Model 3277 Hand and Foot Monitor

Ludlum Measurements

August 2023

Firmware: 1.10.3 and Higher

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LUDLUM MEASUREMENTS, INC
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STATEMENT OF WARRANTY

Ludlum Measurements, Inc. warrants the products covered in this manual to be free of defects due to workmanship, material, and design for a period of twelve months from the date of delivery. The calibration of a product is warranted to be within its specified accuracy limits at the time of shipment. In the event of instrument failure, notify Ludlum Measurements to determine if repair, recalibration, or replacement is required.

This warranty excludes the replacement of photomultiplier tubes, G-M and proportional tubes, and scintillation crystals which are broken due to excessive physical abuse or used for purposes other than intended.

There are no warranties, express or implied, including without limitation any implied warranty of merchantability or fitness, which extend beyond the description of the face there of. If the product does not perform as warranted herein, purchaser's sole remedy shall be repair or replacement, at the option of Ludlum Measurements. In no event will Ludlum Measurements be liable for damages, lost revenue, lost wages, or any other incidental or consequential damages, arising from the purchase, use, or inability to use product.

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CHAPTER 1

INTRODUCTION

The Model 3277 Hand & Foot Monitor is intended for checking low-level alpha and beta contamination on personnel. Two large scintillating detectors are mounted to allow detection on the hand and foot. Since the detectors in the Model 3277 are scintillators, there is no gas to maintain. An optional third detector is also available for frisking. The detection circuitry of the Model 3277 is powered by Model 3002 main boards. This allows calibration in the well-known Model 3000 ecosystem.

The hand and foot detectors include an infrared sensor that tells the system when to start an automatic count. The large, color touch-screen display provides user-friendly instruction and clearly shows the status of each detector.

The system can communicate through a standard Ethernet connection for remote monitoring. The unit is operated from a 120 Vac domestic outlet with the use of a 12 Vdc transformer for operation from 0 to 40 °C (32 to 104 °F). An optional backup battery provides approximately 8 hours of operation. A low-battery indicator on the LCD warns when less than 2 hours of battery life remain.

Setup of the instrument is accomplished through the touch-screen display. Performing calibration, setting alarm points, and count time requires software available from Ludlum Measurements.

CHAPTER 2

GETTING STARTED

2.1 Unpacking and Repacking

Remove the calibration certificate and place it in a secure location. Remove the instrument and ensure that all of the items listed on the packing list are in the carton. Check individual item serial numbers and ensure calibration certificates match between instruments and detectors (if applicable). The Model 3277 serial number is located on the bottom left corner of the front face of the unit.

To return an instrument for repair or calibration, provide sufficient packing material to prevent damage during shipment. Every returned instrument must be accompanied by an **Instrument Return Form**, which can be downloaded from the Ludlum website at `www.ludlums.com`. Find the form by clicking the "Support" tab and selecting "Repair and Calibration" from the drop-down menu. Then choose the appropriate Repair and Calibration division where you will find a link to the form.

2.1.1 Powering the Unit

Connect the instrument to mains power. There is a minor variation if you have the battery backup. Follow the appropriate steps below for with or without backup battery.

If you have the backup battery option, open battery box and connect battery before first use! See Section 4.1 and Section 4.2.

First Power Up **Without** Battery Backup Option
1. Connect power supply to instrument and tighten lock screw. 2. Plug transformer into wall. 3. Set the power switch to the *ON* position.

First Power Up **With** Battery Backup Option
1. Locate battery box behind foot detector. 2. Remove 2 screws that attach the top of the battery box. 3. Connect battery as shown in Section 4.2. 4. Close cover and reinstall screws. 5. Connect the power supply to the bottom of the battery box and tighten the lock screw. 6. Connect the battery output to the instrument and tighten the lock screw. 7. Plug transformer into wall. 8. Set the power switch to the *ON* position.

Some versions of the Model 3277 do not have a power switch. These units should boot up as soon as power is connected.

2.2 Instrument Operational Test

After powering on the instrument, it should start booting. Observe the device during this time. If the LCD does not show the Ludlum logo after a few seconds, or audio fails to work, the device is in need of repair. Please refer to Figure 2.1.

Figure 2.1: Splash-screen/Wallpaper

The instrument will then move to normal operation, displaying the current rate for all detectors as shown in Figure 2.2. The unit should be ready to use at this time.

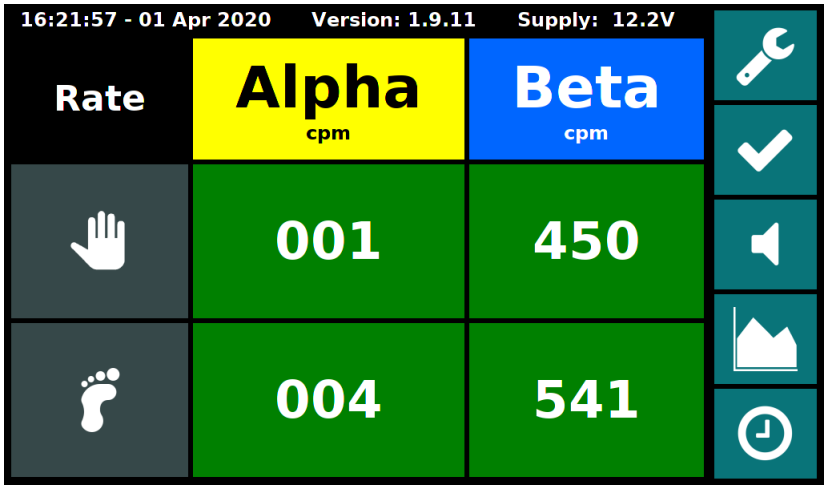


Figure 2.2: System Idle

If the source check lockout feature is enabled, the user may be locked out of using the instrument until a source check has been completed. Please see Chapter 6 for details on performing a source check.

Once this procedure has been completed, the instrument is ready for use.

2.3 Instrument Use and Controls

With the color touch-screen display, the Ludlum Model 3277 is simple and easy to use with minimal training required. While in normal running mode, the unit will look similar to Figure 2.2.

After the system sits idle, the screen may blank. Any touch of the display or activation of any of the sensors will immediately return the display to normal operation.

2.3.1 Main Display

The main display area (Figure 2.3) shows the current readings. The number of detector rows may change depending on the current operation. The top left box indicates the current readings mode.

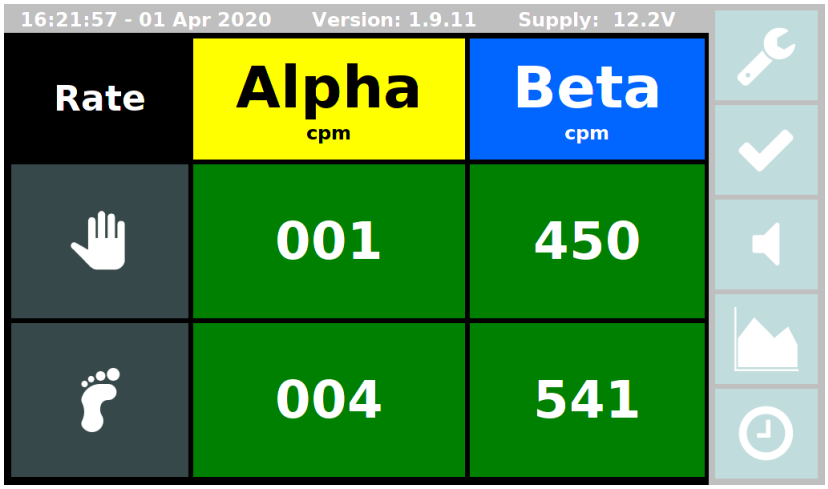


Figure 2.3: Readings

2.3.2 Status Bar

The status bar (Figure 2.4) shows the current time, version of the application, and battery/-supply voltage if available. Table 2.1 describes the power status.

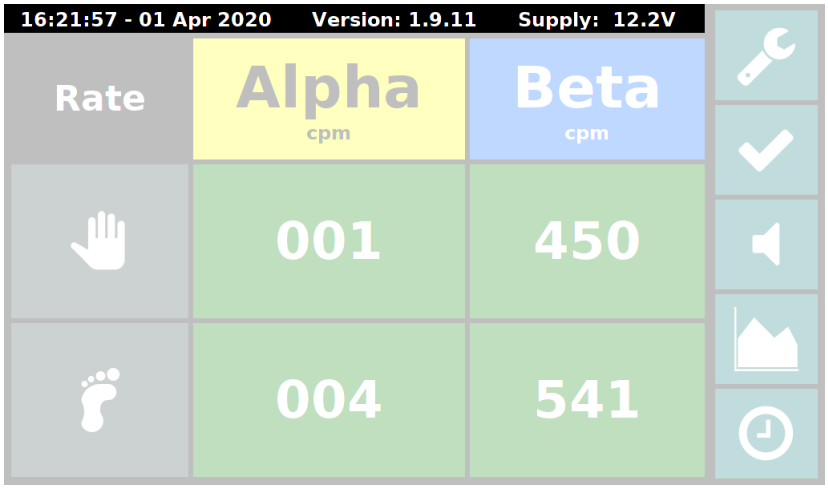


Figure 2.4: Status Bar

Table 2.1: Power Status

Prefix	Meaning
Full:	Battery is at or near full charge
Charging:	Battery is currently charging
Bat:	Running on battery power
Low Bat:	Running on battery power and battery is low
Crit. Bat:	Running on battery and battery is very low, will shutdown very soon
Supply:	Supply voltage, battery telemetry is not available
<No Status>	Battery and supply voltages not available

2.3.3 Button Bar

The button bar (Figure 2.5) shows the main controls/indicators for the current state of operation. Table 2.2 describes the general function of the buttons that can be seen during normal operation.

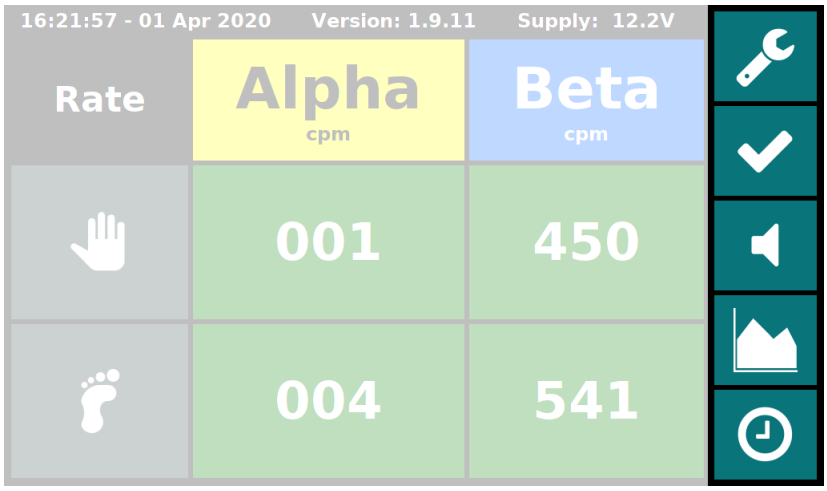


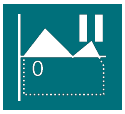
Figure 2.5: Button Bar

Table 2.2: Run Mode Buttons

	Settings Menu
	Acknowledge Alarms
	Click Audio
	Background Subtract
	Mode

The buttons can also be interacted with by touching them. Table 2.3 describes what each icon means and what happens if you tap the button.

Table 2.3: Run Mode Icons and Tap Controls

Icon	Current State	Touch Function
	Run State (Not Settings)	Enter settings menu
		Mute alarm tone and clear alarm message
	Click Audio Muted	Unmute click audio[1]
	Click Audio Enabled	Mute click audio[1]
	Background subtract off	Turn on background subtract[1]
	Background subtract on	Turn off background subtract[1]
	Background subtract off and updating of the background value is paused	Turn on background subtract[1]
	Background subtract on and updating of the background value is paused	Turn off background subtract[1]
	Current readings are rate	Go to count mode and start manual count[1]
	Current readings are background rate	Go to count mode and start manual count[1]
	Current readings are count	Return to rate readings[1]

[1] Manual touch control can be disabled in settings

Some buttons have extended features by pressing, holding for more than 1 second, and then releasing. Table 2.4 lists their functions.

Table 2.4: Run Mode Long Press Functions

	Show current background values

2.4 Detector Sensors

The Ludlum Model 3277 has sensors for the hand (Figure 2.6), foot (Figure 2.7), and optional cradle (Figure 2.8). When these sensors are activated, the hand/foot/frisker icons on the display will light up to indicate the sensor has been activated.

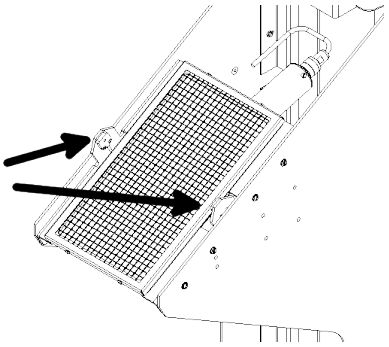


Figure 2.6: Hand Sensor

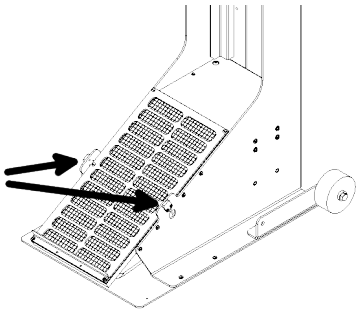


Figure 2.7: Foot Sensor

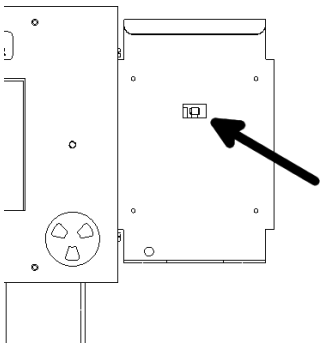


Figure 2.8: Cradle Sensor

When both hand and foot sensors are activated, an automatic count will be performed and the display will focus on the hand and foot readings. The automatic count will start immediately with a Minimum Count Time (MCT) calculated count time. For more details, see Chapter 5

When the optional frisker is removed from the cradle, the display will focus on the frisker readings.

2.5 Detector Fail Diagnostics

Note that the Model 3277 has its own diagnostic tests to ensure that the detector is functioning correctly. The Model 3277 can detect when the radiation detector is malfunctioning and will display an error. If the detector stops detecting radiation for a settable number of seconds, the Model 3277 will display "LOC" instead of a reading. This indication is common if the unit is powered up without a detector connected. If this indication is observed with a connected detector, remove the unit from service and have it evaluated by a qualified repair and calibration technician.

2.6 Minimum Count Time

An automatic count is initiated by activating both the hand and foot detector sensors. This feature utilizes an algorithm to find the optimal counting time based on current operating conditions. See Chapter 5 for more details.

2.7 Source Check

A source check function can be enabled on the Model 3277. When the source check is enabled, the unit will take itself out of service if a source check has not been performed at the configured interval. See Chapter 6 for more details.

2.8 Background Subtract

The Model 3277 accumulates background counts in a sliding window while running. The sliding window is empty at power-on and will store up to five minutes of background readings.

The following events will inhibit background accumulation during and for a few seconds after the event. A few seconds of data before the event will also be removed from the buffer.

- Any Detector Sensor Active
- While in Source Check Menu
- While in Manual Count

2.9 Backup Battery

A Model 3277 can be configured with a backup battery. The battery backup is intended to be used for a few hours during power outages or for temporary portable operation. See Chapter 4 for more information.

CHAPTER 3

NORMAL OPERATION

The normal operating modes of the Model 3277 can be categorized into a few different states. Each of these states is described in the following sections.

- Idle
- Manual Count
- Frisk
- Auto Count

Table 3.1 lists the response times for rate or idle rate modes listed in the following sections.

Table 3.1: Model 3002 Auto Response Times

Count Rate	Auto Response Time: Fast (Seconds)	Auto Response Time: Slow (Seconds)
Less than 3 kcpm (50 cps)	10.5	21
Between 3 kcpm and 4 kcpm (67 cps)	8.4	16.8
Between 4 kcpm and 6 kcpm (100 cps)	6.3	12.6
Between 6 kcpm and 12 kcpm (200 cps)	4.2	8.4
More than 12 kcpm	2.1	4.2

3.1 Idle State

"Idle" for the Model 3277 is defined as the normal condition the unit is in when the frisker is in the cradle, the hand and foot sensors are not triggered, and the unit is not in a source check lockout. Normally the Model 3277 will boot up and is automatically "Idle." If something triggers another state, the unit will automatically return to "Idle" when the triggers are cleared.

The Model 3277 can be configured to show the current rate or the current background average while "Idle." This state also has its own dedicated alarm points that can be configured. See subsection 7.2.2 for information on how to access the settings for the idle state.

Idle mode alarm points are only active while in the "Idle" state. Alarm points are non-latching.

3.1.1 Idle Rate

Idle Rate is the typical rate meter values seen on the **Model 3002 with a response rate configured to auto slow.** See Table 3.1.

3.1.2 Idle Background

Idle Background is a live view of the accumulated background displayed in the same units rate is configured for. This is the same five-minute rolling background value that is used for background subtract.

If a condition that pauses updating of the background is active, the displayed value will not change as it is a view of the paused background value. This is an unusual scenario to see both Idle Background while also paused but worth mentioning.

3.2 Manual Count

A manual count will override the current state/mode and go to count mode readings and units.

A manual count does not change the detectors displayed. E.g. if the frisker is off the holster and is the only detector shown, it will remain the only detector shown but now show count mode readings.

3.3 Frisk

Frisk state is engaged when the frisker is removed from the cradle. The display will only show the frisker readings and automatically enable background subtract and click audio. The values shown will be rate meter readings with a **Model 3002 response rate of auto fast.** See Table 3.1.

While in the frisk state, you can also start a manual count by tapping the mode button. See Section 3.2 for more details.

There is a lockout that prevents the instrument from toggling between frisk state and auto count state. Since they are independent modes with similar triggers, the logic is set to stick with whichever happens first. E.g. the frisker is removed from holster, the unit will be in frisk state; if the hand and foot sensors are then activated the unit will stay in the frisk state.

3.4 Auto Count

An automatic count is started when **both hand and foot sensors** are activated. When this state is triggered, the unit will automatically start a count who's count time is calculated via the MCT function. See Chapter 5 for details.

If the count mode alarm points are not set through Calibration Software, the Model 3277 is unable to calculate a time to count for and will therefore not automatically start a count.

CHAPTER 4

BACKUP BATTERY

The charger circuit automatically maintains the battery in optimal health while connected to wall power. However, there are a few caveats:

Even deep cycle lead acid batteries degrade quickly when they are deeply discharged. To maintain long battery life, it is recommended to discharge the battery to no more than 50% of capacity. That equates to roughly 4 hours of runtime on a new battery with this instrument.

If the 12-volt battery is discharged to below 7 volts, the internal charger circuitry will not attempt to charge the battery when wall power is re-applied. This is a safety measure to protect against incorrect installation of a 6-volt battery.

Similar to a modern car, there are small parasitic loads on the battery even when the unit is off. **If the unit is going to be left disconnected from wall power for a prolonged period, it is recommended to disconnect the battery.** A new fully charged battery can become discharged below 7 volts within 70-80 days.

If the unit is powered from batteries until shutdown and left disconnected from wall power, a new battery can become discharged below 7 volts within 4 days.

Ludlum Measurements, Inc. recommends replacing the batteries every four years.

The following sections describe various maintenance procedures that may need to be performed on the battery.

4.1 Accessing Battery Compartment

To access the battery, remove the two screws from the battery cover and move the cover to the side.

Battery box is located behind the foot detector.

4.2 Connecting Battery

When receiving a new instrument, the battery is disconnected by means of unplugging the battery harness from the battery. The following procedure describes how to properly connect the battery.

1. Remove the cover to access the battery. Refer to Section 4.1 for screw locations.
2. Locate the red and black terminal as well as the red and black battery wires.
3. Connect the red wire with the to the red (positive) terminal.
4. Connect the black wire to the black (negative) terminal.
5. Replace cover and screws.

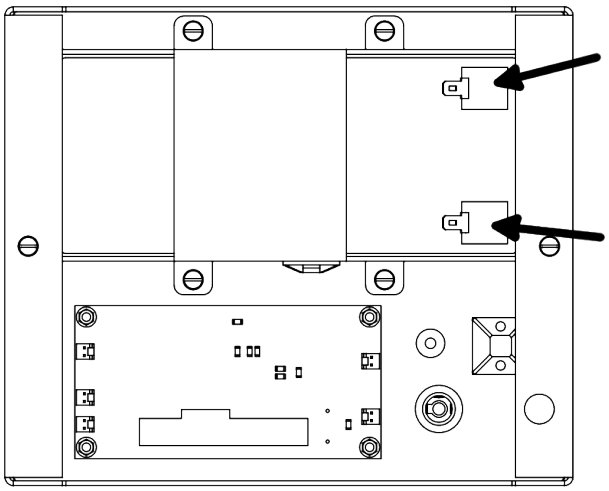


Figure 4.1: Battery Terminal Location

4.3 Recovering Overly Discharged Battery

If you experience an overly discharged battery below 7 volts, you can attempt to manually recharge with the following method. To perform this task you will need a battery charger designed to charge a 12-volt lead acid battery.

1. Remove the cover to access the battery. Refer to Section 4.1 for screw locations.
2. Disconnect battery wires by pulling on the housing of the blade connectors of each terminal.
3. Connect 12-volt lead acid battery charger to the battery terminals by attaching the positive lead to the red battery terminal and the negative lead to the black terminal.
4. Activate charger to a charge current of 1.8 amps or less.
5. Leave connected for a few minutes to allow the batteries resting voltage to rise about 7 volts.
6. Remove charger.
7. Reconnect instrument connections.
8. Replace cover and screws.
9. Immediately plug Model 3277 into wall power and allow unit to fully charge the battery.

You can turn the instrument on to monitor the battery voltage and verify it is charging by monitoring the battery voltage displayed in the top right corner of the display.

4.4 Replacing Battery

Periodically over the life of the instrument the battery will need to be replaced. The following procedure describes how to replace the battery.

1. Remove the cover to access the battery. Refer to Section 4.1 for screw locations.
2. Disconnect battery wires by pulling on the housing of the blade connectors of each terminal.
3. Remove battery mounting strap nuts. Refer to Figure 4.2 for nut locations.
4. Remove battery. Taking care to not damage temperature probe wrapped into foam.
5. Remove foam from old battery and reuse foam or replace foam on new battery. Ensure temperature probe is wrapped inside touching battery, near middle of battery.
6. Install new battery and battery strap.
7. Tighten nuts.
8. Reconnect instrument connections.
9. Replace cover and screws.

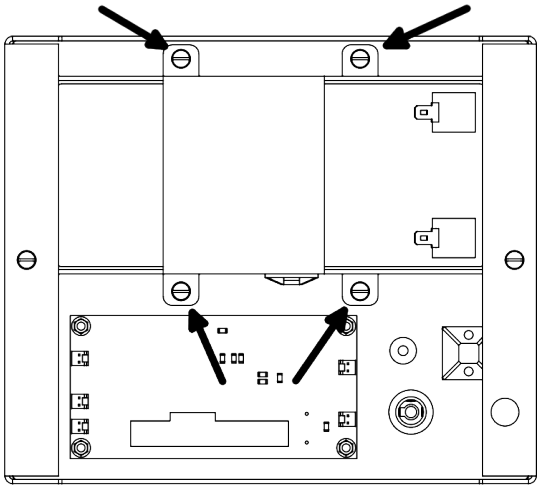


Figure 4.2: Battery Mounting Screws

CHAPTER 5

MINIMUM COUNT TIME

The Minimum Count Time (MCT) is intended to achieve maximum user throughput for a fixed Minimum Detectable Activity (MDA) requirement. MCT calculates the time required to count based on the background average, MDA (set via the Model 3002 alarm point), and detection probability.

5.1 Operation

In the MCT mode, the administrator sets a minimum and maximum count duration in seconds. If at any time the calculated minimum count time needed to meet user-selected probability thresholds exceeds the maximum count time value, an error will occur to indicate the need for parameter adjustment or further investigation of the surrounding conditions and equipment.

5.1.1 Performing a MCT Count

MCT mode is activated by an "automatic count." An "automatic count" is started when both hand and foot sensors have been triggered. When both sensors have been activated, the background average at that time is used to calculate the required time for the measurement. If the calculated time is less than or equal to the maximum MCT count time, a count will start immediately (Figure 5.1). If the calculated time is greater than the maximum MCT count time, an error is displayed (Figure 5.2) and a count is not taken.

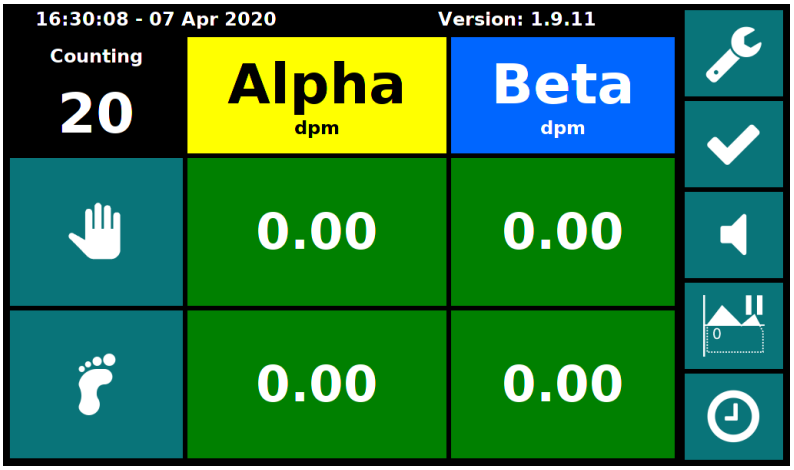


Figure 5.1: MCT Count Starting

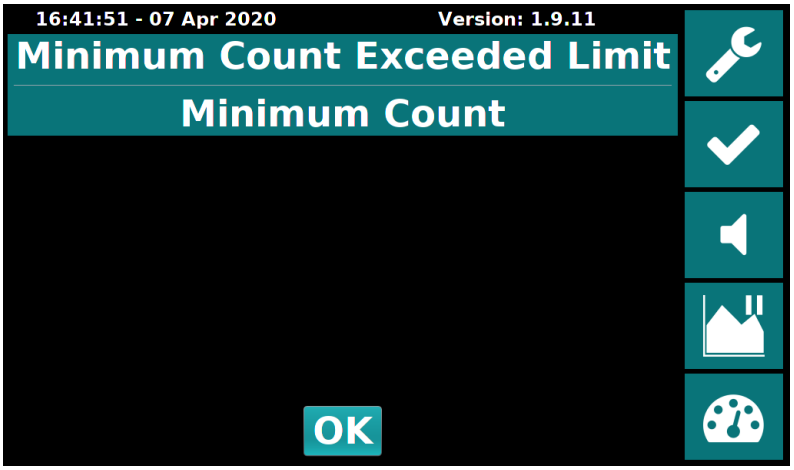


Figure 5.2: MCT Count Time Over Limit

Upon completion of the count, the resultant value is compared to the set-point. If the value is below the set-point, a clean message will be displayed (Figure 5.3). If the the value is at or above the set-point, an alarm message will be displayed (Figure 5.4) along with the detectors and type of particle that is alarming.

If the user removes their hand and/or foot from the detectors before a count is complete, the count will be aborted and a count incomplete message (Figure 5.5) will be displayed.

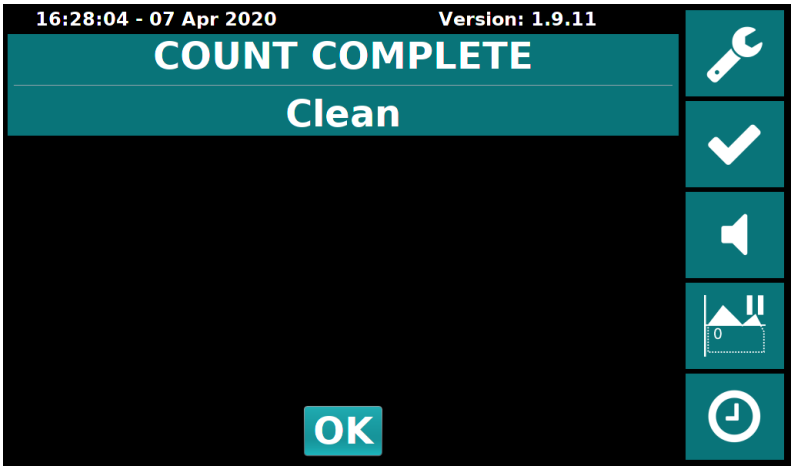


Figure 5.3: MCT Count Completed - Clean

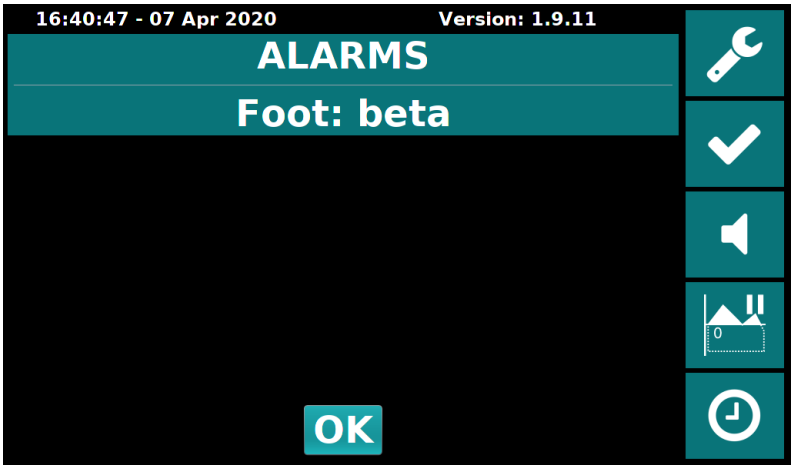


Figure 5.4: MCT Count Completed - Alarm

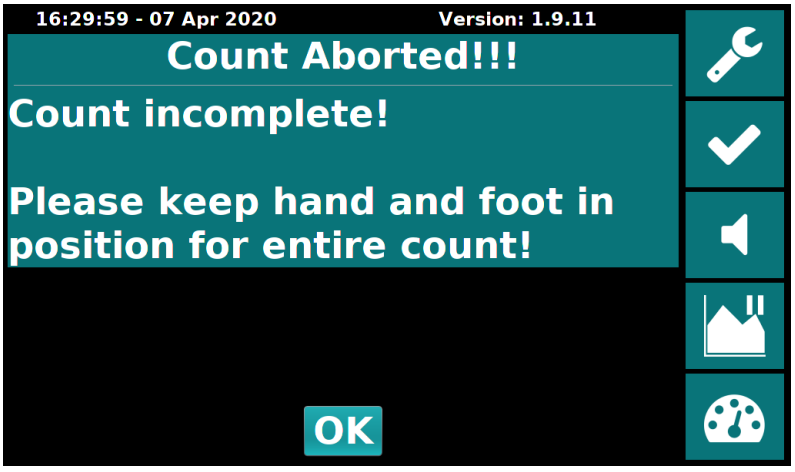


Figure 5.5: MCT Count Incomplete

5.2 Minimum Count Time (MCT) Algorithm

The following equations are used to calculate the time used for an MCT count.

5.2.1 Sigma factor

The sigma factor (k) is the number of standard deviations above the mean expected net count rate calculated using the percent point function (ppf).

$$k = ppf(\%_{Confidence}) \tag{5.1}$$

This results in the following values for k with given confidence.

Table 5.1: Sigma factor

Confidence	k
90%	1.281
95%	1.645
99%	2.326

5.2.2 Critical detection level

The critical detection level (L_c) is calculated using the Counts Per Minute (CPM) value of the current background, as well as the time (T) in minutes that the current background has been accumulating and the time to use for taking a sample.

$$L_c = k \times \sqrt{\left(\frac{CPM_{background}}{T_{sample}}\right) + \left(\frac{CPM_{background}}{T_{background}}\right)} \tag{5.2}$$

5.2.3 Limit of Detection

The limit of detection (L_d) is calculated using the sigma factor (k), the critical detection level (L_c), and the time (T) in minutes the the sample will be taken for.

$$L_d = \frac{k^2}{T_{sample}} + 2 \times L_c \tag{5.3}$$

5.2.4 Minim Detectable Activity

The Minimum Detectable Activity (MDA) is calculated by dividing the limit of detection (L_d) by the efficiency of the detector.

$$MDA = L_d \div Efficiency \tag{5.4}$$

5.2.5 Minimum Count Time

The minimum count time is calculated by iterating through the number of sample count seconds and using Equations 5.1, 5.2, 5.3, and 5.4 until the MDA is greater than or equal to the count alarm value set on the detector board.

CHAPTER 6

SOURCE CHECK

A source check feature can be enabled on this instrument. See subsection 7.2.4 for settings to enable the source check. If the source check is enabled and expired, the instrument will be out of service until a source check is successfully passed. If the source check feature is disabled or the source check is current, the instrument will operate normally.

6.1 Performing a Source Check

The following steps are an overview of performing a source check. The following sections describe each step in more detail.

1. Open source check menu
2. Select detector
3. Select source
4. Start source check
5. Pass or fail the results
6. Repeat until all sources on all detectors have been passed

6.1.1 Open Source Check Menu

A source check can be started by clicking on the settings button from the main screen. See Table 2.2. The user ID for performing a source check is "2222."

6.1.2 Select Detector

The base menu of the source check function is the detector selection screen (Figure 6.1). Tap the desired detector to perform a source check test on that detector.

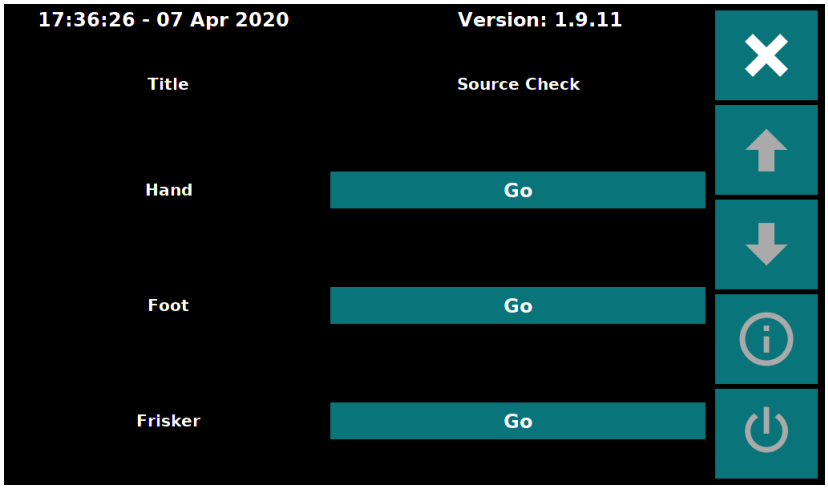


Figure 6.1: Source Check - Detector Selection

6.1.3 Select Source

The next step is to select a source to test for the source check (Figure 6.2). Every source must have a source check performed to complete the source check. The label to the left of the source describes the current state. See Table 6.1 for details.

As each source has been performed and **Passed**, they will have a number of hours that will temporarily remain valid. When all source tests on all detectors have been passed, this will change to **Current** status, and the number of hours will change to the number of hours remaining until the source check expires again.

If a source check is **Current** and a new source check test is performed and **Failed**, the instrument will go into the source check expired state. If the failed source(s) are then re-run and **Passed**, the source check will resume the previous expiration time.

Table 6.1: Source Check - Source Status

Status	Meaning
Current:	Source check is valid and not required at this time
Expired:	Source check has expired and needs to be performed
Failed:	Source check has been run and given a failed status
Passed:	Source check has been run and given a passing status

6.1.4 Start Source Check

After selecting the source to check, the application will wait for the user to start the source check count (Figure 6.3). The check source should be placed on the appropriate detector, or all sources removed for background, before tapping the start button. Once pressed, the count will start with the configured amount of counting time.

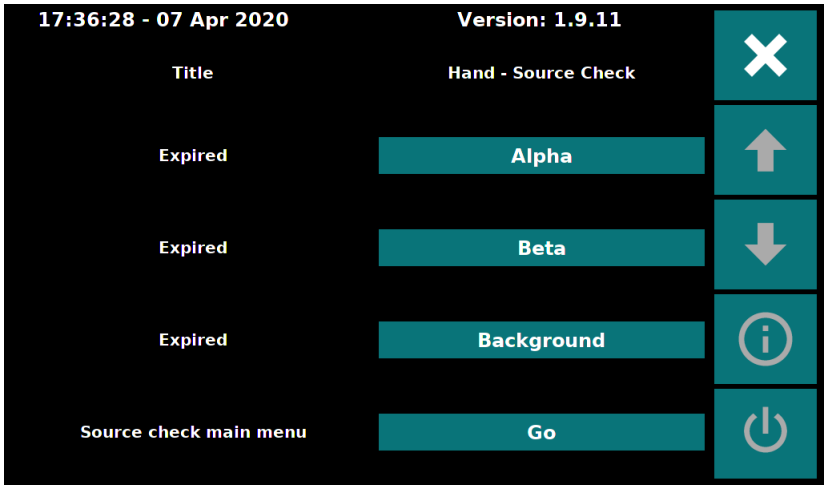


Figure 6.2: Source Check - Source Selection

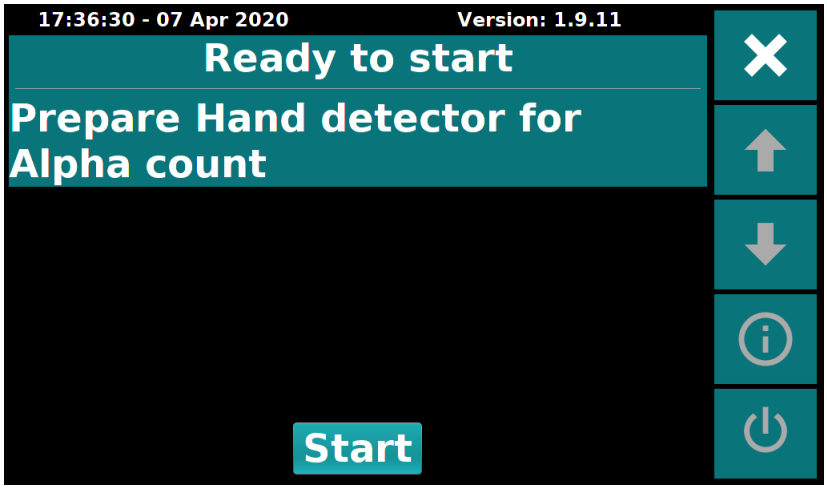


Figure 6.3: Source Check - Start Count

6.1.5 Results

When a source check test count has been completed, the results will be shown to the user (Figure 6.4). The user will have to decide if the test is a pass or fail. Once the user selects the pass or fail status, the display will return to the source test selection screen. If this test is a passing one and is also the final one to complete the source check, there will be a dialog (Figure 6.5) informing the user that all tests have been completed and detailing how long until the next source check is required.

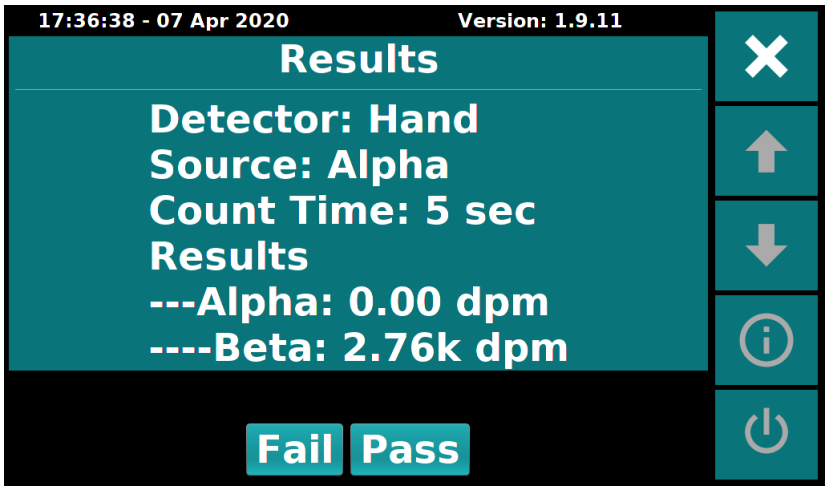


Figure 6.4: Source Check - Results

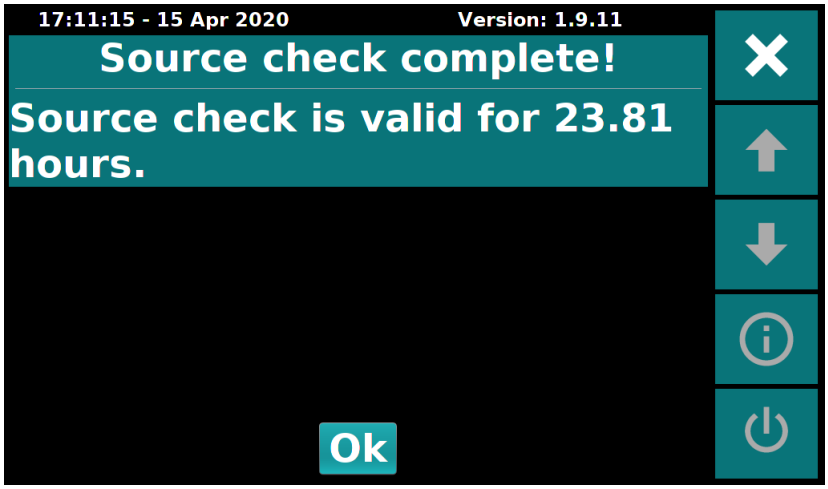


Figure 6.5: Source Check - Current

CHAPTER 7

SETTINGS

General settings on the Model 3277 are easily accessed via the touch-screen interface.

Calibration is not accessed through the settings menu. See Chapter 8 for details.

The Model 3277 has two user levels. The top level has the options to configure how the instruments perform. The second user level is for performing a source check.

Table 7.1: Settings - User IDs

User	ID	Password	Privileges
Admin	1111	<none>	Configure instrument operation
Source Check	2222	<none>	Performs source check

The following sections list the options available to the **Admin** user. For more information on the **Source Check** user, see Chapter 6.

7.1 Basic Usage

Entering the settings menu is accomplished by clicking the "Enter Settings Menu" icon from the main screen (Table 7.2). To exit the settings menu, press the "Exit Settings Menu" button. Table 7.2 shows the typical buttons in the start menu. Some buttons may be greyed out indicating they have no function.

Table 7.2: Settings Buttons

	Enter Settings Menu
	Exit Settings Menu
	Previous Menu
	Next Menu
	Info Menu
	System Control Menu

The user login screen looks like Figure 7.1. Click in the box to the right of "User ID" to bring up the keypad.

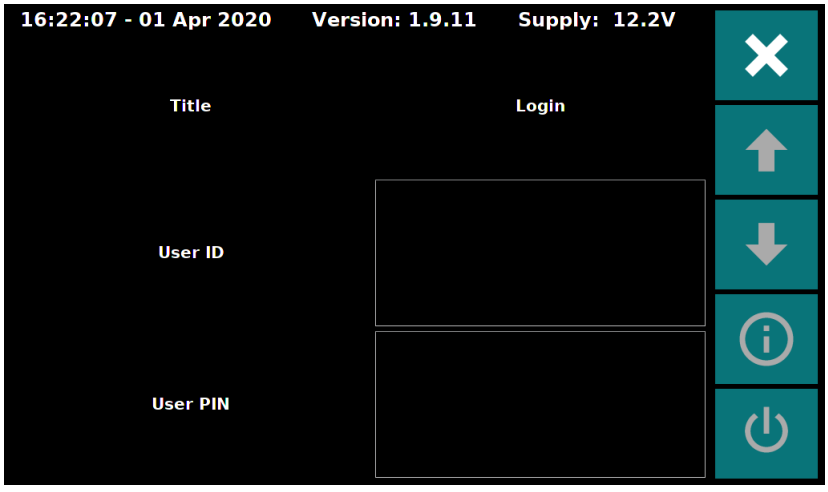


Figure 7.1: Settings - Login

Tap in the desired user ID from Table 7.1 and press the enter button (">") on the bottom right of the keyboard.

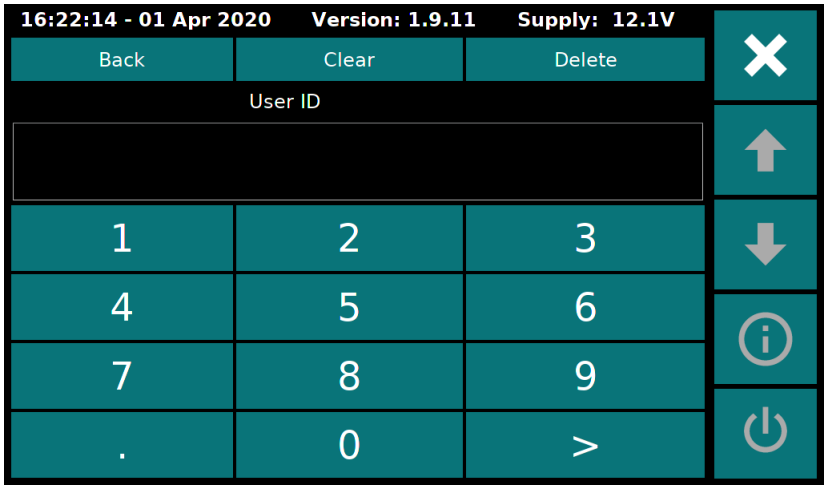


Figure 7.2: Settings - Keypad

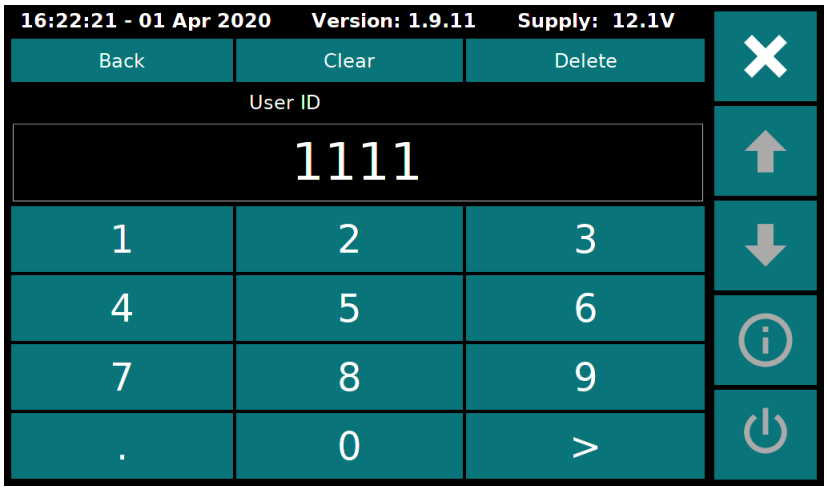


Figure 7.3: Settings - Enter User ID

7.2 Settings Menus

The following subsections list each of the menu pages. These menus can be cycled through by clicking the up and down arrows after logging in.

7.2.1 General Settings

The general settings page is for configuring the basic operation of the instrument.

Table 7.3: General Settings

Setting	Options	Details
Reload Detector Settings	Go Button	Tap of button reloads calibration/configuration settings from the internal detector boards
Detector Layout	H/F	Hand and Foot Detectors
	H/F/Fr	Hand, Foot, and Frisker Detectors
	H/H/F	Hand, Hand, and Foot Detectors
	Fr	Frisker Detector
Auto Activate BG Subtract in Hand/Foot Mode	Check Box	If checked, background subtract will automatically activate when entering Hand/Foot Mode
Auto Activate BG Subtract in Frisk Mode	Check Box	If checked, background subtract will automatically activate when entering Frisker Mode
Disable Background Subtract Button	Check Box	If checked, background subtract button cannot be manually toggled
Disable Mode Button	Check Box	If checked, mode button cannot be manually toggled

7.2.2 Idle Settings

These settings control how the unit operates while idle.

Table 7.4: Idle Settings

Setting	Options	Details
Idle Display	Background	Show 5-minute background average in rate units while idle
	Rate	Show rate mode readings while idle
Idle Rate Alarm Mode	Net	Idle alarm point is based on live rate value minus background
	Gross	Idle alarm point is based on live rate value
Enable Audio Alarm While Idle	Check Box	If un-checked, alarms will be silent while idle
Alpha and Beta Alarms	Integer	Alarm point for alpha and beta alarms in each detector (Only applies when idle)

The units for the alarm points are controlled by the detector board's rate mode settings.

7.2.3 MCT Settings

The minimum count time (MCT) function is controlled with the following settings.

See Chapter 5 for more details on MCT functionality.

Table 7.5: MCT Settings

Setting	Options	Details
Confidence	<percentage>	Selects confidence required for calculating minimum count time
Min MCT Time	Integer	Minimum allowed MCT count seconds
Max MCT Time	Integer	Maximum allowed MCT count seconds

7.2.4 Source Check Settings

The source check menu controls how the source check functions.

Table 7.6: Source Check Settings

Setting	Options	Details
Source Check Count Time	Integer	Number of seconds to count for each source check test
Source Check Expiration Mode	Disabled	Source check is not active
	Time of Day	Source Check will expire at the 24-hour format time of day defined by "Source Check Expiration Hours"
	X Hours	Source Check will expire in the number of hours defined by "Source Check Expiration Hours"
Source Check Expiration Hours	Float	Hour value used for the "Source Check Expiration Mode"

Example: Enable the source check with 10-second counts and have it expire at 6:30 pm every day. Set the following:

Setting	Value
Source Check Count Time	10
Source Check Expiration Mode	Time of Day
Source Check Expiration Hours	18.5

7.2.5 Set Time

This menu is for setting the time.

If a change in date causes a change into or out of daylight savings time, a reboot is recommended after setting the time.

Table 7.7: Set Time

Setting	Options	Details
Time Zone	<Time zones>	Time zone options will vary depending on daylight savings
Hours	Integer	Current time of day in hours (24-hour format)
Minutes	Integer	Current time of day in minutes
Month	Integer	Current month of the year
Day	Integer	Current day of the month
Year	Integer	Current year
Set Time	Go Button	Pressing button sets the system time and time zone to the current settings

7.3 Info Menu

This menu can be accessed by clicking on the info icon.

Table 7.8: Info

Setting	Options	Details
Hostname	<read only>	The name used by this device when connected to the network
IPv4	<read only>	IP address of this device when connected to the network
Upgrade	Web Button	Pressing button will attempt to download and install an update over the internet
Web Server	Start Button	Pressing button will start the maintenance web server

The instrument will attempt to get an IP address via DHCP when it boots up. It is recommended to reboot the instrument if the networking state is changed.

For the self upgrade to work, the instrument must be connected to the network and allowed to access the internet.

For security reasons, the web server is not running on boot. Therefore you will need to manually start it via the settings menu button after a reboot.

7.4 System Control Menu

This menu is for safely shutting down and rebooting the system.

It is recommended to always power off the instrument by performing a shutdown sequence. Failure to follow this may corrupt the operating system.

Table 7.9: System Control

Setting	Options	Details
Reboot	Go Button	Pressing button will immediately reboot system
Shutdown	Go Button	Pressing button will immediately shut down system

If your model is equipped with a power switch, turning the switch to the off position should start a shutdown without using this menu. If a shutdown is performed from this menu, the switch will have to be turned off then back on to power up the instrument again.

CHAPTER 8

DETECTOR BOARD CALIBRATION/CONFIGURATION

The Model 3277 utilizes Model 3002 main boards to power the detectors. The application processor in the Model 3277 communicates with each of these "detector boards" (Model 3002 boards) to get readings. All calibration information is stored in the detector boards.

Calibration can be accomplished with Ludlum's Lumic Calibration software. Each detector board will need to be connected via the USB port (Figure 8.1) to a computer running Lumic Calibration.

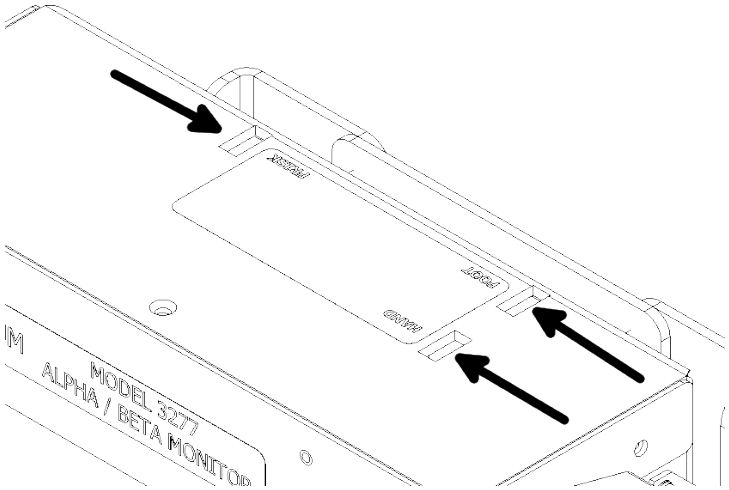


Figure 8.1: Calibration Port

8.1 Required for operation

Table 8.1 describes the parameters every detector board (Model 3002 board) must be configured to for proper operation of the Model 3277. These should all be set correctly at the factory and are listed here for reference.

Table 8.1: Required Parameter Settings

Parameter	Value	Reason
AuxCom Enable	1	Enables the Aux Comm port on the Model 3002
AuxCom Mode	1	Set communication mode to "LMI Comm Direct"
AuxCom Power Mode	0	Turn on Aux Comm port on power up
AuxCom Auto Off Time	0	Do not automatically turn off Aux Comm port
AuxCom Write Protect	0	Allow incoming commands from the Model 3277

8.2 Calibration Parameters

Table 8.2 lists the parameters that need to be configured for proper calibration. These parameters must be set via Lumic Calibration Software.

Table 8.2: Calibration Parameters

Parameter	Effect
High Voltage	Sets the operating voltage of the detector
Thresholds & Windows	Sets the discrimination voltages for the alpha and beta channels
Efficiency	Defines the detection efficiency of the detector
Rate Units	Defines the unit shown while the Model 3277 is idle in the "Rate" mode[1]
Count Units	Defines the unit shown while in all "Counting" modes[2,3]
Rate Alarm	Alarm value while the Model 3277 is idle in the "Rate" mode[4]
Count Alarm	Alarm value while the Model 3277 is in all "Counting" modes[4]
Loss of Count Time	Number of seconds with 0 counts before a "LOC" error
Count Time	Number of seconds for a manual count (has no affect on MCT count times)

[1] Rate units for all detectors must be set to the same unit type
[2] Count units for all detectors must be set to the same unit type
[3] For MCT use, count units must be of rate type (cpm, cps, dpm, or dps)
[4] See subsection 8.2.2 for more information

8.2.1 Idle Alarm Values

Alarms for "Idle" mode are set via the the settings menu. This applies to both "Idle Background" and "Idle Rate." See subsection 7.2.2 for more details.

8.2.2 Rate and Count Alarm Values

This value is the alarm value reference for "Rate" mode and all "Counting" modes in normal operation. It does not apply to "Idle" modes or source check. It is always relative to the value shown on the display. If background subtract is off, the alarm is effectively applied to the gross counts (Figure 8.2). If background subtract is on, the alarm is compared to the net counts (Figure 8.3).

$BackgroundSubtract$	Off
CPM_{Alarm}	$= 100$
CPM_{Gross}	$= 100$
$CPM_{Background}$	$= 10$
CPM_{Net}	N/A
$CPM_{OnDisplay}$	$= 100$
$Alarming$	Yes

Figure 8.2: Count Alarm Example - Background Off

$BackgroundSubtract$	On
CPM_{Alarm}	$= 100$
CPM_{Gross}	$= 100$
$CPM_{Background}$	$= 10$
CPM_{Net}	$= 90$
$CPM_{OnDisplay}$	$= 90$
$Alarming$	No

Figure 8.3: Count Alarm Example - Background On

8.2.3 Count Alarms and MCT

The count mode alarms are also used as the MDA value used in the MCT calculations. It is simultaneously used as the alarm value referenced on the display as shown in subsection 8.2.2, as well as the MDA value used for categorizing "Clean" or "Alarms" for the MCT result. The state of the background subtract will affect the displayed value; however, it will not affect the MCT result.

8.2.4 Ignored Parameters

Table 8.3 lists the parameters that are ignored and/or overridden by the Model 3277.

Table 8.3: Ignored Parameters

Parameter	Value	Reason
Response Time	0	Always in auto response rate
AutoResponse	Varies	With the frisker in the cradle (if equipped), the auto response rate is "**Slow**" If the frisker is removed from the cradle, the auto response rate is "**Fast**"
Device Display Controlled Audio	Off	The Model 3277 controls sets this to ensure alpha and beta pulse are heard

CHAPTER 9

SPECIFICATIONS

9.1 Model 3277HFM System

Part Number 48-4333-1

- **DISPLAY:** 17.8 cm (7 in.) diagonal, TFT LCD SVGA
- **COUNT TIME:** automatic and manual count modes
- **CONTROLS:** touch screen, IR hand/foot sensors
- **ALARMS:** audible and visual alarms
- **CLICK AUDIO:** greater than 75 dB at 0.6 m (2 ft.), approximately 4.5 kHz
- **ALARM AUDIO:** greater than 100 dB at 0.6 m (2 ft.), approximately 2.9 kHz
- **LINEARITY:** within 10%
- **TEMPERATURE RANGE:** 0 to 40 °C (32 to 104 °F)
- **POWER:** 100-240 Vac wall transformer, main electronics 9-15 Vdc, 15W
- **CONSTRUCTION:** aluminum with powder-coat finish, stainless steel
- **SIZE:** 138 x 30.5 x 49.7 cm (54.4 x 12 x 19.6 in.)
- **WEIGHT:** 21.14 kg (46.6 lb)

- **DETECTORS:**
  - **Model 43-203 Hand:**
    - **DETECTOR TYPE:** ZnS(Ag) scintillator adhered to 0.03 cm (0.01 in.) thick plastic scintillator
    - **WINDOW:**
      - Active - 301 cm^2 (46.7 in^2)
      - Open - 238 cm^2 (36.9 in^2)
    - **EFFICIENCY (4π):**
      - Alpha - ^{239}Pu - 20%
      - Beta - ^{99}Tc - 15%
    - **TYPICAL BACKGROUND:**
      - Alpha - ≤ 5 cpm
      - Beta - 700 cpm
    - **CROSS-TALK:**
      - Alpha to Beta ≤ 15%
      - Beta to Alpha ≤ 1%
  - **Model 43-204 Foot:**
    - **DETECTOR TYPE:** ZnS(Ag) scintillator adhered to 0.03 cm (0.01 in.) thick plastic scintillator
    - **WINDOW:**
      - Active - 540 cm^2 (83.7 in^2)
      - Open - 378 cm^2 (58.6 in^2)
    - **EFFICIENCY (4π):**
      - Alpha - ^{239}Pu - 12%
      - Beta - ^{99}Tc - 10%
    - **TYPICAL BACKGROUND:**
      - Alpha - ≤ 7 cpm
      - Beta - 1000 cpm
    - **CROSS-TALK:**
      - Alpha to Beta ≤ 18%
      - Beta to Alpha ≤ 1%

- **OPTIONS:**
  - **Model 43-93 Alpha-Beta Frisker:** (PN: 4519-277) Includes Model 43-93 detector and cradle with switch
  - **Model 43-147 Alpha-Beta Frisker:** (PN: 4519-489) Includes Model 43-147 detector and cradle with switch
  - **Battery Backup:** (PN: 4224-043)
    - Input: 12-15 Vdc, 24 W; Output: 9-15 Vdc, 15 W
    - SIZE: 13.0 x 19.1 x 16.3 cm (5.1 x 7.5 x 6.4 in.)
    - WEIGHT: 3.3 kg (7.2 lb)

CHAPTER 10

REVISION HISTORY

This section of the manual will be updated with each revision of theModel 3277 in order to document changes over time. Ludlum Measurements' policy is to provide free software upgrades to instruments for the life of the instrument.

October 2020: New manual.

April 2021: Updated Firmware to Firmware 1.10.3. In General Settings, updated Section 7.2.1, Table 7.3, by deleting Disable Mute Button row, added Auto Activate BG Subtract in Hand/Food Mode row, and added Auto Activate BG Subtract in Frisk Mode column. Added Appendix A along with Drawing 519 x 255M Frisking Mounting Options.

August 2023: Updated in Chapter 2 and Chapter 4 on how to remove and connect battery. Added Linearity to Chapter 3 Specifications. Updated Drawing 519 x 429H.

CHAPTER 11

RECYCLING

Ludlum Measurements, Inc. supports the recycling of the electronics products it produces for the purpose of protecting the environment and to comply with all regional, national, and international agencies that promote economically and environmentally sustainable recycling systems. To this end, Ludlum Measurements, Inc. strives to supply the consumer of its goods with information regarding reuse and recycling of the many different types of materials used in its products. With many different agencies – public and private – involved in this pursuit, it becomes evident that a myriad of methods can be used in the process of recycling. Therefore, Ludlum Measurements, Inc. does not suggest one particular method over another, but simply desires to inform its consumers of the range of recyclable materials present in its products, so that the user will have flexibility in following all local and federal laws.

The following types of recyclable materials are present in Ludlum Measurements, Inc. electronics products, and should be recycled separately. The list is not all-inclusive, nor does it suggest that all materials are present in each piece of equipment:

Batteries	Glass	Aluminum and Stainless Steel
Circuit Boards	Plastics	Liquid Crystal Display (LCD)

Ludlum Measurements, Inc. products that have been placed on the market after August 13, 2005, have been labeled with a symbol recognized internationally as the “crossed-out wheelie bin,” which notifies the consumer that the product is not to be mixed with unsorted municipal waste when discarding. Each material must be separated. The symbol will be placed on outside of the instrument.

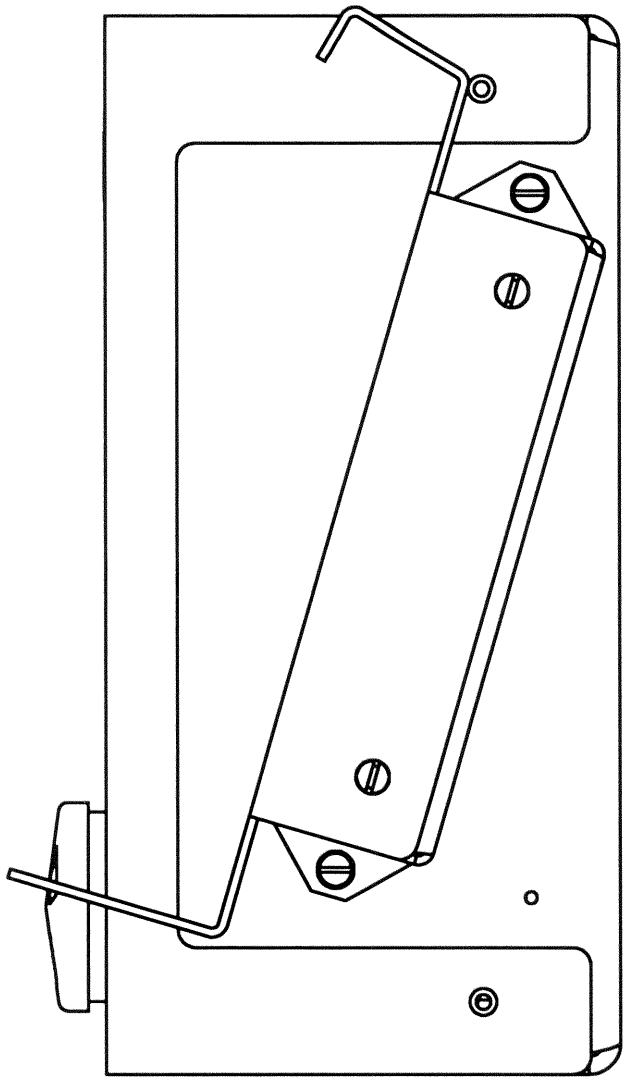
The symbol appears as such: 

APPENDIX A

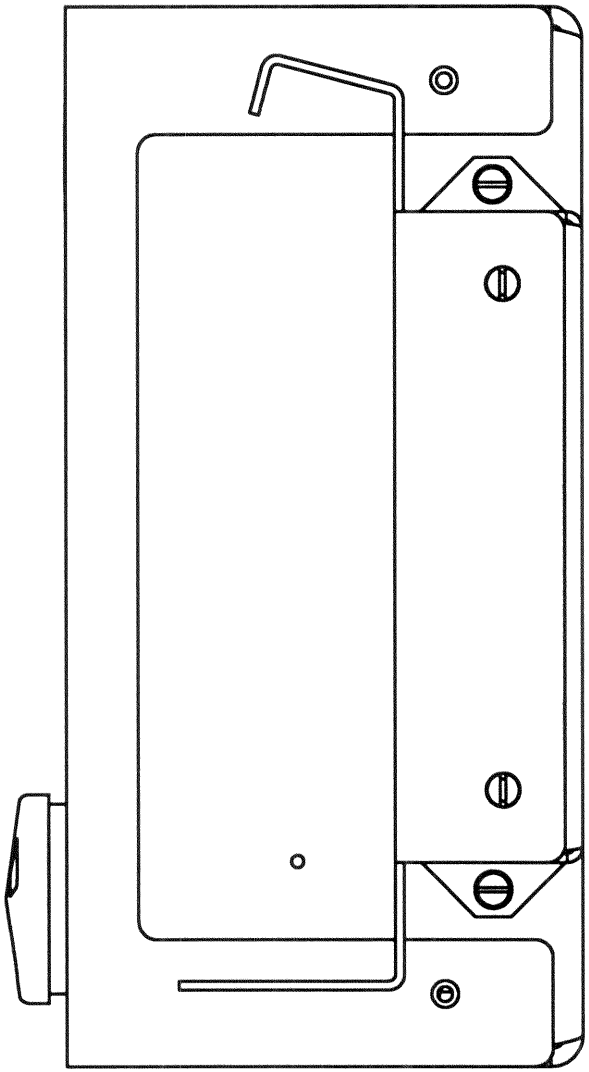
DRAWINGS

REVISION HISTORY			
REV	DESCRIPTION	DATE	BY
1	VALID	9/25/19	DLJ

POSITION 1



POSITION 2



FRISKER OPTION HAS 2 OPTIONS. WHEN ELECTRONICS ARE VERTICAL OR MOUNTED ON A WALL, POSITION 1 IS RECOMMENDED.

WHEN ELECTRONICS ARE AT AN ANGLE, POSITION 2 IS RECOMMENDED.

DWN	DATE	CHK	DATE	APP	DATE
DLJ	9/25/19			JGW	9-25-19

DWG NUM: 4519-255 | SCALE:

TITLE FRISKER MOUNTING OPTIONS

LUDLUM MEASUREMENTS, INC
501 OAK STREET
SWEETWATER, TEXAS 79556

SERIES	SHEET
519	255M