
**LUDLUM MODEL 500
PULSER**

April 2011

**Serial Number 206262 and Succeeding
Serial Numbers**

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PULSER**

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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 500 Pulse Generator (Pulser) provides the functions necessary for use in calibrating Ludlum instruments, as well as many other scaler/ratemeter instruments. The adjustable output pulse rate is displayed on a three-digit LED readout. Potentiometers (both coarse and fine controls) and a multiplier switch provide rates from 10 to 9.9×10^6 counts per minute (cpm). Pulse amplitude is controlled by a multiplier switch and a LO/HI potentiometer, while pulse polarity is chosen by a selector switch. Amplitude may be varied between 0 and ± 5 volts; displayed on an analog meter. The high voltage of the instrument under test is displayed on an analog meter with markings of 0-2.5 kilovolts.



Model 500 Pulser

Section

2

Specifications and Controls

Power: 95-135 Vac, 50/60Hz at less than 20 volt-amperes.

Pulse Output: Standard connector “C” type (“C” cable is provided).

High Voltage Readout: Measured by a high-impedance voltmeter up to 2500 volts on the PULSE OUT connector. Voltmeter impedance is 1000 megohms $\pm 10\%$. Voltmeter linearity is $\pm 5\%$ of the reading.

Pulse Rate: Six multiplying ranges provide pulse rate settings of X0.1 through X10K, displayed on a three-digit LED readout. Minimum pulse rate is 1 count per minute, while the maximum pulse rate is 9,900,000 counts per minute, with accuracy better than 2% of the reading.

Pulse Amplitude: Read on an analog meter labeled 0-5. Four scales are provided: 0-5 millivolts, 0-50 millivolts, 0-500 millivolts and 0-5volts. The desired range is selected using the four-position switch. Actual pulse amplitude is within 10% of the reading.

Note

If the Pulse Rate is above 500 cpm with the range multiplier switch set to X10K, a slight decrease in overall pulse amplitude may occur.

Pulse Polarity: The output pulse polarity may be selected by a switch located on the front panel. Total pulse width (negative pulse) is typically 7.0 microseconds, comprised of a leading edge of 0.3 microseconds, a pulse width of 1.7 microseconds, and a pulse trailing edge of 5 microseconds. The positive pulse width is less than 2.25 microseconds.

Accessories: Series “C” to “BNC” and “C” to “MHV adapters are provided.

Note

If the pulse amplitude from the Pulser exceeds ten times the input sensitivity of the test instrument, double pulsing may occur in the instrument under test.

Section

3

Getting Started

The Ludlum Model 500 Pulser (Pulser) is commonly used to calibrate a variety of radiation detection (survey) equipment to a certain count rate (CPS-counts per second, CPM-counts per minute, KCPM-kilo counts per minute, etc.). This is accomplished by measuring high voltage, determining pulse height threshold, and feeding simulated pulses to an instrument. The basic methods associated with calibrating such equipment will be covered in this section, giving the first time user some valuable principles to build upon as he/she becomes more proficient in the task of electronic calibration.

Before calibrating any piece of survey equipment, some information about that piece of equipment would be of much value and can often found in respective instrument manuals:

1. You should know the polarity of the detector to be used with the instrument. Most radiation detection instruments used with GM (Geiger Muller), proportional, or scintillation detectors produce a negative pulse.
2. You must know the type of detector used with that particular instrument. This is important because the Pulser actually emulates the detector.
3. It is helpful to know the voltage requirements of the detector that will be used with the instrument (often 900 Vdc is required for GM detectors). High voltage requirements for scintillation detectors are determined by the detectors' plateau.
4. Does the instrument you want to calibrate utilize an intermediate preamp or "smart" electronics at the detector? Be aware that the Pulser cannot simulate a detector in these cases.

If you are calibrating an instrument with an analog display, you will first want to ensure that the meter movement has proper mechanical zero. Adjustments are typically on the front of the meter bezel and must be made with the instrument power OFF and the instrument in its normal handheld (or “resting”) position.

Measuring Instrument High Voltage

Use a detector cable of identical length of that which is used in normal operation of the instrument to connect the instrument to the Pulser. Turn the Pulser power switch to the ON position.

Ensure that the instrument power is ON and then adjust the high voltage output (consult instrument manual) for a proper high voltage reading on the Pulser high voltage meter face. Remember, high voltage requirements are based on the detector that will be used with the instrument.

Determining Pulse Height Threshold

On the Pulser, adjust the AMPLITUDE, and –NEG/+POS Pulse Polarity to that which is specified in the particular instruments’ instruction manual (and/or plateau graph) and calibrate if necessary/applicable.

If an instrument manual is not available, the following procedure can be used to determine pulse height threshold.

With the instrument being calibrated set to the highest range, adjust the Pulser count rate until the meter reads full scale. Then, adjust the Pulser AMPLITUDE down until a 25% loss of counts is read on the meter face. Record the pulse height threshold from the Pulser amplitude readout/meter.

Test above and below the threshold by adjusting the Pulser AMPLITUDE while observing a rapid increase or decrease (corresponding to increase or decrease in amplitude) in meter counts.

The Pulser can also be used to set the pulse height threshold on instruments with an adjustable threshold. The procedure is basically the same as the preceding procedure. If the desired threshold has not been achieved, adjust the threshold control and repeat this procedure until the desired results are met.

Electronic Count Rate Calibration

Once the high voltage is set, and the pulse height threshold has been determined, use the following procedure to electronically calibrate the instruments' ranges.

First, make certain that the Pulser AMPLITUDE is set to at least 1.5 times the pulse height threshold of the instrument being calibrated. With the instrument in the highest range, adjust the Pulser pulse frequency (MULTIPLIER, FINE and COARSE controls) to provide a meter deflection (on the instrument being calibrated) of approximately 80% of full scale. Make instrument adjustments to obtain the proper reading (range potentiometers are commonly used). Check the 20% scale indication by reducing the Pulser count rate by a factor of "4." The instrument being calibrated should read within 10% of the actual pulse rate.

Decrease the pulse rate of the Pulser by a decade and adjust the range on the instrument being calibrated to the next lower range. Calibrate as described above, working your way down through the remaining ranges and making adjustments as needed.

For more detailed information on electronic calibration of Ludlum Measurements instruments utilizing the Ludlum Model 500 Pulser, contact Ludlum Measurements, Inc. Training Department, and/or consult Ludlum Measurements, Inc. specific instrumentation manuals for the instruments being calibrated.

CAUTION!

At Ludlum Measurements Inc., Instrument Calibration also involves the detector to be used and a source of radiation of similar energy to that which would be seen in normal use. The preceding steps detail only the electronics side of an instrument calibration, and do not take into account the effects of dead time, or the efficiency of the detector(s) to be used.

Determining Dose Rate Conversion

The Pulser is also frequently used (in accordance with ANSI N323-1997, section 4.2) to determine a conversion constant between count rate and dose rate after an instrument has been calibrated to dose rate (on a range). This conversion constant can then later be used for “Bottom Range” Calibration (see next section).

The following is an example of how a conversion constant is determined in a Model 12SA MicroR Survey Meter, assuming the instrument has already been calibrated to dose rate:

With the Pulser delivering 350,000 cpm and with the instrument in the X1000 Range, calibrated to 2 on the meter face, the conversion constant would be calculated: $350,000 / (2 \times 1000) = 175$ cpm per $\mu\text{R}/\text{hr}$.

Furthermore, with the Pulser delivering 175,000 cpm and with the instrument in the X1000 Range, calibrated to 1 on the meter face, the conversion constant would be calculated: $175,000 / (1 \times 1000) = 175$ cpm per $\mu\text{R}/\text{hr}$.

This conversion (or “calibration”) constant should remain linear throughout the ranges of the instrument and should be checked by following the preceding equation.

“Bottom Range” Calibration

The Pulser is also frequently used to calibrate the lowest range of a scintillation detector/instrument, where background radiation levels introduce significant errors.

For instance, with the conversion constant above of 175 cpm per $\mu\text{R}/\text{hr}$ (for the Model 12SA) the bottom range (X1) would be electronically calibrated as follows:

Apply 350 cpm and calibrate the X1 range to a meter reading of 2.

Apply 175 cpm and calibrate the X1 range to a meter reading of 1

Section

4

Safety Considerations

Environmental Conditions for Normal Use

Indoor use only

No maximum altitude

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

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

Mains supply voltage range of 95-135 Vac (178-240 Vac available),
50/60 Hz single phase (less than 100 mA).

Maximum transient voltage of 1500 Vac

Installation Category II (Overvoltage Category as defined by IEC 1010-1).


Pollution Degree 2 (as defined by IEC 664).


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 500 Pulser is marked with the following symbols:

 **ALTERNATING CURRENT (AC)** (IEC 417, No. 5032) - designates an input receptacle that accommodates a power cord intended for connection to AC voltages. This symbol appears on the back panel.

 **PROTECTIVE CONDUCTOR TERMINAL** (per IEC 417, No., 5019) – designates the central grounding point for the safety ground. This symbol is visible inside the chassis.

 **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 back panel. **Note the following precautions:**

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 disconnect the power cord.
2. Allow the instrument to sit for one minute before accessing internal components.



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 near the AC receptacle. See section 5, “**Recycling**” for further information.

Replacement of Main Fuse (Back Panel)

Warning!

For continued protection against risk of fire, replace only with fuse of the specified type and current rating!

Section

5

Maintenance and Recalibration

Maintenance

Instrument maintenance consists of keeping the instrument clean and periodically checking the calibration. The Model 500 Pulser 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:

1. Turn instrument OFF and disconnect the instrument power cord.
2. Allow the instrument to sit for one minute before cleaning.

Recalibration

Recalibration is required after any repairs or adjustments have been made to the instrument. Recalibration is not normally required following instrument cleaning, battery replacement, or detector cable 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 most other manufacturers' instruments.

Calibration procedures are available upon request for customers who choose to calibrate their own instruments.

Section

6

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.

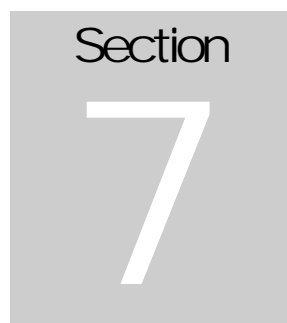
The following types of recyclable materials are present in Ludlum Measurements, Inc. electronics products, and should be recycled separately. The list is not all-inclusive, nor does it suggest that all materials are present in each piece of equipment:

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:




 A gray square containing the word "Section" in a sans-serif font at the top, and a large white number "7" in the center.

Parts List

	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
Model 500 Pulser	UNIT	Completely Assembled Model 500 Pulser	48-1677
PULSER BOARD W/ TEMP. STABLE OSC. (Main Board), Drawing 208 X 61	BOARD	Completely Assembled Circuit Board	5208-084
CAPACITORS	C1	10pF, 100V	04-5573
	C2	0.1 μ F, 100V	04-5521
	C3	0.001 μ F, 100V	04-5519
	C4	100 μ F, 10V	04-5576
	C8-C10	22pF, 100V	04-5552
	C11	0.01 μ F, 100V	04-5523
	C12	1 μ F, 250V	04-5515
	C15	470pF, 100V	04-5555
	C17	0.1 μ F, 100V	04-5521
	C18	100pF, 100V	04-5527
	C20	0.001 μ F, 100V	04-5519
	C21	220pF, 100V	04-5530
	C22-C23	100 μ F, 10V	04-5576
	C24	1 μ F, 35V	04-5575
	C25	0.1 μ F, 35V	04-5574
	C26*	220pF, 100V	04-5530
	C27	47pF, 100V	04-5533
TRANSISTORS	Q1	2N3904	05-5755
	Q2	MPSW51	05-5765
	Q3	2N7000	05-5820
	Q4-Q5	2N3904	05-5755

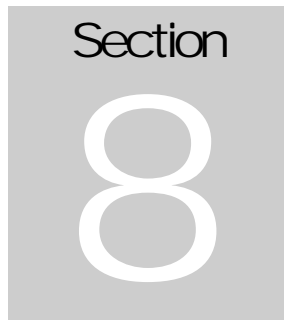
	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
	Q6	MPS6534	05-5763
	Q7	2N7000	05-5820
	Q8	VPO300M SILICONIX	05-5834
	Q9	2N3904	05-5755
	Q10	MPS6534	05-5763
VOLTAGE REGULATOR	VR1	LM320LZ-05	05-5771
INTEGRATED CIRCUITS	U1	AD654JN	06-6317
	U2-U6	CD4017BE	06-6001
	U7	LM555CN (M500 ONLY)	06-6017
	U9	CD4098BE	06-6066
	U11	CD4001BE	06-6064
	U12	LM358N	06-6024
	U13	CD4098BE	06-6066
	U16	CA3140E	06-6033
DIODE	CR1	1N4001	07-6268
POTENTIOMETERS / TRIMMERS	R2	10K, MULTIPLIER – REFERENCE	09-6824
	R5	100K, PULSE WIDTH SET	09-6829
	R11	2K, AMPLITUDE	09-6919
	R19	2K, HV METER	09-6919
	R21	100K, TRIGGER SET	09-6829
RESISTORS	R3	560K, 1/4W, 5%	10-7027
	R4	4.7K, 1/4W, 5%	10-7014
	R6	10K, 1/4W, 5%	10-7016
	R7	1K, 1/4W, 5%	10-7009
	R8	3.3K, 1/4W, 5%	10-7013
	R10	3.9K, 1/4W, 5%	10-7084
	R20	100 Ohm, 1/4W, 5%	10-7004
	R22	1K, 1/4W, 5%	10-7009

	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
	R23	10K, 1/4W, 5%	10-7016
	R24	100K, 1/4W, 5%	10-7023
	R25-R26*	56K, 1/4W, 5%	10-7021
	R28-R29	100K, 1/4W, 5%	10-7023
	R30	10K, 1/4W, 5%	10-7016
	R31	220 Ohm, 1/4W, 5%	10-7041
	R32	100 Ohm, 1/4W, 5%	10-7004
	R33	33 Ohm, 1/4W, 5%	10-7001
	R34	10K, 1/4W, 5%	10-7016
	R36	68 Ohm, 1/4W, 5%	10-7078
	R37	150 Ohm, 1/4W, 5%	10-7005
	R38	10K, 1/4W, 5%	10-7016
	R39-R41	1K, 1/4W, 5%	10-7009
	R42	100K, 1/4W, 5%	10-7023
	R43	2.2K, 1/4W, 5%	10-7012
	R44	10K, 1/4W, 5%	10-7016
M500 READOUT CONTROLLER, Drawing 208 X 173	BOARD	Completely Assembled Readout Controller Circuit Board	5208-171
CAPACITORS			
	C1	100pF, 100V	04-5661
	C2-C3	0.01 μ F, 50V	04-5664
	C4-C6	1 μ F, 16V	04-5701
	C7	4.7 μ F, 25V	04-5653
	C8	1 μ F, 16V	04-5701
VOLTAGE REGULATOR			
	VR1	ADP3308ART-3.3- SOT-23-5	05-5880
INTEGRATED CIRCUITS			
	U1	SN74AHC14D SO-14	06-6474
	U2	MSP430F1101DW SOW-20	06-6529
	U3	SN74AHCT541D SOW-20	06-6527
	U4	TPS3825-33SOT-23-5	06-6558
RESISTORS			
	R1-R2	10K, 1/8W, 1%	12-7839
	R3-R6	2.21K, 1/8W, 1%	12-7835

	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
	R7	33.2K, 1/8W, 1%	12-7842
	R8	10K, 1/8W, 1%	12-7839
CONNECTORS			
	P1	SOCKET-SSQ-108-16PIN	13-8574
	P2	640456-5 MTA 100X5	13-8057
	P3	CON-EDGE/MIN- 10-39.37 PITCH	*
M500 READOUT BOARD, Drawing 208 X 176	BOARD	Completely Assembled Readout Circuit Board	5208-172
CAPACITORS			
	C1	1 μ F, 16V	04-5701
	C2	10 μ F, 25V	04-5655
TRANSISTORS			
	Q1-Q3	2N7002L	05-5840
INTEGRATED CIRCUITS			
	U1	CD74HC4511E	06-6525
MISCELLANEOUS			
	DS1-DS3	LED-HDSP-E103	07-6342
RESISTORS			
	R1-R7	681 Ohm, 1/8W, 1%	12-7852
CONNECTOR			
	P1	HEADER-TSS-108-16PIN	13-8573

Chassis Wiring Diagram, Drawing 208 X 82	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>	
CAPACITORS	C1	1600 μ F, 50V	04-5535	
	C2	1 μ F, 35V	04-5502	
	C3	1600 μ F, 50V	04-5535	
	C4	2.2 μ F, 20V	04-5508	
	C5	0.0056 μ F, 3KV	04-5522	
	C6	2.2 μ F, 20V	04-5508	
	C9	1 μ F, 35V	04-5502	
	VOLTAGE REGULATORS	VR1	LM340K-5	05-5772
		VR2	LM320K-12	05-5797
VR3		LM320K-5	05-5787	
VR4		LM340K-12	05-5784	
DIODES	CR1-CR8	1N4001	07-6268	
SWITCHES	S1	PA-1001	08-6502	
	S2	46206-LR	08-6523	
	S3	PA-1001	08-6502	
	S4	PA-2021	08-6505	
POTENTIOMETERS / TRIMMERS	R8	1K, PULSE HEIGHT	09-6759	
	R9	100K, MIN/MAX	09-6795	
	R19	20K, FINE TUNE	09-6909	
RESISTORS	R1	909 OHMS, 1%	12-7553	
	R2	90.9 OHMS, 1%	12-7552	
	R3	10 OHMS, 1%	12-7554	
	R4	1 OHM, 1%	12-7555	
	R7	1K, 2W	12-7605	
	R10	100	10-7004	
	R17	1G, FHV-1	12-7686	
	R18	1M, 1%	12-7609	
	R20-R21	1.15K, 1%	12-7672	

	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
CONNECTORS			
	P1	AC RECEPTACLE	13-7982
	P2	PULSE OUT; UG568/U C	13-7752
	P3	CJ50-44A-30, 22PIN EDGE	13-7866
	P4	MTA 100X5-26AUG	13-8041
TRANSFORMER			
	T1	M500 110/220VAC	4275-146
MISCELLANEOUS			
	DS1	PILOT LAMP	21-9296
	F1	1A FUSE-#312001 3-AG1	21-9277
	*	FUSE-HOLDER 348-8-7-73	21-9403
	M1	M 500 METER ASSY W/202x121 (Amplitude)	4167-302
	M2	M 500 METER ASSY W/202X14 (High Voltage)	4167-302
	*	M 500 METER ASSY	4208-007-00
	*	ADAPTER-C TO MHV	4208-089
	*	Power Cord-Belden	21-9394
	*	CBL-C	40-1004
	*	ADAPTER-C TO BNC	13-7759



Drawings

PULSER BOARD W/ TEMP STABLE OSC., Drawing 208 X 61

MODEL 500 MAIN BOARD, COMPONENT OUTLINES,
Drawings 208 X 63 and 208 X 63A

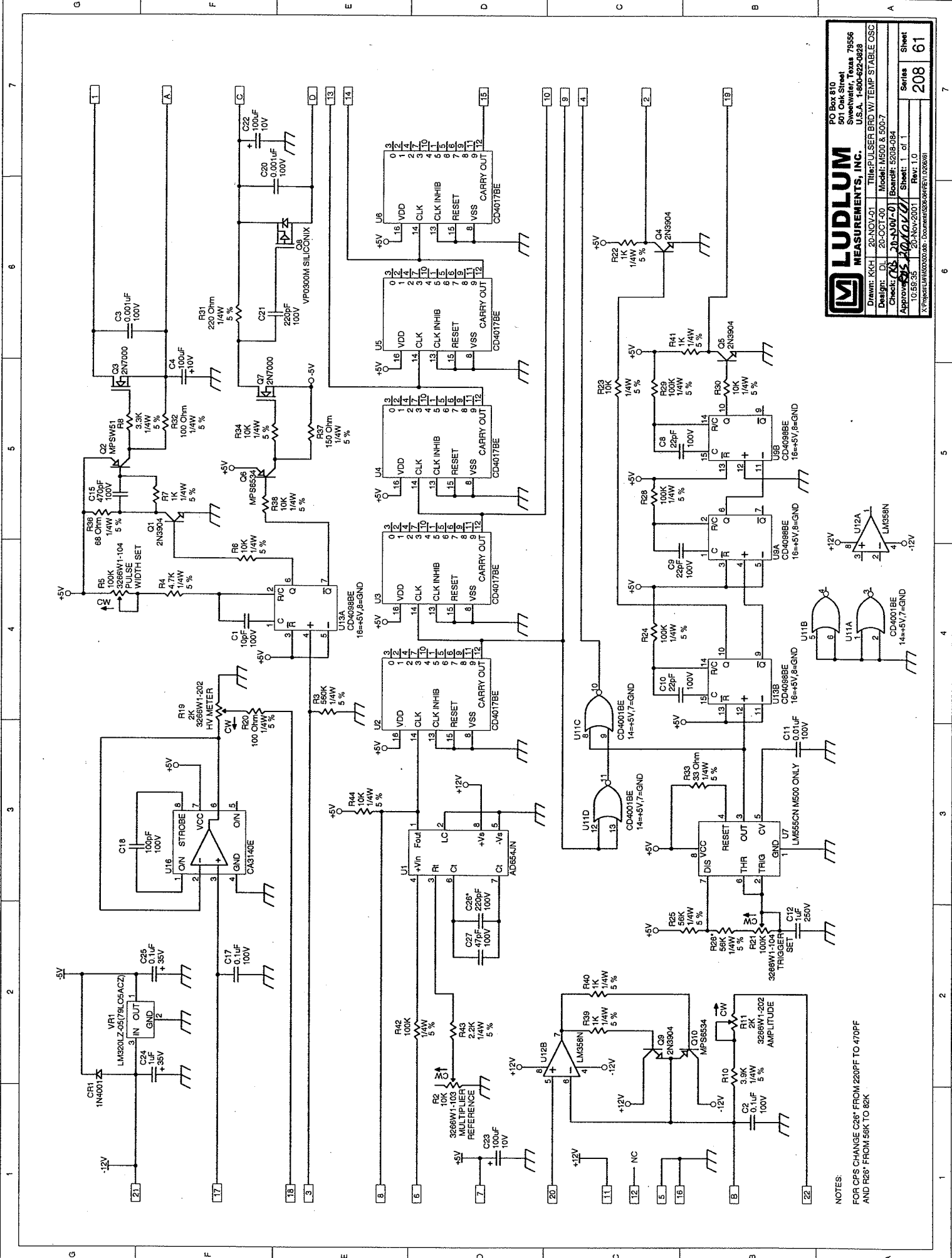
M500 READOUT CONTROLLER, Drawing 208 X 173

M500 READOUT CONTROLLER, Component Outlines, Drawings
208 X 174 (Two Sheets)

M500 READOUT BOARD, Drawing 208 X 176

M500 READOUT BOARD, Component Outlines, Drawings 208 X
177 (Two Sheets)

WIRING DIAGRAM, Drawing 208 X 82

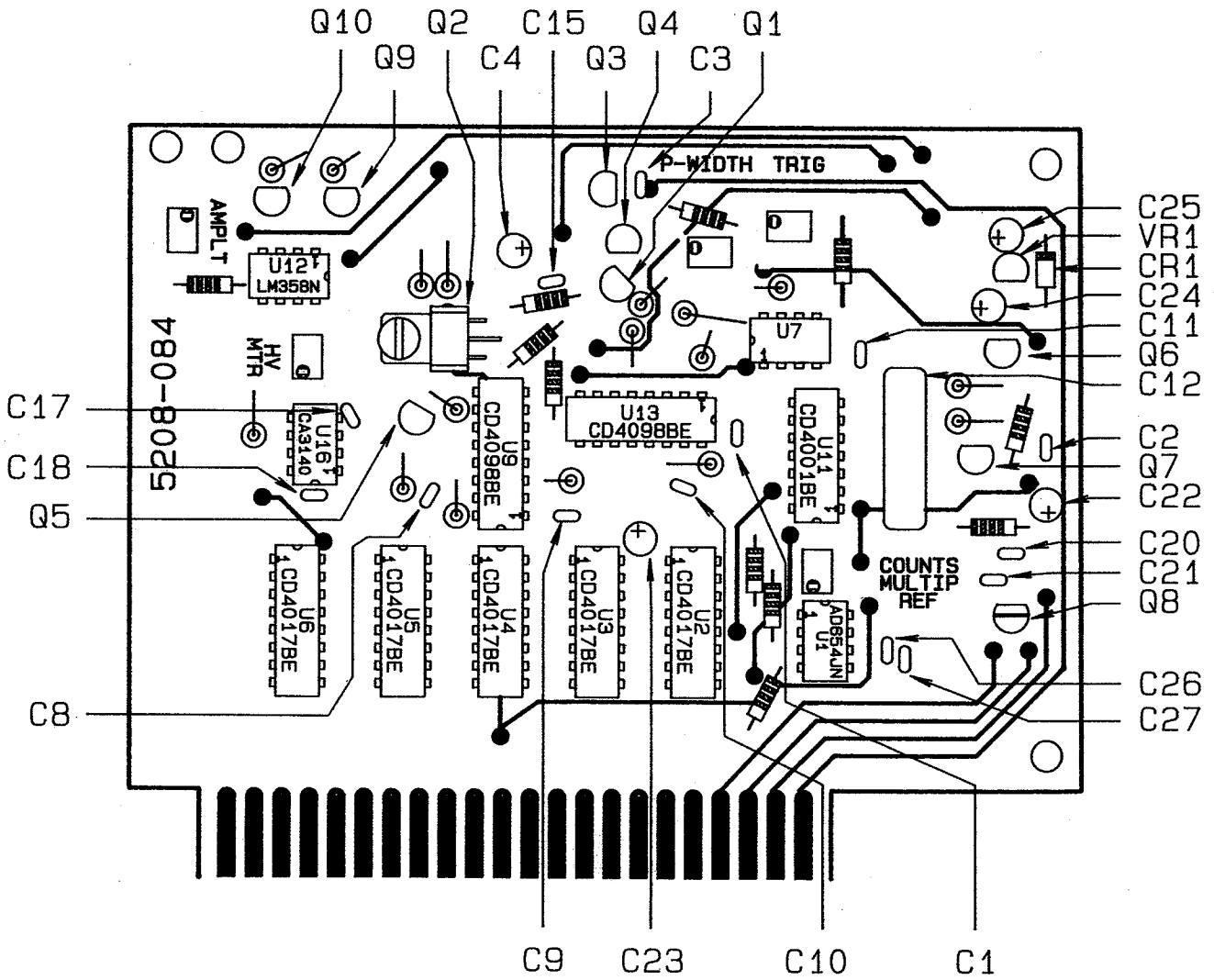


LUDLUM MEASUREMENTS, INC.
 PO Box 810
 501 Oak Street
 Sweetwater, Texas 79556
 U.S.A. 1-800-622-0628

Drawn: KKH 20-NOV-01 Title: PULSER BRD W/ TEMP STABLE OSC
 Design: DL 20-OCT-00 Model: M500 & 500-7
 Check: CS 20-NOV-01 Board#: 5208-084
 Approved: Sheet: 1 of 1
 10,552,35 20-Nov-2001 Rev: 1.0
 X:\Projects\LM500\500.dwg Doc: 5208-084 REV1.0 (2/26/01)

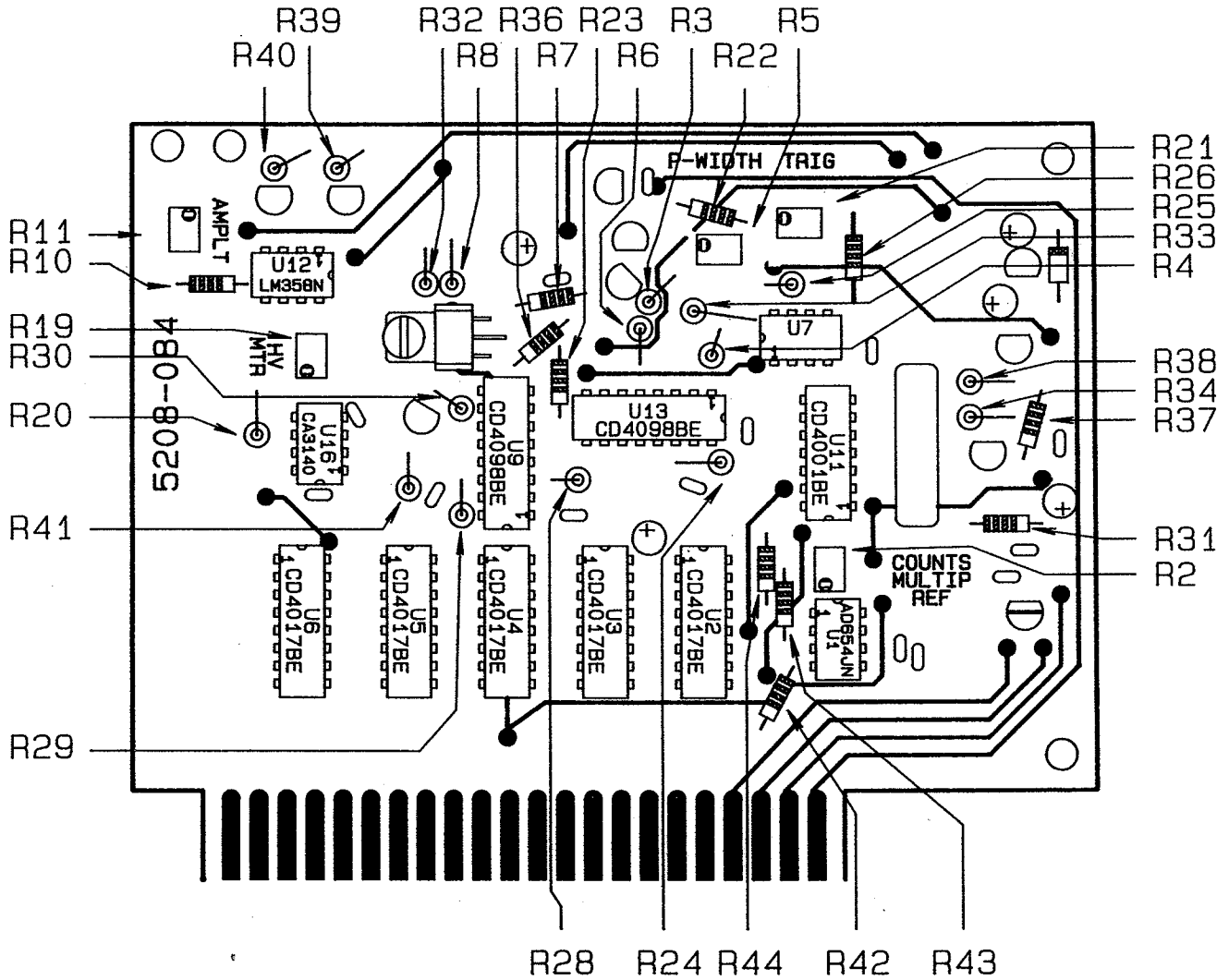
Sheet 208 61

NOTES:
 FOR CPS CHANGE C26* FROM 220PF TO 470PF
 AND R26* FROM 56K TO 82K



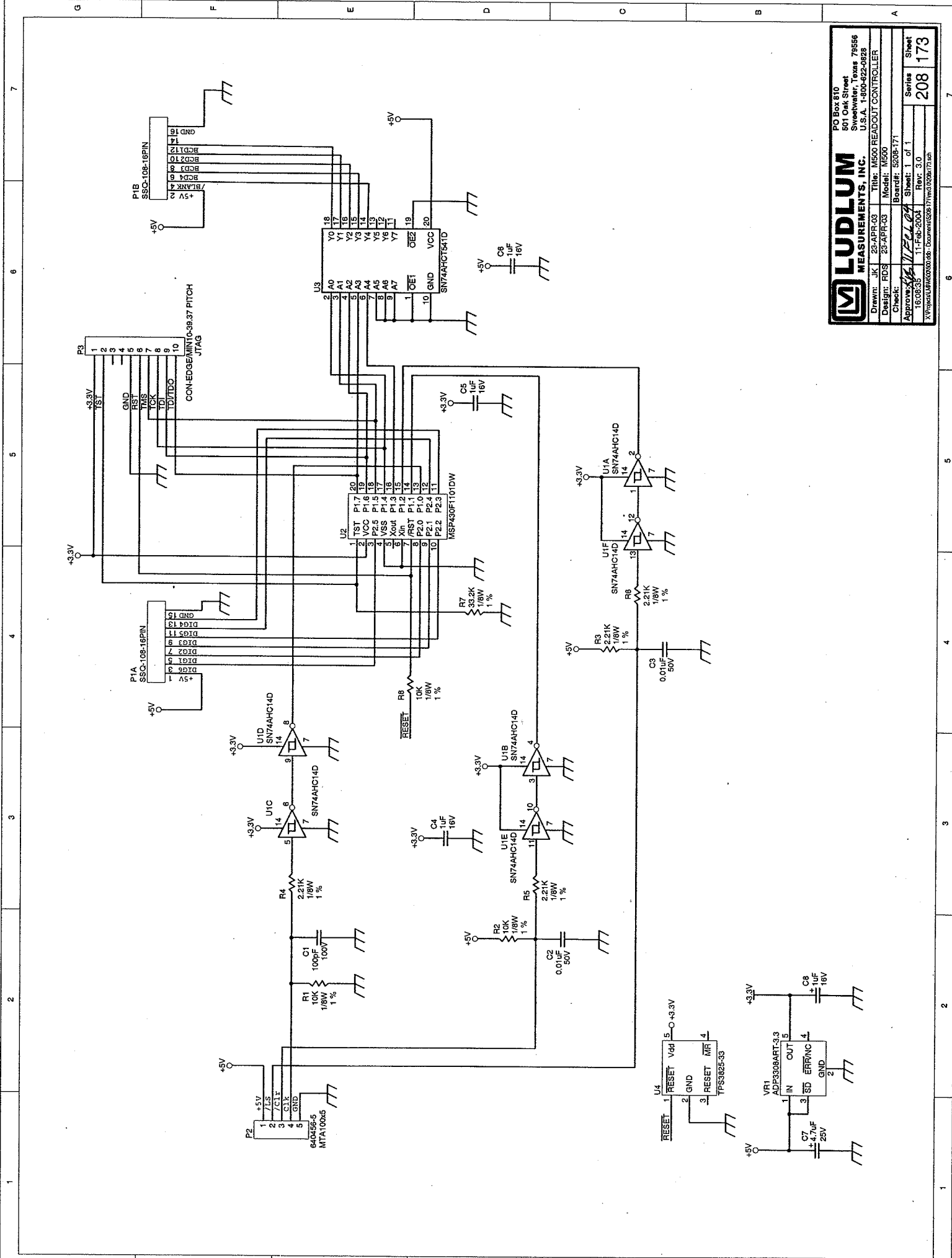
DESC: COMPONENT OUTLINES	
MODEL: 500	
PART #: 5208-084	
DWN: CKB	DATE: 11/10/92
DSGN:	DATE:

CHG NO.		DWN	CHK	APP	
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TITLE MODEL 500 MAIN BOARD					
LUDLUM MEASUREMENTS, INC.		SERIES	SHEET		
501 OAK STREET		208	63		
SWEETWATER, TEXAS 75608					



DESC: COMPONENT OUTLINES-RES.	
MODEL: 500	
PART #: 5208-084	
DWN: CKB	DATE: 11/10/92
DSGN:	DATE:

CHG NO.		DWN	CHK	APP
DWN DATE	CHK DATE	APP DATE		
CKB 11/10/92	CKB 6-22-93	JG 6-22-93		
TOL: SHOP STD	OTHER	SCALE: FULL	OTHER	
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LUDLUM MEASUREMENTS, INC.		SERIES	SHEET	
504 BAK STREET SHEPHERD, TEXAS 75086		208	83A	

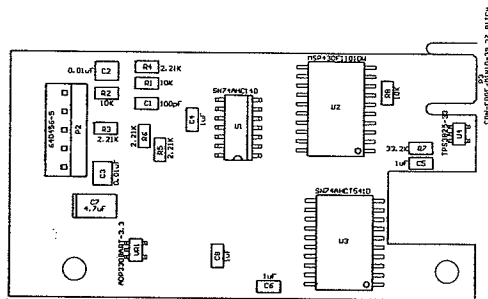


LUDLUM MEASUREMENTS, INC.
 PO Box 810
 801 Oak Street
 Streetwater, Texas 75556
 U.S.A. 1-800-822-0928

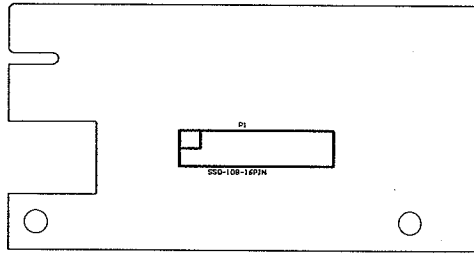
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 Design: JKL 23-APR-03
 Model: M500
 Board#: 5206-171

Drawn: JKL 23-APR-03
 Check: ROS 23-APR-03
 Approved: *[Signature]*
 160835 11-Feb-2004 Rev: 3.0
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Sheet: 1 of 1
 Series: 208
 173



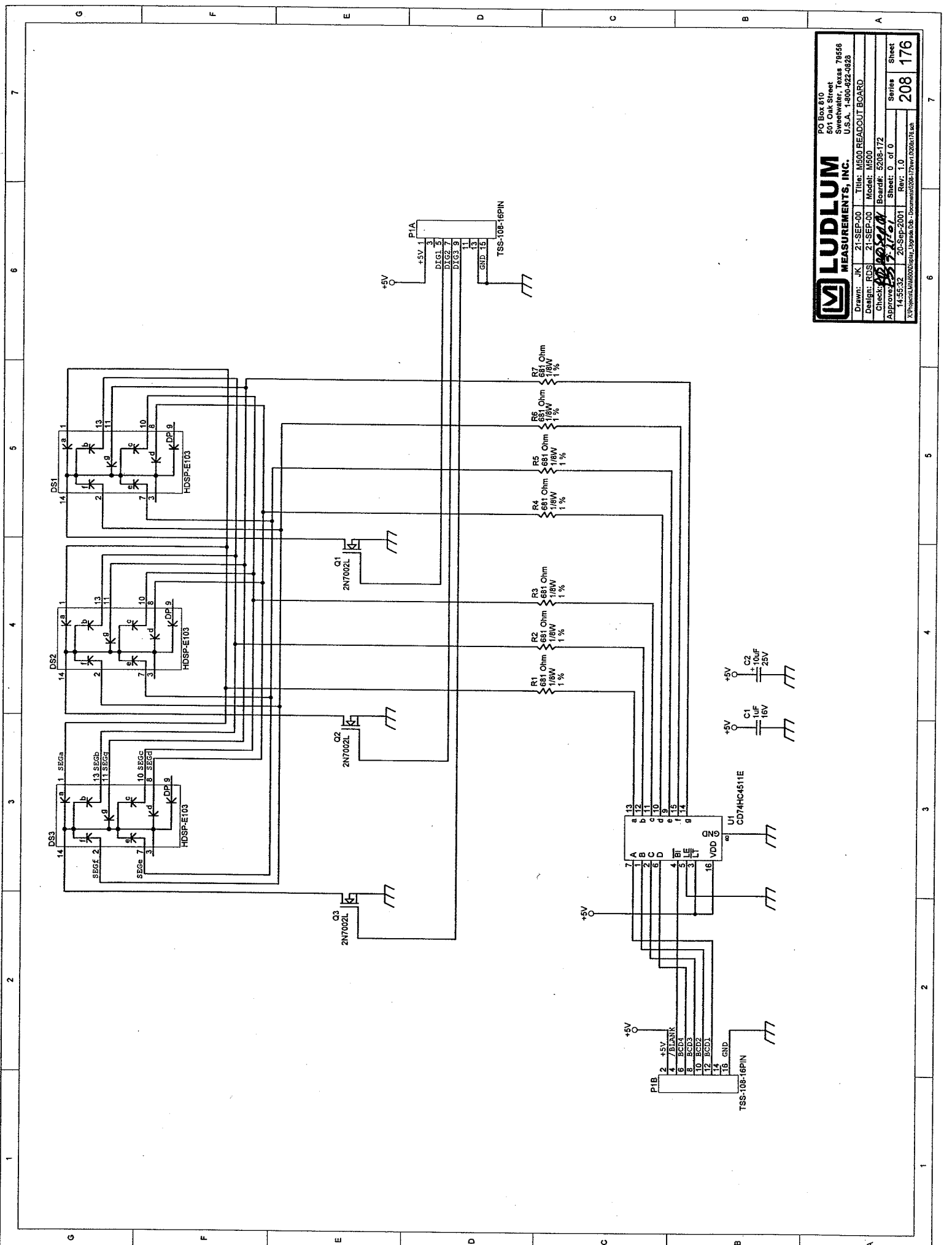
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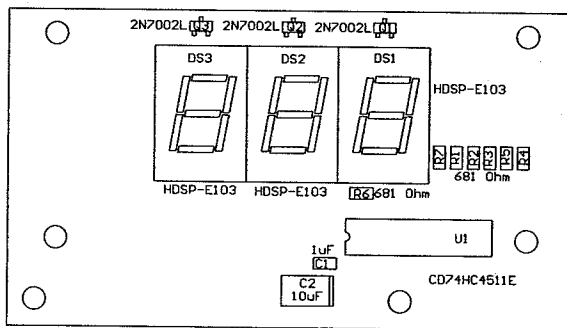


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Design:	RDS	23-APR-03			
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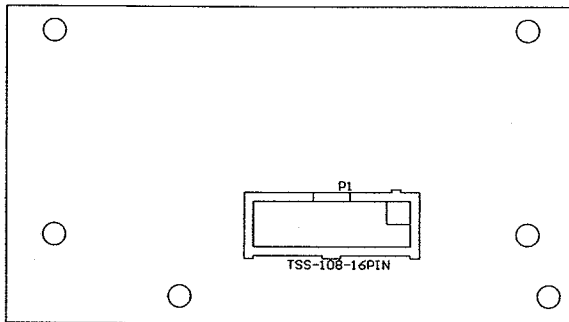
LUDLUM MEASUREMENTS, INC.
 PO Box 810
 Cleveland
 Sweetwater, Texas 75656
 U.S.A. 1-800-822-0828

Drawn: JK	21-SEP-00	Title: M600 READOUT BOARD
Design: RDS	21-SEP-00	Model: M600
Checked: <i>RDS</i>		Board#: 520P-172
Approved: <i>RDS</i>		Sheet: 0 of 0
14-SEP-92	20-SEP-2001	Rev: 1.0
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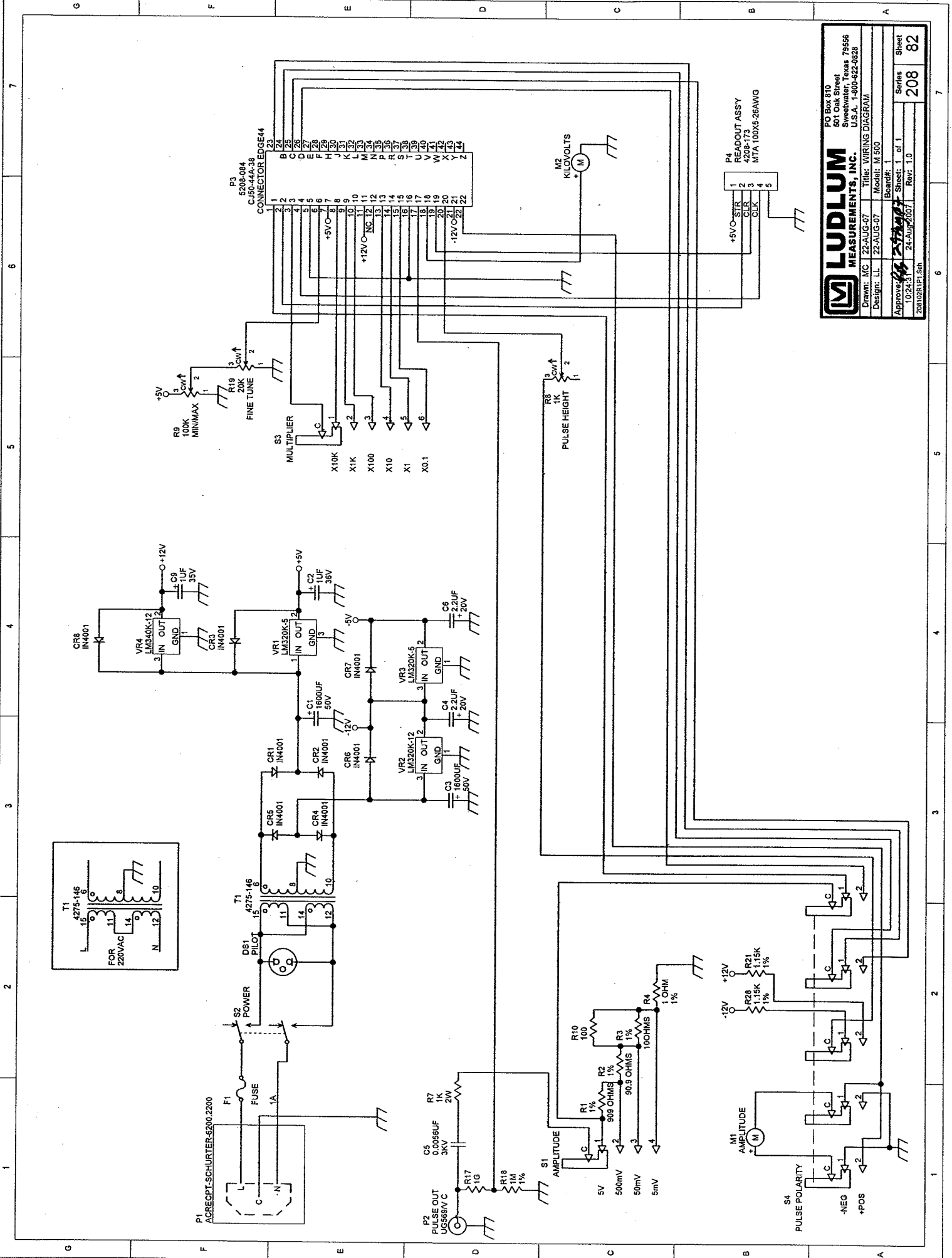




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Design:	RDS	21-SEP-00	M500 READOUT BOARD	
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Approve:	<i>BS</i>	<i>9-21-01</i>	Board#: 5208-172	
Layer:			Rev. 1.0	Series
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Drawn: JK	21-SEP-00	Title: M500 READOUT BOARD	
Design: RDS	21-SEP-00	Model: M500	
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Layer:		SCALE: 0.95	208 177
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Drawn: MC 22-AUG-07 Title: WIRING DIAGRAM
 Design: LL 22-AUG-07 Model: M 500

Approved: *[Signature]* Sheet: 1 of 1
 10/24/07 24-Aug-2007 Rev: T 1.0

Series 208 Sheet 82