

**LUDLUM MODEL 44-157 &  
44-159 & 44-159-1 & 44-162  
GAMMA PIPE MONITORS**

**September 2016**



**LUDLUM MODEL 44-157 &  
44-159 & 44-159-1 & 44-162  
GAMMA PIPE MONITORS**

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**LUDLUM MEASUREMENTS, INC**  
501 OAK STREET, P.O. BOX 810  
SWEETWATER, TEXAS 79556  
325-235-5494, FAX: 325-235-4672



## **STATEMENT OF WARRANTY**

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

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

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**

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## Introduction

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The series of scintillator gamma pipe monitors (Models 44-157, 44-159, 44-159-1 and 44-162) is primarily used for detecting low levels of gamma radiation in the range of 60 keV–1.25 MeV.

The Model 44-157 consists of a 2 x 2 inch NaI crystal coupled to a photomultiplier tube housed in aluminum. The Model 44-159 and 44-159-1 consist of an 18 x 18 mm CsI crystal, and the Model 44-162, a 3 x 3 inch NaI crystal, both also coupled to a photomultiplier tube housed in aluminum.

The detector is energy dependent, typically over-responding in the 100 keV range and under-responding above 1 MeV when normalized to  $^{137}\text{Cs}$ .

The gamma pipe monitors will operate with any Ludlum instruments or equivalent instruments that provide 700–1200 volts. The recommended instrument input sensitivity is approximately 10 mV or higher.

Some common applications for this detector include background radiation monitoring, low-level radiation detection, and spectrum analysis when used in conjunction with a single- or multi-channel analyzer.



*Model 44-159-1*

**Note:**

If the detector is used in a manner not intended by the manufacturer, the detector may not function properly.

**Note:**

The detector does not contain any consumable materials.

## Unpacking and Repacking

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Remove the calibration certificate or detector functional check certificate and place it in a secure location. Remove the detector(s) and accessories (if applicable) and ensure that all items listed on the packing list are in the carton. If multiple detectors are included, refer to the calibration certificates for serial number (SN) matches.

To return an instrument or detector for repair or calibration, provide sufficient packing material to prevent damage during shipment, and affix appropriate warning labels to promote careful handling.

Every returned instrument must be accompanied by an **Instrument Return Form**, which can be downloaded from the Ludlum website at [www.ludlums.com](http://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.



## Specifications

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**Scintillator:** 44-157: 5.1 x 5.1 cm (2 x 2 in.) (Dia x thickness),  
NaI (Tl) crystal  
44-159 & 44-159-1: 18 x 18 mm (0.7 x 0.7 in.) CsI  
(Tl) crystal  
44-162: 7.6 x 7.6 cm (3 x 3 in.) NaI (Tl) crystal

**Compatible Instruments:** general-purpose survey meters,  
ratemeters and scalers

**Sensitivity:** 44-157: 900 cpm/ $\mu$ R/hr ( $^{137}\text{Cs}$  gamma)  
44-159 & 44-159-1: 120 cpm/ $\mu$ R/hr  
44-162: 2300 cpm/ $\mu$ R/hr

**Energy Range:** 44-157: 60 keV to 3 MeV  
44-159 & 44-159-1: 50 keV to 3 MeV  
44-162: 60 keV to 3 MeV

**Background:** 44-157: 9750 cpm  
44-159 & 44-159-1: 750 cpm  
44-162: 2200 cpm

**Operating Voltage:** 44-157: 500-1200 Vdc  
44-159 & 44-159-1: 700-1200 Vdc  
44-162: 500-1200 Vdc

**Dynode String Resistance:** 44-157: 60 megohm  
44-159 & 44-159-1: 100 megohm  
44-162: 60 megohm

**Efficiency:** 44-157:  $^{57}\text{Co}$  is 11%;  $^{137}\text{Cs}$  is 5%; and  $^{60}\text{Co}$  is 10%  
44-159 & 44-159-1:  $^{57}\text{Co}$  is 14%;  $^{137}\text{Cs}$  is 3%; and  
 $^{60}\text{Co}$  is 5%  
44-162:  $^{125}\text{I}$  is 29%

*Model 44-157, 44-159, 44-159-1, 44-162*  
*Gamma Pipe Monitors*

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**Connector:** BNC (others available)

**Tube:** magnetically shielded photomultiplier

**44-157 diameter:** 16 mm (0.63 in.)

**44-159 & 44-159-1 diameter:** 16 mm (0.63 in.)

**44-162 diameter:** 2.9 cm (1.3 in.)

**Construction:** aluminum housing with beige powder-coat finish

**Temperature Range:** -20 to 50 °C (-4 to 122 °F); may be certified for -40 to 65 °C (-40 to 150 °F)

**Size:**

**44-157:** 8.9 x 15.5 cm (3.5 x 6.1 in.) (Dia x L)

**44-159:** 2.5 x 7.1 cm (1 x 2.8 in.) (Dia x L)

**44-159-1:** 2.2 x 8.1 cm (0.875 x 3.2 in.) (Dia x L)

**44-162:** 19.1 x 24.1 cm (7.5 x 9.5 in.) (Dia x L)

**Weight:**

**44-157:** 1.4 kg (3 lb)

**44-159:** 0.1 kg (0.3 lb)

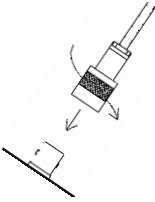
**44-159-1:** 0.1 kg (0.3 lb)

**44-162:** 2.3 kg (5 lb)

## Operating Procedures

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### CONNECTING TO AN INSTRUMENT



Connect one end of the cable provided to the detector by firmly pushing the connector together while twisting clockwise one quarter of a turn until latched. Repeat the process in the same manner with the other end of the cable and the instrument.

### TESTING THE DETECTOR

1. Ensure the instrument high voltage (HV) is at the proper setting for the detector.
2. Connect the detector to the instrument and check for a proper background.
3. Expose the detector to a check source and verify that the instrument indicates within 20% of the check source reading from the last calibration. Alternatively, expose the detector to a source of known value and verify that the detector detects greater than or equal to the efficiency listed in the specification section of this manual.
4. Instruments and detectors that meet these criteria are ready for use. Failure to meet these criteria may indicate a malfunction in the detector.

## **Safety Considerations**

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### **ENVIRONMENTAL CONDITIONS FOR NORMAL USE**

1. Indoor or outdoor use (in a dry environment)
2. No maximum altitude
3. Temperature range of -20 to 50 °C (5 to 122 °F); May be certified for operation from -40 to 65 °C (-40 to 150 °F).
4. Maximum relative humidity of less than 95% (non-condensing)
5. Pollution Degree 3 (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.)

### **CLEANING INSTRUCTIONS AND PRECAUTIONS**

The detector 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 electronics OFF.
2. Allow the instrument to sit for one minute.
3. Disconnect the detector cable before cleaning the detector.

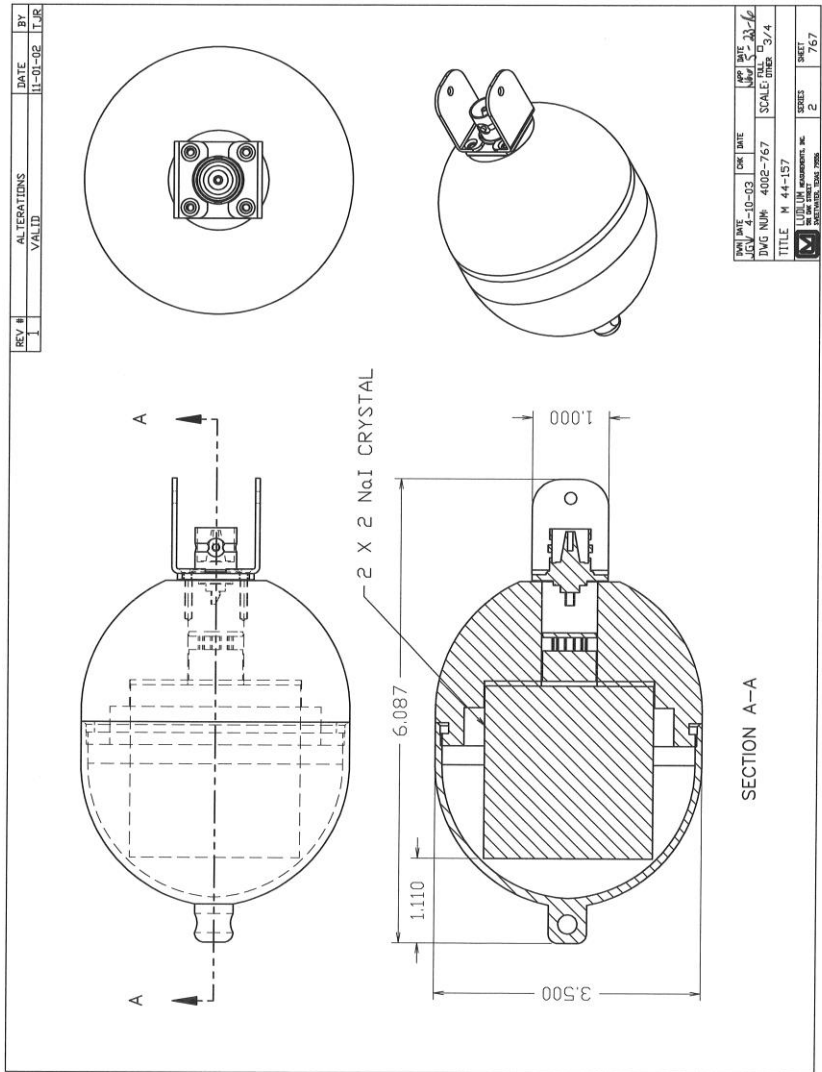
## Parts List, Drawings and Diagrams

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### Model 44-157 Gamma Pipe Monitor

<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
UNIT	Completely Assembled Model 44-157 2X2 SPHERICAL Gamma Pipe	47-3332
1 EA	DETECTOR BODY TOP	7002-703
1 EA	DETECTOR BODY BOTTOM	7002-774
1 EA	GROUND PLATE	7002-775
1 EA	REFLECTIVE RING	7002-776
2 EA	CONN PULL 2	7002-781
3 EA	FOAM RING	7090-015
1 EA	FOAM PAD	7260-001-05
1 EA	2 x 2 in. NaI CRYSTAL	01-5128
1 EA	PM TUBE-R9880U/110	01-5936
1 EA	RECPT-UG568/U PANEL C FLANGE	13-7752
1 EA	O-RING 2-235 BUNA 70	16-8388
4 EA	SCREW 4-40 X 5/16 BH	17-8511
4 EA	WIRE-TEFLON WHITE EE24	21-9362
4 EA	WIRE-#24 BLACK	21-9558

# Model 44-157, 44-159, 44-159-1, 44-162 Gamma Pipe Monitors



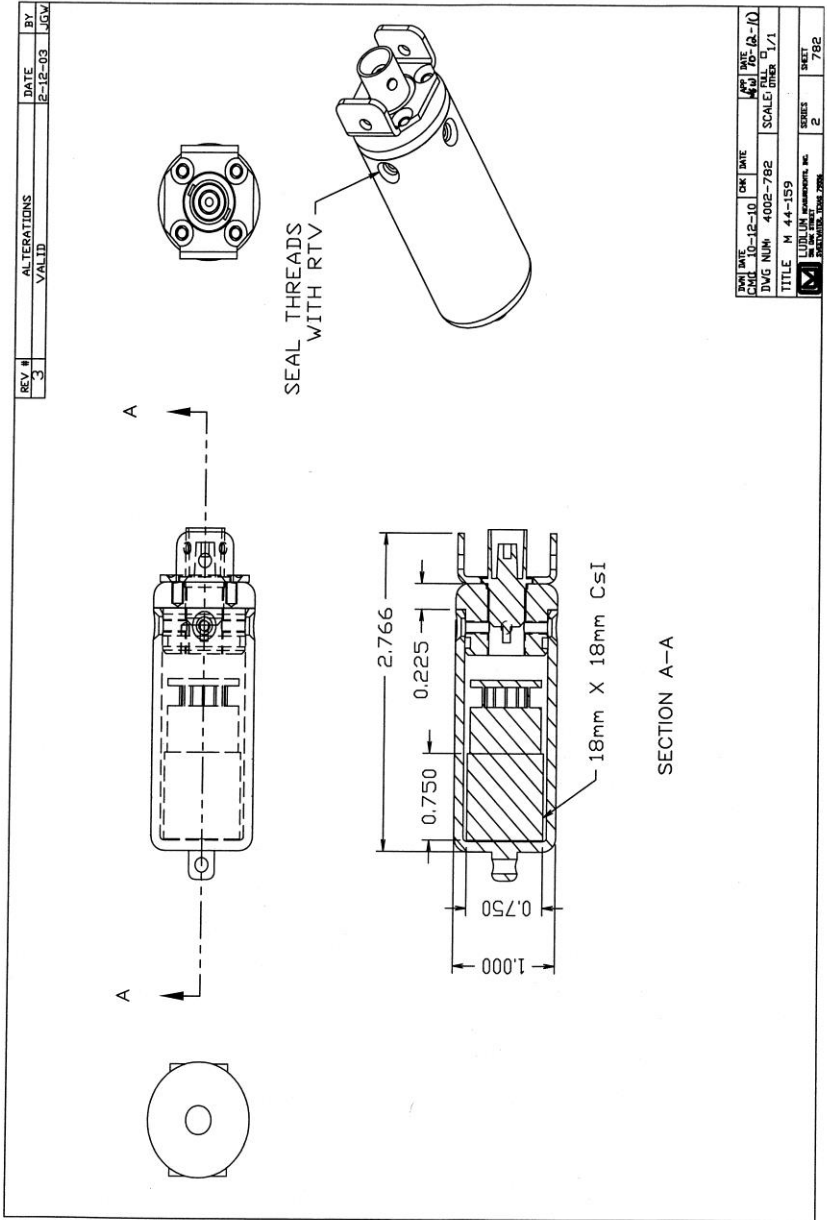
*Model 44-157, 44-159, 44-159-1, 44-162  
Gamma Pipe Monitors*

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**Model 44-159 Gamma Pipe Monitor**

<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
UNIT	Completely Assembled Model 44-159 18 X 18 mm Csl Pipe	47-3346
1 EA	DETECTOR BODY TOP	7002-783
1 EA	DETECTOR BODY BOTTOM	7002-784
1 EA	REFLECTIVE RING	7002-785
2 EA	CONN PULL 2	7002-781
1 EA	SPONGE 4-P BS	7002-065-04
1 EA	18 X 18 mm Csl (TL) CRYSTAL	01-5661
1 EA	PM TUBE-R9880U/110	01-5936
1 EA	RECPT-UG1094/U SCREW BNC	13-7753
1 EA	O-RING-2-017	16-8304
4 EA	SCREW 4-40 X 3/16 BH	17-8509
1 EA	SCREW 2-56 X 1/8 BH	17-8727
4 EA	SCREW 4-40 X 3/16 FH	17-8811
1 EA	LUG #2 922-092	18-9034
2 EA	WIRE-TEFLON WHITE #22 HV	21-8993
2 EA	WIRE-#26 BLACK 0 UL1429	21-9432

Model 44-157, 44-159, 44-159-1, 44-162  
Gamma Pipe Monitors



FORM DATE	CHK DATE	APP DATE
10-12-10	10-12-10	10-12-10
DWG NUM: 4002-782	SCALE: 1/1	SHEET: 1/1
TITLE: M 44-159		
LUDLUM MEASUREMENTS, INC.		
8000 WILSON ROAD, 7986		
SERIES: 2	SHEET: 782	



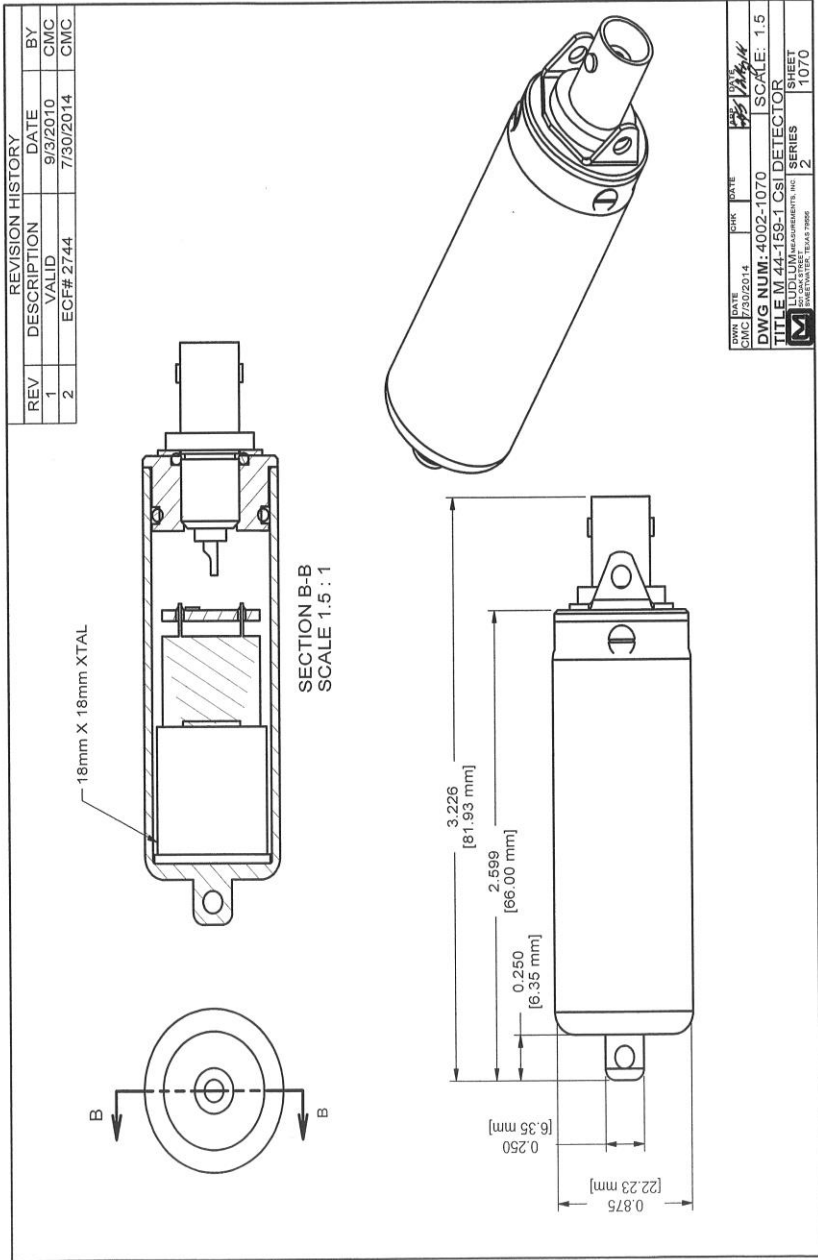
*Model 44-157, 44-159, 44-159-1, 44-162*  
*Gamma Pipe Monitors*

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**Model 44-159-1 Gamma Pipe Monitor**

<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
UNIT	Completely Assembled Model 44-159-1 18 X 18 mm Csl Pipe	47-3820
1 EA	DETECTOR BODY TOP	7002-1071
1 EA	DETECTOR BODY BOTTOM	7002-1072
1 EA	CONN PULL BRACKET	7002-1073
1 EA	SPRING END CUSHION	7002-998
1 EA	SPONGE 4-P BS	7002-065-04
1 EA	18 X 18 mm Csl (TL) CRYSTAL	01-5661
1 EA	PM TUBE-R9880U/110	01-5936
1 EA	RECPT-UG657A SCREW BNC	13-8012
1 EA	O-RING-2-012	16-8302
1 EA	O-RING-2-106 BUNA 17	16-8364
1 EA	SCREW 2-56 X 1/8 BH	17-8727
3 EA	SCREW 2-56 X 1/8 FH	17-8743
1 EA	LUG #2 922-092	18-9034
2 EA	WIRE-TEFLON WHITE #22 HV	21-8993
2 EA	WIRE-#26 BLACK 0 UL1429	21-9432

# Model 44-157, 44-159, 44-159-1, 44-162 Gamma Pipe Monitors

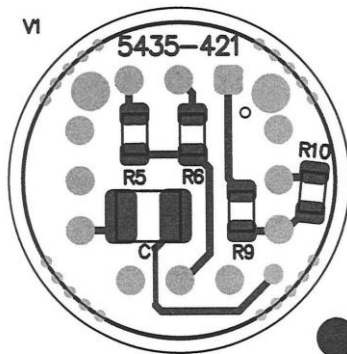
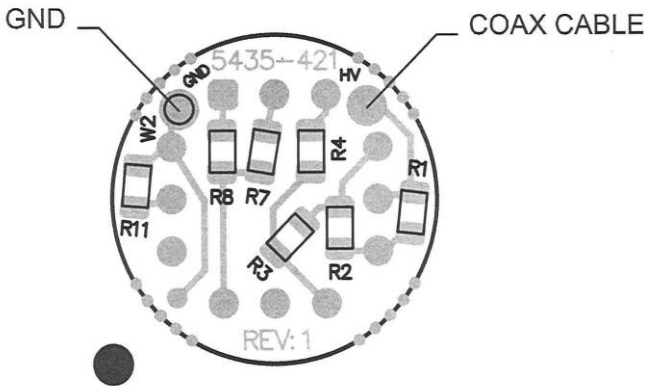


*Model 44-157, 44-159, 44-159-1, 44-162*  
**Gamma Pipe Monitors**

<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
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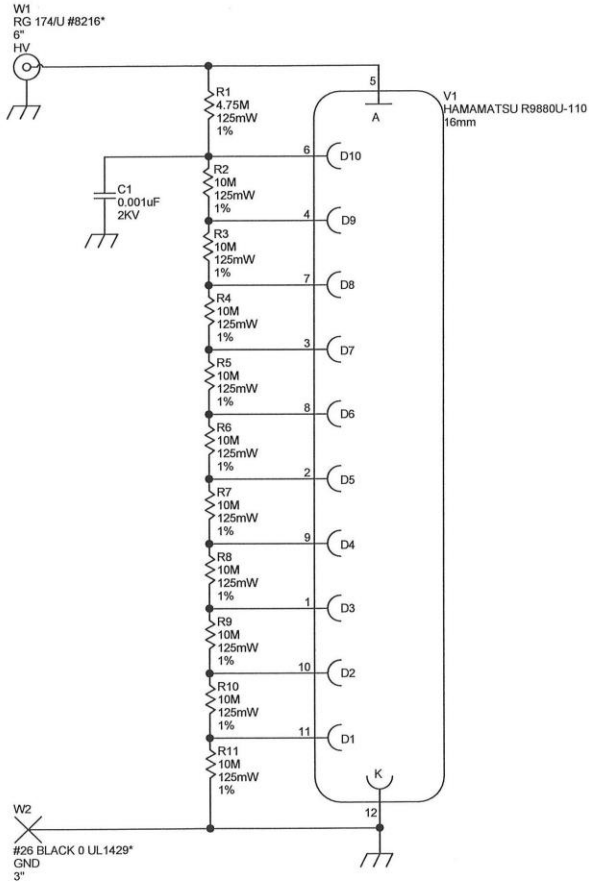
**16 mm 9880V-110 Tube Socket Board**  
**(used in Models 44-157, 44-159 & 44-159-1)**

1 EA	CIRCUIT BOARD	5435-421
1 EA	CAP 0.01 $\mu$ F 2kV	04-5703
10 EA	RES 10 M, $\frac{1}{4}$ W, 1%	12-7105
1 EA	RES 4.75 M, $\frac{1}{4}$ W, 1% SMT	12-7013
1 EA	CBL-M 2401-S 7inch PIG RG174	8303-618



# Model 44-157, 44-159, 44-159-1, 44-162 Gamma Pipe Monitors

## 16 mm 9880V-110 Schematic



<b>LUDLUM</b> MEASUREMENTS, INC.		PO Box 810 501 Oak Street Sweetwater, Texas 79556 U.S.A. 1-800-622-0828	
Drawn: ALC	07/31/2013	Title: 16mm COMBINED SIGNAL DIVIDER	
Design: RSS	07/31/2013	Model: R9880U-110	
		Board#: 5435-421	
Approve: <i>[Signature]</i>		Sheet: 1 of 1	Series
Print Date: 8/1/2013	16:34 PM	Rev: 1	Sheet
W:\Project\MLV\VoltageDividers\5435-421\Rev14\5421R1P1.SchDoc		435	1040

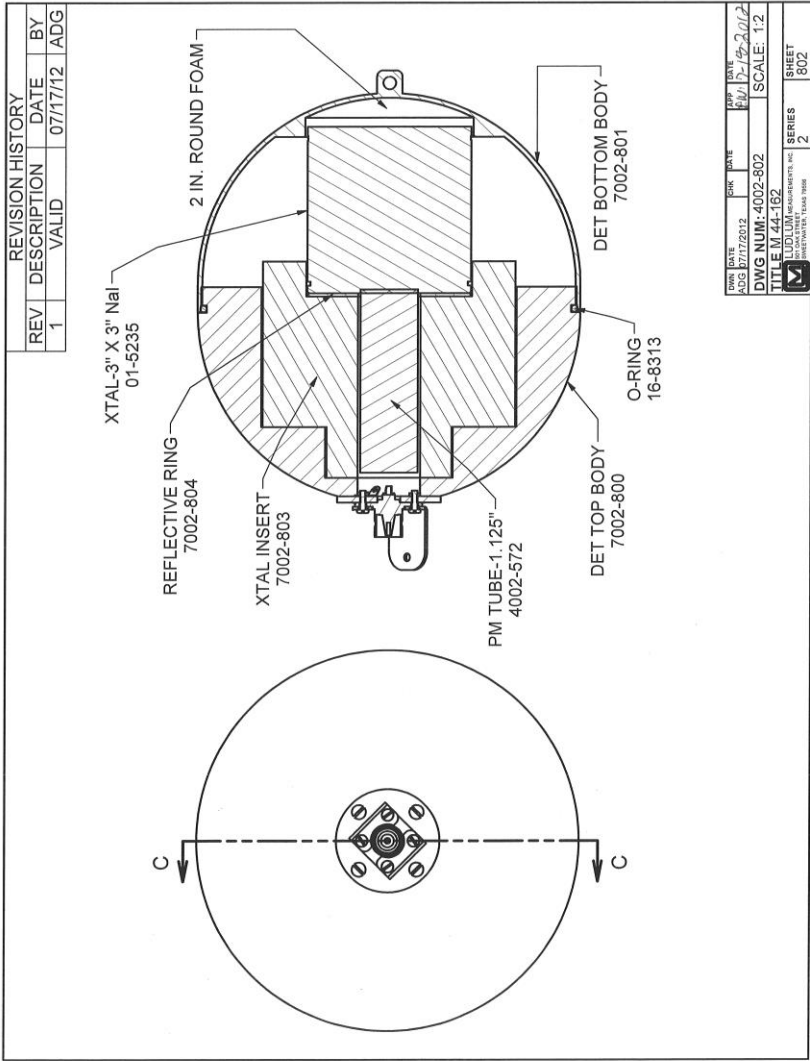
*Model 44-157, 44-159, 44-159-1, 44-162  
Gamma Pipe Monitors*

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**Model 44-162 Gamma Pipe Monitor**

<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
UNIT	Completely Assembled Model 44-162 3 x 3 inch Spherical Pipe	47-3385
1 EA	DETECTOR BODY TOP	7002-800
1 EA	DETECTOR BODY BOTTOM	7002-801
1 EA	CRYSTAL INSERT	7002-803
1 EA	REFLECTICVE RING	7002-804
1 EA	CONN ADAPTER	7002-805
1 EA	CONNECTOR PULL	7002-806
1 EA	3 X 3 inch NaI CRYSTAL	01-5235
1 EA	PM TUBE-1.125inch B29B07	01-5367
1 EA	RECPT-UG568/U PANEL C FLANGE	13-7752
1 EA	O-RING-2-262	16-8313
6 EA	SCREW 6-32 X ¾ FH	17-8600
1 EA	LUG #4 LKG 1HL K908	18-8760
1 EA	NUT-4-40 SMALL PATTERN	20-9022
6 EA	WIRE-TEFLON WHITE #22 HV	21-8993
6 EA	WIRE-#22GA JSF22/168-BLK	21-9154

# Model 44-157, 44-159, 44-159-1, 44-162 Gamma Pipe Monitors

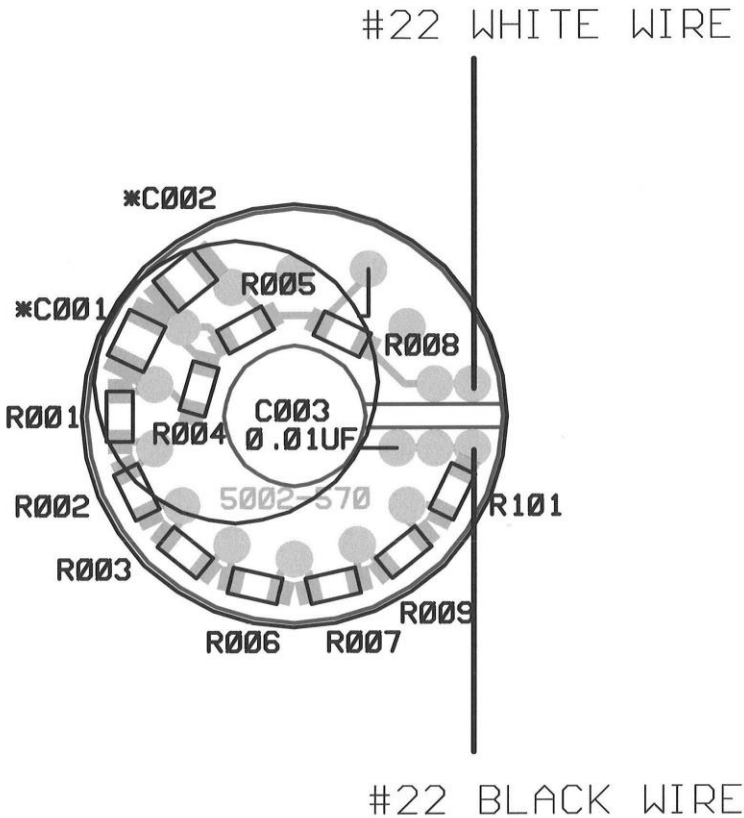


Model 44-157, 44-159, 44-159-1, 44-162  
 Gamma Pipe Monitors

<u>Reference</u>	<u>Description</u>	<u>Part Number</u>
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**1.125 inch Tube Socket Board**  
 (used in the Model 44-162)

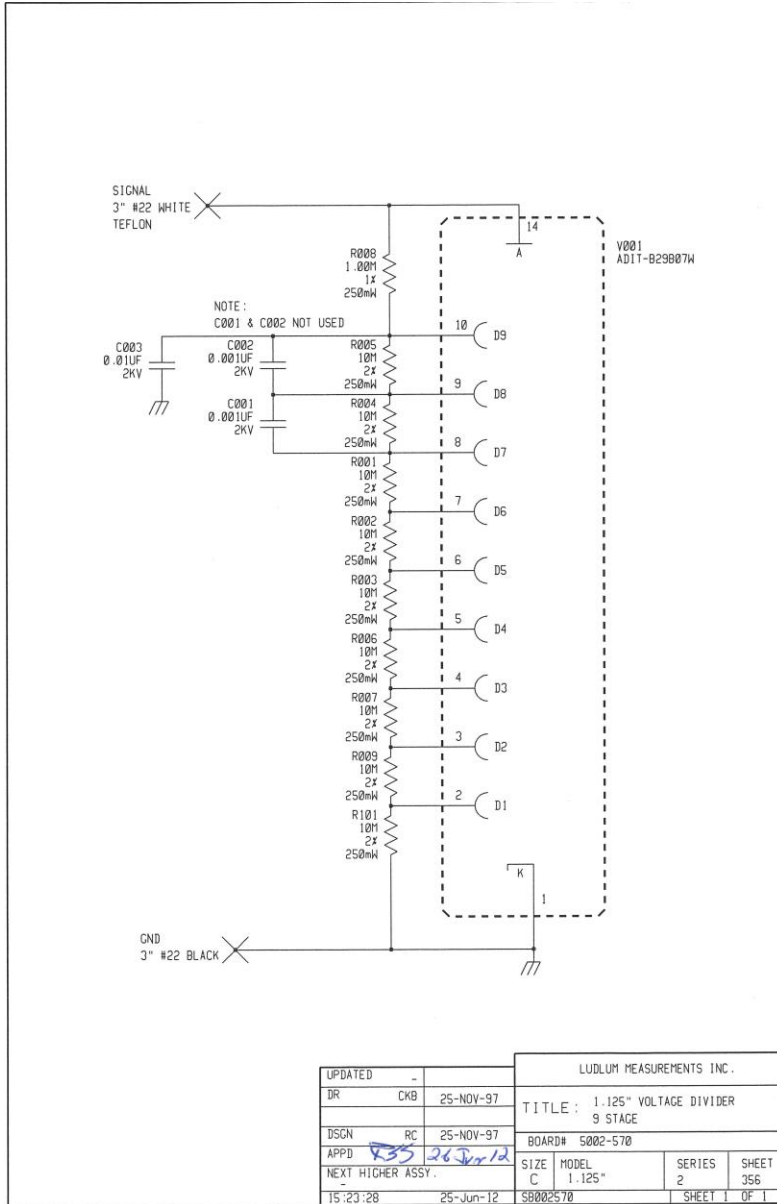
1 EA	CIRCUIT BOARD	5002-570
1 EA	CAP 0.01 $\mu$ F 3kv	04-5525
1 EA	RES 1 M, $\frac{1}{4}$ W, 1%	12-7844
9 EA	RES 10 M, $\frac{1}{4}$ W, 1%	12-7996



\* C001 & C002 ARE NOT PLACED

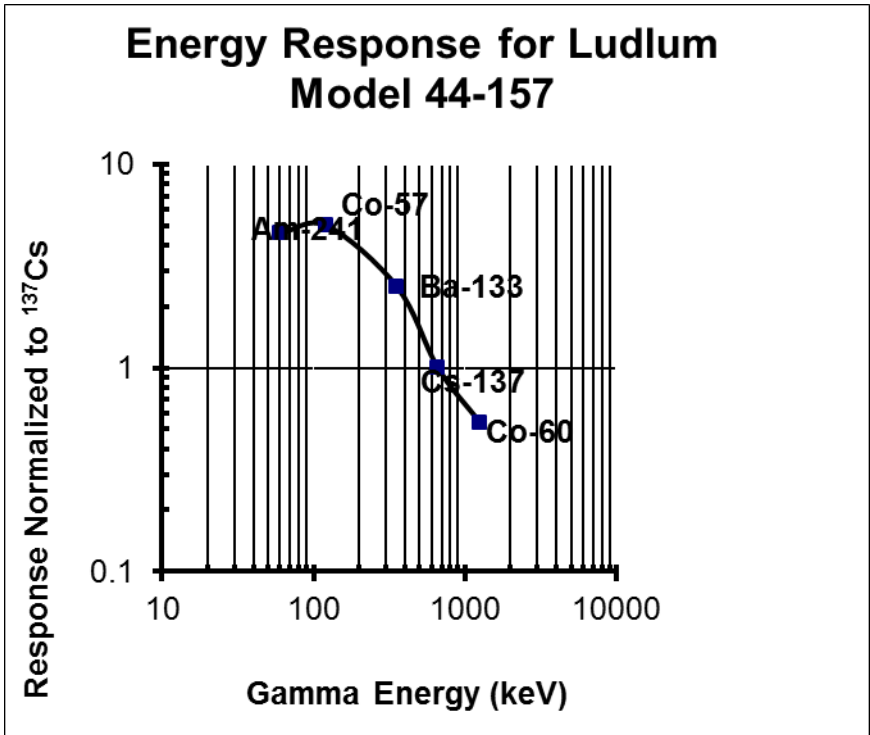
Model 44-157, 44-159, 44-159-1, 44-162  
Gamma Pipe Monitors

**1.125 inch Tube Board Schematic**





## Energy Response Curves



**Energy Response for Models 44-159 and 44-159-1**

