Instructions
and
Operating Manual

X96S

MASS FLOW GAUGE

RONAN
ENGINEERING COMPANY
MEASUREMENTS DIVISION

Table of Contents

NOTE: Regulations will be supplied with the Radiation Safety Manual.

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 communication protocols,
- improved user interface options[1],
- more user functionality, and
- more product flexibility.

Advantages

- Non-Contact Measurement
- 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 the process (no components exposed to process material)
- Not affected by changing process conditions
- Does not make material radioactive
- Does not change the material
- Can be shielded by lead

X96S Advantages

- Multiple communication protocols (HART, Fieldbus)
- 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 Mass Flow Gauge provides both 4-20 mA current loop and other communication protocols (HART, FieldBus)

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 0 to 4 pounds per foot, then an analog current of 12mA (50% of range) will correspond to a weight of 2 pounds per foot.

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 that 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 variables, 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 three types of variables, communications variables, device variables and configuration variables.

Communication Variables

Four communication variables, PV (Primary Variable), SV (Secondary Variable), TV (Tertiary), and QV (Quaternary) are defined. PV is assigned to the primary 4-20 ma loop. Other communication protocols are also communicated over this loop. (HART, FieldBus) SV is assigned to an optional secondary 4-20 ma loop.

Device Variables

The Ronan X96S Mass Flow gauge has 4 device variables: Mass Flow, Density, Flow Rate and Head Temp.

Configuration Variables

The Ronan X96S Mass Flow gauge has many configuration variables that are accessed through its menus.

Theory

Theory of Radiation Gauging

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

A beam of gamma radiation is directed from the source holder, through the process material and housing, 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 density and flow of process material in the pipe while the transmitted radiation is inversely related to the flow and density of process material in the pipe.

Therefore, an **inc**reased process mass flow results in a decrease of transmitted radiation.

Since the radiation that's not being *absorbed* is being *transmitted*, the process mass flow 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 condition.

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

The X96S displays the output measurement range in the selected user units. The "zero" of the measurement range represents the lowest mass flow of interest, while the "span" of the measurement range represents the highest mass flow 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 gauge 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 mass flow 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 gauge response to quick process changes.
- Source Decay Compensation – automatic compensation for the radioisotope decay
- Calibration (Referencing) – calibration of gauge to user process.

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

The mass flow algorithm (or curve) used by the X96S software is a logrithmic function. That is, the relationship between the detector output and the process mass denisty is mathematically expressed as:

Total Mass Flow [Solids & Carrier]

$$R_c = R_0 + Ln(Io/Ic) \times (1/uT) \times a \times f$$

Where:

R_o	=	Reference density on water
R_c	=	Current mass flow in pipe
I_o	=	Detector signal on water
I_c	=	Current detector signal with material in pipe
a	=	ID of pipe in inches
uT	=	Mass absorption coefficient, which for Cs-137 approximately equals 0.04 ft^2/lb or (0.008 M^2/kg)
Ln	=	Natural Log
f	=	Flow rate

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 Mass Flow gauge uses a tree structured menu system.

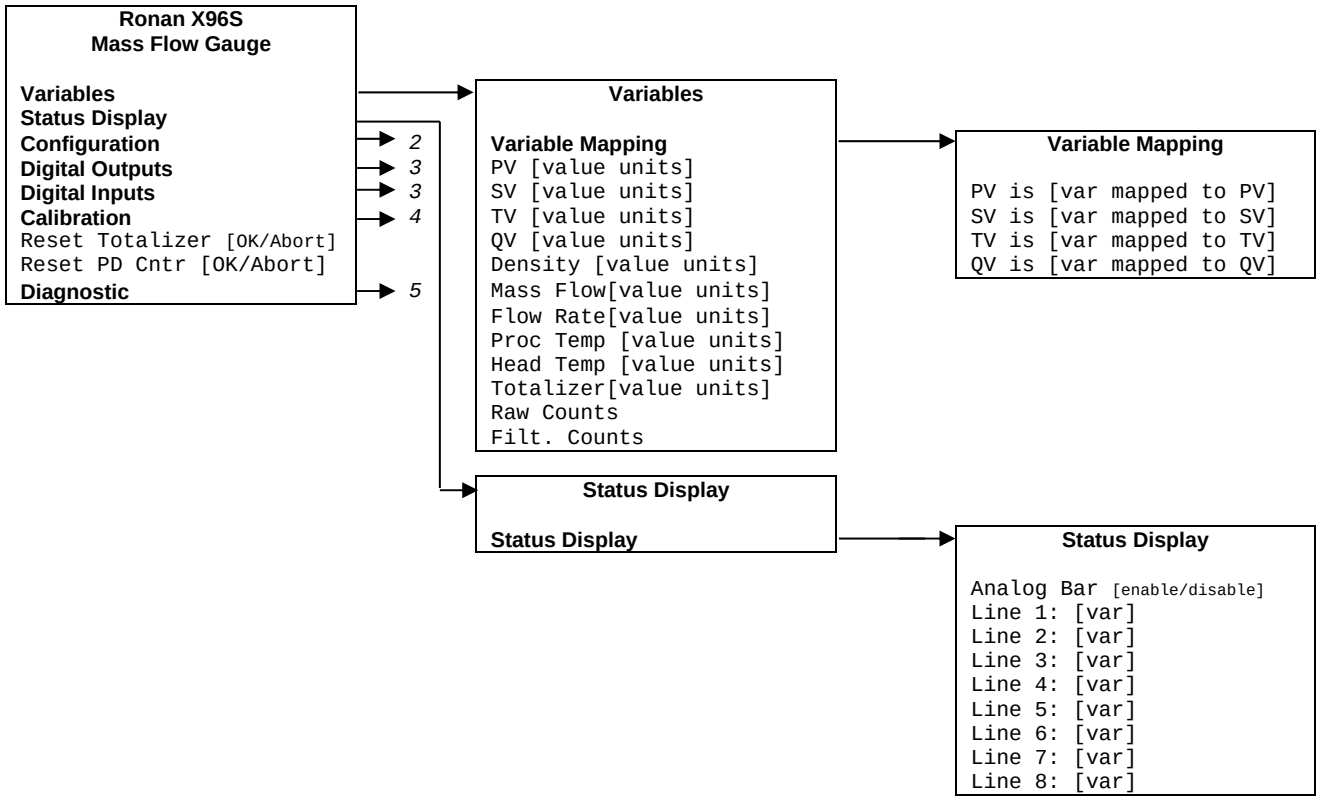


Figure 3-1 – Root, Variables and Display Menus

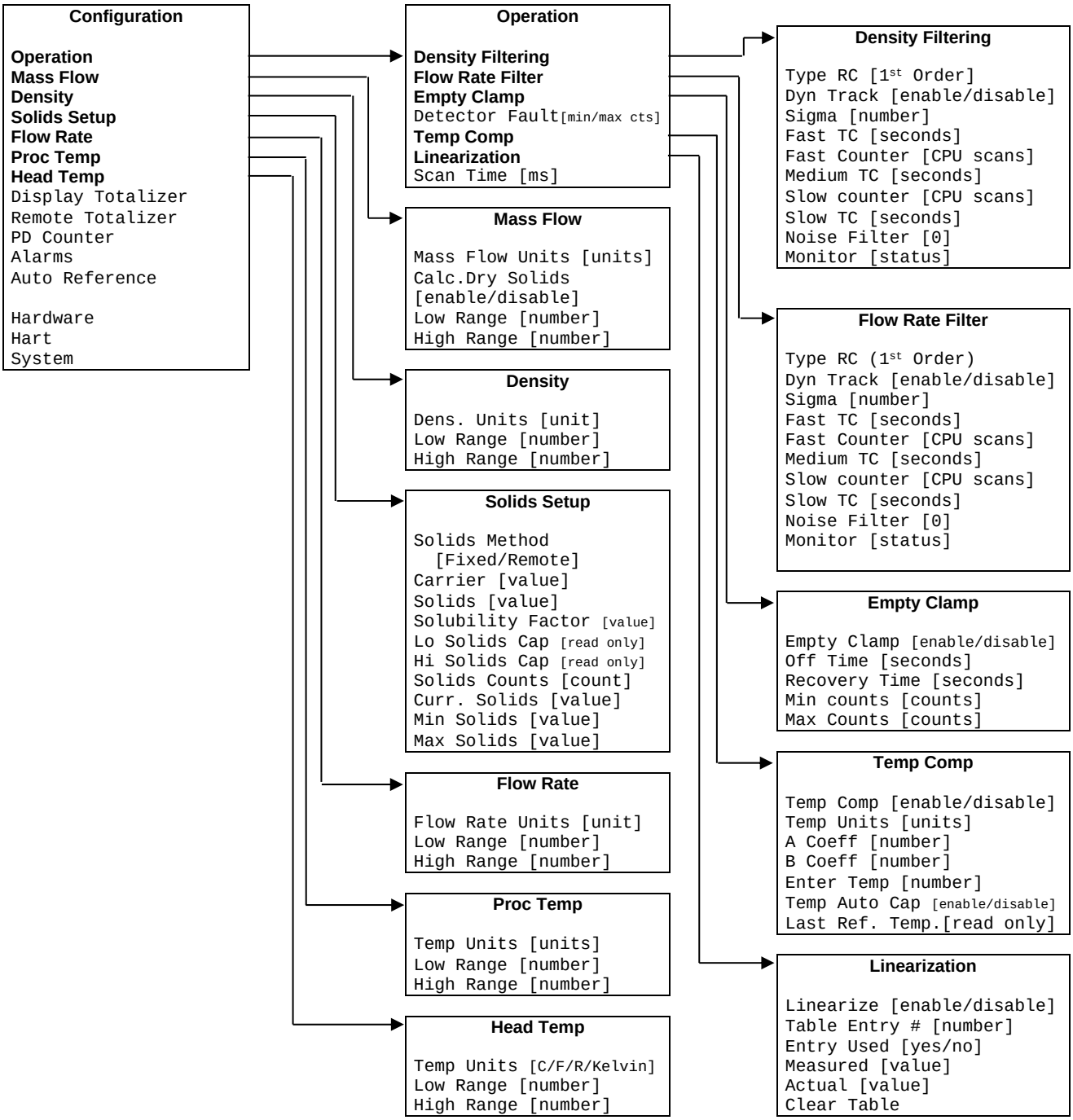


Figure 3-2 Configuration Menus

Continued from previous page

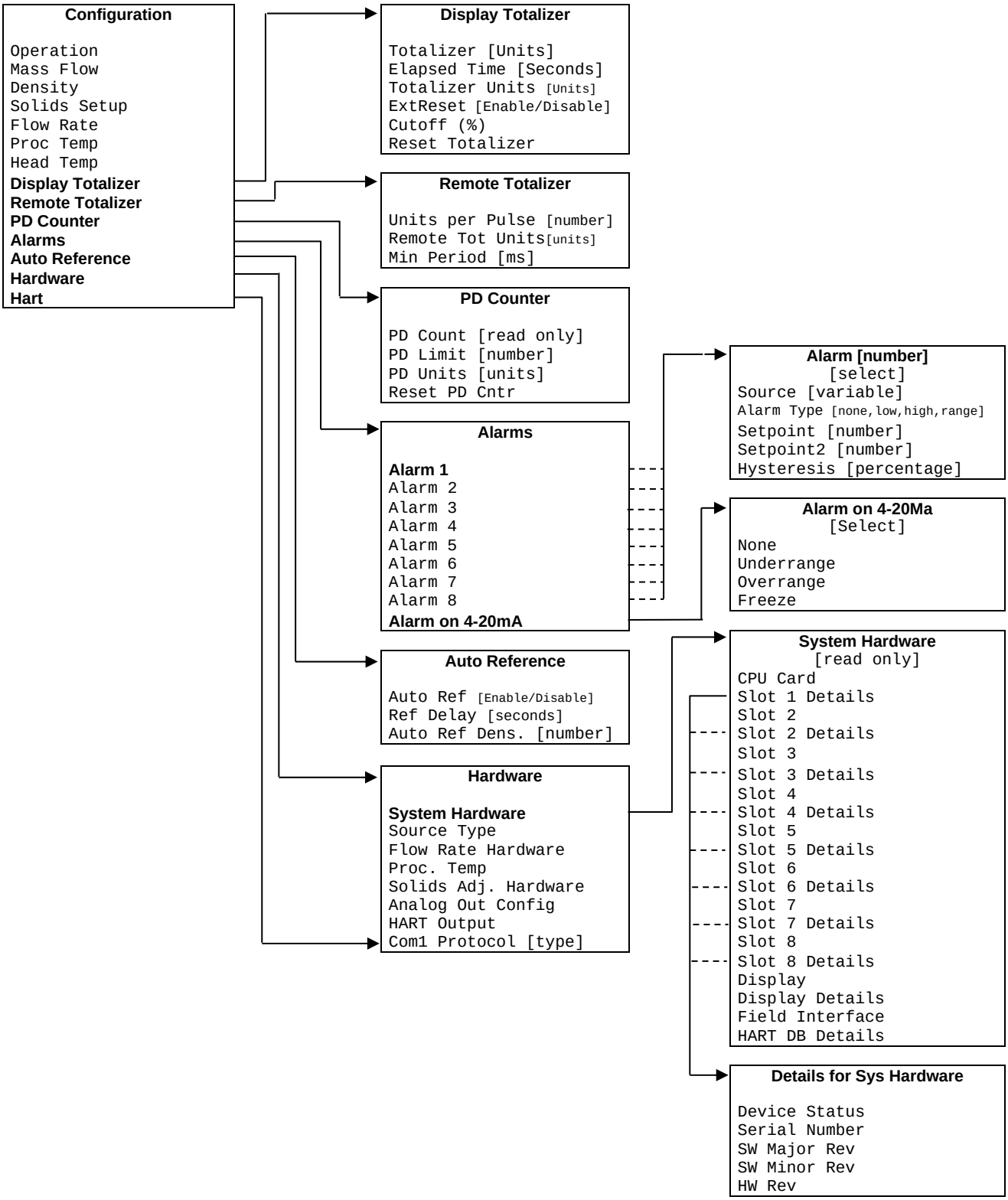


Figure 3-2 Configuration Menus Continued

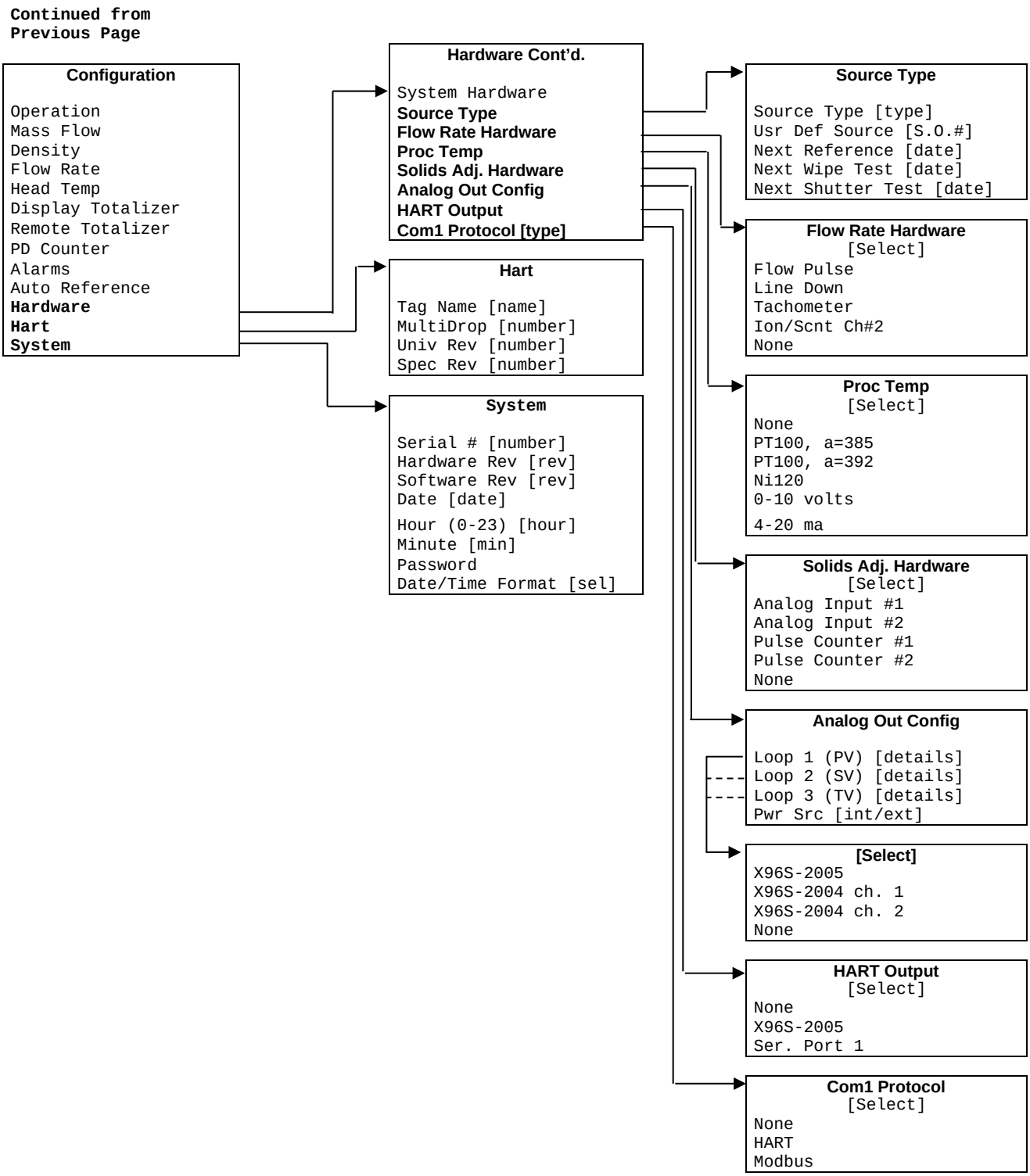


Figure 3-2 – Configuration Menus Continued

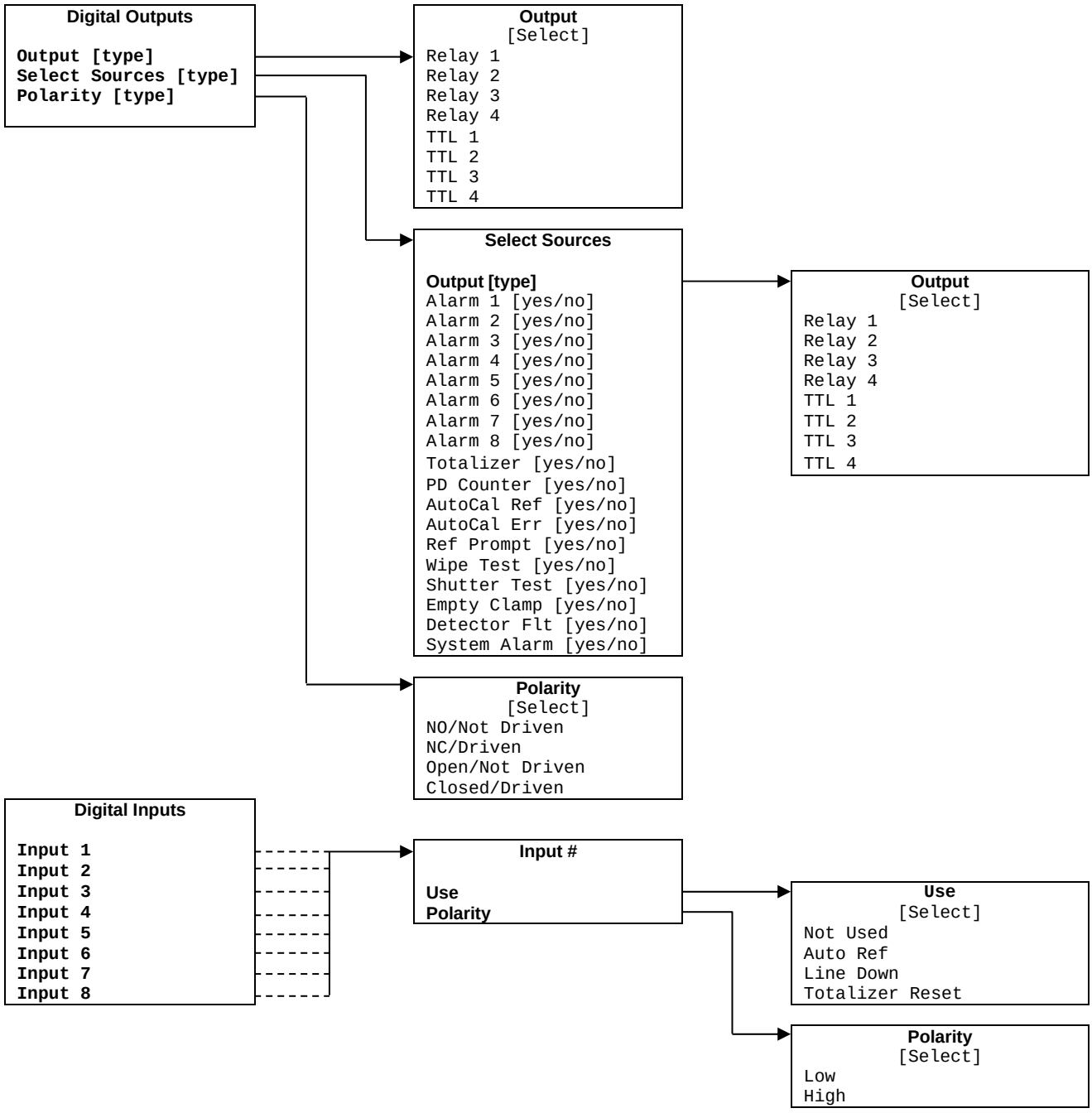


Figure 3-3, Digital Outputs, Digital Inputs Menus

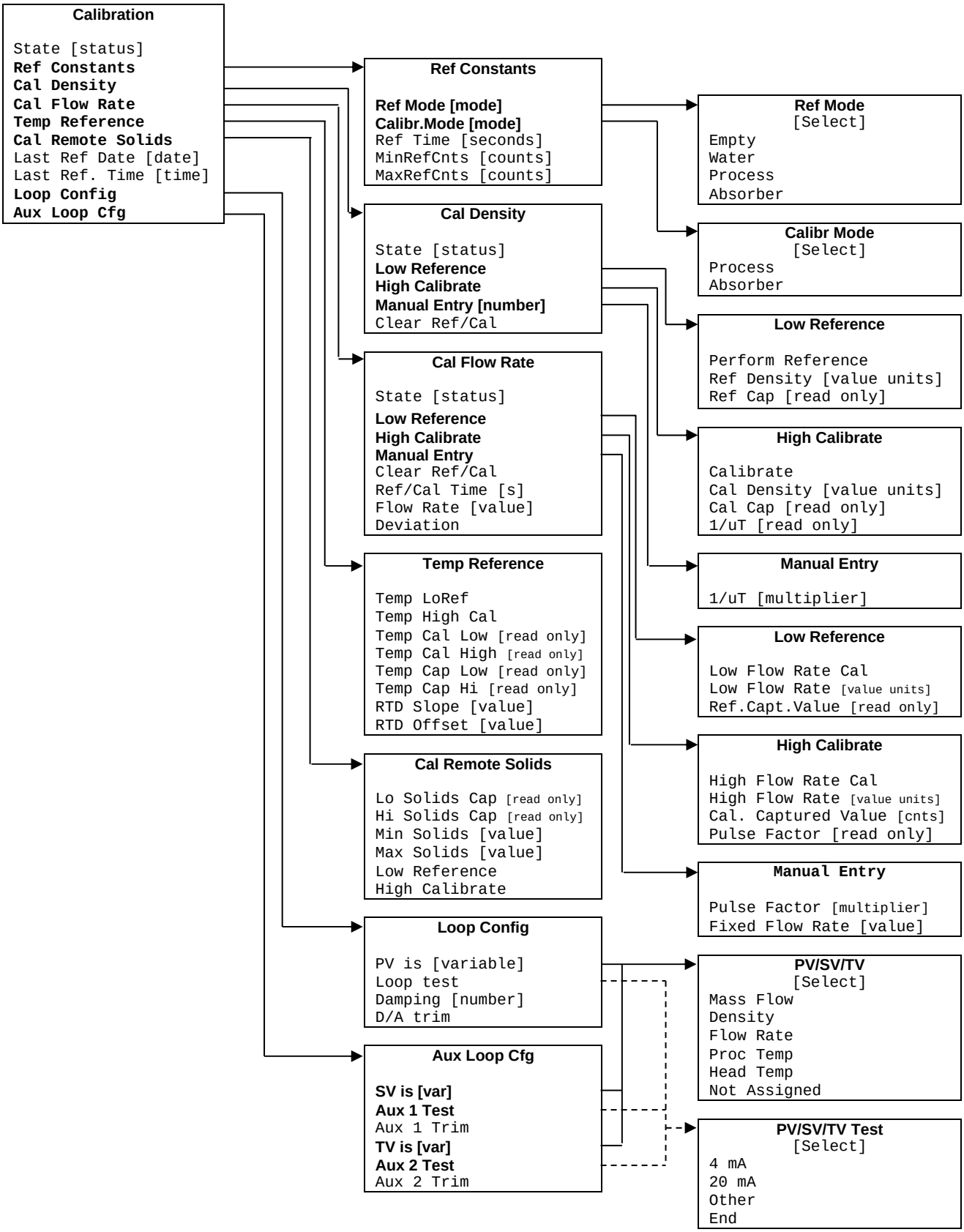


Figure 3-4 Calibration Menu

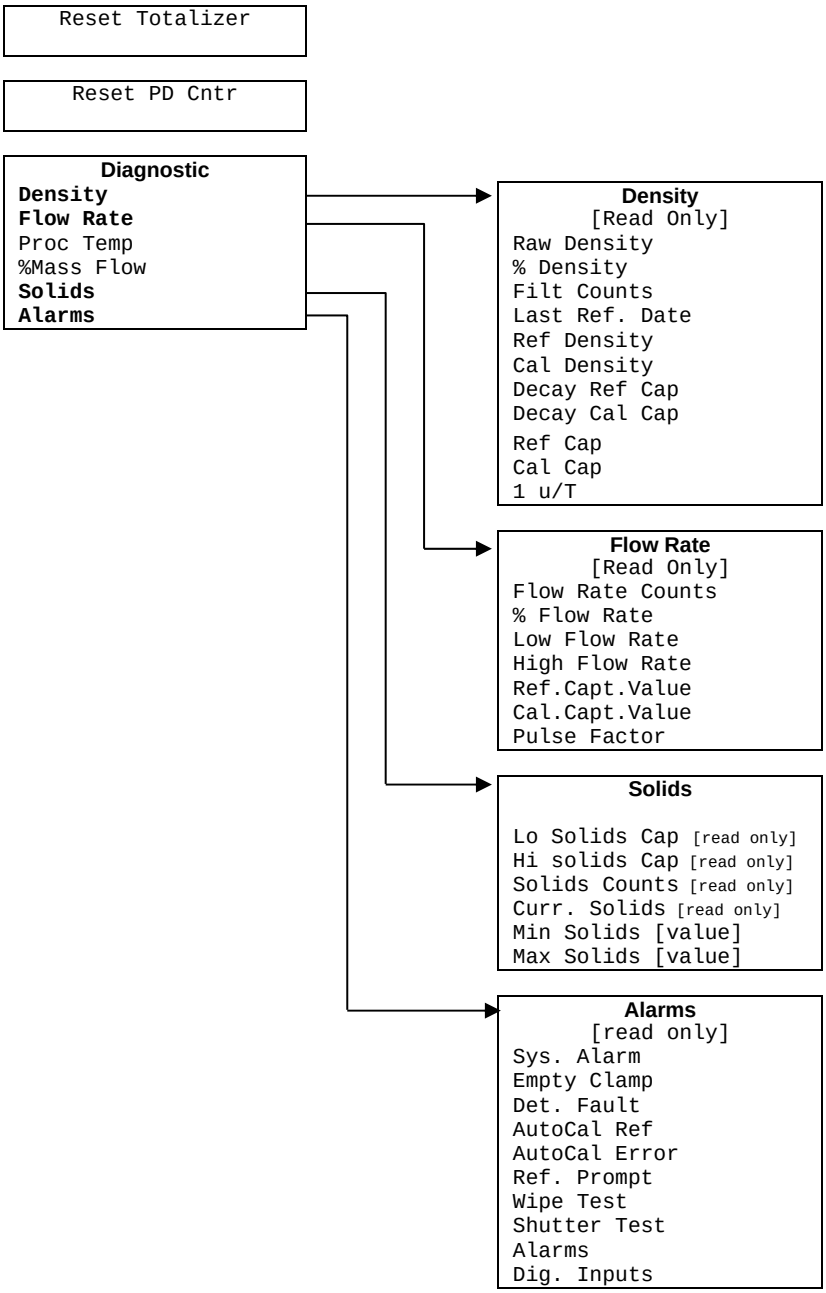


Figure 3-5 – Diagnostics Menu

Root Menu

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

ITEM	FUNCTION
Variables	Selecting this choice takes the user to the Variables menu.
Status Displays	Selecting this choice takes the user to the Status 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.
Calibration	Selecting this choice takes the user to the Calibration menu.
Reset Totalizer	Selecting this choice allows the user to the Reset Totalizer.
Reset PD Cntr	Selecting this choice allows the user to the Reset PD Cntr .
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 Tertiary Variable).
QV	Shows the current value of QV (the Quaternary Variable).
Density	Shows the current value of Rate (the Rate Variable).
Mass Flow	Shows the current value of Mass Flow (the Mass Flow Variable).
Flow Rate	Shows the current value of Flow Rate (the Rate of Flow Variable).
Proc Temp	Shows the current value of Proc Temp (the Processed Temperature).
Head Temp	Shows the current value of Head Temp (the Head Temperature).
Totalizer	Shows the current value of Total Mass Flow (the Total Mass Flow Variable).
Raw Counts	Shows the current value of Raw Counts (the Raw Counts Variable).
Filt Cnts	Shows the current value of Filter Cnts (the Filter Counts Variable).

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
Mass Flow	Mass Flow (example: pounds per hour)
Density	Density (example: pounds per gallon)
Flow Rate	Flow Rate (example: feet per second)
Proc Temp	Proc Temp (example: Deg F, Deg C, Deg R or Kelvin)
Head Temp	Head Temperature (if Available)
Not Assigned	Blank line

Status Display Menu

The Status Display menu is used to configure the device status display. It contains the following items

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

Lines 1 through 8 can select one of the following:

ITEM	MEANING
Mass Flow	Mass Flow (example: pounds per hour)
Density	Density (example: pounds per gallons)
Flow Rate	Flow Rate (example: feet per second)
Totalizer	Totalizer (shows the accumulated flow)
PD Counter	PD Counter (shows the current value in the predetermined counter)
% of Density	Shows the percent of Density based upon the min and max Density range
% of Mass Flow	Shows the percent of Mass Flow based upon the min and max Mass Flow range
% of Flow Rate	Shows the percent of Flow Rate based upon the min and max Flow Rate range
Head Temp	Head Temperature (if Available)
Proc Temp	Shows the temperature of the process in Deg F, Deg C, Deg R, Kelvin
4-20 mA	Shows the 4-20 mA output level
Raw Cnts	Unfiltered counts (from scintillation detector) or raw analog measurement (from ionization detector)
Filt Cnts	Filtered counts (from scintillation detector) or filtered analog measurement (from ionization detector)
Date & Time	Current date and time
Tot Elapsed Time	Shows the Total Elapsed Time since the last time Totalizer was reset
Diagnostic	Selecting this option takes the user to the Diagnostic Menu
Not Assigned	Blank line

Configuration Menu

The Configuration 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.
Mass Flow	Selecting this choice takes the user to the Mass Flow menu.
Density	Selecting this choice takes the user to the Density menu.
Solids Setup	Selecting this choice takes the user to the Solids Setup menu.
Flow Rate	Selecting this choice takes the user to the Flow Rate menu.
Proc Temp	Selecting this choice takes the user to the Proc Temp menu.
Head Temp	Selecting this choice takes the user to the Head Temp menu.
Display Totalizer	Selecting this choice takes the user to the Display Totalizer menu.
Remote Totalizer	Selecting this choice takes the user to the Remote Totalizer menu.
PD Counter	Selecting this choice takes the user to the PD Counter menu.
Alarms	Selecting this choice takes the user to the Alarms menu.
Auto Reference	Selecting this choice takes the user to the Auto Reference 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 Mass Flow Gauge data. It contains the following items:

ITEM	FUNCTION
Density Filtering	Selecting this choice takes the user to the Density Filtering menu.
Flow Rate Filter	Selecting this choice takes the user to the Flow Rate Filter menu.
Empty Clamp	Selecting this choice takes the user to the Empty Clamp menu.
Detector Fault	Selecting this choice takes the user to the Detector Fault menu.
Temp Comp	Selecting this choice takes the user to the Temp Comp menu.
Linearization	Selecting this choice takes the user to the Linearization menu.
Scan Time	Shows the amount of time to accumulate each mass flow sample and allows the user to change the time value.

Density Filtering Menu

The Density Filtering menu is used to configure the parameters associated with the Mass Flow measurement filter. 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. If disabled the filter uses only the Slow TC (time constant).
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 gauge has been in dynamic tracking long enough to be using Medium filter and the raw counts continued to exceed the sigma value, the fast counter value is decreased each consecutive scan. The Fast counter value resets and returns back 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 to be used when the Slow Counter reaches zero.
Slow Counter	Shows the slow count down counter value. If gauge is in dynamic tracking, and the raw counts continued to exceed the sigma value, the slow counter value is decreased each consecutive scan. The Slow counter value resets and returns back 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 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 flow value. Also it allows user to change this number. Erroneous measurement is defined when the raw signal is 4 times the pre-selected sigma multiplier by the user.
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 Mass Flow Gauge).
FILL	The slow filter buffer is filling.
TRACK	The (slow or medium or fast filter buffer is filled and the filter is tracking changes in the flow value.
REFILL	A step change has occurred and the walking average buffer is refilling.

Flow Rate Filter Menu

The Filtering menu is used to configure the parameters associated with the mass flow measurement filter. 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. If disabled the filter uses only the Slow TC (time constant).
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 gauge has been in dynamic tracking long enough to be using Medium filter and the raw counts continued to exceed the sigma value, the fast counter value is decreased each consecutive scan. The Fast counter value resets and returns back 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 to be used when the Slow Counter reaches zero.
Slow Counter	Shows the slow count down counter value. If gauge is in dynamic tracking, and the raw counts continued to exceed the sigma value, the slow counter value is decreased each consecutive scan. The Slow counter value resets and returns back 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 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 flow value. Also it allows user to change this number. The user defines erroneous measurement when the raw signal is 4 times the pre-selected sigma multiplier.
Monitor	Shows the current state of the filtering mechanism.

Monitor (filter state) one of the following:

ITEM	MEANING
ERROR	Filter is not initialized (this state should not occur during normal operation of the X96S Mass Flow Gauge).
FILL	The slow filter buffer is filling.
TRACK	The (slow or medium or fast filter buffer is filled and the filter is tracking changes in the flow value.
REFILL	A step change has occurred and the walking average buffer is refilling.

Empty Clamp Menu

The X96S uses a mechanism called empty clamp to protect detectors (particular scintillation detectors) from saturation conditions.

I.e.: Material being processed is lower than detector range, causing too much radiation to reach the detector, possibly damaging the electronics. The Min Counts and the Max Counts parameters set the threshold (in raw counts[2]) for activation of the empty clamp function. The Count values should be set above (Max Counts) the Reference Counts, and below (Min Counts) the Calibrate Counts and beyond your normal measurement range.

[2] The threshold is in raw counts since the overload is a function of the radiation effect on the detector and not related to any corrected or converted data.

The Empty Clamp menu is used to configure the parameters associated with the mechanism that shuts off power to the detector if the detector received more radiation than it is capable of measuring. It contains the following items:

ITEM	FUNCTION
Empty Clamp	Shows the current state of the Empty Clamp mechanism (enabled or disabled) and allows the user to change the state.
Off Time	Shows and allows the user to change the number of seconds that power to the detector be shut off when the empty clamp mechanism activates before turning the detector on to see if the radiation level has dropped to a value that the detector is capable of measuring. Typical value ranges from 15 to 30 minutes.
Rcvry Time	Shows and allows the user to change the number of seconds that power will be applied to the detector when the empty clamp mechanism has activated to see if the radiation level has dropped to a value that the detector is capable of measuring. Typical value here is 30 seconds.
Min Counts	Shows and allows the user to change the number-minimum number of counts that are used to determine that the detector is saturated (exposed to more radiation than it is capable of measuring).
Max Counts	Shows and allows the user to change the number maximum number of counts that are used to determine that the detector is exposed to more radiation than it is capable of measuring.

Detector Fault Menu

The Detector Fault menu is used to configure a window in which the detector counts must fall within, in order to complete a reference/calibration.

Temp Comp Menu

Temperature compensation in the X96S is calculated as a quadratic function[3]. If temperature compensation is to be used, the process temperature can be captured automatically for you during Referencing by enabling `Temp auto Cap.` If you choose to enter the temperature manually, the entered value should be the temperature of the process material during the Referencing function.

Process temperature is typically read via platinum or nickel, 2 or 3-wire RTD attached to the X96S. In these cases, the X96S needs no temperature calibration. You can optionally feed a 0-10 Volt or 4-20mA signal into the X96S from another source that represents the range of temperature for your process. In this case, you will need to perform a Temp Ref (in the Calibration Menu) to set the range of measurement. You will also need to define the type of temperature device you are using in the Hardware Menu, and Proc Temp menus.

The Temp Comp menu is used to control the temperature compensation mechanism. It contains the following items:

ITEM	FUNCTION
Temp Comp	Shows the current state of the Temp Comp mechanism (enable/disable) and allows the user to change the state.
Temp Units	Shows and allows the user to set the temperature units used by the temperature compensation mechanism.
A Coeff	Shows and allows the user to set the "A" coefficient that relates temperature to changes in mass flow.
B Coeff	Shows and allows the user to set the "B" coefficient that relates to temperature to changes in mass flow.
Enter Temp	Shows and allows the user to set the process temperature at the time that the gauge was Referenced (if Auto Cap was 'enabled' during Referencing).
Temp Auto Cap	This invokes a method that captures the process temperature automatically during gauge Referencing.

[3] compensated density = uncompensated density + (A Coeff* temperature delta) + (B Coeff* temperature delta^2)

Temp Units is one of the following:

ITEM	MEANING
Deg C	Degrees Celsius
Deg F	Degrees Fahrenheit
Deg R	degrees Rankine
Kelvin	degrees Kelvin

Linearization Menu

The X96S is capable of performing a multi-point linearization of the mass flow data when required by an application. The linearization table contains thirty entries, numbered 1 through 32. Each entry consists of a measured (Ronan indicated) value, an actual (physical) value, and a flag that indicates if the entry is used[4].

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 to change the state.
Table Entry #	Shows and allows the user to select an entry in the linearization table
Entry Used	Shows if the entry is used or not.
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 item invokes a method that clears all entries in the linearization table.

Scan Time Menu

The Scan Time menu is used to configure the rate the input board scans the detector signal and the rate the microprocessor updates the LCD display and the output signal.

Mass Flow

The `Mass Flow` menu is used to configure the parameters associated with the Rate measurement. It contains the following items:

ITEM	FUNCTION
Mass Flow Units	Shows and allows the user to set the rate units used.
Calc. Dry Solids	Shows and allows the user to set the dry solids calculations. Disabled = total mass flow; Enabled = dry solids mass flow. ***If density setting is "% sol-wt," dry solids must e enabled to read total flow volume.*
Low Range	Shows and allows the user to set the rate value to be mapped to 4ma on the current loop output, if rate is selected to control that current loop.
High Range	Shows and allows the user to set the rate value to be mapped to 20ma on the current loop output, if rate is selected to control that current loop.

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

Mass Flow Units is one of the following:

ITEMS	MEANING
kg/s	kilograms per second
g/s	grams per second
g/min	grams per minute
g/h	grams per hour
kg/min	kilograms per minute
kg/hour	kilograms per hour
kg/d	kilograms per day
MetTon/min	metric tons minute
Met/h	metric tons per hour
MetTon/day	metric tons per day
lb/s	pounds per second
lbs/min	pounds per minute
lb/h	pounds per hour
lb/d	pounds per day
STon/min	short ton per minute
STon/h	short ton per hour
Ston/d	long ton per day
Lton/h	long ton per hour
Lton/d	long Ton per day

Density

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

ITEM	FUNCTION
Dens. Units	Shows and allows the user to set the units for the density measurement
Low Range	Shows and allows the user to set the mass flow value to be mapped to 4ma on the current loop output, if mass flow is selected to control that current loop
High Range	Shows and allows the user to set the mass flow value to be mapped to 20ma on the current loop output, if mass flow is selected to control that current loop

Units is one of the following:

ITEM	MEANING
SGU	specific gravity units
g/Cucm	grams per cubic centimeter
kg/Cum	kilograms per cubic meter
lb/gal	pounds per gallon
lb/cuft	pounds per cubic foot
g/mL	grams per milliliter
kg/L	kilograms per liter
g/L	grams per liter
lb/Cuin	pounds per cubic inch
STon/Cuyd	Short ton per cubic yard
degTwad	Degree Twaddle
degBrix	Degree Brix
degBaum hv	Degree Baum heavy
degBaum lt	Degree Baum light
degAPI	Degree API
% sol-wt	% solids
degBall	Degree Balling

Solids Setup

The Solids Setup menu contains the following items:

ITEM	FUNCTION
Solids Method	Shows and allows the user to set the method of measurement fixed or remote
Carrier	Shows and allows the user to set the weight of the carrier
Solids	Shows and allows the user to set the weight of the solids
Solubility Factor	Shows and allows the user to set the solubility (multiplier)
Lo Solids Cap	Shows the user the lo solids captured value
Hi Solids Cap	Shows the user the hi solids captured value
Solids Counts	Shows the user the number of counts being used (read only)
Curr. Solids	Shows the user the current solids value
Min Solids	Shows and allows the user to set the minimum solids weight
Max Solids	Shows and allows the user to set the maximum solids weight

Flow Rate

The Flow Rate menu is used to configure the parameters associated with the Flow Rate measurement. It contains the following items:

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

Flow Rate Units is one of the following:

ITEM	MEANING
Cuft/s	Cubic feet per second
Cuft/min	Cubic feet per minute
cuft/h	Cubic feet per hour
cuft/d	Cubic feet per day
cum/s	Cubic meters per second
cum/min	Cubic meters per minute
cum/h	Cubic minutes per hour
cum/d	Cubic minutes per day
l/s	Liters per second
l/min	Liters per minute
l/h	Liter per hour
gal/s	Gallon per second
gal/min	Gallon per minute
gal/h	Gallon per hour
impgal/s	Imperial gallon per second
impgal/min	Imperial gallon per minute
impgal/h	Imperial gallon per hour
impgal/d	Imperial gallon per day
mgal/d	Millions of gallons per day
ml/d	Millions of liters per day

Proc Temp

The Proc Temp. Menu is used to configure the parameters associated with the process temperature measurement. It contains the following items:

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

Temp Units is one of the following:

ITEM	MEANING
Deg C	degrees Celsius
Deg F	degrees Fahrenheit
Deg R	degrees Rankine
Kelvin	degrees Kelvin

Head Temp

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 to20ma on the current loop output, if head temperature is selected to control that current loop.

Temp Units is one of the following:

ITEM	MEANING
Deg C	Degree Celsius
Deg F	Degree Fahrenheit
Deg R	Degree Rankine
Kelvin	Kelvin

Display Totalizer

The Display Totalizer menu is used to configure the parameters associated with the Display Totalizer. It contains the following items:

ITEM	FUNCTION
Totalizer	Shows the accumulated mass flow in the Total Mass Flow register
Elapsed Time	Shows the elapsed time since the last time the Totalizer was reset.
Totalizer Units	Shows and allows the user to set the units to be used for the Totalizer.
Ext Reset	Shows and allows the user to enable/disable the Totalizer to be reset remotely
Cutoff	Shows and allows the user to set the minimum percent of material before totalization occurs
Reset Totalizer	Shows and allows the user to reset the Totalizer locally

Totalizer Units is one of the following:

UNITS	MEANING
Ston	Short Tons
LTon	Long Tons
lb	pounds
ounce	ounces
MetTon	Metric Tons
kg	kilograms
g	grams

Remote Totalizer Menu

The Remote Totalizer menu is used to configure the parameters associated with the Remote Totalizer. It contains the following items:

ITEM	FUNCTION
Units per Pulse	Shows and allows the user to set the number of units per pulse for the Remote Totalizer.
Remote Tot Units	Shows and allows the user to set the units to be used for the Remote Totalizer.
Min Period	Shows and allows the user to set the minimum pulse period.

Remote Totalizer Units is one of the following:

ITEM	MEANING
Ston	short tons
Lton	long tons
Lb	Pounds
ounce	Ounces
MetTon	metric tons
kg	kilograms
g	grams

PD Counter

The PD Counter menu is used to configure the parameters associated with the Pre-Determined Counter. It contains the following items:

ITEM	FUNCTION
PD Count	Shows the accumulated mass flow in the Pre-Determine Count register
PD Limit	Shows and allows the user to set the limit for the PD Counter.
PD Units	Shows and allows the user to set the units to be used for the PD Counter.
Reset PD Cntr	Shows and allows the user to reset the PD Counter locally

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 4-20mA alarm

ITEM	FUNCTION
Source	Show and allows the user to set the source of the alarm.
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.[2]
Hysterisis	Shows and allows the user to set the alarm hysterisis percent.

Source is one of the following

ITEM	MEANING
Density	Uses the Density for the source of the alarm
Mass Flow	Uses the Mass Flow for the source of the alarm
Flow Rate	Uses the Flow Rate for the source of the alarm
Proc Temp	Uses the Process Temp of the detector for the source of the alarm
Head Temp	Uses the Head Temperature of the detector for the source of the alarm
Filtered Counts	Uses the Filtered Counts from the detector for the source of the alarm
4-20 mA	Uses the 4-20 mA from the detector for the source of the alarm

Alarm Type 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

Auto Reference

The Auto Reference menu is used to configure the parameters associated with the Auto Reference. It contains the following items:

ITEM	FUNCTION
Auto Ref	Shows and allows the user to Enable or Disable the Auto Reference
Ref Delay	Shows and allows the user to change the time for the Reference Delay
Auto Ref Density	Shows and allows the user to change the Reference Mass Flow to be used for the Auto Ref Mass Flow

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

Hardware

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 to a list of the hardware modules in the system and the status of these modules
Source Type	Selecting this item takes the user to the Source Type menu
Flow Rate Hardware	Selecting this item takes the user to the Speed Hardware menu
Proc Temp	Shows and allows the user to set the type of probe used to read process temperature
Solids Adj.Hardware	Shows and allows the user to set the density of the solids via an input.
Analog Out Cnfg	Shows and allows the user to set the where the source of power is internal or external
HART Output	Shows and allows the user to adjust the HART output functions
Com1 Protocol	Shows and allows the user to adjust the Com1 Protocols (None/ RonanSetup)

System Hardware

The System Hardware menu takes the user to a list of the hardware modules in the system and shows the status of these modules. It contains the following items:

ITEM	FUNCTION
CPU	Shows the type of CPU card installed (in slot 1)
Slot 1 Details	Shows the status of the card and details of the hardware and software
Slot 2 Card	Shows the type of card (if any) installed in slot 2
Slot 2 Details	Shows the status of the card and details of the hardware and software
Slot 3 Card	Shows the type of card (if any) installed in slot 3
Slot 3 Details	Shows the status of the card and details of the hardware and software
Slot 4 Card	Shows the type of card (if any) installed in slot 4
Slot 4 Details	Shows the status of the card and details of the hardware and software
Slot 5 Card	Shows the type of card (if any) installed in slot 5
Slot 5 Details	Shows the status of the card and details of the hardware and software
Slot 6 Card	Shows the type of card (if any) installed in slot 6
Slot 6 Details	Shows the status of the card and details of the hardware and software
Slot 7 Card	Shows the type of card (if any) installed in slot 7
Slot 7 Details	Shows the status of the card and details of the hardware and software
Slot 8 Card	Shows the type of card (if any) installed in slot 8
Slot 8 Details	Shows the status of the card and details of the hardware and software
Display Type	Shows the type of display module (if any) attached
Display Details	Shows the status of the display module, if the module is attached, else shows None
Field Interface	Shows the status of the card and details of the hardware and software
HART DB Details	Shows the status of the card and details of the hardware and software

Source Type

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 item takes the user to the Usr Def Source menu
Next Reference	Shows and allows the user to set the date for the next low reference
Next Wipe Test	Shows and allows the user to set the date for the next wipe test
Next Shutter Test	Shows and allows the user to set the date for the next shutter test

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 Usr 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 Rate Hardware Menu

The Flow Rate 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

Proc Temp

The Proc Temp is one of the following:

ITEM	MEANING
None	No temperature measurement device configured
PT100, a=385	Platinum RTD with an alpha of 885 (commonly used in USA)
PT100, a=392	Platinum RTD with an alpha of 892 (commonly used in Europe)
Ni120	Nickel RTD
0-10 volts	Temperature measurement device that provides a 0 to 10-volt signal
4-20 ma	Temperature measurement device that provides a 4-20ma signal

Solids Adj. Hardware

The Solids Adj. Hardware

ITEM	MEANING
None	No selection made
Analog Input #1	Shows and allows the user to assign Channel 1 of the Analog input card
Analog Input #2	Shows and allows the user to assign Channel 2 of the Analog input card
Pulse Counter 1	Shows and allows the user to assign the Digital DIO card digital input 1
Pulse Counter 2	Shows and allows the user to assign the Digital DIO card digital input 2

Analog Out Cnfg Menu

The Analog Out Cnfg menu is used to set where the source of power is internal or external. It contains the following items:

ITEM	FUNCTION
Loop 1 (PV)	Shows and allows the user to assign a source to Loop 1
Loop 2 (SV)	Shows and allows the user to assign a source to Loop 2
Loop 3 (TV)	Shows and allows the user to assign a source to Loop 3
Pwr Src	Shows, and allows the user to set where the source of power is internal or external, to power the AO modules outputs

Pwr Src has the following options:

ITEM	MEANING
Internal	The analog output card outputs will use its own internal power supply
External	The analog output card outputs will use an external power supply

HART Output

The HART Output menu is used to define the type of HART Output desired.

ITEM	MEANING
X96S-2005	Selecting this will assign the HART card
Ser. Port 1	Selecting this will allow the user to use Serial Port 1
None	No HART Output desired

Com1 Protocol

The Com1 Protocol menu contains the following items:

ITEM	MEANING
None	No Com1 Protocol
HART	HART Protocol
Modbus	Modbus Protocol
Ronan Setup	Ronan Setup Protocol

HART

The HART 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

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

ITEM	MEANING
Serial #	Shows the device serial number
Hardware Rev	Shows the number of device hardware revisions
Software Rev	Shows the number of device software revisions
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
Password	Shows and allows the user to set a password from the main display to allow access to all menus
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:

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

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
Totalizer [yes/no]	Allows the user to assign Totalizer to the selected digital output
PD Counter[yes/no]	Allows the user to assign PD Counter 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 option 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
Use	Shows and allows the user to set the type of device connected to the digital input
Polarity	Shows and allows the user to set the active state of the digital input

Use is one of the following:

TYPE	MEANING
Not Used	Input is not used
Auto Ref	The input is configured for Auto Referencing
Line Down	The input is configured for flow rate using a dry contact
Totalizer Reset	The input is configured for remote totalizer reset

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

Calibration

This menu is used to view and control the calibration of the X96S Mass Flow Gauge. It contains the following items:

ITEM	FUNCTION
State	Shows the state of the density configuration process
Ref Constants	Selecting this item takes the user to the Ref Constants menu
Cal Density	Selecting this item takes the user to the Calibrate Density menu
Cal Flow Rate	Selecting this item takes the user to the Cal Flow Rate menu
Temp Reference	Selecting this item takes the user to the Temp Reference menu
Cal Remote Solids	Selecting this item takes the user to the Cal Remote Solids menu
Last Ref. Date	Shows the date on which the gauge was most recently Low Referenced.
Last Ref. Time	Shows the time when the gauge 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

Ref Constants

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 pre-selected promptings and values during a reference.
Calibr.Mode	Shows and allows the user to set the pre-selected promptings and values during a calibration.
Ref Time	Shows and allows the user to set the number of seconds of data to collect for a reference or calibrate sample (0 – 999 seconds)
MinRefCnt	Shows and allows the user to set the minimum raw count value to use for a reference or calibrate sample
MaxRefCnt	Shows and allows the user to set the maximum raw count value to use for a reference or calibrate sample

Ref Mode is one of the following:

ITEM	MEANING
Empty	The pipe will be Empty during a reference (just air; no process in the measuring area)
Water	The pipe will be filled with water during the process
Process	Actual process material to be used for reference. (Density must be provided)
Absorber	Absorber plate will be placed in the radiation path and the indicated value noted.

Calibrate Density Menu

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

ITEM	FUNCTION
State	Shows the state of the mass flow configuration process
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
Manual Entry	Shows and allows the user to set the calculated Loading Factor value (Same value as in Calibrate Menu, L.F.)
Clear Ref/Cal	This item invokes method that clears the density reference and L.F. (Loading Factor)

Cal Flow Rate Menu

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

ITEM	FUNCTION
State	Shows the state of the flow rate configuration process
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
Manual Entry	Shows and allows the user to set the calculated Pulse Factor value
Clear Ref/Cal	This item invokes method that clears the mass flow reference and pulse factor
Ref/Cal Time	Shows and allows the user to set the number of seconds of data to collect for a reference or calibrate sample
Flow Rate Deviation	Shows and allows the user to set the percent of deviation of the current counts during calibration

Low Reference (Cal Flow Rate)

This menu is used to reference the minimum flow rate value.

ITEM	FUNCTION
Low Flow Rate Cal	This item invokes a method that performs the low flow rate reference
Low Flow Rate	This item shows and allows the user to set the minimum flow rate
Ref. Capt. Value	This item shows the captured low flow rate counts

High Calibrate (Cal Flow Rate)

This menu is used to calibrate the maximum flow rate value.

ITEM	FUNCTION
High Flow Rate Cal	This item invokes a method that performs the high flow rate calibration
High Flow Rate	This item shows and allows the user to set the maximum flow rate
Cal. Capt. Value	This item shows the captured maximum flow rate counts
Pulse Factor	Shows the user the calculated pulse factor value (read only – multiplier)

Manual Entry (Cal Flow Rate) Menu

ITEM	FUNCTION
Pulse Factor	Shows and allows the user to set the Pulse per flow rate (L/s) value (multiplier)
Fixed Flow Rate	Shows and allows the user to set the fixed flow rate value

Temp Reference

This menu is used ONLY if the Hardware Menu, Proc Temp value is set for 0-10 volts or 4-2- ma
This menu is used to perform the process temperature reference procedure. It contains the following items:

ITEM	FUNCTION
Temp LoRef	This invokes a method that performs the low temp reference
Temp High Cal	This invokes a method that performs the high temp reference
Temp. Cal Low	Temperature value during the Temp Lo Ref procedure
Temp. Cal High	Temp value during the Temp High Cal procedure
Temp Cap Low	Shows the raw captured temperature counts during the low temp reference
Temp Cap High	Shows the raw captured temperature counts during the high temp reference
RTD Slope	Factory value for RTD Slope
RTD Offset	Factory value for RTD Offset

Cal Remote Solids

This menu is used to calibrate the remote input. It contains for following items:

ITEM	FUNCTION
Lo Solids Cap	Shows the user the low solids captured counts
Hi Solids Cap	Shows the user the high solids captured counts
Min Solids	Shows and allows the user to input the minimum solids value
Max Solids	Shows and allows the user to input the maximum solids value
Low Reference	This invokes a method that performs the low reference procedure
Hi Calibration	This invokes a method that performs the high calibration procedure

Loop Config Menu

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

ITEM	FUNCTION
Pv is	Shows and allows the user to set the variable assigned to the primary 4-20mA current loop
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

PV is one of the following:

ITEM	MEANING
Mass Flow	Mass Flow (example: pounds per hour)
Density	Density (example: pounds per linear foot)
Flow Rate	Flow Rate (example: feet per second)
Head Temp	Head Temperature (if Available)
Not Assigned	Blank line

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
Aux 1 Test	This item invokes a method that performs a test on the secondary 4-20ma current loop
Aux 1 trim	This item invokes a method that performs the D/A trimming of the secondary 4-20ma current loop
TV is	Shows and allows the user to set the variable assigned to the tertiary 4-20ma current loop
Aux 2 Test	This item invokes a method that performs a test on the tertiary 4-20ma current loop
Aux 2 Trim	This item invokes a method that performs the D/A trimming of the tertiary 4-20ma current loop

SV is one of the following:

ITEM	MEANING
Mass Flow	Mass Flow (example: pounds per hour)
Density	Density (example: pounds per linear foot)
Flow Rate	Flow Rate (example: feet per second)
Head Temp	Head Temperature (if Available)
Not Assigned	Blank line

TV is one of the following:

ITEM	MEANING
Mass Flow	Mass Flow (example: pounds per hour)
Density	Density (example: pounds per linear foot)
Flow Rate	Flow Rate (example: feet per second)
Head Temp	Head Temperature (if Available)
Not Assigned	Blank line

Diagnostic

This menu is used to provide the available variables needed to troubleshoot on one simple screen. It contains the following:

ITEM	FUNCTION
Density	Selecting this item takes the user to the Density menu
Flow Rate	Selecting this item takes the user to the Flow Rate Menu
Alarms	Selecting this item takes the user to the Alarms menu

Density

This menu contains the following items:

ITEM	MEANING
Raw Counts	Non-filtered counts from the detector
Raw Density	Non-filtered density from the detector
%Density	Shows the percent of density based upon the min and max density range
Filt. Counts	X96S filtered counts from the detector
Last Ref. Date	Shows the date the last reference was performed
Ref Density	Shows the actual value of the last density reference performed
Cal Density	Shows the actual value of the last density calibration performed
Decay Ref Cap	Shows the value of the reference captured counts
Decay Cal Cap	Shows the value of the calibration captured counts
Ref Cap	Shows the captured counts for the last density reference performed
Cal Cap	Shows the captured counts for the last calibration performed
1/uT	Shows the calculated slope value (multiplier)

Flow Rate

This menu contains the following items:

ITEM	MEANING
Flow Rate Counts	Rate of flow (example: feet per second)
% Flow Rate	Shows the percent of flow rate based upon the min and max flow rate range
Low Flow Rate	Shows the minimum flow rate value
High Flow Rate	Shows the maximum flow rate value
Ref.Capt.Value	Shows the captured counts for the minimum flow rate referenced
Cal.Capt.Value	Shows the captured counts for the maximum flow rate for the last calibration performance
Pulse Factor	Shows the user the Pulse per flow rate (L/s) value

Solids

This menu contains the following items:

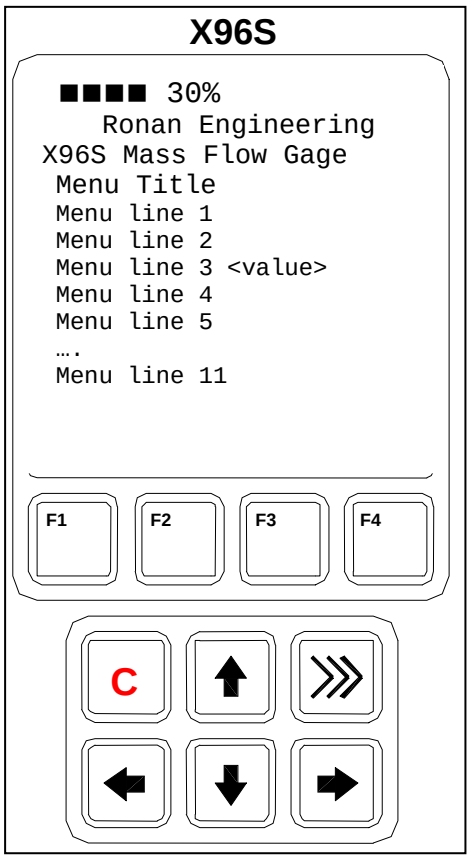
ITEM	MEANING
Lo Solids Cap	Shows the low value solids captured counts
Hi Solids Cap	Shows the high value solids captured counts
Solids Counts	Shows the current solids counts
Curr. Solids	Shows the current solid density value being used for calculating the percent solids.
Min Solids	Shows and allows the user to set the minimum solids range
Max Solids	Shows and allows the user to set the maximum solids range

Alarms

This menu contains the following items:

ITEM	MEANING
Sys. Alarm	Shows the status of the system alarm
Det. Fault	Shows the status of the detector
AutoCal Ref	Shows the status of auto cal reference
AutoCal Error	Shows the status of the auto cal error function
Ref. Prompt	Prompts the user to complete the next reference
Wipe Test	Notifies the user when to conduct the next wipe test (if relay is used)
Shutter Test	Notifies the user when to conduct the next shutter test (if relay is used)
Alarms	Shows the status of the activated alarm
Dig. Inputs	Shows which digital input is in alarm

X96S Local Display



The X96S Local Display consists of a 16 line 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 the lines, with the exception of the last line, is screen or action dependent. The last line displays the active function keys labels.

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

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

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 475 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, like 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.

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.

X96S Local Display Vs 475 Calibrator

The local display user interface is very similar to the 475 Calibrator, but there are some differences. One of the major ones is the fact that the X96S 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 475 Configurator displays the label only and lets the user see the value using the right arrow key. X96S local display will display whatever could fit the display, thus indicating to the user that there is more to be displayed and the right arrow sign is not indicating a new menu.

Installation

Caution

Ronan's Mold Level Gauge uses a sealed radioactive cesium (Cs-137) or cobalt (CO-60) source which is safe if handled properly.

Specific License

(SA or GS Series)

If your gauge is equipped with the SA or GS series source holder, you are required to obtain 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 gauge. DO NOT proceed with unpacking, storage, or installation without the RSO's authorization.

General License

(RLL Source Holder)

If your gauge is equipped with the RLL series source holder, you are not required to obtain a specific license. Your company should assign a responsible party to maintain records and supervise the installation and commission of the source holder.

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 or responsible party 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.

INSPECTION

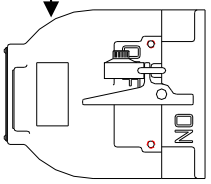
The source holder is equipped with an ON/OFF Mechanism. During shipment and storage, the mechanism MUST BE SECURED in the OFF position with a padlock.

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

Radiation Label

General License Label (if applicable)

SA1



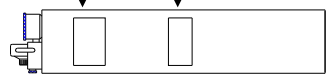
Handle Padlocked OFF

GS-200

Radiation Label

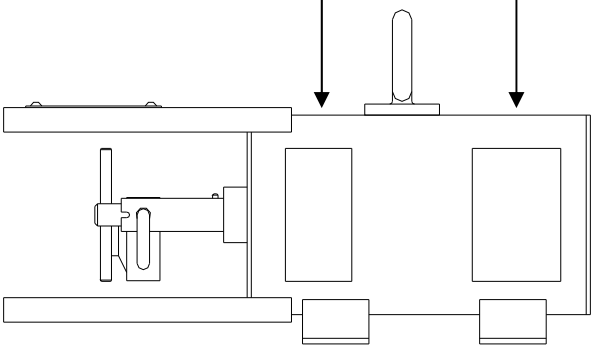
General License Label (if applicable)

Plunger Padlocked OFF



Radiation Label

General License Label (if applicable)



GS-400

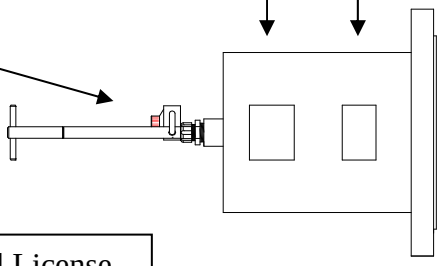
INSPECTION

SA10

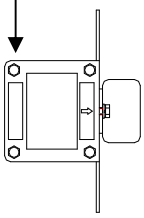
Radiation Label

General License (If applicable)

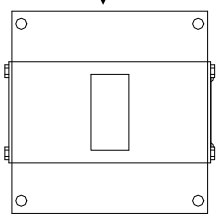
Rod Padlocked OFF



Radiation Label (for Specific License **Users** only)



General License Label



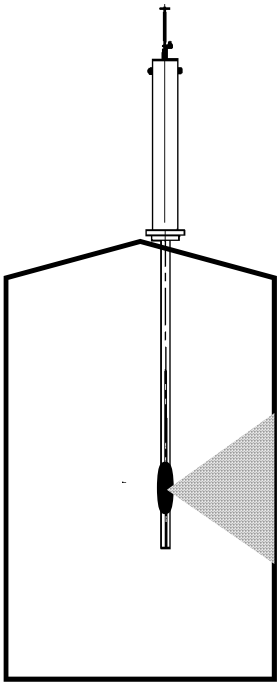
RLL1 or 2

Lock Tag (does not apply to RLL devices)

WARNING

THIS DEVICE MAY BE MOUNTED IN PLACE INITIALLY BY ANY PERSON PROVIDED THE SHUTTER REMAINS LOCKED IN THE OFF POSITION. ONLY A SPECIFICALLY LICENSED PERSON MAY PLACE THE DEVICE IN SERVICE BY INITIALLY OPENING THE SHUTTER AND MAKING THE REQUIRED LEAK TEST, TESTING FOR PROPER OPERATION OF THE ON-OFF MECHANISM AND INDICATOR AND MAKING THE RADIATION SURVEY.

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:

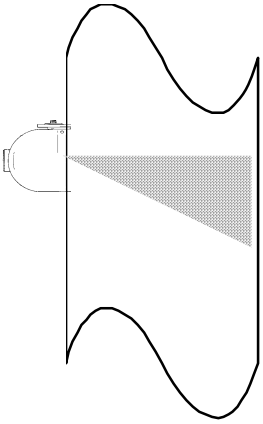
The source holder must remain padlocked in the OFF position until installation is complete.

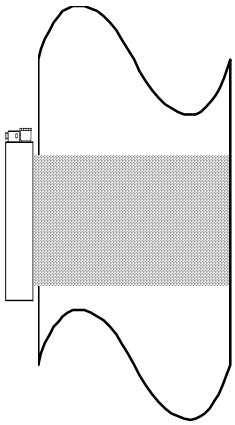
Take all necessary precautions to assure that the source holder is not dropped or damaged.

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

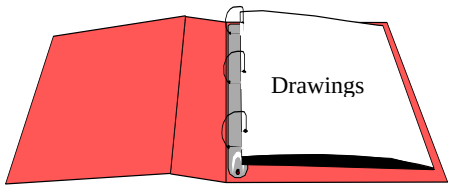
Always turn the source holder to the OFF position when working around it, the detector, or the area between these two components which is referred to as the "measuring gap."

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.

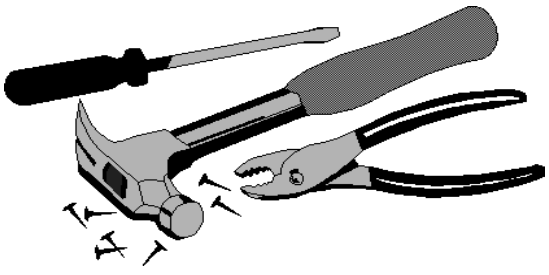
Please reference the dimensional drawings located in the Drawing Chapter of this manual when installing the equipment.

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

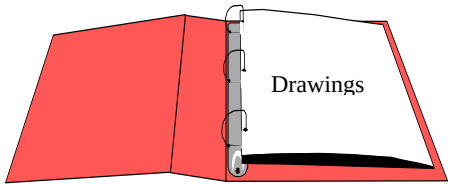
Avoid internal vessel obstructions such as baffles, agitators,
manways, heater/cooler tubes, etc. which could interfere with the transmission through the vessel of the radiation's "active beam."

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 120°F (50°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



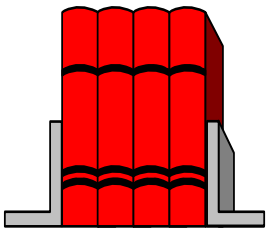
Drawings:
Interconnect

DO NOT APPLY POWER until wiring is carefully checked.

Wire the equipment according to the detailed interconnect drawing which is included in the Drawing section supplied .

Follow local and national electrical codes for all interconnections.

Consider the following guidelines before making any electrical connections:



LOCAL CODE
NATIONAL CODE

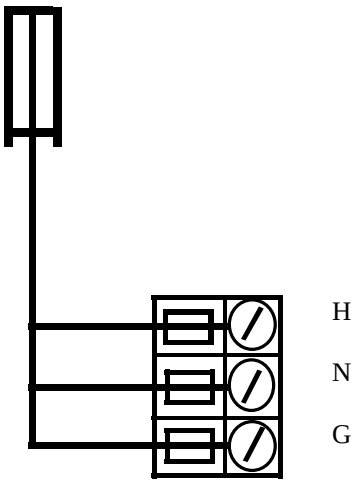
Use continuous conduit runs and protect housing junction boxes from dripping of condensed moisture off of conduit.

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. Verify plug is seated. Turn locking ring until it clicks.

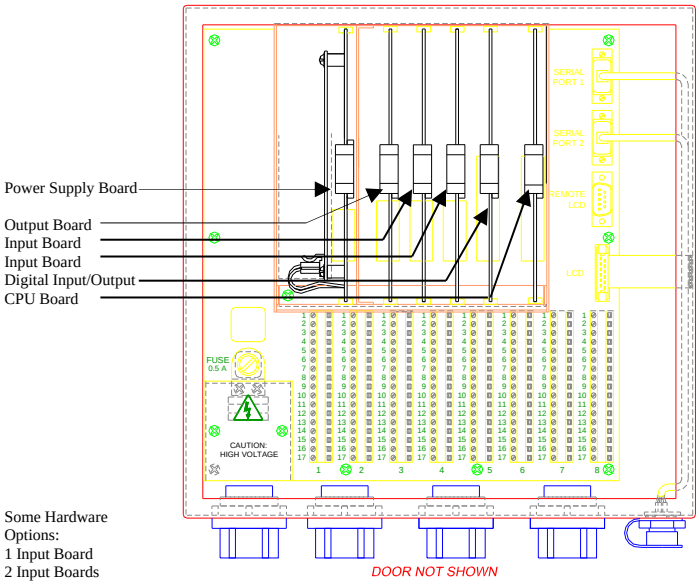
Immediately replace lid of detector housing to keep out water and dirt.

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

Microprocessor Verification

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

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.**

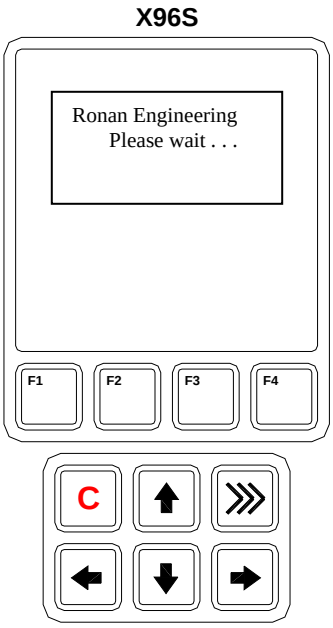


Some Hardware Options:
1 Input Board
2 Input Boards

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 unqiue hardware configuration used to support the software.***

Power-up



Before applying power, verify wiring per interconnect drawing supplied by Ronan. Ensure all boards are fully seated in frame's slots. Close front door of the X96S and secure the door...

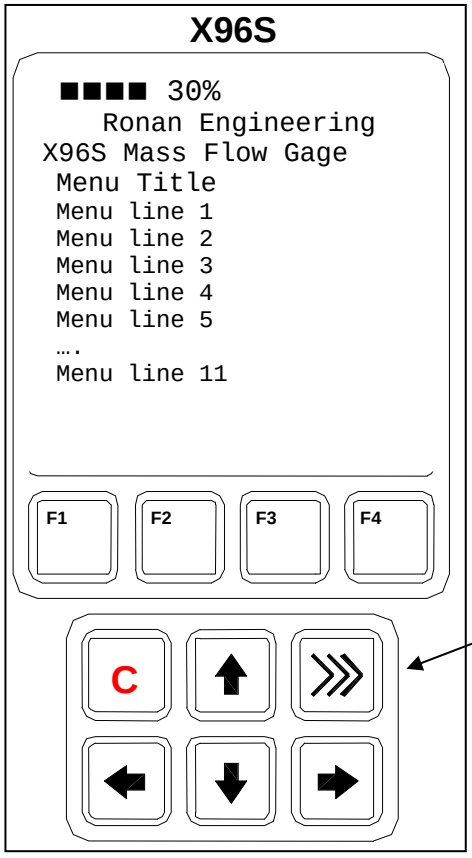
When power is applied the X96S runs a self-diagnostic program.

First display appears for just a second

To adjust the contrast on the LCD display:

Press the "C" button to adjust the contrast on the LCD display. You can make adjustments by pushing The up and down arrows.

When finished adjusting, press the "C" button a Second time to set and complete the procedure.



The status display appears next. From this screen you can navigate through your system's configuration.

To view the status screen at any time or from any point in the software, you can press the Hot Key >>> on the keypad.

To access the main display, press the F3 key and enter the password as shown on the next page.

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

Initial calibration consists of two parts, the flow-rate calibration and the density calibration.

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

Temperature Compensation

If temperature compensation is required for your measurement accuracy, you will want to enable that feature before doing the calibration.

WHY is Temperature Compensation Used?

Process temperature variation will cause a change in process density. If the change in density due to temperature variation is significant, the measurement could be influenced. In those cases, temperature compensation is used to offset the influence.

WHEN is Temperature Compensation Needed?

In general, WIDE temperature variations over NARROW measurement spans usually require temperature compensation.
For example, a 25ºC change in process temperature over a measurement span of 0.6 SpG would NOT require temperature compensation. However, a 25ºC change in process temperature over a measurement span of 0.1 SpG would require temperature compensation.

As a rule-of-thumb, follow this guideline:

If your change in process temperature (in ºC) is greater than 50 times your density span, you will need to use temperature compensation.

EXAMPLE (If using SA1):

IF: $\Delta T = 25^{\circ} C$
AND: Density Span = 0.6
THEN: $50 * 0.6 = 30 > 25$

THEREFORE:
Temp comp IS NOT needed.

HOWEVER:
IF: $\Delta T = 25^{\circ} C$
AND: Density Span = 0.1
THEN: $50 * 0.1 = 5 < 25$

THEREFORE:
Temp comp IS needed

Reference Modes

One of your first tasks will be to calibrate the system. The first step in the calibration procedure is to "reference" the gauge on some known value. The steps involved in the referencing procedure will vary slightly depending upon the *mode* selected in the **"Ref Constants**".

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

- Referencing EMPTY (SpG = 0)
- Referencing with WATER (SpG = 1)
- Referencing with PROCESS OF KNOWN DENSITY
- Referencing with ABSORBER

Most applications use the "Reference with Water" or the "Reference with Process" Mode.

Types of Calibration

Two types of Calibration are available for Ronan's Density Monitor.

Dual-Point Calibration requires an accurate laboratory analysis of truly representative samples of **two** process densities. Dual-Point Calibration is preferred when the process can be varied to obtain two process densities (one at each end of the measurement range).

Single-Point Calibration requires an accurate laboratory analysis of a truly representative sample of **one** process density. Single-Point Calibration is used as an alternative method when it is not physically or economically practical to vary the process density. In these cases, a second point is estimated based on the mathematical formula for radiation transmission/absorption.

Calibration Constant

The two values, the reference density (d_O) and the calibration constant (1/ut), are used by the X96S algorithm to calculate process density (d).

IF USING SA1:

t	ut	1/ut
2"	0.4	2.5
3"	0.6	1.6
4"	0.8	1.25
5"	1.0	1.0
6"	1.2	0.825
8"	1.6	0.625
10"	2.0	0.5

t = mat'l thickness (pipe I.D.)
u = absorption coefficient
= 0.2 for Cs137
1/ut = calibration constant

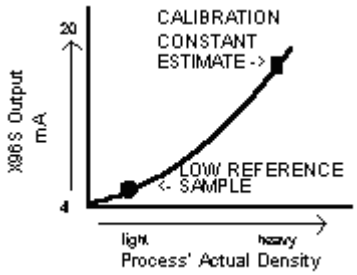
IF USING RLL:

t	ut	1/ut
		0.312
2"	.32	2.083
3"	.48	1.562
4"	.64	1.25
5"	.80	1.042
6"	.96	0.781
8"	1.28	0.625
10"	1.6	

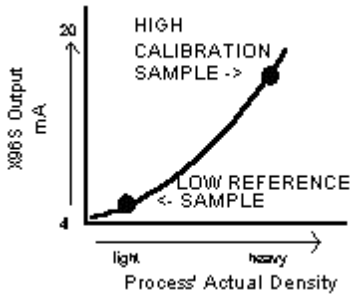
t = mat'l thickness (pipe I.D.)
u = absorption coefficient
= .16 for Cs137
1/ut = calibration constant

Calibration Curve

The first curve below shows the relationship for a single-point calibration between the Low Reference, the Calibration constant, and the X96S output value.



The calibration curve below depicts a two-point calibration and the relationship between the Low Reference, High Calibrate, and the X96S output value.



Preparation for Calibration

WHAT type of process sample is needed?

Any conveniently obtained process density that is within the range of interest can be used. For example, water-based slurries could use water as the reference sample. Sub-water slurries could use an empty pipe for the reference condition.

WHAT type of sampling procedure is needed?

The sampling procedure will depend upon your own process. You will have to do what is necessary to obtain a truly representative sample of the density (ies) on which you are calibrating. Pull a minimum of three samples of each density. (This means at least three samples of one density for single-point calibration, and at least three samples of two densities for dual-point calibration). Take necessary precautions to preserve the integrity of each sample.

WHAT type of laboratory analysis is required?

Precise laboratory analysis will produce the most accurate and useful results. If the results are temperature compensated, you will need to enter the uncompensated values(s) into the X96S software.

Final gauge measurements can be only as accurate as your sampling and analysis technique and level of accuracy.

Important facts to remember –

- Equipment should be running at normal environmental conditions – temperature, pressure, process flow, etc.
- Final gauge measurements can only be as accurate as your sampling and analysis technique.
- Remember to document all changes made to the factory parameters that are active in your system.

Density Low/Reference and High/Calibration

The density calibration correlates the detector counts to the density in the pipe/or vessel. This can be achieved by two different methods. One method consists of Referencing on a known density like water.

Low Density Reference

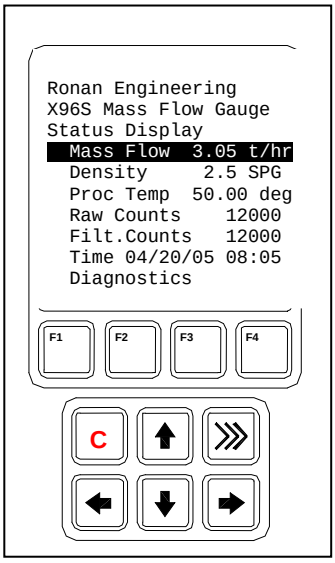
PROCEDURE:

Using the Ronan local display or HART communicator find the Main Menu;
Scroll down until you reach and highlight *Calibration*.
Access Calibration by pressing the right arrow key.
Scroll down until you reach and highlight *Cal Density*.
Access the Cal Density by pressing the right arrow key.
Scroll down until you reach and highlight *Low Reference*.
Access the Low Reference by pressing the right arrow key.
Access the Reference by pressing the right arrow key.
Press the F4 key (OK) to the prompt '*Warning – Remove loop from automatic control, verify that source Is on, and the vessel/pipe is empty.'*

Press the F4 key (OK) to calibrate the gauge. Gauge will count down until calibration is complete.

Scroll down until you reach and highlight *Ref Density 0.0000* (Note *0.0000* value and units may vary depending on the what value and units were selected.) (**Note: You must access the Ref Density and either change or acknowledge the value to complete the reference**.)
Access Ref Density 0.0000 by pressing the right arrow key.
Use the arrow keys to select and change the display value to the correct density. Once the displayed value is correct, press the F4 key (Enter). The Low Reference is complete.

For an illustrated procedure, see the following pages.



Step 1 Start at the Status Display

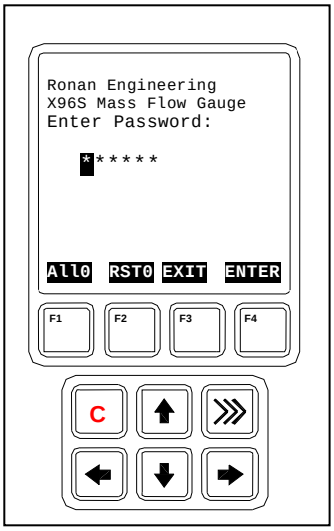
From the Status Display Screen, Press the **F3** (Lock) **Key** to display the Password Screen (or the Main Menus if the password is disabled).

Step 2 Password Menu

With the left most character * highlighted (All digits are set at 000000 at this point), enter in the password '101010'. Press the ↑ **key 1** time to make the left most character equal to 1. Press the → **key 2** times to move to the third character.
Press the ↑ **key 1** time to make the third character equal to 1. Press the → **key 2** times to move to the fifth character.
Press the ↑ **key 1** time 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 *.



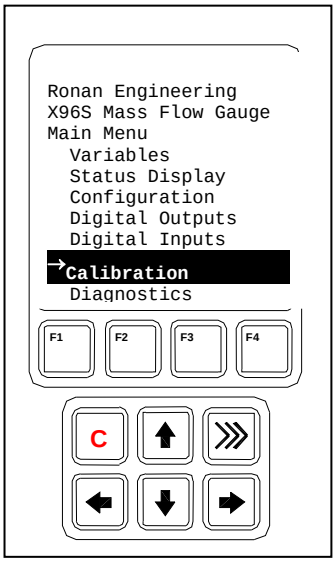
Quick Start Reference – Calibrating Density
(For Completion of a Single Point Reference)

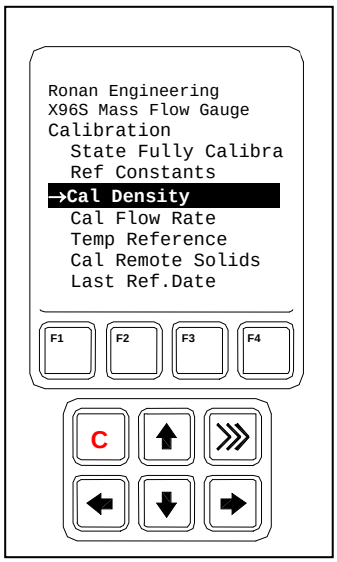
Step 3 'Low Reference Density' Calibration
(Have the process ready filled with water)

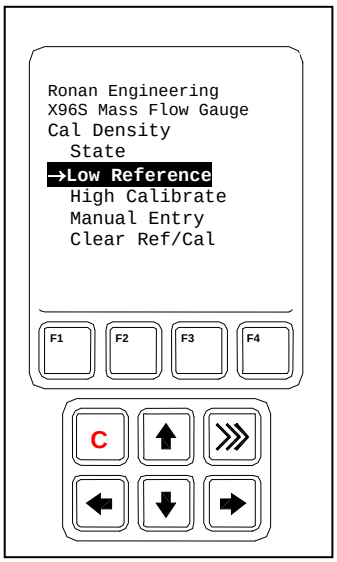
Scroll down ↓ to "Calibration" Press → to enter menu
Scroll down ↓ to "Cal Density" Press the → to enter menu
Scroll down ↓ to **"Low Reference"** Press the → to enter menu
Select **"Perform Reference"** press → to enter menu

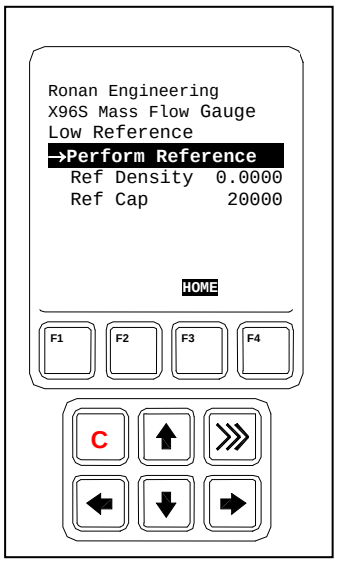
Read the next screen carefully and acknowledge by pressing the **F4 (OK) Key**. Referencing will begin. (This may take several minutes.)

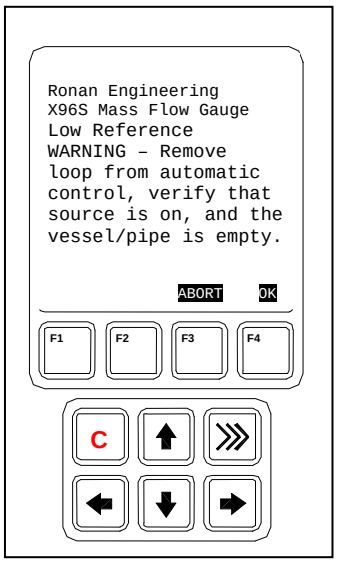
Scroll down ↓ to **"Ref Density"** Press → to enter menu
Notice the value that is displayed.
Use ← **Key** and → **Key** to toggle back and forth between digits.
Change the value using ↑ or ↓
Enter the value of the process (Example 0.0000 %Solids for water).
Press The **F4 Key** to enter and store the value.
Press the F3 Key **(Home) to return to the Main Menu.**

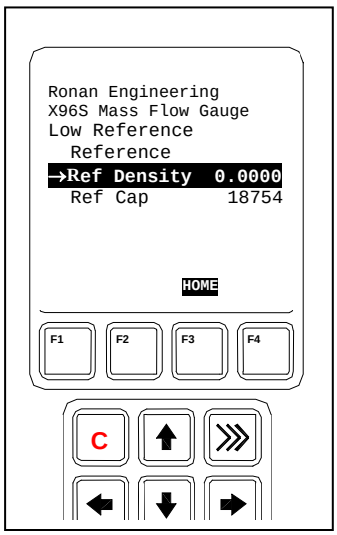


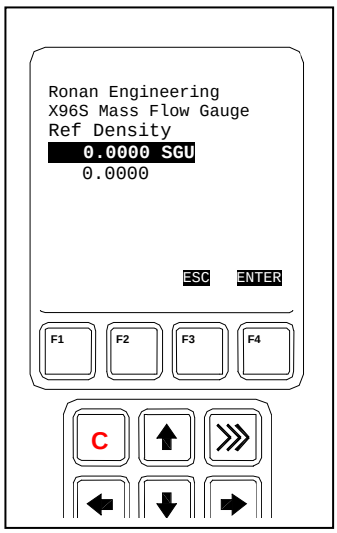












High Density Calibrate

Using the Ronan local display or HART communicator find the Main Menu;
Scroll down until you reach and highlight *Calibration*.
Access Calibration by pressing the right arrow key.
Scroll down until you reach and highlight *Cal Density*.
Access the Cal Density by pressing the right arrow key.
Scroll down until you reach and highlight *High Calibrate*.
Access the High Calibrate by pressing the right arrow key.
Access the Calibrate by pressing the right arrow key.
'*Warning – Remove loop from automatic control, verify that source is on, and the pipe/vessel is full with process*
Press the F4 key (OK) to the prompt '*Verify that source is on, detector output is correct, and process is in calibrate condition'*.
Wait until the prompt changes from

> '*Performing Calibrate procedure*' … to '*calibrate SUCCESS. Remember to enter density of the material*'.

Press the F4 key (OK) to calibrate the gauge. Gauge will count down until calibration is complete

Scroll down until you reach and highlight Cal *Density 20.0000* (Note 2*0.0000* value and units may vary depending on the what value and units were selected.) (**Note: You must access the Cal Density and either change or acknowledge the value to complete the High Calibration**.)
Access Cal Density 20.0000 by pressing the right arrow key.
Use the arrow keys to select and change the display value to the correct density that the absorber plate represents. Once the displayed value is correct, press the F4 key (Enter).).
Verify the status screen is displaying the correct density. If not repeat the calibration procedure again.
The High Calibrate is complete.

For an illustrated procedure, see the following pages.

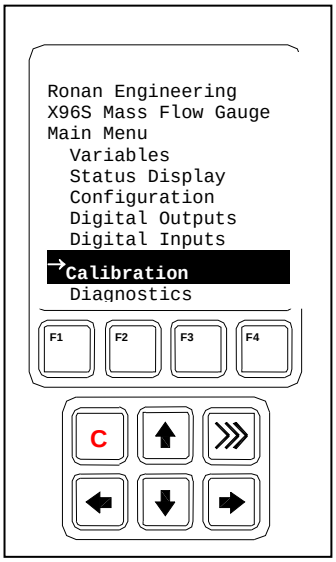
Quick Start Reference – Calibrating Density
(For Completion of a Dual Point Calibration)

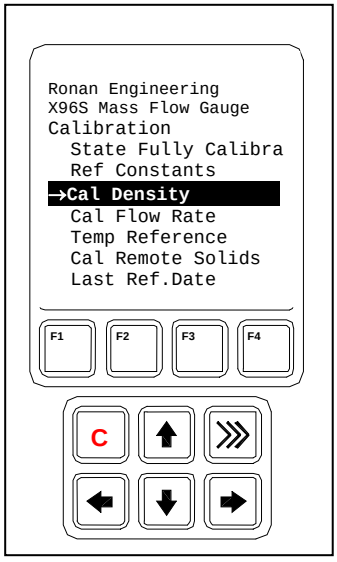
Step 1 High Calibrate
(Have the pipe filled with process)

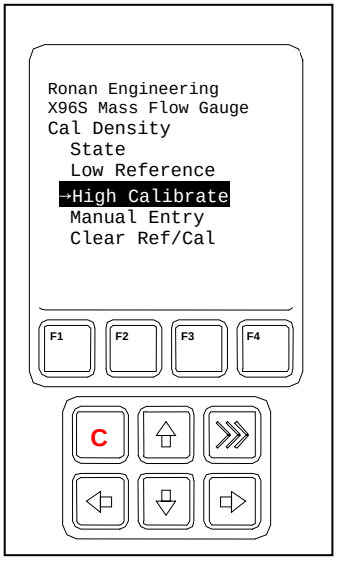
Scroll down ↓ to "Calibration" Press → to enter menu
Scroll down ↓ to "Cal Density" Press the → to enter menu
Scroll down ↓ to **"High Calibrate"** Press the → to enter menu
Select **"Calibrate"** press → to enter menu

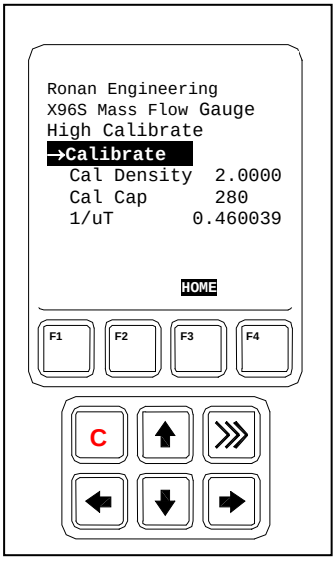
Read the next screen carefully and acknowledge by pressing the **F4 (OK) Key**. Calibration will begin. (This may take several minutes.)

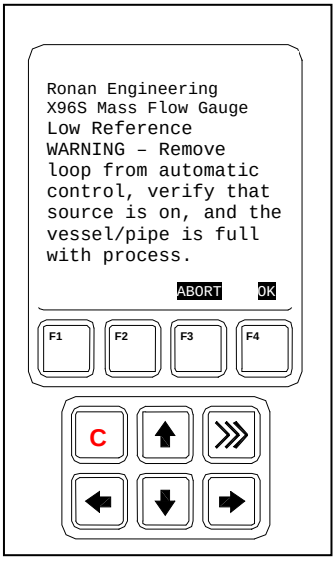
Scroll down ↓ to **"Cal Density"** Press → to enter menu
Notice the value that is displayed.
Use ← **Key** and → **Key** to toggle back and forth between digits.
Change the value using ↑ or ↓
Enter the value of the process (Example 50.0000 %Solids).
Press The **F4 Key** to enter and store the value.
Press the F3 Key **(Home) to return to the Main Menu.**

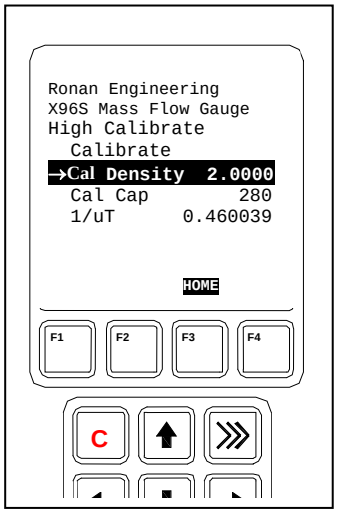


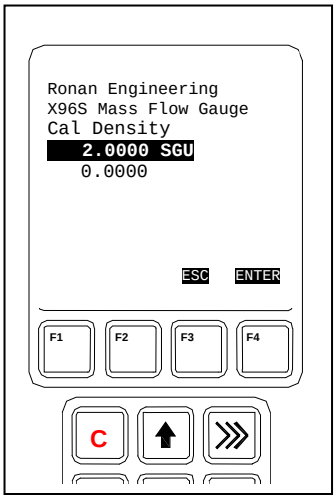












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The Density Calibration is complete.

For future reference, document these items:

(a) Environmental/process conditions (densities, temperatures, etc.) 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 (loading factor), etc.

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

Low and High Flow Calibration

Low Flow Reference

The flow-rate calibration correlates the flow signal to the rate the material is moving. For mass flow using a flow meter this is achieved by stopping the flow and calibrating the minimum flow rate and then running the pump/or flow at full speed and calibrating the maximum flow rate.

PROCEDURE:
For flow meters providing a voltage or current signal to the X96S.
The flow must be stopped or running at the lowest speed during the Low Reference.

Using the Ronan local display or HART communicator find the Main Menu;
Scroll down until you reach and highlight *Calibration*.
Access Calibration by pressing the right arrow key.
Scroll down until you reach and highlight *Cal Flow Rate*.
Access the Cal Flow Rate by pressing the right arrow key.
Scroll down until you reach and highlight *Low Reference*.
Access the Low Flow Rate Cal by pressing the right arrow key.
Press the F4 key (OK) to the prompt '*Warning – Remove loop from automatic control before doing the reference procedure'*.
Wait until the prompt changes from
'*Performing Calibrate procedure*' … (You will also see a timer counting down)
Once the timer reaches zero you will see *'Low Reference Flowrate Counts = 'value" Press OK to accept or Abort to Cancel calibration.'*
Press the F4 key (OK).
Scroll down until you reach and highlight *Low FlowRate 0.0000 gal/min.* (Note *0.000* value and units may vary depending on the what value and units were selected.) (**Note: You must access the Low FlowRate and either change or acknowledge the value to complete the reference**.)
Access Low FlowRate 0.0000 by pressing the right arrow key.
Use the arrow keys to select and change the display value to the correct speed. Once the displayed value is correct, press the F4 key (Enter).). The Low Reference is complete.
You must proceed to High FlowRate Calibration to complete the calibration.

For an illustrated procedure, see the following pages.

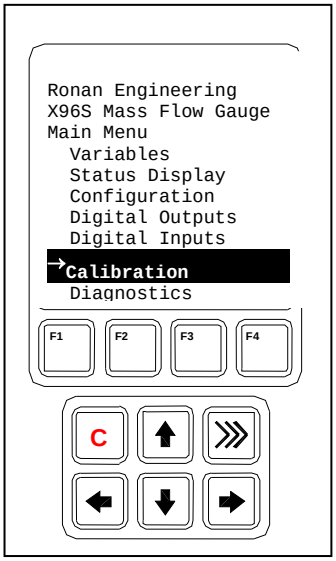
Quick Start Reference – Calibrating Flow Rate
(For Completion of a Single Point Reference)

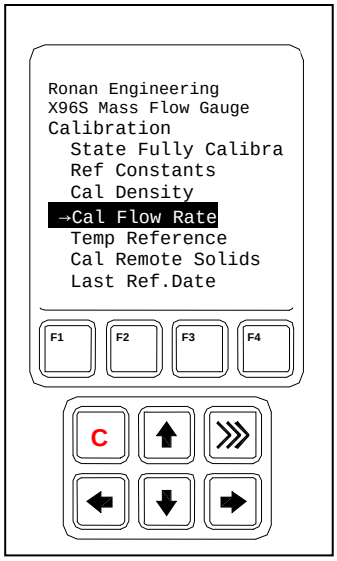
Step 1 Low Reference Flow Calibration
(Have a "0" flow input ready)

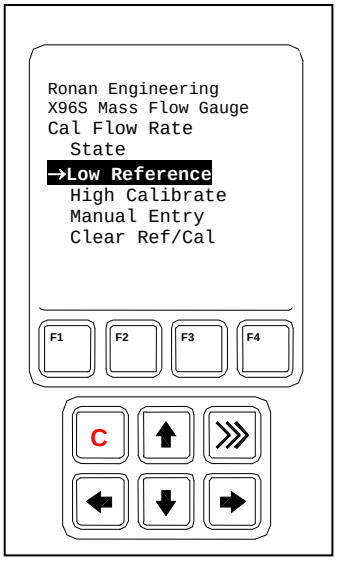
Scroll down ↓ to "Calibration" Press → to enter menu
Scroll down ↓ to "Cal Flow Rate" Press the → to enter menu
Scroll down ↓ to **"Low Reference"** Press the → to enter menu
Select **"Low Flow Rate Cal"** press → to enter menu

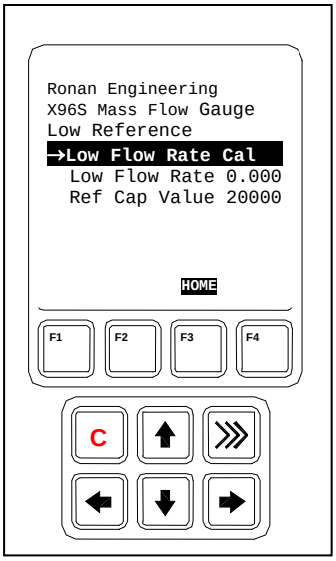
Read the next screen carefully and acknowledge by pressing the **F4 (OK) Key**. Referencing will begin. (This may take several minutes.)

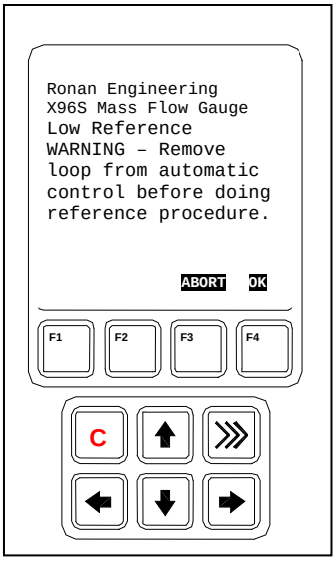
Scroll down ↓ to **"Low Flow Rate"** Press → to enter menu
Notice the value that is displayed.
Use ← **Key** and → **Key** to toggle back and forth between digits.
Change the value using ↑ or ↓
Enter the value of the process (Example 0.0000 Gal per minute).
Press The **F4 Key** to enter and store the value.
Press the F3 Key **(Home) to return to the Main Menu.**

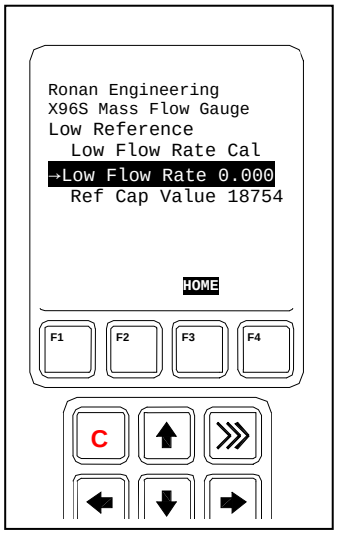


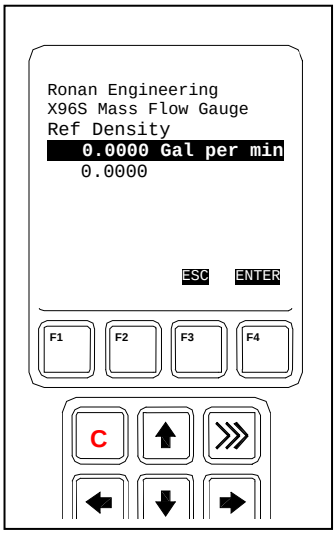












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High Flow Calibration

PROCEDURE
(For flow meters providing a voltage or current signal to the X96S.
The flow must be running at the highest speed during the High Calibration.

Using the Ronan local display or HART communicator find the Main Menu;
Scroll down until you reach and highlight *Calibration*.
Access Calibration by pressing the right arrow key.
Scroll down until you reach and highlight *Cal Speed*.
Access the Cal Flow Rate by pressing the right arrow key.
Scroll down until you reach and highlight *High Calibrate*.
Access the High Calibrate by pressing the right arrow key.
Access the High Flow Rate Cal by pressing the right arrow key.
Press the F4 key (OK) to the prompt '*Warning – Remove loop from automatic control before doing the calibrate procedure'*.
Wait until the prompt changes from
'*Performing Calibrate procedure*' … (You will also see a timer counting down)
Once the timer reaches zero you will see *'High Calibrate Flowrate Counts = 'value" Press OK to accept or Abort to Cancel calibration.'*
Press the F4 key (OK).
Scroll down until you reach and highlight *High Flow Rate 5000.000 gal/min.* (Note *5000.000 gal/min* value and units may vary depending on the what value and units were selected.) (**Note: You must access the High Flow Rate and either change or acknowledge the value to complete the calibration**.)
Access High Flow Rate 5000.0000 gal/min by pressing the right arrow key.
Use the arrow keys to select and change the display value to the correct speed. Once the displayed value is correct, press the F4 key (Enter).
The Flow Calibration is complete.

For an illustrated procedure, see the following pages.

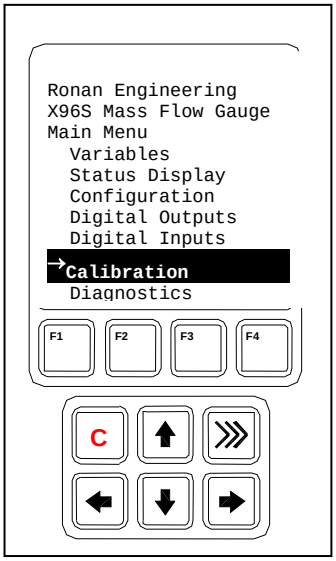
Quick Start Reference – Calibrating Flow Rate
(For Completion of a Dual Point Calibration)

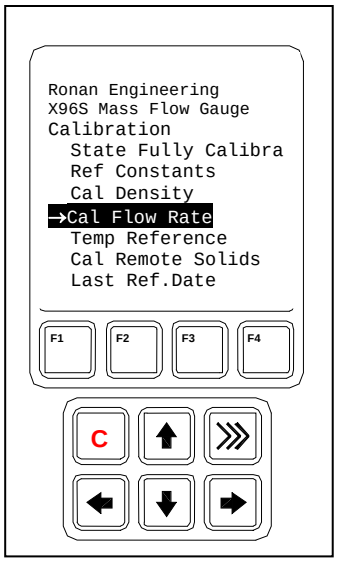
Step 1 High Calibrate
(Have the maximum flow input ready)

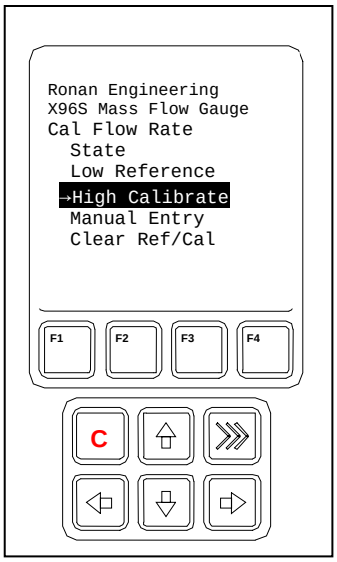
Scroll down ↓ to "Calibration" Press → to enter menu
Scroll down ↓ to "Cal Flow Rate" Press the → to enter menu
Scroll down ↓ to **"High Calibrate"** Press the → to enter menu
Select **"High Flow Rate Cal"** press → to enter menu

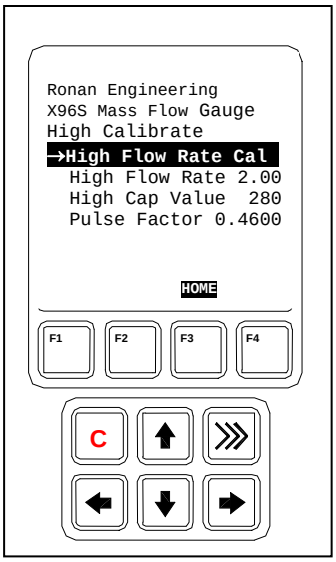
Read the next screen carefully and acknowledge by pressing the **F4 (OK) Key**. Calibration will begin. (This may take several minutes.)

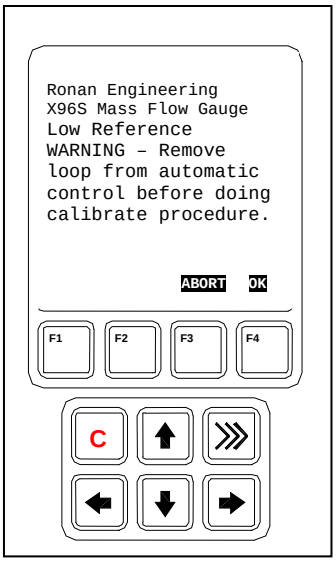
Scroll down ↓ to **"High Flow Rate"** Press → to enter menu
Notice the value that is displayed.
Use ← **Key** and → **Key** to toggle back and forth between digits.
Change the value using ↑ or ↓
Enter the value of the process (Example 8 Gal per min.).
Press The **F4 Key** to enter and store the value.
Press the F3 Key **(Home) to return to the Main Menu.**

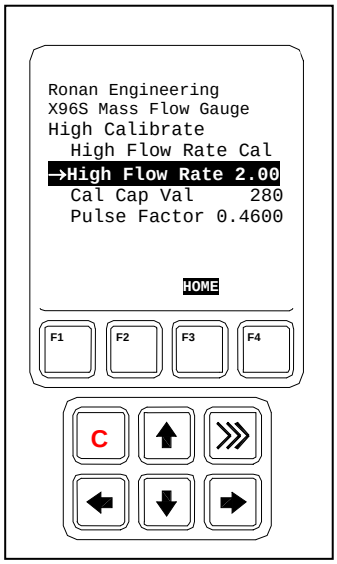


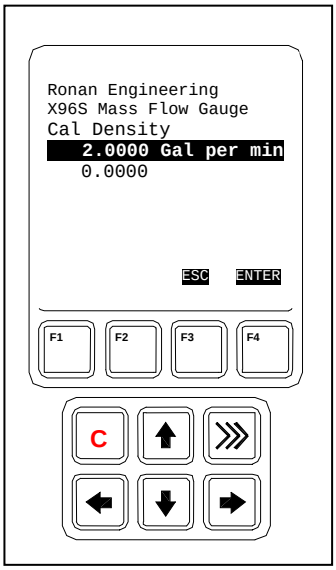












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Configuration

Ronan ships the Mass Flow Gauge 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 density 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 rate/density

- 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.

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 Mass Flow 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 10 ρA, 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, generated by the ion chamber, is fed into an inverting amplifier. The amplifier output is filtered by a resistance capacitance low-pass filter, and fed into another amplifier. The output from that amplifier is proportionally fed back to the input amplifier after going through a gain resistance potentionmeter 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 on the amplifier board is factory adjusted and Glyptal coated.

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

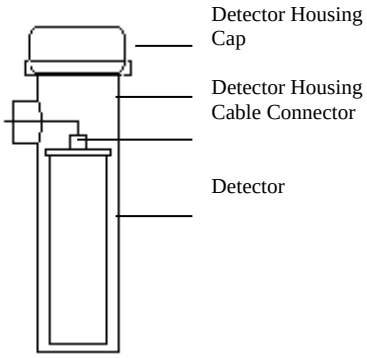
Servicing the Detector

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."

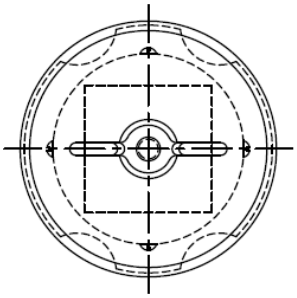
However, a qualified technician can troubleshoot and service the detector's amplifier assembly. Some precautions are needed when handling the detector/amplifier assembly.

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



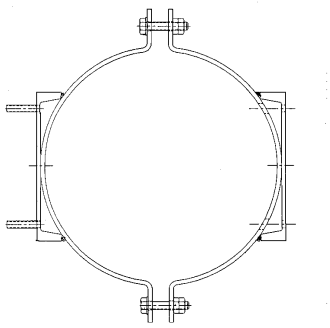
1) Check NOTES below for illustrations and cautions that apply to your specific equipment.
2) Unscrew cap on detector housing.
3) Unscrew connector on top of detector.
4) Remove detector from housing.
5) Carefully install replacement detector in housing.
6) Screw connector back onto detector.
7) Immediately 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 other lifting devices, for prolonged periods of time.

When detector is properly seated on the bottom of the housing, the hold-down clamp should be tightened until the wing nut no longer turns. Make sure the detector is not subject to vibration.



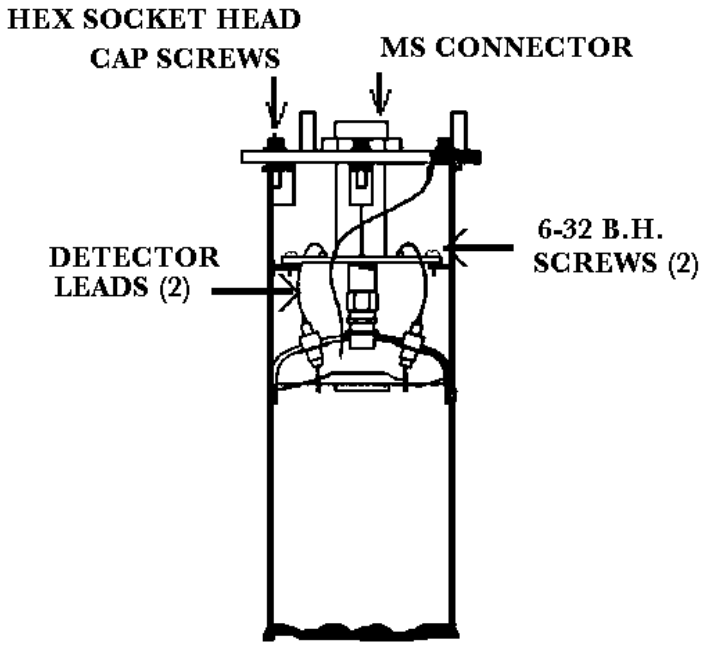
DETECTOR HOUSING/ BRACKET ASSEMBLY NOTES:

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

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

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 (Spare Parts)

X96-2001PL-SP
X96-2001PL is the CPU module

X96-2003-01PL
X96-2003-01PL is the Ionization Chamber Input

X96-2003-02PL
X96-2003-02PL is the PCB assembly, analog input, and 0-5 volt on both channels

X96-2003-03PL
X96-2003-03PL is the PCB assembly, analog input, and 0-20mA on both channels

X96-2003-04PL
X96-2003-04PL is the PCB assembly, analog input, and two-wire transmitter

X96-2003-05PL
X96-2003-05PL is the analog input, 0-15 volt on both channels

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
X96-2005PL is the HART Daughter Module. This module provides both a 4-20 mA current loop and a HART slave interface.

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[2] or live[3] contact monitoring,
- quadrature encoder[4], 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.

The 24 volts DC provided is to be used as a wetting voltage when needed.

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[2] 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.
[3] 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.
[4] The interface to the quadrature encoder shall consist of two inputs, 15 volts DC at 200 mA (described in a later section), and common.

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, but can be used for other purposes if it is not required for this purpose.

X96-2009PL1
X96-2009PL1 is the Scintillation Detector Interface Module. This optional[5] module provides:

- 1 isolated scintillation input (pulse counter, max signal 0-12[6] 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[3].

X96-2009PL2
X96-2009PL2 is the Scintillation Board with ch. 2 modified for 0-20 mA input instead of RTD

X96-2009PL3
X96-2009PL3 is the Scintillation Board with ch. 2 modified for 0-10Vdc input instead of RTD

X96-2029PL
X96-2029PL is the Mold Level Module (board) for scintillation detector, with two digital inputs, two analog outputs and two digital outputs (1 relay, 1 TTL).

X96C148-5
X96C148-5 is the 85 to 230 Volt DC power supply module

X96C148-2
X96C148-2 is the 24 Volt DC power supply module

X96C148-3
X96C148-3 is the 85 to 230 Volt power supply module

X96C148-4
X96C148-4 is the 12 Volt DC “in”, 24 Volt DC “out” power supply module

X96C429-1
X96C429-1 is the display keypad module for the X96S computer.

[5] At least one detector interface module is required.
[6] 8.6 V nominal.
[7] 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 & LCD 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

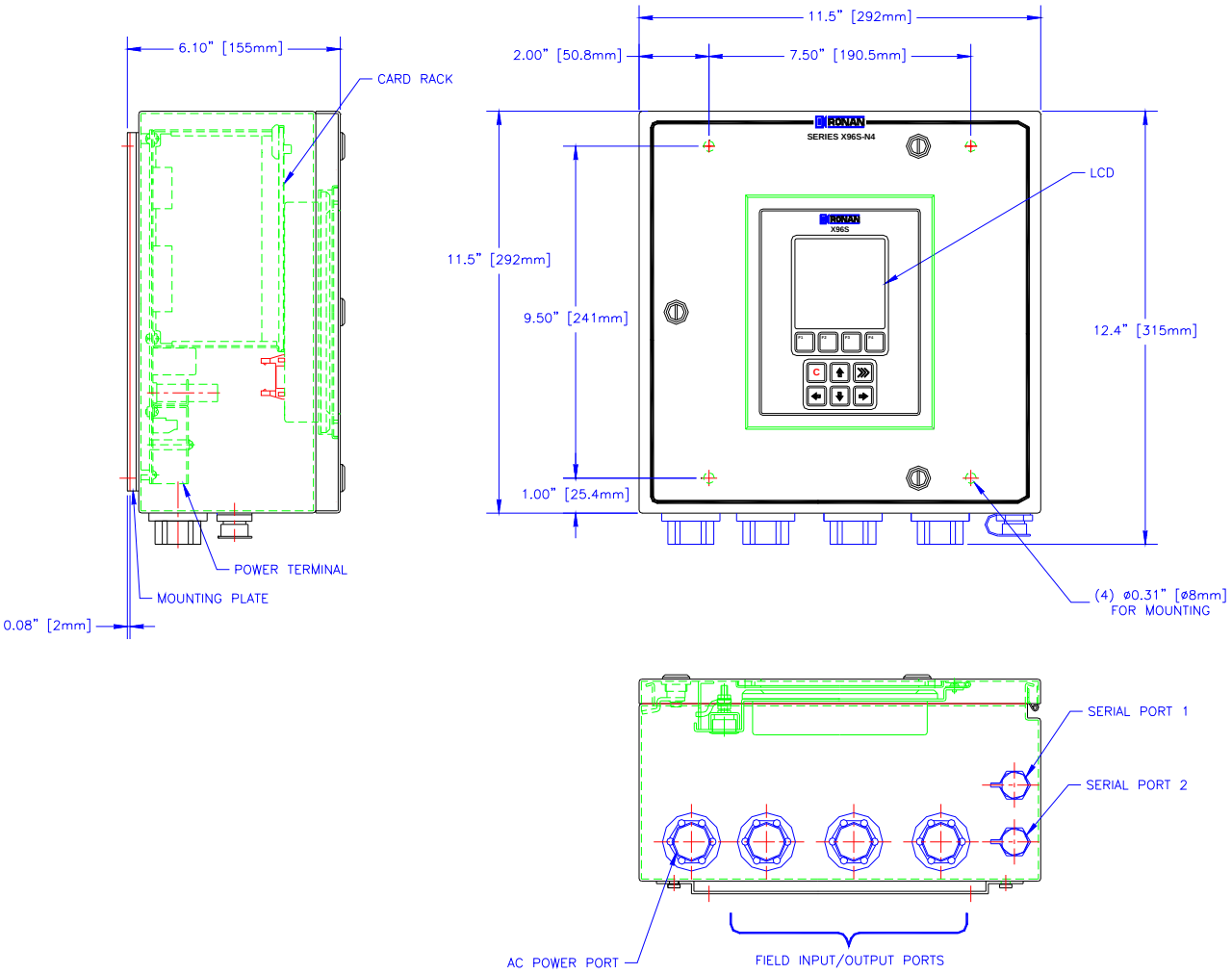
PART NUMBER	DESCRIPTION
X96-2001PL-SP	X96S CPU Module
X96-2003-01PL	X96S Ionization Chamber Input
X96-2003-2PL	PCB Assembly, Analog Input, 0-5 Volt on both channels
X96-2003-3PL	PCB Assembly, Analog Input, 0-20mA on both channels
X96-2003-4PL	PCB Assembly, Analog Input, Two wire transmitter
X96-2003-5PL	PCB Assembly, analog Input, 0-15 volt on both channels
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 Board with modification (Cap -11004 & 1018)
X96-2009PL2	X96S Scintillation Detector Board modified for 0-20mA input instead of RTD
X96-2009PL3	X96S Scintillation Detector Board modified for 0-10V DC input instead of RTD
X96-2029PL	PCB Board, Mold Level, Input/Output for Scintillation
X96C148-5	X96S 85V to 230V Power Supply Module
X96C148-2	X96S 24 V DC Power Supply Module
X96C148-4	X96S 12V DC “in”, 24 V DC “out”, 50 watt Power Supply Module

SPECIFICATIONS

Model X96S

Process Computer:	Microprocessor-based unit with a liquid crystal display, push-button interface, HART® Communications, process control output, process condition input, 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 to 24 VAC +/- 15%, 50/60 Hz; 24 VDC +/- 15%
Environmental:	Ambient Temperature Range: 14° to 122° F (-10° to 50° C) Humidity: 90% Non-Condensing
Electronics:	Processor: Embedded 80 x 86 Compatible Processor Memory: Flash, Static RAM, battery Backup RAM, Mini SD Card A/D Converters: 16-bit, Dual Slope, Auto-Zeroing Display: Graphic LCD, Fluorescent Back-lit
Inputs: (Optional)	Tachometer: 0-10 VDC, 4-20 mA, or Pulse Rate TTL Load Detector: 0.42-2.4 VDC or Pulse TTL Temperature Compensation: 100 Ohm Pt, 120 Ohm Ni, or 4-20 mA (Mass Flow or Density)
Outputs: (Optional)	Three 4-20 mA; One assigned to each Channel Four Single Set-point SPDT Relays: 3 Amp at 28 VDC or 240 VAC Remote Totalizer Pulse: 20 msec Pulse, Open Collector 50 mA at 24 VDC
Display Units:	(Engineering Units per Gauge) Level: in, ft, mm, cm, or m Density: % Solids; SpG, Baume H, Baume L, API, Brix, Ball, or Twaddell Mass Flow: lb/mn, kg/min, mT/min, mT/hr, sT/min, sT/hr, IT/min or IT/hr Weight: lb/min, kg/min, mT/hr, sT/hr, IT/hr, kg/hr or oz/min
Computer Interface:	HART® and Communications

SAMPLE DRAWINGS



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

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Saving Configuration Data on the MicroSD Card

The microprocesser you purchased has the ability to back up your parameter settings on an SD card. To access this feature, you should follow these steps:

1. Verify your display is Version 2.0. (you should see this image)

Please note, it is only visible for a brief time when the microprocessor is powered up.

2. While viewing the Main Menu screen OR the Status Display screen, press the red "C" on the LCD module keypad. Note that the top line of the LCD will say "Adj.contrast up/down".
2. Next press the Hot Key button. (the button with the three right facing arrow heads ">>>".)
3. The LCD screen will change to read "SD Card Write Configuration Triggered".
4. After just a few seconds the write-to-the-SD Card is complete and the LCD changes back to normal.
5. The Configuration file on the SD Card will have a name *X96V30_.use* The blank _ will indicate the system type. L=level, D=density, W=weight, M=mass flow, X=level with density compensation.

Note!

If this procedure is followed, then on the next power up, the gauge will use what is stored on the SD Card to overwrite the active configuration parameters. In other words, if any config changes were made to the gauge after the write to the SD Card, then on next power-up, those changes will be lost and the config data will revert back to what was stored on the SD Card.

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