Instructions
and
Operating Manual

X96S

LEVEL GAUGE

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MEASUREMENTS DIVISION

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Overview

The X96S is a family of measurement products that is intended to replace the obsolete X96N and current X99 product families. These products:

- use nuclear measurement techniques,
- support all features of the obsolete X96N and current X99 products,
- support up to 32 scintillation or ionization detectors,
- optional HART interface,
- improved user interface options[1],
- more user functionality, and
- more product flexibility.

Advantages

- Mounts External to Existing Vessels
- Displays in Customer Units
- Most Applications can be solved with low-energy sources
- Not affected by:
  -extreme temperatures
  -caustic processes
  -sterile processes

Gamma's Advantages

- Mounts external to pipe or vessel (no components exposed to process material)
- Passes through process material
- Does not make material radioactive
- Does not change the material
- Can be shielded by lead

X96S Advantages

- HART Communications
- Identical interface on local display as via HART
- Blind transmitter in detector on self-contained design
- Custom configuration of display
- Surface, panel or rack mount available
- Field mountable
- Push button calibration

[1] This includes the ability to have a simple or complex user interface, a remote user interface, or even no user interface.

Basic Concepts

Communications

The Ronan X96S Level gage provides both 4-20 mA current loop and HART communications.

4-20 MA

For many years, the field communication standard for process automation equipment has been a 4-20 mA current loop signal. The current varies in proportion to the process variable being represented. In typical applications, a signal of 4mA will correspond to the lower limit (0%) of the calibrated range and 20mA will correspond to the upper limit (100%) of the calibrated range. Thus, if the system is calibrated for 1 to 3 feet, then an analog current of 12mA (50% of range) will correspond to a level of 2 feet.

HART

HART® Field Communications Protocol extends the 4-20mA current loop standard to enhance communication with smart field instruments. The HART protocol was designed specifically for use with intelligent measurement and control instruments which traditionally communicate using 4-20mA analog signals. HART preserves the 4-20mA signal and enables two-way digital communications to occur without disturbing the integrity of the 4-20mA signal. Unlike other digital communication technologies, the HART protocol maintains compatibility with existing 4-20mA systems, and in doing so, provides users with a backward compatible solution. HART Communication Protocol is well established as the "de facto" industry standard for digitally enhanced 4-20mA field communication.

The enhanced communications capability of intelligent field instruments employing the HART protocol, offers significantly greater functionality and improved performance over traditional 4-20mA analog devices. The HART protocol permits the process variable to continue to be transmitted by the 4-20mA analog signal and additional information pertaining to other variable, parameters, device configuration, calibration, and device diagnostics to be transmitted digitally at the same time. Thus, a wealth of additional information related to plant operation is available to central control or monitoring systems through HART communications.

Variables

There are two types of variables, communications variables and device variables.

Communication Variables

HART defines four device variables, PV (Primary Variable), SV (Secondary Variable), TV (Tertiary), and QV (Quaternary). PV is assigned to the primary 4-20 ma loop. HART is also communicated over this loop. SV is assigned to an optional secondary 4-20 ma loop.

Device Variables

The Ronan X96S Level gage has 2 device variables:

Device Variable	Value
Level	Level
Head Temp	Head Temperature

Configuration Variables

The Ronan X96S Level gage has many configuration variables that are accessed through its menus.

Theory

Theory of Radiation Gaging

Radiation gages operate on the principle of radiation absorption and transmission.

A beam of gamma radiation is directed from the source holder, through the vessel and its process material, and onto the surface of the detector.

Radiation which is not *absorbed* by the material through which it passes, is *transmitted* to the surface of the detector. Process measurement is possible because the amount of radiation *absorbed and transmitted* is predictable.

The absorbed radiation is directly related to the level of process material in the vessel while the transmitted radiation is inversely related to the level of process material in the vessel.

Therefore, an **increased process level results in a decrease of transmitted radiation.**

Since the radiation that's not being *absorbed* is being *transmitted*, the process level can be inferred by measuring the amount of radiation reaching the detector at any point in time. The detector's output signal, in counts, also *varies inversely* to the process level.

When the process level is low the detector is exposed to a maximum amount of radiation which produces a HIGH output of counts. When the process level is high the process material "shields" the detector and prevents radiation from reaching the detector, producing a LOW output of counts.

The X96S Microprocessor converts the detector signal to user's measurement units of level: m, mm, cm, in, ft.

The X96S displays the output measurement range in the selected user units. The "zero" of the measurement range represents the lowest level of interest, while the "span" of the measurement range represents the highest level of interest.

Reduction of the signal "noise" due to radiation statistics is handled in the stage of signal processing known as digital filtering. Digital filtering is a form of statistical averaging used to smooth, or dampen, random radiation as well as process-related noise. Increasing the digital filter's "time constant" decreases signal noise.

Dynamic tracking permits the gage response to temporarily by-pass the digital filter. This is helpful in some processes where sudden or drastic step changes in process must be observed in their true, or unfiltered, state.

Software also compensates for the decay of the radioactive source activity. On-going adjustments are made automatically for the rate of decay, or source half-life.

Principles of Operation

The detector's raw output signal is processed through several stages of software in the X96S.

Some of the more significant stages of signal processing are:

- Units Conversion – conversion of counts into user-selected level units
- Measurement Range – 4-20 mA output defined by the user-selected range in user-selected units.
- Digital Filtering – signal smoothing to reduce statistical radiation noise
- Dynamic Tracking – quick gage response to quick process changes.
- Source Decay Compensation – automatic compensation for the radioisotope decay
- Calibration (Referencing) – calibration of gage to user process.

The Calibration (or Referencing) procedure relates detector output (in counts) to numeric values that accurately represent the actual process level.

The level algorithm used by the X96S software is a simple transfer function. That is, the relationship between the detector output and the process level is mathematically expressed as:

$$Level = L_0 + \left(\left(\frac{I - I_0}{I_f - I_0} \right) \times \left(L_f - L_0 \right) \right)$$

Where:

I_f = detector signal with calibrate (full) level (L_f) in vessel
I_o = detector signal with reference (low) level (L_0) in vessel
I = current detector signal
L_0 = level @ reference (low level)
L_f = level @ calibration (high level)

Password

Notice:

To access the Programming Menu, the Password is **101010**.

Step 1: Power Up – You should now be on the Status Screen.

Step 2: Press F3 to go back.

Step 3: Now enter the password. (All digits are set at 000000 at this point.)

Press  to get the digit to be # one

Press  2 times (The third digit should be highlighted.)

Press  to get the digit to be # one

Press  2 times (The fifth digit should be highlighted.)

Press  to get the digit to be # one

Press F4 (enter)

Note: If the wrong password was entered, press **F1 (ALL0)** to set all the digits to the number 0 and you can begin re-entering the password from the beginning. Pressing **F2 (RST0)** will set the individual digit that is highlighted back to the number 0.

Note: For security reasons, each digit will always be displayed as an asterisk.

Menus/Operation

Menu Trees

The Ronan X96S Level Gauge uses a tree structured menu system.

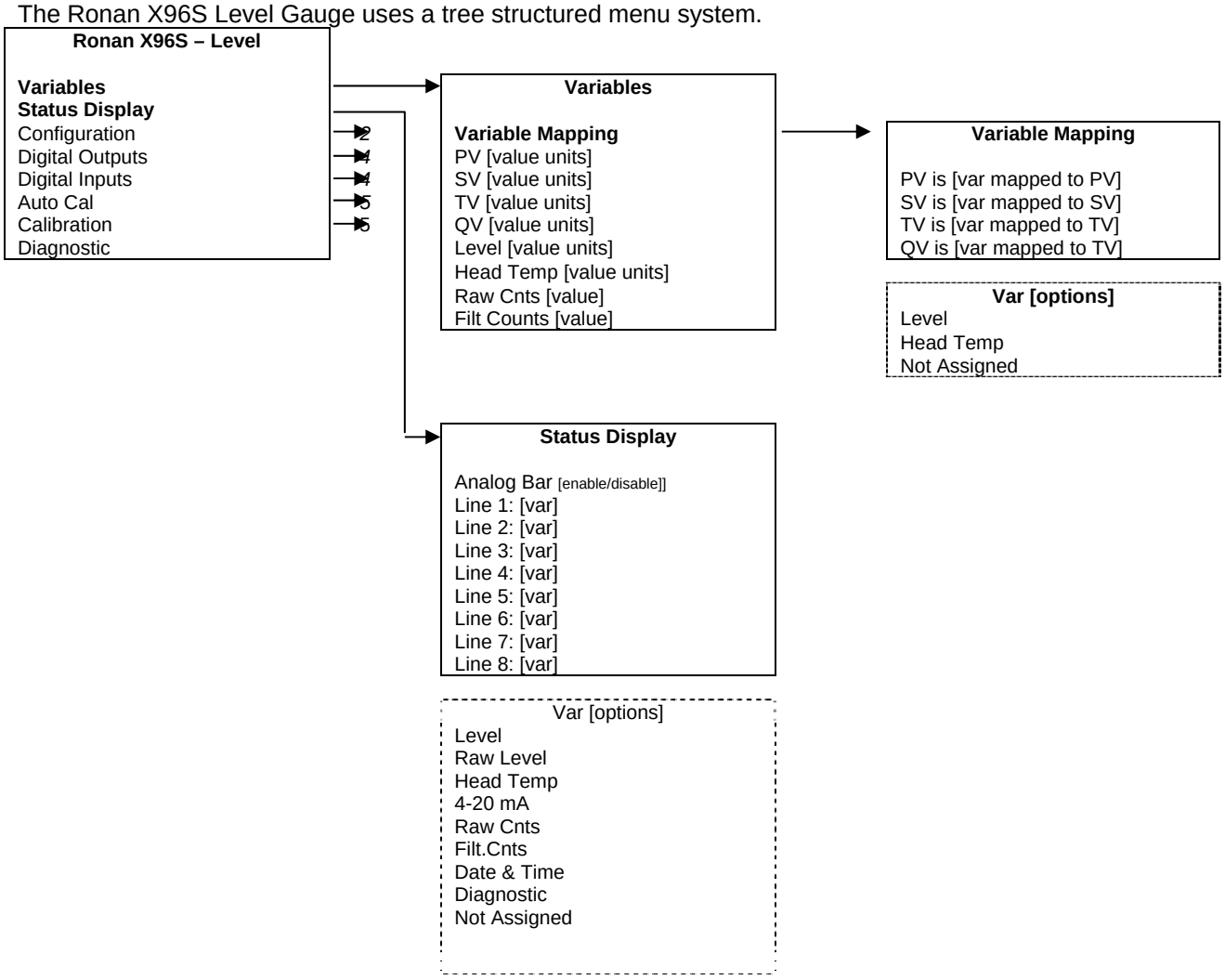

Figure 3-1 – Root, Variables and Displays Menus

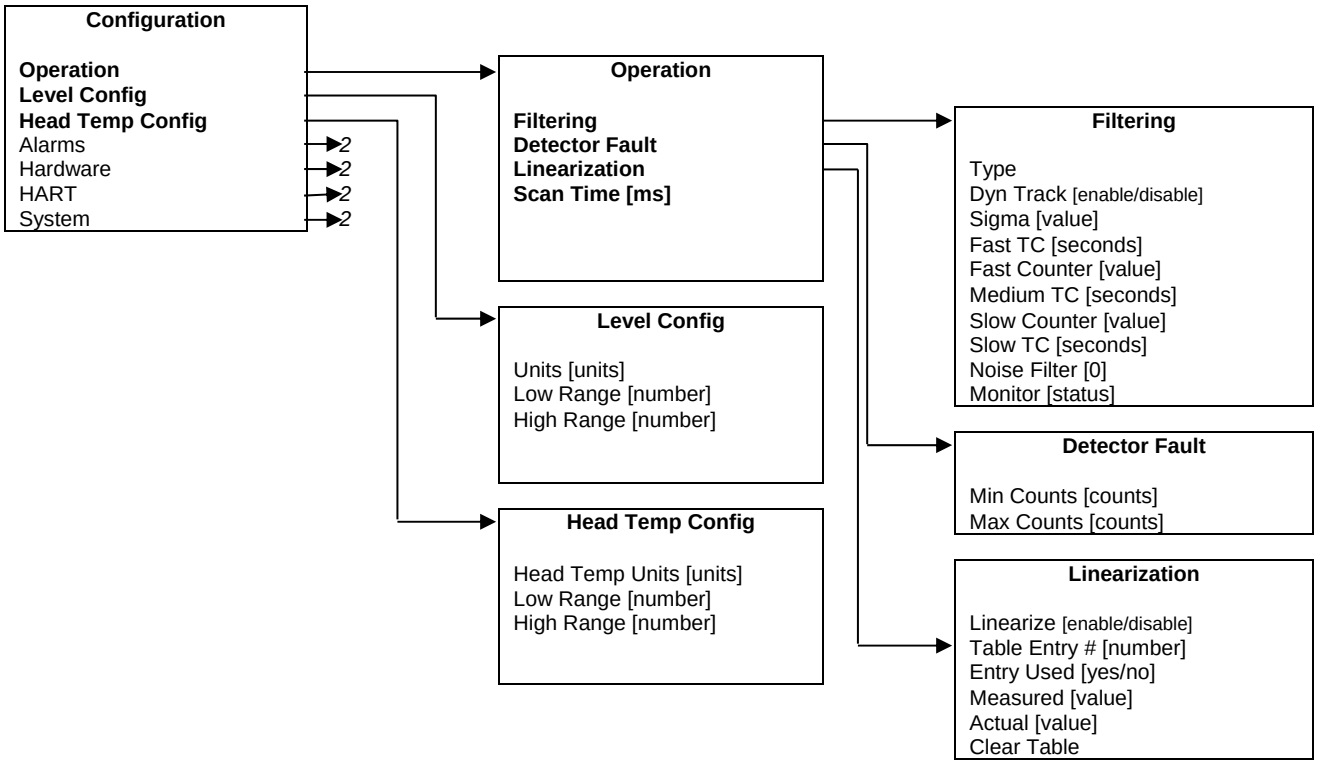

Figure 3-2 – Configuration Menus (1 of 3)

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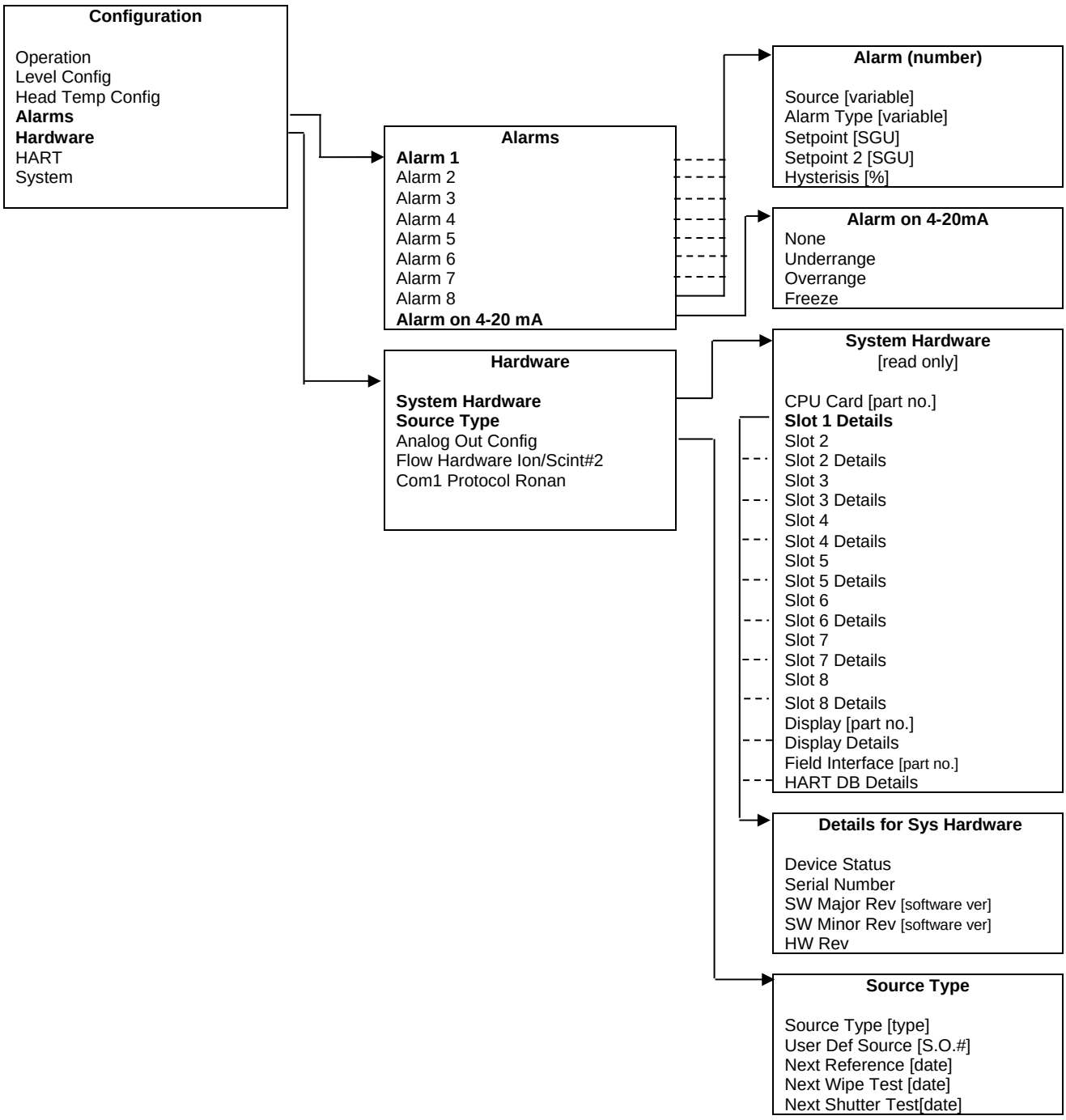

Figure 3-2 – Configuration Menus (2 of 3)

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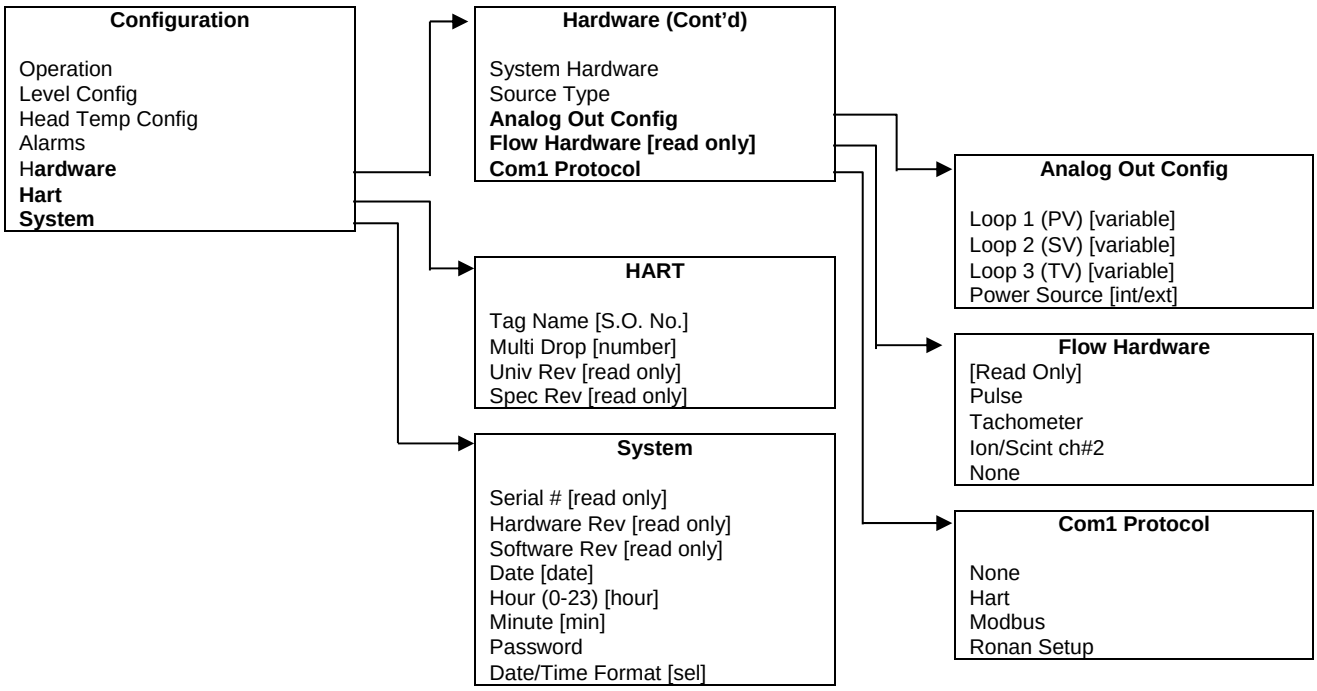


Figure 3-2 – Configuration Menus (3 of 3)

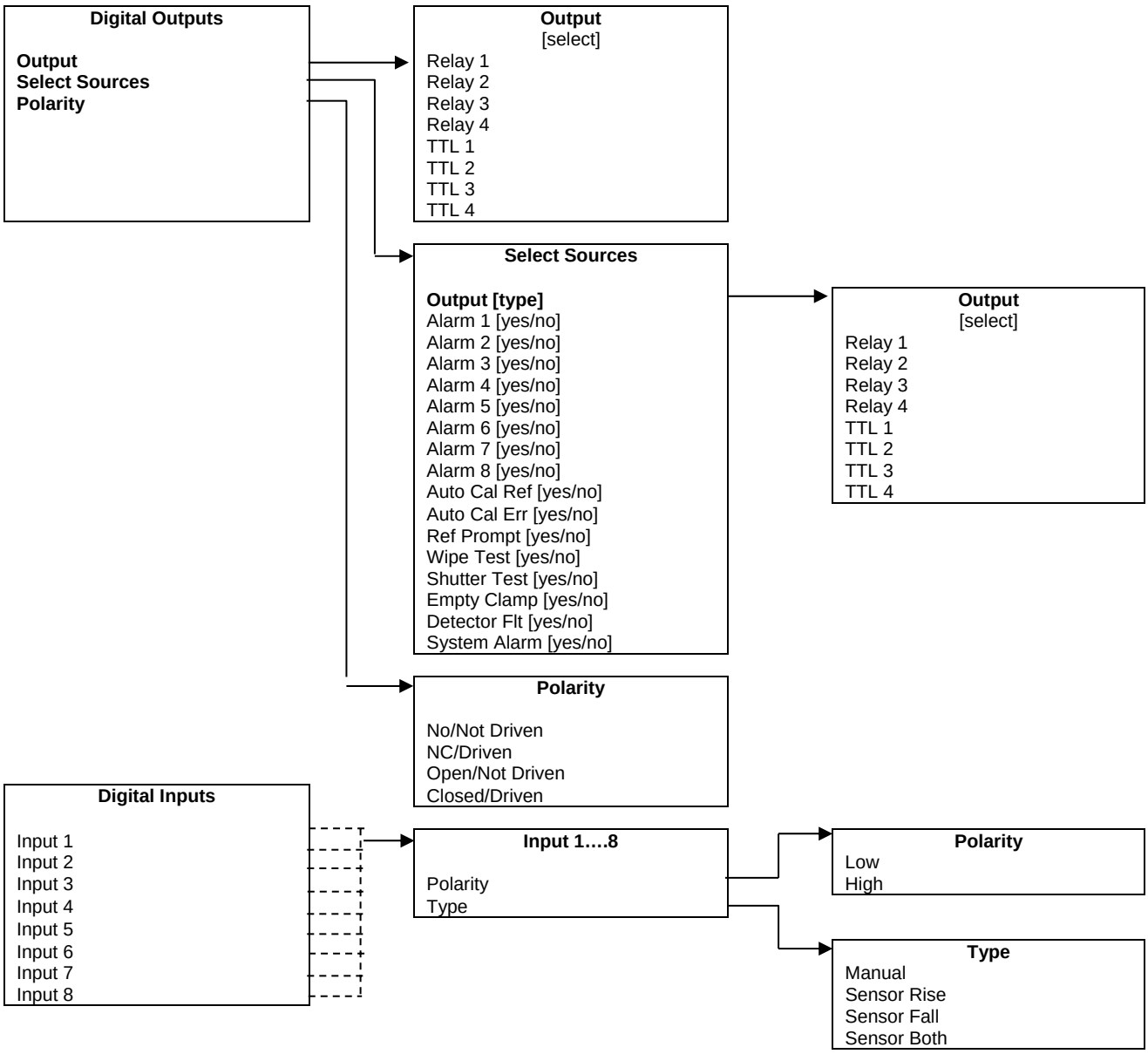


Figure 3-3– Digital Output and Digital Input Menus

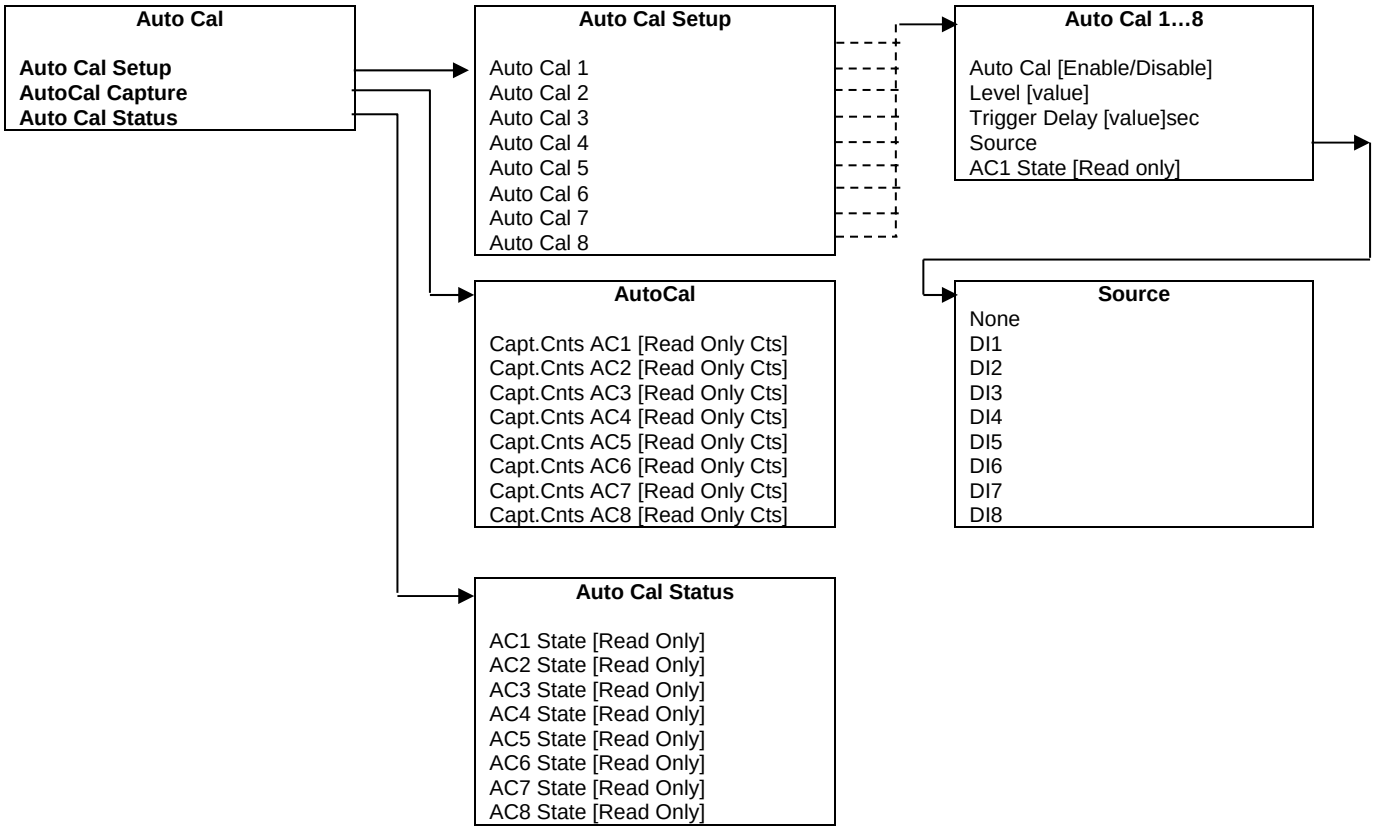


Figure 3-4– Auto Cal Menus

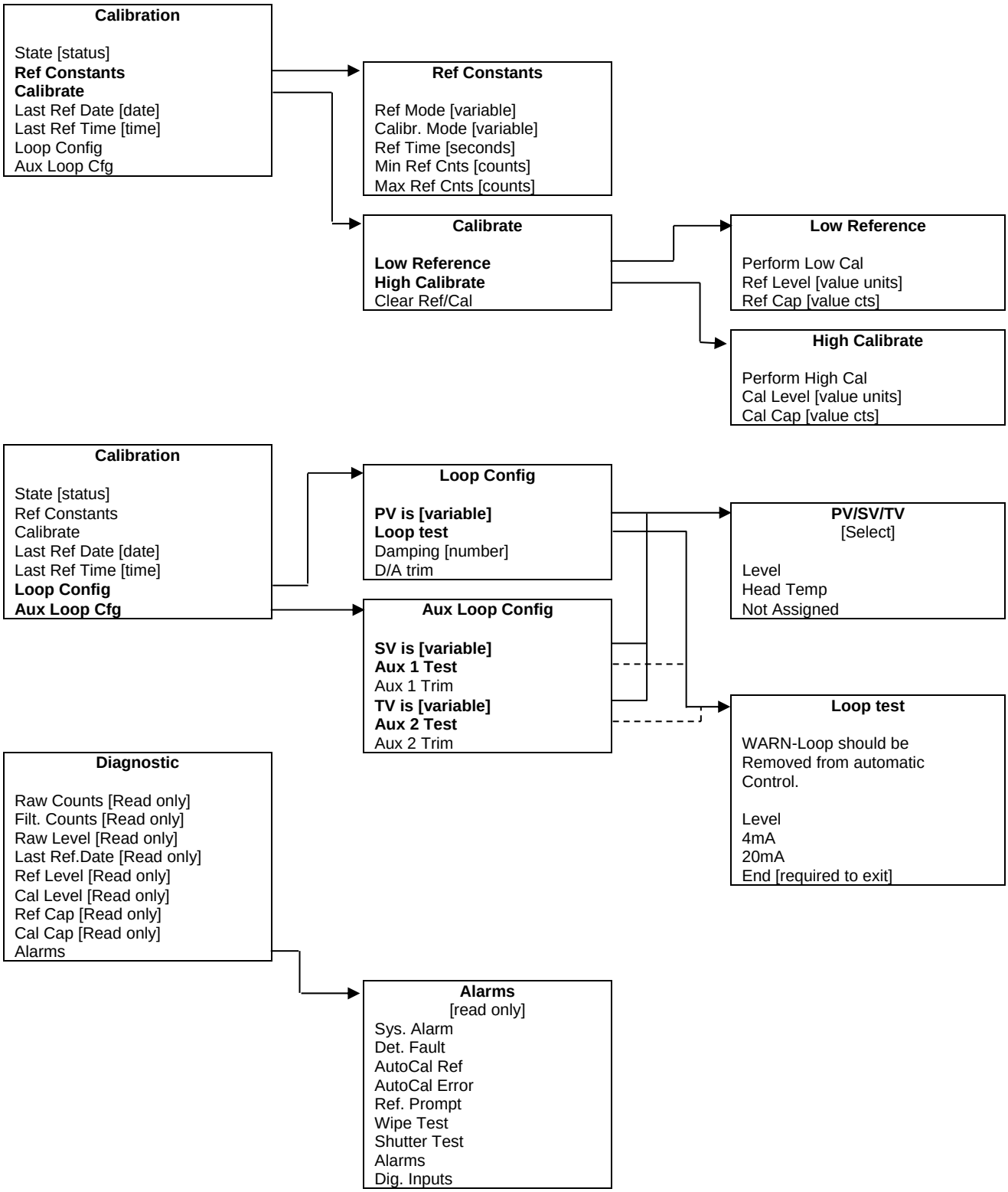


Figure 3-5 – Calibration Menus

Root Menu

The root menu is titled “Ronan X96S – Level”. It contains the following items:

ITEM	FUNCTION
Variables	Selecting this choice takes the user to the Variables menu
Displays	Selecting this choice takes the user to the Displays menu
Configuration	Selecting this choice takes the user to the Configuration menu
Digital Outputs	Selecting this choice takes the user to the Digital Outputs menu
Digital Inputs	Selecting this choice takes the user to the Digital Inputs menu
Auto Cal	Selecting this choice takes the user to the Auto Cal menu
Calibration	Selecting this choice takes the user to the Calibration menu
Diagnostic	Selecting this choice takes the user to the Diagnostic menu

Variables Menu

The menu titled “Variables” contains the following items:

ITEM	FUNCTION
Variable Mapping	Selecting this choice takes the user to the Variable Mapping menu
PV	Shows the current value of PV (the Primary Variable)
SV	Shows the current value of SV (the Secondary Variable)
TV	Shows the current value of TV (the Third Variable)
QV	Shows the current value of QV (the Fourth Variable)
Level	Shows the current value of the Level Variable
Head Temp	Shows the current value of Head Temp (the Head Temperature)
Raw Counts	Shows the current value of Raw Counts
Filt Counts	Shows the current value of Raw Counts

Variable Mapping Menu

The “Variable Mapping” menu allows the user to select the device variable to be mapped to PV, SV, TV, and QV. It contains the following items:

ITEM	FUNCTION
PV is	Shows the device variable assigned to PV and allows the user to change the selection
SV is	Shows the device variable assigned to SV and allows the user to change the selection
TV is	Shows the device variable assigned to TV and allows the user to change the selection
QV is	Shows the device variable assigned to QV and allows the user to change the selection

Each PV, SV, TV, and QV may each select one of the following:

SELECTION	MEANING
Level	Level
Head Temp	Head temperature (if available)
Not Assigned	Not Assigned

Status Display Menu

The Status Display menu is used to configure the device status display. It contains the following items and allow the user to change the selection:

ITEM	FUNCTION
Analog Bar	Shows the current state of the analog bar display (enabled or disabled) and allows the user change the state.
Line 1:	Shows the data to be displayed on line 1 of the status display
Line 2:	Shows the data to be displayed on line 2 of the status display
Line 3:	Shows the data to be displayed on line 3 of the status display
Line 4:	Shows the data to be displayed on line 4 of the status display
Line 5:	Shows the data to be displayed on line 5 of the status display
Line 6:	Shows the data to be displayed on line 6 of the status display
Line 7:	Shows the data to be displayed on line 7 of the status display
Line 8:	Shows the data to be displayed on line 8 of the status display

Each line can select one of the following:

SELECTION	MEANING
Level	Level
Raw Level	Raw Level [Level Indication before any type of correction is applied such as linearization]
Head Temp	Head temperature (if available) The Internal temperature of the detector electronics
4-20 mA	4-20 mA output level. This is a calculated value based upon the current level and the selected min and max range values. This is not a measured value.
Raw Cnts	Raw counts (from scintillation detector) or raw analog measurement (from ionization detector) before any filtering/dampening is applied. (counts per second)
Filtr.Cnts	Filtered Counts (from scintillation detector) or raw analog measurement (from ionization detector) after filtering/ dampening is applied. (counts per second)
Date & Time	Current date and time
Diagnostic	Diagnostic Menus. Allows the user access to the diagnostic menus from the status screen.
Not Assigned	Blank line

Configuration Menu

The Variables menu is used to access area configuration menus. It contains the following items:

ITEM	FUNCTION
Operation	Selecting this choice takes the user to the Operation menu
Level Config	Selecting this choice takes the user to the Level Config menu
Head Temp Config	Selecting this choice takes the user to the Head Temp Config menu
Alarms	Selecting this choice takes the user to the Alarm menu
Hardware	Selecting this choice takes the user to the Hardware menu
HART	Selecting this choice takes the user to the HART menu
System	Selecting this choice takes the user to the System menu

Operation Menu

The Operation menu is used to access the menus and variables that control the processing of the level data. It contains the following items:

ITEM	FUNCTION
Filtering	Selecting this choice takes the user to the Filtering menu
Detector Fault	Selecting this choice takes the user to the Detector Fault menu
Linearization	Selecting this choice takes the user to the Linearization menu
Scan Time	Shows the amount of time to accumulate each level sample and allows the user to change the time value.

Filtering Menu

The Filtering menu is used to configure the parameters associated with the mold level measurement filter, utilizing the standard scan rate. It contains the following items:

ITEM	FUNCTION
Type	Shows and allows the user to change to the RC 1st Order type of filtering (Resistance Capacitance Filtering) or the Walking Average type of Filtering.
Dyn Track	Shows the current state of the dynamic tracking filter (enabled or disabled) and allows the user to change the state.
Sigma	Shows the (sigma) multiplier used to determine maximum number of raw counts variation (for scintillation) or raw analog value (for ion chamber) that the input can vary from the current filtered counts before changing to the dynamic filter. Sigma is the square root of the current filtered counts. Also allows user to change this number.
Fast TC	Fast Time Constant value to be used when the Fast Counter reaches zero.
Fast Counter	Shows the fast count down counter value. If the gauge has been in dynamic tracking long enough to be using Medium filter and the raw counts continue to exceed the sigma value, the fast counter value is decreased each consecutive scan. The Fast counter value resets and returns to the original value if the raw counts do not continue to exceed the sigma value. Once the Fast TC is triggered, it will continue to be used until the counts are within the sigma value for the Fast counter number of times consecutively. Also allows user to change this number.
Medium TC	Medium Time Constant value is to be used when the Slow Counter reaches zero.
Slow Counter	Shows the slow count down counter value. If the gauge is in dynamic tracking, and the raw counts continue to exceed the sigma value, the slow counter value is decreased each consecutive scan. The Slow counter value resets and returns to the original value if the raw counts do not continue to exceed the sigma value. Also allows user to change this number.
Slow TC	Slow Time Constant value is to be used if the Slow Counter has not reached zero
Noise Filter	Shows the maximum number of potentially erroneous measurements in a row to bridge before deciding that a step change has occurred in the density value. Also allows user to change this number. Erroneous measurement is defined when the raw signal is 4 times the pre-selected sigma multiplier.
Monitor	Shows the current state of the filtering mechanism.

Monitor (filter state) is one of the following:

ITEM	MEANING
Error	Filter is not initialized (this state should not occur during normal operation of the X96S Level Gauge)
Fill	The walking average buffer is filling
Track	The walking average buffer is filled and the filter is tracking changes in the density value
Refill	A step change has occurred and the walking average buffer is refilling

Detector Fault Menu

The Detector Fault menu is used to provide an alarm if the detector fails. This alarm is assigned to one of the digital outputs (Relay/TTL).

Min Counts	Shows and allows the user the minimum number of counts the detector would operate under normal operating conditions. Any counts below this value means the detector failed. (typical count is 1 if scintillation; 0 if ion chamber)
Max Counts	Shows and allows the user the maximum number of counts the detector would operate under normal operating conditions. Any counts above this value means the detector failed. (Typical count is 80,000 per second; maximum count is 160,000)

Linearization Menu

The X96S can perform a multi-point linearization of the density data when required by an application. The linearization table contains 32 entries, numbered 1 through 32. Each entry consists of a measured value, an actual value, and a flag that indicates if the entry is used[2].

The Linearization menu is used to control the linearization mechanism. It contains the following items:

ITEM	FUNCTION
Linearize	Shows the current state of the Linearization mechanism (enabled or disabled) and allows the user change the state.
Table Entry	Shows and allows the user to select an entry in the linearization table.
Entry Used	Shows and allow the user to set the entry
Measured	Shows and allows the user to set the displayed indicated value associated with this linearization table entry. This is the nonlinear value calculated by the X96S when linearization is disabled.
Actual	Shows and allows the user to set the actual value associated with this linearization table entry. This value is the physically measured value of the process.
Clear Table	This invokes a method that clears all entries in the linearization table.

Level Config Menu

The Level Config menu is used to configure the parameters associated with the level measurement. It contains the following items:

ITEM	FUNCTION
Units	Shows, and allows the user to set, the level units used
Low Range	Shows, and allows the user to set, the level value to be mapped to 4ma on the current loop output, if level is selected to control that current loop.
High Range	Shows, and allows the user to set, the level value to be mapped to 20ma on the current loop output, if level is selected to control that current loop.

[2] Not all the entries need to be used and the entries do not need to be used in any particular order.

Units is one of the following:

Units	MEANING
ft	feet
m	meter
in	inch
cm	centimeter
mm	millimeter

Head Temp Config Menu

The Head Temp Config menu is used to configure the parameters associated with the detector electronics temperature measurement. This function is used primarily in high-temperature applications where the temperature exceeds the electronics temperature specifications. It contains the following items:

ITEM	FUNCTION
Temp Units	Shows, and allows the user to set, the units to be used for head temperature
Low Range	Shows, and allows the user to set, the temperature value to be mapped to 4ma on the current loop output, if head temperature is selected to control that current loop.
High Range	Shows, and allows the user to set, the temperature value to be mapped to 20ma on the current loop output, if head temperature is selected to control that current loop.

Temp Units is one of the following:

ITEM	MEANING
degC	degrees Celsius
degF	degrees Fahrenheit
degR	degrees Rankine
Kelvin	degrees Kelvin

Alarms

The Alarms menu is used to configure the parameters associated with the analog alarms. This applies to alarms 1-8 as well as the 4-20 mA alarm.

ITEM	FUNCTION
Source	Shows and allows the user to set the alarm source
Alarm Type	Shows and allows the user to set the alarm type
Setpoint	Shows and allows the user to set the alarm set point
Setpoint2	Shows and allows the user to set the second alarm set point[3]
Hysteresis	Shows and allows the user to set the alarm hysteresis percent

Alarm Type (Alarms 1-8) is one of the following:

ITEM	MEANING
None	Alarm not yet set
Low	Alarm when the source is equal to or lower than Setpoint
High	Alarm when the source is equal to or higher than Setpoint
Range	Alarm when the source is equal to or lower than Setpoint OR the source is equal to or higher than Setpoint2

[3] The second alarm set point is only used when the alarm type is range.

Alarm Type (Alarm 4-20 mA only) only occurs under one of the following three conditions:
1) System Failure
2) Empty Pipe Clamp
3) Detector Faults

The 4-20 mA output can be configured as one of the following if in "alarm" conditions:

ITEM	MEANING
None	Does not affect the 4-20mA output.
Under-range	If an alarm, then the 4-20 mA is driven under-range. 3.60 mA output will be transmitted.
Over-range	If an alarm, then the 4-20 mA is driven over-range. 21.00 mA output will be transmitted
Freeze	If there is an alarm, the 4-20mA output is frozen at the current reading just prior to the alarm occurring.

Hardware Menu

The Hardware menu is used to define the type of hardware used to provide measurements and radiation. It contains the following items:

ITEM	FUNCTION
System Hardware	Shows the user the list of hardware modules in the system and the status of these modules.
Source Type	Selecting this item takes the user to the Source Type menu.
Analog Out Config	Shows and allows the user to set the source of power as internal or external.
Flow Hardware	Shows and allows the user to set the type of device used to read the fill rate into the vessel. (Future use for determining linearization points)
Com1 Protocol	Shows and allows the user to adjust the Com1 Protocols [None/Hart/Ronan Setup].

System Hardware Menu

The System Hardware menu shows the user to a list of the hardware modules in the system and the status of these modules:

ITEM	FUNCTION
CPU Card	Shows the type of CPU card installed (in slot 1)
CPU Status	Status of the CPU card
DIO Card	Shows the type of DIO (Digital Input/Output) card installed (in slot 2)
DIO Status	Status of the DIO card
Slot 3 Card	Shows the type of card (if any) installed in slot 3
Slot 3 Status	If a card is installed in slot 3, shows the status of the card, else shows None
Slot 4 Card	Shows the type of card (if any) installed in slot 4
Slot 4 Status	If a card is installed in slot 4, shows the status of the card, else shows None
Slot 5 Card	Shows the type of card (if any) installed in slot 5
Slot 5 Status	If a card is installed in slot 5, shows the status of the card, else shows None
Slot 6 Card	Shows the type of card (if any) installed in slot 6
Slot 6 Status	If a card is installed in slot 6, shows the status of the card, else shows None
Slot 7 Card	Shows the type of card (if any) installed in slot 7
Slot 7 Status	If a card is installed in slot 7, shows the status of the card, else shows None
Slot 8 Card	Shows the type of card (if any) installed in slot 8
Slot 8 Status	If a card is installed in slot 8, shows the status of the card, else shows None
Display Type	Shows the type of display module (if any) attached
Display Status	Shows the status of the display module, if the module is attached, else shows None
HART	Shows the type of HART interface (if any) present
HART Status	Shows the status of the HART interface, if the interface is present, else shows None

Source Type Menu

The Source Type menu is used to define the type of radiation source used. It contains the following items:

ITEM	FUNCTION
Source Type	Shows and allows the user to set the source type
Usr Def Source	Selecting this takes the user to the User Def Source menu
Next Reference	Shows the date of when the next Reference should be completed
Next Wipe Test	Shows the date of when the next Wipe Test should be completed
Next Shutter Test	Shows the date of when the next Shutter Test should be completed

Source Type is one of the following:

ITEM	MEANING
Unknown	Source type not known
co_60	Cobalt 60
cs_137	Cesium 137
am_241	Americium 241
Usr Def	Any source type other than the ones listed above OR a source of the nominal type listed above with a different half-life

The User Def Source menu is used to define the type of radiation source used. It contains the following items:

ITEM	FUNCTION
Name	Shows, and allows the user to set, the source type name
Half Life	Shows, and allows the user to set, the source half life

Flow Hardware Menu

The Flow Hardware menu is used to define the type of flow input used. It contains the following items:

ITEM	MEANING
Flow Pulse	Pulse input through the Digital Input Card
Line Down	Dry Contact signal through the Digital Input Card
Tachometer	Analog signal voltage or current through the Analog Input Card
Ion/Scint, ch.#2	Special configuration of the scintillation/ion card for 4-20mA input
None	No flow input is used

Com1 Protocol contains the following items:

ITEM	MEANING
None	No protocol selected
HART	HART protocol
Modbus	Modbus protocol
Ronan Setup	Ronan Setup protocol

HART Menu

The Hardware menu is used to provide information about the HART interface. It contains the following items:

ITEM	FUNCTION
Tag Name	Shows, and allows the user to set, the device tag name
MultiDrop	Shows, and allows the user to set, the multi-drop address for a device (or 0 if the device is not used on a multi-drop loop)
Univ Rev	Shows the HART universal command revision to which this device is conformant
Spec Rev	Shows the HART specification revision to which this device is conformant

System Menu

The System menu is used to provide information about the X96S. It contains the following items:

ITEM	FUNCTION
Serial #	Shows the device serial number
Hardware Rev	Shows the device hardware revision
Software Rev	Shows the device software revision
Date	Shows and allows the user to set the date
Hour (0-23)	Shows and allows the user to set the hour
Minute	Shows and allows the user to set the minute
Date/Time Format	Shows and allows the user to set the date/time format used on the status display

Date/Time Format is one of the following:

Date/Time Format	MEANING
mm/dd/yy hh:mm:ss	North American date and 24 hour time
mm/dd/yyyy hh:mm:ss	North American Y2K date and 24 hour time
mm/dd/yy hh:mm:ss am/pm	North American date and 12 hour time with am/pm indication
dd-mm-yy hh:mm:ss	European date and 24 hour time
dd-mm-yyyy hh:mm:ss	European Y2K date and 24 hour time
dd/mm/yy hh:mm:ss	European date and 24 hour time
dd/mm/yyyy hh:mm:ss	European Y2K date and 24 hour time

Digital Outputs Menu

This menu is used to view and configure the digital outputs. It contains the following items:

ITEM	FUNCTION
Output	Shows and allows the user to select and configure a specific digital output (Relay 1-4 or TTL 1-4)
Select Sources	Allows the user to assign an array sources to the above digital output
Polarity	Shows and allows the user to set the above digital output

Relay and TTL Menus

The Relay and TTL menus are used to configure the X96S Relay Outputs and the 4 TTL Outputs. The Relay and TTL menus show the settings of the corresponding 4 Relay Outputs and 4 TTL Outputs, allowing the characteristics of the outputs to be changed. Each menu contains the following items:

ITEM	FUNCTION
Relay 1	Selecting this takes the user to the Relay 1 menu
Relay 2	Selecting this takes the user to the Relay 2 menu
Relay 3	Selecting this takes the user to the Relay 3 menu
Relay 4	Selecting this takes the user to the Relay 4 menu
TTL 1	Selecting this item takes the user to the TTL 1 menu
TTL 2	Selecting this takes the user to the TTL 2 menu
TTL 3	Selecting this takes the user to the TTL 3 menu
TTL 4	Selecting this takes the user to the TTL 4 menu

Select sources has the following options to assign:

ITEM	FUNCTION
Alarm 1 [yes/no]	Allows the user to assign Alarm 1 to the selected digital output
Alarm 2 [yes/no]	Allows the user to assign Alarm 2 to the selected digital output
Alarm 3 [yes/no]	Allows the user to assign Alarm 3 to the selected digital output
Alarm 4 [yes/no]	Allows the user to assign Alarm 4 to the selected digital output
Alarm 5 [yes/no]	Allows the user to assign Alarm 5 to the selected digital output
Alarm 6 [yes/no]	Allows the user to assign Alarm 6 to the selected digital output
Alarm 7 [yes/no]	Allows the user to assign Alarm 7 to the selected digital output
Alarm 8 [yes/no]	Allows the user to assign Alarm 8 to the selected digital output
Auto Cal Ref [yes/no]	Allows the user to assign Auto Cal Ref to the selected digital output
Auto Cal Err [yes/no]	Allows the user to assign Auto Cal Err to the selected digital output
Ref Prompt [yes/no]	Allows the user to assign Ref Prompt to the selected digital output
Wipe Test [yes/no]	Allows the user to assign Wipe Test to the selected digital output
Shutter Test [yes/no]	Allows the user to assign Shutter Test to the selected digital output
Empty Clamp [yes/no]	Allows the user to assign Empty Clamp to the selected digital output
Detector Flt [yes/no]	Allows the user to assign Detector Flt to the selected digital output
System Alarm [yes/no]	Allows the user to assign System Alarm to the selected digital output

Polarity has the following options to assign:

ITEM	FUNCTION
NO/Not Driven	Allows the user to configure the selected digital output as non-fail safe mode
NC/Driven	Allows the user to configure the selected digital output as fail safe mode
Open/Not Driven	Allows the user to force the selected digital output open or not driven (relay de-energized) or driven (TTL not driven) **regardless of the state of the source**
Closed/Driven	Allows the user to force the selected digital output closed (relay energized) or driven (TTL driven) **regardless of the state of the source**

Digital Inputs

This menu is used to view and configure the digital inputs. It contains the following items:

ITEM	FUNCTION
Input 1	Selecting this item takes the user to the Input 1 menu
Input 2	Selecting this item takes the user to the Input 2 menu
Input 3	Selecting this item takes the user to the Input 3 menu
Input 4	Selecting this item takes the user to the Input 4 menu
Input 5	Selecting this item takes the user to the Input 5 menu
Input 6	Selecting this item takes the user to the Input 6 menu
Input 7	Selecting this item takes the user to the Input 7 menu
Input 8	Selecting this item takes the user to the Input 8 menu

Each Input Menu (1 through 8) contains the following:

ITEM	FUNCTION
Polarity	Shows and allows the user to set the Polarity of the digital input
Type	Shows and allows the user to set the type of the digital input

Polarity is one of the following:

Polarity	MEANING
Low	A “true” is represented by a low signal on the digital input
High	A “true” is represented by a high signal on the digital input

Type is one of the following:

Type	MEANING
Manual	Push button switch
Sensor Rise	Sensor/relay, only rising level used
Sensor Fall	Sensor/relay, only falling level used
Sensor Both	Sensor/relay, both rising and falling level used

TTL Menus

The TTL menus (TTL 1 through TTL 4) are used to configure the X96S TTL outputs. These four TTL menus show the settings of the corresponding TTL output and allow the characteristics of the output to be changed. Each menu contains the following items:

ITEM	FUNCTION
Source	Shows and allows the user to set the source
Alarm Type	Shows and allows the user to set the alarm type
Setpoint	Shows and allows the user to set the alarm set point
Setpoint2	Shows and allows the user to set the second alarm set point[4]
Hysterisis	Shows and allows the user to set the alarm hysteresis percent
Polarity	Shows and allows the user to set the alarm polarity

Alarm Source is one of the following:

Alarm Source	MEANING
Level	Operate this TTL output when Level is in alarm as defined by the Alarm Type and set points.
HeadTemp	Operate this TTL output when the head temperature is in alarm as defined by the Alarm Type and set points
System Alarm	Operate this TTL output when the X96S detects a problem
Detector Flt	Operate this TTL output when a there is a problem with detector
Rad Disc	Operate this TTL output when the Rad. Disc. function triggers.
Auto Cal Ref	Operate this TTL output when the X96S is performing an automatic calibration
Auto Cal Err	Operate this TTL output if the X96S detects an error while performing an automatic calibration
Not Used	This TTL output is not currently in use.

Alarm Type is one of the following:

Alarm Type	MEANING
None	Alarm not yet set
Low	Alarm when the source is equal to or lower than Setpoint
High	Alarm when the source is equal to or higher than Setpoint
Range	Alarm when the source is equal to or lower than Setpoint or equal to or higher than Setpoint2

Polarity is one of the following:

Polarity	MEANING
Not Driven	Normally not driven
Driven	Normally driven

[4] The second alarm set point is only used when the alarm type is range.

Digital Inputs Menu

This menu is used to view and configure the digital inputs. It contains the following item:

ITEM	FUNCTION
Input 1	Selecting this item takes the user to the Input 1 menu
Input 2	Selecting this item takes the user to the Input 2 menu
Input 3	Selecting this item takes the user to the Input 3 menu
Input 4	Selecting this item takes the user to the Input 4 menu
Input 5	Selecting this item takes the user to the Input 5 menu
Input 6	Selecting this item takes the user to the Input 6 menu
Input 7	Selecting this item takes the user to the Input 7 menu
Input 8	Selecting this item takes the user to the Input 8 menu

Input Menus

The menu of each input (Input 1 through Input 8) contain the following items:

ITEM	FUNCTION
Polarity	Shows and allows the user to set the active state of the digital input
Type	Shows and allows the user to set the device type connected to the digital input

Polarity is one of the following:

Polarity	MEANING
Low	A “true” is represented by a low signal on the digital input
High	A “true” is represented by a high signal on the digital input

Type is one of the following:

Type	MEANING
Manual	Push button switch
Sensor Rise	Sensor/relay, only rising level used
Sensor Fall	Sensor/relay, only falling level used
Sensor Both	Sensor/relay, both rising and falling level used

Auto Cal Menu

This menu is used to view and configure the Auto Calibration. It contains the following items

ITEM	FUNCTION
Auto Cal Setup	Selecting this item takes the user to the Auto Cal Setup menu
Auto Cal Capture	Selecting this item takes the user to the Auto Cal Capture menu
Auto Cal Status	Selecting this item takes the user to the Auto Cal Status menu

Auto Cal Setup is used configured the 8 Auto Cal points. It contains the following:

ITEM	FUNCTION
Auto Cal 1	Selecting this item takes the user to the Auto Cal 1 menu
Auto Cal 2	Selecting this item takes the user to the Auto Cal 2 menu
Auto Cal 3	Selecting this item takes the user to the Auto Cal 3 menu
Auto Cal 4	Selecting this item takes the user to the Auto Cal 4 menu
Auto Cal 5	Selecting this item takes the user to the Auto Cal 5 menu
Auto Cal 6	Selecting this item takes the user to the Auto Cal 6 menu
Auto Cal 7	Selecting this item takes the user to the Auto Cal 7 menu
Auto Cal 8	Selecting this item takes the user to the Auto Cal 8 menu

Auto Cal 1-8 menu is used configure each of the Auto Cal points. It contains the following items:

ITEM	FUNCTION
Auto Cal	This item allows the user to Enable or Disable this Auto Cal point
Level	This item allows the user to select the level value once the Auto Cal is completed
Trigger Delay	Allows user to select the required time the input must be true before executing a calibration.
Source	Allows the user to select which digital input will be used to trigger the Auto Cal
AC (1-8) State	This is a read-only value. It displays the status of the Auto Cal [Disable/Off/On]

AutoCal Capture is used to provide the count value captured during the Auto Calibrations. It contains the following:

ITEM	FUNCTION
Capt.Cnts AC1	Displays the Average detector counts captured during the calibration for AC1
Capt.Cnts AC 2	Displays the Average detector counts captured during the calibration for AC2
Capt.Cnts AC 3	Displays the Average detector counts captured during the calibration for AC3
Capt.Cnts AC 4	Displays the Average detector counts captured during the calibration for AC4
Capt.Cnts AC 5	Displays the Average detector counts captured during the calibration for AC5
Capt.Cnts AC 6	Displays the Average detector counts captured during the calibration for AC6
Capt.Cnts AC 7	Displays the Average detector counts captured during the calibration for AC7
Capt.Cnts AC 8	Displays the Average detector counts captured during the calibration for AC8

Auto Cal Capture is used to provide the count status the 8 Auto Cal points. It contains the following:

ITEM	FUNCTION
AC1 State	Read Only. Provide status of the Auto Cal. [Disable / Off / On] for AC1
AC2 State	Read Only. Provide status of the Auto Cal. [Disable / Off / On] for AC2
AC3 State	Read Only. Provide status of the Auto Cal. [Disable / Off / On] for AC3
AC4 State	Read Only. Provide status of the Auto Cal. [Disable / Off / On] for AC4
AC5 State	Read Only. Provide status of the Auto Cal. [Disable / Off / On] for AC5
AC6 State	Read Only. Provide status of the Auto Cal. [Disable / Off / On] for AC6
AC7 State	Read Only. Provide status of the Auto Cal. [Disable / Off / On] for AC7
AC8 State	Read Only. Provide status of the Auto Cal. [Disable / Off / On] for AC8

Calibration Menu

This menu is used to view and control the calibration of the X96S Level Gage. It contains the following items:

ITEM	FUNCTION
State	Shows the state of the level configuration process
Ref Constants	Selecting this item takes the user to the Ref Constants menu
Calibrate	Selecting this item takes the user to the Calibrate menu
Ref Date	Shows the date on which the gage was most recently Low Referenced.
Loop Config	Selecting this item takes the user to the Loop Config menu
Aux Loop Cfg	Selecting this item takes the user to the Aux Loop Cfg menu

State is one of the following:

State	MEANING
Uncalibrated	Needs reference and calibrate.
Referenced	Needs calibrate
Partial Cal	Needs reference
Need Ref Level	Reference level must be entered
Need Cal Level	Calibration level must be entered
Fully Calibrated	Calibration complete
Invalid Data	Reference and calibrate data is inconsistent

Ref Constants Menu

This menu is used to view and control the reference constants used in the reference and calibration procedures. It contains the following items:

ITEM	FUNCTION
Ref Mode	Shows, and allows the user to set, the reference/calibrate mode
Ref Time	Shows, and allows the user to set, the number of seconds of data to collect for a reference or calibrate sample
MinRefCnts	Shows, and allows the user to set, the minimum raw value to use for a reference or calibrate sample

Ref Mode is one of the following:

Ref Mode	MEANING
Empty/Full	Vessel will be Empty (air) for reference and Full (filled with process) for calibration in measuring area.
Process	Process material in measuring area (not necessarily empty and full for reference and calibration). User will supply actual levels during reference and calibration.
Absorber	Absorber placed in radiation path.

Calibrate Menu

This menu is used to access the various calibration procedures. It contains the following items:

ITEM	FUNCTION
Low Reference	Selecting this item takes the user to the Low Reference menu
High Calibrate	Selecting this item takes the user to the High Calibrate menu
Clear Ref/Cal	This item invokes method that clears the level reference

Low Reference Menu

This menu is used to perform the low reference procedure. It contains the following items:

ITEM	FUNCTION
Reference	This item invokes a method that performs the low reference procedure
Ref Level	Shows and allows the user to set the reference level value
Ref Cap	Shows the raw captured reference counts

High Calibrate Menu

This menu is used to perform the high calibrate procedure. It contains the following items:

ITEM	FUNCTION
Calibrate	This item invokes a method that performs the high calibrate procedure
Cal Level	Shows and allows the user to set the calibrate level value
Cal Cap	Shows the raw captured calibrate counts

Loop Config Menu

This menu is used to access the primary 4-20ma loop calibration procedures. It contains the following items:

ITEM	FUNCTION
Loop test	This item invokes a method that performs a test on the primary 4-20ma current loop
Damping	Shows, and allows the user to set, the damping constant for the primary 4-20ma current loop
D/A trim	This item invokes method that performs the D/A trimming of the primary 4-20ma current loop

Aux Loop Cfg Menu

This menu is used to access the secondary 4-20ma loop calibration procedures. It contains the following items:

ITEM	FUNCTION
SV is	Shows, and allows the user to set, the variable assigned to the secondary 4-20ma current loop
Loop test	This item invokes a method that performs a test on the secondary 4-20ma current loop
Damping	Shows, and allows the user to set, the damping constant for the secondary 4-20ma current loop
D/A trim	This item invokes a method that performs the D/A trimming of the secondary 4-20ma current loop

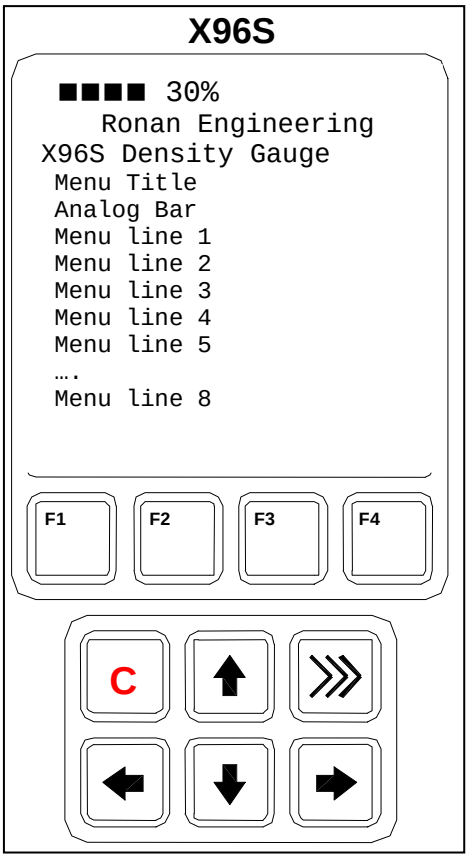
SV is one of the following:

SV is	MEANING
Level	Level
Head Temp	Head temperature (if available)
Not Assigned	Blank line

Diagnostics

ITEM	FUNCTION
Raw Counts	Non-filtered counts from the detector
Filt Counts	X96S filtered counts from the detector
Raw Dens.	Displays the real time raw density value
Current	Displays the real time 4-20ma value
Ref/Cal Data	Displays the information on the reference/calibration data
Alarms	Information available for trouble shooting the alarms

X96S Local Display



The X96S Local Display consists of 8 lines by 21-character display, and a 10-key keypad. The top line of the display is reserved for the analog bar, if enabled. The next line is used for the Ronan logo. Line #3 shows the device model line. Line #4 displays the specific screen title. That title is typically a screen description or required action. The remainder of lines, with the exception of the last line, is screen or action dependent. The last line displays the active function keys labels for keys F1-F4.

Directly beneath the display is a keypad. The keypad is divided into two parts:

- a 4-key function section (F1 – F4) and
- a 6-key (2 rows of 3 keys) cursor control section

The four function keys, F1 – F4 are defined by the last line on the LCD. If the text just above a specific F () key is blank, then that F Key () has no function for current menu being displayed on the LCD.

The six keys below the function keys are for navigating the menus.

The **C key** is the contrast key. Pressing the C key once changes the LCD mode to allow the user to use the ↑ **key** to increase the contrast and the ↓ **key** to decrease the contrast on the LCD. Pressing the C key again changes the LCD mode back to the normal mode.

The ↑ **key and** ↓ **key** are used to move the cursor up to the next line or down to the next line. These keys are also used to increment or decrement the User Entry-values.

← **Key and** → **Key** are used to enter and exit out of the menu tree. These keys are also used to toggle back and forth between digits for User Entry-values.

>>> Key is called the Hot Key. This allows the user to jump from the programmable menus to the status menu with one key stroke.

Navigating Menus

The menu and the display screen are one or more lines, each consisting of a line label (name of the entry) and optional value and units. In most cases the menu navigation is exactly following the Rosemount 275 Configurator's user interface.

The first column is reserved for direction keys if the number of lines does not fit the physical display. The second column will show a right arrow character when the cursor is on this line and there is sub-menu or some other screen or action assigned to this line. If the menu is not at the top level, the end of the menu title line will show left arrow to indicate it, and to remind that the user could 'go back' to the previous menu by pressing left arrow.

If the line length is longer than the physical display, a right arrow will be displayed, and if the right arrow key is pressed, the value will be displayed in a screen, similar to the editing one, but with editing disabled.

Depending on the type of the function assigned to the line a different screen will be shown when the user presses the right arrow key.

If this line is a sub-menu, another menu opens.

Editing Values

The editing of different types of values is designed around the use of the four direction keys and up to 4 function keys. The left and right arrow keys are used to position the cursor to the letter/digit to be edited, and up and down arrow keys are used to scroll between the possible values for this position.

In all editing functions, the edited value is displayed below the current value.

Editing Fixed Point Numbers

Using left and right arrow keys, position the cursor at the desired position and scroll the digit at this position using up and down arrow keys. When the value rolls up or down a carry/borrow occurs from the next/previous digits. When done, press F4. To discard changes and abort, press F3.

Editing Floating Point Numbers

Using left and right arrow keys, position the cursor at the desired position and scroll the digit at this position using up and down arrow keys. When the value rolls up or down a carry/borrow occurs from the next/previous digits. When done, press F4. To discard changes and abort, press F3.

The difference to the fixed-point editing is that the decimal point is automatically skipped when moving the cursor left or right.

Editing Text Strings

Using left and right arrow keys position the cursor at the desired position and scroll the character at this position using up and down arrow keys. The characters are rotated between blank and 'z'. When done, press F4. To discard changes and abort, press F3.
When the string value is a password, it always starts with * for every character to avoid seeing the password.

Editing Enumerated Values

The enumerated values are displayed as menu items below the current value. The up and down arrow keys are used to select the desired choice, and F4 is used to confirm it. F3 is used to abort the editing and leave the value unchanged.

X96 Local Display Vs 275 Calibrator

The local display user interface is very similar to the 275 Calibrator, but there are some differences. One of the major ones is the fact that the X96 local display lacks a numeric keypad. This automatically means that the shortcuts are not supported, as also the value editing is done using only the cursor keys.

Another difference is the fact that all values in the local display are immediately updated, and there is no need to use SEND action whenever a value is changed. Also, the flashing ‘heart’ character indicating that the configurator is exchanging data through HART communication is not needed and thus not presented on the local display.
When there is a value to be displayed and the line length doesn’t fit the display, the 275 Configurator displays the label only and lets the user see the value using the right arrow key. X96 local display will display whatever could fit the display, thus indicating to these that there is more to be displayed and the right arrow sign is not indicating a new menu.

Installation

Caution

Ronan's Monitor Systems use a sealed radioactive cesium (Cs-137) source which is safe if handled properly.

Specific License
(SA or GS Series)

Most Level Monitors are mounted to large vessels. Installations on vessels that permit personnel access require a specific license. Your company's specific license will name a Radiation Safety Officer (RSO) or Radiation Protection Officer (RPO). The RSO for your company must be notified immediately upon receipt of the gage. DO NOT proceed with unpacking, storage, or installation without the RSO's authorization.

General License

Other monitor systems, such as Density Monitors, are mounted to small-diameter process pipes. Those applications do not require a specifically licensed person to unpack or mount the equipment, as long as the source holder remains padlocked in the OFF position. Only a specifically licensed individual is permitted to remove the padlock and turn the source holder to the ON position.

Ronan's field service personnel are available for advice or assistance. (859) 342-8500.

Unpacking

All equipment manufactured by Ronan is carefully packaged to prevent shipping damage. Unpack the equipment in a clean, dry area.

Examine the contents and compare them to the packing list. Immediately report any discrepancy or damage to Ronan, the company's RSO, and the carrier. File a claim with the carrier.

Storage

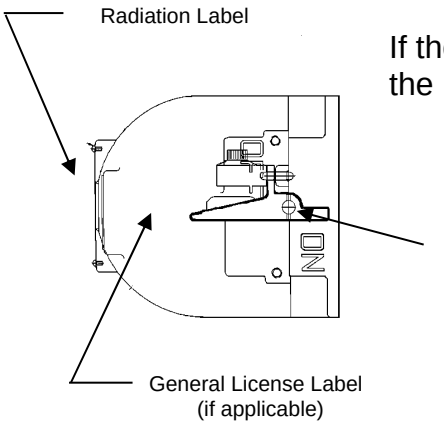
If it is necessary to store this equipment before mounting, the RSO will assign a safe and secure location with no personnel access.

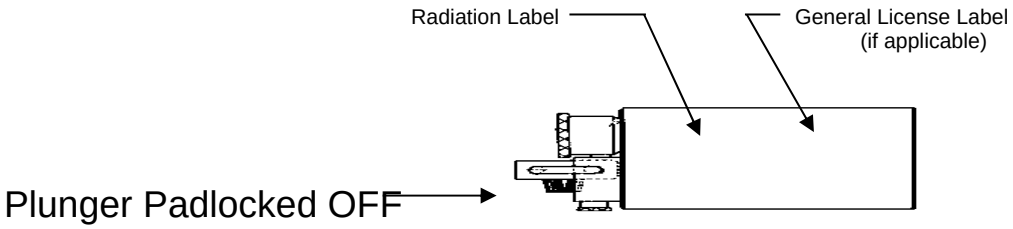
During storage avoid temperatures below freezing, and areas with excessive humidity, moisture, or dirt. The source holder is equipped with an ON/OFF mechanism.

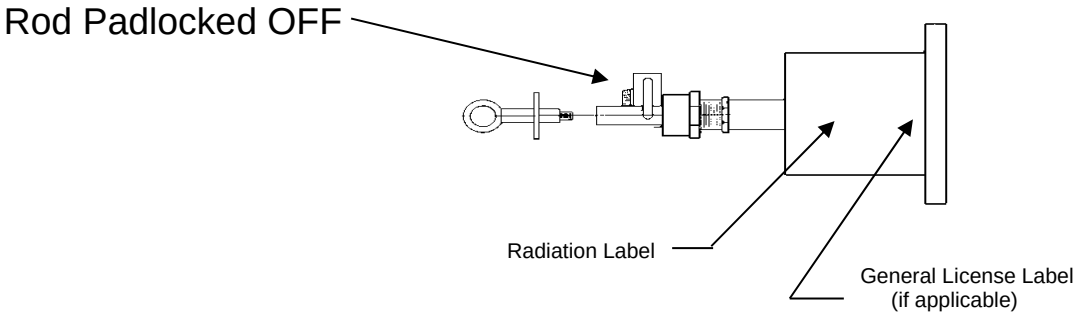
Inspection

The source holder is equipped with an ON/OFF mechanism. During shipment and storage the mechanism MUST BE SECURED in the OFF position with a padlock.

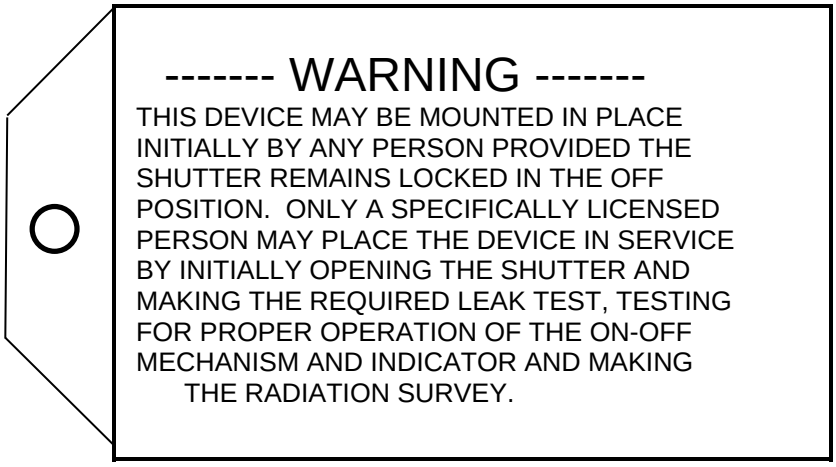
If the padlock is damaged, broken, or missing, contact the RSO immediately.



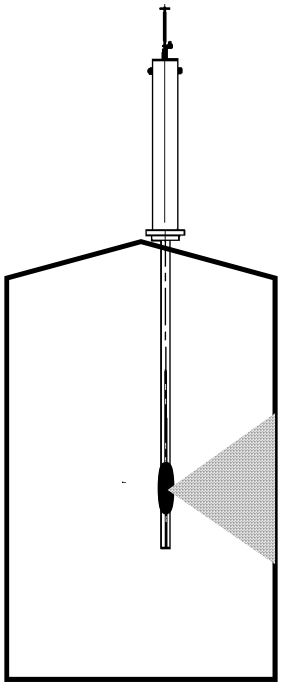




Lock Tag



Safety Precautions



During installation the RSO will provide guidelines to assure safety. Consider the information presented in the Regulation/Safety Chapter of this manual, as well as the following general guidelines:

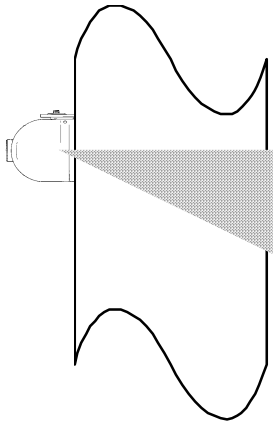
The source holder must remain padlocked in the OFF position until installation is complete.

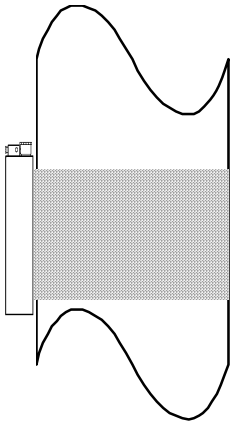
Take all necessary precautions to assure that the source holder is not dropped or damaged.

A specifically licensed individual MUST inspect the installation prior to placing the source holder in the ON position.

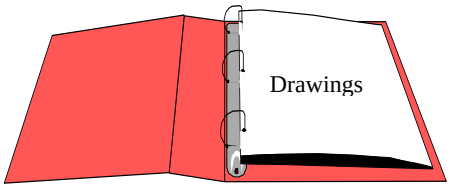
Always turn the source holder to the OFF position when working around it, the detector, or the area between these two components which is referred to as the "measuring gap."

When the source holder is placed in the ON position, avoid the "active beam."





Mechanical Mounting



Drawings:
Configuration
Installation

Review the Configuration Drawing which is included in the Drawing Chapter of this manual.

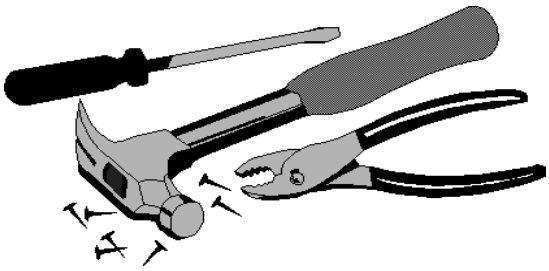
Please reference the dimensional drawings located in the Drawing Chapter of this manual when installing the equipment.

Consider the following general guidelines when mounting the sensor and detector:

Avoid internal vessel obstructions such as baffles, agitators, manways, heater/cooler tubes, etc. which could interfere with the transmission through the vessel of the radiation's "active beam."

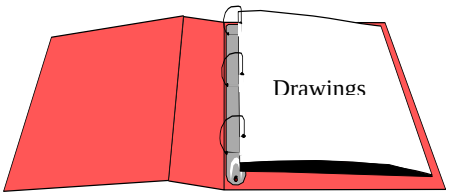
The source and detector must be rigidly mounted so they do not move with respect to each other. Such movement will destroy the system's calibration and/or its measurement.

Insulation must be used at the point of installation IF:
- the temperature of the vessel at that spot exceeds 131°F (55°C), or
- the voltage transmission through the vessel could interfere with the signal transmission from the source to the detector.



Electrical Installation of Interconnect Wiring

DO NOT APPLY POWER until wiring is carefully checked.

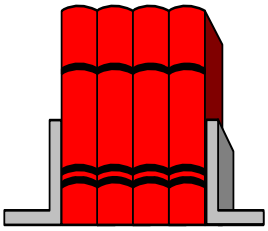


Drawings:
Interconnect

Wire the equipment according to the detailed interconnect drawing which is included in the Drawing Chapter of this manual.

Follow local and national electrical codes for all interconnections.

Consider the following guidelines before making any electrical connections:



LOCAL CODE
NATIONAL CODE

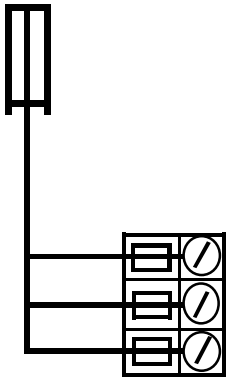
Use continuous conduit runs and protect housing junction boxes from dripping of condensed moisture off of conduit.

Plug unused conduit holes to prevent entry of dirt and moisture.

Run the interconnect cable in a separate conduit. Feed the cable through the conduit starting at the detector end and terminate at the microprocessor end.

DO NOT run AC power cable in the same conduit with any of the low-level cables (signal, mV, mA, etc.)

Maintain transient-free AC power sources between 105-130 VAC for the microprocessor. DO NOT use a line that is connected to a large motor, welding equipment, solenoids, etc.



POWER INPUT

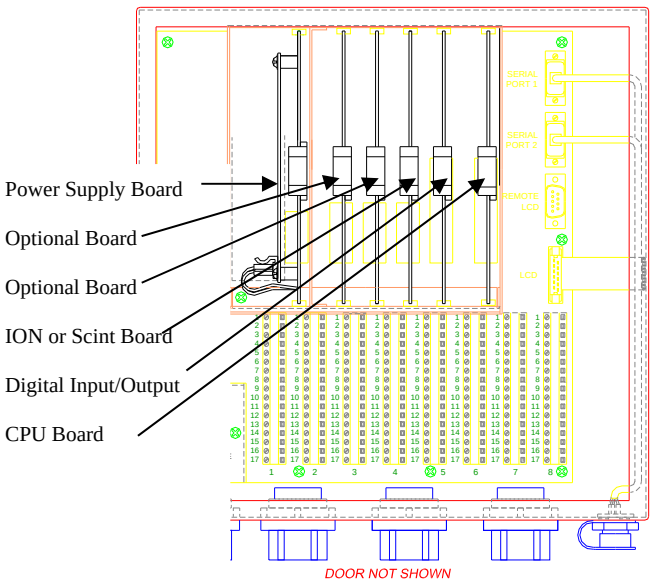
WITH POWER OFF - - -
Connect cable pre-wired MS connector to detector.

Immediately replace lid of detector housing to keep out water and dirt.

Check connections at microprocessor chassis terminals. Verify that all wires are fully inserted in terminal sockets and the screws firmly tightened.

Microprocessor Verification

Rotate latch clockwise to open the enclosure door. Next remove the computer front cover by sliding the black tabs down. Check each board to see if they are fully seated into the mother board . Identify the CPU and other major boards from the drawing below. **Optional configurations are possible.**

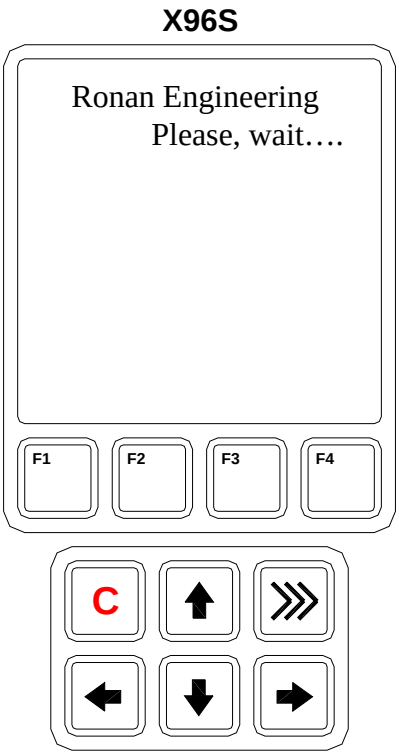


NOTE:
These boards are not interchangeable in the frame's slots.

Identification / Documentation

The Ronan X96S Microprocessor can be programmed for a variety of applications and configurations. ***The specific application supplied with each system is determined by the combination of software and the unique hardware configuration used to support the software.***

Power-up



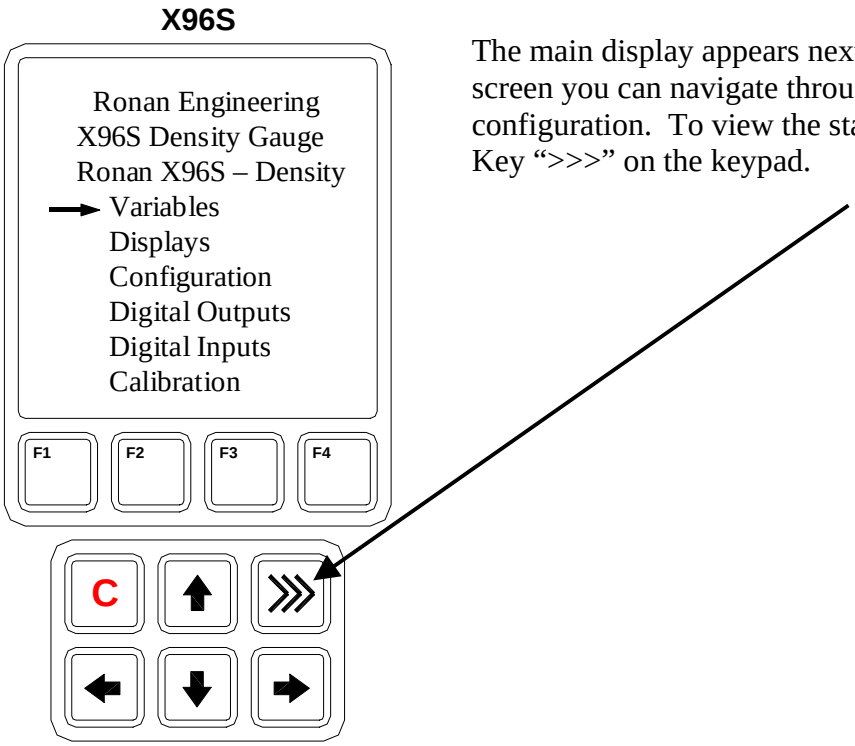
Before applying power, ensure all boards are fully seated in frame's slots. Close front door of the X96S and secure the door...

When power is applied the X96S runs a self-diagnostic program

First display appears for just a second

To adjust the contrast on the LCD display:

Press the "C" button to adjust the contrast. Adjust by pushing the up and down arrows. When finished adjusting, press the "C" button for one second to set and complete the procedure.



The main display appears next as shown. From this screen you can navigate through the system's configuration. To view the status screen, press the Hot Key ">>>" on the keypad.

Password

Notice:

To access the Programming Menu, the Password is **101010**.

Step 1: Power Up – You should now be on the Status Screen.

Step 2: Press F3 to go back.

Step 3: Now enter the password. (All digits are set at 000000 at this point.)

Press  to get the digit to be # one

Press  2 times (The third digit should be highlighted.)

Press  to get the digit to be # one

Press  2 times (The fifth digit should be highlighted.)

Press  to get the digit to be # one

Press F4 (enter)

Note: If the wrong password was entered, press **F1 (ALL0)** to set all the digits to the number 0 and you can begin re-entering the password from the beginning. Pressing **F2 (RST0)** will set the individual digit that is highlighted back to the number 0.

Note: For security reasons, each digit will always be displayed as an asterisk.

Calibration

Calibration correlates the X96S's output to your actual process level. It instructs the microprocessor to read and store the detector counts for a low and high level of process. Once the system is conditioned to recognize the low and high level, it will provide a 4-20 mA output over the entire range of interest.

Reference Modes

One of the first tasks will be to calibrate the system. The first step in the calibration procedure is to "reference" the gage on some known level. The steps involved in the referencing procedure will vary slightly depending upon the *mode* selected as the constant.

One of these three REFERENCE MODES will be active on your system:

- Referencing EMPTY (Level = 0)
- Referencing with PROCESS at known level
- Referencing with ABSORBER

Calibration

Low Reference

Depending on the Reference Mode selected, you must set up the radiation path in the vessel to the Reference condition (vessel is EMPTY, PROCESS is at a known low level, or the proper ABSORBER is in place). If ABSORBER or PROCESS is selected, you will need to supply the actual level represented. If you selected EMPTY, the system will automatically supply a level value of 0 for you.

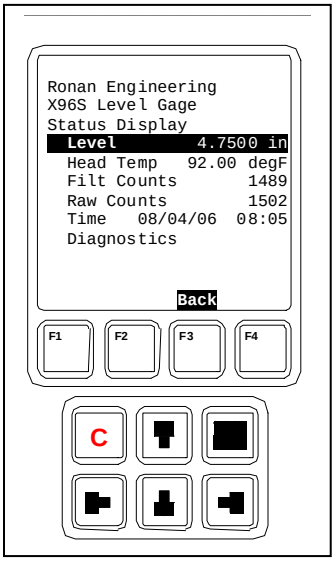
High Calibration

Again, depending on the Reference Mode selected, you must set up the radiation path in the vessel to the Calibration condition. You will also need to supply the actual level being set up.

Preparation for Calibration

Step 1 Start at the Status Display

From the Status Display Screen, Press the F3 Key **to display the Password Screen (or the Main Menus if the password is disabled).**

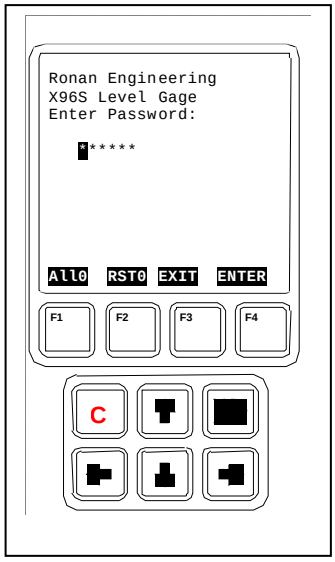


Step 2 Password Menu

With the left-most asterisk* highlighted (All digits are set at 000000 at this point), enter in the password '101010'.
Press the ↑ **key 1** times to make the left most character equal to 1.
Press the → **key 2** times to move to the third character.
Press the ↑ **key 1** times to make the third character equal to 1.
Press the → **key 2** times to move to the fifth character.
Press the ↑ **key 1** times to make the fifth character equal to 1.
Press the **F4 key** (enter) to accept the password.
This will take you to the Main Menu.

Note: If the wrong password was entered, press the F1 (All0) to set all the characters back to a value of 000000. You can begin to re-enter the password from the beginning. Pressing the F2 (RST0) will set the individual character that is highlighted back to the value 0.

Note: For security reasons, each character will always be displayed as an asterisk *.



Step 3 Low Calibration

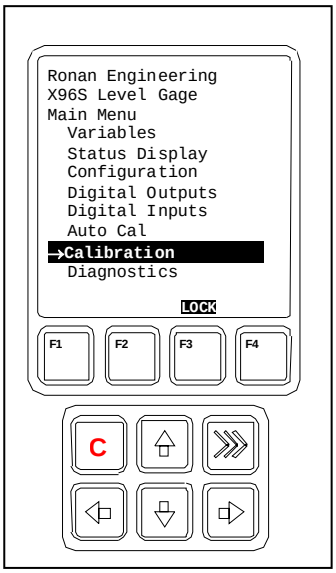
(Have the vessel empty or low as possible under normal operations)

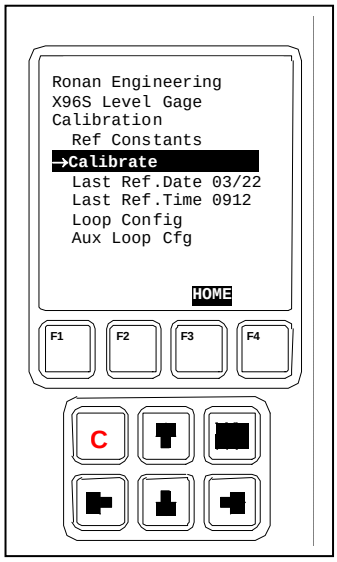
Scroll down ↓ to "Calibration" Press the Enter Key →
Scroll down ↓ to "Calibrate" Press the Enter Key →
Scroll down ↓ to "Low Calibrate**" Press the** Enter Key →
Select "Perform Low Cal**" press the** Enter Key →

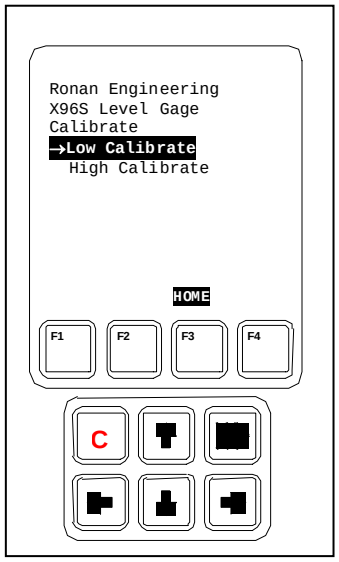
Read the next screen carefully and acknowledge the screen by pressing the F4 Key. **Wait until you see the counter reaches 0. Acknowledge the Low Counts = XXXX by pressing the F4 Key.**

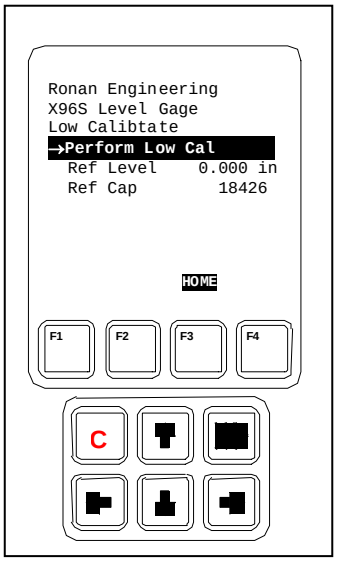
Scroll down ↓ to "Low Cal Level" Press the Enter Key →
Notice the value that is displayed.
Use ← Key **and →** Key **to toggle back and forth between digits.**
Change the value using ↑ or ↓
Enter the value of the process (Example 0.0000 inches for Empty Mold).
Press the F4 Key **to enter and store the value.**

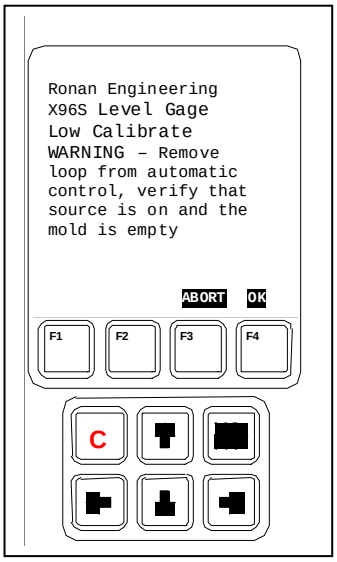
Press F3 Key (Home) **to get back to the Main Menu.**
Press F3 Key (Lock) **to get back to the Status Display.**

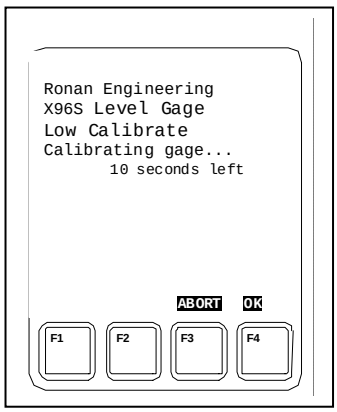


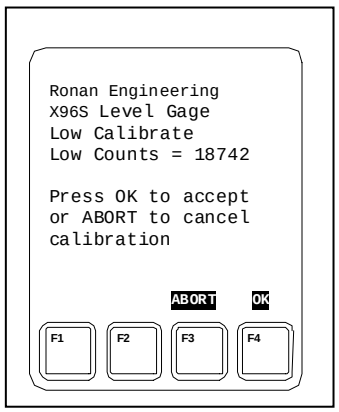


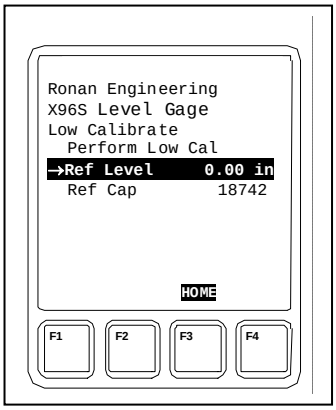


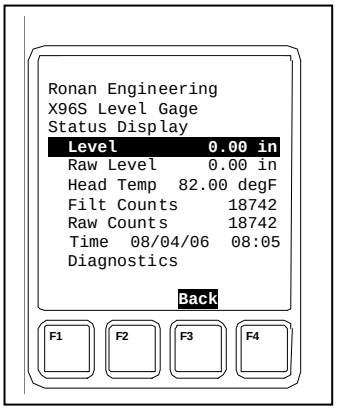












Step 4 High Calibration

(Fill vessel to 100% of range or close source shutter to represent full)

Scroll down ↓ to "Calibration" Press the Enter Key →

Scroll down ↓ to "Calibrate" Press the Enter Key →

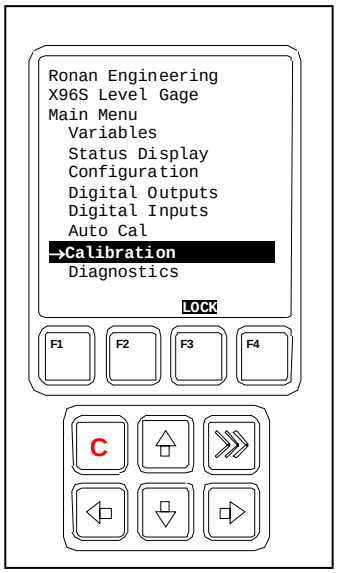
Scroll down ↓ to "High Calibrate**" Press the** Enter Key →

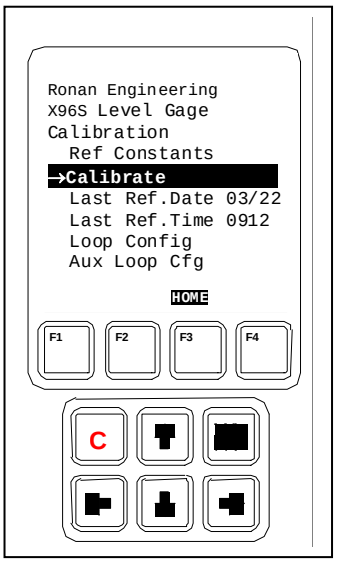
Select "Perform High Cal**" press the** Enter Key →

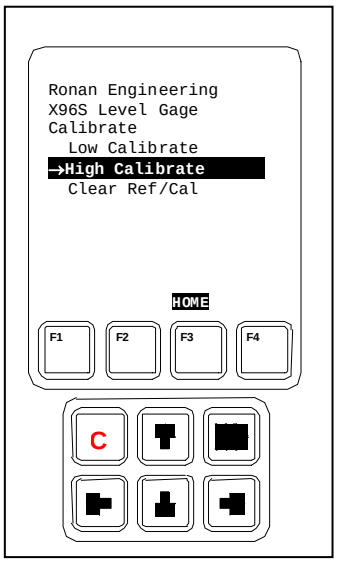
Read the next screen carefully and acknowledge the screen by pressing the F4 Key. **Wait until you see the counter reaches 0.**
Acknowledge the High Counts= XXXX by pressing the F4 key.

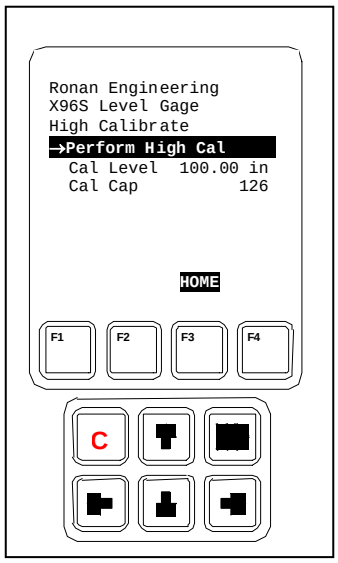
Scroll down ↓ to "High Cal Level" Press the Enter Key →
Notice the value that is displayed.
Use ← Key **and →** Key **to toggle back and forth between digits.**
Change the value using ↑ or ↓
Enter the value for the Full level (Example 6.0000 inches.).
Press the F4 Key **to enter and store the value.**

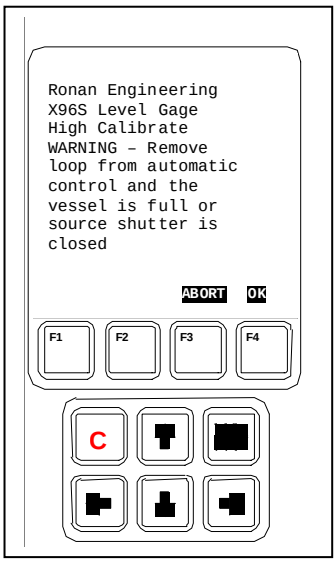
Press F3 Key (Home) **to get back to the Main Menu.**
Press F3 Key (Lock) **to get back to the Status Display.**

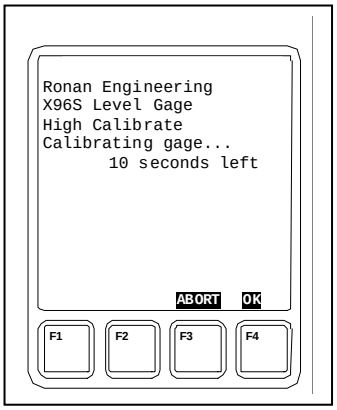


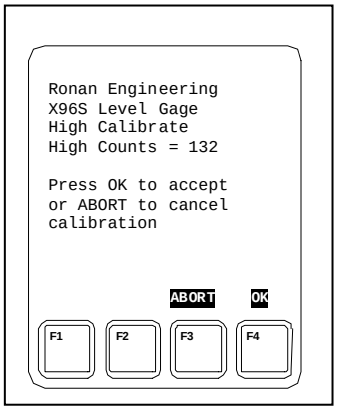


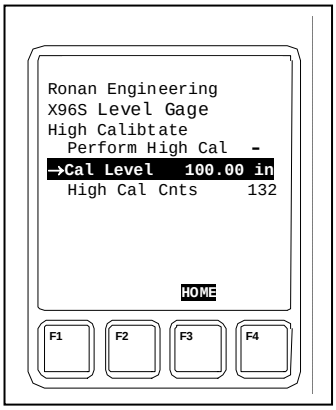


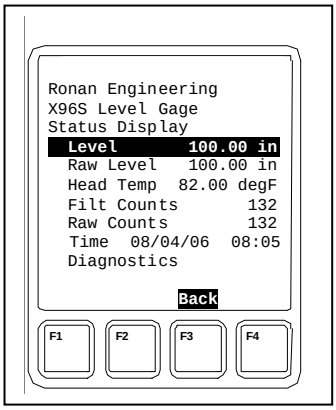












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Configuration

Ronan ships the Level Monitor System with factory-default software settings. Those settings are responsible for the information that initially appears on the status displays.

After installation at your site, you may need to reconfigure the system to fit your application. The goal is to correlate the X96S output with your actual level readings. The list below summarizes the activities that are detailed in the remainder of this chapter:

- Check the factory-default settings to be sure they are appropriate for your circumstances. IF NOT, make the necessary changes and document those changes for future reference.
- Perform an initial calibration to correlate the X96S's output to the actual process level
- Document detector output counts at calibrated values to assist in troubleshooting. Also, record changes you make to factory-default settings. Keep this information for future reference.

Documentation

For future reference, document these items:

(a) Environmental/process conditions that influence the reference/ calibration. The next time a calibration is performed, you will need to duplicate the conditions, or account for the differences.

(b) All changes made to factory-default settings such as time constant, reference constants, gain, etc.

(c) The information from the status displays. A record of "counts" being received from the detector may assist with future troubleshooting efforts.

Detector

Scintillator Detector

Description

The Ronan scintillation detector consists of three main components: The plastic scintillation crystal, the photo-multiplier tube (PMT), and the associated electronics.

Scintillation Crystal

The crystal used for the Level System is poly-vinyl toluene (PVT) plastic. The crystal produces light pulses which are proportional to the incident radiation events striking it.

Typically mounted in a stainless-steel shell the entire crystal assembly is sealed against moisture and dirt and is non-repairable. An integral flange serves to mount the crystal to the PMT. A special silicone membrane serves as an optical coupling medium between the crystal and the PMT.

Photo-multiplier Tube

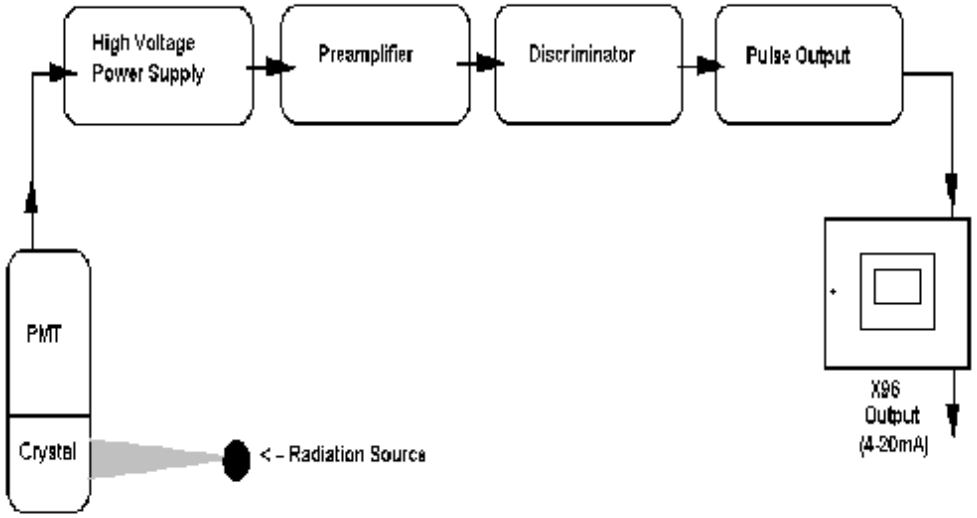
The PMT is a light sensitive vacuum tube with a photosensitive layer that converts the light pulses to an electrical current. Light pulses from the crystal strike the photosensitive layer and release electrons. A high voltage power supply connected to the photosensitive layer accelerates the electrons through stages of current amplification.

The PMT and its associated components are housed in a special magnetic shield. The tube is shock-mounted internally, with an interface plate at the top, which also mounts the electronics and the outer shell.

Electronics

Two to four boards (depending on the scintillator type, housed in a stainless-steel shell, comprise the electronics and their functions.

- High Voltage Power Supply
- Preamplifier
- Discriminator
- Pulse Output



Detector Service

The critical components of the electronic circuit and the PMT/Crystal Assembly are aligned before leaving the factory. If any component of the Scintillation Detector is adjusted or replaced, the performance of the entire system will be adversely affected and will require realignment before continued use is possible.

Therefore, the **scintillation detector IS NOT field serviceable.** Should a problem arise with the detector, the entire Detector Assembly should be returned to Ronan for repair/replacement.

ION Chamber

Detector/Amplifier Assembly

(DET-7471-XXX)

Ronan's ion chamber detector is filled with an inert high-pressure gas. It uses low-voltage (-15VDC) bias and generates a low-level current proportional to the gamma radiation incident on the detector. The current generated is on the order of 10A, so an electrometer amplifier is required to convert the current to a low-impedance, high level voltage signal. The signal is then measured by the X96S Microprocessor, which converts the voltage signal to a output of 4-20mA for a specified measuring range.

Circuit Description

The current (I), generated by the ion chamber, is fed into an inverting input terminal of the electrometer amplifier (ICI). The amplifier output is filtered by a resistance capacitance low-pass filter (R2C4) and fed into another amplifier. The output of from that amplifier (IC2) is proportionally fed back to the inverting terminal to provide a closed-loop gain resistance potentiometer (R2) on the X96S input board.

The detector's gain is adjusted through the X96S gain resistance potentionmeter whenever the signal output of the detector is too high or too low. The output must be less than 3.0VDC with an empty vessel.

An offset zero control (R6), used to null the offset voltage of the electrometer amplifier, is factory adjusted and Glyptal coated. R6 is adjusted to make the output, (TP1), zero with Rf shorted. (TP2 is circuit common).

The most important components of the amplifier are the operational amplifier (ICI) , feedback resistor (Rf), and feedback capacitor (Cf). If these components are substituted, the performance of the system will be adversely affected.

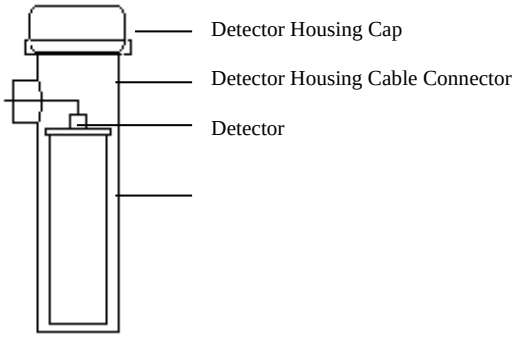
Servicing the Detector

The ion-chamber detector contains pressurized inert gas. The ion chamber itself is not serviceable and must be returned to the factory for service. Instructions follow for "Detector Removal/Replacement."

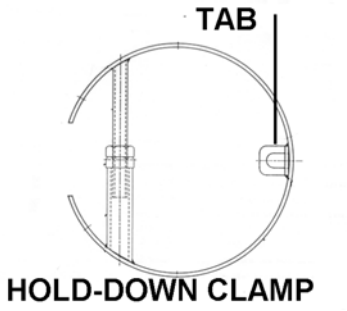
However, a qualified technician can troubleshoot and service the detector's amplifier assembly. Some precautions are needed when handling the detector/amplifier assembly.

It is important to keep the interior of the detector/amplifier dry. Moisture on the high-impedance components will cause leakage currents. If the amplifier lid is opened, it is important to see that warm, dry air is introduced into the amplifier before replacing the gasket lid.

Detector Removal/ Replacement



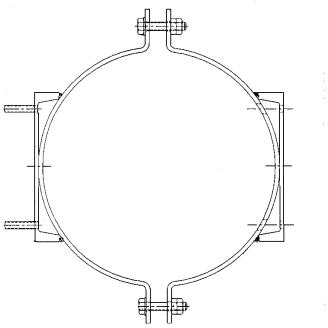
1) Check NOTES below for illustrations and cautions that apply to your specific equipment.
2) Unscrew cap on detector housing.
3) Unscrew connector on top of detector.
4) Remove detector from housing.
5) Carefully install replacement detector in housing.
6) Screw connector back onto detector.
7) Immediately replace detector-housing cap.
8) Follow instruction to REFERENCE and CALIBRATE new detector.



ELONGATED DETECTORS NOTES:

To avoid damage in shipment or installation, the elongated detectors are packaged separate from the housing. Avoid subjecting detectors to mechanical shock. Avoid supporting detector by its chain handle, or other lifting devices, for prolonged periods of time.

When detector is properly seated on the bottom of the housing, the hold-down clamp “tab” will engage and the extension rod screw can be adjusted to tighten detector assembly into housing.



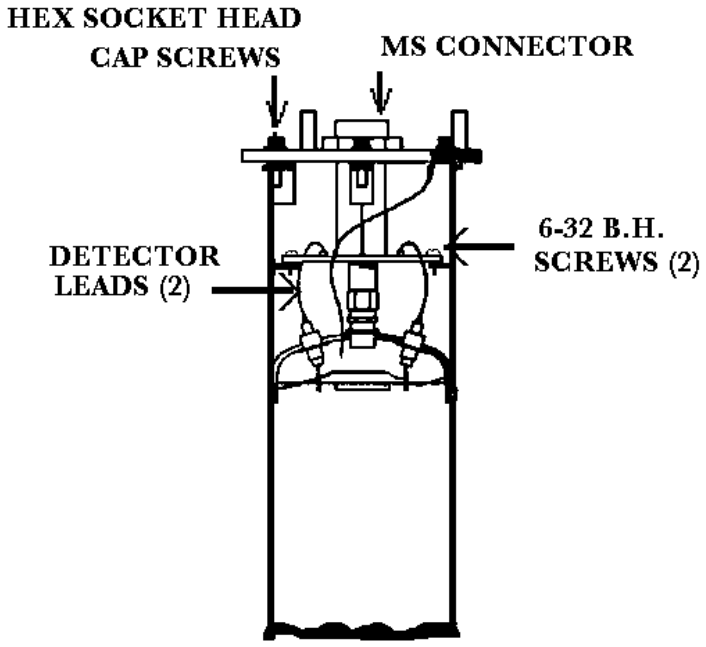
DETECTOR HOUSING/ BRACKET ASSEMBLY NOTES:

Many detectors are shipped inside the housing/bracket assembly. Bolts at the top and bottom of the C-Clamp are used to adjust the assembly around a pipe.

Removing the Detector Amplifier Circuit Board CBAY-6102

Follow this procedure to remove the electrometer amplifier circuit board:

1. Remove the amplifier cover by unscrewing the hex socket head cap screws.



2. Remove the MS connector from the amplifier cover.
3. Remove the two 6-32 binding head screws, which secure the amplifier board to the detector.
4. Using a low power (60W) iron unsolder the detector leads to the printed circuit board standoffs.

CAUTION: Excessive twisting or bending can damage the detector leads.

5. Lift the board/connector assembly from the interior of the detector housing.

Replacing the Detector Circuit Board/Connector Assembly

Refer to drawing B6102K for internal connector wiring and connections to the detector.
Follow this procedure. **CAUTION**: Excessive twisting or bending can damage the detector leads.

1. Carefully straighten the detector leads to clear the holes in the new circuit board.
2. Place the new circuit board/connector assembly in the detector housing.
3. Using the two 6-32 binding head screws with a light coating of Gyptal, secure the board to the detector housing.
4. Taking care the detector leads do not touch the printed circuit board, solder the detector leads to the standoffs.
5. Replace the MS connector into the amplifier cover.
6. Ensure the flat gasket in the amplifier cover is in place and undamaged.
7. Using a light coating of Gyptal on the hex socket head screws, replace the amplifier cover.

Electronics

X96-2001PL

X96-2001PL is a CPU Module that comes without software.

X96-2002PL

X96-2002PL is the local Graphics L.C.D. Module. This optional module provides:

- Graphic LCD
- Keypad

X96-2003PL

X96-2003PL is the Ionization Chamber Interface Module. This optional[5] module provides:

- 1 ionization detector input
- 1 feedback input for ionization detector
- 1 head temperature input
- 1 non-isolated RTD (3-wire) input (stuffing option)
- Power[6] for the ionization detector (15 volts at 35 ma and –15 volts at 5 ma).

X96-2004PL

X96-2004PL is the 2-Channel Analog Output Module. This optional module has two isolated analog outputs each of which can be independently configured as a:

- 4-20 mA current loop,
- a source of 0 to 10 volts, or
- a sink of 0 to 20 ma.

X96-2005PL

X96-2007PL is the HART Daughter Module. This module provides both a 4-20 mA current loop and a HART slave interface.

[5] At least one detector interface module is required.

[6] The power supply has the ability to control power to the ionization detector:

- when commanded by the CPU module,
- when the watchdog timer generates a reset.

X96-2008PL

X96-2008PL is the Digital Input/Output Module. The module provides a total of 16 bits of digital I/O and wetting/encoder power.

8 isolated digital inputs are provided. These inputs can be configured for use as:

- dry[7] or live[8] contact monitoring,
- quadrature encoder[9], or
- pulse counter.

4 relay (2 Amp capacity) output points are provided. Form "C" outputs are brought out to the connector (three connections per relay).

4 isolated open collector output points are provided. These outputs are capable of switching 4.5 to 30 Volts (externally supplied) at a maximum of 50 ma.

24 volts DC is provided for use as a wetting voltage when needed.

An isolated 15-volt DC power supply capable of providing 200 mA is also provided. The primary use of this power supply is to power a quadrature encoder. However, it can be used for other purposes if it is not required for this purpose.

X96-2009PL1

X96-2009PL is the Scintillation Detector Interface Module. This optional[10] module provides:

- 1 isolated scintillation input (pulse counter, max signal 0-12[11] V, threshold 0.6 V)
- 1 head temperature input (1 uA per deg K)
- 1 non-isolated RTD (3-wire) input
- isolated power for the scintillation detector 24 V 40 mA supply[12].

[7] When used with dry contacts, jumpers shall be used on the connector block to provide the wetting voltage. When used in this mode, input to input isolation is not maintained.

[8] When used with live contacts, each input shall be able to accept up to 30 volts DC. Zero volts to 0.8 volts are recognized as a logic zero and 2.5 volts to 20 volts are recognized as logic one.

[9] The interface to the quadrature encoder shall consist of two inputs, 15 volts DC at 200 mA (described in a later section), and common.

[10] At least one detector interface module is required.

[11] 8.6 V nominal.

[12] The power supply has the ability to control the power to the scintillation detector:

- when commanded by the CPU module,
- when the processor on the module detects a condition that could harm the scintillation detector,
- when the watchdog timer generates a reset.

X96-2009PL2

X96-2009PL is the Scintillation Detector Interface Module. This optional[13] module provides:

- 1 isolated scintillation input (pulse counter, max signal 0-12[14] V, threshold 0.6 V)
- 1 head temperature input (1 uA per deg K)
- a 4-20 mA input (Ch. 2)
- isolated power for the scintillation detector 24 V 40 mA supply[15].

X96-2009PL3

X96-2009PL is the Scintillation Detector Interface Module. This optional[16] module provides:

- 1 isolated scintillation input (pulse counter, max signal 0-12[17] V, threshold 0.6 V)
- 1 head temperature input (1 uA per deg K)
- a 0 –10 volt input (Ch. 2)
- isolated power for the scintillation detector 24 V 40 mA supply[18].

[13] At least one detector interface module is required.
[14] 8.6 V nominal.
[15] The power supply has the ability to control the power to the scintillation detector:

- when commanded by the CPU module,
- when the processor on the module detects a condition that could harm the scintillation detector,
- when the watchdog timer generates a reset.

[16] At least one detector interface module is required.
[17] 8.6 V nominal.
[18] The power supply has the ability to control the power to the scintillation detector:

- when commanded by the CPU module,
- when the processor on the module detects a condition that could harm the scintillation detector,
- when the watchdog timer generates a reset.

Options

X96S Mechanical Chassis Part Numbers

PART NUMBER	DESCRIPTION
CHAS-0511-6	X96S-N4-1, NEMA 4 Enclosure, 6 Position, W/O LCD Display
CHAS-0512-9	X96S-N4-2, NEMA 4 Enclosure, 9 Position, W/O LCD Display
CHAS-0513-6-SS	X96S-N4X, NEMA 4X, 6 Position, W/O LCD Display, Stainless
CHAS-0514-9-SS	X96S-N4X, NEMA 4X, 9 Position, W/O LCD Display, Stainless
CHAS-0515-6-SSW	X96S-N4X, NEMA 4X, 6 Position, W/O LCD Display, With Window
CHAS-0516-9-SSW	X96S-N4X, NEMA 4X, 9 Position, W/O LCD Display, With Window
X96C429-1	LCD Display Assembly “Local” for X96S

X96S Electronic Module Part Numbers

PART NUMBER	DESCRIPTION
X96-2001PL	X96S CPU Module
X96-2003PL	X96S Ionization Chamber Interface Module
X96-2004PL	X96S 2-Channel 4-20 mA Analog Output Module
X96-2005PL	X96S HART Daughter Module
X96-2008PL	X96S 8-Channel Digital Input Module, 8-Channel Digital Output Module (4 Transistors + 4 Relays)
X96-2009PL1	X96S Scintillation Detector Brd w/modification(CAP-11004 & 1018)
X96-2009PL2	X96S Scintillation Detector Brd modified for 0-20 mA input.
X96-2009PL3	X96S Scintillation Detector Brd modified for 0-10 VDC Input.
X96-2010PL	X96S I B Bus Jumper Module
X96-2028PL	X96S Fieldbus Interface Daughterboard
X96-2029PL	PCB Board, Mold Level, Input/Output for Scin.
X96C148	X96S 85V to 230V AC Power Supply Module
X96C148-2	X96S 24V DC Power Supply Module
X96D138	X96S 6-Position Motherboard Assembly

RONAN
ENGINEERING COMPANY
MEASUREMENTS DIVISION

SPECIFICATINS

MODEL X96S

Process Computer: Microprocessor-based unit with a liquid crystal display, push-button interface, HART® Communications, process control outputs, process condition inputs, serial communications.

Chassis: 19” rack mount, surface mount, or panel mount.

Enclosure:
Standard NEMA-4
Stainless Steel NEMA-4X
Explosion Proof

Electrical: Power inputs: 90-240VAC +/-15%, 50-60 Hz; 24VDC +/-15%

Environmental:
Ambient temperature range: 14° to 122°F (-10° to 50°C)
Humidity: 90% non-condensing

Electronics:
Processor: Embedded 80x86 compatible processor
Memory: flash, static RAM, battery backup RAM
A/D Converters: 16-bit, dual slope, auto-zeroing
Display: graphic LCD, fluorescent back-lit

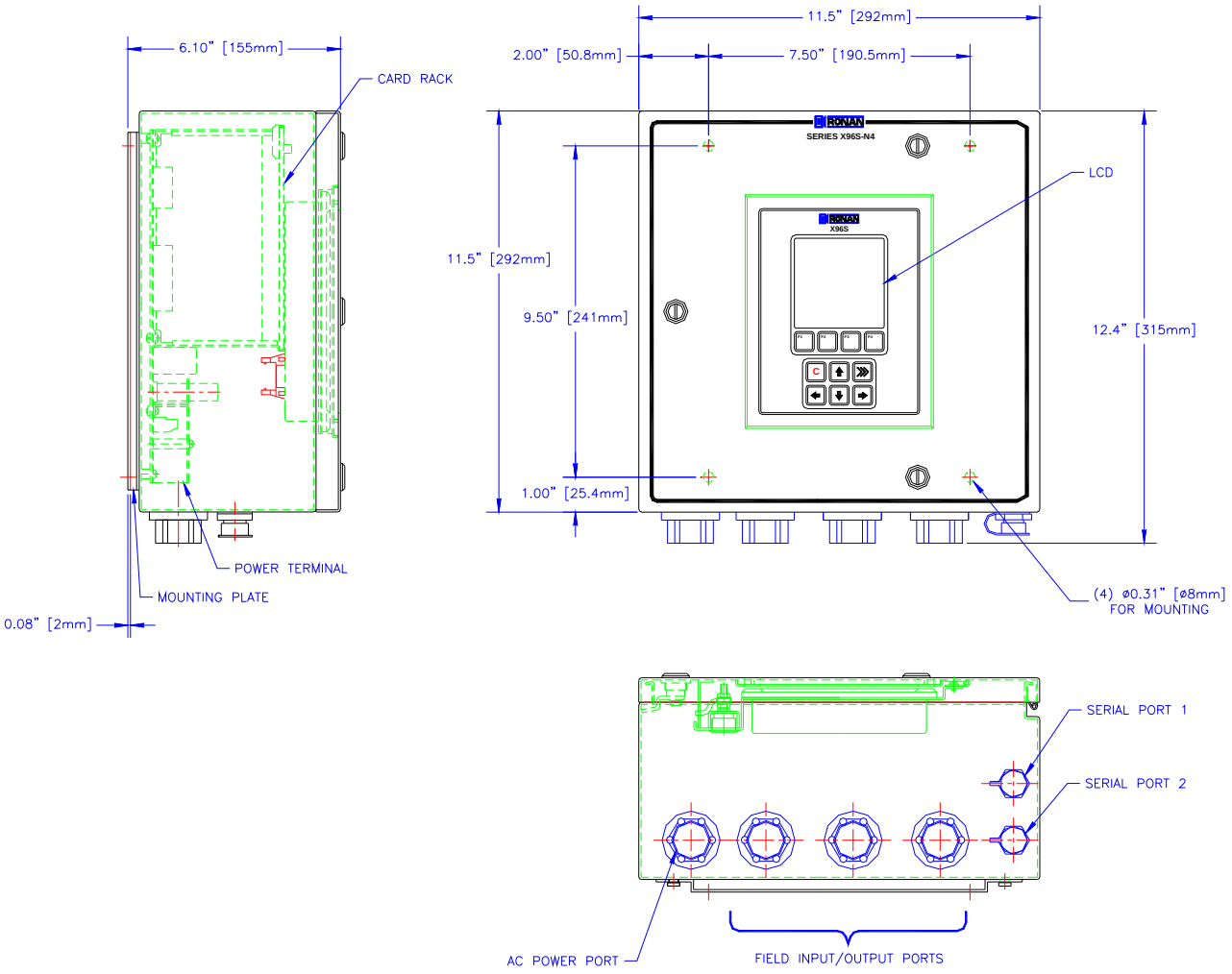
Inputs: (Optional)
Tachometer: 0-10VDC, 4-20mA, or pulse rate TTL load
Detector: 0.42-2.4VDC or pulse TTL
Temperature Compensation: 100 ohm Pt, 120 ohm Ni, or 4-20mA (mass flow or density)

Outputs:
Three 4-20mA; one assigned to each channel
Four single set-point SPDT relays: 3 amp at 28VDC or 240VAC
Remote totalizer pulse: 20 msec pulse, open collector 50mA at 24VDC

Display Units:
(Engineering units per gauge)
Level: in, ft, mm, cm, or m
Density: % solids, SpG, Baume H, Baume L, or API, Brix, Ball or Twadell
Mass Flow: lb/min, Kg/min, mT/min, mT/hr, sT/min, sT/hr, lT/min, or lT/hr
Weight: lb/min, kg/min, mT/hr, sT/hr, kg/hr, or kg/hr, or oz/min

Computer Interface: HART® Communications

SAMPLE DRAWINGS



Sample drawing only. See the drawing section of your packet for specifics.