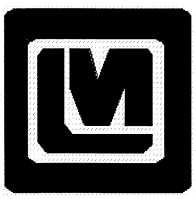
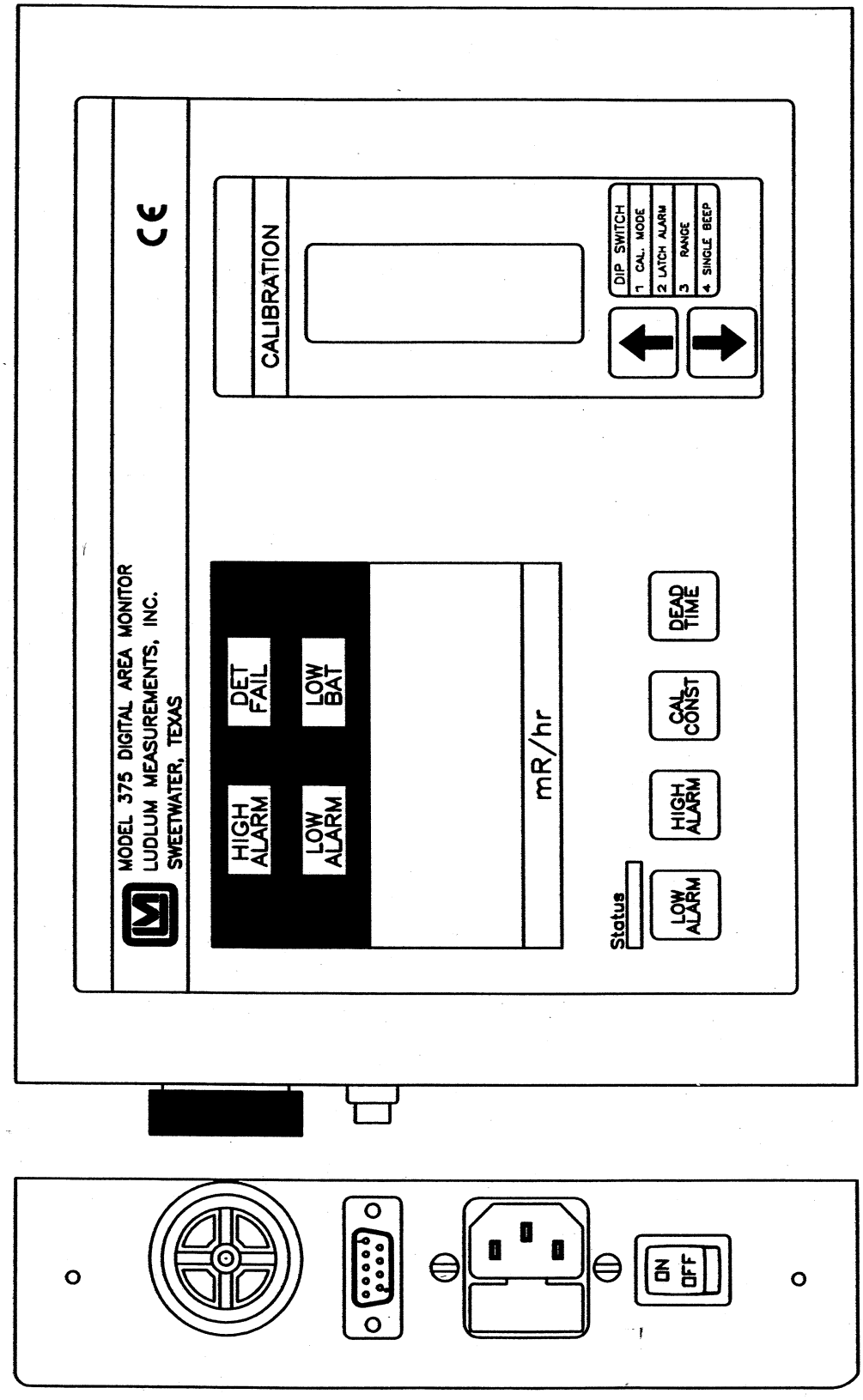
LUDLUM Model 375 (375/2 & 375/4)
DIGITAL WALL-MOUNT AREA MONITOR

August 2004
Serial Number 179939 and Succeeding Serial Numbers



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

REV #	ALTERATIONS	DATE	BY
	VALID	12-12-97	TJR



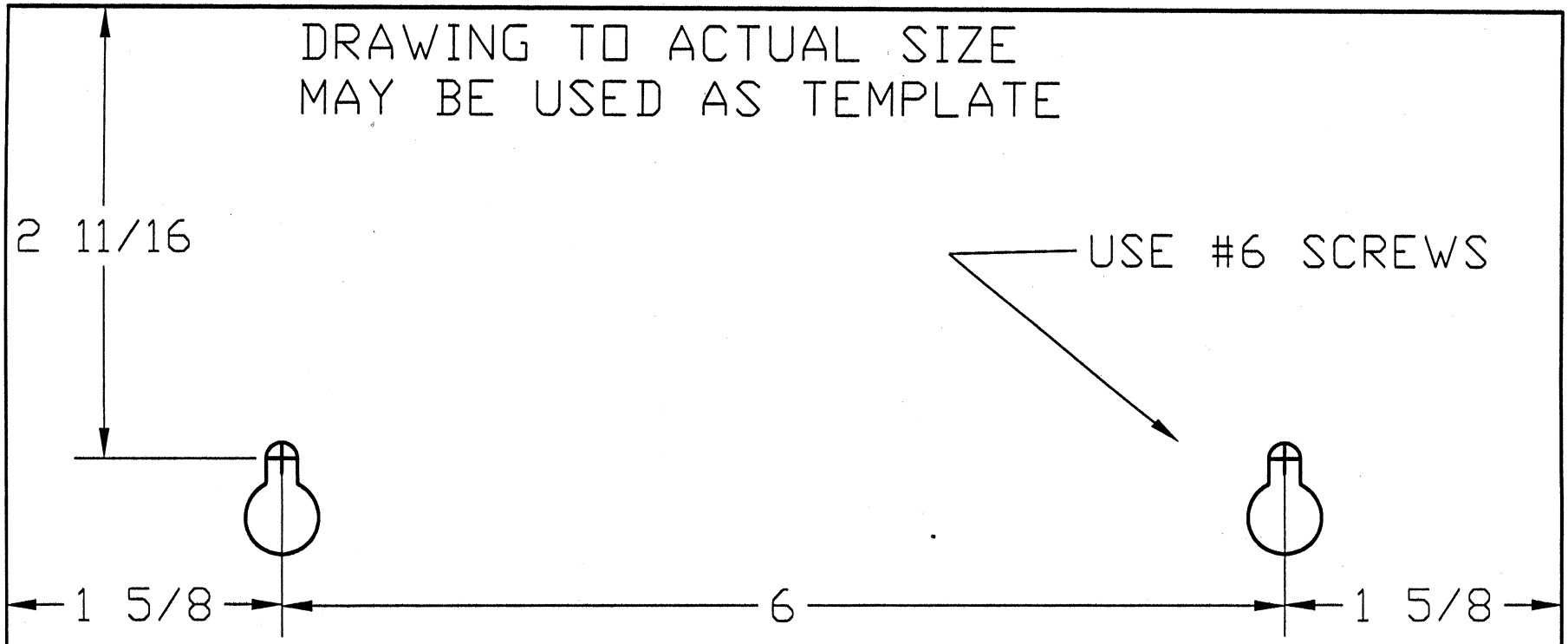
DWN	DATE	CHECKED	APPROVED
TJR	12-12-97	12-12-97 JGW	12-12-97 blh

TITLE: M 375 FRONT PANEL

LUDLUM MEASUREMENTS, INC.
501 OAK STREET
SWEETWATER, TEXAS 79556

SERIES	SHEET
396	30

DRAWING TO ACTUAL SIZE
MAY BE USED AS TEMPLATE



DESC: WALL MOUNTING GUIDE					
MODEL NO.: M 375					
DRW: TJR	DATE: 11-11-99	CHK: [illegible]	DATE: 11-11-99	APP: [illegible]	DATE: 3/Mar02
TOL: SHOP STD [X] OTHER		SCALE: FULL [X] OTHER			
LUDLUM MEASUREMENTS, INC. 501 OAK STREET SWEETWATER, TEXAS 79556		SERIES: 396		SHEET: 166	

TABLE OF CONTENTS

1. DESCRIPTION

The M375 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. Calibration parameters are protected under a calibration cover. Calibration is easily accomplished by using the pushbuttons to increment and decrement the calibration constant and dead time correction parameters. Parameters are stored in non-volatile memory and are retained even with power disconnected. A five-decade logarithmic analog output is provided. The battery backup provides 48 hours of additional use after the primary power is removed. The Model 375 can be furnished with an external detector or an internal detector. A Model 375 with an internal LND 71210 detector is referred to as a Model 375/2. A Model 375 with an internal LND 71412 detector is referred to as a Model 375/4.

2. GETTING STARTED

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.

2.1 External Detectors (Opt.)

The Model 375 can have either an internal or external detector. If your Model 375 has a connector on the bottom side of the instrument, then your Model 375 is designed for an external detector. If you have an external detector, use the cable provided to connect it to the Model 375.

☑ **NOTE: Since the coaxial cable supplies high voltage for detector operation, splicing or re-terminating cables must be done very carefully. Improper termination will result in shorting out the high voltage and a "DET FAIL" condition.**

2.2 Power Up

Plug the power cord into a suitable 120 VAC outlet. If the RS-232 feature is used, plug in a suitably wired 9-pin connector cable. (See section 6 of this manual for the pinout 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. Initial power-up will temporarily turn on front panel lights, audio, and display "8888". The software version number (3960xNyy) is then displayed as "396" and "0xyy". The readout will be blanked, and will then display the current radiation level.

2.3 Radiation Units

The Model 375 may be calibrated for almost any desired radiation units of measure. Common units of measure include mR/hr, µR/hr, R/hr, mSv/h, µSv/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.

2.4 Checking Parameters

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

☐ Check the high alarmpoint setting by pressing the HIGH ALARM button. The high alarmpoint will be displayed as long as the button is pressed. The high alarmpoint is in units of <units>. The high alarmpoint 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.

2.5 Options

When a calibration cover is removed, a four-pole dipswitch is accessible that can activate/deactivate options. These four options are CAL MODE, LATCH ALARM, RANGE, and SINGLEBEEP.

☐ 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 in the current parameters and disables any further changes.

☐ 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 alarmpoint. When switched to the right, the high alarm light and audio are latched until either the LOW ALARM or HIGH ALARM button is pressed.

☐ 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.

☐ Switching the fourth switch to the right places the instrument into singlebeep 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.

3. SPECIFICATIONS

3.1 Power

Input power is by way of the IEC 320 AC power receptacle. Required power is 120 VAC at less than 10 watts. Non-alarm battery current consumption at 6 Vdc is 50 mA. Alarming current consumption at 6 Vdc is 200 mA.

3.2 Battery Backup

The battery backup is a 3,000-mA sealed-lead rechargeable battery. The battery is recharged by way of an on-board trickle charger. Battery life is 48 hours under non-alarm conditions, 12 hours under alarm conditions.

The display is blanked under non-alarm conditions when under battery power. Blanking is suppressed while the CAL MODE switch is to the right.

3.3 Range

The model 375 operates within a selectable four-decade range. The range can be 0.1 <units> - 999.9 <units> or 1 <units> - 9999 <units>. Switching range does not change the calibration.

The linear operating range will depend upon the type of detector used. The operating range of the 375/2 is from 0.1 mR/hr to 1 R/hr. The operating range of the 375/4 is 1 mR/hr to 4 R/hr. Other (external) detectors will have different operating ranges.

3.4 Status

A green light indicates proper instrument operation. A red DET FAIL light warns of improper operation: internal failure, detector overload, or no counts within a fifteen-minute period. A yellow LOW BAT light warns of a low battery and will also trigger the DET FAIL light.

3.5 Audio Output

The Model 375 has three different types of audio output. A LOW ALARM triggers a slow beep, a HIGH ALARM triggers a fast beep, and a DET FAIL causes a steady tone. The audio intensity can be changed by rotating the baffle on the audio device.

3.6 Detector

The detector can be internal or external. If furnished with an external detector, a panel connector for detector connection is provided. The center pin is connected to a low current 2500 Vdc source.

☑ CAUTION: DO NOT TOUCH CENTER PIN, DUE TO RISK OF ELECTRIC SHOCK.

3.7 RS-232 Output

Every two seconds the Model 375 dumps RS-232 data out on pin 4 of the 9-pin connector. The following example program shows how an IBM-compatible PC can be used to collect the data:

```
'Demonstration Program
'Model 375 RS-232 communication program written for QuickBasic
'This program causes the computer screen to display the data being dumped from the Model 375.
'Needs the following cable:
'       Model 375       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 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 coml trapping
ON COM(1) GOSUB Getcomport  'if something comes in coml, 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
```

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:

```
            RS-232 Data Format
The data will be sent to the RS-232 port as:
    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)
```

3.8 Overrange

When dead time correction accounts for more than 75% of the displayed reading, the instrument is in overrange. During overrange the display will show "----" and the low alarm and high alarm will be activated.

3.9 Overload

When excessive radiation fields cause the detector to overload or saturate, the display will show "-OL-" and the FAIL alarm will be activated. Overload is usually set just above the highest range of the detector.

3.10 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. The five potentiometers are detailed below:

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 only with a high impedance (1000-Mohm impedance) voltmeter. 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. Set DISC voltage to 2.5 x desired pulse height threshold. 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 setpoint will cause the FAIL light to engage, and the display will be forced to -OL-.

3.11 Size

The Model 375 is 9.7" (24.6 cm) wide, 7.4" (18.7 cm) high, and 2.5" (6.4 cm) deep.

3.12 Weight

The Model 375 weighs 6.5 lbs. (2.95 kg).

4. CALIBRATION

4.1 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. Note that the analog output goes to full scale during a DET FAIL condition.

4.2 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 (1000 Mohm) voltmeter. A high voltage checkpoint is located next to the HV potentiometer.

4.3 Discriminator

The potentiometer labeled DISC, 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.

4.4 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.

4.5 Overload

The potentiometer labeled OVERLOAD, located under the calibration cover, is used to set the detector current overload point. The desired overload point will depend on the type of detector used. An overload will cause the display to show "-OL-" and illuminate the DET FAIL light.

4.6 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.

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.

5. TYPICAL DETECTOR SETUP

5.1 M375/2

The Model 375/2 is a M375 with an internal energy-compensated LND 7121 GM detector. Typical response and setpoints are as follows:

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

Typical Checkpoints:
- 1 mR/hr
- 4 mR/hr
- 8 mR/hr * calibration constant setpoint
- 40 mR/hr
- 80 mR/hr
- 400 mR/hr * dead time correction setpoint
- 800 mR/hr
- 1,000 mR/hr

5.2 M375/4

The Model 375/4 is a M375 with an internal energy-compensated LND 714 GM detector. Typical response and setpoints are as follows:

Operating Voltage: 550 Vdc
Threshold: 100 mVdc
Calibration Constant: 150 cpm/mR/hr
Dead Time Correction: 30 µsec-150 µsec
Linear Range with DTC: 1 mR/hr - 4 R/hr

Typical Checkpoints:
- 4 mR/hr
- 8 mR/hr
- 40 mR/hr * calibration constant setpoint
- 80 mR/hr
- 400 mR/hr
- 800 mR/hr
- 1,000 mR/hr
- 2,000 mR/hr * dead time correction setpoint
- 4,000 mR/hr

6. CONNECTORS

6.1 9-Pin Data Connector

The 9-pin connectors provide for output signals from the instrument and input voltage to the instrument. The assignments are as follows:

pin1-+BATTERY
pin2-GND IN
pin3-FAIL_L
pin4-RS232 DUMPOUT
pin5-ANALOG OUT
pin6-N.C.
pin7-ALARM_L
pin8-EXT RESET_L
pin9-+5VDC OUT

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

7. CLEANING THE INSTRUMENT

The Model 2200 may be cleaned with a damp cloth (using only water as the wetting agent). Do not immerse the instrument in any liquid. Observe the following precautions when cleaning:

(1) Turn instrument OFF and disconnect the instrument power cord.

(2) Allow the instrument to sit for 1 minute before accessing internal components.

PARTS LIST

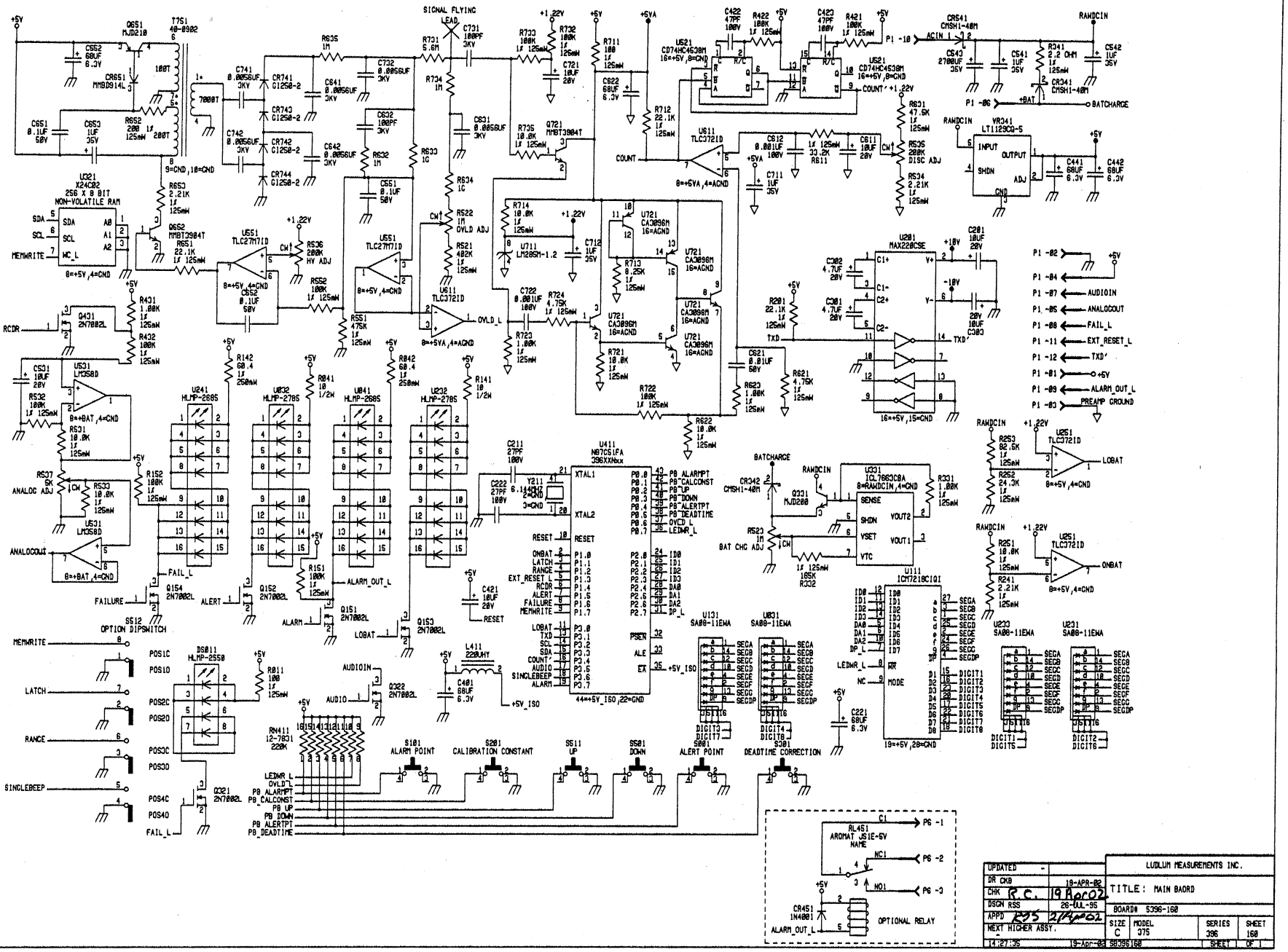
Ref. No.	Description	Part No.
Model 375 Digital Wall-Mount Area Monitor		
UNIT	Completely Assembled Model 375 Area Monitor	48-2230
Circuit Board, Drawing 396 X 160		
BOARD	Assembled Circuit	5396-160
• **CAPACITORS**		
C201	10µF, 20V	04-5655
C211	27pF, 100V	04-5658
C221	68µF, 6.3V	04-5654
C222	27pF, 100V	04-5658
C301-C302	4.7µF, 25V	04-5653
C303	10µF, 20V	04-5655
C401	68µF, 6.3V	04-5654
C421	10µF, 20V	04-5655
C422-C423	47pF, 100V	04-5660
C441-C442	68µF, 6.3V	04-5654
C531	10µF, 20V	04-5655
C541-C542	1µF, 35V	04-5656
C543	2700µF, 10V	04-5621
C551	0.1µF, 50V	04-5663
C552	68µF, 6.3V	04-5654
C611	10µF, 20V	04-5655
C612	0.001µF, 100V	04-5659
C621	0.01µF, 50V	04-5664
C622	68µF, 6.3V	04-5654
C631	0.0056µF, 3kV	04-5522
C632	100pF, 3kV	04-5532
C641-C642	0.0056µF, 3kV	04-5522
C651-C652	0.1µF, 50V	04-5663
C653	1µF, 35V	04-5656
C711-C712	1µF, 35V	04-5656
C721	10µF, 20V	04-5655
C722	0.001µF, 100V	04-5659
C731	100pF, 3Kv	04-5532
C732	0.0056µF, 3kV	04-5522
C741-C742	0.0056µF, 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 REGULATORS**		
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
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	SW-1241.1619.11	08-6728
S101	SW-1241.1619.11	08-6728

Ref. No.	Description	Part No.
S201	SW-1241.1619.11	08-6728
S301	SW-1241.1619.11	08-6728
S501	SW-1241.1619.11	08-6728
S511	SW-1241.1619.11	08-6728
S512	SW-90HBW04S	08-6709
• **RESISTORS**		
R011	100 OHM	12-7840
R041	10 OHM	11-7251
R042	60.4 OHM	12-7962
R141	10 OHM	11-7251
R142	60.4 OHM	12-7962
R151-R152	100k	12-7834
R201	22.1k	12-7843
R241	2.21k	12-7835
R251	10k	12-7839
R252	24.3k	12-7867
R253	82.5k	12-7849
R331	1k	12-7832
R332	165k	12-7877
R341	2.2 OHM	12-7932
R421-R422	100k	12-7834
R431	1.00k	12-7832
R432	100k	12-7834
R521	402k	12-7888
R522-R523	1M Trimmer	09-6778
R531	10k	12-7839
R532	100k	12-7834
R533	10k	12-7839
R534	2.21k	12-7835
R535-R536	200k Trimmer	09-6949
R537	5k Trimmer	09-6948
R551	475k	12-7859
R552	100k	12-7834
R611	33.2k	12-7842
R621	4.75k	12-7858
R622	10k	12-7839
R623	1k	12-7832
R631	47.5k	12-7872
R632	1M	10-7028
R633-R634	1G	12-7686
R635	1M	10-7028
R651	22.1k	12-7843
R652	200 OHM	12-7846
R653	2.21k	12-7835
R711	100 OHM	12-7840
R712	22.1k	12-7843
R713	8.25k	12-7838
R714	10k	12-7839
R721	10k	12-7839
R722	100k	12-7834
R723	1k	12-7832
R724	4.75k	12-7858
R731	5.6M	10-7093
R732-R733	100k	12-7834
R734	1M	10-7028
R735	10k	12-7839
• **RESISTOR NETWORK**		
RN411	220k	12-7831
• **INDUCTORS**		
L411	220µH	21-9678
• **TRANSFORMERS**		
T751	L8050	40-0902
• **CRYSTALS**		
Y211	6.144 MHZ	01-5262
• **MISCELLANEOUS**		
P1	CONN-1-640457-2	13-8464
*	SOCKET 44P PLCC	06-6613
9ea.	Cloverleaf 011-6809	18-8771
• **OPTIONAL RELAY**		
RL451	RELAY	
	AROMAT JS1E-5V	22-9893
CR451	1N4001	07-6268
P2	CONN-640457-3	13-8165

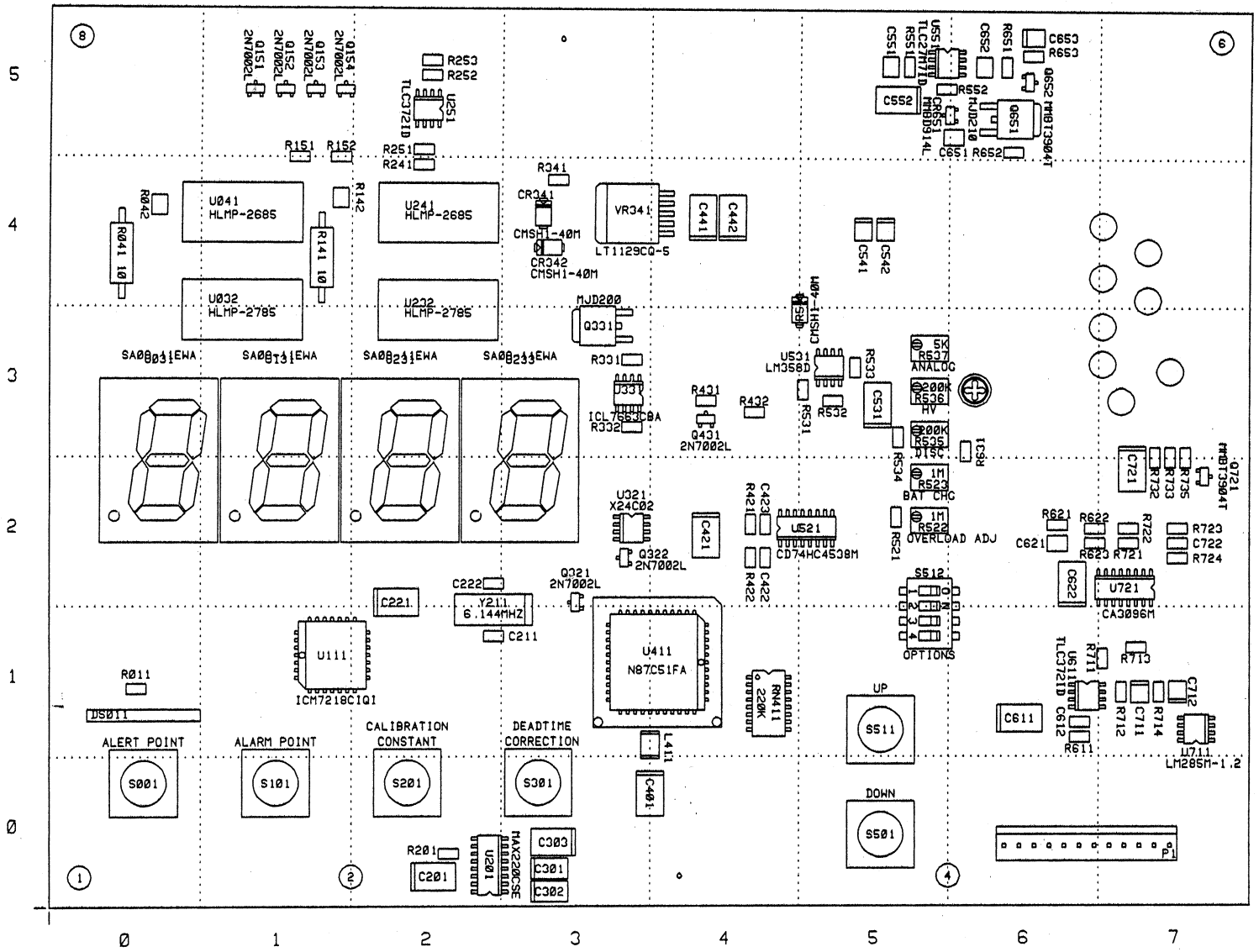
Ref. No.	Description	Part No.
	Chassis Wiring Diagram, Drawing 396 X 176	
	• **AUDIO**	
DS1	MC-V09-530-S	21-9730
	• **CONNECTOR**	
J1	CONN-1-640441-2	13-8431
J2	FILTER CORCOM 3EHG1-2	21-9830
J3	D RECPT-RD9F000V3 9 PIN	13-8003
	• **SWITCHES**	
S1	DM62J12S205PQ W/LEGEND	08-6715
	• **TRANSFORMERS**	
T1	CFP302 115/230V	22-9908
	• **MISCELLANEOUS**	
B1	BATTERY-PS630	21-9705

DRAWINGS AND DIAGRAMS

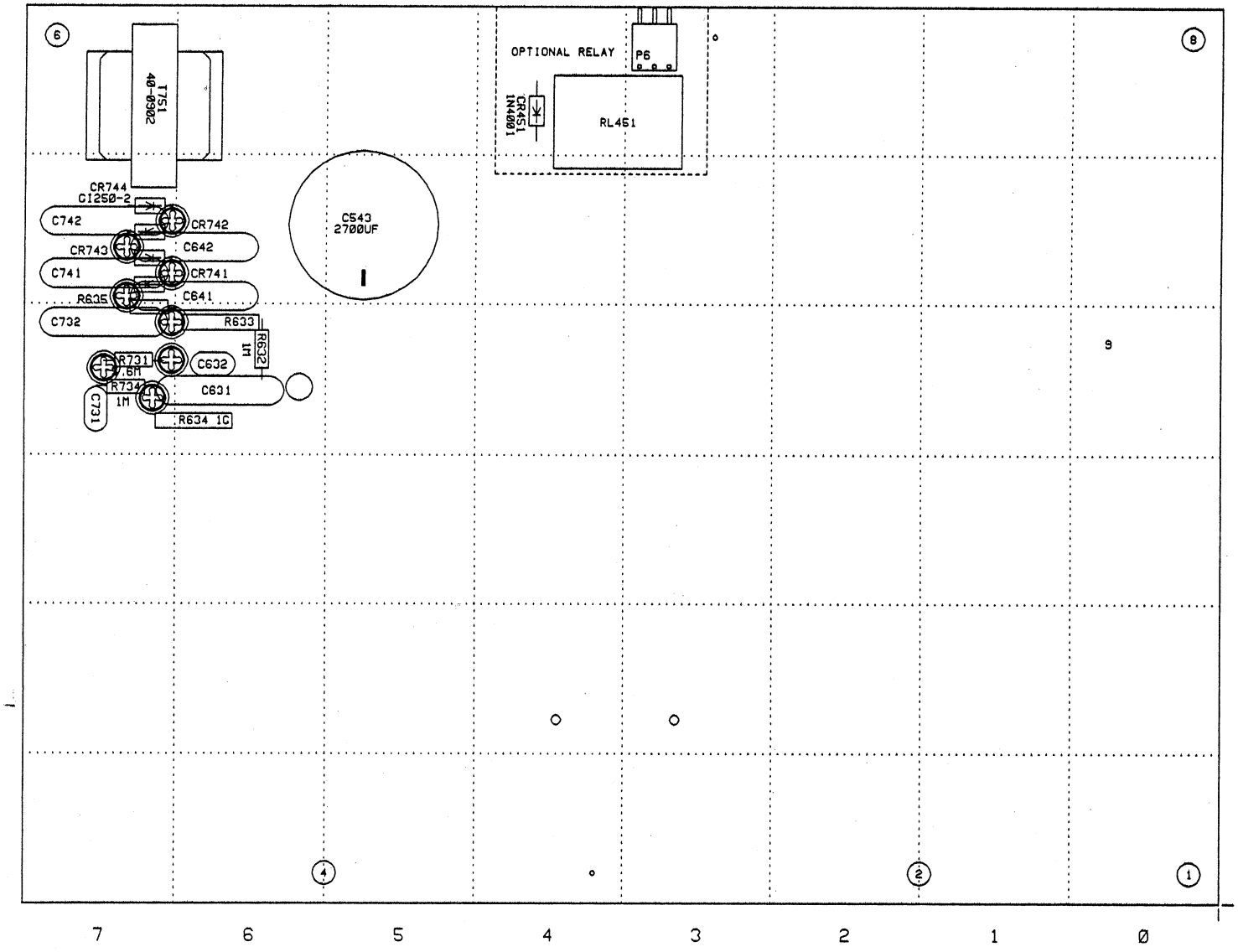
Main Circuit Board, Drawing 396 x 160
Main Circuit Board Component Layout (Top side), Drawing 396 x 161
Main Circuit Board Component Layout (Bottom side), Drawing 396 x 161
Wiring Diagram, Drawing 396 x 176



UPDATED	-	LUDLUM MEASUREMENTS INC.	
DR CKD	19-APR-02		
CHK R.C.	19 Apr 02	TITLE: MAIN BOARD	
DSGN RSS	26-JUL-95	BOARD# 5396-160	
APPD R.S.	27 Apr 02	SIZE C / MODEL 375 / SERIES 396 / SHEET 160	
NEXT HIGHER ASSY.			
14:27:35	19-Apr-02	58396160	SHEET OF 1



LUDLUM MEASUREMENTS INC. SWEETWATER, TX.					
DR	CKB	19-APR-02	TITLE: MAIN BOARD		
CHK	R.C.	19 Apr 02	BOARD# 5396-160		85396160
DSGN	RSS	1-NOV-95	MODEL 375	SERIES 396	SHEET 161
APP	RSS	21 Apr 02	COMP ARTWORK ☐		SLDR ARTWORK ☐
14:28:49		19-Apr-02	COMP OUTLINE ☒		SLDR OUTLINE ☐
COMP PASTE ☐		COMP MASK ☐	SLDR PASTE ☐		SLDR MASK ☐



LUDLUM MEASUREMENTS INC. SWEETWATER, TX.			
DR CKB	19-APR-02	TITLE: MAIN BOARD	
CHK R.C.	19 Apr 02	BOARD# 5396-160	
DSGN RSS	1-NOV-95	MODEL 375	SERIES 396 SHEET 161
APP BSS 21 Apr 02		COMP ARTWORK ☐	SLDR ARTWORK ☐
		COMP OUTLINE ☐	SLDR OUTLINE ☒
COMP PASTE ☐	COMP MASK ☐	SLDR PASTE ☐	SLDR MASK ☐

RELAY OPTIONS

FORM C RELAY (3 PIN CONNECTOR ADDED)
4396-066 + 4396-133

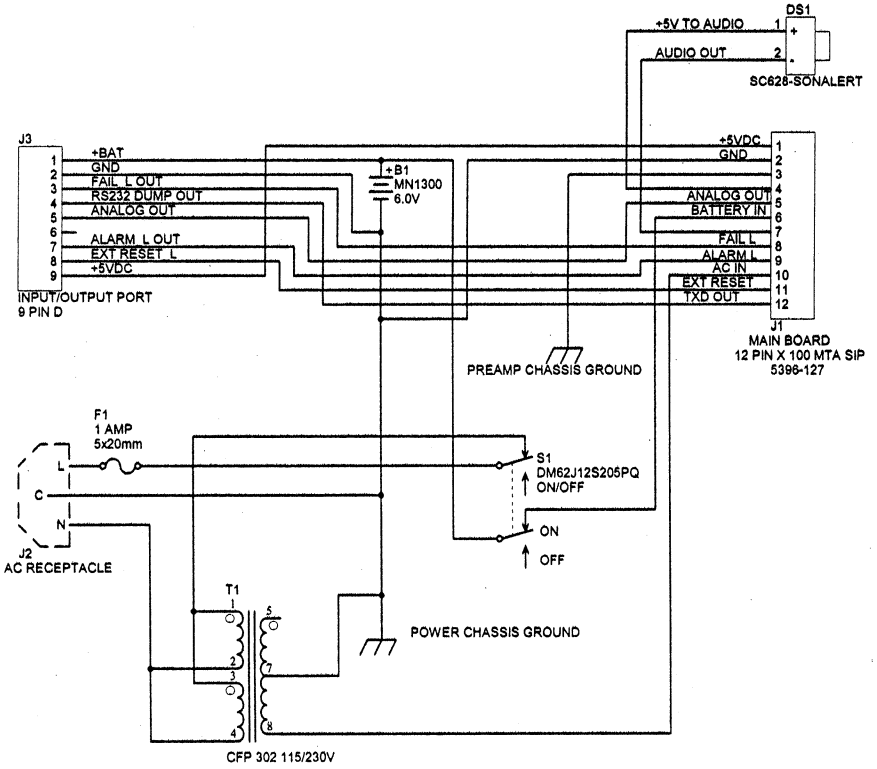
J4
3 PIN CONNECTOR
1 — NORMALLY OPEN
2 — COMMON
3 — NORMALLY CLOSED

FORM C RELAY (3 PIN CONNECTOR ADDED)
4396-098+ 4396-138

J5
3 PIN CONNECTOR
1 — HOT 120VAC 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



RELAY OPTIONS CONT

FORM C RELAY OPTION 4396-066
ALARM RELAY ACTIVATES ON HIGH ALARM

DURING NON-ALARM, 6 & 8 ARE CONNECTED
DURING HIGH ALARM, 6 & 7 ARE CONNECTED
LIMIT CURRENT THROUGH REALY TO 1 AMP

J3
1 — +BAT
2 — GND
3 — FAIL L OUT
4 — RS232 DUMP OUT
5 — ANALOG OUT
6 — RELAY COMMON
7 — RELAY NORMALLY OPEN
8 — RELAY NORMALLY CLOSED
9 — +5VDC
INPUT/OUTPUT PORT
9 PIN D

PREVIOUSLY CONNECTED WIRES CUT OFF
AND INSULATED WITH TAPE OR SHRINK

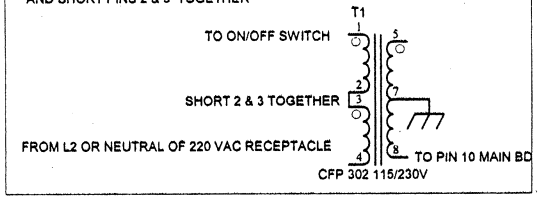
110 VAC RELAY OPTION 4396-096
ALARM RELAY ACTIVATES ON HIGH ALARM
DURING NON-ALARM, PIN 1 IS NORMALLY OPEN
DURING HIGH ALARM, PIN 1 HAS 110 VAC
LIMIT CURRENT THROUGH RELAY TO 1 AMP

J3
1 — 110 VAC ON HIGH ALARM
2 — NEUTRAL
3 — NC
4 — NC
5 — EARTH GROUND
6 — NC
7 — NC
8 — NC
9 — NC
INPUT/OUTPUT PORT
9 PIN D

PREVIOUSLY CONNECTED WIRES CUT OFF
AND INSULATED WITH TAPE OR SHRINK

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



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

Drawn: JK	19-SEP-02	Title: WIRING DIAGRAM		
Design: RDS	19-SEP-02	Model: 375		
Check:		Board#: 396-283		
Approve: RDS 20MAR03		Sheet: 1 of 1	Series	Sheet
16:27:55	20-Mar-2003	Rev: 1.0	396	176
396X176				

OPTIONAL FEATURES

APPENDIX A Time and Date Stamp Option

Time and Date Stamp
Firmware version: 39602N06

Description:

When an alarm or failure occurs the M375 will print the current reading, date, time and either ALARM or FAIL to the RS-232 port. The M375 will print once every 30 seconds as long as the alarm or fail condition is present.

Setup:

You will need the following:

M375
Printer with serial port
Cable

The cable is wired as follows:

M375	Printer (9-pin)	Printer (25-pin)
pin 4 TXD	pin 2	pin 3
pin 2 GND	pin 5	pin 7

Cable connector has male pins on Model 375 side
Cable connector has male pins on Printer side

The printer should be configured at 2400 BPS (baud), no parity, 8 data bits, 1 stop bit, 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.

(continued next page)

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
```

APPENDIX B 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 on a HIGH ALARM. Note that the internal circuit board-mounted relay is rated for 3 amps, but we recommend keeping the current to less than 1 amp. The relay can be configured as a set of Form C contacts or as a 120 VAC output. The signals can either be brought out through the 9 pin D connector, or through the addition of another 3 pin connector on the top of the chassis.

1) Form C Relay (using 9 pin D connector) 4396-066
   This option allows the user to have one set of form C contacts (normally open, normally closed, and common) that activates on a HIGH ALARM condition. These three contacts are made available by removing the signals on the 9 pin D connector, and inserting the three signals:

   Pin 6-common
   Pin 7-normally open (NO)
   Pin 8-normally closed (NC)

2) Form C Relay (3 pin connector added) 4396-066 + 4396-133
   Form C relay as above, but using an additional 3 pin connector, allowing the use of the 9 pin D connector for the Model 271, Model 272 remote, or the 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)

3) 120 VAC Relay Out (using 9 pin D connector) 4396-096
   The 120 VAC Relay Option wires the common of the relay to the instrument "hot" wire, after the fuse. So, upon a HIGH ALARM, the 120 VAC is supplied to the output connector. The "normal" wires are removed from the 9 pin D connector, and these signals brought out as follows:

   Pin 1-black HOT 120 VAC on HIGH ALARM
   Pin 2-white NEUTRAL
   Pin 5-green EARTH GROUND

(continued next page)

4) 120 VAC Relay Out (using 3 pin connector) 4396-096 + 4396-138
Same as above, but allowing the use of the 9 pin D connector for RS-232 or remote use. This 3 pin connector is wired as follows:

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

Internal Chassis-Mounted Relay

A larger relay (4396-147), able to handle 5 amps, can also be mounted in place of the internal battery of the Model 375. This relay is configured in fail-safe mode, interrupting power to another device during an alarm condition. The output of the relay (normally 120 VAC), is available through a 3-pin circular connector.

APPENDIX C Sigma Alarm Modification Option

Sigma Alarm Modification
Firmware 39606N02

The firmware version 39606N02 allows the Model 375 to have a sigma-based alarmpoint in addition to a regular fixed alarmpoint. This sigma-based alarmpoint allows the user to have a floating alarmpoint 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 alarmpoint. 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 alarmpoint, it is necessary first to determine the background radiation level in cps (counts per second). The sigma alarmpoint is then BKGND + (x sigma * square root of BKGND).

The HIGH ALARM has NOT been changed; it is still a fixed alarmpoint and will be activated when the radiation level exceeds that setpoint. 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.

APPENDIX D 4 to 20 mA Isolated Output Driver Addition

4 – 20 mA Driver (Isolated)
Circuit Board Part Number 5328-047

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 5328-047) accepts an analog input, varying between 0 and 1.25 volts, yielding a current output of 4 to 20 mA. Other output ranges are possible, including 0 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 example, Figure 1 below.

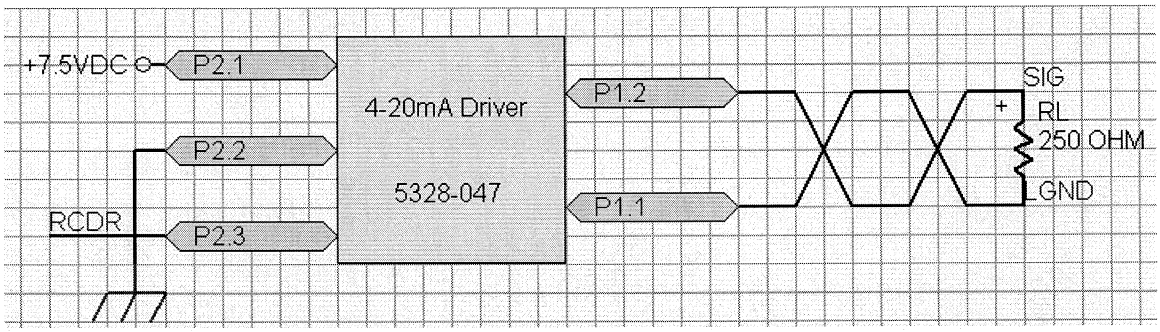


Figure 1: Wiring Diagram.

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

1) Apply 0 counts or reset the Model 375.
2) Adjust the OFFSET trimmer, R6, for a voltage of 1.00 V across Rterm, typically a 250 ohm (V = 0.004 X Rterm) 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.
3) Now apply a full-scale meter reading to the analog input. The voltage at full-scale must be set to 1.25 V ±0.1 V between the analog input and instrument ground. **NOTE**: Instrument ground is not the same as loop ground.
4) Adjust the SPAN trimmer, R5, until the voltage across the 250-ohm terminating resistor is 5 V (V = .020 X Rterm).
5) Repeat steps 1 thru 4 until no further adjustment is necessary to get the 1-volt and 5-volt or 4-mA and 20-mA readings.

Variations on calibration:

☑ **NOTE**: This board may be modified to allow operation from 0 to 20 mA. To do this, remove the offset trimmer, R6, from the board. Calibration in this configuration is a one- point adjustment at full-scale. Drive the analog input to full-scale (1.25VDC) and adjust the SPAN trimmer, R5, for 5 volts across the 250-ohm resistor. Reduce the input to 1/5 full-scale and check for 1 V across or 4 mA through the resistor. An example of this configuration is of that in the Model 177-50, where the beginning of the second decade (1/5 of full-scale) is to output 4 mA. The first decade is then a 0-4 mA output.

The input voltage may also be changed to something other than 1.25 V. The components used will allow full-scale inputs anywhere from 0.25 minimum to 1.5 V maximum. Component changes may allow other input values to be used. Please consult LMI for any special requirements.

Modifications to the Model 375 for optimum performance:

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

1) U531 changes from an LM358 to an OPA2343UA; LMI Part Number 06-6582.
2) C531 changes from 10μF tantalum to 0.047μF "poly film" (polypropylene sulfide); LMI Part Number 04-5729.
3) R432 changes from 100k to 1Meg; LMI Part Number 12-7844.