

Bureau of Radiation Control  
Department of Health  
State of Florida

Radiation Surveillance Procedure 9  
Revision 1  
15 December 2006

CD V-700 Model 7 Upgrade Assembly  
and Quality Testing Procedure

Reviewed by: \_\_\_\_\_ Date \_\_\_\_\_  
David J. Ferguson  
Radiological Surveillance Manager  
DOH Environmental Radiation Surveillance

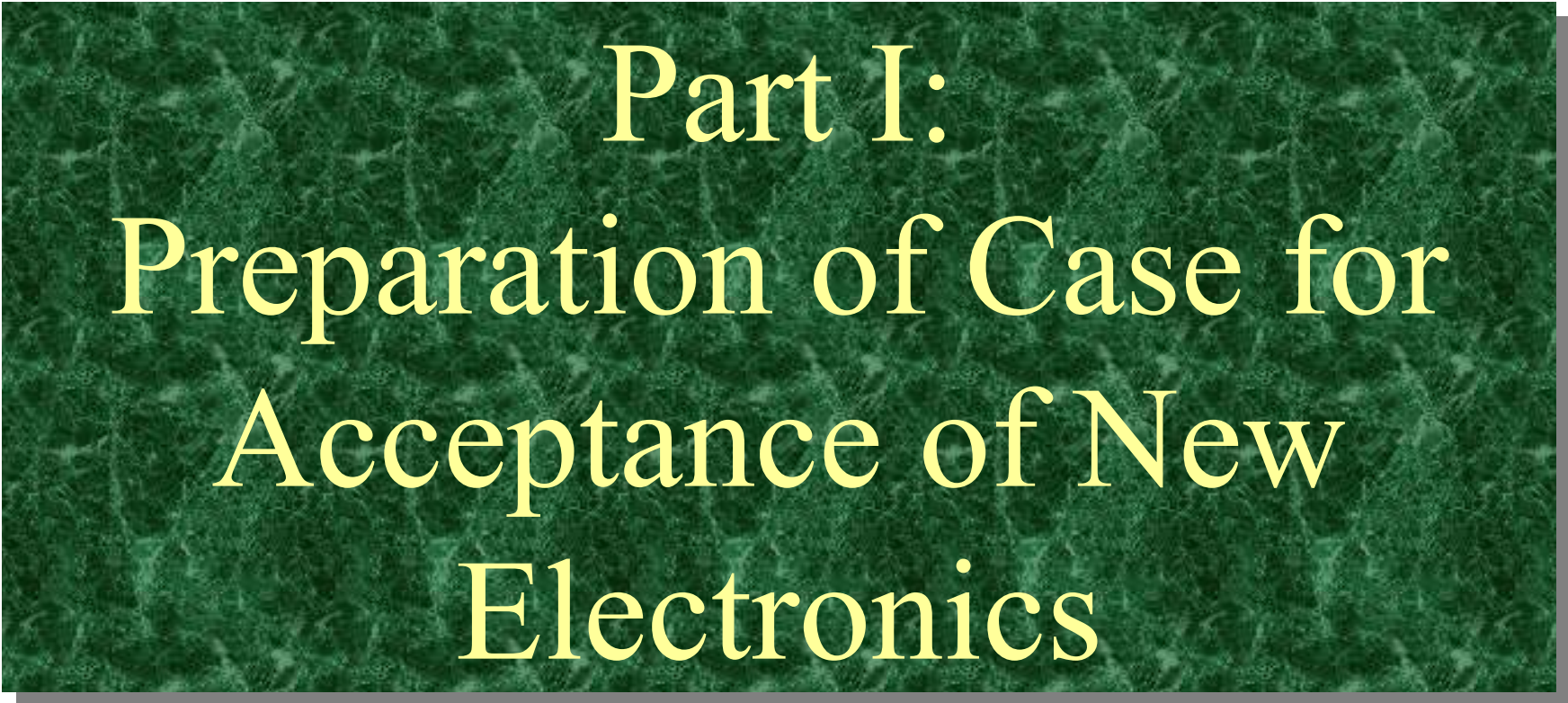
Reviewed by: \_\_\_\_\_ Date \_\_\_\_\_  
John Williamson  
Environmental Administrator  
DOH Environmental Radiation Control

Approved by: \_\_\_\_\_ Date \_\_\_\_\_  
William A. Passetti  
Chief, DOH Bureau of Radiation Control

# Civil Defense Instrumentation



Upgrade and  
Refurbishment Procedure  
for CD V-700 Model 7



Part I:  
Preparation of Case for  
Acceptance of New  
Electronics

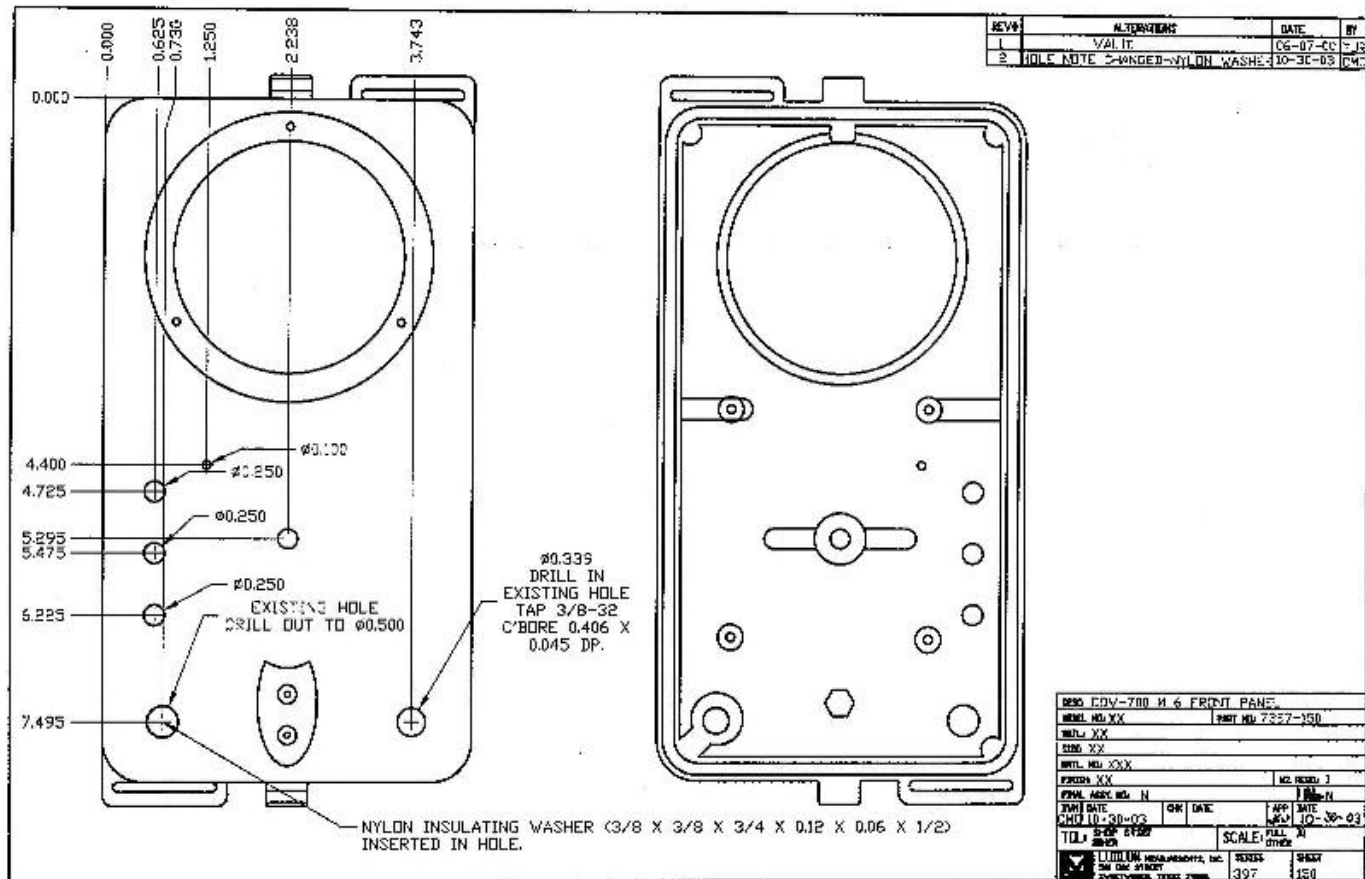
Start with original equipment.



# Disassemble to bare case.



# Machine according to blueprint.



# Machining Specifications

- Switch Holes 0.250" (1/4")
- Headset Jack Hole 0.5" (1/2")
- Speaker Hole 0.1" (3/32")
- "C" Connector Hole 0.339" (~21/64")
- "C" Connector Hole Counter Bore 0.406" (~13/32"), 0.045" Deep
- "C" Connector Hole Tap with 3/8"-32 Thread
- All require Split Head Cobalt Drill Bits

Machine three new switch holes,  
the small speaker hole, and then  
enlarge the headset jack hole.





# Machine new "C" connector hole.



Tap threads in new “C” connector hole by hand using drill press to steady hand.



# Sand off old nomenclature.



Wash off contaminants and  
prepare for painting.



# Painting instrument cases.

- Cover check source, battery warning, and civil defense decals before painting.
- Paint with Rust-Oleum<sup>®</sup> White Clean Metal Primer #7780 and bake for 24 hours at 55°C.
- Paint with Rust-Oleum<sup>®</sup> Sunburst Yellow Enamel #7747 and again bake for 24 hours at 55°C.
- Polish before assembly.

Paint in a paint booth with high volume exhaust ( $>120$  cfm).



Use any of three baking ovens. The oven by the paint booth is preferred.



# Remove metal lanyard and yellow cap from handle assembly





# Part II: Assembly



# Section 1: Electronic Assembly

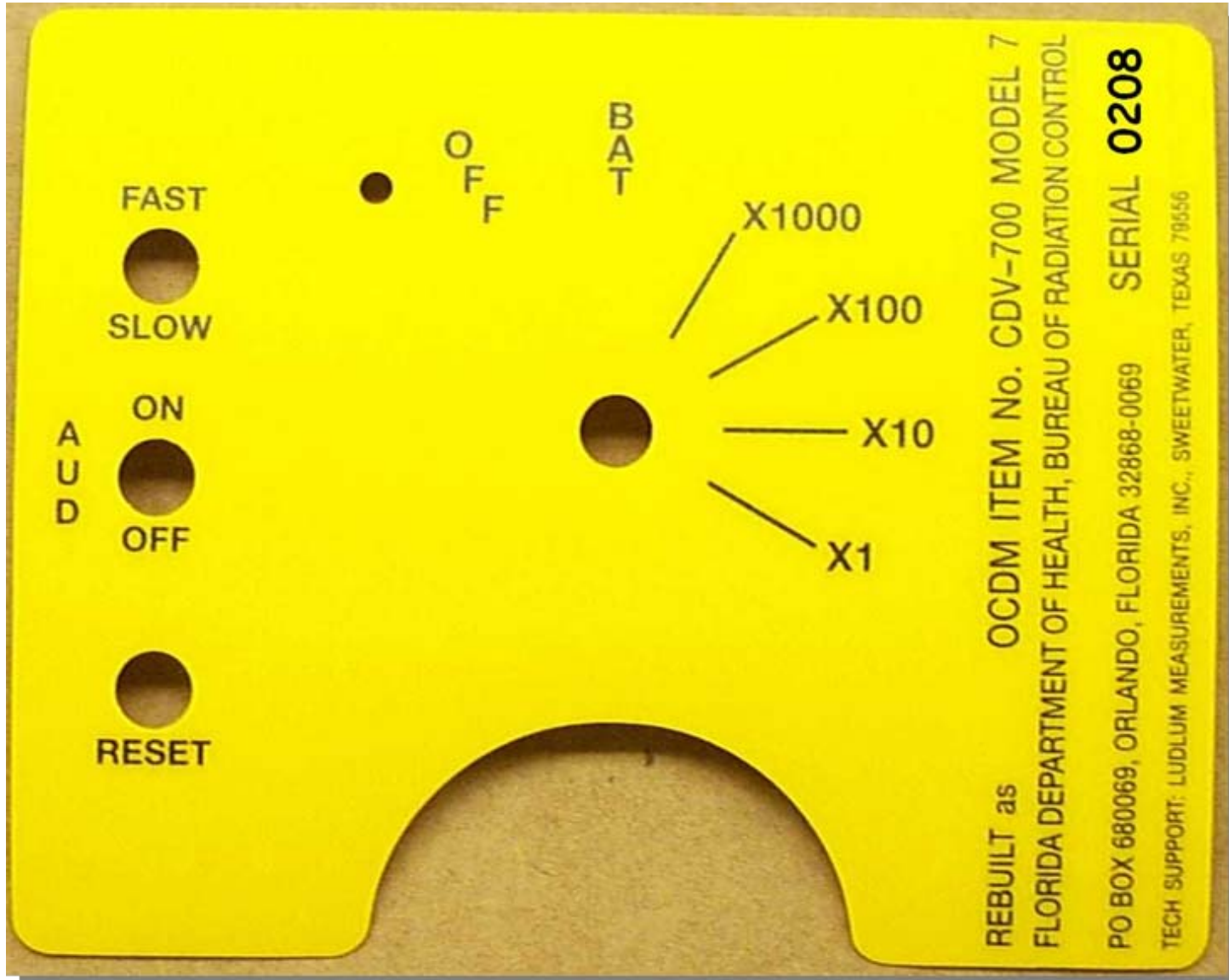
- These components and tools are used for electronic assembly.



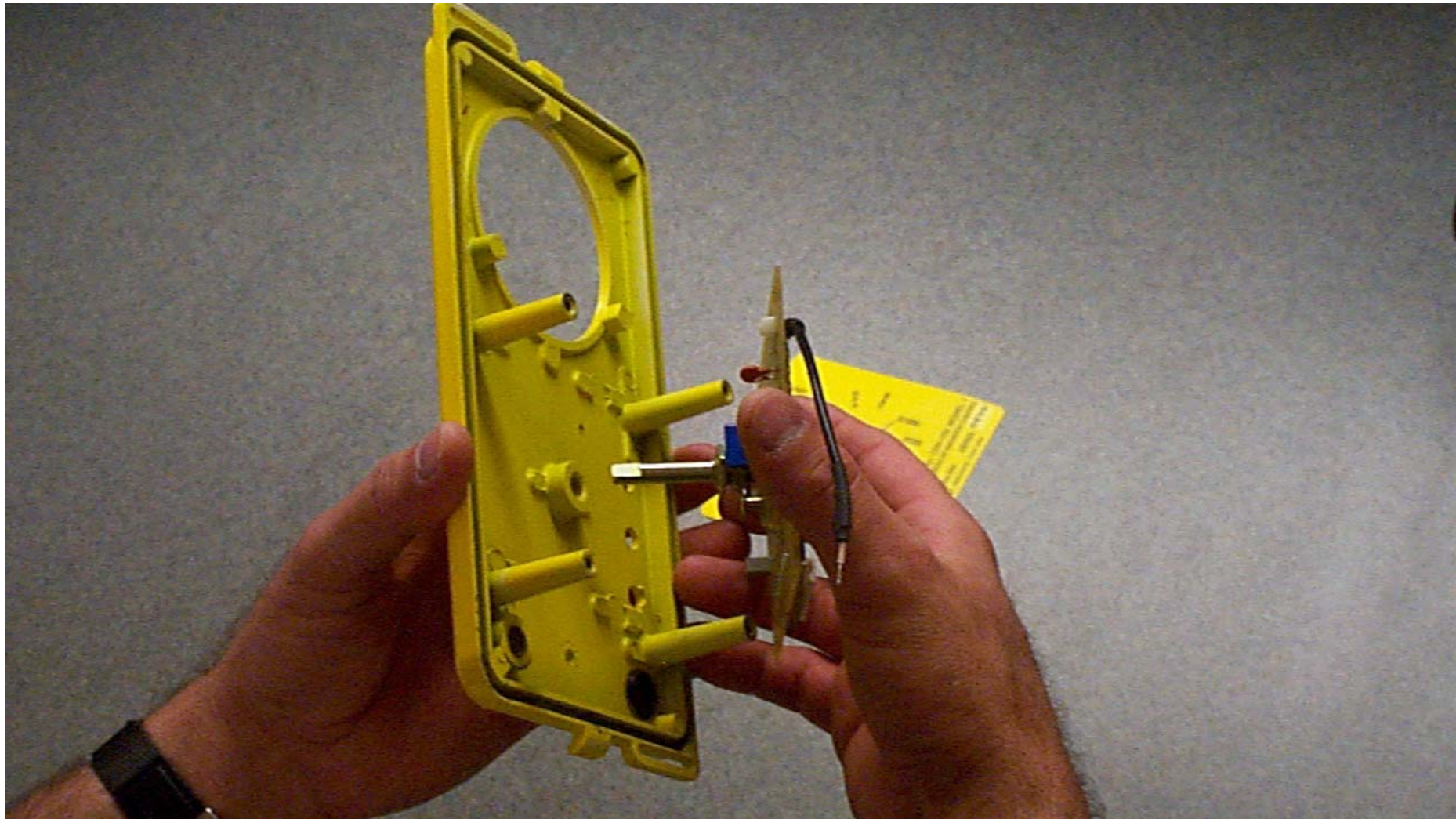
# Electronic Components Assembly: Parts and Tools Required

- Instrument Case Top completed through red assembly procedure.
- Nameplate Overlay and Main Rotary Switch.
- Nylon Insulating Washer ( $3/8'' \times 3/4'' \times 0.12'' \times 0.06'' \times 1/2''$ ) and Nylon Washer ( $3/8'' \times 0.385'' \times 0.75'' \times 0.032''$ ), Switchcraft Cover, and  $1/2''$  Nut Driver or Ratchet for installing phone jack.
- Wire Bundle with switches and speaker, RTV 100% Silicon Glue, speaker hole punch, and  $5/16''$  Nut Driver.
- Handle Assembly completed through red assembly procedure, Screw (10-32 thread,  $1/2''$  long,  $5/16''$  hex head) and  $5/16''$  Nut Driver.

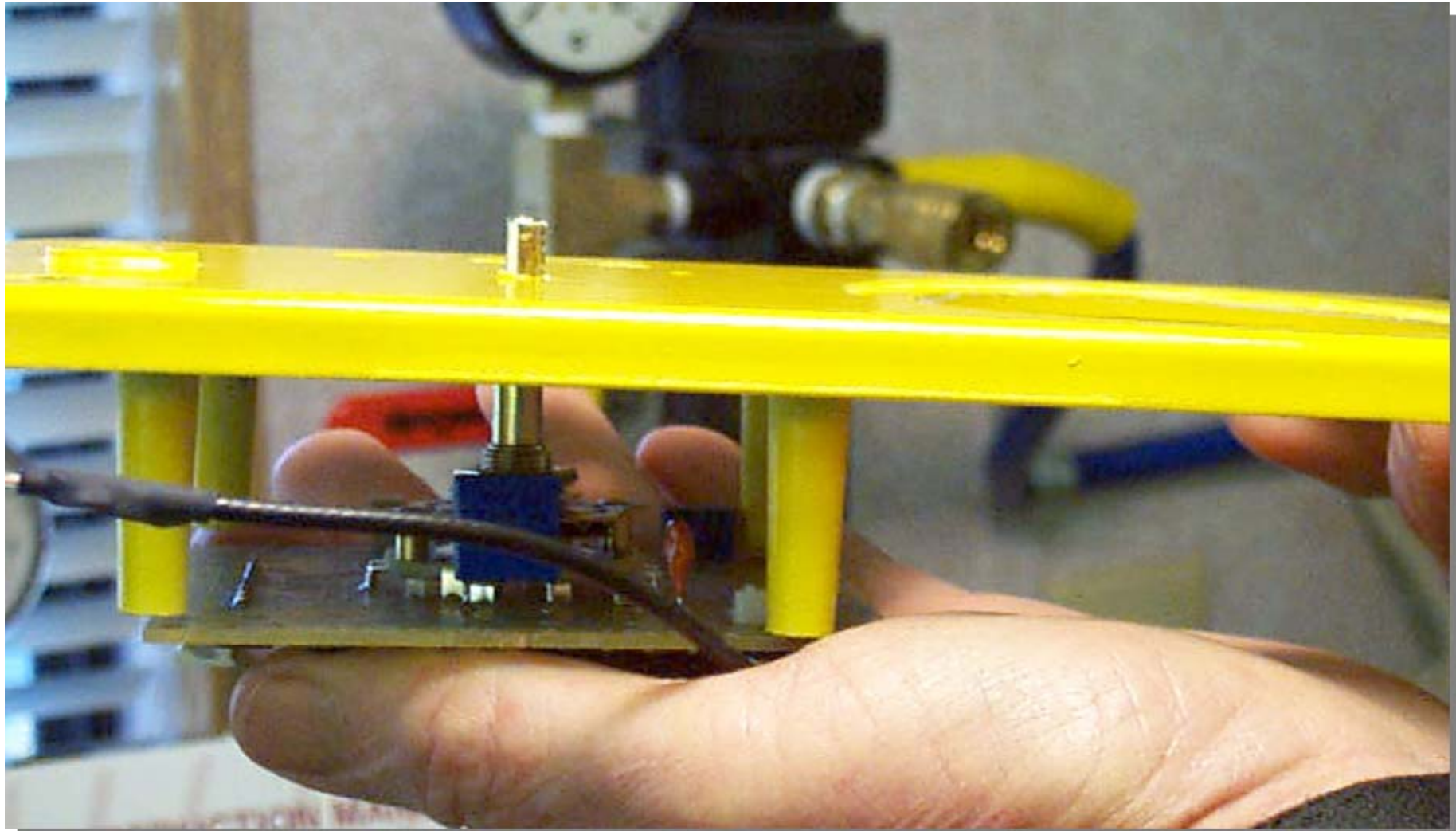
# Install Lexan<sup>®</sup> nameplate overlay.



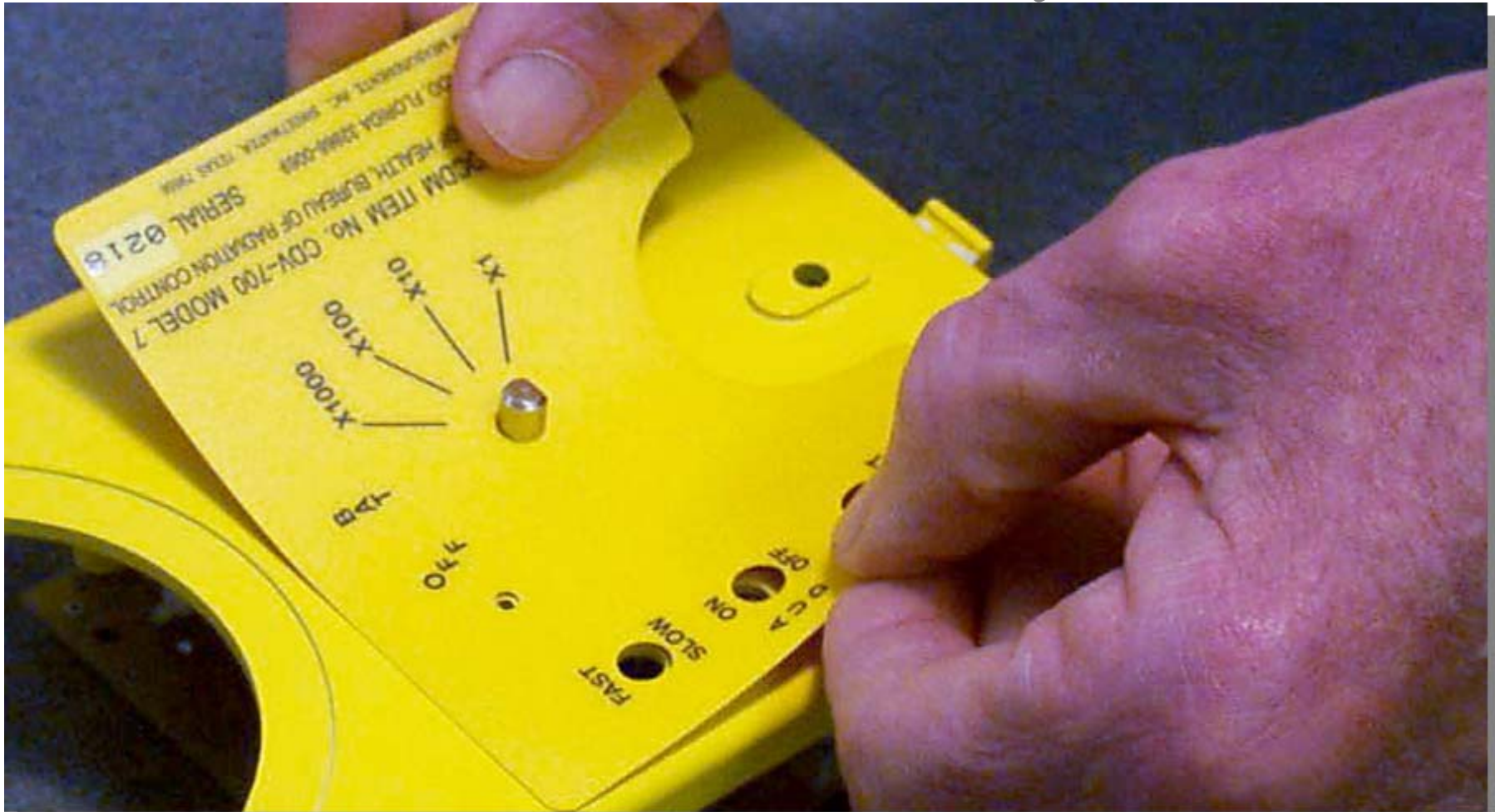
Insert main rotary switch as a guide for overlay placement.



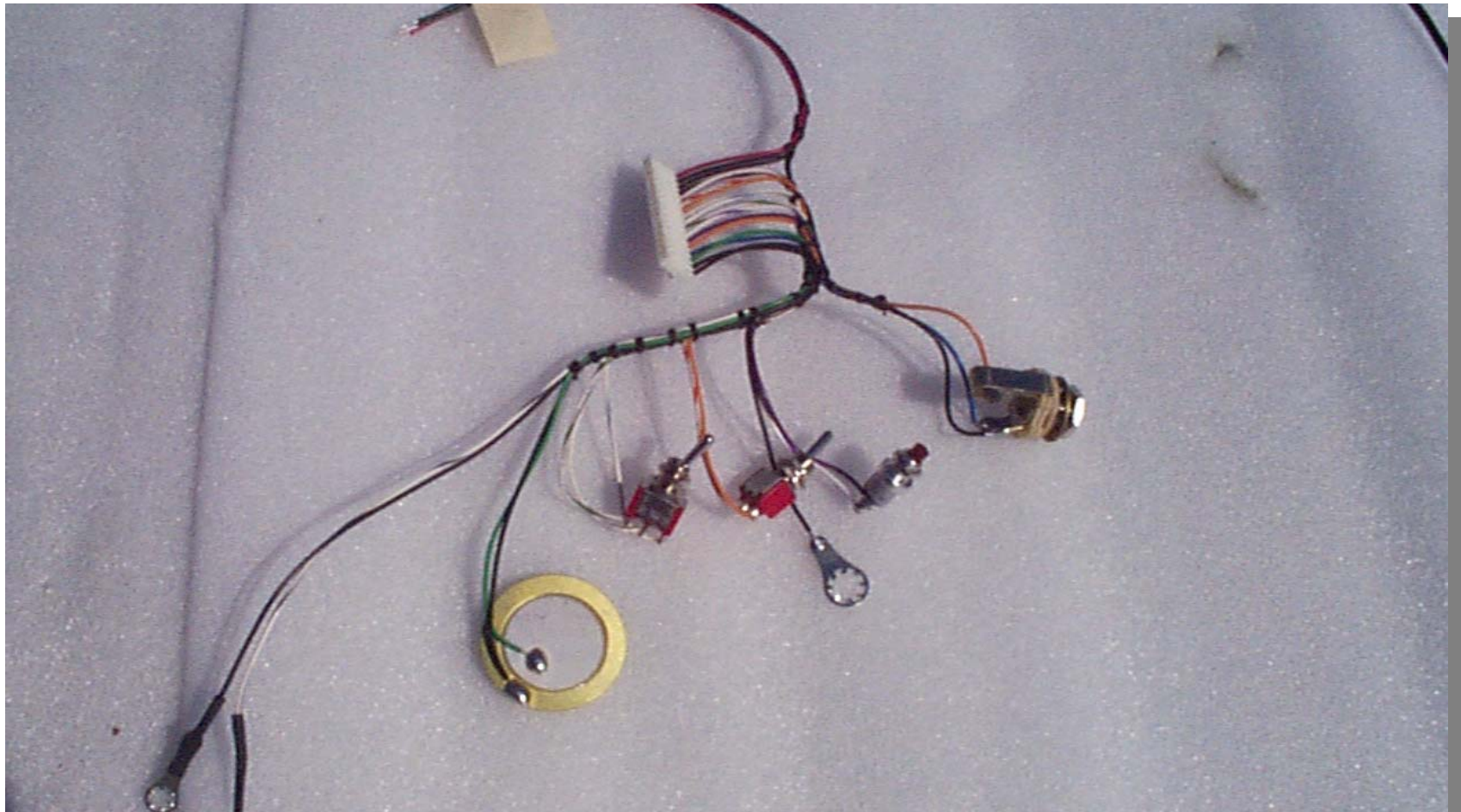
Shaft should protrude the hole.



Clean case top. Use shaft and left edge to center and square overlay on instrument.  
Then remove main rotary switch.



Installing the Wire Bundle.  
Check each pin, lead and solder  
joint for electrical continuity.

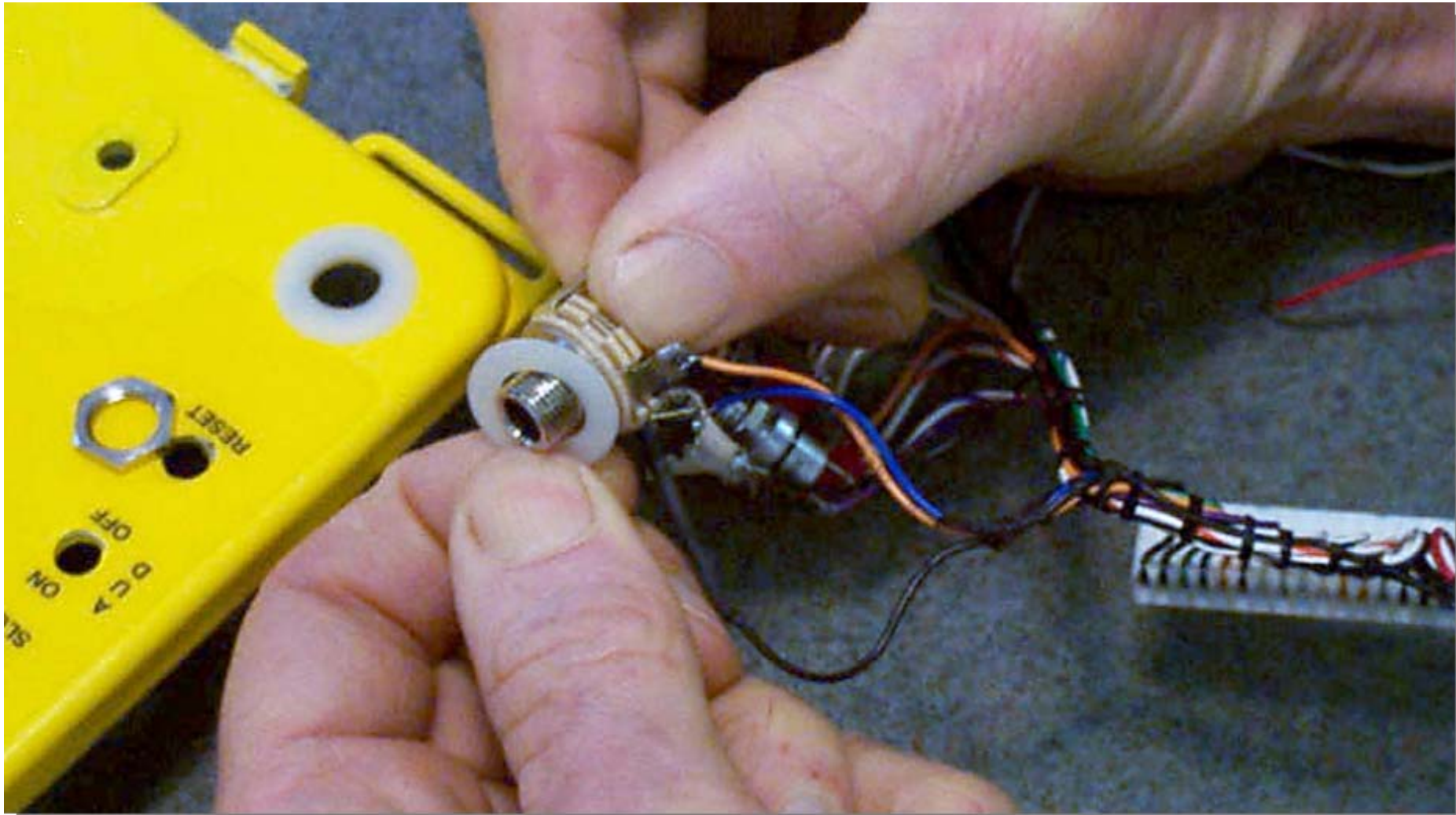




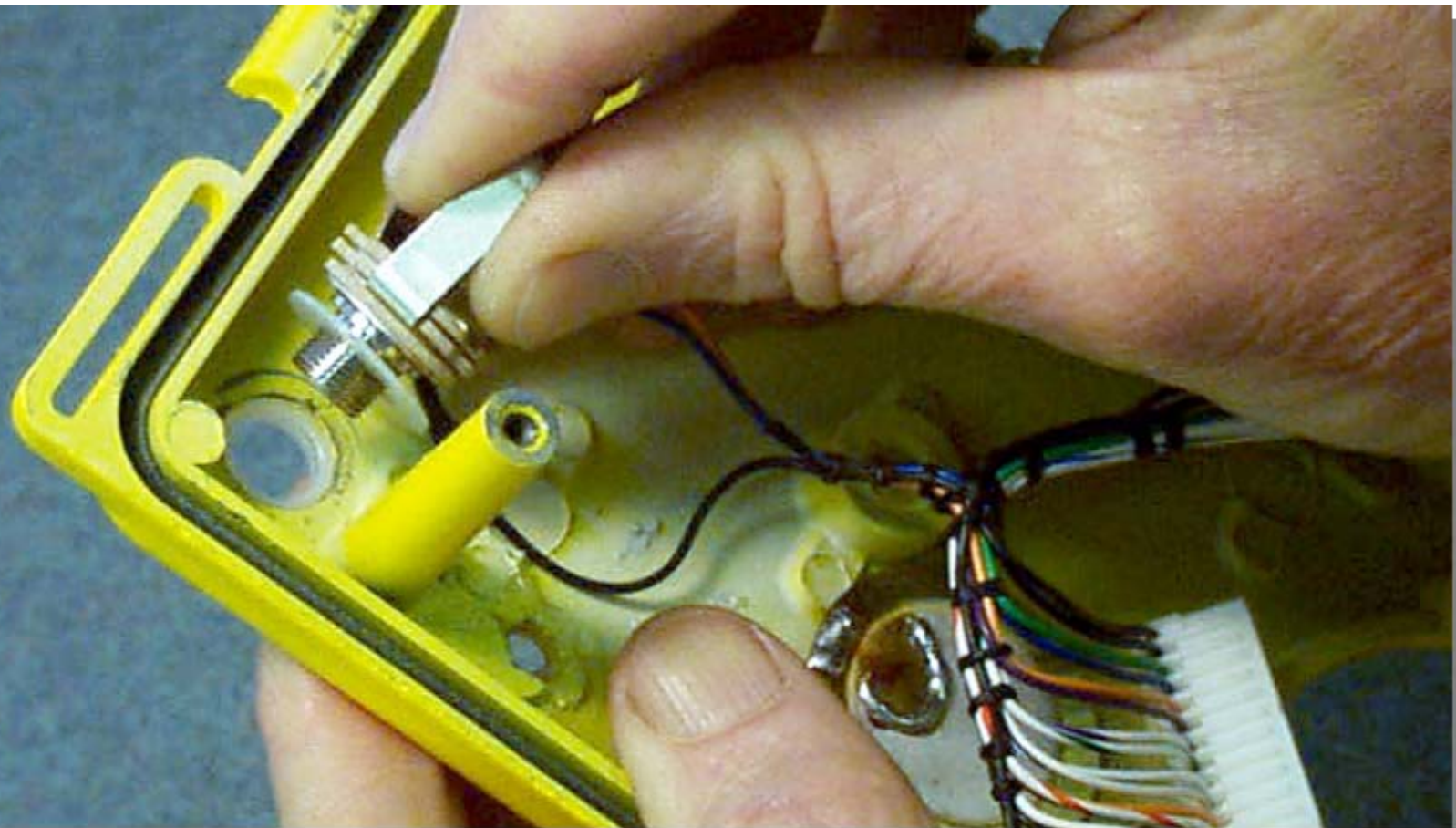
# Install Headphone Jack.



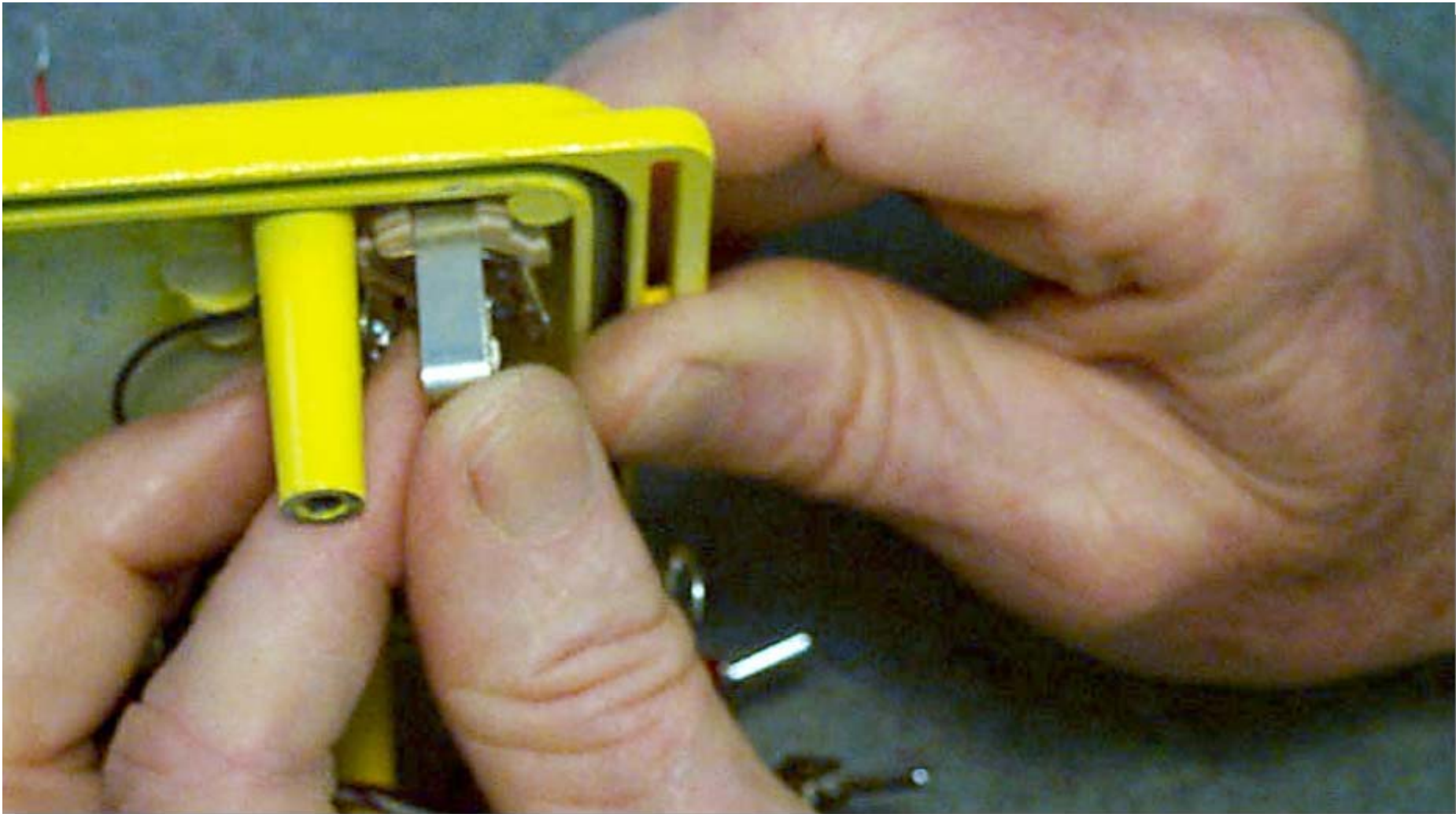
Place Nylon Insulating Washer into hole  
and Nylon Washer over phone jack.



Push Headphone Jack through hole orienting the Speaker Cut-Off Contact (seen between fingers) as shown.



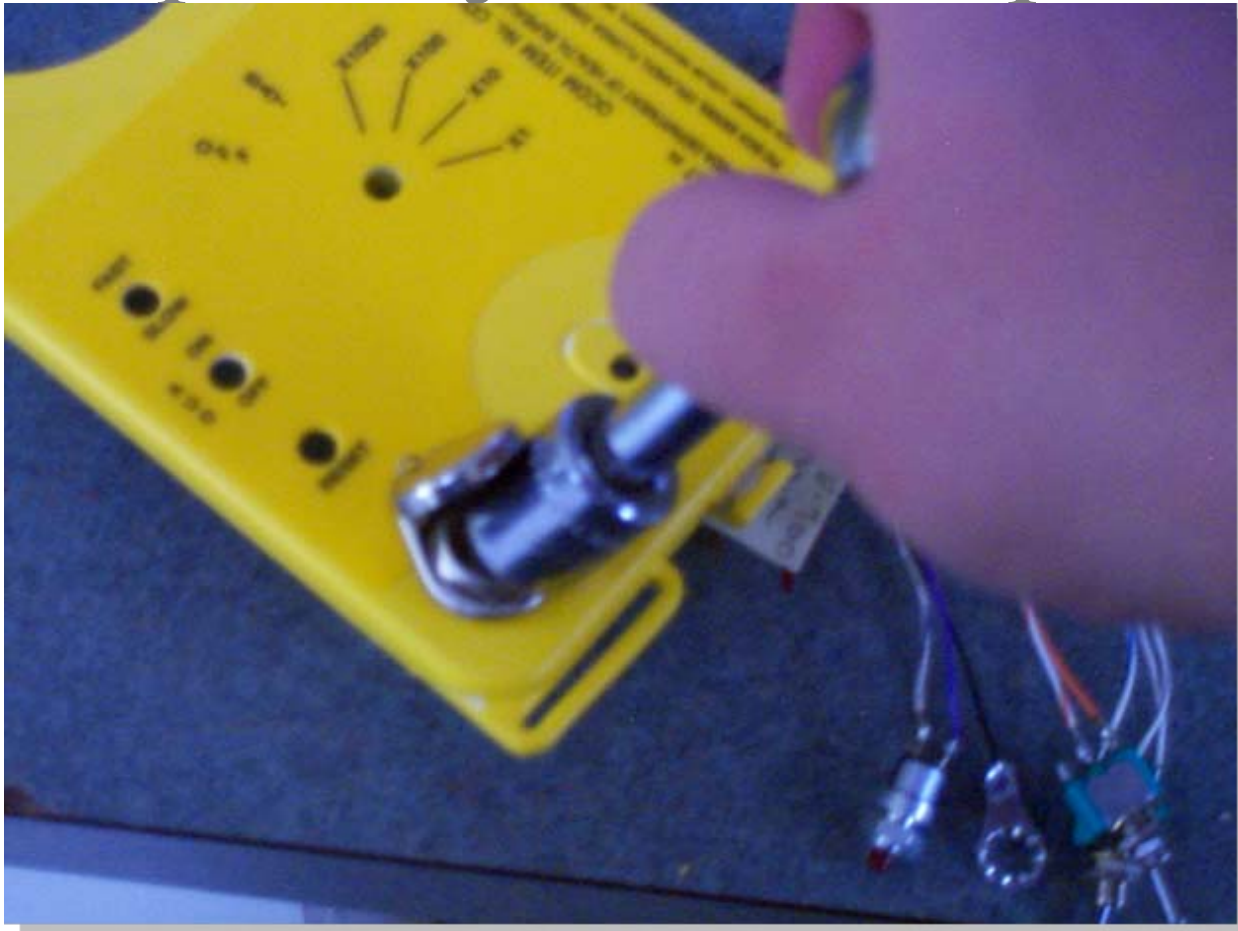
Orientation is very important to prevent shorting the speaker circuit to case ground.



Headphone Jack should protrude two threads above insulating washer. Install and hand tighten the Switchcraft Cover.



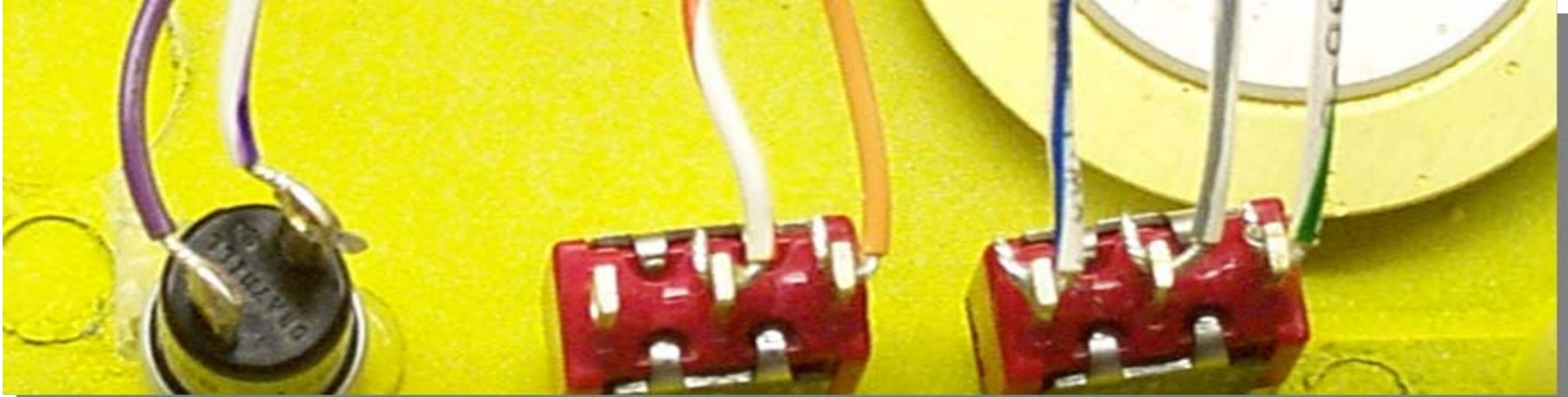
Tighten the retaining nut 1/4 turn past hand snug with the 1/2" nut driver and the phone jack is completed!



# Prepare for switch installation.

- Add two cubic centimeters of clear RTV to the underside of the case at the reset switch hole.
- This overcomes the uneven thickness of the underside of the case top at this location allowing the reset switch to mount level on the surface.

# Install Switches



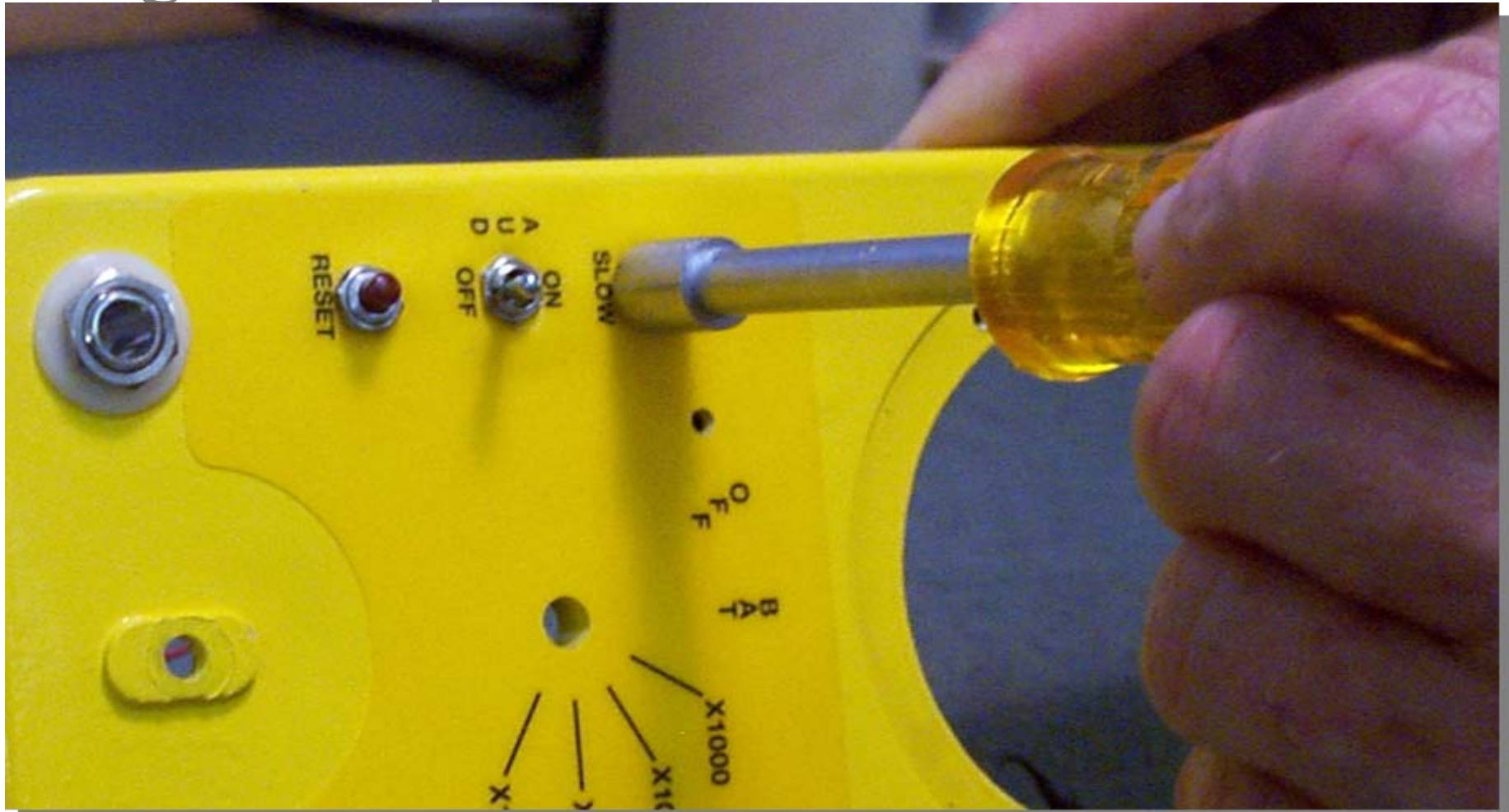
- Position the case top upside down with the phone jack in the bottom left corner and the “C” connector hole in the upper left corner.
- From left to right, the reset switch, the speaker on/off switch, and the fast/slow time constant switch will be installed.
- Ensure that proper switch orientation is maintained as shown above.

## WIRE COLOR ORDER

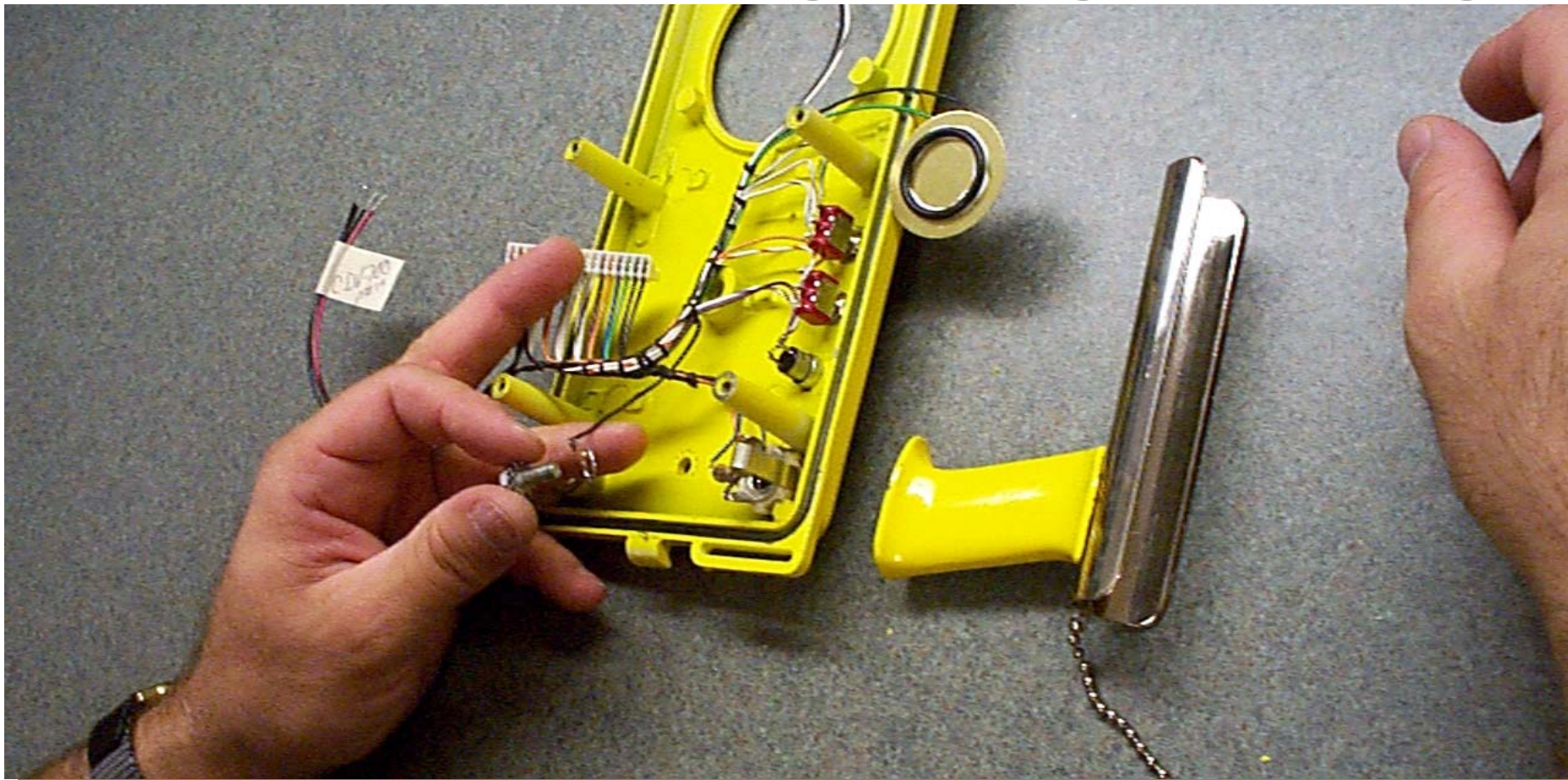
- Reset switch: purple, then purple and white
- Audio switch: orange and white, then orange
- Fast/Slow switch: blue and white, then gray and white, then green and white



Adjust bottom nut to third thread, insert into hole, affix top nut to each switch and tighten top nut with a 5/16" nut driver.



Affix the handle and ground wire by placing the screw (10-32 x 1/2") with lock washer through the ground lug.



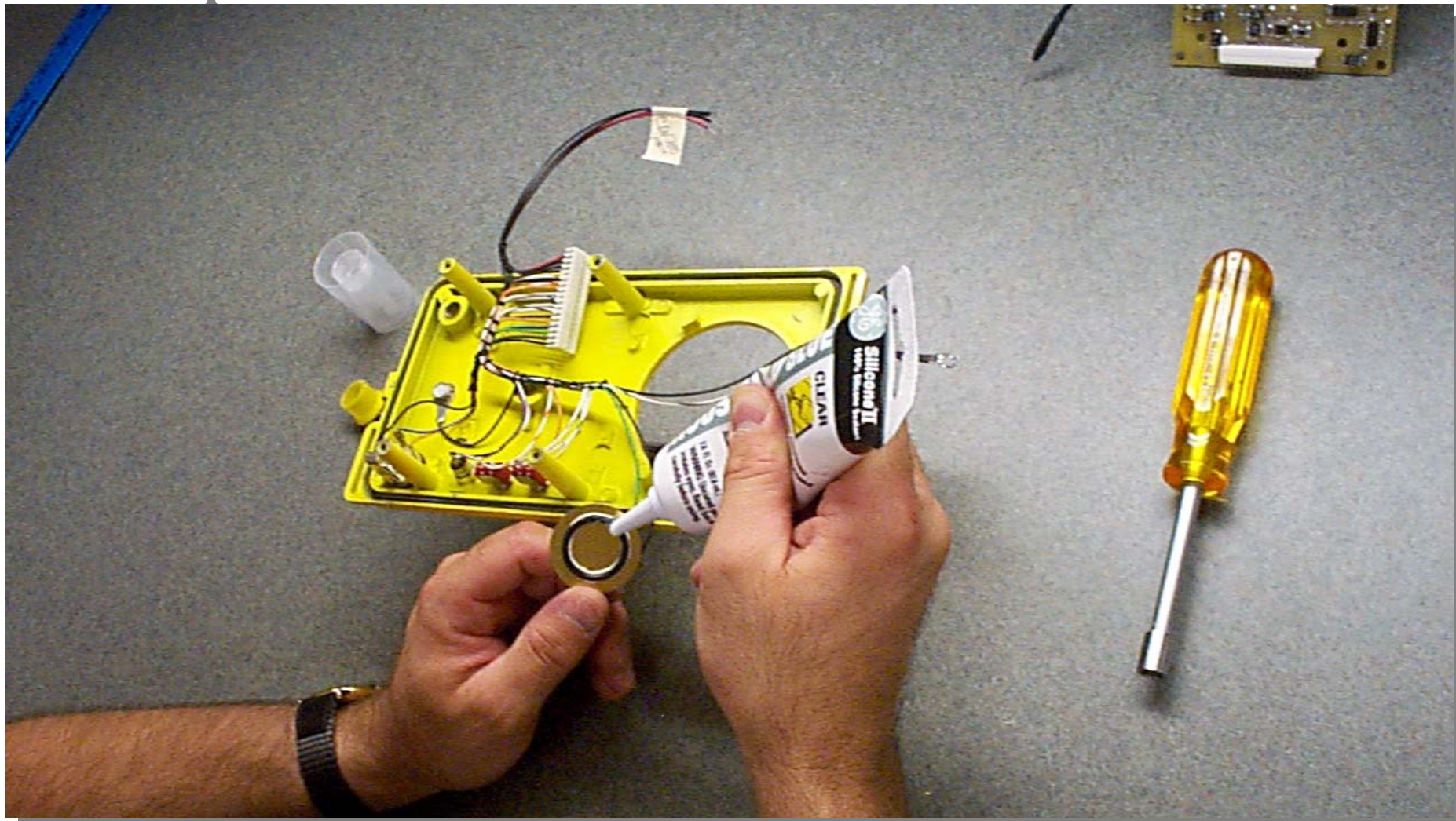
Firmly place handle assembly on the notch on the case top.



Insert the screw and tighten  
with a 5/16" nut driver.



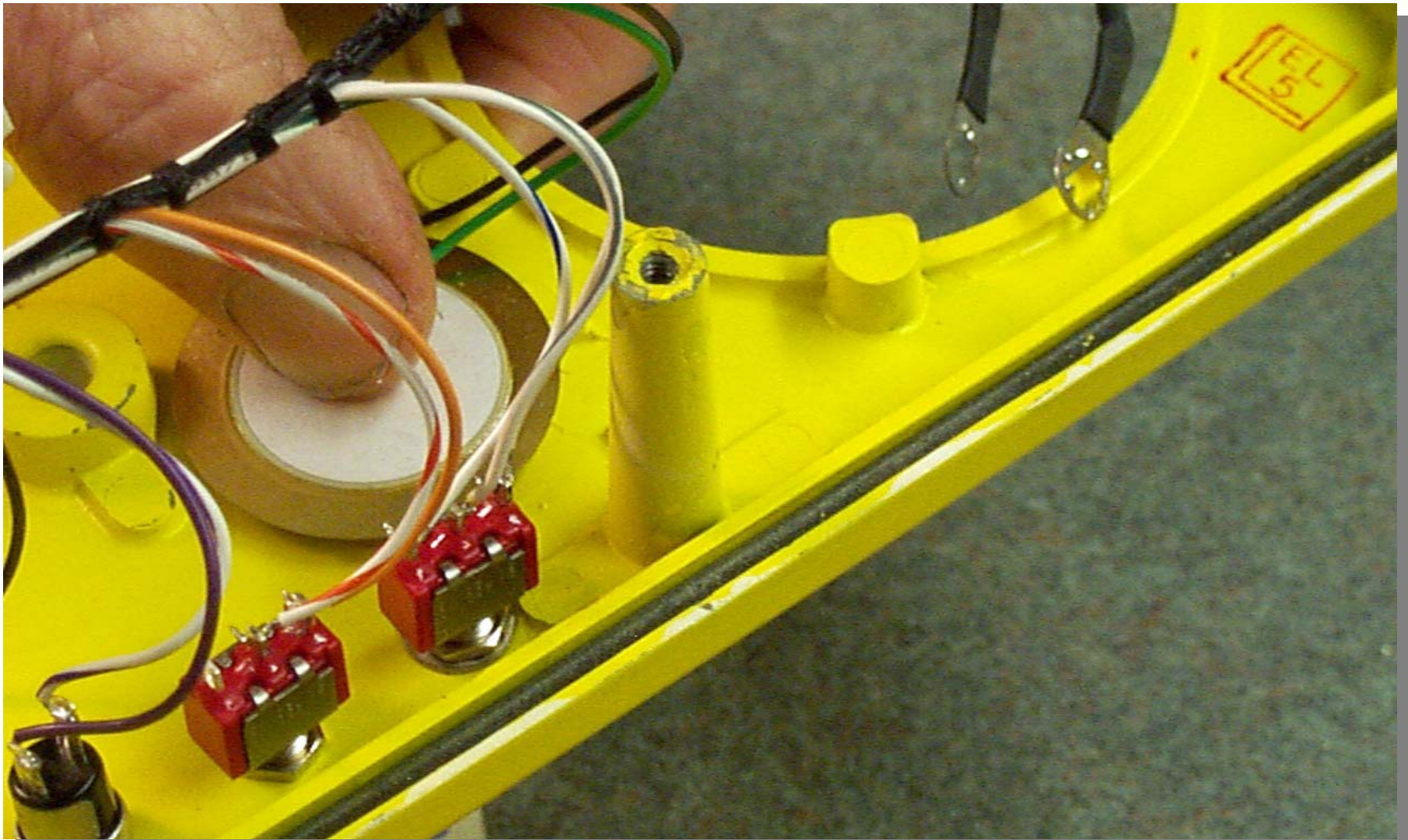
Glue the Unimorph Speaker in place with the RTV adhesive.



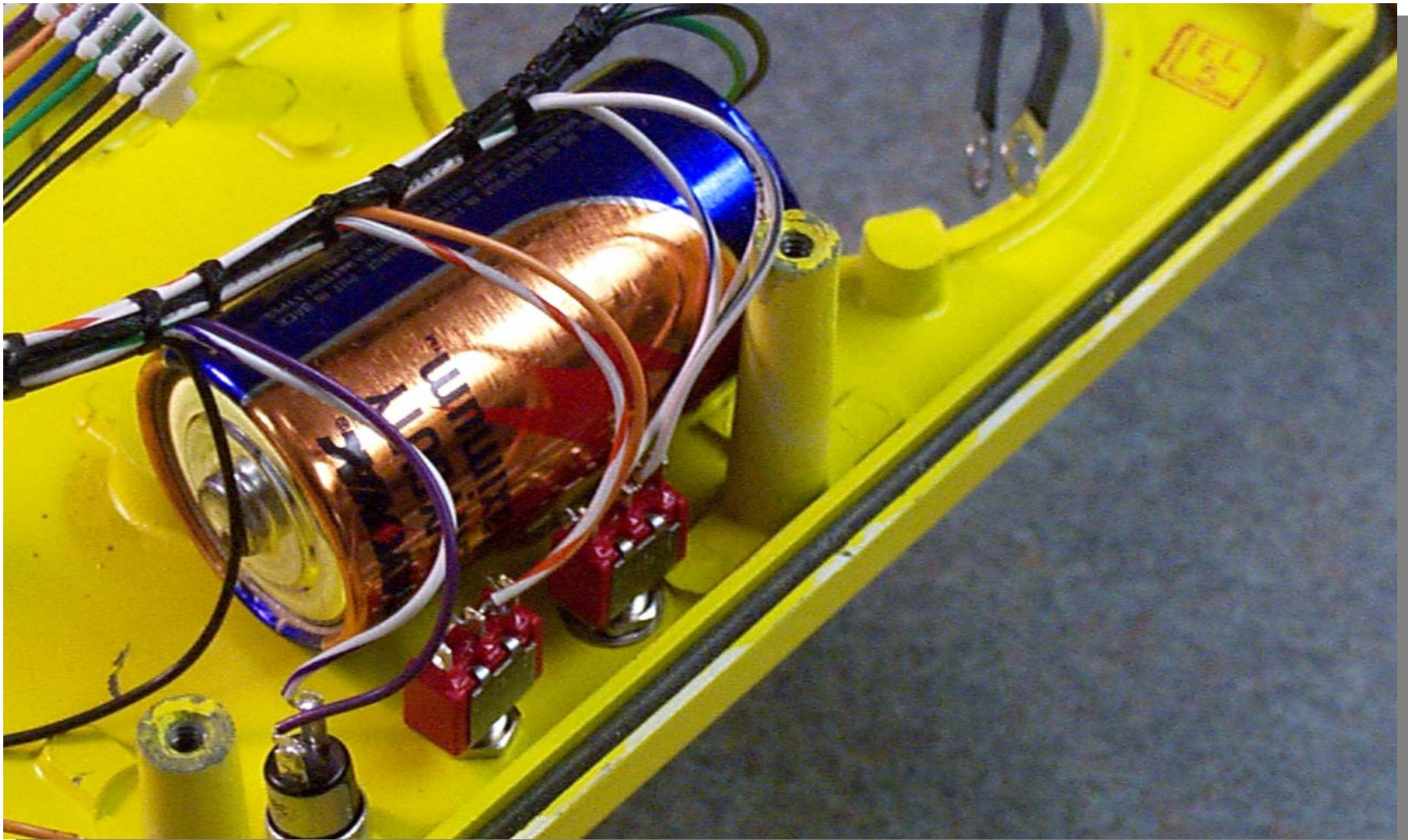
Carefully bead a narrow string of RTV adhesive on the O-ring only.



Center over hole and firmly press.

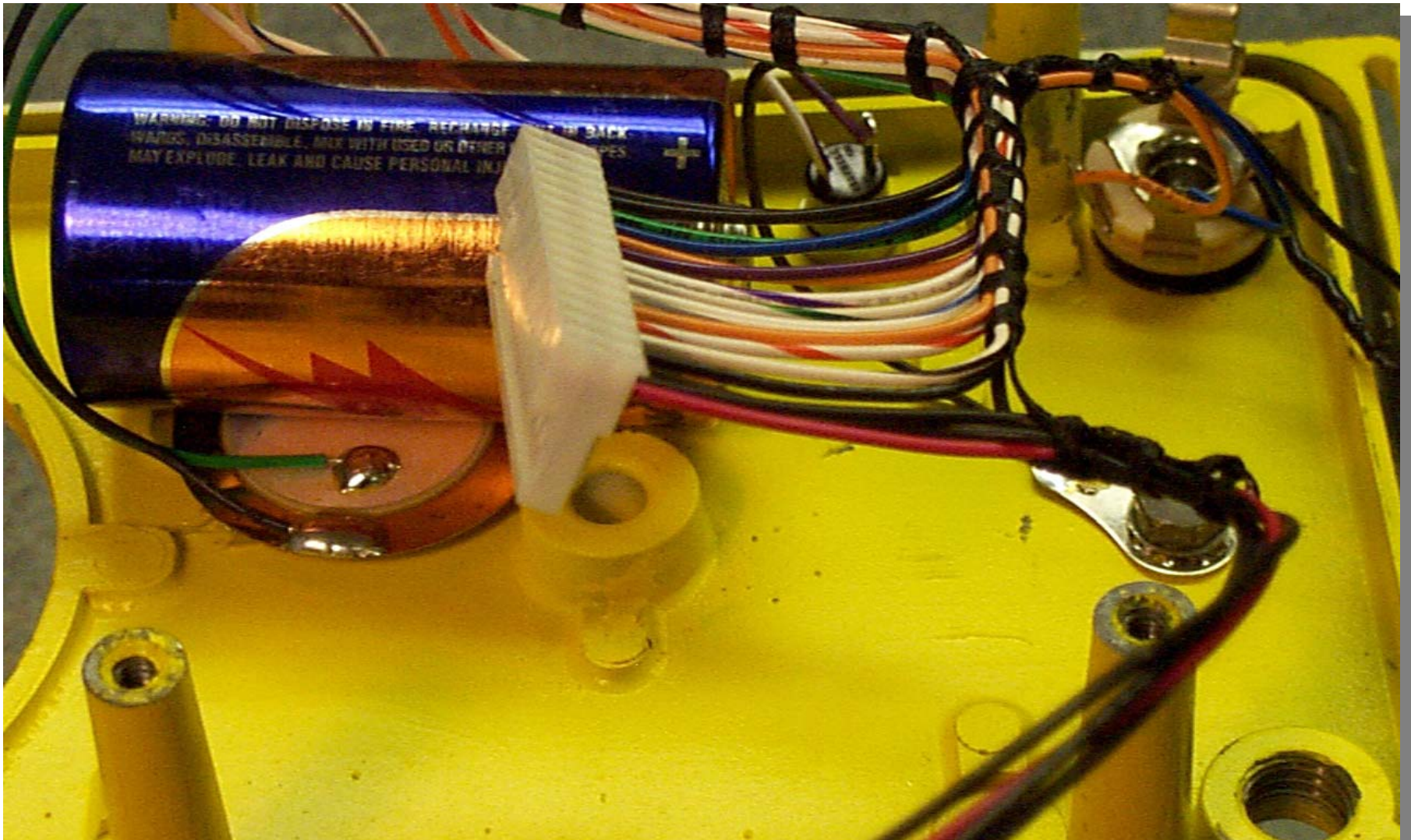


Place small weighty object on speaker.





Allow to cure for 16 hours.

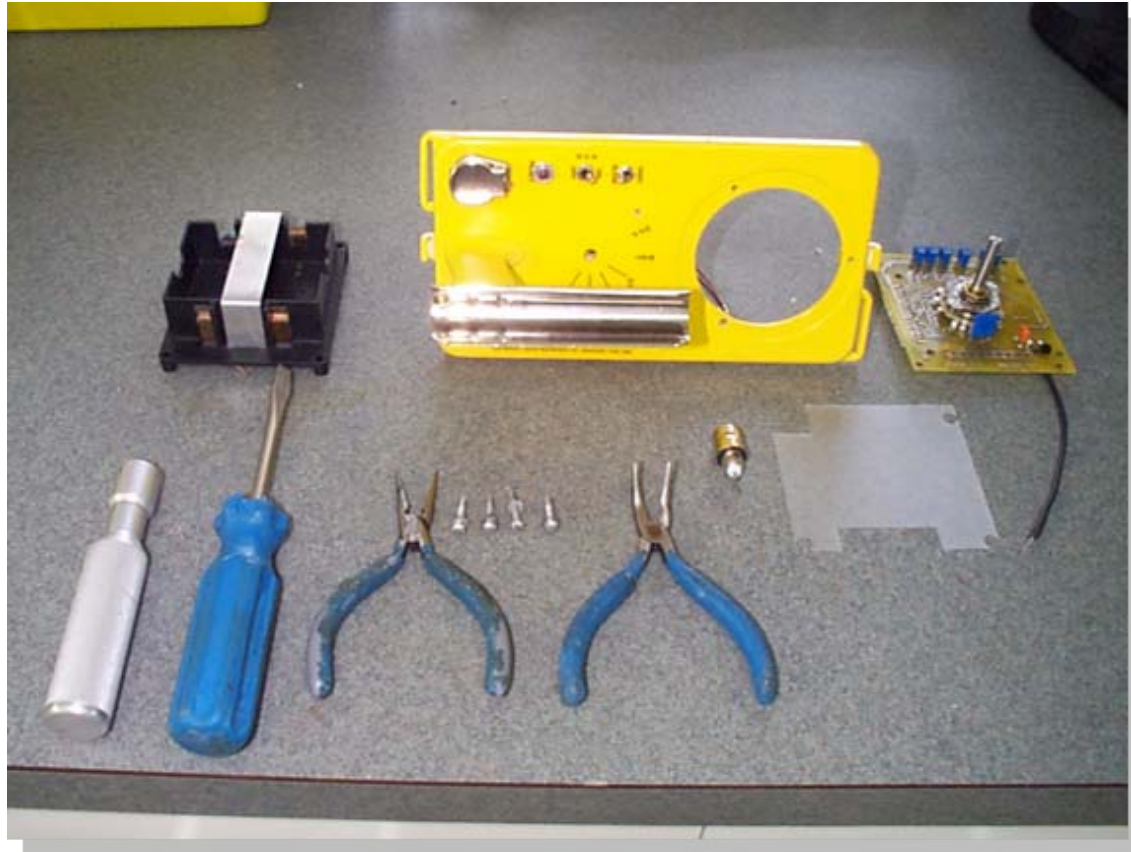


# Punch hole for speaker in Lexan<sup>®</sup> nameplate overlay using specially designed punch.



# Section 2: Solder Connections Assembly

- These components and tools are used for soldering connections.



# Solder Connections Assembly: Parts and Tools Required

- Instrument case top completed through red and green assembly procedures,
- Female “C” connector, 60/40 or 63/37 Tin/Lead solder, specially designed “C” connector installation tool,
- **Lionel/Electro-Neutronics case:** Circuit board and battery holder with four #6-32 x  $\frac{3}{4}$ ” slotted sheet metal screws, a slotted screw driver and both round and bent nose pliers, plastic shield, OR
- **Anton case:** Circuit board and battery holder with four #6-32 x  $\frac{3}{4}$ ” slotted sheet metal screws, four  $\frac{3}{8}$ ” long x  $\frac{1}{8}$ ” ID aluminum stand-offs, four #6-32 x  $\frac{3}{4}$ ” slotted screws and four #6-32 nuts, slotted screw driver,  $\frac{5}{16}$ ” wrench and both round and bent nose pliers, plastic shield,
- Turn on and clean solder irons, open air valve and wet solder station sponges.

# Install “C” connector.



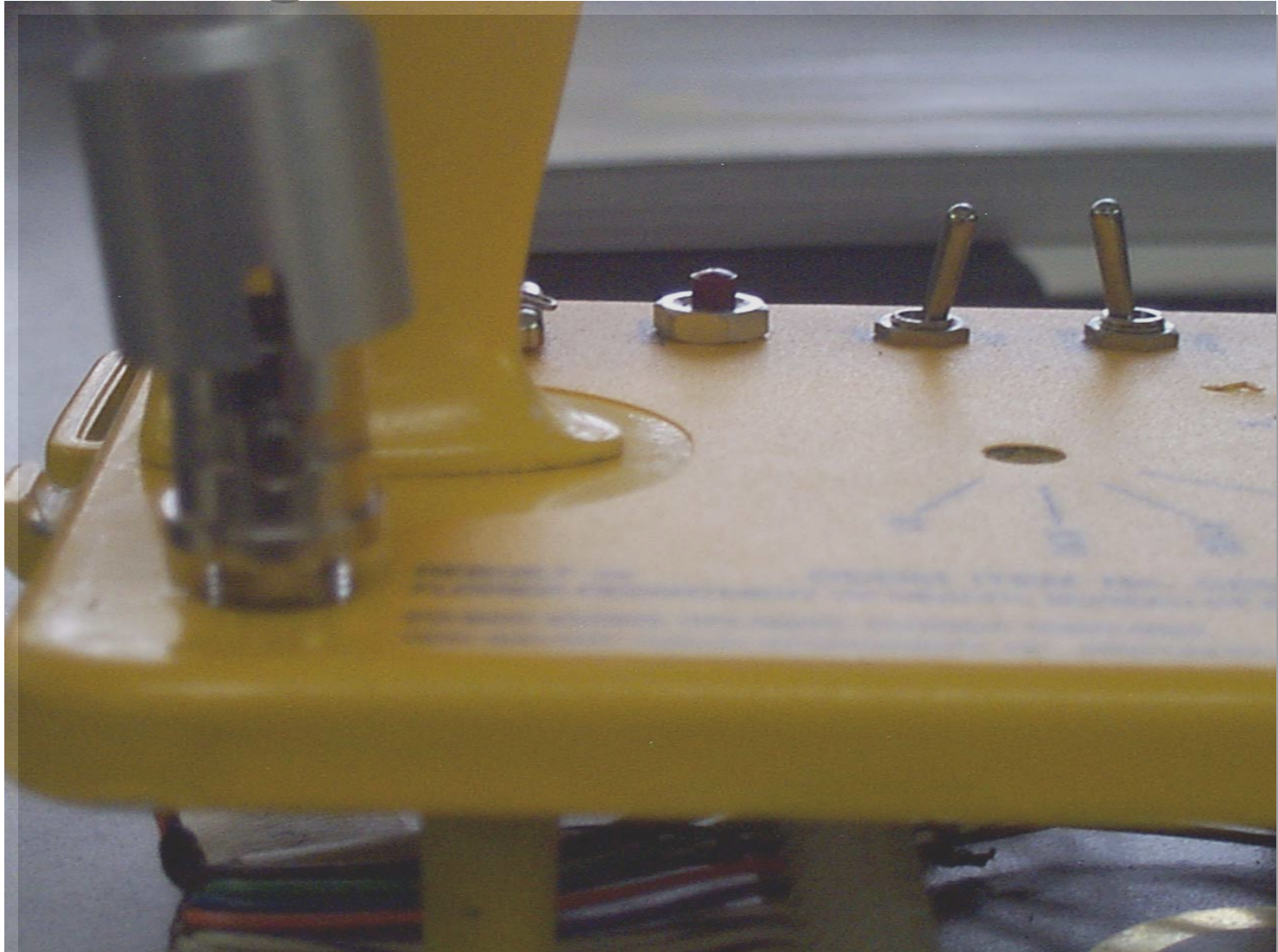
Place gasket on connector.



# Hand tighten connector into case.

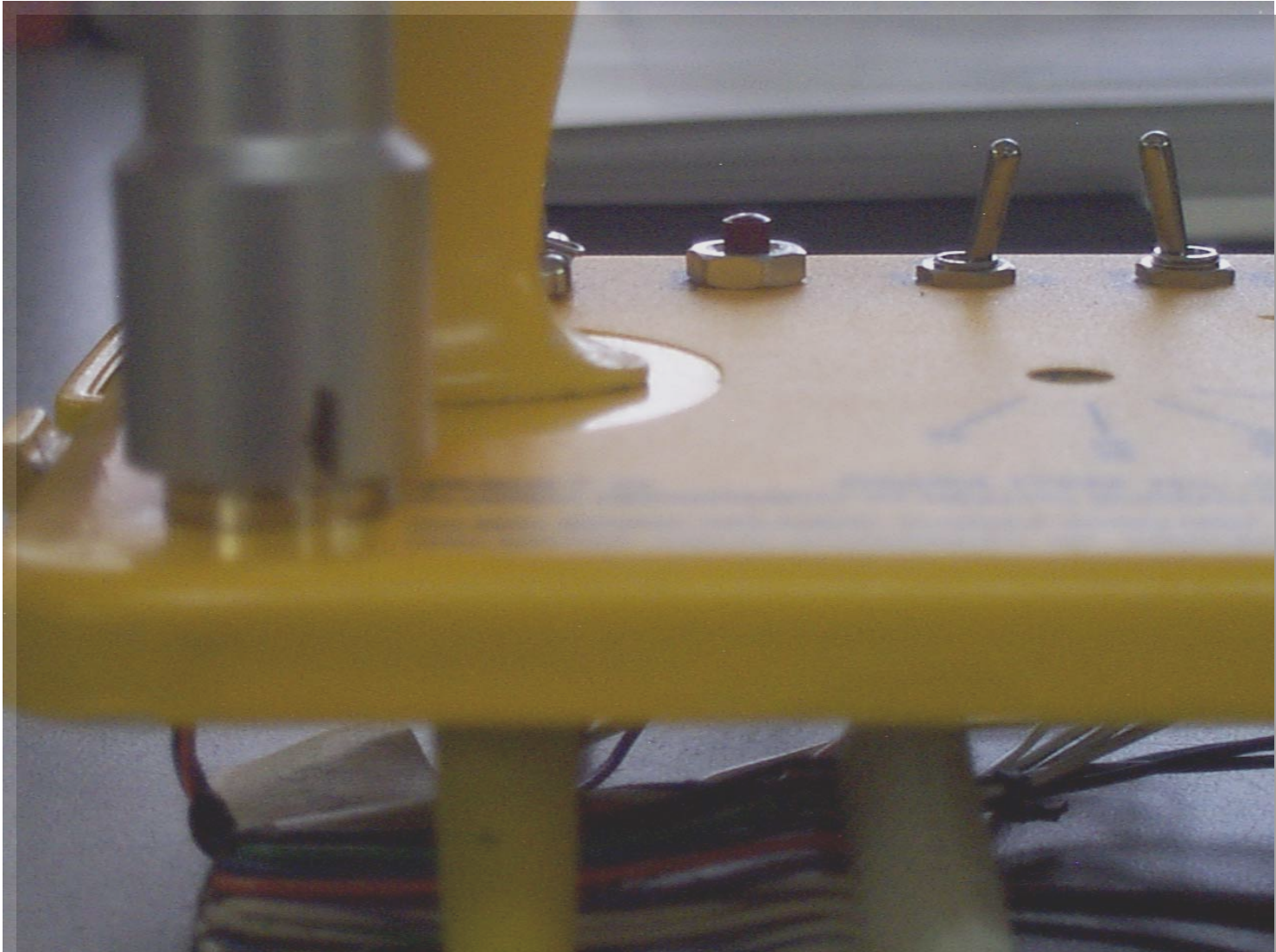


Place specially designed tool on hand tight female “C” connector.

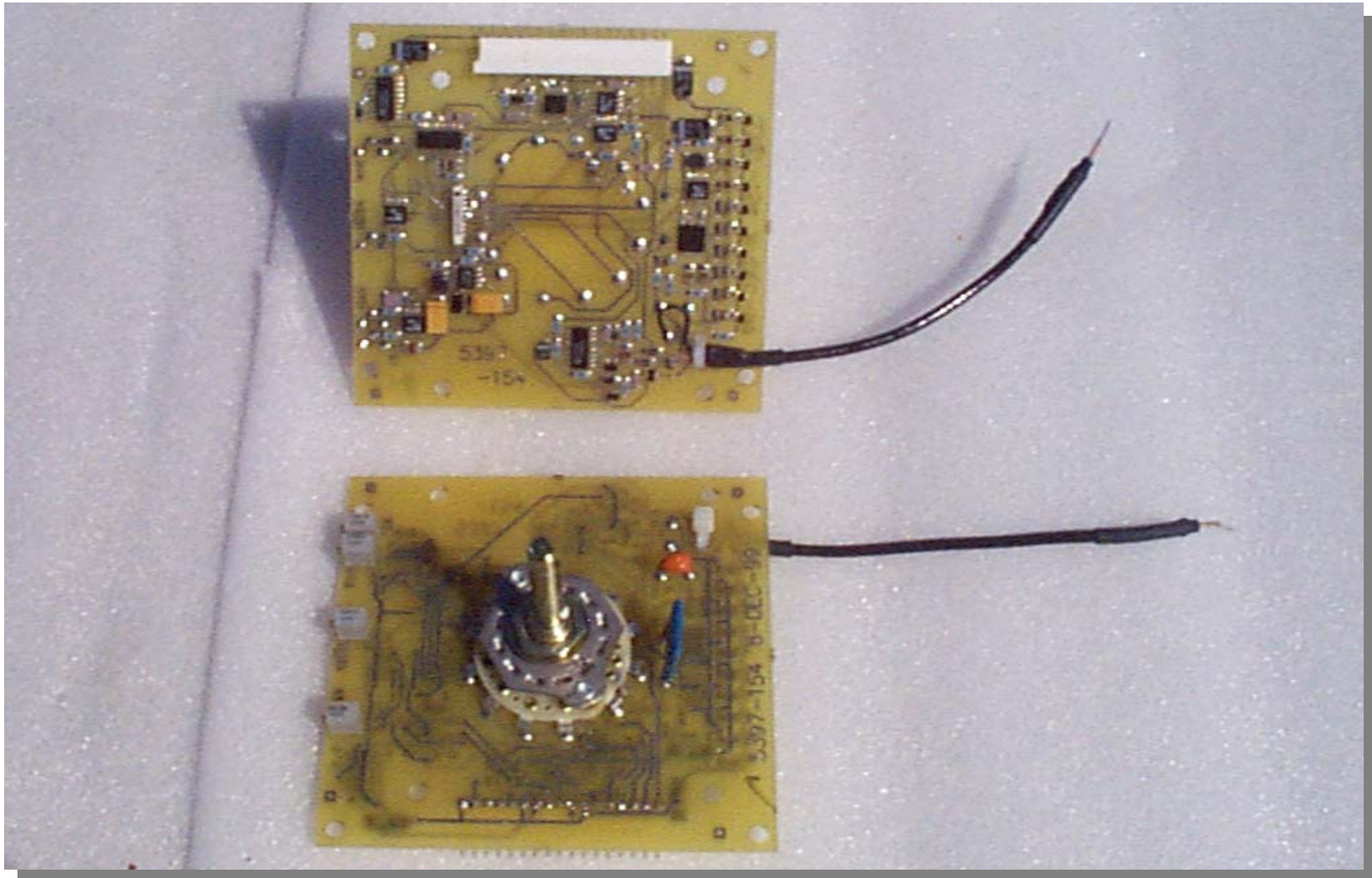




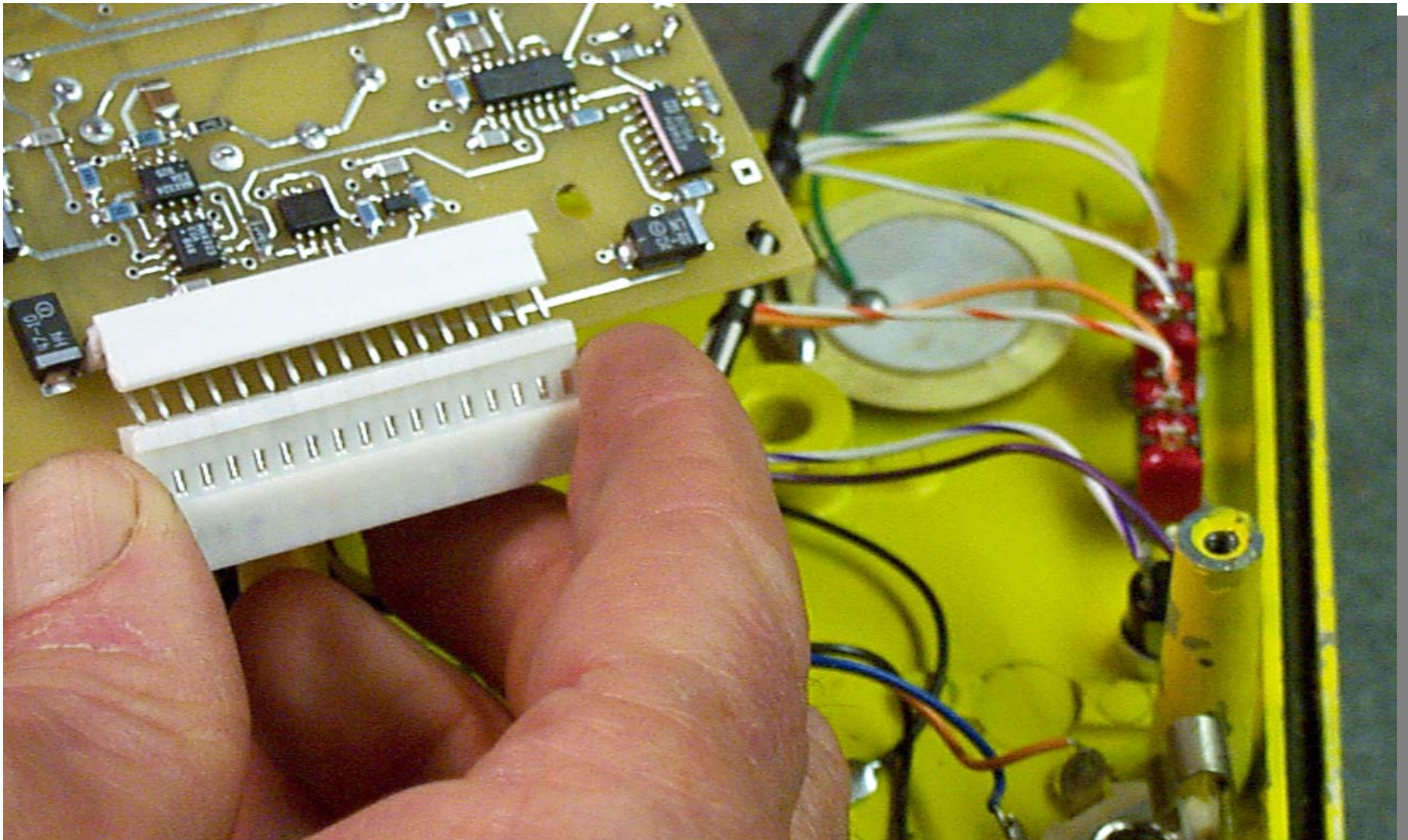
Tighten the installed “C” connection  
1/8 turn past snug.



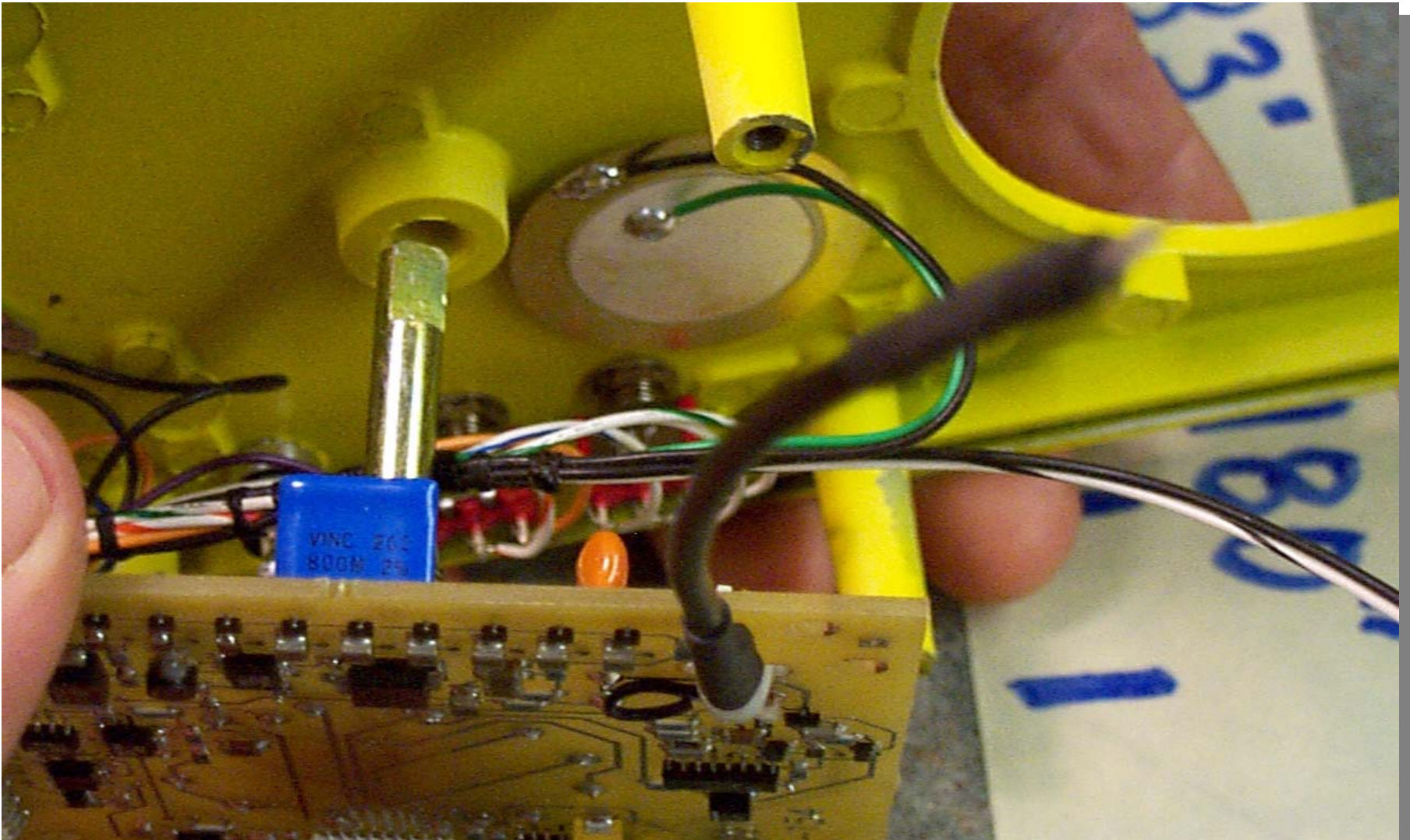
# Install Circuit Board



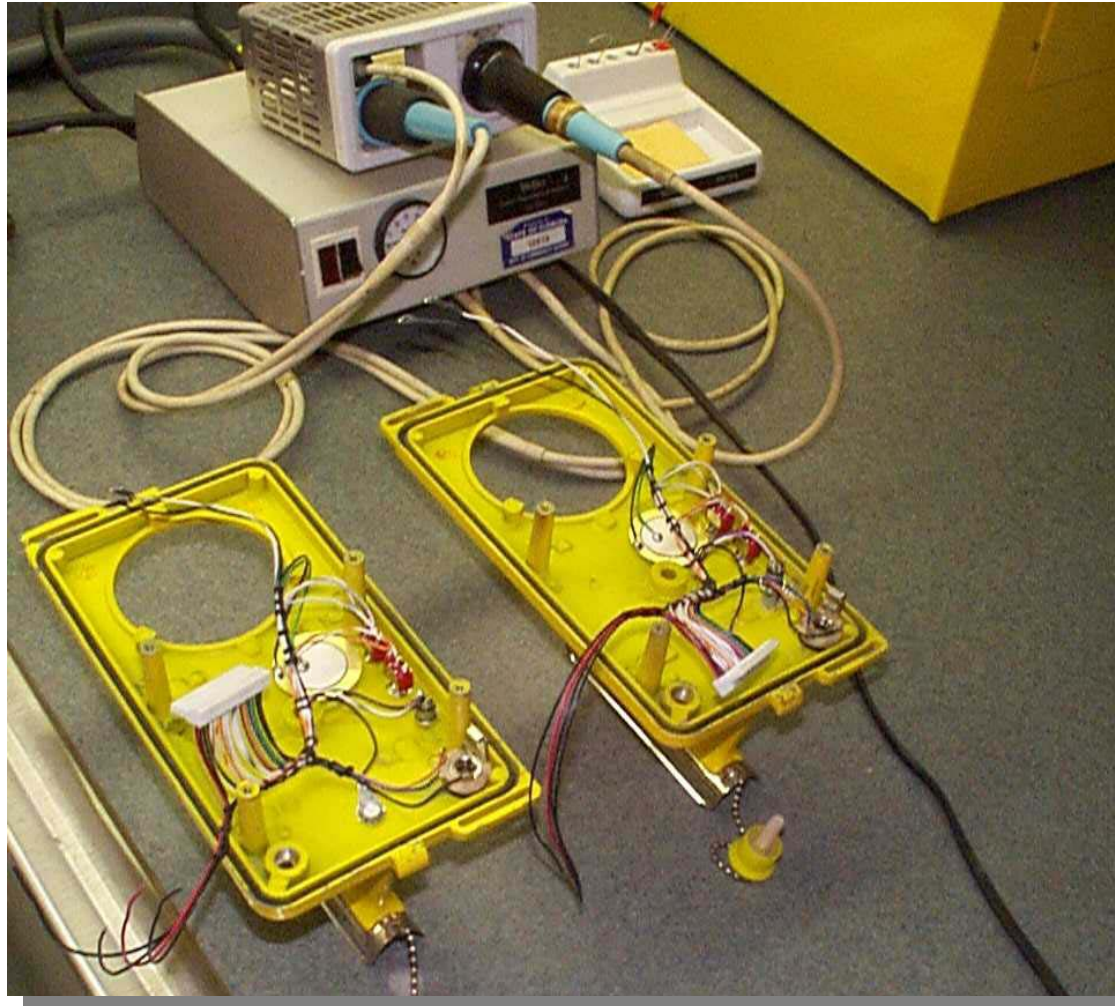
Carefully plug-in connector as shown,  
taking care not to bend any leads.



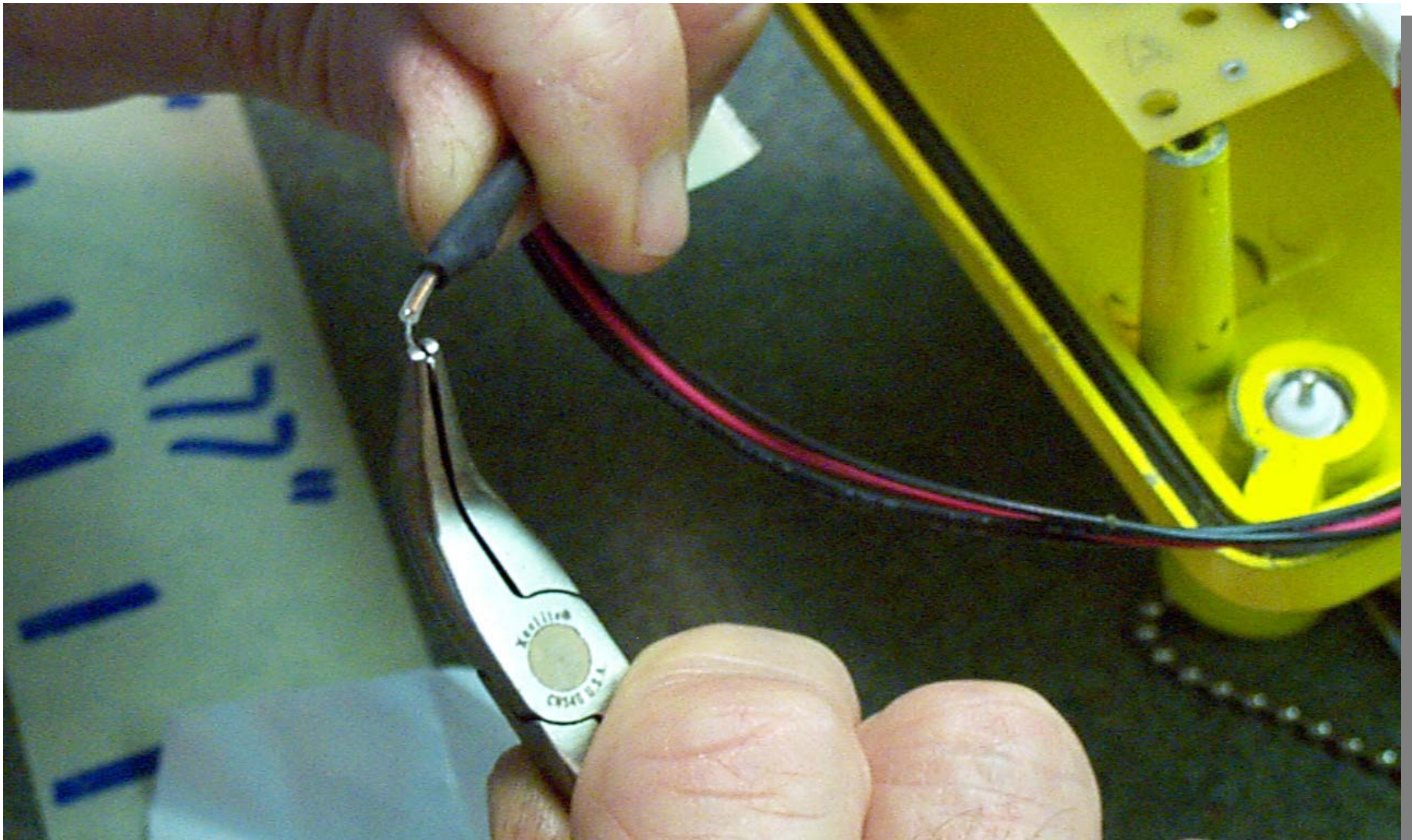
Push rotary switch post through hole  
and line up holes with screw posts.



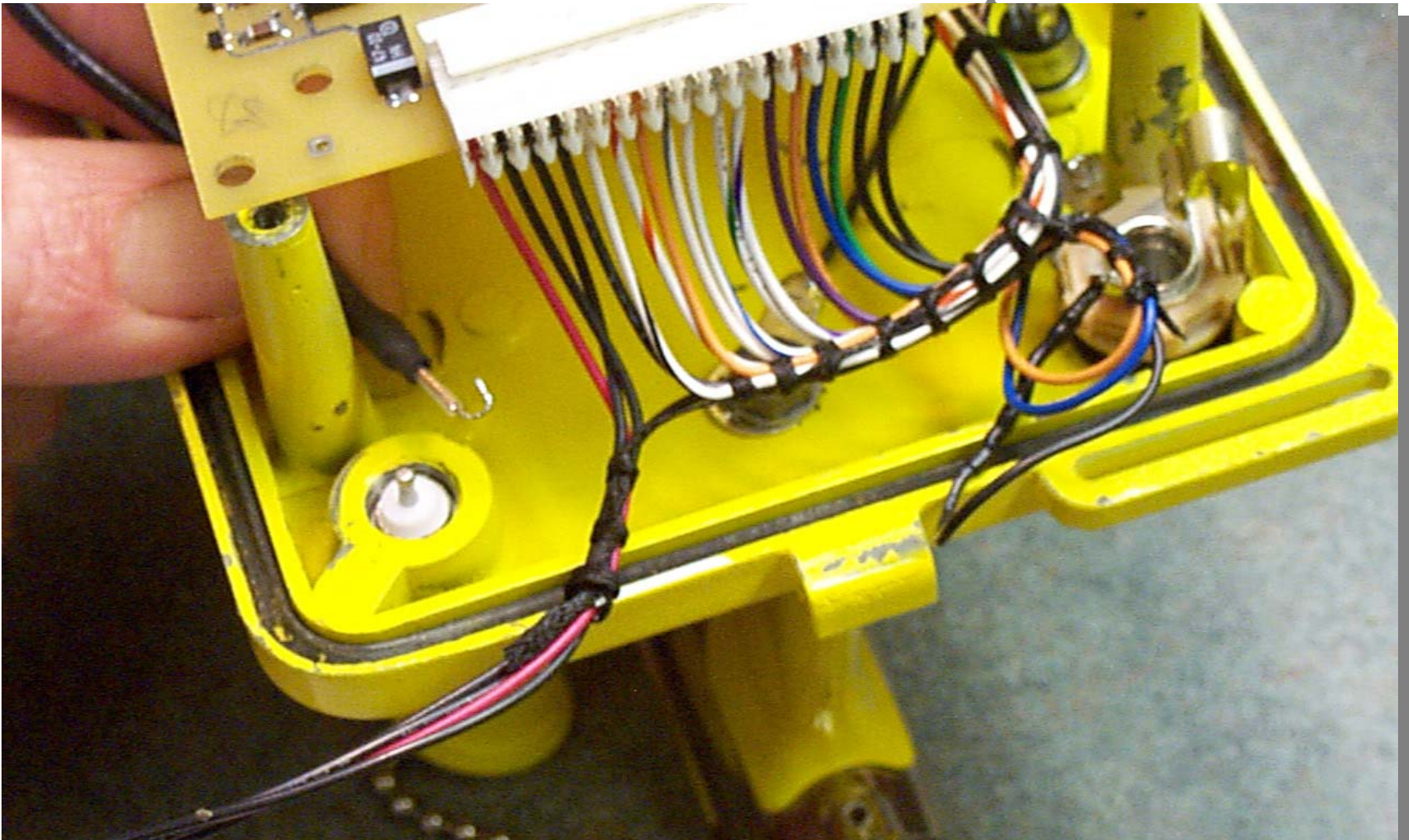
Solder HV lead onto “C” connector  
and battery leads to battery box.



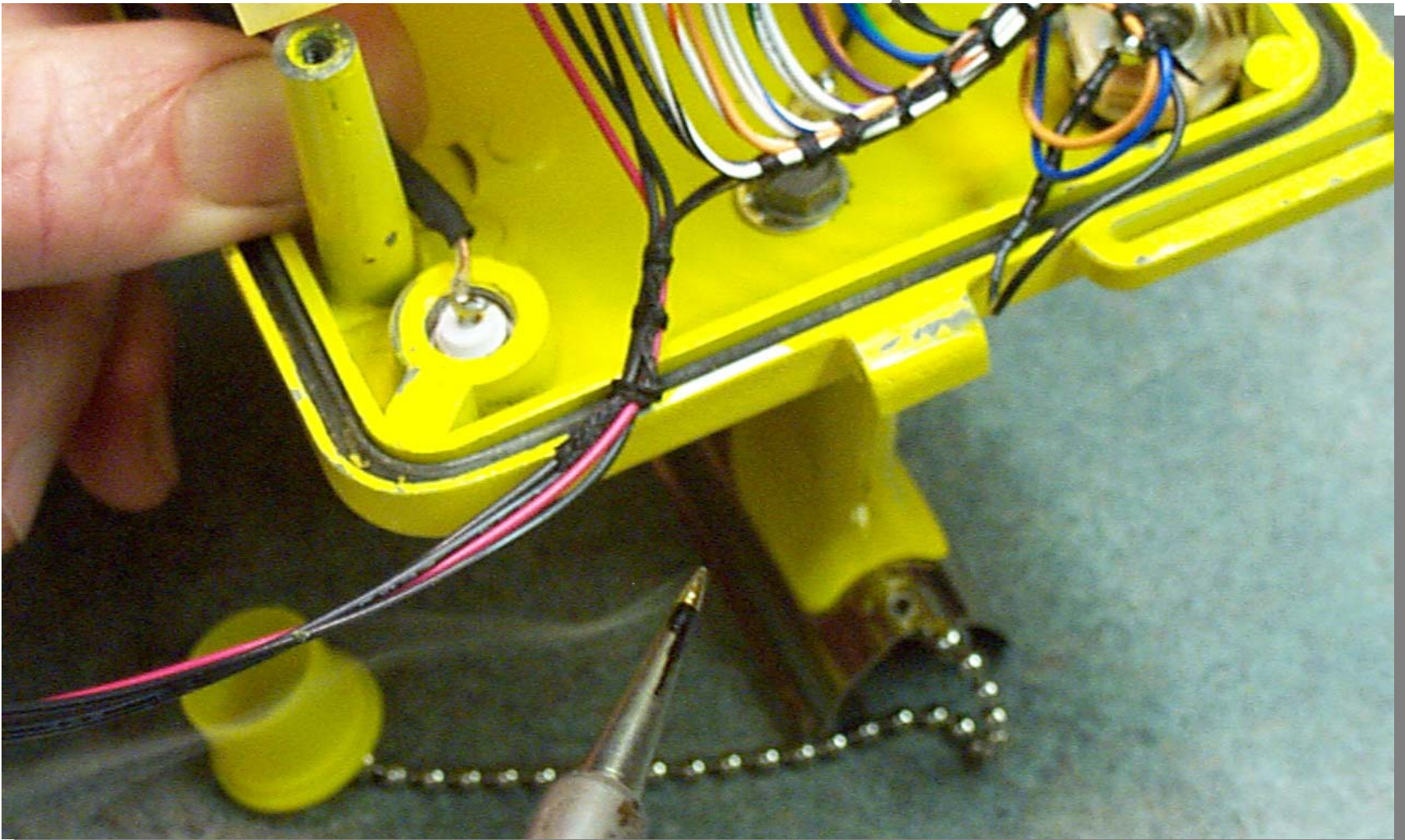
Twist HV lead into a “J” shape.



Feed the HV lead to the  
inside of the screw post.

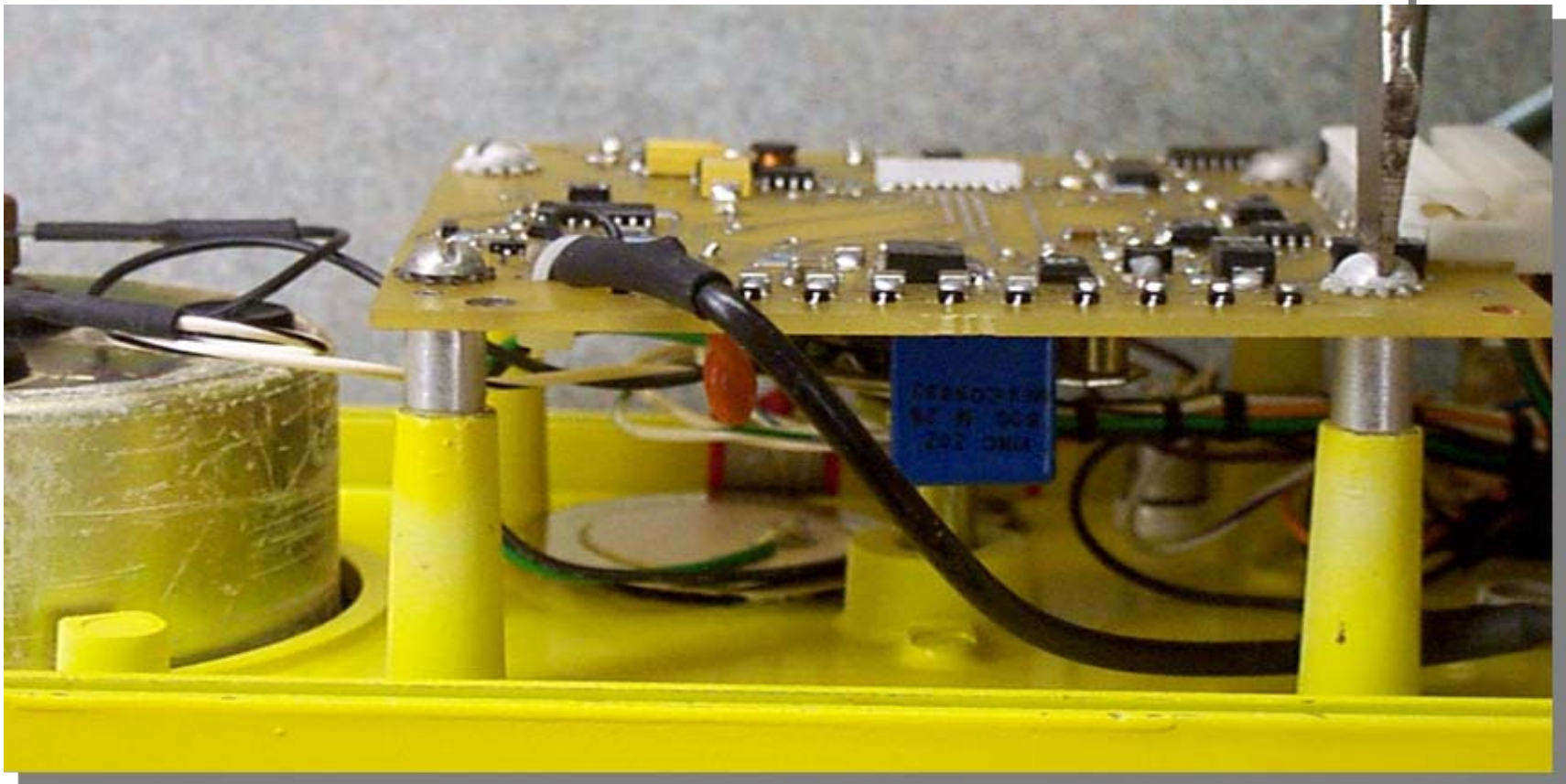


Hook lead onto “C” connector  
and solder into place.

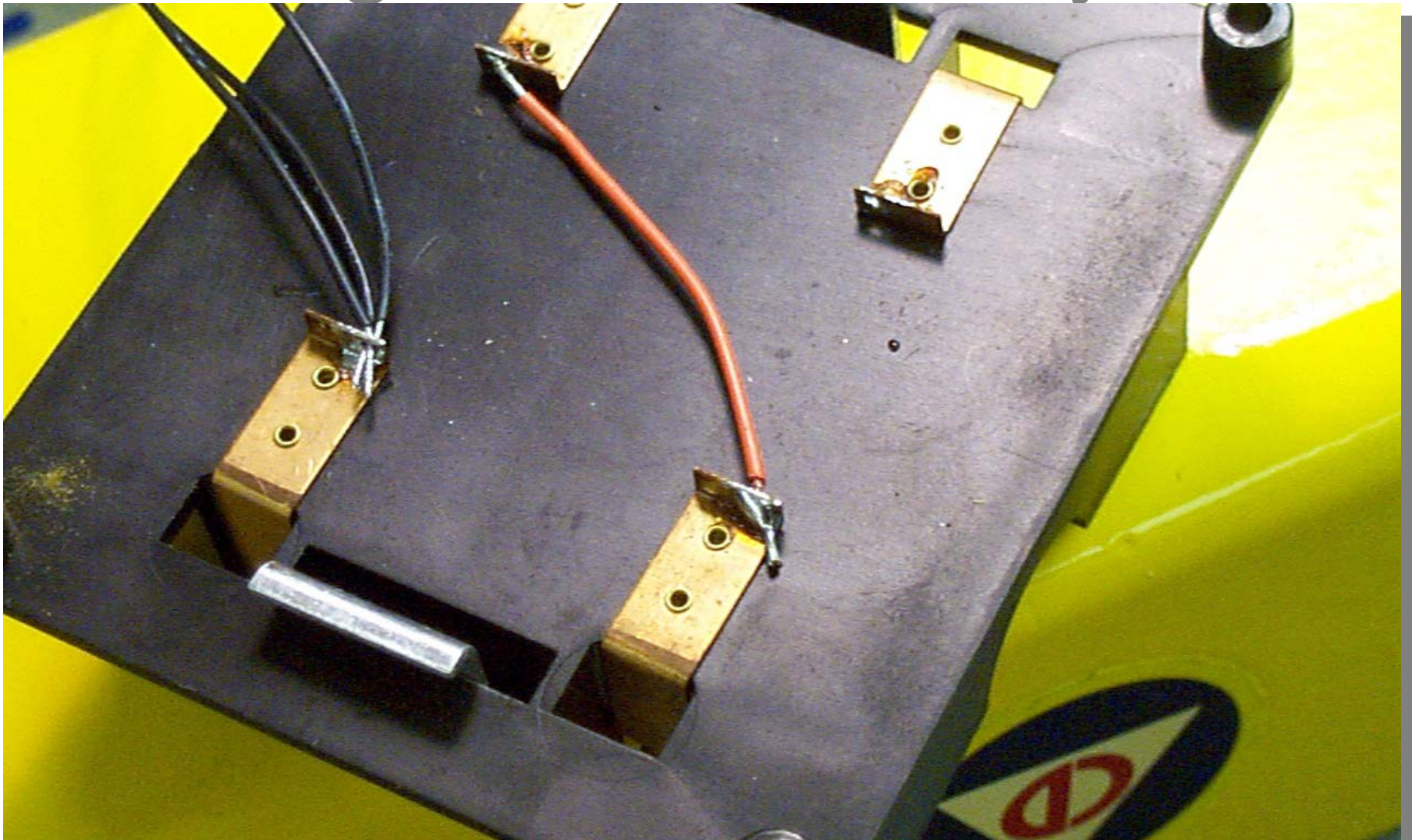




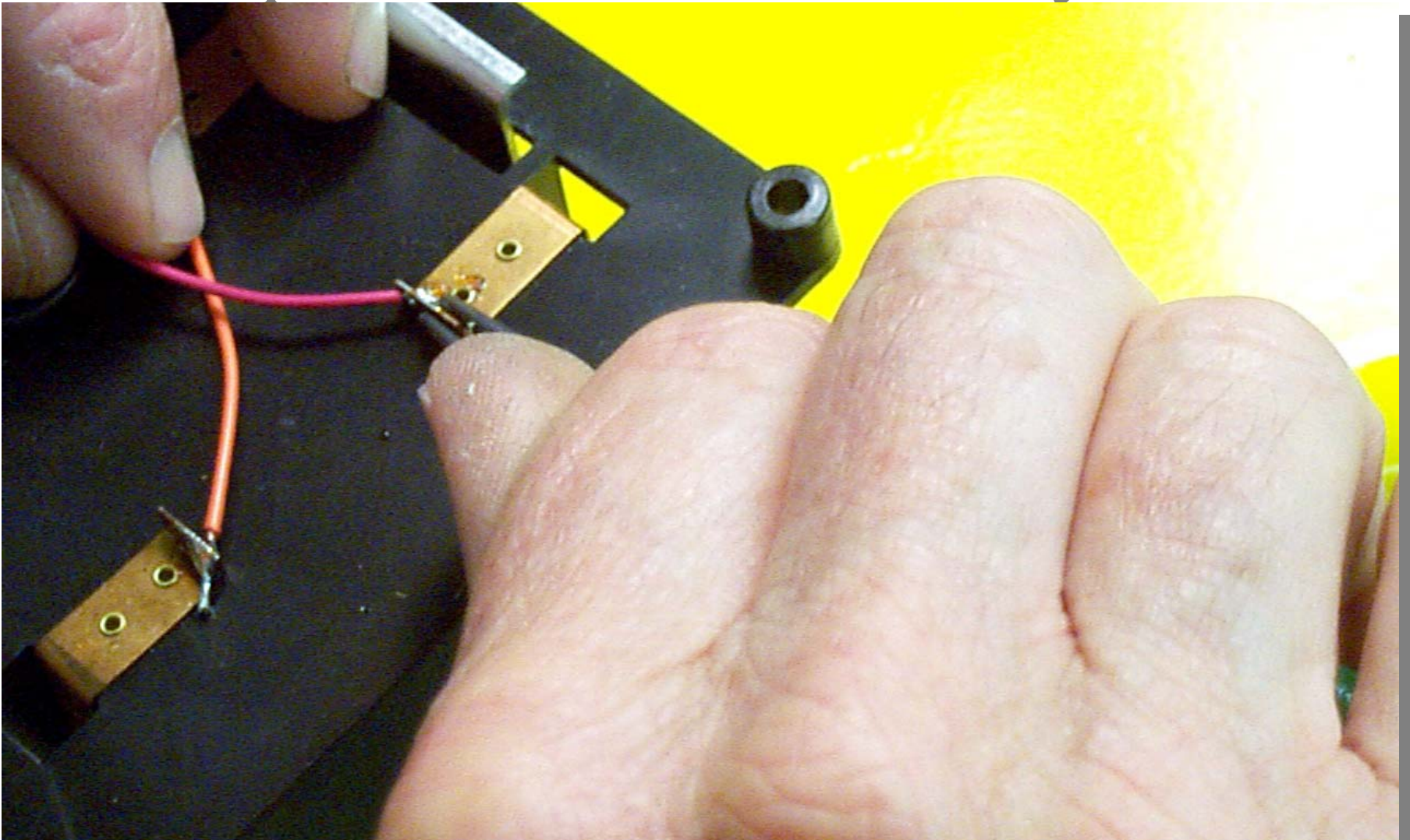
**ANTON ONLY:** Using the four #6-32 x  $\frac{3}{4}$ " slotted sheet metal screws and four  $\frac{3}{8}$ " long x  $\frac{1}{8}$ " ID aluminum stand-offs, fasten circuit board to the case top.



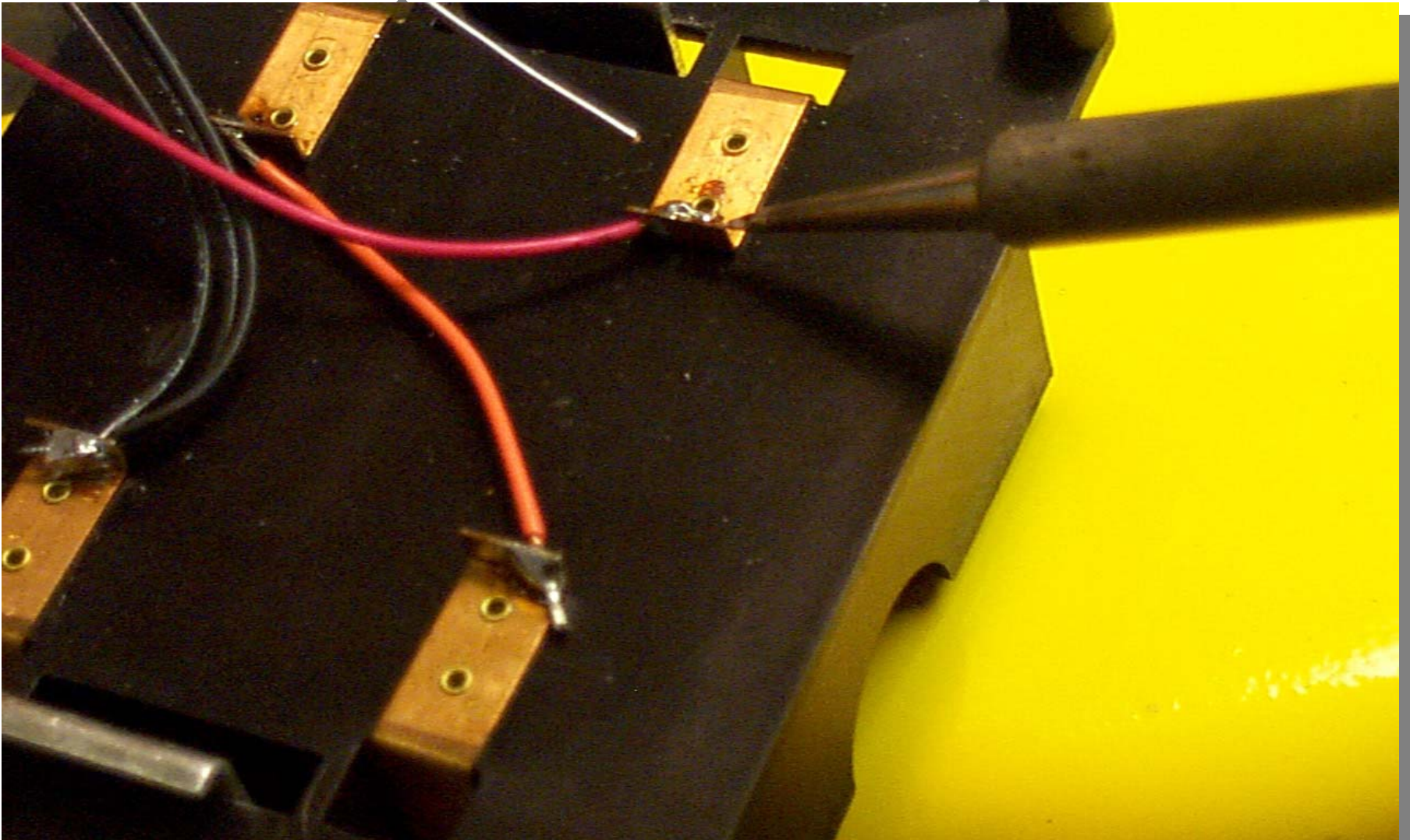
Feed ground leads through terminal on negative side of battery box.



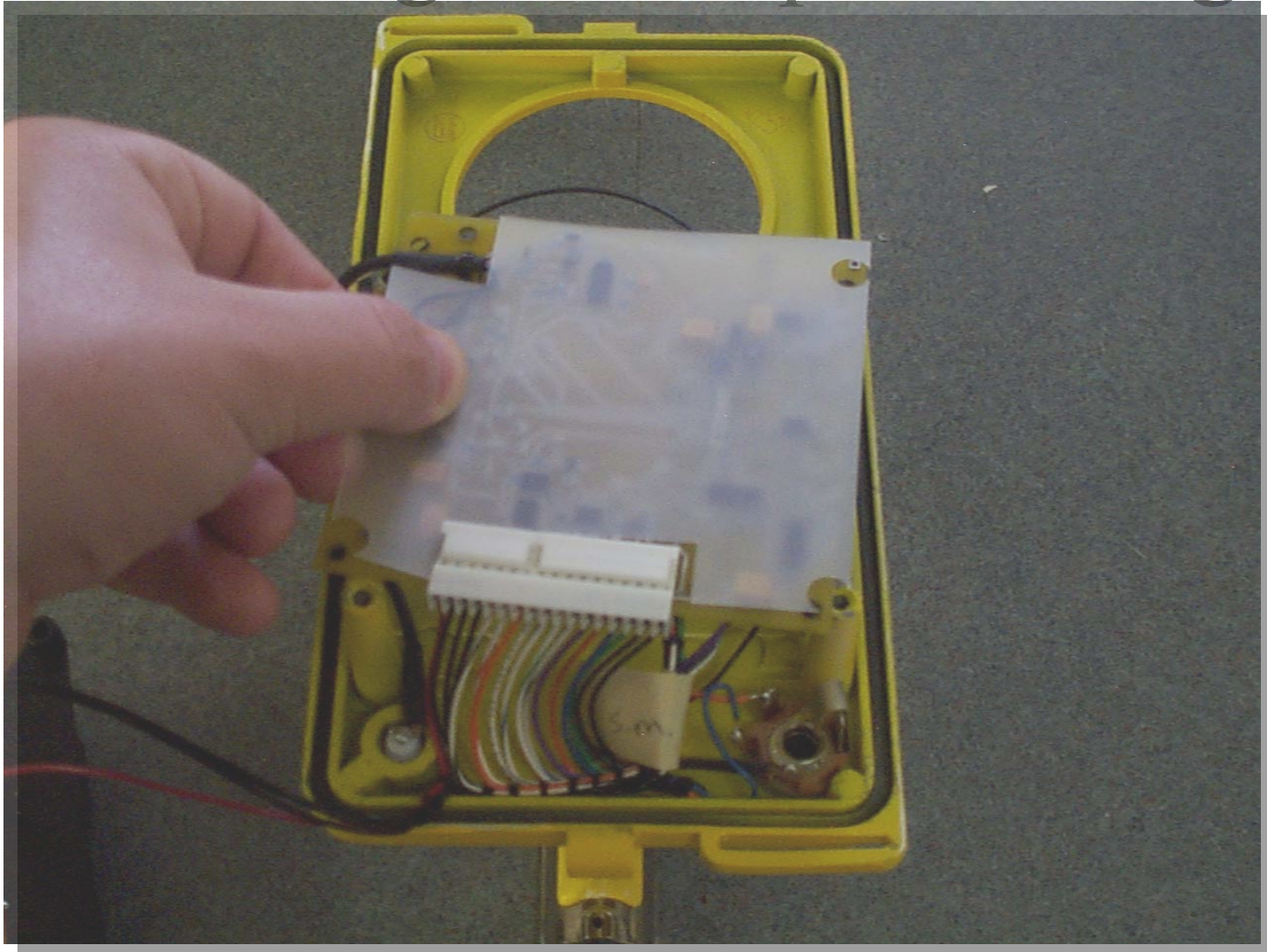
Feed positive lead through terminal  
on positive side of battery box.



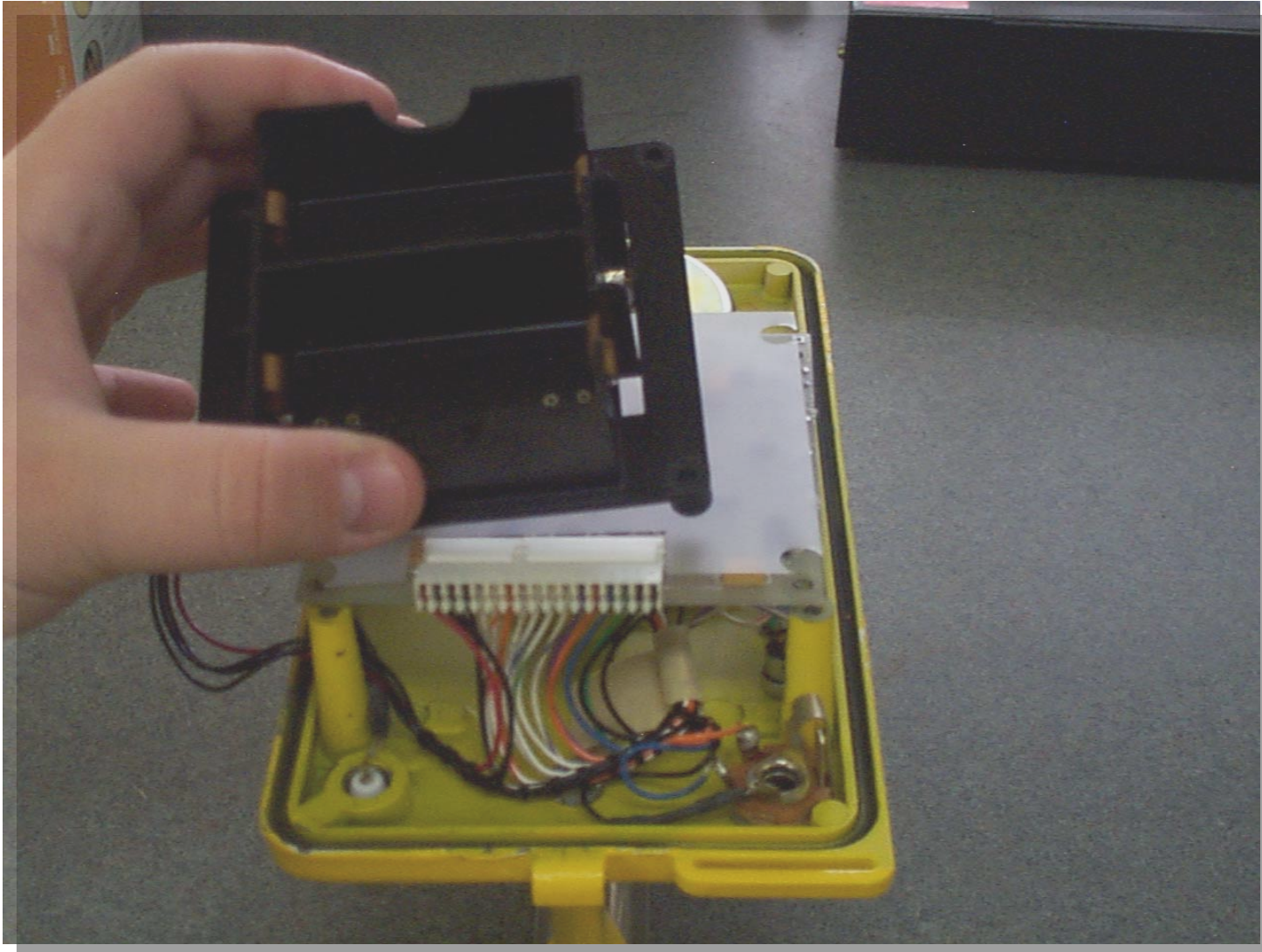
Solder the negative leads  
and positive lead in place.



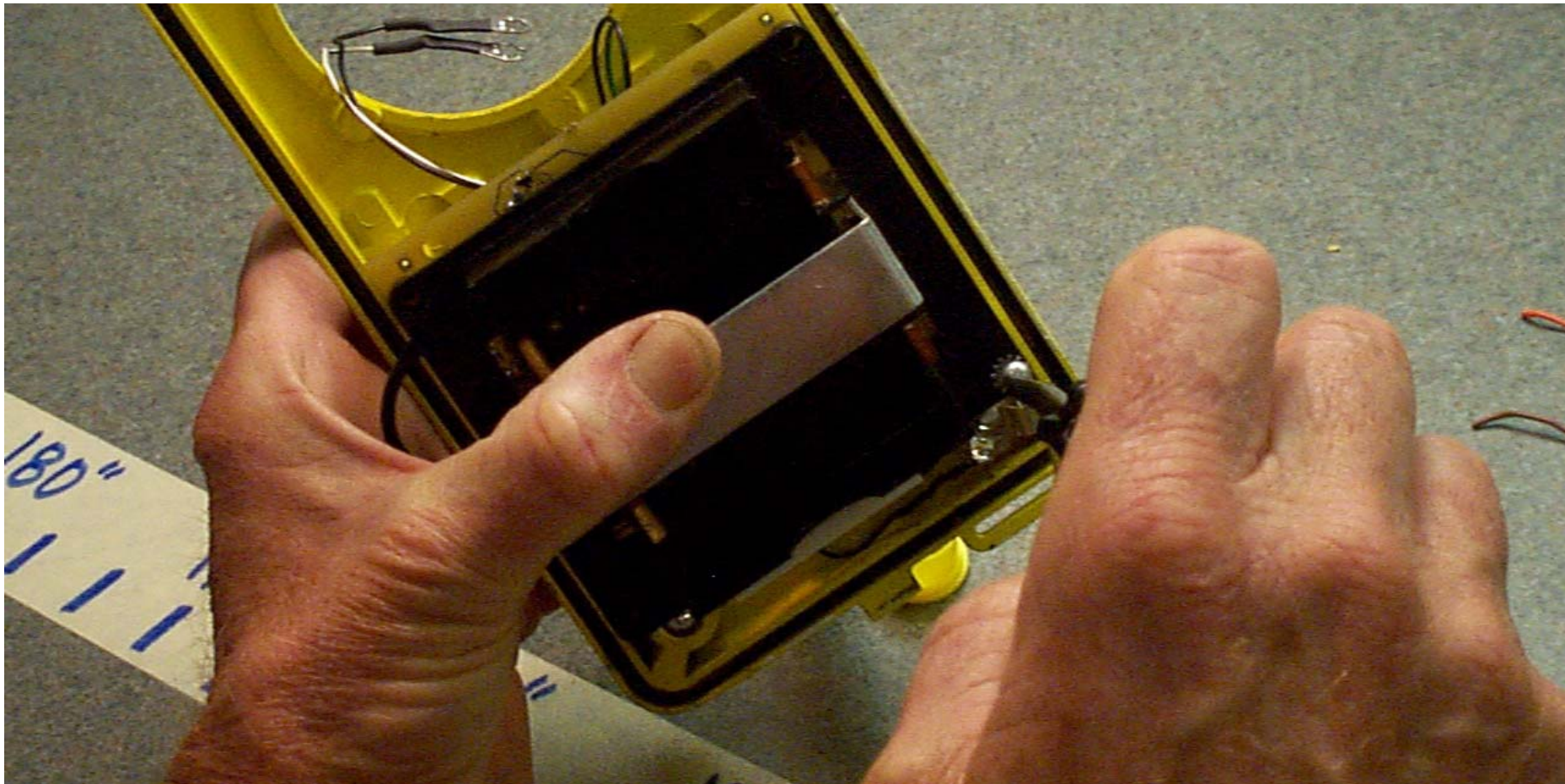
Install plastic protective shield,  
observing correct positioning.



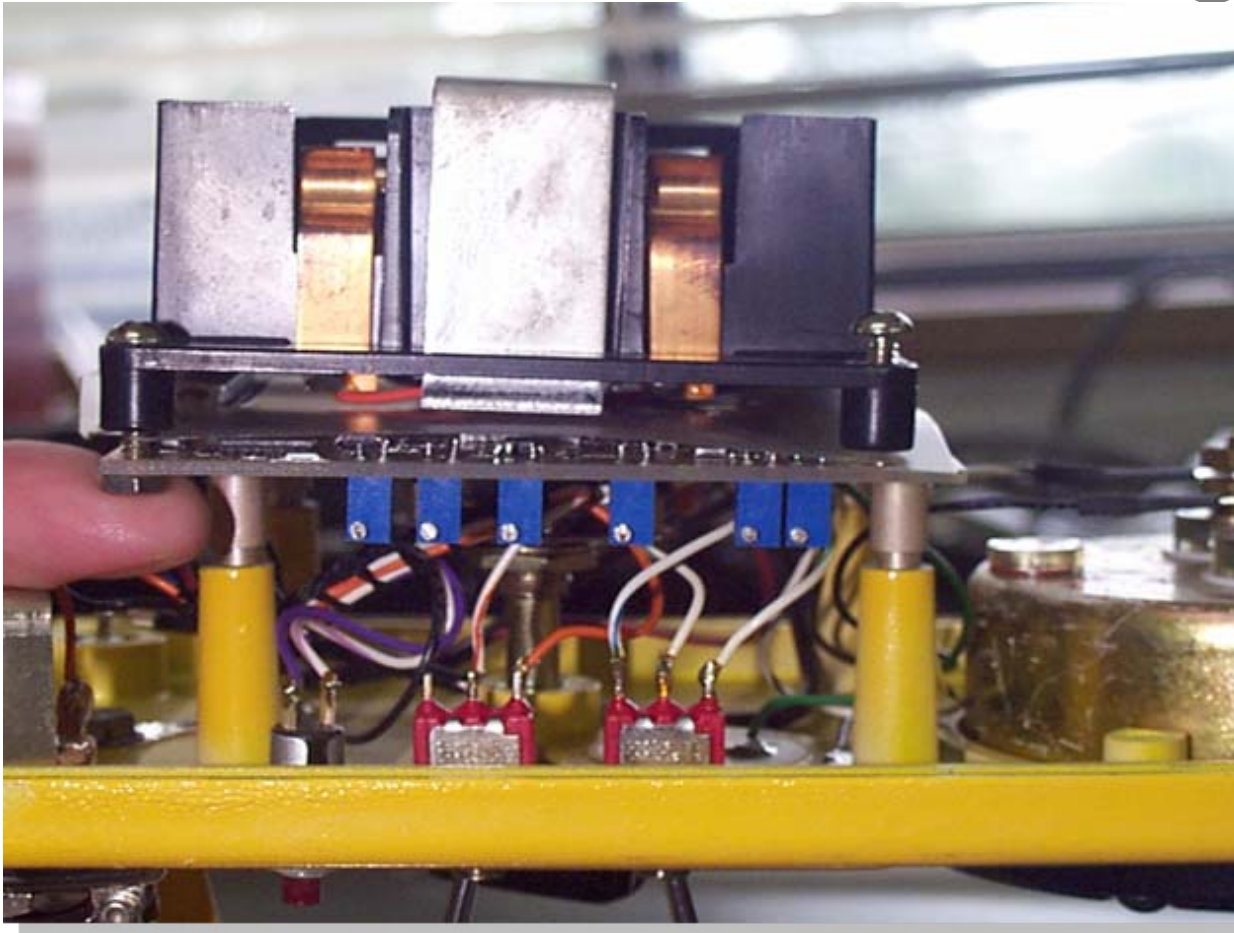
Place battery box on circuit board, positive side on same side as headphone jack.



LIONEL/ENi: Line-up screw holes, insert four #6-32 x  $\frac{3}{4}$ " slotted sheet metal screws and tighten.



ANTON: Line-up screw holes and insert four #6-32 x  $\frac{3}{4}$ " slotted screws and four #6-32 nuts. Hand tighten.





ANTON: Using the slotted screw driver and 5/16" wrench, tighten the screws and nuts attaching the battery box to the circuit board.



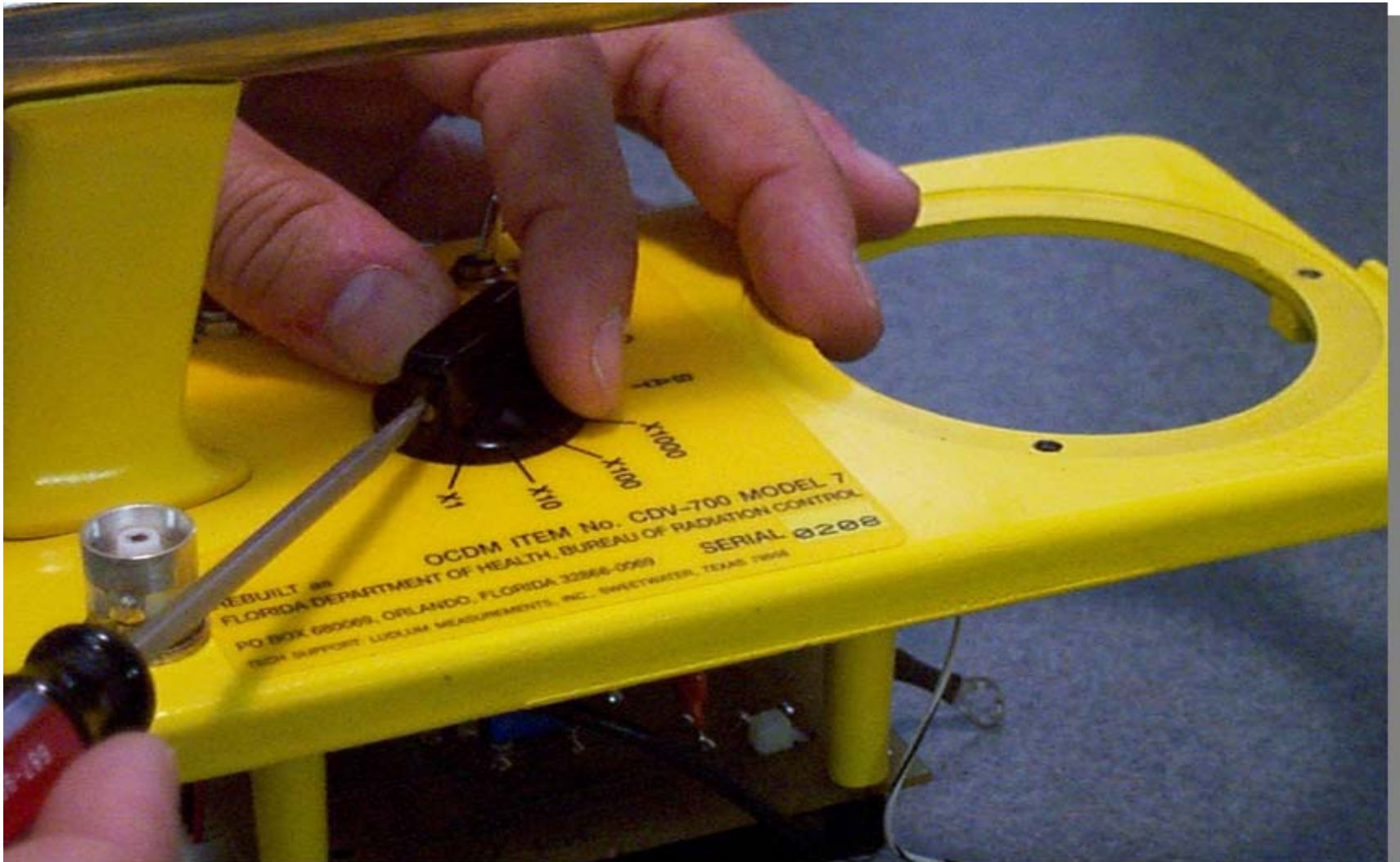
# Section 3: Meter and Detector Assembly



# Meter and Detector Assembly: Parts and Tools Required

- Instrument case top completed through red, green and blue assembly procedures and instrument case bottom.
- One plastic switch knob with two set screws.
- Philips screwdriver #1, 1/8" slotted screwdriver, 3/16" slotted screwdriver, 1 1/32" wrench and 5/16" wrench or nut driver.
- One calibrated 50  $\mu$ amp meter movement, one dual reading (0-0.5 mR/hr and 0-300 cpm) meter face, one meter gasket, three #6-32 x 3/4" black brass Phillips screws, two 1 1/32" brass nuts and two 5/16 brass nuts.
- Reconditioned G-M probe from Ludlum, "C" connector, coiled cable, G-M tube gasket, and two "D" batteries.

Line the switch knob up with the off position and tighten set screws.



Color the meter face as shown for the battery test indication. Mark with a single blue line from the 0.36 mR/hr point to the 0.5 mR/hr point.

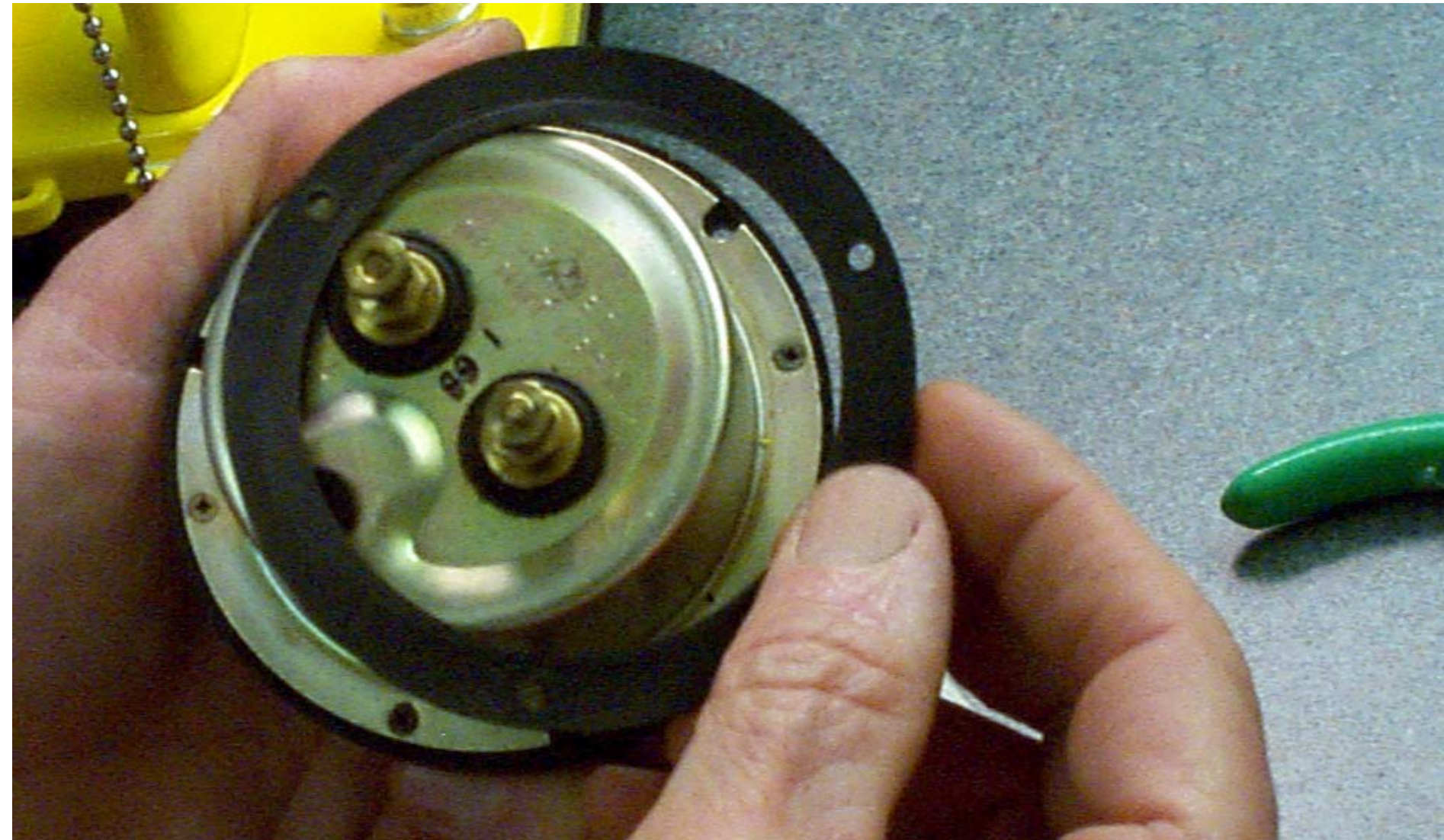


Select proper meter face, clean, assemble and test 50  $\mu$ amp meter.



**NOTE:** Use the procedure in FEMA Repair and Maintenance Manual for Radiological Instruments, Volume 10, Appendix F, Page F-35, **METERS**.

Affix gasket and line-up holes.



Affix meter to case top, line-up holes, insert black Phillips screws and tighten.

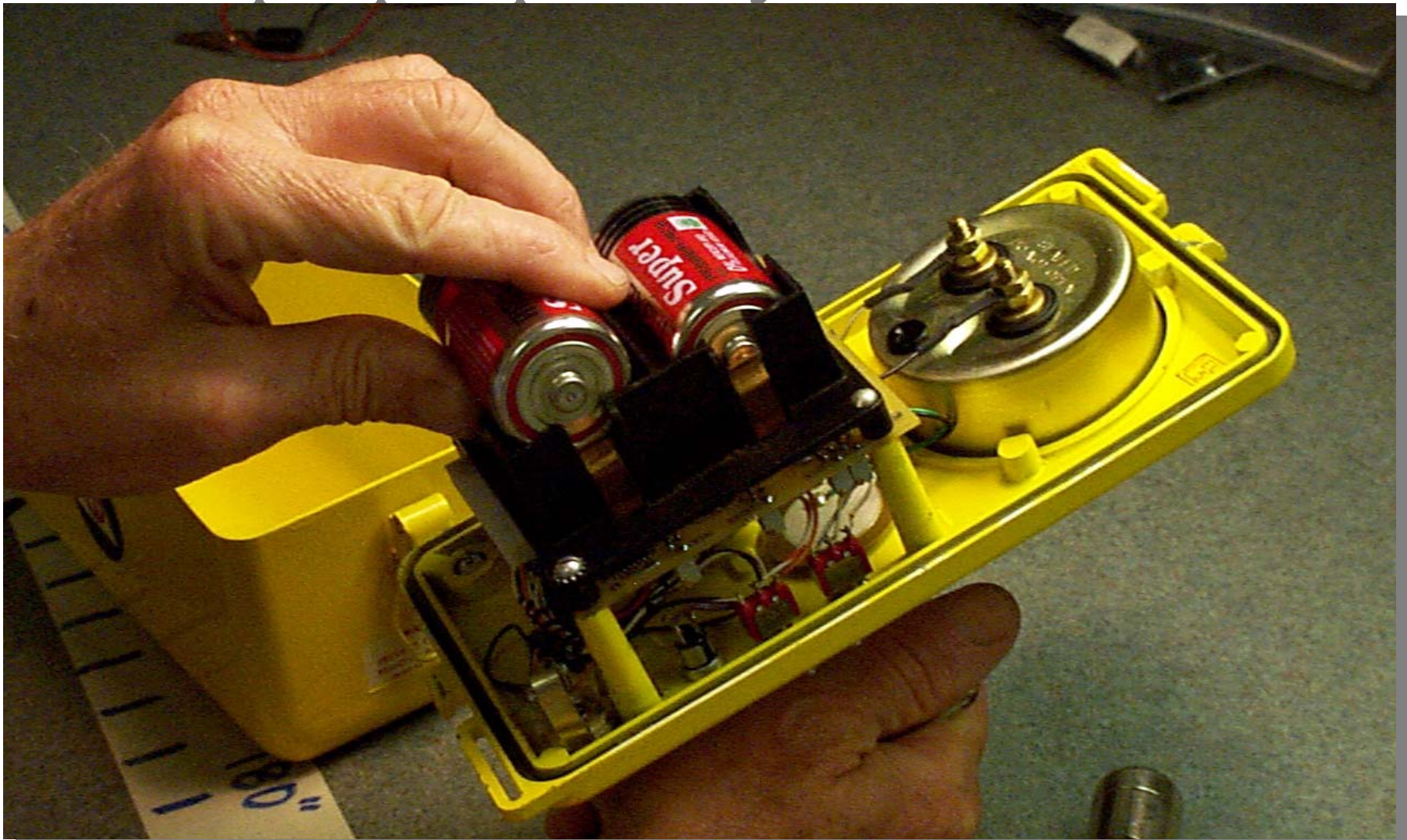




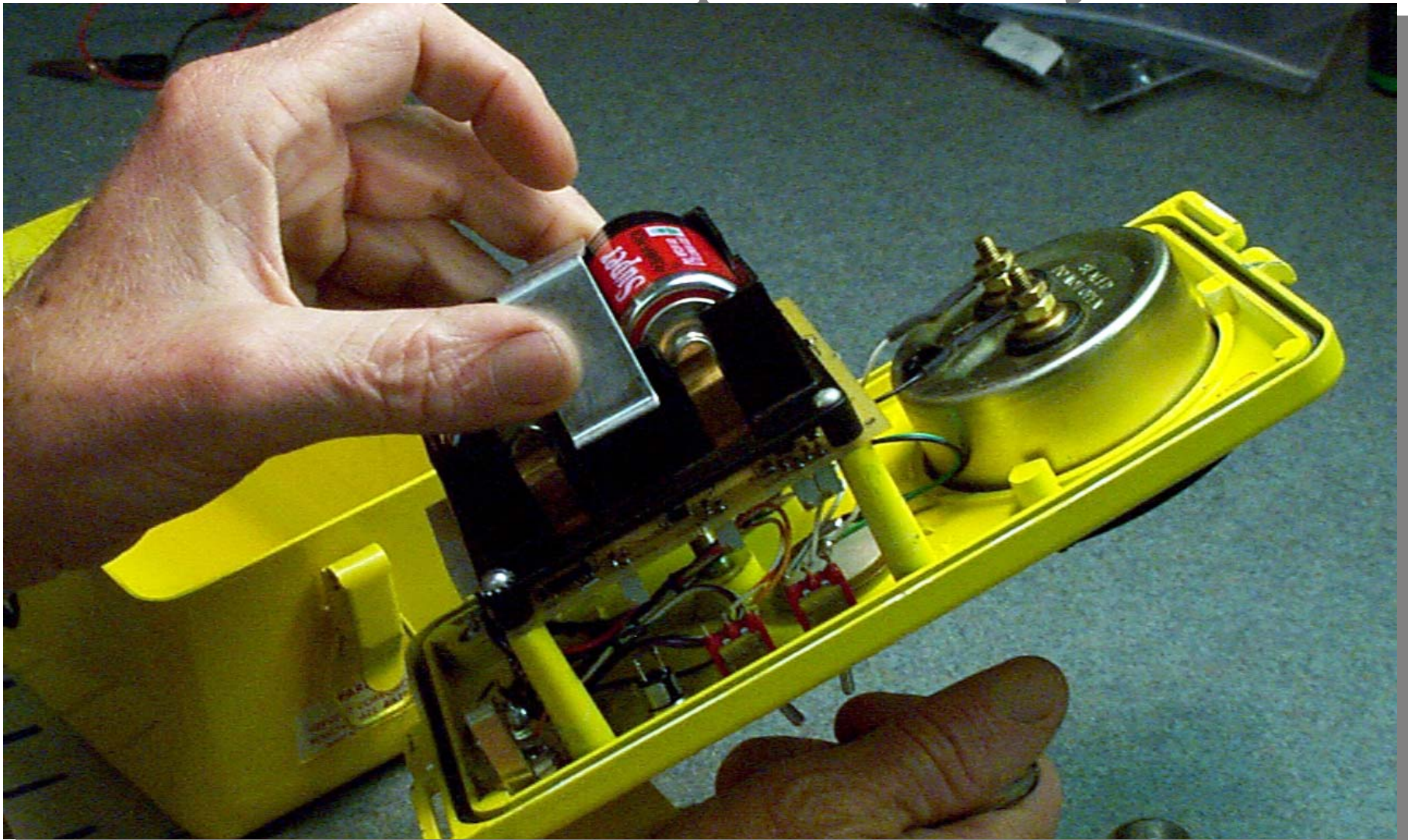
Install meter leads (black is negative) and tighten nuts with 5/16" nut driver.



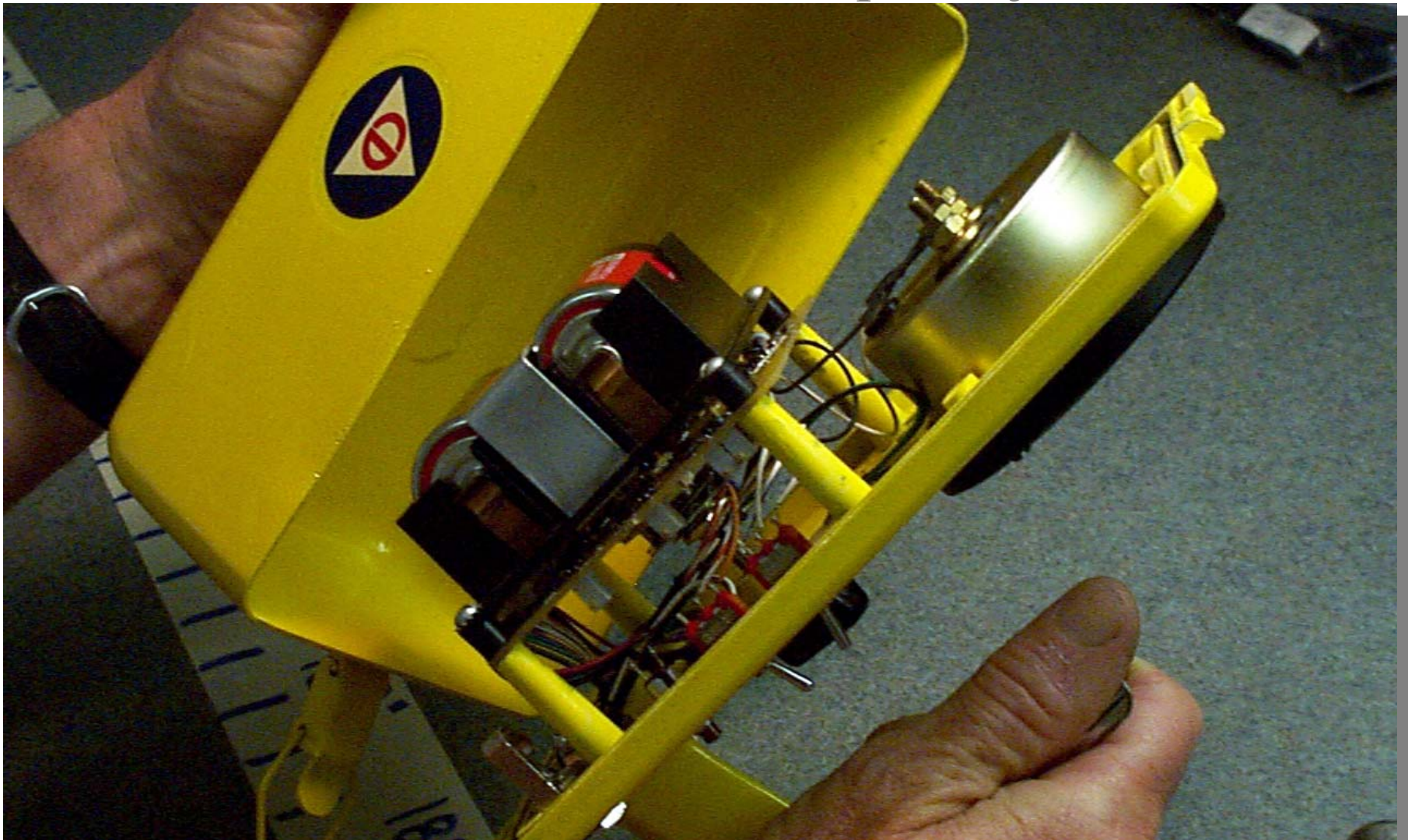
Insert two “D” batteries observing proper polarity as shown.



Place battery retaining clip over batteries and clip to battery case.



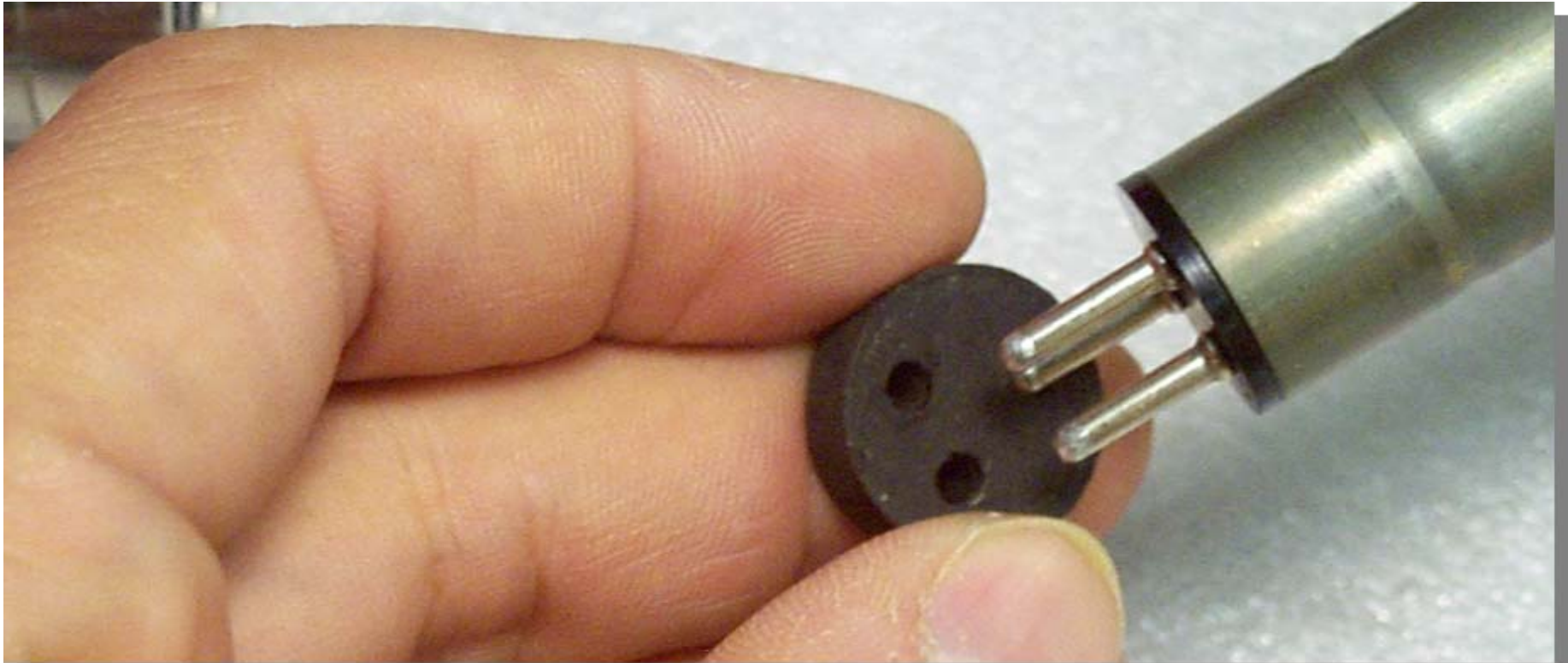
Ensure that the case top O-ring is in good condition. Place case top on case bottom and latch. Civil Defense logo should be on same side as headphone jack.



Disassemble the energy compensated G-M probe by twisting the shielded end counterclockwise and pull apart.



Affix gasket to the base of the G-M tube and reassemble the G-M probe, twisting the entire shielded section clockwise to tighten.



# Attach energy compensated G-M probe and coiled cable.

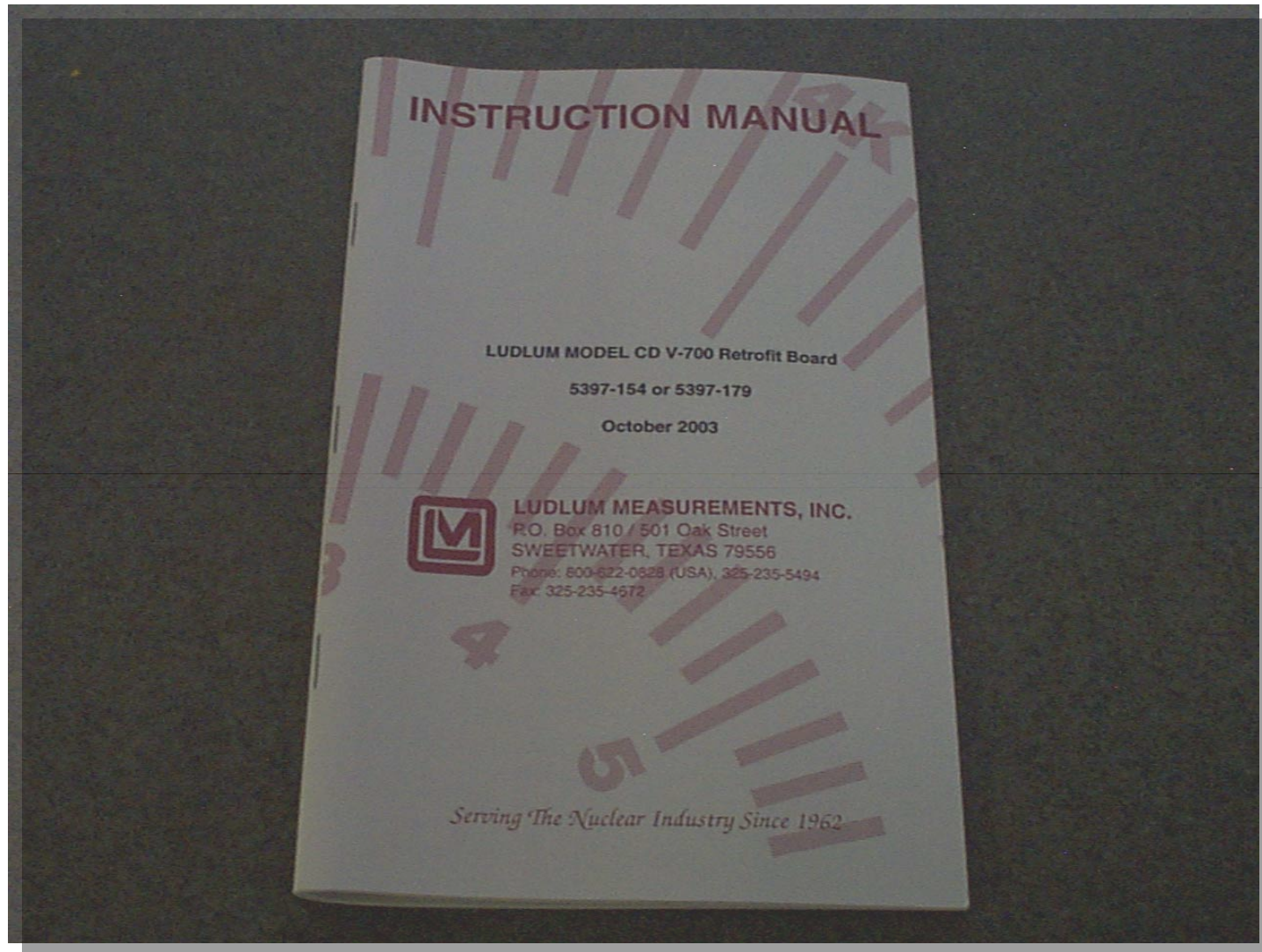


# Part III: Calibration

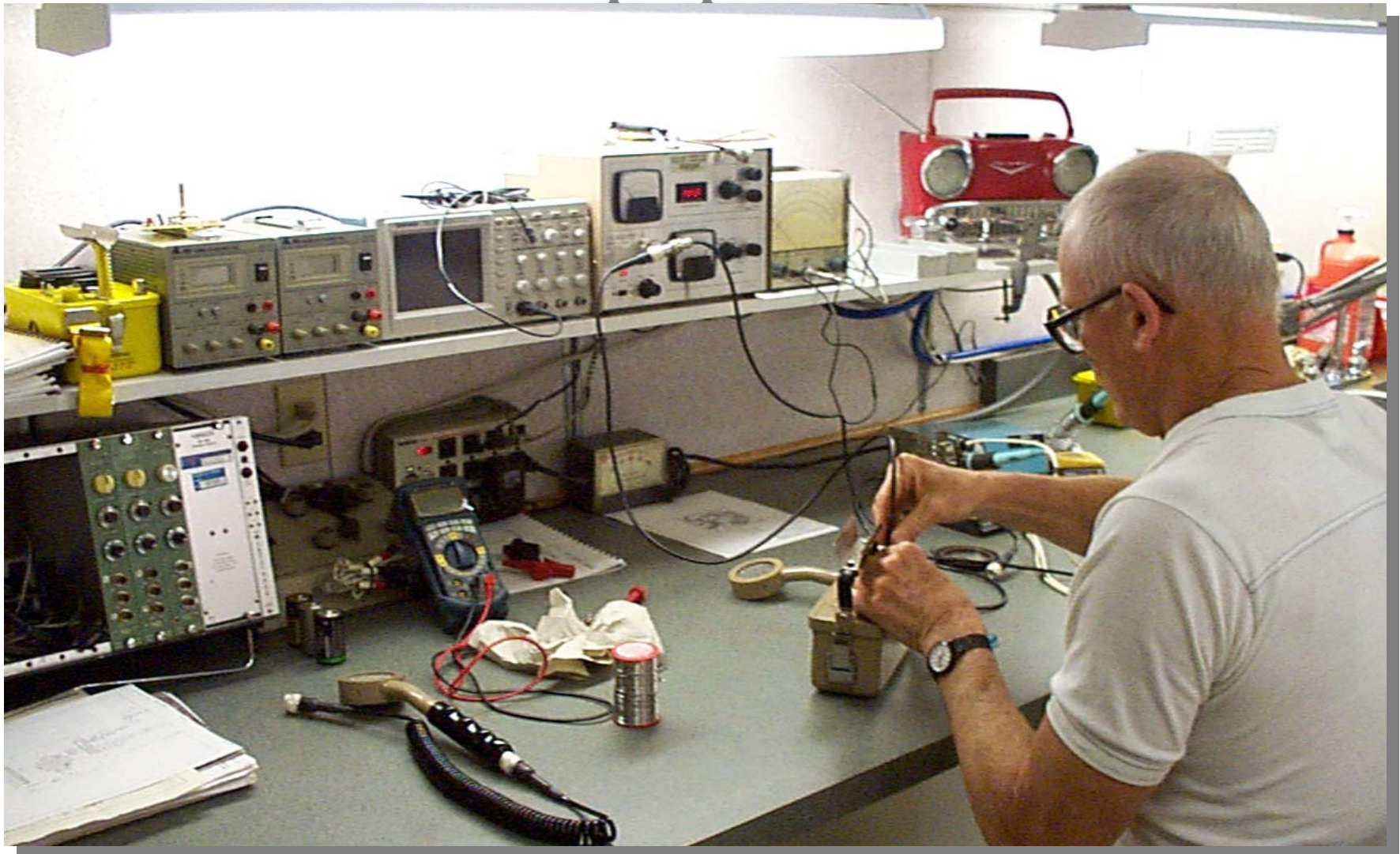




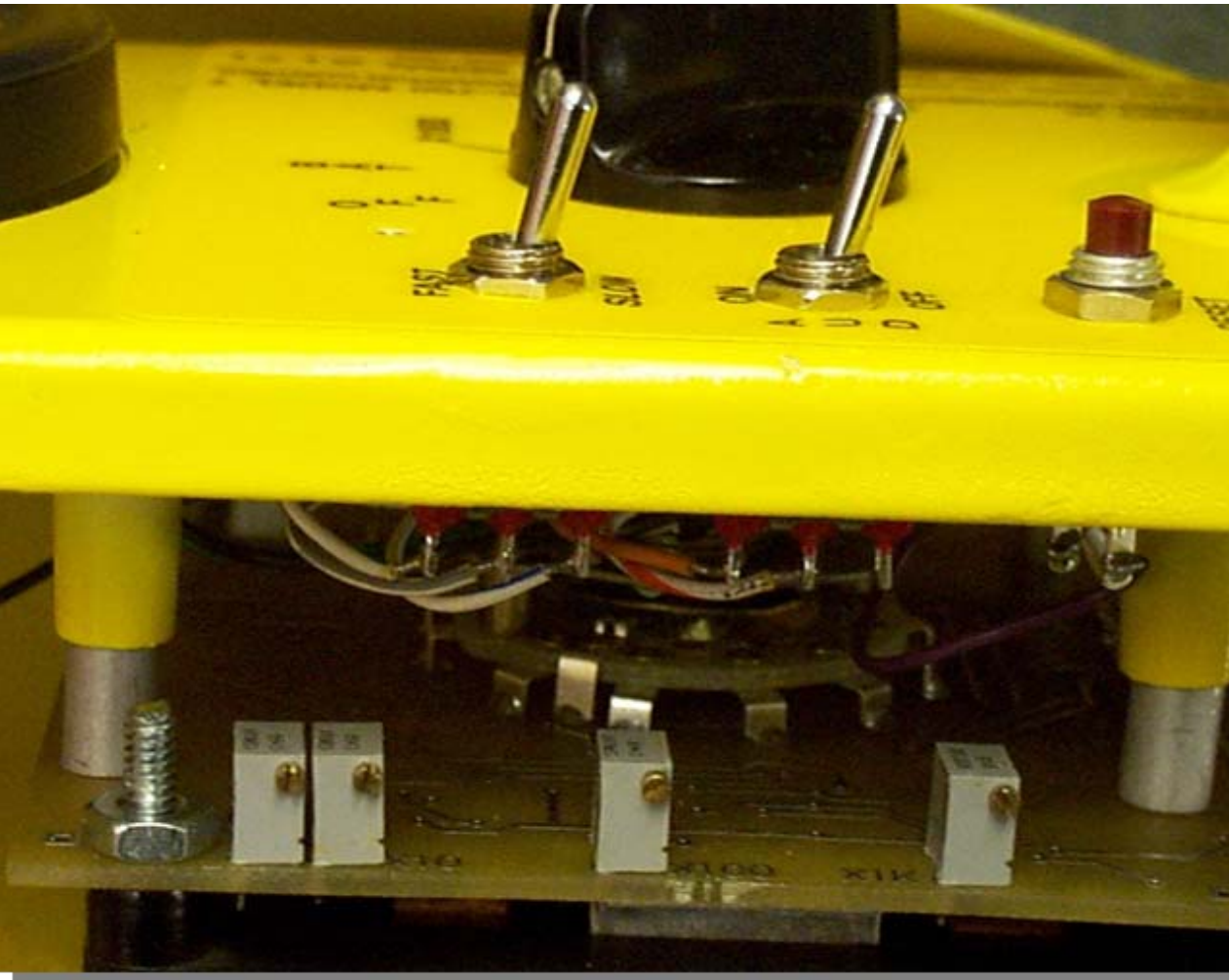
Electronic calibrate according to technical manual (Plate 108 of this procedure).



# Electronic Calibration Sample Equipment



# Radiation calibrate according to FEMA calibration procedure.



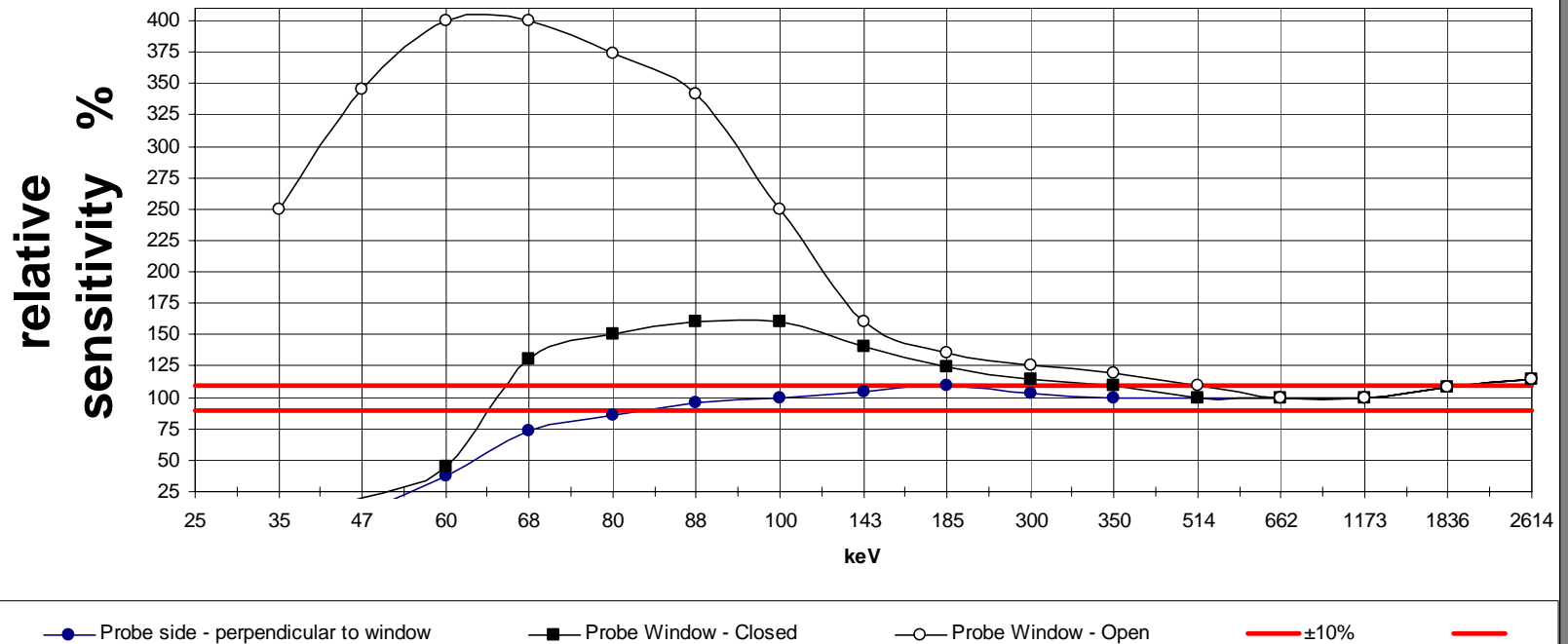
- Use the procedure in the FEMA Repair and Maintenance Manual for Radiological Instruments, Volume 7, Calibration, page 23, for each of the lower three ranges and Volume 8, Calibration, page 4-1, for the highest range. NOTE: Each range has a unique calibration pot.

# Radiation Calibration Sample Equipment



# Energy Response

Energy Response of OCD-D-103 GM tube in CDV700 energy compensated probe



- CD V-700:  $\pm 10\%$  from 80 keV to 2.0 MeV side wall with window closed. Open window sensitive to  $>500$  keV beta. The CD V-700 OCD-D-103 GM tube is not sensitive to alpha.

# Part IV: Distribution



# New CD V-777-1 Kit



# New CD V-777-1 Kit Components

- LMS CD V-700 Model 7 with CD V-103  $\beta/\gamma$  “hot dog” probe
- Telex Headphones set
- LMS Model 44-9Y  $\alpha/\beta/\gamma$  “pancake” probe
- Victoreen CD V-715 Model 1B
- 3 “D” size batteries
- 2 shoulder straps
- Instructional Packet



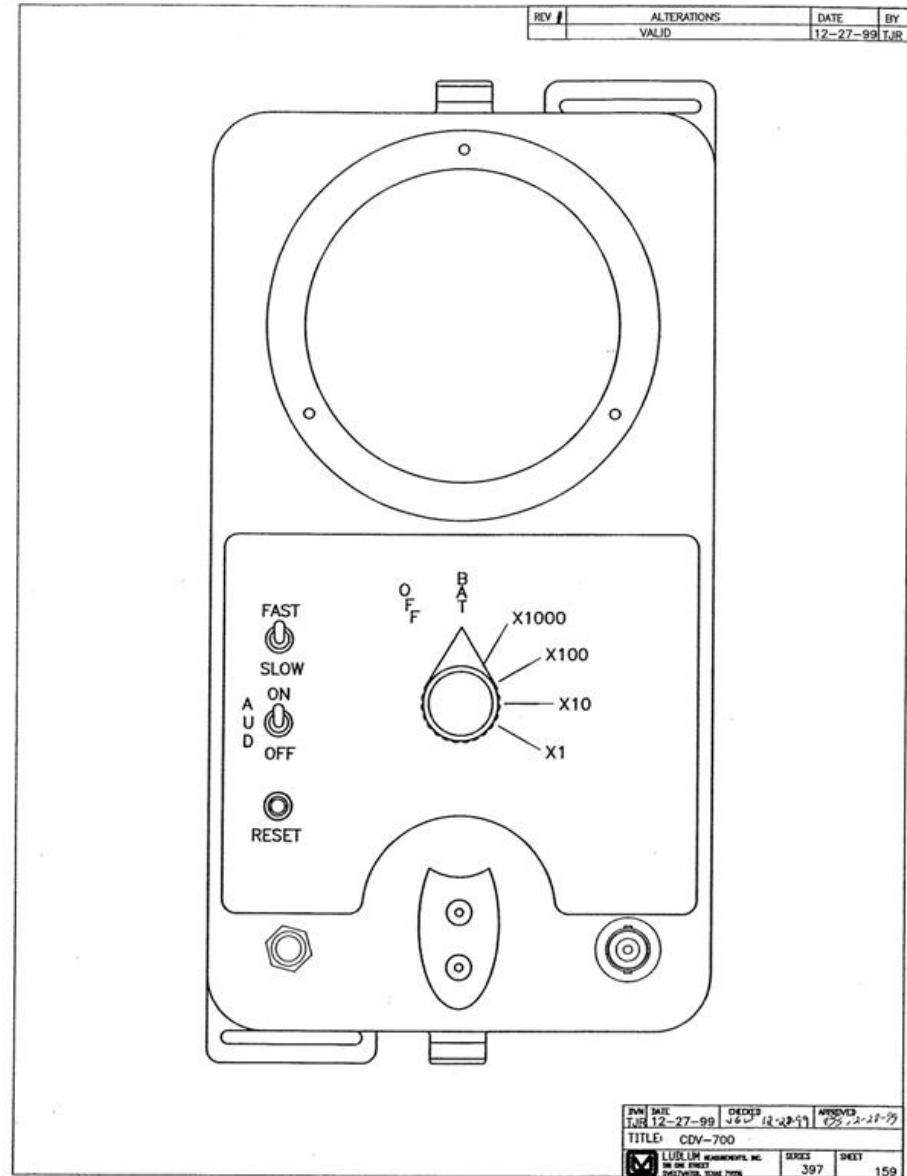


# APPENDIX A

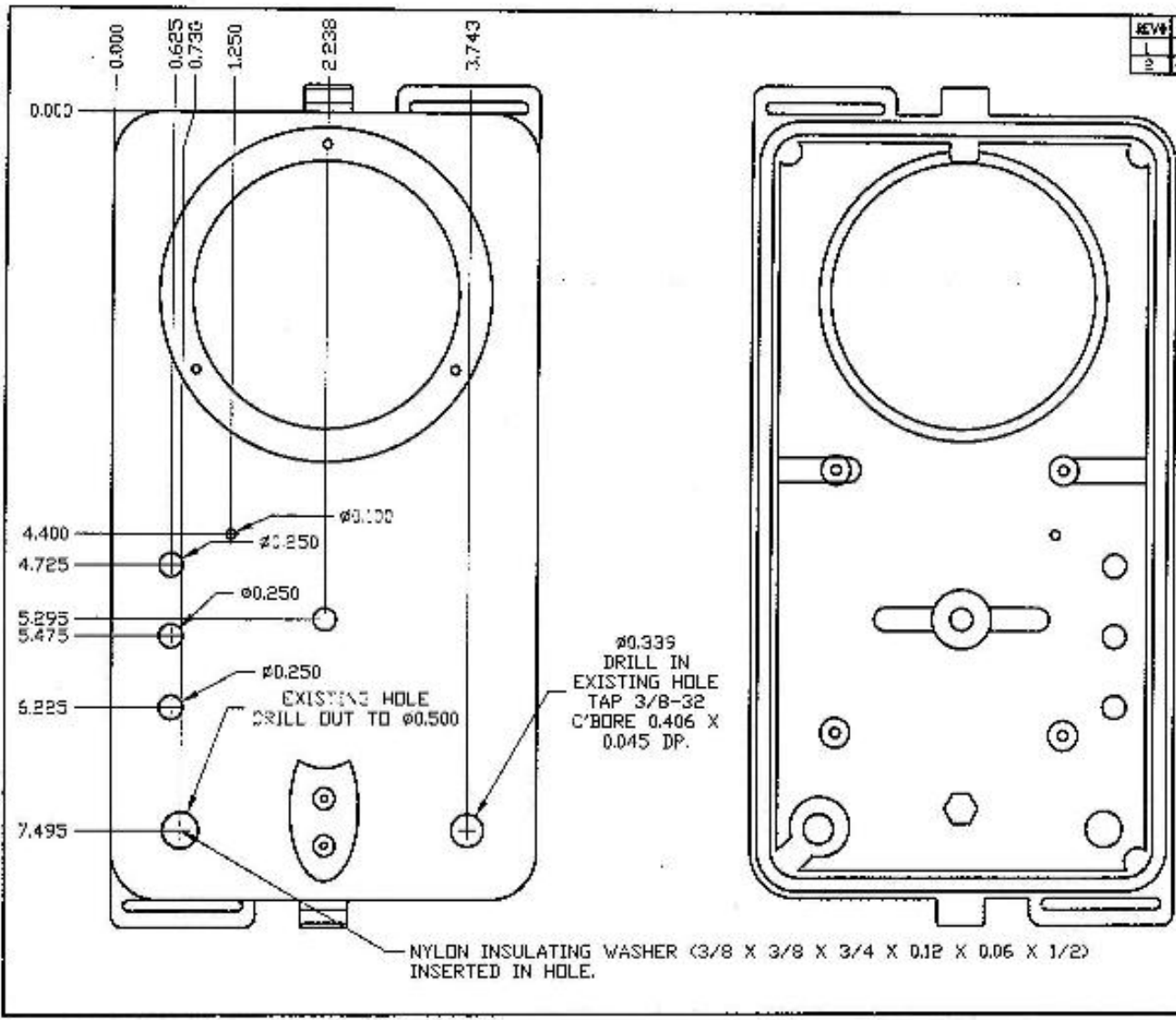
**LUDLUM MODEL CD V-700 Retrofit Board**

5397-154 or 5397-179

October 2003



**LUDLUM MEASUREMENTS, INC.**  
 501 OAK ST., P.O. BOX 810  
 SWEETWATER, TX 79556  
 915/235-5494 FAX: 915/235-4672



REV#	ALTERATIONS	DATE	BY
1	VAL. IT.	06-07-00	PJS
2	HOLE NOTE CHANGED-NYLON WASHER	10-30-03	CYC

DESIGN: EDV-700 H 6 FRONT PANEL			
REVISION: XX	PART NO: 7357-150		
DATE: XX			
BY: XX			
APP. NO: XXX			
FORM NO: N	NO. FIGS: 1		
DATE: 10-30-03	OR DATE:	APP. DATE: 10-30-03	
TITLE: 9-02 2752	SCALE: FULL X	SHEET 150	
LITTON INDUSTRIES, Inc.		397	150

Model CD V-700 Retrofit Board  
5397-154 or 5397-179  
October 2003

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Model CD V-700 Retrofit Board  
5397-154 or 5397-179  
October 2003

1. GENERAL

The Ludlum CDV-700 Retrofit Board (Part Number 5397-14 or 5397-179) is intended to upgrade old civil defense radiation measurement meters. The upgrade can be applied to civil defense meters marked "Anton" or "Lionel" Model 6, 6a or 6b. The newer board 5397-179 has two additional potentiometers to adjust the high voltage and to adjust the battery test point. The upgrade process does involve drilling holes in the aluminum front panel. The upgrade replaces all the electronics but retains the front panel, meter, "D" cell battery holder and instrument can.

The upgrade board features many advantages over the previous electronics. Battery life is extended, and a battery test function added to the main rotary switch. A X1000 range is also added, allowing for higher range measurements. Switches are added to the

front panel for meter reset, fast/slow response and audio on/off. A coaxial connector eliminates the "hard-wired" detector. Maintenance and repairability are vastly improved.

Any G-M detector offered by Ludlum Measurements, Inc. will operate on this unit, as will many of the scintillation detectors. The instrument is set for 900-volt, G-M tube operation. For special requirements, it may be adjusted for operation with any G-M or scintillator tube that operates at a voltage between 500 and 1000 volts.

The unit is operated with two "D" cell batteries for operation from 122°F to approximately 4°F. For temperature operation below 4°F, either very fresh alkaline batteries or rechargeable NiCd batteries may be used. Battery drain averages 20 milliamperes.

2. SPECIFICATIONS

- **POWER:** Two standard "D" size batteries
- **FOUR LINEAR RANGES:** Range multipliers of X1, X10, X100, and X1000
- **SENSITIVITY:**  $-35 \pm 5$  millivolts (mV)
- **AUDIO:** Built-in unimorph speaker with an ON-OFF switch
- **HIGH VOLTAGE:** Fixed at 900 Vdc, adjustable from 500 to 1000 volts by changing resistor value on 5397-154, or from 500-1000 Vdc on 5397-179 by internal potentiometer

- **METER SCALE:** Typically 0 – 300 C/M, 0 – 0.5 mr/hr

- **RESPONSE:** 4 seconds (FAST) or 22 seconds (SLOW) at 90% of final reading

- **CONNECTOR:** Series "C", 706 U/G; BNC or MHV may also be provided

- **END-OF-BATTERY-LIFE AUDIO:** At approximately 2.0 Vdc battery voltage, the instrument emits a steady audio tone, warning the user of a low-battery condition. This audio overrides the audio ON-OFF switch

Model CD V-700 Retrofit Board  
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### 3. DESCRIPTION OF CONTROLS AND FUNCTIONS

• **Range Multiplier Selector Switch:** A six-position switch marked OFF, BAT, X1000, X100, X10 and X1. Turning the range selector switch from OFF to BAT position provides operator a battery check of the instrument. Meter needle deflection to the "0.4 mr/hr" mark (approximately 90% of full-scale) or higher on the scale indicates that the batteries are OK. For normal operation, the operator selects one of the range multiplier positions (X1, X10, X100, X1000). The scale reading is then multiplied by the selected multiplier value to determine the actual reading.

• **AUDIO ON-OFF Toggle Switch:** In the ON position the switch operates the unimorph speaker, located on the left side of the instrument. The frequency of the clicks is relative to the rate of the incoming pulses. The higher the rate, the higher the audio frequency. The audio should be turned OFF when not required to reduce battery drain.

### 4. OPERATING PROCEDURES

Open the can and install two "D" size batteries.

**NOTE:** Center post of flashlight battery is positive.

Close the can. Switch the range switch to BAT. The meter should deflect above the "0.4 mr/hr" mark of the meter scale (approximately 90% of full-scale). If the meter does not respond, recheck that the batteries are installed in the correct position.

Connect the cable to the instrument and detector.

• **FAST-SLOW Toggle Switch:** Provides meter response. Selecting the "FAST" position of the toggle switch provides 90% of final meter reading in 4 seconds. In the "SLOW" position, 90% of final meter reading takes 22 seconds. In "FAST" position there is fast response and large meter deviation. "SLOW" position should be used for slow response and damped meter deviation.

• **RESET Pushbutton Switch:** When depressed, this switch provides a rapid means to drive the meter to zero.

• **Range Calibration Adjustments:** Recessed potentiometers located under the calibration cover on the right side of the front panel. These adjustment controls allow individual calibration for each range multiplier.

• **(Unmarked):** A ¼" headphone jack allows use of headphones in noisy background situations

Turn the instrument range switch to X1000. Expose the detector to a check source. The speaker should click with the AUDIO ON-OFF switched to ON.

Move the range switch to the lower scales until a meter reading is indicated. The toggle switch labeled FAST/SLOW should have fast response in "FAST," slow response in "SLOW."

Depress the RESET switch. The meter should zero.

Check calibration and proceed to use the instrument.

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### 5. CALIBRATION

#### 5.1 Calibrating C/M (CPM) Scale

• To calibrate the C/M (CPM) scale, a Ludlum Model 500 Pulse generator or equivalent is required.

• Connect the pulse generator to the instrument and adjust the pulse frequency to provide 3/4-scale deflection on the X1000 range (200 C/M). Adjust the X1000 range calibration potentiometer as required.

• Decrease the pulser frequency by decades and adjust each range calibration potentiometer accordingly.

#### 5.2 Detector Operating Point

• For most G-M detectors, the HV is already set to 900 volts. For other applications, the power supply may be adjusted from 500 to

1000 volts by adjusting an internal potentiometer.

• For scintillation detectors, adjust the HV for plateau operations. Expose the unit to a source and develop an operating voltage-versus-count rate plot on semi-log paper. Set the operating voltage at the flattest position of the curve near the knee of the curve.

**NOTE:** Measure High Voltage with a Model 500 pulser or a High Impedance voltmeter with a high meg probe. If one of these instruments is not available, use a voltmeter with a minimum of 1000 megohm input resistance. Do not use a vacuum tube type voltmeter for this adjustment unless an external, high-voltage multiplier probe is used.

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## 6. MAINTENANCE

Instrument maintenance consists of keeping the instrument clean and periodically checking the batteries and the calibration.

To assure proper operation of the instrument between calibrations, the instrument should be tested with a check source prior to each use. A reference reading should be obtained when exposed to the check source in a constant and reproducible manner at the time of calibration. If the instrument response differs from the reference reading by more than  $\sqrt{20\%}$ , the instrument should be returned to a calibration facility for maintenance, repair, or recalibration as required.

Recalibration should be accomplished after any maintenance or adjustment of any kind has been performed on the instrument. Battery replacements are not considered to be maintenance and do not normally require the instrument to be recalibrated.

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

The batteries should be removed and the battery contacts cleaned of any corrosion at least every three months. If the instrument has been exposed to a very dusty or corrosive atmosphere, more frequent battery servicing should be used.

### NOTE

**NEVER STORE THE INSTRUMENT OVER 30 DAYS WITHOUT REMOVING BATTERIES. ALTHOUGH THIS INSTRUMENT WILL OPERATE AT VERY HIGH AMBIENT TEMPERATURES, BATTERY SEAL FAILURE CAN OCCUR AT TEMPERATURES AS LOW AS 100° FAHRENHEIT.**

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## 7. THEORY OF OPERATION

### 7.1 Input

Detector pulses are coupled from the detector through C12 to amplifier U10. R30 and CR2 protect the amplifier from input shorts. R27 couples the detector to the high voltage supply.

### 7.2 Amplifier

A self-biased amplifier provides gain in proportion to R25 divided by R30. Transistor (pin 6 of U10) provides amplification. Pin 12, 15 of U10 are coupled as current mirror to provide a load for pin 6 of U10. The output self-biases to  $2 V_{be}$  (approximately 1.4 volts) at pin 7 of U10. This provides just enough bias current through pin 3 of U10 to conduct all of the current from the current mirror.

Positive pulses from pin 7 of U10 are coupled to the discriminator.

### 7.3 Discriminator

Comparator U9 provides discrimination. The discriminator is set by the voltage divider of R18 and R28. These output pulses are coupled to pin 5 of U5 for meter drive and pin 12 of U5 for audio.

### 7.4 Audio

Discriminator pulses are coupled to univibrator pin 12 of U5. Front panel audio ON-OFF selector controls the reset at pin 13 of U5. When ON, pulses from pin 10 of U3 turn on oscillator U6, which drives the can-mounted unimorph. Speaker tone is set by R19, C3; duration by R20.

### 7.5 Digital Analog Convertor

Pin 12, 15 of U4 are coupled as a current mirror. For each pulse of current through R40, an equal current is delivered to C13. This charge is drained off by R22. The voltage across C13 is proportional to the incoming count rate.

### 7.6 Scale Ranging

Detector pulses from the discriminator are coupled to univibrator pin 5 of U5. For each scale, the pulse width of pin 6 of U5 is increased by a factor of 10 with the actual pulse width being controlled by the front panel calibration controls and their related capacitors. This arrangement allows the same current to be delivered to C13 by one count on the X1 range as 1,000 counts on X1K range.

### 7.7 Meter Drive

The meter is driven by U6, coupled as a voltage follower in conjunction with the voltage divider of R43 and R41.

For Battery Test on the 5397-154, the meter movement is directly coupled to the battery through voltage divider R24 and R26. For 5397-179, the output may be adjusted by using R23.

### 7.8 Fast/Slow Time Constant

For slow time constant, C11 is switched from the output of the meter drive to parallel C13.

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**7.9 Low Voltage Supply**

Battery voltage is coupled to U7 and associated components (a switching regulator) to provide 5 volts at pin 8 to power all logic circuits. When battery voltage reached 2.0 Vdc, the LBO pin 2 of U7 goes low, turning on the end-of-battery-life audio.

**7.10 Low Voltage Reference**

U11 provides a 2.5 volt precision reference for the discriminator.

**7.11 High Voltage Supply**

High voltage is developed by switching power supply U12. High voltage pulses are created by the switching action of Q4 and L2. The voltage is "stacked" by voltage multiplier of CR3 through CR1.

Regulation is achieved when the voltage at pin 7 of U12 is 1.31 Vdc. Feed voltage to pin 7 is created by the voltage divider of R35 - R38. For 5397-179 output high voltage may be adjusted from 500 to 1000 Vdc by rotating potentiometer R36.

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5397-154 or 5397-179  
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**PARTS LIST**

Ref. No.	Description	Part No.	Ref. No.	Description	Part No.
<b>Circuit Board, Drawing 397 X 153</b>					
<b>BOARD</b>	<b>Assembled Circuit</b>	<b>5397-154</b>			
<b>• CAPACITORS</b>					
C1	0.047 $\mu$ F, 50V	04-5662			
C2	0.0047 $\mu$ F, 100V	04-5669			
C3	470pF, 100V	04-5668			
C4	0.022 $\mu$ F, 50V	04-5667			
C5-C6	0.001 $\mu$ F, 100V	04-5659			
C7-C8	68 $\mu$ F, 6.3V	04-5654			
C9	47pF, 100V	04-5660			
C10	0.01 $\mu$ F, 50V	04-5664			
C11	47 $\mu$ F, 10V	04-5666			
C12	100pF, 3kV	04-5532			
C13	10 $\mu$ F, 25V	04-5655			
C14	0.01 $\mu$ F, 50V	04-5664			
C15	10pF, 100V	04-5673			
C16	1 $\mu$ F, 35V	04-5656			
C17-C20	470pF, 1kV	04-5693			
C21-C29	0.001 $\mu$ F, 2kV	04-5703			
C30	27pF, 100V	04-5658			
C31	10 $\mu$ F, 25V	04-5655			
<b>• TRANSISTORS</b>					
Q4	MTD2N50E	05-5855			
<b>• INTEGRATED CIRCUITS</b>					
U1-U3	MAX324ESA	06-6453			
U4	MAX323ESA	06-6452			
U5	CD74HC4538M	06-6297			
U6	MIC1557BM5	06-6457			
U7	LT1304CS8-5	06-6434			
U8	CA3096M	06-6288			
U9	MAX985EUK-T	06-6459			
U10	CA3096M	06-6288			
U11	LT1460KCS3-2.5TR	05-5867			
U12	MAX641ACSA-T	06-6388			
U13	LM358D	06-6312			
<b>• DIODES</b>					
CR1	CMSH1-40M	07-6411			
CR2	CMPD2004S	07-6402			
CR3-CR12	CMSD2004S	07-6417			
<b>• RESISTORS</b>					
R1	220K Network	12-7923			
R2	100K Trimmer	09-6823			
R3-R5	1M Trimmer	09-6828			
R6	8.25K, 1/8W	12-7838			
R7-R9	10K, 1/8W	12-7839			
R10	100K, 1/8W	12-7834			
R11-R13	10K, 1/8W	12-7839			
R14-R18	100K, 1/8W	12-7834			
R19	475K, 1/8W	12-7859			
R20	1M, 1/8W	12-7844			
R21	68.1K, 1/8W	12-7881			
R22	200K, 1/8W	12-7992			
R23	18.2 Ohm, 1/8W	12-7890			
R24	649 Ohm, 1/8W	12-7893			
R25	200K, 1/8W	12-7992			
R26	18.2 Ohm, 1/8W	12-7890			
R27	100K, 1/8W	12-7834			
R28	5.62K, 1/8W	12-7871			
R29-R30	4.75K, 1/8W	12-7858			
R31	1K, 1/8W	12-7832			
R32-R34	1M, 1/8W	12-7844			
R35	800Meg, 2 %	12-7009			
R36	68.1K, 1/8W	12-7881			
R37	100K, 1/8W	12-7834			
R38	1M, 1/8W	12-7844			
R39	200 Ohm, 1/8W	12-7846			
R40	18.2K, 1/8W	12-7968			
R41	18.2 Ohm, 1/8W	12-7890			
R43	649 Ohm, 1/8W	12-7893			
<b>• INDUCTORS</b>					
L1	22 $\mu$ H	21-9808			
L2	470 $\mu$ H	21-9224			
<b>• MISCELLANEOUS</b>					
P1	MTA100x17	13-8121			
SW1	SWITCH-ROTARY PCB CD V-700	08-6788			

**Model CD V-700 Retrofit Board**  
**5397-154 or 5397-179**  
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Ref. No.	Description	Part No.	Ref. No.	Description	Part No.
<u>Wiring Diagram, Drawing 464 X 79</u>			• TRANSISTORS		
• AUDIO			Q4	MTD2N50E	05-5855
DS1 UNIMORPH ASSY 4173-116			• INTEGRATED CIRCUITS		
• SWITCHES			U1-U3	MAX324ESA	06-6453
S1-S2	7101-SYZ-QE	08-6511	U4	MAX323ESA	06-6452
S3	30—1-PB CRAYHILL	08-6517	U5	CD74HC4538M	06-6297
• BATTERIES			U6	MIC1557BM5	06-6457
B1-B2	1.5V	21-9313	U7	LT1304CS8-5	06-6434
• CONNECTORS			U8	CA3096M	06-6288
J4	UG706/U "C"	13-7751	U9	MAX985EUK-T	06-6459
• MISCELLANEOUS			U10	CA3096M	06-6288
HJ1	JACK-12A SWITCHCRAFT	21-9853	U11	LT1460KCS3-2.5TR	05-5867
			U12	MAX641ACSA-T	06-6388
			U13	LM358D	06-6312
			• DIODES		
			CR1	CMSH1-40M	07-6411
			CR2	CMPD2004S	07-6402
			CR3-CR12	CMSD2004S	07-6417
			• RESISTORS		
<u>Circuit Board, Drawing 397 X 179A &amp; 179B</u>			R1	220K Network	12-7923
BOARD Assembled Circuit 5397-179			R2	100K Trimmer	09-6823
• CAPACITORS			R3-R5	1M Trimmer	09-6828
C1	0.047oF, 50V	04-5662	R6	8.25K, 1/8W	12-7838
C2	0.0047oF, 100V	04-5669	R7-R9	10K, 1/8W	12-7839
C3	470pF, 100V	04-5668	R10	100K, 1/8W	12-7834
C4	0.022oF, 50V	04-5667	R11-R13	10K, 1/8W	12-7839
C5-C6	0.001oF, 100V	04-5659	R14-R18	100K, 1/8W	12-7834
C7-C8	68oF, 6.3V	04-5654	R19	475K, 1/8W	12-7859
C9	47pF, 100V	04-5660	R20	1M, 1/8W	12-7844
C10	0.01oF, 50V	04-5664	R21	68.1K, 1/8W	12-7881
C11	47oF, 10V	04-5666	R22	200K, 1/8W	12-7992
C12	100pF, 3kV	04-5532	R23	500 Ohm Trimmer	09-6848
C13	10oF, 25V	04-5655	R24	365 Ohm, 1/4W	12-7901
C14	0.01oF, 50V	04-5664	R25	200K, 1/8W	12-7992
C15	10pF, 100V	04-5673	R26	18.2 Ohm, 1/8W	12-7890
C16	1oF, 35V	04-5656	R27	100K, 1/8W	12-7834
C17-C20	470pF, 1kV	04-5693	R28	5.62K, 1/8W	12-7871
C21-C29	0.001oF, 2kV	04-5703	R29-R30	4.75K, 1/8W	12-7858
C30	27pF, 100V	04-5658	R31	1K, 1/8W	12-7832
C31	10oF, 25V	04-5655	R32-R34	1M, 1/8W	12-7844
			R35	800Meg, 2 %	12-7009
			R36	1M Trimmer	09-6828
			R38	1M, 1/8W	12-7844

**Model CD V-700 Retrofit Board**  
**5397-154 or 5397-179**  
**October 2003**

Ref. No.	Description	Part No.	Ref. No.	Description	Part No.
R39	200 Ohm, 1/8W	12-7846	<u>Wiring Diagram, Drawing 464 X 138</u>		
R40	18.2K, 1/8W	12-7968	• RESISTORS		
R41	49.9 Ohm, 1/8W	12-7011	R1	4.7k, 1/4W, 5%	10-7014
R43	649 Ohm, 1/8W	12-7893	• AUDIO		
• INDUCTORS			DS1	UNIMORPH ASSY	4173-116
L1	22oH	21-9808	• SWITCHES		
L2	470oH	21-9224	S1-S2	7101-SYZ-QE	08-6511
• MISCELLANEOUS			S3	30—1-PB CRAYHILL	08-6517
P1	1-640457-0 MTA100X10	13-8168	• BATTERIES		
P2	640457-7 MTA100X7	13-8183	B1-B2	1.5V	(not supplied)
SW1	Central-2P6P	08-6761	• CONNECTORS		
			J4	UG706/U "C"	13-7751
			• MISCELLANEOUS		
			M1	METER 50 MICROAMP	(not supplied)
			HJ1	JACK-12A SWITCHCRAFT	21-9853
			*	WIRING HARNESS	8397-156



**Model CD V-700 Retrofit Board**  
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**DRAWINGS AND DIAGRAMS**

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**Front of Manual:**

CDV-700, Drawing 397 x 159

CDV-700 M6 Front Panel, Drawing 397 x 150

**Back of Manual:**

Retrofit Main Board, Drawing 397 x 153 (Three Sheets)

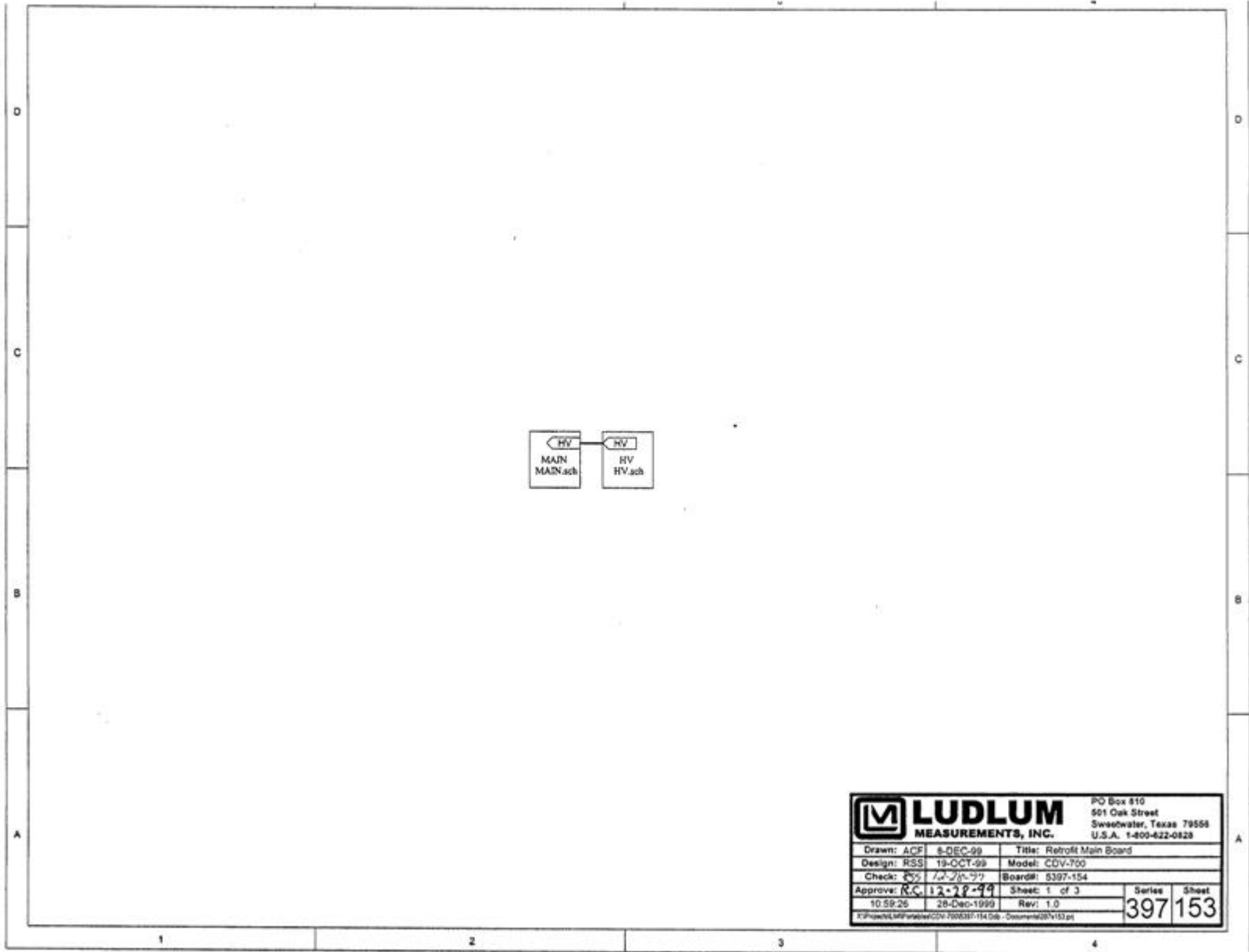
Retrofit Main Board Component Layout, Drawing 397 x 154 (Two Sheets)

Wiring Diagram, Drawing 464 x 079

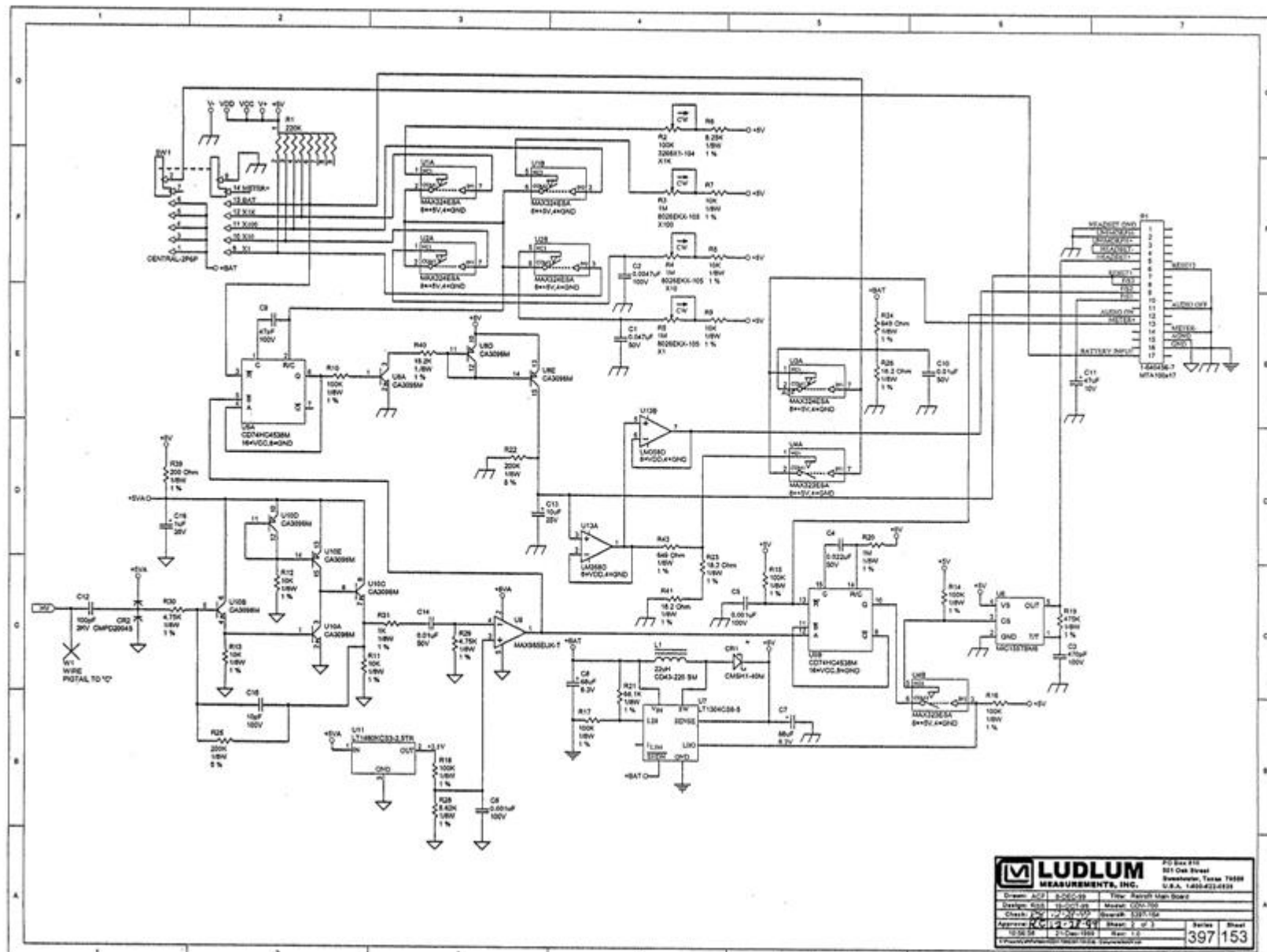
Retrofit Main Board, Drawing No. 397 x 179A and 379 x 179B

Retrofit Main Board Component Layout, Drawing 397 x 180 (Two Sheets)

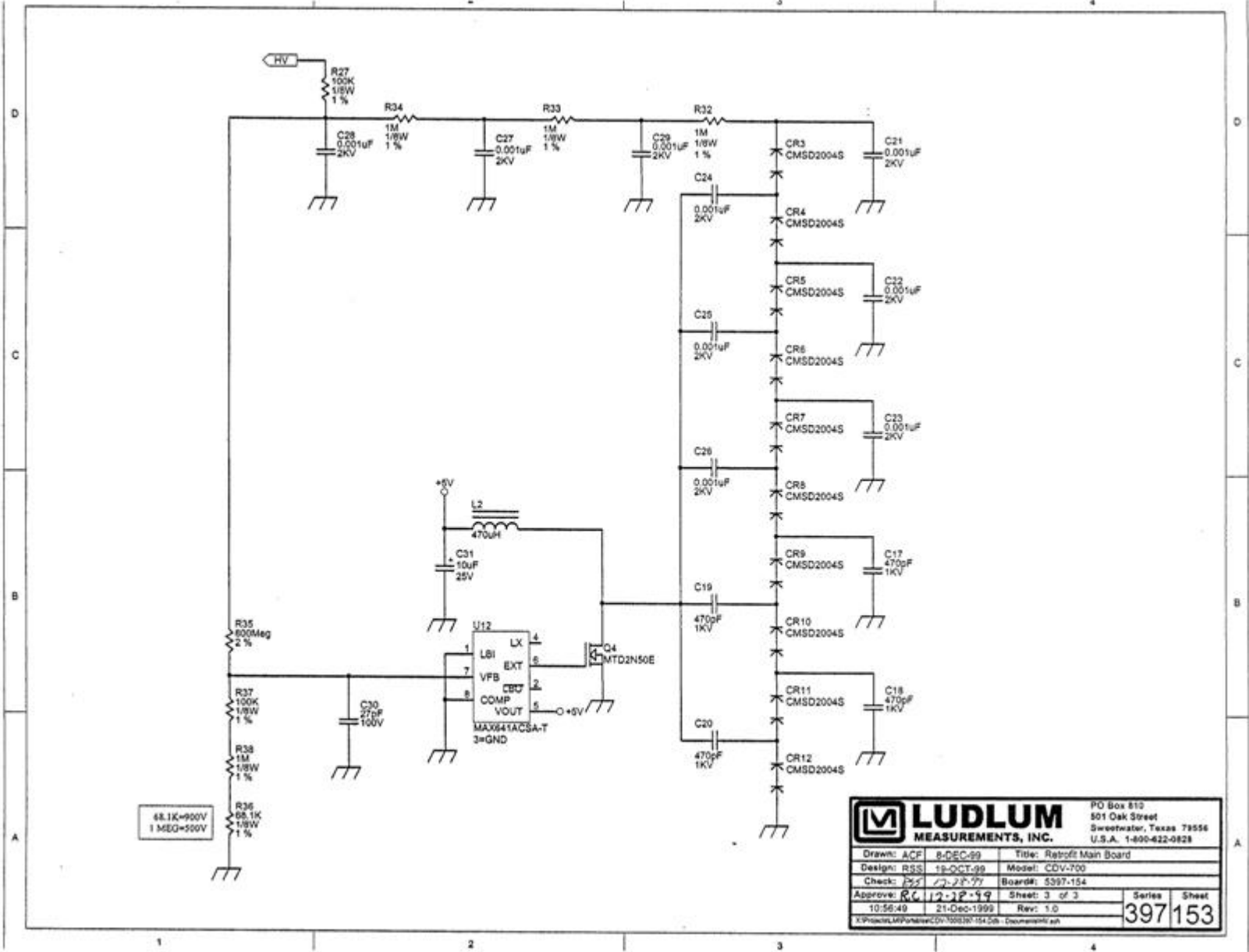
Wiring Diagram, Drawing 464 x 138



		<b>LUDLUM</b>		PO Box 810	
MEASUREMENTS, INC.				501 Oak Street	
				Sweetwater, Texas 79556	
				U.S.A. 1-800-422-0828	
Drawn: ACF	8-DEC-99	Title: Retrofit Main Board			
Design: RSS	19-OCT-99	Model: CDV-700			
Check: R.C.	12-22-99	Board#: 5397-154			
Approve: R.C.	12-22-99	Sheet: 1 of 3	Series	Sheet	
10-59-25	28-Dec-1999	Rev: 1.0	397 153		
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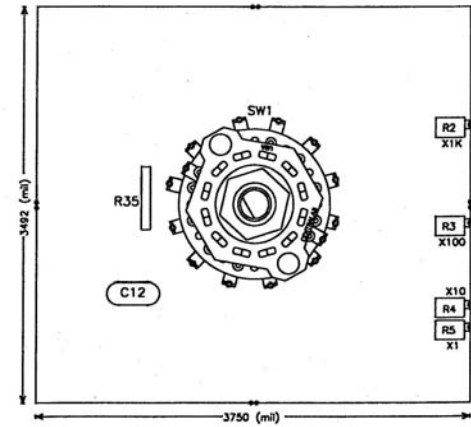
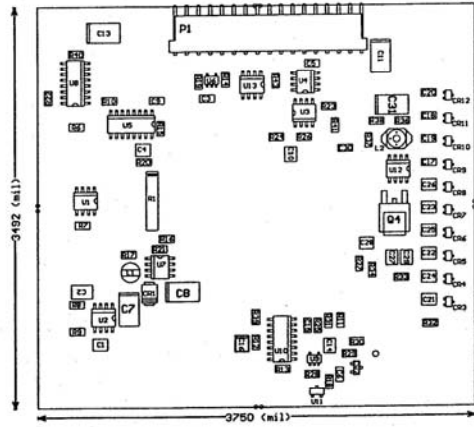


	<b>LUDLUM</b> MEASUREMENTS, INC.	PO Box 810 801 Oak Street Sweetwater, Texas 79689 U.S.A. 1409-421-0929
Drawn: JGJ	DESIGNED BY	Checked: JGJ
Checked: JGJ	APPROVED BY	DATE: 12-1-06
Approved: JGJ	DATE: 12-1-06	Sheet 2 of 3
397		153



48.1K-900V  
1 MEG-500V

<b>LUDLUM</b> MEASUREMENTS, INC.		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-422-0828	
Drawn: ACF	8-DEC-99	Title: Retrofitted Main Board	
Design: R33	19-OCT-99	Model: CDV-700	
Check: <i>RCS</i>	12-28-99	Board: 5397-154	
Approved: <i>RCS</i>	12-28-99	Sheet: 3 of 3	Series: Sheet
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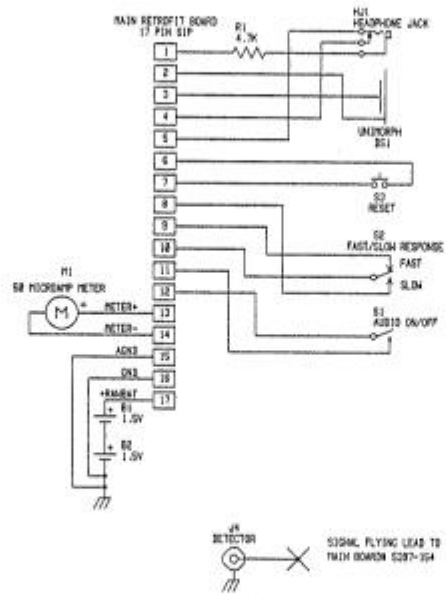


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Approve:	R.C.	12-28-99	Rev:	1.0
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Mech-3	21-DEC-1999			

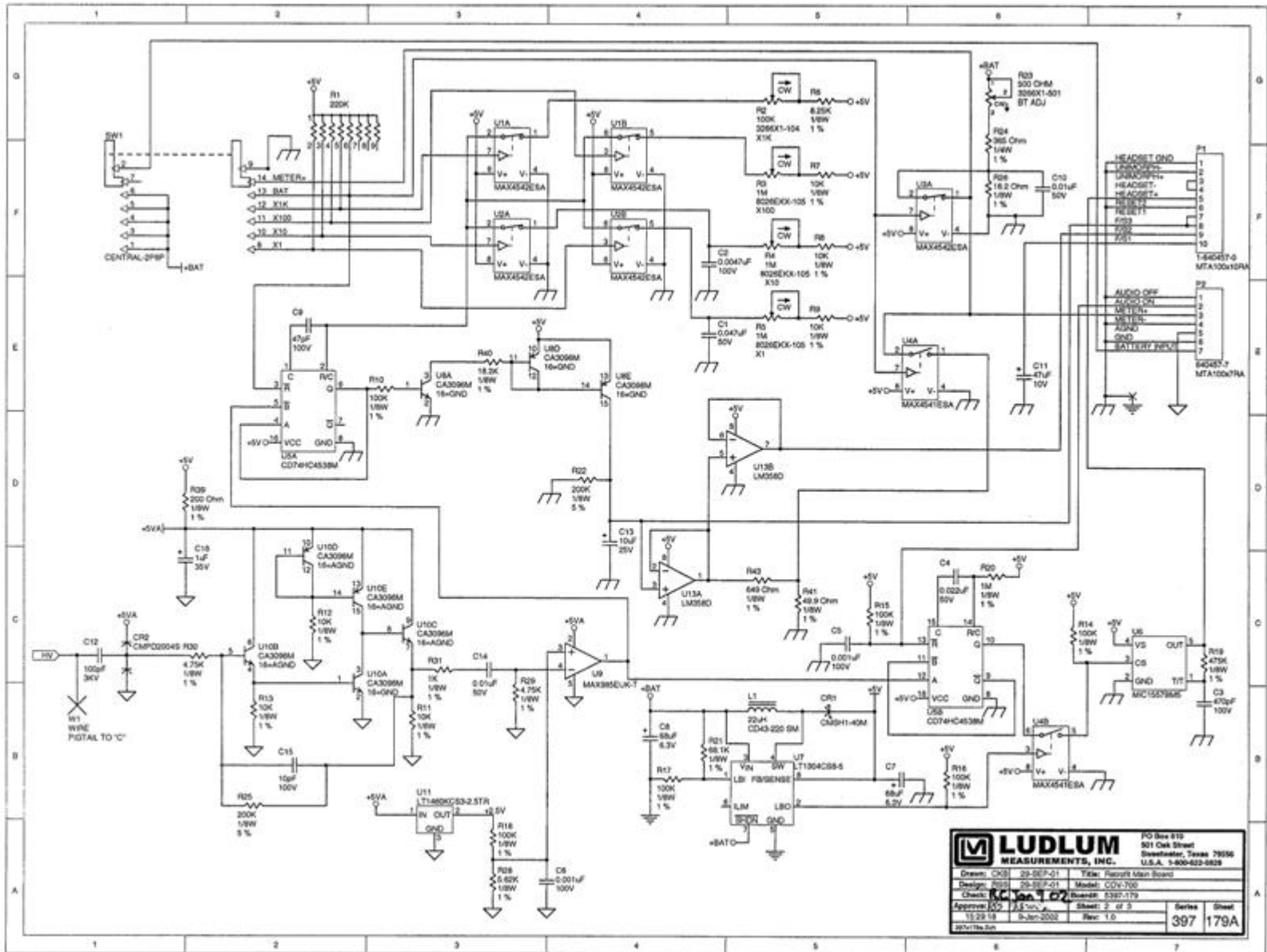
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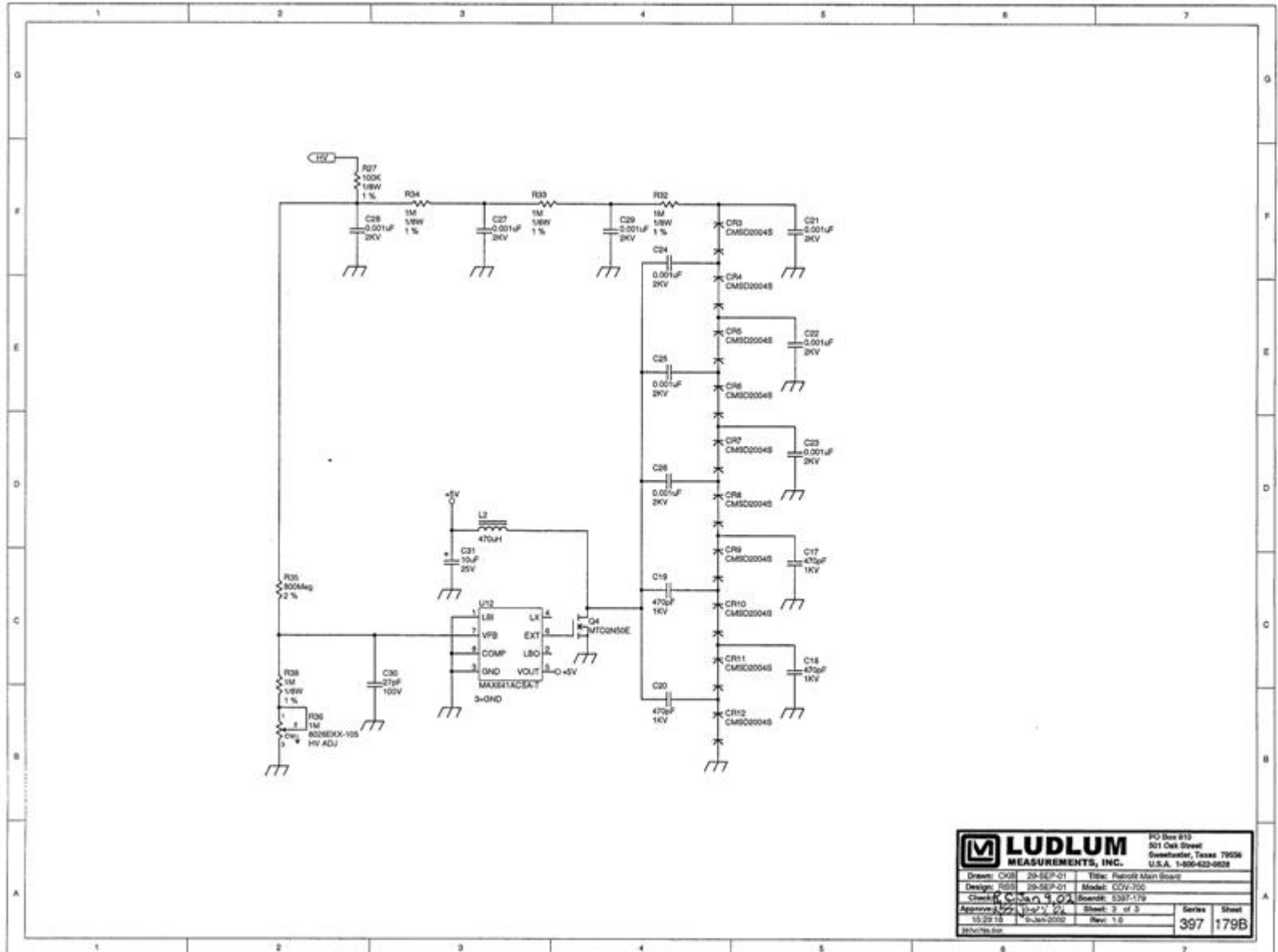
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Approve:	R.C.	12-28-99	Rev:	1.0
Layer:	Bottom Overlay		Series	Sheet
Mech-1	MID		397	154
Mech-2	1121:45		SCALE:	1.00
Mech-3	28-DEC-99			

REV		DESCRIPTION		DATE		APPROVED	



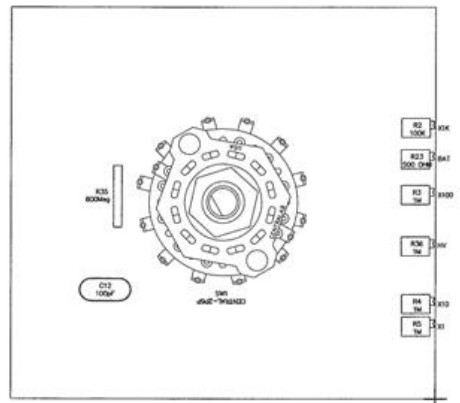
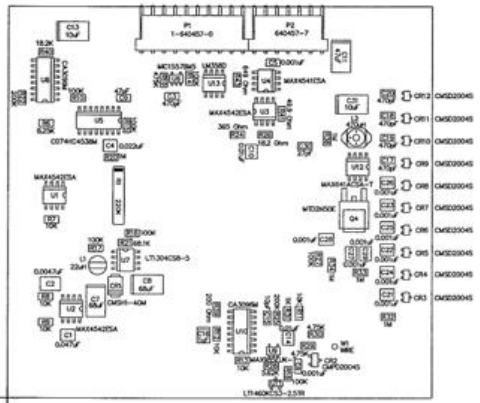
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CHK	ISS	4-23-01	
SOON	ISS	11-10-00	
APP	ISS	01-20-01	
NEXT RECORD NO.			





<b>LUDLUM MEASUREMENTS, INC.</b>		PO Box #13 501 Oak Street Grapevine, Texas 75556 U.S.A. 1-800-622-0629	
Drawn: CKB	29-SEP-01	Title: Retrot Main Board	
Design: RSB	29-SEP-01	Model: COV-705	
Checked: CKB	29-SEP-01	Boards: 5307-178	
Approved: RSB	29-SEP-01	Sheet: 3 of 3	
15-29-01	Rev: 1.0	Series	Sheet
		397	179B

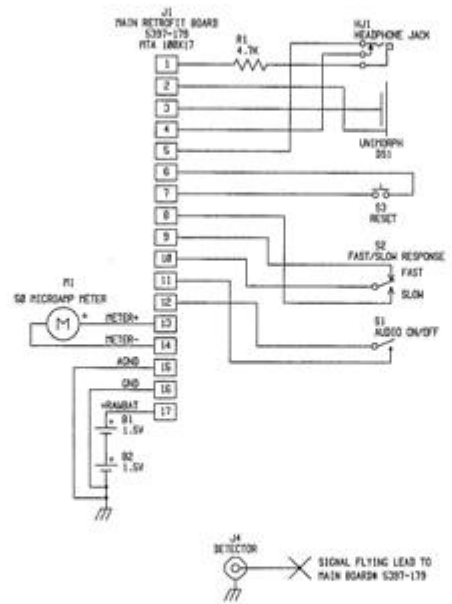




Drawn: CKB	29-SEP-01	Title:	
Design: RSS	29-SEP-01	Retrofit Main Board	
Check: R.C. Jan 9 02		Model:	CDV-700
Approve: <i>[Signature]</i>		Board#:	5397-179
Layer: Top Overlay		Rev: 1.0	Series Sheet
Mech1: MD		SCALE: 1.00	397 180
Mech2: 15-NOV-05	9-Jan-2002		
Mech3: 15-NOV-05			
Mech4: 15-NOV-05			
IN:397179.PCB		PLOT FILE NAME	

Drawn: CKB	29-SEP-01	Title:	
Design: RSS	29-SEP-01	Retrofit Main Board	
Check: R.C. Jan 9 02		Model:	CDV-700
Approve: <i>[Signature]</i>		Board#:	5397-179
Layer: Bottom Overlay		Rev: 1.0	Series Sheet
Mech1: MD		SCALE: 1.00	397 180
Mech2: 15-NOV-05	9-Jan-2002		
Mech3: 15-NOV-05			
Mech4: 15-NOV-05			
IN:397179.PCB		PLOT FILE NAME	

REVISIONS			
NO.	AUTHORITY	DATE	APPROVE



LUSBY MEASUREMENTS INC.			
DATE	REV	BY	CHK
15-JAN-02	010	R.C.	15Jan02
TITLE: WIRING DIAGRAM		BOARD	454-138
ISS	REV	DATE	BY
11-NOV-99	BSS	15Jan02	15Jan02
SIZE	MODEL	SERIES	SHEET
C	COPY-700 RETROFIT	454	138
REV	DATE	BY	CHK
01-NOV-99	15-JAN-02	15Jan02	15Jan02

Model CD V-700 Retrofit Board  
5397-154 or 5397-179  
October 2003



LUDLUM MEASUREMENTS, INC.  
501 OAK ST., P.O. BOX 810  
SWEETWATER, TX 79556  
915/235-5494 FAX: 915/235-4672

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## CHECKOUT PROCEDURE

MODEL: CDV-700 Retrofit Board, LMI Part Number 5397-154  
5 Steps

Revision 1

Revised by:

*Richard Smith*

Date: 29 Oct 03

Approved by:

*Richard Smith*

Date: 29 Oct 03

Q/A Approval:

*Larry Miller*

Date: 31 Oct 03

**Equipment Required:**

Ludlum Model 500 Pulser  
High Voltage (HV) Meter with input impedance greater than or equal to 1000 megohms  
(Pulser HV meter may be used with appropriate cable.)  
Low Voltage Power Supply capable of variable settings from 1.5-3 Vdc.  
DC Voltmeter or multimeter

**Refer to the schematic and component layout of 5397-154 for the following:**

**Electronics Checkout Procedure**

1. Attach power supply and set at 3 Vdc. Turn on power, rotate switch to BAT TEST position and verify current draw is less than 25 mA. Check the +5 Vdc regulated supply for 5.0 Vdc  $\pm$  0.2 Vdc on the positive lead of 68  $\mu$ F capacitor C7. Also check the discriminator 2.5 Vdc reference supply for 2.5 Vdc  $\pm$  0.1 Vdc on pin 2 of U11.
2. Using a high voltage meter or Ludlum Model 500 Pulser, check the HV at the detector connector. Confirm that the HV is 900  $\pm$  25 Vdc.
3. Turn the power supply down to 2.0 Vdc  $\pm$  0.25 Vdc. The audio should turn on and emit a steady tone. Adjust the potentiometer marked BAT until the meter

APPENDIX A

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**Checkout Procedure  
CDV-700 Retrofit Board, LMI Part Number 5397-154  
Revision 1**

**Model CD V-700 Retrofit Board  
5397-154 or 5397-179  
October 2003**

needle aligns with the bottom of the blue hash mark on the meter face (approximately  $67 \text{ mV} \pm 10\text{mV}$ ). This is the visual indication setpoint that the batteries should be changed. Check to see that the steady tone stays on, even if the audio is set to "AUDIO OFF". Turn the power supply voltage back up to between 2.4 and 3.0 Vdc for a full-scale meter needle deflection, indicating a set of good batteries. The alarm should turn off.

4. The audio, when in the "AUDIO ON" position, should emit clicks whenever input pulses cross the input threshold. Use a Ludlum Model 500 Pulser to confirm that the input threshold is  $-35 \text{ mV} \pm 5 \text{ mV}$ .
5. Use the Ludlum Model 500 Pulser to calibrate each range. Set each range so that 300 cpm (X1, X10, X100, X1K) equals 70 mV on the meter output. On one range, confirm that the FAST/SLOW toggle switch changes the response time from  $4 \text{ seconds} \pm 2 \text{ seconds}$  to  $22 \text{ seconds} \pm 4 \text{ seconds}$ . Also confirm that the RESET pushbutton does bring the meter output to less than 2 mV.

---

**APPENDIX B**



**LUDLUM MEASUREMENTS, INC.**  
 501 OAK ST., P.O. BOX 810  
 SWEETWATER, TX 79556  
 915/235-5494 FAX: 915/235-4672

## CHECKOUT PROCEDURE

**MODEL: CDV-700 Retrofit Bd 5397-179**  
 5 Steps

Written by: <i>Richard Jones</i>	Date: <i>Jan 9, 2002</i>
Approved by: <i>Rogelio Cantu Jr.</i>	Date: <i>Jan 9, 2002</i>
Q/A Approval: <i>Larry Kilke</i>	Date: <i>JAN 9, 2002</i>

### Equipment Required:

Ludlum Model 500 Pulser  
 High Voltage (HV) Meter with input impedance greater than or equal to 1000 megohms (Pulser HV meter may be used with appropriate cable.)  
 Low Voltage Power Supply capable of variable settings from 1.5-3 Vdc.  
 DC Voltmeter or multimeter

Refer to the schematic and component layout of 5397-179 for the following:

### Electronics Checkout Procedure

1. Attach power supply and set at 3 Vdc. Turn on power, rotate switch to BAT TEST position and verify current draw is less than 25 mA. Check the +5 Vdc regulated supply for 5.0 Vdc  $\pm$  0.2 Vdc on the positive lead of 68  $\mu$ F capacitor C7. Also check the discriminator 2.5 Vdc reference supply for 2.5 Vdc  $\pm$  0.1 Vdc on pin 2 of U11.
2. Using a high voltage meter or Ludlum Model 500 Pulser, check the HV at the detector connector. Confirm that the HV is adjustable from 500 to 1000 Vdc by adjusting the potentiometer marked HV. Set the HV to 900 $\pm$  25 Vdc.

### CDV-700 Retrofit Bd 5397-179 Checkout Procedure

3. Turn the power supply down to 2.1 Vdc  $\pm$  0.2 Vdc. Adjust the potentiometer marked BAT until the meter output is approximately 57 mV  $\pm$  10mV. At 2.0 Vdc  $\pm$  0.25 Vdc, the audio should turn on and emit a steady tone. Check to see that the steady tone turns on even if the audio is set to "AUDIO OFF". Turn the power supply voltage back up to 3.0 Vdc.
4. The audio, when in the "AUDIO ON" position, should emit clicks whenever input pulses cross the input threshold. Use a Ludlum Model 500 Pulser to confirm that the input threshold is -35 mV  $\pm$  5 mV.
5. Use the Ludlum Model 500 Pulser to calibrate each range. Set each range so that 300 cpm (X1, X10, X100, X1K) equals 70 mV on the meter output. On one range, confirm that the FAST/SLOW toggle switch changes the response time from 4 seconds  $\pm$  2 seconds to 22 seconds  $\pm$  4 seconds. Also confirm that the RESET pushbutton does bring the meter output to less than 2 mV.



# APPENDIX B

**LUDLUM MODEL 44-9  
Alpha, Beta, Gamma Detector**

Revised August 2004  
Serial No. PR090405 and succeeding  
Serial Numbers



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

**MODEL 44-9 Alpha, Beta, Gamma Detector**

**RECEIVING CONDITION EXAMINATION**

Be sure to verify that the shipping carton is received in good condition with no visible damage. Should the instrument be received in a damaged condition, save the shipping container and the packing material and request an immediate inspection by the carrier.

**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 (USA) 325-235-5494**  
**FAX: 325-235-4672**

**MODEL 44-9 Alpha, Beta, Gamma Detector****TABLE OF CONTENTS**

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4. OPERATING PROCEDURES .....	3
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**MODEL 44-9 Alpha, Beta, Gamma Detector****1. GENERAL**

The Model 44-9 GM (Pancake) Detector will detect Alpha, Beta, and Gamma radiation. Its size and shape provide easy handling for surveying or personnel monitoring. The detector is energy dependent, over responding by a factor of six in the 60 keV - 100 keV range when normalized to  $^{137}\text{Cs}$ .

The thin mica window is protected by a 79% open stainless steel screen. The GM tube can be easily removed for replacement if necessary.

The GM detector operates between 850 - 1000 volts. The tube manufacturer recommends operation at approximately 900V. The recommended instrument input sensitivity is approximately 30 mV or higher to prevent the detector from double pulsing.

The GM tube face can rupture above 8000 feet altitude pressure. Consequently, detectors carried in unpressurized aircraft above this altitude would be subject to failure.

The Model 44-9 will operate with any Ludlum instruments or equivalent instruments that provide 900 VDC and an input sensitivity of approximately 30 mV or higher.

**2. SPECIFICATIONS**

**DETECTOR:** Pancake type halogen quenched G-M

**WINDOW:**  $1.7 \pm 0.3$  mg/cm<sup>2</sup> mica

**WINDOW AREA:**

Active - 15 cm<sup>2</sup>

Open - 12 cm<sup>2</sup>

**EFFICIENCY(2pi geometry):** Typically 10%- $^{14}\text{C}$ ; 45%- $^{90}\text{Sr}/^{90}\text{Y}$ ;  
38%- $^{99}\text{Tc}$ ; 65%- $^{32}\text{P}$ ; 30%- $^{239}\text{Pu}$

**SENSITIVITY:** Typically 3300 cpm/mR/hr ( $^{137}\text{Cs}$  gamma )

**ENERGY RESPONSE:** Energy dependant

**DEAD TIME:** Typically 80 $\mu\text{s}$

**COMPATIBLE INSTRUMENTS:** General purpose survey meters, ratemeters, and scalars

**OPERATING VOLTAGE:** 900 volts

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



**MODEL 44-9 Alpha, Beta, Gamma Detector****2. SPECIFICATIONS (cont.)**

**CONSTRUCTION:** Aluminum housing with beige polyurethane enamel paint and stainless steel protective screen (79% open)

**TEMPERATURE RANGE:** 5°F(-15°C) to 122°F(50°C)  
May be certified to operate from -40°F(-40°C) to 150°F(65°C)

**SIZE:** 1.8" (4.6 cm)H X 2.7" (6.9 cm)W X 10.7" (27.2 cm)L  
**WEIGHT:** 1 lb (0.5kg)

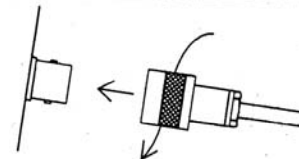
**3. PRELIMINARY INSTRUCTIONS****UNPACKING AND REPACKING**

Remove calibration certificate or detector functional check certificate and place it in a secure location. Remove the detector and accessories (cable, etc.) and ensure that all of the items listed on the packing list are in the carton. If more than one detector is in carton refer to the calibration certificate(s) for serial number(S/N) match. The M44-9 S/N is located on the bottom plate of the detector.

To return the instrument for repair or calibration provide sufficient packing material to prevent damage during shipment and appropriate warning labels to ensure careful handling. The following items and information should also be included to insure a quick turnaround time on your repair/calibration:

- instrument(s) and related cable(s)
- brief information as to the reason for return
- description of service requested
- return shipping address
- customer name and telephone number

**NOTE:** When shipping a Model 44-9 by air, it is necessary to ship the tube in a sealed container to avoid sudden atmospheric changes which could rupture the tube.

**MODEL 44-9 Alpha, Beta, Gamma Detector****4. OPERATING PROCEDURES****CONNECTING DETECTOR TO INSTRUMENT**

Connect one end of the cable provided to the detector by firmly pushing the connectors together while twisting clockwise 1/4 turn until it latches. Repeat the process in the same manner with the other end of the cable and the instrument.

**TESTING THE DETECTOR**

1. Insure that the instrument HV is at the proper setting for the detector (900 volts)
2. Connect the detector to the instrument and check for a proper background reading. (Typically 25 - 50 cpm at a background level of 8 - 15  $\mu\text{R/hr}$ )
3. Expose the detector to a check source and verify that the instrument indicates within  $\pm 20\%$  of the check source reading obtained during the last calibration. Alternatively, expose the detector to a check source of a known value and verify that the detector gets greater than or equal to the efficiency listed in the specification section of this manual.
4. Instruments that meet these criteria are ready for use. Failure to meet these criteria may indicate a malfunction in the detector.

**5. TUBE REPLACEMENT**

1. Remove the back plate by removing the three screws.
2. Loosen the three set screws on the side of the tube housing.
3. Remove the old tube from the detector housing.
4. Remove the anode clip from old tube.
5. Push the clip onto the anode housing.

**NOTE:** Do not over flex the wire when installing the clip.

### MODEL 44-9 Alpha, Beta, Gamma Detector

#### 5. TUBE REPLACEMENT

6. Carefully install tube with window face down in housing and tighten set screws evenly. The tube should be flush against the screen.
7. Replace the back plate and retaining screws.
8. The detector is now ready for use.

**NOTE:** The instrument and detector will need to be recalibrated once the above procedure is complete.

**CAUTION:** The mica window of this tube is extremely thin and will break easily. There is also a thin layer of material to prevent UV interference. The material may come off if touched, thus causing the detector to malfunction.

**DO NOT TOUCH.**

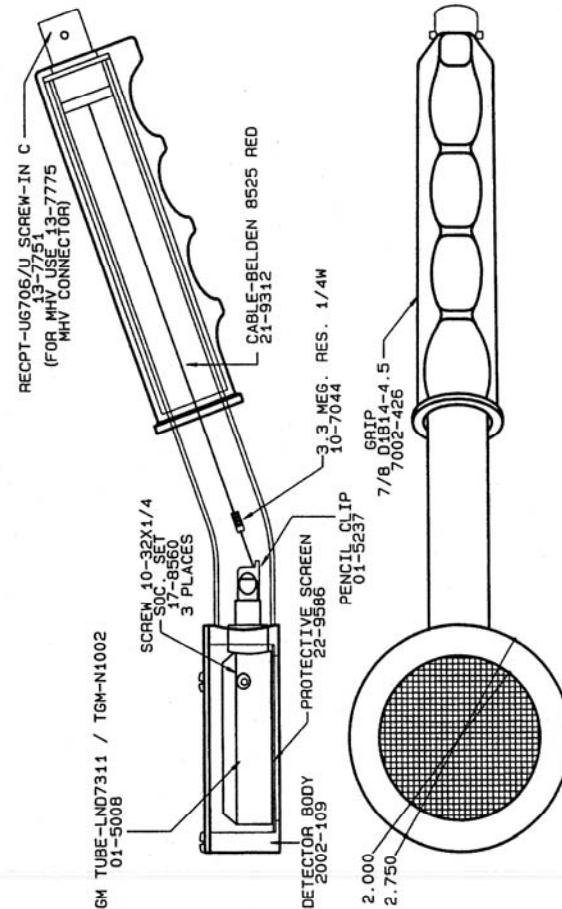
#### 6. PARTS LIST; DRAWINGS; DIAGRAMS

Model 44-9 Alpha-Beta-Gamma Detector		
Ref. No.	Description	Part No.
UNIT	Completely Assembled Model 44-9 Alpha-Beta-Gamma Detector	47-1539
*	DETECTOR BODY	2002-109
*	HANDLE GRIP	7002-426
*	GM TUBE	01-5008
*	(LND 7311, TGM N1002)	
*	SOCKET SET SCREWS	17-8560
	(10-34 X 1/4), 3 EACH	
*	PENCIL CLIP	01-5237
*	RESISTOR, 3.3 MEGOHMS	10-7044
*	CONNECTOR, UG 706/U	13-7751
*	HV WIRE	21-9312
*	PROTECTIVE SCREEN	21-9586
*	RED PROTECTIVE CAP	03-5476

4

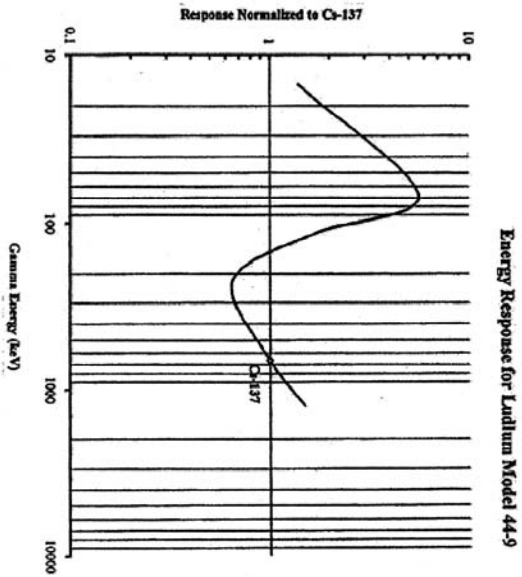
### MODEL 44-9 Alpha, Beta, Gamma Detector

#### 6. PARTS LIST; DRAWINGS; DIAGRAMS



5

MODEL 44-9 Alpha, Beta, Gamma Detector



MODEL 44-9 Alpha, Beta, Gamma Detector

