LUDLUM MODEL 375P SERIES RADIATION DETECTOR SYSTEMS

Includes Model 375P-336, 375P-500, 375P-600, 375P-1000, 375P-2000 & 375P-3500 Series

July 2021

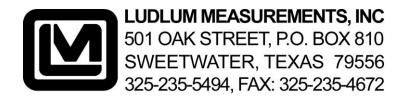
Serial Number 219546 and Succeeding Serial Numbers

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STATEMENT OF WARRANTY

Ludlum Measurements, Inc. warrants the products covered in this manual to be free of defects due to workmanship, material, and design for a period of twelve months from the date of delivery. The calibration of a product is warranted to be within its specified accuracy limits at the time of shipment. In the event of instrument failure, notify Ludlum Measurements to determine if repair, recalibration, or replacement is required.

This warranty excludes the replacement of photomultiplier tubes, G-M and proportional tubes, and scintillation crystals which are broken due to excessive physical abuse or used for purposes other than intended.

There are no warranties, express or implied, including without limitation any implied warranty of merchantability or fitness, which extend beyond the description of the face there of. If the product does not perform as warranted herein, purchaser's sole remedy shall be repair or replacement, at the option of Ludlum Measurements. In no event will Ludlum Measurements be liable for damages, lost revenue, lost wages, or any other incidental or consequential damages, arising from the purchase, use, or inability to use product.

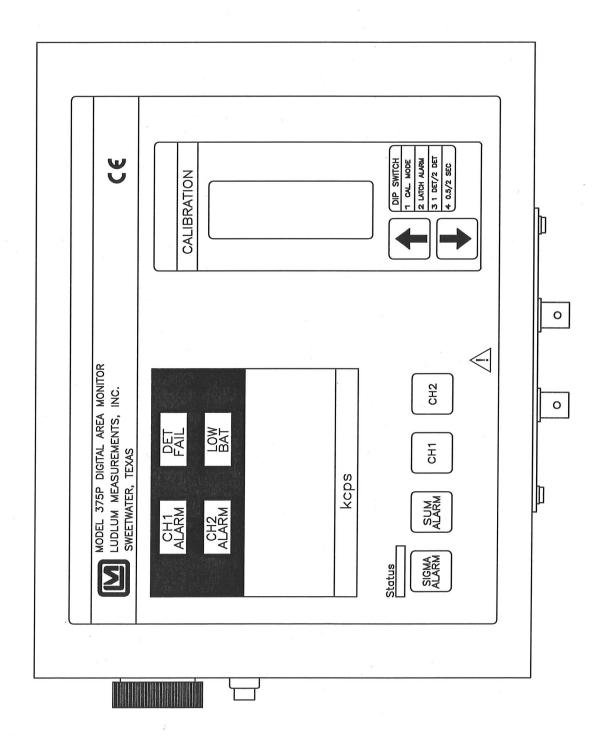
RETURN OF GOODS TO MANUFACTURER

If equipment needs to be returned to Ludlum Measurements, Inc. for repair or calibration, please send to the address below. All shipments should include documentation containing return shipping address, customer name, telephone number, description of service requested, and all other necessary information. Your cooperation will expedite the return of your equipment.

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

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

REV # ALTERATIONS		DATE	BY
	VALID	2/7/05	DDW
2	UPDATED FRONT PANEL	7/28/05	DDW
3	ADDED CONNECTORS	8/5/05	DDW



DWN DATE DDW 8/5/05	CHECKED	АРР	POVED SALS OF			
TITLE: M 375P FRONT PANEL						
LUDLUM MEASUREMENTS, INC. SERIES SHEET						
501 DAK STRE SVEETVATER,		396	725			

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Introduction

he Model 375P Radiation Detector System is designed for visibility and ease of use. Featuring a wall-mount chassis, the Model 375P has a four-digit LED display that is readable from 30 feet away. Backlit indicators warn of detector failure (red), channel 1 radiation alarm (red), channel 2 radiation alarm (red), and low battery (yellow). A green status light is a positive indication of instrument operation. Parameters are protected under a calibration cover. Change of alarm points are easily accomplished by using the pushbuttons to increment and decrement the parameters.

Parameters are stored in non-volatile memory and are retained even with power disconnected. The battery backup provides 24 hours of additional use after the primary power is removed (in a non-alarming condition). Relay output to power a horn and/or strobe light is available by way of a 3-pin connector.

Three common Model 375P systems are:

The Model 375P-336, utilizing two plastic detectors; suitable for indoor mounting, as in a hallway or other entry point.

The Model 375P-1000, utilizing two plastic detectors; suitable for outdoor mounting.

The Model 375P-3500, utilizing a large plastic scintillation detector; suitable for industrial sites and conveyor monitoring.

The Model 375P-336-1 is a version of the Model 375P-336 that utilizes weatherproof detector enclosures to allow for use outdoors. The detector enclosures for the 375P-336 are not recommended for outdoor use. The specifications for the Model 375P-336-1 are otherwise identical to the Model 375P-336, except for the beta response.

Another version of the Model 375P-336 is the Model 375P-336-2. It can be used outdoors, similar to the Model 375P-336-1, except that the detectors are housed in round PVC pipe instead of rectangular aluminum.

There is also a Model 375P-500 series. The Model 375P-500 is a dust monitor conveyor suitable for outdoor mounting and utilizes one plastic detector. The Model 375P-500/M is similar but with increased magnetic shielding.

We also have a Model 375P-2000 series. It is like the Model 375P-1000 except that it has four 7866 cm³ (480 in³) plastic scintillation detectors with 0.33 cm (0.13 in.) lead shielding in weathertight housing while the 375P-1000 has two of those detectors.

The Model 375P-600 is a scale monitor that uses one plastic detector. The Model 375P-600-1 is a gate or conveyor monitor with PVC housing for outdoor use.

These Model 375P detector configurations are detailed in this manual. Consult the accompanying detector manual and/or Ludlum Measurements Engineering Department for questions relating to detector configurations not listed in this manual.

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Getting Started

he Model 375P Radiation Detector System 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 375P will be discussed in this section. Other sections of the manual provide more detailed information.

External Detectors

The Model 375P utilizes a low-voltage interface (nominally 12 Vdc) for connection of one or more external detectors. The detectors used are often large plastic scintillators, which typically connect to the Model 375P by way of cables with BNC type connectors.

If you have an external detector, use the cable provided to connect it to the Model 375P.

Note:

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

Power Up

Caution!

Verify instrument voltage input rating before connecting to a power converter. If the wrong power converter is used, the instrument and/or power converter could be damaged.

Plug the power cord into a suitable 120 Vac outlet. If the RS-232 feature is used, plug in a suitably wired 9-pin connector cable. (See Page 3-3 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.

Initial power-up will momentarily turn on the internal front-panel lights, sound the audio, and display "8888" on the four-digit LED display. The firmware version number (39665Nyy) is then displayed as "396" and "65yy" (where yy represents the current version number). The readout will be blanked, and will then display a 60-second countdown (60 to 0) while a background count is taken.

When the instrument has finished measuring background, it will display the current radiation reading (summed from both detectors) and begin checking for an alarm condition.

Alarm Calculations

The Model 375P has two alarm set points, one for SIGMA ALARM and one for SUM ALARM. The SUM ALARM is most useful as an upper limit for background radiation. If the "summed" detector reading increases above the set SUM ALARM point, then both CH1 ALARM and CH2 ALARM will activate.

Note:

Since its response time (from 10-90% full response) is approximately 60 seconds, the SUM ALARM is not good for detecting sources that are moving quickly through the detectors.

In contrast, the SIGMA ALARM is a fast-acting alarm. Depending on the fourth dipswitch setting, readings will be based on either 0.5 or 2.0 seconds. The SIGMA ALARM is based on the square root of background radiation for each detector.

Formula

ALARM POINT = $Bkg + (SIGMA ALARM \times SQROOT (Bkg))$.

When calculating the ALARM POINT, ensure that the Bkg number is in counts per 0.5 or 2.0 seconds (set by the fourth dipswitch).

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Example

In order to set the sigma alarm for four times the background:

Assume that the Model 375P display shows a background of 21.0 kcps, which is the sum of two detectors. Alternatively, you can multiply the CH1 reading by 2, and that is the number you would use for sigma calculations.

 Assuming the background count rate shown above, determine the desired sigma size in kcps by multiplying the background number by the desired sigma number (in this case, 4).

21 kcpm times 4 = 84 kcpm.

Then subtract background from that number

84 kcps - 21 kcps = 63 kcps

That is the amount of increase desired.

- Thus, the sigma alarm should be set for 63 kcps above the background of 21 kcps.
- If the dip switch is switched to 2 seconds, then we can use the numbers above. If it is set to 0.5 seconds, then all of the numbers above have to be divided by 4 (since 0.5 is ¹/₄ of 2).
- At a background of 21,000, one sigma = square root of 21,000 = 145. Divide the amount of increase desired by the background sigma 63 kcps/145 = 434 sigma
- ALARM POINT = Bkg + (SIGMA ALARM x SQROOT (Bkg))
 21 kcps + (434 sigma x 145) = 84 kcps

Operational Check

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

Note:

Ludlum Measurements suggests that an operational check be performed on a daily basis; local procedures may supersede. Ludlum Measurements foresees no need for complete instrument recalibration as long as the instrument passes this check without indications of failure.

For the operational check, it is necessary to use the radiation check source provided with the instrument to ensure proper alarm function. 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.

 Taking the source in hand, place it so that it is located on the front part of the detector. Hold it there for approximately five seconds and then remove the source from the detector.

Note:

The alarm circuit should activate, causing the audio to sound and the CH1 ALARM and/or CH2 ALARM lights to illuminate. Any remote alarm indicators should also be activated. (i.e. strobe or horn if applicable).

2. Press any front-panel button, and all alarm indicators should go off, including any remote strobe or horn that is connected (if applicable).

Note:

If the alarm is unlatched, the alarm condition will clear automatically when the source is removed.

Repeat the procedure for the other detector if it was not triggered by the first test.

Checking Parameters

Check the sigma alarm point setting by pressing the SIGMA ALARM button. The sigma alarm point will be displayed as long as the button is pressed. The sigma alarm point can be set from 0.1 to 999 sigma. A setting of 5.0 is normally about as low as can be set without having too many false alarms.

Check the sum alarm point setting by pressing the SUM ALARM button. The sum alarm point will be displayed as long as the button is pressed. The high alarm point is in units of kcps (kilo counts per second). The high-alarm point can be set from 0.1 to 9999 kcps.

Check the current detector reading on channel 1 by pressing the CH1 button. The current reading will be displayed as long as the button is pressed. The reading is in units of kcps (kilo counts per second).

Check the current detector reading on channel 2 by pressing the CH2 button. The current reading will be displayed as long as the button is pressed. The reading is in units of kcps (kilo counts per second).

Options

When the calibration cover is removed, a four-pole dipswitch becomes accessible, which is used to activate or deactivate options. The four options are: CAL MODE, LATCH ALARM, # OF DET, and ½SEC-2SEC.

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. In

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addition, when in CAL MODE the display will not blank when using the battery. Moving the CAL MODE switch back to the left locks the current parameters, preventing further changes.

Note:

The top dipswitch (CAL MODE) should be moved to the right prior to connecting to a printer.

- 2. The second switch, LATCH ALARM, changes the alarm to a latching alarm. When switched to the left, the alarm is non-latching, meaning it automatically turns off when the radiation level drops below the alarm point. When switched to the right, the alarm light and audio is latched until either the SIGMA ALARM or SUM ALARM button is pressed.
- 3. The third switch, # OF DET, selects the number of detectors used. To use only one detector, switch the # OF DET switch to the left. To use two detectors, switch the # OF DET switch to the right. This switch can be useful if one detector of a two-detector system is damaged. If that becomes the case, put the working detector into the first channel, move the switch to the left, and the system will operate with the remaining working detector.
- 4. The fourth switch, ½SEC-2SEC, selects the calculation time for the alarm. The ½SEC position means that the alarm is calculated every ½ second, which gives a fast response. The 2SEC position means that the alarm is calculated more slowly (every two seconds). The tradeoff between these two positions is speed versus sensitivity.

RS-232 Output

Printer

With the CALMODE dipswitch switched to the right, the Model 375P may be attached to a printer. The alarm printer output looks like this:

0023.4 ALARM BKG 0210 0238 ALM 0350 0388 MAX 0750 0295 The first line shows the display reading (normally in kcps).

The next three lines show the individual detector readings. These readings are in counts per 0.5 or 2.0 seconds, depending on the fourth dipswitch setting.

The BKG line shows the radiation background level, or "baseline".

The next line, ALM, shows the alarm point.

The last line, MAX, shows the readings that caused the alarm.

In the above example, the SIGMA ALARM is 10.0. So, for CH1:

$$ALM = 10 \times SQROOT(BKG) + BKG$$
, and $350 = 10 \times 14 + 210$

Furthermore, when the system alarmed, CH1 had a "MAX" reading of 750, or nearly twice the alarm point.

Computer Output

With the CAL MODE dipswitch in the left position the Model 375P dumps RS-232 data onto pin 4 of the 9-pin connector every two seconds. The communication parameters 2400 baud, 8 data bits, no parity, 1 stop bit, and no hardware handshaking.



Specifications

Sensitivity: The Model 375P incorporates very sensitive detectors and sensitivity sophisticated electronics. The following tests were performed at Ludlum Measurements, Inc., and the results of these tests should be considered typical of the Model 375P.

Dynamic Sensitivity Test: The dynamic sensitivity test was conducted with the detectors mounted on either side of a 1.5 meter (5-foot) hallway, with a 5 μ Ci ¹³⁷Cs source passed down the center of the hallway at approximately 3 mph. The results were as follows:

<u>SYSTEM</u>	<u>ALARMPT</u>	SOURCE DETECTED
375P-336	6 Sigma	5 out of 5 passes
375P-1000	6 Sigma	5 out of 5 passes
375P-3500	6 Sigma	5 out of 5 passes

Static Sensitivity Test: The following test was conducted by making a slow approach towards a single detector. Distance stated is measured from source to detector at time of alarm.

<u>SYSTEM</u>	<u>SOURCE</u>	<u>ALARMPT</u>	<u>DISTANCE</u>
375P-336	84 μCi ²⁴¹ Am	6 Sigma	1.63 m (5.3 ft)
375P-1000	84 μCi ²⁴¹ Am	6 Sigma	3.4 m (11 ft)
		(18.3 m [60 ft]	w/o PVC enclosure)
375P-3500	84 μCi ²⁴¹ Am	6 Sigma	9.1 m (30 ft)
	127		
375P-336	5 μCi ¹³⁷ Cs	6 Sigma	1.5 m (60 in.)
375P-1000	5 μCi ¹³⁷ Cs	6 Sigma	1.8 m (72 in.)
375P-3500	5 μCi ¹³⁷ Cs	6 Sigma	3 m (118 in.)

Theoretical Sensitivity: Given the following typical data:

<u>SYSTEM</u>	<u>BKGND</u>	¹³⁷ Cs Sensitivity
375P-336	0.8 kcps	0.2 kcps per μR/hr
375P-1000	2.0 kcps	0.4 kcps per μR/hr
375P-3500	5.0 kcps	2.0 kcps per μR/hr

...a six sigma alarm point (with the #4 dipswitch on S512 to the right, or second position) results in the following sensitivity:

<u>SYSTEM</u>	μR/hr at detector to cause alarm
375P-336	0.60 μR/hr above background
375P-1000	$0.47 \mu\text{R/hr}$ above background
375P-3500	$0.15 \mu R/hr$ above background

Power: Input power is by way of the IEC 320 AC power receptacle. Required power is 120 VAC at less than 10 watts. Non-alarm battery current consumption at 6 Vdc is 90 mA. Alarming current consumption at 6 Vdc is 250 mA.

Range: The Model 375P operates within a four-decade display range of 0.1 to 999.9 kcps.

Battery Backup: The battery backup is a 3000 mA sealed lead rechargeable battery. The battery is recharged by way of an onboard trickle charger. Battery life is 24 hours under non-alarm conditions, and six hours under alarm conditions. The display is blanked under non-alarm conditions when under battery power. Blanking is suppressed while the CAL MODE switch is switched to the right.

Warning!:

Only certified technician or calibration personnel should replace battery.

Status: A green light indicates proper instrument operation. A red DET FAIL light warns of improper operation: internal failure or no counts within a 15-second period. A yellow LOW BAT light warns of a low battery and will also trigger the DET FAIL light.

Audio Output: The Model 375P has an audible alarm on either SIGMA ALARM or SUM ALARM. The audio intensity can be changed by rotating the baffle on the audio device.

RS-232 Output: The Model 375P has two modes of RS-232 output (see Section 2, Subsection "RS-232 Output" for further information):

- 1. A two-second dump (for computer data logging)
- 2. An alarm printout (for a hardcopy printer).

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

Calibration Controls: Remove the calibration cover to expose the calibration controls. The calibration controls include the up/down buttons, a calibration potentiometer, and the option dipswitch. The calibration potentiometer is detailed on the following page.

Warning!

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

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

Connector Wiring and Pin Assignments

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

```
+BATTERY
pin1-
pin2-
      GND IN
      FAIL_L
pin3-
pin4-
     RS232 DUMPOUT
pin5-
      (not used)
pin6-
     ALARM2_L
      ALARM1_L
pin7-
pin8-
      EXT RESET_L
      +5VDC OUT
pin9-
```

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

Mains Relay Out: Supplies mains voltage (normally 120 Vac) to alarm on 3-pin connector. This 3 pin connector is wired as follows:

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Pin 1- black HOT 120 Vac on HIGH ALARM

Pin 2- white NEUTRAL

Pin 3- green EARTH GROUND

Detectors

Model 375P-336: 2753 cm³ (168 in³) shielded plastic scintillation detector (2 each)

Model 375P-500: 7865 cm³ (480 in³) shielded plastic scintillation detector (1 each)

Model 375P-600: 10,323 cm³ (630 in³) shielded plastic scintillation detector (1 each)

Model 375P-600-1: 9832 cm³ (600 in³) shielded plastic scintillation detector (1 each)

Model 375P-1000: 7865 cm³ (480 in³) shielded plastic scintillation detector (2 each)

Model 375P-2000: 7865 cm³ (480 in³) shielded plastic scintillation detector (4 each)

Model 375P-3500: 57355 cm³ (3500 in³) shielded plastic scintillation detector (1 each)

Dimensions

Model 375P Electronics: $26.2 \times 24.6 \times 8.4 \text{ cm} (10.3 \times 9.7 \times 3.3 \text{ in.}) \text{ (H x W x D)}$

Model 375P-336 Detectors: $104.1 \times 17.1 \times 5.3 \text{ cm}$ (41 x 6.8 x 2.1 in.) (H x W x Dia), Overall: 2753 cm^3 (168 in^3)

Model 375P-500 Detector: 183 x 20.3 cm (72 x 8 in.) (H x Dia) Overall: $7866 \text{ cm}^3 (480 \text{ in}^3)$

Model 375P-600 Detector: 38 x 71 x 3.8 cm (15 x 28 x 1.5 in.) (H x W x Dia) Overall: 10,323 cm³ (630 in³)

Model 375P-600-1 Detector: $152 \times 12.7 \times 5.1 \text{ cm}$ (60 x 5 x 2 in.) (H x W x Dia) Overall: 9832 cm^3 (600 in³)

Model 375P-1000 & 375P-2000 Detectors: $183 \times 20.3 \text{ cm}$ (72 x 8 in.) (H x Dia) Overall: 7866 cm^3 (480 in^3)

Model 375P-3500 Detectors: $208 \times 62.2 \times 22.9 \text{ cm}$ (82 x 24.5 x 9 in.) (H x W x D)

Weights

Model 375P Electronics: 4.2 kg (9.3 lb)

Model 375P-336 Detectors: 10.7 kg (23.5 lb) each

Model 375P-500, 375P-1000, and 375P-2000 Detectors: $29.5\ kg\ (65\ lb)$

each

Model 375P-3500 Detectors: 295 kg (650 lb)



Safety Considerations

Environmental Conditions for Normal Use

Indoor use only for 375P-336 & 375P-600, outdoor use for Model 375P-500, 375P-600-1, 375P-1000 and 375P-3500 detectors

No maximum altitude

Temperature range of –15 to 50 °C (5 to 122 °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 3 for 375P-336 and 375P-600 (as defined by IEC 664). (Occurs when conductive pollution or dry nonconductive pollution becomes conductive due to condensation. This is typical of industrial or construction sites.)

Pollution Degree 4 for 375P-500, 375P-600-1, 375P-1000, 375P-2000 and 375P-3500 (as defined by IEC 664). (The pollution generates persistent conductivity caused by conductive dust, rain, or snow.)

Cleaning Instructions and Precautions

The Model 375P 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 one 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 375P is marked with the following symbols:



ALTERNATING CURRENT (AC) (IEC 417, No. 5032): designates an input receptacle that accommodates a power cord intended for connection to AC voltages. This symbol appears on the side panel.



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



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

Warning!

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

Caution!

Verify instrument voltage input rating before connecting to a power converter. If the wrong power converter is used, the instrument and/or power converter could be damaged.

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 one 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 6, "Recycling," for further information.

Electrical Safety Precautions

Warning!

Observe the following instructions to avoid a potentially hazardous situation, which, if mishandled, could result in death or serious personal injury, as well as property damage.

- Do not expose the unit to rain or an environment where it may be splashed by water or other liquids, as doing so may result in fire or electric shock.
- Use the unit only with the voltage specified on the unit. Using a voltage higher than that which is specified may result in fire or electric shock.
- Do not cut, kink, or otherwise damage nor modify the power supply cord. IN addition, avoid using the power cord in close proximity to heaters, and never place heavy objects – including the unit itself – on the power cord, as doing so may result in fire or electric shock.
- Avoid installing or mounting the unit or its power supply in unstable conditions, such as a rickety table or a slanted surface. Doing so may result in the unit falling down and causing personal injury and/or property damage.

Replacement of Main Fuse (Side Panel)

Warning!

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

Battery Replacement

Warning!:

Only certified technician or calibration personnel should replace battery.



Calibration

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.

Alarm Parameters

The calibration parameters, SIGMA ALARM and SUM ALARM, can only be changed while in calibration mode. Switch the top dipswitch CAL MODE to the right to switch into calibration mode.

Changing either parameter is done by holding down the parameter key and pressing the up or down arrow buttons. Either 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.

Once parameters are set, it is important to switch the CAL MODE switch back to the left; this protects the parameters from inadvertent changes. Alternatively, in order to preserve the alarm printout (by keeping the CAL MODE switch to the right), simply reattach the calibration cover.

Returning for Repair and Calibration

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

Every returned instrument must be accompanied by an **Instrument Return Form**, which can be downloaded from the Ludlum website at www.ludlums.com. Find the form by clicking the "Support" tab and selecting "Repair and Calibration" from the drop-down menu. Then choose the appropriate Repair and Calibration division where you will find a link to the form.



Recycling

udlum Measurements, Inc. supports the recycling of the electronic 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." This 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:



Model 375P-336, 375P-500, 375P-600, 375P-1000, 375P-2000 & 375P-3500 Radiation Detector Systems

Main Board, Drawing 558 × 503

CRYSTAL

CAPACITORS

Parts List

Reference	e Description	Part Number
UNIT	Completely Assembled Model 375P	48-3478
BOARD	Completely Assembled Main Circuit Board	5396-792
Y1	6.144 MHZ	01-5262
C1 C2	1μF, 35V 68μF, 10V	04-5656 04-5654
C3 C4	0.01μF, 50V	04-5664
C5-C6	10μF, 25V 27pF, 100V	04-5728 04-5658
C7-C9	10μF, 25V	04-5728
C10 C11	1μF, 35V 0.1μF, 16V	04-5656 04-5730
C11	68μF, 10V	04-5654
C12	100μF, 16V-T	04-5794
C14-C15	0.01μF, 50V	04-5664
C16	68μF, 10V	04-5654
C17	0.01µF, 50V	04-5664
C18	68μF, 10V	04-5654
C19	1μF, 35V	04-5656
C20	$0.01 \mu F, 50 V$	04-5664
C21-22	10μF, 25V	04-5728
C23	$0.01 \mu F, 50 V$	04-5664
C24	47pF, 100V	04-5660
C25	$0.01 \mu F, 50 V$	04-5664
C26	1μF, 35V	04-5656
C27	10μF, 25V	04-5728

	Reference	Description	Part Number
	C28	68μF, 25V	04-5828
	C29	47pF, 100V	04-5660
	C30	68μF, 25V	04-5828
	C31	$0.01 \mu F, 50 V$	04-5664
	C32	1μF, 35V	04-5656
	C33	2700μF, 35V	04-5621
		1 /	
TRANSISTORS	Q1-Q5	2N7002L	05-5840
	Q6	MJD200 RL	05-5844
	Q7	2N7002L	05-5840
	Q9-Q10	2N7002L	05-5840
VOLTAGE REGULATOR	VR1	LT1129CQ-5	06-6372
INTEGRATED CIRCUITS	U1	SA08-11EWA	07-6389
Circorro	U2-U3	KB-2685EW RED	07-6400
	U4	SA08-11EWA	07-6389
	U5	ICM7218CIQI	06-6311
	U6	SA08-11EWA	07-6389
	U7	KB-2785YW YELLOW	07-6371
	U8	KB-2685EW RED	07-6400
	U9	TLC372ID	06-6290
	U10	MAX220CSE	06-6329
	U11	SA08-11EWA	07-6389
	U12	AT89C51RC2	06-6893
	U13	M24C02-WMN6TP	06-6299
	U14	ICL7663SCBA-T	06-6302
	U15	CD74HC4538M	06-6297
	U16	LT1304CS8	06-6394
	Q8	MAX810LEUR	06-6424
DIODES	CD1 CD2	CMS111 40M	07 (411
210220	CR1-CR2	CMSH1-40M MMBD914LT1	07-6411 07-6353
		CMSH1-40M	07-6333
	CR4-CR3	ZENER 4.7V SMT R	07-6459
	CR7	CMSH1-40M	07-6411
	CR8	ZENER 4.7V SMT R	07-6459
		2CMSH1-40M	07-6411
	CIC)-CICI2	2CM3111-40M	07-0411
LED	DS1	KB-2550SGD GRN RECT	07-6370
SWITCHES	S1-S6	1241.1619	08-6728
	S7 50 S7	90HBW045	08-6709
	<i>5 i</i>	7 0 1 2 2 7 7 0 1 0	00 0107

	Reference	Description	Part Number
POTENTIOMETER	R26	1M (BAT)	09-6778
RESISTORS	R1	100 Ohm, 1/4W, 1%	12-7840
	R2	60.4 Ohm, 1/4W, 1%	12-7962
	R3	100K, 1/4W, 1%	12-7834
	R4	60.4 Ohm, 1/4W, 1%	12-7962
	R5	100K, 1/4W, 1%	12-7834
	R6	10 Ohm, 1W, 1%	12-7952
	R7	100K, 1/4W, 1%	12-7834
	R8	60.4 Ohm, 1/4W, 1%	12-7962
	R9	2.21K, 1/4W, 1%	12-7835
	R10	22.1K, 1/4W, 1%	12-7843
	R11	68.1K, 1/4W, 1%	12-7881
	R12	10K, 1/4W, 1%	12-7839
	R13	22.1K, 1/4W, 1%	12-7843
	R14	24.3K, 1/4W, 1%	12-7867
	R15	82.5K, 1/4W, 1%	12-7849
	R16	2.2 Ohm, 1/4W, 5%	12-7932
	R17	1K, 1/4W, 1%	12-7832
	R18	165K, 1/4W, 1%	12-7877
	R19	10K, 1/4W, 1%	12-7839
	R20	1K, 1/4W, 1%	12-7832
	R21	1M, 1/4W, 1%	12-7844
	R22	4.75K, 1/4W, 1%	12-7858
	R23	1M, 1/4W, 1%	12-7844
	R24-R25	50 Ohm, 5W	12-7515
	R27	2.21K, 1/4W, 1%	12-7835
	R28	12K, 1/10 W, 1%	12-7164
	R29	100K, 1/4W, 1%	12-7834
	R30-R31	50 Ohm, 5W	12-7515
	R32-R33	100K, 1/4W, 1%	12-7834
	R34	1.5K, 1/4W, 1%	12-7878
	R35	10K, 1/4W, 1%	12-7839
	R36	2.21K, 1/4W, 1%	12-7835
	R40	2.2 Ohm, 1/4W, 5%	12-7932
RESISTOR NETWORK	RN1	220K	12-7831
CONNECTORS	P1-P2	640457-3, MTA100×3RA	13-8165
	P3	640457-2, MTA100×2RA	13-8147
	P4	1-640457-3, MTA100×13RA	13-8113
	P5-P6	640457-2, MTA100×2RA	13-8147

	Reference	Description	Part Number
INDUCTORS	L1 L2-L3 L4	220μH 470μH, TKS1245 22μH, CD43-220 SM	21-9678 21-9699 21-9208
RELAY	RL1	JS1-5V, AROMAT	22-9893
Detector Interface Board, Drawing 215 × 347	BOARD	Completely Assembled Detector Interface Board	5215-347
CAPACITORS	C1 C2 C3 C4 C5 C6 C7 C8 C9-C10 C11 C12 C13 C14 C15 C16 C17 C18-C22 C23-C27	10μF, 25V 4.7μF, 25V 0.001μF, 100V 10μF, 25V 47uF, 10V 0.001μF, 10V 0.01μF, 50V 1μF, 35V 0.01μF, 50V 0.001μF, 2kV 10 pF, 100V 0.01μF, 2KV 47 pF, 100V 10μF, 25V 0.01μF, 2kV 0.01μF, 2kV 0.01μF, 2kV 0.01μF, 2kV 0.01μF, 2kV	04-5655 04-5653 04-5659 04-5655 04-5666 04-5659 04-5664 04-5656 04-5664 04-5703 04-5673 04-5664 04-5722 04-5660 04-5655 04-5722 04-5722 04-5793 04-5696
DIODES	CR1 CR2-CR8	CMSH1-40M CMPD2004S	07-6411 07-6402
TRANSISTOR	Q1	MTD2N50E	05-5855
POTENTIOMETER	R18	1 M, 3269W1-105, HV ADJUST	09-6911
RESISTORS	R1-R4 R5-R6 R7 R8 R9	150 Ohm, 1/2W, 5% 47.5 Ohm, 1/8W, 1% 100K, 1/8W, 1% 1.82K, 1/8W, 1% 10K, 1/8W, 1%	12-7965 12-7966 12-7834 12-7030 12-7839

	Reference	Description	Part Number
	R10 R11 R12	4.75K, 1/8W, 1% 100 Ohm, 1/8W, 1% 1K, 1/8W, 1%	12-7858 12-7840 12-7832
	R13-R15	10K, 1/8W, 1%	12-7839
	R16	4.75K, 1/8W, 1%	12-7858
	R17 R19-R20	392K, 1/8W, 1% 1M, 1/8W, 1%	12-7841 12-7844
	R19-R20	1 GIG-Ohm FHV-1, 2%	12-7644
	R23	1M, 1/8W, 1%	12-7844
INTEGRATED CIRCUITS	U1	ICL7667CBA	06-6510
CIRCUITS	U2	MAX985EUK-T	06-6459
	U3	CA3096M	06-6288
	U4	MAX641ACSA-T	06-6388
VOLTAGE REGULATORS	VR1	LT1460KCS3-2.5TR	05-5867
REGULATORS	VR2	LM78L05ACM	05-5864
INDUCTORS	L1-L2	470uH	21-9224
CONNECTORS	P20	640456-2 MTA100x2	13-8073
	P34 W1	640456-2 MTA-100x2 COAXIAL CONNECTOR,	13-8073
		SIGNAL X	21-9463
Wiring Diagram, Drawing 396 × 726			
AUDIO	DS1	MC-V09-530-S	21-9730
CONNECTORS	J1	CONN-1-640441-2	13-8431
	J2	FILTER CORCOM-3EHG1-2	21-9830
	J3	D RECPT-RD9F000V3 9PIN	13-8003
	J5	CONN-640457-3	13-8165
	J17	CONN-640441-2 CONN-640441-2	13-8196
	J20	COMN-040441-2	13-8196
SWITCH	S1	DM62J12S205PQ W/LEGEND	08-6715
BATTERY	B1	BATTERY-PS630	21-9705
TRANSFORMER	T1	CFP302 115/230V	22-9908

System Miscellaneous	Reference	Description	Part Number
miscenaneous	1 EA 1 EA 1 EA	10 μCi ¹³⁷ Cs Check Source Adapter BNC/BNC MILESTEK Power Cord –	01-5231 13-8481
Other 375P Models		BELDEN 7.5 feet LONG	21-9394
Model 375P-336	2 EA	Model 44-151 Plastic Detectors	47-3347
	2 EA	CBL-BNC CRIMP 200 feet, RG58	8303-668
Model 375P-336-1	2 EA	Model 44-151-1 Plastic Detectors	47-3275
	2 EA	CBL-BNC PGTL 200 feet, RG58	8303-754
Model 375P-336-2	2 EA	Model 44-151-2 Detectors with PV	C Housing 47-3662
	2 EA	CBL-C 300 feet, RG58	40-1004-300
Model 375P-500	1 EA	Model 44-128-1 Plastic Detector	47-3319
	1 EA	CBL-BNC CRIMP 200 feet, RG58	8303-668
Model 375P-600	1 EA	Model 44-139 Plastic Detector	17-3149
Model 375P-600-1	1 EA 1 EA	Model 44-128-9-1 Plastic Detector 4 CBL-BNC CRIMP 200 feet, RG58	
Model 375P-1000	2 EA	Model 44-128-1 Plastic Detectors	47-3319
	2 EA	CBL-BNC CRIMP 200 feet, RG58	8303-668
Model 375P-2000	4 EA	Model 44-128-1 Plastic Detectors	47-3319
	4 EA	CBL-BNC CRIMP 200 feet, RG58	8303-668
Model 375P-3500	2 EA	Model 44-173-1 Plastic Detectors	47-3707
	2 EA	CBL-BNC CRIMP 200 feet, RG58	8303-668
1 1/8 in. Voltage Divider, Drawing 435 × 435	BOARD	Completely Assembled Circuit Board (×2)	5435-182
CAPACITORS	C1-C3	0.01μF, 200V	04-5725
	C4	0.0047μF, 3KV	04-5547
RESISTORS	R1	10M, 1/8W, 1%	12-7996
	R2	7.5M, 1/8W, 5%	12-7971
	R3-R10	10M, 1/8W, 1%	12-7996

	R11 R12-R13	2.21M, 1/4W, 1% 6.04M, 1/4W, 1%	12-7002 12-7071
MISCELLANEOUS	W1 W4	TEFLON WHITE EE22 6 in. HV #22 BLACK UL1430 GND 6 in.	21-9759 21-9154
Detector Electronics			
1.125 in. Voltage Divider, Drawing 2 × 191	BOARD	Completely Assembled Circuit Board (×2)	5002-241
CAPACITOR	C2	0.01μF, 2KV	04-5525
RESISTORS	R1 R2-R12	1Meg, 1/3W, 1% 10M, 1/3W, 1%	12-7609 12-7749



Drawings

Main Circuit Board, Drawing 396 x 792 (4 sheets)

Main Circuit Board Component Layout (Top Side), Drawing 396 x 793A (2 sheets)

Main Circuit Board Component Layout (Bottom Side), Drawing 396 x 793A (2 sheets)

Detector Interface Board, Drawing 215 × 347

Detector Interface Board Component Layout, Drawing 215 × 348

1 1/8 in. Voltage Divider, Drawing 435×435

1 1/8 in. Voltage Divider Component Layout (Top side), Drawing 435×436 A

1.125 in. Voltage Divider Component Layout (Bottom side), Drawing $435 \times 436A$

1.125 inch Voltage Divider, Drawing 2×191

Wiring Diagram, Drawing 396 × 726

Model 375P-336 Installation, Drawing $396 \times 864 - 864C$

Model 375P-500 Conveyor Installation, Drawing 384 x 1193

Model 375P-600-1 Conveyor Installation, Drawing 384 x 1194

Model 375P-1000 Installation, Drawings $396 \times 272A - 272D$

Model 375P-2000 Installation, Drawings 396 x 1180 – 1180E

Anchor Bolt and Concrete Template, Drawing 511 x 836

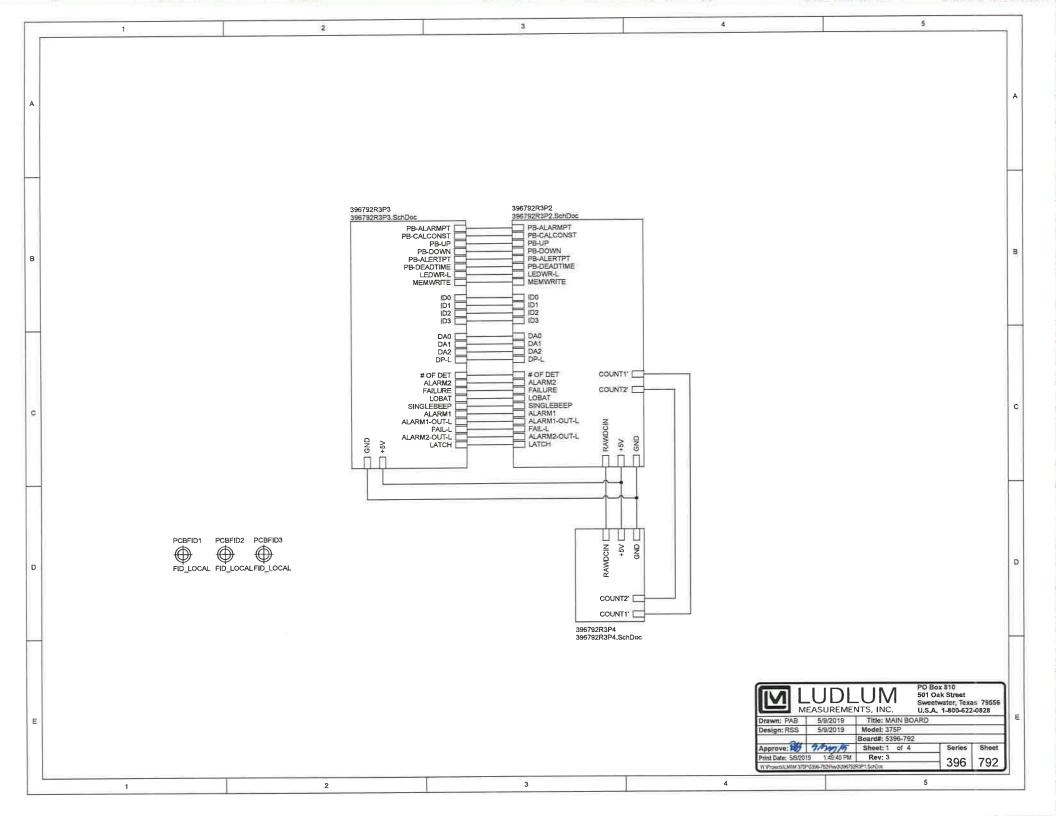
Model 375P-3500 Conveyor Installation, Drawing 396 × 957

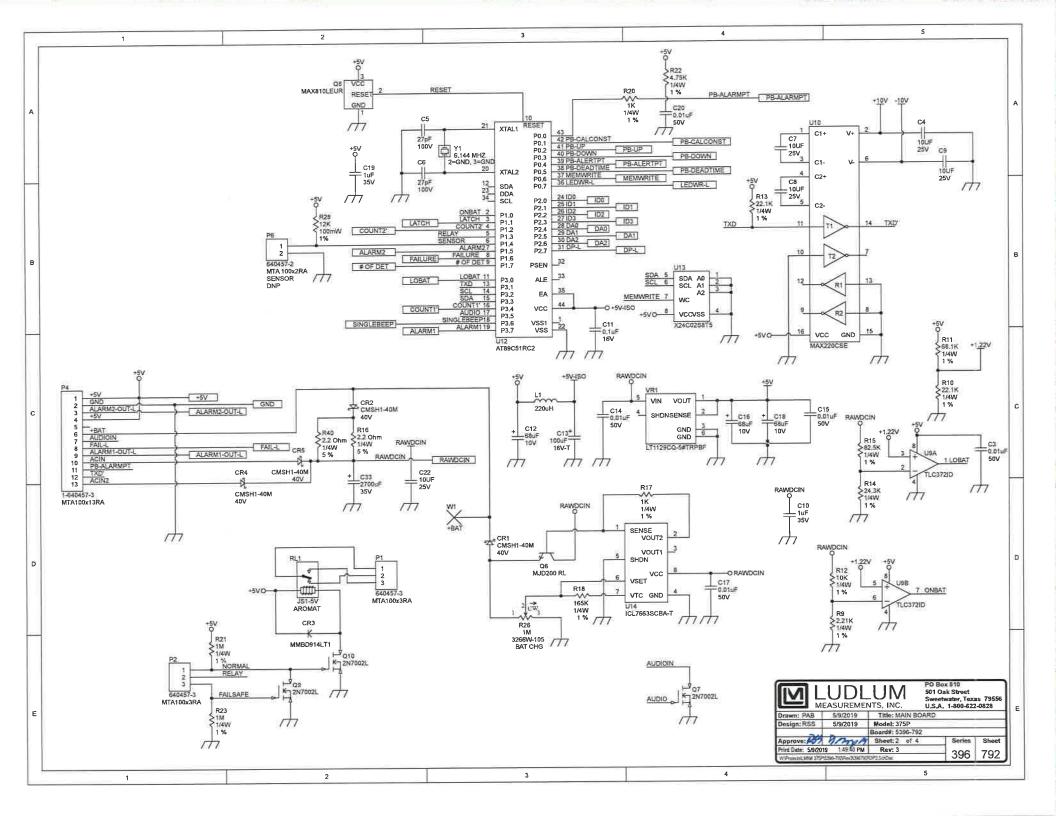
Model 44-151 Detector Dimensions, 215 x 415

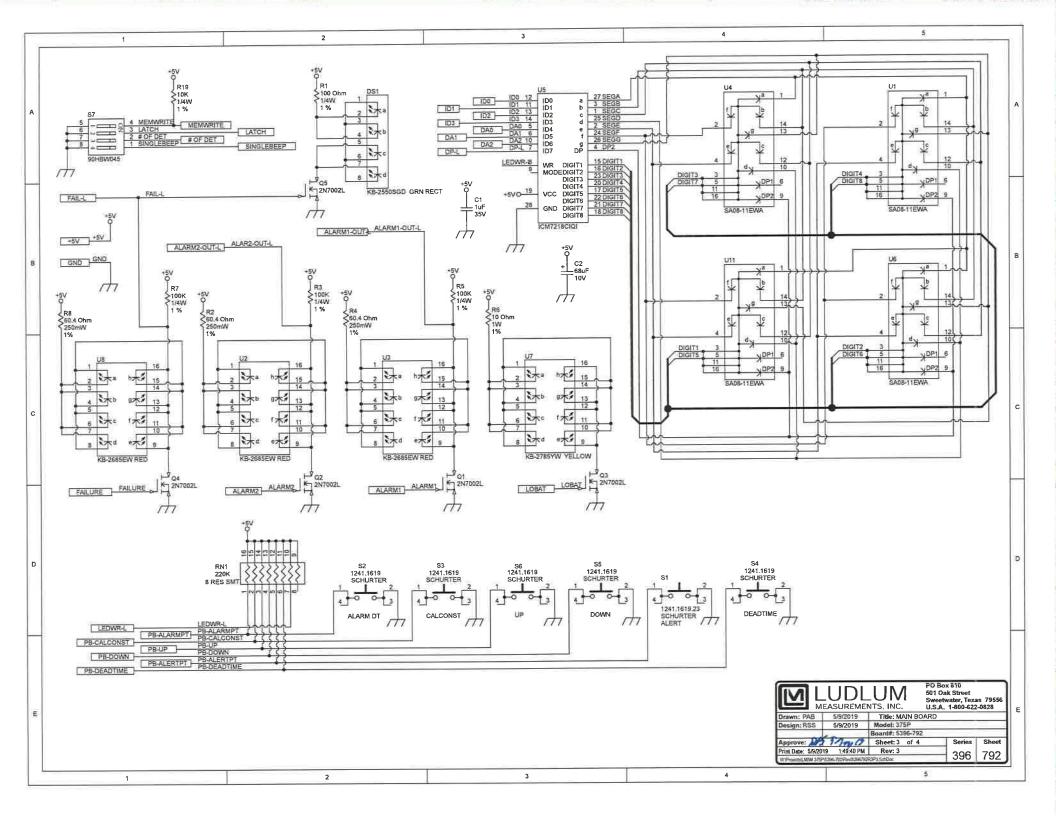
Model 44-151-1 Detector Dimensions, 396×247

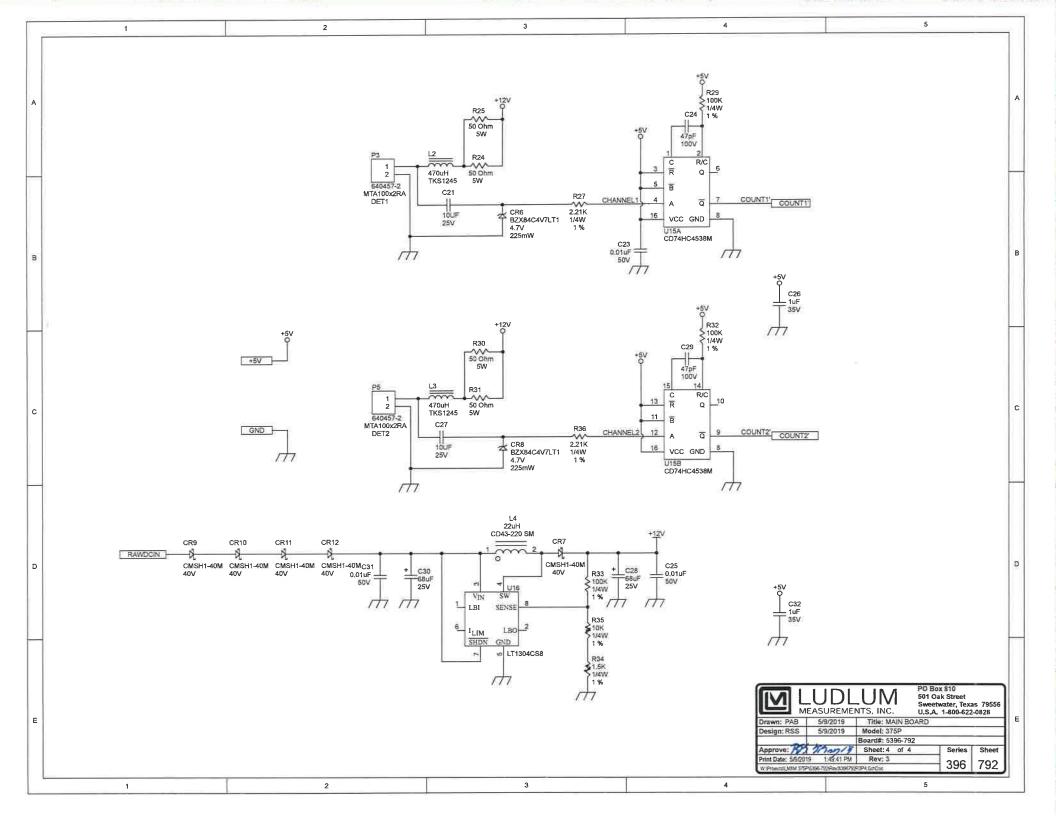
Model 44-151-2 Detector Dimensions, 215 x 651

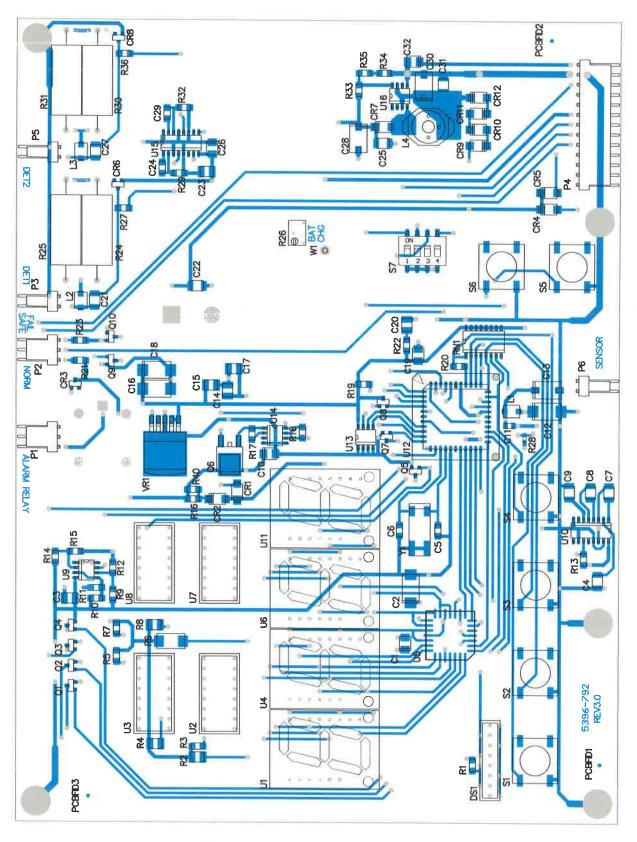
Wall Mounting Guide, Drawing 396 x 166



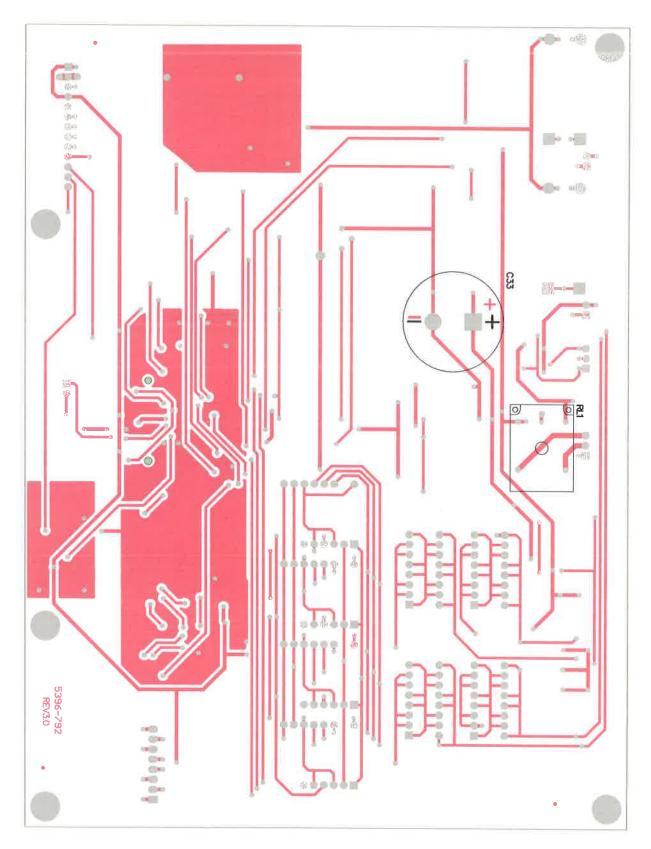




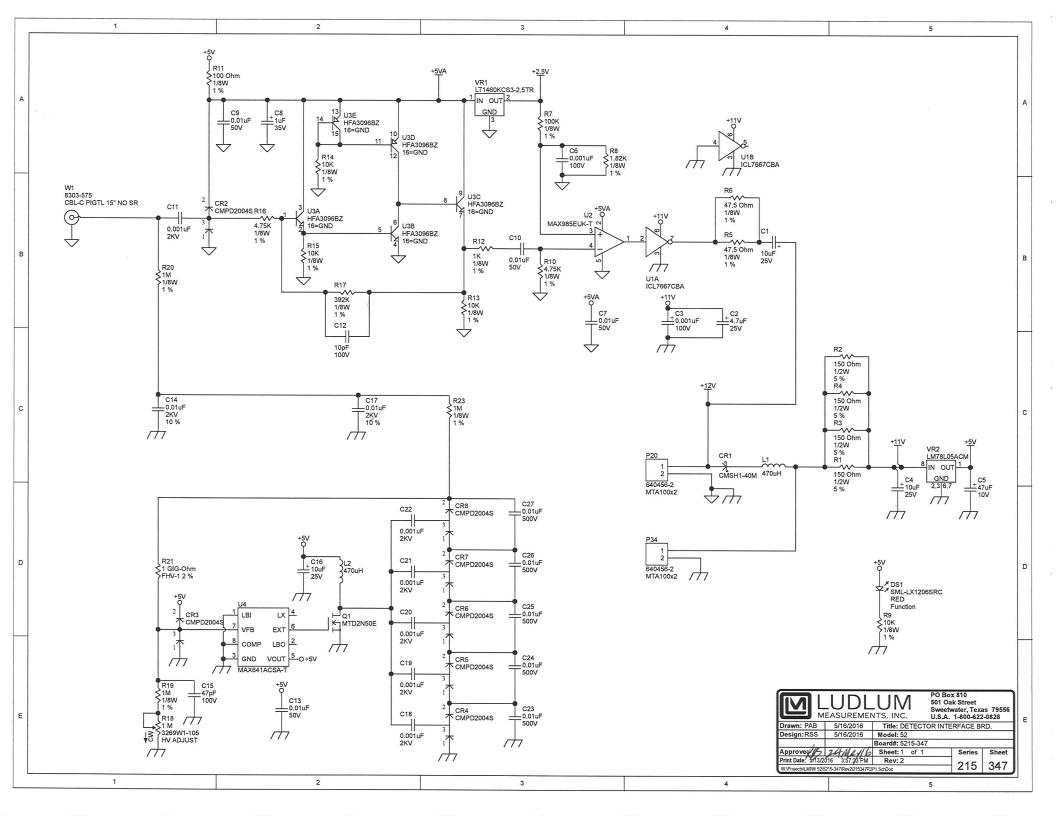


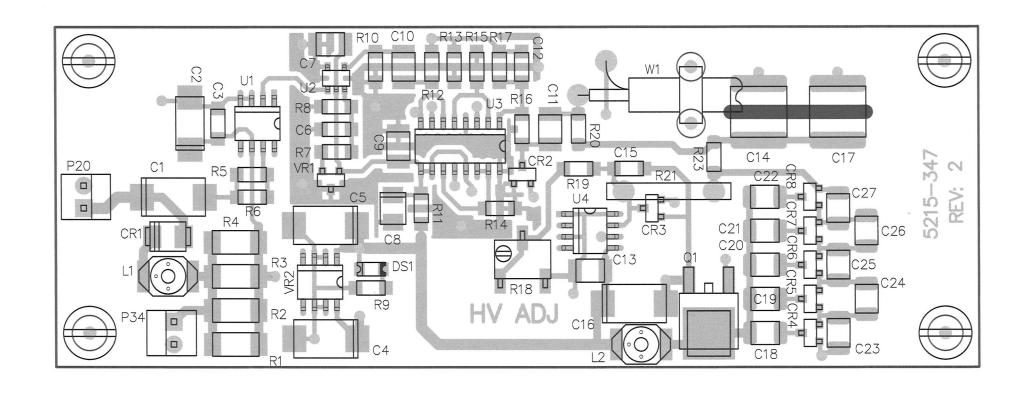


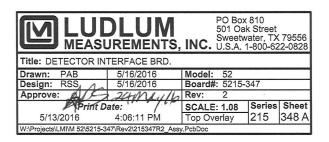


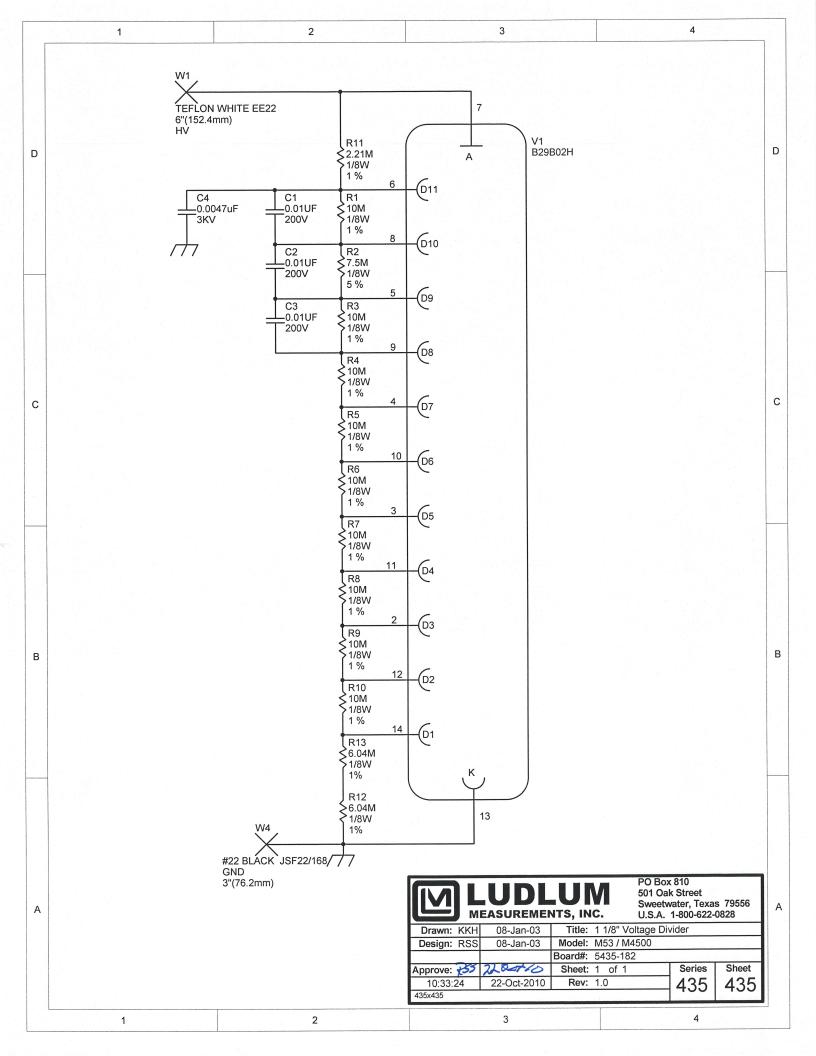


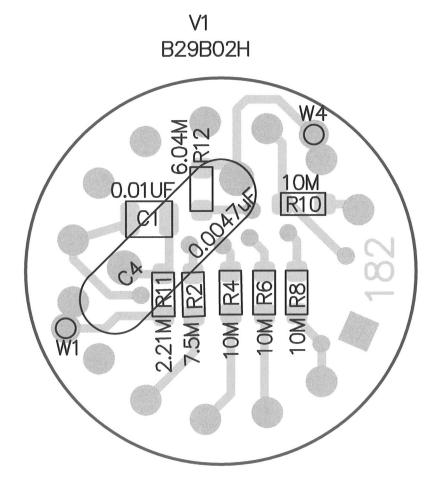








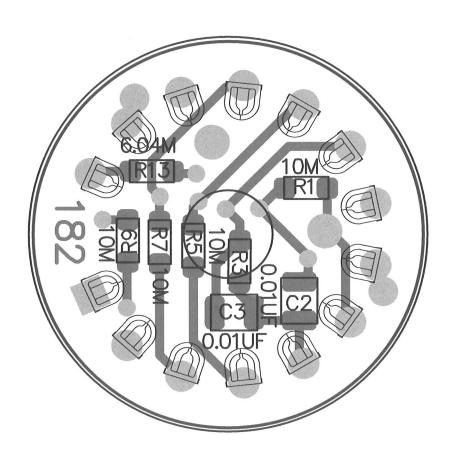






Title: 1	1/8" VOL	TAGE DIVIDER
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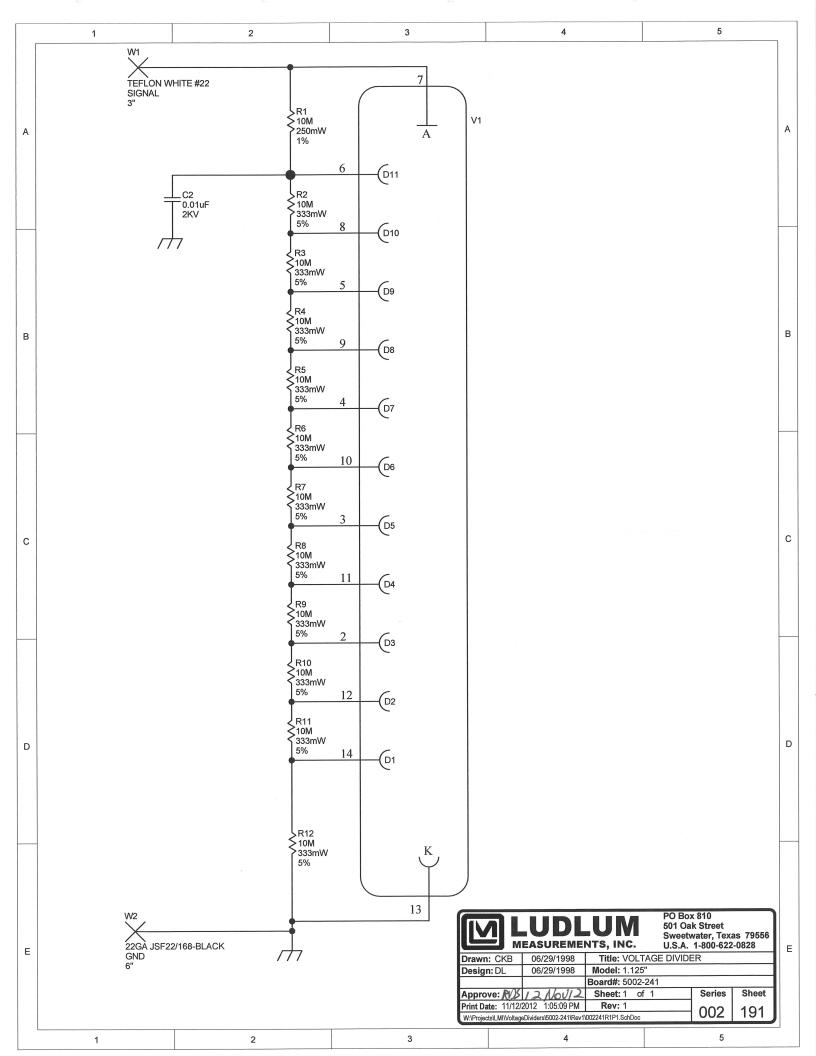
TITIE: 1 1/8" VOLTAGE DIVIDER								
Drawn: PAB	1/27/2014	Model: B29B1						
Design: LL	3/24/2003	Board#: 5435-182						
Approve:	200mm	Rev: 2						
PCBA Drawii	ng		Series					
Print Date: 1/28/2014 9:35:12 AM Top Overlay 435 436A								
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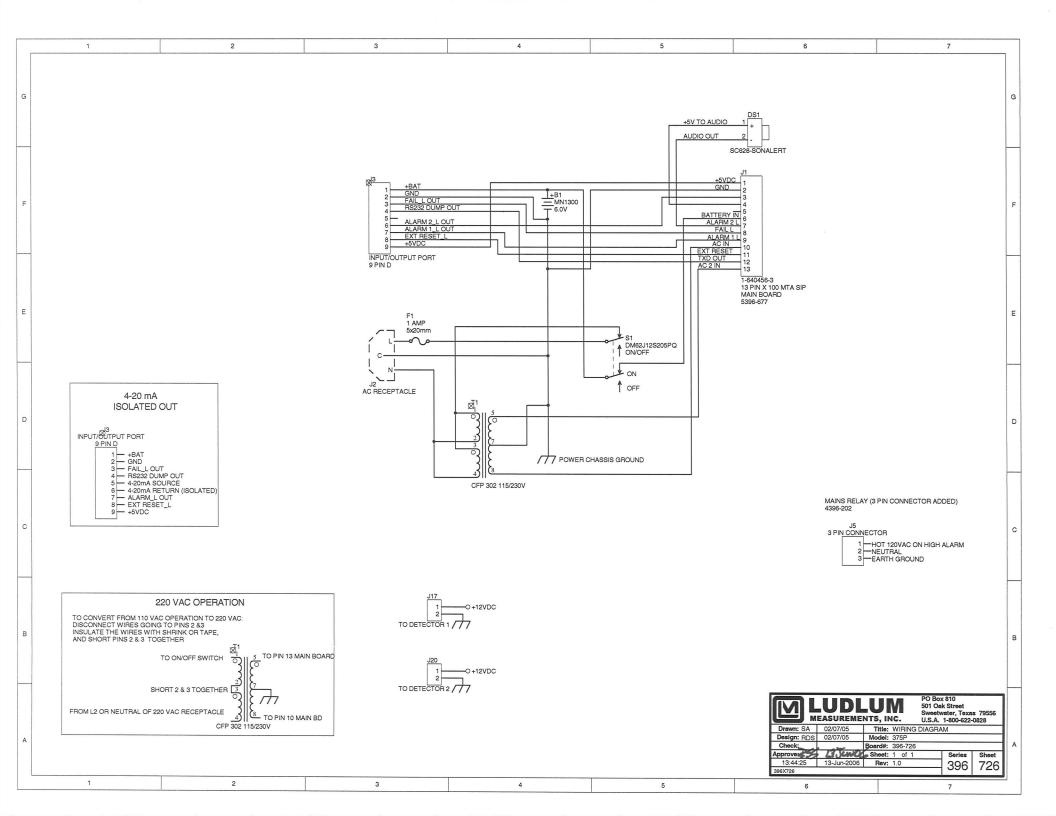


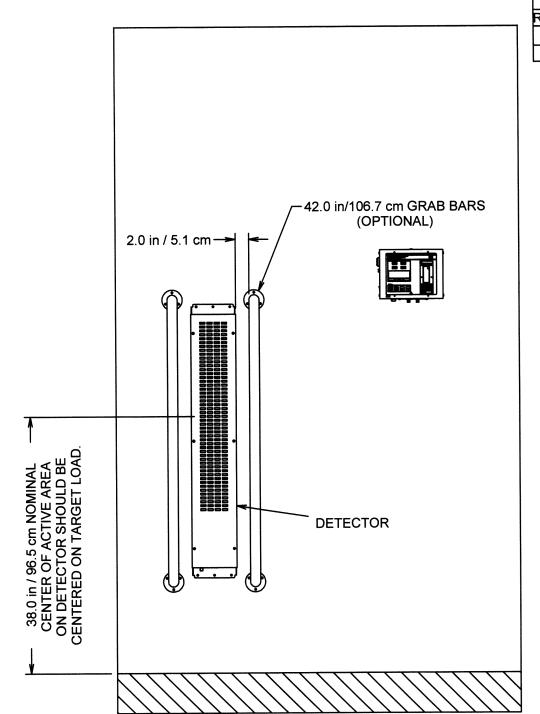


Title:	1	1/8"	VOLTAGE	DIVIDER
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TILLE: 1 1/6 VOLTAGE DIVIDEN									
Drawn: PAB	1/27/2014	Model: B29B10H							
Design: LL	3/24/2003	Board#: 5435-182							
Approve: 2	28 19014	Rev: 2							
PCBA Drawin	ng	SCALE: 6.97	Series	Sheet					
Print Date: 1/28/2014	9:35:13 AM	Bottom Overlay	435	436A					
W:\Projects\LMI\VoltageDividers\5435-182\Rev2\435182R2_Assy.PcbDoc									





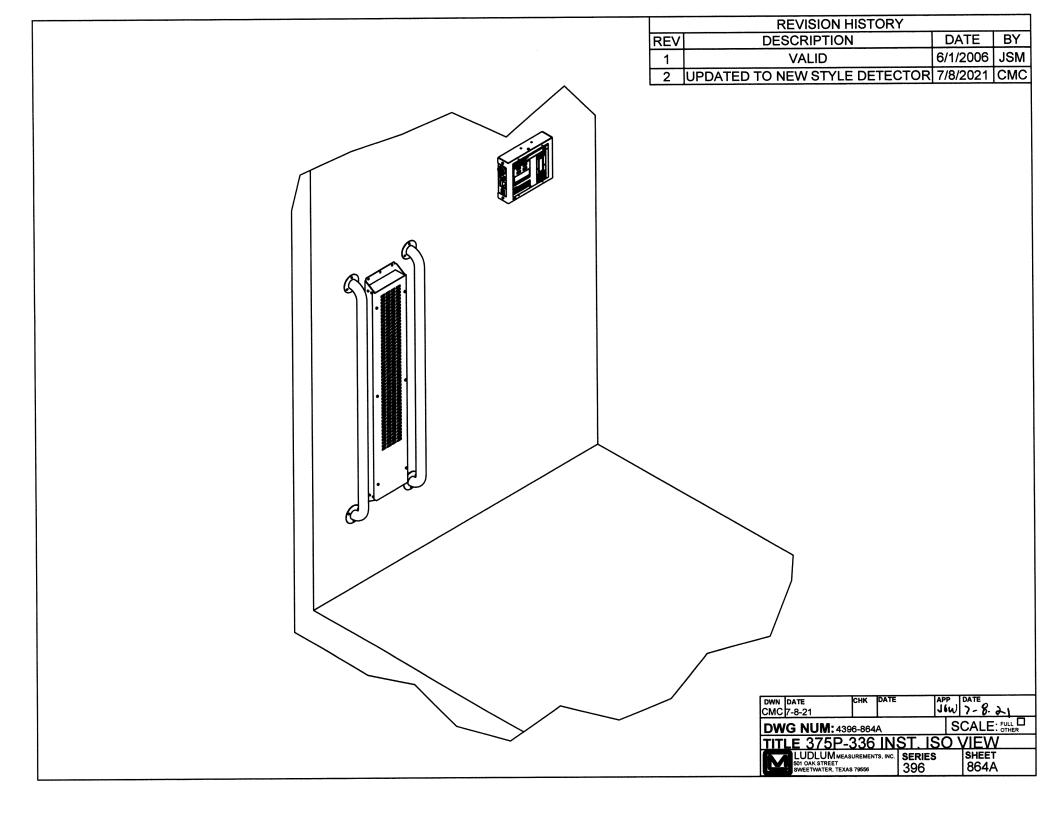


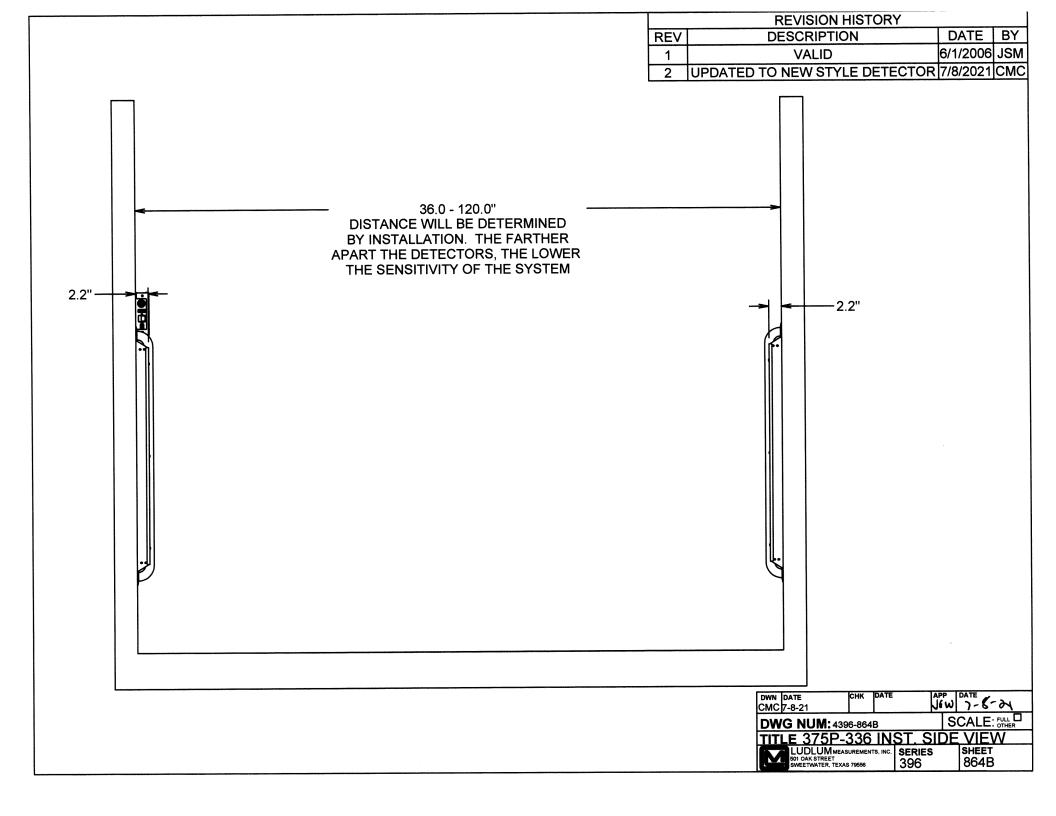
REVISION HISTORY							
REV	DESCRIPTION	DATE	BY				
1	VALID	6/1/2006	JSM				
2	UPDATED TO NEW STYLE DETECTOR	7/8/2021	СМС				

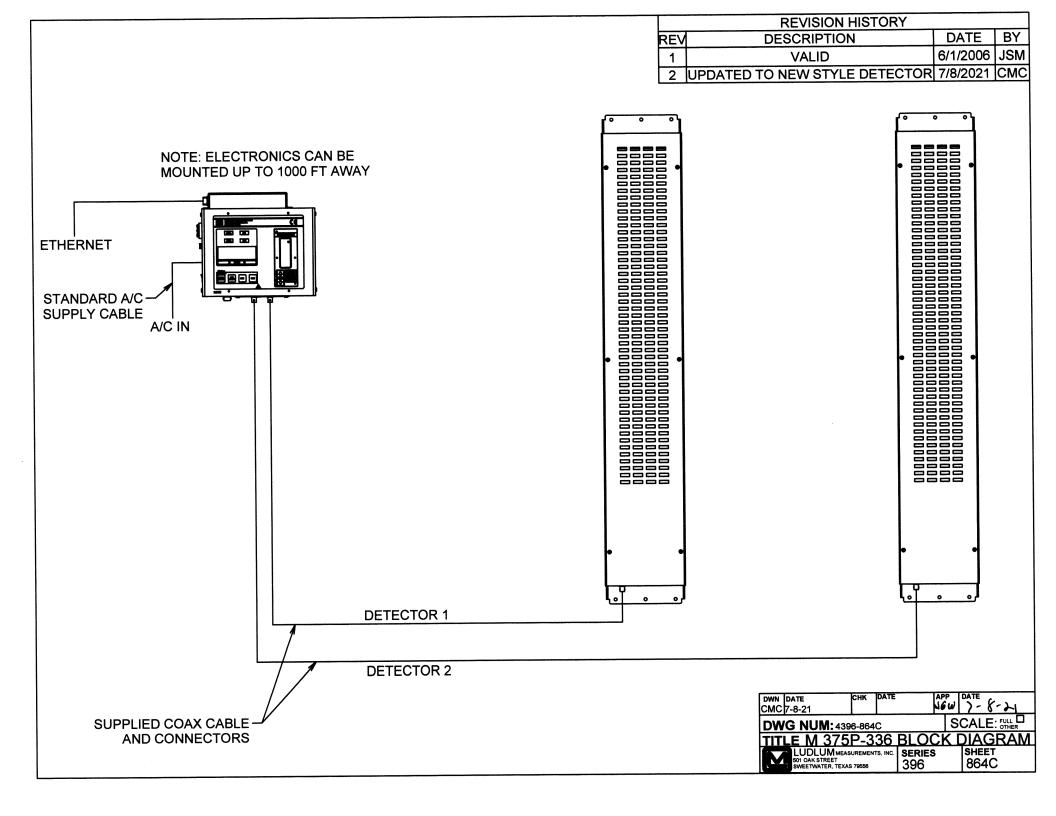
NOTE: ELECTRONICS CAN BE MOUNTED UP TO 1000 FT/304.8 M AWAY

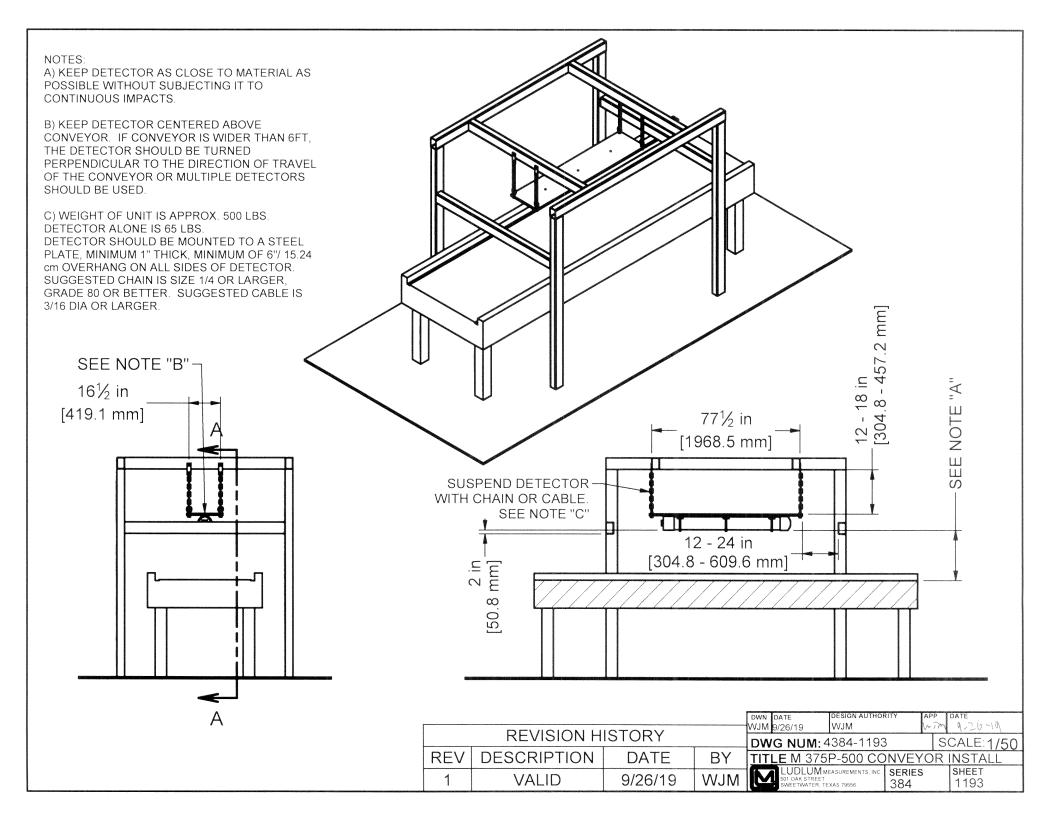
MAX RECOMMENDED DISTANCE
BETWEEN DETECTORS = 120 in/304.8 cm.
THEY CAN BE SPACED FARTHER APART,
BUT SENSITIVITY GOES DOWN AS
DISTANCE INCREASES.

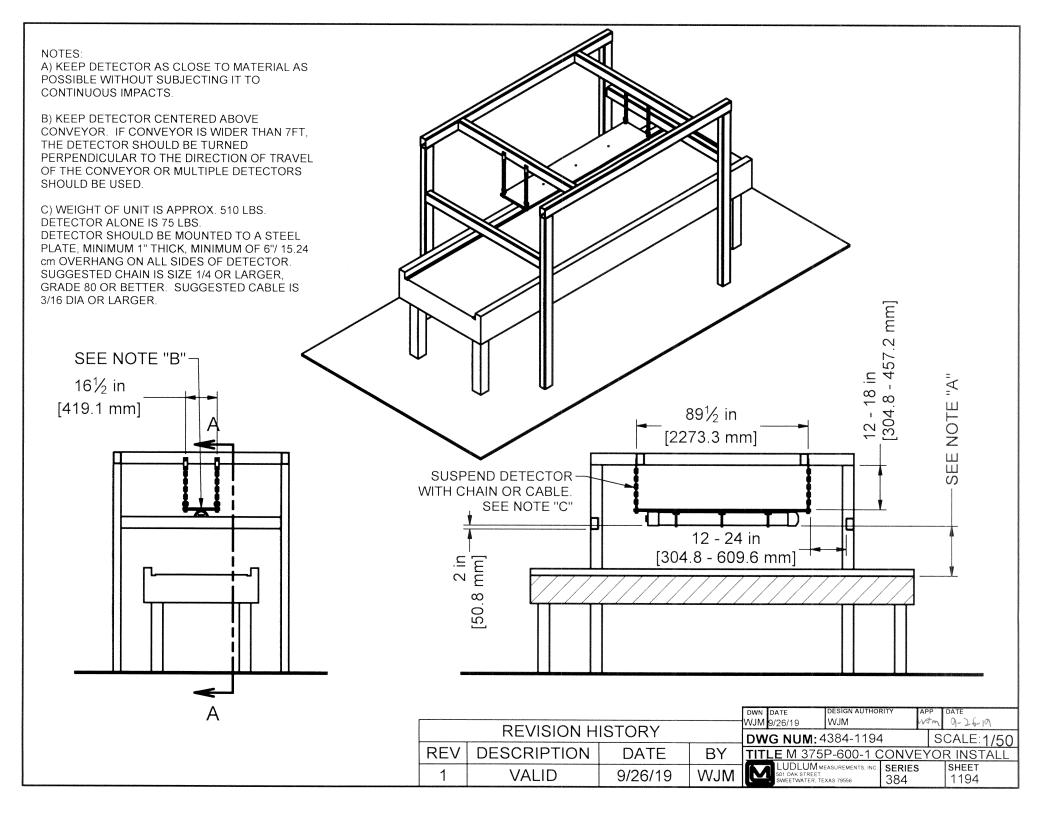
DWN DATE CMC 7-8-21	СНК	DATE	À	PP (w)	DATE 7-8-	٠ <u>٨</u> ١
DWG NUM: 439					CALE:	
TITLE M 375	P-3	36	INSTA	۱LL	ATIO	N
LUDLUM MEAS 501 OAK STREET SWEETWATER, TEXAS		TS, INC.	SERIES 396		SHEET 864	

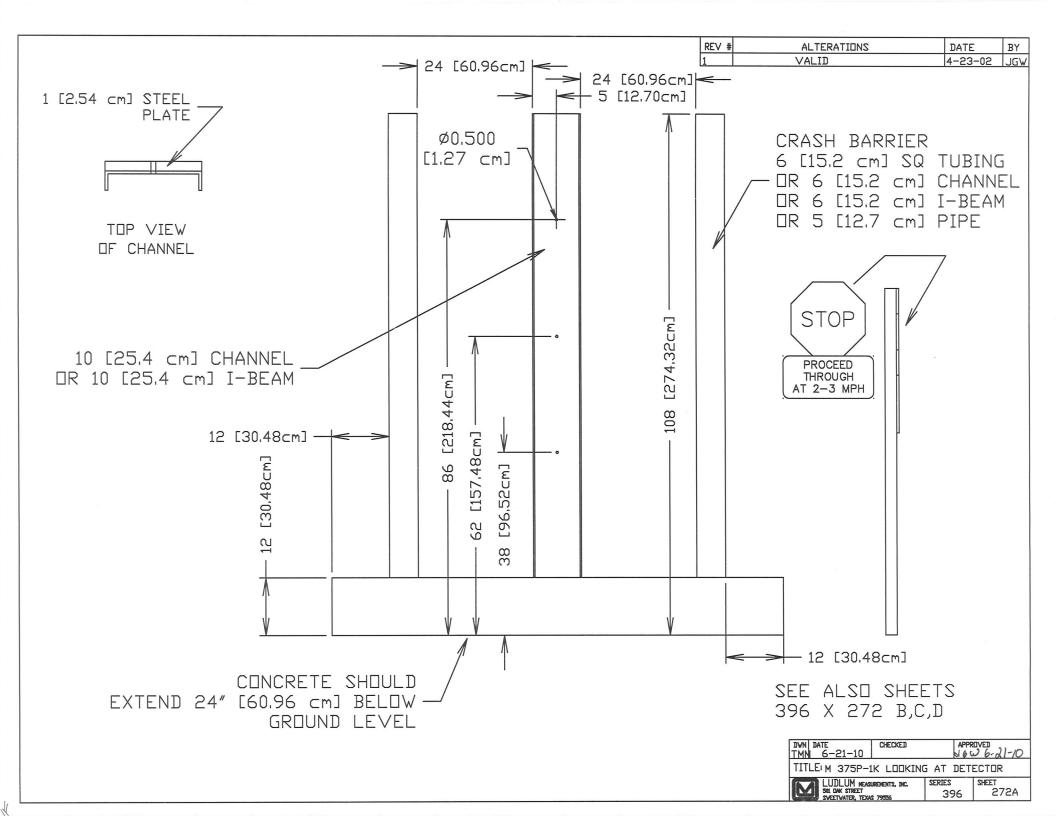






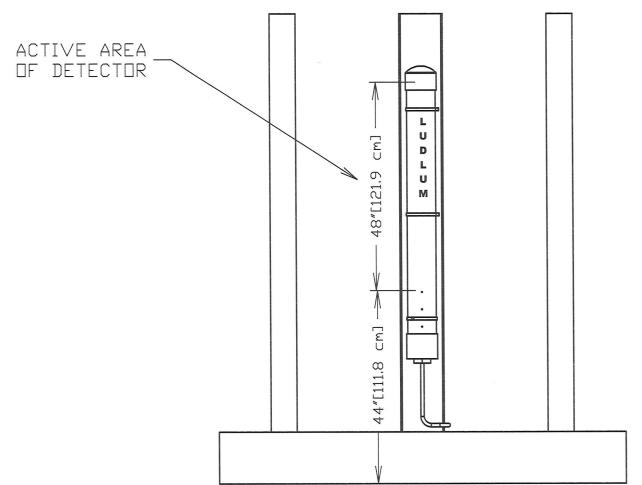






 REV #
 ALTERATIONS
 DATE
 BY

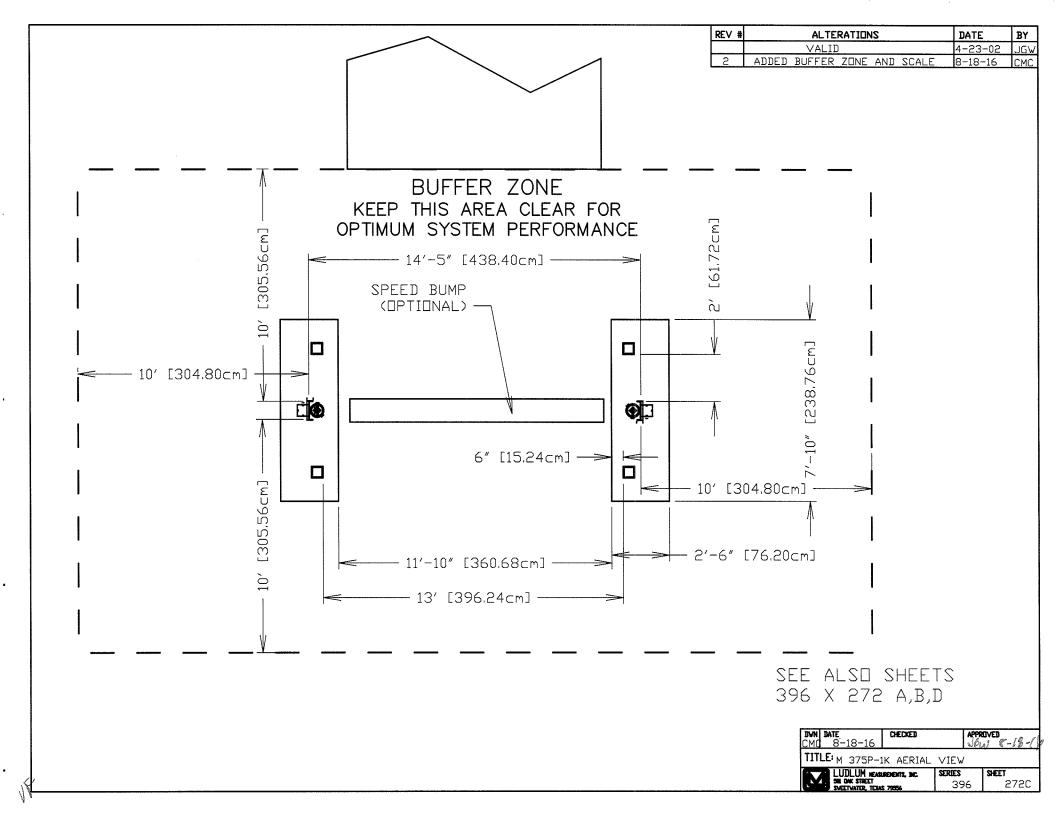
 1
 VALID
 4-23-02
 JGW



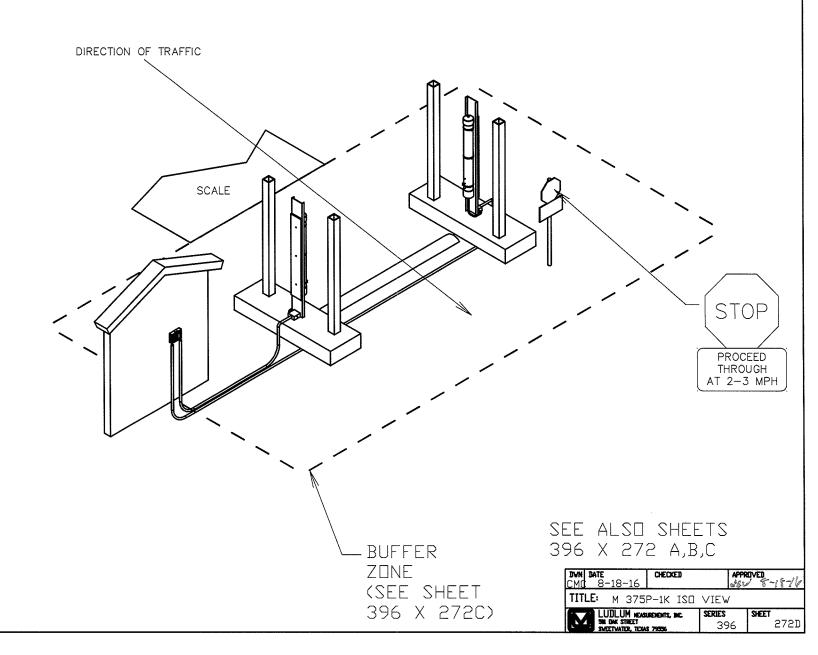
HEIGHT WILL BE
DETERMINED BY
INSTALLATION.
EXCLUSIVE TRUCK OR
RAIL USE MAY REQUIRE
RAISING DETECTORS.

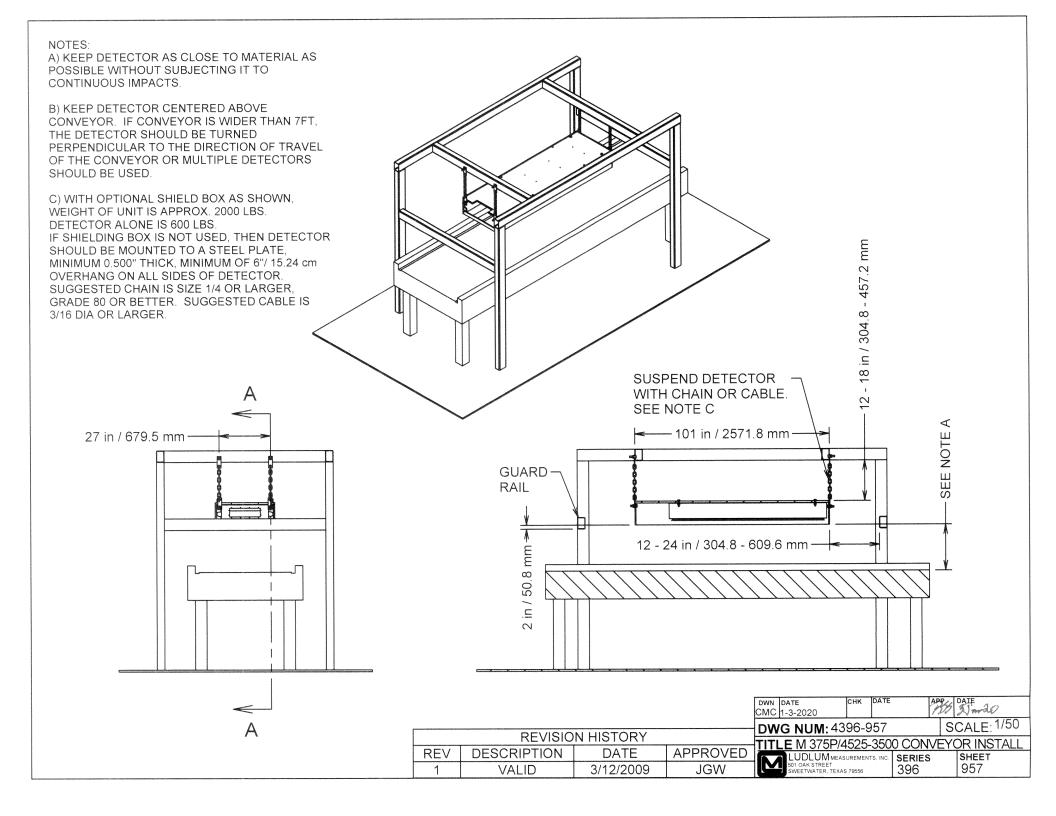
SEE ALSO SHEETS 396 X 272 A,C,D

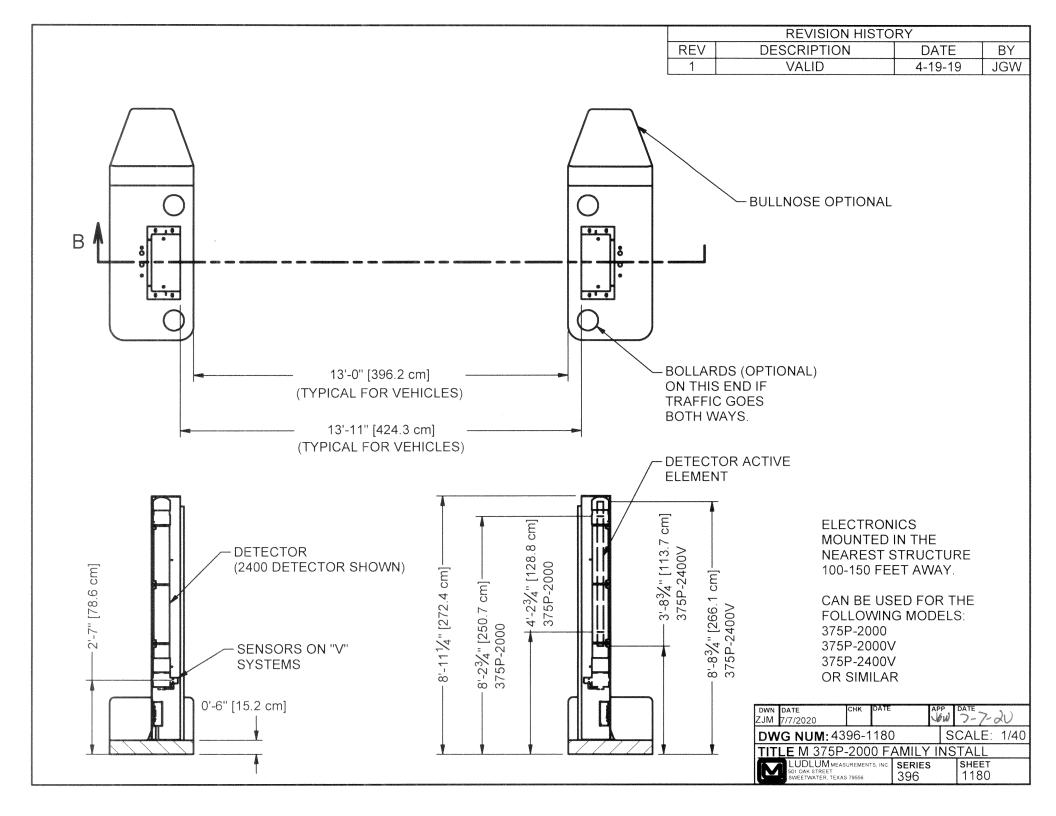
DWN DATE JLW 5/27/16	CHECKED		APPR	N 2-871
TITLE: M 375P-1	K LOOKING	aT i	DETE	ECTOR
LUDLUM NEAS 501 DAK STREET		SERIES 39	96	SHEET 272B

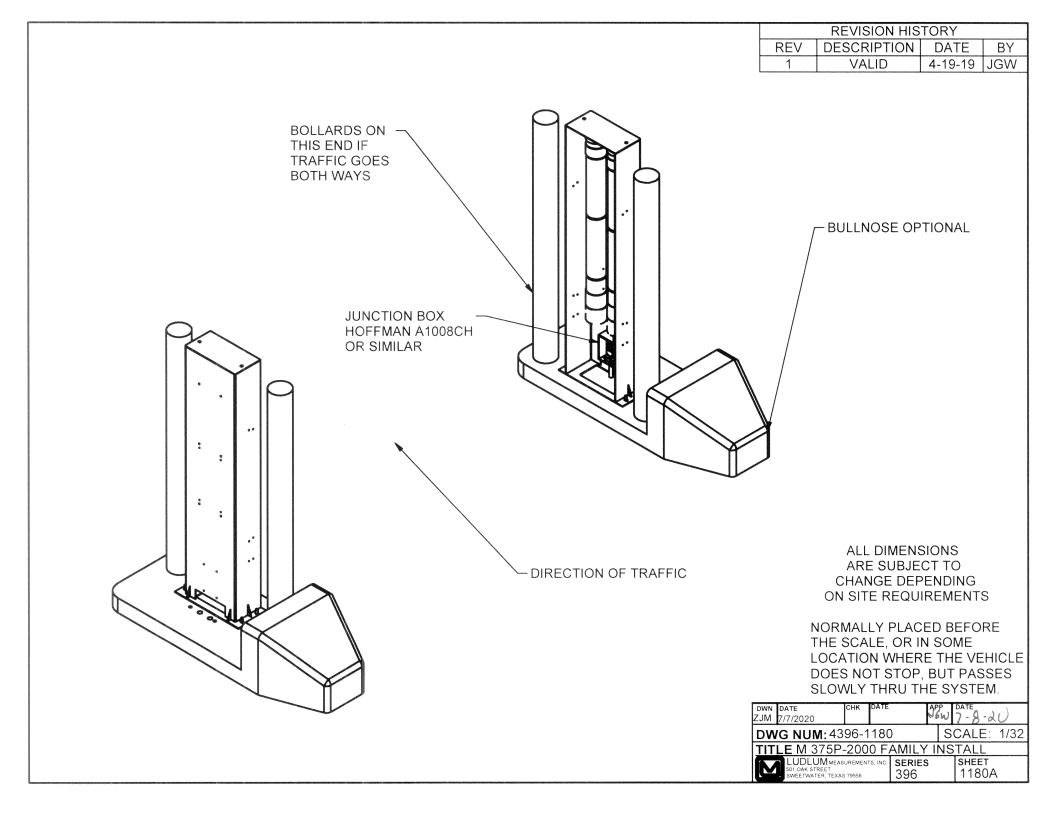


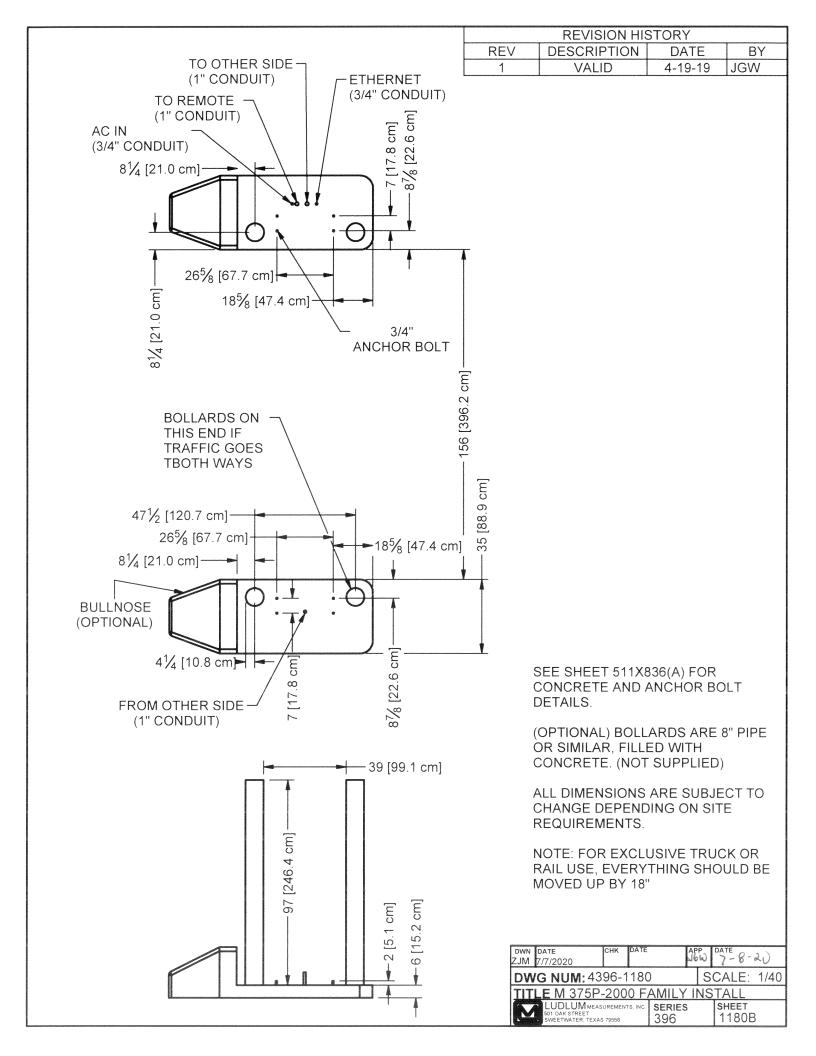
REV #	KEV # ALTERATIONS				DATE	BY	
	VALID				4-23-02	JGW	
2	ADDED	SCALE	AND	BUFFER	ZONE	8-18-16	СМС

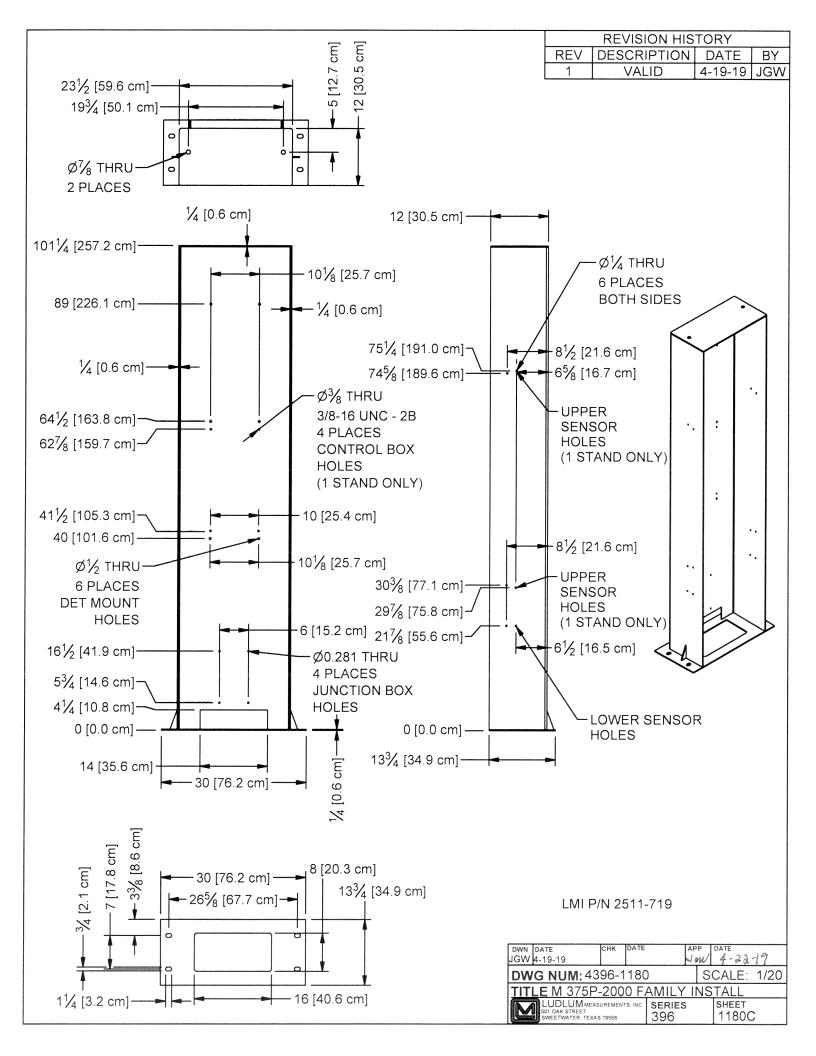


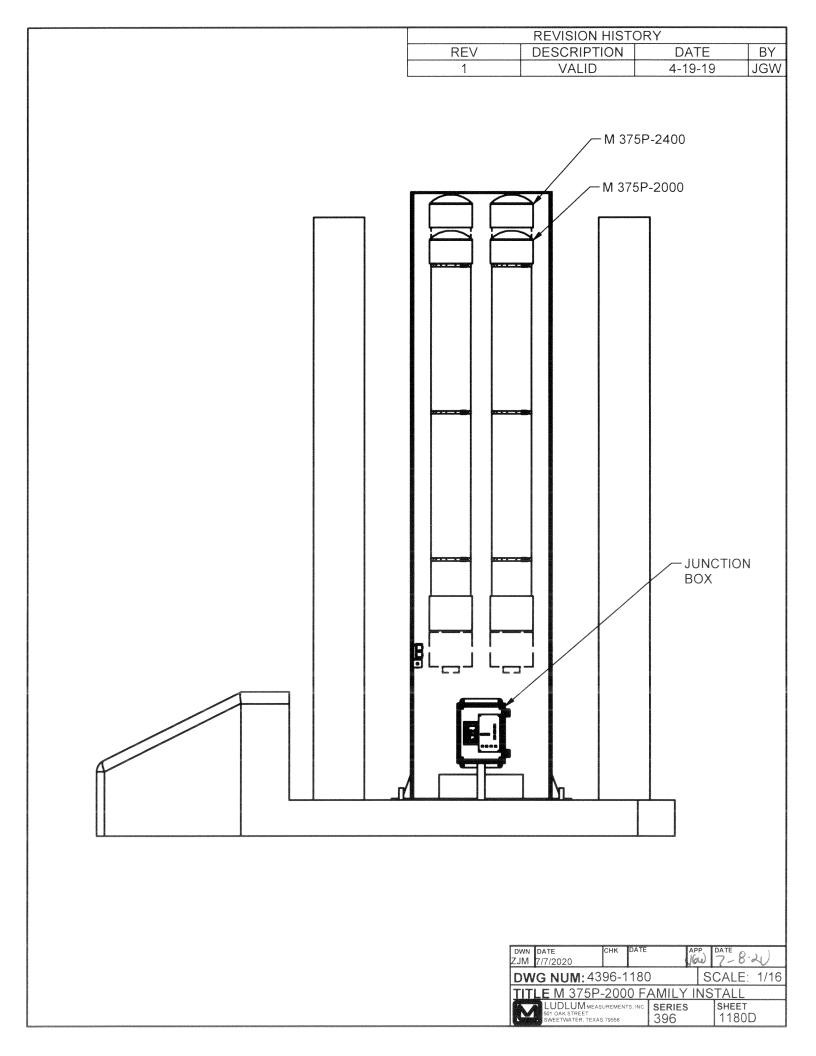




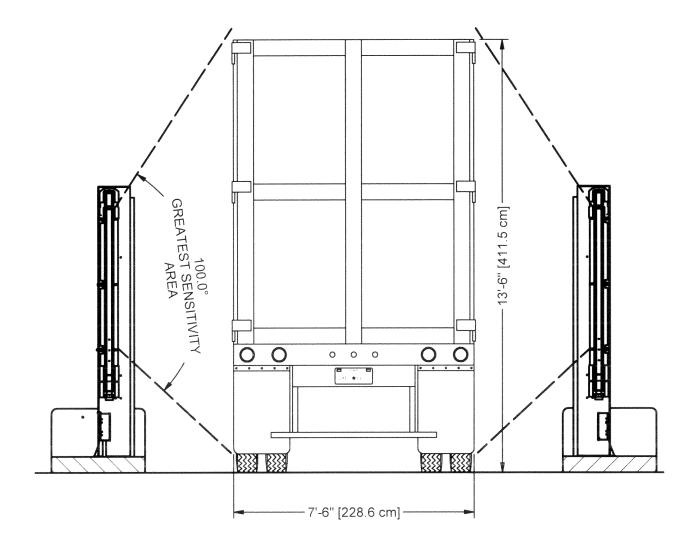








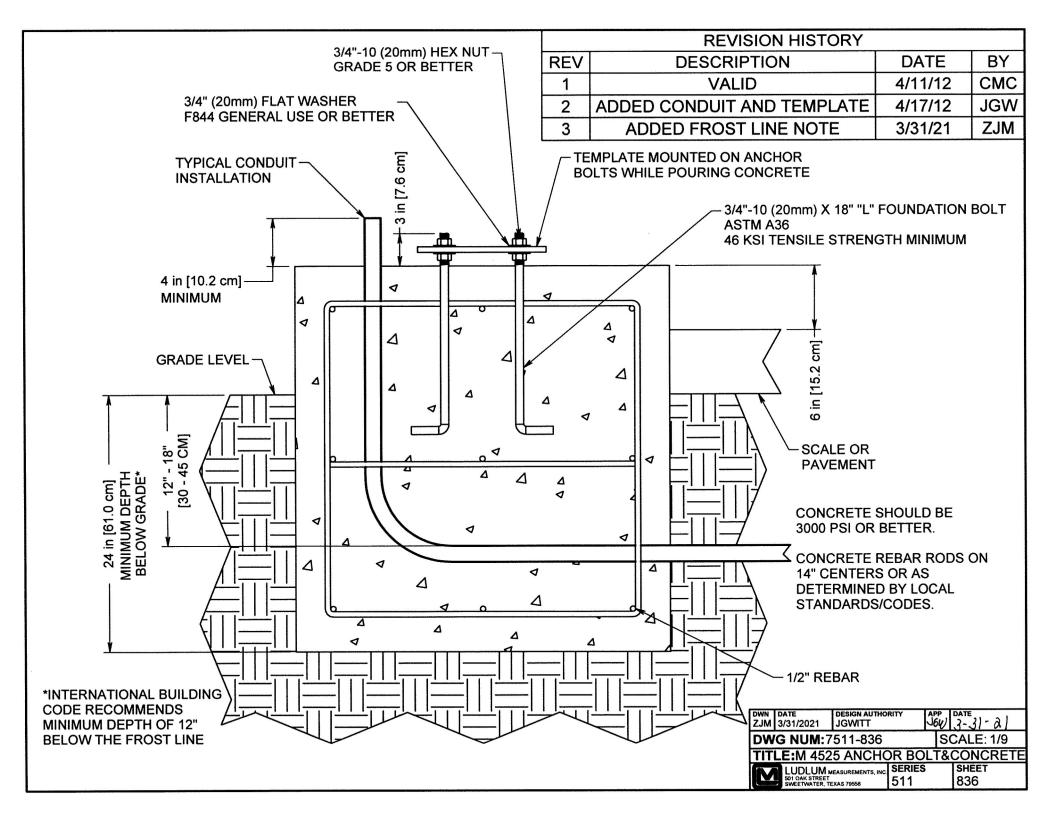
оншинской ровой	REVISION HISTORY								
	REV	DATE	BY						
	1	VALID	7/8/20	ZJM					

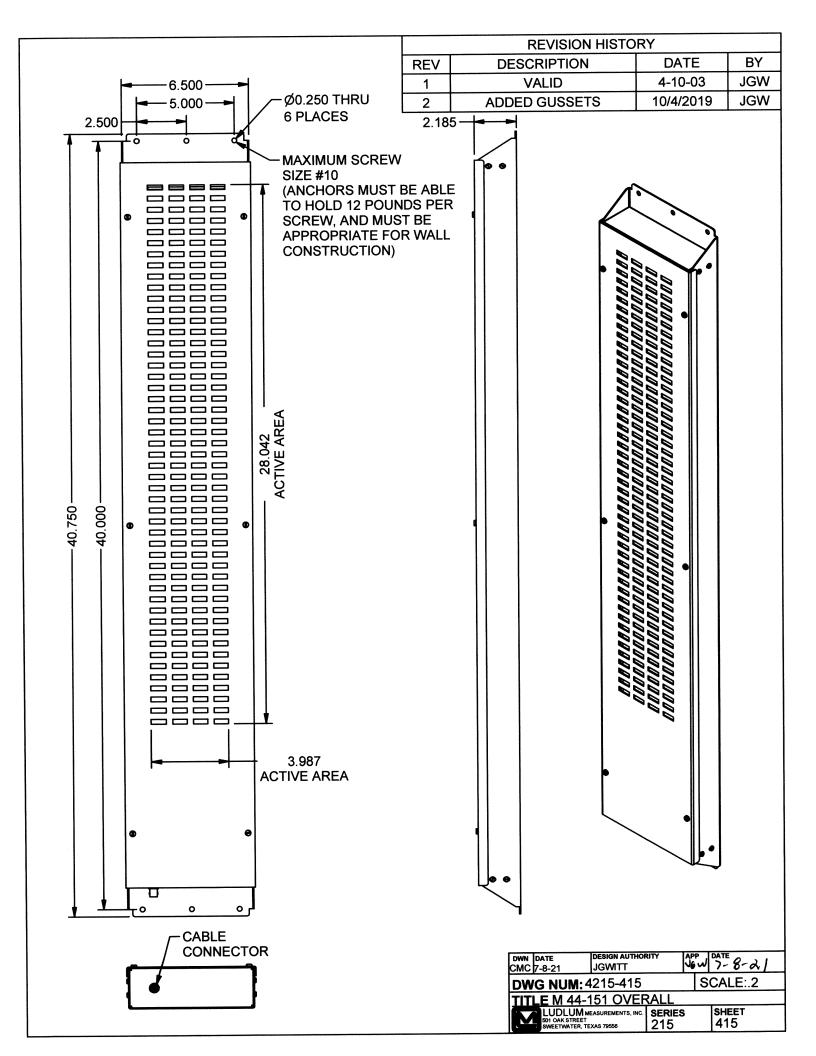


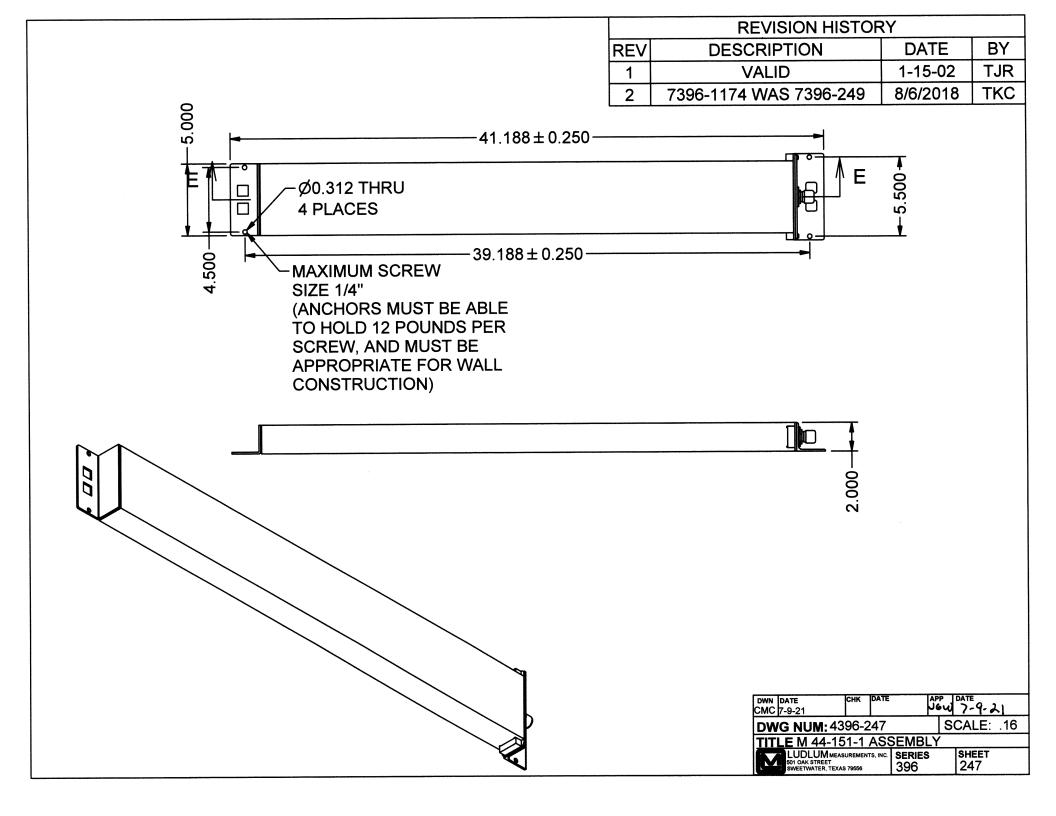
SENSITIVITY NOTE:
AREA SHOWN IS THE GREATEST
SENSITIVITY AREA. THE SYSTEM WILL
DETECT RADIATION OUTSIDE OF THAT
AREA, BUT WITH REDUCED SENSITIVITY.

ALL DIMENSIONS ARE SUBJECT TO CHANGE DEPENDING ON SITE REQUIREMENTS.

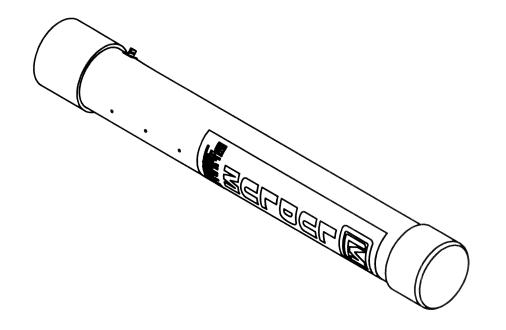
DWN	DATE	CHK	DATE		APP	DATE		
ZJM	7/8/2020			Ý	6W	7-8-20		
DW	G NUM: 43	96-1	180)	5	SCALE: 1/36		
TIT	TITLE M 375P-2000 FAMILY INSTALL							
V	LUDLUM MEAS	UREMENT	rs, INC.	SERIES	;	SHEET		
	SWEETWATER, TEXAS	79556		396		1180E		

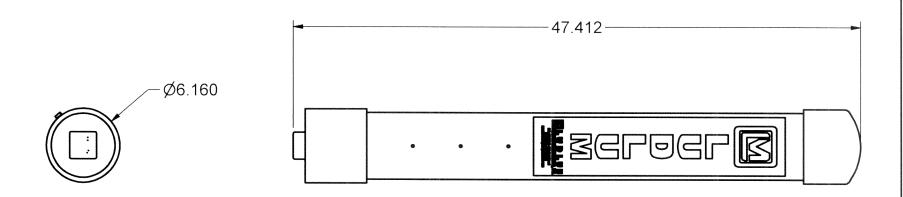






REVISION HISTORY								
REV	DESCRIPTION	DATE	BY					
1	VALID	06/17/19	ABM					





DWN DATE ABM 06/17/19 DESIGN AUTHORITY JWITT DWG NUM: 4215-651 SCALE:1/8

TITLE M 44-151-2 ASSEMBLY
LUDLUM MEASUREMENTS, INC SERIES 215

SERIES 215

SHEET 651

