

# INSTRUCTION MANUAL

## GAMMA AREA MONITOR



**TYPE : GA720**

## **NUCLEONIX SYSTEMS PRIVATE LIMITED**

Plot No : 162 A & B, PHASE II, I.D.A.Cherlapally, Hyderabad - 500 051

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## **UNPACKING**

The Gamma Area Monitor Type: GA720 has been thoroughly tested and is dispatched in ready to operate condition. However, on unpacking and prior to operation, it is advisable to check visually and make sure that there is no visible damage caused in transit.

If any damage to the instrument is observed, do not switch ON the unit and report the matter immediately to:

Customer Support Division  
Nucleonix Systems Private Limited  
Plot No: 162 A & B, PHASE II,  
I.D.A.Cherlapally,  
Hyderabad - 500 051.

Ph : 91-040-27263701/30918055, FAX : 91-040-27262146, e-mail : [info@nucleonix.net](mailto:info@nucleonix.net)

In all correspondence regarding the instrument, please mention the type, serial number of the unit, date of supply etc., of the unit.

## CHAPTER- I INTRODUCTION

Gamma Area monitor (Micro) Type: GA 720, manufactured & supplied by NUCLEONIX SYSTEMS is designed using state-of-art electronic devices (latest) including microcontroller with embedded code. Use of these devices makes it compact & highly reliable. Powerful embedded code adds-up and enhances its performances and gives extra advantage from the angle of fault diagnostics. This unit is primarily designed to indicate dose rates in the range of (0-100mR/hr).

This unit will be useful for monitoring Gamma dose rate levels in working areas of Radio Isotope Laboratories, Radiology departments, Medical & Industrial Radiological installations apart from its usefulness in Atomic Power Stations and other active labs.

This unit goes into acquisition mode directly after power on after the initial introduction & self check. It indicates dose rate digitally on 6x7 segment LED display as well a 16x2 LCD display. There are two visual annunciator lamp windows GREEN & RED for NORMAL & ACTIVE conditions. The ACTIVE window flashes once the dose rate alarm occurs and in normal condition the NORMAL lamp glows.

The user interface is through a front panel keypad comprising of EHT, PROG, INC, DEC, ACK & RESET keys. PROG key shows up different menu options on successive operation. INC, DEC are used to scroll / select various PROG options. ACK and RESET are used for acknowledging and resetting the unit during Active mode. The unit has user selectable options like Alarm preset level, Baud rate (for serial communication), Reset mode (auto or manual) and other system settings. Pressing EHT key displays the current EHT value in the detector probe.

For external detector arrangement the detector can be connected 10 meters away from the monitor through a cable arrangement.

Some important features of this unit are :

- Microcontroller based design has been employed
- Dose rate range covered (0.1 - 100)mR/hr
- Auto ranging & auto TC selection in the range of 16 sec to 0.5 sec depending upon dose rate
- Large size 6x7 segment LED indication for dose rate is provided
- Designed using LND GM tube type 712
- Large size WINDOWS for NORMAL & ACTIVE alarm condition
- 16x2 LCD display dotmatrix display for visualization & settings of various options

### VIEW OF GAMMA AREA MONITOR TYPE : GA720



## CHAPTER - II

### FRONT PANEL & SIDE PANEL CONTROLS

#### 2.1 FRONT PANEL CONTROLS

##### 2.1.1. NORMAL & ACTIVE LAMPS

The NORMAL lamp (GREEN) glows during acquisition mode until the dose rate exceeds alarm preset value. Once dose rate exceeds alarm preset value then the NORMAL lamp turns OFF and the ACTIVE lamp (RED) blinks. Once the dose rate falls below the preset level, then (i) if Reset mode is AUTO then it comes back to normal mode. (ii) if RESET mode is manual, then it comes back to normal mode only after RESET key is pressed.

##### 2.1.2. DOSERATE (mR/hr) [6x7 segment display]

This gives the visual display of the current dose rate in acquisition mode. On pressing EHT key it displays the current EHT value. It also displays fault conditions like EHT fail, Supply fail. It also displays the overrange indication by blinking the maximum dose rate.

##### 2.1.3. STATUS DISPLAY : [16x2 LCD dot-matrix display]

This is a 16 X 2 alpha numeric LCD dotmatrix and responds to all the commands from the keypad and displays dose rate in acquisition mode with "A" blinking. It also displays the different parameters like Preset alarm level, Reset mode, Audio status, Baud rate, Calibration adjustment, Audio frequency adjustment.

#### 2.2. SIDE PANEL CONTROLS

##### 2.2.1. MAINS

This is a 3 pin MS connector for connecting the power cable.

##### 2.2.2. ON

This is a toggle switch (inside the unit) which is used to power the unit. When the switch is put 'ON' the mains AC power is available to the unit.

##### 2.2.3. AUDIO ALARM

There is an audio alarm also which produces loud beeps alternately with the ACTIVE lamp. The audio alarm can be turned off by pressing ACK key. It can be made OFF permanently through the AUDIO ALARM - ON/OFF option in PROG menu.

**CHAPTER - III**  
**SPECIFICATIONS**

- Radiation detected** : X – ray & Gamma Radiation
- Range** : 0.1 mR/hr to 100 mR/hr
- Detector** : Halogen quenched GM tube LND712
- Accuracy** : +/-10% Full scale
- Display** : Auto – ranging direct reading, 6 digit 7 segment LED display & 16x2 LCD display. 6 x 7 segment display is interfaced using multiplexed display driver IC & used for display of dose-rate information. 16x2 LCD for visualization of preset alarm & other parameters.
- Time Constant** : Time constant varies continuously from 16 sec to 0.5 sec depending upon countrate
- Calibration Accuracy** : +/-10% throughout the range
- Calibration Stability** : Better than +/-10% over a period of six months
- Alarm range** : 0.1 mR/hr to 99.9 mR/hr  
Alarm setting accuracy & stability  
Better than +/-10% over a period of six months
- Alarm System** : a. Alarm indication is by flashing Red (LED) large area window display and Loud audio alarm  
b. Distinctive EHT / Detector failure alarm  
c. The instrument has alarm acknowledgement and Reset switches on front panel  
d. Provision for remote alarm acknowledge and reset  
e. Alarm annunciation scheme: as tabulated below

Condition	Visual indication (Red LED)	Audio
Normal	OFF	OFF
Abnormal (Active)	Flashing	ON
On acknowledgement after being abnormal	Steady Red	OFF
Reset after returning to Normal	OFF	OFF

- Monitor Enclosure** : Vapour-tight, rugged & elegant. The instrument can be offered with compliance to required IP standards.
- Mounting** : Monitor is wall-mountable type.
- Data Storage** : Microcontroller has on-chip EEPROM to store the preset alarm levels and other settings.
- Self-Diagnostics** : The monitor has built-in self-diagnostics. On being powered it performs tests to check for the High voltage supply, Detector and pulse processing electronics .
- Power** : 230 VAC +/-10%, 50 Hz, single-phase supply.
- Environment** : The instrument will be able to withstand temperature upto 60 deg C and relative humidity upto 90% in radiation areas.
- Front panel keypad** : Keypad provided on Front Panel facilitates user to configure & program the Area Monitor (deactivated by internal jumper selection).

## **CHAPTER - IV**

### **INSTALLATION**

This unit can be used as wall mounted unit or can be operated as a table top model. For wall mounting arrangement the unit is provided with suitable clamps to be fixed on to wall and hooks have been provided on the unit for hanging. The unit is provided with two handles for lifting and shifting purposes.

For installing the unit, Mains cord is to be fixed to the three pin circular connector on the unit side and the other side through the three pin plug to 230V A.C. mains supply.

Now the unit can be switched ON for use. Alarms can be preset to the desired level.

The unit goes into dose rate acquisition mode on power on after performing hardware self check. The dose rate in mR/hr is indicated both in the 6x7 segment display as well as in the 16x2 LCD display.

# CHAPTER – V

## OPERATING INSTRUCTIONS

**5.1. INTRODUCTION:** This chapter illustrates details on configuring and operating the instrument, for a desired installation in a plant environment. Basically, operating instructions are illustrated with the help of menu options / responses that appear on LCD / LED displays. Each of the menus facilitate the user to choose function/ value to be set or entered as desired for its operation, at the installed location.

An important note (to follow) for the user is

- ▲ - key can be used to increase the value at the cursor position / toggle the option.
- ▼ - key can be used to shift the cursor position from right to left / toggle the option.

**5.2 POWER ON CONDITION:** When instrument is switched on, initially, the audio visual observations noticed till the indications shown are stable is called **power on condition**.

When the power is switched on, the following audio visual indications are noticed. First, to start with, one audio beep is heard. Followed by this the following visual indications will be lit. Red cluster LED window will flash for a while and goes off. Followed by this, normal cluster LED window will be lit, additionally other LED's for "dose rate unit" indication will all glow for a while and default selected unit LED will lit permanently. The status of LCD and large LED display with power on condition is given in the following table.

When we switch ON the unit, the LCD display will show-up

LCD display

AREA GAMMA MONITOR
-----------------------

for 1 sec

Then

NUCLEONIX SYSTEMS
----------------------

for another 1 sec

Followed by this, unit goes into acquisition mode and displays the following on

½ " LED display

XXX.XX
--------

And 16x2 LCD display

XXXX.XX mR/hr A
-----------------

Character 'A' blinks indicating that dose rate acquisition is ON & mR/hr unit is default unit, stored.



### 5.3 ENTER PASSWORD

Now to program & configure the unit for desired functions or to change preset values, user has to go through 'PROG' button / key. Different menus will appear as follows. On pressing 'PROG' key first time unit will display menu as follows, prompting the user to enter factory set four digit PASSWORD

ENTER                    ^
PASSWORD : XXXX

To enter the password use ▲ or ▼ keys. If the password entered is correct then it will go to next option of the menu as given below & facilitates the user to enter 'ALARM SET POINT'.

### 5.4 ALARM SET POINT

GA720 will show the current default alarm set value of 5.00 mR/hr. If user wants he can change to another value, by ▲ or ▼ keys.

ALARM SET
POINT :    XXX.XX

Once alarm set point is programmed, user can Press 'PROG' key once again to go to next option in the menu i.e., given below.

### 5.5 RESET MODE

RESET    AUTO/MANU
MODE

'RESET' option user can either set it as AUTO or MANU (manual). In manual reset, user has to press the RESET button to bring back the unit into normal mode, once the dose rate falls below the alarm set point. In auto mode, once the dose rate falls below the alarm set point, the unit automatically returns to normal mode and the alarm condition is turned off. AUTO/MANU option can be selected by ▲ or ▼ keys. Default setting is = **Manual**

Once RESET MODE, option is selected user can now press 'PROG' button to go to next menu option i.e 'Audio Status'

### 5.6 AUDIO STATUS

There are FOUR options, for the user and any one of the options can be selected by ▲ or ▼ keys.

D = TONE / TONE 2 / TONE 1 / OFF
----------------------------------

These four options include dual tone, Tone2, Tone1 & off mode. Once this option is selected then press 'PROG' key to go to next menu option 'BAUD RATE'. Default setting is = **D TONE**

### 5.7 IP ADDRESS

XXX.XXX.XXX.XXX

### 5.7 BAUD RATE

Baud rate is to be selected for data communication in a networked environment for RS485 communication. There are two options as indicated in LCD display.

BAUD RATE 9600/19200

One can select any of the two options for baud rate by using by ▲ or ▼ keys. Having done that, user can go to next option by pressing 'PROG' key. The next option that appears in LCD display is hardware check. Default setting is = **9600**

### 5.8 HARDWARE CHECK

Hardware check can be performed by ▲ or ▼ keys.

HW. CHK

This checks LV supplies & EHT. If these are found to be alright, display prompts with an indication as 'OK'. Following this indication user can now go to the next option in menu by again pressing 'PROG' key. This prompts a menu as 'calibration factor'.

### 5.9 CALIBRATION FACTOR

This is a feature provided in the design, to facilitate the user to set calibration factor such that the calibration accuracy is within specified range. It may so happen that detector to detector sensitivity may slightly vary & by setting this value suitably one can get desired calibration accuracy. Range provided is 0.75 to 1.25 for calibration factor.

CALIB. XX.XX  
FACTOR

By default it is set to 1.00 default. If user wants to go through calibration again, after changing the calibration factor, he may do so. Having set this & upon pressing 'PROG' key, the next menu option that appears is SET UNIT.

### 5.10 SET UNIT (setting of Engineering unit)

Here there are four options that appear in the LCD display as shown below

SET UNIT mR/hr /  $\mu$ Sv/hr / cps / cpm

User can select any one of the four units as required by his plant / facility. However by default, mR/hr unit is set at factory. Selection is by ▲ or ▼ keys. The next menu option that will appear, on selection of 'PROG' key after this above function set, is 'DEVICE ADDRESS'.

Default setting is = **mR/hr**

**5.11 DEVICE ADDRESS**

This is a three character numerical value. This is RS485 address of the instrument limits 0 - 255  
Default settings is = 000

DEVICE ADDRESS      XXX
----------------------------

User can select desired three digit address (ID) of the instrument. Use ▲ or ▼ keys to load this value. Having completed this task press 'PROG' button for the next menu i.e., 'AUTO ACK'

**5.12 AUTO ACKNOWLEDGE**

This is a selection option for alarm Ack

AUTO ACK    ON/OFF (5 min)
-------------------------------

By ▲ or ▼ one can select or toggle this option. If it is selected as ON, after 5 minutes automatically alarm is acknowledged & audio alarm goes 'MUTE'. However visual alarm remains active. Followed by this the next menu option is 'MAX SCALE' which is prompted on pressing 'PROG' button. Default setting is = **OFF**

**5.13 MAX. SCALE**

Depending on the unit chosen i.e., mR/hr or μSv/hr or cps or cpm, the maximum permissible scales are 100, 1000, 2000 and 50,000 respectively. User can choose any value upto a max of this upper limit & a value above the minimum value. Any value chosen out of these boundaries will be ignored, (at the time of saving settings) and default values will be loaded . In the display, chosen unit will appear & appropriate max value desired can be entered by the user. Similar is the case for other units such as μSv/hr, cps or cpm. After selection of max. scale, user can now select 'PROG' button to go to next menu option, as follows. Default setting is = **100.00mR/hr**

MAX mR/hr (4-20mA)      XXX.XX
-----------------------------------

**5.14 MIN. SCALE**

MIN mR/hr (4-20mA)      XXX.XX
-----------------------------------

Depending on the scale selected initially, appropriate unit (i.e typical mR/hr) appears in the display. User cannot enter the min. scale value which is equal or above the max. scale value selected. Any value not meeting boundary conditions will be ignored while saving the settings & default value will be loaded. Similar if the engineering unit changed then the min. & max. scales are tabulated as follows,

Engineering Unit	Max. scale (4-20mA)	Min. scale (4-20mA)
mR/hr	100.00	000.00
μSv/hr	1000.0	0000.0
CPS	2000	0000
CPM	50000	00000

Followed by this, on pressing 'PRG' button, the following menu appears 'load default settings?

**Note :** Max. & Min. scales are primarily for current loop scaling, for control room operation. Also, in the visual LED display also the same scales are set. Any value exceeding this max. scale will show as over range, as per definition in the LED display However in the lower LCD display it continues to show dose rate, as per actual value. Default setting is = **000.00mR/hr**

#### 5.15 LOAD DEFAULT SETTINGS

In case the user wants to retain default settings, he can skip all the previous menus & select this menu & chose option by pressing ▲ or ▼ key for default settings.

LOAD DEFAULT  
SETTINGS?

Followed by this selection & upon pressing 'PROG' key one would see the menu as given below.

#### 5.16 MODIFY PASSWORD

MODIFY  
PASSWORD YES/NO

If user wants to change the pass word, he can do so by ▲ or ▼ key. Select no option to retain same password. Having done that, finally we have completed all the 'PROG' button functions & are ready to save settings. The next menu that appear as given below.

#### 5.17 SAVE SETTINGS

SAVE ?  
SETTINGS

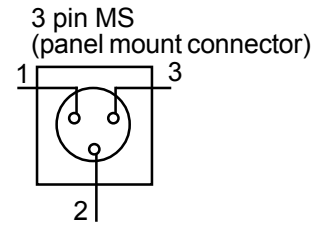
Use ▲ or ▼ keys to save all the above settings. These are permanently stored in the EEPROM and will be recalled at next powering on of the instrument. Having configured for required settings unit is now ready for operation, once settings are saved unit automatically gets into operation mode and starts acquiring dose rates and indicates in the display visually.

## CHAPTER - VI

### SIDE PANEL CONNECTOR DETAILS

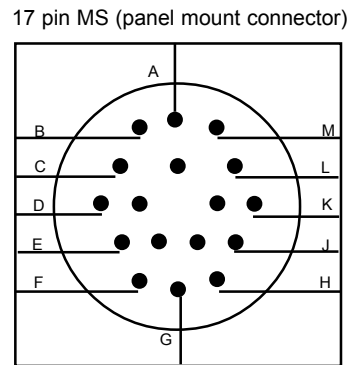
**a. 3 pin MS Male connector (Mains)**

Pin Number	Signal
1	Live
2	Neutral
3	Chasis/Earth/GND



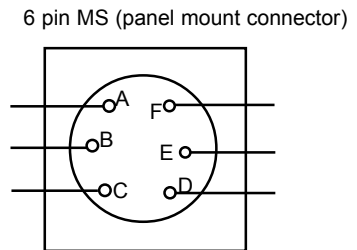
**b. 17 pin MS Male connector (EXT I/O)**

Pin Number	Signal
A,B,C,D,E,F	No Connection
G	COM Changeover II
H	N/C Changeover II
J	N/O Changeover II
K	COM Changeover I
L	N/O Changeover I
M	N/C Changeover I
N,R,P	No Connection



**c. 6 pin MS connector Male connector (To Detector Probe)**

Pin Number	Signal
A	GND
B	+5V
C	RS-485 ("A") (For connecting to detector side)
D	RS-485 ("B") RS485 Transceiver)
E	Fraction of HV
F	NC



## CHAPTER - VII

### CALIBRATION

#### Procedure for Calibration with Source

This unit namely Gamma Area Monitor Type GA 720 has been calibrated at Radiation Standard & Calibration Lab of Nucleonix Systems (P) Ltd., using Gamma Survey Instruments Calibrator of AEA Technology, USA. It operates in the range of Dose rate mode (0.1 mR/hr – 100mR/hr) for Gamma Radiation.

#### Calibration Procedure with Gamma Source (Cs – 137 – 136.742mCi)

The instrument is calibrated with gamma instrument calibrator of Nucleonix Associates. This comprises of a 164 mCi – 137 gamma source traceable to NIST.

The monitor is pre-loaded with a lookup table for computation of dose rate. To calibrate instrument with source, expose the detector to below dose rates and record the observed dose rates. Detector axis is to be perpendicular to source beam. Keep the source at marked up positions for various dose rate and observe the monitor reading.

Expected Doserate (mR/hr)	Observed Doserate (mR/hr)
0.0 mR/hr	
1.0 mR/hr	
5.0 mR/hr	
10.0 mR/hr	
20.0 mR/hr	
50.0 mR/hr	
100.0 mR/hr	

**Very Important Note :** Please note that for a required dose-rate, always choose to keep detector probe at maximum possible distance from source with minimum no. of lead block attenuators. This is to prevent scattering effect due to attenuator blocks at close distance (<50 cm)

Now in case a reading exceeds the tolerance of +/- 10%, of expected dose rate then adjust calibration factor or monitor such as to make entire readings fall within +/- 10% of expected dose rate.

When the manual is dispatched to the customer, calibration factor is to be mentioned below and also saved in the instrument program.

#### Over Load Test

#### Passed

- |     |                         |        |
|-----|-------------------------|--------|
| (a) | 10 Times Highest Range  | Yes/No |
| (b) | 50 Times Highest Range  | Yes/No |
| (c) | 100 Times Highest Range | Yes/No |

Calibration Factor : \_\_\_\_\_ Calibrated by : \_\_\_\_\_

Calibration Date : \_\_\_\_\_ Instrument S.No. : \_\_\_\_\_

Calibration Due : \_\_\_\_\_

Tested By : \_\_\_\_\_ Approved By : \_\_\_\_\_

Date : \_\_\_\_\_ Date : \_\_\_\_\_

## CHAPTER - VIII

### AVAILING OF MAINTENANCE/ CALIBRATION SERVICES AND WARRANTY CLAUSE (with in India)

#### 8.1 GENERAL

As per the warranty clause of the company, we provide one year warranty during which period we provide free service at our works. Hence in case of any mal-function in our instruments, you are requested to send the unit back to our works by RPP/COURIER/SPEED POST PARCEL/GATI/XPS/door delivery. We shall arrange immediate rectification/replacement within two weeks from the date of receipt of the equipment at our place. Please note that the equipment will be serviced at our works only.

The equipment is to be sent to:

The Servicing Department  
NUCLEONIX SYSTEMS PRIVATE LIMITED  
Plot No: 162 A & B, PHASE II, I.D.A. Cherlapally,  
Hyderabad - 500 051 Ph: 040-27263701/329145448/32918055  
E-mail: info@nucleonix.com www.nucleonix.com

For all the Radiation monitoring equipment, detectors built-in or external probes will not have one-year warranty, but only inspection warranty at the time of supply is provided. Since detectors will / may have fragile glass construction, we do not provide warranty. In case of failure of these components, Nucleonix will supply detector replacement at cost-cost price.

**Note:** In respect of all types of portable radiation monitors, it may be necessary to checkup and recalibrate the equipment once a year at our works.

#### 8.2 EQUIPMENT REPAIRS / SERVICING POLICY (WITH IN INDIA)

##### (a) During Warrantee

The following procedure is to be followed by the customers with in India for availing services/ repairing facility during warrantee period.

- Equipments are to be sent to our works for availing free repair services during warrantee, after the customer receives approval from the customer support division, by sending an e-mail.
- For all equipments, costing less than 6.0 lakhs one year warrantee & free service is offered, when the equipments are sent to our works only. For larger systems such as installed systems, networked systems, specialized systems, costing more than 6.0 lakhs during one year warrantee, free service is offered at site. Field service Engineer will be deputed subject to warrantee terms & conditions.
- This does not include personal computer related problems, for which local computer service provider of the PC vendor is to be contacted. Also for software related problems online support will be provided. Software support doesn't include cleaning of virus problems etc.
- When the equipments are sent to our works for warrantee services, they are to be properly packed with adequate cushion to prevent any transportation damages. Nucleonix Systems is not responsible for damages or loss during transportation.
- Packing / Freight charge is to be borne by customer when he sends the equipment to our works. However when we return after servicing packing will be Nucleonix responsibility & Freight charges will be to your account. Only services are free.
- Please indicate in your correspondence equipment model & serial number.
- All the equipments are to be sent to our works only on door delivery basis.
- For Door Delivery Transportation contact XPS/GATI cargo in your city / town or a reliable courier service to pick the consignment from your place. For their nearest local address & phone no's look into their websites. Transit insurance if the customer feels is necessary it is to be covered.
- Nucleonix Systems will not receive the equipments sent by other modes of transportation, such as Rail/Road.
- After servicing, equipments will be sent back by same mode of transport such as XPS/GATI/COURIER/ RPP.

- All types of Radiation detectors, glass ware, PMTs etc which are fragile are not covered in warrantee, if the failure is due to physical damage, external or internal due to shock, dropping, miss-handling etc. If the failure is due to a natural fault then only it is covered under warrantee for a limited period of three months. However complete electronics is covered for 1 year warrantee.
- You can also send the equipment personally to our works for repairs either during or after warrantee, after fixing up with our service dept (Customer Support Division). If possible we may repair on same day or your person can stay for a day or two & get it repaired & or calibrated.

**(b) After warrantee Services**

- On expiry of 1yr warrantee if you like to send the equipment (low cost less than 6.0 lakhs) for repairs to our works, you may please observe the following procedure.
- Send an e-mail with details mentioning that you agree to pay service charges which includes: Basic service charges per unit / module in the range of Rs: 2500 to Rs : 10,000 depending on the sophistication of the unit calibration charges ( if applicable for your equipment) + cost of components + packing charges + Return Freight charges @ actual.
- Once our customer support department responds & requests you to despatch the equipment to our works for repairs, you may do so by following the steps given below.
- Followed by this you can send the equipment straight away if it is within 5 yrs old. If the equipment is beyond 5 yrs old, then also you can send it for repairs, however only after you receive confirmation from Customer Support Division, that it is repairable & is not an obsolete model. If the design is obsolete then customer support division (CSD) may give you 'buy back' offer to replace with new model or upgrade it with electronic circuit boards & enclosure.
- For all installed equipments costing above Rs: 6.0 lakhs which are larger in size & for which field servicing only is recommended, you can obtain a quotation with relevant details by sending an e-mail & avail the services accordingly.
- For all field servicing jobs, since we need to depute engineers, it is likely, to take time & also it will cost more which includes Engineer's TA & DA etc., apart from basic service charges + cost of spares etc. Please note that basic service charges will be different for different products depending upon sophistication.
- Also in some cases it may not be possible to fix-up the problems in the field itself, in such cases we may advise you to send them to our works.
- For all jobs to be serviced in the field, customer is requested to provide adequate details on the nature of problems, to enable our engineer to come prepared with adequate spares.
- For any additional information send an e-mail to info@nucleonix.com, Atten: Customer support division.

**8.3 EQUIPMENT REPAIRS / SERVICING POLICY (FOR EXPORTS)**

Equipments, manufactured & exported are subjected to a well defined quality assurance (QA) plan & Factory acceptance tests (FAT). Nucleonix systems has the following policy to provide maintenance support to overseas customers either directly or through international dealers / distributors.

**(a) During & after warranty:**

- For minor problems, which can be handled by customers, servicing tips have been provided in the user manual / servicing manual.
- Also most of the equipments have built-in fault diagnostic features which will indicate to the user nature of problem in the equipment. Based on the visual indication in the instrument Display, user can take corrective action or contact Nucleonix systems by email for help.
- Nucleonix systems will guide in localizing the defective part / module or sub-system by interacting with the customer if required. Skype will be used for communication.
- During warranty free replacement of sub-system or board (PCB) will be done. However customer has to send defective sub-system back to Nucleonix system with-in 15 days on arranging replacement.
- During & after warranty, any Freight charges & customs clearance charges are to be borne by customers, both ways.
- If it is a manufacturing defect, then Nucleonix system will bear the replacement cost of sub-system / unit. However any Freight charges & customs clearance charges in their country are to be borne by customer.
- After warranty, services will be similar to that of services during warranty. However, customer will have to pay for cost of parts replaced, freight charges both ways & customs clearance charges in both the countries. Nucleonix systems plans to introduce audio visuals on web or on CDs to facilitate product demonstration, installation & minor maintenance very soon.



#### 8.4 HOW TO AVAIL CALIBRATION SERVICES (FOR INDIAN CUSTOMERS)

Nucleonix Systems offers radiation calibration services to its customers. Calibration services are provided for Nucleonix Systems manufactured products only, in general, as a company policy.

How to avail calibration services:

It is best advised that each of the Radiation monitors including Area monitors are calibrated once in a year. When you want to send your Radiation monitor / Area monitor / Contamination monitor for calibration to our works. You may send the equipment for calibration, by following the steps given below:

1. Our standard calibration charges per equipment (All types of Radiation monitors including portable survey meters, contamination monitors & Area Gamma Monitors) are Rs: 2500 + Packing + Freight charges. You can email a 'work order' accepting these charges.
2. Email your work order and despatch / send the equipment to our works if it is 5 years old or less including details of mode of transport sent with docket particulars.
3. Also mention in your work order & clearly indicate that you will agree to pay calibration charges & also equipment repair charges additionally if the unit is faulty & requires repairs before one can take it up for calibration.
4. You are requested to ensure good packing to avoid any transportation damages. Especially if there are external detector probes, they are to be packed with sufficient soft foam to ensure no damage in transportation.
5. Use only the specified following mode of transportation system for dispatching on door delivery basis. XPS/GATI cargo / Courier/RPP/Speed Post parcel etc. Send the equipment on freight paid basis. (Equipments sent by other methods such as Rail/Road etc will not be collected). Also you can cover for transit insurance both ways if you wish. Nucleonix system is not responsible for any transportation damages or loss during transportation both ways.
6. Immediately on receipt of the equipment, we will send an acknowledgement & also a proforma bill by email/ post.
7. Based on the proforma bill, once we receive the payment, equipment will be dispatched back by similar mode of transportation as mentioned above.

#### 8.5 HOW TO AVAIL CALIBRATION SERVICES (FOR FOREIGN CUSTOMERS)

Foreign customers can calibrate Nucleonix make Radiation monitors/equipments in their country at any of their accredited Radiation calibration labs. Nucleonix systems will be happy to provide any help and guidance if needed, for calibration. Alternatively if you send the equipment here to India we can also provide calibration services.

Calibration Standards Lab & Facility:

We have two calibration labs.

- i. Low Level Calibration Lab.
- ii. High Dose Rate Calibration lab.

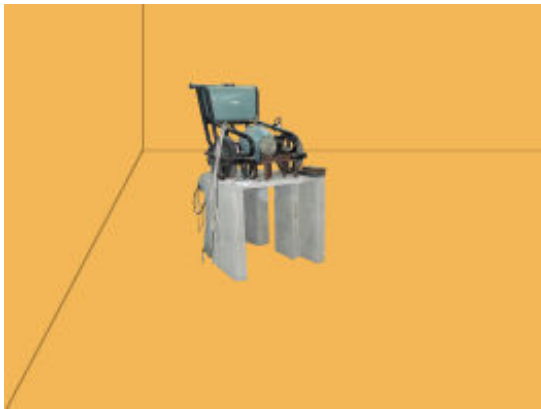
**Low Level Calibration Lab:** This has a Cs-137, 165 mCi standard. "Gamma Survey Instruments Calibrator" from Amersham.

This calibration service has NIST Traceability standard. Calibration of all portable radiation monitors, survey meters, contamination monitors, Area monitors etc., is carried out in this lab upto 1 R/hr max dose rates.



Gamma Survey instruments calibrator has Cs-137 source 161.5 mCi as on 05 Aug 2002. It is basically a gamma survey instruments calibrator procured from AEA Technologies UK/USA. Has NIST traceability accuracy within +/- 7%

Gamma Survey instruments calibrator has Cs-137 source 161.5 mCi as on 05 Aug 2002. It is basically a gamma survey instruments calibrator procured from AEA Technologies UK/USA. Has NIST traceability accuracy within +/- 7%



CRC-2 camera has Co-60 standard obtained from Bhabha Atomic Research Centre, Mumbai. It is a certified source.

## 8.5 ANNUAL MAINTENANCE CONTRACT (AMC)

### **Annual maintenance contract (AMC) services:**

For all sophisticated instruments & systems and also for installed monitors & networked systems in a nuclear facility or a Radiological lab or in a Medical cyclotron facility where no. of instruments are networked, it is advised that customer enters into an economical Annual maintenance contract with Nucleonix system.

Detailed AMC proposal can be obtained from our customer support division (CSD), by giving required inputs.

### **Inputs required by our CSD to send you AMC proposal:**

- Name, year & date of purchase, Sl. Nos. of equipments, Model No's, No. of equipments for which AMC is required. Additionally no. of calls per annum required for preventive & breakdown maintenance may also be indicated.

### **Advantage of entering into AMC:**

- Equipment services offered will be prompt & timely
- Nucleonix systems maintain required spares, spare tested PCBs, detectors & other critical components which may become obsolete.
- Obsolescence in electronics is quite rapid. If you enter into AMC guaranteed service for the period of AMC will be the responsibility of Nucleonix Systems.
- Nucleonix Systems will maintain Engineers at your disposal to attend to AMC calls on time
- Without AMC prompt service calls are not guaranteed.
- If some critical components become obsolete, then Nucleonix systems may request you to upgrade the product with new model or new electronics which may be expensive if you are not under AMC.

### **Training on maintenance / servicing:**

- To a limited extent, we offer training on maintenance / repairs at our works to customers on chargeable basis. Details can be obtained from our customer support division, by customers who may require such services.

## CHAPTER - IX

### BLOCK DIAGRAM DESCRIPTION

Area gamma monitor GA720 is shown in block diagram on the next page. It mainly consists of two parts.

- (a) Detector probe with associated electronics &
- (b) Main measuring unit with majority of  $\mu\text{C}$  based functional electronics & embedded code.

#### 9.1 DETECTOR PROBE ELECTRONICS

This consists of energy compensated detector 71210 or its equivalent, with pulse processing electronics, TTL to RS485 converter and +500V, HV module for detector biasing. Detector output signals generated from RS485 transmitter chip are fed to main PCB through 5 pin I/O cable, connected to the Electronic unit. These signals are received by RS485 receiver chip & counted by a 6 digit BCD counter in the main PCB. The output of this counter is read by micro-controller continuously. The +5V power supply, required for HV module and pulse processing SIL chip, generated on main board, is taken through a 5 pin I/O cable, to this detector probe unit.

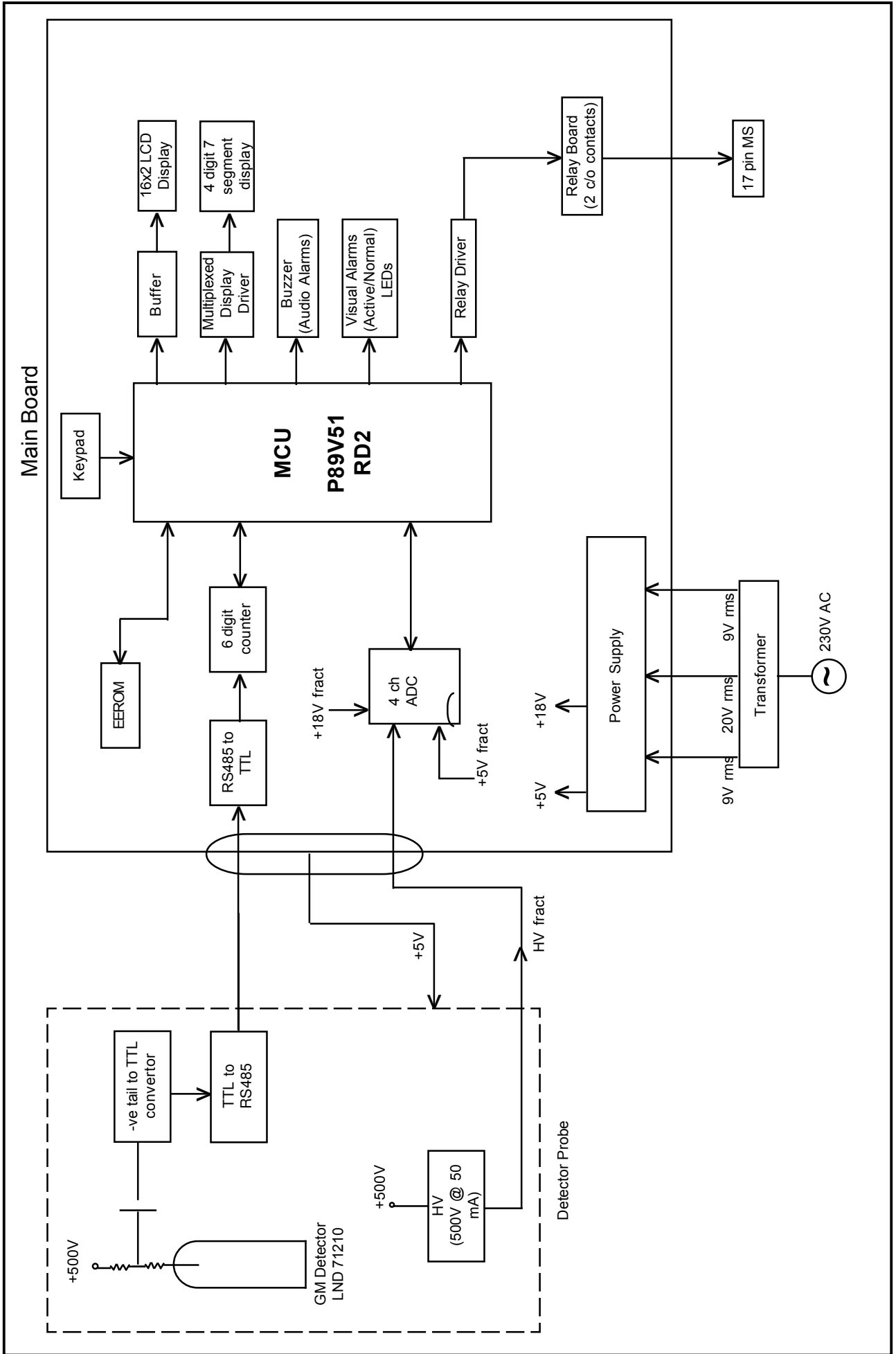
#### 9.2 MAIN PCB CIRCUITS

Low voltage supplies +5V, +18V, & +5V<sub>ISO</sub> are generated through mains transformer, secondary & three terminal regulator chips. All these supplies are used internally to power-up various circuits, for their functionality. A four channel ADC reads fraction of HV & LVs & reports to micro-controller under program control to indicate HV & LV failures if any to the user.

User interface to GA720 is through keypad command buttons EHT, PROG, INC, DEC, ACK & RESET. These keys enable the user to configure & select various programmable options such as alarm set point, unit of measurement, baud rate for communication, calibration factor & many more such functions etc., EEPROM serves as a memory device to store all the configured parameters including instrument ID etc., There are two visual displays provided (a) 16x2 LCD display & (b) 6 digit 7 segment LED display, driven by multiplexed display driver. LCD display indicates all programmable functions & their values while programming & it also indicates, dose rate, in acquisition mode (normal situation).  $\frac{1}{2}$  " LED display indicates dose rate in the selected unit (such as mR/hr or  $\mu\text{Sv/hr}$  or cps or cpm)

The other interfaces to micro-controller include;

- Visual alarms (ACTIVE & NORMAL) cluster LED array GREEN & RED with their driver circuit to indicate alarm & normal condition.
- A relay driver with relay PCB provides two sets of change over contacts for external use. This relay is in energized condition in NORMAL condition of area gamma monitor & in de-energized state in ACTIVE condition.
- For data transmission from area gamma monitor to SCADA, an RS485 interface has been built using TXD & RXD pins of micro-controller. This facilitates area gamma monitors RS485 networking for data communication. These RS485 signals have been brought out on a pair of 9 pin D-connectors (male / female) for RS485 daisy chain connection of devices. Additionally these signals are made available on 17 pin also. Most of the interfacing devices or circuits or peripheral chips are connected to micro-controller through I2C bus, or ports or I/O expanders etc., for interfacing.



## CHAPTER - X

### FACTORY ACCEPTANCE TEST / QA REPORT / CALIBRATION DATA

**FACTORY ACCEPTANCE TEST  
REPORT  
FOR  
AREA GAMMA MONITOR**

**MODEL NO. : GA720**  
**SI. No. :**  
**Date :**

#### **NUCLEONIX SYSTEMS PRIVATE LIMITED**

Plot No: 162 A & B, Phase II, I.D.A. Cherlapally, Hyderabad - 500 051.  
Ph: 91-040-27263701, Fax: 27262146, e-mail: info@nucleonix.com

Document Name : FAT Procedures for GA720

**QC REPORT FOR GAMMA AREA MONITOR  
TYPE: GA720**

Sl.No :

Date:

**1. MECHANICAL INSPECTION (HARDWARE FIXTURES):**

No	Description	Observation	
•	Hardware fixtures	Check the dimensions of the unit	OK/NOT OK
•	Front panel control	Check the keypad, displays & lamp stickers properly or not	OK/NOT OK
•	Side panel control	Check socket of main card 3 pin,5 pin I/O connecter	OK/NOT OK
•	Inside of the unit	Check proper mounting of PCB Transformer, relay etc	OK/NOT OK
•	Labels of main unit	Check for labels of front & side panel of each connector	OK/NOT OK
•	Label of GM probe	Check for the labels of probe (direction & axis of detector)	OK/NOT OK

**2. PAINTING / PLATING / ANODIC PRINTING:**

No	Description	Observation	
•	Box painting	Check the color of unit (Dark gray (s))	OK/NOT OK
•	Anodic printing	Check whether the unit is according to NSPL standard or not.	OK/NOT OK
•	Inside chassis irradiating	Check whether the unit is according to NSPL standard or not.	OK/NOT OK
•	Front panel	Check the printing of letters are polycarbonate stickers pasted properly or not	OK/NOT OK
•	Heat shrink	Check whether the cable is having proper heat shrink with sleeve or not	OK/NOT OK
•	Jumpers	Check whether all appropriate jumpers are placed or not.	OK/NOT OK

### 3. FUNCTIONAL TESTING:

No	Description	Observation	
•	Status at the time of switch ON	The unit should go to acquisition mode on 'Switch ON' and & is displayed in both x segment and LCD display respectively.	OK/NOT OK
•	Testing of front panel key pad	Check the front panel keys for about 20 times each.	OK/NOT OK
•	EHT key	Check whether EHT value 500 is displayed on 7 segments LED display ON pressing EHT key.	OK/NOT OK
•	Programme Key	Check whether all the items are displayed or not on pressing PRG key.	OK/NOT OK
•	ACK and RESET keys	Check whether Ack and reset keys are working properly in ACTIVE condition.	OK/NOT OK
	Proper working of lamps		
	(i) Normal and Active lamp	Active lamp glows once the dose rate exceeds preset level	OK/NOT OK
	(ii) Alarm	Unit gives loud audible sound when the alarm mode in ON.	OK/NOT OK
•	Working of alarm status	Check proper working of alarm status and Alarm Acknowledge and Reset.	OK/NOT OK
•	Power supply and EHT	Power supplies & EHT having rippled within specified limits and to recheck with the data available with test engineers.	OK/NOT OK
•	Source calibration	Check proper response of the unit with check source and high range source.	OK/NOT OK
•	Calibration factor	Check for correct calibration factor saved or not.	OK/NOT OK
•	Burn-in test	Check for proper working of the unit for 168 hours continually with out any failure.	OK/NOT OK
•	Heat shrink sleeve	Check for proper heat shrink sleeve for all cables.	OK/NOT OK
•	Cables	Check for proper cable lengths as per purchase order.	OK/NOT OK
•	Specification check list	Check for all specifications incorporated as per PO.	OK/NOT OK

**SOURCE CALIBRATION & CORRESPONDING VOLTAGE, CURRENT LOOP VALUES :**

<b>CPS</b>	<b>Expected Dose rate</b>	<b>Observed Dose rate</b>
18	1 mR/hr	
90	5 mR/hr	
180	10 mR/hr	
360	20 mR/hr	
900	50 mR/hr	
1800	100 mR/hr	

<b>Over Load Test</b>	<b>Passed Status</b>	
	<b>Yes</b>	<b>No</b>
(a) 10 Times Highest Range		
(b) 100 Times Highest Range		

**4.MECHANICAL INSPECTION (HARDWARE FIXTURES)**

<b>No</b>	<b>Description</b>	<b>Observation</b>	
1.	Inside the unit	Check proper fixing of PCB and all connectors.	OK/NOT OK
2.	Labels of main unit	Check for labels of front and side panels of each connector.	OK/NOT OK
3.	Labels of GM probe	Check for the labels of GM probe.	OK/NOT OK
4.	Dropping test	Dropping test from height of 1meter 6times on thermocol and recheck for proper operation	OK/NOT OK
5.	Packing quality	Check for proper packing of the unit with thermocol sheet.	OK/NOT OK
6.	Clamps	Check the fixed clamps are supplied with unit for wall mountable.	OK/NOT OK
7.	Manual and spares	Check for proper user manual and spares supplied with unit.	OK/NOT OK

TESTED BY:

APPROVED BY:

DATE:

DATE:



## AREA GAMMA MONITOR (TYPE: GA720)

### CALIBRATION DATA

Name of the Customer :

Work Order No :

Unit Sl.No. :

Calibration Date :

Calibration Factor :

Calibrated by :

Name of the calibration device used : Cesium Cs-137, 137mCi Standard Calibration Device (NIST traceable). (source certificate & calibration certificate of the device is also enclosed)

#### **CALIBRATION DATA:**

EXPECTED DOSERATE mR/hr	OBSERVED DOSERATE mR/hr	Tolerance	Remarks OK / NOT OK
1		+/- 10% (0.99 – 1.10)	OK
2		+/- 10% (1.80 – 2.20)	OK
5		+/- 10% (4.50 – 5.50)	OK
8		+/- 10% (7.20 – 8.80)	OK
10		+/- 10% ( 9.00 – 11.00)	OK
20		+/- 10%(18.00 – 22.00)	OK
50		+/- 10% (45.00 – 55.00)	OK
80		+/- 10% (72.00 – 88.00)	OK
100		+/- 10% (90.00-110.00)	OK

Calibration Accuracy: Is found to be within +/- 10% with respect to Cs-137 standard.

**CHECKED BY:**

**APPROVED BY:**

**J.DHEERAJ REDDY (RSO)**



**AEA Technology  
QSA Inc.**

40 North Avenue  
Burlington, MA 01803  
Telephone (781) 272-2000  
Telephone (800) 815-1383  
Facsimile (781) 273-2216

# Source Certificate

Radionuclide : Cesium-137

Source Model : 77302

ISO/ANSI Classification : C66546

Source Serial : S-1028

IAEA Special Form Certification : GB 24 /S

Measured Equivalent Activity : 161.5 millicuries on 05-Aug-02

Source Physical Size :

Diameter : 0.118 in 3.00 mm  
Length : 0.118 in 3.00 mm  
Maximum : 0.167 in 4.24 mm

Quality Control Tests

Wipe Test A : < 0.001 µci  
Wipe Test B : < 0.001 µci  
Test Date : 05-Aug-02

Decay Data

Date	Activity (MilliCuries)	Date	Activity (MilliCuries)
05-Aug-02	161.5	26-Dec-09	136.1
03-Nov-02	160.6	26-Mar-10	135.4
01-Feb-03	159.7	24-Jun-10	134.6
02-May-03	158.8	22-Sep-10	133.8
31-Jul-03	157.9	21-Dec-10	138.1
29-Oct-03	157.0	21-Mar-11	132.3
27-Jan-04	156.1	19-Jun-11	131.6
26-Apr-04	155.2	17-Sep-11	130.8
25-Jul-04	154.3	16-Dec-11	130.1
23-Oct-04	153.4	15-Mar-12	129.3
21-Jan-05	152.6	13-Jun-12	128.6
21-Apr-05	151.7	11-Sep-12	127.9
20-Jul-05	150.8	10-Dec-12	127.1
18-Oct-05	150.0	10-Mar-13	126.4
16-Jan-06	149.1	08-Jun-13	125.7
16-Apr-06	148.3	06-Sep-13	125.0
15-Jul-06	147.4	05-Dec-13	124.3
13-Oct-06	146.6	05-Mar-14	123.6
11-Jan-07	145.8	03-Jun-14	122.9
11-Apr-07	144.9	01-Sep-14	122.2
10-Jul-07	144.1	30-Nov-14	121.5
08-Oct-07	143.3	28-Feb-15	120.8
06-Jan-08	142.5	29-May-15	120.1
05-Apr-08	141.7	27-Aug-15	119.4
04-Jul-08	140.9	25-Nov-15	118.7
02-Oct-08	140.1	23-Feb-16	118.1
31-Dec-08	139.3	23-May-16	117.4
31-Mar-09	138.5	21-Aug-16	116.7
29-Jun-09	137.7	19-Nov-16	116.1
27-Sep-09	136.9	17-Feb-17	115.4

AEA Technology plc registered office  
329 Harwell, Oxfordshire OX11 0BA  
Registered in England and Wales  
number 3093862

**FA**mersham QSA

40 North Avenue  
Burlington Massachusetts

## GAMMA RAY SOURCE CALIBRATION

Isotope Cesium <sup>137</sup>	Half Life 30.2years	Rhm/Ci 0.32	Test No. 5923
Date Measured 05-AUG-2002	Source Identification S-1028	MilliRoentgens/hr at 1 meter 51.7	MilliCuries 161.5

Source exposure conditions :

In calibration device model 773, serial number 397

The gamma-ray emission of the sealed source herein described was measured with a Radcal Corporation model 20X5-180 Ion Chamber whose relative response to cobalt<sup>60</sup>, cesium<sup>137</sup>, and 50 kvp X-rays had been determined by a National Institute of Standards and Testing, approved calibration laboratory. Sensitivity of the Ion chamber is monitored by reference to a NIST-Traceable cobalt60 source. Readings were corrected for atmospheric temperature and pressure and for ambient air scattering and absorption. The source was measured with its axis of symmetry perpendicular to the line joining source and chamber center. The reported output represents the intensity expected in the absence of air and surrounding objects. It is believed to be accurate within +/- 7%, made up of the stated +/-5% uncertainty of the NIST source calibration and the +/-2% estimated precision of comparison.

Signed   
DATE \_\_\_\_\_