

## CR7890B 7800 SERIES Integrated Burner Control

### PRODUCT DATA



### APPLICATION

The Honeywell CR7890B Integrated Burner Control is a microprocessor-based control for automatically fired gas, oil, or combination fuel single burner applications. The CR7890B Integrated Burner Control consists of a self contained relay module, amplifier and a shutter type solid state Ultraviolet Detector for sensing the ultraviolet radiation generated by the combustion of gas, oil, or other fuels. Options include the S7800 Keyboard Display Module (KDM), for use during burner setup or troubleshooting.

Functions the CR7890B provides include automatic burner sequencing, flame supervision, system status indication, system or self-diagnostics and troubleshooting.

This document provides installation and static checkout instructions. One other applicable publication is form 65-0090: S7800A Keyboard Display Module Product Data.

### FEATURES

- Oscillating shutter interrupts ultraviolet radiation reaching the UV sensor to provide the UV sensor checking function. Amplifier circuitry components are checked from the microprocessor in the CR7890B Control.
- Device can be mounted horizontally, vertically or at any other angle. The device has faceplate alignment and integral locating reference points to assure proper shutter mechanism operation.
- Quartz viewing window is field replaceable.
- CR7890B1019 uses Brad Harrison® 3R9006A20A120 connector.
- A swivel mount is available to facilitate flame sighting.
- -40°F (-40°C) rated ultraviolet sensing tube.
- High pressure 50 psi (345 kPa) quartz viewing window, magnifying lens and antivibration mount are available as accessories.
- Housing meets NEMA 4 enclosure standards. (NEMA 1 when access cover is used.)
- Protective heat block built into mounting flange.
- Power LED blinks a fault code when device is in ALARM state.
- Optional Keyboard Display Module (KDM) provides additional troubleshooting and diagnostic information.

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## SPECIFICATIONS

### IMPORTANT

*The specifications in this publication do not include normal manufacturing tolerances. Therefore, this unit may not exactly match the specifications listed. This product is tested and calibrated under closely controlled conditions, and minor differences in performance can be expected if those conditions are changed.*

### Models:

CR7890B1019—Solid state ultraviolet integrated burner control with Brad Harrison® 3R9006A20A1210 Connector.

### Electrical Ratings:

Voltage and Frequency:

120 Vac (+10%/-15%), 50/60 Hz (±10%).

Power Dissipation: 6.3W.

Maximum Total Connected Load: 2000 VA.

Fusing Total Connected Load: 20A maximum, fast-acting type.

### 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).

NOTE: Operating Ambient Temperature reduces to +135°F (+57°C) under certain load conditions. See Table 4.

NOTE: Operating Ambient Temperature reduces to 130°F (54°F) when the 32006648-001 Cover is used.

Humidity: 90% relative humidity continuous, noncondensing.

Vibration: 1.0G environment.

### Approvals:

Underwriters Laboratories Inc. Listed: File Number TBD, Guide Number MCCZZ.

Canadian Standards Association Certified: Master File 158158 (LR95329) Certificate 1368754.

Factory Mutual Approved: Pending.

Industrial Risk Insurers Acceptable.

### Housing:

Blue, cast-aluminum cover. Separate mounting flange (with heat block) and faceplate provide heat insulation and sealoff.

Meets NEMA 4 enclosure requirements (indoor, outdoor protection; rain-tight, dust-tight, hose-directed water protection).

### Pressure Rating of Quartz Viewing Window:

CR7890B: 20 psi (138 kPa), see Replacement Parts.

### Pressure Rating of Quartz Focusing Lens: 20 psi

(138 kPa), see Accessories.

### Mounting:

CR7890B: Mounting flange with 3/4 NPT internal threads for attaching to sight pipe. 1 in. mount available, see Accessories.

**Threaded Leadwire Faceplate Opening:** 1/2-14 NPSM internal threads for attaching conduit.

**Connector:** Brad Harrison® 3R9006A20A120. Requires mating 9-pin 47001, 47002, 47003 or 47043 connector, not supplied from Honeywell.

**Dimensions:** See Fig. 1.

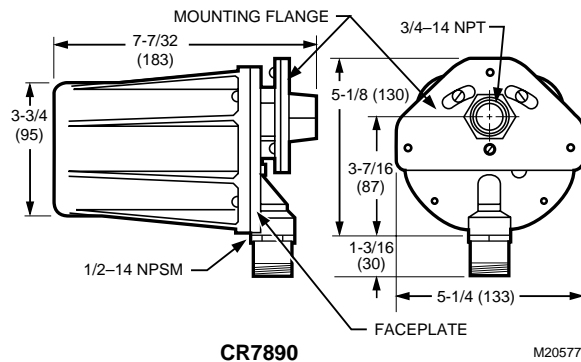


Fig. 1. CR7890B dimensions in in. (mm).

## ORDERING INFORMATION

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

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Automation and Control Products Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care  
1885 Douglas Drive North  
Minneapolis, Minnesota 55422-4386

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

International Sales and Service Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.

**Weight:**

CR7890B1019: 3.78 lb (1.71 kg).

**Replacement Parts:****All Models:**

- 114372 Quartz Viewing Window; rated for 20 psi (138 kPa).
- 114465 Gasket, silicone rubber; for installing viewing window (three required).
- 120739 Gasket, fiber-neoprene; heat insulation and seal-off for mounting flange.

**Accessories:**

- 118367A Swivel Mount.
- 122748 Quartz Viewing Window, rated for 50 psi (345 kPa).
- 124204 Quartz Focusing Lens, rated for 20 psi (138 kPa); increases the CR7890-sensed ultraviolet radiation.
- 120934 Mounting Flange, aluminum, with 3/4 inch NPT internal threads for attaching to sight pipe.
- 124198 Mounting Flange, aluminum, with 1 inch NPT internal threads for attaching to sight pipe.
- 123539 Antivibration Mount.
- 204341A Mirror Assembly.
- 32005580-001 Cable for connecting Keyboard Display Module (KDM) to CR7890.
- 32006648-001 Cover with Communications Port Access, NEMA1, 130°F (54°C) Ambient Operating Temperature.
- 32007181-001 Wiring Harness with 9-pin Brad Harrison® Connector.
- S7800A1001 Keyboard Display Module (English). Other language models are available.

## INSTALLATION

### WARNING

**Fire or Explosion Hazard.****Can cause property damage, severe injury or death.**

To prevent possible hazardous burner operation, verify 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 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 product operation as provided in these instructions.

### WARNING

**Electrical Shock Hazard.****Can cause serious injury or death.**

1. Disconnect power supply before beginning installation to prevent electrical shock and equipment damage. More than one disconnect may be involved.
2. Do not remove the blue housing from the base. High voltage exists within the device and could cause serious injury or death.

**IMPORTANT**

1. All wiring must be NEC Class 1 (line voltage).
2. Wiring must comply with all applicable codes, ordinances and regulations.
3. Voltage and frequency of the power supply connected to this device must agree with the values marked on the device.
4. Loads connected to the CR7890 must not exceed those listed on the device label or the specifications.
5. Limits and interlocks must be rated to simultaneously carry and break current to the ignition transformer, pilot valve, and main fuel valve(s).
6. All external timers must be listed or component-recognized by authorities who have proper jurisdiction.
7. 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).
8. Sight the device so it does not respond to ignition spark.
9. On multiburner installations, each device must respond only to the flame of the burner it is supervising.
10. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, can cause interference in 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 can cause interference, in which case, the users, at their own expense, may be required to take whatever measures are required to correct this interference.

**Canadian EMI:** This digital apparatus does not exceed the Class B limits for radio noise for digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la Classe B prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

Proper flame detector installation is the basis of a safe and reliable flame safeguard installation. Refer also to the burner manufacturer instructions. Carefully follow all instructions for the best possible flame detection application.

## Basic Requirements

The combustion flames of most carbon-based fuels emit sufficient ultraviolet radiation to enable the CR7890B Integrated Burner Control to prove the presence of a flame in a combustion chamber. The CR7890 is mounted outside the combustion chamber with its mounting flange or union threaded to one end of a sight pipe inserted through the wall of the combustion chamber. The ultraviolet sensor in the control sights the flame through the pipe.

When a flame is present, the sensor in the CR7890 senses the ultraviolet radiation emitted. The CR7890 then produces a signal that pulls in the flame relay to allow proper system operation.

Because it is necessary for the UV sensor to actually see the flame, it is best to locate the CR7890 as close to the flame as physical arrangement, temperature, and other restrictions permit. These restrictions are described in detail in the following paragraphs.

## Determine Location

Before beginning the actual installation, determine the best location for mounting the CR7890. Carefully consider the factors discussed in this section before deciding on the location.

### Temperature

Install the CR7890 where the ambient temperature (outside the case) stays within the ambient operating temperature ratings.

To keep the CR7890 below its maximum rating, it may be necessary to add additional insulation between the wall of the combustion chamber and the device. A shield or screen can be added to reflect radiated heat away from the device. If the CR7890 continues to get too hot, additional cooling is necessary.

Refer to the Sight Pipe Ventilation section.

## Location

### Humidity

install the CR7890 where the relative humidity never reaches the saturation point. The CR7890 is designed to operate in a maximum 85% relative humidity continuous, noncondensing, moisture environment. Condensing moisture can cause a safety shutdown.

### Vibration

Do not install the CR7890 where it can be subjected to vibration in excess of 1.0G continuous maximum vibration.

### Clearance

Make sure there is enough room to easily mount the sight pipe, CR7890 and all required fittings, and to remove the CR7890 for troubleshooting and servicing.

## Radiation Sources (Other Than Flame)

Examples of sources (other than flame) that could actuate the detection system:

1. Flame-simulating sources:
  - a. Hot refractory above 1800°F (582°C).
  - b. Spark:
    - (1) Ignition transformers.
    - (2) Welding arcs.
    - (3) Lightning.
  - c. Welding flames.
  - d. Bright incandescent or fluorescent artificial light.
  - e. Solar radiation.
  - f. Gas lasers.
  - g. Sun lamps.
  - h. Germicidal lamps.
  - i. Bright flashlight held close to sensing tube.
2. Gamma ray and X-ray sources:
  - a. Diffraction analyzers.
  - b. Electron microscopes.
  - c. Radiographic X-ray machines.
  - d. High voltage vacuum switches.
  - e. High voltage condensers.
  - f. High voltage coronas.
  - g. Radioisotopes.

Except under unusual circumstances, none of these sources, except hot refractory and ignition sparks, would be present in or near the combustion chamber. Verify that the CR7890 does not respond to these sources *after* installation.

The CR7890 may respond to hot refractory above 1800°F (582°C) if the refractory surface represents a significant percentage of the CR7890 field of view. If the temperature of the hot refractory causes the flame relay in the flame safeguard control to pull in, re-aim the pipe so that the CR7890 views a cooler area of the refractory surface.

Ignition spark is an intense source of ultraviolet radiation. When installing the CR7890, make sure it does not respond to ignition spark.

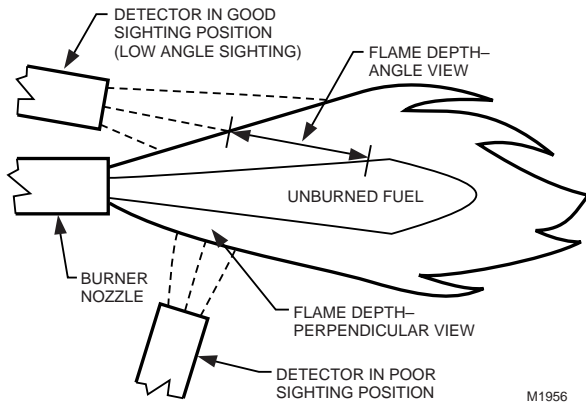
## Single Burner Requirements

The CR7890 must have an unobstructed view of a steady part of the flame it is supervising. This requires a proper sighting angle and minimized ultraviolet radiation attenuation effects. Supervising only one burner simplifies sighting requirements.

### Sighting Angle (Fig. 2)

The first 30 percent of a flame closest to the burner nozzle (the flame root) emits the most ultraviolet energy. Also, if the CR7890 sights the flame at an angle instead of perpendicularly, it views more flame depth. Therefore, the best sighting angle is nearly parallel to the axis of the flame, permitting the CR7890 to view a large portion of the first 30 percent of the flame closest to the burner nozzle, as illustrated in Fig. 2.

Low angle sighting permits the CR7890 to view a greater depth of flame, thus reducing the effects of instabilities in the flame pattern. Also, the environment near the burner nozzle is usually cleaner than at any other part of the combustion chamber. This provides a clearer line of sight and can keep the viewing window cleaner, thus reducing the maintenance required.



**Fig. 2. CR7890 sighting angle.**

**NOTE:** When possible, it is desirable to tilt the CR7890 and sight pipe downward to prevent the buildup of soot in the pipe or on the viewing window.

In most installations, the CR7890 needs to respond to the pilot flame alone, then the pilot and main burner flame together, and finally the main burner flame alone. The CR7890 must meet all sighting requirements that apply:

- Pilot flame alone—the smallest pilot flame that can be detected must be capable of reliably igniting the main burner.
- Pilot and main burner flame together—the CR7890 must sight the junction of both flames.
- Main burner flame alone—the CR7890 must sight the most stable part of the flame for all firing rates.

## Screening Effects

Smoke, oil mist, dirt and dust are masking agents that attenuate the ultraviolet radiation that the flame emits. If they absorb too much radiation, the amount of ultraviolet radiation reaching the CR7890 is reduced. The flame signal can then become too low to hold in the flame relay, resulting in burner shutdown.

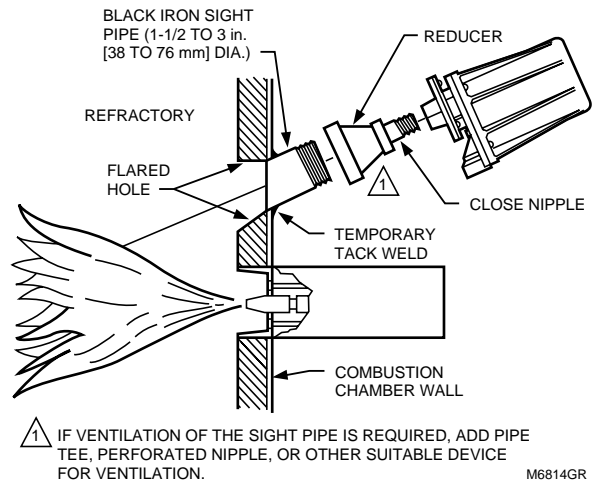
Diluting the contaminants can eliminate the problem. A strong flow of air through the sight pipe clears a viewing path through the attenuating material. Refer to the Sight Pipe Ventilation section.

It is also desirable to sight the CR7890 in an area containing fewer masking agents such as near the burner nozzle or near the entrance of the combustion air. Increasing the viewing area of the CR7890 by shortening the sight pipe or by increasing the diameter of the sight pipe also reduces the attenuating effects of masking agents.

## Install the Sight Pipe (Fig. 4)

After you have determined the location and sighting angle, select the sight pipe. A black iron pipe with a diameter of at least 1-1/2 in. (38 mm) is recommended. Do not use stainless steel or galvanized pipe because they reflect ultraviolet radiation internally and complicate aiming the pipe.

Sight pipes with diameters 2 to 3 in. (51 to 76 mm) produce better results for horizontal rotary burners, which require wide viewing angles. A wide viewing angle can also be obtained by using a short sight pipe.



**Fig. 3. Typical mounting of CR7890.**

## Prepare Hole in Combustion Chamber Wall

Cut or drill a hole of the proper diameter for the sight pipe in the wall of the combustion chamber at the selected location. Flare the hole to leave room for small adjustments of the sighting angle. The taper of the hole should be about 1 in. for every 3 in. (25 mm for every 76 mm) of wall thickness.

## Mount Sight Pipe

Thread one end of the pipe to fit the mounting flange, union or required coupling. Cut the pipe to the desired length (as short as practical) and at an angle so it fits flush with the wall

of the combustion chamber. Tack weld the pipe to the wall in a trial position. Do not weld the sight pipe permanently in place until after completing the Adjustments and Checkout.

**NOTE:** If you use 118367A Swivel Mount and you are positive about the location and sighting angle, you can permanently weld the pipe.

## Install Fittings

In some cases, the sight pipe does not directly fit the CR7890 mounting flange or union. Also, it may be desirable or necessary to ventilate the sight pipe. You may also want to use a swivel mount or an antivibration mount. Each of these cases can require additional fittings.

## Reducer

For sight pipes of larger diameter than the mounting flange connector or union, install a reducer as illustrated in Fig. 3. The reducer requires a close nipple with 3/4 in. NPT external threads.

## Sight Pipe Ventilation

It may be necessary to ventilate the sight pipe to cool the CR7890 or to clear a viewing path through UV radiation attenuating material.

For a negative pressure combustion chamber, drilling a few holes in the section of the sight pipe outside of the combustion chamber allows air at atmospheric pressure to flow through the sight pipe and into the chamber. A perforated pipe nipple between the sight pipe and the CR7890 can also be used.

For a positive pressure combustion chamber, connect a supply of pressurized air from the burner blower to flow through the sight pipe and into the chamber. The air pressure must be greater than the chamber pressure.

## Swivel Mount

To facilitate proper flame sighting, use 118367A Swivel Mount (ordered separately). The swivel mount requires a reducer of the proper size to mount it onto the sight pipe. It also requires a 3/4-inch close nipple for mounting to a CR7890 with a one-inch connector. (For 118367A Swivel Mount mounting details, refer to 60-0361.)

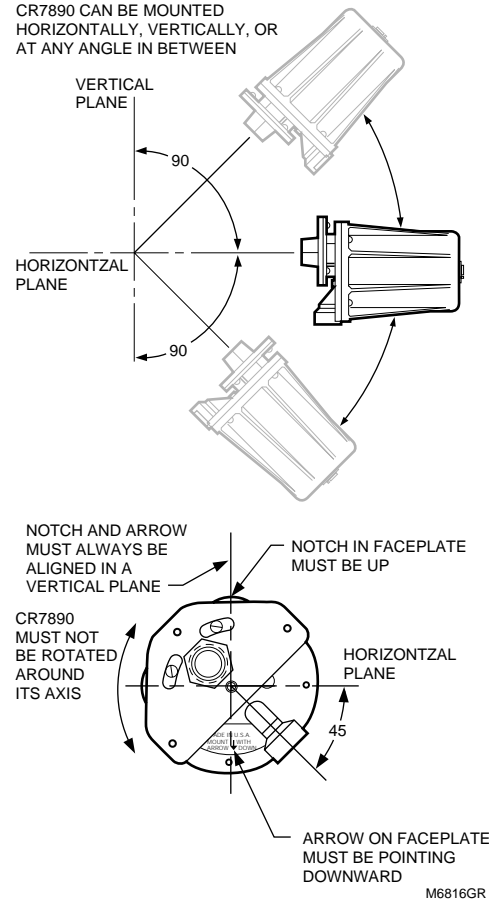
## Antivibration Mount

The CR7890 withstands normal burner vibration. If the vibration is excessive, 123539 Antivibration Mount is available. (For mounting details, see form 60-0361.) If you use this mount, install it before positioning and sighting the CR7890.

## Mount the CR7890 (Fig. 4)

Mount the CR7890 onto the sight pipe, reducer, or other fitting (see Fig. 4).

The CR7890 incorporates an oscillating shutter mechanism and, therefore, require special consideration for mounting positions other than vertically sighting downward or upward, as illustrated in Fig. 4. The CR7890 has notch and arrow indicators (see Fig. 4) on the faceplate to facilitate mounting in positions other than those shown in Fig. 4. The notch and arrow must be vertically aligned with the notch in the UP position and the arrow pointing downward (see Fig. 4). The CR7890 must be mounted with the conduit opening located approximately 45 degrees below the horizontal (see Fig. 4).



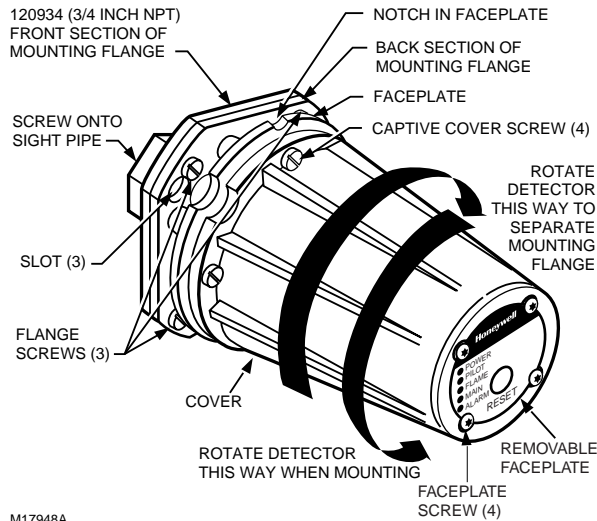
**Fig. 4. CR7890 mounting positions.**

### IMPORTANT

*The notch and arrow on the faceplate of the CR7890 must be aligned in a **vertical plane** with the notch **up** and the arrow pointing **downward**.*

To mount a CR7890B (Fig.5):

1. The mounting flange is in two pieces. Loosen (but do not remove) the three screws holding the flange together.
2. Slightly rotate the device clockwise so the slots in the back section of the mounting flange clear the screws in the front section; then separate the two sections.
3. Screw the front section of the mounting flange onto the sight pipe, reducer, or other fitting.
4. Fit the slots in the back section of the mounting flange (with the device) over the three screws in the front section, and rotate the device counterclockwise so the screws hold the flange together.
5. Tighten the screws securely.



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**Fig. 5. Mounting CR7890 Integrated Burner Control.**

## Wiring

### **⚠ WARNING**

#### **Electrical Shock Hazard.**

**Can cause serious injury, death or property damage.**

Disconnect the power supply before wiring.

1. For proper wiring and sequence chart, refer to Fig. 7.
2. Disconnect the power supply from the main disconnect before beginning installation to prevent electrical shock and equipment damage. More than one disconnect can be required.
3. All wiring must comply with all applicable electrical codes, ordinances and regulations. Wiring, where required, must comply with NEC, Class 1 (Line Voltage) wiring.
4. Use recommended wire routing of leadwires:
  - a. Do not run high voltage ignition transformer wires with wires supplying the CR7890.
5. For recommended wire size and type, see Table 1.
6. For recommended grounding practices, see Table 2.
7. For high temperature installations, use moisture-resistant 14 AWG wire selected for a temperature rating above the maximum operating temperature.
8. Refer to Fig. 9 through 16 for wiring connections.
9. Be sure loads do not exceed the terminal ratings. Refer to the label on the CR7890 or to the terminal ratings in Table 3.

**Table 1. Recommended Wire Sizes and Part Numbers.**

Application	Recommended Wire Size	Recommended Part Numbers
Line voltage wires	14, 16, or 18 AWG copper conductor, 600 volt insulation wire.	TTW60C, THW75C, THHN90C.

**Table 2. Recommended Grounding Practices.**

Ground Type	Recommended Practice
Earth Ground (CR7890)	<ol style="list-style-type: none"> <li>1. Used to provide a connection between the CR7890 and the control panel of the equipment. Earth ground must be capable of conducting enough current to blow the 20A fast-blow fuse (or breaker) in the event of an internal short.</li> <li>2. Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire is required, use 14 AWG copper wire.</li> <li>3. Make sure that mechanically tightened joints along the ground path are free of nonconductive coatings and protected against corrosion on mating surfaces.</li> </ol>

Table 3. Terminal Ratings.

Terminal Number <sup>a</sup>	Description	Ratings
7	Earth Ground <sup>b</sup>	—
5	Line Voltage Common	—
9	Line Voltage Supply (L1)	120 Vac (+10%/-15%), 50 or 60 Hz (±10%). <sup>c</sup>
3	Alarm	120 Vac, 1A pilot duty.
6	Reset	120 Vac, 10 mA maximum.
1	Burner Controller and Limits	120 Vac, 8A run, 43A inrush.
8	Pilot Valve/Ignition	120 Vac. <sup>d</sup>
2	Main Fuel Valve	120 Vac. <sup>d</sup>
4	Ignition	120 Vac, 4.5A ignition. <sup>d</sup>

<sup>a</sup> Numbers refer to pin numbers on Brad Harrison® 3R9006A20A120 Connector.

<sup>b</sup> The CR7890 must have an earth ground providing a connection between the device and the control panel or the equipment. The earth ground wire must be capable of conducting the current to blow the 15A fast-blow fuse (or breaker) in event of an internal short circuit. The CR7890 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 rather than leadwires are preferred. Be careful to verify 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.

<sup>c</sup> 2000 VA maximum connected load to the CR7890 Assembly.

<sup>d</sup> See Tables 4 and 5 for device load combinations.

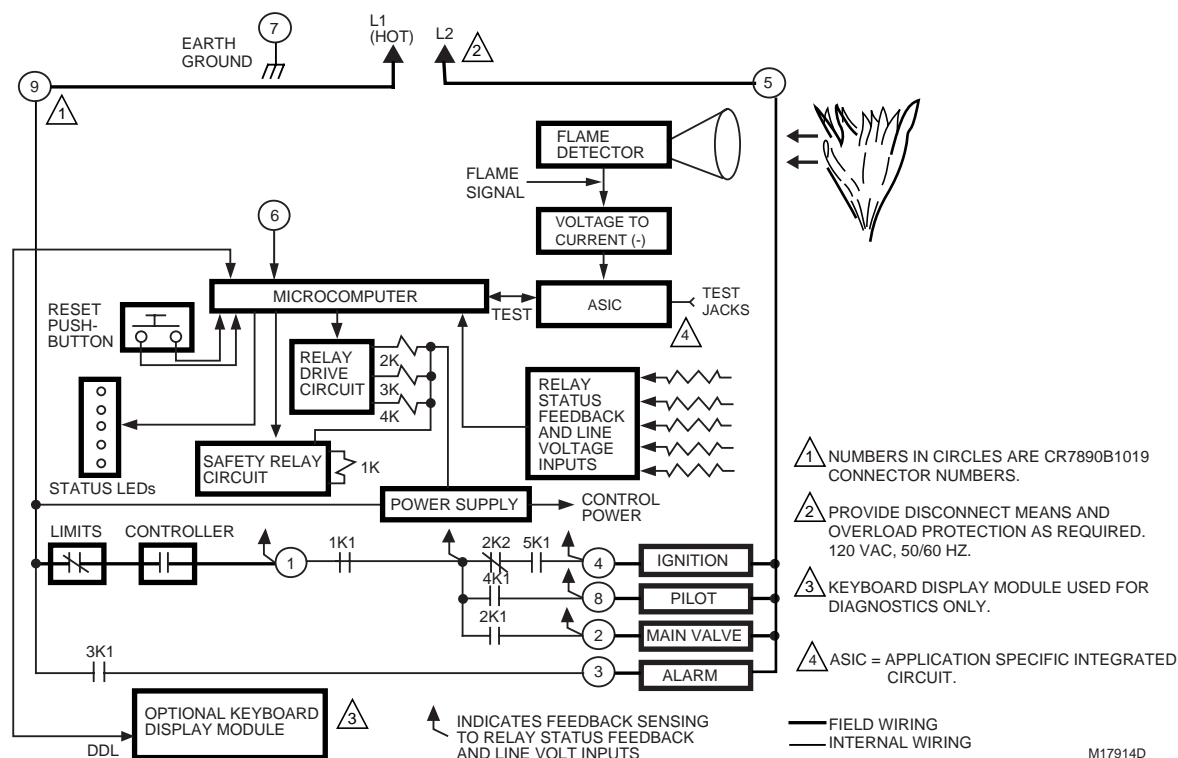


Fig. 6. Internal block diagram of the CR7890.





Table 5. Composition of Each Combination.

A	B	C	D	F
4.5A ignition	50 VA Pilot Duty plus 4.5A ignition.	180 VA ignition plus motor valves with: 660 VA inrush, 360 VA open, 250 VA hold.	2A Pilot Duty	65 VA Pilot Duty plus motor valves with: 3850 VA inrush, 700 VA open, 250 VA hold.

## Final Wiring Check

1. Check the power supply circuit. The voltage and frequency tolerance must match those of the CR7890. A separate power supply circuit can be required for the CR7890. Add the required disconnect means and overload protection.
2. Check all wiring circuits and complete the Static Checkout in Table 6 before installing the CR7890.
3. Restore the panel power.

## STATIC CHECKOUT

After checking all wiring, perform this checkout before applying power to the CR7890. These tests verify that the wiring is correct, and that the external controllers, limits, interlocks, actuators, valves, transformers, motors and other devices are operating properly.

### WARNING

#### Explosion Hazard.

#### Can cause serious injury, death or equipment damage.

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

### CAUTION

#### Equipment Damage Hazard.

#### Can cause equipment damage or equipment failure.

Do not perform a dielectric test with the CR7890 installed. Internal surge protectors break down and conduct a current, causing the CR7890 to fail the dielectric test or possibly destroy the internal lightning and high current protection.

## Equipment Recommended

1. Voltmeter (1M ohm/volt minimum sensitivity) set on the 0 to 300 Vac scale.
2. Two jumper wires, No. 14 wire, insulated, 12 in. (305 mm) long with insulated alligator clips at both ends.

## General Instructions

1. Perform all applicable tests listed in the Static Checkout, Table 6, in the order listed.
2. Make sure all manual fuel shutoff valves are closed.
3. For each test, open the master switch and install the jumper wires between the subbase wiring terminals listed in the Test Jumpers column.
4. Close the master switch before observing the 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 proper connections, tight terminal screws, and appropriate wire and wiring techniques.
8. Replace all damaged or incorrectly sized wires.
9. Replace faulty controllers, limits, interlocks, actuators, valves, transformers, motors and other devices, as required.
10. Make sure normal operation is obtained for each required test before continuing the checkout.
11. After completing each test, be sure to remove the test jumper(s).
12. Verify that the CR7890 does not respond to radiation sources (other than flame, see list).

### WARNING

#### Explosion Hazard.


#### Can cause serious injury or death.

Be 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).*

Table 6. Static Checkout.

Test No.	Test Jumpers	Voltmeter	Normal Operation	If Operation is Abnormal, Check the Items Listed Below
1	—	9 to 5	Line voltage.	1. Master switch. 2. Power connected to the master switch. 3. Overload protection (fuse, circuit breaker, etc.) has not opened the line.
2	—	1 to 5	Line voltage.	1. Limits. 2. Burner control.
3	9 to 4	—	Ignition spark (if ignition transformer is connected to terminal 4).	1. Watch for spark or listen for buzz. a. Ignition electrodes are clean. b. Ignition transformer is okay.
4	9 to 8	—	1. Ignition spark (if ignition transformer is connected to terminal 8). 2. Automatic pilot valve opens (if connected to terminal 8).  NOTE: Refer to wiring diagram of system being tested.	1. Watch for spark or listen for ignitor buzz. a. Ignition electrodes are clean. b. Ignition transformer is okay. 2. Listen for click or feel head of valve for activation: a. Actuator if used. b. Pilot valve.
5	9 to 2	—	Automatic fuel valve(s) open(s). If using direct spark ignition, check the first stage fuel valve(s) instead of the pilot valve.	Same as test no. 4. If using direct spark ignition, check the first stage fuel valve(s) instead of the pilot valve.
6	9 to 3 (alarm)	—	Alarm (if used) turns on.	1. Alarm.
FINAL	 <b>CAUTION</b> <b>Equipment Damage Hazard.</b> <b>Can cause equipment damage.</b> After completing these tests, open the master switch, remove all test jumpers and remove any bypass jumpers from the low fuel pressure limits to prevent equipment damage.			

## PRINCIPAL TECHNICAL FEATURES

The CR7890 provides all customary flame safeguard functions as well as significant advancements in safety, annunciation, and system diagnostics.

### Safety Shutdown (Lockout) Occurs if:

1. INITIATE PERIOD
  - a. AC line power errors occurred, see Operation.
  - b. Four minute INITIATE period has been exceeded.
2. STANDBY PERIOD
  - a. Ignition/intermittent pilot valve output is energized.
  - b. Internal system fault occurred.
  - c. Main valve terminal is energized.
3. SAFE START CHECK
  - a. Ignition/intermittent pilot valve output is energized.
  - b. Internal system fault occurred.
  - c. Main valve output is energized.
4. PILOT FLAME ESTABLISHING PERIOD (PFEP)
  - a. Ignition/intermittent pilot valve output is not energized.
  - b. Internal system fault occurred.
  - c. Main valve output is energized.
  - d. No flame present at end of PFEP.

### 5. RUN PERIOD

- a. Ignition output is energized.
- b. Internal system fault occurred.
- c. Main valve output is not energized.
- d. No flame present.
- e. Pilot valve output is not energized.

## OPERATION

### Sequence of Operation

The CR7890 has the operating sequences listed below; see Fig. 2. The CR7890 LEDs provide positive visual indication of the program sequence: POWER, PILOT, FLAME, MAIN and ALARM.

#### Initiate

The CR7890 enters the INITIATE sequence when the relay module is initially powered. The CR7890 can also enter the INITIATE sequence if the relay module verifies voltage fluctuations of +10/-15% or frequency fluctuations of  $\pm 10\%$  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 is initiated and is displayed on the optional KDM for at least five seconds. When the tolerances are met, the INITIATE sequence restarts. If the condition is not corrected and the hold condition exists for four minutes, the CR7890 locks out. Causes for hold conditions in the INITIATE sequence:

- a. AC line dropout detection.
- b. AC line noise that can prevent a sufficient reading of the line voltage inputs.
- c. Brownouts caused by a low line voltage.

## Standby

The CR7890 is ready to start an operating sequence when the operating control input (terminal 1) recognizes a call for heat. The burner switch, limits, operating limit control and all microcomputer monitored circuits must be in the correct state for the CR7890 to continue into the Safe Start Check.

## Normal Start-Up Safe Start Check

The CR7890 verifies that a flame or flame simulating condition does not exist and proceeds into the Ignition Trial. If a flame or flame simulating condition is present, the CR7890 remains in the STANDBY period.

## Ignition Trials

1. Pilot Flame Establishing Period (PFEP):
  - a. The pilot valve and ignition transformer, outputs 8 and 4, are energized. The CR7890 is an intermittent pilot valve device.
  - b. Flame must be proven by the end of the ten-second PFEP or a safety shutdown occurs.
  - c. Once flame is proven, the ignition, output 4 is de-energized and the main valve, output 2, is energized.

## Run

The CR7890 is now in RUN and remains in RUN until the controller input, terminal 1, opens, indicating that the demand is satisfied or a limit has opened. If flame signal is lost during RUN, the CR7890 goes to a Safety Shutdown state, which de-energizes the pilot valve, output 8 and main valve, output 2 are de-energized and alarm, output 3 is energized, along with the red LED. A code 22 will flash on the Power LED.

# ADJUSTMENTS AND CHECKOUT

## Burner Lightoff

For initial burner lightoff, consult the burner manufacturer instructions or the flame safeguard control instructions.

## Adjust CR7890 Sighting

With the CR7890 installed and the burner running, adjust the sighting position for optimum flame signal.

## Measure the flame signal with a volt/ohmmeter.

It is suggested that a volt/ohmmeter with a minimum sensitivity of one megohm/volt and a zero to five or ten Vdc scale be used for flame signal measurements.

1. Remove the four black faceplate screws (Fig. 5) from the faceplate.
2. Remove the faceplate.
3. Measure the flame signal as illustrated in Fig. 8. Be careful to make the proper connections of positive (red) meter lead to positive (+) control jack and negative (black) meter lead to negative (-) or (-Com).



**Fig. 8. Measuring the CR7890 flame signal voltage (with the cover removed).**

4. Measure the voltage flame signal, CR7890 (with nameplate removed).
5. Move the device and sight pipe around to sight the flame from various positions and angles. Try to get a maximum reading on the meter that is above the minimum acceptable voltage of 2.0 Vdc. The maximum reading is 5.0 Vdc.
6. Measure the flame signal for the pilot alone, the main burner flame alone, and both together (unless monitoring only the pilot flame when using an intermittent pilot, or only the main burner flame when using direct spark ignition).
7. Measure the flame signal at low and high firing rates and while modulating in between (as applicable). With the CR7890 in its final position, all required flame signals must be steady (or stable) and greater than 2.0 Vdc. If you cannot obtain the proper signal, refer to the Troubleshooting section.
8. Replace the faceplate and secure with the screws removed in step 1.
9. Tighten the screws to ensure that the foam gasket is fully compressed. Avoid cracking the faceplate by overtightening the screws.

## Pilot Turndown Test

When the CR7890 is used to prove a pilot flame before the main fuel valve(s) can be opened, perform a Pilot Turndown Test before welding the sight pipe into position. Follow the procedures in the flame safeguard control instructions and in the burner manufacturer instructions.

## Ultraviolet Response Tests Ignition Spark Response Test

Test to be sure that ignition spark is not actuating the flame relay in the flame safeguard control.

1. Close the pilot and main burner manual shutoff valves.
2. Start the CR7890 and run through the Ignition period. Ignition spark should occur, but the flame LED must not light. The flame signal should not be greater than 0.25 Vdc.
3. If the flame relay does pull in, reposition the CR7890 farther from the spark, relocate or resight the CR7890 to eliminate or reduce the CR7890 response to reflected UV radiation. It may be necessary to construct a barrier to block the ignition spark from the CR7890 view. Continue adjustments until the flame signal due to ignition spark is less than the flame signal values indicated in step 2.

## Weld the Sight Pipe

When the flame signal is acceptable after all adjustments are made, remove the CR7890 and weld the sight pipe in its final position. (If you are using a swivel mount, the pipe may be already welded.) Then reinstall the CR7890.

## Final Checkout

Before putting the burner into service, check out the installation using the Checkout procedures in the Instructions for the appropriate flame safeguard control. After completing the Checkout, run the burner through at least one complete cycle to verify correct operation.

### IMPORTANT

*Do not put the system into operation until all Checkout tests in the Instructions for the appropriate flame safeguard control and any others specified in the burner installation instructions are satisfactorily completed.*

## SERVICE

### WARNING

**Electrical Shock Hazard.**

**Can cause serious injury or death.**

Open the master switch to disconnect power before removing or installing the CR7890 or its cover. More than one disconnect can be involved.

## Periodic Maintenance

1. Clean the viewing window (or focusing lens) when necessary. Remove the CR7890 (see Troubleshooting section) and use a clean cloth over the eraser end of a pencil. Do not remove the window (or lens) to clean it. If it is broken or damaged or it is coated with a substance that cannot be removed, replace the CR7890 (see Fig. 13).
2. Keep the CR7890 adjusted for the smoothest, most reliable operation as recommended by the burner manufacturer.

## TROUBLESHOOTING

### WARNING

**Electrical Shock Hazard.**

**Can cause serious injury or death.**

Open the master switch to disconnect power before removing or installing the CR7890 or its cover. More than one disconnect can be involved.

## Equipment Required

For 7800 SERIES controls, a voltohmmeter with an input impedance of one megohm/volt and a zero-to-five or zero-to-ten Vdc scale is suggested.

## Unsatisfactory Flame Signal

If a satisfactory flame signal cannot be obtained while adjusting the sighting position of the CR7890, consider 124204 Quartz Focusing Lens. If you encounter other problems in the system, refer to the Troubleshooting section in the instructions for the appropriate flame safeguard control.

## Troubleshooting Procedures

First perform the Preliminary Inspection. Then follow the applicable procedures for either a low meter reading or a zero meter reading. After reinstalling the CR7890 or replacing its cover, recheck the meter reading. To try to obtain the proper flame signal, adjust the position of the CR7890. If you complete all of the procedures and yet cannot obtain a proper flame signal, replace the CR7890.

## Preliminary Inspection

1. Check for the proper line voltage. Make sure the master switch is closed, connections are correct, and power supply is of the correct voltage and frequency.
2. Check the CR7890 wiring for defects:
  - a. Incorrect connections.
  - b. Wrong type or size of wire.
  - c. Deteriorated wire.
  - d. Open circuits.
  - e. Short circuits.
  - f. Leakage paths caused by moisture, soot, or dirt.
3. With the burner running, check the temperature at the CR7890. If it exceeds 135°F (57°C) [see Table 4]:
  - a. Add additional insulation between the wall of the combustion chamber and the CR7890.
  - b. Add a shield or screen to reflect radiated heat away from the CR7890, or
  - c. Add cooling (refer to Sight Pipe Ventilation and Accessories sections).

## Removing CR7890 from Sight Pipe (Refer to Fig. 7)

Loosen the three screws holding the mounting flange; rotate the CR7890 slightly so the screws clear the slots in the back section of the flange; separate the flange; and pull off the back section (with the UV sensor).

NOTE: The CR7890 is free when the collar is unscrewed; do not drop it.

## Procedure for Zero Meter Reading

If you cannot obtain a meter reading, replace the CR7890.

### IMPORTANT

*At the completion of Troubleshooting, be sure to perform the Adjustments and Checkout procedures.*

## WARNING

### Electrical Shock Hazard.

### Can cause serious injury or death.

Open the master switch to disconnect power before removing or installing the CR7890 or its cover. More than one disconnect may be involved.


## Fault Codes

In addition to the above checks, the CR7890B POWER LED provides fault identification when the CR7890B locks out on an alarm. Fault identification is a series of fast and slow blinking LED lights. The fast blinks identify the tens portion of the fault code (two fast blinks is 20) while the slow blinks identify the units portion of the fault code (one slow blink is the number one). Two fast blinks followed by one slow blink would be fault code 21. This identifies a flame sensed during STANDBY.

The LED code repeats as long as the fault exists. To clear the fault, press the RESET button.

See Table 7 for a list of fault codes.

**Table 7. CR7890B Fault Codes and Recommended Troubleshooting.**

Fault Code	System Failure	Recommended Troubleshooting
Code 11 *Low AC Line Voltage*	Low ac line voltage detected.	<ol style="list-style-type: none"> <li>1. Check the CR7890B and Keyboard Display Module connections.</li> <li>2. Reset and sequence the CR7890B.</li> <li>3. Check the power supply and make sure that frequency and voltage meet specifications.</li> <li>4. Check the backup power supply, as appropriate.</li> </ol>
Code 12 *AC Quality Problem*	Excessive noise or device running on slow, fast, or ac line dropout detected.	
Code 21 *Unexpected Flame Signal*	Flame sensed when no flame is expected during STANDBY or PURGE.	<ol style="list-style-type: none"> <li>1. Check that flame is not present in the combustion chamber; correct any errors.</li> <li>2. Check the wiring and correct any errors.</li> <li>3. Reset and sequence the CR7890B.</li> <li>4. If the fault persists, replace the CR7890B.</li> </ol>
Code 22 *Flame Signal Absent*	No-flame time present at the end of the Pilot Flame Establishing Period; lost during the Main Flame Establishing Period or during Run.	<ol style="list-style-type: none"> <li>1. Measure the flame signal. If one exists, verify that it meets specifications.</li> <li>2. Inspect the main fuel valve(s) and valve connection(s).</li> <li>3. Verify that the fuel pressure is sufficient to supply fuel to the combustion chamber. Inspect the connections to the fuel pressure switches. Make sure they are functioning properly.</li> <li>4. Check the CR7890B sighting position; reset and recycle. Measure the flame signal strength. Verify that it meets specifications.</li> <li>5. If the fault persists, replace the CR7890B.</li> </ol>
Code 23 *Flame Signal Overrange*	Flame signal value is too high to be valid.	<ol style="list-style-type: none"> <li>1. Reset and sequence the CR7890B.</li> <li>2. Check the CR7890B sighting position; reset and recycle. Measure flame strength. Verify that it meets specifications.</li> <li>3. If the fault persists, replace the CR7890B.</li> </ol>
Code 42 *Wiring Problem/Internal Fault*	Pilot (ignition) valve terminal, Main valve, Ignition or Pilot Valve 2 was on when it should have been off.	 <b>WARNING</b> <b>Electrical Shock Hazard, Fire or Explosion Hazard.</b> <b>Can cause serious injury, death or equipment damage.</b> Remove system power and turn off power supply.  <ol style="list-style-type: none"> <li>1. Remove system power and turn off fuel supply.</li> <li>2. Check wiring, correct any errors.</li> <li>3. Inspect Pilot Fuel Valve(s), both places, and connections.</li> <li>4. Reset and sequence the CR7890B.</li> <li>5. If the fault persists, replace the CR7890B.</li> </ol>
Code 43 *Flame Amplifier Problem*	Flame not sensed, or sensed when checked.	<ol style="list-style-type: none"> <li>1. Check wiring, correct any errors.</li> <li>2. Reset and sequence the CR7890B.</li> <li>3. If the fault persists, replace the CR7890B.</li> </ol>
Code 61 *Internal Faults*	CR7890B self-test failure.	<ol style="list-style-type: none"> <li>1. Reset and sequence the CR7890B.</li> <li>2. If fault reappears, remove power from the CR7890B, reapply power, then reset and sequence the CR7890B.</li> <li>3. If the fault persists, replace the CR7890B.</li> </ol>





**Automation and Control Solutions**

Honeywell International Inc.	Honeywell Limited-Honeywell Limitée
1985 Douglas Drive North	35 Dynamic Drive
Golden Valley, MN 55422	Scarborough, Ontario
	M1V 4Z9

**Honeywell International**

Control Products  
Honeywell Building  
17 Changi Business Park Central 1  
Singapore 486073

**Honeywell Europe S.A.**

3 Avenue du Bourget  
1140 Brussels  
Belgium

**Honeywell Latin American  
Region**

480 Sawgrass Corporate Parkway  
Suite 200  
Sunrise FL 33325

