

LUDLUM MODELS
43-78 ALPHA SAMPLE COUNTER
43-78-1 BETA SAMPLE COUNTER
43-78-3 ALPHA - BETA SAMPLE COUNTER

February 2016
Serial No. PR131358 and PR168302
and Succeeding Serial Numbers

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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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Model 43-78/43-78-1/43-78-3 Alpha Beta Sample Counters

1. GENERAL

The Model 43-78 is an Alpha Sample Counter, the Model 43-78-1 is a Beta Sample Counter, and the Model 43-78-3 is an Alpha-Beta Sample Counter for counting filters. The Sample Counter can be used with any of the Ludlum scaler instruments or other equivalent counting instruments. If simultaneous alpha-beta discrimination is desired (Model 43-78-3 ONLY), the counting instrument must have separate power supplies or threshold controls for each channel. The Ludlum Model 3030, Model 2929 Scaler, Model 2223, or Model 2224 instruments provide the necessary circuitry for simultaneous alpha-beta discrimination.

The detector area is 12.7 cm (5 in.) in diameter. ZnS(Ag) is used for alpha radiation detection and plastic scintillation material is used for detection of beta radiation.

The scintillator materials are adhered to a light pipe, and they are:

- Model 43-78 - zinc sulfide (ZnS)
- Model 43-78-1 – 0.25 cm (0.010 in.) thick plastic scintillator
- Model 43-78-3 -“phoswich” with 0.25 cm (0.010 in.) thick plastic scintillator coated with zinc sulfide (ZnS)

2. OPERATION

- Connect the Model 43-78, -1, -3 to the scaler. The coax cable with "C" connectors carries both the signal and HV.
- HV is applied to the photomultiplier tube (PMT) when the sample slide is pushed completely in, and the Open/Close knob is rotated to the CLOSED position.
- Select appropriate count time and record background counts. ≤ 3 counts per minute for alpha and ≤ 500 cpm for beta can be expected as normal background activity at the proper operating voltage.
- For counting source material, place the source material in the sample depression. Do not allow the source material to extend above the top of the sample slide. Place sample slide in locked position for a short time before taking count to allow room light to decay out of the scintillation material.
- A background count should be taken after each source count to check for contamination on the sample holder or area within the O-ring.

Model 43-78/43-78-1/43-78-3 Alpha Beta Sample Counters

3. SPECIFICATIONS

Photomultiplier Tube: 12.7 cm (5 in.) diameter, 14 pin tube base, 10 pin dynode structure

Scintillator Material: ZnS(Ag) for Model 43-78; EJ212 for Model 43-78-1; Model 43-78-3 has both

Sample Size: 12.7 cm (5 in.) diameter x 0.46 cm (0.18 in.) deep (maximum)

HV Switch: turning knob to OPEN position

Efficiency:

Alpha: 37% for ^{230}Th ; 37% for ^{239}Pu

Beta: 40% for $^{90}\text{Sr}/^{90}\text{T}$; 12% for ^{14}C ; 35% for ^{99}Tc

Typical Background: ≤ 500 cpm beta-gamma, ≤ 3 cpm alpha (in ambient background of $10\mu\text{R/hr}$)

Channel Cross Talk (Model 43-78-3): alpha in beta channel $\leq 10\%$; beta in alpha channel $\leq 1\%$

Size: 19.1 x 31.8 cm (7.5 x 12.6 in.) (Dia x L)

Weight: 6.8 kg (15 lb)

4. CALIBRATION PROCEDURE FOR Model 43-78 and Model 43-78-1

4.1 Counting Instrument

- Calibrated Scaler Instrument
- HV Range - Nominally 900-1200 volts
- Input Sensitivity – 2-500 mV; nominally 10 mV

Note: Model 43-78 or 43-78-1 should be dark adapted; slide closed and locked a minimum of 2 hours after assembly before taking data.

4.2 Procedure

Background Check

- Connect the Model 43-78/Model 43-78-1 to counting instrument with proper cable.
- Push sample drawer in and lock.

- Record background count starting at 500 volts with 50-volt increments. Increase voltage until background count exceeds 3 cpm or greater for the Model 43-78 and, 500 cpm for the Model 43-78-1. Do not exceed 1500 volts.

Source Plateau

- Place check source in sample drawer. Close and lock. Raise source from bottom of sample drawer if thickness of source permits for better counting geometry.
- Record sample count starting at 500 volts with 50-volt increments. Increase voltage to maximum background voltage, determined in above step.
- Set HV just above knee of plateau. Background count should be less than 7 counts per 10 minutes for the Model 43-

Model 43-78/43-78-1/43-78-3 Alpha Beta Sample Counters

78 and ≤ 500 cpm for the Model 43-78-1 at that operating point.

Determining Efficiency

NIST traceable check source required.

Source may be in cpm, dpm or microcuries.

CPM Source: Position source for best geometry in sample drawer.

- Set HV as determined in Source Plateau section, third step.
- Record source count.

DPM Source: Position source for best geometry in sample drawer.

- Set HV as determined in Source Plateau section, third step.

- Record source count divided by calibrated dpm source, corrected for backscatter, times 100 for 4 pi efficiency. The source manufacturer should provide information as to the amount of backscatter expected.

Microcurie Source: Position source for best geometry in sample drawer.

- Set HV as determined in Source Plateau section, third step.
- To calculate dpm from microcurie source, change microcuries to dpm equivalent and calculate efficiency by recording source count divided by calibrated dpm source, corrected for backscatter, times 100 for 4 pi efficiency. (1 microcurie is equal to 2.22×10^6 dpm.)

5. CALIBRATION PROCEDURE FOR Model 43-78-3

5.1 Counting Instrument

- Calibrated dual-channel scaler instrument
- HV Range - nominally 800-1200 volts
- Input Sensitivity - 4 mV Beta Channel; 175 mV Alpha Channel; 50 mV Beta Window

Note: Model 43-78-3 instrument should be dark adapted; slide closed and locked a minimum of 2 hours after assembly before taking data.

5.2 Procedure

Background Check

- Connect Model 43-78-3 to counting instrument with proper cable.
- Push sample drawer in and lock.
- Record background count starting at 800 volts with 25-volt increments. Increase voltage until background count exceeds 3 cpm for the alpha channel or 500 cpm for the beta channel. Do not exceed 1500 volts.

Source Plateau

- Place check source (alpha or beta) in sample drawer. Close and lock. Raise source from bottom of sample drawer if

Model 43-78/43-78-1/43-78-3 Alpha Beta Sample Counters

thickness of source permits for better counting geometry.

- Record sample count starting at 800 volts with 25-volt increments. Increase voltage to maximum background voltage, determined in above step. Record crosstalk.
- Set HV just above knee of plateau. Background count should be less than 3 counts per minute in the alpha channel and 500 cpm in the beta channel at that operating point. In addition, the channel crosstalk (alpha counts in beta channel and beta counts in alpha channel) should correspond to the following:

Alpha in beta channel: $\leq 10\%$ of gross counts

Beta in alpha channel: $\leq 1\%$ of gross

counts

Determining Efficiency

- Calibrated check source required.
- Source may be in cpm, dpm or microcuries.
- Set the HV as determined in the Source Plateau section.
- Place calibrated source in the sample drawer and close it.
- Record the source count
- Divide the source count by the value of the source.

6. TROUBLE SHOOTING

6.1 Zero or Very Low Counts

- Large light leak
- PMT malfunction
- Broken wire in tube socket
- Inoperative HV switch or broken wire
- Counting instrument malfunction
- Cable malfunction

Model 43-78 & Model 43-78-3

- Alpha source too far from scintillation material
- ZnS brushed off or too thin

6.2 No Source Plateau

- Light leak, slide not sealed properly against true base
- Noisy PMT
- Noisy HV switch

- Poor PMT-to-scintillation, light pipe interface

6.3 Excessive Background Count

- Light leak
- PMT malfunction
- Cable malfunction
- Noisy HV switch
- Incorrect operating voltage setting
- Instrument contaminated

Model 43-78/43-78-1/43-78-3 Alpha Beta Sample Counters

PARTS LIST

Ref. No.	Description	Part No.
Model 43-78 Alpha, Model 43-78-1 Beta, and Model 43-78-3 Alpha-Beta Sample Counters		
Completely Assembled Model 43-78 Alpha Sample Counter		
		47-2180
Completely Assembled Model 43-78-1 Beta Sample Counter		
		47-2307
Completely Assembled Model 43-78-3 Alpha-Beta Sample Counter		
		47-2762
1 ea.	Tube Socket Board	5002-934
6 ea.	Sponge (w/hole)	7142-096
3 ea.	Sponge	7142-097
1 ea.	Plexiglass Spacer	7142-084
1 ea.	Lift Shaft	7142-087
1 ea.	Sample Holder	7142-188
1 ea.	Sample Holder Tray	7142-120
2 ea.	Tray Stop	7142-090
1 ea.	Tube Ring	7142-083
1 ea.	Nylon Slide Tray	7142-080
1 ea.	Spring Plate	7142-089
1 ea.	Shaft Rider	7142-088
1 ea.	Micro Switch Bracket	7142-081
1 ea.	Name Plate (M43-78)	9142-091
	Name Plate (M43-78-1)	9142-094
1 ea	5 inch PM Tube (ADIT)	01-5014
1 ea.	BZ-2RD-A2	08-6538
1 ea.	UG568/U	13-7752
4 ea.	Spring-CO-480-045-1005	21-9675
1.5 ft.	0.070 Silicone Cord	22-9863
*	4.990 x 0.010 (43-78-1 & 43-78-03)	01-5269

Ref. No.	Description	Part No.
Switch Filter Board, Drawing 142 x 58		
BOARD	Assembled Switch Filter	5142-103
• CAPACITORS		
C1-C2	0.0056μF,3 KV	04-5522
C3	0.0015μF, 3 KV	04-5518
• RESISTORS		
R1-R2	1 M, 1/4W, 5%	10-7028
Voltage Divider, Drawing 2 x 934		
BOARD	Assembled Voltage Divider	5002-934
• CAPACITORS		
C1	0.01μF, 2kV, x7R SMT	04-5722
• RESISTORS		
R1-R13	4.75 M, 250 mW, 1%	12-7995

DRAWINGS AND DIAGRAMS

Assembly View, Drawing 142 x 94

Assembly View, Drawing 142 x 94A

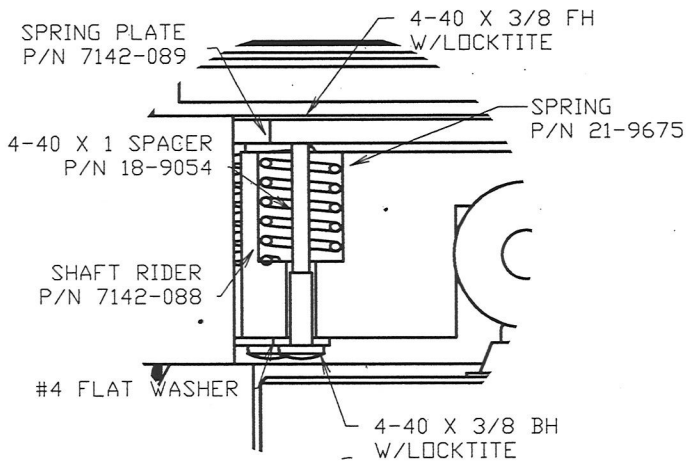
Switch Filter Board, Drawing 142 x 58

Switch Filter Board Component Layout, Drawing 142 x 59

Voltage Divider, Drawing 2 x 934

REV #	ALTERATIONS	DATE	BY
1	VALID	12-14-99	DDW
2	TITLE WAS M 43-78 & M 43-78-1 ASSY	12-14-99	DDW

SPRING PLATE ASSY.

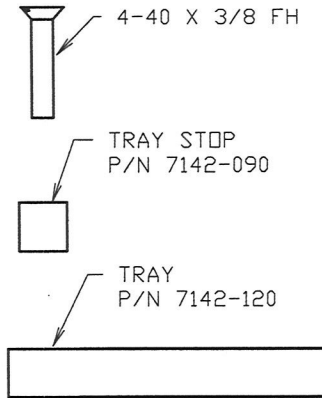


TUBE SOCKET BD.
P/N 5002-934

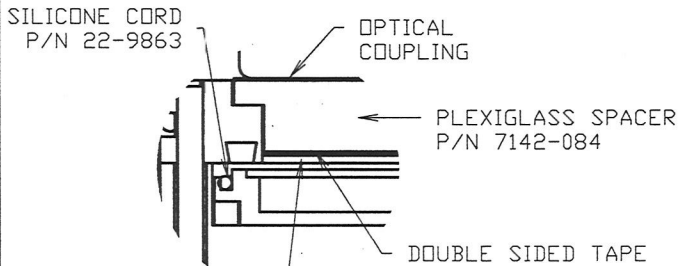
UPPER CAP
P/N 7142-078

SPONGE
P/N 7142-096
P/N 7142-097

TRAY STOP ASSY.



WINDOW ASSY.

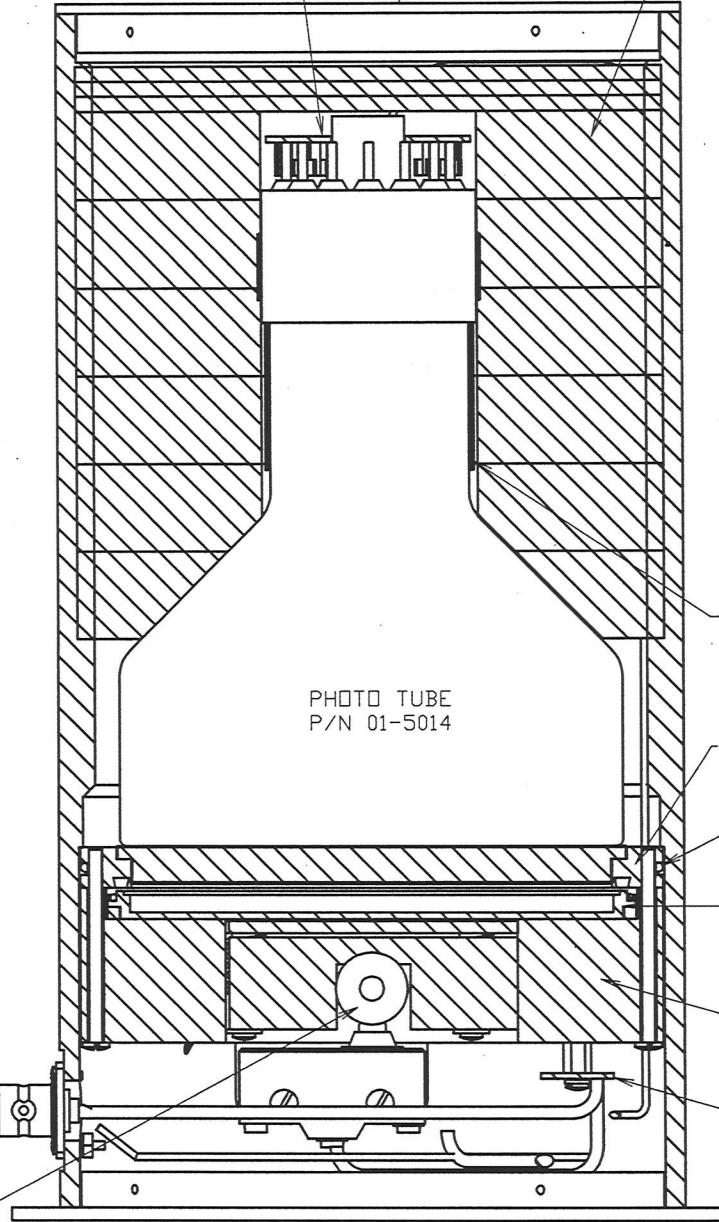


M 43-78 = ZnS
M 43-78-1 = EJ212 PLASTIC SCINT
M 43-78-3 = ZnS & EJ212

"C" FLANGE
P/N 13-7752

LIFT SHAFT
P/N 7142-087

BASE PLATE
P/N 7142-079 OR 7142-095



NETIC FOIL
P/N 01-5019
&
CO-NETIC FOIL
P/N 01-5026

TUBE RING
P/N 7142-083

O-RING
P/N 16-8356

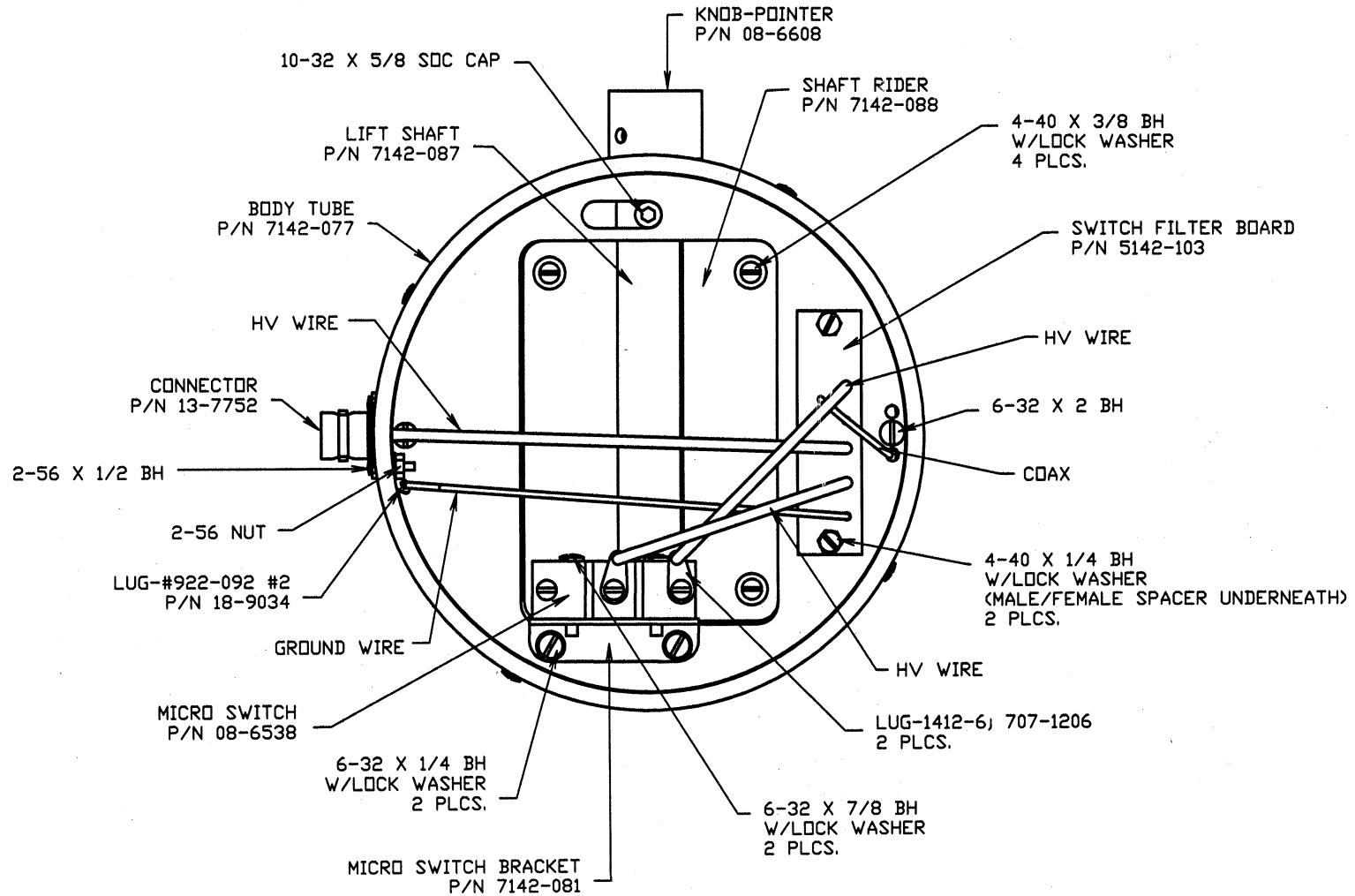
TRAY P/N 7142-120
SAMPLE HOLDER P/N 7142-188

NYLON SLIDE TRAY
P/N 7142-080

BOARD
5142-103

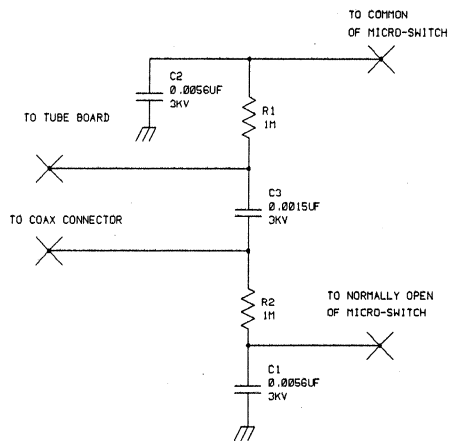
DWN	DATE	CHECKED	APPROVED
WJM	2/15/16		WJM 2-16-16
TITLE: M 43-78, -1, & -3 ASSY.			
LUDLUM MEASUREMENTS, INC. 501 ONE STREET SWEETWATER, TEXAS 75556		SERIES	SHEET
		142	94

REV #	ALTERATIONS	DATE	BY
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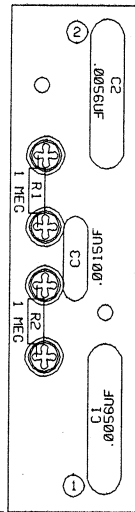


DWN DATE DSW 9/14/01	CHECKED Jew 9-17-01	APPROVED DSW 9-18-01
TITLE: M 43-78		
LUDLUM MEASUREMENTS, INC. 301 ONE STREET SWEETWATER, TEXAS 75556	SERIES 142	SHEET 94A

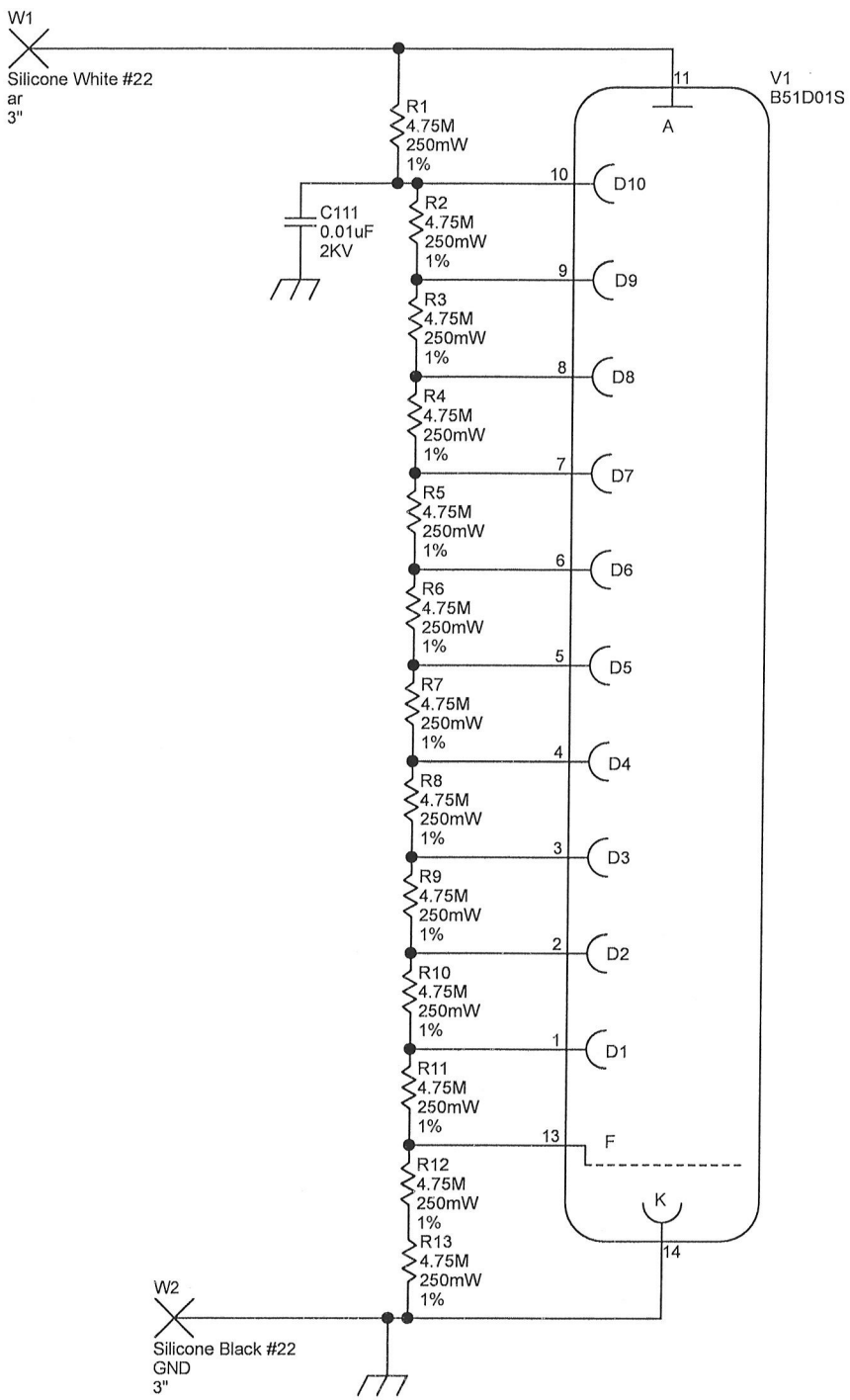
REVISIONS				
EFF	AUTHORITY	ZONE	LTR	APPROVED



UPDATED		LUDLUM MEASUREMENTS INC.		
DR PW	10/20/92	TITLE: SWITCH		
CHK	CKB 07-JAN-93	FILTER BOARD		
DSCR PW	10/20/92	BOARD# 5142-103		
APPD	CS 11-6-61	SIZE	MODEL	SHEET
NEXT HIGHER ASSY.		C	43-10	58
08:36:53	27-Jan-93	SB142103	SHEET 1 OF 1	



<input checked="" type="checkbox"/> LUDLUM MEASUREMENTS INC. SHEETWATER, TX.		TITLE: SWITCH FILTER BOARD	
DR	PW	10/20/92	
CHK	<i>CKB</i>	27-JAN-99	
DSCN	PW	10/20/92	BOARD# 5142-103
APP	<i>RJS</i>	1-22-99	MODEL 43-10
07:28:59	27-Jan-99	COMP SIDE <input type="checkbox"/>	SLDR SIDE <input type="checkbox"/>
COMP PASTE <input type="checkbox"/>	COMP MASK <input type="checkbox"/>	SLDR PASTE <input type="checkbox"/>	SLDR MASK <input type="checkbox"/>
			BS142103
			SHEET 59
			OUTLINE <input checked="" type="checkbox"/>



		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
		Drawn: RC Design: PAB Approved: <i>RIS 12/20/15</i> Print Date: 11/3/2015 10:52:05 AM	Title: 2" VOLTAGE DIVIDER Model: N/A Board#: 5002-934 Rev: 3
<small>W:\Projects\LMV\VoltageDividers\5002-934\Rev3\002934R3P1.SchDoc</small>			