

**LUDLUM MODEL 52-8  
OUTDOOR PORTABLE PORTAL MONITOR**

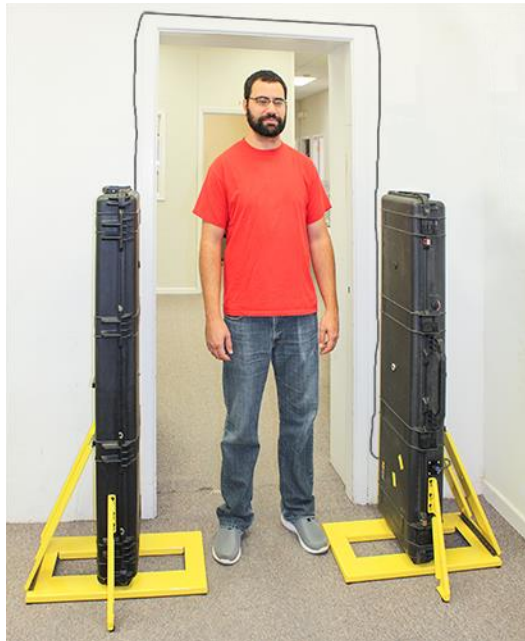
**January 2024**

**Serial Number 25019271 and Succeeding  
Serial Numbers**

# **LUDLUM MODEL 52-8 OUTDOOR PORTABLE PORTAL MONITOR**

**January 2024**

**Serial Number 210041 and Succeeding  
Serial Numbers**



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



## **STATEMENT OF WARRANTY**

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

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

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

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If equipment needs to be returned to Ludlum Measurements, Inc. for repair or calibration, please send to the address below. All shipments should include documentation containing return shipping address, customer name, telephone number, description of service requested, and all other necessary information. Your cooperation will expedite the return of your equipment.

**LUDLUM MEASUREMENTS, INC.  
ATTN: REPAIR DEPARTMENT  
501 OAK STREET  
SWEETWATER, TX 79556**

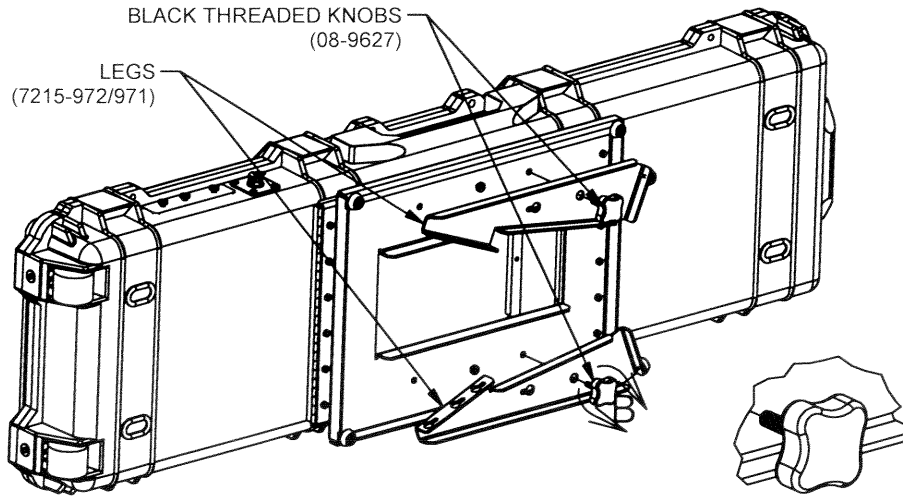
**800-622-0828    325-235-5494  
FAX 325-235-4672**

REVISION HISTORY			
REV	DESCRIPTION	DATE	BY
1	VALID	9/12/19	WJM

1) REMOVE THE THREADED KNOBS HOLDING THE LEGS IN PLACE.

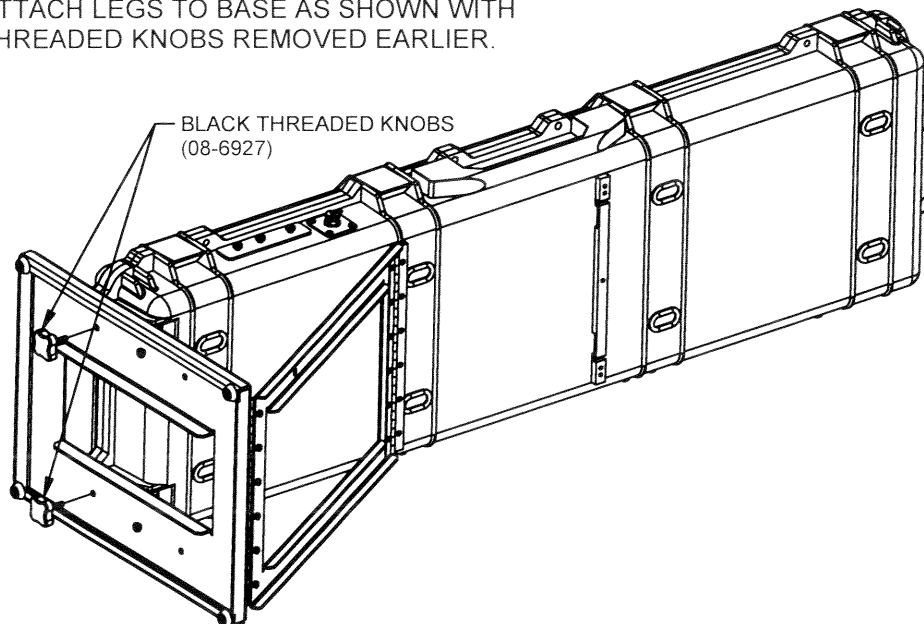
2) SLIDE THE LEGS IN THEIR KEYED SLOT AND REMOVE THEM.

3) SET LEGS ASIDE AND UNFOLD BASE FROM BACK.

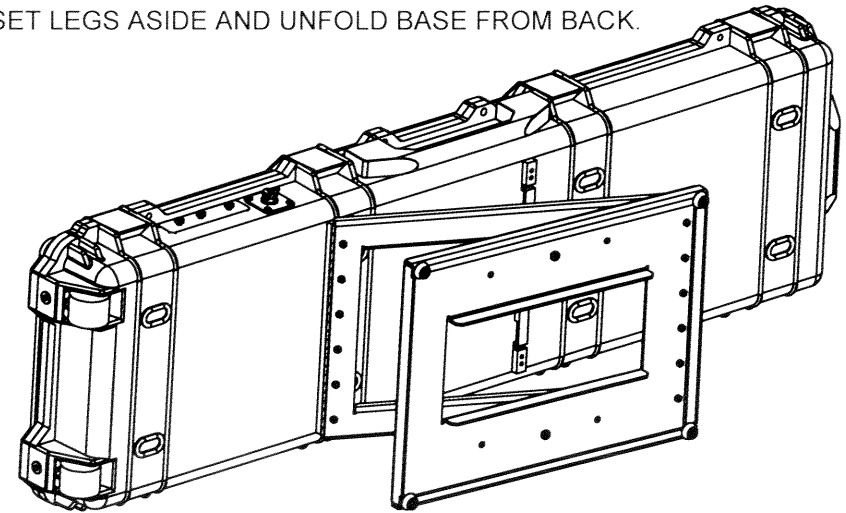


BLACK THREADED KNOB  
(08-6927)

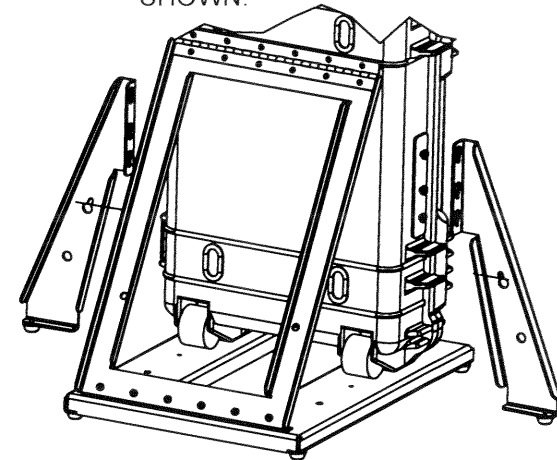
4) ATTACH LEGS TO BASE AS SHOWN WITH THREADED KNOBS REMOVED EARLIER.




BLACK THREADED KNOBS  
(08-6927)



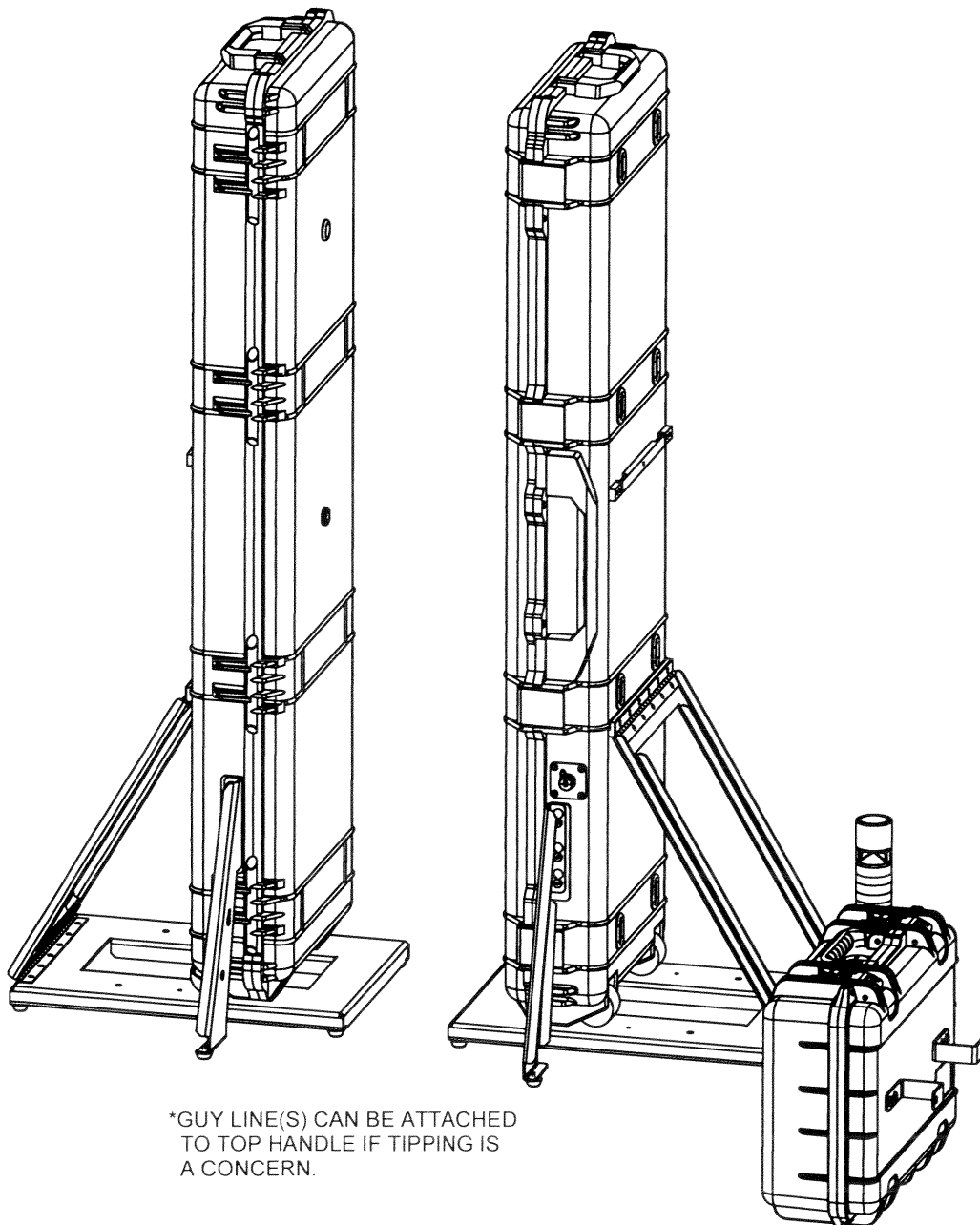
5) AFTER STANDING, ATTACH LEGS TO THE SIDE IN THEIR KEYED SLOTS AS SHOWN.



DWN	DATE	DESIGN AUTHORITY	APP	DATE
WJM	9/12/19	WJM	WJM	9-12-19
DWG NUM: 4215-1002			SCALE: 1/10	
TITLE M 52-8 DETECTOR SETUP				
 LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556		SERIES 215	SHEET 1002	

REVISION HISTORY

REV	DESCRIPTION	DATE	BY
1	VALID	9/12/19	WJM



SET DETECTORS AT DESIRED DISTANCE APART. ENSURE THEY ARE FACING EACH OTHER AND LINED UP DIRECTLY ACROSS FROM EACH OTHER SO THE IR SENSOR WILL FUNCTION PROPERLY.

CONNECT RECEIVER CASE TO RECEIVER (DET. 1) PORT ON ELECTRONICS USING CABLE 8215-901 (30 FT. CABLE).

CONNECT TRANSMITTER CASE TO TRANSMITTER (DET. 2) PORT ON ELECTRONICS USING SECOND 8215-901 CABLE.


ROTATE STACK LIGHT ON ELECTRONICS UNTIL IT IS POINTED UP, SO IT CAN BE SEEN BETTER (LIGHT WILL STILL WORK WHEN POINTED DOWN).

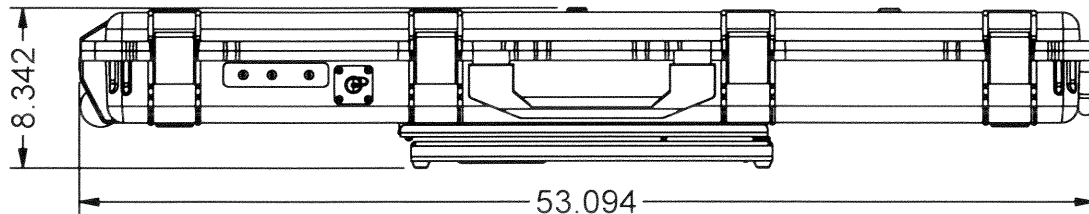
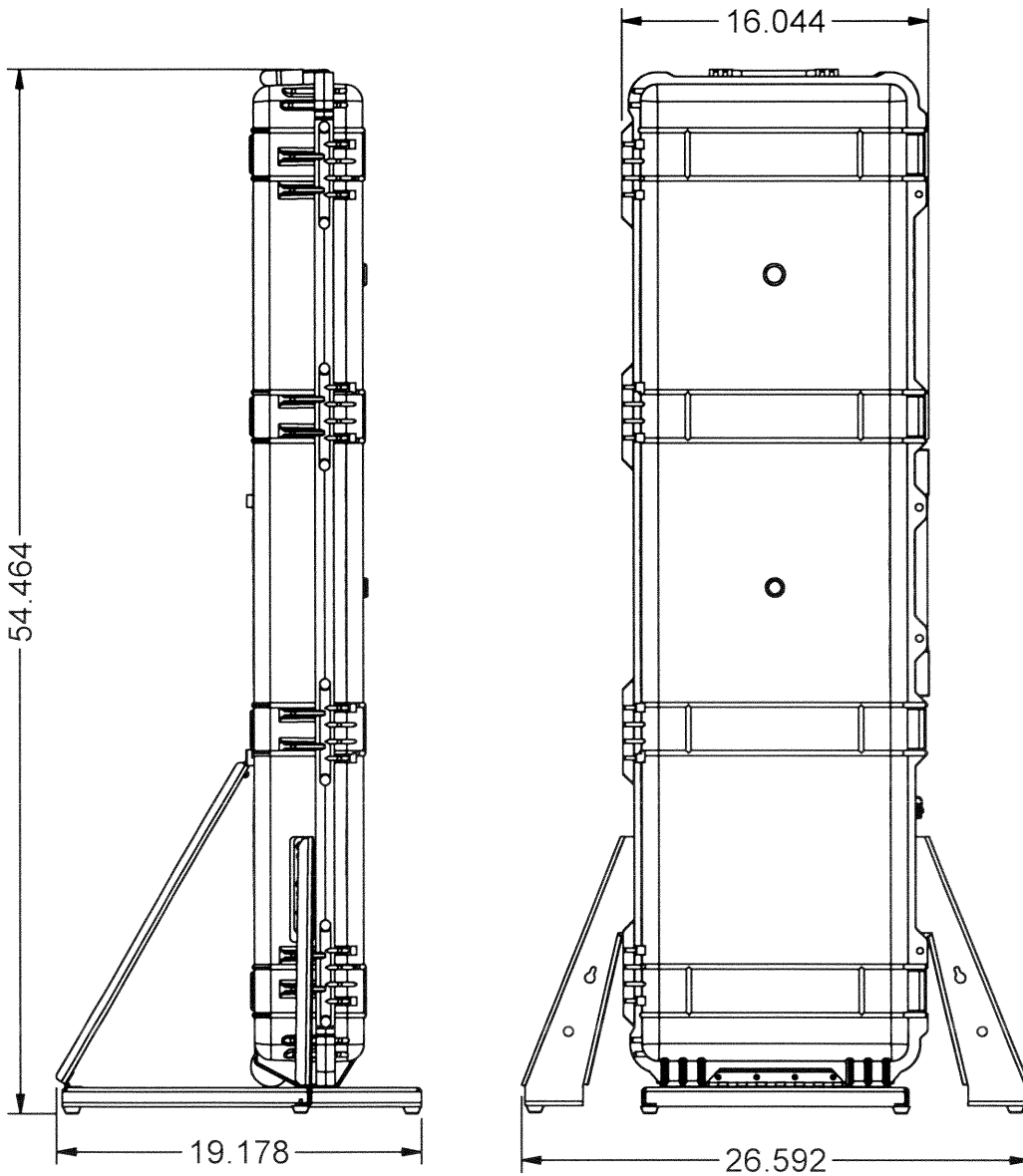
IF USING BATTERY POWER, INSTALL D-CELL BATTERIES THEN LIFT RED SWITCH GUARD AND TOGGLE SWITCH TO "ON" TO START POWER-UP.

IF USING EXTERNAL POWER, CONNECT 12V OR AC POWER USING CABLES 8303-1029, 8215-819, OR 8215-925 (AC OPTION) THEN LIFT RED SWITCH GUARD AND TOGGLE SWITCH TO "ON" POSITION TO START POWER-UP.

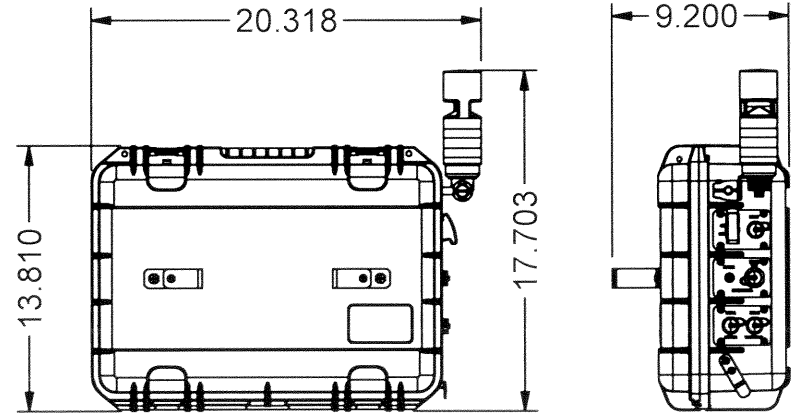
ON POWER-UP, THE INSTRUMENT WILL TAKE 60 SECONDS TO PERFORM ITS INITIAL SETUP AND BACKGROUND MEASUREMENTS.

\*GUY LINE(S) CAN BE ATTACHED TO TOP HANDLE IF TIPPING IS A CONCERN.

DWN	DATE	DESIGN AUTHORITY	APP	DATE
WJM	9/12/19	WJM	WJM	9-12-19
DWG NUM: 4215-1002			SCALE: 1/10	
TITLE M 52-8 SETUP				
 LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556		SERIES	SHEET	
		215	1002A	



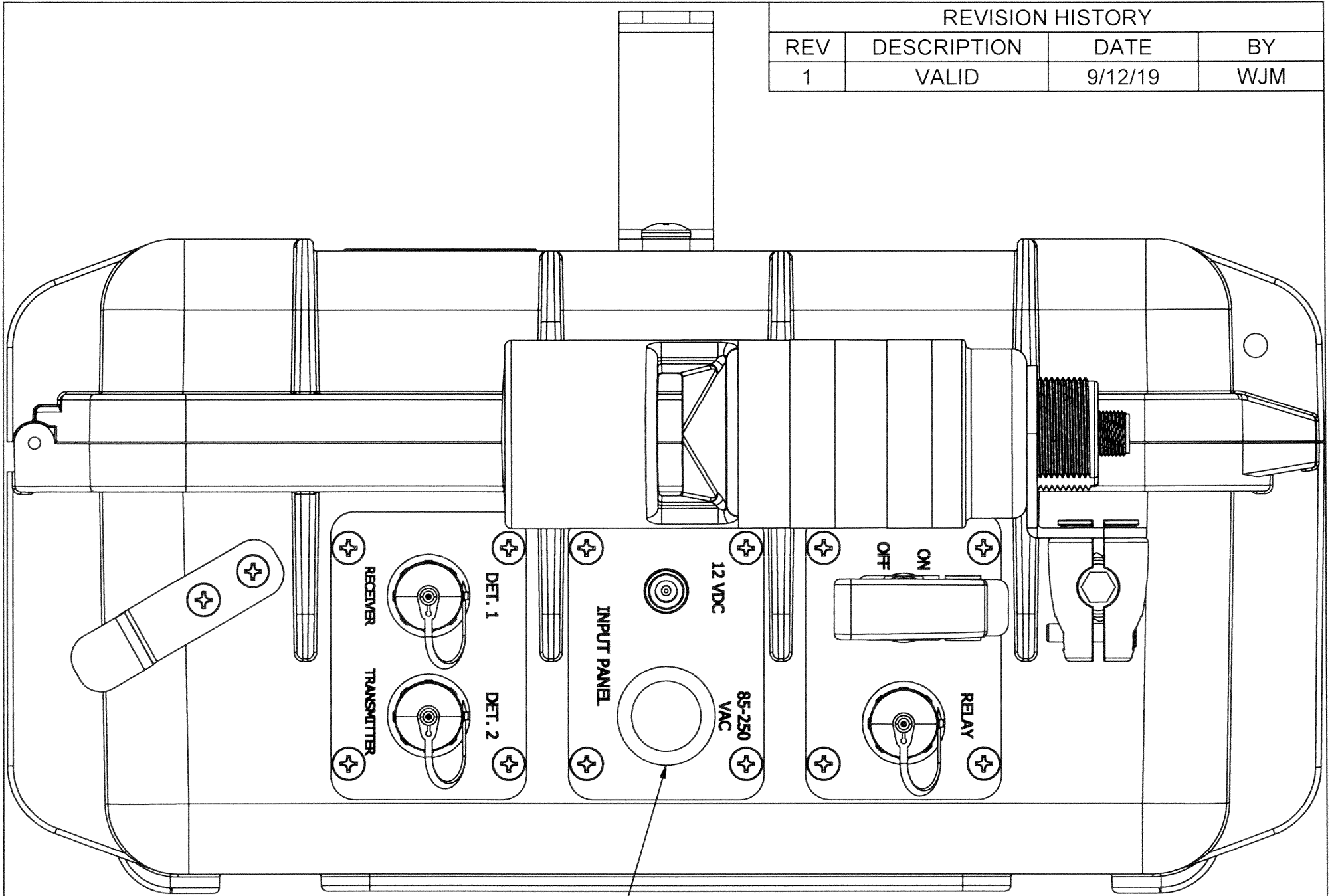
REVISION HISTORY			
REV	DESCRIPTION	DATE	BY
1	VALID	9/12/19	WJM




DWN	DATE	DESIGN AUTHORITY	APP	DATE
WJM	9/12/19	WJM	WJM	9-12-19
<b>DWG NUM: 4215-1002</b>			<b>SCALE: 1/10</b>	
<b>TITLE M 52-8 DIMENSIONS</b>				
	LUDLUM MEASUREMENTS, INC.		SERIES	SHEET
	501 OAK STREET SWEETWATER, TEXAS 79556		215	1002B

REVISION HISTORY

REV	DESCRIPTION	DATE	BY
1	VALID	9/12/19	WJM



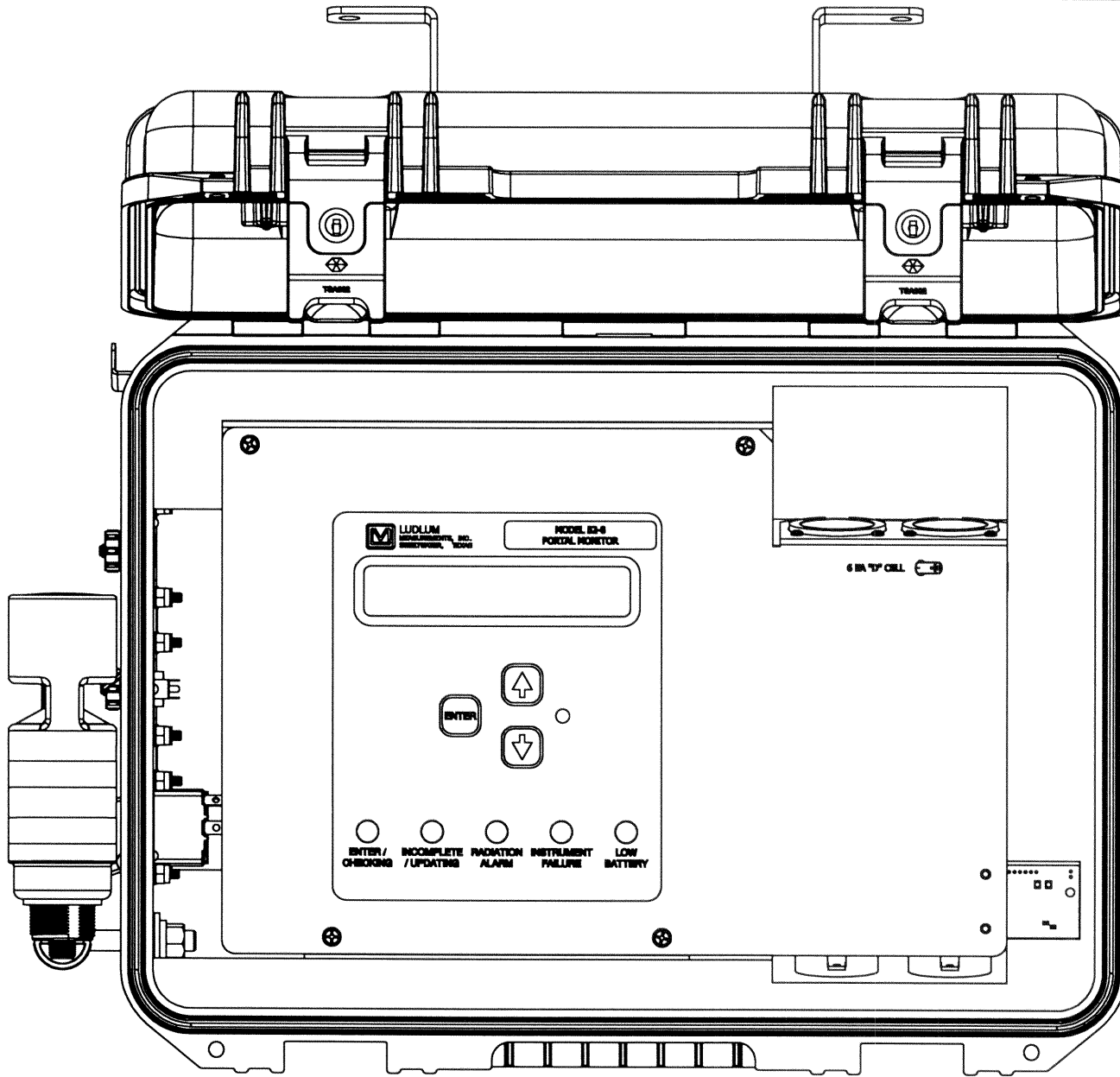
AC POWER SUPPLIED THRU  
A 3 PIN CONNECTOR HERE.  
WITH ADDITION OF 4215-925  
OPTION.

DWN WJM	DATE 9/12/19	DESIGN AUTHORITY WJM	APP WJM	DATE 9-12-19
DWG NUM: 4215-1002			SCALE: 3/4	
TITLE M 52-8 ELEC. CONNECTIONS				
 LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556		SERIES 215	SHEET 1002C	



REVISION HISTORY

REV	DESCRIPTION	DATE	BY
1	VALID	9/12/19	WJM



DWN WJM	DATE 9/16/19	DESIGN AUTHORITY WJM	APP WJM	DATE 9-16-19
DWG NUM: 4215-1002			SCALE: 1/3	
TITLE M 52-8 ELEC. FRONT PANEL				
	LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556	SERIES 215	SHEET 1002D	

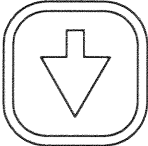
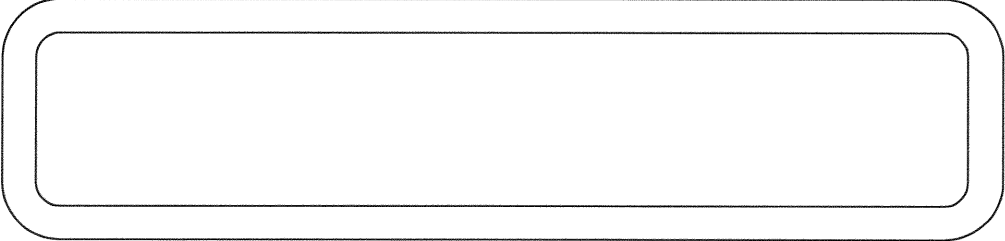
REVISION HISTORY

REV	DESCRIPTION	DATE	BY
1	VALID	9/12/19	WJM



LUDLUM  
MEASUREMENTS, INC.  
SWEETWATER, TEXAS

**MODEL 52-8  
PORTAL MONITOR**



ENTER /  
CHECKING

INCOMPLETE  
/ UPDATING

RADIATION  
ALARM

INSTRUMENT  
FAILURE

LOW  
BATTERY

DWN	DATE	DESIGN AUTHORITY	APP	DATE
WJM	9/16/19	WJM	WJM	9.16.19
DWG NUM: 4215-1002			SCALE: 1:1	
TITLE M 52-8 ELEC. FRONT PANEL 2				
LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556		SERIES 215	SHEET 1002E	

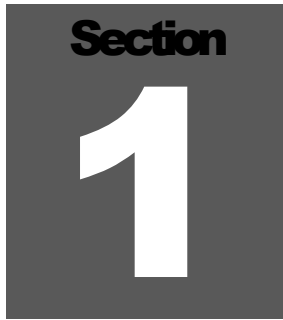
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## Introduction

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The Model 52-8 is a weather resistant portable scintillation portal monitor. It is designed to detect very low levels of radiation coming from personnel or vehicles that move through the portal. It is designed to be deployed quickly, and to operate outdoors even under wet conditions.

The Model 52-8 meets the Federal Emergency Management Agency (FEMA) standard for Emergency Response Portal Monitoring (FEMA-REP-21). It is designed for ease of transportation and storage, and can be deployed in five minutes or less without tools. All parameters are stored in non-volatile memory, which requires no battery backup. These parameters allow easy operation with minimal setup by minimally trained personnel. The parameters are pre-set at the factory to detect a 1.0  $\mu\text{Ci}$   $^{137}\text{Cs}$  source in a 10  $\mu\text{R/hr}$  background field, in accordance with the FEMA standard. This sensitivity is reached as long as the detectors are spaced no more than 122 centimeters (48 inches) apart. Sensitivity decreases when the detectors are further apart.

The Model 52-8 typically has two detectors total, one per side, housed in weatherproof transit wheeled cases. The detector cases have a pair of infrared sensors to detect when a vehicle or person is between the detectors. Two size versions are available: a "52-8/1" version with 960  $\text{in}^3$  of plastic scintillator and a "52-8/2" with 2000  $\text{in}^3$  of plastic scintillator. The larger plastic scintillator provides approximately 40% more sensitivity than the smaller version. The electronics package is housed in a third weatherproof case with a mounted on/off toggle switch and red/green strobe light. The two detector cables are attached and wound on the side of the electronics case to facilitate deployment. The instrument can be operated in bad weather without opening any case.

The instrument also complies with the applicable European Standards required for CE marking of the instruments.

The electronics are microprocessor-based for ease of setup and reliability. Status LEDs indicate count cycle status. Audible signals (which may be turned off to avoid alarming the occupants) accompany the LEDs for additional indication. Audio levels can also be controlled by rotating the baffle at the front of the audio device. Detector counts, background, and all parameters may be viewed on the Liquid Crystal Display (LCD). All setup is accomplished by way of pushbuttons located below the LCD.

These portal monitors can be operated in a walk-through basis with a quick scan occurring while a person is passing through the portal. In this mode, checking is performed every 200 milliseconds while the portal is occupied and 800 milliseconds after the portal is occupied. A check is also performed before the portal is occupied based on the value of the "# of Samples" parameter. For example, if the "# of Samples" parameter is set to 3, when a person enters the portal, the instrument immediately checks for an alarm based on the last 3 samples (3 x 200 milliseconds) or 600 milliseconds. This check helps to catch contamination on the foot or hand that passes by the detectors just before the occupancy sensor is triggered.

The portal monitor can also monitor in a stop-and-count mode, allowing for a more sensitive scan. In stop-and-count mode, the fixed count time may be set from 1 to 20 seconds.

The Model 52-8 can also operate in a drive-through mode. Detector cables are 9 m (30 ft) in length, allowing the detectors to be spaced further apart. A cable guard (not included) is recommended to decrease the subsequent wear on the cable when used for this purpose.

This instrument has automatic background update and dynamic alarm setting capabilities. On startup, it will take a background count and calculate alarm levels for each detector. Self-diagnostic routines check the background count and warn if the background becomes either too high or too low. Alarms are calculated with a user-adjustable sigma parameter and the current background count. During setup, the user can also specify individual alarms only, sum alarm only, or both individual and sum alarms. The sum alarm groups upper detectors and lower detectors.

The Model 52-8 is able to operate from +12V with the provided 6 m (20 ft) cable, which features a cigarette lighter plug (with a 1A fuse in the tip) to easily connect to a vehicle. The Model 52-8 is also provided with a +12V power supply that connects to main (85-250 Vac) power.

The Model 52-8 may also be operated from six “D” cell batteries. The Model 52-8 has a fourth (optional) power input possibility: a mains input option to be able to operate directly from 85-250 Vac 50/60Hz.

# Section 2

## Specifications

**Construction:** waterproof and dustproof polyethylene cases

**Display (Setup):** 2 line-by-20-character backlit LCD, inside the electronics case. Can display up to four detectors, marked RA, RB, TA, and TB.

**Display (User):** five large status LEDs inside the electronics case

**Detector Cable Length:** 9.1 m (30 ft) standard length

**+12V Input Power Cable Length:** 6.1 m (20 ft)

**Power:** +12 Vdc input (with 1A fuse inside the cigarette adapter plug), +12V power supply that connects to mains power (85-250 Vac), or six D-cell batteries. It is recommended to disconnect the strobe when powering the unit from D-cell batteries. Typical battery life is 18 hours using alkaline batteries without the strobe connected. The instrument has an option for 85-250 Vac mains input, 50/60 Hz, 100 watts maximum.

**Count Time:** adjustable from 0 to 20 seconds (“0” indicates walk-through mode)

**Output:** RS-232 (9-pin D connector available inside the electronics package {optional}), Bluetooth, and +12 V relay for radiation alarm and failure conditions

**Sensitivity:** 1  $\mu\text{Ci}$   $^{137}\text{Cs}$  in walk-through mode with detectors spaced no more than 1.2 m (48 in.) apart

**Gamma Energy Response:** 60 keV to 3 MeV

**Audio:** audio for alarm and incomplete conditions, and a continuous beeping for radiation alarm and instrument failure

### Dimensions :

172 x 51 x 36 cm (67.6 x 20.2 x 14.1 in.) (H x W x L) detector cases (2)

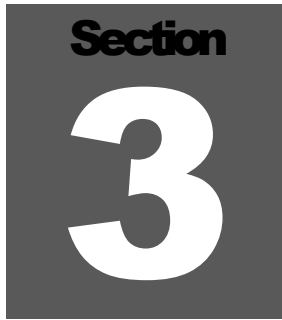
52 x 45 x 22 cm (20.3 x 17.7 x 8.7 in.) (H x W x L) electronics case

**Detector Size:** Each of the side detectors of the 52-8/1 has 7866 cm<sup>3</sup> (480 in<sup>3</sup>) of plastic scintillator, for a total of 31463 cm<sup>3</sup> or 1920 in<sup>3</sup>. Each of the side detectors of the 52-8/2 has 16387 cm<sup>3</sup> (1000 in<sup>3</sup>) of plastic scintillator, for a total of 32774 cm<sup>3</sup> or 2000 in<sup>3</sup>.



**IP Rating:** Ingress Protection (IP rating) of 66

**Weight:** approximately 33 kg (72 lb) for each detector case, 8.2 kg (18 lb) for the electronics case with attached cables

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## User Operation

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**T**his section gives instructions how to set up and use the instrument to monitor a person or vehicle for radiation.

### Assembly Instructions

See the 215 x 1002 Series of drawings located at the front of this manual. They may assist with the assembly process. In general, the instruments may be assembled indoors or outdoors, and may be utilized either for pedestrians or vehicles.

The portal monitor consists of three containers that are used for shipping and storage. The pieces and quantities that make up the system are:

- 1 – Electronics case with attached cables and strobe
- 1 – Detector 1 with Receiver Infrared Sensor, in wheeled case
- 1 – Detector 2 with Transmitter Infrared Sensor, in wheeled case

All three containers have labels on the outside with a common serial number to help in keeping the three parts distinct from other systems.

The portal monitor can be assembled without tools.

#### **Caution!**

Due to the high weight of the two detector cases (each can weigh up to 33 kg [72 lb]), transportation and setup may be easier done with two people working as a team.

Remove the two black-knobbed screws on the side of each detector case to release the hinged base and two side brackets. Reconnect the two black-knobbed screws with the hinged base at the base of the detector case. Set the stands on level ground, and lift the detector to the vertical position. Then attach the side brackets of the case, securing the detectors from tipping over. Ensure that the infrared sensors, located about two feet high on the cases, are pointed at each other.

**Caution!**

While the stands have been designed to provide some protection from the danger of tipping over, additional guy lines may be attached to the top handle to provide more safety.

Unwind the two detector cables from the side of the electronics case. Connect the two detector cables to the appropriate detector. A cable guard (not provided) may be used to protect the cable from wear.

If you have +12V voltage available, plug the **12 Vdc** cable into the vehicle's cigarette lighter socket. Note that the cable's cigarette adapter plug has a 1A fuse inside the tip. You can also supply +12V power by using the supplied wall-mount power supply. Alternatively, you can install six "D" cell batteries into the battery compartment inside the electronics case. The power cord and batteries may both be installed at the same time, but the portal monitor does not charge the batteries. It is recommended to disconnect the strobe when operating from D-cell batteries, in order to increase battery life.

Move the protective red guard and turn on the switch marked ON/OFF located on the side of the electronics, and allow about a minute for the instrument to initialize. The internal audio will beep during the 60-second initialization and then be quiet, which indicates successful initialization.

If the preprogrammed settings are acceptable, it is ready for use. The red/green strobe, if connected, will normally be green, but change to red if a radiation alarm or malfunction occurs. Proceed to the next section. If the settings need to be changed or checked, proceed to Parameter Setup, Section 6.

Disassembly is reverse of assembly. Note that it is recommended to remove batteries before storage of the instrument.

## Operational Check

To ensure the instrument is functioning correctly, an operational check should be performed routinely or before using the instrument. This check verifies that the instrument is turned on, that the settings are appropriate, and that the system alarms when the detectors are exposed to excess radiation (above background level). Ludlum Measurements suggests that this operational check be performed after setup and before use. As long as the system passes the operational check, no calibration or other checks are necessary. If the response or any function of the portal monitor changes, the instrument should be checked and brought into compliance with the manufacturer's original specifications.

Check each of the detectors for sensitivity to gamma radiation. First, verify that the system has completed initialization and that the green ENTER status LED is lit. Verify that you get a RADIATION ALARM, using a check source, if available ( $^{137}\text{Cs}$ , 1  $\mu\text{Ci}$ ). This source should cause an alarm when brought within 1.2 m (48 in.) of a detector, and the infrared presence sensor is blocked.

In walk-through (or drive-through) mode, simply move through the portal, holding the source in proximity to one side or the other. This action should cause the portal to enter the RADIATION ALARM status until the alarm time parameter is complete. In stop-and-count mode, the subject should stop in the portal for the duration of the count time. At the end of the count time, the portal should enter the RADIATION ALARM status until the alarm time parameter is complete.

Repeat alarm checks for both sides to confirm that all detectors are functioning.

To also provide assurance that the instrument meets the FEMA emergency response criteria prior to operation of this portal, do the following: Pass a 1  $\mu\text{Ci}$   $^{137}\text{Cs}$  check source through the center of the portal at several points between 15.2 and 152 cm (0.5 and 5 ft) from the floor of the portal and verify that the alarm is triggered each time. If the portal does not alarm each time, the user may need to adjust the count time, the alarm points, or move the portal to a location with lower background radiation.

## Personnel or Vehicle Monitoring

Checking for a radiation alarm starts when someone (or something) blocks the infrared beam. A count can only be started when the system is in the **ENTER** mode. Do not enter the portal while the yellow **UPDATING** status LED is flashing.

Prior to monitoring, the monitor must be allowed to initialize and update the background count. This mandatory update occurs just after power-up and takes one minute. New background data is compared to the low and high background set points that have been programmed into the unit. If the set points have been exceeded, an **INSTRUMENT FAILURE** alarm is given, and the unit continues measuring background. The value displayed represents the sum of counts every 0.2 seconds (200 msec), when unoccupied. The instrument will continue to update the background until the alarm condition has been corrected; that is, when the background goes down or failed detectors are repaired.

Please note, however, that high levels of external radiation can cause the **INSTRUMENT FAILURE** alarm.

To monitor personnel or vehicles for radiation, follow the steps below:

- The green **ENTER** light must be illuminated in order to use the instrument. A yellow **UPDATING** light may be flashing, indicating that a background update is taking place. When the **UPDATING** light is flashing, the system should not be used, and all subjects to be checked should remain at least 3.7 m (12 ft) away until the **ENTER** light is illuminated.
- The subject moves into the portal, breaking the infrared beam, and the green **READY** light will start flashing, indicating that the portal is now **CHECKING**. A soft, low-pitched beep will also occur. While occupied, the numbers shown for each channel represent the peak value, in sigma, above background.
- In walk-through mode, the subject may simply continue moving through the portal. The red **RADIATION ALARM** light will illuminate if excess radiation is detected.
- In stop-and-count mode, the yellow **INCOMPLETE** light will illuminate if the subject leaves the portal before the count is complete. A soft, low-pitched beeping will also warn the subject to return to the portal to finish the count. When the count is complete, the green **ENTER** light and a second soft, low-pitched beep will occur OR the red **RADIATION ALARM** light will be illuminated.
- The subject then moves out of the portal.

## Section

## 4

## Description of Controls and Functions

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### Front Panel

**Readout:** Liquid Crystal Display (LCD), 2-line, 20-character alphanumeric display. Background and alarm data is displayed on up to four detectors – two detectors in the Receiver detector case marked RA and RB, and two detectors in the Transmitter detector case marked TA and TB. The value displayed represents the sum of counts every 0.2 seconds (200 msec), when unoccupied. While occupied, the numbers shown for each channel represent the peak value, in sigma, above background.

**Enter Key:** selects or advances display.

**Increment (Up Arrow ↑) Button:** increases or changes a parameter. If this button is pressed while turning the instrument ON, the portal monitor enters setup mode. All instrument parameters may be changed in the setup mode.

**Decrement (Down Arrow ↓) Button:** decreases or changes a parameter. During operation, pressing this key will show the number of alarms and the number of passages since power-up.

If the ENTER key is pressed while turning the instrument ON, the instrument is loaded with a set of default parameters.

The parameters that are set are:

Default Value	
Language	English
Month	1 (January)
Day	2
Year	00
Hour	8
Minute	15
Count Time	0 sec
Alarm Time	15 sec

Incomplete Time	10 sec
Low Bkgnd (background)	20
High Bkgnd (background)	2000
Sigma	4.5
RDA Size	500
LT Attenuation	0.0%
LB Attenuation	0.0%
RT Attenuation	0.0%
RB Attenuation	0.0%
HD Attenuation	0.0%
FT Attenuation	0.0%
Individual Alarms	Y
Sum Alarms	Y
# of Samples	3
Bkgnd Update	8
Audio On	Y

The default condition is for all detectors to be active.

**Status LEDs (side of portal):** (see front-panel drawing in front of manual for LED layout).

**Enter/Checking (green) LED:** normally illuminated prior to any personnel entry, indicating that the system is ready to take a count. It flashes to indicate the system is checking for excess radiation. It stops flashing at the end of the count time in stop-and-count mode or whenever the subject leaves the portal in walk-through mode.

**Incomplete/Updating (yellow) LED:** indicates that a count was in progress and the subject moved out of the portal before the count was complete. The **INCOMPLETE** LED stays on for the incomplete time or until the subject moves back into the portal. An **INCOMPLETE** resets the count time.

If no subject moves back into the portal during the incomplete time, the portal monitor goes back to the ready state, illuminating the **ENTER** LED. This LED also indicates **UPDATING** background while flashing. Do not enter or allow personnel within 1.8 m (6 ft) while the unit is updating background.

**Radiation Alarm (red) LED:** indicates that the system has detected radiation levels above background.

**Instrument Failure (red) LED:** indicates that the system has detected a high- or low-background condition. If there is a background problem, the **UPDATING** LED will also be illuminated.

**Low Battery (red) LED:** indicates the batteries are low and must be replaced immediately.

## Connector Panel

**ON/OFF:** toggle switch to turn unit on and off

**12 VDC:** connection to +12 Vdc power, usually from a vehicle's cigarette lighter jack or wall-mount power supply

**DET 1 RECEIVER:** 8-pin connector for connection to the detector case with the infrared receiver

**DET 2 TRANSMITTER:** 8-pin connector for connection to the detector case with the infrared transmitter

**RELAY:** 6-pin connector to connect +12 V (1 amp) relays, used for strobe

Relay pinouts:

P1	Alarm Normally Closed
P2	+12 V
P3	Alarm Normally Open
P4	Instrument Fail Normally Closed
P5	+12 V
P6	Instrument Fail Normally Open

## Parameters and Functions

This section lists the different parameters of these instruments and their functions. Press the **Increment (Up Arrow) Button** to enter the setup mode. This will allow the user to change the parameters.

**Count Time:** adjustable from 0 to 20 seconds, where 0 sets the portal in the walk-through mode.

**Alarm Time:** adjustable from 1 to 255 seconds. This parameter controls the duration of the RADIATION ALARM.

**Incomplete Time:** adjustable from 1 to 255 seconds. This parameter controls the duration of INCOMPLETE.

**Sigma:** This parameter sets the number of standard deviations above background that it takes to set off an alarm. A standard deviation is assumed to be equal to the square root of the background count. A simple example, a 3-sigma alarm of a detector with a background count rate of 100 counts is calculated as 3.0 times the square root of 100 or 30. In this simple example, a sudden count of 130 counts would case an alarm.



**Attenuation:** This parameter is used in the stop-and-count mode to compensate for the shielding effect of a human body inside the portal. This parameter will vary depending on local background radiation. Typical set points might be 0.5% to 2.0%. To determine this parameter, find the percentage decrease in background with an average-sized person inside the portal. Alternatively, measure the percentage decrease of several different people, and then determine the average decrease. Although the shielding effect is slight, this parameter is very useful for highest sensitivity applications. If not being used, this parameter should be set to 0.0%.

**Low Background (BKGND) Alarm:** This parameter sets the number of counts per 0.2-second interval that the background should not fall below in normal operation. If background falls below this level, an INSTRUMENT FAILURE alarm will occur. This alarm indicates if a detector has failed or is not connected. This alarm will also indicate if the ambient background has decreased significantly.

**High Background (BKGND) Alarm:** This alarm is the opposite of the LOW BACKGROUND alarm. This alarm will indicate that background radiation has increased or that a detector has failed.

**# of Samples:** In walk-through mode, this number determines how many 0.2-second samples to group for each alarm calculation.

**BKG Update:** This number, adjustable from 1 to 9, adjusts how fast the background is updated while the portal is unoccupied. The BKG UPDATE number, multiplied by 18 seconds, gives the response time of the internal background accumulation.

**RDA Size:** This number, in nCi, indicates the size of the source used during the automatic RDA calculation. (The Model 52-8 does not utilize the automatic RDA feature, and the RDA size is set to 500.)

## BLUETOOTH Port (optional)

The optional Bluetooth port allows the instrument to be connected wirelessly to a remote device so that a record can be kept of the activity of the instrument. This port uses a standard 9-pin D RS-232 connector that can also be connected to a printer. This 9-pin D connector is located inside the electronics chassis.

When the instrument is first turned on, the instrument will output the parameter settings. From then on, when an alarm occurs, the instrument

will output the time and date, the background counts, and the number of sigma above background for all channels. See the example below.

An example output from the Model 52-8 Bluetooth port after power-on is shown here:

```
LUDLUM MODEL 52-8 PORTAL
02-JAN-16 14:52
SETUP REPORT
SIGMA= 4.5
COUNT TIME=000
ALARM TIME= 015
INCOMPLETE= 010
RDA SOURCE = 500
LOW BKG= 20
HIGH BKG= 2000
ACTIVE DET: RA TA
IND. ALARM=Y
SUM ALARM= Y
# OF SAMPLES=3
BKG UPDATE=8
```

An example output from the Model 52-8 after a complete count is shown below. Note that the BKG column is expressed in counts per 0.2-second intervals, while the COUNT column is expressed in terms of sigma above background.

```
LUDLUM MODEL 52-8 PORTAL
02-JAN-16 14:53
RADIATION ALARM
SIGMA=4.5 COUNT TIME= 0
CHAN BKG COUNT ALARM
RA 278 6.2 YES
RB 000 0.0 NO
TA 272 5.0 YES
TB 000 0.0 NO
```

## Theory of Background Measurement

These Ludlum instruments are designed to detect very small increases in radiation above the ambient “background” radiation. The ambient background fluctuates due to variations in cosmic radiation, radon gas buildup, etc. Therefore, these instruments must constantly be aware of what the background is in order to decide if any extra radiation is present. So, measuring the “true” background radiation level is of utmost importance to determine the baseline for setting an alarm point.

On power-up, the portal monitor takes a 60-second background count and checks to see if the counts are excessively low or excessively high. If the background counts are normal, then the instrument calculates the alarm points, and is ready to monitor. For every six seconds, if no subject is detected in the portal, the instrument takes the background count from three seconds prior and updates the background count. Using the three-second prior count ensures that a subject moving up to the monitor or leaving the monitor is at least three seconds away. When a subject is detected in the portal, the background updating process is stopped immediately and restarted after the subject leaves the portal.

One very important consideration for the background measurement process is accounting for the shielding effect of the subject. A human body or vehicle inside or next to the portal actually lowers the background by several percent. This drop in background can seriously affect the alarm point, which can either increase the false alarm rate or decrease the sensitivity.

For example, suppose the alarm point is equivalent to 4% above background. A large person entering the portal might drop the background count by 5%. Therefore, if that person had radiation contamination on his clothes, the contamination would have to be at least 9% above background to trigger the alarm. Alternatively, suppose the same person is standing next to the portal when it is updating background at power-up. Next to the portal, that person might reduce background by 2.5%. If that person leaves and a smaller person enters the portal, then the possibility for a false alarm is much higher than normal. These problems can be avoided by ensuring that people stay back at least four meters from the portal while it is updating background and by using the attenuation parameter to compensate for the attenuation of a person inside the portal. During setup, have an average-sized person stand in the portal while the initial background is calculated. Figure the average percentage change in background between unoccupied and occupied background, and use that number for the attenuation parameter. The same process could be applied to vehicles.

During setup, another parameter that can be chosen that affects background is the Update Background parameter. This number, which can be set from 1 to 9, controls how fast or slow the background is updated. Background counts are averaged in order to smooth out background fluctuations. The time required to fully change the background is the Update Background parameter times 18 seconds. Thus, you can set the Update Background parameter to vary the update time from 18 to 162 seconds.

There are two modes for checking subjects (either persons or vehicles) with these instruments. The walk-through mode, chosen by setting the Count Time parameter to 0, allows subjects to simply move through the portal. Checking is performed every 200 milliseconds while the portal is occupied, 600 milliseconds before, and 600 milliseconds after the portal is occupied. The stop-and-count mode, chosen by setting the Count Time parameter to a number of seconds that subjects must stop in the center of the portal, allows greater sensitivity. The stop-and-count mode also has an extended count time that extends the original count twice as long in order to make a determination on questionable counts. For example, an original count time of two seconds may get extended another four seconds if the count during the original two seconds is not clearly less than the alarm point or clearly more than the alarm point. The requirement for extending a count time is that the count is 2.5 standard deviations above the background without being above the alarm point. (The following paragraph gives more information on standard deviations.)

The alarm parameter Sigma is the number of standard deviations above background to set the alarm point. The standard deviation is equal to the square root of the background count for the time period in question. For example, if the 200-millisecond background count is 300, the standard deviation for a 2-second count is the square root of 3000, or 54.8. How high the alarm should be set depends on the desired sensitivity and the false alarm rate. False alarm rates may be found by utilizing a statistical table that details the area under the standard normal curve. An abbreviated table that shows the percentage of counts above a certain number of standard deviations is shown below:

1.0 Sigma = 15.87%	or 15.87 in 100 false alarms
2.0 Sigma = 2.28%	or 2.28 in 100 false alarms
3.0 Sigma = 0.13%	or 13 in 10,000 false alarms
3.1 Sigma = 0.10%	or 1 in 1,000 false alarms
3.7 Sigma = 0.01%	or 1 in 10,000 false alarms
4.0 Sigma = 0.003%	or 3 in 100,000 false alarms
5.0 Sigma = 0.00003%	or 3 in 10,000,000 false alarms
6.0 Sigma = 0.00000001%	or 1 in 1,000,000,000 false alarms

As can be seen from this table, false alarm rates decrease rapidly as the Sigma setting increases above 3.0 Sigma.

Another factor to consider is how many chances there are to alarm with each passage through the portal. In walk-through mode there are five chances to alarm every second, while in stop-and-count mode there is only one chance per passage. There is also the number of detectors and sum alarms to consider. If there are five detectors, and the individual alarms are set, then there are 25 chances to alarm every second in walk-through mode, and five chances to alarm in stop-and-count mode for each passage. Setting both individual alarms and sum alarms means there are 10 chances to alarm in stop-and-count mode, and 50 chances to alarm per second while in walk-through mode. Note the big difference between “1/1000 false alarm rate” and 1 false alarm per 1000 passages. It is important to account for how many chances for alarm are made per passage.

**Section**  
**5****Safety Considerations**

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**Environmental Conditions for Normal Use**

Indoor or outdoor use

No maximum altitude

Temperature range of -20 to 50 °C (-4 to 122 °F)

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

Maximum transient voltage of 1500 Vac

Installation Category II (Overvoltage Category as defined by IEC 1010-1)

Pollution Degree 3 (as defined by IEC 664) (Conductive pollution or dry non-conductive pollution becomes conductive due to condensation. This is to be found in industrial environments or construction sites.)

**Cleaning Instructions and Precautions**

The Model 52-8 may be cleaned externally with a damp cloth, using only water as the wetting agent. Do not immerse the instrument in any liquid. Observe the following precautions when cleaning:

1. Turn the instrument OFF and disconnect any instrument power cord.
2. Allow the instrument to sit for one minute before cleaning.

**Electrical Safety Precautions****Warning!**

Please follow the instructions below. If you do not, a potentially hazardous situation could develop, which could result in death or serious personal injury.

- Do not expose the unit to rain or an environment where it may be splashed by water or other liquids, as doing so may result in fire or electric shock.
- Use the unit only with the voltage specified on the unit. Using a voltage higher than that which is specified may result in fire or electric shock.
- Do not cut, kink, otherwise damage nor modify the power supply cord. In addition, avoid using the power cord in close proximity to heaters, and never place heavy objects – including the unit itself – on the power cord, as doing so may result in fire or electric shock.
- Avoid installing or mounting the unit or its power supply in unstable locations, such as a rickety table or a slanted surface. Doing so may result in the unit falling down and causing personal injury and/or property damage.

**Caution:**

Verify instrument voltage input rating before connecting to a power converter. If the wrong power converter is used, the instrument and/or power converter could be damaged.

## Warning Markings and Symbols

**Caution!**

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 52-8 Outdoor Portable Portal Monitor is marked with the following symbols:**

**ALTERNATING CURRENT (AC)** (IEC 417, No. 5032) - designates an input receptacle that accommodates a power cord intended for connection to AC voltages. This appears on AC panel, bottom side.



**PROTECTIVE CONDUCTOR TERMINAL** (per IEC 417, No. 5019) – input receptacle that accommodates a power cord intended for connection to AC voltages. This appears on AC panel, bottom side.



**CAUTION** (per ISO 3864, No. B.3.1) – designates hazardous live voltage and risk of electric shock. During normal use, the stabilizer legs must be installed to avoid a tip-over of the unit. Without the stabilizer legs, a substantial impact to the front or back of the unit could cause the unit to tip and fall. This symbol appears on the side panels near the stabilizer leg attachment points. **Note the following precautions:**

**Warning!**

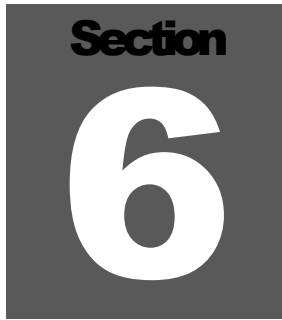
The operator is strongly cautioned to take the following precautions to avoid contact with internal hazardous live parts that are accessible using a tool:

1. Turn the instrument power OFF and disconnect the power cord.
2. Allow the instrument to sit for one minute before accessing internal components.



The “CE” mark is used to identify this instrument as being acceptable for use within the European Union.



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## Maintenance and Recalibration

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### Maintenance

Instrument maintenance consists of keeping the instrument clean and periodically checking the calibration. The Model 52-8 may be cleaned externally with a damp cloth, using only water as the wetting agent. Do not immerse the instrument in any liquid. Observe the following precautions when cleaning:

1. Turn instrument OFF and disconnect any instrument power cord.
2. Allow the instrument to sit for one minute before cleaning.

### Recalibration

Recalibration is required after any repairs or adjustments have been made to the instrument. Recalibration is not normally required following instrument cleaning, battery replacement, or detector cable replacement.

**Note:**

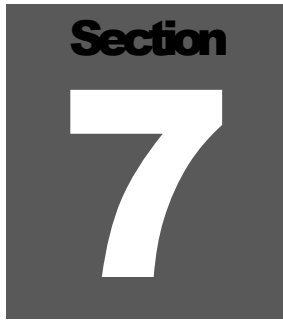
Ludlum Measurements, Inc. recommends recalibration at intervals no greater than one year. Check the appropriate regulations to determine required recalibration intervals.

Ludlum Measurements offers a full-service repair and calibration department. We not only repair and calibrate our own instruments, but most other manufacturers' instruments.

To return an instrument for repair or calibration, provide sufficient packing material to prevent damage during shipment and proper labeling. Every returned instrument must be accompanied by an **Instrument Return Form**, which can be downloaded from the Ludlum website at [www.ludlums.com](http://www.ludlums.com). Find the form by clicking the "Support" tab and

selecting “Repair and Calibration” from the drop-down menu. Then choose the appropriate Repair and Calibration division where you will find a link to the form.

Calibration procedures are available upon request for customers who choose to calibrate their own instruments.

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## Checkout Procedures

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### General

The Model 52-8 detector boards (which are the same as Model 52-1 detector boards) are set for -4 mV sensitivity (pulse height) for their plastic scintillation detectors. These boards have manual adjustment potentiometers to adjust the high voltage required for the detector that they are connected to. Due to variations in photomultiplier (PMT) gain, high voltage adjustment may be needed whenever a board is first connected to a detector.

### Equipment Required

1. Ludlum Model 500 Pulser or equal.
2. High-impedance voltmeter for high-voltage measurements (1000 megohm or better)
3. 8 to 15 Vdc power supply if this test is done at the bench
4. Digital counter or oscilloscope for negative-going 5 Vdc pulses
5. Low-energy isotope, typically <sup>241</sup>Am of a few microcuries in size

### Checkout Procedure

Checkout of the portal monitor is accomplished by determination of the pulse threshold and high voltage of each detector interface board located on each detector of the portal frame. No adjustments are possible to the threshold voltage level, which is fixed by component values. The design threshold level is -4 mV and operating high voltage is approximately 700-1200 Vdc.

Proper high-voltage setting is determined by completing a high-voltage plateau with the isotope(s) of interest. A typical plateau involves recording background and source counts with the HV at 50-volt

increments between 700 and 1200 volts. The best point of operation may be selected by calculating a figure of merit (FOM) for each high-voltage point. The FOM can be defined as either the net source counts divided by the square root of the background, or as the net source counts squared divided by the background.

- Connect the cable from the Model 500 Pulser to one of the detector interface boards. Apply power to the board by supplying +12 Vdc and ground on the 2-pin connector on the detector interface board.
- Attach the counter or oscilloscope to pin 1 of the Max 985 comparator (U2). Adjust pulser amplitude to approximately -4 mV  $\pm$  1 mV, until pulses just appear.
- Adjust R18 until the Model 500 Pulser reads within 5% of the correct high voltage. The correct high voltage should be determined by running a voltage plateau with the detector and one or more radioactive isotopes.

**Section**  
**8**

**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.

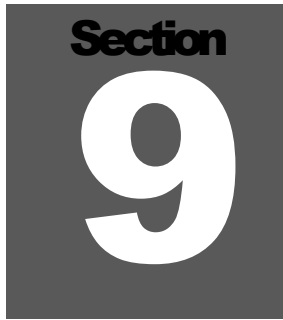
The following types of recyclable materials are present in Ludlum Measurements, Inc. electronics products, and should be recycled separately. The list is not all-inclusive, nor does it suggest that all materials are present in each piece of equipment:

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

Ludlum Measurements, Inc. products which have been placed on the market after August 13, 2005 have been labeled with a symbol recognized internationally as the “crossed-out wheelie bin” which notifies the consumer that the product is not to be mixed with unsorted municipal waste when discarding; each material must be separated. The symbol will be placed near the AC receptacle, except for portable equipment where it will be placed on the battery lid.

The symbol appears as such:





**Models 52-8  
Portable  
Scintillation Portal  
Monitor**

## Parts List

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Reference	Description	Part Number
UNIT	Completely Assembled Model 52-8 Portal Monitor	48-4207
BOARD	Completely Assembled Main Circuit Board	5215-340
BOARD	Completely Assembled Power Supply	5215-1133
BOARD	Completely Assembled Status Board	5215-264
BOARD	Completely Assembled Detector Interface Board	5215-347
DETECTOR	Model 44-217 (w/o lead)	47-4214
CABLE	Model 52-8 Detector Cable	8215-901
CABLE	Model 52-8 Strobe Cable	8215-902

**Section**  
**10**

## **Drawings and Diagrams**

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### **Front of Manual**

#### **Assembly and Setup**

Model 52-8 Detector Setup, Drawing 215 x 1002 & 1002A

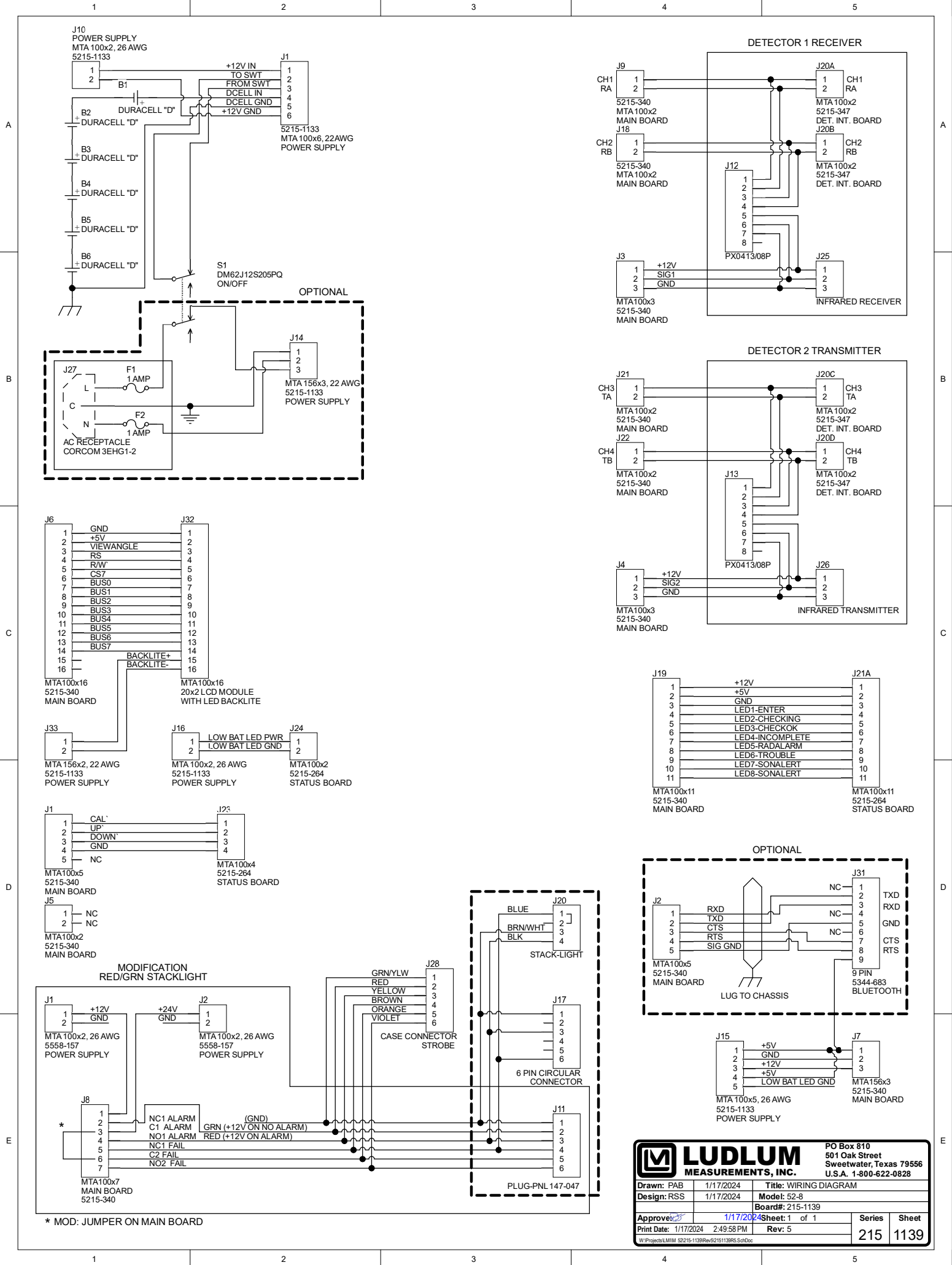
Model 52-8 Dimensions, Drawing 215 x 1002B

Model 52-8 Electrical Connections, Drawing 215 x 1002C

Model 52-8 Front Panel, Drawing 215 x 1002D & 1002E

### **Back of Manual**

Wiring Diagram, Drawing 215 x 1139



**LUDLUM MEASUREMENTS, INC.**  
PO Box 810  
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Drawn: PAB	1/17/2024	Title: WIRING DIAGRAM
Design: RSS	1/17/2024	Model: 52-8
Approved: [Signature]	1/17/2024	Board#: 215-1139
Print Date: 1/17/2024 2:49:58 PM	Rev: 5	Sheet: 1 of 1
W:\Projects\1139\Rev\52151139RS.SchDoc		Series: 215
		Sheet: 1139