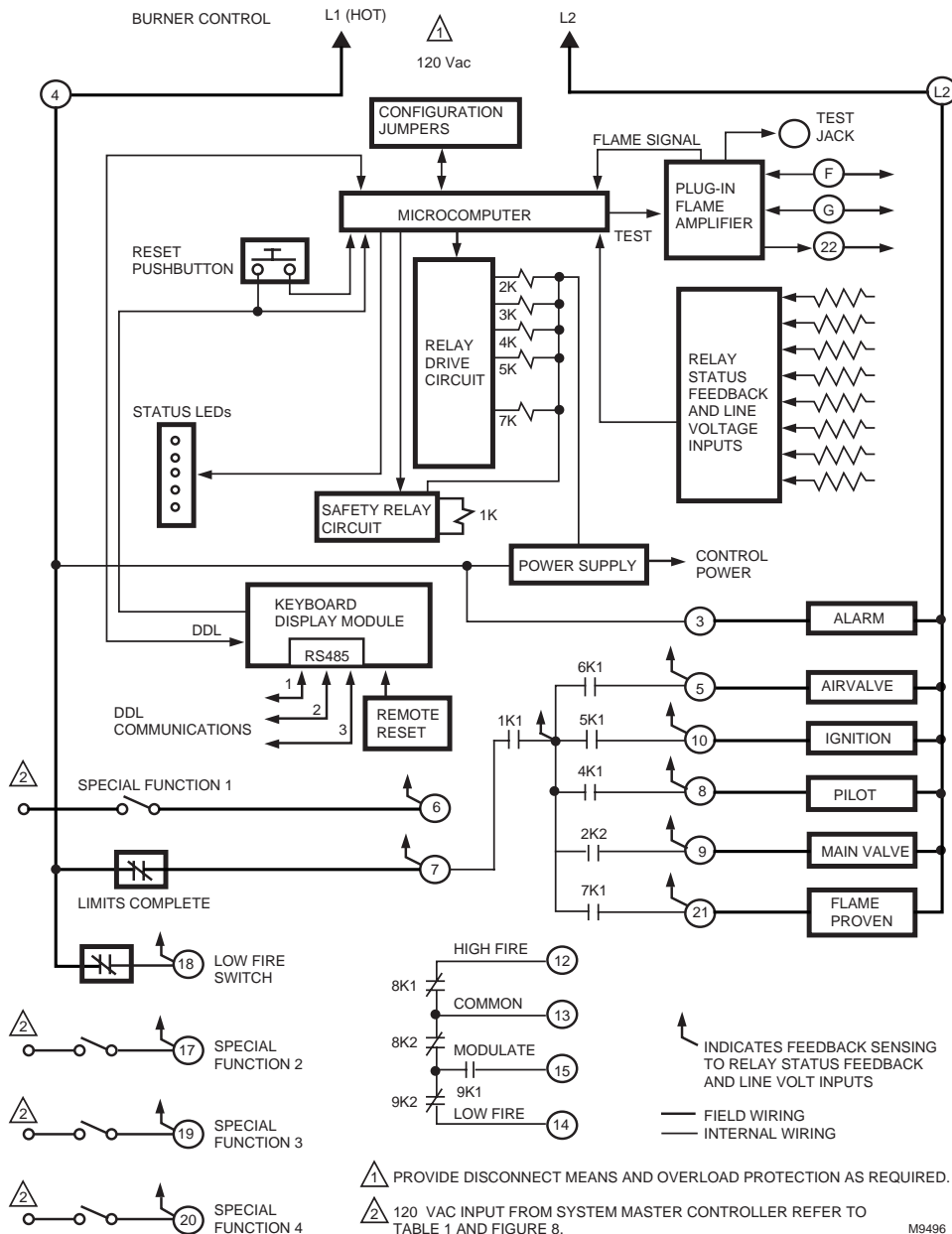
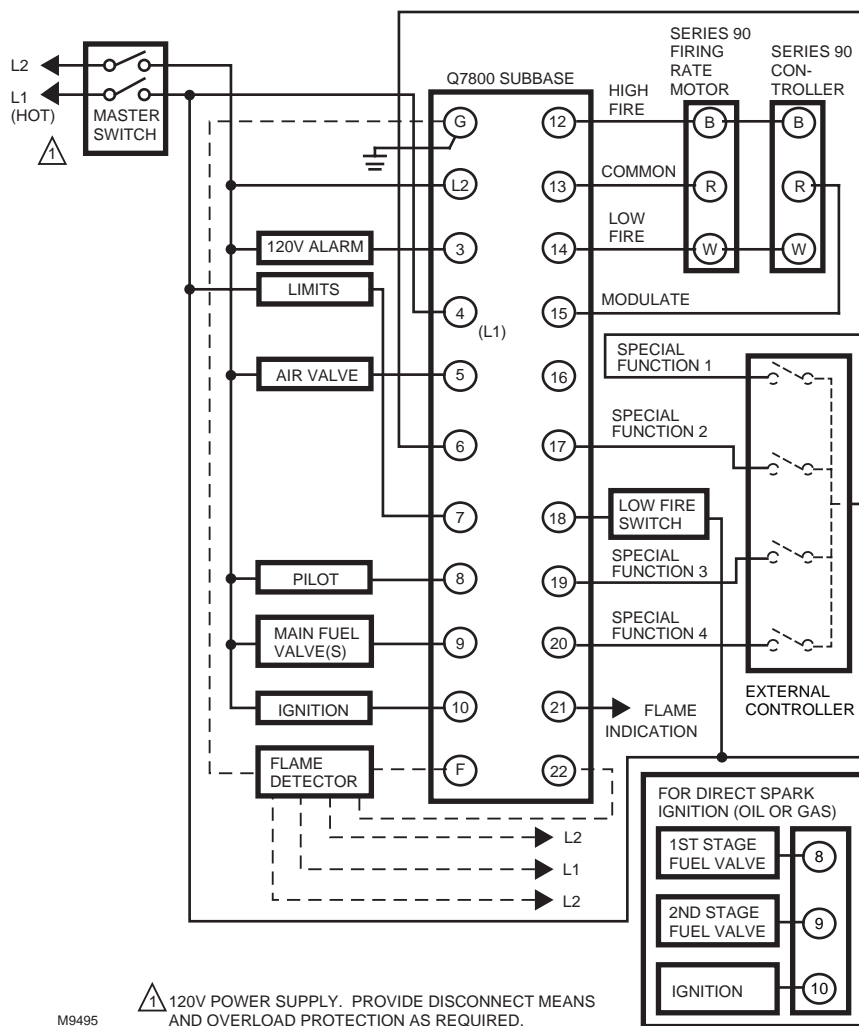**Fig. 7—RM7888A internal block diagram.**

Fig. 8—RM7888A wiring diagram.

SERIES 90
FIRING
RATE
MOTOR

SERIES 90
CON-
TROLLER

Q7800 SUBBASE

HIGH FIRE

COMMON

LOW FIRE

MODULATE

SPECIAL FUNCTION 1

SPECIAL FUNCTION 2

LOW FIRE SWITCH

SPECIAL FUNCTION 3

SPECIAL FUNCTION 4

EXTERNAL CONTROLLER

FLAME INDICATION

FOR DIRECT SPARK IGNITION (OIL OR GAS)

1ST STAGE FUEL VALVE

2ND STAGE FUEL VALVE

IGNITION

120V ALARM

LIMITS

AIR VALVE

PILOT

MAIN FUEL VALVE(S)

IGNITION

FLAME DETECTOR

L2
L1 (HOT)
MASTER SWITCH

1 120V POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
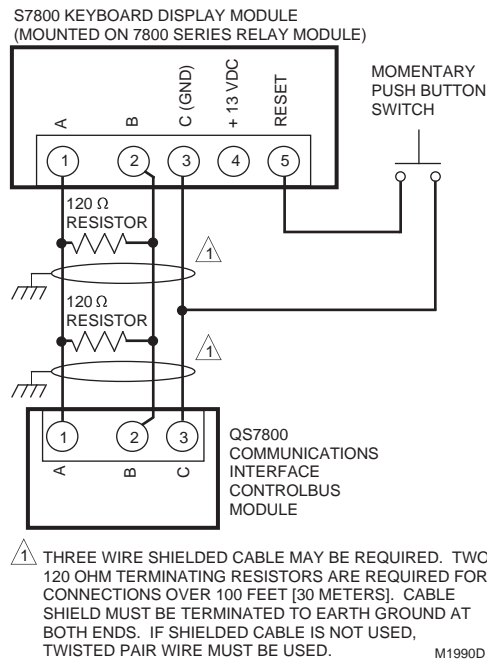
M9495

4. Recommended wire size and type:
a. Use No. 14, 16, or 18 copper conductor (TTW60C or THW75C or THHN90C) 600 volt insulation wire for all line voltage terminals. For high temperature installations, use wire selected for a temperature rating above the maximum operating temperature. All leadwires must be moisture resistant.
b. Keyboard Display Module—For communications purposes, use an unshielded 3-wire twisted cable if the leadwire run and noise conditions permit; however, some installations may need up to five wires; three for communications and two for remote reset (either in a single cable or separate cables for communications or remote reset) or use Belden 8771 shielded cable or equivalent. The Keyboard Display Module, DATA CONTROLBUS MODULE™ (for remote mounting or communications) or Communications Interface ControlBus Module must be wired in a daisy-chain configuration, 1(a)-1(a), 2(b)-2(b), 3(c)-

3(c)). The order of interconnection of all the devices is not important. Be aware that modules on the closest and farthest end of the daisy chain configuration require a 120-ohm (1/4 watt minimum) resistor termination across terminals 1 and 2 of the electrical connectors for connections over 100 feet [30 meters], see Figs. 10, 11 and 12.
c. DATA CONTROLBUS MODULE™—For communications purposes, use an unshielded 3-wire twisted cable if the leadwire run and noise conditions permit; however, some installations may need up to five wires; three for communications and two for remote rest (either in a single cable or separate cables for communications or remote reset) or use Belden 8771 shielded cable or equivalent. The Keyboard Display Module, DATA CONTROLBUS MODULE™ (for remote mounting or communications) or Communications Interface ControlBus Module must be wired in a daisy-chain configuration, 1(a)-1(a), 2(b)-2(b),

3(c)-3(c)). The order of interconnection of all the devices is not important. Be aware that modules on the closest and farthest end of the daisy chain configuration require a 120-ohm (1/4 watt minimum) resistor termination across terminals 1 and 2 of the electrical connectors for connections over 100 feet [30 meters].

d. Remote Reset—Use no. 22 or greater twisted pair wire, insulated for low voltage.

e. Communication Interface ControlBus Module—For communications purposes, use an unshielded 3-wire twisted cable if the leadwire run and noise conditions permit; however, some installations may need up to five wires; three for communications and two for remote reset (either in a single cable or separate cables for communications or remote reset) or use Belden 8771 shielded cable or equivalent. The Keyboard Display Module, DATA CONTROLBUS MODULE™ (for remote mounting or communications) or Communications Interface ControlBus Module must be wired in a daisy-chain configuration, 1(a)-1(a), 2(b)-2(b), 3(c)-3(c)). The order of interconnection of all the devices is not important. Be aware that modules on the closes and farthest end of the daisy chain configuration require a 120-ohm (1/4 watt minimum) resistor termination across terminals 1 and 2 of the electrical connectors for connections over 100 feet [30 meters].

5. Recommended grounding practices:

a. Use earth ground to provide a connection between the subbase and the control panel or the equipment. The earth ground wire must be capable of conducting the current to blow the 20A fuse (or breaker) in the event of an internal short circuit. The RM7888A needs a low impedance ground connection to the equipment frame which, in turn, needs a low impedance connection to earth ground. For a ground path to be low impedance at RF frequencies, the connection must be made with minimum length conductors that have a maximum surface area. Wide straps or brackets are preferred rather than leadwires. Make sure that mechanically tightened joints along the ground path, such as pipe or conduit threads or surfaces held together with fasteners, are free of nonconductive coatings and are protected against mating surface corrosion.

b. Keyboard Display Module, DATA CONTROLBUS MODULE™ or Communication Interface ControlBus Module—The shield, if used, should be connected to the signal ground terminal 3(c) provided as part of the 7800 SERIES device ControlBus connection. The shield should be connected at both ends to ground.

Fig. 9—Wiring the Keyboard Display Module with Communications Interface ControlBus Module.

Fig. 10—Wiring for multiple Keyboard Display Modules.
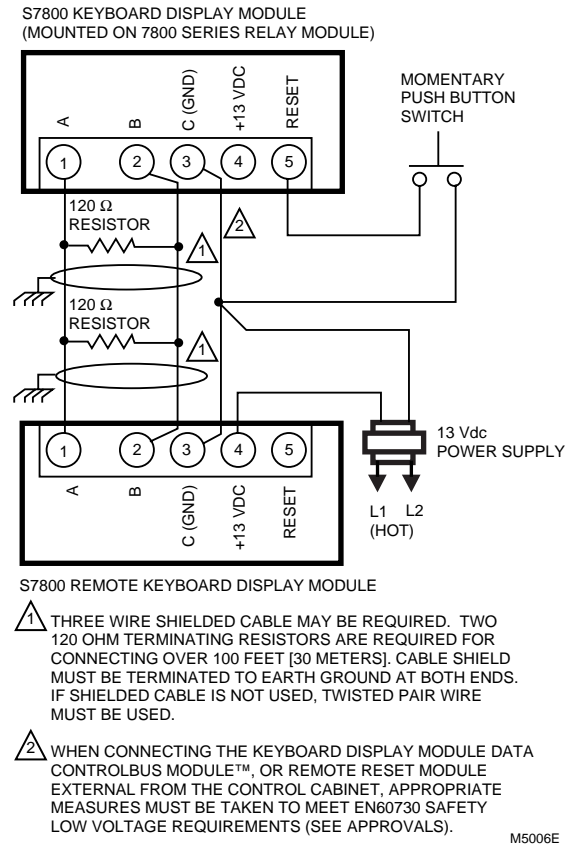
c. RM7888A—Each RM7888A will have an earth ground terminal that must be grounded to the metal control panel with wire as short as practical. Each ground wire must be capable of carrying a fault current equal to the rating of the protective fuse (20A). A number 14 copper conductor is adequate, but wide straps or brackets are preferred to leadwires.

6. Recommended wire routing:

a. Flame detector leadwires:
1. Do not run high voltage ignition transformer wires in the same conduit with flame detection wiring.
2. Do not route scanner wires in a conduit with line voltage circuits.
3. Enclose scanner wires without armor cable in metal cable or conduit.
4. Follow directions given in flame detector instructions.

b. DATA CONTROLBUS MODULE™:
1. Do not run high voltage ignition transformer wires in the same conduit or in close proximity to the DATA CONTROLBUS MODULE™ wiring.
2. Do not route DATA CONTROLBUS MODULE™ wires in conduit with line voltage circuits.

c. Keyboard Display Module:
1. Because the VFD is powered from a low voltage, energy limited source, mount it outside a control panel, without using special wiring procedures, if it is protected from mechanical damage.

d. Remote Reset:
1. Do not run high voltage ignition transformer wires in the same conduit with the Remote Reset wiring.
2. Do not route Remote Reset wires in the same conduit with line voltage circuits.

7. Maximum wire lengths:

a. For the flame detector leadwires, the maximum flame sensor leadwire length is limited by the flame signal strength.

b. For the Remote Reset leadwires, the maximum length of wire is 1000 feet to a Remote Reset pushbutton.

c. For the DATA CONTROLBUS MODULE™, the maximum DATA CONTROLBUS MODULE™ cable length depends on the number of system modules connected, the noise conditions and the cable used. The maximum length of all interconnecting wire is 1000 feet [305 meters].

8. Make sure loads do not exceed the terminal ratings. Refer to the label on the RM7888A or to the ratings in the specifications; see Table 1.

9. Check the power supply circuit. The voltage and frequency tolerance must match those of the RM7888A. A separate power supply circuit may be required for the RM7888A with the required disconnect means and overload protection added.

10. Check all wiring circuits and complete the Static Checkout before installing the RM7888A on the subbase: see Table 10.

11. Install all electrical connectors.

12. Restore power to the panel.

Assembly

MOUNTING THE RM7888A

NOTE: For installation dimensions, see Figs. 1 or 2.

RELAY MODULE MOUNTING(FIGS. 11 AND 12)
1. Mount RM7888A vertically, see Figs. 11 or 12, or mount horizontally with the knife blade terminals pointing downward. When mounted on the Q7800A, the RM7888A must be in an electrical enclosure.

2. Select the location in the electrical enclosure. Be sure to allow adequate clearance for servicing, installation and removal of the RM7888A, Keyboard Display Module, flame amplifier, flame amplifier signal voltage probes, electrical signal voltage probes and electrical connections.
a. Allow an additional two inches below the RM7888A for the flame amplifier mounting.
b. Allow an optional three-inch minimum to both sides of the RM7888A for electrical signal voltage probes.

3. Make sure no subbase wiring is projecting beyond the terminal blocks. Tuck in wiring against the back of the subbase so it does not interfere with the knife blade terminals or bifurcated contacts.

IMPORTANT: *The RM7888A must be installed with a plug-in motion rather than a hinge action.*

Fig. 11—Electrical panel installation.

Fig. 12—Wall or burner installation.

4. Mount the RM7888A by aligning the four L-shaped corner guides and knife blade terminals with the bifurcated contacts on the wiring subbase and securely tightening the two screws without deforming the plastic.

MOUNTING THE KEYBOARD DISPLAY MODULE (FIG. 13)

1. Align the two interlocking ears of the Keyboard Display Module with the two mating slots on the RM7888A.

2. Insert the two interlocking ears into the two mating slots and, with a hinge action, push on the lower corners of the Keyboard Display Module to secure it to the RM7888A.

3. Make sure the Keyboard Display Module is firmly in place.

Fig. 13—Keyboard Display Module mounting.

MOUNTING THE DATA CONTROLBUS MODULE™ AND THE EXTENSION CABLE ASSEMBLY (FIGS. 14 AND 15)

1. Align the two interlocking ears with the two mating slots on the RM7888A.

2. Insert the two interlocking ears into the two mating slots and push on the lower corners of the DATA CONTROLBUS MODULE™ or Extension Cable Assembly to secure it to the RM7888A.

3. Make sure the DATA CONTROLBUS MODULE™ is firmly in place.

Fig. 14—DATA CONTROLBUS MODULE™ mounting.

Fig. 15—Extension Cable Assembly mounting.

**REMOTE MOUNTING THE KEYBOARD
DISPLAY MODULE (FIG. 16)**

1. The Keyboard Display Module can be mounted either on the face of a panel door or other remote locations.

NOTE: A DATA CONTROLBUS MODULE™ or an Extension Cable Assembly is required to connect RM7888A to a remote Keyboard Display Module.

2. When mounting the Keyboard Display Module on the face of the door panel, closely follow these instructions:
   a. Select the location on the door panel for flush mounting. Pay attention to the insertion dimension of the two Keyboard Display Module screws, two interlocking ears and the two plug-in connectors to allow for sufficient clearance (1/4 in. [6 mm] minimum) inward from the surface of the door panel.
   b. Use Fig. 30 as a template. Mark the two screw locations, two interlocking ear locations and the two plug-in connector locations. Drill the pilot holes for the mounting screws. Provide for two holes on the door panel for the interlocking ears and two holes for the plug-in connectors.
   c. Mount the Keyboard Display Module on the door using two no. 4 screws.

3. When mounting the Keyboard Display Module on a wall or remote location, use part number 203765, Remote Mounting Bracket.
   a. Using the Remote Mounting Bracket as a template, mark the four screw locations and drill the pilot holes.
   b. Mount the Remote Mounting Bracket using four no. 6 screws.
   c. Mount the Keyboard Display Module by aligning the two interlocking ears with the two mating slots on the Remote Mounting Bracket.
   d. Insert the two interlocking ears into the two mating slots. Push on lower corners of the Keyboard Display Module to secure it to the Remote Mounting Bracket.
   e. Make sure the Keyboard Display Module is firmly in place.

**INSTALLING THE PLUG-IN FLAME SIGNAL
AMPLIFIER (FIG. 17)**

1. Disconnect the power supply before beginning the installation to prevent electrical shock and equipment damage. More than one disconnect may be involved.

2. Align the amplifier circuit board edge connector with the keyed receptacle on the RM7888A. Make sure the amplifier nameplate faces away from the Relay Module.

3. Push in the amplifier until the circuit board is fully inserted into the receptacle and then push the amplifier toward the RM7888A retaining clasp.

4. Make sure the amplifier is firmly in place.

5. Perform all required checkout tests.

**Fig. 16—Remote mounting of Keyboard
Display Module.**

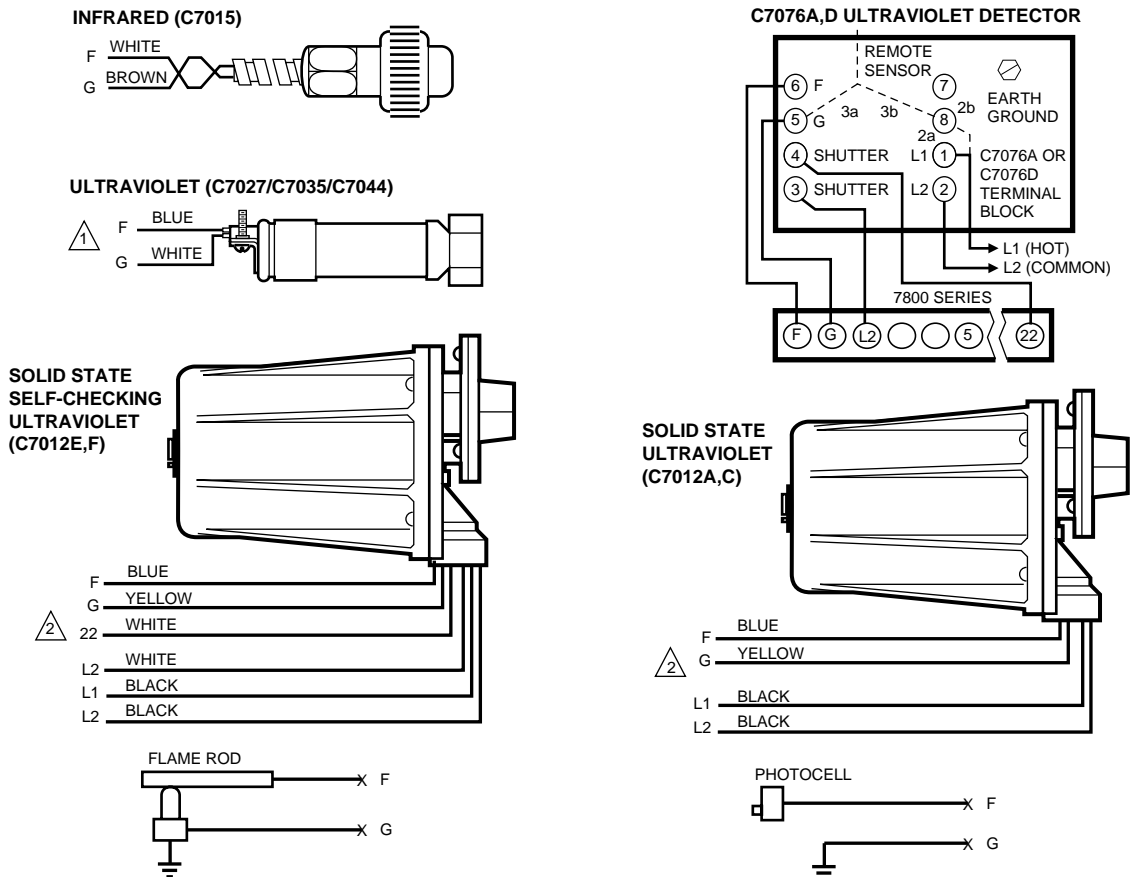**Fig. 17—Flame signal amplifier mounting.**

INSTALLING THE FLAME DETECTOR (FIG. 18)

NOTE: Table 2 lists the flame detection systems available for use with the RM7888A. Make sure the correct combination of amplifier and flame detector(s) is used.

Proper flame detector installation is the basis of a safe and reliable flame safeguard installation. Refer to the instructions packed with the flame detector and the equipment manufacturer instructions.

Keep the flame signal leadwires as short as possible from the flame detector to the wiring subbase. Capacitance increases with leadwire length, decreasing the signal strength. The maximum permissible leadwire length depends on the type of flame detector, leadwire and conduit. The ultimate limiting factor in the flame signal is the flame detector leadwire, see Table 8.

Fig. 18—Flame detector wiring.

INFRARED (C7015)

ULTRAVIOLET (C7027/C7035/C7044)

SOLID STATE SELF-CHECKING ULTRAVIOLET (C7012E,F)

C7076A,D ULTRAVIOLET DETECTOR

SOLID STATE ULTRAVIOLET (C7012A,C)

⚠1 FLAME DETECTOR LEADS ARE COLOR CODED. THE BLUE LEAD MUST BE CONNECTED TO THE F TERMINAL AND THE WHITE MUST BE CONNECTED TO THE G TERMINAL. THE UV SENSING TUBE IS POLARITY SENSITIVE. REVERSING THE LEADS EVEN MOMENTARILY CAN DAMAGE OR DESTROY THE UV TUBE.

⚠2 FLAME DETECTOR LEADS ARE COLOR CODED. THE BLUE LEAD MUST BE CONNECTED TO THE F TERMINAL AND THE YELLOW MUST BE CONNECTED TO THE G TERMINAL. THE UV SENSING TUBE IS POLARITY SENSITIVE. REVERSING THE LEADS EVEN MOMENTARILY CAN DAMAGE OR DESTROY THE UV TUBE.

M1969B

Operation

⚠️ **WARNING**

The user of the RM7888A is responsible for providing an effective purge that meets the approval of the authority having jurisdiction for a particular installation. Failure to provide an effective purge can result in a fire or explosion that can cause damage, serious injury or death.

Sequences of Operation

The RM7888A has five user selectable operating sequences: Pilot—PV Return; Pilot—MV Lo Fire; Direct Spark Ignition (DSI) Normal Operating Sequence; DSI High/Low Stepfire Operating Sequence and DSI Off/On Stepfire Operating Sequence. Each operating sequence will be discussed in detail.

⚠️ **CAUTION**

The user selects the appropriate control sequence by clipping configuration jumpers. Sequence selection must be done correctly. Failure to select the sequence correctly can be hazardous. Follow instructions in this specification.

SELECTABLE SITE-CONFIGURABLE JUMPERS

The RM7888A has five site-configurable jumper options and three options that will result in a lockout, see Fig. 19 and Table 4. The site-configurable jumpers should be clipped with side cutters and the resistor removed from the Relay Module.

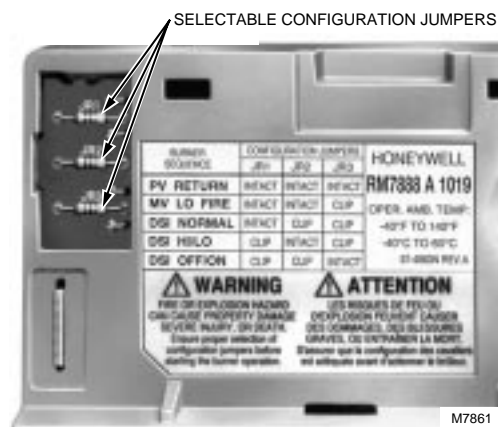**Fig. 19—Selectable site-configurable jumpers.**

TABLE 4—SITE-CONFIGURABLE JUMPER OPTIONS.

Jumper			
J1	**J2**	**J3**	**RM7888A Action**
Intact	Intact	Intact	Default, selects the Pilot Configuration Burner Sequence, including the Pilot Relight Function.(PV Return)[1]
Intact	Clipped	Clipped	Selects DSI Normal Burner Sequence.[1]
Clipped	Intact	Clipped	Selects DSI High/Low Stepfire Burner Sequence.[1]
Clipped	Clipped	Intact	Selects DSI Off/On Stepfire Burner Sequence.[1]
Intact	Intact	Clipped	Selects Pilot Configuration Burner Sequence, but excludes the Pilot Relight Function.(MV Lo Fire)[1].
Intact	Clipped	Intact	Illegal; will result in a lockout.
Clipped	Intact	Intact	Illegal; will result in a lockout.
Clipped	Clipped	Clipped	Illegal; will result in a lockout.

[1] Each operating sequence is described individually in the Operation section of this specification. Read the appropriate operating sequence section carefully **before** clipping jumpers. The sequence selection **cannot** be reversed.

Pilot Configuration Operating Sequence.

The Pilot Configuration Operating Sequence has two distinct operating sequences that are entered from the Standby/Standby Purge states. The sequences are:

  a. PV Return: allows the control to reestablish the pilot and de-energize the main flame in response to the system heating requirements.

  b. MV Lo Fire: will not allow the pilot to be re-established once RUN has been entered; the main valve remains energized with Lo Fire being the lowest firing rate allowed.

See Table 5 for the state names, the text that appears on the S7800 Keyboard Display Module, and the purpose.

TABLE 5—PILOT CONFIGURATION OPERATING SEQUENCE STATES.

Pilot Configuration State Name	S7800 Keyboard Display Module Displayed Text	Purpose of State
Initiate	(See below)	The Initiate state allows the relay module to complete initialization after a power-up or whenever a problem that would prevent normal operation (such as an ac line problem), the Initiate state is entered.
Initiate	INITIATE mm:ss	Displayed during timed portion of the Initiate state.
Initiate	INITIATE HOLD: AC (AC Freq/Noise)	Displayed during Initiate state if the ac frequency is low or noise is present.
Initiate	INITIATE HOLD: AC (AC Line Dropout)	Displayed during Initiate state if the ac line power was lost.
Initiate	INITIATE HOLD: AC (AC Frequency)	Displayed during Initiate state if the ac frequency is high.
Initiate	INITIATE HOLD: AC (Low Line Voltage)	Displayed during Initiate state if the ac line voltage is low.
Off	STANDBY	Remaining idle until valid input(s) are received. All safety loads are commanded off.
—	STANDBY HOLD: F/G (Flame Detected)	Displayed when a flame is detected.
—	STANDBY HOLD: T7 (Lockout ILK)	Displayed when a call for operation is active and the Limits Complete signal is off.
	PURGE HOLD: T18 (Low Fire Switch)	Displayed when a call for operation is active and the Low Fire Switch signal is off.
Purge	PURGE 01:00	Purge at high fire. All safety loads are commanded off. Display indicates Purge type 1 = Purge.
Control Cool	PURGE 02:00	Purge at the motor position commanded by the modulating control. All safety loads are commanded off. Display indicates Purge type 2 = Control Cool.
Low Combustion Air Only	PURGE 03:00	Purge at low fire. All safety loads are commanded off. Display indicates Purge type 3 = Low Combustion Air Only.
Pilot Ignition	PILOT IGN mm:ss	Establish a pilot flame. Display shows state and elapsed time. At end of Pilot Ignition timed state, timer will stop and display will show final time while a hold exists.
Main Train Fuel On	MAIN IGN 00:00	Allow for main valve operators to be placed into the normal operating condition. Display shows state with zero elapsed time while waiting for a hold condition(s).
Burner Fuel Valve Open (Pilot Timeout)	MAIN IGN 00:ss	Establish a main flame and drop the pilot flame. Display will show MFEP state elapsed time.
Release to Modulation	RUN	Allow normal operation to take place where a modulating control provides the motor position signal.

(Continued)

TABLE 5—PILOT CONFIGURATION OPERATING SEQUENCE STATES *(Continued)*.

Pilot Configuration State Name	S7800 Keyboard Display Module Displayed Text	Purpose of State
—	RUN	When special function input terminal 20 is off, relay module will command a Low Fire motor position.
@Low 10 Sec	RUN	When the Low Fire input becomes energized for a continuous time period of 10 seconds, the sequence will leave the Release to Modulation state and proceed to the Pilot Relight state (PV Return sequence only).
Pilot Relight	PVHOLD IGN 00:ss	Re-establish the pilot flame and drop the main flame. Display indicates elapsed time in this timed state (PV Return sequence only).
Low Off 5 Sec.	PVHOLD IGN 01:00	Wait for the Low Fire input signal to become de-energized for a continuous period of five seconds and then proceed to the Main Train Fuel On state after driving back to the Low Fire position. Display indicates that sequence is in Pilot Hold State type 1 = Waiting for Low Off 5 Sec.
Drive to Low	PVHOLD IGN 02:00	Commands the low fire motor position and waits until the Low Fire input becomes energized before proceeding to the Main Train Fuel On state. Display indicates that sequence is in Pilot Hold State type 2 = Waiting for Low Fire On.

PILOT CONFIGURATION SEQUENCE OF OPERATION

⚠ *WARNING*

The user of the RM7888A is responsible for providing the correct signal to each special function input terminal and must make sure that safety is not compromised if an incorrect special function input is applied.

INITIATE

The RM7888A enters the INITIATE sequence when the Relay Module is powered. The RM7888A also enters the INITIATE sequence if the Relay Module verifies voltage fluctuations of +10/-15 percent or frequency fluctuations of ±10 percent during any part of the operating sequence. The INITIATE sequence lasts for ten seconds unless the voltage or frequency tolerances are not met. When the tolerances are not met, a hold condition will be initiated and will be displayed on the Keyboard Display Module for at least five seconds. When the tolerances are met, the INITIATE sequence will restart. If the condition is not corrected and the hold condition exists for four minutes, the RM7888A will lock out. Causes for hold conditions in the INITIATE sequence are:

• AC line dropout is detected.
• AC line frequency error caused by using a 60 Hz device on an 50 Hz line, or vice versa.
• AC line noise that can prevent a sufficient reading of the line voltage outputs.
• Brownouts caused by a low line voltage.

STANDBY

The Standby states include Standby-Off, Standby-Purge, Standby-Control Cool, and Standby-Low Combustion Air Only, and Standby-Hold. All Standby states command the ignition, pilot and main off and will lockout if the feedback signals indicate that one of those terminals is energized. The Flame Proven output will be commanded off without regard to the current Flame Sensed signal. After the first three seconds of Standby, if the Flame Sensed signal indicates flame, the special function inputs will be ignored, the Air Valve will be commanded off and the motor position commanded to Low Fire. The alarm output will be commanded off.

The Standby state selected is based on the state of special function inputs 1, 2, 3 and 4 (terminals 6, 17, 19 and 20).

A three-second transition period runs when the Standby state is entered. This time period allows enough time for the master system controller to set up the desired combination of special function input signals so when the time period expires, the required motor position command and air valve output status are commanded. During the time period, the motor control is commanded to the Low Fire position, the Air Valve is commanded off, the special function input terminals are ignored, and the safety loads (Ignition, Pilot and Main Valve) are commanded off immediately upon entering Standby.

When special function 1 is energized, a request for burner operation is in effect, the Air Valve will be commanded off and the LowFire motor position commanded. In this case, special functions 2, 3, and 4 are ignored. The burner will sequence to the Pilot Ignition state as soon as the Low Fire input and the Limits Complete input are energized.

⚠ *WARNING*

The user of the RM7888A is responsible for providing an effective purge that meets the approval of the authority having jurisdiction for a particular installation. The RM7888A does not directly monitor the presence or absence of airflow and cannot guarantee that the air valve or fan is working. Failure to provide an effective purge can result in a fire or explosion that can cause damage, serious injury or death.

Standby-Hold

The RM7888A has a request to sequence out of standby (special function terminal 1 is energized), but a condition such as a de-energized Low Fire input or Limits Complete input signal keeps the sequence in Standby.

When Special Function 1 is energized, the sequence will hold for eight minutes while waiting for the Low fire signal to become energized, with an alarm after four minutes of hold. The sequence will hold for 120 seconds while waiting for the Limits Complete signal to become energized. If either time limit expires, a lockout will occur.

When Special Function 1 is de-energized, one of four Standby states are possible. The Standby state in effect depends on the status of the special function inputs. The four Standby states are:

1. Off: the relay module is commanding the Low Fire motor position and the Air Valve off.

2. Purge: The relay module is commanding the High Fire motor position and the Air Valve on.

3. Control Cool: The relay module is commanding the modulated motor position and the Air Valve on.

4. Low Combustion Air Only: The relay module is commanding the Low Fire motor position and the Air Valve on.

If Special Function inputs 2, 3 and 4 are all de-energized, the Standby-Off state is in effect: the Air Valve is commanded off and the Low Fire state is ordered.

During Standby/Standby-Purge states, when special function 1 is de-energized, special function terminals 2, 3 and 4 provide a signal that requests that the RM7888A command a particular motor position and Air Valve status. If any one or more of the special function inputs (terminals 17, 19, or 20) is energized, a Standby-Purge state is in effect with the Air Valve commanded on and either Low Fire, High Fire, or the modulated position commanded (see Table 6).

Table 6 defines the combinations of special function inputs and corresponding output state (Air Valve and Motor Output) during Standby.

PILOT CONFIGURATION IGNITION TRIALS (PV RETURN AND MV LO FIRE SEQUENCES)

Pilot Ignition State

Pilot Ignition is entered only from the Standby state with the Limits Complete and Low Fire input signals energized, Special Function input 1 (terminal 6) energized and the Air Valve either on or off, depending on which Standby state preceded the Pilot Ignition state.

At the start of the Pilot Ignition state, the ignition and pilot outputs are commanded on, Low Fire is commanded, and the Air Valve is commanded off. The RM7888A will lockout if the Low Fire input becomes de-energized after the first two seconds of the Pilot Ignition state. A one- to two-second transition state precedes the Pilot Ignition state so the Low Fire switch has at least three seconds to stabilize. This reduces the possibility of a contact bounce causing a lockout. The RM7888A will lockout if the Limits Complete input becomes de-energized.

For the first ten seconds, the Pilot Ignition state attempts to establish a pilot flame. If, at the end of ten seconds, a pilot flame has not been established, a lockout will occur. Otherwise, with a flame established, the igniter is commanded off, the Flame Proven output is commanded on and the pilot flame continues. This pilot state, with only the pilot output on and a pilot flame proven, will continue for at least five seconds, but may continue indefinitely depending on the status of the special function input terminals.

If a flameout occurs any time after this point in the burner sequence, a lockout will occur.

TABLE 6—SPECIAL FUNCTION INPUTS/OUTPUT STATES DURING STANDBY.

Special Function 2 (Terminal 17)	Special Function 3 (Terminal 19)	Special Function 4 (Terminal 20)	Air Valve Output	Motor Position Commanded
De-energized	De-energized	De-energized	De-energized	Low Fire
De-energized	De-energized	Energized	Energized	High Fire
De-energized	Energized	Energized	Energized	Modulate
Energized	Energized	Energized	Energized	Low Fire
De-energized	Energized	De-energized	Energized	Modulate
Energized	De-energized	De-energized	Energized	Low Fire
Energized	De-energized	Energized	Energized	Low Fire
Energized	Energized	De-energized	Energized	Low Fire

⚠ *WARNING*

The Flame Proven output is an RM7888 safety output, whose output status is monitored by RM7888A. This output is to be used by external equipment that can respond to the signal. The end user must assure that the Flame Proven output cannot be misinterpreted. Misinterpretation of this signal could create a hazardous situation, resulting in fire or explosion that can cause damage, serious injury or death.

Pilot Ignition-(Hold)

After the five second period following the ten-second pilot establishing period has expired, the RM7888A will respond to special functions 2 and 3. If special functions 2 and 3 are both de-energized, or if special function 2 is de-energized and special function 3 is energized, the pilot state will continue indefinitely. If, after four minutes, special function 2 does not become energized, the alarm will be commanded on. If special function 2 is still de-energized after an additional four minutes (eight minutes total), a lockout will occur.

If special function 2 becomes energized and special function 3 is de-energized, the pilot state will sequence to the Main Train Fuel On state. If special functions 2 and 3 both become energized at the same time, the pilot state will sequence to the Burner Fuel Valve Open/Pilot Timeout state, bypassing the Main Train Fuel On state.

Main Train Fuel On

At Main Train Fuel On, the Air Valve and the Main Fuel are commanded on. The motor position will continue at Low Fire, and the pilot valve will stay on. The sequence will lockout if either the Low Fire input, or the Limits Complete de-energize, or a flame failure occurs.

The Main Train Fuel On state will proceed to the Burner Fuel Valve Open/Pilot Timeout state as soon as special function 3 becomes energized in addition to special function 2. If special function 2 becomes de-energized after the first two seconds while in the Main Train Fuel On state, a lockout will occur. After four minutes, if special function 3 does not become energized, the alarm will be commanded on. After an additional four minutes, if special function 3 is still de-energized, a lockout will occur.

Burner Fuel Valve Open/Pilot Timeout (Main Flame Establishing)

During Burner Fuel Valve Open/Pilot Timeout, the main flame will be established and the pilot extinguished.

When the Burner Fuel Valve Open/Pilot Timeout state is entered, the pilot, main, and Air Valve will be commanded on, the ignition commanded off, the motor position to low fire, and a ten second timer starts.

A lockout will occur if the Low Fire input or the Limits Complete becomes de-energized, or a flame failure occurs, or Flame Proven output is de-energized. After the first two seconds, a lockout will occur if the special function 2 or 3 de-energize.

At the end of the ten second period, the pilot is commanded off and a five second minimum flame stabilization period begins. When the stabilization period is completed, the RM7888A will respond to the status on special function 4. If special function 4 is energized, the sequence will proceed to the Release to Modulation state (Run state).

If special function 4 is de-energized, the sequence will remain indefinitely at the Main Flame Low Fire state. A lockout will occur if the Pilot, Ignition or Main Valve outputs are not in the commanded states, if the flame is lost, if special function 2 or 3 becomes de-energized, or Flame Proven output is de-energized.

Release to Modulation State (Run State)

When the Release to Modulation state is entered, the only change in the commanded output status is the motor position; it is commanded to Modulate instead of Low Fire.

The sequence will lockout if the Limits Complete becomes de-energized, a flame failure occurs, special function 2 or 3 becomes de-energized, or Flame Proven output is de-energized.

If the site configurable jumpers are configured to include Pilot Relight (PV Return Sequence) Pilot Relight is initiated as follows. When the motor position is Modulate and the Low Fire input is energized during the Release to Modulation state for a continuous time period of ten seconds, the sequence will proceed to the Pilot Relight state. Normally, the requirements of the process will be sufficient to keep the modulating control above the Low Fire position.

If the site configurable jumpers are configured to exclude Pilot Relight (MV Lo Fire Sequence), Pilot Relight will not be initiated; the burner modulates to Low Fire during the Run state and remains there until the RM7888A is commanded off (Standby).

Run-Low Fire(part of Run State)

If special function 4 becomes de-energized during the Run state, the sequence will command the motor position to Low Fire and start a 240-second timer. If the @Low Fire input fails to energize or becomes de-energized after the time period has expired while special function 4 remains de-energized, the alarm output will be made active. If special function 4 becomes energized, the time period measurement will end and the normal Release to Modulation (Run) state will be active.

Pilot Relight—PV Return Sequence Only

When the Pilot Relight state is entered, the Ignition, Pilot, Main, and Air Valve will be commanded on, the motor position will be commanded to Low Fire and a ten second timer will be started. Flame Proven remains on.

The sequence will lockout if the Limits Complete de-energizes or a flame failure occurs. Lockout will also occur if the Low Fire input or special function 2 or 3 becomes de-energized during Pilot Relight.

At the end of the ten-second period, the Wait for Low Off state is entered. The ignition, main valve and Air Valve are commanded off, the Pilot remains commanded on, and

the motor is commanded to the Modulate position. The Modulate position is commanded to detect a process load increase by noticing that the modulating control has requested a position other than the Low Fire position.

If the Low Fire input is de-energized during the Wait for Low Off state for a continuous time period of five seconds, the sequence will proceed to the Drive to Low Fire state. Otherwise, the sequence will remain in the Wait for Low Off state indefinitely while waiting for the modulating control to request more heat by commanding a motor position from Low Fire that signals that the process load has increased and the burner will sequence back to the Run state. The sequence will lockout if the special function 2 (terminal 17) becomes de-energized, but will ignore special functions 3 and 4.

Drive to Low Fire

The purpose of the Drive to Low Fire state is to drive the motor position back to Low Fire in preparation for return to main fuel.

When the Drive to Low Fire Position state is entered, the Ignition, Main Valve and Air Valve are commanded off, the Pilot is commanded on, the motor position is commanded to the Low Fire position and a 15-second timer is started.

If the 15-second time period expires, the sequence will hold waiting for the Low Fire input to become energized and the alarm output will be commanded on. The sequence will proceed to the Main Train Fuel On state when the Low

Fire input becomes continuously energized for three seconds. If special function 2 is de-energized, a lockout will occur.

Lockout State

The Lockout State is entered when a timed sequence hold expires or a signal is not in the required state. The RM7888A Pilot Configuration sequence description details the conditions under which the sequence will lockout.

Pilot Sequence Timing Diagram

Fig. 20 shows the timing relationships between the RM7888A inputs and outputs for each sequence state described in the preceding paragraphs.

DIRECT SPARK IGNITION (DSI) OPERATING SEQUENCE

The Direct Spark Ignition (DSI) configuration has three distinct operating sequences that are entered from the Standby/Standby Purge states. The sequences are:
- Normal sequence.
- High/Low Stepfire sequence.
- Off/On Stepfire sequence.

Each sequence is user-selectable using the configuration jumpers. The sequence that is used is dictated by the requirements of a particular application. Each sequence consists of a burner operating sequence with several states.

Normal sequence is used when the application requires the burner flame to be modulated during the Run state.

TABLE 7—DSI CONFIGURATION OPERATING SEQUENCE STATES.

DSI State Name	Displayed Text	Purpose
Normal—Part 1 (Main Flame Establishing Period [MFEP])	MAIN IGN 00:ss	Establish a Low Fire flame. Display shows elapsed time for Normal—Part 1.
Normal—Part 2 (Main Flame Establishing Period [MFEP])	MAIN IGN 00:ss	Allow for main valve operators to be placed into the normal operating condition while at Low Fire position. Display shows elapsed time for Normal—Part 2.
Normal—Part 3 (Run)	RUN	Allow normal operation to take place where a modulating control provides the motor position signal.
High/Low Stepfire—Part 1 (Main Flame Establishing Period [MFEP])	MAIN IGN 00:ss	Establish a Low Fire flame. Display shows elapsed time.
High/Low Stepfire—Part 2 (Run)	RUN	Run with Low Fire flame while commanding Low Fire for an indefinite time period. When the appropriate special function signals are present, the sequence will advance into the HI (Run at High Fire) state.
Run—High	RUN	Run with a High Fire flame for an indefinite period. From this state, the sequence can return to the Low Fire state upon command without recycling. Commanded output state is the same as Normal—Part 3, but special function signals are different.
OFF/ON Stepfire—Part 1 (Main Flame Establishing Period [MFEP])	MAIN IGN 00:ss	Establish a Low Fire flame. Display shows elapsed time.
OFF/ON Stepfire—Part 2 (Run)	RUN	Run with a high fire flame for an indefinite period. Commanded output state is the same as Normal Part 3 but special function signals are different.

Fig. 20— RM7888A Relay Module Pilot Sequuence timing diagram.

INPUT & OUTPUT SIGNALS	PV Return and MV Lo Fire							PV Return Only			
	STANDBY / STANDBY-PURGE	PILOT / IGNITION 1ST 10 SEC	PILOT-IGNITION LAST 5-INFINITE SECONDS	MAIN TRAIN FUEL ON 0-INFINITE TIME	BURNER FUEL VALVE OPEN-PILOT TIMEOUT 1ST 10 SEC	BURNER FUEL VALVE OPEN-PILOT TIMEOUT LAST 5 TO INFINITE	RELEASE TO MODULATION RUN: 0 TO INFINITE SEC	PILOT RELIGHT 10 SEC	PILOT RELIGHT AFTER 10 SEC WAIT FOR LOW OFF FOR 5 SEC 5 TO INFINITE SEC	DRIVE TO LOW FIRE POSITION 2 TO 5 SEC. (WITH 2-3 SEC. AT LOW STABILIZE)	RETURN TO MAIN TRAIN FUEL ON STATE
POWER	●POWER	●POWER	●POWER	●POWER	●POWER	●POWER	●POWER	●POWER	●POWER	●POWER	
PILOT	○	●PILOT	●PILOT	●PILOT	●PILOT	○PILOT	○PILOT	●PILOT	●PILOT	●PILOT	
FLAME	○	●FLAME	●FLAME	●FLAME	●FLAME	●FLAME	●FLAME	●FLAME	●FLAME	●FLAME	
MAIN	○	○	○	●MAIN	●MAIN	●MAIN	●MAIN	●MAIN	○	○	
ALARM	○	○	○	○	○	○	○	○	○	○	

IGNITION- T10											
PILOT- T8											
MAIN- T9											
AIR VALVE-T5											
FLAME PROVEN- T21											
ALARM- T3											
MOTOR POSITION- T12-T15	L/H/MOD	L	L	L	L	L	MOD	L	MOD	L	
@ LOW FIRE INPUT- T18											
LIMITS COMPLETE- T7											
SF1 SPECIAL FUNCTION- T6											
SF2 SPECIAL FUNCTION- T17											
SF3 SPECIAL FUNCTION- T19											
SF4 SPECIAL FUNCTION- T20											
FLAME SENSED											

M9497

High/Low Stepfire sequence is used when the application requires the burner flame to be switched, on command, between a Low Fire and a High Fire Run state.

Off/On Stepfire sequence is used when the application requires the burner flame to be switched, on command, between a Standby state and a Main Flame state.

Each DSI operating sequence has several states. See Table 7 for the state names, the text as shown on an S7800A Keyboard Display Module, and a brief description of the state purpose. All three sequences have the Standby state in common.

⚠ **WARNING**

The user of the RM7888A is responsible for providing the correct signal to each special function input terminal and must make sure that safety is not compromised if an incorrect special function input is applied.

Initiate State

The Initiate state will be entered when the RM7888A is powered. The sequence will transition to the Standby state after a ten second period. However, if any condition exists that could prevent reliable operation of the RM7888A, the sequence will remain in the Initiate state until the condition is corrected. These conditions include the detection of the loss of ac power, insufficient ac power level, incorrect ac line frequency, and excess noise present on the ac line. A ten second stabilization period occurs after the condition is corrected before the sequence transitions to the Standby state. Also, any condition that is detected will remain annunciated for a minimum of five seconds.

Standby State

Standby states for the DSI sequences are the same as those for the Pilot sequences. See Pilot Configuration Ignition Trials.

⚠ *WARNING*

The user of the RM7888A is responsible for providing an effective purge that meets the approval of the authority having jurisdiction for a particular installation. The RM7888A does not directly monitor the presence or absence of airflow and cannot guarantee that the air valve or fan is working. Failure to provide an effective purge can result in a fire or explosion, causing damage, serious injury or death.

NOTE: When special function 1 is energized, the RM7888A will sequence to the initial DSI state based on the setting of the configuration jumpers. A hold, as previously defined, will prevent the sequence from exiting the Standby state.

Normal—Part 1

The Normal—Part 1 state is entered only from the Standby state with the Limits Complete signal and @Low Fire input on, and special function 1 energized. On entry, the Air Valve will be commanded off, the Ignition and Pilot (Low Fire Valve) outputs are commanded on, and Low Fire position is commanded. The Main Valve and Flame Proven outputs are commanded off. The RM7888A will lockout if the @Low Fire input becomes de-energized after the first two seconds of the Normal—Part 1 state. A one- to two-second transition state precedes the Normal—Part 1 state so the Low Fire switch has at least three seconds (total) to stabilize. This reduces the chance of a nuisance lockout due to a contact bounce on the @Low Fire input. The RM7888A will lockout if the Limits Complete is de-energized.

For the first four seconds, the Normal—Part 1 state attempts to establish a Pilot (Low Fire Valve) flame. At the end of the first four seconds, the Ignition output is commanded off. If flame has not been established, a lockout will occur. With flame established, an indefinite hold will occur if special function 2 is de-energized and the Flame Proven output is commanded on. Otherwise, with flame established and special function 2 energized, the Normal—Part 2 state is entered.

⚠ *WARNING*

The Flame Proven output is an RM7888A safety output with an output status monitored by the RM7888A. This output is used by external equipment which can respond to the signal. The end user must assure that the Flame Proven output cannot be misinterpreted. Misinterpretation of this signal could create a hazardous situation, resulting in fire or explosion that can cause damage, serious injury or death.

Normal—Part 2

Upon entry, the igniter is commanded off, the Flame Proven output is commanded on, and the Main Fuel Valve and Air Valve are commanded on. The Pilot (Low Fire) Valve remains on. The commanded Low Fire motor position is unchanged. This state will continue for five seconds. A flame failure will result in a lockout. A lockout will also occur if the @Low Fire input becomes de-energized during this state. Special function terminal 2 is ignored during this timed period. At the end of the timed period, the sequence will go back to the end of the Normal—Part 1 state if special function 2 is de-energized. If special function 2 is energized and special function 4 is de-energized, a Hold will occur. If special function 4 is energized, the sequence will proceed to the Normal—Part 3 state.

Normal—Part 3

All commanded outputs remain unchanged. The igniter is commanded off and Flame Proven output, Pilot (Low Fire Valve), Main Fuel Valve and Air Valve are commanded on. The sequence will lockout if the Limits Complete is de-energized or a flame failure occurs. The sequence will lockout if special function 2 is de-energized. and special function 4 is energized. If special functions 2 and 4 are energized , the motor position will be Modulated. If special function 2 is energized and special function 4 is de-energized, the commanded motor position will be the Low Fire position and an alarm will occur if the Low Fire input is de-energized after four minutes. If special functions 4 and 2 are both de-energized, an alarm will occur if

the Low Fire input is de-energized anytime after four minutes and a lockout will occur after a total of eight minutes has elapsed. If special functions 2 and 4 are de-energized, the sequence will return to the end of the Normal—Part 1 state when the Low Fire input is energized (after a two- to three-second Debounce period). Otherwise, the Normal—Part 3 state will proceed to Standby when special function 1 becomes de-energized.

NOTE: For High/Low Stepfire and Off/On Stepfire sequences, the @Low Fire input (Low Fire switch) is not used but must be jumpered to prevent a Hold condition in Standby.

High/Low Stepfire—Part 1

High/Low Stepfire—Part 1 is entered only from the Standby state with Limits Complete and @Low Fire inputs energized and special function 1 energized. Upon entry to this state, the Igniter and the Pilot (Low Fire Valve) are commanded on, and the motor position is commanded to Low Fire. The Main Valve, Air Valve and Flame Proven outputs are commanded off.

HIGH/LOW STEPFIRE—PART 1 LASTS FOR FOUR SECONDS.
The @Low Fire input is ignored during this state, and special functions 2, 3 and 4 are ignored. If, at the end of the timed period, the flame has not been established, a lockout will occur. Otherwise, with flame established, the High/Low Stepfire—Part 2 is entered.

High/Low Stepfire—Part 2

Upon entry to this state, the Pilot (Low Fire) Valve is commanded on, the Igniter and Main Valve are commanded off, the Flame Proven output is commanded on, the commanded motor position is Low Fire and a two-second timer is started. A lockout will occur if a flame failure occurs. Special functions 3 and 4 are ignored.

The High state will be entered if special function 2 is energized and the two-second timer has expired. Otherwise, High/Low Stepfire—Part 2 continues. The @Low Fire input is ignored during this state.

High State

Upon entry to High State, the Main and Air Valves are commanded on, and the Pilot (Low Fire Valve) and Flame Proven outputs are commanded on. A two-second timer is

started. The commanded motor position is changed from Low Fire to Modulate. A lockout will occur if a flame failure occurs. The @Low Fire input and special functions 3 and 4 are ignored.

The High/Low Stepfire—Part 2 state will be re-entered if special function 2 is de-energized and the two-second time has expired. Otherwise, High State will continue until special function 1 is de-energized, causing entry to Standby.

Off/On Stepfire—Part 1

Off/On Stepfire—Part 1 is entered only from the Standby state, with Limits Complete, @Low Fire and special function 1 energized. When Off/On Stepfire—Part 1 is entered, the igniter, Pilot (Low Fire Valve) and Air Valve are commanded on, while the Main Valve and Flame Proven are commanded off. The commanded motor position is Modulate. Part 1 lasts for four seconds.

The flame signal and @Low Fire inputs are ignored during this state while a Pilot/Low Fire (flame) is being established. The sequence will lockout if Limits Complete becomes de-energized. Special functions 2, 3 and 4 are ignored. At the end of the time period, if the flame has not been established, a lockout will occur. Otherwise, with the flame established, Off/On Stepfire—Part 2 is entered.

Off/On Stepfire—Part 2

When On/Off Stepfire—Part 2 is entered, the igniter is commanded off and the Pilot (Low Fire) Valve, Main Valve and Flame Proven are commanded on. The commanded motor position remains at modulate. Special functions 2, 3 and 4 are ignored. The RM7888A will lockout if a flame failure occurs. The @Low Fire input is ignored during this state. The sequence will lockout if the Limits Complete becomes de-energized. Off/On Stepfire—Part 2 proceeds to Standby if special function 1 becomes de-energized.

Lockout

Lockout is entered when a timed sequence hold expires or a signal is not in the required state. The RM7888A DSI configuration sequence description details the conditions under which the sequence will lockout.
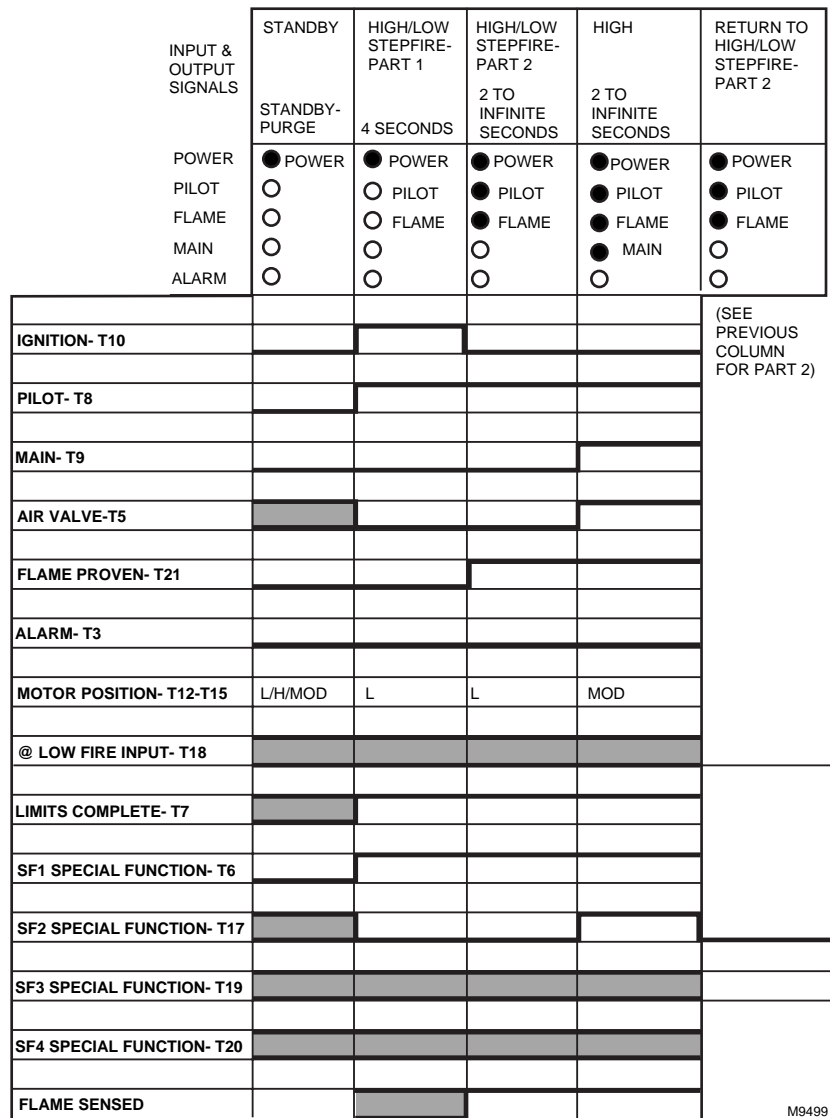
Figs. 21 through 23 show the timing relationship between the RM7888A inputs and outputs for each sequence state during DSI Normal, DSI High/Low Stepfire and DSI Off/On Stepfire sequences.

Fig. 21—DSI Normal sequence timing diagram.

INPUT & OUTPUT SIGNALS	STANDBY	NORMAL-PART 1	NORMAL-PART 2	NORMAL-PART 3
	STANDBY-PURGE	4 SECONDS, POSSIBLE INFINITE HOLD	5 SECONDS, POSSIBLE INFINITE HOLD	0 TO INFINITE SECONDS
POWER	● POWER	● POWER	● POWER	● POWER
PILOT	○	● PILOT	● PILOT	● PILOT
FLAME	○	● FLAME	● FLAME	● FLAME
MAIN	○	○	● MAIN	● MAIN
ALARM	○	○	○	○
IGNITION- T10				
PILOT- T8				
MAIN- T9				
AIR VALVE-T5				
FLAME PROVEN- T21				
ALARM- T3				
MOTOR POSITION- T12-T15	L/H/MOD	L	L	MOD OR LOW
@ LOW FIRE INPUT- T18				
LIMITS COMPLETE- T7				
SF1 SPECIAL FUNCTION- T6					TO STANDBY
SF2 SPECIAL FUNCTION- T17					TO END OF PART 1
SF3 SPECIAL FUNCTION- T19				
SF4 SPECIAL FUNCTION- T20				
FLAME SENSED				

M9498

Fig. 22—DSI High/Low Stepfire sequence timing diagram.

INPUT & OUTPUT SIGNALS	STANDBY	HIGH/LOW STEPFIRE- PART 1	HIGH/LOW STEPFIRE- PART 2 2 TO INFINITE SECONDS	HIGH 2 TO INFINITE SECONDS	RETURN TO HIGH/LOW STEPFIRE- PART 2
	STANDBY- PURGE	4 SECONDS			
POWER	● POWER	● POWER	● POWER	● POWER	● POWER
PILOT	○	○ PILOT	● PILOT	● PILOT	● PILOT
FLAME	○	○ FLAME	● FLAME	● FLAME	● FLAME
MAIN	○	○	○	● MAIN	○
ALARM	○	○	○	○	○
					(SEE PREVIOUS COLUMN FOR PART 2)
IGNITION- T10					
PILOT- T8					
MAIN- T9					
AIR VALVE-T5					
FLAME PROVEN- T21					
ALARM- T3					
MOTOR POSITION- T12-T15	L/H/MOD	L	L	MOD	
@ LOW FIRE INPUT- T18					
LIMITS COMPLETE- T7					
SF1 SPECIAL FUNCTION- T6					
SF2 SPECIAL FUNCTION- T17					
SF3 SPECIAL FUNCTION- T19					
SF4 SPECIAL FUNCTION- T20					
FLAME SENSED					

M9499

Fig. 23—DSI On/Off Stepfire sequence diagram.

INPUT & OUTPUT SIGNALS	STANDBY STANDBY-PURGE	OFF/ON STEPFIRE-PART 1 4 SECONDS	OFF/ON STEPFIRE-PART 2 5 TO INFINITE SECONDS	
POWER	● POWER	● POWER	● POWER	● POWER
PILOT	○	● PILOT	● PILOT	○
FLAME	○	● FLAME	● FLAME	○
MAIN	○	○	● MAIN	○
ALARM	○	○	○	○
IGNITION- T10				
PILOT- T8				
MAIN- T9				
AIR VALVE-T5				
FLAME PROVEN- T21				
ALARM- T3				
MOTOR POSITION- T12-T15	L/H/MOD	MOD	MOD	
@ LOW FIRE INPUT- T18				
LIMITS COMPLETE- T7				
SF1 SPECIAL FUNCTION- T6				TO STANDBY
SF2 SPECIAL FUNCTION- T17				
SF3 SPECIAL FUNCTION- T19				
SF4 SPECIAL FUNCTION- T20				
FLAME SENSED				

M9492

KEYBOARD DISPLAY MODULE (FIG. 24)

The keyboard contains four pushbuttons and each has separate functions (SCROLL-Down, SCROLL-Up, MODE and Change-Level). The MODE and Change-Level functions, when pressed together, provide a SAVE function.

1. Scroll Down-Up pushbuttons (◊) (see Fig. 25.

The scroll Down-Up pushbuttons (◊) are used to scroll through the selectable messages. The double-headed arrow (◊), which is located in the lower left position of the second line of the display, represents the SCROLL Down-Up pushbuttons. The SCROLL Down-Up pushbuttons (◊) can be pressed to display the selectable messages one at a time or held down to scroll through the selectable messages at a rate of two per second. When the last item of the selectable messages is viewed, the display wraps around and again displays the first selectable message.

2. Change-Level pushbutton (↔) (see Fig. 26).

The Change-Level pushbutton is used to change between the first hierarchy of selectable messages to a subset of selectable messages. The symbol (>) located on the second line in the lower right corner of the VFD represents a first level hierarchy of selectable message. The symbol (<) located on the second line in the lower right corner of the VFD represents a subset of selectable messages.

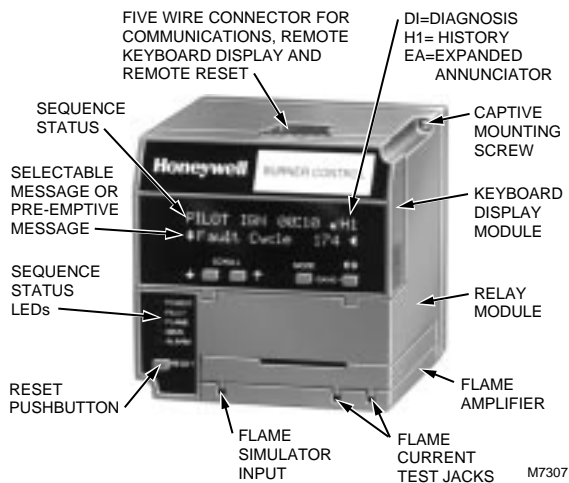**Fig. 24—Keyboard Display Module and sequence.**

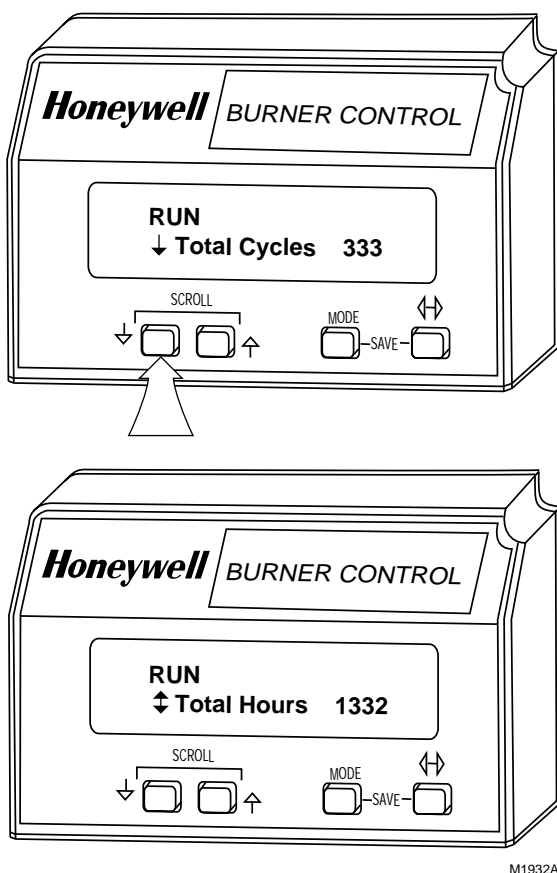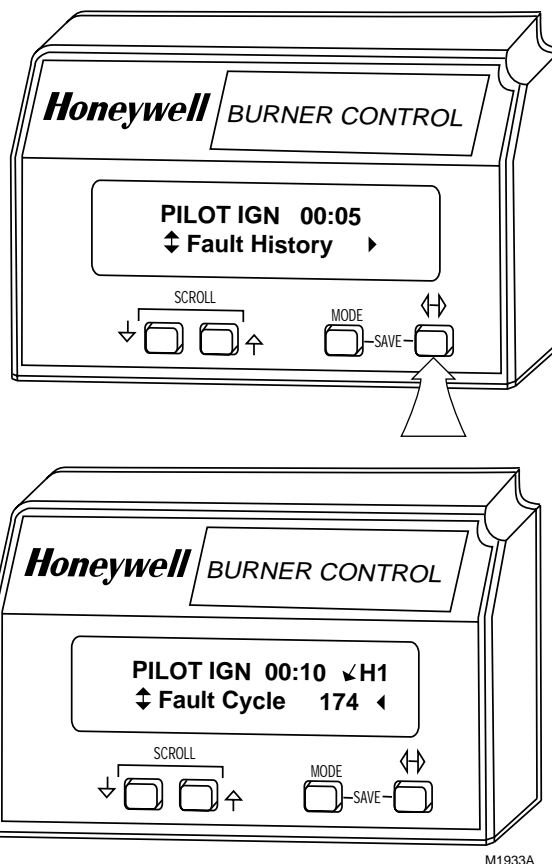**Fig. 25—(◊) SCROLL pushbutton function.**

Fig. 26 (↔)—Change-Level pushbutton function

3. Mode pushbutton (see Fig. 27).

The Mode pushbutton instantaneously switches the display from a *second-line-selectable* message to the *second-line-pre-empted* message as does the sixty second timeout function. The MODE pushbutton will work only if there is a *second-line-pre-empted* message or lockout message.

4. SAVE Function (see Fig. 28).

The SAVE function enables users to identify the selectable message they want to view upon power restoration. The second line selectable message will be restored to the most recently saved selection when power returns. The SAVE function is performed by pressing and holding the MODE key and then pressing the Change-Level pushbutton (↔). The second line of the display will briefly note "…SAVING…" to confirm the key press.
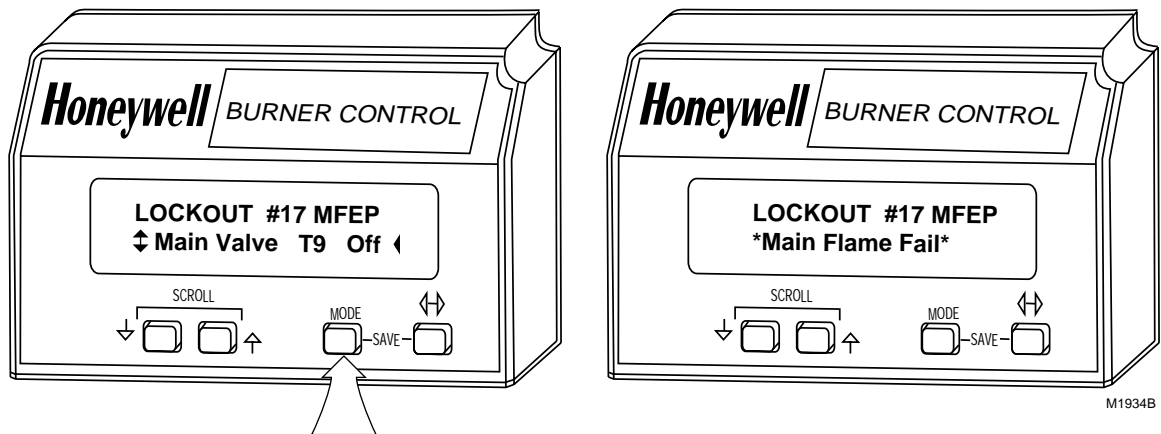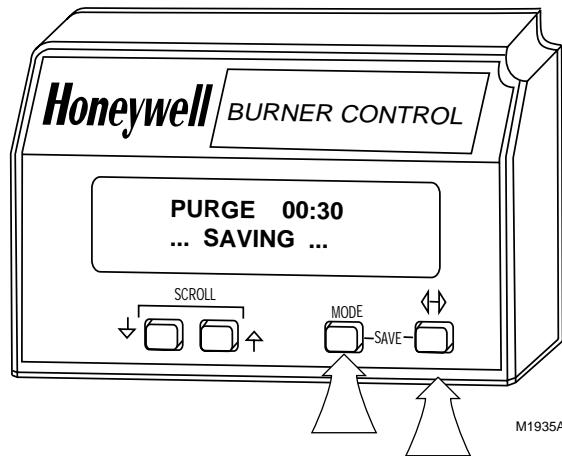
Fig. 27—Mode pushbutton function.

Fig. 28—Save function.

SELECTABLE MESSAGES

VFD Second Line Display, Two-Level Hierarchy; see Table 8.

The display values are as follows:

n represents a numbered value.

T represents the terminal number.

TABLE 8—SELECTABLE MESSAGES.

Selectable Message (Second Line)	Display Value (Second Line)		First Line Message
↕ Flame Signal	n.nV		
↕ Total Cycles	nnnnn		
↕ Total Hours	nnnnn		
↕ Fault History1			
↕ Fault Cycle	nnnnn	<	↓H1
↕ Fault Hours	nnnnn	<	↓H1
↕ Fault Code	nnn	<	↓H1
↕ *fault —message*<			↓H1
↕ sequence—message<			↓H1

(Continued)

TABLE 8—SELECTABLE MESSAGES *(Continued)*.

Selectable Message (Second Line)	Display Value (Second Line)	First Line Message
↕ (second-line-msg)<		↓H1
↕ Fault Cycle	nnnnn <	↓H2
↕ Fault Hours	nnnnn <	↓H2
↕ Fault Code	nnn <	↓H2
↕ *fault —message*<		↓H2
↕ sequence—message<		↓H2
↕ (second-line-msg)<		↓H2
↕ Fault Cycle	nnnnn <	↓H3
↕ Fault Hours	nnnnn <	↓H3
↕ Fault Code	nnn <	↓H3
↕ *fault —message*<		↓H3
↕ sequence—message<		↓H3
↕ (second-line-msg)<		↓H3
↕ Fault Cycle	nnnnn <	↓H4
↕ Fault Hours	nnnnn <	↓H4
↕ *fault —message*<		↓H4
↕ sequence—message<		↓H4
↕ (second-line-msg)<		↓H4
↕ Fault Cycle	nnnnn <	↓H5
↕ Fault Hours	nnnnn <	↓H5
↕ Fault Code	nnn <	↓H5
↕ *fault —message*<		↓H5
↕ sequence—message<		↓H5
↕ (second-line-msg)<		↓H5
↕ Fault Cycle	nnnnn <	↓H6
↕ Fault Hours	nnnnn <	↓H6
↕ Fault Code	nnn <	↓H6
↕ *fault —message*<		↓H6
↕ sequence—message<		↓H6
↕ (second-line-msg)<		↓H6
↕ Diagnostic Info[1]↔		
↕ Device	RM78nnx<	↓DI
↕ Device Suffix	nnnn<	↓DI
↕ Operating Control (OperControl)[2]	T6 ON or OFF<	↓DI
↕ Interlock[2]	T7 ON or OFF<	↓DI
↕ Pilot Valve	T8 ON or OFF<	↓DI
↕ Main Valve	T9 ON or OFF<	↓DI
↕ Ignition	T10 ON or OFF<	↓DI
↕ Pilot Valve Hold	T16 ON or OFF<	↓DI
↕ Manual Open Valve Switch[2]	T17 ON or OFF <	↓DI
↕ LowFire Sw	T18 ON or OFF<	↓DI
↕ HighFireSw[2]	T19 ON or OFF<	↓DI
↕ Preignition Interlock (PreIgn ILK)[2]	T20 ON or OFF<	↓DI
↕ Pilot Valve (Valv/Start)[2]	T21 ON or OFF<	↓DI
↕ Jumper 1	INTACT or CLIPPED<	↓DI
↕ Jumper 2	INTACT or CLIPPED<	↓DI
↕ Jumper 3 or SHUTTER	INTACT or CLIPPED<	↓DI
↕ Flame Response	0.8s or 3s<	↓DI
↕ Purge Time	mm:ss<	↓DI
↕ Manufacturing Code (Mfg Code)	nnnn<	↓DI
↕ Software Revision (SW Rev.)	nnnn/nnnn<	↓DI
↕ Expanded Annun.[1]↔ (see Table 9)		
↕ Remote Command	NONE/HOLD/HF/LF	

[1] Expanded Annunciator Diagnostic Current Status Messages can be reviewed in Table 9.
[2] The RM7888A uses different terminal descriptions than other 7800 SERIES™ controls. Refer to Table 1 for the actual RM7888A terminal designations.

EXPANDED ANNUNCIATOR MESSAGES (TABLE 9)

The Expanded Annunciator (EA) may or may not be connected because it is an optional device. If the EA is not connected, a display message of "(EA not connected)" will be shown. If the EA is connected, display messages will be shown (see Table 4, 14 or 15) for fault codes. When accessing Expanded Annunciator Messages, follow the same operations as used with the Selectable Messages.

TABLE 9—EXPANDED ANNUNCIATOR.

Selectable Message (Second Line)	Display Value (Second Line)	First Line Message
↕ Expanded Annun.		
↕ Expanded Annunciator (EA not connected)<		
↕ Current Status (CS:)±	EA Message<	↓EA
↕ Valve Closure (Valve Close)	T4　　　ON or OFF<	↓EA
↕ Burner Switch (Burner Sw.)	T5　　　ON or OFF<	↓EA
↕ Auxiliary Limit (Aux Limit 1)	T7　　　ON or OFF<	↓EA
↕ Low Water Cutoff (LWCO)	T9　　　ON or OFF<	↓EA
↕ High Limit (High Limit)	T10　　ON or OFF<	↓EA
↕ Auxiliary Limit (AuxLimit 3)	T11　　ON or OFF<	↓EA
↕ Oil Selection Switch (Oil Select)	T12　　ON or OFF<	↓EA
↕ High Oil Pressure Switch (Hi OilPres)	T13　　ON or OFF<	↓EA
↕ Low Oil Pressure Switch (LowOilPres)	T14　　ON or OFF<	↓EA
↕ High Oil Temperature Switch (Hi OilTemp)	T15　　ON or OFF<	↓EA
↕ Low Oil Temperature Switch (LowOilTemp)	T16　　ON or OFF<	↓EA
↕ Atomizing Switch (Atomize Sw)	T19　　ON or OFF<	↓EA
↕ Gas Selection Switch (Gas Select)	T17　　ON or OFF<	↓EA
↕ High Gas Pressure Switch (Hi GasPres)	T18　　ON or OFF<	↓EA
↕ Low Gas Pressure Switch (LowGasPres)	T19　　ON or OFF<	↓EA
↕ Airflow Switch (Airflow Sw)	T20　　ON or OFF<	↓EA
↕ Auxiliary Interlock (Aux ILK 4)	T21　　ON or OFF<	↓EA
↕ Auxiliary Interlock (Aux ILK 5)	T22　　ON or OFF<	↓EA
↕ EA Fault Code	nnn<	↓EA
↕ Software Revision (SW Rev.)	nnnn<	↓EA

Static Checkout

⚠ *CAUTION*

1. Use extreme care while testing the system. Line voltage is present on most terminal connections when power is on.
2. Open the master switch before installing or removing a jumper on the subbase.
3. Before continuing to the next test, be sure to remove the test jumper(s) used in the previous tests.
4. Replace all limits and interlocks not operating properly. Do not bypass limits and interlocks.
5. Close all manual fuel shutoff valve(s) before starting these tests.

After checking all wiring, perform this checkout before installing the RM7888A on the subbase. These tests verifies that the Q7800 Wiring Subbase is wired correctly, and that the external controllers, limits, interlocks, actuators, valves, transformers, motors and other devices are operating properly.

NOTE: Do not perform a dielectric test with the RM7888A installed. Internal surge protectors will break down and conduct a current. This could cause the RM7888A to fail the dielectric test or possibly destroy the internal lightning and high current protection.

EQUIPMENT RECOMMENDED
- Voltmeter (20 kohm/volt minimum sensitivity) set on the 0-300 Vac scale.
- Two jumper wires; no. 14 wire, insulated, 12 inches (304.8 mm) long, with insulated alligator clips at both ends.

GENERAL INSTRUCTIONS

1. Perform all applicable tests listed in Static Checkout, Table 10, in the order listed.

2. *Make sure that all manual fuel shutoff valve(s) are closed.*

3. For each test, open the master switch and install the jumper wire(s) between the subbase wiring terminals listed in the **Test Jumpers** column.

4. Close the master switch before observing operation.

5. Read the voltage between the subbase wiring terminals listed in the **Voltmeter** column.

6. If there is no voltage or the operation is abnormal, check the circuits and external devices as described in the last column.

7. Check all wiring for correct connections, tight terminal screws, correct wire, and proper wiring techniques. Replace all damaged or incorrectly sized wires.

8. Replace faulty controllers, limits, interlocks, actuators, valves, transformers, motors and other devices as required.

9. Obtain normal operation for each required test before continuing the checkout.

10. After completing each test, be sure to remove the test jumper(s).

TABLE 10—STATIC CHECKOUT.

Test No.	Test Jumpers	Voltmeter	Normal Operation	If Operation Is Abnormal, Check The Items Listed Below
			WARNING Make sure all manual fuel shutoff valves are closed.	
			IMPORTANT: *Low fuel pressure limits, if used, could be open. Bypass them with jumpers for the remaining Static Tests (if required).*	
1	None	4-L2	Line voltage at terminal 4.	1. Master switch. 2. Power connected to the master switch. 3. Overload protection (fuse, circuit breaker) has not opened the power line.
2	None	7-L2	Line voltage at terminal 7.	1. Limits.

3	4-5		1. Air Valve starts.	1. Air Valve circuit.
				  a. Manual switch of Air Valve.
				  b. Air Valve power supply, overload protection, and starter.
				  c. Air Valve.

4	4-10	—	Ignition spark	1. Watch for spark or listen for buzz.
				  a. Ignition electrodes are clean.
				  b. Ignition transformer.

5	4-8	—	1. Automatic pilot valve opens
			
			NOTE: Refer to wiring diagram of system being tested.
				1. Listen for click or feel head of valve for activation.
				  a. Actuator if used.
				  b. Pilot valve.

6	4-9	—	Automatic main fuel valve(s) opens.	1. Listen for and observe operation of the main fuel valve(s) and actuator(s). 2. Valve(s) and actuator(s).
7	4 -3	—	Alarm (if used) turns on.	1. Alarm
8	4-5 and 12-13	18-L2	Firing rate motor drives open; zero volts at terminal 18 after motor starts driving open.	1. Low Fire Start Switch. 2. Firing rate motor and transformer.
9	4-5 and 14-13	18-L2	Firing rate motor drives closed; line voltage at terminal 18 after motor is in Low Fire position.	1. Low Fire Start Switch. 2. Firing rate motor and transformer.
			WARNING Make sure all manual fuel shutoff valves are closed.	

(Continued)

TABLE 10—STATIC CHECKOUT *(Continued)*.

Test No.	Test Jumpers	Voltmeter	Normal Operation	If Operation Is Abnormal, Check The Items Listed Below
10	15-13	—	1. If modulation is used, raise setpoint of series 90 controller—firing rate motor should drive toward *open*. 2. Lower set point of series 90 controller—firing rate motor should drive toward *closed*.	1. Series 90 Controller. 2. Firing rate motor and transformer.
11	4-21	—	Verify Flame Proven indication received by external device.	1. Flame Proven circuit.
*	Apply 120 Vac power to the special function inputs from the external controller/device one at a time (in sequence) and perform tests 12 through 15.			
12	—	1. 6-L2 2. 17, 19, 20-L2	1. Line voltage at terminal 6. 2. Verify no voltage is present.	1. Special Function 1 circuit.
13	—	1. 17-L2 2. 6, 19, 20-L2	1. Line voltage at terminal 17. 2. Verify no voltage is present.	1. Special Function 2 circuit.
14	—	1. 19-L2 2. 6, 17, 20-L2	1. Line voltage at terminal 19. 2. Verify no voltage is present.	1. Special Function 3 circuit.
15	—	1. 20-L2 2. 6, 17, 19-L2	1. Line voltage at terminal 20. 2. Verify no voltage is present.	1. Special Function 4 circuit.
Final	*CAUTION* On completing these tests, open the master switch and remove all *test jumpers* from the subbase terminals. Also remove bypass jumpers from the low fuel pressure limits (if used).			

Checkout

⚠ *WARNING*

Do not allow fuel to accumulate in the combustion chamber. If fuel is allowed to enter the chamber for longer than a few seconds without igniting, an explosive mixture could result. It is recommended that the trial for pilot be limited to ten seconds, and the attempt to light the main burner be limited to two seconds from the time the fuel has reached the burner nozzle. In any case, do not exceed the nominal lightoff time specified by the equipment manufacturer. Close the manual fuel shutoff valve(s) if the flame is not burning at the end of the specified time.

⚠ *CAUTION*

1. Use extreme care while testing the system. Line voltage is present on most terminal connections when power is on.
2. Open the master switch before removing or installing the RM7888A.
3. Make sure all manual fuel shutoff valve(s) are closed before starting the initial lightoff check and the Pilot Turndown tests.
4. Do not put the system in service until you have satisfactorily completed all applicable tests in this section and any others required by the equipment manufacturer.

⚠ *CAUTION*

If an RM7888A is replaced with a lower function-ing 7800 SERIES Relay Module, the burner will not sequence unless wiring changes are made.

IMPORTANT:

1. If the system fails to perform properly, refer to the Troubleshooting section and 7800 SERIES System Annunciation and Troubleshooting, form 65-0118.
2. Repeat ALL required Checkout tests after all adjust-ments are made. ALL tests must be satisfied with the flame detector(s) in its FINAL position.

EQUIPMENT RECOMMENDED

Volt-ohmmeter (20 kohm/volt minimum sensitivity) with:
- 0-300 Vac capability.
- 0-6000 ohm capability.
- 0-10 Vdc capability.

CHECKOUT SUMMARY

- Preliminary inspection—all installations.
- Flame signal measurement—all installations.
- Initial lightoff check for proved pilot—all installations using a pilot.
- Initial lightoff check for direct spark ignition of oil—all burners using DSI.
- Pilot turndown test—all installations using a pilot.
- Hot refractory saturation test—all installations using Infrared (lead sulfide) Flame Detectors.
- Hot refractory hold-in test—all installations.
- Ignition interference test—all installations using flame rods.
- Ignition spark pickup—all installations using Ultra-violet Flame Detectors.
- Response to other ultraviolet sources—all installa-tions using Ultraviolet Flame Detectors.
- Flame signal with hot combustion chamber—all installations.
- Safety shutdown tests—all installations.

See Fig. 24 for location of component parts and see Figs. 7, 8, 9, and 10 or Q7800 Specifications for terminal locations.

PRELIMINARY INSPECTION

Perform the following inspections to avoid common problems. Make certain that:

1. Wiring connections are correct and all terminal screws are tight.
2. Flame detector(s) is clean, installed and positioned properly. Consult the applicable Instructions.
3. Correct combination of amplifier and flame detector(s) is used. See Table 2 in the Specifications section.
4. Plug-in amplifier is securely in place.
5. Burner is completely installed and ready to fire; consult equipment manufacturer instructions. Fuel lines are purged of air.
6. Combustion chamber and flues are clear of fuel and fuel vapor.
7. Power is connected to the system disconnect switch (master switch).
8. Lockout is reset (push in reset button), only if the RM7888A is powered, see Fig. 24.
9. System is in the Standby condition. POWER LED is energized.
10. All limits and interlocks are reset.

FLAME SIGNAL MEASUREMENT (TABLE 11 AND FIG. 29)
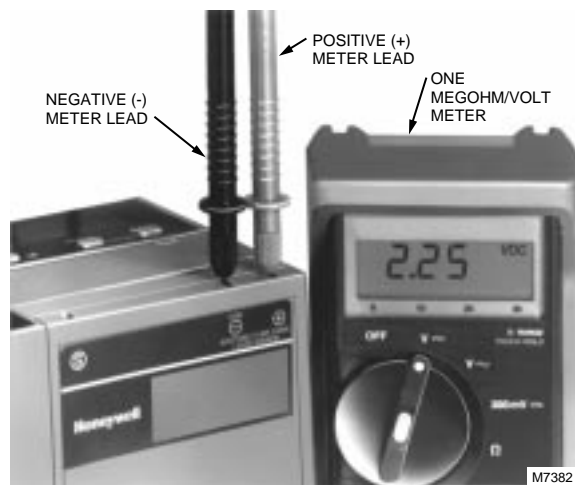
Fig. 29—Flame signal measurement.

POSITIVE (+) METER LEAD

NEGATIVE (-) METER LEAD

ONE MEGOHM/VOLT METER

M7382

TABLE 11—FLAME SIGNAL.

Flame Detector	Signal Amplifier	Minimum Acceptable Steady dc Voltage[a]	Maximum Expected dc Voltage
Flame Rod Photocell C7012A,C	R7847A,B[c]	1.25 Vdc	5.0 Vdc at Keyboard Display Module or 5.0 Vdc at a 20 kohm/volt meter
C7012E,F	R7847C[b]		
C7015A	R7848A,B[c]		
C7027A	R7849A,B[c]		
C7035A			
C7044A			
C7076A,D	R7886A		

[a] This minimum or stronger signal should be obtained easily if the detector is correctly installed and positioned to properly sense the flame. This voltage must be obtained before completing checkout.

[b] The flame signal amplifier circuitry is tested one-half second every five seconds during burner operation and shuts down the burner if the amplifier fails (all installations).

[c] The flame amplifier is an Ampli-Check™ type.

Measure the flame signal at the appropriate times defined in the following checkout tests. Read the flame signal in volts dc at the flame amplifier test jacks + and -(Com).

1. Use a 20 kohm/volt meter with a 0 to 10 Vdc capability.

2. Set the 20 kohm/volt meter to the 0 to 10 Vdc range.

3. Insert the positive (red) probe into the + jack of the flame amplifier. Insert the negative (black) probe into the -(Com) jack of the flame amplifier (see Fig. 23).

4. Allow a few seconds for the meter reading to stabilize.

5. If using AMPLI-CHECK™ or shutter check amplifiers, read the average stable voltage, disregarding the peaks caused by the self-checking operation.

6. The meter reading must be as specified in Table 11 after all tests are completed and all adjustments made.

As an option, the flame signal can be checked by using the optional Keyboard Display Module.

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

1. Check the supply voltages at terminals 4 (L1) and L2 (N). Make sure the master switch is closed, connections are correct, and the power supply is of the correct voltage, frequency and is sinusoidal.

2. Check the detector wiring for defects including:
- Incorrect connections.
- Wrong type of wire.
- Deteriorated wire.
- Open circuits.
- Short circuits.
- Leakage paths caused by moisture, soot or accumulated dirt.

3. For a flame rod, make sure:
- There is enough ground area.
- The flame rod is properly located in the flame.
- The temperature at the flame rod insulator is no greater than 500° F (260° C).

4. For all optical detectors, clean the detector viewing window and inside of the sight pipe as applicable.

5. With the burner running, check the temperature at the detector. If it exceeds the detector maximum rated temperature:
- Add a heat block to stop conducted heat traveling up the sight pipe.
- Add a shield or screen to reflect radiated heat.
- Add cooling (refer to sight pipe ventilation in the detector Instructions).

6. Make sure that the flame adjustment is not too lean.

7. Make sure that the detector is properly sighting the flame.

8. If necessary, resight or reposition the detector.

INITIAL LIGHTOFF CHECK FOR PROVED PILOT

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

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

1. Open the master switch.

2. Make sure that the manual main fuel shut off valve(s) is closed. Open the manual pilot shutoff valve. If the pilot takeoff is downstream from the manual main fuel shutoff valve(s), just very slightly open the manual main valve to supply pilot gas flow. Make sure the main fuel is shut off just upstream from the burner inlet, or disconnect power from the automatic main fuel valve(s).

3. Verify the combustion chamber has been properly purged.

4. Close the master switch and start the system by energizing terminal 6 (Special Function 1). See RM7888A Sequence of Operation. The program sequence should start the ten second INITIATE sequence.

5. Ignition spark should occur and the pilot should light. If the pilot ignites, the FLAME LED will be energized. Proceed to step 8.

6 If the pilot flame is not established in ten seconds, safety shutdown occurs. Let the sequence complete its cycle. Consult the equipment operating manual for further information.

7. Push the reset pushbutton, and let the system recycle once. If the pilot still does not ignite, make the following ignition/pilot adjustments:

    a. Open the master switch and remove the RM7888A from the subbase.

    b. On the subbase, jumper terminal 4 to ignition terminal 10.

    c. Close the master switch to energize only the ignition transformer.

    d. If the ignition spark is not strong and continuous, open the master switch and adjust the ignition electrode spark gap setting to the manufacturer recommendations.

    e. Make sure the ignition electrodes are clean.

    f. Close the master switch and observe the spark.

    g. After a continuous spark is obtained, open the master switch and add a jumper on the subbase from terminal 4 (L1) to the pilot terminal 8.

    h. Close the master switch to energize both the ignition transformer and the pilot valve.

    i. If the pilot does not ignite and if the ignition spark is still continuous, adjust the pressure regulator until a pilot is established.

    j. When the pilot ignites properly and stays ignited, open the master switch and remove the jumpers from terminals 4 to 8 and 4 to 10 of the subbase.

    k. Check for adequate bleeding of the fuel line.

    l. Reinstall the RM7888A on the subbase and close the master switch, then return to step 3.

8. When the pilot ignites, measure the flame signal. If the pilot flame signal is unsteady or approaching the 1.25 Vdc minimum value, adjust the pilot flame size or detector sighting to provide a maximum and steady flame signal.

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

10. Energize Special Functions 2 (terminal 17) and 3 (terminal 19).

11 When the MAIN IGN period is displayed by the MAIN LED, make sure the automatic main fuel valve is open; then smoothly open the manual main fuel shutoff valve(s) and watch for main burner flame ignition. When the main burner flame is established, proceed to step 18.

12. If the main burner flame is not established within five seconds or the normal lightoff time as specified by the equipment manufacturer, close the manual main fuel shutoff valve(s).

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

14. Smoothly open the manual fuel shutoff valve(s) and try lightoff again. (The first re attempt may be required to purge the lines and bring sufficient fuel to the burner.)

15. If the main burner flame is not established within five seconds or the normal lightoff time specified by the equipment manufacturer, close the manual main fuel shutoff valves(s). Check all burner adjustments.

16. If the main burner flame is not established after two attempts:

    a. Check for improper pilot size.

    b. Check for excess combustion air at low fire.

    c. Check for adequate low fire fuel flow.

    d. Check for proper gas supply pressure.

    e. Check for proper valve operation.

    f. Check for proper pilot flame positioning.

17. Repeat steps 12 through 16 to establish the main burner flame; then proceed to step 18.

18. With the sequence in RUN, make burner adjustments for flame stability and Btu input rating.

19. Shut down the system by opening the burner switch or by de-energizing terminal 6. Make sure the main flame goes out. There may be a delay due to gas trapped between the valve(s) and burner. Make sure all automatic fuel valve(s) close.

20. Restart the system by closing the burner switch and/or energizing terminal 6. Make sure that the pilot is established during PILOT IGN. Energize terminals 17 and 19 and make sure that the main burner flame is established during MAIN IGN within the normal lightoff time.

21. Measure the flame signal. Continue to check for the proper signal, see Table 11 through the RUN period. Check the signal at both High and Low Firing Rate positions and while modulating.

22. Run the burner through another sequence, observing the flame signal for:

    a. Pilot flame alone (unless using DSI)

    b. Pilot and main flame together.

    c. Main flame alone. Also observe the time it takes to light the main flame. Ignition of main flame should be smooth.

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

24. Return the system to normal operation.

NOTE: After completing these tests, open the master switch and remove all test jumpers from the subbase terminals, limits/controls or switches.

INITIAL LIGHTOFF CHECK FOR DIRECT SPARK IGNITION

This check applies to gas and oil burners that do not use a pilot. It should immediately follow the preliminary inspection. Refer to the appropriate sample block diagram of field wiring for the ignition transformer and fuel valve(s) hookup.

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

1. Open the master switch.

2. Complete the normal *ready-to-fire* checkout of the fuel supply and equipment as recommended by the equipment manufacturer.

3. Close all manual main fuel shutoff valve(s). Check that the automatic fuel valve(s) are closed. Make sure fuel is not entering the combustion chamber.

4. Verify that the combustion chamber has been properly purged.

5. Close the master switch and start the system by energizing terminal 6 (Special Function 1). See RM7888A Sequence of Operation. The program should start the ten second INITIATE sequence.

6. Ignition spark should occur. Listen for the click of the first stage fuel solenoid valve(s).

7. Let the program sequence complete its cycle.

8. Open the manual fuel shutoff valve(s).

9. Push the reset pushbutton and recycle the program.

10. Watch for the FLAME LED to help determine when the first stage burner flame is established. If it is established, proceed to step 16.

11. If the first stage burner flame is not established within four seconds, or within the normal lightoff time specified by the equipment manufacturer, close the manual fuel shutoff valve(s), and open the master switch.

12. Check all burner adjustments.

13 Wait about three minutes. Close the master switch, open the manual fuel shutoff valve(s), and try to lightoff the burner again. The first attempt may have been required to purge the lines and bring sufficient fuel to the burner.

14. If the first stage burner flame is not established within four seconds, or within the normal lightoff time specified by the equipment manufacturer, close the manual fuel shutoff valve(s) and open the master switch.

15. If necessary, repeat steps 12 through 14 to establish the first stage burner flame after verifying that the system has been properly purged. Then proceed to step 16.

16. When the first stage burner flame is established, the sequence will advance when the appropriate special function input (terminal 17, 19, or 20) is energized. See RM7888A Sequence of Operation. Make burner adjustments for flame stability and input rating.

17. Shut down the system by opening the burner switch or by de-energizing terminal 6 (Special Function 1). Make sure the burner flame goes out and all automatic fuel valves close.

18. If used, remove the bypass jumpers from the low fuel pressure limit and subbase.

19. Restart the system by closing the burner switch and/or energizing special function 1 (terminal 6). Observe that the burner flame is established during PILOT IGN, within the normal lightoff time specified by the equipment manufacturer. Cycle system by energizing the appropriate special function input. See RM7888A Sequence of Operation.

20. Measure the flame signal. Continue to check for the proper signal, see Table 11, through the RUN period. Check the signal at both High and Low firing rate positions and while modulating. Any pulsating or unsteady readings will require further attention.

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

NOTE: Upon completing these tests, open the master switch and remove all test jumpers from the subbase terminals, limits/controls or switches.

22. Return the system to normal operation.

PILOT TURNDOWN TEST
(ALL INSTALLATIONS USING A PILOT)
Perform this check on all installations that use a pilot. The purpose of this test is to verify that the main burner can be lit by the smallest pilot flame that will hold in the flame amplifier and energize the FLAME LED. Clean the flame detector(s) to make sure that it will detect the smallest acceptable pilot flame. If using Ampli-check™ or Self-Checking Amplifier and 20 kohm/volt meter, the flame signal will fluctuate every time the amplifier does a self-check or a shutter check.

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

1. Open the master switch.

2. Close the manual main fuel shutoff valve(s).

3. Connect a manometer (or pressure gauge) to measure pilot gas pressure during the turndown test.

4. Open the manual pilot shutoff valve(s).

5. Close the master switch and start the system with a *call for heat*. (Energize terminal. 6 [Special Function 1].) The program sequence should start.

NOTE: If the sequence does not stop, reset or restart the system and make sure the special function inputs (terminals 17, 19 and 20) are in the proper state. See RM7888A Sequence of Operation..

6. Very slowly turn the pilot pressure down, reading the manometer (or pressure gauge) as it drops. Stop instantly when the FLAME LED goes out. Note the pressure at the RM7888A flame relay dropout point. The pilot is at the minimum turndown position. Immediately turn up the pilot pressure until the FLAME LED comes on again.

NOTE: If there is no flame for a period of time exceeding the flame failure response time [FFRT] of the amplifier, the RM7888A will lockout.

7. Repeat step 6 to verify the pilot gas pressure reading at the exact point the FLAME LED light goes out.

8. Increase the pilot pressure immediately until the FLAME LED comes on, and then turn it down slowly to obtain a pressure reading just above the dropout point or until the flame signal increases to 1.25 Vdc.

9. Energize the appropriate special function input (terminal 17, 19, or 20) and let the sequence proceed. At ten seconds into the Ignition Trial period, make sure the automatic main fuel valve(s) open; then smoothly open the manual main fuel shutoff valve(s) (or any other manually opened safety shutoff valve(s), if used) and watch for main burner ignition. If the main burner flame is established, proceed to step 14.

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

10. If the main burner flame is not established within five seconds, or within the normal lightoff time specified by the equipment manufacturer, close the manual main fuel shutoff valve(s) and open the master switch. If the lightoff was rough, the pilot flame size is too small.

11. Recycle the burner and stop the sequence in PILOT IGN period.

12. Increase the pilot flame size by increasing its fuel flow until a smooth main flame is accomplished.

13. Reposition the flame scanner sight tube or use orifices until the pilot flame signal voltage is in the range of 1.25 to 1.50 Vdc.

14. When the main burner lights reliably with the pilot at turndown, disconnect the manometer (or pressure gauge) and turn the pilot gas flow up to the recommendation of the equipment manufacturer.

15. If used, remove the bypass jumpers from the subbase terminals, limits/controls or switches.

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

17. Return the system to normal operation.

IGNITION INTERFERENCE TEST (ALL FLAME RODS)

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

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

Start the burner and measure the flame signal with both ignition and pilot (or main burner) on, and then with only the pilot (or main burner) on. Any significant difference (greater than .5 Vdc) indicates ignition interference.

TO ELIMINATE IGNITION INTERFERENCE

1. Make sure there is enough ground area.

2. Be sure the ignition electrode and the flame rod are on opposite sides of the ground area.

3. Check for correct spacing on the ignition electrode:

a. 6000V systems—1/16 to 3/32 in. (1.6 to 2.4 mm).

b. 10,000V systems—1/8 in. (3.2 mm).

4. Make sure the leadwires from the flame rod and ignition electrode are not too close together.

5. Replace any deteriorated leadwires.

6. If the problem cannot be eliminated, the system may have to be changed to an ultraviolet flame detection system.

HOT REFRACTORY SATURATION TEST (ALL INFRARED DETECTORS)

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

Start the burner and monitor the flame signal during the warmup period. A decrease in signal strength as the refractory heats up indicates hot refractory saturation. If saturation is extreme, the flame signal will drop below 1.25 Vdc and the system will shut down as though a flame failure occurred.

If hot refractory saturation occurs, the condition must be corrected. Add an orifice plate in front of the cell to restrict the viewing area, try to lengthen the sight pipe or decrease the pipe size (diameter). Continue adjustments until hot refractory saturation is eliminated.

HOT REFRACTORY HOLD-IN TEST (RECTIFYING PHOTOCELL OR ALL INFRARED DETECTORS)

Test to make certain hot refractory will not delay the flame detection system response to a flameout. This condition can delay response to flame failure and also can prevent a system restart as long as hot refractory is detected.

To check rectifying photocells for hot refractory hold-in, operate the burner until the refractory reaches its maximum temperature. Then terminate the firing cycle by lowering the set point of the operating controller, or setting the Fuel Selector Switch to OFF. Do not open the master switch. Visually observe when the burner flame or FLAME LED goes out. If this takes more than .8 or 3 seconds (depending on the FFRT of the amplifier), the photocell is sensing hot refractory. This condition must be corrected as described in the last paragraph of this test.

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

To check infrared (lead sulfide) detectors for hot refractory hold-in, operate the burner until the refractory reaches its maximum temperature. If the installation has a multifuel burner, burn the heavier fuel that is most likely to reflect, bend or obscure the hot refractory steady infrared radiation. When the maximum refractory temperature is

reached, close all manual fuel shutoff valve(s), or open the electrical circuits of all automatic fuel valve(s). Visually observe when the burner flame or FLAME LED goes out. If this takes more than three seconds, the infrared detector is sensing hot refractory. Immediately terminate the firing cycle. (Lower the set point to the operating controller, or set the Fuel Selector Switch to OFF. Do not open the master switch.)

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

If the detector is sensing hot refractory, the condition must be corrected. Add an orifice plate in front of the cell to restrict the viewing area of the detector. If this does not correct the problem, resight the detector at a cooler, more distant part of the combustion chamber. While re-sighting the detector, be aware that it must also properly sight the flame. For an infrared detector, try lengthening the sight pipe or decreasing the pipe size (diameter). For details, refer to the detector Instructions and the equipment Operating Manual. Continue adjustments until hot refractory hold-in is eliminated.

ULTRAVIOLET SENSOR, IGNITION SPARK RESPONSE TEST (ALL ULTRAVIOLET DETECTORS)

Test to make certain that the ignition spark is not actuating the FLAME LED:

1. Close the pilot and main burner manual fuel shutoff valve(s).

2. Start the burner and energize Special Function 1 (terminal 6) **only** to stop the sequence in the PILOT IGN period. Ignition spark should occur, but the flame signal should not be more than 0.5 Vdc.

3. If the flame signal is higher than 0.5 Vdc and the FLAME LED does come on, consult the equipment operating manual and resight the detector farther out from the spark, or away from possible reflection. It may be necessary to construct a barrier to block the ignition spark from the detector view. Continue adjustments until the flame signal due to ignition spark is less than 0.5 Vdc.

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

RESPONSE TO OTHER ULTRAVIOLET SOURCES

Some sources of artificial light, such as incandescent or fluorescent bulbs, mercury, sodium vapor lamps and daylight, produce small amounts of ultraviolet radiation. Under certain conditions, an ultraviolet detector will respond to these sources as if it is sensing a flame. To check for proper detector operation, check the FFRT and conduct Safety Shutdown Tests under all operating conditions.

FLAME SIGNAL WITH HOT COMBUSTION CHAMBER (ALL INSTALLATIONS)

With all initial start-up tests and burner adjustments completed, operate the burner until the combustion chamber is at the maximum expected temperature. Observe the equipment manufacturer warmup instructions. Recycle the burner under these hot conditions and measure the flame signal. Check the pilot alone, the main burner flame alone, and both together (unless monitoring only the pilot flame when using an intermittent pilot, or only the main burner flame when using DSI). Check the signal at both the High and Low Firing Rate positions and while modulating, if applicable.

Check the FFRT of the Flame Amplifier. Lower the set point of the operating controller and observe the time it takes for the burner flame to go out. This should be within .8 or 3 seconds maximum depending on the amplifier selected.

If the flame signal is too low or unsteady, check the flame detector temperature. Relocate the detector if the temperature is too high. If necessary, realign the sighting to obtain the proper signal and response time. If the response time is still too slow, replace the Plug-In Flame Signal Amplifier. If the detector is relocated or re sighted, or the amplifier is replaced, repeat all required Checkout tests.

SAFETY SHUTDOWN TESTS (ALL INSTALLATIONS)

Perform these tests at the end of Checkout, after all other tests have been completed. If used, the external alarm should turn on. Press the RM7888A reset pushbutton to restart the system.

1. Opening a Limits Complete interlock during PILOT IGN, MAIN IGN or RUN period. (Safety shutdown will occur.)

2. Detection of flame 40 seconds after entry to STANDBY.

a. Simulate a flame to cause the flame signal voltage level to be at least 1.25 Vdc for 40 seconds after entry to STANDBY.

b. Safety shutdown will occur.

3. Failure to ignite pilot.

a. Close the pilot and main fuel manual shutoff valve(s).

b. Depress the reset button.

c. Start the system.

d. The automatic pilot valve(s) should be energized but the pilot cannot ignite.

e. Safety shutdown will occur.

4. Failure to ignite main.

a. Open the manual pilot valve(s); leave the main fuel manual shutoff valve(s) closed.

b. Depress the reset button.

c. Start the system.

d. The pilot should ignite and the flame signal should be at least 1.25 Vdc but the main burner cannot light.

e. Energize the appropriate special function input (terminal 17, 19 or 20) to sequence to RUN. See the RM7888A Sequence of Operation.

f. The flame signal should drop below 1.25 Vdc within .three or eight seconds (depending on the FFRT of the amplifier) after the pilot goes out.

g. Safety shutdown will occur.

5. Loss of flame during RUN.

a. Open the main fuel manual shutoff valve(s) and open the manual pilot shutoff valve(s).

b. Depress the reset button.

c. Start the system. Start-up should be normal and the main burner should light normally.

d. Energize the appropriate special function input (terminal 17, 19 or 20) to sequence to RUN. See the RM7888A Sequence of Operation.

e. After the sequence is in the normal RUN period for at least ten seconds with the main burner firing, close the manual main fuel shutoff valve(s) to extinguish the main burner flame.

f. The flame signal should drop below 1.25 Vdc within .three or eight seconds after the main flame goes out.

g. Safety shutdown will occur (depending on the FFRT of the amplifier).

IMPORTANT:

1. If the RM7888A fails to shut down on any of these tests, take corrective action; refer to the Troubleshooting section and the RM7888A diagnostics and return to the beginning of all Checkout tests.

2. When all Checkout tests are completed, reset all switches to original states.

Troubleshooting

RM7888A SYSTEM DIAGNOSTICS

Troubleshooting of control system equipment failures is easier with the RM7888A self-diagnostics and first-out annunciation. In addition to an isolated spst alarm relay (audible annunciation), the RM7888A provides visual annunciation by displaying the ALARM LED.

Self-diagnostics of the RM7888A enable it to detect and annunciate both external and internal system problems. External faults such as interlock failures, flame failures and false flame signals, are annunciated by the RM7888A lockout, which energizes the ALARM LED, by using the optional Keyboard Display Module or 7800 SERIES System Annunciation Diagnostics and Troubleshooting, form 65-0118.

The RM7888A provides diagnostic information to aid the service mechanic to obtain information when troubleshooting the system, see Table 5 or Table 7.

The optional Keyboard Display Module displays sequence status messages indicating: STANDBY, PREPURGE, PILOT IGN, MAIN IGN, RUN and POSTPURGE. The selectable messages also provide visual indication, current status and historical status of the equipment such as: Flame Signal, Total Cycles, Total Hours, Fault History, Diagnostic Information and Expanded Annunciator Terminal Status (if used). With this information, most problems can be diagnosed without extensive trial and error testing. Data available in the Diagnostic Information file includes: Device Type, Device Suffix, Software Revision, Manufacturing Code, Flame Amplifier Type, Flame Failure Response Time, Selectable Jumper Configuration Status, Run/Test Switch Status and Terminal Status.

Diagnostic Information Index

The RM7888A with the optional Keyboard Display Module can monitor input/output terminals and can display the status of the terminal at the VFD (for example, Pilot Valve T8 ON<), see S7800A1001 Keyboard Display Module Specifications. A complete terminal description and number are provided. The display will show the actual status of the terminal. If voltage is detected at the terminal, ON is displayed; but if no voltage is detected at the terminal, OFF is displayed.

Historical Information Index

The RM7888A has nonvolatile memory that allows the Relay Module to retain historical information for the six most recent lockouts. Each of the six lockout files retains the cycle when the fault occurred, the hour of operation when the fault occurred, the fault message and burner status when the fault occurred. See the S7800A1001 Keyboard Display Module Specifications.

SERVICE NOTE: A Lockout condition or restart of an RM7888A can be accomplished by pressing the reset pushbutton on the RM7888A, or pressing a remote reset pushbutton wired through an optional Keyboard Display Module, DATA CONTROLBUS MODULE™, Extension cable Assembly, or Remote Reset Module. A powerup reset will cause an electrical reset of the RM7888A but will not reset a Lockout condition.

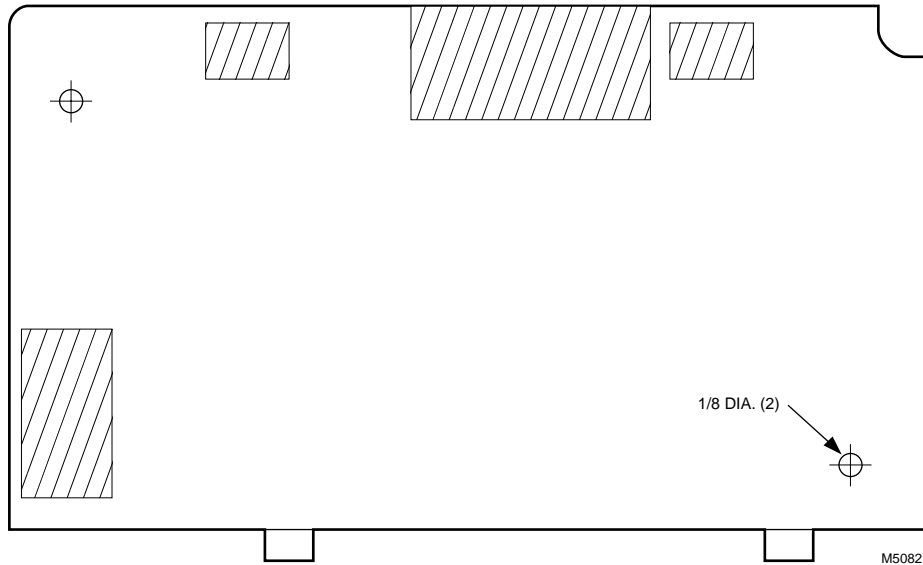**SERVICE NOTE:** Remove the access slot covers on the sides of the Q7800A,B to check voltage.

⚠ *CAUTION*

Reinstall access slot covers on the Q7800A,B sub-base after performing voltage checks.

SERVICE NOTE: Maximum ambient operating temperature of a C7012E,F Series 1 through 6 will be reduced to 125° F because of the duty cycle operation of the RM7888A Relay Module.

SEQUENCE AND STATUS HOLD MESSAGES.
Refer to Tables 5 and 7 for sequence display information.

Fig. 30—Flush mounting of Keyboard Display Module template.

1/8 DIA. (2)

M5082

Honeywell