

Spec for SL300EU

LoRaWAN CO2 Sensor



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SL300EU is long range low power CO2 sensor based on Semtech SX1262, which is standard LoRaWAN Class A compatible and is widely adopted in Environment Monitoring, Green House, Smart Agriculture etc.

Main features:

NDIR Tech for CO2 Sensor

2.9 inch screen local display

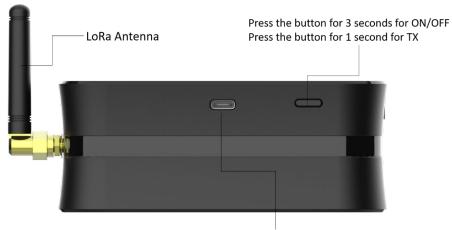
Type-C for Local Configuration

Internal Battery Up to 2 Years

LoRa SX1262, Long Range Low Power

LoRaWAN Class A Compatible

1. Details:



Type-C for Local Configuration



| Parameter | Feature |
|---------------------|---------------------------------------------------|
| CPU | M0+ |
| Wireless | LoRaWAN(SX1262) |
| Encryption | AES128 Optional |
| Power | Built-in Li-battery (Changeable, and No Recharge) |
| Working Temperature | -45℃~+ 85℃ |
| Working Humidity | 0-100%RH |
| Communication | Half duplex |
| Response Time | Less than 15 Seconds |
| CO2 Measuring Range | 400ppm-10000ppm |
| CO2 Accuracy | ±(30ppm+3%) |
| Power Capacity | 38000mAh |
| Lifespan | 2 Years, Data Uploading for Every 10 mins |
| Data Speed | 300bps-62.5k bps |
| Size | 115mm*80mm*45mm |
| TX Power | 22dBm Max |
| RX Sensitivity | -140 dBm |
| Frequency | CH 470MHz~510MHz EU 868MHz US 915MHz |

2. Size: 123mm*778mm*48mm

3. Installation:

Lay the product flat on the table



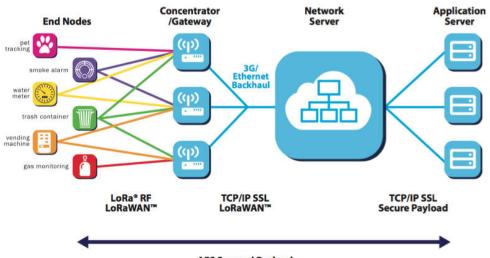


Hang on the wall



4. Connect to LoRaWAN Network

LoRaWAN Network Structure



AES Secured Pavload

SL300EU CO2 sensor is based on standard LoRaWAN Class A, so you can connect to any LoRaWAN network as below:

SL300EU sensor data uplink format with LoRaWAN by ABP, ABP parameter as below: AppKey: 11223344556677889900aabbccddeeff

ADDR: Sensor ID as display on screen

DEVUI: Customer can add 4 bytes based on sensor ID displayed on screen, or customer can read 8 bytes ID through UART with Rejeee AT command.



Connecting to The Things Network, please make sure choose manually connect and ABP as below:

Register end device

| From The LoRaWAN Device Repository M | anually | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--|
| LoRaWAN version ⑦* | | |
| MAC V1.0 | | |
| Regional Parameters version ⑦* | | |
| PHY V1.0 | | |
| Frequency plan ⑦* | | |
| Europe 863-870 MHz (SF12 for RX2) | v | |
| Over the air activation (OTAA) Activation by personalization (ABP) Denne muticast group (ABP & Multicast) Additional LoRaWAN class capabilities ⑦ | | |
| | | |
| None (class A only) | ~ | |
| | v | |
| | | |
| Network defaults ⑦ | | |
| Network defaults ⑦ | | |
| Network defaults ⑦ Use network's Rx and frequency defaults Cluster settings ⑦ | | |

5. Wireless LoraWAN Sensor Data Format

| Header | DevAddr | FCtrl | SeqNo | | Sensor Da | ta | CRC |
|--------|---------|-------|--------|-----------------------------|----------------------|----------------------|-----------------------------|
| 1Byte | 4Bytes | 1Byte | 2Bytes | Data 1 | | Data N | 2 Bytes |
| Header | DevAddr | FCtrl | SeqNo | Type+ Data N Bytes | Type+Data N Bytes | Type+Data N Bytes | CRC16= Header to Body |

LoRaWAN Format:

In order to connect to LoRaWAN network, the sensor support ABP data uploading.

AT+SIP=02(Start LoRaWAN format)

AT+AK=<32 Hex Chars>, which means AppKey, NwkSKey and AppSKey share the same secret key.

AT+ADDR=<8 Hex Char> or AT+ADDR? That means customers can set his own ADDR

or choose sensor ADDR as LoRaWAN DevAddr.

AT+TFREQ=<8 Hex Char> according to different zone to set the starting



frequency(By default, there are 8 frequencies), If the area standard frequency

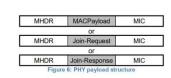
point is discontinuous, AT+NET=00 can be used to fix the transmission frequency

point.

Picture as below, FRMPayload is sensor data, MIC replaces CRC.

PHYPayload:

MACPavload.



FHDR FPort FRMPayload

| | | | | FRMPayload | /lessage) | MIC |
|------|------|-------|-----------|------------|-----------|---------|
| | | | Data 1 | | Data N | 4 Bytes |
| MHDR | FHDR | FPort | Type+Data | Type+Data | Type+Data | |
| | | | N Bytes | N Bytes | N Bytes | |

6. Sensor Data Definition

Device(0x00)

| Туре | | Value | | | | | | | | |
|--------|------------------------|------------------------|---------|--|--|--|--|--|--|--|
| 1 Byte | 2 Byte | | | | | | | | | |
| Status | Version | Level | Reserve | | | | | | | |
| | 3bit | 1 bit | | | | | | | | |
| 0x00 | 000 x xxxx yyyyyyy | | | | | | | | | |
| | First 3 is version, la | ast 5 is battery level | | | | | | | | |

CO2/CH4/CO etc.(0x30)

| Туре | Length | Value | Value |
|--------|--------|----------|--------------------------|
| 1 Byte | 1 Byte | 1 Byte | 4 Byte |
| 0x30 | 0x05 | 0x01 CH4 | Resolution ratio is 0.01 |
| | | 0X02 CO | CH4 is 0.01%LEL |
| | | 0X03 HS | CO/HS/CO2/NH3 is 0.01ppm |
| | | 0X04 CO2 | |
| | | 0X05 NH3 | |

For Example:

03 3D 36 01 CF 00 00 42 00 3F 24 30 05 04 00 00 C3 50 xx xx

30 is gas

05 is length

04 is CO2

00 00 C350 is the content of 500.00ppm

xx xx is CRC, The calculation shall be based on the actual content

7. CRC checkout

Here below is the CRC check algorithm for this document:



```
static uint16 t get crc16(uint16 t inData, uint16 t outData) {
outData = (outData >> 8) | (outData << 8);</pre>
outData ^= inData;
outData ^= (outData & 0xff) >> 4;
outData ^= outData << 12;
outData ^= (outData & 0xff) << 5;</pre>
return outData;
}
static uint16_t cal_crc16(const uint8_t *pData, const uint32_t len)
{
uint32 t i = 0;
uint16_t crc16 = 0xFFFF;
for (i = 0; i < len; i++) {
crc16 = get_crc16(*(pData++), crc16);
}
return crc16;
```

```
}
```

8. Local Configuration:

Note: Factory reset data uploading is every 10 mins, customers can change data uploading frequency as below:

Connect sensor with a USB-C cable to computer for local configuration, through local configuration, you can change the packet frequency. Download config tool here: <u>http://www.rejeee.com/#/w</u>, unpack the document as below:

Double click ConfigTool.exe to the page below, this is the factory reset parameter, and you can change each one to connect to other network, but normally customer only need to change data uploading frequency.

| R | Ī | オ | トう | - | | 打 | 吏 | | 11 | 矢下 | 1 | 2 | - | ム月 | とと | | |
|---|---|---|----|---|---|---|---|---|----|----|---|---|---|----|----|---|--|
| | R | E | J | E | Ε | E | Т | E | ¢ | Н | Ν | 0 | L | 0 | G | γ | |

| 4 LoRa module c | onfig tool | | | | | | | | - 🗆 X |
|--------------------|------------------------|-----------------------|------------------|-----------------------------------------|---------|------------------|-----------|------|-----------------------------------------------------------------|
| SenceMode More | e | | | | | | | | |
| SerialPort : CON | 13 - USB-SERIAL CH34 | 40 (C 🗸 🛛 Refresh | Baudrate : | 9600 ~ P | arity : | 8N1 ~ 💋 | Close | | Serial Open |
| Device Information | ı | Settings(Blue is Ofte | en,T is TX, R is | RX) | | | | | AT Interactive message |
| 🤹 ReadConfig | | 📄 UpdateConfig | | | | | | | Humidity: 53.09%], Level 31[3.615V] ^ |
| Modulation: | LORA | Modulation : | 01 - LoRa | ~ |] | NetMode : | 00 - Fix | ~ | <: +ATI: 2, 1007 |
| NetMode: | Node to Node | TFrequency : | | 470.3 | Mhz | RFrequency : | 50 | 00.3 | Mhz <: NET: |
| | 470300kHz 500300kHz | Bandwidth(BW) : | 07 - 125K | ~ |] hz | TxPower(POW) : | | 22 | dBm <: TFREQ: 470300kHz <: RFREQ: 500300kHz <: POW: 22dBm |
| Power: | 22dBm | TSF : | | 7 |] | RSF : | | 12 | <pre></pre> |
| Bandwidth: | 125kHz | CodeRate(CR) : | 01 - 4/5 | ~ |] | SyncWord(SYNC) : | | 52 | <: RSF: 12 <: CR: 4/5 |
| SpreadingFactor: | 7,12 | Inverted(TIQ) : | 00 - OFF | ~ | 1 | Inverted(RIQ) : | 01 - ON | ~ | <: MODE: LORA |
| CodeRate: | 4/5 | LCP : | | 20 | secs | LFT : | 1 | 800 | <pre><: SYNC: 0x34 <: PREM: 16,10</pre> |
| SyncWord: | 0x34 | | | 20 |] | | I | 800 | <: FIX: 0,0 <: CRC: ON |
| Preamble: | 16,10 | Backoff(NB) : | | 4 |] | | | | <: TIQ: OFF |
| CRC: | ON | BaudRate(BRATE) : | 03 - 9600bp | ps v |] | Parity(PAR) : | 00 - None | ~ | <: RIQ: ON <: SEQ: OFF |
| IQ Inverted: | OFFON | | SetBaud | rate | - | | | | <: IP: ON <: AES: ON |
| LowDataRate: | 0,0 | AES Key(Hex) : | 000000000 | 000000000000000000000000000000000000000 | 000000 | 00 | | | <: ACK: OFF |
| LinkCheckPeriod: | 20 | | Set AE | | ar AES | Clear LCP | Reset | | <pre>. <: LDR: 0,0 <: LCP: 20</pre> |
| LifeTime: | 1800 | | Set AL | is Cle | ar AES | Clear LCP | Reset | | <: LFT: 1800 <: RXW: 0 |
| SEQ/IP: | OFFON | | | | | | | | <: FNB: 0x84 |
| AES: | ON | | | | | | | | <: TYPE: 0x00 <: MIN: -50 |
| ACK: | OFF | | | | | | | | <: MAX: 150 >: ATI |
| FNB: | 0x84 | | | | | | | | <: +ATI: 2, 1007 |
| TYPE: | 0x00 | | | | | | | | >: ATT <: ER08 |
| Version(ATI): | 2,1007 | | | | | | | | · · · · · · · · · · · · · · · · · · · |
| | | Contribut | tors: felix.liu@ | rejeee.com | | www.rejeee.com | | | |

Following below steps to change packet uploading frequency:

- 1. Refresh
- 2. Open the serial port

| senceMode | dule config tool More | | _ | | | | - 0 | × |
|-------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------|------------------------------------------|--------------------------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|---|
| | COM3 - USB-SERIAL CH | 340 (C 🗸 Refresh | Baudrate : 9600 V P | Parity : 🛛 8N1 🗸 🍠 | Open 2 | | | |
| Device Inform | nation | Settings(Blue is Ofte | n,T is TX, R is RX) | | | AT Interac | tive message | |
| 🕏 ReadConfi | ig | 🔚 UpdateConfig | | | | <: MAX: >: ATI | 150 | ^ |
| NetM TFI RFI | ation: LORA Node to Node REQ: 470300kHz REQ: 500300kHz ower: 22dBm | Modulation : TFrequency : Bandwidth(BW) : TSF : | 01 - LoRa → 470.3 07 - 125K → 7 | NetMode : Mhz RFrequency : hz TxPower(POW) : RSF : | 500.3 22 | <: +ATI: >: AT+CFG Mhz <: NET: <: TFREQ dBm <: RFREQ <: POW: <: SF: | ? Node to Node 470300kHz 500300kHz 22dBm 125kHz 7 | |
| SpreadingFa Codef SyncW | vidth: 125kHz actor: 7,12 Rate: 4/5 Vord: 0x34 mble: 16,10 | CodeRate(CR) : Inverted(TIQ) : LCP : Backoff(NB) : | 01 - 4/5 ~ 00 - OFF ~ 3 4 | SyncWord(SYNC) : Inverted(RIQ) : secs LFT : | | <pre></pre> | 12 4/5 LORA 0x34 16,10 0,0 ON OFF | |
| | CRC: ON rted: OFFON | | 03 - 9600bps v SetBaudrate | Parity(PAR) : | 00 - None ~ | <: RIQ: <: SEQ: <: IP: <: AES: <: ACK: | ON OFF ON ON | |
| LinkCheckPe | | AES Key(Hex) : | O000000000000000000000000000000000000 | ar AES Clear LCP | Reset | | 0,0 3 1800 | |
| | Q/IP: OFFON AES: ON ACK: OFF | | | | | <pre><: FNB: <: FNB: <: TYPE: <: MIN: <: MAX: >: ATI</pre> | 0x84 0x00 -50 150 | |
| т | FNB: 0x84 TYPE: 0x00 (ATI): 2,1007 | | | | | >: AII <: +ATI: >: ATT <: ER08 | 2, 1007 | |
| version(| (ATT): 2,1007 | | ors: felix.liu@rejeee.com | www.rejeee.com | | | | |

- 3. Read config information
- 4. Update the date uploading frequency for LCP and LFT. LCP is the frequency for sensor data collecting, LTF is the frequency for data uploading.

| toRa module co SenceMode More | | | | | | | | | | | | | | × |
|----------------------------------|----------------------------------------------------------------------------------------------------------------|--------------|-------------------|-----------------------------------------|------------|---------|------------------|-----------|-------|-----|------------------------|------------------------|---------|--------|
| | 3 - USB-SERIAL CI | H340 (C | ~ Refresh | Baudrate : 9600 | ~ P | arity : | 8N1 ~ 🦻 | Close | | | | Config F | Read Su | iccess |
| Device Information | | Sett | ings(Blue is Ofte | en,T is TX, R is RX) | | | | | | | AT Interactive | e message | | |
| 🕏 ReadConfig | | ₿] U | IpdateConfig | | | | | | | | <: ER08 | | | ^ |
| Modulation: | LORA | | Modulation : | 01 - LoRa | ~ | | NetMode : | 00 - Fix | ~ | | <: ER00 | | | |
| NetMode: | Node to Node | | TFrequency : | | 470.3 | Mhz | RFrequency : | | 500.3 | Mhz | >: AT+CFG? <: NET: | Node to Node | | |
| TFREQ: | 470300kHz | Bi | andwidth(BW) : | 07 - 125K | ~ | hz | TxPower(POW) : | | 22 | dBm | <: TFREQ: <: RFREQ: | 470300kHz 500300kHz | | |
| RFREQ: | 500300kHz | - | TSF : | 07 - 125K | | | RSF : | | | 1 | <: POW: <: BW: | 22dBm 125kHz | | |
| Power: | | | ISF : | | 7 | | KSF : | | 12 | | <: TSF: | 7 | | |
| Bandwidth: | | | CodeRate(CR) : | 01 - 4/5 | ~ | | SyncWord(SYNC) : | | 52 |] | <: RSF: <: CR: | 12 4/5 | | |
| SpreadingFactor: | | | Inverted(TIQ) : | 00 - OFF | ~ | | Inverted(RIQ) : | 01 - ON | ~ | 1 | <: MODE: <: SYNC: | LORA 0x34 | | |
| CodeRate: | | 4 | LCP : | | 20 | secs | LFT : | | 1800 | | <: PREM: | 16,10 | | |
| SyncWord: | | | Backoff(NB) : | | | | | | | | <: FIX: <: CRC: | 0, 0 ON | | |
| Preamble: | | | | | 4 | | | | | | <: TIQ: <: RIQ: | OFF | | |
| CRC: | | Bau | dRate(BRATE) : | 03 - 9600bps | ~ | | Parity(PAR) : | 00 - None | ~ | | <: SEQ: <: IP: | OFF | | |
| IQ Inverted: | | | | SetBaudrate | | | | | | | <: AES: | ON | | |
| LowDataRate: | | | AES Key(Hex) : | 000000000000000000000000000000000000000 | 0000000000 | 000000 | 0 | | |] | <: ACK: <: LDR: | OFF 0,0 | | |
| LinkCheckPeriod: | | | | Set AES | Cle | ar AES | Clear LCP | Rese | t | | <: LCP: | 20 | | |
| LifeTime: | | | | | | | | | | | <: LFT: <: RXW: | 1800 0 | | |
| SEQ/IP: | the second s | | | | | | | | | | <: FNB: <: TYPE: | 0x84 0x00 | | |
| AES: | | | | | | | | | | | <: MIN: | -50 | | |
| ACK: | _ | | | | | | | | | | <: MAX: >: ATI | 150 | | |
| FNB: | | | | | | | | | | | <: +ATI:2,1 >: ATT | 007 | | |
| TYPE: | 0x00 | | | | | | | | | | <: ER08 | | | |
| Version(ATI): | 2,1007 | | | | | | | | | | | | | |

5. Update config, and when configuration update successfully, close the config tool, and local configuration has been finished.

| SerialPort : COM3 - USB-SERIAL C | H340 (C V Refresh | Baudrate : 9600 v P | arity: 8N1 v 🎤 C | lose | | Config Update Succe |
|----------------------------------|-----------------------|-----------------------------------------|--------------------------------|-------------|------------------|--------------------------------------|
| Device Information | Settings(Blue is Ofte | en,T is TX, R is RX) | | | AT | Interactive message |
| SeadConfig | 🔛 UpdateConfig | 5 | | | | +ATI: 2, 1007 AT+LCP=0014 |
| Modulation: LORA | Modulation : | 01 - LoRa 🗸 🗸 | NetMode : | 00 - Fix ~ | <: | OK |
| NetMode: Node to Node | TFrequency : | 470.3 | Mhz RFrequency : | 500.3 | Mhz <; | AT+CFG? NET: Node to Node |
| TFREQ: 470300kHz | Bandwidth(BW) : | 07 - 125K v | hz TxPower(POW) : | 22 | | TFREQ: 470300kHz RFREQ: 500300kHz |
| RFREQ: 500300kHz Power: 22dBm | TSF : | 7 | RSF : | 12 | | POW: 22dBm BW: 125kHz |
| Bandwidth: 125kHz | CodeRate(CR) : | 01 - 4/5 System Notice | | × 52 | | TSF: 7 RSF: 12 CR: 4/5 |
| SpreadingFactor: 7,12 | Inverted(TIQ) : | | | current Y | K: | MODE: LORA |
| CodeRate: 4/5 | | Congratulatio | ons, your configuration update | successful. | K: 1 K: K: | SYNC: 0x34 PREM: 16,10 |
| SyncWord: 0x34 | LCP : | | | 1800 | <: | FIX: 0,0 |
| Preamble: 16,10 | Backoff(NB) : | | | ок | <: (:) | CRC: ON TIQ: OFF |
| CRC: ON | BaudRate(BRATE) : | 03 - 9600bps ~ | Parity(PAR) : | 00 - None 🗸 | | RIQ: ON SEQ: OFF |
| IQ Inverted: OFFON | | SetBaudrate | | | | IP: ON AES: ON |
| LowDataRate: 0,0 | AES Key(Hex) : | 000000000000000000000000000000000000000 | 0000000 | | 1 Ki | ACK: OFF |
| LinkCheckPeriod: 20 | | | | | | LDR: 0,0 LCP: 20 |
| LifeTime: 1800 | | Set AES Cle | ar AES Clear LCP | Reset | K. | LFT: 1800 |
| SEQ/IP: OFFON | | | | | | RXW: 0 FNB: 0x84 |
| | | | | | Ki Ki | TYPE: 0x00 |
| AES: ON | | | | | <. | MIN: -50 |
| ACK: OFF | | | | | <: >: . | MAX: 150 |
| FNB: 0x84 | | | | | <: | +ATI: 2, 1007 |
| TYPE: 0x00 | | | | | >: . | ATT ER08 |
| Version(ATI): 2,1007 | | | | | N | EROO |

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