

# Area Monitor Probes

**AMP-50** - *Low Range GM Probe*  
*0.5  $\mu$ Sv/h to 40,000  $\mu$ Sv/h*  
*0.05 mR/h to 4,000 mR/h*

**AMP-100** - **Medium Range GM Probe**  
*0.05 mSv/h to 10,000 mSv/h*  
*0.005 R/h to 1,000 R/h*

**AMP-200** - *High Range GM Probe*  
*0.01 Sv/h to 100 Sv/h*  
*1.0 R/h to 15,000 R/h*

**AMP-300** - *Very High Range GM Probe*  
*1 mSv/h to 300 Sv/h*  
*0.1 R/h to 30,000 R/h*  
*0.2*

## Operating & Maintenance Manual

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*ROTEM Industries Ltd. reserves the right to change specifications without advance notice*

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# 1. Area Monitor Probes

## 1.1. General Description

The Area Monitor Probe (AMP), a GM-tube based rate meter, is a state-of-the-art microprocessor-based instrument. The AMP is designed for highly stable and accurate measurements of dose rate from gamma radiation.

The AMP instrument is available in three versions:

AMP-50 - 0.5  $\mu\text{Sv/h}$  up to 40,000  $\mu\text{Sv/h}$  (0.05 mR/h to 4000 mR/h).

AMP-100 - 0.05 mSv/h up to 10,000 mSv/h (0.005 R/h to 1000 R/h).

AMP-200 - 0.01 Sv/h up to 150 Sv/h (1.0 R/h to 15,000 R/h).

AMP-300 - 1 mSv/h up to 300 Sv/h (0.1 R/h to 30,000 R/h).

The AMP is a lightweight and compact instrument with a large, four 7-segment LCD display. The sophisticated software offers special features and optimal performance. The wide dynamic range is obtained by automatic dead time correction, according to the preset calibration. A special averaging function smoothes the readout and maintains fast response time, while keeping the standard deviation at a minimum.

An automatic self-diagnostic procedure continuously checks both meter and detector and reports any case of detector failure. The meter also alarms if the reading exceeds the threshold value, or if the probe is in a field higher than the measuring range, or if the battery potential drops below an acceptable value. The threshold can be selected from a list of 11 preset values. When the meter is turned off the last parameters (threshold value, calibration factor, dose status, communication mode, communication baud rate) are retained in memory and will be recalled the next time the instrument is turned on.

The AMP may be used in one of four ways:

- by locally reading the smoothed digital display via the hand held meter display,
- by connecting the meter to a PC,
- by connecting the meter to an AM-16 Area Monitor (wired),
- by connecting the meter to an external WRM transmitter (wireless).

The AMP system contains four components (see Figure 1-1, AMP system block diagram): meter, cable, probe head and communication interface. Connection between the meter and the detector is accomplished via a four-wire shielded cable of up to 100 meters length. An optional WRM transmitter may be connected via a standard four-wire telephone cable. Two types of meter-to-PC cables are available.

The meter includes two boards: HV board and CPU board, including rate-meter and display. A built-in RS-232 connection is used with the area monitor or WRM.

The detector includes an energy-compensated GM tube, an amplifier and driver.

The AMP's connections and probe head feature watertight sealing to allow for use in underwater applications. Quick disconnect detectors allow customization of cable length and facilitate easy de-contamination.

The detectors for the AMP-50, AMP-100 and AMP-200 include an energy compensated GM tube, an amplifier and driver. The detector for the AMP-300 contains silicon diode

The AMP's connections and probe head feature watertight sealing to allow for use in underwater applications. Quick disconnect detectors allow customization of cable length and facilitate easy decontamination.

## 1.2. Applications

- Real-time monitor applications include any area with radiation levels from 0.01  $\mu\text{Sv/h}$  (0.001 mR/h) to up to 300 Sv/h (30,000 R/h). For example, the probe head may be placed *directly onto* a filter housing or against a resin tank for the purpose of providing survey data or resin transfer results.
- Replacement of traditionally “difficult to calibrate” underwater instruments.
- Provides a rugged detector for environments where the use of an electronic dosimeter is undesirable.
- Provides real-time, remote monitoring in geometries developed for extendible “pole” rate meters (TelePole, Teletector, etc.).
- Local readout of hand-held meter allows its use as a portable survey instrument.

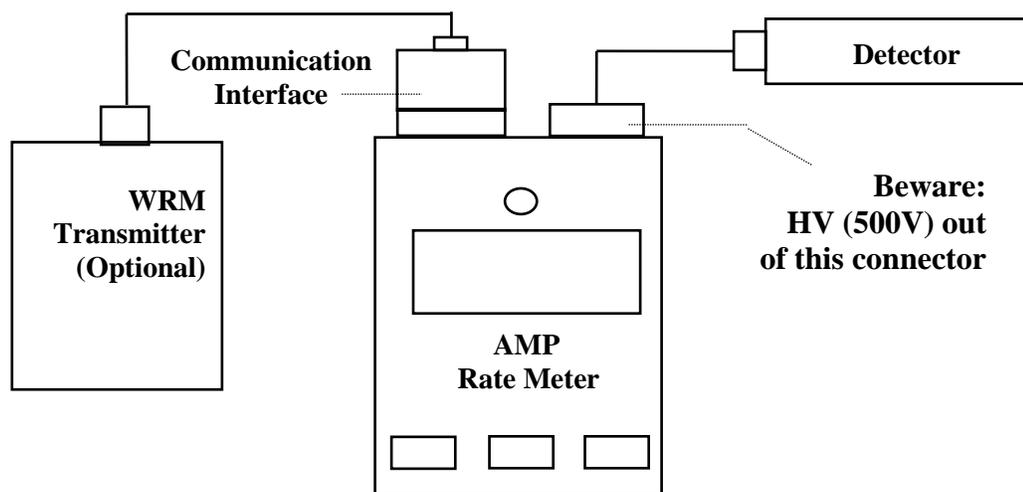


Figure 1-1. The AMP System Block Diagram

## 1.3. AMP Communication

### 1.3.1. AMP to WRM Communication

WRM – MGP Wireless Remote Monitoring System

The AMP's meter may be connected to an external WRM transmitter through an adapter. In this mode, the AMP's meter transmits its reading data using the same format as a dosimeter. Data is displayed on the computer screen, as appropriate for the application (i.e. SMARTS OnLine, TeleView, WinWRM, etc.).

### **1.3.2. AMP to PC Communication**

The AMP's meter may be connected to a PC via an external cable. In this mode, the AMP's meter transmits its reading data using the WRM format. Data is displayed on the computer screen, as appropriate for the application (i.e.AMP-View).

### **1.3.3. AMP Identification Number**

Each AMP has a different identification number (ID#) consisting of six digits. When the first ID# digit is (6), it indicates the monitoring software that the transmitting instrument is of AMP type. The last 3 digits represent the instrument serial number.

## 2. Specifications

<b>Display:</b>	<b>LCD readout showing:</b>	
		<ul style="list-style-type: none"><li>- Four digits for accurate and easy readout</li><li>- Detector failure</li><li>- Low battery</li><li>- Overflow</li><li>- Threshold</li></ul>
	<b>Audio:</b>	Internally mounted piezo-electric element used for "chirp" and alarm functions
<b>Measuring range:</b>	<b>AMP-50</b>	0.5 uSv/h to 40 mSv/h (0.05 mR/h to 4000 mR/h)
	<b>AMP-100</b>	0.05 mSv/h to 10 Sv/h (0.005 R/h to 1000 R/h)
	<b>AMP-200</b>	0.01 Sv/h to 150 Sv/h (1.0 R/h to 15,000 R/h)
	<b>AMP-300</b>	1 mSv/h to 300 Sv/h (0.1 R/h to 30,000 R/h)
<b>Display range :</b>	<b>AMP-50</b>	10 nSv/h to 40 mSv/h (0.001 mR/h to 4000 mR/h)
	<b>AMP-100</b>	10 nSv/h to 10 Sv/h (0.001 R/h to 1000 R/h)
	<b>AMP-200</b>	1 mSv/h to 150 Sv/h (0.1 R/h to 15,000 R/h)
	<b>AMP-300</b>	1 mSv/h to 300 Sv/h (0.1 R/h to 30,000 R/h)
<b>Controls:</b>		<ul style="list-style-type: none"><li>- ON/OFF push-button</li><li>- RESET push-button</li><li>- SPEAKER push-button</li></ul>
<b>Power source:</b>		One 9-volt cell battery or external 9V power supply providing 50 hours minimum continuous operation and automatic battery check under full load
<b>Detector:</b>	<b>AMP-50</b>	Energy compensated GM tube (ZP1201 or equivalent)
	<b>AMP-100</b>	Energy compensated GM tube (ZP1301 or equivalent)
	<b>AMP-200</b>	Energy compensated GM tube (4G60M or equivalent)
	<b>AMP-300</b>	Silicon Diode
<b>Sensitivity (137Cs):</b>	<b>AMP-50</b>	17 cps/mR/h
	<b>AMP-100</b>	300 cps/R/h
	<b>AMP-200</b>	77 cps/R/h
	<b>AMP-300</b>	8.33 cps/R/h
<b>Accuracy:</b>		±10% of reading within the measuring range
<b>Energy range:</b>		70 keV to 2.0 MeV
<b>Energy dependence:</b>		±20% related to 137Cs
<b>Angular dependence:</b>		Less than ±20% for 45° from centerline indicator
<b>Temperature range:</b>		Operation: -10°C to +50°C (15°F to 122°F) Storage: -20°C to +60°C (-5°F to 140°F)
<b>Humidity range:</b>		40% to 95% RH (non condensing)
<b>Casing:</b>	<b>Meter:</b>	Aluminum
	<b>Detector:</b>	Aluminum, waterproof to 20 meters
<b>Dimensions:</b>	<b>Meter:</b>	12 cm x 7.2 cm x 3.4 cm (4.72" x 2.83" x 1.34")

**Detector:**  
**AMP-50** 3.3 cm x 17 cm (1.3" x 6.7") without cable  
**AMP-100/200/300** 2.45 cm x 14.3 cm (0.96" x 5.71") without cable  
**Weight: Meter:** 340 g (0.76 lbs) including battery  
**Detector:**  
**AMP-50** 223 g (0.45 lbs) without cable  
**AMP-100/200/300** 131 g (0.29 lbs) without cable  
**Cable length:** Standard: 9m, 25 feet  
 Maximum: 100m ,350 feet

**Part #**

BAK-0071	AMP-50 ROTEM ( $\mu\text{Sv/h}$ ) (incl. 9m cable) Radiation Detection Meter
BAK-0061	AMP-50 ROTEM (mR/h) (incl. 9m cable) Radiation Detection Meter
BAK-0171	AMP-100 ROTEM (mSv/h) (incl. 9m cable) Radiation Detection Meter
BAK-0161	AMP-100 ROTEM (mR/h) (incl. 9m cable) Radiation Detection Meter
BAK-0281	AMP-200 ROTEM ( $\mu\text{Sv/h}$ ) (incl. 9m cable) Radiation Detection Meter
BAK-0271	AMP-200 ROTEM (mR/h) (incl. 9m cable) Radiation Detection Meter
BAK-4490	AMP-300 ROTEM (R/h) (incl. 25m cable) Radiation Detection Meter
BAK-4460	AMP-300 ROTEM (Sv/h) (incl. 25m cable) Radiation Detection Meter

1.

# Operating Instructions

## 1.1. Preparation for Use

Remove the instrument from the shipping container and check for physical damage. In case of damage, report it immediately to the carrier.

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

## 1.2. Starting-up

Before connecting the detector cable to the detector side, perform the following:

1. Clean the cable connector from any dust, using air blast and alcohol.
2. Spread a thick layer of silicone grease on the o-ring.
3. Connect the cable connector to the detector connector.

Ensure the detector connection to the meter. **CAUTION:** Beware the HIGH VOLTAGE (500 Volts) on the meter's connector (see Figure 1-1).

Press the ON/OFF push-button. When the meter is turned on, it carries out a short self test procedure indicated by displaying all the segments on the display, and emitting a beep for a short period. Following the test, the meter is ready for use.

## 1.3. General Functions

**Readout:** The meter utilizes an auto-ranging display.

AMP-50 [ $\mu$ Sv/h]	AMP-100 [mSv/h]	AMP-200/300 [Sv/h]
0.00 - 9.99	0.00 - 9.99	0.000 - 0.999
10.0 - 99.9	10.0 - 99.9	1.00 - 9.99
100 - 999	100 - 999	10.0 - 99.9
1.00E - 9.99E	1000 - 9999	100 - 150
10.0E - 40.0E		

AMP-50 [mR/h]	AMP-100 [R/h]	AMP-200/-300 [R/h]
0.001 - 0.999	0.001 - 9.999	0.1 - 9.9
1.00 - 9.99	10.00 - 99.99	10.0 - 99.9
10.0 - 99.9	100.0 - 999.9	100 - 999
100 - 999	1000 - 9999	1000 - 9999
1000 - 3999		10.0E - 15.0E (10,000-15,000)

**Reading reset:** To reset the reading press the RESET push-button. The reset function provides a rapid means of discharging the display reading and enables accurate measurement of low level count rate.

**Audible alarm:** In the case of threshold alarm or instrument failure, the audible alarm is activated. To mute the audible alarm, press the SPEAKER push-button.

## 1.4. Turning the Meter on

When turning the meter on the following parameters are displayed:

1. EPROM version: **Epr. → 020- → -305 (020305)**
2. Unit I.D. # **Id. → 123- → -756 (123756)**
3. Dose status **d-0** (without dose function) **d-1** (including dose function)
4. Communication mode **tri** or **Au: 04** or **Au: 10** **Au: 30** **Au: 60**
5. Meter baud rate **300, 4800, 9600**

## 1.5. Dose Status

1.5.1. The user can choose between two operating modes:

- a. Display dose value enable and transmission to WRM connection (d-1)
- b. Display dose value disable and transmission of 888888.8 to the WRM instead of the dose value (d-0).

The dose value is calculated since the meter is turned-on even if the dose display and transmission are disabled

1.5.2. On turning the meter on the accumulated dose equals 0.

1.5.3. To display dose value, press SPEAKER and RESET push-buttons simultaneously. The dose value is displayed and blinks for 10 seconds; afterwards, the meter turns back to display the rate value. . To zero the dose rate value, press the RESET push-button during dose display.

1.5.4. Dose display and transmission enable/disable selection. (See flowchart in section 3.9.)

1.5.5. Dose display range:

<b>AMP-50</b>	0.01 $\mu$ Sv/h to 999E $\mu$ Sv/h
<b>AMP-100</b>	0.01 mSv/h to 999 mSv/h
<b>AMP-200</b>	0.001 Sv/h to 999 Sv/h
<b>AMP-300</b>	0.001 Sv/h to 999 Sv/h

1.5.6. The dose mode **d-0** / **d-1** is stored in the EEPROM's memory. When the meter is turned on, the dose mode is automatically set according to the recent mode used before the meter was turned off.

## 1.6. Threshold Selection

The threshold value can be selected from a list of 11 programmed values values (for AMP-50 – a list of 15 programmed values). The selected value is kept in memory even after the meter is turned off.

The following threshold values may be selected:

<b>AMP-50</b>	0.25, 0.50, 0.75, 1.0, 5.0, 25, 100, 250, 500, 1.00E, 2.50E, 5.00E, 7.50E, 39.9E [ $\mu$ Sv/h] 0.025, 0.050, 0.075, 0.1, 0.5, 2.5, 10, 25, 50, 100, 250, 500, 750, 3999 [mR/h]
<b>AMP-100</b>	0.5, 2.0, 50, 100, 250, 500, 1000, 2500, 5000, 7500, 9999 [mSv/h] 0.05, 0.2, 5, 10, 25, 50, 100, 250, 500, 750, 999.9 [R/h]
<b>AMP-200</b>	0.050, 0.100, 0.250, 0.500, 1.00, 2.50, 5.00, 10.0, 50.0, 100, 150 [Sv/h] 5, 10, 25, 50, 100, 250, 500, 1000, 5000, 10000, 15000 [R/h]

**AMP-300** 0.050, 01.00, 0.250, 0.500, 1.00, 2.50, 5.00, 10.0, 50.0, 100, 150 [Sv/h]  
5, 10, 25, 50, 100, 250, 500, 1000, 5000, 10000, 15000 [R/h]

To choose the required threshold value, proceed with the following steps:

- 1.6.1. Enter threshold mode by pressing the MODE push-button for two seconds. The reading will be zero, after which the **thr.** LCDs will be displayed to indicate that threshold setting mode is activated.



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- 1.6.2. Pressing the SPEAKER push-button displays the existing threshold value.
- 1.6.3. Each additional press on the SPEAKER push-button advances the display to the next threshold value, according to the order described in section 3.6.
- 1.6.4. To exit set threshold mode and to save the new threshold value, press the MODE push-button for two seconds. Saving will be verified by blinking of the new threshold value.
- 1.6.5. To exit the set threshold mode without saving new value (cancel threshold change), press RESET push-button for a very short period (less than two seconds). Saving will be verified by blinking of the “old” threshold value

## 1.7. Alarms

- a. **Detector alarm:*** If the detector is defective or disconnected, the **Err.** LCDs will blink on the display and interrupted audible alarm will be activated. To mute the audible alarm, press the SPEAKER push-button.



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If the detector is defective the alarm will be activated as follows:

- AMP-50** - after 2 minutes
- AMP-100** - after 15 minutes
- AMP-200** - after 120 minutes
- AMP-300** - after 120 minutes

If the detector is disconnected for at least one second, the error and audio alarms are activated. If the error condition (detector disconnection) lasts more than one minute, the meter is turned off automatically.

- b. **Battery alarm:*** If battery voltage decreases below 6.2 Volts, the **bAt.** LCDs blink on the display and an interrupted audible alarm is activated.



To display the measured readings and mute the audible alarm, press the SPEAKER push-button. After the

SPEAKER push-button is pressed, the **bAt.** LCDs will reappear every five minutes for two seconds, and every 30 minutes accompanied by an audible beep to remind users of the low battery condition.

- b. Overflow alarm:** If the displayed count rate is higher than the meter's measuring range:

AMP-50	40,000 $\mu$ Sv/h	4000 mR/h,
AMP-100	10,000 mSv/h	1000 R/h,
AMP-200	150 Sv/h	15000 R/h,
AMP-300	300 Sv/h	30000 R/h



the **OFLO** LCDs blink on the display and an interrupted audible alarm is activated. To mute the audible alarm, press the SPEAKER push-button.

- d. Threshold alarm:** If the reading exceeds threshold value, **ALr.** LCDs and the reading are displayed alternately, accompanied by an audible beep.



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Pressing the SPEAKER push-button mutes the audible alarm, but the **ALr.** LCDs and the reading are continuing to be displayed alternately, until the reading decreases to 75% of the threshold value. If the reading exceeds threshold value and then quickly decreases to below 75% of threshold value, the **ALr.** LCDs and the beep are automatically cancelled, even though the SPEAKER push-button has not been pressed.

## 1.8. Push-button Functions

**Note:**

For operating RESET perform a short press on RESET / MODE push-button.

For operating MODE perform a long press on RESET / MODE push-button.

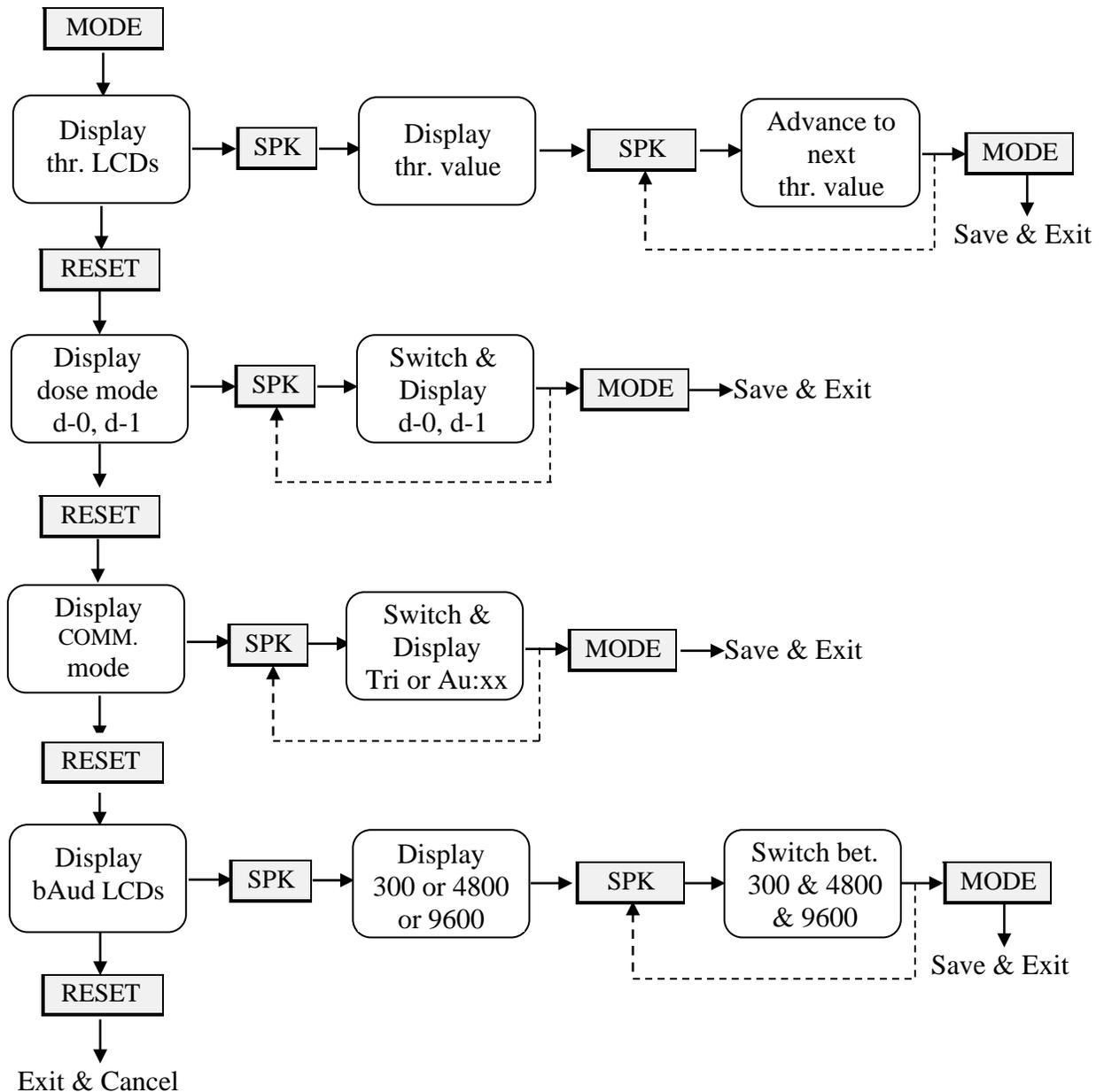
Function	Push-button
Meter on/off	ON / OFF
Instantaneous reading reset	RESET
Mutes audible alarm	SPEAKER
Dose display	RESET + SPEAKER
In / out setting meter's parameters	MODE
In / out setting meter's ID #	Long SPEAKER (5 sec.)
Displays and enables calibration factors setting	RESET + SPEAKER (within calibration mode)

## 1.9. Meter's Parameters Setting Flowchart

### Reading:

RESET ⇒ Short press (less than 2 seconds) on RESET / MODE push-button.

MODE ⇒ Long press (more than 3 seconds) on RESET / MODE push-button.



## 1.10. Battery Replacement

The battery compartment is located at the instrument back. To replace the battery, slide out the battery compartment cover carefully. Use one 9-Volt alkaline battery; be sure to connect it with the right polarity.

### External Power Supply

The AMP is equipped with an external DC input, may be operated either with a 9V battery or an external 9V DC power supply. The battery can be used in conjunction with the external power supply. In case of external power failure the battery supplies the current. The DC voltage should be 10 to 12 Volts, to avoid drain current from the battery. *The internal battery remains connected to function as a back-up power supply.*

## 2. Communications

The AMP communication is available in two methods:

1. Meter to AM-16 Area Monitor (wired) or to WRM external transmitter (wireless).
2. Direct download from Meter to PC.

### 2.1. Meter to AM-16 Area Monitor (wired) or to WRM

To download data from the AMP's meter to the Smarts Online or Televue system, connect the meter to the AM-16 or the WRM transmitter via the WRM adapter and telephone cable.

Each time the AMP's meter receives a trigger from the AM-16 Area Monitor (wired) or the WRM, the meter transmits a data record to the Smart Online system.

### 2.2. Direct Download from Meter to PC

Two modes can be selected using the meter's push-buttons:

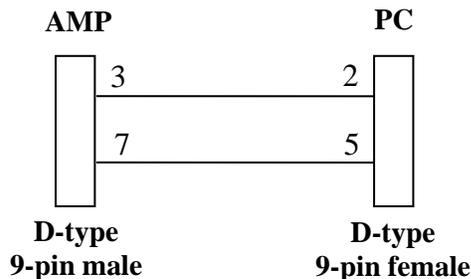
**Tri mode (trigger)** – The meter transmits a data record each time it receives a trigger from the customized cable.

**Auto mode (Automatic)** - The meter transmits a data record at fixed preset time interval which can be selected by the user as follows: 4, 10, 30, 60 [sec.].

### 2.3. Hardware Components

The WRM adapter (D-type to telephone) and telephone cable are designated to connect the AMP's meter to the AM-16 Area Monitor (wired) or to the WRM transmitter.

The following cable is designated to connect the AMP's meter to the PC while working in automatic mode.



## 2.4. Communication Protocol

Byte	Description	
1	LF	Meter ID serial number
2	N5	
3	N4	
4	N3	
5	N2	
6	N1	
7	N0	
8	Status1 msb	OK = 30H, det. fail = 38H, over thr. = 32H
9	Status1 lsb	
10	D5	Dose [ $\mu$ Sv]
11	D4	
12	D3	
13	D2	
14	D1	
15	D0	
16	D-1	
17	30H	
18	X	Rate = X.YZW x 10 <sup>T</sup> [ $\mu$ Sv/h]
19	Y	
20	Z	
21	T	
22	W	
23	Status 3 lsb	
24	CS msb	
25	CS lsb	
26	CR	

Byte format: 8 bit, 1stop bit, no parity.

### 3. Calibration

#### 3.1. Switching the AMP's Meter into Calibration Mode

- Open the AMP battery compartment cover and turn the internal dip-switch 4 (the right dip-switch, see Figure 5-1) to the ON (calibration) position. The dip-switch position is specified by a **Cal.** label inside the battery compartment.
  - The Cal. LCDs are displayed.
- To display the current calibration factors press the RESET push-button. The display will start flashing between the reading and the factors.

→ F1 → 1.07F → F2 → 0.99F → F3 → 0.96F → 0.01 →  
↑ \_\_\_\_\_ ↓

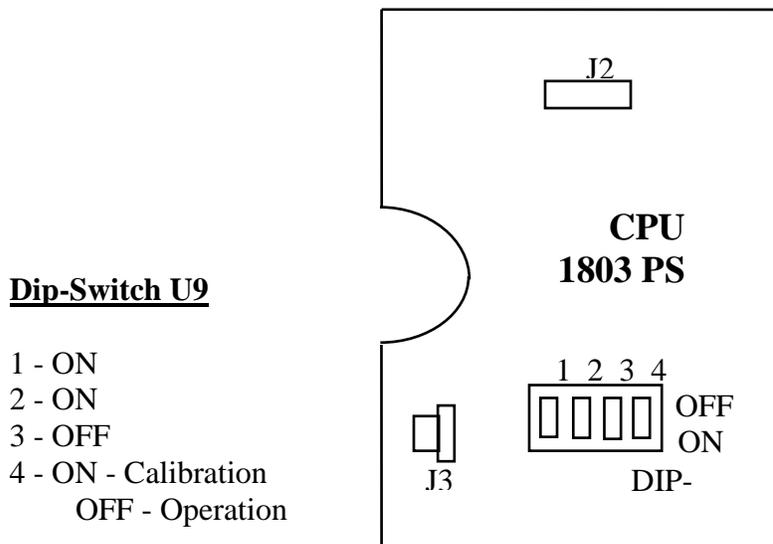


Figure 5-1. CPU Card

### 3.2. Calibration for AMP-50

To improve linearity, the AMP-50 includes three calibration factors. The calibration factors are displayed in the **CAL.** mode by pressing the RESET push-button.

**F1**, the first calibration factor, is used to compensate the Geiger sensitivity tolerance.

**F2**, the second calibration factor and

**F3**, the third calibration factor, are used as the dead time correction factors.

Calibration of AMP-50 requires checking of each of the three factors. In addition, as factors are checked, one or more may need to be adjusted.

**F1** should be checked / adjusted at 100 μSv/h ±20 μSv/h

**F2** should be checked / adjusted at 6,000 μSv/h ±1,200 μSv/h

**F3** should be checked / adjusted at 20,000 μSv/h ±4,000 μSv/h

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

**Up to 10,000 μSv/h:**  $N(\mu\text{Sv/h}) = [n * F1 + \text{dead time correction } \{n * F2\}] / 17$

**Over 12,000 μSv/h:**  $N(\mu\text{Sv/h}) = [n * F1 + \text{dead time correction } \{n * F3\}] / 17$

Where:

**n** is the detector frequency obtained in the radiation field

**N** is the updated measurement reading

Between 10,000 μSv/h to 12,000 μSv/h, a weighed average of F2 and F3 is used as the dead time correction factor. The calculation of the “averaged factor” and the corresponding measurement formula follow:

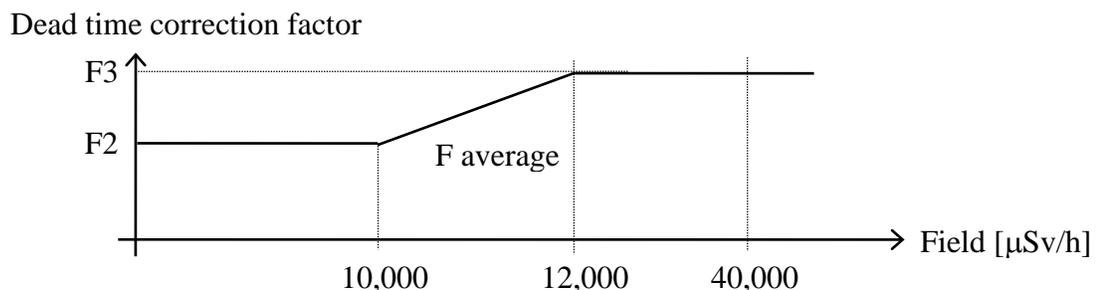
$x = (\text{last } N(\mu\text{Sv/h}) - 10,000) / 2,000$

**Last N** = previous measurement reading

**F average** =  $(1-x) * F2 + x * F3$

$N(\mu\text{Sv/h}) = [n * F1 + \text{dead time correction } \{n * F \text{ average}\}] / 17$

The following graph illustrates the ranges over which F2, F3 and F average are used as the AMP-50's dead time correction factor:



### 3.3. Calibration Procedure for AMP-50

3.3.1. To set the factors, press the SPEAKER and RESET push-buttons simultaneously.

In a field higher than 10  $\mu\text{Sv/h}$ , the meter automatically enables only the display and setting of the appropriate factor, depending on the field intensity.

**F1** if the probe head is in a field higher than 10  $\mu\text{Sv/h}$  and lower than 500  $\mu\text{Sv/h}$ .

**F2** if the probe head is in a field higher than 500  $\mu\text{Sv/h}$  and lower than 11,000  $\mu\text{Sv/h}$ .

**F3** if the probe head is in a field higher than 11,000  $\mu\text{Sv/h}$ .

Expose the detector to a radiation field of 100  $\mu\text{Sv/h} \pm 20 \mu\text{Sv/h}$ .

Press the RESET + SPEAKER push-buttons simultaneously.

The display will show:

→ F1 → F (factor) →  $\mu\text{Sv/h}$  (reading) →  
↑ \_\_\_\_\_ ↓

Change the factor by pressing the RESET or SPEAKER push-button to obtain the desired reading.

3.3.2. Expose the detector to a radiation field of 6,000  $\mu\text{Sv/h} \pm 1,200 \mu\text{Sv/h}$ .

The display will show:

→ F2 → F (factor) →  $\mu\text{Sv/h}$  (reading) →  
↑ \_\_\_\_\_ ↓

Change the factor by pressing the RESET or SPEAKER push-button to obtain the desired reading.

3.3.3. Expose the detector to a radiation field of 20,000  $\mu\text{Sv/h} \pm 4,000 \mu\text{Sv/h}$ .

The display will show:

→ F3 → F (factor) →  $\mu\text{Sv/h}$  (reading) →  
↑ \_\_\_\_\_ ↓

Change the factor by pressing the RESET or SPEAKER push-button to obtain the desired reading.

3.3.4. When the required reading (factor) is obtained, turn the internal switch back to the measuring position and the meter will enter the measuring mode. The calibration factors values are between 0.60 to 1.40 and are stored in the EEPROM.

### 3.4. Calibration for AMP-100

To improve linearity, the AMP-100 includes three calibration factors.

The calibration factors are displayed in the **CAL.** mode by pressing the RESET push-button.

**F1**, the first calibration factor, is used to compensate the Geiger sensitivity tolerance.

**F2**, the second calibration factor and

**F3**, the third calibration factor, are used as the dead time correction factors.

Calibration of the AMP-100 requires the checking of each of the three factors. In addition, as the factors are checked, one or more may need to be adjusted.

**F1** should be checked / adjusted at 100 mSv/h  $\pm$ 20 mSv/h

**F2** should be checked / adjusted at 2,000 mSv/h  $\pm$ 600 mSv/h

**F3** should be checked / adjusted at 6,000 mSv/h  $\pm$ 1000 mSv/h

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

$$\text{Up to 3,000 mSv/h: } N(\text{mSv/h}) = [n * F1 + \text{dead time correction } \{n * F2\}] / 300$$

$$\text{Over 4,000 mSv/h: } N(\text{mSv/h}) = [n * F1 + \text{dead time correction } \{n * F3\}] / 300$$

Where:

**n** is the detector frequency obtained in the radiation field

**N** is the updated measurement reading

Between 3,000 mSv/h to 4000 mSv/h, a weighed average of F2 and F3 is used as the dead time correction factor. The calculation of the “averaged factor” and the corresponding measurement formula follow:

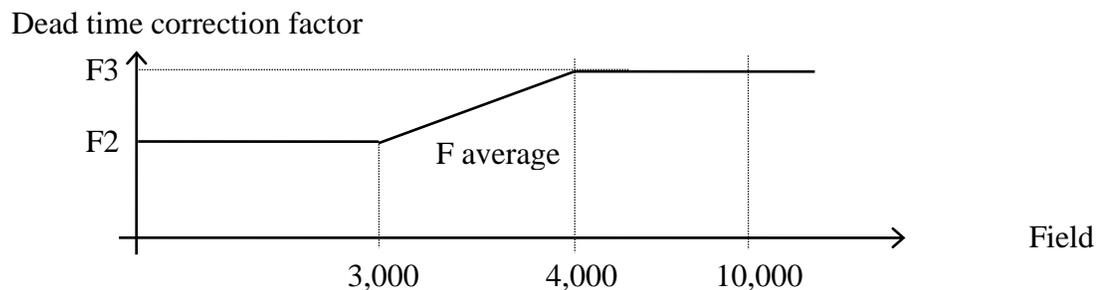
$$x = (\text{last } N(\text{mSv/h}) - 3000) / 1000$$

**Last N** = previous measurement reading

$$\text{F average} = (1-x) * F2 + x * F3$$

$$N(\text{mSv/h}) = [n * F1 + \text{dead time correction } \{n * \text{F average}\}] / 300$$

The following graph illustrates the ranges over which F2, F3 and F average are used as the AMP-100's dead time correction factor:



### 3.5. Calibration Procedure for AMP-100

- 3.5.1. To set the factors, press the SPEAKER and RESET push-buttons simultaneously.  
In a field higher than 0.1 mSv/h, the meter automatically enables only the display and setting of the appropriate factor, depending on the field intensity.  
**F1** if the probe head is in a field higher than 0.1 mSv/h and lower than 500 mSv/h.  
**F2** if the probe head is in a field higher than 500 mSv/h and lower than 3500 mSv/h.  
**F3** if the probe head is in a field higher than 3500 mSv/h.
- 3.5.2. Expose the detector to a radiation field field of 100 mSv/h  $\pm$ 20 mSv/h.  
Press the RESET + SPEAKER push-buttons simultaneously.  
The display will show:  
→ F1 → F (factor) → mSv/h (reading) →  
↑ \_\_\_\_\_ ↓  
Change the factor by pressing the RESET or SPEAKER push-button to obtain the desired reading
- 3.5.3. Expose the detector to a radiation field of 2000 mSv/h  $\pm$ 600 mSv/h.  
The display will show:  
→ F2 → F (factor) → mSv/h (reading) →  
↑ \_\_\_\_\_ ↓  
Change the factor by pressing the RESET or SPEAKER push-button to obtain the desired reading.
- 3.5.4. Expose the detector to a radiation field of 6000 mSv/h  $\pm$ 1000 mSv/h.  
The display will show:  
→ F3 → F (factor) → mSv/h (reading) →  
↑ \_\_\_\_\_ ↓  
Change the factor by pressing the RESET or SPEAKER push-button to obtain the desired reading.
- 3.5.5. When the required reading (factor) is obtained, turn the internal switch back to the measuring position and the meter will enter the measuring mode. The calibration factors values are between 0.60 to 1.40 and are stored in the EEPROM.

### 3.6. Calibration for AMP-200/300

To improve linearity, the AMP-200 includes three calibration factors.

The calibration factors are displayed in the **CAL.** mode by pressing the RESET push-button.

**F1** -the first calibration factor is used to compensate the Geiger sensitivity tolerance.

**F2** - the second calibration factor and

**F3** - the third calibration factor, are used as the dead time correction factors.

Calibration of the AMP-200 requires the checking of each of the three factors. In addition, as the factors are checked, one or more may need to be adjusted.

**F1** should be checked / adjusted at 0.2 Sv/h /h  $\pm 0.05$  Sv/h

**F2** should be checked / adjusted at 10 Sv/h  $\pm 2$  Sv/h

**F3** should be checked / adjusted at 80 Sv/h  $\pm 10$  Sv/h

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

**Up to 35 Sv/h:**  $N(\text{Sv/h}) = [n * F1 + \text{dead time correction } \{n * F2\}] / 77$

**Over 55 Sv/h:**  $N(\text{Sv/h}) = [n * F1 + \text{dead time correction } \{n * F3\}] / 77$

Where:

**n** is the detector frequency obtained in the radiation field

**N** is the updated measurement reading

Between 35 Sv/h to 55 Sv/h, a weighted average of F2 and F3 is used as the dead time correction factor. The calculation of the “averaged factor” and the corresponding measurement formula follow:

$$x = (\text{last } N - 35) / 20$$

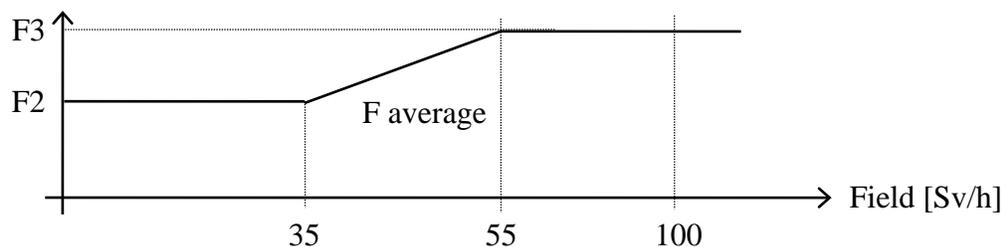
**Last N** = previous measurement reading

$$\mathbf{F \text{ average}} = (1-x) * F2 + x * F3$$

$$\mathbf{N} = [n * F1 + \text{dead time correction } \{n * \mathbf{F \text{ average}}\}] / 77$$

The following graph illustrates the ranges over which F2, F3 and F average are used as the AMP-200's dead time correction factor:

Dead time correction factor



### 3.7. Calibration Procedure for AMP-200/300

3.7.1. To set the factors, press the SPEAKER and RESET push-buttons simultaneously.

In a field higher than 0.01 Sv/h the meter automatically enables only the display and setting of the appropriate factor, depending on the field intensity.

**F1** - if the probe head is in a field between 0.01 Sv/h to 5 Sv/h.

**F2** - if the probe head is in a field between 5 Sv/h to 60 Sv/h.

**F3** - if the probe head is in a field higher than 60 Sv/h.

3.7.2. Expose the detector to a radiation field field of 0.2 Sv/h  $\pm$ 0.05 Sv/h.

Press the RESET + SPEAKER push-buttons simultaneously.

The display will show:

→ F1 → F (factor) → Sv/h (reading) →  
↑ \_\_\_\_\_ ↓

Change the factor by pressing the RESET or SPEAKER push-button to obtain the desired reading

3.7.3. Expose the detector to a radiation field of 10 Sv/h  $\pm$ 2 Sv/h.

The display will show:

→ F2 → F (factor) → Sv/h (reading) →  
↑ \_\_\_\_\_ ↓

Change the factor by pressing the RESET or SPEAKER push-button to obtain the desired reading.

3.7.4. Expose the detector to a radiation field of 80 Sv/h -  $\pm$ 10 Sv/h.

The display will show:

→ F3 → F (factor) → Sv/h (reading) →  
↑ \_\_\_\_\_ ↓

Change the factor by pressing the RESET or SPEAKER push-button to obtain the desired reading.

3.7.5. When the required reading (factor) is obtained, turn the internal switch back to the measuring position and the meter will enter the measuring mode. The calibration factors values are between 0.60 to 1.40 and are stored in the EEPROM.

### 3.8. CPU Unit Pulser Check

**Note:**

Although it is possible to “calibrate” the AMP meters using a series of input pulses (from a pulser), the manufacturer strongly recommends against this. Checking the instrument response to input pulses ensures the meter’s proper operation, *but indicates nothing about the detector*. The manufacturer recommends that the AMP system should be calibrated according to the calibration procedure described in this manual, meaning exposing the probe head to known radiation fields and adjusting factors appropriately. This process ensures that both, the detector and the meter, operate properly.

The meter counts input pulses, calculates dead time correction, averages the calculation results and displays the reading. The meter may (optionally) be checked by the following procedure.

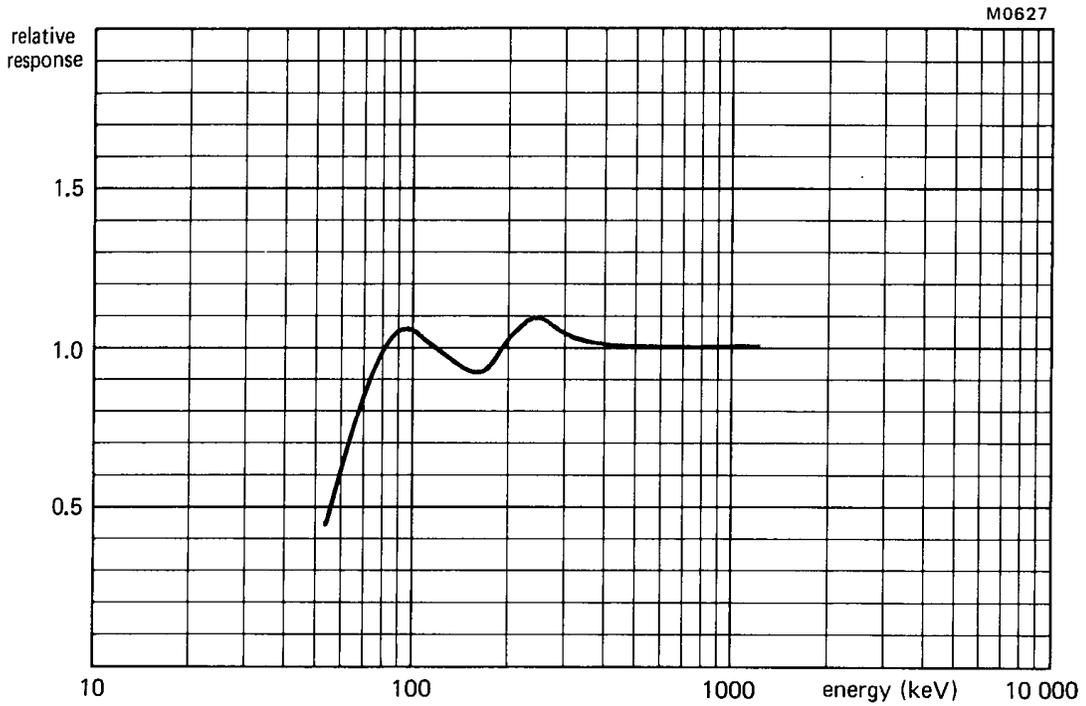
- Disconnect the detector D-type connector from the meter.
- Adjust the output pulser to obtain a five Volts amplitude and 10 µsec width pulse.
- Connect the output pulser as follows: (+) to pin 1 and (-) to pin 6.
- First, turn the meter on, and then turn the pulser on. Ensure that the meter reads (within ±10%) according to the following table:

AMP-50		AMP-100		AMP-200	
Input Frequency [Hz]	Display [µSv/h]	Input Frequency [Hz]	Display [mSv/h]	Input Frequency [Hz]	Display [Sv/h]
340	200	30	1.0	77	0.01
3000	2.29E	300	10	770	0.1
4000	3.35E	3200	107	9612	1.36
5000	4.90E	10000	392	47256	10.9
53000	5.30E	30000	1960	98712	57.4
6000	6.64E	40000	3290	123710	124
7000	7.51E	50000	5250	132933	OFLO
7500	9.43E	60000	8150		
8000	10.5E	75000	OFLO		
10000	16.0E				
13000	28.8E				
15000	OFLO				

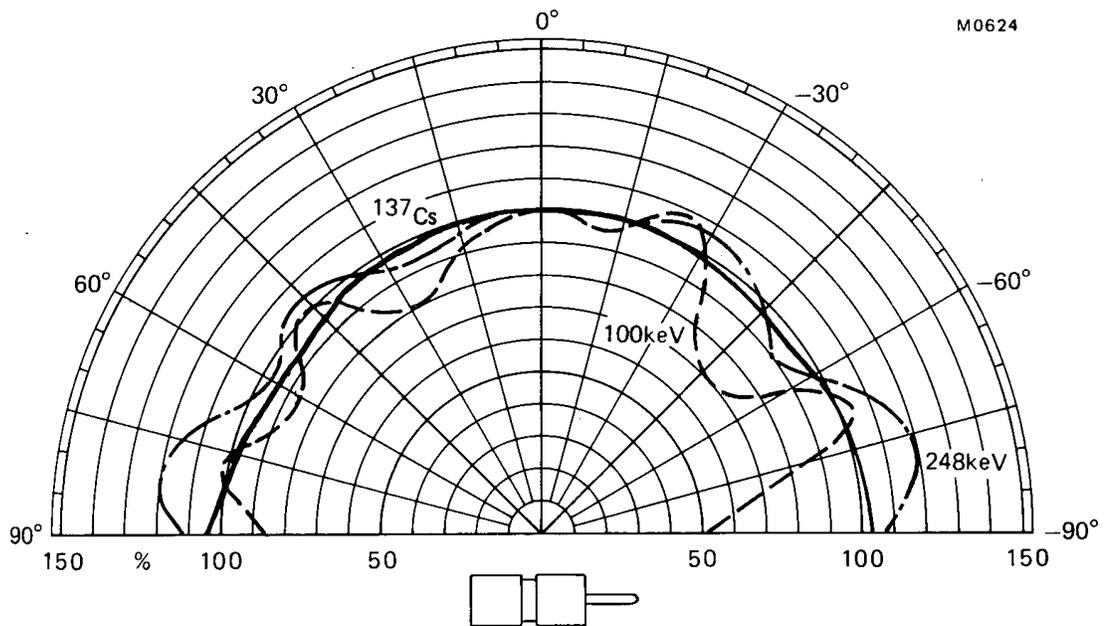
*These results are valid only when all factors are equal to 1.*

## 4. Energy Response

Energy response for AMP-50 and AMP-100

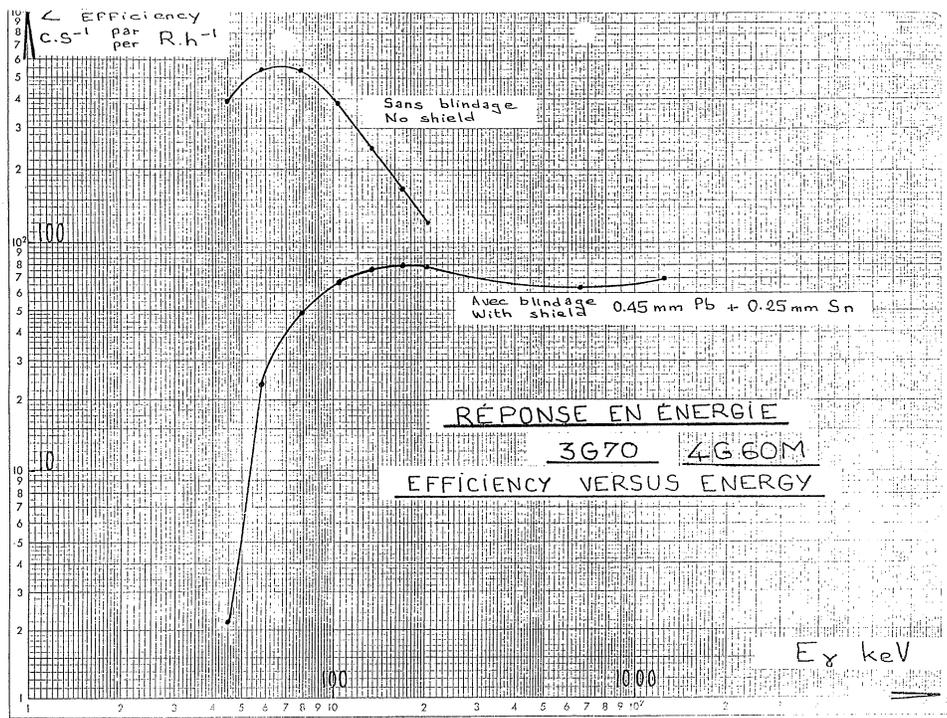


Typical energy response relative to  $^{137}\text{Cs}$

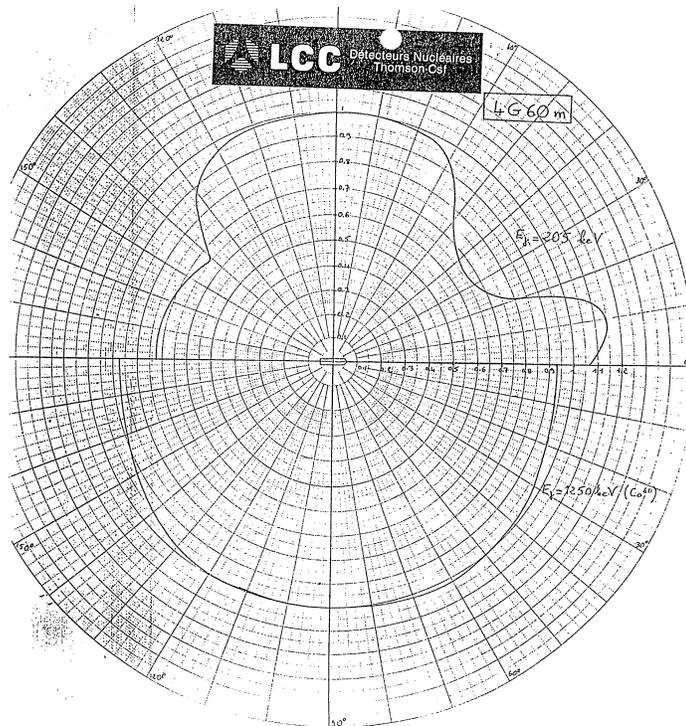


Typical polar responses (normalised to 100% at 0°)

# Energy response for AMP-200



NP 1005



## 5. Setting ID Number

Each AMP meter includes both, a factory serial number marked on the meter case label, and an ID number for communication purposes.

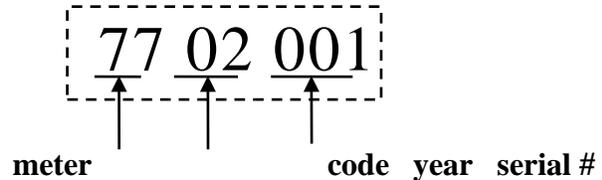
**Note:** *Setting the ID # must be done only by an authorized user.*

### 5.1. Factory Serial Number

The serial number code is as follows:

Meter codes:

For AMP- 50            09  
 For AMP-100         50  
 For AMP-200         77

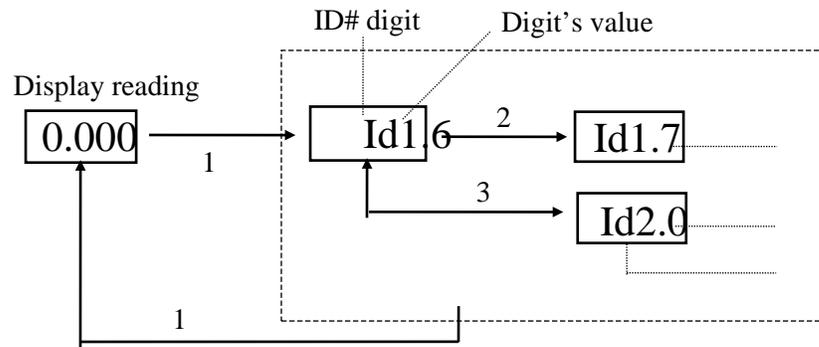


### 5.2. Setting and Checking the ID #

The ID # includes six digits.

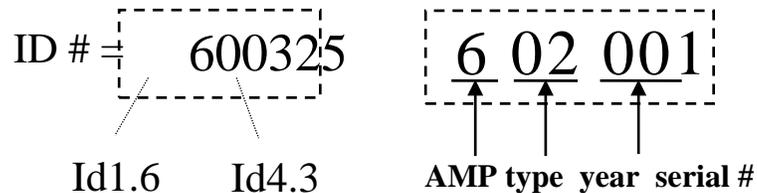
The first digit in the ID # indicates the meter type.

By default, the AMP first digit always equals to 6.



- 1 - Long press (5 sec.) on SPEAKER push-button – In/out display and set ID #.
- 2 - Short press on SPEAKER push-button - Increases displayed digit value.
- 3 - Short press on RESET push-button - Displays next digit value.

For example:



### 5.3. Correlation

Number and the ID #

Between the Factory Serial

	<u>Factory S.N.</u>	<u>ID #</u>
AMP- 50	09 02 001	6 02 801
AMP-100	50 02 001	6 02 001
AMP-200	77 02 001	6 02 501

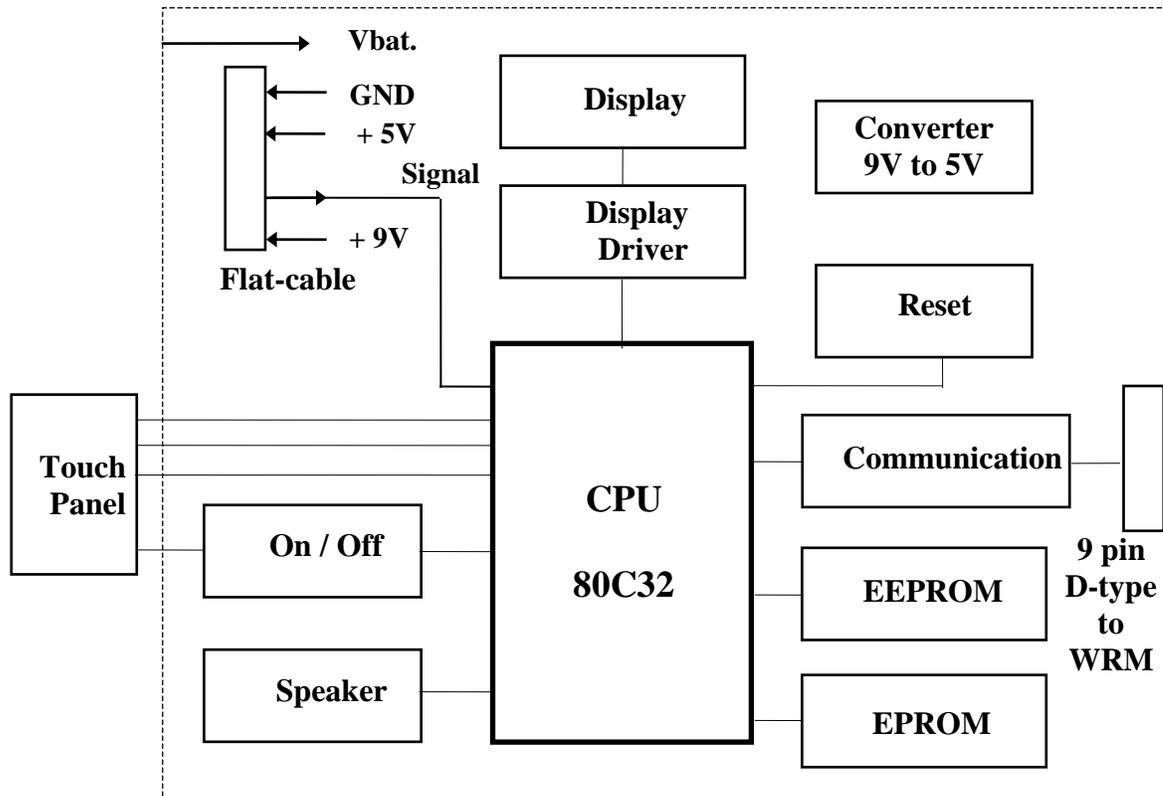
## 6. Electronic Block Diagrams Description

See block and wiring diagram DRW# 12730-50-03.

### 6.1. Meter

The meter unit includes the CPU and high voltage (HV) boards.

#### 6.1.1. CPU Board Description



CPU Board Block Diagram

#### CPU Board

DRW #12730-43-00, PC #1938.

#### On /Off Circuit (Q1, Q3, Q4)

A momentary short between pin J2/1 and J2/2 switches Q1 and Q4 on.

The battery voltage powers the LM2931 converter.

U5/8 is set to "1" (in software), Q1 is switched on, and as a result the meter is turned on.

An additional momentary short between J2/1 and J2/2 sets U5/9 to "0" through Q3. U5/8 is set to "0" and the meter is turned off.

#### Reset

When the meter is turned on, the CPU receives a reset signal via C13.

### Speaker Circuit (U3)

The speaker circuit is activated in the following cases:

- a. Meter reading exceeds threshold level.
- b. Instrument malfunction.
- c. Indication of pressing push-button.

In each of the above cases U5/15 is set to 5 VDC, a 3 KHz signal on pin U3/3 activates the speaker.

### Touch Panel

The touch panel push-buttons are directly connected to the micro-controller chip in the CPU board, except the on/off push-button, which is connected to the on-off circuit.

### Display (U4, U8)

The display shows the meter readings.

The display driver (U4) receives serial data and clock from the CPU and transmits it in parallel to the display.

U8 - LCD, 4-character 7-segment, three decimal points and two column points.

### EPROM Circuit (U6, U7)

U6 - 74HC 373, Address  $A_0 - A_7$ , latch from  $AD_0 - AD_7$ .

U7 - 27C 256, EPROM contains software code.

### CPU Circuit (U5)

The micro-controller circuit manages all of the meter's activities.

### EEPROM Back up Memory

The X2C04 is a 512-byte serial EEPROM (Electrically Erasable Prom).

The EPROM stores threshold values, ID number and calibration factors values.

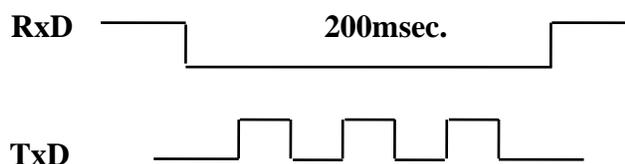
### External Communication Circuit

**J4/3 TxD** - This is the serial data line transmitted from the AMP-100. The logic level swings are 0 to 5 Volts, and can be described as RS-232 TTL level. This circuit is able to drive TTL, LSTTL, and CMOS inputs.

**J4/2 RxD** - This is the serial data line received in the AMP-100. The AMP-100 accepts serial data either in RS-232 signal levels (low: -3 to -15 Volts, high: +3 to 15 Volts) or TTL levels (low: 0.8 Volts, high: 2.0 Volts).

J4/7 - ground, J4/3 - + 5V

The communication port receives a trigger from the WRM transmitter and transmits the data to the WRM system.

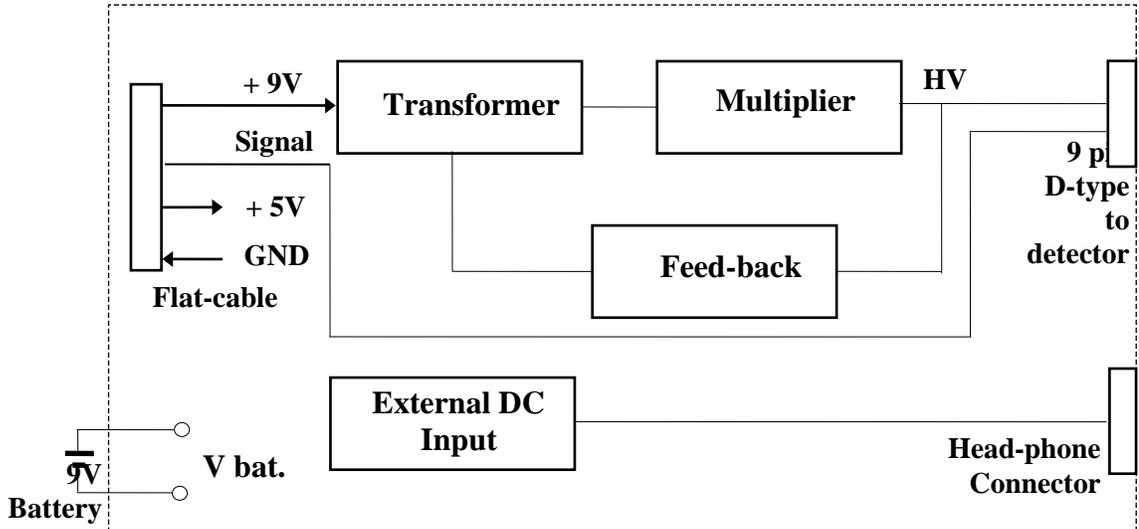


## Converter

The U2 - LM2931 - AZ 5.0 and two 4.7 $\mu$ F capacitors convert the 9V battery voltage to 5V. The input voltage range is from 5.6V to 26V.

### 6.1.2. High Voltage Board

DRW #12730-42-00.



HV Board Block Diagram

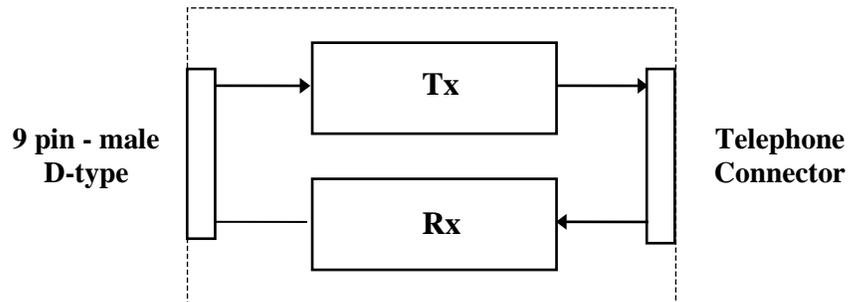
## High Voltage Board

The HV board includes an 8075 transformer, a voltage multiplier (D1, D2, D3, C2, C3), and an RV4192 switching regulator.

R10 and R1 are voltage feed-back for the switching regulator.

## 6.2. WRM Adapter

DRW #12730-40-00.

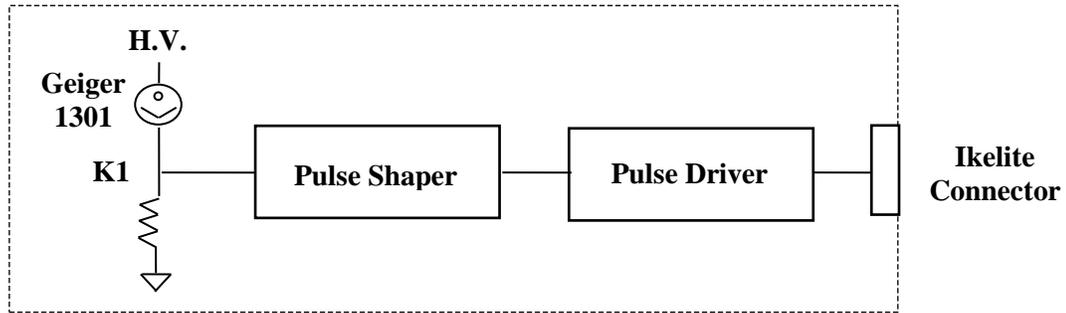


WRM Adapter Block Diagram

Adapter between the WRM transmitter and AMP-100 voltage levels.

### 6.3. Detector

DRW #12730-41-00.



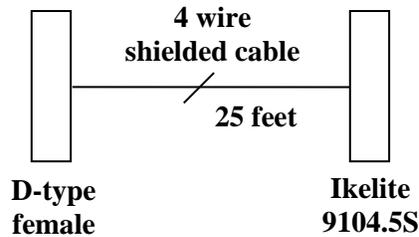
Detector Block Diagram

The high voltage,  $500V \pm 5\%$  generated in the HV board is transmitted to the detector via the meter's cable. When the detector is positioned in a radiation field, positive pulses are obtained on pin K1 of the Geiger. These pulses are shaped and amplified by Q1, Q2 and RC components. Q3 and Q4 drive these pulses in the meter's direction.

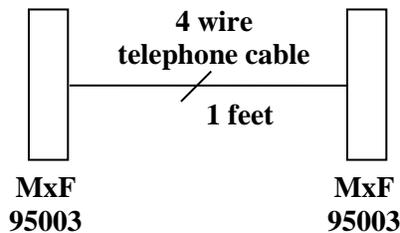
### 6.4. Cables

DRW #12730-50-00.

#### 6.4.1. Meter to Detector



#### 6.4.2. WRM Adapter to WRM Transmitter



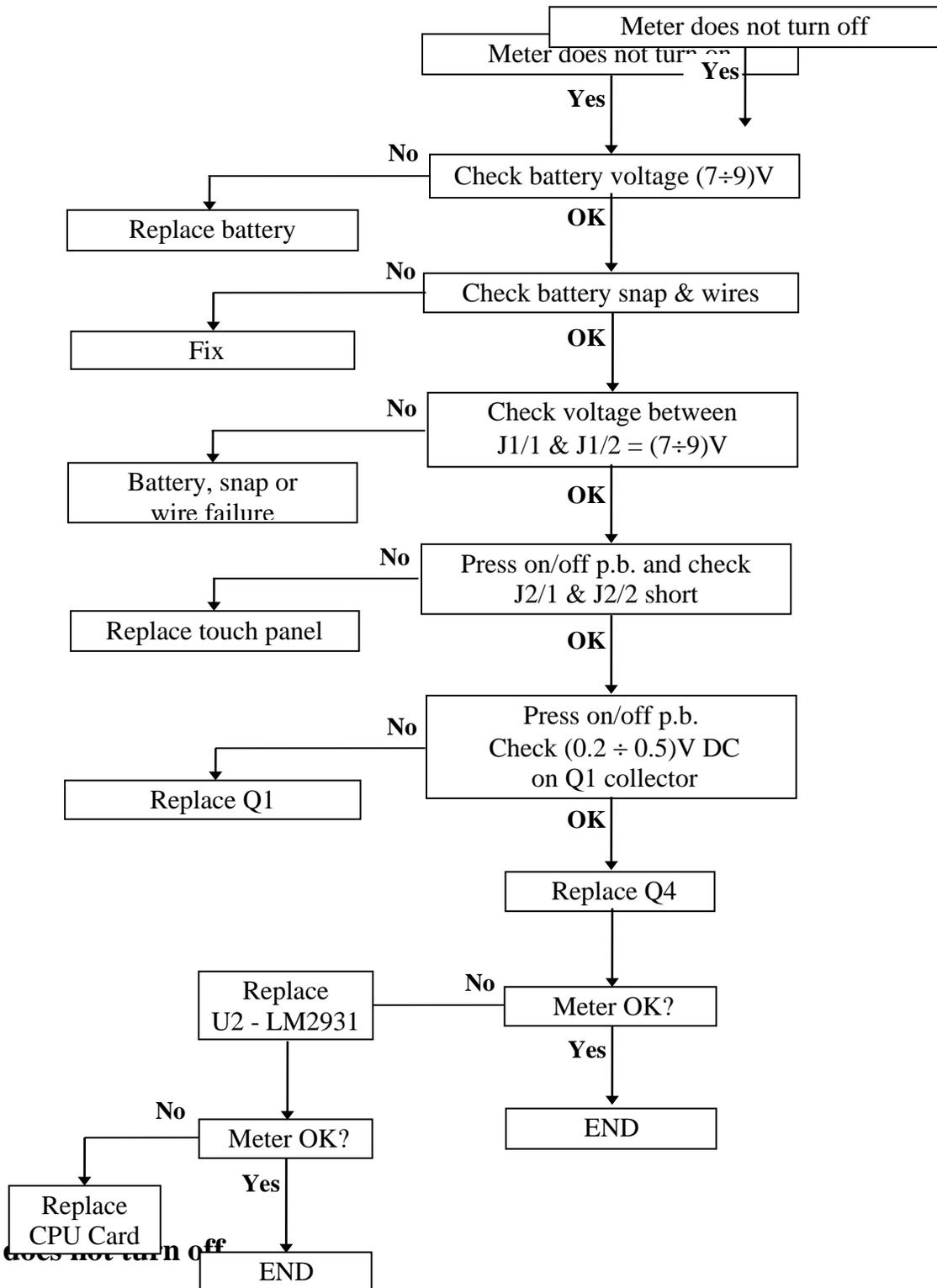
### 6.5. Power Supply

There are two ways to power the meter on:

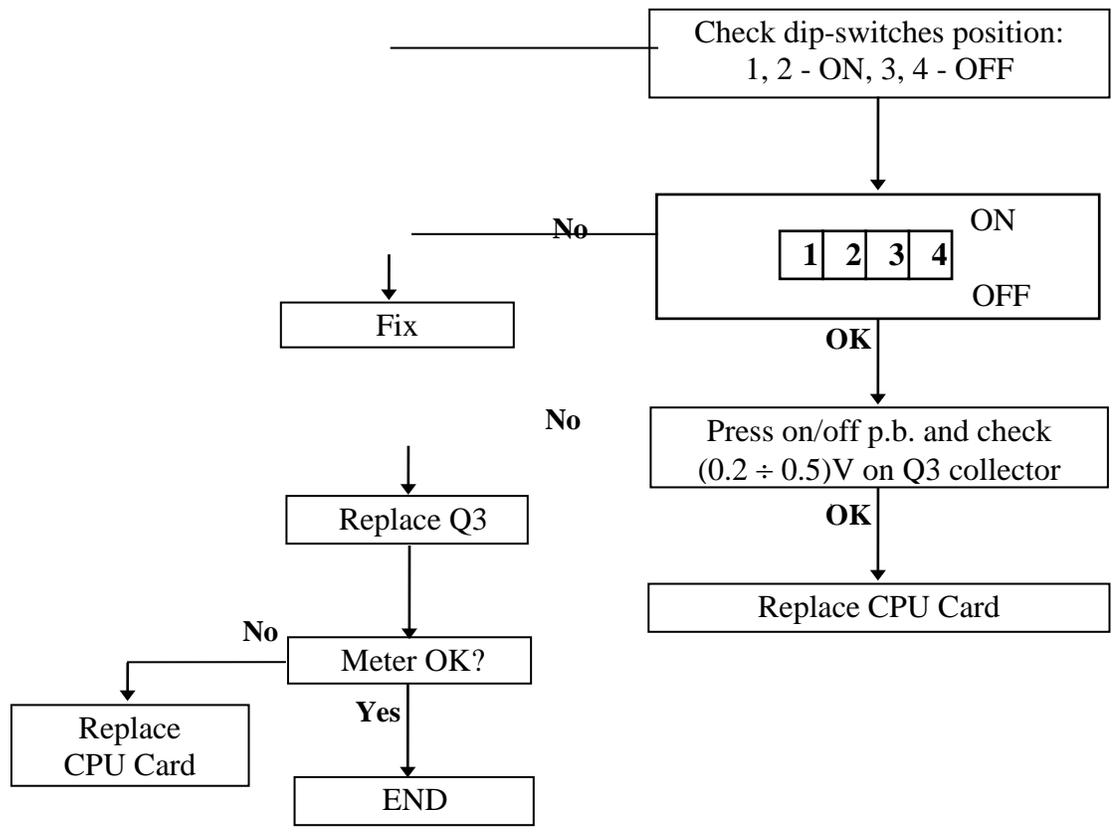
- 9V battery.
- External DC voltage ( $8V \div 10V$  DC).

## 7. Troubleshooting

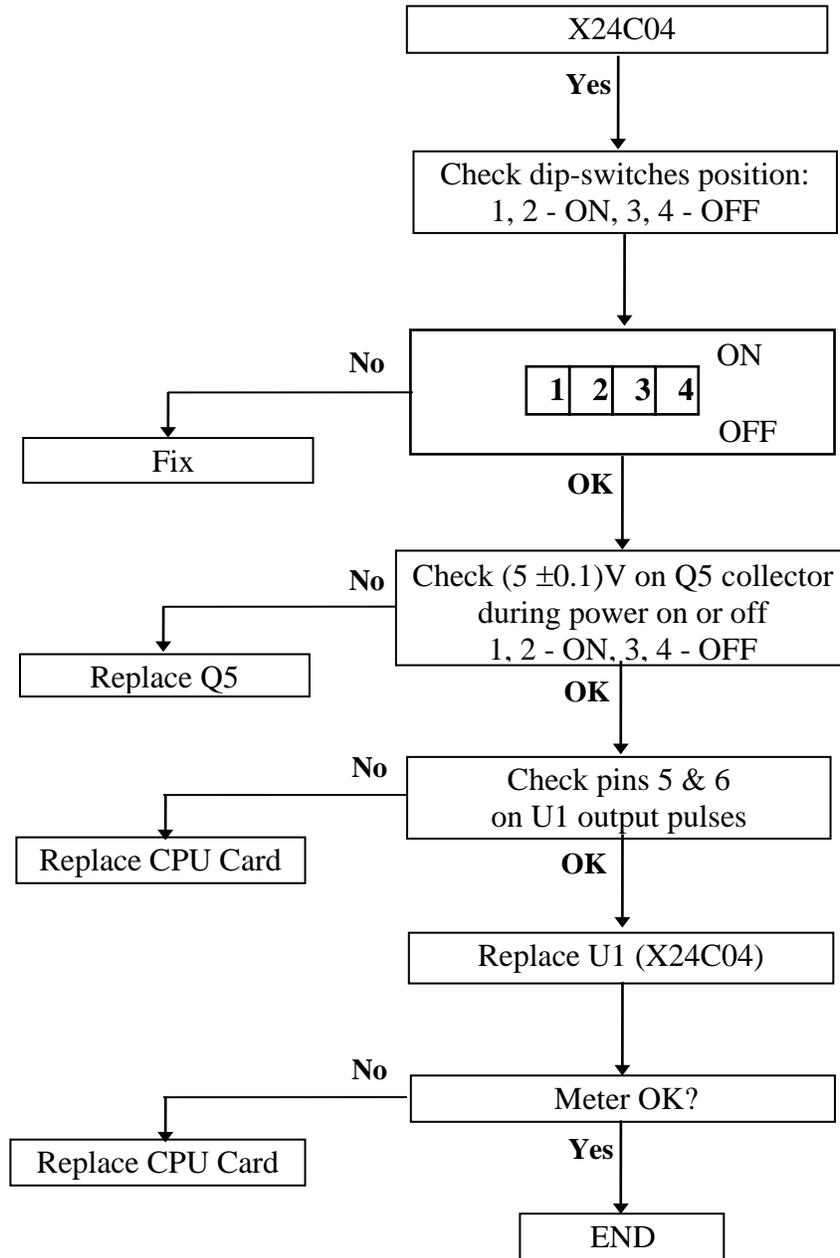
## 7.1. Meter does not turn on



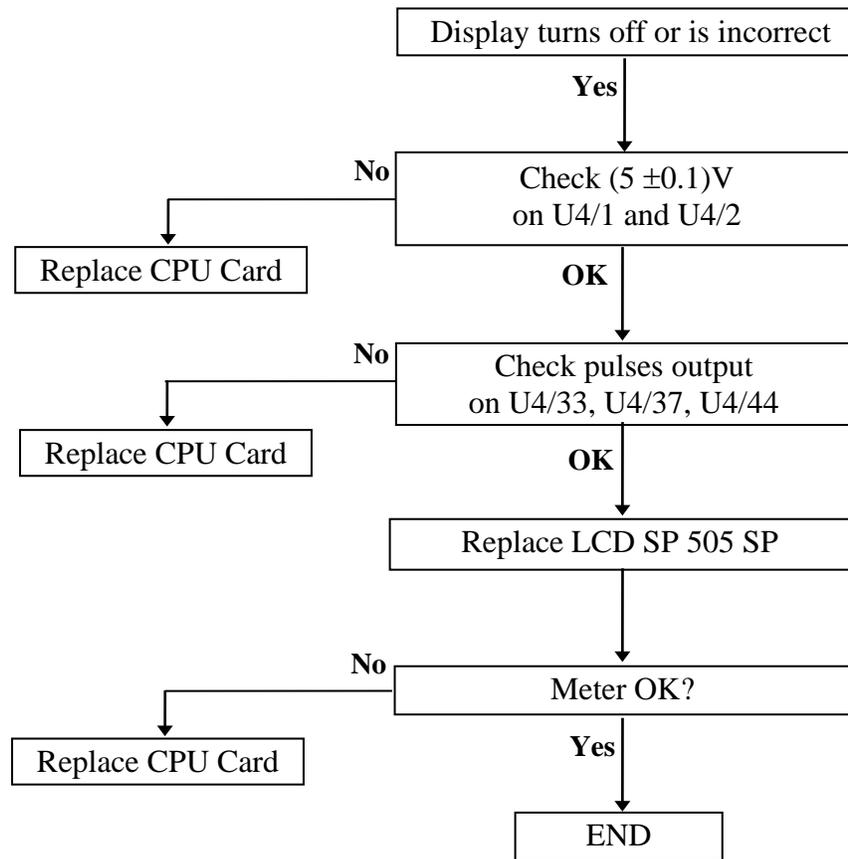
## 7.2. Meter does not turn off



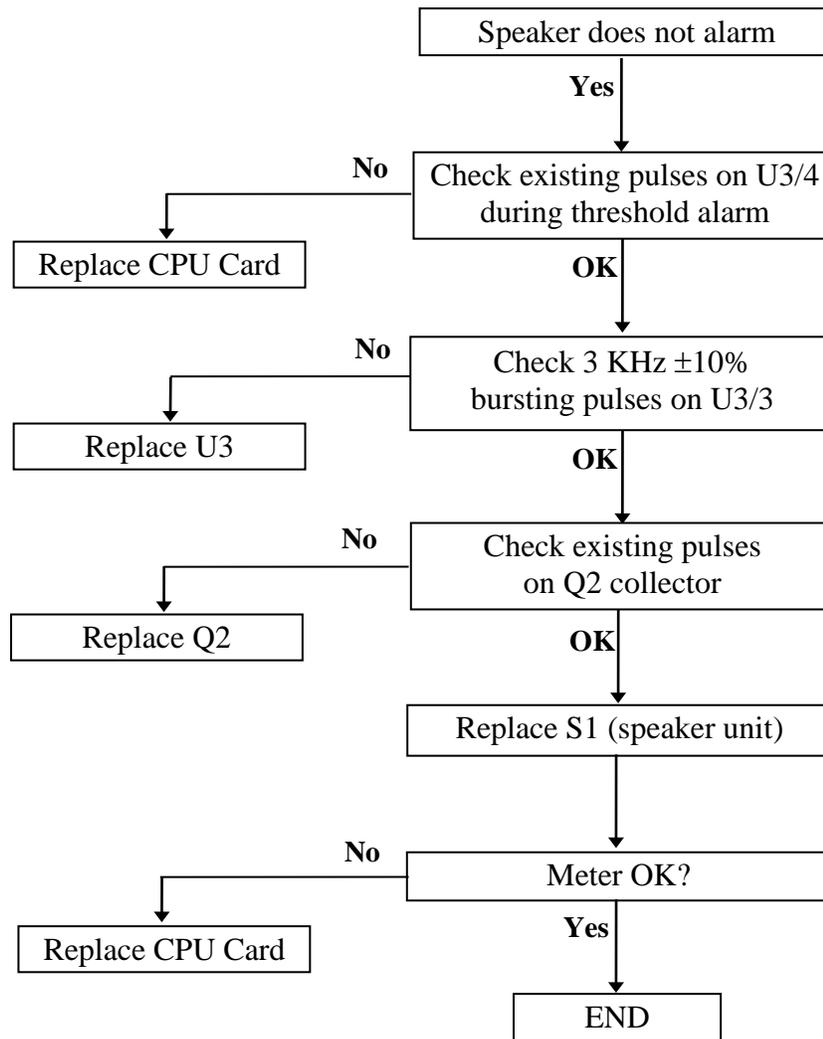
### 7.3. Meter parameters are not saved in the internal memory



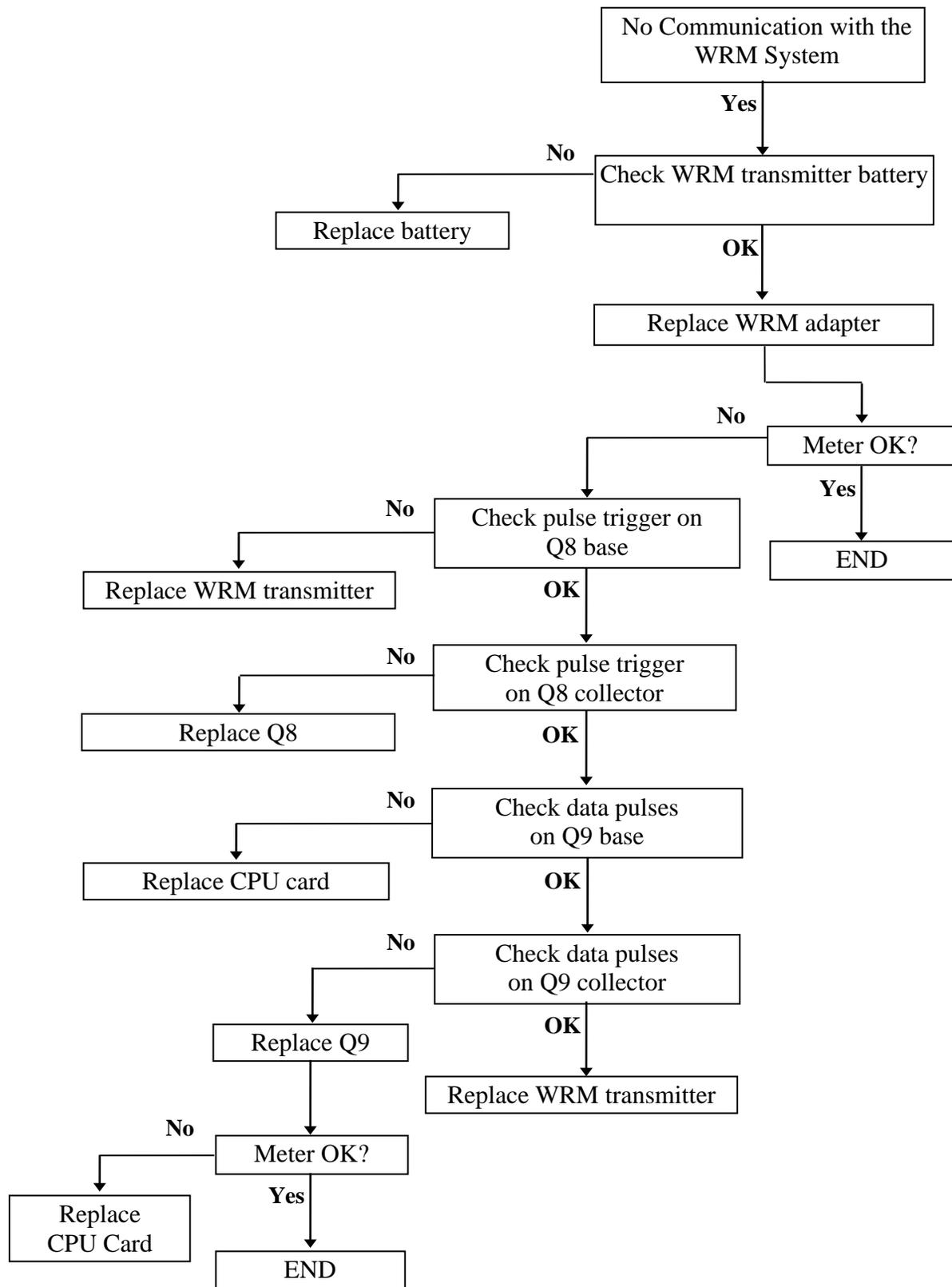
#### 7.4. Display turns off or is incorrect



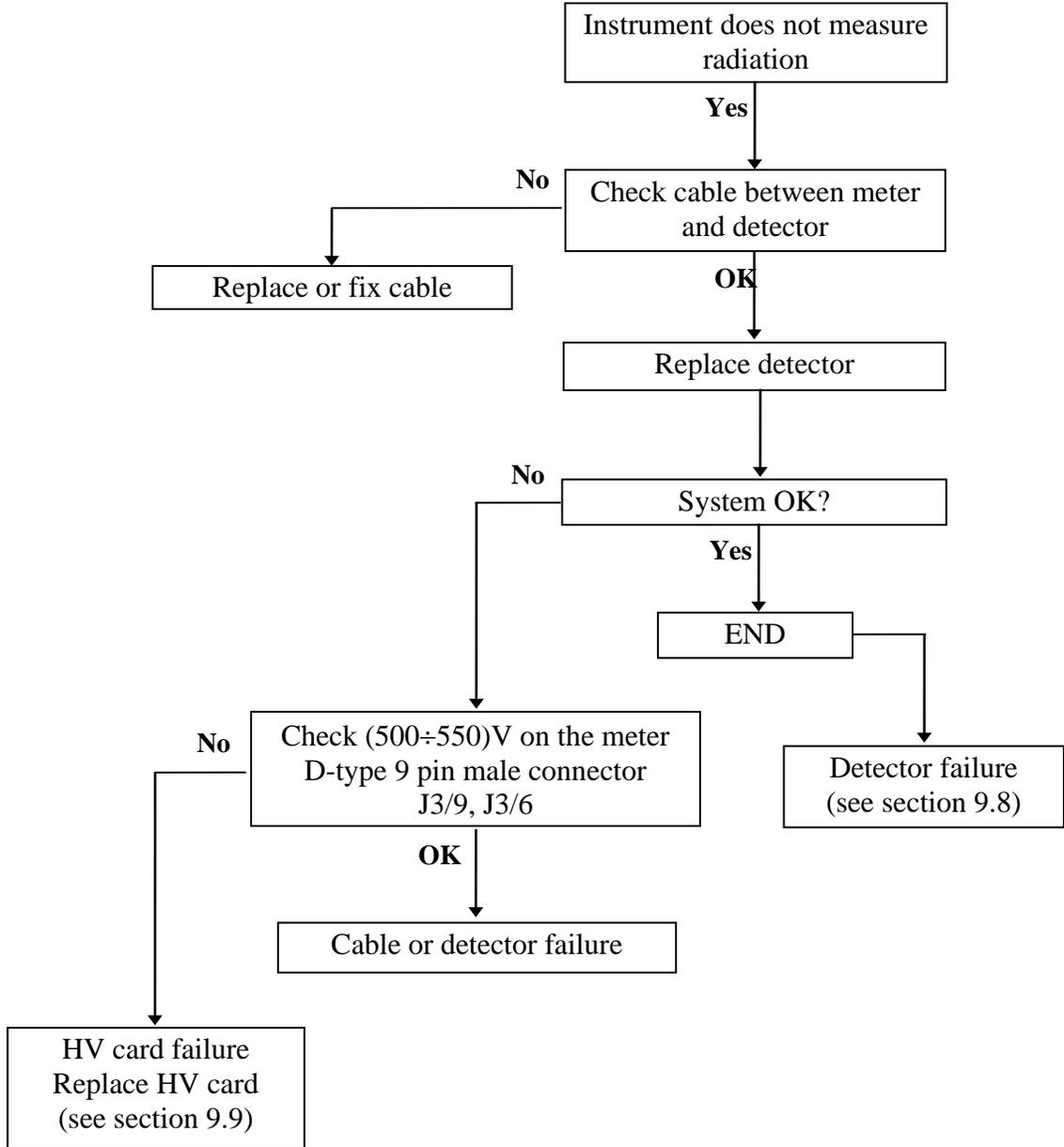
## 7.5. Speaker does not alarm



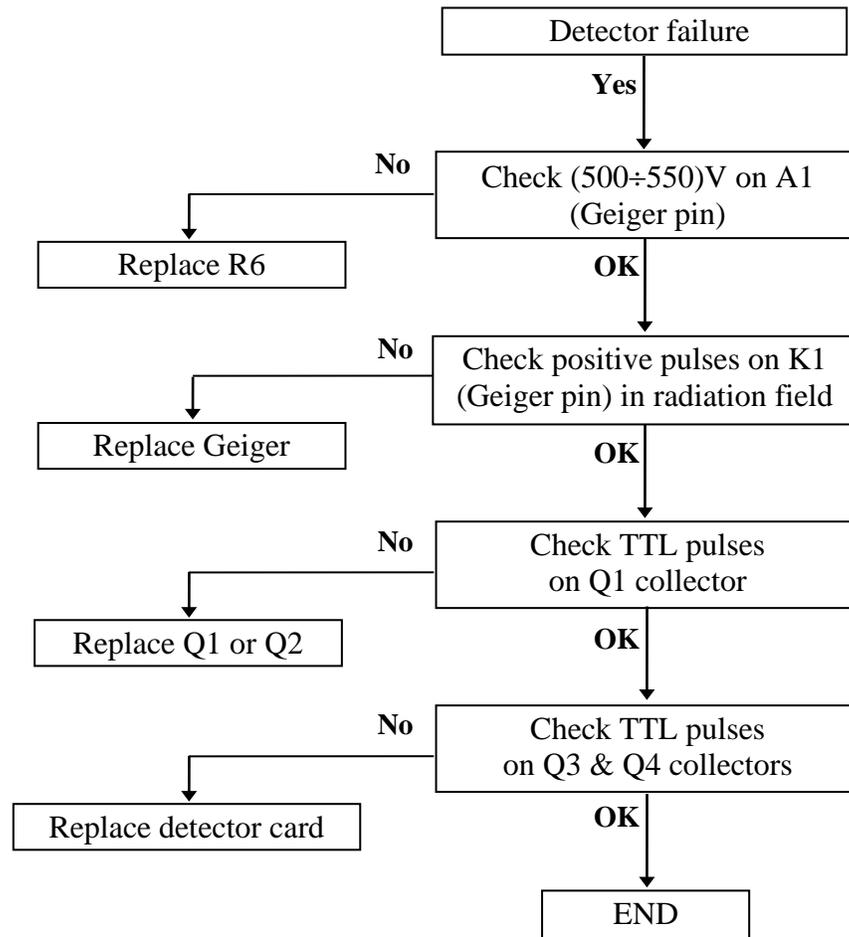
## 7.6. No communication with the WRM system



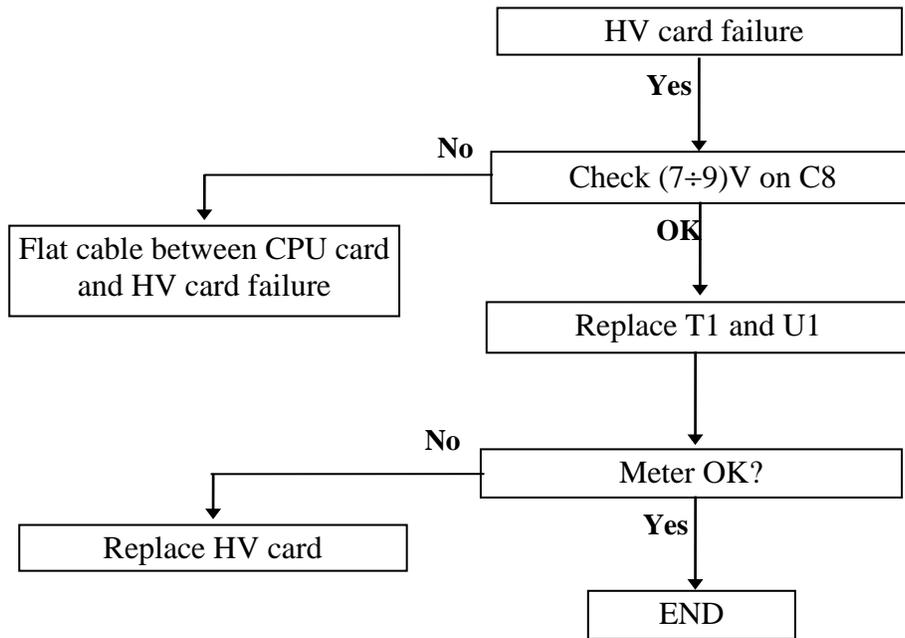
## 7.7. Instrument does not measure radiation



## 7.8. Detector failure

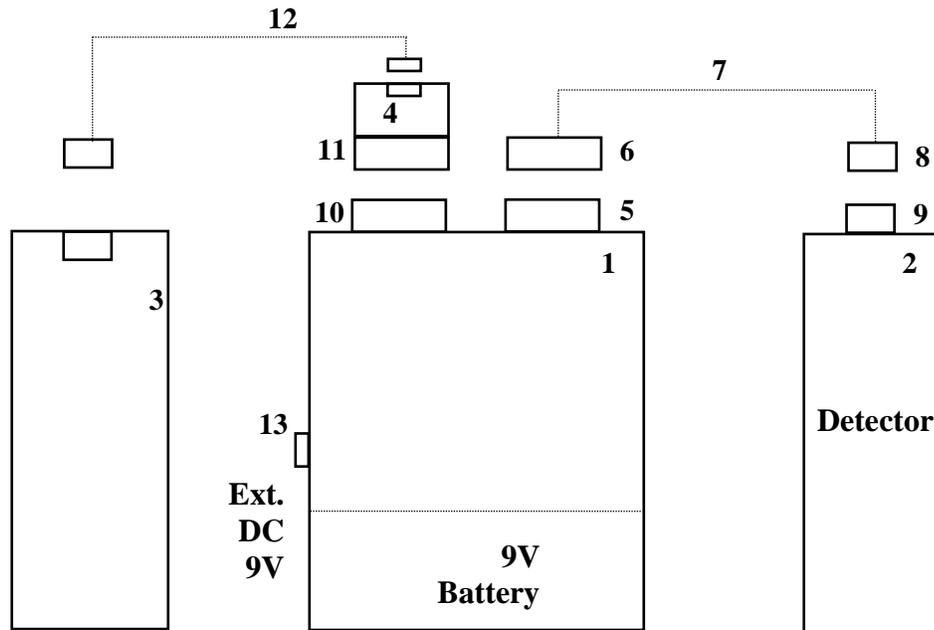


## 7.9. HV card failure

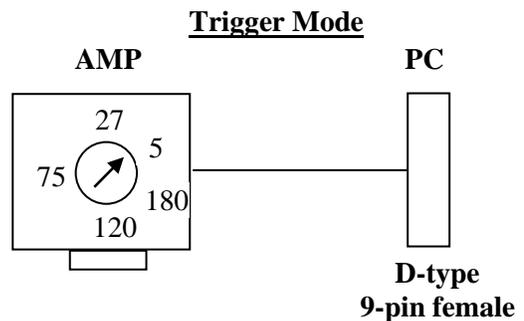
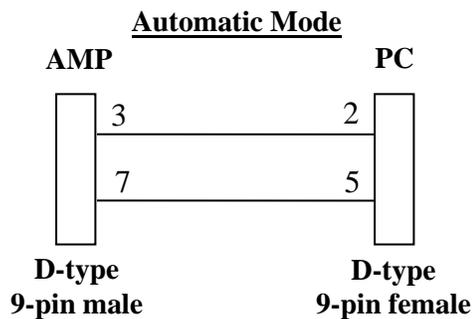


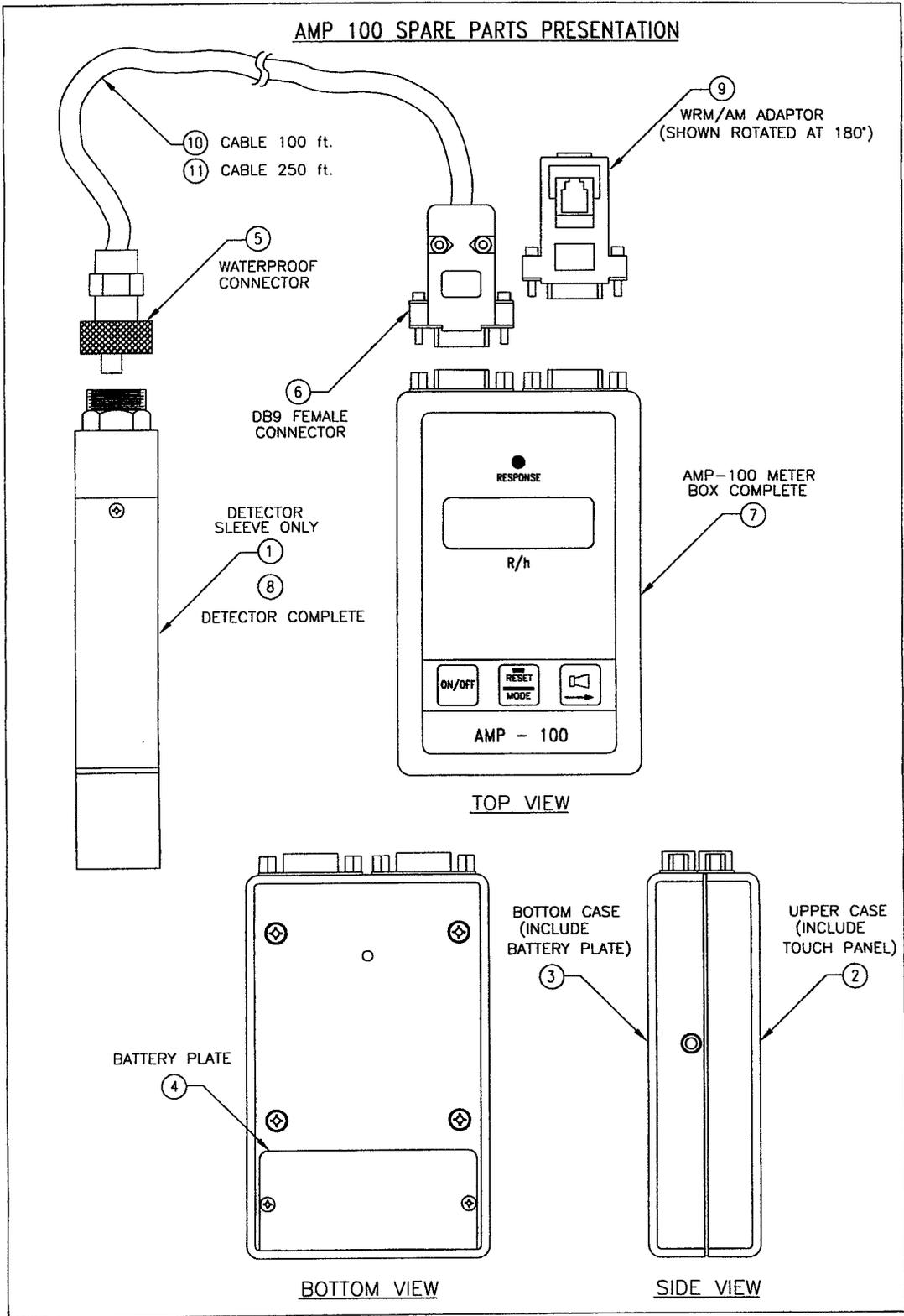
# Appendix 1.

## The AMP System Parts List



- 1 - Meter
- 2 - Detector
- 3 - WRM transmitter (optional)
- 4 - WRM adapter
- 5 - D-type male connector
- 6 - D-type female connector
- 7 - 4-wire shielded cable
- 8 - Ikelite connector II9104.15 (cable)
- 9 - Ikelite connector II9104.55 (panel)
- 10 - D-type female connector
- 11 - D-type male connector
- 12 - 4-wire telephone cable
- 13 - Audio connector 3.5 mm (external DC)
- 14 - AMP to PC communication cable (automatic mode)
- 15 - AMP to PC communication cable (trigger mode)

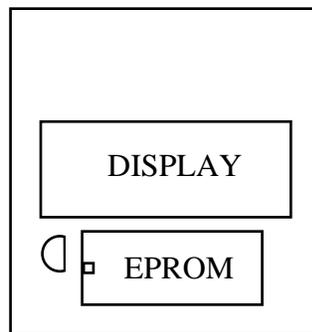




## Appendix 2.

### Instructions for EPROM Replacement

1. Disconnect the detector cable from the meter.
2. Disconnect the communication cable from the meter.
3. Loosen the two capture screws on the battery compartment cover, take out the battery.
4. Loosen the four screws on the rear panel, turn and separate the meter's parts.
5. Disconnect the touch panel flat cable (5-pin).
6. Loosen the two screws adjusting the PC #1938 board (located above the flat-cable connector).
7. Remove the EPROM.
8. Insert a new EPROM.
9. *Take care to insert the EPROM in the correct direction.*



PC 1938

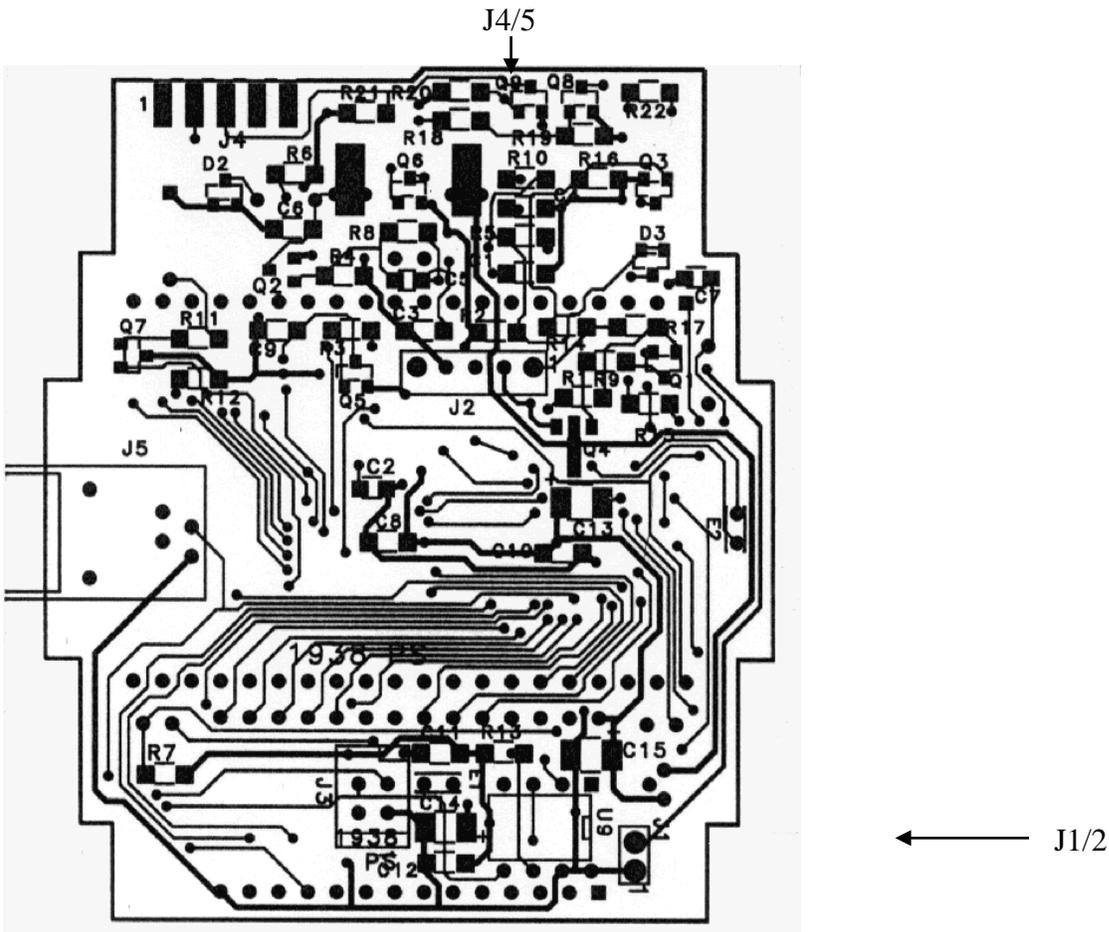
10. Assemble the meter following steps 1 to 6 in the reverse order.

## Appendix 3.

### External Power Supply From AM-16 or WRM Transmitter

In order to enable direct power supply from the AM-16 or WRM Transmitter to the AMP, the following change has to be performed on the CPU Board - PC #1938.

- Open the AMP case.
- Solder a wire between J1/2 and J4/5 on the CPU board, on the print side, as shown in the following figure:



**Note:** This change has to be performed on the instruments with serial # 5095\*\*\* and CPU board version #1.0.

There is no need to perform this change on instruments serial # 5097\*\*\* and 5098\*\*\*.

## Appendix 4

### AMP VIEW

#### AMP to PC Down Loading Data

##### Preface

AMP View Software is WINxx compatible. The software is aimed to download the AMP's meter measurements to the PC.

##### Required Equipment

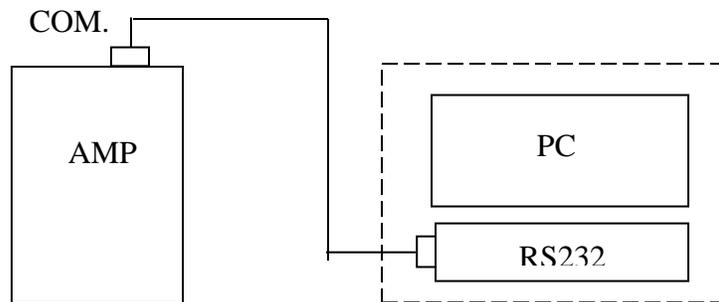
- PC WINxx compatible and RS-232 communication port.
- ROTEM's customized AMP to PC communication cable (trigger mode) or AMP to PC communication cable (automatic mode), see section 4.3.
- AMP's meter
- AMP View Software supplied by ROTEM on two 1.4 floppy disks or one CD.

##### Software Installation

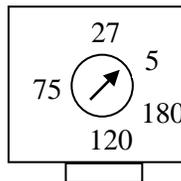
Insert the CD into the CD drive. Select **Start**, then run and select the **setup.exe** file.

##### Operating Instructions

1. Connect the AMP's meter to the PC via RS-232 communication port, via the communication cable.

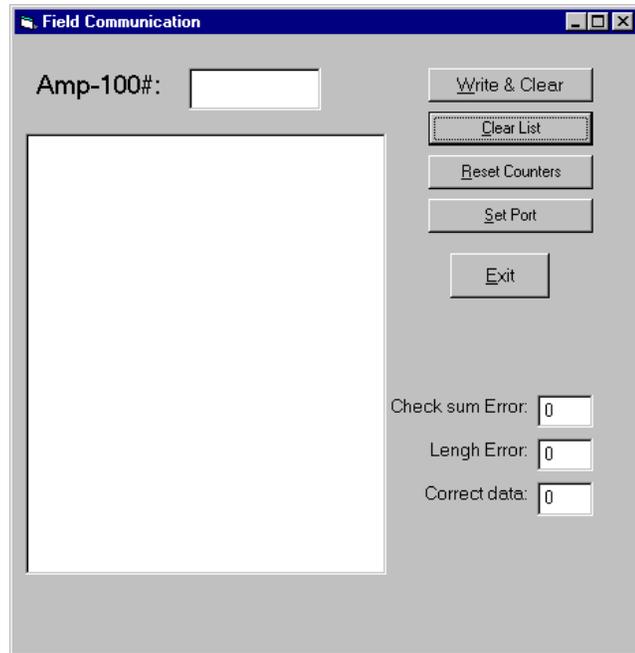
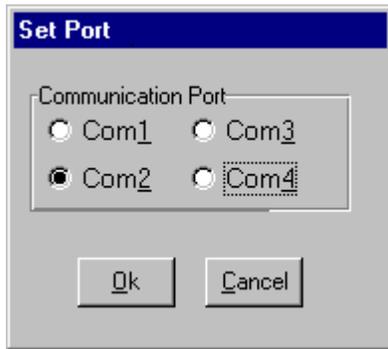


2. Set the down loaded data trigger time from 5 sec. to 180 sec., by using the trimpot on the D-type connector of the customized cable.

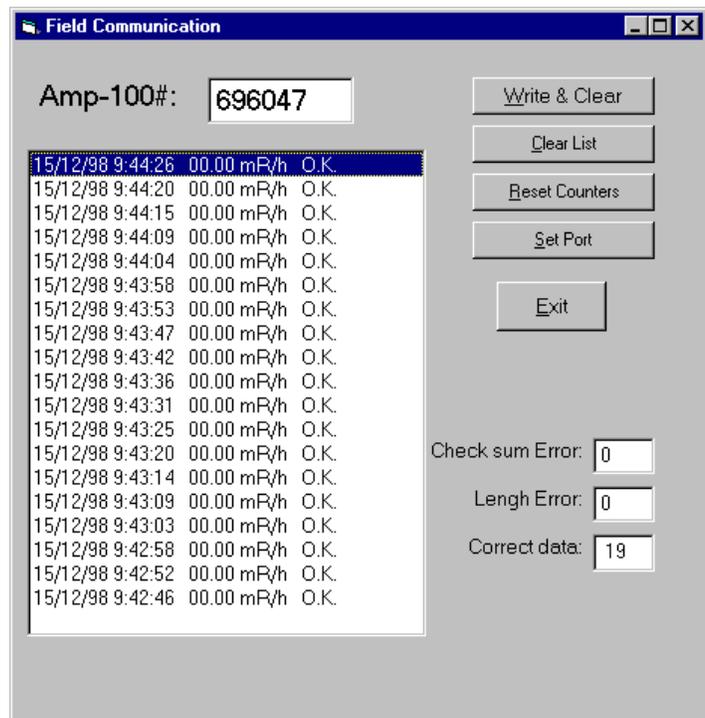
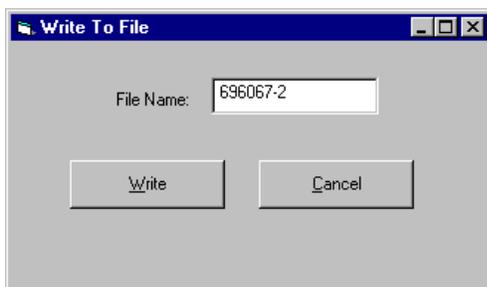


3. Run the AMP VIEW software.

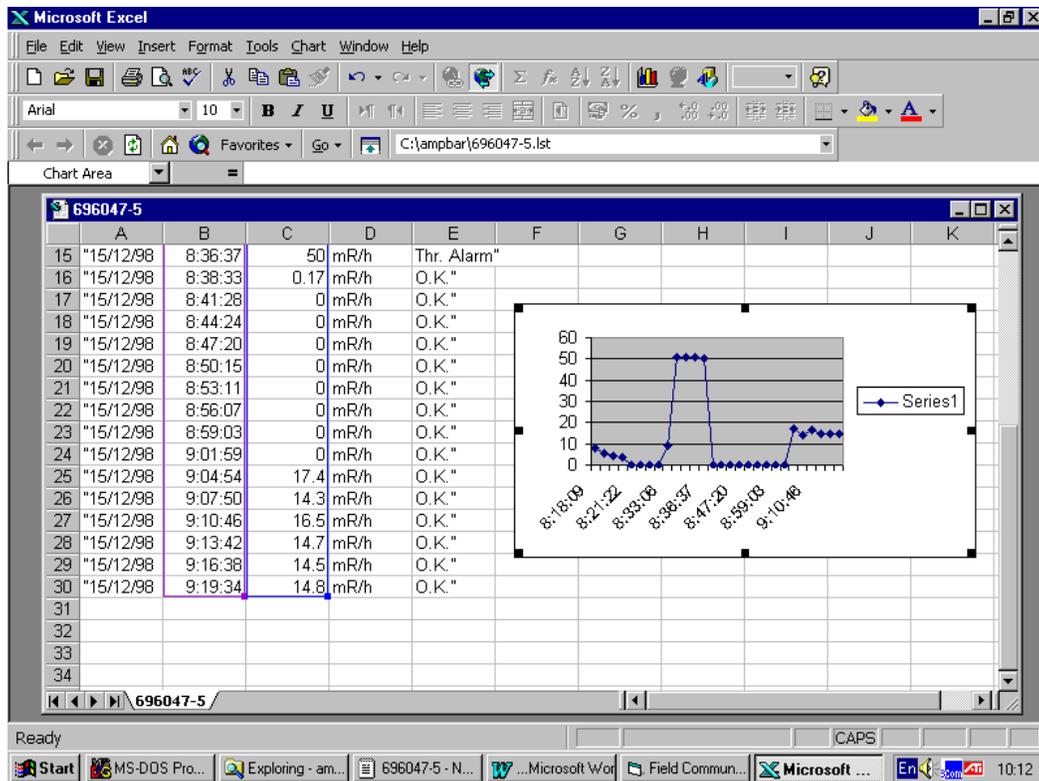
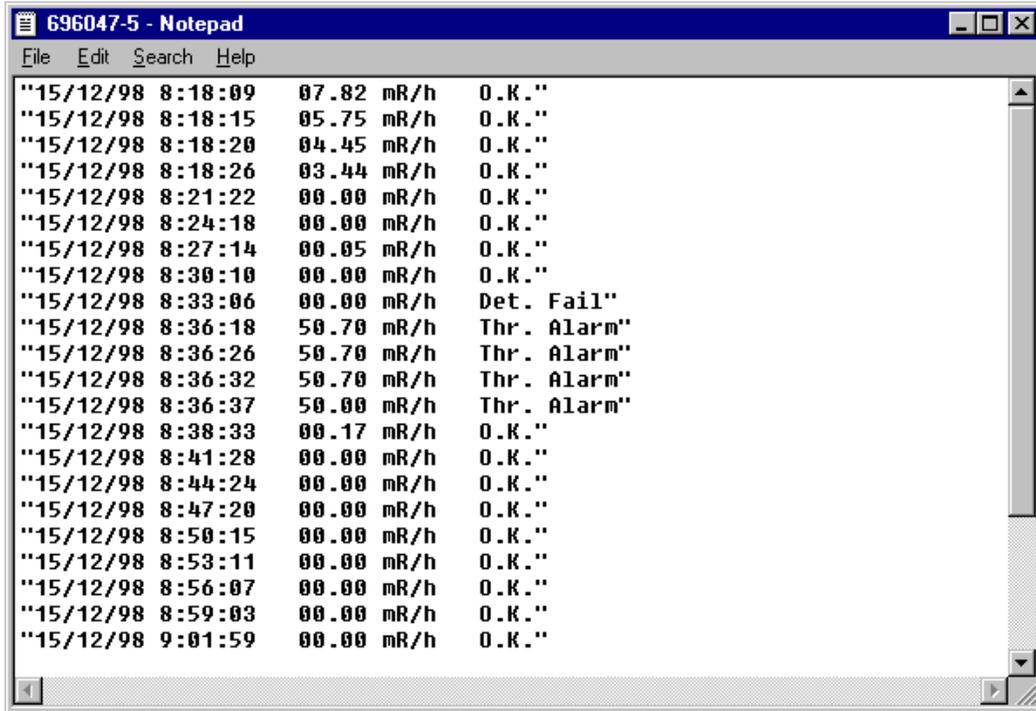
4. Set the comm. port.



5. Turn the AMP's meter on.
6. The data contains: date, time, measurements, units, status.  
Date & time - PC date.  
Status options - ok, detector. fail, threshold alarm.
7. To save and clear the buffer data press Write & Clear, type the File Name.
8. To clear the buffer data without saving press Clear List and Reset Counters.



9. Use the NOTEPAD or EXCEL software to process the data.



## Appendix 5

### AMP-50, AMP-100, AMP-200

#### Electronic Drawings List

#	DRW #	Ver./Rev.	Name	PC #
1	12730-43-00	2.4	CPU Card	1938
2	12730-42-00	1.1	HV Card	2013
3	12730-41-00	1.3	AMP-100, AMP-200, Detector Card	1930
4	13550-40-00	1.0	AMP-50 Detector Card	2078
5	12730-50-01	1.2	Internal Wiring Diagram	--
6	12730-50-00	1.2	External Wiring Diagram	--
7	12730-50-02	1.2	Graphic Wiring	--
8	12730-44-00	1.2	Power Supply - WRM Adapter	1963
9	12730-40-00	1.1	WRM Adapter	--
10	12730-46-00	1.2	Computer Interface	2026