HIS-07　　离子感烟探测器电离室

根据计算机模拟最佳性能设计的单源双室 DSCB 型电离室，专用于感烟探测器。该电离室作为感烟探测器的主要部件完全符合美国 UL217 标准，欧洲 EN-54-7 标准及 GB4715-93 国家标准。产品质量一致性好，组装探测器不需对电离室进行逐个测量，便于自动化生产。

工作原理

当流经内外电离室的电离电子流不平衡时，收集极充电直到电离电流达到平衡。在无烟或无燃烧物时，收集极除受电离电流统计涨落影响外，保持平衡电位。当烟进入电离室时对电离电流产生影响，易于进烟的外电离室受影响大于内电离室，电离电流下降，收集极重新充电直到新的平衡电位，这种电位变化可用于触发报警电路。

特色

（1）　单源双室结构；体积小，便于安装在小型报警器中；
（2）　在相对温、湿度 40℃和 95%条件下，收集极平衡电位变化值在基本参数范围内；
（3）　电离室结构符合 UL217 9.5 节对防虫网的要求；
（4）　不锈钢和聚酸酯材料及电离源表面金属钯均具有高耐腐蚀性能；
（5）　收集极平衡电位一致性好，分散度小，可以用于模拟量感烟探测器；
（6）　所有焊点预先涂焊料，便于焊接安装。

技术规格

条件：外罩电极与源基电极间电压（工作电源电压）：9 V
　　　环境温度：20±3℃　　大气压：接近标准大气压，清洁空气

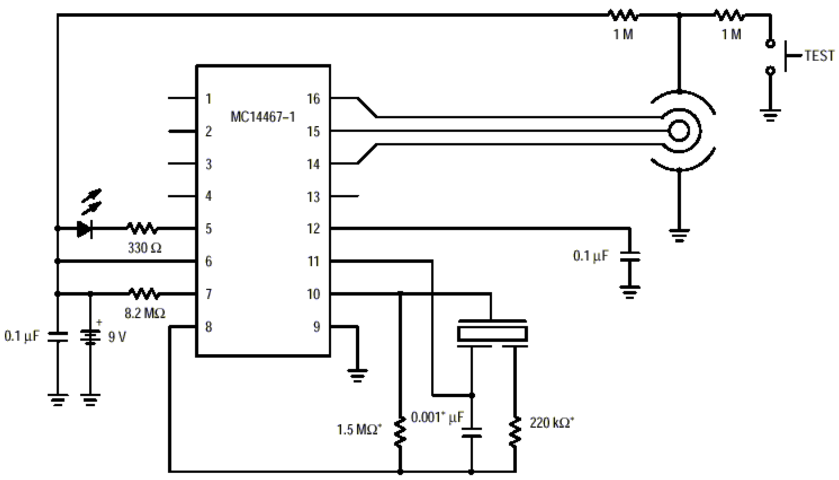
项目	数值
收集极平衡电位	5.5±0.3 V
收集极电位随烟浓度变化：	
减光率为 1%/英尺	0.6 V
减光率为 4%/英尺	2.2 V
绝缘体漏电电流（Max）	0.5pA
电容（收集极至外罩+至源基极间）	6pF

电离源特性和辐射安全性能

电离室内安装一个高性能低活度 Am—241 电离源。

电离源活度		0.5μCi(18kBq)±10%	0.8μCi(30kBq)±10%
电离源 α 能谱	峰值	4.5MeV±10%	
	FWHM	＜0.7 MeV	
安全分极标准（GB4075≈ISO2919）		C64444	
电离室 25cm 处辐射剂量率		0.03mGy/年（低于人群体剂量标准 1mGy 值）	

推荐线路图　如果感烟探测器采用 MC14467 元件时，可参考如下电路原理图。



灵敏度特性

（根据 UL217 标准 风速 0.1M/每秒 ）

烟雾浓度（%/英尺）	输出电压（V）	误差（ΔV）
0	5.6±0.4	0
1	5.3±0.5	0.3±0.1
2	5.0±0.5	0.6±0.1
3	4.7±0.5	0.9±0.2
4	4.4±0.5	1.2±0.2
5	4.2±0.5	1.4±0.2

电源电压特性（25℃. 60%RH）

电源电压	输出电压（V）
6	3.3±0.3
9	5.6±0.4
12	8.0±0.7
15	10.0±0.85
18	13.0±1.0

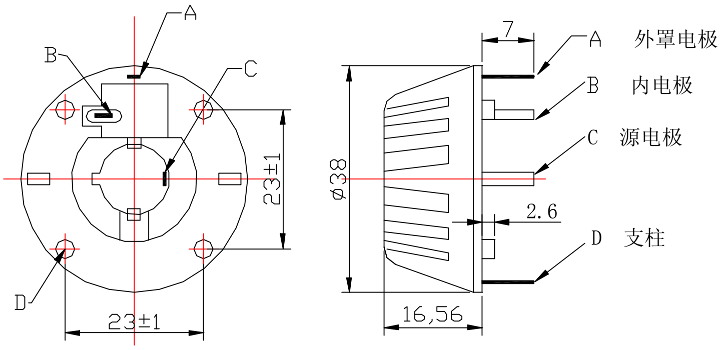
温度特性:（湿度：60%）

温度（%℃）	输出（V）
0	5.15±0.4
25	5.6±0.4
50	5.85±0.4

湿度特性（温度：25℃）

湿度（%C）	输出（V）
30	5.75±0.5
60	5.6±0.4
90	5.45±0.4

外形及结构

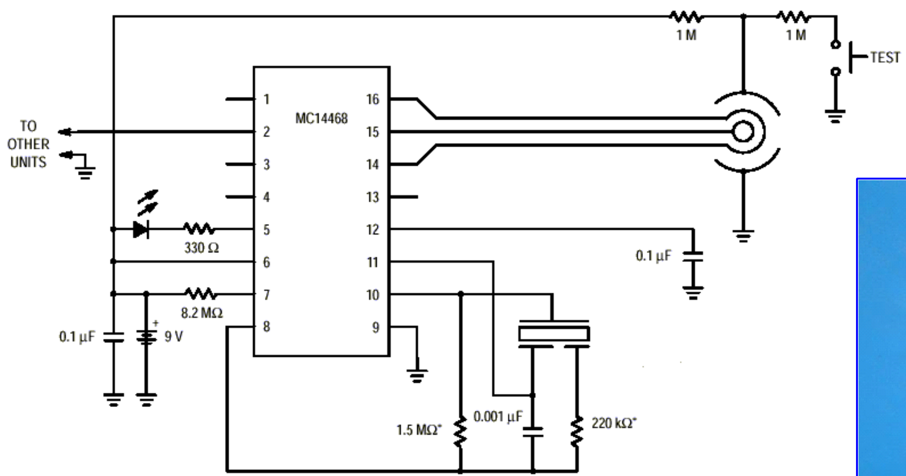


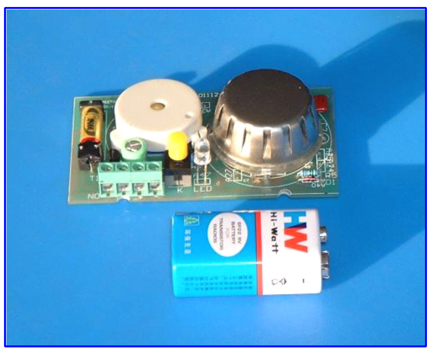
A 外罩电极：接正极或电源正
B 内电极：输出信号
C 源电极：接地线或电源负

注意事项

1. 检测输出电压需要用 1014NM 以上阻抗的仪表或 IC 集成电路(MC14467/14468)。普通的仪表会造成检测结果的不准确。
2. 组装烟雾报警器的时候，不要将焊锡等杂物误入器件离子室中，否则必须进行清洗。
3. 器件的输出引线应悬空连接(一般情况下用特氟隆支持引线)，因为普通的电路板会造成微小的漏电流，使检测结果不准确。
4. 器件引线和 FET 及 IC 的输入引线需用环氧树脂密封，这样使湿度造成的漏电流达到最小。
5. 由于器件的输出电流很小，所以器件需要屏蔽。而输入和输出部分受外界影响最大，这部分一定要进行屏蔽处理。

采用 MC14468 的烟雾探测器电原理图





产 品 技 术 规 格

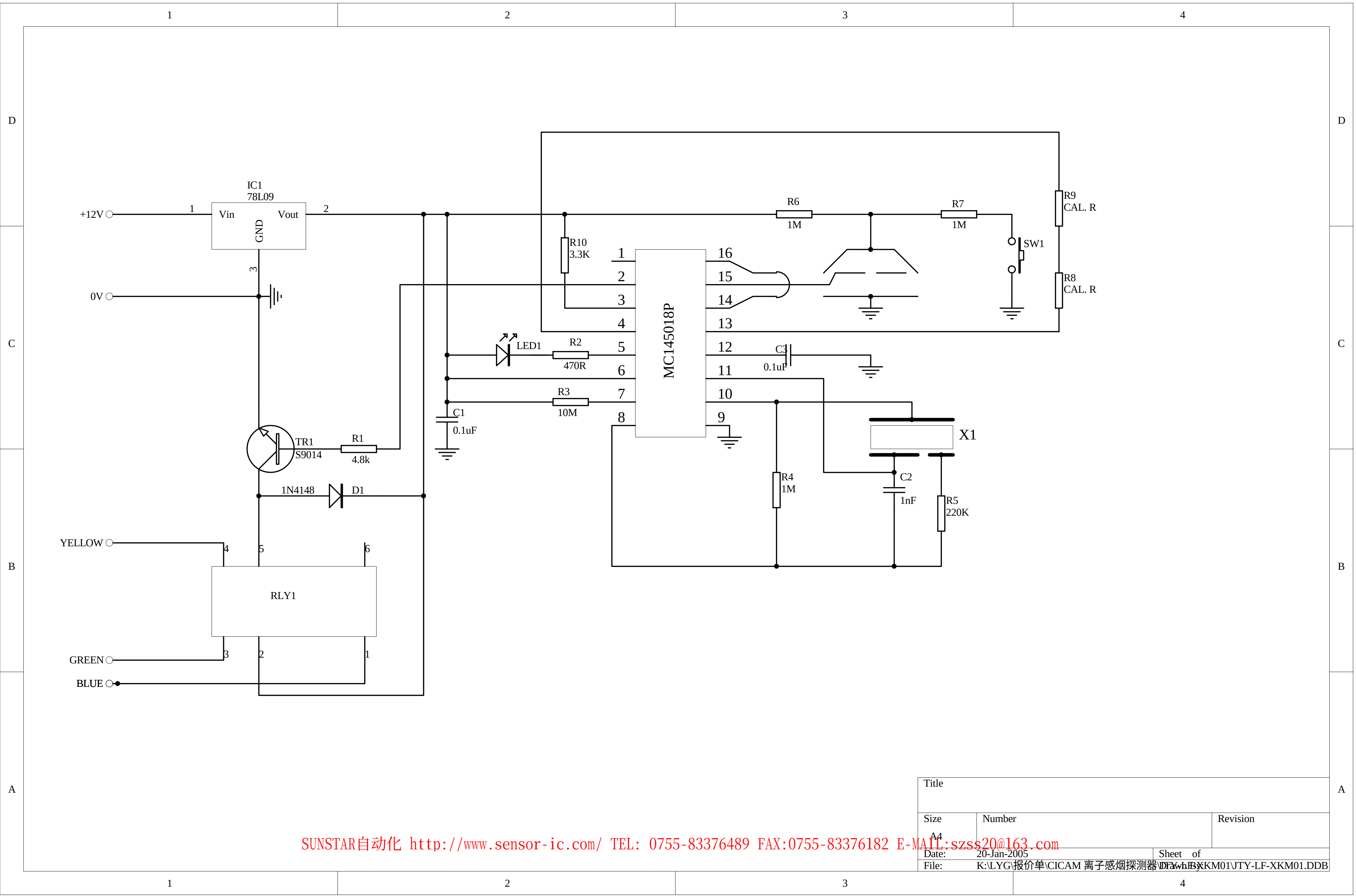
DSC.B1C 型电离室技术规格

1. **DSC.B1C 型电离室特性：**

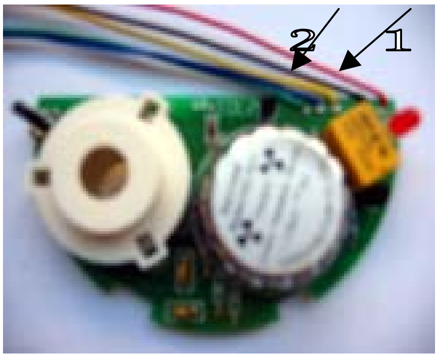
（1）用计算机模拟设计的单源双室结构；
（2）在近似标准大气压，相对湿度９５％和－１０℃——４０℃清洁空气中，工作电源电压为９V，收集极平衡电位变化值保持在５．３－６．３V;也可适应不同工作电源电压，其参数相应随电压而变化；
（3）辐射安全：单源，活度低，安全性能达到分级标准：（GB4075≈ISO2919）C６４６４６；
（4）采用不锈钢和高性能绝缘材料，漏点电流小；电离源表面是高耐户腐蚀的金属钯；
（5）电离室基部的支架和空槽适于安装在 IC 件的上部，IC 件１５接脚和收集电极接近，易焊接，可有效地屏蔽 RF 干扰；
（6）所有焊点预先涂有焊锡，便于焊接方便；
（7）产品一致性好。

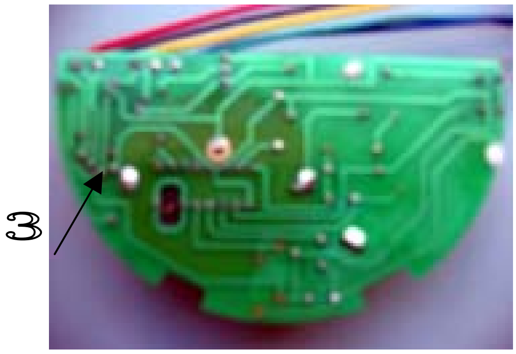
2. **产品技术规格：**

工作电源电压：	９V
收集极平衡电位：	５.３－６.5V
收集极电位随烟浓度变化：	
减光率４.0%/ft	２.０V
绝缘体最大漏电电流：	０.５ pA
电容（收集极至外罩电极＋至源基极）：	６.０pF
Am-241 源活度：	< ０.８uCi


IC1
78L09
Vin
Vout
GND
+12V
0V
YELLOW
GREEN
BLUE
TR1
S9014
R1
4.8k
1N4148
D1
RLY1
C1
0.1uF
LED1
R2
470R
R3
10M
R10
3.3K
MC145018P
R6
1M
R7
1M
R9
CAL. R
R8
CAL. R
SW1
C3
0.1uF
X1
R4
1M
C2
1nF
R5
220K
Title
Size
A4
Number
Revision
Date:
20-Jan-2005
Sheet of
File:
K:\LYG\报价单\CICAM 离子感烟探测器\JTY-LF-XKM01\JTY-LF-XKM01.DDB
Drawn By:

JTY-LF-XKM01 探测器测试要求





1. 在红线 1 和黑线 2 之间加 12V-20V 的直流电压，IC1 输出脚 3 的电压应在 8.9V-9.1V；
2. 测试绿线和蓝线、绿线和黄线之间的导通情况，绿线和蓝线之间导通、绿线和黄线之间断路；
3. 按住测试按钮，探测器会发出刺耳的报警声，发光二极管不停的闪动，此时绿线和蓝线、绿线和黄线之间的导通状况同不报警时正好相反；
4. 用高阻抗万用表的红表笔接触 IC（MC145018P）的 14 或 16 脚，黑表笔接触电离室源基电极（电源的地）测试它们之间的电压，灵敏电阻 R8、R9 的阻值配置如下：

电离室 BV 值	R8 阻值	R9 阻值
5.3 – 5.59V		
5.60 – 5.89V		
5.90 – 6.19V		
6.20-6.5V		

5. 老化、潮湿实验，用老化潮湿室，连续 8 小时不会误报；
6. 灵敏度测试，用标准烟箱，灵敏度要求按国家标准。

注：第 4 点的测试就是在探测器上测试电离室的平衡电压，也就是简易的电离室测试方法。

Smoke detector ionisation chamber type DSCB1C

General Description

The DSCB1C (fig 1) is a small, compact and robust dual ionisation chamber of advanced design containing a single radioisotope source producing ionisation in both chambers. The chamber has a unique internal geometry, which allows the detector chip to be positioned beneath the chamber within a recess in the moulded plastic base. Pin15 of the chip can be connected directly to the collector electrode inside the protective RF shield of the cover. This isolates the highly sensitive connection between the collector electrode and pin 15 from other parts of the detection circuitry and it provides a high degree of immunity from external electrical interference.

The external design features and dimensions of the DSCB1C can be seen in figures 2 and 3. The electrodes and source holder are made of AISI 316 stainless steel. The plastic insulator material is specially chosen for its exceptional mechanical stability and resistance to moisture and oxidising chemicals in the air. The units are supplied assembled and ready to mount on a suitable printed circuit board using the pre-tinned tags provided.

Details of the sealed source design can be found in the data sheets 'Americium-241 alpha foil and sources' (4) and 'Safety and Packaging' (5). Both of these are available on request. In accordance with OECD requirements (6) the source activity is less than 37kBq (1μCi) ^{241}Am. The Recommended Working Life of the source is 10 years. The BS/ISO/ANSI rating of the ionisation chamber is C64646.

The design, manufacture and testing of the DSCB1C is managed within the scope of AEA Technology's Quality System which is certified by Lloyds Register Quality Assurance for compliance with BS EN ISO9001:1994 (1)

AEA Technology expertise in the design and construction of ion chambers is well established and wide-ranging. A consultancy service is available to assist in the design of systems using ion chambers and in the provision of testing and computational modelling services to measure and model the performance of customers' own designs.

The internal design of the DSCB1C is shown schematically in figure 4. This figure highlights the compact internal design features and the location of the ion cloud within the chamber.

Fig1, DSCB1C

Fig 2, Side view

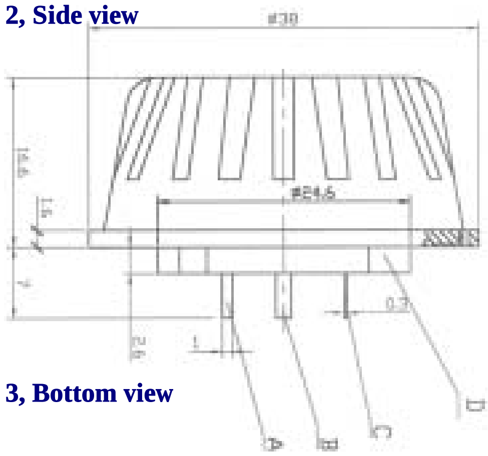
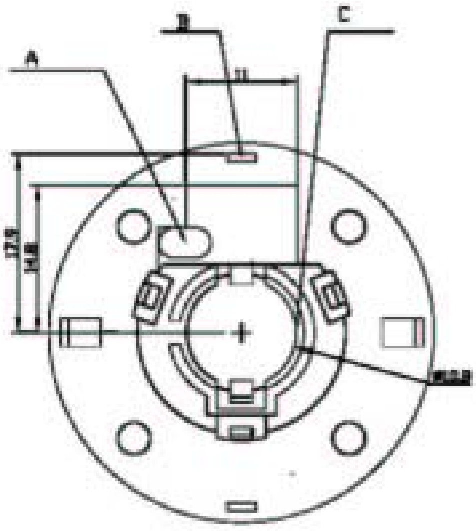
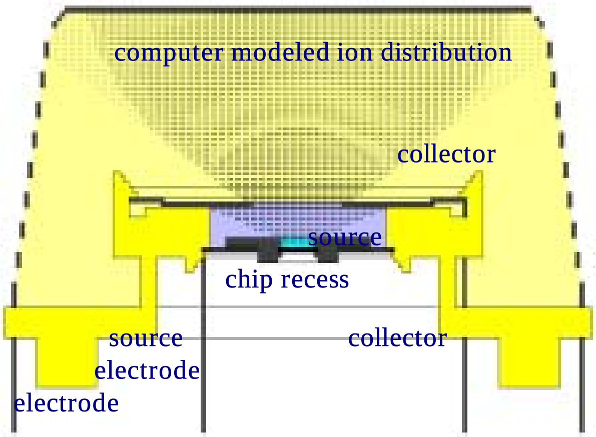


Fig 3, Bottom view



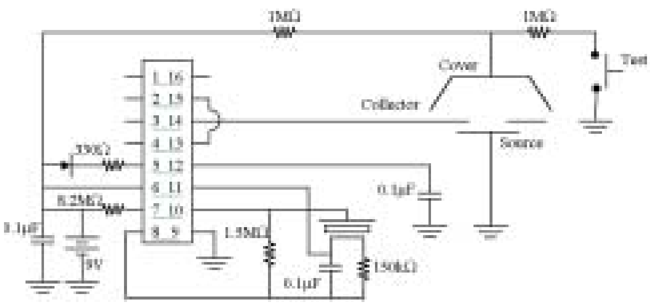
A. Collector electrode
B. Cover Electrode
C. Source Electrode

Fig 4, DSCB1C - internal design



The design is compatible with commercially available integrated circuits. A recommended detection circuit for use with the DSCB1C can be found in fig 5.

Fig 5 Recommended circuit design for use with the MC1446 detector chip



The smoke detection performance of the DSCB1C chamber has been measured using a variety of different types of smoke. Sensitivity to smouldering paper, smoky paraffin and smouldering wick can be found in figures 6a, 6b and 6c.

Fig 6a DSCB1C smouldering paper sensitivity

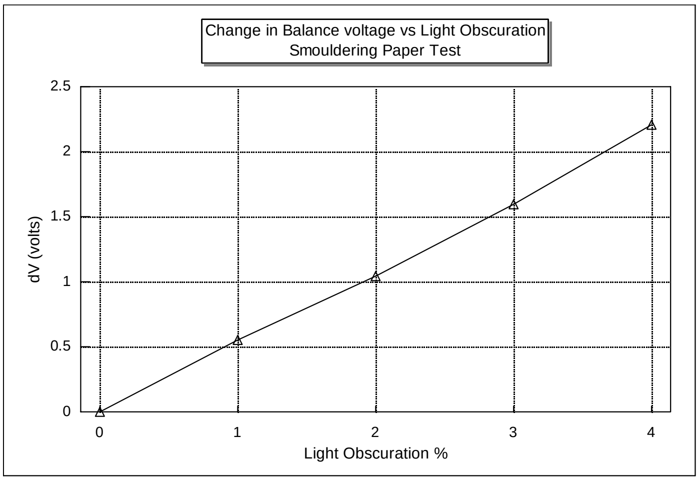


Fig 6b DSCB1C smoky paraffin sensitivity

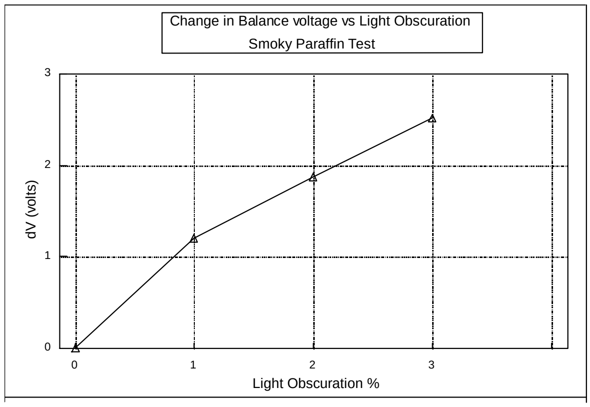
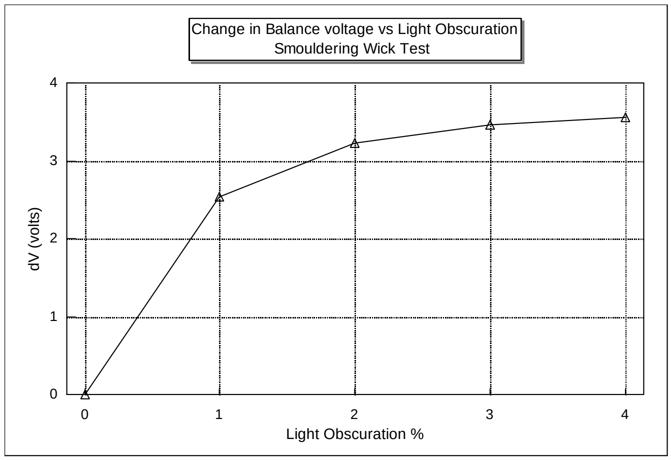
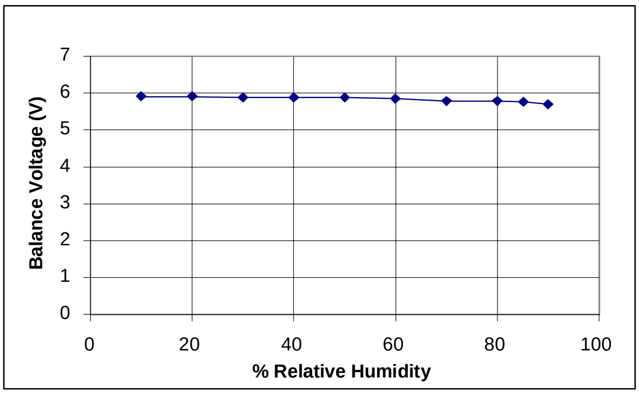


Fig 6b DSCB1C smouldering wick sensitivity



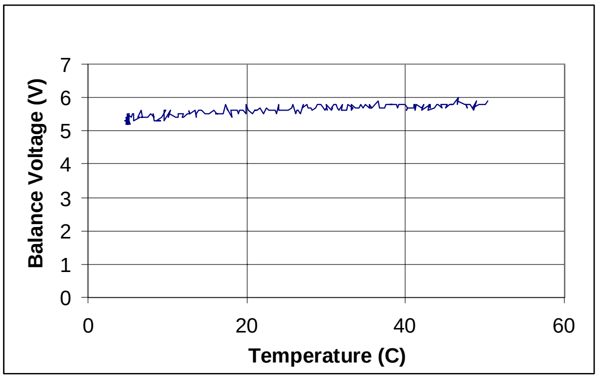
The sensitivity of the DSCB1C to humidity is shown in figure 7.

Fig 7 DSCB1C humidity response at 23^{0}C



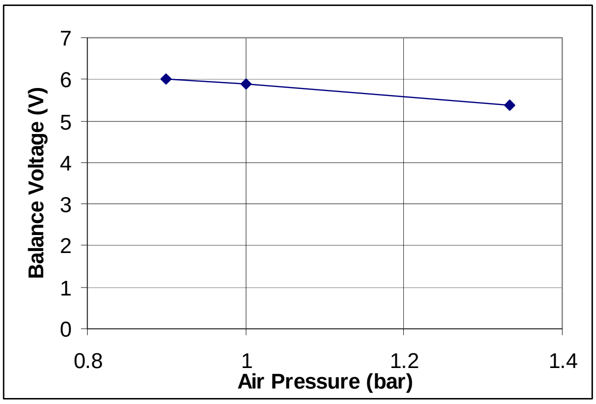
The sensitivity of the DSCB1C to temperature is shown in figure 8.

Fig 8 DSCB1C Temperature response at 60%RH



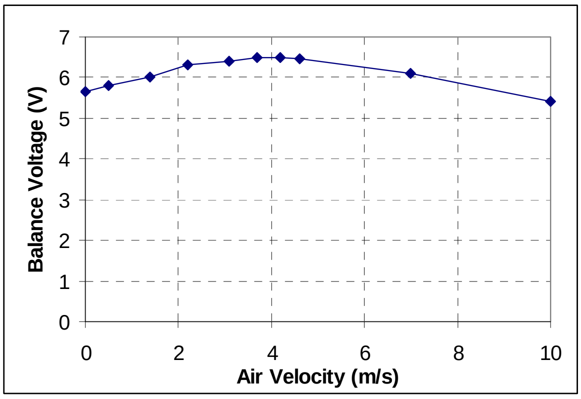
The sensitivity of the DSCB1C to air pressure can be seen in figure 9

Fig 9 DSCB1C Air pressure Response



The sensitivity of the DSCB1C to air velocity can be seen in figure 10.

Fig 10 DSCB1C Air Velocity Response (provisional)



The air velocity response is highly dependent on the design of customers' own detector circuits and detector housing and may vary significantly from the above diagram.

Regulatory Compliance

AEA Technology sealed foil sources used in the detectors meet the regulatory requirements of most national authorities world wide. Virtually all ionisation smoke detectors use such sealed sources.

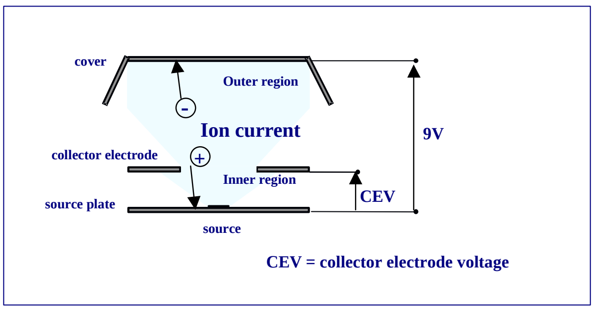
Specifically AEA Technology sources comply with:

- Underwriters Laboratories Inc. Standard UL 217[2]
- European Norm EN 5446[3] and GB 4715-1993.
- UK National Radiological Protection Board (NRPB) criteria of acceptability[7] upon which UK government legislation relating to smoke detectors is based.
- Performance criteria of Massachusetts Radiation Control Program where they have been registered under model number AMM.1001H. Registrations are recognised in the USA as equivalent to NRC registration and so have nation-wide validity.

Principle of Operation

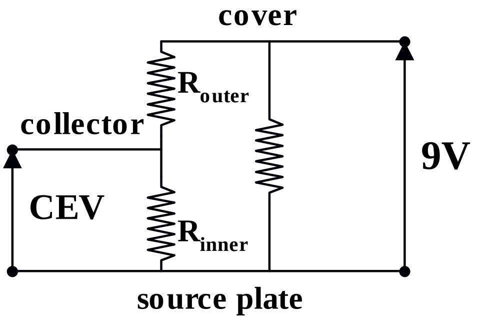
Basic designs consist of a cover electrode with louvers to allow smoke to enter and a source electrode and collector electrode, which are connected by highly insulating plastic supports as in figure 11. A radioactive source emits alpha particles into the chamber, through an aperture in the collector electrode. Alpha particles passing through the inner and outer regions produce positive and negative ions throughout the chamber. An ion current flows when a typical voltage of 9V is applied between the cover and the source plate. The applied voltage can be positive or negative.

Fig 11 Basic Ion Chamber Concept



An equivalent circuit diagram representing an idealised ion chamber is shown in figure 12. The diagram shows the effective electrical resistance of the inner region (R_{inner}) in series with the outer region (R_{outer}). The collector electrode voltage (CEV) floats to an intermediate value between 0V and 9V depending on the chamber design and field gradients. The CEV is affected by the ion concentration in the inner and outer region and by ion recombination. The combined effects determine the values of R_{inner} and R_{outer}.

Fig 12 Equivalent circuit diagram (highly simplified)



The value of the collector electrode voltage (CEV) is approximated by the following equation:

$CEV = V / [1 + R_{outer}/R_{inner}]$

At high applied voltage such as ~500V the chamber saturates and there is no ion recombination. Under these conditions the ion current reaches a maximum, determined by the total number of ions in the chamber.

Commercial chambers tend to be designed with a large outer region and a small inner region, so most of the ions are produced in the outer region. Consequently R_{outer} is normally lower than R_{inner} under ambient conditions and the ratio R_{outer}/R_{inner} is therefore normally <1. The CEV of typical chambers often lies in the range 5-6V.

About half the ions in a typical ion chamber recombine in clean air. The majority of these recombine where the voltage gradient and the drift velocity are especially low. Because of this ions in the outer region are especially sensitive to particulate materials in the chamber. They collide with particle surfaces where they may be immobilised and recombine. In the presence of smoke, ions recombine very rapidly, causing the value of R_{outer}/R_{inner} to increase and the CEV to drop. Smoke detectors are designed to alarm when the CEV drops below a certain threshold value. This is typically set to be about 4.5V in commercial alarms.

Precautions and Recommendations

The ionisation current is approximately 16pA. Precautions to preserve the insulation of the input connection path to the electronics are critical for correct operation of the device. In particular the collector electrode and its connections must remain free from contamination e.g. from solder flux or manual contact. The lead from the collector electrode to the detector circuit should preferably be short and clear of the circuit board and other components. Direct connection between pin 15 of the detector chip and the collector electrode within the recess of the chamber moulding enables this sensitive connection to remain isolated from other circuit components

The chamber is shielded from external electric fields by its outer cover. Suitable shielding should be provided for the associated circuitry, because of the necessarily high impedance of the circuit connected to the chamber collector electrode.

Chambers intended for use at high altitudes may require adjustment of the tripping level of the detector circuit for optimum sensitivity.

The collector electrode voltage has minimal sensitivity to variations in temperature, humidity and wind velocity as shown in figures 8-10. AEA Technology can advise on applications in which the ion chamber may operate outside the ambient ranges illustrated.

Specification

The general specification and operating performance under ambient environmental conditions are as follows:

- Temperature 20^0C +/-3^0C
- Ambient pressure: atmospheric, near sea level, clean air
- Outer electrode to source electrode potential: 9V
- The CEV is nominally 5.3V-6.5V.
- Special arrangements can be made to supply batches of chambers in narrow CEV bands, for example as follows: 5.3-5.6V, 5.61-5.9V, 5.91-6.2V, 6.21-6.5V.
- Change in CEV with smoke (see figures 6a,b and c)
  1% obscuration /foot* 0.6V typical
  4% obscuration / foot* 2.2V typical
- Insulation leakage <0.5pA.

- Capacity (collector to outer + source electrode) 6pF
- ^{241}Am activity 30kBq (~0.8µCi) +/-15%

* obscuration limits specified by UL217 (2)

Radiological Data

Users of these units in all countries should ensure that they comply with all relevant regulations on the control of radioactive materials.

AEA Technology ^{241}Am alpha foil products have been independently assessed and found satisfactory in the following respects:

- general radiological assessment by the NRPB(8).
- NEA 1200^{0}C incineration test by the NRPB(9)

Copies of the NRPB reports are available on request.

References

1. 'Quality systems: Model for quality assurance in design, development, production, installation and servicing.' BS EN ISO 9001, British Standards Institution, London 1994.

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4. 'Americium-241 alpha foil and sources.' Data sheet No 11262, AEA Technology, 1977.

5. 'Safety and Packaging.' Data sheet reference SOU/120/95/KL, AEA Technology, 1995.

6. 'Recommendations for ionisation chamber smoke detectors in implementation of radiation protection standards.' Section 6 Nuclear Energy Agency, Organisation for Economic Co-operation and Development, Paris, 1977.

7. 'Board Statement on Approval of Consumer Goods Containing Radioactive substances.' Documents of the NRPB, Volume 3, No. 2, National Radiological protection Board, Didcot, 1992.

8. 'Measurement Report: Radiological Assessment.' EMR/1 34/79, National radiological Protection Board, Didcot, 1979.

9. 'Analytical Report: NEA 1200^{0}C incineration test.' NRPB/CP 3/016, National Radiological Protection Board, Leeds, 1985.