LUDLUM MODEL 43-10-1

ALPHA-BETA SAMPLE COUNTER

December 2019

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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

Model 43-10-1 Alpha/Beta Sample Counter
December 2019

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1. GENERAL

The Model 43-10-1 is an Alpha-Beta Sample Counter capable of holding up to a 5.1 cm (2 in.) diameter filter or planchet. The sample drawer, when fully closed, strikes a microswitch to allow high voltage (HV) 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.

The detector is a 6.4 cm (2.5 in.) diameter "phoswich" with a 0.025 cm (0.010 in.) thick plastic scintillator coated with zinc sulfide (ZnS). ZnS(Ag) is used for alpha radiation detection, and the plastic scintillation material is used for detection of beta radiation. The scintillation material is covered by 0.4 mg/cm^2 metalized polyester to reduce light response (excessive background). If simultaneous alpha-beta discrimination is desired, the counting instrument must have 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.

2. SPECIFICATIONS

SCINTILLATOR MATERIAL: ZnS disc; plastic 0.025 cm (0.010 in.) thick

DETECTOR OPERATING VOLTAGE: 500-1200 Vdc

WINDOW: 0.4 mg/cm^2

BACKGROUND:
≤ 80 cpm beta-gamma, ≤ 3 cpm alpha
(in ambient background of 10μR/hr)

CHANNEL CROSS TALK: alpha in beta channel ≤ 10%; beta in alpha channel ≤ 1%

EFFICIENCY (4π): 37% for ^{239}Pu, 5% for ^{14}C, 27% for ^{99}Tc, 32% for ^{230}Th, 39% for ^{238}U, 29% for ^{137}Cs, 26% for ^{99}Sr/^{90}Y

HV SWITCH: opening sample slide disables PMT high voltage

PHOTOMULTIPLIER TUBE: 5.1 cm (2 in.) diameter, 10 pin dynode structure

SAMPLE SLIDE AND HOLDER: sample cavity size is 56.9 mm (2.24 in.) diameter x 10.8 mm (0.428 in.) deep, with an insert cavity size of 50.8 mm (2.0 in.) diameter x 4.4 mm (0.175 in.) deep or 28.3 mm (1.115 in.) diameter x 4.4 mm (0.175 in.) deep.

MAXIMUM SAMPLE SIZE: 56.9 mm (2.24 in.) diameter x 10.8 mm (0.428 in.) deep

CONSTRUCTION: aluminum housing with beige powder coating

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

3. OPERATING PROCEDURES

Connect the Model 43-10-1 to the scaler counting instrument. The coax cable with "C" connectors carries both the signal and HV.

HV is applied to the PMT when the sample slide is pushed completely in, tripping the microswitch. Rotate the sample slide lever to the locked position, securing sample slide in the "ON" position.

Alpha background count is approximately less than or equal to 3 cpm.

Beta background count is approximately 60-100 cpm.

To check a radioactive sample, place sample on the appropriate side of the sample holder for the 2.5 or 5.1-centimeter (1 or 2 in.) filters. Do not allow the 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 the sample holder or area within the O-ring.

4. CALIBRATION

CAUTION: Do not tip sample counter over with sample holder in sample slide. The sample holder will tear the thin metalized polyester window, allowing light to scintillate the ZnS and cause excessive count 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

Calibrated scaler instrument
HV range, nominally 800 ±200 volts
Nominal input sensitivity:
alpha channel = 175 mV
beta channel = 4 mV (with upper discriminator set at 50 mV)

4.2 Operating Voltage

1. Connect Model 43-10-1 to the counting instrument with proper cable.

2. Place a calibrated ^{14}C source in the sample holder. Close and lock the sample drawer.

3. Adjust the counting instrument HV until it receives at least 5% (4π) efficiency.

4. Decrease HV by 25 volts.

5. Record the HV.

6. Record the ^{14}C source count and beta crosstalk in the alpha channel.

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

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

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

10. Increase the HV by 25 volts.

11. Repeat steps 5-10 until one or more of the following conditions is met (assuming a 10 μR/hr background exposure):
   (a) beta background exceeds 80 cpm

(b) alpha background exceeds 3 cpm
(c) alpha crosstalk in the beta channel exceeds 10%
(d) beta crosstalk in the alpha channel exceeds 1%

12. The operating voltage should be selected as a point where:
(a) ^{14}C efficiency $(4\pi) \geq 5\%$
(b) ^{239}Pu efficiency $(4\pi) \geq 37\%$
(c) alpha crosstalk in beta channel less than or equal to 10%
(d) beta crosstalk in alpha channel less than or equal to 1%

4.3 Calculating Efficiency

1. NIST-traceable sources required.
2. Set HV as determined above.
3. Record a one-minute background and one-minute source count. Subtract the background count from the source count. Divide the net source count by the dpm value of the source, times 100 for 4π efficiency.

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

4. 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. TROUBLESHOOTING

5.1 Zero or Very Low Counts

- Large light leak
- PMT malfunction
- Broken wire in tube socket
- Inoperative HV switch on sample counter 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

PARTS LIST

Ref. No.	Description	Part No.
Model 43-10-1 Alpha/Beta Sample Counter		
UNIT	Completely Assembled 43-10-1 Detector	47-1305
Assembly View, Drawing 142 x 39B		
*	PM TUBE ASSY	01-5919
*	EJ444L-2.20 x .010 ZnS	01-5698
*	METALIZED MYLAR	01-5143
*	TUBE HOLDER/BASE	2142-002-02
*	CONNECTOR CAP	7142-014
*	SAMPLE DRAWER Model 43-10	7142-001-06
*	O-RING-2-229	16-8286
*	ACRYLIC DISC	7142-002-01
2 EA.	SPACER STRIP .015	7142-002-03
*	ADAPTER PLATE	7142-003-01
*	CASE TOP	7142-004-03
*	CASE BOTTOM	7142-004-04
*	CAP GASKET	7142-017
*	BASE PLATE	7142-018
*	SHAFT	7142-019
*	LIFTER	7142-020
*	PIN	7142-021
*	O-RING-2-226	16-8270
2 EA.	SPACER STRIP .010	7142-232
5 EA.	5.1 cm (2 in.) X-TAL FOAM PAD	7260-001-05
10 EA.	PLANCHETTE-2/X1/8 IN.	7525-371A
*	PLANCHET HOLDER	7142-001-07
*	BRACKET	7142-004-01
*	CAP	7142-004-02
1 EA.	SWITCH-BZ-2RD-A2	08-6538
1 EA.	KNOB-90 4 2G POINTER	08-6608
1 EA.	RECPT-UG706/U “C” LMI	4478-011
4 EA.	BUMPER PADS	21-9376
2 EA.	SPACERS	18-9043

Ref. No.	Description	Part No.
Switch Filter Board, Drawing 142 X 58		
BOARD	Assembled Switch Filter	5412-103
▪	**CAPACITORS**	
C1-C2	CAP-0.0047µF, 3kV, NPO	04-5547
C3	CAP-0.0015µF, 3kV, C	04-5518
▪	**RESISTORS**	
R1-R2	RES-1MEG, 1/4W, 5%	10-7028
Voltage Divider Board, Drawing 435 X 964		
BOARD	Assembled Voltage Divider	5435-401
▪	**CAPACITORS**	
C1	0.01µF, 2kV, C	04-5722
▪	**RESISTORS**	
R1-R12	4.75 MEG, 1/8W, 1%	12-7995

DRAWINGS AND DIAGRAMS

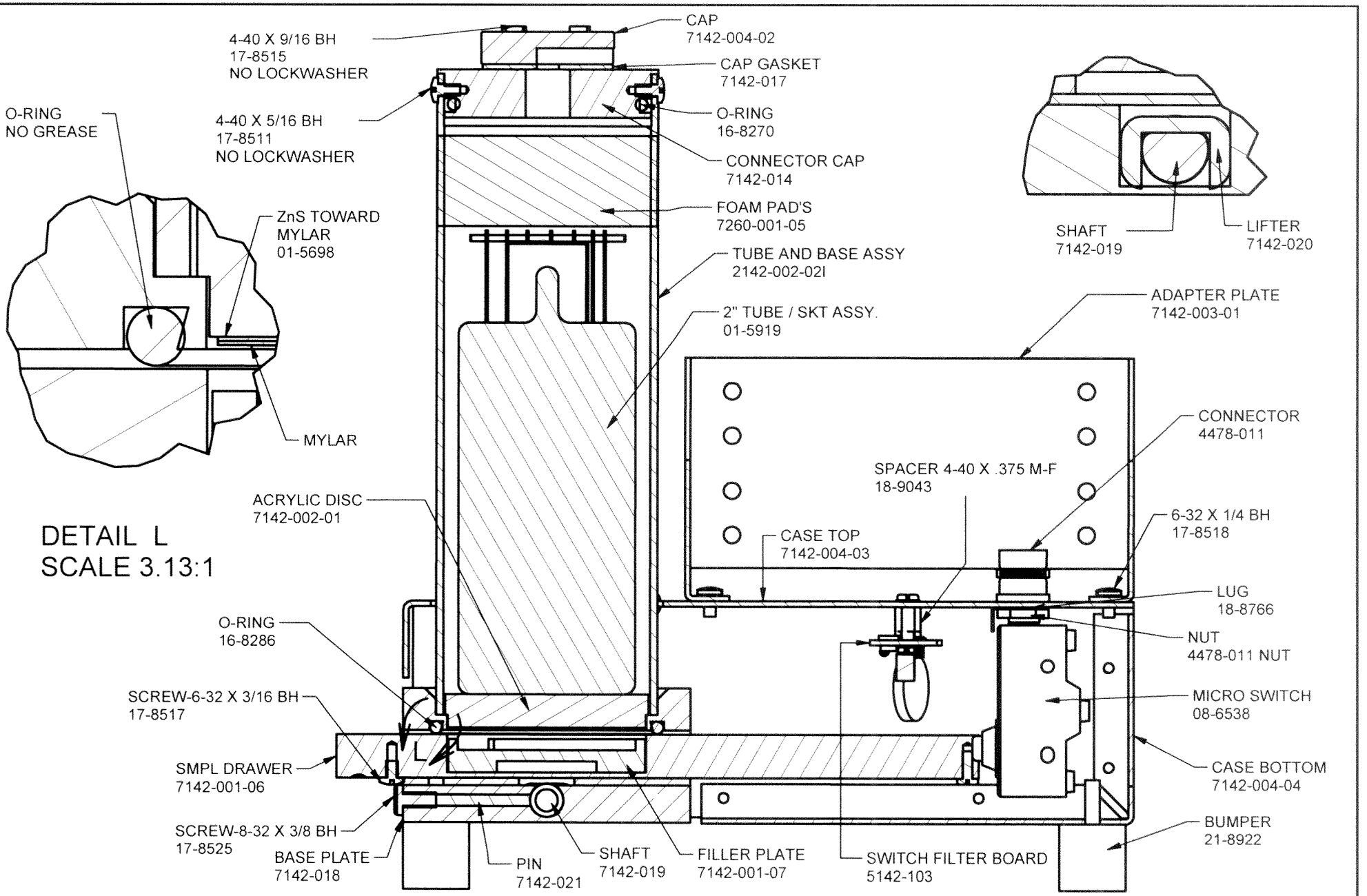
Model 43-10-1 Assembly View, Drawing 142 x 39B

Switch Filter Board, Drawing 142 x 58

Switch Filter Board Layout, Drawing 142 x 59

5.1 cm (2 in.) Voltage Divider Board, Drawing 435 x 964

5.1 cm (2 in.) Voltage Divider Board Layout, Drawing 435 x 965



DETAIL L
SCALE 3.13:1

REVISION HISTORY			
REV	DESCRIPTION	DATE	BY
3	ECF # 1072	10/31/01	DSW
4	REDRAWN ON COMPUTER	05/23/2012	ADG
5	PLACED LOCKWASHERS	1/2/18	ZSZ
6	17-8518 WAS 17-8511	11/19/19	DLJ

DWN	DATE	CHK	DATE	APP	DATE
ABM	11/27/19			JGW	11-27-19

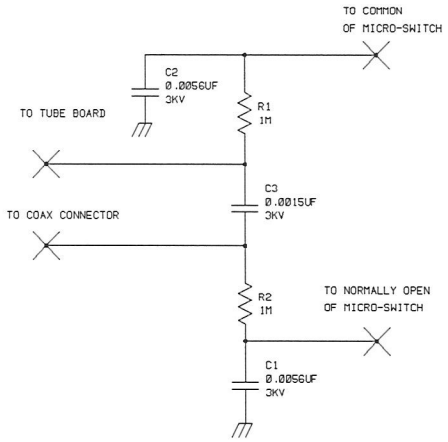
DWG NUM: 4142-076 SCALE: 1:1.5

TITLE M 43-10-1

LUDLUM MEASUREMENTS, INC
501 OAK STREET
SWEETWATER, TEXAS 79556

SERIES 142 SHEET 39B

REVISIONS						
EFF	AUTHORITY	ZONE	LTR	DESCRIPTION	DATE	APPROVED



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DSGN PW	10/20/92
APPD	11-6-91
NEXT HIGHER ASSY.	-
08:36:53	27-Jan-99

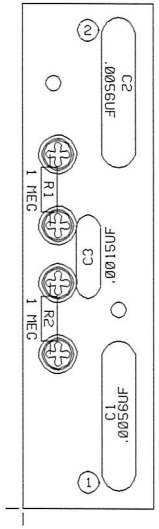
LUDLUM MEASUREMENTS INC.

TITLE: SWITCH
FILTER BOARD

BOARD# 5142-103

SIZE	MODEL	SERIES	SHEET
C	43-10	142	58

SB142103 SHEET 1 OF 1



LUDLUM MEASUREMENTS INC. SWEETWATER, TX.					
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DSGN PW	10/20/92	BOARD# 5142-103			BS142103
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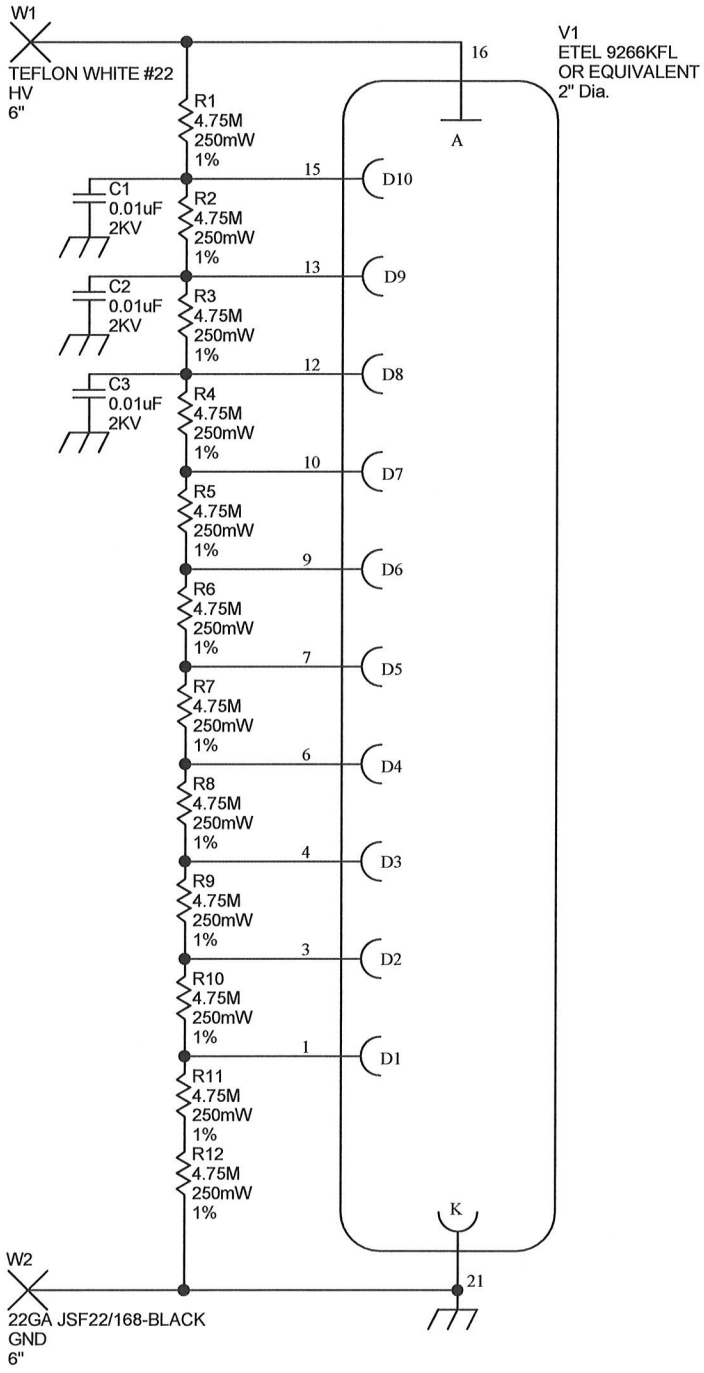
COMP PASTE ☐	COMP MASK ☐	SLDR PASTE ☐	SLDR MASK ☐		



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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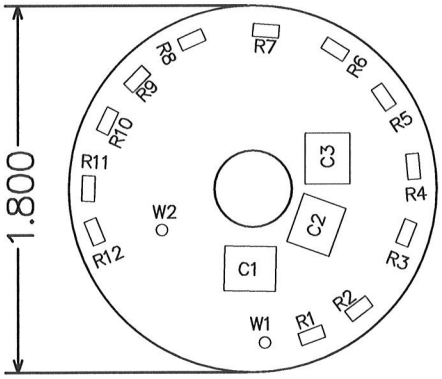

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Drawn: AC	05/07/2012	**Model:** VARIOUS	
Design: RSS	05/07/2012	**Board#:** 5435-401	
Approve: JGW	10-22-12	**Rev:** 2	
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