

**LUDLUM MODEL 43-65 Series  
SCINTILLATORS**

**June 2024**

# **LUDLUM MODEL 43-65 Series SCINTILLATORS**

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**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.

## **RETURN OF GOODS TO MANUFACTURER**

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**

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## 1. GENERAL

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The Model 43-65 Series of scintillators each has a detector (probe) designed for either alpha or beta radiation survey, or both, when used with general purpose survey meters, ratemeters, and scaler instruments.

The Model 43-65, which measures just alpha, utilizes a zinc sulfide scintillation crystal doped with silver [ZnS(Ag)] and a 3.8 cm (1.5 in.) diameter magnetically shielded photomultiplier tube (PMT).

The Model 43-65-1 scintillator consists of 0.03 cm (0.01 in.) thick plastic scintillation material to detect beta.

The Model 43-65-2 detects both alpha and beta and has both the zinc sulfide crystal doped in silver with a magnetically shielded PMT and the ZnS(Ag) adhered to plastic scintillation material.

The window is protected by a 79% open, 20-gauge stainless steel 0.64 cm (0.25 in.) hex screen.

A plastic protective cover is provided for protection of the detector face against puncture of the metalized polyester when the detector is not in use. Pinholes in the window will cause light leaks and malfunction of the detector.

## 2. SPECIFICATIONS

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**WINDOW:** two layers of 0.4 mg/cm<sup>2</sup> aluminized metalized polyester (10 gauge). When intended for outdoor use, an extra layer of metalized polyester is recommended (total of 1.2 mg/cm<sup>2</sup> thickness).

**WINDOW AREA:** 50 cm<sup>2</sup> (7.8 in<sup>2</sup>) open; 63 cm<sup>2</sup> (9.8 in<sup>2</sup>) active

**EFFICIENCY (4 $\pi$ ):** (typical values)

**Model 43-65:** 17% for <sup>239</sup>Pu; 17% for <sup>230</sup>Th

**Model 43-65-1:** 15% for <sup>99</sup>Tc; 20% for <sup>90</sup>Sr <sup>90</sup>Y, and 1% for <sup>14</sup>C

**Model 43-65-2:**

**Alpha:** 17% for <sup>239</sup>Pu; 17% for <sup>230</sup>Th

**Beta:** 15% for <sup>99</sup>Tc, 20% for <sup>90</sup>Sr <sup>90</sup>Y, and 1% for <sup>14</sup>C

**BACKGROUND:**

**Alpha:** 3 or less counts per minute

**Beta:** 200 cpm or less

**CROSS TALK (for Model 43-65-2):**

**Alpha to Beta:** less than 10%

**Beta to Alpha:** less than 1%

**DETECTOR UNIFORMITY:**

within 10% of average reading

**DETECTOR:** alpha ZnS(Ag) scintillator for the Model 43-65. Plastic scintillation material of 0.03 cm (0.01 in.) thickness is for the Model 43-65-1 for beta detection. The 43-65-2 has the ZnS(Ag) adhered to the plastic scintillation material.

**PHOTOMULTIPLIER TUBE:** 3.8 cm (1.5 in.) diameter

**DYNODE STRING RESISTANCE:**

100 megohm

**OPERATING VOLTAGE:** 500-1200 volts

**CONNECTOR:** Series "C" (others available)

**CONSTRUCTION:** powder-coated, computer beige aluminum housing

**SIZE:** 10.2 x 10.2 x 24.9 cm (4 x 4 x 9.8 in.) (H x W x L)

**WEIGHT:** 0.5 kg (1.2 lb)

### 3. MAINTENANCE

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Normally, causes of malfunction of the Model 43-65 series of detectors are due to either light leaks or a defective photomultiplier tube. The malfunction caused by holes in the thin metalized polyester (light leaks) gives an increase in background noise, or complete saturation where the instrument may indicate zero counts. If a light leak is suspected, cover the probe face with an opaque material. By moving the opaque material to different areas of the face, a light leak should be detectable.

#### 3.1 Operation

A plateau should be run with the probe in order to determine the operating voltage of the PMT. If possible, the plateau should be run with the instrument that will be used with the probe during normal operation.

#### Toe and Heel Uniformity Check

Uniformity of the detector should be within 10% of the average reading. This is confirmed by measuring an alpha source at three locations (middle, bottom left, and top right) finding the average, and then calculating the percentage difference from each measurement to the average.

Pu-239 is typically used to verify efficiency and uniformity. Efficiency is typically 17% ( $4\pi$ ) or higher. A background (no source) measurement is done to confirm a reading of 3 cpm or less.

If the probe is required to operate at a pre-determined high voltage, the gain potentiometer located underneath the set screw can be adjusted. This will change the pulse amplitude from the PMT and will allow it to operate at higher voltages.

During the use of the probe, daily source checks should be made to determine that the probe is operating correctly. If the instrument

used with the probe does not have an overload circuit, it is possible to induce a large light leak that would saturate the PMT and cause a zero count reading. This could be mistaken for normal background. To prevent this from happening, source checks should be performed on a routine basis, and also whenever a light leak is suspected.

#### 3.2 Repair of Probe Face

To repair the face of the probe, perform the following steps: (Refer to Drawing 366 x 23 for assembly view.)

1. Remove protective window frame.
2. Remove protective screen.
3. Remove window with metalized polyester assembly from scintillation retainer face.
4. Remove aluminized metalized polyester from window frame and clean off old glue from the frame.
5. Inspect silicone gasket and replace if damaged.
6. Inspect scintillation retainer face for a complete coating of ZnS. Re-coat if necessary.
7. Re-glue two layers of  $0.4 \text{ mg/cm}^2$  metalized polyester to the window frame. See CAUTION.

#### **\*\*CAUTION\*\***

**The thin metalized polyester is very susceptible to puncture. Extreme care should be exercised while gluing the aluminum metalized polyester to the window frame and when re-installing the window with metalized polyester assembly to the face of the probe.**

8. Check to make sure the gasket is in place.
9. Re-install window with metalized polyester to the face of the probe.

### 3.3 Replacement of PMT

Malfunctions caused by the tube, such as a zero count or an intermittent or a much reduced count, may occur. After thoroughly checking for a light leak, replacement of the tube may be necessary. After removing the tube from the probe body, check the front of the tube face. A tube that has become defective may show clear through the face, instead of the dark amber color it should have.

To replace the PMT, perform the following steps: (Refer to Drawing 366 x 23 for assembly view.)

**NOTE:** If the replacement is for an original “based” tube (Part No. 01-5001), refer to instructions included in the installation kit.

**NOTE:** When needed, use thermal strippers to strip the white Teflon high voltage/signal wire to prevent damaging the wire.

1. Unfasten connector end cap (removing four screws).
2. Slowly remove connector end cap and pull out as far as wires will allow.
3. Remove (de-solder) ground and high-voltage wires from connector end cap.
4. Remove sponges.
5. Remove photomultiplier tube assembly (including circuit board).
6. Light pipe may have to be removed from the other end in order to clean the old light coupling compound off.
7. Unplug ground and high-voltage wires

from tube circuit board.

8. Remove metallic shield.
9. Slide the metallic shield over the new tube and tape to the tube.
10. Plug in ground and high-voltage wires to appropriate connectors.
11. Apply optical compound to the face of the PMT.
12. Place tube assembly into handle.
13. Install sponges.
14. Re-connect (solder) the high-voltage and ground wires to connector end cap.
15. Install connector end cap to complete final assembly.
16. After replacement of PMT, the Model 43-65 series probe should be dark-adapted, then plateaued to determine the operating voltage. Dark-adapt the probe for at least 12 hours before running the plateau. If time permits, allow up to 24 hours before plateau is run.

#### 4. REPLACEMENT PARTS LIST

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##### Basic Parts for 43-65 Series Scintillators

Ref. No.	Description	Part No.
UNIT	Completely Assembled Model 43-65 Probe	47-1441
UNIT	Completely Assembled Model 43-65-1 Probe	47-2061
UNIT	Completely Assembled Model 43-65-2 Probe	47-2397
1 EA.	1.5 inch Photomultiplier Tube Assembly	4002-510
1 EA.	Tube Shield	40-4006
1 EA.	Model 43-65 Cap W/Gain Adjust	7366-021
1 EA.	Adjustable Gain Cap Board	5209-019
1 EA.	Model 43-65 Metallized Polyester Window	4366-020
1 EA.	Model 43-65 Window Frame	7366-013
1 EA.	Model 43-65 Window Screen	7366-015
1 EA.	Model 43-65 Bottom Plexiglass	7366-025
1 EA.	Model 43-65 Rectangular Plexiglass	7366-011
1.125 FT.	Gasket (Silicone Cord 0.139)	22-9631
1 EA.	O-Ring-2-126	16-8281
4 EA.	Sponge	7002-029-05
1 EA.	RECPT-UG706/U "C" Connector	4478-011

##### For the Model 43-65-1 & 43-65-2 Only:

1 EA.	Model 43-65-1 Light Pipe	7366-056
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##### 1.5 inch Voltage Divider, Drawing 2 x 317

BOARD	Completely Assembled 1.5 inch Voltage Divider	5002-502
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##### CAPACITORS

C001	0.01 $\mu$ F, 2kV	04-5525
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##### RESISTORS

R001	10 MEG, 1/4 W, 1 %	12-7996
R002	1 MEG, 1/8 W, 1 %	12-7844
R003-R006	10 MEG, 1/4 W, 1 %	12-7996
R011	10 MEG, 1/4 W, 1 %	12-7996

<b>Ref. No.</b>	<b>Description</b>	<b>Part No.</b>
R101-R104	10 MEG, ¼ W, 1 %	12-7996
R111	10 MEG, ¼ W, 1` %	12-7996

**Adjustable Gain Cap Board, Drawing 209 x 18**

BOARD	Completely Assembled Adjustable Gain Cap Board	5209-019
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**CAPACITORS**

C1	0.0047µF, 3kV	04-5547
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**RESISTORS**

R1	100k Trimmer	09-6813
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## **5. DRAWINGS AND DIAGRAMS**

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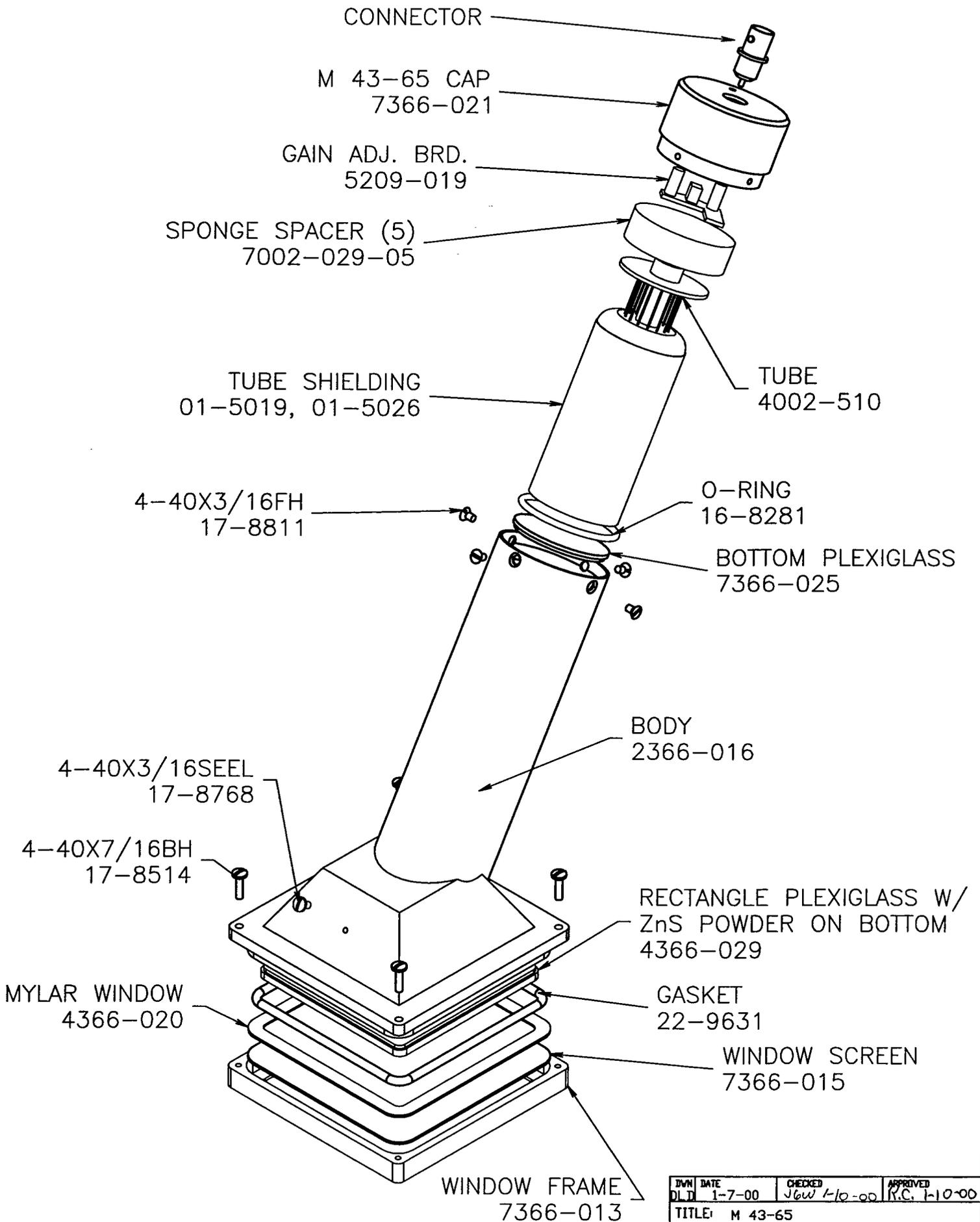
Model 43-65 Assembly View, Drawing 366 x 23

1.5 inch Voltage Divider Board, Drawing 2 x 317

1.5 inch Voltage Divider Board Component Layout, Drawing 2 x 318 (2 sheets)

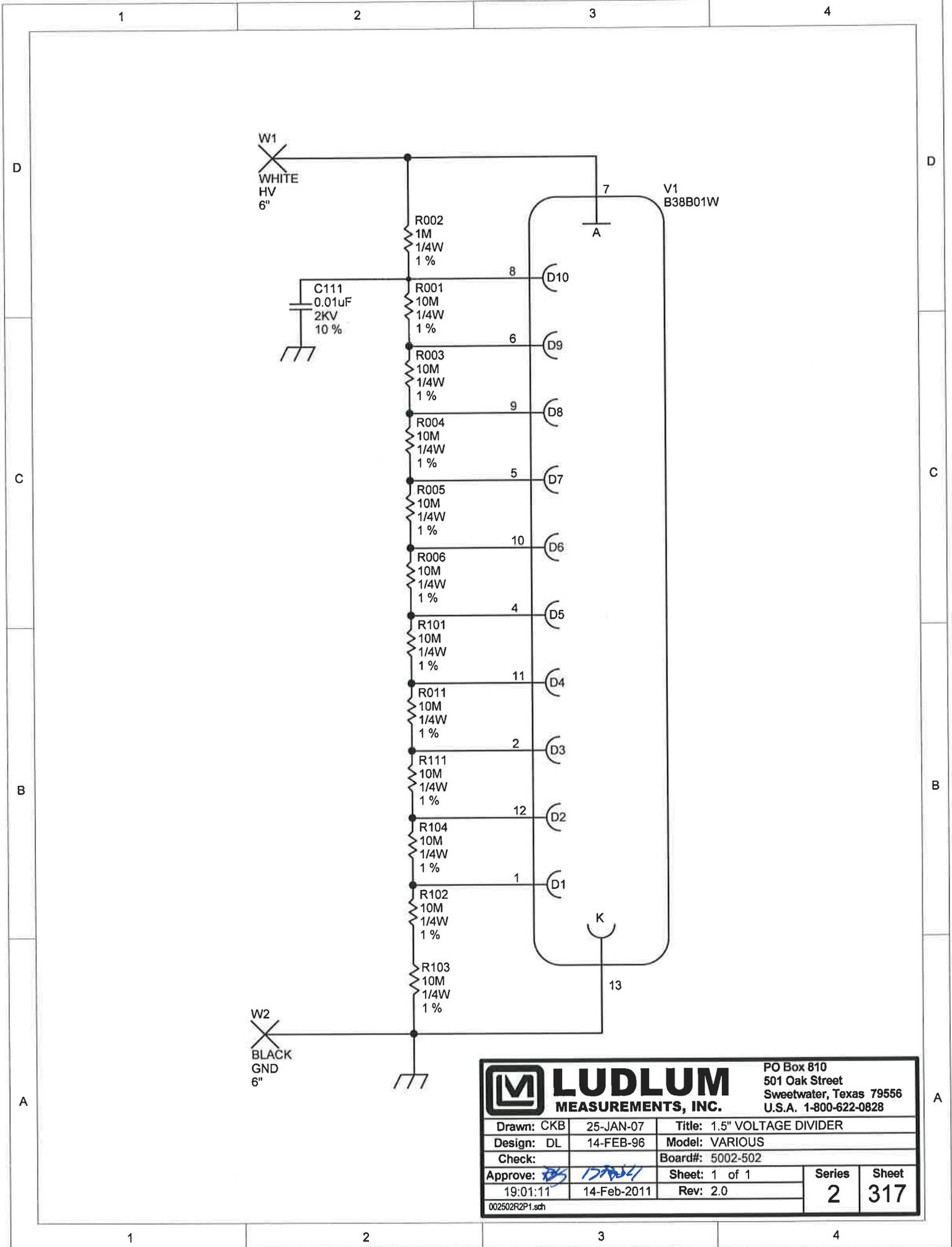
Adjustable Gain Cap Board, Drawing 209 x 18

REV #	ALTERATIONS	DATE	BY
1	VALID	1-7-00	DLT



4366-061.DWG

DWN	DATE	CHECKED	APPROVED
DLT	1-7-00	Jaw 1-10-00	R.C. 1-10-00
TITLE: M 43-65			
LUDLUM MEASUREMENTS, INC. 501 DAK STREET SWEETWATER, TEXAS 75556		SERIES 366	SHEET 23



		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
		Drawn: CKB Design: DL Check:	25-JAN-07 14-FEB-96 19:01:11
Approve: <i>[Signature]</i> 19:01:11		14-Feb-2011	Sheet <b>317</b>
002502R2P1.sch			

A

B

C

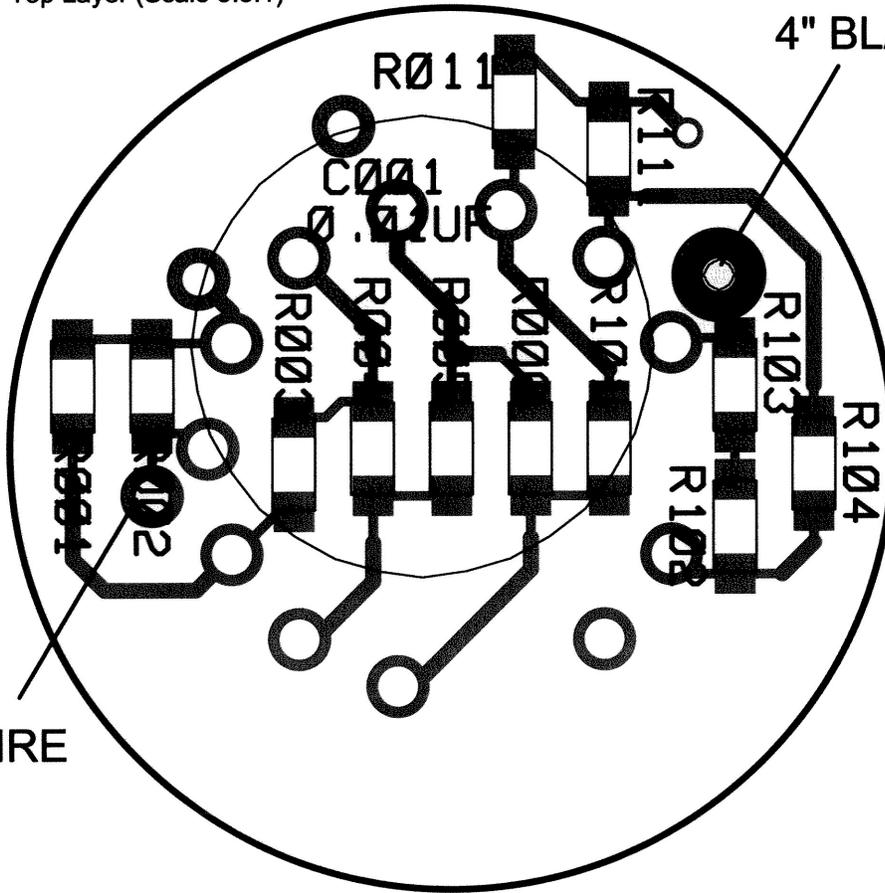
D

1

1

Top Layer (Scale 3.5:1)

4" BLACK WIRE



4" WHITE WIRE

4

4

5

5

6

6

<b>M LUDLUM MEASUREMENTS</b>				
Part: 5002-502		Model: N/A		
Desc: 1.5" VOLTAGE DIVIDER				
Design: DL	Date: 02/14/1996	Rev:	2	
Drawn: PAB	Date: 3/7/2023	SHEET	SERIES	SHEET
Apr: <i>RDS</i>	Date: <i>11 Apr 23</i>	1 of 3	002	318
\\freedom\pcb\Projects\LMI\VoltageDividers\5002-502\Rev				

A

B

C

D

A

B

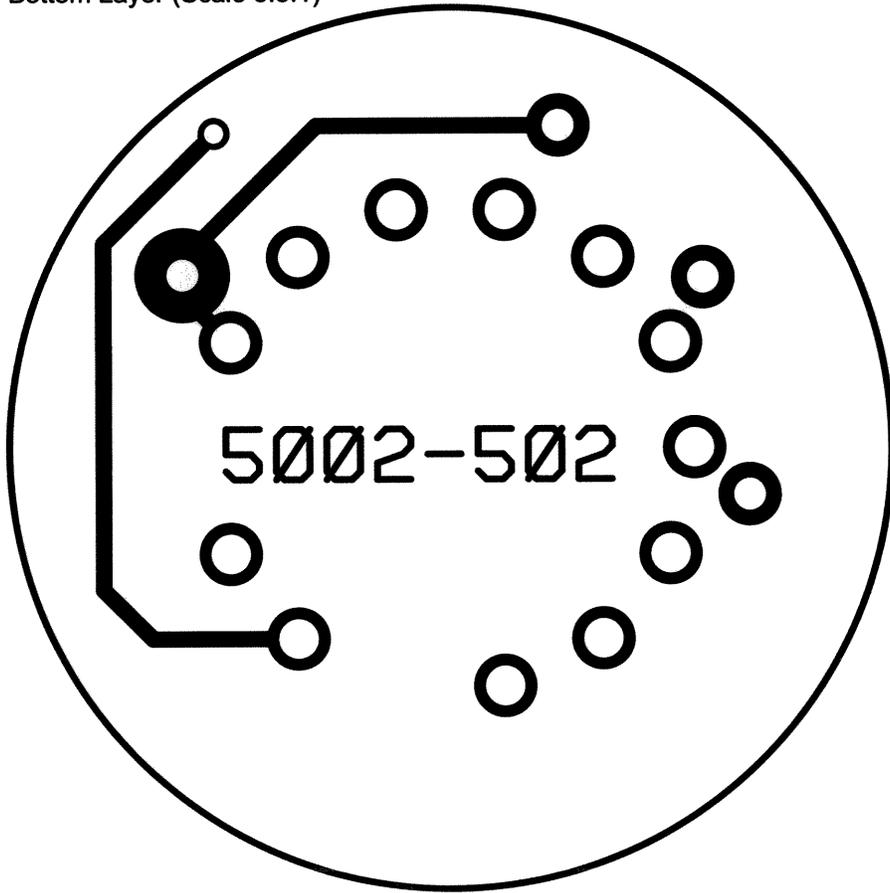
C

D

1

1

Bottom Layer (Scale 3.5:1)



2

2

3

3

5002-502

4

4

5

5

6

6

					<b>LUDLUM MEASUREMENTS</b>				
Part: 5002-502			Model: N/A						
Desc: 1.5" VOLTAGE DIVIDER									
Design: DL		Date: 02/14/1996			Rev:		2		
Drawn: PAB		Date: 3/7/2023		SHEET	SERIES		SHEET		
Apr:		Date:		2 of 3		002		318	
\\freedom\pcb\Projects\LM\VoltageDividers\5002-502\Rev									

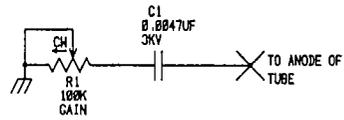
A

B

C

D

REVISIONS			
EFF	AUTHORITY	ZONE   LTR	DESCRIPTION
			DATE   APPROVED



UPDATED	-	LUDLUM MEASUREMENTS INC.			
DR	CKB	07-FEB-07	TITLE: MOUNTING-ADJUST GAIN/CAP BOARD		
CHK	D.W.	2-10-99	BOARD# 5209-019		
DSGN	-	-	SIZE	MODEL	SHEET
APPR	PSS	2-10-99	C	VARIOUS	18
NEXT HIGHER ASSY.	-	-	SERIES	209	OF
08733:22		10-Feb-97	S8209019	SHEET	OF