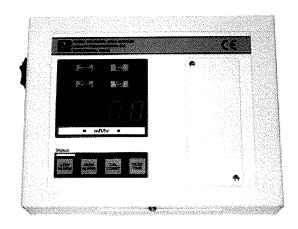
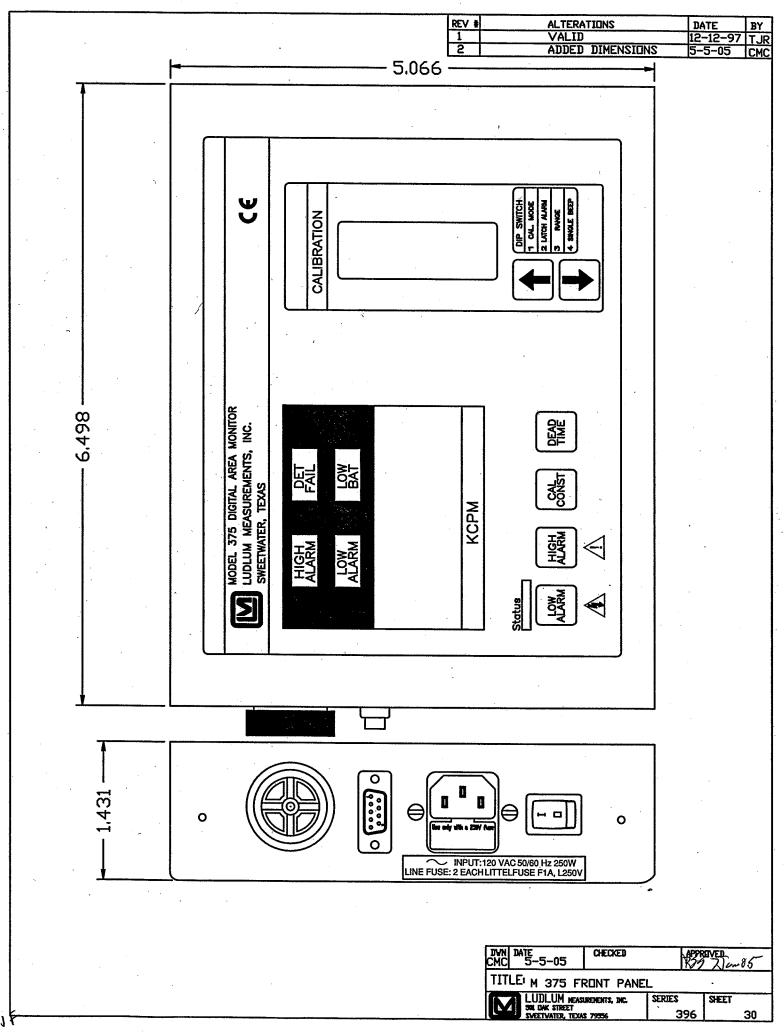
LUDLUM MODELS 375-20, 375-30, 375-32 AND 375-34 DIGITAL WALL-MOUNT AREA MONITORS

March 2006 Serial Number 179939 and Succeeding Serial Numbers







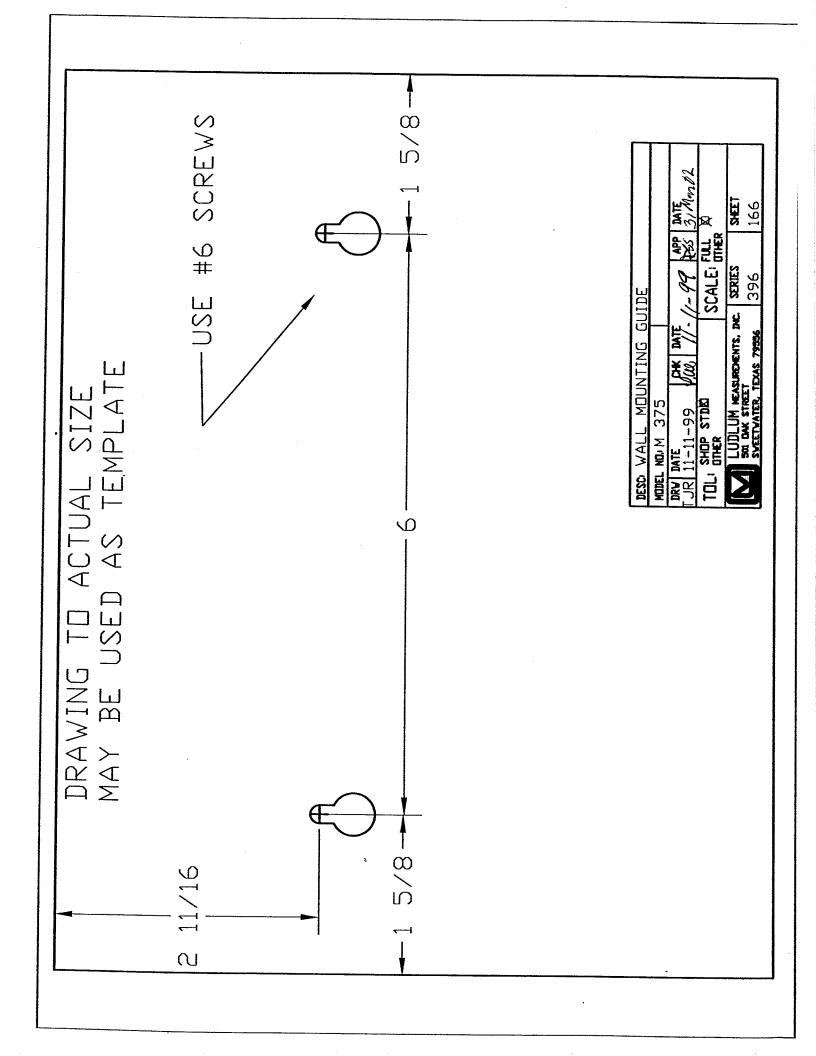


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Introduction

he 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.

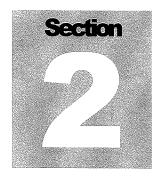
The information contained in this manual is pertinent to the following Model 375 systems:

The Model 375-20 with two Model 44-137 scintillation detectors and custom length cables.

The Model 375-30 with two Model 44-99 scintillation detectors, each with internal lead shield to reduce background radiation.

The Model 375-32 featuring an instrument chassis that mounts in one of two freestanding towers; furnished with two Model 44-99 scintillation detectors (one in each tower), each with internal lead shield to reduce background radiation.

The Model 375-34 featuring two chassis mounted into two freestanding towers including two displays (one in each tower); furnished with four Model 44-99 scintillation detectors, each with an internal lead shield to reduce background radiation.



Getting Started

he 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.

Power Up

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

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.

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 alarmpoint(s) is discussed in detail below and on pages 2-3 and 7-1 of this manual.

Initial power-up (by way of the power switch on the left side panel) 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, μ R/hr, R/hr, mSv/h, μ Sv/h, cps, cpm, and kcpm. In each case, the unit of measure is indicated underneath the four-digit display. Throughout the rest of this manual, the notation <units> will be used as a substitute.

Checking Parameters

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

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

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

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

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 one of the detectors. 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.
- 4. Repeat the procedure for the other detector(s) if it was not triggered by the first test.



Specifications

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 μ R/hr, mR/hr, R/hr, μ Sv/h, mSv/h, Sv/h, μ Fv/h, mrem/hr, rem/hr, cpm, cps, and others.

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

Operating Range: Depends upon the type of detectors used and the units of measure.

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 detectors or instrument failure.

LOW BAT: Indicated by a yellow light, when 2 hours of battery life remain.

Connector: Dependant upon the system.

Calibration Controls: Accessible from the front of the 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.

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

Instrument Size: $9.7" (24.6 \text{ cm}) \text{ W} \times 7.4" (18.7 \text{ cm}) \text{ H} \times 2.5" (6.4 \text{ cm}) \text{ D}.$

Instrument Weight (each): 6.5 lbs. (2.95 kg).



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. 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.

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

'Demonstration Program

'Model 375 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 pin 7

'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

COM(1) ON

ON COM(1) GOSUB Getcomport

WHILE (1)

'Press Esc key to stop reading data."

'enable coml trapping

'if something comes in coml, then get it

'loop until Esc key is hit

comment• = INKEY•

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

WEND

endloop:

COM (1) OFF

CLOSE #1

END

Getcomport:

WHILE LOC(1) <> 0

ComPortInput• = INPUT•(1,#1)

PRINT ComPortInput*;

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:

'CLOSE COM port.

'bring in data from serial port 'print data to screen

BYTE1 \mathbf{x} BYTE2 \mathbf{x} \mathbf{x} BYTE3 OR BYTE4 BYTE5 BYTE6 n \mathbf{x} BYTE7 Audio Status =1=onBYTE8 High Alarm Status=1=on BYTE9 Low Alarm Status =1=on BYTE10 Over Range Status=1=on BYTE11 Monitor Status =1=onBYTE12 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 FAIL and HIGH ALARM digital signal outputs are open drain 2N7002 outputs, able to sink about 50 mA each.

Detector Setups

Model 375-20

Typical response and set points for the Model 375-20 with Model 44-137 Scintillation Detectors are as follows:

```
Operating Voltage: Determined by comparing plateaus Threshold: 10 mVdc (using a 39-inch cable) Calibration Constant: 1600 cpm/µR/hr Dead Time Correction: 5 µsec Linear Range with DTC: 10 µR/hr – 1500 µR/hr
```

Typical Checkpoints:

| 100 μR/hr 150 μR/hr 200 μR/hr | - calibration constant set point |
|-------------------------------------|----------------------------------|
| $500\mu\mathrm{R/hr}$ | |
| $1000\mu\mathrm{R/hr}$ | - dead time correction set point |
| $1500 \mu R/hr$ | - |

MODELS 375-30, 375-32 & 375-34

Typical response and set points for Models 375-30, 375-32 and 375-34 with Model 44-99 Scintillation Detectors are as follows:

Operating Voltage: Determined by comparing plateaus

Threshold: 10 mVdc (using a 39-inch cable) Calibration Constant: 2400 cpm/µR/hr

Dead Time Correction: 5 µsec

Linear Range with DTC: $10 \mu R/hr - 1500 \mu R/hr$

Typical Checkpoints:

 $\begin{array}{ll} 100~\mu R/hr\\ 150~\mu R/hr\\ 200~\mu R/hr\\ 500~\mu R/hr\\ 1000~\mu R/hr\\ 1500~\mu R/hr \end{array} - dead~time~correction~set~point$



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 | Н |
| 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 | $\overline{\mathrm{M}}$ | Byte 27 | Space (20H) |
| Byte 11 | \mathbf{M} | Byte 28 | A Space |
| Byte 12 | / | Byte 29 | L F |
| Byte 13 | D | Byte 30 | A ORA |
| 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 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 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).

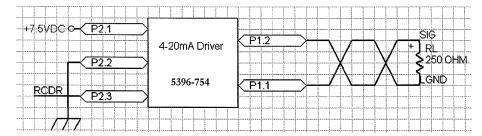


Figure 1: Wiring Diagram.

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 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.

Check for a voltage of $1.00~\rm V \pm 5\%$ across Rterm, typically a 250 ohm (V = $0.004~\rm X$ 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 $5.00\,\mathrm{V}$ $\pm 0.1\,\mathrm{V}$ 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 \pm 5% (V = .020 X Rterm).

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 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.



Safety Considerations

Environmental Conditions for Normal Use

Indoor use only (instrument); Indoor or Outdoor use (detectors)

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 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.



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:**

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 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 connectors unless the unit has turned off and power has been removed for at least 1 minute!



Calibration

High Voltage

The high voltage is adjustable from 200-2500 Vdc using the HV potentiometer located under the calibration cover. 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. The high voltage required will depend on the type of detectors used. Normally, each detector in a two detector system is separately plateaued and documented. The two plateau sheets are then compared and an operating voltage is selected that is compatible to both detectors.

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 detectors are 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 44-137 detector has a calibration constant of 1000 cpm (1 kcpm). A Ludlum Model 44-99 detector has a calibration constant of approximately 2400 cpm/ μ R/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 detectors are 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 detectors

during the detector's dead time. Scintillation detectors generally have short dead times of 1-10 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 detectors. The desired pulse threshold depends on the type of detectors 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.



Recycling

udlum Measurements, Inc. supports the recycling of the electronics products it produces for the purpose of protecting the environment and to comply with all regional, national and international agencies that promote economically and environmentally sustainable recycling systems. To this end, Ludlum Measurements, Inc. strives to supply the consumer of its goods with information regarding reuse and recycling of the many different types of materials used in its products. With many different agencies, public and private, involved in this pursuit it becomes evident that a myriad of methods can be used in the process of recycling. Therefore, Ludlum Measurements, Inc. does not suggest one particular method over another, but simply desires to inform its consumers of the range of recyclable materials present in its products, so that the user will have flexibility in following all local and federal laws.

The following types of recyclable materials are present in Ludlum Measurements, Inc. electronics products, and should be recycled separately. The list is not all-inclusive, nor does it suggest that all materials are present in each piece of equipment:

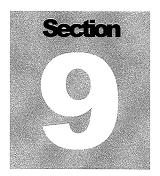
Batteries Glass Aluminum and Stainless Steel

Circuit Boards Plastics Liquid Crystal Display (LCD)

Ludlum Measurements, Inc. products 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:





Receiving and Installation

Unpacking and Repacking

Remove the calibration certificate and place it in a secure location. Remove the instrument and accessories (cables, detectors, etc.) and ensure that all of the items listed on the packing list are in the carton. Check individual item serial numbers and ensure calibration certificates match. The Model 375 serial number is located on the lower left corner of the front panel. Most Ludlum Measurements, Inc. detectors have a label on the base or body of the detector for model and serial number identification.

Important!

If multiple shipments are received, ensure that the detectors and instruments are not interchanged. Each instrument is calibrated to specific detectors, and therefore not interchangeable.

To return an instrument for repair or calibration, provide sufficient packing material to prevent damage during shipment. Also provide appropriate warning labels to ensure careful handling. Include detector(s) and related cable(s) for calibration. Include brief information as to the reason for return, as well as return shipping instructions:

- Return shipping address
- Customer name or contact
- Telephone number
- Description of service requested and all other necessary information

Installation

MODEL 375-20

The following is intended to be a general guide for installing the Ludlum Model 375-20 Wall-Mount Area Monitor. Exact installation details depend on the customer's specific location and use.

LOCATION: The placement of the detector will depend on the relative importance of the following factors:

Exclusiveness- finding a point that all waste goes through

Proximity- closer to the waste means more sensitivity

Shielding- smaller containers mean less shielding around possible sources of radiation

Accountability- finding out where the waste is coming from

DETECTORS: Place detectors as close as is practical to the load. Elevate the detectors to the typical center of the load.

INSTRUMENT (COUNTER): Connect the instrument to Mains power.

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.

The Model 375 instrument is designed for indoor use only and must be protected from adverse weather conditions.

CABLES: Route cables from the detectors to the instruments. Protect the cables from physical abuse. Plastic or metal conduit may be used to protect the cables.

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!

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, a DET FAIL and/or blown-fuse condition.

OPTIONAL REMOTE ALARMS: Remote alarm monitors such as the Model 271 or 272 may be operated by the Model 375-20.

MODEL 375-30, 375-32 or 375-34

The following is intended to be a general guide for installing the Ludlum Model 375-30, 375-32 or 375-34 Wall-Mount Area Monitor. Exact installation details depend on the customer's specific location and use.

LOCATION: The placement of the detector will depend on the relative importance of the following factors:

Exclusiveness- finding a point that all waste goes through

Proximity- closer to the waste means more sensitivity

Shielding- smaller containers mean less shielding around possible sources of radiation

Accountability- finding out where the waste is coming from

DETECTORS: Place detectors as close as is practical to the load. Elevate the detectors to the typical center of the load. The detectors may be mounted with fiberglass NEMA 4 enclosures or with aluminum brackets.

INSTRUMENT (COUNTER): Connect the instrument to Mains power. The Model 375 instrument is designed for indoor use only and must be protected from adverse weather conditions.

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.

CABLES: Route cables from the detectors to the instrument. Protect the cables from physical abuse. Plastic or metal conduit may be used to protect the cables. The cables have watertight fittings and a type "C" connector on the monitor end. A gasketed washer and conduit nut inside the detector is used to attach the watertight fitting to the NEMA enclosure. The coaxial cable (Belden type RG58/U) is rugged and weatherproof, but not waterproof.

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!

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, a DET FAIL condition and/or blownfuse condition.

OPTIONAL REMOTE ALARMS: Remote alarm monitors such as the Model 271 or 272 may be operated by the Model 375-30, 375-32 or 375-34.



Parts List

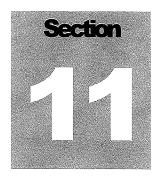
| | Reference | <u>Description</u> | Part Number |
|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Model 375-20 Digital Wall-Mount Area Monitor | UNIT | Completely Assembled Model 375-20 | 48-3245 |
| Model 375-30 Digital Wall-Mount Area Monitor | UNIT | Completely Assembled Model 375-30 | 48-2601 |
| Model 375-32 Digital Wall- Mount Area Monitor | UNIT | Completely Assembled Model 375-32 | 48-2754 |
| Model 375-34 Digital Wall- Mount Area Monitor | UNIT | Completely Assembled Model 375-34 | 48-2798 |
| Main Board, Drawing 396 × 160 | BOARD | Completely Assembled Main Circuit Board (common to all) | 5396-160 |
| CRYSTAL | Y211 | 6.144 MHZ | 01-5262 |
| CAPACITORS | C201 C211 C221 C222 C301-C302 C303 C401 C421 C422-C423 C441-C442 C531 C541-C542 C543 C551 | 10UF, 20V 27PF, 100V 68UF, 6.3V 27PF, 100V 4.7UF, 25V 10UF, 20V 68UF, 6.3V 10UF, 20V 47PF, 100V 68UF, 6.3V 10UF, 20V 1UF, 35V 2700UF, 10V 0.1UF, 50V | 04-5655 04-5658 04-5654 04-5658 04-5653 04-5655 04-5654 04-5655 04-5660 04-5654 04-5655 04-5656 04-5656 04-5621 04-5663 |

| | Reference | Description | Part Number |
|----------------------|---------------|---------------|-------------|
| | 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 | U031 | SA08-11EWA | 07-6389 |
| CIRCUITS | 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 |
| | U 24 1 | HLMP-2685 | 07-6400 |
| | U251 | TLC372ID | 06-6290 |
| | U321 | X24CO2S8I | 06-6299 |
| | U331 | ICL7663CBA | 06-6302 |
| | U411 | N87C51FA | 06-6286 |

| | Reference | Description | Part Number |
|---------------|-------------------------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| | 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 | \$001 \$101 \$201 \$301 \$501 \$511 \$512 | ALERT POINT ALARM POINT CALIBRATION CONSTANT DEADTIME CORRECTION DOWN UP OPTION DIPSWITCH | 08-6728 08-6728 08-6728 08-6728 08-6728 08-6728 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 | 12-7835 |
| | R241 | 2.21K, 1%, 125mW | 12-7839 |
| | R251 | 10.0K, 1%, 125mW | 12-7867 |
| | R252 | 24.3K, 1%, 125mW | 12-7867 |
| | R253 | 82.5K, 1%, 125mW | 12-7849 |
| | R331 | 1.00K, 1%, 125mW | 12-7832 |
| | R332 | 1.00K, 1%, 125mW | 12-7877 |
| | R341 | 2.2 OHM, 1%, 125mW | 12-7932 |

| | <u>Reference</u> | <u>Description</u> | Part Number |
|------------------|------------------|-------------------------|-------------|
| | 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%, 125 m W | 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 |

| | Reference | <u>Description</u> | Part Number |
|-----------------------------------------|----------------------|------------------------------------------------------------------------|-------------------------------|
| TRANSFORMER | T751 | L8050 | 40-0902 |
| MISCELLANEOUS | * 9ea. | SOCKET 44P PLCC Cloverleaf 011-6809 | 06-6613 18-8771 |
| OPTIONAL RELAY | RL451 CR451 P6 | RELAY AROMAT JS1E-5V 1N4001 CONN-640457-3 | 22-9893 07-6268 13-8165 |
| Wiring Diagram, Drawing 396 × 176 AUDIO | DS1 | MC-V09-530-S | 21-9730 |
| CONNECTOR | J1 J2 J3 | CONN-1-640441-2 FILTER CORCOM 3EHG1-2 D RECPT-RD9F000V3 9 PIN | 13-8431 21-9830 13-8003 |
| SWITCH | S1 | DM62J12S205PQ W/LEGEND | 08-6715 |
| TRANSFORMER | T1 | CFP302 115/230V | 22-9908 |
| BATTERY | B1 | BATTERY-PS630 | 21-9705 |



Drawings

Model 375 Instruments Main Circuit Board, Drawing 396 × 160

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

Wiring Diagram, Drawing 396 × 176

Model 375-20 Systems M 375-20 Aerial View, Drawing $385 \times 576A$

M 375-20 Looking at Detector, Drawing $385 \times 576B$

M 375-20 Looking at Scale, Drawing 385 × 576C

M 375-20 ISO VIEW, Drawing $385 \times 576D$

M 44-137 ASSY., Drawing 385×386

M 44-137 WEATHER ENCLOS. ASSY., Drawing 385 × 577

Model 375-30, 375-32 & 375-34 Systems M 44-99 OVERALL VIEW, Drawing 385×63

M 44-99 OVERALL VIEW, Drawing 385 × 63A

Model 375-30 Systems M 375-30RWM Typical Installation, Drawing 385 × 442

M 3503/3530/375-30 Enclosure, Drawing 385 × 106

M 375-30/3530 Detector Mounting, Drawing 385×120

Model 375-32 & 375-34 Systems

M 3532; 3534; 375-32; 375-34, Drawing 385×60

M 3532; 3534; 375-32; 375-34 ASSY., Drawing 385 × 60A

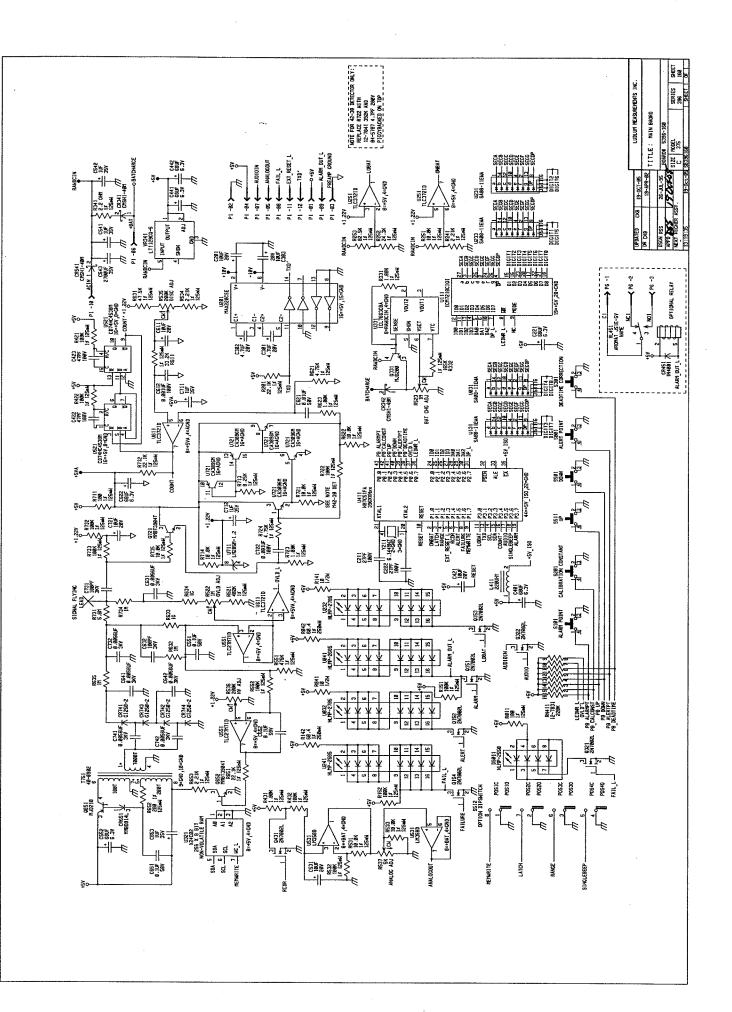
Detector Bracket Mount Assy., Drawing $385 \times 60B$

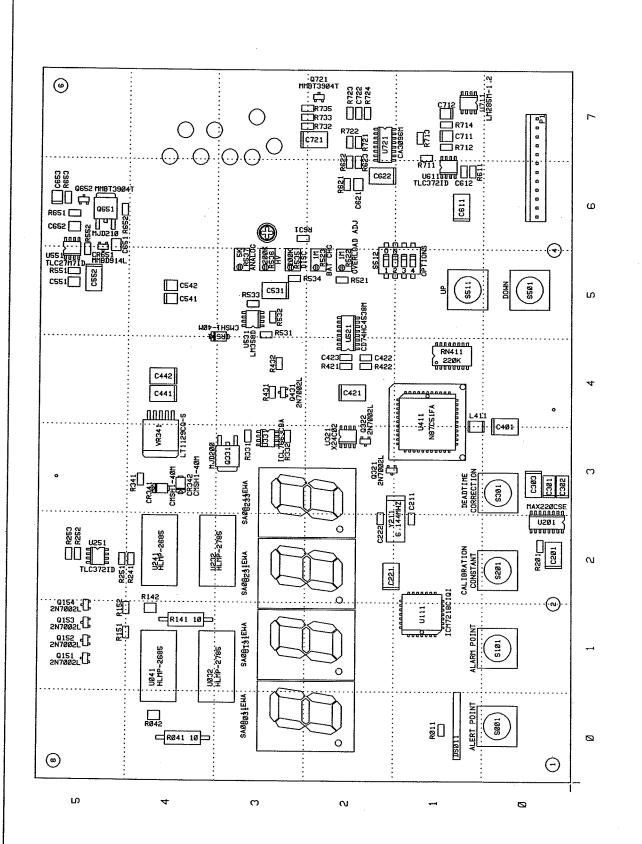
Side to Bracket Mount Assy., Drawing 385 × 60C

Base Bracket & Side Assy., Drawing 385 × 60D

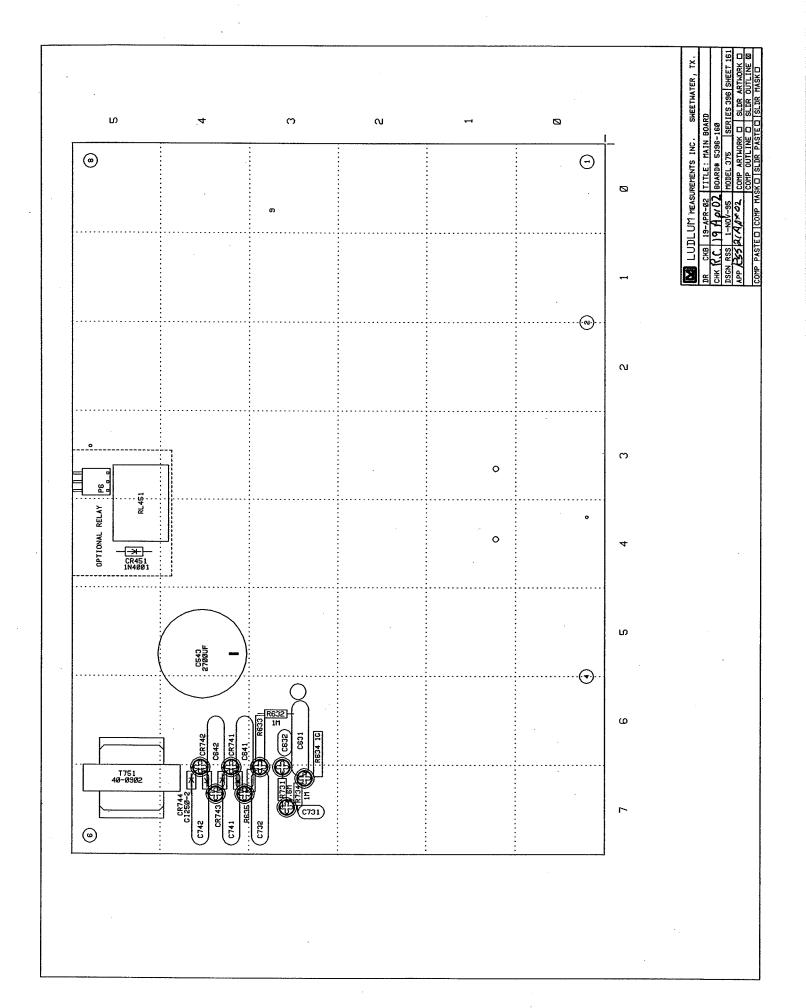
Customer Final Assembly, Drawing 385 × 60F

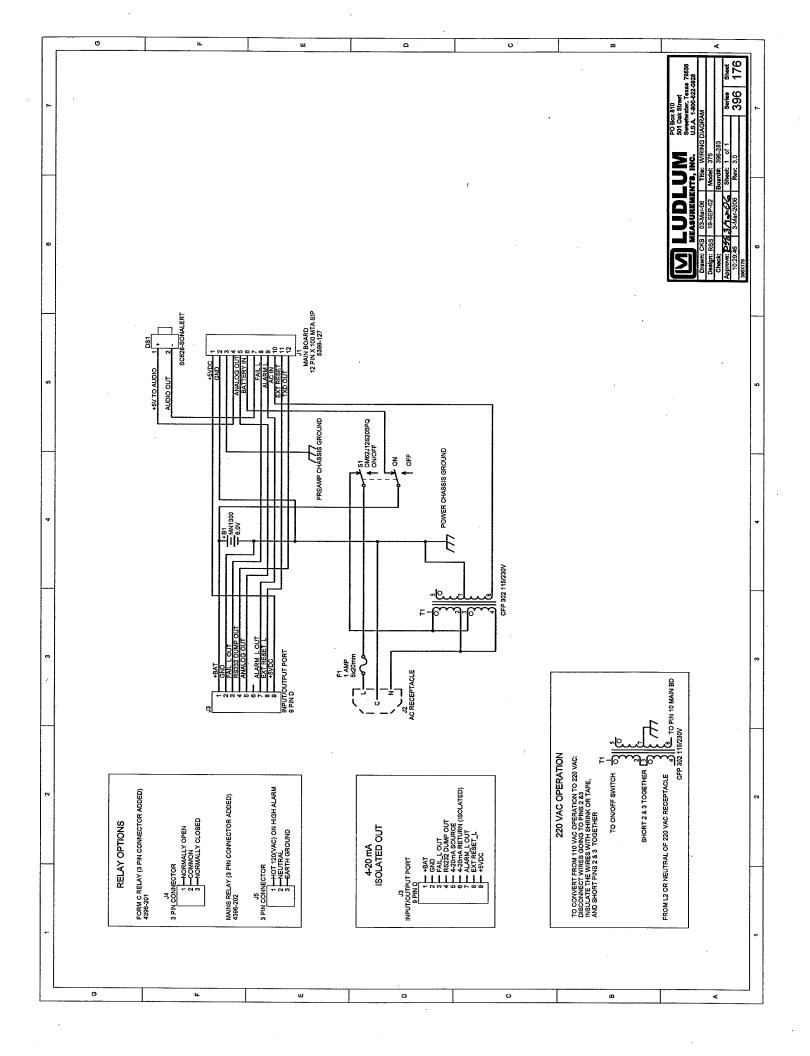
M 3532; 3534; 375-32; 375-34 ASSY., Drawing 385 × 60G

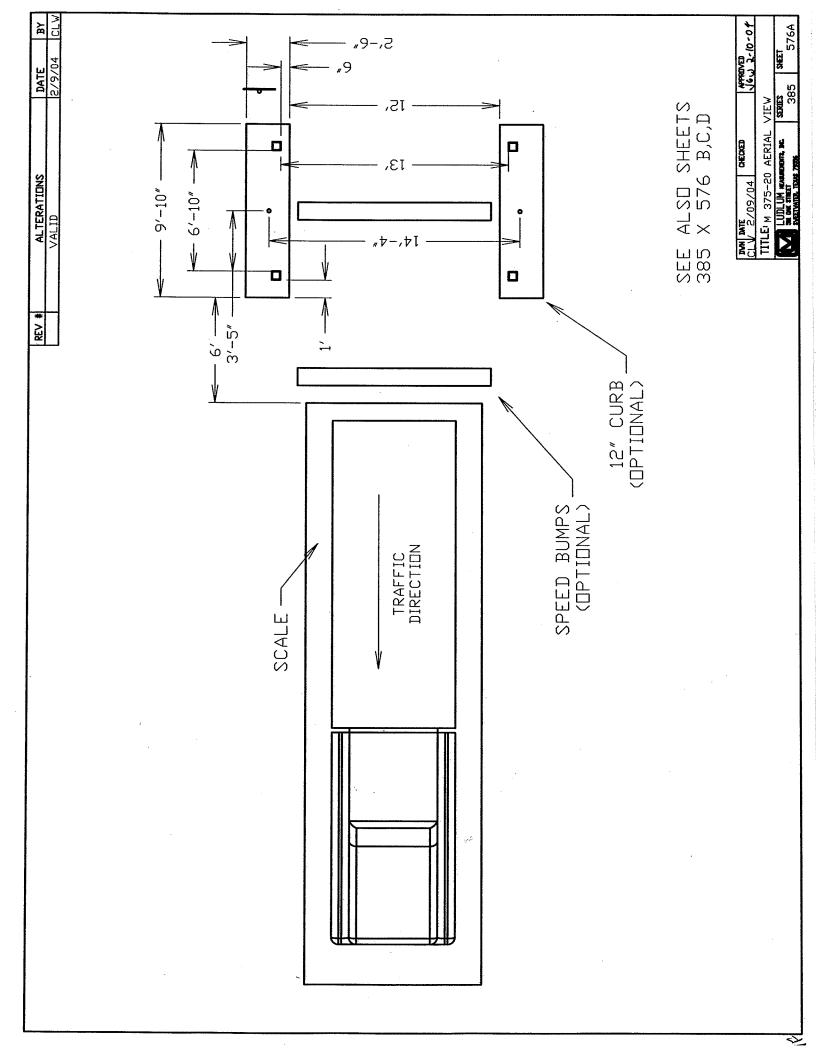


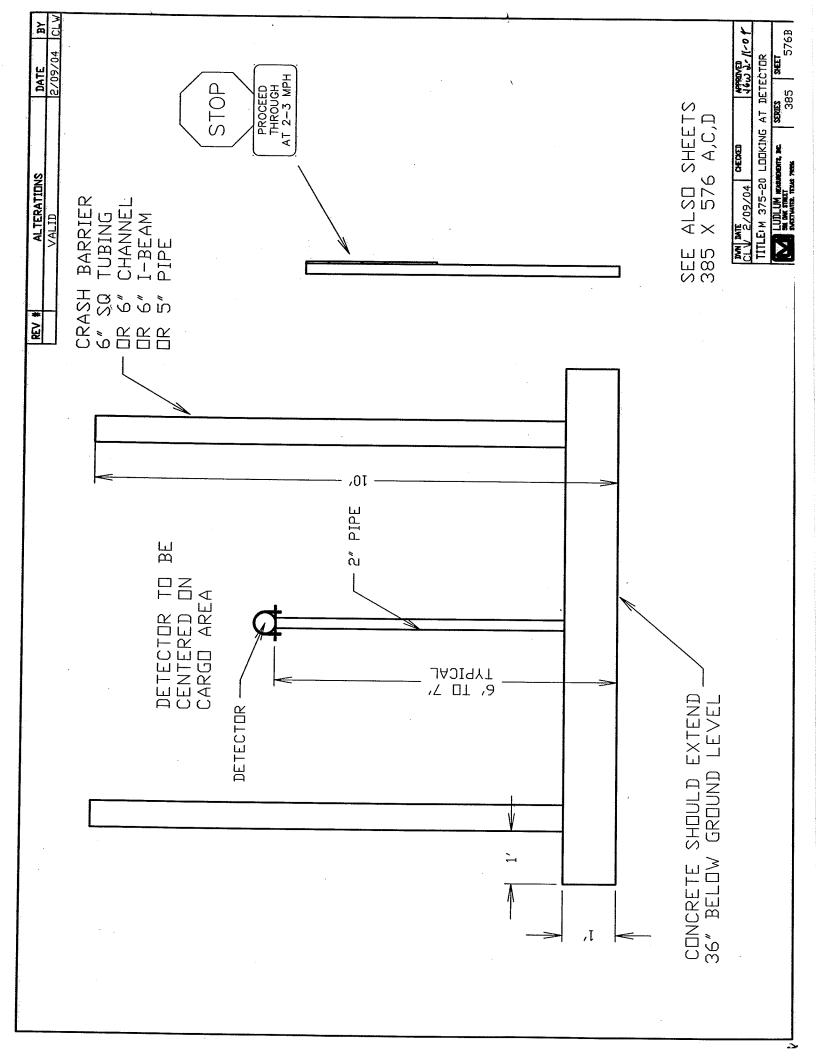


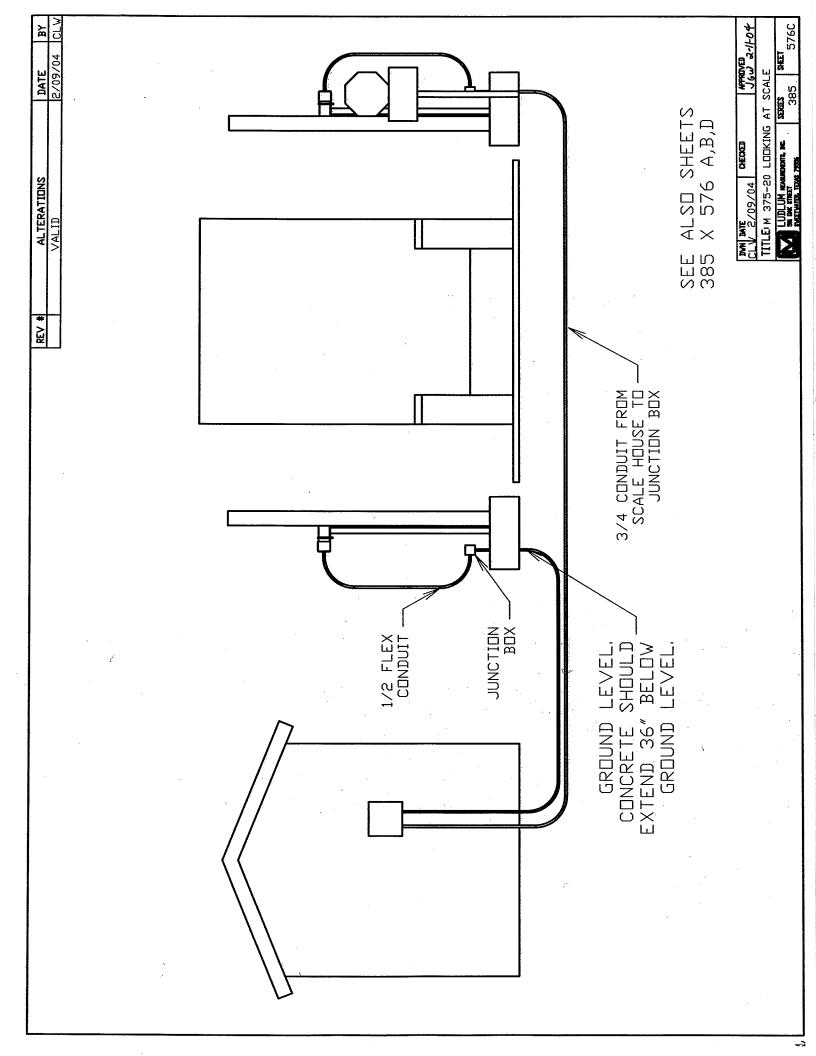
DR CKB 19-APR-02 TITLE: MAIN BOARD CHK R, C. 19 Apr 02 BOARD# 5396-160
DSCN RSS 1-NOV-95 HODEL 375 SERIES 396 SHEET 16
APP RSS 1-NOV-95 HODEL 375 SERIES 396 SHEET 16
14:38149 19-APP-92 COMP ARTHORK D SLOR ARTHORK D 14:38149 19-APP-92 COMP OUTLINE D SLOR DOUTLINE D COMP PASTED COMP ANSKED SLOR PASTED SLOR PASKED

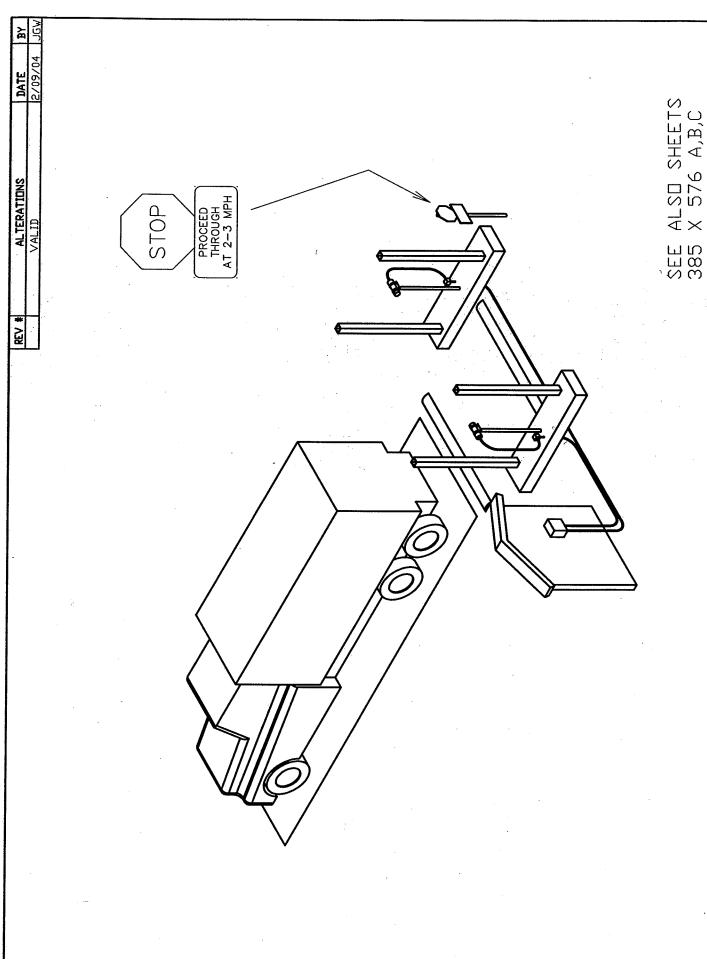












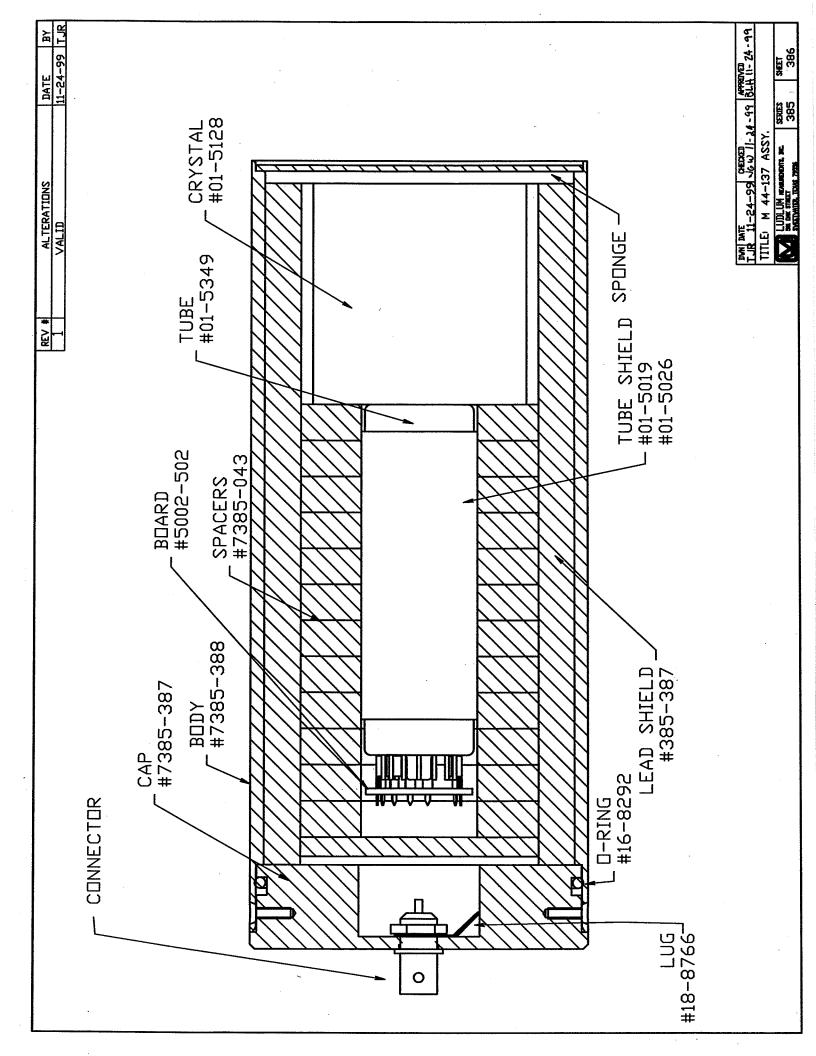
SHOWN WITH OPTIONAL CURB AND SPEED BUMPS

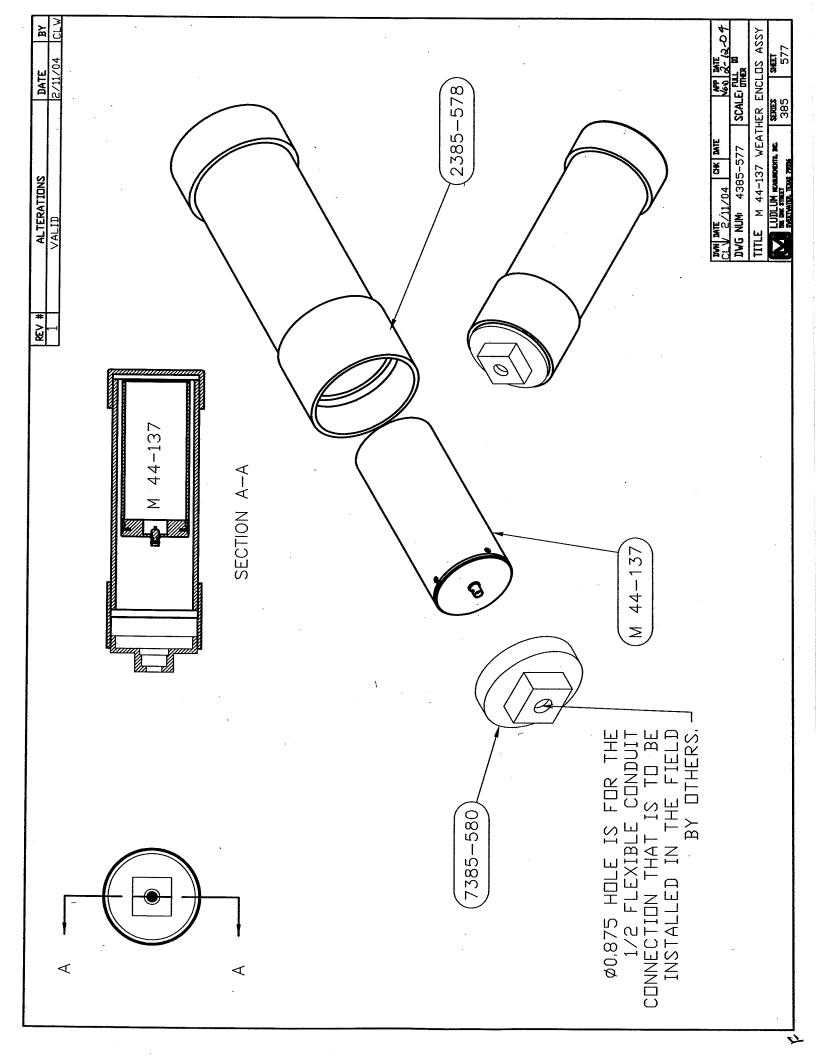
TITLE: M 375-20 IS□ VIEW

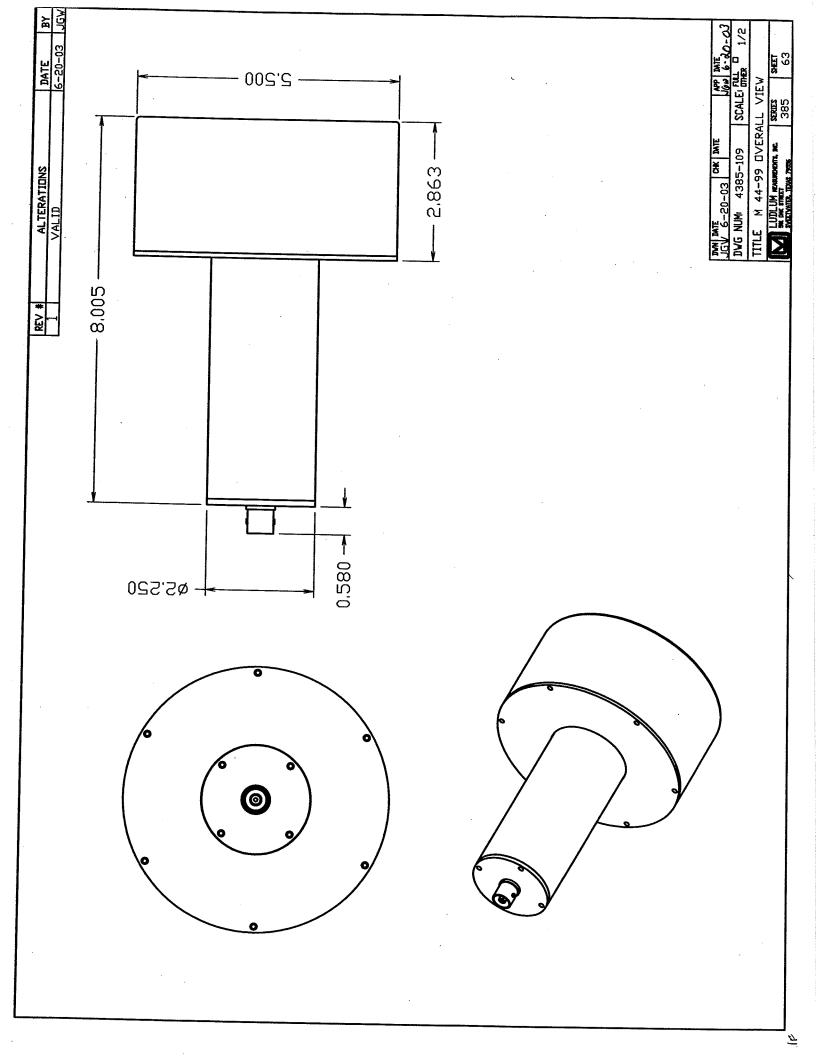
LUDLUM reparament, at: SERUES

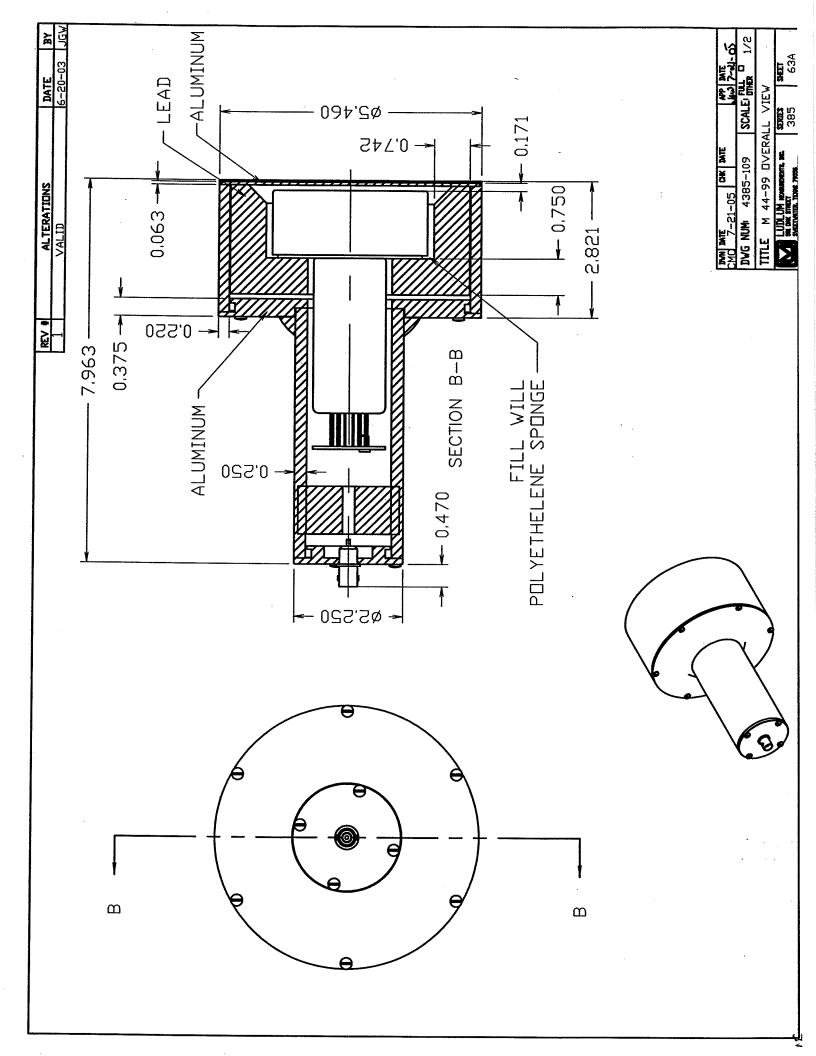
AMERICAN TABLE 7555

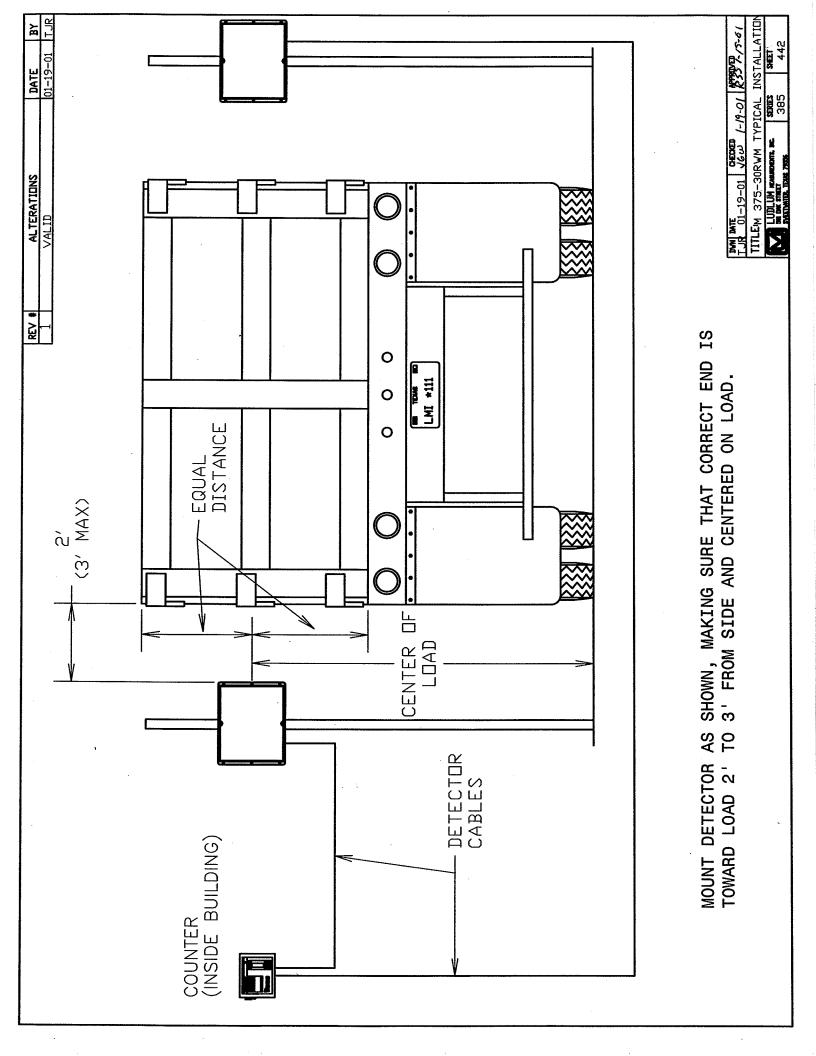
385 575□

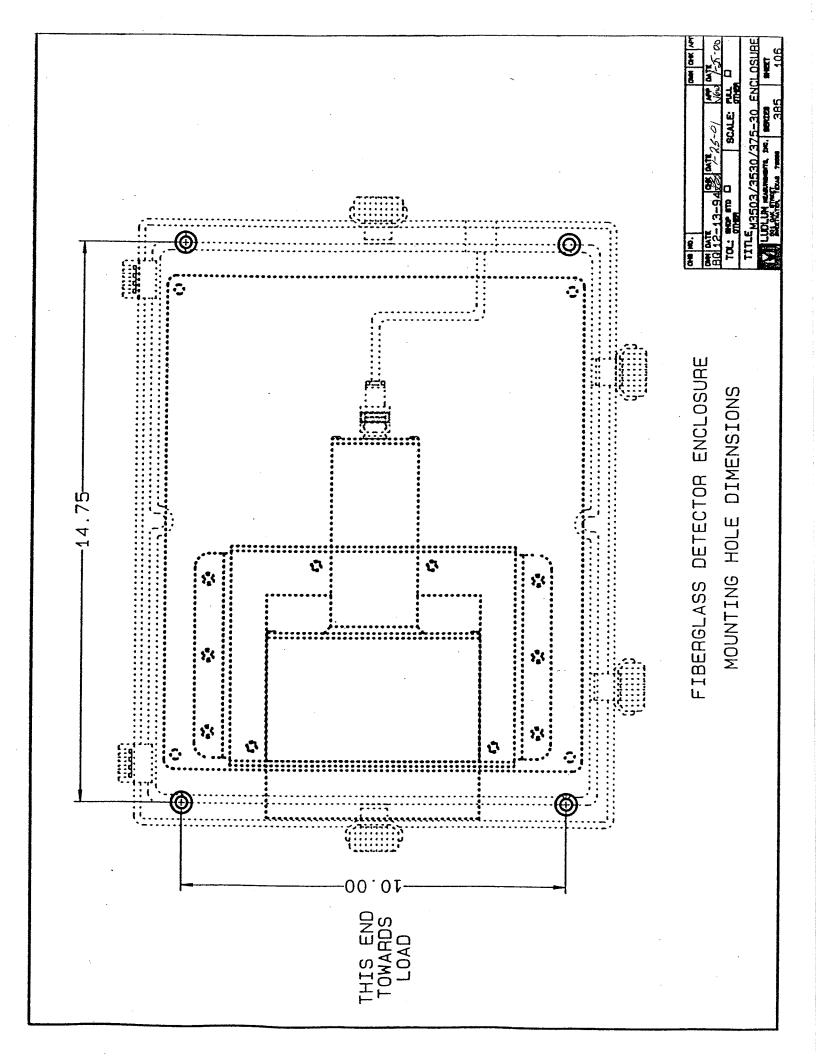


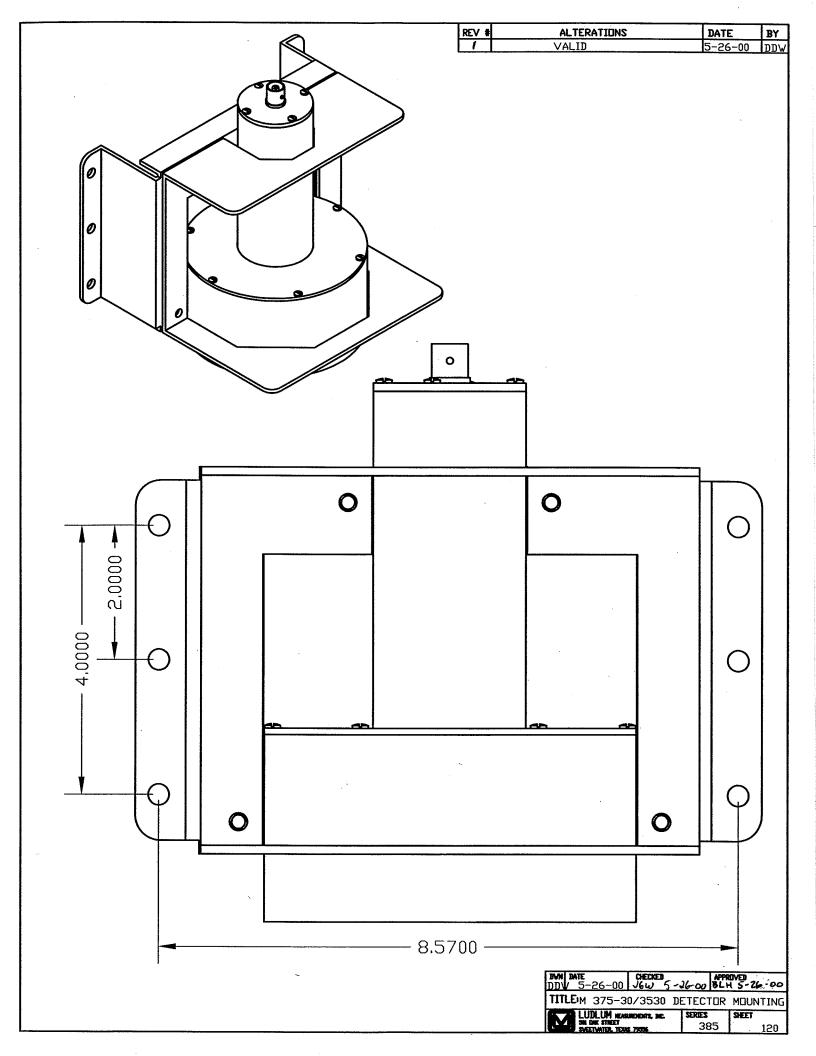


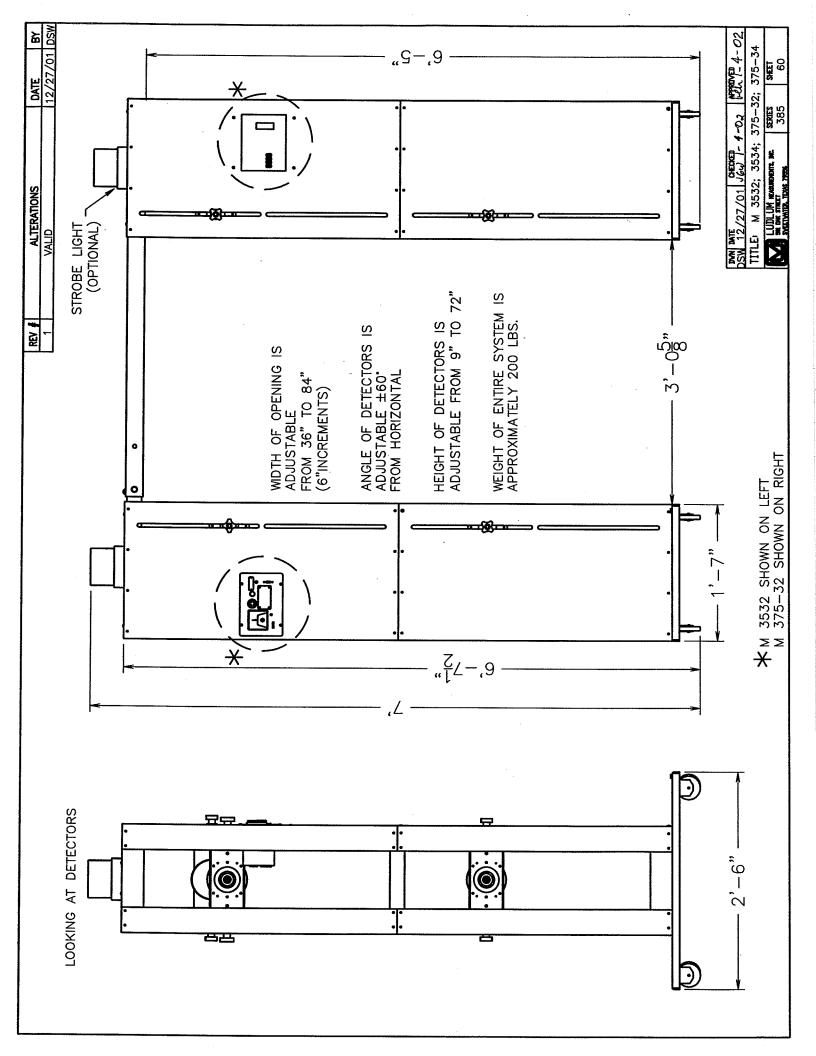


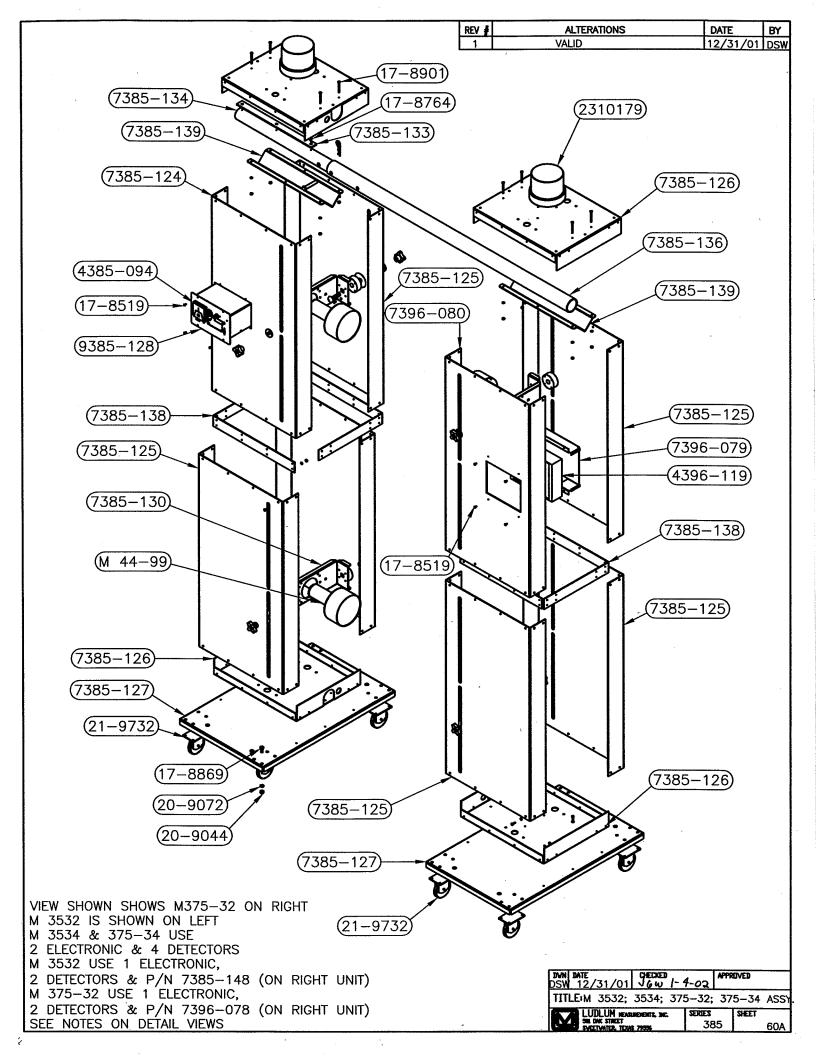


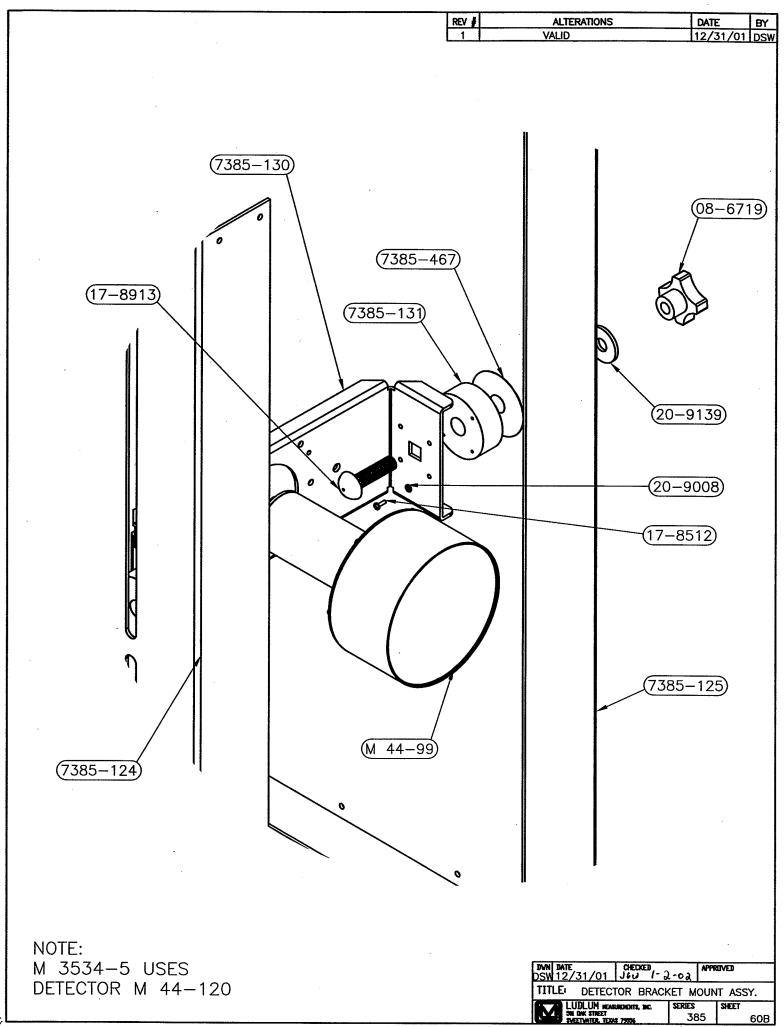


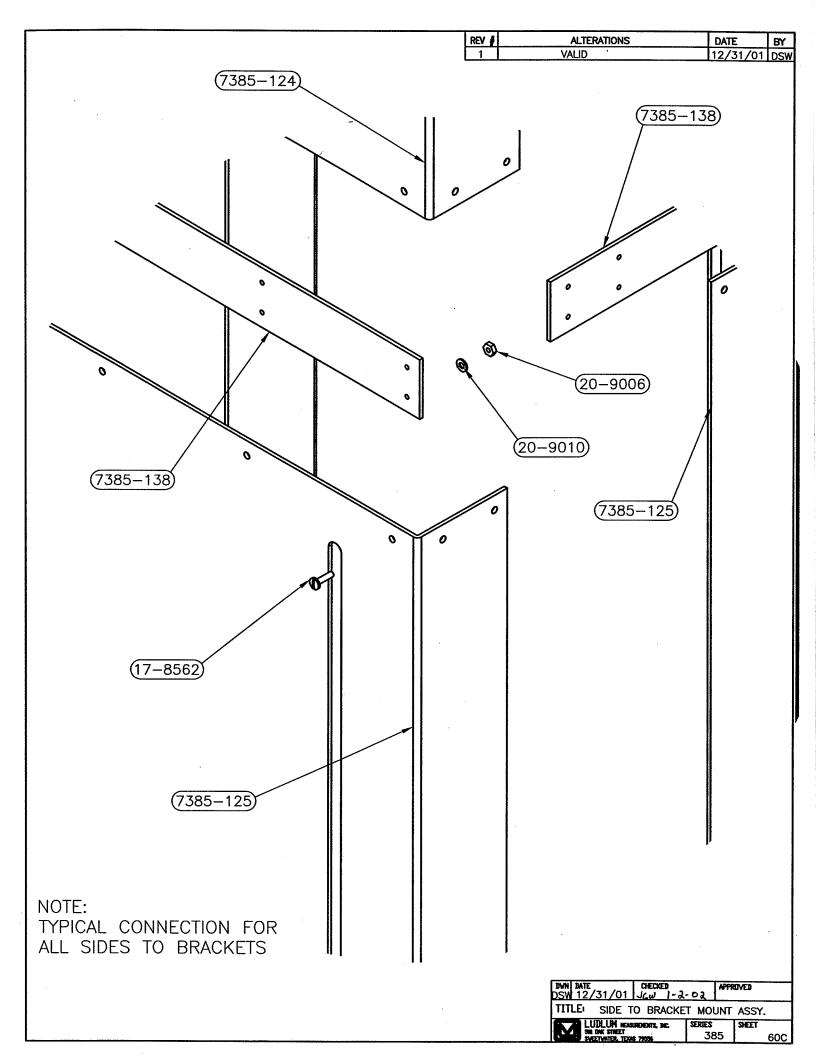


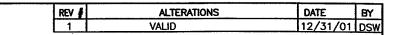


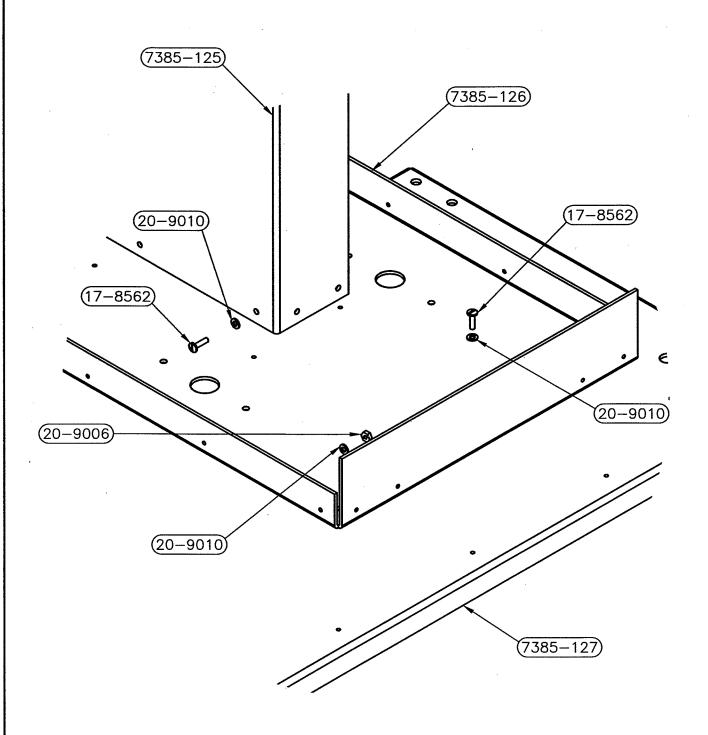












NOTE:

TYPICAL CONNECTION FOR ALL BASE TO SIDE USE WASHERS ON INSIDE AND OUTSIDE ON BOTTOM ONLY

| BVN DATE | /31/01 | CHECKED | 2-31-01 | APPROVED |
|----------|-----------|---------------|---------|----------|
| TITLE | BASE | BRACKET | r & SID | E ASSY. |
| 4 1 | UDLUM MAS | DENENTS, INC. | SERIES | SHEET |

