

**LUDLUM MODEL 375-9
DIGITAL WALL-MOUNT AREA MONITOR
WITH MODELS 45-9 & 45-9-1 ION CHAMBERS**

June 2023

**Serial Number 230666 and Succeeding
Serial Numbers**

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Section**1**

Introduction

The Model 375-9 Digital Wall-Mount Area Monitor is designed for visibility and ease of use. Featuring a wall-mount chassis, the Model 375-9 has a four-digit LED display that is readable from thirty feet away. Backlit indicators warn of low radiation alarm (yellow), high radiation alarm (red), instrument failure (red) and low battery (yellow). A green status light is a positive indication of instrument operation.

Note:

The Model 375-9 Ethernet (1370-055) option:

The Model 375-9 can also be modified to add a 100BaseT Ethernet port. This port allows remote display and logging of the data from the Model 375-9. To do this, special firmware allows combinations of front-panel buttons to perform additional functions. For example, press the LOW ALARM and the CAL CONST buttons to set the unit ID and press the LOW ALARM and DEADTIME buttons to set the Port number- 0 to 9999 = port 50000 – 59999. Consult the Ludlum Model 375 Ethernet manual for further assistance.

Parameters are protected under a calibration cover. Calibration is easily accomplished by moving the CAL dipswitch to the right, and using the pushbuttons to increment or decrement the calibration constant, dead time correction and alarm point parameters. Parameters are stored in non-volatile memory (retained even with power disconnected).

A five-decade logarithmic analog output is provided. A battery backup provides 48 hours of additional use after the primary power is removed. The Model 375-9 comes equipped with an external detector, able to detect gamma radiation. Typical range is from 0.1 mR/hr to 1 R/hr (other ranges available)

Two common Model 375-9 systems with external detector are:

The Model 375-9 with Model 45-9 Ion Chamber

The Model 375-9 with Model 45-9-1 Ion Chamber Both detectors utilize a stainless steel pressurized ion chamber with lead shielding for energy compensation. An energy response curve is provided in the back of this manual for quick reference.

Detector and electrometer are housed in an aluminum case. The electrometer converts the detector signal to a pulse train for instrument recognition, and generates the voltage for the detector anode

Section
2

Getting Started

The Model 375-9 Digital Wall-Mount Area Monitor is designed for ease of use. This section of the manual is designed to help the first-time user get started. Initial power-up and basic features of the Model 375-9 will be discussed in this section. Other sections of the manual provide more detailed information.

Unpacking and Repacking

Remove the calibration certificate and place it in a secure location. Remove the instrument and ensure that all items listed on the packing list are in the carton. Check individual item serial numbers and ensure calibration certificates match between instruments and detectors (if applicable).

To return an instrument for repair or calibration, provide sufficient packing material to prevent damage during shipment.

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.

Notice!

Volume 49 of the Code of Federal Regulations (Transportation) applies anytime a person is transporting or offering for transport, a hazardous material to, from or through the United States

United States law states that shipping of hazardous materials/dangerous goods requires that each Hazmat Employee as defined by 49 CFR 171.8, must receive training and be tested in accordance with 49 CFR 172.700 – 172.704.

Connecting the Detector

The Model 375-9 comes equipped with either a Model 45-9 or 45-9-1 Ion Chamber (detector). The instrument detector connector is located on the bottom of the chassis. Use the cable provided to connect the detector to the Model 375-9.

Power Up

Plug the power cord into a suitable wall (Mains) outlet.

Note:

Model 375-9 units will normally be wired internally for 120 VAC. If requested, the unit may be wired for 220 VAC. Check the label next to the AC input receptacle to verify the required input voltage.

If the RS-232 feature is used, plug in a suitably wired 9-pin connector cable. (See Page 4-4 for the pin assignment of the 9-pin connector.) Turn power ON with the left side panel switch. Do not turn power OFF unless the unit is to be removed from service.

Please set the alarm point(s) on this instrument to conform to your requirements. The factory-set alarm points may be incorrect for your use.

Refer to the instrument manual for more information on setting alarm points.

**FAILURE TO RESET THE ALARM POINT(S)
MAY RESULT IN EXCESSIVE ALARMS OR
LACK OF SENSITIVITY.**

Read and then remove the sticker (illustrated to the left) from the instrument calibration cover. Checking and setting of the alarm-point(s) is discussed in detail pages 2-2 and 7-1 of this manual.

Initial power-up will momentarily activate the internal front panel lights, sound the audio, and display "8888" on the 4-digit LED display. The firmware version number (39665Nyy) is then displayed as "396" and "65yy" (where yy represents the current version number).

When the instrument has finished measuring background, it will display the current radiation reading and begin checking for an alarm condition.

Radiation Units

The Model 375-9 may be calibrated for almost any desired radiation units of measure. Common units of measure include mR/hr, μ R/hr, R/hr, mSv/h, μ Sv/h, cps, cpm, and kcpm. In each case, the unit of measure is indicated underneath the four-digit display. Throughout the rest of this manual, the notation <units> will be used as a substitute.

Checking Parameters

Check the low alarm point setting by pressing the LOW ALARM button. The low alarm point will be displayed as long as the button is pressed. The low alarm point is in units of <units>. The low alarm point can be set from 0.1 <units> to 9999 <units>.

Check the high alarm point setting by pressing the HIGH ALARM button. The high alarm point will be displayed as long as the button is pressed. The high alarm point is in units of <units>. The high alarm point can be set from 0.1 <units> to 9999 <units>.

Check the calibration constant by pressing the CAL CONST button. The calibration constant will be displayed as long as the button is pressed. The calibration constant is in units of cpm (counts per minute) per <units>. The calibration constant can be set from 0.1 cpm/<units> to 9999 cpm/<units>.

Check the detector dead time correction by pressing down on the DEAD TIME button. The dead time correction will be displayed as long as the button is pressed. The dead time correction is in units of microseconds. The dead time correction can be set from 0.1 microseconds to 9999 microseconds.

Check the background subtract parameter by simultaneously pressing both LOW ALARM and HIGH ALARM buttons. This feature allows the user to set a number to subtract from all measurements. This feature is necessary since the ion chamber electrometer is normally set to output 400 cpm (6.67 cps) as the zero reference.

Setting Alarm-points

The LOW ALARM and HIGH ALARM points can only be changed while the instrument is in calibration mode. Switch the top dipswitch CAL MODE (behind the calibration cover) to the right to place the instrument into calibration mode.

Changing alarm-points is done by holding down the corresponding parameter key and pressing the up or down arrow buttons. Alarm-points can be set in the range of 0.1 to 9999. When an alarm-point is changed the instrument will sound an audible beep to confirm the saving of the parameter, and will then return to displaying the current radiation level.

Note:

Once the alarm point(s) is set, it is important to remember to switch the CAL MODE switch back to the left. This action protects the parameters from inadvertent changes.

Operational Check (optional)

The operational check is an important assurance that the radiation detector and electronics are working correctly.

Note:

Ludlum Measurements suggests that an operational check be performed on a regular basis. Local procedures may supersede.

For an operational check it is necessary to use a radiation check source (not included, but available). When not being used, store the check source in a secure area.

Note:

LMI check sources present very minimal risks and are therefore unlicensed (Exempt Quantity Sources reference: 10 CFR 30.71 Schedule B). The radioactive element is sealed (permanently bonded or fixed inside a capsule) so you need not wash your hands after handling. Radiation exposure while handling this source is very minimal with no identified long or short term risks. Although the amount of radiation given off by exempt sources is so low that it presents no significant hazard, they should be handled with care and respect. Time, distance and shielding are the best ways to control exposure.

1. Taking the source in hand, place it so that it is located on or near the center (same location each time) of the detector. (For internal detector models, a metal plate on the bottom of the chassis identifies the location of the internal detector.) Hold it there for approximately 5 seconds or until the reading stabilizes. Take note of the displayed level of radiation.
2. Verify that the reading is within 20% of the last reading obtained. Remove the source from the detector.
3. If an alarm is activated, ensure that all visual and audible devices (if applicable) work correctly.

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

Display: 4-digit LED display with 2 cm (0.8 in.) character height.

Display Range: 000.0-9999

Display Units: can be made to display in mR/hr, R/hr, μ Sv/h, mSv/h.

Linearity: Readings within 10% of true value with detector connected.

Operating Range: typically 0.1 mR/hr to 1R/hr

Status (green light): indicates the instrument is functioning properly

Low Alarm: indicated by a yellow light and slow beep (1 per second) audible tone (can be set at any point from 0.0-9999)

High Alarm: indicated by a red light and a fast beeping, (4 per second) audible tone (can be set at any point from 0.0-9999)

Note:

Audible indicators can be configured as a single beep if desired. Audio intensity is controlled by rotating the baffle on the audio device.

DET Fail: indicated by a red light and an audible tone greater than 68 dB at 60.1 cm (2 ft) for conditions of instrument failure or no count from detector

Low Bat: indicated by a yellow light; less than 2 hours of battery life remaining

Calibration Controls: accessible from the front of instrument (protective cover provided)

Dead Time: adjustable to compensate for dead time of the detector and electronics (can be read on the display)

Over-range: a display reading of "----" and activated low and high alarms indicate that the radiation field being measured has exceeded the counting range of the instrument (or when dead time correction accounts for more than 75% of the displayed reading)

Data Output: a 9-pin connector providing 5-decade log output, RS-232 output, signal ground connection, FAIL and HIGH ALARM signals (current sink), and direct connection to battery and ground

RS-232 Output: a 2-second dump for computer data logging

Remote (optional): Ludlum Model 271 (part # 48-2475) or Model 272 (part # 48-2656) remote units

Power: 95-135 Vac (178-240 Vac available), 50-60 Hz single phase (less than 100 mA), 6-volt sealed lead acid rechargeable backup battery (built-in)

Battery Life: typically 48 hours in non-alarm condition; 12 hours in alarm condition

Battery Charger: Battery is continuously trickle charged when the instrument is connected to line power and turned on.

Warning!:

Only a certified technician or calibration personnel should replace battery.

Construction: aluminum housing with ivory powder-coat finish

Size: 18.7 x 24.6 x 6.4 cm (7.4 x 9.7 x 2.5 in.) (H x W x D), excluding detector

Weight: 2.9 kg (6.5 lb), excluding detector

Detector Specifications

Detector: external, typically a Model 45-9 or 45-9-1 ion chamber as detailed below (others are available)

Detector Housing: aluminum with beige powder-coat finish, 7.6 x 25.7 cm (3 x 10.1 in.) (Dia x L)

Ion Chamber: 17 cm³ volume; stainless steel wall chamber filled with Xenon at 1.01 MPa (10 atm) pressure

Energy Compensation: lead shield, 0.130 cm (0.051 in.) thick

Low Energy Cut-off: 60 keV

Range: typical configurations of 0.1 mR/hr through 1 R/hr, 1 mR/hr through 10 R/hr, or 10 mR/hr through 100 R/hr. Selection of ranges must be decided at time of purchase. Contact LMI for further details.

Detector Voltage: 150 V

Calibration Reference: ^{137}Cs

Signal Output: transistor collector with internal pull-up resistor of 100 k Ω connected to a 5-volt supply line. This will supply a negative pulse train proportional to the radiation field.

Power Supply: 5 V at up to 100 mA

Bias Output: With no radiation signal from the detector, the output pulse rate is set at 400 counts per minute (cpm). This signal must be subtracted from the radiation signal for good linearity.

Control: a multi-turn subsurface potentiometer for setting the bias output. Start with the control fully clockwise, then slowly turn counterclockwise until a count rate of 400 cpm is obtained.

Connectors: 5-pin circular; weatherproof

Warm-up Time: approximately 5 minutes

Section**4**

Operator Controls and Setup

Calibration Controls

Remove the calibration cover to expose the calibration controls. The calibration controls include the up/down buttons, three calibration potentiometers, and the option dipswitch (detailed in the following subsection). The three potentiometers are detailed below/

Warning!

Do not touch the circuit board in the calibration window due to potential for electric shock.

RCDR: Used to adjust the logarithmic analog voltage output. Adjusted in calibration mode to the full-scale voltage reading or adjusted to a known point at some given reading.

THRESHOLD: Internal discriminator used to set the pulse threshold for counting pulses from the detector. Pad allows direct measurement of threshold voltage.

BAT CHARGE: Used to set the backup battery trickle charging voltage. It is set to 6.9 Vdc while the battery is disconnected.

Dipswitch (under calibration cover)

When the calibration cover is removed, a four-pole dipswitch is accessible that can activate or deactivate options. These four options are CAL MODE (MEMWRITE), LATCH, ALARM, RANGE and SINGLE BEEP.

Dipswitch 1: Switching the top CAL MODE switch to the right places the instrument into calibration mode. Parameters can only be changed while the instrument is in calibration mode. Calibration mode also changes the RCDR output to full-scale so that the full-scale voltage may be set by the RCDR potentiometer. Moving the CAL MODE switch back to the left locks the parameters and disables any further changes.

Dipswitch 2: The second switch, **LATCH ALARM**, changes the high alarm to a latching alarm. This switch does not affect the low alarm, which is always non-latching. When switched to the left, the high alarm is non-latching; the alarm automatically turns off when the radiation level drops below the alarm point. When switched to the right, the high alarm light and audio signals are latched until either the **LOW ALARM** or **HIGH ALARM** button is pressed.

Dipswitch 3: The third switch, **RANGE**, selects the range of the instrument. To select the 0.1 <units> - 999.9 <units> range, switch the **RANGE** switch to the left. To select the 1 <units> - 9999 <units> range, switch the **RANGE** switch to the right.

Dipswitch 4: Switching the fourth switch to the right places the instrument into **SINGLE-BEEP** mode. This option limits the audio output to a single half-second beep on **LOW ALARM** and **HIGH ALARM**. **DET FAIL** audio output (steady tone) is not limited.

RS-232 Output

With the **CAL MODE** dipswitch in the left position the Model 375-9 dumps RS-232 data onto pin 4 of the 9-pin connector every two seconds.

An example program which shows how an IBM compatible PC can be used to collect the data is given on following page.

'Demonstration Program

'Model 375-9 RS-232 communication program written for QuickBasic

"This program causes the computer screen to display the data being dumped from the Model 375-9.

'Needs the following cable:

'	Model 375-9	PC (9-pin)	PC (25-pin)
'	pin 4 TXD	pin 2	pin 3
'	pin 2 GND	pin 5	pin7

'Cable connector has male pins on Model 375-9 side

'Cable connector has female pins on PC side

'open up communications with serial port #1
 'at 2400 bps (baud), no parity, 8 data bits, 1 stop bit
 'no handshaking, buffer size of 8k

OPEN "COM1:2400,n,8,1,bin,CS0,DS0,CD0, RB0" FOR INPUT AS #1

'open up filename• for output

CLS

'clear the screen

LOCATE 1

PRINT

'Press Esc key to stop reading data."

COM(1) ON

'enable com1 trapping

ON COM(1) GOSUB Getcomport

'if something comes in com1, then get it

WHILE (1)

'loop until Esc key is hit

comment• = INKEY•

IF comment• = CHR• (27) THEN GOTO endloop

WEND

endloop:

COM (1) OFF

CLOSE #1

'CLOSE COM port.

END

Getcomport:

WHILE LOC(1) <> 0

ComPortInput• = INPUT•(1 ,#1)

'bring in data from serial port

PRINT ComPortInput•;

'print data to screen

WEND

RETURN

1.

The RS-232 data includes the current radiation readings and the current condition of the status lights. The data is presented in the following format:

BYTE1	0	x
BYTE2	x	x
BYTE3	x	OR x
BYTE4	x	x
BYTE5	.	.
BYTE6	x	0
BYTE7	Audio Status	=1=on
BYTE8	High Alarm Status	=1=on
BYTE9	Low Alarm Status	=1=on
BYTE10	Over Range Status	=1=on
BYTE11	Monitor Status	=1=on
BYTE12	Error Code	
BYTE13	Carriage Return (ODH)	
BYTE14	Line Feed (0AH)	

9-Pin Data Connector

The 9-pin connector provides output signals from the instrument and input voltage to the instrument. The pin assignments are:

pin1-	+BATTERY
pin2-	GND IN
pin3-	FAIL_L
pin4-	RS232 DUMP
pin5-	RCDR
pin6-	NA
pin7-	HIGH ALARM_L
pin8-	EXT RESET_L
pin9-	+5VDC OUT

The FAIL and HIGH ALARM digital signal outputs are open drain 2N7002 outputs, able to sink about 50 mA each.

Section**5**

Common Options and Modifications

Time and Date Stamp Option

Description:

When an alarm or failure occurs the Model 375-9 will print the current reading, date, time and either ALARM or FAIL to the RS-232 port. The Model 375-9 will print once every 30 seconds as long as the alarm or fail condition is present.

Setup:

You will need the following: A Model 375-9 instrument, a 1220 40-column printer, and a cable (8303-674).

The printer should be configured at 2400 BPS (baud), no parity, 8 data bits, 1 stop bit, and no handshaking. See printer manual for proper setup instructions.

Setting the date and time:

Check the month and day (MMDD) by pressing the LOW ALARM and HIGH ALARM buttons simultaneously. The month and day will be displayed as long as those buttons are pressed. The month and day can be set from 0101 to 1231.

Check the year (YYYY) by pressing the LOW ALARM and CAL CONST buttons simultaneously. The year will be displayed as long as those buttons are pressed. The year can be adjusted from 0000 to 9999.

Check the hours and minutes (HHMM) by pressing the LOW ALARM and DEAD TIME buttons simultaneously. The hours and minutes will be displayed as long as those buttons are pressed. The hours and minutes can be adjusted from 0000 to 2359.

RS-232 Data Format:

The data will be sent to the RS-232 port as:

Byte 1	0	x	Byte 18	Space (20H)
Byte 2	x	x	Byte 19	H
Byte 3	x	OR x	Byte 20	H
Byte 4	x	x	Byte 21	:
Byte 5	.	.	Byte 22	M
Byte 6	x	0	Byte 23	M
Byte 7	Space (20H)		Byte 24	:
Byte 8	Space (20H)		Byte 25	S
Byte 9	Space (20H)		Byte 26	S
Byte 10	M		Byte 27	Space (20H)
Byte 11	M		Byte 28	A Space
Byte 12	/		Byte 29	L F
Byte 13	D		Byte 30	A OR A
Byte 14	D		Byte 31	R I
Byte 15	/		Byte 32	M L
Byte 16	Y		Byte 33	Carriage Return (0DH)
Byte 17	Y		Byte 34	Line Feed (0AH)

Example Output:

```
0642.1 04/21/95 16:56:24 ALARM
0000.0 04/21/95 08:32:16 FAIL
```

Relay Options

Internal Circuit-Board-Mounted Relay

The Model 375-9 has relay options that allow the user to attach strobe lights or horns that will be activated during HIGH ALARM. The internal circuit board-mounted relay is rated for 3 amps. However, it is recommended the current be kept less than 1 amp. The relay can be configured as a set of Form C contacts or as mains (120 VAC) output. The signal or contacts can be brought out through a 3 pin connector on the bottom of the chassis.

Form C Relay (3 pin connector added) PN4396-201:

This option allows the user to have one set of form C contacts (normally open, normally closed and common) which activate upon HIGH ALARM. This is achieved by using an additional 3 pin connector. This option keeps the 9-pin D connector dedicated for the use of a remote (Model 271 or 272) or RS-232 signal. The added 3 pin connector has the following connections:

- Pin 1- normally open (NO)
- Pin 2- common
- Pin 3- normally closed (NC)

Mains (120 VAC) Relay Out (using 3 pin connector) PN4396-202:

Same as above, allowing the use of the 9-pin D connector for RS-232 or remote use. This additional 3-pin connector is wired as follows:

- Pin 1- black HOT mains (120 VAC) on HIGH ALARM
- Pin 2- white NEUTRAL
- Pin 3- green EARTH GROUND

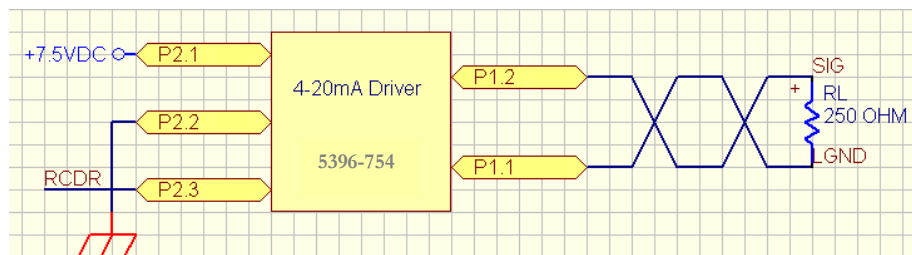
4 to 20 mA Isolated Output Driver Option

4 – 20 mA Driver (Isolated) Modification Kit Part Number 4396-258

This circuit may be added to the Model 375-9 analog output, providing an isolated 4 to 20 mA output capability. The circuit board (LMI Part Number 5396-754) accepts an analog input, varying between 0 and 5.00 volts, yielding a current output of 4 to 20 mA.

The circuit has an internal loop supply, generating +12 Vdc from the RAWDC of the Model 375-9. It is designed for a 2-wire configuration, with one conductor carrying the 4-20 mA current signal and the second conductor providing a return (isolated loop ground). See Wiring Diagram, Figure 1 (below).

Figure 1: Wiring Diagram.



SPECIFICATIONS

Power Required: 7.5VDC at 100 mA. Minimum $V_{in}=5.5V$ and Maximum $V_{in}=15V$.

Terminating Resistor: 250 ohm.

Model 375-9 Recorder Output Connections (9-pin D-sub connector)

Pin 5 is “SIG”, current output (was voltage output).

Pin 6 is “LGND”, Isolated Loop Return or Loop Ground.

Board Header Pin-out

P1-1) Loop GND (Isolated)

P1-2) 4-20 current output (Isolated)

P2-1) +7.5VDC , RAWDC from main circuit board number 5396-160
(May range from +5.5 to 15VDC).

P2-2) GND

P2-3) RCDR voltage in or analog input (0-1.25VDC).

CALIBRATION

Apply 0 counts or RESET the Model 375-9.

Check for a voltage of $1.00\text{ V} \pm 5\%$ across R_{term} , typically a 250 ohm ($V = 0.004 \times R_{term}$) terminating resistor. The resistor should be placed between Pin 5 (the 4-20 mA output) and Pin 6 (Loop ground).

Note:

Loop ground is isolated from instrument ground.

Now apply a full-scale meter reading to the analog input, or move the CAL dipswitch to the right. The voltage at full-scale must be set to $5.00\text{ V} \pm 0.1\text{ V}$ between the analog input and instrument ground.

Note:

Instrument ground is not the same as loop ground.

Adjust the SPAN trimmer, R5, until the voltage across the 250-ohm terminating resistor is $5\text{ V} \pm 5\%$ ($V = .020 \times R_{term}$).

Section**6**

Safety Considerations

Environmental Conditions for Normal Use

Indoor use only

No maximum altitude

Temperature range of -20°C to 50°C (5°F to 122°F); May be certified for operation from -40°C to 65°C (-40°F to 150°F).

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

Mains supply voltage range of 95-135 VAC (178-240 VAC available), 50/60Hz single phase (less than 100 mA typical, 1 amp max).

Maximum transient voltage of 1500 VAC

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

Pollution Degree 3 (as defined by IEC 664)

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United States law states that shipping of hazardous materials/dangerous goods requires that each Hazmat Employee as defined by 49 CFR 171.8, must receive training and be tested in accordance with 49 CFR 172.700 – 172.704.

Cleaning Instructions and Precautions

The Model 375-9 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 1 minute before cleaning.

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 375-9 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 side 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:**

Caution!:

Do not touch the circuit board in the calibration window due to possible electric shock.

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 1 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 8, “Recycling” for further information.

Replacement of Main Fuse (Side Panel)

Warning!

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

Battery Replacement

Warning!:

Only certified technicians or calibration personnel should replace battery.

Section**7**

Calibration

Instrument Calibration Parameters

The calibration parameters, LOW ALARM, HIGH ALARM, CAL CONST, DEAD TIME and BACKGROUND SUBTRACT can only be changed while in calibration mode. Switch the top dipswitch CAL MODE to the right to switch into calibration mode. Changing any parameter is done by holding down the parameter key and pressing the up or down arrow buttons. Any parameter can be set in the range of 0.1 to 9999. If a parameter is changed, the instrument will beep to confirm the saving of the parameter, and then return to displaying the current radiation level.

Note:

Once parameters are set, it is important to remember to switch the CAL MODE switch back to the left. This action protects the parameters from inadvertent changes.

Analog Output

The analog output is a five-decade logarithmic voltage out. The maximum voltage out while under primary power is 6 volts. The maximum voltage out while under battery backup power is 4.5 volts. The five decades are:

0.1 <units> - 1.0 <units>
1 <units> - 10 <units>
10 <units> - 100 <units>
100 <units> - 1000 <units>
1000 <units> - 10000 <units>

When the CAL MODE dip switch is switched to the right, the analog output goes to full scale. The analog output goes to full scale during a DET FAIL condition.

Threshold

The THRESHOLD potentiometer located under the calibration cover is used to set the threshold for pulses coming from the detector. The typical set point is 500 mV.

Battery Charge

The potentiometer labeled BAT, located under the calibration cover, is used to set the backup battery trickle charge voltage. This is typically set to 6.9 Vdc with the battery disconnected.

Detector Calibration

With the top CAL MODE dipswitch to the right, press the LOW ALARM and HIGH ALARM buttons simultaneously and adjust the up and down buttons for a BACKGROUND SUBTRACT of 0.1 cps.

Set CAL CONST to 1.0 and DEAD TIME to 0.1. This forces the instrument to display radiation units in cps (counts per second).

With the ion chamber at normal background radiation levels (NOT in a radiation field), adjust the NULL potentiometer (underneath the 1/4-inch Allen bolt) until the display reads 6.7 cps.

Reset the BACKGROUND SUBTRACT number to 6.7 cps. From this point forward the ion chamber is effectively “zeroed.”

Note:

The following calibration steps reflect an ion chamber configured for a range of 0.1 mR/hr to 1 R/hr. If using a different configuration, appropriately move the decimal point in the following figures.

Expose the detector to a radiation field of 100 mR/hr and adjust the CAL CONSTANT for a readout of 100 mR/hr (approximately 65,000 cpm).

Expose the detector to a radiation field of 0.1 mR/hr and adjust BACKGROUND SUBTRACT for a reading of 0.1 mR/hr.

Check the reading at 1R/hr, 100 mR/hr, 10 mR/hr, 1 mR/hr, and 0.1 mR/hr.

Detector Electronics Checkout

Warning!

The majority of the components of the electrometer operate at 150 volts above chassis potential. Accidental short circuit to the case can cause component failure indicated by a sudden increase in supply current.

Electrometer

Connections: Supply 0-5 volts to pin 2 and common to pin 4. Connect pin 3 through a 100-1 attenuator to the input of a Ludlum Model 2200 Scaler (or equivalent). Pin 4 is common. (Refer to Figure 1.)

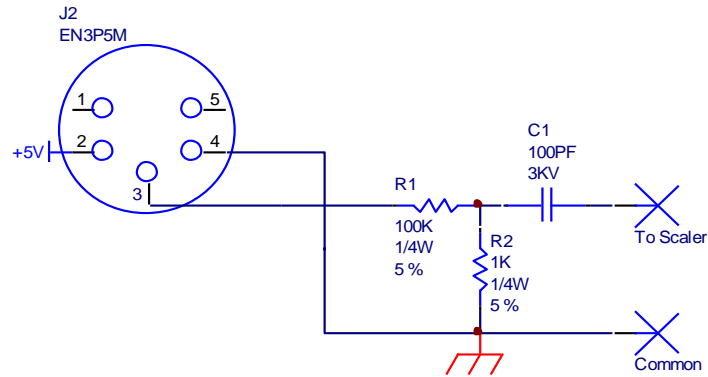
Power Up: Start at zero volts and slowly increase the supply voltage. After stabilizing at 5 volts input, current should be 15.5 milliamps.

Note:

If current exceeds 100 milliamps, a fault may be present which could destroy electrometer components.

Voltage Checks

1. Voltage at R17/R18 junction to case ground at 150 ± 5 volts.
2. Connect voltmeter common to junction of R19 and C19.
 - a. Voltage junction of CR7/C14 at $+16 \pm 1$ volt.
 - b. Voltage at pin 7-U1 at 4.1 ± 0.2 volts less than voltage at step a.
 - c. Voltage at pin 4-U1 at -0.08 ± 0.03 volts.
 - d. Voltage at pin 5-VR1 at 5 ± 0.1 volts.
 - e. Voltage at pin 5-U4 at -5 ± 0.1 volts.



Isolating capacitor C1 is connected to the Scaler with high voltage on the counting line.

Figure 1

Output Check

1. With the detector connected and the electrometer in the housing, adjust R1 NULL potentiometer fully clockwise. Output count rate should be approximately 3000 cpm.
2. Slowly adjust R1 counterclockwise. Count rate should decline. As count rate approaches zero, count rate may stop declining or start “kicking” upscale. This indicates VCO (U2) instability. Instability point should be less than 200 cpm.
3. Set R1 for 400 cpm.

Caution!

If R1 is adjusted from the counterclockwise position, a 400 cpm setting could be attained in the unstable range.

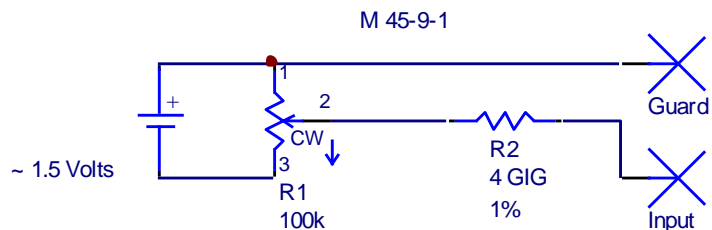


Figure 2: Detector Simulator

4. Disconnect detector and connect detector simulator. (Refer to Figure 2.)
 - a. Apply 1.5 volts and record the full-scale count rate (approximately 1,100,000 cpm).
 - b. Apply 0.8 volts and record the count rate.
 - c. Apply 0.08 volts and record the count rate.
 - d. Confirm linearity within 5%.

Caution!

Components may be damaged if detector simulator comes in contact with the detector chassis, supply voltage, or supply voltage common.

Section

8

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” which notifies the consumer that the product is not to be mixed with unsorted municipal waste when discarding; each material must be separated. The symbol will be placed near the AC receptacle, except for portable equipment where it will be placed on the battery lid.

The symbol appears as such:



Section 9

Parts List

	Reference	Description	Part Number
Model 375-9 Digital Wall-Mount Area Monitor	UNIT	Completely Assembled Model 375 Digital Wall-Mount Area Monitor	48-3036
Main Board, Drawing 396 × 608	BOARD	Completely Assembled Main Board	5396-608
CRYSTAL	Y1	6.144MHZ	01-5262
CAPACITORS	C1-C2	27pF, 100V	04-5658
	C3	0.01uF, 50V	04-5664
	C4-C5	10uF, 25V	04-5728
	C6	0.047uF, 16V	04-5729
	C7	0.01, 50V	04-5664
	C8-C10	10uF, 25V	04-5728
	C11	2700uF, 35V	04-5621
	C12	1uF, 35V	04-5656
	C13	0.01uF, 50V	04-5664
	C14-C15	10uF, 25V	04-5728
	C16-C19	68uF, 10V	04-5654
	C20	0.01uF, 50V	04-5664
	C21	100pF, 100V	04-5661
	C22	47pF, 100V	04-5660
	C23	0.01uF, 50V	04-5664
	C24	0.001uF, 100V	04-5659
	C25-C28	0.01uF, 50V	04-5664
	C29-C30	68uF, 10V	04-5654
	C40	0.01uF, 50V	04-5664
TRANSISTORS	Q1-Q7	2N7002L	05-5840
	Q8	MJD200 RL	05-5844
	Q10-Q13	2N7002L	05-5840

	Reference	Description	Part Number
	Q14	MAX810LEUR	06-6424
INTEGRATED CIRCUITS	U1	MAX220CSE	06-6329
	U2	OPA2192IDR	06-6981
	U3	AT89C51RC2	06-6893
	U4	X24C02S8T5	06-6299
	U5	TLC372ID	06-6290
	U6	ICL7663SCBA-T	06-6302
	U7	ICM7218CIQI	06-6311
	U8-U11	SA08-11EWA LED/DISPLAY	07-6389
	U12-U13	KB-2685EW RED	07-6400
	U14-U15	KB-2785YW YELLOW	07-6371
	U16	CD74HC4538M	06-6297
	U17	MAX985EUK-T	06-6459
	U20	LM285M-1.2	05-5845
VOLTAGE REGULATOR	VR1	LT1129CQ-5	06-6372
DIODES	CR1-CR3	CMSH1-40M	07-6411
	CR4	MMBD914LT1	07-6353
	CR5	CMSH1-40M	07-6411
	CR12	MMBD914LT1	07-6353
LED	DS1	KB-2550SGD GRN RECT	07-6370
SWITCHES	S1	90HBW045, OPTIONS	08-6709
	S2	1241.1619, UP	08-6728
	S3	1241.1619, ALARM POINT	08-6728
	S4	1241.1619, CAL	08-6728
	S5	1241.1619, DOWN	08-6728
	S6	1241.1619, ALERT POINT	08-6728
	S7	1241.1619, DEADTIME CORRECTION	08-6728
POTENTIOMETERS	R22	5K, 3266W-1502, RCDR	09-6849
	R29	1M, 3266W-105, BAT CHARGE	09-6778
	R42	200K, 3266W-1-204, THRESHOLD	09-6949
RESISTORS	R1-R2	1K, 1/8W, 1%	12-7832
	R3	0 OHM (JUMPER)	12-7104
	R4	10K, 1/8W, 1%	12-7839

	Reference	Description	Part Number
	R5	1M, 1/8W, 1%	12-7844
	R6-R8	100K, 1/8W, 1%	12-7834
	R9	196K, 1/8W, 1%	12-7897
	R10-R11	100K, 1/8W, 1%	12-7834
	R12	0 OHM (JUMPER)	12-7104
	R13-R16	10K, 1/8W, 1%	12-7839
	R18	22.1K, 1/8W, 1%	12-7843
	R21	22.1K, 1/8W, 1%	12-7843
	R23	2.2 Ohm, 1/4W, 5%	12-7932
	R24	82.5K, 1/8W, 1%	12-7849
	R25	24.3K, 1/8W, 1%	12-7867
	R26	165K, 1/8W, 1%	12-7877
	R27-R28	2.21K, 1/8W, 1%	12-7835
	R30	100 Ohm, 1/8W, 1%	12-7840
	R36-R37	60.4 Ohm, 1/4W, 1%	12-7962
	R38-R39	10 Ohm, 1W, 1%	12-7952
	R40	33.2K, 1/8W, 1%	12-7842
	R41	47.5K, 1/8W, 1%	12-7872
	R43	NOT USED	
	R56-R59	1M, 1/8W, 1%	12-7844
RESISTOR NETWORK	RN1	220K, 8 RES SMT	12-7831
CONNECTOR	P1	1-640457-3, MTA100x13RA	13-8113
	P2	640457-3, MTA100x3RA, ALARM RELAY	13-8165
	P3	640457-5, MTA100x5RA	13-8102
	P4	640457-3, MTA100x3RA, FAIL RELAY	13-8165
INDUCTOR	L1	220uH	21-9678
RELAYS	RL1	JS1-5V, AROMAT	22-9893
MISCELLANEOUS	JP1-JP2	SAMTEC 3PIN-RA JUMPER	13-7914
	W4-W6	WIRE *	

	Reference	Description	Part Number	
Wiring Diagram, Drawing 396 × 869 SWITCH	S1	DM62J12S205PQ, ON/OFF	08-6715	
	CONNECTORS	J1	1-640456-3, MTA100x13, 5396-608	13-8100
		J2	640456-3, MTA100x3, ALARM RELAY	13-8081
		J3	640456-5, MTA100x5, ACC.	13-8057
		J4	640456-3, MTA100x3	13-8081
		J5	640456-3, MTA100x3, 3 PIN CONNECTOR	13-8081
		J7	640456-3, MTA100x3, DETECTOR	13-8081
		J8	640456-9, MTA100x9	13-8094
		J9	INPUT/OUTPUT PORT, 9 PIN D	13-8003
		J10	640456-3, MTA100x3	13-8081
FUSE		F1	1 AMP, 5x20mm	21-9704
BATTERY	B1	MN1300, 6.0V	21-9705	
AUDIO	DS1	SC628-SONALERT	21-9730	
TRANSFORMER	T1	CFP 302 115/230V	22-9908	
Model 45-9 Remote Area Monitor	UNIT	Completely Assembled Model 45-9 Remote Area Monitor	47-3324	
Model 45-9-1 Remote Area Monitor	UNIT	Completely Assembled Model 45-9-1 Remote Area Monitor	47-3339	
Remote Electrometer, Drawing 280 × 219	BOARD	Completely Assembled Electrometer (common to all)	5280-218	
	CAPACITORS	C1	330pF, 100V	04-5657
		C2	1uF, 16V	04-5701

	Reference	Description	Part Number
	C3	0.01 μ F, 200V	04-5725
	C4	10 μ F, 50V	04-5995
	C5	100pF, 100V	04-5661
	C6	0.47 μ F, 50V	04-5681
	C7	0.01 μ F, 200V	04-5725
	C8	10 μ F, 50V	04-5995
	C9	0.01 μ F, 50V	04-5664
	C10	0.001 μ F, 100V	04-5659
	C12	10 μ F, 50V	04-5995
	C13-C15	1 μ F, 50V	04-5953
	C16	0.01 μ F, 200V	04-5725
	C17	0.1 μ F, 200V	04-5710
	C18	0.01 μ F, 200V	04-5725
	C19	0.1 μ F, 200V	04-5710
	C20-C23	10 μ F, 50V	04-5995
TRANSISTOR	Q1	MMBT3904LT1	05-5841
INTERGRADED CIRCUITS	U1	LMC6041M	06-6502
	U2	AD654JR	06-6317
	U3	MIC1557BM5	06-6457
	U4	ICL7660SCBA	06-6437
	U5-U6	LT1304CS8	06-6394
VOLTAGE REGULATOR	VR1	LT1761ES5-5	06-6540
DIODES	CR1	TZM5234B-GS08	07-6602
	CR2-CR3	BZX84C18	07-6447
	CR4-CR5	MMBD914LT1	07-6353
	CR6	CMSH1-40M	07-6411
	CR7-CR8	MBR0540LT1	07-6546
	CR9	ZENER 4.7V	07-6459
	CR10	CMPD2004S	07-6402
	CR11	LM4040CIM3-4.1	05-5862
POTENTIOMETER	R1	1M, NULL	09-6752
RESISTORS	R2	22.1k, 1/4W	12-7843
	R3	4.75K, 1/8W	12-7858
	R4	100K, 1/8W	12-7834

	Reference	Description	Part Number
	R5	10M, 1/4W	12-7996
	R6	100K, 1/4W	12-7834
	R7	392 OHM, 1/4W	12-7054
	R8	100K, 1/4W	12-7834
	R9	6.81K, 1/4W	12-7857
	R10	22.1K, 1/4W	12-7843
	R11	100K, 1/4W	12-7834
	R12	1M, 1/4W	12-7844
	R13	10 OHM, 1/4W	12-7836
	R14	14.7K, 1/4W	12-7068
	R15	110K, 1/8W	12-7052
	R16	82.5K, 1/4W	12-7849
	R17-R19	10M, 1/4W	12-7996
	R20	100K, 1/4W	12-7834
	R21	10K, 1/4W	12-7839
	R22	100K, 1/4W	12-7834
	R23	1M, 1/8W	12-7844
	R24	50 GIG, 200V, 10%	12-7046
	R25-R26	200M, 330mW	12-7060
	R27-28	10 Ohm, 1/4W	12-7836
CONNECTORS	P1	640457-4 MTA100	13-8089
TRANSFORMERS	T1	B66296-B1006	4275-162
	T2	31032R	21-9925
MISCELLANEOUS	W2	LUG	18-9160

Section**10****Drawings and Diagrams**

Main Board Schematic, Drawing 396 × 608 (4 sheets)

Main Board Component Layout, Drawing 396 × 609 (2 sheets)

Wiring Diagram, Drawing 396 × 869

Remote Electrometer, Drawing 280 × 219

Electrometer Board Component Layout, Drawing 280 × 220 (2 sheets)

Energy Response Curve for Models 45-8, 45-9 & 45-9-1

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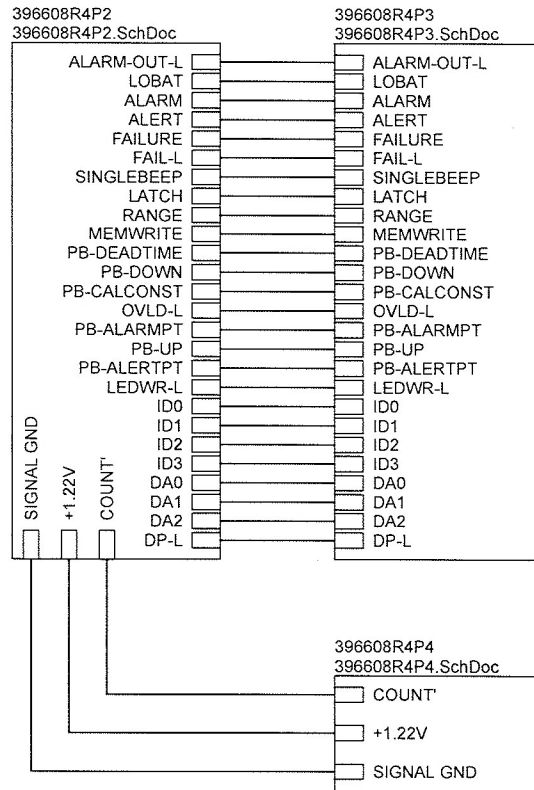
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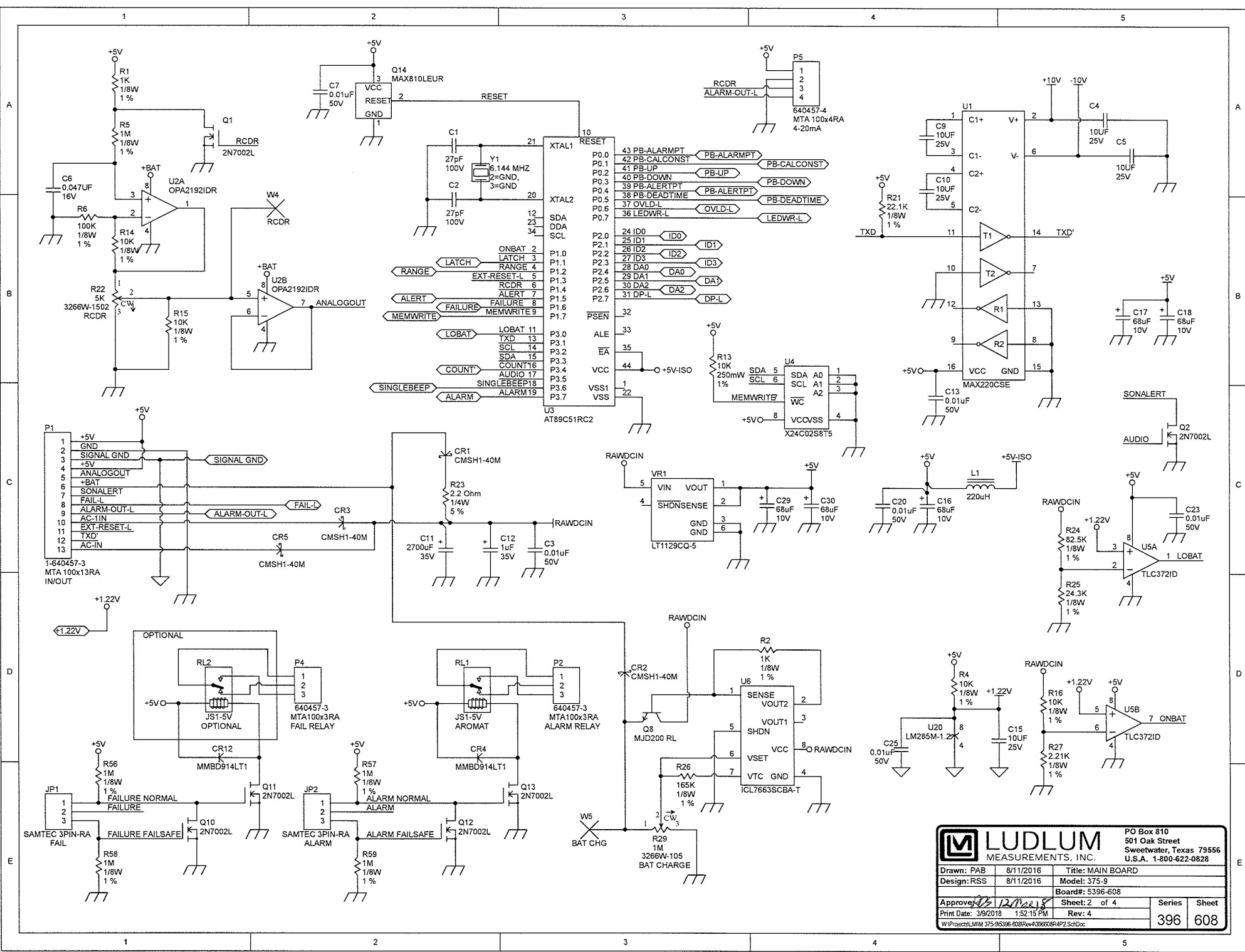
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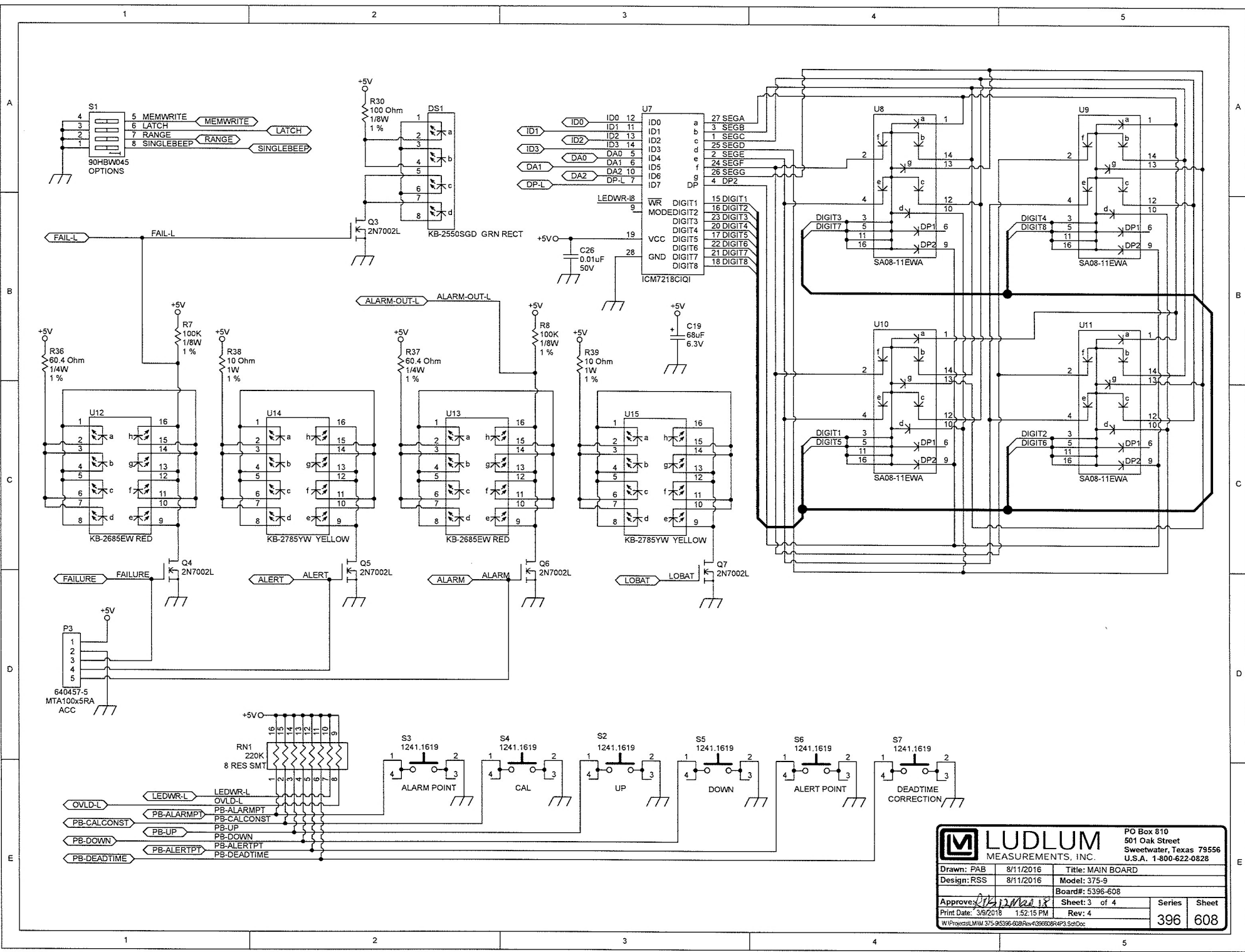
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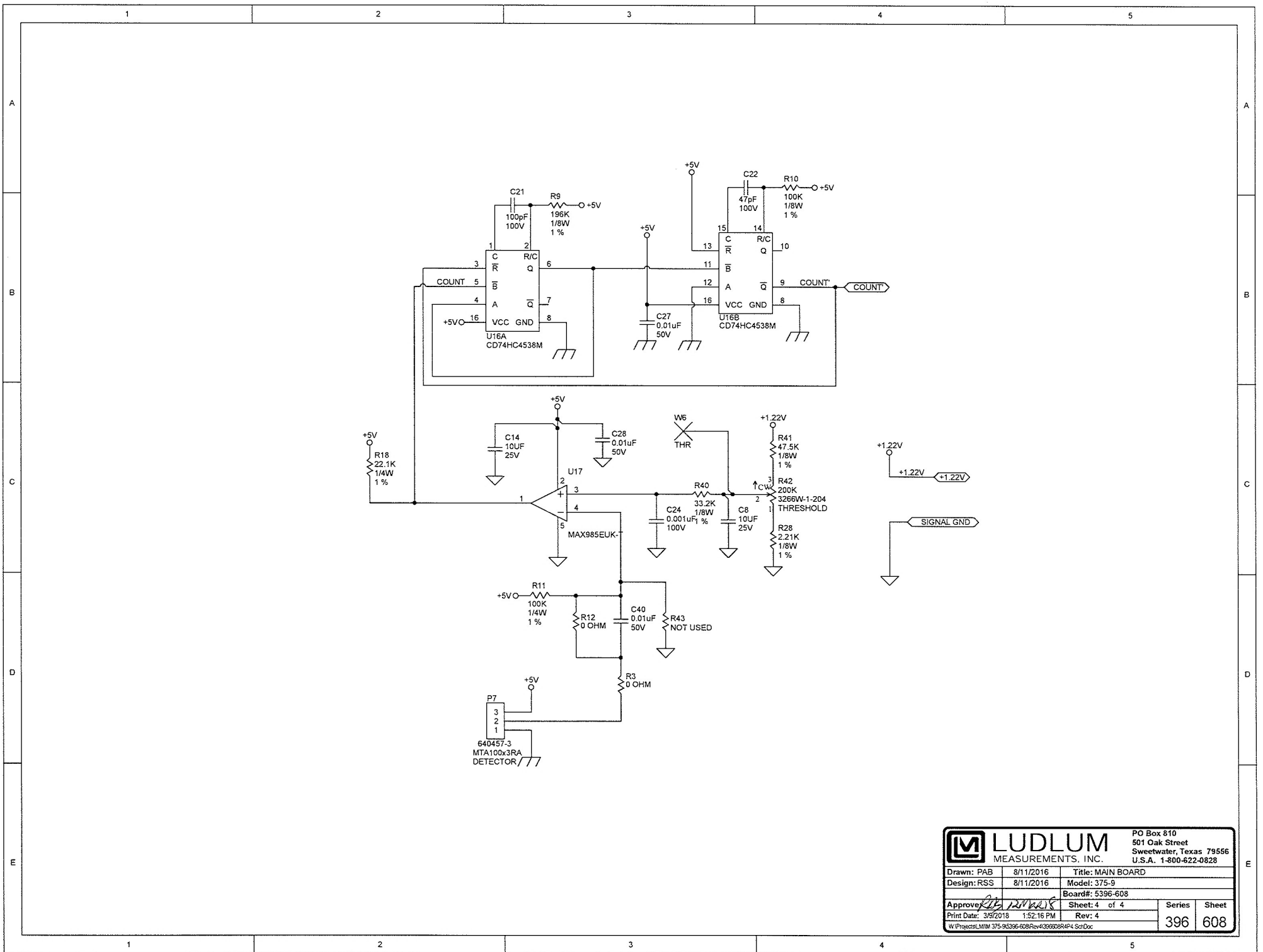
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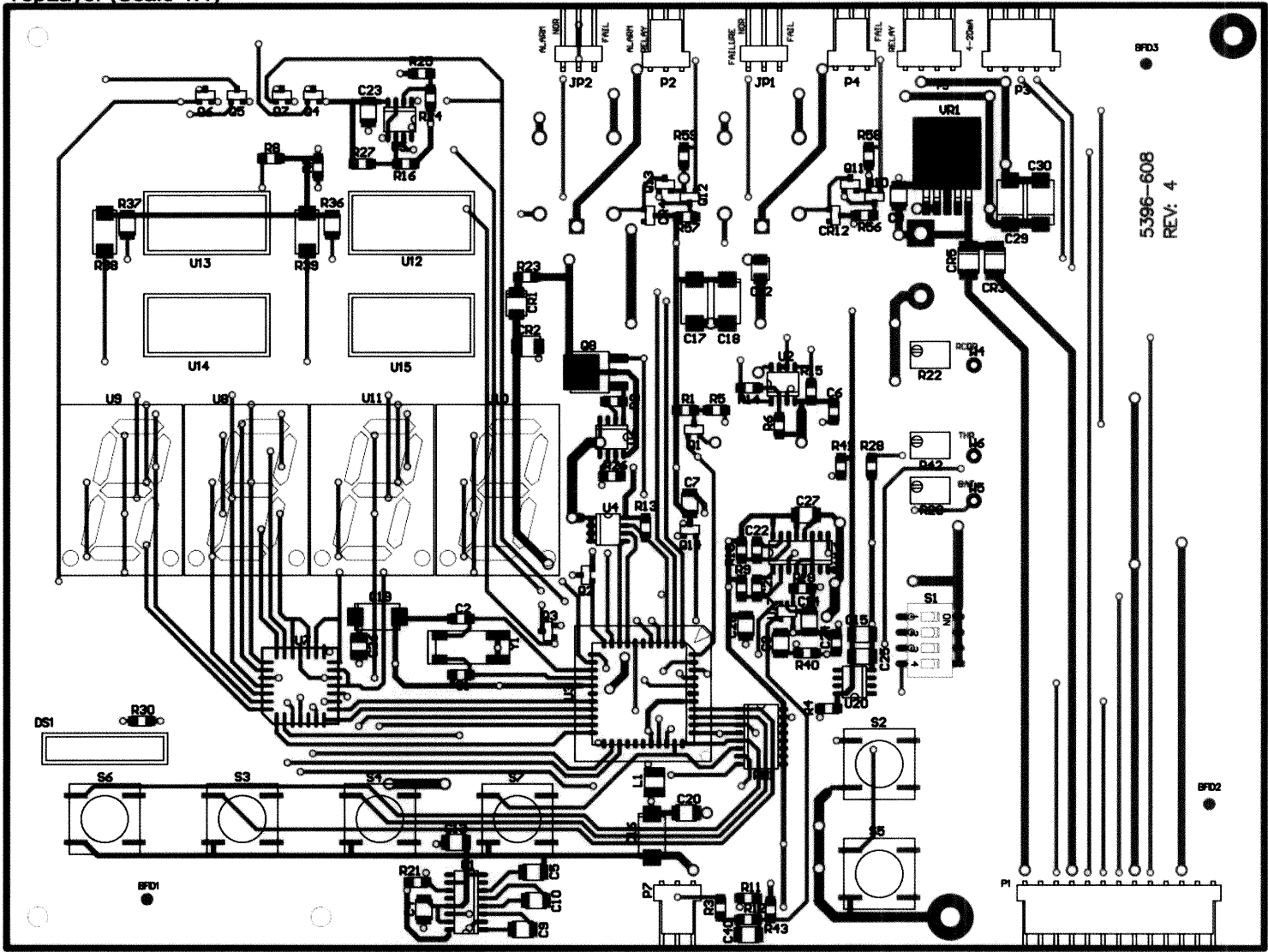


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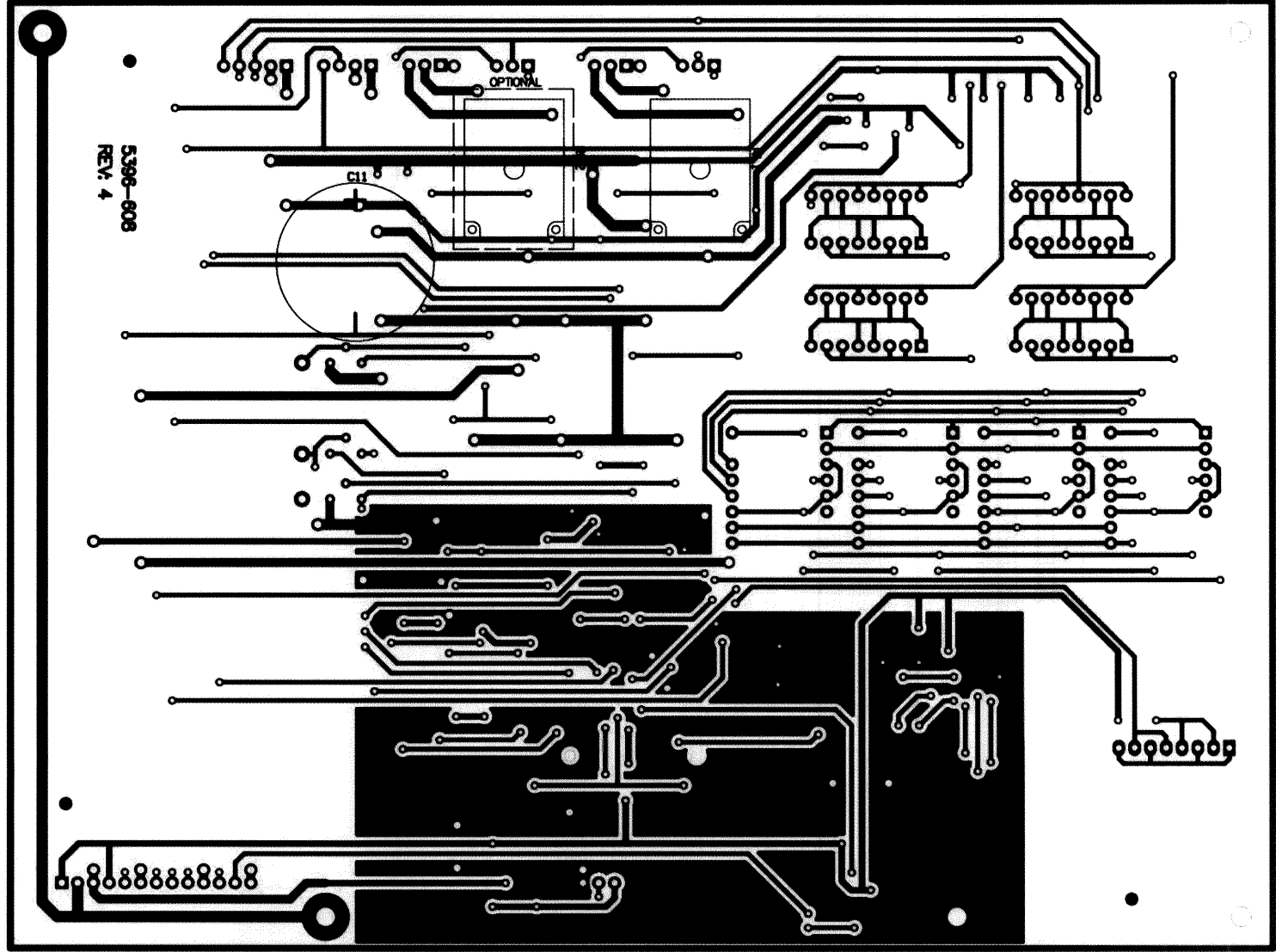



5396-608
REV: 4

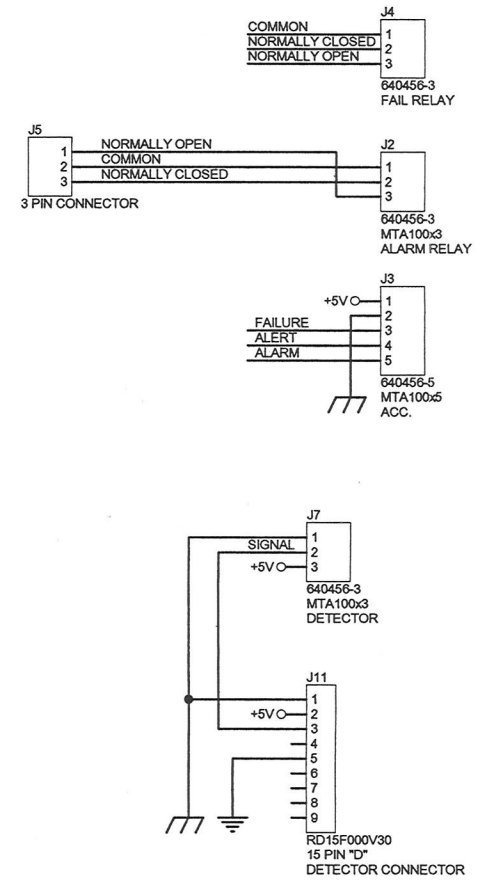
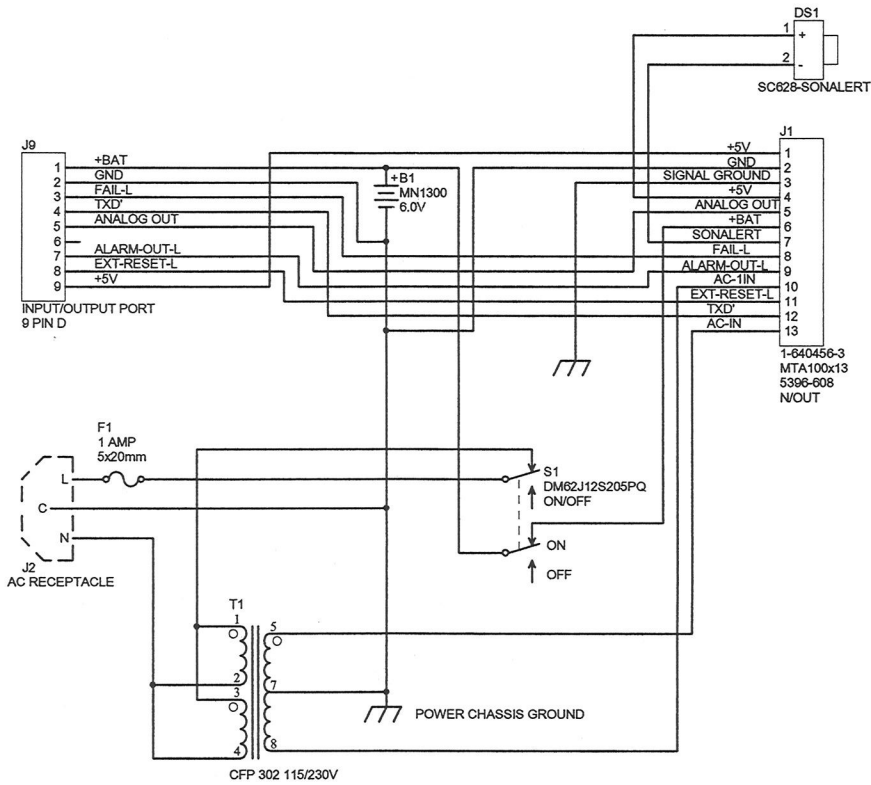
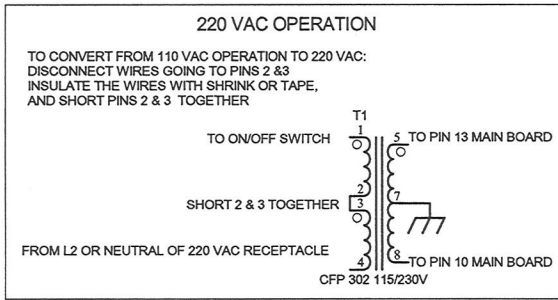
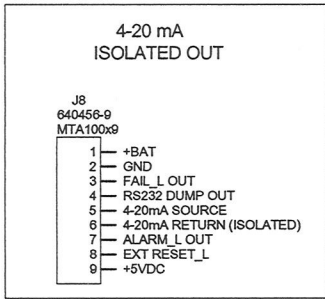
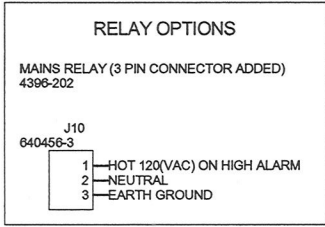
DO NOT PLACE R43, RL2 AND P5

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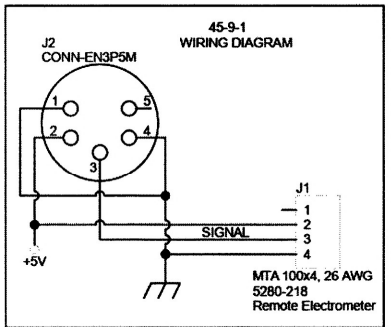
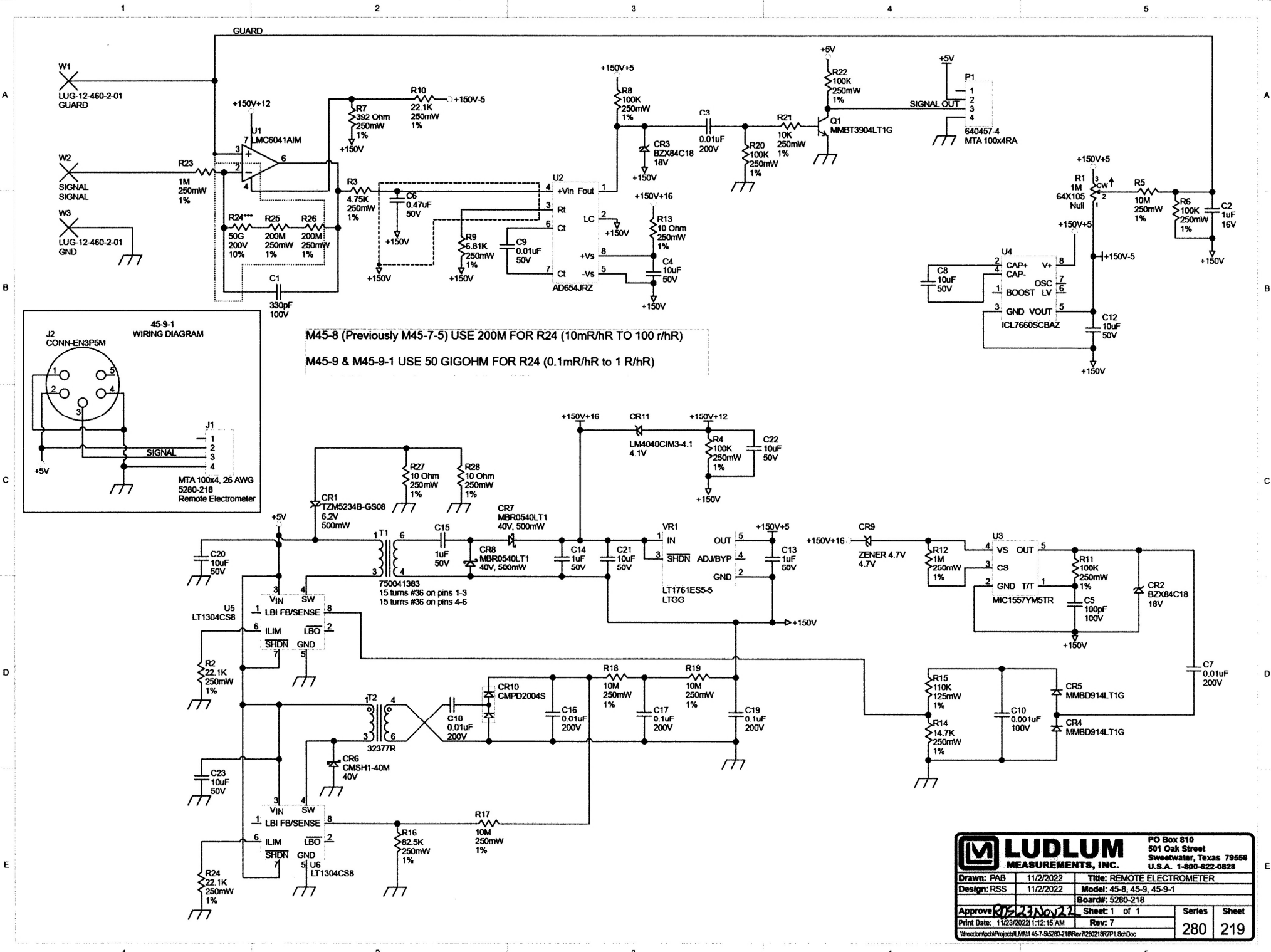
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Desc: MAIN BOARD				
Design: RSS	Date: 8/11/2016	Rev:	4	
Drawn: BAB	Date: 4/17/2023	SHEET	SERIES	SHEET
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LUDLUM MEASUREMENTS, INC.		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
Drawn: PW	07/02/09	Title: WIRING DIAGRAM	
Design: RC	07/02/09	Model: 375-9	
Check:		Board#: 396-899	
Approve: <i>DL</i>	2-Jul-2009	Sheet: 1 of 1	Series
15:46:17	2-Jul-2009	Rev: 1.0	396 869



M45-8 (Previously M45-7-5) USE 200M FOR R24 (10mR/hR TO 100 r/hR)
 M45-9 & M45-9-1 USE 50 GIGOHM FOR R24 (0.1mR/hR to 1 R/hR)

LUDLUM		MEASUREMENTS, INC.		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0823	
Drawn: PAB	11/2/2022	Title: REMOTE ELECTROMETER			
Design: RSS	11/2/2022	Model: 45-8, 45-9, 45-9-1			
		Board#: 5280-218			
Approved: <i>RSS</i>	11/23/2022	Sheet: 1 of 1	Series	Sheet	
Print Date: 11/23/2022 1:12:15 AM	Rev: 7			280	219
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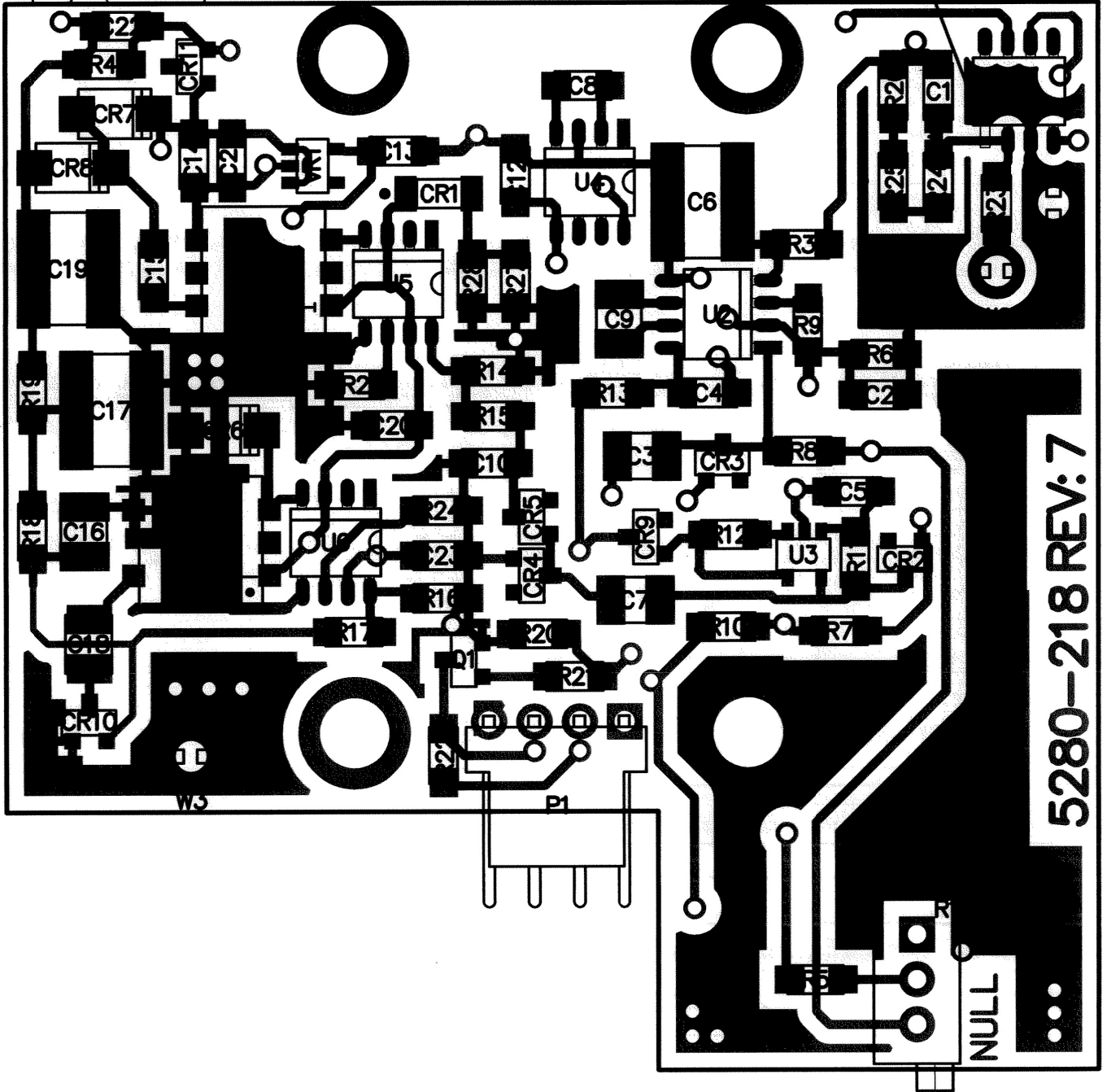
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CUT PIN1 ON U1

TopLayer (Scale 3:1)



M LUDLUM MEASUREMENTS				
Part: 5280-218		Model: 45-8, 45-9, 45-9-1		
Desc: REMOTE ELECTROMETER				
Design: RSS	Date: 11/2/2022	Rev:	7	
Drawn: PAB	Date: 6/21/2023	SHEET	SERIES	SHEET
Apr: <i>RDS</i>	Date: <i>21 JUN 23</i>	1 of 3		
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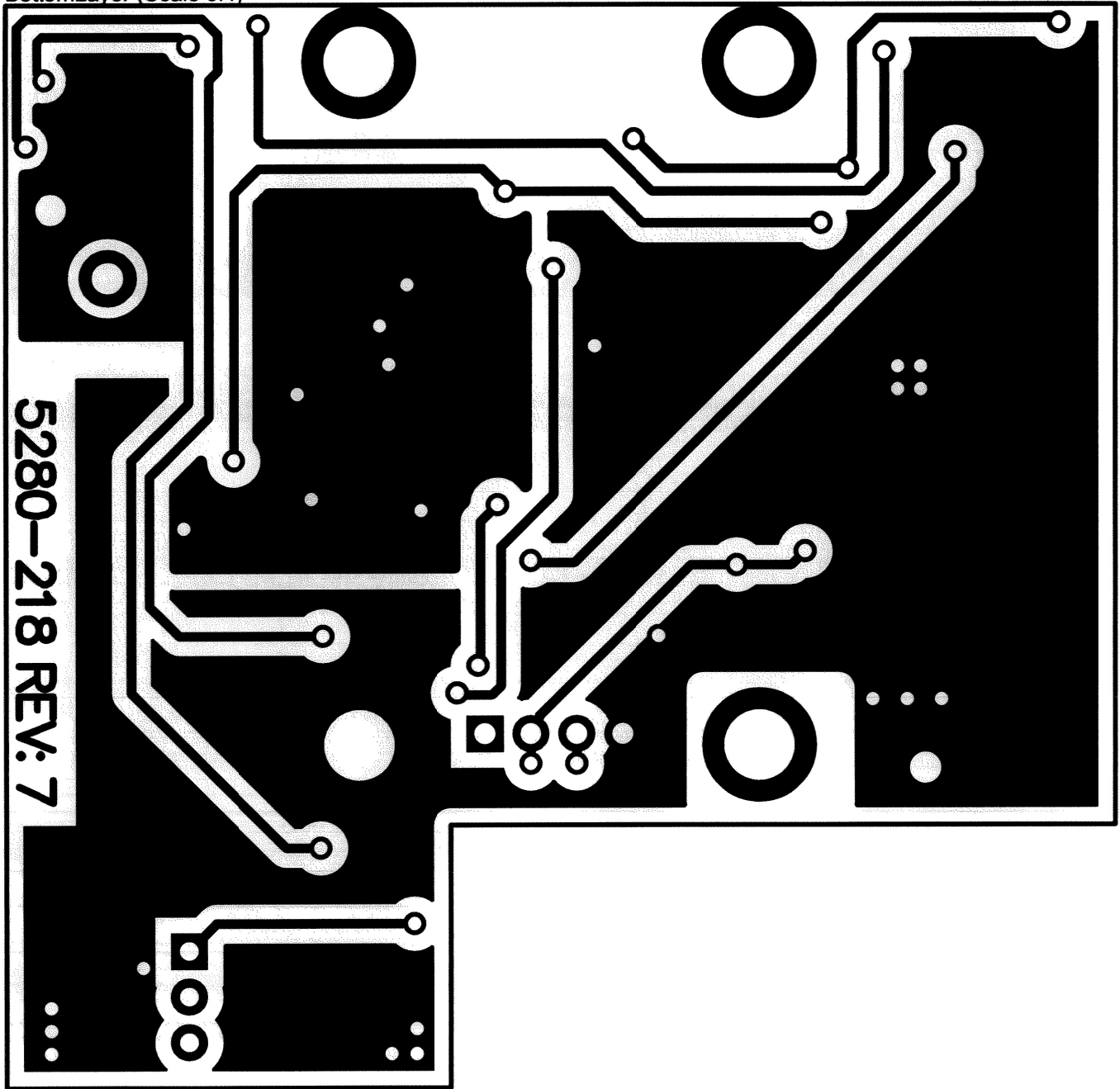
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5280-218 REV: 7



LUDLUM MEASUREMENTS

Part: 5280-218

Model: 45-8, 45-9, 45-9-1

Desc: REMOTE ELECTROMETER

Design: RSS	Date: 11/2/2022	Rev:	7
Drawn: PAB	Date: 6/21/2023	SHEET	SERIES SHEET
Apr: <i>RDS</i>	Date: <i>21 Jun 23</i>	of 3	280 220

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A

B

C

D

1

2

3

4

5

6

1

2

3

4

5

6

Energy Response Curve for Models 45-8, 45-9 & 45-9-1

