

# DRM Family of Wireless Data Radiation Monitors

DRM-1, DRM-1D, DRM-2, DRM-2D, DRM-2E, DRM-2H, DRM-2EN



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**MIRION**  
TECHNOLOGIES



## Revision Log

Revision #	Date	Revised Pages	Comments
0	July 2004	N/A	Original issue.
1	March 2005	ALL	Added DRM-1D information, specifications, calibration, FCC information about WRM2, instructions on using MMV software (removed AMPView), and section for optional display unit and corrected typographic errors (formatting). Changed title.
2	May 2005	6,11-13, and 30	Added outline drawings for the DRM-1/D and information about the automatic background subtraction feature for the DRM-1D
3	October 2006	15	Added note about dipswitch settings for field use and calibration, section 3.22  Better description of DRM-1D calibration, Section 9.1
4	July 2007	ALL	Inclusion of DRM-2/2D, Power Saving Mode update, Environmental & Solar Enclosure configurations, minor editing through-out.
5	April 2008	ALL	Added new features with firmware 071111 for DRM-1/2 for 4 threshold settings and selectable using the 'ACK' button on the DRM-1/2 display. Added new screen shots of MMV for threshold settings and instructions
6	Sept. 2008	Page 11	Added WRM2 Radio information in DRM Specifications section.
7	Dec. 2011	All	Changed RMV references to MMV.
		All	Included references to DRM-2H
		Cover	Inserted picture of DRM-2E.
		6	Insert a paragraph noting the similarities between the DRM-2 and DRM-2E.



## Revision Log (cont'd)

Revision #	Date	Revised Pages	Comments
7 (cont'd)		10	Noted display and alarm properties for DRM-1D/2D Specifications refer to 2D only.
		9-12	Added accessory details.
		11	Inserted DRM-2 Environmental Characteristics and Dimensions.
		12-13	Added specifications for the DRM-2H.
		13-14	Added specifications regarding optional External Display & Alarm.
		19-22	Added drawings for the DRM-2, DRM-2H, and DRM-2E.
		24	Added response time table for DRM-2H.
		25	Inserted picture of DRM-2E with RTM-9135 external display & alarm.
		29	Added automatic range switching details for DRM-2H.
		34	Added external display measurements for the DRM-2H.
		42-43	Added DRM-2H calibration ranges.
		44	Combined sections 9 and 10.
			Added DRM-2H calibration tables.
		53	Added CPS to mR/h conversion tables.
		59-62	Updated Electronic Schematics
		68	Removed Section 14.
8	Jan. 2012	7	Changed DRM-2 and DRM-2H measuring ranges.
		10	Changed DRM-2 measuring and display range to 999E.
		12, 34	Changed DRM-2H measuring and display range to 9,999 R/h.
		24	Changed DRM-2H Fast Response Time setting to 9,999 R/h.
		42	Changed DRM-2 and DRM-2H maximum ranges.



9	April 2012	9	Defined measurement terminology.
		9, 10, 12, 13	Added reporting ranges.
		11	Change DRM-2 highest measurement range.
		13,31,43	Changed low end of DRM-2H measurement range to 0.05 mR/h and calibration points to low end fields to 0.05 mR/h.
		13, 35	Changed DRM-2H low end display range to 0.001 R/h.
		31	Changed DRM-2H overflow to 10,000 R/h.
10	Dec 2015	8	Added a brief introduction to the DRM-2EN.
		14-15	Added DRM-2EN technical specifications
		55-59	Added DRM-2EN calibration instructions

## WRM-2 FCC COMPLIANCE

**WARNING:**

This device complies with Part 15 of the FCC rules. Operation is subject to the following conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation, FCC ID Number: 'our9xstream'.

## ANTENNA WARNING

**WARNING:**

This device has been tested with Reverse Polarity SMA and MMCX connectors with the antennas that are supplied with the equipment. When integrated in the OEM product, these fixed antennas require installation preventing end users from replacing them with non-approved antennas. Any antennas not supplied by Mirion (MGPI) Technologies must be tested to comply with FCC Section 15.203 for unique antenna connectors and section 15 emissions.

## FCC QUALIFICATIONS

**Important:** The WRM2 radio modules have been certified by the FCC for integration into OEM products without any further certifications (as per FCC section 2.1091). Changes not expressly approved by Mirion (MGPI) Technologies could void the user's authority to operate this equipment.

**Note:** The WRM2 System utilizes a proprietary communication (WRM) protocol and specific firmware identification for each component and is configured for optimal performance.

Operation of the WRM2 system in a configuration not consistent with MIRION settings, or modifications to hardware and firmware may result in degraded system performance and loss of warranty.

**CAUTION:** Only the power supplies and batteries specified by MIRION should be used with all DRM components. Non-approved power sources can result in component damage or personal injury. Contact MIRION for additional information!



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# 1. The DRM Family

## 1.1. General Description

The Data Radiation Monitors, DRM-1/2 and DRM-2H, are auto switching two GM-tube based dose rate meters, and the DRM-1/2D is a sensitive CsI (TI) scintillated coupled to a PMT. The DRM-1, DRM-2, and DRM-2H are dose rate meters for detection, using state-of-the-art microprocessor-based technology and combined with telemetry using the WRM2 900 MHz or 2.4 GHZ FHSS radio. The DRM is designed for highly stable and accurate dose rate measurements from gamma radiation. The DRM-1/2 (GM) measuring range is from 0.05 mR/h up to 999 R/h. The DRM-2H measuring range is from .05 mR/h up to 9,999 R/h, and the DRM-1/2D's measuring range is from 0.001 mR/h up to 10 mR/h.

**Note:** The DRM-2E is similar to the DRM-2, with the only difference being that the DRM-2E has a waterproof external probe, compared with the internal probe of the DRM-2. Thus, unless specifically noted, any properties or directions included for the DRM-2 apply to the DRM-2E as well.

The DRM-2EN is an auto switching neutron based dose rate meter for detection, using state-of-the-art microprocessor-based technology and combined with telemetry using the WRM2 900 MHz or 2.4 GHZ FHSS radio. The DRM is designed for highly stable and accurate dose rate measurements from neutron radiation from background (typical 0.05 mrem/h) to 1 rem/h. The external neutron detector is connected to the DRM using the standard 30 ft. AMP cable.

The DRM is a lightweight and compact instrument with sophisticated software offering special features and optimal performance for telemetry data. The wide dynamic range is obtained by the DRM-1/2 and DRM-2H's two GM-Tubes with automatic range switching and an automatic dead time correction, according to the preset calibration. The DRM-1/2D's sensitive range is obtained by CsI (TI) scintillator (30\*30mm) coupled to PMT and an automatic dead time correction and back ground subtraction, according to the preset calibration. A special averaging function smoothes the data reading and maintains fast response time, while keeping the standard deviation at a minimum for the DRM-1/2, DRM-2H, and DRM-1/2D.

Software is used to configure (MMV) and calibrate (RMC) the DRM family of detectors.

An automatic self-diagnostic procedure continuously checks both electronics and detectors and reports any case of detector failure.

The DRM may be used in the following ways:

- by connecting the meter to a PC
- by connecting the meter to a DDC-16/AM-16 Area Monitor (wired)
- by using the internal WRM2 FHSS radio to transmit data
- by connecting the meter to an external WRM transmitter (wireless)
- by using an internal or externally connected network adapter

The meter includes four boards: HV board, CPU board, WRM2 radio and the board for the dual GM-Tube detectors or a cesium iodine detector. A built-in RS-232 is the connection used for calibration and configuration. A custom connector is needed when using the WRM external transmitter. The WRM2 FHSS radio is already included in the DRM-1/2(H) package and a base station (MIRION P/N: WR2-9001) is needed for reception of telemetry data. A second DB-9 female connector is available for an optional alarm and display unit for all DRM instruments.



## 1.2. Applications for GM-Tube (DRM-1, DRM-2, DRM-2H) and Csl (DRM-1D, DRM-2D) Detectors

- Perimeter & Boundary Surveillance
- Vehicle Access Points
- Turnstile entries
- Collection of Survey Data for Real-time Mapping & Surveillance Software
- General Area Monitoring
- Hospital Emergency Room Entrances and CBRNE storage areas
- Response vehicles
- Event Monitoring

## 1.3. Definitions

The following terms are used in describing the measurement functionality of the DRM devices:

- **Measurement Range:** The limits to what energy levels the DRM can reliably and accurately read.
- **Display Range:** The display range for the front LCD display of the DRM-2 series.
- **Reporting Range:** The range for what the DRM can report to telemetry software (e.g., Soteira and WinWRM2).

# 2. DRM Specifications

## 2.1. DRM-1 General (GM Tube)

- **Detector:**
  - GM tube ZP-1301 (or equivalent) - high range
  - GM tube ZP-1201 (or equivalent) - low range
  - Optional GM tube ZP-1300 non-energy compensated – low range
- **Measurement Ranges:**
  - 0.05 mR/h to 1,000 R/h (0.5  $\mu$ Sv/h to 10 Sv/h)
  - Automatic switching between the two GM tubes at 600 mR/h and 800 mR/h
- **Reporting Range:**
  - 0.001 mR/h to 999 R/h
- **Accuracy:**
  - $\pm 10$  % of reading, within the measuring range
- **Energy Response ( $^{137}\text{Cs}$ ):**
  - $\pm 20$  % at 70 keV to 2 MeV

- **Sensitivity (137Cs):**
  - 17 cps/mR/h (low range)
  - 0.3 cps/mR/h (high range)
- **Power Source:**
  - External power supply and battery backup
  - External power supply: Input 120-250 Vac, Output 6 Vdc to 15 Vdc with locking connector
  - Battery back-up: Three (3) 1.2v NiMH 2100mA rechargeable
  - Battery operating lifetime: Up to 12 hours of continuous operation
  - Power Saving Mode On/Off using Meter View Software
- **Temperature Range:**
  - Operation: -10°C to +50°C (15°F to 122°F)
  - Storage: -20°C to +60°C (-5°F to 140°F)
- **Humidity Range:**
  - 10% to 95% RH (non condensing)
  - Enclosure Material Aluminum
- **Dimensions:**
  - 7" L x 2.5" D x 4.25" W
  - Weight: 907 g (2 lbs)
- **Optional Accessories:**
  - External Display & Alarm (see Section 2.4)
  - Magnet Mounting Attachments

## 2.2. DRM-1D/2D Cesium Iodine (TL) Specifications

- **Detector:**
  - CsI (TI) (30 x 30 mm) crystal optically coupled to PMT with 0.5 mm aluminum housing and solid mu metal shield. With optional automatic background subtraction using the MMV software.
- **Measurement Range:**
  - 1 µR/h to 9,999 µR/h (0.001 mR/h to 9.999 mR/h)
  - Overflow Alarm for reading > 9999 µR/h
  - Overload for field > 1 R/h
  - Sensitivity: 6.8 cps/µR/h for 137-Cs
  - Optional : background subtraction via the MMV software
- **Display Range (DRM-2D only):**
  - 0.01 mR/h to 9,999 mR/h
- **Reporting Range:**
  - 0.001 mR/h to 9.999 mR/h

- **Dimensions:**
  - **DRM-1D:** 7" L x 3.5" D x 4.25" W
  - **DRM-2D:** 10.25" L x 4.28" D x 4.88" W
- **Display – LCD Readout (DRM-2D only):**
  - 4 digits for accurate and easy display
  - Detector failure
  - Low battery
  - Overflow
  - 4 Threshold Settings
- **Audio (DRM-2D only):**
  - Two internally mounted piezo-electric elements (used for alarm functions)
- **Accuracy (137Cs):**
  - $\pm 10$  % of reading, within the measuring range
- **Energy Response:**
  - 45 KeV to 2 MeV
- **CsI Sensitivity (137Cs):**
  - 6.8 cps/ $\mu$ R/h
- **Power Source:**
  - External power supply and battery backup
  - External power supply: Input 120-250 Vac, Output 9 to 15 Vdc with locking connector
  - Battery back-up: Three (3) 1.2v NiMH rechargeable AA batteries
  - Battery operating lifetime: Up to **8 hours** of continuous operation (with optional Alarm and Display Unit: **4 hours**)
  - Power Saving Mode On/Off using Meter View Software
- **Temperature Range:**
  - Operation: -10°C to +50°C (15°F to 122°F)
  - Storage: -20°C to +60°C (-5°F to 140°F)
- **Humidity Range:**
  - 10% to 95% RH (non condensing)
  - Enclosure Material Aluminum
- **Optional Accessories:**
  - External Display & Alarm (see Section 2.4)
  - Magnet Mounting Attachments

## 2.3. DRM-2 (GM Tube) Specifications

- **Detector:**
  - GM tube ZP-1301 (or equivalent) - high range
  - GM tube ZP-1201 (or equivalent) - low range
  - Optional GM tube ZP-1300 non-energy compensated – low range

- **Measurement Ranges:**
  - 0.05 mR/h to 1,000 R/h (0.5  $\mu$ Sv/h to 10 Sv/h)
  - Automatic switching between the two GM tubes at 600 mR/h and 800 mR/h
- **Display Range:**
  - 0.01 mR/h to 999E (999,000 mR/h)
- **Reporting Range:**
  - 0.001 mR/h to 999 R/h
- **Accuracy:**
  - $\pm 10$  % of reading, within the measuring range
- **Energy Response (137Cs):**
  - $\pm 20$  % at 70 keV to 2 MeV
- **Sensitivity (137Cs):**
  - 17 cps/mR/h (low range)
  - 0.3 cps/mR/h (high range)
- **Power Source:**
  - External power supply and battery backup
  - External power supply: Input 120-250 Vac, Output 6 Vdc to 15 Vdc with locking connector
  - Battery back-up: Three (3) 1.2v NiMH rechargeable AA batteries
  - Battery operating lifetime: Up to 12 hours of continuous operation
  - Power Saving Mode On/Off using Meter View Software
- **Display – LCD Readout:**
  - 4 digits for accurate and easy display
  - Detector failure
  - Low battery
  - Overflow
  - 4 Threshold Settings
- **Audio:**
  - Two internally mounted piezo-electric elements (used for alarm functions)
- **Measurement Units:**
  - mR/h
- **Controls:**
  - Alarm Acknowledgment push-button
  - DIP Switches for functionality
- **Temperature Range:**
  - Operation: -10°C to +50°C (15°F to 122°F)
  - Storage: -20°C to +60°C (-5°F to 140°F)

- **Humidity Range:**
  - 10% to 95% RH (non condensing)
  - Enclosure Material Aluminum
- **Environmental Characteristics:**
  - **DRM-2E External Probe:** Waterproof in up to 50 feet (15.24 m) of water.
- **Dimensions:**
  - **Control Unit:** 10.25" L x 4.28" D x 4.88" W
  - **External Probe (DRM-2E only):** 9.5" L x 1.75" W attached to CU with ≤300' AMP cable.
- **Optional Accessories:**
  - External Display & Alarm (see Section 2.4)
  - Magnet Mounting Attachments

## 2.4. DRM-2H Specifications

- **Detector:**
  - GM tube 4G60M (or equivalent) - high range
  - GM tube ZP-1201 (or equivalent) - low range
  - Optional GM tube ZP-1300 non-energy compensated - low range
- **Measurement Ranges:**
  - 0.05 mR/h to 9,999 R/h (0.5  $\mu$ Sv/h to 99.99 Sv/h)
  - Automatic switching between the two GM tubes at 1,000 mR/h and 1,500 mR/h
- **Display Range:**
  - 0.001 R/h to 9,999 R/h
- **Reporting Range:**
  - 0.001 mR/h to 9,999 R/h (0.01  $\mu$ Sv/h to 99.99  $\mu$ Sv/h)
- **Accuracy:**
  - $\pm 10$  % of reading, within the measuring range
- **Energy Response (137Cs):**
  - $\pm 20$  % at 70 keV to 2 MeV
- **Sensitivity (137Cs):**
  - 17 cps/mR/h (low range)
  - 77 cps/R/h (high range) (DRM-2H)
- **Power Source:**
  - External power supply and battery backup
  - External power supply: Input 120-250 Vac, Output 6 Vdc to 15 Vdc with locking connector
  - Battery back-up: Three (3) 1.2v NiMH rechargeable AA batteries
  - Battery operating lifetime: Up to 12 hours of continuous operation
  - Power Saving Mode On/Off using Meter View Software

- **Display – LCD Readout:**
  - 4 digits for accurate and easy display
  - Detector failure
  - Low battery
  - Overflow
  - 4 Threshold Settings
- **Audio:**
  - Two internally mounted piezo-electric elements (used for alarm functions)
- **Measurement Units:**
  - R/h
- **Controls:**
  - Alarm Acknowledgment push-button
  - DIP Switches for functionality
- **Temperature Range:**
  - Operation: -10°C to +50°C (15°F to 122°F)
  - Storage: -20°C to +60°C (-5°F to 140°F)
- **Humidity Range:**
  - 10% to 95% RH (non condensing)
  - Enclosure Material Aluminum
- **Environmental Characteristics:**
  - **DRM-2E External Probe:** Waterproof in up to 50 feet (15.24 m) of water.
- **Dimensions:**
  - **Control Unit:** 10.25" L x 4.28" D x 4.88" W
- **Optional Accessories:**
  - External Display & Alarm (see Section 2.4)
  - Magnet Mounting Attachments

## 2.5. DRM-2EN Specifications

- **Detector:**
  - PRESCILA proton recoil scintillator
- **Neutron Energy Response**
  - Thermal to 100 MeV
- **Measurement Range:**
  - 0.05 mrem/h to 1 rem/h
- **Sensitivity:**
  - approximately 350 cpm/mrem/hr (<sup>241</sup>AmBe)

- **Angular Dependence:**
  - within 15% over wide range of energies
- **Gamma Rejection**
  - 0 – 100 mrem/h  $\gamma$ :  $\leq 2$  mrem/h neutron displayed
  - 100 mrem/h – 200 mrem/h  $\gamma$ :  $\leq 3$  mrem/h neutron displayed
- **Operating Voltage:**
  - typically 500-700 volts
- **Connector**
  - Ikelite 5 pin female
- **Detector Cable Length**
  - 10 – 100 feet
- **External Probe Construction:**
  - aluminum housing with black powder-coat finish and an ergonomic foam grip
- **Display – LCD Readout:**
  - 4 digits for accurate and easy display
  - Detector failure
  - Low battery
  - Overflow
  - 4 Threshold Settings
- **Audio:**
  - Two internally mounted piezo-electric elements (used for alarm functions)
- **Measurement Units:**
  - mrem/h
- **Controls:**
  - Alarm Acknowledgment push-button
  - DIP Switches for functionality
- **Temperature Range:**
  - Operation: -10°C to +50°C (15°F to 122°F)
  - Storage: -20°C to +60°C (-5°F to 140°F)
- **Dimensions:**
  - 10.125 x 4.25 x 4.25 in. (25.7 x 10.8 x 10.8 cm) (H x W x L)
- **Weight:**
  - 5 lbs (2.2 kg)
- **CE Certified**
  - Yes

## 2.6. Optional DRM External Display & Alarm

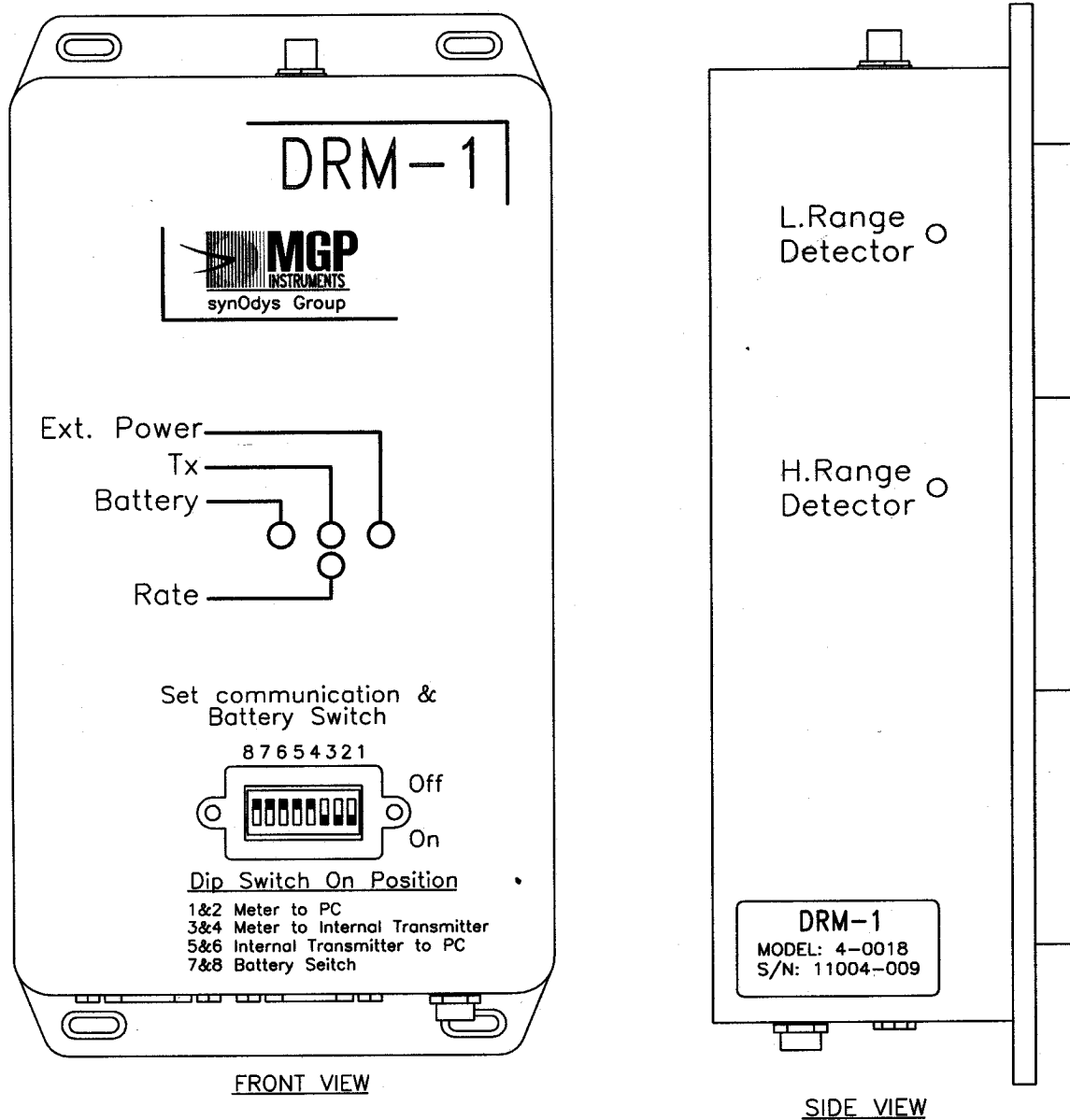
- **Display Range:**
  - Same as parent DRM
- **Power Source:**
  - DRM via a cable connection with a D-type 9 pin connector
- **Display – LCD Readout:**
  - 4 digits for accurate and easy display
  - 4 Threshold Settings
- **Audio:**
  - One externally mounted piezo-electric element (used for alarm functions)
- **Measurement Units:**
  - mR/h
- **Controls:**
  - Alarm Acknowledgment push-button
- **Temperature Range:**
  - Operation: -10°C to +50°C (15°F to 122°F)
  - Storage: -20°C to +60°C (-5°F to 140°F)
- **Humidity Range:**
  - 10% to 95% RH (non condensing)
  - Enclosure Material Aluminum
- **Dimensions:**
  - Control Unit: 8.56" L x 2.4" D x 4.4" W

## 2.7. WRM2 Radio Transmitter Characteristics for the DRM

- 10.25" L x 4.28" D x 4.88" W
- Transmit power output 100 mW (900 MHz), 50 mW (2.4 GHz), 3.5 mW (868 MHz)
- Receiver sensitivity -110 dBm (900 MHz) and -105 dBm (2.4 GHz)
- 868 MHz, 900 MHz or 2.4 GHz spread spectrum hopper (FHSS)
- Range for the 900 MHz unit 1500' (500 m) indoors-industrial environment, 2 miles (3.2 km) outdoors RF line-of-sight with standard dipole antenna, up to 20 miles (32 km) with high gain directional antenna
- Range for the 2.4 GHz unit 600' (200 m) indoors, 1.5 (2.4 km) miles outdoors with RF line-of-sight w/ dipole antenna, up to 10 miles (16 km) w/ high gain antenna
- Over the air data stream at 19,200 BAUD
- Addressable from 0 to 65,000
- FCC approved, IC Certified, 2.4 GHz and 868 MHz are CE marked
- Programmable transmission intervals from 1 sec to 16 sec.

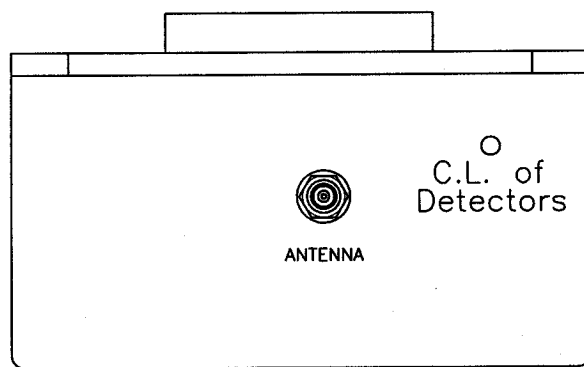


## 2.8. DRM-1 Outline Drawings

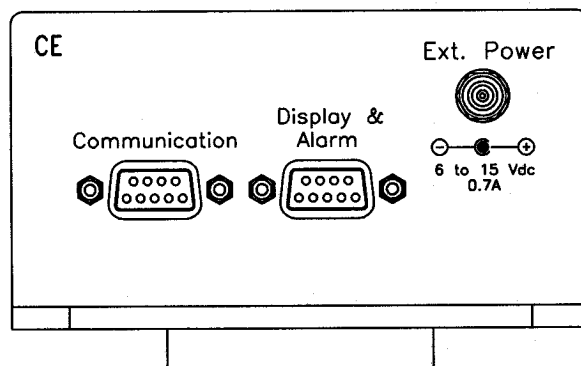




## DRM-1 Outline Drawings (continued)



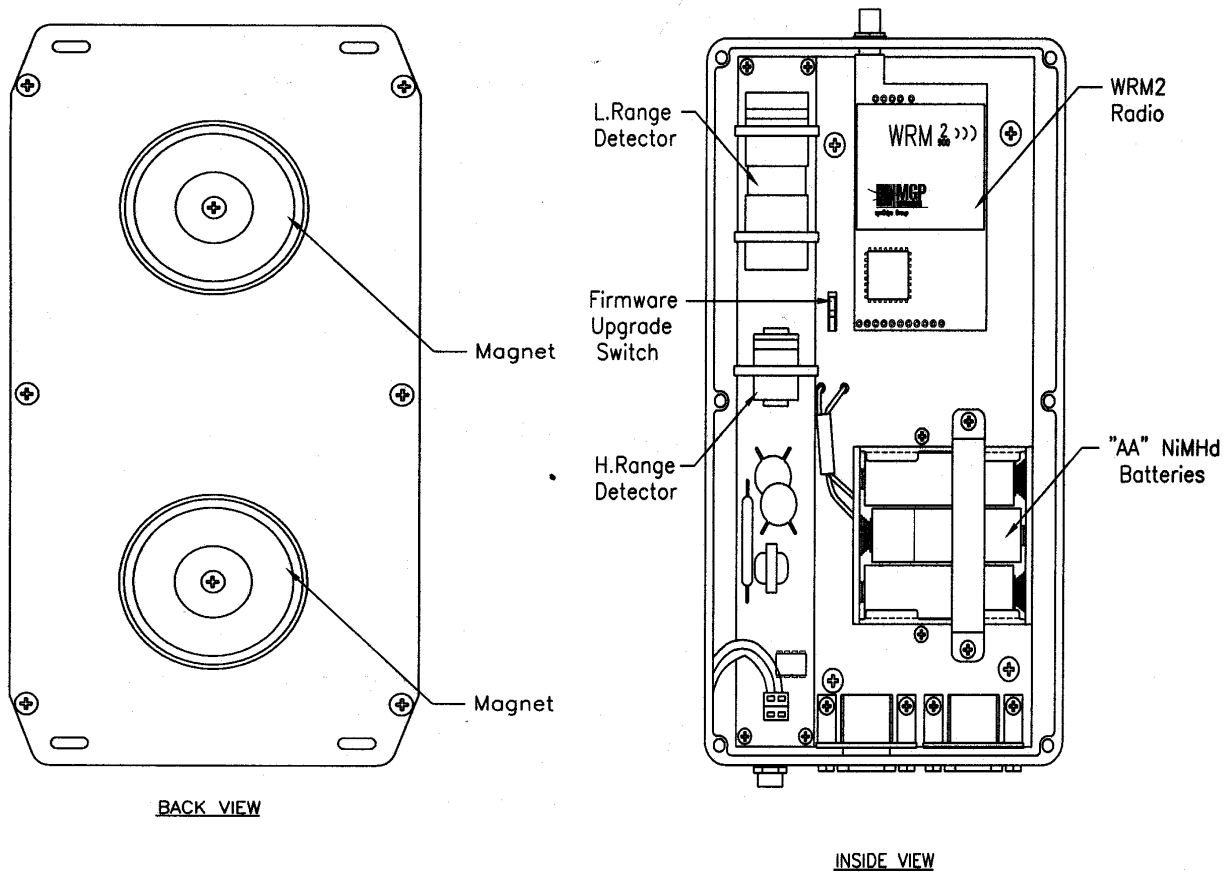
TOP VIEW



BOTTOM VIEW

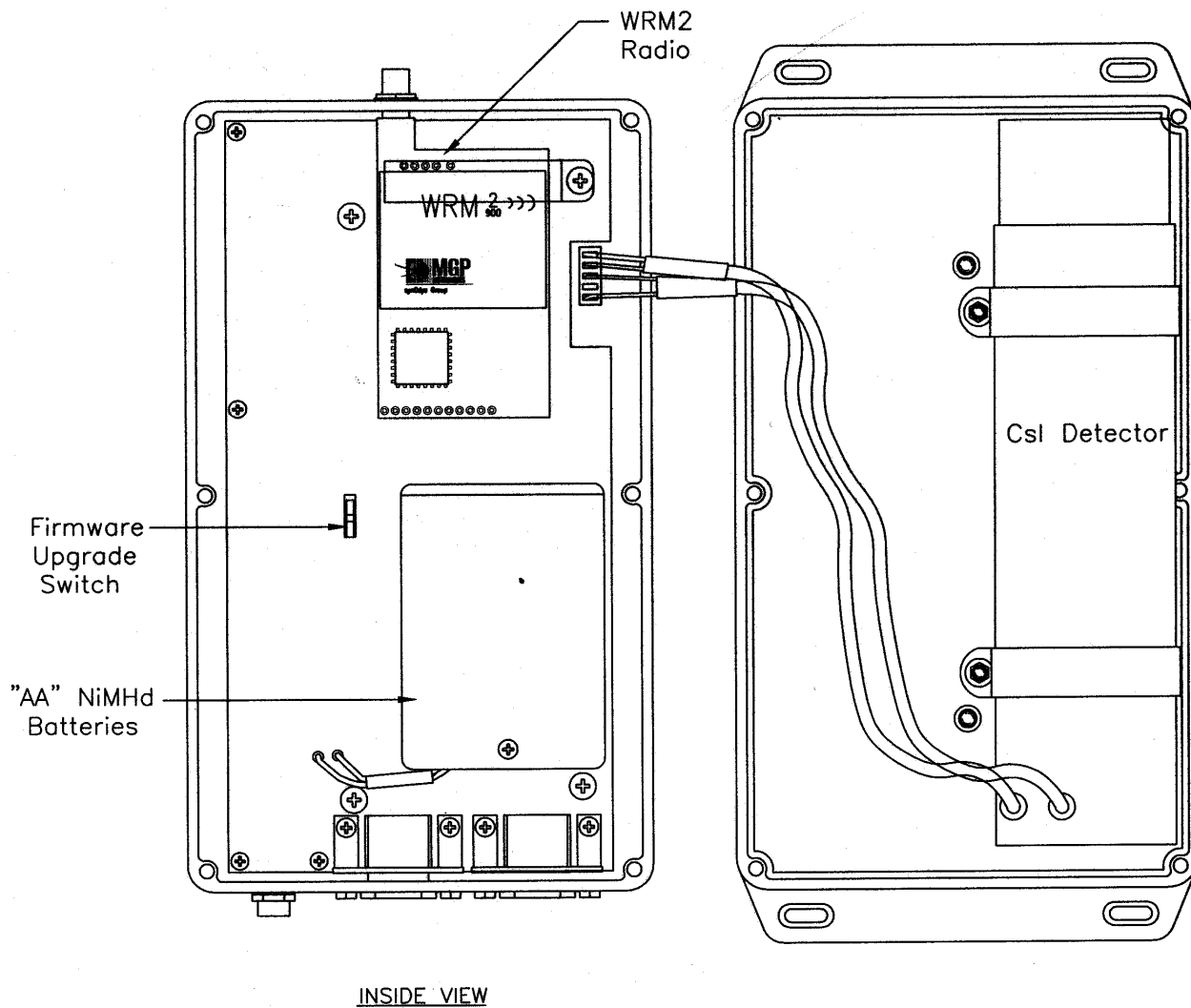
## DRM-1 Outline Drawings (continued)

### DRM-1 Inside View



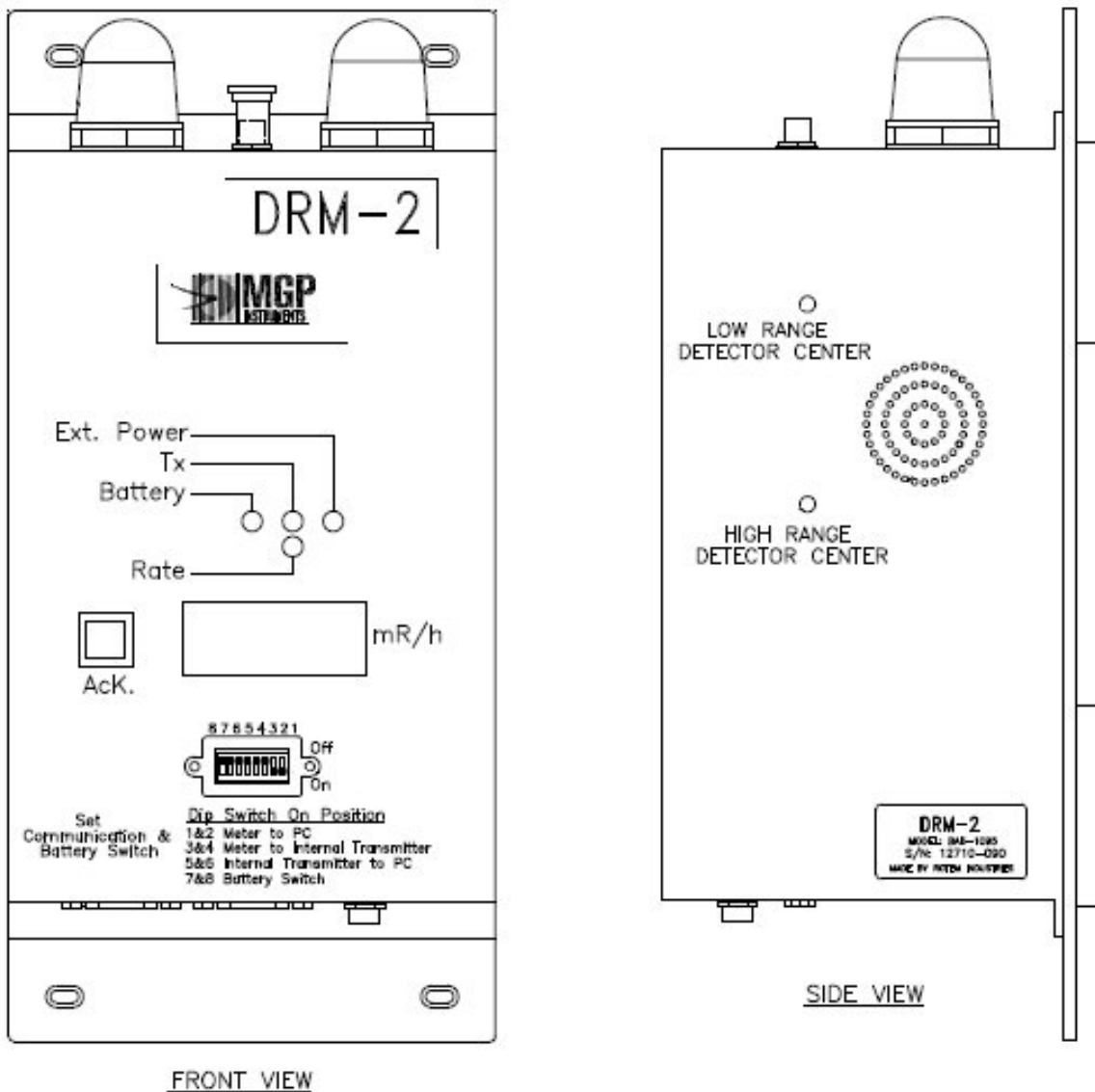
## 2.9. DRM-1D Outline Drawings

**DRM-1D Inside View**

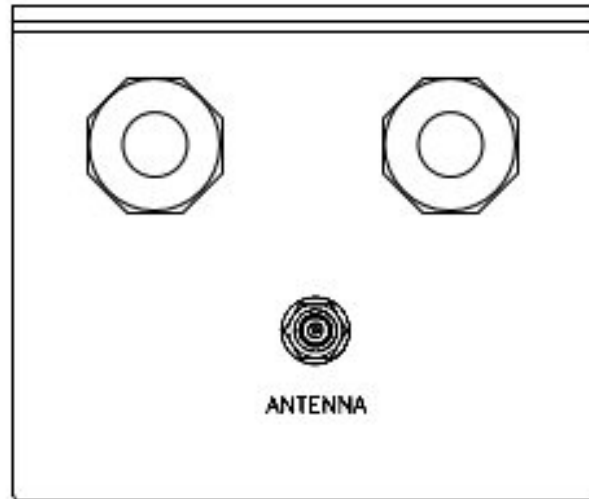




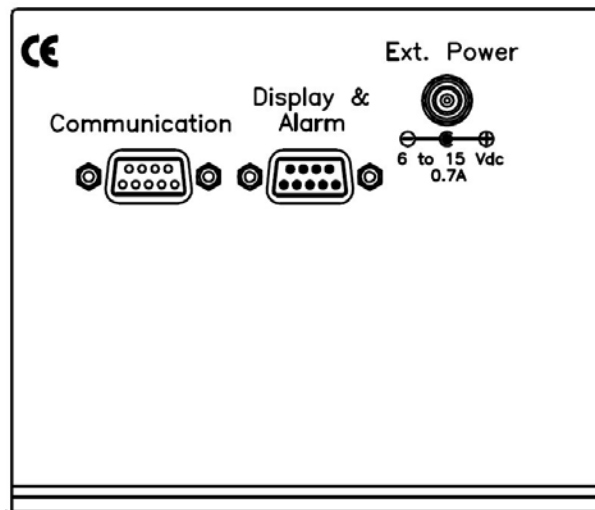
## 2.10. DRM-2 Outline Drawings



## DRM-2 Outline Drawings (continued)

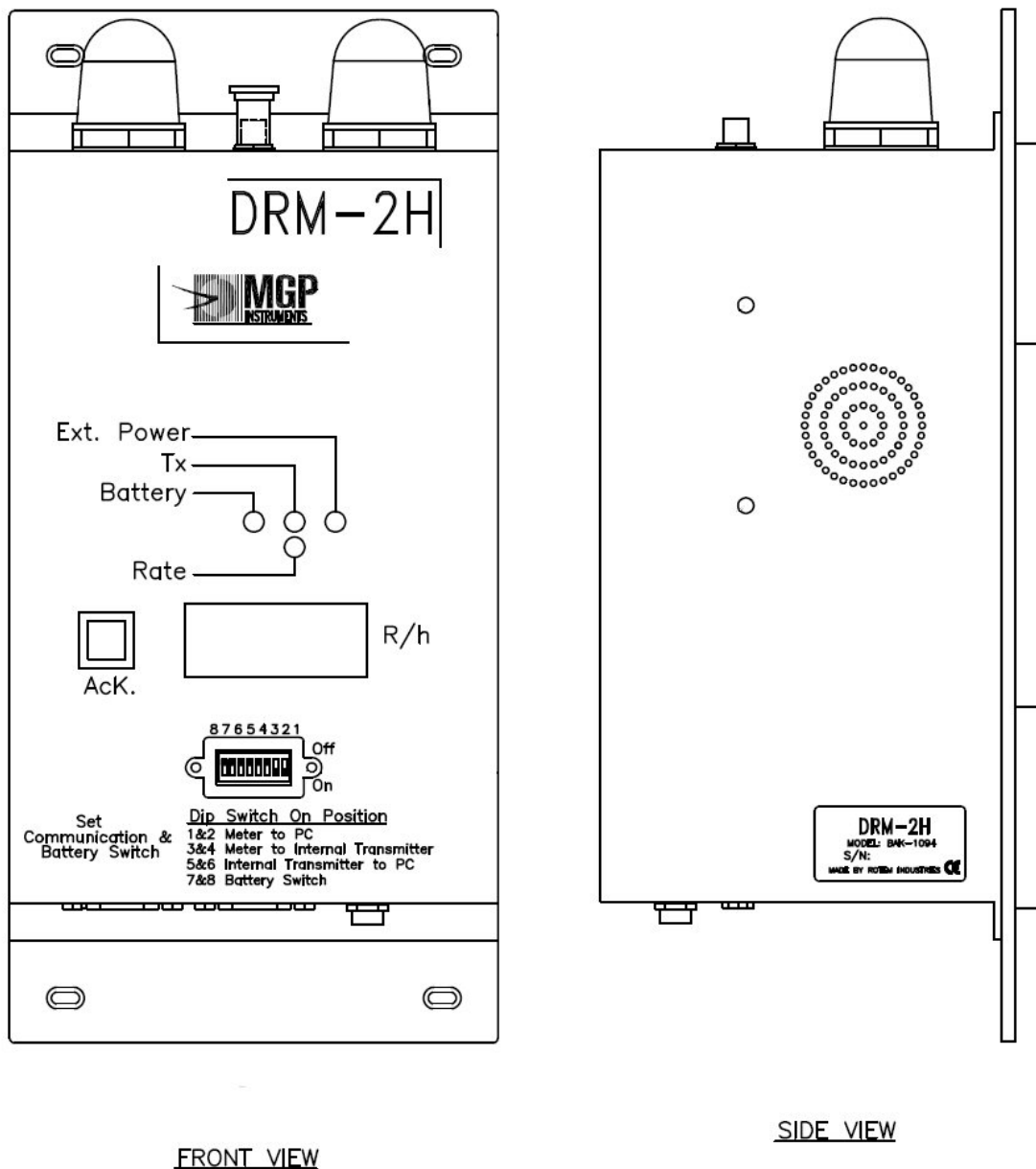


TOP VIEW



BOTTOM VIEW

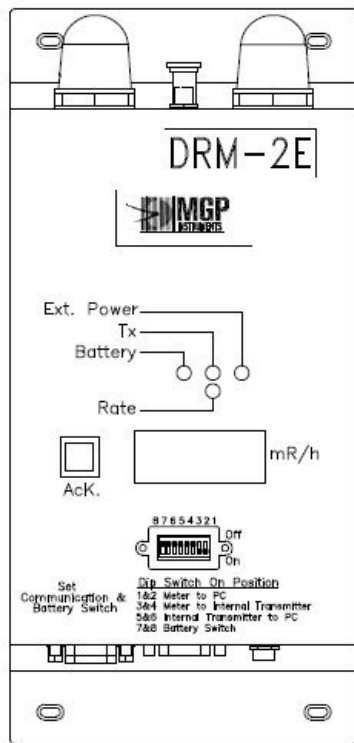
## 2.11. DRM-2H Outline Drawings



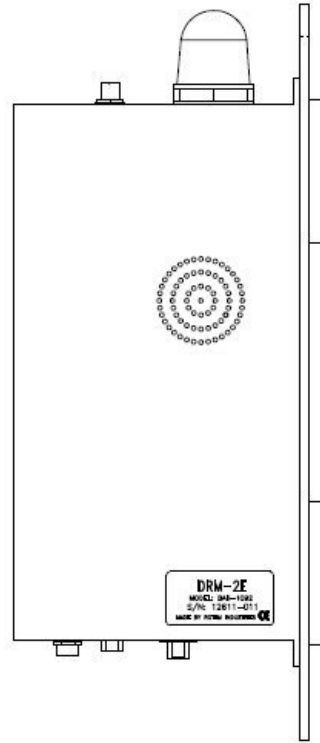
**Note:** Top and Bottom views of the DRM-2H are the same as the Top and Bottom views of the DRM-2 (please see Section 2.9).



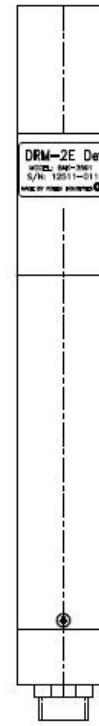
## 2.12. DRM-2E Outline Drawings



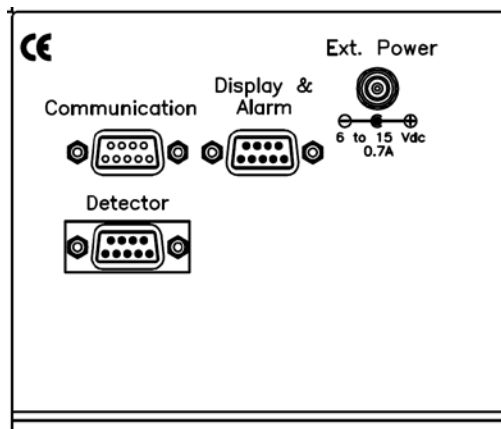
FRONT VIEW



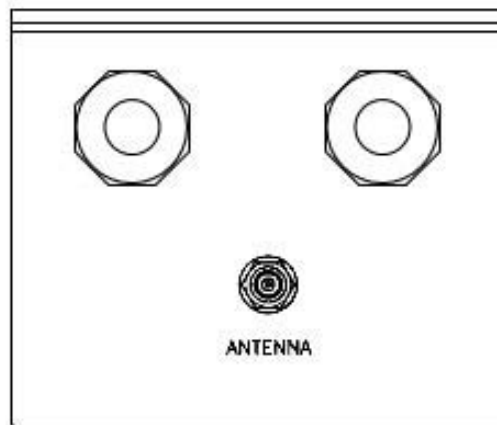
SIDE VIEW



DETECTOR



BOTTOM VIEW



TOP VIEW



## 2.13. Over the Air Communications

900 MHz or 2.4 GHz FHSS (Frequency Hopping Spread Spectrum) Radios with External Antenna (WRM<sup>2</sup> system) – Base receiver required for use with WRM<sup>2</sup> receiver.

## 2.14. Response Times for the GM Tubes

### 2.14.1. DRM-2 (ZP1201 & ZP1301):

**Table 1**  
**Response Time for Small Changes**

Radiation Field Range [mR/h]	Response Time [sec.]
< 0.5	45
0.5 - 1.5	30
1.5 - 2.5	20
2.5 - 6	10
6 - 12	6
12 - 24	4
20 - 60	3
60 - 800	2
0.6 - 1.2 R/h	5
1.2 - 2 R/h	4
2 - 3 R/h	3
3 - 10 R/h	2 – 3
> 10 R/h	≤ 2

**Table 2**  
**Fast Response Time**

Radiation field [mR/h] from to/above		Response Time [sec.]
0.05	1.0	≤ 2
0.5	3.0	≤ 2
1.5	5.0	≤ 2
2.5	12	≤ 2
6	20	≤ 2
12	40	≤ 2
20	60	≤ 2
1 R/h	2 R/h	≤ 2
2 R/h	2.6 R/h	≤ 2

If the radiation field measured by the meter increases significantly, the response time will be ≤ 2 sec. as seen in Table 2. In other cases the response time is according to Table 1.

For example:

- For a radiation field increase from 2.5 mR/h to 12 mR/h, the response time will be ≤ 2 sec.
- For radiation field fluctuations between 2.5 mR/h and 6 mR/h, the response time will be 10 sec.

### 2.14.2. DRM-2H (ZP1201 & 4G60M):

**Table 1**  
**Response Time for Small Changes**

Radiation Field Range [mR/h]	Response Time [sec.]
0.6	70
1.6	40
2.3	30
5.9	13
12	10
24	7
35	5
58	4
175	3
175-1500	2
<b>Switch to 4G60M; R/h</b>	
1.5	10
5.2	7
7.8	5
13	4
38	3
> 38 R/h	2

**Table 2**  
**Fast Response Time**

Radiation field [mR/h] from to/above		Response Time [sec.]
0.1	0.7	≤ 2
1	2.8	≤ 2
10	16	≤ 2
100	118	≤ 2
250	1500	≤ 2
<b>Switch to 4G60M; R/h</b>		
1.0	1.8	≤ 2
10	12.6	≤ 2
50	56	≤ 2
>56	9999 R/h	≤ 2

### 2.15. DRM-1/2D Response Times for the CsI (TL) Detector

The instrument's response time is less than 2 seconds once the radiation intensity at the reference point increases or decreases by a factor of 10. e.g. 0.001 to 0.01 mR/h (1μR/h to 10μR/h).

## 3. Operating Instructions

### 3.1. Preparation for Use

Remove the instrument from the shipping container and check for any physical damage. In the case of damage, report it to the carrier and contact Mirion Technologies (MGPI).

***Caution: Do not attempt to install or operate damaged equipment since safety and performance may be affected.***

## 3.2. Starting-up

- 3.2.1. Connect the antenna to the WRM2 PRSMA connector located on the top of the enclosure. The antenna is only needed when transmitting data over-the-air.
- 3.2.2. Switch dipswitch 3, for data output from the WRM2 radio, to the ON position or dipswitch 5 & 6 to the ON position when programming the internal WRM2 radio See “Wireless Remote Monitoring Operating Manual”, 15-00043 for configuring the WRM2 radio.

**Note:** Ensure dipswitches 1,2,3,7 and 8 are in the ON position when deploying the unit for field use. Dipswitch 4 must be in the OFF position at on times for field use and calibration.

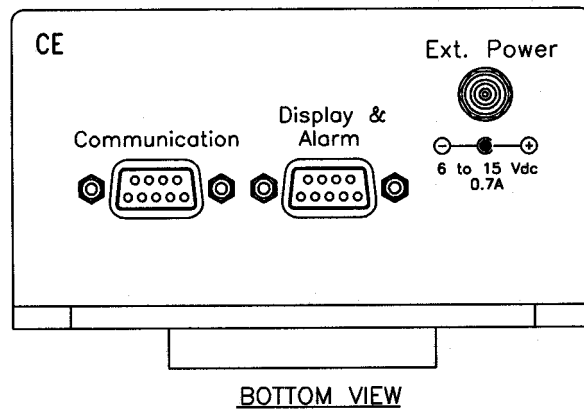
- 3.2.3. Switch dipswitch 7&8 to the ON position to engage the battery backup
- 3.2.4. Connect the external power supply to the locking miniature power supply connector
- 3.2.5. Connect external WRM transmitter if used and ensure that the baud rate for the DRM and the WRM External Transmitter are set to 300 bps. The interval level for the DRM needs to be set to ZERO (0), using MMV, so that the WRM transmitter can request the data from the device.

**Note:** By engaging the battery or the external power supply, the meter will start operating. The unit is not supplied with an On-Off switch.

- 3.2.6. **(Firmware >= 071111 [MARCH 2008] and board updates)** By pressing the “ACK” button once on the DRM-1 external display or the DRM-2 will show the current threshold rate setting, **thr.0** then the rate setting i.e., **300**. By pressing the ACK button a second time and so forth will show user preset threshold settings that were configured using the MMV software. See section 4.2.10 for MMV software Dose Rate Threshold settings. See section 4.2.10 for more information on setup and usage

ACK → thr.0 = selected    ACK → thr.1    ACK → thr.2    ACK → thr.3    ACK → thr.4

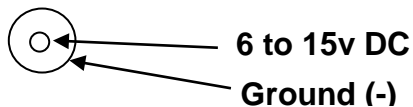
### 3.3. Meter Connectors



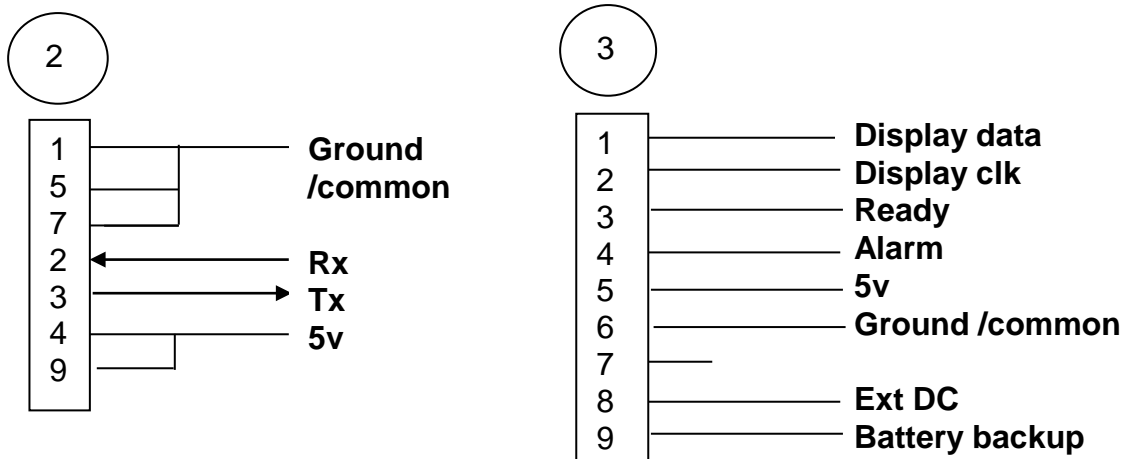
#### 3.3.1. Connectors:

The DRM-1 contains three connectors:

1. 2.5 mm External power supply connector (type L712RA supplied by Switch craft, center post is positive)



2. D-type 9 pin female for RS232 communication port
3. D-type 9 pin male for remote display & alarm

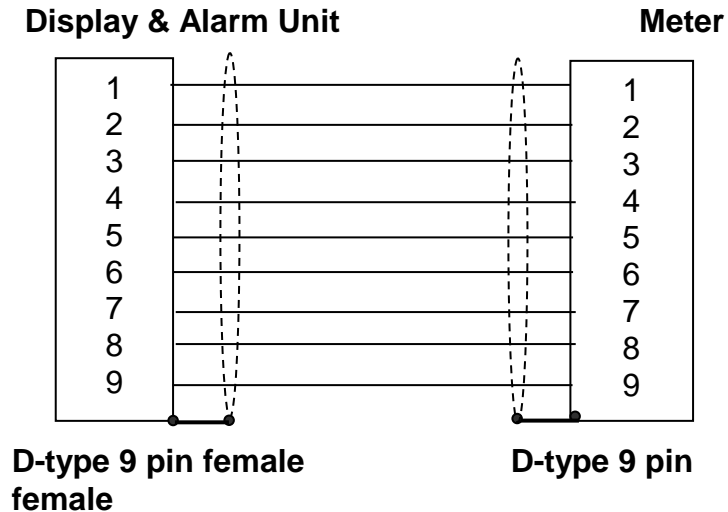


### 3.3.2. External Connectors:

#### Meter to PC RS232 Cable



#### Meter to External Display & Alarm Unit (length 25')



### 3.4. Power Supply & Battery

- External power supply type CINCON 418-TR1507-12 (15v) with locking plug (type 761K Switchcraft - center positive)
- Input 120-250 VAC
- Output 15 VDC 1.6A
- The meter can be operated using DC power from 5 volt to 16 volt (0.7A)
- The meter is protected in case of reverse polarity
- Battery backup: 3 units of NiMH GP2100 type AA 1.2V, 2100mA

## 4. General Functions

### 4.1. Dipswitch Selector

- 4.1.1. To set the dipswitch, unscrew two screws located at the meter front panel and remove the dipswitch cover.
- 4.1.2. The dipswitch (8 switches) is located on the meter's front panel. Using these dipswitches you can setup two functions:
  - Communication mode, and;
  - Connect-disconnect the backup batteries.
- 4.1.3. Dipswitches position: For the ON position, press the dipswitch downward.
- 4.1.4. The DRM has one UART (Universal Asynchrony Receive Transmit Port) and one communication RS232 port; the dipswitch position enables a selection of the communication mode
- 4.1.5. To set the dipswitch, unscrew two screws located at the meter front panel and remove the dipswitch cover.

### 4.2. Dipswitch Positions

#### 4.2.1. 1&2 On

- Connects the DRM UART to the RS232 communication port via the D-type 9 pin female connector
- Enables connection of the meter to PC for meter parameter setting, calibration or download the meter reading directly to PC, (Using MMV software for configuration and RMC for calibration).

#### 4.2.2. 3 On & 4 Off

- Connects the DRM UART to the internal wireless transmitter to send data reading via WRM2. Switch 3 is for transmitting and Switch 4 is for receiving data.

#### 4.2.3. 5&6 On

- Connects the internal wireless transmitter to the RS232 communication port via the D-type 9 pin female connector. See "Wireless Remote Monitoring 2 Operating manual, 15-00043" for configuring the WRM2 radio.
- Enables the setting of internal wireless transmitter WRM2 parameters.

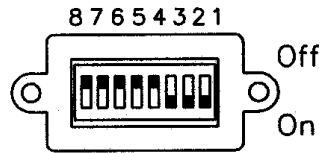
#### 4.2.4. 7&8 On

- Connects the internal three NiMHd rechargeable batteries for back-up power if the external power is disconnected

**Note:** If the external power supply is connected, the battery will be charged even though the dip switches 7&8 are in the OFF position.

- Set switch 7&8 to the OFF position only in case the meter is being stored.

Set communication &  
Battery Switch



Dip Switch On Position

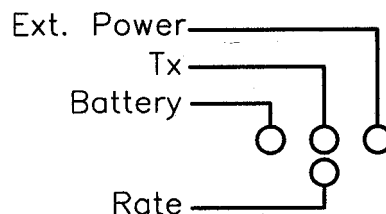
1&2 Meter to PC  
 3&4 Meter to Internal Transmitter  
 5&6 Internal Transmitter to PC  
 7&8 Battery Switch

#### Important Note:

For operational/configuration settings ensure dipswitches 1, 2, and 3 (dipswitch 3 is for transmitting data) are in the ON position. For field use ensure dip switches 1, 2, 3, 7 and 8 are turned ON (7 and 8 are for battery backup).

### 4.2.5. LED position and function

LED	Color	Function
Ext. power	Red	External power supply > 7.5v – led on External power supply < 7.5v – led blinks No external power supply & no Battery – LED off
Tx.	Green	For each transmission sent, the led blinks
Battery	Yellow	Battery connected & Battery voltage > 7.5v – LED is on Battery disconnected or Battery voltage < 7.5v – LED blinks No external power supply & no Battery – LED is off
Rate	Yellow	Blinks according the radiation trend



## 4.2.6. Automatic Range Switching

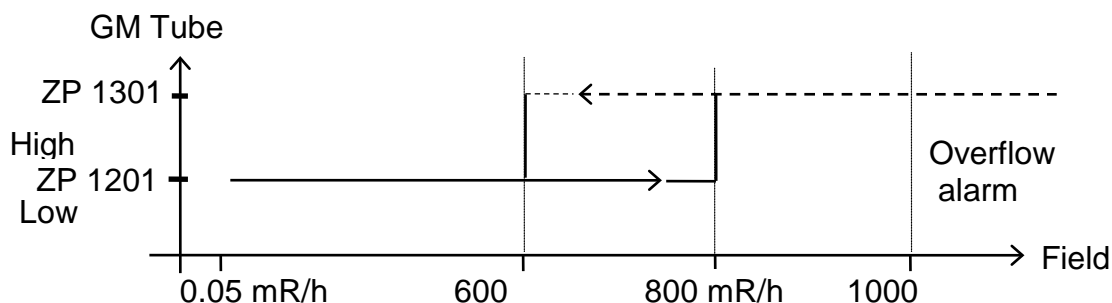
### 4.2.6.1. DRM-1/2:

The detector includes two GM Tubes:

Low range - ZP-1201 (or equivalent), and high range - ZP-1301 (or equivalent).

In a field of 0.05 mR/h to 800 mR/h both GM tubes are connected and the field is measured by the low range GM tube. If the radiation field is higher than 800 mR/h, the low range detector is disconnected, and the radiation field is measured by the high range GM tube.

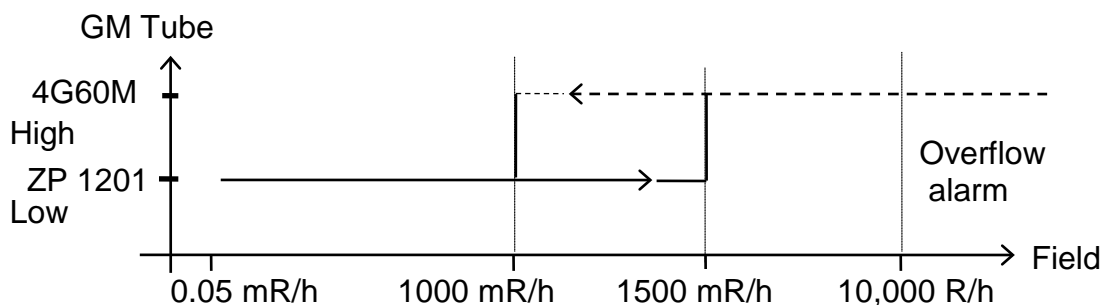
The switching between the low and high range GM-Tube is performed at 800 mR/h when the radiation field increases (low range detector is disconnected), and at 600 mR/h when the radiation field decreases (low range detector is connected).



### 4.2.6.2. DRM-2H:

The detector includes two GM Tubes:

The switching between the low and high range GM-Tube is performed at 1500 mR/h when the radiation field increases (low range detector is disconnected), and at 1000 mR/h when the radiation field decreases (low range detector is connected). (DRM-2H see note).





#### 4.2.7. Measuring Range for the DRM-1/2D

- 0.001 mR/h to 9.999 mR/h (0.01  $\mu$ Sv/h to 99.99  $\mu$ Sv/h)
- Automatic background subtraction is available via MMV software
- Overflow Alarm for reading > 10 mR/h
- Overload for field > 1 R/h

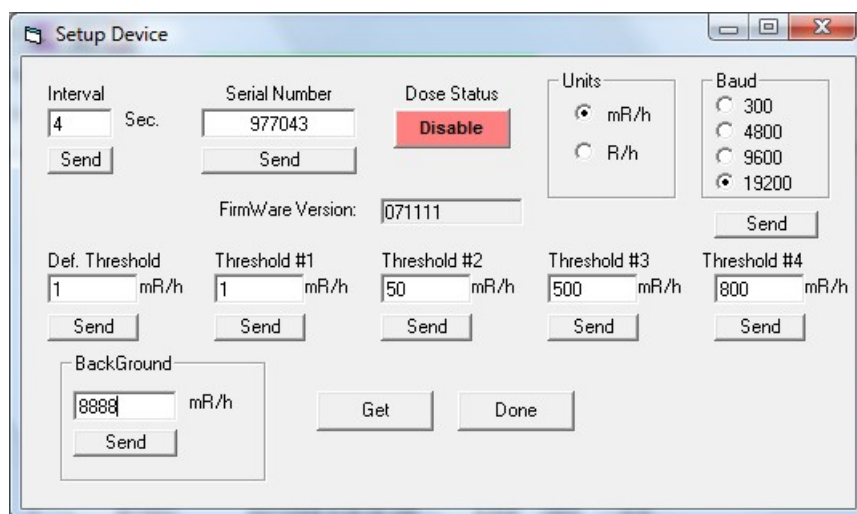
#### 4.2.8. Automatic Background Subtraction

For the **DRM-1/2D**, the Automatic Background Subtraction is set (using the MMV software) by changing the “Background” number to “**9999**”. The DRM-1/2D will count the background for 60 seconds and then set the current background internally. To ensure a new update for the backgrounds, turn off dipswitches 7 and 8 and unplug the AC adapter from power. When the device is powered on, the background will automatically update in 60 seconds. The displayed value on the optional display or software will show the net dose rate.

#### 4.2.9. Power Saving Mode Feature

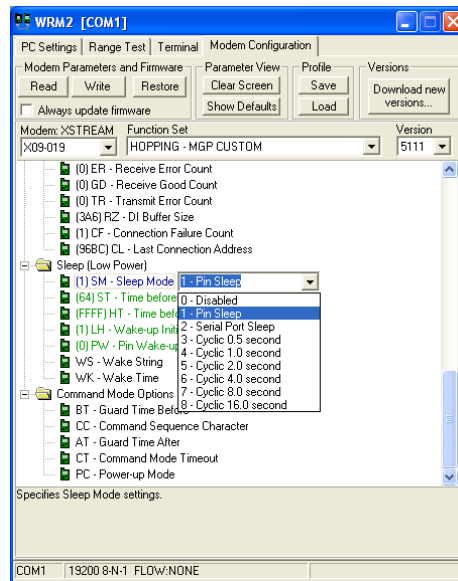
The Power Saving Mode will reduce power consumption in case the AC power is not present. The WRM2 radio must be setup for **Pin Sleep** configuration, for this function to work properly. Contact Mirion (MGPI) Technologies for assistance.

The Power Saving Mode will be activated after the send code “8888” (via MMV in the Background icon) is entered, sent and updated. If the DRM is set for a longer transmission interval (i.e. 60 seconds to conserve power), and the Threshold alarm is reached, the DRM will be set to a transmission interval level of 4 seconds (factory default) and transmit at the interval level until the Threshold Level rate falls below the current set point and the transmission interval level will revert back to 60 seconds.



Example of the Setup Device Window for the DRM in the MMV Software

**Note:** The sleep mode can be cancelled by the send code “7777” (via MMV in background icon) is entered, sent and updated.



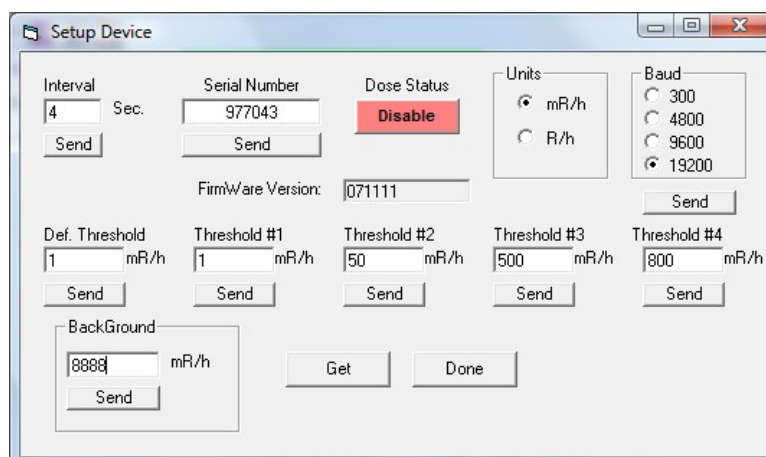
Example of the WRM2 Radio Configuration Screen (pin sleep)

The Interval time level is based on how long a unit can run without AC power, 99 seconds is the maximum transmission time interval.

To check if the DRM is in Power Saving Mode press on the “GET BUTTON” in the “Setup Device” window in the MMV software and the background window will be display “8888” to signify that the DRM is in the Power Saving Mode.

## 4.2.10. Dose Rate Alarm Threshold Settings

Dose threshold settings are configured via the MMV software (Version 4.01 and DRM firmware). The Def. Threshold (thr.0) is the current default setting in the DRM, i.e. Threshold (1) one is the current default dose rate threshold (see figure below), thr.0. To change the threshold setting using the ACK button on the display, toggle to the desired Threshold number, i.e. thr.3, let go of the ACK button and the display will show the stored threshold setting and will be defaulted to this rate threshold alarm setting.



Example of the Setup Device Window for with the Dose Rate Threshold Settings

## 4.2.11. Dose Function

Dose reading can be read as a part of the data record sent by the DRM.

To enable this function:

- Connect the DRM to the PC and run MMV software
- Move dipswitch 1&2 to the ON position, and set DOSE enable in the MMV software

If the DOSE reading is disabled, in place of a real dose reading, the record will be shown as **888888.8**. The Dose reading will be reset to zero in two cases: Disable\Enable Dose function, turn the DRM On. Each time the instrument is turned ON; the Dose reading is reset to zero.

## 4.3. DRM Optional External Display & Alarm



An optional external display (part # RTM-9135) is available for remote locations of the read-out, audible and/or visual alarms with and with an alarm acknowledge button.



A 25 foot cable connects the display to the DRM via a D-type 9 pin connector and supplies the power to the remote display. The DB-9 connectors must be fastened securely for the display to operate properly.



**Note:** Internal battery life is reduced when no external power supplied is used while using the remote display.

### Remote Display Functionality Description

Status	Failure	No alarm & ready	Failure	Over threshold alarm
Red Lamp	BLINK	OFF	BLINK	ON
Green Lamp	OFF	ON	OFF	ON
Buzzer	BLINK	OFF	BLINK	ON
Display	FAiL	Dose rate reading [mR/h]	FAiL	Thr and Dose rate reading [mR/h] simultaneous

#### 4.3.1. External Display and Alarm Unit Display Ranges

A 7 segment 4 digit display unit displaying in the following formats:

- Meter display format:
- Measuring reading **0.000 to 9.999** mR/h for the **DRM-1/2D**
- Measuring reading for the **DRM-1/2**:
  1. 0.001 to 9.99
  2. 10.0 to 99.9
  3. 100 to 999
  4. 1.0E to 9.99E
  5. 10.0E to 99.9E
  6. 100E to 999E
- For numbers 1-3 the units will be mR/h
- For numbers 4-6 (with E) the units will be R/h
- Measuring reading 0.001 to 9,999 R/h for the DRM-2H:

**OFLO** in case of overload, reading > 10mR/h

**ALr.** and measuring reading blink simultaneity in case of meter reading is over the setting threshold alarm

**Err1** in case of detector not connected.

**Err2** In case of detector malfunction.

#### 4.4. Battery Replacement

The battery holder is located inside of the DRM meter.

- Disconnect the external power supply and switch dipswitch 7 & 8 to the OFF position.
- Unscrew the six screws located at the back meter panel.
- Unscrew the two screws located at omega clip on the battery pack.
- Replace a new set of three 1.2v NiMH AA batteries.

#### **DO NOT USE ALKALINE BATTERIES AS REPLACEMENTS FOR NIMH BATTERIES.**

- Screw back on the omega clip on the battery pack.
- Screw back the six screws located at the back meter panel.
- Connect an external power supply.
- The battery backup will be charged and ready for use after 16 hours.

## 5. Communication

### 5.1. Communication

The communication between the DRM and PC can be performed in 3 ways:

- 1) Wireless Radio WRM2 located inside the meter.
- 2) Direct RS232 via the meter communication port (D-type 9 pin female connector using a Null Modem Adaptor).
- 3) WRM External Transmitter can be connected to the D-type 9 pin female connector via the AMP to WRM adapter.

### 5.2. Protocol

Communication parameters:

- Baud rate: can be selected between 300, 4800, 9600 and **19200 is the default.**
- Parity: None
- Hardware handshaking: None
- Software handshaking: None
- Stop bit: 1
- Prefix: LF
- Suffix: CR
- Data format: 8 data bits

## 6. Communication Protocol

Description: DRM data to PC via radio or RS232

**Byte 1** LF

**Byte 2 to byte 7** Id meter number for communication set via Meter View software

**Byte 8** status = 0x30=okay, 0x31=over load, 0x32=over threshold, 0x33=no external power, 0x34=low backup battery, 0x38=detector fault.

**Byte 9 Status** = multiple status messages – See information below.

**Byte 10 to byte 16** Dose Reading (x.xxxxx) or 8.88888 in case the Dose is disabled

**Byte 17** = 0x30

**Byte 18 to byte 22** rate reading  $X.YZW \times 10^T$

**Byte 23** = 0x30

**Byte 24 to byte 25** check sum

**Byte 26** CR

Byte	Description
1	LF
2	N5
3	N4
4	N3
5	N2
6	N1
7	N0
8	Status
9	Status
10	D5
11	D4
12	D3
13	D2
14	D1
15	D0
16	D-1
17	30H
18	X
19	Y
20	Z
21	T
22	W
23	Status 3 lsb
24	CS msb
25	CS lsb
26	CR

See Table below  
for Status 9

### Status Message - Byte 9

Overflow	Threshold Alarm	Loss of external power	Low Battery or battery OFF	Error with Detector	Status Code
					30H
1					31H
	1				32H
		1			33H
			1		34H
				1	35H
1		1			36H
1			1		37H
1		1	1		38H
	1	1			39H
	1		1		41H
	1	1	1		42H
		1	1		43H
		1		1	44H
		1	1	1	45H
			1	1	46H

## 6.1. Set Meter Parameter via the PC

The parameters are set via the PC using the MMV software.

### PC to meter

0	1	2	3	4	5	6	7	8	9	10
LF	Status	D5	D4	D3	D2	D1	D0	0F	0F	CR

Status byte:

- Read meter parameters=30H
- Set Baud=31H
- Set Time=34H
- Set Threshold alarm value=35H
- Set Dose status=37H
- Set meter serial no.=38H

### 6.1.1. Read the Meter Parameters=30H

#### PC to meter

0	1	2	3	4	5	6	7	8	9	10
LF	30	20	20	20	20	20	20	0F	0F	CR

#### Meter to PC

0	1	2	3	4-9	10-14	15	16-19	20	21-26
LF	30	Meter type	Meter unit	Meter #	Thr. value	Meter baud	Down load time	Dose En/Dis	Firmware version

27-28	29
36h,37h	CR

#### Byte 2:

AMP50 = 30  
AMP100=31  
AMP200=32

#### Byte 3:

mR/h = 30  
uSv/h = 31

#### Byte 15:

300=30  
4800=31  
9600=32  
19200=33

#### Byte 20

disable =30  
enable=31

byte 10-14 : threshold X.YZW \* 10 T (X=byte10, Y=11, Z=12, W=13, T=14)

### 6.1.2. Set down load interval Time=34H

#### PC to meter

0	1	2	3	4	5	6	7	8	9	10
LF	34	Sec* 1000	Sec*100	Sec* 10	sec	20	20	0F	0F	CR

The interval time can be set from between 0 and 99.

### 6.1.3. Set Threshold alarm value=35H

PC to meter

0	1	2	3	4	5	6	6	7	8	9
LF	35	X	Y	Z	W	T	20	0F	0F	CR

### 6.1.4. Set Dose status = 37H

PC to meter

0	1	2	3	4	5	6	7	8	9	10
LF	37	D-30 E-31	2 0	20	20	20	20	0F	0F	CR

### 6.1.5. Set meter serial no. = 38H

PC to meter

0	1	2	3	4	5	6	7	8	9	10
LF	38	D5	D4	D3	D2	D1	D0	0F	0F	CR

### 6.1.6. Set Baud Rate = 31H

PC to meter

0	1	2	3	4	5	6	7	8	9	10
LF	31	code	2 0	20	20	20	20	0F	0F	CR

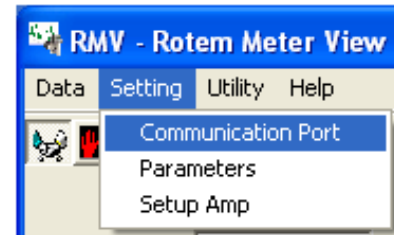
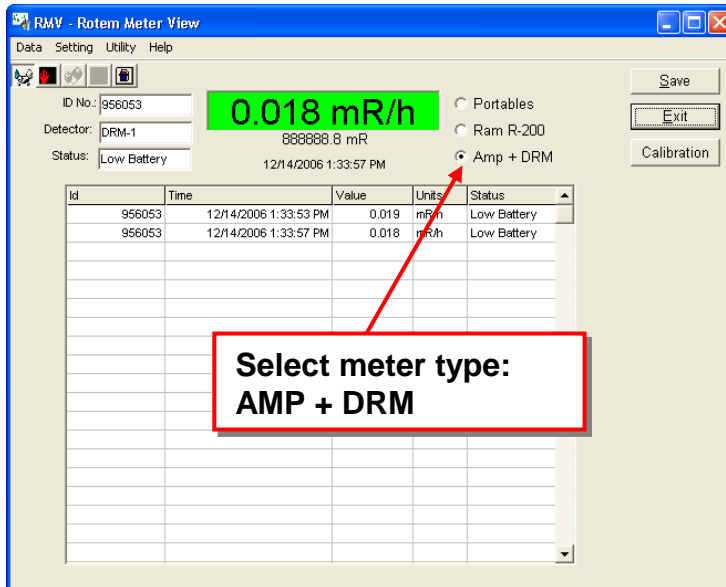


Code:

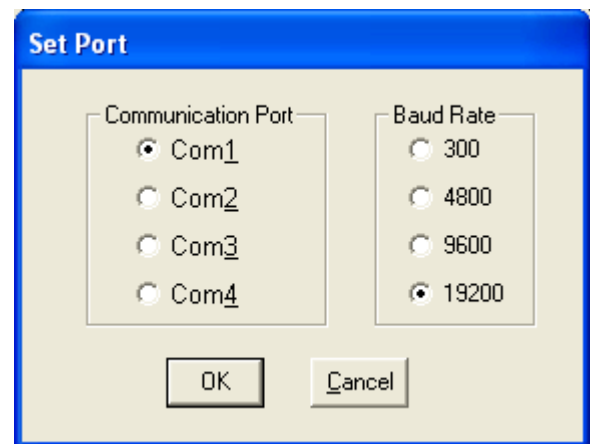
30h=300      32h=9600  
 31h=4800      33h=19,200



## 7. Setting Meter Parameters using the MMV Software



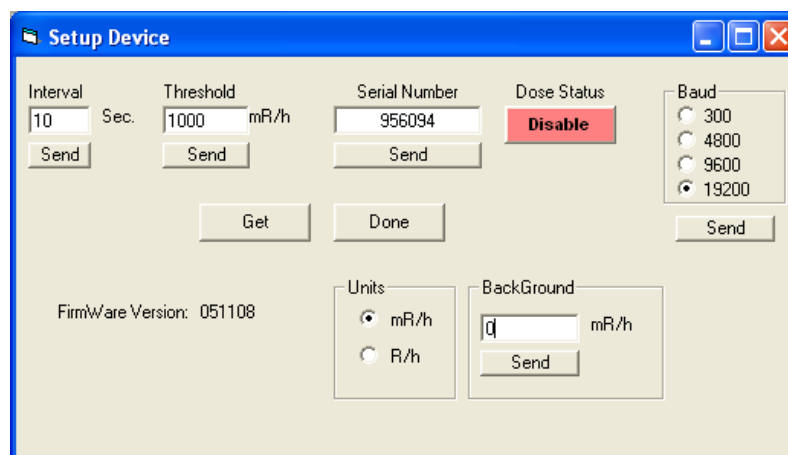
### 7.1. Set PC communication parameters



### 7.2. Set & Display Meter Parameters

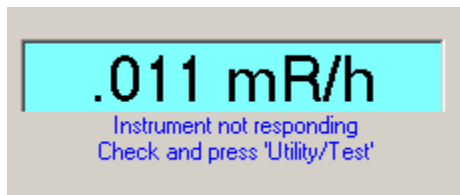
To set new parameter value, type the required value on each window and then click on the **Send** button for each parameter.

i.e.: Interval = 10 → Send      Threshold = 1000 → Send

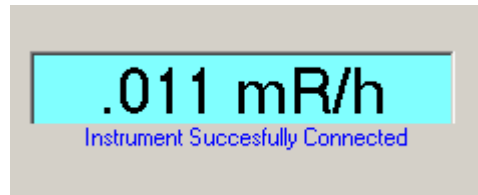


### 7.3. MMV Operating Instructions:

- 7.3.1. Start the MMV software by CLICKING on the CALIBRATION button on the MMV software connect the DRM to the P.C. via the RS232 connection with a null modem connector, ensure dipswitches 1 and 2 on in the ON position.
- 7.3.2. Set the correct Communication port.
- 7.3.3. Select meter type, **AMP+DRM**.
- 7.3.4. Verify that the communication between the meter and the PC is okay. If the communication is fail, change the baud rate by clicking on the **Setting, Communication port** button, and select another baud rate. Then click on **Utility, Test** to check again.



**Failed communication**



**Communication OK**

- 7.3.5. Once the communication is okay, use the **Setting, Setup AMP** button to configure the meter's working parameters.
- 7.3.6. The Serial Number shown in the Setup Device screen refers to the ID number used in the communication protocol and not the serial number of the instrument which is setup using the RMC (Rotem Meter Calibration) or the AMP View software. All portable instruments telemetry ID will start with a '9' followed by the unique identification number.

#### Meter Code for Telemetry (Area Monitors/Portable Instruments 9xxxxx)

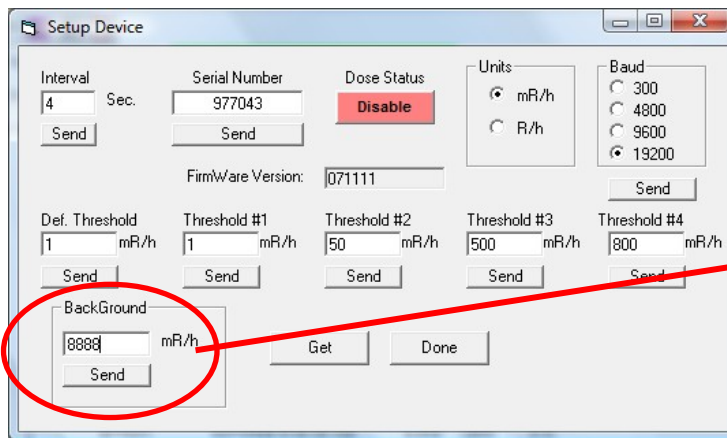
Instrument	Type Code
TelePole	0
Ram Ion	1
AMP-50	2
AMP-100	3
AMP-200	4
DRM-1/2(H)	5
DRM-1/2D	6

**Note:** Correlation between the factory serial number and the Telemetry ID #

	<u>Factory S.N.</u>				<u>ID #</u>	
<b>AMP- 50</b>	09	02	801	9	22	801
<b>AMP-100</b>	50	02	001	9	32	001
<b>AMP-200</b>	77	02	501	9	42	501
<b>DRM-1</b>	<b>11004 - 0008</b>			<b>9</b>	<b>54</b>	<b>008</b>

Example:

9 54 008  
 ↑     ↑     ↑  
**Meter type   year   serial # (DRM-1)**



**Input "9999" to activate  
the Automatic Background  
mode for the DRM-1D**

***(Does not apply to  
DRM-1/2 model)***

**Note:** For the DRM-1D/2D, the Automatic Background Subtraction is activated by changing the "Background" number to "9999" and press Send. The DRM-1/2D will count the background for 60 seconds and then set the current background internally. The displayed value on the optional display or software will show the net dose rate.

## 7.4. Automatic Background Options:

- 7.4.1. When the Backup battery is disconnected (dipswitch 7& 8 in off) , connect the external power supply, the meter will turn ON and enter to calculate the background during the 60 second count, automatically, after 60 second this value will be kept in memory.
- 7.4.2. Connect the meter to PC and run the MMV software, in the AMP setup function type "9999" for automatic calculation, the meter will enter to calculate the background during 60 second, after 60 second this value will be kept in memory.

**Note:** If the threshold alarm setting is lower than the background when performing the automatic background subtraction the alarm will be activated until the background is stored and the display is showing the net rate.

- 7.4.3. Connect the meter to PC (using the null modem adapter) and run the MMV software, in the Amp setup function type desirable "9999" the background value.

## 8. Calibration Summary for the DRM-1/2

### 8.1. Preface

#### 8.1.1. Calibration Factors

To improve the linearity, the **DRM-1/2(H)** includes five calibration factors: The two lower factors are for the low range GM tube, from 0.05 mR/h to 800 mR/h; and the other three are for the high range GM tube, from 600 mR/h to 999 R/h (DRM-1/2) or 1000 mR/h to 9,999 R/h (DRM-2H). Once the F factors have been set a linearity verification should be performed on all ranges.

The calibration factors will be set using the RMC software:

**F1** - first calibration factor for low range.

**F2** - second calibration factor for low range.

**F3** - first calibration factor for high range.

**F4** - second calibration factor for high range.

**F5** - third calibration factor for high range.

- **F1** and **F3** are used to compensate the GM tube sensitivity tolerances.
- **F1** for the low range (ZP1201) and **F3** for the high range (ZP1301 [DRM1/2]) (4G60M [DRM-2H]).
- **F2**, **F4** and **F5** are used to compensate the dead time tolerances.
- **F2** for the low range (ZP1201) and **F4**, **F5** for the high range (ZP1301 [DRM1/2]) (4G60M [DRM-2H]).

#### 8.1.2. Calibration Ranges

DRM-1/2	DRM-2H
<b>F1</b> should be set at 50 mR/h $\pm$ 20 mR/h	<b>F1</b> should be set at 50 mR/h $\pm$ 20 mR/h
<b>F2</b> should be set at 350 mR/h $\pm$ 50 mR/h	<b>F2</b> should be set at 600 mR/h $\pm$ 100 mR/h
<b>F3</b> should be set at 10 R/h $\pm$ 2 R/h	<b>F3</b> should be set at 20 R/h $\pm$ 5 R/h
<b>F4</b> should be set at 200 R/h $\pm$ 60 R/h	<b>F4</b> should be set at 1000 R/h $\pm$ 200 R/h
<b>F5</b> should be set at 600 R/h $\pm$ 100 R/h	<b>F5</b> should be set 8000 R/h $\pm$ 1000 R/h

Measured (displayed) readings are calculated by one of the following two formulas, depending on the intensity of the radiation field:

- **Low range:**  $N(\text{mR/h}) = [n \cdot F1 + \text{dead time correction } \{n \cdot F2\}] / 17$
- **High range, up to 300 R/h:**  $N(\text{R/h}) = [n \cdot F3 + \text{dead time correction } \{n \cdot F4\}] / 300$  (DRM2)
- **High range, over 400 R/h:**  $N(\text{R/h}) = [n \cdot F3 + \text{dead time correction } \{n \cdot F5\}] / 300$  (DRM2)
- **High range, up to 3500 R/h:**  $N(\text{R/h}) = [n \cdot F3 + \text{dead time correction } \{n \cdot F4\}] / 77$  (DRM-2H)
- **High range, over 5500 R/h:**  $N(\text{R/h}) = [n \cdot F3 + \text{dead time correction } \{n \cdot F5\}] / 77$  (DRM-2H)

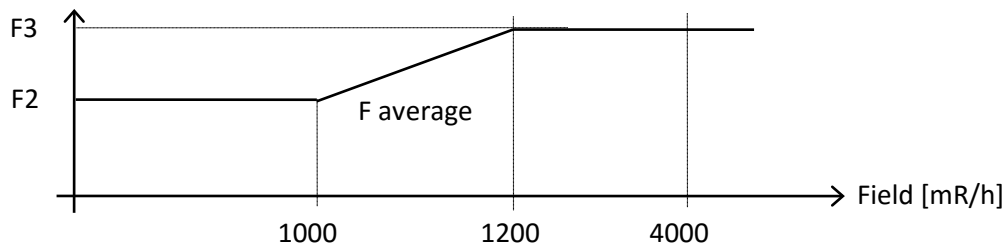
Where:

- **n** is the detector frequency obtained in the radiation field.
- **N** is the updated measurement reading.
- Between 300 R/h to 400 R/h (for DRM-1/2) and between 35,000 R/h to 55,000 R/h (DRM-2H), a weighted average of F4 and F5 is used as the dead time correction factor. The calculation of the "averaged factor" and the corresponding measurement formula follow:
- $x = (\text{last } N(\text{R/h}) - 300)/100$  (DRM-1/2)
- $x = (\text{last } N(\text{R/h}) - 3500)/2000$  (DRM-2H)
- **Last N** = previous measurement reading
- **F average** =  $(1-x) \cdot F4 + x \cdot F5$
- $N(\text{R/h}) = [n \cdot F3 + \text{dead time correction } \{n \cdot F \text{ average}\}] / 300$  (DRM-1/2)
- $N(\text{R/h}) = [n \cdot F3 + \text{dead time correction } \{n \cdot F \text{ average}\}] / 77$  (DRM-2H)

The following graphs illustrate the ranges over which F2, F3 and F average are used as the DRM's dead time correction factor:

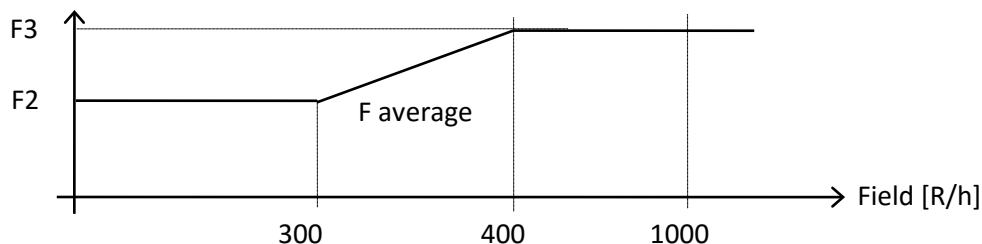
Low Range:

**Dead time correction factor**



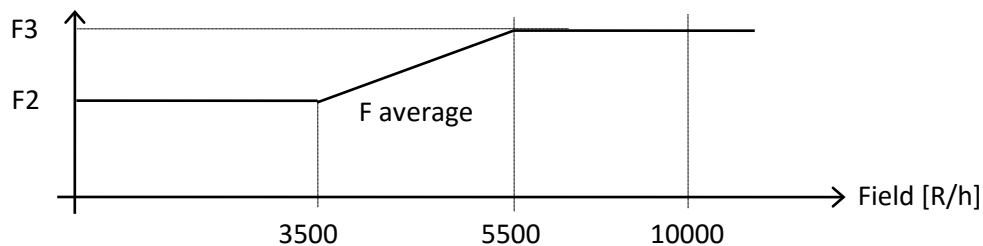
High Range (DRM-2):

**Dead time correction factor**



High Range (DRM-2H):

**Dead time correction factor**



## 9. Calibration Guidelines

### 9.1. Summary for the DRM-1/2D

#### 9.1.1. Preface

##### 9.1.1.1. Calibration Factors

The **DRM-1D/2D** requires only one calibration point which requires only one change to **Factor 1 (F1)** in the Meter Calibration software. Once the F1 factor has been set performed, linearity verification should be performed.

The DRM-1D/2D can be calibrated via the RS232 communication port with a NULL modem adapter in a similar method to Section 9.2 below.

Switch to the ON position dipswitches 1&2 for RS232 and the calibration will be performed by using the Meter Calibration software. Refer to section 10.1 for instructional use of the calibration software.

##### 9.1.1.2. Calibration Ranges

**F1** is recommended to be set at 0.1 to 0.2 mR/h.

### 9.2. Calibration Procedure for the DRM-1/2, DRM-2H, and DRM-1/2D

#### 9.2.1. Preface

The DRM-1/2, DRM-2H, and DRM-1/2D can be calibrated via the RS232 communication port with a NULL modem adapter.

Switch to the ON position dipswitches 1&2 for RS232 and the calibration will be performed by using the Meter Calibration software.

If the radiation field is greater than 10 mR/h, the software will automatically enable the setting of the appropriate factor, depending on the field intensity for the **DRM**. Refer to section 10.1 for instructional use of the calibration software.

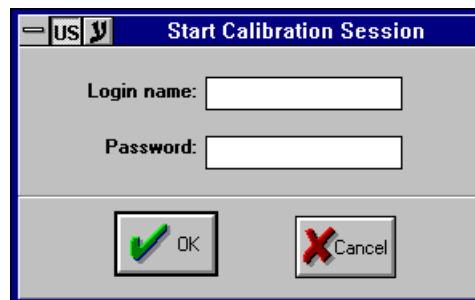
##### 9.2.1.1. Calibration Ranges

<b>DRM-1/2</b>	<b>DRM-2H</b>
<b>F1</b> in a field > 10 mR/h and < 100 mR/h	<b>F1</b> in a field > 10 mR/h and < 100 mR/h
<b>F2</b> in a field > 100 mR/h and < 800 mR/h.	<b>F2</b> in a field > 400 mR/h and < 1000 mR/h.
<b>F3</b> in a field > 800 mR/h and < 50 R/h	<b>F3</b> in a field > 1.5 R/h and < 500 R/h
<b>F4</b> a field > 50 R/h and < 350 R/h	<b>F4</b> in a field > 500 R/h and < 6000 R/h
<b>F5</b> in a field > 350 R/h	<b>F5</b> in a field > 6000 R/h

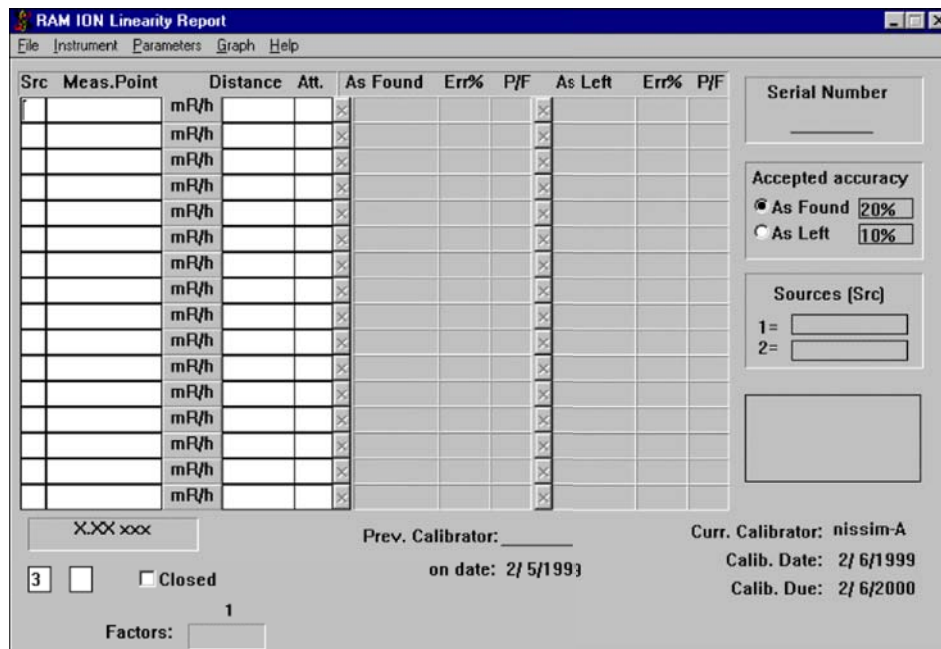
**Note:** If the radiation field is lower than 10 mR/h, each factor can be set manually by the calibration software.

## 9.3. Operating Instructions

- 9.3.1. Run the calibration program via the RMC.EXE file (or icon).
- 9.3.2. Enter a Login name/calibrator ("jsmith") name that will appear in the calibration documentation (up to 12 characters).
- 9.3.3. Enter Password – "Mirion" in lower case.



- 9.3.4. Click OK, the program enters the main window.
- 9.3.5. The caption in the main window (linearity report) displays the previous template. In the displayed template the operator executes the required operations to complete the calibration and linearity.
- 9.3.6. To start the procedure, click File/New Report.



Src	Meas.Point	Distance	Att.	As Found	Err%	P/F	As Left	Err%	P/F
	mR/h								
	mR/h								
	mR/h								
	mR/h								
	mR/h								
	mR/h								
	mR/h								
	mR/h								
	mR/h								
	mR/h								
	mR/h								
	mR/h								
	mR/h								
	mR/h								
	mR/h								

X.XX xxx      Prev. Calibrator: \_\_\_\_\_      Curr. Calibrator: nissim-A  
 3      Closed      on date: 2/ 5/1993      Calib. Date: 2/ 6/1999  
 Factors: 1      Calib. Due: 2/ 6/2000

## 9.4. Template & Parameters Setup

The template includes setup parameters and instrument parameters. To select or create a new template, proceed as follows.

### 9.4.1. To select an existing template

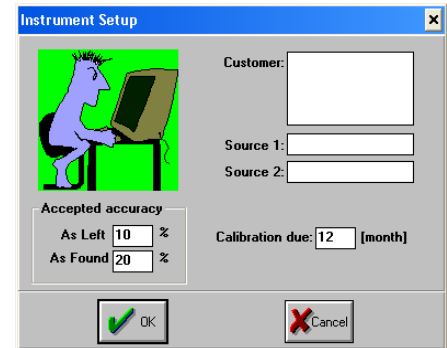
The RMC program is supplied with a number of default templates. Click File/ Open template and select the required template.

### 9.4.2. To create a new template

**9.4.2.1.** Fill the following parameters in the displayed template: Src (source), Measuring Point including units, Distance, and Attenuators. To select between mR/h and R/h, or cps and Kcps, or cpm and Kcpm, click each of the unit's columns.

**9.4.2.2.** Select **Parameters / Setup** from the pull down menu. Complete the following

- **Customer** - Enter header (up to 4 lines) for the calibration & linearity certificate.
- **Accepted accuracy:**
  - **As Left** - Enter maximum allowed deviation
  - **As Found** - Enter maximum allowed deviation
  - **Source 1** - Enter source type used in the calibration facility.
  - **Source 2** - Enter source type used in the calibration facility.
  - **Calibration due** - Set the calibration interval.
  - Click **OK** to save data and quit.
  - Click **Cancel** to cancel data changes and quit.



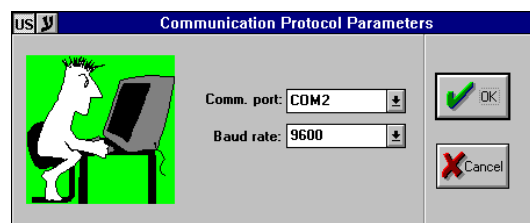
### 9.4.3. Select Parameters / Template from the pull down menu.

In the **Template Settings** window perform the following:

- **Template name** - Fill new template name
- **Instrument** - Select instrument type/ name
- Note: For the DRM select TelePole meter.
- **Units** - Select units to be used in this template
- **New template** - Save current template settings into a new file
- **Open template file** - Select existing template without changing it

### 9.4.4. Set PC Communication Port

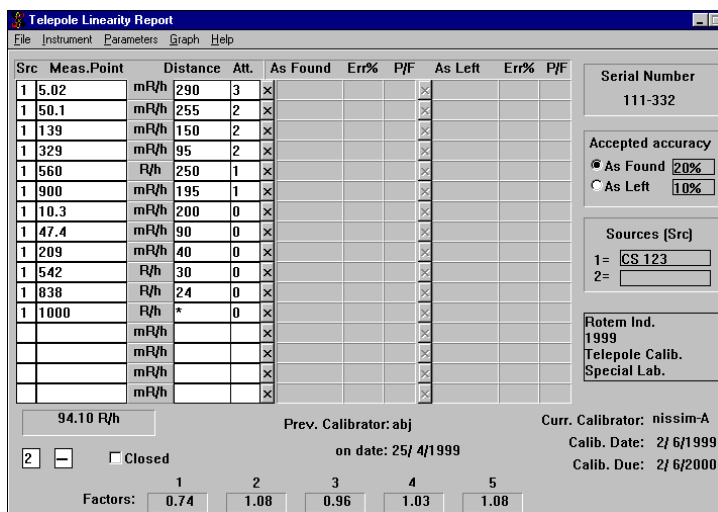
- Select Parameters / Communication from the pull down menu.
- Set the **Comm. port**.
- Set Baud rate (19200 BPS).





## 9.5. Starting-up the Calibration & Linearity Process

- 9.5.1. Connect the DRM to the computer via the appropriate Comm. Port using a NULL Modem adaptor (according to the selected port in the set up program).
- 9.5.2. Turn the meter on and ensure dipswitches 1 and two are in the ON position
- 9.5.3. Execute the RMC file.
- 9.5.4. Enter User name up to 12 characters i.e., jsmith.
- 9.5.5. Enter Password, type Mirion (in small letters).
- 9.5.6. To check and calibrate the instrument, first enter Linearity and check As Found. Then enter from the pull down menu to Instrument/ Calibration. After calibration is performed, return to Linearity and check As Left.



**Telepole Linearity Report**

File Instrument Parameters Graph Help

Src	Meas.Point	Distance	Att.	As Found	Err%	P/F	As Left	Err%	P/F
1	5.02	mR/h	290	3	x				
1	50.1	mR/h	255	2	x				
1	139	mR/h	150	2	x				
1	329	mR/h	95	2	x				
1	560	R/h	250	1	x				
1	900	mR/h	195	1	x				
1	10.3	mR/h	200	0	x				
1	47.4	mR/h	90	0	x				
1	209	mR/h	40	0	x				
1	542	R/h	30	0	x				
1	838	R/h	24	0	x				
1	1000	R/h	*	0	x				
		mR/h			x				
		mR/h			x				
		mR/h			x				
		mR/h			x				

Serial Number: 111-332

Accepted accuracy:  
☒ As Found 20%  
☐ As Left 10%

Sources (Src)  
 1= CS 123  
 2=

Rotem Ind.  
 1999  
 Telepole Calib.  
 Special Lab.

94.10 R/h

Prev. Calibrator: abj  
 on date: 25/ 4/1999

Curr. Calibrator: nissim-A  
 Calib. Date: 2/ 6/1999  
 Calib. Due: 2/ 6/2000

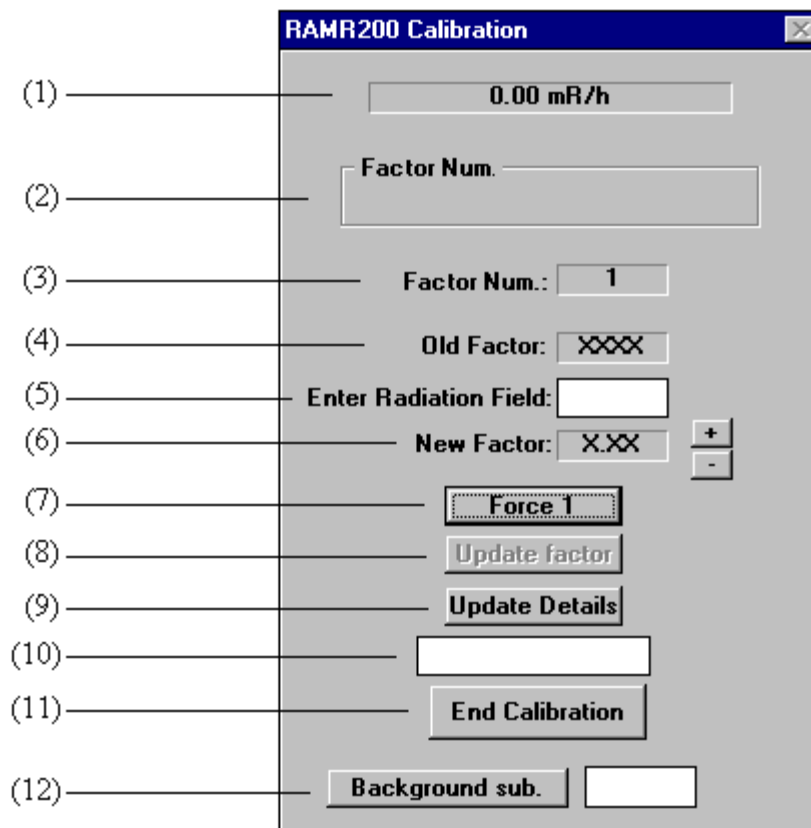
Factors: 1: 0.74, 2: 1.08, 3: 0.96, 4: 1.03, 5: 1.08



**Note:** If the computer / instrument communication failure or is disconnection, the Communication Error Message is displayed in the computer's display. Check the communication cable, Comm. Port, or dip switch settings on the DRM. Also, check the communications port of the PC.

## 9.6. Calibration

Select **Instrument/Calibrate...** from the pull down menu. The calibration menu will be displayed.



The screenshot shows the 'RAMR200 Calibration' window. The fields and buttons are numbered as follows:

- (1) Points to the '0.00 mR/h' display at the top.
- (2) Points to the 'Factor Num.' label above a text box.
- (3) Points to the 'Factor Num.: 1' display.
- (4) Points to the 'Old Factor: XXXX' display.
- (5) Points to the 'Enter Radiation Field:' label above a text box.
- (6) Points to the 'New Factor: X.XX' display, with '+' and '-' buttons to its right.
- (7) Points to the 'Force 1' button.
- (8) Points to the 'Update factor' button.
- (9) Points to the 'Update Details' button.
- (10) Points to an empty text box below the 'Update Details' button.
- (11) Points to the 'End Calibration' button.
- (12) Points to the 'Background sub.' label next to an empty text box at the bottom.

(1) **Instrument reading** – Current dose rate reading

(2) **Factor Num.** - Factor number for the calibration. The listing in this screen depends on the amount of calibration points available from the instrument. If the “Auto” radio button is selected the software will recognize the filed value and allow for calibration of the pertinent point. If the calibrator wants to insert a factor into a specific range, he or she simply selects the field.

(3) **Factor Num.** - Current active factor number. This window will display the current active factor number and is especially useful in the Auto mode for reference purposes.

**Note:** The calibration factors are selected according to the detector's radiation field location. Only the displayed factor can be changed.

(4) **Old Factor:** - Previous calibration factor as saved (stored) in the instrument memory.

(5) **Enter Radiation Field:** - Factor can be changed in two modes:

- Insert the measured field. The computer will calculate the new factor dependant on the radiation field and the old factor. The new factor value will be displayed on the **New Factor** box.
- Using the  $\pm$  boxes.

- (6) **New Factor:** - The New Factor will be displayed and is a function of the actual current reading against the Radiation field that was typed into the window. If the calculated factor value is lower than 0.6 or higher than 1.4, calibration will be not performed.
- (7) **Force 1** – Select in case the operator wants to force the calibration factor to 1.00. Use this when an incorrect factor was stored.
- (8) After the factor changing, press Update Factor. Ensure to obtain the status: Factor Accepted.
- (9) **Update Details** - Press Update Details.
- (10) Ensure to obtain Status: Details Accepted.
- (11) **End Calibration** – Click to quit the calibration function and return to the main menu.
- (12) Background sub (currently not in use).

## 9.7. Linearity

To enter the Linearity Report window press File → New Report. The Linearity Report window includes As Found and As Left columns. Before calibration and linearity check, perform the proceeding steps in the following order:

- Check the linearity in As Found column.
- If linearity fail is obtained the instrument is defective and cannot be calibrated (P/F –fail).
- If linearity As Found is ok, calibrate the instrument.
- Check the linearity in As Left column.
- In order to check linearity and perform calibration to other instrument, select File →New report on the pull down menu.

### 9.7.1. Linearity Report Window Description

**Src** - Type of source employed for calibration and linearity. The source type is defined in the set-up parameters.

**Meas.Point** - Radiation field where linearity tests are performed.

**Unit** - Measurement units.

**Distance and Att.** - Distance between detector and source and attenuator factor.

**As Found** - Instrument reading prior to calibration.

**As Left** - Instrument reading after calibration.

**Err%** - Reading deviation % between measuring point (calculated value) and meter reading.

**P/F** - Notifies that linearity checking is correct.

**Serial Number** - Instrument number, may be changed in **Parameters / Instrument**.

**Accepted accuracy** - Permitted deviation in % between the instrument reading and radiation. Defined in the **Parameters / Set up**.

**Sources [Src]** - Source type by which calibration and linearity were performed. Source defined in the set-up parameters.

**Customer Header**- Customer: Enter header (up to 4 lines) for the calibration & linearity certificate.

**Curr. Calibrator** - Present calibrator's name and calibration date.

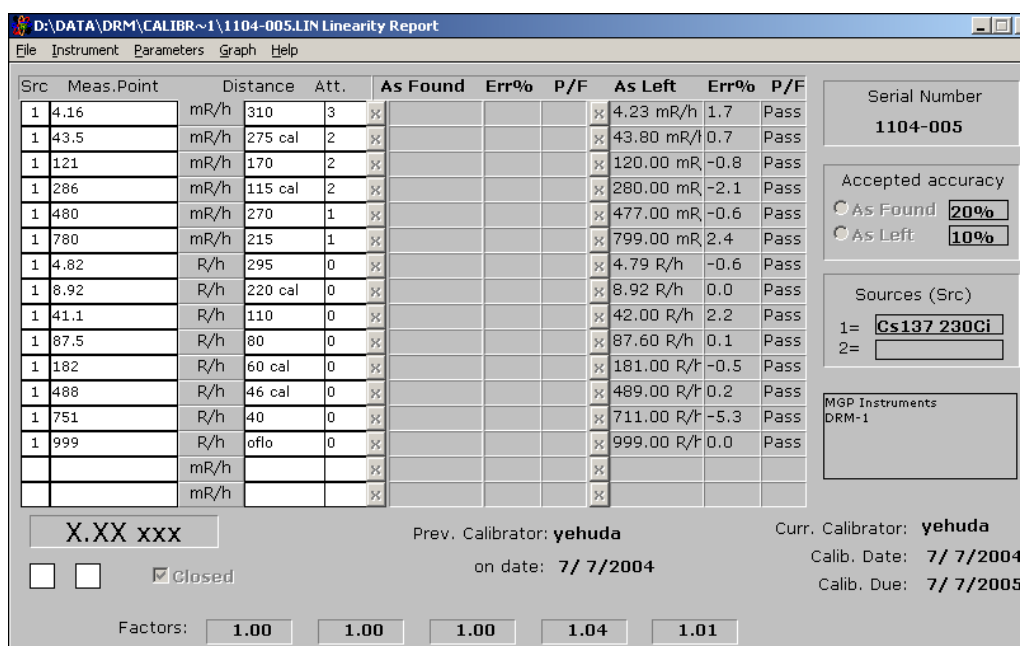
**Prev. Calibrator** - Former calibrator's name and calibration date.

**Factors** - Factors' value.

9.7.2. (1) Checking adequate connection between instrument and computer. If after the fifth time there is no communication, an alarm message is displayed.

9.7.3. (2) 0.00 mR/h - Instrument reading is updated every second.

9.7.4. (3) Closed - After checking the first reading by pressing X on the tested point line, it is recommended to perform **File** → **Save** as. From now on, the file is automatically updated and saved after checking of each tested point. As long as the **Closed** text box is not marked, it is possible to make changes while entering and exiting the file. At the end of the linearity check process, marking 3 in the **Closed** text box will make the file "read only". From now on, when entering the saved file marked 3 **Closed**, it will be impossible to perform any changes in the **Linearity Report** window.



**D:\DATA\DRM\CALIBR~1\1104-005.LIN Linearity Report**

File Instrument Parameters Graph Help

Src	Meas.Point	Distance	Att.	As Found	Err%	P/F	As Left	Err%	P/F
1	4.16	mR/h	310	3			4.23 mR/h	1.7	Pass
1	43.5	mR/h	275 cal	2			43.80 mR/h	0.7	Pass
1	121	mR/h	170	2			120.00 mR	-0.8	Pass
1	286	mR/h	115 cal	2			280.00 mR	-2.1	Pass
1	480	mR/h	270	1			477.00 mR	-0.6	Pass
1	780	mR/h	215	1			799.00 mR	2.4	Pass
1	4.82	R/h	295	0			4.79 R/h	-0.6	Pass
1	8.92	R/h	220 cal	0			8.92 R/h	0.0	Pass
1	41.1	R/h	110	0			42.00 R/h	2.2	Pass
1	87.5	R/h	80	0			87.60 R/h	0.1	Pass
1	182	R/h	60 cal	0			181.00 R/h	-0.5	Pass
1	488	R/h	46 cal	0			489.00 R/h	0.2	Pass
1	751	R/h	40	0			711.00 R/h	-5.3	Pass
1	999	R/h	oflo	0			999.00 R/h	0.0	Pass
		mR/h							
		mR/h							

X.XX xxx

Prev. Calibrator: **yehuda** Curr. Calibrator: **yehuda**

on date: **7/ 7/2004** Calib. Date: **7/ 7/2004**

Calib. Due: **7/ 7/2005**

Factors: **1.00** **1.00** **1.00** **1.04** **1.01**

Serial Number  
**1104-005**

Accepted accuracy  
☐ As Found **200%**  
☐ As Left **100%**

Sources (Src)  
 1= **Cs137 230Ci**  
 2=

MGP Instruments  
DRM-1

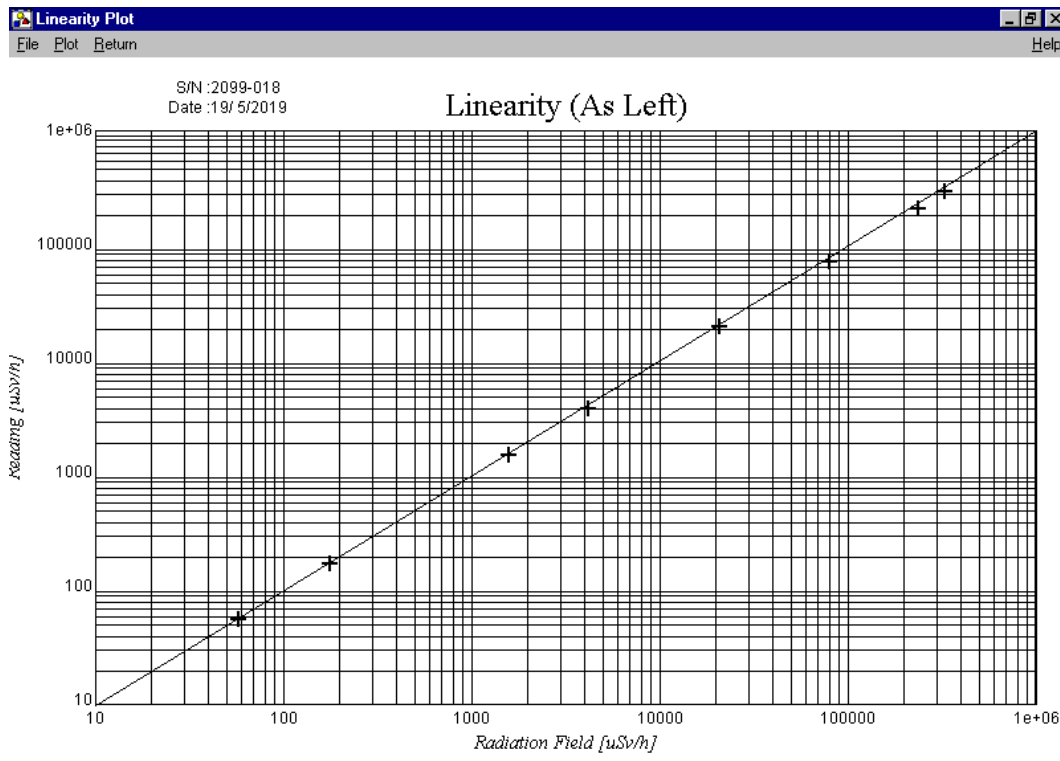
## 9.8. Save, Load and Print Calibration and Linearity Certificate

### 9.8.1. Save and Print Current Calibration and Linearity Certificate

- Click File / Save for saving the Calibration and Linearity Certificate in a file.
- Click File / Print for Calibration and Linearity Certificate printout.
- Click Graph to display Linearity graph.
- Click Plot and select Linearity or Relative Error graph.
- Click File / Print for Linearity graph printout.

### 9.8.2. Load and Print Previous Calibration and Linearity Certificate

- To load a previous Calibration and Linearity Certificate click File/ Open.
- Double click to select the appropriate drive.
- Double click to select the appropriate file.
- Click File / Print for Calibration and Linearity Certificate printout.
- Click Graph to display Linearity graph.
- Click Plot and select Linearity or Relative Error graph.
- Click File / Print for Linearity graph printout.



## 9.9. CPS to mR/h Conversion Tables

### 9.9.1. DRM-1/2 CPS to mR/h Conversion Table

Table 1 - Low Range GM tube		Table 2 - High Range GM tube	
Input Frequency [Hz]	Display [mR/h]	Input Frequency [Hz]	Display [R/h]
17	1.00	300	1.00
170	10.0	3200	10.7
2000	141	10,000	39.2
4000	365	30,000	183
5000	534	40,000	323
6000	730	50,000	525
6300	804*	60,000	839
		75,000	O.F. (overflow)

- Switches to high range detector

**Note:** These results are valid only when all factors equal to 1.

### 9.9.2. DRM-2H

Input Frequency [Hz]	Display [mR/h]	Input Frequency [Hz]	Display [R/h]
17	1.00	77	1.0
170	10.0	770	10.0
2000	141	9612	136
4000	365	47256	1098
5000	534	98712	5748
6000	730	123710	12400
6300	804*	132933	OFLO

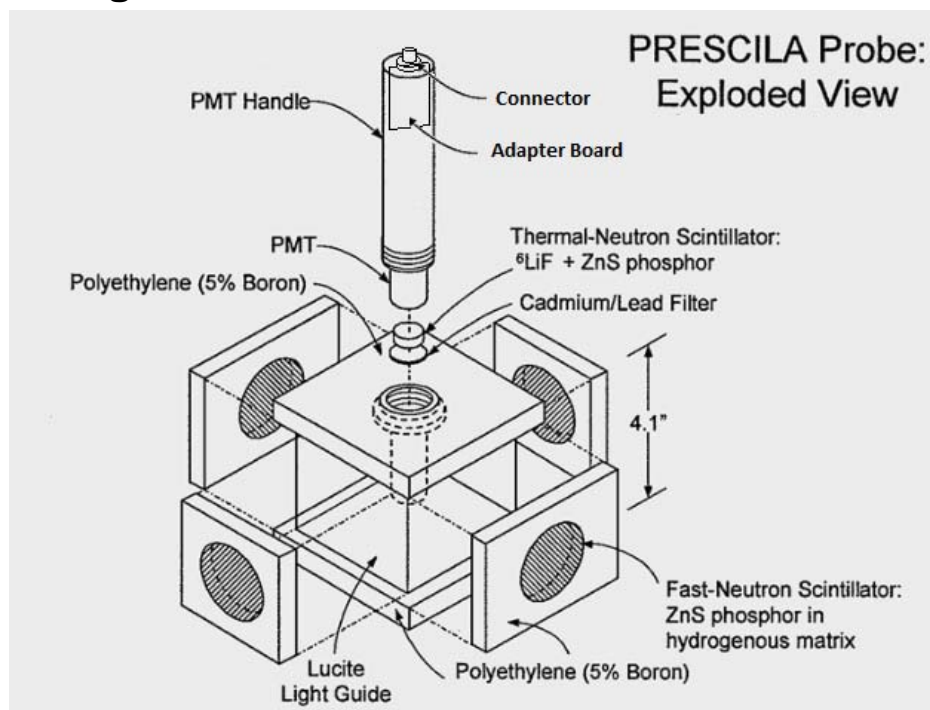
- Switches to high range detector

### 9.9.3. DRM-1D/2D CPS to mR/h Conversion Table

Input Frequency [KHz]	Display [mR/h]
1	0.147
2.8	0.397
4.9	0.795
8.75	1.590
11.9	2.385
14.6	3.180
16.9	3.975
19.1	4.770
21.1	5.565
22.7	6.360
24.4	7.155
25.8	7.950
28.5	9.540
30	OFLO

These results are valid only when F1 is equal to 1.

### 9.10. Calibrating the DRM-2EN



The DRM-2EN with the Prescila neutron detector are supplied with calibration certificates from the manufacturer. The calibration should be checked annually and if necessary should be adjusted according to the following instructions.

**Reference Point: 15 mrem/h**

To calibrate the neutron detector, two adjustments should be performed:

**H.V. Adjustment:** to bring the adapter into the correct range

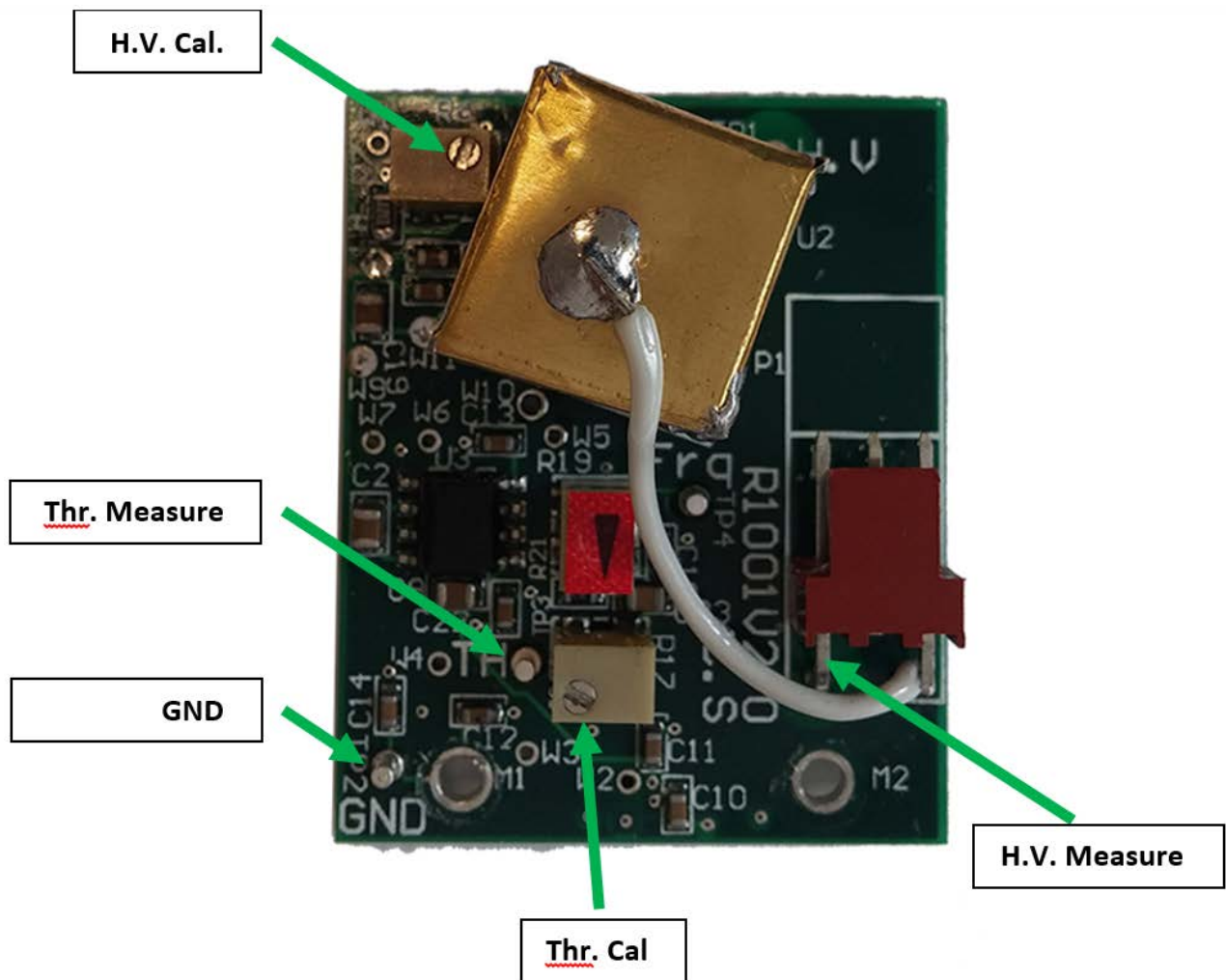
**Threshold Adjustment:** To fine tune the correlation between the displayed dose rate and pulses.

- Place the detector in a neutron dose rate field of 15 mrem/h and check the result on the display. If the result is  $\pm 10\%$  of the expected reading, we suggest verifying the full range for linearity, which should be  $\pm 20\%$  of the expected reading.
- If the reference point reading is outside the range of  $\pm 10\%$  follow calibration procedure described below.

**Calibration Procedure**

- 9.10.1. Place the detector in the reference point (15 mrem/h) and expose the source. If the reading is more than 50% over the expected reading, you need to modify the H.V. setting.
- 9.10.2. If the reading is more than 50% under the expected reading, you need to modify the threshold.
- 9.10.3. The H.V. modification is done by adjusting the H.V. CAL. screw while using a Digital Multimeter with H.V. probe connected to the H.V. measure point and Ground to receive the current H.V. setting.
- 9.10.4. The HV value should be in the range of 500 to 700 volts.
- 9.10.5. The Threshold modification is done by adjusting the THR. Cal screw while using Digital Multimeter with clamp probe connected to the Thr. Measure Point and GND.

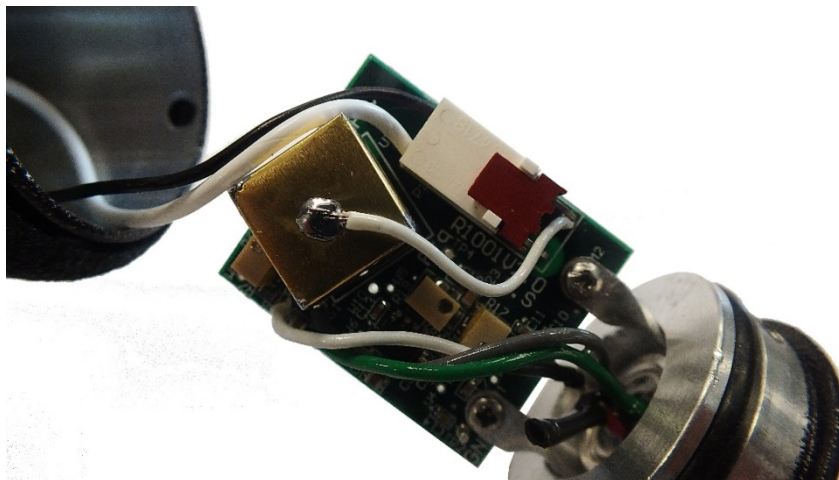




**DRM-2EN Adapter Board**

- 9.10.6. Remove the adapter board from the inside of the neutron detector by peeling back the rubber handle and opening the 4 screws






- 9.10.7. Connect the cable from the DRM-2EN to the connector of the detector
- 9.10.8. Power up the DRM-2EN
- 9.10.9. Caution!!! The detector operating voltage (HV) is supplied to the detector via the detector input connector. A mild shock may be experienced if you make contact with the center pin of the input connector.
- 9.10.10. Connect the H.V. probe to H.V measure point or the Clamp probe to the threshold measure point accordingly to the measured deviation
- 9.10.11. Adjust the required screw (H.V. or Threshold).
- 9.10.12. Replace the cap to test the modification. The cap must be closed so that no light enters the PMT of the detector tube during the irradiating procedure.
- 9.10.13. Step 9.10.12 should be repeated until the accuracy of the reference point is within the range of  $\pm 10\%$ .
- 9.10.14. Once the reference point is set, we recommend that the entire measuring range be checked to be no more than  $\pm 20\%$  over the full range.
- 9.10.15. Gamma rejection should be verified that a 100 mrem/h dose rate field should produce no more than 2 mrem/h reading on the DRM-2EN.

## 10. Upgrading the DRM firmware

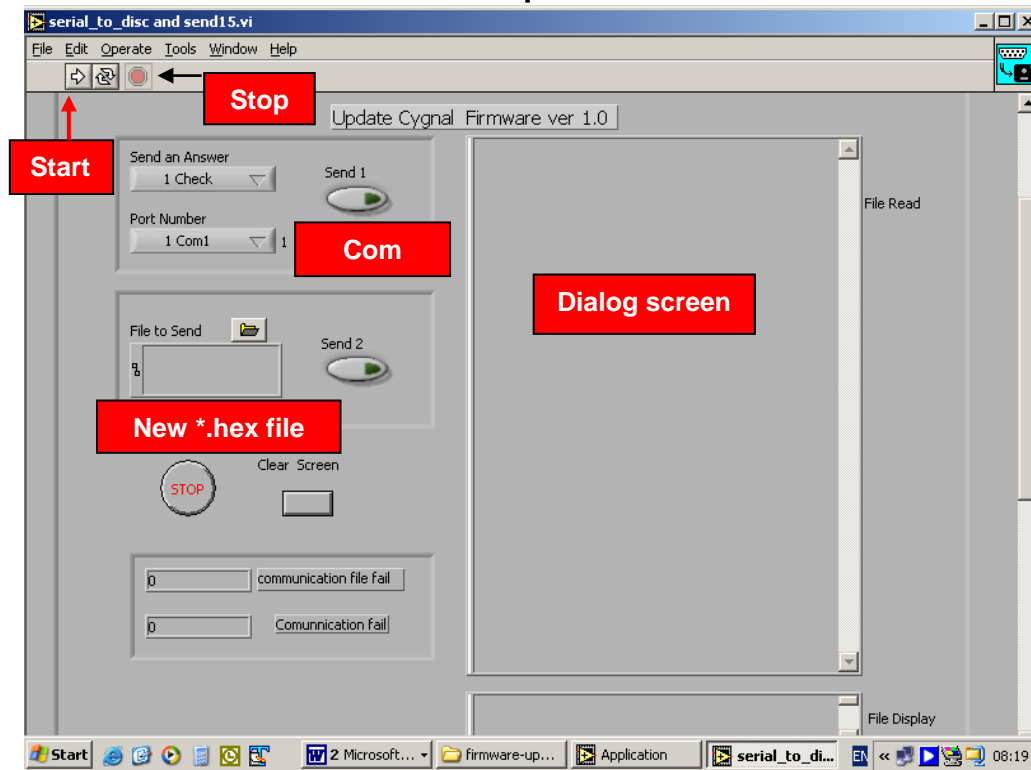
**Note:** Follow these directions carefully (contact MIRION for assistance).

- 10.1. Install the DRM Firmware Updater software by unzipping the files to a known directory and clicking on the “Setup” in the “Installer” directory.

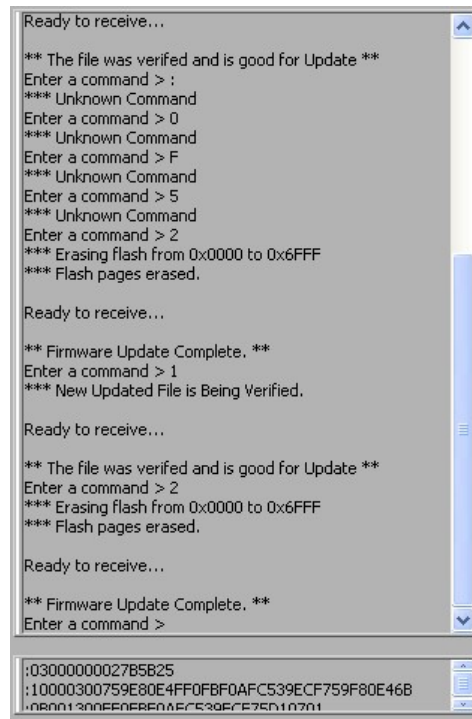
- 10.2. Disconnect the meter from the power supply and ensure that the **battery back-up is also turned OFF**; dip switches 1 and 2 in the OFF position, see figure 2 or 3.
- 10.3. Set dipswitch 1& 2 to on position.
- 10.4. Set dipswitch 3 to 8 to off position.
- 10.5. Open the back meter panel, see figure 2 or 3.
- 10.6. Switch E1 located at mother board card to update position (upward). See Figure2 for the DRM-1 or Figure 3 DRM-1D.
- 10.7. Connect the meter to the PC via the RS-232 cable and NULL modem adapter.
- 10.8. To start the Firmware Updater software double clicking the "Application.exe" icon in the known directory (see next page for screen view). 
- 10.9. Set the PC Communications Port and load the supplied \*.hex file,, i.e. "drm1-4769.hex" located in the known created directory for the software.
- 10.10. Select "send an answer" function 1 (Check).
- 10.11. Click on the Start (white arrow) to initialize the program.
- 10.12. Connect the meter to the power supply information should appear in the File Read screen.
- 10.13. If the menu does not appear, turn (disconnect) the power supply off, click on the stop (red point) icon and go back to item 10.
- 10.14. Click on the "send 1" button.
- 10.15. Check that the right hand window displays "Enter to command > 1 \*\*\*\* **Ready to receive**".
- 10.16. Click on "send 2".
- 10.17. Check that the right hand window displays "**The file was verified and is good for update.**" Enter command.
- 10.18. Select "send an answer" function 2 (Update).
- 10.19. Click on "send 1".
- 10.20. Check that the right hand window displays "Enter to command > 2 \*\*\*\* **Ready to Receive**".
- 10.21. Click on "send 2" wait...

- 10.22. Check that the right hand window displays “**Firmware update complete**” and verify that the information in the window is exactly like figure 1 before removing the AC power.
- 10.23. Disconnect the power supply and remove the serial/null cable.
- 10.24. Switch E1 located on the motherboard card 2143 to inverse "update" position (downward).
- 10.25. Connect the power supply and verify that the meter operates.
- 10.26. Ensure Dip Switches 1, 2, and 3 are in the ON position.

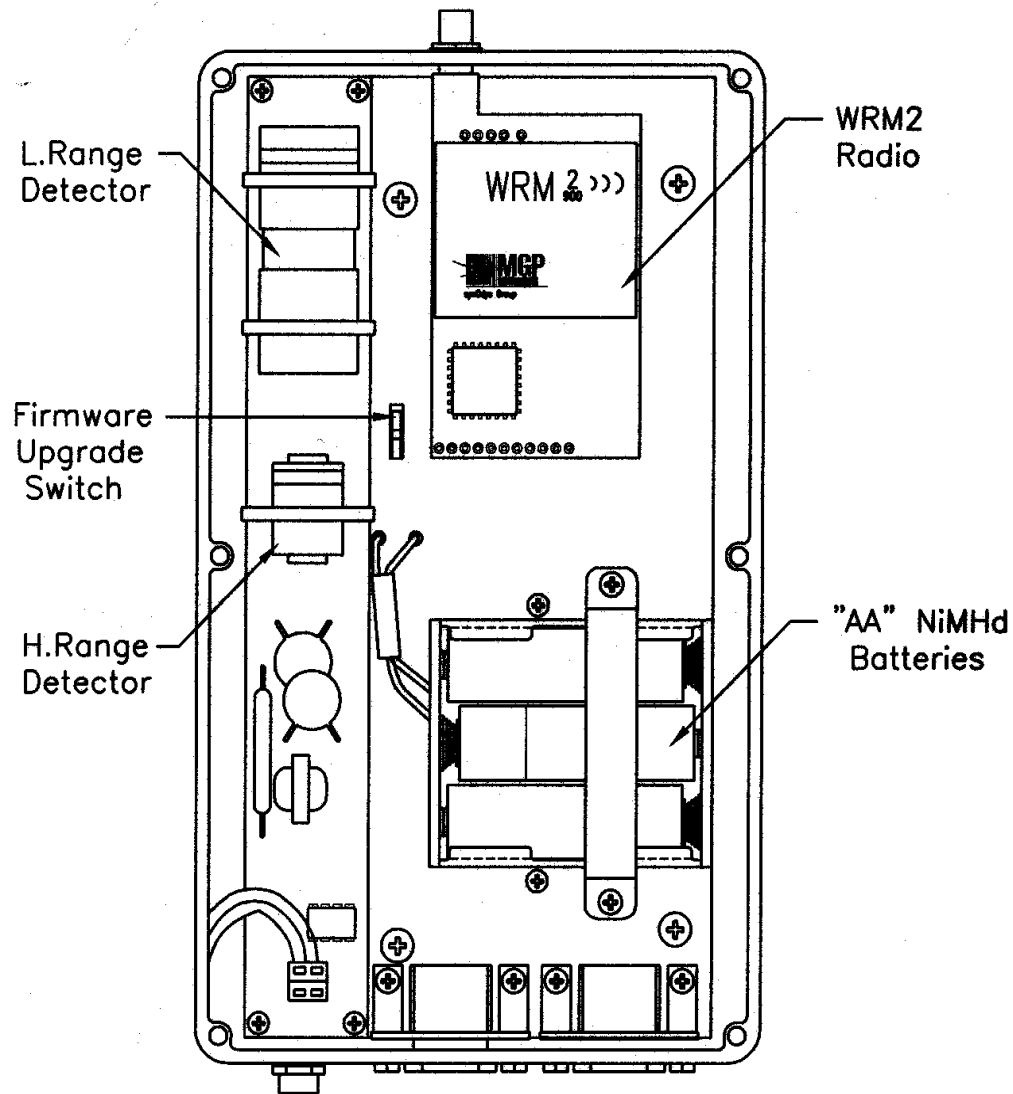
## Firmware Update Screen



## Firmware “Updated” Screen



**Figure 2. DRM-1**



**INSIDE VIEW**

Set communication &  
Battery Switch

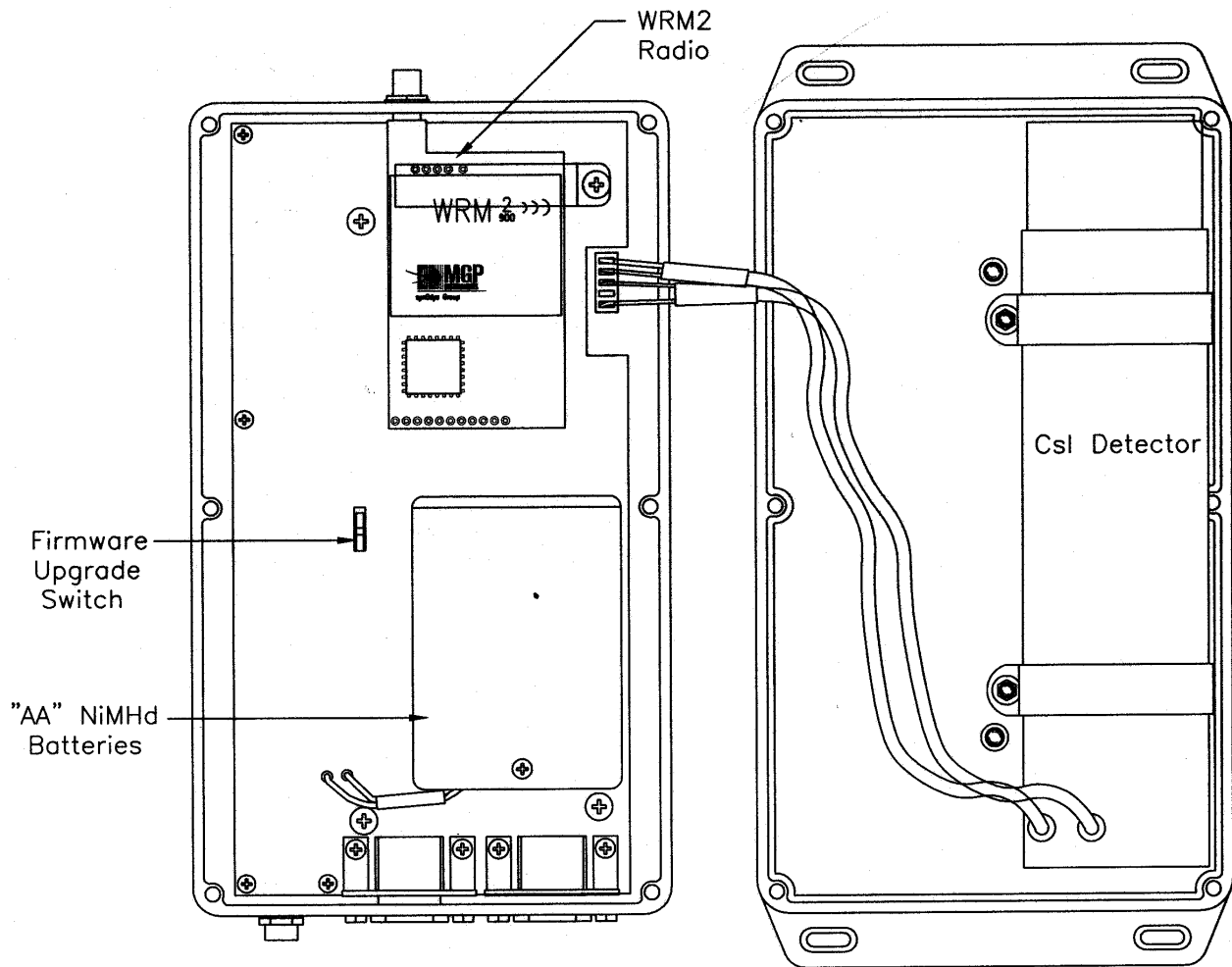
8 7 6 5 4 3 2 1



**Dip Switch On Position**

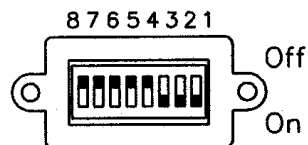
1&2 Meter to PC  
3&4 Meter to Internal Transmitter  
5&6 Internal Transmitter to PC  
7&8 Battery Switch

**Figure 3. DRM-1D**



INSIDE VIEW

Set communication &  
Battery Switch



Dip Switch On Position

1&2 Meter to PC  
3&4 Meter to Internal Transmitter  
5&6 Internal Transmitter to PC  
7&8 Battery Switch

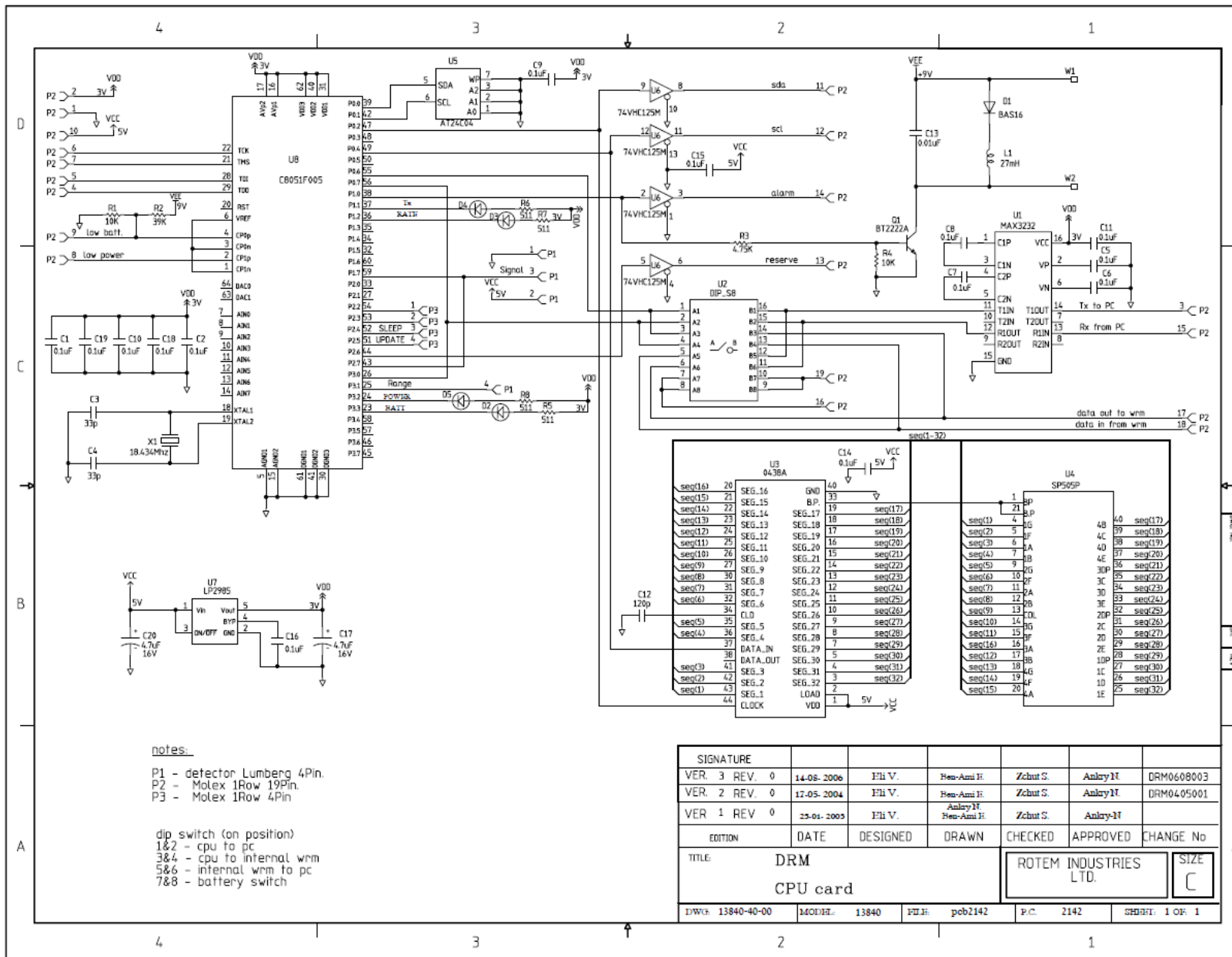
**11.**

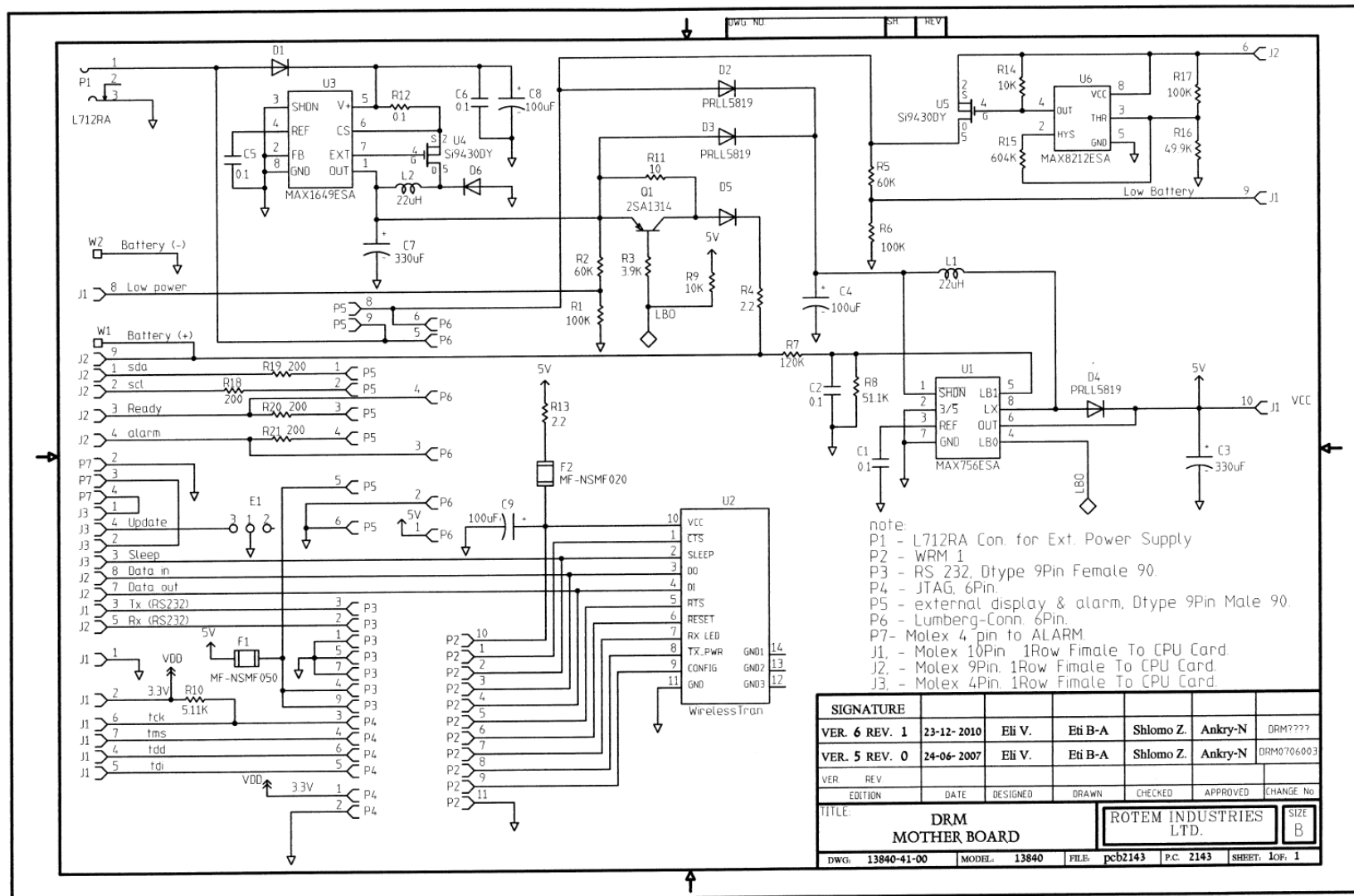
## 11. DRM - List of Electronic Schematics

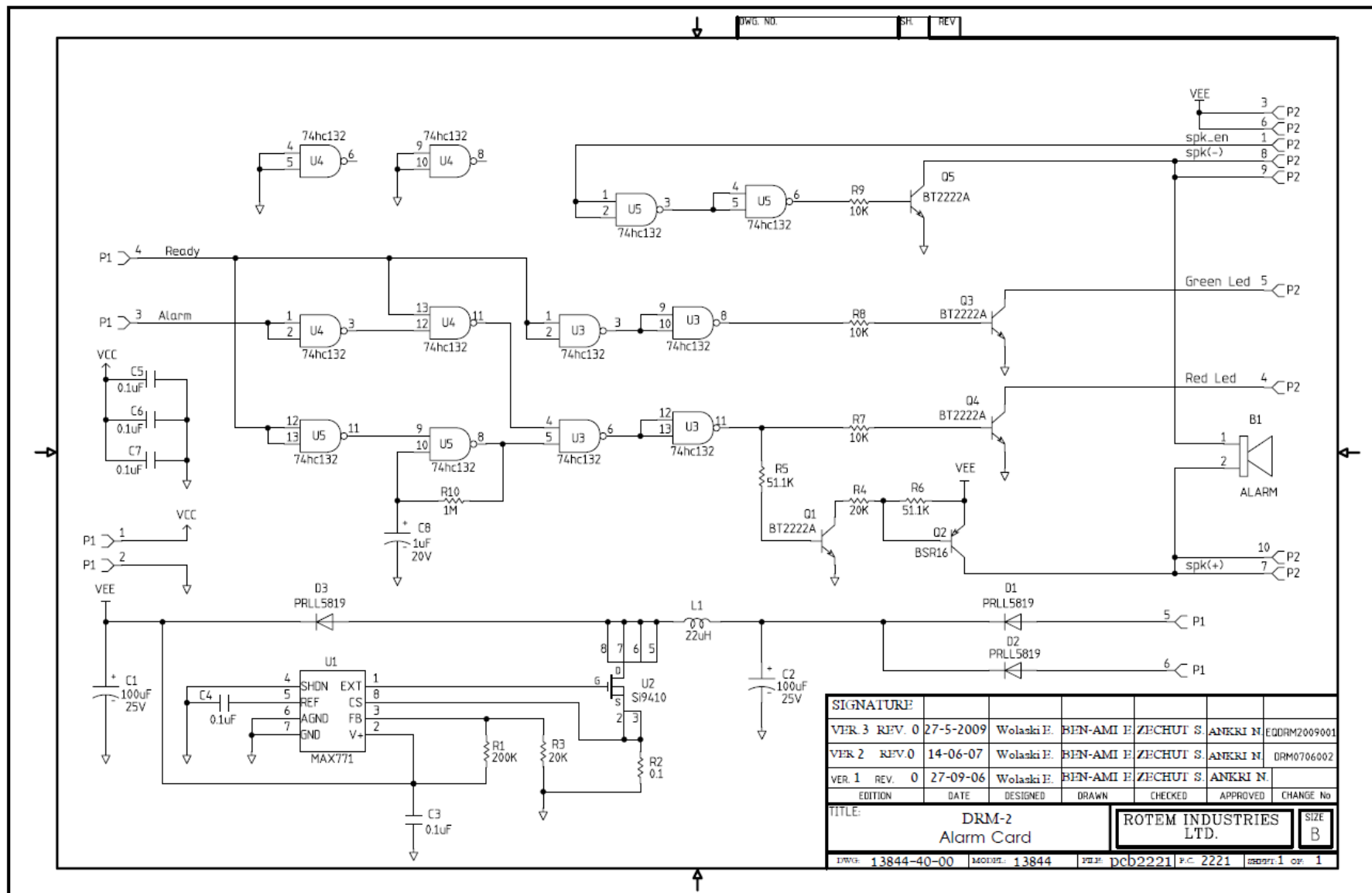
**Note:** The following schematics are for information only and are not subject to revision control.

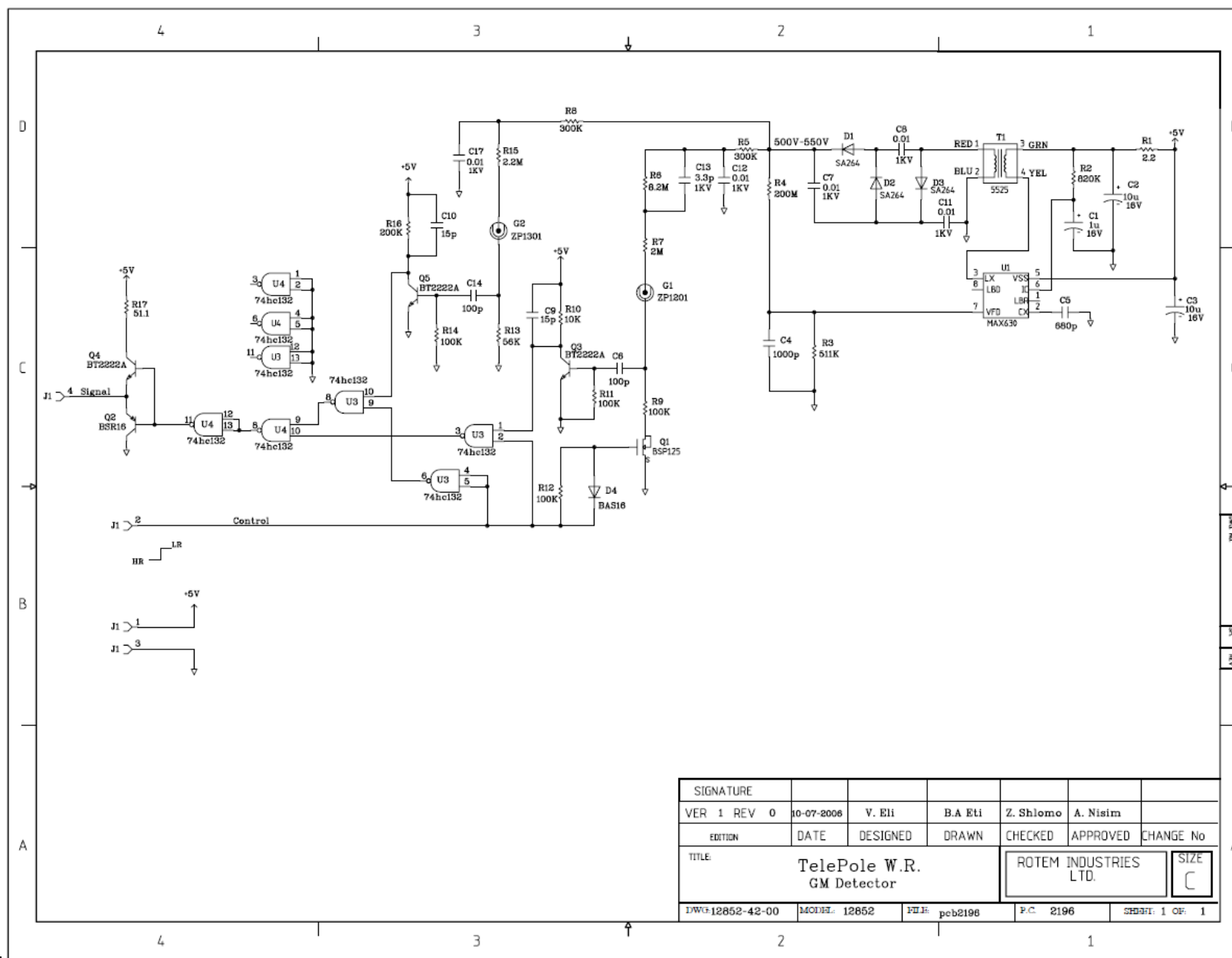
- DRW #13840-40-00 DRM CPU card - PC #2142
- DRW #13840-41-00 DRM MOTHER BOARD PC #2143
- DRW #13844-40-00 DRM-2, Alarm Card, PC #2221
- DRW #12852-42-00 TelePole W.R. GM Detector PC #2196
- DRM-2 Wiring Diagram
- DRM-2E Wiring Diagram

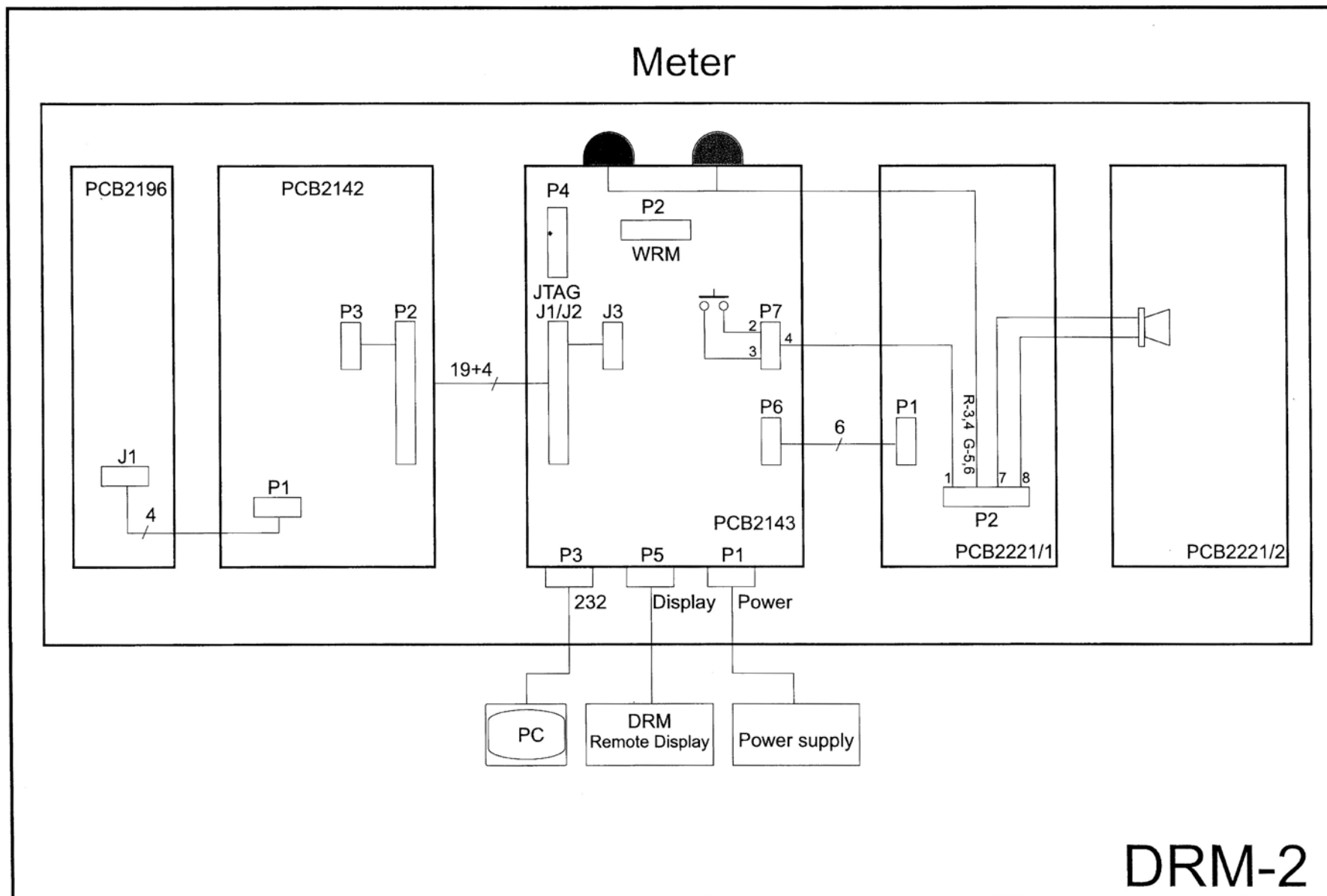


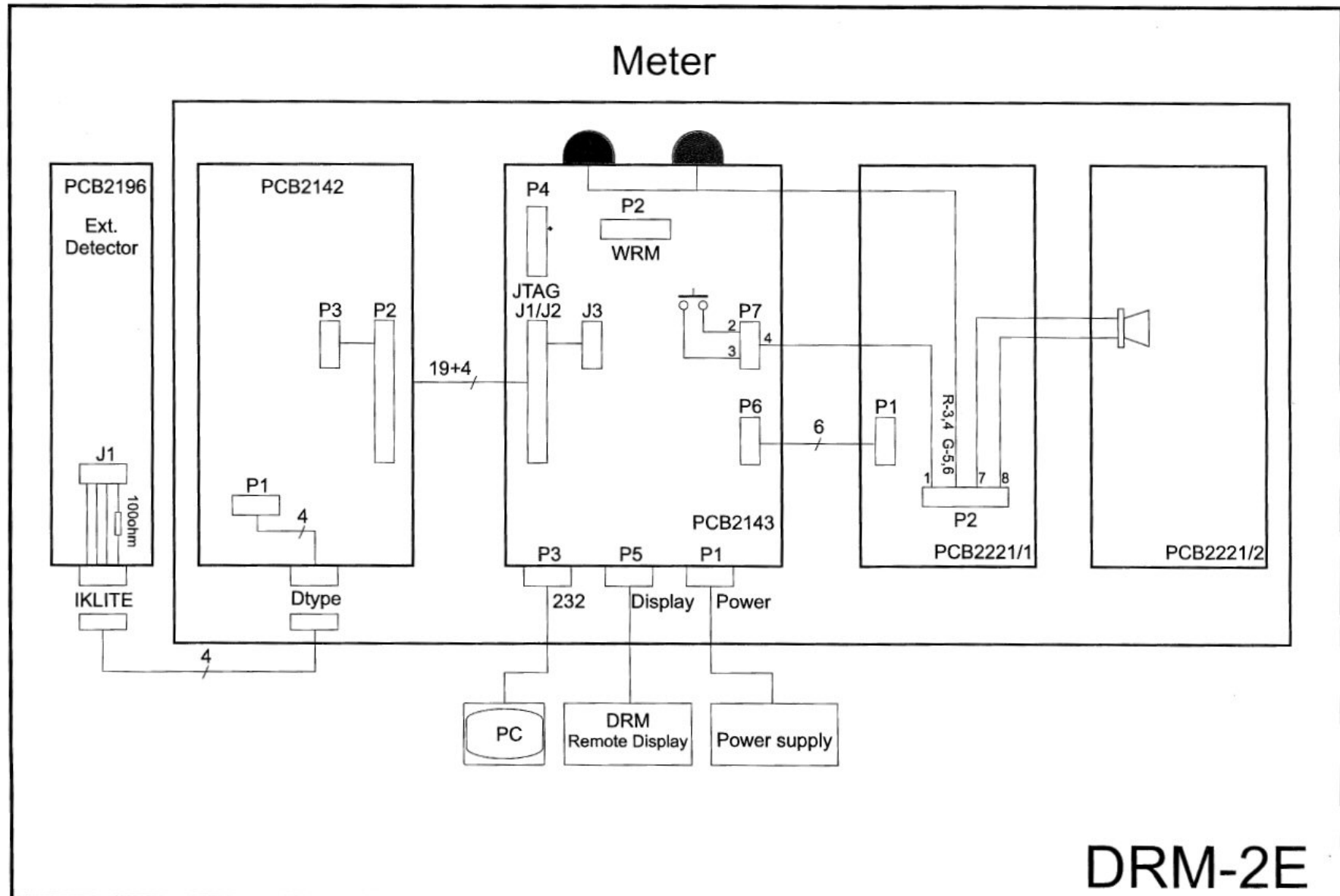






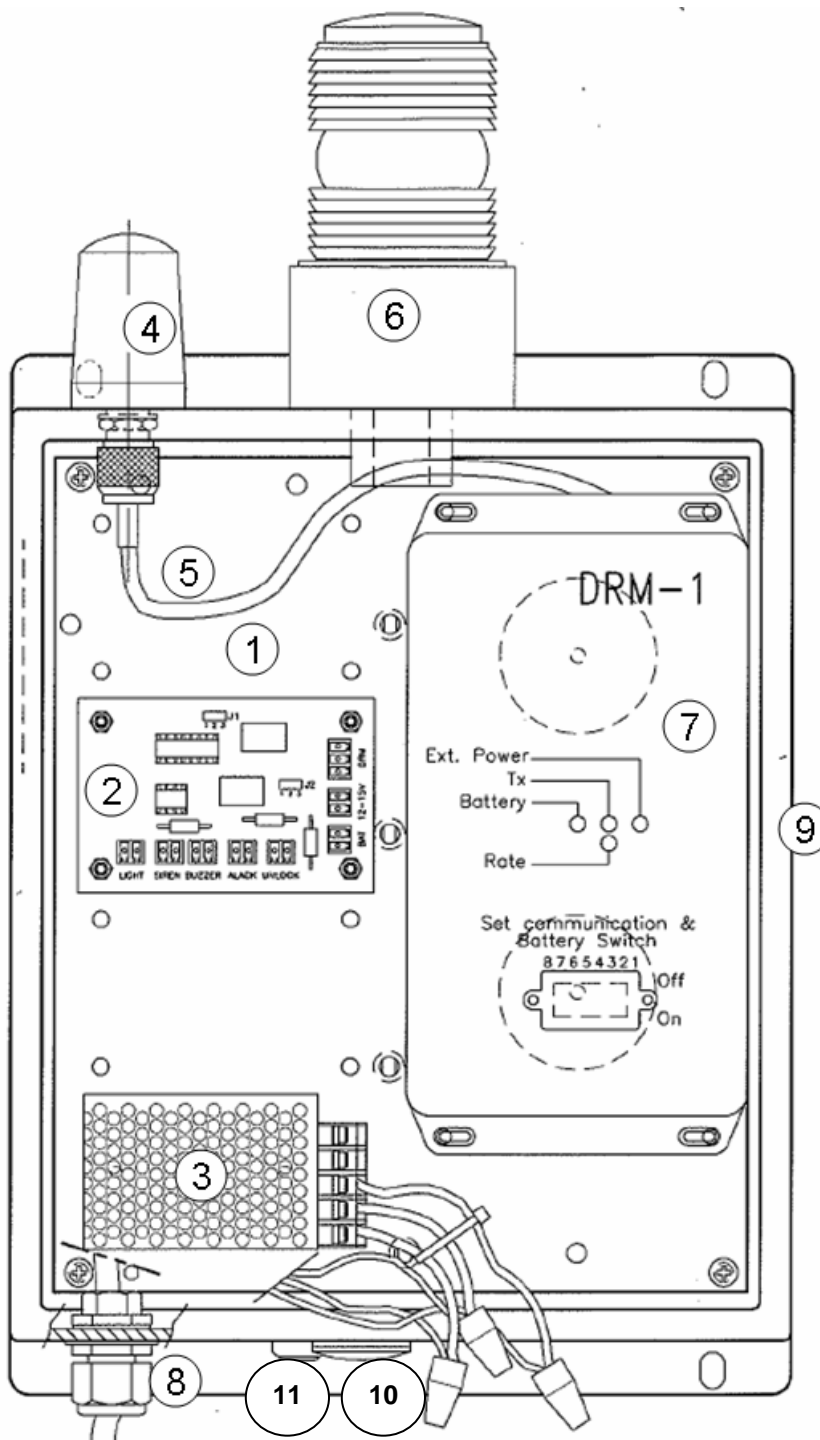






## 12. DRM - Environmental Enclosure Configuration

**Environmental Enclosure Assembly: Figure 13-1**



**Environmental Enclosure Assembly (Figure 14-1)**

- 1 Mounting Plate
- 2 Circuit Board
- 3 Power Supply
- 4 Telemetry Antenna
- 5 Antenna Cable
- 6 Strobe Light
- 7 DRM-1/D Monitor
- 8 Power Cable
- 9 Environmental Enclosure
- 10 Audible Buzzer
- 11 Acknowledge Pushbutton