# Model 3276 Series Frisker/Area Monitor

**Ludlum Measurements**

**September 2023**

**Serial Number: 353108 and Succeeding**

**Firmware: n42.4810 and Higher**

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**LUDLUM MEASUREMENTS, INC**
501 OAK STREET, P.O. BOX 810
SWEETWATER, TEXAS 79556
325-235-5494, FAX: 325-235-4672

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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.

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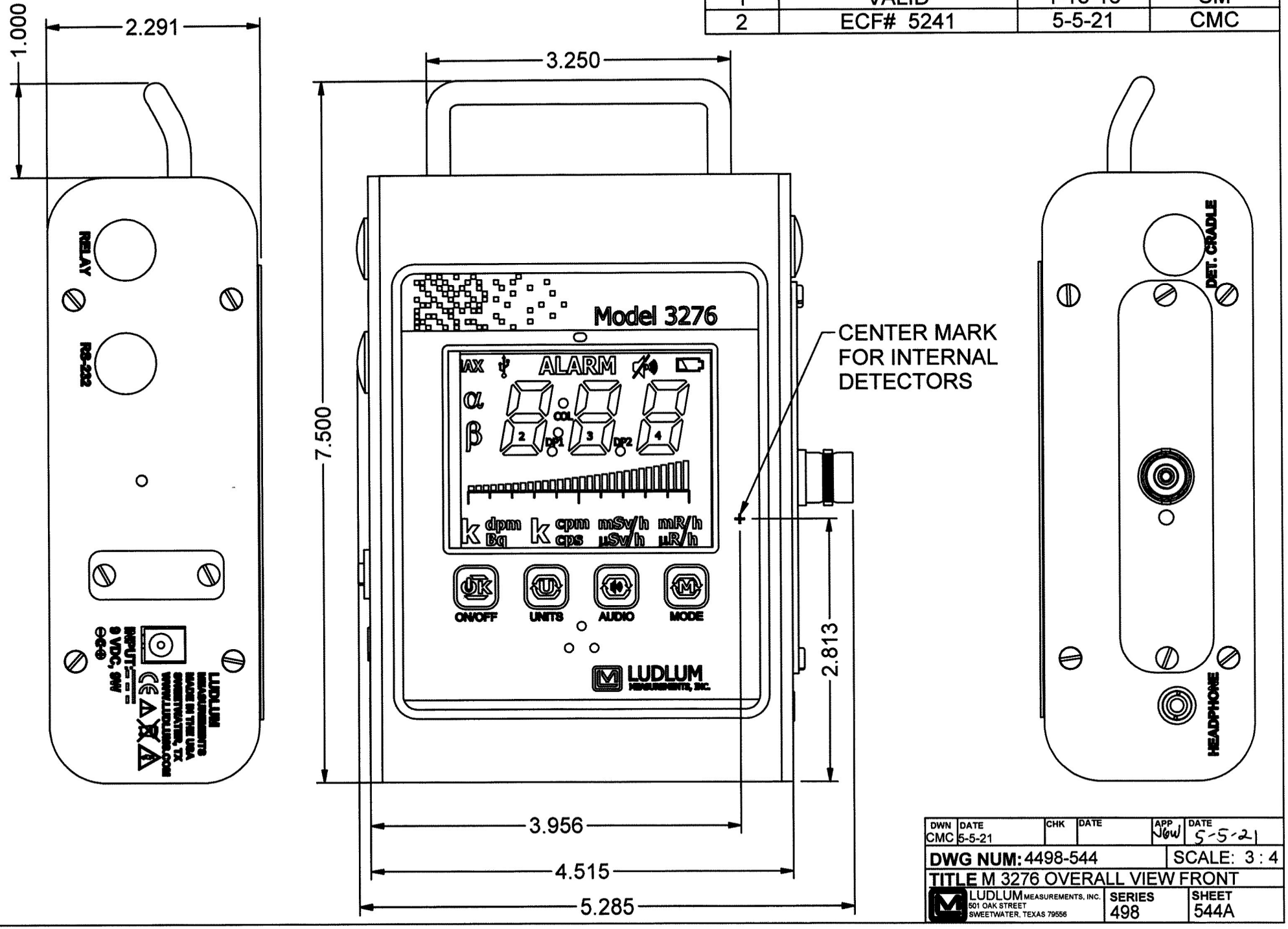
**ATTN: REPAIR DEPARTMENT**
**501 OAK STREET**
**SWEETWATER, TX 79556**

**800-622-0828 325-235-5494**
**FAX 325-235-4672**

| REVISION HISTORY | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | APPROVED |
| 1 | VALID | 1-13-16 | SM |
| 2 | ECF# 5241 | 5-5-21 | CMC |




| DWN | DATE | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| CMC | 5-5-21 | | | JGW | 5-5-21 |

**DWG NUM:** 4498-544 SCALE: 3 : 4

**TITLE** M 3276 OVERALL VIEW FRONT

LUDLUM MEASUREMENTS, INC.
501 OAK STREET
SWEETWATER, TEXAS 79556

SERIES 498

SHEET 544A

| REVISION HISTORY | | | |
|---|---|---|---|
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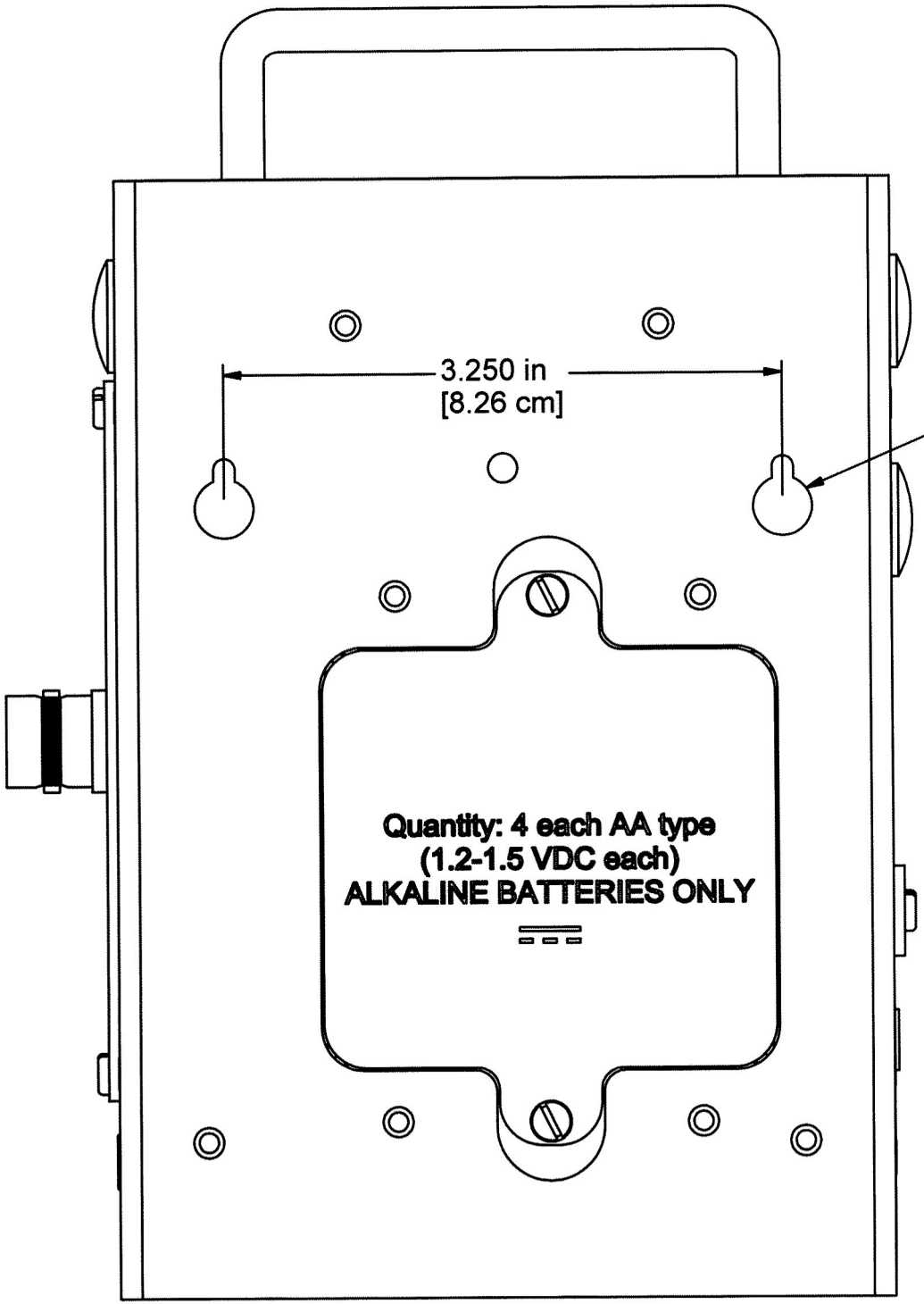
| 2 | ECF# 5241 | 5-5-21 | CMC |




USE #6 SCREWS TO
MOUNT DIRECTLY TO WALL

ACTUAL SIZE CAN BE USED
AS TEMPLATE FOR MOUNTING HOLES

NOTE: BECAUSE OF PRINTER DIFFERENCES, WHEN USING THIS DRAWING AS A TEMPLATE, MAKE SURE MEASUREMENT IS ACCURATE BEFORE USING.

| DWN | DATE | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| CMC | 5-5-21 | | | NGW | 5-5-21 |

**DWG NUM:** 4498-544 SCALE: 1 : 1

**TITLE** M 3276 REAR VIEW

LUDLUM MEASUREMENTS, INC.
501 OAK STREET
SWEETWATER, TEXAS 79556

**SERIES** 498

**SHEET** 544B

| REVISION HISTORY | | | |
|---|---|---|---|
| REV | DESCRIPTION | DATE | APPROVED |
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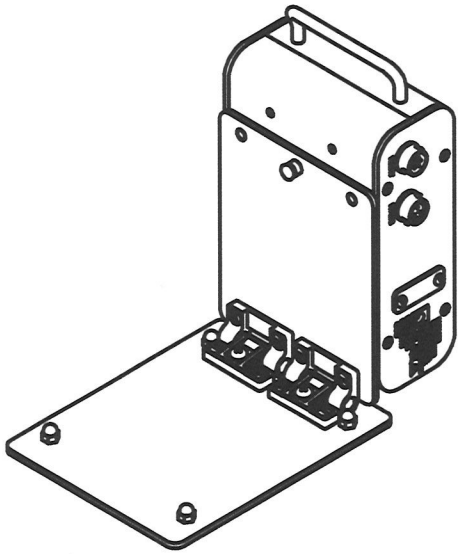

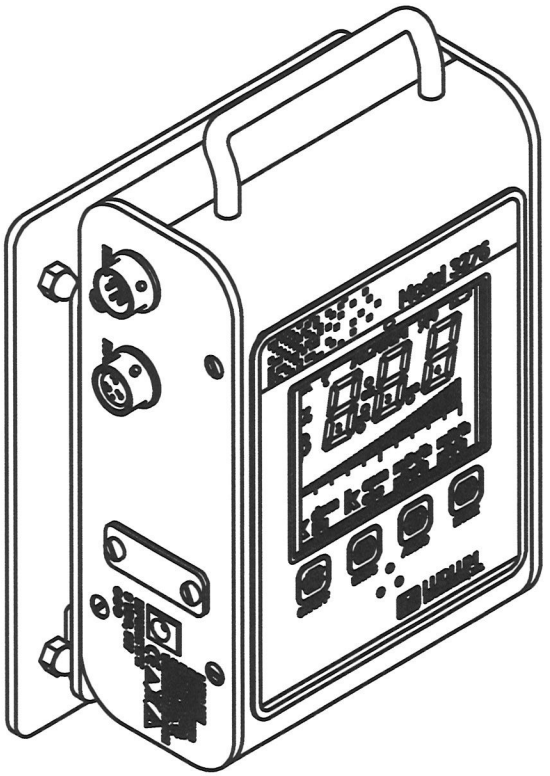


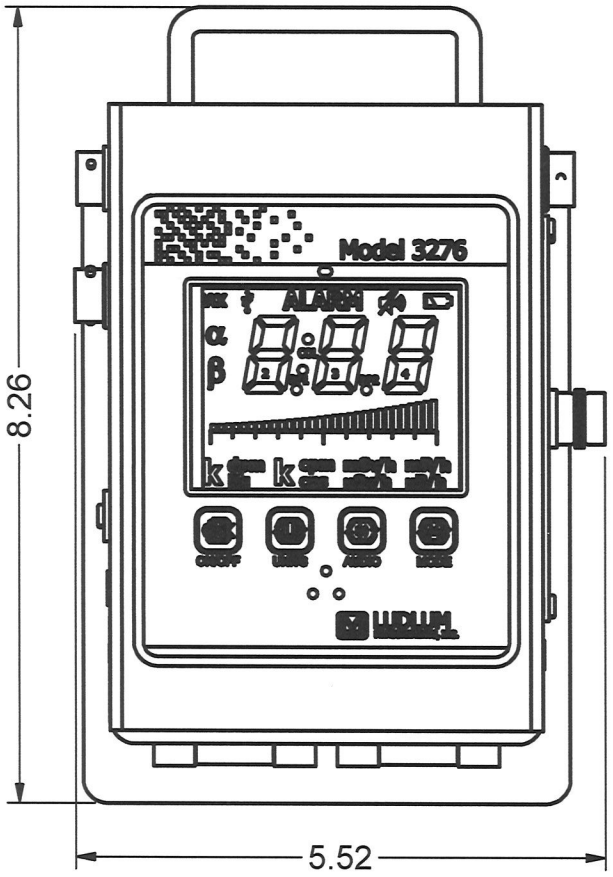


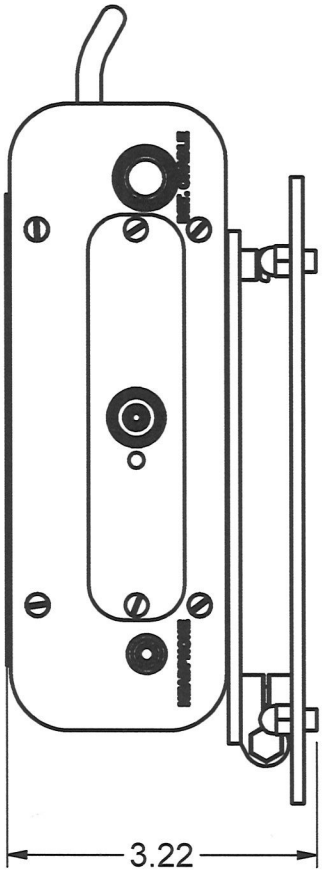


| DWN | DATE | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| ZSZ | 12/21/17 | | | JGW | 12-21-17 |

**DWG NUM:** 4498-784 SCALE: 1 : 2

**TITLE** M 3276 DESKTOP MOUNT ASSY

LUDLUM MEASUREMENTS, INC.
501 OAK STREET
SWEETWATER, TEXAS 79556

**SERIES** 498 **SHEET** 784 A

| REV # | ALTERATIONS | DATE | BY |
|---|---|---|---|
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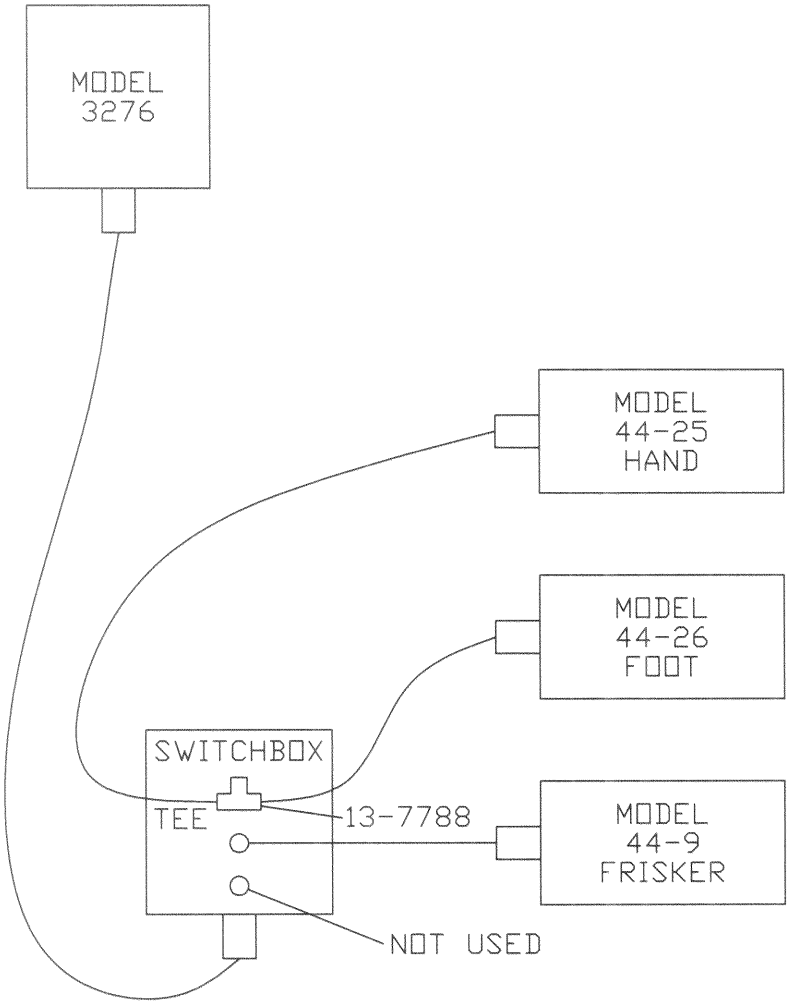
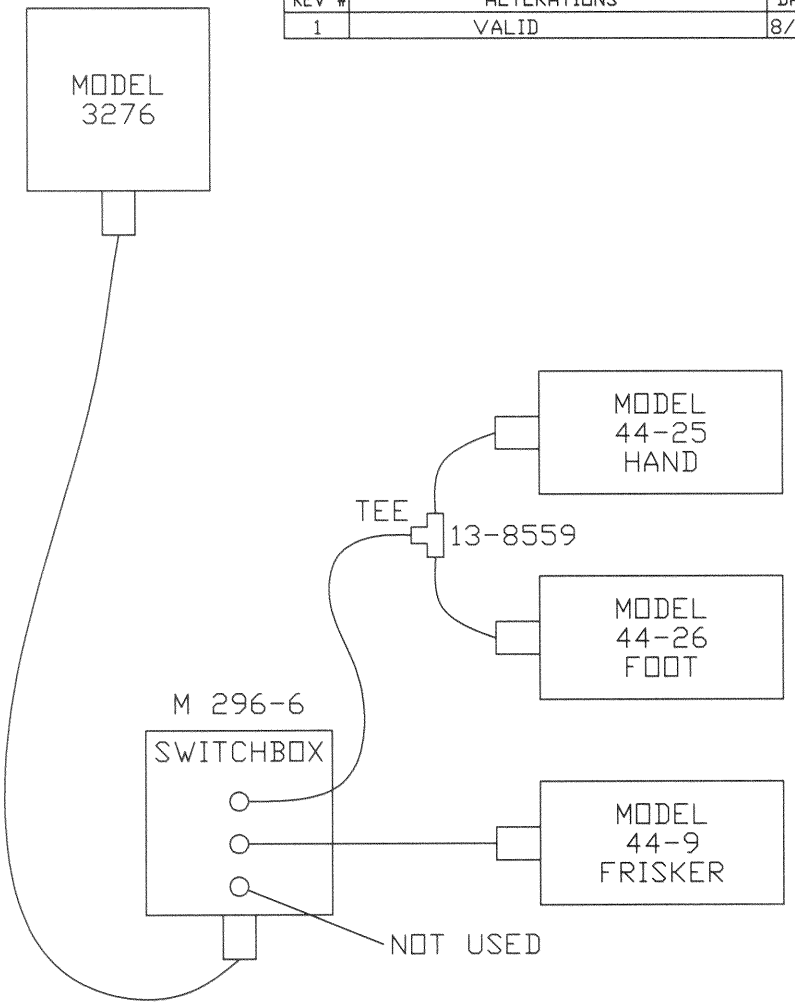



COMBINED WITH TEE 13-7788
SWITCH SELECTIONS
A - HAND & FOOT*
B - FRISKER
* HAND AND FOOT CANNOT BE SEPARATED




COMBINED WITH TEE 18-8559
SWITCH SELECTIONS
A - HAND & FOOT*
B - FRISKER
* HAND AND FOOT CANNOT BE SEPARATED

| DWN | DATE | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| CMC | 8/12/20 | | | MGW | 8-12-20 |

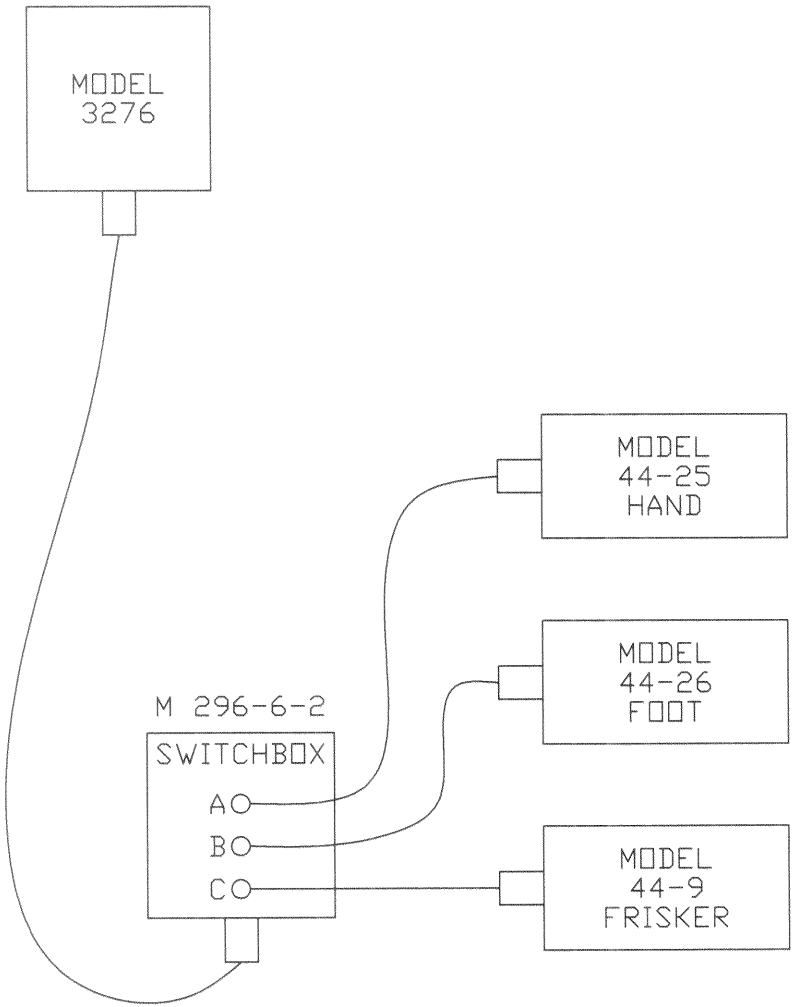
PART NUM: 7519-571 SCALE: FULL ☐ OTHER

TITLE: M 3276 CABLE DIAGRAM-TEES

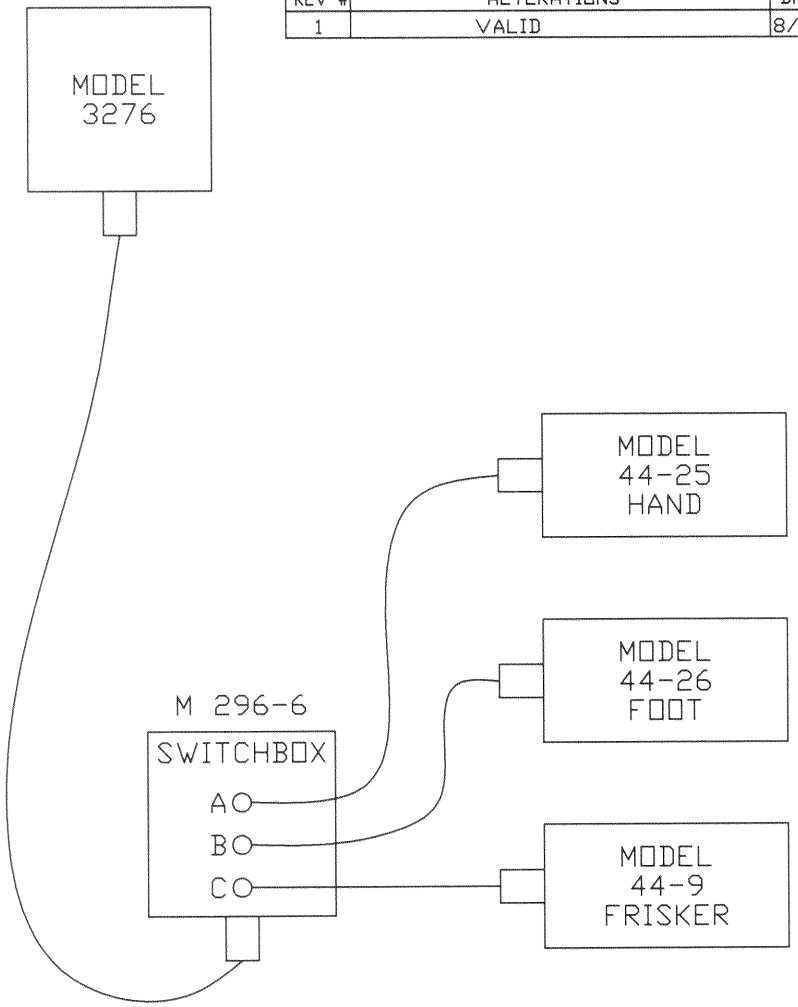
LUDLUM MEASUREMENTS, INC.
501 OAK STREET
SWEETWATER, TEXAS 79556

SERIES 519 SHEET 571

| REV # | ALTERATIONS | DATE | BY |
|---|---|---|---|
| 1 | VALID | 8/12/20 | CMC |




WIRING WITH 4 POSITIONS SWITCHBOX (M 296-6-2)
SWITCH SELECTIONS
A - HAND ONLY
B - FOOT ONLY
A & B - HAND & FOOT TOGETHER
C - FRISKER




NO "TEE" REQUIRED
WIRING FOR INDIVIDUAL CONNECTION
SWITCH SELECTIONS
A - HAND*
B - FOOT*
C - FRISKER
* HAND AND FOOT CANNOT BE COMBINED

| DWN | DATE | CHK | DATE | APP | DATE |
|---|---|---|---|---|---|
| CMC | 8/12/20 | | | NGW | 8-12-20 |

PART NUM: 7519-571 SCALE: FULL ☐ OTHER

TITLE: M 3276 CABLE DIAGRAM

LUDLUM MEASUREMENTS, INC.
501 OAK STREET
SWEETWATER, TEXAS 79556

SERIES 519

SHEET 571A

# CONTENTS

**Contents** 3

**List of Figures** 7

**List of Tables** 9

**1 Introduction** 11
1.1 Various Configurations of the Model 3276 . . . 12

**2 Getting Started** 15
2.1 Unpacking and Repacking . . . 15
2.2 Battery Installation . . . 15
2.3 Instrument Operational Test . . . 16
2.3.1 Turning the Instrument On . . . 16
2.4 Sigma Audio . . . 17
2.5 Detector Failure Diagnostics . . . 18
2.5.1 Detector Loss of Count . . . 18
2.5.2 Detector Over Range . . . 18
2.5.3 Detector Overload . . . 19
2.6 Instrument Use And Controls . . . 19
2.6.1 ON/OFF Button: . . . 20
2.6.2 UNITS Button: . . . 21
2.6.3 AUDIO Button: . . . 21
2.6.4 MODE Button: . . . 22
2.7 RATE Mode Operation . . . 22
2.8 MAX Mode Operation . . . 23
2.9 COUNT Mode Operation . . . 24

**3 Specifications** 29

**4 Setup Mode** 31
4.1 Setup Overview . . . 31
4.2 Setup Parameters . . . 32
4.3 Entering Setup Mode . . . 33
4.4 Setup Mode Operation . . . 34
4.5 Model 3276 List of Parameters (in order) . . . 36
4.6 Setup Page 1 . . . 37
4.7 Setup Page 2 . . . 40
4.8 Setup Page 3 . . . 43
4.9 Setup Page 4 . . . 45

**5 Software** 49
5.1 Connecting to Lumic 2.0 Calibration/Configuration Software . . . 49

**6 Advanced Features** **51**
6.1 Dead Time Correction . . . 51
6.2 Units . . . 51
6.3 R to Sv Conversion . . . 52
6.4 Software Calibration Tools . . . 52
6.5 Hardware Correction . . . 52
6.6 Other Device Data . . . 52
6.7 Battery Life . . . 53
6.8 Real-time Streaming . . . 53
6.9 CPS Offset . . . 53

**7 Safety Considerations** **55**
7.1 Environmental Conditions for Normal Use . . . 55
7.2 Warning Markings and Symbols . . . 55
7.3 Cleaning and Maintenance Precautions . . . 56

**8 Revision History** **57**

**9 Recycling** **59**

**10 Options** **61**

**11 Standard Parts List** **63**

**A Model 3276 Variations** **65**
A.1 Model 3276 Hand & Foot Monitor . . . 65
A.1.1 Model 44-25 Hand Monitor Detector . . . 65
A.1.2 Model 44-25 Specifications . . . 66
A.1.3 Model 44-26 Foot Monitor Detector . . . 66
A.1.4 Model 44-26 Specifications . . . 66
A.1.5 Model 44-9 Frisker Detector . . . 67
A.1.6 Model 44-9 Specifications . . . 67
A.2 Model 3276 with Model 44-9 Wall-Mounted Frisker . . . 67

**B Auxiliary Communications** **69**
B.1 AuxCom Overview . . . 69
B.2 Requirements . . . 69
B.3 Usage . . . 69
B.3.1 AuxCom Usage - Hot Key . . . 69
B.4 Settings . . . 70
B.4.1 AuxCom Setting - Mode . . . 70
B.4.2 AuxCom Setting - 375 Ethernet Mode Port . . . 70

**C Ethernet Network Settings** **71**
C.1 Modes of Operation . . . 71
C.2 Finding the Instruments on the Network . . . 72
C.3 Network Settings . . . 73
C.4 Common Settings . . . 74

C.5 Password Settings . . . . . 75
C.6 Model 375 TCP Mode . . . . . 75
C.7 Model 375 UDP Mode . . . . . 76
C.8 Model 4525 Mode . . . . . 77

# LIST OF FIGURES


2.1 Startup Display (All Segments Shown) . . . . . 16
2.2 Firmware Version Display . . . . . 16
2.3 Battery Voltage Display . . . . . 17
2.4 Detector Loss of Count Display (Display Will Flash) . . . . . 18
2.5 Detector Over Range (Display Will Flash) . . . . . 19
2.6 Detector Overload Alarm (Display Will Flash) . . . . . 19
2.7 RATE Mode Displaying Background Radiation Rate . . . . . 23
2.8 MAX Mode Display With ALARM Indication . . . . . 24
2.9 COUNT Mode Displaying COUNT Timer of 5 Minutes, 30 Seconds . . . . . 27

4.1 Setup Page Selection Display (showing page 4-CAL) . . . . . 35

A.1 Model 3276 Hand and Foot Monitor . . . . . 65
A.2 Model 3276 With Wall Mount Frisker . . . . . 68

B.1 Example – Lumic 2.0 Calibration Software . . . . . 70

C.1 Device Finder . . . . . 72
C.2 Model 375 TCP Mode . . . . . 73
C.3 Model 375 UDP Mode . . . . . 74
C.4 Model 4525 Mode . . . . . 74

# LIST OF TABLES


1.1 Model 3276 Series Internal Detectors . . . . . 13

2.1 COUNT Mode Units and Result . . . . . 25

4.1 Setup Parameters . . . . . 33
4.2 Primary Units and Multipliers . . . . . 40
4.3 Primary Unit Multipliers . . . . . 42
4.4 Secondary Units and Multipliers . . . . . 43
4.5 Secondary Unit Multipliers . . . . . 44
4.6 Response Time Based on Count Rate . . . . . 46

6.1 Features That Affect Units in All Modes . . . . . 52

11.1 Standard Parts List . . . . . 63

B.1 AuxCom Mode . . . . . 70

C.1 Ethernet Option Parts . . . . . 71
C.2 MAC Addresses . . . . . 72

CHAPTER 1

# INTRODUCTION

The Model 3276 is an ergonomic, versatile instrument that can be used for multiple radiation detection or measurement purposes. Its design allows it to be used as either a frisker or as an area monitor. It features the ability to measure radiation in count rate, exposure rate/dose, activity rate, integrated exposure/dose, time-averaged rates, and scaler counts. The Model 3276 may utilize either internal or external radiation detectors to detect alpha, beta, or gamma radiation. When used as a frisker, three modes of operation are available for the Model 3276 – RATE, MAX, and COUNT.

RATE mode operation will display the current count, exposure, or activity rate.

MAX mode is used to capture the highest count, activity, or exposure rate detected – useful for finding a peak rate, or frisking when the display is not visible. Two sets of units (primary and secondary) for RATE and MAX modes can be chosen from among cps, cpm, Bq, dpm, R/h, or Sv/h. The user can switch between these two units by simply pressing the UNITS button.

COUNT mode allows the user to perform a count for a predetermined time. Depending on the count units chosen, the result can be a scaler count (in counts or disintegrations), a time-averaged rate (cpm, dpm, Bq, cps), a time-averaged exposure or dose (R/h, Sv/h), or an integrated exposure or dose (R or Sv).

The Model 3276 is auto-ranging; therefore, when using Model 375 software or remotes, the unit multiplier will not always be accurate unless minimum and maximum displays are configured so that the multiplier does not change (i.e., 0.00 kcpm-999 kcpm; 0.00 mR/hr-999 mR/hr). It is also recommended to disable the Secondary Units (Unit 2) and Count Mode

RATE and MAX modes can be silent or utilize a “click” audio; the “click” audio is now enabled during COUNT mode. A "sigma" audio mode can be enabled (In COUNT mode, click audio will be utilized.) when scintillator detectors are used, and this mode makes it easy for the user to find small increases above the background radiation level. In this mode, the instrument measures background for 8 seconds after powerup, and then beeps whenever the rate increases by a small amount.

Users are freed from watching the numeric value to "find" something. They can simply listen for multiple beeps. When used as an area monitor, the mode choices are limited to just the RATE mode by default, appropriate for constantly scanning the radiation level. The units can also be limited to a single set of radiation units so that the display is always showing the same measurement.

When used as an area monitor, the audio is limited to activating on an alarm condition, and not the click-per-event or sigma audio more appropriate to frisking.

The instrument features a large backlit LCD (liquid crystal display), a piercing audio warning, and easy, intuitive use. The display backlight is on at all times to promote visibility; however, the backlight may be disabled through software (see Advanced Features Section 6 of this manual). The unit body is made of lightweight, rugged aluminum. It is not intended for outdoor use and should be protected from splashing water. It does have a handle to allow a user to transport it between sites. The primary keypad includes four push buttons: ON/OFF to toggle instrument power, UNITS to change between available units, AUDIO to change audio levels, and MODE to switch between available modes.

Setup of the instrument is accomplished through the front-panel buttons, or through Lumic 2.0 software available from Ludlum Measurements.

Front-panel setup can be disabled via the internal switch on the Model 3276 in order to protect settings from inadvertent changes. When the settings are protected, the user can view the settings or modify a limited number of settings as defined with the Lumic software. Using the Lumic software, the Model 3276 can be configured to allow changes to the alarms and/or count time even when in protect mode.

The unit is operated with a wall-mounted DC supply that provides 9 VDC to the instrument and has interchangeable prongs to operate on 100-250 VAC at 50-60 Hz in most areas of the world. Four alkaline AA batteries supply backup power for operation from -20 to 50 °C (-5 to 122 °F). Battery life is approximately 50 hours with the backlight ON, 16-hour low battery warningÀ low-battery indicator on the LCD warns when less than 16 hours of battery life remain. The Model 3276 has a number of options that can be ordered with the new instrument, or be added on later. These options include relay, headphones, RS-232 output, and a detector cradle that silences the instrument's click audio when the external detector is in the cradle. For more advanced use: See Appendix A for information on our Auxiliary Communications features, which allow the instrument to expand its capabilities with a variety of external devices through a standard serial interface.

## 1.1 Various Configurations of the Model 3276

There are also other configurations of the Model 3276. The Model 3276/1, 3276/2, 3276/4, and 3276/6 all have an internal detector and are designed just for monitoring. The type of detector in the instrument is what makes each one different. Sales can help you determine what fits your needs best. Each different version operates at a different range. See the table below.

| Model | Operating Range | Part # |
|---|---|---|
| 3276/1 | 0.010 µSv/h-500 µSv/h (1.0 µR/hr-50.0 mR/hr) | 48-4169 |
| 3276/2 | 1.0 µSv/h-50 mSv/h (0.10 mR/hr-5.00 R/hr) | 48-4170 |
| 3276/4 | 10.0 µSv/h-500 mSv/h (1.0 mR/hr-50 R/hr) | 48-4171 |
| 3276/6 | 40.0 µSv/h-10.0 Sv/h (4.0 mR/hr-999 R/hr) | 48-4283 |

Table 1.1: Model 3276 Series Internal Detectors

We also have other variations that pair the Model 3276 with separate detectors and provide different set-ups for unique applications. See A of this manual for more details on those variations.

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 3276 serial number is located on a label on the front side of the unit.

To return an instrument for repair or calibration, provide sufficient packing material to prevent damage to the instrument 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 “Service Department” from the drop-down menu. Then choose the appropriate form located under the "Returned Goods Form" heading.

## 2.2 Battery Installation

A low-battery indicator appears at the top of the LCD when less than 16 hours of battery life remain. When this indicator is present, follow these steps to replace the four standard AA batteries:

1. Turn off power to the instrument.
2. Turn the instrument over so that the bottom of the instrument is facing up.
3. Use a straight, medium-sized screwdriver to remove both screws on the battery cover.
4. Release and remove the battery cover.
5. Replace all four AA batteries.
6. Replace the cover and install both screws by turning clockwise to secure.

## 2.3 Instrument Operational Test

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

### 2.3.1 Turning the Instrument On

Turn the instrument ON by pressing the ON/OFF button for about a second, and then releasing. The instrument should activate all the LCD segments and the audio. Observe the device during this time. If any LCD segments are missing, or audio fails to work, the device is in need of repair. Please refer to Figure 2.1.

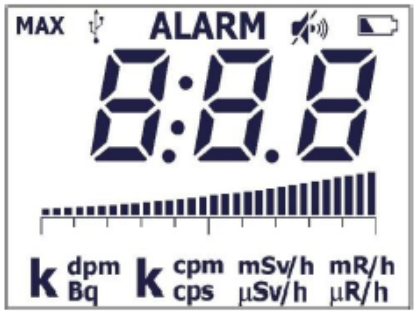



Figure 2.1: Startup Display (All Segments Shown)

The instrument then displays the firmware version. Please refer to figure below.

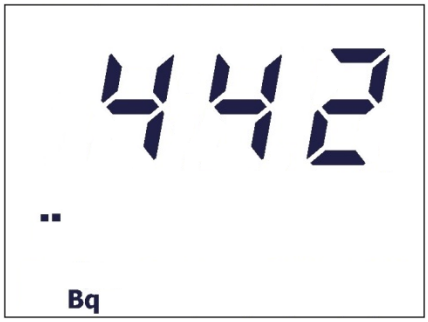



Figure 2.2: Firmware Version Display

**Note:** Firmware versions with Bq units are equipped with auxiliary communication.

Beginning with the n42 version firmware, the tick marks below the firmware number define the board generation which will help with future firmware updates. Once n42 is installed, the user will no longer have to open the instrument to determine which version of the main processor board was used in the instrument. Instead, use the following table to determine which main processor board is installed in the instrument:

- 1 tick - 5498-770
- 2 ticks - 5519-785

The instrument then displays the battery voltage. Please see Figure below.

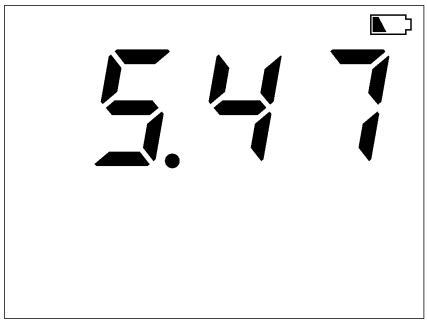



Figure 2.3: Battery Voltage Display

The instrument will then move to normal operation, displaying the current rate for the Primary units (factory default: mR/h). This boot-up process takes about 5 seconds, plus another 8 seconds if Sigma Audio is enabled.

If the Sigma Audio option is selected, the unit will display a countdown from :08 to :01 (in seconds) as the unit measures background radiation levels.

Ensure that the low-battery indicator is not present. If the low-battery indicator is present, replace the batteries as soon as possible. Should the instrument detect a battery voltage that is high enough to power on, but too low to safely operate, the display will blank and the low-battery icon will flash. Normal operation will not be available until the batteries have been replaced. Under extreme low-battery conditions, be aware that the unit may not even turn on or may turn itself off abruptly.

To assure proper operation of the instrument and detectors(s) between calibrations, an instrument operational check including battery test and instrument test should be performed at least daily or prior to use, whichever is less frequent. A reference reading (or readings) with a dedicated check source should be obtained with the detector(s) in a constant and reproducible manner at the time of calibration or at the time the instrument is received in the field.

If at any time the instrument fails to read within 20% of the reference reading when using the dedicated check source, it should be removed from service and sent to a calibration facility for recalibration and/or repair. If desired, multiple readings may be taken at different distances and/or with different sources so that other scales are checked.

Example of a Check Source reading:

Check Source #_____ Rate_____ Units_____

## 2.4 Sigma Audio

The Ludlum Model 3276 has the standard "click" audio that is widely used by radiation instruments; however, it also has a Sigma Audio mode that can be enabled to change the audio sound. This mode is useful for scintillation detectors because their high count rate makes the "click" audio less useful.

In the sigma audio mode, the instrument measures the background radiation for eight seconds on power-up, and then automatically sets a low threshold alarm rate above the background rate. Afterwards, the instrument will produce a beep any time that the instrument "sees" more than this threshold value. The user doesn't need to watch the display to find a small increase over background; the user may just listen for multiple beeps. Thus, the unit has an audio alarm that, on power-up, adjusts to just above the current background level and provides a sensitive audio indication to the user.

Note that this audio alarm can also work in conjunction with the fixed alarm, i.e. the user can have both a floating audio alarm (resulting in audio beeps) based on the background level, and a fixed tone audio and a steady ALARM icon when a predetermined fixed alarm level is exceeded.

## 2.5 Detector Failure Diagnostics

Note that the Model 3276 has its own diagnostic tests to ensure that the detector is functioning correctly.

### 2.5.1 Detector Loss of Count

If the detector stops detecting radiation for a settable number of seconds, the Model 3276 will flash the minimum display value to indicate which units have been affected by the loss of count event. 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.

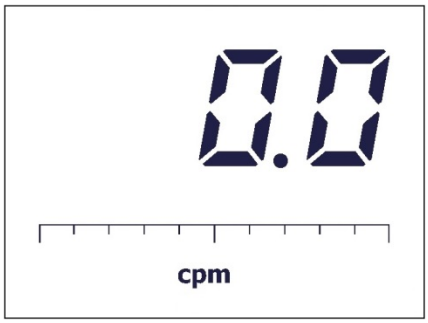



Figure 2.4: Detector Loss of Count Display (Display Will Flash)

### 2.5.2 Detector Over Range

If the detector is exposed to high levels of radiation or has an internal malfunction that causes it to count high or excessively, the unit flashes the maximum display value for the currently selected units as a warning. Additionally, the ALARM icon is displayed at the top of the screen, an audio alarm sounds (which can be silenced by a long press of the ON/OFF button ), and the device status OVERRANGE is streamed . The user should ensure whether this condition is being caused by a high radiation field, by a shorted cable, or by internal malfunction. If a Maximum Display parameter is set, then it is possible for the display to flash the Maximum Display value under this condition.

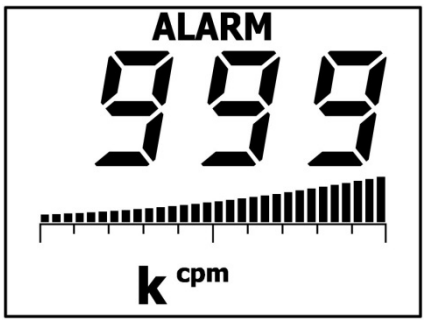



Figure 2.5: Detector Over Range (Display Will Flash)

### 2.5.3 Detector Overload

As another diagnostic test, the Model 3276 monitors the HV supply's detector current. A current overload threshold can be set via Setup Mode or Lumic Software. (A setting of 0 disables this alarm.) In general, this alarm setting can be used to detect when there is some detector failure, a cable failure, or a possible high level of radiation. When this alarm is triggered, the LCD will display "OL" in place of the numerical values, and an alarm tone will sound. Once the detector current goes below the threshold, the Model 3276 will return to normal operation.

Figure 2.6: Detector Overload Alarm (Display Will Flash)

## 2.6 Instrument Use And Controls

With four front-panel buttons and one handle button (as seen in front-panel drawing in front of manual), the Ludlum Model 3276 offers many features in a small package. Each button may be pressed and held for a predetermined length of time, signified by instrument beeps, to access unique instrument features. As the button is pressed, the instrument will beep to indicate the user has reached a new level of button access.

- A short press and release, less than 1/2 second and before any instrument beeps occur, will activate the first level of button operation. When the button is released, a single beep will occur as an acknowledgement.

- A long press, greater than 1/2 second but less than 2 seconds, will force the instrument to emit one beep. Release the button after the beep to activate the second level of operation.

- An extra-long press, greater than 2 seconds and after the second instrument beep, will activate the highest level of operation. After the second beep, the button may be released.

By default, the majority of functions are assigned to short presses of the buttons.

### 2.6.1 ON/OFF Button:

Used to power the Model 3276 ON and OFF.

- Power On: Press for approximately one second and release.
- Power Off: Press and hold for approximately five seconds. The display will show a 3, 2, 1 countdown after the second beep. Releasing the ON/OFF button during shutdown will return the device to the previous state of operation. At completion of the shutdown count, the LCD will go blank (unless a USB cable is connected in which case the USB icon will flash).

**Short Press (press and release before one beep):**

- During normal operation, it will acknowledge/silence alarms in any mode of operation.
- Will move selection position in the device menu.

**Long Press (press and release after one beep):**

- In RATE mode, it will reset the currently displayed rate if the user has permission (permission set from Lumic 2.0 software). The minimum display will be shown before returning to the exposure rate.
- In RATE mode, when Sigma Audio is enabled, the instrument will take a new background reading and update the Sigma Audio level.
- In MAX mode, it will reset the current MAX value.
- In COUNT mode, it will:
  - If COUNT mode is ready: It will initiate the count.
  - If COUNT mode is in progress: It will stop the current count and reinitialize the instrument to begin the next count.
  - If COUNT mode is complete: It will reset the count mode and reinitialize the instrument to begin the next count.

**Extra-Long Press (press and release after two beeps):**

- Currently has no effect.

### 2.6.2 UNITS Button:

In default operation, the display shows the current exposure rate using the Primary units. A short press of the UNITS button (1 beep) will switch between Primary and Secondary units.

**Short Press (press and release before one beep):**

- Used to switch between Primary and Secondary units.

**Long Press (press and release after one beep):**

- Currently has no effect.

**Extra-Long Press (press and release after two beeps):**

- Enables/disables the Auxiliary Communications in conjunction with the Mode button.
- In Count mode with the timer ready, will increment through the available count times.
  - User defined.
  - 0 (minimum display) or Continuous Count
  - 6 seconds (0:06)
  - 30 seconds (0:30)
  - One minute (1:00)
  - Two minutes (2:00)
  - 5 minutes (5:00)
  - 10 minutes (9:60)

**Press and Hold:**

- In Count mode with the timer ready, continuing to hold the button after the second beep will allow the instrument to cycle through the available count times at approximately one-second intervals.

### 2.6.3 AUDIO Button:

The Audio button's primary function is to adjust the audio level of the instrument.

**Short Press (press and release before one beep):**

- During normal operation, it will increment the audio through available volume levels which include mute and high.

**Long Press (press and release after one beep):**

- Currently has no effect.

**Extra-Long Press (press and release after two beeps):**

- Device Menu: When viewing the detector current overload set point, this will switch the display between the live current reading and the set point value.

### 2.6.4 MODE Button:

The Mode button's primary function is to switch between available enabled modes.

**Short Press (press and release before one beep):**

- During instrument initialization and within 4 seconds after the power-up screen, three short presses of the MODE button will place the instrument into setup mode. Once the instrument is displaying normal operation, and 4 seconds have passed, the button can be used to advance to the next available mode.
- Used to advance between the three operating modes: RATE, MAX, and COUNT. While RATE must always be enabled, any combination of MAX and COUNT modes may be disabled from use.

**Long Press (press and release after one beep):**

- Currently has no effect.

**Extra-Long Press (press and release after two beeps):**

- Enables/disables the Auxiliary Communications in conjunction with the UNITS button.

## 2.7 RATE Mode Operation

In RATE mode, the current count/exposure rate will be displayed. The maximum displayable value, regardless of units, is 999 k.

If an alarm is not in progress, a long press of the ON/OFF button will reset the averaged rate before releasing the button. The Reset feature must be enabled through Lumic 2.0 Calibration software and will be disabled when Sigma Audio is enabled.

A short press of the UNITS button will switch the displayed value between the Primary and Secondary Units.

A short press of the AUDIO button will toggle click audio between Off and On (Hi). When Sigma Audio is enabled, a short press of the AUDIO button will toggle the Sigma Audio volume levels.

If an alarm condition is present, a short press of the ON/OFF button will acknowledge and turn off the alarm audio. Under an alarm condition, the ALARM display indicator will be activated. There are two user settable alarms for both the primary and secondary units. If both alarms for a particular unit are set, the first alarm will activate beeping alarm audio and a flashing ALARM display indicator; If only one alarm is set or the second alarm is triggered, both the alarm audio and the ALARM display indicator are continuous. Alarms are non-latching in RATE mode.

When Sigma Audio is enabled, and an alarm condition is not present, a long press of the ON/OFF button will reset the Sigma Audio alarm level. The Sigma count can only be reset in RATE mode. If sigma audio and device rate reset are both enabled, the device rate reset will automatically be disabled.

If other operational modes are available, a short press of the MODE button will move to the next available operational mode.

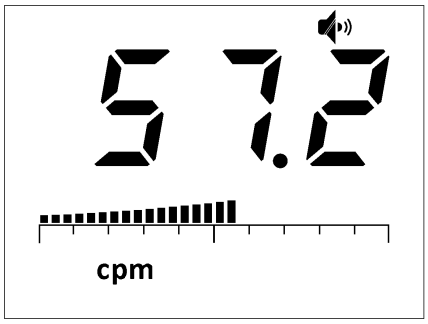



Figure 2.7: RATE Mode Displaying Background Radiation Rate

## 2.8 MAX Mode Operation

While in MAX mode, the highest detected count rate (since MAX mode was selected) is displayed. The word MAX will be displayed when in MAX mode. A short press of the UNITS button will switch the displayed value between the Primary and Secondary Units.

A short press of the AUDIO button will toggle click audio between Off and On (Hi). When Sigma Audio is enabled, a short press of the AUDIO button will toggle the Sigma Audio volume levels.

Under a non-alarm or alarm condition, a long press of the ON/OFF button will reset the display. When Sigma Audio is enabled, the Sigma Audio alarm level cannot be reset in Max Mode.

If an alarm condition is present, a short press of the ON/OFF button will acknowledge and turn off the alarm audio. Under an alarm condition, the ALARM display indicator will be activated. There are two user settable alarms for both the primary and secondary units. If both alarms for a particular unit are set, the first alarm will activate beeping alarm audio and

a flashing ALARM display indicator; If only one alarm is set or the second alarm is triggered, both the alarm audio and the ALARM display indicator are continuous. Alarms are latching in MAX Mode. Under an alarm condition, the ALARM display indicator will remain on until the display is reset.

If other operational modes are available, a short press of the MODE button will move to the next available operational mode.

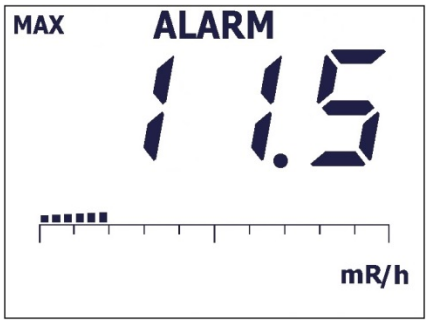



Figure 2.8: MAX Mode Display With ALARM Indication

## 2.9 COUNT Mode Operation

When entering COUNT Mode from another operational mode, the currently selected COUNT Unit will be displayed for approximately one second. The purpose of COUNT mode is to count for a predetermined amount of time, and to display the results on the display. Predefined count times of 6 seconds, 30 seconds, 1 minute, 2 minutes, 5 minutes, and 10 minutes are available as well as a user-defined count time and continuous counting operation (count time displayed as 0 or the minimum display). The maximum user-defined count time is 600 seconds or 10 minutes (9:60). The maximum displayable value, regardless of units, is 999 k.

Count mode operation is very flexible, depending on the units chosen. A common choice is for the count mode to just perform a scaler count for a specified time, with a resulting answer in counts (equaling detected radiation events).

There are three different options for COUNT mode, which can be set through software.

Go to “Cnt Display Mode” in the Dev tab. Select the desired option:

- Timer: Will only show the countdown timer while the timer is active (default selection).
- Readings: Will only show the current gathered reading.
- Timer/Readings: Will cycle between showing the countdown timer and the current reading.

Sigma audio is completely disabled in Count Mode. Audio ‘clicks’ are disabled in COUNT mode by default but may be enabled thru software (see Lumic 2.0 software parameter Dev-Cnt-Audio Mode). Adjusting Dev Cnt Audio Mode will enable or disable the click audio during a COUNT.

- Off - always off
- On - always on
- W/Count - audio is only enabled during an active count

If a result in terms of activity is desired, the scaler count can also be in units of "d" or disintegrations. But if the count units are chosen to be cpm or cps, then the resulting answer is an averaged count rate over the time interval. Similarly, if count units of Bq or dpm are chosen, the resulting answer is an averaged disintegration rate.

If the user desires the instrument to show results in terms of disintegrations/area (eg. dpm/100 $cm^2$), then the instrument should be configured for dpm and the appropriate factor should be placed in the Efficiency parameter.

Other choices are to have count mode units of R/h or Sv/h, in which case the COUNT mode result is an averaged exposure or dose rate. But if count mode units of R or Sv are chosen, the result is shown in accumulated exposure or accumulated dose over the chosen count time. The following tables lists the possibilities:

| UNITS | RESULT |
|---|---|
| c | counts per count time |
| d | disintegrations per count time |
| cpm, cps | count rate averaged over the count time |
| dpm, Bq | disintegration rate, averaged over the count time |
| R/h, Sv/h | exposure or dose rate, averaged over the count time |
| R, Sv | integrated exposure or dose over the count time |

Table 2.1: COUNT Mode Units and Result

In COUNT mode, operation depends on the current state of the Count Timer.

**When the Count Timer is Ready:**

- The display will show the Count Time.
- A short press of the UNITS button will switch between the Primary and Secondary Count Units. The newly selected Count Units will be displayed for approximately one second, and the display will then return to the Count Timer.
- A long press of the ON/OFF will initiate a count.
- An extra-long press of the UNITS button will change the count time to the next available time.

- Pressing and holding the UNITS button will also change the count time to the next available time but will scroll through all possible count times at approximately one-second intervals.

- If other operational modes are available, a short press of the MODE button will move to the next available operational mode.

**When the Count Timer is Active:**

- The display will show either Count Time (default), both Count Time and Counts, or just Counts, depending on Device Count Display Mode.

- If needed, a long press of the ON/OFF button will stop the count and reset the Count Timer .

- Click audio, if enabled, can be adjusted by a short press of the AUDIO button.

- If an alarm condition occurs, the ALARM display indicator will turn on, and the Alarm audio will sound as soon as the count is complete. (If the count unit is an averaged rate, it is possible for the ALARM icon to come on during the count, but if the averaged rate falls below the alarm threshold by the end of the count, no ALARM will be active.)

- If other operational modes are available, a short press of the MODE button will cancel the current Count Timer and move to the next available operational mode.

**When the Count Timer has Finished:**

- The display will show either the accumulated total for c, d, R, and Sv, or the timed ratemeter average for cps, cpm, dpm, or the average exposure or average dose in R/h and Sv/h.

- A short press of the UNITS button will switch between the Primary and Secondary Count Units.

- a long press of the ON/OFF button will reset the Count Timer and initialize for a new count.

- If an alarm condition occurred during the Timed Count, a continuous audio tone will sound as the ALARM display indicator will already be on. To acknowledge and turn off the continuous tone alarm audio, a short press of the ON/OFF button is required. To clear the alarm condition and reset the Count Timer, a long press of the ON/OFF button is required.

- If other operational modes are available, a short press of the MODE button will move to the next available operational mode.

Figure 2.9: COUNT Mode Displaying COUNT Timer of 5 Minutes, 30 Seconds

CHAPTER 3

# SPECIFICATIONS

**Detector:** Internal energy-compensated GM

**Energy Response:** 60 keV to 3 MeV (±25%)

**Detector Range:**

- 3276/1 (48-4169) 0.010 to 500 µSv/h (1.0 to 50000 µR/hr)
- 3276/2 (48-4170) 0.001 to 50 mSv/h (0.1 to 5,000 mR/hr)
- 3276/4 (48-4171) 0.01 to 500 mSv/h (1.0 to 50,000 mR/hr)
- 3276/6 (48-4283) 0.00004 to 10 Sv/h (0.004 to 999 R/hr)

**HV:** 550 Vdc

**Threshold Range:** -4 to -100 mVdc, typically set to -35 mV for GM detectors

**Linearity:** readings within 10% of true value

**Resolving Time:** approximately 5 µsec as defined by IEC 60325

**Response Time:** user-selectable from 1 to 60 seconds, auto-response rate of fast or slow

**Alarms:** two adjustable count rate, exposure/dose, and count alarm setpoints adjustable over the display range

**Overload Protection:** high count rate saturation protection designed to prevent the false display of lower count rates

**Loss of Count Protection:** after a user-settable number of seconds, typically 60 seconds, of no pulses from the detector, the alarm audio will be triggered

**Dead Time Correction:** employs first and second order corrections for extended performance

**Overrange:** if the reading should exceed the predefined detector range, the instrument will flash a maximum reading and trigger an audio warning

**LCD Display:** 3-digit LCD with large 20 mm (0.8 in.) digits, (k)cps, (k)cpm, (k)Bq, (k)dpm, (μ)(m)R(/h), (μ)(m)Sv(/h), low-battery indicator, MAX, ALARM, AUDIO

**Backlight:** built-in ambient light sensor automatically activates low-power LED backlight or backlight level may be user defined, unless internal dip switch is set to continuous-on (will reduce battery life)

**User Controls:**

- ON/OFF – extra-long press to turn ON, short press to acknowledge alarms, extra-long press plus 3 seconds to turn OFF
- UNITS – short press changes the units between count rate, dose/exposure, or disintegration, an extra long press to change count time in COUNT mode
- AUDIO - short press to adjust audio level
- MODE – short press alternates between available modes: RATE (displays count rate), MAX (captures peak rate), and COUNT (captures rate or dose readings for a user-selectable count time from 0 to 10 minutes)

**Audio:** approximately 4.5 kHz, click audio greater than 65 dB at 0.6 m (2 ft), alarm audio greater than 72 dB

**Headphone Jack (optional):** 1/8 inch stereo jack for use with headphones for audio output. It will be located to the left of the instrument handle.

**Power:** four alkaline "AA" batteries

**Battery Life:** approximately 50 hours with the backlight ON, 16-hour low battery warning of operation, 16-hour low-battery warning

**Maximum Current:** 50 mAdc

**Construction:** aluminum with powder coat finish and subsurface printed front panel

**Temperature Range:** -20 to 50 °C (-5 to 122 °F), may be certified for operation from -40 to 65 °C (-40 to 150 °F)

**Environmental Rating:** NEMA (National Electrical Manufacturers Association) rating of 2 or IP (Ingress Protection) rating of 51

**Size:** 5.8 x 13.5 x 19.1 cm (2.3 x 5.3 x 7.5 in.) (H x W x L)

**Weight:** 0.9 kg (2.0 lb) (excluding detectors and clips)

CHAPTER 4

# SETUP MODE

Only advanced users or administrators should consider changing any of the parameters in the following section. Incorrect settings could jeopardize the safety of users depending on this instrument.

## 4.1 Setup Overview

Your instrument has been shipped from Ludlum Measurements only after passing electronic checkout, a 24-hour burn-in process, and a careful calibration process. Calibration papers are supplied with each instrument shipped from Ludlum Measurements.

Recalibration should be accomplished after a predetermined calibration frequency (Ludlum Measurements, Inc. recommends no more than a one-year interval), or when the operation of the instrument is suspect or maintenance has been performed on the instrument. Recalibration is not normally required following instrument cleaning or battery replacement. While recalibration does not require any special tools or software to perform, Lumic software available through Ludlum Measurements, Inc. will greatly ease calibration, especially when second-order deadtime correction (extended calibration) is being utilized. As a result, the use of Lumic software is highly recommended.

Ludlum Measurements offers a full-service repair and calibration department. Not only do we repair and calibrate our own instruments, we also service most other manufacturers' instruments. Calibration procedures are available upon request for customers who choose to calibrate their own instruments.

Ludlum Measurements, Inc. recommends recalibration at intervals no greater than one year, assuming that regular operational checks are performed. Check the appropriate local, state, and federal regulations to determine required recalibration intervals.

## 4.2 Setup Parameters

| Setting | Setup Parameter | 3276/2 | 3276/3 | 3276/4 |
|---|---|---|---|---|
| P1-1 | Calibration Constant Mantissa | 600 | 270 | 600 |
| P1-2 | Calibration Constant Exponent | 05 | 05 | 04 |
| P1-3 | Dead Time Correction 1 | 80 | 45 | 45 |
| P1-4 | Dead Time Correction 2 Mantissa | varies | | |
| P1-5 | Dead Time Correction 2 Exponent | varies | | |
| P1-6 | Efficiency | 15.0 | | |
| P1-7 | High Voltage Set Point | 550 | | |
| P1-8 | Discriminator Threshold | 35 | | |
| P1-9 | Detector Current Overload Threshold | 100 | | |
| P1-10 | Loss of Count Alarm Time | 60 | 60 | 300 |
| P2-1 | Unit 1 - Units and Minimum Display | 0.00 mR/h | 00.0 mR/h | 00.0 mR/h |
| P2-2 | Unit 1 - Units Maximum Display | 5.00 R/h | 25.0 R/h | 50.0 R/h |
| P2-3 | Unit 1 - RATE/ MAX Mode Alarm 1 | 2.00 mR/h | 20.0 mR/h | 20.0 mR/h |
| P2-4 | Unit 1 - RATE/ MAX Mode Alarm 2 | 5.00 mR/h | 50.0 mR/h | 50.0 mR/h |
| P2-5 | Unit 1 - Count Units and Minimum Display | 000 µR | | |
| P2-6 | Unit 1 - Count Units Alarm 1 | 000 | | |
| P2-7 | Unit 1 - Count Units Alarm 2 | 000 | | |
| P3-1 | Unit 2 - Units Minimum Display | 000 cpm | | |
| P3-2 | Unit 2 - Units Maximum Display | 999 kcpm | | |
| P3-3 | Unit 2 - RATE/ MAX Mode Alarm 1 | 2.00 kcpm | | |
| P3-4 | Unit 2 - RATE/ MAX Mode Alarm 2 | 5.00 kcpm | | |
| P3-5 | Unit 2 - Count Units and Minimum Display | 000 c | | |
| P3-6 | Unit 2 - Count Units Alarm 1 | 000 c | | |

| Setting | Setup Parameter | 3276/2 | 3276/3 | 3276/4 |
|---|---|---|---|---|
| P3-7 | Unit 2 - Count Units Alarm 2 | 000 c | | |
| P4-1 | Response Time | 0 | | |
| P4-2 | Response Rate | S | | |
| P4-3 | Enabled Modes | Rate/Max/Count | | |
| P4-4 | Count Time | 1 | | |
| P4-5 | Auto Shutdown Time | 0 hours (disabled) | | |
| P4-6 | Sigma Audio Mode | LO | | |
| P4-7 | Dual Level Audio | oFF | | |
| P4-8 | Area Monitor Mode | oFF (On for internal detector and cradle option) | | |

Table 4.1: Setup Parameters

## 4.3 Entering Setup Mode

To enter Setup Mode, power down the Model 3276 then turn the unit back ON. When the instrument has begun normal operation, three short presses of the MODE button will place the instrument into Setup mode.

This process is different if you are in Sigma Audio Mode, rather than in the "click" Audio Mode. While trying to enter Setup Mode with Sigma Mode enabled, once the screen begins the Sigma countdown, press the Mode button three times. Do not wait until the countdown is complete, which will prevent you from getting into the Setup Mode. There is no countdown for the "click" Audio Mode.

Entry to Setup Mode can be confirmed when the numeric portion of the display shows P-1, indicating the first setup page is selected. If you simply wish to view the parameters, select the desired Setup Page by a short press of the MODE button. A short press of the UNITS button will advance through the parameters available on the selected Setup Page. To return to normal operation, advance back to the Setup Page selection by pressing the UNITS button for at least a half second. Pressing the UNITS for at least a half second again will exit, or holding the UNITS button for approximately 5 seconds will exit from anywhere in the menu.

If the menu is not exited properly, any changes made will not be saved.

**SETUP PROTECT:** By default, the Model 3276 is shipped with DIP Switch 2 in the OFF (back) position and all available Model 3276 parameters may be modified in Setup mode. To protected the Model 3276 from changes in Setup mode, open the instrument, by removing the six screws on the bottom of the can, and slide DIP Switch 2 (the rightmost switch) to the ON (forward) position to activate Setup Protect Mode.

The dipswitch has a plastic cover, which protects the switch during manufacturing. This plastic cover is left on the dipswitch after assembly and is not removed until the dipswitch is needed. If the plastic cover still remains on the dipswitch, please remove the cover before changing the switch settings.

There are four different options for protect mode, which can be set through the Lumic 2.0 Calibration Software. Locate the Parameter “Setup Prtct” in the Dev tab and select the desired option.

**- Normal:** All parameters are protected from change through the device menu. This is the default mode when the Setup Protect dipswitch is configured to the ON position.

**- Bypass Alarms:** All parameters except for Rate, Count, and Dose Alarms are protected from change through the device menu.

**- Bypass Alarms Count:** All parameters except for Rate Alarms, Count Alarms, Dose Alarms, and the User Defined Scaler Count Time are protected from change through the device menu.

**- Bypass All:** All parameters may be changed from the Setup Menu, similar to leaving the Setup Protect DIP Switch set to the OFF position.

With the DIP Switch 2 in the ON position, setup mode may be entered through the front panel, and any parameter which has not been bypassed may be viewed, but changes cannot be made. Only bypassed parameters may be changed.

**DISPLAY BACKLIGHT ‘Continuous On’:** The Model 3276 display backlight can be set to remain on continuously during operation. Follow the steps from **SETUP PROTECT** to access the DIP switch but change DIP Switch 1 for display backlight selection. Setting DIP Switch 1 to the ON (forward) position will configure the display backlight to remain on during operation. Set DIP Switch 1 to the OFF (back) position, and the display will be backlit only when light levels are low.

Setting the display backlight for continuous-on operation can result in reduced battery life. The backlight can be configured to always be off as well through the device menu or Lumic 2.0 Calibration Software.

## 4.4 Setup Mode Operation

Once the Model 3276 is in Setup mode, setup page selection will be displayed on the LCD and the Page number will be blinking indicating it as the selected item. The number of available parameters per Setup Page will be displayed using the graph where the number of segments indicates the number of parameters. Short press the MODE button to choose the Setup Page you are interested in. Once the desired Setup Page is shown, short press the UNIT button

to cycle down to the first parameter of that Setup Page. Further short presses on the MODE button will cycle down through the parameters for that page. Extra-long-pressing the UNIT button will go back up to the Setup Page. Extra-long pressing again will exit the Setup Mode.

Figure 4.1: Setup Page Selection Display (showing page 4-CAL)

To exit more quickly, press and hold the UNIT button. No matter what parameter is shown, it will walk the user through all previous Setup Menu levels until the instrument returns to normal operation. Changed parameters are only saved when exiting the Setup Menu using the UNITS button.

When you get to a parameter that you want to change, use the MODE button to make the change. If numbers are displayed on the parameter, the MODE button will increment the numbers. Otherwise, the MODE button will cycle through the available settings. If more than one parameter can be changed on the page, short press the ON/OFF button to advance through the available parameters, and then use the MODE to change the parameter. When you have adjusted the parameter setting to your desired number or setting, extra-long press the UNIT button to return to the previous screen.

**For example:**

**Rate Mode, Unit 1, Alarm 1 Value to 150 mR/h.**

Enter the Setup Menu.

- Use the MODE button to advance to P-2.
- Press the UNIT button to enter the menu.
- Press the UNIT button to get to the third of the seven menu items. This is the parameter setting for the “Unit 1 RATE/MAX Mode Alarm 1.”
- Press the ON/OFF button to advance to the tens digit.
- Press the MODE button to increment the value to 5.
- Press the ON/OFF button to advance to the hundreds digit.
- Press the MODE button to increment the value to 1.
- Press the ON/OFF button to advance to the decimal point.

- Press the MODE button to until no decimal is displayed.
- Press the ON/OFF button to advance to the multiplier.
- Press the MODE button to until mR/h is displayed.
- Press and hold the UNIT button until the instrument returns to normal operation.

The list below shows the setup pages and the parameters in order, on each page.

## 4.5 Model 3276 List of Parameters (in order)

Page 1

- Calibration Constant Mantissa
- Calibration Constant Exponent
- Dead Time Correction 1
- Dead Time Correction 2 Mantissa
- Dead Time Correction 2 Exponent
- Efficiency
- High Voltage Setting
- Pulse Threshold
- Detector Current Overload Threshold
- Loss of Count Alarm Time

Page 2

- Primary Units and Minimum Display
- Primary Units Maximum Display
- Primary Units RATE/MAX Mode Alarm 1
- Primary Units RATE/MAX Mode Alarm 2
- Primary COUNT Units and Minimum Display
- Primary COUNT Mode Alarm 1
- Primary COUNT Mode Alarm 2

Page 3

- Secondary Units and Minimum Display
- Secondary Units Maximum Display
- Secondary Units RATE/MAX Mode Alarm 1
- Secondary Units RATE/MAX Mode Alarm 2
- Secondary COUNT Units and Minimum Display
- Secondary COUNT Mode Alarm 1
- Secondary COUNT Mode Alarm 2

Page 4

- Response Time
- Auto Response Rate
- Operational Modes
- COUNT Time
- Auto Shutdown Time
- Sigma Audio
- Dual Level Audio
- Area Monitor Mode

## 4.6 Setup Page 1

**Calibration Constant Mantissa -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Value is used with Calibration Constant Exponent to express counts per R. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)

**Calibration Constant Exponent -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Value is used with Calibration Constant Mantissa to express counts per R. Available values are:

- Ones Place (0-9)

- Tens Place (0-9)

**Dead Time Correction 1 -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Value is in microseconds. Value should be set to zero when checking instrument with a pulser or function generator; otherwise, higher count rates will result in non-linearities. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)

**Dead Time Correction 2 Mantissa -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)

**Dead Time Correction 2 Exponent -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Available values are:

- Value between -6 and -12 inclusive

**Channel 1 – Efficiency -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)
- Number of Decimal Places (0 or 1)

Normally the efficiency is used on a per detector basis or 4pi basis, i.e. the efficiency of the detector is calculated by dividing the count rate received from a source by the total disintegration rate of the source. When either dpm or Bq units are chosen, the use of the 4pi efficiency allows the display of the source size or activity on the Model 3276 display.

But if the user desires to have the Model 3276 show results in terms of dpm/100 cm2, the user could manipulate the efficiency to produce this result by multiplying the efficiency times the

ratio of the detector area to 100 cm2. For example, using a detector with an area of 15 cm2, if we start with 10% efficiency to measure in dpm, then the parameter could be changed to 1.5% to measure in dpm/100 cm2.

Or likewise for Bq/cm2, efficiency could be calculated as: efficiency = count rate/disintegration rate*detector area (in cm2). For example, with the same detector as above with an area of 15 cm2, and starting with an efficiency value of 15%, then the parameter could be changed to 225% to measure in Bq/cm2.

**High Voltage -** Short press the ON/OFF to select the value to adjust, and MODE to adjust the value. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)
- k Multiplier (on/off)

Use the ON/OFF button to select the appropriate parameter, and use the MODE button to scroll through the parameter options.

The k multiplier also activates left-most decimal point. If k multiplier is used, Hundreds Place becomes the Thousands Place, Tens Place becomes the Hundreds Place, and Ones Place becomes the Tens Place.

**Pulser Threshold -** Short press the ON/OFF to select the value to adjust, and MODE to adjust the value. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)

Audio is enabled for this parameter only for ease of setting.

**Detector Current Overload Threshold (Default 100) -** Upon entry into Detector Current Overload Threshold, one of the following parameters will be selected (flashing).

- Rightmost Digit (0-9)

- Middle Digit (0-9)
- Leftmost digit (0-9)
- µ/m/<> Multiplier with all digits flashing (adjustable from x.xx µ to x.xx)

Perform an extra-long press of the AUDIO button to view the live current draw of the active detector. Performing an extra-long press of the AUDIO button again will return to the set point value.

**Loss of Count Alarm Time -** Upon entry into Channel 1 Loss of Count Time, one of the following parameters will be selected (flashing). Short press the ON/OFF to select the value to adjust, and MODE to adjust the value. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)

## 4.7 Setup Page 2

**Primary RATE/MAX Units and Minimum Display -** A short press of the ON/OFF to select the value to adjust, and MODE to adjust the value. Available values are:

- Number of Decimal Places (0, 1, or 2)
- Minimum Units - See List Below

| cpm | kcpm | cps | kcps | dpm | kdpm | Bq |
|---|---|---|---|---|---|---|
| kBq | µR/h | mR/h | R/h | µSv/h | mSv/h | Sv/h |

Table 4.2: Primary Units and Multipliers

**Primary Units RATE/MAX Maximum Display -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Units will be the same as selected earlier with Primary Units. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)
- Number of Decimal Places (0, 1, or 2)
- Range (k on/off for cpm, cps, dpm, Bq; µ, m or none for R/h and Sv/h)

**Primary Units RATE/MAX Mode Alarm 1 -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Units will be the same as selected earlier with Primary Units. The ALARM LCD Segment will flash to indicate Alarm 1. Set this Alarm to 000 to disable. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)
- Number of Decimal Places (0, 1, or 2)
- Range (k on/off for cpm, cps, dpm, Bq; µ, m or none for R/h and Sv/h)

If the Primary Units has changed to a value other than that used to previously set this Alarm Point, the Alarm Point will be reset to 000.

**Primary Units RATE/MAX Mode Alarm 2 -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Units will be the same as selected earlier with Primary Units. The ALARM LCD Segment will remain solid to indicate Alarm 2. Set this Alarm to 000 to disable. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)
- Number of Decimal Places (0, 1, or 2)
- Range (k on/off for cpm, cps, dpm, Bq; µ, m or none for R/h and Sv/h)

If the Primary Units has changed to a value other than that used to previously set this Alarm Point, the Alarm Point will be reset to 000.

**Primary Count Units and Minimum Display -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Available vallues are:

- Number of Decimal Places (0, 1, or 2)
- Minimum Units depend on the selected Primary Units. See list below.

| Primary Units | Primary Count Units Available |
|---|---|
| cps kcps | cps c |
| cpm kcpm | cpm c |
| Bq kBq | Bq d |
| dpm kdpm | dpm d |
| µR/h mR/h R/h | µR/h mR/h R/h µR mR R |
| µSv/h mSv/h Sv/h | µSv/h mSv/h Sv/h µSv mSv Sv |

Table 4.3: Primary Unit Multipliers

**Primary Units COUNT Mode Alarm 1 -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Units will be the same as selected earlier with Primary Count Units. The ALARM LCD Segment will flash to indicate Alarm 1. Set this Alarm to 000 to disable. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)
- Number of Decimal Places (0, 1, or 2)
- Range (k on/off for cpm, cps, dpm, Bq; µ, m or none for R/h and Sv/h)

If the Primary Count Units has changed to a value other than that used to previously set this Alarm Point, the Alarm Point will be reset to 000.

**Primary Units COUNT Mode Alarm 2 -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Units will be the same as selected earlier with Primary Count Units. The ALARM LCD Segment will remain solid to indicate Alarm 2. Set this Alarm to 000 to disable. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)
- Number of Decimal Places (0, 1, or 2)
- Range (k on/off for cpm, cps, dpm, Bq; µ, m or none for R/h and Sv/h)

If the Primary Count Units has changed to a value other than that used to previously set this Alarm Point, the Alarm Point will be reset to 000.

## 4.8 Setup Page 3

**Secondary RATE/MAX Units and Minimum Display -** A short press of the ON/OFF to select the value to adjust, and MODE to adjust the value. Available values are:

- Number of Decimal Places (0, 1, or 2)
- Minimum Units - See List Below

| cpm | kcpm | cps | kcps | dpm | kdpm | Bq |
|---|---|---|---|---|---|---|
| kBq | µR/h | mR/h | R/h | µSv/h | mSv/h | Sv/h |

Table 4.4: Secondary Units and Multipliers

**Secondary Units RATE/MAX Maximum Display -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Units will be the same as selected earlier with Secondary Units. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)
- Number of Decimal Places (0, 1, or 2)
- Range (k on/off for cpm, cps, dpm, Bq; µ, m or none for R/h and Sv/h)

**Secondary Units RATE/MAX Mode Alarm 1 -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Units will be the same as selected earlier with Secondary Units. The ALARM LCD Segment will flash to indicate Alarm 1. Set this Alarm to 000 to disable. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)
- Number of Decimal Places (0, 1, or 2)
- Range (k on/off for cpm, cps, dpm, Bq; µ, m or none for R/h and Sv/h)

If the Secondary Units has changed to a value other than that used to previously set this Alarm Point, the Alarm Point will be reset to 000.

**Secondary Units RATE/MAX Mode Alarm 2 -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Units will be the same as selected earlier with Secondary Units. The ALARM LCD Segment will remain solid to indicate Alarm 2. Set this Alarm to 000 to disable. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)
- Number of Decimal Places (0, 1, or 2)
- Range (k on/off for cpm, cps, dpm, Bq; µ, m or none for R/h and Sv/h)

If the Secondary Units has changed to a value other than that used to previously set this Alarm Point, the Alarm Point will be reset to 000.

**Secondary Count Units and Minimum Display -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Available vallues are:

- Number of Decimal Places (0, 1, or 2)
- Minimum Units depend on the selected Secondary Units. See list below.

| Secondary Units | Secondary Count Units Available |
|---|---|
| cps kcps | cps c |
| cpm kcpm | cpm c |
| Bq kBq | Bq d |
| dpm kdpm | dpm d |
| µR/h mR/h R/h | µR/h mR/h R/h µR mR R |
| µSv/h mSv/h Sv/h | µSv/h mSv/h Sv/h µSv mSv Sv |

Table 4.5: Secondary Unit Multipliers

**Secondary Units COUNT Mode Alarm 1 -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Units will be the same as selected earlier with Secondary Count Units. The ALARM LCD Segment will flash to indicate Alarm 1. Set this Alarm to 000 to disable. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)

- Number of Decimal Places (0, 1, or 2)
- Range (k on/off for cpm, cps, dpm, Bq; µ, m or none for R/h and Sv/h)

If the Secondary Count Units has changed to a value other than that used to previously set this Alarm Point, the Alarm Point will be reset to 000.

**Secondary Units COUNT Mode Alarm 2 -** A short press of ON/OFF to select the value to adjust, and MODE to adjust the value. Units will be the same as selected earlier with Secondary Count Units. The ALARM LCD Segment will remain solid to indicate Alarm 2. Set this Alarm to 000 to disable. Available values are:

- Ones Place (0-9)
- Tens Place (0-9)
- Hundreds Place (0-9)
- Number of Decimal Places (0, 1, or 2)
- Range (k on/off for cpm, cps, dpm, Bq; µ, m or none for R/h and Sv/h)

If the Secondary Count Units has changed to a value other than that used to previously set this Alarm Point, the Alarm Point will be reset to 000.

## 4.9 Setup Page 4

**Response Time -** A short press of ON/OFF to select the value to be adjusted, and MODE to adjust the value. Setting the Response Time to a fixed value is useful primarily when performing surveys to a fixed MDA (Minimum Detectable Activity) level. Setting the Response Time to 0 will enable the Auto-Response mode for the Model 3276 (see the next parameter). Available values for the Response Time (in seconds) are:

- Ones Place (0-9)
- Tens Place (0-6, 6 forces max Response Time of 60)

**Auto-Response Rate -** A short press of ON/OFF to select Fast (F) or Slow (S). When operating in Auto-Response mode, the Model 3276 will vary the Response Time based on the Auto-Response Rate selected (Fast or Slow) and the current Count Rate. The following table shows the response time for different count rates when these auto response modes are chosen:

| Count Rate | Auto Response Time - Fast (Seconds) | Auto Response Time - Slow (Seconds) |
|---|---|---|
| Less than 3kcpm (50cps) | 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 |

Table 4.6: Response Time Based on Count Rate

The Model 3276 also utilizes a Step function in Auto Response mode, which enables faster response to a significant increase or decrease in Count Rate. When the instrument detects a sudden change in count rate from the detector, the response time is reduced to 1 second to quickly show the new value.

**Operational Modes -** A short press of MODE to adjust the value. Available values are:

- 0 - RATE, MAX and COUNT modes
- 1 - RATE and MAX Modes only
- 2 - RATE AND COUNT Modes only
- 3 - RATE Mode only

**Count Time -** A short press of ON/OFF to select the value to be adjusted, and MODE to adjust the value. Setting Count Time to 0 enables continuous count until reset. If 9 minutes are selected, then the maximum seconds value is 60; otherwise, the maximum seconds value is 59. Available values are:

- Ones Place (0-9)
- Tens Place (0-6, 6 only available if minutes value is 9)
- Hundreds Place (0-9)

**Auto Shutdown Time (Default 0 - off) -** A short press of MODE to adjust the value. Available values are:

- Ones Place (0-9) hours

**Sigma Audio -** A short press of MODE to adjust the value. Available values are:

- ON - Sigma Audio Enabled
- OFF - Sigma Audio Disabled (Normal 'Click' audio active)

The Sigma Mode may not work properly until the 8-second background is completed. If the 8-second background count is too low or too high, the device will continually beep until an acceptable background count rate (500 cpm - 200 kcpm) is obtained. Sigma Audio is disabled in Count Mode. If Count audio and Sigma Audio are enabled, Count audio will be "click" audio.

**Dual Level Audio (Default OFF)** - Use MODE to adjust the value. Available values are:

- ON - Dual Level Audio Enabled (Audio settings: Hi, LO, and Mute)
- OFF - Dual Level Audio Disabled (Audio settings: Hi and Mute)

**Area Mode (Default OFF)** - Use MODE to adjust the value. Available values are:

- ON - Area Mode Enabled (Device used as an area monitor, audio is turned off)
- Area Mode Disabled (Device used as a Frisker)

CHAPTER 5

# SOFTWARE

## 5.1 Connecting to Lumic 2.0 Calibration/Configuration Software

The Lumic 2.0 Calibration/Configuration software is sent with a standard two-meter cable. (A five-meter cable can be provided if requested. However, any cable longer than two meters may have issues with some USB hubs and computers, typically laptops.)

To connect an instrument to the computer, please connect one end of the USB cable to the instrument first, and then the other end to the computer. Do not connect both ends to the computer.

Please allow Windows® a moment to install the proper HID drivers for the instrument before trying to use any software.

We recommend that you plug the USB cable into the back of your PC that connects to your motherboard instead of a USB hub.

Some parameters may only be edited in software, such as the backlight thresholds, COUNT Display Mode, COUNT Audio Mode, and Setup prtct.

Follow the Lumic 2.0 Calibration/Configuration software manual.

CHAPTER 6

# ADVANCED FEATURES

## 6.1 Dead Time Correction

All pulse counting detectors have a "dead time" in which the detector is unable to register another event. In relatively low fields this is not an issue. However, as the field strength approaches the high end of the detector's range, dead time causes the pulse rate to become non-linear with respect to the real radiation field. Dead time correction is used to linearize the measurements, allowing a wider linear response range for a given detector.

This instrument uses a second order dead time correction using the equation

$rate_c = rate_m / [1 - (DTC_1 * rate_m) + (DTC_2 * rate_m^2)]$

Where $DTC_1$ and $DTC_2$ are the dead time correction coefficients, $rate_m$ is the measured count rate, and $rate_c$ is the corrected rate.

Dead time correction coefficients are configured through the device setup menu or through Lumic Calibration software. Lumic Calibration software also includes a wizard that will automate finding and setting the correct coefficients.

$DTC_1$ is represented in microseconds (µs) on the device setup menu and in the software. The equation must be calculated in terms of seconds (s) and must be scaled appropriately. $DTC_2$ has more complex units and are not shown. However, the representation of the coefficient on the setup menu and in software do not require scaling.

Setting the $DTC_2$ to zero will disable the second order correction, while setting $DTC_1$ to zero will disable both, regardless of the value of $DTC_2$.

## 6.2 Units

Depending on the chosen display units, different features will affect the value of the reading. The following table lists the features that apply to each of the display units.

| UNITS | Feature |
|---|---|
| cpm, cps, counts | Deadtime Correction |
| Bq, dpm, disintegrations | Deadtime Correction, Efficiency |
| R/h, R | Deadtime Correction, Calibration constant |
| Sv/h, Sv, | Deadtime Correction, Calibration constant , R to Sv Conversion |

Table 6.1: Features That Affect Units in All Modes

## 6.3 R to Sv Conversion

The R to Sv conversion is a setting available in Lumic Calibration software. It defines the conversion factor between R and Sv. Since the calibration constant is directly tied to R (counts per R), calibrating Sv requires a correct setting of both calibration constant and R to Sv conversion.

Example: An R to Sv conversion factor of 0.0106 will cause a reading of 10.6 mSv/h while in a 1 R/h field.

## 6.4 Software Calibration Tools

Lumic Calibration software includes wizards that will assist in calibrating and plateauing detectors. After configuring the wizard for a specific detector, the wizard will automate much of the data collection and calculation required for calibration.

## 6.5 Hardware Correction

This instrument provides the user with the ability to manually enter a voltage for both high voltage and threshold. To ensure that the voltage entered by the user produces a proper high voltage or threshold voltage that is within instrument tolerances, the instrument is adjusted at the factory during manufacturing. As a result, adjustment of any parameters visible in the DevCal menu of the Lumic 2 software is not required and should not be adjusted in the field. However, if hardware correction is required (due to board rework, etc.) the hardware correction settings are available in Lumic 2 Calibration software on the DevCal tab.

## 6.6 Other Device Data

The following parameters on the instrument allow recording import device information within the device:

**Firmware Version:** This is a read-only presentation of the firmware version. With a firmware version of F.x.y.zzzz, the F.x.y will show up on the device screen during the power-on sequence and signifies the released version.

**Device – Model Name:** This should match the model name on the front face of the instrument.

**Device – Serial Number:** This should match the serial number of the instrument.

**Detector – Model:** This can store the model of the detectors the instrument was calibrated for.

**Detector – Serial Number:** This can store the serial number of the detectors the instrument was calibrated for.

## 6.7 Battery Life

The instrument leaves the shop with adjustments to meet most consumer demands; however, advanced users may use the Lumic software to adjust the LED and backlight brightness to maximize battery life. By changing the backlight mode of operation and adjusting the brightness settings for the backlight and LED to meet user needs, it is possible to reduce battery current consumption by as much as 50%.

## 6.8 Real-time Streaming

Lumic Calibration 2.0 software and this instrument have the ability to stream data from the instrument to a computer. The data can be viewed live inside software or can be recorded in a file.

Multiple user-selected parameters can be streamed simultaneously including:

- Remote display of the screen
- All unit values
- Device status
- Live HV current measurement

## 6.9 CPS Offset

Using the Lumic Calibration 2.0 software, the user can enter a CPS Offset for a given channel. The CPS Offset is counts per second, which are subtracted from the channel reading's base counts before any dead time correction or unit conversion is applied. This is a useful method by which to perform background subtraction in a controlled environment.

The instrument does not calculate the CPS Offset for the user. The CPS Offset is a fixed value, which must be configured while the instrument is connected to the Lumic Calibration 2.0 software and which is stored in the instrument and reused each time the instrument is powered on.

By default, CPS Offset is 0 and no count subtraction is performed.

CHAPTER 7

# SAFETY CONSIDERATIONS

## 7.1 Environmental Conditions for Normal Use

Indoor or outdoor use (While rain resistant, user is cautioned to avoid getting water through detector opening.)

No maximum altitude

Temperature range of -20 to 50 °C (-5 to 122 °F), may be certified for operation from -40 to 65 °C (-40 to 150 °F)

Maximum relative humidity of less than 95% (non-condensing)

Pollution Degree 3 (as defined by IEC 664): (Occurs when conductive pollution or dry nonconductive pollution becomes conductive due to condensation. This is typical of industrial or construction sites.)

Not certified for use in an explosive atmosphere

## 7.2 Warning Markings and Symbols

The operator or responsible body is cautioned that the protection provided by the equipment may be impaired if the equipment is used in a manner not specified by Ludlum Measurements, Inc.

The Model 3276 Survey meter is marked with the following symbols:

The “crossed-out wheelie bin” symbol notifies the consumer that the product is not to be mixed with unsorted municipal waste when discarding. Each material must be separated. The symbol is placed on the label located on the side panel. See section 10, “Recycling,” for further information.

The "CE" mark is used to identify this instrument as being acceptable for use within the European Union. This symbol is located on the label on the side panel.

CAUTION (per ISO 3864, No. B.3.1): designates hazardous live voltage and risk of electric shock. During normal use, internal components are hazardous live. This instrument must be isolated or disconnected from the hazardous live voltage before accessing the internal components. This symbol appears on the label on the side panel. Be sure to take the precautions noted in the next section whenever necessary.

## 7.3 Cleaning and Maintenance Precautions

The Model 3276 may be cleaned externally with a damp cloth, using only water as the wetting agent.

Observe the following precautions when cleaning or performing maintenance on the instrument:

- Turn the instrument OFF and remove the batteries.
- Allow the instrument to sit for one minute before cleaning the exterior or accessing any internal components for maintenance.

CHAPTER 8

# REVISION HISTORY

This section of the manual will be updated with each revision of the Model 3276 in order to document changes over time. Ludlum Measurements' policy is to provide free software upgrades to instruments for the life of the instrument.

**March 2016:** New manual.

**July 2016:** Updated drawing 498 x 544B, front of manual.

**September 2017:** Added a note to page 1-1; description of backlight updated on page 1-2; Firmware updated which affected Section 2 with more screens at turn-on and changes in what buttons do and how to press/tap them, added Auxiliary Communication to Section 2; updated Audio in Section 3 Specifications; in Section 4 updated table on page 4-2 and detailed how to press/tap buttons in setting up pages; added Section 5 Software; added Section 6 Advanced Features; added Electrical Safety Precautions in Section 7; added parameters Dead Time Correction 2, Device Count Audio Mode, Device Count Display Mode; added Lumic kits to Options; corrected ON/ACK button reference to ON/OFF throughout; Updated front-panel drawing 498 x 544A and wiring diagram in back 498 x 818.

**November 2017:** Updated firmware to 49830n30 from n26; Corrected wording in parentheses on page 1-2, first paragraph for clarity; added two paragraphs and an Operating Range table on page 1-3 about the other configurations of the Model 3276; On page 4-2 in the Setup Parameters table, P1-11 row was deleted, and on page 4-3, Pr-8 row was added; added an appendix to the back for Model 3276 variations.

**July 2019:** Fixed Threshold Range spec in Section 3 to have negative numbers. Added Dead Time Correction to Specs Section 3 and to Intro. Added desk mount Drawing 498 x 784A to front.

**August 2020:** Added Cable Diagram Drawings 519 x 571 and 519 x 571A to drawings in front of manual.

**January 2021:** Made corrections to the table of Operating Ranges on page 1-3.

**October 2021:** New manual format. Firmware updated to version n41, which re-enables

many features not available in n34. Updated Drawings 498 x 544A and 498 x 544B in front of manual. Minor modifications to Chapter 1, along with references to Lumic software. Modified Chapter 2: COUNT Mode Operation to explain predefined count times and proper operation. Removed Aux Comm and 375 Output sections from Chapter 2 and put that information in Appendix B. In Chapter 3: Specifications, Detector is now "Internal energy-compensated GM;" added Energy Response, Detector Range, Linearity, Overrange, and Headphone Jack; changed HV Range to just HV at 550 Vdc; added "two adjustable" to Alarms; removed Display Range; and changed Weight to 2 pounds (0.9 kg) from 1.6 pounds. Modified Chapter 4: Setup Parameters to add primary and secondary rate and second count alarms. On the Setup Parameters table, changed the detectors to 3276/2, 3276/3, and 3276/4 from 133-2, 44-2, alpha or beta, 43-31H, and 44-132. Backlight Threshold was added while Dual Level Audio and Area Monitor Audio were removed from Page 4 settings. Added Bypass All as the fourth option for protect mode on page 30 and replaced RS-232 Relay section with Display Backlight Continuous On. In Chapter 5: Software, deleted Extended Features section. In Chapter 6 Advanced Features, added Section 6.7 Battery Life and 6.9 CPS Offset on page 49. In Chapter 7: Safety Considerations, deleted Electrical Safety Precautions. In Chapter 10 Options, changed the part number to the Lumic Calibration Kit to 4519-563 from 4498-1018, added Ethernet Option, Model 375 Software with its note, Strobe and Horn with its list, and Remote Display with its note; also changed Wall-Mount Cradle Assembly part 4498-859 to Wall Mount with Detector Cradle for Model 44-9 part 4498-859-02. In Appendix A: Model 3276 Variations, removed Background from the Model 44-9 Specifications on page 63. Added Appendix B: Auxiliary Communications.

**December 2021:** Firmware updated to version n42 to address new board designs. Added explanation of feature to identify the board installed in the instrument.

**February 2022:** Changed main board part number to newest version.

**July 2022:** Made names of software more clear in Chapters 5 and 6 when referencing Lumic Datalogger software kit and Lumic 2.0 Calibration/Configuration Software.

**March 2023:** In Chapter 3 Specifications, changed Zero Protection to Loss of Count Protection. In Chapter 4 Setup Mode, Section 4.4 Setup Mode Operation, updated explanation of how changed parameters are saved.

**May 2023:** Added Appendix C Ethernet Network Settings.

**August 2023:** In Chapter 6 Advanced Features, changed Section 6.5 from Instrument Calibration to Hardware Correction. Changed wording of this section to better explain what is accomplished at the factory to produce proper high voltage or threshold voltage and points out "adjustment of any parameters visible in the DevCal menu of Lumic 2 software is not required and should not be adjusted in the field."

**September 2023:** Corrected Page 4 parameters P4-6, P4-7, and P4-8 in Chapter 4 Setup Mode.

CHAPTER 9

# 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. On the instrument, the symbol will be placed on the serial number label located on the side of the instrument.

The symbol appears as such:

CHAPTER 10

# OPTIONS

**Lumic Calibration Kit (part # 4519-865):** The kit includes calibration software plus the cable required for calibration. The software allows users to collect data and read, print, and save device parameters. It allows administrators to adjust device parameters.

**Headphone Option (part # 4498-555):** This provides the Model 3000 series of instruments with a jack and circuitry required for a standard headphone plug. Ludlum Measurements also offers mono/stereo headphones with volume control.

**RS-232 Connector (part # 4498-873):** a 3-pin Hirose connector may be installed in order to have RS-232 output to either a Ludlum Model 272D (p/n 4498-1014) remote with cable, or to use for data streaming. An Ethernet adapter (p/n 4498-958) is also available, and allows for connection to Ludlum Universal Software. (See manual addendum for this option for more information.)

**Ethernet Option (part # 4498-958):** Adds Ethernet port to instrument.

**Alarm Relay (part # 4498-1005):** a 6-pin male Hirose connector and 6-wire cable pigtail may be installed in order to access an internal Form C (common, normally open, normally closed) relay capable of handling 30 Vdc at up to 2 amps, AND a relay that sources +12V (+12VNO, +12VNC, GND) on an alarm, suitable for connection to a +12V horn or stack lite. Other options exist for bringing out 3 wires for either relay, and options for a red alarm strobe or a red/green stacklite.

**Wall Mount with Detector Cradle for Model 44-9 (part # 4498-859-02):** Includes a mounting bracket for the Model 3276 and a detector cradle with a switch for the Model 44-9 detector. (Model 44-9 detector not included.) The audio is silenced while the detector is in the cradle and is enabled when the detector is lifted from the cradle.

**Model 375 Software:** The Model 3276 can be configured to be used with Model 375 software.

Because the Model 375 software uses a fixed unit display, the preferred unit of measurement for the display must be specified when ordering (ex: mR/hr, µSv/h). The Model 3276 minimum and maximum display parameters must also be set to preclude units other than those specified for the software.

**Desktop Stand (part # 4498-784):** Metal stand to support instrument for desktop applications.

**Strobe and Horn (part # 4498-1016):** 12 V Strobe & Horn assembly with relay:

- Flash Energy: 2 J at 12 Vdc (1,000,000 peak effective candle power)
- Flash Rate: 60-90 flashes per minute
- Audio: 90 dB
- Temperature Range: -34 °C to 52 °C (-30 °F to 125 °F)
- Environmental: Rain tight

**Remote Display (part # 4498-1014):** Includes Model 272D remote display, RS-232 option, and cable.

Because the Model 272D has a fixed unit display, the preferred unit of measurement for the display must be specified when ordering (ex: mR/hr, µSv/h). The Model 3276 minimum and maximum display parameters must also be set to preclude units other than those specified for the Model 272D.

CHAPTER 11

# STANDARD PARTS LIST

| Part Description | Part Number |
|---|---|
| Model 3276 Digital Survey Meter | 48-4160 |
| Model 3276 Main Board | 5519-785 |
| Model 3276 Front Chassis Assembly | 4498-546 |
| Model 3276 Rear Chassis Assembly | 4498-548 |
| Main Keypad Membrane Switch | 7498-547 |
| Battery Holder Modified | 7498-917 |
| LCD 82 mm x 61.64 mm | 7498-417 |

Table 11.1: Standard Parts List

APPENDIX A

# MODEL 3276 VARIATIONS

## A.1 Model 3276 Hand & Foot Monitor

A Model 3276 Hand & Foot configuration connects a Model 3276 to both a Model 44-25 hand monitor detector and a Model 44-26 foot monitor detector to monitor personnel for alpha, beta, and gamma contamination. It can be supplied either as a wall-mounted system, with the meter and detectors independently mounted, or as a single unit with the meter and detectors mounted in a stand.

A Model 44-9 detector can also be included in either configuration for frisking.

Pictured to the right is the wall-mounted hand and foot system (part # 48-4160-1) (shown with the optional Model 44-9 frisker). Shown left is the system mounted into a stand (part # 48-4160-2).

Figure A.1: Model 3276 Hand and Foot Monitor

### A.1.1 Model 44-25 Hand Monitor Detector

The Model 44-25 is designed to detect alpha, beta, or gamma on the hands. It has two pancake-type, halogen-quenched GM tubes. It is energy dependent, over-responding by a factor of 6 in the 60-100 keV range when normalized to $^{137}$Cs.

This detector operates between 850-1000 V, with a recommendation of 900 Vdc. It will operate with any Ludlum instrument or equivalent that provides 900 Vdc and an input sensitivity of approximately 80 mV or higher.

### A.1.2 Model 44-25 Specifications

**Window:** 1.7 ±0.3 mg/cm$^2$ mica

**Window Area (active):** 31 cm$^2$ (4.8 in$^2$)

**Efficiency (4π):** typically 5% for $^{14}$C; 22% for $^{90}$Sr/$^{90}$Y; 19% for $^{99}$Tc; 32% for $^{32}$P; 15% for $^{239}$Pu

**Sensitivity:** typically 6600 cpm per mR/hr

**Dead Time:** 80 µs

**Construction:** aluminum housing with beige powder-coat finish; stainless steel protective screen

**Temperature Range:** -15 to 50 °C (5 to 122 °F); may be certified for -40 to 65 °C (-40 to 150 °F)

**Size:** 24.1 x 15.2 x 19.8 cm (9.5 x 6 x 7.8 in.) (H x W x L)

**Weight:** 1.5 kg (3.3 lb)

### A.1.3 Model 44-26 Foot Monitor Detector

The Model 44-26 is designed to detect alpha, beta, gamma on the foot/shoe. It has three pancake-type, halogen-quenched GM tubes. It is energy dependent, over-responding by a factor of 6 in 60-100 keV range with $^{137}$Cs.

This detector operates between 850 and 1000 V, with a recommendation of approximately 900 Vdc. Recommended instrument input sensitivity is approximately 80 mV or higher to prevent the detector from double-pulsing (where the detector "counts" a single pulse from the instrument multiple times). It will operate with any Ludlum instrument or equivalent that provides 900 Vdc and an input sensitivity of approximately 80 mV or higher.

### A.1.4 Model 44-26 Specifications

**Window:** 1.7 ±0.3 mg/cm$^2$ mica

**Window Area (active):** 46 cm$^2$ (7.1 in$^2$)

**Efficiency (4π):** typically 5% for $^{14}$C; 22% for $^{90}$Sr/$^{90}$Y; 19% for $^{99}$Tc; 32% for $^{32}$P; 15% for $^{239}$Pu

**Sensitivity:** typically 9900 cpm per mR/hr

**Dead Time:** 80 µs

**Construction:** aluminum housing with beige powder-coat finish; stainless steel protective screen

**Temperature Range:** -15 to 50 °C (5 to 122 °F); may be certified for -40 to 65 °C (-40 to 150 °F)

**Size:** 24.7 x 17.8 x 22.9 cm (10.8 x 7 x 9 in.) (H x W x L)

**Weight:** 2 kg (4.4 lb)

### A.1.5 Model 44-9 Frisker Detector

The Model 44-9 GM detector detects alpha, beta, and gamma radiation. The size and pancake shape of this handheld detector provide for easy personnel monitoring. As part of this system, it allows additional frisking of personnel aside from the hands and feet survey.

This detector is energy dependent, over-responding by a factor of 6 in the 60 to 100 keV range when normalized to $^{137}$Cs. The thin mica window is protected by a 79% open stainless steel screen.

The Model 44-9 operates between 850 and 1000 V, with a recommendation of 900 Vdc. Recommended instrument input sensitivity is approximately 30 mV or higher to prevent double-pulsing. It will operate with any Ludlum instrument or equivalent that provides 900 Vdc and an input sensitivity of approximately 30 mV or higher.

### A.1.6 Model 44-9 Specifications

**Window:** 1.7 ±0.3 mg/cm$^2$ mica

**Window Area (active):** 15.5 cm$^2$ (2.4 in$^2$)

**Efficiency (4$\pi$):** typically 5% for $^{14}$C; 22% for $^{90}$Sr/$^{90}$Y; 19% for $^{99}$Tc; 32% for $^{32}$P; 15% for $^{239}$Pu;≤ 1% for $^{99m}$Tc

**Sensitivity:** typically 3300 cpm per mR/hr

**Dead Time:** 80 µs

**Construction:** aluminum housing with beige powder-coat finish; stainless steel protective screen

**Temperature Range:** -15 to 50 °C (5 to 122 °F); may be certified for -40 to 65 °C (-40 to 150 °F)

**Size:** 4.6 x 6.9 x 27.2 cm (1.8 x 2.7 x 10.7 in.) (H x W x L)

**Weight:** 0.5 kg (1 lb)

## A.2 Model 3276 with Model 44-9 Wall-Mounted Frisker

Pairing the Model 3276 monitor with the Model 44-9 hand-held detector onto a wall mount gives the user the ability to create a compact frisking station. The Model 44-9 pancake detector allows for frisking personnel and objects for alpha, beta, and gamma radiation. The 44-9 (frisker) rests in a cradle, from which it can be lifted as it's connected to the Model 3276 mon-

itor that is serving as a digital meter, displaying a readout for the user. Lifting the detector from the cradle enables “click” audio.

See specifications for the Model 44-9 in the text above.

Figure A.2: Model 3276 With Wall Mount Frisker

APPENDIX B

# AUXILIARY COMMUNICATIONS

## B.1 AuxCom Overview

AuxCom, short for Auxiliary Communications, is a feature included on certain Ludlum instruments. An AuxCom port allows the instrument to expand its capabilities with a variety of external devices through a standard serial interface.

## B.2 Requirements

In order to take advantage of the AuxCom functionality, you will need the following:

- A serial or RS-232 serial option
- A wiring harness to connect the target device
- The correct mode set for the AuxCom port

## B.3 Usage

Usage of the AuxCom port is generally very simple from the user's perspective. Most modes initialize everything to be plug-n-play; however, there are a couple of caveats.

### B.3.1 AuxCom Usage - Hot Key

**Enable:** If the UNITS button and MODE buttons are both held for longer than 1 second (1 beep), the AuxCom port will toggle on and off each time this is done. Off or On will appear on the screen to indicate the current AuxCom state.

## B.4 Settings

The settings for AuxCom are only configurable through software. See B.1.

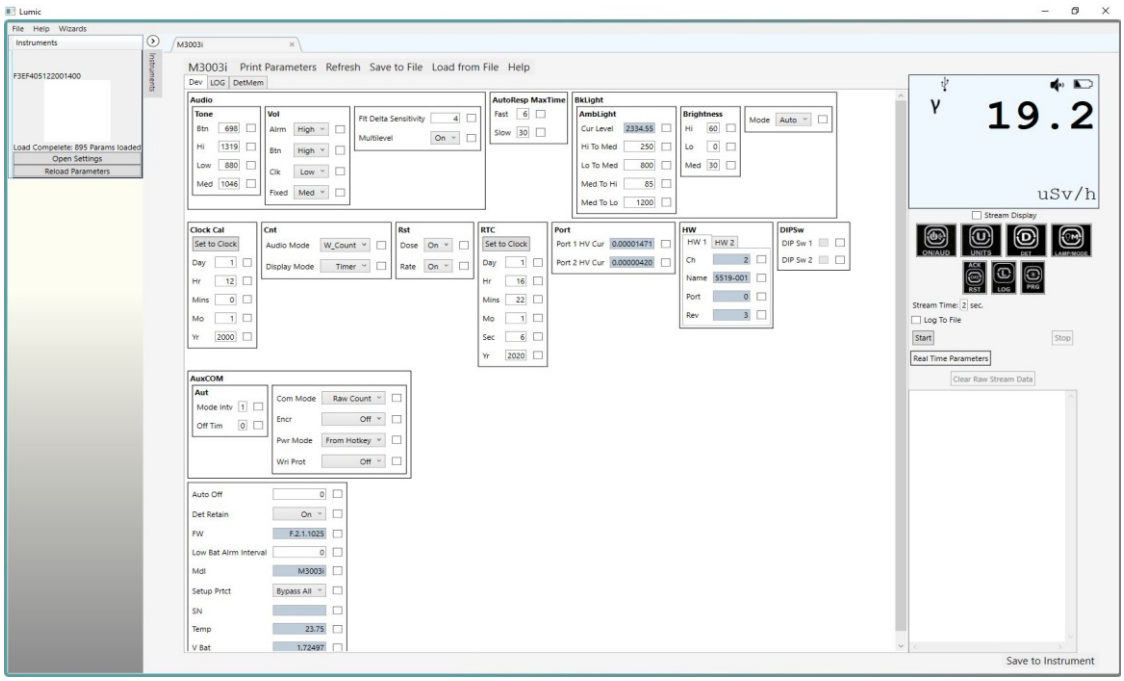



Figure B.1: Example – Lumic 2.0 Calibration Software

### B.4.1 AuxCom Setting - Mode

The mode setting for AuxCom configures how the port will function. The table below lists the modes and their baud rates.

| Mode | Baud Rate |
|---|---|
| 375 Standard | 2400 |
| 375 Ethernet | 2400 |
| 375 for 272D | 2400 |

Table B.1: AuxCom Mode

**375 Standard:** Legacy support for Model 375 Standard output. This is compatible with the Model 375 Logger software and some versions of the Model 3276 Ethernet Kit (LMI# 4498-958).

**375 Ethernet:** Extended version of “375 Standard” that is intended for use with Model 3276 Ethernet Kit (LMI# 4498-958 **FW# N09 Only**) and the Ludlum Universal Software.

**375 for 272D:** Special version of “375 Standard” that makes the 272D display follow the instrument display more closely with regards to leading zeros and decimal places.

### B.4.2 AuxCom Setting - 375 Ethernet Mode Port

If the instrument is equiped with the Model 3276 Ethernet Kit, this setting sets the unique Ethernet port identification. Valid values are from 50000 to 59999.

APPENDIX C

# ETHERNET NETWORK SETTINGS

This appendix describes how to configure the network settings for a 375 Series, 3276, 4525, or 4530 that has been configured for Ethernet using the new ESP32 Ethernet board. Ethernet boards using the Rabbit Ethernet chip do not support all the features described below.

| Part Number | Description |
|---|---|
| 4396-579 | Model 375 Ethernet Hardware Kit |
| 4498-958 | Model 3276 Ethernet Hardware Kit |
| 4511-954-01 | Model 4525-5000 Main Module Ethernet Kit |
| 4517-540 | Model 4530 Parts Kit |
| 4558-566 | Model 375 Ethernet Option |
| 4558-567 | Model 375 Legacy Ethernet Option |
| 4557-616 | Model 375 Legacy ESP32-POE Assembly/Mount Board |
| 4558-617 | Model 375 ESP32-POE Assembly/Mount Board |
| 4558-618 | Model 4525 ESP32-POE Assembly/Mount Board |
| 5396-565 | Model 4525 Main Board |
| 5558-536 | Model 4530 Main Board |

Table C.1: Ethernet Option Parts

## C.1 Modes of Operation

The new firmware in the Ethernet kit supports all the instruments above using a single firmware version. The three different modes are:

1. Model 375 TCP – Compatible with the Model 375 Webpage and Universal software.
2. Model 375 UDP – Compatible with the Model 375 Ethernet software.
3. Model 4525 – Compatible with the Model 4525/4530.

The mode can be changed by selecting the radio button at the top of the network settings page and saving. The mode must be saved first before the corresponding parameters are shown.

It is no longer necessary to have custom firmware on the 375 main board to support Ethernet software using the 375 UDP mode. The UDP port and unit ID are now handled by the Ethernet board. If the firmware is already installed, those settings will be ignored in favor of the settings on the Ethernet board.

## C.2 Finding the Instruments on the Network

The instruments can be found by launching the Device Finder utility. This can be downloaded from our website here: https://ludlums.com/software/DeviceFinder.zip

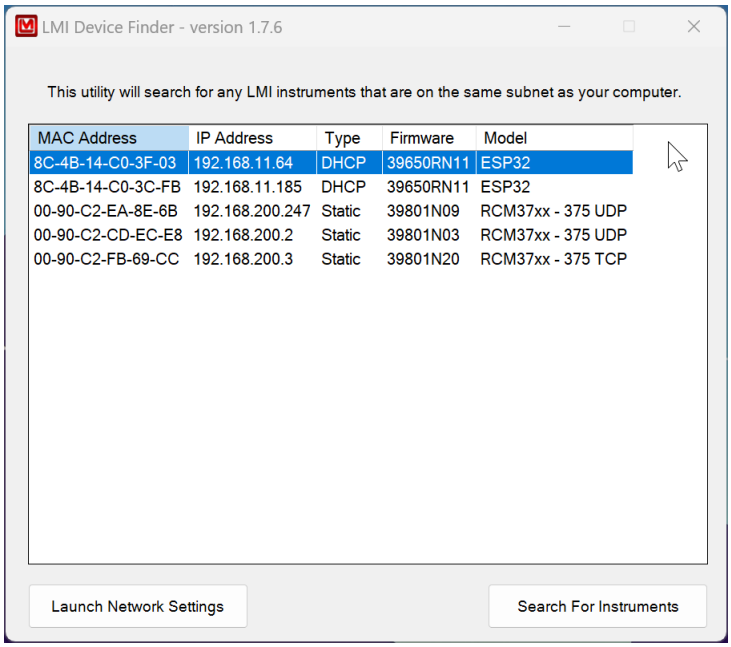



Figure C.1: Device Finder

Device Finder will search the local subnet for any instruments on the network using a UDP broadcast message on UDP port 20034. This port must be opened on the computer running the utility for it to find any instruments.

The MAC address, IP address, Type (DHCP or Static), Firmware versions, and Model will be displayed.

| MAC Address | Description |
|---|---|
| 00-90-C2 or 00-C0-33 | Rabbit RCM37xx (Obsolete) |
| 8C-4B-14 or 08-3A-AF | ESP32 (New Board) |

Table C.2: MAC Addresses

To open the instrument's network settings page, select the instrument from the list and click **Launch Network Settings**. This will open the default web browser to the IP address of the instrument. You can also type in the IP address into a web browser directly to access the network settings page.

RCM37xx – 375 UDP does not have a network settings page.

If an instrument does not show up in the list or was added to the network after the search was completed, click the **Search for Instruments** button to perform another search.

## C.3 Network Settings

Using either the Device Finder app or typing the IP address directly into a web browser will open the Network Settings page of the Ethernet board. Depending on the current mode of operation, the network settings page will display different parameters. The modes will all have some common parameters such as serial number and network settings. Before the applicable settings are displayed, the mode must be changed using the password and Submit button.

Figure C.2: Model 375 TCP Mode

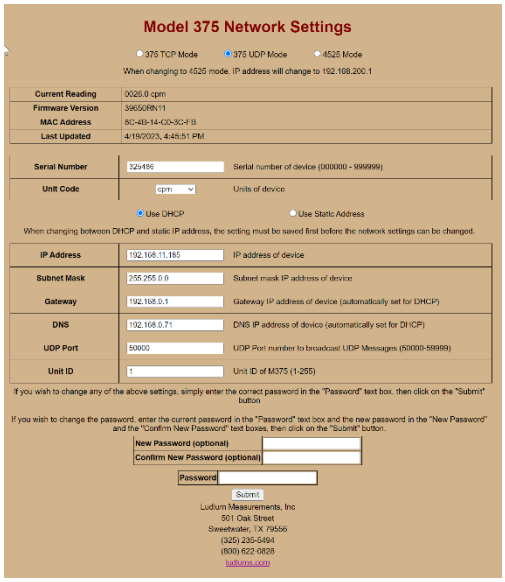



Figure C.3: Model 375 UDP Mode

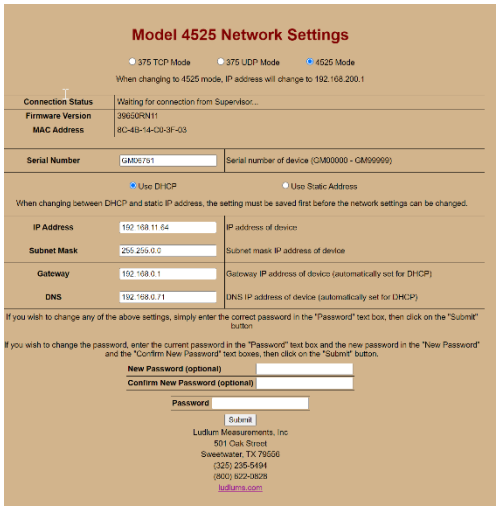



Figure C.4: Model 4525 Mode

## C.4 Common Settings

The following settings are common to all operating modes.

**DHCP/Static IP Address** – These two radio buttons determine if the IP address and other network settings are set statically (Manually Assigned) or automatically through DHCP. When set to DHCP, the network settings shown are the values set by DHCP. To set the network settings manually, click the Use Static IP address radio button and fill in the appropriate values for the network settings.

When in DHCP mode, if the radiation monitor cannot get an IP address automatically, it will fall back to an IP address in the 169.254.x.x range.

**Serial Number** – This is the serial number stamped on the front of the instrument or on a sticker.

**IP Address** – An IP address is a unique IPV4 address assigned to each device on the network. It can be assigned manually or dynamically through DHCP.

**Subnet Mask** - A subnet mask is a 32-bit number created by setting host bits to all 0s and setting network bits to all 1s. In this way, the subnet mask separates the IP address into the network and host addresses.

**Gateway** – The Default Gateway IP address is the device that allows access to servers that are outside of the network.

**DNS** – The DNS IP address is the server that is responsible for converting human readable names into IP addresses.

## C.5 Password Settings

To save settings, the correct password must be entered into the Password field. By default, the password is "password." To change the password, enter the new password in the New Password field and retype it in the Confirm New Password field. Then enter the current password and click the Submit button.

## C.6 Model 375 TCP Mode

The TCP mode sends data to a user-defined IP address and user-defined TCP port number. This mode is compatible with both the 375 Webpage and Universal software. The following settings can be set in this mode.

**Unit Code** – Set the display units reported to the software. This must match the label on the front of the instrument. Choices are: µR/hr, mR/hr, R/hr, µSv/hr, mSv/hr, Sv/hr, µrem/hr, mrem/hr, rem/hr, cpm, cps, kcpm, and kcps.

**TCP/IP Port** – Sets the port number that the Supervisor computer is listening on. The default is 50000 but can be adjusted from 50000 to 59999.

**Supervisor IP Address** – Sets the IP address that the instrument will connect to. This is the computer running the Windows service of the Webpage or Universal software.

The data is sent every two seconds in the following format:

<?xml version="1.0" encoding="us-ascii"?>
<area_monitor rev ="1.0" serial="12345"><status>
<rate>9999.9</rate>
<units_code>99</units_code>
<audio>1</audio>
<alarm1>1</alarm1>
<alarm2>1</alarm2>
<over_range>1</over_range>
<monitor>1</monitor>

<error_code>9</error_code> </status>
</area_monitor>

The data has been formatted here to show the structure more easily. The actual data does not have line breaks after each section and is one continuous line.

## C.7 Model 375 UDP Mode

The UDP mode sends data to a user-defined UDP port number. This mode is compatible with the Model 375 Ethernet software. The data are sent using a broadcast IP Address of 255.255.255.255. Any device on the same subnet will be able to see the data on the correct UDP port number. The following settings can be set in this mode.

**Unit Code** – Set the display units reported to the software. This must match the label on the front of the instrument. Choices are: µR/hr, mR/hr, R/hr, µSv/hr, mSv/hr, Sv/hr, µrem/hr, mrem/hr, rem/hr, cpm, cps, kcpm, and kcps.

**UDP Port** – Sets the UDP port that the data will be broadcasted. This is adjustable from 50000 to 59999.

**Unit ID** – This is a unique ID number assigned to each instrument on the network. Typically instrument one is assigned a unit ID of 1, the next one is 2, etc.

Previous versions of the Ethernet board required a special firmware to be installed in the Model 375 to be able to set the unit ID and UDP port. On the newer versions, this is set here in the network settings page, so no special firmware is required. If the instrument has the special firmware, the unit ID and UDP port are ignored, instead using the values set on the network settings page.

The data is formatted as a string, very much like the standard RS-232 data output. See below:

Byte 1 L
Byte 2 M
Byte 3 I
Byte 4 0 x
Byte 5 x x
Byte 6 x OR x
Byte 7 x x
Byte 8 . .
Byte 9 x 0
Byte 10 Audio Status = 1 = on
Byte 11 Alarm Status = 1 = on
Byte 12 Alert Status = 1 = on
Byte 13 Over Range Status = 1 = on
Byte 14 Monitor Status = 1 = on

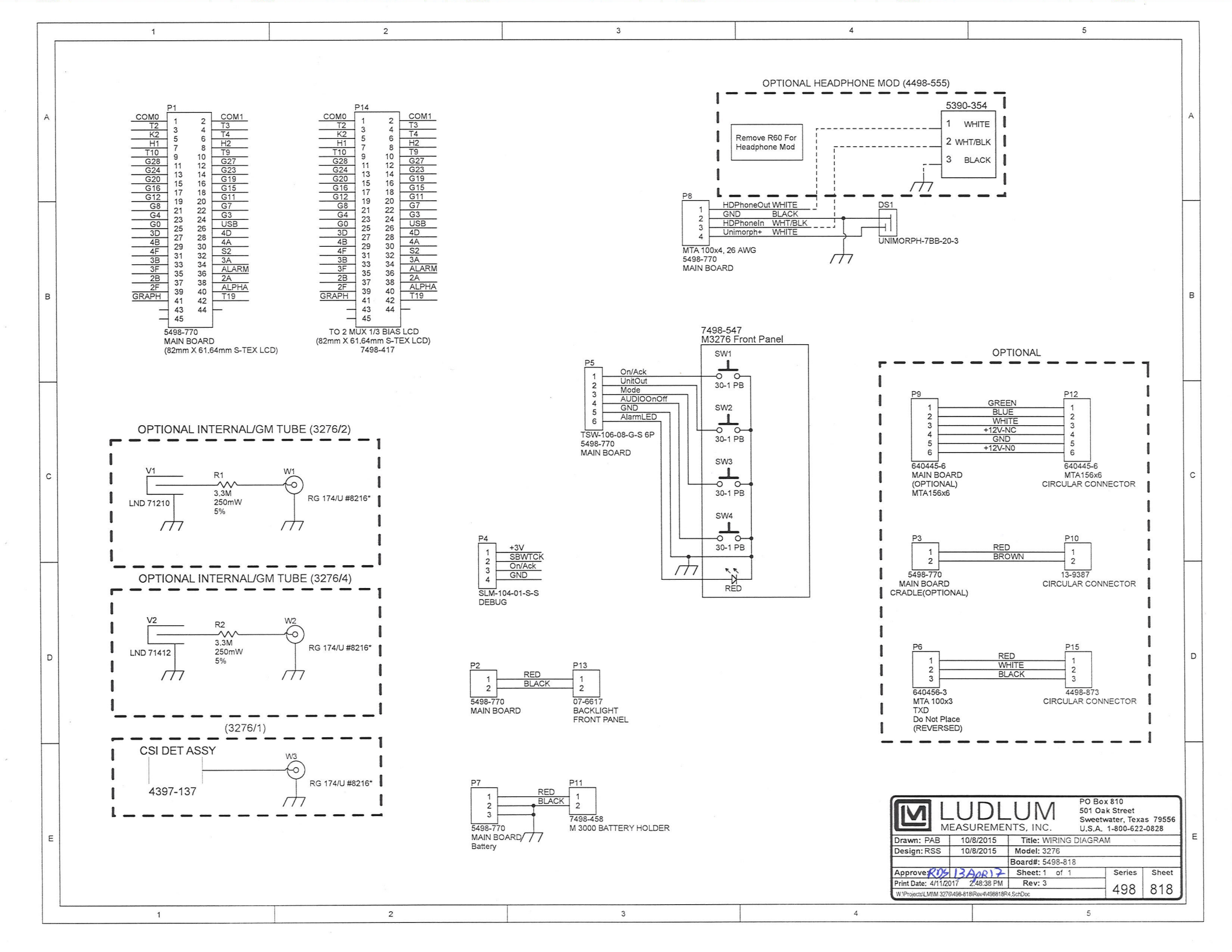
Byte 15 Error Code
Byte 16 UNIT ID CHAR 1
Byte 17 UNIT ID CHAR 2
Byte 18 UNIT ID CHAR 3
Byte 19 PORT NUM CHAR 1
Byte 20 PORT NUM CHAR 2
Byte 21 PORT NUM CHAR 3
Byte 22 PORT NUM CHAR 4
Byte 23 3 Firmware version of Model 375|
Byte 24 9
Byte 25 6
Byte 26 x
Byte 27 x
Byte 28 n
Byte 29 x
Byte 30 x
Byte 31 3 Firmware version of Ethernet board
Byte 32 9
Byte 33 8
Byte 34 x
Byte 35 x
Byte 36 n
Byte 37 x
Byte 38 x
Byte 39 Carriage Return (0DH)
Byte 40 Line Feed (0AH)

The firmware version of the Ethernet board is not sent out the serial port of the Model 375!

If the firmware in the instrument is standard, then the values for the instrument firmware in the data output will all be the letter “X.”

## C.8 Model 4525 Mode

The Model 4525 mode is compatible with both the 4525 and 4530 gate monitors. The Ethernet board waits for a connection from the Supervisor computer on TCP port 23. Once the connection is established, it begins passing data back and forth from the Supervisor computer and the gate monitor’s serial port.


P1
COM0 1 2 COM1
T2 3 4 T3
K2 5 6 T4
H1 7 8 H2
T10 9 10 T9
G28 11 12 G27
G24 13 14 G23
G20 15 16 G19
G16 17 18 G15
G12 19 20 G11
G8 21 22 G7
G4 23 24 G3
G0 25 26 USB
3D 27 28 4D
4B 29 30 4A
4F 31 32 S2
3B 33 34 3A
3F 35 36 ALARM
2B 37 38 2A
2F 39 40 ALPHA
GRAPH 41 42 T19
43 44
45
5498-770
MAIN BOARD
(82mm X 61.64mm S-TEX LCD)
P14
COM0 1 2 COM1
T2 3 4 T3
K2 5 6 T4
H1 7 8 H2
T10 9 10 T9
G28 11 12 G27
G24 13 14 G23
G20 15 16 G19
G16 17 18 G15
G12 19 20 G11
G8 21 22 G7
G4 23 24 G3
G0 25 26 USB
3D 27 28 4D
4B 29 30 4A
4F 31 32 S2
3B 33 34 3A
3F 35 36 ALARM
2B 37 38 2A
2F 39 40 ALPHA
GRAPH 41 42 T19
43 44
45
TO 2 MUX 1/3 BIAS LCD
(82mm X 61.64mm S-TEX LCD)
7498-417
OPTIONAL HEADPHONE MOD (4498-555)
Remove R60 For Headphone Mod
5390-354
1 WHITE
2 WHT/BLK
3 BLACK
P8
1 HDPhoneOut WHITE
2 GND BLACK
3 HDPhoneIn WHT/BLK
4 Unimorph+ WHITE
MTA 100x4, 26 AWG
5498-770
MAIN BOARD
DS1
UNIMORPH-7BB-20-3
7498-547
M3276 Front Panel
SW1
SW2
SW3
SW4
30-1 PB
RED
P5
1 On/Ack
2 UnitOut
3 Mode
4 AUDIOOnOff
5 GND
6 AlarmLED
TSW-106-08-G-S 6P
5498-770
MAIN BOARD
P4
1 +3V
2 SBWTCK
3 On/Ack
4 GND
SLM-104-01-S-S
DEBUG
OPTIONAL
P9
1 GREEN
2 BLUE
3 WHITE
4 +12V-NC
5 GND
6 +12V-N0
640445-6
MAIN BOARD
(OPTIONAL)
MTA156x6
P12
640445-6
MTA156x6
CIRCULAR CONNECTOR
P3
1 RED
2 BROWN
5498-770
MAIN BOARD
CRADLE(OPTIONAL)
P10
13-9387
CIRCULAR CONNECTOR
P6
1 RED
2 WHITE
3 BLACK
640456-3
MTA 100x3
TXD
Do Not Place
(REVERSED)
P15
4498-873
CIRCULAR CONNECTOR
OPTIONAL INTERNAL/GM TUBE (3276/2)
V1
R1
W1
LND 71210
3.3M
250mW
5%
RG 174/U #8216*
OPTIONAL INTERNAL/GM TUBE (3276/4)
V2
R2
W2
LND 71412
3.3M
250mW
5%
RG 174/U #8216*
(3276/1)
CSI DET ASSY
W3
4397-137
RG 174/U #8216*
P2
1 RED
2 BLACK
5498-770
MAIN BOARD
P13
1
2
07-6617
BACKLIGHT
FRONT PANEL
P7
1 RED
2 BLACK
3
5498-770
MAIN BOARD/
Battery
P11
1
2
7498-458
M 3000 BATTERY HOLDER
LUDLUM MEASUREMENTS, INC.
PO Box 810
501 Oak Street
Sweetwater, Texas 79556
U.S.A. 1-800-622-0828
Drawn: PAB 10/8/2015
Design: RSS 10/8/2015
Title: WIRING DIAGRAM
Model: 3276
Board#: 5498-818
Approved: RDS 13APR17
Sheet: 1 of 1
Print Date: 4/11/2017 2:48:38 PM
Rev: 3
Series 498
Sheet 818
W:\Projects\LM\M 3276\498-818\Rev4\498818R4.SchDoc