



# OEM Digital NDIR CO sensor

## Carbon Monoxide Model 2015SPI-CO Flow through gas cell

**RANGE** is user adjustable from 10% to 100% CO

The **VALTRONICS** Model 2015SPI-CO is an OEM NDIR sensor with digital signal processing and temperature compensation. The firmware **VERSION** depends upon the specific customer interface requirements. The **SPI** (Serial Peripheral Interface) See App Notes **A59** & **A64**. Each serial numbered sensor is individually gas calibrated and temperature compensated at the factory. **RS-232 Test Board** for field gas calibration (See **Application Note A66**). On board & remote switches for calibration or via SPI.

### Model 2015SPI-CO Specifications: RANGE defines the analog 0-1 volt output

- Method: ..... NDIR with Digital Signal processing and temperature compensation
- Gas: ..... Carbon Monoxide (CO)
- Full scale & RANGE: ..... 0-100% CO (RANGE is user selectable anywhere from 10 to 100% CO)
- CAUTION:** ..... Lower Explosive Limit (LEL) is 12.5 % CO by volume in air  
 ..... Upper Explosive Limit (UEL) is 74% CO by volume in air
- Input Power: ..... +12 VDC (@ 0.250 amp max., 0.135 amp ave, 16.0 volts max, 8.0 volts min)
- Accuracy: ..... 0 to 20.0±1.0% CO and 5% of reading from 20 to 100% CO .
- Resolution / Repeatability: ..... ±1% of RANGE (challenge with same gas sample multiple times & assure zero)
- Stability: ..... Less than 1% of RANGE during any 20 second period at constant temperature
- Output Signal: ..... Digital SPI and linear 0 to 1 volt output signal See App Note A59 & A66
- RS232 Test Board:** ..... Required for diagnostic & test use , see **Application Note A66**
- LED** Indicators: ..... IR Source ON/OFF Indicator, Power ON indicator, Cal Switch Indicators.
- Input Signal: ..... Digital SPI input for calibration and diagnostic modes. See App Note A59
- Calibration Switches: ..... SW1 (Zero), SW2 (Span Target), SW3 (Span), SW4 (Range adj), remote via J3
- Operating Temperature Range: ..... 0 to 50°C (32° to 122°F) see **Application Note A12**
- Ambient Relative Humidity: ..... 0 to 95% RH non-condensing: see **Application Note A30**
- CO<sub>2</sub> Interference: ..... Less than 2% CO response to 100% CO<sub>2</sub>  
 ..... Less than 2% CO increased response with a mixture of 20% CO & 1.6% CO<sub>2</sub>
- Storage Temperature range: ..... -40 to +70°C (-40 to +158°F)
- Weight: ..... Less than 0.25 pound (<0.11 kilogram)
- External Dimensions (PCB) ..... 4.9" x 2.9" x 3.5" vertical see page 2 for mounting

0.156 dia. hole four places on 2.5 x 4.5 inch centers

IR source ON/OFF indicator



Hose barbs for 1/8 inch ID tube, Flow between 0.3 to 1.0 LPM

Power on indicator

All dimensions are in inches, max. vertical clearance is 3.5 inch

J3: remote cal switches (see page 2) Thomas & Betts 501-6-27ESR

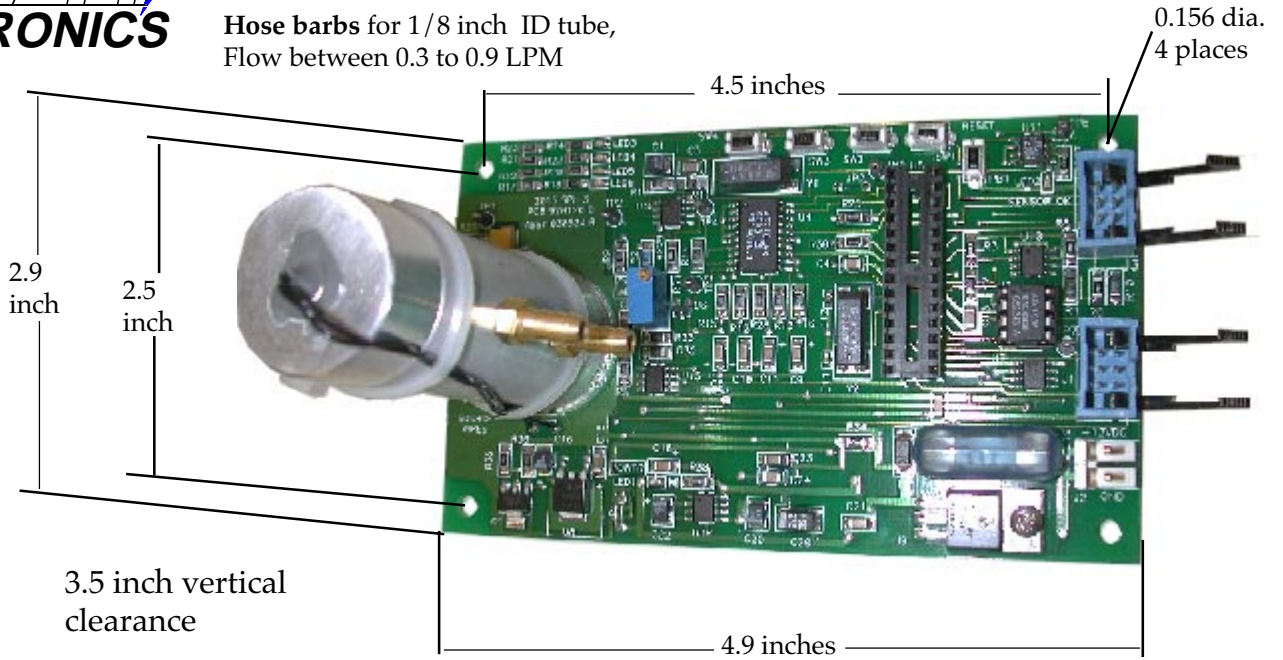
J1: I/O connector: Thomas & Betts 501-6-27ESR a 6 pin keyed header with ejector latches. SPI input/output & 0-1 volt linear

J2: 12 VDC input power 2 pin, 0.156 inch center header for insulation displacement connector like AMP or Panduit.



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Hose barbs for 1/8 inch ID tube,  
Flow between 0.3 to 0.9 LPM



See **Application Note A67** for gas conditioning requirements and information about gas sample pumps and filters. Use a **Hydrophobic Filter** immediately in front of gas inlet hose barb. **Push gas through the gas cell at a rate between 0.3 to 1.0 liter per minute.** See **Application Note A79** for more info about the hydrophobic filter.

Component Callouts:

- Master/Slave jumper JP2  
Slave mode if installed
- Reset Switch
- LED2 IR source  
ON/OFF indicator

Switch ground for more than 2 seconds initiates the function

**J3: Cal Switches**

+5V	6 ●	5 ●	STAR
SPAN	4 ●	3 ●	ZERO
RANGE	2 ●	1 ●	GND

**J1: Output / Input**

SDO	6 ●	5 ●	SDI
SCK	4 ●	3 ●	DATA_ENAB
0-1V	2 ●	1 ●	GND

**J2: 12 VDC input power, 2 pin, 0.156 inch center header Panduit MLSS156-2-D-B.**

1	+12 V
2	(-)12 volt return



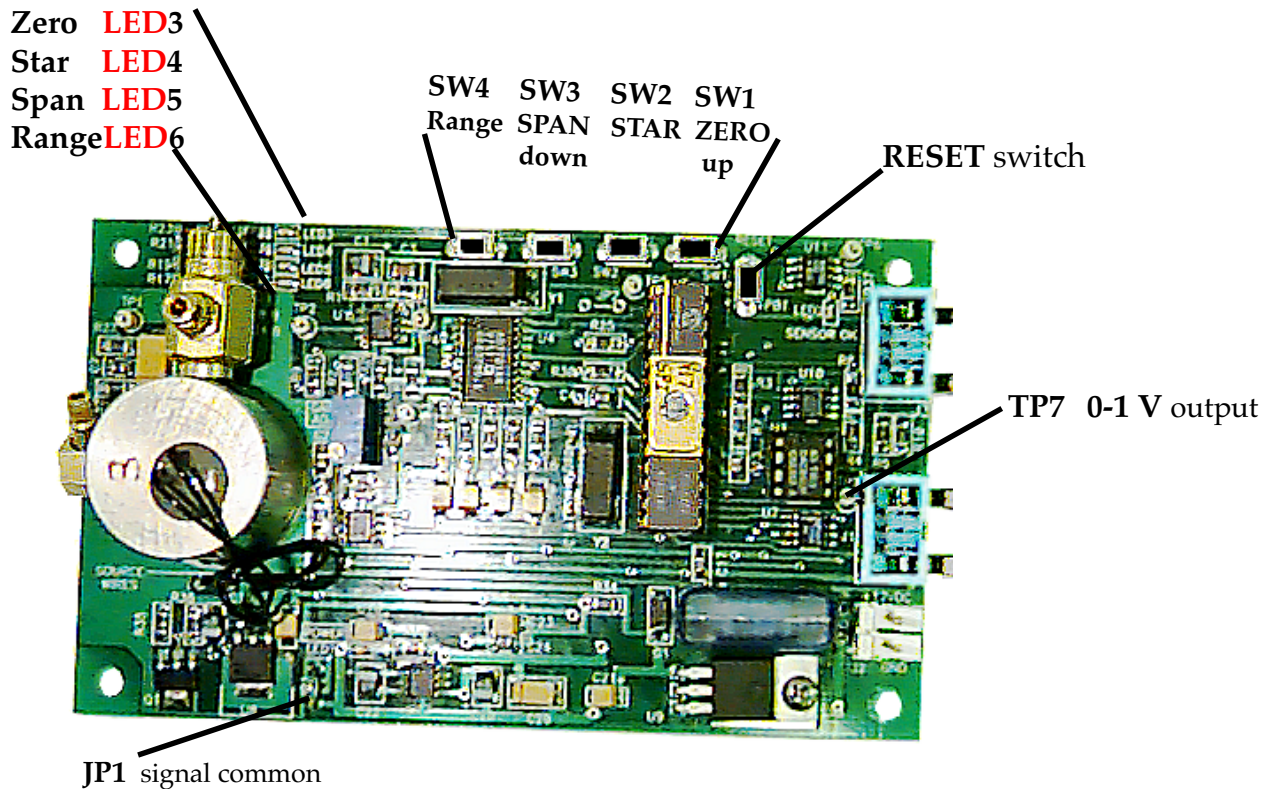
**Gas calibration** may be initiated via a command from the SPI input on **J3** (see page 4, definition of SDI or serial data in ) or from the on board or remote **switches** (Logic "0" to initiate)below (**Application Note A66**):

**ZERO (SW1 or remote J4-3)**: With nitrogen flowing in gas calibration tube press and hold SW1 for 2 seconds. **LED3** through 6 will flash on & off together. If they flash on/off sequentially the sensor has detected an error & the **RESET** button must be pressed. Wait 1 minute and continue where you left off. The 0 to 1 volt output should snap to  $0.0 \pm 0.01$  volt measured with a **DVM "+"** lead connected to **TP7** and "-" lead connected to **GND** test point. **LED3** will be **ON** to indicate a ZERO calibration.

**RANGE (SW4 or remote J4-2)**: To set the full scale or **range** press and hold SW4. From the chart on page 4 find the voltage value that corresponds to the full scale that you want from 10 to 100%. **LED6** will be **ON**. Use SW1 as an **UP** and SW3 as a **DOWN** switch to adjust this value (examples:30% = 0.30 v, 25% = 0.25 v, 10% = 0.1 v).

**STAR (SW2 or remote J4-5)**: To set the Span Target (calibration gas value) press and hold SW2. **LED4** will be **ON** Use SW1 as an **UP** and SW3 as a **DOWN** switch to adjust this value read on the DVM. See chart on page 4.

**SPAN (SW3 or remote J4-4)**: To **SPAN** calibrate while flowing certified span gas like  $10 \pm 0.2\%$  **CO** into gas calibration tube for at least 30 seconds at about 300 ml/min. Press & hold SW2 for 2 seconds.**LED5** will be **ON**. The DVM voltage should snap to the STAR value entered above & **LED3** through 6 will flash on & off together.



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Below is a table that shows the 0 to 1 volt output equivalent to any value for Full Scale **Range** or Span Target (STAR) anywhere from **10** to **100% CO**. See the procedure on page 3 & **Application Note A66** for more detail. A typical application would be a full scale range of **25.0** and a **STAR** of **10.0% CO**.

The Full Scale **Range** will set what % CO will give an output of 1.00 volt in **normal operation**.

A **Range** of **50** will give a 0-1 V output of **0.500** volt for a concentration of **25% CO** in gas cell.

A **Range** of **25** will give a 0-1 V output of **0.500** volt for a concentration of **12.5% CO** in gas cell.

The lowest **Range** of **10** will give a 0-1 V output of **0.250** volt for a concentration of **2.5% CO** in gas cell.

Please remember that calibration using the **RS-232 Test Board** will give the user much better visibility than just looking at the 0-1 volt output. See **Application Note A66**.

Table used for **Calibration** for setting the **Range** & the Target Span Gas value, **STAR** (certified tank %)

Rng / STAR % gas	0 to 1 V Output	Rng / STAR % gas	0 to 1 V Output	Rng / STAR % gas	0 to 1 V Output	Rng / STAR % gas	0 to 1 V Output	Rng / STAR % gas	0 to 1 V Output
100	1.000	50	0.500	25.9	0.259	19.6	0.196	13.3	0.133
99	0.990	49	0.490	25.8	0.258	19.5	0.195	13.2	0.132
98	0.980	48	0.480	25.7	0.257	19.4	0.194	13.1	0.131
97	0.970	47	0.470	25.6	0.256	19.3	0.193	13.0	0.130
96	0.960	46	0.460	25.5	0.255	19.2	0.192	12.9	0.129
95	0.950	45	0.450	25.4	0.254	19.1	0.191	12.8	0.128
94	0.940	44	0.440	25.3	0.253	19.0	0.190	12.7	0.127
93	0.930	43	0.430	25.2	0.252	18.9	0.189	12.6	0.126
92	0.920	42	0.420	25.1	0.251	18.8	0.188	12.5	0.125
91	0.910	41	0.410	25.0	0.250	18.7	0.187	12.4	0.124
90	0.900	40	0.400	24.9	0.249	18.6	0.186	12.3	0.123
89	0.890	39	0.390	24.8	0.248	18.5	0.185	12.2	0.122
88	0.880	38	0.380	24.7	0.247	18.4	0.184	12.1	0.121
87	0.870	37	0.370	24.6	0.246	18.3	0.183	12.0	0.120
86	0.860	36	0.360	24.5	0.245	18.2	0.182	11.9	0.119
85	0.850	35	0.350	24.4	0.244	18.1	0.181	11.8	0.118
84	0.840	34	0.340	24.3	0.243	18.0	0.180	11.7	0.117
83	0.830	33	0.330	24.2	0.242	17.9	0.179	11.6	0.116
82	0.820	32	0.320	24.1	0.241	17.8	0.178	11.5	0.115
81	0.810	31	0.310	24.0	0.240	17.7	0.177	11.4	0.114
80	0.800	30.0	0.300	23.9	0.239	17.6	0.176	11.3	0.113
79	0.790	29.9	0.299	23.8	0.238	17.5	0.175	11.2	0.112
78	0.780	29.8	0.298	23.7	0.237	17.4	0.174	11.1	0.111
77	0.770	29.7	0.297	23.6	0.236	17.3	0.173	11.0	0.110
76	0.760	29.6	0.296	23.5	0.235	17.2	0.172	10.9	0.109
75	0.750	29.5	0.295	23.4	0.234	17.1	0.171	10.8	0.108
74	0.740	29.4	0.294	23.3	0.233	17.0	0.170	10.7	0.107
73	0.730	29.3	0.293	23.2	0.232	16.9	0.169	10.6	0.106
72	0.720	29.2	0.292	23.1	0.231	16.8	0.168	10.5	0.105
71	0.710	29.1	0.291	23.0	0.230	16.7	0.167	10.4	0.104
70	0.700	29.0	0.290	22.9	0.229	16.6	0.166	10.3	0.103
69	0.690	28.9	0.289	22.8	0.228	16.5	0.165	10.2	0.102
68	0.680	28.8	0.288	22.7	0.227	16.4	0.164	10.1	0.101
67	0.670	28.7	0.287	22.6	0.226	16.3	0.163	10.0	0.100
66	0.660	28.6	0.286	22.5	0.225	16.2	0.162	9.9	0.099
65	0.650	28.5	0.285	22.4	0.224	16.1	0.161	9.8	0.098
64	0.640	28.4	0.284	22.3	0.223	16.0	0.160	9.7	0.097
63	0.630	28.3	0.283	22.2	0.222	15.9	0.159	9.6	0.096
62	0.620	28.2	0.282	22.1	0.221	15.8	0.158	9.5	0.095
61	0.610	28.1	0.281	22.0	0.220	15.7	0.157	9.4	0.094
60	0.600	28.0	0.280	21.9	0.219	15.6	0.156	9.3	0.093
59	0.590	27.9	0.279	21.8	0.218	15.5	0.155	9.2	0.092
58	0.580	27.8	0.278	21.7	0.217	15.4	0.154	9.1	0.091
57	0.570	27.7	0.277	21.6	0.216	15.3	0.153	9.0	0.090
56	0.560	27.6	0.276	21.5	0.215	15.2	0.152	8.9	0.089
55	0.550	27.5	0.275	21.4	0.214	15.1	0.151	8.8	0.088
54	0.540	27.4	0.274	21.3	0.213	15.0	0.150	8.7	0.087
53	0.530	27.3	0.273	21.2	0.212	14.9	0.149	8.6	0.086
52	0.520	27.2	0.272	21.1	0.211	14.8	0.148	8.5	0.085
51	0.510	27.1	0.271	21.0	0.210	14.7	0.147	8.4	0.084
		27.0	0.270	20.9	0.209	14.6	0.146	8.3	0.083
		26.9	0.269	20.8	0.208	14.5	0.145	8.2	0.082
		26.8	0.268	20.7	0.207	14.4	0.144	8.1	0.081
		26.7	0.267	20.6	0.206	14.3	0.143	8.0	0.080
		26.6	0.266	20.5	0.205	14.2	0.142		
		26.5	0.265	20.4	0.204	14.1	0.141		
		26.4	0.264	20.3	0.203	14.0	0.140		

After setting the **Range** to **25% CO**, the new **STAR** & response chart for the 0-1 V output will start with 25% equals 1.00 volt and 12.5% equals 0.50 volt.

Please remember, the **minimum Range** for proper operation is **10.0% CO**.

If you set the **Range** to **10.0% CO** the new **STAR** and response chart for the 0-1 V output will start with 10% equals 1.00 volt and 5.0% equals 0.50 volt. With the **Range** set to **10.0% CO**, the **STAR** could be set as low as **3.0 % CO** by pressing the **STAR** switch and running the 0 to 1 volt output down to 0.30 volt.