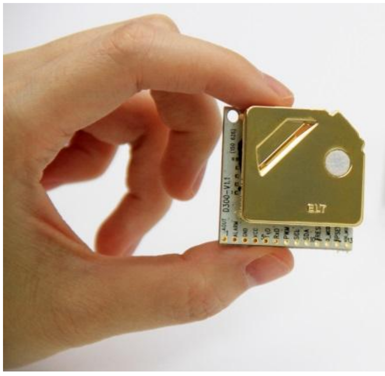
General

Ver 1.11

CH4-D3-3V is one of the smallest size Dual Channel Methane sensor module in the world. Its Persistent Stability and Temperature Effect Resistance are much favored in flammable and explosion hazard gas and consistent accuracy through the life cycle.

ELT Sensor
Data Sheet for CH4-D3-3V



Features

- Non-Dispersive Infrared (NDIR) Dual Channel Technology to measure CH4 levels.
- Excellent compensation of Temperature Effect on CH4 concentration.
- Output : TTL-UART, I2C, ALARM
  (Option: Analog Voltage, PWM)
- Easy Calibration with Non-Periodic Manual Calibration (0_MCDL : CAL1) and Periodic Automatic Calibration (0_ACDL : CAL2).

- Size : 33mmx33mmx13.1mm
- Weight : 10 grams

Specifications

Applications

Gas leakage alarming detector or equipment of CH_4, LNG or combustible gases in Mine, metallurgy, liquefied gas station, petroleum, fuel gas ,etc.

General Performance

Operating Temperature : -20 ~ 50℃

Operating Humidity : 0 ~ 95% RH (Non-condensing), 0 ~ 99% RH (Non-condensing) (1)

Storage Temperature : -30℃ ~70℃

Measurement

Sensing Method : NDIR (Non-dispersive Infrared)

Measurement Range : 0 ~ 100% LEL (=0~50,000ppm vol. is optional) (2)

Accuracy : ±3% of F.S.(3),(4),(5)

Resolution: 1% LEL (=500ppm vol.)

Detection Limit: 2% LEL (=1,000ppm vol.)

Step Response Time (90%, 1/e) : 100 seconds / 70 seconds

Sampling Interval: 3 seconds

Warming-up Time : < 6 seconds (for Detection), 5 minutes (for Accuracy)

Electrical Data

Power Input : 3.2V ~3.6 (6)

Current Consumption : Normal mode : 12mA, Peak : 190mA, Sleep < 0.3mA

Product Derivatives and Relative Functions

Products	Feature	Option
CH4-D3-3V	UART,I2C, 1st +2ndALARM, PWM, 0_MCDL(CAL1)/0_ACDL(CAL2)	CH4-D3
CH4-D3**L**-3V	**Sleep mode** is added on CH4-D3for Low Power, which consume < 0.5mA	CH4-D3L
CH4-D3**G**-3V	**Analog Voltage output ,** 0_MCDL(CAL1)/0_ACDL(CAL2)	CH4-D3G
CH4-D3**LG**-3V	**Sleep mode + 99% Humidity**	CH4-D3LG

(1) CH4-D3G : 0 ~ 99% RH (Non-condensing) for Industrial Application of Methane gas.

(2) PPM unit output is selectable as option when you designate on issuing order.

(3) 2% should be added for absolute measurements for uncertainty of calibration gas mixture unless '0' ppm or '0'ppm standard gas calibration is done.

(4) Air pressure is assumed as 101.3 kPa.

(5) If sensor is affected by the shock, may need field calibration before installation.

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

CH4-D3-3V 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.

Pin Map with J11&J12 Connectors

J-11	Description
1/3	V_{DD} (+3.2~3.6VDC)
2/4	GND

J-12	CH4-D3-3V	CH4-D3-3V (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 (0.5~3.0V)
7	CAL2-pin : 0_ACDL (for every 7 days ACDL with periodic CH4-'0'ppm circumstance)	
8	Reserved	
9	CAL1-pin : 0_MCDL (for 2 minutes MCDL with CH4-'0'ppm- N2-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 resister 10kΩ

TTL Level Voltage : $0 \le V_{IL} \le 0.4$, $2 \le V_{IH} \le V_{DD}$, $0 \le V_{OL} \le 0.4$, $2.4 \le V_{OH} \le V_{DD}$ (Volt)

ALARM : Open Collector type
ex) Alarm_On : 25% LEL, Alarm-Off : 20% LEL

Analog Voltage(option)**:** 0~5.3.0V

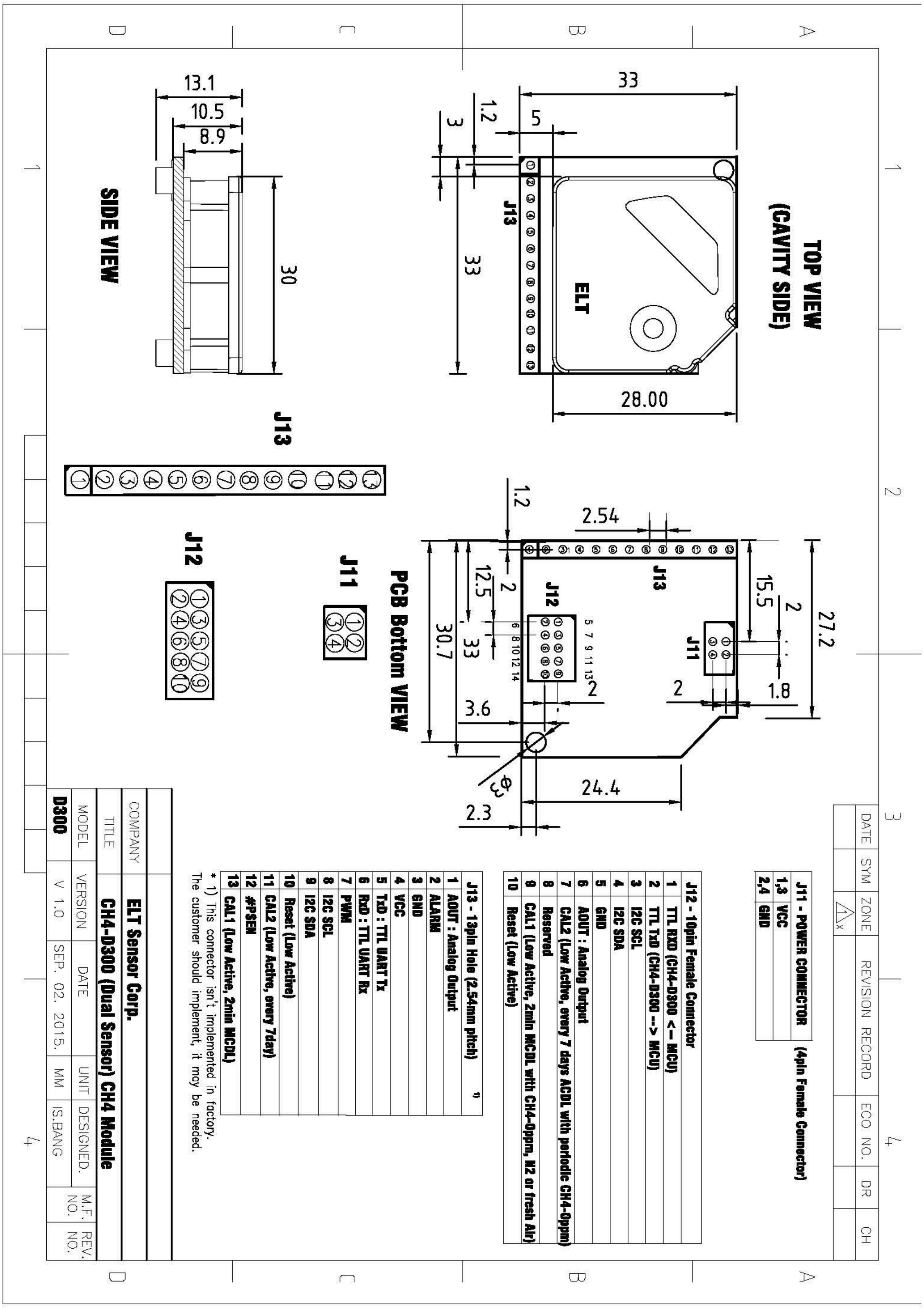
PWM(option) t_H = 2 msec(Start) + 1,000 msec x (Measurement$_{(ppm)}$/ Range$_{(ppm)}$), T_L= 2,000 ms - t_H ,

Pin Map with J13 Connectors

J-13	CH4-D3-3V	CH4-D3-3V (PWM / Analog Option)
1	Reserved	Analog Voltage Output (0.5~3.0V)
2	1st Alarm (Open Collector)	
3	GND	
4	V_{DD} (+3.3VDC)	
5	TTL TXD (→ CPU of Master Board)	
6	TTL RXD (← CPU of Master Board)	
7	Reserved	PWM Output (TTL)
8	I2C SCL	
9	I2C SDA	
10	Reset (Low Active)	
11	CAL2-pin (for every 7 days ACDL with periodic CH4-'0'ppm circumstance)	
12	Reserved	
13	CAL1-pin (for 10 minutes MCDL with CH4-'0'ppm-N2-based-gas or Fresh Air)	

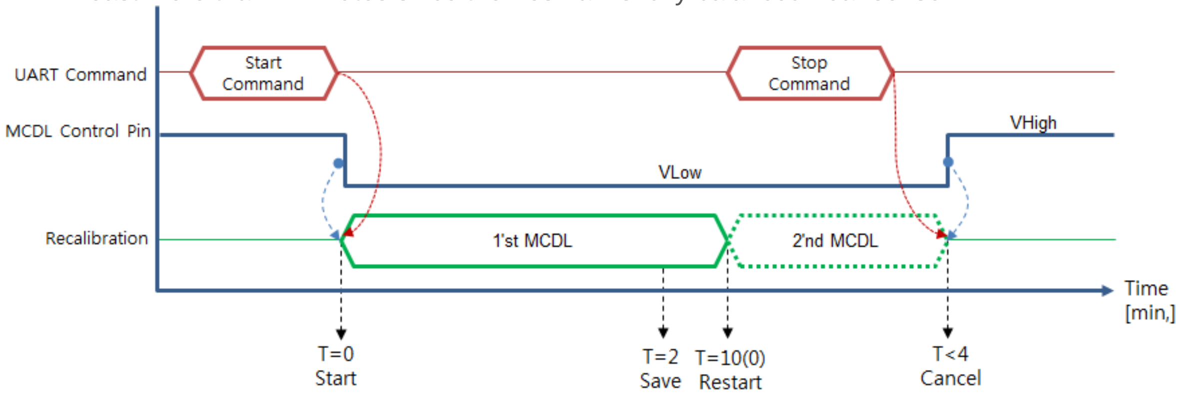
Cavity Dimensions (unit : mm)

Dimensions unit : mm



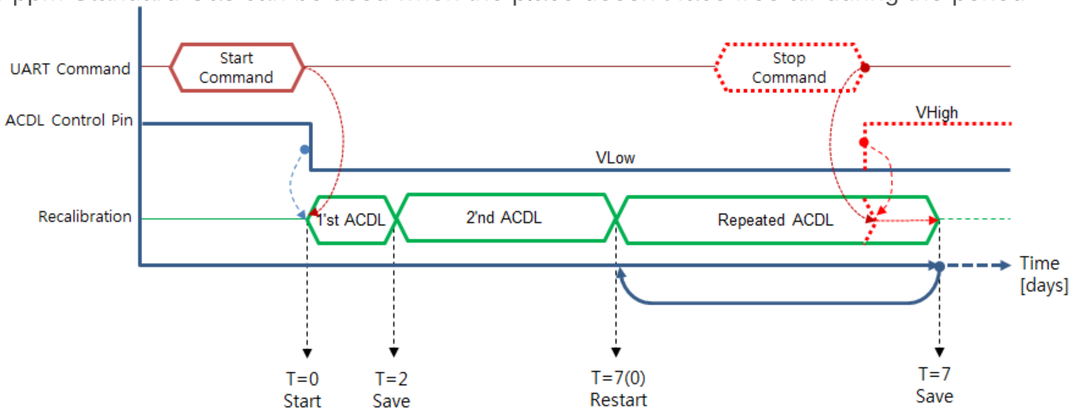
0_MCDL (2 minutes Manual Calibration)

'0' ppm Manual Calibration can be done by giving start command or low signal to CAL1-pin at least more than 2 minutes since the fresh air is fully balanced near sensor.



0_ACDL (Periodic Automatic Calibration)

'0' ppm Periodic Automatic Calibration can be used by giving start command or low signal to CAL2-pin. The sensor calibrate automatically first in 2 days, seconds 5 days and every week. '0'ppm Standard Gas can be used when the place doesn't face free air during the period.



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 or with 0'ppm Standard Gas 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 'ELTWSD')** is available

Method 5. CAL1 / CAL2-pin settings for 0_MCDL / 0_ACDL

CAL1 0_MCDL	CAL 2 0_ ACDL	Function	Process
Low	High	H/W '0'ppm MCDL	Let CH4-D3 sensor be located at ambient place where no methane gas exist and wait 2 minute. '0'ppm Standard gas can be used when '0'ppm is not guaranteed.
High	Low	H/W '0' ppm ACDL	Automatic Calibration can be used where CH4 meet the clear air more than 3 minutes per week.
High	High	Normal	Operate with Factory Calibrated or previously set status

※ 1. CAL-1pin and CAL-2pin shouldn't have 'Low' at the same time.
2. Be sure to escape MCDL fetch loop between 2 minutes and 4minutes to avoid inappropriate calibration.

Output Descriptions

UART Descriptions

Data Format

SP	SP	SP	D2	D1	'%'	SP	'L'	'E'	'L'	CR	LF

SP x 3	Space: 0x20
D2 ~ D1	2 byte CH4 density string
%	% : 0x25
SP	Space: 0x20
'LEL'	' LEL' string
CR	Carriage return : 0x0D
LF	Line feed : 0x0A

Above 12byte consist by 2 byte hexadecimal digits, <SP>,<SP>,<SP>, D2, D1, 0x25, <SP>, 'L', 'E', 'L', <CR><LF> , where decimal '0' (corresponds to hexadecimal digit '0x30') is replaced by space (corresponds to hexadecimal digit '0x20'),

EX) 7% LEL (= 3,500 ppm) string is '0x20 0x20 0x20 0x20 0x37 0x25 0x20 0x4C 0x45 0x4C, 0x0D 0x0A',, of which display on the screen is '____7%_LEL<CR><LF>'.

'ppm' display is Option on sale, which D6~D1 string display the CH4 concentration of

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

EX) 3,500 ppm string is '0x20 0x20 0x33 0x35 0x30 0x30 0x20 0x70 0x70 0x6D 0x0D 0x0A', of which display on the screen is '__3500_ppm<CR><LF>'.

I2C Communication (Only Slave Mode Operation)

Internal pull up resister 10kΩ

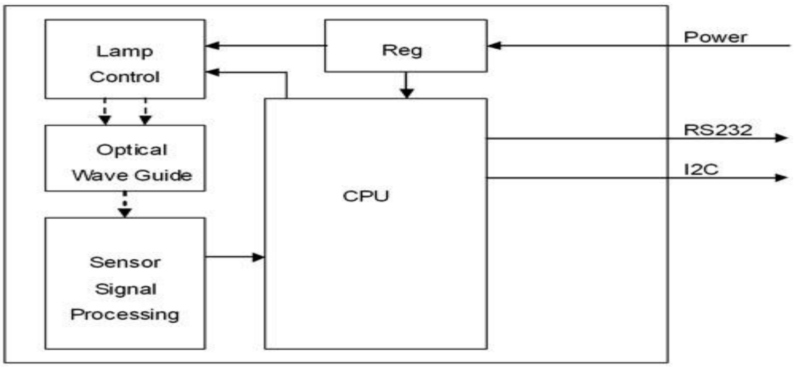
Slave Address: 0x31, Slave Address Byte: Slave Address(0x31) 7 Bit + R/W 1 Bit

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)

Header	CH4	reserved	reserved	Reserved	reserved
1 Byte	2 Byte	0x00	0x00	0x00	0x00

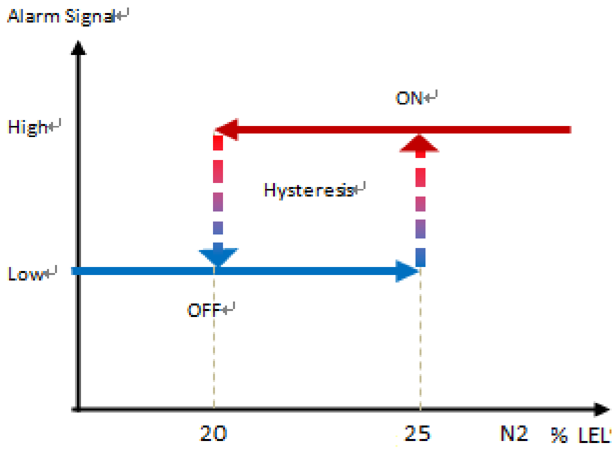
0	0	0	0	1	0	0	0

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 CH4 measured value beyond 25% LEL until it go down to 20% LEL. It is designed to be activated when CH4 measured value surpass 25% LEL and deactivated down to 20%LEL to avoid unwanted rapid switching by hysteresis effect.

Alarm_On : 25% LEL, Alarm-Off : 20% LEL

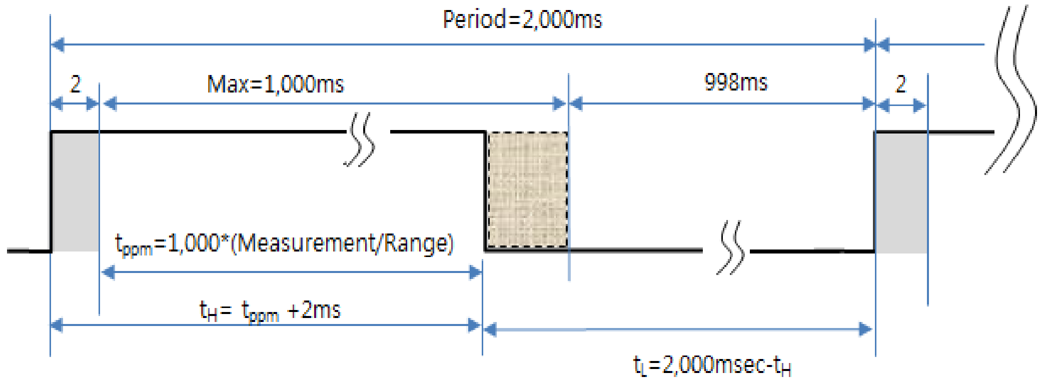


EK-100SL series is available for customer to enable to change alarm activation & deactivation point.

PWM Descriptions (Option)

* Measurement$_{(ppm)}$ = (t_H-2msec)/1000msec x Range$_{(\% LEL)}$ (t_H : High Pulse Width)

* Range$_{(ppm)}$: 0~100% LEL (=0~50,000ppm)



EX) t_H (High Pulse Width) calculation for 50% LEL in 0~100% LEL Range.

*Measurement$_{(\% LEL)}$ = 50% LEL = (t_H-2ms)/2,000msec x Range$_{(\% LEL)}$,

*t_H= 1,000 msec * (50% LEL / 100% LEL) + 2msec = 502msec

(cf: T_L= Period - t_H = 2,000 msec – 502 msec = 1,498 msec.)

Analog Voltage Output Descriptions (Option)

Measured Voltage 0.5V~3V match proportionally to 0 ~ 100% LEL.

* CH4 Measurement$_{(ppm)}$ = ((Output $_{Voltage}$– 0.5)/ (3 – 0.5) $_{Voltage}$)x 100% LEL.

EX) if the Output $_{Voltage}$ is 1.25V in 0~100% LEL range,

CH4 (% LEL) = (1.25 – 0.5) V÷ (3 – 0.5)V x 100% LEL

=0.5 x 100% LEL = 50% LEL

※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, 0_MCDL with CAL1 or 0_ACDL with 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

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