Instructions
and
Operating Manual

X96S
Level with Density Compensation Gage

RONAN

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Overview

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

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

Advantages

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

Gamma's Advantages

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

X96S Advantages

- HART Communications
- Identical interface on local display as via HART
- Custom configuration of display
- Surface, panel or rack mount available
- Field mountable
- Push button calibration

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

Basic Concepts

Communications

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

4-20 MA

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

HART

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

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

Variables

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

Communication Variables

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

Device Variables

The Ronan X96S Level with Density Compensation gage has 6 device variables:

Device Variable	Value
Level	Level
Density	Density
Uncomp.Level	Uncompensated Level
Density Comp	Density Compensation
Head Temp	Head Temperature
Not Assigned	Not Assigned

Configuration Variables

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

Theory

Theory of Radiation Gaging

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

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

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

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

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

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

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

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

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

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

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

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

Principles of Operation

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

Some of the more significant stages of signal processing are:

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

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

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

$$Level = L_0 + \left(\left(\frac{I - I_0}{I_{f-} I_0} \right) \times \left(L_{f-} L_0 \right) \right)$$

Where:

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

Password

Notice:

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

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

Step 2: Press F3 to go back.

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

Press  to get the digit to be # one

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

Press  to get the digit to be # one

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

Press  to get the digit to be # one

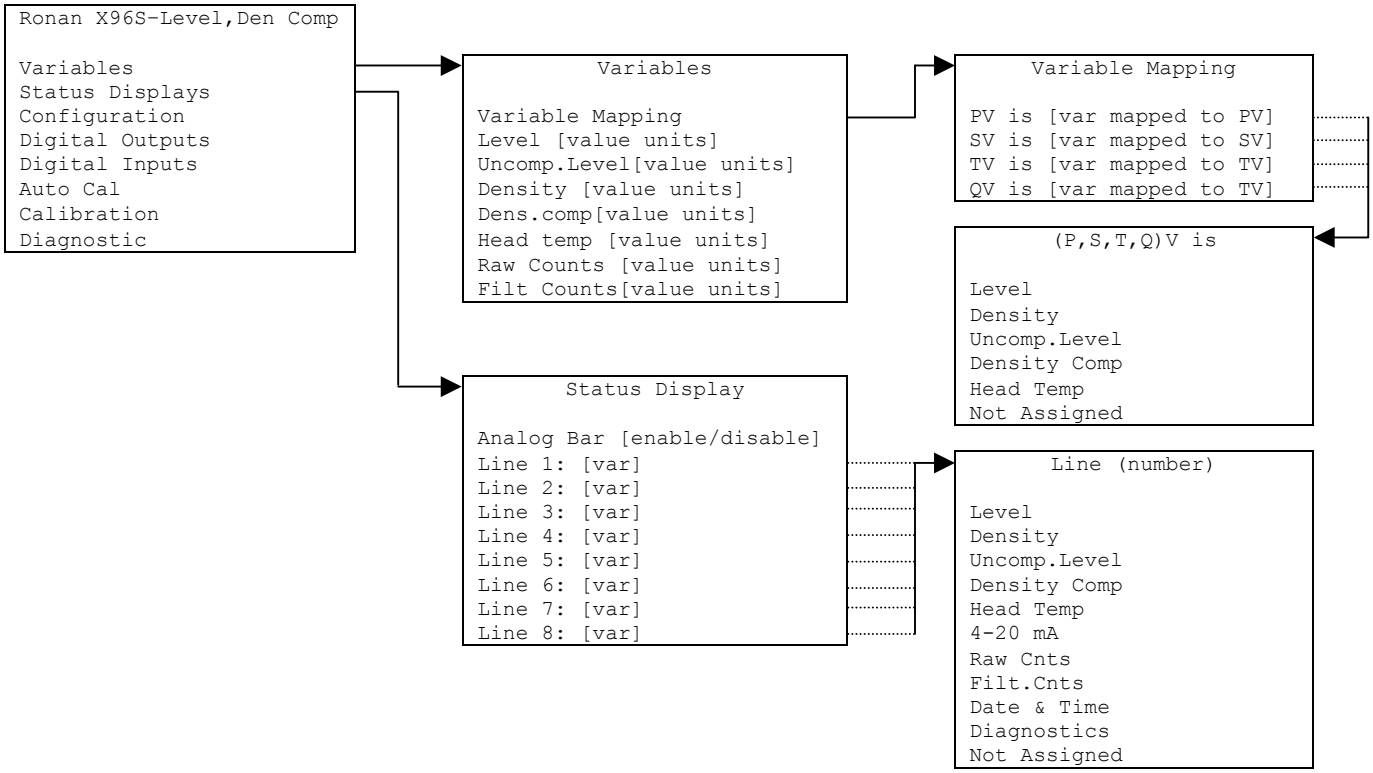
Press F4 (enter)

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

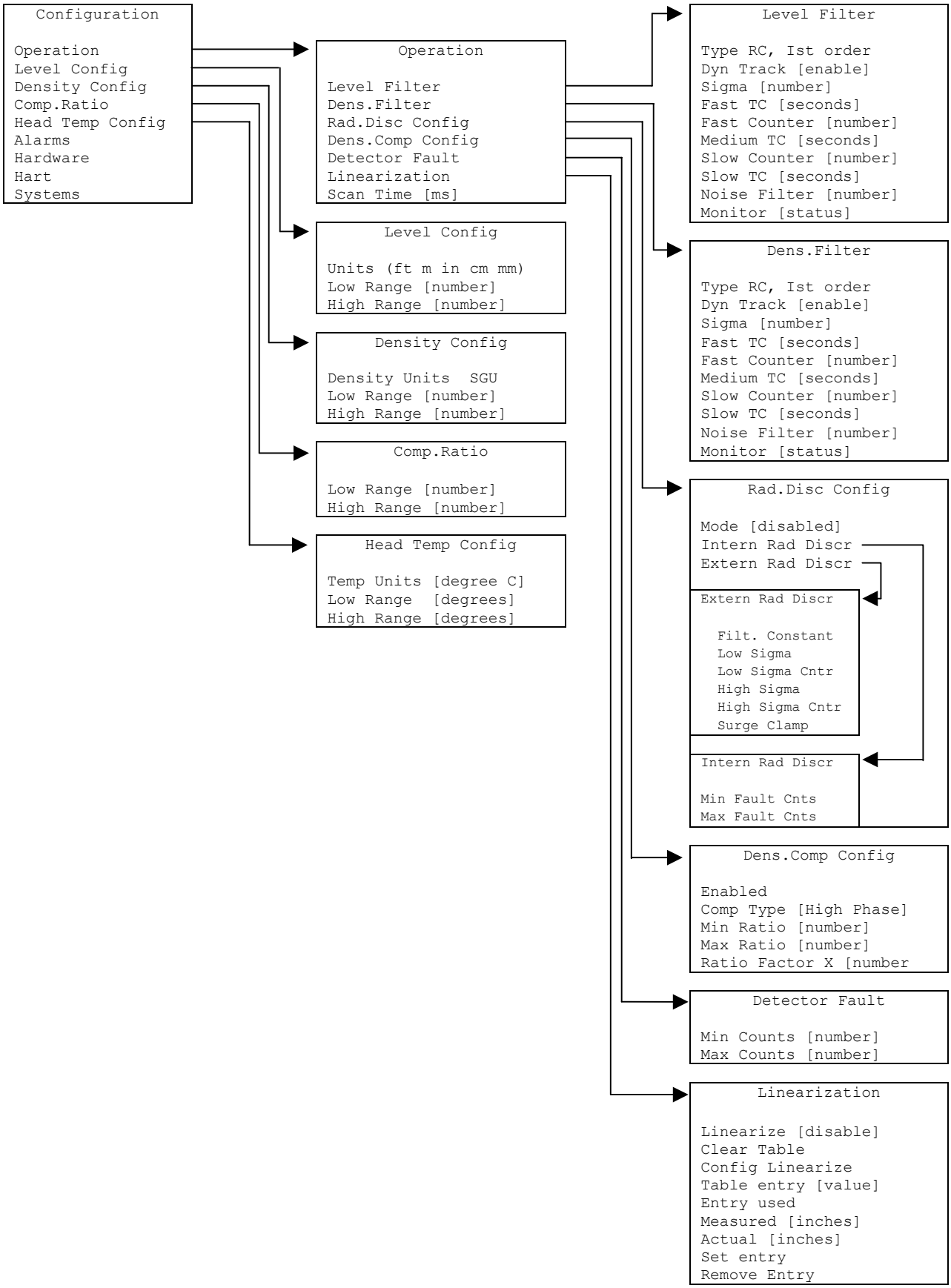
Note: For security reasons, each digit will always be displayed as an asterisk.

Menus/Operation

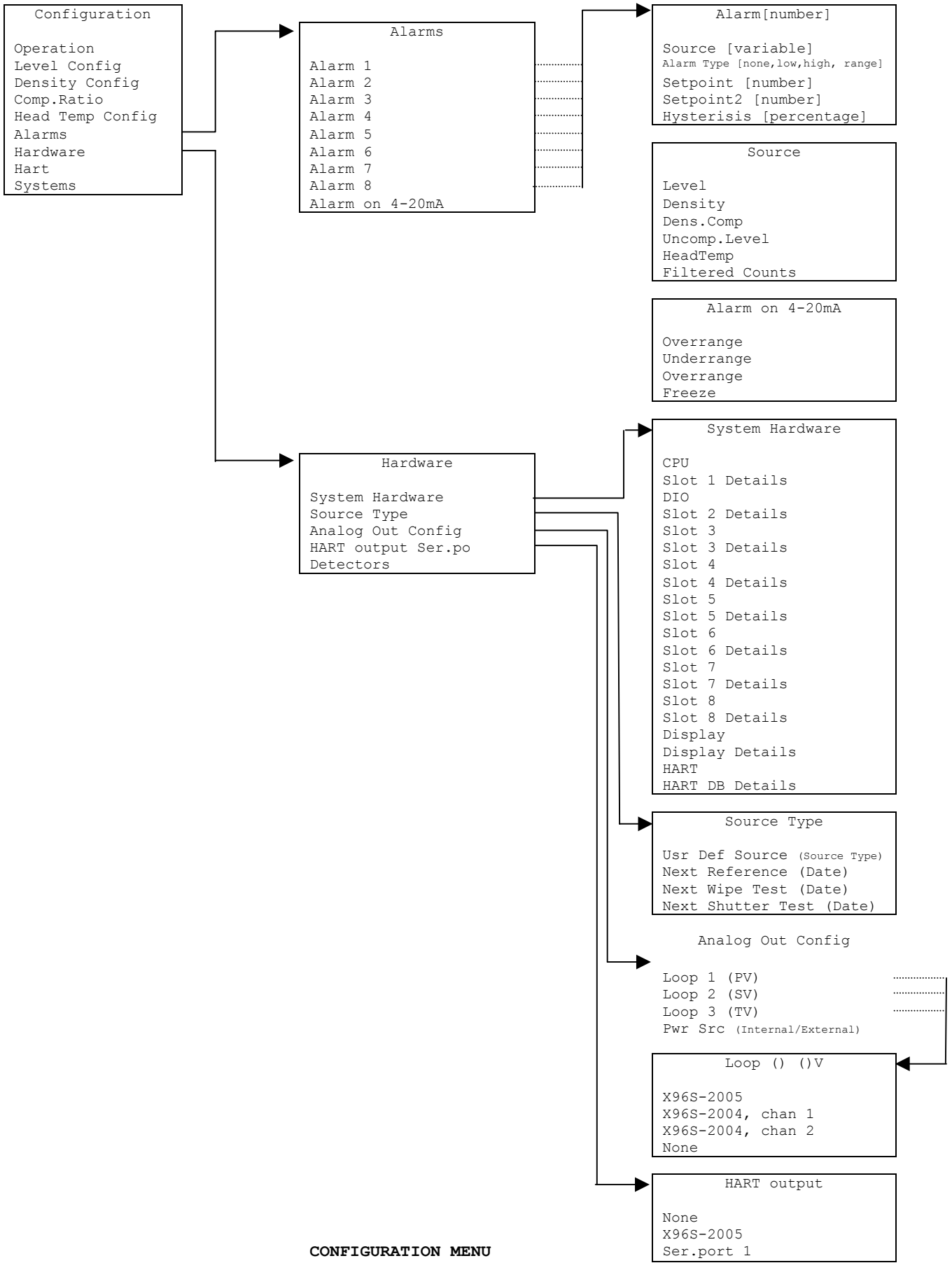
The Ronan X96S Level with Density Compensation Gage uses a tree structured menu system.



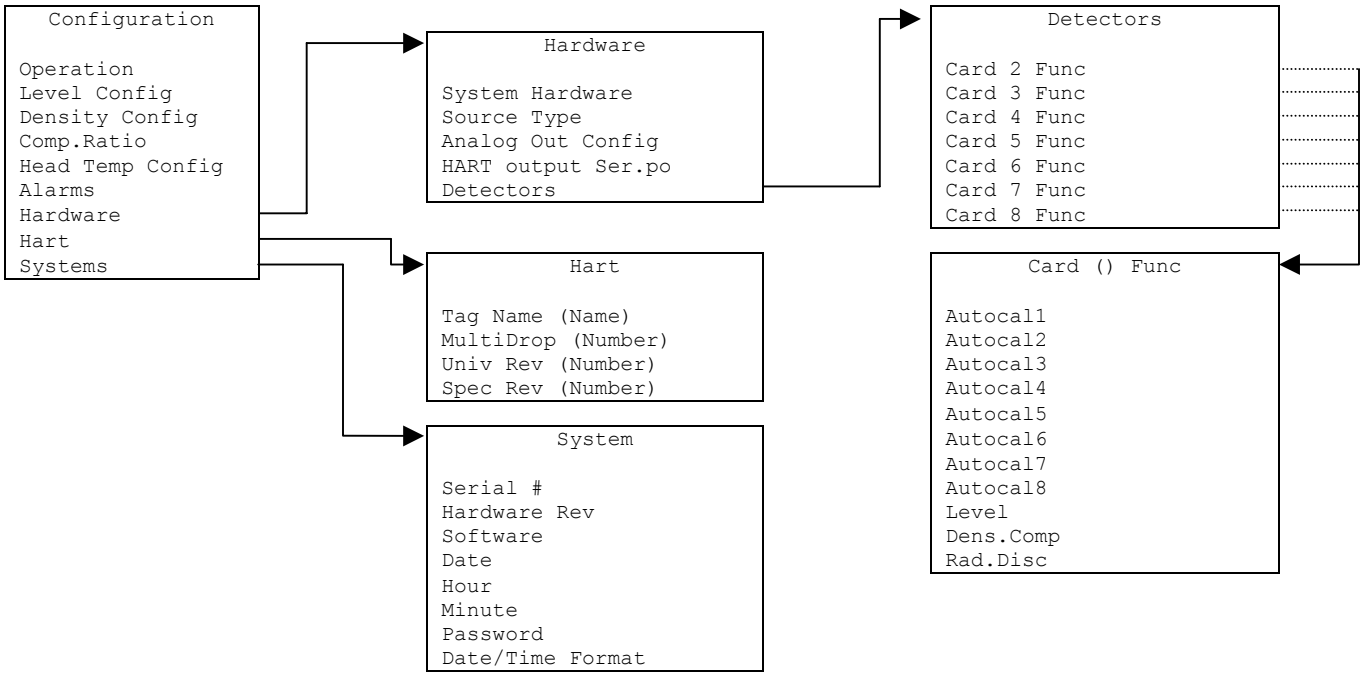
ROOT, VARIABLE AND DISPLAY MENUS



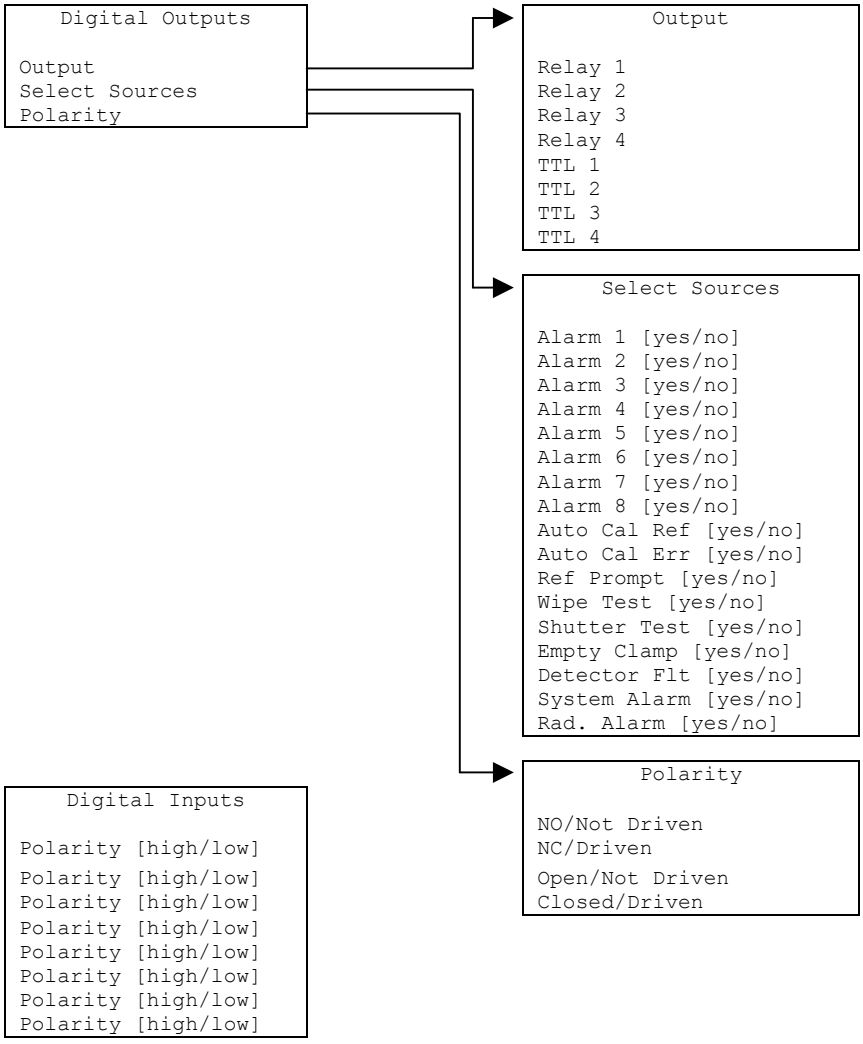
CONFIGURATION MENU



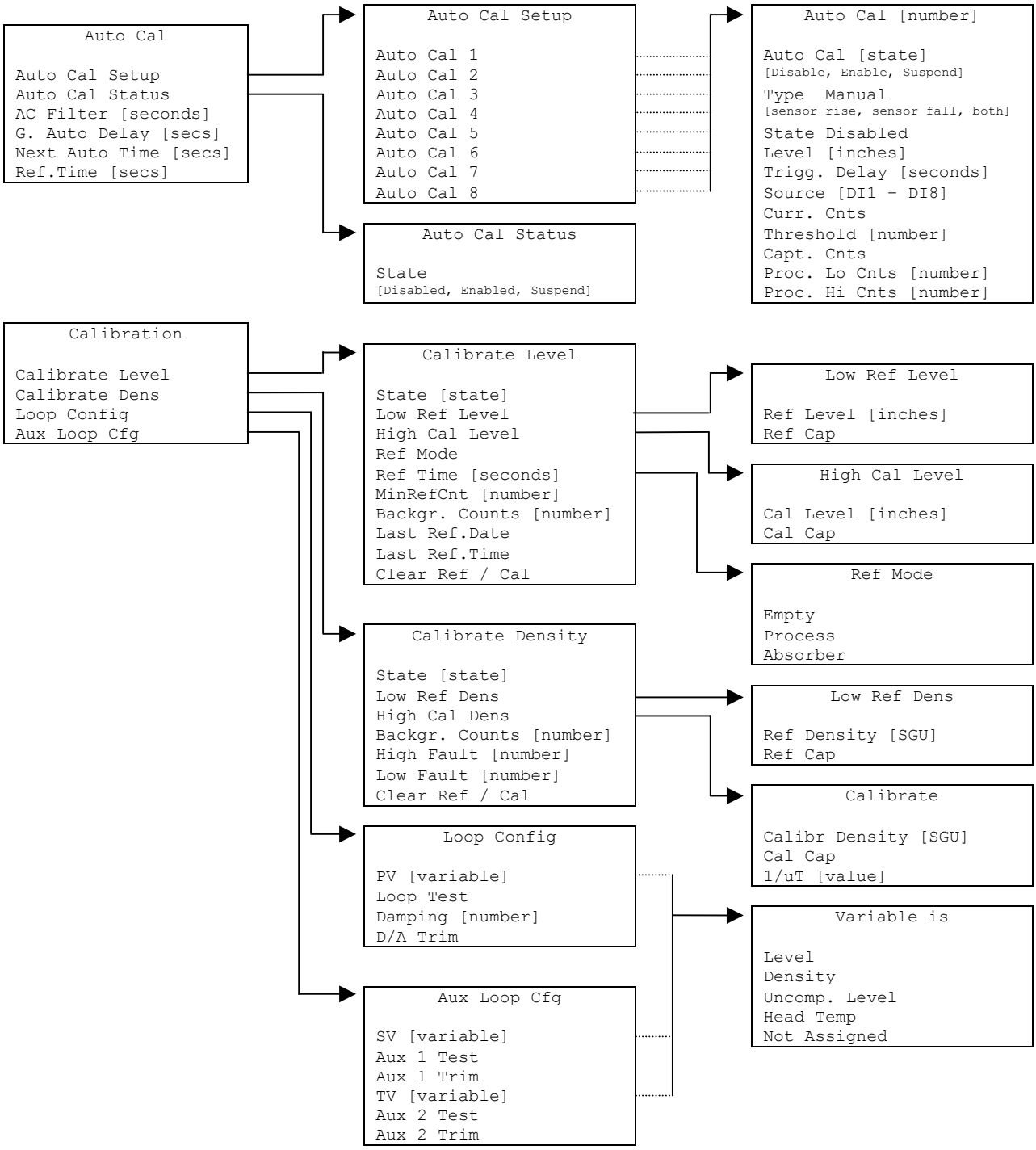
CONFIGURATION MENU



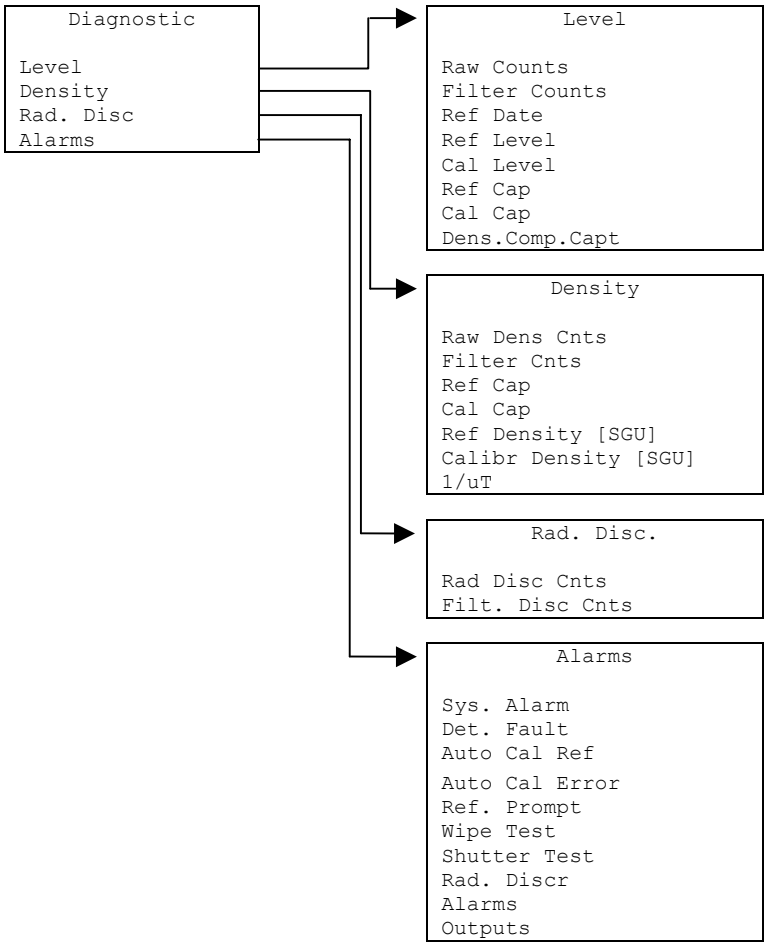
CONFIGURATION MENU



DIGITAL OUTPUT AND INPUT MENUS



CALIBRATION MENUS



DIAGNOSTIC MENU

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

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

Variables Menu

The menu titled "Variables" contains the following items:

ITEM	FUNCTION
Variable Mapping	Selecting this choice takes the user to the Variable Mapping menu
Level	Shows the current value of the Level Variable
Uncomp.Level	Shows the current value of the Uncomp.Level Variable
Density	Shows the current value of the Density Variable
Comp.Ratio	Shows the current value of the Comp.Ratio Variable
Head Temp	Shows the current value of Head Temp (the Head Temperature)
Raw Counts	Shows the current value of the Raw Counts Variable
Filt.Counts	Shows the current value of the Filt.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
Level	Level
Density	Density
Uncomp.Level	Uncompensated Level
Density Comp	Density Compensation
Head Temp	Head temperature (if available)
Not Assigned	Blank line

Displays Menu

The menu titled "Displays" contains the following item:

ITEM	FUNCTION
Status Display	Selecting this choice takes the user to the Status Display menu

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 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

Each line may each select one of the following:

SELECTION	MEANING
`Level`	Level
`Density`	Density
`Uncomp.Level`	Uncompensated Level
`Density Comp`	Density Compensation
`Head Temp`	Head temperature (if available)
`4-20 mA`	4-20 mA output level
`Raw`	Raw counts (from scintillation detector) or raw analog measurement (from ionization detector
`Filt.Cnts`	Filter Counts
`Date & Time`	Current date and time
`Diagnostic`	Diagnostic
`Not Assigned`	Blank line

Configuration Menu

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

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

Operation Menu

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

ITEM	FUNCTION
Level Filter	Selecting this choice takes the user to the Level Filter menu
Dens.Filter	Selecting this choice takes the user to the Dens.Filter menu
Rad.Disc Config	Selecting this choice takes the user to the Rad.Disc Config menu
Dens.Comp Config	Selecting this choice takes the user to the Dens.Comp Config menu
Detector Fault	Selecting this choice takes the user to the Detector Fault menu
Linearization	Selecting this choice takes the user to the Linearization menu
Scan Time	Shows the amount of time to accumulate each level sample and allows the user to change the time value.

Level Filter Menu

The `Level Filter` menu is used to configure the parameters associated with the weight measurement filter. It contains the following items:

ITEM	FUNCTION
`Type`	Shows the type of filtering averaging the system is using (RC, 1st order, Walking avg)
`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 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 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 weight value. Also it allows user to change this number. Erroneous measurement is define 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) one of the following:

`Monitor`	MEANING
ERROR	Filter is not initialized (this state should not occur during normal operation of the X96S Weigh Scale)
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 weight value
REFILL	A step change has occurred and the walking average buffer is refilling.

Density Filter Menu

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

ITEM	FUNCTION
`Type`	Shows the type of filtering averaging the system is using (RC, 1st order, Walking avg)
`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 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 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 weight value. Also it allows user to change this number. Erroneous measurement is define 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) one of the following:

`Monitor`	MEANING
ERROR	Filter is not initialized (this state should not occur during normal operation of the X96S Weigh Scale)
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 weight value
REFILL	A step change has occurred and the walking average buffer is refilling.

Rad.Disc Config Menu

Radiation Discrimination is used where radiography is frequently used to inspect vessel welds. There are two types of configurations. The first is using an optional external detector to sense the changes in the background radiation. This configuration provides the maximum type of protection because it senses small changes in background. The second option uses the same level detector that is used for the level measurement. Using this configuration can only provide protection when the background field exceeds the normal vessel operating field.

The `Rad.Disc Config` menu is used to control the Radiation Discrimination. It contains the following items:

ITEM	FUNCTION
`Mode`	Shows the current state of the Radiation Discrimination Mode (Disabled, Internal, External) and allows the user change the state.
`Intern Rad Discr`	Selecting this item takes the user to the `Intern Rad Discr` menu
`Extern Rad Discr`	Selecting this item takes the user to the `Extern Rad Discr` menu

The `Inter Rad Discr` menu is used to configure the internal detector (level detector) as the sensing detector for radiation discrimination.

ITEM	FUNCTION
`Min Fault Cnts`	Shows the minimum counts the internal detector must have for normal operation. If the detector signal fall below this value, the rad disc feature is enabled.
`Max Fault Cnts`	Shows the maximum counts the internal detector must have for normal operation. If the detector signal goes above this value, the rad disc feature is enabled.

The `Extern Rad Discr` menu is used to configure the external radiation detector as the sensing detector for radiation discrimination.

ITEM	FUNCTION
`Filt.Constant`	Show the amount of time that is used for averaging the background counts.
`Low Sigma`	Shows the (sigma) multiplier used to determine the threshold that the raw counts must exceed before the system can go into Radiation Discrimination. Sigma is the square root of the current filtered counts. This value can be changed by the user.
`Low Sigma Cntr`	Shows the Low Sigma Cntr value. The Low Sigma Cntr is the number of consecutive scan the raw counts variations must exceed Low Sigma threshold before the Radiation Discrimination is enabled.
`High Sigma`	Shows the (sigma) multiplier used to determine the threshold that the raw counts must exceed before the system can go into Radiation Discrimination. Sigma is the square root of the current filtered counts. This value can be changed by the user.
`High Sigma Cntr`	Shows the High Sigma Cntr value. The High Sigma Cntr is the number of consecutive scan the raw counts variations must exceed High Sigma threshold before the Radiation Discrimination is enabled.
`Surge Clamp`	This is the saturation level counts from the dtector. its value should be down around 5, assuming your background counts never get that low. If they do, then use a value of 1.

Dens.Comp Config

This function will modify, or adjust, the current level based on the signal received from the density compensation detector being used to measure the density.

ITEM	FUNCTION
`Enabled`	Show the current state of Density Compensation (Yes/No). Enables or Disables the Density Compensation function.
`Comp Type`	Show the current type of Compensation being used. (Low Phase/High Phase)
`Min Ratio`	Min Ratio is a safeguard to limit the amount of correction the Density Compensation can provide to the indicated level.
`Max Ratio`	Max Ratio is a safeguard to limit the amount of correction the Density Compensation can provide to the indicated level.
`Ratio Factor X`	Ratio Factor X is used to linearize the change in density compensation signal with the change in level signal.

Detector Fault

This function will provide a detector fault (alarm) that can be assigned to the Digital outputs or to the Alarm on the 4-20 mA output.

ITEM	FUNCTION
`Min Counts`	Shows the minimum counts the detector must have for normal operation. If the detector signal fall below this value, the detector fault is tripped.
`Max Counts`	Shows the maximum counts the detector must have for normal operation. If the detector signal goes above this value, the detector fault is tripped.

Linearization Menu

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

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

ITEM	FUNCTION
`Linearize`	Shows the current state of the Linearization mechanism (enabled or disabled) and allows the user change the state.
`Clear Table`	This item invokes a method that clears all entries in the linearization table
`Config Linearize`	Selecting this item takes the user to the `Config Linearize` menu

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

Config Linearize Menu

The Config `Linearize` menu is used to configure the parameters associated with linearization of the measured data. It contains the following items:

ITEM	FUNCTION
`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 measured value associated with this linearization table entry. This is a value calculated by the X96S.
`Actual`	Shows, and allows the user to set, the actual value associated with this linearization table entry. This value is the result of actual level knowledge, and compares to the `Measured` value above.
`Set Entry`	This item invokes a method that sets a table entry
`Remove Entry`	This item invokes a method that removes a table entry

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.

Level Config Menu

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

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

Units is one of the following:

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

Density Config Menu

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

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

Units is one of the following:

Density Units	MEANING
SGU	specific gravity
degTwad	degrees twaddle
degBrix	degrees brix
degBaum_hv	degrees baume heavy
degBaum_lt	degrees baume light
degAPI	degrees API
Percent_sol_wt	percent solids by weight
degBall	degrees balling
percent_StmQual	percent steam quality

Comp.Ratio Menu

The `Comp.Ratio` menu is used to configure the parameters associated with the density compensation. It contains the following items:

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

Head Temp Config Menu

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

ITEM	FUNCTION
`Temp Units`	Shows, and allows the user to set, the units to be used for head temperature
`Low Range`	Shows, and allows the user to set, the temperature value to be mapped to 4ma on the current loop output, if head temperature is selected to control that current loop.
`High Range`	Shows, and allows the user to set, the temperature value to be mapped to20ma on the current loop output, if head temperature is selected to control that current loop.

Alarms

The `Alarms` menu is used to configure the parameters associated with the analog alarms 1-8 and the 4-20mA alarm.

The `Alarms 1-8` is one of the following:

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[3]
`Hysterisis`	Shows, and allows the user to set the alarm hystersis percent

The `Source` is one of the following:

`Source`	MEANING
`Level`	Uses the Level for the source of the alarm
`Density`	Uses the Density for the source of the alarm
`Comp.Ratio`	Uses the Density Compensation Ratio for the source of the alarm
`Uncomp.Level`	Uses the Uncompensated Level for the source of the alarm

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

Source	MEANING
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

The Alarm on 4-20 mA output has one of the following options:

Option	Meaning
None	This option will disable the alarm function on the 4-20 mA output
Underrange	This option, during an alarm, causes the 4-20 mA output to be forced to 3.60 mA
Overrange	This option, during an alarm, causes the 4-20 mA output to be forced to 21.00 mA
Freeze	This option, during an alarm, causes the 4-20 mA output to be clamped to the last output just prior to the event of the alarm.

Hardware Menu

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

ITEM	FUNCTION
System Hardware	Shows the user 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
Analog Out Cnfg	Shows and allows the user to set the where the source of power is internal or external
HART output	Selecting this item takes the user to the HART output menu
Detectors	Selecting this item takes the user to the Detector menu

System Hardware Menu

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

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

Source Type Menu

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

ITEM	FUNCTION
`Source Type`	Shows, and allows the user to set, the source type
`Usr Def Source`	Selecting this item takes the user to the Usr Def Source menu

Source Type is one of the following:

Source Type	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

Usr Def Source Menu

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

Analog Out Config Menu

The Analog Out Config Menu is used to assign the PV, SV and TV 4-20mA outputs to hardware.

Source Type	MEANING
`Loop 1 (PV)`	Shows and allows the user to set PV to a specific output (X96S-2005, X96S-2004, Chan1 or Chan 2, None)
`Loop 2 (SV)`	Shows and allows the user to set SV to a specific output (X96S-2005, X96S-2004, Chan1 or Chan 2, None)
`Loop 3 (TV)`	Shows and allows the user to set TV to a specific output (X96S-2005, X96S-2004, Chan1 or Chan 2, None)
`Pwr Src`	Shows and allows the user to set where the source of power is internal (X96S) or external.

Hart Output Menu

HART output is one of the following:

Option	MEANING
`None`	No HART output selected
`X96S-2005`	HART output is assigned through the X96S-2005 4-20mA output
`Ser.port 1`	HART output is assigned through the Serial Port 1 located on the chassis

Detector Menu

Detector has the one of the following options:

Item	MEANING
`Card 2 Func`	Selecting this item takes the user to the Card 2 Func menu
`Card 3 Func`	Selecting this item takes the user to the Card 3 Func menu
`Card 4 Func`	Selecting this item takes the user to the Card 4 Func menu
`Card 5 Func`	Selecting this item takes the user to the Card 5 Func menu

Item	MEANING
Card 6 Func	Selecting this item takes the user to the Card 6 Func menu
Card 7 Func	Selecting this item takes the user to the Card 7 Func menu
Card 8 Func	Selecting this item takes the user to the Card 8 Func menu

Card Function has one of the following option:

Option	MEANING
N.A.	Do not assign this card slot
Autocal1	Assign this card slot as Autocal1 Detector
Autocal2	Assign this card slot as Autocal2 Detector
Autocal3	Assign this card slot as Autocal3 Detector
Autocal4	Assign this card slot as Autocal4 Detector
Autocal5	Assign this card slot as Autocal5 Detector
Autocal6	Assign this card slot as Autocal6 Detector
Autocal7	Assign this card slot as Autocal7 Detector
Autocal8	Assign this card slot as Autocal8 Detector
Level	Assign this card slot as Level Detector
Dens.Comp	Assign this card slot as Density Compensation Detector
Rad.Disc	Assign this card slot as Radiation Discrimnation Detector

HART Menu

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

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

System Menu

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

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

Date/Time Format is one of the following:

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

Date/Time Format	MEANING
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
Relay 1	Selecting this item takes the user to the Relay 1 menu
Relay 2	Selecting this item takes the user to the Relay 2 menu
Relay 3	Selecting this item takes the user to the Relay 3 menu
Relay 4	Selecting this item takes the user to the Relay 4 menu
TTL 1	Selecting this item takes the user to the TTL 1 menu
TTL 2	Selecting this item takes the user to the TTL 2 menu
TTL 3	Selecting this item takes the user to the TTL 3 menu
TTL 4	Selecting this item takes the user to the TTL 4 menu

Relay Menus

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

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

Alarm Source is one of the following:

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

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

Alarm Type is one of the following:

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

Polarity is one of the following:

Polarity	MEANING
NO	Normally open
NC	Normally closed

TTL Menus

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

ITEM	FUNCTION
Source	Shows, and allows the user to set, the source
Alarm Type	Shows, and allows the user to set, the alarm type
Setpoint	Shows, and allows the user to set, the alarm set point
Setpoint2	Shows, and allows the user to set, the second alarm set point[5]
Hysterisis	Shows, and allows the user to set, the alarm hysterisis percent
Polarity	Shows, and allows the user to set, the alarm polarity

Alarm Source is one of the following:

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

Alarm Type is one of the following:

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

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

Polarity is one of the following:

Polarity	MEANING
Not Driven	Normally not driven
Driven	Normally driven

Digital Inputs Menu

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

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

Input Menus

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

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

Polarity is one of the following:

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

Auto Cal Menu

This menu is used to view and setup the Auto Calibration for the X96S Level with Density Compensation Gage. It contains the following items:

ITEM	FUNCTION
Auto Cal Setup	Selecting this item takes the user to the Auto Cal Setup menu
Auto Cal Status	Selecting this item takes the user to the Auto Cal Status menu. The Auto Cal Status shows the state for each Auto-Cal.
AC Filter	Shows and allows the user to set the AC Filter value. The AC Filter is the time constant used for filtering the level detector signal during the auto calibration
G.Auto Delay	Shows and allows the user to set the G.Auto Delay value. G.Auto Delay is the amount of time that must take place before the any of the other auto cal detectors can begin an auto cal. This is to prevent simultaneous auto-calibrations.
Next Auto Time	Shows and allows the user to set the Next Auto Time value. Next Auto Time is the amount of time that must take place before the same auto-cal detector can perform another auto-cal. This is to prevent the same detector from being in continuous auto calibration.
Ref.Time	Shows and allows the user to set the Ref.Time value. The Ref.Time is the amount of time it will take for an auto calibration to be completed. Recommend the Ref.Time value should be at least 3 times the AC Filter value.

Auto Cal Setup Menu

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

Auto Cal Configuration Menu

ITEM	FUNCTION
Auto Cal	Shows and allows the user to Enable / Disable the Auto Cal
Type	Shows and allows the user to select the auto cal signal. Selecting this item takes the user to the Type menu
State	Show the state of the auto cal.
Level	Show the user at what level the X96S will be auto calibrated
Trigg.Delay	Shows and allow the user to change the Trigg.Delay time. The Trigg.Delay is the amount of time the auto-cal detector must be tripped before an auto calibrations can begin.
Source	Show and allows the user to select the source of the auto calibrations. Selecting this item takes the user to the Source menu.
Curr.Cnts	Shows the user the detector counts (signal) from the auto calibrate detector.
Threshold	Shows and allows the user to change the Threshold value. The Threshold is the value the auto cal detector signal must rise above or fall below to begin the auto calibration.
Capt.Cnts	Shows the user the level detector counts (signal) saved after the last successful auto-cal took place.
Proc.Lo Cnts	Shows and allows the user to change the Proc.Lo Cnts. The Proc.Lo Cnts is the minimum counts from the continuous level detector needed for an auto-calibration.
Proc.Hi Cnts	Shows and allows the user to change the Proc.Hi Cnts. The Proc.Hi Cnts is the maximum counts from the continuous level detector needed for an auto-calibration

Type is one of the following:

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

Source is one of the following

ITEM	FUNCTION
None	Selecting this item assigns the source as none
DI1	Selecting this item assigns Digital Input 1 as the source
DI2	Selecting this item assigns Digital Input 2 as the source
DI3	Selecting this item assigns Digital Input 3 as the source
DI4	Selecting this item assigns Digital Input 4 as the source
DI5	Selecting this item assigns Digital Input 5 as the source
DI6	Selecting this item assigns Digital Input 6 as the source
DI7	Selecting this item assigns Digital Input 7 as the source
DI8	Selecting this item assigns Digital Input 8 as the source
Detector	Selecting this item assigns the auto cal detector as the source

Calibration Menu

ITEM	FUNCTION
Calibrate Level	Shows the state of the level configuration process
Calibrate Dens	Selecting this item takes the user to the Ref Constants menu
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

Calibrate Level Menu

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

ITEM	FUNCTION
State	Shows the state of the level configuration process
Low Ref Level	Selecting this item takes the user to the Low Ref Level menu
High Cal Level	Selecting this item takes the user to the High Cal Level menu
Ref Mode	Shows and take the user to the Ref Mode menu
Ref Time	Shows and allows the user to set the number of seconds of data to collect for a Low Reference or High Calibrate sample
MinRefCnt	Shows and allows the user to set the minimum unfiltered counts the level detector must provide to allow during a Low reference or High calibration. If the detector counts are below this value, the Low reference is aborted.
Backgr.Counts	Shows and allows the user to set the Backgr.Counts. The background counts are used with low detector count applications. This value used to calculate the indicated level. Consult Factory before using this function. Typically used with **Low** Phase Density Compensation.
Last Ref.Date	Shows the date the last time the user performed a low referenced.
Last Ref.Time	Shows the time of day the last time the user performed a low referenced.
Clear Ref/Cal	This item invokes a method that clears the level low reference and high calibration. This allows the user to start over with out any stored reference or calibrated values.

State is one of the following:

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

`Low Ref Level` is one of the following

State	**MEANING**
`Reference`	This item invokes a method that performs the low reference procedure. After the reference procedure is completed, it is important the user access the Ref Lev value and insert or acknowledge the value.
`Ref Level`	Shows and allows the user to set the reference to the level of the process
`Ref Cap`	Shows the Referenced Captured Counts the last time the user performed a successful low referenced

`High Cal Level` is one of the following

State	**MEANING**
`Calibrate`	This item invokes a method that performs the high calibrate procedure. After the calibrate procedure is completed, it is important the user access the Cal Lev value and insert or acknowledge the value.
`Cal Level`	Shows and allows the user to set the calibration to the level of the process
`Cal Cap`	Shows the Calibrated Captured Counts the last time the user performed a successful High Calibration.

`Ref Mode` is one of the following:

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

Calibrate Dens Menu

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

ITEM	FUNCTION
State	Shows the state of the level configuration process
Low Ref Dens	Selecting this item takes the user to the Reference menu
High Cal Dens	Selecting this item takes the user to the High Cal Dens menu
Backgr.Counts	Shows and allows the user to set the Backgr.Counts. The background counts are used with low detector count applications. This value used to calculate the indicated level. Consult Factory before using this function. Typically used with **Low** Phase Density Compensation.
Hi fault	Shows and allows the user to set the Hi fault. The Hi Fault is used for the density compensation. When the density detector counts fall below this value, the compensation is force to 1.0000
Lo fault	Shows and allows the user to set the Lo fault. The Hi Fault is used for the density compensation. When the density detector counts goes above this value, the compensation is force to 1.0000
Clear Ref/Cal	This item invokes a method that clears the level low reference and high calibration. This allows the user to start over with out any stored reference or calibrated values.

State is one of the following:

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

Low Ref Density is one of the following

State	MEANING
Reference	This item invokes a method that performs the low reference procedure
Ref Density	Shows and allows the user to set the reference density
Ref Cap	Shows the Referenced Captured Counts the last time the user performed a successful low referenced

High Cal Density is one of the following

State	MEANING
Calibrate	This item invokes a method that performs the high calibrate procedure
Cal Density	Shows and allows the user to set the reference density
Cal Cap	Shows the Calibrated Captured Counts the last time the user performed a successful High Calibration.
1/uT	Shows the user the cal constant the X96S calculated during a High Calibration.

Loop Config Menu

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

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

Aux Loop Cfg Menu

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

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

SV is is one of the following:

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

Diagnostic

ITEM	FUNCTION
Level	Selecting this item takes the user to the Level menu
Density	Selecting this item takes the user to the Density menu
Rad.Disc	Selecting this item takes the user to the Rad.Disc menu
Alarms	Selecting this item takes the user to the Alarm menu

Level

ITEM	FUNCTION
Raw Counts	Shows the user the Raw Counts (unfiltered counts) which is from the Level detector
Filt.Counts	Shows the user the Filt.Counts (filtered counts) which is from the Level detector
Raw Level	Shows the user the Raw Level which is nonlinear and uncompensated
Last Ref.Date	Shows the user the date the Level was referenced
Ref Level	Shows the user at what level the X96S was referenced
Cal Level	Shows the user at what level the X96S was calibrated
Ref Cap	Shows the user at what (level) detectors counts the X96S was referenced
Cal Cap	Shows the user at what (level) detector counts the X96S was calibrated

ITEM	FUNCTION
Comp.Ratio Capt	Shows the user at what (density compensation) detector counts the X96S was calibrated or referenced depending on if the density compensation is low phase or high phase

Density

ITEM	FUNCTION
Raw Dens Cnts	Shows the user the Raw Counts (unfiltered counts) which is from the Density detector
Filt.Counts	Shows the user the Filt.Counts (filtered counts) which is from the Density detector
Ref Cap	Shows the user at what (density) detectors counts the X96S was referenced
Cal Cap	Shows the user at what (density) detector counts the X96S was calibrated
Ref Density	Shows the user at what density the X96S was referenced
Calibr Density	Shows the user at what density the X96S was calibrated
1/uT	Shows the user at what cal constant value the density calculations are using

Rad.Disc.

ITEM	FUNCTION
Raw Disc Cnts	Shows the user the Raw Counts (unfiltered counts) which is from the Radiation discrimination detector
Filt.Disc Counts	Shows the user the Filt.Counts (filtered counts) which is from the Radiation discrimination detector

Alarms

ITEM	FUNCTION
Sys.Alarm	Shows the status of the System Alarm. 0 = Reset. Any other value indicates the system alarm is trip. The value indicates which card is the source.
Det.Fault	Shows the status of the System Alarm. 0 = Reset. Any other value indicates the system alarm is trip. The value indicates which card is the source.
AutoCal Ref	Shows the status of the AutoCal Ref. Alarm. No = AutoCal Ref is completed. Yes = AutoCal Ref is currently performing a reference.
AutoCal Error	Shows the status of the AutoCal Error alarm. No = No error. Yes = AutoCal failed during the calibration. To clear the alarm, a successful AutoCalbration must take place.
Ref.Prompt	Shows the status of the Ref.Prompt Alarm. No = No alarm. Yes = Alarm. To clear the alarm, a new date must be entered under Configuration/Hardware/SourceType/Next Reference
Wipe Test	Shows the status of the Wipe Test Alarm. No = No alarm. Yes = Alarm. To clear the alarm, a new date must be entered under Configuration/Hardware/SourceType/Wipe Test
Shutter Test	Shows the status of the Shutter Test Alarm. No = No alarm. Yes = Alarm. To clear the alarm, a new date must be entered under Configuration/Hardware/SourceType/Shutter Test
Rad.Disc	Shows the status of the Ref.Prompt Alarm. No = No alarm. Yes = Alarm. To clear the alarm, a new date must be entered under Configuration/Hardware/SourceType/Next Reference
Alarms	Shows the status of the Alarms 1-8. Underscore = Clear X = Trip
Outputs	Shows the status of the output of the DIO board. Relays 1-4 and TTL 1-4. Underscore = Not Energize/0 X = Energized/1

Configuration

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

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

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

Detector

Scintillator Detector

Description

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

Scintillation Crystal

The crystal used for the Weigh 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.

Photomultiplier Tube

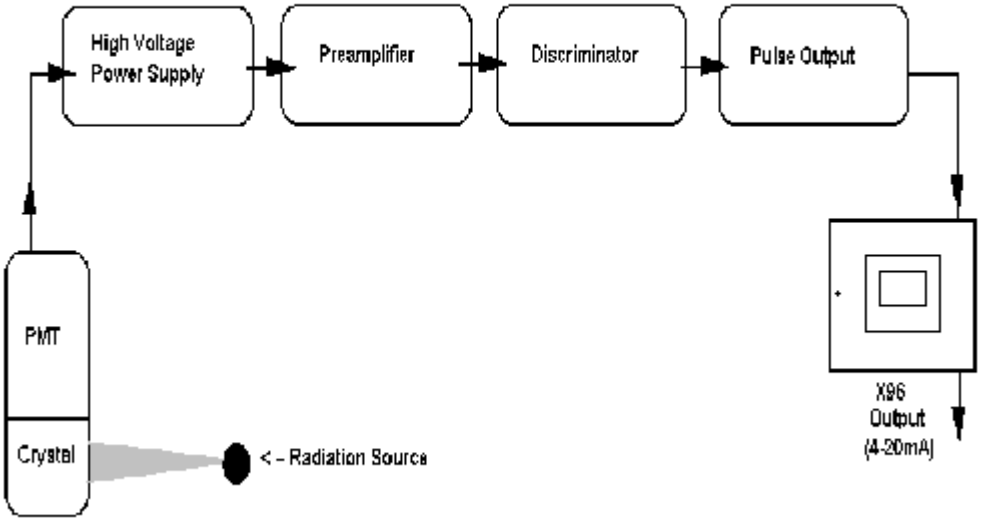
The PMT is a light sensitive vacuum tube with a photosensitive layer that converts the light pulses to an electrical current. Light pulses from the crystal strike the photosensitive layer and release electrons. A high voltage power supply connected to the photosensitive layer accelerates the electrons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

Reference:
B-6409-K
B-9742-K

Refer to drawing B-6409-K. The current (I), generated by the ion chamber, is fed into the inverting input terminal of the electrometer amplifieer, (IC1). The electrometer amplifier output is filtered by R2C4 (a microphonic, low-pass filter) and fed into a follower amplifier. The output of IC2 is proportionally fed back to the inverting terminal to provide a closed-loop gain based on the value of the gain resistance potentionmeter (R2) on the X96S input board. (B-9742-K).

The detector's gain is adjusted whenever the signal output of the detector is too high and may saturate the input of the X96S, which is approximately 3.5VDC. The output must be less than 3.0VDC with an empty vessel.

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

The most important components of the amplifier are the operational amplifier (IC1), feedback resistor (Rf), and feedback capacitor (Cf). If these components are substituted, the performance of the system will be adversely affected.

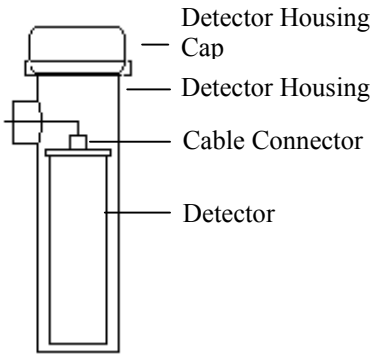
Servicing the Detector

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

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

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

Detector Removal/ Replacement



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

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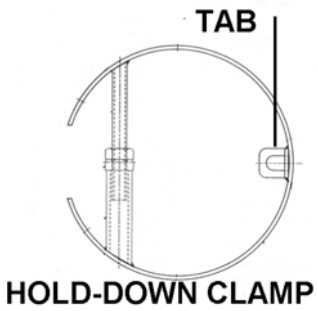


ELONGATED DETECTORS NOTES:

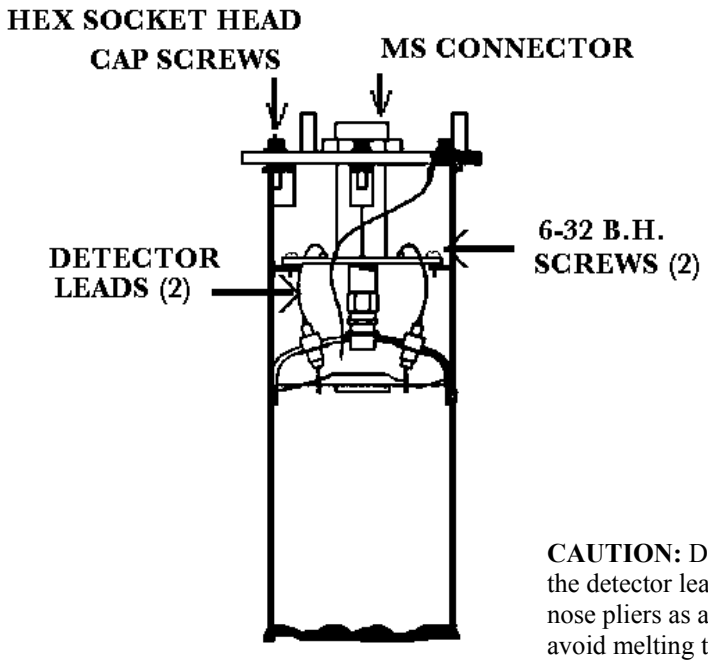
To avoid damage in shipment or installation, the elongated detectors are packaged separate from the housing. Avoid subjecting detectors to mechanical shock. Avoid supporting detector by its chain handle, or other lifting devices, for prolonged periods of time.

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

Removing the Detector Amplifier Circuit Board (CBAY-6102)

Follow this procedure to remove the electrometer amplifier circuit board:

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



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

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

CAUTION: DO NOT over heat the detector leads. Using long-nose pliers as a heatsink will avoid melting the solder at the detector feed-through.

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

Electronics

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

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

X96-2003PL
X96-2003PL is the Ionization Chamber Interface Module. This optional[6] module provides:
- 1 ionization detector input
- 1 feedback input for ionization detector
- 1 head temperature input
- 1 non-isolated RTD (3-wire) input (stuffing option)
- Power[7] for the ionization detector (15 volts at 35 ma and –15 volts at 5 ma).

X96-2004PL
X96-2004PL is the 2-Channel Analog Output Module. This optional module has two isolated analog outputs each of which can be independently configured as a:
- 4-20 mA current loop,
- a source of 0 to 10 volts, or
- a sink of 0 to 20 ma.

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

X96C148-1
X96C148-1 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.

[6] At least one detector interface module is required.
[7] The power supply has the ability to control power to the ionization detector:
- when commanded by the CPU module,
- when the watchdog timer generates a reset.

X96-2008PL

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

8 isolated digital inputs are provided. These inputs can be configured for use as:
- dry[8] or live[9] contact monitoring,
- quadrature encoder[10], or
- pulse counter.

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

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

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

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

X96-2009PL

X96-2009PL is the Scintiallation Detector Interface Module. This optional[11] module provides:
- 1 isolated scintillation input (pulse counter, max signal 0-12[12] 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[13].

[8] 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.
[9] 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.
[10] The interface to the quadrature encoder shall consist of two inputs, 15 volts DC at 200 mA (described in a later section), and common.
[11] At least one detector interface module is required.
[12] 8.6 V nominal.
[13] The power supply has the ability to control the power to the scintillation detector:
- when commanded by the CPU module,
- when the processor on the module detects a condition that could harm the scintillation detector,
- when the watchdog timer generates a reset.

Options

X96S Mechanical Chassis Part Numbers

PART NUMBER	DESCRIPTION
X96S-N4-1	X96S NEMA 4 Enclosure, 6 Position, with Front Panel L.C.D. & Motherboard
X96S-N4-2	X96S NEMA 4 Enclosure, 9 Position, with Front Panel L.C.D. & Motherboard
X96S-SM-1	X96S Surface Mount, 6 Position, with Motherboard
X96S-SM-2	X96S Surface Mount, 9 Position, with Motherboard
X96S-PM-SD	Panel Mount Serial Display Assembly
X96S-SRRD-1	Relay Rack Mount Serial L.C.D. Displays ONE L.C.D.
X96S-SRRD-2	Relay Rack Mount Serial L.C.D. Displays TWO L.C.Ds
X96S-SRRD-3	Relay Rack Mount Serial L.C.D. Displays THREE L.C.Ds
X96S-SPD	X96S Serial Portable L.C.D. Display

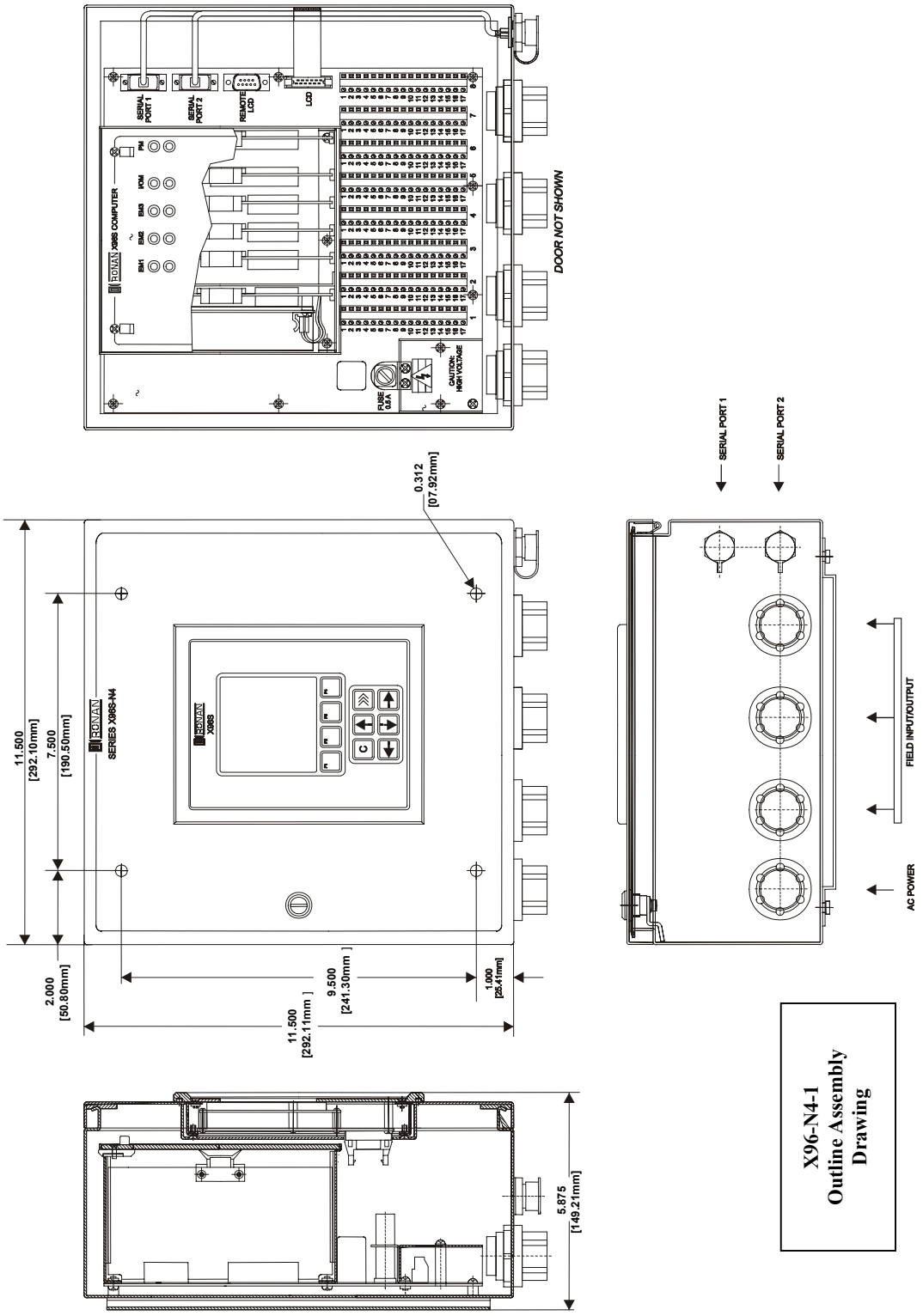
X96S Electronic Module Part Numbers

PART NUMBER	DESCRIPTION
X96-2001PL	X96S CPU Module
X96-2002PL	X96S Graphics L.C.D. Base Module
X96-2003PL	X96S Ionization Chamber Interface Module
X96-2004PL	X96S 2-Channel 4-20 mA Analog Output Module
X96-2007PL	X96S HART Daughter Module
X96-2008PL	X96S 8-Channel Digital Input Module, 8-Channel Digital Output Module (4 Transistors + 4 Relays)
X96-2009PL	X96S Scintiallation Detector Interface Module
X96-2010PL	X96S I B Bus Jumper Module
X96C148	X96S Power Supply Module
X96D138	X96S 6-Position Motherboard Assembly
SFTW-X96S-DEN	Standard Density software for CPU Module
SFTW-X96S-DEN-H	HART Density software for CPU Module with HART Daughter Module installed
SFTW-X96S-LDC	Standard Level with Density Compensation software for CPU Module
SFTW-X96S-LDC-H	HART Level with Density Compensation software for CPU Module with HART Daughter Module installed
SFTW-X96S-LEV	Standard Level software for CPU Module
SFTW-X96S-LEV-H	HART Level software for CPU Module with HART Daughter Module installed
SFTW-X96S-MSF	Standard Mass Flow software for CPU Module
SFTW-X96S-MSF-H	HART Mass Flow software for CPU Module with HART Daughter Module installed
SFTW-X96S-WGT	Standard Weight software for CPU Module
SFTW-X96S-WGT-H	HART Weight software for CPU Module with HART Daughter Module installed

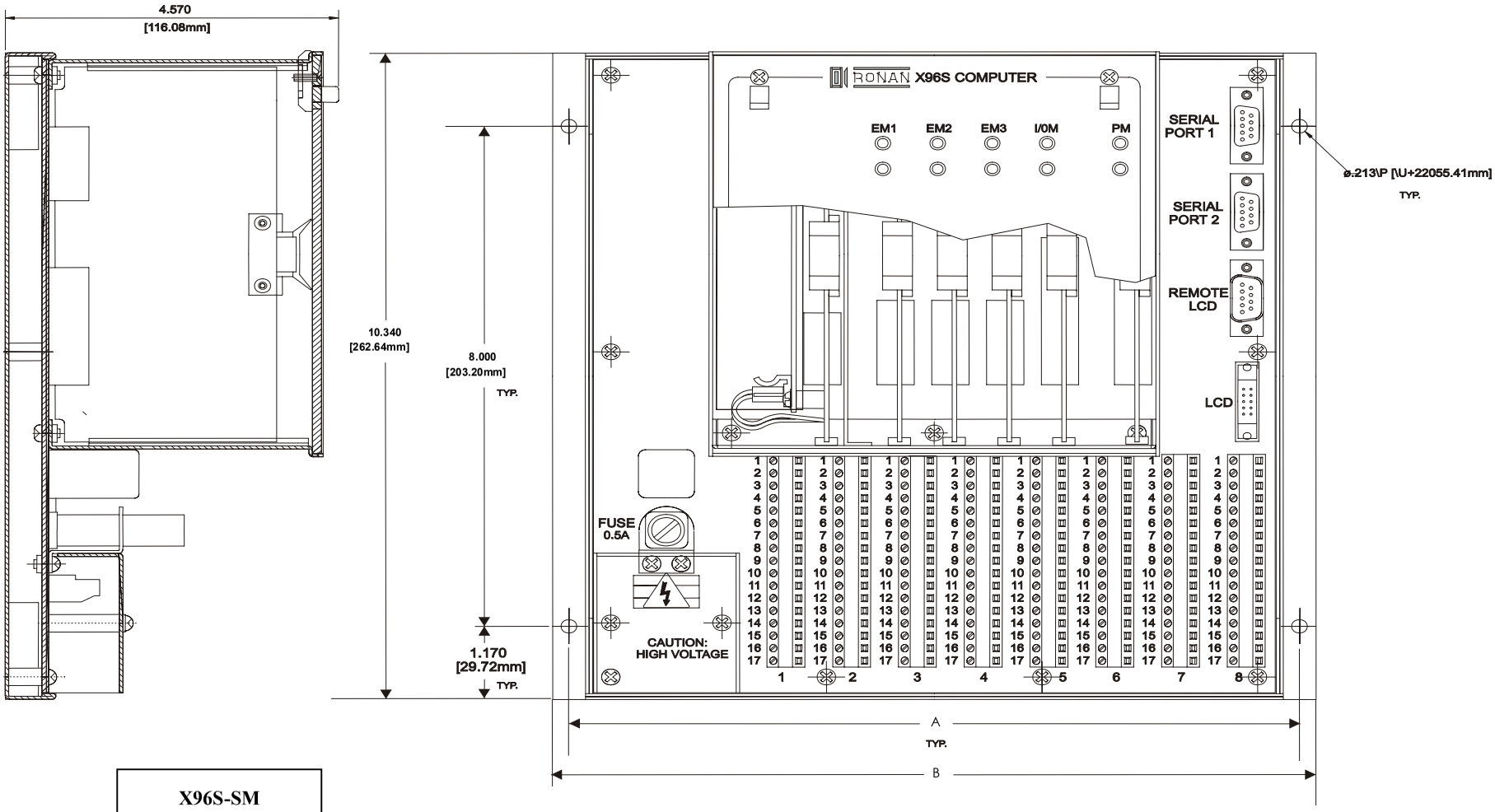
Regulations

Regulations will be supplied with Radiation Safety Manual.

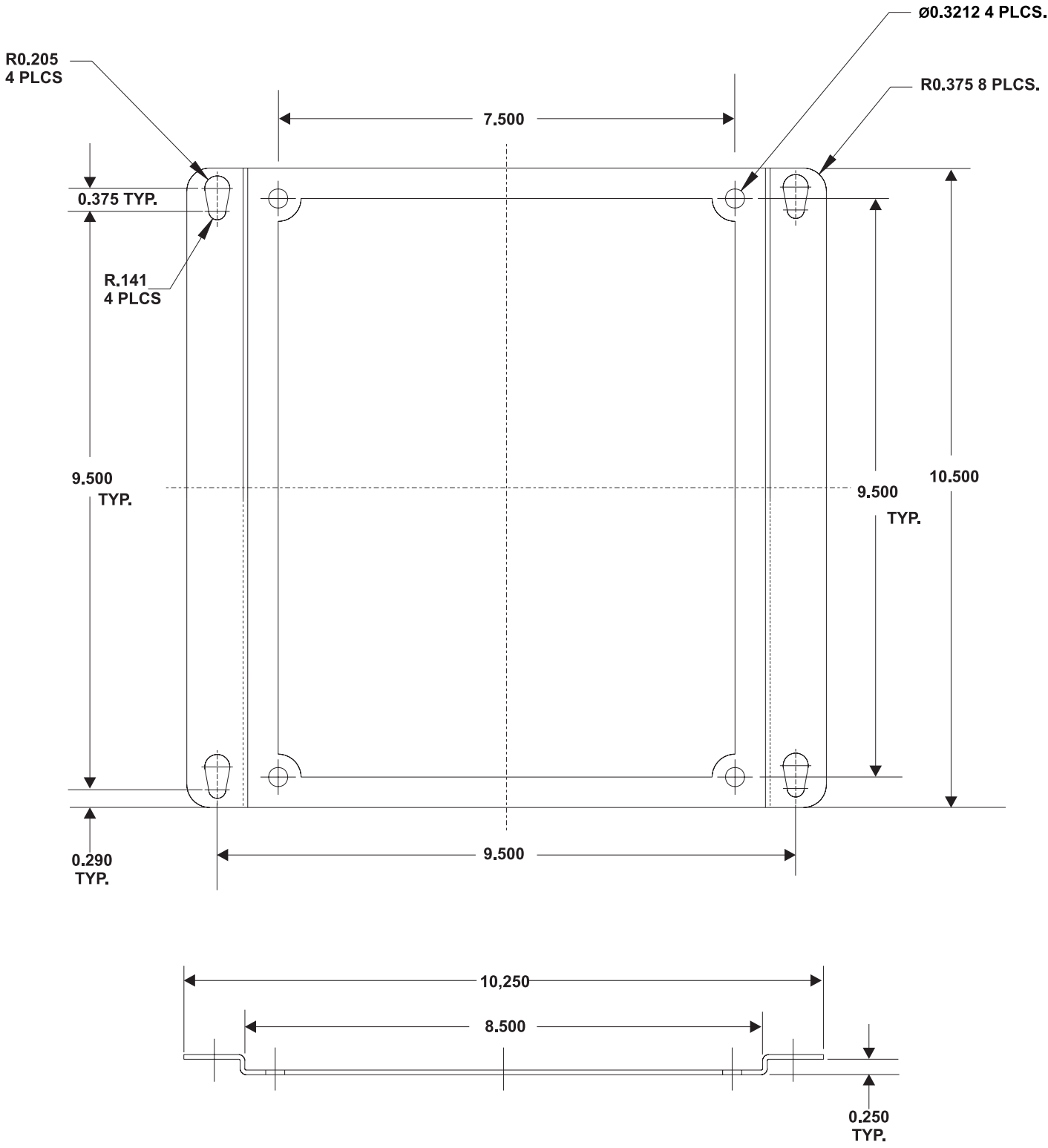
Drawings



X96-N4-1
Outline Assembly Drawing



X96S-SM Outline/Assembly Drawing



Mounting Plate

RONAN ENGINEERING COMPANY
21200 Oxnard Street
Woodland Hills, California 91367 U.S.A.
(800) 327-6626 • FAX (818) 992-6435
E-Mail: sales@ronan.com
Web Site: http//www.ronan.com

RONAN ENGINEERING COMPANY
Measurements Division
8050 Production Drive
Florence, Kentucky 41042 U.S.A.
(859) 342-8500 • (859) 342-6426
E-mail: ronan@ronanmeasure.com
Web Site: http//www.ronanmeasure.com

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