



INSTRUCTIONS

Flame Safeguard System

R9005N Controller

C9501N, C9502N, C9503M Flame Scanner

SYSTEM APPLICATION

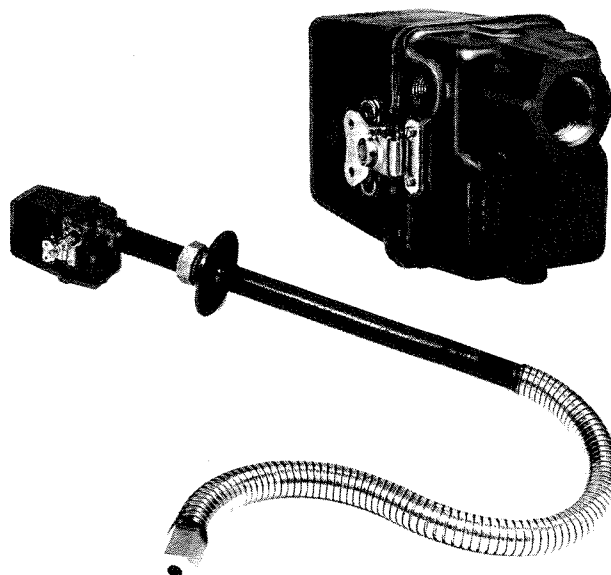
Detector Electronics burner management systems provide recognition and continuous monitoring of fossil fuel flames in semiautomatically controlled boilers and furnaces. The R9005N Controller monitors signals from one flame scanner, and provides relay switching in response to flame loss. In conjunction with solid state or microprocessor-based control logic and the appropriate interlock and limit sensing devices, the R9005N Controller prevents burner startup unless required conditions have been verified, and initiates immediate shutdown if limit conditions are exceeded during burner operation.

Flame scanners to meet almost any boiler need are available for use with the R9005N Controller. The C9501N Ultraviolet Flame Scanner responds to ultraviolet (UV) radiation wavelengths between 1850 and 2650 angstroms, which is emitted by gaseous and liquid fuel flames. The C9502N Infrared Flame Scanner responds to infrared (IR) radiation wavelengths between 5,000 and 10,000 angstroms, enabling the detection of coal, oil and other residual fuel flames that tend to mask or absorb UV radiation, making UV flame detection difficult.

The C9503M Flame Scanner uses a fiber optic link to transmit the burner flame radiation to the scanner electronics. Encased in a flexible steel carrier, the fiber optic transmission link allows the scanner head to move up and down, tracking a moving burner such as that found in a tangentially-fired tilting-burner boiler. The C9503M Scanner responds to radiation wavelengths within the range of 5,000 and 10,000 angstroms, suitable for monitoring coal and oil flames.

FEATURES

- Adjustable flame threshold.
- Selectable flame on delay time - 1 or 2 seconds (1 second delay time only for FM approved model).
- Selectable flame off and marginal flame delay time - 3.5 or 6 seconds (3.5 second delay time only for FM approved model).
- External output for remote flame intensity voltmeter (0 to 10 vdc).



- Accommodates ultraviolet, infrared and fiber optic flame scanners to provide a choice of application solutions. (Different scanner types do not require controller modification.)

- Self-checking light chopper simulates flame loss every 10 seconds to thoroughly test scanner for proper operation.
- Check Fault relay energizes if response to simulated flame loss is improper.
- Two separate adjustable gain settings provide enhanced discrimination in multi-burner applications. Gain channels are externally switchable.
- Front panel analog voltmeter and select switch allow indication of the flame threshold of the controller or the flame intensity monitored by the scanner.
- When the flame signal falls to marginal level (within 2 volts of flame threshold setting), a marginal relay is de-energized.
- Controller to scanner power is fused for system protection.

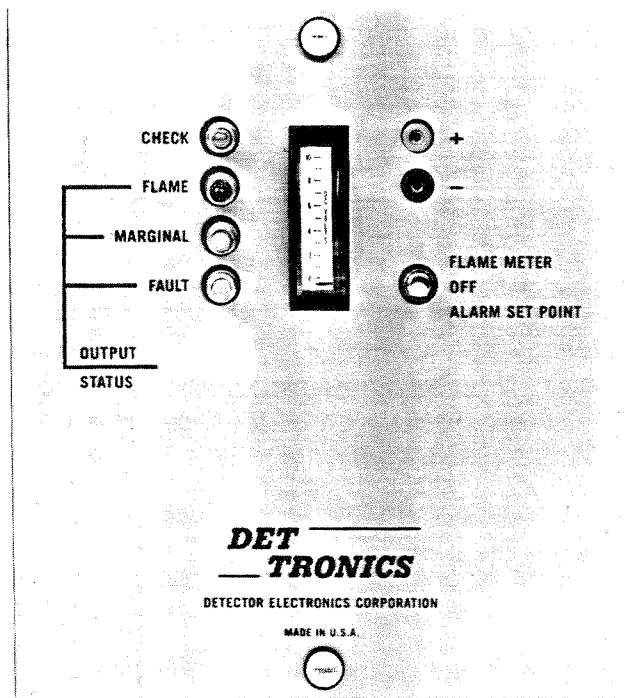


Figure 1—R9005N Faceplate

DESCRIPTION

The R9005N Controller processes signals from one flame scanner and energizes the Flame and Marginal relays in response to flame conditions. The R9005N includes a self-checking feature that tests response to a loss of flame once every 10 seconds. This test is accomplished by mechanically blocking light from the flame, then checking the controller for the appropriate response. In the event of a failure, the Fault relay will energize and the FAULT LED will illuminate. The faceplate indicators, consisting of four LED status outputs and one analog flame intensity meter, allow remote monitoring while the self-checking feature ensures constant system reliability. The following list summarizes the front panel controls and indicators. Refer to Figure 1.

CHECK LED—illuminated during the scanner test.

MARGINAL LED—illuminated when the flame intensity signal exceeds the marginal flame setpoint and the Marginal relay is energized.

FLAME ON LED—illuminated when the flame intensity signal exceeds the flame-on setpoint and the Flame relay is energized.

FAULT LED—illuminated when the system is not responding to self-test properly and the Fault relay is energized.

Meter Select Switch—allows monitoring of either the flame threshold (ALARM SETPOINT) on the controller or the flame intensity monitored by the scanner (FLAME METER).

Three potentiometers are mounted inside the R9005N Controller, their functions are described below:

SETPOINT—adjusts the flame threshold setpoint.

GAIN 1—adjusts the Channel 1 flame signal amplitude.

GAIN 2—adjusts the Channel 2 flame signal amplitude.

NOTE

When two different flames may be viewed by the scanner (for example a pilot and a main flame), the gain controls can be set so that the controller responds appropriately to each flame. A signal from an external switch applied to the controller determines which gain setting is used. Only one gain setting can be used at a time. Refer to the "Gain Adjustment" section of this manual for further information.

THEORY OF OPERATION

The Detector Electronics R9005N Controller monitors signals from a flame scanner and generates relay output switching in response to changes in flame status. Burner flame discrimination is accomplished by incorporating an adjustable flame threshold to compensate for background radiation and adjacent burner interference. Two gain channels allow the controller to respond appropriately to the selected flame. An input from an external switch determines which channel will be used. The flame response circuitry monitors the signal from the

flame scanner and energizes the Flame relay when the scanner signal exceeds the marginal flame setpoint, which is two volts greater than the flame on threshold setting. At ten second intervals, a mechanical light chopper in the scanner blocks the signal from the flame to simulate a flame loss. If response to the simulated flame loss is improper, the Fault relay is energized.

Referring to Figure 2:

- Scanner signal pulses, periodically interrupted by the self-test, are transmitted through the selected gain channel to the integrator buffer circuit.
 - The flame signal is sent to the flame meter and to terminals for connection to a remote meter.
 - The flame signal is sent to the marginal flame threshold detector.
- If the flame signal exceeds the marginal flame setpoint, the flame controller initiates the turn on timer (1 second for FM approved models, selectable between 1 or 2 seconds for other models).
- If the flame signal remains above the setpoint for the selected amount of time, the MARGINAL LED is turned on and the Marginal relay is energized.

- If the flame signal falls below the marginal flame setpoint, the flame controller initiates the turn off timer (3.5 seconds for FM approved models, selectable between 3.5 or 6 seconds for other models).
- If the flame signal remains below the setpoint for the selected amount of time, the marginal flame timer “times out” causing the Marginal relay (K2) and the MARGINAL LED to turn off.

- The flame signal is sent to the flame on threshold circuit.
- If the flame signal exceeds the flame on threshold setpoint, the signal initiates the turn on timer (1 second for FM approved models, selectable between 1 or 2 seconds for other models).
- If the flame signal remains above the threshold setpoint for the selected amount of time, the FLAME LED is turned on and the Flame relay (K3) is energized.
- If the flame signal falls below the flame on threshold setpoint, the flame detector initiates a turn off timer (3.5 seconds for FM approved models, selectable between 3.5 or 6 seconds for other models).
- If the flame signal remains below the setpoint for the

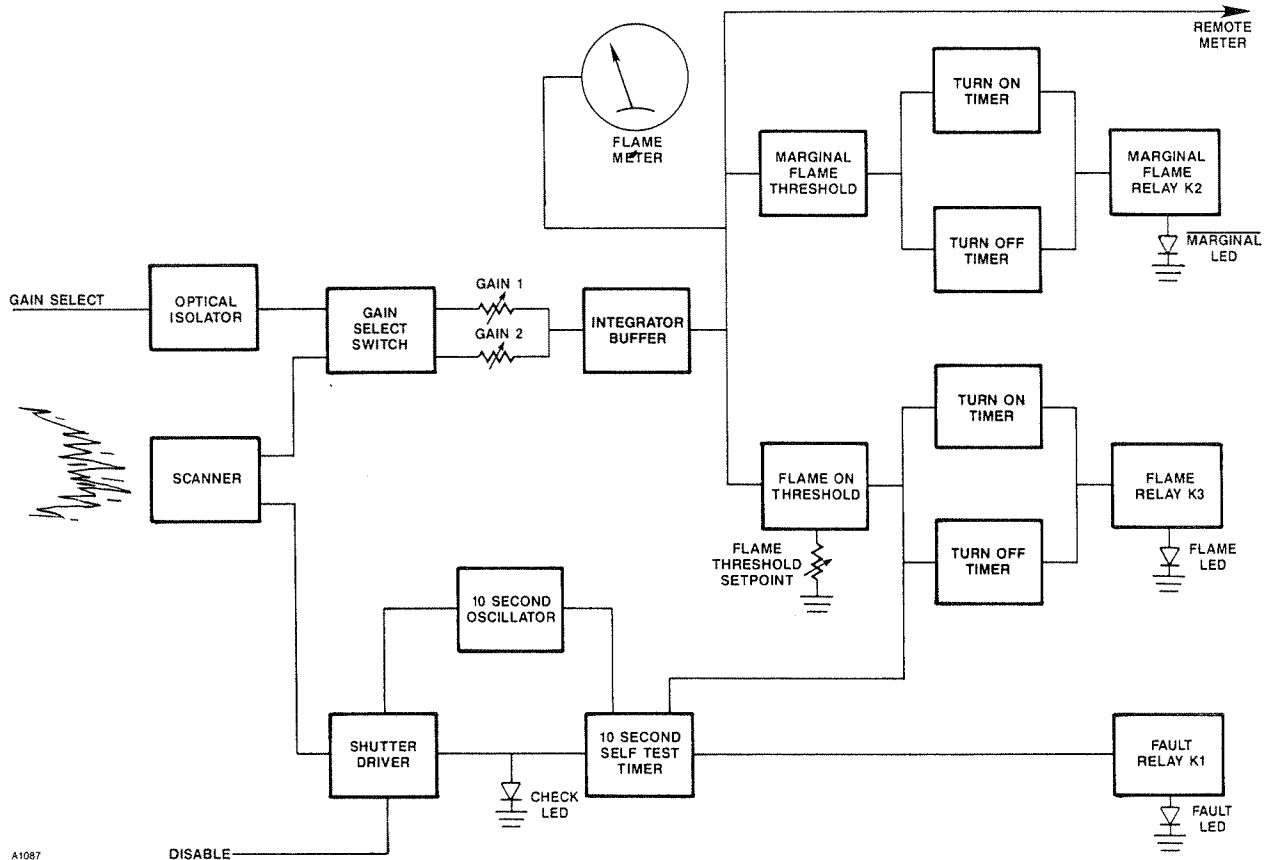


Figure 2—Flame Response Circuitry Block Diagram

selected amount of time, the turn off timer "times out" causing the Flame relay (K3) to de-energize and the FLAME LED to turn off.

- When the flame signal exceeds the flame on threshold setpoint, the signal is passed to the self test timer.

—If the flame signal does not drop below the flame on threshold setpoint (in response to a successful scanner self-test) on any two successive check cycles, the fault test timer will "time out" causing relay K1 to energize and the FAULT LED to illuminate.

NOTE

Since the Flame relay and the FLAME LED are controlled by a timer set at either 3.5 or 6 seconds, they are unaffected by the 1.0 second check period in which the flame is blocked during the scanner self-test.

- Front panel indicators reflect normal system operation in the following manner:
 - When the Meter Select switch is set in the FLAME METER position, the front panel meter displays flame intensity. (If remote meter is connected, it will display flame intensity regardless of the switch position.)
 - When the Meter Select switch is in the OFF position, no signal is displayed.
 - When the Meter Select switch is set in the ALARM SETPOINT position, the adjustable Flame On threshold setpoint is displayed.
 - The green CHECK LED is illuminated for 1 out of every 10 seconds by the self-check circuitry.
 - The amber MARGINAL LED is on, indicating that the marginal flame setpoint has been exceeded, and K2 is energized.
 - The red FLAME ON LED is illuminated, indicating that the flame on threshold has been exceeded, and K3 is energized.
 - The amber FAULT LED is normally not illuminated. When this LED is on, it indicates improper response during self-test and that relay K1 is energized.

SPECIFICATIONS

R9005N CONTROLLER

GAIN SELECT (from external switch)—
No voltage applied selects Channel 1 gain setting. Line

voltage applied (see OPERATING VOLTAGE specifications) selects CHANNEL 2 gain setting.

DISABLE (from external switch)—
Line voltage (see OPERATING VOLTAGE specifications) applied disables the scanner.

OUTPUTS—
Relay contact ratings - Fault relay K1, Marginal relay K2 and Flame relay K3: (Form 3) 3 amperes at 30 vdc or 240 vac resistive; 1.5 amperes at 120 vac inductive, 1 ampere at 240 vac inductive.

FLAME METER OUTPUT—
0 to 10 vdc.

OPERATING VOLTAGE—
Two models: 120 vac, 50/60 Hz (+15 vac, -18 vac)
240 vac, 50/60 Hz (+30 vac, -36 vac).

POWER CONSUMPTION
12 watts typical.

TEMPERATURE RANGE—
Operating: -40°F to +167°F (-40°C to +75°C).
Storage: -40°F to +220°F (-40°C to +105°C).

HUMIDITY—
5 to 95% relative (non-condensing).

SHIPPING WEIGHT (Approximate)—
4.0 pounds (1.8 kilograms).

FLAME FAILURE AND MARGINAL FLAME RESPONSE TIME—
FM approved models - 3.5 seconds.
Selectable models - 3.5 or 6 seconds.

SELF-CHECK PERIOD—
10 seconds (9 seconds viewing, 1 second blocked).

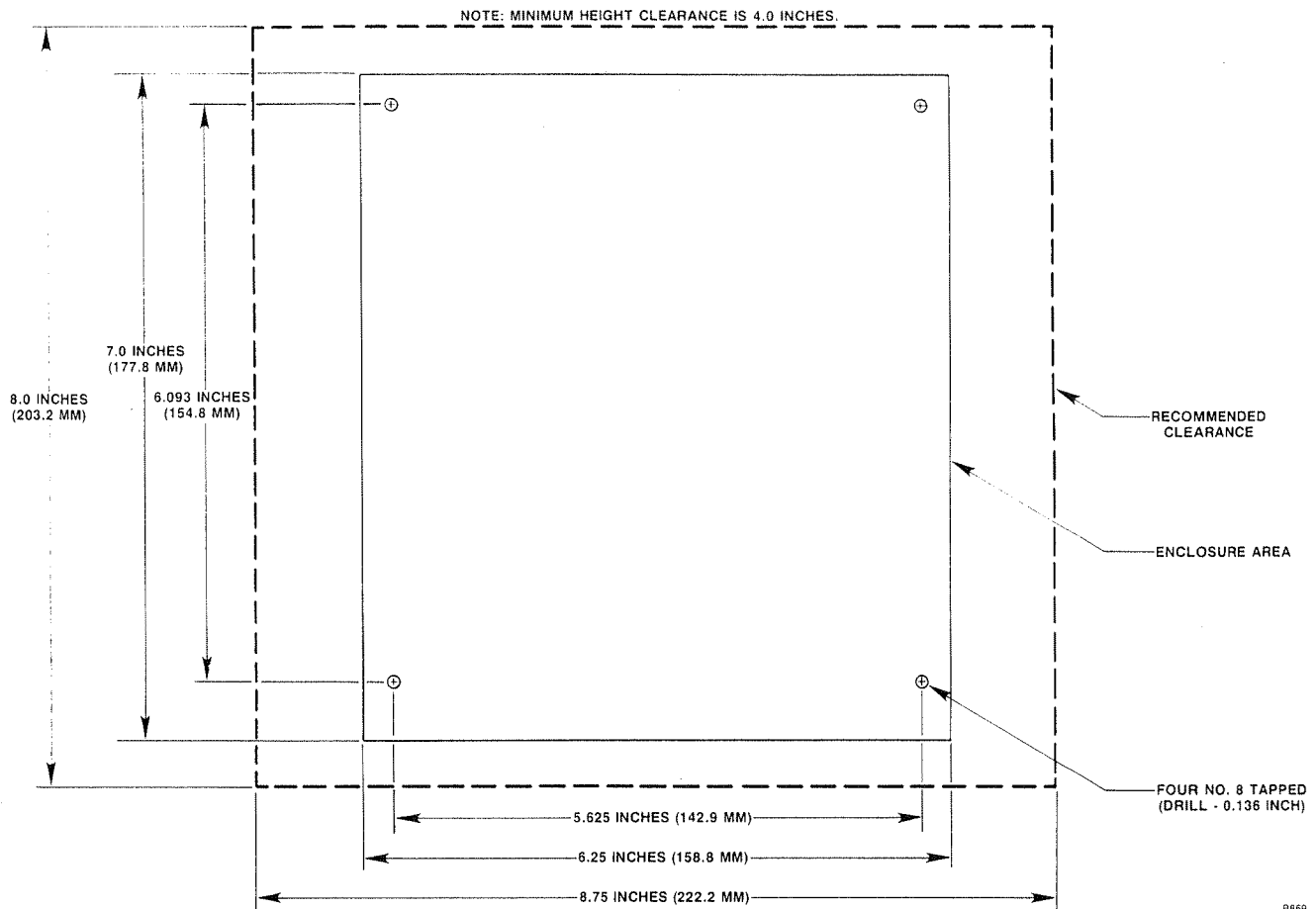
FLAME-ON THRESHOLD—
Adjustable, 2 to 6 volts relative meter reading.

MARGINAL-ON THRESHOLD—
2 volts greater than the Flame On threshold setting (4 to 8 volts relative meter reading).

FLAME RECOGNITION TIME—
FM approved models - 1 second.
Selectable models - 1 or 2 seconds.

DIMENSIONS—
See Figure 3.

MOUNTING—
Surface mount.



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Figure 3—R9005 Controller Mounting Dimensions

FLAME SCANNERS

ELECTRICAL—

Choice of a front mounting base or a fiber optic base. Eight foot standard (additional lengths available) non-shielded 18 Awg wires (five), insulation rated at 220°F (105°C), 600 vdc breakdown, oil-resistant, or a military connector.

MECHANICAL—

1 inch NPT to sight pipe, (1-1/4 inch NPT to sight pipe on fiber optic base), 3/4 inch NPT purge air, 1/2 inch NPSM tap for electrical fitting.

TEMPERATURE RANGE—

-4°F to +200°F (-20°C to +93°C) measured at mounting hub, housing ambient air not to exceed 160°F (71°C).

SHIPPING WEIGHT—

7 pounds (3.18 kilograms).

RESPONSE RANGE—

C9501N Ultraviolet Flame Scanner: 1850 to 2650 angstroms.

C9502N Infrared Flame Scanner: 5,000 to 10,000 angstroms.

C9503M Fiber Optic Scanner: 5,000 to 10,000 angstroms.

DIMENSIONS—

See Figure 4.

INSTALLATION

Controller Mounting

1. Select a vertical mounting surface that is relatively free of vibration and where operating temperatures will be within the specified tolerance (see "Specifications" section for temperature limits).
2. The actual width of the R9005N is 6-1/4 inches. However, because connectors P1 and P2 are located on either side of the controller, it is recommended that the minimum width allowed be 8-3/4 inches.
3. The R9005N consists of three parts: base, circuit board and cover. To remove the cover, turn the two front spring-loaded locking screws counterclockwise, then slide the cover off the base.
4. Refer to Figure 3 for the mounting dimensions of the base. Use a No. 8 screw with a lockwasher in each of the four holes to mount the base.

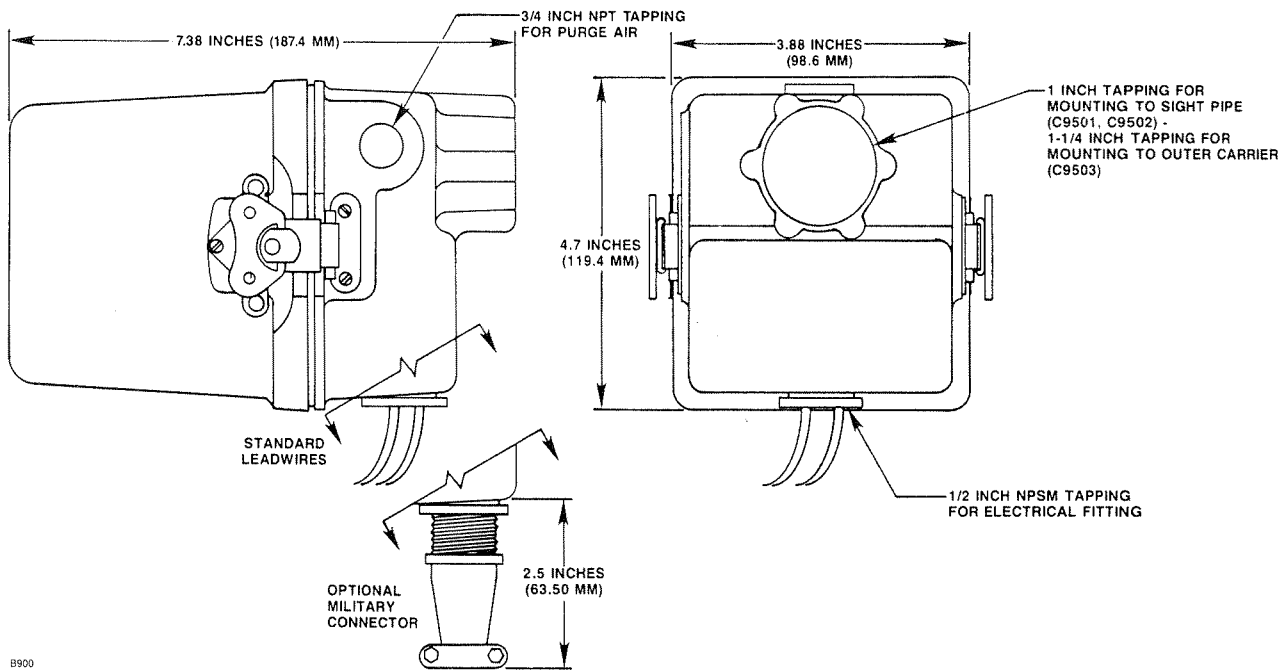


Figure 4—C9501/C9502 Dimensions

CONTROLLER WIRING

1. The electrical connections of the R9005N Controller are shown in Figure 5.
2. From the front of the controller, connector P1 is located on the left side and connector P2 is located on the right side of the cover.
3. Each terminal is designed for a maximum of one 12 Awg wire. Rather than connecting a greater number, make splices in a junction box. Do not make splices in conduit or fittings.
4. For any wiring runs on or near hot surfaces, use wire rated for 220°F (105°C) or higher.

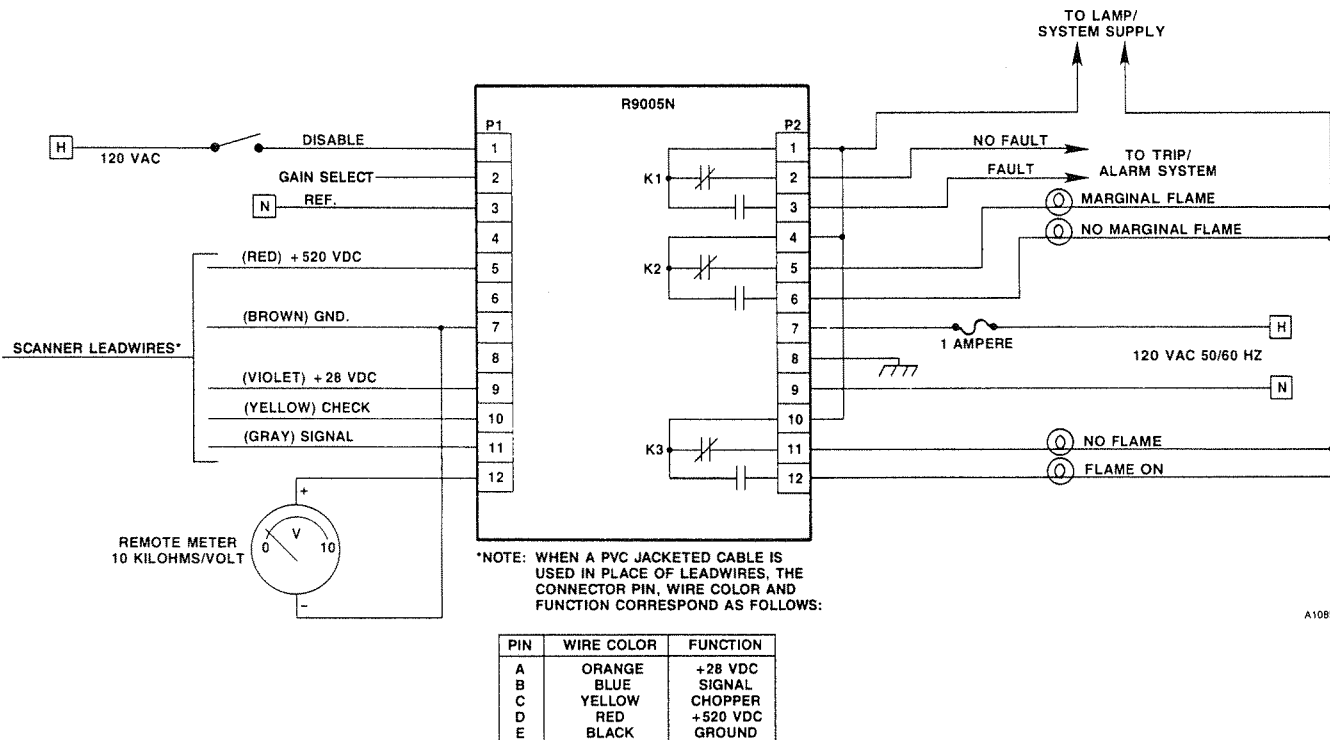


Figure 5—R9005N Electrical Connections

- Wire in accordance with the National Electrical Code and local code requirements.

Flame Scanner Mounting

Choose a sighting location where the scanner will have an unobstructed view of the flame under all firing conditions. Greatest ultraviolet radiation is produced near the base of the flame in the area immediately ahead of the burner. Greatest infrared radiation is produced in the later (cooler) stages of combustion, further out into the combustion chamber. A scanner monitoring a pilot flame and a main flame must be positioned so that it can sight both flames.

For further information refer to the applicable scanner operating manual (listed below).

- C9501N - Publication 65-8037
- C9502N - Publication 65-8025
- C9503M - Publication 65-8005

SIGHTING THE SCANNER

Prior to making adjustments, set both GAIN potentiometers inside the R9005N (see Figure 6) to maximum sensitivity (fully clockwise). Set the SETPOINT potentiometer to the lowest threshold setting (fully counter-clockwise).

With the burner that is to be monitored by the controller off and any other burners in the boiler operating normally, place the toggle switch on the faceplate of the R9005N in the FLAME METER position. Observe the meter reading for the background radiation indication. If the meter reading is greater than 3.5 volts, the background radiation that the scanner is sighting is too high. Using the Q2625 Swivel Assembly, reposition the scanner to decrease the amount of background radiation in its field of view.

SETPOINT ADJUSTMENT

Once the background radiation detected is below 3.5 volts, hold the faceplate toggle switch in the ALARM SETPOINT position and observe the meter reading. This is the Flame relay threshold setpoint. Adjust the SETPOINT potentiometer on the R9005 circuit board (see Figure 6) to obtain a reading that is 1 volt higher than the background radiation observed in the previous step.

GAIN ADJUSTMENT

The R9005N has one scanner input, however, this signal can be routed through one of two gain channels. Connector P1, pin 2 (see Figure 5) on the controller is used to select the gain channel. With no voltage applied, Gain 1 is selected. With line voltage applied to P1, pin 2, Gain 2 is selected. The two gain channels can be independently adjusted using the following procedure.

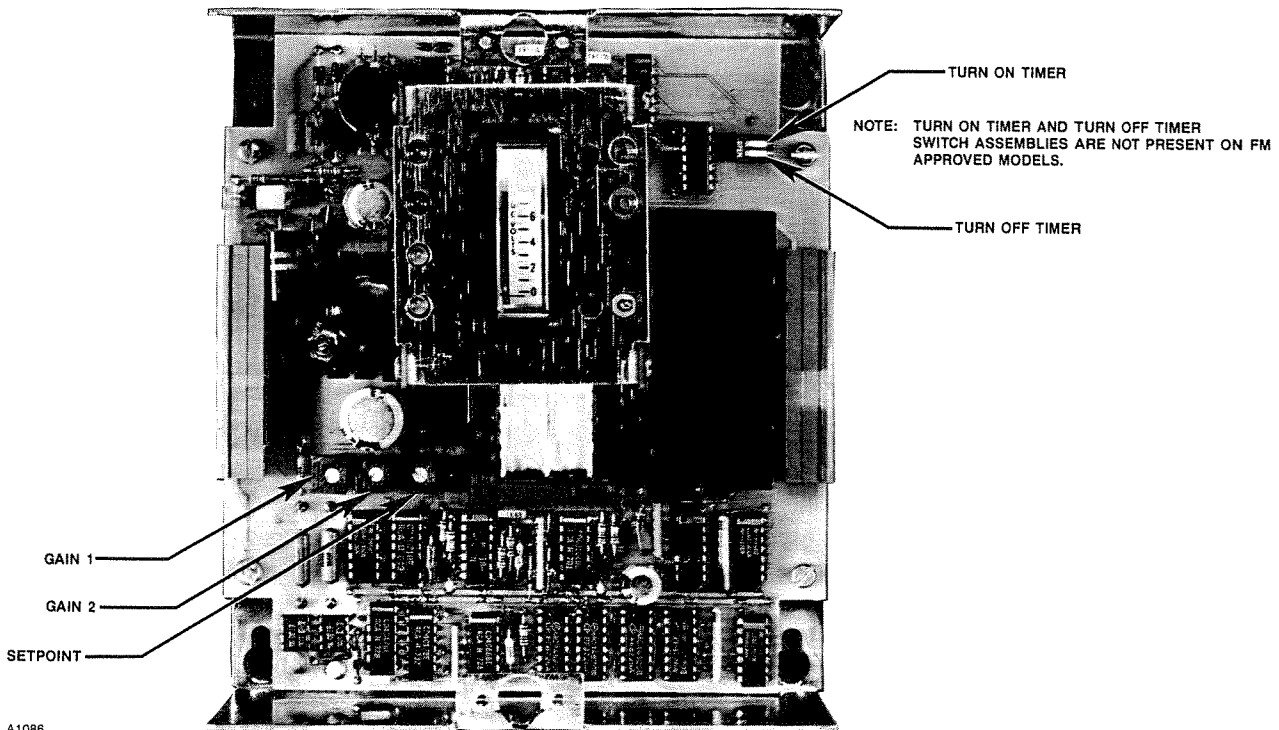


Figure 6—Circuit Board, R9005N Potentiometer Locations

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1. Ensure that the appropriate signal is applied to P1, pin 2 to select the desired Gain channel (see above).
2. Ignite the burner that is to be monitored through the selected Gain channel.
3. Place the toggle switch on the R9005N faceplate to the METER position.
4. Adjust the corresponding GAIN potentiometer to obtain a signal reading between 7 and 8 volts on the faceplate meter.
5. If the other gain channel is to be used, select it by applying the appropriate voltage to P1, pin 2 (see above).
6. Ignite the burner that is to be monitored through the selected Gain channel.
7. Place the toggle switch on the R9005N faceplate to the METER position.
8. Adjust the corresponding GAIN potentiometer to obtain a signal reading between 7 and 8 volts on the faceplate meter.

SELECTING FLAME RECOGNITION TIME

The MARGINAL and FLAME ON times are adjustable using the switches on the circuit board of the R9005N (see Figure 6). The turn on timer is common for both the marginal and flame on circuits and can be set for either 1 or 2 seconds. The turn off timer is also common for both circuits and can be set for either 3.5 or 6 seconds.

NOTE

On FM approved models, the MARGINAL and FLAME ON timers are not adjustable. The turn on timer is common for both the marginal and flame on circuits and is set for 1 second. The turn off timer is also common for both circuits and is set for 3.5 seconds.

DEVICE REPAIR AND RETURN

Prior to returning devices or components, contact the nearest local Detector Electronics office so that an RMI (Return Material Identification) number can be assigned. A written statement describing the malfunction must accompany the returned device or component to expedite finding the cause of the failure, thereby reducing the time and cost of the repair to the customer.

Return all equipment transportation prepaid to the Minneapolis location.

Office locations

Detector Electronics Corporation
6901 West 110th Street
Minneapolis, Minnesota 55438 USA
Telephone (612) 941-5665
Telex 6879043 DETEL UW
Cable Detronics
Facsimile (612) 829-8750

Detector Electronics Corporation
3000 Wilcrest
Suite 145
Houston, Texas 77042 USA
Telephone (713) 782-2172

Detector Electronics Corporation
Graviner Limited
Colnbrook
Slough
SL3 OHB
ENGLAND
Telephone 0753683245
Telex 848124 Gravin
Facsimile (0753) 685126

Detronics Scandinavia AB
Box 81
S-260 83 Vejbystrand
SWEDEN
Telephone 431-53002/53240
Telex 72008
Facsimile 431-52236

Detector Electronics Europe S.r.l.
Via Trivulzio n° 30
20146 Milan
ITALY
Telephone 02-4048641 or 02-4048642
Telex 312625

Detronics A/S
Haneborgveien 91
1472 Fjellhamar
NORWAY
Telephone 47-02973050
Telex 47-02971820

Detronics AB
Rochussenstraat 49A
3015 Ec Rotterdam
HOLLAND
Telephone 010-436-2777
Facsimile 010-436-0296

REPLACEMENT PARTS

DE601-104E	Front mounting base, 8 foot non-shielded 18 Awg wires (5) insulation rated at 220°F (105°C), 600 vdc breakdown, oil-resistant.
DE601-104D	Front mounting base, military connector.
DE601-112C	Fiber optic base, 8 foot non-shielded 18 Awg wires (5), insulation rated at 220°F (105°C), 600 vdc breakdown, oil-resistant.
DE601-112B	Fiber optic base, military connector.
DE601-006	Military Connector installation kit for DE601-104 and DE601-112C bases.
DE601-106	UV Scanner assembly (plug-in module, without base).
DE601-108A	IR Scanner Assembly (plug-in module, without base).
DE601-110	IR Fiber Optic Scanner Assembly (plug-in module, without base).
101363-002	Fuse

ORDERING INFORMATION

When ordering specify:

R9005N Controller
C9501N Ultraviolet Flame Scanner
C9502N Infrared Flame Scanner
C9503M Fiber Optic Infrared Flame Scanner

When ordering scanners, specify whether standard 8 foot leadwires, custom length leadwires or a military connector is required.

For assistance in ordering a system to fit your application, please contact:

Detector Electronics Corporation
6901 West 110th Street
Minneapolis, Minnesota 55438
Telephone (612) 941-5665
Telex 6879043 DETEL UW
Cable Detronics
Facsimile (612) 829-8750