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N725

Product Specifications

Issue 2.1.1 Date 2023-03-30

Notice

This document provides guide for users to use N725.

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

THIS GUIDE PROVIDES INSTRUCTIONS FOR USERS TO DESIGN THEIR PRODUCTS. THE USER MUST DESIGN AND DEBUG THE PRODUCT ACCORDING TO THE SPECIFICATIONS AND PARAMETERS IN THIS DOCUMENT. NEOWAY ASSUMES NO RESPONSIBILITY FOR PERSONAL INJURY AND PROPERTY LOSS CAUSED BY USER'S IMPROPER OPERATION.

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About This Document

Scope

This document is applicable to the N725 series.

It defines the features, indicators, and test standards of the N725 module and provides reference for the hardware design of each interface.

Audience

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

Change History

Issue	Date	Change	Changed By
1.0	2022-05	Initial draft	Zou Shiqiang
1.1	2022-06	• Updated the supported variant to "CA". • Updated the block diagram. • Updated the product thickness to 2.80 mm. • Updated the input voltage typical value to 3.6 V in Chapter 5.1 "Electrical Characteristics". • Updated the RF parameters to conform to the standard specification. • Added the ESD protection note.	Wilford Liu
2.0	2022-8	• Updated Block Diagram • Updated Basic Features • Updated N725 pinouts (top view) • Updated the parameters in Table 6-2, Table 6-3, Table 6-4, and Table 6-5.	Rujia Ren
2.1	2022-10	• Modified the temperature range of eCall • Modified description in Section 2.1 “Product Overview”	Rujia Ren

Conventions

Symbol	Indication
	Indicates danger or warning. This information must be followed. Otherwise, a catastrophic module or user device failure or bodily injury may occur.
	Indicates caution. This symbol alerts the user to important points about using the module. If these points are not followed, the module or user device may fail.
	Indicates instructions or tips. This symbol provides advices or suggestions that may be useful when using the module.

Related Documents

Neoway_N725_Datasheet

Neoway_N725_Hardware_User_Guide

Neoway_N725_AT_Commands_Mannual

Neoway_N725_EVK_User_Guide

1 Safety Recommendations

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

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

  If the product is used in a place with flammable gas or dust such as propane gas, gasoline, or flammable spray, the product will cause an explosion or fire.

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

  If the product is used in medical institutions or on airplanes, electromagnetic waves emitted by this product may interfere with surrounding equipment.

Please follow the requirements below in design and use of the application for this module:

- 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 touching the pins of the module directly in case of damages caused by ESD.
- Do not insert/remove a USIM card or memory card from the module while it is still powered on.

2 About N725

This chapter introduces product overview, block diagram, and basic features of N725.

2.1 Product Overview

N725 is an industry-grade cellular module that supports FDD-LTE (Cat. 4), TDD-LTE (Cat. 4), WCDMA, and GSM. It has dimensions of (30.00±0.10) mm × (28.00±0.10) mm × (2.80±0.20) mm and supports rich hardware interfaces. With industrial-grade high performance, N725 is applicable to developing in-vehicle products including passenger vehicles, commercial vehicles and two-wheeled vehicles.

N725 has the following characteristics:

- ARM Cortex-A7, 1.2 GHz main frequency, 32 kB L1 cache at most.
- Supported network modes: LTE Cat. 4, WCDMA, GSM.
- Supported interfaces: USIM, I2S/PCM, UART, USB, RMII/RGMII, SD/MMC, SDIO, I2C, SPI, *PCIe, and GNSS (optional).

Table 2-1 lists the variants and frequency bands that N725 supports.

Table 2-1 Variants and frequency bands

Variant	Region	Category	Band	GNSS[1]	Codec
CA	Chinese mainland	Cat.4	FDD-LTE: B1, B3, B5, B8 TDD-LTE: B34, B38, B39, B40, B41 WCDMA: B1, B5, B8 GSM/GPRS/EDGE: 900/1800 MHz	Supported	Not supported
EA	Europe/Middle East/Africa	Cat.4	FDD-LTE: B1, B3, B5, B7, B8, B20, B28 TDD-LTE: B38, B40, B41 WCDMA: B1, B5, B8 GSM/GPRS/EDGE: 900/1800 MHz	Supported	Not supported

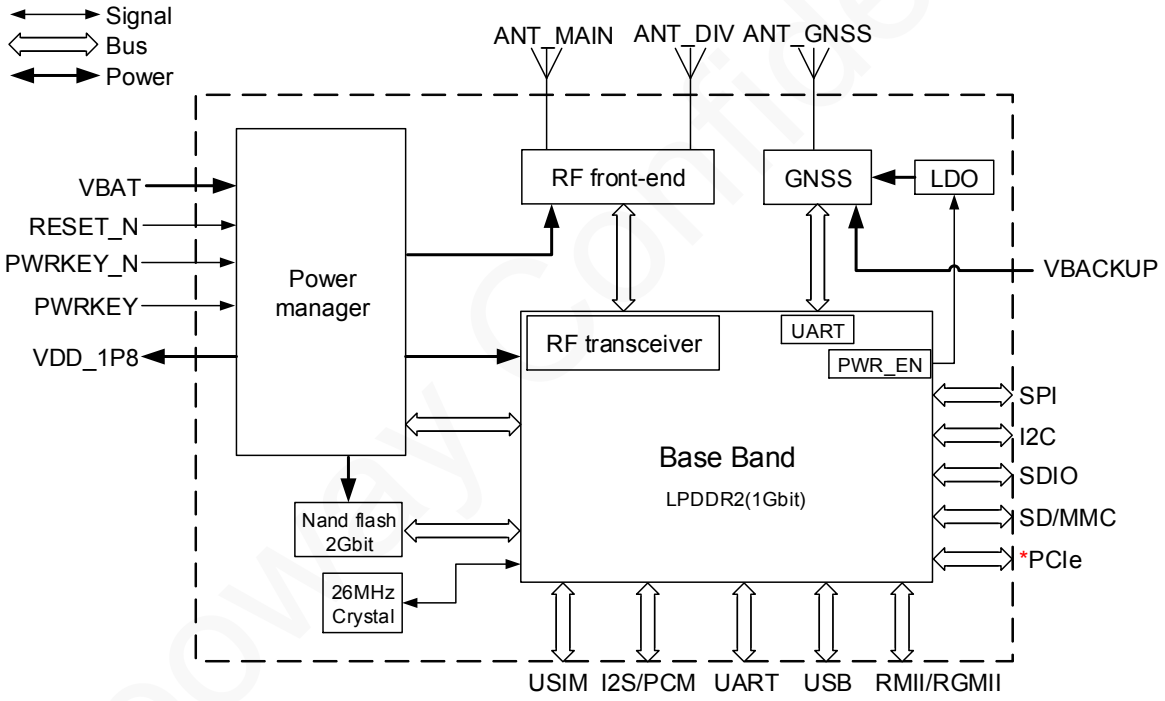
[1] GNSS is optional.

2.2 Block Diagram

N725 consists of the following functionality units:

- Baseband
- 26 MHz crystal
- Power management
- Radio frequency
- Flash
- GNSS
- Digit interfaces (I2S/PCM, RMII/RGMII, USIM, UART, USB, SDIO, SD/MMC, I2C, SPI, *PCIe)

Figure 2-2 Block diagram



2.3 Basic Features

Parameter	Description
Physical features	• Dimensions: (30.00±0.10) mm × (28.00±0.10) mm × (2.80±0.20) mm • Package: 100-pin LGA • Weight: about 5.20 g
Temperature	Operating: -40°C to +85°C

ranges	Storage: -40°C to +90°C
Operating voltage (DC)	VBAT: 3.4 V- 4.2 V, typical value: 3.6 V
Operating current	Sleep mode[2]: ≤ 3 mA
	Standby mode[3]: ≤ 20 mA
	Operating[4] (LTE mode): ≤ 650 mA
Application processor	ARM Cortex-A7, 1.2 GHz main frequency, 32 kB L1 cache at most.
Memory	RAM: 128 MB ROM: 256 MB
Band	See Table 2-1.
Wireless rate	GPRS: Max 85.6 Kbps (DL)/Max 85.6 Kbps (UL) EDGE: Max 236.8 Kbps (DL)/Max 236.8 Kbps (UL) WCDMA: HSPA+, Max 21 Mbps (DL)/Max 5.76 Mbps (UL) LTE-FDD: Cat4, no-CA, Max 150 Mbps (DL)/Max 50M bps (UL) LTE-TDD: Cat4, no-CA, Max 130 Mbps (DL)/Max 30 Mbps (UL)
Transmit power	EGSM900: +33 dBm (Power Class 4) DCS1800: +30 dBm (Power Class 1) EDGE 900 MHz: +27 dBm (Power Class E2) EDGE1800 MHz: +26 dBm (Power Class E2) WCDMA: +23 dBm (Power Class 3) LTE: +23 dBm (Power Class 3)
Application interfaces	2G/3G/4G antenna, diversity antenna, GNSS antenna. All of each has a characteristic impedance of 50 Ω.
	Three UART (one of which is a Debug UART)
	One USIM interface, 1.8 V/3.0 V adaptive
	One USB 2.0 interface
	One SDIO interface
	One SD/MMC interface
	One PCM/I2S interface

Sleep mode[2] the module enters a low power consumption state. In this state, the peripheral interface of the module is disabled, but the radio frequency (RF) is functioning properly. The module will exit the sleep mode when there is an incoming call or SMS message, and will re-enter the sleep mode at the end of the incoming call or conversation.

[3]Standby mode: the module is in normal working state, but there is no on-going data service.

[4]Operating mode: operating current of the module when there is data communication. Only the currents in LTE mode are listed here. For details about currents under other network standards, see the N725 current test report.

	One RMII/RGMII interface
	One SPI interface, host mode only
	One I2C interface, master mode only
	One PCIe Gen1 interface, supporting only RC mode
AT commands	3GPP Release 9 Neoway extended commands
SMS	PDU, TXT
Data	PPP, RNDIS
Protocol	TCP/TCPS, UDP, HTTP/HTTPS, FTP, MQTT
Certification approval	CCC, SRRC, CTA, RoHS

3 Reference Standards

N725 is designed by referring to the following standards:

- 3GPP TS 36.521-1 V9.10.0 User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Radio Resource Management (RRM) conformance testing
- 3GPP TS 21.111 V9.0.0 USIM and IC card requirements
- 3GPP TS 31.102 V9.19.0 Characteristics of the Universal Subscriber Identity Module (USIM) application
- 3GPP TS 31.111 V9.12.2 Universal Subscriber Identity Module (USIM) Application Toolkit (USAT)
- 3GPP TS 27.007 V9.9.0 AT command set for User Equipment (UE)
- 3GPP TS 27.005 V9.0.1 Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE - DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)

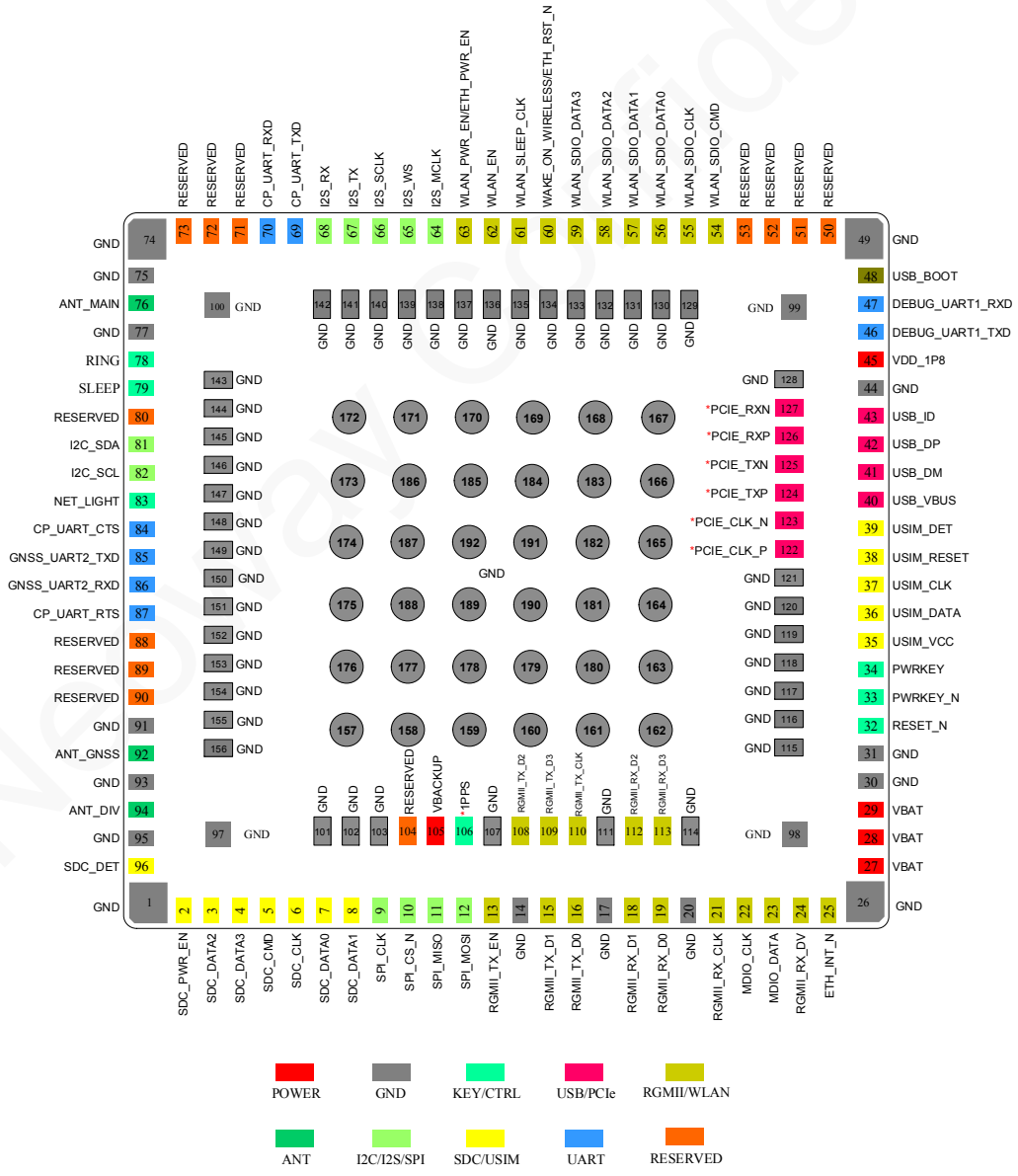
4 Module Pins

There are 192 pins on N725 and their pads are introduced in LGA package.

4.1 Pin Layout

The following figure shows the pad layout of N725.

Figure 4-1 N725 pinouts (top view)



*PCIe: in development

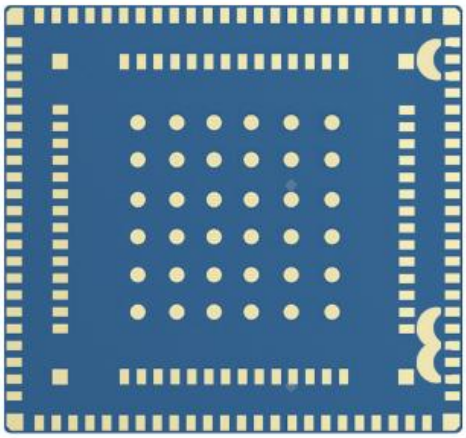
*1PPS: in development

N725 does not support GNSS_UART2 and USB_ID by default.

4.2 Appearance

Figure 4-2 Top view of N725

Figure 4-3 Bottom view of N725



The label and bottom views of the N725 module in the above picture are for reference only. Detailed information is in accordance with the final product.

5 Electrical Characteristics and Reliability

This chapter describes the electrical characteristics and reliability of the N725 module, including the input and output voltage and current of the power supply, current consumption of the module in different states, operating and storage temperature range, and ESD protection characteristics.

5.1 Electrical Characteristics

- 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 2.5A current. The 2.5A current occurs when the module is working at the maximum power level of the GSM mode. The peak current during burst transmission has a short duration. Placing a large capacitor on the VBAT pin of the module can effectively enhance the flyback capability of the power supply and avoid excessive voltage drops that may cause exceptions, such as module shutdown.

Table 5-1 N725 electrical characteristics

Parameter		Minimum Value	Typical Value	Maximum Value
VBAT	V_{in}	3.4 V	3.6 V	4.2 V
	I_{in}	N/A	N/A	2.5 A

Table 5-2 N725 current consumption (Typical)

Status Network Standard and Band	Sleep (mA)	Idle (DRX) (mA)	Active (mA) @max power
LTE-FDD: B1, B3, B5, B7, B8, B20, B28	≤ 3.0	≤ 20	≤ 650
LTE-TDD: B34, B38, B39, B40, B41	≤ 3.0	≤ 20	≤ 400
WCDMA: B1, B5, B8	≤ 3.0	≤ 20	≤ 560
GSM900	≤ 3.0	≤ 20	≤ 560
GSM1800	≤ 3.0	≤ 20	≤ 400

5.2 Temperature Characteristics

Table 5-3 N725 temperature characteristics

Parameter	Minimum Value	Typical Value	Maximum Value
Operating	-40℃	25℃	85℃
Storage	-40℃	25℃	90℃
eCall	-40℃	25℃	90℃

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.

5.3 ESD Protection

Electronic products generally need to undergo strict ESD testing. The following details the ESD protection capability of the main pins of the module. When designing related products, you need to add corresponding ESD protection according to the industry where the product is used to ensure product quality.

Test environment: humidity 45%; temperature 25℃

Table 5-4 N725 ESD protection characteristics

Testing point	Contact discharge	Air discharge
GND	±8 kV	±15 kV
ANT	±8 kV	±15 kV
Cover	±8 kV	±15 kV

6 RF Characteristics

N725 supports GSM, WCDMA, FDD-LTE, and TDD-LTE (Cat.4) network modes, as well as GNSS. This chapter describes the RF characteristics of N725.

6.1 Operating Band

Table 6-1 N725 operating bands

Operating band	Uplink	Downlink
EGSM900	880~915MHz	925~960MHz
DCS1800	1710~1785MHz	1805~1880MHz
WCDMA B1	1920~1980MHz	2110~2170MHz
WCDMA B5	824~849MHz	869~894MHz
WCDMA B8	880~915MHz	925~960MHz
FDD-LTE B1	1920~1980MHz	2110~2170MHz
FDD-LTE B3	1710~1785MHz	1805~1880MHz
FDD-LTE B5	824~849MHz	869~894MHz
FDD-LTE B7	2500~2570MHz	2620~2690MHz
FDD-LTE B8	880~915MHz	925~960MHz
FDD-LTE B20	832~862MHz	791~821MHz
FDD-LTE B28	703~748MHz	758~803MHz
TDD-LTE B34	2010~2025MHz	2010~2025MHz
TDD-LTE B38	2570~2620MHz	2570~2620MHz
TDD-LTE B39	1880~1920MHz	1880~1920MHz
TDD-LTE B40	2300~2400MHz	2300~2400MHz
TDD-LTE B41	2535~2655MHz	2535~2655MHz

6.2 TX Power and RX Sensitivity

Table 6-2 N725 RF transmit power

Band	Max power	Min. power
EGSM900	33 dBm±2.7 dB	5 dBm±5 dB
DCS1800	30 dBm±2.7 dB	5 dBm±5 dB
WCDMA B1	24 dBm+1/-3 dB	< -50 dBm
WCDMA B5	24 dBm +1/-3 dB	< -50 dBm
WCDMA B8	24 dBm +1/-3 dB	< -50 dBm
FDD LTE B1	23 dBm±2.7 dB	< -39 dBm
FDD LTE B3	23 dBm±2.7 dB	< -39 dBm
FDD LTE B5	23 dBm±2.7 dB	< -39 dBm
FDD LTE B7	23 dBm±2.7 dB	< -39 dBm
FDD LTE B8	23 dBm±2.7 dB	< -39 dBm
FDD LTE B20	23 dBm±2.7 dB	< -39 dBm
FDD LTE B28	23 dBm±2.7 dB	< -39 dBm
TDD LTE B34	23 dBm±2.7 dB	< -39 dBm
TDD LTE B38	23 dBm±2.7 dB	< -39 dBm
TDD LTE B39	23 dBm±2.7 dB	< -39 dBm
TDD LTE B40	23 dBm±2.7 dB	< -39 dBm
TDD-LTE B41	23 dBm±2.7 dB	< -39 dBm

Table 6-3 GSM RX sensitivity of N725

Band	Receiving sensitivity
EGSM900	≤ -102 dBm
DCS1800	≤ -102 dBm

Table 6-4 WCDMA receiving sensitivity

Band	Receiving sensitivity
WCDMA B1	≤ -106.7 dBm
WCDMA B5	≤ -104.7 dBm

WCDMA B8	≤ -103.7 dBm

Table 6-5 LTE RX sensitivity of N725

Band	Receiving sensitivity	Duplex mode
LTE B1	≤-96.3 dBm	FDD
LTE B3	≤-93.3 dBm	FDD
LTE B5	≤-94.3 dBm	FDD
LTE B7	≤-94.3 dBm	FDD
LTE B8	≤-94.3 dBm	FDD
LTE B20	≤-93.3 dBm	FDD
LTE B28	≤-94.8 dBm	FDD
LTE B34	≤-96.3 dBm	TDD
LTE B38	≤-96.3 dBm	TDD
LTE B39	≤-96.3 dBm	TDD
LTE B40	≤-96.3 dBm	TDD
LTE B41	≤-94.3 dBm	TDD

The preceding indexes are test data in a laboratory environment. The test results of LTE (Cat 4) in a bandwidth of 10 MHz will have a certain deviation due to the influence of the network environment.

6.3 GNSS Technical Parameters

Table 6-6 GNSS technical parameters

Parameter	Notice
GPS L1 operating frequency	1575.42 ± 1.023 MHz
GLONASS operating frequency	1597.5 - 1605.9 MHz
BDS operation frequency	1559.1 - 1563.1 MHz
Tracking sensitivity	-160 dBm
Acquisition sensitivity	-156 dBm
Positioning precision (in air)	<3 m (CEP50)
Hot start (in air)	<1s
Cold start (in air)	<33s

Update frequency	<10 Hz
Max. positioning altitude	18000 m
Max. positioning speed	515 m/s
Max. positioning acceleration	1G
CNRin/CNRout	3 dB
GNSS data type	NMEA-0183
GNSS data type	Passive/active antenna

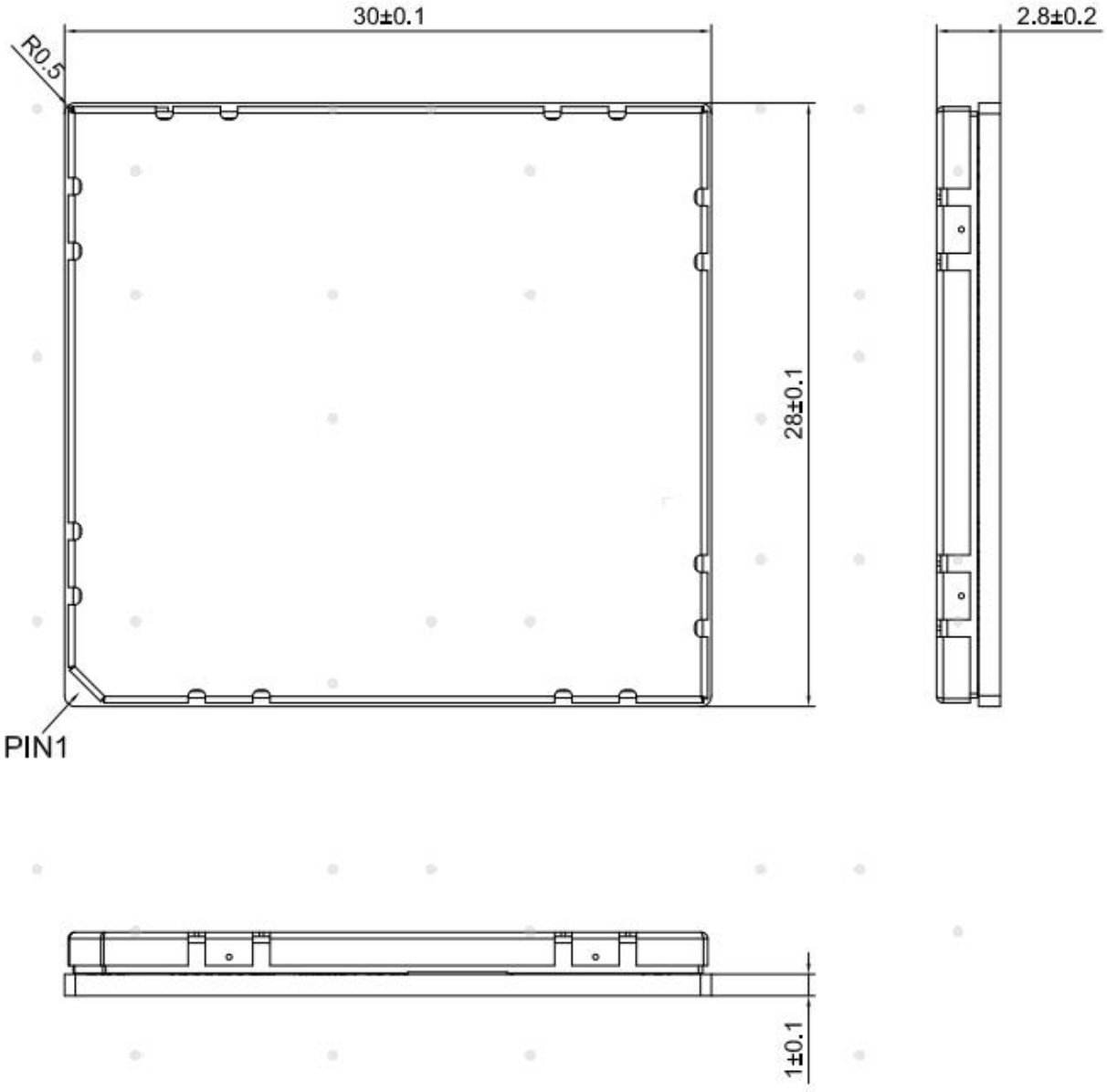
The tracking sensitivity and recapture sensitivity are obtained from the signaling test on SPIRENTGSS7000. The values are the maximum values obtained from multiple measurements performed on samples. No external LNA, active antenna, or other signal amplification measures are used during the test.

7 Mechanical Characteristics

This chapter describes mechanical characteristics of the N725 module.

7.1 Dimensions

Figure 7-1 N725 dimensions (unit: mm)



7.2 Label

The label information is laser carved on the cover. The following figure shows the label of N725.

Figure 7-2 N725 label

The picture above is only for reference.

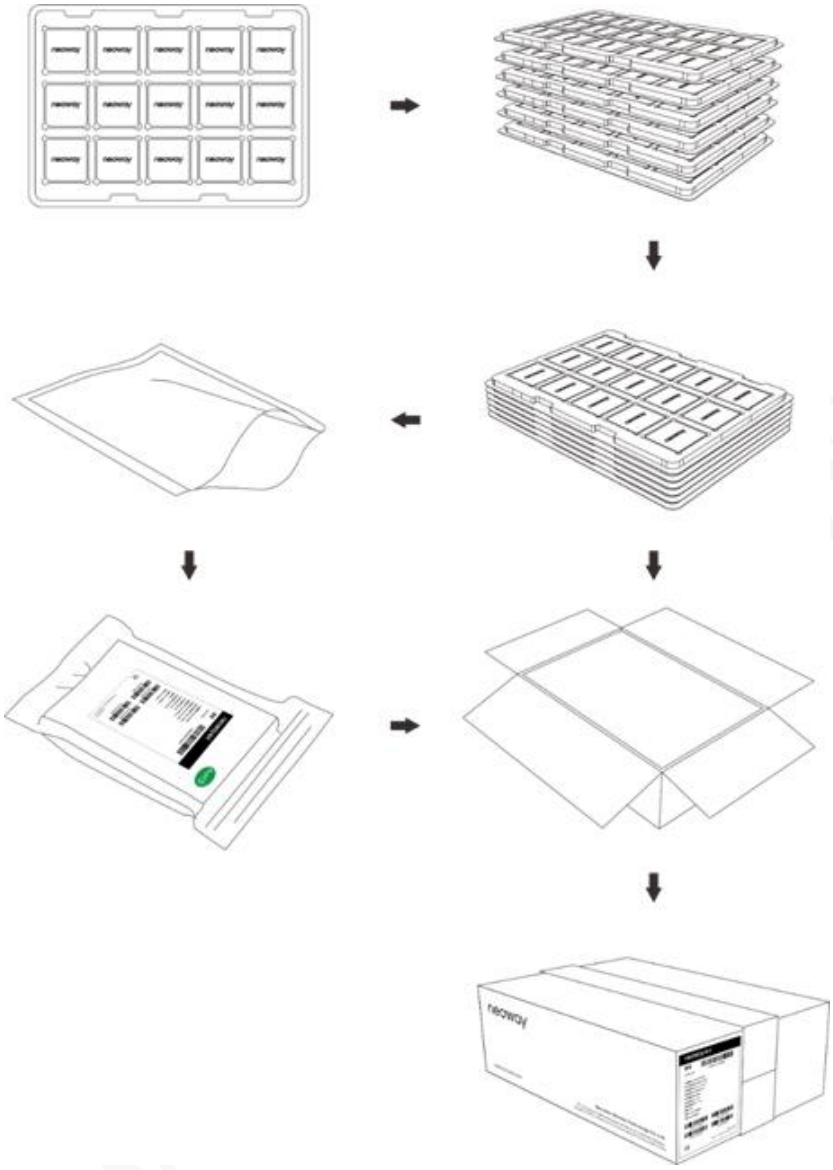
7.3 Packing

The N725 module adopts the SMT method for oven soldering. To prevent the products from being damped before they are delivered to customers, use the tray for moisture-proof packaging and use the aluminum foil bag, desiccant, humidity indicator card, tray, vacuum and other processing methods to ensure the dryness of the product and extend its service life.

7.3.1 Tray

The mass-produced module is packed and shipped using the following tray method:

Figure 7-3 Packing process



The picture above is only for reference.

7.3.2 Moisture

N725 is a level 3 moisture-sensitive electronic element, in compliance with IPC/JEDEC J-STD-020 standard.

After the module is unpacked, if it is exposed to the air for a long time, the module will get damped, and may be damaged during reflow soldering or laboratory soldering. Bake it before mounting the module. The baking conditions depend on the moisture degree. It is recommended to bake the module at a temperature higher than 90 degrees for more than 12 hours. In addition, since the package tray is made of non-high temperature resistant material, do not bake modules with the tray

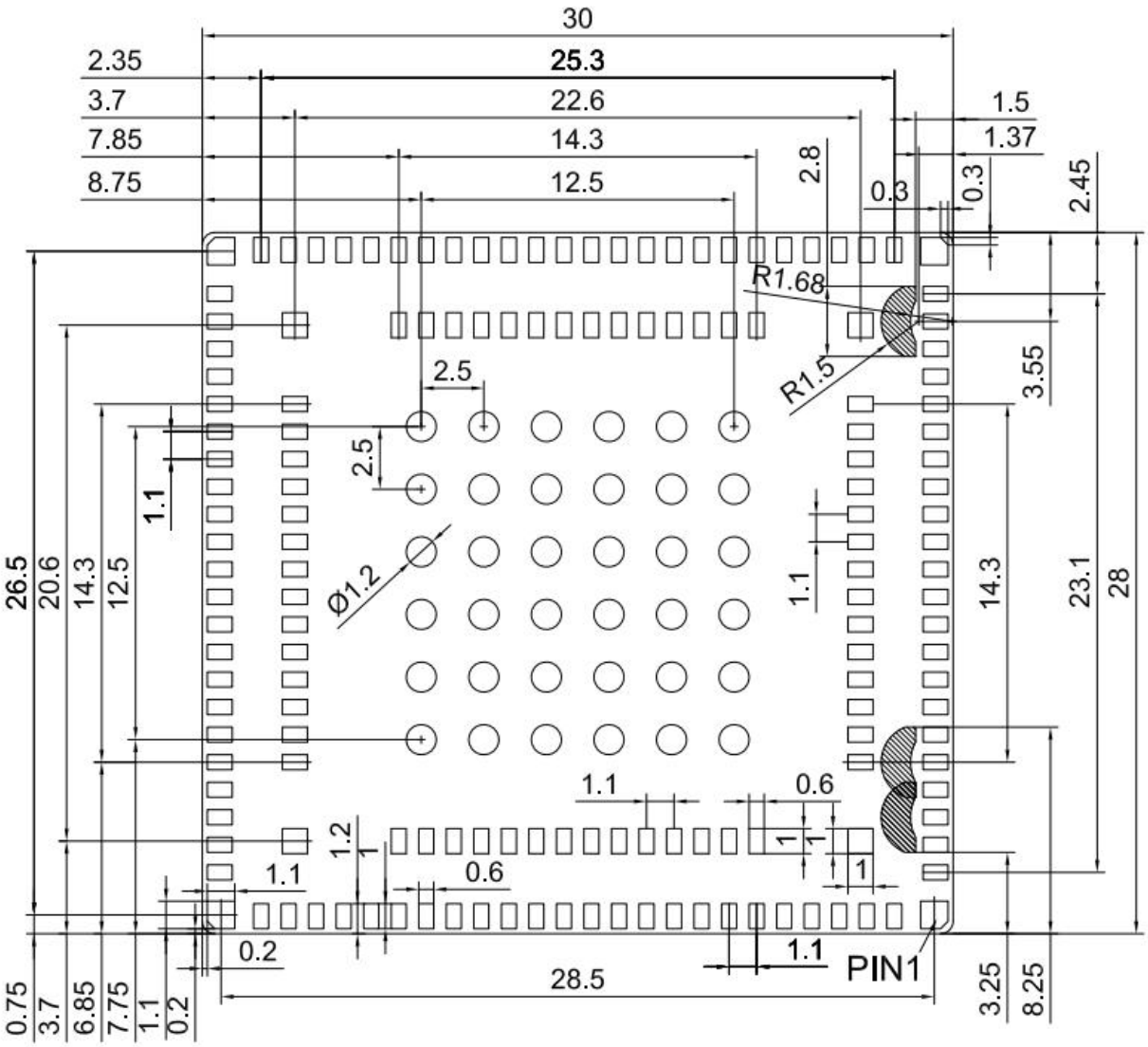
directly.

8 Mounting

This chapter describes the module PCB package and application PCB package of N725, as well as the key points of SMT related technology.

8.1 PCB Package

Figure 8-1 Bottom view of N725 PCB package (unit: mm)

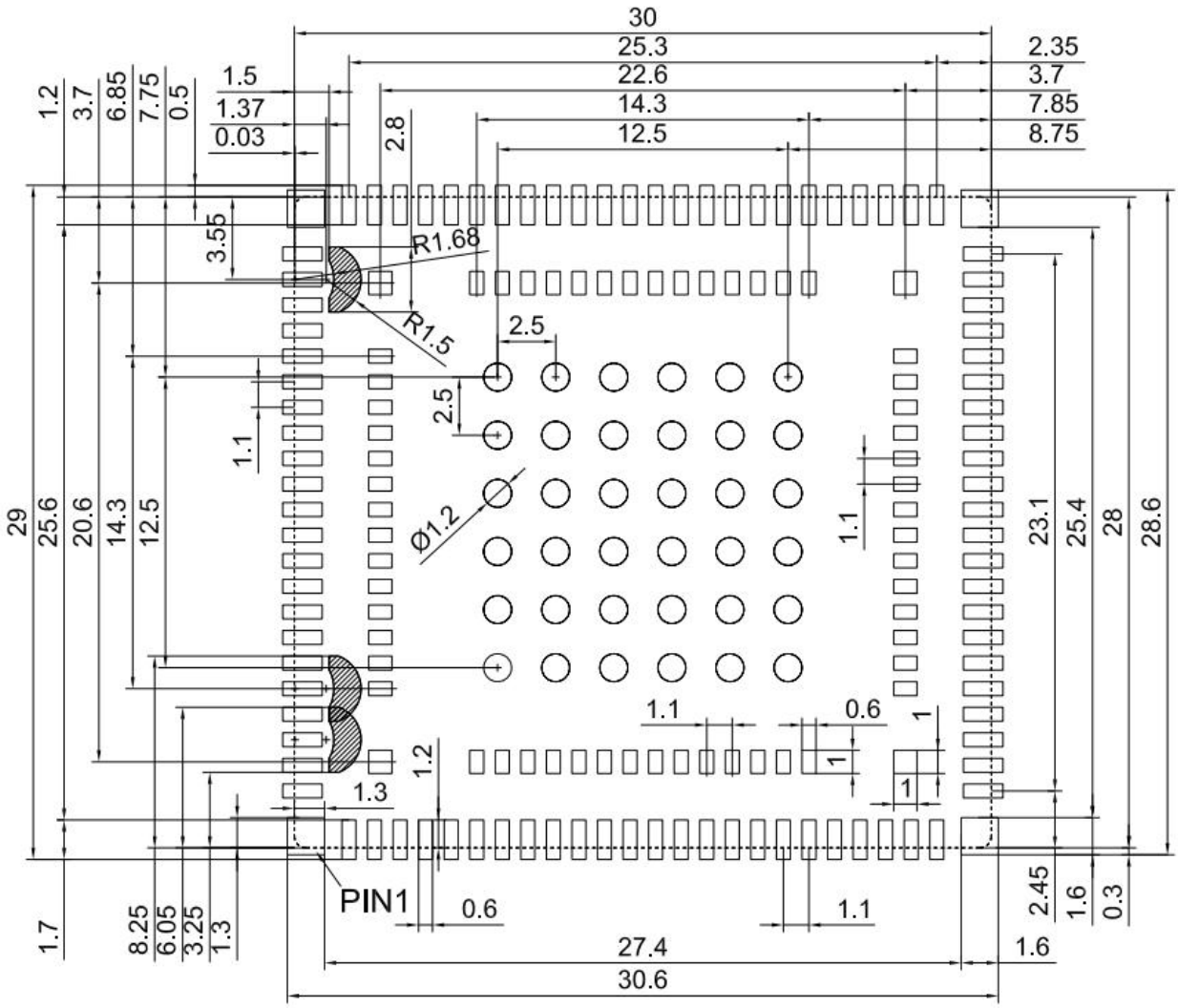


8.2 Application Foot Print

The N725 module has a total of 192 pins in LGA package. and the recommended application PCB package is as follows:

Only GND via-holes and pour coppers are allowed in the shaded area "" of the PCB package to ensure the proper operation of the module.

Figure 8-2 N725 recommended footprint of the application PCB (unit: mm)



8.3 Stencil

The recommended stencil thickness is at least 0.15 mm to 0.20 mm.

8.4 Solder Paste

The thickness of the solder paste and the flatness of the PCB are essential for the production yield.

It is recommended to use the same kind of leaded solder paste used during the production process of Neoway.

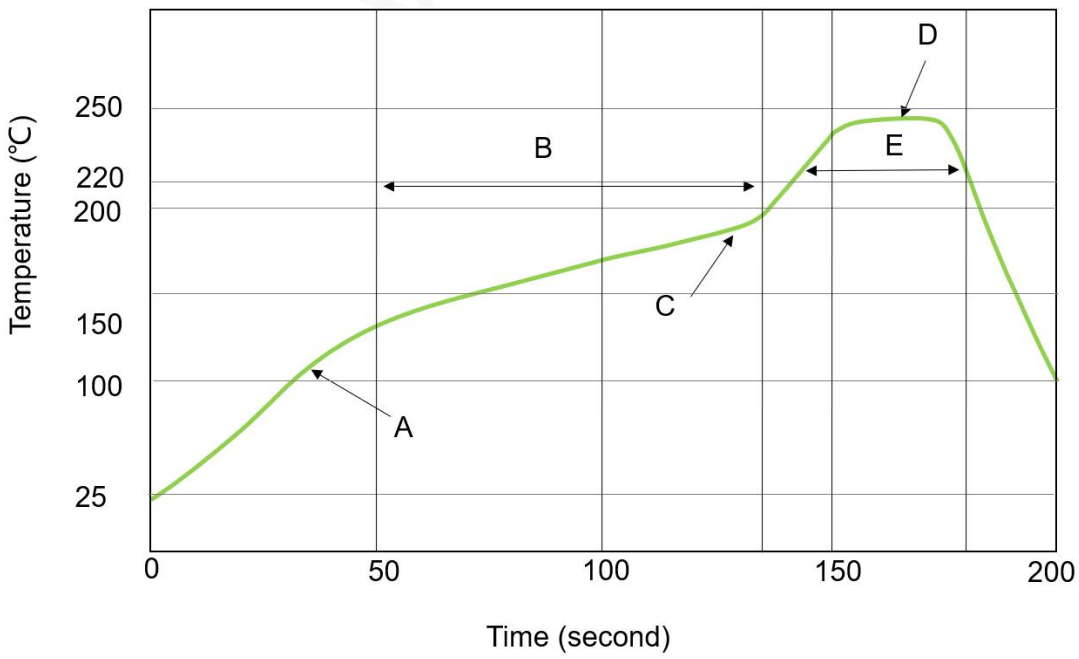
- The melting point of the leaded solder paste is 35℃ lower than that of the lead-free solder paste, and the temperature in the reflow process parameters is also lower than that of the lead-free solder paste. Therefore, the soldering time is shorter accordingly, which easily causes a false solder because LGA in the module is in a semi-melted state during the secondary reflow.
- 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.

8.5 SMT Oven Temperature Profile

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

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 8-3 Oven temperature profile



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 - 100s
- Reflow zone: >220°C, Time: 40 - 90s
- Peak temperature: 235 - 245°C

For information about cautions in storage and mounting, refer to *Neoway_Reflow_Soldering_Guidelines_For_Surface-Mounted_Modules*.

When manually desoldering the module, use heat guns with great opening, adjust the temperature to 245°C (depending on the type of the solder paste), and heat the module till the solder paste is melted. Then remove the module using tweezers. Do not shake the module at high temperatures while removing it. Otherwise, the components inside the module might get misplaced.

A Abbreviations

Abbreviation	Full name
ARM	Advanced RISC Machine
bps	Bits per Second
CCC	China Compulsory Certification
DC	Direct Current
DCS	Digital Cellular System
DI	Digital Input
DL	Downlink
DO	Digital Output
DRX	Discontinuous Reception
EGSM	Enhanced GSM
ESD	Electronic Static Discharge
EVK	Evaluation Kit
FDD	Frequency Division Duplexing
GNSS	Global Navigation Satellite System
3GPP	3rd Generation Partnership Project
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communications
I2C	Inter-Integrated Circuit
IO	Input/Output
LGA	Land Grid Array
LTE	Long Term Evolution
PCB	Printed Circuit Board
RAM	Random Access Memory
RF	Radio Frequency
ROM	Read-only Memory
SDIO	Secure Digital Input Output
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	Wide-band Code Division Multiple Access