

N77-GL

Product Specifications

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Notice

This document is specifically for N77-GL.

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 N77-GL.

Audience

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

Change History

| Issue | Date | Change | Changed By |
|-------|---------|------------------------|------------|
| 1.0 | 2023-06 | Initial draft | Li Xuzhe |
| 1.1 | 2025-01 | Adding CE&FCC warnings | Ben Li |

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. |
| i | Means note or tips for readers to use the module |

1 Safety Recommendations

Please read carefully and strictly adhere to the following safety recommendations to ensure that the product complies with national and environmental requirements, and to avoid potential threats to personal safety and protect the product and work environment from damage:

- Do not use in areas where there is a risk of fire or explosion.

Using the product in areas with flammable gases, such as propane, gasoline, or combustible sprays, or dust, can result in explosions or fires.

- In places where wireless communication is prohibited, please turn off the wireless communication function.

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

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

- Do not disassemble the product without authorization, otherwise, the product's after-sales warranty service cannot be provided.
- Please design the product correctly according to the Hardware User Guide. Please connect the product to a stable power supply voltage, and the wiring should comply with safety and fire prevention management requirements.
- Avoid touching the pins of the module directly in case of damages caused by ESD.
- Do not insert or remove the USIM card or mobile storage card while the product is not turned off.

2 About N77-GL

N77-GL is an industry-grade cellular module that supports GSM/EDGE, WCDMA, FDD-LTE (Cat 4), and TDD-LTE (Cat 4).

2.1 Product Overview

Table 2-1 lists the variant and frequency bands that N77-GL supports.

Table 2-1 Supported frequency bands

| Variant | Region | Category | Frequency band | GNSS |
|---------|--------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| GL | Global | Cat4 | FDD-LTE: B1, B2, B3, B4, B5, B7, B8, B12, B13, B17, B18, B19, B20, B26, B28, B66 TDD-LTE: B34, B38, B39, B40, B41 WCDMA: B1, B2, B5, B8 GSM/EDGE: 850/900/1800/1900 MHz | Not supported |

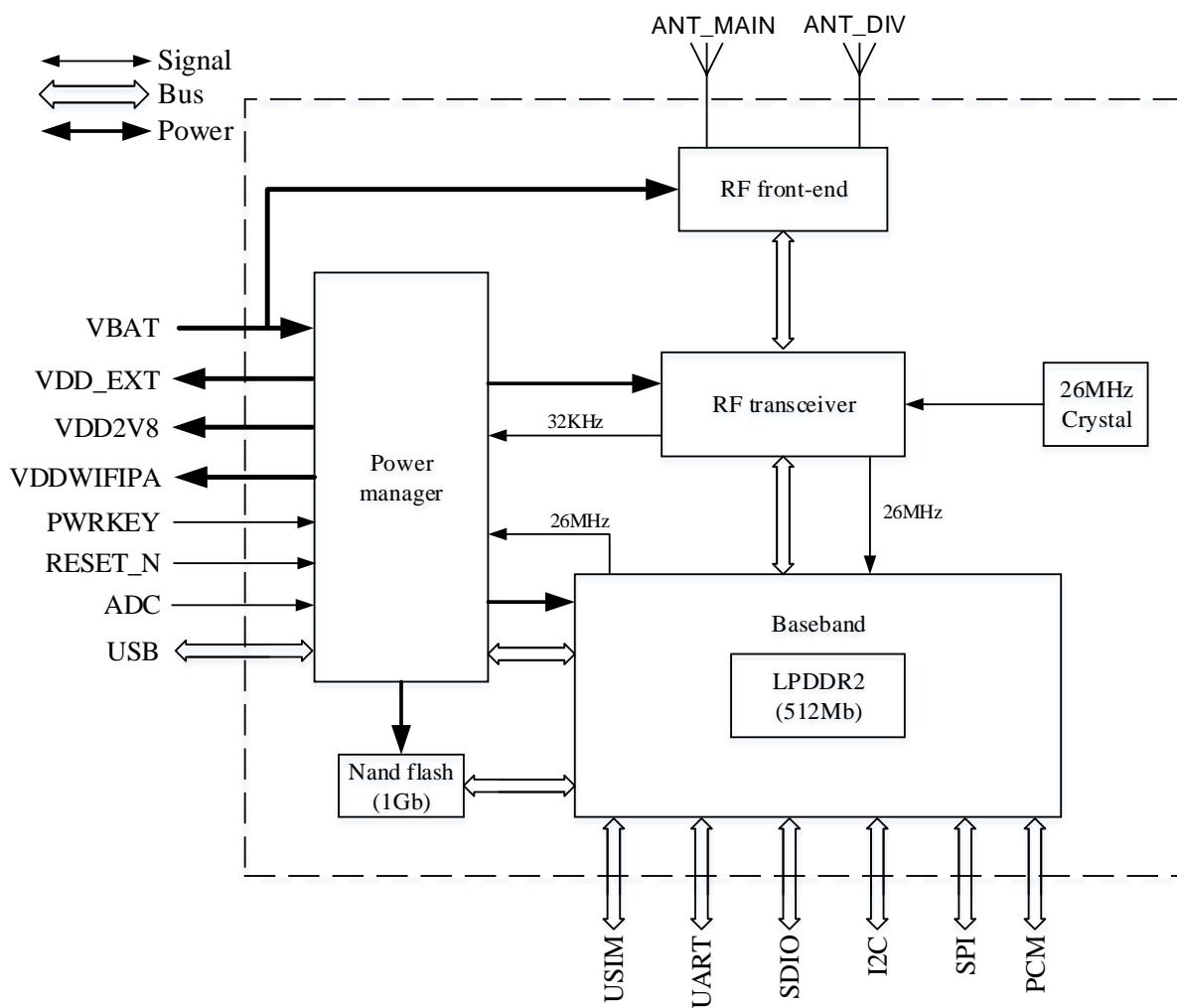
The N77-GL module has a total of 144 pins and uses LGA packaging with a size of (29.0 ± 0.1) mm \times (32.0 ± 0.1) mm \times (2.4 ± 0.2) mm. It has industrial-grade high performance and is suitable for developing IoT communication devices such as wireless meter reading terminals, vehicles, handheld POS, industrial routers, and so on.

2.2 Block Diagram

N77-GL consists of the following functionality units:

- Baseband chip
- 26 MHz crystal
- Power management
- Radio frequency unit
- Storage unit
- Digital interface (USIM, USB, UART, SDIO, I2C, SPI, PCM)
- Analog interface (ADC)

Figure 2-1 Block diagram



2.3 Basic Features

| Parameter | Description |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Physical features | <ul style="list-style-type: none"> Dimensions: $(29.0 \pm 0.1) \text{ mm} \times (32.0 \pm 0.1) \text{ mm} \times (2.4 \pm 0.2) \text{ mm}$ Package: LGA Weight: TBD |
| Temperature ranges | Operating: -30°C to $+75^\circ\text{C}$ Extended ¹ : -40°C to $+85^\circ\text{C}$ Storage: -40°C to $+90^\circ\text{C}$ |
| Operating | VBAT: 3.4 V to 4.2 V, typical value: 3.6 V |

extended temperature¹: The module can be registered on the network, but some indicators cannot meet 3GPP standards.

| | |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| voltage | Sleep mode ² : TBD |
| Operating current | Standby mode ³ : TBD Operating mode ⁴ (LTE mode): TBD |
| Application processor | ARM Cortex-A7 processor, with CPU clock speed up to 1.0 GHz, 64 KB L1 and 128 KB L2 cache. |
| Memory | RAM: 512 Mb ROM: 1 Gb |
| 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: HSDPA, Max 21 Mbps (DL) /Max 5.76 Mbps (UL) LTE-FDD: Cat4, Max 150 Mbps (DL)/Max 50 Mbps (UL) LTE-TDD: Cat4, Max 130 Mbps (DL)/Max 30 Mbps (UL) |
| Transmit power | GPRS 850/900 MHz: 33 ± 2 dBm (Power Class 4) GPRS 1800/1900 MHz: 30 ± 2 dBm (Power Class 1) EDGE 850/900 MHz: 27 ± 3 dBm (Power Class E2) EDGE 1800/1900 MHz: 26 ± 3 dBm (Power Class E2) WCDMA: 24+1/-3 dBm (Power Class 3) LTE: 23 ± 2 dBm (Power Class 3) |
| | 2G/3G/4G main antenna, 3G/4G diversity reception antenna The characteristic impedance of each antenna is 50Ω . |
| | Three UART interfaces, one of which is a Debug interface. |
| | Two I2C interfaces, for master mode only |
| Application interfaces | One SPI interface |
| | Two USIM interfaces, supporting either 1.8 V or 3.0 V USIM card. |
| | One USB2.0 interface |
| | Two SDIO 3.0 interface, with SDC1 used for WLAN and SDC2 used for SD cards. |
| | Two 11-bit ADC interfaces, with voltage detection ranging from 0.1 V to VBAT. |

Current in sleep mode² means the current drawn by the module in sleep mode, a low power consumption state, in which its RF function is functioning properly but its peripheral interfaces are disabled. If there is an incoming call or SMS, the module will exit from the sleep mode, and after the incoming call or voice instant messaging has ended, the module will re-enter the sleep mode.

Current in standby mode³: means the current drawn by the module in a normal operating mode, but no data service is being processed.

Current in operating mode⁴ 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.

| | |
|------------------------|------------------------------------------------|
| AT commands | 3GPP Release 11 Neoway extended AT commands |
| SMS | PDU, TXT |
| Data | PPP, ECM |
| Protocol | TCP, UDP, FTP, HTTP*/HTTPS* |
| Certification approval | RoHS, CE |

* means under development.

3 Reference Standards

N77-GL 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)

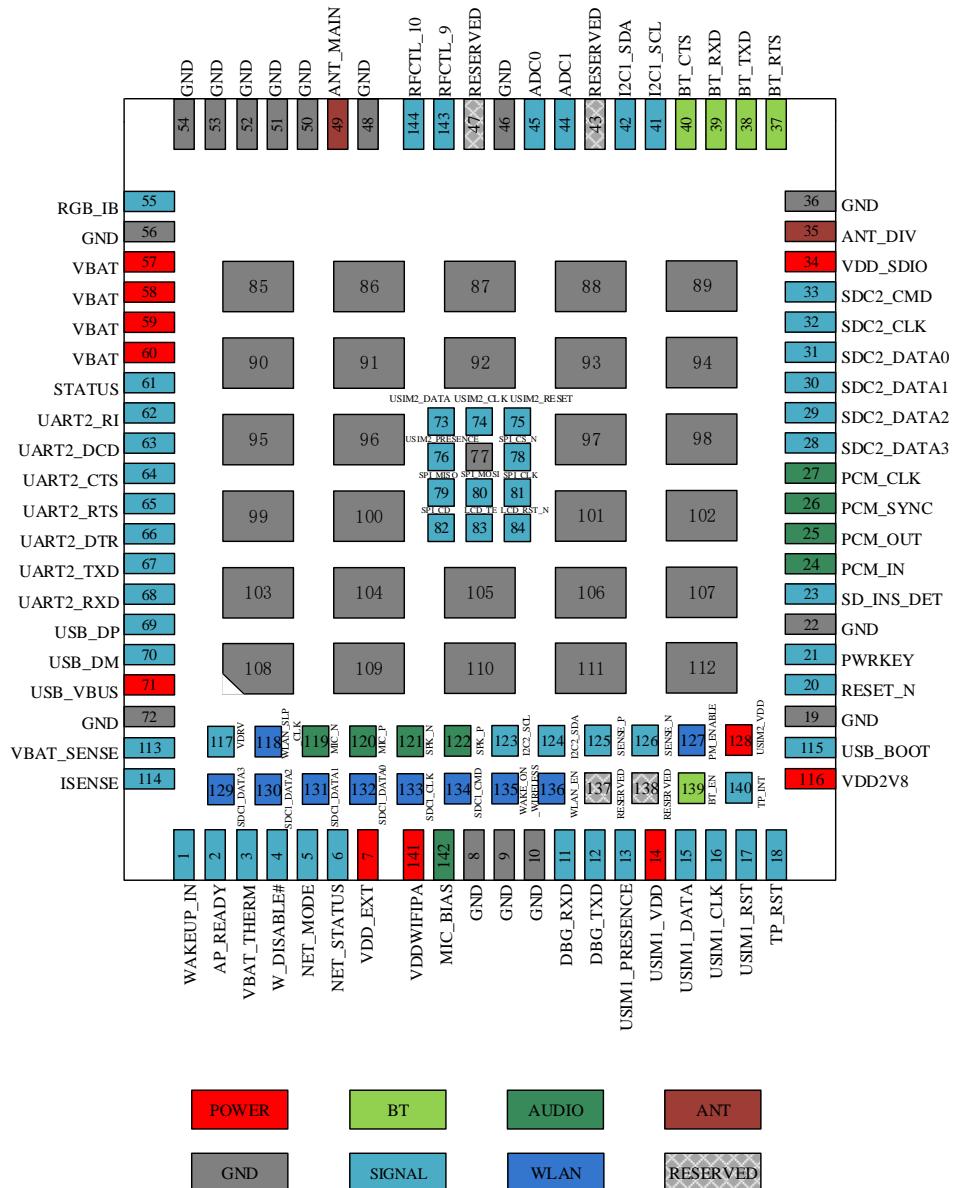
4 Pad Layout

There are 144 pins on N77-GL module and their pads are introduced in LGA package.

4.1 Pad Layout

Table 2-1 shows the N77-GL pad layout.

Figure 4-1 N77-GL pad layout (top view)

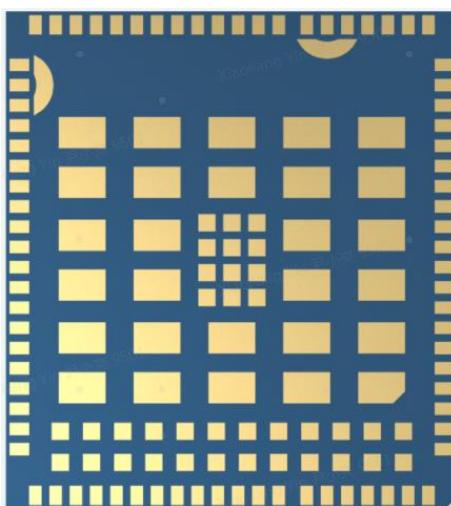


4.2 Module Appearance

Figure 4-2 Top view of N77-GL



Figure 4-3 Bottom view of N77-GL



The label and bottom views of the N77-GL module in the above picture are for reference only. Detailed information is in accordance with the final product.

5 Electrical Characteristics and Reliability

5.1 Electrical Characteristics



- If the voltage is lower than the 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.
- When using LDO or DC-DC to power the module, ensure that it can output at least 2.5 A of instantaneous current. The 2.5 A current corresponds to the maximum power level of the module during GSM mode, and the peak current during burst transmission only lasts for a short time. Placing a large capacitor at the VBAT pin of the module can effectively enhance the freewheeling current of the power supply, preventing abnormalities like module shutdown caused by excessive voltage drop.

Table 5-1 N77-GL operating conditions

| Parameter | Minimum value | Typical value | Max. value |
|-----------|---------------|---------------|------------|
| VBAT | V_{in} | 3.4 V | 3.6 V |
| | I_{in} | N/A | 2.5 A |

5.2 Temperature Characteristics

Table 5-2 N77-GL temperature characteristics

| Parameter | Minimum value | Typical value | Max. value |
|-----------|---------------|---------------|------------|
| Operating | -30°C | 25°C | 75°C |
| Extended | -40°C | 25°C | 85°C |
| Storage | -40°C | 25°C | 90°C |



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 after the temperature is restored, the RF index can be restored to meet the 3GPP standard.

5.3 ESD Protection Characteristics

To guarantee quality, electronic products are required to undergo comprehensive electrostatic discharge (ESD) testing. Therefore, it is crucial to take into account the electrostatic protection capabilities of the primary module pins during the design of related products. The following is the ESD protection characteristic data of this module. When designing related products, you need to add appropriate ESD protection according to the industry, depending on the industry in which the product will be used to prevent damage and ensure optimal performance.

Test environment: humidity 45%; temperature 25°C

Table 5-3 N77-GL ESD protection characteristics

| Contact point | Contact discharge | Air discharge |
|-----------------|-------------------|---------------|
| GND | TBD | TBD |
| ANT | TBD | TBD |
| Shielding cover | TBD | TBD |

6 RF Characteristics

The N77-GL module can provide connectivity on GSM, WCDMA, FDD-LTE (Cat4), and TDD-LTE (Cat4) networks. This chapter introduces the RF characteristics of N77-GL.

6.1 Operating Frequency Bands

Table 6-1 N77-GL operating frequency bands

| Operating band | Uplink | Downlink |
|----------------|-----------------|-----------------|
| GSM850 | 824 - 849 MHz | 869 - 894 MHz |
| EGSM900 | 880 - 915 MHz | 925 - 960 MHz |
| DCS1800 | 1710 - 1785 MHz | 1805 - 1880 MHz |
| PCS1900 | 1850 - 1910 MHz | 1930 - 1990 MHz |
| WCDMA B1 | 1920 - 1980 MHz | 2110 - 2170 MHz |
| WCDMA B2 | 1850 - 1910 MHz | 1930 - 1990 MHz |
| WCDMA B5 | 824 - 849 MHz | 869 - 894 MHz |
| WCDMA B8 | 880 - 915 MHz | 925 - 960 MHz |
| FDD-LTE B1 | 1920 - 1980 MHz | 2110 - 2170 MHz |
| FDD-LTE B2 | 1850 - 1910 MHz | 1930 - 1990 MHz |
| FDD-LTE B3 | 1710 - 1785 MHz | 1805 - 1880 MHz |
| FDD-LTE B4 | 1710 - 1755 MHz | 2110 - 2155 MHz |
| FDD-LTE B5 | 824 - 849 MHz | 869 - 894 MHz |
| FDD-LTE B7 | 2500 - 2570 MHz | 2620 - 2690 MHz |
| FDD-LTE B8 | 880 - 915 MHz | 925 - 960 MHz |
| FDD-LTE B12 | 699 - 716 MHz | 729 - 746 MHz |
| FDD-LTE B13 | 777 - 787 MHz | 746 - 756 MHz |
| FDD-LTE B17 | 704 - 716 MHz | 734 - 746 MHz |
| FDD-LTE B18 | 815 - 830 MHz | 860 - 875 MHz |
| FDD-LTE B19 | 830 - 845 MHz | 875 - 890 MHz |
| FDD-LTE B20 | 832 - 862 MHz | 791 - 821 MHz |

| | | |
|-------------|-----------------|-----------------|
| FDD-LTE B26 | 814 - 849 MHz | 859 - 894 MHz |
| FDD-LTE B28 | 703 - 748 MHz | 758 - 803 MHz |
| TDD-LTE B34 | 2010 - 2025 MHz | 2010 - 2025 MHz |
| TDD-LTE B38 | 2570 - 2620 MHz | 2570 - 2620 MHz |
| TDD-LTE B39 | 1880 - 1920 MHz | 1880 - 1920 MHz |
| TDD-LTE B40 | 2300 - 2400 MHz | 2300 - 2400 MHz |
| TDD-LTE B41 | 2496 - 2690 MHz | 2496 - 2690 MHz |
| FDD-LTE B66 | 1710 - 1780 MHz | 2110 - 2180 MHz |

6.2 TX Power and RX Sensitivity

Table 6-2 N77-GL RFTX power

| Band | Max power | Min. power |
|-------------|----------------|------------|
| GSM850 | 33 dBm±2 dB | 5 dBm±5 dB |
| EGSM900 | 33 dBm±2 dB | 5 dBm±5 dB |
| DCS1800 | 30 dBm±2 dB | 0 dBm±5 dB |
| PCS1900 | 30 dBm±2 dB | 0 dBm±5 dB |
| WCDMA B1 | 24 dBm+1/-3 dB | < -50 dBm |
| WCDMA B2 | 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 dB | < -39 dBm |
| FDD-LTE B2 | 23 dBm±2 dB | < -39 dBm |
| FDD-LTE B3 | 23 dBm±2 dB | < -39 dBm |
| FDD-LTE B4 | 23 dBm±2 dB | < -39 dBm |
| FDD-LTE B5 | 23 dBm±2 dB | < -39 dBm |
| FDD-LTE B7 | 23 dBm±2 dB | < -39 dBm |
| FDD-LTE B8 | 23 dBm±2 dB | < -39 dBm |
| FDD-LTE B12 | 23 dBm±2 dB | < -39 dBm |
| FDD-LTE B13 | 23 dBm±2 dB | < -39 dBm |
| FDD-LTE B17 | 23 dBm±2 dB | < -39 dBm |

| | | |
|-------------|-------------|-----------|
| FDD-LTE B18 | 23 dBm±2 dB | < -39 dBm |
| FDD-LTE B19 | 23 dBm±2 dB | < -39 dBm |
| FDD-LTE B20 | 23 dBm±2 dB | < -39 dBm |
| FDD-LTE B26 | 23 dBm±2 dB | < -39 dBm |
| FDD LTE B28 | 23 dBm±2 dB | < -39 dBm |
| TDD-LTE B34 | 23 dBm±2 dB | < -39 dBm |
| TDD-LTE B38 | 23 dBm±2 dB | < -39 dBm |
| TDD-LTE B39 | 23 dBm±2 dB | < -39 dBm |
| TDD-LTE B40 | 23 dBm±2 dB | < -39 dBm |
| TDD-LTE B41 | 23 dBm±2 dB | < -39 dBm |
| FDD-LTE B66 | 23 dBm±2 dB | < -39 dBm |

Table 6-3 RF sensitivity of N77-GL

| Band | RX sensitivity |
|-------------|----------------|
| GSM850 | ≤ -107 dBm |
| EGSM900 | ≤ -107 dBm |
| DCS1800 | ≤ -107 dBm |
| PCS1900 | ≤ -107 dBm |
| WCDMA B1 | ≤ -107 dBm |
| WCDMA B2 | ≤ -107 dBm |
| WCDMA B5 | ≤ -107 dBm |
| WCDMA B8 | ≤ -107 dBm |
| FDD-LTE B1 | ≤ -97 dBm |
| FDD-LTE B2 | ≤ -95 dBm |
| FDD-LTE B3 | ≤ -94 dBm |
| FDD-LTE B4 | ≤ -97 dBm |
| FDD-LTE B5 | ≤ -95 dBm |
| FDD-LTE B7 | ≤ -95 dBm |
| FDD-LTE B8 | ≤ -94 dBm |
| FDD-LTE B12 | ≤ -94 dBm |
| FDD-LTE B13 | ≤ -94 dBm |
| FDD-LTE B17 | ≤ -94 dBm |

| | |
|-------------|-------------|
| FDD-LTE B18 | ≤ -97 dBm |
| FDD-LTE B19 | ≤ -97 dBm |
| FDD-LTE B20 | ≤ -94 dBm |
| FDD-LTE B26 | ≤ -94.5 dBm |
| FDD-LTE B28 | ≤ -95.5 dBm |
| TDD-LTE B34 | ≤ -97 dBm |
| TDD-LTE B38 | ≤ -97 dBm |
| TDD-LTE B39 | ≤ -97 dBm |
| TDD-LTE B40 | ≤ -97 dBm |
| TDD-LTE B41 | ≤ -95 dBm |
| FDD-LTE B66 | ≤ -96.5 dBm |



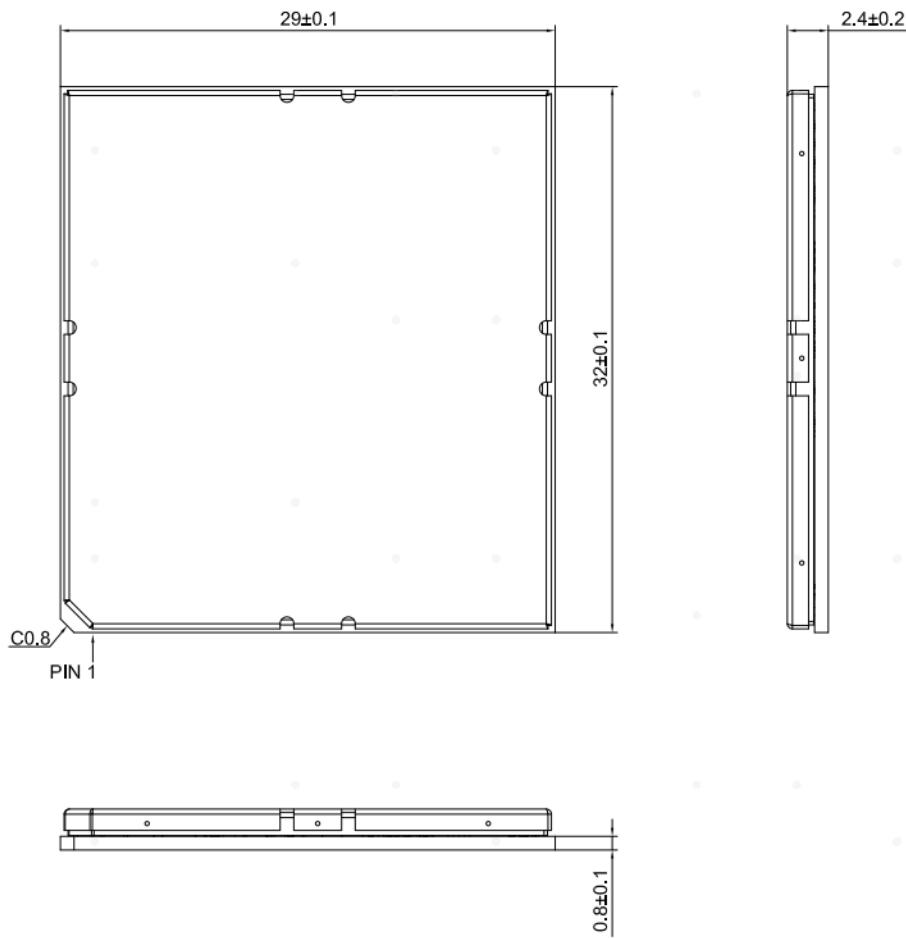
The preceding indexes are test data in a laboratory environment. The test results of LTE in a bandwidth of 10MHz will have a certain deviation due to the influence of the network environment.

7 Mechanical Characteristics

This chapter introduces mechanical characteristics of N77-GL.

7.1 Dimensions

Figure 7-1 N77-GL top and side view dimensions (unit: mm)



7.2 Labeling

The label information is laser carved on the cover. The following figure shows the label of N77-GL.



The picture above is only for reference.

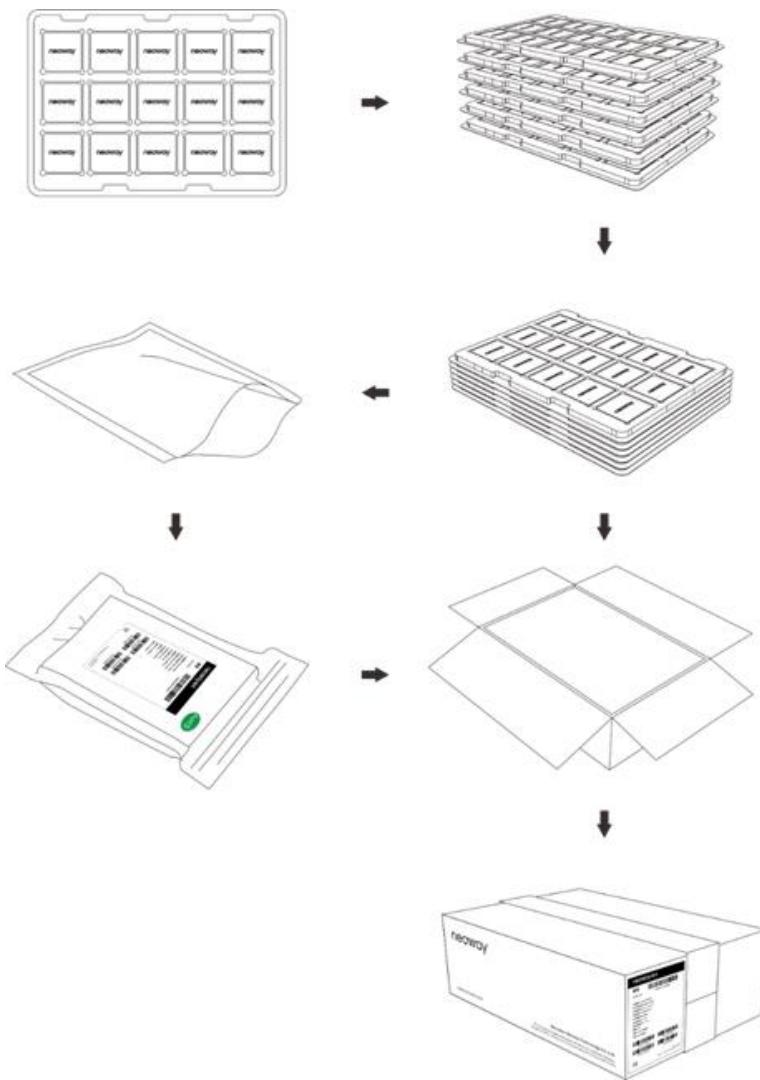
7.3 Packaging

N77-GL adopts the SMD reflow soldering process for electronics assembly. The modules are delivered in trays, which are packed in vacuumed moisture-proof aluminium foil bag. To ensure the dryness of the product and prolong their service life, the bag also holds desiccant and a humidity indicator card.

7.3.1 Tray

Neoway modules are delivered on trays as shown below:

Figure 7-2 N77-GL packaging



The above figure is for reference only. For authentic appearance, please refer to the module that you receive from Neoway.

7.3.2 Moisture Sensitivity Level



N77-GL is a level 3 moisture-sensitive electronic element, in compliance IPC/ JEDEC J-STD-020 standard.

After unpacking, avoid leaving the module exposed to air for too long. If exposed to air for a prolonged period, the module could become damp, increasing the risk of damage 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 temperatures 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 package tray directly.

8 Mounting N77-GL onto Application Board

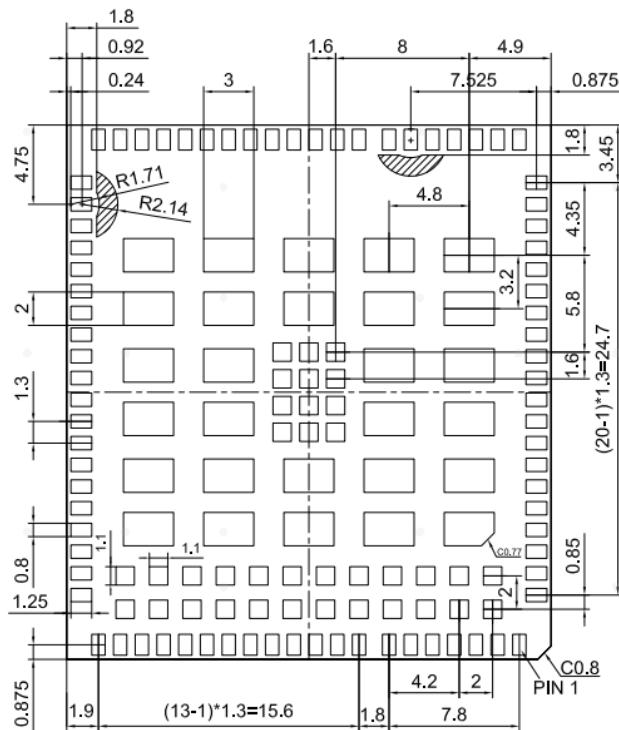
The N77-GL module is assembled using the 144-pin LGA package and SMT soldering method.

8.1 PCB Package



- To ensure proper operation of the module, only GND via-holes and copper pouring are allowed within the shaded area "■" of the PCB package.
- To achieve higher yield during module production, it is recommended that the distance between other components on the PCB board and the module pads be at least 3 mm to avoid the risk of tin connection when using stepped stencil.

Figure 8-1 Bottom view of N77-GL PCB package (unit: mm)



8.2 Stencil

It is recommended to use stencil thickness of at least 0.15 mm to 0.20 mm (0.18 mm recommended), which can be adjusted as per the actual SMT situation.

8.3 Solder Paste

The thickness of solder paste and the flatness of 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°C 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 time above 220°C (reflow temperature) exceeds 45 seconds and the peak temperature does not exceed 240°C.

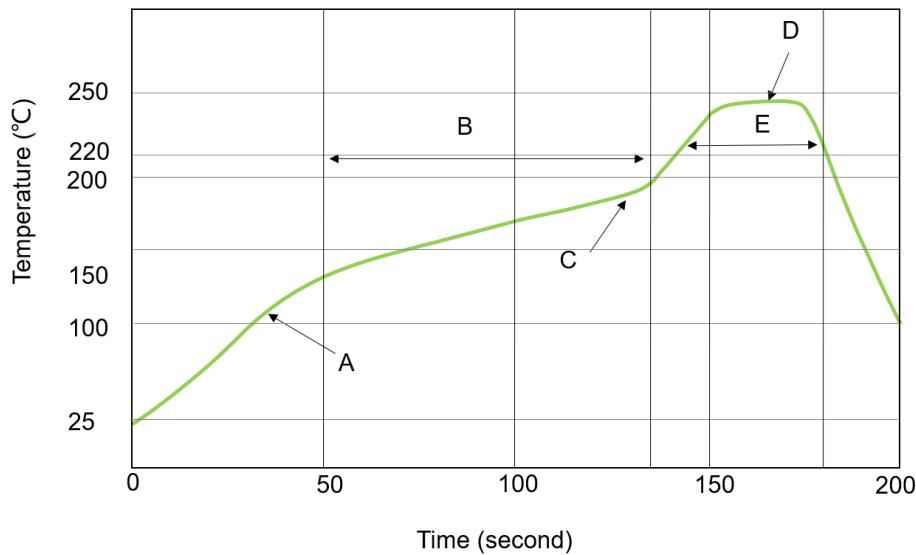
8.4 Oven Temperature Profile



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

If the PCB is large, it is important to avoid bending of the printed circuit material during an SMT process. So a bending prevention tool must be placed on the bottom of the printed circuit board. It is recommended to use loading tools during the SMT and reflow soldering process to avoid poor solder joint caused by PCB bending.

Figure 8-2 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 removing a module from your application's PCB board, it is important to use heat guns with large openings. Adjust the temperature to about 245°C (depending on the type of solder paste used) and heat the module until the solder paste melts. Use tweezers to remove the module, being careful not to shake it at high temperatures. Shaking the module may cause components inside to become misplaced.

9 Warnings

9.1 CE warnings

This equipment complies with CE radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.

The simplified EU declaration of conformity referred to in Article 10(9) shall be provided as follows: Hereby, neoway declares that the radio equipment type [designation of type of radio equipment] is in compliance with Directive 2014/53/EU.

9.2 FCC warnings

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.

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 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.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device is intended only for OEM integrators under the following conditions: (For module device use)

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna. As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains FCC ID: PJ7-N77-GL". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re- evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

OEM/Integrators Installation Manual

Important Notice to OEM integrators 1. This module is limited to OEM installation ONLY. 2. This module is limited to installation in mobile or fixed applications, according to Part 2.1091(b). 3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations 4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part 15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are compliant with the transmitter(s) rule(s). The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

Antenna

- (1) The antenna must be installed such that 20 cm is maintained between the antenna and users,
- (2) The transmitter module may not be co-located with any other transmitter or antenna.

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC/IC authorization is no longer considered valid and

the FCC ID/IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC/IC authorization. To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, maximum antenna gain (including cable loss) must not exceed 1.5dBi

List of applicable FCC rules :

This module has been tested and found to comply with part 22, part 24, part 27, part 90, requirements for Modular Approval. The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

10 Abbreviations

| Abbreviation | Full name |
|--------------|-----------------------------------------|
| AI | Analog Input |
| AO | Analog Output |
| ARM | Advanced RISC Machine |
| Bps | Bits per Second |
| CCC | China Compulsory Certification |
| CS | Chip Select |
| CTS | Clear to Send |
| 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 |
| ESR | Equivalent Series Resistance |
| EVK | Evaluation Kit |
| FDD | Frequency Division Duplexing |
| GNSS | Global Navigation Satellite System |
| GPIO | General Purpose Input Output |
| 3GPP | 3rd Generation Partnership Project |
| GPRS | General Packet Radio Service |
| GSM | Global System for Mobile Communications |
| I2C | Inter-Integrated Circuit |
| IO | Input/Output |
| LCC | Leadless Chip Carriers |
| LED | Light Emitting Diode |

| | |
|-------|---------------------------------------------|
| LGA | Land Grid Array |
| LTE | Long Term Evolution |
| MCLK | Main Clock |
| MCU | Microcontroller Unit |
| PCB | Printed Circuit Board |
| PWM | Pulse Width Modulation |
| 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 |
| WiFi | Wireless Fidelity |
| WCDMA | Wide-band Code Division Multiple Access |
| WLAN | Wireless Local Area Network |