LUDLUM MODEL 2000 SCALER

July 2025 Serial Number 195271 and Succeeding Serial Numbers

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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.

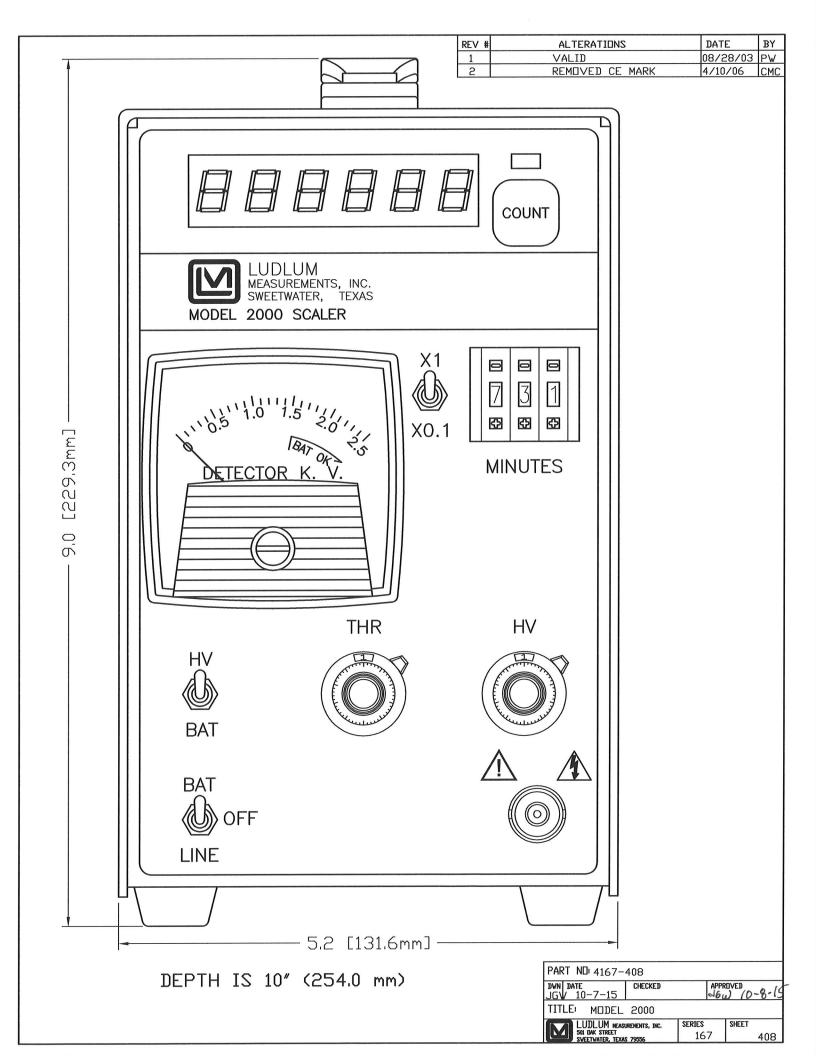
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RETURN OF GOODS TO MANUFACTURER

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: SERVICE DEPARTMENT 501 OAK STREET SWEETWATER, TX 79556

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



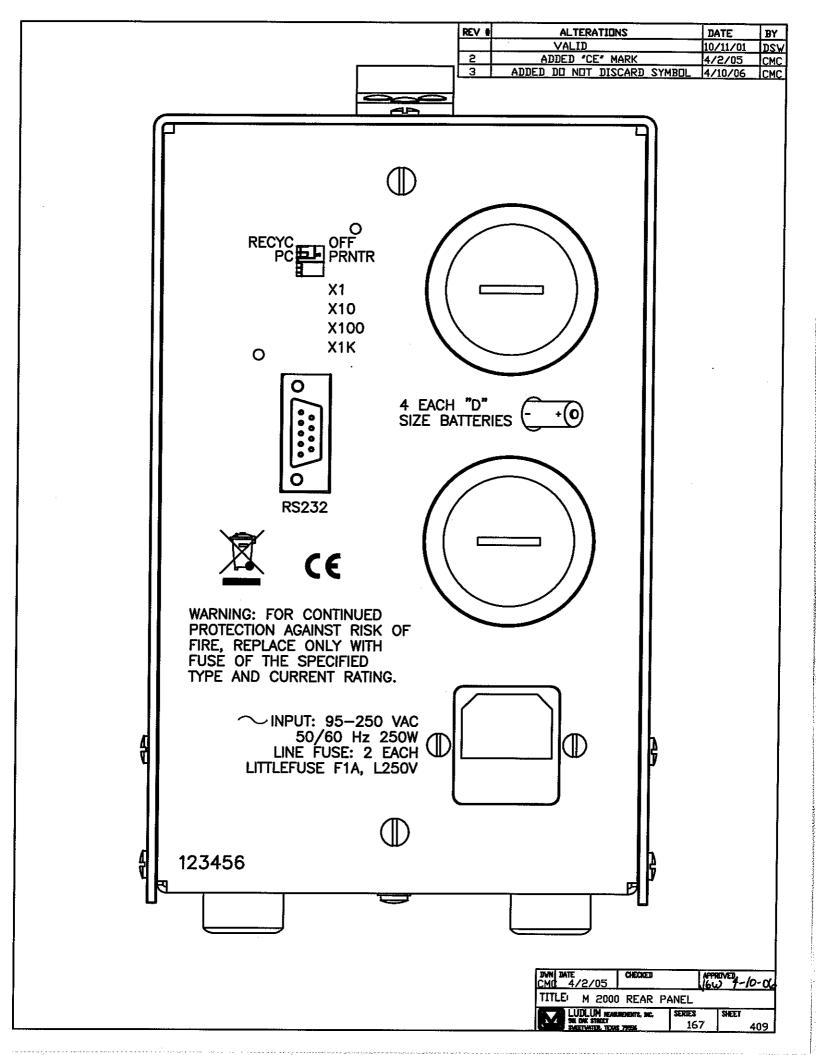


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Introduction

he Ludlum Model 2000 Scaler is a self-contained counting instrument designed for operation with scintillation, proportional, or GM (Geiger-Mueller) detectors. Counting is displayed as a scaler count on an LED (light-emitting diode) display. The instrument may be powered by 95-250 VAC, 50-60 Hz or by four "D" cell batteries. The unit is complete with a voltage-sensitive preamplifier, linear amplifier, electronic timer, and detector high-voltage power supply.

An RS-232 serial port is provided for attachment to a computer or optional printer. Computer interface cable and software are provided to start, stop, and record counts.



Getting Started

Unpacking and Repacking

Remove the calibration certificate and place it in a secure location. Remove the instrument and ensure that all of the items listed on the packing list are in the carton. Check individual item serial numbers and ensure calibration certificates match. The Model 194 serial number is located on the side of the unit.

To return an instrument for repair or calibration, provide sufficient packing material to prevent damage during shipment. Be aware that the thin mica window of the detector may be damaged (imploded) because of pressure differentials if the unit is shipped by air. Protect the unit by putting it inside a sealed can or other protective enclosure.

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.

Note:

Ludlum Measurements, Inc. recommends recalibration at intervals no greater than one year, assuming that regular operational checks are performed. Check the appropriate local, state, and federal regulations to determine required recalibration intervals.

Power

Select either line (LINE) or battery (BAT) operation with the power switch.

LINE operation: Connect the instrument to line power of 95–250 Vac, 50 60 Hz using the power cord supplied with the instrument. Turn the power switch to LINE and proceed to use the instrument.

BATTERY operation: The battery lids are located at the rear of the instrument. Use a coin or screwdriver to open the lids. Place four "D" cell batteries in the instrument with the terminal "buttons" (positive ends) facing out. Turn the power switch to the BAT position. Check the battery condition by pushing the HV BAT selector to BAT. (A downscale reading indicates battery reversal.) Adequate power is assured when the meter needle is above the BAT OK mark.

Operational Check

Determine if the instrument is operational by pressing the COUNT button. The count lamp should illuminate. (This action starts the scaler count.)

THR (Threshold) Setting

The instrument THR control is designed so that 1.00 on the threshold dial is approximately equal to a 10 mV (millivolt) input sensitivity.

Set THR for appropriate detector.

For scintillation detectors: Set THR on 1.00 (approximate 10 mV input threshold).

For GM detectors: Set THR at 3.5 (approximate 35 mV input threshold).

For proportional detectors: Set THR on 0.20 (approximate 2 mV input threshold).

Operating Point

The instrument and detector operating point is established by setting the probe voltage (HV) and instrument sensitivity (THR). Efficiency, background and noise for a given detector system are fixed by the physical makeup of the detector and rarely vary 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 the singular case of the GM detector, a minimum operating voltage is required to establish the GM operating region. (At lower voltages, the detector operates as a very insensitive proportional counter.) This detector is not capable of energy discrimination (pulse height discrimination).

For gain sensitive detectors (proportional or scintillation), the most straightforward method of selecting the operating point is to develop a graph, relating count rate to system gain. This relationship is commonly referred to as a plateau or instrument plateau curve. System gain may be changed by adjusting detector high voltage (HV).

Determining Instrument Plateau

Set the time multiplier toggle switch to $\times 0.1$ and the MINUTES thumbwheel switch to "001." This gives a 0.1 min (6 second) count.

Set the THR control to 1.0 for a scintillation detector or to 0.2 for a proportional detector.

With the detector shielded from the source, adjust the high-voltage control by 50 V increments, and take a plot of HV-versus-background count rate until the detector voltage rating is reached. Return the HV control to zero.

Expose detector to source and make another count-versus-voltage plot.

Plot both sets of data and select the operating point to correspond with the maximum source count and minimum background count. Avoid areas of very fast count rate changes with small changes in detector voltage. The optimum operating point for low background detectors is just above the inflection point (or break-over point) of the plateau curve. If the background count is irrelevant, shift the operating point to the plateau center for greater stability.



Specifications

Power: line or battery power

Line Power: 95–250 Vac, 50-60 Hz single phase, 250W

Batteries: four "D" cells with typical life of 120 hours; self contained in the instrument

Input Sensitivity: voltage sensitive for use with all types of detectors, including air proportional, GM, and scintillation

High Voltage: adjustable with a ten-turn control from 200 to 2500 V; supports 60 megohm scintillation loads to 1500 V

Input Connector: series "C" coaxial connector; other connectors are available upon request

Scaler: a six-digit, light emitting diode, LED readout

Time: Time base is normally in minutes from 0-999 with multiples of $\times 0.1$ and $\times 1$.

Optional: Instrument may be switched to a *seconds* time base by placing the internal dipswitch (SW1), switch "2," to the ON position. In this case, the count time may be set from 0-999 *seconds* with a multiplier switch of $\times 1$ and $\times 10$.

Timer Accuracy: Time base for the scaler is crystal controlled and has a timer accuracy of $\pm 0.2\%$ of the thumb-switch setting.

Meter: 1 mA, 6.4 cm (2.5 in.) scale, self shielded DC mechanism, displaying 0 to 2.5 kV

Scaler Accuracy: within 2% of reference value

Size: 21.6 x 12.7 x 23.5 cm (8.5 x 5 x 9.3 in.) (H x W x L)

Weight: 3.1 kg (6.9 lb)

Finish: beige powder coat with sub-surface printed front panel



Description of Controls and Functions

Front Panel

Count Lamp: a red LED, indicating that the scaler is in the count cycle

COUNT switch: resets and starts the scaler counting. The scaler turns off at the end of the preset time.

Count time: Time base is normally in minutes from 0 to 999 with multiples of $\times 0.1$ and $\times 1$. It may be changed to seconds by an internal dipswitch.

MINUTES: a three-decade, thumb-wheel switch used for presetting count time

Function Selector Switch: a two-position switch labeled HV and BAT. The function of this switch is to allow the operator to have HV readout or battery check status on the meter. The BAT position is momentary; the switch springs back to the HV position when released.

THR: a ten-turn control used to set the basic pulse discrimination point of the scaler. This control is linear in the range of 1.00 through 10.00.

Detector Input Connection: a series "C" coaxial connector; other connectors are available upon request

Power Switch: a three-position toggle switch. OFF indicates that power is off. LINE powers the instrument from line power of 95-250 VAC, 50-60 Hz. BAT provides power from the 4 "D" cell batteries.

HV: a ten-turn control for adjusting the HV from 200 to 2500 V, providing a linear adjustment of the detector voltage supply. Changing the detector voltage will cause the detector gain to change. A linear change in voltage will cause an exponential change in detector gain. The instrument will support 60 megohm scintillation loads to 1500 V.

Count Readout: a six-decade LED with a readout indicating the count

Back Panel

RS-232 connector: a 9 pin "D" connector, allowing output to a computer or optional printer

RS-232 Data Dipswitch: two-pole dipswitch located on the rear chassis underneath the calibration cover; controls the RS-232 data

The top switch (PC/PRNTR) controls the type of data. In PC mode, data is bi-directional, allowing the computer to start/stop counting. If the dipswitch is set to PC, and the push-wheels are all set to zero, the instrument count time can be changed by the computer through the RS-232 port. In the PRNTR mode, the scaler count is output only at the end of each count. If the dipswitch is set to PRNTR, setting the push-wheels to "000" sets the count time to infinity, allowing for very long count times.

The bottom dipswitch (RECYCLE OFF) allows counting to recycle instead of requiring a manual count for each cycle.

Input Power: a receptacle for 95-250 Vac, 50-60 Hz line cord

Battery compartment: holds four "D" cell batteries

Internal Controls

Time-base Dipswitch: two-pole dipswitch located on the main circuit board. This switch allows for selection of a *seconds* time base, variable from 0 to 999 seconds, with a multiplier switch of ×1 and ×10. Setting all pushwheels to zero allows the instrument count time to be set by an external computer through the RS-232 port if the RS-232 back-panel dipswitch is set to PC. If the RS-232 dipswitch is set to PRNTR, setting the push-wheels to "000" sets the count time to infinity, allowing for very long count times.



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 95-250 VAC, 50/60Hz single phase, 250W

Maximum transient voltage of 1500 VAC

Installation Category II (Over-voltage Category defined by IEC 1010-1)

Pollution Degree 1 (as defined by IEC 664)

Cleaning Instructions and Precautions

The Model 2000 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 the instrument OFF and disconnect the instrument power cord.
- 2. Allow the instrument to sit for one minute before cleaning.

Warning Markings and Symbols

Caution!

The operator or responsible party 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 2000 Scaler 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 front 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.



CAUTION, RISK OF ELECTRIC SHOCK (per ISO 3864, No. B.3.6) – designates a terminal (connector) that allows connection to a voltage exceeding 1 kV. Contact with the subject connector while the instrument is on or shortly after turning off may result in electric shock. This symbol

appears on the front panel.



The "CE" mark is used to identify this instrument as being acceptable for use within the European Union. It is located on the rear panel.



The "crossed-out wheelie 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 7, "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!



Data Output

he Ludlum Model 2000 RS-232 serial port can be connected to a computer or printer for data logging of the scaler count information. WindowsTM-based software and cable are supplied with the instrument. The computer software can control the count time, start and stop counting, time/data stamp data, and print or save data. An optional printer may also be purchased to print each scaler reading.

The two-pole dipswitch on the rear chassis underneath the calibration cover controls the RS-232 data. The bottom switch (PC/PRNTR) controls the type of data. In PC mode, data is bi-directional, allowing the computer to start/stop counting. In the PC mode, the count time can also be changed by the computer, but only if the count time push-wheels are set to "000". In the PRNTR mode, the scaler count is output at the end of each count only. The top switch (RECYC/OFF) allows counting to recycle instead of requiring a manual push of the COUNT button for each cycle. This mode is useful with the optional printer for taking many separate counts.

Software

PRIOR TO INSTALLATION OF SOFTWARE

Ensure that both the computer and the Model 2000 are turned OFF.

Connect one end of the supplied RS-232 cable to the Model 2000 and connect the other end of the cable to any unused serial port on the back of the computer. (This unused port should be labeled COM1, COM2, COM3, or COM4.)

INSTALLATION OF SOFTWARE

1. Insert LMI Model 2200/2000 Software CD into the CDROM drive. Setup will automatically start. If it does not, double-click on the "setup.exe" file located on the CD.

The program will be installed to: C:\Program Files\m2200/2000.

An icon in the start menu is created under: Start/Programs/Ludlum Measurements, Inc. /Model 2200/2000.

3. Prior to running the program, ensure that the Model 2000 is in the PC mode and the count time push-wheels are set to "000."

BUTTON FUNCTIONS

Start/Stop Count: Click on this button to start a count. Clicking on it again will hold the count. The Model 2000 automatically sends the final count to the computer when the count time expires.

Read Count: Click on this button to read the current count as displayed on the Model 2000 display.

Set Count Time: Click on this button to set the count time. The count time push-wheels must be set to "000" for this to work.

Read Count Time Left: Click on this button to read the remaining count time left during a timed count. If a count is not in progress, this returns "0"

Start Logging/Stop Logging: Click on this button to start taking a series of timed counts. The number of counts taken can be adjusted to continuous, 10 counts, 100 counts, 200 counts, or a user-defined value.

After the logging has been stopped, the data may be saved to a commadelimited file or printed to a printer. A temporary file called "grid.dat" is created when logging is started. The format for the file is a commadelimited text file.

If the program is closed before the Save or Print button is used, the data can be retrieved from this file.

Save: Click on this button to save the logged data to a comma-delimited file for import into a spreadsheet or database program.

Print: Click on this button to print the logged data to a printer.

RS-232 COMMANDS

The Model 2000 communicates by way of an RS-232 interface. The RS-232 port operates at: 2400 baud, 8 data bits, 1 stop bit, no parity, and hardware (RTS/CTS) flow control.

A standard RS-232 cable with straight-through connections is required.

Pin-outs of RS-232 Connector/Cable:

| <u>M</u> | odel 2000 | <u>PC (9-1</u> | Pin) |
|----------|-----------|----------------|------|
| 2 | TXD | RXD | 2 |
| 3 | RXD | TXD | 3 |
| 5 | GND | GND | 5 |
| 7 | CTS | RTS | 7 |
| 8 | RTS | CTS | 8 |

All RS-232 commands must be in UPPERCASE and terminated with either a carriage return [13] + linefeed [10] or just a linefeed [10] character. The instrument uses the linefeed character to determine when a valid command has been received. The commands are as follows:

SS

Start/Stop a scaler count.

SO

Start/Stop a scaler count. When the count completes, the scaler reading is automatically sent to the computer.

RS

Read the scaler count

RL

Read the count time left.

RM

Read count time base; returns "0" for minutes and "1" for seconds.

SC

Set count time. Count time is adjustable from 1 to 65535. The count time pushwheels must be set to "000" for this count time to be active.

RC

Read the current count time. If the count time pushwheels are set to "000", the PC count time is returned.

Software License Agreement

Rev. (number) 1.0

Written by (or Revised by):

Date: 20 Jan 06

Approved by:

Date: 201ANOU

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Recycling

udlum 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 that 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:





Parts List

| | <u>Reference</u> | <u>Description</u> | Part Number |
|----------------------------------|--|--|--|
| Model 2000 Scaler | UNIT | Completely Assembled Model 2000 Scaler | 48-1648 |
| Main Board, Drawing 167 × 395 | BOARD | Completely Assembled Main Circuit Board | 5167-383 |
| CRYSTAL | Y1 | MICRO 6.144 MHZ | 01-5262 |
| CAPACITORS | C1 C2 C3 C4 C5 C6-C7 C8 C9 C10-C11 C12-C18 C19 C20 C22 C23-C26 C27 C28 C32 C33 C34 C36 C39-C40 C41-C44 C45 | 100 pF, 100V 0.01uF, 500V 100 pF, 100V 0.1uF, 50V 0.001uF, 100V 0.01uF, 500V 68uF, 10V 0.02uF, 3KV 0.01uF, 500V 10uF, 25V 0.01uF, 500V 0.001uF, 100V 0.1uF, 50V 0.001uF, 3KV 47pF, 100V 100uF, 20V 1uF, 16V 68uF, 10V 47pF, 100V 27 pF, 100V 1uF, 16V 47uF, 10V | 04-5661 04-5696 04-5661 04-5663 04-5659 04-5654 04-5654 04-5704 04-5696 04-5728 04-5696 04-5659 04-5663 04-5663 04-5727 04-5660 04-5583 04-5701 04-5654 04-5658 04-5658 04-5666 |

| | Reference | Description | Part Number |
|----------------|--------------------|---------------------------|-------------------------------|
| | C46-C47 C48-C57 | 10uF, 25V 0.01uF, 500V | 04-5728 04-5696 04-5672 |
| | C61-C62 C64-C65 | 22uF, 20V | |
| | C64-C65 C66-C67 | 0.1uF, 50V | 04-5663 04-5728 |
| | C68 | 10uF, 25V 47uF, 10V | 04-5666 |
| | C69 | | 04-5701 |
| | C09 | 1uF, 16V | 04-3701 |
| TRANSISTORS | Q1 | MMBT3904LT1 | 05-5841 |
| | Q2 | REG-LT1460KCS3 | 05-5867 |
| | Q3 | MMBT3904LT1 | 05-5841 |
| | Q4 | MAX810LEUR | 06-6424 |
| | ζ. | | |
| INTEGRATED | U1 | LM358D | 06-6312 |
| CIRCUITS | U2 | CD74HC4538M | 06-6297 |
| | U3 | TLC372ID | 06-6290 |
| | U4 | LT1304CS8-5 | 06-6434 |
| | U7 | CMXT3906 | 05-5890 |
| | U8 | AT89C51RC2 | 06-6893 |
| | U9 | MAX232D | 06-6382 |
| | U10 | LT1304CS8 | 06-6394 |
| | U11 | CMXT'3904 | 05-5888 |
| | | 55.2.2.5.7.7. | |
| DIODES | CR1-CR5 | CMPD2004S | 07-6402 |
| | CR6-CR10 | CMSH1-40M | 07-6411 |
| | CR11-CR17 | CMPD2004S | 07-6402 |
| | CR18 | CMSH1-40M | 07-6411 |
| | CR19 | CMPD2004S | 07-6402 |
| | | | |
| SWITCHES | SW1 | DIP-2 POS | 08-6712 |
| | SW2 | A6ER-2101RA | 08-6782 |
| | | | |
| POTENTIOMETERS | R26 | 5K, HVM CAL | 09-6918 |
| | R28 | 100K, HV CAL | 09-6930 |
| | | • | |
| RESISTORS | R1-R2 | 500 MEG, 3KV, 2% | 12-7031 |
| | R3 | 365K, 1/8W, 1% | 12-7049 |
| | R4-R5 | 100K, 1/8W, 1% | 12-7834 |
| | R6 | 1MEG, 1/8W, 1% | 12-7844 |
| | R7 | 22.1K, 1/8W, 1% | 12-7843 |
| | R8-R9 | 100K, 1/8W, 1% | 12-7834 |
| | R10 | 200K, 1/8W, 1% | 12-7992 |
| | | | |

| | Reference | <u>Description</u> | Part Number |
|--------------|-----------|--------------------|-------------|
| | R11 | 200 OHM, 1/8W, 1% | 12-7846 |
| | R12-R19 | 1K, 1/8W, 1% | 12-7832 |
| | R20 | 10K, 1/8W, 1% | 12-7839 |
| | R21 | 2.21K, 1/8W, 1% | 12-7835 |
| | R22 | 100K, 1/8W, 1% | 12-7834 |
| | R23 | 33.2K, 1/8W, 1% | 12-7842 |
| | R24 | 10 OHM, 1W | 12-7526 |
| | R25 | 100 OHM, 1/4W, 1% | 12-7904 |
| | R27 | 1MEG, 1/8W, 1% | 12-7844 |
| | R29 | 10K, 1/8W, 1% | 12-7839 |
| | R31-R32 | 10K, 1/8W, 1% | 12-7839 |
| | R33 | 22.1K, 1/8W, 1% | 12-7843 |
| | R34 | 10K, 1/8W, 1% | 12-7839 |
| | R35-R36 | 100K, 1/8W, 1% | 12-7834 |
| | R38-R39 | 100K, 1/8W, 1% | 12-7834 |
| | R40 | 200K, 1/8W, 1% | 12-7992 |
| | R41 | 33.2K, 1/8W, 1% | 12-7842 |
| | R42 | 22.1K, 1/8W, 1% | 12-7843 |
| | R43 | 8.25K, 1/8W, 1% | 12-7838 |
| | R45-R46 | 22.1K, 1/8W, 1% | 12-7843 |
| | R47 | 4.75K, 1/8W, 1% | 12-7858 |
| | R50-R51 | 4.75 OHM, 1/8W, 1% | 12-7980 |
| | R52 | 4.75K, 1/8W, 1% | 12-7858 |
| | R53 | 200 OHM, 1/8W, 1% | 12-7846 |
| | R54-R55 | 1K, 1/8W, 1% | 12-7832 |
| INDUCTORS | L1-L2 | 22uH | 21-9808 |
| | L3 | 220uH | 21-9678 |
| TRANSFORMERS | T1 | 32377R | 21-9925 |
| CONNECTORS | P1 | 640456-4 MTA100×4 | 13-8088 |
| | P3-P4 | 640456-3 MTA100×3 | 13-8081 |
| | P5 | 640456-6 MTA100×6 | 13-8095 |
| | P6 | 1-640456-0 MTA100 | 13-8066 |
| | P7 | 747020-2 | 13-8555 |
| | P8 | 11007 | 18-8116 |
| | P9 | 640456-6 MTA100×6 | 13-8095 |
| | P10 | 640456-2 MTA 100×2 | 13-8073 |
| | P12 | 640456-3 MTA100×3 | 13-8081 |
| | P13 | CONTACT #1434 | 18-9124 |
| | | | |

| | <u>Reference</u> | <u>Description</u> | <u>Part Number</u> |
|--|----------------------------|---|--|
| Push-wheel Board, Drawing 167 × 264 | BOARD | Completely Assembled Push-wheel Board | 5167-333 |
| CAPACITORS | C1-C3 | 0.001uF, 100V | 04-5519 |
| SWITCHES | SW1-SW3 | PUSHWHEEL | 4167-504 |
| DIODE | * | 1N4148 | 07-6272 |
| CONNECTOR | P11 | 640456-8 MTA100 | 13-8039 |
| Display Board, Drawing 167 × 276 | BOARD | Assembled Display Board | 5167-337 |
| CAPACITORS | C1 C2-C5 | 47uF, 16V, C 0.001uF, 16V, C | 04-5550 04-5519 |
| LED Displays | U1-U6 U7 | HDSP-E103 MAX7219ENG | 07-6342 06-6443 |
| DIODE | CR1 | LED DISPLAY | 07-6377 |
| RESISTORS | R1-R4 R5 | 22K, 1/4W, 5% 47K, 1/3W, 5% | 10-7070 12-7758 |
| SWITCH | SW1 | SCHURTER, COUNTING | 08-6783 |
| CONNECTOR | P15 | 640456-6 MTA100 | 13-8095 |
| Wiring Diagram, Drawing 167 × 433 | | | |
| SWITCHES | SW1 SW2-SW3 | MTF206P 7101-SYZ-QE | 08-6780 08-6658 |
| POTENTIOMETERS | R3-R4 | 10K, 10-TURN POT | 09-6761 |
| CONNECTORS | P7 J1 J2 J3 J4 | RS232 640456-4 MTA100 UG706/U "C" CONN. 640456-3 MTA100 640442-3 MTA100 | 13-8607 13-8087 4478-011 13-8081 13-8135 |

| | <u>Reference</u> | Description | Part Number |
|---------------|------------------|---------------------|-------------|
| | J5 | 640442-6 MTA100 | 13-8171 |
| | J6 | 1-640442-0 MTA100 | 13-8136 |
| | J9 | 640442-6 MTA100 | 13-8171 |
| | J10 | 640456-2 MTA100 | 13-8073 |
| | J11 | 640442-8 MTA100 | 13-8184 |
| | J12 | 640442-3 MTA100 | 13-8135 |
| | J13 | COAX PIGTAIL | 8167-432 |
| | J15 | 640442-6 MTA100 | 13-8171 |
| | J19 | AC RECEPTACLE W/ | |
| | J | CORCOM FILTER | 21-9830 |
| MISCELLANEOUS | * | M2200/2000 SOFTWARE | 1370-049 |
| | PS1 | POWER SUPPLY | 22-9321 |
| | F1 | 3AG 1A FUSE | 21-9704 |
| | * | METER ASSY | 4167-302 |
| | M1 | M2200 METER | 15-8048 |
| | B1-B4 | BATTERY | 21-9313 |
| | 2 EA. | BATTERY HOLDER | 22-9400 |
| | * | MAIN HARNESS | 8167-411 |
| | * | POWER HARNESS | 8167-347 |
| | * | READOUT HARNESS | 8167-374 |
| | 4 EA. | BUMPER PAD-BLK | 21-9302 |
| | * | COVER-SCALER | 18-8987 |
| | * | HANDLE | 21-9346 |
| | * | CALIBRATION COVER | 9167-380 |
| | * | Belden POWER CORD | 21-9394 |
| | * | CABLE "C" | 40-1004 |



Drawings

Main Board, Drawing 167×395 (5 sheets)

Main Board Component Layout, Drawing 167 × 396 (2 sheets)

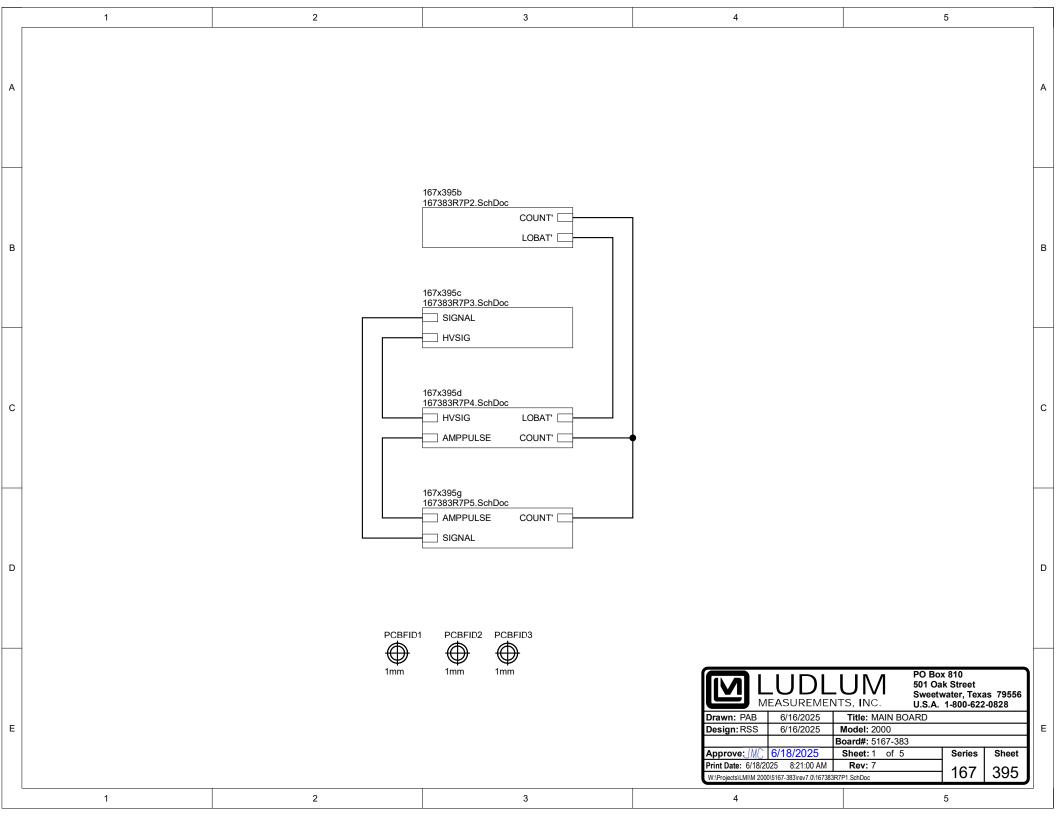
Push-wheel Board, Drawing 167 × 264

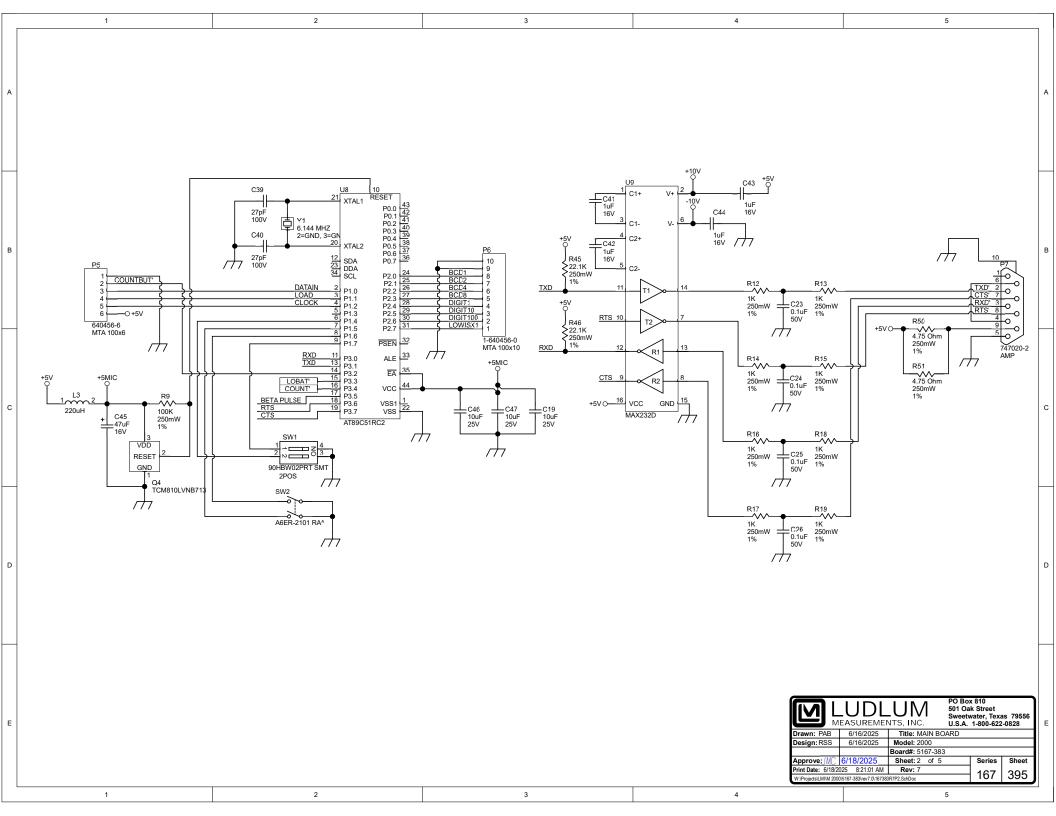
Push-wheel Board Component Layout, Drawing 167×265 (2 sheets)

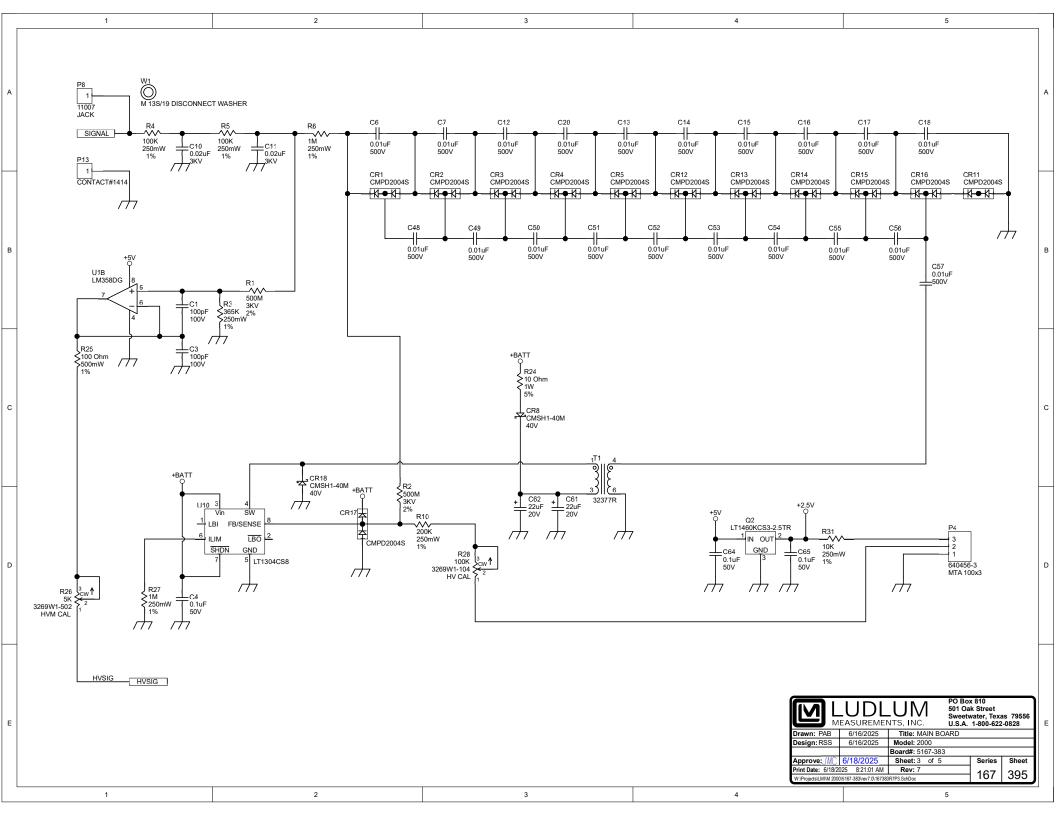
Display Board, Drawing 167 × 276

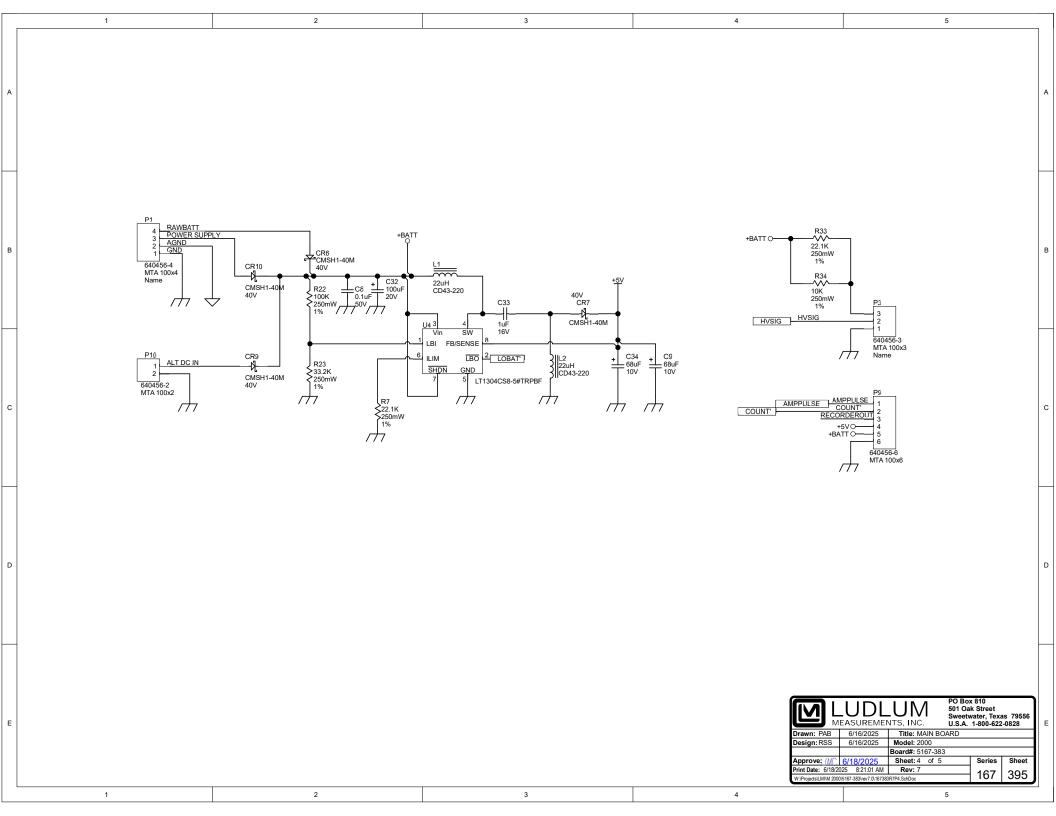
Display Board Component Layout, Drawing 167 × 277 (2 sheets)

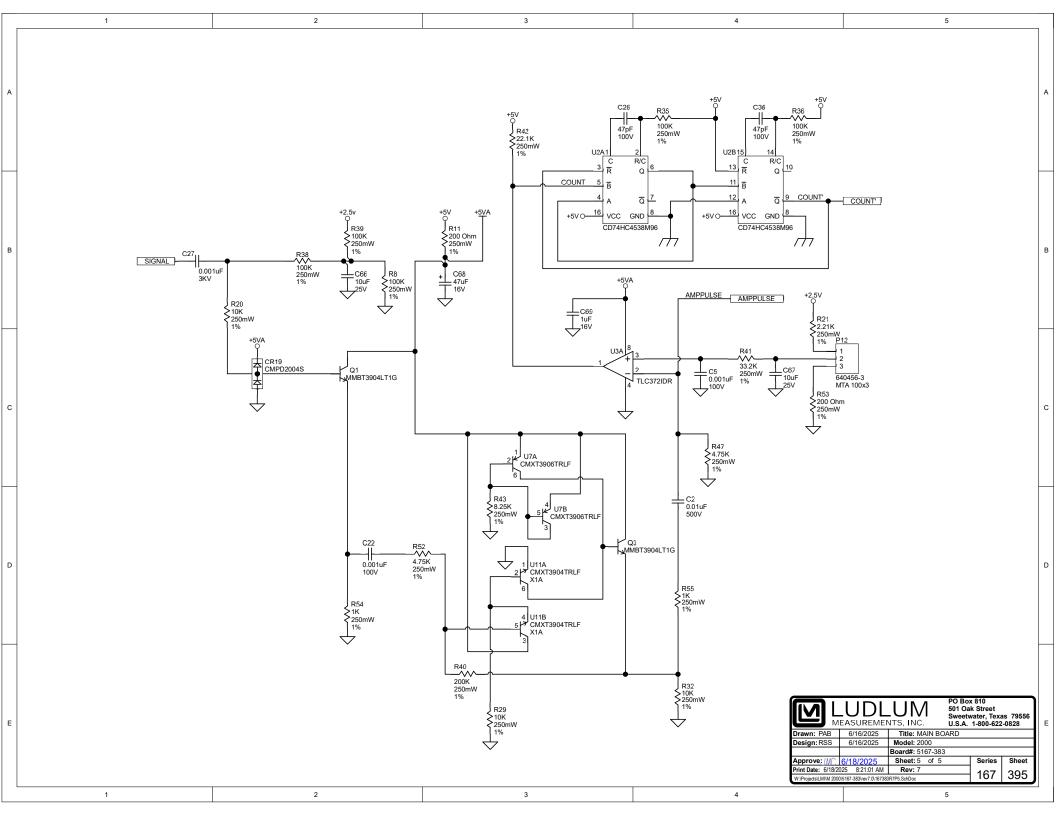
Wiring Diagram, Drawing 167 × 433

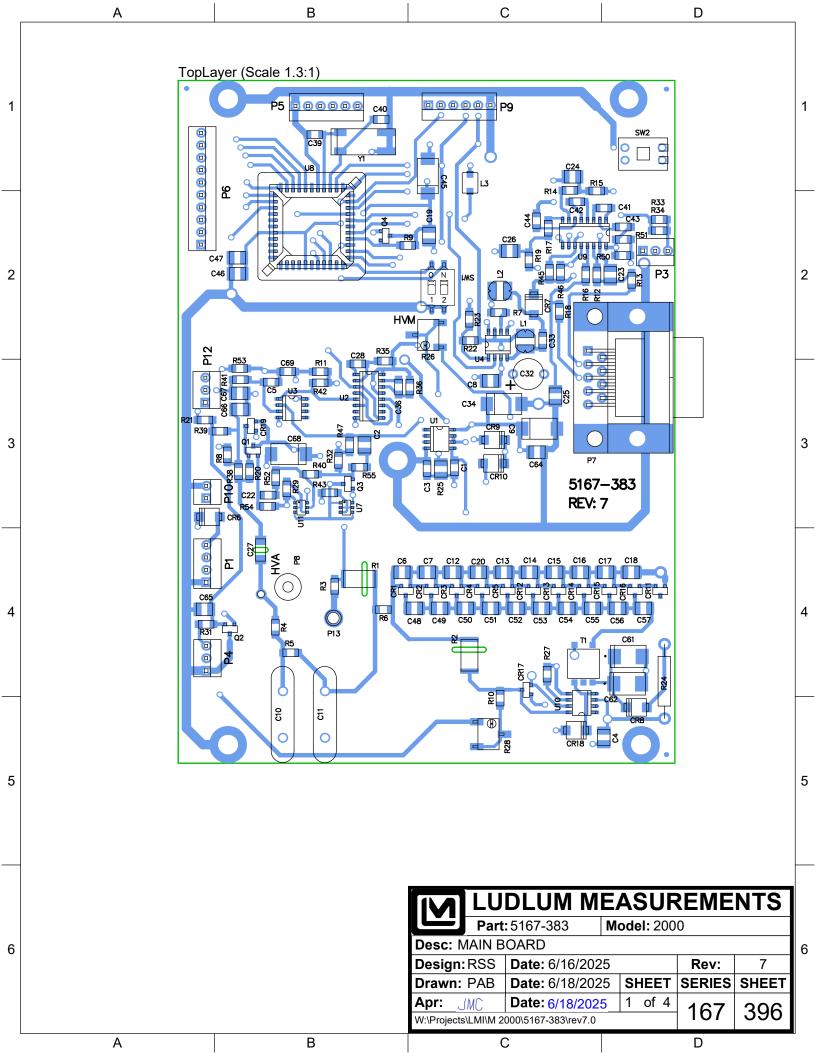


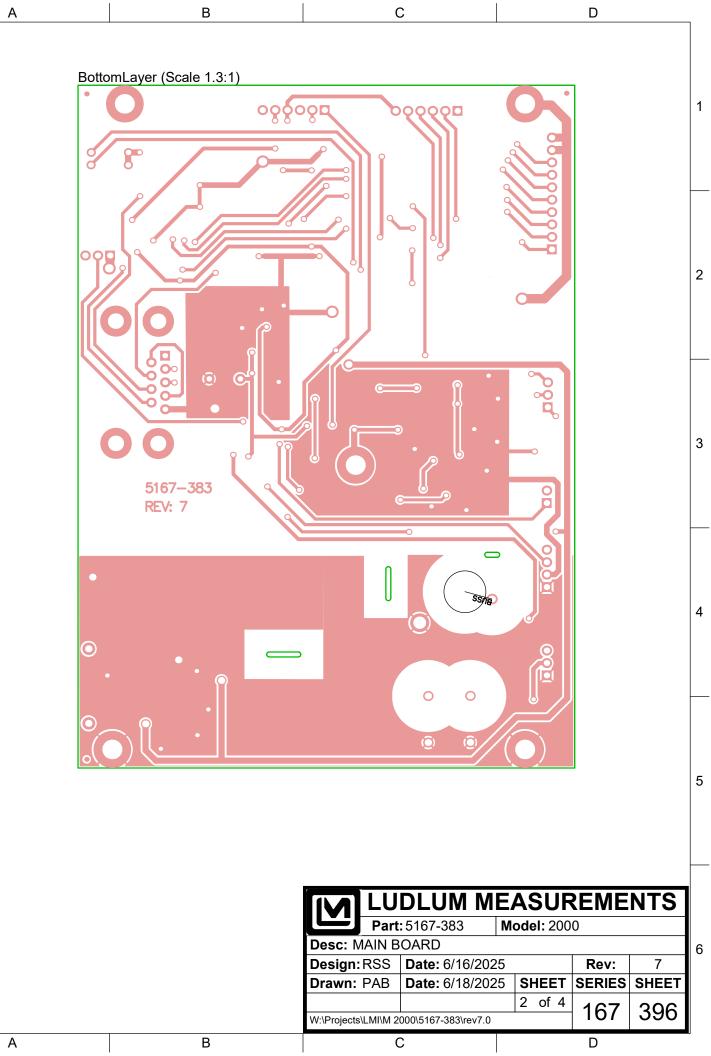


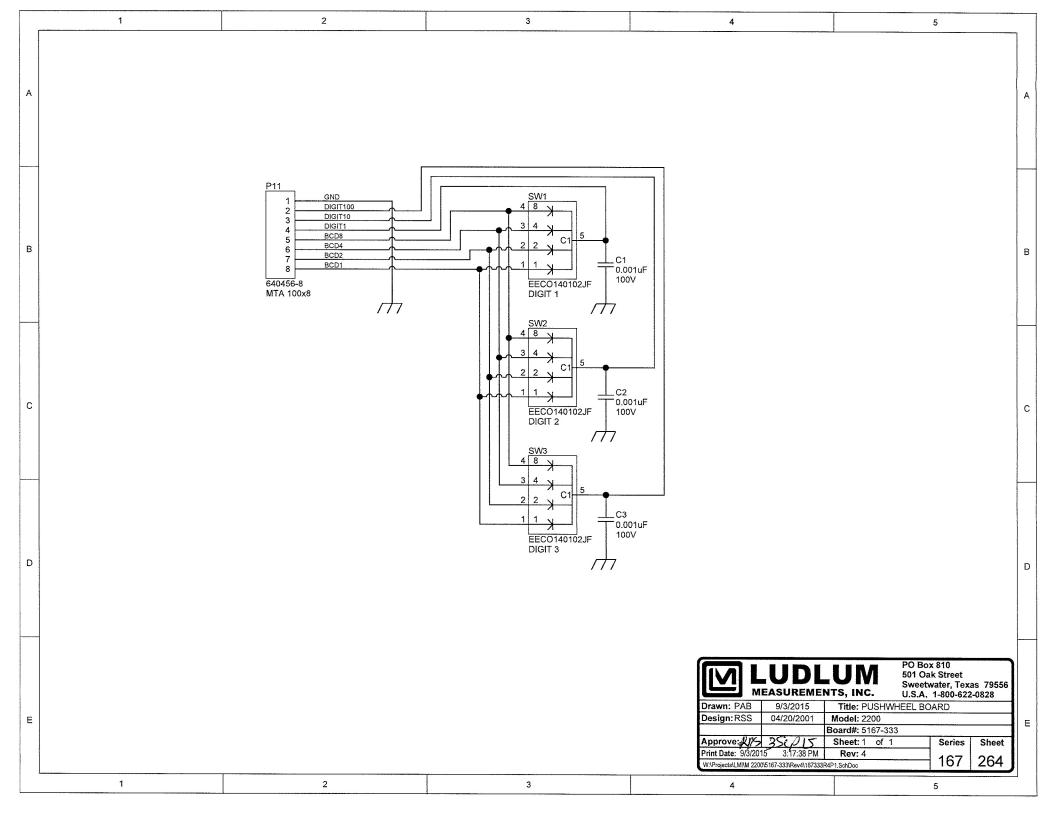


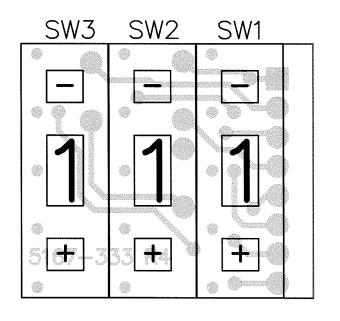


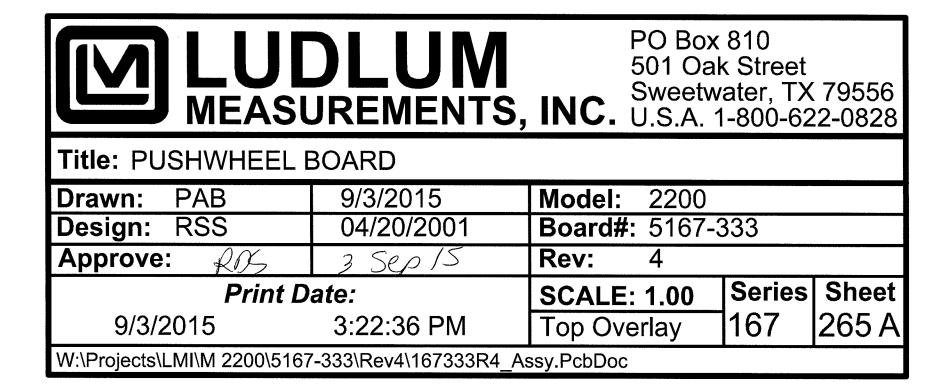


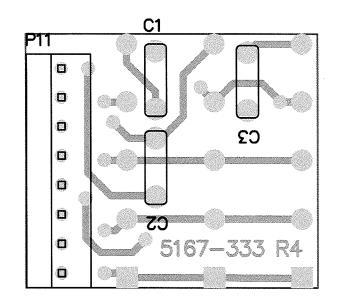














PO Box 810

| Title: | PL | SHW | /HEEL | BOARD |
|--------|----|-----|-------|--------------|
|--------|----|-----|-------|--------------|

| Drawn : PAB | 9/3/2015 | Model: 2200 |
|--------------------|------------|--------------------------|
| Design: RSS | 04/20/2001 | Board# : 5167-333 |
| Approve: 20% | 35ep15 | Rev: 4 |

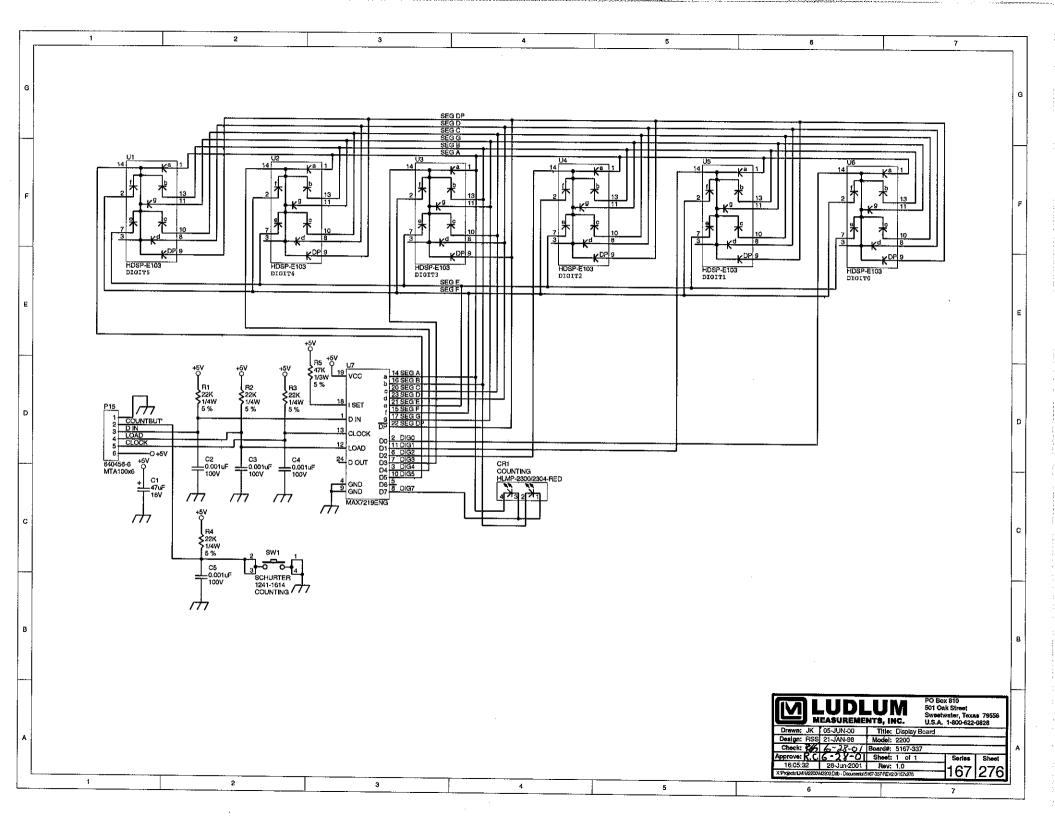
Print Date:

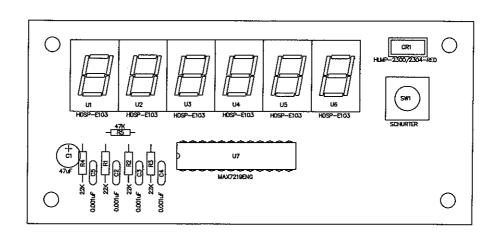
9/3/2015 3:22:39 PM

Series **Sheet SCALE: 1.00**

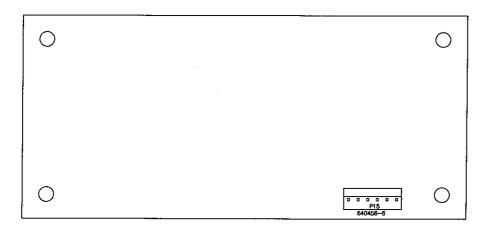
Bottom Overlay 167 265 A

W:\Projects\LMI\M 2200\5167-333\Rev4\167333R4 Assy.PcbDoc





| Draw | n: JK | 05-JUNE-00 | Title: | u | |
|--------------------|------------------------------|--------------|------------------|--------|-------|
| Desig | n: RSS | 21-JAN-98 | Display Board | | |
| Chec | *: <i>R15</i> | 6-28-01 | Model: 2200 | | |
| Approv | re: R.C. | 6-28-DI | Board#: 5167-337 | | |
| Lay er. | | | Rev: 1.0 | Series | Sheet |
| | MID: 16:05:43 28-Jun-2001 | | SCALE: 1.00 | 167 | 277 |
| <u></u> | 10.00.10 | 20 0011 2001 | | 107 | 2,, |



| Draw | vn: JK | 05-JUNE-00 | Title: | | |
|--------------------------------------|------------------|-------------|------------------|---------|-------|
| Desig | jn: RSS | 21-JAN-98 | Display Board | | |
| Chec | * R55 | 6-28-01 | Model: 2200 | ··· ,,, | |
| Approv | /e: R.C. | 6-28-01 | Board#: 5167-337 | | |
| Layer: | BOTTOM OVERLA | AY | Rev: 1.0 | Series | Sheet |
| Mech.1 Mech.2 Mech.3 Mech.4 | MID: 16:05:43 | 28-Jun-2001 | SCALE: 1.00 | 167 | 277 |
| | | | | | |

