ROTEM INDUSTRIES LTD.
ROTEM INDUSTRIAL PARK P.O. Box 9046 BEER SHEVA 84190, ISRAEL
Tel: 972-8-6564781, Fax:972-8-6568005, email: Laurence@rotemi.co.il

Test and Calibration Procedure

Pm-11

Translated from document # EBPM11M0905

ROTEM INDUSTRIES LTD.
ROTEM INDUSTRIAL PARK P.O. Box 9046 BEER SHEVA 84190, ISRAEL
Tel: 972-8-6564781, Fax: 972-8-6568005, email: Laurence@rotemi.co.il

ROTEM

1 Required test equipment

1. 6 x ^{137}Cs sources with activities as shown in the table below:

No	Source Number	Activity
1	771	20 µCi
2	772	20 µCi
3	779	20 µCi
4	684	5 µCi
5	685	5 µCi
6	690	5 µCi

2. 1 x ^{22}Na source with 13 KBq activity
3. Computer with spectrum PCA display capabilities including amplifier and delay in Bin system
4. DPU with latest firmware version
5. A special jig for the detector which includes 6 slots for placement of the sources
6. A Test Bench, model 10735
7. Oscilloscope
8. Power Supply
9. High voltage probe (1-1,000) compatible to the DVM

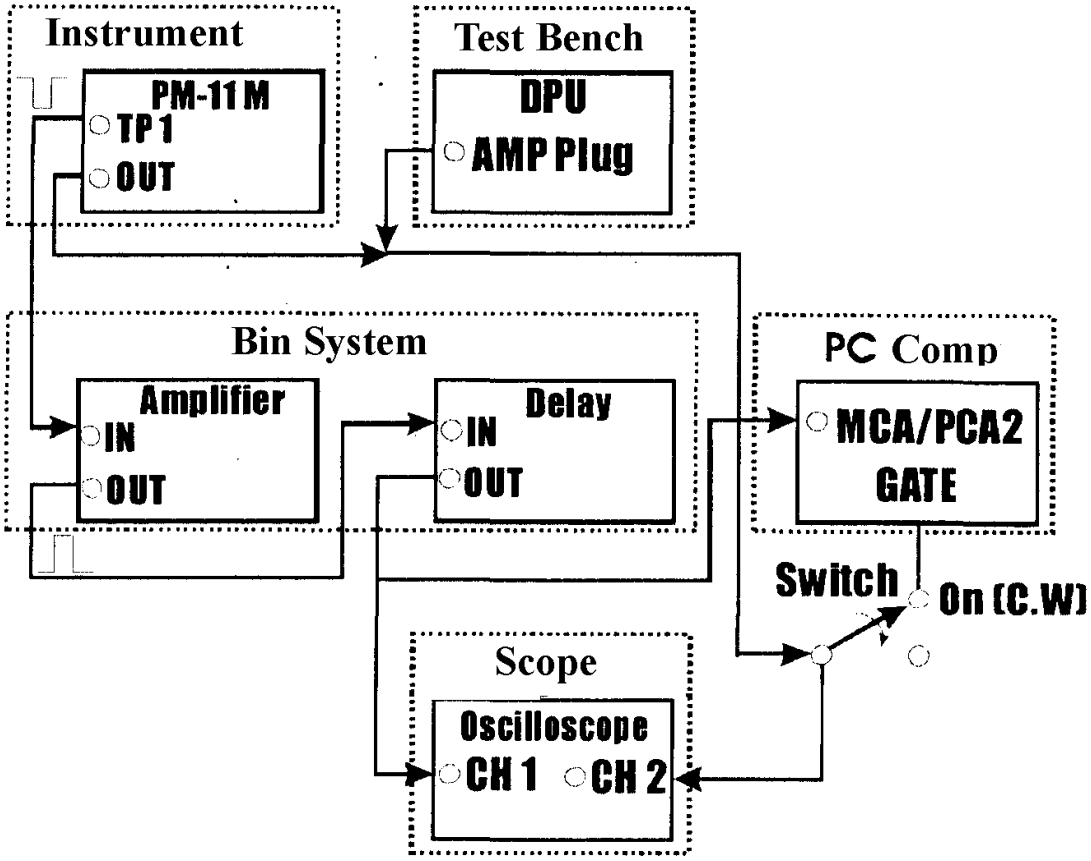
2 Electrical Calibration

1. Connect the AMP connector from the Test Bench to the PM-11 detector
2. Connect the BNC cable from the test bench to the counter instrument
3. Feed 9V into the detector from the PSU
4. Using the DVM meter, check/calibrate the following values on the shaper card:

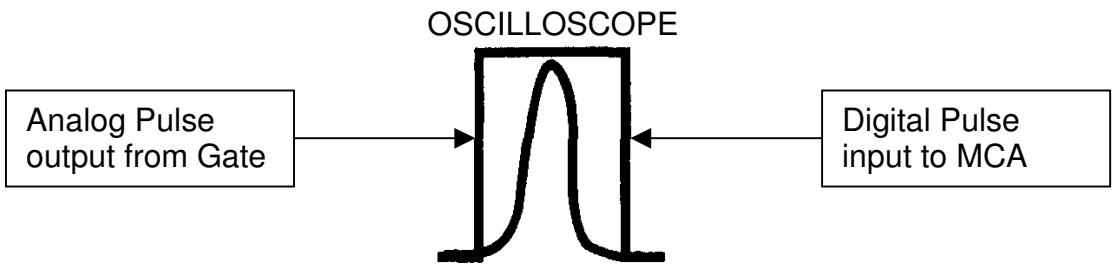
    a. TP1- 2.2 to 2.4 V – If not replace U1 for it has failed.
    b. TP2- 4.0 $V^{\pm 0.03}$ – using trimpot R6
    c. TP3- 3.7 $V^{\pm 0.03}$ – using trimpot R7
    d. TP4- 2.2 $V^{\pm 0.03}$ – using trimpot R8

5. Move switch S2 to Cal (calibration) position
6. Check/calibrate, using R25, the frequency factor on the counter to be 100 Hz ± 10 KHz.
7. Using trimpot R5 on the board, calibrate the initial voltage (on the resistor R1) to be 700 VDC
8. Return the switch back to S2 (signal) mode
9. Move the 137Cs source close to the detector and verify that the source is detected by seeing a difference in the counter

3 Physiological Calibration

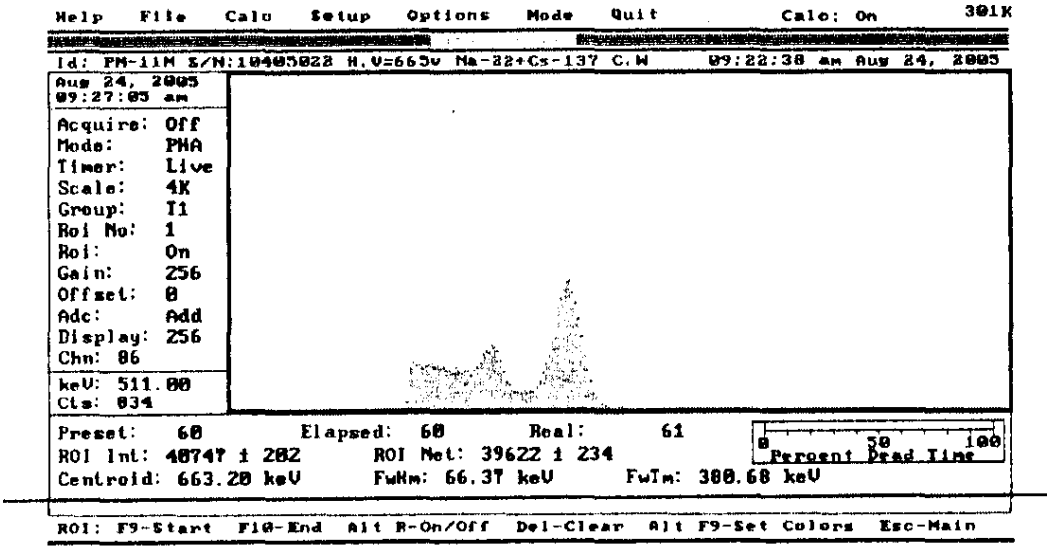


1. Connect the DPU to 12VDC Power Supply
2. Connect the AMP connector of the DPU to the detector
3. Connect the TP1 point to the input of the spectrum amplifier
4. Connect the output of the amplifier to the to the input of the DELAY card
5. Connect the output of the DELAY card to the PCA card of the MCA which is installed on the computer.
6. Check, by using an oscilloscope the synchronization of the GATE pulse which is inputted into the MCA, when the pulses are synchronized the oscilloscope will display the following “locked” position. In case the position is not locked, modify the DELAY until the following is displayed.



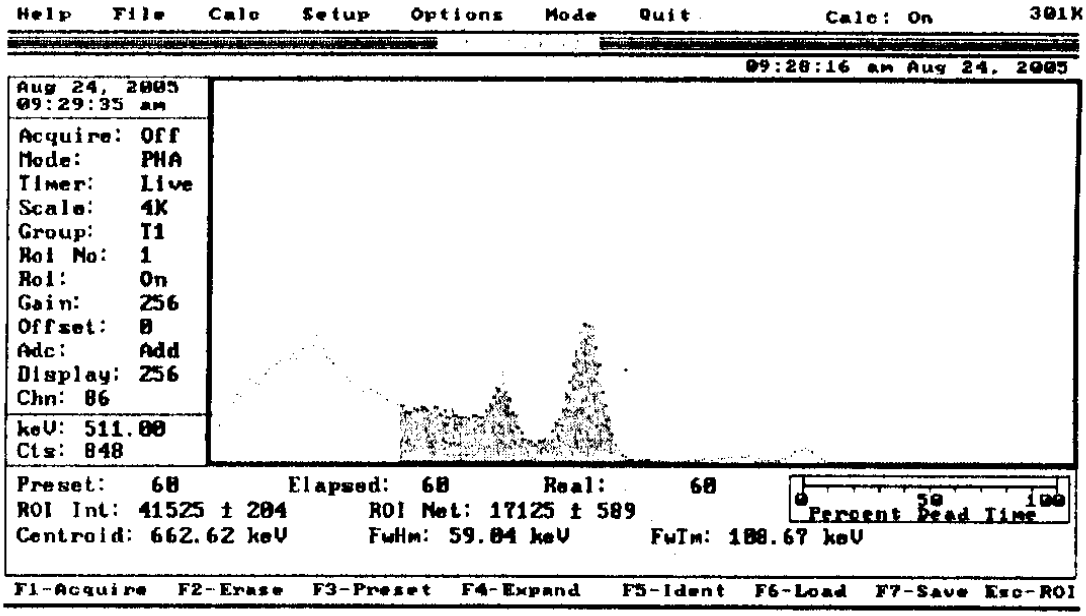
7. Connect the OUTPUT of the DPU to the Gate of the MCA on the computer
8. Move a ^{137}Cs source, with activity of 5 µCi and a the source of ^{22}Na with activity of 13KBq closer to the detector until the DPU displays a reading of between 600 – 700 CPS. Mark the exact location of each source on the bench and then remove the ^{22}Na source. The DPU should display a reading of 230 (± 20) CPS. Replace the ^{22}Na source and remove the ^{137}Cs source. The DPU should display a reading of 460 (± 40) CPS

9. Activate the PCA program; at this stage you should be able to see the peaks of both the Cs and Na clearly. Perform a spectrum test with a closed window (GATE) by calibrating the High voltage on the detector using the R5 potentiometer on the HV card so that there is no sliding of the spectrum to the left or right. Following the calibration you should see the following display:



Note: A Spectrum test with a closed window shows no sliding to the left and right of the field between 390 – 730 keV. Also the peak on the right for ^{137}Cs (662 keV) and on the left for ^{22}Na (511 keV)

10. Perform a spectrum test as per the previous instructions only this time, disconnect the gate and you should see the following:



4 Overflow Calibration

1. Use the test bench for the PM-11 model 10735
2. Feed 9VDC into the test bench
3. Connect the AMP connector to the PM-11
4. Insert the Pm-11 into the jig and add 3 x ^{137}Cs sources (activity of 20 µCi each) into the jig in such a way that between each source there is an empty slot.
5. Calibrate R34 so that the OVERFLOW light is lit up.
6. Remove one of the three sources and check that the OVERFLOW light turns off. In case the overload light does not turn off turn the R34 in an anti-clockwise direction. Return the source to the jig and check that the overload light lights up and repeat the operation until the R34 is set correctly.
7. Lock the R34 using loctite glue or similar.

5 Linearity Test

1. Perform linearity testes according to the table below

Distance	Test Source No	Error (%)	Comment	Actual Reading (CPS)	Expected Value (CPS)
0	1		Linearity		1.21k
5	1		Linearity		257
10	2		Linearity		2.78k
23	2		Linearity		766
Jig 1	2		Linearity		4.80k
Jig 2	2+3		Linearity		9.40k
0	4	OVERFLOW	Software Overflow	Overflow	>5000
-	-	OK	OK	OK	<9

Test Source No's:

Test source No 1: ^{22}Na – 34 kBq.
Test source No 2: ^{137}Cs – 20 µCi
Test source No 3: ^{137}Cs – 5 µCi
Test source No 4: ^{137}Cs – 60 µCi

Fill in the column marked **Actual Reading,** calculate the error and verify that the reading is no more than 10%.

Fill in the column marked **Error %** and save as a file in the computer

2. Lock the TP 5 on the HV card using loctite similar substance
3. Using the high voltage probe, measure the voltage at R1 on the HV card and note the voltage on the accompanying production tag

ROTEM INDUSTRIES LTD.
ROTEM INDUSTRIAL PARK P.O. Box 9046 BEER SHEVA 84190, ISRAEL
Tel: 972-8-6564781, Fax:972-8-6568005, email: Laurence@rotemi.co.il

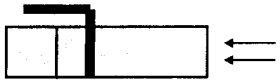
נספח – דוגמא לתעודת כיול שיש למסור ללקוח יחד עם מכשיר ה- PM-11M

(את תעודות הכיול יש להדפיס על דפים בפורמט אנגלית רותם)

Calibration Certificate for PM – 11M Detector

Customer

Serial No.: 10405022
(Field radiation)
Specification: Energy range: above 390 ÷ 730 KeV



Conditions:

Test source No 1: ^{22}Na - 34 kBq
Test source No 2: ^{137}Cs - 20 µCi
Test source No 3: ^{137}Cs - 5 µCi
Test source No 4: ^{137}Cs - 60 µCi

1. Voltage measurements

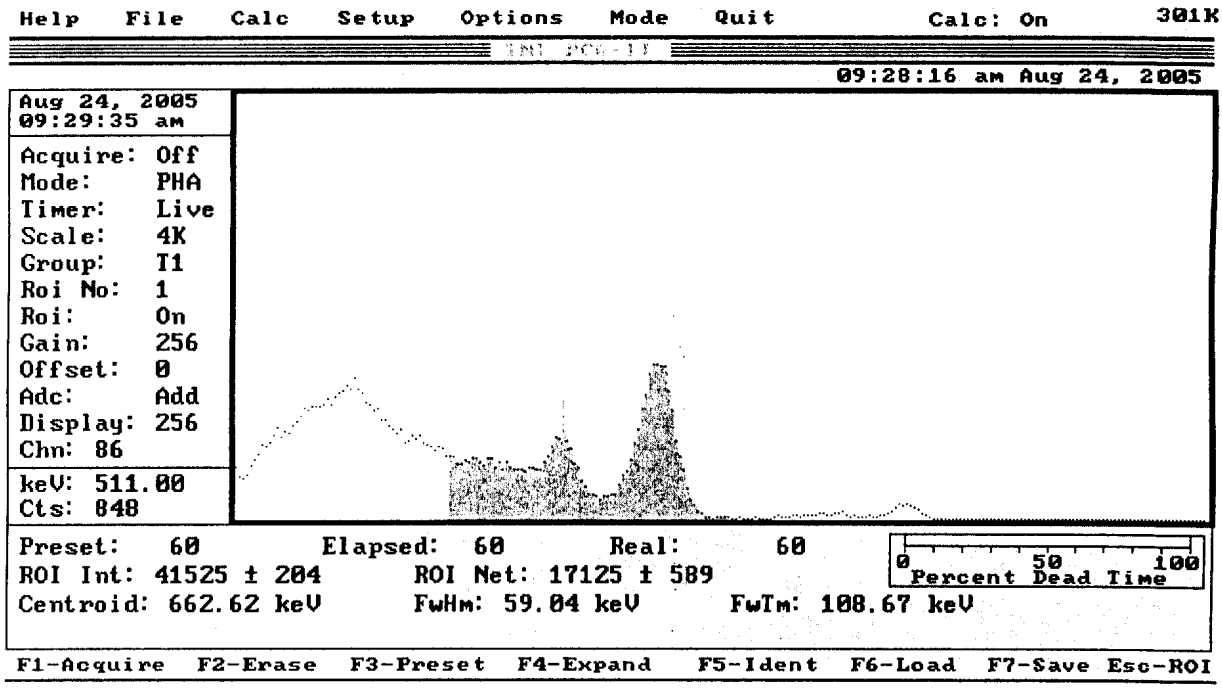
Test point	Expected value [Vdc]	Measured value [Vdc]
Tp - 2	4.0 ± 0.2	4.0
Tp - 3	3.7 ± 0.2	3.7
Tp - 4	2.2 ± 0.1	2.2
H.v	660 ± 5	665

2. Linearity Checks

Expected Value [cps]	Actual Reading [cps]	Comment	Error [%]	Test Source No	Distance [cm]
1.21k	1.25k	linearity	3.3	1	0
257	245	linearity	4.9	1	5
2.78k	2.82k	linearity	1.4	2	10
766	787	linearity	2.7	2	23
4.80k	4.55k	linearity	5.5	2	Jig1
9.40k	8.80k	linearity	6.8	2+3	Jig2
>5000	Overflow	Software Overflow	Overflow	4	0
<9	OK	Background	OK	-	-

ROTEM INDUSTRIES LTD.
ROTEM INDUSTRIAL PARK P.O. Box 9046 BEER SHEVA 84190, ISRAEL
Tel: 972-8-6564781, Fax:972-8-6568005, email: Laurence@rotemi.co.il

Spectrum Before Window



Spectrum After Window