

**LUDLUM MODEL 78-6  
ANALOG STRETCH SCOPE**

**September 2011**

**Serial Number 225433 and Succeeding  
Serial Numbers**

# **LUDLUM MODEL 78-6 ANALOG STRETCH SCOPE**

**September 2011**

**Serial Number 225443 and Succeeding  
Serial Numbers**



**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**

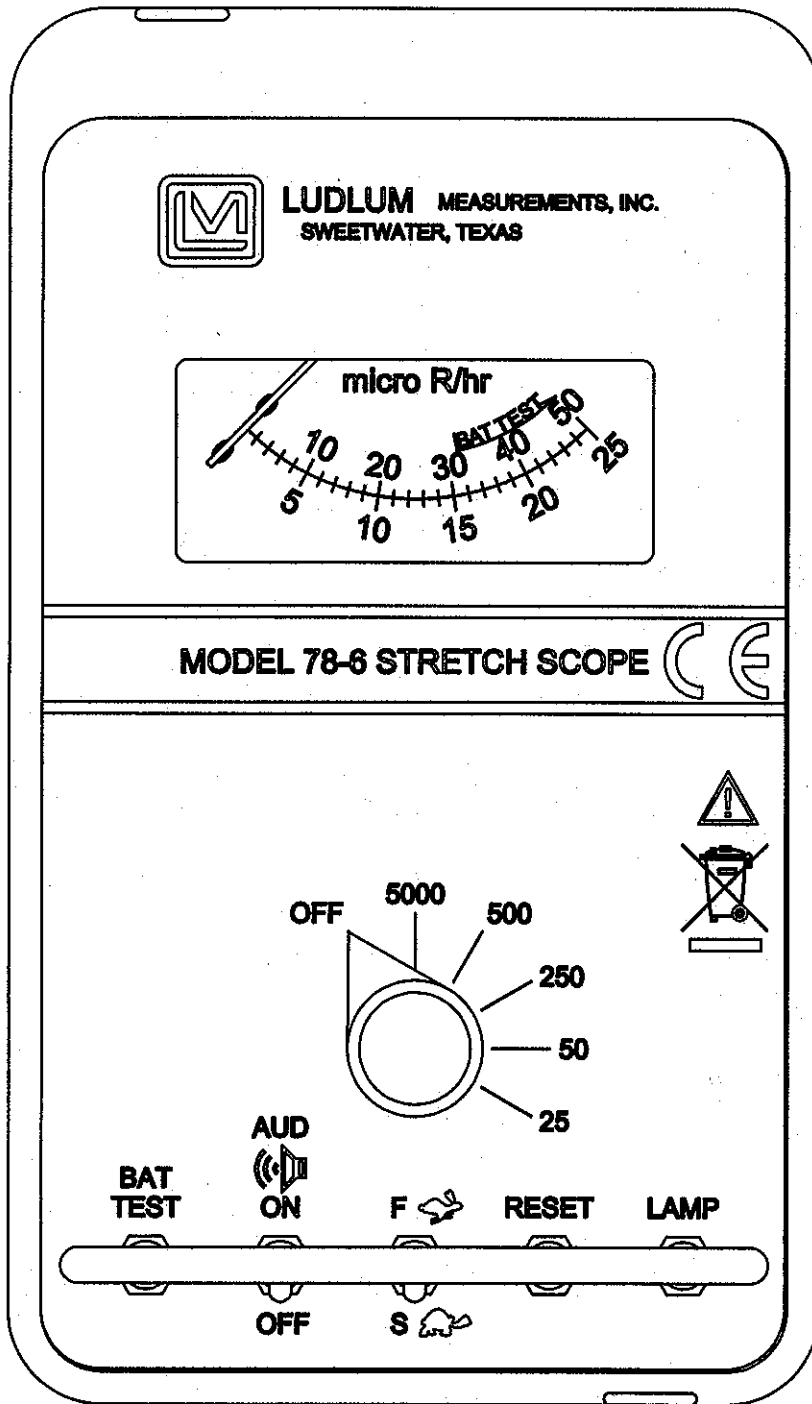
If equipment needs to be returned to Ludlum Measurements, Inc. for repair or calibration, please send to the address below. All shipments should include documentation containing return shipping address, customer name, telephone number, description of service requested, and all other necessary information. 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**



REVISION HISTORY			
REV	DESCRIPTION	DATE	BY
1	VALID	09/09/2011	PW



DWN	DATE	CHK	DATE	APP	DATE
PW	09/09/2011			<i>PW</i>	9-9-2011
<b>DWG NUM: 4272-370</b>				<b>SCALE: 1=1</b>	
<b>TITLE M 78-6 FRONT PANEL</b>					
<b>LUDLUM MEASUREMENTS, INC.</b> 501 OAK STREET SWEETWATER, TEXAS 79556		<b>SERIES</b> 272	<b>SHEET</b> 370		

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**Section****1****Introduction**

The Ludlum Model 78-6 Analog Stretch Scope features a 2.5 x 2.5 cm (1 x 1 in.) NaI (Tl) scintillator mounted on a 3.7 m (12 ft) extendable pole to offer an optimum performance in counting low-level gamma radiation. The NaI scintillator is energy sensitive. Refer to the energy response curve in this manual for the relative response. The gamma scintillator measures gamma radiation from 1  $\mu\text{R/hr}$  to 5000  $\mu\text{R/hr}$  (.01  $\mu\text{Sv/h}$  – 50  $\mu\text{Sv/h}$ ).

Five range divisions are provided in the 0-5000  $\mu\text{R/hr}$  spectrum. The meter face is made up of two scales, 0-50 and 0-25, plus battery test. The 0-50 scale corresponds to the 50, 500 and 5000 positions on the range selector switch. The 0-25 scale corresponds to the 25 and 250 positions on the range selector switch.

Other instrument features include Dead Time Correction (DTC) to compensate for detector dead time; audible click-per-event with programmable 1, 10, 100, and 1000 divide-by; LCD backlight with programmable "on" time; programmable fixed or variable response time; and a count overflow visual alarm.

**Warning**

There is a reduced response in pulsed fields due to the detector dead time.

The electronics front panel is equipped with switches for control of detector selection, audio on/off, fast or slow response times, LCD backlight, display reset, and power on/off. A headphone jack is also available. The instrument is capable of using either standard flashlight batteries or nickel-cadmium rechargeable batteries. However, the Model 78-6 does not include circuitry for recharging the batteries.

The stretch scope is made of stainless steel tubing that retracts to an overall length of 106 cm (41.7 in.). The handle can be removed for storage, reducing the length to 92.2 cm (36.3 in.).

All controls, including a calibration potentiometer for each range, are located inside. Front-panel switches are sealed with rubber "boots" for resistance to moisture. The electronics are housed in an aluminum body with a beige powder-coat finish and subsurface-printed Lexan front panel. The two "D" cell batteries are located in the handle and easily changed from the front panel.



**Section****2****Getting Started**

---

**Unpacking and Repacking**

Remove the calibration certificates and place them in a secure location. Remove the instrument, detectors, and accessories (batteries, cable, etc.), and ensure that all of the items listed on the packing list are in the carton. Check individual item serial numbers and ensure calibration certificates match. The Model 78-6 serial number is located on the front panel above the analog meter face. Most Ludlum Measurements, Inc. detectors have a label on the base or body of the detector for model and serial number identification.

**Important!**

If multiple shipments are received, ensure that the detectors and instruments are not interchanged. Each instrument is calibrated to a specific detector(s), and is therefore not interchangeable.

To return an instrument for repair or calibration, provide sufficient packing material to prevent damage during shipment. Also provide appropriate warning labels to ensure careful handling. Include brief information as to the reason for return, as well as return shipping instructions:

- **Return shipping address**
- **Customer name or contact**
- **Telephone number**
- **Description of service requested and all other necessary information**

**Battery Installation**

Ensure the Model 78-6 ON/OFF switch is in the OFF position. Remove the handle by rotating the handle counterclockwise. Install two "D" size batteries in the compartment with the posts pointing toward the instrument. Re-install the handle, rotating clockwise.

**Note:**

The center post of the battery is positive. Batteries are placed in the battery compartment with the posts pointing toward the instrument.

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**Section****3****Specifications**

**METER:** 1 mA, 6.4 cm (2.5 in.) scale, pivot-and-jewel suspension

**DETECTOR:** photomultiplier coupled to a 2.5 x 2.5 cm (1 x 1 in.) NaI(Tl) crystal mounted inside the instrument housing

**COUNTING RANGES:** two-scale meter face presenting 0-50  $\mu\text{R/hr}$  with full-scale range positions of 5000, 500, and 50; and 0-25  $\mu\text{R/hr}$  with full-scale positions of 250 and 25

**LINEARITY:** within 10% of true value with connected detector

**INPUT IMPEDANCE:** 0.1 megohm

**HIGH VOLTAGE:** variable from 400 to 1500 Vdc, electronically regulated to within 1%

**ANGULAR RESPONSE:** within 30% as detector is rotated from 0 to 90 degrees (calibration reference is with radiation field parallel to the long axis of the detector)

**GEOTROPISM:** referenced to the unit in horizontal position with display up. The indication will not vary more than 2% of the full-scale reading with the unit in any other orientation.

**WARM-UP TIME:** unit may be used immediately after the LCD initialization sequence is completed – approximately five seconds after turning on

**ALERT/ALARM:** visual and audible adjustable alarm points

**CALIBRATION CONSTANT:** 0.001 to  $280 \times 10^9$  counts/unit

**DETECTOR DEAD TIME COMPENSATION (DTC):** adjustable from 0 to 9999 microseconds

**Backlight "ON" Time:** 5, 15, 30, 60, 90, 120, 180, or  $240 \pm 1$  second

**HEADPHONE JACK:** size 0.32 cm (1/8 inch)

**POWER:** two standard "D" size batteries secured in an isolated compartment; current drain approximately 15 mA (backlight off); minimum battery voltage  $2.2 \pm 0.1$  Vdc

**BATTERY DEPENDENCE:** Meter readings vary by less than 3% from fully charged batteries until the battery symbol appears, indicating the need for recharge or replacement.

**BATTERY LIFE:** approximately 1000 hours for alkaline batteries; battery failure indicated on display

**SIZE:** 17.7 x 10.2 x 114 cm retracted; 396 cm fully extended (7 x 4 x 45 in. retracted; 156 in. fully extended) (H x W x L, fully extended L)

**WEIGHT:** 2.9 kg (6.4 lb), including batteries

**CONSTRUCTION:** The main instrument housing is fabricated of aluminum with beige powder-coat finish and printed, membrane front panel. The detector housing consists of a polished stainless steel telescope assembly with brass fittings.

**Section****4****Identification of Controls and Functions**

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**Front Panel Controls**

**Range Selector Switch:** a six-position switch marked OFF, 5000, 500, 250, 50, and 25. Moving the range selector switch to one of the range positions (5000, 500, 250, 50, 25) provides the operator with an overall range of 0-5000  $\mu\text{R/hr}$ . Note that the range positions 5000, 500, and 50 are screened in black and correspond to the meter scale screened in black. The range positions 250 and 25 are screened in red and correspond to the meter scale screened in red.

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

**F/S Toggle Switch:** provides meter response. Selecting the fast, "F," position of the toggle switch provides 90% of full-scale meter deflection in four seconds. IN the slow, "S," position, 90% of full-scale meter deflection takes 22 seconds. In "F" position, there is a fast response and large meter deviation. The "S" position should be used for slow response and damped, meter deviation.

**BAT Test Push-button Switch:** When depressed, this switch indicates the battery charge status on the meter. The range selector switch must be out of the OFF position.

**RES Push-button Switch:** When depressed, this switch provides a rapid means to drive the meter to zero.

**LAMP Push-button Switch:** When depressed, this switch lights the meter face.

*The following adjustments can be accessed by removing the calibration cover:*

**HV Adjustment:** provides a means to vary the high voltage from 400 to 1500 V

**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.

**Section****5****Operating Procedures**

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The Model 78-6 is a simple to operate due to the fact all controls and adjustments are located on the front panel, along with the battery compartment. The 2.5 x 2.5 cm (1 x 1 in.) NaI(Tl) scintillator is mounted internally.

**Note:**

To open the battery compartment, remove the handle by rotating the handle counterclockwise.

- Open compartment and install two “D” size batteries. Note (+) (-) marks on the inside of the lid. Match the battery polarity to these marks.

**Note:**

The posts should be pointing towards the instrument.

- Close the battery box lid.
- Adjust the audio AUD ON-OFF switch as desired.
- Adjust the meter response F-S switch as desired.
- Select the 0-5000 range with the range selector switch.
- Depress the BAT test button. Check the BAT TEST on the appropriate scale. Replace the batteries if the meter pointer is below the BAT TEST line.
- Depress the light button (Lamp). Check for light on the meter face.

- Check the meter response in the “F” and “S” positions.
- Check for audio indication with the AUD ON-OFF switch.
- Check the instrument for the proper scale indication with a known source.
- Depress the reset (RES) push-button. Check to see that the meter pointer returns to the zero position.

**Section****6****Safety Considerations****Environmental Conditions for Normal Use**

Indoor or outdoor use

No maximum altitude

Temperature range of -20 to 50 °C (-4 to 122 °F); may be certified for operation from -40 to 65 °C (-40 to 150 °F)

Maximum relative humidity of less than 95% (non-condensing)

Pollution Degree 3 (as defined by IEC 664). (Occurs when conductive pollution or dry nonconductive pollution becomes conductive due to condensation. This is typical of industrial or construction sites.)

**Warning Markings and Symbols****Caution!**

The operator or responsible body is cautioned that the protection provided by the equipment may be impaired if the equipment is used in a manner not specified by Ludlum Measurements, Inc.

**The Model 78-6 Analog Stretch Scope is marked with the following symbols:**



**CAUTION** (per ISO 3864, No. B.3.1) – designates hazardous live voltage and risk of electric shock. During normal use, internal components are hazardous live. This instrument must be isolated or disconnected from the hazardous live voltage before accessing the internal components. This symbol appears on the front panel. **Note the precautions on the following page:**



**Warning!**

The operator is strongly cautioned to take the following precautions to avoid contact with internal hazardous live parts that are accessible using a tool:

1. Turn the instrument power OFF and remove the batteries.
2. Allow the instrument to sit for one minute before accessing any internal components.



The “**crossed-out wheeled bin**” symbol notifies the consumer that the product is not to be mixed with unsorted municipal waste when discarding; each material must be separated. The symbol is placed on the front panel. See Section 9, “Recycling,” for further information.



The “CE” mark is used to identify this instrument as being acceptable for use within the European Union. This symbol is on the front panel.

**Section****7****Maintenance**

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**I**nstrument maintenance consists of keeping the instrument clean and periodically checking the batteries and the calibration. The Model 78-6 instrument may be externally cleaned with a damp cloth (using only water as the wetting agent). Do not immerse the instrument in any liquid. Observe the following precautions when cleaning:

1. Turn the instrument OFF and remove the batteries.
2. Allow the instrument to sit for one minute before performing any external cleaning or accessing internal components for maintenance.

**Recalibration**

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.

**Note:**

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

Ludlum Measurements offers a full-service repair and calibration department. We not only repair and calibrate our own instruments, but most other manufacturers' instruments as well.

See Section 9 for further details on instrument calibration.

## Batteries

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 the batteries. Although this instrument will operate at very high ambient temperatures, battery seal failure can occur at temperatures as low as 37 °C (100 °F).

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**Section****8****Technical Theory of Operation**

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**Detector**

The detector consists of a crystal of sodium iodide with Thallium activation (NaI(Tl)) that gives off light pulses when penetrated by radiation photons.

The light pulses are converted to electrical pulses by the photo cathode of the photomultiplier tube. The photomultiplier includes a 10 or 11-stage electron amplifier. This amplifier utilizes an electrostatic field for each stage, adding up to a required 500 to 1500 V supply.

**Input**

Detector pulses are coupled from the detector through C57 to emitter follower Q96. R83, R89 provide bias. R137 protects Q96 from input shorts. R27 couples the detector to the high-voltage supply.

**Amplifier**

A self-biased amplifier provides gain in proportion to R63 divided by R70. Transistor (pin 6 of U1) provides amplification. Pin 12 and 15 of U1 are coupled as current mirror to provide a load for pin 6 of U1.

**Discriminator**

Comparator U2 provides discrimination. The discriminator is set by the voltage divider, R75 and R196, coupled to pin 3 of U2. These pulses are coupled to pin 5 of U3 for meter drive and pin 12 of U3 for audio.

**Audio**

Discriminator pulses are coupled to univibrator pin 13 of U3. Front-panel audio ON-OFF selector controls the reset at pin 13 of U4. When ON, pulses from pin 10 of U3 turn on oscillator U5, which drives the can-mounted unimorph. Speaker tone is set by R84, C112; duration by R86.

## Analog Converter

Pin 12 and 15 of U4 are coupled as a current mirror. For each pulse of current through R72, an equal current is delivered to C105. This charge is drained off by R74. The voltage across C105 is proportional to the incoming count rate.

## Scale Ranging

Detector pulses from the discriminator are coupled to univibrator pin 5 of U3. For each scale, the pulse width of pin 6 of U3 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 C105 by one-tenth of a count on the X.1 range as 100 counts on X100 range.

## Meter Drive

The meter is driven by the emitter to Q6, coupled as a voltage follower in conjunction with pin 1 of U6. For ratemeter drive, the meter is coupled to C105 at P1-15. For battery test, the voltage follower is bypassed, and the meter movement is directly coupled to the battery through R150.

## Meter Compensation

When the unit is provided with a high-torque meter movement, with 1.2 V drive, a temperature compensation circuit is provided on the main circuit board (components R181, R189, and R190).

## Fast/Slow Time Constant

For slow time constant, C104 is switched from the output of the meter drive to parallel C105.

## Low Voltage Supply

Battery voltage is coupled to U7 and associated components (a switching regulator) to provide 5 V at pin 5 to power all logic circuits. Unregulated battery voltage is used to power the meter drive (Q6) and the high-voltage blocking oscillator (Q145).

## Low Voltage Reference

U101 provides a 1.22 V precision reference for HV supply. This unit also biases Q96.

## High Voltage Supply

High voltage is developed by blocking oscillator Q145-T165 and rectified by voltage multiplier CR 166, 167, 169, and 175. Output voltage increases as current through Q44 increases, with maximum output voltage with Q445 saturated.

High voltage is coupled back through R47 to opamp pin 6 of U6. R147 completes the high-voltage circuit-to-ground. High-voltage output is set by front-panel control HV, which sets bias of pin 5 of U6. During stable operation, the voltage at pin 5 of U6 will equal the voltage at pin 5 of U6. Pin 7 of U6 will cause conduction of Q44 to increase or decrease until the high voltage seeks a level of stability.

## Section

## 9

## Calibration

Following are the steps in calibration a Model 78-6:

**Note:**

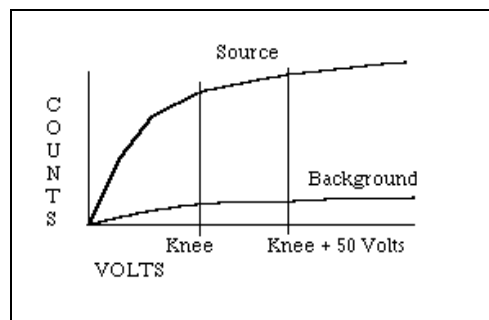
The detector is not light-tight outside of the can.

- Plateau instrument with  $^{241}\text{Americium}$ , using HV adjust potentiometer on front panel. To measure the HV, remove the can and connect HV meter to the junction of R27 and C57.

**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.

- Increment the HV in 50-volt steps to produce a graph similar to the one below.



- The plateau is that portion of the curve from the knee to the point where either the source or background counts start to rapidly increase with a small change in detector high voltage.
- Adjust the HV 50 V above the plateau knee. The plateau length should be at least 100 V.
- Replace instrument can.
- Switch the range multiplier to the 5000 position. Expose the instrument to a calibrated gamma field, which corresponds to approximately 80% of full meter scale. Adjust the 5000 range calibration control for proper reading. Position the instrument in a field that corresponds to approximately 20% of meter scale and confirm meter indicates within 10% of the field. Repeat calibration for the 500, 250, 50, and 25 ranges.

**Note:** If in the previous step the calibration range background is too high for the lower scale(s) or if the appropriate radiation fields are not available, the lower scale(s) will have to be electronically (pulser) calibrated as follows:

- Turn instrument off and remove the instrument from can.
- Connect a Ludlum Model 500 Pulser to the C57-R27 junction and switch to the lowest calibrated range position.
- Adjust the pulser count rate until the meter reads approximately 80% of full meter scale. Note the count rate.
- Switch the Model 78-6 to the next lower position and decade the pulser to the next lowest range.
- Calibrate the current position to correspond to approximately 80% of full-scale reading. Check the 20% scale indication by dividing the pulser count rate by 4.
- Disconnect pulser and turn instrument off.
- Reconnect HV jumper and replace instrument can.



## Section

## 10

## Recycling

Ludlum Measurements, Inc. supports the recycling of the electronics products it produces for the purpose of protecting the environment and to comply with all regional, national, and international agencies that promote economically and environmentally sustainable recycling systems. To this end, Ludlum Measurements, Inc. strives to supply the consumer of its goods with information regarding reuse and recycling of the many different types of materials used in its products. With many different agencies – public and private – involved in this pursuit, it becomes evident that a myriad of methods can be used in the process of recycling. Therefore, Ludlum Measurements, Inc. does not suggest one particular method over another, but simply desires to inform its consumers of the range of recyclable materials present in its products, so that the user will have flexibility in following all local and federal laws.

The following types of recyclable materials are present in Ludlum Measurements, Inc. electronics products, and should be recycled separately. The list is not all-inclusive, nor does it suggest that all materials are present in each piece of equipment:

Batteries	Glass	Aluminum and Stainless Steel
Circuit Boards	Plastics	Liquid Crystal Display (LCD)

Ludlum Measurements, Inc. products, which have been placed on the market after August 13, 2005, have been labeled with a symbol recognized internationally as the “crossed-out wheelie bin.” This notifies the consumer that the product is not to be mixed with unsorted municipal waste when discarding; each material must be separated. The symbol will be placed near the AC receptacle, except for portable equipment where it will be placed on the battery lid.

The symbol appears as such:



# Section 11

## Parts List

### Model 78-6 Analog Stretch Scope

### Main Circuit Board, Drawing 367 x 53

#### CAPACITORS

<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
UNIT	Completely Assembled Model 78-6 Analog Stretch Scope	48-3411
BOARD	Completely Assembled Main Circuit Board	5367-071
C38	0.0015 $\mu$ F, 3kV, C	04-5518
C40-C41	0.0015 $\mu$ F, 3kV, C	04-5518
C42	0.0027 $\mu$ F, 3kV, C	04-5520
C50	100pF, 3kV, C	04-5532
C56	100 $\mu$ F, 10V, DT	04-5576
C57	100pF, 3kV, C	04-5532
C102	100 $\mu$ F, 10V, DT	04-5576
C103	10 $\mu$ F, 20V, DT	04-5592
C104	47 $\mu$ F, 16V, DT	04-5550
C105	10 $\mu$ F, 20V, DT	04-5592
C106	0.001 $\mu$ F, 100V, C	04-5519
C109	0.01 $\mu$ F, 100V, C	04-5523
C112	470pF, 100V, C	04-5555
C113	0.01 $\mu$ F, 100V, C	04-5523
C115	100 $\mu$ F, 10V, DT	04-5576
C117	47pF, 100V, C	04-5533
C119	0.001 $\mu$ F, 100V, C	04-5519
C121	330pF, 100V, C	04-5531
C126	10 $\mu$ F, 20V, DT	04-5592
C134	100 $\mu$ F, 10V, DT	04-5576
C163	0.01 $\mu$ F, 100V, C	04-5523
C170	0.1 $\mu$ F, 100V, C	04-5521
C171	1 $\mu$ F, 35V, DT	04-5575
C191	0.0015 $\mu$ F, 3kV, C	04-5518

	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
TRANSISTORS	Q6	2N3904	05-5755
	Q15	MPS6534	05-5763
	Q44	2N3904	05-5755
	Q96	2N3904	05-5755
	Q145	MPS6534	05-5763
INTEGRATED CIRCUITS	U1	CA3096	06-6023
	U2	TLC372	06-6265
	U3	CD4098	06-6066
	U4	CA3096	06-6023
	U5	ICM7555	06-6136
	U6	TLC27M7IP	06-6248
	U7	MAX631	06-6249
	U101	LM385Z-1.2	05-5808
DIODES	CR94	1N4148	07-6272
	CR166-CR167	1N4007	07-6274
	CR169	1N4007	07-6274
	CR175	1N4007	07-6274
RESISTORS	R18	1k	10-7009
	R27	22k	10-7070
	R36	10M	10-7031
	R46	10k	10-7016
	R47	1G	12-7686
	R63	82k	10-7022
	R64	1k	10-7009
	R65	10k	10-7016
	R66	1k	10-7009
	R70	4.7k	10-7014
	R72	SAT (TYP. 33k)	10-7019
	R74	180k	10-7068
	R75	33k	10-7019
	R76	100 OHM	10-7004
	R77	2.2k	10-7012
	R78	22k	10-7070
	R79	100k	10-7023
	R81	10k	10-7016
R83	100k	10-7023	
R84	470k	10-7026	
R86	2.7M	10-7029	

	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
	R87	10k	10-7016
	R89	100k	10-7023
	R91	4.7k	10-7014
	R128	100k	10-7023
	R137	10k	10-7016
	R138	1M	10-7028
	R147	SAT (TYP. 715k, 1%)	12-7645
	R150	SAT (TYP. 2.37K, 1%)	12-7648
	R159	10k	10-7016
	R172	47k	10-7020
	R177	200OHM	10-7006
	R189	301 OHM, 1%	12-7855
	R196	10k	10-7016
THERMISTORS	R181	R1006-98.4-59-D1	07-6332
	R190	R1006-98.4-59-D1	07-6332
INDUCTOR	L13	470UHY	21-9600
TRANSFORMER	T165	L8050	40-0902
MISCELLANEOUS	*	RECEPTACLE (7 ea) Cloverleaf 011-6809	18-8771
	*	CONNECTOR (1 ea) 1-640456-2 MTA 100	13-8061
	*	CONNECTOR (1 ea) 640456-2 MTA 100	13-8073
<b>Calibration Board, Drawing 367 × 55</b>	BOARD	Completely Assembled Calibration Board	5367-072
CAPACITORS	C1	220pF, 100V, C	04-5530
	C2	0.001μF, 100V, C	04-5519
	C3	0.0022μF, 100V, C	04-5564

	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
RESISTORS	R1	100k TRIMMER	09-6813
	R2-R5	1 MEG TRIMMER	09-6814
	R6	100k TRIMMER	09-6813
RESISTOR NETWORK	RN1	10k, SIP, 10P	12-7727
CONNECTORS	P3	CONN-640456-5 MTA100	13-8057
	P4	CONN-640456-4 MTA100	13-8088
<b>Wiring Diagram, Drawing 367 x 145</b>			
AUDIO	DS1	UNIMORPH 60690	21-9251
CONNECTOR	J1	CONN-1-640442-2 MTA100	13-8407
	J2	CONN-640442-2 MTA100	13-8178
	J3	CONN-640442-5 MTA100	13-8140
	J4	CONN-640442-4 MTA100	13-8170
SWITCHES	S1	PA-600-210	08-6501
	S2-S3	7101-SYZ-QE TOGGLE	08-6511
	S4-S5	30-1-PB GRAYHILL	08-6517
	S6	923 PB SWTCHCRFT	08-6518
BATTERY	B1-B2	“D” DURACELL BATTERY	21-9313
DETECTOR	V1	M12S/19/30-97	47-1574
RESISTOR	R1	1 MEG	12-7844
	R2-R11	10 MEG	12-7996
CAPACITOR	C1	0.01 $\mu$ F, 2kV	04-5525

	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
MISCELLANEOUS	*	TUBE/XTAL ASSY	2004-061
	DS2	MODEL 19 LAMP BOARD	5367-113
	M1	METER 0-1 Ma	15-8066
	*	MODEL 19 METERFACE (202-1071)	7272-337
	*	MODEL 2401 METER WINDOW	7397-033
	*	METERMOVEMENT (1mA)	15-8066
	*	CAN ASSY	4272-305
	*	MODEL 78-6 FRONT PANEL ASSY	4272-370
	*	MODEL 78 SCOPE AND STRAP HK ASSY	4272-372
	*	STRAP NYLON 6 FT 3 INCHES M77	22-9649
	*	MODEL 44-2 HI ENERGY GAMMA SCINT.	47-1532
	*	MODEL 77-6 DETECTOR MOUNT	7272-233
	*	M78 HANDLE ASSY	4272-306

**Section**  
**12**

## **Drawings**

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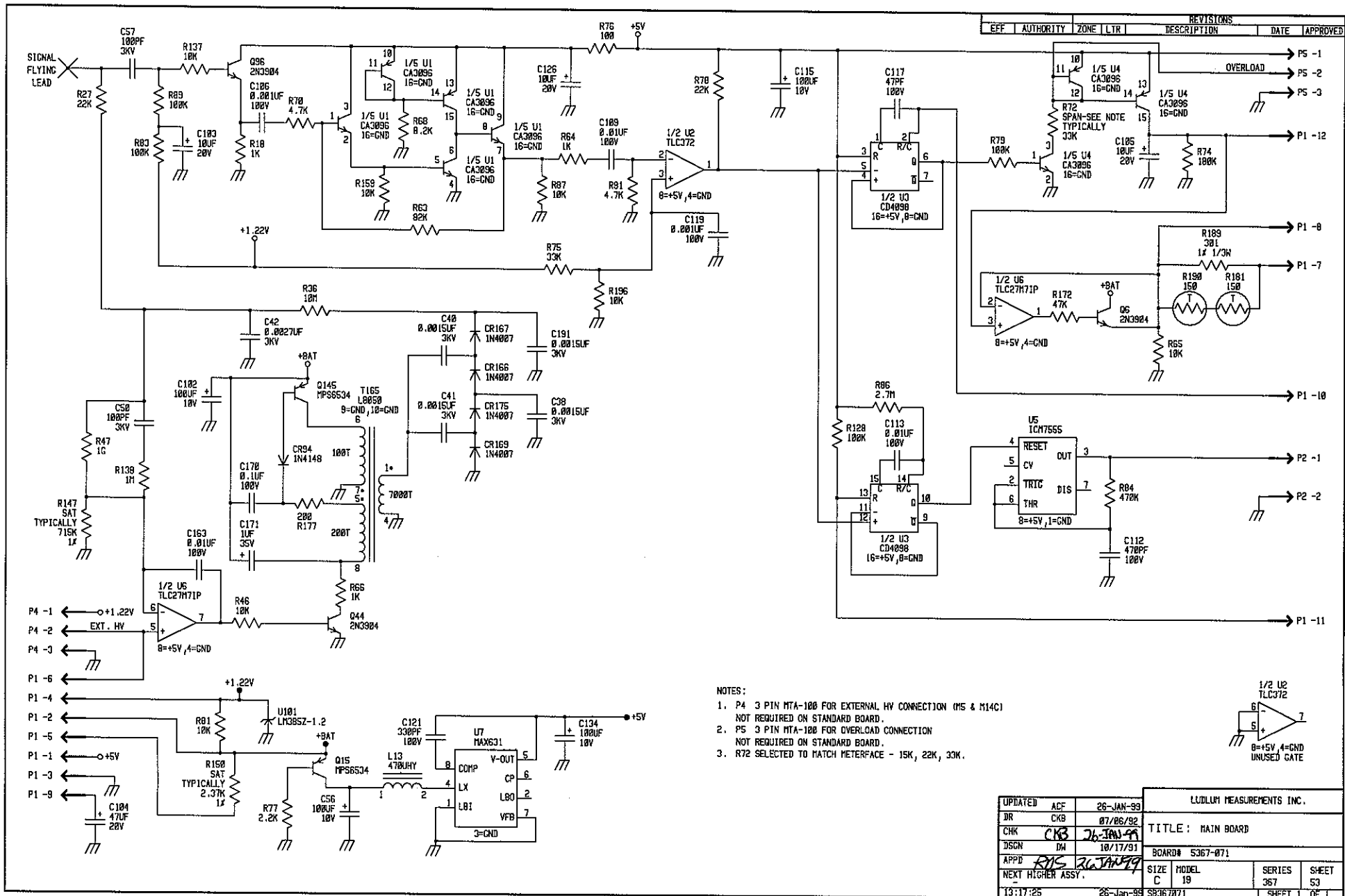
Main Circuit Board, Drawing 367 x 53

Main Circuit Board Component Layout, Drawing 367 x 54

Calibration Board, Drawing 367 x 55

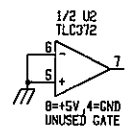
Calibration Board Component Layout, 367 x 56

Wiring Diagram, Drawing 367 x 145



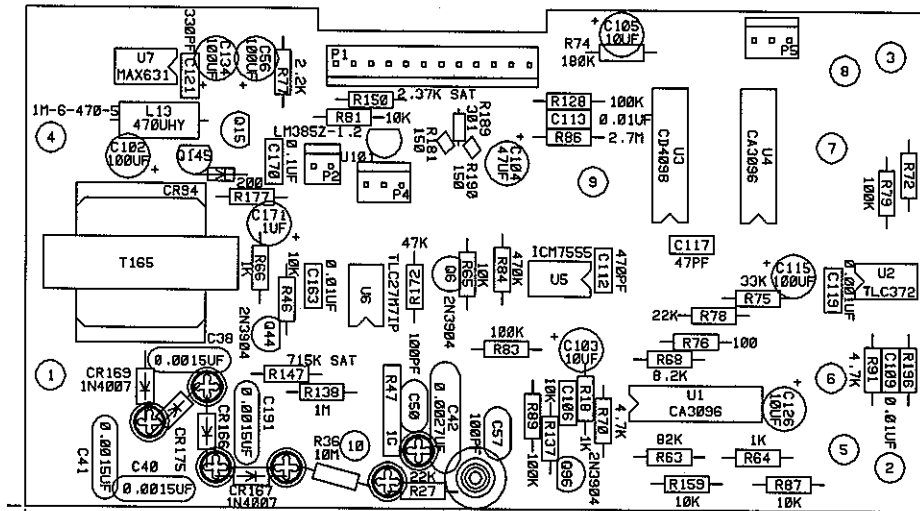
REVISIONS				
EFF	AUTHORITY	ZONE	LTR	DESCRIPTION

- NOTES:
- P4 3 PIN MTA-100 FOR EXTERNAL HV CONNECTION (M5 & M14C) NOT REQUIRED ON STANDARD BOARD.
  - P5 3 PIN MTA-100 FOR OVERLOAD CONNECTION NOT REQUIRED ON STANDARD BOARD.
  - R72 SELECTED TO MATCH METERFACE - 15K, 22K, 33K.



UPDATED	ACF	26-JAN-99	LUDLUM MEASUREMENTS INC.		
DR	CKB	07/06/92	TITLE: MAIN BOARD		
CHK	CKB	26-JAN-99	BOARD# 5367-071		
DSGN	DH	10/17/91	SIZE	MODEL	SHEET
APPD	RHS	26-JAN-99	C	19	367
NEXT HIGHER ASSY.					53
19:17:25		26-Jan-99	S9367071		SHEET 1 OF 1





BOARD

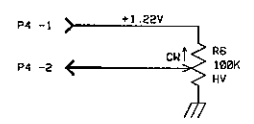
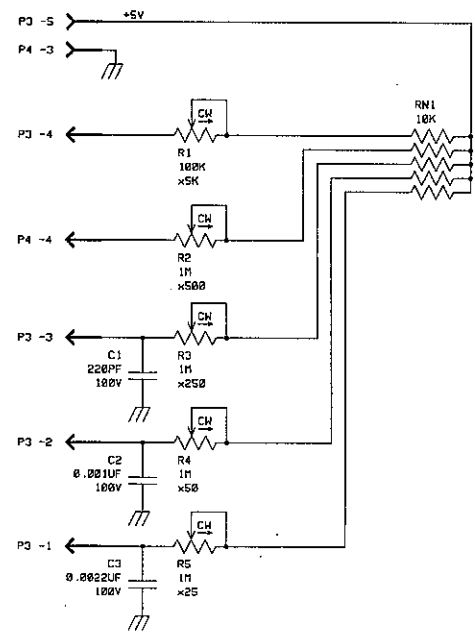
DIMENSIONS:  
 WIDTH = 5.147"  
 HEIGHT = 2.810"

MOUNTING HOLE

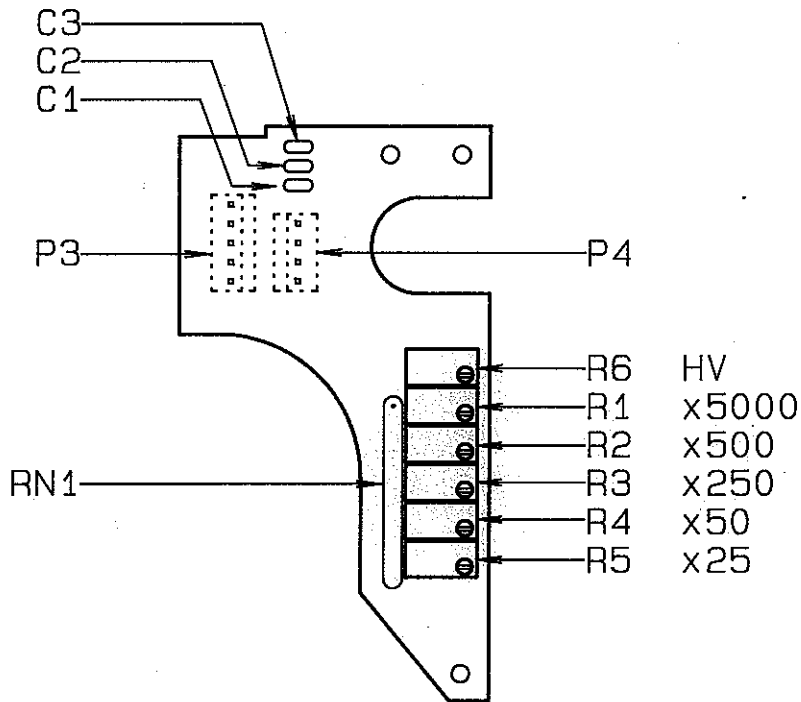
- LOCATIONS:
1. X=0.140"  
Y=0.734"
  2. X=4.897"  
Y=0.250"
  3. X=4.897"  
Y=2.560"
  4. X=0.140"  
Y=2.076"

<input checked="" type="checkbox"/> LUDLUM MEASUREMENTS INC. SHEETWATER, TX.			
DR	ACF 26-JAN-99	TITLE: MAIN BOARD	
CHK	CKB 26-JAN-99	BOARD# 5367-071	BS367071
DSGN	DW 10/17/91	MODEL 19	SHEET 54
APP	ROS 26-JAN-99	SERIES 367	
12:41:59 26-Jan-99 COMP <input type="checkbox"/> SLDR <input type="checkbox"/> OUTLINE <input checked="" type="checkbox"/>			
COMP PASTE <input type="checkbox"/> COMP MASK <input type="checkbox"/> SLDR PASTE <input type="checkbox"/> SLDR MASK <input type="checkbox"/>			

REVISIONS						
EFF	AUTHORITY	ZONE	LTR	DESCRIPTION	DATE	APPROVED

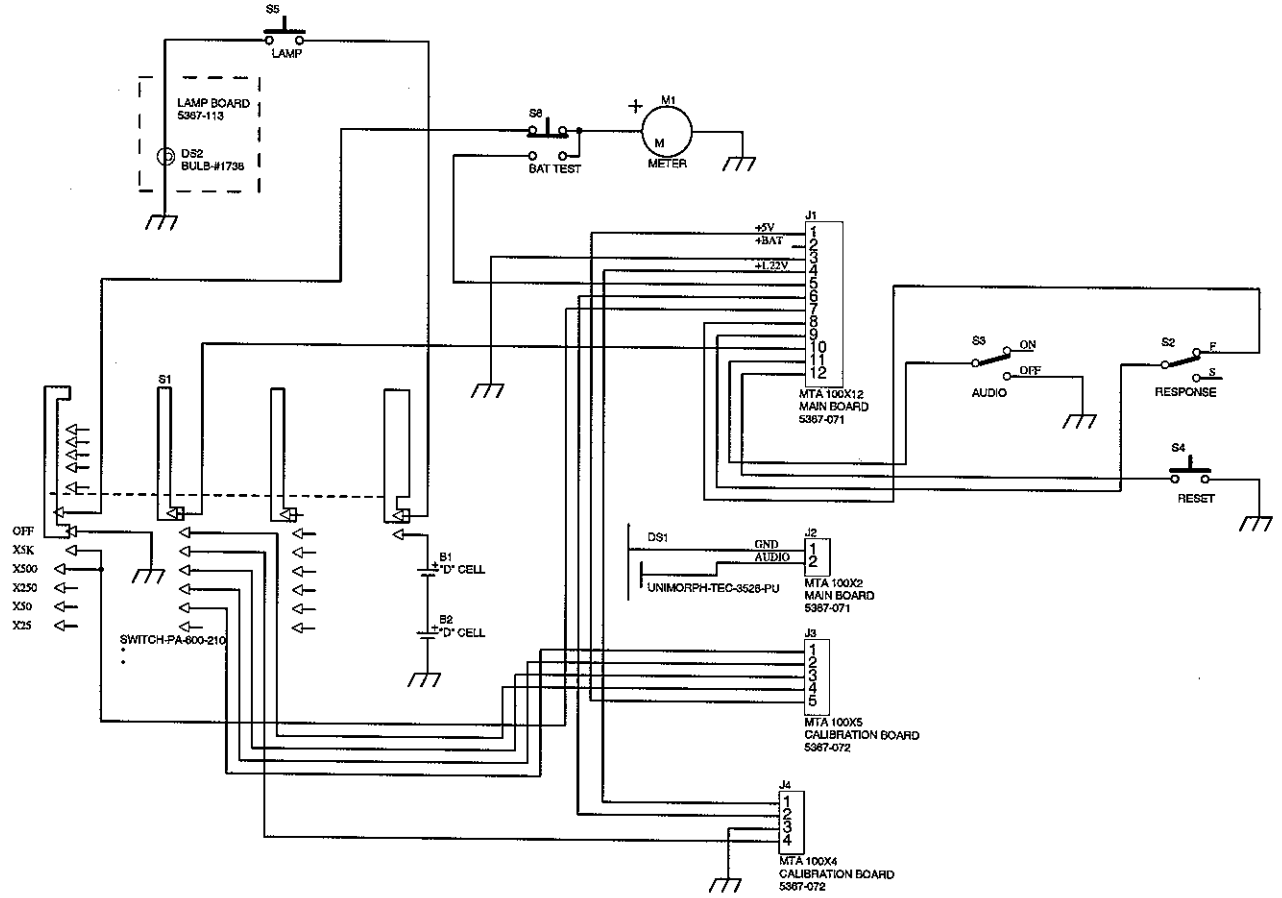
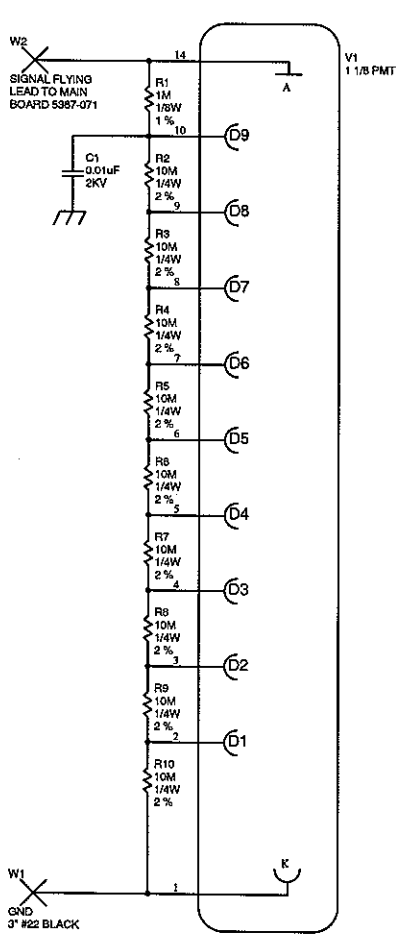


UPDATED	-	LUDLUM MEASUREMENTS INC.			
DR	CKB	05/22/92	TITLE: CALIBRATION BOARD		
CHK	<i>DW</i>	8/27/95			
DSCN	-	-	BOARD# 5367-872		
APPD	JGW	8/29/95	SIZE	MODEL	SHEET
NEXT HIGHER ASSY.	-	-	D	19	367 55
11:52:00	29-Aug-95	S8367872	SHEET 1 OF 1		



DESC: CALIBRATION BOARD	
MODEL: 19	
PART #: 5367-072	
DWN: CKB	DATE: 06/24/92
DSGN:	DATE:

CHG NO.		DWN	CKB	APP
DWN DATE	CKB DATE	APP DATE		
CKB 06/24/92	DL 8/25/92	SLW 9-29-95		
TOL: SHOP STD <input type="checkbox"/>	OTHER	SCALE: FULL <input checked="" type="checkbox"/>	OTHER	
TITLE MODEL 19 CALIBRATION BOARD				
LUCUM MEASUREMENTS, INC.		SERIES	SHEET	
501 OAK STREET		367	58	
BRECKENRIDGE, TEXAS 75606				



**LUDLUM MEASUREMENTS, INC.** PO Box 810  
501 Oak Street  
Sweetwater, Texas 79556  
U.S.A. 1-800-622-0828

Drawn: JK	20-NOV-01	Title: WIRING DIAGRAM
Design:	Model: 19	
Check: <i>PLM</i>	<i>11-20-01</i>	Board#: 5367-145
Approve: <i>ES</i>	<i>11-20-01</i>	Sheet: 1 of 1
09:37:53	20-Nov-2001	Rev: 1.0

367145

X:\Projects\LMTM19\W19.Ddb - Documents\367-145\rev1.0\367145.sch