Using the VOC-A4 and VOC-B4 sensors

Using a VOC Sensor with a Corresponding CO Sensor

The 4-electrode electrochemical VOC sensors detect a range of gases including VOCs and CO. Using a VOC-A4 sensor with a CO-A4 sensor or a VOC-B4 sensor with a CO-B4 sensor allows the responses to CO and VOCs to be distinguished.

Using the VOC-A4 or VOC-B4 with a Voltage Bias from 0 to 0.3V

It is possible to alter the manner the sensor responds to different gases by applying a voltage bias on the sensor. In general, the higher the bias voltage, the more VOCs the sensor will detect. Therefore, at higher bias the sensor can work as a broad range VOC sensor. Please refer to the section 'Experimental data' below.

However, working at zero voltage bias also has its advantages. If the VOCs of interest are already detectable at low or no bias, increasing the voltage bias would increase interference from other VOCs. The background current or zero current in air rises with bias voltage. Increased temperature over STP would also add to the zero current. Additional influences on zero current and the resulting adjustment to zero offset may be inconvenient when measuring low concentrations of gas.

Correcting the signal

Sensor response can be processed to compensate for environmental influences such as temperature. The greater challenge is to compensate for environmental influences on the sensor zero baseline. This is important when working with low concentrations of gas. This would usually involve studying the sensors in your working conditions to determine your zero baseline output.

Experimental data

Tests have been performed to provide indicative values for the sensor sensitivity for a selection of compounds (see Table 1 & Table 2 below). With some knowledge of the VOCs present, these sensors can be used to estimate the concentrations present.
Due to the high sensitivity of these sensors, caution is advised when subjecting them to prolonged or high concentrations of VOC. In these conditions the sensor may take longer times to recover or could even be permanently affected.

The tables below contain for given voltage bias (0, 0.1, 0.2 and 0.3V), several common gases and VOCs:

1) Example sensitivity in nA/ppm calculated from the average result of sample sensors tested with the Gas/VOC

2) Example percentage cross sensitivity as percentage of the output expected for the same concentration of calibration gas. CO at 0V bias in this case

3) Indicative response and recovery times as t90 in seconds. That is, the time taken to reach 90% change in response upon exposure to a fixed concentration of gas and recovery upon removal of that gas. t90 is provided for consideration, as how quickly the sensor can provide a close response to gases may be an important factor in your application.

If dealing with a mixture of VOCs it is reasonable to assume that the concentrations are additive without interference between different VOCs.

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Disclaimer: The VOC-A4 and VOC-B4 sensors are expected to show consistent performance when tested with CO. The same is expected for some VOCs, however it will be the customer's responsibility to calibrate their instrument and ensure repeatability for their specific VOCs and concentrations of interest.

Table 1: A4 Format Sensors

VOC-A4	0V				0.1V				0.2V				0.3V			
	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)
Zero Air (nA)	-87				37				88				813			
CO	331		18	15	242	73%	20	20	308	93%	20	20	281	85%	20	20
NO	100	30%	15	15	312	94%	240	120	368	111%	60	30	414	125%	30	30
H2	38	11%	20	20	21	6%	20	20	12	4%	20	20	9	3%	20	20
Ethylene	354	107%	310	240	470	142%	260	180	622	188%	240	160	635	192%	160	70
Ethylene Oxide	294	89%	360	300	529	160%	300	240	748	226%	260	200	943	285%	100	70
Isobutylene	412	124%	240	3	545	165%	120	180	549	166%	60	150	585	177%	30	65
Ethanol	446	135%	90	90	395	119%	35	35	350	106%	40	40	351	106%	40	40
Formaldehyde	505	153%	-	-	660	199%	-	-	594	179%	-	-	673	203%	-	-
Benzene	2.7	1%	-	-	23	7%	120	60	69	21%	180	90	168	51%	1280	1000
Toluene	31	9%	450	320	83	25%	300	250	160	48%	400	360	349	105%	400	440

CO-A4	0V				0.1V				0.2V				0.3V			
	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)
Zero Air (nA)	-40				70				41				769			
CO	342		15	15	274	80%	15	15	310	91%	15	15	310	91%	15	15
Ethylene	63	18%	180	2000	88	26%	180	180	100	29%	180	200	118	35%	150	90
Ethylene Oxide	230	67%	400	400	386	113%	380	320	679	199%	320	360	824	241%	300	320
Isobutylene	-8	-2%	15	15	-7	-2%	20	20	0	0%			5	1%	15	15
Ethanol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Formaldehyde	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	1.8	1%	-	-	11	3%	90	50	71	21%	200	90	162	47%	1100	900
Toluene	17.6	5%	500	300	68	20%	320	300	117	34%	420	330	220	64%	460	380

Where value is – the output is too small or test artefacts too significant to produce rational numbers.

Table 2: B4 Format Sensors

VOC-B4	0V				0.1V				0.2V				0.3V			
	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)
Zero Air (nA)	-66				149				240				1380			
CO	634		30	30	602	95%	30	30	520	82%	30	30	530	84%	30	30
NO	124	20%	10	10	511	81%	450	280	625	99%	60	30	686	108%	30	30
H2	92	15%	30	25	37	6%	20	20	18	3%	20	20	12	2%	20	20
Ethylene	598	94%	280	240	914	144%	240	150	1026	162%	240	150	1214	191%	180	90
Ethylene Oxide	397	63%	380	380	734	116%	330	240	1214	191%	300	240	1716	271%	240	150
Isobutylene	678	107%	100	200	944	149%	100	150	925	146%	40	120	991	156%	30	90
Ethanol	560	88%	90	90	638	101%	60	60	605	95%	60	60	531	84%	60	60
Formaldehyde	745	118%	-	-	866	137%	-	-	1008	159%	-	-	909	143%	-	-
Benzene	5.5	1%	10	20	73	12%	480	360	173	27%	180	240	376	59%	300	240
Toluene	47	7%	360	400	169	27%	240	300	296	47%	400	320	559	88%	420	300

CO-B4	0V				0.1V				0.2V				0.3V			
	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)	nA/ppm	%XS (of CO @ 0V)	t90 response (s)	t90 recovery (s)
Zero Air (nA)	-90				59				48				880			
CO	516		30	30	525	102%	30	30	483	94%	30	30	482	93%	30	30
Ethylene	102	20%	140	240	177	34%	160	160	230	45%	180	180	219	42%	140	100
Ethylene Oxide	289	56%	450	360	539	104%	420	360	1100	213%	380	360	1326	257%	300	320
Isobutylene	72	14%	10	10	31	6%	15	15	23	4%	15	15	5	1%	15	15
Ethanol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Formaldehyde	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	1.5	0%	-	-	19	4%	50	30	64	12%	240	140	194	38%	360	320
Toluene	14.7	3%	500	320	66	13%	400	200	137	27%	450	380	256	50%	460	240

Where value is – the output is too small or test artefacts too significant to produce rational numbers.

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