TN-TS010
Technical Note
October 2009

Technical Information & Calibration Procedure
A guide to Telasia CO-T1 carbon monoxide transmitter

SCOPE

This note provides additional technical information and support customers who wish to verify or re-calibrate CO-T1 carbon monoxide sensor/transmitter by injecting some known CO gas concentration to the transmitter

Associated Documents :

CO-T1 specification
CO-T1 instruction manual

INTRODUCTION

CO-T1 carbon monoxide sensor/transmitter is an electrochemical sensor. It is designed specifically for ventilation control of car park spaces or areas involving vehicle repairs and operation.

CO-T1 is a simple 2-wire loop-powered sensor. It needs to be connected to a DC power source (see DC Voltage Source on page 2). The output is a 4~20mA current signal corresponding to the CO measurement (standard model, 0 ~ 100ppm CO). When properly connected, the LED lights up and the light intensity varies with measured concentration; that is brighter at higher CO concentration.

Standard model : CO-T1

⚠CAUTION
Health Hazard.
Improper use may create dangerous situations.
Use in application for sensing carbon monoxide *only*.
For life-safety applications, this device can function only as a secondary or lesser device.

DC Voltage Source

CO-T1 requires a DC source. The minimum voltage V1, required to ensure proper operation of CO-T1 is determined by,

$$V1_{min} = V2 + V3$$

Where V2 is the voltage drop across CO-T1 terminals and V3 is the voltage drop across the termination resistor, R.

At the maximum output condition (full range, 20mA), the minimum voltage across CO-T1, V2 must be more than 9.0V. Therefore, minimum supply voltage depends on the voltage drop on **R,** OR

$$\mathbf{V1_{min} = 9.0 + 0.02 \times R}$$

For instance, if the termination resistor used is 250 ohm, then minimum supply voltage must be $V1_{min}$ = 14V. The output signal becomes 1 ~ 5V.

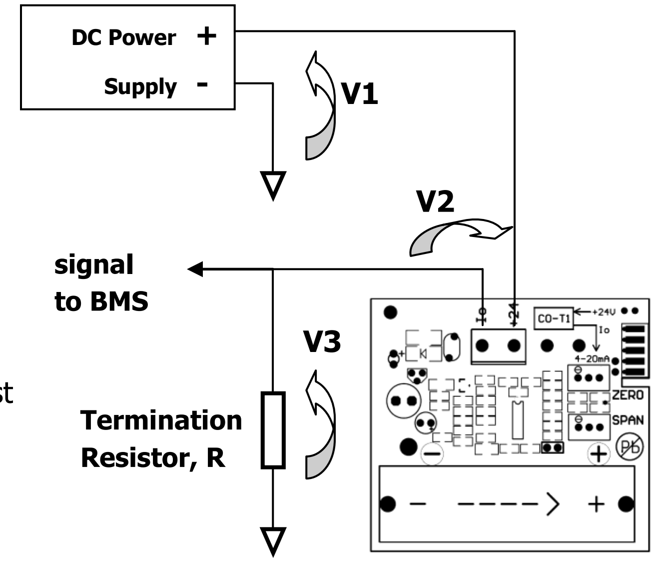

Fig 2. CO-T1 typical wiring

Termination Resistor, R	Voltage signal to BMS	Min. supply voltage, V1
100 ohms	0 ~ 2V	11 Vdc
250 ohms	0 ~ 5V	14 Vdc
500 ohms	0 ~ 10V	19 Vdc

Basic Sensitivity Characteristic

Fig 3 shows the sensitivity of CO-T1 to various gases. The output current is linear to CO concentration with deviation of less than +/-5%. Cross sensitivity of other gases is tabulated in Table 1.

Please note that the linear relationship between CO-T1 output and CO concentration is constant regardless of CO concentration range, according to the sensor cell's working principle.

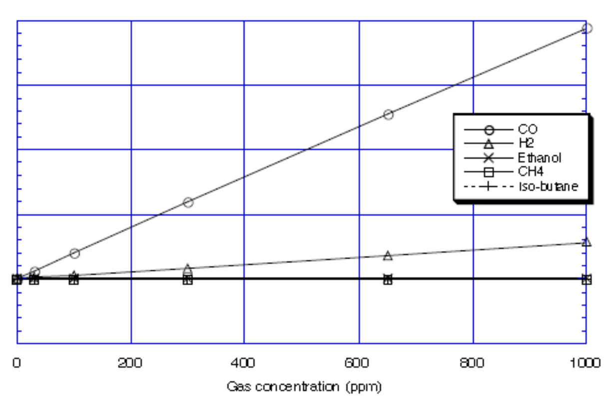

Fig 3. Sensitivity to various gases
(data source: sensor cell manufacturer's spec.)

Gas		Concentration	CO equivalent
Hydrogen		1000ppm	<350ppm
Methane	Heptane	1000ppm	<30ppm
Butane	IPA		
BtOH	Freon R22		
HMDS (Si vapor)	Acetylene		
Toluene	Ethylene		
NO2	Hexane		
Benzene chloride	CO2		
Formaldehyde	NH3	200ppm	
Acetoaldehyde	SO2		
CH3COOH	Ethyl acetate		

Table 1. Cross sensitivity to various gases (data source: sensor cell manufacturer's spec.)

Temperature Dependency

Figure 4 shows the temperature dependency of CO-T1 under constant humidity (~ 50%RH) and CO at various temperature (0 ~ 50 ^{o}C, normalized to data @ 25^{o}C).

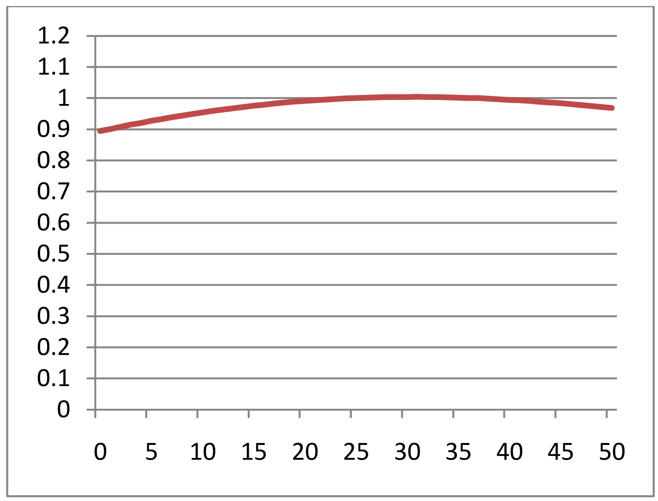

Fig 4. Temperature dependency

Humidity Dependency

Figure 5 shows the humidity dependency of CO-T1 under constant temperatures. The Y-axis shows the output in CO at various relative humidity normalized to that at 20 /50%RH. The data shows negligible relative humidity dependency.

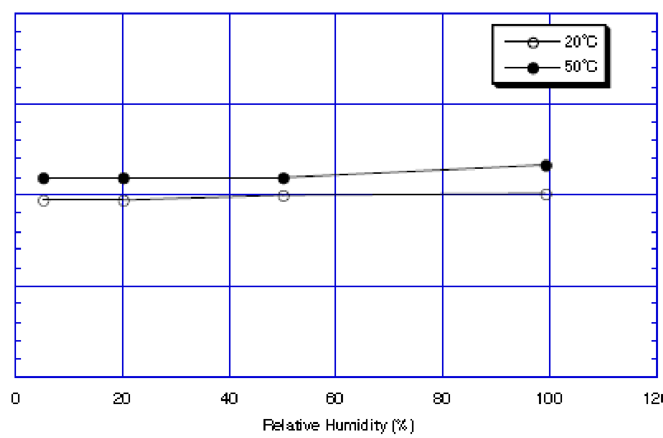

Fig 5. Humidity dependency (data extracted from sensor cell manufacturer's spec.)

CO-T1 sensor cell behavior

The heart of CO-T1 is an electrochemical cell that responds to the exposure of CO gas concentration in a linear manner. CO-T1 is calibrated with certified calibration gas concentration (see appendix I for sample of CO gas certificate) in controlled environment before it is delivered to the customer.

The zero point constant of CO-T1 does not drift due to the non-reaction to zero CO gas. In the same manner, the sensor aging does not affect the zero constant. The aging however, affects the span constant when the sensor's sensitivity reduces. Therefore, in car park installations, it is a good practice to perform sensor verification or re-calibration every 12 ~ 15 months' period.

When the sensor is installed in the building, the most precise way to verify or test the sensor is to inject a known CO gas concentration into the sensor cell using an adaptor. The Calibration Procedure below illustrates the method of performing a span calibration.

Calibration Procedure

For re-calibration, always check the ZERO point first, ensure that CO-T1 is reading close to zero in fresh-air environment. That is the output current should be approximately 4mA.

After the ZERO point verification, the SPAN calibration can be performed as below:

1. Cover the sensor cell with the adaptor (11-96-4) as shown in Figure 6, be sure that the adaptor is pushed all the way in. For consistency in re-calibration, please also note the direction of the gas inlet position.
2. Monitor the CO-T1 out using;
   - (i) LCD monitor board connected to CO-T1 circuit board (Figure 7). The sensor reading is then displayed (in ppm) on the LCD board.
   - (ii) If LCD monitor board is not available, one could still monitor the 0-5V output using a digital voltmeter (DVM) from the test points indicated in Figure 7 OR monitor the current output of the transmitter.

   In both cases, check that the output current (4~20mA) also corresponds to the CO concentration.
3. Control the flow of the calibration gas through the sensor cell adaptor with pressure and flow regulators. The flow should be controlled at a rate of 50 c.c. per sec.

Fig 6. Re-Calibration

4. The calibration gas should take 2 or 3 minutes to stabilize in the adaptor or sensor cell. Wait for the sensor reading to stabilize and adjust the SPAN trim-pot until the output equals the calibration gas concentration.

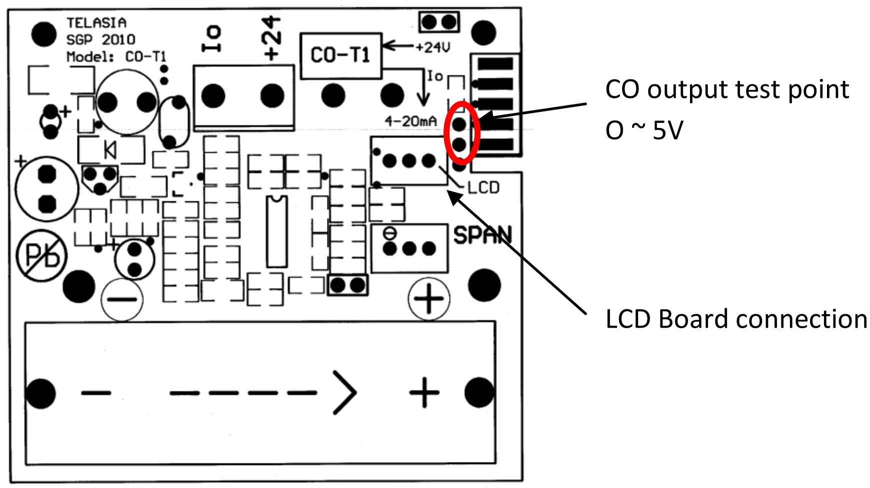

Fig 7. Circuit Board Layout

Special Notes

1. Pressure build-up & back diffusion

When applying the calibration gas to the sensor cell, there are two issues one has to consider, namely pressure build up and back diffusion from the surrounding air via the leakages and holes around the sensor cell.

The sensor reading is proportional to gas pressure, so a pressure build-up will introduce an error in SPAN calibration. Static over-pressure, as well as oscillating gas cylinder pressure/flow regulator will degrade the SPAN measurement accuracy.

The influence of back diffusion depends on the difference between the ambient and the calibration gas concentration. The back diffusion is reduced with increasing calibration gas flow rate. On the other hand, increased flow rate means increased risk of pressure build-up in the sensor cell.

2. Minor difference between Test voltage & current output

The output current is derived or converted from voltage signal at the "test point". The voltage to current conversion carries an error. In the actual calibration, the output current should be used as the main signal since it is connected to the external monitoring and control.

Appendix I. Sample of Gas Concentration certificate

AIR LIQUIDE

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SOXAL 星氧

CERTIFICATE OF COMPOSITION

CUSTOMER	TELASIA SYMTONIC PTE LTD CYL	CERTIFICATE NO	A136489
PO NO	P090107	CYLINDER SIZE	10L
DO NO	SD00253865	VALVE OUTLET	BS NO 4
WIP NO	S63140	CYLINDER TYPE	ALUM CYLINDER
OWNERSHIP	COP	FILLING PRESSURE	100.0 bars
PREPARATION MTHD	VOLUMETRIC	CONTENT	1.0 M3
CERTIFICATION DATE	20 Jan 2009	EXPIRY DATE	16 Jan 2012
		MIN. STORAGE TEMP	-10 DEG C

CYLINDER NO. / ~~PALLET NO~~ : PD04541

COMPONENT NAME	REQUESTED CONC	CERTIFIED RESULTS	UNIT	CERTIFICATION ACCURACY	CERTIFICATION METHOD
CARBON MONOXIDE	100	88.6	MOL PPM	+/-5% REL	GC-FID-M
AIR	BALANCE	BALANCE			

his mixture was certified by weight or/and analysis using weighing scales certified against weights traceable to N.I.S.T/National Standard, or calibration standards prepared in that manner.

Analyst	Reviewed By	Remarks	
hongyong.lim Name: Date: 21 Jan 2009	SG Analytical Chemi Name: Tan BZ Date: 21016 9	Testing Laboratory Special Gases 24 Jalan Buroh Singapore 619480 Tel: 62623788 Fax: 62653788 (Template/R5)	ISO 9000 PSB CERT. NO. : 2002-1-03 SS ISO 9001: 2000

Singapore Oxygen Air Liquide Pte Ltd No.16 Jalan Buroh, Singapore 619475 Tel: 6265 3788 Fax: 6265 1441 GST No: M2-0011500-7 Co. Regn. No: 197001157D