LUDLUM MODEL 375-600
DIGITAL RADIATION MONITOR
WITH INTERNAL SCINTILLATOR

August 2010

Serial Number 179939 and Succeeding

Serial Numbers

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Table of Contents

Section

1

Introduction

The Model 375-600 Digital Radiation Monitor with internal shielded plastic scintillation detector is designed for visibility and ease of use. The system features a four-digit LED display that is readable from thirty feet away. Backlit indicators warn of high radiation (red), instrument failure (red) and low battery (yellow). A green status light is a positive indication of instrument operation. A very loud Sonalart alarm and highly visible strobe light (red) indicate alarm status; reset by way of a top chassis mounted pushbutton (red) when alarm is latched.

Parameters are protected under a calibration cover. Calibration is easily accomplished by moving the CAL dipswitch (under protective cover) 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 as is a battery backup for providing up to 8 hours of additional use after the primary power is removed.

Section

2

Getting Started

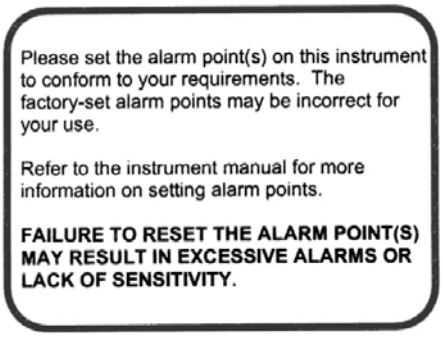
The Model 375-600 Digital Radiation Monitor is designed for ease of use. This section of the manual is designed to help the first-time user get started. Initial power-up and basic features of the Model 375-600 will be discussed in this section. Other sections of the manual provide more detailed information.

Power Up

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

> Note:
>
> Model 375-600 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.



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 on pages 2-2 and 7-1 of this manual.

Initial power-up will momentarily activate the internal front panel lights (except LOW BAT), sound the audio, and display "8888" on the 4-digit LED display. The firmware version number (396xxNyy) is then displayed as "396" and "xxyy" (where xx and yy represent 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 375-600 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.

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 micro-seconds.

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 (one is supplied with the system). 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 the center (same location each time) of the detector.

Note:

The four corners of the detector are denoted by dimples on the left side panel. Utilizing these points, the center of the detector can be determined.

Hold the check source 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 work correctly.

Section

3

Specifications

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

Display Range: 000.0-9999.

Display Units: Typically set to kcpm. Can be made to display in μR/hr, mR/hr, R/hr, μSv/h, mSv/h, Sv/h, μrem/hr, mrem/hr, rem/hr, cpm, cps, and others.

Display Blanking: under non-alarm conditions and when under battery power; or when CAL MODE dipswitch is placed to the right.

Detector: Internal 630 in^3 shielded plastic scintillation detector.

Sensitivity: 30 kcpm/μR/hr with ^{137}Cs.

Dimensions: 38 x 71 x 3.8 cm (15 x 28 x 1.5 inch)

Shielding: 0.318 cm(0.125 inch lead, on five sides.

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

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).

Sigma Alarm (optional): Indicated by red light (HIGH ALARM) and rapid beep.

High Alarm: Indicated by a red light (HIGH ALARM) 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.

Low Battery: Indicated by a yellow light (LOW BAT); 2 hours of battery life remain.

Detector Fail: Indicated by a red light (DET FAIL) and an audible tone greater than 68dB at 2 feet for conditions of detector overload, no count from detector within 15 seconds or instrument failure. Also triggered by the LOW BAT light.

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 DET 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, DET 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.

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

Battery Life: Typically 8 hours in non-alarm condition.

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

Chassis Construction: Steel housing with aluminum door. Ivory powder-coat finish.

Overall Size: 61 x 91.5 x 30.5 cm (24 x 36 x 12 inch)(H x W x D)

Overall Weight: 60.8 kg(134 lb).

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, five calibration potentiometers, and the option dipswitch (detailed in the following subsection). 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. 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. Set the DISC voltage to 2.5 times the 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 set point will cause the DET 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 375-600 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 the following page.

```
'Demonstration Program
'Model 375-600 RS-232 communication program written for QuickBasic
'This program causes the computer screen to display the data being dumped from the Model 375-600.
'Needs the following cable:
                              '     Model 375-600     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 375-600 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:

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- ANALOG OUT
pin6- NA
pin7- HIGH ALARM_L
pin8- EXT RESET_L
pin9- +5VDC OUT

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

Internal Detector Setup

Typical response and set points for the Model 375-600 with internal 630 in³ shielded plastic scintillation detector (Model 44-139) are as follows:

Operating Voltage: As determined by plateau (typically 800-1200 Vdc)
Threshold: 10 mVdc
Calibration Constant: 1000 kcpm
Dead Time Correction: 1 μsec

Typical Checkpoints:

4000 kcpm
1000 kcpm - calibration constant set point
400 kcpm
100 kcpm
40 kcpm
10 kcpm
4 kcpm
1 kcpm

Section

5

Common Options and Modifications

Time and Date Stamp Option

Description:

When an alarm or failure occurs the Model 375-600 will print the current reading, date, time and either ALARM or FAIL to the RS-232 port. The Model 375-600 will print once every 30 seconds as long as the alarm or fail condition is present.

Setup:

You will need the following: A Model 375-600 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 375-600 has relay options that allow the user to attach strobe lights or horns that will be activated during HIGH ALARM. The Model 375-600 comes equipped with Mains Relay Out for control of the top chassis mounted strobe light (for HIGH ALARM) as described on the following page. 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 front 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 375-600 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 375-600.

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 sigma * 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 375-600 is turned ON, in order to allow the Model 375-600 to accumulate a stable background radiation reading.

Two other changes were made to the Model 375-600. 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 375-600 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 375-600. 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).

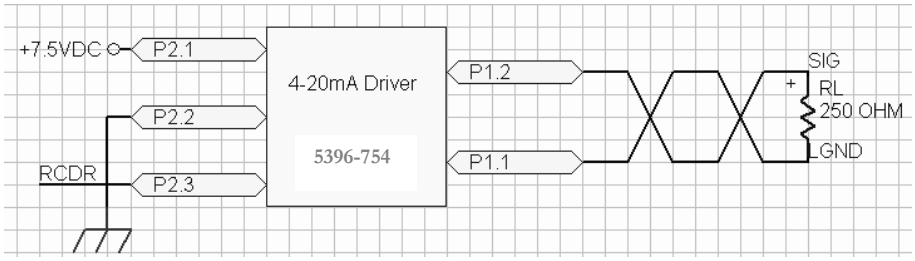


Figure 1: Wiring Diagram.

SPECIFICATIONS

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

Terminating Resistor: 250 ohm.

Model 375-600 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 375-600.

Check for a voltage of 1.00 V ± 5% 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.

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 ±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 V ± 5% (V = .020 X Rterm).

MODIFICATIONS TO THE MODEL 375-600 FOR OPTIMUM PERFORMANCE

The Model 375-600 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 10µF tantalum to 0.047µF "poly film" (polypropylene sulfide); LMI Part Number 04-5729.

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

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 then 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 375-600 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 375-600 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 near the AC receptacle.

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

CAUTION (per ISO 3864, No. B.3.1) – designates hazardous live voltage and risk of electric shock. During normal use, internal components are hazardous live. This instrument must be isolated or disconnected from the hazardous live voltage before accessing the internal components. This symbol appears on the front panel. **Note the following precautions:**

Warning!

The operator is strongly cautioned to take the following precautions to avoid contact with internal hazardous live parts that are accessible using a tool:

1. Turn the instrument power OFF and disconnect the power cord.
2. Allow the instrument to sit for 1 minute before accessing internal components.

The "**crossed-out wheelie bin**" symbol notifies the consumer that the product is not to be mixed with unsorted municipal waste when discarding; each material must be separated. The symbol appears on the front panel. See section 8, "Recycling" for further information.

Replacement of Main Fuse

Warning!

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

Section

7

Calibration

High Voltage

The high voltage is adjustable from 200-2500 Vdc using the HV potentiometer located under the calibration cover. The internal scintillation detector usually requires a voltage of 500-1250 Vdc. Ensure that the high voltage is checked with a high impedance (≥1000 megohm) voltmeter only. A high voltage checkpoint is located next to the HV potentiometer.

Instrument 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. When the CAL MODE dipswitch is set to the right the analog output goes full-scale (as in a DET FAIL condition). 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: 

Section

9

Parts List

	Reference	Description	Part Number
Model 375-600 Digital Area Monitor	UNIT	Completely Assembled Model 375-600 Area Monitor	48-3458
Main Board, Drawing 396 × 160	BOARD	Completely Assembled Main Circuit Board	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
	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

	Reference	Description	Part Number
	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
	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

	Reference	Description	Part Number
	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
	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

	Reference	Description	Part Number
	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
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
RELAY	RL451	RELAY AROMAT JS1E-5V	22-9893
	CR451	1N4001	07-6268
	P6	CONN-640457-3	13-8165
MISCELLANEOUS	*	SOCKET 44P PLCC	06-6613
	9ea.	Cloverleaf 011-6809	18-8771

Chassis Wiring Diagram

	Reference	Description	Part Number
AUDIO	*	SONALERT SC616N VERY LOUD	22-9780
CONNECTORS	J1	CONN-1-640441-2	13-8431
	J2	FILTER CORCOM 3EHG1-2	21-9830
	J3	D RECPT-RD9F000V3 9 PIN	13-8003
	J6	CONN-640442-3	13-8135
	*	CONN-640457-3 MTA100 RA	13-8165
	*	D-TAB-D9	13-8377
DIODE	*	1N4001 09F3576 ON SEMI	07-6268
SWITCH	S1	DM62J12S205PQ W/LEGEND	08-6715
	*	ABD410N-R MUSHRM	08-6786
TRANSFORMER	T1	186C12 115/230V	21-9173
MISCELLANEOUS	B1	BATTERY-PS630	21-9705
	F1	FUSE-1 AMP-5x20mm	21-9704
	*	CBL-ETHERNET EXTENSN 4"	8396-797
	*	POWER CORD BELDEN	21-9394
	*	M 375-600 ENCLOSURE ASSY.	4396-613
	*	STROBE-RED 120VAC	2310179
	*	RESET BUTTON	9396-646
	*	SOURCE- CS137 370 kBq10uCi	01-5231

Model 44-139 Scintillator

	UNIT	Completely Assembled Model 44-139 Scintillator	47-3149

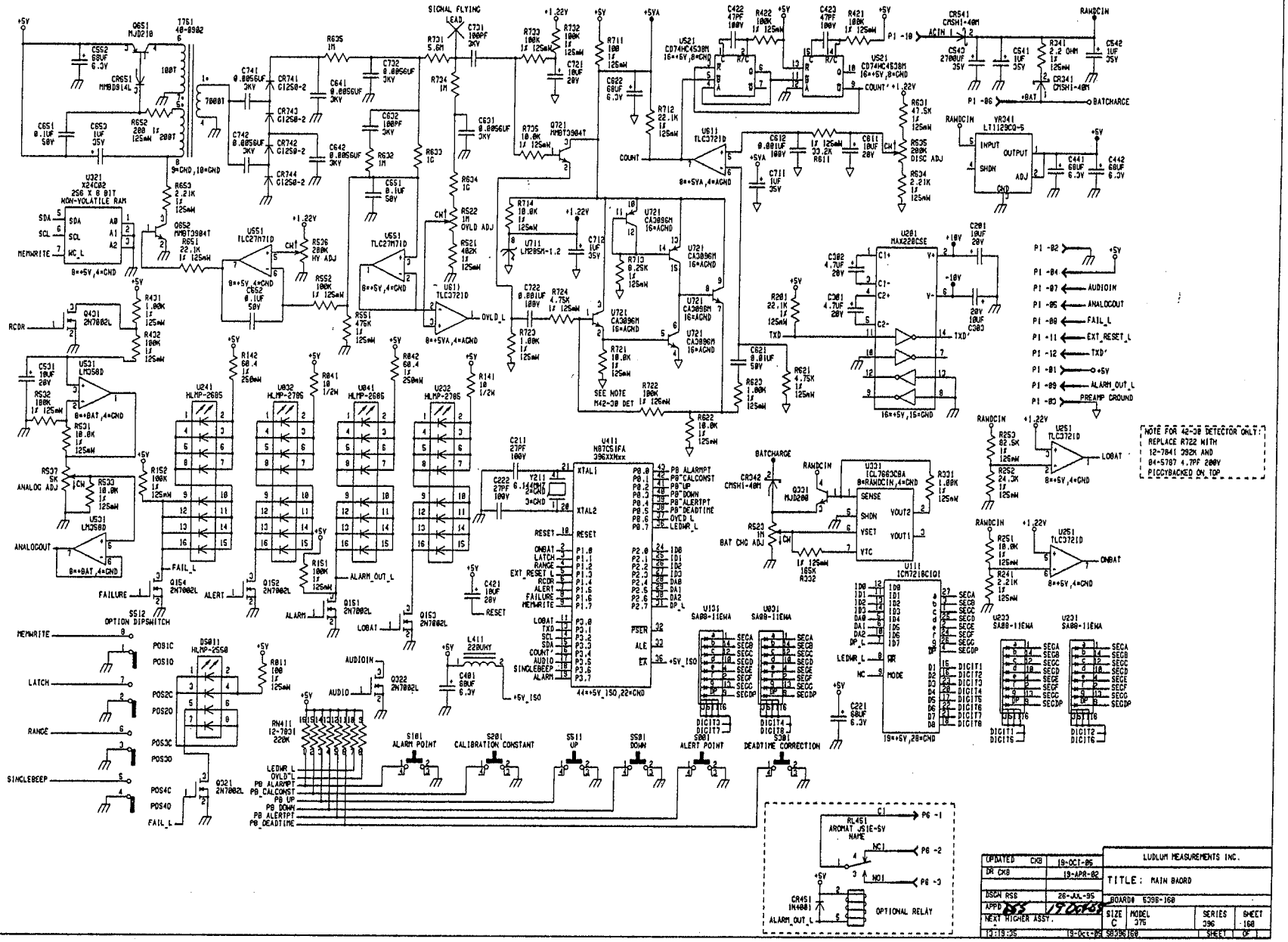
Section

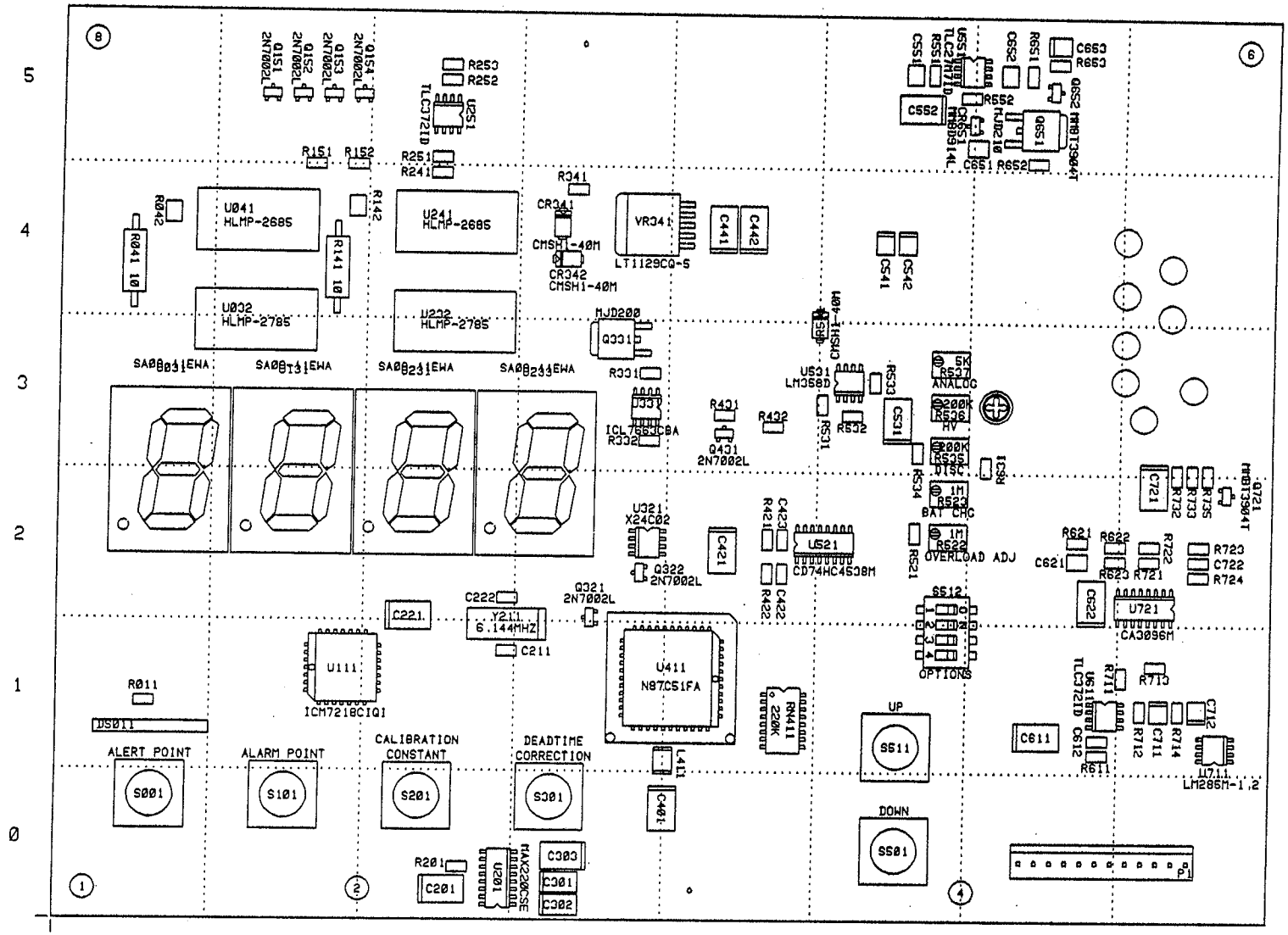
10

Drawings and Diagrams

Main Circuit Board, Drawing 396 × 160

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


SIGNAL FLYING LEAD
Q651 MJD210
T751 40-8982
CR651 MMBD914L
U321 X24C02 256 X 8 BIT NON-VOLATILE RAM
Q852 MMBT3904T
U551 TLC27M71D
U611 TLC3721D
U521 CD74HC4538M
U721 CA3096M 16*AGND
U711 LM285M-1.2
Q721 MMBT3904T
U261 MAX228CSE
U331 ICL7663CBA
U111 ICM7218C101
U411 N87C51FA 396XXMxx
U241 HLMP-2685
U032 HLMP-2786
U841 HLMP-2686
U203 HLMP-2785
U231 SA88-11EWA
U131 SA88-11EWA
U831 SA88-11EWA
DS811 HLMP-2658
Q651 2N7002L
Q152 2N7002L
Q151 2N7002L
Q153 2N7002L
Q154 2N7002L
Q321 2N7002L
Q322 2N7002L
Q331 MJD200
CR342 CMSH1-40M
CR541 CMSH1-40M
CR241 CMSH1-40M
VR341 LT1129CQ-5
RN411 12-7831 220K
S512 OPTION DIPSWITCH
S101 ALARM POINT
S201 CALIBRATION CONSTANT
S511 UP
S581 DOWN
S901 ALERT POINT
S301 DEADTIME CORRECTION
RL451 AROMAT JS1E-5V
CR451 1N4001
OPTIONAL RELAY
P1 -1
P1 -2
P1 -3
P1 -82
P1 -84
P1 -85
P1 -88
P1 -11
P1 -12
P1 -81
P1 -89
P1 -83
AUDIOIN
ANALOGOUT
FAIL_L
EXT_RESET_L
TXD'
+5V
ALARM_OUT_L
PREAMP GROUND
BATCHARGE
RAWDCIN
LOBAT
ONBAT
NOTE FOR 42-3B DETECTOR ONLY:
REPLACE R722 WITH
12-7841 392K AND
84-5787 4.7PF 200V
PIGGYBACKED ON TOP
LUDLUM MEASUREMENTS INC.
TITLE: MAIN BOARD
BOARD# 5396-160
SIZE C
MODEL 375
SERIES 396
SHEET 160
UPDATED CKB 19-OCT-95
DR CKB 19-APR-82
DSGN RSS 26-JUL-95
APPD BS 19Oct95
NEXT HIGHER ASSY.
12:19:35 19-Oct-95 5396160



LUDLUM MEASUREMENTS INC. SWEETWATER, TX.					
DR CKB		19-APR-02	TITLE: MAIN BOARD		
CHK R.C.		19 Apr 02	BOARD# 5396-160		BS396160
DSGN RSS		1-NOV-95	MODEL 375	SERIES 396	SHEET 161
APP RSS R/Amo2			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-96	MODEL 375	SERIES 396 SHEET 161
APP RSS 19 Apr 02		COMP ARTWORK ☐	SLDR ARTWORK ☐
		COMP OUTLINE ☐	SLDR OUTLINE ☒
COMP PASTE ☐	COMP MASK ☐	SLDR PASTE ☐	SLDR MASK ☐