

# Honeywell

# Flare Stack Monitor

## SPECIFICATION DATA



## APPLICATION

The WATCHDOGIII(BE) Flare Stack Pilot Monitoring System consists of three components, the Model S256BE viewing head, the Model P222 signal processor, and interconnecting cable with connector. The WATCHDOGIII(BE) Flare Stack Pilot Monitor electro-optically detects the presence or absence of a flame at the flare tip.

The WATCHDOGIII(BE)'s ultraviolet sensor dependably and reliably monitors the amount of ultraviolet energy being emitted by the flame.

When ultraviolet (UV) energy from the flame is detected, the WATCHDOGIII(BE) indicates that the flame is present. When no flame is detected, two flame proving relays with adjustable flame failure response time will be de-energized after the user-chosen time delay expires.

The WATCHDOGIII(BE) is designed to operate under typical and harsh conditions that may be present. The UVTron sensor used in the S256BE viewing head does not respond beyond wavelengths of 300nm; sun radiation is beyond 300nm. The response range allows the S256BE to be mounted anywhere around the flare stack - even when aiming straight towards the sun. The UVTron will work satisfactorily under heavy rain, snow, dust storms and fog. If the human eye can detect the flare flame from the viewing head location, the S256BE will perform

satisfactorily. The R1 flame relay includes an adjustable delay of 0-60 seconds and may be used for relighting the pilot. The R2 flame relay includes an adjustable delay of 0-3,600 seconds.

The S256BE is ground-mounted. The distance from the flare tip to the viewing head can be up to 1000 feet (300 meters), allowing the system to be installed, operated and maintained without interrupting the operation of the flare stack. Because the S256BE viewing head is ground mounted, it allows maintenance personnel easy access, should servicing be required.

## SPECIFICATIONS

### ELECTRICAL INPUT TO PROCESSOR

**AC Power:** 85 to 264VAC, 47 to 440 Hz  
300mA maximum with viewing head connected

**DC Power (As Main Power):** 22 to 26VDC, 300 mA maximum with viewing head connected  
**DC Backup Power:** 22 to 24VDC, 300mA with viewing head connected. Backup and main power can be connected simultaneously.

### ENVIRONMENTAL

**Model P222 Signal Processor:** Ambient Temperature: 0° C to 60° C (32° F to 140° F)

**Model S256BE Viewing Head:**  
Ambient Temperature: -40° C to 80° C (-40° F to 176° F)

**Viewing head housing:** NEMA type 4X / IP66

### OUTPUTS

**Relay R1:** 2 Form C contacts, adjustable delay of 0-60 seconds

**Contact Ratings:** 5A at 30VDC or 250VAC

**Relay R2:** 1 Form C contact, adjustable delay of 0-3600 seconds

**Contact Ratings:** 5A at 30VDC or 250VAC

**Analog Flame Signal:** 0 to 19.8 mA output for remote meters, or 4 to 19.8 mA output (360 ohm max resistance)



32-00034-02

**Power to Viewing Head:** 24 to 26VDC, 150 mA (powered from signal processor). Fused with self-resetting fuse at 0.25A

## INPUTS

**Manual Clear:** Connect to GND via remote switch to clear

**Channel Select:** Connect 24VDC to select channel B

## SERIAL COMMUNICATION

**RS-422/485 (Differential):** 4800, 9600, 19200 or 38400 baud (User selected)

## VIEWING HEAD

**Distance from pilot:** Up to 1,000 ft (300 meters) line of sight

**Field of view:** 40 ft (12 meters) Target diameter at 1,000 ft (300 meters).

**Cable Requirements:** 4 Conductor, #22 AWG, with braided shield. Honeywell C330S cable is recommended.

## APPROVALS

**Standards:** CSA C22.2 No. 213-M1987 (R2008), CSA C22.2 No 142-M1987 (R2009) and suitable for use in hazardous location; CLASS I, DIV 2, GROUPS C, D, T4

# INSTALLATION

## Power Requirements

The P222 can be powered from an AC Line Voltage between 85 to 264VAC at 47 to 440 Hz., or from an external 24VDC power supply. A 30W power supply is sufficient to power both the signal processor and viewing head.

The viewing head is powered by the P222 signal processor via a 0.25A self-resetting fuse. The power to the signal processor itself is via a 0.75A self-resetting fuse. These self-resetting fuses are reset when power to the signal processor is removed.

## Signal Processor Wiring

The P222 signal processor should be mounted in a suitable weatherproof and/or hazardous location enclosure as required by the application.

Refer to Fig. 1 on the following page, and proceed to wire the signal processor as follows:

## AC POWERED SYSTEM

Terminals are located on the top left of the unit.

1. Connect AC Line (hot) power supply to terminal AC1
2. Connect AC Neutral (or return to line power supply) to terminal AC2
3. Connect Ground to terminal GND. Local codes may require additional wiring requirements. Follow all installation site local jurisdiction requirements.

## DC POWERED SYSTEM

Terminals are located on the top left of the unit.

1. Connect +24VDC power to +24V IN
2. Connect -24VDC power to GND

## Relay R1 and Connections

Relay R1 will energize when flame is detected, and de-energize when flame has not been detected for R1 TRIP DELAY seconds. When energized, the R1 RELAY ON Led on the front panel will be illuminated. Often the flame relay R1 is used to trigger an ignition system to re-ignite the flame. It could also serve to trigger an alarm as a warning of loss of pilot. Two sets of Form C (SPDT) contacts are provided (DPDT). One set may be used for re-lighting the pilot and the second may be used for alarm.

Connections to this relay are made on the top right terminal connectors.

R1A COM and R1B COM are the common terminals, with R1A ON and R1B ON being closed for Flame On, and R1A OFF and R1B OFF being closed for Flame Off.

## Relay R2 and Connections

Flame relay R2 is typically used for alarm indication. The time delay for relay R2 must be longer than the time delay for relay R1. When the pilot flame is detected, the relay energizes immediately and provides a FLAME ON indication. The R2 RELAY ON LED on the front panel will be illuminated. When a flame is no longer detected, the R2 relay de-energizes after its adjustable R2 TRIP DELAY time, which must be longer than the R1 TRIP DELAY time.

Connections to this relay are made to the top center terminal connector. One set of Form C contacts are provided (SPDT).

R2 COM is the common terminal, with R2 ON being closed for Flame On (Delayed), and R2 OFF being closed for Flame Off (Delayed).

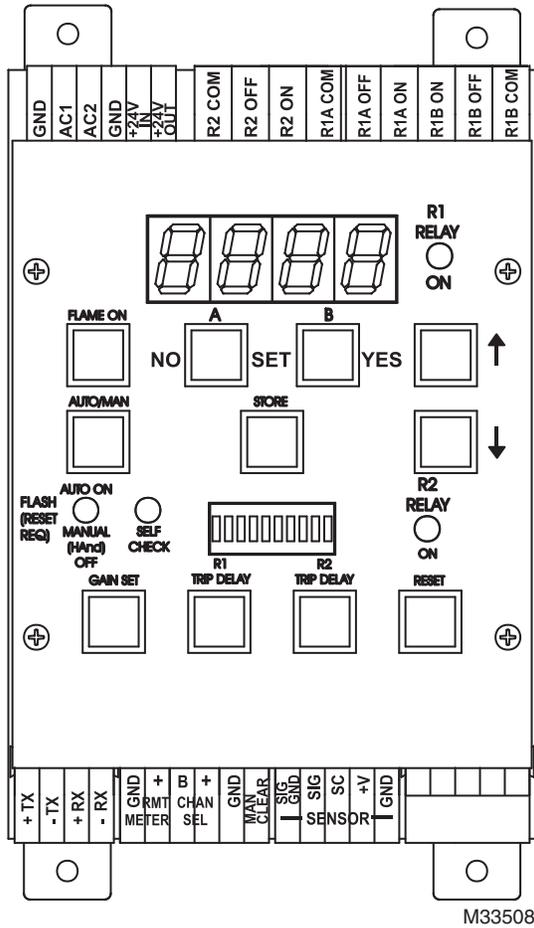


Fig. 1. Terminal labeling.

### Viewing Head Connections

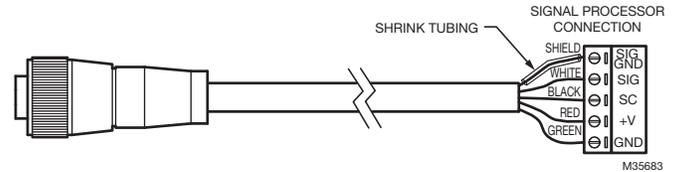
Connections to the viewing head are made to the connector on the bottom right.

For wiring, refer to the diagram in Fig. 2.

NOTE: Ensure that the viewing head signal wire and the signal ground (braided shield in the four conductor cable) are both connected, since this ground connection is the only return path for the signal and self checking circuit.

Important: Install the source impedance matching resistor on the signal processor between the terminals marked SC and SIG GND.

The required resistor is 330 Ohm, 1/4 Watt if the distance between the signal processor and the viewing head is less than 500 feet (150 meters). For a distance greater than 500 feet (150 meters), but less than 1000 feet (300 meters), a 150 Ohm, 1/4 Watt resistor is required. For distances greater than 1000 feet (300 meters), contact your local Honeywell distributor or the factory for guidance.



S256BE Connector

Fig. 2. Viewing head connector wiring.

### Remote Meter

The terminals located at the bottom of the signal processor designated RMT METER (to the left of the CHAN SEL terminals) are for the remote meter connection. This output is a current-driven signal that ranges from 0 to 20mA for remote meters, and can be switched to a range of 4 to 20mA (refer to the GAIN SET button).

The current signal can be used with an external volt meter by connecting a resistor across the analog output terminals marked GND and +RMT. For full scale deflection of 10 volts, use a 500 Ohm, 1/2 Watt resistor.

### Modbus Transmission to PC

The P222 signal processor uses RS422 data transmission over two, twisted wire pairs. The four terminals labeled +TX, -TX, +RX, and -RX are used for the serial communication link. Serial communication is achieved by using Modbus RTU.

RS422 converter is required to communicate via the USB communication port on the host computer.

NOTE: The terms "transmit" and "receive" used here with respect to the P222 will be reversed with respect to the RS422 to USB converter.

### Channel Select

A second set of configuration parameters can be stored and used in circumstances where flame characteristics and/or configuration needs require a second set of parameters. The CHAN SEL terminals are located at the bottom of the signal processor.

To set channel B configuration parameters press and hold the "B" button until it begins to flash quickly (the P222 is now in B channel adjust mode and all configurations for viewing head gain, time settings and flame off level can now be adjusted).

NOTES:

1. Whenever Channel A or Channel B parameters are being adjusted the appropriate channel light will flash quickly.
2. The B Channel is not active until selected by closing the contacts between the terminals marked B and +. The + terminal must be connected to the +24V OUT terminal located on top of the signal processor, next to the incoming power supply. A Modbus register is also available for switching Channel A and B control via an external computer.

## Manual Mode

Manual mode is entered by pressing the AUTO/MAN button on front of the signal processor. Additionally, manual mode is entered if the flame signal is absent for a period equal to the longest delay (relays de-energized). In manual mode, (HAnd), the Signal processor will not automatically respond (energize the relays) after a loss of flame until manually acknowledged (cleared)

Manual mode is indicated by the AUTO ON (yellow LED) being off.

If the flame signal is absent for a period equal to the longest delay (relays de-energized) the processor will enter the Manual Mode Tripped state (AUTO ON yellow led flashing), which requires a user RESET. In this mode the relays will not be energized if the flame is detected unless the manual mode is cleared by either a remote switch on the MAN CLEAR Terminal to Ground, or by pressing the RESET button on front of the signal processor. Note that pressing the RESET button in the Manual Mode Tripped state, will toggle between Tripped and back to ready states (indicated by the yellow LED flashing or off). The user must also select the Auto mode via the AUTO/MAN button for the signal processor to return to it automatic state.

## Wiring the Viewing Head

The viewing head wiring terminals are located on the lower right side of the P222 signal processor. The terminal descriptions are noted below in Table 1.

**Table 1. Terminal description.**

TERMINAL	DESCRIPTION
GND	Power Ground
+V	+24VDC Power to Viewing Head
SC	Self-Check signal to Viewing Head
SIG	Flame Signal from Viewing Head
SIG GND	Signal Ground

Fig. 2 shows a four-conductor cable connected to the viewing head plug.

### NOTES:

1. The WATCHDOG III BE comes standard with a 50' cable, longer cable lengths are available under Honeywell part numbers ASY55XBE-100 (100'), ASY55XBE-200 (200'), and ASY55XBE-300 (300').
2. The shield is used as a signal return path. The shield must be a braided type for this application, such as the Honeywell C330S. A foil only type shield should NOT be used for this application as it can break or open.
3. A source impedance resistor is required at the signal processor between the SC and SIG GND terminals for proper signal transmission. For resistor value and wiring instructions, refer to the Viewing Head Connections section.

## S256BE Connection

1. Thread the connector onto the S256BE ¼ turn beyond finger tight.
2. The cable at the signal processor end should be prepared as shown in the wiring diagram Fig. 1, making sure that the shield does not touch the other adjacent terminals.

## Viewing Head Location

Locate and mount the S256BE viewing head in the location that provides a clear view of the flame and also provides easy access. As the S256BE viewing head uses the UVTron tube, it is not affected by sun light. However, the following guidelines will help in satisfactory operation:

1. Limit elevation of the S256BE to 45 degrees or less. This will prevent debris from falling onto the lens assembly.
2. Make sure line of sight is clear and not obstructed by a building or activities that are typical in an industrial plant, such as road transportation.
3. If the site is dusty, air pressure may be required to ensure a clear view. Install an air connection on the S256BE hood.

## Viewing Head Aiming

At the back of the S256BE viewing head is a digital display, which shows the two most significant digits of the UV signal value shown on the P222 signal processor display.

Aim the S256BE using its telescope hood to align the viewing head to the target flame area. Note that both elevation and horizontal position adjustment are necessary.

Adjust the elevation and/or lateral movement to obtain the maximum signal. Refer to the Configuring the P222 section.

## OPERATION

### Self-Checking Function

When the signal processor is powered and the viewing head is properly connected, the self-checking function indicator SELF-CHECK LED flashes at a rate of once per second, confirming that both the P222 signal processor and the viewing head are functioning.

Any component failure will cause a lockout condition that will de-energize the flame relays. The SELF-CHECK light on the P222 will indicate this condition with a steady on or off illumination. A reset via the RESET button is required to return the system to the normal operating state. Reset can also be accomplished through serial communications.

If the fault condition still exists, the SELF-CHECK LED will be steady on or completely off. Generally, a steady on SELF-CHECK LED indicates the viewing head is experiencing an issue. If the SELF-CHECK LED is off, the most likely cause is that the signal processor is experiencing an issue.

Refer to the troubleshooting section for guidance.

## Front Panel LED Indications and Push Button Functions

The following describes the functions of the LED indicators, displays and push buttons of the P222 signal processor:

- Four digit display:
  - When in operating mode, the display indicates the current flame signal
  - After the FLAME ON button is pressed, the display indicates Flame On setpoint. This parameter may be adjusted using the up/down arrow buttons.
  - After buttons A and B are pressed, the display shows the menus to adjust gain, set default, select Modbus address, etc. Refer to the programming flowcharts in Fig. 8 and 9.
- R1 RELAY ON LED (red):
  - Only illuminated if the R1 relay is energized
- FLAME ON push button:
  - Allows user to select flame on threshold value. When the flame signal is above the selected value, the flame relay will be energized.
- A Push button:
  - Used in conjunction with B push button to select programming menu
  - Selects Channel A as indicated by flashing or steady on
  - Also acts as NO button while programming; do not accept during menu/adjustment selection
- B Push button:
  - Used in conjunction with A push button to select programming menu
  - Selects Channel B as indicated by flashing or steady on
  - Also acts as YES button while programming; do not accept during menu/adjustment selection
- ▲ (Up) Push button:
  - Used to increase parameter value when in programming mode
- AUTO/MAN push button:
  - Toggles between Auto and Manual modes as indicated on the display (Auto or HAnd).
  - Used in conjunction with AUTO ON LED, which when on indicates auto mode, when off means manual mode and when flashing means reset required (press RESET button)
  - In auto mode, flame relays R1 and R2 automatically energize when flame is recognized after a flame out condition.
  - In manual mode, flame will only be recognized after manual acknowledgement by the operator (press RESET button).
  - Note: Reset can also be accomplished from a remote point by closing the contacts between the GND and MAN CLEAR terminals on the signal processor
- STORE push button:
  - Stores new parameter values such as Flame On threshold and Gain
  - After making changes - - - - will be displayed indicating the new values are accepted and stored
- ▼ (Down) Push button:
  - Used to decrease parameter value when in programming mode
- AUTO ON / MANUAL (HAnd) / OFF LED (orange):
  - Steady on indicates auto mode
    - Off indicates the P222 is in manual mode (HAnd)
    - Flashes when reset is required (press RESET button)
- SELF-CHECK LED (green):
  - Flashes when system operation passes all self-check tests (normal)
  - Steady on indicates a lockout condition
  - Off indicates no power to P222 or internal fault
- Bar Graph display:
  - Indicates proportional flame signal level
  - Use GAIN SET push button and up/down arrow buttons to adjust output
- R2 RELAY ON LED (red):
  - Only illuminated if the R2 relay is energized
- GAIN SET push button:
  - Use in conjunction with the up/down arrow buttons to change the bar graph display gain. This button does not change the UV tube gain setting.
- R1 TRIP DELAY push button:
  - Use in conjunction with the up/down arrow buttons to adjust the R1 RELAY time delay (0-60 seconds) for flame failure response time
  - Value displayed as \_\_00
  - R1 relay output may be used for auto re-ignition of the pilot
  - Setting MUST be less than R2 TRIP DELAY setting
- R2 TRIP DELAY push button:
  - Use in conjunction with the up/down arrow buttons to adjust the R2 RELAY time delay (1second to 60 minutes) for flame failure response time
  - Value displayed as \_\_00 for time in seconds and 00\_\_ for time in minutes
  - R2 relay output may be used for alarm indication
  - Setting MUST be greater than R1 TRIP DELAY setting
- RESET push button:
  - Resets a lockout condition
  - Also used to exit a menu while programming the P222
  - Used to acknowledge the flame signal in manual (HAnd) mode, enabling the relays to energize
  - When pushed together with ▼ down arrow button, P222 will display the viewing head temperature in degrees C

## Configuring The P222

### Setting the R1 Relay Delay

Press the R1 Trip Delay button notice the current trip delay is displayed in seconds preceded by two underscores ( \_\_ 0 5).

Adjust to the desired value using the Up and Down arrow buttons and press store. (- - - -) will be displayed to indicate that the new value has been saved and the value that was saved is re-displayed for verification. The range in seconds is from 1 to 60 or from 1 to the value of R2 relay delay if it is less than 60.

### Setting the R2 Relay Delay

Press the R2 Trip Delay button. Notice that the current trip delay is displayed in seconds or minutes. If the value is preceded by two underscores ( \_\_ 0 5), then the delay is in seconds, else if the value is followed by two dashes ( 0 5 - - ), then the delay is in minutes. Adjust this to the

desired value using the UP and DOWN arrow buttons and press STORE. (---) will be displayed to indicate that the new value has been saved and the value that was saved is re-displayed for verification.

The relay R1 time delay must be shorter or equal to that set on the relay R2 time delay.

**NOTE:** If adjusting time delays during the wait period, the new setting will not take effect until after the previous set time has expired (or the flame is detected).

## Setting the UV Gain

The UV gain (00-99) can be set as follows:

1. If both the A and B configurations are used, first select the channel to be configured (A or B) by pressing and holding the appropriate button until it starts flashing.
2. Next press both the A and B buttons simultaneously (not the Gain Set button).
3. The LED for the channel being adjusted will flash and "Adj?" will be displayed.
4. To select manual adjustment, press the YES button. Pressing the NO button will result in the next step.
5. In adjust mode note display (Au32). Using the UP and DOWN arrows, adjust the gain to the desired value and press YES to store (do not push the STORE button to store the value). (---) will be displayed to indicate that the value has been saved and the value that was saved is re-displayed for verification.

In default mode, note display (dEF?). Press YES to reset all channel settings to default.

The processor will remain in adjust mode until the value is stored with the YES button or aborted with the NO button.

## Gain Set Button (Adjusting 4 to 20 mA Output)

Use the Gain Set button only to adjust the analog output gain (also indicated by the bar graph display). Use the UP and DOWN buttons to adjust until the correct value is displayed and press STORE to save.

Utilizing the bar graph as an indicator to the output is helpful in adjusting this value. The (---) will be displayed to indicate that the value has been saved and the value that was saved is re-displayed for verification.

## Changing Between 0 to 20 and 4 to 20 mA

At power-up, the current setting is displayed (followed by the Firmware version and viewing head detected).

To change from 4-20mA to 0-20mA analog output:

1. While holding the UP and DOWN buttons, simultaneously press the FLAME ON, AUTO/MAN and GAIN SET buttons. Release the FLAME ON, AUTO/MAN and GAIN SET buttons.
2. While continuing to hold the UP and DOWN buttons, press R1 TRIP DELAY and R2 TRIP DELAY buttons.

3. While continuing to hold the UP and DOWN buttons, simultaneously press the FLAME ON, AUTO/MAN and GAIN SET buttons. The new setting will be displayed:

## Viewing Head Temperature

Press both the RESET and the DOWN Buttons simultaneously on the P222 to display the internal temperature of the viewing head. Excessively high temperatures may reduce the life of the viewing head. The P222 will display a high temperature warning by flashing the viewing head temperature if the internal viewing head temperature exceeds specified limits.

## Troubleshooting

1. On power up, the P222 signal processor should display the current software version and "S256" if the viewing head connections are correct. If the display shows "0000" the most likely cause is a missing source impedance matching resistor. Refer to the Viewing Head Connections section.
2. On power up if the display shows "loop", and older version of the signal processor is being used. Install a jumper across the external meter connections GND and RMT+.
3. If the system has been operational and the flame signal is lost (assuming the flame signal is still present), the likely cause is improper S256BE viewing head aim due to movement/misalignment.

## Module Communications

The P222 communicates with any host computer that can be connected to a USB to RS422 or RS485 converter running appropriate Modbus protocol software. The baud rate is displayed with the module address in the current versions (see SETTING ADDRESSES, section). The data transmitted to and from the P222 is over two twisted pairs that are differentially driven and received according to the RS-422 standard (it can also be configured to communicate over a single shielded twisted pair using the RS-485 standard). The differential mode allows long wire runs in harsh environments.

## Communication Setting (Setting Addresses)

The P222 can communicate in Modbus RTU mode, with the following configuration:

- 4800, 9600, 19200 or 38400 baud (adjustable)
- 8 data bits (fixed)
- none, odd or even parity (adjustable)
- 1 stop bit (fixed)

The factory default of a P222 unit Modbus address 0. It is important to change the address number so that there are no duplicate addresses when setting up a network and/or replacing a processor.

To change or check the unit Modbus address number of the P222, proceed as follows:

1. Press and hold the Reset button for 2 seconds.
2. The 4 LED digits will show the baud rate and the Modbus address. The 2 leftmost digits are the baud rate (19, 38, 48 or 96); the 2 rightmost digits are the station number from (0 to 63).
3. Press the up/down button to change the Modbus address. When the display passes 63, it will indicate the baud rate. Pressing the up arrow button at this point will select a higher baud rate. For a lower baud rate, press the down arrow button until the display passes 0. Pressing the down arrow button at this point will select a slower baud rate.
  - Press the Store button to save the new Modbus address.
  - Press and hold the Reset button for 2 seconds.
  - The 4 LED digits will show the baud rate and the station number.
4. Simultaneously push the 2 buttons Flame On and Auto/Man.
5. The parity will immediately change to and display the new setting.

### MODBUS RTU Functions Supported

- 03 Holding Register Read
- 06 Preset Single Holding Register
- 16 Preset Multiple Holding Register

### Communication With Human-Interface Host Computer

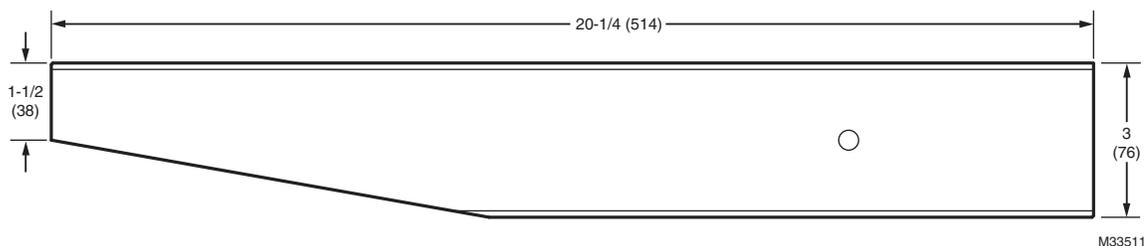
A number of Modbus drivers for your operating system are available from third party developers. These drivers allow your application programs to communicate with the P222 signal processors directly.

### RS-422 CONVERSION

Numerous converters are available to convert to RS-422 or RS-485 from RS-232, USB, EIA-232-E or TTL serial (Palm® compatible).

**Table 2. Registers Map.**

40001	R/O	Flame Count	
40002	R/O		
	0	Channel	0=Chan A 1= Chan B
	1	Delayed relay R2	Relay R2
	2	Lockout	Processor lockout status 0 = lockout
	3	Panel access	Disabled = 0
	4	Ma out type	1 = 4 to 20
	5	Early relay R1	Relay R1
40003	R/W	Flame on channel A (0 -> 2999)	
40004	R/W	Flame on channel B (0 -> 2999)	
40007	R/W	Ma out gain channel A (0 - 99)	
40008	R/W	Ma out gain channel B (0 - 99)	
40012	R/W	UV tube gain channel A (0 - 99)	
40016	R/W	UV tube gain channel B (0 - 99)	
40017	R/O	Viewing head A type	
40018	R/O	Viewing head B type	
40019	R/O	Temperature viewing head A	
40020	R/O	Temperature viewing head B	
40021	R/W	Delay time R2 Chan A	1 to 3600
40022	R/W	Delay time R1 Chan A	1 to 60
40023	R/O	Version	
40024	R/O	222	
40034	R/W	Delay time R2 Chan B	1 to 3600
40035	R/W	Delay time R1 Chan B	1 to 60
40062	R/O	Operational time in 2 hr increments	



**Fig. 3. S256BE viewing head dimensions.**

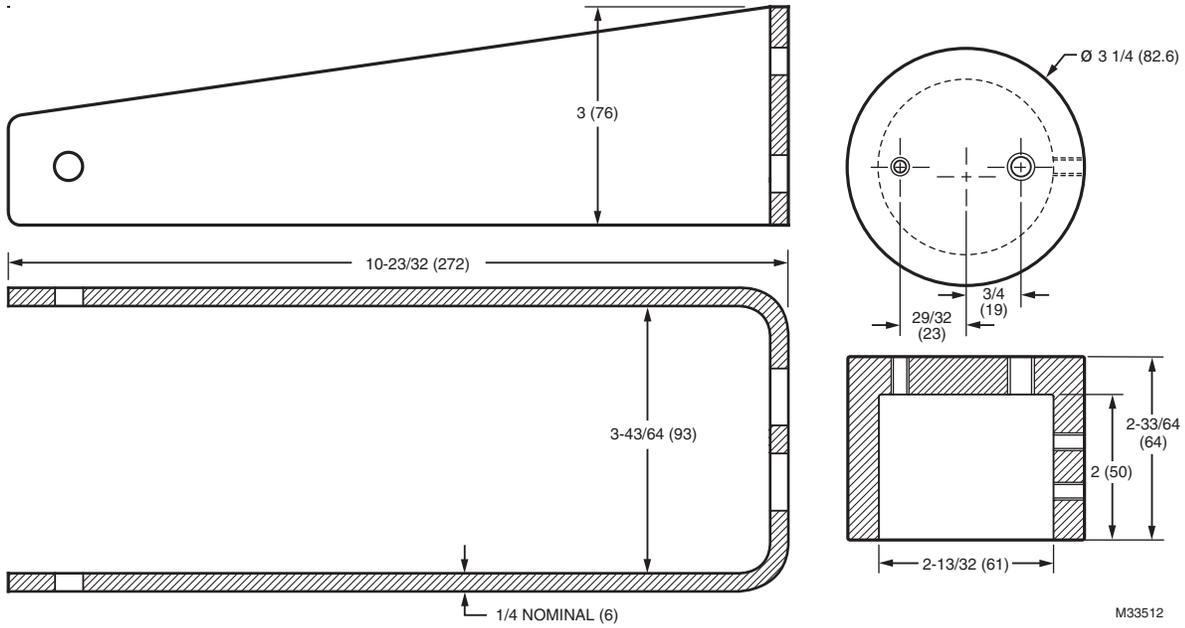


Fig. 4. Viewing head yoke and mount dimensions.

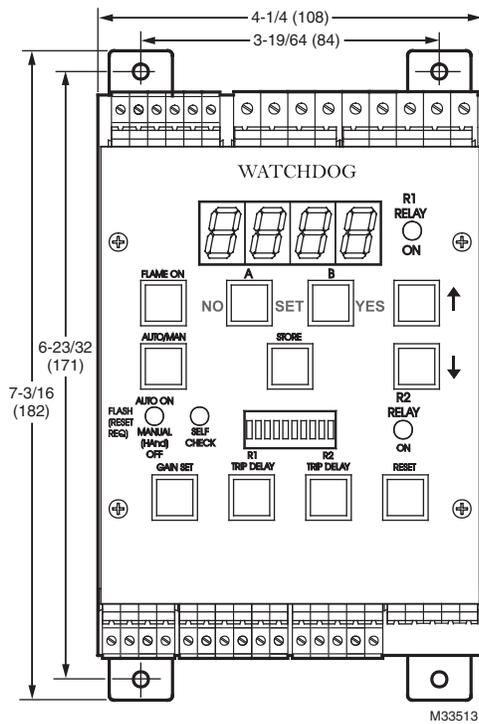


Fig. 5. P222 front dimensions.

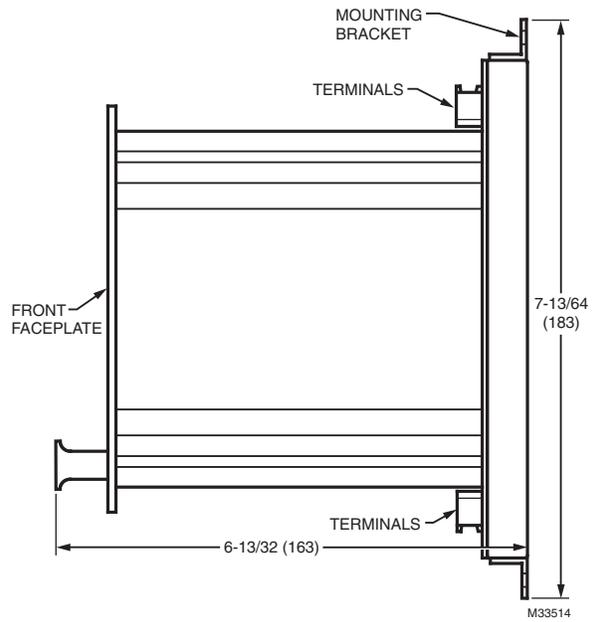


Fig. 6. P222 side dimensions.

## Programming for Watchdog III(BE)

Always disconnect and reconnect the viewing head while the signal processor power is disconnected. Connecting the viewing head while the P222 is "hot" may damage the unit and will not allow the processor to communicate with the viewing head.

Refer to page 5 for the P222 LED, display and push button functions.

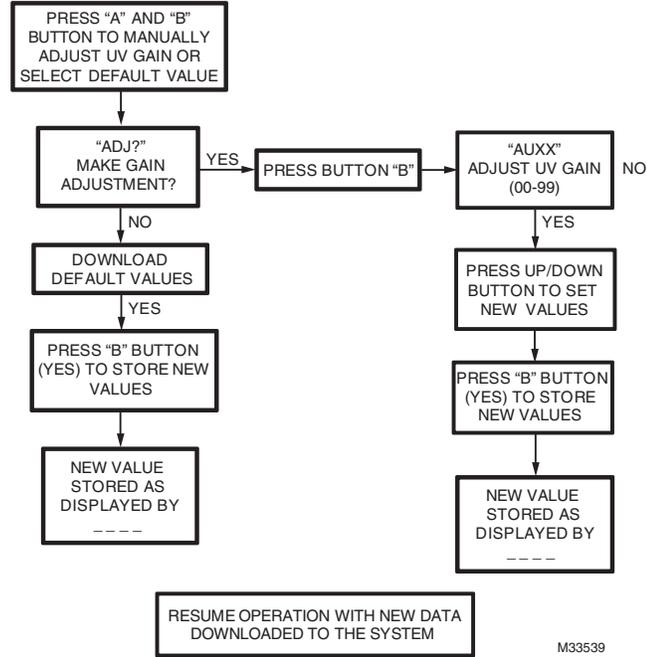


Fig. 7. Programming information flow chart.

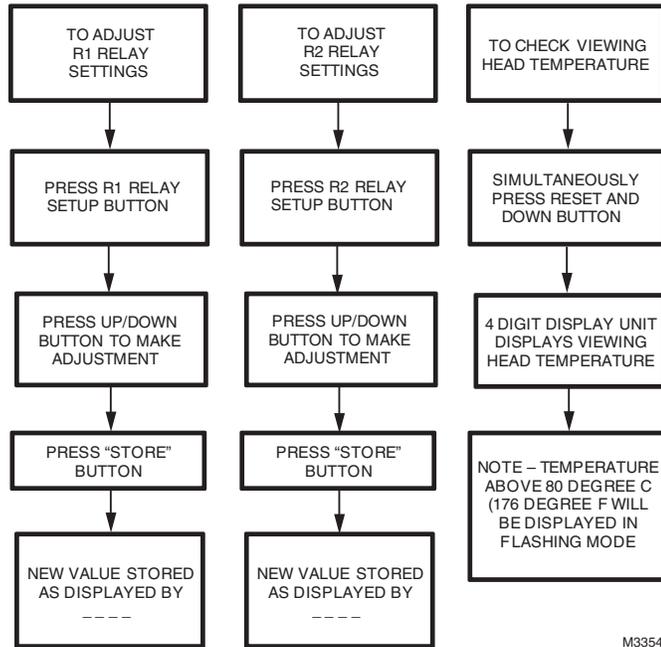


Fig. 8. Programming information flow chart





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