Instructions
and
Operating Manual

X96S

WEIGH SCALE

RONAN
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MEASUREMENTS DIVISION

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

Overview

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

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

Advantages

- Non-Contact Measurement
- Displays in Customer Units
- Most Applications can be solved with low-energy sources
- Not affected by:
  -extreme temperatures
  -caustic processes
  -sterile processes

Gamma's Advantages

- Mounts external to the conveyor (no components exposed to process material)
- Not affected by changing belt tension
- Does not make material radioactive
- Does not change the material
- Can be shielded by lead

X96S Advantages

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

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

Basic Concepts

Communications

The Ronan X96S Weigh Scale provides both 4-20 mA current loop and other communication protocols (HART, Fieldbus, Modbus, etc.).

4-20 MA

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

HART

HART® Field Communications Protocol extends the 4-20mA current loop standard to enhance communication with smart field instruments. The HART protocol was designed specifically for use with intelligent measurement and control instruments 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 configuration, calibration, and device diagnostics to be transmitted digitally at the same time. Thus, a wealth of additional information related to plant operation is available to central control or monitoring systems through HART communications.

Variables

There are three types of variables, communications variables, device variables and configuration variables.

Communication Variables

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

Device Variables

The Ronan X96S Weigh scale has 4 device variables: Rate, Weight, Speed and Head Temperature

Configuration Variables

The Ronan X96S Weigh scale has many configuration variables that are accessed through its menus.

Theory

Theory of Radiation Gauging

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

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

Radiation that 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 weight of process material in/on the conveyor while the transmitted radiation is inversely related to the weight of process material on the belt.

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

Since the radiation that's not being *absorbed* is being *transmitted*, the process weight 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 weight.

When the process weight is low the detector is exposed to a maximum amount of radiation which produces a HIGH output of counts. When the process weight 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 weight: lb/ft, oz/ft, kg/m, g/mt, and rate: STon/h, Lton/h, lb/min, oz/min, MetTon/h, kg/h, kg/min.

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

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

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

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

Principles of Operation

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

Some of the more significant stages of signal processing are:

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

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

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

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

Where:

R_o	=	Reference weight with empty conveyor
R_c	=	Current weight on the conveyor
I_o	=	Detector signal with empty conveyor
I_c	=	Current detector signal with material on the conveyor
a	=	Width of the conveyor in units of feet (or meter)
uT	=	Mass absorption coefficient, which for Cs-137 approximately equals 0.04 ft^2/lb or (0.008 M^2/kg)
Ln	=	Natural Log

Password

Notice:

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

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

Step 2: Press F3 to go back.

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

Press  to get the digit to be # one

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

Press  to get the digit to be # one

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

Press  to get the digit to be # one

Press F4 (enter)

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

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

Menus/Operation

Menu Trees

The Ronan X96S Weigh scale uses a tree structured menu system.

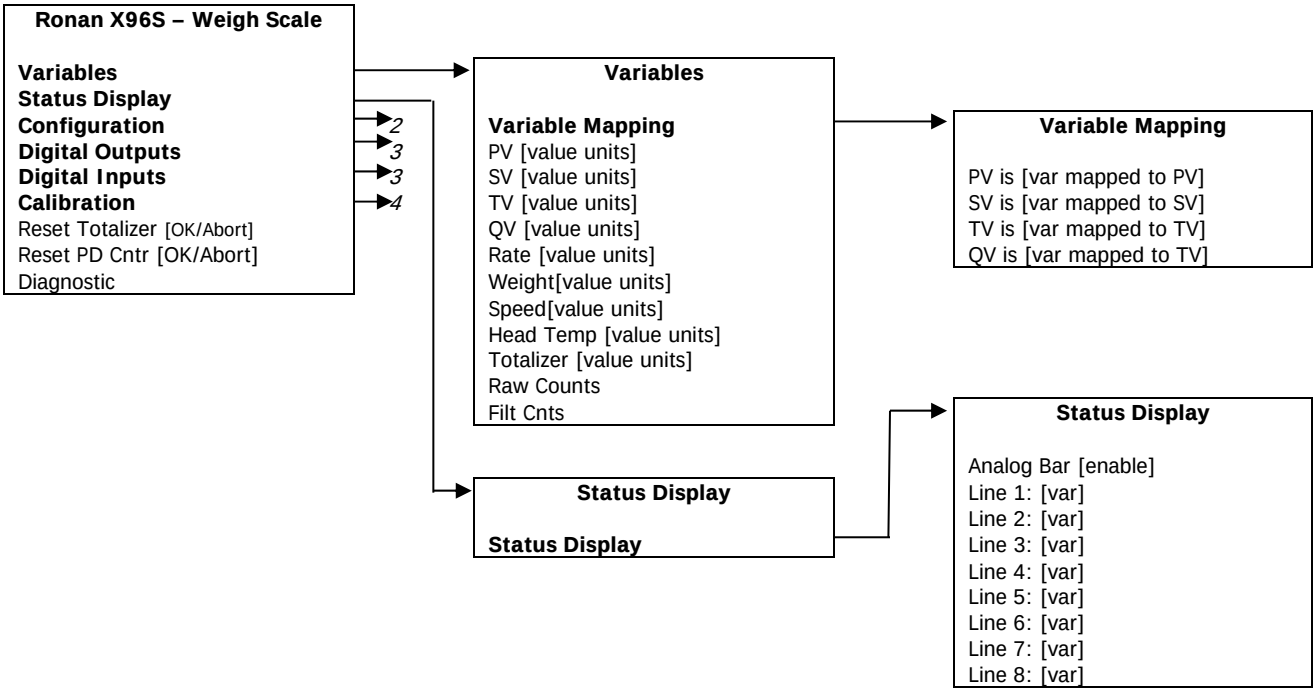

Figure 3-1 – Root, Variables and Display Menus

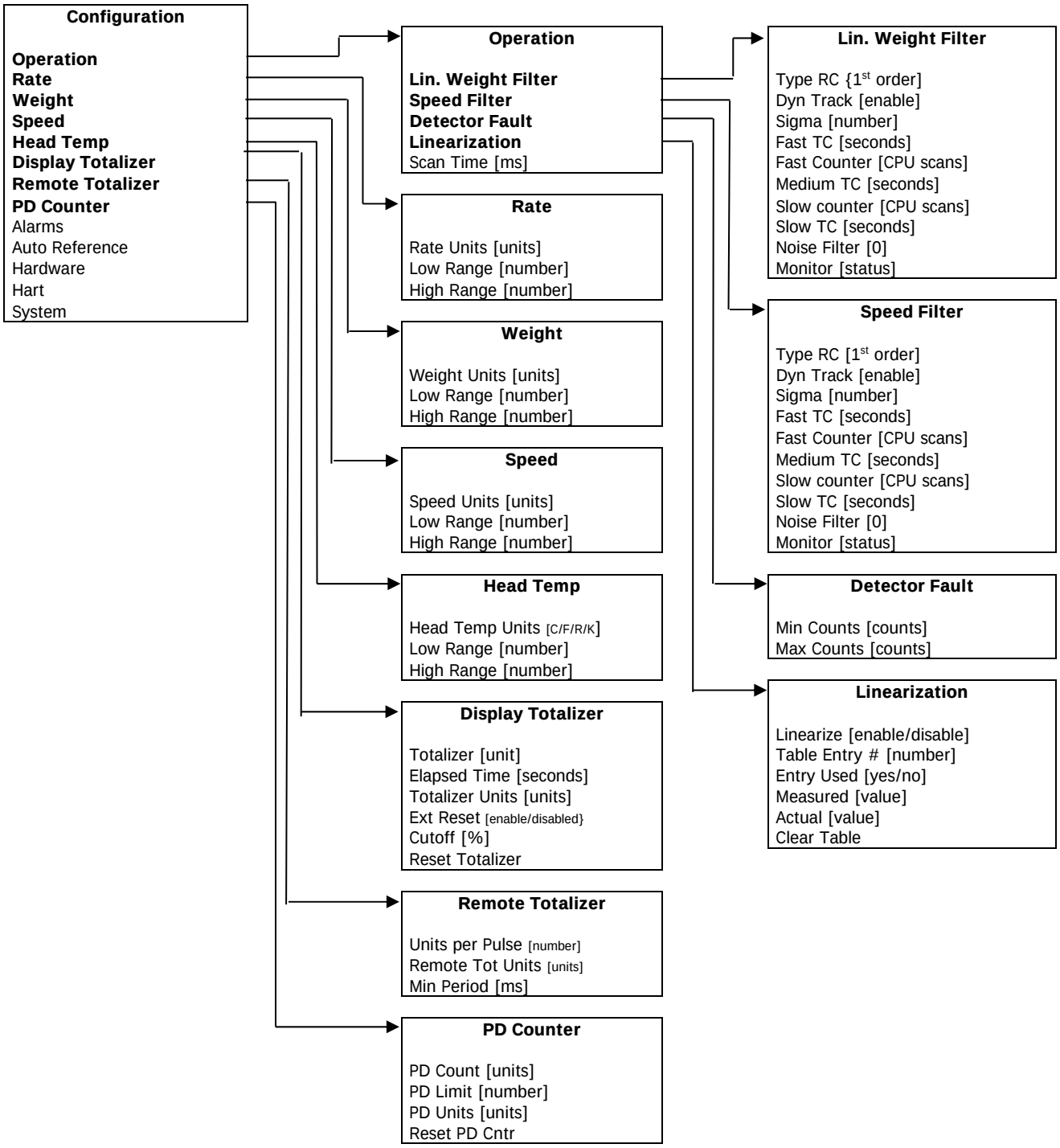

Figure 3-2 – Configuration Menus

Continued from Previous Page

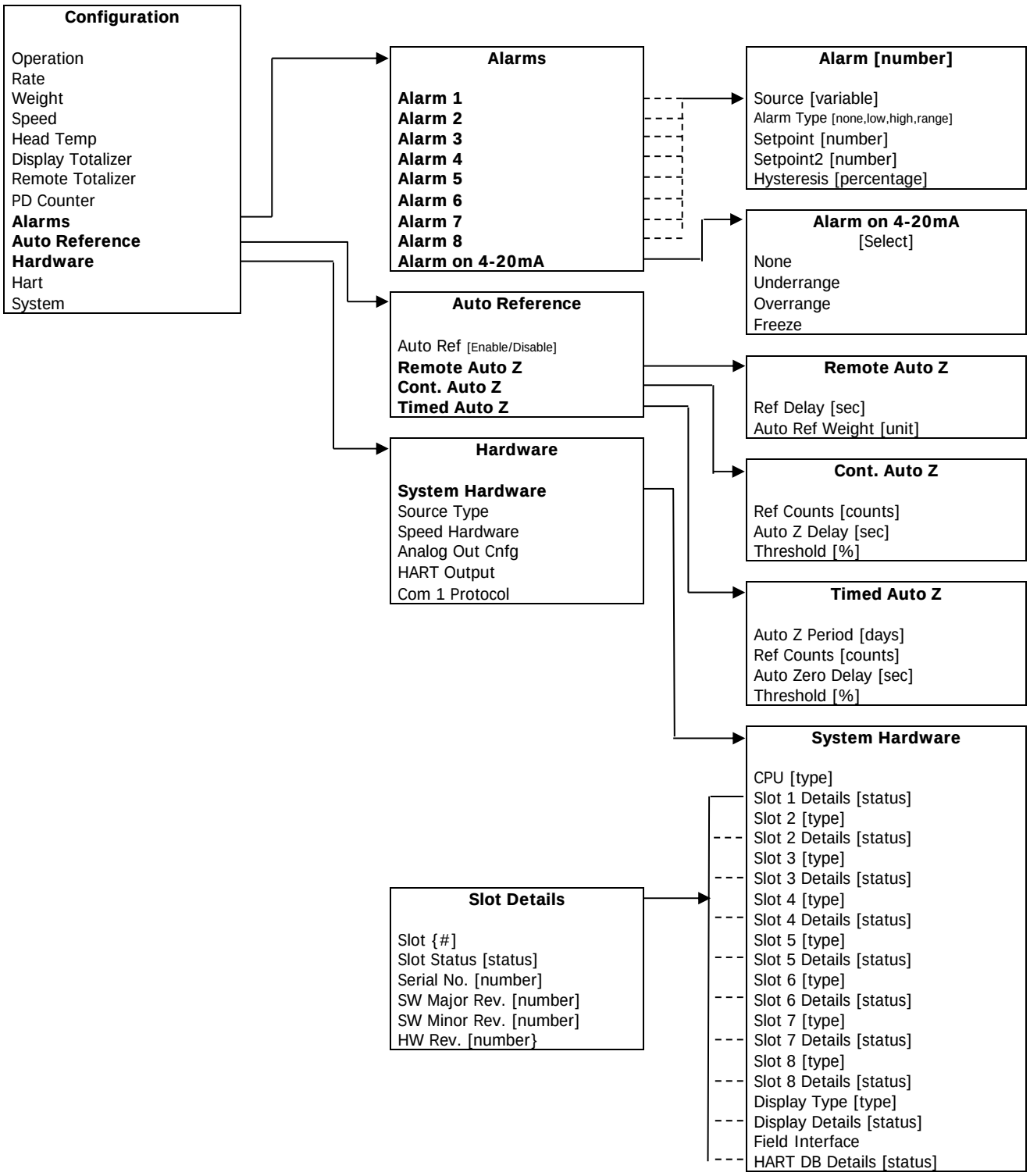

Figure 3-2 – Configuration Menus Cont'd.

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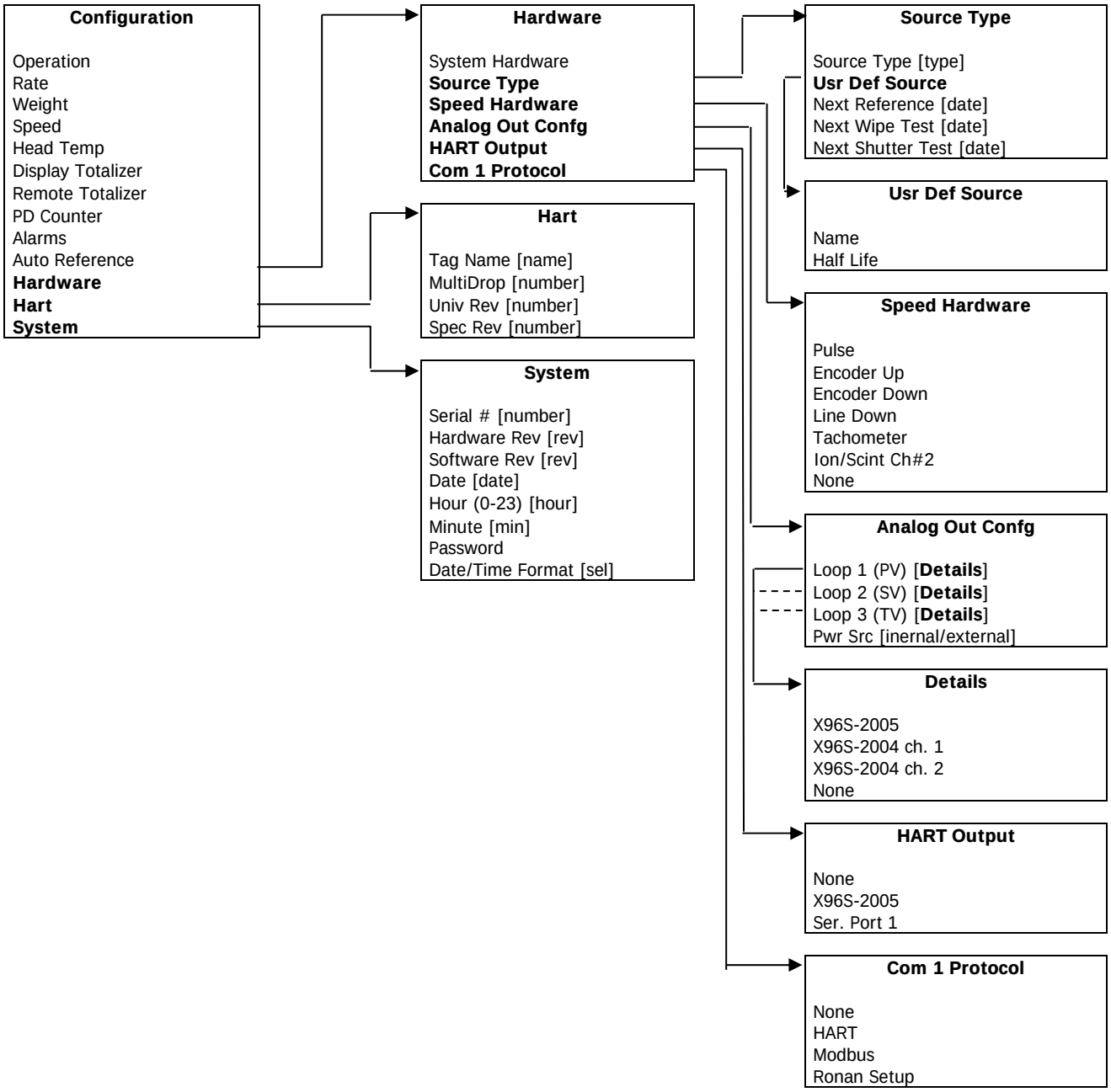


Figure 3-2 – Configuration Menus Cont'd.

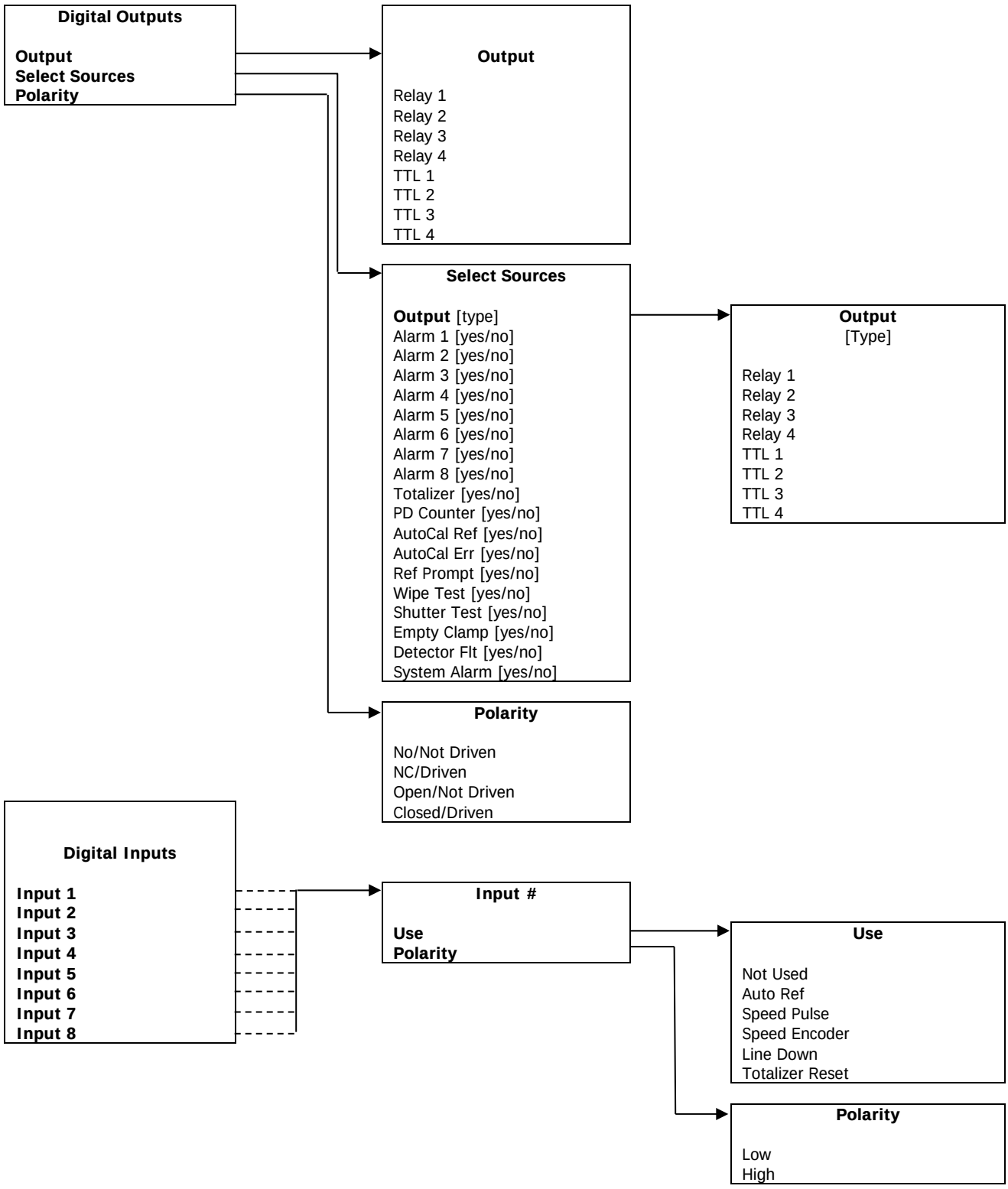


Figure 3-3 – Digital Output and Digital Input Menus

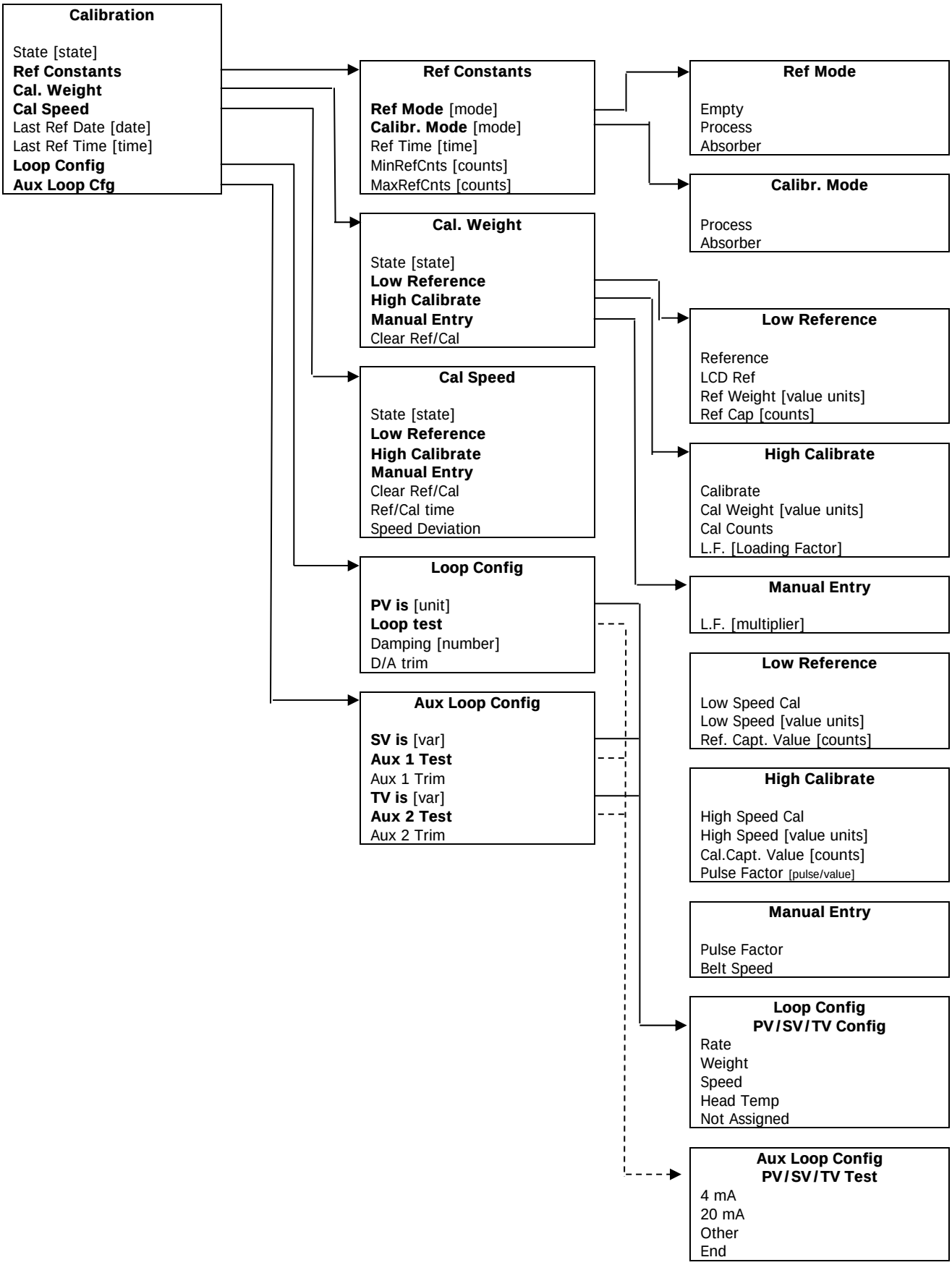


Figure 3-4 – Calibration Menus

Root Menu

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

ITEM	FUNCTION
Variables	Selecting this choice takes the user to the Variables menu
Status Displays	Selecting this choice takes the user to the Status Displays menu
Configuration	Selecting this choice takes the user to the Configuration menu
Digital Outputs	Selecting this choice takes the user to the Digital Outputs menu
Digital Inputs	Selecting this choice takes the user to the Digital Inputs menu
Calibration	Selecting this choice takes the user to the Calibration menu
Reset Totalizer	Selecting this choice takes the user to the Reset Totalizer menu
Reset PD Cntr	Selecting this choice takes the user to the Reset PD Cntr 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)
Rate	Shows the current value of Rate (the Rate Variable)
Weight	Shows the current value of Weight (the Weight Variable)
Speed	Shows the current value of Speed (the Speed Variable)
Head Temp	Shows the current value of Head Temp (the Head Temperature)
Total Weight	Shows the current value of Total Weight (the Total Weight Variable)
Filt Cnts	Shows the current value of Filter Cnts (the Filter Counts Variable)

Variable Mapping Menu

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

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

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

SELECTION	MEANING
Rate	Rate (example: pounds per hour)
Weight	Weight (example: pounds per linear foot)
Speed	Speed (example: feet per second)
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 to change the state.
Line 1:	Shows the data to be displayed on line 1 of the status display and allows the user to change the selection
Line 2:	Shows the data to be displayed on line 2 of the status display and allows the user to change the selection
Line 3:	Shows the data to be displayed on line 3 of the status display and allows the user to change the selection
Line 4:	Shows the data to be displayed on line 4 of the status display and allows the user to change the selection
Line 5:	Shows the data to be displayed on line 5 of the status display and allows the user to change the selection
Line 6:	Shows the data to be displayed on line 6 of the status display and allows the user to change the selection
Line 7:	Shows the data to be displayed on line 7 of the status display and allows the user to change the selection
Line 8:	Shows the data to be displayed on line 8 of the status display and allows the user to change the selection

Each line may each select one of the following:

SELECTION	MEANING
Rate	Rate (example: pounds per hour)
Weight	Weight (example: pounds per linear foot)
Speed	Speed (example: feet per second)
Totalizer	Totalizer (shows the accumulated weight)
PD Counter	PD Counter (shows the current value in the predetermined counter)
% of Weight	Shows the percent of Weight based upon the min and max Weight range
% of Rate	Shows the percent of Rate based upon the min and max Rate range
% of Speed	Shows the percent of Speed based upon the min and max Speed range
Head Temp	Head Temperature (if Available)
4-20 mA	4-20 mA output level
Filt Cnts	Filter counts (from scintillation detector) or raw analog measurement (from ionization detector)
Date & Time	Current date and time
Tot Elspd Time	Shows the Total Elapsed Time since the last time the Totalizer was reset
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
Rate	Selecting this choice takes the user to the Rate menu
Weight	Selecting this choice takes the user to the Weight menu
Speed	Selecting this choice takes the user to the Speed menu
Head Temp Config	Selecting this choice takes the user to the Head Temp menu
Display Totalizer	Selecting this choice takes the user to the Display Totalizer menu
Remote Totalizer	Selecting this choice takes the user to the Remote Totalizer menu
PD Counter	Selecting this choice takes the user to the PD Counter menu
Alarms	Selecting this choice takes the user to the Alarm menu
Auto Reference	Selecting this choice takes the user to the Auto Reference menu
Hardware	Selecting this choice takes the user to the Hardware menu
HART	Selecting this choice takes the user to the HART menu
System	Selecting this choice takes the user to the System menu

Operation Menu

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

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

Filtering Menu

The Filtering menu is used to configure the parameters associated with the weight measurement filter. 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. 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 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. The user defines erroneous measurement when the raw signal is 4 times the pre-selected sigma multiplier.
Monitor	Shows the current state of the filtering mechanism.

Monitor (filter state) one of the following:

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.

Linearization Menu

The X96S is capable of performing a multi-point linearization of the weight data when required by an application. The linearization table contains thirty 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 to 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

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 the nonlinear value calculated by the X96S when linearization is disabled.
Actual	Shows, and allows the user to set, the actual value associated with this linearization table entry. This value is the 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.

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

Rate Menu

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

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

Units is one of the following:

Units	MEANING
lb/h	pounds per hour
STon/h	Short Tons per hour
LTon/h	Long Tons per hour
STon/min	Short Tons per minute
LTon/min	Long Tons per minute
lb/min	pounds per minute
oz/min	ounces per minute
MetTon/h	Metric Tons per hour
kg/h	kilograms per hour
MetTon/min	Metric Tons per minute
kg/min	kilograms per minute
kg/sec	kilograms per second

Weight Menu

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

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

Units is one of the following:

Units	MEANING
lb/ft	pounds per foot
oz/ft	ounces per foot
kg/m	kilograms per meter
g/mt	grams per meter

Speed Menu

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

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

Units is one of the following:

Units	MEANING
ft/min	feet per minute
in/min	inches per minute
m/s	meter per second

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.

Units is one of the following:

Units	MEANING
degC	degree Celsius
degF	degree Fahrenheit
degR	degree Rankine
Kelvin	Kelvin

Display Totalizer Menu

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

ITEM	FUNCTION
Total Weight	Shows the accumulated weight in the Total Weight register
Elapsed Time	Shows the elapsed time since the last time the Totalizer was reset.
Totalizer Units	Shows and allows the user to set the units to be used for the Totalizer.
Ext Reset	Shows and allows the user to enable the Totalizer to be reset remotely
Reset Totalizer	Shows and allows the user to reset the Totalizer locally

Totalizer Units is one of the following:

Units	MEANING
STon	Short Tons
LTon	Long Tons
lb	pounds
ounce	ounces
MetTon	Metric Tons
kg	kilograms
g	grams

Remote Totalizer Menu

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

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

Remote Totalizer Units is one of the following:

Units	MEANING
STon	Short Tons
LTon	Long Tons
lb	pounds
ounce	ounces
MetTon	Metric Tons
kg	kilograms
g	grams

PD Counter Menu

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

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

Totalizer Units is one of the following:

Units	MEANING
STon	Short Tons
LTon	Long Tons
lb	pounds
ounce	ounces
MetTon	Metric Tons
kg	kilograms
g	grams

Alarms

The Alarms menu is used to configure the parameters associated with the analog alarms.

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]
Hysteresis	Shows, and allows the user to set the alarm hysteresis percent

Source is one of the following

Source	MEANING
Rate	Uses the Rate for the source of the alarm
Weight	Uses the Weight for the source of the alarm
Speed	Uses the Speed for the source of the alarm
Totalizer	Uses the Totalizer for the source of the alarm
PD Counter	Uses the PD Counter for the source of the alarm
% of Weight	Uses the % of Weight for the source of the alarm
% of Rate	Uses the % of Rate for the source of the alarm
% of Speed	Uses the % of Speed for the source of the alarm
Head Temp	Uses the Head Temperature of the detector for the source of the alarm
Filtered Counts	Uses the Filtered Counts from the detector for the source of the alarm
4-20 mA	Uses the 4-20 mA 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

Auto Reference Menu

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

ITEM	FUNCTION
Auto Ref	Shows and allow the user to Enable or Disable the Auto Reference
Ref Delay	Shows and allow the user to change the time for the Reference Delay
Auto Ref Wght	Shows and allows the user to change the Reference Weight to be used for the Auto Ref Wght.

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

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
Speed Hardware	Selecting this item takes the user to the Speed Hardware menu
Analog Out Cnfg	Shows and allows the user to set the where the source of power is internal or external

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)
Slot 1 Details	Shows the status of the card and details of the hardware and software
DIO Card	Shows the type of DIO (Digital Input/Output) card installed (in slot 2)
Slot 2 Details	Shows the status of the card and details of the hardware and software
Slot 3 Card	Shows the type of card (if any) installed in slot 3
Slot 3 Details	Shows the status of the card and details of the hardware and software
Slot 4 Card	Shows the type of card (if any) installed in slot 4
Slot 4 Details	Shows the status of the card and details of the hardware and software
Slot 5 Card	Shows the type of card (if any) installed in slot 5
Slot 5 Details	Shows the status of the card and details of the hardware and software
Slot 6 Card	Shows the type of card (if any) installed in slot 6
Slot 6 Details	Shows the status of the card and details of the hardware and software
Slot 7 Card	Shows the type of card (if any) installed in slot 7
Slot 7 Details	Shows the status of the card and details of the hardware and software
Slot 8 Card	Shows the type of card (if any) installed in slot 8
Slot 8 Details	Shows the status of the card and details of the hardware and software
Display Type	Shows the type of display module (if any) attached
Display Details	Shows the status of the display module, if the module is attached
HART	Shows the type of HART interface (if any) present
HART Details	Shows the status of the card and details of the hardware and software

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	Shows and allows the user to set the date for the next low reference
Next Wipe Test	Shows and allows the user to set the date for the next wipe test
Next Shutter Test	Shows and allows the user to set the date for the next shutter test

Source Type is one of the following:

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

Speed Hardware Menu

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

ITEM	FUNCTION
Speed Hardware	Shows, and allows the user to set, the type on speed input

Speed Hardware has the following options:

Speed Hardware	MEANING
Pulse	Pulse input through the Digital Input Card
Encoder up	Encoder using quadrature outputs through 2 channels of the Digital Input Card
Encoder down	Encoder using quadrature outputs through 2 channels of the Digital Input Card
Line Down	Dry Contact signal through the Digital Input Card
Tachometer	Analog signal voltage or current through the Analog Input Card
None	No speed input is used

Analog Out Cnfg Menu

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

ITEM	FUNCTION
Pwr Src	Shows, and allows the user to set where the source of power is internal or external.

Pwr Src has the following options:

Pwr Src	Meaning
Internal	The analog output card outputs will use its own internal power supply
External	The analog output card outputs will use an external power supply

HART Menu

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

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

System Menu

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

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

Date/Time Format is one of the following:

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

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

Select Sources has the following option to assign:

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

Polarity has the following option to assign:

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

Digital Inputs 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
Use	Shows, and allows the user to set, the type of device connected to the digital input
Polarity	Shows, and allows the user to set, the active state of the digital input

Use is one of the following:

Type	MEANING
Not Used	Input is not used
Auto Ref	The input is configured for Auto Referencing
Speed Pulse	The input is configured for speed using a single channel of pulses
Speed Encoder	The input is configured for speed using two channels of pulses
Line Down	The input is configured for speed using a dry contact
Totalizer Reset	The input is configured for remote totalizer reset

Polarity is one of the following:

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

Calibration Menu

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

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

State is one of the following:

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

Ref Constants Menu

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

ITEM	FUNCTION
Ref Mode	Shows, and allows the user to set, the reference/calibrate mode
Ref Time	Shows, and allows the user to set, the number of seconds of data to collect for a reference or calibrate sample (0 – 999 seconds)
MinRefCnts	Shows, and allows the user to set, the minimum raw count value to use for a reference or calibrate sample (0 – 10000)

Ref Mode is one of the following:

Ref Mode	MEANING
Empty	The belt or screw will be Empty for reference
Process	The belt or screw will have process material on/in it for reference. User will supply actual weight during reference and calibration.
Absorber	Absorber will be placed in radiation path.

Calibrate Menu

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

ITEM	FUNCTION
State	Shows the state of the weight configuration process
Low Reference	Selecting this item takes the user to the Low Reference menu
High Calibrate	Selecting this item takes the user to the High Calibrate menu
Manual Entry	Shows and allows the user to set the calculated Loading Factor value (Same value as in Calibrate Menu, L.F.)
Clear Ref/Cal	This item invokes method that clears the weight reference and L.F. (Loading Factor)

Low Reference (Calibrate) Menu

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

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

High Calibrate (Calibrate) Menu

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

ITEM	FUNCTION
Calibrate	This item invokes a method that performs the high calibrate procedure
Cal Weight	Shows and allows the user to set the calibrate weight value
Cal Cap	Shows the raw captured calibrate counts
L.F.	Shows the calculated Loading Factor (Same value as in Calibrate Menu, Manual Entry)

Cal Speed Menu

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

ITEM	FUNCTION
State	Shows the state of the speed configuration process
Low Reference	Selecting this item takes the user to the Low Reference (Cal Speed) menu
High Calibrate	Selecting this item takes the user to the High Calibrate (Cal Speed) menu
Manual Entry	Shows and allows the user to set the calculated Pulse Factor value (Same value as in Cal Speed Menu)
Clear Ref/Cal	This item invokes method that clears the speed reference and pulse factor

Low Reference (Cal Speed) Menu

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

ITEM	FUNCTION
Low Speed Cal	This item invokes a method that performs the low speed calibration procedure
Low Speed	Shows and allows the user to set the Low Speed value
Captured Value	Shows the captured low speed counts (or speed signal strength)

High Calibrate (Cal Speed) Menu

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

ITEM	FUNCTION
High Speed Cal	This item invokes a method that performs the high speed calibrate procedure
High Speed	Shows and allows the user to set the High-Speed value
Captured Value	Shows the captured high-speed counts (or speed signal strength)

Manual Entry (Cal Speed) Menu

This menu is used to allows the user to set the calculated Pulse Factor value. It contains the following items:

ITEM	FUNCTION
Belt Speed	Shows and allows the user to set the Belt Speed value. This variable is used only if line down contact is select for speed input

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

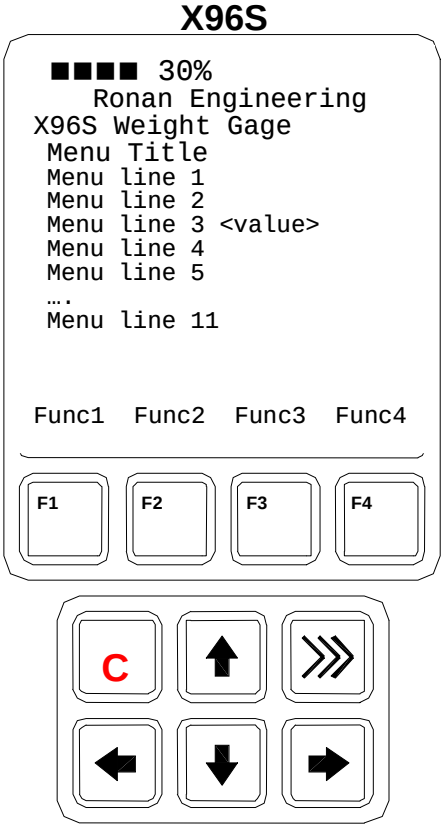
SV is one of the following:

SV is	MEANING
Rate	Rate
Weight	Weight
Speed	Speed
Head Temp	Head temperature (if available)
Not Assigned	Blank line

TV is one of the following:

TV is	MEANING
Rate	Rate
Weight	Weight
Speed	Speed
Head Temp	Head temperature (if available)
Not Assigned	Blank line

X96S Local Display



The X96S Local Display consists of a 16 line by 21-character display and a 10-key keypad. The top line of the display is reserved for the analog bar, if enabled. The next line is used for the Ronan logo. Line #3 shows the device model line. Line #4 displays the specific screen title. That title is typically a screen description or required action. The remainder of the lines (except for 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 475 Configurator's user interface.

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

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

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

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

Editing Values

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

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

Editing Fixed Point Numbers

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

Editing Floating Point Numbers

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

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

Editing Text Strings

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

Editing Enumerated Values

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

X96S Local Display Vs 475 Calibrator

The local display user interface is very similar to the 475 Calibrator, but there are some differences. One of the major ones is the fact that the X96S local display lacks a numeric keypad. This automatically means that the shortcuts are not supported, as also the value editing is done using only the cursor keys.

Another difference is the fact that all values in the local display are immediately updated, and there is no need to use SEND action whenever a value is changed. Also, the flashing 'heart' character indicating that the configurator is exchanging data through HART communication is not needed and thus not presented on the local display.

When there is a value to be displayed and the line length doesn't fit the display, the 475 Configurator displays the label only and lets the user see the value using the right arrow key. X96S local display will display whatever could fit the display, thus indicating to the user that there is more to be displayed and the right arrow sign is not indicating a new menu.

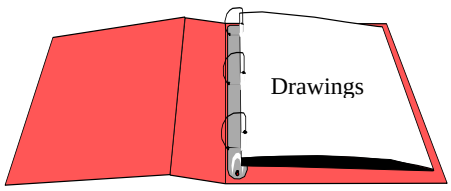
Source Inspection and Installation

Please see the Basic Radiation Safety Manual that is shipped with the source and source holder. It will contain information about unpacking, inspection and storage for your source and source holder.

Safety Precautions

During installation the RSO will provide guidelines to assure safety. Consider the information presented in the Basic Radiation Safety Manual.

Mechanical Mounting



Drawings:
Configuration
Installation

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

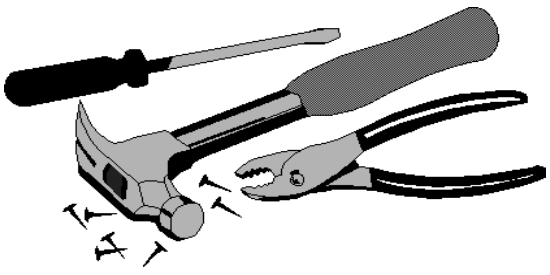
Please reference the dimensional drawings located in the Drawing Chapter of this manual when installing the equipment.

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

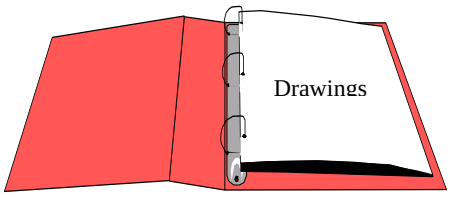
Avoid internal vessel obstructions such as baffles, agitators, manways, heater/cooler tubes, etc. which could interfere with the transmission through the conveyor/screw of the radiation's "active beam."

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

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



Electrical Installation of Interconnect Wiring



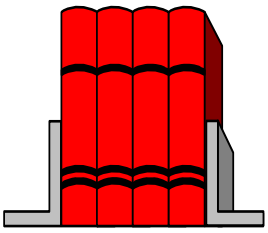
Drawings:
Interconnect

DO NOT APPLY POWER until wiring is carefully checked.

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

Follow local and national electrical codes for all interconnections.

Consider the following guidelines before making any electrical connections:



LOCAL CODE
NATIONAL CODE

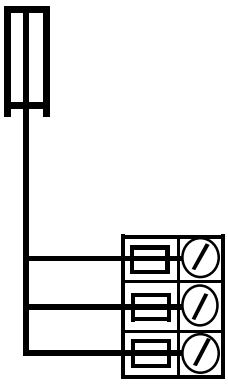
Use continuous conduit runs and protect housing junction boxes from dripping of condensed moisture off of conduit.

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

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

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

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



POWER INPUT

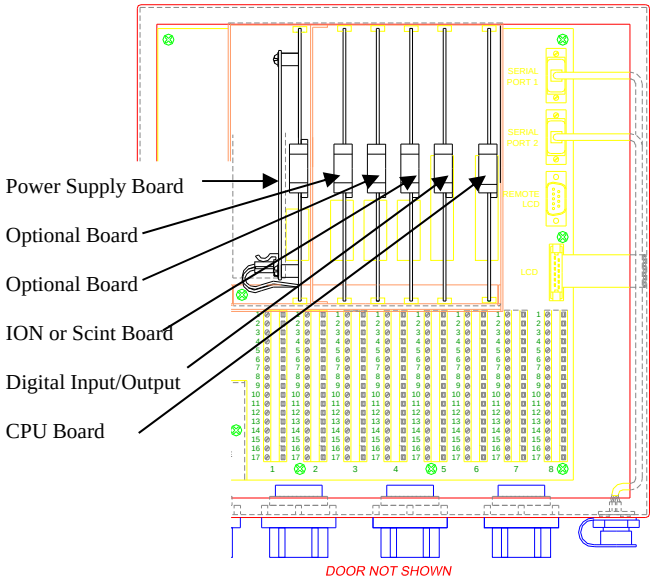
WITH POWER OFF - - -

- Connect cable pre-wired MS connector to detector.
- Immediately replace lid of detector housing to keep out water and dirt.
- Check connections at microprocessor chassis terminals. Verify that all wires are fully inserted in terminal sockets and the screws firmly tightened.

Microprocessor Verification

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

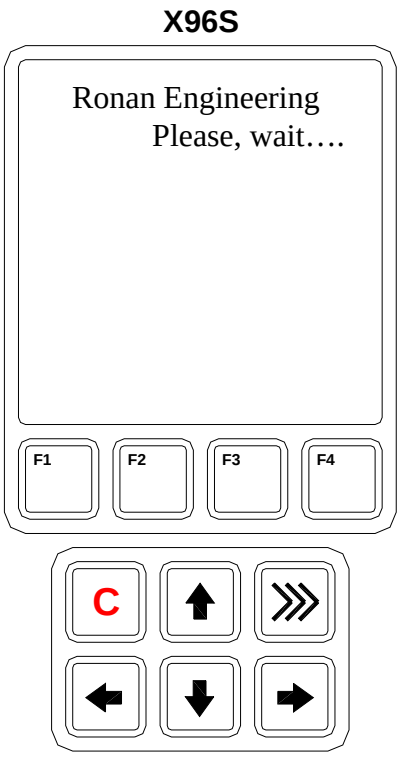
NOTE:
These boards are not interchangeable in the frame's slots.



Identification / Documentation

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

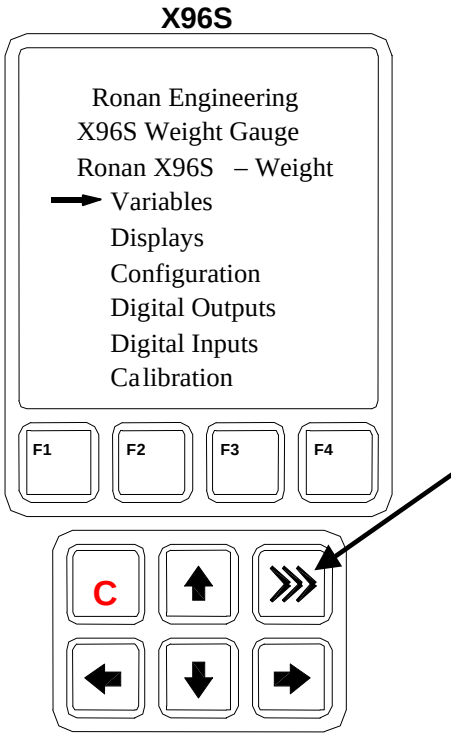
Power-up



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

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

First display appears for just a second



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

Initial calibration consists of two parts, the belt speed calibration and the mass density calibration.

The belt speed calibration correlates the speed signal to the rate the material is moving. For weigh scale using an encoder or tachometer this is achieved by stopping the belt and calibrating the minimum speed and running the belt at full speed and calibrating the maximum. (If the weigh scale uses line down contact, calibration requires only entering the belt speed through the keypad. No calibration is required.)

Speed Low and High Calibration

Low Speed Reference

PROCEDURE:
For weigh scales using tachometer or encoder for speed. If speed input is a signal from a line down contact, see Speed Calibration using Line down Contact.
The belt must be stopped or running at the lowest speed during the Low Speed Reference.

Using the Ronan local display or HART communicator find the Main Menu;
Scroll down until you reach and highlight *Calibration*.
Access Calibration by pressing the right arrow key.
Scroll down until you reach and highlight *Cal Speed*.
Access the Cal Speed by pressing the right arrow key.
Scroll down until you reach and highlight *Low Reference*.
Access the Low Reference by pressing the right arrow key.
Access the Low Speed Cal by pressing the right arrow key.
Press the F4 key (OK) to the prompt '*Warning – Remove loop from automatic control before doing the reference procedure*'.
Wait until the prompt changes from
'*Performing Calibrate procedure*' … *to 'Low speed calibrate SUCCESS. Remember to enter speed*'.
Press the F4 key (OK).
Scroll down until you reach and highlight *Low Speed 0.0000 ft/min.* (Note 0.000 ft/min value and units may very depending on the what value and units were selected.) (**Note: You must access the Low Speed and either change or acknowledge the value to complete the reference**.)
Access Low Speed 0.0000 ft/min by pressing the right arrow key.
Use the arrow keys to select and change the display value to the correct speed. Once the displayed value is correct, press the F4 key (Enter).). The Low Speed Reference is complete.
You must proceed to High Speed Calibration to complete the calibration.

High Speed Calibration

PROCEDURE
(For weigh scales using tachometer or encoder for speed). If speed input is a signal from a line down contact, see Speed Calibration using Line down Contact.

The belt must be running at the highest speed during the High Speed Calibration.

Using the Ronan local display or HART communicator find the Main Menu;
Scroll down until you reach and highlight *Calibration*.
Access Calibration by pressing the right arrow key.
Scroll down until you reach and highlight *Cal Speed*.
Access the Cal Speed by pressing the right arrow key.
Scroll down until you reach and highlight *High Calibrate*.
Access the High Calibrate by pressing the right arrow key.
Access the High Speed Cal by pressing the right arrow key.
Press the F4 key (OK) to the prompt '*Warning – Remove loop from automatic control before doing the calibrate procedure*'.
Wait until the prompt changes from
'*Performing Calibrate procedure*' … *to 'High speed calibrate SUCCESS. Remember to enter speed*'.
Press the F4 key (OK).
Scroll down until you reach and highlight *High Speed 50.000 ft/min.* (Note 50.000 ft/min value and units may very depending on the what value and units were selected.) (**Note: You must access the High Speed and either change or acknowledge the value to complete the calibration**.)
Access High Speed 50.0000 ft/min by pressing the right arrow key.
Use the arrow keys to select and change the display value to the correct speed. Once the displayed value is correct, press the F4 key (Enter).
The Speed Calibration is complete.

Speed Calibration with Line Down Contact

PROCEDURE
(For weigh scales using line down contact for speed signal)
(If the weigh scale uses encoder or tachometer, see Low Speed Reference and High Speed Calibration Procedures.)

Using the Ronan local display or HART communicator find the Main Menu;
Scroll down until you reach and highlight *Calibration*.
Access Calibration by pressing the right arrow key.
Scroll down until you reach and highlight *Cal Speed*.
Access the Cal Speed by pressing the right arrow key.
Scroll down until you reach and highlight *Manual Entry*.
Access the Manual Entry by pressing the right arrow key.
Scroll down until you reach and highlight *Belt Speed*.
Access Belt Speed by pressing the right arrow key.
Use the arrow keys to select and change the display value to the correct speed. Once the displayed value is correct, press the F4 key (Enter).
The Speed Calibration is complete.

Mass Density Low / Reference and High / Calibration

The mass density calibration correlates the detector counts to the mass upon belt. This can be achieved by several different methods. One method consists of Referencing on Empty Belt. The next step requires running predetermined weights past the gauge and comparing the indicated weight to the actual weight. For alternative calibration methods, consult Ronan Engineering.

First you will **REFERENCE** the system on an Empty Belt. Then you will **CALIBRATE** the system by one of the following means:

1) passing or catching a known amount of material through the scale,
2) placing a static load on the belt that you must weigh or
3) inserting an Absorber Plate of a predetermined value in the absorber guide (usually located in front of the source holder).

Low Reference

PROCEDURE:
The belt must be empty and running at the normal speed during the Low Reference.

Using the Ronan local display or HART communicator find the Main Menu;
Scroll down until you reach and highlight *Calibration*.
Access Calibration by pressing the right arrow key.
Scroll down until you reach and highlight *Cal Weight*.
Access the Cal Weight by pressing the right arrow key.
Scroll down until you reach and highlight *Low Reference*.
Access the Low Reference by pressing the right arrow key.
Access the Reference by pressing the right arrow key.
Press the F4 key (OK) to the prompt "*Warning – Remove loop from automatic control before doing the reference procedure."*
Press the F4 key (OK) to the prompt "*Verify that source is on, detector output is correct, and process is in reference condition."*
Wait until the prompt changes from "*Performing Calibrate procedure' … to 'Low weight calibrate SUCCESS. Remember to enter weight*."
Press the F4 key (OK).
Scroll down until you reach and highlight *Ref Weight 0.0000 lb/ft.* (Note *0.0000 lb/ft* value and units may vary depending on what value and units were selected.) (**Note: You must access the Ref Weight and either change or acknowledge the value to complete the reference**.)
Access Ref Weight 0.0000 *lb/ft* by pressing the right arrow key.
Use the arrow keys to select and change the display value to the correct weight on the conveyor.
Once the displayed value is correct, press the F4 key (Enter).). The Low Reference is complete.
You must proceed to High Calibration to complete the calibration.

High Calibrate

PROCEDURE (Option 1)
Passing or collecting a known amount of material through the scale and manually entering the L.F. value (Loading Factor)**).** Initially (if you are first commissioning the gauge) you should start off the L.F. value with the active detector length (in feet). You will want to make sure you run at least a 30-minute load through the scale to get an accurate calibration. This is achieved by first zeroing the totalizer. Next, you pass the known amount of weight past the Ronan X96S weigh scale. You then calculate the new L.F. (Load Factor) by comparing the measured weight to the actual weight. You enter the new calculated value into the X96S microprocessor. You should run two to three more test loads and make sure the Ronan Weigh Scale is within the accuracy of the scale. (See original quote to determine the accuracy of your scale to your application).

Zero the totalizer

Using the Ronan local display or HART communicator find the Main Menu;
Scroll down until you reach and highlight *Reset Totalizer*.
Access Reset Totalizer by pressing the right arrow key.
Press the F4 key (OK) to the prompt '*WARNING – This will reset the Totalizer'*.
Press the F4 key (OK) to the prompt '*Totalizer Cleared* .

Pass a known amount of process through the Ronan X96S Weigh Scale
Access the totalizer by pressing the Status Display key (Top Right blue key with the mark >>>)
The line with 'Total Weight 0.00000' is the totalizer. If this option is not enabled you can return to the Main Menu and select 'Status Display' to assign one of the status display lines as Totalizer.
After you have passed a known amount of process through the scale, wait until the totalizer stops accumulating weight. Record this value (measured). Record the actual weight passed through the weight.

High Calibrate (Continued)

PROCEDURE (Option 1 Continued)

Calculate the new L.F. (Loading Factor) and input the value into the X96S
Using the Ronan local display or HART communicator find the Main Menu;
Scroll down until you reach and highlight *Calibration*.
Access Calibration by pressing the right arrow key.
Scroll down until you reach and highlight *Cal Weight*.
Access the Cal Weight by pressing the right arrow key.
Scroll down until you reach and highlight *Manual Entry*.
Access the Manual Entry by pressing the right arrow key. This value is the current L.F.
Calculate the new L.F. by using the following equation:

$$\text{New L.F.} = \frac{\text{(Current L.F. x Actual Weight)}}{\text{Measured weight}}$$

Access L.F. by pressing the right arrow key.
Use the arrow keys to select and change the display value to the calculated value. Once the displayed value is correct, press the F4 key (Enter).

Calibrate is complete.
The Mass Density Calibration is complete.

High Calibrate (Continued)

PROCEDURE (Option 2)

Placing a static load on the belt that you must weigh**)**:

Before proceeding, ensure that the belt is loaded with an up-scale loading at least 75% of maximum full-scale loading. **The up-scale loading may be obtained by placing a static load onto a stopped conveyor, in the radiation beam**. The loading in lbs/ft is obtained by taking the through-put in lbs/min and dividing by the speed (ft/min). The static loading should be a spread of material that covers at least two linear ft. of conveyor e.g., if the desired calibration loading is 20 lbs/ft, 2 ft. of loading is 40 lbs. The calibration is to be done with product spread evenly over the conveyor shaped to the natural slump of the product. The value of the calibration loading is assigned to the calibration after the gauge output is read on the measured material.

Using the Ronan local display or HART communicator find the Main Menu;
Scroll down until you reach and highlight *Calibration*.
Access Calibration by pressing the right arrow key.
Scroll down until you reach and highlight *Cal Weight*.
Access the Cal Weight by pressing the right arrow key.
Scroll down until you reach and highlight *High Calibrate*.
Access the High Calibrate by pressing the right arrow key.
Access the Calibrate by pressing the right arrow key.
Press the F4 key (OK) to the prompt '*Warning – Remove loop from automatic control before doing the calibrate procedure'*.
Press the F4 key (OK) to the prompt '*Verify that source is on, detector output is correct, and process is in calibrate condition'*.
Wait until the prompt changes from
'*Performing Calibrate procedure*' … *to 'calibrate SUCCESS. Remember to enter weight of the material*'.
Press the F4 key (OK).
Scroll down until you reach and highlight Cal *Weight 20.0000 lb/ft.* (Note 2*0.0000 lb/ft* value and units may very depending on the what value and units were selected.) (**Note: You must access the Cal Weight and either change or acknowledge the value to complete the High Calibration**.)
Access Cal Weight 20.0000 *lb/ft* by pressing the right arrow key.
Use the arrow keys to select and change the display value to the correct weight on the conveyor.
Once the displayed value is correct, press the F4 key (Enter).). The High Calibrate is complete.
The Mass Density Calibration is complete.

High Calibrate (Continued)

PROCEDURE (Option 3)

An alternative to calibrating with process material is to use an absorber plate. The procedure is much the same as that used for a process calibration, the only difference is that instead of material being placed on the belt, the equivalent absorber plate is inserted into the space provided and the value assigned to the plate is used as the calibration value. This value is determined after the scale has been commissioned on process. Once the weigh scale has been calibrated by option 1 or 2, the conveyor is then run emptied and the absorber plate is inserted into the space provided. The value displayed from the X96S Weight (lb/ft) is recorded and also is marked on the absorber plate. This value will be the absorber equivalent weight.

Insert the absorber plate into the space provided. **Run the conveyor empty at normal operating speed** during the high calibration.

Using the Ronan local display or HART communicator find the Main Menu;
Scroll down until you reach and highlight *Calibration*.
Access Calibration by pressing the right arrow key.
Scroll down until you reach and highlight *Cal Weight*.
Access the Cal Weight by pressing the right arrow key.
Scroll down until you reach and highlight *High Calibrate*.
Access the High Calibrate by pressing the right arrow key.
Access the Calibrate by pressing the right arrow key.
Press the F4 key (OK) to the prompt '*Warning – Remove loop from automatic control before doing the calibrate procedure*'.
Press the F4 key (OK) to the prompt '*Verify that source is on, detector output is correct, and process is in calibrate condition*'.
Wait until the prompt changes from
'*Performing Calibrate procedure*' … *to 'calibrate SUCCESS. Remember to enter weight of the material*'.
Press the F4 key (OK).
Scroll down until you reach and highlight Cal *Weight 20.0000 lb/ft.* (Note 2*0.0000 lb/ft* value and units may very depending on the what value and units were selected.) (**Note: You must access the Cal Weight and either change or acknowledge the value to complete the High Calibration**.)
Access Cal Weight 20.0000 *lb/ft* by pressing the right arrow key.
Use the arrow keys to select and change the display value to the correct weight that the absorber plate represents. Once the displayed value is correct, press the F4 key (Enter).).
Verify the status screen is displaying the correct weight. If not repeat the calibration procedure again.
Once the high calibration is finished, do not forget to **remove the absorber plate**. Make sure you store away the absorber plate for future calibration.
The High Calibrate is complete.

The Mass Density Calibration is complete.

For future reference, document these items:

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

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

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

Configuration

Ronan ships the Weight Scale 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 weight readings. The list below summarizes the activities that are detailed in the remainder of this chapter:

- Check the factory-default settings to be sure they are appropriate for your circumstances. IF NOT, make the necessary changes and document those changes for future reference.
- Perform an initial calibration to correlate the X96S's output to the actual process rate/weight
- 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

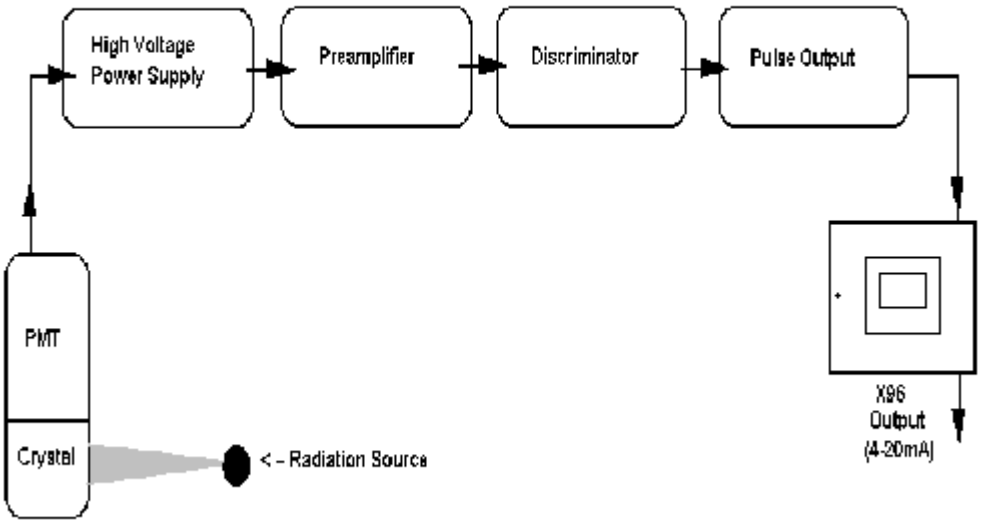
The PMT is a light sensitive vacuum tube with a photosensitive layer that converts the light pulses to an electrical current. Light pulses from the crystal strike the photosensitive layer and release electrons. A high voltage power supply connected to the photosensitive layer accelerates the electrons 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 ·A, so an electrometer amplifier is required to convert the current to a low-impedance, high level voltage signal. The signal is then measured by the X96S Microprocessor, which converts the voltage signal to a output of 4-20mA for a specified measuring range.

Circuit Description

The current (I), generated by the ion chamber, is fed into the inverting input terminal of the electrometer amplifier, (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.

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.

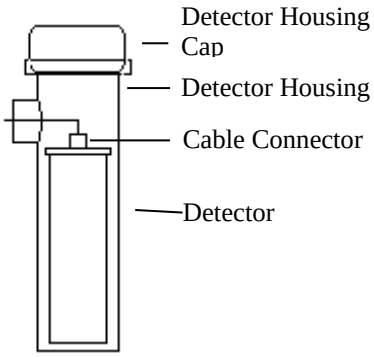
Servicing the Detector

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."

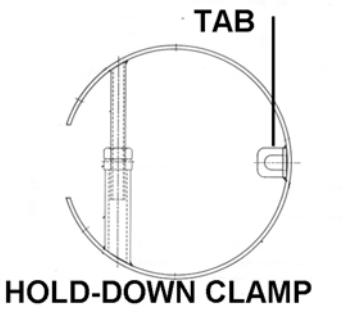
However, a qualified technician can troubleshoot and service the detector's amplifier assembly. Some precautions are needed when handling the detector/amplifier assembly.

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.



ELONGATED DETECTOR NOTES:

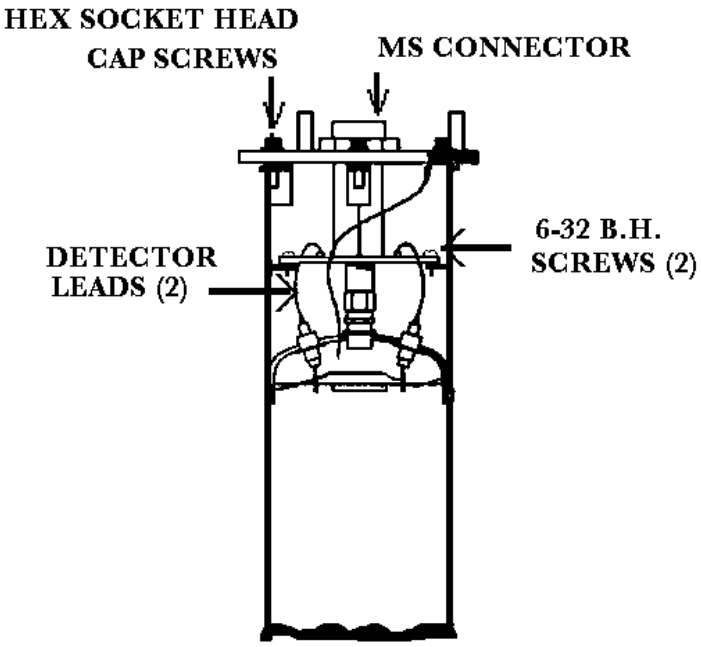
To avoid damage in shipment or installation, the elongated detector is packaged separate from the housing. Avoid subjecting detector to mechanical shock. Avoid supporting detector by its chain handle, or other lifting devices, for prolonged periods of time.

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.

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

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.

Electronics (Spare Parts)

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

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

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

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

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

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

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

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

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

X96-2008PL
X96-2008PL is the Digital Input/Output Module. The module provides a total of 16 bits of digital I/O and wetting/encoder power. Eight (8) isolated digital inputs are provided. These inputs can be configured for use as:

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

[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 volt 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.

The 24 volts DC provided is 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 Scintillation Detector Interface Module. This optional[5] module provides:
- 1 isolated scintillation input (pulse counter, max signal 0-12[6] V, threshold 0.6 V)
- 1 head temperature input (1 uA per K°)
- 1 non-isolated RTD (3-wire) input
- isolated power for the scintillation detector 24 V 40 mA supply[4]

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).

X96C148-1
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-SP is a CPU Module that comes without firmware.

[5] At least one detector interface module is required.
[6] 8.6 V nominal.
[7] The power supply can control the power to the scintillation detector:
- when commanded by the CPU module,
- when the processor on the module detects a condition that could harm the scintillation detector,
- when the watchdog timer generates a reset.

Options

X96S Mechanical Chassis Part Numbers

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

X96S Electronic Module Part Numbers

PART NUMBER	DESCRIPTION
X96-2001PL-SP	X96S CPU Module
X96-2003-01PL	X96S Ionization Chamber Input
X96-2003-2PL	PCB Assembly, Analog Input, 0-5 Volt on both channels
X96-2003-3PL	PCB Assembly, Analog Input, 0-20mA on both channels
X96-2003-4PL	PCB Assembly, Analog Input, Two wire transmitter
X96-2003-5PL	PCB Assembly, analog Input, 0-15 volt on both channels
X96-2004PL	X96S 2-Channel 4-20 mA Analog Output Module
X96-2005PL	X96S HART Daughter Module
X96-2008PL	X96S 8-Channel Digital Input Module, 8-Channel Digital Output Module (4 Transistors + 4 Relays)
X96-2009PL1	X96S Scintillation Detector Board with modification (Cap -11004 & 1018)
X96-2009PL2	X96S Scintillation Detector Board modified for 0-20mA input instead of RTD
X96-2009PL3	X96S Scintillation Detector Board modified for 0-10V DC input instead of RTD
X96-2029PL	PCB Board, Mold Level, Input/Output for Scintillation
X96C148	X96S 85V to 230V Power Supply Module
X96C148-2	X96S 24 V DC Power Supply Module
X96C148-4	X96S 12V DC “in”, 24 V DC “out”, 50-watt Power Supply Module

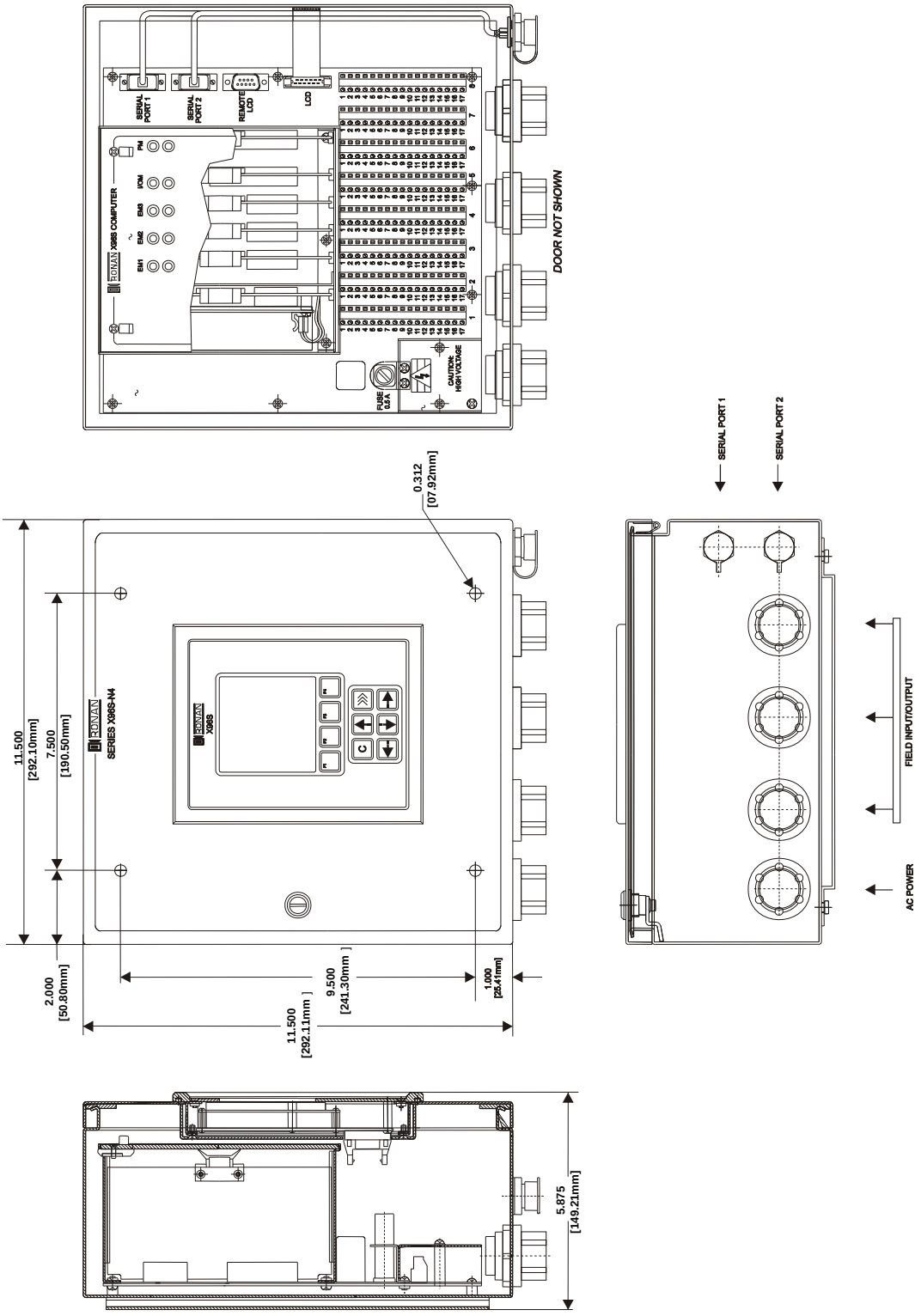
RONAN
ENGINEERING COMPANY
MEASUREMENTS DIVISION

SPECIFICATIONS

MODEL X96S

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

Drawings


SERIAL PORT 1
SERIAL PORT 2
REMOTE LCD
LCD
DOOR NOT SHOWN
0.312
[07.92mm]
SERIAL PORT 1
SERIAL PORT 2
FIELD INPUT/OUTPUT
AC POWER
11.500
[292.10mm]
7.500
[190.50mm]
SERIES X98S-H4
2.000
[50.80mm]
9.500
[241.30mm]
1.000
[25.41mm]
11.500
[292.11mm]
5.875
[149.21mm]

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