

BETA-GAMMA HAND, FOOT & CLOTHING MONITOR TYPE : BM731(G.M Based)

Technical Data



FEATURES :

- ❑ Developed using state of art ARM7 based SBC working on embedded Linux platform and FPGA technologies.
- ❑ Provided with a 7 ½" colour TFT display for graphical & multi-lingual user interface during measurement mode. Voice & visual languages supported - English, Hindi, Tamil & Marathi.
- ❑ Uses GM133 for Hand, Foot & Clothing channels.
- ❑ Uses I/O interface is through a detachable keypad & colour TFT display
- ❑ Built-in RS485 & Ethernet interface using MODBUS protocols allow centralized monitoring and fault diagnostics.
- ❑ Monitor design ensures continuous maintenance free operation in harsh atmospheric conditions in Radiochemical plants.
- ❑ Designed in accordance to IEC61098 performance specification for personnel monitors.
- ❑ Built-in fault diagnostics for fault location or bypassing.

Beta-Gamma Hand, Foot & Clothing Monitor BM731 manufactured by NUCLEONIX SYSTEMS primarily serve as a personnel monitoring system for checking the contamination of hands, foot & clothing of radiation worker / technicians working in Nuclear Power Plants, reactors, Radiochemical plants and other similar installations.

This instrument has been developed using state of art ARM7 based SBC working on embedded Linux platform. GUI & multi-lingual user interface & corresponding voice messages are facilitated by a colour TFT monitor & a stereo sound device.

Guidance to the user during monitoring in the form of colour graphic monitor for left / right hand / foot & status indications during monitoring & at the end of monitoring are a unique feature for Nucleonix systems make.

Advanced fault diagnostic features facilitate the user to diagnose the problem easily. Also provision for faulty channel bypassing feature has been provided. RS485 & Ethernet communication interfaces using MODBUS protocols facilitate remote monitoring, configuration & fault diagnostics.

Each Hand & Foot detector assembly shown in figure is modular in construction with two detectors plugged onto a single pre-amp box, facilitating easy maintenance incase of problems.

SPECIFICATIONS

The Beta Gamma Hand, Foot and clothing monitor shall comprise a set of detectors and an electronic unit.

DETECTORS:

a) Hand probes:

- Number of monitoring channels: 4 (Right hand upper & lower, Left hand upper & lower).
- Detector type : Halogen quenched G.M. detectors Type LND 719 or equivalent.
- Detector Wall Material : 40 - 60 mg/cm²
- Detection Efficiency : 5 - 6% for Sr-90 Beta for each face of the hand with phantom source.
- Probe Construction : Each channel shall have 2 G.M. detectors. The detectors shall be provided with Lead shielding of 25 mm thickness to keep the background counts below 100 counts in 20 secs. counting time. They shall be fabricated and fitted in the instrument so that they can be detached easily for maintenance.
- Sensitive Area. : 300 sq. cm.
- Protection Grill : The whole detector assembly shall be protected by a suitable thin metallic grill.
- Detector dimensions and performance shall conform to IEC 61098 specifications.

b) Foot probes:

- Number of monitoring channels: 2 (Right foot and Left foot).
- Detector type : Halogen quenched G.M. detectors Type LND 719 or equivalent.. / Pancake detector.
- Detector Wall Material : 40 - 60 mg/cm²
- Detector Plateau : Shall have minimum plateau length of 200 volts and shall be insensitive to ordinary light.
- Detection Efficiency : 5-6% for Sr-90 Beta with a phantom source.

- Probe Construction : Each channel shall have 2 G.M.detectors. The detectors shall be provided with necessary Lead shielding of 25mm thickness to keep the background counts below 100 counts in 20 secs. Counting time. They shall be fabricated and fitted in the instrument so that they can be detached easily for maintenance.
- Sensitive Area. : 300 sq. cm.
- Protection Grill : The whole detector assembly shall be protected by a suitable thin metallic grill and foot support.
- Detector dimensions and performance shall conform to IEC 61098 specifications.

c) Clothing probe:

- Number of monitoring channels: one
- Detector type : Halogen quenched G.M. detectors Type LND 719 or equivalent.
- Detector Wall Material : 40 - 60 mg/cm²
- Detector Plateau : Shall have minimum plateau length of 200 volts and shall be insensitive to ordinary light.
- Detection Efficiency : Greater than 2 - 2.5% for Beta gamma over complete detector area.
- Probe Construction : Hand-held type; Side window probe in a protective housing with a rotatable shutter for cutting off beta particles. It shall be placed on a holder with micro-switch assembly on the side of the monitor. On lifting the detector, the monitoring shall be started.
- Detector dimensions and performance shall conform to IEC 61098 specifications.

ELECTRONIC UNIT :

The electronic unit consisting of the following

- a. Signal processing and display unit.
- b. Mother board
- c. Switched mode LV supplies unit
- d. 13 channel pre-amplifier unit
- e. High voltage power supplies unit

Signal processing and display unit :

The signal processing & display unit comprising of an ARM7 based SBC & 7 ½" LCD is the data acquisition & control device. It carries out the following functions of

- User interface during configuration & measurement through the 7 ½" TFT display, 4x4 matrix keypad and optical sensors.
- Counting of pulses from 13 individual detectors.
- Storage of last 100 acquired data and last 100 contamination data.
- Configuration of various parameters like PM time, BG time, BG dwell time, Low BG set point, High BG set point, Alarm set point, Baud rate, Device ID, IP address, Voice & visual guidance languages, fault diagnostic configuration, detector efficiency, detector status etc.
- Interfacing with status & alarm indicating bar LEDs during measurement cycle.
- Generation of voice guidance messages through stereo O/P sound device during measurement cycle.
- Initiates / terminates measurement cycle by sensing optical sensors status.
- Communicates to remote PC through RS485 / Ethernet ports using MODBUS protocol.

Mother board :

Signal from the pre-amplifier unit optical sensors, RS485 port control & reference signals for HV module are routed to the signal processing unit through this board. The LV supplies to all the sub-systems are routed through this board.

Switch mode power supplies unit

: An AC-DC converter generates the necessary DC voltages of +12, +24 & +5V necessary to the power the electronic sub-systems. It is also provided with a line filter & other EMC suppression components.

13 channel pre-amplifier unit :

This unit comprises of 13 individual pre-amplifier modules used for connecting the -ve tail pulses to TTL coming from each of the GM detectors. HV bias to the GM tubes is fed through the pre-amplifier unit.

• **Counting Range :**

- 0 to 9999 counts
- 0 to 9999 CPS
- 0 to 9999 Bq
- 0 to 99999 CPM
- On overflow the display shall indicate 'OR'

• **Timing range :**

Pre-settable from 1 to 99 seconds in 1 sec steps for COUNTS, Bq, CPS or CPM modes for Hand and Foot monitoring. Time constant for checking the Clothing monitoring is 5 seconds with display being refreshed every second.

HUMAN MACHINE INTERFACE:

Indications & controls:

Mains switch : The mains switch shall be provided inside the cabinet of the monitor.

Mains indication : Red LED to indicate mains power ON is provided on the display panel.

Optical sensor : The monitor shall be provided with optical sensor inside the detector cavities for initializing the counting.

Test switch :

Through detachable keypad, provision to check the background is given.

Visual alarm :

Each channel visual mimic indication on LED indicators and additionally color mimics for each channel are provided on the colour LCD display.

Audio Alarm : Loud audio tone.

Audio Instructions :

Audio instructions shall be generated for clear, contaminated, instrument fault, monitoring in progress and incomplete operation.

Multi-lingual messages shall be played back in either Hindi / Tamil / Marathi based on the selection.

Operational Guidance :

Operational guidance messages shall be displayed Before monitoring, On Clear, On Contamination and On Incomplete operations shall be generated in either Hindi / Tamil / Marathi apart from the primary language English.

Incomplete operation :

Yellow LED indicator along with Multi-lingual textual indication accompanied by audio alert are generated when counting is interrupted.

Clear Indication :

Green LED indicator and LCD mimic indicator will be ON when all the channels are clear.

Counting in progress Indication :

Busy LED indicator will be ON and Time left is displayed when counting is in progress.

Visual display :

7.5" colour LCD display. Given below is a partial list of the functions being carried out by the visual display.

- Display normal status messages.
- Visual display of monitoring in progress (including count down of time in seconds)
- Display of individual channel readings
- Alarm annunciation
- Background checking and display
- Instructions for use.
- Self explanatory, language independent symbols / user instructions.

Computer interface :

The monitor shall have a RS485 serial & Ethernet 10/100 Mbps port for interfacing with a remote IBM PC-compatible computer. The features supported by Ethernet port are given below.

- The PC and the monitor shall operate in a host-slave configuration and the software protocol will be MODBUS/RTU or MODBUS / TCP
- The firmware of the monitor shall be able to send the instrument data like Instrument ID, Instrument type, Maximum counting range, Timer range, alarm settings, alarm status, current reading etc. to the Host PC on demand.
- The firmware shall be able to receive commands from Host PC and carry out the setting of different parameters like Instrument ID, Instrument type, Maximum counting range, Timer range, alarm settings, instrument address etc.
- The PC as the host shall give commands and send queries. The monitor will carry out various functions in response to the queries.

Power supplies:

The monitor shall have a High voltage power supply unit for the detectors and a low voltage power supply unit which supplies the DC power supplies required for the Electronic unit. It shall have a very good line voltage and load regulation for all the supplies. It shall be fitted with Mains line filters to avoid line interferences.

The High voltage output shall be adjustable by handheld configurator or host PC and EHT should be displayed on the display on demand. The EHT shall adjustable from 300 V to 1500 V DC.

Instrument fault indication :

Fault diagnostics are carried out periodically and any failures are reported on the display like LV, HV and detector failures.

Fault indications shall be cleared automatically if normal status is resumed.

HOUSING:

- Most of the modules of the Electronic unit and detectors shall be integrated into a column shaped cabinet with castor wheels.
- The hand probes shall be fitted so that both the hands can be inserted and the optical sensors inside the cavities are activated when hands are placed to start monitoring.

- The modules shall be plug in type with all the controls and display on the front panel.
- The cabinet shall be rat-proof, rugged & elegant.

Self diagnostics :

The monitor shall have built-in self diagnostics. On being powered it shall perform tests to ensure that all components and sub systems are functioning properly. It shall check for the Power supply, High Voltage Supply, Detector, Counting and measuring circuits, Alarm Systems, Display Systems and communication port.

The firmware should not halt monitoring / data acquisition function any time. The firmware shall be designed for high reliability and availability.

Test points shall be provided for checking the EHT voltage and for connecting external input pulse signals.

Input Power :

230VAC +/-10%, 50Hz, single phase supply. Power ON/OFF indication shall be provided with an indicator LED. Line filter and spike suppressor shall be provided.

Environment :

The instrument shall be able to withstand temperature upto 50°C and relative humidity upto 90% in radiation areas.

Foot Detector Assembly



Foot Detector Assembly



Foot Assembly Dust Tray



Pancake Detector Probe



Beta - Gamma Clothing Probe



Display Module



Clothing Probe with GM133 (LND 719)



Pancake Detector Probe

TYPICAL SCREEN SHOTS



INSTRUMENT READY....



BOTH HANDS	
कृपया दोनों हाथ रखिये	
	

LEFT FOOT	
कृपया बाँया पांव रखिये	
	

ACQUISITION ON

TIME LEFT	10	Sec
समय बाकी		सेकंद

LEFT HAND बाँया हाथ	COUNT	RIGHT HAND दाँया हाथ	COUNT
	UPPER 00100		UPPER 00000
	LOWER 00100		LOWER 00000


LEFT FOOT बाँया पांव	COUNT	RIGHT FOOT दाँया पांव	COUNT
	00100		00100



ACQUISITION STOPPED



LEFT HAND	बाँया हाथ
RIGHT FOOT	दाँया पांव

REMOVED
निकाल दिये


ACQUISITION COMPLETE



	YOU ARE CLEAN
CLEAN	आप शुद्ध है



LEFT HAND बाँया हाथ	COUNT	RIGHT HAND दाँया हाथ	COUNT
	UPPER 00500		UPPER 00500
	LOWER 00500		LOWER 00500

LEFT FOOT बाँया पांव	COUNT	RIGHT FOOT दाँया पांव	COUNT
	00500		00500

ACQUISITION COMPLETE

	YOU ARE CONTAMINATED
CONTAMINATED	आप संदूषित है
LEFT HAND BOTH FEET	बाँया हाथ दोनों पांव

LEFT HAND बाँया हाथ	COUNT	RIGHT HAND दाँया हाथ	COUNT
	UPPER 04600		UPPER 00000
	LOWER 04600		LOWER 00000

LEFT FOOT बाँया पांव	COUNT	RIGHT FOOT दाँया पांव	COUNT
	04600		04600