

# IRIS



## FLAME MONITORING SYSTEM MODELS S550B, S552B and S556B VIEWING HEADS OPERATION AND APPLICATION MANUAL



**WORLD LEADER IN FLAME MONITORING**

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**INTRODUCTION**

For the sake of simplicity, only the operation of the S550B viewing head in combination with the P522 signal processor will be described in detail. The S552B and the S556B will be discussed separately in their respective sections.

The S550B, S552B and S556B can be used with IRIS Models P531, P532 and later versions of the Model P520 and P522 signal processors. Refer to the respective processor manual for connection and operation not described in this manual.

**DIFFERENCES BETWEEN THE S550B AND S550**

The Model S550B is basically the same in operation as the earlier S550, except that a two line numeric readout replaces the two color LED for displaying and monitoring the UV and IR count rates. The displayed value is the pulse rate divided by 100.

The S550B provides an additional analog output that can be measured as a current to ground. This can be achieved by placing a 1000 ohm resistor in series with the shield and the SGND terminal on the processor, and monitoring the voltage across the resistor.

If the internal temperature of these viewing heads exceed 70° C, the temperature will be displayed once every four seconds.

If the digits “99” are displayed, this indicates that the IR sensor is saturating. Either reduce the IR “analog” gain or install an orifice disc. (The IR analog gain is the first digit of the IR gain).

*The IR gain should be set so that the displayed count is well below the saturation point (34 at the viewing head, or 3400 at the signal processor) at maximum firing rate. The signal processor and the viewing head are designed to “Fail Safe” (Show “No Flame”) in case of saturation. This may also cause the pulse counter to start from zero, causing the flame relay to de-energize.*

*In some applications, an orifice disk may be required to discriminate between background radiation and main flame. See **ORIFICING** on page 9.*

**SIGNAL PROCESSOR COMPATIBILITY**

Viewing heads described in this manual are compatible with currently manufactured P520, P522 DC and

P522 AC signal processors. Some earlier manufactured P522 units may require an upgrade. All P531 and P532 signal processors are fully compatible with these viewing heads.

Note: Source impedance resistors, 470 Ohm 1/4 Watt must be installed between SC and SGND for all cable runs between 300 and 700 ft. from the signal processor to the viewing head.

**MODEL S550B GENERAL DESCRIPTION**

The IRIS Model S550B is a dual channel, state-of-the-art flame monitoring viewing head capable of monitoring both the UV (ultraviolet) and IR (Infra-red) components of a flame. This is accomplished by utilizing two types of detectors, an IR solid state sensor and a UV Photo detector, together with a unique dichroic beam-splitting mirror.

The S550B produces output pulse rates proportional to the flame signal strength; the pulse rates are displayed at the front panel of the signal processor, and at the rear of the viewing head. The S550B uses a two line digital readout which displays the pulse rate divided by 100. The upper readout displays the UV count in green digits, and the lower readout displays the IR count in red. This information can readily be used to achieve maximum flame signal strength while aiming and sighting the viewing head.

Certain parameters in the S550B, S552B and S556B viewing heads can be selected or adjusted remotely from the front panel of the signal processor. These parameters are:

- a) UV gain                      0-99
  
- b) Filter Selection            1:     16Hz  
     2:     24Hz  
     3:     33Hz  
     4:     52Hz  
     5:     75Hz  
     6:     100Hz  
     7:     155Hz  
     8:     215Hz
  
- c) IR gain                        0-699

Once adjusted, the new parameters are stored in an EEPROM in the signal processor. If power is removed from the signal processor, which powers the

viewing head, and then reapplied, the signal processor automatically re-sends the stored parameters to the viewing head. In addition, at the front panel of the signal processor the operator may also select "CAL", a semi-automatic mode which will help to speed up the setup. This is explained in detail in the section **CALIBRATING THE S550B**, and further illustrated in **FIGURE 8: S550B PROGRAMMING FLOWCHART**.

The S550B can be described as a dual-sensor viewing head where the gain and filter selections are adjusted and stored remotely by the signal processors to which it is connected.

**MODEL S552B GENERAL DESCRIPTION**

The S552B viewing head is designed for IR sensing only. It is basically an S550B without the UV capability, and a single line display. The IR pulse rate is displayed in Red. The Signal Processor detects and identifies the viewing head model to which it is connected, and will only allow adjustments related to that model to be performed. In the Model S552B, these adjustments are:

- a) Filter Selection      1-8
- b) IR gain                0-699

In addition, features such as CAL are limited to the features of the attached viewing head, in this case the S552B. These features are further illustrated in **FIGURE 9: S552B PROGRAMMING FLOWCHART**

**MODEL S556B GENERAL DESCRIPTION**

The S556B viewing head is designed for UV sensing only. It is basically an S550B without the IR capability. The Signal Processor detects and identifies the viewing head model to which it is connected, in this case the model S556B, and will only allow adjustments related to that model to be performed. In the Model S556B, this adjustment is:

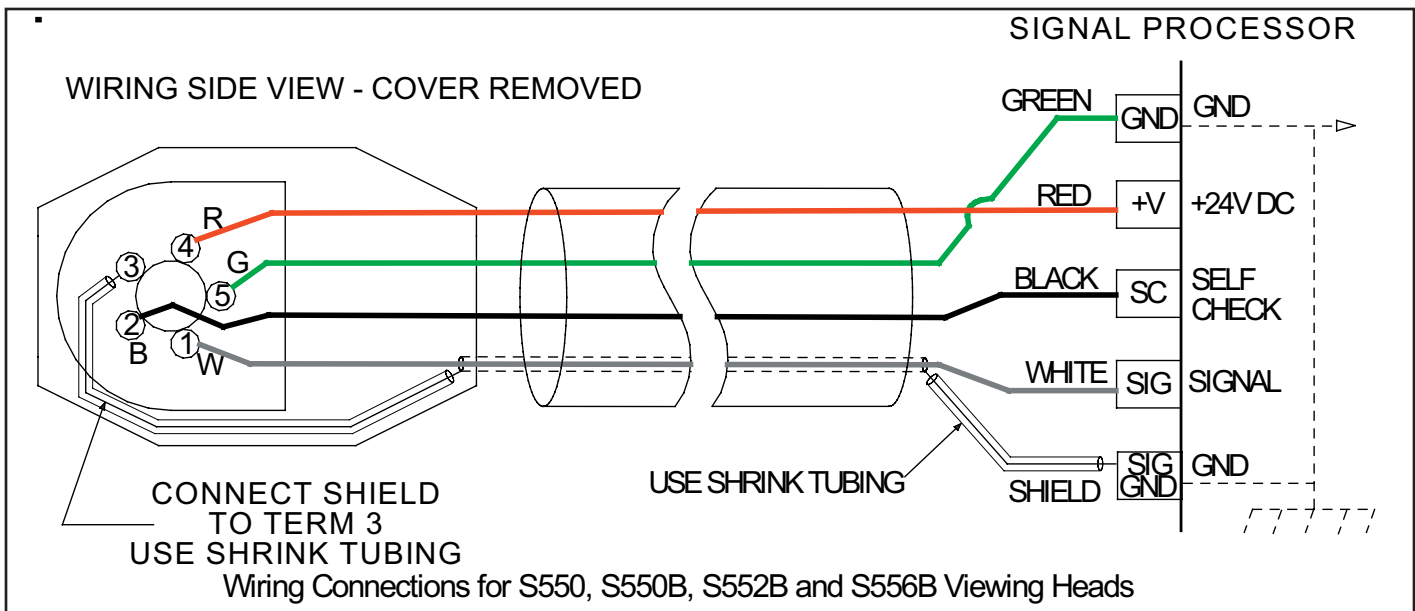
- a) UV gain 0-99

In addition, features such as CAL are limited to the features of the attached viewing head, in this case the S556B. These features are further illustrated in the S556B PROGRAMMING FLOWCHART, shown in Figure 10 on page 19.

**VIEWING HEAD WIRING**

Viewing heads are wired to the appropriate terminals located on the bottom of the P522, P531 and P532 signal processors, and on the terminals located on the rear PC Board of the P520. These terminals are listed functionally in the table below.

TERMINAL	DESCRIPTION
GND	Power Ground
+V	+24VDC Power to Viewing Head
SC	Shutter Drive Signal to Viewing Head
SIG	Flame Signal from Viewing Head
SIG GND	Signal Ground



**FIGURE 1: WIRING TERMINATION DIAGRAM**

The diagram in Figure 1 shows the wiring of the viewing head connector to the signal processor using the recommended IRIS type C328 cable. This cable has a UL ITC rating and can be used in the US in hazardous locations. Note that the flame signal wire is shielded, and that the shield is terminated at both ends.

The shield is used as the signal ground wire which goes to terminal SIG GND on the signal processor, and to pin 3 on the viewing head plug. The shield must be a braided type for this application in order to maintain an electrical path. For this reason, a foil type shield should not be used. This signal ground shield is also the self-checking or shutter drive circuit return path. It is recommended that the IRIS C328 cable be used for all applications.

Connection of the IRIS type C328 cable to the viewing head plug is shown on the following page in **FIGURE 2, CONNECTOR WIRING**, and should be done as follows:

Remove the cable entry nut from the plug housing. Remove the rubber grommet and flat sealing washer. With a pair of long-nosed pliers remove the center ring only of the rubber grommet.

1. Strip 2 inches of the cable outer cover from the cable removing any cellophane wrap or filler material. Strip the insulation from the shielded wire (if insulated over shield) a full 2 inches to expose the shield.
2. Slide the shield back until a bulge develops close to where the wire exits the cable outer covering.
3. Carefully spread a few strands of the shield at the bulge (making sure not to break any strands) to create an opening and pull the wire out of shield through opening.
4. Carefully return shield to original shape and length by pulling gently, then cover the shield with heat shrink tubing to insulate it.
5. Slide the nut (with threads toward the cable end), the washer and the grommet approximately six inches onto the cable.
6. Slip the cable through the bottom opening of the connector making sure that the cable outer jacket is secure under the cable clamp and tighten the two screws on the cable clamp.

7. Reassemble the grommet, flat washer, and cable entry nut and tighten.
8. Strip each wire 3/8" as shown in the assembly drawing figure 2 on the following page.
9. Proceed to wire the connector as follows: (Refer to the wiring diagram figure 1 for terminal locations.)

Connect the viewing head signal wire (the shielded wire) WHT to terminal No. 1 by inserting into opening and then tightening the retaining screw.

Connect the self-checking signal wire BLK to terminal No. 2.

Connect the signal ground shield from WHT wire with shrink tubing to terminal No. 3.

Connect the + 24VDC power wire RED to terminal No. 4.

Connect the power ground wire GRN to terminal No. 5.

Assemble the back of the plug and insert the jackscrew through plug assembly.

The cable at the signal processor end should be prepared in a similar way to the plug end, particularly the shield from the WHT wire. Follow the wiring connections as shown in the wiring diagram figure 1, making sure that the shield does not touch the other adjacent terminals.

## VIEWING HEAD INSTALLATION

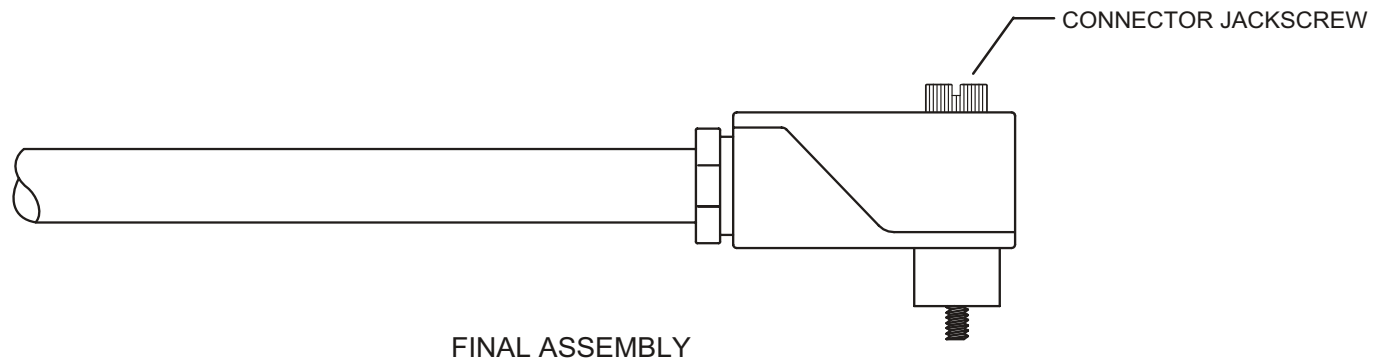
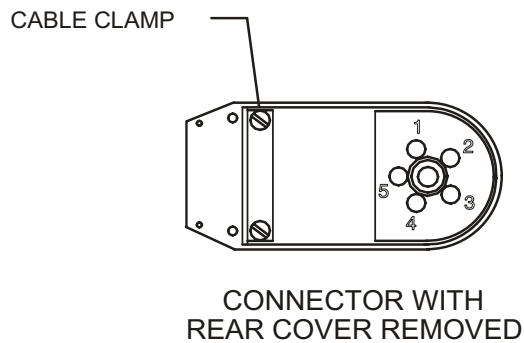
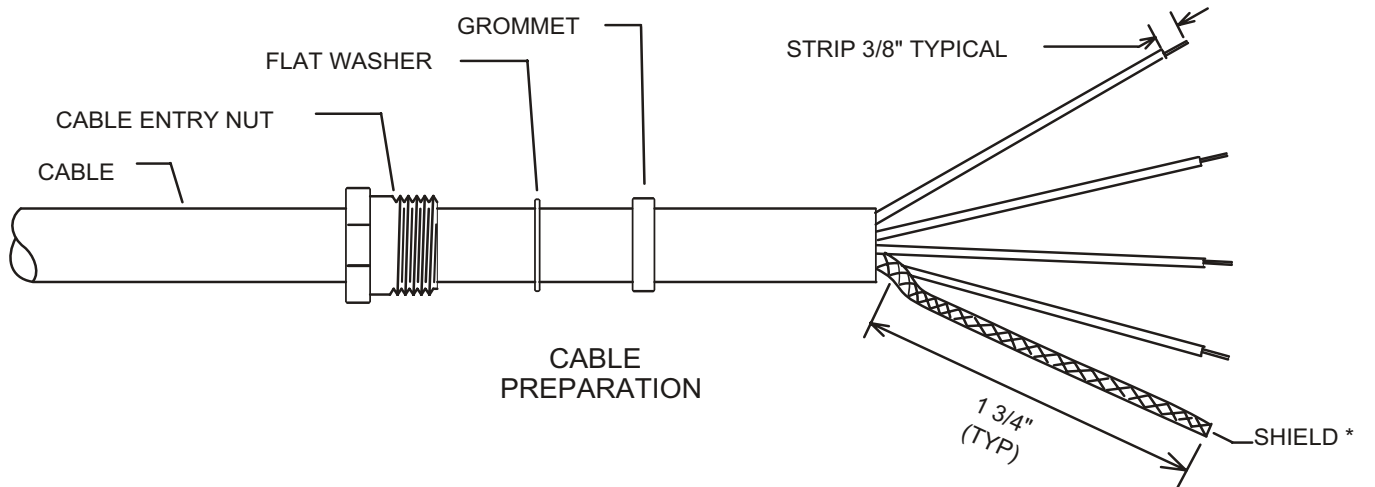
Before beginning the actual installation, determine the best location for mounting the viewing head based upon the following factors:

**PRESSURE:** The viewing head lens will withstand 5 psi. If the lens assembly is exposed to greater than 5 psi through the sight pipe, then an isolation unit must be used. An IRIS isolation unit with purge air entrance model ISO/ Unit is available as an accessory.

**TEMPERATURE:** The viewing head will withstand an ambient temperature to 80° C (176° F). However, **the case temperature of the housing must not exceed 60° C (140° F).**

**IRIS C328 CABLE**

3 CONDUCTORS PLUS 1 COAX  
 3 CONDUCTORS: 16 AWG 19 STRAND INSULATED WITH  
 CROSSED-LINKED-POLYETHYLENE .017 THK  
 COLORS: BLACK-RED-GREEN  
 1 COAX: 16 AWG 19 STRAND INSULATED WITH  
 CROSSED-LINKED-POLYETHYLENE .017 THK  
 COLOR WHITE  
 36 AWG BRAIDED SHIELD 90% COVERAGE  
 WITH .012 THK JACKET COLOR BLACK  
 CABLED: POLYPROPYLENE FILLERS FOR ROUNDNESS  
 JACKET: CROSSED-LINKED-POLYETHYLENE



\* CABLE IS SHOWN WITH SHIELD  
 ALREADY REMOVED FROM WHITE WIRE

**FIGURE 2: CONNECTOR WIRING**

Purge air will help reduce conducted heat through the sight pipe and flange. A heat insulating ultem nipple (IRIS part R-508-12) will reduce this conducted heat, but direct radiation can cause housing case temperature to exceed limits. If the ambient heat (direct radiation) is excessive, then a fiber optic extension should be considered. This uses a fiber optic cable between the sight pipe and the viewing head, allowing the viewing head to be placed further away from the heat source. Refer to the Fiber Optic Manual, or the IRIS web site for more information.

The model S550 and S55XB series of viewing heads have in place a sensor for sensing the internal temperature of the head. To access the reading of the viewing head temperature, press the “Reset” and the “Down” arrow key at the same time. The temperature reading will be displayed in the four-digit readout. The reading (indicated in °C) will disappear and the normal reading will continue after several seconds.

**VIBRATION:** Do not install the viewing head where it could be subject to vibration. A vibrating IR sensing viewing head can simulate flame when viewing a glowing background. Provide an anti-vibration mount if excessive vibrations are present.

**CLEARANCE:** Make sure there will be sufficient room to remove the viewing head housing for servicing.

**SIGHT PIPE**

A minimum two inch diameter black iron pipe together with a swivel mount is recommended for use with all IRIS viewing heads. IRIS manufactures a range of swivel mounts, both pipe thread or flange mounting. See the IRIS ACCESSORY CATALOG on the User Manuals CD, or view it on the IRIS web site.

**PURGE AIR**

Use a flexible air supply line, to allow for repositioning of the viewing head and sight pipe until a final and permanent position has been decided. A continuous flow of air must be maintained in order to keep the

viewing cool and the sight pipe clean. At least three CFM at approximately eight inches of water column above windbox pressure is recommended for each viewing head. The air supply must be clean, free of oils and water, and preferably cool.

**VIEWING HEAD SIGHTING**

The sighting of the viewing head should be parallel to the center line of the burner in the direction of the flame. The sight pipe should be mounted as close to the center line as possible, the idea is to sight along the flame rather than across the flame. This will help prevent drop outs of the flame under changing load conditions. See figures 4 and 5 on page 15

Utilizing a sighting or the sight pipe aimed at the root of the flame (where the turbulent combustion air mixes with the flame) is a good starting point for optimizing the sighting. Using a swivel mount to “zero-in” on the highest signal will assure maximum performance. A typical viewing head installation using a swivel mount is shown in figure 7 on page 16.

The sight pipe diameter should be large enough to allow a reasonable field of view, and to allow for adjustment of the swivel mount angle. The S550B has two angles of view, one for the IR detector, which is 1.0° and one for the UV detector which is about 3.0°; this translates into a circle of view that varies with the viewing distance as shown in the following table.

Distance	Distance	Diameter of IR View	Diameter of UV View
ft	inches	inches	inches
2	24	.64	1.3
3	36	.73	1.9
6	72	1.45	3.8
12	144	2.9	7.6
18	216	4.35	11.4

Detecting flame in a sulfur recovery unit can present a challenge for flicker type flame monitors. The IR detector will detect natural gas used for the warm-up of the reactor. Usually the combustion air is turbulent enough to cause a good flicker signal.

When the sour gas is introduced and the natural gas is shut down, the flame signal may drop off or drop out entirely. The reason for this is that there is a complete change in the flicker content for the existing viewing

head sighting. If this is the case, then optimizing the flame signal for the sour gas by “zeroing-in” on this flame, and not the warm-up burner is recommended

Once optimizing the sighting for the sour gas has been completed, it may be found that the signal level is too low on the natural gas. In this case, using the UV detector for this application may be required. It may be necessary to use two sets of set points for flame ON and flame OFF, one set for proving and detecting the natural gas flame and the other for proving and detecting the sour gas flame. The switch-over from Channel A to Channel B should be done when removing the natural gas burner. This can be implemented from the burner control system. This switch-over and the use of Channels A and B with their independent settings is explained in the section “ASSIGNING SETTINGS TO CHANNELS A AND B” on page 9.

### IR DETECTOR

The IR detector responds to flicker content in the flame. Flame flicker is caused by the combustion, or forced air injected into the flame. This combustion air can be mixed with the fuel (pulverized coal) or can be introduced separately. In either case, forced air at high velocity is introduced in such a way as to aid the combustion process. This air is usually made turbulent by causing it to swirl with spin vanes located in the burner barrel.

Flame flicker is created when this turbulent air mixes with the flame. It is composed of random frequencies from zero Hz to over 2,000 Hz. The amount of high frequency flicker (above 200 Hz) is dependent on the fuel and burner. The amplitude of the flicker frequencies always follows an exponential curve with zero frequency having the highest amplitude and the higher frequencies the lowest. The amplitude level of the higher frequencies is usually 40dB down (factor of 100) from zero Hz or DC.

The S550B and S552B viewing heads respond to flicker frequencies 16 Hz and above. The lower frequencies are ignored so it is important to sight the viewing head on the highly turbulent portion of the flame that contains these higher frequencies. The location of these higher frequencies can be predicted by examining the burner with regard to where the flame envelope begins and where the turbulent air enters this flame. This spot can be chosen by examining the drawings of the

burner but it is better to do this empirically by using a swivel mount on the viewing head.

### UV DETECTOR

The UV Photo Detector in the S550B and S556B viewing heads have a spectral response of 190-215nm. The output of the detector is a pulse stream of randomly spaced pulses whose average rate is proportional to the UV radiation present in the flame.

The very narrow spectral response of this type of detector makes it ideal for discriminating between flame and glowing refractory and other burners. However, because the detector responds to only the very short wavelengths, this radiation is easily absorbed and masked, for example with pulverized coal, by unburned fuel or other impurities in the fuel. Sour gas (H<sub>2</sub>S) will readily absorb these short 200nm wavelengths as well as other waste fuels resulting in a dropout of the flame signal. Even standard glass will absorb this wavelength, hence, the necessity of using a quartz lens with these viewing heads.

In general, these viewing heads will work well on natural gas flames. They will respond to oil flames but with a lower signal level. The sighting for both oil and gas flames should be parallel to the axis of the burner and aimed at the root of the flame, as with the IR detector. (See previous section “IR DETECTOR”.) Photographs of gas and oil flames using visual and UV-sensitive film clearly shows that the UV zone is much smaller than the visible zone, and the highest UV intensity occurs near the flame root. In addition, the zone of higher UV intensity does not overlap the same zones of adjacent or opposing burners so that, with proper sighting, discrimination is predictable.

As a general rule, the sighting of the S556B and the S550B when using the UV detector, will more likely be a “line-of-sight” than the IR flicker detector which will read flame signals bouncing off the side of the sight pipe and other “reflectors”. Sometimes the reading with the IR detectors can be greater with a reflected signal than the direct line of sight. The UV detector, on the other hand, will have to be aimed at the part of flame that has the highest concentration of UV, which usually is at the root of the flame (at the throat of the burner) and in a very narrow region. The angle of view of the S550B UV sensor is somewhat wider than the S550B IR sensor, but this does not offset the fact that

the UV radiation present is from a very small region.

This small region emitting UV is not the case however, for low NO<sub>x</sub> gas burners. The UV radiation is usually much less in intensity and spread out with this type of burner, and relatively high readings can be obtained from all over the furnace when many burners are on. This is particularly true when flue gas recirculation is used. There will however, be a relatively stronger signal near the “root” of the flame and this more intense spot should be located during the aiming or sighting process. This “root” or intense spot may be further out than with the standard gas burner so it is imperative that a swivel mount be used when making these sighting adjustments.

Another factor that needs to be considered when aiming the viewing head, is the load condition of the boiler. The flames from a burner can be radically different at different loads. This is one of the reasons for trying to choose a sighting initially that will minimize this changing flame at different loads. If the flame extends further out at higher loads then the parallel to the burner axis sighting will be the most effective. The use of a large diameter sight pipe with a swivel mount is recommended for all installations on large multi burner boilers.

**ORIFICING**

In some applications, the extreme brightness of the burner flames can cause the sensors in the viewing head to saturate. Under these conditions, orificing of the viewing head sight path will greatly improve the performance, particularly with regard to discrimination between flames. Saturation is more probable with large power utility boilers where the burners are very large and relatively close to one another. If the flame is bright enough to cause the eye to hurt when looking at the flame, then orificing should be used. This eye test applies to incandescent type flames such as oil and coal but will not be valid for natural gas flames.

Orificing may help improve the discrimination characteristics for the UV detector as well as the IR. The UV detector is not likely to saturate; however, orificing will usually improve the discrimination ratio for large size burners.

An orifice disc is simply a metal disc with a circular hole in the center which is placed directly in front of

the lens. Four orifice discs are available with center hole diameters of 3/8, 1/4, 3/16 and 1/8 inch. These discs are installed with retaining rings in the flange at the edge of the 1/2 inch NPT female pipe thread for the purge air. An internal type retaining ring is first installed by positioning a ring in the machined groove inside flange opening from the housing side. The orifice disc is then inserted. Use a second retaining ring to hold it in place so that it is sandwiched tightly between the two retaining rings.

Usually an orifice disc with a larger diameter hole is tried first. There will be a reduction in the signal level so if the associated viewing head and signal processor has been previously calibrated, it will be necessary to calibrate the processor again so that the gain settings will be correct. If the discrimination is still not satisfactory then an orifice disc with a smaller diameter hole should be tried.

Generally speaking, orificing should always be considered when the burner(s) are large (50K lbs of steam and up), particularly when the IR detector is used which would be the case for oil or pulverized coal.

The following table shows the signal reducing characteristics of the different orifice disks.

Aperture Hole	Fn (f Stop)	Relative light passing power
1"	2	1
3/8"	5.3	1/8
1/4"	8	1/16
3/16"	10.7	1/32
1/8"	16	1/64

**DEFAULT SETTINGS FOR THE S550B**

A new signal processor will set the attached viewing head default values as follow:

UV Gain = 32 (out of 0-99 range)

Filter = Filter 3 (high pass above 33Hz)

IR Gain = 451 (out of 0- 699 range)

These are nominal settings that should allow for initial sightings and adjustments. Both UV and IR sensors are active in the default mode. If the settings for the viewing head has been changed from the default values, they can be reset to the factory default from

the P520 / P522 control panel. (See “RETURN TO DEFAULT SETTINGS” on Page 13.)

### **STORED VIEWING HEAD SETTINGS**

Viewing Head settings are stored in an EEPROM in the particular signal processor to which it is attached. In the event of a power down or power loss, these settings will be restored upon power up. If an S550B viewing head is replaced with another, the stored settings will be applied to the replacement. This simplifies field replacements since these viewing heads are made to close tolerances, and will work virtually the same as the viewing head it replaced.

### **ASSIGNING SETTINGS TO CHANNELS A AND B**

The P520 and P522 signal processors, when used with an S550B viewing head, allows assigning one group of settings to Channel A and another group to Channel B.

If the CHAN SEL input to the P520 or P522 is open or de-energized, then the Channel A lighted push-button on the front panel will be ON. If a voltage of 7.5V to 30V is applied across the two CHAN SEL inputs, then Channel B will be selected and the Channel B lighted push button will be ON.

When Channel A is selected, any P520 or P522 parameters changed (this includes Flame ON and Flame OFF set points and the analog gain of the P520/P522 as well as the gain and filter selection for the S550B) will be stored for use when Channel A is selected. Similarly, when Channel B is selected any P520 or P522 changes are stored for use when Channel B is selected. When the CHAN SEL input is changed, the P520/P522 changes the set points in use accordingly and sends the appropriate gain and filter selections to the S550B viewing head.

In the P520 and P522, it is possible to observe and change settings for the channel which is not selected, by pressing the other channel push button - it will blink indicating that the selection is temporary - and then proceed as if the CHAN SEL input had changed.

This method is available for examining or changing Flame ON and Flame OFF set points and other settings in the P520 and P522. The same procedure applies to manually changing viewing head settings when the desired channel is not selected: press the push-button for the desired channel and

then proceed.

During the process of examining or changing the S550B settings, with the Channel A and B (NO and YES) push buttons, the red LED for the channel which the changes apply to, will be blinking.

A visual check should be made to see which channel push-button is lighted when the S550B settings are being reviewed or changed. It is possible to unintentionally get into the S550B CAL modes with the wrong channel selected.

### **USING TWO VIEWING HEADS ON THE P520/P522**

The P520 and P522 signal processors are capable of supporting two viewing heads by using the V.H. A and V.H. B inputs. To achieve this, a 24VDC channel select signal must be applied simultaneously to the coil of the VH select relay and to the channel select input. When the channel selection is changed, the alternate set of data inputs from viewing head B will be switched into the signal processor by the VH select relay and the processor will apply a different group of set points and gains in response to the A/B Channel switch.

There are no restrictions on how viewing heads may be mixed between the two channels. An S550B can be used on one channel and an S511 on another, or an S552B on one channel and an S556B on another. It should be noted however, that only one viewing head can be active at any given time.

The earlier 500 series viewing heads - Models S506, S511 and S512 - are not adjustable remotely as the S550B family of viewing heads are. The P520 or P522 signal processors will continue to work as they have in the past with an earlier S5XX series viewing head when the channel with that viewing head is selected.

### **BEFORE MAKING ADJUSTMENTS**

Before making any adjustments to the S550B, the flame signal strength should be optimized by aiming the viewing head at the most intense part of the flame as explained in the two previous sections “IR DETECTOR” and “UV DETECTOR”. This operation should be done with the default setting

### **CALIBRATING THE S550B**

The calibrate feature is designed to aid with the setup of the viewing head. It is basically an automatic gain

adjustment for the selected sensor; the gain for the sensor not selected is set to zero. The CAL feature narrows the displayed count to about 1200, and automatically sets the Flame ON set point to 800 and the Flame OFF set point to 600. The filter selection remains unchanged.

### Calibration Procedure:

- 1) Perform a preliminary sighting of the viewing head, aiming for a high signal strength, as indicated by the digital readout on the S550B. The upper display will indicate the IR value in red, the lower display indicates the UV value in green.
- 2) Ensure that the external input for CHAN SEL is properly set for the channel about to be calibrated, and that the channel LED is illuminated. When using the calibrate feature, the option of working with the channel that is not selected by the external input is not available.
- 3) Bring the firing rate of the burner to a low fire condition.
- 4) If the flame relay has not yet energized, adjust the flame on & off set points so that it does. If "CAL" was activated without the flame relay being energized, the following display will show: "bon?". Press the reset button to return to the previous state.
- 5) Determine whether to calibrate using the UV or IR sensor. See the earlier sections on IR DETECTOR and UV DETECTOR. At the front panel of the P520 or P522 press both A and B push buttons simultaneously.

The display will respond with "CAL?".

Press YES. The display will then show "CALu". Press YES to calibrate the UV response, else press NO.

If NO is pressed, the display will show "CALr". Press YES to calibrate the IR response. (Pressing NO will return the P520/P522 to normal operation, exiting the S550B CAL mode.)

The P520/P522 will automatically adjust the gain for the selected sensor; this takes a few seconds. If this adjustment is successful the display will show "----", and the P520/P522 will return to normal

operation, displaying a reading of 1100 to 1300.

However, if the signal input is too low, the P520/P522 will display "2-Lo". Press the RESET button to return to the previous settings. If the signal level is too high, the display will show "OrIF". (See the section on **ORIFICING** on page 9.)

Press RESET to return to the previous settings.

- 6) If step 5 was successful, re-aim the viewing head for a final adjustment using the digital readout to adjust the viewing angle for a maximum signal strength. The CAL sequence should then be repeated as in step 5). The Flame Relay will remain energized. The display should show a reading between 1100 and 1300.
- 7) Review the settings for F.F.R.T. And TIME DELAY ON and adjust if necessary.

### EXAMINING THE RESULTS OF GAIN SETTINGS FROM CALIBRATION

The gain settings, determined automatically by the calibration procedure described above, may be viewed by following the procedure for checking or changing the UV or IR gain described below. If needed, changes can be made to these settings as required, to suit a particular circumstance.

For example, the gain could be increased so that the nominal displayed value is 1500 instead of 1200. Note that the calibration procedure sets the gain of the sensor not being used to zero, but the gain of the unused sensor can be adjusted so that the S550B viewing head responds to both sensors. Both sensor outputs are summed.

### CHECKING OR CHANGING UV GAIN

On the P520/P522 front panel, press both A and B push buttons simultaneously.

The display will read: "CAL?" meaning, "Do you wish to Calibrate?"

Pressing YES will enter the Calibration mode described in the previous section. Press NO to enter the Adjust mode. The display will show "AdJ?" meaning, "Do you wish to make manual adjustments?". Press "YES"

The display will show "AuNN" where NN is the current UV gain with the range 00 - 99.

A gain of 00 turns off the sensor. To change the UV gain use the up or down push buttons. Press YES to store the new value. Pressing NO will discard any changes.

### CHECKING OR CHANGING THE IR FILTER

This next step allows changes to the IR filter. The display will show “ArFN” where N is the current filter selected ranging from 1 to 8.

Use the up and down push-buttons to change the filter if required. See the section “MODEL S550B GENERAL DESCRIPTION” on page 3 for a listing of the high-pass frequencies for these filters.

Press YES to accept a new filter value or NO to ignore and discard any changes you may have made. It is recommended that the #3 default filter (33Hz cutoff) be used for all of the initial setup procedures described in this manual.

### CHECKING OR CHANGING IR GAIN

A final adjustment of the IR gain can now be made. After the filter selection, the display will show “ANNN” where NNN, the IR gain, ranges from 000 to 699. The up and down push buttons can be used to change the IR gain. Changed values can be accepted by pressing YES or discarded by pressing NO.

If the S550B settings are changed, the display will show “----” indicating that the values are stored in EEPROM, before continuing with the normal numerical display.

If you do change the IR gain you may find that the displayed gain values “jump” as you scroll through them. As you increase the gain from zero you will see the following sequence:

000 - 099  
150 - 199  
250 - 299  
350 - 399  
450 - 499  
550 - 599  
650 - 699

The two least significant digits are linear gain multipliers; e.g., from 150 to 199 is a 99/50 increase in gain. But the most significant digit is nonlinear; with each step change in the most significant digit, the gain doubles. For example, a setting of 250 has twice the gain as a setting of 150. Now it is possible to see why, as the gain

is increased from 150 to 199 the next step is to 250; an increase from 150 to 199 is an increase of 99/50, which is a gain increase of almost 2, but the next step to 250 is to a gain increase, theoretically, to exactly 2. This relationship is true of all the gains to 699. The two least significant digits can be used below 050 down to 000; 000, of course, selects a gain of zero (which turns OFF the sensor). When the display is ramped down from 699 the following sequence will be seen:

673 - 637  
573 - 537  
473 - 437  
373 - 337  
273 - 237  
173 - 137  
073 - 000

This approach makes a wide range available for gain multiplier changes using the two least significant digits. For example, over a range of 137 to 199 the gain is changed by a ratio of 99/37. It is advantageous for moderate changes in gain to change only the gain multiplier digits because the response to these changes is very linear. When changes are made in the most significant gain digit, the gain change is not always exactly an ideal 2:1 step change.

### MANUAL SETUP OF THE S550B

The steps below for manual setup should result in the P520 or P522 displaying a reading close to 1200 with flame on. This procedure should provide similar gain settings for each selected sensor as in the “**Calibration Procedure**” described earlier.

- 1) Bring the firing rate of the burner to a low fire condition.
- 2) Ensure that the external input for CHAN SEL is properly set for the channel calibration (A or B) that is currently being set and the channel LED is illuminated.
- 3) Determine whether to setup using the UV or IR sensor before aiming the viewing head. In some flames the best UV reading of the flame envelope may be found at a different location from the best IR reading. See earlier sections “IR DETECTOR” and “UV DETECTOR”. Use the Adjust Mode (“AdJ?”) procedure described above and set the gain for the sensor not being used to zero.

- 4) If the IR sensor is being used, before final aiming but with a typical reading on the display, verify that the viewing head is not saturated by reducing the IR gain by 100. The displayed reading should be reduced by roughly 1/2. If it stays the same or actually increases, the viewing head is saturated. Continue reducing the gain in steps of 100 until the displayed reading is reduced. Set the gain so the reading is in the 1000 to 1400 range. If the IR sensor was not saturated, skip paragraph 5) below.
- 5) If the viewing head was saturating check the aiming by using the display readout on the back of the housing to adjust the viewing angle of the head for a maximum signal strength. If the display flashes “99”, change the gain once more by using the Adjust Mode procedure to get a reading in the 1000 to 1400 range. The signal strength should now be maximized by re-aiming the viewing head. This procedure of optimizing the sighting and adjusting the gain may have to be done more than once to ensure that the viewing head is properly set up.
- 6) If the UV sensor has been chosen adjust the gain (00-99) using the Adjust Mode so the displayed reading is close to 1200. The UV sensor is not likely to saturate but if the flame signal readings are very high on low gain settings then an orifice should be used. See the section **ORIFICING** on page 9.
- 7) Set or at least check the Flame ON and Flame OFF set points. If they are still at the factory default values (Flame ON at 800 and Flame OFF at 600) they may be satisfactory as they are. If the Flame ON reading is less than 1200 the Flame OFF setting should be proportionately less.
- 8) Review the settings for F.F.R.T. and TIME DELAY ON and adjust if necessary.

### RETURN TO DEFAULT SETTINGS

It is recommended that all previously made settings be recorded before proceeding with this next step, should you have the need to return to your previous settings.

There are three major branches available on the decision tree once the setup menu is entered into by pushing the A and B push buttons. Refer to the flow chart in figure 8 on page 17. A response of NO to “CAL?”, will display the adjust option. A response of NO to “AdJ?”, displays the return to default settings option.

A response of NO to “dEF?”, will return the P520/P522 and the viewing head to normal operation. A response of YES to defaults, will restore the original default settings that are stored for the selected channel, overwriting the previous settings for that channel.

Once all final settings have been completed, record all settings for future reference.

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### MAINTENANCE

The UV sensor has a limited lifespan. Under extreme conditions, the lifespan can be as low as 10,000 hours. However in the most favorable conditions, the lifespan is 50,000 hours or more. The service life of the UV sensor is considered terminated when the sensitivity becomes lower than 50% of the initial value.

A monthly sensitivity check is suggested to determine if the UV sensor’s life is terminated. The reading of the digital display of the signal processor should be compared to the initial reading of the unit when it was installed. Ensure similar burner fire conditions of the application, and that the same gain settings of the viewing head, are used during each sensitivity check. If it is determined that the sensitivity is below 50% of the initial value (terminated life of the sensor), the sensor should be replaced.

S550B, S552B AND S556B DIMENSIONS

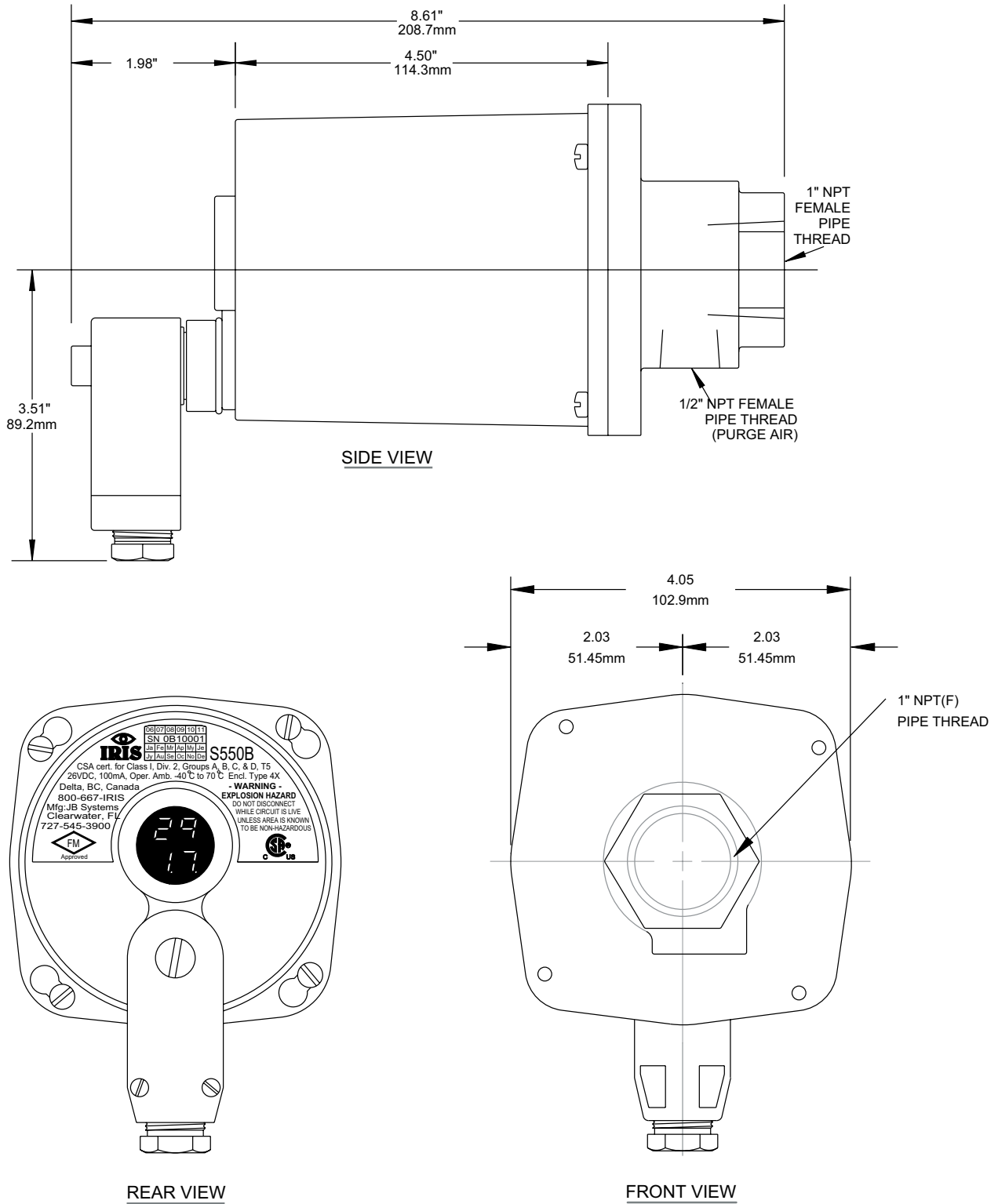
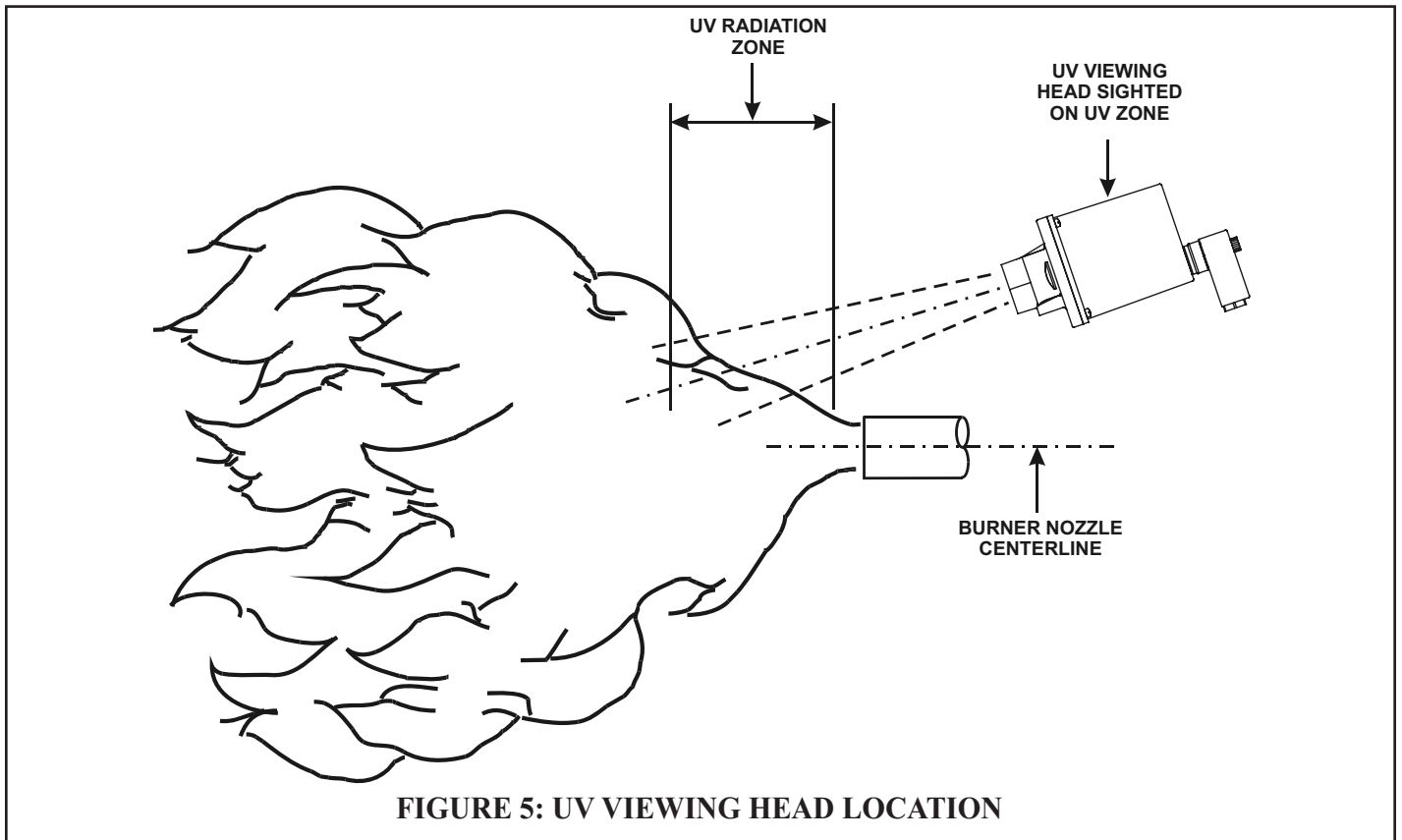
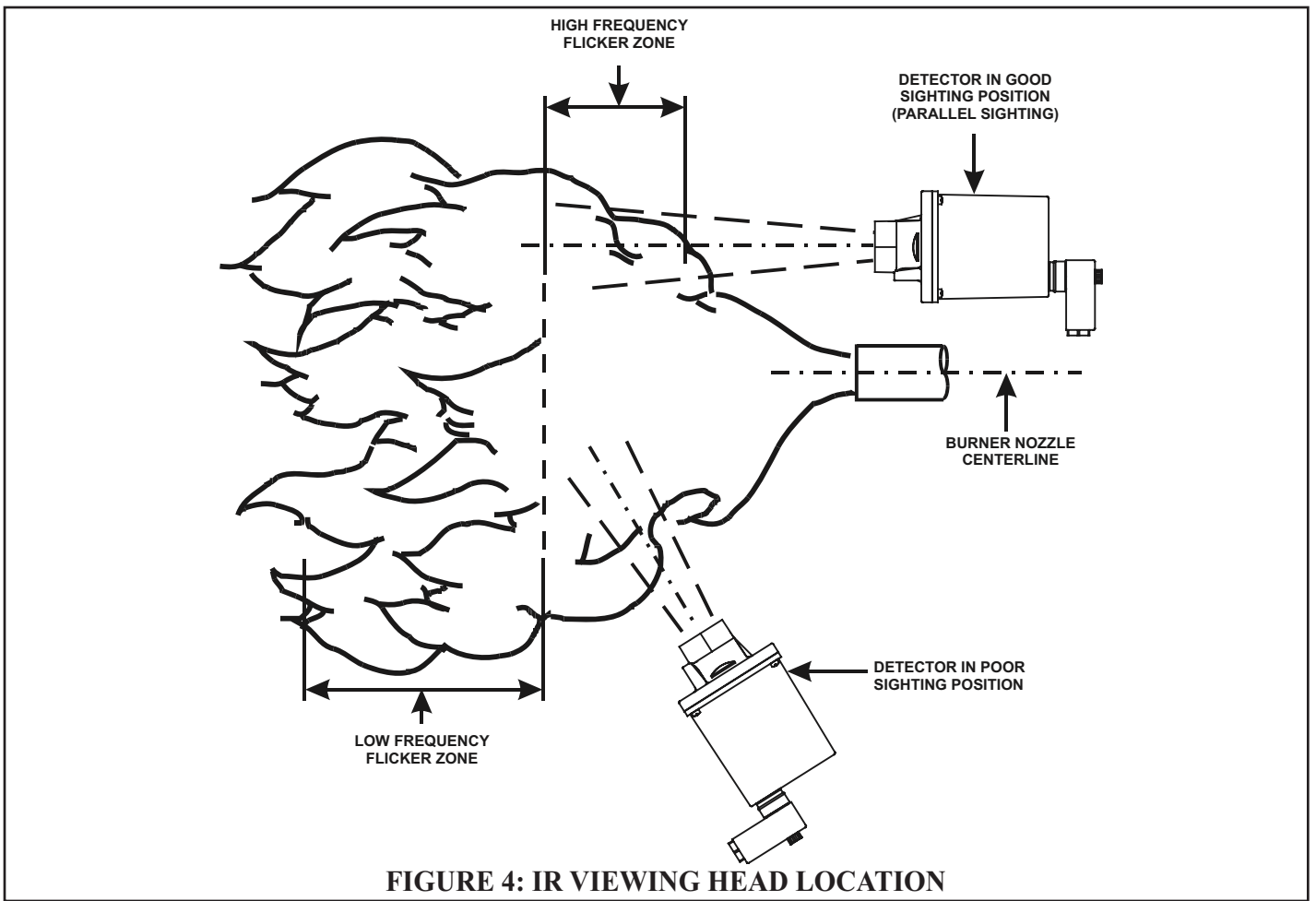
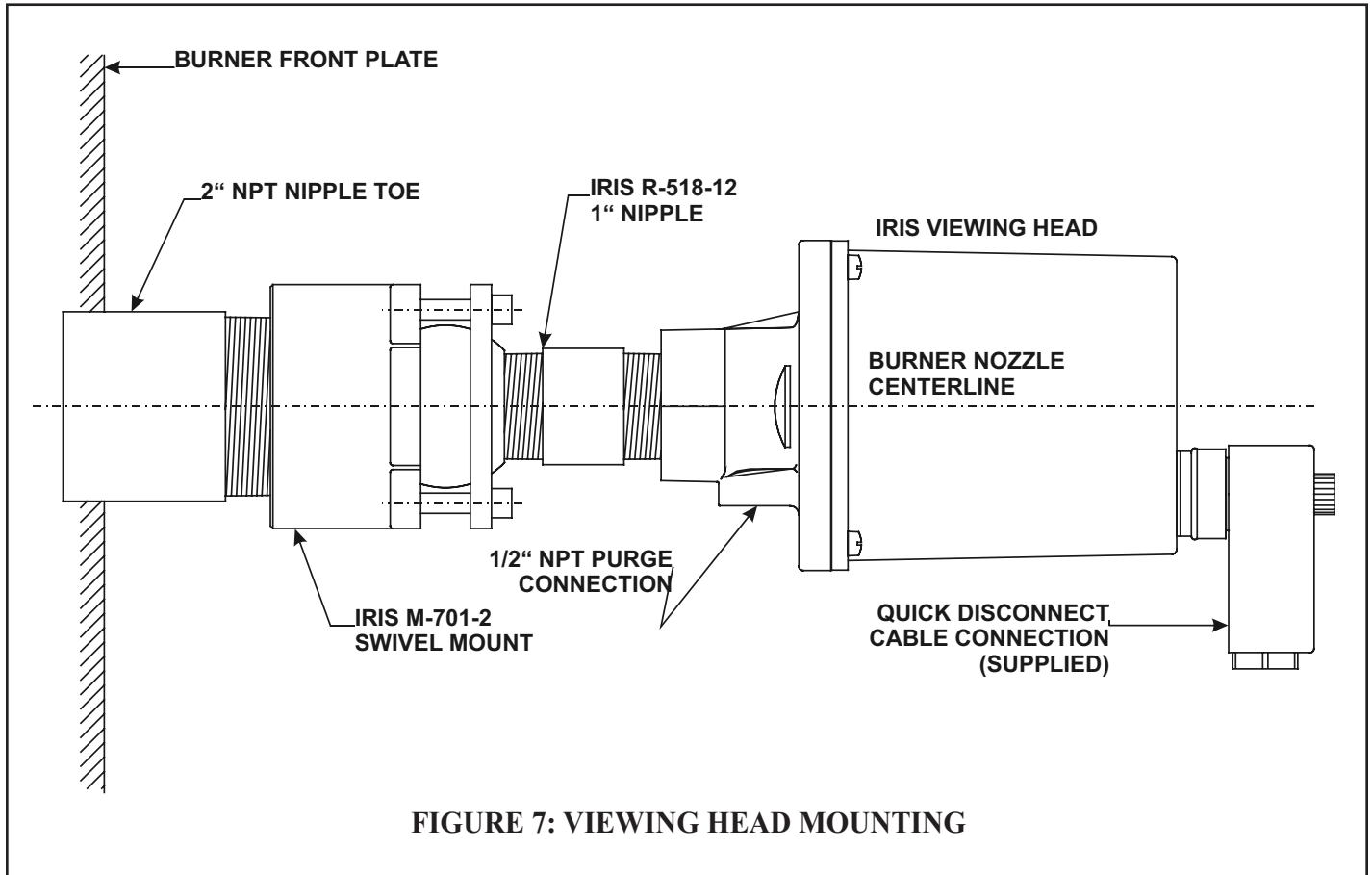
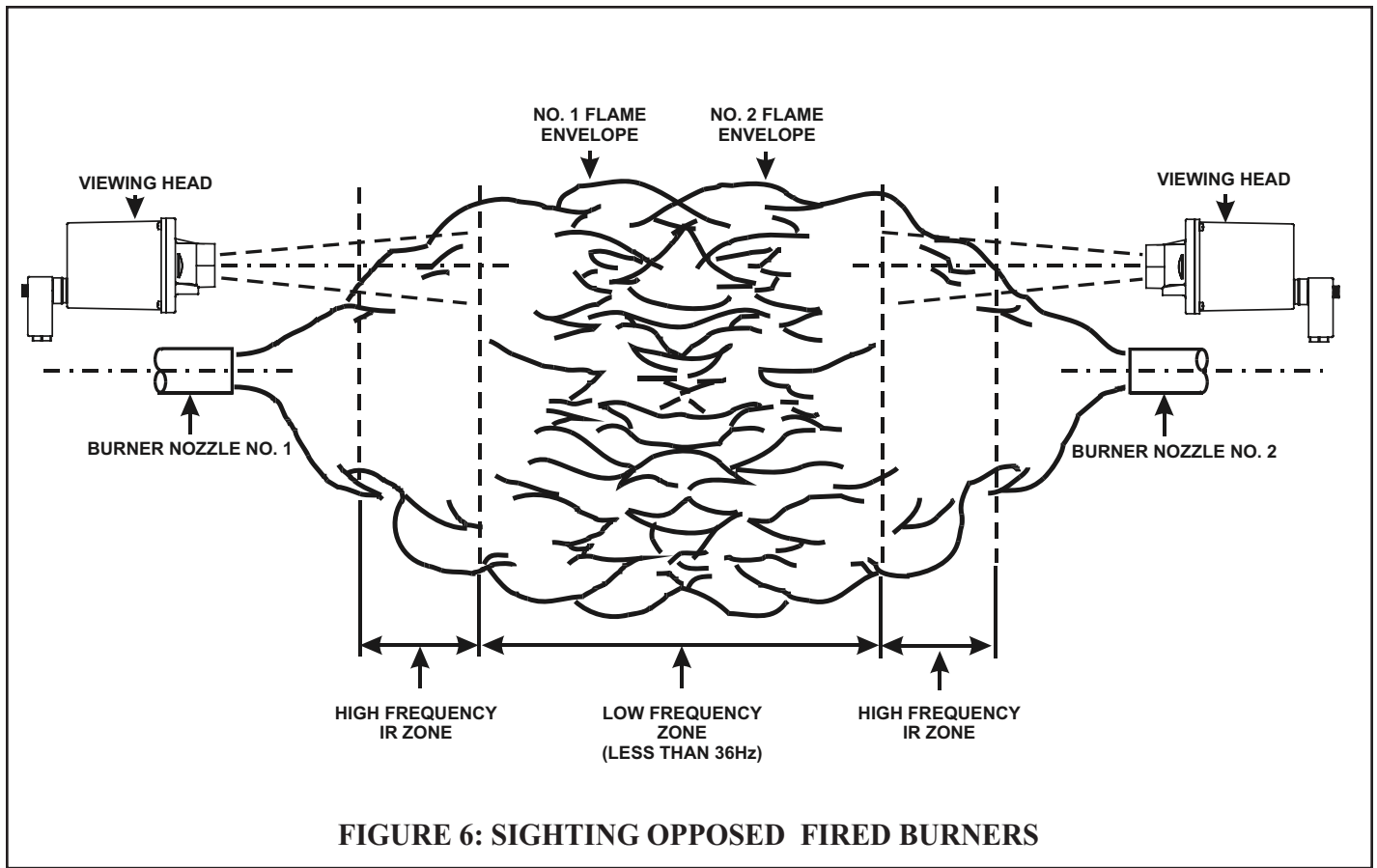


FIGURE 3: VIEWING HEAD DIMENSIONS





FLOWCHART FOR S550B PROGRAMMING

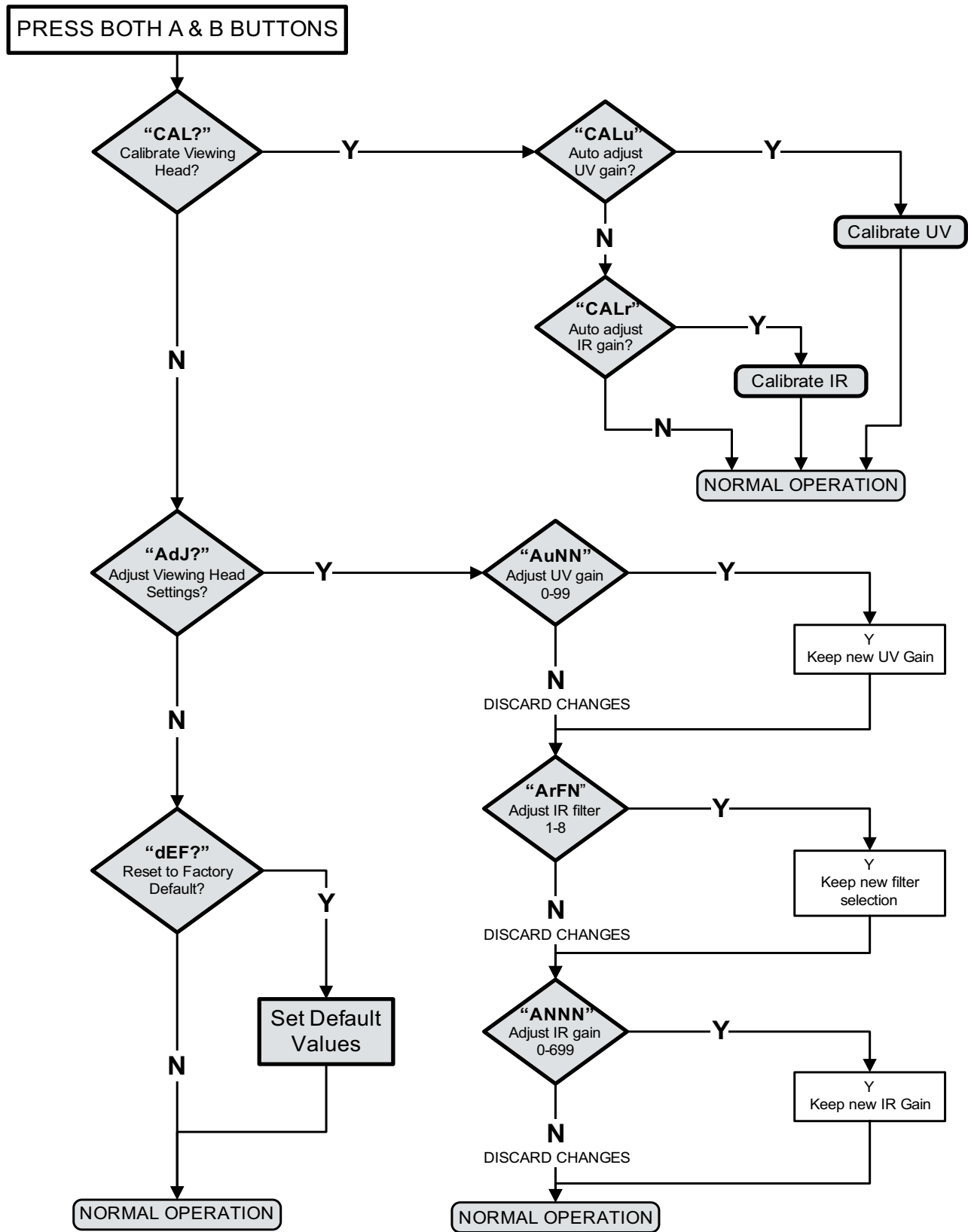
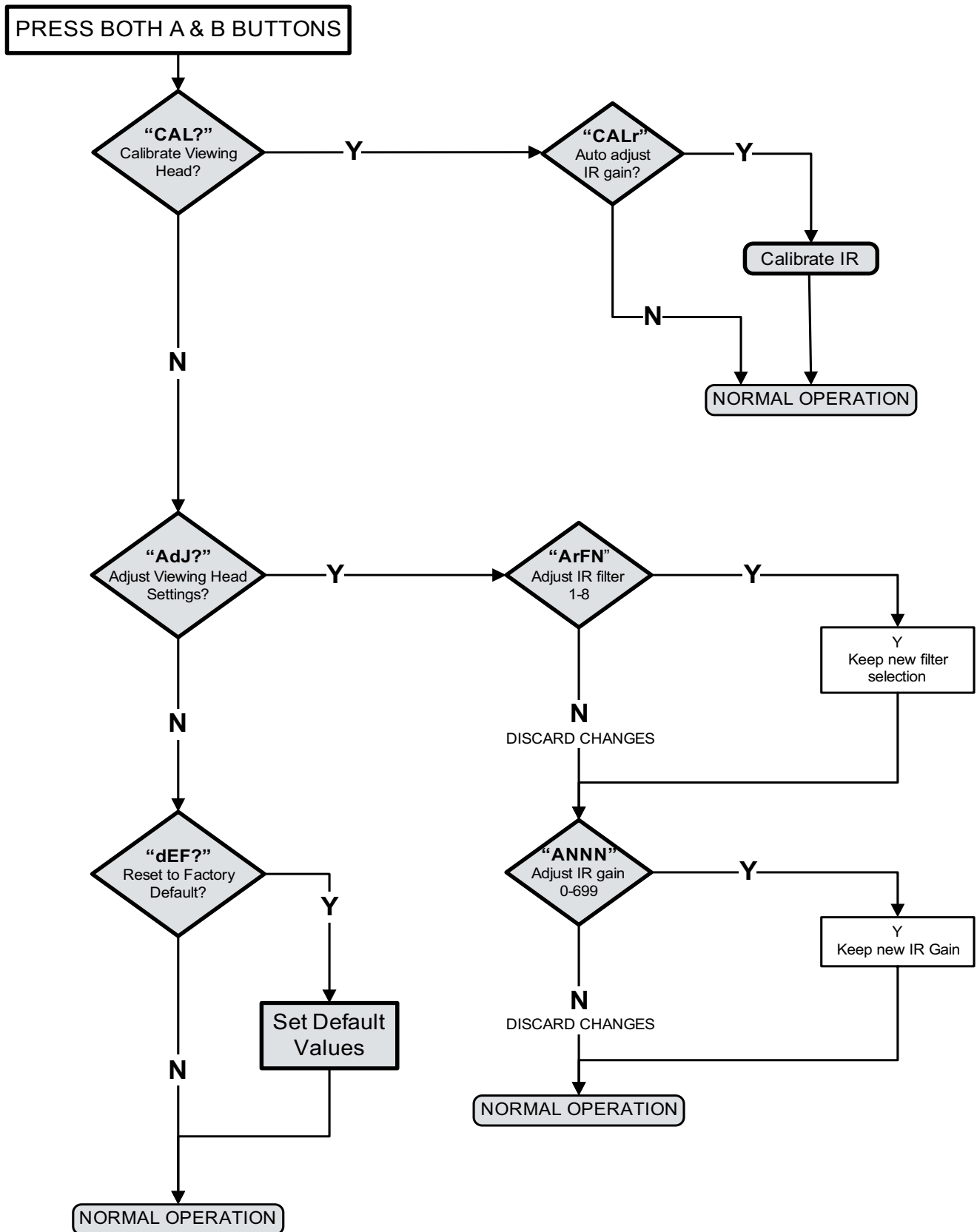


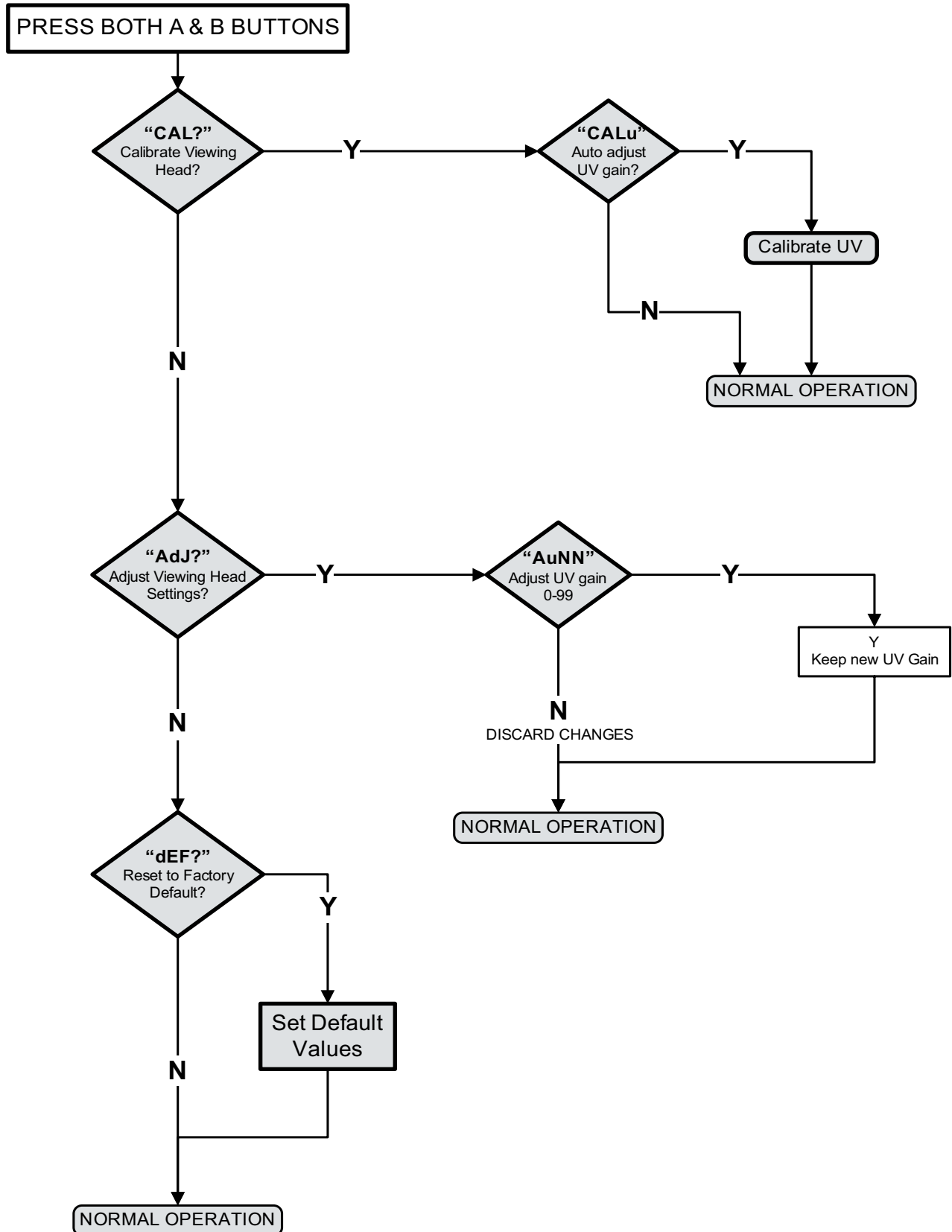
FIGURE 8: S550B PROGRAMMING FLOWCHART

**FLOWCHART FOR S552B PROGRAMMING**



**FIGURE 9: S552B PROGRAMMING FLOWCHART**

**FLOWCHART FOR S556B PROGRAMMING**



**FIGURE 10: S556B PROGRAMMING FLOWCHART**

## SPECIFICATIONS

### ELECTRICAL

Input Power: 24VDC +10%, 100mA ( powered from Signal Processor)

### ENVIRONMENTAL

Sealing: Viewing Head Housing NEMA TYPE 4

Operational Ambient Temperature: -40° F to 158° F (-40° C to 70° C)

### OPTICAL

Angle of View  
IR 1.0°  
UV 3.0°

### CABLE

Signal Processor to  
Viewing Head  
4 conductor, #16AWG or #18AWG.  
One wire shielded with braided shield for flame signal  
such as IRIS Part Number C328