General

T-110 series is the world’s smallest CO₂ sensor module. T-110 is much favored by customers due to its Temperature independence besides the long life cycle.

ELT Sensor Data Sheet for T-110

Features

• Non-Dispersive Infrared (NDIR) technology used to measure CO₂ levels.
• The world’s smallest size
• Pre-calibrated
• Available output: TTL-UART, I2C, ALARM, PWM/Analog Voltage.
• Gold-plated sensor provides long-term calibration stability.
• Installed re-calibration function
• Operate as ACDL mode (Automatic Calibration in Dimming Light mode).
• Manual Re-Calibration function is executable.
• Size: 19mmx29.3mmx8.5mm
• Weight: 5 grams
**T-110 Specifications**

**General Performance**
- **Operating Temperature**: 0 ~ 45°C
- **Operating Humidity**: 0 ~ 85% 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 (2/3/5/10% is optional)
- **Accuracy**: ±70ppm ±3% of reading (T-110A: ±50ppm ± 3% of reading) for 0~10,000 ppm
  - (±200ppm ± 3% of reading up to 5%,  ±200ppm ± 5% of reading up to 10%)
- **Step Response Time (90%)**: 3 minutes
- **Sampling Interval**: 5 seconds
- **Warming-up Time**: 3 minutes

**Electrical Data**
- **Power Input**: 5.0V ± 5%
- **Current Consumption**: Normal mode : 20mA, Peak : 200mA, Sleep: 0.5mA

**Product Derivatives with Functions**

<table>
<thead>
<tr>
<th>Products</th>
<th>Option List</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-110A</td>
<td>ACDL software, 10’ MCDL, UART, ALARM, Analog Voltage or PWM, 10pin,</td>
</tr>
<tr>
<td>T-110L</td>
<td>Low Power, 10’ MCDL UART, ALARM, Analog Voltage or PWM, 10pin,</td>
</tr>
<tr>
<td>T-110M</td>
<td>10’ MCDL, UART, ALARM, Analog Voltage or PWM, 10pin,</td>
</tr>
<tr>
<td>T-110G</td>
<td>Resistant to 99% Humidity for Green House, 10’ MCDL, UART, ALARM, Analog Voltage or PWM, 10pin,</td>
</tr>
</tbody>
</table>

10 minute MCDL (Manual Calibration in Dimming Light) Function is executable in all T-100 Series.

T-110G is for Greenhouse and Stock Raising which need to be resistant to humidity while as T-100L is Low Power model, consumes less than 0.5mA in Sleep mode.

T-110A has ACDL (Automatic Calibration in Dimming Light) software in Sensor for Indoor Air-Quality Monitoring which could face ambient status with period. (2day at first, and every week as default).

‘Technical Datasheet for T-110 series’ could be provided by contacting on Sales Rep.
Output Pin Map

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>T-110A</th>
<th>T-110A(PWM Option)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+5V VCC</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>UART-RX</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>No Output</td>
<td>PWM (Pulse Width Modulation)</td>
</tr>
<tr>
<td>5</td>
<td>UART-TX</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Alarm (Open Collector)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Analog Voltage Output</td>
<td>No Output</td>
</tr>
<tr>
<td>8</td>
<td>SCL</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>SDA</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>MCDL</td>
<td></td>
</tr>
</tbody>
</table>

**UART**
38,400BPS, 8bit, No parity, 1 stop bit, TTL Level Voltage (for inspection use)

**I2C** (J-12:P3&P4)
Slave mode only, Internal pull up resister
TTL Level Voltage : $0 \leq V_{IL} \leq 1.2$, $3.5 \leq V_{IH} \leq 5$, $0 \leq V_{OL} \leq 0.4$, $4.2 \leq V_{OH} \leq 5$ (Volt)

**PWM**

$t_H = 2 \text{ msec (Start)} + 1,000 \text{ msec} \times \left( \frac{\text{Measurement}_{ppm}}{\text{Range}_{ppm}} \right)$,
$t_L = 2,000 \text{ ppm} - t_H$, (Period : 2,000 ppm)

**Analog Voltage**: 0.5~4.5V

**ALARM**
Open Collector type, 1,000 ppm ≤ Alarm ON, 800 ppm ≥ Alarm OFF
10 minute Manual Re-Calibration Function.

ACDL mode (Automatic Re-Calibration in Dimming light with period)

Automatic Re-Calibration software is installed for T-110A, recommended for Indoor Air-Quality Monitoring which could face ambient status with period. (2day at first, and every week as default)

10 minute Manual Re-Calibration Function (10’ MCDL function).

Method 1. Apply TTL Low signal to pin-10 for 10 minutes, or
※To activate MCDL function, the user’s application must be designed to give Low Active Signal to pin-10

Method 2. Let Sensor install on Jig Board (TRB-100: Test and Recalibration Board) with ambient air-flow condition and execute by moving jumper following Manual, which is downloadable on the website.

Method 3. Send String command set below to RXD-pin of Sensor on Emulation program.

DK-100 (Download kit, with Emulation program ‘ELTWSD’) 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.

UART Descriptions

Data Format

<table>
<thead>
<tr>
<th>SP</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>SP</th>
<th>’p’</th>
<th>’m’</th>
<th>CR</th>
<th>LF</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SP</td>
<td></td>
<td></td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>D6 ~ D1</td>
<td>6 byte CO2 density string</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>’ppm’</td>
<td></td>
<td></td>
<td>CR</td>
<td>Line feed : 0x0A</td>
</tr>
<tr>
<td>’ppm’</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Carriage return : 0x0D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Above 13 byte consist by <SP>, 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 0x20 0x31 0x32 0x35 0x35 0x20 0x20 0x70 0x70 0x6D 0x0D 0x0A', which displays ‘___1255 ppm<CR><LF>’ on screen.

**I2C Communication (Only Slave Mode Operation)**

Internal pull up resister

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

<table>
<thead>
<tr>
<th>Bit7</th>
<th>Bit6</th>
<th>Bit5</th>
<th>Bit4</th>
<th>Bit3</th>
<th>Bit2</th>
<th>Bit1</th>
<th>Bit0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>R/W Bit</td>
</tr>
</tbody>
</table>

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**

![Block Diagram](image)

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

**PWM Descriptions**

* Measurement\(_{\text{ppm}}\) = (\(t_{\text{H}}\)-2\text{msec})/1000\text{msec} \times \text{Range\(_{\text{ppm}}\})  \ (t_{\text{H}} : \text{High Pulse Width})

* Range\(_{\text{ppm}}\) : 2,000/3,000/5,000/10,000 ppm (20,000/30,000/50,000/100,000 is optional.)

EX) \(t_{\text{H}}\) (High Pulse Width) calculation for 400 ppm in 2,000 ppm Range.

*Measurement\(_{\text{ppm}}\) = 400 ppm = (\(t_{\text{H}}\)-2\text{ms})/2,000\text{msec} \times \text{Range\(_{\text{ppm}}\)}  ,

*\(t_{\text{H}}\) = 1,000 \text{ msec} * (400 ppm / 2,000 ppm) + 2\text{msec} = 202\text{msec}  
(cf: \(T_{l}\) = Period - \(t_{\text{H}}\) = 2,000 ppm – 202 msec = 1,798 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
DK-100 series is available for customer to enable to change alarm activation & deactivation point.