



OEM Digital NDIR CO₂ sensor

flow through gas cell 0.2 to 2.0% CO₂ full scale



Model 2015SPI-1

The **VALTRONICS** Model 2015SPI-1 is an OEM NDIR CO₂ sensor with digital signal processing and temperature compensation. The firmware **VERSION** depends upon the specific customer interface requirements. The **SPI** (Serial Peripheral Interface) is described on pages 2 and 3. 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.

Model 2015SPI-1 Specifications:

- Method: **NDIR** with Digital Signal processing and temperature compensation
- Gas: **Carbon Dioxide (CO₂)**
- Range: **0-2% CO₂** (Full scale is user selectable anywhere from **0.2 to 2.0%**)
- Input Power: **+12 VDC** (@ 0.250 amp max., 0.135 amp ave., 16.0 volts max, 8.0 volts min)
- Accuracy: If calibrated at 0.5% CO₂ using 0.5±0.01% CO₂ gas, the accuracy is
..... 0 to 0.5±0.02% CO₂ and 5% of reading from 0.55 to 2% CO₂.
..... 16 bit analog to digital converter: Delta-Sigma Conversion Method, 12 bit DAC for 1V
- Resolution / Repeatability : **±0.002% CO₂** (challenge with same gas sample multiple times & assure zero)
- Stability: Short term < 0.002% CO₂ in 20 sec., Long term: 0.5±0.1 or 1±0.2% CO₂ per year
- Output Signal: Digital **SPI** and linear **0 to 1 volt output** signal See **Notes A59 and A62**
- Optional **RS-232** Serial Interface: .. PCB for com. with any PC - see App. Note **A66** Type "VTI" to **UNLOCK LED** Indicators: **IR** Source ON/OFF Indicator, Power ON indicator, Cal Switch Indicators.
- Input Signal: Digital **SPI** input for calibration and diagnostic modes. See page 3
- 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**
- Storage Temperature range: -40 to +70°C (-40 to +158°F)
- Weight: Less than 0.25 pound (<0.11 kilogram)
- External Dimensions (PCB Card): . **4.9" x 2.9" x 3"** see page 2 for mounting

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

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

See **Application Note A75**
for **interface connector**
part numbers.

IR source ON/OFF indicator

J3: remote cal switches:
Thomas & Betts 501-6-27ES

J1: I/O connector: Thomas & Betts 501-6-27ES
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.

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

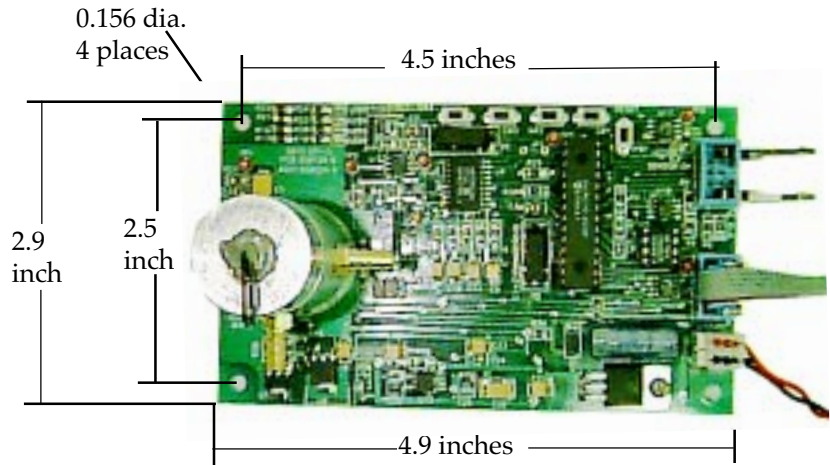
Power on indicator





Model 2015SPI-1 (0.2 to 2.0% CO₂ full scale)

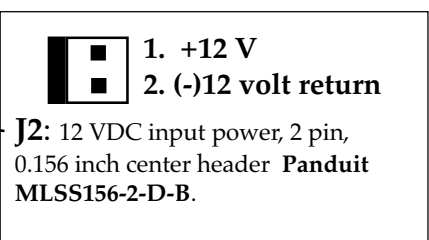
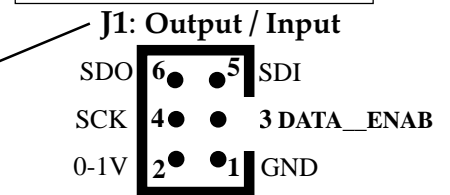
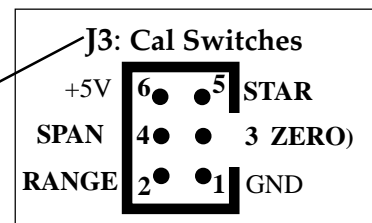
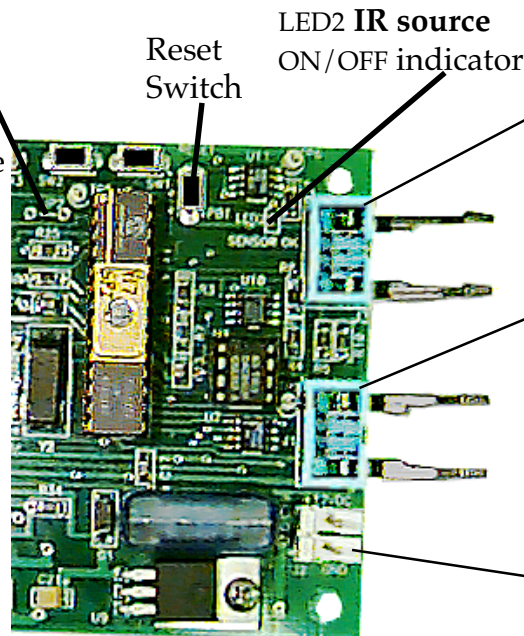
Hose barbs for 1/8 inch ID tube, Flow adjust between 0.2 to 0.8 LPM



See **Application Note A7** for gas conditioning requirements and information about gas sample pumps and filters.

Important Note: Digital ground **Pin# 1** **MUST** be directly connected to the Master Microprocessor's digital ground, **NOT** just connected via the DC power supply common.

Master/Slave jumper JP2
Slave mode if installed
If JP2 is installed, JP1 on RS232 board must also be installed.



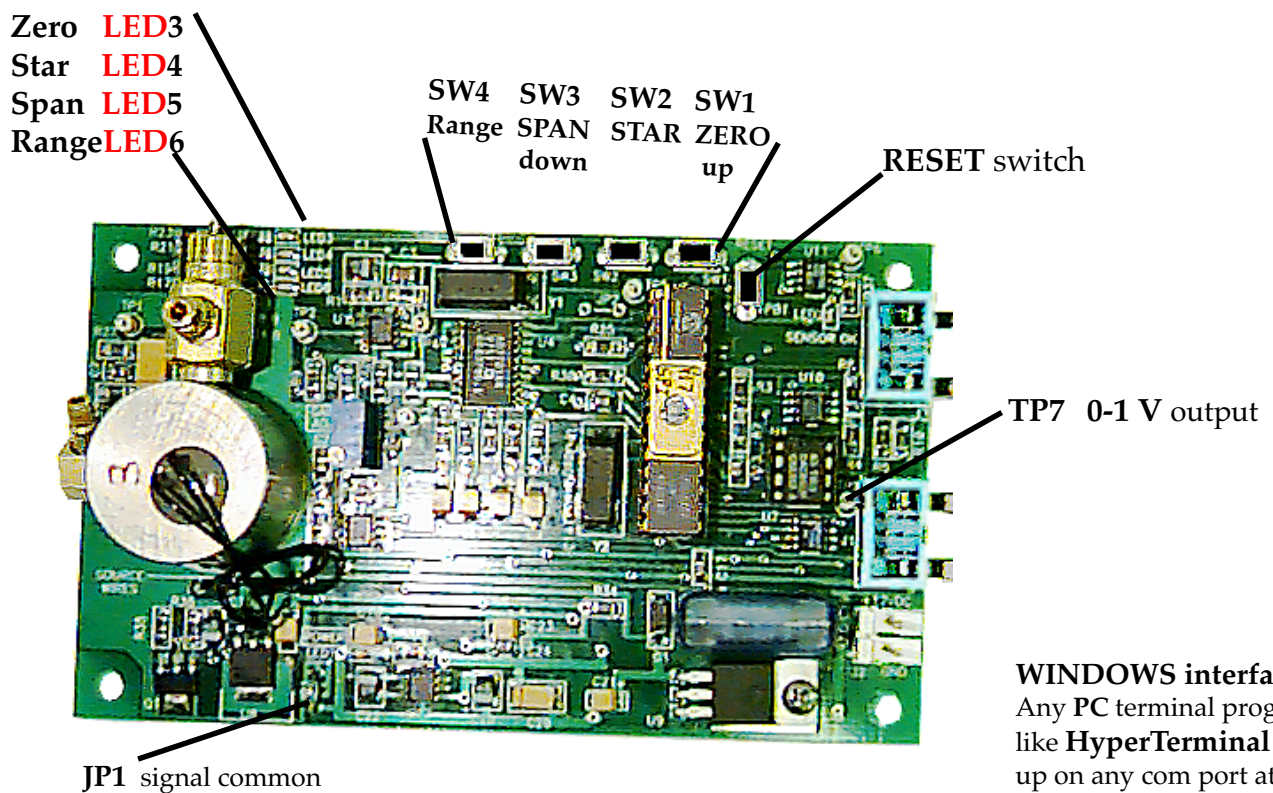
Gas calibration may be initiated via a command from the SPI input on **J3** (see page 4, definition of SDI or serial data in) or from the on board or remote **switches** (Logic "0" to initiate)below (**Application Note A54**):

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 ± 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 6 find the voltage value that corresponds to the full scale that you want from 0.2 to 2.0%. **LED6** will be **ON**. Use SW1 as an **UP** and SW3 as a **DOWN** switch to adjust this value (examples: 2% = 1.00 v, 1% = 0.50 v, 0.5% = 0.25 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 6.

SPAN (SW3 or remote J4-4): To **SPAN** calibrate while flowing certified span gas like $0.5 \pm 0.01\%$ CO₂ into gas calibration tube for at least 30 seconds at about 300 ml/min. Press & hold SW3 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.



WINDOWS interface:
Any PC terminal program like **HyperTerminal** set up on any com port at 9600 baud, no parity, 8 bits and 1 stop bit, Xon/Xoff under Port Settings in HyperTerminal Properties

Type: " VTI " to UNLOCK

RS232 Test Board





Model 2015SPI-1 (0.2 to 2.0% CO₂ full scale)

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 0.2 to 2% CO₂. See the procedure on page 3 and **Application Note A54 & A59** for more detail. A typical application would be a full scale range of 1.0 and a STAR of 0.5% CO₂

The Full Scale **Range** will set what % CO₂ will give an output of 1.00 volt in **normal operation**.

A Range of **2.0** will give a 0-1 V output of **0.500** volt for a reading of **1.0%** CO₂.

A Range of **1.5** will give a 0-1 V output of **0.333** volt for a reading of **0.5%** CO₂.

A Range of **0.2** will give a 0-1 V output of **0.200** volt for a reading of **0.04%** CO₂.

Please remember that calibration using the RS-232 interface board or via the SPI digital interface will give the user much better visibility.

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

Range / STAR % gas	0 to 1 V Output	Range / STAR % gas	0 to 1 V Output	Range / STAR % gas	0 to 1 V Output	Range / STAR % gas	0 to 1 V Output
2.000	1.000	1.500	0.750	1.000	0.500	0.500	0.250
1.990	0.995	1.490	0.745	0.990	0.495	0.490	0.245
1.980	0.990	1.480	0.740	0.980	0.490	0.480	0.240
1.970	0.985	1.470	0.735	0.970	0.485	0.470	0.235
1.960	0.980	1.460	0.730	0.960	0.480	0.460	0.230
1.950	0.975	1.450	0.725	0.950	0.475	0.450	0.225
1.940	0.970	1.440	0.720	0.940	0.470	0.440	0.220
1.930	0.965	1.430	0.715	0.930	0.465	0.430	0.215
1.920	0.960	1.420	0.710	0.920	0.460	0.420	0.210
1.910	0.955	1.410	0.705	0.910	0.455	0.410	0.205
1.900	0.950	1.400	0.700	0.900	0.450	0.400	0.200
1.890	0.945	1.390	0.695	0.890	0.445	0.390	0.195
1.880	0.940	1.380	0.690	0.880	0.440	0.380	0.190
1.870	0.935	1.370	0.685	0.870	0.435	0.370	0.185
1.860	0.930	1.360	0.680	0.860	0.430	0.360	0.180
1.850	0.925	1.350	0.675	0.850	0.425	0.350	0.175
1.840	0.920	1.340	0.670	0.840	0.420	0.340	0.170
1.830	0.915	1.330	0.665	0.830	0.415	0.330	0.165
1.820	0.910	1.320	0.660	0.820	0.410	0.320	0.160
1.810	0.905	1.310	0.655	0.810	0.405	0.310	0.155
1.800	0.900	1.300	0.650	0.800	0.400	0.300	0.150
1.790	0.895	1.290	0.645	0.790	0.395	0.290	0.145
1.780	0.890	1.280	0.640	0.780	0.390	0.280	0.140
1.770	0.885	1.270	0.635	0.770	0.385	0.270	0.135
1.760	0.880	1.260	0.630	0.760	0.380	0.260	0.130
1.750	0.875	1.250	0.625	0.750	0.375	0.250	0.125
1.740	0.870	1.240	0.620	0.740	0.370	0.240	0.120
1.730	0.865	1.230	0.615	0.730	0.365	0.230	0.115
1.720	0.860	1.220	0.610	0.720	0.360	0.220	0.110
1.710	0.855	1.210	0.605	0.710	0.355	0.210	0.105
1.700	0.850	1.200	0.600	0.700	0.350	0.200	0.100
1.690	0.845	1.190	0.595	0.690	0.345		
1.680	0.840	1.180	0.590	0.680	0.340		
1.670	0.835	1.170	0.585	0.670	0.335		
1.660	0.830	1.160	0.580	0.660	0.330		
1.650	0.825	1.150	0.575	0.650	0.325		
1.640	0.820	1.140	0.570	0.640	0.320		
1.630	0.815	1.130	0.565	0.630	0.315		
1.620	0.810	1.120	0.560	0.620	0.310		
1.610	0.805	1.110	0.555	0.610	0.305		
1.600	0.800	1.100	0.550	0.600	0.300		
1.590	0.795	1.090	0.545	0.590	0.295		
1.580	0.790	1.080	0.540	0.580	0.290		
1.570	0.785	1.070	0.535	0.570	0.285		
1.560	0.780	1.060	0.530	0.560	0.280		
1.550	0.775	1.050	0.525	0.550	0.275		
1.540	0.770	1.040	0.520	0.540	0.270		
1.530	0.765	1.030	0.515	0.530	0.265		
1.520	0.760	1.020	0.510	0.520	0.260		
1.510	0.755	1.010	0.505	0.510	0.255		



To Check what **RANGE** (Full Scale) is selected, press & hold SW4 (see page 3) and measure the voltage out at TP7. As an example TP7 will read 0.25 volt for a full scale **RANGE** of 0.5% CO₂. The **STAR** will be relative to the new full scale **RANGE**. As an example, a **STAR** of 0.1% CO₂ with a full scale **RANGE** of 0.2% will give a 0 to 1 volt output with the **STAR** switch pressed of 0.50 volt. A **STAR** of 0.1% CO₂ with a full scale **RANGE** of 1.0% will give a 0 to 1 volt output with the **STAR** switch pressed of 0.10 volt.