Instructions
and
Operating Manual

X96S

MOLD LEVEL GAGE

RONAN

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Basic Concepts

Communications

The Ronan X96S Mold 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 variables, parameters, device configurations, calibration, and device diagnostics to be transmitted digitally at the same time. Thus, a wealth of additional information related to plant operation is available to central control or monitoring systems through HART communications.

Variables

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

Communication Variables

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

Device Variables

The Ronan X96S Level gage has 2 device variables:

Device Variable	Value
Level	Level
Head Temp	Head Temperature

Configuration Variables

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

Theory

Theory of Radiation Gaging

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

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

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

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

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

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

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

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

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

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

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

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

Principles of Operation

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

Some of the more significant stages of signal processing are:

- Units Conversion – conversion of counts into user-selected level units
- Measurement Range – 0-10 Vdc or 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 and display ******.)

Press ⇧ 1 time to get the digit to be # one

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

Press ⇧ 1 time to get the digit to be # one

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

Press ⇧ 1 time 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 Mold Level Gage uses a tree structured menu system.

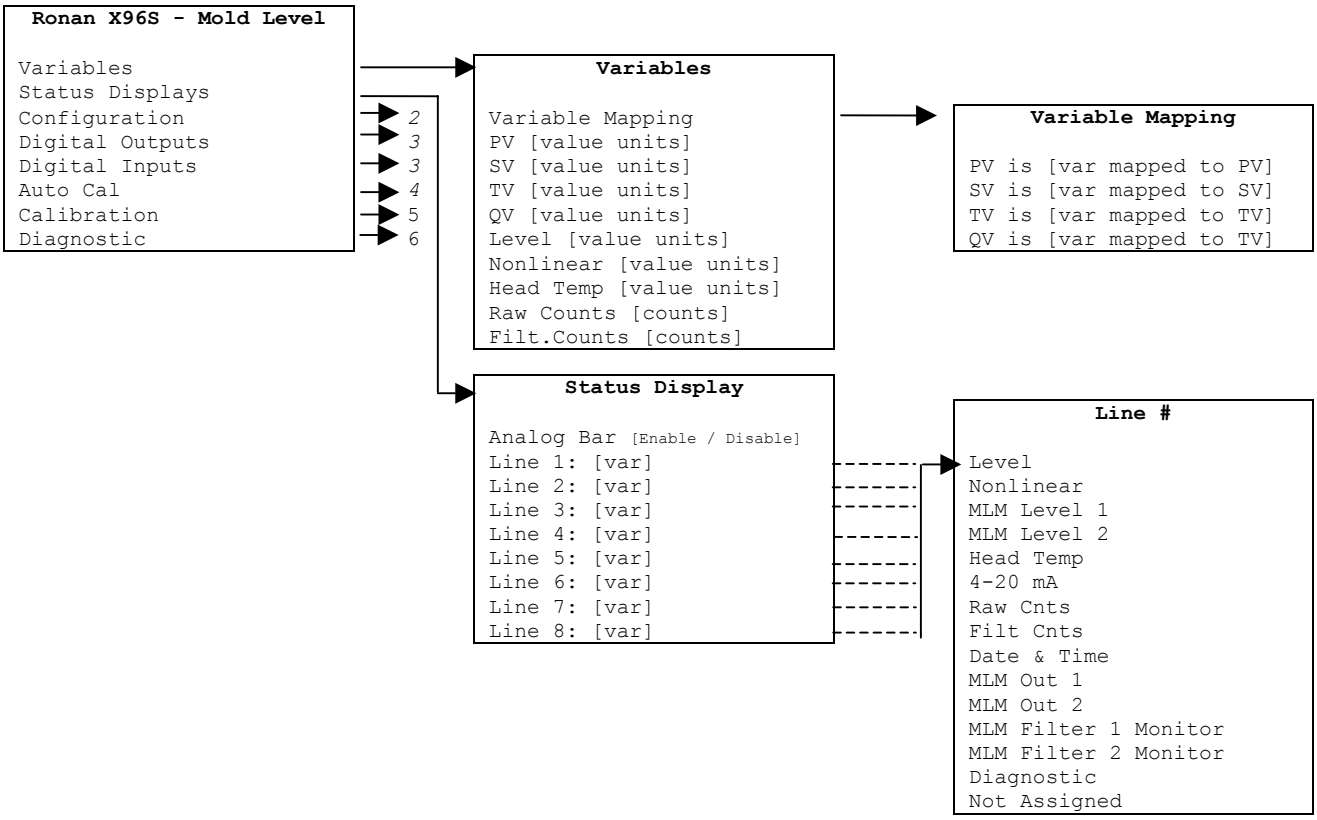


Figure 1 – Root, Variables and Display Menus

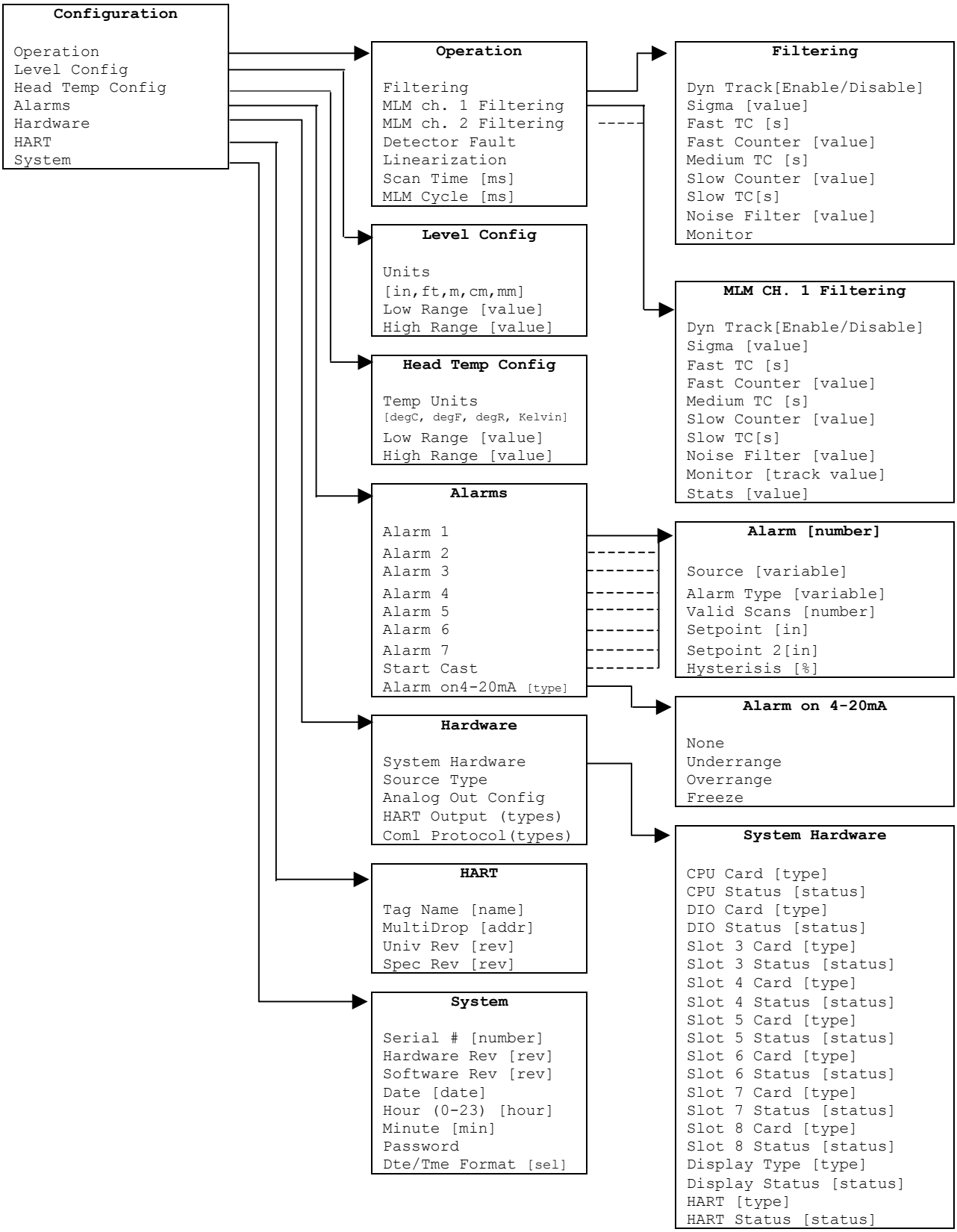


Figure 2 – Configuration Menus (1 of 2)

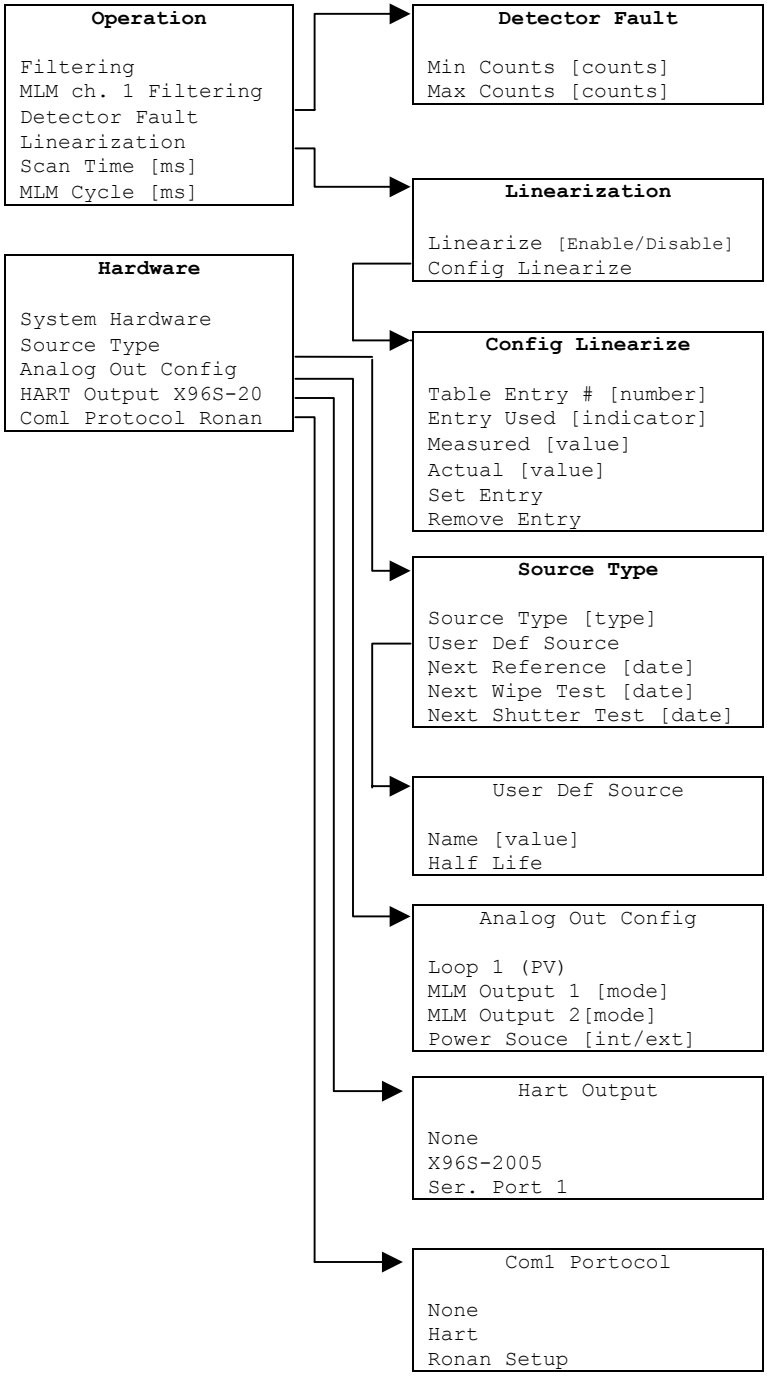


Figure 2 Configuration Menus (2 of 2)

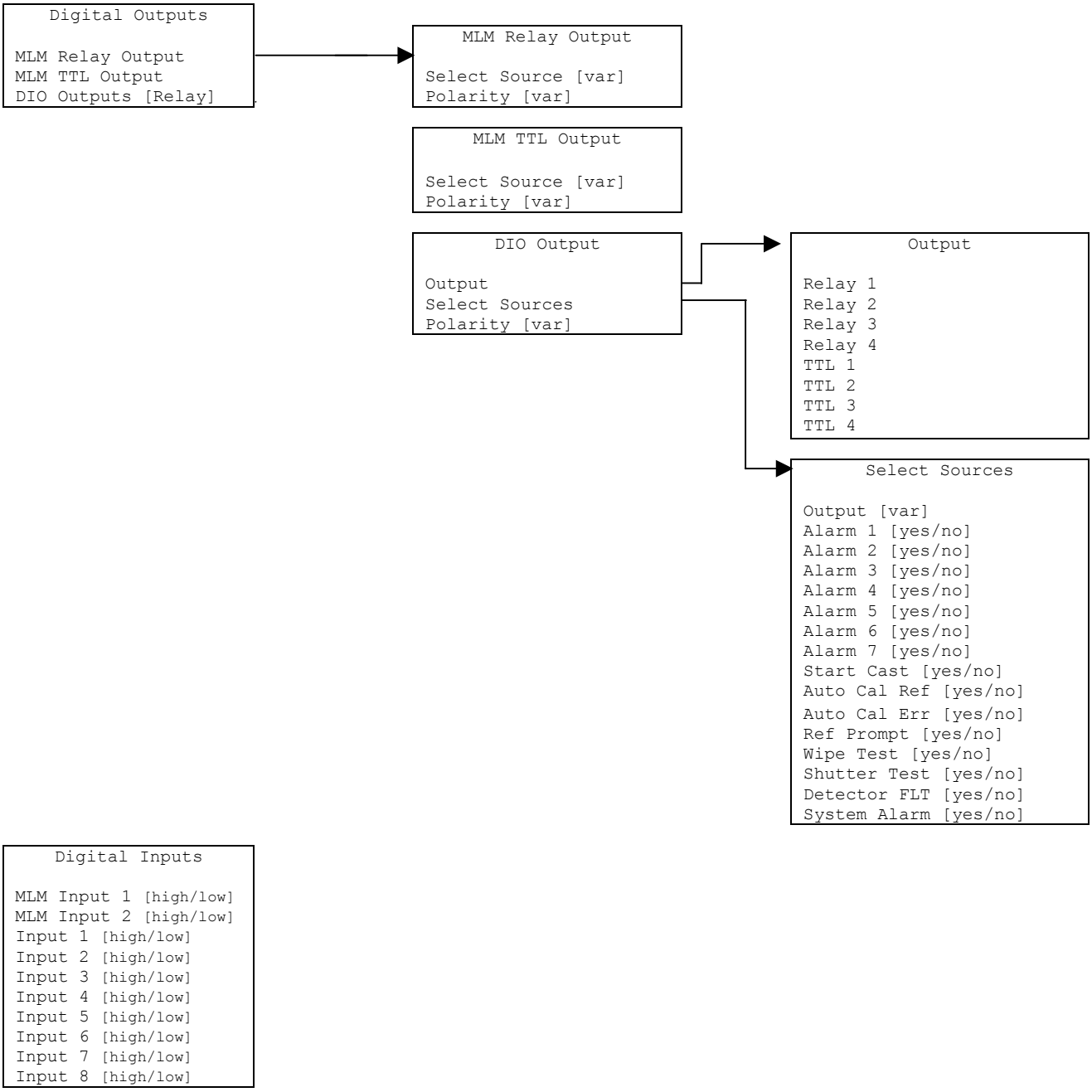


Figure 3 – Digital Output and Digital Input Menus

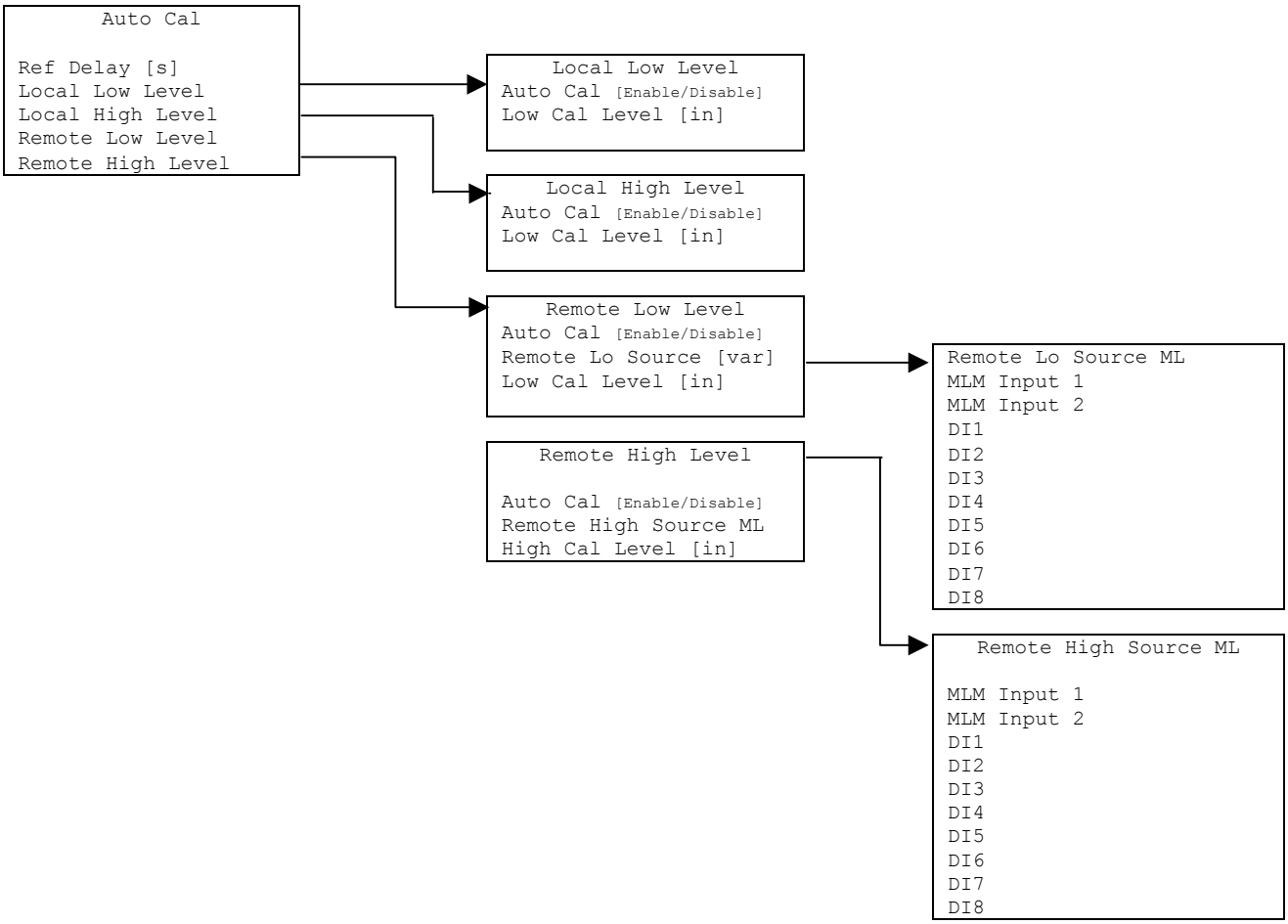


Figure 4 - Auto Cal Menus

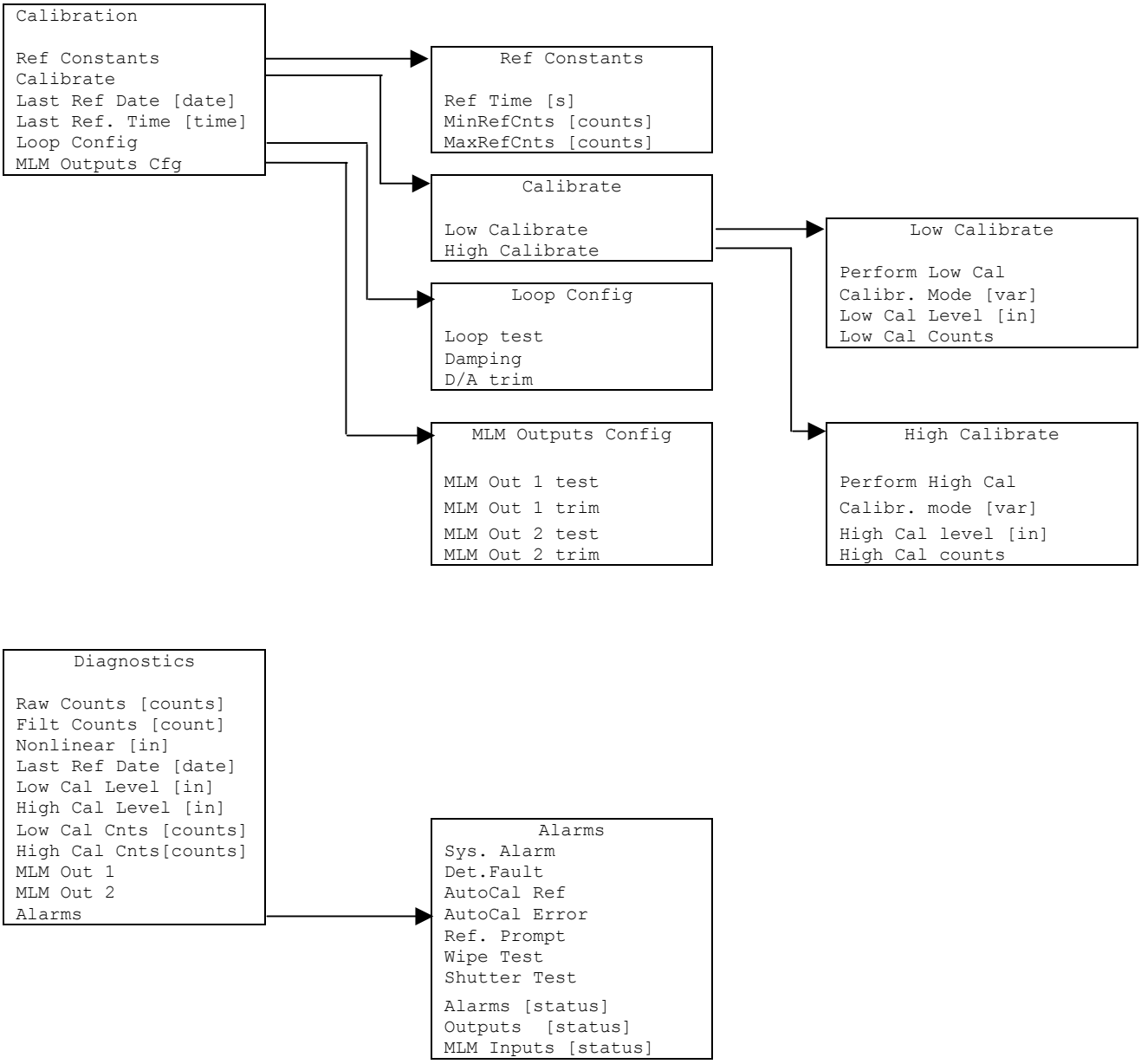


Figure 5 – Calibration & Diagnostic Menus

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

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

Variables Menu

The menu titled "Variables" contains the following items:

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

Variable Mapping Menu

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

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

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

SELECTION	MEANING
Level	Level
Head Temp	Head temperature (if available)
Not Assigned	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 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 select one of the following:

SELECTION	MEANING
Level	Level [Std. Update]
Nonlinear	Nonlinear level [no curve correction]
MLM Level 1	Level [Fast Updates]
MLM Level 2	Level [Fast Updates]
Head Temp	Head temperature [if available]
`4-20 mA`	4-20 mA output level
Raw Counts	Raw counts (from scintillation detector) or raw analog measurement (from ionization detector (non-filtered)
Filtered Counts	Filtered counts (from scintillation detector) or (from ionization detector)
Date & Time	Current date and time
MLM Out 1	Output from MLM 1
MLM Out 2	Output from MLM 2
MLM Filter 1 Monitor	Shows the current state of the filtering mechanism for MLM 1
MLM Filter 2 Monitor	Shows the current state of the filtering mechanism for MLM 2
Diagnostic	Selecting this choice 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
Level Config	Selecting this choice takes the user to the `Level Config` menu
Head Temp Config	Selecting this choice takes the user to the `Head Temp Config` menu
Alarms	Selecting this choice takes the user to the `Alarm` menu
Hardware	Selecting this choice takes the user to the `Hardware` menu
HART	Selecting this choice takes the user to the `HART` menu
System	Selecting this choice takes the user to the `System` menu

Operation Menu

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

ITEM	FUNCTION
Filtering	Selecting this choice takes the user to the `Filtering` menu
MLM ch. 1 Filtering	Selecting this choice takes the user to the MLM ch. 1 Filtering menu
MLM ch. 2 Filtering	Selecting this choice takes the user to the MLM ch. 2 Filtering menu
Detector Fault	Selecting this choice takes the user to the Detector Fault menu
Linearization	Selecting this choice takes the user to the `Linearization` menu
Scan Time	Shows the amount of time to accumulate each mold level sample and allows the user to change the time value. This scan time applies to all I/O cards except the MLM Board
MLM Cycle	Shows the amount of time to accumulate each mold level sample and allows the user to change the time value. This scan time applies to the MLM card which effects the outputs of the MLM Out 1 and MLM Out 2

Filtering Menu

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

ITEM	FUNCTION
Dyn Track	Shows the current state of the dynamic tracking filter (enabled or disabled) and allows the user to change the state
Sigma	Shows the (sigma) multiplier used to determine maximum number of raw counts variation (for scintillation) or raw analog value (for ion chamber) that the input can vary from the current filtered counts before changing to the dynamic filter. Sigma is the square root of the current filtered counts. Also allows user to change this number.
Fast TC	Fast Time Constant value to be used when the Fast Counter reaches zero
Fast Counter	Shows the fast count down counter value. If gage 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 gage is in dynamic tracking, and the raw counts continue to exceed the sigma value, the slow counter value is decreased each consecutive scan. The Slow counter value resets and returns 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 mold level value. Also allows user to change this number. Erroneous measurement is defined when the raw signal is 4 times the pre-selected sigma multiplier
Monitor	Shows the current state of the filtering mechanism

`Monitor` (filter state) one of the following:

MONITOR	MEANING
TRACK	The track will display the current status of the filter whether it is in slow, medium, or fast mode

MLM Ch. 1 & MLM Ch. 2Filtering Menu

The MLM Ch. 1 and MLM Ch. 2 `Filtering` menu is used to configure the parameters associated with the mold level measurement filter, utilizing the fast scan rate only. Both contain the following items:

ITEM	FUNCTION
Dyn Track	Shows the current state of the dynamic tracking filter (enabled or disabled) and allows the user to change the state
Sigma	Shows the (sigma) multiplier used to determine maximum number of raw counts variation (for scintillation) or raw analog value (for ion chamber) that the input can vary from the current filtered counts before changing to the dynamic filter. Sigma is the square root of the current filtered counts. Also allows user to change this number
Fast TC	Fast Time Constant value to be used when the Fast Counter reaches zero
Fast Counter	Shows the fast count down counter value. If gage 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 gage is in dynamic tracking, and the raw counts continue to exceed the sigma value, the slow counter value is decreased each consecutive scan. The Slow counter value resets and returns 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 mold level value. Also allows user to change this number. Erroneous measurement is defined when the raw signal is 4 times the pre-selected sigma multiplier
Monitor	Shows the current state of the filtering mechanism.
Stats	The stats display 3 columns: Left = slow; Center = medium; Right = fast. Each column displays the number of times per second the filter was in the slow, medium and fast TC

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.

ITEM	FUNCTION
Min Counts	Shows and allows the user to select min count value
Max Counts	Shows and allows the user to select max count value

Linearization Menu

The X96S is capable of performing a multi-point `linearization` of the mold level data when required by an application. The linearization table contains ten 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[1].

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

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:

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

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 mold 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

Mold Level Config Menu

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

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

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. This applies to alarms 1-7 as well as Start-Cast and 4-20mA alarm.

ITEM	FUNCTION
Source	Shows and allows the user to set the source of the alarm
Alarm Type	Shows and allows the user to set the alarm type
Valid Scans	Shows and allows the user to set the number of consecutive scans before signaling the alarm to trip

ITEM	FUNCTION
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

Source is one of the following:

Source	MEANING
Level	Uses the linerarized level for the source of the alarm
MLM Ch. #1 Level	Uses the MLM Ch. #1 Level for the source of the alarm
MLM Ch. #2 Level	Uses the MLM Ch. #2 Level 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

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 the source is equal to or higher than Setpoint2

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 source of power as internal or external
HART Output	Shows and allows the user to adjust the HART Output function
Com1 Protocol	Shows and allows the user to adjust the Com1 Protocols [None/HART/RonanSetup]

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

System Hardware Menu

The `System Hardware` menu takes 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
`Next Reference`	Allows the user to set the date for notification by using X96S relays
`Next Wipe Test`	Allows the user to set the date for notification by using X96S relays
`Next Shutter Test`	Allows the user to set the date for notification by using X96S relays

`Source Type` has one of the following isotopes:

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

The **`Usr Def Source`** menu is used to define the type of isotope that is not listed. It contains the following items:

ITEM	FUNCTION
`Name`	Shows and allows the user to set the isotope type (name)
`Half Life`	Shows and allows the user to set the isotope half life (number of days)

Analog Out Config

The `Analog Out Config` menu is used to set where the source of power is. It contains the following items:

ITEM	FUNCTION
`Loop 1`	Shows and allows the user to assign a source to Loop 1
`MLM Output 1`	Shows and allows the user to assign a source to MLM1
`MLM Output 2`	Shows and allows the user to assign a source to MLM 2
`Power Source`	Shows and allows the user to set where the source of power is internal or external, to power the AO modules outputs

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`	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:

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

Digital Outputs Menu

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

ITEM	FUNCTION
MLM Relay Output	Shows and allows the user to configure the MLM Relay Output
MLM TTL Output	Shows and allows the user to configure the MLM TTL Output
DIO Outputs	Shows and allows the user to configure the DIO Outputs

MLM Relay Output

This menu is used to view and configure the MLM Relay output. It contains the following items:

ITEM	FUNCTION
Select Source	Shows and allows the user to select the source type [source]
Polarity	Shows and allows the user to select No – Not driven; NC – Driven

Select Source has the following options to assign:

ITEM	MEANING
None	No alarm has been assigned
Alarm 1	Allows user to assign Alarm 1 to the selected MLM Relay Output
Alarm 2	Allows user to assign Alarm 2 to the selected MLM Relay Output
Alarm 3	Allows user to assign Alarm 3 to the selected MLM Relay Output
Alarm 4	Allows user to assign Alarm 4 to the selected MLM Relay Output
Alarm 5	Allows user to assign Alarm 5 to the selected MLM Relay Output
Alarm 6	Allows user to assign Alarm 6 to the selected MLM Relay Output
Alarm 7	Allows user to assign Alarm 7 to the selected MLM Relay Output
Start Cast	Allows user to assign Start Cast to the MLM Relay Output

Polarity has the following options to assign:

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

MLM TTL Output

This menu is used to view and configure the TTL output. It contains the following items:

ITEM	FUNCTION
Select Source	Shows and allows the user to select the source type [source]
Polarity	Shows and allows the user to select No – Not driven; NC – Driven

Select Source and **Polarity** have the same options as **MLM Relay Output**

DIO Output

This menu is used to view and configure the DIO output. It contains the following items:

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

Polarity has the following options to assign:

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

Relay and TTL Menus

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

Output (Cont'd.)

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

Select Source and **Polarity** have the same options as **Relays 1 through 4.**

Relay Menus

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

Assign one or more of ITEMs listed that will activate the relay:

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
Start Cast	Yes/no	Allows the user to assign Start Cast Alarm to the selected digital output
AutoCal Ref	Yes/no	Allows the user to assign AutoCal 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
Detector Fault	Yes/no	Allows the user to assign Detector Fault to the selected digital output
System Alarm	Yes/no	Allows the user to assign System Alarm to the selected digital output

`Polarity` is one of the following:

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

Digital Inputs Menu

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

ITEM	FUNCTION
MLM Input 1	Selecting this item takes the user to the MLM Input 1 menu
MLM Input 2	Selecting this item takes the user to the MLM Input 2 menu
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

Auto Cal

This menu is used to show/allow the user to modify the time period required at the digital input before activating a remote low level or high level calibration.

ITEM	FUNCTION
Ref Delay	Shows and allows the user to change the time for the Reference Delay
Local Low Level	Shows and allows the user to Enable or Disable and/or set the Local Low Level [0.000]
Local High Level	Shows and allows the user to Enable or Disable and/or set the Local High Level [6.000]
Remote Low Level	Shows and allows the user to select the Remote Low Level
Remote High Level	Shows and allows the user to select the Remote High Level

Calibration Menu

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

ITEM	FUNCTION
Ref Constants	Selecting this item takes the user to the Ref Constants menu
Calibrate	Selecting this item takes the user to the Calibrate menu
Last Ref Date	Shows the date on which the gage was most recently Low Referenced
Last Ref Time	Shows the time when the gate was most recently Low Referenced
Loop Config	Selecting this item takes the user to the Loop Config menu
MLM Outputs Cfg	Selecting this item takes the user to the MLM Outputs Cfg menu

Ref Constants Menu

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

ITEM	FUNCTION
Ref Time	Shows and allows the user to set the number of seconds of data to collect for a reference or calibrate sample
MinRefCnts	Shows and allows the user to set the minimum raw value to use for a reference or calibrate sample
MaxRefCnts	Shows and allows the user to set the maximum raw value to use for the high range calibrate sample

Calibrate Menu

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

ITEM	FUNCTION
`Low Calibrate`	Selecting this item takes the user to the `Low Calibrate` menu
`High Calibrate`	Selecting this item takes the user to the `High Calibrate` menu

Low Calibrate Menu

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

ITEM	FUNCTION
`Perform Low Cal`	This item invokes a method that performs the low calibrate procedure
`Calibr. Mode`	This allows the user to select the method of calibration (empty mold/process/absorber)
`Low Cal Level`	Shows and allows the user to set the low cal level value
`Low Cal Counts`	Shows the raw captured counts for the low calibration

High Calibrate Menu

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

ITEM	FUNCTION
`Perform High Cal`	This item invokes a method that performs the high calibrate procedure
`Calibr. Mode`	This allows the user to select the method of calibration (empty mold/process/absorber)
`High Cal Level`	Shows and allows the user to set the high cal level value
`High Cal Counts`	Shows the raw captured counts for the 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

MLM Outputs Cfg Menu

This menu is used to access the MLM Outputs configuration. It contains the following items:

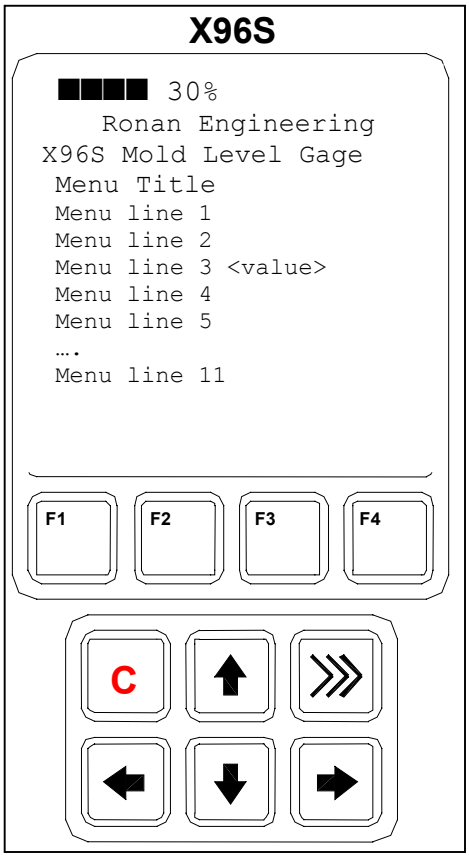
ITEM	FUNCTION
`MLM Out 1 Test`	This item invokes a method that performs a test on the primary 4-20mA (or 0-10 volt MLM Out 1) loop
`MLM Out 1 Trim`	This item invokes a method that performs the D/A trimming of the MLM1 4-20mA (or 0 – 10 volts) loop
`MLM Out 2 Test`	This item invokes a method that performs a test on the primary 4-20mA (or 0-10 volt MLM Out 2) loop
`MLM Out 2 Trim`	This item invokes a method that performs the D/A trimming of the MLM2 4-20mA (or 0 – 10 volts) loop

DIAGNOSTICS

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

ITEM	MEANING
Raw Counts	Non-filtered counts from the detector
Filtered Counts	X96S filtered counts from the detector
Nonlinear	Shows the current state of the mold level (No curve correction used)
Last Ref. Date	Shows the date the last low calibrate was performed
Low Cal Level	Shows the current value of the low cal level variable
High Cal Level	Shows the current value of the high cal level variable
Low Cal Cnts	Shows the raw captured counts for the low calibration
High Cal Cnts	Shows the raw captured counts for the high calibration
MLM Out 1	Shows the current output from MLM 1
MLM Out 2	Shows the current output from MLM 2
Alarms	Information available for troubleshooting the alarms

X96S Local Display



The X96S Local Display consists of 8 lines by 21-character display and a 10 key keypad. The top line of the display is reserved for the analog bar, if enabled. The next line is used for the Ronan logo. Line #3 shows the device model line. Line #4 displays the specific screen title. That title is typically a screen description or required action. The remainder of lines, with the exception of the last line, are 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 275 Configurator's user interface.

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

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

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

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

Editing Values

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

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

Editing Fixed Point Numbers

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

Editing Floating Point Numbers

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

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

Editing Text Strings

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

Editing Enumerated Values

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

X96S Local Display Vs 275 Calibrator

The local display user interface is very similar to the 275 Calibrator, but there are some differences. One of the major ones is the fact that the 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 275 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 Gage 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 gage 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 gage. DO NOT proceed with unpacking, storage, or installation without the RSO's authorization.

General License

(RLL Source Holder)

If your gage 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

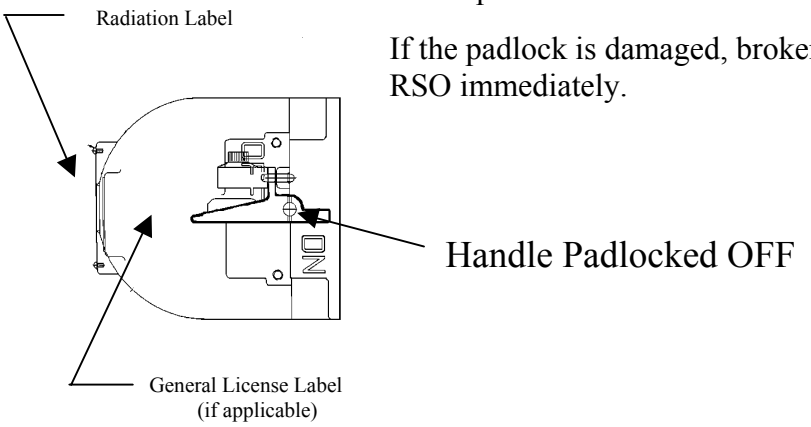
If it is necessary to store this equipment before mounting, the RSO or responsible party will assign a safe and secure location with no personnel access.

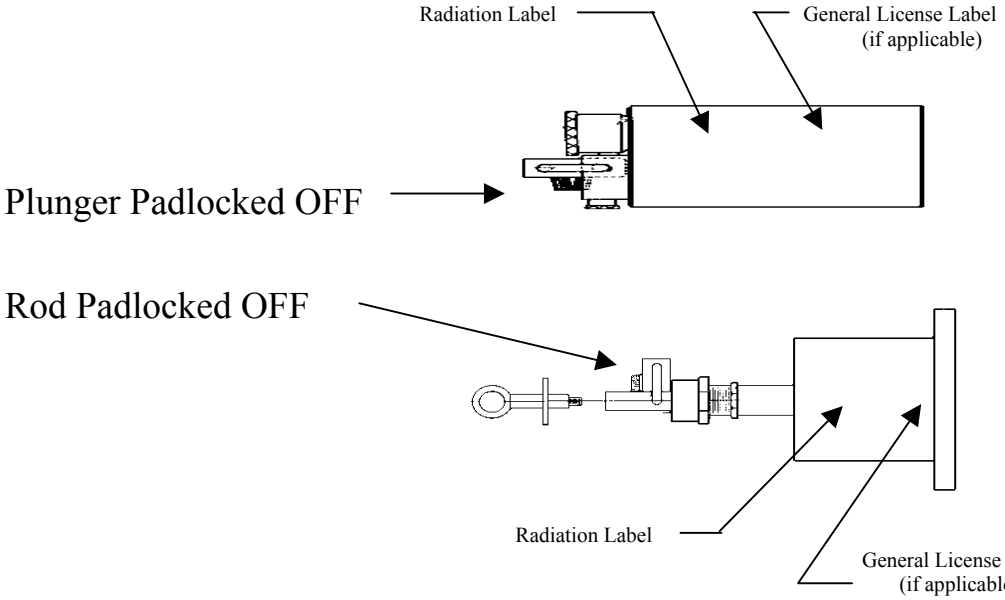
During storage avoid temperatures below freezing, and areas with excessive humidity, moisture, or dirt.

Inspection

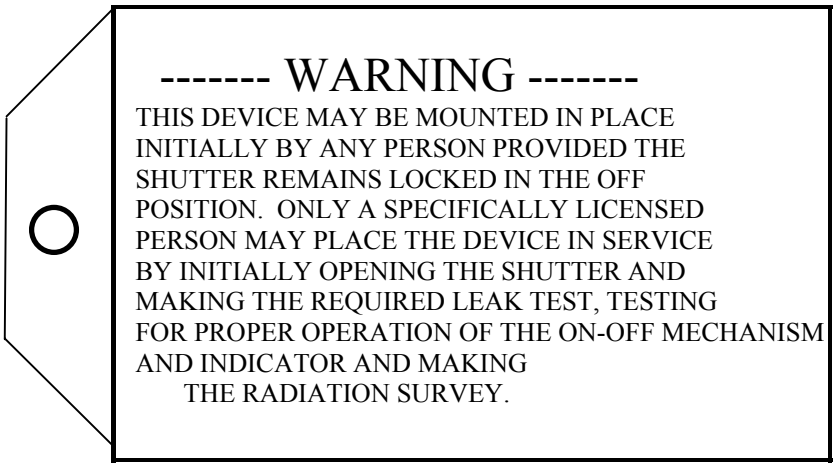
The source holder is equipped with an ON/OFF mechanism. During shipment and storage the mechanism MUST BE SECURED in the OFF position with a padlock.

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

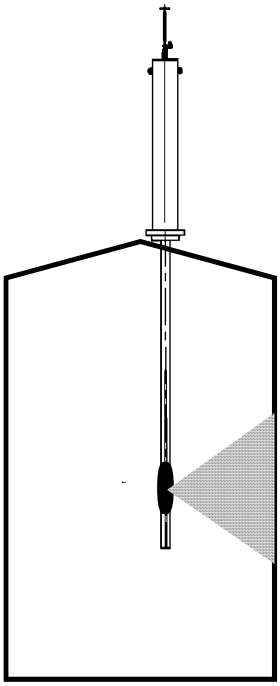




Lock Tag



Safety Precautions



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

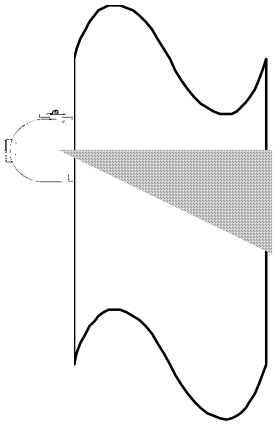
The source holder must remain padlocked in the OFF position until installation is complete.

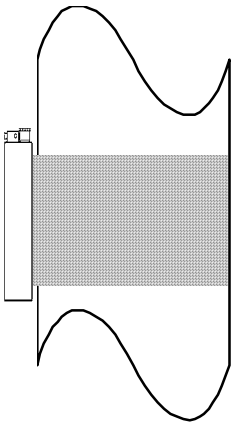
Take all necessary precautions to assure that the source holder is not dropped or damaged.

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

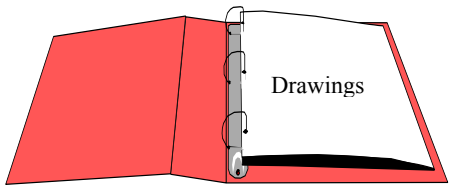
Always turn the source holder to the OFF position when working around it, the detector, or the area between these two components which is referred to as the "measuring gap."

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





Mechanical Mounting



Drawings:
Configuration
Installation

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

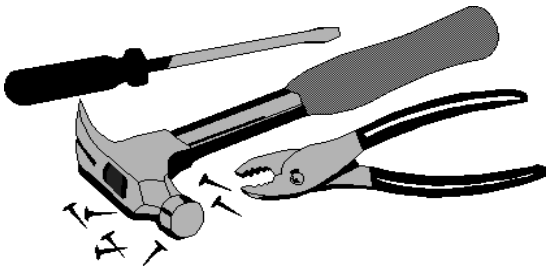
Please reference the dimensional drawings located in the Drawing Chapter of this manual when installing the equipment.

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

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

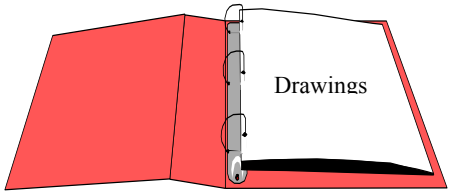
The source and detector must be rigidly mounted so they do not move with respect to each other. Such movement will destroy the system's calibration and/or its measurement.

Insulation must be used at the point of installation IF:
- the temperature of the vessel at that spot exceeds 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

DO NOT APPLY POWER until wiring is carefully checked.

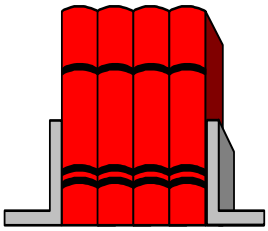


Drawings:
Interconnect

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

Follow local and national electrical codes for all interconnections.

Consider the following guidelines before making any electrical connections:



LOCAL CODE
NATIONAL CODE

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

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

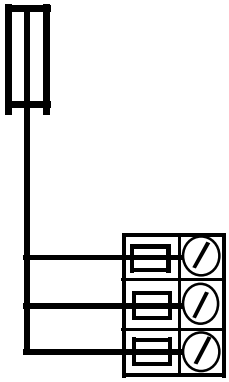
Run the interconnect cable in a separate conduit. Feed the cable through the conduit starting at the detector end and terminate at the microprocessor end.

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

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

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

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



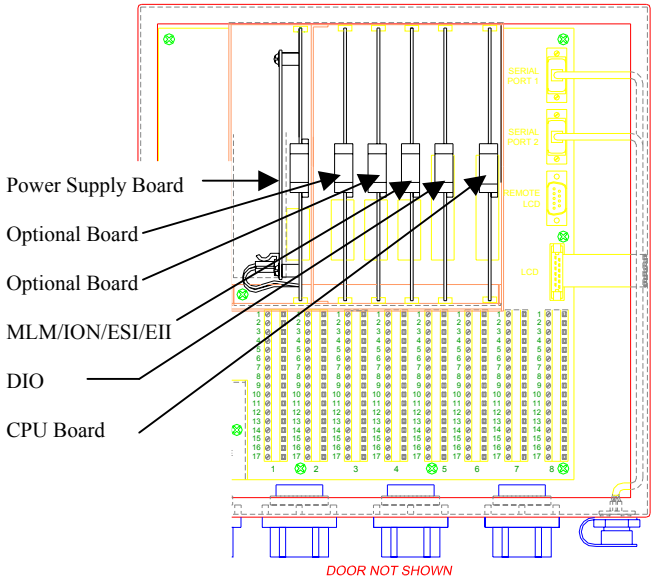
POWER INPUT

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

Microprocessor Verification

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

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

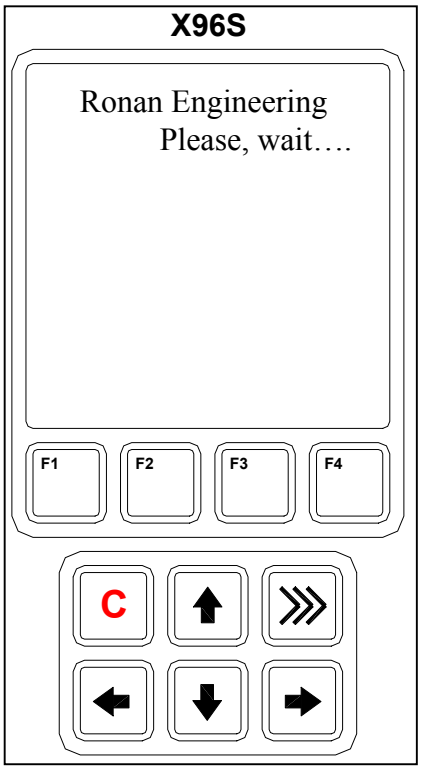


MLM - Mold Level Module
ESI – Electronic Scintillator Input
EII – Electronic Ion Input
DIO – Digital Input/Output
CPU – Central Processing Unit

Identification / Documentation

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

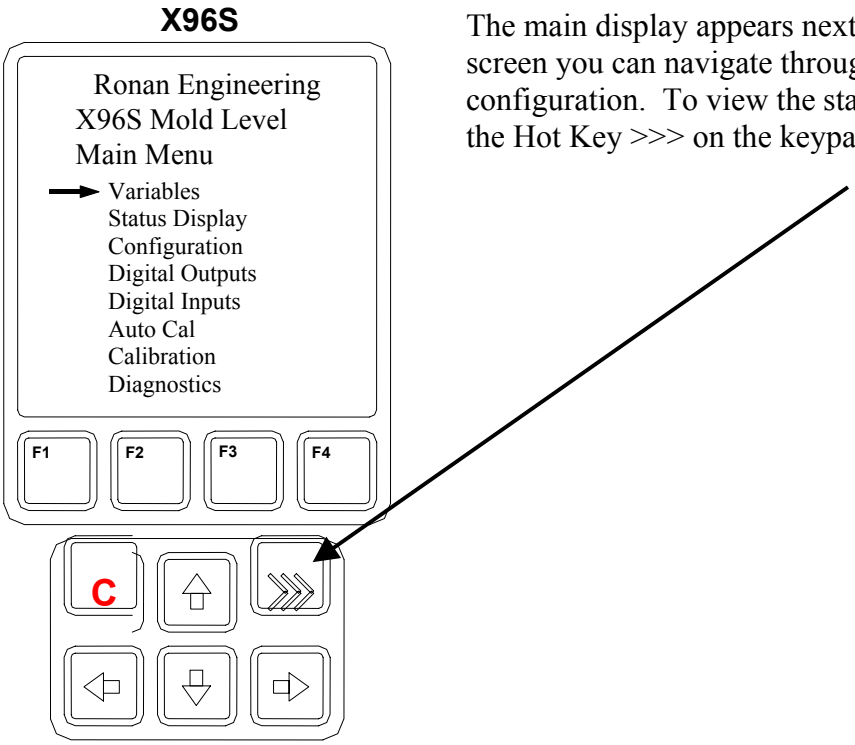
Power-up



Before applying power, ensure all boards are fully seated in the 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.



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

Password

Notice:

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

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

Step 2: Press F3 to go back.

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

Press ⇧ to get the digit to be # one

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

Press ⇧ to get the digit to be # one

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

Press ⇧ to get the digit to be # one

Press F4 (enter)

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

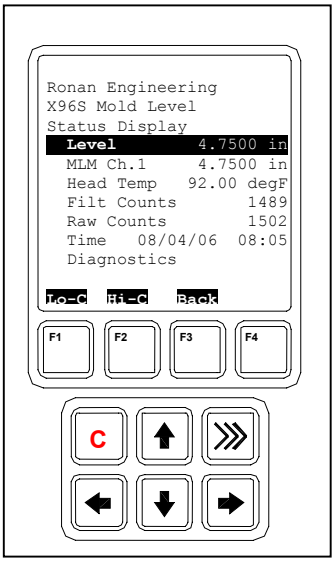
Note: For security reasons, each digit will always be displayed as an asterisk.

Calibration

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

Step 1 Start at the Status Display

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

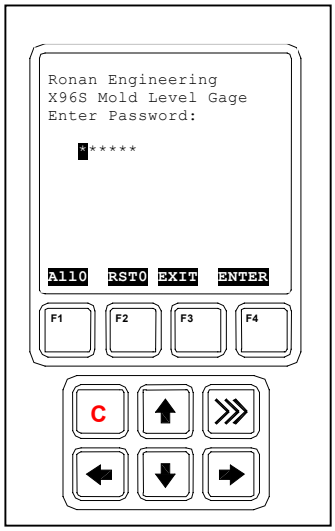


Step 2 Password Menu

With the left most 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 *.



Step 3 Low Calibration

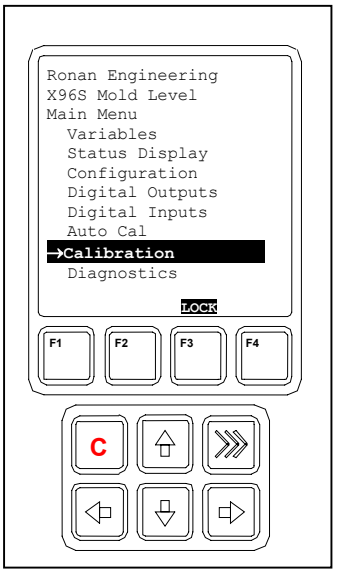
(**Have the mold empty with mold water and oscillator running**)

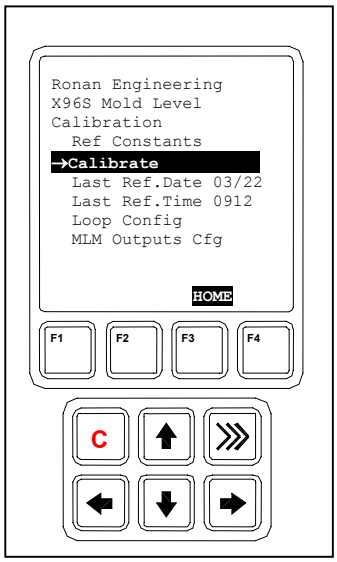
Scroll down ↓ to “Calibration” Press the **Enter Key** →
Scroll down ↓ to “Calibrate” Press the **Enter Key** →
Scroll down ↓ to “**Low Calibrate**” Press the **Enter Key** →
Select “**Perform Low Cal**” press the **Enter Key** →

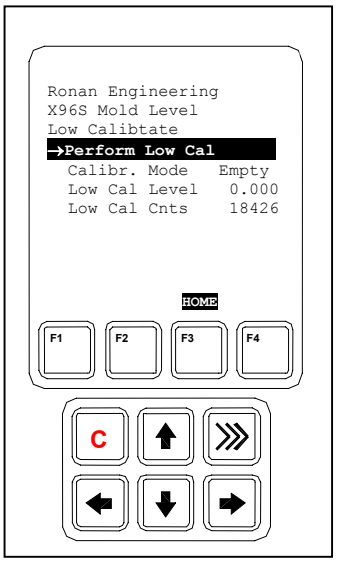
Read the next screen carefully and acknowledge the screen by pressing the **F4 Key.** Wait until you see the counter reach 0. Acknowledge the Low Counts = XXXX by pressing the F4 Key.

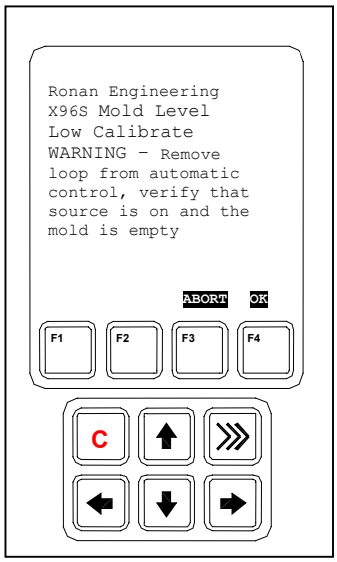
Scroll down ↓ to “Low Cal Level” Press the **Enter Key** →
Notice the value that is displayed.
Use ← **Key** and → **Key** to toggle back and forth between digits.
Change the value using ↑ or ↓
Enter the value of the process (Example 0.0000 inches for Empty Mold).
Press the **F4 Key** to enter and store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

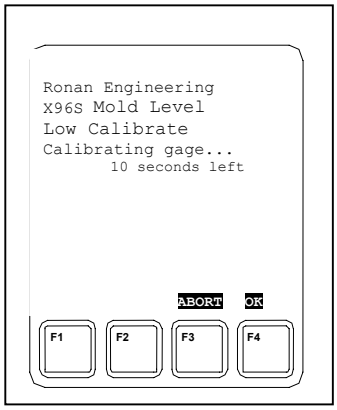
Press **F3 Key (Home)** to get back to the Main Menu.
Press **F3 Key (Lock)** to get back to the Status Display.

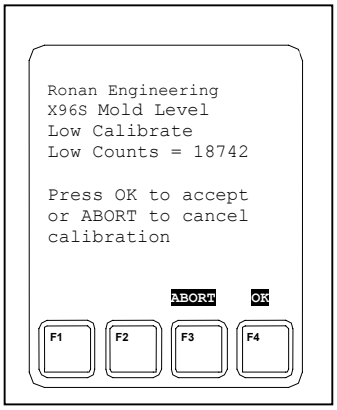


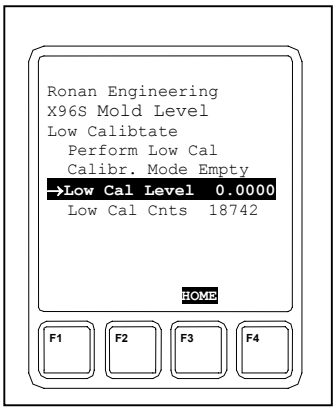


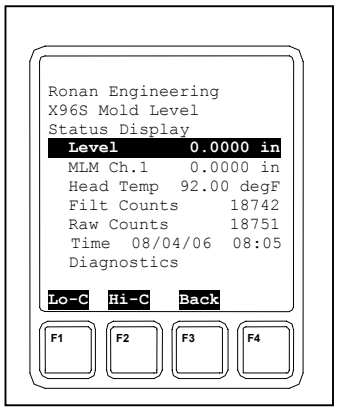












Step 4 High Calibration

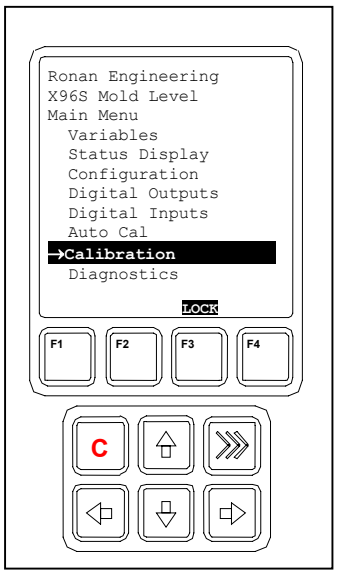
(Insert a test block into the mold covering the full range of measurement)

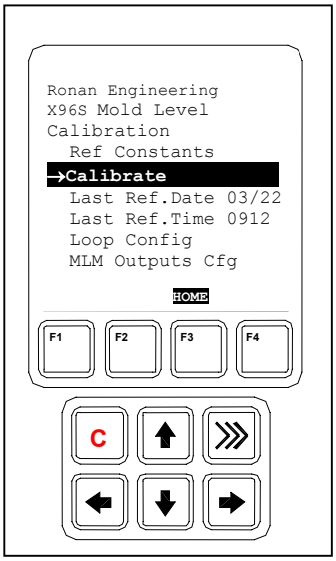
Scroll down ↓ to “Calibration” Press the **Enter Key** →
Scroll down ↓ to “Calibrate” Press the **Enter Key** →
Scroll down ↓ to “**High Calibrate**” Press the **Enter Key** →
Select “**Perform High Cal**” press the **Enter Key** →

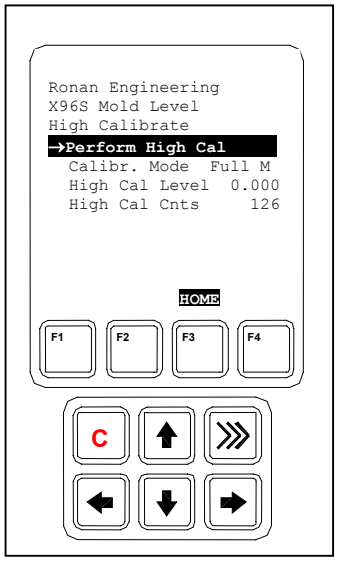
Read the next screen carefully and acknowledge the screen by pressing the **F4 Key.** Wait until you see the counter reaches 0. Acknowledge the High Counts= XXXX by pressing the F4 key.

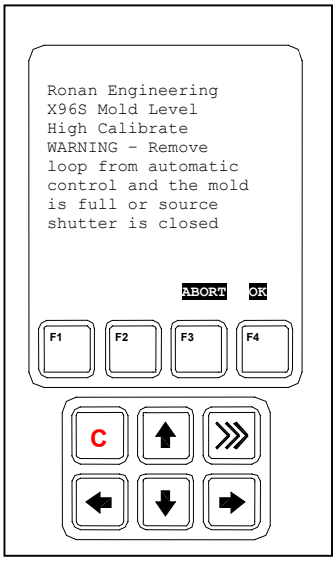
Scroll down ↓ to “High Cal Level” Press the **Enter Key** →
Notice the value that is displayed.
Use ← **Key** and → **Key** to toggle back and forth between digits.
Change the value using ↑ or ↓
Enter the value for the Full level (Example 6.0000 inches.).
Press The **F4 Key** to enter and store the value.

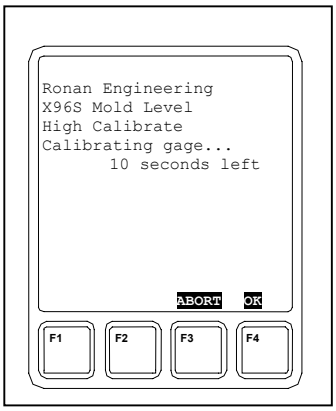
Press **F3 Key (Home)** to get back to the Main Menu.
Press **F3 Key (Lock)** to get back to the Status Display.

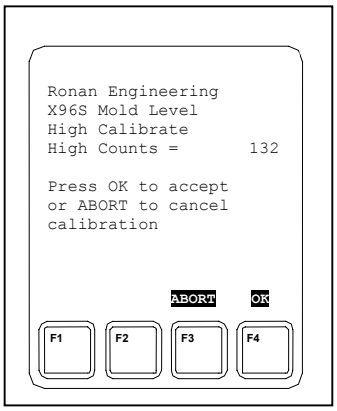


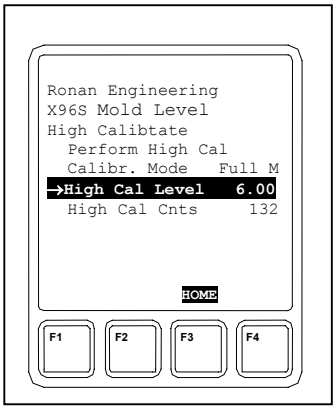


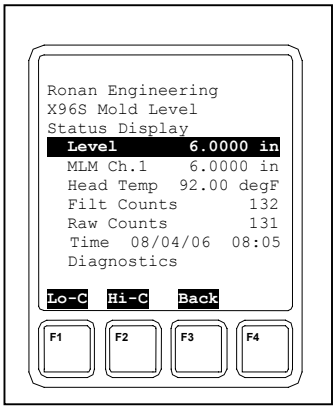












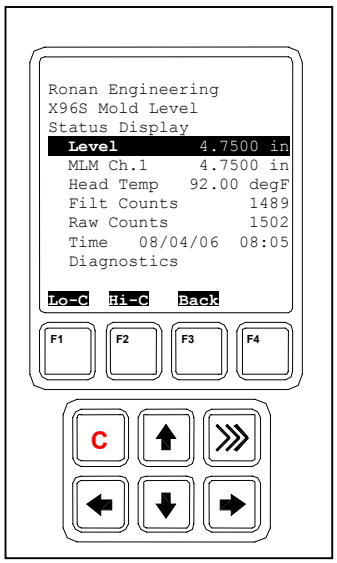
Step 1 Low Calibration using the Local Auto Cal Feature

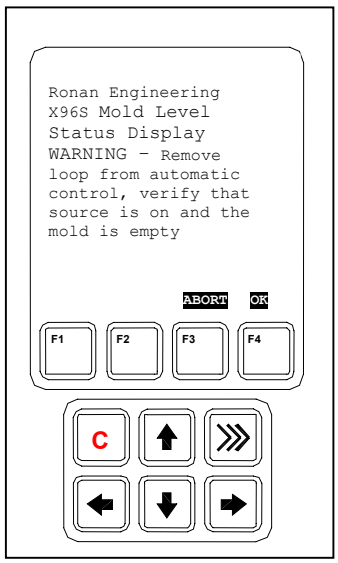
(**Have the mold empty with mold water and oscillator running**)

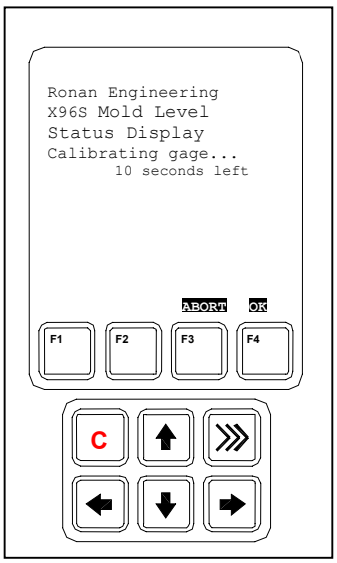
Press **F1 Key (Lo-C)** to perform an Auto Low calibration.

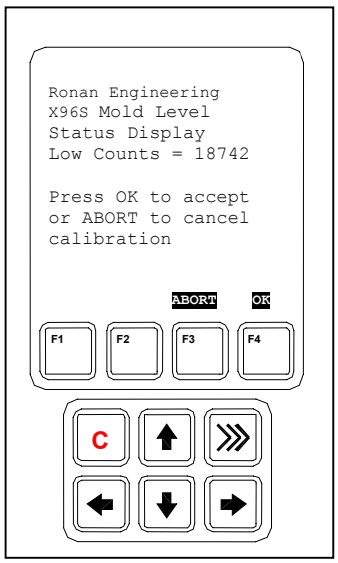
Read the next screen carefully and acknowledge the screen by pressing the **F4 Key.** Wait until you see the counter reach 0.

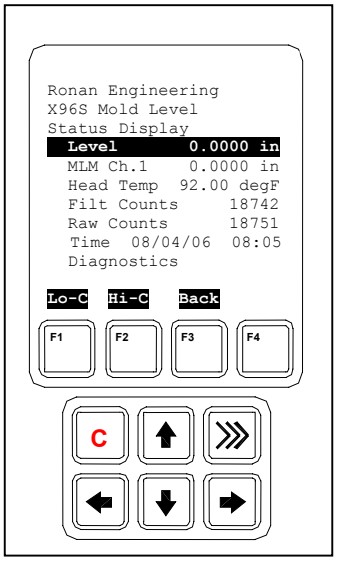
Acknowledge the Low Counts = XXXX by pressing the **F4 Key**.











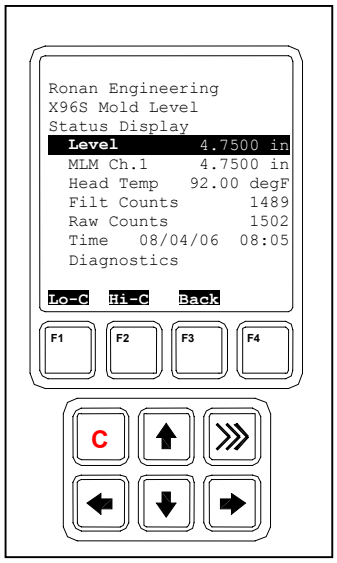
Step 2 High Calibration using the Local Auto-Cal Feature

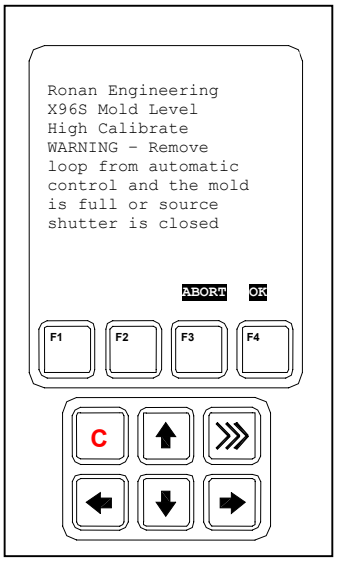
(Insert a test block into the mold covering the full range of measurement)

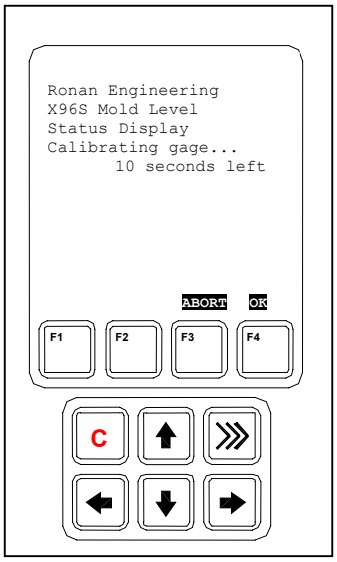
Press **F2 Key (Hi-C)** to perform an Auto High calibration.

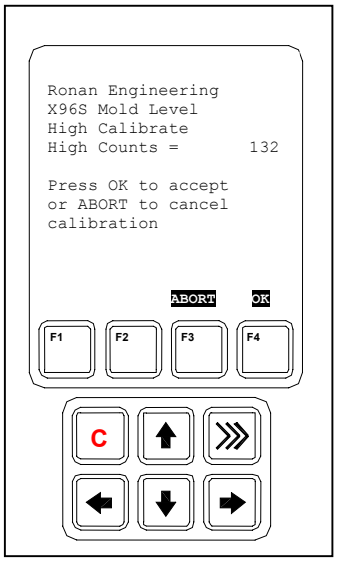
Read the next screen carefully and acknowledge the screen by pressing the **F4 Key.** Wait until you see the counter reaches 0.

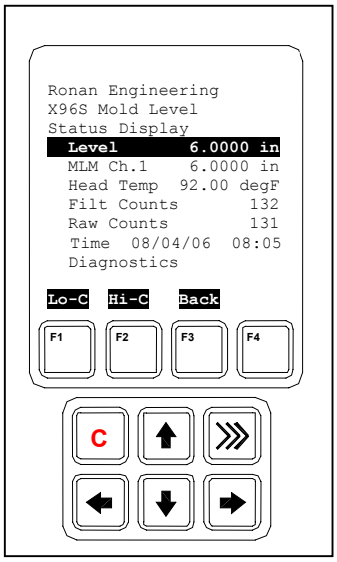
Acknowledge the High Counts = XXXX by pressing the **F4 Key**









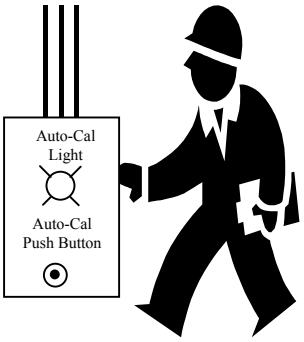


Step 1 Low Calibration using the Remote Auto Cal Feature

(**Have the mold empty with mold water and oscillator running**)

Locate the Remote Low Auto-Cal pushbutton and the Auto-Calibration indication. Hold the pushbutton for 3 to 5 seconds until the Auto-Calibration indication turns on. Continued to run the mold in the empty condition until the Auto-Reference indication turns off.

X96S Mold Level output should indicate zero (example: 4.00 mA or 0 Vdc). If not, repeat steps 1 & 2 again.



Step 2 High Calibration using the Remote Auto Cal Feature

(**Insert the test block into them mold covering the full range of the measurement**)

Locate the High Auto-Calibrate pushbutton and the Auto-Calibrate indication. Hold pushbutton for 3 to 5 seconds until the Auto-Calibrate indication turns on. Continued to hold the test-block in front of the mold until the Auto-Calibrate indication turns off.

X96S Mold Level output should indicate full (example: 20.00 mA or 10.00 Vdc). If not repeat steps 1 & 2 again.

Documentation

For future calibrations, document these items:

(a) Environmental/process conditions that influence the low calibrate / high calibrate. 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 filtering values, calibrations values, detector counts, etc.

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

Configuration

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

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

- Check the factory-default settings to be sure they are appropriate for your circumstances. IF NOT, make the necessary changes and document those changes for future reference.
- Perform an initial calibration to correlate the X96S's output to the actual mold level
- Document the detector counts during the low calibration and the high calibration. Document the actual level during the low calibration and the high calibration. Note if the mold water was running and if the oscillator was running. 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 or NaI (sodium iodine) crystal, the photomultiplier tube (PMT), and the associated electronics.

Scintillation Crystal

The crystal used for the Continuous Mold Level Monitor System is either NaI (sodium iodine) or 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

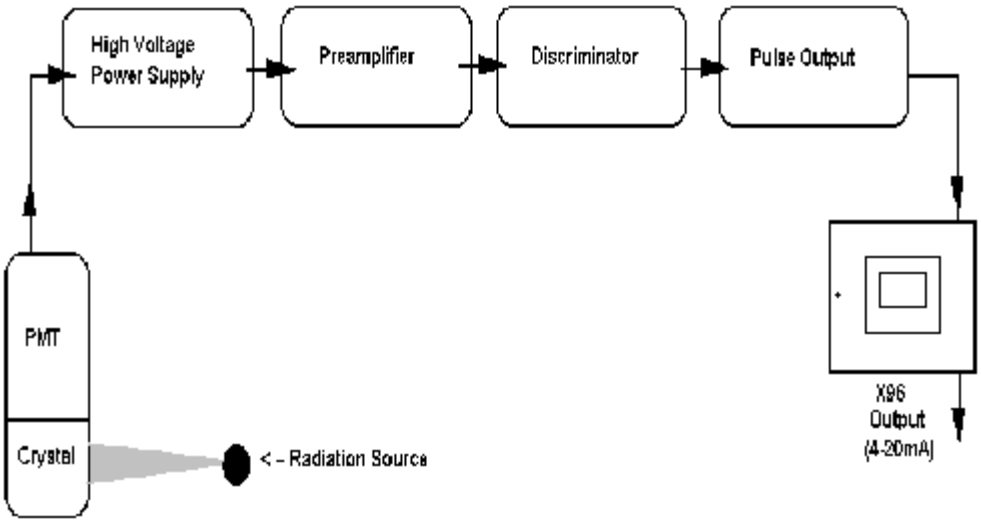
The PMT is a light sensitive vacuum tube with a photosensitive layer that converts the light pulses to an electrical current. Light pulses from the crystal strike the photosensitive layer and release electrons. A high voltage power supply connected to the photosensitive layer accelerates the electrons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

Four boards, 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 level (or density) 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.

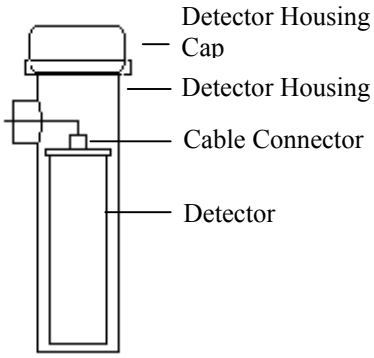
Servicing the Detector

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."

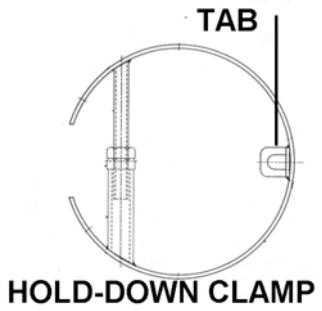
However, a qualified technician can troubleshoot and service the detector's amplifier assembly. Instructions follow for that procedure as well. Some precautions are needed when handling the detector/amplifier assembly.

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



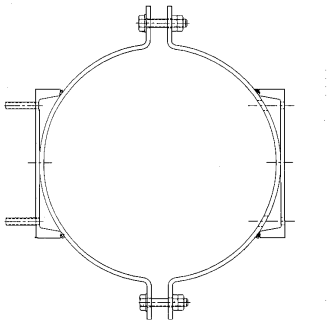
1) Check NOTES below for illustrations and cautions that apply to your specific equipment.
2) Unscrew cap on detector housing.
3) Unscrew connector on top of detector.
4) Remove detector from housing.
5) Carefully install replacement detector in housing.
6) Screw connector back onto detector.
7) Immediately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



ELONGATED DETECTOR NOTES:

To avoid damage in shipment or installation, the elongated detector is 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 the 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 the detector assembly into housing.



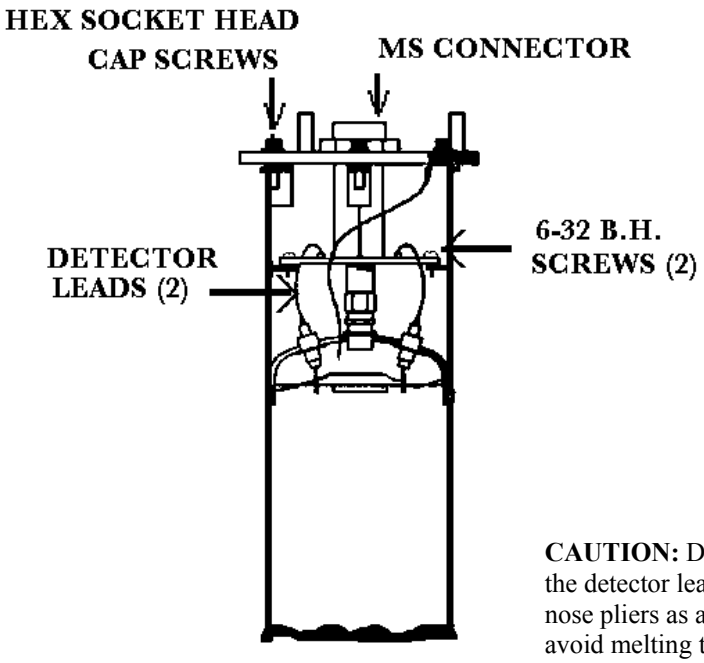
DETECTOR HOUSING/ BRACKET ASSEMBLY NOTES:

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

Removing the Detector Amplifier Circuit Board (CBAY-6102)

Follow this procedure to remove the electrometer amplifier circuit board:

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



2. Remove the MS connector from the amplifier cover.

3. Remove the two 6-32 binding head screws, which secure the amplifier board to the detector.

4. Using a low power (60W) iron unsolder the detector leads to the printed circuit board standoffs.

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

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.

Replacing the Detector Circuit Board/Connector Assembly

Reference:
B-6102-K

If installing a new electrometer amplifier board, refer to drawing B-6102-K for internal connector wiring and connections to the detectors.

Be sure the detector leads are straightened to clear the holes in the new circuit board.

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 glyptal on the hex socket head screws, replace the amplifier cover.

Electronics

X96-2001PL

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, 0-5 volt on both channels

X96-2003-03PL

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

X96-2003-04PL

X96-2003-04PL is the PCB assembly, analog input, 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. 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[2] or live[3] contact monitoring,
- quadrature encoder[4], or
- pulse counter.

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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.

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.

X96-2009PL1

X96-2009PL1 is the Scintiallation 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[7].

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

X96C148 is the 85 to 230 Volt power supply module

X96C148-2

X96C148-2 is the 24 Volt DC power supply module

X96C148-4

X96C-148-4 is the 12 V DC "in", 24 V DC "out" 50 watt power supply module

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[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
X96C143-1	LCD Display Assembly "Local" for X96S
X96C143-2	LCD Display Assembly "Remote" for X96S
X96C429-1	"**NEW**" LCD Display Assembly "Local" for X96S

X96S Electronic Module Part Numbers

PART NUMBER	DESCRIPTION
X96-2001PL	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 0-10 Vdc input instead of RTD
X96-2029PL	PCB Board, Mold Level, Input/Output for Scintillation
X96C148	X96S 85V to 230V Power Supply Module
X96C148-2	X96S 24 V DC Power Supply Module
X96C-148-4	X96S 12V DC "in", 24 V DC "out", 50 watt Power Supply Module

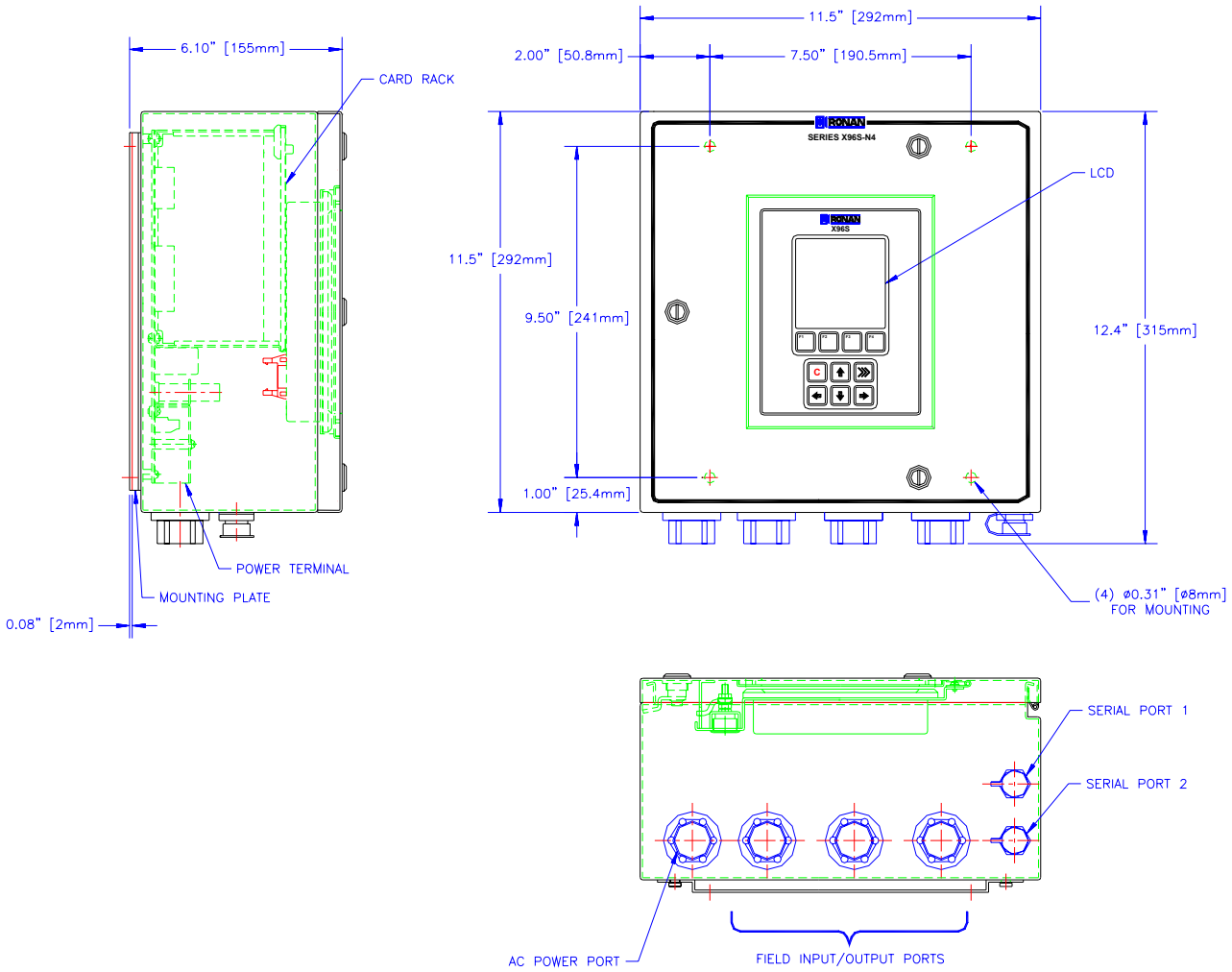
SPECIFICATIONS

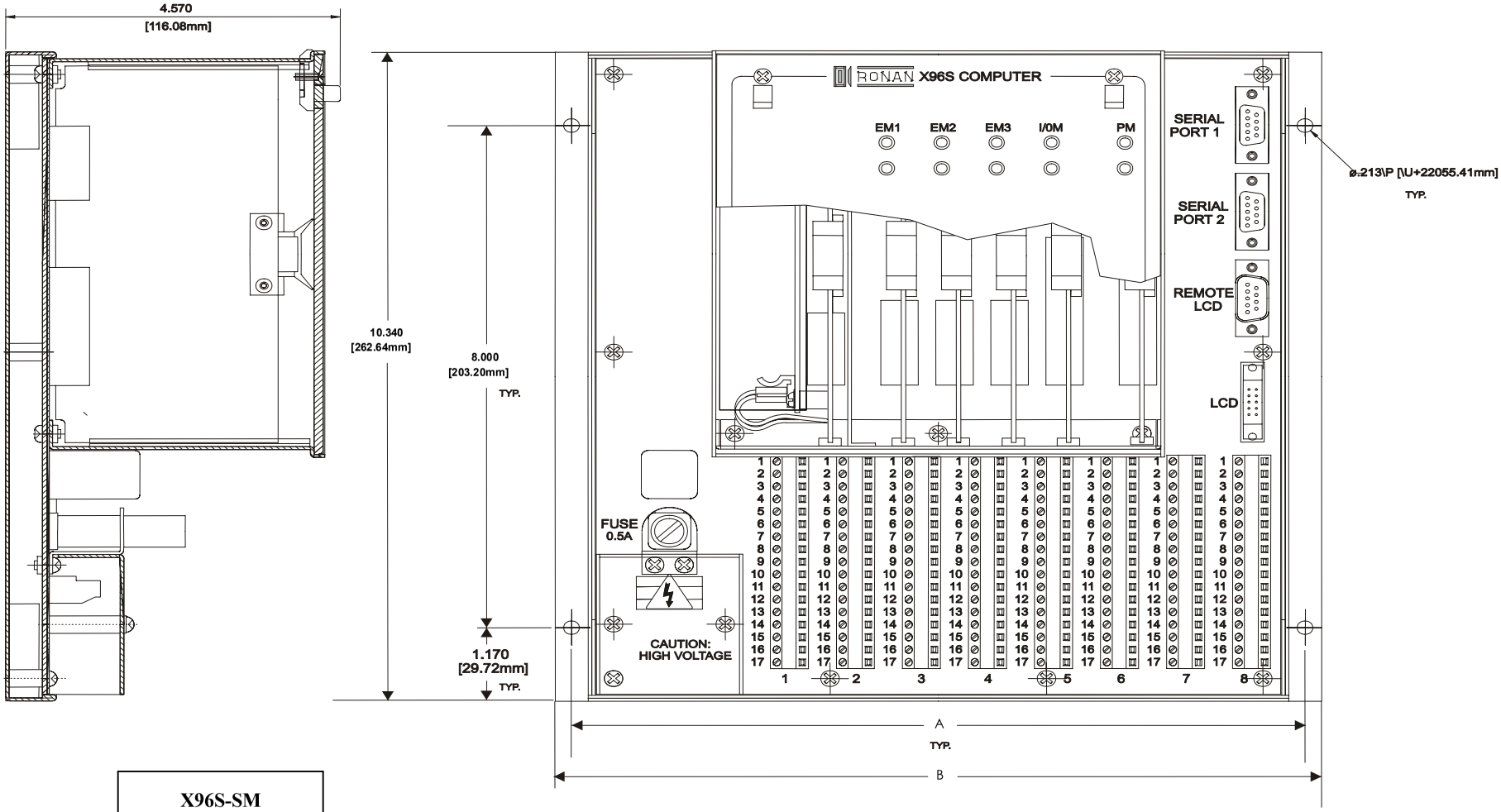
MODEL X96S

Process Computer:	Microprocessor-based unit wit a liquid crystal display, push-button interface, HART® Communications, process control outpus, process condition inputs, serial communications.
Chassis:	19” Rack Mount, Surface Mount or Panel Mount
Enclosure:	Standard NEMA-4 Stainless Steel NEMA-4X Explosion Proof
Electrical:	Power inputs: 90 to 24 VAC +/- 15%, 50/60 Hz; 24 VDC +/- 15%
Environmental:	Ambient Temperature Range: 0° to 140° F° (-18° to 60° C) Hunidity: 90% Non-Condensing
Electronics:	Processor: Embedded 80 x 86 Compatible Processor Memory: Flash, Static RAM, battery Backup RAM A/D Converters: 16-bit, Dual Slope, Auto-Zeroing Display: Graphic LCD, Fluorescent Back-lit
Inputs: (Optional)	Tachometer: 0-10 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 Gage) 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

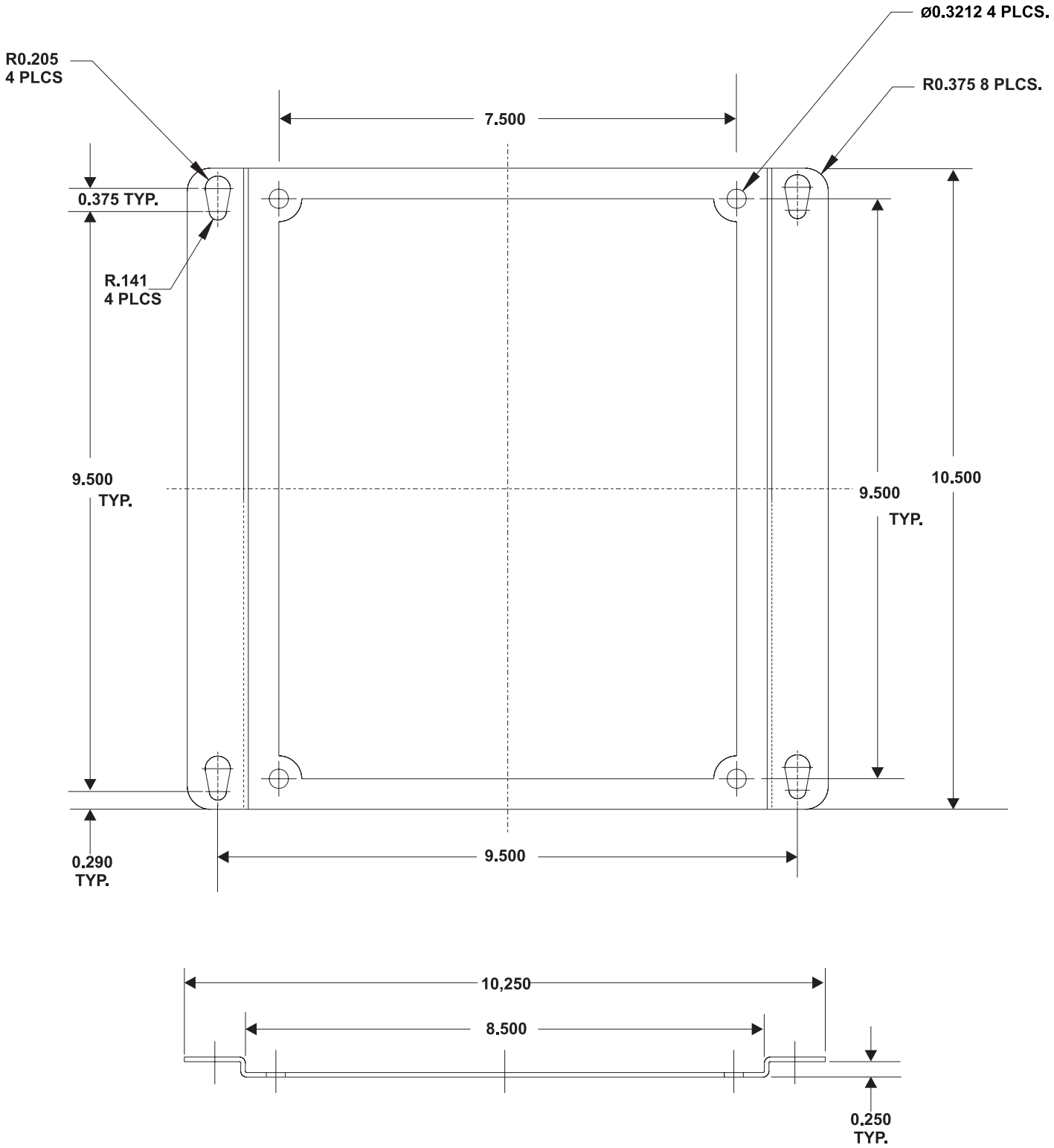
Regulations

Regulations will be supplied with Radiation Safety Manual.


6.10" [155mm]
CARD RACK
POWER TERMINAL
MOUNTING PLATE
0.08" [2mm]
11.5" [292mm]
2.00" [50.8mm]
7.50" [190.5mm]
RONAN
SERIES X96S-N4
LCD
RONAN
X96S
11.5" [292mm]
9.50" [241mm]
12.4" [315mm]
1.00" [25.4mm]
(4) ø0.31" [ø8mm]
FOR MOUNTING
SERIAL PORT 1
SERIAL PORT 2
AC POWER PORT
FIELD INPUT/OUTPUT PORTS



X96S-SM Outline/Assembly Drawing



Mounting Plate

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X96S Mold Level_ Gage 012407

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