

General

S-300 series is one of world's smallest NDIR CO₂ sensor module, of which persistent Stability and Temperature effect resistance besides various outputs are much favored by customers in stocks raising, greenhouse, HVAC, scientific projects, etc.

Version 2.710

ELT Sensor Data Sheet for S-300



Features

- Non-Dispersive Infrared (NDIR) technology used to measure CO₂ levels.
- Pre-calibrated
- Available outputs : TTL-UART, I2C, ALARM, PWM/Analog Voltage.
- Gold-plated sensor provides long-term calibration stability.
- Installed re-calibration function
- ACDL (Periodical Automatic Calibration) and MCDL (Non-Periodical Manual Calibration) are available
- ROHS Directive- 2011/65/EU, [EN50581 : 2012, IEC 62321-3-1 : 2013].
- Size : 33mmx33mmx13.1mm
- Weight : 10 grams

S-300 Specifications

General Performance

Operating Temperature : -10 ~ 60 °C

Operating Humidity : 0 ~ 95% RH (Non-condensing)

Operating Environment : Residential, Commercial spaces

Storage Temperature : -30 °C ~70 °C

CO₂ Measurement

Sensing Method : NDIR (Non-dispersive Infrared)

Measurement Range : 0 ~ 2,000/3,000/5,000/10,000 ppm (2%/3%/5% models are available)

Accuracy : for 0~2,000 ppm : ± 30ppm ± 3% of reading ⁽¹⁾ ⁽²⁾

Step Response Time (1/e) : 60 seconds

Sampling Interval: 3 seconds

Warming-up Time : 90 seconds

Electrical Data

Power Input : 5V ± 5% ⁽³⁾⁽⁴⁾

Current Consumption : Normal mode : 20mA, Peak : 180mA for all model,

Note 1) IAQ application, accuracy is defined after minimum 3 times calibration for 3 weeks.

2) +/- 3% is added for absolute measurements for uncertainty of calibration gas mixture unless the measurement is done with certified calibration mixtures.

3) DC Supply should be regulated , low noise power source for best accuracy.

4) 3.2V~3.45V for Low Voltage model, < 0.16mA for 3.3 Vin Low Power Consumption model.

Product Derivatives and Relative Functions

Products	Feature	Option
S-300	UART,I2C, 1 st +2 nd ALARM, AVO(PWM option), 10' MCDL, ACDL, 13+14 Connector	S-300-3V
S-300L (Low Power)	Sleep mode is added on S-300, which consume < 0.5mA	S-300L-3V
S-300G (99% Humidity)	Resistance up to 99% Humidity is added on S-300, for Application of Green House	S-300G-3V
S-300A (ACDL S/W)	ACDL Software is added on S-300, which Calibrate Sensor every week	S-300A-3V

S-300 has various output TTL-UART, I2C, ALARM, AVO (or PWM is selectable as option) and 2.54pitch 13pin side hole connector besides 2mm pitch 10 and 4pin 2 row header connectors. and Periodic Automatic Calibration (ACDL) and Non-Periodic Manual Calibration (10' MCDL) are executable with H/W pin-setting change.

There are 3 derivatives which has additional function on S-300, S-300L is Low Power model, consumes less than 0.5mA in Sleep mode while as S-300G is hardware-enforced one to be resistant to endure up to 99% humidity for customers whose application is Greenhouse and Stock Raising, and S-300A has ACDL software and calibrate weekly after once in 2day from power-on, without 'Low signal' to J12-7 and J13-13 during operation, appropriate for Indoor Air-Quality Monitoring.

Pin Map with J11&J12 Connectors

UART (J-12:P1&P2) : 38,400BPS, 8bit, No parity, 1 stop bit

I2C (J-12:P3&P4) : Slave mode only, Internal pull up resister

TTL Level Voltage : : $0 \leq V_{IL} \leq 0.8$, $2.0 \leq V_{IH} \leq V_{DD}$, $0 \leq V_{OL} \leq 0.4$, $2.4 \leq V_{OH} \leq V_{DD}$ (Volt)

J-11	Description	
1/3	V _{DD} (+5V VCC)	
2/4	GND	

J-12	S-300	S-300 (PWM Option)
1	TTL RXD (← CPU of Master Board)	
2	TTL TXD (→ CPU of Master Board)	
3	I2C SCL	
4	I2C SDA	
5	GND	
6	Analog Voltage Output (0.5~4.5V)	2 ND Alarm (V _{5V} /V _{0V} TTL Signal Switching)
7	Automatic Calibration (ACDL)	
8	Reserved	
9	10 min. Manual Calibration(MCDL)	
10	Reset (Low Active, ≤0.4V)	

Analog Voltage(J-12:pin-6, J-13:pin-1) : 0.5~4.5V

In case the PWM option is chosen, Alarm signal comes out instead Analog Voltage.

PWM (J-13:pin-7 is available) :

$$t_H = 2 \text{ msec (Start)} + 1,000 \text{ msec} \times (\text{Measurement}_{(\text{ppm})} / \text{Range}_{(\text{ppm})}), T_L = 2,000 \text{ ms} - t_H,$$

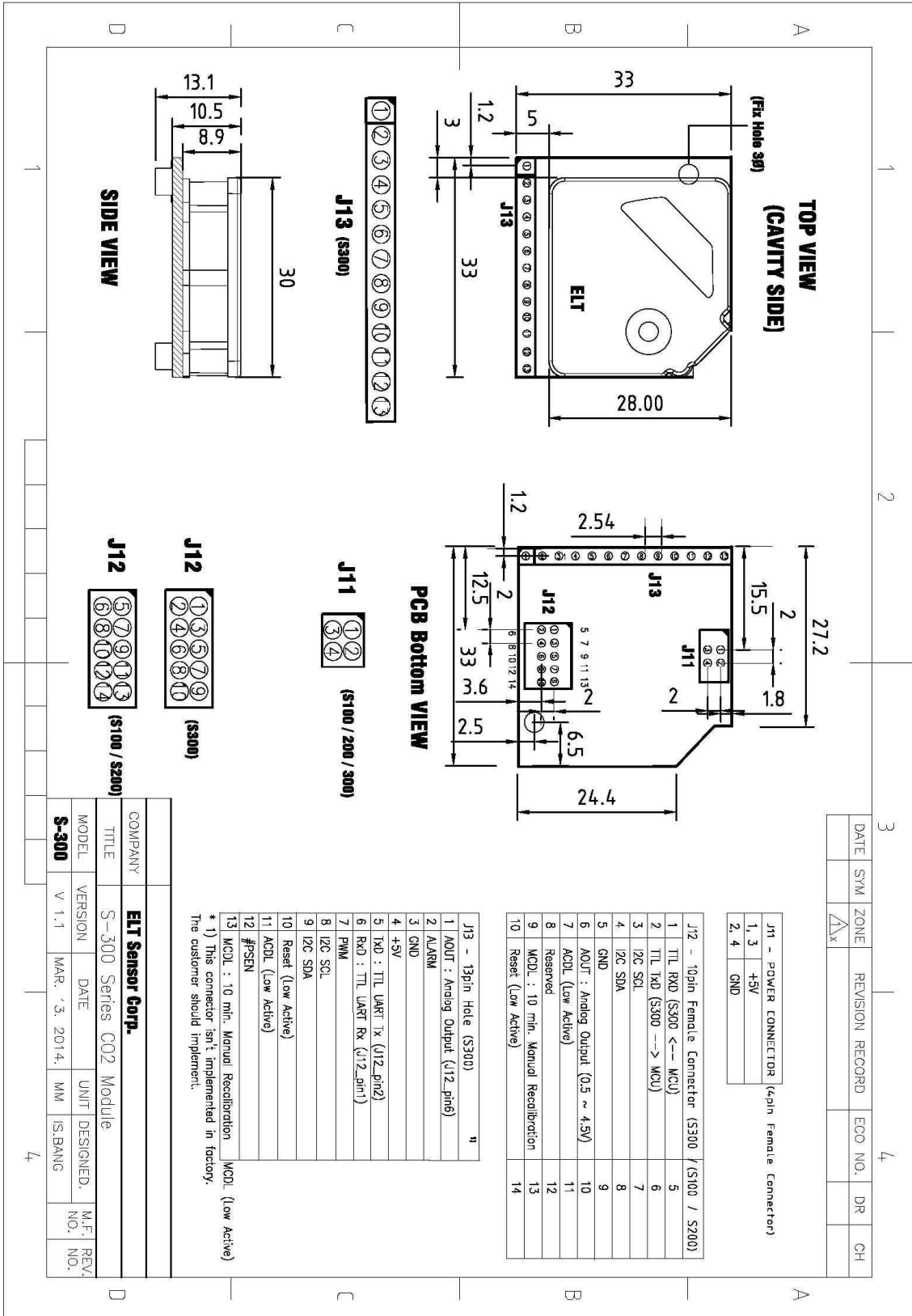
ALARM (1st Alarm : Open Collector type, 2nd Alarm : V_{5V}/V_{0V} TTL Signal Switching)

1,000 ppm ≤ Alarm ON, 800 ppm ≥ Alarm OFF and alarming range can be change by EK-100TL with connected to PC.

Pin Map with J13 Connectors

J-13	S-300	S-300 (PWM Option)
1	Analog Voltage Output (0.5~4.5V)	2 ND Alarm (TTL Signal V _{5V} /V _{0V} Switching)
2	1 st Alarm (Open Collector)	
3	GND	
4	V _{DD} (+5V VCC)	
5	TTL TXD (→ CPU of Master Board)	
6	TTL RXD (← CPU of Master Board)	
7	2 nd Alarm (V _{5V} /V _{0V} TTL Signal Switching)	PWM Output as O.C Default,
8	I2C SCL	
9	I2C SDA	
10	Reset (Low Active)	
11	Automatic Calibration (ACDL)	
12	#PSEN	
13	10 min. Manual Calibration(MCDL)	

Cavity Dimensions (unit : mm)

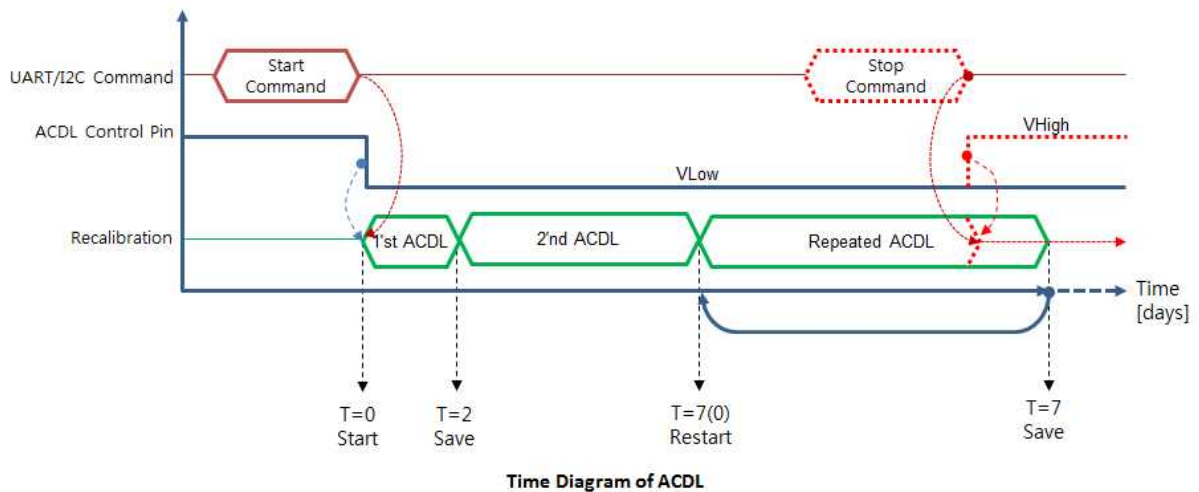


COMPANY	ELT Sensor Corp.			
TITLE	S-300 Series CO2 Module			
MODEL	VERSION	DATE	UNIT	DESIGNED.
S-300	V 1.1	MAR. '3. 2014.	MM	IS.BANG
				M.F. REV. NO.
				NO.

DATE	SYM	ZONE	REVISION RECORD	ECO. NO.	DR	CH
			Δx			

ACDL function (Automatic Calibration Function in Dimming light with period)

ACDL could be activated as by setting below.



Method 1. UART Command Set; J12: pin-1 (UART-RX) and pin-2 (UART-TX) to Main-Board.
(J13: pin-6 and pin-5 are available as well)

Method 2. I2C Command Set; J12: pin-3 (SCL) and pin-4 (SDA) to Main-Board. (J13: pin-8 and pin-9 are available as well)

Method 3. Execute Hardware based ACDL.

J12:pin-7 or J13:pin-11	J12:pin-9 or J13:pin-13	Status	Notes
Low	High	H/W ACDL	Calibrate weekly after 2 days since power-on
High	High	Normal	Operate with Pre-calibrated value in Factory or previous state.

※ 1. (J12:pin-7 or J13:pin-11) and (J12:pin-9 or J13:pin-13) shouldn't have 'Low' at any time.
Cf.) Unlike other S-300 series, S-300A operate with software based ACDL setting, which make sensor always operate with ACDL as default unless MCDL is activated.

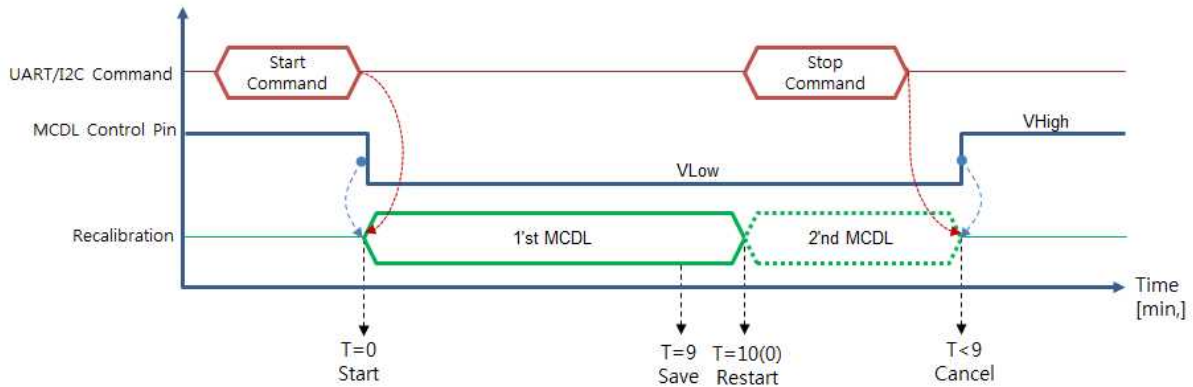
Method 4. **TRB-100ST (Test and Recalibration Board)** is purchasable to executable, letting sensor be located at ambient air-flow condition and execute by moving jumper following Manual, which is downloadable on the website.

Method 5. Send string command set below to RXD-pin of Sensor on Emulation program.
EK-100SL (Evaluation kit, with Emulation program 'ELTWSO') is available.

\

10' MCDL function (10 minute Manual Calibration Function in Dimming light).

MCDL enable customer to calibrate as needed, MCDL keep at least 10 minute once it start and should be stopped before 18minute to avoid MCDL fetch repetition.



Time Diagram of MCDL

Method 1. UART Command Set; J12: pin-1 (UART-RX) and pin-2 (UART-TX) to Main-Board (J13: pin-6 and pin-5 are available as well.)

Method 2. I2C Command Set; J12: pin-3 (SCL) and pin-4 (SDA) to Main-Board. (J13: pin-8 and pin-9 are available as well.)

Method 3. Execute Hardware based MCDL.

J12:pin-7 or J13:pin-11	J12:pin-9 or J13:pin-13	Status	Notes
High	Low	H/W MCDL	sensor should be located in 400ppm environment (outside) for 10 minutes
High	High	Normal	Operate with Pre-calibrated value in Factory or previous state.

- ※ 1. (J12:pin-7 or J13:pin-11) and (J12:pin-9 or J13:pin-13) shouldn't have 'Low' at any time.
- 2. Be sure to quit MCDL fetch loop before 18minute.
- cf.) Unlike other S-300 series, S-300A has nothing to do with (J12:pin-7 or J13:pin-11). It is designed to execute MCDL during pin-13 get Low Active Signal. it return to ACDL as the signal to pin-13 is changed to High De-Active Signal.

Method 4. Let Sensor install on Jig Board, **TRB-100ST (Test and Recalibration Board)** with ambient air-flow condition and execute by moving jumper following Manual on the website.

Method 5. Send string command set below to RXD-pin of Sensor on Emulation program.
EK-100SL (Evaluation kit, with Emulation program 'ELTWSO') is available.

Output Descriptions

Analog Voltage Output Descriptions

Measured Voltage 0.5V~4.5V match proportionally to 0~ 2,000 each for 2,000 ppm scale sensor

And any of 0~3,000 or 5,000 or 10,000 ppm scale sensor could be set by designating on sale.

Therefore 4.5V will match 2,000 or 3,000 or 4,000 or 10,000 ppm or 2% or 3% or 5% or 10% each.

* CO2 Measurement_(ppm) = Output Voltage - 0.5 / (4.5 - 0.5) Voltage x F.S. ppm ,

cf. F.S. (ppm) : 2,000/3,000/5,000/10,000 ppm (20,000/30,000/50,000/100,000 is optional.)

EX) if the Output Voltage is 2.5V in 2,000 ppm (F.S. of Reading range)

$$\begin{aligned} \text{CO2 Measurement}_{\text{ppm}} &= (2.5 - 0.5) \text{ V} \div (4.5 - 0.5) \text{ V} \times 2,000. \text{ ppm} \\ &= 0.5 \times 2,000 \text{ ppm} = 1,000 \text{ ppm} \end{aligned}$$

UART Descriptions

Data Format

D6	D5	D4	D3	D2	D1	SP	'p'	'p'	'm'	CR	LF
----	----	----	----	----	----	----	-----	-----	-----	----	----

D6 ~ D1	6 byte CO2 density string
SP	Space: 0x20
'ppm'	'ppm' string
CR	Carriage return : 0x0D
LF	Line feed : 0x0A

Above 12byte consist by 6 byte hexadecimal digits, <SP>, 0x70 0x70 0x6D, <CR> <LF> , where decimal '0' (corresponds to hexadecimal digit '0x30') is replaced by space (corresponds to hexadecimal digit '0x20'),

EX) 1,255 ppm, results '0x20 0x20 0x31 0x32 0x35 0x35 0x20 0x70 0x70 0x6D 0x0D 0x0A', which displays '_1255_ppm<CR> <LF>' on screen.

I2C Communication (Only Slave Mode Operation)

Internal pull up resistor

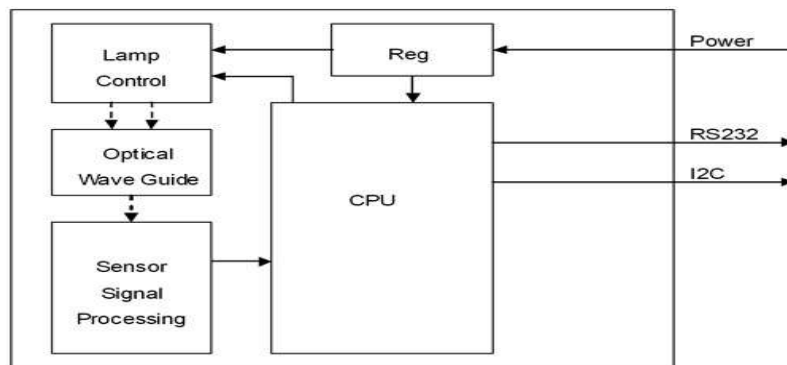
Slave Address: 0x31, Slave Address Byte: Slave Address(0x31) 7 Bit + R/W 1 Bit

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	1	1	0	0	0	1	R/W Bit

R/W Bit : Read = 1/Write = 0

When reading the data, Slave Address Byte is 0x63, When writing the data, Slave Address Byte is 0x62.

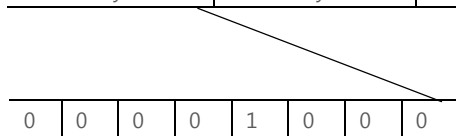
Block Diagram



Transmission Sequence in Master

- 1) I2C Start Condition
- 2) Write Command(Slave Address + R/W Bit(0) = 0x62) Transmission and Check Acknowledge
- 3) Write Command(ASCII 'R' : 0x52) Transmission and Check Acknowledge
- 4) I2C Stop Command
- 5) I2C Start Command
- 6) Read Command(Slave Address + R/W Bit(1) = 0x63) Transmission and Check Acknowledge
- 7) Read 7 Byte Receiving Data from Module and Send Acknowledge
(Delay at least 1ms for reading each byte)

Configuration	CO ₂	reserved	reserved	reserved	reserved
1 Byte	2 Byte	0x00	0x00	0x00	0x00

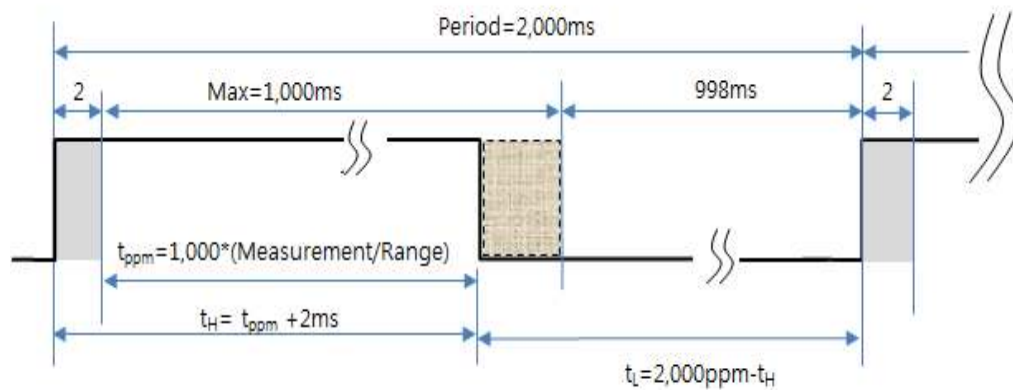


In need of detail protocol specification and time sequence, 'I2C programming guide' could be provided by contacting Sales Rep.

PWM Descriptions

* $Measurement_{(ppm)} = (t_H - 2msec) / 1000msec \times Range_{(ppm)}$ (t_H : High Pulse Width)

* $Range_{(ppm)}$: 2,000/3,000/5,000/10,000 ppm (20,000/30,000/50,000/100,000 is optional.)



EX) t_H (High Pulse Width) calculation for 400 ppm in 2,000 ppm Range.

* $Measurement_{(ppm)} = 400 \text{ ppm} = (t_H - 2ms) / 2,000msec \times Range_{(ppm)}$,

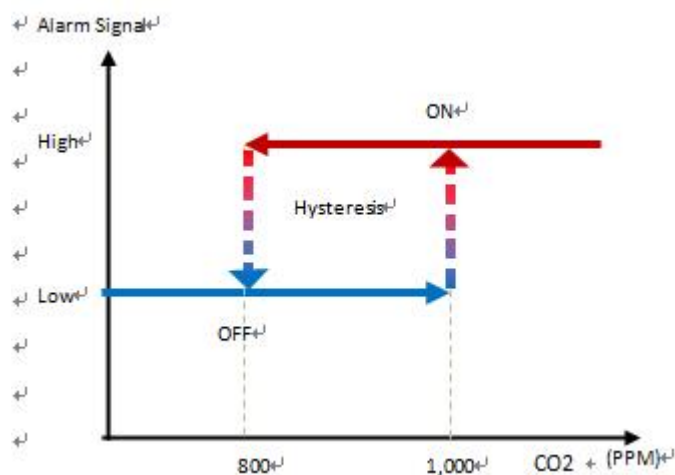
* $t_H = 1,000 \text{ msec} * (400 \text{ ppm} / 2,000 \text{ ppm}) + 2msec = 202msec$

(cf: $T_L = \text{Period} - t_H = 2,000 \text{ ppm} - 202 \text{ msec} = 1,798 \text{ msec.}$)

Alarm Descriptions

Alarm signal operates as Open Collector type and send TTL on signal since CO2 measured value beyond 1,000 ppm until it go down to 800 ppm. It is designed to be activated when CO2 measured value surpass 1,000 ppm and deactivated down to 800 ppm to avoid unwanted rapid switching by hysteresis effect.

1,000 ppm ≤ Alarm ON, 800 ppm ≥ Alarm OFF



2nd Alarm use 0.5V/3V TTL signal Switching instead of SPST (Single Pole Single Throw) method.

EK-100SL series is available for customer to enable to change alarm activation & deactivation point.

ELT SENSOR Corp.

Chunui Technopark 101-909) 36, Bucheon-ro 198beon-gil, Wonmi-
gu, Bucheon-si, Gyeonggi-do, 420-857, Korea
Phone. +82-32-719-8055, <http://www.eltsensor.co.kr>

Subject to change without notice. Printed in KOREA
2015 ELT Sensor Corp. All rights reserved.
2015. January