LUDLUM MODEL 4
COUNT RATEMETER

July 1999
Serial No. 156715 and Succeeding
Serial Numbers

LUDLUM MEASUREMENTS, INC.
501 OAK ST., P.O. BOX 810
SWEETWATER, TX 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.

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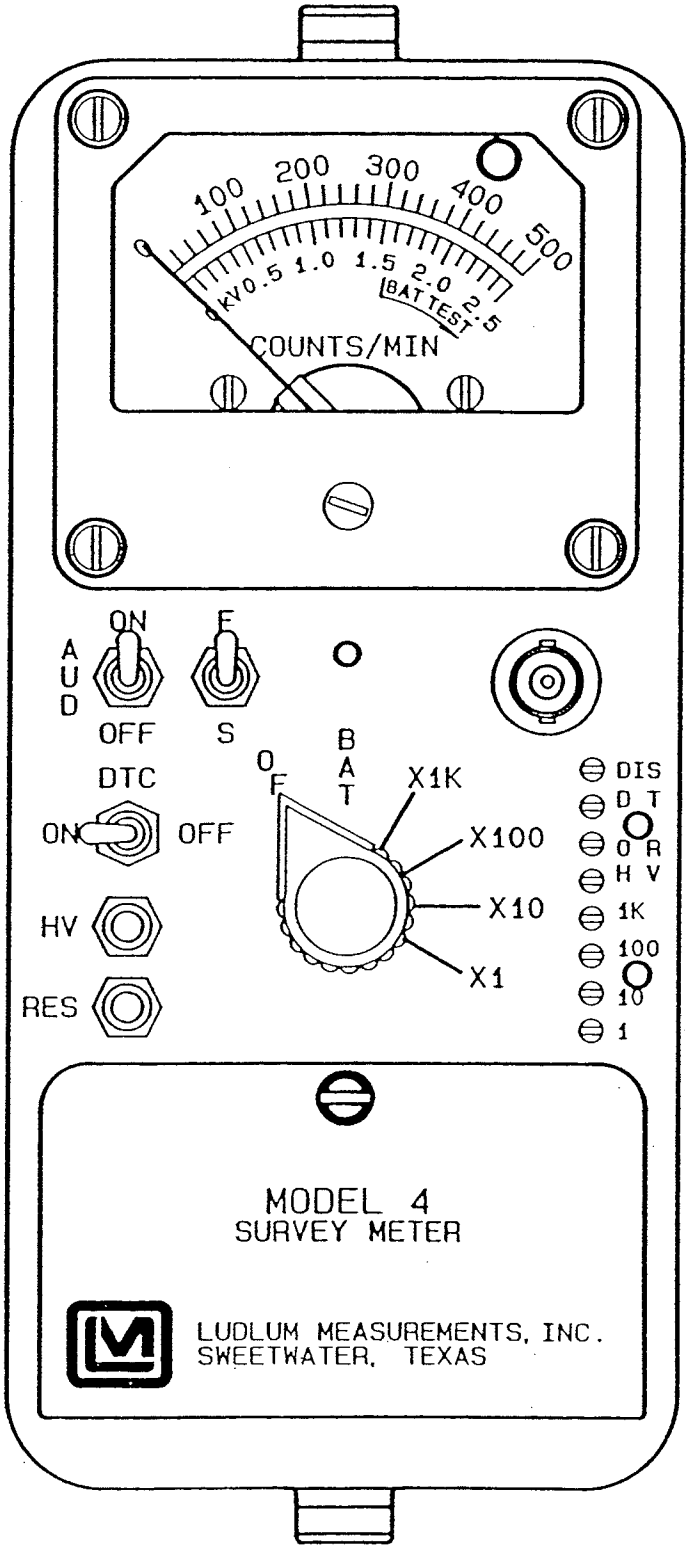
LUDLUM MEASUREMENTS, INC.
ATTN: REPAIR DEPARTMENT
501 OAK STREET
SWEETWATER, TX 79556

800-622-0828 325-235-5494
FAX 325-235-4672



CHG	NO.			DWN	CHK	APP
DWN BK	DATE 12-21-80	CHK	DATE 1-16-82	APP	DATE 01-16-82	
TOL: SHOP STD ☐ OTHER			SCALE: FULL ☐ OTHER			
TITLE MODEL 4 SURVEY METER						
LUDLUM MEASUREMENTS, INC. SWEETWATER, TEXAS 79556			SERIES 383		SHEET 348	

M4 Survey Meter
July 1999
TABLE OF CONTENTS

M4 Survey Meter
July 1999

1. GENERAL

The Ludlum Model 4 Survey Meter provides the required electronic circuitry for radiation monitoring with proportional, scintillation and G-M detectors.

This instrument has additional features to complete alpha scintillation monitoring. An overrange circuit is added to give warning with light and full-scale indication for overrange conditions including detector light leaks.

Dead time correction is available with a toggle switch to compensate for coincidence loss. Also, a pulse width discriminator may be internally activated to allow enhanced gamma discrimination. This feature is disabled unless specifically requested by the user.

2. SPECIFICATIONS

- **POWER**: Two flashlight batteries, standard "D" cells; Mercury or rechargeable cells directly interchangeable

- **HIGH VOLTAGE**: Adjustable from 200 to 2,500 volts; electronically regulated to 1%; HV support of scintillation loads to 1,500 volts, proportional to 2,500 volts.
High voltage test indicated on meter.

- **SENSITIVITY**: Adjustable from 2 to 40 millivolts. Control under calibration cover

- **INPUT IMPEDANCE**: 0.1 megohm

- **METER**: 1 mA, 2 1/2-inch scale, pivot-and-jewel suspension

- **RANGE**: 0-500,000 counts/minute (cpm)

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

- **BATTERY DEPENDANCE**: Instrument calibration change less than 3% within battery check limits on meter

- **CALIBRATION CONTROLS**: Individual potentiometers for each range; accessible from the front cover while in operational status

- **OVERRANGE**: Response to high radiation or scintillation light leak is indicated by overrange lamp and full scale meter

- **DEAD TIME COMPENSATION**: Compensation for detector and ratemeter dead time may be selected by toggle switch. Calibration of detector dead time is under the calibration cover.

- **PULSE WIDTH DISCRIMINATION**: Pulse width discrimination may be activated with internal jumper to enhance gamma rejection for alpha scintillation detectors

- **AUDIO**: Built-in unimorph speaker with ON-OFF switch

- **RESPONSE**: 4 or 22 seconds for 90% of final meter reading

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

- **SIZE** : 10.67cm (4.2")H x 8.9cm (3.5")W x 21.6cm (8.5")L, exclusive of handle

- **WEIGHT**: 1.3kg (3 lbs.), less detector and batteries

- **FINISH**: Drawn-and-cast aluminum fabrication, with computer-beige polyurethane enamel and silk-screened nomenclature

3. DESCRIPTION OF CONTROLS AND FUNCTIONS

- **Range Selector Switch**: A six-position switch marked OFF, BAT, X1000, X100, X10, X1. Turning the range selector switch from OFF to BAT position provides the operator with a battery check of the instrument. A BAT check scale on the meter provides a visual means of checking the battery-charge status. Moving the range selector switch to one of the range multiplier positions (X1000, X100,X10, X1) provides the operator with an overall range of 0 to 500,000 cpm. Multiply the scale reading by the multiplier for determining the actual scale reading.

- **AUD ON-OFF Toggle Switch**: In the ON position, operates the unimorph speaker, located on

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.

- **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 fast response and large meter deviation. "S" position should be used for slow response and damped, meter deviation.

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

- **HV Pushbutton Switch**: When depressed, displays the detector high voltage on the meter.

Test high voltage with detector connected. High voltage will decline with scintillation detectors, due to internal resistance.

- **HV Adjustment**: Provides a means to vary the high voltage from 200 to 2500 volts. The high voltage setting may be checked at the connector with an appropriate voltmeter.

- **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.

- **Discriminator Adjustment**: Allows the input sensitivity to be adjusted from 2 to 40 millivolts. The Discriminator is normally set for 10 millivolts at the factory.

- **OR Control**: Allows adjustment for detector overrange. When the detector is exposed to very high radiation or an alpha scintillator develops a light leak, detector current increases. This control is adjusted to sense the higher current resulting in the meter lamp on and meter drive full scale.

- **DT Control**: Allows adjustment for detector dead time.

- **DTC ON-OFF Switch**: Allows dead time correction to be disabled. Turn this switch OFF when detecting non-random counts. Turn switch OFF for pulser calibration.

4. OPERATING PROCEDURES

✔ NOTE: To open the Battery Lid, twist the lid button counterclockwise 1/4 turn. To close, twist clockwise 1/4 turn.

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

✔ NOTE: Center post of flashlight battery is positive.

- ○ Close the battery box lid.

- ○ Adjust the range switch to BAT. The meter should deflect to the battery check portion of the meter scale. If the meter fails to respond, check that the batteries have proper polarity.

- ○ Turn the instrument range multiplier switch to X1000. Expose the detector to a radiation check source. The speaker should click with the audio switch turned to the ON position.

- ○ Move the range switch to the lower scales until a meter reading is indicated. The toggle switch labeled F-S should have fast response in "F" position and slow response in "S" position.

- ○ Depress the RES Button. The meter should zero.

- ○ The operating point for the instrument and probes is established by setting the probe voltage and instrument sensitivity (HV and DIS). The proper selection of this point is the key to instrument performance. Efficiency, background sensitivity and noise are fixed by the physical makeup of the given detector and rarely varies from unit to unit. However, the selection of the operating point makes a marked difference in the apparent contribution of these three sources of count.

- ○ In setting the operating point, the final result of the adjustment is to establish the system gain so that the desirable signal pulses are above the discrimination level and the unwanted pulses from background radiation and noise are below the discrimination level and are not counted.

- The total system gain can be controlled by adjusting either the instrument gain or the high voltage. Voltage affects control in the probe; DIS (Discriminator) controls the amplifier gain.

- In the special case of G-M detectors, a minimum voltage must be applied to establish the Geiger-Mueller characteristic. Further changes in gain will not affect this type probe.

The operating point for each detector is set at a compromise point of sensitivity, stability and background contribution. These operating points are best for general monitoring. In application, these arbitrarily selected points may not be a better operating point, the following guides are presented:

☐ G-M DETECTORS: Are not capable of amplitude discrimination; so, the discrimination control has no function. The ratemeter will operate at any setting of the Discriminator control with a G-M detector. Set the gain control 30-40 mV and the HV control for 900 volts.

☐ PROPORTIONAL DETECTORS: Set the DIS control for 2 millivolt discrimination (near maximum clockwise). Expose the detector to a check source. Adjust the HV until the low energy source is detected. Refine the HV adjustment for an optimum source count with a minimum acceptable background count.

☐ AIR PROPORTIONAL ALPHA DETECTORS: Set the (Discriminator) for 2 millivolt discrimination. Adjust the HV until the detector just breaks down. This is shown by a very rapid increase of count rate without a source present. Measure the HV output; then decrease the HV setting to operate 100 volts below breakdown.

☐ SCINTILLATORS: Set the DIS for 10 millivolts. Plateau HV versus count rate for desired source. HV just above the knee of the plateau.

In the special case of alpha scintillators, increase HV until a few background counts are noticed. Then lower high voltage until detector exhibits unacceptable probe face uniformity. Now select a "best fit" operating voltage between the limits of background count and detector face and linearity.

✔NOTE: The internal high voltage reading will be approximately 50 volts lower with a scintillator than with the Model 500 Pulser, G-M, or proportional detector. The output resistance of the power supply is 5.7 megohms. The resistance between the voltmeter pickoff and detector is 1 megohm.

- Check that overrange responds to overrange responds to overrange conditions.

- Confirm calibration and proceed to use the instrument.

5. CALIBRATION

Calibration controls are located on the front of the instrument under the calibration cover. The controls may be adjusted with an 1/8-inch blade screwdriver.

The instrument may be calibrated to true reading or, when used with a single source, geometry calibration may be used. Both methods are described below. Unless otherwise specified, the instrument is calibrated to true reading at the factory.

✔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.

☐ Ratemeter: Set DTC ON-OFF. Leave this switch OFF unless specifically instructed to turn ON. Set range switch to X100. Select 40,00 CPM. Increase pulse height until a stable count rate is observed. Calibrate X100 scale to 400 X100.

☐ Discriminator: Set range switch to X100. Select 40,000 CPM and pulse height at 10 millivolts. Adjust discrimination control (DIS) until the meter reads 300 X100.

☐ Proceed with above step and then return to previous step. Adjust pulse height to 20 millivolts and recheck X100 calibration. Calibrate X1K, X10, and X1 scales.

☐ Overrange: Place detector in high range field and adjust overrange control until meter lamp just turns on. Meter should indicate full scale. Slowly remove the detector from the high range. The meter should remain at full scale until the detector exposure would indicate a lower reading. In the special case of alpha scintillation, introduce a small light leak by loosening the window.

✔NOTE: The detector voltage must be set before overrange is adjusted. See OPERATING PROCEDURES section.

☐ Dead Time: With the selector on X1K, the detector exposed to a full scale source, and DTC switch OFF, adjust the dead time control until the count rate indicated drops 2-5% of full scale. Now turn the DTC switch ON. The meter reading should increase to near full scale. Now back off the control until the meter just drops off. Count the turns. Adjust the control half way between the two points.

✔NOTE: The DTC ON setting will give erroneous readings with a linear pulser. When the dead time is not to be used, set the DT control to the maximum counterclockwise position.

☐ Geometry Calibration: Follow the above procedure only substitute lower pulser readings as dictated by the detector efficiency.

☐ To correlate this calibration to detected radiation value, probe efficiency must be determined. Select the operating point for the probe used, as outlined in DESCRIPTION OF CONTROLS AND FUNCTIONS section. Then determine the count rate with the probe exposed to a calibrated source. The ratio of the instrument count rate versus the known source value is the probe efficiency. This degree will be different for various types of probes and sources. By using probe efficiency, one determines the actual emission rate of an unknown source.

✔NOTE: For proportional and scintillation detectors, changes in the HV and DIS (Discriminator) controls will change the apparent detector efficiency for many sources.

☐ Geometry calibration is often used when the instrument is utilized to measure radiation with a limited spectrum; for example, a single isotope contamination. To calibrate the instrument using this technique, obtain calibration sources with a spectrum similar to the unknown radiation. Expose the probe to the source and adjust the calibration control until the meter reading corresponds to the source value. Repeat this procedure with scaled sources for each instrument range.

✔NOTE: In the event that only one source is available, calibrate the corresponding range to that source. Disconnect the probe and connect a pulse generator to the instrument. Determine the pulse rate for 3/4 scale deflection on the calibrated range. Using this reading as a reference, increase or decrease this rate by factors of ten for calibrating each succeeding range.

☐ Pulse Width Discrimination: If pulse width discrimination is to be utilized, calibrate input sensitivity to desired level. Then remove jumper from J166, J169 and place between J166, J168. Connect detector and place in unwanted radiation; then in wanted radiation. Select R164 for best fit of minimum detection of unwanted radiation, with minimum acceptable count from wanted radiation.

The unit is set for discrimination of gamma pulse with alpha scintillators, with R164 equal to 47k.

☐ After selection of R164, check sensitivity with pulser. Make a special note of this value for future reference. The apparent sensitivity is usually higher.

6. THEORY OF OPERATION

• 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, 15 of U1 are coupled as current mirror to provide a load for pin 6 of U1. The output self-biases to 2 Vbe (approximately 1.4 volts) at pin 7 of U1. This provides just enough bias current through pin 6 of U1 to conduct all of the current from the current mirror.

Positive pulses from pin 7 of U1 are coupled to the discriminator.

• DISCRIMINATOR: Comparator U2 provides discrimination. The discrimination is set by the DIS control located on the front panel, coupled to pin 3 of U2.

• PULSE SHAPER: Univibrator pin 6 of U3 gives a standard pulse width when turned on by the comparator U2. This pulse width is controlled by Dead Time Compensation Control (DT), located on the front panel. This pulse width is set to approximately the longest pulse width from the detector.

• PULSE WIDTH DISCRIMINATION: Pulses from discriminator U2 are also coupled to univibrator pin 10 of U3. This circuit is set at a very narrow pulse width to block gamma pulses from alpha scintillators. When activated, pin 9 of U3 is coupled to the rest of the pulse shaper and keeps it from activating for short pulses.

- AUDIO: Selected pulses are coupled from pin 6 of U3 to univibrator pin 12 of U4. Front panel audio ON-OFF selector controls the reset at pin 13 of U4. When ON, pulses from pin 10 of U4 activates oscillator U7, which drives the can mounted unimorph from pin 3 of U7. Speaker tone is set by R84, C112; duration by R86.

- DIGITAL ANALOG CONVERTOR: Pin 12, 15 of U9 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 pin 6 of U3 are coupled to univibrator (pin 5 of U4). For each scale, the pulse width of pin 6 of U4 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 count on the X1 range as 1,000 counts on X1K range.

- DEAD TIME CORRECTION: Since the unit is unable to count while pin 6 of U4 is high, the drain from C105 through R74 is blocked by pin 9 of U9 when pin 6 of U4 is high. This corrects the count loss from a random count source. (It will give a false high reading from a pulser input).

Additionally, pin 9 of U9 conduction is blocked when pin 7 of U3 is low, due to the detector pulse width. This is normally only observed on the X1K range, due to the wide ratemeter pulses.

- DEAD TIME DISABLE: Dead time is disabled by front panel control shorting pin 9 of U9 to ground.

- METER DRIVE: The emitter drives The meter to Q6, coupled as a voltage follower in conjunction with pin 1 of U5. For a ratemeter drive, the meter is coupled to C105 at P2-6. For high voltage, the meter is coupled to R132 at P-14. For Battery Test, the voltage follower is bypassed and the meter movement is directly coupled to the battery through R150.

- METER COMPENSATION: A temperature compensation package is mounted internally; located behind meter movement.

- 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 U6 and associated components as a switching regulator to provide 5 volts 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.

Q15 provides provides protection from reversed batteries

- LOW VOLTAGE REFERENCE: U101 provides a 1.22 volt precision reference for HV supply. This unit also biases the Q96.

- HIGH VOLTAGE SUPPLY: High voltage is developed by blocking oscillator Q145-T25 and rectified by voltage multiplier CR34, 157, 158, and 29. Output voltage increases as current through Q44 increases, with maximum output voltage with Q44 saturated.

High voltage is coupled back through R47, R147 to operational amplifier pin 6 of U8. R147 completes the high voltage circuit to ground. High voltage output is set by front panel control HV, which sets bias of pin of U8. During stable operation, the voltage at the junction of R174, R147 will equal the voltage at pin 5 of U8. Pin 7 of U8 will cause conduction of Q44 to increase or decrease until the high voltage seeks a level for stability.

- OVERRANGE: Detector current through R28 is sensed by amplifier pin 2 of U8. Pin 3 of U8 is used by as a comparator. Reference voltage is set by pin 3 through R47 by panel located OR (overrange) control. Pin 2 of U8 senses the detector current through R48. When this voltage drops below the set point, pin 1 of U8 goes high, Q97 and Q125 conduct activating OR lamp, causing the ratemeter to go full scale.

7. OPERATION WITH MODEL 43-65

- Initial Calibration:

☐ Set discriminator on Model 4 to 10 millivolts.

☐ Set dead time (DT) and overrange (OR) controls fully counterclockwise.

☐ Set high voltage at value labeled on Model 43-65 or refer to current calibration certificate for proper value. Make this setting with 43-65 and disconnect. The detector will "load" the high voltage supply to a lower voltage.

☐ Calibrate all scales to true counts or geometry counts with dead time correction (DTC) in OFF position.

☐ Connect Model 43-65 to the Model 4. Set on X1K.

☐ Remove the seal screw on the front body of the Model 43-65. Cover the hole with your finger.

✔NOTE: As the light into the hole increases, the meter will go full scale and then decline to zero. The detector is now paralyzed. Allow just enough light into the detector to drive the meter full scale.

☐ Adjust overrange control (OR) until the meter red lamp comes on.

☐ Reinstall the seal screws. Check the Model 43-65 with a source (at near full scale) to insure the red lamp is OFF with the instrument just at full scale.

☐ Expose the Model 43-65 to a full scale source, with the Model 4 on X1K. DTC ON-OFF switch is set at OFF. Now adjust the DT control until the count rate just starts to decline 2-5%. Turn DTC to ON. The count rate should increase to the corrected source value.

- **Probe Changes**

Model 43-65 changes will require readjustment of the HV and DT controls. Set the HV at the value marked on the detector.

☐ Repeat preceding step for the DT control.

✔ In an emergency, the DT control may be turned full counterclockwise. Under this condition all scales except the X1K will have dead time compensation and the X1K scale will be partially compensated.

NOTE: If the DT control is over-adjusted, the X1K scale will read less than the calibrated value with the DTC switch in the OFF position.

PARTS LIST

Ref. No.	Description	Part No.
	Model 4 Survey Meter	
UNIT	Completely Assembled Model 4 Survey Meter	48-2166
	Circuit Board, Drawing 363 x 347	
BOARD	Assembled Circuit	5363-468
	• **CAPACITORS**	
C37-C38	0.0047µF, 3kV, C	04-5547
C40-C41	0.0047µF, 3kV, C	04-5547
C42	0.0056µF, 3kV, C	04-5522
C50	100pF, 3kV, C	04-5532
C56	100µF, 15V, DT	04-5583
C57	100pF, 3kV, C	04-5532
C102	100µF, 15V, DT	04-5583
C103	10µF, 20V, DT	04-5592
C104	100µF, 15V, DT	04-5583
C105	22µF, 35V, DT	04-5594
C106	0.001µF, 100V, C	04-5519
C107	0.01µF, 100V, C	04-5523
C109-C110	0.01µF, 100V, C	04-5523
C112	470pF, 100V, C	04-5555
C113	0.01µF, 100V, C	04-5523
C115	10µF, 20V, T	04-5507
C116	47pF, 100V, C	04-5533
C117-C118	100pF, 100V, C	04-5527
C119	0.001µF, 100V, C	04-5519
C121	330pF, 100V, C	04-5531
C122	0.0047µF, 3kV, C	04-5547
C126	10µF, 20V, DT	04-5592
C134	100µF, 15V, DT	04-5583
C161	0.01µF, 100V, C	04-5523
C162	0.001µF, 100V, C	04-5547
C163	0.001µF, 100V, C	04-5519
	• **TRANSISTORS**	
Q6	2N3904	05-5755
Q15	MPSU51	05-5765
Q44	2N3904	05-5755
Q96	2N3904	05-5755
Q97	2N6000	05-5820
Q125	2N7000	05-5820
Q145	MPSU51	05-5765

Ref. No.	Description	Part No.
	• **VOLTAGE REFERENCE**	
U101	LM385Z-1.2	05-5808
	• **INTEGRATED CIRCUITS**	
U1	CA3096	06-6023
U2	TLC372	06-6265
U3-U4	CD4098	06-6066
U5	TLC27M7IP	06-6248
U6	MAX631	06-6249
U7	ICM7555	06-6136
U8	TLC27MTIP	06-6248
U9	CA3096	06-6023
	• **DIODES**	
CR29	MR250-2	07-6266
CR34	MR250-2	07-6266
C94	1N4148	07-6272
CR156-CR158	MR250-2	07-6266
	• **RESISTORS**	
R18	1k	10-7009
R27	1 MEG	10-7028
R28	4.7 MEG	10-7030
R36	1 MEG	10-7028
R43	100k	10-7023
R46	22k	10-7070
R47-R48	1G	12-7686
R63	82k	10-7022
R64	1k	10-7009
R65	10k	10-7016
R66	1k	10-7009
R68	8.2k	10-7015
R70	4.7k	10-7014
R72	15k	10-7017
R73	270k	10-7025
R74-R75	82k	10-7022
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

R85	100 OhM	10-7004
R86	2.7 MEG	10-7029
R87	10k	10-7016
R88-R90	100k	10-7023
R91	4.7k	10-7014
R128	100k	10-7023
R131	100k TRIMMER	09-6813
R132	1 MEG TRIMMER	09-6814
R137	10k	10-7016
R138	1 MEG	10-7028
R147	SAT (TYP. 715k, 1%)	
R150	SAT (TYP. 2.2k)	
R151	1.5 MEG	10-7038
R159	10k	10-7016
R164	47k	10-7020
R174	365k	12-7728

- **INDUCTORS**

L13	IM6-470uH-5	21-9600

- **TRANSFORMERS**

T25	M2221, 2300 HVPS	4275-037

- **MISCELLANEOUS**

1 EA.	CONN-640456-2 MTA100	13-8073
1 EA.	CONN-640456-6 MTA100	13-8095
1 EA.	CONN-1-640456-4 MTA100	13-8141
9 EA.	CLOVERLEAF RECEPT-011-6809	18-8771

Calibration Board, Drawing 363 x 348

BOARD	Assembled Calibration	5363-469

- **CAPACITORS**

C1	0.047µF, 100V, C	04-5565
C2	0.0047µF, 100V, C	04-5570

- **RESISTORS**

R1-R2	1 MEG TRIMMER	09-6814
R3	100k TRIMMER	09-6813
R4	1 MEG TRIMMER	09-6814
R5	100k TRIMMER	09-6813
R6-R7	1 MEG TRIMMER	09-6814
R8	120k	10-7050
R9	100k TRIMMER	09-6813
R10	1k, 1/3W. 5%	12-7750
R11	100k TRIMMER	09-6813
R12	10k, 1/3W, 5%	12-7748

- **RESISTOR NETWORK**

RN	10k	12-7720

- **MISCELLANEOUS**

1 EA.	CONN-640456-5 MTA100	13-8057
1 EA.	CONN-640456-7 MTA100	13-8115

Chassis Wiring Diagram, Drawing 363 x 349

- **AUDIO**

DS1	UNIMORPH T904-001-101/00	21-9251

- **CONNECTORS**

J1	CONN-1-640442-4 MTA100	13-8173
J2	CONN-640442-5 MTA100	13-8140
J3	CONN-640442-7 MTA100	13-8172
J4	CONN-640442-6 MTA100	13-8171
J5	CONN-640442-2 MTA100	13-8178
J6	RECPT-UG706/U SCREW-IN "C"	13-7751

- **SWITCHES**

S1	PA-600-210	08-6501
S2	#923 SWTCHCRFT	08-6518
S3	30-1-PB GRAYHILL	08-6517
S4-S6	7101-SYZ-QE	08-6511

- **BATTERY**

B1-B2	DURACELL "D"	21-9313

- **LEDS**

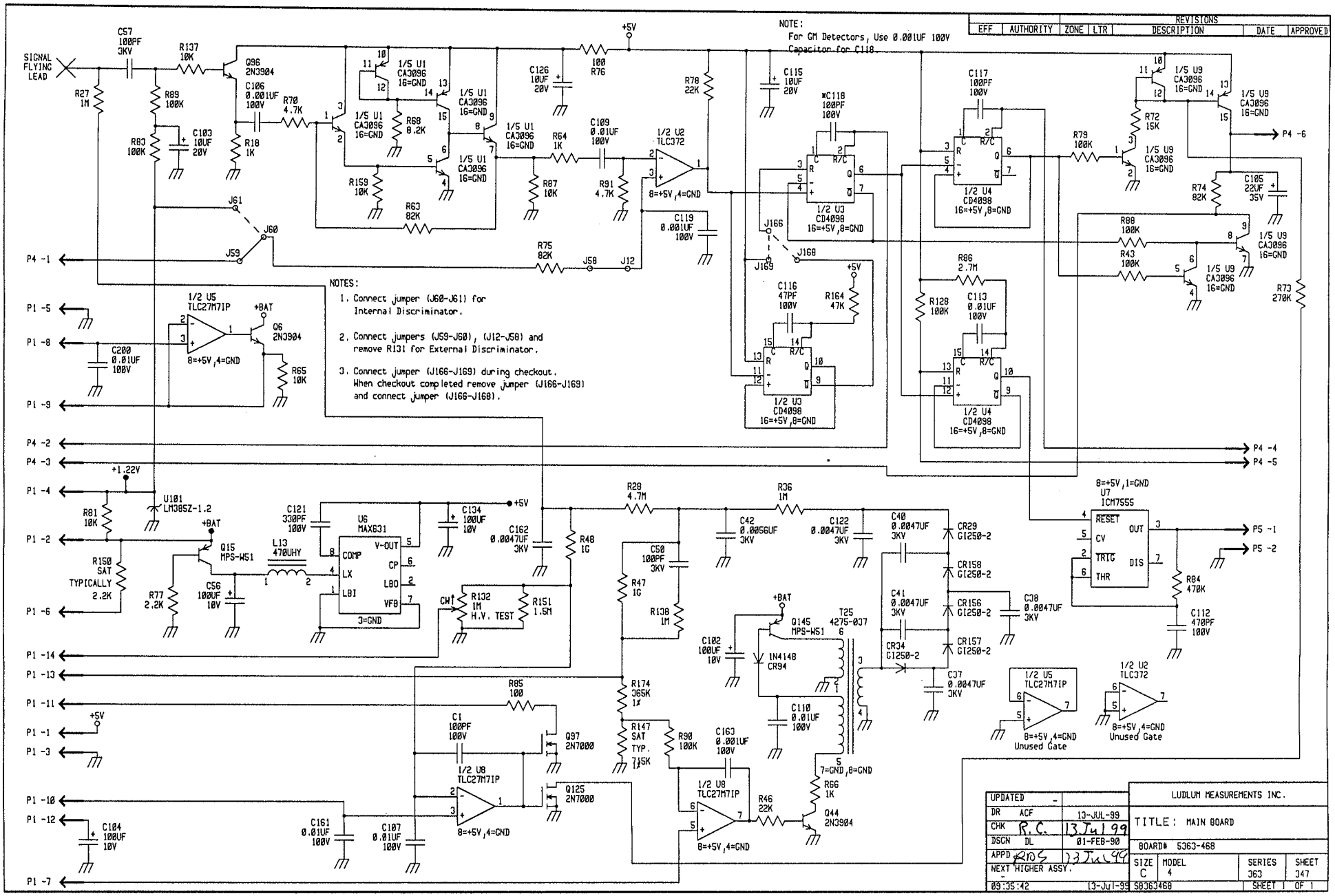
CR1	LED-SLH-56-VR3 RED	07-6308

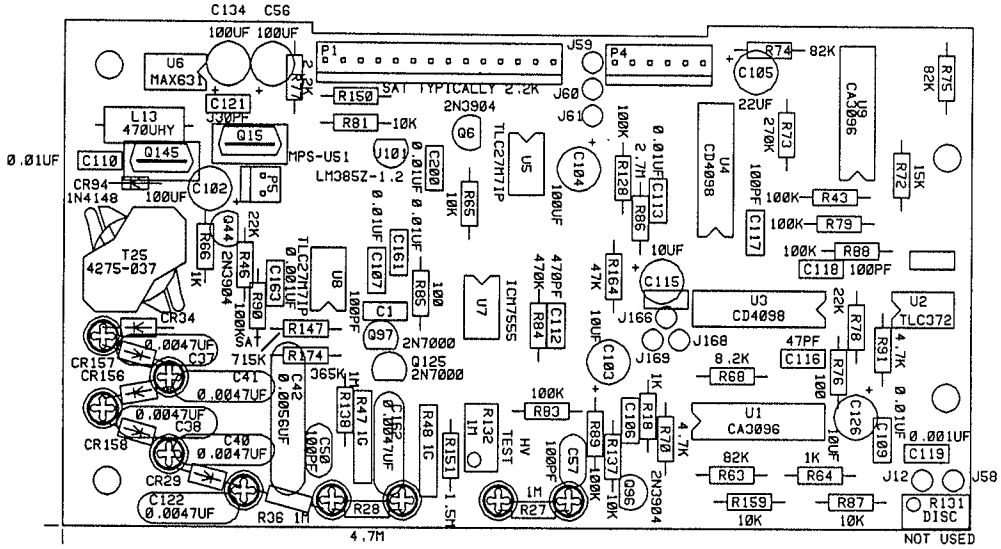
- MISCELLANEOUS

M1	M4/3-9/12-7 BEZEL ASSY.	4363-424
*	METER BEZEL W/GLASS W/O SCREWS	4363-352
*	METER MOVEMENT (1mA)	15-8030
*	M295 BATTERY CONTACT SET	40-1707
*	M 4/12-7 CASTING	9363-420
*	M 12-7 MAIN HARNESS	8363-428
*	PORT CAN ASSY	4363-441
*	PORTABLE KNOB	08-6613
*	M 4/3-9/12-7 METERFACE	7363-419
*	M 4 BATT LID W/LATCH SET	9363-461
*	PORT LATCH KIT W/O BATT LID	4363-349
*	PORT CAL COVER W/SCREWS	9363-200
*	PORT HANDLE (ROLLED) W/SCREWS	7363-139
*	PORT HANDLE FOR (CLIP) W/SCREWS	7363-203
*	CABLE- "C" S.R. (STD. 39")	40-1004
*	CLIP (44-3 TYPE) W/SCREWS	7002-026-01
*	CLIP (44-7 TYPE) W/SCREWS	7010-007-01
*	CLIP (44-6 TYPE) W/SCREWS	7010-008-01

DRAWINGS AND DIAGRAMS

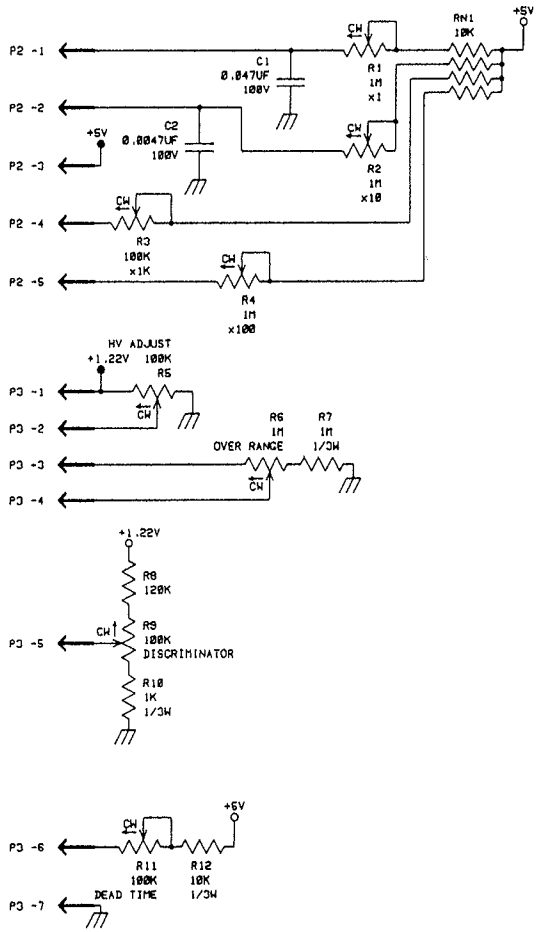
Main Circuit Board Schematic, Drawing No. 363 x 347
Main Circuit Board Component Layout, Drawing No. 363 X 636
Calibration Board Schematic, Drawing No. 363 x 348
Calibration Board Component Layout, Drawing No. 363 x 350
Chassis Wiring Diagram, Drawing No. 363 x 349


NOTE:
For GM Detectors, Use 0.001UF 100V Capacitor for C118.
NOTES:
1. Connect jumper (J60-J61) for Internal Discriminator.
2. Connect jumpers (J59-J60), (J12-J58) and remove R131 for External Discriminator.
3. Connect jumper (J166-J169) during checkout. When checkout completed remove jumper (J166-J169) and connect jumper (J166-J168).
REVISIONS
EFF | AUTHORITY | ZONE | LTR | DESCRIPTION | DATE | APPROVED
SIGNAL FLYING LEAD
C57 100PF 3KV
R137 10K
Q96 2N3904
C106 0.001UF 100V
R70 4.7K
R27 1M
R89 100K
R83 100K
C103 10UF 20V
R18 1K
1/5 U1 CA3096 16=GND
R68 8.2K
R159 10K
R63 82K
C126 10UF 20V
100 R76
+5V
R78 22K
C115 10UF 20V
C109 0.01UF 100V
R64 1K
R87 10K
R91 4.7K
1/2 U2 TLC372
8=+5V,4=GND
C119 0.001UF 100V
*C118 100PF 100V
1/2 U3 CD4098 16=+5V,8=GND
C117 100PF 100V
1/2 U4 CD4098 16=+5V,8=GND
R79 100K
R72 15K
1/5 U9 CA3096 16=GND
P4 -6
C105 22UF 35V
R74 82K
R88 100K
R43 100K
R73 270K
J61
J60
J59
J58
J12
J166
J169
J168
R75 82K
P4 -1
P1 -5
P1 -8
P1 -9
1/2 U5 TLC27M71P
+BAT
Q6 2N3904
C200 0.01UF 100V
R65 10K
R86 2.7M
R128 100K
C113 0.01UF 100V
C116 47PF 100V
R164 47K
P4 -2
P4 -3
P4 -4
P4 -5
+1.22V
P1 -4
P1 -2
P1 -6
U101 LM385Z-1.2
R81 10K
R150 SAT TYPICALLY 2.2K
R77 2.2K
Q15 MPS-W51
C56 100UF 10V
L13 470UHY
C121 330PF 100V
U6 MAX631
COMP
LX
LBI
V-OUT
CP
LBO
VFB
3=GND
C134 100UF 10V
C162 0.0047UF 3KV
R48 1G
R132 1M H.V. TEST
R151 1.5M
CW
R28 4.7M
R36 1M
C42 0.0056UF 3KV
C122 0.0047UF 3KV
C40 0.0047UF 3KV
CR29 GI250-2
CR158 GI250-2
CR156 GI250-2
CR157 GI250-2
CR34 GI250-2
C41 0.0047UF 3KV
C38 0.0047UF 3KV
C37 0.0047UF 3KV
8=+5V,1=GND
U7 ICM7555
RESET
CV
TRIG
THR
OUT
DIS
P5 -1
P5 -2
R84 470K
C112 470PF 100V
C50 100PF 3KV
R47 1G
R138 1M
R174 365K 1%
R147 SAT TYP. 715K
R90 100K
C102 100UF 10V
+BAT
Q145 MPS-W51
T25 4275-037
1N4148 CR94
C110 0.01UF 100V
C163 0.001UF 100V
7=GND,8=GND
R66 1K
Q44 2N3904
R46 22K
1/2 U8 TLC27M71P
8=+5V,4=GND
R85 100
C1 100PF 100V
Q97 2N7000
Q125 2N7000
C161 0.01UF 100V
C107 0.01UF 100V
C104 100UF 10V
P1 -14
P1 -13
P1 -11
P1 -1
P1 -3
P1 -10
P1 -12
P1 -7
1/2 U5 TLC27M71P
8=+5V,4=GND
Unused Gate
1/2 U2 TLC372
8=+5V,4=GND
Unused Gate
UPDATED
DR ACF 13-JUL-99
CHK R.C. 13 Jul 99
DSCN DL 01-FEB-90
APPD R.C. 13 Jul 99
NEXT HIGHER ASSY.
09:35:42 13-Jul-99
LUDLUM MEASUREMENTS INC.
TITLE: MAIN BOARD
BOARD# 5363-468
SIZE C | MODEL 4 | SERIES 363 | SHEET 347
SB363468
SHEET 1 OF 1

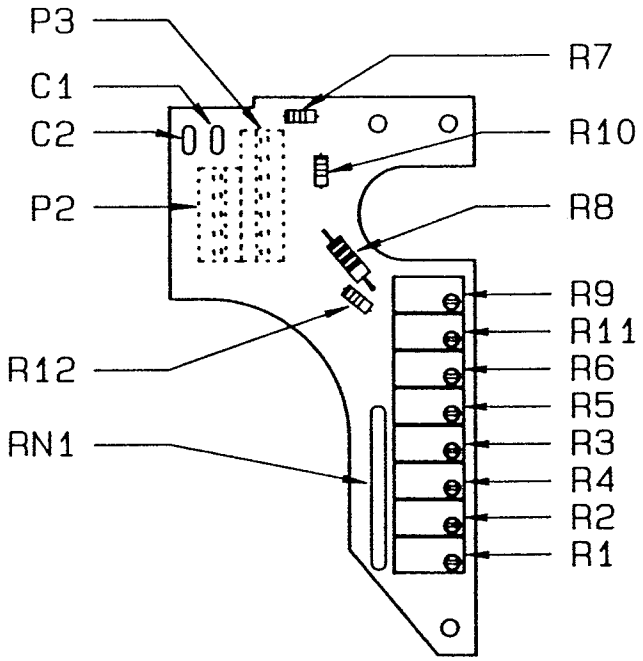


LUDLUM MEASUREMENTS INC. SWEETWATER, TX.					
DR ACF	13-JUL-99	TITLE: MAIN BOARD			
CHK R.C	13-Jul 99	BOARD: 5363-468			
DSGN DL	01-FEB-90	MODEL: 4			
APP D.S.	13 Jul 99	FILENAME: BS363468			
COMPONENT	SOLDER	09:40:43	13-Jul-99		
		REVISION	SERIES	SHEET	
OUTLINE	OUTLINE	1.0	363	636	

REVISIONS						
EFF	AUTHORITY	ZONE	LTR	DESCRIPTION	DATE	APPROVED



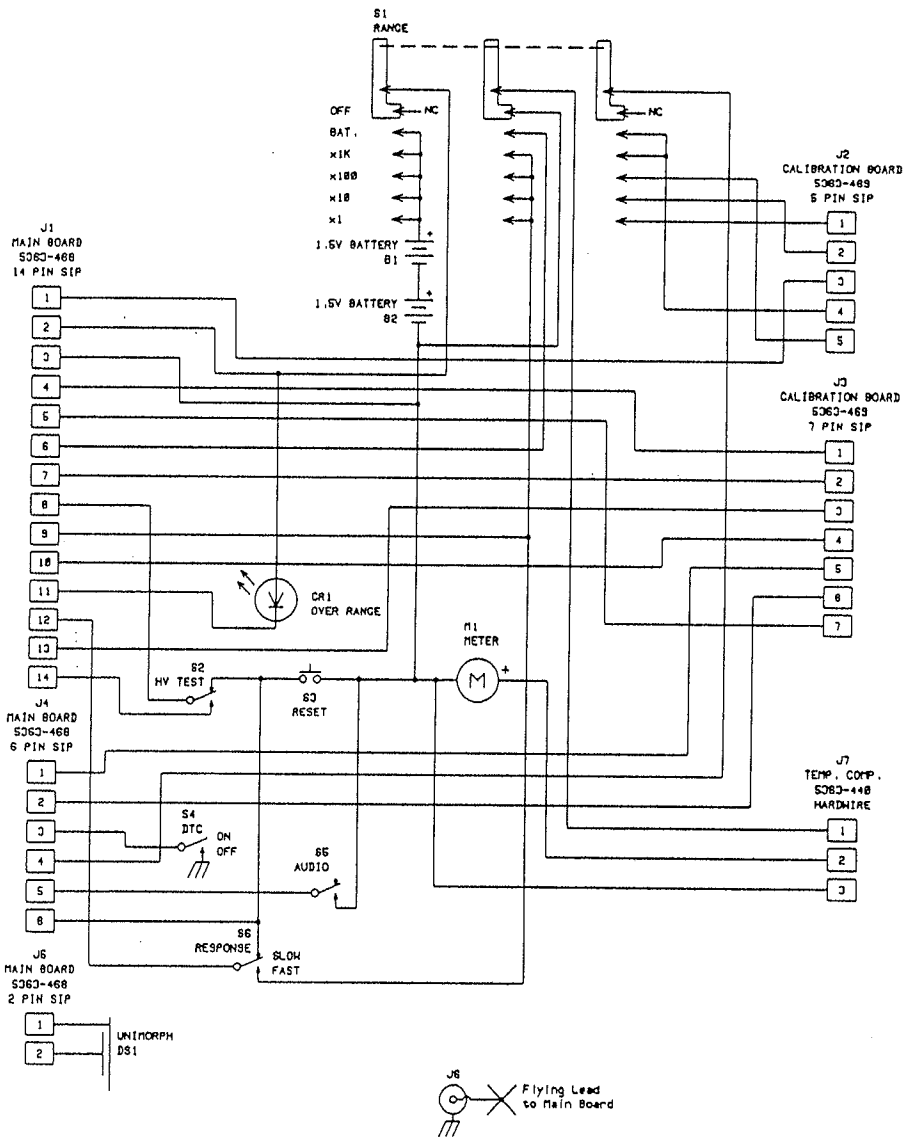
CONTRACT -		LUDLUM MEASUREMENTS INC.	
DR CKB	10/01/90	TITLE: CALIBRATION BOARD	
CHK DLL	10/2/90		
DSGN -	/ /	BOARD# 5363-469	
APPD JGW	10/2/90	SIZE D / MODEL 4 / SERIES 363 / SHEET 348	
NEXT HIGHER ASSY. -			
16:31:12	10-01-90	A:5363469.DRW	SHEET 1 OF 1



DESC: COMPONENT OUTLINE	
MODEL: 4	
PART #: 5363-469	
DWN: CKB	DATE: 10/01/90
DSGN:	DATE:

CHG	NO.				DWN	CHK	APP
DWN	DATE	CHK	DATE	APP	DATE		
CKB	10/01/90		10-1-90		10-2-90		
TOL: SHOP STD ☐ OTHER			SCALE: FULL ☒ OTHER				
TITLE MODEL 4 CALIBRATION BOARD							
LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556			SERIES 363		SHEET 350		

REVISIONS						
EFF	AUTHORITY	ZONE	LTR	DESCRIPTION	DATE	APPROVED



CONTRACT -		LUDLUM MEASUREMENTS INC.	
DR CKD	10/01/98	TITLE: WIRING DIAGRAM	
CHK Dw	10/1/98		
DSGN DL	09/98	BOARD# 363-470	
APPD JGW	10/2/98	SIZE D / MODEL 4 / SERIES 363 / SHEET 349	
NEXT HIGHER ASSY. -			
16:42:07	10-01-98	A:5363470.DRW	SHEET 1 OF 1