



# eLR100-UL-00

Powered by MS500

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# 1. INTRODUCTION

The eLR100-UL-00 is a compact, low power, bidirectional radio module. The module provides ultra-long range spread spectrum communication and high interference immunity while minimizing current consumption.

This eLR100-UL-00 is a highly-integrated, low power, bi-directional radio transceiver module enhanced for use in the 868 MHz ISM frequency bands

## 1.1. FEATURES

- eWBM ultra-low power advanced security MCU MS500
  - Cortex M0
  - Hardware Security system.
  - UART, SPI and I2C interface
- Semtech SX1276 radio transceiver supporting LoRa.
  - LORAWAN CERTIFIED Product (EU)
  - High sensitivity down to -135.5 dBm
  - Supported Frequencies:  
867 Mhz ~ 868.6MHz (CE certification)
  - Modulation: LoRa™, FSK
    - LoRa Modulation
      - ◆ Bandwidth: 125KHz (OCW150KHz), 250KHz (OCW300KHz)
      - ◆ Spread Factor (SF): 7 ~ 12
        - 125KHz: SF7~12
        - 250KHz: SF7
  - Maximum Output Power 13.97dBm(25mW)
  - RF Interface optimized to 50 Ω
- AT+Command Interface over UART
- Dimension and Supply voltage
  - Compact module 15.3 x 22.15 x 2.5mm
  - Supply voltage DC3.3V (3.0 to 3.6V)

"This device can be operated in at least one Member State without infringing applicable requirements on the use of radio spectrum."

## 1.2. APPLICATION

- Automated Meter Reading.
- Home-, Building- and Industrial Automation.
- Industrial Monitoring and Control.
- Wireless Sensors.
- Wireless Alarm and Security Systems.

## 1.3. BLOCK DIAGRAM

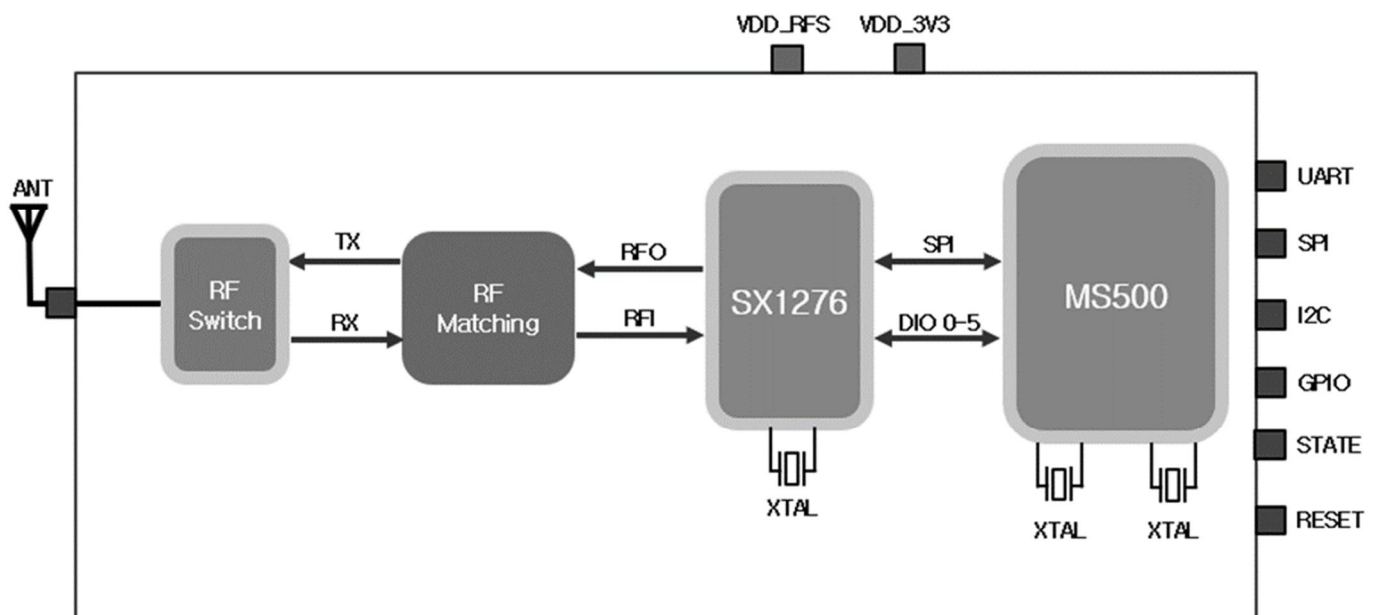


Figure 1. eLR100-UL-00 Block Diagram

## 2. TECHNICAL SPECIFICATION

### 2.1. ABSOLUTE MAXIMUM RATING

Table 1. Absolute Maximum Rating

Parameter		Min.	Max	Unit
Storage Temperature		-30	85	°C
Supply Voltage	VDD_RFS	3.0	3.6	V
	VDD_3V3	3.0	3.6	V
RF Input Power			10	dBm

### 2.2. RECOMMENDED OPERATION RATING

#### 2.2.1. Temperature, Supply Voltage

Table 2. Recommended Operating Rating

Parameter		Min.	Typ.	Max	Unit
Operating Temperature		-30	-	65	°C
Supply Voltage	VDD_RFS	3.0	-	3.6	V
	VDD_3V3	3.0	-	3.6	

#### 2.2.2. Current Consumption

Table 3. Current Consumption

Mode	Description	Total Typ. Current at 3.3V
Tx Mode	RFOP Setting = 0dBm	29.5mA
	RFOP Setting = 7dBm	41.7mA
	RFOP Setting = 10dBm	44.9mA
Rx Mode	SF7, BW 125KHz	17.6mA
	SF7, BW 250KHz	18.3mA
Sleep Mode		5.6uA

\* Note: The results shown in Table 3 may vary depending on Firmware Version

### 2.2.3. RF Specifications

**Table 4. Transmitter Specification**

Parameter	Condition	Min	Typ	Max	Unit
Frequency Range		867		868.6	MHz
TX Power Range		-3.5		13.97 (25mW)	dBm
Modulation Techniques			LoRa™, FSK		
Tx Frequency Tolerance	25 °C	-20		20	kHz

**Table 5. Receiver Specification**

Description	Conditions	Min	Typ	Max	Unit
125 kHz bandwidth (OCW 150KHz)	SF = 7		-122.5		dBm
	SF = 8		-125.5		
	SF = 9		-128.5		
	SF = 10		-131.5		
	SF = 11		-133.5		
	SF = 12		-135.5		
250 kHz bandwidth (OCW 300KHz)	SF = 7		-118.5		

### 3. PIN DESCRIPTION

#### 3.1. PIN MAP

##### 3.1.1. Pin Description (Bottom View)

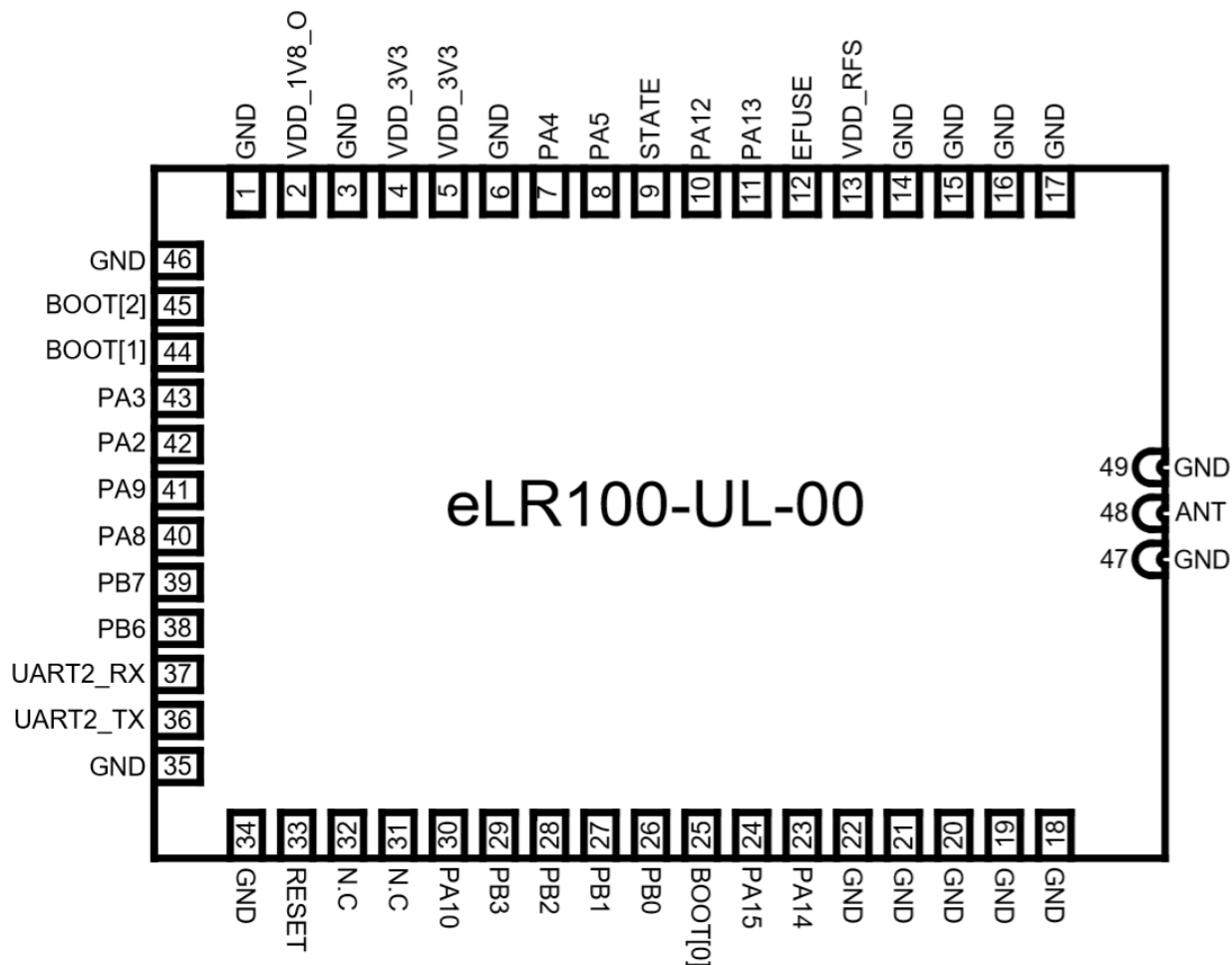


Figure 2. Pin Assignment



## 3.1.2. Pin Description

Table 6. Pin Description #1

PIN	NAME	TYPE	DESCRIPTION
1	GND	POWER	Ground
2	VDD_1V8_O	POWER OUT	N.C (1.8V OUT)
3	GND	POWER	Ground
4	VDD_3V3	POWER IN	3.3V Supply Voltage
5	VDD_3V3	POWER IN	3.3V Supply Voltage
6	GND	POWER	Ground
7	PA4	Digital IN/OUT	GPIO / I2C2_SCL
8	PA5	Digital IN/OUT	GPIO / I2C2_SDA
9	STATE	Digital OUT	Sleep State: Low, Normal State: High
10	PA12	Digital IN/OUT	GPIO / SSP2_SCK
11	PA13	Digital IN/OUT	GPIO / SSP2_SSN
12	EFUSE	POWER IN	N.C (2.5V IN)
13	VDD_RFS	POWER IN	3.3V Supply Voltage for SX1276
14	GND	POWER	Ground
15	GND	POWER	Ground
16	GND	POWER	Ground
17	GND	POWER	Ground
18	GND	POWER	Ground
19	GND	POWER	Ground
20	GND	POWER	Ground
21	GND	POWER	Ground
22	GND	POWER	Ground
23	PA14	Digital IN/OUT	GPIO / SSP2_MISO
24	PA15	Digital IN/OUT	GPIO / SSP2_MOSI
25	BOOT[0]	Digital IN	N.C
26	PB0	Digital IN/OUT	GPIO / SSP1_SCK / I2C4_SCL
27	PB1	Digital IN/OUT	GPIO / SSP1_SSN / I2C4_SDA
28	PB2	Digital IN/OUT	GPIO / SSP1_MISO / I2C1_SCL
29	PB3	Digital IN/OUT	GPIO / SSP1_MOSI / I2C1_SDA
30	PA10	Digital IN/OUT	GPIO
31	N.C	-	N.C
32	N.C	-	N.C
33	RESET	Digital IN	MS500 Reset (Need 1.8V IO Level input)
34	GND	POWER	Ground

Table 7. Pin Description #2

PIN	NAME	TYPE	DESCRIPTION
35	GND	POWER	Ground
36	UART2_TX	Digital OUT	UART2 TX MS500 FW Update / Debug / AT+command
37	UART2_RX	Digital IN	UART2 RX MS500 FW Update / Debug / AT+command
38	PB6	Digital IN/OUT	GPIO / UART3_TX / I2C2_SCL
39	PB7	Digital IN/OUT	GPIO / UART3_RX / I2C2_SDA
40	PA8	Digital IN/OUT	GPIO / UART1_TX
41	PA9	Digital IN/OUT	GPIO / UART1_RX
42	PA2	Digital IN/OUT	GPIO / I2C3_SCL
43	PA3	Digital IN/OUT	GPIO / I2C3_SDA
44	BOOT[1]	Digital IN	N.C
45	BOOT[2]	Digital IN	N.C
46	GND	POWER	Ground
47	GND	POWER	Ground
48	ANT	RF IN/OUT	External 50ohm port for Antenna connection
49	GND	POWER	Ground

### 3.1.3. Pin Mux Information

The eLR100-UL-00 module supports the I/O interfaces such as GPIO, SPI, UART, and I2C.

**Table 8. Pin Mux Table**

PIN	PIN NAME	SPI	UART	I2C
7	PA4			I2C2_SCL
8	PA5			I2C2_SDA
26	PB0	SSP1_SCK		I2C4_SCL
27	PB1	SSP1_SSN		I2C4_SDA
28	PB2	SSP1_MISO		I2C1_SCL
29	PB3	SSP1_MOSI		I2C1_SDA
36	UART2_TX		UART2_TX	
37	UART2_RX		UART2_RX	
38	PB6		UART3_TX	I2C2_SCL
39	PB7		UART3_RX	I2C2_SDA
40	PA8		UART1_TX	
41	PA9		UART1_RX	
42	PA2			I2C3_SCL
43	PA3			I2C3_SDA

Note: The UART2 port is used for firmware update, debug message display, and AT+Command channel.

## 4. HARDWARE CONNECTION

### 4.1. RESET PIN (PIN 33)

The reset pin of eLR100-UL-00 module is active low. Unlike other pins (e.g. GPIO), the reset pin works at 1.8V of voltage level due to the 1.8V pull up resistor inside the module. If the reset pin needs to be operated at 3.3V, there are two ways to do it.

#### 4.1.1. Method of using GPIO input mode setting of MCU:

[1] Set a GPIO to Input mode. The voltage level of the reset pin becomes 1.8V due to the pull up resistor in the module.

[2] Switch the GPIO to Output mode, and then drive it to LOW (0) value for at least 1 ms.

[3] Switch the GPIO back to Input mode to control the reset pin.

- GPIO Mode Setting Sequence: INPUT --> OUTPUT LOW --> INPUT

- *Example Code (for Arduino DUE)*

```
pinMode(8,INPUT);
pinMode(8,OUTPUT);
digitalWrite(8,LOW);
delay(1);
pinMode(8,INPUT);
```

#### 4.1.2. Method of adding Circuit:

Add an external P-MOSFET circuitry to control Reset as shown in Figure 3. (Active Low)

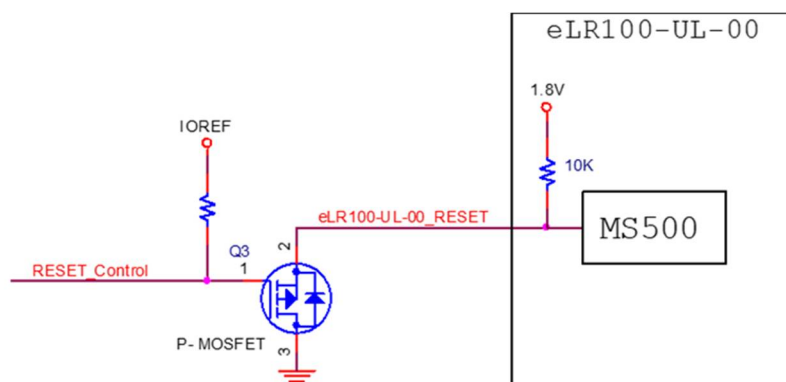


Figure 3. External P-MOSFET Circuitry

## 4.2. BOOT [2:0] (PIN 45, 44, 25)

The Boot Mode for MS500 can be set by using BOOT[2:0]. There are Default Mode (Low, Low, Low) and Firmware Update Mode (Low, High, Low). The Firmware Update mode can be set by setting BOOT[1] to High as shown in Table 9. Once the Firmware update is completed, switch back to the Default Mode for normal operation. Note that the BOOT[2:0] pins are connected to pull-down resistors.

**Table 9. Boot Mode**

Boot Mode	PIN Setting			Description
	BOOT[2]	BOOT[1]	BOOT[0]	
Default Mode (ROM BOOT)	Low	Low	Low	- Default Mode
Firmware Update Mode (UART to Flash Boot)	Low	High	Low	- To update Firmware

### 4.3. STATE (PIN 9)

The Pin 9 is used to check the status of eLR100-UL-00 module.

- Normal Mode: HIGH
- Sleep Mode: LOW

### 4.4. UART2

The UART2 port supports AT+Command, Firmware Update, and Debugging functions.

#### 4.4.1. UART2 (PIN 36, 37): AT+Command, Debug, FW Update

Table 10. UART2

PIN	PIN NAME	PIN TYPE	DESCRIPTION
36	UART2_TX	Digital OUT	UART2_TX MS500 FW Update / Debug / AT+Command
37	UART2_RX	Digital IN	UART2_RX MS500 FW Update / Debug / AT+Command

- UART settings for Debug Mode / AT+Command Mode

Baudrate: 115200

Data: 8 bit

Parity: None

Stop: 1 bit

Flow Control : none

- FW Update Setting
  - Refer to FW Update

## 5. REFERENCE CIRCUIT

### 5.1. APPLICATION CIRCUIT

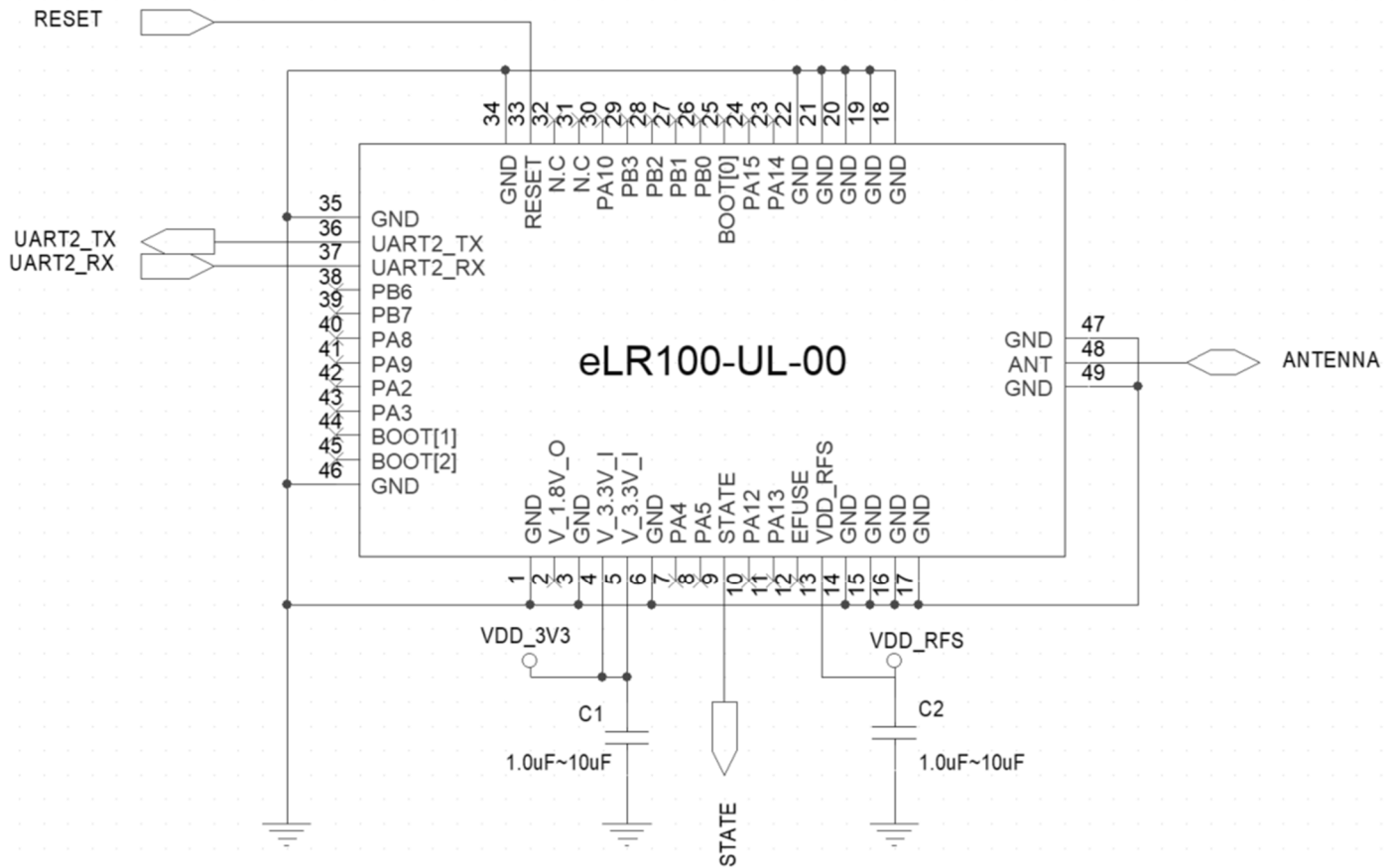


Figure 4. Application Circuit

## 6. MECHANICAL DIMENSIONS

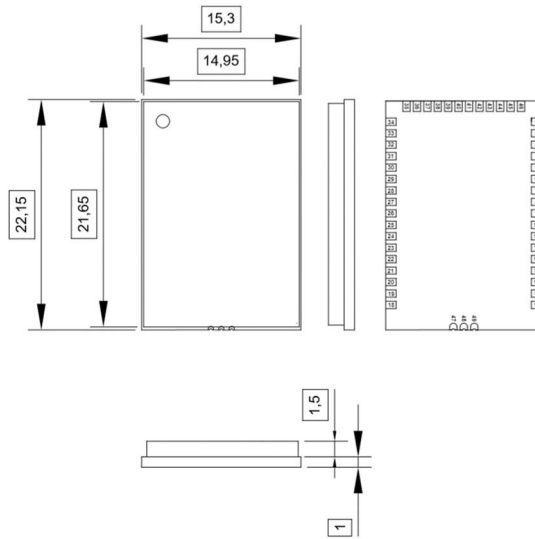


Figure 5. Dimensions

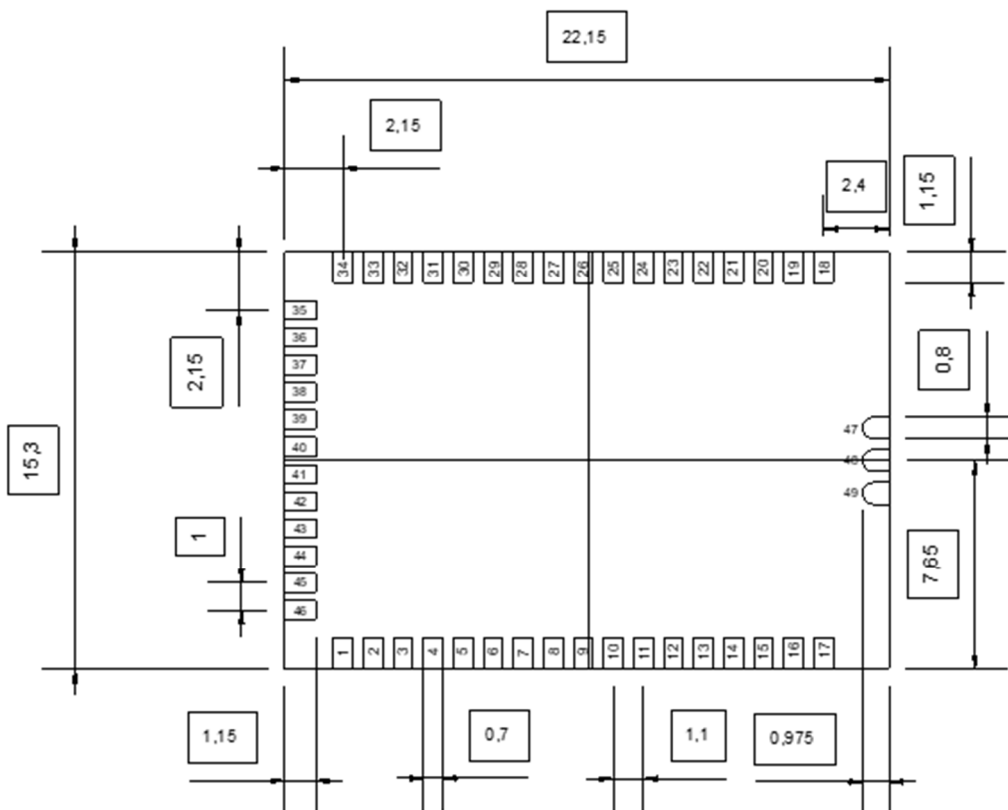


Figure 6. MECHANICAL DIMENSIONS (top view)



### 6.1. SOLDERING FOOTPRINT

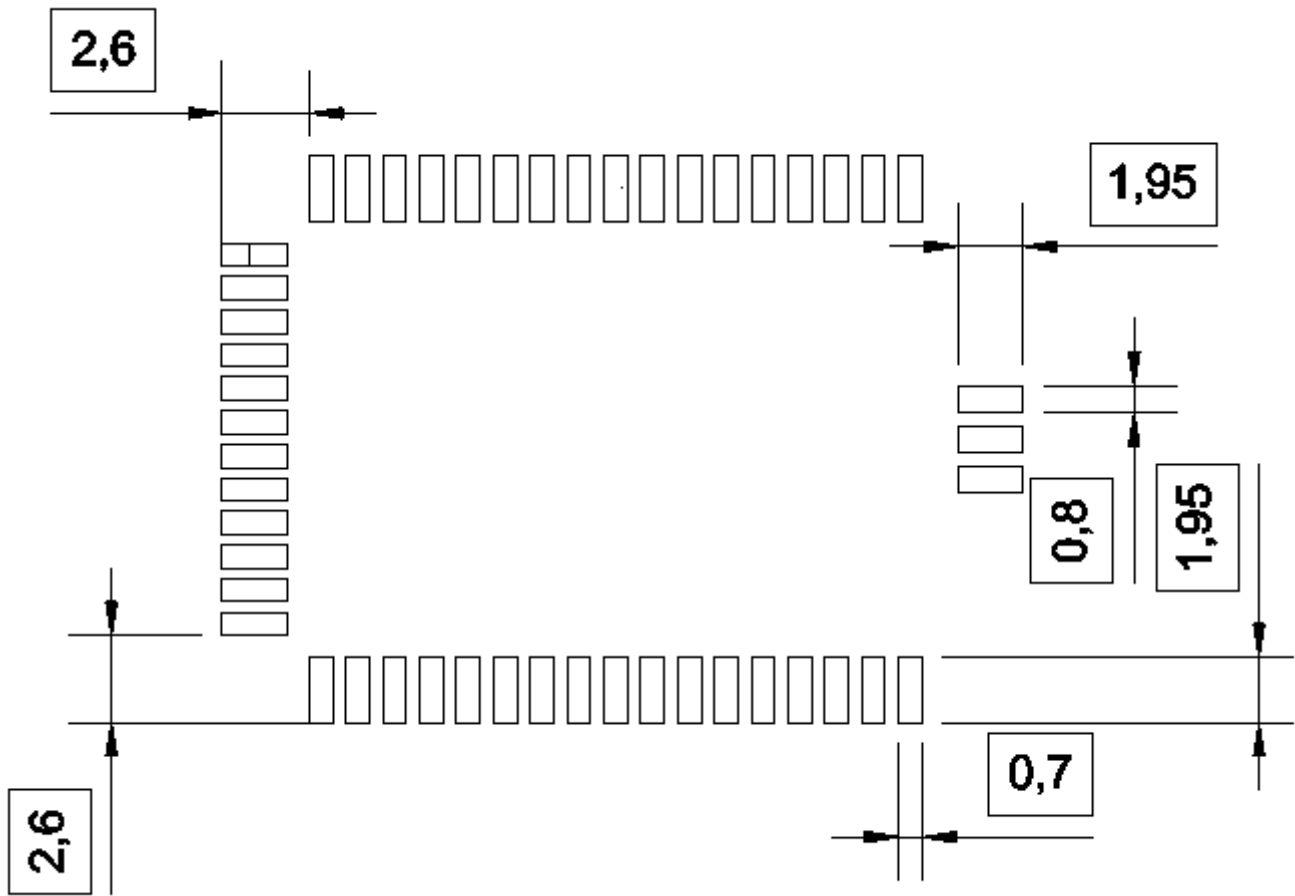
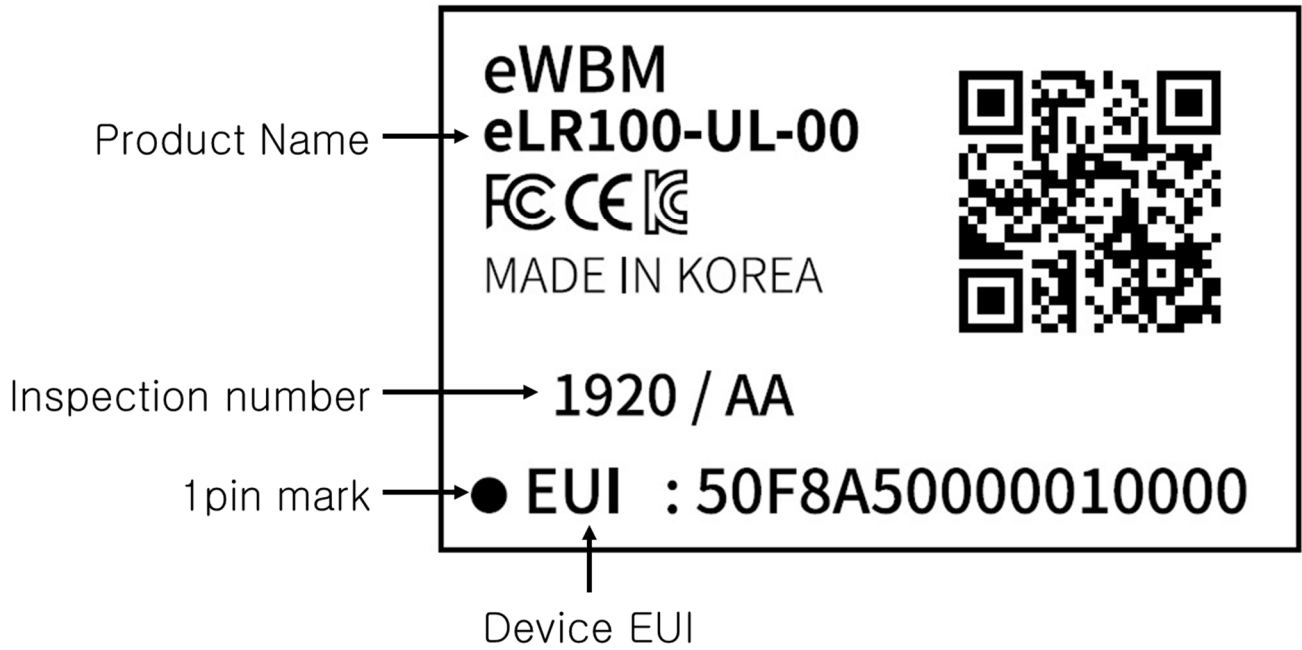
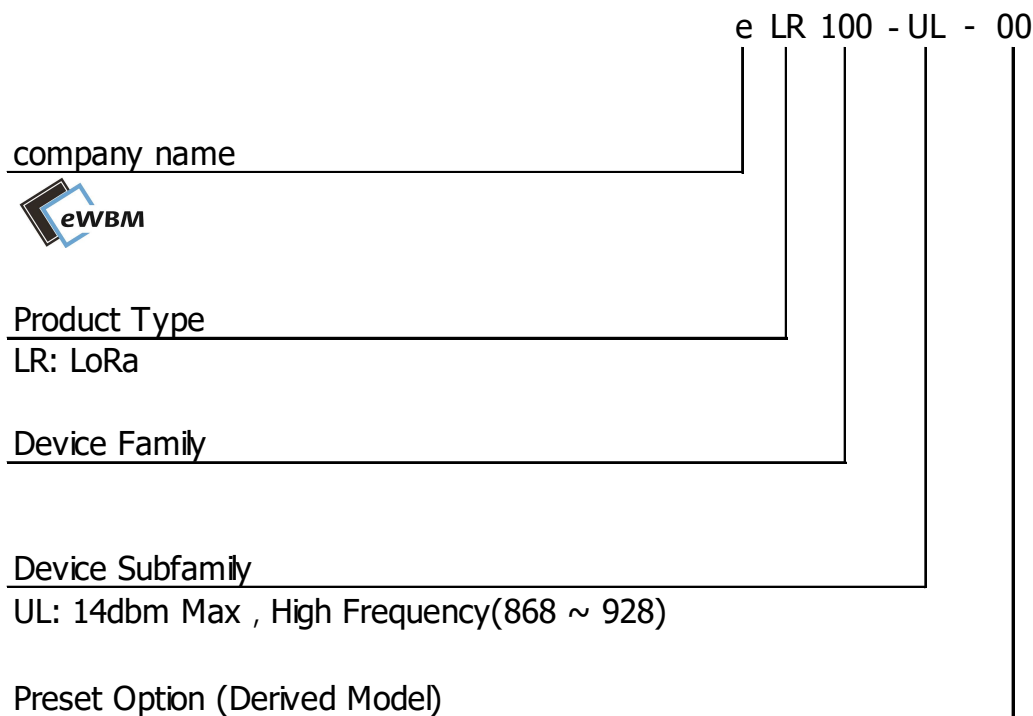


Figure 8. Soldering Footprint (Top View)

## 7. LABEL



## 8. ORDERING INFORMATION



00: Default model

01: Preset for eWBM (Secure Boot Enable)

2n: Preset for Customer (Secure Boot Disable)

2n+1: Preset for Customer (Secure Boot Enable)

Range: 00~99

\* Please contact eWBM for presetting.

## 9. PACKING -TBD



# 10. REFLOW PROFILE

Referred to IPC/JEDEC standard.  
 Peak Temperature : <250°C  
 Number of Times : ≤2 times

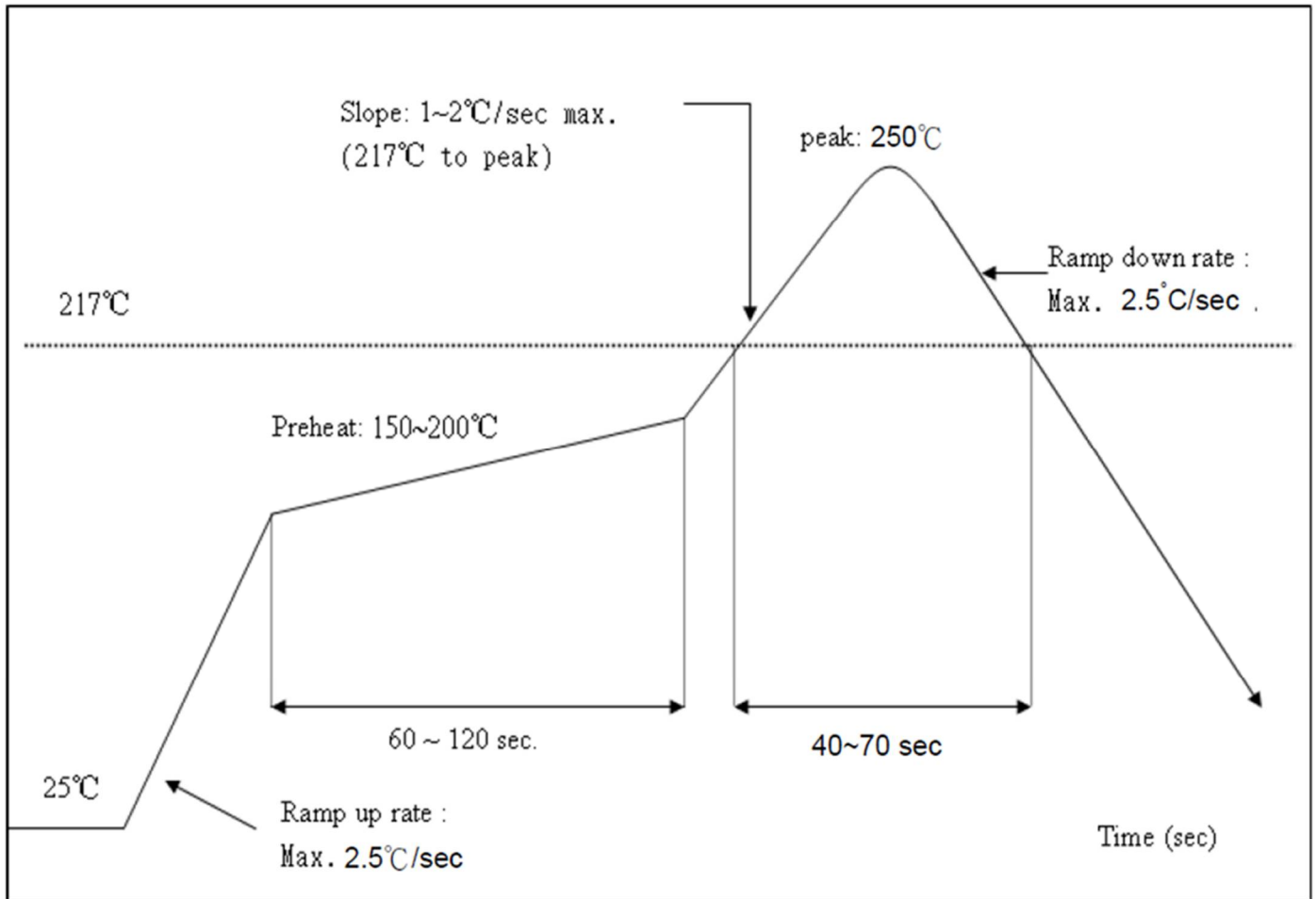


Figure 7. Reflow profile

# DOCUMENT REVISION AND REFERENCE

## Revision History

Revision	Date	Description
0.1	2019-02-13	1 <sup>st</sup> Release
0.2	2019-05-20	Updates in foot print info
0.3	2019-05-22	Updates Current Consumption info

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