

## P522 Signal Processor

### OPERATING INSTRUCTIONS

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### 1 APPLICATION

P522AC and DC Signal Processors are used with Honeywell model S55XBE Viewing Heads to create an Industrial Flame Monitor.

### 2 SPECIFICATIONS

#### Electrical Rating:

P522DC: 22-26VDC +5%, -20%, 300mA; 100mA per additional viewing head

P522AC: 100-240VAC, 50/60Hz, 300mA; 100mA per additional viewing head

Battery Backup Voltage for both: 22-26Vdc, 300mA; 100mA per additional viewing head

#### Ambient Temperature:

P522 Signal Processor: 0°C to +50°C (32F to +122F)

#### Outputs:

Flame Relay: 2 Form C Contacts (DPDT)

Self-Check Relay: 1 Form C Contact (SPDT)

Self-Check Contact Ratings:

Max switching power - 60 W 125Vac

Max switching voltage - 220VDC, 250Vac

Max switching current - 2A DC, AC

Analog Flame Signal: User Selectable 0-20mA or 4-20mA (360 Ohm max)

Power to Viewing Heads:

+26Vdc maximum, fused 0.25A

+14.3Vdc pulsing 0.2 seconds ON, 0.8 seconds OFF

#### Inputs:

Channel Select (Isolated Input):

7.5-30 VDC range

Input resistance 3900 Ohms

26Vdc maximum, 6.4mA

10Vd c, 2.3mA

Flame Signal from Viewing Head (Isolated Input):

7.5-30 VDC range

Input resistance 3900 Ohms

13.6Vdc. 3.2mA

#### Serial Communications:

##### RS-422 (Differential)

4800 or 9600 Baud (user selected)

4 wire / 2 twisted pair

#### Cable & Connectors - S55xBE Viewing Heads

New Installations - Highest level of EMI shielding available:

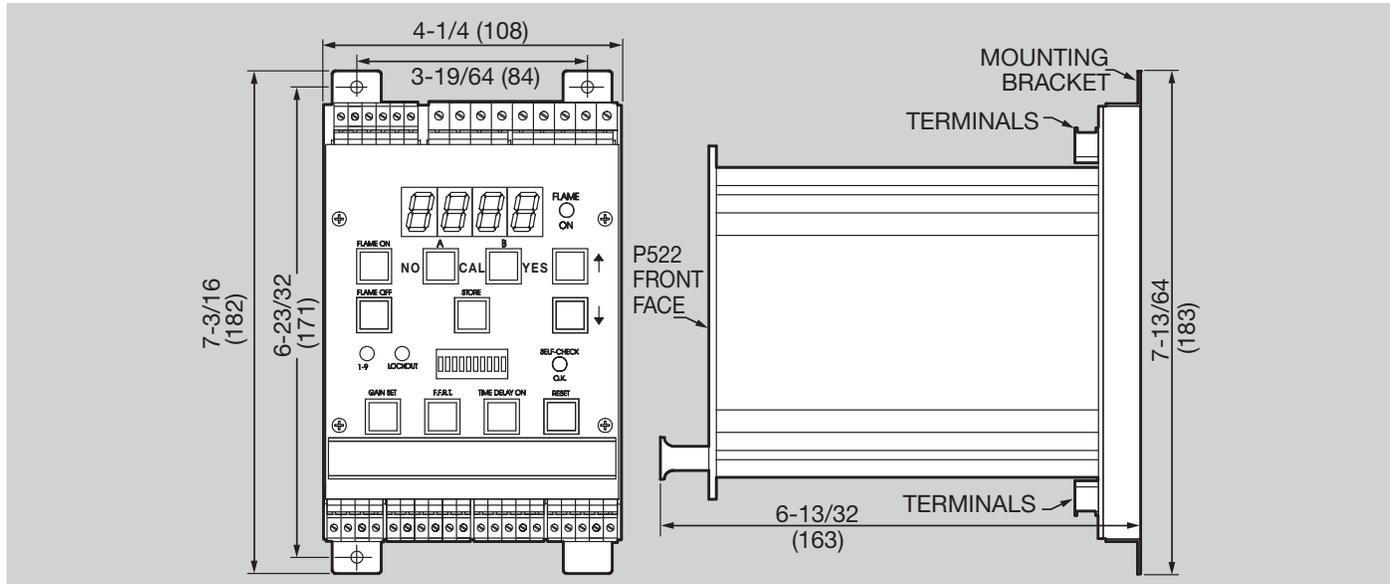
ASY55XBE --> 50 foot C330S cable with molded connector.

ASY55XBE-200 --> 200 foot C330S cable with molded connector.

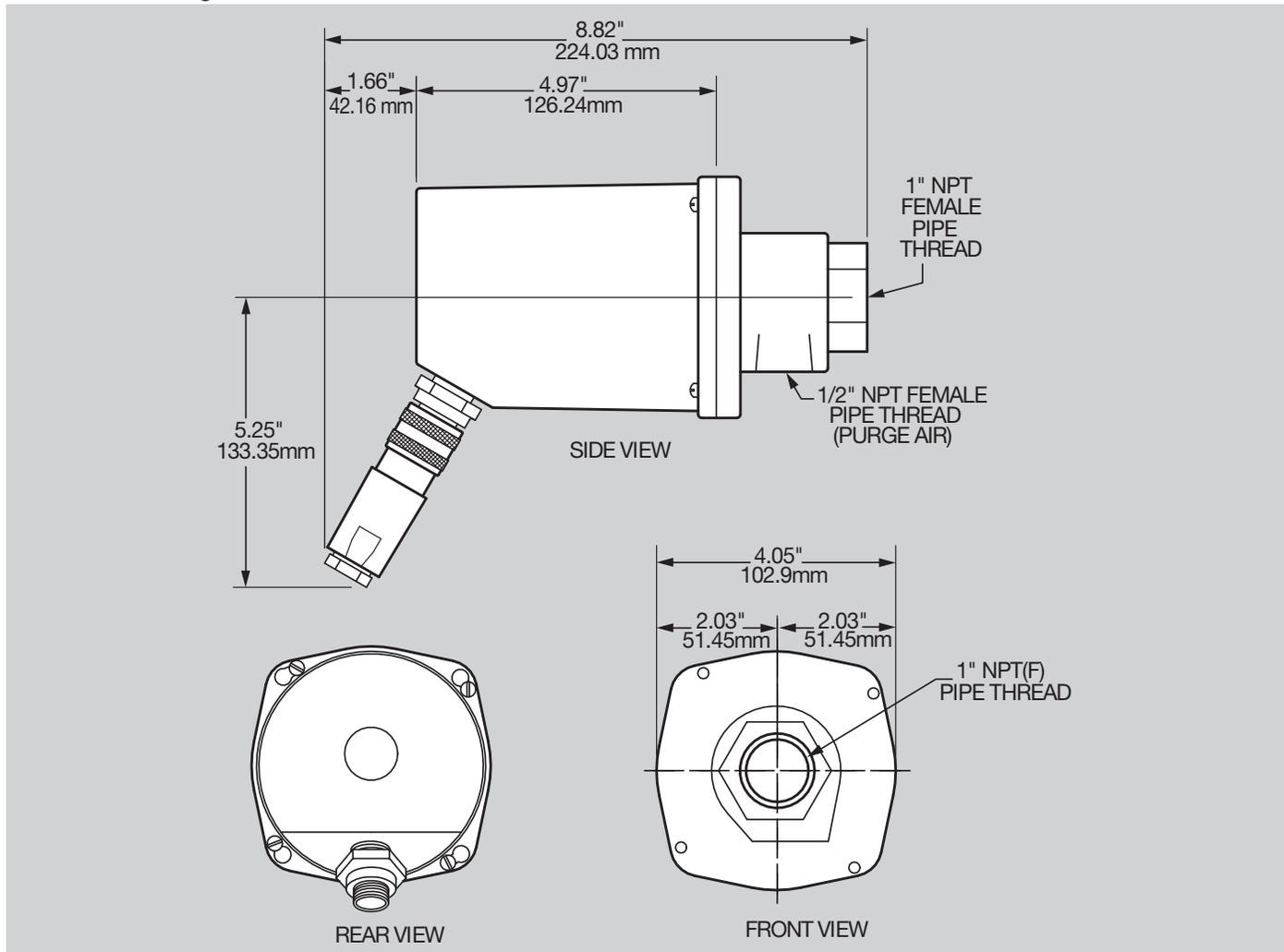
Field Wire-able Connector w/sleeve options - S55xBE Viewing Heads  
 Not recommended for new installations.  
 R-518-09 --> connector accepts 10-12mm cable (existing C328 cable).  
 R-518-11 --> connector accepts 6-8mm cable (C330 or C330S cable).

**Approvals:**  
 FM Approval for Combustion Safety  
 CSA

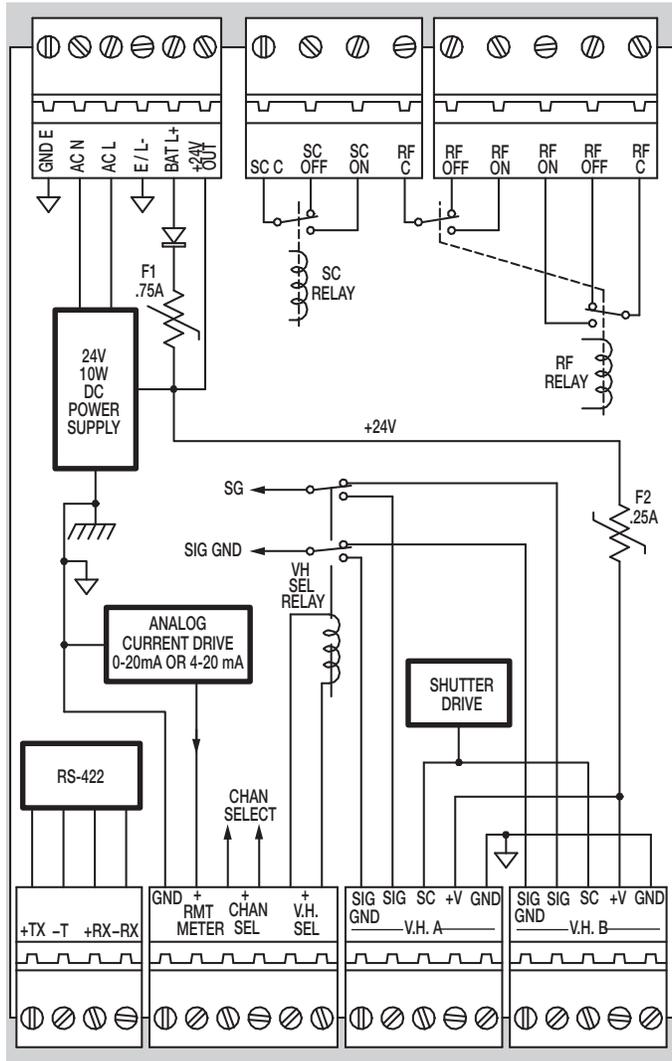
**2.1 P522 Front Panel Dimensions**



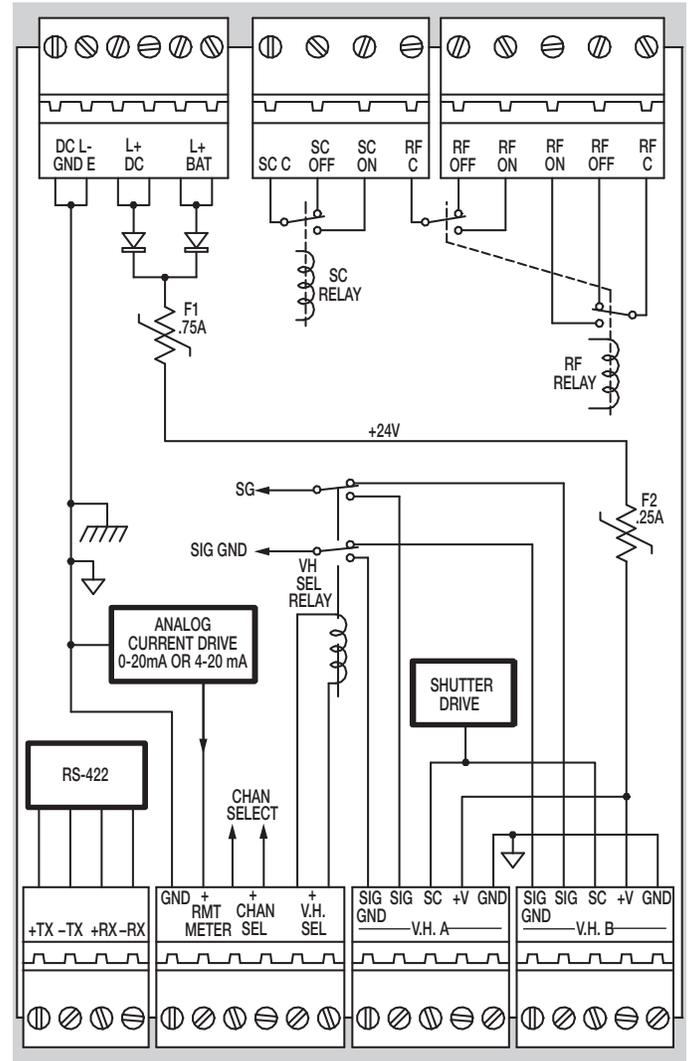
**2.2 S55XBE Viewing Head Dimensions**



### 2.3 P522AC Terminals



### 2.4 P522DC Terminals



## 3 INSTALLATION

### 3.1 When Installing this Product...

- 1 Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
- 2 Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
- 3 Installer must be a trained, experienced, flame safeguard control technician.
- 4 After installation is complete, check out product operation as provided in these instructions.

### 3.2 S55xBE Viewing Head Hazardous Location Installation of Cables and Connectors

The S55xBE viewing heads must be installed with a connector and cable assembly that maintains an IP64 seal at the S55xBE viewing head. Additionally, ITC/CIC approved cable installed in cable tray, or ITC/CIC approved cable in metal conduit must be used between the S55xBE and Signal Processor. Pre-assembled molded cable assemblies are listed below that provide the proper seal at the viewing head, and meet ITC/CIC approvals. A field wire-able connector that provides a proper seal at the S55xBE viewing head, along with ITC/CIC rated raw cable are also available and listed below. The cable installation must conform to the latest version of the National Electric Code, or Canadian Electrical Code for Class I, Division 2 hazardous locations.

Additionally, the connector be secured as follows: hand-tighten the connector at viewing head, until it can no longer be turned. Continue tightening the connector an additional 180 degrees using pliers, or similar tool. Verify that connector cannot be loosened by hand. If necessary, tighten in additional 180 degree steps until hand loosening is impossible. This is required for hazardous location installations.

ASY55XBE – Pre-assembled over-molded connector and 50 foot cable assembly, >IP64 rated with CIC/ITC approved cable.

ASY55XBE-200 – Pre-assembled over-molded connector and 200 foot cable assembly, >IP64 rated with CIC/ITC approved cable.

R-518-11 Field-wireable connector may be used with C330S cable to provide >IP64 rating at viewing head.

C330S – ITC/CIC rated 4 conductor 22g cable with drain wire, and overall shield.

### 3.3 Grounding and Shielding

NOTE:

*Installer must be a trained, experienced flame safeguard service technician and should be familiar with the equipment operation and limitations and be aware of any applicable local codes and regulations.*

- 1 The viewing head and all associated cable/conduit must be at least 12 inches (31 cm) from any source of high energy or voltage (for example, igniter equipment).
- 2 Install a ground wire from the ignition transformer case to the igniter assembly.
- 3 Minimize length of the igniter cable between ignition transformer and point of spark. Ensure all igniter wires and cables show no signs of wear. Replace any igniter cables or wires that are frayed or cracked.
- 4 The viewing head must be electrically isolated from the burner front.
  - a Electrical isolation can be accomplished by installing an Ultem nipple or an Ultem locking coupler adapter in conjunction with a locking coupler between the viewing head flange and the burner mount.
  - b The purge air line should also be isolated from the viewing head. This can be accomplished by installing any insulating material, for example a rubber hose, in between the purge air line and the viewing head.
- 5 The viewing head housing may be attached to earth ground, but care must be taken to ensure earth ground at housing, and ground at signal processor are the same potential. Damage to the signal processor or cable can re-sult if these two potentials are different.

On the plug-in terminals going to the viewing heads at the bottom of the P522, the terminals marked GND go to pin 5 on the viewing head plug. Pin 5 of the viewing head male receptacle has an internal tab that grounds this connection to the viewing head housing. The terminal marked GND connects to the chassis ground of the P522. This ground is made through the etch on the rear side of the PC board to the metal base. It is important that the AC power be a grounded source (i.e., GND going to plant ground). Interference problems can occur if the power supply chassis and the P522 chasis are at a different ground potential than the viewing head housing, which will be at a ground potential associated with the burner front. In these situations, the Honeywell flame monitor effectively supplies a plant ground between the burner front and the panel enclosure.

- 6 If there is a large potential difference between these points, considerable current can flow through the viewing head cable, which can, in turn, damage the P522 signal processor or the associated power supply. 6. If there is a voltage difference between the viewing head and the sight pipe, then you should use a nonconductive, one-inch plastic nipple between the sight pipe and the viewing head mounting flange. This voltage difference can be easily measured by disconnecting the viewing head from the mounting flange so that there is no continuity between the viewing head and the boiler front.

NOTE:

*Use a battery operated multimeter on a high voltage AC range for making this measurement.*

This measurement should be made under various conditions (i.e., during the sequencing of the igniter and burner). In addition to using the isolated nipple for the viewing head flange, you must use a nonconductive rubber or plastic hose for the purge air (there is a 1/2-inch NPT pipe thread on the flange). This will prevent the current from flowing through the Honeywell cable (power ground) back to the P522.

### 3.4 Wiring to the Plug-In Terminals

Figure 1 illustrates the plug-in terminals on the rear board and how they are connected internally. The flame relay and self-checking relay contacts are situated together in the upper right portion of the diagram.

RF C refers to the common terminal of the flame relay, with ON being flame on, and OFF being flame off. You will note that there are two sets of contacts used for the flame relay.

SC C refers to the common terminal of the self-checking relay. There is only one pair of contacts used for the self-checking function. Here, the designation ON refers to the self-checking taking place in a normal manner. OFF indicates a failure in the viewing head or processor resulting from:

- the internal or external hardware
- electronic critical component failure
- the power to the unit is OFF – the most likely condition.

For P522DC signal processor, the main power feeds in through the terminals situated on the upper left side (see GND, +26V and BAT). Each designated terminal is a double terminal, or pair, so that the wiring from the power supply can be “daisy chained” from one P522 to the next without having to twist wires together into one termination. The pair designated BAT is for battery backup, if used. Note the rectifier used internally to prevent the 24VDC main power supply from feeding into the battery. The backup battery, if used, should be 24 volts, to ensure that the 24VDC power feeding the P522 will not feed back into the battery. In other words, no current will flow from the battery as long as voltage of the main power supply is above that of the battery. The negative side of the battery goes to the GND terminal on the left.

On newer units (those with NO, CAL, and YES in red letters on the front panel) these fuses are self-resetting types, and will recover from an overload automatically after power is removed from the P522 for 10 seconds.

The viewing head terminals (bottom right) are identified as V.H. A. and V.H. B. If only one viewing head is used, you must wire to the V.H. A. terminals. To the left of the viewing head terminals are two terminals marked V.H. SEL (viewing head selector relay). Energizing this connection with 19 to 38 VDC will cause the relay on this PC board to switch to viewing head B. The nominal voltage of this relay is 24VDC, and the 24VDC power circuit can be used to switch this relay, if desired.

Only the viewing head signal wire (SIG) and the signal ground wire (SIG GND) are switched with this changeover relay; the 24VDC and power ground circuit is not disturbed. The 24VDC used to switch this relay must be connected with the proper polarity, because the relay used is a single-side stable type.

The pair of terminals designated CHAN SEL (to the left of the V.H. SEL terminals) is used for selecting channel A or channel B on the P522. Energizing this pair of terminals causes the B channel to be selected. Polarity must be observed when wiring this connection (the positive terminal is on the right). This is an isolated input, so two wires are required. DC voltage from 7.5 to 30 may be used. The current required will depend upon the voltage, because this is a photocoupler interface circuit with a 3900 ohm resistor feeding the LED light source.

For example: a 24VDC voltage will result in a current flow of  $25/3900 = .0064$  Amp.

If flame is being detected and the channels are switched, the flame relay will remain energized for one cycle regardless of the new set points, allowing channel changes "on the fly." If the new flame OFF set point is equal to or greater than the current signal count, then the flame relay will de-energize on the subsequent cycle.

The pair of terminals designated RMT METER (to the left of the CHAN SEL terminals) is for the remote meter connection. This output is a current-driven signal that ranges from 0 to 20 mA for remote meters, and can be switched to a range of 4 to 20 mA for DCS (distributed control system) applications (refer to section 4-20mA REMOTE OUTPUT). Connect the terminal marked "positive" to the positive meter terminal. This current signal can be used with a volt meter by feeding the signal to a resistor connected to the ground. The voltage developed across the resistor will follow Ohm's law  $V = IR$ .

For example: a 3-volt meter can be used with a resistor of  $3/.02 = 150$  ohms, which will result in a full-scale reading of 3 volts for a 20mA output.

The four terminals called +TX, -TX, +RX, and -RX (to the left of RMT METER terminals) are used for the serial communication link. The serial communication is achieved by using ASCII character code transmission at 4800 or 9600 baud through the USB port on the host computer. The P522 uses RS-422 data transmission which is over two, twisted pairs that are differentially transmitted and received, allowing long wire runs to be used through noisy environments. A USB to RS422 converter must be used to communicate with the P522, and the connections are made to the terminals marked +TX, -TX, +RX and -RX. The transmitting, twisted pair goes to the TX terminals, and the receiving, twisted pair goes to the RX terminals.

NOTE:

*The terms "transmit" and "receive" used here with respect to the P522 will be reversed with respect to the con-verter connection on the host computer. Refer to later sections in this manual for a detailed description of the software and how it is to be used with the P522.*

### 3.5 Wiring of Viewing Head

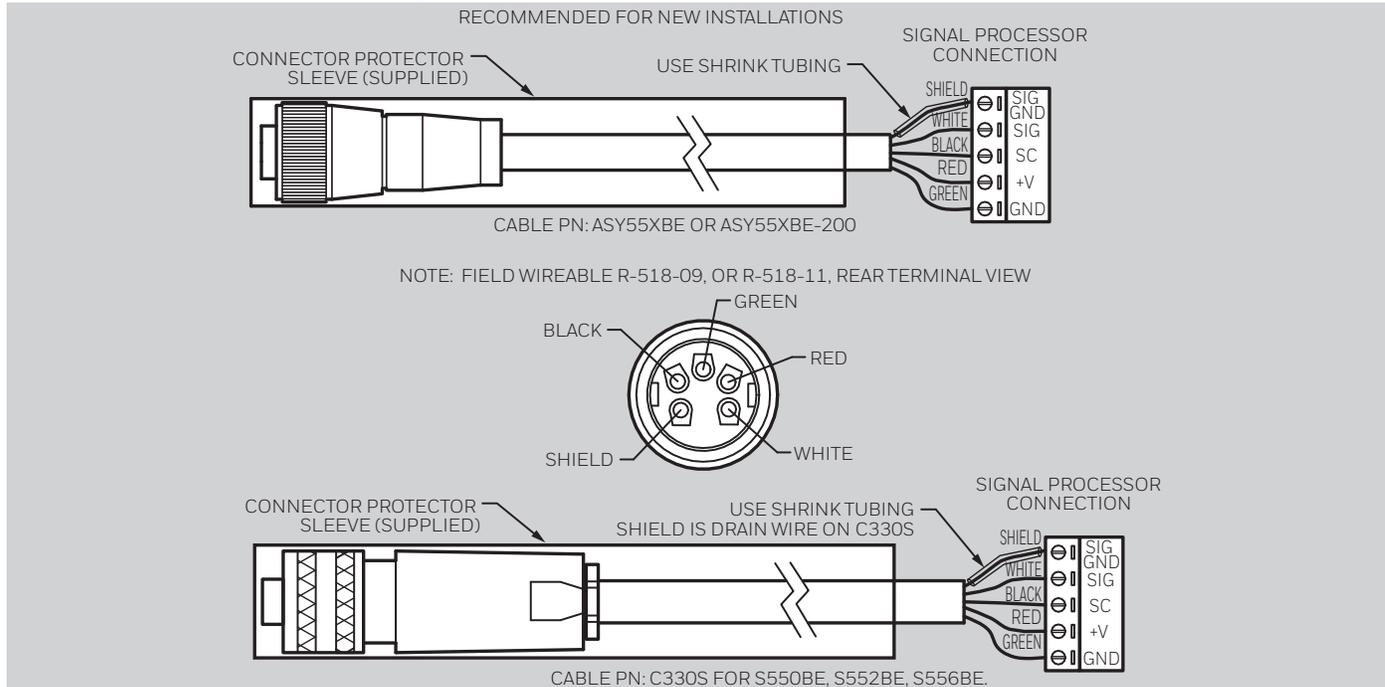
Wiring of the viewing head is made to the terminals on the lower right side of the P522. These terminals are described as follows:

### P522 Terminal Descriptions

Terminal	Description	Wire Color
+V	24 VDC power to viewing head	Red
GND	Power Ground	Green
SC	Check/shutter drive signal to viewing head	Black
SIG	Flame signal from viewing head	White
SIG GND	Drain Wire	Shield

See drawing below for S55xBE connections.

### Cable & Connections for the S550BE, S552BE, and S556BE viewing heads.



### Important

**Source impedance resistor required at the signal processor between SC and SIG GND terminals for proper signal transmission. For resistor value and wiring instructions, refer to the applicable signal processor manual.**

A source impedance resistor is required when using the P522 module with a S55XBE viewing heads. This resistor should be 330 ohm (factory installed) for viewing head cable runs up to 500 feet (152 meters), and it should be 150 ohm for cable runs 500 feet to 1000 feet (152 to 305 meters). The resistor should be installed across the SC and SIG GND terminals. A 1/4 watt resistor is suitable.

The shield is connected to the SIG GND pin of signal processor. The shield must be foil and braid type with drain wire >22g in order to maintain electrical path. It is recommended that Honeywell C330S cable be used for all new installations.

For detailed instructions on cable preparation and wiring the viewing head connector, refer to the applicable manual for the viewing head being installed.

### 3.6 Power Supply

#### NOTE:

*P522AC performs in a similar manner, but incoming power is converted to 24 VDC. For simplicity, reference is made below to the 24 VDC powered P522DC only.*

Careful consideration should be given to the power supply used for the P522. 24VDC is used to back bias the “steering” rectifier, to prevent the power from feeding into the 24 VDC supply. Each P522 module draws approximately 150 mA, and each viewing head draws about 100 mA of power current (24VDC). The amount of current drawn by the P522 will depend upon other factors that can affect the peak current, such as whether or not there is flame being detected, the remote meter output is connected, and serial communication is occurring.

The viewing head is powered through the P522 via a 0.25 A self-resetting fuse. In other words, the 24VDC power feeds into the P522 (through a 0.75 A self-resetting fuse) and feeds back out through a 250 mA fuse to the viewing head, resulting in a current drain of about 0.25 A for each P522 (with one viewing head). This small amount of current means that one power supply could support a number of P522 modules. The self-resetting fuses change to high resistance when their current ratings are exceeded, but recover to their normal low resistance when power is removed.

It is recommended that a maximum of four P522 signal processors be connected to one 24VDC power supply. For instance, four P522 processors with one viewing head each equals a total of 26 watts – a relatively small power supply, particularly if an efficient, switching type is used.

Other possible combinations can be used; for instance, the battery backup terminal could be used for redundancy. However, care must be taken with these redundant schemes to make sure that failure of the primary power supply won't affect the backup power supply, as well.

### 3.7 Redundant Power Supplies

It may be more economical to use larger-capacity power supplies for applications using twelve or more P522 signal processors.

For example: a 100-watt power supply may handle twelve P522 modules, each with one viewing head. Should the power supply fail, a redundant scheme utilizing two power supplies with “steering” rectifiers to prevent current from flowing into a failed power supply output would prevent the twelve flame monitors from being de-energized.

Larger power supplies can be used with this redundant wiring scheme if there are more than twelve P522 modules in a system. Care should be taken when wiring multiple P522s to ensure the selected bus wires will carry the current. The plug-in terminals on the P522 will accommodate a wire size up to 14AWG, allowing for relatively high currents. Note that, if the power wiring (24VDC) is “daisy chained” by using the terminal pairs provided, the pairs are “jumped” by copper traces on the mother board; so, if the plug is pulled out, the jumped connection is broken.

## 4 OPERATION

### 4.1 Self-checking

The self-check circuitry guards against internal component failures. There are several tasks that require intelligent interaction between the viewing heads and the signal processor. If all of the interactions do not occur properly, the viewing head will not send pulses back to the signal processor and the flame relay will open.

Verifying the validity of the gain code received is one of the tasks performed by the processor in the viewing heads. The self-check pulse from the signal processors is a 100ms-wide, 20V to 24V pulse with two notches or breaks in it. The position of each of the two notches communicates a gain code one to nine plus parity to the viewing head. The viewing head sends back an ID pulse in the first half of the 100ms self-check time. One viewing head expects to receive data with one parity and the other expects to receive data with the other parity. If a viewing head does not receive its correct parity plus the gain code once per second, it produces no output pulses.

### 4.2 Powering up the P522

Once the power is connected (24VDC) to the plug-in connector, the P522 will be operational. There is no ON/OFF switch on the P522; the moment it is powered on, it will reset and initialize. The self-checking light will start flashing, and one of the channel LEDs (A or B) will light (A will be ON if the channel select input at the plug-in connector is de-energized). The P522 will be reset when the power is turned on. For example: if the power goes off while you are in the process of storing a set point (either from the front panel or from the remote, host computer), the internal power monitor circuit will signal the P522 processor to complete the store function before shutting down in an orderly manner. This prevents bogus numbers from being stored and protects existing data in the EEPROM (Electrically Erasable Programmable Read Only Memory) from corruption, and is facilitated by a special internal power supply that holds a charge (like a battery) just long enough to allow the processor to do its job before going dead. This internal circuit monitors the 24VDC power feeding the P522, and when the voltage drops to about 19 volts, the processor shuts down, the program stops running, and the self-checking function ceases (the self-checking relay de-energizes). The blinking, SELF-CHECK O.K. light on the front panel will go out, and the flame relay will de-energize. Please note that the S509 and S512 viewing heads will shut down at about 17.0 volts; these heads have their own power-monitoring capability, and will shut down on their own, independent of the signal processor.

When the power feeding the P522 exceeds 19 volts, the processor starts the program again. The SELF-CHECK O.K. light will start blinking, and the selfcheck relay will energize. If flame is present and a S509 or S512 viewing head is being used, the flame signal will not come back on until the power reaches 21.5 volts. This can cause a lockout condition if the viewing head turns on during the dark period (defined by the periodic self-check signal going to the viewing head each second), requiring a manual reset of the P522. There is a 20 per cent probability that a lockout will occur because of the duty cycle of the selfcheck function (200 mSEC on and 800 mSEC off). The other viewing heads (the S506, S511) do not incorporate the power-monitoring shutdown function, and will not cause a lockout condition.

### 4.3 Set Points

There are 16 set points stored in memory in the P522, divided into two equal sets, A and B. The 5 items listed in table 2 can be accessed directly from the buttons on the face of the signal processor per the instructions below.

Set Point	Display	Number
Flame On	4-digit number	0001-2999
Flame Off	4-digit number	0000-2999
Gain Set For Analog Output	2-digit number	00-99
F.F.R.T.	1-digit number	1, 2, or 3
Time Delay On	1-digit number	0, 1, 2, or 3

To review any of the current set points for the 5 items above, simply push the desired button. For instance, to determine the current FLAME ON set point, press the FLAME ON button. The set point will be displayed on the readout for about four seconds, then return to normal. The set points displayed will be for the channel that is active, which is indicated by a steady illumination of push-button A or B. To see the other channel set points, first select the channel (A or B), then press the desired set point button.

For example: if channel A is already ON, indicating it is functional, and B is pressed, A will go out and B will proceed to flash slowly, indicating that further action is required. If A is already ON and A is pressed, it will stay steady ON and start to blink rapidly after any of the five set point buttons listed above are pressed.

In all cases, A or B will rapidly blink after the set point is selected. This action alerts the user that the current display is no longer that of the flame signal, and further action is required.

The fact that A or B is already on has nothing to do with the process of viewing the current set points, except that you do not have to select the channel if it is already on. The steady illumination of A or B indicates which channel is functionally active, and is selected at the plug-in terminals marked CHAN SEL.

At any time, you can press the reset button causing the P522 to go back to its normal operating condition. The reset button is also used for resetting the lockout condition.

Additionally, the viewing head temperature can be viewed by pressing the reset and down arrow button simultaneously.

### 4.4 Changing Set Points

Changing any of the five set points shown in table 2 can be accomplished by selecting the set point via its button on the control face and using the UP and DOWN arrow buttons to change the displayed value. When the desired number is displayed, press the STORE button. When the set point is stored, four dashes are displayed momentarily, indicating that the selected number was stored into the EEPROM. Illogical settings cannot be made; so, if four “E’s” are displayed when pushing STORE P.B., then an error was made when selecting the set points. For instance, selecting a flame out set point that is equal to or greater than the flame on set point will result in this error indication.

As well, the set points can be selected remotely through the serial communication port using a host computer.

### 4.5 Additional Set Points

Additional set points can be accessed by pressing the A and B buttons simultaneously. See Table below for settings, and flow chart at back of this manual.

Set Point	Display	Number
IR Gain	IR Filter	UV Gain
3-digit number	1-digit number	2-digit number
0-699	1-8	0-99

Additionally, the viewing head temperature can be viewed by pressing the reset and down arrow button simultaneously.

Only adjustment information pertinent to the attached viewing head(s) will be visible to the user; for a UV only viewing head, no IR GAIN or IR FILTER settings would be shown and for an IR only viewing head, no UV GAIN setting would be shown.

#### 4.6 IR Gain Adjustment

The adjustable range for IR Gain is 0-699 with a factory default value of 450. When adjusting IR gain, the user will notice gain “jumps”. As the gain is increased, the user will notice the following:

- 000 – 099 is linear and then it jumps to 150
- 150 - 199 is linear and then it jumps to 250
- 250 - 299 is linear and then it jumps to 350
- 350 - 399 is linear and then it jumps to 450
- 450 - 499 is linear and then it jumps to 550
- 550 - 599 is linear and then it jumps to 650
- 650 - 699 is linear

With each step change or “jump”, the gain is double but values in between are linear. For example, a setting of 250 doubles the gain setting of 150. When gain is adjusted to 000, the IR contribution is zero. There are 8 high pass filter settings available for most IR viewing heads (model dependent) as shown below.

- 1 = 16 HZ
- 2 = 24 HZ
- 3 = 33 HZ
- 4 = 52 HZ
- 5 = 75 HZ
- 6 = 100 HZ
- 7 = 155 HZ
- 8 = 215 HZ

#### IR Sensor Saturation

IR levels that exceed the range of the scanner will indicate flame counts >3400 at the P522 display, while indicating “99” on the S55x-BE flame scanner. This is IR sensor saturation. Saturation may occur from large flickering IR, or extremely high non-flickering IR (high temp or high gain setting). This allows for IR discrimination in low to high IR intensity applications while preventing nuisance shutdowns. See Setup and Adjustment Procedures for more information on proper setup.

#### 4.7 Flame Failure Response Time (FFRT)

The flame failure response time, or FFRT, is defined as the time it takes for the flame relay to deenergize after the flame signal (from the viewing head) is below the programmed Flame Off setpoint. This time delay is programmable from both the front panel of the P522 and a remote, host computer. Only three settings are possible: one, two and three seconds.

The maximum time delay is limited to three seconds in compliance with the FM (Factory Mutual) limit of the FFRT to less than four seconds.

#### 4.8 4-20 mA Remote Output

The standard remote meter output has a 0-20mA range and is designed to drive remote meters, as explained earlier in this manual. You can convert this output to a 4-20mA range, as follows: Press the front panel push-buttons (indicated in the table below) while holding down both the  $\gamma$  and  $\beta$  buttons. Press all buttons in each row together (i.e., three in the first row, two in the second row, and three in the last row).

#### Remote Output Setting

Flame On	Flame Off	Gain Set	FFRT	Time Del On
X	X	X		
			X	X
X	X	X		

Doing this toggles the function back and forth between the 0-20mA and 4-20mA ranges.

The change will be verified by four dashes “----” and “4- 20” momentarily displayed. If the module is programmed for the 4-20mA range, “4-20” will be displayed; toggling back to the 0-20mA range will again cause four dashes to appear on power-up of the unit. The factory default setting are 4-20.

The 4-20mA signal from the P520 is powered from the P520 itself. When sending the signal to a remote device (such as a distributed control system, PLC or burner management system), the input must be isolated. If there is a ground potential difference between the two systems, then there could be noise and performance problems. You will not encounter this problem when using a remote meter by itself, because it will not be tied into another electrical system (will not be sharing grounds).

The bar graph reading on the front panel will not be affected by this change to 4-20mA output. It will remain the same as before (i.e., go to zero on no signal detected). The 4-20mA output will still perform the same way on the high end (i.e., on a strong signal, it will saturate at the same level, slightly above 22mA).

Specifications for the analog current output signal are provided in the SPECIFICATIONS section.

## 5 SETUP AND ADJUSTMENT PROCEDURES

### 5.1 Sighting Adjustment

Before making definitive settings (i.e., establishing the set points) for FLAME ON/OFF, the user must first optimize the sighting of the viewing head. For detailed mounting and sighting information, refer to the applicable literature for the viewing head used.

### 5.2 Initial Setup

The initial settings for the P522 signal processor should be as follows:

- 1 F.F.R.T. (Time Delay Off) to 3 SEC.
- 2 GAIN SET to 25.
- 3 TIME DELAY ON to 0.
- 4 FLAME ON to 200.
- 5 FLAME OFF to 100.
- 6 IR GAIN to 451.
- 7 IR FILTER to 3 (33 Hz).
- 8 UV GAIN 32.

The above settings will be satisfactory for most applications, but are used only as a starting point. So many variables can affect the readings that it is impossible to catalogue all the settings, and each viewing head has its own characteristics for the different types of fuels and burners. We recommend that you become knowledgeable about the characteristics of the different viewing head models available before applying them to a particular application. Detailed descriptions of the viewing heads are provided in this manual, and the VIEWING HEAD APPLICATION TABLES (Fig. 9) are a useful summary of the viewing heads and their response to different fuels. The initial settings for the flicker type viewing heads (S509, S511, S512) should be as follows:

- 1 Set filter switch to LL position.
- 2 Gain potentiometers (POTS) full clockwise (these are 25-turn potentiometers – a slight clicking sound will be heard when the POT is maximum clockwise). There are two POTS on the S509: one for the Si channel, and one for the PbS channel. If the fuel is natural gas, turn the Si channel off (POT full counter clockwise). There are no initial settings for the S506 UV viewing head. It is important that this viewing head be properly aimed to pick up the maximum signal, as described in the previous section.

### 5.3 Adjusting Set Points

Before adjusting the set points, take readings with the P522 on the two following conditions; record the flamecount for the burner ON and OFF (with other burners on) under low load conditions, and then record the flamecount for the burner ON and OFF under high load conditions.

There must be a definitive ratio between the readings for burner ON and burner OFF. This ratio can be defined by using the lowest reading for burner ON from both of the load conditions, and the highest reading for burner OFF from both of the load conditions. If the readings are 2:1 or more (BNR ON to BNR OFF) then there should be no problem discriminating between burners.

A good balance for the set points would be:

$$\text{ON (Set Point)} = 0.75A + 0.25B$$

OFF (Set Point) =  $0.25A + 0.75B$

where A is the lowest burner ON reading, and B is the highest burner OFF reading.

A smaller ratio will work, as long as the lowest BNR ON reading and the highest BNR OFF reading never deteriorates to the point the former is equal to or less than the latter. In other words, A must always be greater than B. Using a safety factor of 2:1 will allow for flame signal changes that probably will occur over different operating conditions.

#### 5.4 Testing for proper operation

The system must be tested after commissioning to ensure that the flamecount produced from background radiation is less than the flame off threshold when the monitored flame is extinguished. (ex. When target flame is extinguished, flamecount drops and flame relay opens). Proper flame scanner setup is required to ensure safe operation.

#### 5.5 Background Burner Flame Test

Background burner flame radiation may be present when monitoring inside of a large furnace with multiple burners.

Below are example steps for testing and resolution.

- 1 Turn off monitored flame, while background flames are still present. Operate the background burner(s) at most intense flamecount. Flame relay should be open.
- 2 Restart monitored flame, and verify that flame relay closes.
- 3 Turn off monitored flame while background flames are present. Verify that flame relay opens.
- 4 If the flamerelay remains closed, then you are incorrectly detecting background flames.
- 5 If the scanner is detecting background flames, use one or more of the following suggestions to correct, and repeat test steps to ensure scanner is no longer sensing background flames:
  - Increase IR filter setting to reject background flames.
  - Reduce UV, or IR gains.
  - Re-position viewing head to sense high frequency of target flame, and low frequency background flame
  - Re-position head to view high intensity of monitored flame, and low intensity of background flame.

#### 5.6 IR Hold In Test

It is possible to setup the scanner so that hot refractory is detected as flame, causing the flame relay to “hold in” when flame has been extinguished. It is important to setup the scanner system properly so that background flame or refractory glow does not indicate flame presence when the monitored flame is extinguished.

Below are example steps for testing and resolution of hot refractory hold in.

- 1 Operate the burner until the refractory reaches its maximum temperature. If the installation is a multi-fuel burner, burn the heavier fuel that is most likely to reflect, bend or obscure the hot refractory steady infrared radiation.
- 2 When the maximum refractory temperature is reached, close all manual shutoff valves, or open the electrical circuits of all automatic fuel valves.
- 3 Visually observe the monitored flame, and note how long it takes from the time of flame loss, to when the scanner flamecounts fall below the off threshold, turning off the flame relay. If this time is longer than the FFRT time, then the scanner is sensing hot refractory.
- 4 Immediately terminate the firing cycle. Lower the setpoint to the operating controller, or set the Fuel Selector Switch to OFF. Do not open the master switch. NOTE: Some burners continue to purge oil lines between the valves and nozzles even though the fuel valves are closed. Terminating the firing cycle (instead of opening the master switch) allows purging the combustion chamber. This reduces a buildup of fuel vapors in the combustion chamber caused by oil line purging.
- 5 If the burner scanner is detecting hot refractory, use one or more of the following suggestions to reduce IR level, and repeat test steps to ensure scanner is no longer sensing hot refractory:
  - Reduce IR gain setting.

- Add an orifice to the flame scanner (see accessories).
- Re-sight the scanner at a cooler, more distant part of the combustion chamber. Make sure the detector properly sights the monitored flame.
- Try lengthening the sight pipe or decreasing the pipe diameter size.

#### 5.7 XRAY Radiation

Xray radiation does not affect signal processor, or viewing head IR sensor performance, and does not adversely affect viewing head tube sensor performance under the following conditions:

Radiation Source of 65 Curie Iridium 192

Distance > 5'

Exposure type Direct

UV tube gain set to default

Flame off threshold >600

If viewing heads are subjected to more severe conditions, system must be tested to ensure that radiation does not cause flame-counts above flame off threshold. If this occurs, flame off threshold must be increased, UV tube gain must be reduced, or lead shielding must be used.

#### 5.8 Viewing Head Temperature

The model S55XB/BE 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.

## 6 TROUBLESHOOTING

### Basic Troubleshooting Guide

Problem	Troubleshooting Steps
No Flame Signal and No Display	<ol style="list-style-type: none"> <li>1. Check wiring.</li> <li>2. Using a volt meter check the voltage at PWR IN terminals with a volt meter. It should measure approximately 24VDC or 85-264 VAC. If not, check the power supply and wiring, or replace the power supply.</li> <li>3. If 24VDC is measured, remove the power for 10 seconds. If the self-resetting fuse has tripped, removing then reapplying power will reset the fuse.</li> </ol>
Digital Display is Showing 0000 and No Flame Signal	<ol style="list-style-type: none"> <li>1. Remove connector from viewing head and check wiring per figures 2 and 3.</li> <li>2. Ensure the proper impedance resistor is in place (refer to Wiring of Viewing Head section).</li> <li>3. Using a volt meter, check the viewing head terminals on the P522, for 24VDC across +V and GND. If the voltage is low, check input voltage to the signal processor. If the input voltage is measured to be in spec, remove power and disconnect all connections to the viewing head(s). Wait 10 seconds (which resets the self-resetting fuse) and then reapply power and re-measure voltage across +V and GND.</li> <li>4. If voltage measures +24VDC (nominal) at the viewing head terminals at the signal processor, turn off power to the signal processor and using an ohmmeter check continuity of each cable wire from the signal processor terminals to the viewing head connector terminals. If cable continuity checks out, the viewing head may be defective.</li> </ol>
Flame Signal Shows On Display; Flame On Relay and Light are Off	<ol style="list-style-type: none"> <li>1. The viewing head is incorrectly wired, or defective (see above).</li> <li>2. The set point values for flame ON are incorrect.</li> </ol>
Flame Signal Shows On Analog Bar Graph Display; Flame On Light is Off; Lockout Light is On	<ol style="list-style-type: none"> <li>1. The viewing head may be defective.</li> <li>2. There may be a noise or grounding problem. Check that equipment is properly grounded and ensure good clean contact on all ground connections. Move viewing head and cable/conduit at least 12 inches (31 cm) away from any source of high powered switching (e.g. igniter equipment). Refer to Grounding and Shielding section.</li> <li>3. Press RESET button on front panel.</li> </ol>
I-9 LED Stays On	<ol style="list-style-type: none"> <li>1. There may be a noise or grounding problem (see above and refer to Grounding and Shielding section).</li> <li>2. The viewing head may be defective.</li> </ol>
Front Panel Buttons Do Not Respond	<ol style="list-style-type: none"> <li>1. The P522 front panel may be locked out.</li> <li>2. Signal processor may be in remote operation only mode.</li> <li>3. Cycle power to the signal processor with the viewing head connected.</li> </ol>

#### 6.1 Module Communications

The P522 communicates with any host computer that has a USB port and supports ASCII character code transmission at 4800 baud (or, in current revisions of the processor chip, at 4800 or 9600 baud). The baud rate is displayed with the module address in the current versions (see SETTING ADDRESSES, section). The data transmitted to and from the P522 is over two twisted pairs that are differentially driven and received according to the RS-422 standard. The differential mode allows long wire runs in harsh, electrical environments. Honeywell offers a RS485/422 to USB converter to use in conjunction with the P520 signal processor. The Honeywell part number is COMMOD. Modbus Communication protocol allows the P522 to communicate with open process controllers or human-interface host computers that support this protocol. The P522 processor status and settings are organized as 23 4X holding registers and five 0X discrete registers. For more information on Modbus protocol, please refer to Modicon's Modbus Protocol Reference Guide (PI-MBUS-300 Rev E).

##### 6.1.1 Communication Setting

P522 can communicate only in Modbus RTU mode, with the following configuration:

- 9600 baud
- 8 data bits
- No parity
- 1 stop bit

The factory default of a P522 station number is 0. It is important to change the station number so that there are no duplicate stations in the network.

To change or check the station number of the P522, proceed as follows:

- 1 Press and hold Reset button for 4 seconds.
- 2 The 4 LED digits will show the baud rate and the station number. The 2 left most digits are the baud rate (96 or 48); the 2 right most digits are station number from (0 to 63).
- 3 Press up/down button to change the station number.
- 4 Press Store button to save station number.

##### 6.1.2 Protocol Detect

P522 with firmware version 5.0 still supports the existing Honeywell proprietary protocol. After power-up, the processor will listen for both protocols. Once the protocol has been detected, communication must remain in this protocol until the unit is powered off.

##### 6.1.3 MODBUS RTU Function Supported

Four Modbus functions are supported:

- 01 Output Coil Read
- 03 Holding Register Read
- 06 Preset Single Holding Register
- 16 Preset Multiple Holding Register

### 6.1.4 Registers Map

Value	Description
<b>4X or Numerical Registers</b>	
400001	Flame Count Of Active Channel (read only)
400002	Processor Status (read only)
400002/0	View head/Channel Selected (0=Channel A)
400002/1	Flame On Relay Status
400002/2	Processor Lockout Status (0=lockout)
400002/3	Panel Access Disabled (0=disabled)
400002/4	4-20 output Status (0=0-40)
400003	Flame On Channel A
400004	Flame On Channel B
400005	Flame Off Channel A
400006	Flame Off Channel B
400007	Gain Channel A
400008	Gain Channel B
400009	IR Analog Gain Channel A
400010	IR Digital Gain Channel A
400011	IR Filter Channel A
400012	UV Gain Channel A
400013	IR Analog Gain Channel B
400014	IR Digital Gain Channel B
400015	IR Filter Channel B
400016	UV Gain Channel B
400017	View Head Type Channel A (read only)
400018	View Head Type Channel B (read only)
400019	Temperature Channel A (read only)
400020	Temperature Channel B (read only)
400021	Time Delay on (Upper nibble = B lower = A)
400022	FFRT (Upper nibble = B lower = A)
400023	Firmware Version # (read only)
<b>0X or Discrete Registers (All Read Only)</b>	
000001	View head/Channel Selected (0=Channel A)
000002	Flame On Relay Status
000003	Processor Lockout Status (0=lockout)
000004	Panel Access Disabled (0=disabled)
000005	4-20 output Status (0=0-40)

### 6.1.5 Communication with Human-Interface Host Computer

A number of Modbus drivers for Microsoft Windows 95 and NT are available from the third party developer, such as Rockwell Software's WinTelligent Linx Modicon. A Modicon driver allows application programs such as Microsoft Excel, Wonderware and RSView to communicate with the P520/P522 scanners directly.

### 6.2 USB to RS422 Conversion

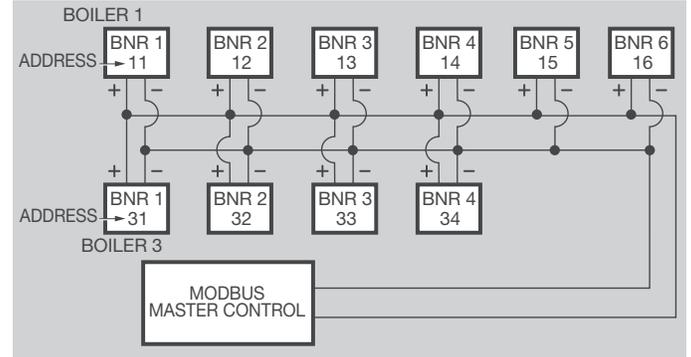
It is necessary to use a converter at the host computer. The Honeywell COMMOD converter module can be used, and is recommended because of its photocoupler isolation. The converter must have galvanic ground isolation.

### 6.3 Setting Addresses

Each P522 must have its own unique address. The address is easy to change. Press the RESET push button for >2 seconds, causing the P522 to display its address on the four-digit display (0000 to 0063), and change using the UP or DOWN arrow buttons. When the desired address is displayed, push the STORE button, and the P522 will restore this new address.

In P520 signal processors with software revision 3.p and higher, the baud rate can also be changed when the module address is changed. The baud rate is displayed in the highest two digits of the numeric display (i.e., 4802 is 4800 baud and address 2). To change to 9600 baud, increase the display past 4863. The next display will be 9600, which is 9600 baud, address 0. Then increase the display further to the desired address. To return to 4800 baud, reduce the display below 9600, and set the desired address.

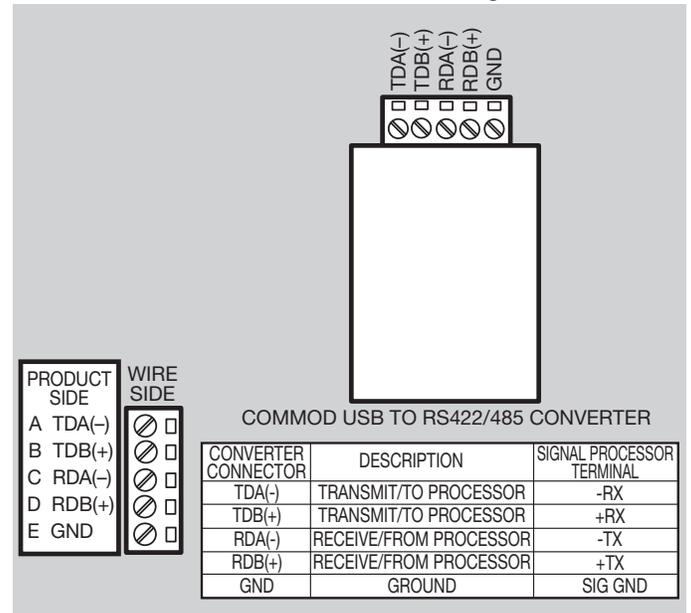
### Typical Communications wiring and recommended addressing



#### NOTES:

A CONVERTER MAY BE NECESSARY FOR COMMUNICATION WITH THE MODBUS MASTER CONTROL. USE SHIELDED CABLE FOR COMMUNICATIONS WIRING. DRAWING IS FOR GENERAL REFERENCE ONLY. FOR RS422 COMMUNICATION WITH THE P522, 4 WIRES FROM EACH SIGNAL PROCESSOR WILL BE REQUIRED (+RX, -RX, +TX, -TX), FOLLOWING POLARITY FROM EACH SIGNAL PROCESSOR. AT THE CONVERTER, THE TRANSMIT AND RECEIVE WIRES WILL BE REVERSED. REFER TO FIG. 9 FOR CONVERTER TO SIGNAL PROCESSOR WIRING DETAILS.

### COMMOD communication converter wiring

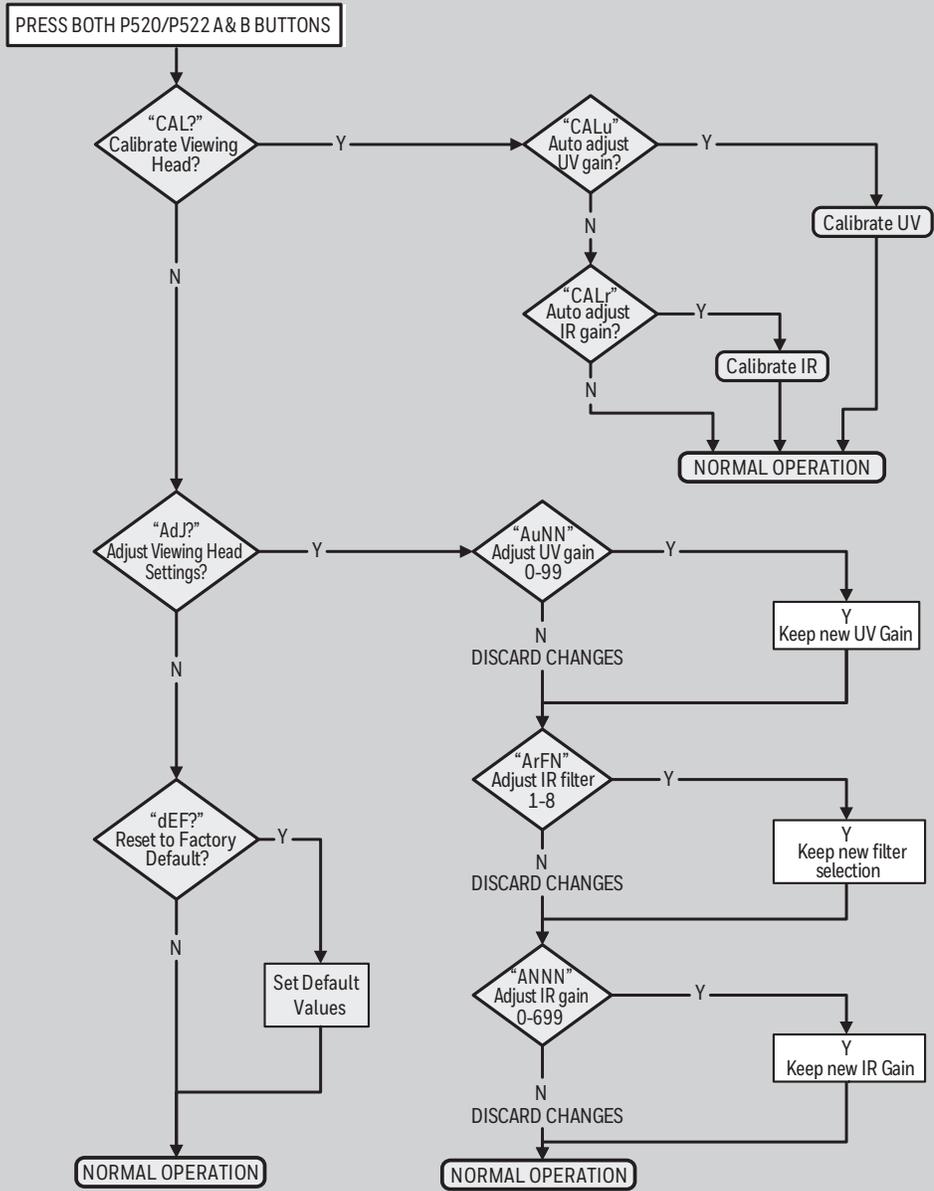


#### NOTES:

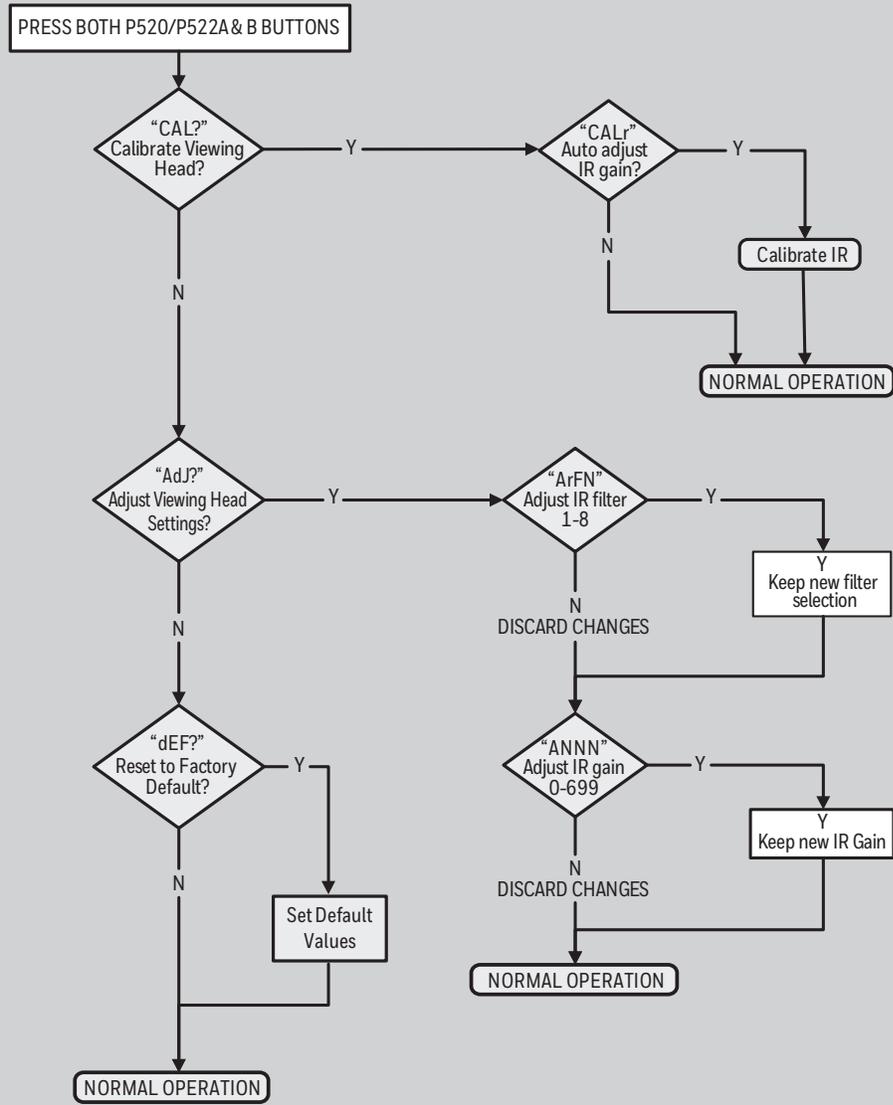
SELECT THE APPROPRIATE DIP SWITCH SETTINGS FOR RS-485 COMMUNICATION PER THE VENDOR'S INSTRUCTION SHEET.

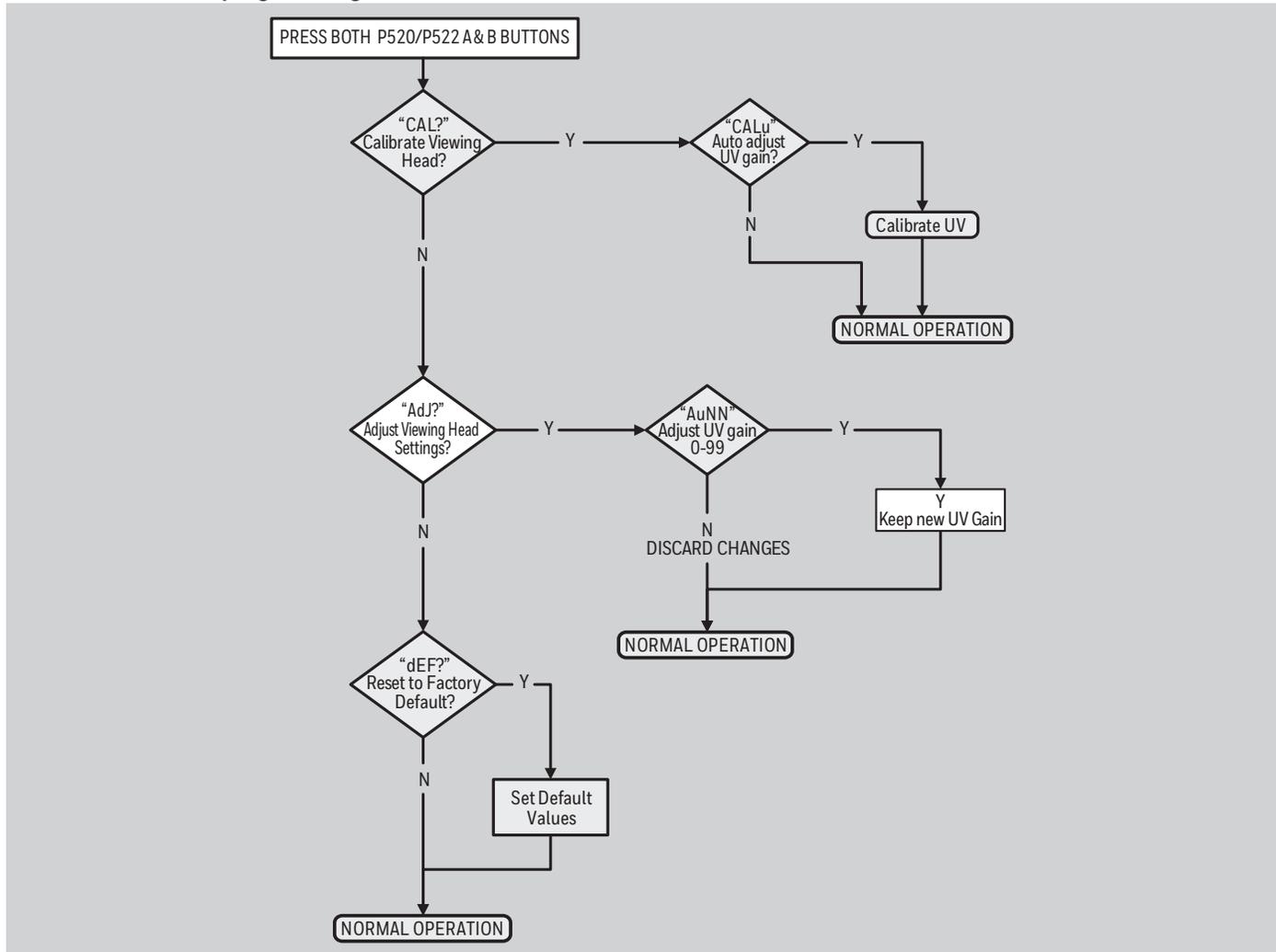
SOFTWARE DRIVERS MAY BE DOWNLOADED FROM B&B ELECTRONICS' WEBSITE.

P522 with S550B/BE programming flowchart



P522 with S552B/BE programming flowchart





## 7 SAFETY MANUAL

### 7.1 P522 Product Declaration

#### FIT FOR USE IN A LOW DEMAND SAFETY APPLICATION

Models: P522AC, P522DC

Models	SIL	HFT	PFD	SFF	$\lambda_S$	$\lambda_{DD}$	$\lambda_{DU}$
P522AC	3	0	$2.03 \times 10^{-4}$	>99%	$5.14 \times 10^{-6}$	$8.33 \times 10^{-9}$	$9.28 \times 10^{-9}$
P522DC	3	0	$2.03 \times 10^{-4}$	>99%	$4.49 \times 10^{-6}$	$8.33 \times 10^{-9}$	$9.28 \times 10^{-9}$

System Architecture	1oo1
MTTR	8 hours
Proof Test Interval	5 years
Fit for use in	SIL 3 environment

### 7.2 Definitions

Term	Definition
Dangerous Failure	Failure that has the potential to put the safety-related system in a hazardous or fail-to-function state.
Safety-Related System	A system that implements the safety functions required to achieve or maintain a safe state and is intended to achieve on its own or with other systems the necessary safety integrity for the required safety functions.
Safety Function	A defined function that is performed by a safety-related system with the aim of achieving or maintaining a safe state for the plant, in respect of a specified hazardous event.
Proof Test	Periodic test performed to detect failures in a safety-related system so that, if necessary, the system can be restored to an "as new" condition or as close as practical to this condition.
MTTR (Mean Time To Restoration)	The average duration required for restoration of operations after a failure.
$\lambda_{sd}$	Rate of safe detectable failures per one billion hours. For example, if $\lambda_{sd} = 3000$ , then it is estimated that there will be about 3000 safe detectable failures during every one billion hours of operation. For $\lambda_{sd} = 3000$ , this is about one safe detectable failure every 38 years.

Term	Definition
$\lambda_{su}$	Rate of safe undetectable failures per one billion hours.
$\lambda_{dd}$	Rate of dangerous detectable failures per one billion hours.
$\lambda_{du}$	Rate of dangerous undetectable failures per one billion hours.
System Architecture	Specific configuration of hardware and software elements in a system.
PFD <sub>AVG</sub> (Average Probability of Failure on Demand)	Average Probability of Failure on Demand. In this case regarding the P522 Signal Processor
FIT (Failures in Time)	A unit of measurement representing one failure per one billion hours. 1,000,000,000 hours is approximately 114,155.25 years.

### 7.3 Safety Function of the P522

The safety function of the P522 consists of a double pole double throw (DPDT) Flame Relay that behaves as follows:

The Flame Relay (Normally Open):

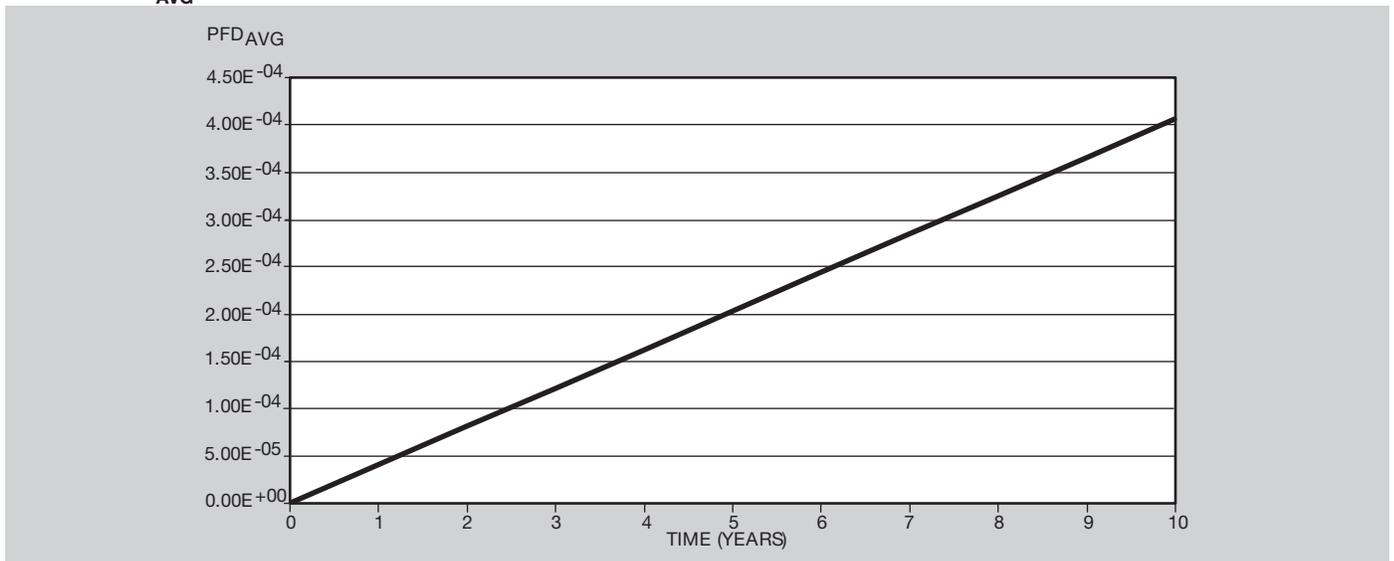
- The Flame Relay will be energized when the product is powered and a flame on condition is detected.
- The Flame Relay will be de-energized when the product is powered, a flame off condition is detected, and the FFRT (Flame Failure Response Time) has elapsed.
- The Flame Relay will be de-energized when the product is powered and detects a fault condition.

As an added safety feature, the coil of the Flame Relay is wired in series with a second pole of contacts on a Self Check Relay. The Self Check Relay is designed to be closed during operation of the signal processor and open during detection of a fault or power down. It is recommended that the user wire the Flame and Self Check Relays in series.

### 7.4 Proof Test Interval

The proof test must be conducted every 1 to 5 years. This range is given to allow for the test to be performed during the normally scheduled burner shutdown period. It is the responsibility of the user to perform the proof test in the specified time frame. The following diagram is used as an example to show the dependence of PFD<sub>AVG</sub> on proof test interval. PFD<sub>AVG</sub> increases as proof test interval increases.

**P522 DC PFD<sub>AVG</sub> vs time**



## 7.5 Proof Test Procedure

### 7.5.1 Equipment

- 1 P522AC or DC connected to S55XBE viewing head.
- 2 Multimeter capable of measuring up to 100VDC, and 1A DC.
- 3 DC power supply for DC and AC power supply for AC model.
- 4 A source capable of generating UV or IR signals as required.

#### NOTE:

For UV use Honeywell UV source.

For IR connect incandescent lamp to AC source.

### 7.5.2 Setup

- 1 Ensure the P522 under test is correctly connected to a compatible viewing head and is fully operational.
- 2 While performing the proof test, disconnect the 522 outputs so that any outputs due to testing do not affect the overall safety system and potentially cause a hazardous situation.
- 3 Record all previously entered user programmable settings so that you can restore them to their desired values after the proof test.

### 7.5.3 Tests

- 1 Apply 7.5-30V DC across the V.H. SEL terminals, being sure to obey polarity, then cycle power to the P522.
  - a If there is a viewing head connected to V.H. B on the P522 verify its operation using your light source.
  - b If no viewing head is connected to V.H. B verify the viewing head connected to V.H. A does not work using your light source.
- 2 Remove the voltage applied to VH SEL and cycle power to the P522.
  - a Verify the operation of the viewing head connected to V.H. A.
- 3 Apply 19-38V DC across the CHAN SEL terminals, being sure to obey polarity, then cycle power to the P522.
- 4 Remove the voltage applied to CHAN SEL and cycle power to the P522.
- 5 Remove power to the P522 and, using a multimeter, ensure continuity between SC C and SC OFF.
- 6 Reapply power to the P522 and, using a multimeter, ensure continuity between SC C and SC ON.
- 7 Use a light source to generate a flame on condition and, using a multimeter, ensure continuity between RF C and RF ON after the Time Delay ON has elapsed.
- 8 Remove light source to generate a flame off condition and, using a multimeter, ensure continuity between RF C and RF OFF after the F.F.R.T. delay has elapsed.
- 9 Measure the current draw of the P522 with at least one viewing head attached and ensure it is less than 330 mA
- 10 Measure the DC voltage between ground "GND" and "+V" going to V.H. A and V.H. B. Ensure it is between 20 and 26 V DC.
- 11 Change one of the settings of the P522 and store the changed setting. Remove power to the P522 for 10 seconds. Restore power to the P522 and ensure the settings value was stored correctly (remains unchanged).
- 12 Use your light source to generate flame counts of between 1200 and 2800 on the P522. Note the flamecount.
  - a Increase the UV or IR gain (whichever is appropriate for your sensor and light source) and store the settings. Ensure the flamecounts increased.
  - b Decrease the UV or IR gain (whichever is appropriate for your sensor and light source) and store the settings. Ensure the flamecounts decreased.

- 13 Restore all original settings as recorded in Setup and reconnect the P522 to the safety system.

## 7.6 Product Decommissioning

When required, decommissioning of the P522 Signal Processor should be performed in accordance with requirements of the overall safety system.

## 8 DISPOSAL

Devices with electronic components:

### WEEE Directive 2012/19/EU – Waste Electrical and Electronic Equipment Directive



At the end of the product life (number of operating cycles reached), dispose of the packaging and product in a corresponding recycling centre. Do not dispose of the unit with the usual domestic refuse. Do not burn the product. On request, old units may be returned carriage paid to the manufacturer in accordance with the relevant waste legislation requirements.

## FOR MORE INFORMATION

The Honeywell Thermal Solutions family of products includes Honeywell Combustion Safety, Eclipse, Exothermics, Hauck, Kromschröder and Maxon. To learn more about our products, visit [ThermalSolutions.honeywell.com](http://ThermalSolutions.honeywell.com) or contact your Honeywell Sales Engineer.  
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