Product Information

LB 110 Tritium-Monitor

Applications

- Biochemical research laboratories
- Synthesis laboratories
- Research laboratories for pharmaceutical industry
- Neutron generators and accelerators
- Nuclear technology and reprocessing
- All Laboratories and factories where Tritium or Tritium-containing compounds and materials are manufactured, processed or stored

Functions

- Monitoring of ^{3}H activity concentration in room and exhaust air
- Direct and specific measurement
- High sensitivity
- Low interference of increased background levels or other gaseous nuclides than ^{3}H
- Two measuring channels
- Compensation of other gaseous nuclides than ^{3}H or background (optional)
- Optimization for max. ^{3}H sensitivity or low spillover
- Detector with thermostat-controlled heating (optional)
- Two different gas mixtures available:
  - Methane (CH_4)
  - Argon-Methane (P10)
- Two different data acquisition systems available:
  - Data Logger LB 9000
  - Data Logger LB 5340

RADIATION PROTECTION

BERTHOLD TECHNOLOGIES

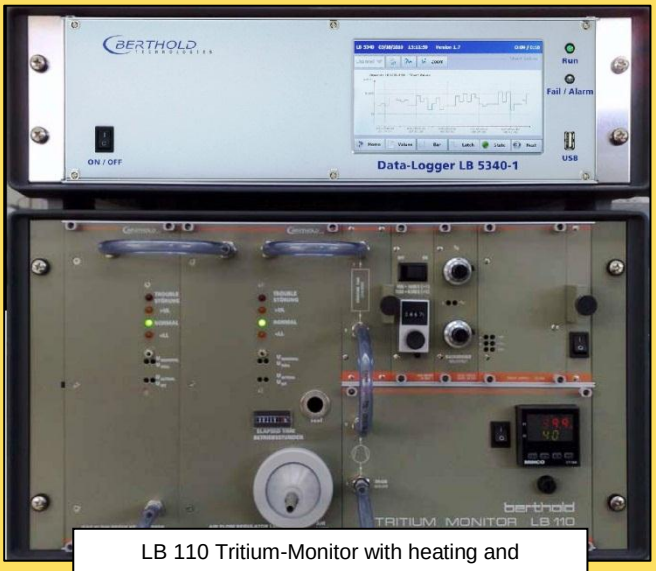
LB 110 Tritium-Monitor

Device concept

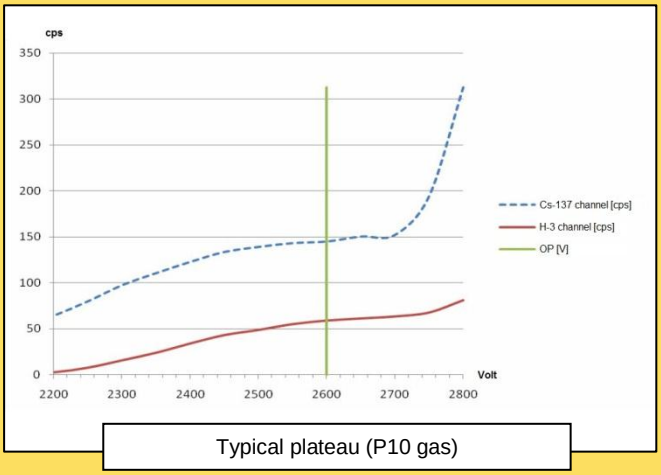
Tritium (^3H) in air is mostly available in the form of water vapor (H_1H_3O) or gaseous hydrogen (H_1H_3). Since the Beta particles emitted by Tritium have a very short range (only a few millimeters in air), windowless counter tubes must be used, i.e. the air to be measured has to be added to the counting gas. For a continuous measurement, the counter tube must therefore operate in the flow-through mode.

The air to be measured is mixed with a suitable counting gas and passed through a 1.3 liter volume proportional counter tube. Methane (mixing ratio air/gas 1:3) or Argon-Methane (P10, mixing ratio air/gas 1:4) are used as counting gas.

The distinction of Tritium pulses from those of other nuclides or from Gamma radiation – and hence the Tritium -specific measurement – is carried out using Berthold's patented pulse rise discrimination method, which offers major benefits as compared to the earlier used range discrimination (F. Berthold, Tritium-in-Air Measurements by Pulse Shape Discrimination Methods, in: Radiation-Risk-Protection Vol. III, Pages 1091 - 1094, FS-84-35 T, Verlag TÜV Rheinland, Köln 1984). This method yields better response sensitivity data, relative to the same gas consumption.

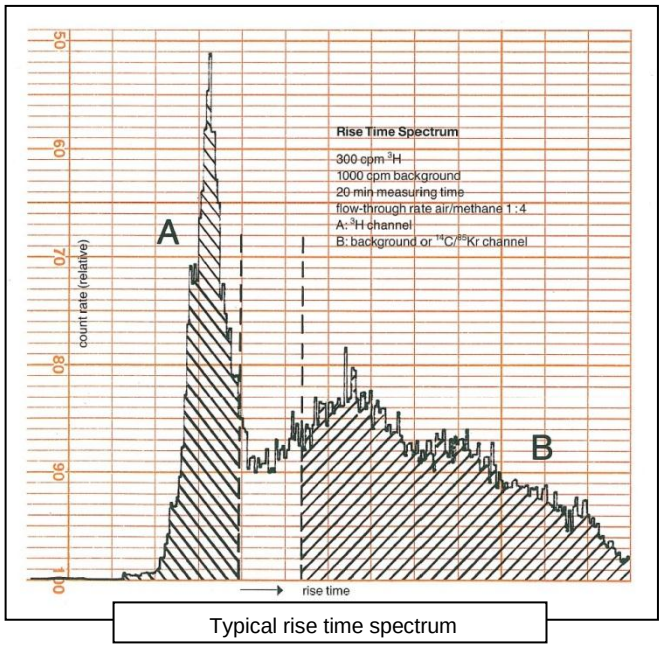


LB 110 Tritium-Monitor with heating and LB 5340 Data Logger as evaluation unit (19"-rack)



Typical plateau (P10 gas)

Rise time discrimination is based on the fact that the rise time in proportional counter tubes is dependent on differences in the drift time that electrons occurring in the primary ionization track need to get in the vicinity of counting wires. These drift time differences are dependent on the length and the course of the primary ionization track. In the case of Tritium, this track – due to the low particle energy – has to be regarded as point-shaped in contrast to the long ionization tracks caused by high-energy Beta or Gamma sources.



Typical rise time spectrum

Device Components

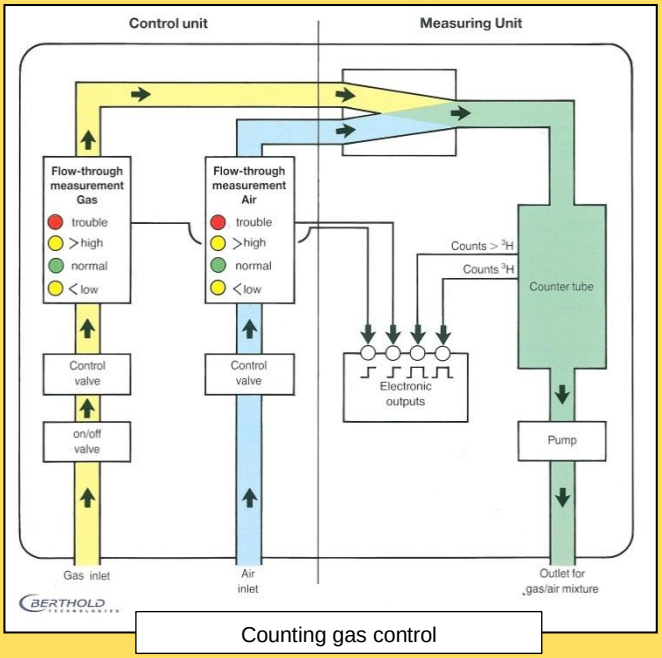
- Pump and detector unit incl. operation electronics
- Evaluation and display electronics (depending on measurement task)
- Mixing and pump system (inside)
- Flow-through counter tube (inside)

LB 110 Tritium-Monitor

Counting gas control

The accuracy of the measurement is dependent on the constancy of the mixing ratio of air and counting gas. Due to that the LB 110 ensures a good and reliable gas-air control. Measuring air and counting gas flow are measured separately and kept at a constant level via a control circuit. The current gas and air flow rate is measured using an electronically controlled flow-through meter which operates according to the principle of thermal mass measurement.

An essential benefit of this principle is that the measurement is largely independent of pressure and temperature. Compared to volumetric principles, neither pressure nor temperature has to be measured in addition. The electronics integrated into the air and gas module is used to control and evaluate the signals modified by the flow-through controller. Gas and air supply are measured separately and kept on a constant level by one control circuit each.



Counting gas control

Evaluation Electronics

There are two evaluation units for the LB 110 Tritium-Monitor: The data loggers LB 5340 or LB 9000.

Due to the modular design the **LB 5340** can be equipped, corresponding to the application needed, with different probes, sensors and peripherals by means of modules. The usage of up to 6 different modules enables to configure a large system with up to 6 radiometric measuring channels and 2 sensor inputs combined with up to 8 relay outputs 8 digital outputs, 4 digital inputs as well as 10 analog outputs. For more information please refer to the LB 5340 Data Logger Product Information.

The **LB 9000** offers a wide spectrum of applications due to the passive backplane with 11 slots for the usage of 5 different, multi deployable modules. Up to 25 virtual measuring channels and 96 digital in- and outputs are configurable.

LB 5340 Data Logger
(19”-rack, 3 HE, 7’’ TFT Touchscreen)

LB 9000 Data Logger
(19”-rack, 8 HE, 12.1’’ TFT Touchscreen)

Technical Data LB 110 Tritium-Monitor

Mechanical Data	
Dimensions counter tube LB 6225:	430 mm x Ø 80 mm (active volume 1.3 l)
Dimensions / weight device LB 110	500 mm x 420 mm x 335 mm (L x W x H) / 20 kg

Calibration and Setting Data		
Counting gas	Methane (CH_4)	P10 (90% Ar, 10% CH_4)
Air-counting gas-Mixture	1 : 3	1 : 4
Flow rate l / min	0.25 : 0.75 l	0.20 : 0.80 l
Measuring air contents in the counter tube	0.325 l	0.260 l
Efficiency for H-3	approx. 60%	approx. 55%
Calibration factor for H-3 (kBq / m³ per cps)	5.1	7.0
Background in H-3 channel	0.4 to 3 cps	0.4 to 3 cps
Measuring range	500 Bq/m³ - 20 MBq/m³	500 Bq/m³ - 20 MBq/m³
Spillover factor for Cs-137 into the H-3 channel	5 to 7%	5 to 7%
Spillover factor for Kr-85 into the H-3 channel	3 to 5%	3 to 5%
Spillover factor for C-14 into the H-3 channel	23 to 25%	23 to 25%

Detection Limits for H-3 in kBq/m³ at a background of 2 cps		
Measuring time \ Counting gas	Methane (CH_4)	P10 (90% Ar, 10% CH_4)
30 s	4.0	5.4
60 s	2.8	3.8
600 s	0.9	1.2
1 h	0.4	0.5
24 h	0.07	0.1

Gas and air connections (connection nozzle)	
Gas / Measuring air / Outlet for gas-air mixture	Ø 7 mm / Ø 7 mm / Ø 7 mm

Power supply	
Voltage	230 VAC 50 Hz or 115 VAC 60 Hz
Power consumption	Max. 40 W
Fuses	230 VAC: 0.5 A, T / 115 VAC: 1 A, T

Heating supply (optional)	
Voltage	230 VAC 50 Hz or 115 VAC 60 Hz
Power consumption	Max. 82 W
Fuses	230 VAC: 2 A, T / 115 VAC: 3.15 A, T
Heating controller (front panel fuse)	230 V / 0.315 A, T

Ambient conditions	
Operating temperature range:	0°C to 50°C
Relative humidity:	0 to 90%, no condensation
Protection type	IP32 in desktop housing (according to DIN IEC 60529)

Order Information and accessories		
LB 110-1	230 V	80872 - 10
LB 110-3	115 V	80872 - 20
LB 110-1	230 V with heating	80872 - 11
LB 110-3	115 V with heating	80872 - 21
LB 5340-1 Data Logger	230 V / 115 V	54000 - 01
LB 9000 Data Logger	230 V	42836 - 12
LB 9000 Data Logger	115 V	42836 - 21

Subject to change without prior notice.

Berthold Technologies GmbH & Co. KG • Calmbacher Straße 22 • 75323 Bad Wildbad, Germany
Tel: (+49) 7081-177-0 • Fax: (+49) 7081-177-100 • E-Mail: nuclear@Berthold.com • Internet: www.Berthold.com

LB 110 engl · Id. 80872PR2 · 08-2012 · Rev.02