

**LUDLUM MODEL 9-7
ION CHAMBER
9-7-LD, 9-7-BM & 9-7-BH**

September 2020

**Serial Number 274228 Succeeding
Serial Numbers**

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ION CHAMBER &
9-7-LD, 9-7-BM & 9-7-BH**

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LUDLUM MEASUREMENTS, INC
501 OAK STREET, P.O. BOX 810
SWEETWATER, TEXAS 79556
325-235-5494, FAX: 325-235-4672

STATEMENT OF WARRANTY

Ludlum Measurements, Inc. warrants the products covered in this manual to be free of defects due to workmanship, material, and design for a period of twelve months from the date of delivery. The calibration of a product is warranted to be within its specified accuracy limits at the time of shipment. In the event of instrument failure, notify Ludlum Measurements to determine if repair, recalibration, or replacement is required.

This warranty excludes the replacement of photomultiplier tubes, G-M and proportional tubes, and scintillation crystals which are broken due to excessive physical abuse or used for purposes other than intended.

There are no warranties, express or implied, including without limitation any implied warranty of merchantability or fitness, which extend beyond the description of the face there of. If the product does not perform as warranted herein, purchaser's sole remedy shall be repair or replacement, at the option of Ludlum Measurements. In no event will Ludlum Measurements be liable for damages, lost revenue, lost wages, or any other incidental or consequential damages, arising from the purchase, use, or inability to use product.

RETURN OF GOODS TO MANUFACTURER

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

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

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



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Section
1

Introduction

The Ludlum Model 9-7 is an ion chamber capable of measuring high-range beta and gamma fields. The user may purchase and alternate between three detectors:

Model 9-7-LD Low Range Detector

Model 9-7-BM Mid Range Detector

Model 9-7-BH High Range Detector

(All detectors are sold separately and do not come with the basic Model 9-7 instrument.) For measuring gamma fields, the ion chamber detector's reading capability is from .001 R/hr to 19.99 kR/hr. No recalibration is required when switching detectors.

The detectors are connected to the Model 9-7 by flexible cables, by rigid extensions, or by mounting directly onto the instrument. Combinations of flexible cables and rigid extensions may also be used. Underwater detectors are also available.

Each of the three detectors reads out directly in R/hr or kR/hr on the liquid crystal display of the Model 9-7. The decimal point is automatically located according to the detector attached. A red LED is on when the highest range detector is in use. If the maximum rate is exceeded for a particular detector, the display will show a 1 in the most significant digit, and the rest of the display will be blank.

NOTE:

The Model 9-7 ion chamber family of instruments is not RoHS compliant because the connector used is semi-custom and is backwards compatible to older units. An RoHS compliant version is not available. In order to keep the backwards compatibility of the instrument, we must continue to use this specific connector.

The model numbers assigned to the various components are as follows:

9-7 Basic Digital Readout Instrument	48-3689
9-7-LD Low Range Detector (gamma only)	47-3693
9-7-BM Mid Range Detector (beta/gamma with removable beta shields)	47-3694
9-7-BH High Range Detector (beta/gamma with removable beta shields)	47-3696
9-7-C15 Flexible Cable, 4.6 m (15 ft) long	8293-689-15
9-7-C60 Flexible Cable, 18.3 m (60 ft) long	8293-689-60

Section
2**Specifications****Model 9-7 Basic Electronics**

Readout: **Green Lamp** indicates battery OK, **Red Lamp** indicates 20 kR/hr range (20,000 R)

Displays: liquid crystal 3 ½ digits, digit height 1.3 cm (0.5 in.); includes decimal points and negative sign; illumination provided. The reading is updated approximately three times a second.

Signal Sensitivity: displays maximum reading (1999, with decimal point) with -1 Vdc input

Response time: detector dependent

Linearity: (9-7 only): within 2%

Controls: power switch labeled **OFF**, **BAT TEST**, and **ON**; Toggle switch **LAMP ON-OFF** controls the readout back light. **ZERO ADJUST** allows readout to be zeroed in a low radiation field.

Batteries: two type “D” cell

Battery Life: 160 hours

Overall Dimensions: 24.1 x 9.7 x 23.6 cm (9.5 x 3.8 x 9.3 in.) (H x W x L), excluding detector

Weight: 1.6 kg (3.5 lb) with batteries

Temperature: operational from -20 to 50 °C (-4 to 122 °F)

Humidity Range: 0-90% (non-condensing)

Model 9-7 LD Low Range Detector (Gamma Only):

Range: 0.001 R/hr to 1.999 R/hr

Resolution: 0.001 R/hr (1mR/hr)

Linearity: within 10%

Ion Chamber: aluminum housing, plastic lined, filled with air at atmospheric pressure; aluminum housing thickness nominally 1.5 mm (0.060 in.); acrylic thickness nominally 3.2 mm (0.13 in.); chamber dimensions 2.5 x 10 cm (1 x 4 in.) (Dia x L)

Chamber Active Volume: 50 cm³

Signal Output: -1.0 V at full scale

Power Input: supplied by the Model 9-7

Detector Dimensions: 3.8 x 21.6 cm (1.5 x 8.5 in.) (Dia x L)

Weight: 0.30 kg (0.70 lb)

Temperature Range: -20 to 50 °C (-4 to 122 °F)

Humidity Range: 0-90% (non-condensing)

Model 9-7- BM Mid Range Detector

Range: 0.1 R/hr to 199.9 R/hr

Resolution: 0.1 R/hr

Linearity: within 10 %

Ion Chamber: aluminum housing, plastic lined thin entry window filled with air at atmospheric pressure; aluminum housing thickness nominally 1.5 mm (0.060 in.); acrylic thickness nominally 3.2 mm (0.13 in.)

Chamber Active Volume: 7 cm³

Signal Output: -1.0 V at full scale

Power Input: supplied by Model 9-7

Detector Dimensions: 4.8 x 14 cm (1.9 x 5.5 in.) (Dia x L), including beta shield

Weight: 0.18 kg (0.40 lb), including beta shield

Temperature Range: -20 to 50 °C (-4 to 122 °F)

Humidity Range: 0-90% (non-condensing)

Window : 7 mg/cm² aluminized Mylar

Model 9-7 BH High Range Detector

Range: 0.01 kR/hr – 19.99 kR/hr

Resolution: 0.01 kR/hr

Linearity: within 10%

Ion Chamber: aluminum housing, plastic lined thin entry window filled with air at atmospheric pressure; aluminum housing thickness nominally 1.5 mm (0.060 in.); acrylic thickness nominally 3.2 mm (0.13 in.)

Chamber Active Volume: 7 cm³

Signal Output: -1.0 V at full scale

Power Input: supplied by Model 9-7

Detector Dimensions: 4.8 x 14 cm (1.9 x 5.5 in.) (Dia x L), including beta shield

Weight: 0.18 kg (0.40 lb), including beta shield

Temperature Range: -20 to 50 °C (-4 to 122 °F)

Humidity Range: 0-90% (non-condensing)

Window : 7 mg/cm² aluminized Mylar

Cables

Model 9-7-C15: 4.6 m (15 ft)

Model 9-7-C60: 18.3 m (60 ft)

Model 9-7-RX2: rigid extension, 62 cm (2 ft)

Model 9-7-RX5: rigid extension, 1.5m (5 ft)

Section**3****Operation****Description of Controls****External Controls, Model 9-7 Chassis:**

OFF - BAT CHECK - ON: controls all power in the instrument except ion chamber wall voltage, provides battery check

ZERO Knob: a zero control to set the reading to zero when the detector is in an insignificant field relative to its range

Lamp Switch: switch used to illuminate the display

Internal Controls 9-7 Chassis:

Calibration control: located on the circuit board to adjust full scale reading (1999) with a -1 V input signal

Internal Controls, Detectors:

CAL control: A screwdriver adjustable control, located under the noted screw labeled **CAL**, is used to calibrate the output signal to correspond to the gamma field strength at the detector. Output at full scale is approximately -1.0 Volts.

Preparation for Use

1. Connect a detector to the instrument by an appropriate method. A cable, a rigid extension, or a combination of both may be used, or the detector may be connected directly to the instrument. To install a rigid extension, remove the four screws in the front plate, gently pull the assembly forward, and disconnect the internal connector. Install the extension by reversing the procedure. All connectors are of the quarter-turn, quick-disconnect type.

2. Set the switch to **BAT TEST**. Note the green lamp is on.
3. Set the switch to **ON**.
4. If a 9-7-BM or 9-7-BH (mid or high range detector) was installed, the reading should go rapidly toward zero (in the absence of a significant gamma field).
5. If a 9-7-LD (low range detector) was installed, the reading may be beyond full scale for a few seconds and then go more gradually toward zero (insignificant gamma field). Allow time for the reading to settle before making zero adjustments or taking measurements.
6. Check for proper display indications according to the detector installed.
 - a. 9-7-LD, Low Range: 1.999 R/hr maximum possible reading (decimal point check)
 - b. 9-7-BM, Mid Range: 199.9 R/hr maximum possible reading (decimal point check)
 - c. 9-7-BH, High Range: 19.99kR/hr maximum possible reading (decimal point check). Note that the red kR/hr lamp is on.
7. Operate the light switch to check for display illumination.
8. Set the **ZERO** control for zero reading if the detector is in an insignificant gamma field. The minus sign appears if the reading is “down scale.” This is useful in adjusting toward zero.

Using the Instrument

Warning!

This is a very high-range instrument and is not to be hand-held in high-range fields. Place the instrument in position for measurement and move to a safe place before radiation source is exposed.

1. Set the switch to the **ON** position.
2. Place the detector in the area to be measured. The active ion chamber volume begins at the beta window and extends back one inch for the Model 9-7-BM and the Model 9-7-BH. The active volume of the Model 9-7 LD starts at 0.32 cm (0.13 in.) behind the front edge and extends back

10.2 cm (4 in.). The field strength of narrow beams, which do not encompass the entire volume, will be measured in error.

3. The basic calibration specified in Section 4 of this manual is to a gamma field. The Model 9-7-BM and the Model 9-7-BH are calibrated with the beta shield in place.

Section**4**

Safety Considerations and Maintenance

Environmental Conditions for Normal Use

Indoor or outdoor use

Altitude dependent: Response decreases approximately 3% for every increase in 1000 feet of elevation above the calibration elevation. (For further information, see the Average Model 9-7 Altitude Dependence graph in Section 8 of this manual.)

Temperature range of -20 to 50 °C (-4 to 122 °F)

Maximum relative humidity of 0-90%(non-condensing)

Pollution Degree 3 (as defined by IEC 664) (Conductive pollution or dry nonconductive pollution that becomes conductive due to condensation, found in industrial environments or construction sites considered harsh environments.)

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.

Caution!

Verify instrument voltage input rating before connecting to a power converter. If the wrong power converter is used, the instrument and/or power converter could be damaged.

The Model 9-7 Ion Chamber is marked with the following symbols:



The “**crossed-out wheellie 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 battery compartment lid. See section 6, “Recycling,” for further information.



DIRECT CURRENT (DC) (IEC 417, No. 5032) – designates that the unit is powered by direct current. This symbol appears on the battery door.



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 symbol appears on the front panel. **Note the following precautions:**

Warning!

The operator is strongly cautioned to take the following safety measures 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 internal components.



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

Mylar Window Precaution

Caution!

Damage to the Mylar window on the front side of the detector may result if careful instrument handling is not practiced. The window is very fragile and may be punctured quite easily.

Cleaning and Maintenance Precautions

Instrument maintenance consists of keeping the instrument clean and periodically checking the batteries and calibration. The Model 9-7 may be

cleaned externally 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 or performing maintenance on the instrument:

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

Note:

The wall voltage is always **ON** when batteries are installed.

Maintenance

RECALIBRATION

Recalibration should be accomplished after maintenance or adjustments have been performed on the instrument or detector. Recalibration is not normally required following instrument cleaning or battery replacement

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 also most other manufacturers' instruments. Calibration procedures are available upon request for customers who choose to calibrate their own instruments.

To return an instrument for repair and calibration, provide sufficient packing material to prevent damage during shipping. Every returned instrument must be accompanied by an **Instrument Return Form**, which can be downloaded from the Ludlum website at www.ludlums.com. Find the form by clicking the "Support" tab and selecting "Repair and Calibration" from the drop-down menu. Then choose the appropriate Repair and Calibration division where you will find a link to the form.

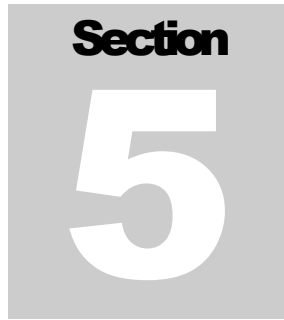
BATTERIES

The batteries should be removed any time the instrument is placed into storage. Battery leakage may cause corrosion on the battery contacts, which must be scraped off and/or washed using a paste solution made from baking soda and water.

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 may occur at temperatures as low as 38 °C (100 °F).

If the instrument is stored in an area with high humidity, rapid changes in temperature should be avoided. A storage cabinet with a light bulb inside is one means of keeping the instrument in a slightly warmer than ambient temperature environment, in order to prevent problems from rapid changes in temperature and humidity.

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Technical Theory of Operation

Model 9-7

General

The Model 9-7 is designed to accept a negative 1.0 volt signal from an ion chamber resulting in a readout signal of 1999. The range is controlled by the connected ion chamber assembly that controls where the decimal display is placed.

The instrument provides -56 volts with a floating ± 5 volt supply for the electrometer circuitry. The instrument is compatible with any manufacturer's ion chambers with the same connector and electronic requirements. The readout and internal circuitry floats on the -56 volt supply, allowing the chamber wall to operate at ground potential. The battery test lamp and readout back light operate directly from the battery pack.

An internal shunt allows the -56 volt supply to be on with the instrument **ON** or **OFF**. This shunt minimizes warm-up time.

-56 Volt Supply

U307 is a negative DC-DC converter that converts the 2-3 volts battery power to -75 volts at R305/307, which is then filtered and regulated by CR311 to -56 volts. JP1 allows the supply to run continuously if pin 2-3 is shunted or only with instrument on with 1-2 shunted.

± 5 Volt Supply with -56 Volt Reference

U305 is a positive DC-DC converter that generates approximately 6.2 volts at CR302/C305 relative to -56 volts. The output is isolated from ground by T301 and C314. U303 is a DC-AC converter that supplies an output signal in proportion to the DC voltage on pin 4 U303. The output signal is coupled through C314 to AC-DC converter CR306-CR307, which is then coupled back to the sense pin on U305, allowing the circuit to control the 6.2 voltage.

U301 allows development of a negative voltage. The negative voltage is regulated to -5 volts by U304, and the positive voltage is regulated to + 5 volts by U302.

+5 Volt Supply with Chassis Ground

Reference

DC-DC converter U306 develops +5 volt supply for the readout back light, pin 3 and 4 of P1. U306 also detects adequate battery voltage and allows the battery OK lamp to receive power thru pin 1 and 2 of P1.

Readout and Zero Control

Pin 3 U304 relative to pin 1 U304 provides the input signal. With no signal, the **ZERO** control connected to P302 can adjust the readout least significant digit to 0. With 1 volt present at pin 3 relative to pin 1 P304, R334 can adjust the voltage at pin 7 relative to pin 6 of P305 to 0.2 volts, which corresponds to a 1999 readout. The decimal point is controlled by another circuit. This is the only internal control and is set normally with -0.8 volts input with an output reading of 1600. Readout power is provided by the +5 volt converter relative to -56 volts at pin 1 P305.

Decimal Point

The decimal point is selected by the voltage at pin 2 of P2, relative to -56 volts. With the voltage at -56 +5, the decimal point is at 00.00. With -56 the decimal point is 000.0, and with -56 -5 volts the decimal point is 0.000. The logic circuits Q307 through U310 control the circuit path for the proper digit pins 11, 12, and 13 of P3. Note that on the high range, -56 +5 is applied through CR313 to turn the kR/hr lamp on.

Model 9-7 Detectors

General

The operating principles of the detectors are identical. The Model 9-7-LD is a gamma-only detector with a longer chamber. The electrometer feedback resistor is 100 GΩ. The Model 9-7-BM and Model 9-7-BH respond to beta gamma.

The Model 9-7-BM utilizes a 7.5 G Ω feedback resistor. The Model 9-7-BH utilizes a 75 M Ω . R106 and R104 are changed for a slightly different temperature coefficient.

Decimal Point

Model 9-7-LD, connect pin F to pin C

Model 9-7-BM, connect pin F to pin D

Model 9-7-BH, connect pin F to pin E

5293-565 Power Supply

Pin 4 operates at -56 volts and is the guard and the common circuit reference line. Positive-five volts at pin 2 P1 is regulated to +2.5 volts by regulator U1, and -5 volts at pin 5 P1 is regulated to -2.5 volts by regulator U2. R6 provides gain control. Pin 2 receives the electrometer signal and the calibrated output signal (chassis connector pin B), and is connected to pin 1.

Electrometer Board

Model 9-7-LD Board 5293-558

The constant current signal from the ion chamber electrode is connected to op amp input pin 8 U100 and is converted to a voltage output calibrated by 100 G Ω feedback resistor R100. Temperature compensation is controlled by RT100 and associated components in the feedback loop.

Model 9-7-BM Board 5293-692

This circuit is identical to the Model 9-7-LD, except the feedback resistor R100 is 7.5 G Ω .

Model 9-7-BH Board 5293-691

This circuit is identical to the Model 9-7-LD, except the feedback R100 is 75 M Ω . An additional change uses different values for R104 and R106 for temperature compensation.

Section

6

Recycling

Ludlum Measurements, Inc. supports the recycling of the electronic 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. electronic 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:

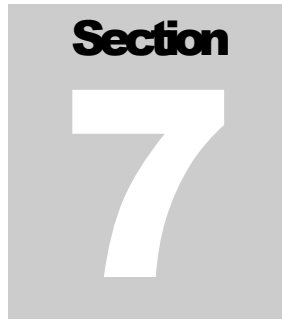
Batteries Glass Aluminum and Stainless Steel

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 wheelee 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:




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Parts List

	Reference	Description	Part Number	
Model 9-7 Ion Chamber	UNIT	Completely Assembled		
		Model 9-7 Ion Chamber	48-3689	
	*	Model 9-7-LD Low Range Ion Chamber	47-3693	
	*	Model 9-7-BM Mid Range Ion Chamber	47-3694	
	*	Model 9-7-BH High Range Ion Chamber	47-3696	
Main Circuit Board, Drawing 293 x 583	BOARD	Completely Assembled		
	Main Circuit Board	5293-583		
CAPACITORS	C301, C302	10uF, 10V-DT	04-5766	
	C303	68uF, 10V	04-5654	
	C304	10uF, 10V-DT	04-5766	
	C305, C306	68uF, 10V	04-5654	
	C307	0.47uF, 100V	04-5776	
	C308	10uF, 10V-DT	04-5766	
	C309, C310	68uF, 10V	04-5654	
	C311	0.01uF, 50V	04-5664	
	C312	0.001uF, 100V	04-5659	
	C313	100pF, 100V	04-5661	
	C314-C321	0.01uF, 200V	04-5765	
	C322	0.01uF, 50V	04-5664	
	C323	68uF, 10V	04-5654	
	TRANSISTORS	Q302	2N7002L	05-5840
		Q303, Q305	SI2301BDS-TI	07-6486
Q306-Q308		2N7002L	05-5840	

	Reference	Description	Part Number
INTEGRATED CIRCUITS	U301	ICL7660SCBA	06-6437
	U302	LT1761ES5-5	06-6540
	U303	MIC1557BM5	06-6457
	U304	LT1964ES5-BYP	06-6663
	U305	LT1304CS8	06-6394
	U306	LT1304CS8-5	06-6434
	U307	LT1617	06-6755
	U309	LMC6041M	06-6502
	U310	SN74AHHC1G00GW	06-6644
	U311	LMC6462AIM	06-6584
	DIODES	CR301, CR302	CMSH1-40M
CR303, CR304		BZX84C18	07-6447
CR305		CMSH1-40M	07-6411
CR306, CR307		MMBD914LT1	07-6353
CR308-CR310		CMPD2005S	07-6468
CR311		MMBZ5263BLT1	07-6475
CR312, CR313		CMPD	07-6498
POTENTIOMETER	R334	1M, 64x105	09-6752
RESISTORS	R301	1M, 1/4W, 1%	12-7844
	R302	22uH, 1/4W, 5%	12-7972
	R303	75K, 1/4W, 1%	12-7876
	R304	22.1K, 1/4W, 1%	12-7843
	R305, R306	10M, 1/4W, 1%	12-7996
	R306	1M, 1/4W, 1%	12-7844
	R307	4.02M, 1/4W, 1%	12-7042
	R308	75K, 1/4W, 1%	12-7876
	R309	68.1K, 1/8W, 1%	12-7881
	R310	24.3K, 1/4W, 1%	12-7867
	R311	665Ohm, 1/4W, 1%	12-7066
	R312	22uH, 1/4W, 5%	12-7972
	R313	75K, 1/4W, 1%	12-7876
	R314	27K, 1/4W, 1%	12-7243
	R315, R316	1M, 1/4W, 1%	12-7844
	R317	332 Ohm, 1/4W, 1%	12-7854
	R318-R326	1M, 1/4W, 1%	12-7844
	R327	221 K, 1/4W, 1%	12-7845
	R328-R330	1M, 1/4W, 1%	12-7844
	R331	221K, 1/4W, 1%	12-7845

	Reference	Description	Part Number
	R332, R333	665Ohm, 1/4W, 1%	12-7066
	R335	200K, 1/4W, 1%	12-7992
	R336	49.9Ohm, 1/4W, 1%	12-7011
CONNECTORS	P301	103-185-3 Jumper	13-8612
	P302	640456-3 MTA100×3	13-8081
	P303	640456-4 MTA100×4	13-8088
	P304	640456-9 MTA100×9	13-8094
	P305	1-640456-3 MTA100×13	13-8100
	P306	640456-2 MTA100×2	13-8073
TRANSFORMERS	T301	B66296-B1006-T1	21-9825
INDUCTORS	L301, L302	22uH	21-9808
Low Range Electrometer Board, Drawing 293 x 558	BOARD	Completely Assembled Low Range Electrometer Board	5293-558
CAPACITORS	C100	2pF, 200V	04-5726
	C102, C103	0.1uF, 100V	04-5792
INTEGRATED CIRCUIT	U100	LMP7721MA	06-6728
RESISTORS	R100	100G, 20%, Power	12-8023
	R102	10K, 1/4W, 1%	12-7839
	R104	100K, 1/4W, 1%	12-7834
	R106	12.1K, 1/8W, 1%	12-7879
MISC	RT100	10K	21-8919
CONNECTORS	P100	640456-6 MTA100×6	13-8095

**Mid Range
Electrometer Board,
Drawing 293 x 692**

	BOARD	Completely Assembled Mid Range Electrometer Board	5293-692
CAPACITORS	C102, C103	0.1uF, 100V	04-5792
INTEGRATED CIRCUIT	U100	LMP7721MA	06-6728
RESISTORS	R100	7.5G	12-8024
	R102	10K 1/4W, 1%	12-7839
	R104	100K, 1/4W, 1%	12-7834
	R106	12.1K, 1/8W, 1%	12-7879
MISC	RT100	10K	21-8919
CONNECTORS	P200	640456-6 MTA100×6	13-8095

**High Range
Electrometer Board,
Drawing 293 x 691**

	BOARD	Completely Assembled High Range Electrometer Board	5293-691
CAPACITORS	C100	2pF, 200V	04-5726
	C102, C103	0.1uF, 100V	04-5792
INTEGRATED CIRCUIT	U100	LMP7721MA	06-6728
RESISTORS	R100	100M, 1%	12-8256
	R102	10K, 1/4W, 1%	12-7839
	R104	61.9K, 1/8W, 1%	12-7026
	R106	15K, 1/4W, 1%	12-7998
MISC	RT100	10K	21-8919
CONNECTORS	P300	1-640456-1 MTA100×11	13-8095

**Calibration Board
Drawing 293 x 565**

	BOARD	Completely Assembled Model 9-7 Calibration Board	5293-565
CAPACITORS	C1	1uF, 35V	04-5656
	C2	10uF, 10V	04-5757
	C3	1uF, 35V	04-5656
	C4	10uF, 10V	04-5757
	C5, C6	0.01uF, 500V	04-5747
	POTENTIOMETER	R6	100K, 64W
INTEGRATED CIRCUIT	U1	LT1761ES5-BYP	06-6662
	U2	LT1964ES5-BYP	06-6663
RESISTORS	R1, R2	61.9K, 1/8W, 1%	12-7026
	R3	14.7K, 1/4W, 1%	12-7068
	R4	61.9K, 1/8W, 1%	12-7026
CONNECTORS	P400	640456-5, MTA 100×5	13-8057
	P401	640456-2, MTA 100×2	13-8073

Section
8**Drawings**

MAIN BOARD, Drawing 293 x 583 (3 sheets)

MAIN BOARD LAYOUT, Drawing 293 x 584A and 584B

CALIBRATION BOARD, Drawing 293 x 565

CALIBRATION BOARD LAYOUT, Drawing 293 x 566 (2 sheets)

LOW RANGE ELECTROMETER BOARD, Drawing 293 x 558

LOW RANGE ELECTROMETER BOARD LAYOUT, Drawing 293 x 559

LOW RANGE ION CHAMBER, Drawing 293 x 579

MID RANGE ELECTROMETER BOARD, Drawing 293 x 692

MID RANGE ELECTROMETER BOARD LAYOUT, Drawing 293 x 693A
(2 sheets)

HIGH RANGE ELECTROMETER BOARD, Drawing 293 x 691

HIGH RANGE ELECTROMETER BOARD LAYOUT, Drawing 293 x 714

MID/HIGH RANGE ION CHAMBER, Drawing 293 x 568

WIRING DIAGRAM, Drawing 293 x 718 (2 sheets)

DETECTOR END CAP, Drawing 293-632

CONNECTOR WIRING, Drawing 293 x 568C

1 2 3 4 5 6 7

G

G

F

F

E

E

D

D

C

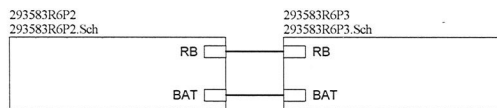
C

B

B

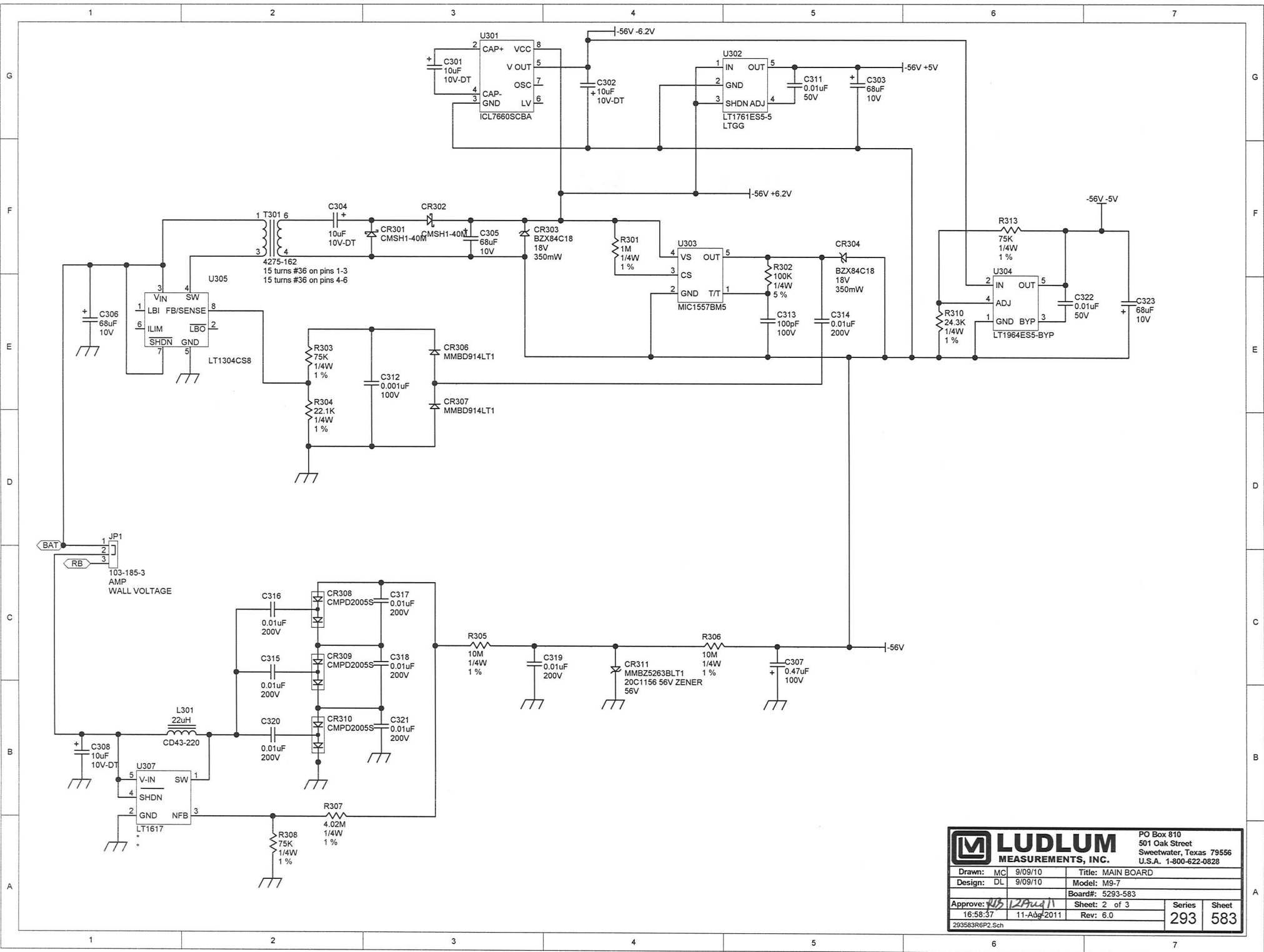
A

A

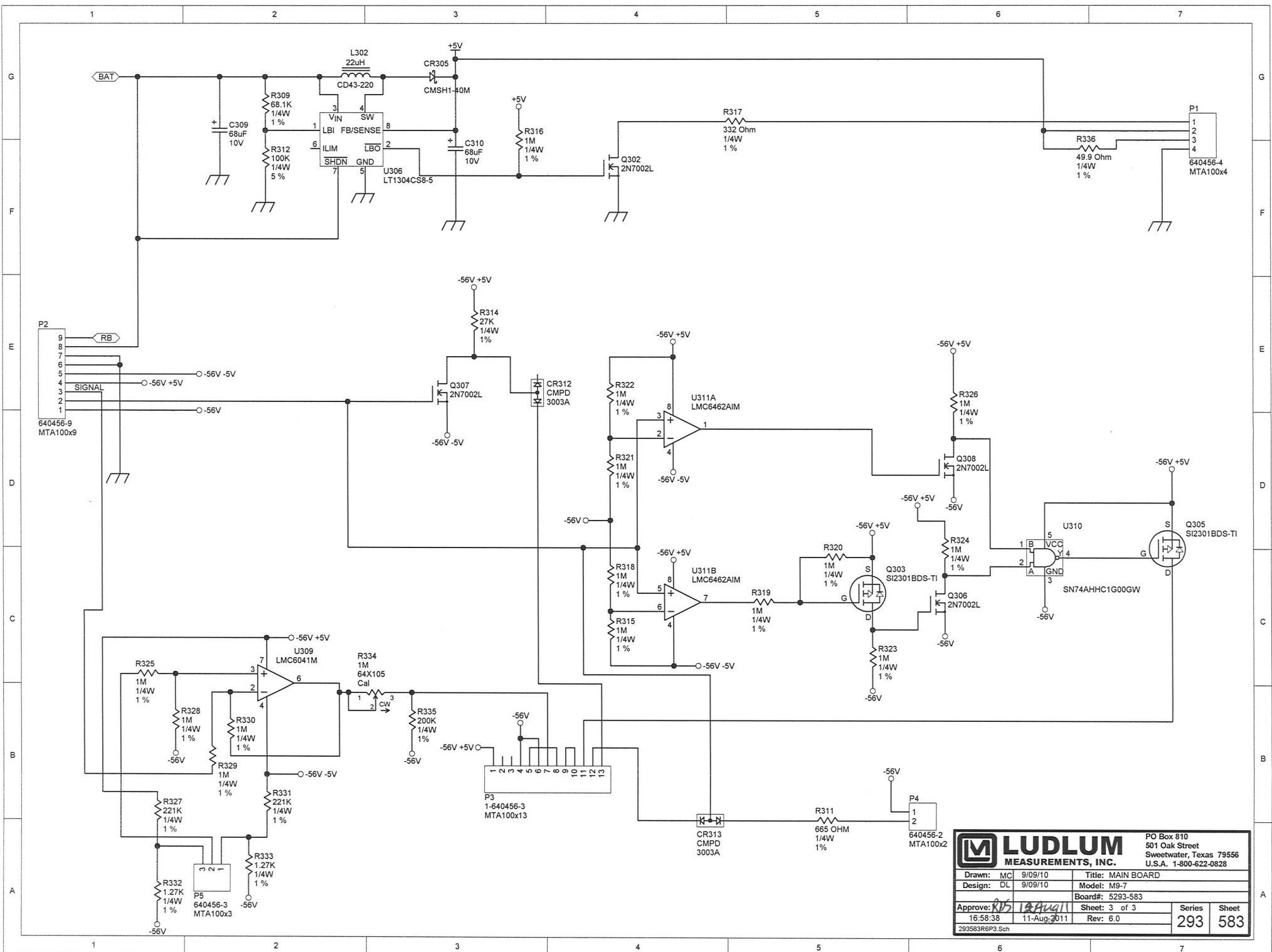


		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
Drawn: MC	9/09/10	Title: MAIN BOARD	
Design: DL	9/09/10	Model: M9-7	
Approve: <i>RJE</i>		Board#: 5293-583	
16:58:37	11-Aug-2011	Sheet: 1 of 3	Series
293583R6P1.Sch	Rev: 6.0	293	Sheet 583

1 2 3 4 5 6 7



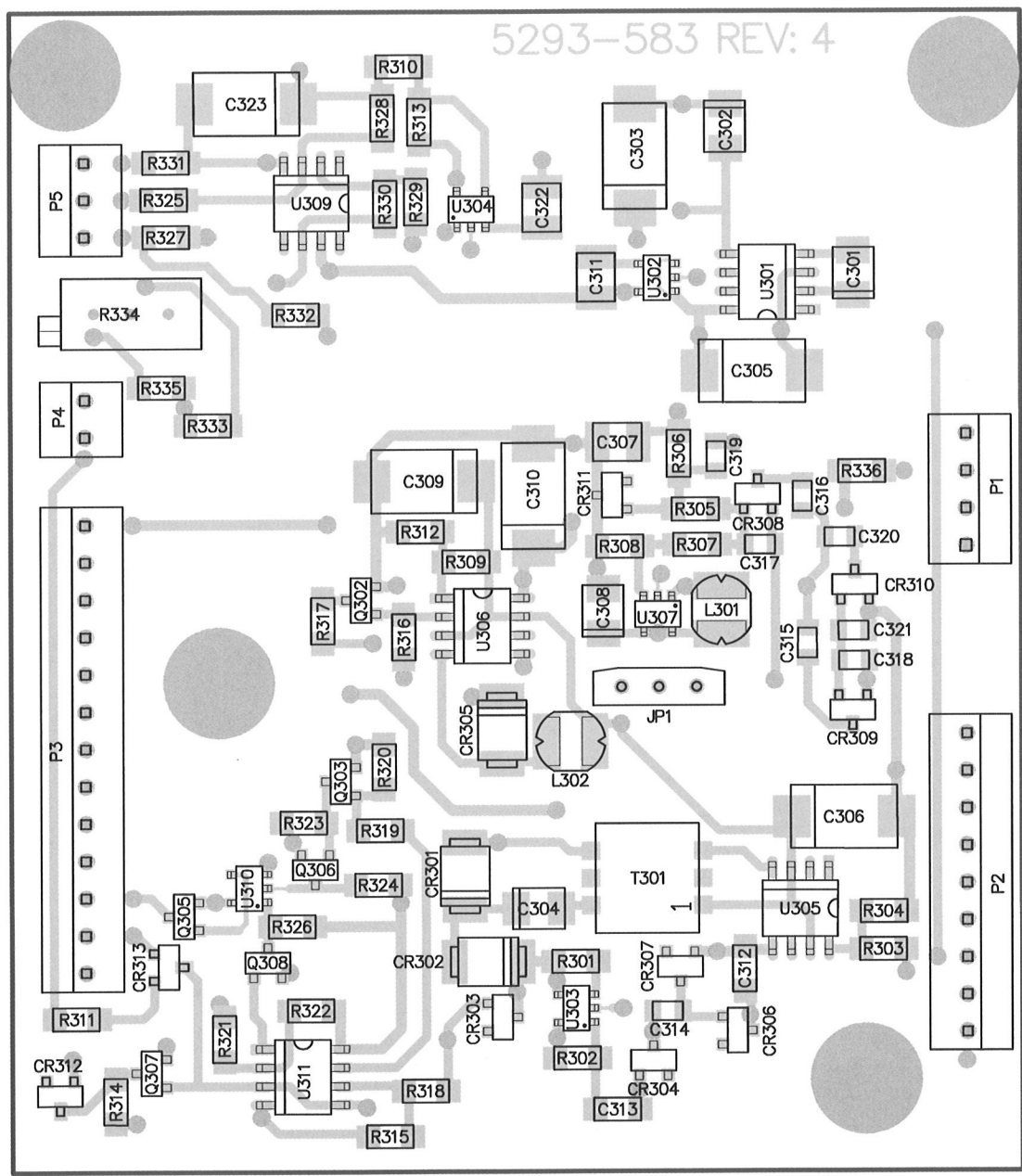
LUDLUM MEASUREMENTS, INC.		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
Drawn: MC	9/09/10	Title: MAIN BOARD	
Design: DL	9/09/10	Model: M9-7	
		Board#: 5293-583	
Approve: <i>DL</i>	<i>12/29/11</i>	Sheet: 2 of 3	Series
16:58:37	11-Aug-2011	Rev: 6.0	Sheet 293 583
293583R6P2.Sch			



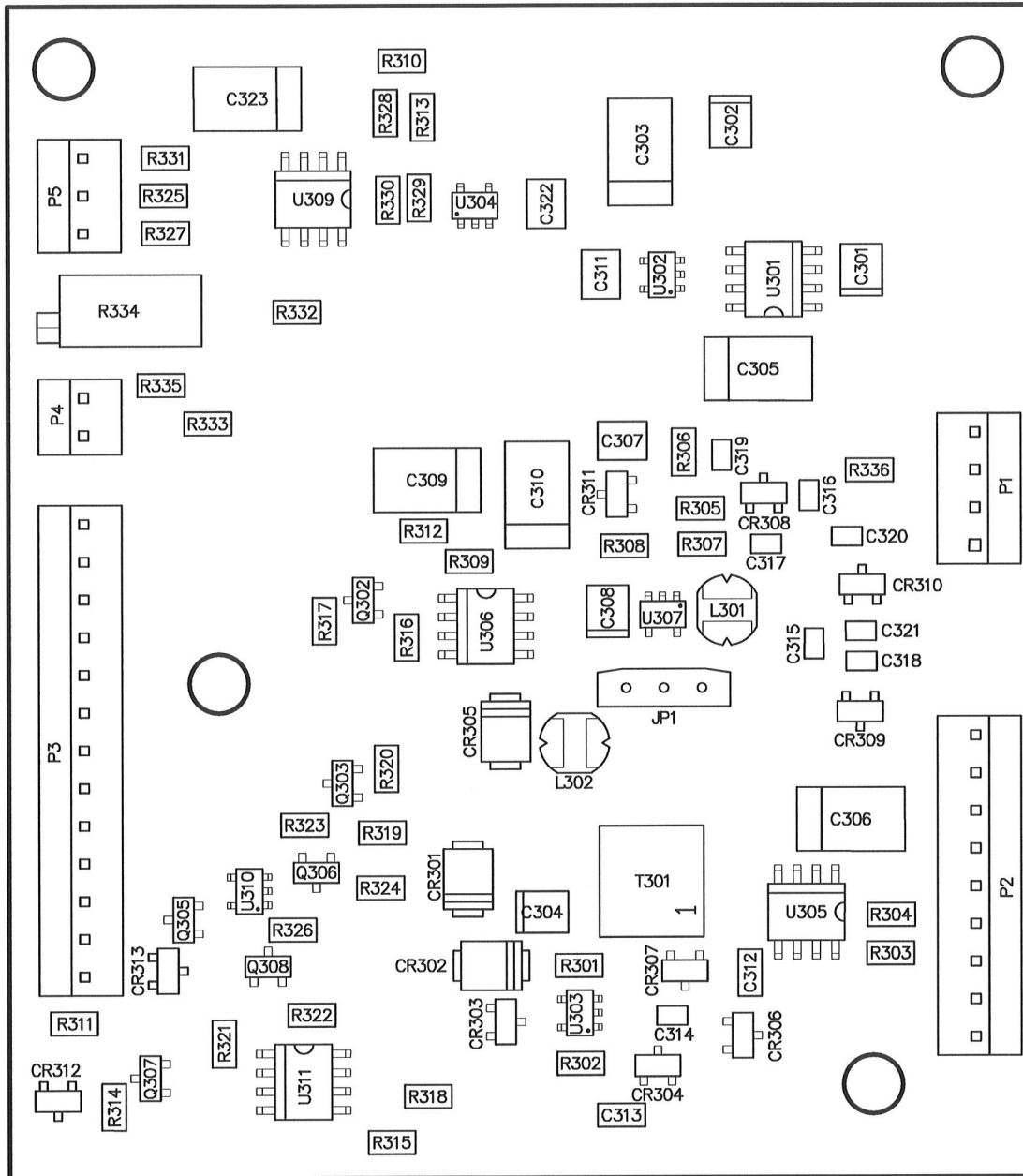
		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
		Drawn: MC 9/09/10 Design: DL 9/09/10 Approve: <i>DL</i> 11-Aug-2011 16:58:38	Title: MAIN BOARD Model: M9-7 Board#: 5293-583 Sheet: 3 of 3 Rev: 6.0

293583RepP3.Sch

5293-583 REV: 4



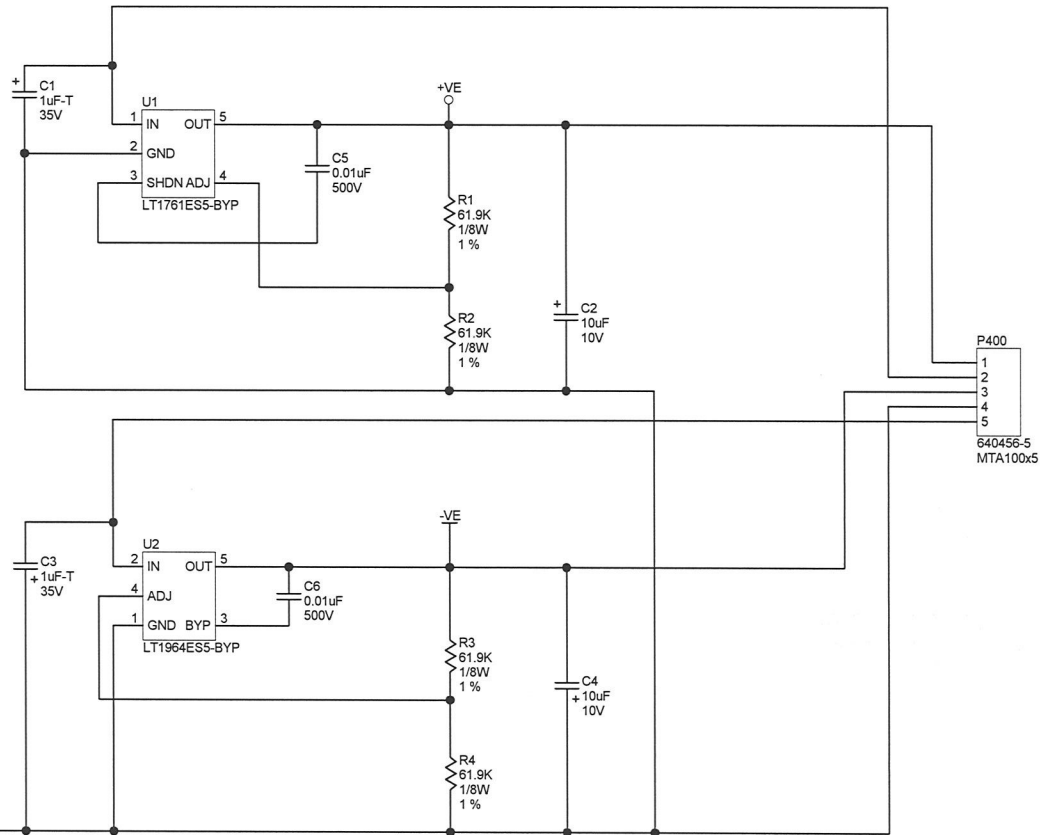
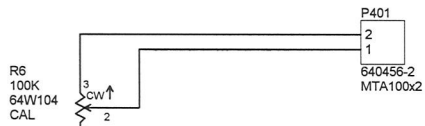
		PO Box 810 501 Oak Street Sweetwater, TX 79556 U.S.A. 1-800-622-0828	
Title: Main Board			
Drawn: MC	09/09/2010	Model: 9-7	
Design: DL	09/09/2010	Board#: 5293-583	
Approve: <i>DL</i>	<i>10-29-13</i>	Rev: 4	
PCBA Drawing		SCALE: 1.05	Series Sheet
Print Date: 10/29/2013 11:08:09 AM		Top Overlay	293 584A
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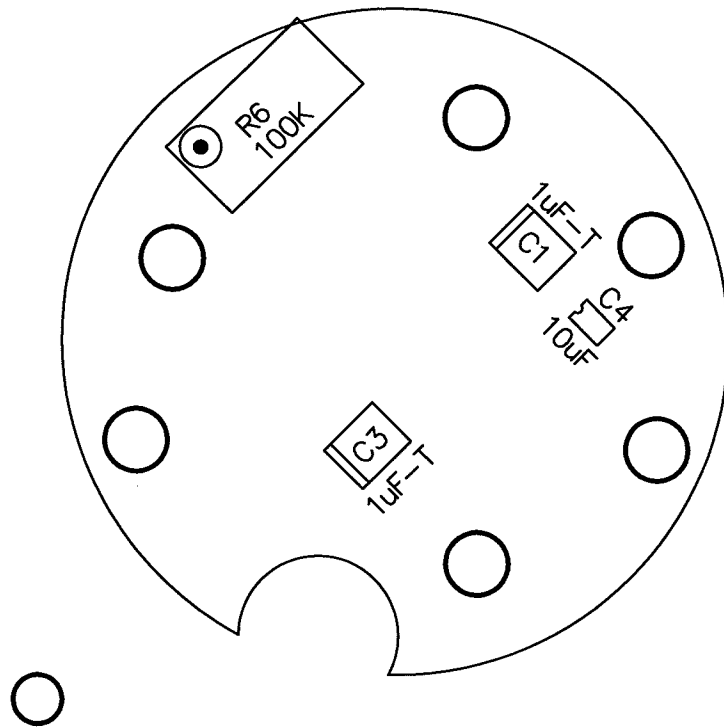
LUDLUM MEASUREMENTS, INC.
 PO Box 810
 501 Oak Street
 Sweetwater, TX 79556
 U.S.A. 1-800-622-0828

Title: Main Board			
Drawn: MC	09/09/2010	Model: 9-7	
Design: DL	09/09/2010	Board#: 5293-583	
Approve: <i>DLW</i>	<i>10-29-13</i>	Rev: 4	
PCBA Manual Drawing		SCALE: 1.05	Series Sheet
Print Date: 10/29/2013 11:08:02 AM		Top Overlay	293 584B

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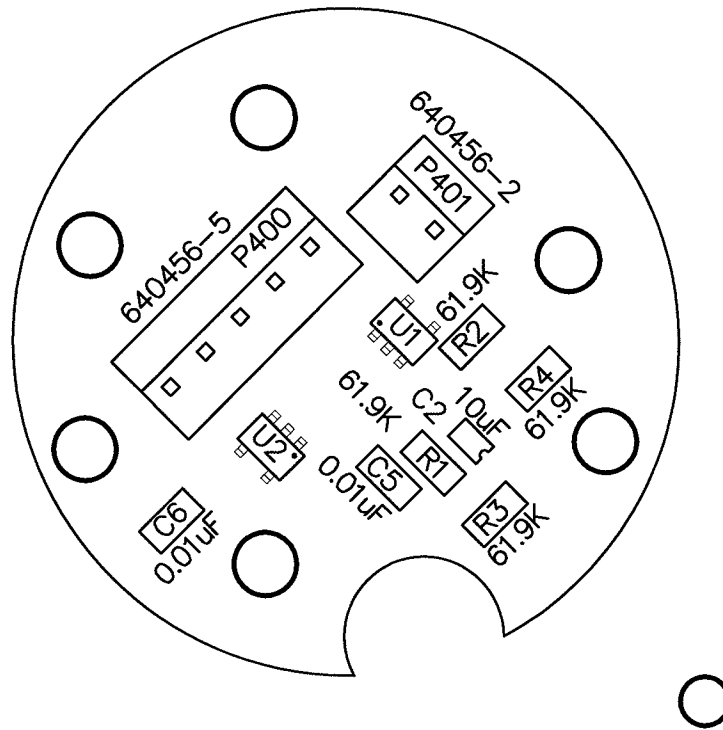


		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
Drawn: MC	4/01/09	Title: CALIBRATION BOARD	
Design: DL	4/01/09	Model: M9-7 Detector	
Board#: 5293-565		Sheet: 1 of 1	
Approve: <i>[Signature]</i>	08:04:07	12-Oct-2009	Rev: 4.0
29356SR4P1.Sch		Series	Sheet
		293	565



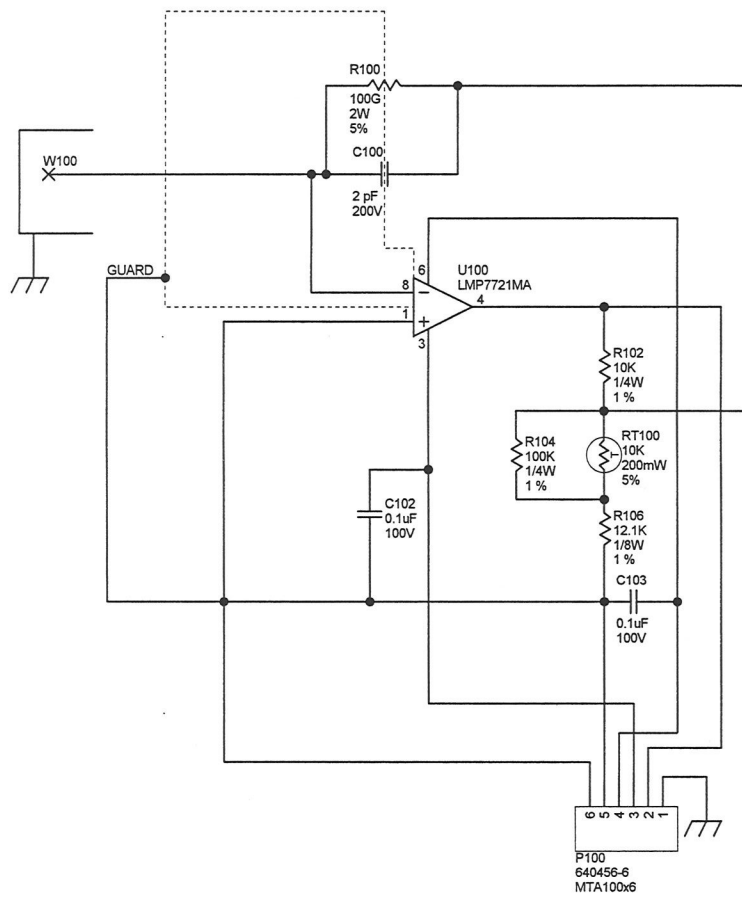
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Design: DL		01-APR-09			
				Model: M9-7 Detector	
Approve: <i>RSS</i>		<i>16 Oct 09</i>		Board#: 5293-565	
Layer: Mech.1 Mech.2 Mech.3 Mech.4	Top		Rev: 4.0		Series
	MID:		SCALE: 2.57		293
	09:26:47	12-Oct-2009			
293565R4X1.Pcb				566	

2

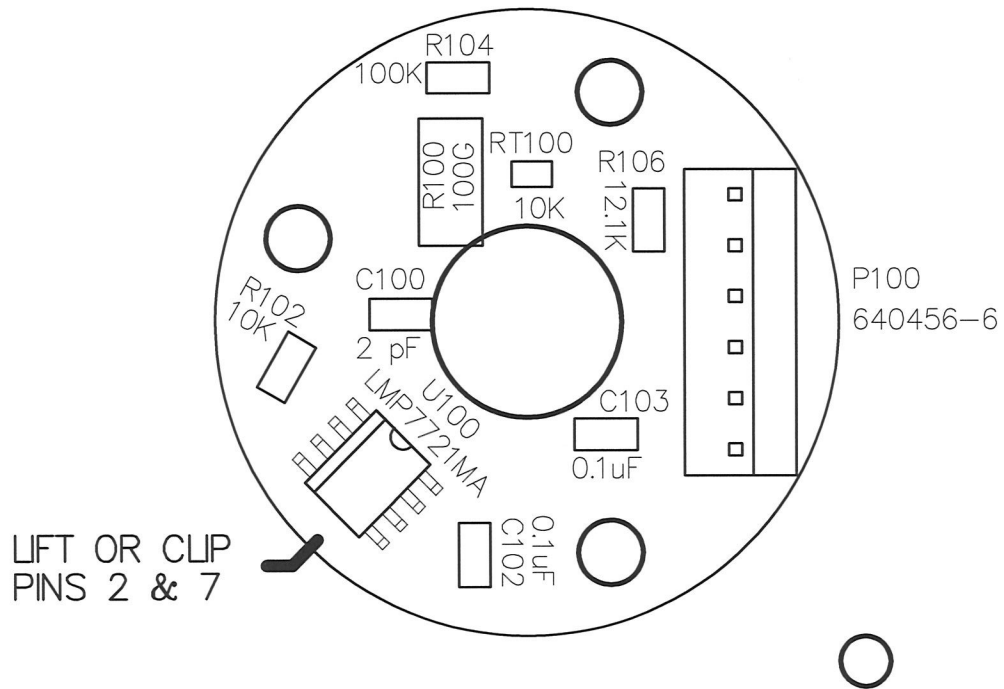


Drawn:	MC	01-APR-09	Title:	
Design:	DL	01-APR-09	CALIBRATION BOARD	
			Model: M9-7 Detector	
Approve:	<i>RSS</i>	<i>16 Oct 09</i>	Board#: 5293-565	
Layer:			Rev: 4.0	Series
Mech.1				Sheet
Mech.2	MID:	Bottom		
Mech.3			SCALE: 2.57	293
Mech.4	09:26:47	12-Oct-2009		566
293565R4X1.Pcb				

9

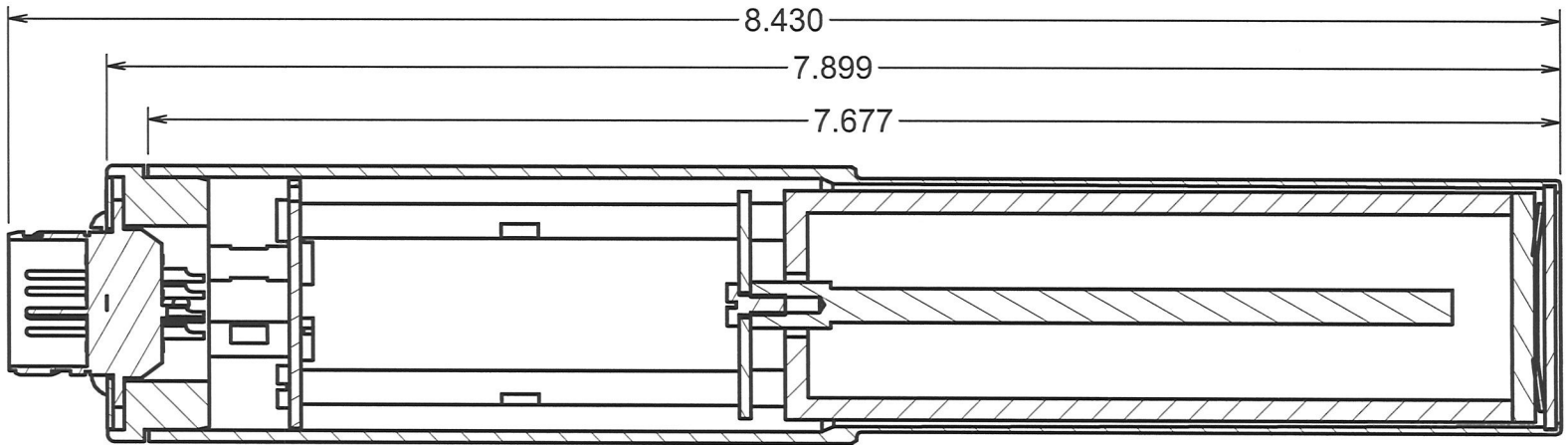
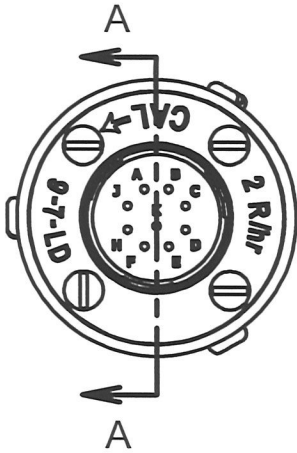
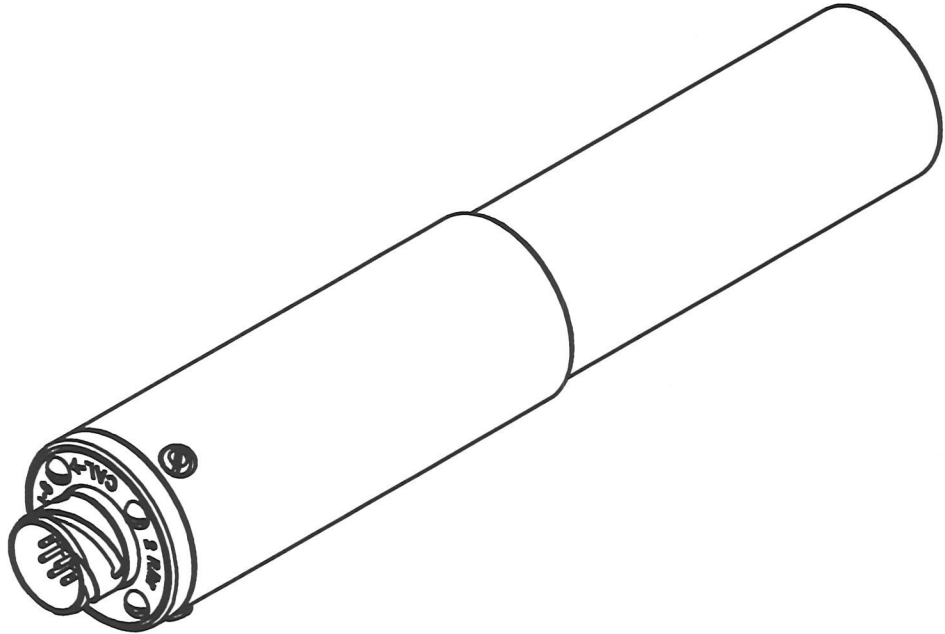


		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
		Drawn: MC 8/21/08 Design: DL 8/21/08	Title: LOW RANGE ELECTROMETER Model: 9-7LD Board#: 5293-558
Approve: <i>[Signature]</i> 13:35:53 293558R3P1.Sch	Sheet: 1 of 1 28-Sep-2009 Rev: 3.0	Series 293	Sheet 558



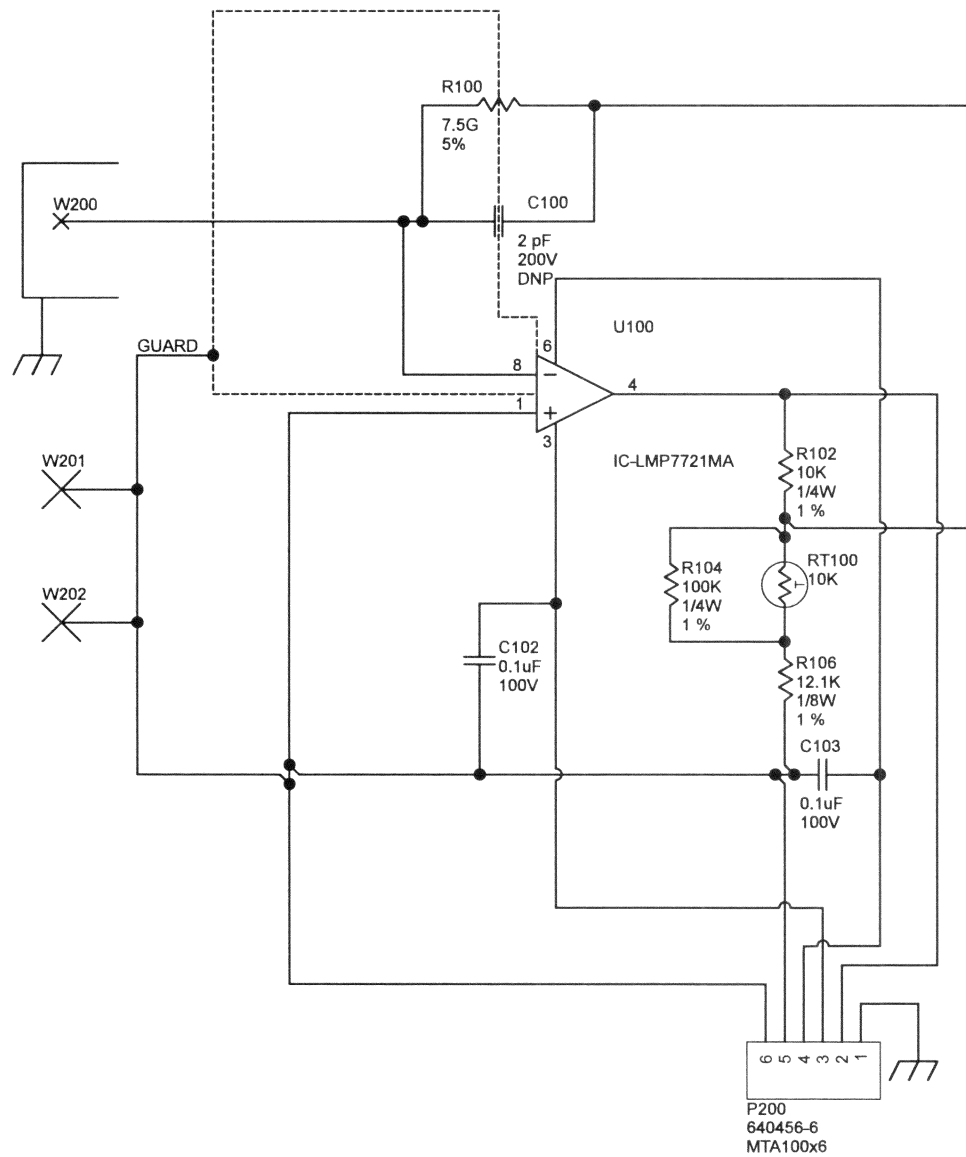
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Design:	DL	09-JUL-09	LOW RANGE ELECTROMETER BOARD	
			Model: 9-7LD	
Approve:	<i>RSS</i>	<i>16 Oct 09</i>	Board#: 5293-558	
Layer:	Bottom		Rev: 3.0	Series
Mech.1	MID:		SCALE: 0.77	293
Mech.2	08:19:56			
Mech.3	12-Oct-2009			
Mech.4				
293558R3X1.Pcb				

REVISION HISTORY			
REV	DESCRIPTION	DATE	BY
1	VALID	9/4/2008	DDW

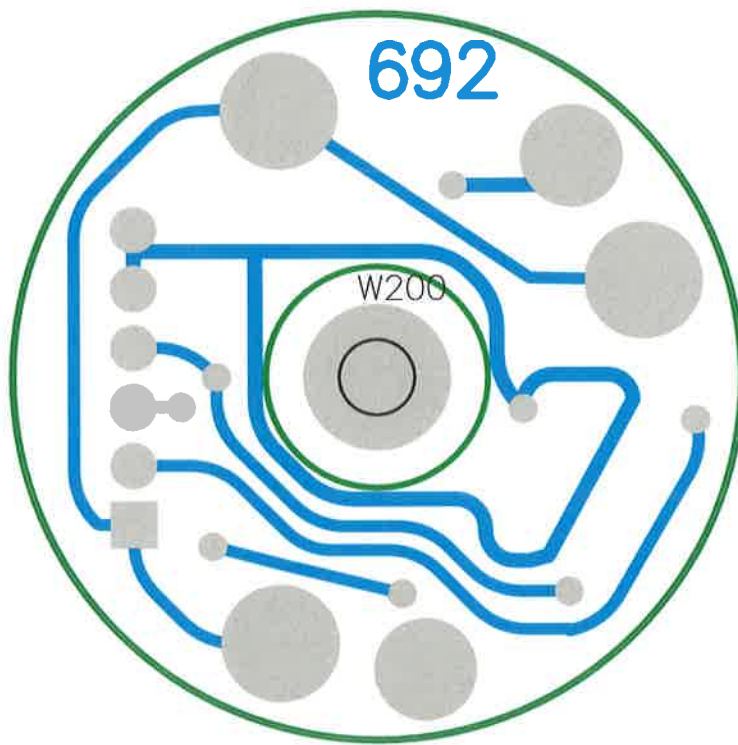


SECTION A-A
SCALE 1 : 1

DWN	DATE	CHK	DATE	APP	DATE
DDW	9/4/08			<i>[Signature]</i>	1/16/09
DWG NUM: 4293-579.iam				SCALE: 1:1	
TITLE M 9-7 LOW RANGE ION CHAMBER					
LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556			SERIES	SHEET	
			293	579	



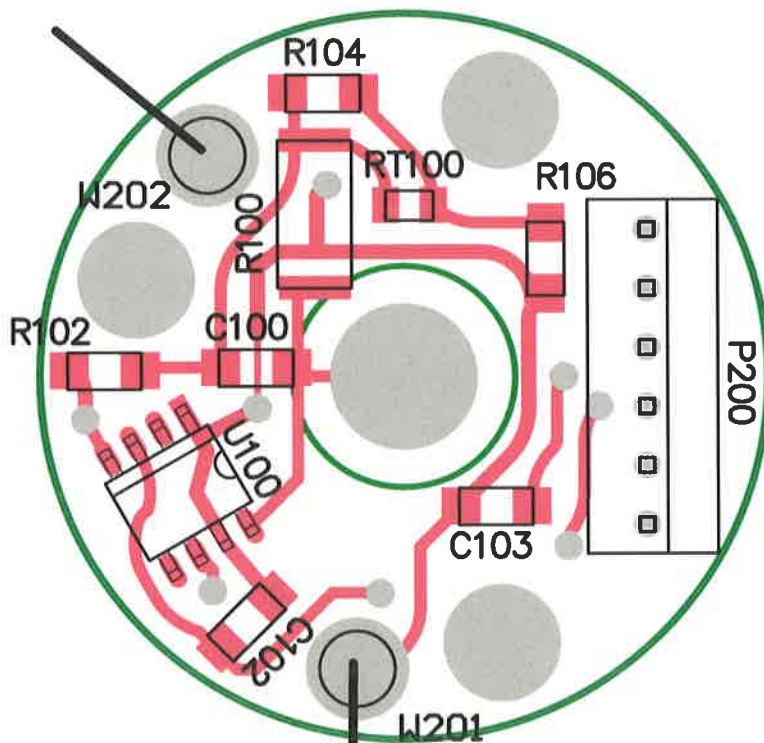
		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
		Drawn: PAB Design: DL Approve: <i>[Signature]</i>	Title: Mid Range Electrometer Model: 9-7 Print Date: 9/1/2020 1:06:29 PM
<small>\\freedom\pcb\Projects\L\MIM 9-7\5293-692\Rev3\293692R3P1.SchDoc</small>			



		LUDLUM MEASUREMENTS, INC.		PO Box 810 501 Oak Street Sweetwater, TX 79556 U.S.A. 1-800-622-0828	
Title: Mid Range Electrometer					
Drawn:	PAB	9/1/2020	Model:	9-7	
Design:	DL	9/1/2020	Board#:	5293-692	
Approve:	<i>RUG</i>		Rev:	3	
PCBA Drawing			SCALE:	1.08	Series
Print Date:	9/1/2020	1:06:13 PM	Top Overlay	293	Sheet
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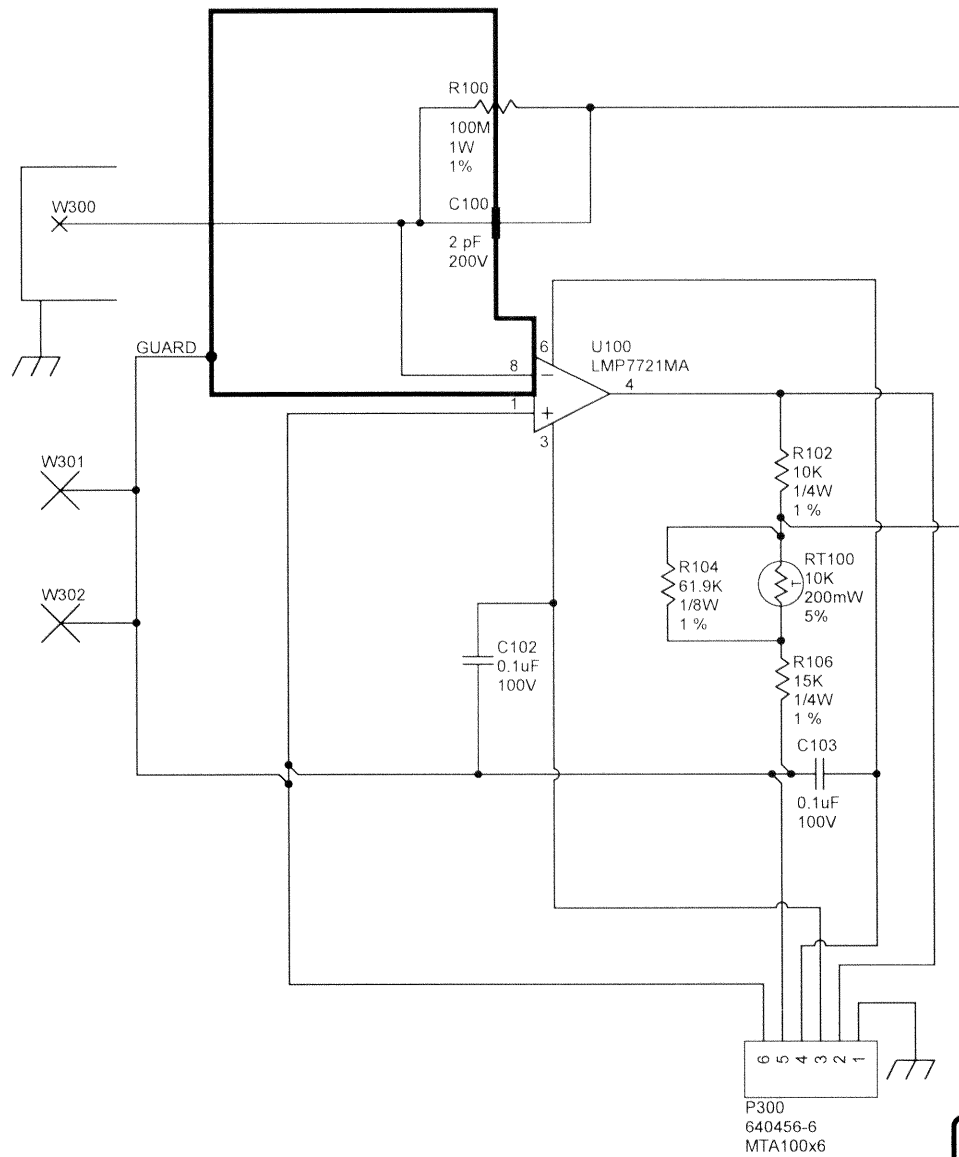
Use Impact Staker Tool to secure stand off to board before soldering

STAND OFF(18-9304)

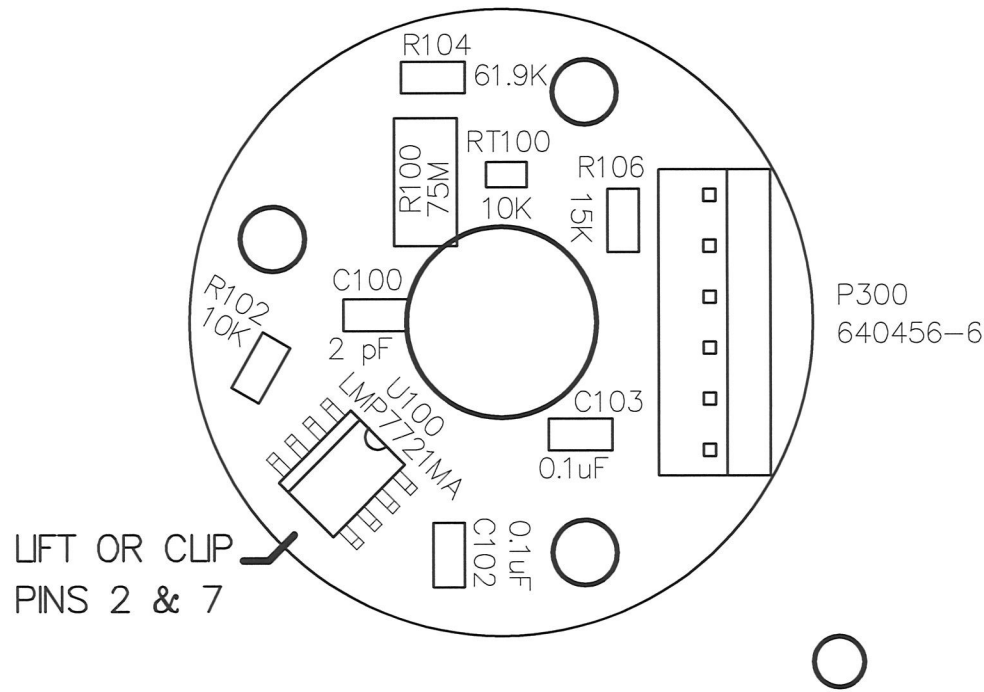


STAND OFF(18-9304)

		PO Box 810 501 Oak Street Sweetwater, TX 79556 U.S.A. 1-800-622-0828	
Title: Mid Range Electrometer			
Drawn: PAB	9/1/2020	Model: 9-7	
Design: DL	9/1/2020	Board#: 5293-692	
Approve: <i>RDS 15 Sep 20</i>		Rev: 3	
PCBA Drawing		SCALE: 1.08	Series Sheet
Print Date: 9/1/2020	1:06:17 PM	Bottom Overlay	293 693A
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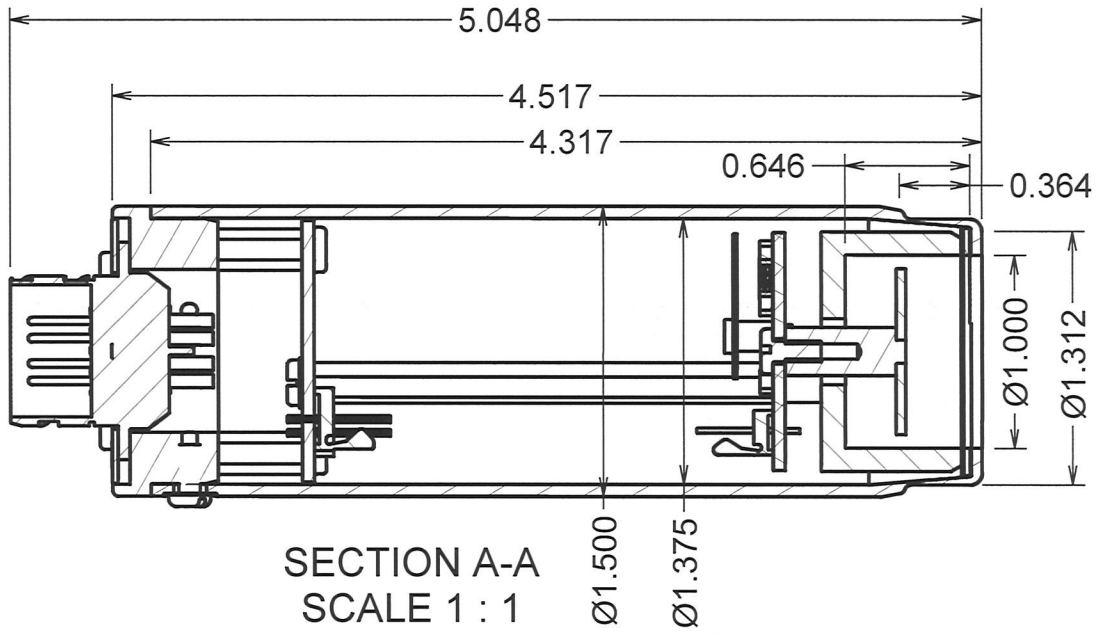
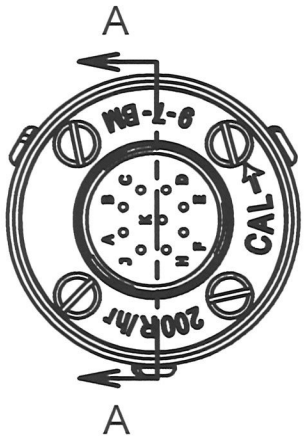
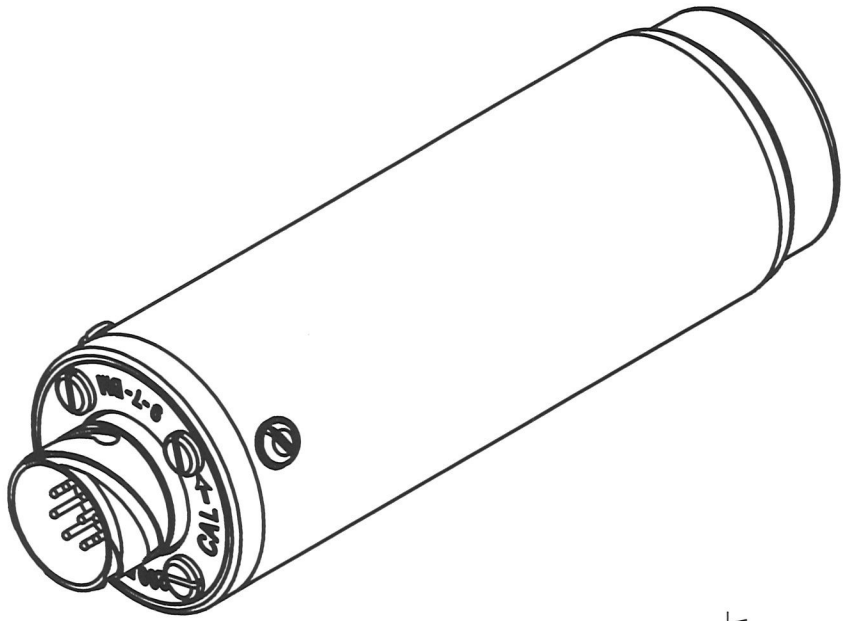


		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
Drawn: PAB	1/7/2019	Title: High Range Electrometer	
Design: DL	08/12/2010	Model: 9-7BH	
		Board#: 5293-691	
Approve: <i>[Signature]</i>	7 Jan 19	Sheet: 1 of 1	Series
Print Date: 1/7/2019	8:24:49 AM	Rev: 3	Sheet
		293	691
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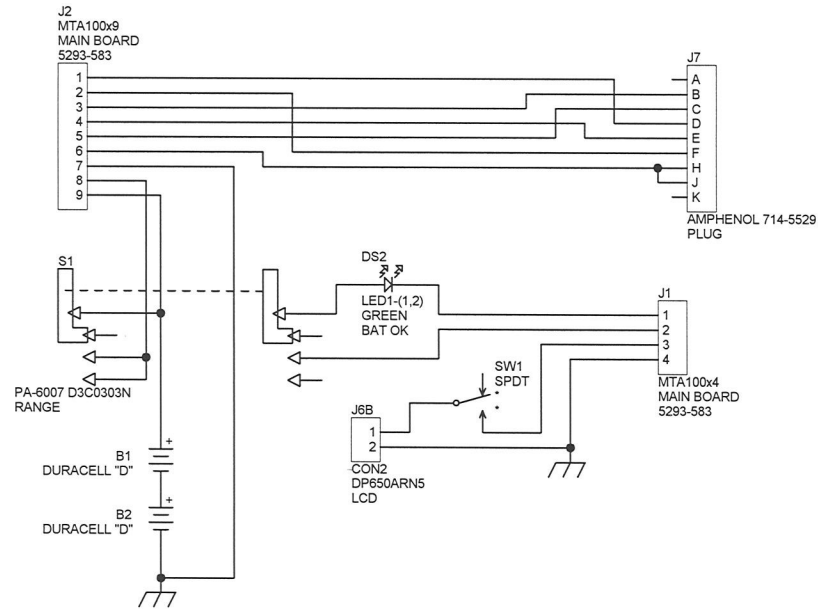
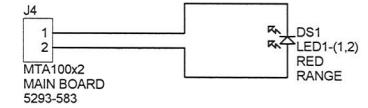
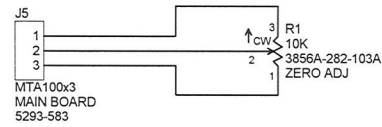
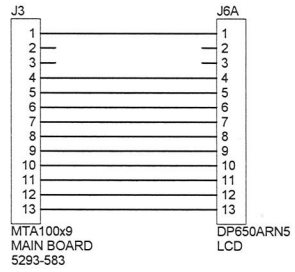


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Design:	DL	09-JUL-09	HIGH RANGE ELECTROMETER BOARD		
			Model: 9-7BH		
Approve:	<i>RSS</i>	<i>16 Oct 09</i>	Board#: 5293-691		
Layer:			Rev: 1.0	Series	Sheet
Mech.1			SCALE: 2.64	293	714
Mech.2	MID:				
Mech.3	08:13:47	12-Oct-2009			
Mech.4					
293691R1X1.Pcb					

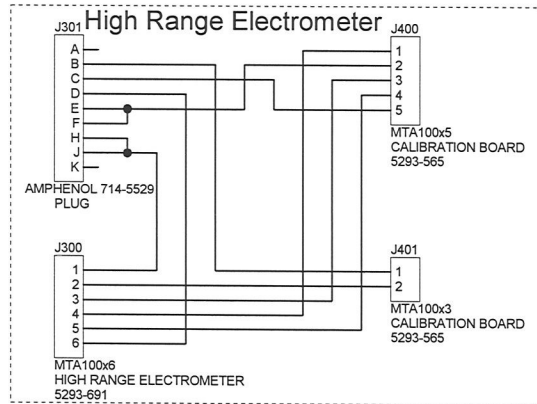
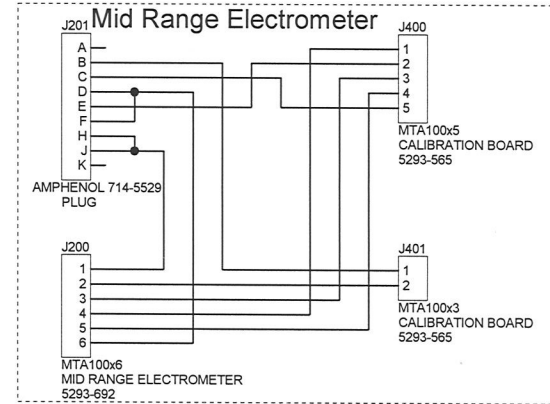
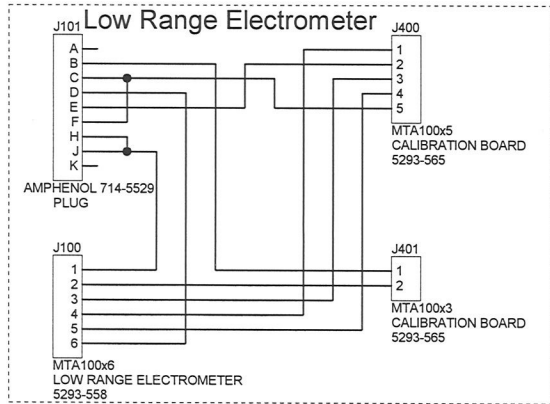
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REV	DESCRIPTION	DATE	BY
1	VALID	12/2/2008	DDW
2	ECF 2763	11/18/2013	JLG



DWN	DATE	CHK	DATE	APP	DATE
JLG	11/18/13				11-15-14
DWG NUM: 4293-568.iam				SCALE: 1:1	
TITLE M 9-7 MID/HIGH RANGE ION CHMBR					
LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556			SERIES 293	SHEET 568	



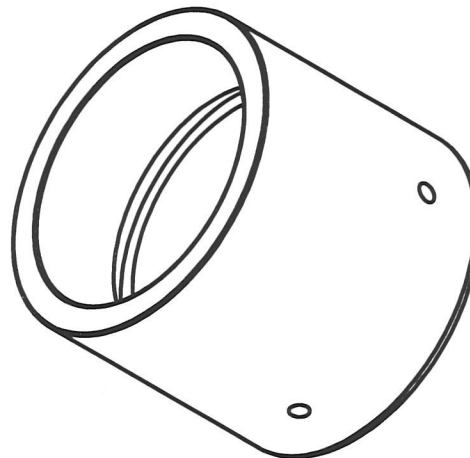
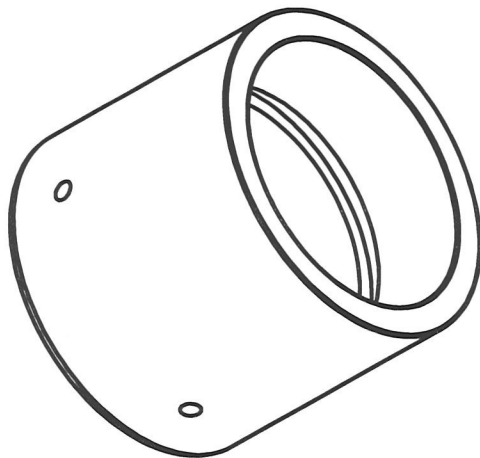
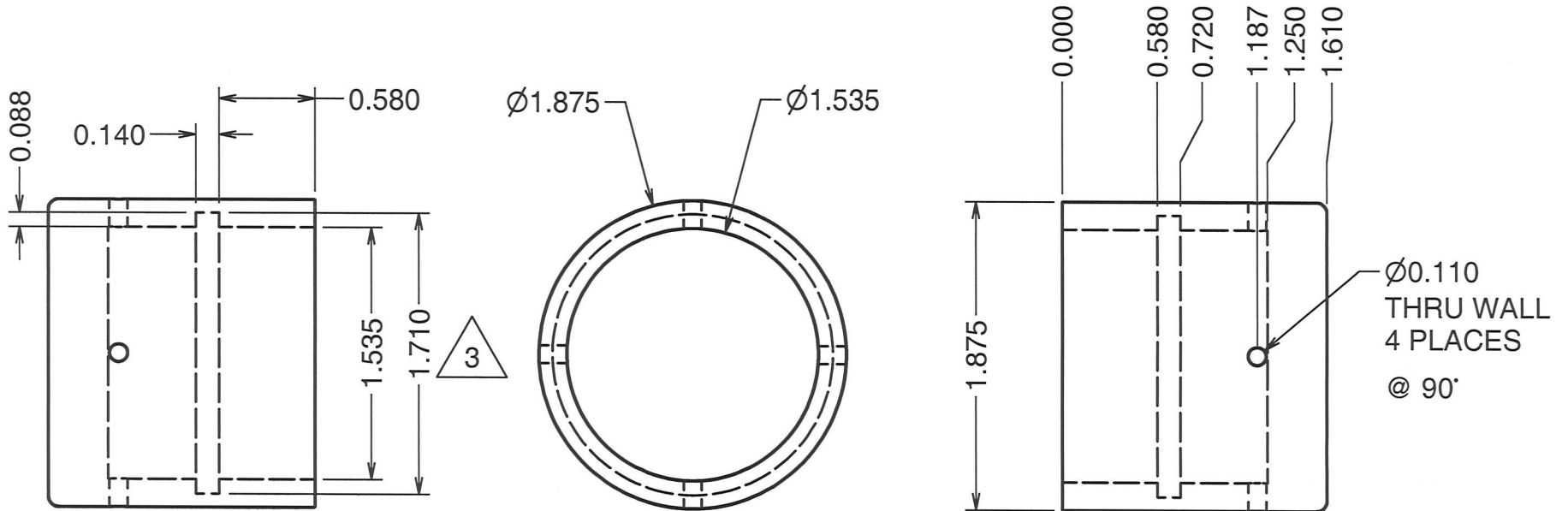
		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
		Drawn: MC 7/13/09 Design: DL 7/13/09	Title: WIRING DIAGRAM Model: M9-7
Approve: <i>[Signature]</i> 08:21:36 293-718P1.Sch	Board#: 293-718 Sheet: 1 of 2 12-Oct-2009 Rev: 1.0	Series 293	Sheet 718



		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
Drawn: MC	7/13/09	Title: WIRING DIAGRAM	
Design: DL	7/13/09	Model: M9-7 DETECTORS	
		Board#: 293-718	
Approve: <i>[Signature]</i>		Sheet: 2 of 2	Series
08:21:33	12-Oct-2009	Rev: 1.0	Sheet
293-718P2.Sch			293 718

REVISION HISTORY

REV	DESCRIPTION	DATE	BY
1	VALID	11/26/2008	PW
2	INCREASE O-RING GROOVE SIZE	7/13/2009	DDW
3	O-RING GROOVE DIA TO 1.710	8/4/2009	DDW

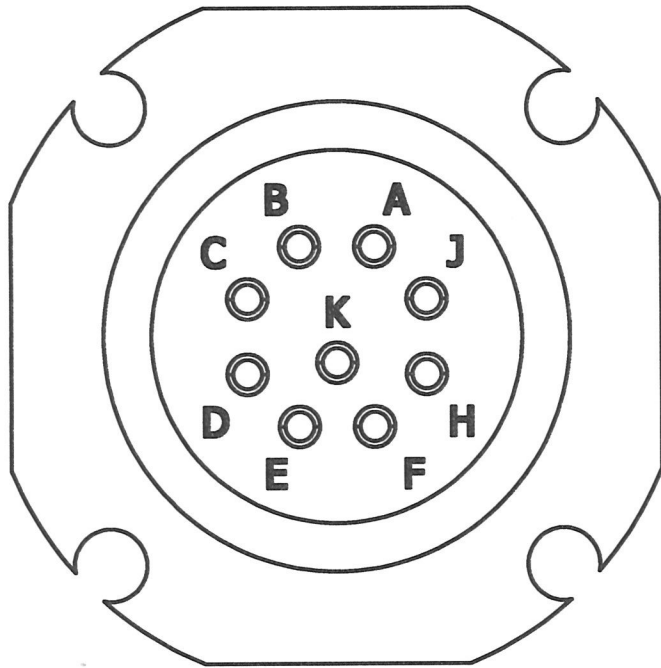


DESC: DETECTOR END CAP			
MODEL NO.: 9-7		PART NO.: 7293-632	
MAT'L.: 1.875" DIA. ACRYLIC ROD			
SIZE: 2.000" LONG			
MAT'L. NO.: 29-9941			
FINISH: CLEAN AND DEBUR		NO. REQ'D: 1	
FINAL ASSY NO.:			
DWN	DATE	CHK	DATE
DDW	8/4/09		8/4/09
TOLERANCES UNLESS NOTED OTHERWISE		SCALE: 1:1	
MILL, LATHE, STRIPPIT = ± 0.005		ANGLES = ± 0.5°	
BENDS ON SHEETMETAL PARTS = ± 0.010			
LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556		SERIES 293	SHEET 632

REVISION HISTORY

REV	DESCRIPTION	DATE	BY
1	VALID	03/31/2009	PW
2	CHANGED SHEET NO.	12/09/2009	PW

7293-576



HIGH RANGE

- A-NC
- B-WHT
- C-GRN
- D-GRY
- E-BUSS TO F, RED
- F-BUSS TO E
- H-BUSS TO J, BLU
- J-BUSS TO H
- K-NC

MID RANGE

- A-NC
- B-WHT
- C-GRN
- D-BUSS TO F, GRY
- E-RED
- F-BUSS TO D
- H-BUSS TO J, BLU
- J-BUSS TO H
- K-NC

LOW RANGE

- A-NC
- B-WHT
- C-BUSS TO F, GRN
- D-GRY
- E-RED
- F-BUSS TO C
- H-BUSS TO J, BLU
- J-BUSS TO H
- K-NC

LOOKING AT BACK OF CONNECTOR

DWN	DATE	CHK	DATE	APP	DATE
PW	12/09/2009			PW	12-9-09
DWG NUM: 4293-568C				SCALE: 1:1	
TITLE M 9-7 CONNECTOR WIRING					
LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556			SERIES 293	SHEET 568C	