

## **CONTINUOUS AIR MONITOR (BETA) TYPE : AM732B**

### Technical Data



#### **FEATURES :**

- ❑ State-of-art electronics design using controllers with embedded code, I2C, micro-wire bus based devices makes the equipment compact and highly reliable.
- ❑ END window GM tube is used as beta detector  
Efficiency is achieved is better than 30% with Sr90.
- ❑ Collection efficiency for both chambers is better than 97%.
- ❑ 16x2 LCD display is used for display of count-rate status and other information.
- ❑ Detachable hand-held keypad for configuration of the instrument.
- ❑ Ethernet port built-in for remote monitoring and diagnostics.
- ❑ 4-20mA current loop o/p for full-scale range of each channel.
- ❑ Count-rate display additionally provided on SIX-digit SEVEN-segment display.

Continuous Air Monitor(Beta), Type: AM732B manufactured by Nucleonix Systems, designed using state-of-art electronics is primarily used for monitoring Beta activity present in the form of suspended particulate in air. It is very much essential to monitor the quality of air in & around Radiochemical plants, reprocessing plants and other similar facilities.

It essentially has an air suction system comprising of a suction pump, rotometers to measure air flow rate, Beta suction chamber. This system has Beta air-sampler detector assembly consists of a filter holder 60mm dia, a suction chamber with air inlet and outlet & detector housing fabricated with stainless steel. End window GM detector of 1"dia facing the filter paper counts for Beta activity in CPS/CPM/Bq on continuous basis. Collection efficiency better than 97% is achieved with this design. Suction chamber design facilitates the user to easily replace the filter paper(s) periodically as per the requirement.

Electronic module built-in will indicate, the air sample activity deposited on the filter paper in terms of CPM/ CPS/ Bq. Other electronic sub-systems built-in include HV module, SMPS, controller card, EMI/EMC filters current loop circuit, relay & relay driver circuit etc. Front panel has 16X2 LCD dot matrix display, 6-digit 7 segment display, alarms indicating cluster LED displays, audio buzzer, 9-pin D-connector to facilitate connection to external keypad etc. Rear panel has connectors for connecting to Beta probe, test socket, 17 pin I/O connector, test sockets, 9-pin D-connectors for RS485 in/out, A.C. mains switch, fuse holder etc. This module will provide alarm annunciation both visual and aural when the activity exceeds preset level. This system provides current loop output; relay output on 17 pin I/O connector. RS485 IN/OUT ports facilitate connection to SCADA for data communication for visualization of CAM parameters. In respect of AM732B one electronic module is used, This is configured for monitoring of Beta particulate activity.

---

## SPECIFICATIONS

The Continuous air monitor (Beta) is designed to monitor airborne releases of Beta-emitting radio nuclides. The instrument comprises of an air sampler cum detector assembly and an electronic unit. The detector used is a End window halogen quenched GM type. The electronic unit comprises of low voltage supplies, High voltage supply, Pre-amplifier & Amplifier, Count rate meter and Alarm generation module.

**Air-Sampler cum Detector Assembly :** The air sampler cum detector assembly will consist of a filter holder 50mm dia., a suction chamber with two nozzles (air inlet and outlet) with one touch coupler and detector housing.

Air sampler will be fabricated with stainless steel SS 304L. Air sampler is designed and fabricated to achieve the particle collection efficiency more than 99% for air particles down to 0.3 micron size on glass filter paper.

The assembly is shielded by 50mm of lead in a manner that provides easy access for loading and unloading of the filter paper and removal of detector. The lead assembly will be designed with proper care to avoid any injury to the technicians while opening and closing the assembly.

The Detector assembly for Beta monitoring will have the following specifications:-

**Option (A) :**

**Type:Halogen-quenched end-window G.M. Counter.**

Window : 1.5 - 2.0 mg/cm<sup>2</sup>, mica, effective dia. 39 mm.

Wall thickness : 1.5 mm Effective length : 36.25 mm. Effective dia : 28.12 mm

Material : 446 SS

Max. tube dia. : 33.0 mm.

Max. overall length : 52.50 mm

Operating voltage range :450-750V.

Operating voltage : 500V

Beta efficiency response : Upto 4 Mev

Gamma energy : 0.3 MeV to 1.5 MeV

**Option (B) :**

Detector & Size : Plastic scintillator EJ212 or equivalent, 50mm dia coupled to a matched PMT with pre-amplifier.

Window thickness : 1.5 mg/cm<sup>2</sup>. light tight pin hole free aluminized mylar with protection against puncture.

Detector efficiency : Better than 25% with Sr<sup>90</sup>.

**Suction / Vacuum system :** This Suction / Vacuum system will provide the required suction for drawing air through the filter paper in the air sampler assembly. The system will comprise a Dry type, noise-free, continuous duty, pump-motor set.

**Vacuum pump-motor set :**

Free air displacement : 150 litres / min.

Ultimate vacuum : 550 mm Abs(22" Hg)

Pressure : 1.4 Kgs/cm<sup>2</sup> (20 lbs.)

Duty : Continuous.

Electric Motor : ¾ HP, 1440 RPM with gear box, 220/230V AC, capacitor start, single phase TEFC B-56 frame, Class "B" insulation, continuous rating Crompton or equivalent.

Vanes : Made of self lubricant special H17 grade graphite.

Bearings : Sealed ball bearings.

Mountings

Drive : Pump and motor mounting will be on a common base plate.

"V" belt and pulley driven (belt covered by belt guard )

Air inlet/outlet : ¼" serrated nozzles.

Vibration : suitable anti-vibration pad.

Silencer : The pump is provided with a silencer to give a noise free operation.

Pump failure alarm : Pump failure alarm indication is provided on the instrument and the same will be wired on the remote console.

**Flow measurement and regulation:**

a) The instrument uses a Air rotameter 50-200 lpm. With ¼" serrated SS nozzles for connection to 12 mm ID PVC tubing.

b) Rotameter is mounted in a tamper-proof manner in the air sampling line.

c) An additional rotameter is provided with necessary tubing so that the pump can be operated at the rated flow rates without overheating or excessive throttling.

d) Provision is given to discharge the hot air from the vacuum pump

**Electronic Unit:** The electronic Unit comprises of a Low voltage power supply, EHT supply unit, count-rate meter based on Intel Microprocessor/microcontroller, and an audio visual alarm system.

**Low Voltage power supply:** The low voltage power supply unit generates the DC power supplies required for the operation of the electronic module. It has a very good line voltage and load regulation. It is fitted with Mains line filters to avoid line interferences.

**EHT Supply :** This unit generate the high voltage necessary for the working of the GM detector. Its output will be continuously variable from +100V to +1500V. Output will be adjustable by screwdriver and EHT can be shown on the display using the detachable keypad

**Pre-amplifier and Amplifier :** The Pre-amplifier & amplifier module will be compatible with the Halogen quenched end window GM detector. It will provide the amplification and shaping for the pulse signals from the detectors. The output of the amplifier will be given to the Count rate meter for further data processing and display.

**Count-rate meter :**

Unit : CPM / CPS / Bq

Ranges : 0 - 50000 CPM (OR) 0 2000 CPS (OR) 0 - 50000 Bq, with provision for unit selection and range adjustment.

Time Constant : Between 60 to 1 sec automatically varying inversely with count-rate through out the range.

Display : Auto Ranging direct reading, 6 digit 7 segment LED display & 16x2 LCD display. 6x7 LED display is interfaced using multiplexed display driver and is used for display of count-rate and hardware status indication & 16x2 LCD for visualization of preset alarm and other parameters

Display updating : First reading on Power ON within 12 secs.

Normal (Slow) : 60 sec to 12 sec automatically varying inversely with the radiation level.

Abrupt detection : Update the current reading within 1 sec and return to normal mode.

Overload : Senses overload above 200% of fullscale and indicates on display "OL"

Over-range : Senses if the radiation field being measured has exceeded the measurement range of the instrument and upto 200% of the range of the instrument and displays "OFI"

Recorder output : 4 to 20 mA, with 600 ohm load.

Recorder output stability

(a) Non-linearity :Max = 0.025% of Span

(b) Offset current (I<sub>o</sub>=4mA) : Max = 0.0005% of Span / C

(c) Span Error (I<sub>o</sub>=20mA) : Max = 0.005% of Span / C

Accuracy : +/- 5% Full scale.

Calibration Accuracy : +/- 5% through out the range.

Testing Facilities : Provision to inject a suitable pulse generator signal for routine testing of Count rate meter is provided on the rear panel. Additionally a test pulse mode through software for checking count-rate meter is also provided

Instrument "ON" Indication: Large Area Green LED Lamp. This will indicate the Normal condition also.

**Audio Visual Alarm system :**

Alarm range : 1 to full scale reading

Alarm setting : The alarm level setting can be carried out through detachable keypad / serial port with handheld configurator / PC with password protection.

Alarm Indication:

- a) Red (LED) flashing large area window display
- b) Loud audio tone. (Dual frequency)

**Alarm annunciation scheme:** As tabulated below;

Parameter Status	Visual indication (Red LED)	Audio
Normal	OFF	OFF
Abnormal	Flashing	ON
On ACK	Steady Red	OFF
Back to normal	Steady Red	OFF
Reset on abnormal	Steady Red	OFF
Reset on normal	OFF	OFF

**OFF Instrument Controls :**

- a) Acknowledgement switch for muting audio
- b) Reset switch for resetting the Alarm indication and alarm relay.
- c) Power ON/OFF switch with Power ON indication
- d) EHT ON/OFF control provided on the front panel of the instrument

**Instrument Fault indication:**

- a) EHT failure: Visual alarm with flashing red LED indication & "Eht" message on display
- b) Detector failure: Visual alarm with flashing red LED & "d-FL" message on display.
- c) Microprocessor / microcontroller failure: Visual alarm with flashing green lamp.
- d) Fault indications will be cleared automatically if normal status is resumed.

**Housing :** The Electronic unit will be housed in rack mounted type cabinet. The unit will be plug in type and all the controls and display are on the front panel. The enclosure will comply with IP-21.

**Remote /External Console :**

- a) 4 - 20 mA linear proportional to full scale display output. Current output will be able to drive load of 600 ohms. Output circuitry will be able to drive 200 mtrs.of twisted pair of wires.
- b) Two sets of potential free contacts of Alarm relay (Change over). Contact rating 3 Amp at 250 VAC. The relay will be energized on normal condition and de-energised under alarm condition.
- c) Remote alarm acknowledgement and reset signals for the field instruments.
- d) Indication of instrument fault condition (detector, EHT & LV supplies failure), over range & overload conditions by up-scale or 4-20 mA(22.5 mA)
- e) Pump failure alarm contact.
- f) All these signals are terminated on a 17 pin socket (Allied Connectors). The corresponding mating plug with 5 mtr cable will be supplied with the monitor.
- g) RJ 45 connector for Ethernet port
- h) RS-485 serial port (optional). This will be in parallel with D-type connectors.

**Computer Interface :** The monitor shall have a 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/TCP.
- The PC as the host shall give commands and send queries. The monitor will carry out various functions in response to the queries.

- The firmware of the monitor shall be able to send the instrument data like instrument ID, instrument type, input range, display range, alarm settings, alarm status, current reading, diagnostic status of EHT/ GM tube 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, input range, display range, alarm settings, Ack, Reset, instrument address etc.

**RS485 (optional)**

The monitor is provided with a RS-485 Serial Communication port for interfacing with a IBM PC-compatible computer. The PC and the monitor will operate in a host-slave configuration in a multi-drop network through this interface. The PC as the host will give commands and send queries. The monitor will carry out the various functions as per the required information in response to the queries.

The firmware of the monitor will be able to send the instrument data like Instrument ID, Instrument type, Input range, Display range, alarm settings, alarm status, current reading, diagnostic status of EHT/ GM tube etc. to the Host PC on demand. The firmware will be able to receive commands from Host PC and carry out the setting of different parameters like Instrument ID, Instrument type, Input range, Display range, alarm settings, Ack, Reset, EHT setting, instrument address etc. The configuration settings will be password protected and the password will be user defined.

The detailed specifications for the interface will be as follows:-

Type : RS-485 Multidrop Serial Communication Port, Half Duplex Bi-directional communication.  
 Character Format : ASCII  
 Protocol : MODBUS / RTU  
 Bit Rate: User configurable to 9600 or 19200 bits per sec.

Address : User configurable from 0 to 255.

Connector : 9-pin D-type connectors (2 connectors connected in parallel for daisy chaining a number of instruments). The mating connectors with cover will be supplied.

**Hand held Configurator:**

- a) The configurator is a full function LCD display terminal comprising a keyboard/navigating keys and a large alphanumeric LCD display.
- b) The configurator will be capable of fully configuring and monitoring of all functions of the Continuous air monitor.
- c) The configurator is not instrument specific and will be able to work in conjunction with all Continuous air monitors meeting the above specifications.
- d) Dimension will be such that it can be easily held in single hand. It is provided with a carrying case and shoulder belt.
- e) It will be operated on a rechargeable battery of long life and the battery charger will be part of the supply. The configuration settings are password protected and the password will be user defined.

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

The firmware will not halt monitoring / data acquisition function any time. The firmware is designed for high reliability and availability.

Test points are 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 is provided with

an indicator LED. Spike suppressor and line filter protection is provided.

**Environment:** The instrument is designed to be able to withstand temperature up to 50 deg C and relative humidity upto 90% in radiation areas.

**Environmental compliance :** As per IS 9000 / ANSI N 42.17

The instrument enclosure and detector assembly will comply with IP-21. Electronic units will withstand cumulative radiation dose of 10000 Rad. (30 years of operation).

**EMI / EMC compliance:** As per IEC 61000 / ANSI N42.17

**Mechanical Dimensions (overall)**  
 : Size : \*Height : 1500mm  
 \*Width : 650m \*Depth : 480mm

**Instrument Trolley :**

- a) All the hardware like Vacuum pump, Air sampler & detector assembly, lead shielding, rotameters, Electronic unit etc may be fitted in an Instrument trolley made of M.S.
- b) The trolley is provided with castor wheels with locks / breaks.
- c) The trolley is powder coated with DA Grey colour.
- d) It is fabricated to provide protection as per IP-21.
- e) Front and Rear sides will have doors with magnetic lock.
- f) The vacuum pump is fitted at the bottom with guards & shock absorbers.
- g) Pump discharge (hot air) will go out of cabinet.
- h) Two Mains supply boards with required sockets, indicators and switches / MCBs will be provided inside the trolley.
- i) One power board will be used for Vacuum pump and the other will be used for electronic unit.
- j) Internal PVC tubing will be done between Suction head, rotameter, pump etc.

**Options :**

- (1) 16 bit resolution current loop (4-20mA) instead of 14 bit resolution.
- (2) Log scale O/P for 4-20mA instead of 4-20 linear O/P
- (3) 3.5" QVGA color TFT display in lieu of 7 segment LED & 16x2 LCD display.
- (4) Digital flow meter is used instead of conventional rotameter for each channel. This will have a measurement range 0-100lpm and is read out in electronic unit for computations / fault diagnostics.
- (5) RS485 serial interface
- (6) Plastic scintillator based Beta detector assembly.