S2

Product Specifications

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Notice

This document provides guide for users to use S2.

This document is intended for system engineers (SEs), development engineers, and test engineers.

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About This Document

Scope

This document is applicable to S2 series.

It defines the features, indicators, and test standards of the S2 module.

Audience

This document is intended for system engineers (SEs), development engineers, and test engineers.

Change History

Issue	Date	Change	Changed By
1.0	2018-08	Initial draft	Runmao Lin
1.1	2019-01	• Deleted B7 • Added BT and Wi-Fi • Modified transmit power and operating frequency bands	Tony Zhang
1.2	2019-07	• Added pin definition • Modified electric parameters	Jakn Wang
1.3	2019-11	• Added current data • Added configurations	Jakn Wang

Conventions

Symbol	Indication
	This warning symbol means danger. You are in a situation that could cause fatal device damage or even bodily damage.

⚠️	Means reader be careful. In this situation, you might perform an action that could result in module or product damages.
ℹ️	Means note or tips for readers to use the module

Related Documents

Neoway_S2_Datasheet

Neoway_S2_HW_User_Guide

Neoway_S2_AT_Command_Mannual

Neoway_S2_EVK_User_Guide

1 About S2

S2 is an intelligent LTE module that is developed on UNISOC SL8521E platform. It supports LTE-FDD, TD-LTE, WCDMA, and GSM cellular networks as well as GNSS, Bluetooth, and Wi-Fi connections. The S2 smart module also provides peripheral interfaces including LCD, camera, MIC, SPK, earpieces, keypad, USB2.0, etc.

1.1 Product Overview

Table 1-1 shows the variant and frequency bands of S2.

<p align="center">Table 1-1 Variant and frequency bands</p>

Module	Variant	Category	Band	GNSS	Wi-Fi	BT
S2	CN	Cat4	LTE FDD: B1,B2,B3,B5,B8 LTE TDD: B38,B39,B40,B41 WCDMA: B1,B2,B5,B8 GSM/GPRS/EDGE:850/900/1800/1900 MHz	Supported	Supported	Supported

S2 adopts 240-pin LCC+LGA package and its dimensions are 35 mm x 36 mm. This smart module runs Android OS and Linux OS is optional. With high performance, it is well applicable to PoC terminals, POS, and other IoT terminals.

1.2 Block Diagram

S2consists of the following functionality units:

- Baseband circuit

- Crystal oscillation (26MHz)

- Power management unit

- Memory

- Digital interfaces (USIM/UART/I2C/SPI/Keypad/Camera/SDIO3.0/LCD/USB)

- Analog interfaces (Audio/ADC)

- RF unit (2G/3G/4G antenna/GNSS antenna/2.4G Wi-Fi&Bluetooth antenna)

Figure 1-1 Block Diagram
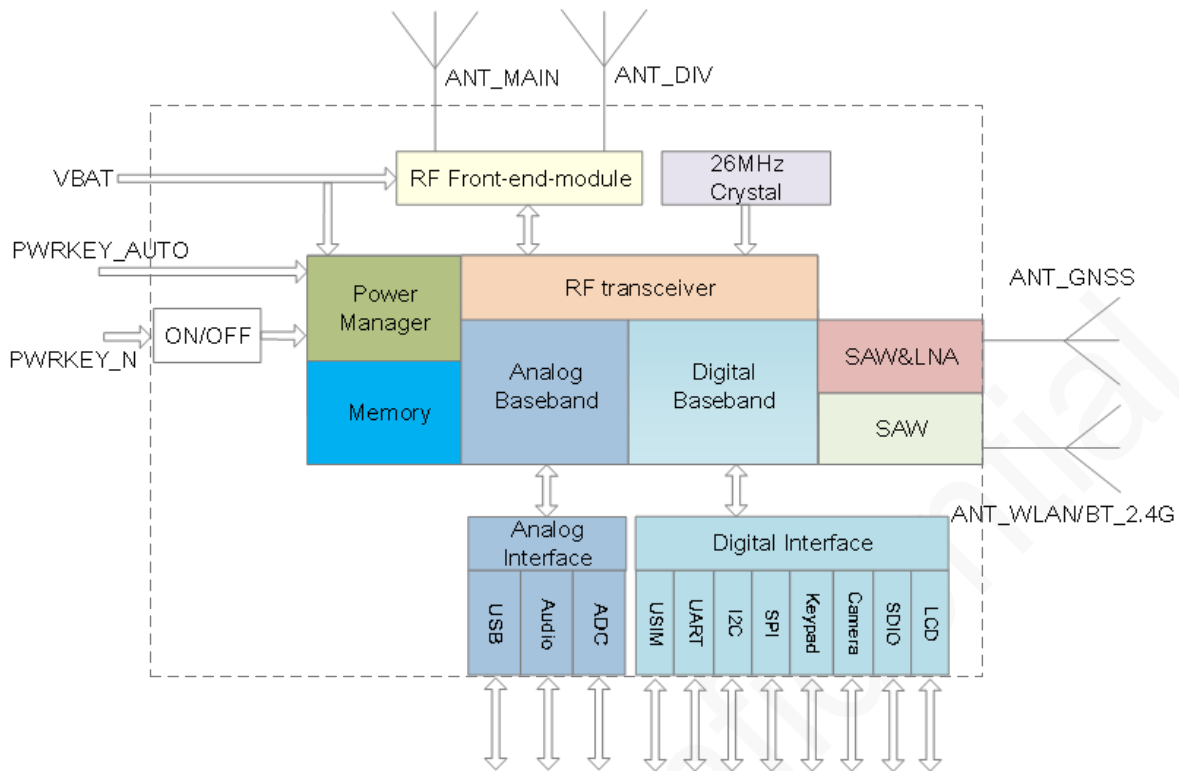
1.3 Basic Features

Table 1-2 S2 baseband and wireless features

Parameter	Description
Physical features	Dimensions: (35.0±0.15) mm × (36.0±0.15) mm × (2.9±0.1) mm Weight: 7.5g Package: 134-Pin LCC + 106-Pin LGA
Temperature ranges	Operating: -30°C to +75°C Extended: -40°C to +85°C Storage: -40°C to +90°C
Operating voltage	VBAT: 3.4V to 4.2V, TYP: 3.8V
Operating current	Sleep ≤ 2 mA
	Idle ≤ 4mA
Basic features	
MIPS processor	ARM Cortex-A53 dual-core processor, 1.3 GHz main frequency, 256kB L2 cache
Multimedia	ARM® mali T820 @384MHz

processor	
OS	Android 4.4 Linux 4.4 optional
Memory	4Gb NAND Flash + 2Gb LPDDR2 (default) 4Gb NAND Flash + 4Gb LPDDR2 (optional) 1Gb NAND Flash + 1Gb LPDDR2 (for Linux only)
RF Features	
Wireless rate	GPRS: Max 85.6 Kbit/s(DL) / Max 85.6 Kbit/s(UL) EDGE: Max 236.8Kbps(DL) / Max 236.8Kbps(UL) WCDMA: HSDPA, Max 21Mbps(DL)/Max 5.76Mbps(UL) LTE-FDD: Cat4, Max 150Mbps(DL)/Max 50Mbps(UL) LTE-TDD: Cat4, Max 130Mbps(DL)/Max 35Mbps(UL)
Transmit power	GSM850: 33dBm±2dB (Power Class 4) EGSM900: 33dBm±2dB (Power Class 4) DCS1800: 30dBm±2dB (Power Class 1) PCS1900: 30dBm ±2dB (Power Class 1) EDGE 850MHz: 27dBm±3dB (Power Class E2) EDGE 900MHz: 27dBm ±3dB (Power Class E2) EDGE1800MHz: 26dBm ±3dB (Power Class E2) EDGE1900MHz: 26dBm ±3dB (Power Class E2) WCDMA: 24dBm+1/-3dB (Power Class 3) LTE-FDD: 23dBm ±2dB (Power Class 3) LTE-TDD: 23dBm ±2dB (Power Class 3)
Satellite positioning	GPS/BEIDOU/GLONASS/QZSS[1]
Antenna Interface	2G/3G/4G antenna, 4G diversity antenna [2], GNSS antenna, 2.4G Wi-Fi&Bluetooth antenna
Multimedia	
Display interface	Supports two interfaces[3] One SPI LCD interface, supporting QVGA (240*320) at most. One MIPI LCD interface, supporting WVGA (480*800) at most.
Camera Interfaces	Supports two interfaces ● One interface supports 2-lane MIPI CSI and supports at most 5 MP.[4] ● One interface supports 1-lane MIPI CSI and supports at most 2 MP.

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[1] The GPS is not supported by the 1Gb+1Gb memory.

[2] The diversity antenna is optional but not supported by default.

[3] Only one LCD screen is supported simultaneously.

[4] The 5MP camera is supported by the 4Gb+4Gb memory only.

Video processing	Coding ● H.264 BP/MP/HP – 720p, 30 fps ● MPEG-4 SP – 720p, 30 fps Decoding ● H.264 BP/MP/HP – 720p, 30 fps ● MPEG-4 SP/AP – 720p, 30 fps ● H.263 BP – 720p, 30 fps ● VP8 – 720p, 30 fps
Graphics processing unit	ARM ® Mali T820, at most 384 MHz 3D graphics processing
Audio	
Audio format	MP3/AMR/AAC
Audio Input	Three MICs (embedding bias), one main MIC, one earpieces MIC, one sub MIC
Audio Output	Class AB stereotype earpieces output Class AB differential receiver output Class D speaker amplifier output
Interface	
UART	One UART interface, supporting hardware flow control and at most 2 Mbit/s
I2C	Three I2C interfaces, host mode only
USIM	Two USIM interfaces at most, 1.8V/3.0V dual-voltage adaptive[5] Single SIM is supported by default and dual-SIM is optional. To use the dual-SIM function, you need to develop the feature in software.
USB	One USB2.0 high-speed interface (support Type-C)
SDIO	One SDIO interface, SD2.0 by default, support SD3.0
ADC	Two 12-bit ADC interfaces, detectable voltage ranging from 0 to 3.0V.
GPIO	12 GPIO interfaces, four of which can be configured as I2S interface, one of which supports PWM, and three of which embed interrupt
Connection feature	
WLAN	2.4G single band, supporting 802.11b/g/n, at most 150 Mbps AP mode
Bluetooth	BLE4.2 and earlier version
Commissioning Interface	
USB-boot mode	Forcibly enable USB control

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[5] The variant running Linux supports only one SIM card.

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2 Compliant Standards

S2 complies with the following standards:

- YD/T 2220-2011 Technical Requirement and test method of WCDMA/GSM(GPRS) dual mode digit mobile user equipment (phase 4)

- GB4943.1-2011 Information technology equipment - Safety - Part 1: General requirements

- CNCA-O7C-031:2007Rules for Compulsory Certification of Telecommunication Equipment Telecommunication Terminal Equipment

- 3GPP TS GSM Specification Set

- 3GPP TS WCDMA Specification Set

- 3GPP TS LTE Cat4 4G Specification Set

3 Module Pins

3.1 Pad Layout

There are 240 pins on S2 and their pads are introduced in LCC+LGA package.

Figure 2-1 shows the pad layout of S2.

Figure 3-1 S2 Pin definition

3.2 Appearance

Figure 3-2 Top view of S2

Figure 3-3 Bottom view of S2
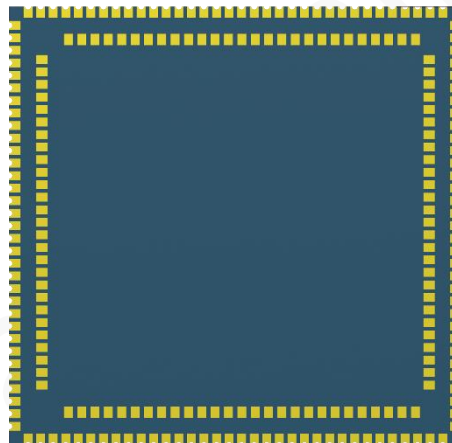
4 Electric Feature and Reliability

This chapter describes the electric features and reliability of S2, including current and voltage of each power pin, operating and storage temperature ranges, and ESD protection features.

4.1 Electric Features

Table 4-1 Electric Features of S2

Status		Minimum Value	Typical Value	Maximum Value
VBAT	V_{in}	3.4V	3.8V	4.2V
	I_{in}	/	/	3A

⚠️ If the voltage is lower than threshold, the module might fail to start. If the voltage is higher than threshold or there is a voltage burst during the startup, the module might be damaged permanently.

If you use LDO or DC-DC to supply power for the module, ensure that it outputs at least 3A current.

4.2 Temperature Features

Table 4-2 Temperature feature of S2

Status	Minimum Value	Typical Value	Maximum Value
Operating	-30℃	25℃	75℃
Extended	-40℃		85℃
Storage	-40℃		90℃

ℹ️ If the module works in an environment where the temperature exceeds the thresholds of the operating temperature range, some of its RF performance indicators might be worse but it can still work properly.

4.3 ESD Protection

Electronics need to pass ESD tests. The following table shows the ESD capability of key pins of this

module. It is recommended to add ESD protection based on the application scenarios to ensure product quality when designing a product.

Humidity 45%   Temperature 25℃

Table 4-3 ESD protection of S2

Testing Point	Contact Discharge	Air Discharge
VBAT	±8KV	±15KV
GND	±8KV	±15KV
ANT	±8KV	±15KV
Cover	±8KV	±15KV
Others	±2KV	±4KV

5 RF Features

S2 supports 2G/3G/4G network modes and frequency bands as well as the GNSS function. This chapter describes the RF features of S2.

5.1 Operating Bands

Table 5-1 Operating bands of S2

Operating Bands	Uplink	Downlink
GSM850	824~849MHz	869~894MHz
EGSM900	880~915MHz	925~960MHz
DCS1800	1710~1785MHz	1805~1880MHz
PCS1900	1850~1910MHz	1930~1990MHz
WCDMA B1	1920~1980MHz	2110~2170MHz
WCDMA B2	1850~1910MHz	1930~1990MHz
WCDMA B5	824~849MHz	869~894MHz
WCDMA B8	880~915MHz	925~960MHz
LTE-FDD B1	1920~1980MHz	2110~2170MHz
LTE-FDD B2	1850~1910MHz	1930~1990MHz
LTE-FDD B3	1710~1785MHz	1805~1880MHz
LTE-FDD B5	824~849MHz	869~894MHz
LTE-FDD B8	880~915MHz	925~960MHz
LTE-TDD B38	2570~2620MHz	2570~2620MHz
LTE-TDD B39	1880~1920MHz	1880~1920MHz
LTE-TDD B40	2300~2400MHz	2300~2400MHz
LTE-TDD B41	2555~2655 MHz	2555~2655 MHz

5.2 TX Power and RX Sensitivity

Table 5-2 TX power and RX sensitivity of S2

Band	TX Power	RX Sensitivity
GSM850	33 dBm+2/-2dBm	<-108 dBm
EGSM900	33 dBm+2/-2dBm	<-108 dBm
DCS1800	30dBm+2/-2dBm	<-108 dBm
PCS1900	30dBm+2/-2dBm	<-108 dBm
WCDMA B1	24dBm +1/-3dBm	<-108 dBm
WCDMA B2	24dBm +1/-3dBm	<-108 dBm
WCDMA B5	24dBm +1/-3dBm	<-108 dBm
WCDMA B8	24dBm +1/-3dBm	<-108 dBm
LTE-FDD B1 (10MHz)	23 dBm+2/-2dBm	<-97 dBm
LTE-FDD B2 (10MHz)	23 dBm+2/-2dBm	<-96 dBm
LTE-FDD B3 (10MHz)	23 dBm+2/-2dBm	<-96 dBm
LTE-FDD B5 (10MHz)	23 dBm+2/-2dBm	<-97 dBm
LTE-FDD B8 (10MHz)	23 dBm+2/-2dBm	<-97 dBm
LTE-TDD B38 (10MHz)	23 dBm+2/-2dBm	<-98 dBm
LTE-TDD B39 (10MHz)	23 dBm+2/-2dBm	<-97 dBm
LTE-TDD B40 (10MHz)	23 dBm+2/-2dBm	<-98 dBm
LTE-TDD B41 (10MHz)	23 dBm+2/-2dBm	<-96 dBm

5.3 GNSS Feature

Parameter	Scope
GPS L1 operating frequency	1575.42±1.023MHz
GLONASS operating frequency	1598.5~1606.5 MHz
BDS operation frequency	1559.1~1563.1 MHz
Tracking sensitivity	-158 dBm
Acquisition sensitivity	-148.5 dBm (cold start)
Positioning precision (in air)	5m
Hot start (in air)	<1S

Cold start (in air)	< 35S (@-130 dBm)
CNRin/CNRout	40 dB (@-130 dBm)
GNSS antenna type	Passive/active antenna

5.4 WLAN/BT Features

Table 5-3 WLAN/BT TX power and RX sensitivity

Operating Bands	Rate	Transmit power	Receiving Sensitivity
802.11b (2.4G)	11 Mbps	17 dBm±2 dB	< -85 dBm
802.11g (2.4G)	54Mbps	14 dBm±2 dB	< -71 dBm
802.11n (2.4G, 20MHz)	MCS0	12 dBm±2 dB	
	MCS7	12 dBm±2 dB	
Bluetooth	BR/EDR	3 dBm±3 dB	<-70 dBm

6 Mechanical Features

This chapter describes the mechanical features of S2.

6.1 Dimensions

Figure 6-1 S2 dimensions (Unit: mm)
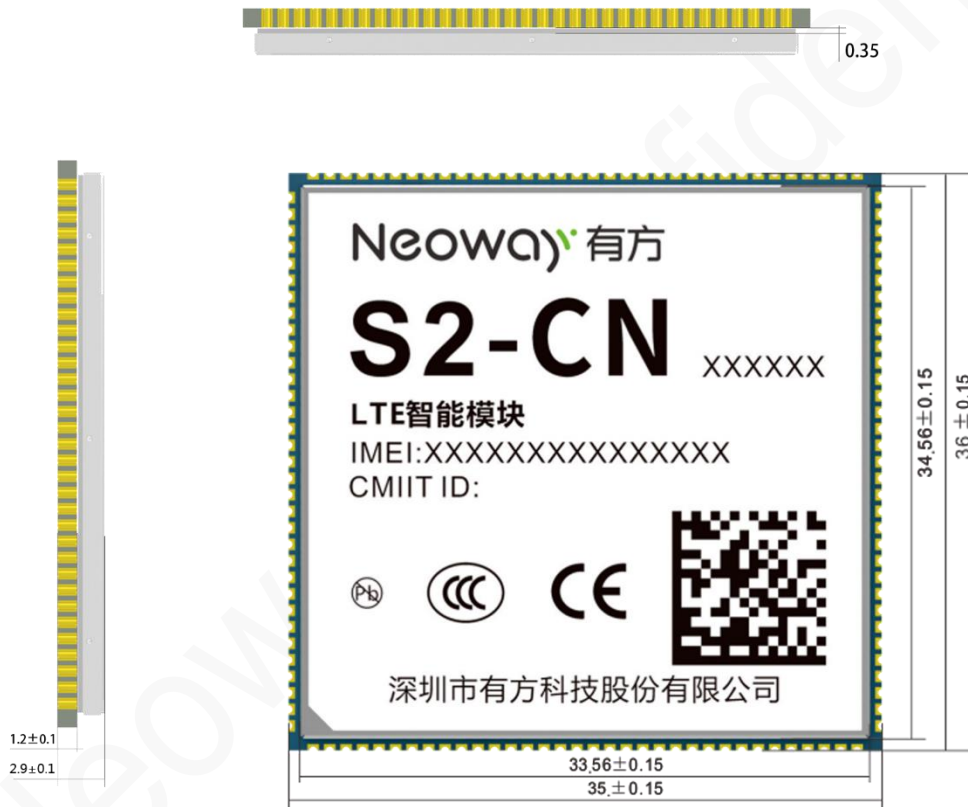
6.2 Label

The label is made of materials that are deformation-resistant, fade-resistant, and high-temperature-resistant and it can endure high temperature up to 260 °C.
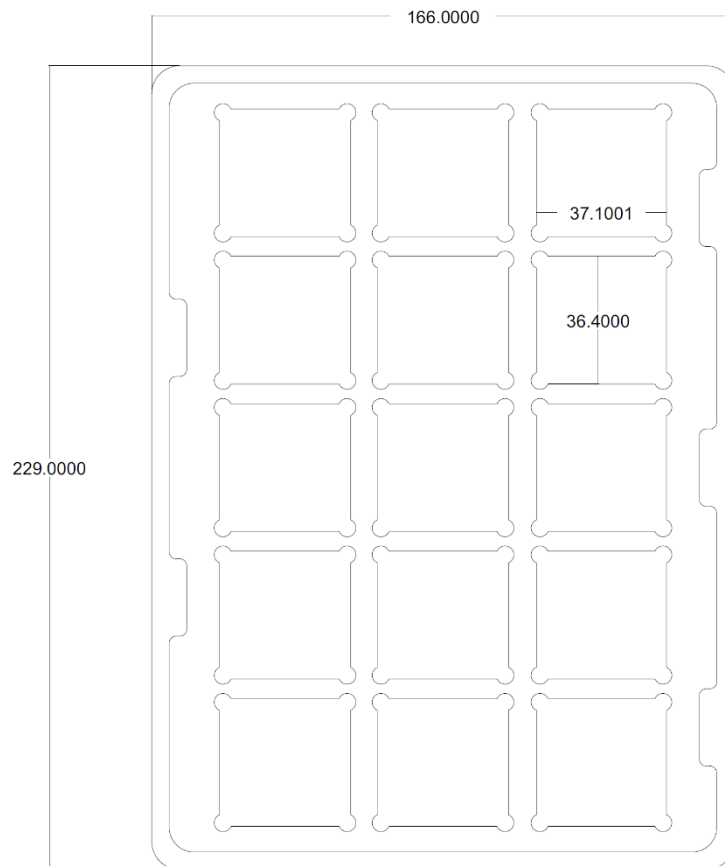
Figure 6-2 S2 Label

6.3 Packing

S2 modules are packed in sealed bags on delivery to guarantee a long shelf life. Follow the same package of the modules again in case of opened for any reasons.

6.3.1 Tray

Figure 6-3 Tray

6.3.2 Moisture

S2 is a level 3 moisture-sensitive electronic elements, in compliance with IPC/JEDEC J-STD-020 standard.

If the module is exposed to air for more than 48 hours at conditions not worse than 30°C/60% RH, bake it at a temperature higher than 90 degree for more than 12 hours before SMT. Or, if the indication card shows humidity greater than 20%, the baking procedure is also required. Do not bake modules with the package tray directly.

6.4 Storage

- Temperature: 20°C ~26°C

- Humidity: 40%-60%

- Period: 120 days

7 Mounting S2 onto Application PCB

S2 adopts in 134-pin LCC +106-pin LGA package. This chapter describes S2 foot print, recommended PCB design and SMT information to guide users how to mount the module onto application PCB board.

7.1 Bottom Dimensions

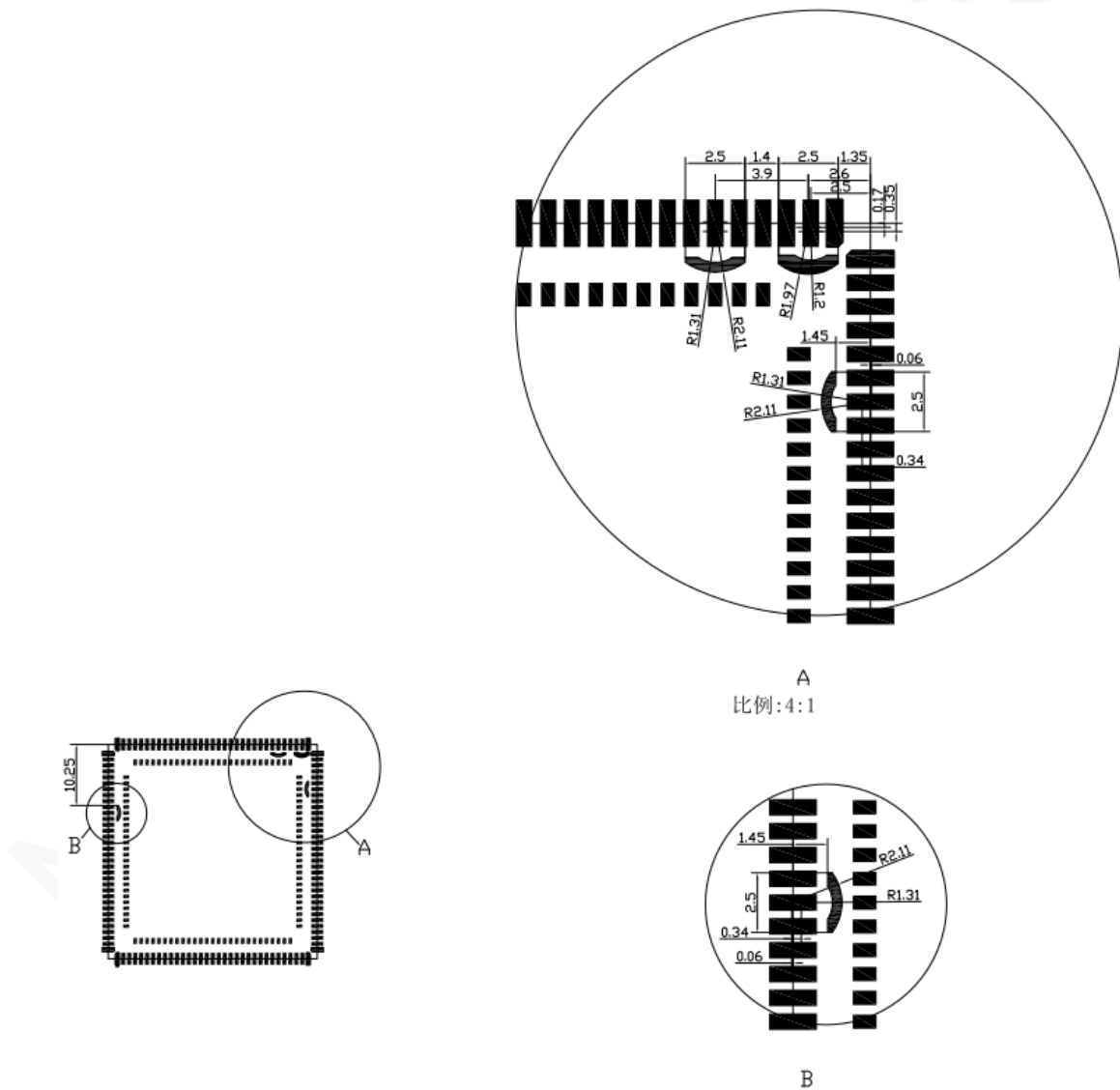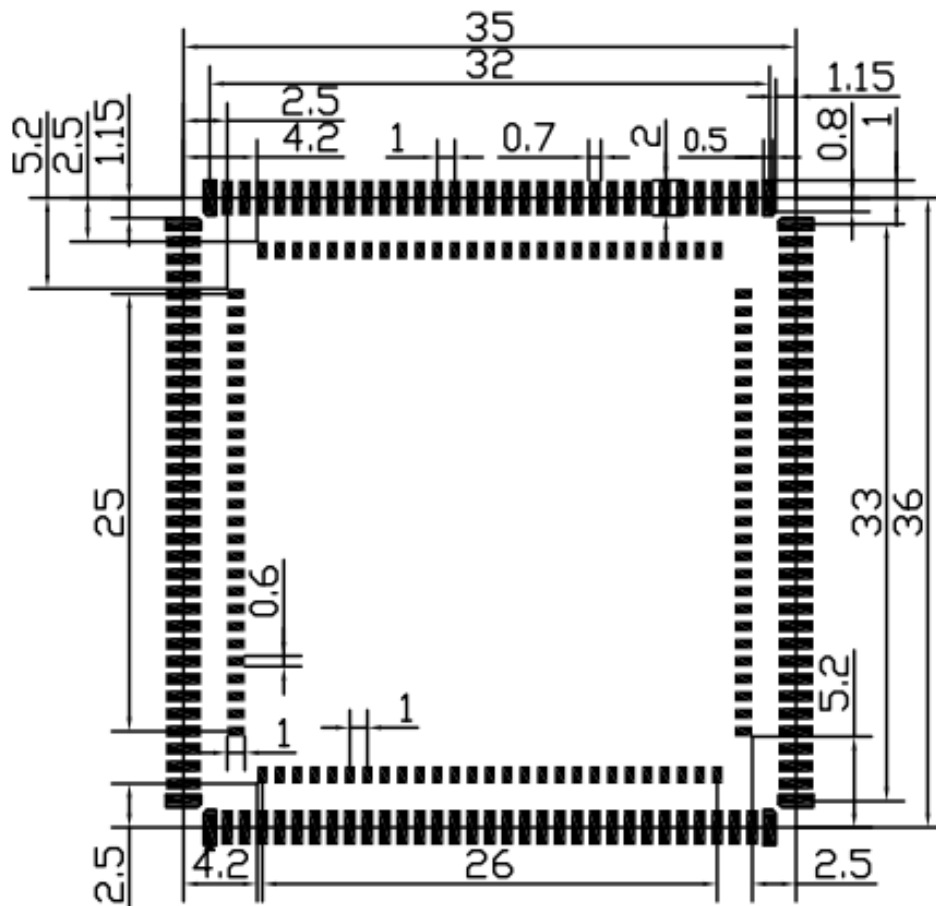Figure 7-1 PCB dimensions of S2 (top view, Unit: mm)

Figure 7-2 Recommended application foot print for S2 (Unit: mm)

7.2 Stencil

The recommended stencil thickness is at least 0.12 mm to 0.15 mm.

7.3 Solder Paste

Do not use the kind of solder paste different from our module technique.

- The melting temperature of solder paste with lead is 35 °C lower than that of solder paste without lead. It is easy to cause voiding for LCC inside the module after second reflow soldering.

- When using only solder pastes with lead, please ensure that the reflow temperature is kept at 220 °C for more than 45 seconds and the peak temperature reaches 240 °C.

7.4 SMT Furnace Temperature Curve

Thin or long PCB might bend during SMT. So, use loading tools during the SMT and reflow soldering process to avoid poor solder joint caused by PCB bending.

Figure 7-3 SMT furnace temperature curve
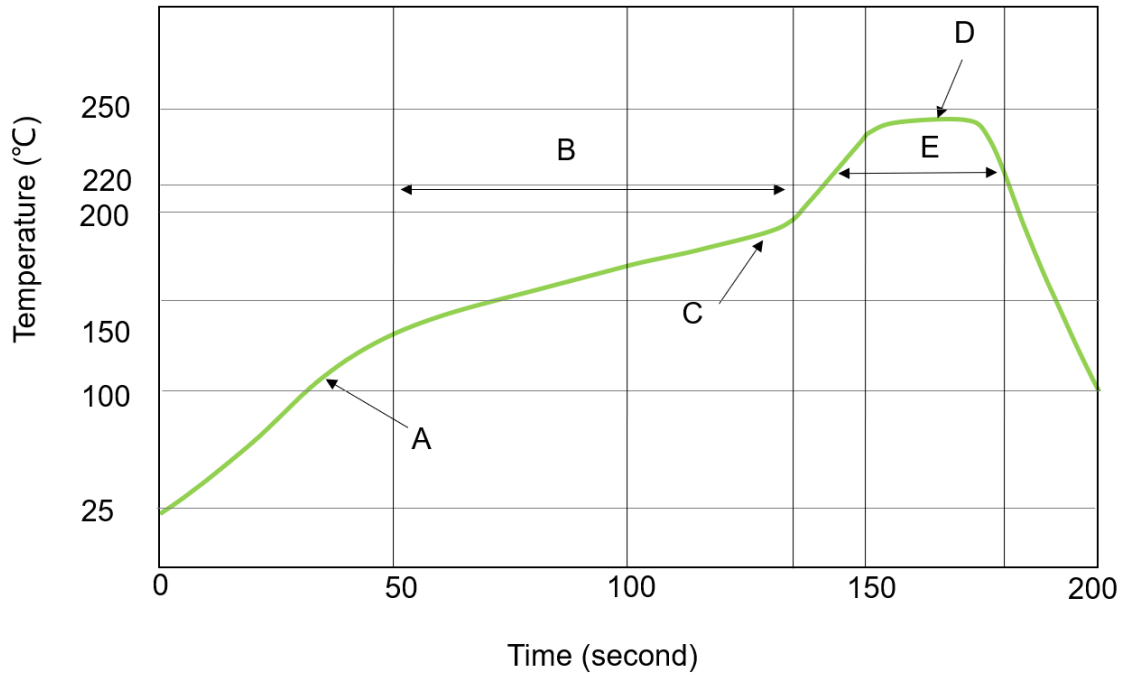
Technical parameters:

- Ramp up rate: 1 to 4 °C/sec

- Ramp down rate: -3 to -1 °C/sec

- Soaking zone: 150-180 °C, Time: 60-100 s

- Reflow zone: >220 °C, Time: 40-90 s

- Peak temperature: 235-245 °C

> ! Neoway will not provide warranty for heat-responsive element abnormalities caused by improper temperature control.

For information about cautions in S2 storage and mounting, refer to *Neoway Module Reflow Manufacturing Recommendations*.

When manually desoldering the module, use heat guns with great opening, adjust the temperature to 245 degrees (depending on the type of the solder paste), and heat the module till the solder paste

is melt. Then remove the module using tweezers. Do not shake the module in high temperatures while removing it. Otherwise, the components inside the module might get misplaced.

8 Safety Recommendations

Ensure that this product is used in compliant with the requirements of the country and the environment. Please read the following safety recommendations to avoid body hurts or damages of product or work place:

- Do not use this product at any places with a risk of fire or explosion such as gasoline stations, oil refineries, etc.

- Do not use this product in environments such as hospital or airplane where it might interfere with other electronic equipment.

  Please follow the requirements below in application design:

- Do not disassemble the module without permission from Neoway. Otherwise, we are entitled to refuse to provide further warranty.

- Please design your application correctly by referring to the HW design guide document and our review feedback on your PCB design. Please connect the product to a stable power supply and lay out traces following fire safety standards.

- Please avoid touch the pins of the module directly during manufacturing and test in case of damages caused by ESD.

- Do not remove the USIM card in idle mode if the module does not support hot plugging.

A Conformity and Compliance

A.1 Approvals

- CCC
- Type Approval

A.2 Chinese Notice

A.2.1 CCC Class A Digital Device Notice

This product has been tested and found to comply with the limits for class A digital devices. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

B Abbreviation

Abbreviation	English Full Name
AAC	Advanced Audio Coding
ADC	Analog-Digital Converter
AMR	Adaptive Multi-Rate
ANT	Antenna
AP	Access Point
ARM	Advanced RISC Machine
BDS	The BeiDou Navigation Satellite System
BLE	Bluetooth Low Energy
BT	Bluetooth
CNR	Carrier to Noise Rate
DCS	Digital Cellular System
DL	Downlink
DSI	Display Serial Interface
EDGE	Enhanced Data Rate for GSM Evolution
EGSM	Enhanced GSM
ESD	Electronic Static Discharge
FDD	Frequency Division Duplexing
GLONASS	GLOBAL NAVIGATION SATELLITE SYSTEM
GND	Ground
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input Output
GPRS	General Packet Radio Service

GPS	Global Positioning System
GSM	Global System for Mobile Communications
HSDPA	High Speed Downlink Packet Access
I2C	Inter-Integrated Circuit
LCC	Leadless Chip Carriers
LCD	Liquid Crystal Display
LGA	Land Grid Array
LPDDR	Low Power Double Data Rate
LTE	Long Term Evolution
MIC	microphone
MIPI	Mobile Industry Processor Interface
MP3	Moving Picture Experts Group Audio Layer III
PCB	Printed Circuit Board
PCS	Personal Communications Service
PWM	Pulse Width Modulation
QVGA	Quarter Video Graphics Array
QZSS	Quasi-Zenith Satellite System
RF	Radio Frequency
SD	Secure Digital
SDIO	Secure Digital Input Output
SIM	Subscriber Identification Module
SPI	Serial Peripheral Interface
TDD	Time Division Duplex
UART	Universal asynchronous receiver-transmitter
UL	Uplink
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module

VBAT	Battery Voltage
WCDMA	Wideband Code Division Multiple Access
Wi-Fi	Wireless Fidelity
WLAN	Wireless Local Area Networks
WVGA	Wide Video Graphics Array