KRILPRO

Neutron Backscatter Foam Level/Interface Device
User Guide
P/N 717908

Revision H

Part of Thermo Fisher Scientific

Thermo SCIENTIFIC

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User Guide
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Thermo
S C I E N T I F I C

Revision History

Revision Level	Date	Comments
A	10-2007	Initial release (ERO 6001).
B	02-2008	Revised per ECO 6206.
C	05-2008	Revised per ECO 6363.
D	07-2008	Revised per ECO 6479.
E	11-2008	Revised per ECO 6684.
F	08-2010	Revised per ECO 7456.
G	09-2010	Revised per ECO 7504.
H	09-2020	Revised per ECO 9998

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Contents

Safety Information & Guidelines

This chapter contains information that must be read and understood by all persons installing, using, or maintaining this equipment.

Safety Considerations

Failure to follow appropriate safety procedures or inappropriate use of the equipment described in this manual can lead to equipment damage or injury to personnel.

Any person working with or on the equipment described in this manual is required to evaluate all functions and operations for potential safety hazards before commencing work. Appropriate precautions must be taken as necessary to prevent potential damage to equipment or injury to personnel.

The information in this manual is designed to aid personnel to correctly and safely install, operate, and / or maintain the system described; however, personnel are still responsible for considering all actions and procedures for potential hazards or conditions that may not have been anticipated in the written procedures. **If a procedure cannot be performed safely, it must not be performed until appropriate actions can be taken to ensure the safety of the equipment and personnel.** The procedures in this manual are not designed to replace or supersede required or common sense safety practices. All safety warnings listed in any documentation applicable to equipment and parts used in or with the system described in this manual must be read and understood prior to working on or with any part of the system.

Failure to correctly perform the instructions and procedures in this manual or other documents pertaining to this system can result in equipment malfunction, equipment damage, and / or injury to personnel.

7200A Safety Cover Notice

Warning Read and abide by all safety precautions when handling nuclear devices. It is the operator's responsibility to understand and follow all safety precautions. ▲

Each 7200A unit will be shipped with one safety cover with fastening hardware and packaged within the shipping container. The image below shows what this cover looks like when it is not installed and where it should be installed. The safety cover kit assembly part number is 341-720001 and includes the safety cover and fasteners. Install the safety cover only if removing the 7200A source housing unit for service or repair. Install the cover with the text facing outward.

Warning Since this top hat unit contains a nuclear source, the cover must be installed immediately after the source housing is removed. Failure to do so can result in exposure to radiation if you reach into the top hat, intentionally or unintentionally. ▲

Do not discard the safety cover and fasteners for any reason. If the safety cover and fasteners are missing, contact Thermo Fisher immediately to order a new safety cover kit.

SOURCE HOUSING

TEXT
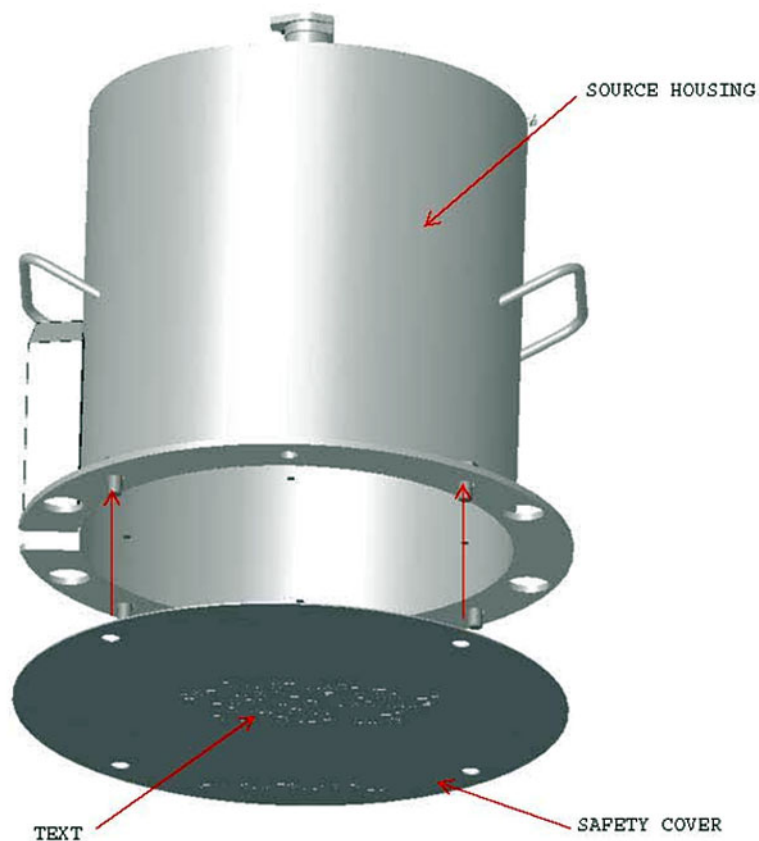
SAFETY COVER

Safety cover for 7200A unit

Boron Trifluoride Gas (BF3)

The ion chamber detector may be filled with Helium-3 (He3) or Boron Trifluoride (BF3) gas. If the detector is filled with BF3, it is critical to read this section carefully. The type of gas is identified on the instrument housing.

Warning BF3 is a pungent smelling, toxic, corrosive gas with a suffocating odor. Inhalation will cause moderate to severe irritation or burns to the respiratory system. Appropriate precautions must be taken to ensure the safety of personnel. ▲

Warning If exposed to extremely high temperatures, BF3 can decompose and generate irritating vapors and toxic gases. ▲

Warning Health risks vary depending on duration and level of exposure. Exposure to 50 ppm, for example, may be fatal if inhaled for 30–60 minutes (due to massive inflammation and congestion of the lungs). Inhalation of lower concentrations of BF3 can lead to nose and throat irritation. Respiratory equipment and other personal protection equipment must be used. ▲

BF3 is a colorless, fuming, pungent smelling gas. It is heavier than air and fumes strongly in moist air, producing a dense, white cloud of fluoroboric acid mist. The odor and dense, white appearance of this gas, upon release, are distinctive warning properties associated with it.

Warning Fluoroboric acid mist can burn the skin or eyes. Burns may not be immediately painful or visible. Depending on the exposure, effects can be immediate or delayed. Skin contact can lead to pain, redness, and burns. Eye contact may result in blindness. Personal protection equipment must be used. ▲

Warnings, Cautions, & Notes

The following admonitions are used throughout this manual to alert users to potential hazards or important information. **Failure to heed the warnings and cautions in this manual can lead to injury or equipment damage.**

Warning Warnings notify users of procedures, practices, conditions, etc. which may result in injury or death if not carefully observed or followed. The triangular icon displayed with a warning varies depending on the type of hazard (general, electrical, radiation). ▲

Caution Cautions notify users of operating procedures, practices, conditions, etc. which may result in equipment damage if not carefully observed or followed. ▲

Note Notes emphasize important or essential information or a statement of company policy regarding an operating procedure, practice, condition, etc. ▲

Quick Setup

The following procedure assumes that the unit has been correctly wired and installed (reference KRILPRO installation guide, p/n 717909) and that the software version is 5.05 or later. This procedure provides a basic setup that is adequate for most applications. For additional information, refer to the remainder of this guide.

Follow these steps to configure and calibrate the gauge for a primary measurement of "%".

1. Set up the gauge:

   a. Use direct access code (DAC) **82** to erase memory.

   b. Use DAC **1003** to load the KRILPRO setup data.

2. Calibrate the gauge:

   a. With the coke drum approximately two hours into the preheat cycle, use DAC **80** to perform the calibration cycle for Cal Point 1.

   b. With the coke drum in the quench cycle (water in the drum), use DAC **003004** to set the calibration point to Cal Point 2. Then use DAC **80** to perform the calibration cycle for Cal Point 2.

Note For instructions on using direct access codes, refer to "The Direct Access Method" in Chapter 2. ▲

Chapter 1
Product Overview

Introduction The Thermo Scientific KRILPRO neutron backscatter foam level / interface device consists of the Thermo Scientific 7200A neutron sensor housing and 1400S transmitter. The 7200A neutron sensor contains a neutron source and an ion chamber detector package with signal conditioning electronics. The 7200A neutron sensor provides a milliamp output signal that is proportional to the hydrogen density in front of the gauge. The 1400S transmitter is a microprocessor-based system that processes the milliamp signal from the 7200A head to provide percent level signal output, readout, and optional relay alarms. The figure below depicts a typical system.
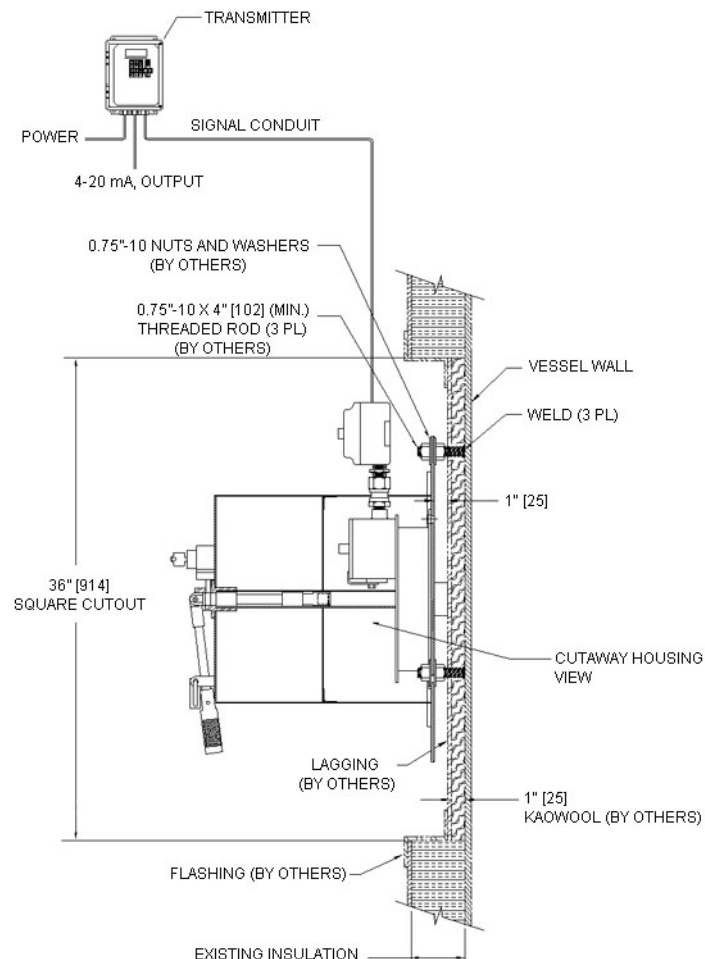
Figure 1–1. Typical system

Function

KRILPRO Sensor Overview

The neutron source is contained in a capsule and emits fast neutrons. A two-position lever controls the location of this capsule. In the closed position (OFF), the capsule is located in the center of the housing and the radiation outside the housing is minimized. In the ON position, the capsule is located at the front edge of the housing close to the vessel wall. Fast neutrons go through the vessel wall and bounce off the bulk product. The hydrogen, carbon, and oxygen of the bulk product act as neutron moderators (slowing down the neutrons), with the hydrogen being significantly more effective at this task than the carbon or oxygen. The number of slow neutrons being scattered back towards the detector will depend on the nature and the density of the material present in the vessel in front of the gauge. The greatest number of backscattered neutrons will be when water / coke is in front of the sensor, and the smallest number of backscattered neutrons will be when the vessel is empty. Heavy hydrocarbon foam will give a bigger signal than light hydrocarbon foam. The slow neutrons are detected with a gas-filled ionization chamber. The gas becomes ionized, and the charged ions are collected on the center electrode, producing a small picoamp (10^{-12} A, ρA) current. This current is amplified and sent to the transmitter as a 0–20 mA signal. The transmitter then calculates the percentage of full scale from the signal and the calibration constants and provides a 4–20 mA DC output signal proportional to the percentage of full scale.

Neutron Source

The 7200A housing contains the neutron source. A two-position shutter mechanism controls the amount of energy that is radiated outside the housing. When the shutter is closed and locked (OFF), the source is retracted, allowing for the safe storage, shipping, and installation of the instrument. With the shutter open (ON), the source has been moved towards the vessel to be measured.

Thermo Fisher uses Americium 241: Beryllium (Am241:Be). The isotope is doubly encapsulated in stainless steel. These capsules are Tungsten Inert Gas welded and nitrogen leak tested. They are then secured in the center of the housing.

Due to the precautions taken during manufacture, the chance of leakage is remote. However, the United States Nuclear Regulatory Commission (NRC) requires that the source housing be leak tested at regular intervals, not to exceed three years. Canadian regulations require that leak test intervals not exceed one year. Refer to the Neutron Radiation Safety Guide (p/n 717905) for further information. Thermo Fisher is licensed to perform these tests and can do so through contract services. The first test or "wipe" is done at start-up by licensed personnel or a qualified representative.

If the source housing is damaged or the system is abandoned, the source housing must be disposed of properly. Regulations for the NRC, U.S. Department of Transportation, and the Canadian Nuclear Safety Commission are continuously being updated; contact Thermo Fisher for information on proper source disposal.

Neutron Detector

The neutron sensor is contained within the source housing. It is a slow neutron ion chamber detector that is filled with He3 or BF3 gas.

Warning BF3 is a pungent smelling, toxic, corrosive gas with a suffocating odor. Inhalation will cause moderate to severe irritation or burns to the respiratory system. Appropriate precautions must be taken to ensure the safety of personnel. ▲

The geometry of the source and detector provides maximum instrument sensitivity and efficiency, while minimizing externally radiated energy. This geometry also minimizes the effects of external radiation sources on the detector.

A negative potential is applied to the inside wall of the ion chamber. When the neutrons strike the gas in the detector, it becomes ionized. The voltage potential forces the charged ions to collect on the center electrode, producing a ρA current that is directly proportional to the incident neutron intensity detected.

Transmitter

The 1400S transmitter uses the signal from the detector to calculate the percent signal. This value, as well as the signal value, can be displayed, sent to serial ports, or used to drive current outputs and alarms. The transmitter also monitors system performance and generates system fault and warning alarms.

Note Refer to the equipment tag on the instrument to verify the hazardous location certifications. ▲

Communications & the Display

The integral keypad on the transmitter is normally used as the primary means of communication with the instrument. Menu selections, commands, and parameter values are entered using the keypad. The transmitter has a four-line display that shows either one menu item or up to eight readouts in alternation (four at a time).

The RS232 serial port can also be used to communicate with the instrument using a PC with terminal emulation software.

Inputs & Outputs

Refer to the following table.

Table 1–1.

Type	Characteristics	Comments
Transmitter input power	AC: 115/230 Vac (100–240 V), 50/60 Hz, 17.2 W DC: 24 Vdc (20–28 V), 12 W	Unit can be operated with AC or DC power or with DC as a backup power source.
Current output	3.8–20.5 mA DC (adjustable operating range) 　　Configurable as: 　　Isolated, self-powered or 　　Isolated, loop-powered (user-supplied 24 Vdc loop power input) Maximum load: 700 ohms	Default range is 4–20 mA DC. One current output standard. Maximum of two additional current outputs. Self-powered configuration is standard. Configure as loop-powered by removing a jumper.
Serial communications	RS232: 1 terminal block	Full duplex communication with remote terminal or PC.
Current input	0–20 mA DC current input from 7200A neutron detector head	The VPI board is required for powering the neutron detector head and for the input signal coming from that same detector head.
Relays	2 optional relays on each I/O board, Form C SPDT, isolated, 8 A, 220 Vac	Maximum of 6 relays. Assign process alarms to control relays.
Display	Backlit, 4-line x 20-character LCD	English language setup menus.

Output Signals   You can assign any measurement to the 4–20 mA current output, or you can have the measurement values sent to a remote terminal or host computer as serial data. One current output is provided on the standard I/O board, and two additional current outputs (one per I/O board) are available.

Two optional relay outputs can be provided on each I/O board.

Associated Documentation

In addition to this guide, the following documents must be read and understood by all persons installing, using, or maintaining this equipment:

● KRILPRO installation guide (p/n 717909)

● Neutron Radiation Safety (p/n 717905)

Chapter 2
Getting Started

The integral keypad and display on the transmitter are normally used to communicate with the instrument.

Optional Serial Communication Setup

The RS232 serial port provides an alternate communication method by supporting communication with the instrument via a PC with terminal emulation software. The optional TMTComm software enables you to upload instrument setup parameters to a PC and then download a previously saved file to the instrument.

Connect the serial port on a PC directly to the instrument's RS232 port. The default communication settings for the instrument are 7 data bits, even parity, 1 stop bit, and 9600 baud. Reference "Serial Port Setup" in Chapter 8 for instructions on setting up serial communications.

Gauge Operation
Initial Power-Up

The first time you apply power to the instrument, the message below is displayed on the transmitter. If the display is blank, refer to Chapter 11 for troubleshooting.

```
 Unit has not
 been set up!

 For setup, press →
```
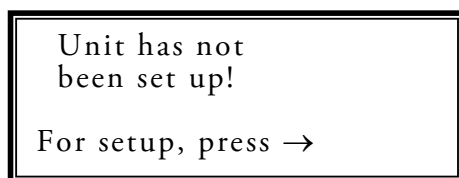
Figure 2–1.

Entering Data

Following are descriptions of the keys used to operate the instrument:

Table 2–1.

Key	Action
Right arrow	Press to enter the setup menus and to step through the top-level menu headings. Also use to scroll through the list of menu options.
Up arrow	Return to the previous menu item or scroll through menu items in the reverse direction.
Left arrow	Press to return to the previous option.
Down arrow	Press to select an option and continue to the next menu item.
Period	Press once to enter a decimal. Press twice to enter the decimal in scientific notation. If you are entering data from a terminal keyboard, you can press **E** or **e** before entering the exponent value rather than pressing the period key twice.
Number keys	Press to enter data values.
Minus sign	Press to indicate a negative number.

The Setup Menus

The setup menus take you through the steps for entering the data required for instrument operation. In each menu item, data values that can be entered or changed are flashing. When accessing the setup menus, the display times out and returns to the measurement display if no entries are made for five minutes. Changes or entries you made up to that point are saved and used by the instrument. Continue with the setup by using the arrow keys to return to the menu most recently accessed.

To exit the setup menus, press the **EXIT SETUP** key on the transmitter keypad. This saves any changes you made and returns you to the measurement display.

The Direct Access Method

With the direct access method, users input codes to view or change parameters or to issue commands to the transmitter. This method allows you to bypass the menu structure and directly access a specific menu item. In order to use the direct access method, you must know the direct access code (DAC or the keypad code) for the desired parameter or command. For example, **007004** is the DAC for the time constant and **80** is the command DAC used to calibrate a selected point. The parameter DACs have six digits, and the command DACs have one, two, or three digits.

Note Use the direct access method with caution. When entering or changing a parameter value for one menu item, you may also need to enter or modify the value of other menu items. ▲

Note Appendix D provides a table of common direct access codes. ▲

Changing or Viewing Parameters

This section will show you how to change a parameter using the direct access method. In this example, change the default value of the time constant (128 seconds) to 30 seconds. The DAC for the time constant is **007004**.

1. Press: **EXIT SETUP, 007004, down arrow.**

2. Read the current value.

    a. To leave the value as is, press **EXIT SETUP**, and the gauge will return to its normal display mode.

    b. To change the value to 30 seconds, enter **30** and press the **down arrow**.

3. Press **EXIT SETUP** to store the new value. The gauge will begin using the new value immediately and will return to normal display mode.

Issuing Commands

This section will show you how to issue commands using the direct access method. In this example, force the current output to 20 mA. The command DAC is **5**.

1. Press: EXIT SETUP, 5, down arrow.

2. The display shows two options. Press the left arrow to reject the command or the right arrow to execute it.

3. Press the **right arrow** to execute the command. The current output is now 20 mA.

Resetting Factory Defaults

If the display shown in Figure 2–1 is not displayed upon power-up, the instrument has been at least partially set up. If you do not want the instrument to use these settings or if the instrument has been moved to a new location, you can restore factory defaults.

Use command DAC 82 (Erase All Entries Except COMM Setup) to reset all user entries except communication settings to factory defaults. Use command DAC 74 (Erase All Entries) to reset all user entries including communication settings to factory defaults.

Additional Menu Items

The menu structure contains two "layers" of menu items. The user layer is the default layer and is adequate for most applications. The service layer provides numerous special purpose menu items and can be enabled using the Special Functions menu.

Saving Entries

If you exit the setup menus at any time, any changes or entries you made are automatically saved and used by the software. To exit the setup menus, press **EXIT SETUP** on the transmitter keypad.

If you do not exit the setup menus, entries or changes are stored and used by the software after five minutes of inactivity.

Chapter 3
Setup & Calibration

Basic Setup

The following procedure assumes that the unit has been correctly wired and installed (refer to the KRILPRO installation guide) and that the software version is 5.05 or later. The steps below provide a basic setup that is adequate for most applications. If this setup is inadequate for your application, contact Thermo Fisher.

1. **Check the jumper settings.**

   Before setting up the software, check the VPI board jumper settings. The VPI board is located inside the transmitter on the right. In order to operate the KRILPRO, the jumper must be on JP1 (ion chamber). A main function of this jumper is to tell the software to use input 8 for the signal.

   The other jumper locations are JP2 and JP3.

   Note JP2 and JP3 should not have a jumper attached. ▲

   Caution Changing this jumper while power is applied may result in destruction of the VPI board. If the jumper needs to be relocated, remove power from the transmitter, relocate the jumper, and then reapply power to the transmitter. ▲

2. **Load the KRILPRO setup parameters.**

   Press: **EXIT SETUP, 1003, down arrow, right arrow, right arrow.**

   Once the setup is loaded, the display will show "-999.9%". This is normal, as calibration has not yet been done.

   The unit is setup and ready for calibration.

Calibration

Calibration consists of acquiring two process calibration points. The first calibration point is done with the vessel approximately two hours into the preheat cycle, but with actual level below the gauge location. The second calibration point is done during the quench cycle, when either water or coke will be in front of the gauge. This point is defined as the 95% level point.
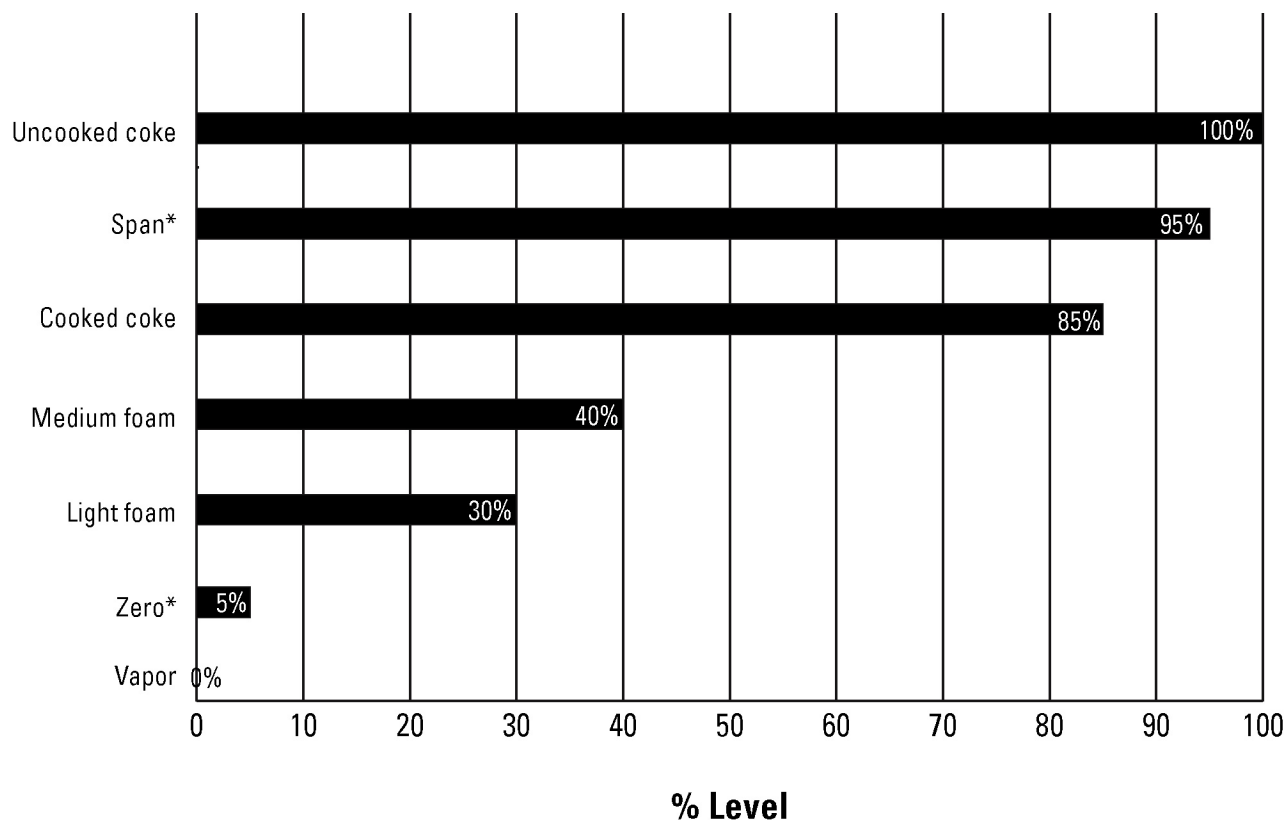
1. **Obtain calibration point 1.** Perform this step when the drum is closed, heated, approximately two hours into the preheat cycle, and when the level is guaranteed to be below the level of the gauge.

   a. Enter the Level Gauge Calibration menu. Press: **right arrow, up arrow, right arrow.**

   b. Access the "Next cal cycle will be point 1" screen. Press: **down arrow three times.** Verify the calibration point shown is 1.

   c. Access the "Start calibration cycle" screen. Press: **down arrow two times.**

   d. Begin the calibration cycle. Press: **right arrow.** A timer will appear on the display and count down from 1024 seconds.

   e. When the calibration cycle is finished, the display will show "5.0%" on the top line.

Caution The level indication will change during the fill and cooking cycles. These indications are not reliable until the second calibration point is obtained. Therefore, do not use the gauge for process control until calibration point 2 is obtained. ▲

2. **Obtain calibration point 2.** Perform this step when the drum is finished cooking and has been filled with water for the quench cycle.

   a. Enter the Level Gauge Calibration menu. Press: **right arrow, up arrow, right arrow.**

   b. Access the "Next cal cycle will be point 1" screen, and change to calibration point 2. Press: **down arrow three times, right arrow.**

   c. Access the "Start calibration cycle" screen. Press: **down arrow two times.**

   d. Begin the calibration cycle. Press: **right arrow.** A timer will appear on the display and count down from 1024 seconds.

   e. When the calibration cycle is finished, the display will show "95.0%" on the top line.

The gauge is now fully calibrated and can be placed into service. The percent span reading indicates the density of material in front of the sensor in the coke drum. Refer to the graph below.
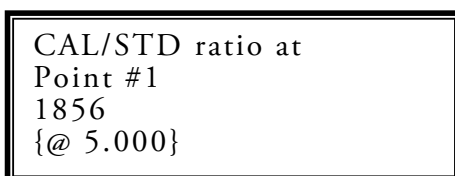
Material	% Level
Uncooked coke	100%
Span*	95%
Cooked coke	85%
Medium foam	40%
Light foam	30%
Zero*	5%
Vapor	0%

% Level

*May fluctuate slightly

Figure 3–2.

Reviewing Calibration Points

The signal stored in memory for calibration points #1 and #2 should be viewed and recorded for future troubleshooting.

For calibration point #1

Press: **EXIT SETUP, 120013, down arrow, view or record the number, EXIT SETUP** (to return to normal display mode).
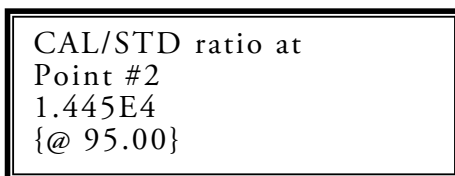
The value shown below (1856) is an example only.

```
CAL/STD ratio at
Point #1
1856
{@ 5.000}
```

Figure 3–3.

For calibration point #2

Press: **EXIT SETUP, 120023, down arrow, EXIT SETUP** (to return to normal display mode).

The value shown below (1.445E4) is an example only.

```
CAL/STD ratio at
Point #2
1.445E4
{@ 95.00}
```
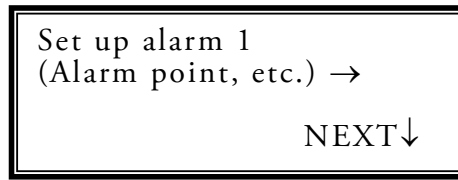
Figure 3–4.

CAL / STD ratio point 1: _____

CAL / STD ratio point 2: _____

Chapter 4
Alarm Setup

The Set up Alarm 1 submenu heading appears in the Set up Level and Level Alarms menu. Enter this submenu to set up an alarm.
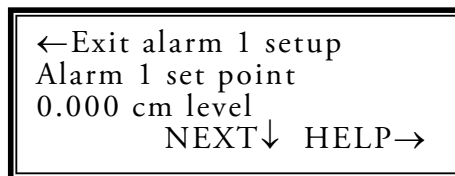
```
┌─────────────────────────────────┐
│ Set up alarm 1                  │
│ (Alarm point, etc.) →           │
│                                 │
│                       NEXT↓     │
└─────────────────────────────────┘
```

Figure 4–1.

This subgroup allows you to assign and set up a process alarm for the level measurement. You can define up to 16 process alarms. It is recommended that you keep a record of each alarm set up (assigned measurement, set point, clear point, alarm action) for future reference.

Note If relays are not installed, the Set up Relay menu item is not displayed. You can still set up a process alarm to perform other functions, such as executing a command. See "Special Functions" in Chapter 8 for details on enabling alternate alarms. ▲

The Menu Items

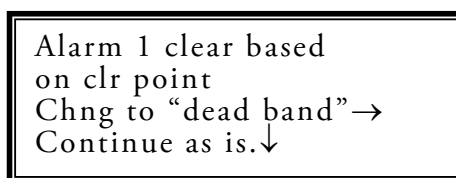1. Enter the level at which the alarm will activate.

```
┌─────────────────────────────────┐
│ ←Exit alarm 1 setup             │
│ Alarm 1 set point               │
│ 0.000 cm level                  │
│           NEXT↓  HELP→           │
└─────────────────────────────────┘
```

Figure 4–2.

Note Enter a set point to activate the remaining menus in this subgroup. ▲

2. Select a clear point or dead band configuration.

```
Alarm 1 clear based
on clr point
Chng to "dead band"→
Continue as is.↓
```
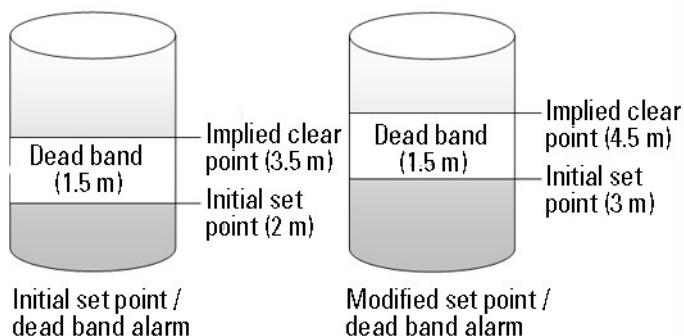
Figure 4–3.

Clear Point or Dead Band

An alarm is defined with either a set point/clear point configuration or a set point/dead band configuration. The set point defines the measurement value at which the alarm is activated. The clear point or the dead band defines the measurements at which the alarm is cleared.

A clear point sets a fixed measurement value at which the alarm clears. The position of the clear point is independent of the set point and remains the same even if the set point is moved. This is illustrated in Figure 4–4 as changing the set point from 3.0 m to 3.5 m has no effect on the clear point.

A dead band defines a fixed distance between the set point and an implicit clear point. If the set point is moved, the implicit clear point moves as well, maintaining the distance from the set point specified by the dead band. Figure 4–4 also shows that changing the set point from 2 m to 3 m moves the implied clear point from 3.5 m to 4.5 m. The relative distance between the implied clear point and the set point remains fixed at 1.5 m (dead band value).

Use a clear point configuration if you want to be able to change the alarm set point in the future without affecting the alarm clear point. Use a dead band configuration if you want the alarm clear point to remain at a fixed distance relative to the set point.

Figure 4–4.

Alarm Setup
The Menu Items

Enter the desired clear point value (the level at which the alarm clears) or the span of the dead band relative to the set point. The relative values assigned to the set point and the clear point determine whether the alarm is low limit or high limit.

3. Enter the desired clear point value or the span of the dead band relative to the set point, if dead band was selected.

```
Alarm 1 clear point
0.00 cm level
{Makes alarm "Low"
limit}    NEXT↓ HELP→
```
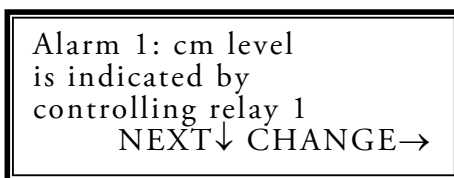
Figure 4–5.

Low & High Limit Alarms

If you enter a set point value less than the clear point or if the dead band value is positive, the alarm is a low limit alarm and is activated as the measurement value decreases below the set point value. The alarm remains active until the measurement value goes above the clear point value.

If you enter a set point value greater than the clear point or if the dead value is negative, the alarm is a high limit alarm and is activated as the measurement value increases above the set point value. The alarm remains active until the measurement value drops to the clear point value.

These terms, low limit and high limit, refer to the relative magnitude of the set point and the clear point, not necessarily to a low or high level. Alarm behavior depends on the measurement associated with the alarm. Thus, a low limit alarm (set point is less than clear point) for an ullage (unfilled volume) measurement corresponds to a high limit level alarm. The low limit ullage alarm is trigged when the unfilled volume drops below the clear point and reaches the set point value. A decreasing value for the ullage corresponds to an increasing value for the level measurement.

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4. Select the action used to indicate that alarm 1 has been triggered.

```
Alarm 1: cm level
is indicated by
controlling relay 1
      NEXT↓ CHANGE→
```
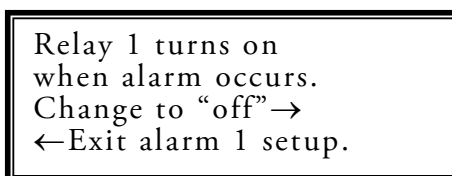
Figure 4–6.

Alarm Indicators

This menu item allows you to specify the action used to indicate that the alarm has been triggered. The default is to do nothing. Other options are listed below.

● Control relay 1: Turns the relay on when alarm is activated and off when alarm clears. This option is only displayed if relays are installed and is repeated for each relay installed.

If selected, the item shown below is displayed. By default, the relay turns on when the alarm activated and off when the alarm clears.
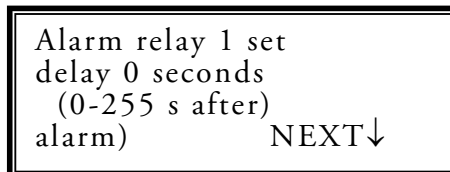
```
Relay 1 turns on
when alarm occurs.
Change to "off"→
←Exit alarm 1 setup.
```

Figure 4–7.

● Meas #1 dspy flash: Flashes Meas #1 on the display while the alarm is active. This selection is repeated for each defined measurement.

● Out1 to FAULT LOW: Holds the current output at Fault Low value (3.6 mA or less) while the alarm is active.

● Out1 to FAULT HIGH: Holds the current output at Fault High value (21.0 mA or greater) while the alarm is active.

● Outputs to alt: Switches the current output(s) to Alternate mode (if defined).

● #1 act on ALM action: Executes the command assigned as the "#1action" (if one is assigned) when the alarm is activated. This option is repeated for #2 and #3 actions if actions have been assigned.
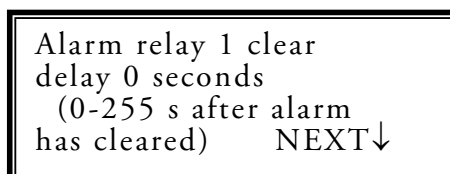
5. The Special Relay Controls items are displayed only if the corresponding relay related options are enabled in the Special Functions menu (Chapter 8).

   a. Enter the length of time that the activate alarm condition must be present before the alarm is activated.

   ```
   Alarm relay 1 set
   delay 0 seconds
     (0-255 s after)
   alarm)         NEXT↓
   ```
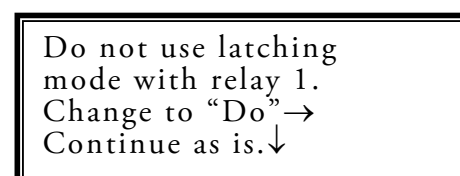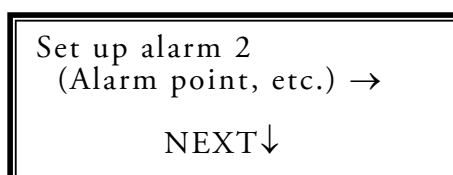
   Figure 4–8.

   b. Enter the length of time that the alarm clear condition must be present before the alarm is cleared.

   ```
   Alarm relay 1 clear
   delay 0 seconds
     (0-255 s after alarm
   has cleared)     NEXT↓
   ```

   Figure 4–9.

   c. When latching is enabled for a relay, the relay remains in the alarm state when the alarm clears. The relay state only clears when you enter a Clear Alarms command or when power is turned off.

   ```
   Do not use latching
   mode with relay 1.
   Change to "Do"→
   Continue as is.↓
   ```

   Figure 4–10.

6. After you set up an alarm, you are prompted to set up the next alarm. You can define up to 16 alarms. Press the right arrow to set up another alarm, and repeat the steps in this procedure.

   ```
   Set up alarm 2
     (Alarm point, etc.) →

           NEXT↓
   ```
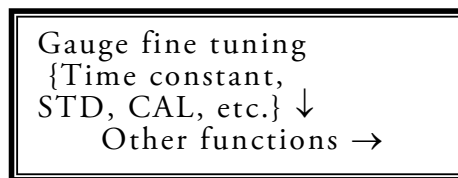
Figure 4–11.

Chapter 5
Gauge Fine Tuning

After completing the basic setup, you can use the fine tuning menus to modify the gauge's time constant or to perform additional standardization cycles.
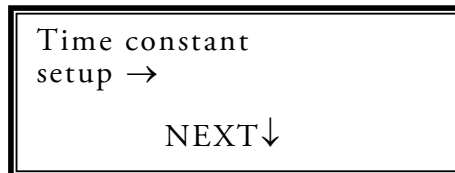
```
Gauge fine tuning
 {Time constant,
STD, CAL, etc.} ↓
      Other functions →
```

Figure 5–1.

Press the **right arrow** to access the related menu items.

Time Constant Setup

The Time Constant Setup menu item lets you modify the gauge time constant and related items.

1. Press the **right arrow** to access the related menu items.

```
Time constant
setup →

      NEXT↓
```

Figure 5–2.

2. Enter the time constant. The default setting for the time constant is 60 seconds.

```
Level signal
time constant
60 sec
      NEXT↓  HELP→
```
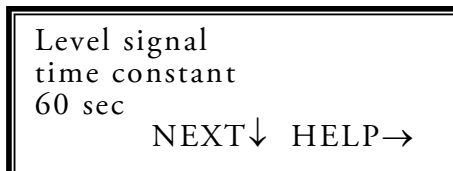
Figure 5–3.

Time Constant

A certain amount of noise or fluctuation is inherent in any radiation-based measurement. The effectiveness of the instrument's filtering to reduce the effect of statistical variations in the radiation measurement depends on the (primary) time constant.

Increase the signal time constant to improve the measurement stability at the expense of increasing the response time of the instrument to process changes. The larger the time constant, the less variability (due to randomness inherent in counting radiation events) in the measurement. Decrease the time constant to improve the instrument's response at the expense of increased measurement fluctuations. The time constant also determines the cycle time for standardization and calibration.

3. **Disable dynamic tracking during normal operation.** This is a service only item.

```
Do not disable
dynamic tracking
Change to "Do"→
Continue as is.↓
```
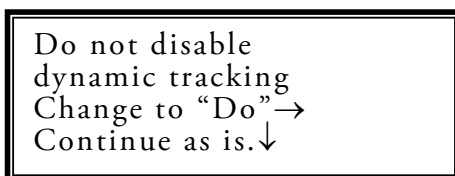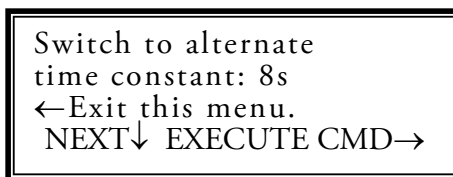
Figure 5–4.

4. The Source Half Life screen is only displayed if you have enabled service only items. The instrument uses this value to adjust the standardization value for source decay.

```
Source half-life
458.00 yr

        NEXT ↓
```
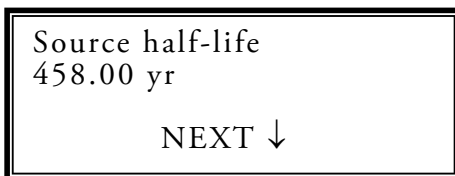
Figure 5–5.

5. The default alternate time constant is 8 seconds. This value is typically set to a much shorter time than the primary time constant. During periods when the process is known to be changing, switching from the primary time constant to the shorter, alternate time constant makes measurements more responsive but less stable. Switch to the longer time constant when the process has again stabilized to increase the measurement stability.
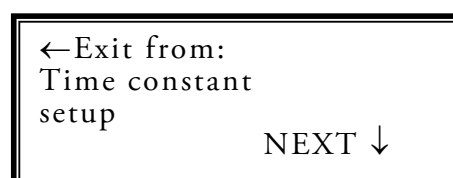
```
Switch to alternate
time constant: 8s
←Exit this menu.
 NEXT↓  EXECUTE CMD→
```

Figure 5–6.

The alternate time constant is not used for any instrument function until you enable it from this menu item.

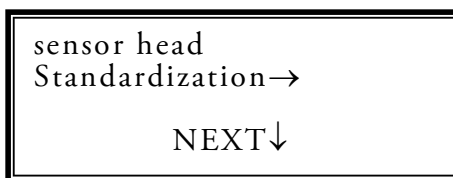6. Press the left arrow to exit this group of menu items.

```
 ←Exit from:
 Time constant
 setup
              NEXT ↓
```
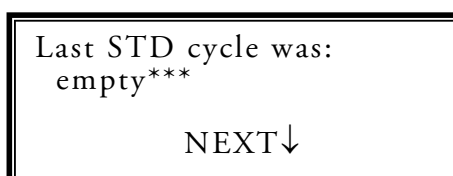
Figure 5–7.

Sensor Head Standardization

1. To standardize, the drum must be full of water and the shutter must be in the MEASURE position, access the sensor head standardization menu item. Press the right arrow to access the menu items.

```
sensor head
Standardization→
         NEXT↓
```
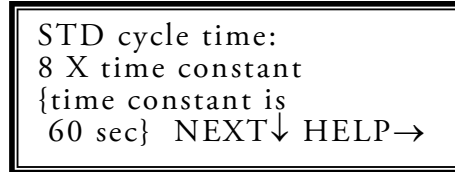
Figure 5–8.

2. The Last STD Cycle screen is a read-only menu item that indicates the status of the last standardization cycle (none, empty, deferred).

```
Last STD cycle was:
  empty***
          NEXT↓
```

Figure 5–9.

3. The default standardization cycle averages the measured radiation level over eight time constant periods. When using the default time constant (60 seconds), the standardization cycle lasts about 8 minutes (8 x 60 seconds). You can change the duration of the standardization cycle by altering the time constant value (reference "Time Constant Setup") or by changing the number of time constant periods used. In this menu item, specify the number of time constant periods used for the standardization measurement. Note that the cycle time must be set to at least two constant periods or the gauge automatically aborts the cycle.

The precision of the measured radiation level improves as the measurement time is increased. Since any error in the standardization value results in a corresponding error in the measurement readouts, we recommend that you do not shorten the default standardization cycle time.
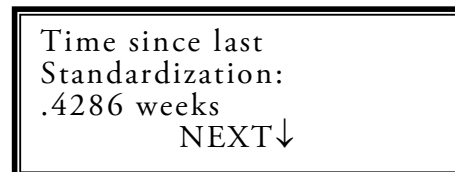
```
STD cycle time:
8 X time constant
{time constant is
 60 sec}  NEXT↓ HELP→
```

Figure 5–10.

4. The Time Since Last Standardization screen displays the amount of time in weeks since the last standardization cycle was performed. The value is automatically adjusted to account for the reduced source level due to the radioactive decay of the source. Whenever a standardization measurement is performed, the instrument resets the source decay counter.
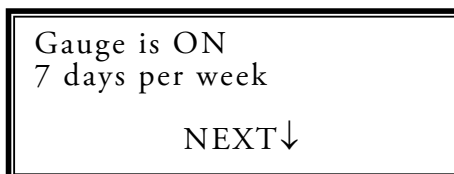
The half-life of Am-Be is 432.2 years, and it is automatically entered with the KRIL Load command (1002). The counter that tracks this value stops when power is removed from the transmitter. However, the source decay continues. If power is removed for a significant length of time (for more than several weeks), we recommend updating this value by adding the length of time in weeks that the power was off to the displayed value. Another way to update this value is to perform a standardization cycle and reset this value.

```
Time since last
Standardization:
.4286 weeks
        NEXT↓
```
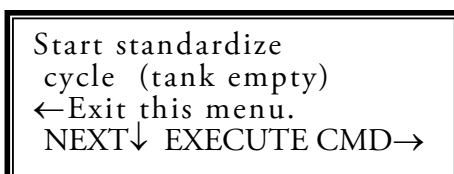
Figure 5–11.

5. The instrument maintains a counter (time since last standardization) to adjust the standardization value for the effects of source decay. By default, the counter assumes that power is applied to the instrument continuously. If the instrument is shut down periodically, such as over the weekend, an error will accumulate in the counter over time. To improve the decay counter accuracy, enter the number of days per week that power is applied to the gauge.

```
Gauge is ON
7 days per week

        NEXT↓
```

Figure 5–12.

6. Press the right arrow to begin the standardization measurement.

```
Start standardize
 cycle  (tank empty)
←Exit this menu.
 NEXT↓  EXECUTE CMD→
```

Figure 5–13.

Chapter 6

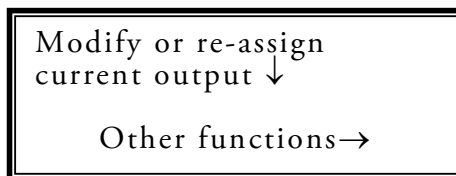# Current Output & Alarms

Modify/Reassign Current Output

Overview The primary measurement (% level) is assigned to the current output in both normal and alternate modes by default. Two different measurements can be assigned to control the current output, with one assigned to the current output in normal mode and the second assigned to the current output in alternate mode. The current output can be set up to switch from normal mode to alternate mode when an alarm is triggered, as described in "Setting up Alarms to Execute Commands." You can also directly enter a command to force a switch between normal and alternate modes. For example, if you are interested in monitoring a maximum level of 5 feet during one portion of the process and a maximum level of 3 feet during another part of the process, you can set up the measurements and current output as follows:

1. Set up measurement 1 (primary measurement) as level and assign it to drive the current output in normal mode with the maximum current output corresponding to 5 feet.

2. Set up measurement 2 as a level measurement but assign it to drive the current output in alternate mode with the maximum current output corresponding to 5 feet.
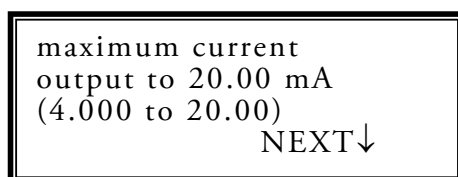
The Menu Items

1. Press the down arrow to access the menu items.

```
Modify or re-assign
current output ↓

      Other functions→
```

Figure 6–1.

2. The maximum current output value ranges from the minimum current output values (4.0 mA by default) to 20.0 mA. The default value for the maximum current output is 20.0 mA.

```
maximum current
output to 20.00 mA
(4.000 to 20.00)
            NEXT↓
```

Figure 6–2.

3. The minimum current output value ranges from approximately 3.5 mA to the maximum current output (20.0 mA). The default value for the minimum current output is 4.0 mA.

```
Minimum current
output to 4.00 mA
(.0001 to 20.00)
            NEXT↓
```
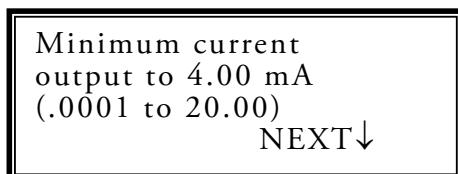
Figure 6–3.

Note You can enter values as low as 0.001 mA; however, the minimum output achievable is approximately 3.5 mA. Enter a value of exactly "0.0" to reset the minimum current output to the default value of 4.0 mA. ▲

4. The two menu items below are only displayed if you have more than one measurement set up.

    a. Assign a measurement to the current output in normal mode.

    ```
    Mea 1: ft level
    is sent to current
    out 1 in normal
    mode. NEXT↓  CHANGE→
    ```

    Figure 6–4.

    b. Assign a measurement to the current output in alternate mode.

    ```
    Mea 1: ft level
    is sent to current
    out 1 in alternate
    mode. NEXT↓  CHANGE→
    ```

    Figure 6–5.

5. Fine tune the maximum current output value to correct for any variation among systems. The maximum current output value is scaled by the value entered here.

    ```
    correction factor
    for current output
    at maximum: 1.000
             NEXT→
    ```

    Figure 6–6.

6. Fine tune the minimum current output value to correct for any variation among systems. The minimum current output value is scaled by the value entered here.

    ```
    correction factor
    for current output
    at minimum: 1.000
             NEXT→
    ```

    Figure 6–7.

7. Enter the midrange hold value for the current output. The value is entered as a percentage of the maximum current output value. The default is 50%.

```
current output
hold mode value
50.00% of scale
              NEXT→
```
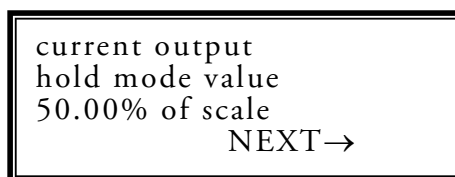
Figure 6–8.

Set up Fault Alarms / Change Process Alarms

The Set up Fault Alarms or Change Process Alarm Assignments menu allows you to perform the following tasks:

● Set up alarms to execute commands.

● Assign relays to warning and fault alarms.

● Assign relays to mode alarms.

● Choose whether to show the relay status on the measurement display.

● Set up fault alarms to change process alarm assignments.

Note If relays are not installed, the Set Up for Alarms to Execute Commands menu group is not displayed. You must enable alarm related selections via the Special Functions menu (Chapter 8). ▲

Alarm Types

There are three types of alarms: process, fault/warning, and mode. Specify the desired indicator for each alarm. In some cases, for example, when standardization or calibration modes are active, a warning message is displayed even if no other alarm indicator has been assigned. You can review the status and history of alarms via the View Alarm Status and View Alarm History menu items in the Alarm Action Items group (Chapter 7).

Process alarm actions occur when a process measurement value passes either the alarm set point or alarm clear point.

Fault and warning alarms alert you to potential problems with the gauge operation. Fault and warning alarms are listed below:

● System fault

● CAL cycle aborted

● Sensor under range (alarm occurs during a standardization measurement if the radiation level is less than the background level)

● Sensor over range

● Current output maximum or minimum reached (alarm occurs when the current output has reach the maximum or minimum value)

Mode alarms provide information about the status of the gauge. They are listed below:

● STD mode

● CAL mode

● Hold(s) active

● Current output is set to alternate mode

● Alternate time constant in use

● Keypad in use

● Power has been off

Set Up Alarms to Execute Commands

Use these menu items to assign commands for up to three pairs of alarm actions. Each alarm action pair consists of a command to be executed when an alarm is activated (set) and a second command to be executed when the alarm is cleared. Once an alarm action pair is defined, the alarm action is added to the list of alarm indicators and can be assigned as an alarm indicator for a specific alarm.

Note To assign a command action set to a process measurement alarm, you must have set up the measurement and assigned an alarm to the measurement. ▲

Note Due to limited display space, the Alarm Indicated By selection cannot display the full command name. The alarm action pairs are referred to as "#1 act on ALM action," etc. We recommend writing down each command action pair you assign for future reference. ▲

1. From the Set up Fault Alarms or Change Process Alarm Assignments menu, press the down arrow to step to the Set up for Alarms to Execute Commands menu item (shown below). Press the right arrow to access the menu items.

```
Set up for alarms to
execute commands→

              NEXT↓
```
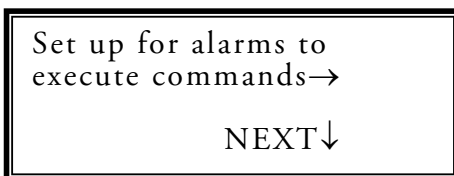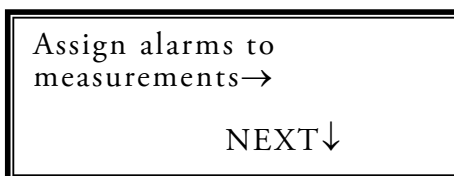
Figure 6–9.

2. Use the right arrow to scroll through the list of commands available to be executed when the alarm is activated. Selecting a command other than Do Nothing makes the Action on ALM CLR menu item available. These menu items are repeated for alarm action sets #2 and #3.

```
#1 act on ALM SET is      #1 act on ALM CLR is
"Do nothing" command      "Do nothing" command

  Continue↓  Change→        Continue↓  Change→
```
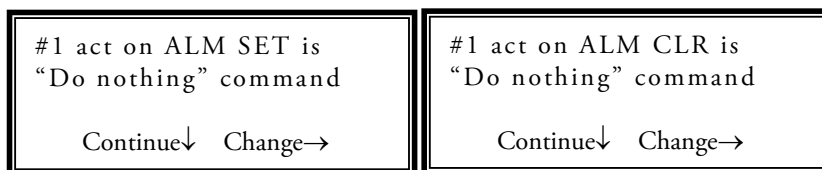
Figure 6–10.

Note The following menu items are only displayed if you have set up more than one measurement. By default, all 16 alarms are assigned to the primary measurement. ▲

3. Press the right arrow to access the menu items.

```
Assign alarms to
measurements→

              NEXT↓
```

Figure 6–11.

4. By default, all process alarms are assigned to the primary measurement (measurement 1). The menu item shown in Figure 6–12 is repeated for all alarms that have been set up. Use the right arrow to scroll through the list of measurements that you have set up until the one you want is displayed. The message on the third line indicates the measurement type corresponding to the measurement number.

```
#1 alarm monitors
measurement 1
ft level
    Continue↓  Change→
```

Figure 6–12.

Assign Relays to Warning & Fault Alarms

Access the Assign Relays to Warning Alarms and Fault Alarms menu group to assign actions to indicate a warning alarm state, a system fault alarm, or a signal loss alarm. Alarm indicators include:

- Relay control
- Flash the measurement display
- Zero the current output
- Execute a command

```
Assign "relays" to
warning alarms and
fault alarms→
            NEXT↓
```

Figure 6–13.

Assign Relays to Mode Alarms

Access this menu group to assign actions to mode alarms.

```
Assign "relays" to
mode alarms→

            NEXT↓
```

Figure 6–14.

Show Relay Status

You can choose to display status of relays if they are installed by accessing the Do/Do not Show Relay Status menu item. If enabled, relay status appears on the fourth line of the measurement display. Only the numbers of the relays currently turned on are displayed.

Chapter 7
Action Items

The Action Items menus provide access to frequently used commands. These commands are grouped by function:

- Common action items
- Alarm action items
- Hold action items
- Serial port related action items

Common Action Items

The Common Action Items group allows you to restart the system, erase all entries, clear alarms, and access other useful system commands.

1. Access the Common Action Items menu to restart the system, erase all entries, clear all holds, change mode, and zero relays. Press the right arrow to access the menu items.

```
Common action items
(clear  memory, etc) →

            NEXT↓
```
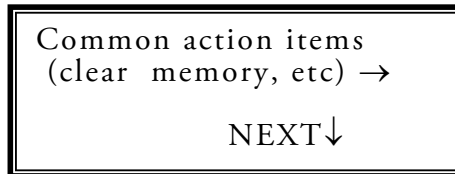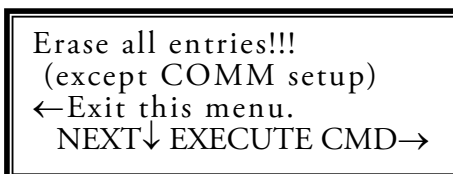
Figure 7–1.

2. Press the right arrow to perform a warm boot. This command restarts the system and erases temporary memory. User-entered setup data is not affected.

```
System restart. Does
not affect user data
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
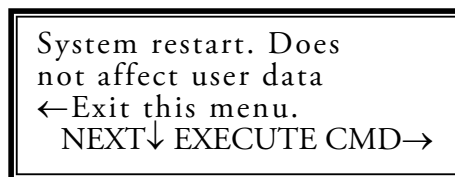
Figure 7–2.
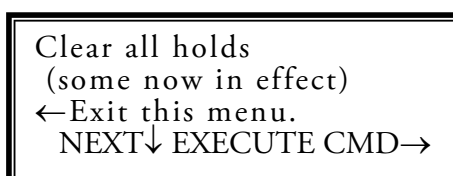
3. The Erase All Entries (Except COMM Setup) command erases previously entered setup data. All settings except for the serial communication settings are reset to factory defaults.

```
Erase all entries!!!
 (except COMM setup)
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```

Figure 7–3.
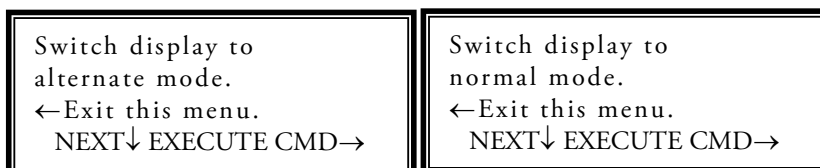
4. The Clear All Holds command clears holds that are currently in effect.

```
Clear all holds
 (some now in effect)
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```

Figure 7–4.

5. Switching to alternate mode is only an option when the number of measurements set up is greater than the number of measurements that can be displayed at one time.

```
Switch display to
alternate mode.
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
```
Switch display to
normal mode.
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```

Figure 7–5.

Alarm Action Items

The Alarm Action Items menu group enables you to view alarm status and history, acknowledge or clear alarms, and disable or erase all alarm action assignments.

1. Access the Alarm Action Items menu to view alarm status and history, acknowledge or clear alarms, and disable or erase all alarm action assignments.

```
Alarm action items
 (View, clear, etc) →

             NEXT↓
```
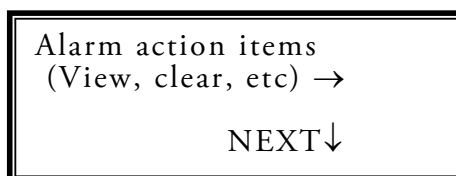
Figure 7–6.

2. The View Alarm Status and View Alarm History screens allow you to review all alarms currently in effect and the history of all alarms that have occurred since the last Clear All Alarms command. Both menu items include process, warning, fault, and mode alarms.

```
View alarm status →        View alarm history →
      NEXT↓                       NEXT↓
```
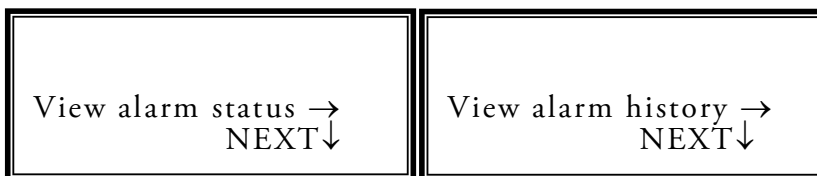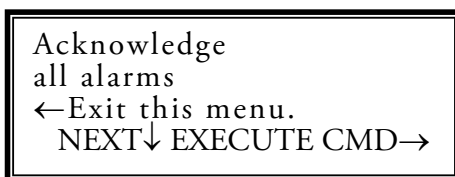
Figure 7–7.

3. Executing the Clear All Alarms command acknowledges, clears, and resets all alarms. Alarm actions are cleared, but the setups are not affected. Alarms actions are re-established when the alarms activates again.

```
Clear all alarms

←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
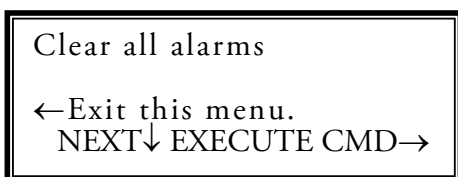
Figure 7–8.
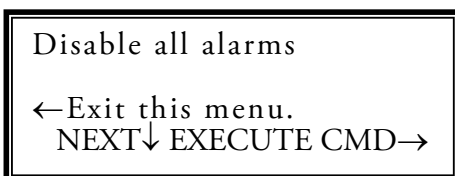
4. The Acknowledge All Alarms command acknowledges but does not clear or reset alarms. The alarm actions are cleared, but the actual alarm remains activated. Alarm actions are not re-established until the alarm is cleared by command or change in process and the alarm is again activated.

```
Acknowledge
all alarms
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```

Figure 7–9.
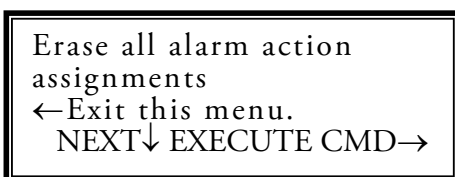
5. The Disable All Alarms command causes the system to ignore alarms (all alarms are turned off until manually turned on).

```
Disable all alarms

←Exit this menu.
  NEXT↓ EXECUTE CMD→
```

Figure 7–10.

6. The Erase All Alarm Action Assignments command erases entries for alarm assignments to relays, command execution, display flash, and zeroing current output. Execution returns all alarm assignments to their defaults.

```
Erase all alarm action
assignments
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```

Figure 7–11.

7. The menu items shown below are only displayed if alarm delay times are enabled in the Special Functions menu (Chapter 8) and a delay time for alarm activation or alarm clear has been entered for one or more alarms. If an alarm condition is true but alarm activation is being delayed due to a set alarm delay time, the end alarm command cancels the delay time, and the alarm will be activated. If an alarm clear condition is true but alarm clear is being delayed due to a set alarm clear (un-alarm) delay time, the end un-alarm command cancels the delay time, and the alarm will be cleared.

```
End alarm
delay command
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
```
End un-alarm
delay command
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
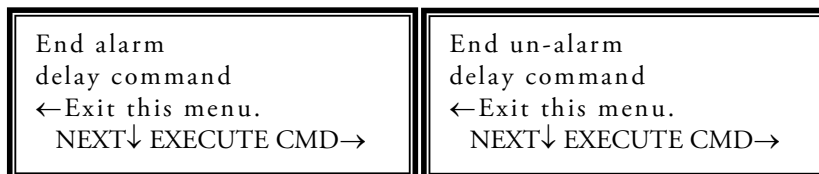
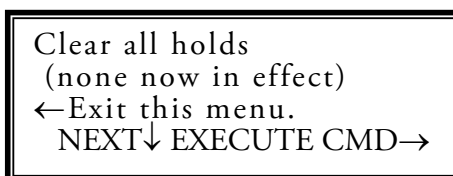**Figure 7–12.**

Hold Action Items

Access the Hold Action Items menu to clear holds, set hold mode value, and to set holds for the level measurement.

1. Access the Hold Action Items menu to clear holds, set hold mode value, and set holds for level measurement.
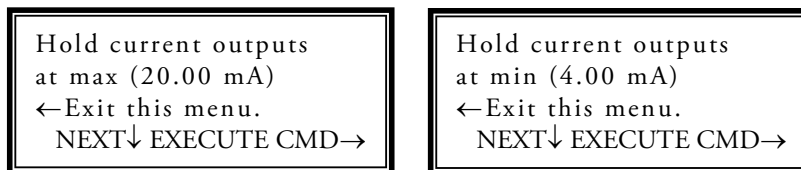
```
"Hold" action items
 (Hold reading, etc) →

        NEXT↓
```
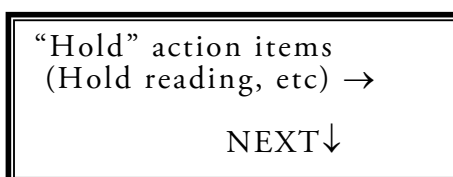
Figure 7–13.

2. Execute the Clear All Holds command to clear any holds currently in effect.

```
Clear all holds
 (none now in effect)
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
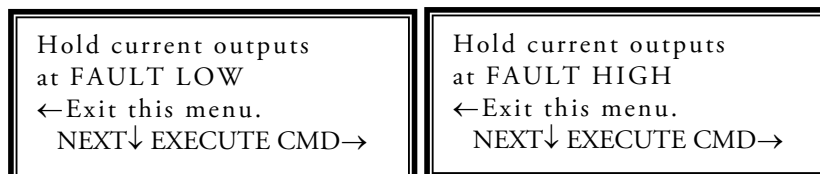
Figure 7–14.

3. The Hold Current Output at Max/Min commands allow you to hold the current outputs at maximum/minimum output values.

```
Hold current outputs
at max (20.00 mA)
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
```
Hold current outputs
at min (4.00 mA)
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
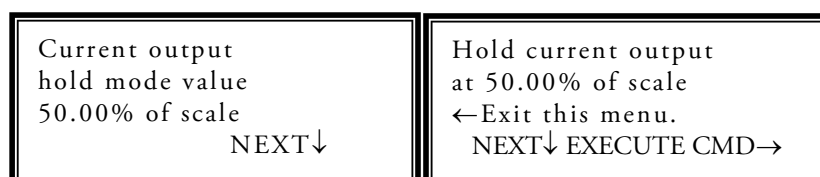
Figure 7–15.

4. The Hold Current Output at FAULT LOW/HIGH commands allow you to hold the current outputs at the FAULT LOW (3.6 mA or less) or FAULT HIGH level (20.8 mA or greater).
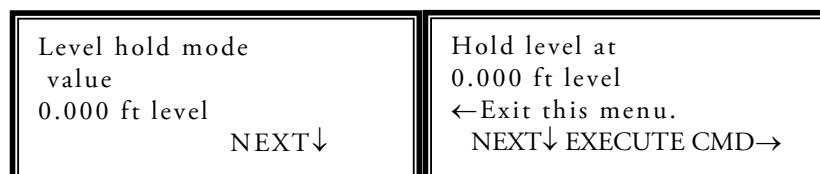
```
Hold current outputs
at FAULT LOW
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
```
Hold current outputs
at FAULT HIGH
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```

Figure 7–16.

5. Enter the value (in percentage) of the midrange current output hold value. The default value is 50.00%. Execute the Hold Current Output command to hold the current output at the midrange value you specified.

```
Current output
hold mode value
50.00% of scale
              NEXT↓
```
```
Hold current output
at 50.00% of scale
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```

Figure 7–17.

6. Enter the hold value for the level measurement. Press the down arrow. At the next screen, press the right arrow to hold the level measurement value at the hold value specified in the previous menu item.
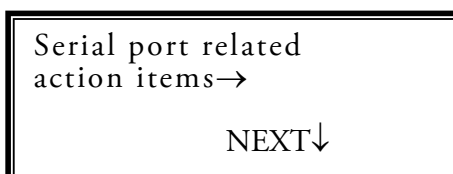
```
Level hold mode
 value
0.000 ft level
              NEXT↓
```
```
Hold level at
0.000 ft level
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```

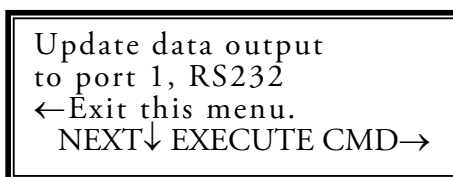**Figure 7–18.**

Serial Port Action Items

Access the Serial Port Related Action Items menu to update, set up, and enable the serial ports.

1. Press the right arrow to access this menu group.

```
Serial port related
action items→
            NEXT↓
```

Figure 7–19.

2. Executing this command sends a data set as defined by the serial transmit setup or default to the RS232 port.

```
Update data output
to port 1, RS232
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```

Figure 7–20.

Chapter 8

Serial Ports, Contact Inputs, & Special Functions

From the Set up Serial Ports, Contact Input, or Special Functions menu you can perform the following tasks:

- Configure the RS232 port communication parameters and set up data streaming parameters.

- Assign commands to the contact closure inputs.

- Control relay operations and customize the measurement displays.

Serial Port Setup

The instrument offers an RS232 single drop (port 1) serial interface, which provides independent access to the instrument's measurement and software functions.

You can communicate with the instrument using:

- A remote ANSI terminal: The instrument sends ANSI escape sequences for screen and cursor control that are supported by ANSI terminals and by most PC-based communication packages. This setup allows full access to the instrument menu system from the terminal.

- Blind mode: Only available if service only menu items are enabled. Blind mode is a special mode that supports access to the instrument via a user-written program or scrip. The menu system is not available; the hexadecimal version of the direct entry keyboard codes must be used to enter parameters. The instrument echoes a > character (ASCII code 62) if the code is understood and a < character (ASCII code 60) if the code is not understood. This mode supports user-written scripts from within a terminal emulation communications package to automate a setup or data monitoring procedure.

You can connect the RS232 port of the instrument directly to the RS232 comm port on a PC.

Modify Port Configuration

The Modify Port 1 menus allow you to set communication parameters for the RS232 port.

1. Enter the Modify Port menu to set up the baud rate and other communication parameters for each port. Default parameters are 9600, 7-E-1. Port 2 configuration is currently not available.
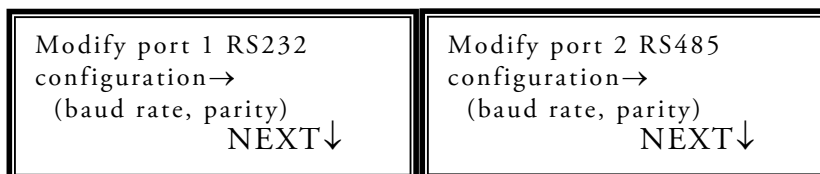
```
Modify port 1 RS232
configuration→
  (baud rate, parity)
            NEXT↓
```
```
Modify port 2 RS485
configuration→
  (baud rate, parity)
            NEXT↓
```

Figure 8–1.

2. Access the item below to set up parameters to control the selection, formatting, and transmission of measurement readouts to the terminal via the RS232 port. Data transmission is discussed further in "Data Transmission Setup" (next section).

```
Set up port 1 RS232
data xmit→
  (data streaming)
            NEXT↓
```
```
Set up port 2 RS485
data xmit→
  (data streaming)
            NEXT↓
```
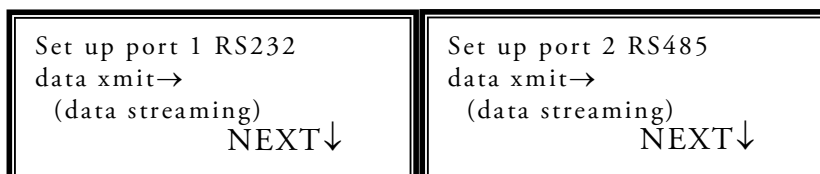
Figure 8–2.

3. Enter the item below to assign commands to be executed based on user-supplied open/close signal to contact closure #1. This menu repeats for each contact closure switch.

```
Assign commands to
execute on contact
open/close 1 →
            NEXT↓
```
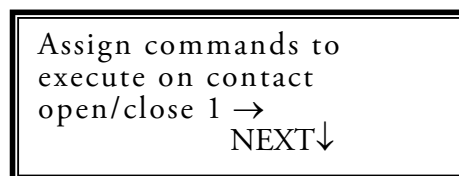
Figure 8–3.

Data Transmission Setup

```
┌─────────────────────────────────────┐
│ Set up data format. →                │
│                                      │
│                        NEXT↓          │
└─────────────────────────────────────┘
```

Figure 8–4.

Within this menu group, you can select whether to:

- Send an ANSI clear/home escape string after and/or before a data set.

- Send a logical NEWLINE after and/or before the transmission of the data set.

- Send the measurement's unit string (ft level, etc.) after each reading.

- Append a TAB (ASCII character 9) after each reading. This setting is useful for sending columnar data to a printer.

- Send a custom message before each data set. If enabled, the Set up Custom Data Set Messages screen becomes available. You set up custom data messages the same way you set up custom units messages (detailed later in this chapter).

- Send an ANSI command to position the readout start on a specified row number (not available in blind or printer terminal modes).

- Send an ANSI command to position the readout start in a specified column number (not available in blind or printer modes).

Contact Inputs

You can assign commands to be executed based on a contact input open or close. The menu items displayed in Figure 8–5 are available for each contact closure input installed in your gauge. If you do not have a current I/O board installed, this menu group is not displayed.

Use the right arrow to scroll through the list of commands until the one you want is displayed.

```
┌──────────────────────────┐ ┌──────────────────────────┐
│ Do nothing command       │ │ Do nothing command       │
│ executed by closing      │ │ executed by opening      │
│ switch 1.                │ │ switch 1.                │
│         Use↓ Chg→        │ │         Use↓ Chg→        │
└──────────────────────────┘ └──────────────────────────┘
```
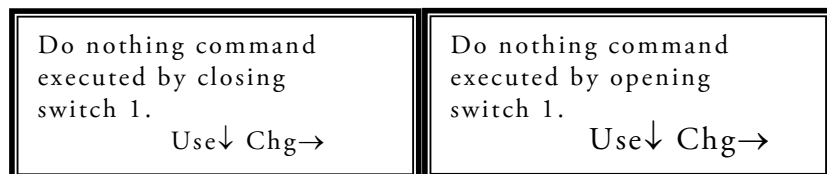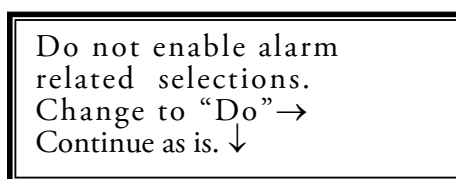
Figure 8–5.

Special Functions

The Special Functions menu group contains specialized menu items for conrol relay operation and for specifying what is shown on measurement displays.

```
special functions→



```
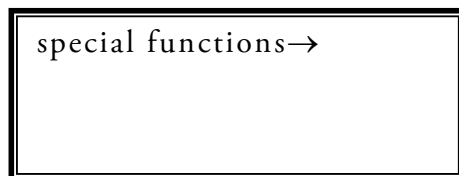
Figure 8–6.

1. This menu item is only displayed if relays are installed. Change to **Do** to enable relay alarm delay time entries in menus which set up process limit alarms.

```
Do not enable alarm
related  selections.
Change to "Do"→
Continue as is. ↓
```

Figure 8–7.

2. The Relay Delay Times item is only displayed if relays are installed.

```
Do not enable alarm
relay delay times.
Change to "Do"→
Continue as is. ↓
```
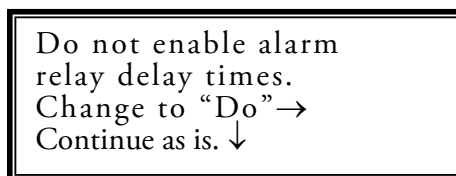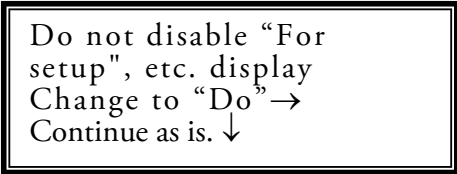
Figure 8–8.

3. The Relay Latching item is only displayed if relays are installed. Choose whether to enable relay latch mode entries in menus that set up process limit alarms.

```
Do not make relay
latching available
Change to "Do"→
Continue as is. ↓
```
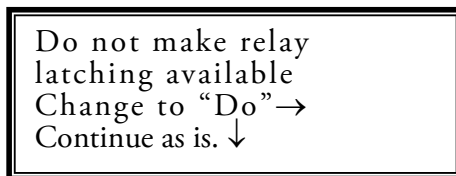
Figure 8–9.
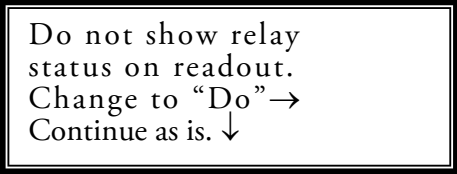
4. You can disable the "For setup…" message on the fourth line of the normal readout through the menu item shown below. Doing so allows all four lines to be used for measurement readouts.

```
Do not disable "For
setup", etc. display
Change to "Do"→
Continue as is. ↓
```

Figure 8–10.
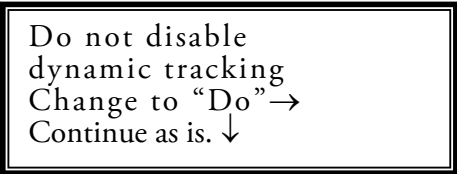
5. Choose whether to display relay status on the measurement display. The numbers of the relays currently turned on are displayed along with the normal measurement readouts.

```
Do not show relay
status on readout.
Change to "Do"→
Continue as is. ↓
```

Figure 8–11.
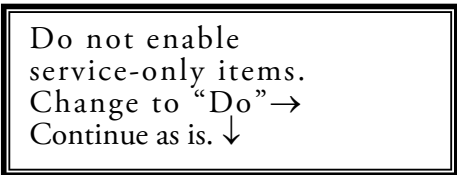
6. Disable dynamic tracking.

```
Do not disable
dynamic tracking
Change to "Do"→
Continue as is. ↓
```

Figure 8–12.

7. This function should only be enabled under direction from Thermo Fisher.

```
Do not enable
service-only items.
Change to "Do"→
Continue as is. ↓
```

Figure 8–13.

8. Enter the AUX INPUT menu subgroup to set up the time constant for the AUX INPUT value, the AUX current input minimum (0 mA default) and maximum (20 mA default) values, and the value of the AUX parameter at the minimum and maximum current input values.

```
┌──────────────────────────────┐
│                              │
│   AUX INPUT setup→           │
│                              │
│              NEXT↓           │
│                              │
└──────────────────────────────┘
```
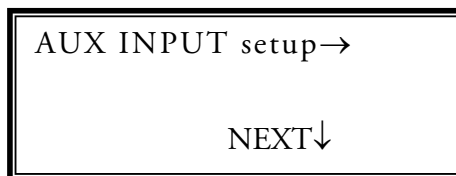
Figure 8–14.

9. The Special Span Entries Level menu item allows you to change the current output span for the primary measurement (meas 1 reading for current output maximum/minimum), overriding the span defined by entries in the primary setup section.

```
┌──────────────────────────────┐
│                              │
│   Special span entries       │
│   Level→                     │
│              NEXT↓           │
│                              │
└──────────────────────────────┘
```
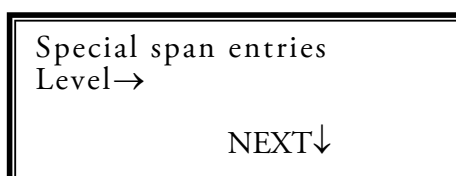
Figure 8–15.

10. Custom messages are detailed in the section titled "Custom Units Messages" (later in this chapter).

```
┌──────────────────────────────┐
│                              │
│   Set up custom units        │
│   messages →                 │
│              NEXT↓           │
│                              │
└──────────────────────────────┘
```
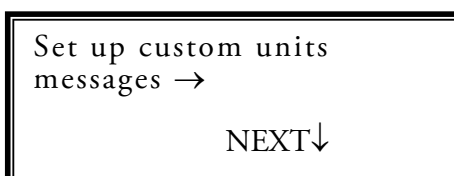
Figure 8–16.

Custom Units Messages

You can use custom messages to redefine units and to provide headers for serial data. The system supports up to eight custom message strings, each with a maximum of ten characters. You can find these menus within the Special Functions menu and the Set up Data Format submenu of the Set up Port…Data Transmission menu. In each case, you can select any of the custom messages that have been entered. You can also modify an existing message or add a new message.

You enter message characters by using the right and left arrow keys to scroll through the available character selections or by using the ASCII codes for the characters given in the following table.

Note Enter a value of 0 for the first character to reset the message to the null string (default value). ▲

Table 8–1. Codes for custom units messages

Code	Character	Code	Character	Code	Character
32	SP(ace)	64	@	96	`
33	!	65	A	97	a
34	"	66	B	98	b
35	#	67	C	99	c
36	$	68	D	100	d
37	%	69	E	101	e
38	&	70	F	102	f
39	'	71	G	103	g
40	(	72	H	104	h
41	)	73	I	105	i
42	*	74	J	106	j
43	+	75	K	107	k
44	,	76	L	108	l
45	-	77	M	109	m
46	.	78	N	110	n
47	/	79	O	111	o
48	0 (zero)	80	P	112	p
49	1	81	Q	113	q
50	2	82	R	114	r
51	3	83	S	115	s
52	4	84	T	116	t

Code	Character	Code	Character	Code	Character
53	5	85	U	117	u
54	6	86	V	118	v
55	7	87	W	119	w
56	8	88	X	120	x
57	9	89	Y	121	y
58	:	90	Z	122	z
59	;	91	[	123	{
60	<	92	¥	124		
61	=	93	]	125	}
62	>	94	^	126	→
63	?	95	–		

1. Enter the menu to set up custom messages.

```
Set up custom units
messages→

        NEXT ↓
```
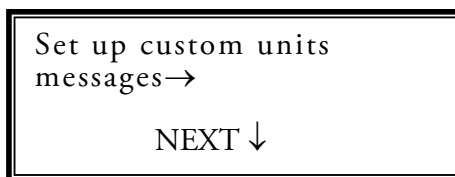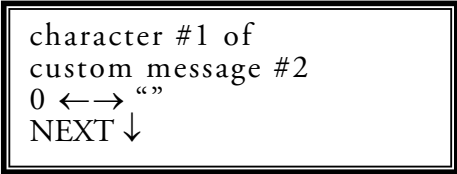
Figure 8–17.

2. Enter the first character of the first custom message. Use the arrow keys to scroll through the available characters, or enter the ASCII character code from the table above. Press the down arrow after selecting a character to move to the next character in the message. If you press the down arrow twice, you move to the next message.

```
character #1 of
custom message #1
0 ←→ " "
NEXT ↓
```
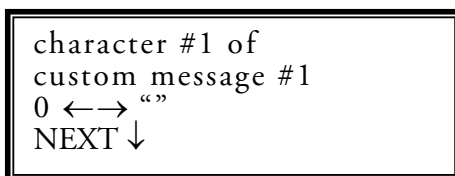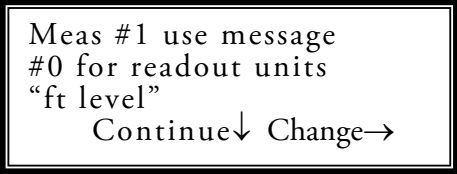
Figure 8–18.

3. Enter the characters for the second custom message, or press the down arrow to continue to the next menu item.

```
character #1 of
custom message #2
0 ←→ " "
NEXT ↓
```

Figure 8–19.

4. Select the message to use with Meas #1. Press the right arrow to scroll through and select the message. Leave at 0 to use the default message ("ft level"). This menu item is repeated for each measurement that you have set up.

```
Meas #1 use message
#0 for readout units
"ft level"
        Continue↓ Change→
```

Figure 8–20.

Chapter 9
Security, Service, & Diagnostics Functions Menu

Overview

The Security, Service and Diagnostic Functions menu is divided into four primary menu subgroups:

- Security items
- Diagnostics
- User service and related items
- Factory service and related items

Security Items

1. Security items allows you to set a password to prevent unauthorized personnel from making new setup entries or changing existing entries in the setup menus. Press the right arrow to access the menu items.

```
Security items:
(Password, etc.)

          NEXT→
```
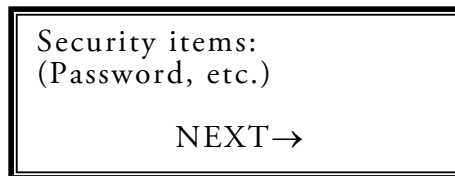
Figure 9–1.

2. Passwords are numeric entries that can be from 1 to 8 digits in length. Once you have set a password, you must enter it whenever you use the set up menus. Upon entering the correct password, you can access the menus without entering the password again for approximately five minutes. Disable this function by entering '0' (zero).

```
Password ********
(Lock out setup)

        NEXT↓  HELP→
```
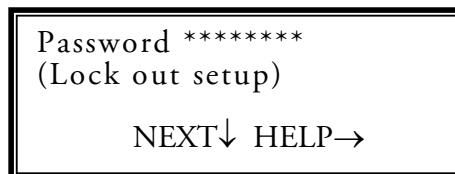
Figure 9–2.

Caution Do not forget your password. Without it, you cannot change entries or fine tune the instrument. ▲

3. Whenever entries are changed and saved, the count shown in Figure 9–3 increases by one. Use this item to check for unauthorized entries. After you complete setting up the instrument, note this value and periodically check this item to see if the number has changed.

```
Entries have been
changed 14 times
(read only)
        NEXT↓ HELP→
```
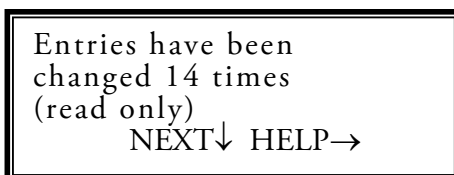
Figure 9–3.

4. The Keypad in Use alarm indicates that the system setup menus are being accessed via the keypad or serial port. Press the right arrow to scroll through the available alarm indicators.

```
Keypad is in use
alarm indicated by
(Nothing)
        NEXT↓ CHANGE→
```
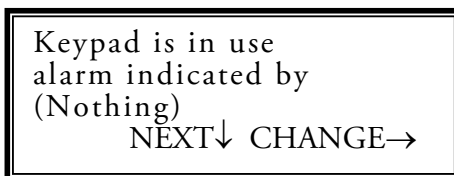
Figure 9–4.

Diagnostics

The Diagnostics menu provides diagnostic tools if you encounter a problem with the gauge. For additional diagnostics and troubleshooting, refer to Chapter 11.

1. Press the right arrow to access the menu items.

```
Diagnostics: System
test, related items→

        NEXT ↓
```
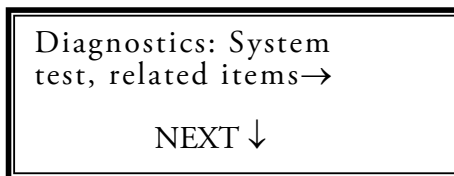
Figure 9–5.

2. The Self Test command performs a system diagnostic check. The system performs an automatic test and verification function every 10 minutes, and all user-entered data is double stored and periodically cross-checked. Errors are automatically corrected, and an alarm is activated when an error is detected.

```
Run self test

←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
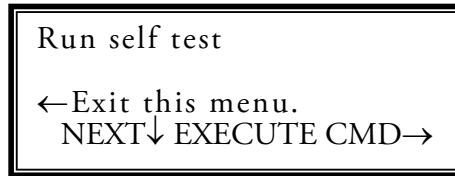
Figure 9–6.

3. The menu items shown in Figure 9–7 allow you to review all alarms currently in effect and the history of all alarms that have occurred since the last Clear All Alarms command. Both menu items include process, warning, fault, and mode alarms.

```
View alarm status→          View alarm history→
            NEXT↓                        NEXT↓
```
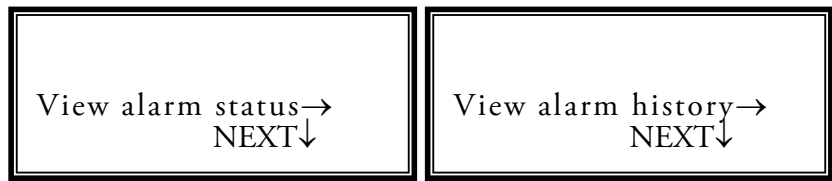
Figure 9–7.

Testing Relays

The Test Relays menu subgroup is a service only item and is displayed if relays are installed.

1. Enter the relay number to test in the following two menu items.

```
Commands 88, 89, 153
relay to test = #1

        NEXT↓
```
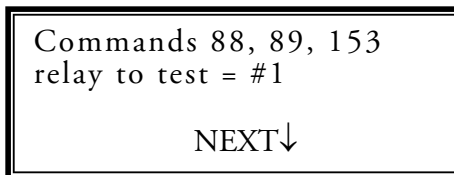
Figure 9–8.

2. Press the right arrow to test setting (turning on) and test clearing (turning off) the specified relay.

```
Test-set relay #1

←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
```
Test-clr relay #1

←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
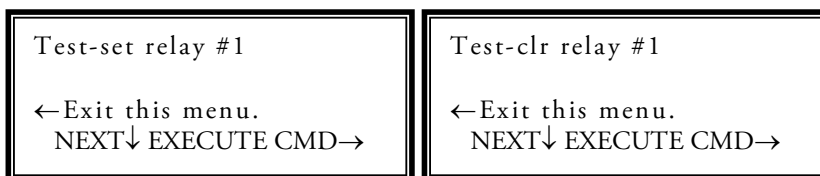
Figure 9–9.

3. Press the right arrow to test all the relays in both on and off states.

```
Test-set relay #1

←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
```
Test-clr relay #1

←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
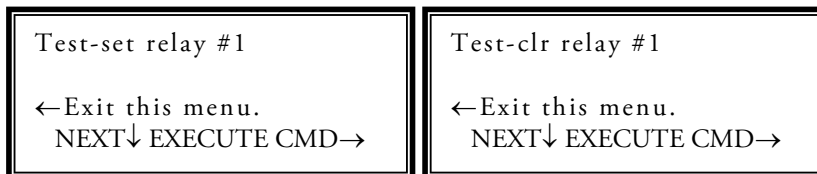
Figure 9–10.

4. Press the right arrow to clear any holds currently in effect.

```
Clear all holds
(none now in effect)
←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
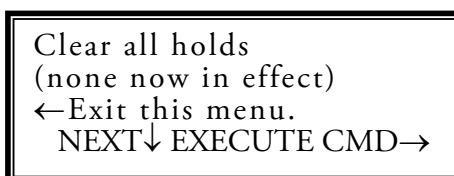
Figure 9–11.

5. Press the right arrow to test closing each relay in sequence, beginning with the relay number entered in the first item of this menu.

```
Test step relay #1

←Exit this menu.
  NEXT↓ EXECUTE CMD→
```
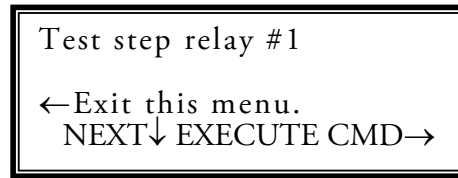
Figure 9–12.

Chapter 10
Maintenance

Maintaining the Source Housing

Periodically check the source and remove any debris that has accumulated in the beam path between the source housing and the outer process vessel.

Warning Do not place your hand between the source and the tank. Use a brush or other tool to remove any debris. ▲

Check the shutter to make sure it is working correctly. For source housings with an exposed shutter lever pivot, you can apply grease to the pivot if necessary to prevent corrosion and jamming.

Note Do not paint or overcoat the source housing without first masking its identification tag and other labeling. All labels on the source housing must remain visible. ▲

Transmitter Boards

Warning Remove all power from the unit prior to opening the transmitter enclosure. Electrocution can result if power is present. ▲

Removing a Board

1. Verify that power has been removed from the transmitter.

2. Loosen the screws on the door and open it.

3. Unplug any screw-in terminal connectors that have been wired from the board.

4. Remove the board retaining screw in the upper card guide.

Installing a Board

Follow the procedure below to replace the transmitter boards except for the ac power supply (refer to "Replacing the AC Power Supply").

1. Verify that power has been removed from the transmitter.

2. Loosen the screws on the door and open it.

3. Align the board with the upper and lower card guide slots, and insert the board into the slots.

4. Line up the 3-pin by 16-pin male connector on the board with the corresponding connector on the back of the transmitter.

5. Carefully push on the board until the connector is fully seated.

6. Insert and tighten the board retaining screw in the upper card guide.

7. Connect the screw-terminal connector(s) to the corresponding replacement board connectors.

8. Close the transmitter and tighten the cover screws.

Replacing the AC Power Supply

Warning If a power supply fails, the input capacitor might still be charged at a high voltage (up to 400 V). ▲

Caution Do not remove the four screws that are used to secure the power supply to the mounting bracket. The power supply and mounting bracket are placed as a single unit. ▲

Note The old power supply assembly is not field repairable. ▲

1. Use the procedure in "Removing a Board" (above) to remove all other transmitter boards (CPU, PCB 1, PCB 2, PCB 3, and PCB 4).

2. Remove the two hold-down screws from the base of the power supply mounting bracket. These screws secure the power supply mounting bracket to the main board.

3. Disconnect cables from the power supply (AC, DC, and Protective Safety Ground). Remove and replace the existing power supply and mounting bracket assembly.

4. Reconnect the cables to the power supply.

5. Tighten the two hold-down screws to secure the power supply to the main board. (A screw-holding screwdriver facilitates installation.)

6. Use the procedure in "Installing a New Board" to reinstall and reconnect all other boards.

Transmitter Jumper Settings

The current output is normally shipped from the factory configured as an isolated, self-powered output. You can reconfigure the current output as an isolated, loop-powered output by removing the jumper from pins 3 and 4 on the J5 connector on the I/O board. In the loop-powered configuration, you must supply +24 Vdc loop power to pin 3 of J5. Pin 2 of J5 is Iout+.

Chapter 11

Troubleshooting & Service

In addition to the troubleshooting procedures provided here, refer to the Diagnostics menu items found within the Security, Service and Diagnostics Functions menu group (Chapter 9).
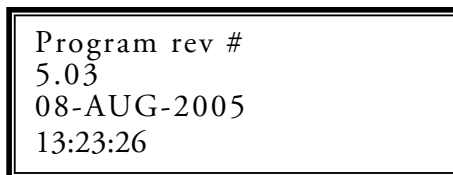
Diagnostics

Diagnostic menu items can be accessed through the Security, Service, and Diagnostic Functions menu (Chapter 9). This section provides additional information on several of these items and how to access them directly.

Program revision #

Press: **EXIT SETUP, 031001, down arrow.**

This item displays the software version number. Have this number available when contacting Thermo Fisher with questions.
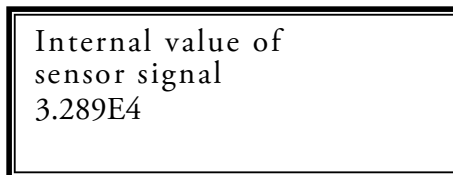
```
Program rev #
5.03
08-AUG-2005
13:23:26
```

Figure 11–1.

Detector snapshot

Press: **EXIT SETUP, 112003, down arrow.**

This screen displays the detector signal. The signal from the 7200A neutron detector is a 0–20 mA current connected to input 8 of the VPI board. 0 mA corresponds to 0 on the display, and 20 mA corresponds to about 65540 (displayed in scientific notation). This signal value is averaged by the time constant and updated continuously.

```
Internal value of
sensor signal
3.289E4
```

Figure 11–2.

Dynamic Process Tracking

Press: **EXIT SETUP, 001010, down arrow.**

The normal time constant (entered with DAC 007004) is decreased automatically by a factor of 8 when the gauge detects a rapid change in the process. This allows for the tracking of big changes more rapidly.

Leave this parameter (DAC 001010) disabled, as shown in the figure below.

```
Do Disable
Dynamic tracking
    Change to "Do not" →
```
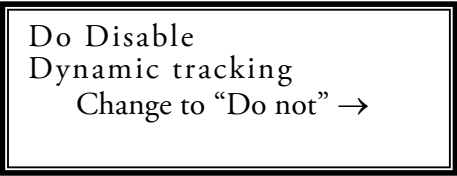
Figure 11–3.

Board identification and location

You can check the location of the different boards using the DACs shown in the table below.

Table 11–1.

DAC	Identifies
114012	Board in socket 1*
114022	Board in socket 2
114032	Board in socket 3
114042	Board in socket 4

*Socket 1 is to the right of the CPU board.

Example: **EXIT SETUP, 114042, down arrow.**

```
Soc 4 board type:
Volt-Freq INPUT
```
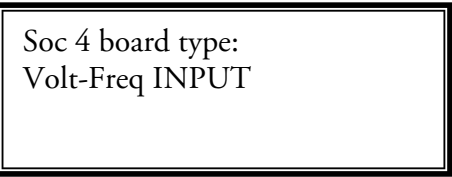
Figure 11–4.

The VPI board is identified as the Volt-Freq Input board.

Jumper setting

Press: **EXIT SETUP, 116002, down arrow.**

The jumper setting of the VPI board must be set at location 1 (ion chamber).

INPUT BRD JP code 1
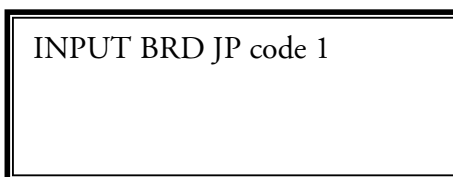
Figure 11–5.

System restart

Press: **EXIT SETUP, 81, right arrow.**

Use this command to reset the transmitter (cycle power). It will not destroy setup parameters that are stored in non-volatile memory.

System restart. Does
not affect user data
←Exit this menu.
  NEXT↓ EXECUTE CMD→
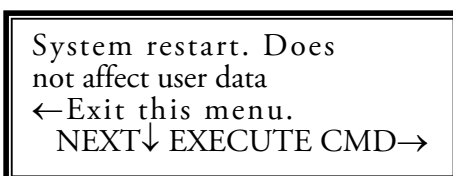
Figure 11–6.

The Display

Unless the setup menus are being accessed, the instrument should continuously send the measurement readouts or a setup message to the remote terminal via the serial ports.

If the transmitter display appears blank after supplying power, the display contrast may not be set properly. If the characters on the display are faint or if the display appears to be a solid yellow-green color, increase the contrast by pressing the up arrow on the transmitter.

If the transmitter display appears to consists of dark rectangles, decrease the contrast by pressing the down arrow on the transmitter.

If adjusting the contrast does not fix the display problem, perform the following steps.

1. Verify the power supply at the source.

2. Disconnect all power to the transmitter. Open it and verify:

   a. The power supply is properly seated on the main board and is properly wired. Refer to the KRILPRO installation guide.

   b. The ribbon cable from the transmitter display is properly seated on the CPU board.

   c. All boards are properly seated on the transmitter main board.

If the display still appears blank, contact Thermo Fisher.

The Current Board

If you suspect a problem with the current output, attach an ammeter in series with the current output load and verify the current output at various levels. Use the commands from the Hold Action Items submenu (Chapter 7) to hold the current output at specific levels for testing.

The Relays

If you suspect a problem with a relay output, attach a continuity tester to the suspected relay output and use the Test Relays commands to test relay operation.

Contact Information

The local representative is your first contact for support and is well equipped to answer questions. You can also contact Thermo Fisher at the following locations.

27 Forge Parkway Franklin, MA 02038 Tel: +1 713-272-0404 Fax: +1 713-272-2272	14 Gormley Industrial Avenue Gormley, Ontario L0H 1G0 **CANADA** Tel: +1 905-888-8808 Fax: +1 905-888-8828
Ion Path, Road Three Winsford, Cheshire, CW7 3GA **UNITED KINGDOM** Tel: +44 (0) 1606 548700 Fax: +44 (0) 1606 548711	Room 1010-1019 Ping An Mansion No 23 Jing Rong St Beijing 100032 **CHINA** Tel: +86 (10) 5850-3588 Fax: +86 (10) 6621-0847
A-101, 1CC Trade Tower Senapati Bapat Road Pune 411 016 **INDIA** Tel: +91 (20) 6626 7000 Fax: +91 (20) 6626 7001	On the Web www.thermoscientific.com

Warranty

Thermo Scientific products are warranted to be free from defects in material and workmanship at the time of shipment and for one year thereafter. Any claimed defects in Thermo Scientific products must be reported within the warranty period. Thermo Fisher Scientific shall have the right to inspect such products at Buyer's plant or to require Buyer to return such products to Thermo Fisher plant.

In the event Thermo Fisher requests return of its products, Buyer shall ship with transportation charges paid by the Buyer to Thermo Fisher plant. Shipment of repaired or replacement goods from Thermo Fisher plant shall be F.O.B. Thermo Fisher plant. A quotation of proposed work will be sent to the customer. Thermo Fisher shall be liable only to replace or repair, at its option, free of charge, products which are found by Thermo Fisher to be defective in material or workmanship, and which are reported to Thermo Fisher within the warranty period as provided above. This right to replacement shall be Buyer's exclusive remedy against Thermo Fisher.

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Appendix A
Ordering Information

Table A–1. 1400S transmitter

Part Number	Description
MTXR-KRILPRO-SS	1400S stainless steel transmitter
885747	Panel assembly with keypad, display, and cables
886766	Kit, KRIL / 4790 CPU with Level EPROM
886712	VPI interface
886675-1	Current output module #1 (NO relays)
OPWRAC1	Kit, AC power supply with cable

Table A–2. 7200A detector

P/N	Description
262-720001	Detector / preamp assembly, CSA (C, US) approvals
262-720005	Detector / preamp assembly, ATEX approvals
560-000107	Detector-transmitter cable, 25 ft min. / 500 ft max. in 1-ft increments; 2-conductor shielded (3 lengths required)

Appendix B
Specifications

Results may vary under different operating conditions.

Table B–1. Overall system specifications

Stability	Drift less than 0.1% absolute radiation change per 6 months

Table B–2. 1400S transmitter

System architecture	Multiprocessor-based electronics for uninterrupted output during data entry and system interrogation. All user data doubly stored in non-volatile memory with no battery backup required.
Display	Four-line backlit display. Displays up to eight readouts simultaneously.
Current output	One standard. Maximum of three current outputs available, with each representing independent span channels.
	Standard configuration: Isolated, self-powered, 800-ohm max. load.
	Alternate configuration: Isolated, loop-powered, 24 Vdc nominal supply voltage, 800-ohm max. load.
Serial outputs	RS485 half-duplex. RS232 full duplex.
Contact closure outputs	Up to 16 available. 115 Vac / 28 Vdc SPDT @ 10 amps (230 Vac SPDT @ 8 amps).
Inputs	Up to three additional I/O available. Dry contact closure.
Programming options	Menu-driven, direct keypad entry.
Power supply	AC: 115/230 Vac (100–240 V), 50/60 Hz, 17.2 W
	DC: 24 Vdc (20–28 V), 12 W
Dimensions	See Figure B–1.

Table B–2 , cont.

Approvals	NEMA 4X / IP65.
	ATEX: II 3 G Ex nA nC IIC Gc T6 (-40°C ≤ Ta ≤ 60°C) DC version.
	ATEX: II 3 G Ex nA nC IIC Gc T4 (-20°C ≤ Ta ≤ 50°C) AC version.
	CSA: Class I, Div. 2, Groups A, B, C, and D; Class II, Div. 2, Groups F and G; Class III Enclosure type 4X, Temperature code T3C / T4.
	Power = 20–28 Vdc, 12 W, 100–240 Vac, 50/60 Hz, 2 A, 25 VA maximum.
	Ambient temperature variation: -40°C to +60°C (-40°F to +140°F).
	CE compliant.
	Low Voltage Directive compliant.
	EMC Directive compliant.

Table B–3. 7200A detector

Supply voltage & consumption	Power supplied from 1400S transmitter.
Operating temperature	-40°F to +185°F (-40°C to + 85°C).
Humidity	0–95 % RH, non-condensing.
Enclosure	ANSI 300 Series, stainless steel.
Connections	1 x 3/4" NPT conduit entry.
Output	0–20 mA loop powered. 0–10 volts DC.
Interconnecting cable	Maximum 1000 ft depending on wire gauge.
ATEX Approvals (tag shown in Figure B–2)	ITS10ATEX17103X II 2 G Ex db IIC T3-T6 Gb (T6: Tamb -20°C to +40°C) (T4: Tamb -20°C to +55°C) (T3: Tamb -20°C to +70°C) IP66
CSA & CSA (US) Approvals (tag shown in Figure B–2)	Class I, Div. 1, Groups B, C, & D Class I, Div. 2, Groups A, B, C, & D Class II, Div. 1, Groups E, F, & G Class III Temp Code: T6 Type 4X Ta: -40°C to +80°C
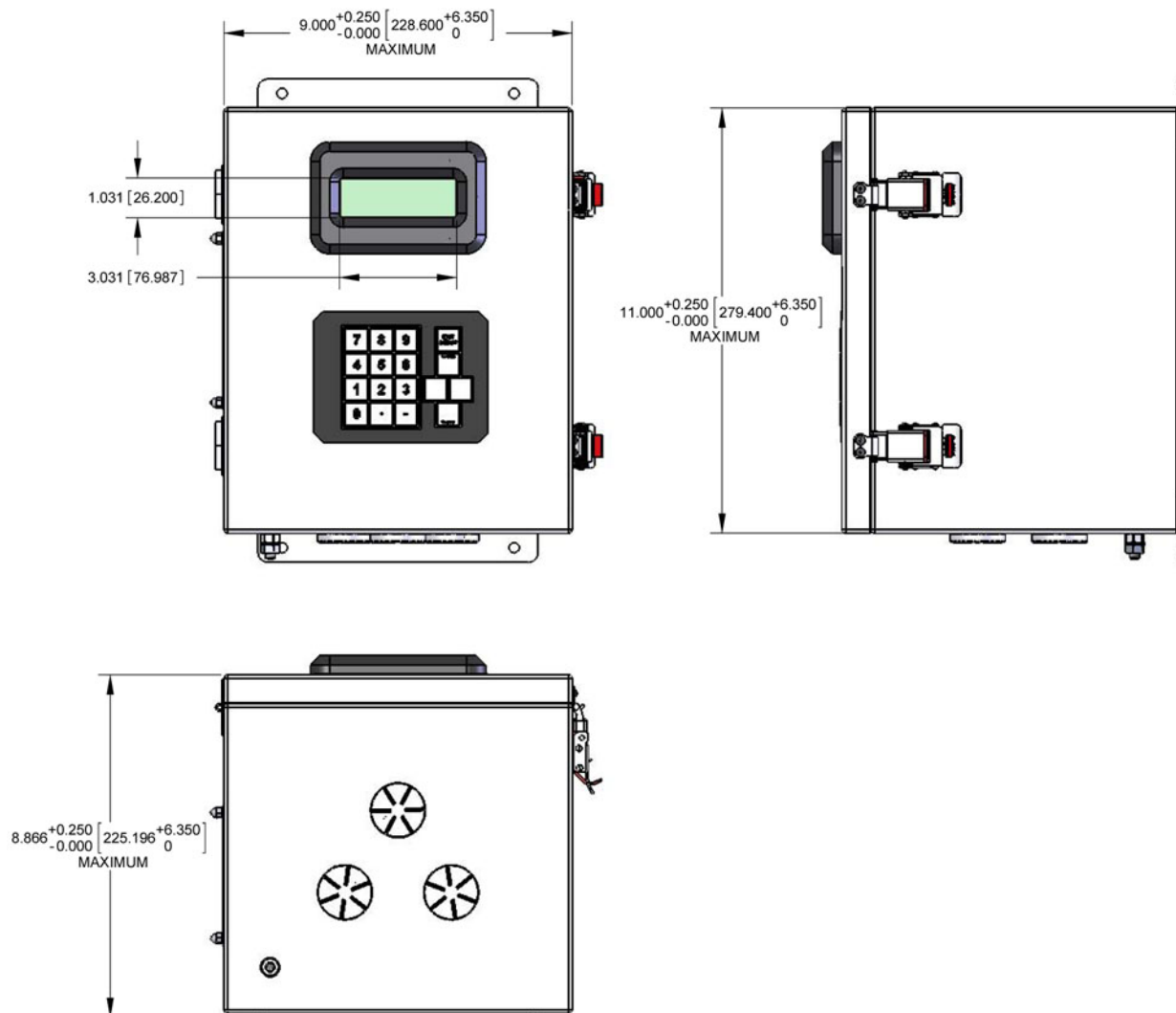
Figure B–1. 1400S transmitter dimensional diagram
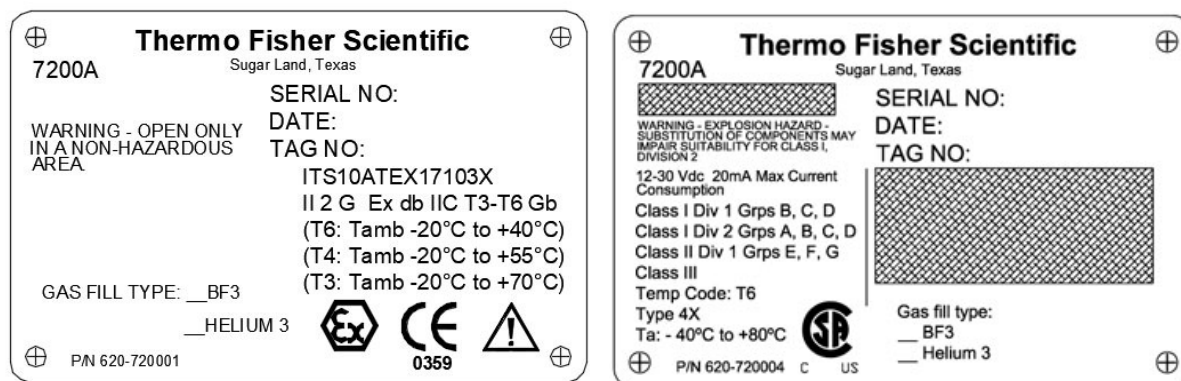
Figure B–2. ATEX and CSA certification tags

Appendix C
Toxic & Hazardous Substances Tables

The English and Chinese versions of the Toxic and Hazardous Substances tables are shown below.

Toxic & Hazardous Substances Table – KRILPRO

For Chinese Regulation: Administrative Measure on the Control of Pollution Caused by Electronic Information Products

Names and Content of Toxic and Hazardous Substances or Elements

Parts Name	Toxic and Hazardous Substances or Elements (KRILPRO)					
	Pb	Hg	Cd	Cr6+	PBB	PBDE
Housing	O	O	O	O	O	O
Ion Chamber	X	O	O	O	O	O
Customer Connection Interface	O	O	O	X	O	O
M-Transmitter	X	O	X	O	O	O
Cabling	O	O	O	O	O	O

○：Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in **SJ/T11363-2006**
X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in **SJ/T11363-2006**

有毒有害物质名称及含量的标识格式

部件名称	有毒有害物质或元素 (KRILPRO)					
	铅 （Pb）	汞 （Hg）	镉 （Cd）	六价铬 （Cr6+）	多溴联苯 （PBB）	多溴二苯醚 （PBDE）
外壳	O	O	O	O	O	O
离子腔	X	O	O	O	O	O
客户连接接口	O	O	O	X	O	O
M-发射机	X	O	X	O	O	O
缆线连接	O	O	O	O	O	O

○：表示该有毒有害物质在该部件所有均质材料中的含量均在**SJ/T 11363-2006**标准规定的限量要求以下
x: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出**SJ/T 11363-2006**标准规定的限量要求

Appendix D
Direct Access Codes

These commands must be installed before calibration can take place.

Table D–1. KRILPRO parameter DACs

Description of Parameter	DAC	Recommended Value
Time constant	007004	128 seconds
Disable Dynamic Process Tracking	001010	Do disable
Source half-life	023003	432
Background value	109013	0.01
Standardization value	128003	1.0
Top of span (reading at 20 mA)	114013	100%
Bottom of span (reading at 4 mA)	115013	0%
Calibration point number	003004	1 or 2
Span value in % at calibration point #1	119013	5%
Span value in % at calibration point #2	119023	95%
CAL/STD ratio at point #1 = Calibration value at point #1	120013	Signal value acquired by calibration command 80
CAL/STD ratio at point #2 = Calibration value at point #2	120023	Signal value acquired by calibration command 80
Software version	031001	
Snapshot of detector signal	112003	
STD lock*	048010	True
CAL lock*	048020	True
BAC lock*	048080	True

*For factory use only.

Table D–2. KRILPRO command DACs

Description of Command	DAC
Hold current output at 50% (12 mA for a 4–20 mA)	2
Hold current output at maximum (20 mA for a 4–20 mA)	5
Hold current output at minimum (4 mA for a 4–20 mA)	8
Clear all holds	9
Clear all alarms	3
Reset without clearing data	81
Perform calibration for point indicated by 003004	80
Erase all entries	74
Clear protect data	159
Run background	104 (empty vessel)
Run standardization	103

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