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VOC Sensor

B/ESO150-DSO150
B/ESO152-DSO152

User's Manual

Updated on 01/02/2011

Cod. INSTUM_00072_en

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1.Product presentation

The VOC (volatile organic compound) sensor measures the volatile organic compounds in the air.

The sensor works according to the PID (photo ionization detector) principle: a UV lamp delivers 10.6 eV nominal-energy photons and they can ionize some types of gas molecules. These molecules go through 2 excitation flaps equipped with a potential difference of about 70 V; the latter generate a field and displaces the ions towards the respective flaps. The weak produced current is amplified and is proportional to the gas concentration. This sensor is operative for about 1 year.

The sensor is able to measure VOC gases with an ionization energy less than 10.6 eV which belong to the group of aromatic hydrocarbons (benzene, ethylbenzene, toluene, etc.), aliphatic hydrocarbons (butane, octane, etc.), alcohols (ethanol, propanol, butyl alcohol and its derivatives), etc. Many are the sources of such compounds: cleaning products such as floor and furniture waxes (spray and liquid), abrasive paste, dishwashing liquid, solid and spray deodorants, products to clean the bathroom, glass and ovens; paints and associated products such as oil, urethane and acrylic paints, spirit paints for shellac, wood mordant and dyes, thinners for brushes, paint removers; pesticides, insecticides and disinfectants; glues and adhesives; products for personal care and cosmetics; products for cars; products for photographic development; do-it-yourself products; furniture and fabrics; building material; office products such as printers, photocopiers, highlighters and similar stationery; heating and conditioning systems (reservoirs), kitchens, fireplaces; tobacco; human, animal e vegetable organic substances; industrial and vehicle emissions.

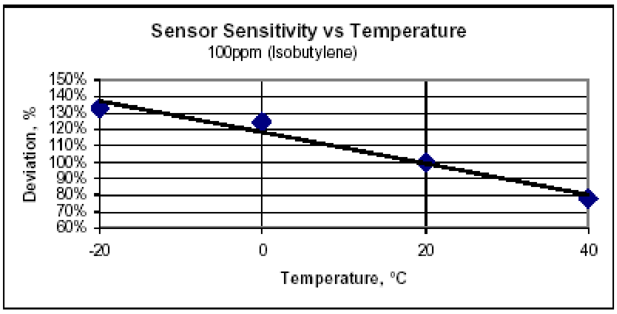
The sensor measurements may be influenced by relative humidity and dust, which can be reduced by using a filter and a good geometry of the sensor.

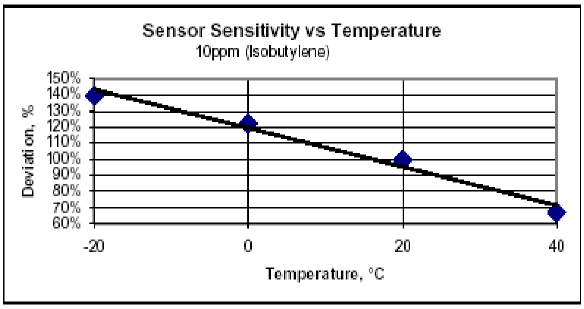
2.Technical features:

	B/ESO150 - DSO150	B/ESO152 - DSO152
Measuring range	0-20 ppm VOC (isobutylene)	0-2000 ppm VOC (isobutylene)
Sensitive element	PID	
Threshold	0.01 ppm (Isobutylene)	0.1 ppm (Isobutylene)
Temperature coefficient	-1.0% / °C in the range from -20 to 40 °C	
Repeatability (in the short run)	+/-2% VL	
Relative humidity influence	< 10 % of the signal in the range from 10 to 90 % RH (influence due to the presence of water vapor molecules)	
Warm-up	20 minutes for daily use 1 hour for rarely uses	
Response time (T90%) (for diffusion)	≤ 20 seconds	
Response time (T90%) (with a 150 cc/min flow)	≤ 3 seconds	
Working environment limitation	-20 ÷ 40°C	0 ÷ 40 °C
Power consumption	<100 mW	<100 mW
Output signal	B/ESO150: 60 ÷ 300 mV DSO150: 4 ÷ 20 mA	B/ESO152: 60 ÷ 300 mV DSO152: 4 ÷ 20 mA
Power supply	6 ÷ 9 Vcc	12 Vcc
Connection	B/ESO150: "minidin" connector DSO150: wired (length=10 m)	B/ESO152: "minidin" connector DSO152: wired (length=10 m)
Shell material	aluminum	
Dimensions	ϕ= 54 mm h=42.5 mm	
Weight	220 g	

2.1.Temperature drift

These pictures show the sensor measurement drift depending of the ambient temperature.

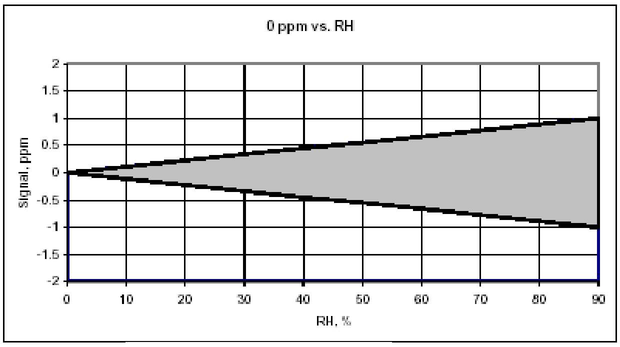




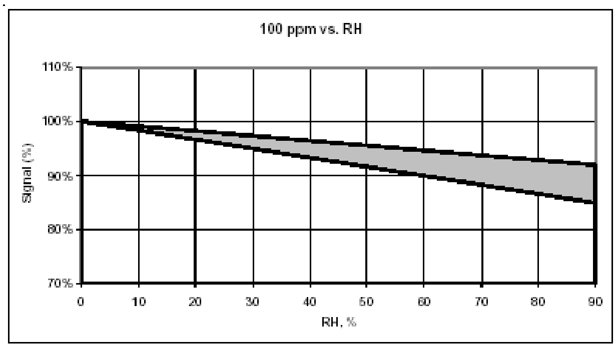
2.2.Relative humidity influence

This probe is influenced of two phenomenon related to relative humidity in pure air and with VOC gas:

1. In the case of Humidity Response to Moisture pure Hydrocarbon Free (HCF) air is applied to the sensor, with some humidity present in the sample. The maximum expected shift does not exceed ±1.0 ppm (Isobutylene). For improving the accuracy of low level measurements, it is recommended to zero the sensor at the same level of relative humidity (RH) as expected in the sample;
2. With a fixed VOC concentration, measured value can be less from 8 to 15 % when relative humidity is 90 % (humidity quenching).



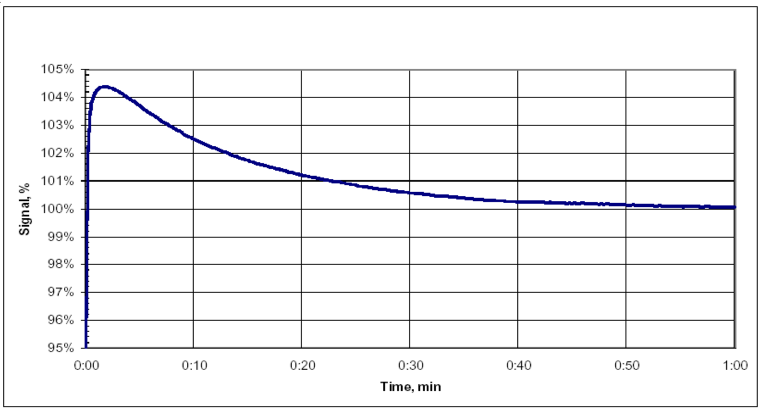
Humidity Response



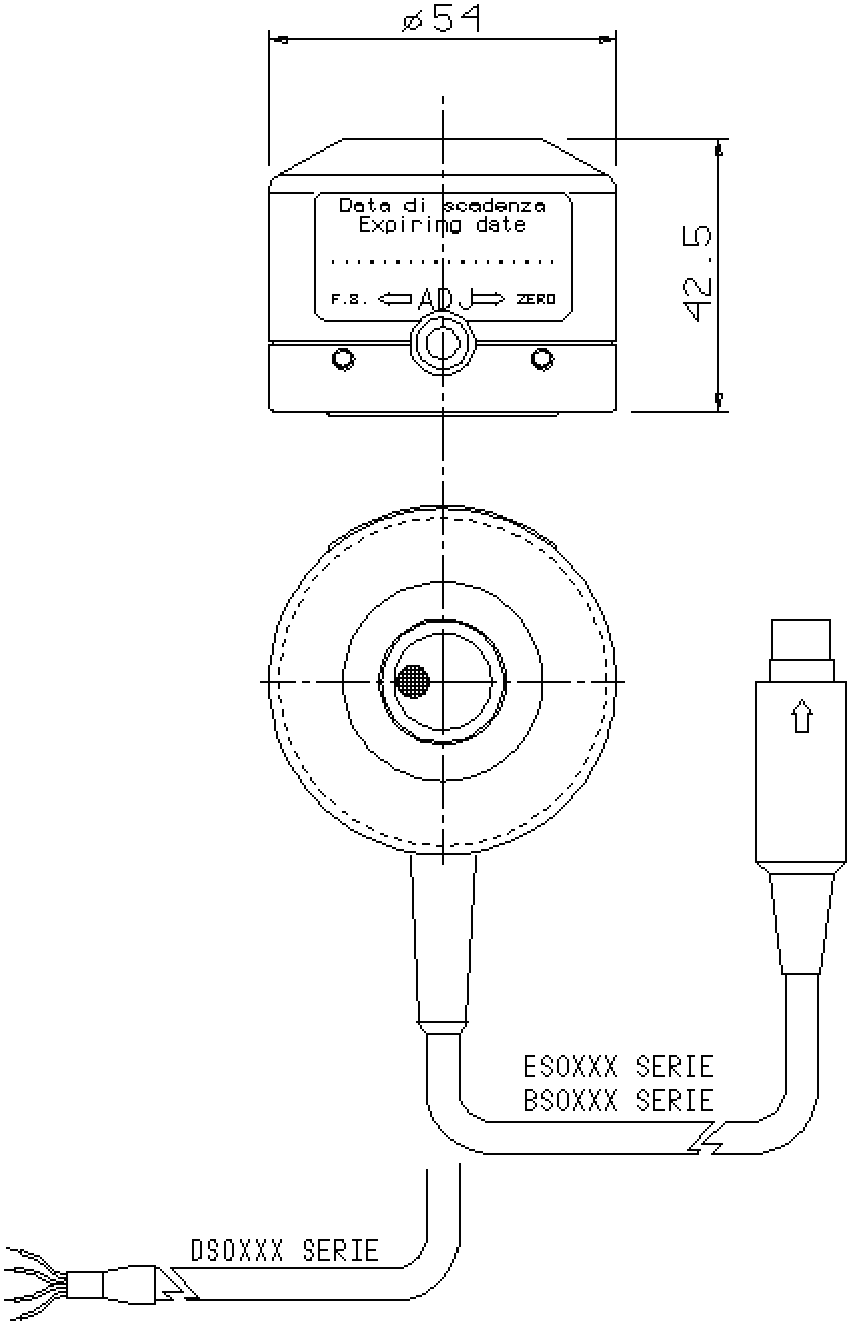
Humidity Quenching Effect

2.3.Warm-up

If the sensor is used daily, the measurement is stable after a 20 minute time from power up; after prolonged storage, it is recommended to operate the sensor for a longer period of time before operating it (see picture below).



3.Connection diagram



FILO/WIRE	
MARRONE/BROWN	+ Vcc/Vdc ALIMENTAZIONE / POWER SUPPLY
ROSSO/RED	+ Sig. (Vedi targhetta See label)
VERDE/GREEN	- Sig. (Vedi targhetta See label)
BLU/BLUE	0V ALIMENTAZIONE / POWER SUPPLY

4. Using the sensor

4.1. Models BSO150 and BSO152

Connect the sensor to the Babuc instrument, then start the survey on the instrument; it will automatically recognize the VOC gas concentration measures.

The table below shows a list of operative codes and sub-codes used by Babuc for the acquisition of the BSO150 probe:

Input name	*Text on Babuc*	*Op. Code*	*Sub Op. Code*
VOC gas concentration	Conc-gasVOC	117	134
VOC gas concentration	Conc-gasVOC	118	134

The sensor is compatible with LSI LASTEM acquisition instruments of the Babuc/A/M line running version 5.11 or higher.

4.2. Models ESO150 and ESO152

Connect the probe to R-Log or M-Log instrument, switch on and configure the datalogger or make the automatic recognition of connected probes; after this operation, the survey will start automatically.
For more information on configuration of dataloggers see their manuals on website www.lsi-lastem.it or available on LSI LASTEM product's DVD (MW6501).

Sensors are compatible with datalogger with connector inputs: ELR510 and ELO009 models.

4.3. Models DSO150 and DSO152

Connect the terminals for power and signal as described in the diagram in paragraph 3.

5.Calibration

Calibrate the probe daily. If the environment is not particularly polluted calibration may take place weekly or monthly.

Zero calibration may take place by using a cylinder containing nitrogen or fresh air, rotating the zero trimmer.

End scale calibration may take place by using a cylinder containing isobutylene (with air or nitrogen bottom) with a known concentration (for example: 15 ppm isobutylene per BSO/ESO/DSO150 and 1500 ppm per BSO/ESO/DSO152) rotating the FS trimmer.

LSI LASTEM supplies the probe with an aluminum union adapter for the cylinder with silicon rubber pipe. These materials don't absorb gas so they do not influence the measurement.

6.Maintenance

Using the probe its internal lamp degrades slowly. The operation of the lamp may be impaired due to:

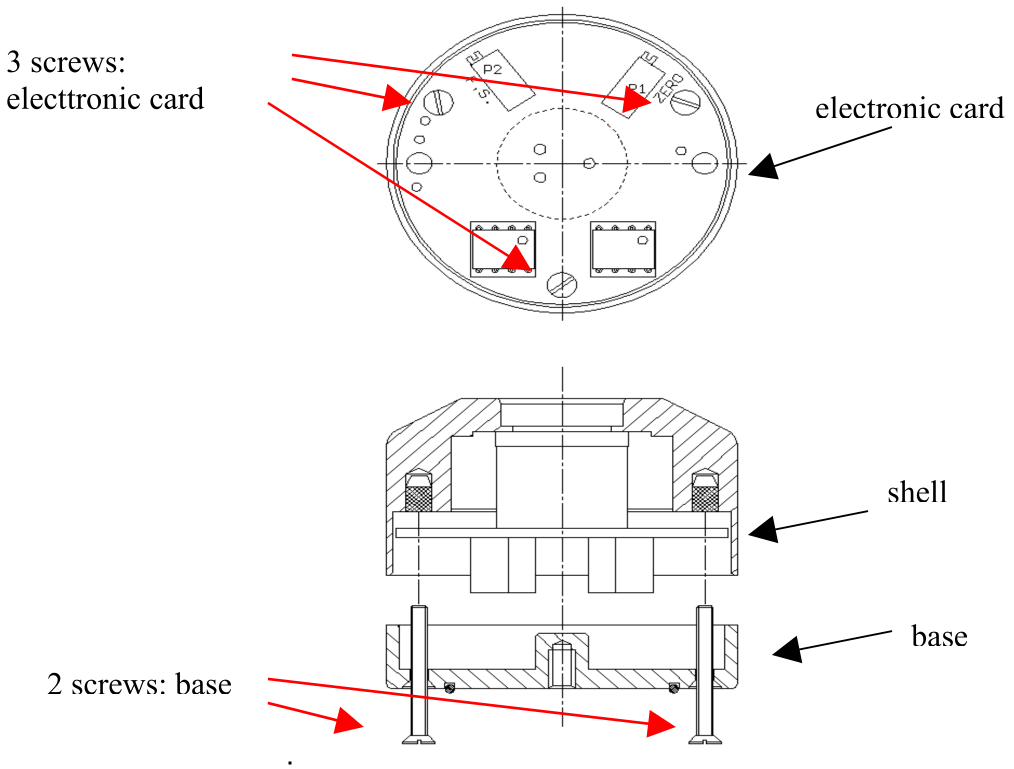
- Internal wear: after about 6000 working hours;
- Window contamination due to the pollution of the volatile particles.

To clean the lamp window follow the instructions in paragraph 6.1. The lamp can last longer by frequently calibrating the sensor.

6.1.Cleaning the lamp

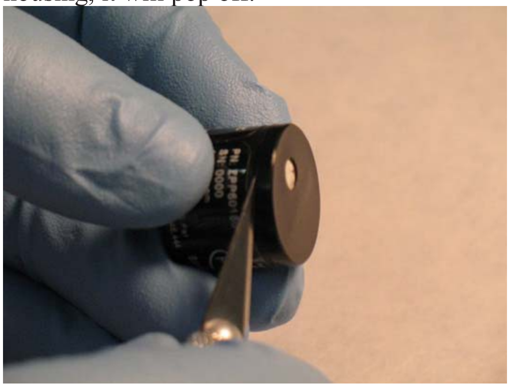
To clean the lamp open the sensor shell and remove the electronic board that holds the PID cell.

In order to remove the cell, take down the lower base of the probe's shell by unscrewing the 2 lower screws; then unscrew the 3 screws that hold the electronic board to the shell and remove it.

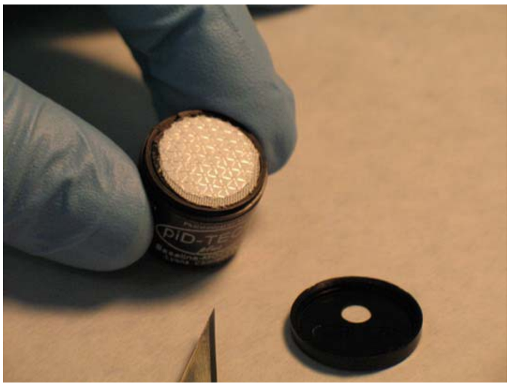


Disassembly

Remove the Filter Cap by applying slight upward pressure with the tip of a screwdriver or X-Acto blade just below the hole in the cap and between the cap and housing, it will pop off.

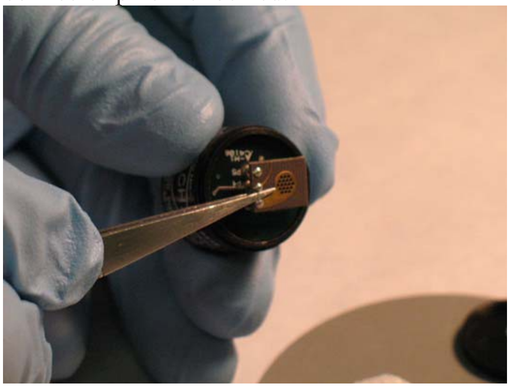


With fine-tipped tweezers, remove both the Filter Media and set aside.

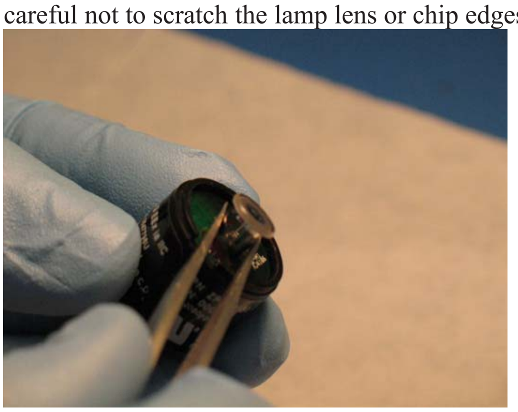


Using the X-Acto blade, remove the spacer and set aside.

With fine-tipped tweezers, carefully remove the Cell Assembly by prying under the Cell's edge where connector pins are located.

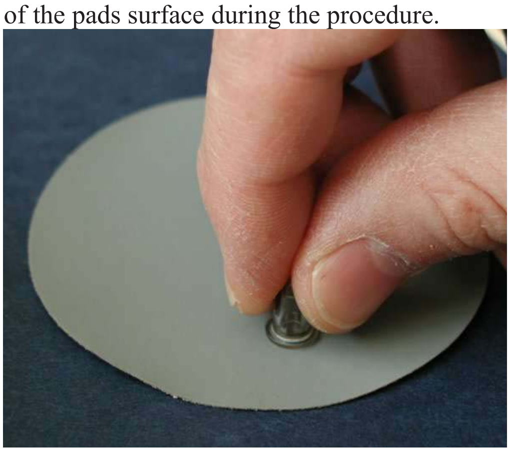


With fine-tipped tweezers, grasp the lamp by placing the tips in the housing notch and gently pull it out. Be careful not to scratch the lamp lens or chip edges.



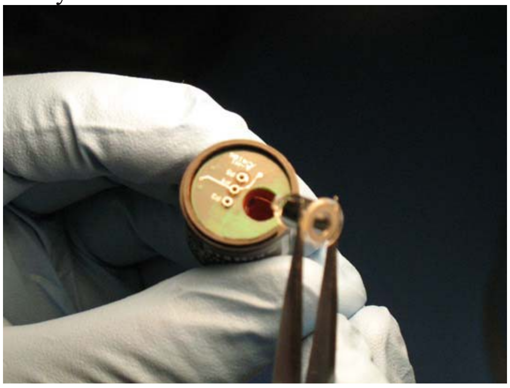
Cleaning the Lamp

Grab the lamp by the cylindrical glass body and clean the window by rubbing it against the Polishing Pad. Use a circular motion and try to keep the window surface flat relative to the pad. Five seconds of rubbing will be enough in most cases. Another indication of cleaning completeness is that you have used about 1/6th of the pads surface during the procedure.

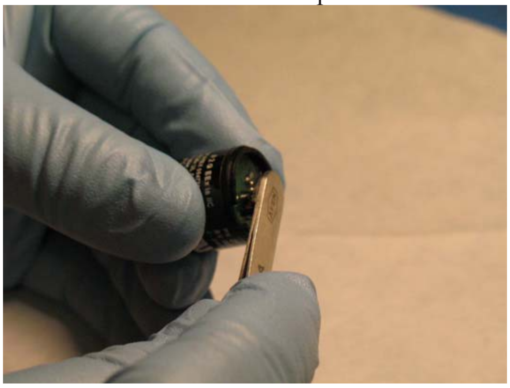


Reassembly

Install the lamp into the sensor, making sure that the lamps metalized pads are aligned with the corresponding excitation springs inside the lamp cavity.

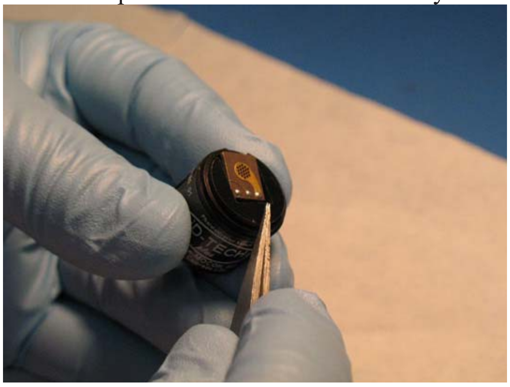


With the end of the clean tweezers, or the clean blade of a screwdriver, press down firmly. Be careful not to scratch the surface of the lamp.



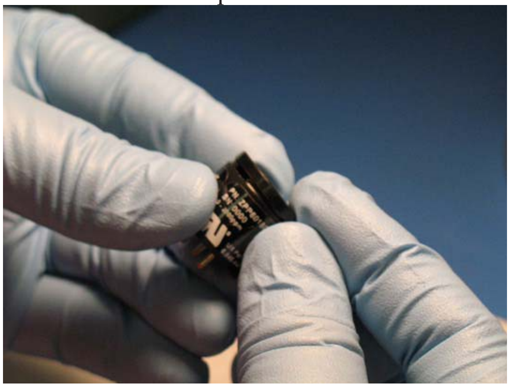
Using fine-tipped tweezers, install the cell assembly. Align the pins with the corresponding sockets on the sensor and push down on the end with the pins. Make sure the cell assembly is flush with the lamp window.

Place the spacer around the cell assembly.



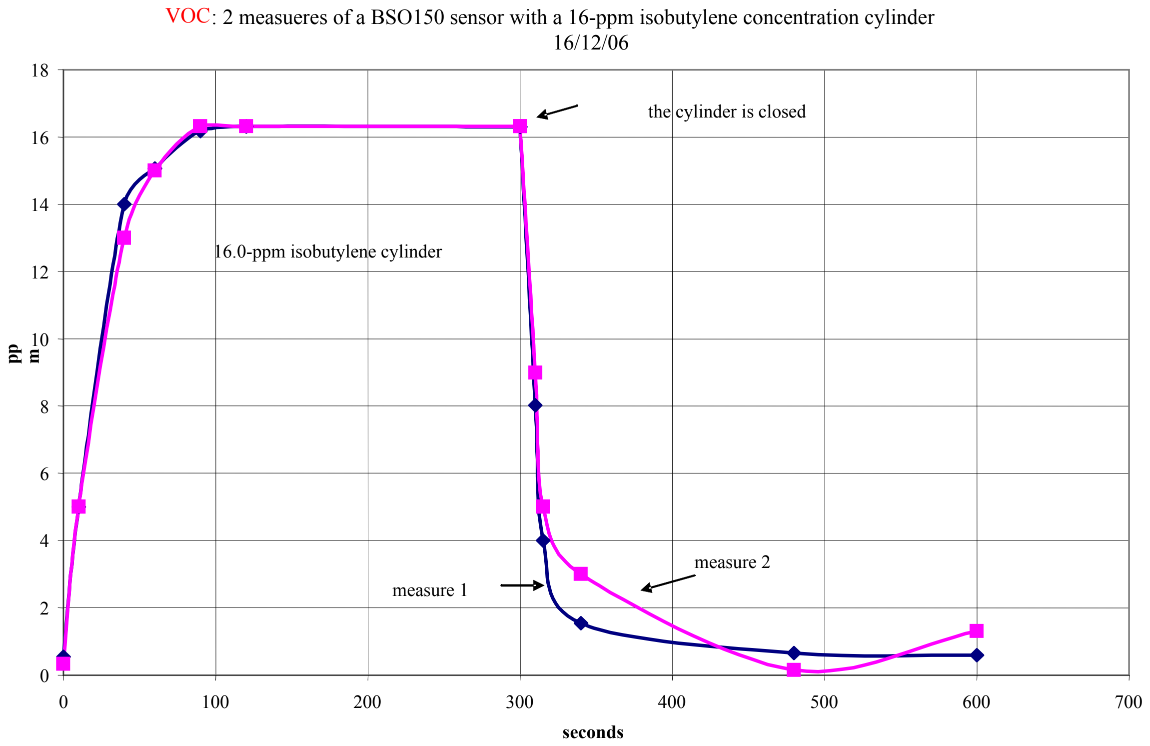
Place the Filter Media over the Cell Assembly centered on top of the sensor. Make sure the filters are installed in the correct order. Filter Media #2 first, then Filter Media #1 on top, with the shiny side up.

Alight the Cap Key with the notch on the housing. Starting at the side opposite the notch, press down until the Filter Cap snaps on to the housing. If the Cap Key is incorrectly aligned, there will be a noticeable bulge on the side of the cap.



Appendix 1: measure with reference gas

The picture below shows the response of a BSO150 sensor when applied to a 16-ppm isobutylene gas flow.



7. Appendix 2: response factors respect to isobutylene

The following table indicates the sensor response factors regarding the isobutylene gas.

1,2,3-trimethylbenzene	0.49
1,2,4-trimethylbenzene	0.43
1,2-dibromoethane	11.7
1,2-dichlorobenzene	0.5
1,2-dichloroethane (11.7 lamp)	0.5
1,3,5-trimethylbenzene	0.34
1,4-dioxane	1.4
1-butanol	3.4
1-methoxy-2-propanol	1.4
1-propanol	5.7
2-butoxyethanol	1.3
2-methoxyethanol	2.5
2-pentanone	0.78
2-picoline	0.57
3-picoline	0.9
4-hydroxy-4-methyl-2-pentanone	0.55
acetaldehyde	10.8
acetic acid	11
acetone	1.2
acetophenone	0.59
acrolein	3.9
allyl alcohol	2.5
ammonia	9.4
amylacetate	3.5
arsine	2.6
benzene	0.53
bromoform	2.3
bromomethane	1.8
butadiene	0.69
butyl acetate	2.4
carbon disulfide	1.2
chlorobenzene	0.4
cumene (isopropylbenzene)	0.54
cyclohexane	1.5
cyclohexanone	0.82
decane	1.6
diethylamine	1
dimethoxymethane	11.3
dimethyl disulfide	0.3
diesel fuel #1	0.9
diesel fuel #2	0.75
epichlorhydrin	7.6
ethanol	10
ethyl acetate	4.2
ethyl acetoacetate	0.9
ethyl acrylate	2.3
ethyl ether (diethyl ether)	1.2
ethyl mercaptan	0.6
ethylbenzene	0.51
ethylene	10.1
ethylene glycol	15.7
ethylene oxide	19.5
gasoline	1.1
heptane	2.5
hydrazine	2.6
hydrogen sulfide	3.2
isoamyl acetate	1.8
isobutanol	4.7
isobutyl acetate	2.6
isobutylene	**1**
isooctane	1.3
isopentane	8
isophorone	0.74
isoprene (2-methyl-1,3-butadiene)	0.6
isopropanol	5.6
isopropyl acetate	2.6
isopropyl ether	0.8
isopropylamine	0.9
Jet A fuel	0.4
JP-5 fuel	0.48
JP-8 fuel	0.48
mesityl oxide	0.47
methanol (11.7 lamp)	2.5
methyl acetate	7
methyl acetoacetate	1.1
methyl acrylate	3.4
methyl benzoate	0.93
methyl ethyl ketone	0.9
methyl isobutyl ketone	1.1
methyl mercaptan	0.6
methyl methacrylate	1.5
methyl tert-butyl ether	0.86
methylamine	1.2
methylbenzil alcohol	0.8
methylene chloride (11.7 lamp)	0.85
m-xylene	0.53
naphtalene	0.37
n,n-dimethylacetamide	0.73
n,n-dimethylformamide	0.8
n-hexane	4.5
nitric oxide	7.2
n-nonane	1.6
nitrogen dioxide (11.7 lamp)	10
n-pentane	9.7
n-propyl acetate	3.1
octane	2.2
o-xylene	0.54
phenol	1
phosphine	2.8
pinene, alpha	0.4
pinene, beta	0.4
propionaldehyde (propanal)	14.8
propylene	1.3
propylene oxide	6.5

p-xylene	0.5
pyridine	0.79
quinoline	0.72
styrene	0.4
tert-butyl alcohol	3.4
tert-butyl mercaptan	0.55
tert-butylamine	0.71
tetrachloroethylene	0.56
tetrahydrofuran	1.6
thiophene	0.47
toluene	0.53
trans-1,2-Dichloroethene	0.45
trichloroethylene	0.5
trimethylamine	0.83
turpentine - crude sulfite	1
turpentine - pure gum	0.45
vinyl acetate	1.3
vinyl bromide	0.4
vinyl chloride	1.8
vinylcyclohexane (VCH)	0.54
vinylidene chloride (1,1-DCE)	0.8