LUDLUM MODEL 43-10-6
ALPHA-BETA SAMPLE COUNTER

SERIAL NUMBER PR151543
AND SUCCEEDING SERIAL NUMBERS

December 2015

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LUDLUM MEASUREMENTS, INC
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Model 43-10-6 Alpha-Beta Sample Counter
December 2015

1. GENERAL

The Model 43-10-6 is an Alpha-Beta Sample Counter capable of holding up to a 7 cm (2.75 in.) diameter filter. Use of the filler plate allows smaller samples to fit snugly in the sample drawer.

The sample drawer, when fully closed, strikes a microswitch to allow high voltage to be applied to the photomultiplier tube (PMT). The sample drawer is locked in the closed position by rotation of the slide lever mounted on the side of the instrument. To discriminate between alpha and beta radiation simultaneously, the counting instrument has to have either separate power supplies or threshold controls for each channel. The Ludlum Model 2929 Scaler, Model 2223, or Model 2224 instruments provide the necessary circuitry for simultaneous alpha-beta discrimination. ZnS (Ag) is used for alpha radiation detection, and plastic scintillation material is used for detection of beta radiation. The scintillation material is covered by 0.4 mg/cm^2 metallized polyester to reduce light response (excessive background).

2. OPERATION

- Connect the Model 43-10-6 to the scaler. The coax cable with "C" connectors carries both the signal and high voltage (HV).

- HV is applied to the photomultiplier tube (PMT) when the sample drawer is pushed completely in, tripping the microswitch. Rotate sample drawer lever to the locked position, securing sample drawer in the ON position.

- Alpha background count is approximately 3 counts per minute (cpm) or less. Beta background count is approximately 80 cpm.

- To count a radioactive sample, place sample on appropriate side of sample holder for the one- or two-inch filters. Do not allow sample to extend above the top of the sample slide.

- A background count should be taken after each source count to check for contamination on sample holder or area within O-ring.

3. SPECIFICATIONS

Scaler Input Sensitivity: 2 to 200 mV

Photomultiplier Tube: 5.1 cm (2 in.) diameter, 14-pin tube base, 10-pin dynode structure

Scintillator Material: ZnS disc; plastic (EJ212) 0.025 cm (0.01 in.) thick

Detector Operating Voltage: 500-1200 Vdc

Window: 0.4 mg/cm^2

HV Switch: opening sample slide disables PMT high voltage

Sample Sizes: 1 1/8 inch diameter x 3/16 inch deep, 2 inch diameter x 3/16 inch deep, 2-1/4 inch diameter x 3/8 inch deep, or 2–3/4 inch diameter X 1/8 inch deep

Efficiency (4 pi): 35% for ^{239}Pu, 5% for ^{14}C

Channel Cross Talk: alpha in beta channel ≤10%; beta in alpha channel ≤1%

Construction: aluminum housing with beige powder cotang.

Size: 23.6 x 11.4 x 23.6 cm (9.3 x 4.5 x 9.3 in.) (H x W x L)

4. CALIBRATION PROCEDURE

Caution: Do not tip sample counter over with sample holder in sample slide. The sample holder will tear the thin metallized polyester window, allowing light to scintillate the ZnS, which causes excessive counts in the beta channel.

For instruments with separate power supplies (fixed threshold), the alpha channel will operate at a lower voltage than the beta channel.

4.1 Counting Instrument

For Calibrated Scaler Instrument:

HV Range is Nominally 800 ±200 volts. For instruments with separate power supplies and fixed threshold, the alpha channel will operate at a lower voltage than the beta channel.

Nominal input sensitivity and alpha channel at 175 mV, beta channel at 4 mV, and upper discriminator set at 50 mV

The Model 43-10-6 instrument should be dark-adapted before taking data.

4.2 Procedure

Determining Operating Voltage

- Connect the Model 43-10-6 to the counting instrument with proper cable.
- Place a calibrated ^{14}C source in the sample holder. Close and lock the sample drawer.
- Adjust counting instrument HV until it receives 5% (or greater) 4pi efficiency is achieved.
- Decrease HV by 25 volts.
- Record the HV.
- Record ^{14}C source count and beta crosstalk in alpha channel.

- Remove ^{14}C source and record background count in alpha and beta channels.

- Place calibrated ^{239}Pu source in sample holder. Close and lock sample drawer.

- Record ^{239}Pu source count and alpha crosstalk in beta channel.

- Increase the HV by 25 volts.

- Repeat the six previous steps until one or more of the following conditions are met:
    1. Beta background exceeds 80 cpm.
    2. Alpha background exceeds 3 cpm.
    3. Alpha crosstalk in beta channel exceeds 10%.
    4. Beta crosstalk in alpha channel exceeds 1%.

- The operating voltage should be selected as a point where:
    1. ^{14}C efficiency ≥ 5%
    2. ^{239}Pu efficiency ≥ 37%
    3. crosstalk alpha in beta channel ≤10%
    4. crosstalk beta in alpha channel ≤1%

Determining Efficiency

- NIST traceable check sources required.

- Set HV as determined previously.

- Record a one-minute background and one-minute source count. Subtract the background from the source count. Divide the net source count by the dpm value of the source, times 100 for 4 π efficiency.

If the source value is listed in microcuries (activity):

- Convert the microcurie value to a dpm value by multiplying the microcurie value by 2.22×10^6. Calculate the 4π efficiency as in the previous steps.

5. TROUBLE SHOOTING

5.1 Zero or Very Low Counts

- Large light leak
- PMT malfunction
- Broken wire in tube socket
- Inoperative HV switch on Model 43-10-6 or broken wire
- Counting instrument malfunction
- Source too far from scintillation material
- Cable malfunction

5.2 No Source Plateau

- Light leak, slide not sealed properly against true base
- Noisy PMT
- Noisy HV switch
- Poor PMT-to-scintillation light pipe interface

5.3 Excessive Background Count

- Light leak
- PMT malfunction
- Cable malfunction
- Noisy HV switch
- Instrument contaminated

6. PARTS LIST

Ref. No.	Description	Part No.
	Model 43-10-6 Alpha Sample Counter	
UNIT	Assembled Model 43-10-6 Alpha/Beta Sample Counter	47-2794
	Assembly View, Drawing 142 x 113	
*	2 inch PM Tube Assembly	01-5919
*	Plastic Scintillator Material (EJ444L-2.20 x .010 ZnS)	01-5698
*	Tube and Base Assembly	2142-128
*	M43-10 Connector Cap	7142-014
*	M43-10-6 Sample Tray	7142-126
*	M43-10 Acrylic Disc	7142-002-01
*	M43-10 Spacer Strip	7142-002-03
*	M43-10 Adapter Plate	7142-003-01
*	M43-10 Case Top	7142-004-03
*	M43-10 Case Bottom	7142-004-04
*	M43-10 Cap Gasket	7142-017
*	M43-10/43-17 Base Plate	7142-018
*	M43-10/43-17 Shaft	7142-019
*	M43-10/43-17 Lifter	7142-020
*	M43-10/43-17 Pin	7142-021
	2 inch X-TAL Foam Pad	7260-001-05
*	Metallized polyester	01-5143
*	M43-10-6 Filler Plate	7142-129
*	M43-10 Bracket	7142-004-01
*	M43-10 Cap	7142-004-02
*	SWITCH-BZ-2RD-A2 Micro Switch	08-6538
*	KNOB-90 4 2G Pointer	08-6608
*	RECEPT-UG568/U, C	4478-011
*	BUMPER-Pad	21-9376
*	Silcone Cord	22-9863

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
	MISCELLANEOUS	
*	CLVRLF-011-6809-000-599	18-8771
*	CONTACT-#1434	18-9124
	Voltage Divider Board, Drawing 435 x 964	
BOARD	Assembled Voltage Divider	5435-401
	CAPACITORS	
C1-C3	0.01µF, 2kV, C	04-5722
	RESISTORS	
R1-R12	4.75 MEG, 1/8W, 1%	10-7995

DRAWINGS AND DIAGRAMS

Assembly View, Drawing 142 x 113

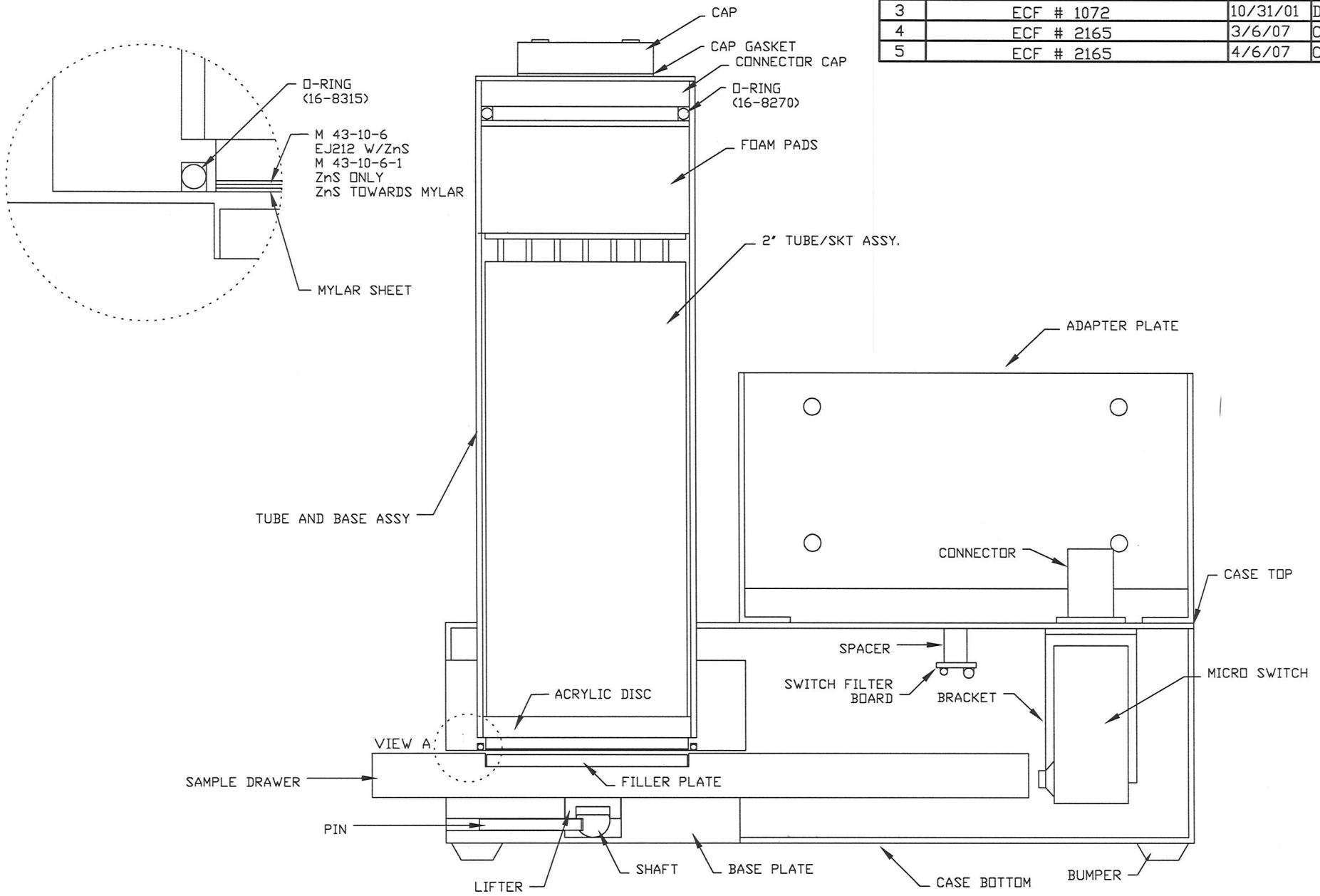
Switch Filter Board, Drawing 142 x 58

Switch Filter Board Component Layout, Drawing 142 x 59

Voltage Divider Board, Drawing 435 x 964

Voltage Divider Board Component Layout, Drawing 435 x 965

REV #	ALTERATIONS	DATE	BY
2	CHANGED TUBE/SKT ASSY ECF-802	6-29-98	DDW
3	ECF # 1072	10/31/01	DSW
4	ECF # 2165	3/6/07	CMC
5	ECF # 2165	4/6/07	CMC



DWN	DATE	CHK	DATE	APP	DATE
CMC	4-6-07			RDS	6APR07

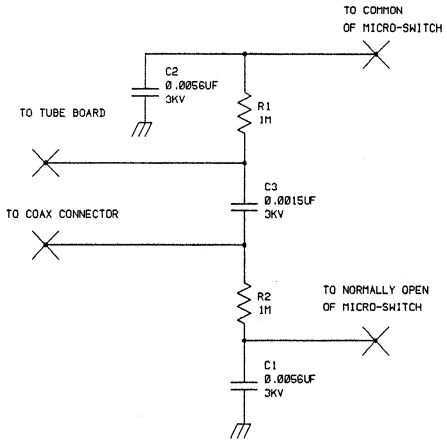
PART NUM: 4142-181 SCALE: FULL ☐ OTHER

TITLE M 43-10-6, M 43-10-6-1

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

SERIES 142 SHEET 113

EFF	AUTHORITY	REVISIONS ZONE	LTR	DESCRIPTION	DATE	APPROVED



UPDATED -		LUDLUM MEASUREMENTS INC.
DR PW	10/20/92	TITLE: SWITCH FILTER BOARD
CHK CKB	27-JAN-93	BOARD# 5142-103
DSGN PW	10/20/92	SIZE C | MODEL 43-10 | SERIES 142 | SHEET 58
APPD CBS	11-6-61	
NEXT HIGHER ASSY. -		
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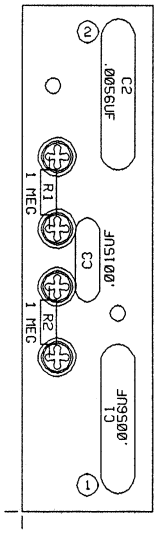

LUDLUM MEASUREMENTS INC. SWEETWATER, TX.					
DR PW	10/20/92	TITLE: SWITCH FILTER BOARD			
CHK CKR	27-JAN-99				
DSGN PW	10/20/92	BOARD# 5142-103			BS142103
APP RJS	1-27-99	MODEL 43-10	SERIES 142		SHEET 59
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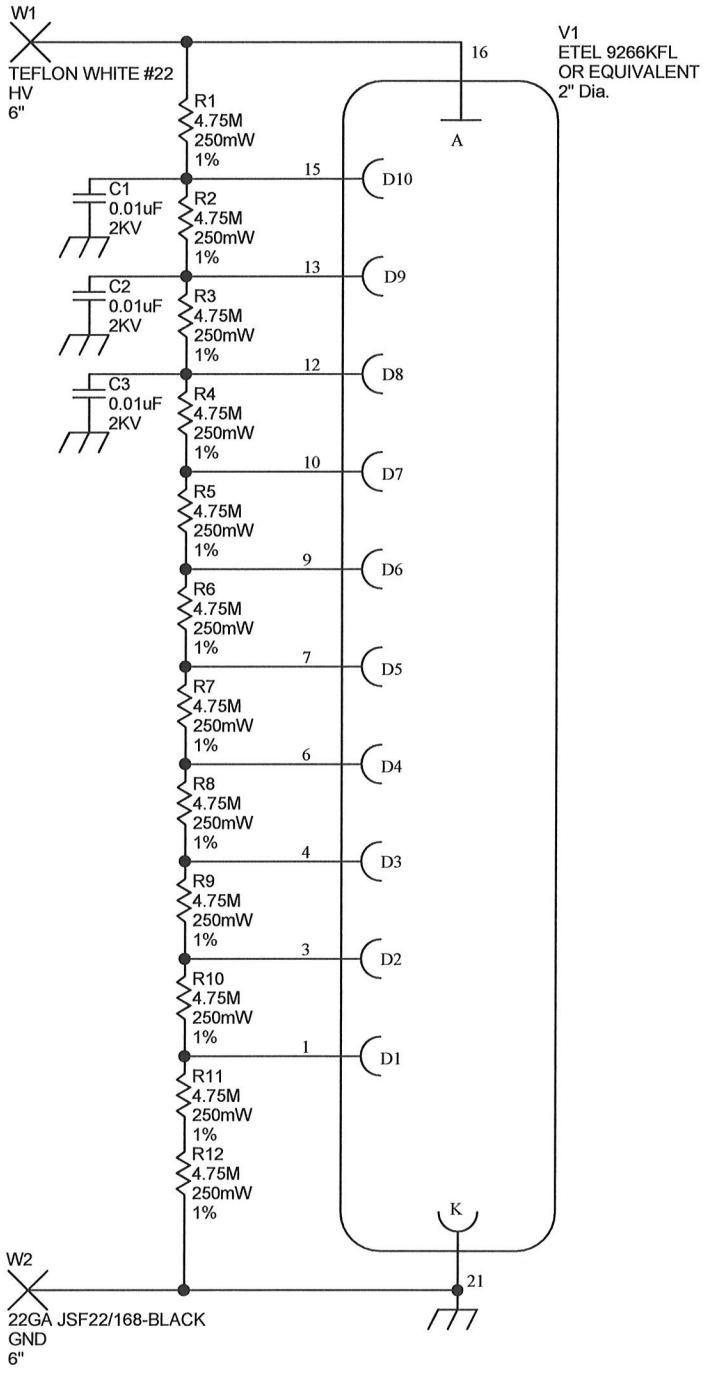
COMP PASTE ☐	COMP MASK ☐	SLDR PASTE ☐	SLDR MASK ☐		



LUDLUM MEASUREMENTS, INC.		**PO Box 810, 501 Oak Street, Sweetwater, Texas 79556 U.S.A. 1-800-622-0828**	
Drawn: AC	05/07/2012	**Title:** VOLTAGE DIVIDER	
Design: RSS	05/07/2012	**Model:** VARIOUS	
		Board#: 5435-401	
Approve: JOV	10-22-12	**Sheet:** 1 of 1	**Series** 435 / **Sheet** 964
Print Date: 10/10/2012 9:37:50 AM		**Rev:** 2	
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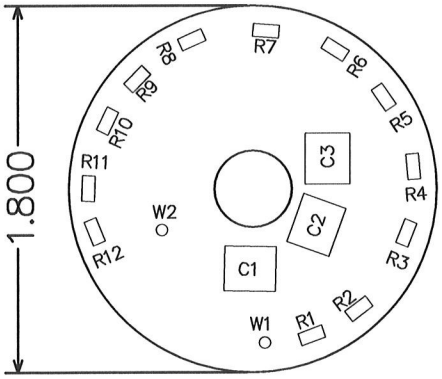

LUDLUM MEASUREMENTS, INC.		PO Box 810 501 Oak Street Sweetwater, TX 79556 U.S.A. 1-800-622-0828	
Title: VOLTAGE DIVIDER			
Drawn: AC	05/07/2012	**Model:** VARIOUS	
Design: RSS	05/07/2012	**Board#:** 5435-401	
Approve: JGW	10-22-12	**Rev:** 2	
Print Date: 10/10/2012 9:37:52 AM		**SCALE: 1.00** Top Overlay	**Series** 435 / **Sheet** 965
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