



FIREYE® C9707A ALL FUEL SCANNER

DESCRIPTION

The C9707A All Fuel Scanner is used with the FIREYE R9107A Flame Controller to provide continuous monitoring of burner flames in industrial and utility boilers and furnaces. The Scanner views the burner flame through a one inch inside diameter straight sight pipe. The C9707A uses a UV sensor that responds to radiation in the range of 185 to 265 nanometers and an IR sensor that responds to radiation in the range of 500 to 1,000 nanometers, making it suitable for monitoring the flames of natural gas, no. 2 oil, no. 6 oil, pulverized coal and bark. The C9707A is a versatile flame scanner that is capable of sensing flames from a variety of burning fuels, eliminating the limitations of standard scanners that are more fuel specific.

The C9707A Flame Scanner consists of sensors, a quartz window, electronic circuitry for generating an output signal, and a self-checking feature for verifying that the scanner will respond to the absence of a flame.

The scanner chassis is mounted in a weatherproof cast aluminum enclosure made up of a base and a cover assembly. The base casting and cover casting fit together and are secured with spring-loaded, half-turn fasteners. The base casting has a 1 inch NPT (National Pipe Thread) tapping for mounting onto a threaded sight pipe. The base also includes a 3/4 inch NPT tapping for connection of a purge air line.

FEATURES

- The C9707A is capable of detecting flames from a majority of burning fuels used in today's boilers and furnaces.
- Scanner testing (self-checking) feature allows verification of scanner operation by periodically interrupting the incoming flame radiation.
- Automatic gain control compensates for varying firing rates to decrease the risk of unwanted actuation caused by radiation from adjacent burners.
- Plug-in electronics package can be removed and replaced in seconds without disturbing wiring.
- Low impedance signal transmission from scanner to controller provides maximum transient immunity.
- Gasketed weatherproof enclosure allows outdoor installation.
- For use with R9107A Controller, see bulletin 65-8046.
- For use with 25SU3-2100 Controller, see bulletin CU-34.
- FM approved.



OPERATION

Flame Detection and Signal Processing

The C9707A incorporates sensors that detect both ultraviolet (185 to 265 nanometers) and infrared (500 to 1000 nanometers) radiation, which is produced by burning gas, oil, coal, waste and other solid fuel flames. Switching between the UV and IR sensors is handled at the R9107A Controller.

The circuitry described below processes the detected signal in order to increase flame discrimination, minimize the effects of airborne matter blocking the scanner view and compensate for size, distance and variations of the flame.

IR Gain Adjustment

Hot refractory can emit significant levels of infrared (IR) radiation, making flame discrimination difficult. To counter this, when IR operation is selected, the C9707A sends a flame signal to the controller only when the radiation being detected is "flickering." Flicker is caused by the turbulent mixing of fuel with air during the combustion process. Different combustion processes have different flicker frequencies. A bandpass filter determines the range of frequencies to which the C9707A will respond. **This bandpass filter can be adjusted on the C9707A to match the flicker frequency of the fuel being burned using the IR Gain potentiometer.** A low gain setting selects a high flicker frequency, a high gain setting selects a low flicker frequency.

Automatic Gain Control

An automatic gain control (AGC) circuit, which is able to sense large variances in radiation intensity levels, is another important feature of the C9707A. This circuitry automatically compensates for varying firing rates and decreases the possibility of unwanted actuation of controller outputs caused by the flame of an adjacent burner. The AGC circuit decreases the amplifier gain of the scanner when the radiation intensity level increases, thereby maintaining a relatively constant flame signal. The AGC switch can be set "ON" or "OFF," depending on the application and the level of extraneous radiation. **The AGC switch is shipped in the "OFF" position.**

IR HI/LO Gain Switch

A HI/LO gain switch that represents fixed values is used for applications where IR radiation is emitted but the signal reaching the scanner is attenuated. For example, when coal is being burned, the coal dust can obscure some of the signal reaching the scanner so the HI/ LO switch would be set on "HI" to compensate. When oil is being burned, there is not as much attenuation of signal, so the HI/LO switch would be set for "LO" gain. **The IR gain switch is shipped in the "LOW" position.**

UV Gain Adjustment

The UV gain potentiometer is used to adjust ultraviolet (UV) radiation signals to levels that are usable for the controller to process. The amount of UV radiation reaching the scanner can vary greatly with the distance, sighting and size of the flame. As a result, the flame signal can also vary greatly. In order for the flame controller to properly process the UV flame signal, it must fall within certain parameters. The UV gain adjustment allows this, making the system as reliable with a small flame as with a large flame, regardless of distance and sighting.

SCANNER TESTING (SELF-CHECK)

Scanner testing is initiated by a test signal from the controller that causes a mechanical light blocking chopper in the scanner to block the flame radiation from reaching the sensors for one out of every 10 seconds. The system must respond to this absence of a flame signal or the controller will indicate a fault condition.

SPECIFICATIONS

ELECTRICAL: Power for the flame scanner is provided by the supervising flame controller. Cables with a military connector are available in standard lengths. See the “Accessories” section.

MECHANICAL: 1 inch NPT to sight pipe, 3/4 inch NPT purge.

OPERATING TEMPERATURE RANGE: -4°F to +160°F (-20°C to +71°C).

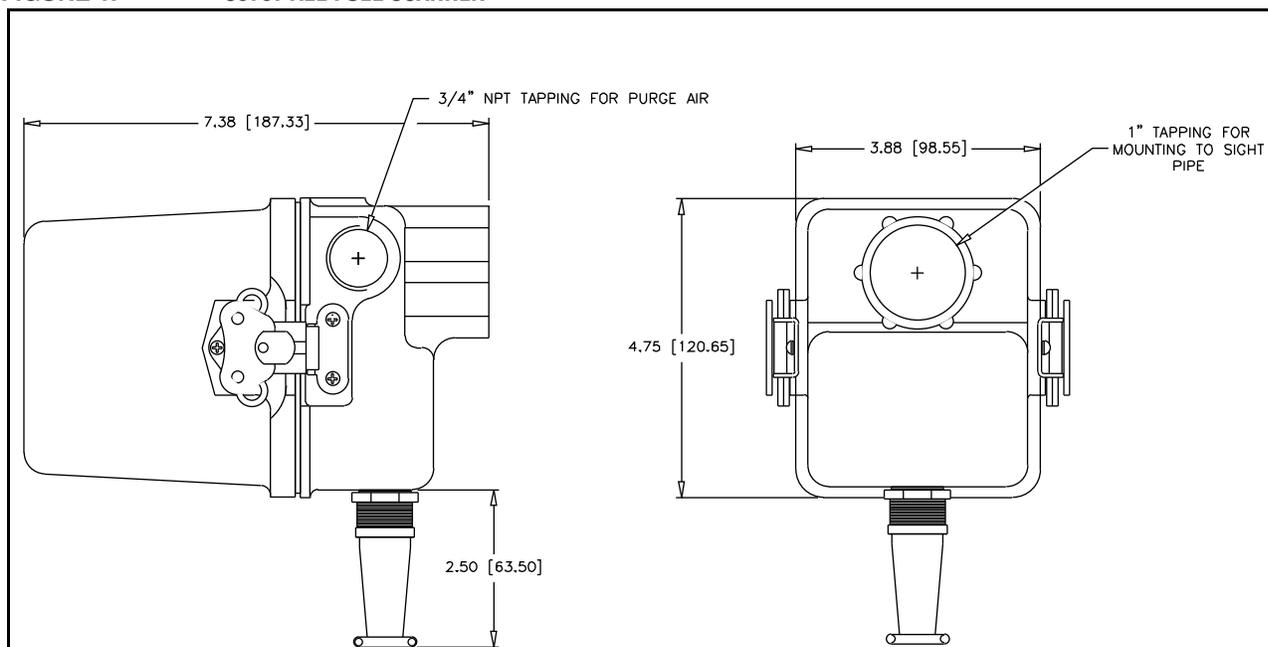
SHIPPING WEIGHT: 7 pounds (3.18 kilograms).

RESPONSE RANGE: UV: 185 to 265 nanometers. IR: 500 to 1000 nanometers.

DIMENSIONS: See Figure 1.

PURGE AIR RECOMMENDED: 600 standard cubic feet per hour at 13 inches water column over furnace pressure.

FIGURE 1. C9707 ALL FUEL SCANNER



INSTALLATION

Flame Scanner Mounting

1. 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.

A scanner monitoring a pilot flame and a main flame must be positioned so that it can sight both flames.

In multiple burner furnaces, choose a sighting angle with the best possible view of the flame of interest and the poorest view of other flames in the furnace. The sight pipe should be inclined slightly downward, so that unburned particles or condensed moisture will not fall or drain onto the scanner.

2. Prepare a hole in the burner front or windbox wall to clear the sight pipe at the angle of approach selected. Select a length of 1 inch standard pipe (with NPT thread on one end) no longer than is necessary to place the scanner housing in an unobstructed and accessible area. If a sight pipe longer than 12 to 18 inches is required, the sight pipe should be of larger diameter (2 inch pipe, for example) with the reduction to 1 inch occurring as close to the scanner as practical, so the field of view will not be reduced to a narrow angle.



3. Thread the scanner base assembly onto the sight pipe until tight, **making certain that, in the final position, the wiring connector points down.**
4. Tack weld the sight pipe to the boiler front plate at the selected location and angle of sight. Project the pipe through the hole in the firewall surface.
5. In many instances it will be convenient to use a swivel mount (model number 60-1664-3) that is threaded onto the sight pipe. This arrangement allows angular adjustment within a cone of approximately 20 degrees.
6. Terminate the assembly at a junction box and connect the cable lead wires to conductors extending to the flame control module. Table 1 identifies the scanner cable color codes and pin connections. The standard cable is an 18 gauge 5 conductor cable with a 5 pin connector at the scanner end. Fireeye also offers a kit to facilitate this connection.

The introduction of cooling and/or purging air is required. A positive flow of air down the sight pipe can eliminate the necessity for frequent window cleaning and prevent transmission losses caused by products of combustion in the sight path. The purge air source must be oil free and dry and it should provide 600 standard cubic feet per hour at 13 inches water column over furnace pressure. Unless the purge line includes a flexible connecting portion, it cannot be attached until the permanent scanner position has been determined.

TABLE 1—SCANNER CABLE COLOR CODES AND PIN CONNECTIONS

CONNECTOR PIN	FUNCTION	CURRENT CABLE COLOR CODE	EARLY CABLE COLOR CODE
A	+28 VDC	ORANGE	ORANGE
B	SIGNAL	BLUE	GREEN
C	SHUTTER	YELLOW	WHITE
D	IR/UV SELECT	RED	RED
E	GROUND	BLACK	BLACK

SIGHTING ADJUSTMENT

An inadequate signal can be the result of improper sighting, poor combustion or an improper scanner for the fuel being burned. If the sight pipe was only tack welded, as instructed, or if it is on a swivel mount, vary the angle to achieve the highest voltage signal reading.

If the scanner is used to monitor both pilot and main flames, adequate signal from each flame should be verified with the other flame off. If a good signal can be acquired from both flames only at two different sighting angles, either the sight pipe should be relocated to a more appropriate area or the use of two scanners should be considered.

In multiple burner furnaces where individual flame discrimination is required, it is possible that a strong signal will be received from an interfering flame as well as from the flame of interest. The best way to correct this condition is to restrict the size of the viewing orifice on the scanner so that the signal intensity from both flames is reduced. Assuming that the monitored flame, which has an optimized sighting angle, will provide a greater signal than an adjacent flame, a reduction of signal strength (by reducing the field of view using an orifice) will permit the differences in signal level from the two flames to be recognized.

IMPORTANT

The electric spark used to ignite a pilot flame is an emitter of ultraviolet and infrared radiation. To ensure that the sighting arrangement does not permit the detection of direct or reflected spark energy, a flame signal reading of no more than 1 volt should exist with fuel sources shut off and spark energized. Realign the scanner or optically shield the igniter, if necessary, to avoid spark detection. As an additional precaution, it is a common and recommended practice to de-energize the ignition transformer simultaneously with the energizing of main fuel valves.

IMPORTANT

A scanner should not respond to a pilot flame that is too small to reliably ignite the main burner. This can be checked by reducing the pilot flame size to the smallest that can be detected (sensitivity set to maximum) and then determining that such reduced flame will readily ignite the main burner.



WARNING: If ignition of main flame does not occur at once, or is slower than usual, shut off fuel immediately, readjust the scanner to sight further out and repeat the test.

If the pilot flame signal is relatively strong, the viewing orifice should be restricted to inhibit detection of a pilot flame. The sensitivity control should not be used to attenuate the signal in this instance unless some means is provided to guard against the setting being changed.

IMPORTANT

When satisfactory sighting has been achieved, the sight pipe should be permanently welded in place to maintain the selected position. If a swivel mount is used, tack weld it to prevent further movement.

With the sight pipe in a fixed position, a permanent purge air line connection can be made to the scanner base.

FINAL CALIBRATION

A voltage applied to the controller is used to select either the UV or the IR sensor. With Gain 1 selected at the controller (no voltage applied at terminal 15 of the R9107A Controller) the UV sensor is activated. With Gain 2 selected (line voltage applied at terminal 15 of the R9107A Controller) the IR sensor is activated.

The final adjustments should be made only after the scanner is properly sighted. The settings on the scanner before beginning the final adjustments should be: UV Gain set at 50 percent, IR Gain set at 50 percent, AGC switch turned "OFF" for oil burning or "ON" for coal burning, HI/LO Gain switch set on "LO" for oil burning or "HI" for coal burning. Proceed to the scanner adjustments below that correspond to the fuel being burned. If more than one type of fuel will be burned, perform adjustments for each with that fuel burning.

To adjust the C9707A, remove the rear cover of the scanner housing and locate the potentiometers and switches shown in Figures 2 and 3. Use a thin standard blade screwdriver to adjust the UV Gain and IR Gain potentiometers. Before proceeding, ignite the burner that is to be monitored. Place the R9107 controller faceplate toggle switch to the METER position.

UV GAIN (Gas and Light Oil Burning)

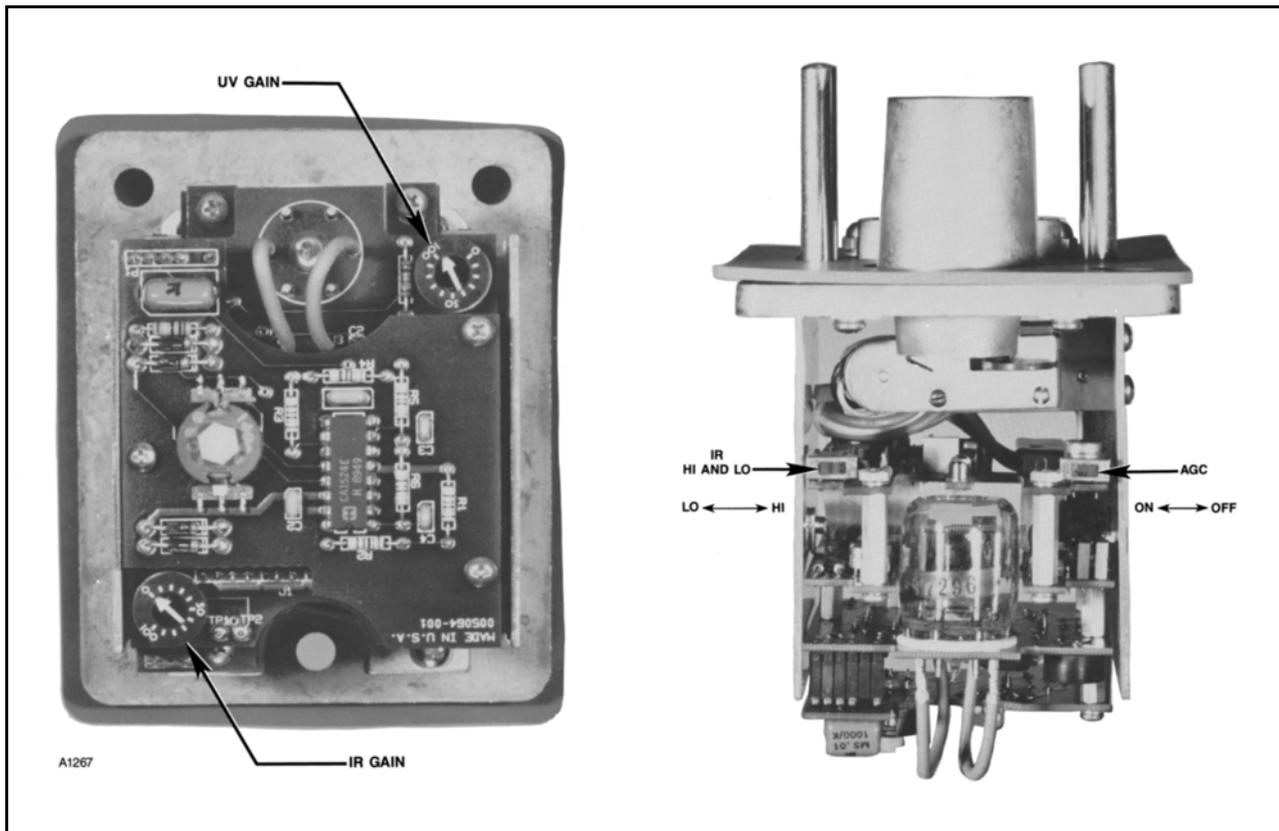
Ensure that the correct Gain 1 channel is selected at the controller. Set the controller Gain 1 potentiometer to maximum. Adjust the C9707A UV Gain potentiometer to get a reading over 10 vdc on the controller meter. Reduce the controller Gain setting until the controller meter reads between 7 and 8 vdc.

IR GAIN (Coal and Heavy Oil Burning)

Ensure that the Gain 2 channel is selected at the controller. Adjust the Gain 2 potentiometer on the controller faceplate for a meter reading of 7 to 8 volts. If the required signal readings cannot be obtained using the gain adjustment on the controller, the C9707A IR Gain potentiometer can also be adjusted to obtain the required readings. Adjust the potentiometer upward just until the faceplate meter indicates the highest signal (as close to 10 volts as possible). Do not over-adjust as this results in loss of discrimination. Stop turning the potentiometer as soon as the high point is reached. Return to the controller and set the Gain potentiometer there for a 7 to 8 volt signal reading.

HI/LO GAIN SWITCH (Coal and Heavy Oil Burning) For coal fires, set the switch to “HI.” For oil fires, set the switch to “LO.” **Scanners are shipped with the IR GAIN switch in the “LOW” position.**

AGC SWITCH (Coal Burning) The AGC circuit automatically raises or attenuates the scanner signal to compensate for variations in flame intensity. **Scanners are shipped with the AGC switched in the “OFF” position.** An especially hot, bright coal flame can cause the AGC to lower the flame signal below acceptable limits. In such cases, the AGC should be switched “OFF”.





ORDERING INFORMATION

When ordering specify:

PART NUMBER	DESCRIPTION
C9707A1012	All fuel scanner, standard model. Includes DE701-007A electronics assembly and DE 601-104G mounting base.
C9707A1023	All fuel scanner, conformally coated model. Includes DE701-007C electronics assembly and DE601-104G mounting base.

REPLACEMENT PARTS

PART NUMBER	DESCRIPTION
DE601-104G	Scanner front mounting base, military connector for C9707A1012 and C9707A1023 scanners.
DE701-007A	UV/IR Scanner Electronics Assembly (without base) for C9707A1012, standard model.
DE701-007C	UV/IR Scanner Electronics Assembly (without base) for C9707A1023, conformally coated model.
DE4606-001	Sight Restrictor Kit (Consists of three sight restricters and one retaining ring). See bulletin 65-8052 for more information.
101537-001	Retaining ring for sight restricter.

ACCESSORIES

PART NUMBER	DESCRIPTION
DE601-006	5 pin military connector kit with cable clamp. See bulletin 65-8027 for more information.
DE601-006B	5 pin military connector kit with flexible conduit adapter. See bulletin 65-8027 for more information.
500287-001	Scanner cable, 18AWG, 600V sold by the foot. Use with DE601-006, -006B connector kits.
60-1664-3	Swivel mounting assembly.

Prefabricated Scanner Cables

When ordering scanner cables, specify the part number and the length required.

PART NUMBER	DESCRIPTION
DE4360-XXX	Cable/Connector with cable-clamp assembly. Available lengths: 10, 20, 40, 60, 80 and 100 feet.
DE4599-XXX	Cable/Connector with flexible conduit adapter. Available lengths: 10, 20, 40, 60, 80, 100, 120, 140, 160, 180 and 200 feet.
000710-023	Test cable, 10 ft. (allows scanner electronics assembly to be removed from the DE601-104G base for testing).



NOTICE

When Fireeye products are combined with equipment manufactured by others and/or integrated into systems designed or manufactured by others, the Fireeye warranty, as stated in its General Terms and Conditions of Sale, pertains only to the Fireeye products and not to any other equipment or to the combined system or its overall performance.

WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps, electronic tubes and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireeye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireeye be liable for consequential or special damages of any nature that may arise in connection with such product or part.



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