



FLAME MONITORING SYSTEM

MODEL S550, S552, S556 VIEWING HEAD

APPLICATION MANUAL



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S550 GENERAL DESCRIPTION

The IRIS Model S550 is a state-of-the-art flame monitor viewing head utilizing two types of detectors, an IR (infrared) solid state and UV (ultraviolet) tube.

The S550's work with the latest version of the P520/P522 signal processors. Like other viewing heads in the S500 family, the S550's produce output pulse rates proportional to the flame signal strength; the pulse rates are displayed at the front panel of the signal processors. But, unlike the other members of the S500 family, certain parameters in the S550 viewing head can be selected or adjusted remotely from the front panel of the P520/P522 signal processors. The parameters are:

- a) UV gain 0-99
- b) Filter Selection 1-8
- c) IR gain 0-699

Once adjusted, the new parameters are stored in EEPROM in the signal processor. If power is removed from the signal processor which powers the viewing head and then reapplied, the signal processor then automatically re-sends the stored parameters out to the S550 viewing head. In addition, at the front panel of the signal processors the operator may also select "CAL", a semiautomatic mode which will help to speed up the S550 setup. This is explained in detail in the section called **CALIBRATING THE S550** on page 10. Also notice the **FLOWCHART OF S550 PROGRAMMING**, Figure 3 on page 15. Thus the S550 is a dual-sensor viewing head where the gain and filter selections are adjusted remotely and stored in the P520/P522 signal processors.

S552 GENERAL DESCRIPTION

The S552 is for IR sensing only. It is basically an S550 without a UV capability. The P520 or P522 will be aware of which viewing head of the S550 family is connected to it so that only those adjustments which are appropriate to the S552 will be made available to the operator. These adjustments apply to the S552:

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

When it comes to features like CAL, which will be described later, the operator is only given those choices which are appropriate. For example, he does not have to choose between calibrating with the UV sensor or the IR sensor; in CAL he is only offered the choice of calibrating with the IR sensor or not. This is shown in the **FLOWCHART OF S552 PROGRAMMING**, Figure 4 on page 16.

To keep the manual straightforward only the operation of an S550 is described. If one has an S552 one should simply disregard references to those features of the S550 which are UV-related.

S556 GENERAL DESCRIPTION

The S556 is for UV sensing only. It is basically an S550 without an IR capability. The P520 or P522 will be aware of which viewing head of the S550 family is connected to it so that only the adjustment which is appropriate to the S556 will be made available to the operator:

- a) UV gain 0-99

When it comes to features like CAL, which will be described later, the operator is only given those choices which are appropriate. For example, he does not have to choose between calibrating with the UV sensor or the IR sensor; in CAL he is only offered the choice of calibrating with the UV sensor or not. This is shown in the **FLOWCHART OF S556 PROGRAMMING**, Figure 5 on page 17.

To keep the manual straightforward only the operation of an S550 is described. If one has an S556 one should simply disregard references to those features of the S550 which are IR-related.

COMPARISON WITH OTHER MODEL 500 SERIES VIEWING HEADS

The S550 uses a Germanium sensor for IR detection like an S511 and uses a high-voltage vacuum tube sensor for UV detection like the S506's, but **both** sensors are in the same housing in the S550. The pulses from the UV and IR sensors are summed internally into a single pulse stream out to the signal processor.

A dual-LED indicator is used to indicate the pulse rate out of the S550. It is visible at the rear of the

viewing head housing. (See Fig. 2). For every 128 pulses from the UV sensor it emits one green pulse; for every 128 pulses from the IR sensor it emits one red pulse. With a count rate of 1200 displayed at the signal processor the LED will flash 9 or 10 times per second. This is very useful for aiming and sighting the viewing head. One can readily distinguish differences in pulse rates at the LED and use this indicator to adjust the sighting to obtain a maximum pulse rate at the LED and therefore a maximum reading at the signal processor.

The S550 differs from older models in that the gain for each sensor and the selection of the filter for IR may be set remotely through the front panel of the P520/P522 signal processors.

Also the earlier IR sensitive family members had only 4 high pass filters to choose from; the S550 has 8:

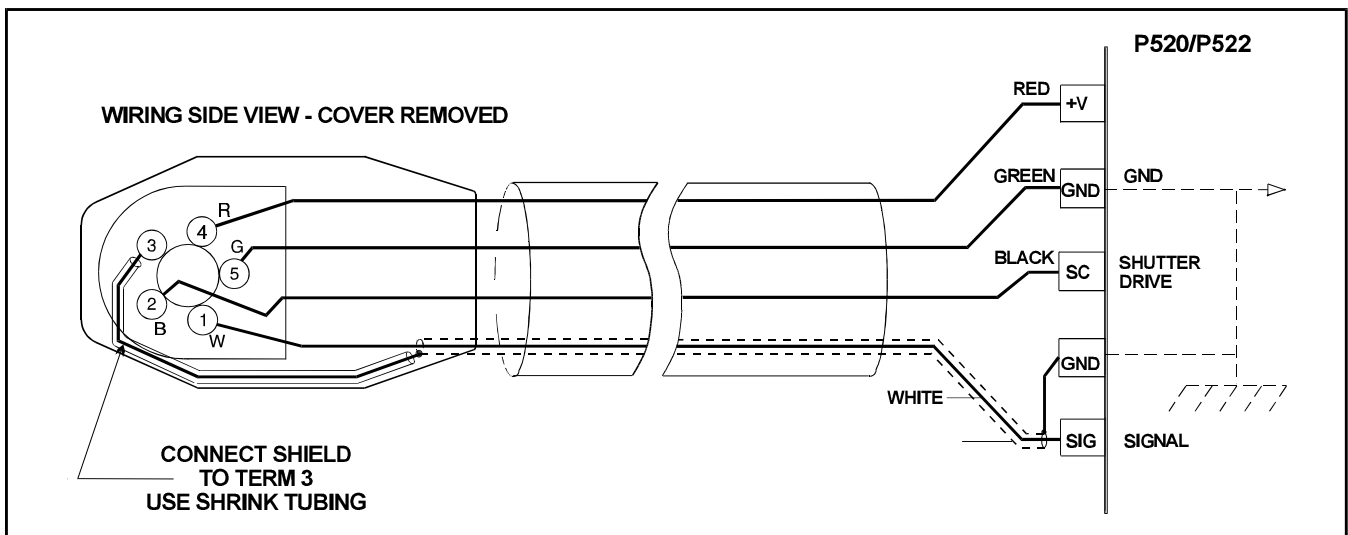
S511 & S512		S550	
LL	36 Hz	1	16 Hz
L	71 Hz	2	24 Hz
M	105 Hz	3	33 Hz
H	186 Hz	4	52 Hz
		5	75 Hz
		6	100 Hz
		7	155 Hz
		8	215 Hz

TECHNOLOGY USED IN THE S550

The UV and IR sensors in the S550 share a common optical axis efficiently by using a unique dichroic beamsplitting mirror. Over 80% of the ultraviolet light is reflected off the surface of the 45 degree mirror and yet over 80% of the infrared radiation is transmitted through the beamsplitting mirror.

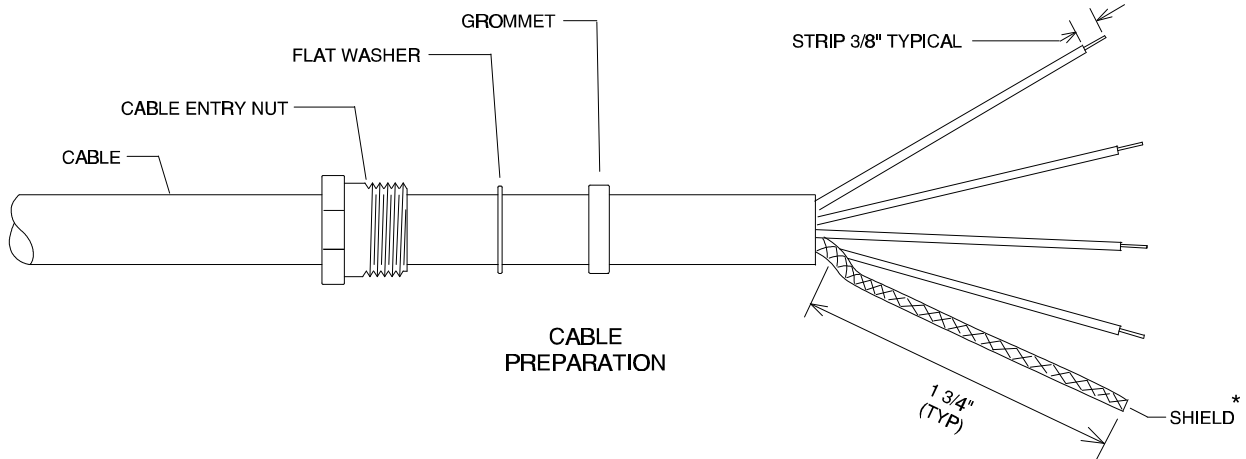
The electronics in the S550 is designed using highly reliable surface mount technology.

The high pass frequency responses of eight different filters in the S550 and S552 are implemented computationally in a high-performance, CMOS microcontroller inside the viewing heads. This approach reduces the parts count and

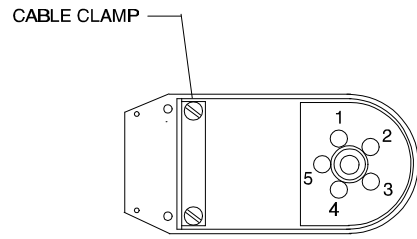


IRIS CABLE

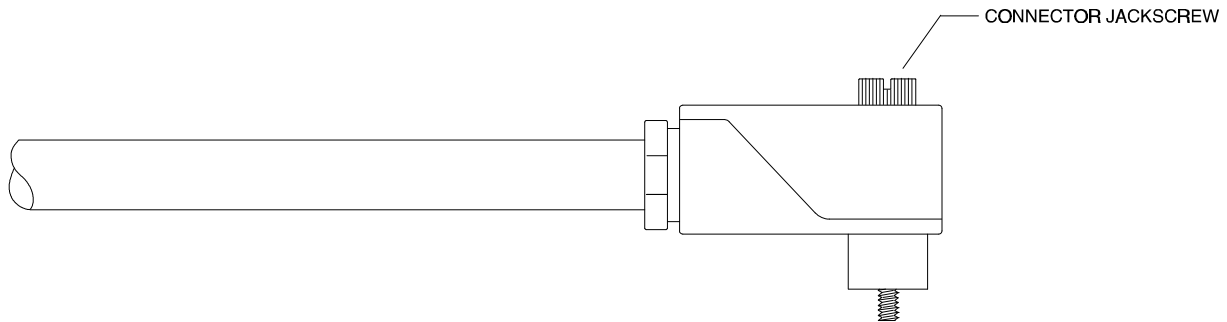
3 CONDUCTORS PLUS 1 COAX
 3 CONDUCTORS: 16 AWG 19 STRAND INSULATED WITH
 CROSSED-LINKED-POLYETHYLENE .017 THK
 COLORS: BLACK-RED-GREEN
 1 COAX: 16 AWG 19 STRAND INSULATED WITH
 CROSSED-LINKED-POLYETHYLENE .017 THK COLOR WHT
 36 AWG BRAIDED SHIELD 90% COVERAGE
 WITH .012 THK JACKET COLOR BLACK
 CABLED: POLYPROPYLENE FILLERS FOR ROUNDNESS
 JACKET: CROSSED-LINKED-POLYETHYLENE .036 THK
 COLOR LIGHT BLUE



INSULATE SHIELD WITH SHRINK TUBING LEAVING 3/8" STICKING OUT



CONNECTOR WITH REAR COVER REMOVED



FINAL ASSEMBLY

*
 CABLE IS SHOWN WITH SHIELD ALREADY REMOVED FROM WHITE WIRE

increases the reliability of the S550 compared to earlier approaches that used discrete analog components to implement four active filters. The microcontroller also handles communications with the P520/P522 signal processors.

WIRING OF VIEWING HEAD

Wiring of the viewing head is made to the terminals on the rear backplane PC board (or output module) on the P520 signal processor and is made to the terminals on the lower right side of the P522. These terminals are listed functionally as follows:

TERM	DESCRIPTION
GND	Power Ground
+V	+24 VDC power to viewing head
SC	Shutter Drive Signal to V.H.
SIG	Flame Signal from V.H.
SIG GND	Signal Ground

The figures on the previous pages show a four conductor cable to the viewing head. Note that the flame signal wire going to terminal SIG is shielded and the shield is terminated at **both** ends of the cable(SIG GND).

The standard IRIS Model 500 cable is designated as part number C328. It is specified as a four conductor cable with one wire shielded. The shield is used as the signal ground wire which goes to terminal SIG GND on the P520/P522 and to pin 3 on the viewing head plug. The shield is a braided type for this application (a foil type shield should not be used) so that a solid signal ground is maintained. This signal ground shield is also the self-checking or shutter drive circuit return path. It is recommended that the IRIS cable be used for all applications. Refer to the diagrams on pages 3 and 4 for wiring details.

Connections of the IRIS cable to the viewing head plug should be done as follows:

Remove the plug from its packaging and layout the components.

1. Strip 2 inches of the cable outer cover from the cable removing any cellophane wrap or filler material and strip the insulation from the shielded wire (if insulated over shield) a full 2 inches to expose 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 slip wire out of shield through opening.
4. Carefully return shield to original shape and length by pulling gently, then cover with plastic shrink tubing to prevent shorts.
5. Slide nut (with threads toward the cable end), the washer and the grommet onto cable approximately 6 inches.
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. Before wiring to connector, strip each wire 3/8" as shown in assembly drawing on previous page.
9. Proceed to wire the connector as follows: (Refer to drawings on page 3 for terminal locations.)

Connect 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 + 24 VDC 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 jackscrew through plug assembly.

The cable wiring on the other end going to the signal processor is easier to do. The cable should be prepared in a similar way to the plug end particularly the shield from the WHT wire. Make sure the shield doesn't touch the other terminals.

SIGHTING OF VIEWING HEAD

The sighting of the viewing head should be parallel to the centerline of the burner in the direction of the flame. The sight pipe should be mounted as close to the centerline 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.

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. Make sure the diameter of this sight pipe is large enough to allow a reasonable field of view. The S550’s 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	2.90	7.6
18	216	4.35	11.4

Detecting flame in a sulfur recovery unit can present problems for flicker type flame monitors such as the IR detector in the S550 viewing head. 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 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 one should try and optimize the flame signal for the sour gas by “zeroing-in” on this flame, not the warm-up burner.

After optimizing the sighting for the sour gas one may find that the signal level is too low on the natural gas. One should then try the UV detector for this application. 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 DIFFERENT S550 SETTINGS TO CHANNEL A and B** on page 9.

IR DETECTOR

The IR detector responds to the 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 S550 and S552 respond to flicker frequencies 16 Hz and above. They ignore the lower frequencies so it is important to sight the viewing head on the highly turbulent portion of the flame that contains these higher frequencies. One can predict where these higher frequencies will be 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 S550 viewing head with its dichroic mirror and UV tube have a combined spectral response of 190-215 nm. The UV tube is inherently a pulsing device, that is, the power supply has been designed so that the tube emits pulses when UV radiation is present. Its output is pulse stream of randomly spaced pulses whose average rate is proportional to the UV radiation present.

The very narrow spectral response of the S550 viewhead makes it ideal for discriminating between flame and glowing refractory and other burners. However, because the tube responds to only the very short wavelengths, problems can occur because this radiation is easily absorbed and masked, for example with pulverized coal, by unburned fuel or other impurities in the fuel. Sour gas (H_2S) 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 this viewing head.

In general, the UV viewing head will work well on natural gas flames. It 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 show clearly 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 S550 when using the UV detector, will be more likely 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 S550 UV is somewhat wider than the S550 IR 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_x gas burners. The UV radiation is usually much less in intensity and spread out with this type of burner, such that one gets relatively high readings from all over the furnace when many burners are on. This is particularly true when flue gas recirculation is used. There will be, however, 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 one use a swivel mount when making these sighting adjustments.

Also, another factor one must consider 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 pick a sighting initially that will minimize this changing flame at different loads. If the flame moves further out at higher loads then the parallel to the burner axis sighting will be the best. Using a large diameter sight pipe with a swivel mount is recommended for all installations on large multiburner boilers.

ORIFICING

There are many applications where the burner flames can be so bright they will saturate the S550 sensors. With these conditions orificing the

viewing head sight path will greatly improve the performance, particularly with regard to discrimination between flames. Although saturation is less likely with the Ge (germanium) IR photodetector used for the S550 as compared to prior model viewing heads using the PbS (lead sulfide) type photodetector, the possibility should not be ignored. Saturation is more probable with large power utility boilers where the burners are very large and relatively close to one another. If one cannot look at the flame with the naked eye without it hurting, then orificing should be used. This eye test works for 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 tube in the S550 is not likely to saturate; however, orificing will usually improve the discrimination ratio for large size burners.

An orificing disc is simply a metal disc with a circular hole in the center which is placed directly in front of the lens. Four orificing 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 orificing 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 orificing disc with a larger diameter hole is tried first. There will be a reduction in the signal level so if the associated S550 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 try an orificing disc with a smaller diameter hole.

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 orificing discs:

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 S550

A new P520 / P522 will send the S550’s default “Gains” 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.** They are the same settings that will be active in an S550 when used with an older version of the P520/P522 or with an M502 signal processor. If the settings for the S550 have been changed from the default settings the operator may reset the “Gain” to the factory default from the P520 / P522 control panel. (See **Return to Default Settings** on Page 12.)

WHERE S550 SETTINGS ARE STORED

Settings for the S550s are stored in EEPROM *in the particular P520/P522* which made the adjustments. On subsequent power-up cycles the P520/P522 will send out the settings again to the S550 viewing head. In fact, if one S550 is exchanged with another one, the P520/P522 cannot tell one S550 from another and will send out the same settings. This simplifies field replacements; all S550’s are made to very close

tolerances, so any other S550 will work virtually the same as the one it replaces.

NOTE: the S550 is designed to work only with newer P520/P522 signal processors. However, besides working with newer signal processors, S552's and S556's are designed to work also with older P520/P522 and M502 signal processors; with these they will operate at their default gain settings.

ASSIGNING DIFFERENT S550 SETTINGS TO CHANNEL A AND B

With the P520/P522 an operator may assign one group of S550 settings to Channel A and another group of S550 settings to Channel B, just as he would assign different Flame ON and Flame OFF set points to Channels A and B. How one may store settings for each channel in the P520/P522 will be briefly reviewed.

If the CHAN SEL input to the P520/P522 is open or de-energized, then the Channel A lighted push-button on the front panel will be continuously 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 continuously ON. When Channel A is selected, any P520/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 S550) will be stored for use when Channel A is selected. Similarly, when Channel B is selected any P520/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 S550 viewing head.

In the P520/P522 there is a way to observe and change settings for the channel which is not selected: simply press 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/P522. The same procedure applies to manually changing

S550 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 S550 settings, with the Channel A and B (NO and YES) push buttons, the red LED for the channel which the changes apply, will be blinking.

One should visually check which channel push button is lighted when the S550 settings are being reviewed or changed. It is easy to get into the S550 CAL modes with the wrong channel selected. For example, if the Channel A LED is on or blinking and one intends to press both buttons at the same time to enter the CAL mode for Channel A, but, instead, one presses the Channel B push button well before the Channel A push button, the P520/P522 will think that the operator has selected Channel B then subsequently pressed both push buttons. Then, in the CAL modes, the red LED for Channel B will be blinking, which is not what was intended. If this happens, one should get out of the CAL mode, select the desired channel, and press both push buttons again to reenter the CAL mode, but this time pressing both push buttons at approximately the same time.

USING TWO VIEWING HEADS PER AMPLIFIER

Two viewing heads can easily be hooked up to the same amplifier using the V.H. A and V.H. B inputs. To permit this to work properly the P520 or P522 should be wired so that a 24VDC channel select signal will be applied simultaneously to the coil of the VH select relay and to the channel select input. Then, 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 is no restriction on how viewing heads may be mixed between the two channels. One can have an S550 on one channel and an S511 on another, or an S552 on one channel and an S556 on another, or any combination. Of course, the earlier 500 series viewing heads - Models S506, S511 and S512 - are not adjustable remotely as the S550 family of viewing heads are. The P520 or

P522 signal processors will continue to work as they have in the past with an earlier 500 series viewing head when the channel with that viewing head is selected.

BEFORE MAKING ADJUSTMENTS

Before making any adjustments to the S550 one should optimize the flame signal strength 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 settings.

NEW P520/P522 FRONT PANEL

Please refer to Fig. 1 at the end of this manual which shows the current front panel for the P520/P522. The words **NO**, **CAL** and **YES** are shown here in black but are actually red. This latest version of the P520/P522 signal processors may be used to communicate with the S550 viewing heads as described below.

CALIBRATING THE S550

The S550 calibrate feature is designed to aid with the setup of the S550. It is basically an automatic gain adjustment for the selected sensor; the gain for the sensor not selected is set to zero. CAL tries to bring the displayed count to about 1200. It also automatically sets the Flame ON set point at 800 and Flame OFF set point at 600, which control the Flame Relay. The filter selection remains unchanged.

Calibration Procedure:

- 1) Make a quick initial adjustment of the sighting of the viewing head, trying to obtain a high pulse rate. Red pulses from the LED indicate that the IR sensor is producing output pulses; green pulses indicate that the UV sensor is producing output pulses.
- 2) Be sure that the external input for CHAN SEL is properly set for the channel about to be calibrated and that the channel LED is on continuously. When Using the calibrate feature one does not have the option of working with the channel that is not selected by the external input.

- 3) Bring the firing rate of the burner to a low fire condition.
- 4) If the flame relay has not pulled in, adjust the flame on & off set points so it does pull in.
- 5) Decide whether to calibrate using the UV or IR sensor. See earlier sections on **IR DETECTOR** and **UV DETECTOR**.

At the front panel of the P520/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 or 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 S550 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. But 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 section on **ORIFICING**.) Press RESET to return to the previous settings.

- 6) If step 5 was successful, re-aim the S550 for a final adjustment using the LED to adjust the viewing angle for a maximum pulse rate. Then redo the CAL sequence as in step 5). The Flame Relay will remain pulled-in. 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 forgoing calibration procedure may be viewed by following the steps below for checking or changing the UV and IR gain. Changes to these

settings, of course, may be made. The automatic calibration process is not sacred; it only finds gain values. The user may change these, if he wishes, to suit his needs. For example, one may wish to increase the gain so 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 one can adjust the gain of the unused sensor **so the S550 responds to both sensors**. The S550 sums the sensor outputs.

CHECKING OR CHANGING UV GAIN

At the front panel of the P520/P522 press both A and B push buttons simultaneously. The current numerical data on the 4 digit display will be replaced with "CAL?" meaning, "Do you wish to Calibrate?" If you press YES you 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?" If you do, press the button near YES, which is the B push button. 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. If you then press YES the new value will be stored; if you press NO (Channel A push-button) the new value will be ignored.

CHECKING OR CHANGING IR FILTER

You next have an opportunity to change 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 you wish. See **COMPARISON WITH OTHER MODEL 500 SERIES VIEWING HEADS** for a listing of the high-pass frequencies for these filters. Press YES to accept a new filter value or NO to ignore 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. Further information on how these filters can affect the discrimination ratio is found in the P520 APPLICATION MANUAL and in the P522 APPLICATION MANUAL in the section **MULTIBURNER REQUIREMENTS**.

For further information please call the factory or contact IRIS Systems Inc. See page 13 for contact information.

CHECKING OR CHANGING IR GAIN

You now have an opportunity to make a final adjustment of the IR gain. 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 ignored by pressing NO. If the S550 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 be surprised to see the displayed gain values "jump" as you scroll through them. As you increase the gain from zero you will see this 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 S550

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) Be sure 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 ON continuously.
- 3) Decide whether to setup the S550 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 for the S550 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 S550 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 S550 is saturated. Continue reducing the gain in steps of 100 until the displayed reading is reduced. Then set the gain so the reading is in the 1000 to 1400 range. If the IR sensor was not saturated one can skip paragraph 5) below.

- 5) If the S550 was saturating one should check the aiming of the S550 again using the LED on the back of the housing to adjust the viewing angle of the head for a maximum pulse rate. If the LED pulse rate is then too high (the LED is ON almost continuously) change the gain once more by using the Adjust Mode procedure to get a reading in the 1000 to 1400 range. Then maximize the pulse rate by re-aiming the S550 viewing head. This procedure of optimizing the sighting and adjusting the gain may have to be done more than one time to be assured that the S550 is properly setup.
- 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 one should orifice the sighting. See section **ORIFICING**.
- 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

There are three major branches on the decision tree after one gets into the S550 setup by pressing the A and B push buttons. Refer to Fig. 3 at the end of this manual. That is, if one says NO to “CAL?”, one is asked if one wishes to do adjust. If one says NO to “AdJ?”, one is asked if one wishes to go back to the default settings. If one says NO to “dEF?”, then the P520/P522 and S550 continue

with normal operation. If one says YES to defaults, then the original default settings are stored for the selected channel overwriting the previous S550 settings for that channel.

ANGLE OF VIEW

The angle of view for S550 viewing head utilizing the IR detector will be the same as the S511 because the Ge photodetector element is 1mm in diameter which results in an angle of 1.0°. When using the UV detector the angle of view will be the same as the S506 which is about 3.0°. See section **SIGHTING OF VIEWING HEAD** for details.

GENERAL COMMENTS

It will be obvious to the user of this new innovative product that this is the ultimate state-of-the-art flame monitor. The way it works has been described only in a general sense and obviously the algorithms implemented by the embedded controller software are proprietary and will not be made public. Any existing P520 or P522 signal processor can be upgraded to an S550 compatible processor by changing the controller chip and the front panel.

TECHNICAL HELP

For technical help in applying this product please contact:

Factory and Repairs:

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(JB Systems, Inc.)

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1-800-667-IRIS

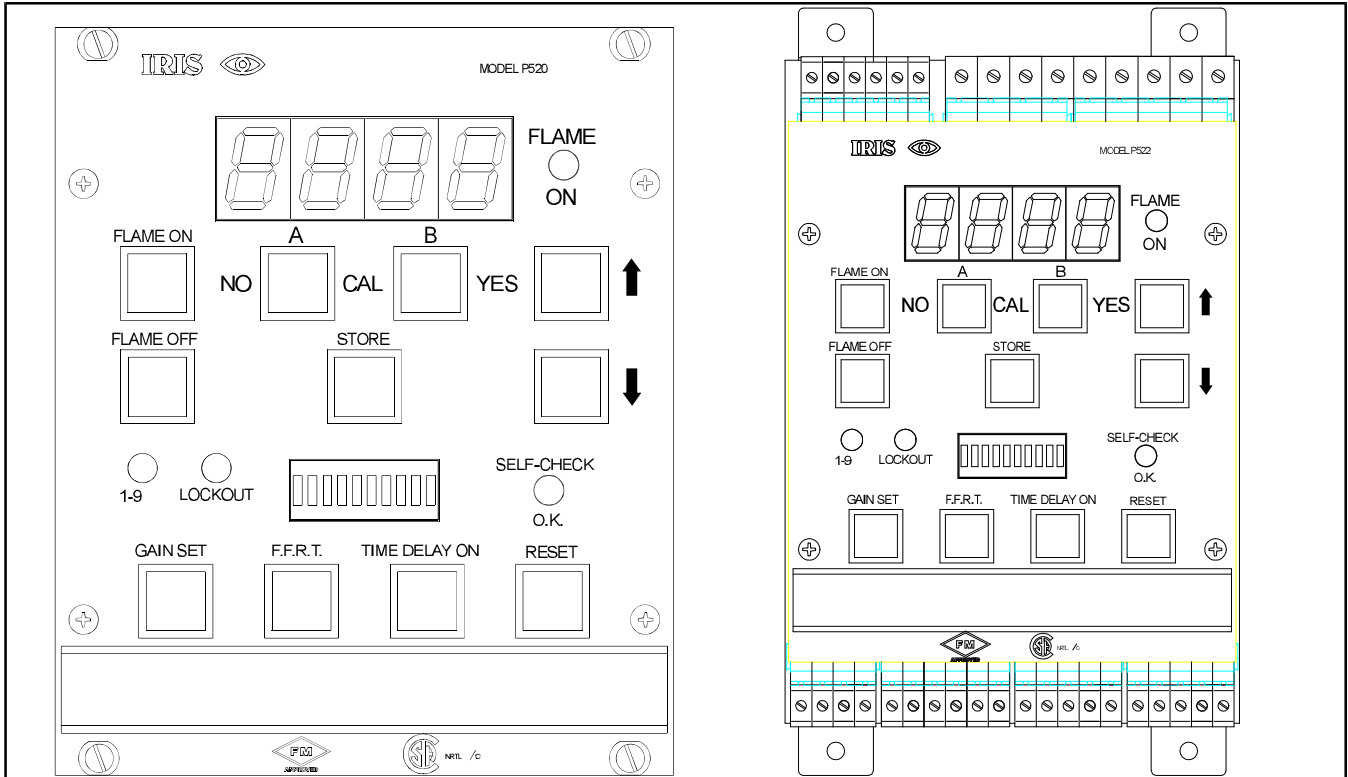


Figure 1

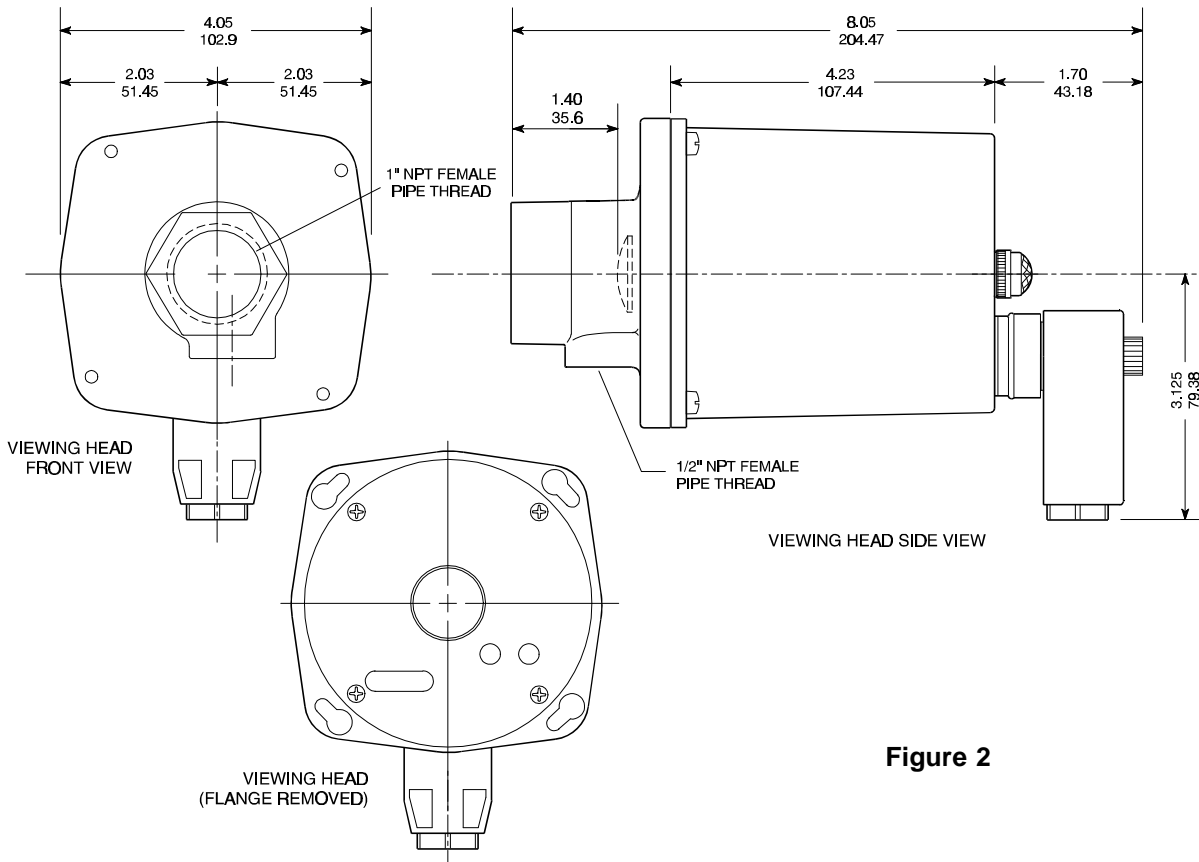


Figure 2

FLOWCHART OF S550 PROGRAMMING

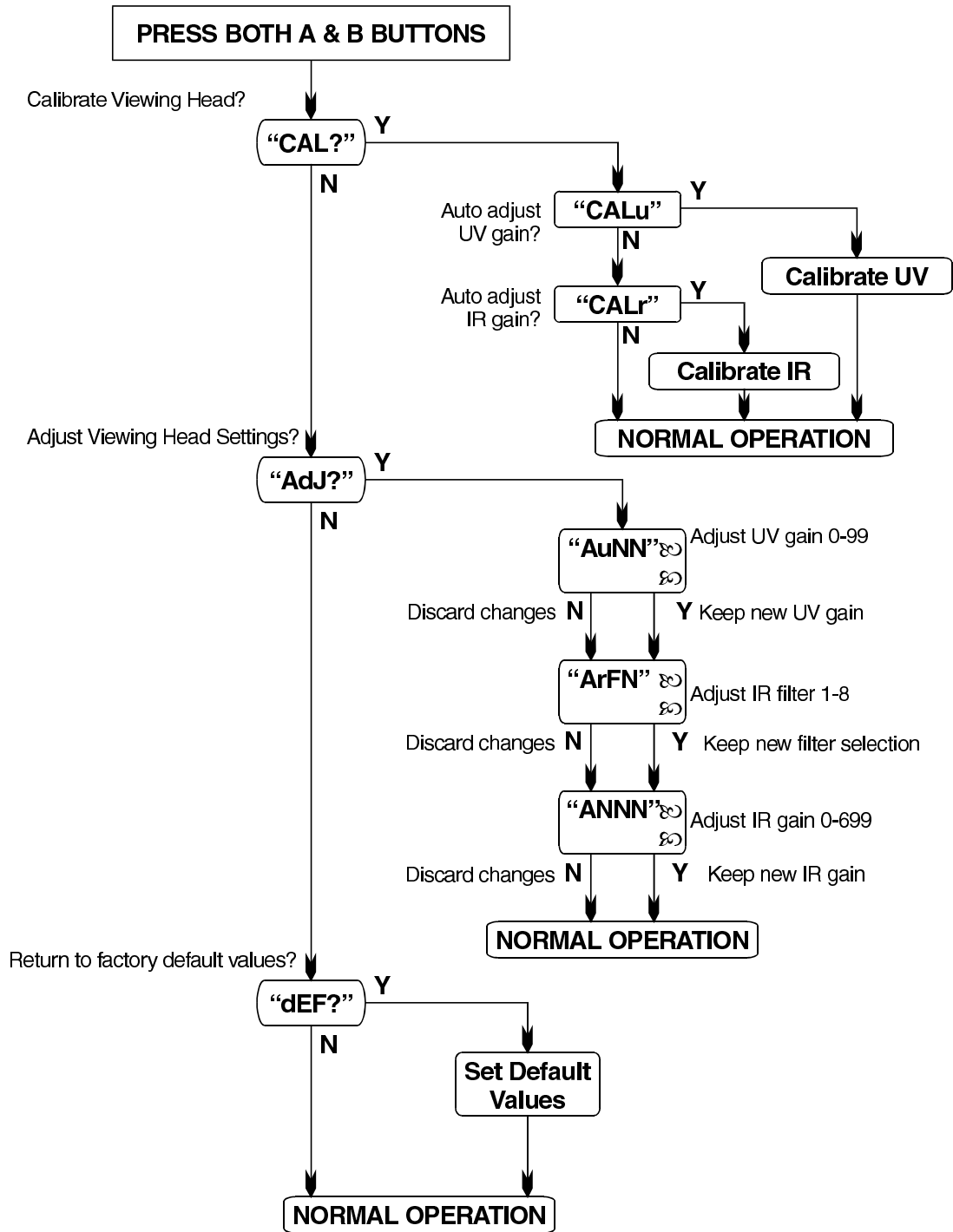


Figure 3

FLOWCHART OF S552 PROGRAMMING

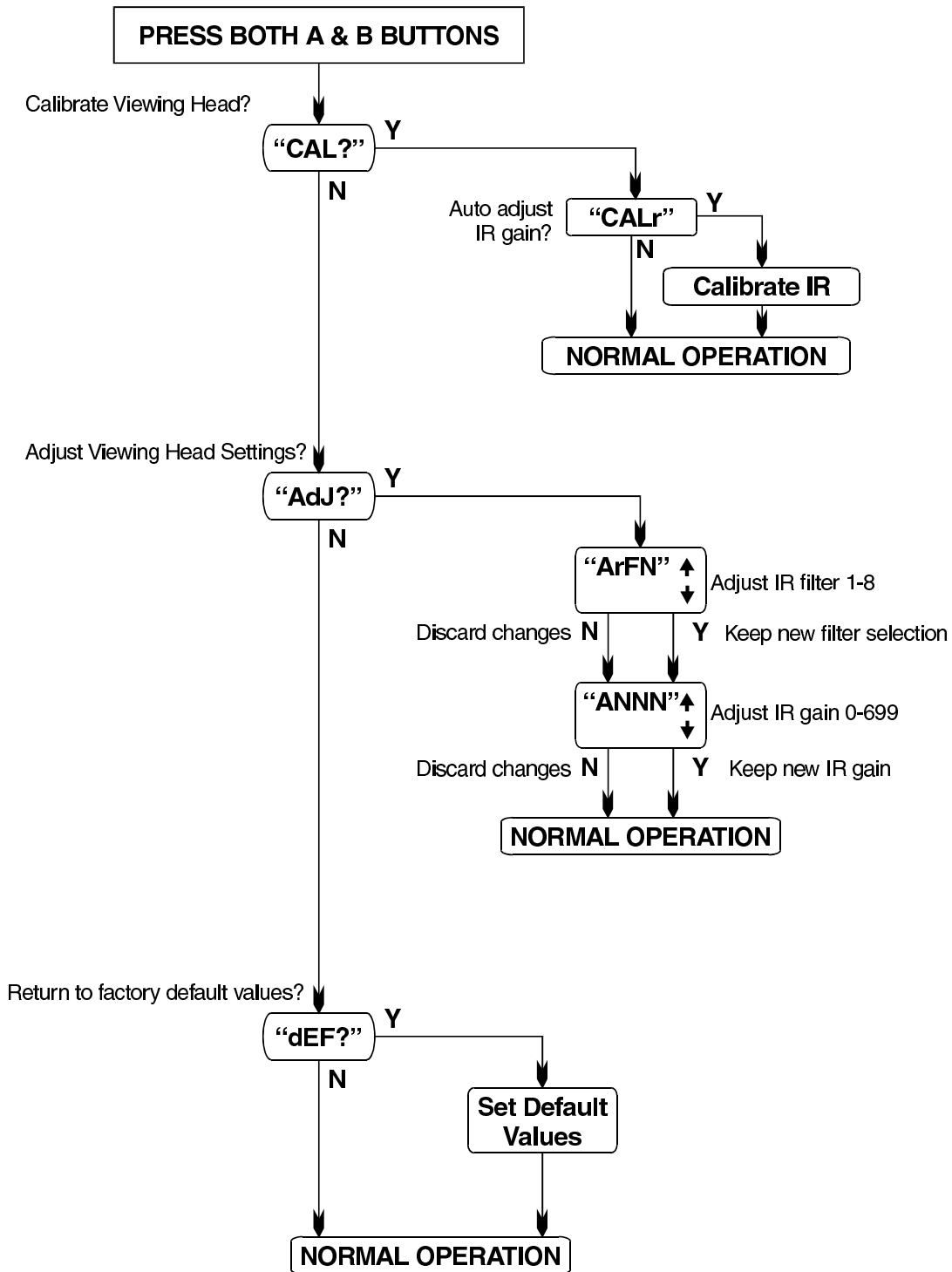


Figure 4

FLOWCHART OF S556 PROGRAMMING

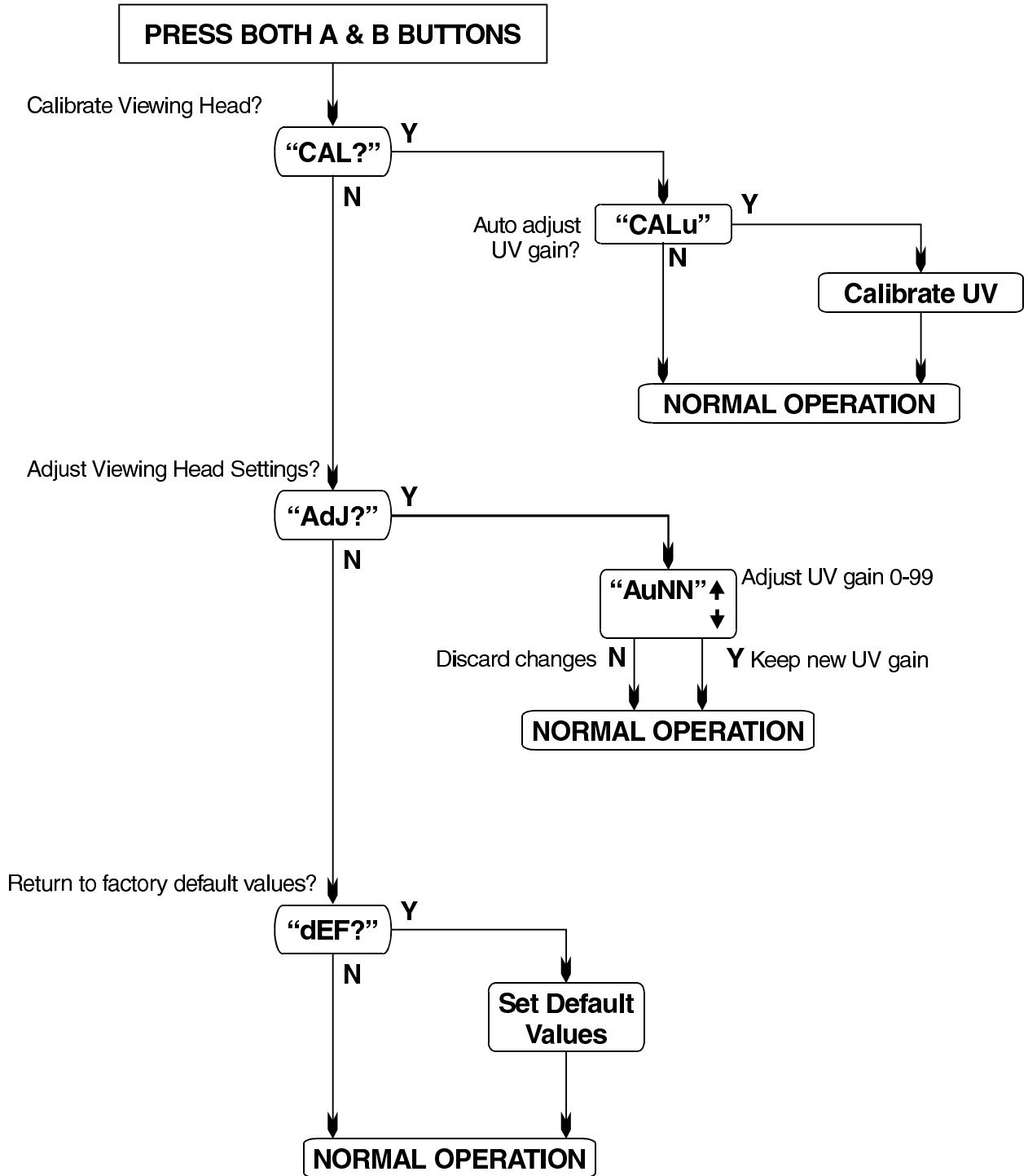


Figure 5

