

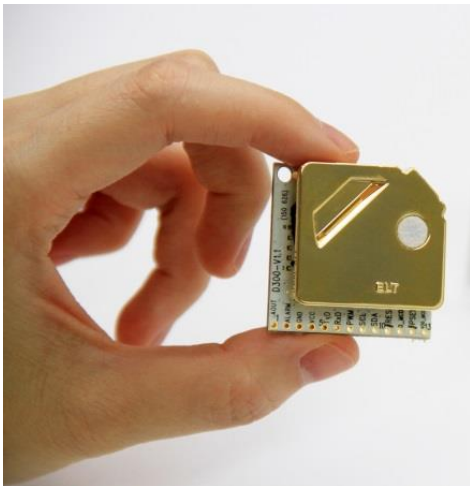
General

Ver 1.2

D-300(LG) series is the smallest Dual CO₂ sensor module in the world. Its Persistent Stability and Temperature Effect Resistance are much favored in warehouse, greenhouse, hospitals etc. besides the small size and consistent accuracy through the life cycle.

ELT Sensor Data Sheet for D-300(LG)

Features



- Non-Dispersive Infrared (NDIR) Dual Channel Technology to measure CO₂ levels.
- Excellent compensation of Temperature Effect on CO₂ concentration.
- Output mode : TTL-UART, I2C, ALARM, Option (Analog Voltage, PWM).
- Gold-plated sensor provides long-term calibration stability.
- Two kinds of MCDL (CAL1 with 400ppm CO₂ gas and CAL2 with N₂ gas) are executable.
- Size : 33mmx33mmx13.1mm
- Weight : 10 grams

D-300(LG) Specifications

General Performance

Operating Temperature : -20 ~ 50°C

Operating Humidity : 0 ~ 95% RH (Non-condensing) ('G' option : 0 ~ 99% RH (Non-condensing) ⁽¹⁾)

Operating Environment : HVAC in Hospital, Warehouse, Greenhouse

Storage Temperature : -30°C ~70°C

CO₂ Measurement

Sensing Method : NDIR (Non-dispersive Infrared)

Measurement Range : 0 to 2,000 (3k/5k/10k ppm, 2%/3%/5%/7%/10% models are available)

Accuracy : ±30ppm ±3% of Reading ⁽²⁾⁽³⁾⁽⁴⁾

±300ppm ±3% of Reading for 2%,3%,5%,7%,10% high concentration models

Step Response Time (90%, 1/e) : 150 seconds / 90 seconds

Sampling Interval: 3 seconds

Warming-up Time : < 30 seconds (for Operation), 5 minutes (for Accuracy)

Electrical Data

Power Input : 5V ± 5%⁽⁵⁾

Current Consumption : Normal mode : 25mA, Peak : 250mA, Sleep < 0.5mA

Product Derivatives and Relative Functions

Products	Feature	Option
D-300	UART,I2C, ALARM, AVO/PWM option, '0/400'ppm MCDL	D-300-3V
D-300L	Sleep mode is added on D-300 for Low Power, which consume < 0.5mA	D-300L-3V
D-300G	Resistant up to 99% Humidity for Application of Agricultural Green House, Stock Raising,etc	D-300G-3V
D-300LG	Sleep mode + 99% Humidity	D-300LG-3V

D-300 has various output TTL-UART, I2C, ALARM while as AVO or PWM is selectable as option. 2.54pitch 13pin side hole connector besides 2mm pitch 10 and 4pin 2 row header connectors. Three kinds of MCDL (with CO₂-'400'ppm-N₂-based-gas or CO₂-'0'ppm-N₂-based-gas or Fresh Air) are executable.

(1) D-300G: 0 ~ 99% RH (Non-condensing) for Application of Green House

(2) Accuracy of ±30ppm ±3% is acquirable through ACDL logic after 3 times 3 weeks

(3) or 10 minutes MCDL with Standard CO₂ gas can be used as option..

(4) Air pressure is assumed as 101.3 kPa

(5) DC Supply should be regulated without ripple < 100mV, low noise power source is needed for best accuracy.

Pin Map with J11&J12 Connectors

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

J-12	D-300	D-300 (Analog Voltage Option)
1	TTL RXD (← CPU of Master Board)	
2	TTL TXD (→ CPU of Master Board)	
3	I2C SCL	
4	I2C SDA	
5	GND	
6	Reserved	Analog Voltage Output (0.5~4.5V) : Option
7	CAL2-pin (for 10 minutes MCDL with CO ₂ -'0'ppm-N ₂ -based-gas)	
8	Reserved	
9	CAL1-pin (for 10 minutes MCDL with CO ₂ -'400'ppm-N ₂ -based-gas or Fresh Air)	
10	Reset (Low Active)	

UART : 38,400BPS, 8bit, No parity, 1 stop bit
 9,600 or 19,200 BPS can selectable through command sets or EK-100SL.

I2C : Slave mode only, Internal pull up resistor 10kΩ
 TTL Level Voltage : $0 \leq V_{IL} \leq 0.8$, $2 \leq V_{IH} \leq V_{DD}$, $0 \leq V_{OL} \leq 0.4$, $2.4 \leq V_{OH} \leq V_{DD}$ (Volt)

ALARM : Open Collector type
 1,000 ppm ≤ Alarm ON, 800 ppm ≥ Alarm OFF
 Alarming range can be change by EK-100SL with connected to PC.

Analog Voltage : 0.5~4.5V (option)

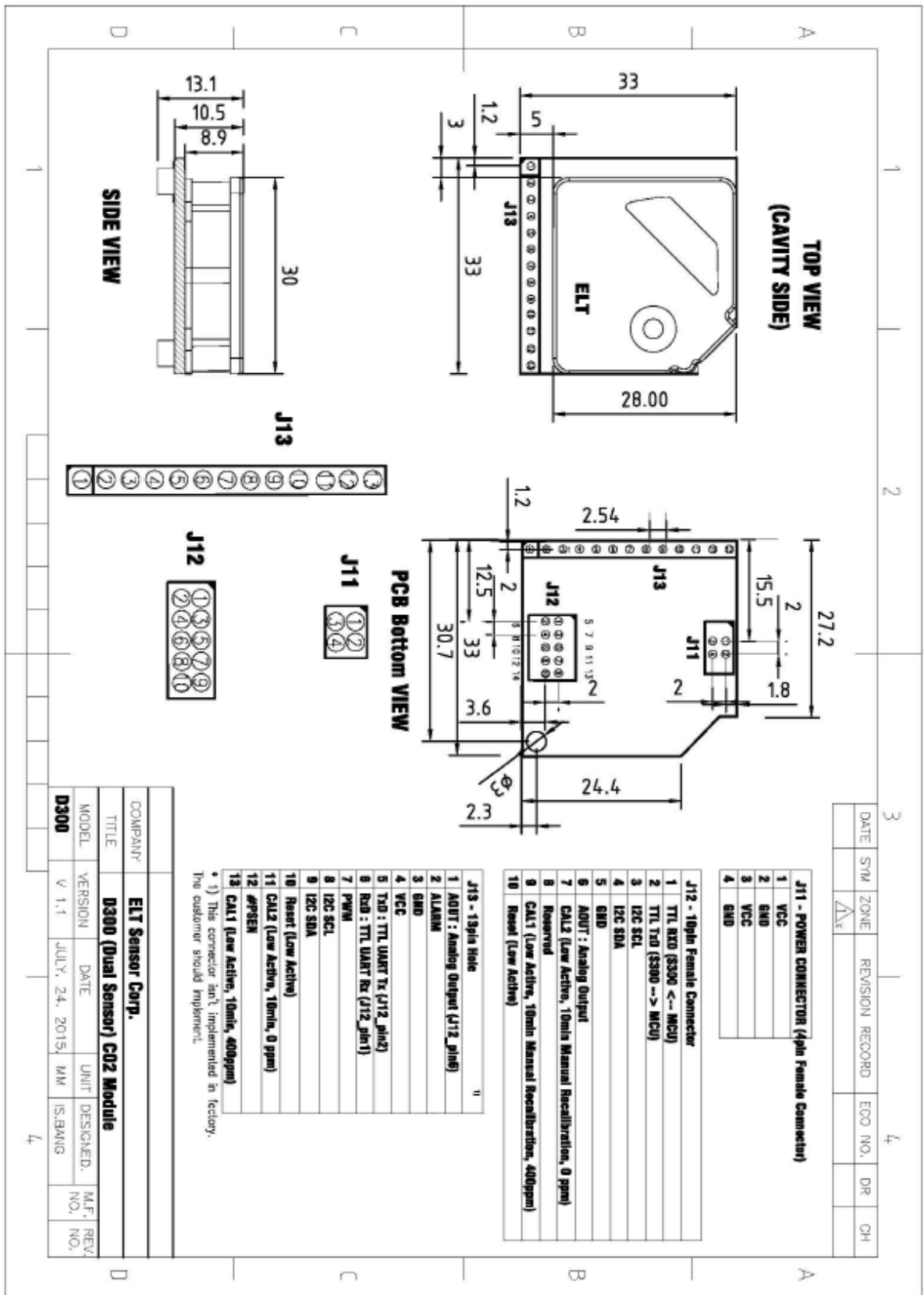
PWM (option)

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

Pin Map with J13 Connectors

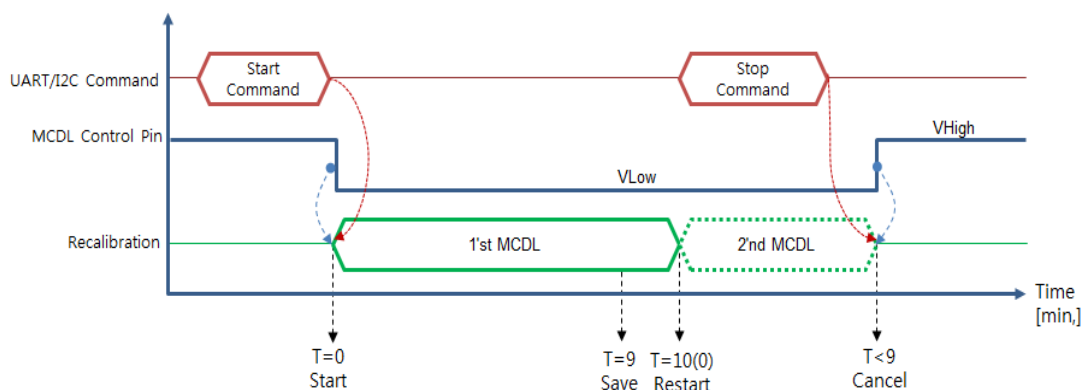
J-13	D-300	D-300(PWM / Analog Option)
1	Reserved	Analog Voltage Output (0.5~4.5V) : Option
2	Alarm (Open Collector)	
3	GND	
4	V _{DD} (+5VDC)	
5	TTL TXD (→ CPU of Master Board)	
6	TTL RXD (← CPU of Master Board)	
7	Reserved	PWM Output (TTL) : Option
8	I2C SCL	
9	I2C SDA	
10	Reset (Low Active)	
11	CAL2-pin (for 10 minutes MCDL with CO ₂ -'0'ppm-N ₂ -based-gas)	
12	Reserved	
13	CAL1-pin (for 10 minutes MCDL with CO ₂ -'400'ppm-N ₂ -based-gas or Fresh Air)	

Cavity Dimensions (unit : mm)



MCDL with CAL1 /CAL2

CAL1 with CO₂-‘400’ppm-N₂-based-gas or CAL2 with CO₂-‘0’ppm-N₂-based-gas is to restore the specification accuracy. Fresh air calibration is also available although the accuracy decreases with the distance from 400ppm.



Time Diagram of MCDL

Method 1. UART Command Set; J12: pin-1 (UART-RX) and pin-2 (UART-TX) to Main-Board (J13: pin-5 and pin-6 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. 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 4. Send string command set below to RXD-pin of Sensor on Emulation program.

EK-100SL (Evaluation kit, with Emulation program ‘ELTWSO’) is available

Method 5. Execute Hardware based Manual Calibration (MCDL).

MCDL-pin	CAL-1pin (J12:pin-7 or J13:pin-11)	CAL-2pin (J12:pin-9 or J13:pin-13)	Reference Gas	Calibration time
CAL-1	High	Low	CO ₂ -‘400’ppm-N ₂ -based-gas / Fresh Air	Calibration should be finished in between 10 and 18minutes
CAL-2.	Low	High	CO ₂ -‘0’ppm-N ₂ -based-gas	

- ※ 1. CAL-1pin and CAL-2pin shouldn't have 'Low' at the same time.
- 2. Be sure to escape MCDL fetch loop between 10 minutes and 18minutes to avoid inappropriate calibration.

Output Descriptions

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 10kΩ

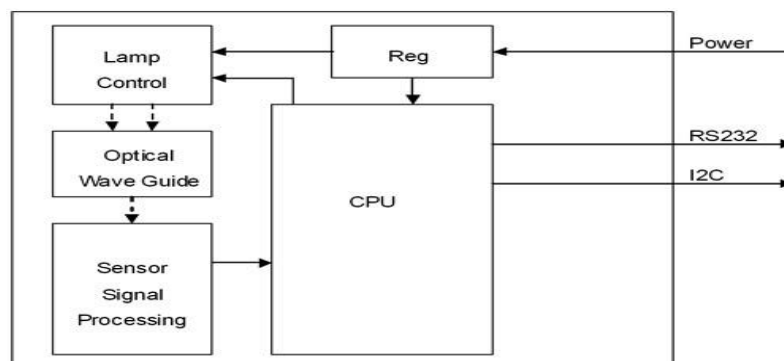
Slave Address: 0x31, Slave Address Byte: Slave Address(0x31) 7 Bit + R/W 1 Bit

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)

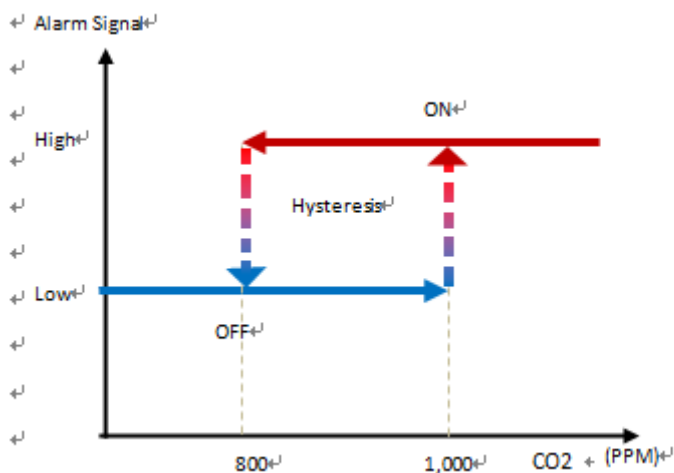
Configuration	CO ₂	reserved	reserved	Reserved	reserved								
1 Byte	2 Byte	0x00	0x00	0x00	0x00								
		<table border="1" style="width: 100%; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td> </tr> </table>				0	0	0	0	1	0	0	0
0	0	0	0	1	0	0	0						

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

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



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

Analog Voltage Output Descriptions : Option

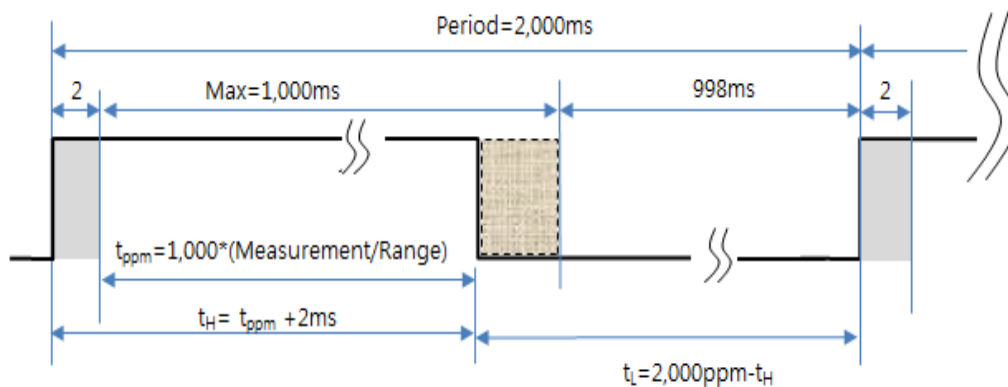
Measured Voltage 0.5V~4.5V match proportionally to 0~ 2,000 each for 2,000 ppm scale sensor and any of 0~3,000 or 5,000 or 10,000 ppm scale sensor could be set by designating on sale. Therefore 4.5V will match 2,000 or 3,000 or 4,000 or 10,000 ppm or 2% or 3% or 5% or 10% each.

* 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)
 CO2 Measurement_{ppm} = (2.5 - 0.5) V ÷ (4.5 - 0.5) V x 2,000. ppm
 = 2 ÷ 4 x 2,000 ppm = 1,000 ppm

PWM Descriptions : Option

* Measurement_(ppm) = (t_H-2msec)/1000msec x 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 ppm = (t_H-2ms)/2,000msec x Range_(ppm) ,

*t_H = 1,000 msec * (400 ppm / 2,000 ppm) + 2msec = 202msec

(cf: T_L = Period - t_H = 2,000 ppm - 202 msec = 1,798 msec.)

※ Caution

1. Please use only 'PCB' of sensor to avoid the physical shock on sensor without holding Cavity

directly. Rough handling or Transportation could result in inaccurate reading..

But, MCDL with CAL1/CAL2 are available to correct the sensor to normal status.

2. Proper ESD protection during handling is important to avoid electrostatic defect occurrence. The storage of sensor should be insulated as well

* Revision History

Version	Upgrade	Remark
1.0	Launch	2015.JULY
1.1	Analog, PWM -> Option	2015.DEC