



eLR100-UL-00

Powered by MS500

CONTETNS

Contetns	2
1. Introduction	3
1.1. Features	4
1.2. Application	5
1.3. Block Diagram.....	5
2. Technical Specification.....	6
2.1. Absolute Maximum Rating.....	6
2.2. Recommended Operating Rating	6
3. Pin Description	8
3.1. Pin Map.....	8
4. Hardware Connection	8
4.1. Reset	12
4.2. Boot [2:0] (PIN 45, 44, 25).....	13
4.3. State (Pin 9).....	14
4.4. UART	14
5. Reference Circuit.....	15
5.1. Application Circuit	15
5.2. Mechanical Dimensions	16
5.3. Soldering Footprint.....	16
5.4. Reflow Profile	22
Document Revision and Reference.....	22

1. INTRODUCTION

eLR100-UL-00 은 LoRa™ 변조 기술을 사용하는 소형, 저전력, 양방향 라디오 모듈입니다.

특히 보안 MCU MS500 을 이용하여 보안기능이 강화 되어있습니다.

“이 기기는 사용 중 전파혼신 가능성이 있으며, 타 기기로부터 유해한 혼신을 받을 수 있음”

적합성 평가표시	
제품명	eWBM LoRa Module
모델명	eLR100-UL
기자재 명칭	RFID/USN 용 무선기기(917 MHz~923.5MHz 대역 사용 USN 기기)
제조년월	2019 년 6 월
제조사(상호)	(주)이더블유비엠
제조국	한국
인증번호	

1.1. FEATURES

- 860-930MHz LPWA Module
- Chipset: SX1276(Semtech) + MS500(eWBM)
- eWBM 저전력 향상된 보안 MCU MS500
 - Cortex M0
 - Hardware 보안시스템
 - UART, SPI and I2C interface
- LoRa 를 지원하는 Semtech SX1276 radio transceiver Chip 사용
 - sensitivity down to -135.5 dBm
 - Supported Frequencies:
922.1MHz ~ 923.3MHz (KC certification),
865 Mhz ~ 868.6MHz (CE certification),
 - 변조방식(Modulation): LoRa™, FSK
 - LoRa Modulation
 - Bandwidth: 125KHz, 250KHz, 500KHz
 - Spread Factor: 7 ~ 12
 - Maximum Output Power +14dBm (EIRP)
 - 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)

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

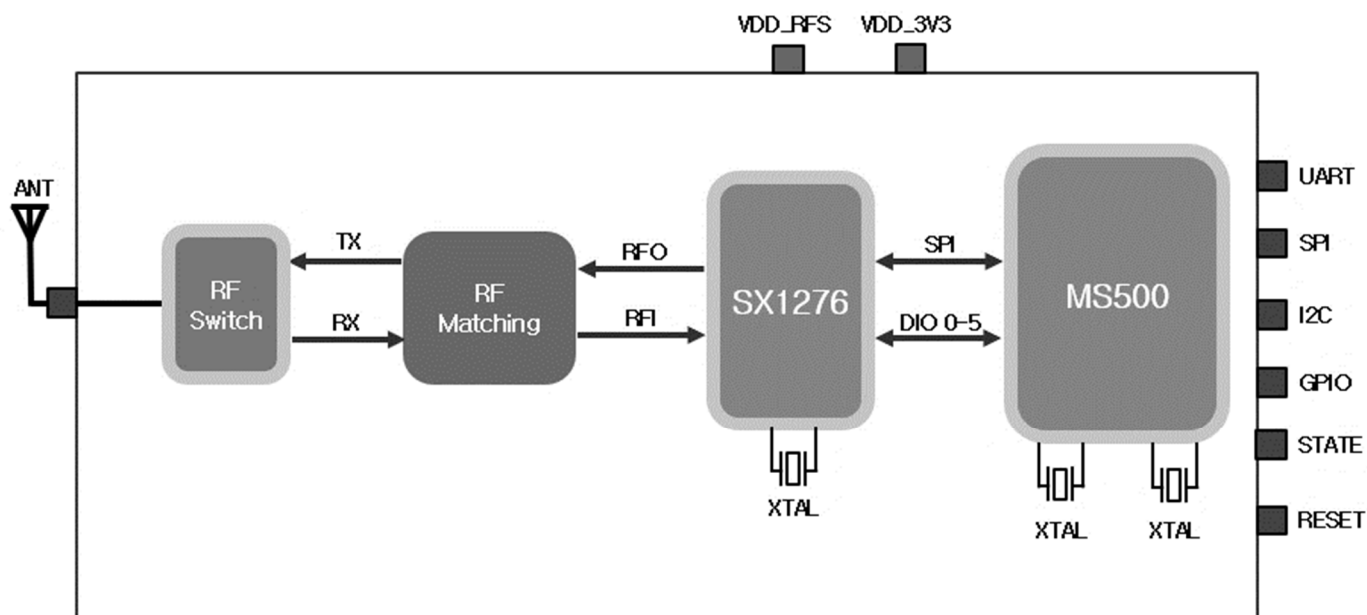


Figure 1. eLR100-UL-00 Block Diagram

2. TECHNICAL SPECIFICATION

2.1. ABSOLUTE MAXIMUM RATING

Table 1. Absolute Maximum Rating

Parameter		Min.	Max	Unit
Storage Temperature		-40	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 OPERATING RATING

2.2.1. Temperature, Supply Voltage

Table 2. Recommended Operating Rating

Parameter		Min.	Typ.	Max	Unit
Operating Temperature		-30	-	65	°C
RF Test Temperature (KC)		-20		50	°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
	RFOP Setting = 14dBm	46.0mA
Rx Mode	SF7, BW 125KHz	17.6mA
	SF7, BW 250KHz	18.3mA
Sleep Mode		5.6uA

* Note) The outcome of the results shown above depends on Firmware Version

2.2.3. RF Specifications

Table 4. Transmitter Specification

Parameter	Condition	Min	Typ	Max	Unit
Frequency Range		868		928	MHz
TX Power Range		-3.5		14	dBm
Modulation Techniques		LoRa™, FSK			
Tx Frequency Tolerance	25 °C	-20		20	kHz
LBT 송신전 수신시간 (KC Certification)		5			ms

Table 5. Receiver Specification

Description	Conditions	Min	Typ	Max	Unit
125 kHz bandwidth (KC, CE Certification)	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 (CE Certification)	SF = 7		-118.5		
	SF = 8		-121.5		
	SF = 9		-127		
	SF = 10		-130		
	SF = 11		-133		
	SF = 12		-136		

3. PIN DESCRIPTION

3.1. PIN MAP

3.1.1. Pin Description (Bottom View)

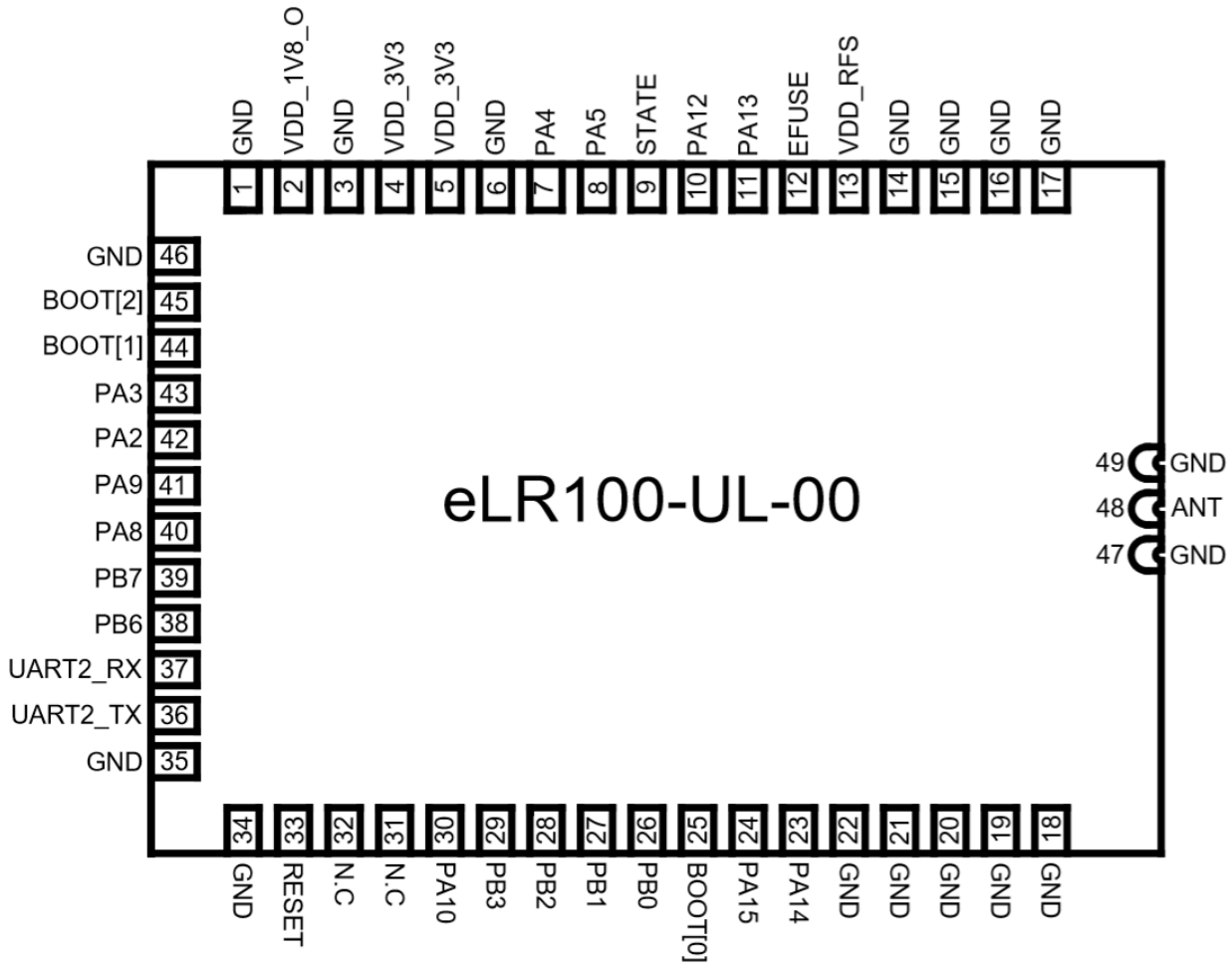


Figure 2. Pin Assignment

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

- eLR100-UL-00 은 GPIO, SPI, UART, I2C 인터페이스를 지원한다.

Table 8. Pin Muxing 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		I2C_SCL
29	PB3	SSP1_MOSI		I2C_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 : UART2 는 펌웨어 업데이트 & 디버그 메시지 및 AT+Command 용도로 사용한다.

4. HARDWARE CONNECTION

4.1. RESET PIN (PIN 33)

- eLR100-UL-00 모듈의 Reset 신호는 Low Active 로 제어됩니다.
- 모듈의 GPIO 는 3.3V 레벨로 Toggle 하도록 되어 있고, Reset 신호는 1.8V 레벨로 Toggle 이 되도록 제어해야 합니다.
- 3.3V 레벨로 Toggle 하는 MCU 를 사용하려면 아래에 명시한 두 가지 방법으로 사용할 수 있습니다.

4.1.1. MCU 의 GPIO 입력모드 셋팅을 이용하는 방법

- 모듈 내부에 1.8V Pull-Up 저항이 있으므로 전원이 투입되면 모듈의 Reset 신호는 기본적으로 High 상태로 유지됩니다.
- 모듈에 연결된 MCU 의 3.3V GPIO 를 사용하여 모듈의 Reset 신호를 제어하고자 하는 경우,
 - 1) MCU 의 GPIO 셋팅을 Input 모드로 셋팅 하면 모듈 내부의 1.8V Pull-Up 저항에 의해 모듈의 Reset 핀에는 HIGH 가 입력됩니다.

[2] MCU 의 GPIO 를 Output 모드로 변경한 뒤 GPIO 출력 값을 LOW(0)로 변경하면 모듈의 Reset 핀에는 LOW(0)가 입력(Reset 상태)되게 됩니다. 이때 LOW(0)상태는 1ms 이상 유지되어야 합니다.

[3] 다시 MCU 의 GPIO 를 Input 모드로 변경하면 모듈은 내부의 1.8V Pull-Up 저항에 의해 HIGH 상태로 되어, Reset 상태에서 풀려나 정상 동작을 하게 됩니다.

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

- Example Code (Arduino DUE)

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

4.1.2. 외부의 TR 회로를 통한 Reset 제어

외부에 P-Channel MOSFET 회로를 추가하여, GPIO 로 Reset 을 제어할 수 있습니다. (Active Low)

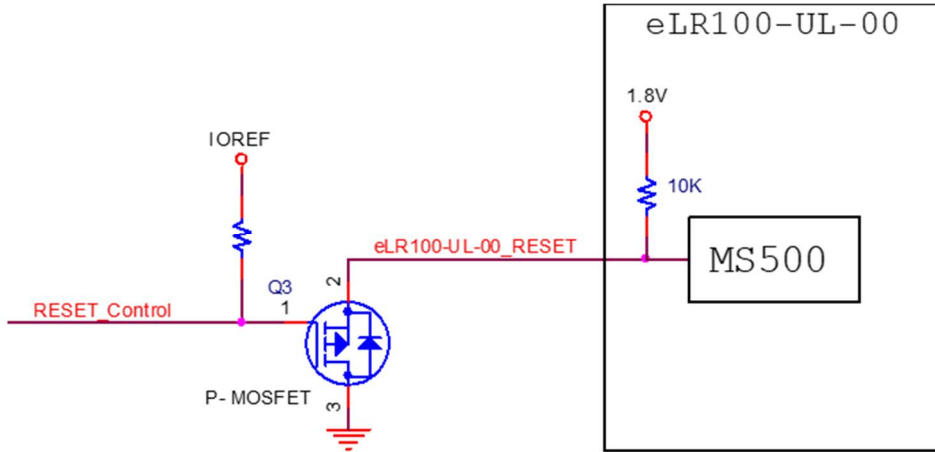


Figure 3. Control by External P-Channel MOSFET Circuit

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

Boot[2:0]을 이용해서 MS500 의 Boot Mode 를 설정합니다.

ROM Boot 가 기본이며, Firmware 를 업데이트 하고자 하는 경우 이 Boot Mode Input 핀을 사용하여 진행할 수 있습니다.

eLR100-US-00 의 Boot[2:0] 핀에는 Pull-Down 저항들이 연결되어 있습니다.

Table 9. Boot Mode

Boot Mode	PIN Setting			Description
	BOOT[2]	BOOT[1]	BOOT[0]	
Default Mode (ROM BOOT)	Low	Low	Low	- 기본 동작 Mode
Firmware Update Mode (UART to Flash Boot)	Low	High	Low	- Firmware Update 시 사용 - Update 가 끝나면 ROM BOOT 모드로 변경 해야함

4.3. STATE (PIN 9)

LoRa Module(eLR100-UL-00)의 상태를 확인하기 위한 PIN 입니다.

- Normal Mode: HIGH
- Sleep Mode: LOW

4.4. UART

UART2 는 AT+Command 및 펌웨어의 업데이트와 디버깅 용도로 사용됩니다.

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

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

- Debug Mode / AT+Command Mode UART Setting
 - Baudrate: 115200
 - Data: 8 bit
 - Parity: None
 - Stop: 1 bit
 - Flow Control : none
- FW Upload Setting
 - FW Update 참조

5. REFERENCE CIRCUIT

5.1. APPLICATION CIRCUIT

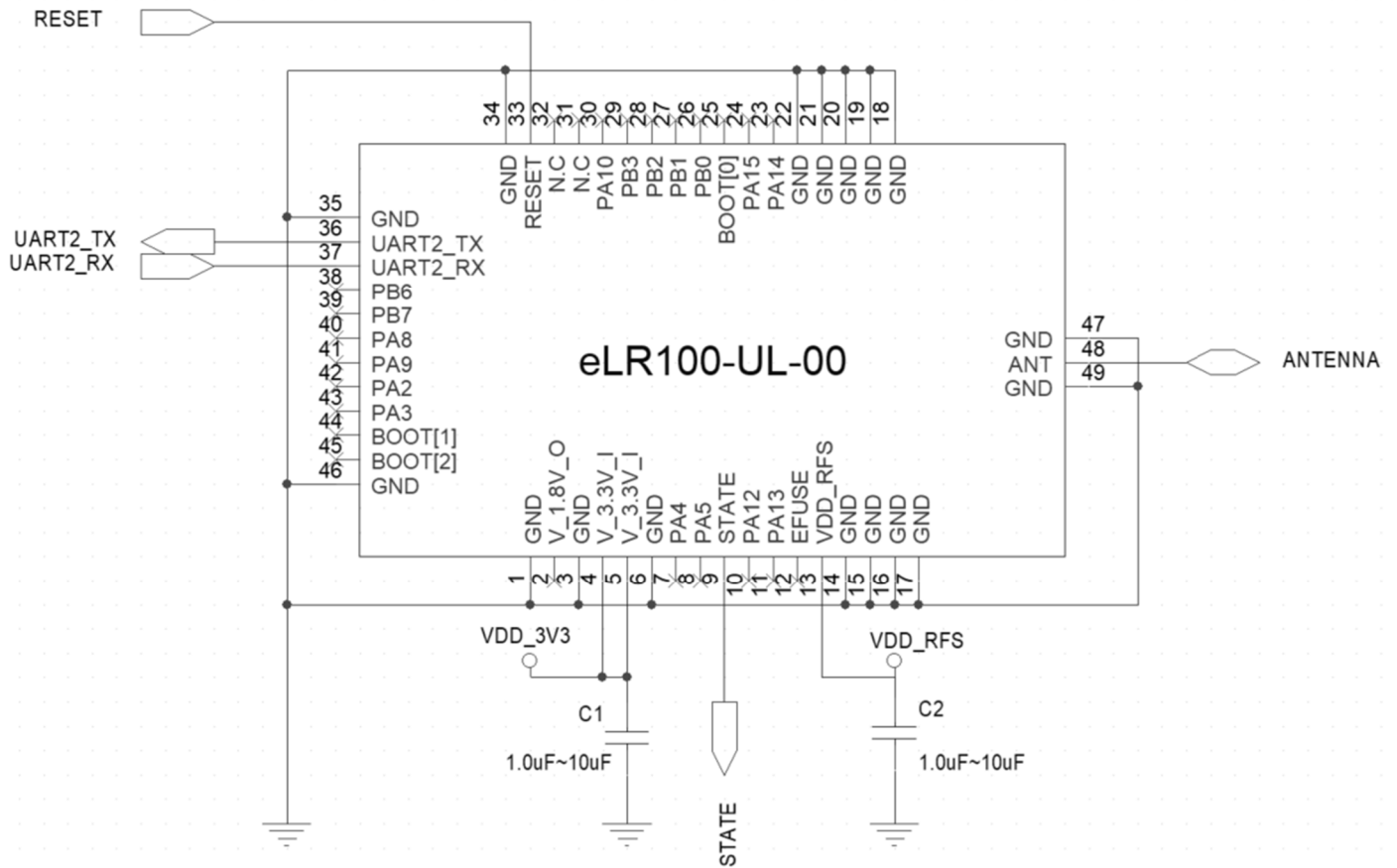


Figure 4. Application Circuit

6. MECHANICAL DIMENSIONS

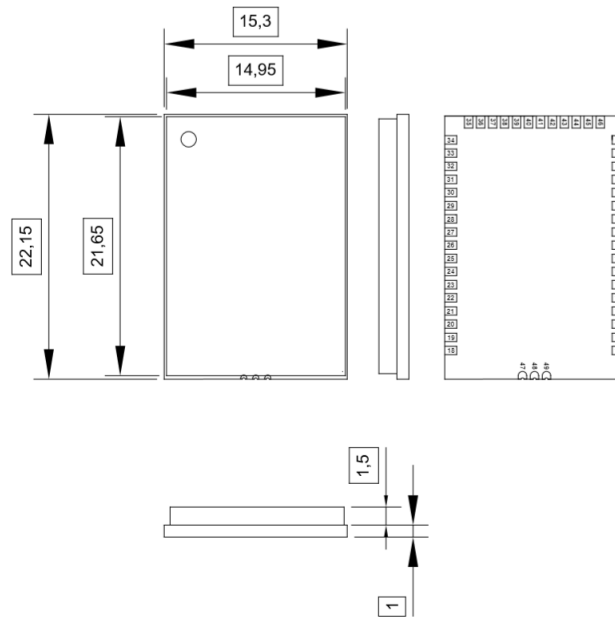


Figure 5. Dimensions

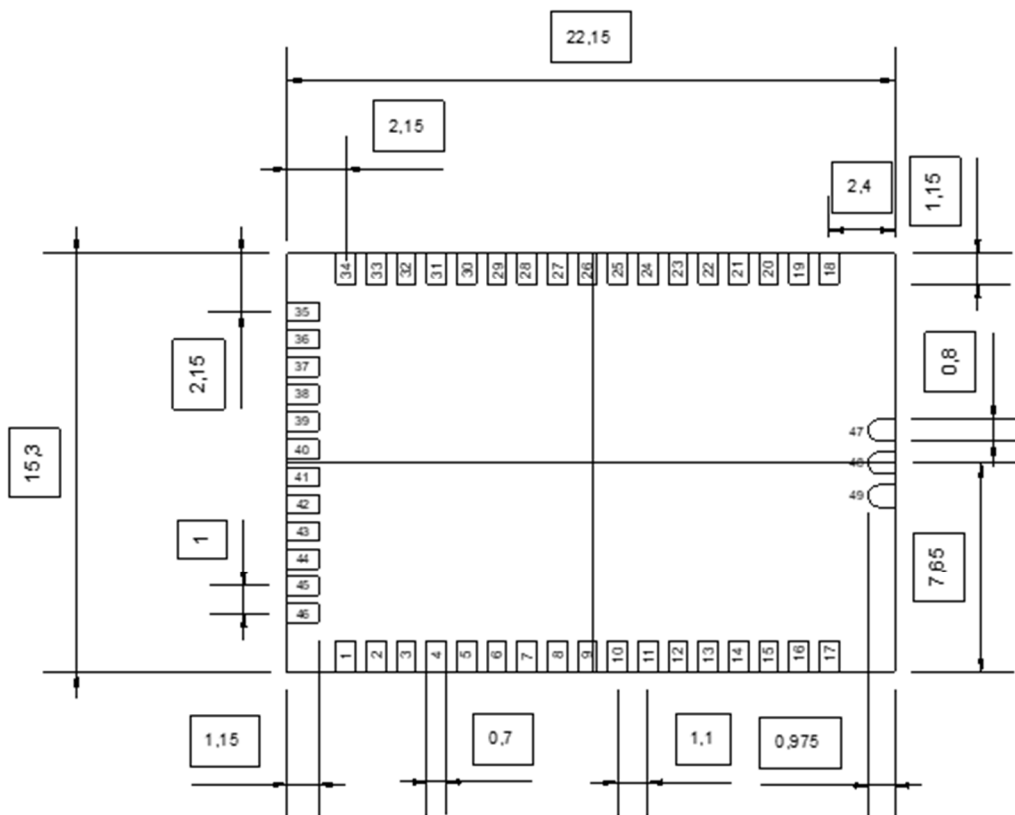


Figure 6. MECHANICAL DIMENSIONS (top view)

6.1.SOLDERING FOOTPRINT

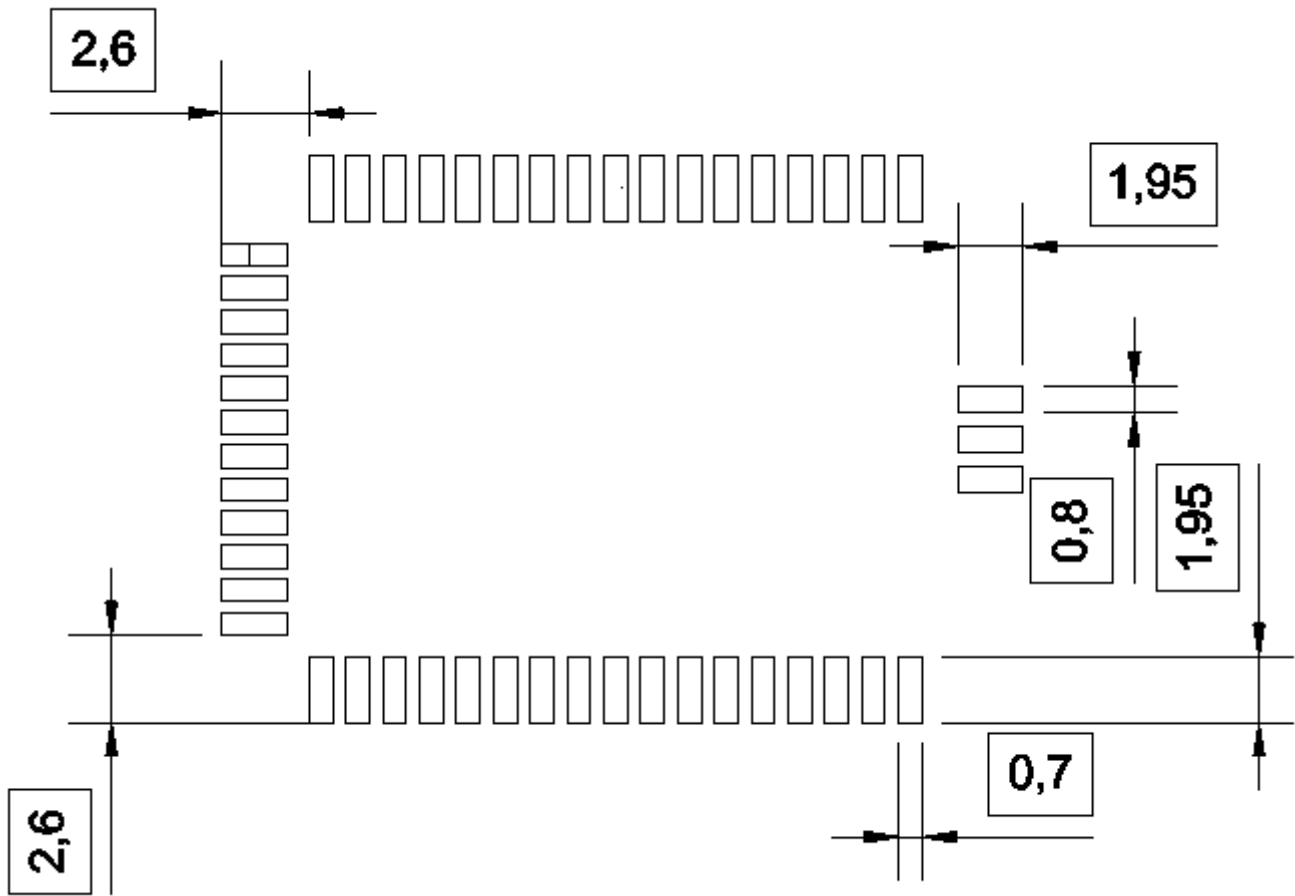
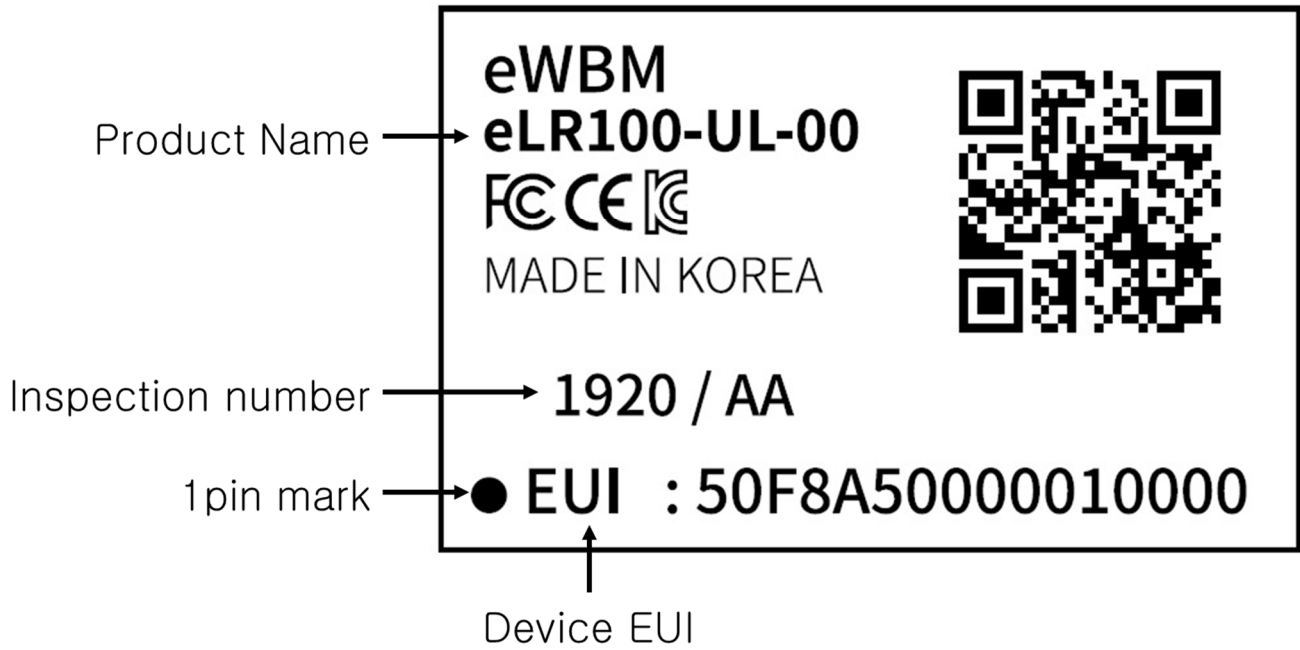
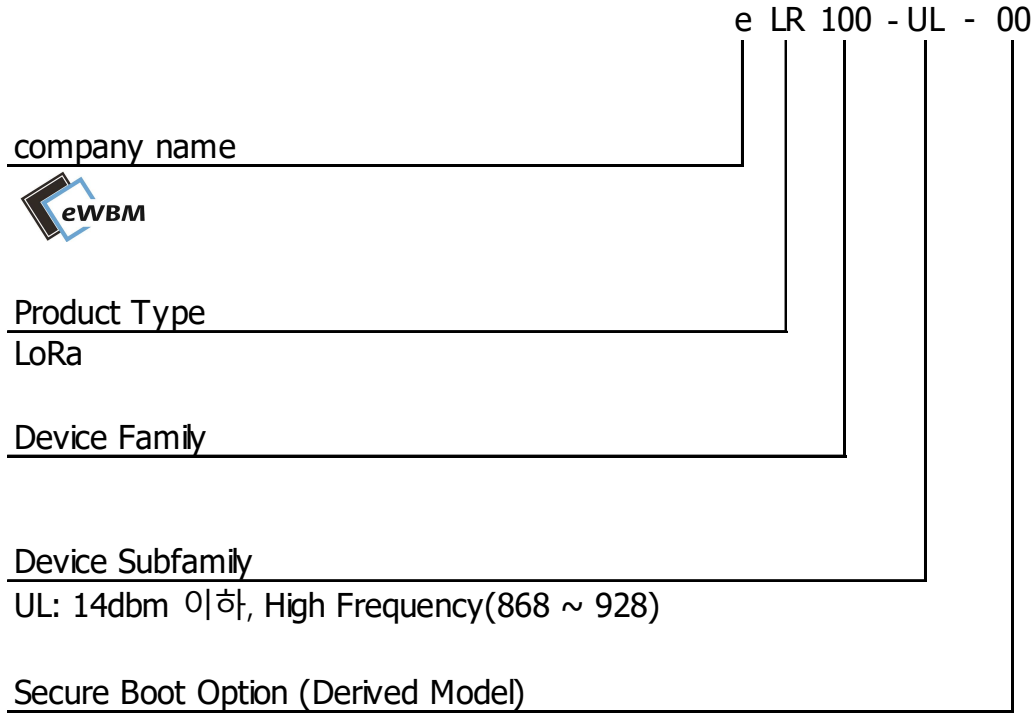


Figure 8. Soldering Footprint (Top View)

7. LABEL



8. ORDERING INFORMATION



00: for development purposes

01: Preset for eWBM (Secure Boot Enable)

2n: Preset for Customer (Secure Boot Disable)

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

범위: 00~99

* 사전 설정을 하기 위해서는 eWBM에 문의바랍니다.

9. PACKING -TBD

10. REFLOW PROFILE

Referred to IPC/JEDEC standard.

Peak Temperature : <250°C

Number of Times : ≤2 times

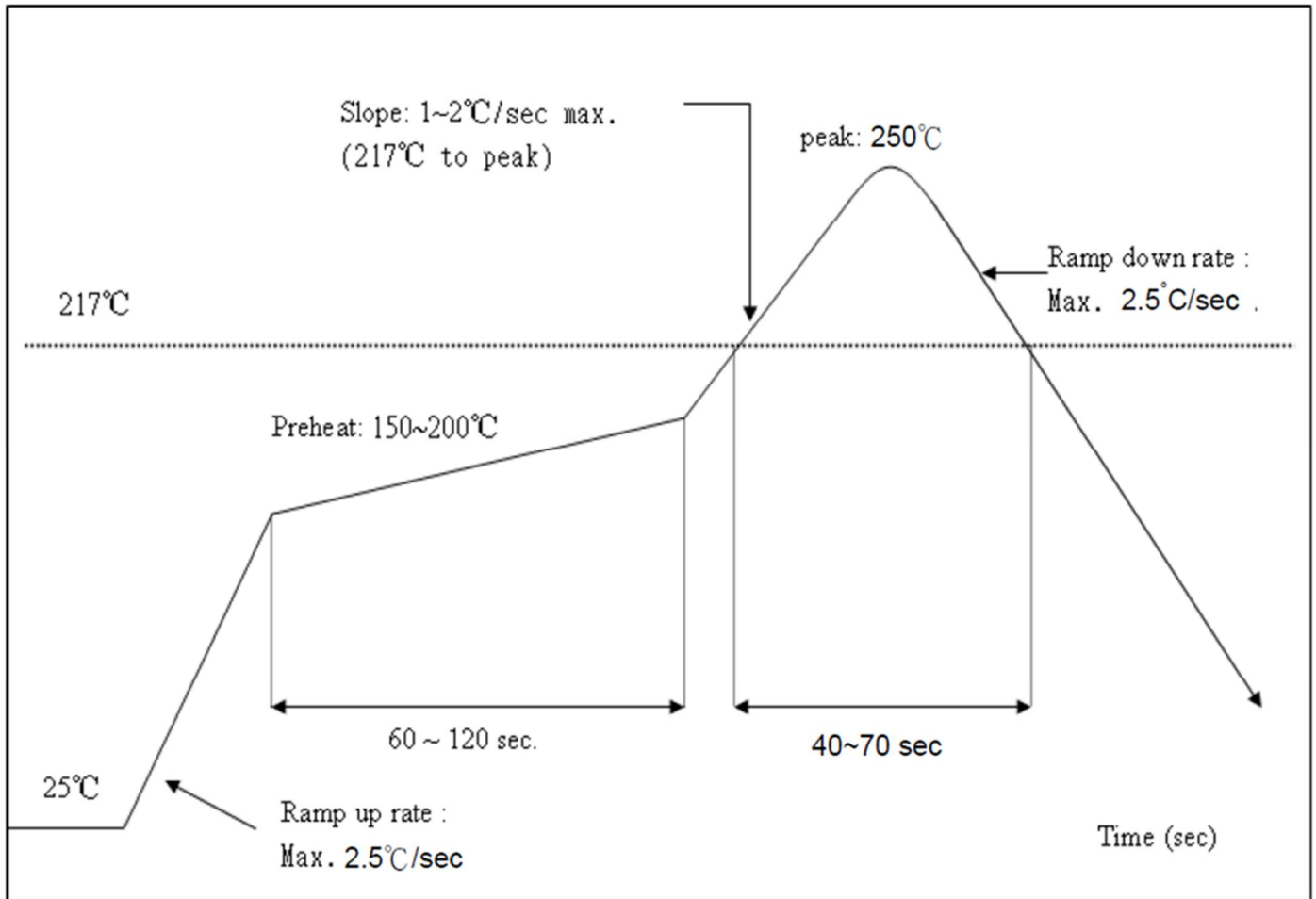


Figure 9 Reflow Profile

DOCUMENT REVISION AND REFERENCE

Revision History

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

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