

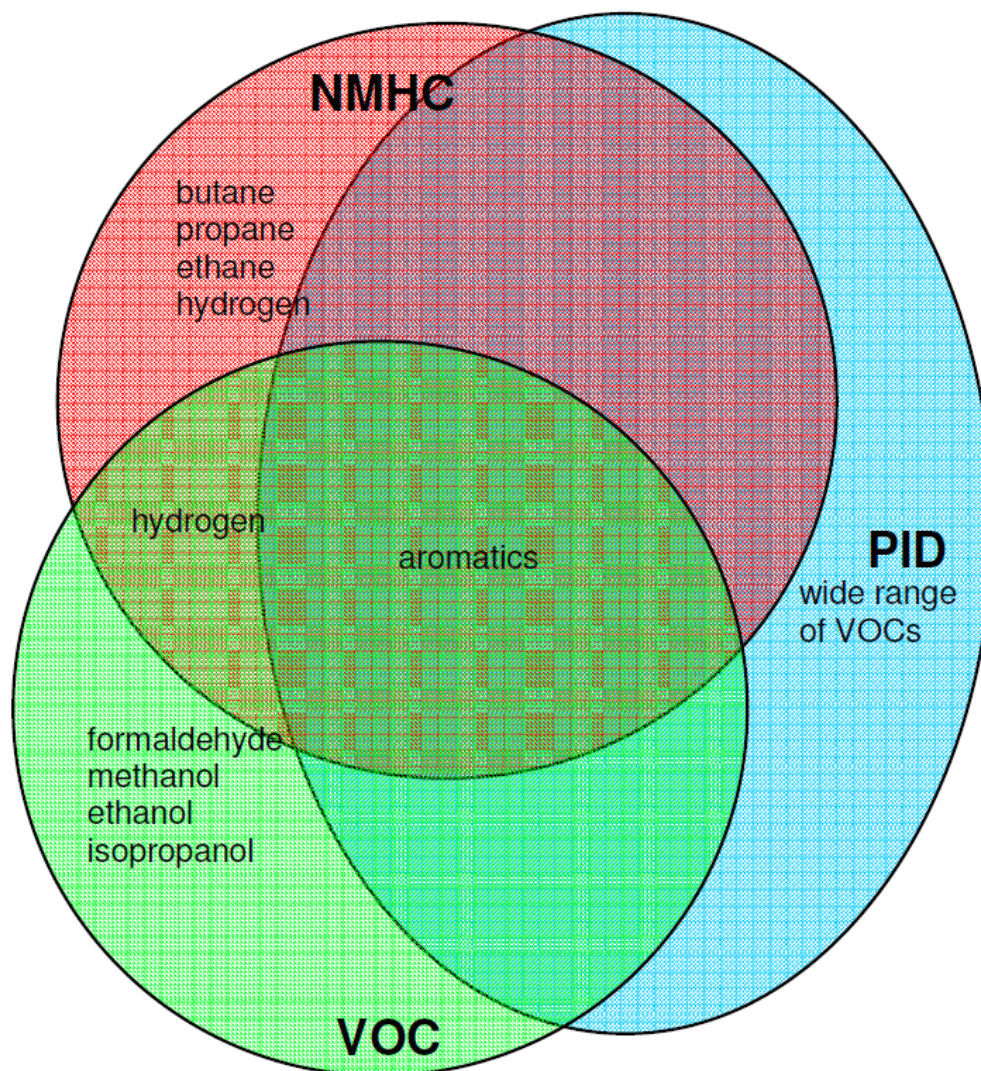
PID versus GSS Sensors



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The Ultimate Measurements

Kanomax offers three different types of sensor for measurement of volatile organic compounds (VOCs): PID, GSS VOC and GSS NMHC. These sensors have been designed to respond to a broad range of VOCs although they each display a unique sensitivity to certain VOCs or classes of hydrocarbon, (see Table). However, the range of sensitivity of each sensor substantively overlaps with the others (see Diagram).

Sensor	Selectivity	Ambient gases
PID	Sensitive to wide range of gases but insensitive to some common gases eg propane, formaldehyde, alcohols	Aromatic hydrocarbons, fuels
GSS NMHC	Most sensitive to hydrocarbons	Aromatic hydrocarbons, fuels, olefins
GSS VOC	Sensitive to wide range of gases	Hydrocarbons, alcohols, formaldehyde



PID Gas Response Times



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The PID sensors offered by Kanomax have a different response to a variety of gases as shown in the table below. The Response Factor (RF) provides a sensitivity measure relative to isobutylene (RF=1). The PID sensor is more sensitive to compounds with lower RF values. Compounds not listed may also be detected by PID - please contact us for more information.

PID Sensor Specifications:

Calibrated Range (ppm)	Maximum Exposure (ppm)	Lowest Detection Limit	Accuracy of Calibration	Resolution (ppm)	Response Time (T ₉₀)	Sampling Method	Operational Range	
							Temp.	RH non condensing
0 - 20	100	0.01 ppm	<±0.02ppm + 10%	0.01	30s	Fan	0 to 40°C	0 to 95%
0-1000	1000	0.1 ppm	<±0.2ppm + 10%	0.1	30s	Fan	0 to 40°C	0 to 95%

Response Factors:

- The default sensor concentration reading is in units of ppm of Isobutylene.
- The user can convert this into ppm of another gas by multiplying the reading by the response factor (RF) listed below.
- For example, the PID sensor head is calibrated against Isobutylene and is being used to measure the concentration of heptane. The reading in ppm of Isobutylene is 10ppm. Therefore the concentration of heptane is 10 ppm x 2.5 = 25 ppm.
- The VOC sensor can also be used to qualitatively indicate the total VOC level. The units of measurement are ppm Isobutylene equivalent.

Compound	Response Factor (RF)*
1,2,3-trimethylbenzene	0.49
1,2,4-trimethylbenzene	0.43
1,2-dibromoethane	11.7
1,2-dichlorobenzene	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

Compound	Response Factor (RF)*
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	1.0

* A smaller RF means the PID is more sensitive to the compound

Compound	Response Factor (RF)*
dimethoxymethane	11.3
dimethyl disulfide	0.3
diesel fuel #1	0.9
diesel fuel #2	0.75
epichlorhydrin	7.6
ethanol	10.0
ethyl acetate	4.2
ethyl acetoacetate	0.9
ethyl acrylate	2.3
diethyl ether	1.2
ethyl mercaptan	0.6
ethylbenzene	0.51
ethylene	10.1
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	1.0
isooctane	1.3
isopentane	8.0
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
methyl acetate	7.0
methyl acetoacetate	1.1
methyl acrylate	3.4
methyl benzoate	0.93
methyl ethyl ketone	0.9
methyl isobutyl ketone	1.1
ketone	1.1
methyl mercaptan	0.6
methyl methacrylate	1.5

Compound	Response Factor (RF)*
methyl tert-butyl ether	0.86
ether	0.86
methylamine	1.2
methylbenzil alcohol	0.8
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
n-pentane	9.7
n-propyl acetate	3.1
octane	2.2
o-xylene	0.54
phenol	1.0
phosphine	2.8
pinene, alpha	0.4
pinene, beta	0.4
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	1.0
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

* A smaller RF means the PID is more sensitive to the compound

GSS Technology Background



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Gas Sensitive Semiconductor (GSS) technology is a combination of smart measurement techniques and mixed metal oxide semiconductor sensors that exhibit an electrical resistance change in the presence of a target gas.

This resistance change is caused by a loss or a gain of surface electrons as a result of adsorbed oxygen reacting with the target gas. If the oxide is an n-type, there is either a donation (reducing gas) or subtraction (oxidising gas) of electrons from the conduction band. The result is that n-type oxides increase their resistance when oxidising gases such as NO₂ and O₃ are present while reducing gases such as CO and hydrocarbons lead to a reduction in resistance. The converse is true for p-type oxides where electron exchange due to gas interaction leads either to a rise (oxidising gas) or a reduction (reducing gas) in electron holes in the valence band. This then translates into corresponding changes in electrical resistance. Quantitative response from the sensor is possible as the magnitude of change in electrical resistance is a direct measure of the concentration of the target gas present.

Since the surface reaction causes the change in electrical resistance in the sensing oxide, maximising the surface area intensifies the response to gas. To take advantage of this effect, commercial gas sensors consist of highly porous oxide layers, which are either printed or deposited onto alumina chips. The electrodes are usually co-planar and located at the oxide/chip interface (see diagram below). A heater track is also applied to the chip to ensure the sensor runs "hot" which minimises interference from humidity and increases the speed of response. The microstructure of the oxide, its thickness and its running temperature are optimised to improve selectivity. Catalytic additives, protective coatings and activated-carbon filters are also applied to enhance selectivity.

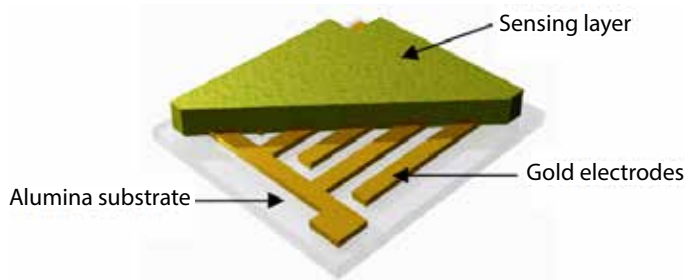
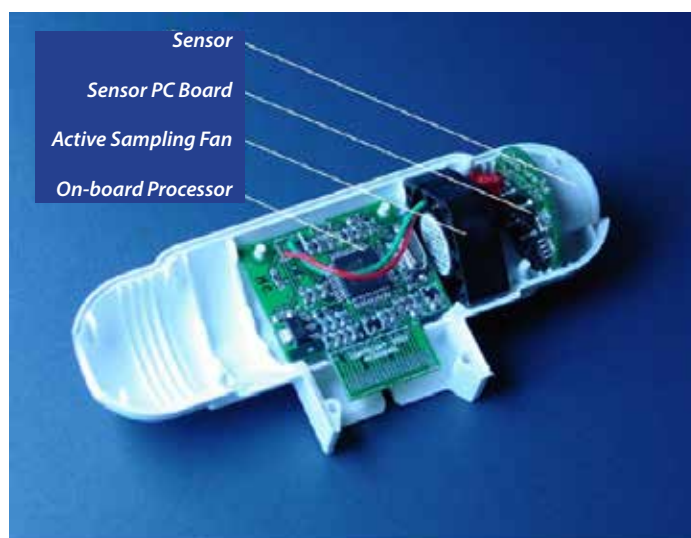


Diagram of typical sensor formulation



Typical sensor head & key components

The range of GSS sensor-based products offered by Kanomax has been designed to provide near scientific accuracy, high reliability and functionality at an affordable price. Aeroqual's concept of fully interchangeable sensor heads eliminates the need for field calibration and provides users with unique application focused solutions.

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