

**LUDLUM MODELS 375 (INCLUDING SERIES ONE),  
375/2, 375/4, AND 375WT**

**DIGITAL WALL-MOUNT AREA MONITORS**

**May 2021**

**Serial Number 179939 and Succeeding  
Serial Numbers**

**Legacy Version**

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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.

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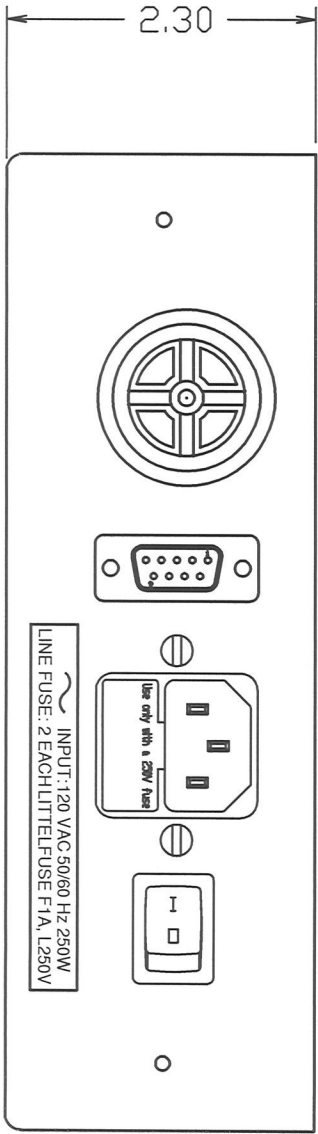
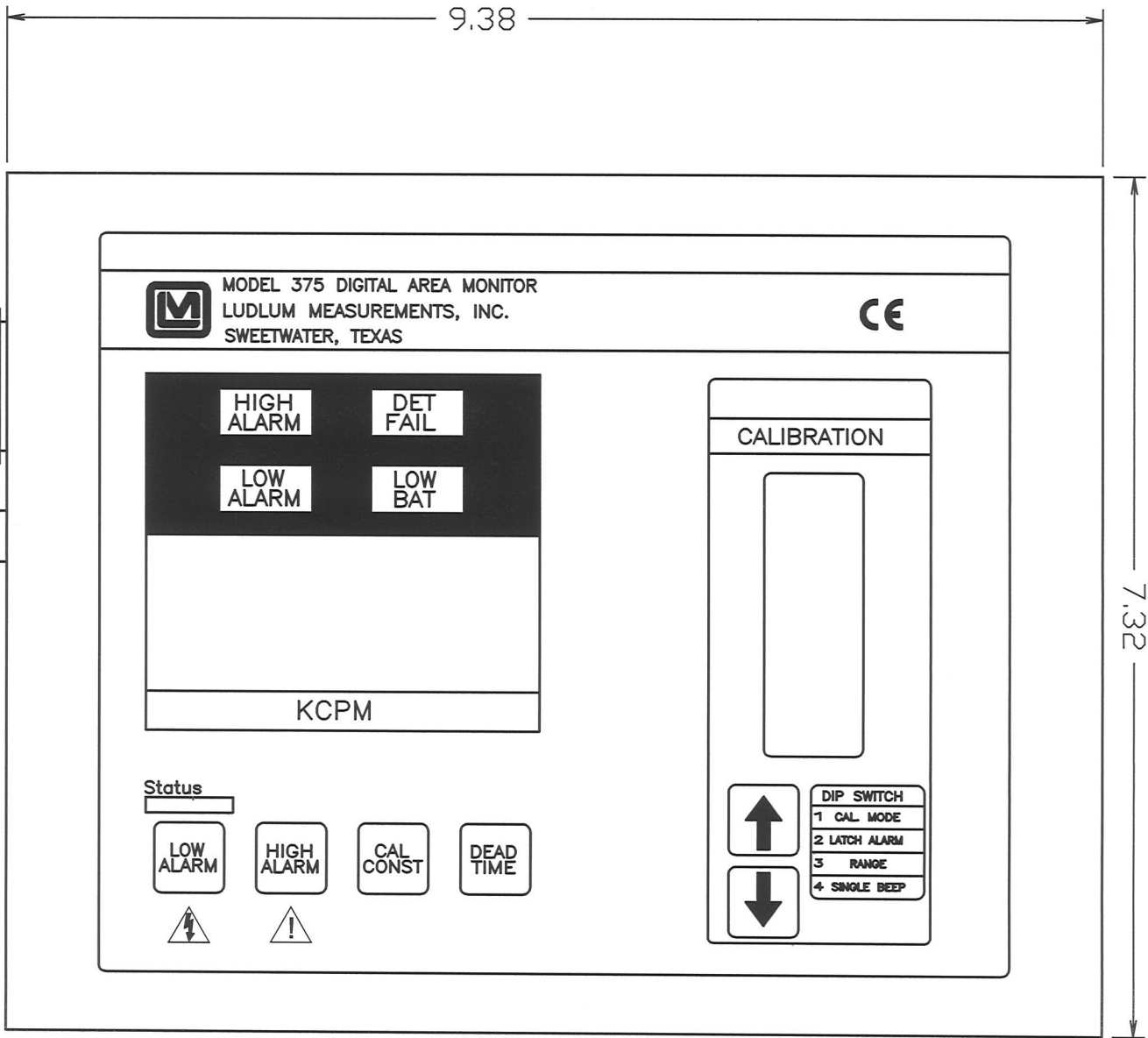
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**LUDLUM MEASUREMENTS, INC.  
ATTN: REPAIR DEPARTMENT  
501 OAK STREET  
SWEETWATER, TX 79556**

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

REV #	ALTERATIONS	DATE	BY
2	ADDED DIMENSIONS	5-5-05	CMC
3	CORRECTED DIMENSIONS	10-21-10	JGW



DWN	DATE	CHECKED	APPROVED
JGW	10-21-10		JGW 10-21-10

TITLE: M 375 FRONT PANEL

LUDLUM MEASUREMENTS, INC. 501 DMK STREET SWEETWATER, TEXAS 79556	SERIES 396	SHEET 30
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DRAWING TO ACTUAL SIZE  
MAY BE USED AS TEMPLATE

USE #6 SCREWS

2.679

1.648

6.000


1.648

3

3

MINIMUM  
CLEARANCE

ANCHORS MUST BE ABLE TO HOLD  
12 POUNDS PER SCREW, AND MUST  
BE APPROPRIATE FOR WALL  
CONSTRUCTION

DESC: WALL MOUNTING GUIDE					
MODEL NO.: M 375					
DRW	DATE	CHK	DATE	APP	DATE
TJR	11-11-99			Jew	7-17-15
TOL: SHOP STD <input checked="" type="checkbox"/>			SCALE: FULL <input checked="" type="checkbox"/>		
OTHER			OTHER		
 LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556			SERIES	SHEET	
			396	166	

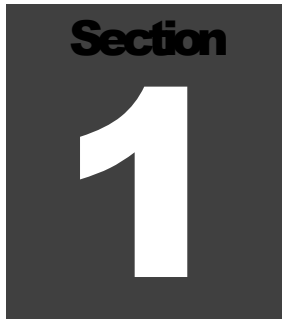
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## Introduction

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The Model 375 Digital Wall-Mount Area Monitor is designed for visibility and ease of use. Featuring a wall-mount chassis, the Model 375 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.

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. Depending on the needs of the customer, the Model 375 comes equipped with an internal detector or a connector for use with an external detector.

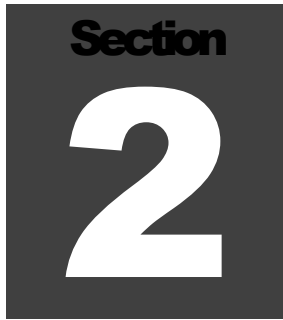
Two common Model 375 systems with internal detectors are:

The Model 375/2 with an internal LND 71210 detector.

The Model 375/4 with an internal LND 71412 detector.

The Ludlum Model 375 Series One is a Model 375 with modified firmware. Changes include certain display values in decimal points and units. Details can be found in sections "Getting Started" and "Specifications".

The Ludlum Model 375WT- Digital Waste Truck Monitor is a Model 375 which has been modified to operate on 12 Vdc. The modification is detailed in the "Common Options and Modifications" section of this manual.

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## Getting Started

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The Model 375 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 will be discussed in this section. Other sections of the manual provide more detailed information.

### External Detector (Option)

**Warning!**

Potential electrical shock hazard - Do not touch the center pin of the detector connector unless the unit has turned off and power has been removed for at least 1 minute!

The Model 375 comes equipped with either an internal detector or a connector for use with an external detector. If your Model 375 is equipped with a connector on the bottom side of the chassis, an external detector is required. If you have an external detector, use the cable provided to connect it to the Model 375.

**Note:**

Splicing or re-terminating cables must be done carefully. Improper termination will result in the “shorting-out” of the detector voltage, a DET FAIL and/or blown-fuse condition.

### Power Up

Plug the power cord into a suitable wall (Mains) outlet (see note on following page).

**Note:**

Model 375 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.

**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.

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.**

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.

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 below and on pages 2-3 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 may be calibrated for almost any desired radiation units of measure. Common units of measure include mR/hr,  $\mu$ R/hr, R/hr, mSv/h,  $\mu$ 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.

\* **Model 375 Series One:** In the special case of the Model 375 Series One make note of the following changes resulting from firmware modification:

With the CAL dipswitch in the left position (normal operating mode), two decimal places will be displayed instead of one.

With the CAL dipswitch in the right position (calibration mode), only one decimal place will be displayed.

Calibration constant will be displayed in cps per unit, instead of cpm per unit.

Dead Time Correction will display in  $10^{\text{th}}$ s of microseconds (i.e. 50  $\mu\text{sec}$  instead of 5  $\mu\text{sec}$ ).

## 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\*.

## 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:**

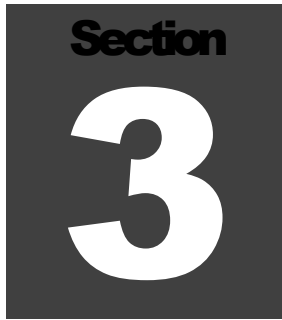
Ludlum Measurements suggests that an operational check be performed on a regular basis. Local procedures may supersede this suggestion.

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.

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## Specifications

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**Compatible Detectors:** G-M, proportional and scintillation.

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

**Display Range:** 000.0-9999\*.

**Display Units:** Can be made to display in  $\mu\text{R/hr}$ ,  $\text{mR/hr}$ ,  $\text{R/hr}$ ,  $\mu\text{Sv/h}$ ,  $\text{mSv/h}$ ,  $\text{Sv/h}$ ,  $\mu\text{rem/hr}$ ,  $\text{mrem/hr}$ ,  $\text{rem/hr}$ ,  $\text{cpm}$ ,  $\text{cps}$ , and others.

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

**Operating Range:** Depends upon the type of detector used. The operating range of the 375/2 is from 0.1  $\text{mR/hr}$  to 1  $\text{R/hr}$ . The operating range of the 375/4 is from 1  $\text{mR/hr}$  to 8  $\text{R/hr}$ . External detectors will have different operating ranges.

**Response:** Typically 3 seconds from 10% to 90% of final reading.

**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 beep (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 68dB at 2 feet for conditions of detector overload, no count from detector or instrument failure.

**Low bat:** Indicated by a yellow light, beginning when 2 hours of battery life remain.

**Connector:** Series "C" (others available).

**Calibration Controls:** Accessible from the front of instrument (protective cover provided).

**High Voltage:** Adjustable from 200-2500 volts.

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

**Overload:** A display reading of "-OL-" and audible FAIL alarm indicate detector saturation. Usually set to initiate just above the highest range of the detector.

**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 or 272 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!:**

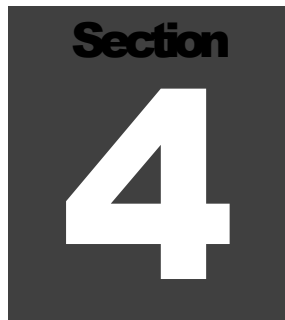
Only certified technician or calibration personnel should replace battery.



**Construction:** Aluminum housing with ivory powder-coat finish.

**Size:** 9.7" (24.6 cm) W × 7.4" (18.7 cm) H × 2.5" (6.4 cm) D

**Weight:** 5.2 lb. (2.4 kg)

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## Operator Controls and Setup

### Calibration Controls

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

#### Warning!

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

**ANALOG:** 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.

**HV:** Used to set the high voltage required for detector operation. Adjustable from 0-2500 Vdc. The high voltage required will depend on the type of detector used. Internal GM detectors typically require 550 Vdc. Be sure to check the high voltage with a high impedance (1000-Mohm impedance) voltmeter only. A high voltage checkpoint is located next to the HV potentiometer.

**DISC:** Internal discriminator used to set pulse threshold for counting pulses from the detector. Pad allows direct measurement of threshold voltage. Utilize a Ludlum Model 500 Pulser or equivalent to inject pulses of the desired threshold size. The pulse height threshold is adjustable from 2.0 mVdc to 100 mVdc.

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

**OVERLOAD:** Used to set the detector current overload point. When excessive radiation causes the detector to overload, this set point will cause the FAIL light to engage, and the display will be forced to -OL-.

## 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, 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 analog output to full-scale so that the full-scale voltage may be set by the ANALOG potentiometer. Calibration mode also slows the response time of the display and increases the accuracy. If the display seems too erratic, leaving this switch in the calibration mode during operation will help. 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 dumps RS-232 data onto pin 4 of the 9-pin connector every two seconds. The communication parameters are 2400 baud, 8 data bits, no parity, 1 stop bit, and no hardware handshaking.

## 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-	ANALOG OUT
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.

## Typical Internal Detector Setups

### **Model 375/2**

Typical response and set points for the model 375 with internal energy-compensated LND 71210 GM detector is as follows:

Operating Voltage: 550 Vdc  
Threshold: 100 mVdc  
Calibration Constant: 1000 cpm/mR/hr  
Dead Time Correction: 30  $\mu$ sec-150  $\mu$ sec  
Linear Range with DTC: 0.1 mR/hr - 1 R/hr

Typical Checkpoints:

1 mR/hr	
4 mR/hr	
8 mR/hr	- calibration constant set point
40 mR/hr	
80 mR/hr	
400 mR/hr	
800 mR/hr	- dead time correction set point
1,000 mR/hr	

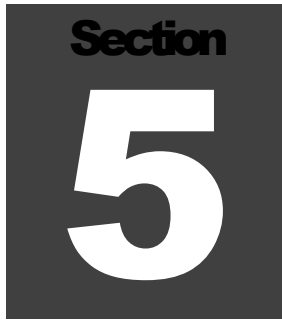
**Model 375/4**

Typical response and set points for the model 375 with internal energy-compensated LND 71412 GM detector is as follows:

Operating Voltage: 550 Vdc  
Threshold: 100 mVdc  
Calibration Constant: 150 cpm/mR/hr  
Dead Time Correction: 30  $\mu$ sec-150  $\mu$ sec  
Linear Range with DTC: 1 mR/hr - 8 R/hr

Typical Checkpoints:

4 mR/hr  
8 mR/hr  
40 mR/hr - calibration constant set point  
80 mR/hr  
400 mR/hr  
800 mR/hr  
4,000 mR/hr - dead time correction set point  
8,000 mR/hr



# Section 5

## Common Options and Modifications

---

### Time and Date Stamp Option

**Description:**

When an alarm or failure occurs the Model 375 will print the current reading, date, time and either *ALARM* or *FAIL* to the RS-232 port. The Model 375 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 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 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

## Sigma Alarm Modification Option

With this option, special firmware allows the Model 375 to have a sigma-based alarm point in addition to a regular fixed alarm point. This sigma-based alarm point allows the user to have a floating alarm point that will stay at “x” sigma above the radiation background. As the background changes, the sigma alarm also changes. The sigma alarm, when activated, activates a rapid beeping and activates the HIGH ALARM indicator on the front panel of the Model 375.

To set the sigma alarm, one first needs to consult a probability table showing one-sided sigma values. If the sigma alarm (read or set by the LOW ALARM button) is set to 3.0, that setting statistically means that 99.87% of normal background readings would be less than the alarm point. To look at the false alarm rate, it means that 0.13% or 1 out of 769 comparisons would result in a false alarm. Since comparisons are made every second, a setting of 3.0 will result in a false alarm about every 13 minutes. Similarly, a setting of 5.0 would result in a false alarm every 38 days. To actually calculate the sigma alarm point, it is necessary first to determine the background radiation level in cps (counts per second). The sigma alarm point is then  $BKGND + (x \text{ sigma} \times \text{square root of BKGND})$ .



The HIGH ALARM has *not* been changed; it is still a fixed alarm point and will be activated when the radiation level exceeds that set-point. This feature allows the sigma alarm to trigger quickly if a small amount of radiation is present, and allows the fixed alarm to warn that the background radiation is too high. Since the sigma alarm is allowed to rise if the background rises, the HIGH ALARM is necessary to have an absolute value or ceiling for the radiation level. The time constant for the background radiation level and the displayed radiation reading is 20 seconds. The sigma alarm is not activated until 60 seconds after the Model 375 is turned ON, in order to allow the Model 375 to accumulate a stable background radiation reading.

Two other changes were made to the Model 375. The first change was to deactivate the LOW ALARM indicator. Both the sigma-based alarm (set by the LOW ALARM button) and the fixed alarm (HIGH ALARM button) trigger the HIGH ALARM indicator. The second change was to lower the detector loss-of-count time frame to 15 seconds. This change means that the DET FAIL indicator is activated if no pulses are received from the radiation detectors in 15 seconds. Since the sigma alarm is most useful for scintillation detectors that have several hundred pulses per minute, this change allows a faster determination of detector failure.

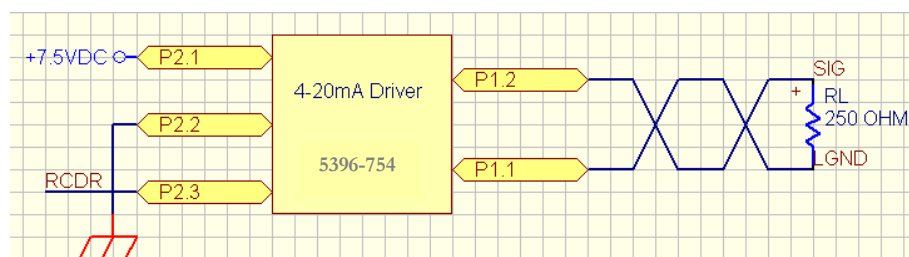
## 4 to 20 mA Isolated Output Driver Option

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

This circuit may be added to the Model 375 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. 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 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 Pinout**

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.

Check for a voltage of  $1.00 V \pm 5\%$  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  $5.00 V \pm 0.1 V$  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  $5\text{ V} \pm 5\%$  ( $V = .020 \times R_{\text{term}}$ ).

### **Modifications to the Model 375 for optimum performance**

The Model 375 main board (LMI Part Number 5396-160) should be modified as follows:

U531 changes from an LM358 to an OPA2343UA; LMI Part Number 06-6582.

C531 changes from  $10\mu\text{F}$  tantalum to  $0.047\mu\text{F}$  “poly film” (polypropylene sulfide); LMI Part Number 04-5729.

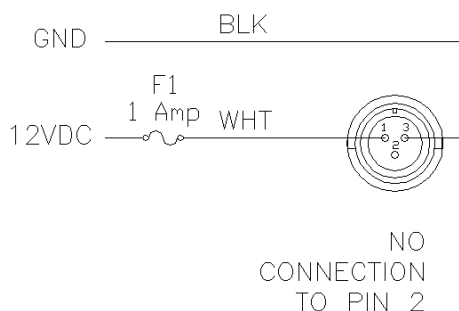
R432 changes from 100k to 1Meg; LMI Part Number 12-7844.

### **Waste Truck (Model 375WT) Modification**

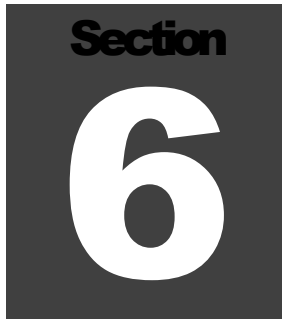
The Ludlum Model 375WT Digital Waste Truck Monitor is a Model 375 modified to be powered by a +12 Vdc power supply. This modification allows the instrument to connect to a truck battery or charging system. The instrument will, however, also work if connected to Mains (120 VAC) through the standard AC connector. If powered through the +12 Vdc connector, the system will have a current draw of approximately 200 mA.

#### **Important!**

The user is responsible for properly fusing the input +12Vdc supply with a fast-acting 1 amp fuse or breaker as illustrated below.



The mating plug for the +12 Vdc connector is supplied with a short length of cable for testing purposes. The cable is pre-wired for +12 Vdc on the white wire, and ground on the black wire. The internal battery is removed for this modification.

A dark gray square with the word "Section" in white at the top and a large white number "6" in the center.

## Safety Considerations

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### Environmental Conditions for Normal Use

Indoor use only

No maximum altitude

Temperature range of  $-20^{\circ}\text{C}$  to  $50^{\circ}\text{C}$  ( $5^{\circ}\text{F}$  to  $122^{\circ}\text{F}$ ); May be certified for operation from  $-40^{\circ}\text{C}$  to  $65^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$  to  $150^{\circ}\text{F}$ ).

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 1 (as defined by IEC 664)

### Cleaning Instructions and Precautions

The Model 375 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.

### The Model 375 is marked with the following symbols:



**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 (Applicable for Models with an external detector).



**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!

## Detector Connector

**Warning!**

Potential electrical shock hazard - Do not touch the center pin of the detector connector unless the unit has turned off and power has been removed for at least 1 minute!

## Battery Replacement

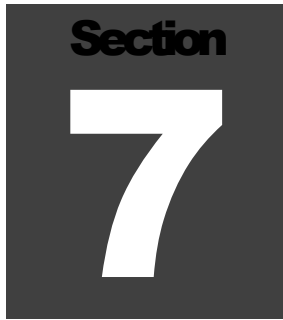
**Warning!:**

Only certified technicians or calibration personnel should replace battery.

**Note:**

Ludlum Measurements, Inc. recommends replacing batteries every four years.

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## Calibration

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### High Voltage

The high voltage is adjustable from 0-2500 Vdc using the HV potentiometer located under the calibration cover. The high voltage required will depend on the type of detector used. Internal GM detectors usually require 550 Vdc. Ensure that the high voltage is checked only with a high impedance ( $\geq 1000$  megohm) voltmeter. A high voltage checkpoint is located next to the HV potentiometer.

**Warning!**

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

### Calibration Parameters

The calibration parameters, LOW ALARM, HIGH ALARM, CAL CONST, and DEAD TIME 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.

The calibration constant (CAL CONST) is set when the detector is exposed to a "low" radiation field. A "low" radiation field in this case is defined as a field where dead time losses do not exceed 5%. The calibration constant is usually given for a certain detector. A Ludlum Model 133-4 detector, for example, has a calibration constant of approximately 150 cpm/mR/hr. Once the calibration constant is set and checked at a low radiation field, the dead time correction can be set.



The dead time correction (DEAD TIME) is set when the detector is exposed to a "high" radiation field. A "high" radiation field in this case is defined as a field where dead time losses exceed 30%. The dead time correction will elevate the ratemeter reading to account for counts arriving at the detector during the detector's dead time. GM tubes typically have long dead times from 50-150 microseconds. Neutron and scintillation detectors generally have short dead times of 1-5 microseconds.

**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.

## Discriminator

The DISC potentiometer located under the calibration cover is used to set the threshold for pulses coming from the detector. The desired pulse threshold depends on the type of detector used. It is adjustable from 2.0 mVdc to 100 mVdc.

## 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.

# 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:





## Parts List

---

	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
<b>Model 375 Digital Wall-Mount Area Monitor without Detector</b>	UNIT	Completely Assembled Model 375	48-2230
<b>Model 375/2 Digital Wall-Mount Area Monitor</b>	UNIT	Completely Assembled Model 375/2	48-2410
<b>Model 375/4 Digital Wall-Mount Area Monitor</b>	UNIT	Completely Assembled Model 375/4	48-2411
<b>Model 375 Series One without Detector</b>	UNIT	Completely Assembled Model 375 Series One	48-2676
<b>Model 375/2 Series One</b>	UNIT	Completely Assembled Model 375/2 Series One	48-2931
<b>Model 375/4 Series One</b>	UNIT	Completely Assembled Model 375/4 Series One	48-3007
<b>Model 375WT without Detector</b>	UNIT	Completely Assembled Model 375WT	48-3291
<b>Main Board, Drawing 396 x 160</b>	BOARD	Completely Assembled Main Circuit Board (common to all)	5396-160
CRYSTAL	Y211	6.144 MHZ	01-5262
CAPACITORS	C201	10UF, 20V	04-5655
	C211	27PF, 100V	04-5658
	C221	68UF, 6.3V	04-5654
	C222	27PF, 100V	04-5658
	C301-C302	4.7UF, 25V	04-5653

	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
	C303	10UF, 20V	04-5655
	C401	68UF, 6.3V	04-5654
	C421	10UF, 20V	04-5655
	C422-C423	47PF, 100V	04-5660
	C441-C442	68UF, 6.3V	04-5654
	C531	10UF, 20V	04-5655
	C541-C542	1UF, 35V	04-5656
	C543	2700UF, 10V	04-5621
	C551	0.1UF, 50V	04-5663
	C552	68UF, 6.3V	04-5654
	C611	10UF, 20V	04-5655
	C612	0.001UF, 100V	04-5659
	C621	0.01UF, 50V	04-5664
	C622	68UF, 6.3V	04-5654
	C631	0.0056UF, 3KV	04-5522
	C632	100PF, 3KV	04-5532
	C641-C642	0.0056UF, 3KV	04-5522
	C651-C652	0.1UF, 50V	04-5663
	C653	1UF, 35V	04-5656
	C711-C712	1UF, 35V	04-5656
	C721	10UF, 20V	04-5655
	C722	0.001UF, 100V	04-5659
	C731	100PF, 3KV	04-5532
	C732	0.0056UF, 3KV	04-5522
	C741-C742	0.0056UF, 3KV	04-5522
TRANSISTORS	Q151-Q154	2N7002L	05-5840
	Q321-Q322	2N7002L	05-5840
	Q331	MJD200	05-5844
	Q431	2N7002L	05-5840
	Q651	MJD210	05-5843
	Q652	MMBT3904T	05-5841
	Q721	MMBT3904T	05-5841
VOLTAGE REGULATOR	VR341	LT1129CQ-5	06-6372
INTEGRATED CIRCUITS	U031	SA08-11EWA	07-6389
	U032	HLMP-2785	07-6371
	U041	HLMP-2685	07-6400
	U111	ICM7218CIQI	06-6311
	U131	SA08-11EWA	07-6389
	U201	MAX220	06-6329

	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
	U231	SA08-11EWA	07-6389
	U232	HLMP-2785	07-6371
	U233	SA08-11EWA	07-6389
	U241	HLMP-2685	07-6400
	U251	TLC372ID	06-6290
	U321	X24CO2S8I	06-6299
	U331	ICL7663CBA	06-6302
	U411	N87C51FA	06-6286
	U521	CD74HC4538M	06-6297
	U531	LM358D	06-6312
	U551	TLC27M7ID	06-6292
	U611	TLC372	06-6290
	U711	LM285M-1.2	05-5845
	U721	CA3096M	06-6288
DIODES	CR341-C342	CMSH1-40M	07-6411
	CR541	CMSH1-40M	07-6411
	CR651	MMBD914L	07-6353
	CR741-CR744	MR250-2	07-6266
LED	DS011	HLMP-2550	07-6370
SWITCHES	S001	ALERT POINT	08-6728
	S101	ALARM POINT	08-6728
	S201	CALIBRATION CONSTANT	08-6728
	S301	DEADTIME CORRECTION	08-6728
	S501	DOWN	08-6728
	S511	UP	08-6728
	S512	OPTION DIPSWITCH	08-6709
POTENTIOMETER	R522	1M, OVLD ADJ	09-6778
	R523	1M, BAT CHG ADJ	09-6778
	R535	200K, DISC ADJ	09-6949
	R536	200K, HV ADJ	09-6949
	R537	5K, ANALOG ADJ	09-6948
RESISTORS	R011	100, 1%, 125mW	12-7840
	R041	10, 1/2W	11-7251
	R042	60.4, 1%, 250mW	12-7962
	R141	10, 1/2W	11-7251
	R142	60.4, 1%, 250mW	12-7962
	R151-R152	100K, 1%, 125mW	12-7834

<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
R201	22.1K, 1%, 125mW	12-7843
R241	2.21K, 1%, 125mW	12-7835
R251	10.0K, 1%, 125mW	12-7839
R252	24.3K, 1%, 125mW	12-7867
R253	82.5K, 1%, 125mW	12-7849
R331	1.00K, 1%, 125mW	12-7832
R332	165K, 1%, 125mW	12-7877
R341	2.2 OHM, 1%, 125mW	12-7932
R421-R422	100K, 1%, 125mW	12-7834
R431	1.00K, 1%, 125mW	12-7832
R432	100K, 1%, 125mW	12-7834
R521	402K, 1%, 125mW	12-7888
R531	10.0K, 1%, 125mW	12-7839
R532	100K, 1%, 125mW	12-7834
R533	10.0K, 1%, 125mW	12-7839
R534	2.21K, 1%, 125mW	12-7835
R551	475K, 1%, 125mW	12-7859
R552	100K, 1%, 125mW	12-7834
R611	33.2K, 1%, 125mW	12-7842
R621	4.75K, 1%, 125mW	12-7858
R622	10.0K, 1%, 125mW	12-7839
R623	1.00K, 1%, 125mW	12-7832
R631	47.5K, 1%, 125mW	12-7872
R632	1M	10-7028
R633-R634	1G	12-7686
R635	1M	10-7028
R651	22.1K, 1%, 125mW	12-7843
R652	200, 1%, 125mW	12-7846
R653	2.21K, 1%, 125mW	12-7835
R711	100, 1%, 125mW	12-7840
R712	22.1K, 1%, 125mW	12-7843
R713	8.25K, 1%, 125mW	12-7838
R714	10.0K, 1%, 125mW	12-7839
R721	10.0K, 1%, 125mW	12-7839
R722	100K, 1%, 125mW	12-7834
R723	1.00K, 1%, 125mW	12-7832
R724	4.75K, 1%, 125mW	12-7858
R731	5.6M	10-7093
R732-R733	100K, 1%, 125mW	12-7834
R734	1M	10-7028
R735	10.0K, 1%, 125mW	12-7839

	<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
RESISTOR NETWORK	RN411	220K	12-7831
CONNECTOR	P1	CONN-1-640457-1	13-8397
INDUCTORS	L411	220UHY	21-9678
RELAY	RL451	JS1-5V, AROMAT	22-9893
TRANSFORMER	T751	L8050	40-0902
MISCELLANEOUS	*	SOCKET 44P PLCC	06-6613
	9ea.	Cloverleaf 011-6809	18-8771
OPTIONAL RELAY	RL451	RELAY AROMAT JS1E-5V	22-9893
	CR451	1N4001	07-6268
	P6	CONN-640457-3	13-8165
<b>Wiring Diagram, Drawing 396 x 176</b> AUDIO	DS1	MC-V09-530-S	21-9730
CONNECTOR	J1	CONN-1-640441-2	13-8431
	J2	FILTER CORCOM 3EHG1-2	21-9830
	J3	D RECPT-RD9F000V3 9 PIN	13-8003
SWITCH	S1	DM62J12S205PQ W/LEGEND	08-6715
TRANSFORMERS	T1	CFP302 115/230V	22-9908
BATTERY	B1	BATTERY-PS630	21-9705
<b>Internal Detectors</b>	*	Model 375/2 (only) DET ASSY.	4396-055
	*	Model 375/4 (only) DET ASSY.	4396-056

**Section**  
**10**

## **Drawings**

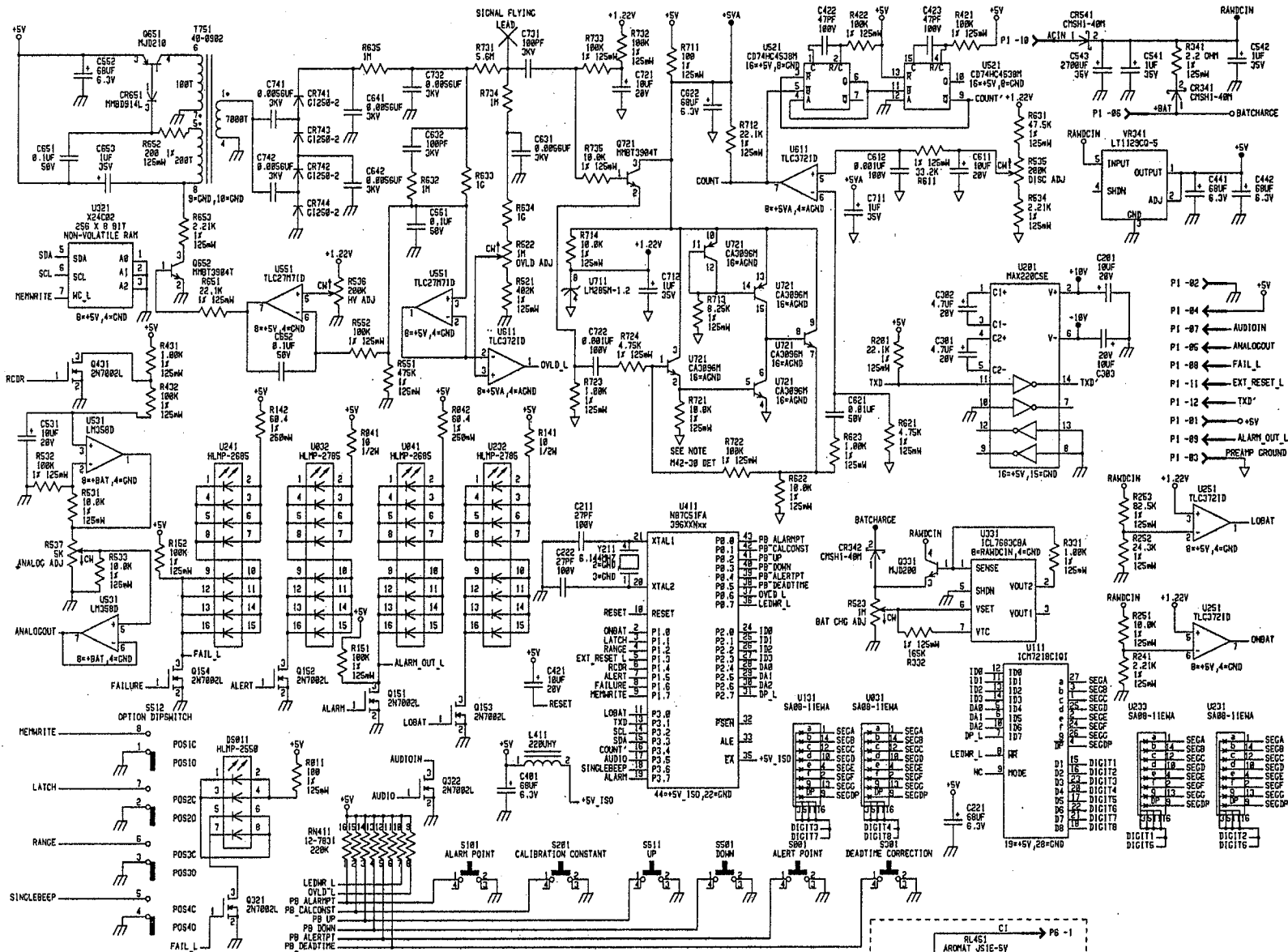
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Main Circuit Board, Drawing 396 × 160

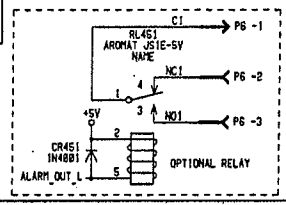
Main Circuit Board Component Layout Drawing 396 × 161A (2 sheets)

Wiring Diagram, Drawing 396 × 176

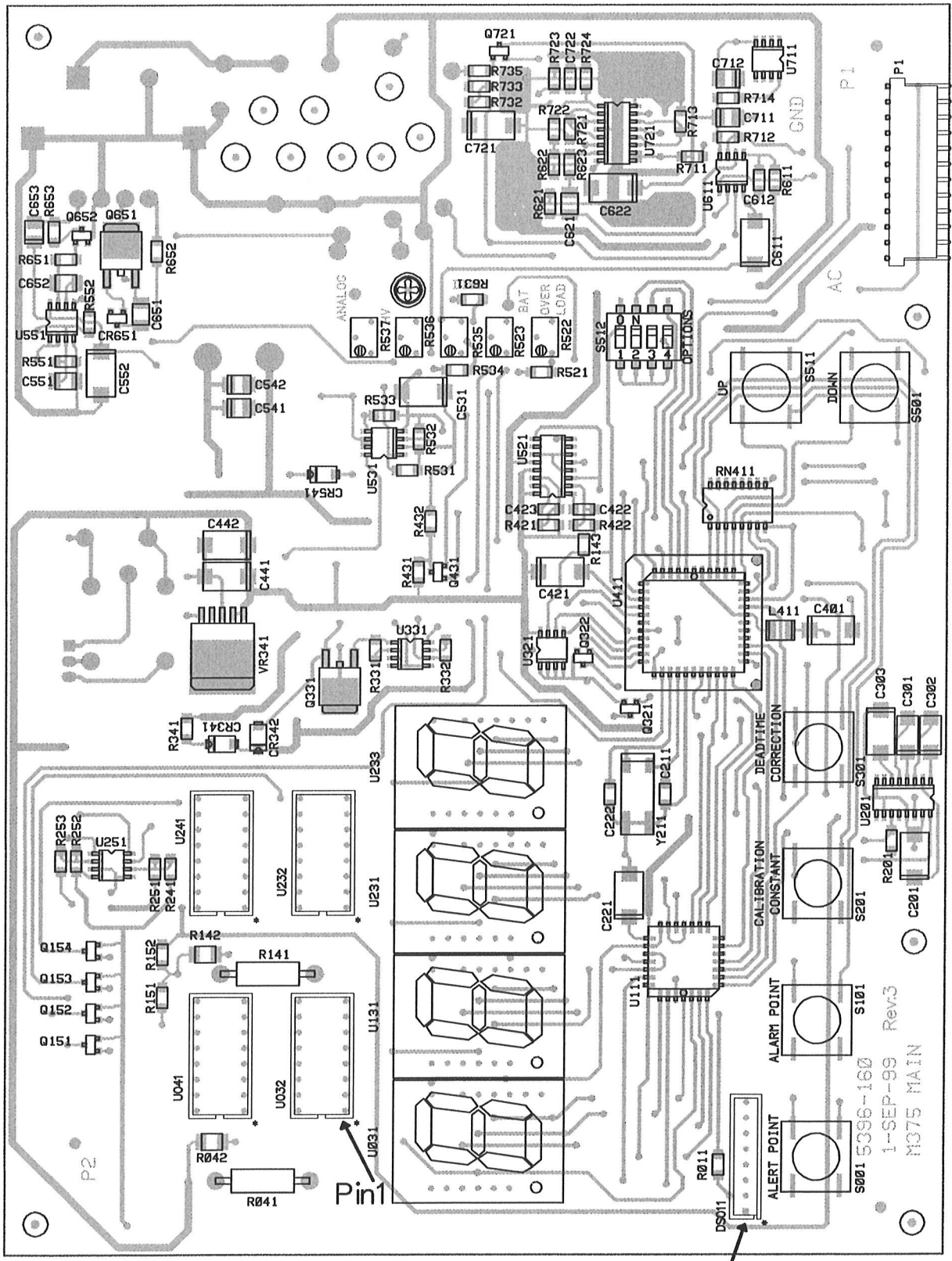





NOTE FOR 42-38 DETECTOR ONLY:  
 REPLACE R722 WITH  
 1 12-7841 392K AND  
 84-5787 4.7P 200V  
 PICCOBACKED ON TOP



UPDATED		19-OCT-95		LUDLUM MEASUREMENTS INC.	
DR	CKB	19-APR-92		TITLE: MAIN BOARD	
DSGN	RSS	26-JUL-95	BOARD#	6396-160	SHEET
APP'D			SIZE	MODEL	396
NEXT HIGHER ASSY.			C	376	160
13:19:35		19-OCT-95	DR	SR396160	SHEET
					OF 1



S001 5396-160  
 1-SEP-99 Rev.3  
 M375 MAIN

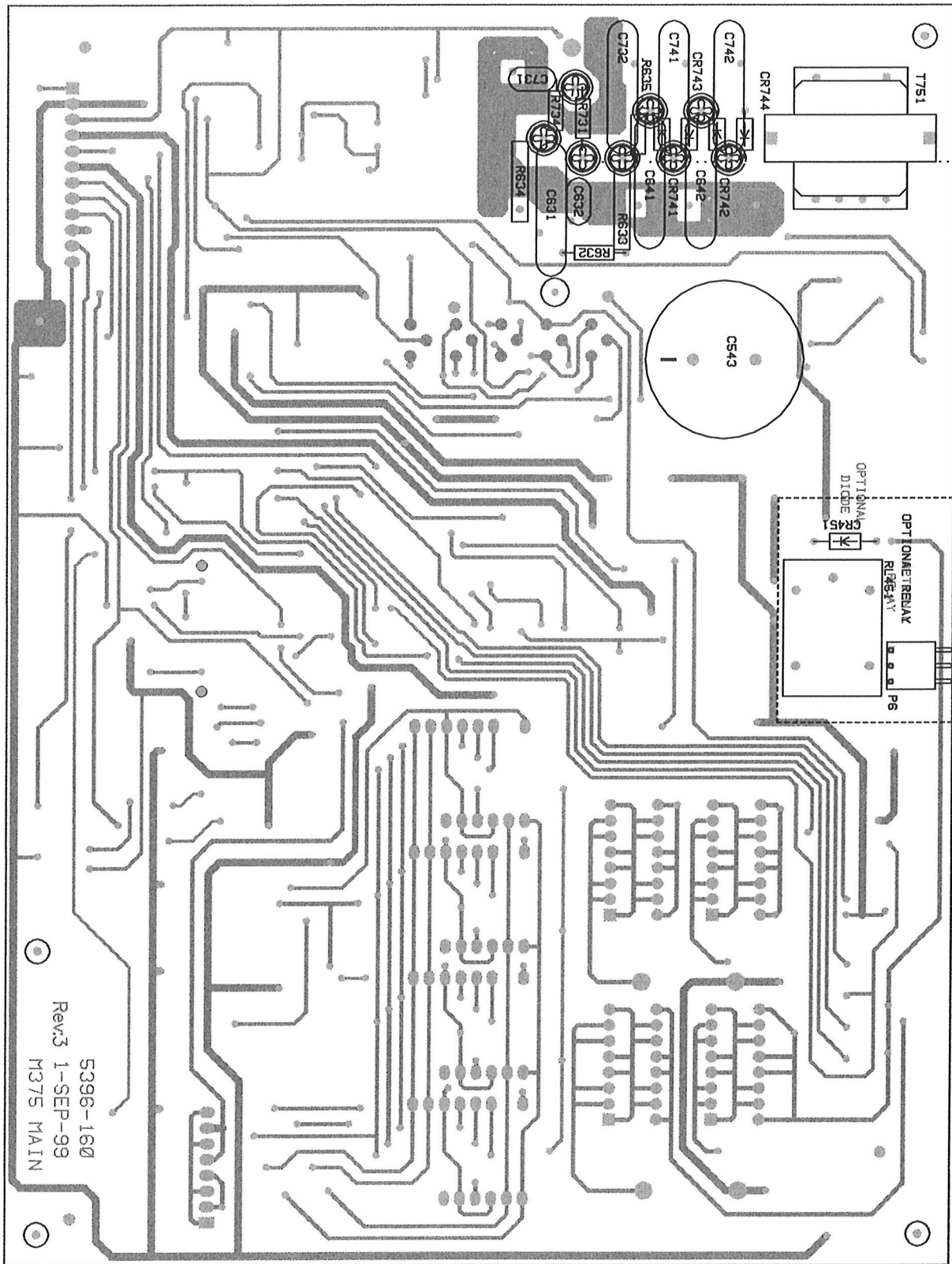


**LUDLUM**  
MEASUREMENTS, INC.

PO Box 810  
501 Oak Street  
Sweetwater, TX 79556  
U.S.A. 1-800-622-0828

<b>Title:</b> Main Board		
<b>Drawn:</b> CKB	04/19/02	<b>Model:</b> M 375
<b>Design:</b> RSS	07/26/95	<b>Board#:</b> 5396-160
<b>Approve:</b> <i>Ros</i>	<i>245015</i>	<b>Rev:</b> 3
<b>PCBA Drawing</b>		<b>SCALE:</b> 1.08
<b>Print Date:</b> 9/22/2015	12:17:03 PM	<b>Series</b> Sheet
		396 161A

W:\Projects\LMM 375\5396-160\Rev3\396160R3\_Assy.PcbDoc



5396-160  
 Rev.3 1-SEP-99  
 M375 MAIN

**LUDLUM MEASUREMENTS, INC.**  
 PO Box 810  
 501 Oak Street  
 Sweetwater, TX 79556  
 U.S.A. 1-800-622-0828

<b>Title:</b> Main Board		
<b>Drawn:</b> CKB	04/19/02	<b>Model:</b> M 375
<b>Design:</b> RSS	07/26/95	<b>Board#:</b> 5396-160
<b>Approve:</b> <i>RDS</i>	<i>24 SEP 95</i>	<b>Rev:</b> 3
<b>PCBA Drawing</b>		<b>SCALE:</b> 1.08
<b>Print Date:</b> 9/22/2015	12:17:06 PM	<b>Series</b> Sheet
W:\Projects\LMM\375\5396-160\Rev3\396160R3_Assy_Pcb.Doc		<b>Bottom Overlay</b> 396 161A

### RELAY OPTIONS

FORM C RELAY (3 PIN CONNECTOR ADDED)  
4396-201

J4  
3 PIN CONNECTOR

- 1 — NORMALLY OPEN
- 2 — COMMON
- 3 — NORMALLY CLOSED

MAINS RELAY (3 PIN CONNECTOR ADDED)  
4396-202

J5  
3 PIN CONNECTOR

- 1 — HOT 120(VAC) ON HIGH ALARM
- 2 — NEUTRAL
- 3 — EARTH GROUND

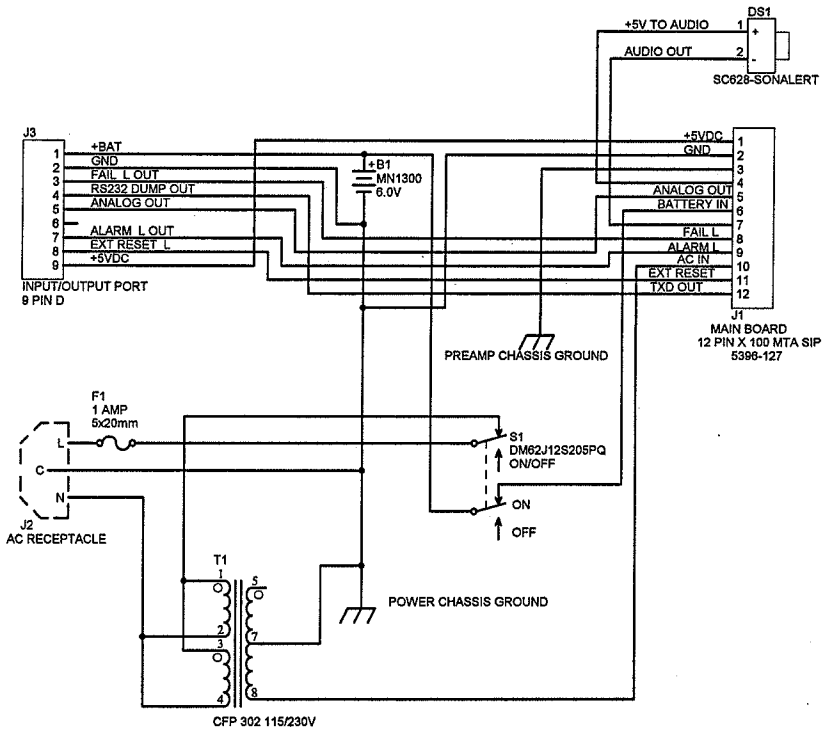
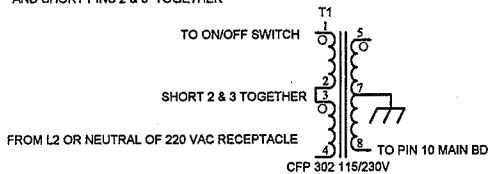
### 4-20 mA ISOLATED OUT

J3  
INPUT/OUTPUT PORT  
9 PIN D

- 1 — +BAT
- 2 — GND
- 3 — FAIL\_L OUT
- 4 — RS232 DUMP OUT
- 5 — 4-20mA SOURCE
- 6 — 4-20mA RETURN (ISOLATED)
- 7 — ALARM\_L OUT
- 8 — EXT RESET\_L
- 9 — +5VDC

### 220 VAC OPERATION

TO CONVERT FROM 110 VAC OPERATION TO 220 VAC:  
DISCONNECT WIRES GOING TO PINS 2 & 3  
INSULATE THE WIRES WITH SHRINK OR TAPE,  
AND SHORT PINS 2 & 3 TOGETHER



<b>LUDLUM MEASUREMENTS, INC.</b>		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
Drawn: CKB	03-Mar-06	Title: WIRING DIAGRAM	
Design: RSS	19-SEP-02	Model: 375	
Check:		Board#: 398-283	
Approved: <i>[Signature]</i>	10:29:46	Sheet: 1 of 1	Series: 396
	3-Mar-2006	Rev: 3.0	Sheet: 176
396X176			