CONTINUOUS AIR MONITOR (ALPHA/BETA)
TYPE : AM732AB

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 achieved is better than 30% with Sr-90 Beta.
- Loose Mylar ZnS (Ag) scintillator screen coupled to 2" PMT is used as Alpha detector. Efficiency for Am-241 alpha is better than 25%.
- 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, Type: AM732AB manufactured by Nucleonix Systems, designed using state-of-art electronics is primarily used for monitoring Alpha & 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 with arrangement for trapping of suspended dust particulate onto the filter paper. An end window GM tube of 1" dia facing the filter paper counts for Beta activity in CPM /CPS/Bq on continuous basis. Additionally this system has Alpha 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 .Alpha Detector consists of ZnS (Ag) deposited on loose mylar support of 50mm dia coupled to matched PMT with Pre-amplifier. Detector Efficiency achieved is of the order of 25% for Plutonium alpha particles over the entire window area. Collection efficiency better than 97% is achieved with this design for both these chambers. Suction chambers design facilitates the user to easily replace the filter paper(s) periodically as per the requirement.

Electronic modules 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 key pad etc. Rear panel has connectors for connecting to Alpha probe, 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 AM732AB two electronic modules are used, one configured for monitoring of Alpha particulate activity and the other for monitoring of Beta particulate activity.

SPECIFICATIONS

The Dual Channel Continuous air monitor (Alpha & Beta) is designed to monitor airborne releases of alpha-emitting and beta emitting radio nuclides. The instrument will comprise a common vacuum pump, two sets of air sampler cum detector assembly and an electronic unit. The detectors will be of ZnS (Ag) Scintillation detector & Halogen quenched end window GM detector. The electronic unit comprises of two channels of low voltage supplies, High voltage supply, Pre-amplifier & Amplifier, Count rate meter and Alarm generation module. The electronic unit and the detector assemblies are mounted inside a single floor mounted trolley.

(A) Air-Sampler cum Detector Assembly (Alpha):

The air sampler cum detector assembly for alpha consists of a filter holder 60mm dia., a suction chamber with two nozzles (air inlet and outlet) of size ¼" serrated and detector housing.

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

The Detector assembly for Alpha monitoring has the following specifications:-

Detector and size: ZnS (Ag) phosphor, 50mm dia coupled to a matched photo-multiplier with pre amplifier.

Window Thickness: 1.5 mg/cm^2 light-sensitive pin-hole free aluminized mylar with protection against puncture.

Detector Efficiency: Not less than 25% for plutonium alpha particles over the entire window area.

(B) Air-Sampler cum Detector Assembly (Beta):

The air sampler cum detector assembly for beta consists of a filter holder 60mm dia., a suction chamber with two nozzles (air inlet and outlet) of size ¼" serrated and detector housing.

Air samplers are fabricated with stainless steel SS 304L. Air samplers are designed and fabricated to achieve the particle collection efficiency better than 99% for air particles down to 0.3 micron size on glass filter paper.

The assembly is to be 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^2, 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: 450-750 V.

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^2. light tight pin hole free aluminized mylar with protection against puncture.

Detector efficiency : Better than 25% with Sr^{90}.

(C) Suction / Vacuum system:

This Suction / Vacuum system provides 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 liters/min

Ultimate vacuum : 550 mm Abs (22" Hg)

Pressure : 1.4 Kgs/cm^2 (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.

Make : M/s Tawde Engineering works.

(D) Flow measurement and regulation:
The instrument has two sets of Air rotameter 50- 200 lpm. with ¼" serrated SS nozzles for connection to 12 mm ID PVC tubing.
Rotameters are mounted in a tamper-proof manner in the air sampling line.
One rotameter will be connected to the air sampler for Alpha and the other to the air sampler for beta.
Provision is given to discharge the hot air from the vacuum pump.

(E) Electronic Unit: Qty 2 Nos.
Each electronic Unit will comprise of single channel of Low voltage power supplies, EHT supply, pre-amplifier, count-rate meter based on microcontroller and audio visual alarm system will be provided for the two detectors.

Low Voltage power supply : Independent low voltage power supplies supply the DC power supplies required for the operation of each channel of electronic module. They have a very good line voltage and load regulation. The modules are be fitted with Mains line filters to avoid line interferences.

EHT Supply : Single channel EHT voltage module is provided for the working of either the GM detector or Photomultiplier tube. The output voltage of each channel will be continuously variable from +100V to +1200V independently. Output will be adjustable by screwdriver and EHT can be shown on the display using the detachable keypad.

Pre-amplifier : Single channel Pre-amplifier module compatible with the GM detector & ZnS Scintillation detector is provided in the unit. 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 : The count rate meter is provided for processing the data from the corresponding detector and display the same. Important features of the countrate meter are listed below.

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 full-scale 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 instrument and displays "OFl".
Recorder output : 4 to 20 mA, with 600 ohm load.

Recorder output stability
(a) Non-linearity : Max = 0.025% of Span
(b Offset current (Io=4mA):Max = 0.0005% of Span / C
(c) Span Error (Io=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 will be provided on the rear panel.
Additionally a test pulse mode through software for checking count-rate meter will be provided
Instrument "ON" Indication: Large Area Green LED Lamp. This will indicate the Normal condition also.

Audio Visual Alarm system:
The instrument is provided with two sets of alarm circuits with independent LEDs for Normal operation, Alarm etc. Two sets alarm relays will be provided.

Alarm range : 1 to full scale reading
Alarm setting : The alarm level setting will be carried out through RS-485 serial port with handheld configurator / PC with password protection.
Alarm Indication :
a) Red (LED) flashing large area window display
b) Loud audio tone (single / dual frequency tones)

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

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 switch is provided on the front panel

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 are cleared automatically if normal status is resumed.

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

Remote /External Console:

The instrument is provided with two remote console connectors for the two channels.

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 will be terminated on 17 pin sockets (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. 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)

Each channel of the instrument has 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.

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 will be provided with an indicator LED. Spike suppressor and line filter are 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 : 650mm *Depth : 480mm

Instrument Trolley:

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