SL103 With Three External Probe

FCC ID：2AF6B-SL103

1.General Information

SL103 (LoRa version) is a 3-way DS18B20 temperature sensor that uses LoRa spread spectrum wireless communication, supports standard LoRaWAN wireless protocol, and has built-in global regional specifications (such as CN470, CN479, EU433, EU868, US915, AU915, AS923, IN865, etc.). Users can adapt to various LoRaWAN standards in different regions by simply configuring and selecting different regional specifications when using the LoRaWAN mode.

Sensor Type	Model No.	Document
DS18B20*3	SL103-LF-LED-A0 (CN433/CN479) SL103-HF-LED-A0 (EU868/US915/AU915/AS923/IN865)	

Note
LF: Frequency：433~510 MHz
HF: Frequency：863~928 MHz

1.1.Product features

SL103 supports both LoRa and LoRaWAN, all parameters are open for configuration, easily compatible with all LoRa applications.
There is a USB Type-C (USB-C) interface next to the battery for configuring and firmware updating. By default, 2 replaceable AA batteries are used, which is convenient to use and easy to deploy. It can be used in low-power wide area IoT scenarios such as warehouses, computer rooms, smart buildings, and greenhouses.
or SensorTool for configuration. In addition, the product supports serial port firmware upgrade for easy maintenance and functional expansion.

2. Parameters

Parameters	Feature
CPU	Cortex-M
Wireless	SX1268/SX1262
Encription	AES128
Power	AA*2
Peak current	120 mA
Sleeping current	35 uA
Working temp	-40 ~ 85 ℃ ≤95%RH

Parameters	Feature
Measuring range	-40 ~ 125 ℃
Data speed	300 bps ~ 62.5 kbps
Size	103mm*60mm*27mm
TX power	22dBm Max
RX sensitivity	-140 dBm（BW=125K，SF=12）
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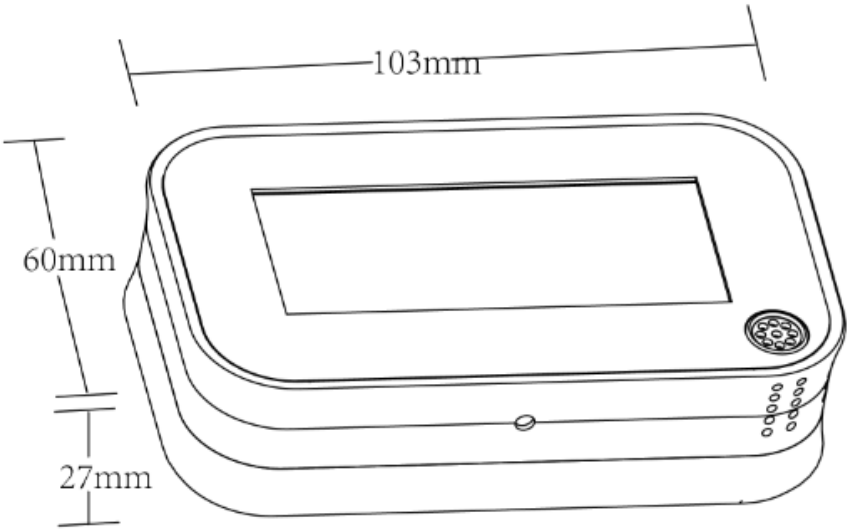
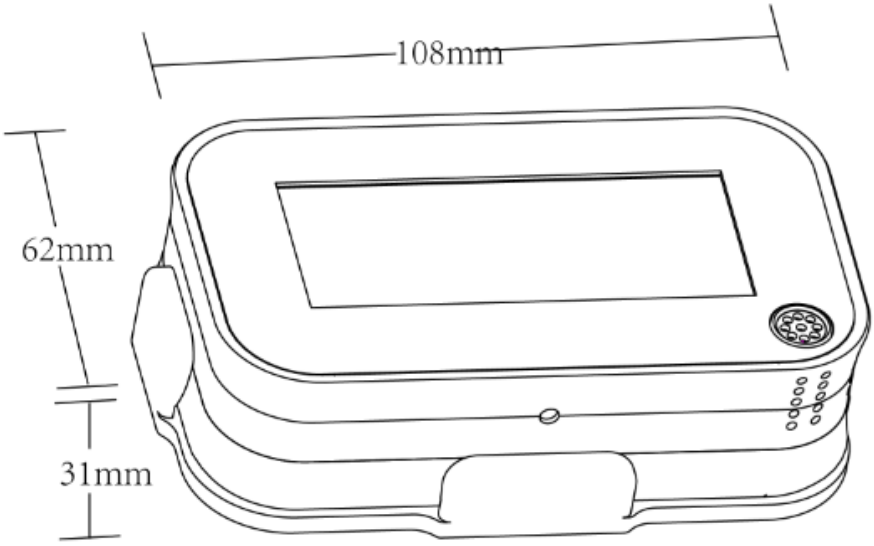
3. Size





4. User instructions

4.1.Applications

The device is used in various scenarios that require low-power wireless transmission. Through the long-distance characteristics of LoRa, it better adapts to various complex environments and provides information support for providing convenient and fast temperature monitoring solutions. The overall architecture of the system is shown below.

4.2.Device detail

4.2.1.Interfaces

1.Indicator

When there is USB-C plug in, indicator is red.

Sensor data indicator, indicator is green when data sending.

2.Turn on/off indicator

The button is on the left side of the device. Automatically turn on the device when powered on. After the system is running, you can use this button to turn off or restart it.

3.Data button on the right

The botton on the right side is for sending data.

4.Battery compartment

The back cover can be opened to replace the battery. The warehouse provides a USB connection port for users to modify more parameters and upgrade firmware.

4.2.2.Turn on/off

Turn on：The factory equipment is turned on by default, and can be pressed and held for 3 seconds to turn off, and indicator will turn off one by one.

Turn off：When the device is turned off, press the button for 3 seconds to turn on the device.

Note: The device will be automatically turned on when powered on again.

4.3.Instructions

The USB port is located in the battery compartment, and the device is equipped with a USB to serial port chip. Users can modify the device’ s parameters through the SensorTool serial port configuration tool on the computer by using a standard USB Type-C data cable. The steps are as follows:

1. Insert the USB-C cable and connect to the computer. Note that the serial port driver needs to be installed in advance, and the serial port to USB chip is CH340.
2. Open the SensorTool, use the default baud rate of 115200, select the COM port corresponding to the device through “Serial Port Selection”, and click “Open Serial Port” to automatically read the device parameters. Wait for the reading to complete before viewing or modifying parameters.
3. The configuration interface is shown below. After modifying the parameters, click the “Update Configuration” button to set the parameters.

4.4. Configuration instruction

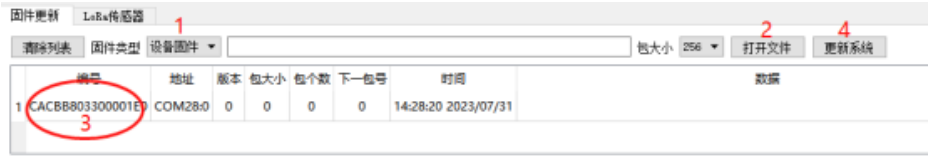
To adapt to different business scenarios, the device supports parameter modification using USB and button modes. For users, the main modification is data Uplink peroid .

4.4.1 Uplink peroid

The unit of this parameter is seconds, and sensor data is collected and reported when the set time expires.
The default data uplink peroi of the system is 600 seconds (i.e. 10 minutes, equivalent to heartbeat transmission). In a constant environment, data is reported every 10 minutes. This parameter can be adjusted according to the actual situation.

4.5.Firmware update

Use the Sensor Tool to upgrade the firmware of the device. Please refer to the Sensor Tool documentation for specific details. The main steps are shown in numerical order: determine the firmware type, select the firmware file (. bin), and then select the device to be updated in the device list. Click the “Update System” button to upgrade the firmware.



5. Wireless data format

5.1.Wireless data format

In order to support various business models and application scenarios, the terminal can be configured as a non LoRaWAN or LoRaWAN mode.

5.1.1.Non LoRaWAN方

Header	DevAddr	FCtrl	SeqNo	Sensor Data1	...	Sensor DataN	CRC
1 byte	4 bytes	1 byte	2 bytes	Data 1	...	Data N	2 bytes
Protocol header	Device address	Control word	Package number	TLV (refer to specific Type)		TLV (refer to specific Type)	CRC16=Header to Sensor DataN (i.e. all bytes before CRC)

5.1.2.LoRaWAN

In order to save transmission bytes, duplicate or redundant data items are not reported in LoRaWAN mode, and only sensor data content is uploaded. As shown below, FRMPayload refers to sensor data in non LoRaWAN mode.

<table>
<tr><td rowspan="3">MHDR</td><td rowspan="3">FHDR</td><td rowspan="3">FPort</td><td colspan="3">FRMPayload（SensorData）</td><td rowspan="3">MIC</td></tr>
<tr><td>Data 1</td><td>...</td><td>Data N</td></tr>
<tr><td>TLV(Refer to specific types of SensorData)</td><td></td><td>TLV(Refer to specific types of SensorData)</td></tr>
</table>

FPort：1
FRMPayload：e.g sensor data(message body)

5.2. Uplink data format

5.2.1.Data type notification

Type	Notification
0x00~0x0F and 0xFF	formats (T+V), basic sensor type, fixed data format, omitting length bytes
0x10~0x1F	Format (T+L+V), universal type, reserved length to meet customized requirements
0x20~0x3F	Format (T+L+V), customized project needs, different projects adapt to different content
0x80~Undefined	Format (T+L+V), user parameter configuration and query, different projects adapt to different content

5.2.2.Basic sensor type list

Type	Value	Value discription
Universal response 0xFF	2 bytes	The first byte corresponds to the downstream instruction (the answered command) The second byte corresponds to the result
Device information 0x00	2 bytes	Device information package content is known, so ignoring the length field saves bytes

5.2.3.Customized type list

Type 1 Byte	Length 1 Byte	Value	Value discription
Multi temp 0x14	N*2	N*2 Byte Content	N sensor temp

5.3. Basic sensor data definition

5.3.1 Device infor（0x00）

Type	Value	Value	Value
1 Byte	3 bit	5bit	1 Byte
0x00	Version	Voltage Level	Reserve

5.4. Details of customized type sensor

5.4.1.Multi temp（0x14）

Adapt N-way temperature according to length, and if N is 1, the basic temperature type 0x04 can be directly used.
If N>1 channel temperature needs to be transmitted, merge similar data items in the following order.

Type	Length	Value	Value	Value
1 Byte	1 Byte	int16_t	...	int16_t
0x14	2*N	No. 1 temp	...	No. 2 temp

For example, if there are three temperature measuring probes, the type N mentioned above is 3, and the single temperature length (int16_t) is 2 bytes.

5.4.Query Configuration Type

Read user parameters in related projects, such as peroid, calibration values, variable settings, etc.
Values are listed in order, using Length for adaptive wireless query configuration. If Length is 4, it means that only the reporting and testing cycles are included later. If Length is 8, it means it includes reporting and testing cycles as well as calibration values.
Read user parameters in related projects, such as peroid, calibration value, and change setting.
Type	Length	Value	Value	Value	Value	Value	Value
:———:	:———:	:———:	:———:	:———:	:———:	:———:	:———:
1 Byte	1 Byte	uint16_t	uint16_t	int32_t	uint8_t	uint8_t	uint8_t
0x81	Value lenght	Uplink peroid	Check peroid	Calibration	Chnage 1	Change 2	Change 3

5.5. Sensor upload example

The device defaults to running in non LoRaWAN mode, including the complete content of prefix parts such as protocol header, device address, and CRC suffix parts. As shown below, the sensor data section mainly includes device information (0x00) and multi-channel temperature (0x14).
In LoRaWAN mode, the data only has FRMPayload, which is the sensor data section. Report content of types 0x00 and 0x14 by default.

5.6.Sensor downlink data format

The downlink is sent to the gateway by external or platform, and is executed through the gateway. The format of the data message sent to the terminal as a whole is consistent with the data format reported by the terminal.

5.6.1. Sensor downlink type list

Type 1 Byte	Value	Value discription
Read 0x01	1 Byte	Distinguish different requests based on Value content If Value==0x81, read user configuration data
Write 0x02	(1+N) Byte	The first byte is used to determine the type of content

Type 1 Byte	Value	Value discription
		written. 0x00+YYMMDDhhmmss

Currently, the downlink content of the device is only applicable in LoRaWAN mode. The supported instructions include reading user configuration parameters, change peroids, and variables.

5.6.2. Detailed format of read instructions

Type 1 Byte	Value	Value discription
0x01	0x81 Read user configuration	Read peroid and related calibration settings, please refer to the uplink for return information

5.6.3. Write instruction detailed format

Type 1 Byte	Value 1 Byte	Value N Byte	Notification
0x02	0x11 Uplink peroid	uint16_t	e.g LFT，unit is second

5.6.Message tail（CRC16）

The CRC verification algorithm used by the device is as follows.

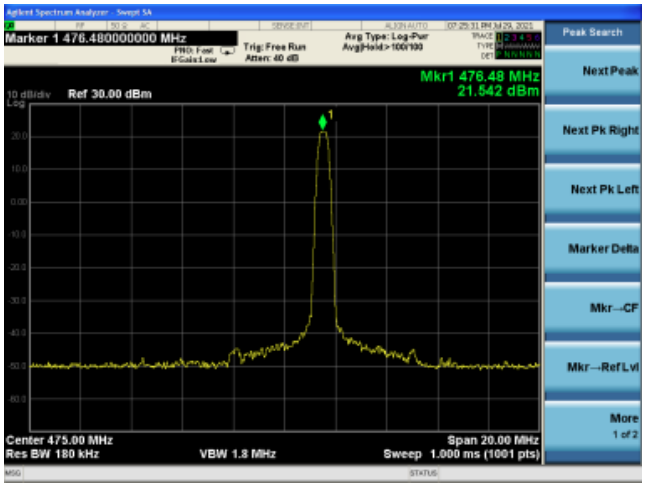
```
static uint16_t get_crc16(uint16_t inData, uint16_t outData) {
  outData = (outData >> 8) | (outData << 8);
  outData ^= inData;
  outData ^= (outData & 0xff) >> 4;
  outData ^= outData << 12;
  outData ^= (outData & 0xff) << 5;
  return outData;
}

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;
}
```

6.Feature test

6.1.Sensitivity test

SF	Sensitivity dBm, @BW=125K, 470MHz
SF=7	-126
SF=8	-129
SF=9	-131
SF=10	-134
SF=11	-136
SF=12	-139

6.2.TX power test



7. Document version

Edit date	version	notification
2023.08	V1.0	First version
2023.10	V1.1	modify 4.2.1 and 4.2.2 indicator discription

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC statements:
This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
NOTE: The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications or changes to this equipment. Such modifications or changes could void the user’ s authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Federal Communication Commission (FCC) Radiation Exposure Statement
When using the product, maintain a distance of 20cm from the body to ensure compliance with RF exposure requirements.