# N10 Series_Hardware Design

**GNSS Module Series**

**Version：** V1.9

**Date：** 2020-06-09



Shanghai Mobiletek Communication Ltd

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# Version History

| Date | Version | Modify records | Author |
|---|---|---|---|
| 2016-06-12 | V1.0 | Origin | Xuliangbo |
| 2016-08-30 | V1.1 | Modify page header Table Description | Xuliangbo |
| 2016-09-07 | V1.2 | Modify the design of Table | Xuliangbo |
| 2016-09-26 | V1.3 | Modify mechanical dimensions | Xuliangbo |
| 2016-10-12 | V1.4 | Optimized layout format | Xuliangbo |
| 2017-02-22 | V1.5 | Add description of BD2 performance<br>Modify the Power domain of VCC_RF | Xuliangbo |
| 2017-08-09 | V1.6 | Modify Note 1 Description | Xuliangbo |
| 2017-09-29 | V1.7 | Modify storage temperature<br>Update Pin8 description<br>Update the company log<br>Modify the picture of module<br>Add product label description<br>Modify the voltage domain of VCC_RF | Xuliangbo |
| 2019-06-03 | V1.8 | Series of compatible:N10/N10B/N10B-M<br>Modify the table 2-1<br>Add 2.4 GNSS module system configuration and 2.1 NOTE | Lintianpan |
| 2020-06-09 | V1.9 | Add N10B-H<br>Delete Alwayslocate mode | Jason.Liao |



 

# CONTENT

# 1. Introduction

The N10 series modules includes:N10/N10B/N10B-M/N10B-H. This document describes the hardware interface of the MOBILETEK module N10 series which can be used as a GNSS or A-GPS （Assisted Global Positioning System） receiver. As a wide range of applications can be integrated in N10 series, all functional components of N10 series are described in great detail.

# 2. N10 Series Overview

N10 series is a GNSS or A-GPS receiver. With built-in LNA, N10 series don't need for external LNA. N10 series can track as low as -165dBm signal even without assistance network (up to 45dB C/N of SVs in open sky).

N10 series has excellent low power consumption characteristic.N10 series supports various location and navigation applications, including autonomous GPS/Galileo/Glonass/BD2/QZSS/SBAS (WAAS, EGNOS, GAGAN, MSAS), DGPS and A-GPS.

Table2-1 N10 series module configuration differences

| **Module** | **N10** | **N10B** | **N10B-M** | **N10B-H** |
|---|---|---|---|---|
| Configuration | GPS+QZSS | GPS+QZSS+BD2/GPS+QZSS+GLONASS | GPS+QZSS+BD2 | GPS+QZSS+GLONASS |
| Maximum update rate | 5Hz | 10 Hz (w/o ading), 5 Hz (with ading) | | |
| Receiver type | 22 tracking / 66 acquisition | 33 tracking / 99 acquisition | | |
| 5 PIN | EXTINT | EXTINT | NC | NC |
| 16 PIN | NC | TXD1/SDA | NC | NC |

| | | | | |
|---|---|---|---|---|
| Platform | MT3337 | MT3333 | AG3331 | AG3331 |
| Baud rate | 9600 bps | 9600/115200 bps | | |
| SBAS | Not support | Support | | |

Key Features

- Small footprint: 10 .1x 9.7 x 2.5mm, 18-pin LCC package
- 12 multi-tone active interference cancellers and jamming elimination
- Indoor and outdoor multi-path detection and compensation
- Advanced software features
    1. EASY™ self-generated orbit prediction for instant positioning fix
    2. AGPS Support for Fast TTFF(EPO orbit prediction)
    3. Supports logger function
    4. Supports active interference cancellation (AIC)
- Pulse-per-second (PPS) GNSS time reference

  Adjustable duty cycle

  Typical accuracy: ±10ns
- Interface

  UART0 (Default) / UART1 (Special version configurable)
- Operating temperature: -40 ~ +85ºC
- Accuracy <2.5m CEP
- ROHS compliant

The module provides complete signal processing from antenna input to host port in either NMEA messages. The module requires 3.0V~4.3V power supply. The host port is configurable to UART. Host data and I/O signal levels are 2.85V CMOS compatible.



 

## 2.1 N10 Series Functional Diagram

The following figure shows a functional diagram of the N10 series and illustrates the mainly functional parts:

- The GNSS chip
- SAW filter
- LNA
- The antenna interface
- The communication interface
- The control signals

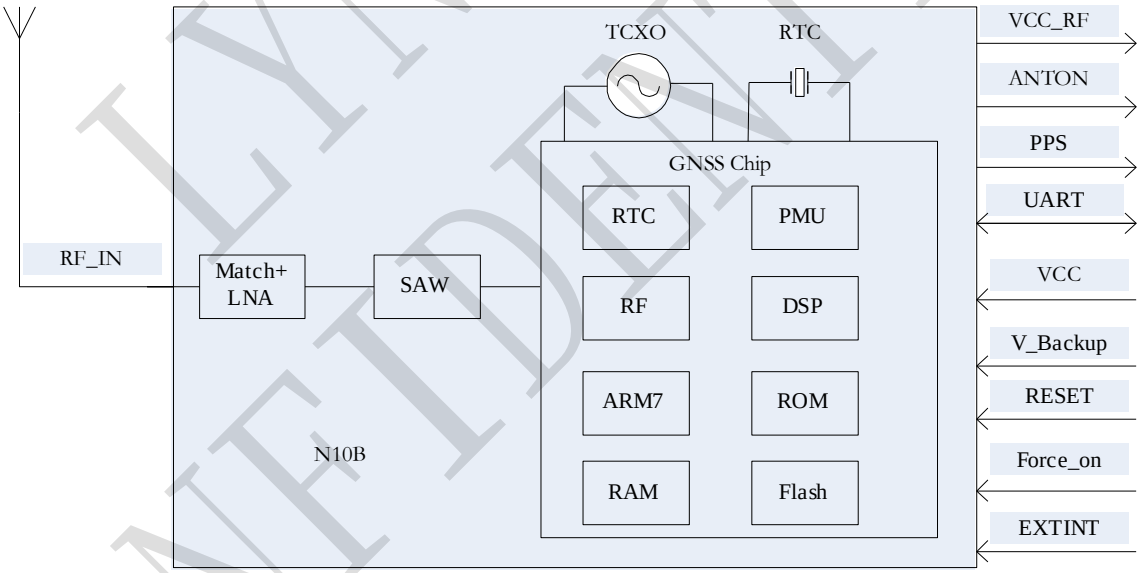


Figure 2-1 N10 series functional diagram

NOTE:The EXTINT interface is not supported by N10B-M and N10B-H.

## 2.2 GNSS Performance

Table 2-2 GNSS performance

| Item | Parameter | Description | Performance | | | |
|---|---|---|---|---|---|---|
| | | | Min | Type | Max | Unit |
| N10 | Horizontal Position Accuracy(1) | Autonomous | | <2.5 | | m |
| | Velocity Accuracy(2) | Without Aid | | 0.1 | | m/s |
| | Acceleration Accuracy | Without Aid | | 0.1 | | $m/s^2$ |
| | Timing Accuracy | | | 10 | | ns |
| | Dynamic Performance | Maximum Altitude | | | 18000 | m |
| | | Maximum Velocity | | | 515 | m/s |
| | | Maximum Acceleration | | | 4 | G |
| | Time To First Fix(3) without Easy™ | Hot start | | <1 | | s |
| | | Warm start | | 30 | | s |
| | | Cold start | | 32 | | s |
| | TTFF with EASY™ | Hot start | | <1 | | s |
| | | Warm start | | 5 | | s |
| | | Cold start | | 15 | | s |
| | Sensitivity(3) | Autonomous acquisition(cold start) | | -148 | | dBm |
| | | Re-acquisition | | -160 | | dBm |
| | | Tracking | | -165 | | dBm |
| | Receiver | Channels | | 88 | | |
| | | Update rate | | 1 | 5 | Hz |
| | | Tracking L1, CA Code | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Protocol support NMEA,PMTK | | | | |
| | Power consumption(4) | Acquisition | | 18 | | mA |
| | | Continuous tracking | | 16 | | mA |
| | | Standby current | | 340 | | uA |
| | | Backup current | | 8 | | uA |
| N10B | Horizontal Position Accuracy(1) | Autonomous | | <2.5 | | m |
| | Velocity Accuracy(2) | Without Aid | | 0.1 | | m/s |
| | | DGPS | | 0.05 | | m/s |
| | Acceleration Accuracy | Without Aid | | 0.1 | | m/s2 |
| | | DGPS | | 0.05 | | m/s2 |
| | Timing Accuracy | | | 10 | | ns |
| | Dynamic Performance | Maximum Altitude | | | 18000 | m |
| | | Maximum Velocity | | | 515 | m/s |
| | | Maximum Acceleration | | | 4 | G |
| | GPS Time To First Fix(3) | Hot start | | <1 | | s |
| | | Warm start | | 30 | | s |
| | | Cold start | | 35 | | s |
| | BD2 Time To First Fix(3) | Hot start | | <1 | | s |
| | | Warm start | | 29 | | s |
| | | Cold start | | 36 | | s |
| | GPS+Glonass Time To First Fix(3) | Hot start | | <1 | | s |
| | | Warm start | | 23 | | s |
| | | Cold start | | 25 | | s |
| | GPS+BD2 Time To First Fix(3) | Hot start | | <1 | | s |
| | | Warm start | | 26 | | s |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Cold start | | 28 | | s |
| | A-GPS TTFF(EASY™ mode) | Hot start | | <1 | | s |
| | | Warm start | | 1.5 | | s |
| | | Cold start | | 15 | | s |
| | A-GPS TTFF(EPO mode) | Hot start | | <1 | | s |
| | | Warm start | | 2 | | s |
| | | Cold start | | 14 | | s |
| | GPS Sensitivity(5) | Autonomous acquisition(cold start) | | -148 | | dBm |
| | | Re-acquisition | | -160 | | dBm |
| | | Tracking | | -165 | | dBm |
| | BD2 Sensitivity(5) | Autonomous acquisition(cold start) | | -142 | | dBm |
| | | Re-acquisition | | -155 | | dBm |
| | | Tracking | | -160 | | dBm |
| | GPS+BD2 Sensitivity(5) | Autonomous acquisition(cold start) | | -148 | | dBm |
| | | Re-acquisition | | -160 | | dBm |
| | | Tracking | | -165 | | dBm |
| | GPS+Glonass Sensitivity(5) | Autonomous acquisition(cold start) | | -148 | | dBm |
| | | Re-acquisition | | -160 | | dBm |
| | | Tracking | | -165 | | dBm |
| | Receiver | Channels | | 132 | | |
| | | Update rate | | 1 | 10 | Hz |
| | | Tracking L1, CA Code | | | | |
| | | Protocol support NMEA,PMTK | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | GPS Power consumption(4) | Acquisition | | 20 | | mA |
| | | Continuous tracking | | 19 | | mA |
| | | Sleep current | | 340 | | uA |
| | | Backup current | | 14 | | uA |
| | BD2 Power consumption(4) | Acquisition | | 23 | | mA |
| | | Continuous tracking | | 21 | | mA |
| | | Sleep current | | 340 | | uA |
| | | Backup current | | 14 | | uA |
| | GPS+BD2 Power consumption(4) | Acquisition | | 30 | | mA |
| | | Continuous tracking | | 26 | | mA |
| | | Sleep current | | 340 | | uA |
| | | Backup current | | 14 | | uA |
| | GPS+Glonass Power consumption(4) | Acquisition | | 27 | | mA |
| | | Continuous tracking | | 22 | | mA |
| | | Standby current | | 340 | | uA |
| | | Backup current | | 14 | | uA |
| N10B-M | Horizontal Position Accuracy(1) | Autonomous | | <2.5 | | m |
| | Velocity Accuracy(2) | Without Aid | | 0.1 | | m/s |
| | Acceleration Accuracy | Without Aid | | 0.1 | | $m/s^2$ |
| | Timing Accuracy | | | 10 | | ns |
| | Dynamic Performance | Maximum Altitude | | | 18000 | m |
| | | Maximum Velocity | | | 515 | m/s |
| | | Maximum Acceleration | | | 4 | G |
| | GPS+BD2 Time To First Fix(3) | Hot start | | <1 | | s |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Warm start | | 29 | | s |
| | | Cold start | | 31 | | s |
| | A-GPS TTFF(EASY™ mode) | Hot start | | <1 | | s |
| | | Warm start | | 1.5 | | s |
| | | Cold start | | 15 | | s |
| | A-GPS TTFF(EPO mode) | Hot start | | <1 | | s |
| | | Warm start | | 2 | | s |
| | | Cold start | | 14 | | s |
| | GPS+BD2 Sensitivity(5) | Autonomous acquisition(cold start) | | -147 | | dBm |
| | | Re-acquisition | | -158 | | dBm |
| | | Tracking | | -161 | | dBm |
| | Receiver | Channels | | 88 | | |
| | | Update rate | | 1 | 5 | Hz |
| | | Tracking L1, CA Code | | | | |
| | | Protocol support NMEA,PMTK | | | | |
| | GPS+BD2 Power consumption(4) | Acquisition | | 25 | | mA |
| | | Continuous tracking | | 22 | | mA |
| | | Standby current | | 360 | | uA |
| | | Backup current | | 7 | | uA |
| N10B-H | Horizontal Position Accuracy(1) | Autonomous | | <2.5 | | m |
| | Velocity Accuracy(2) | Without Aid | | 0.1 | | m/s |
| | Acceleration Accuracy | Without Aid | | 0.1 | | $m/s^2$ |
| | Timing Accuracy | | | 10 | | ns |
| | Dynamic Performance | Maximum Altitude | | | 18000 | m |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Maximum Velocity | | | 515 | m/s |
| | | Maximum Acceleration | | | 4 | G |
| | GPS+GLonass Time To First Fix(3) | Hot start | | <1 | | s |
| | | Warm start | | 25 | | s |
| | | Cold start | | 28 | | s |
| | A-GPS TTFF(EASY™ mode) | Hot start | | <1 | | s |
| | | Warm start | | 1.5 | | s |
| | | Cold start | | 15 | | s |
| | A-GPS TTFF(EPO mode) | Hot start | | <1 | | s |
| | | Warm start | | 2 | | s |
| | | Cold start | | 14 | | s |
| | GPS+GLonass Sensitivity(5) | Autonomous acquisition(cold start) | | -147 | | dBm |
| | | Re-acquisition | | -157 | | dBm |
| | | Tracking | | -163 | | dBm |
| | Receiver | Channels | | 88 | | |
| | | Update rate | | 1 | 5 | Hz |
| | | Tracking L1, CA Code | | | | |
| | | Protocol support NMEA,PMTK | | | | |
| | GPS+GLonass Power consumption(4) | Acquisition | | 24 | | mA |
| | | Continuous tracking | | 22 | | mA |
| | | Standby current | | 360 | | uA |
| | | Backup current | | 7 | | uA |

(1) 50% 24hr static, -130dBm

(2) 50% at 30m/s

(3) –130dBm, GPS&Glonass&BD2 mode

(4) Single Power supply 3.3V under GPS/BD2/ GPS+Glonass/BD2 signal@-130dBm

(5) Single Power supply 3.3V under GPS/BD2/ GPS+Glonass/BD2 signal

# 3. Package Information

## 3.1 Pin Out Diagram

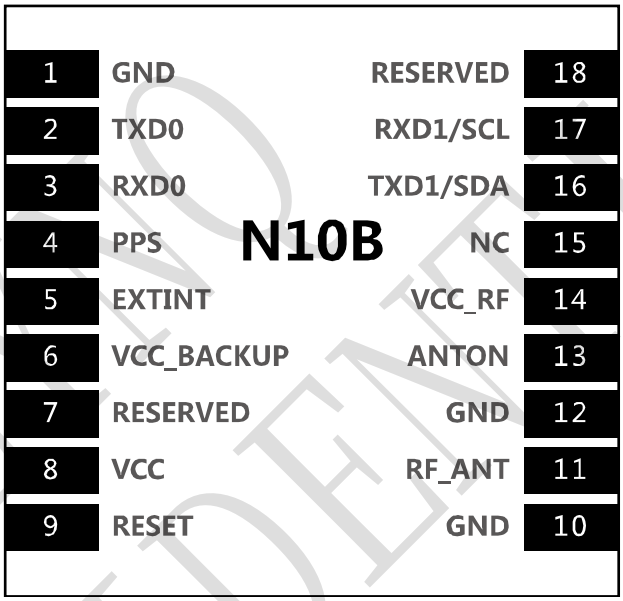


Figure 3-1 N10 series pin out diagram (Top view)

## 3.2 Pin Description

Table 3-1 Pin description

| Pin name | Pin number | I/O | Description | Comment |
|---|---|---|---|---|
| **Power supply** | | | | |
| VCC | 8 | I | Main power input, Typical: 3.3V. Recommend LDO as VCC, ripple rejection: >60dB@1kHz | Add a 4.7uF capacitor to this pin for decoupling. |
| ANTON | 13 | O | 2.8V power output supply for active antenna or external LNA control pin for power save | If unused, keep open. |
| VCC_RF | 14 | O | Power supply for active antenna or | If unused, keep open. |

| | | | | |
|---|---|---|---|---|
| | | | external LNA | |
| VCC_BACKUP | 6 | I | The backup battery input power supply for RTC 2.0V~4.3V, Typical 3.0V | If unused, keep open. |
| GND | 1 10 12 | | Ground | |
| **Host port interface** | | | | |
| TXD0 | 2 | O | Serial data output of NMEA | |
| RXD0 | 3 | I | Serial data input for firmware update | |
| TXD1/SDA | 16 | I/O | Serial output as RTCM | I2C requires a special version, please contact MOBILETEK |
| RXD1/SCL | 17 | I | Serial input as RTCM | |
| **GPIOS** | | | | |
| PPS | 4 | O | 1PPS Time Mark Output 2.85V CMOS Level ,timing pulse related to receiver time | If unused, keep open. |
| RESET | 9 | I | Reset input, active low, default pull-up | If unused, keep open. |
| EXTINT(NC) | 5 | I | This interrupt source could act as wake up event during power saving mode. | If unused, keep open.<br>Not supported by N10B-M, N10B-H please keep open. |
| RESERVED (FORCE_ON) | 18 | I | Logic high will Force module to be waked up from backup mode | Keep this pin open or pulled low before Entering into backup mode. If unused, keep open |
| **RF interface** | | | | |
| RF_ANT | 11 | I | GNSS antenna port | Impendence must be controlled to 50Ω. |
| **Other interface** | | | | |
| RESERVED/ NC | 7 15 | | Not Connected | |

## 3.3 Package Dimensions

Following figure shows the Mechanical dimensions of N10 series (top view, side view and bottom view).

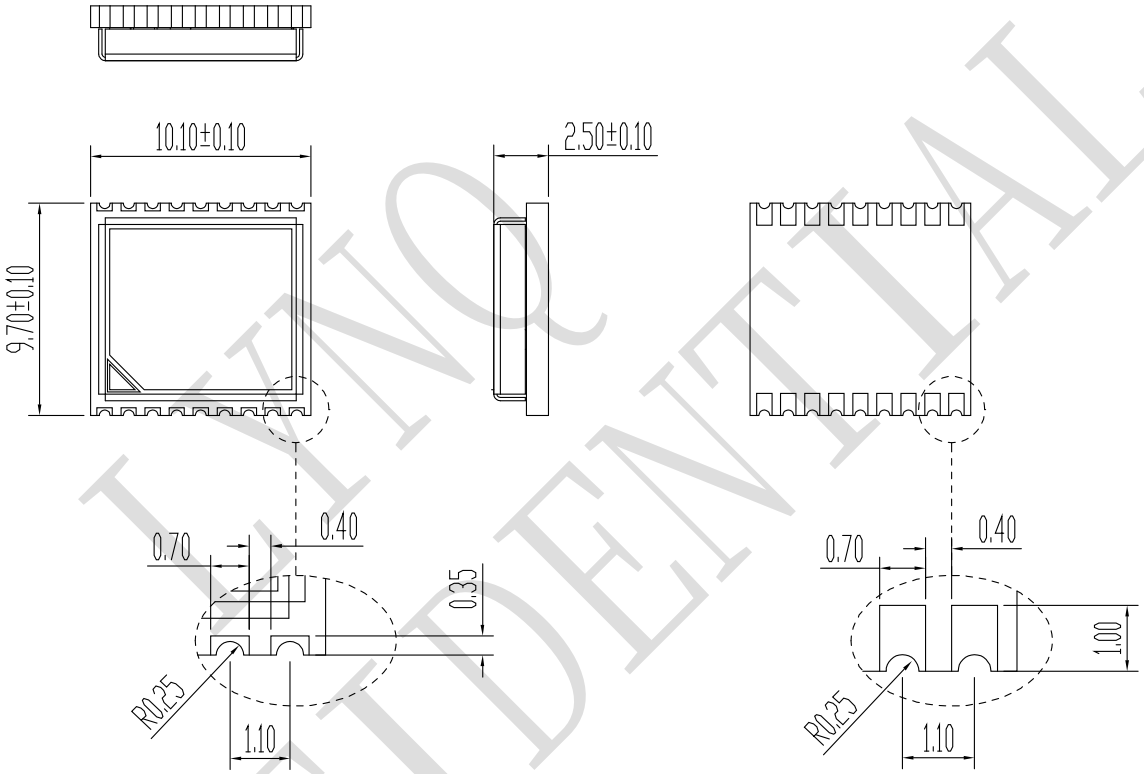


Figure 3-2 N10 series mechanical dimensions (Unit: mm)

## 3.4 N10 Series Recommended PCB Decal

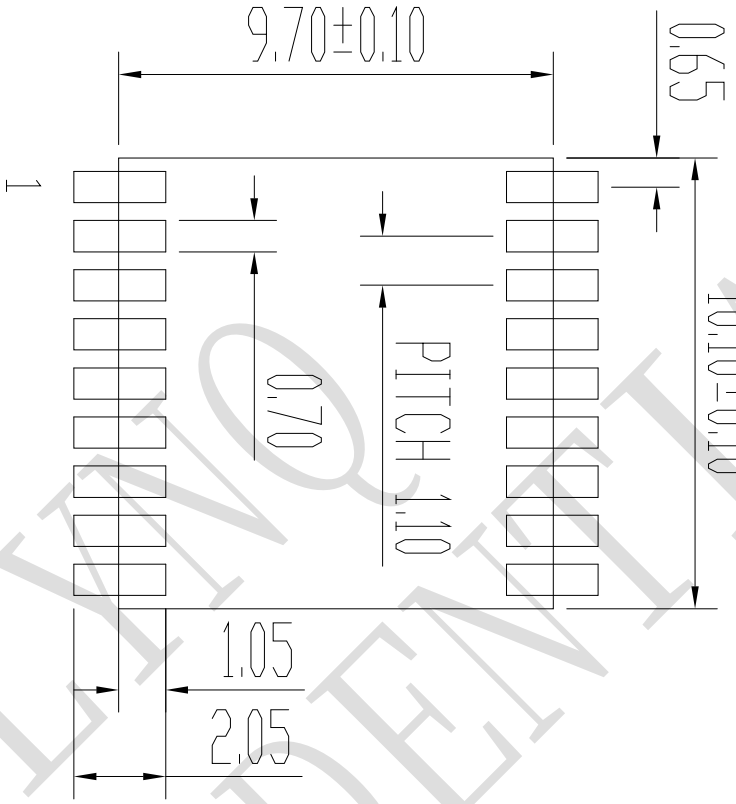


Figure 3-3 Recommended PCB decal (top view) (Unit: mm)

# 4. Application Interface

## 4.1 Power Management

### 4.1.1 Power Input

The power supply range of N10 series is from 3.0V to 4.3V. The power supply should be able to provide sufficient current up to 100mA.

The power supply range of VCC_BACKUP is from 2.0V to 4.3V, typical 3.0V, suggesting customer keep the VCC_BACKUP supply active all the time, module will perform a quick start every time it is power-on.

**Note: IF VCC_BACKUP power was not reserved, the GNSS module will perform a lengthy cold start every time it is powered-on because previous satellite information is not retained and needs to be re-transmitted**

### 4.1.2 Starting N10 Series

When power is first applied, N10 series goes into operation mode.

### 4.1.3 Verification of N10 Series Start

System activity indication depends upon the chosen serial interface: When it is activated, N10 series will output messages at the selected UART speed and message types.

### 4.1.4 Power Saving Modes

N10 series supports operating modes for reduced average power consumption like standby mode, backup mode, and periodic mode.

- **Standby mode**: In this mode ($PMTK161,0*28) the receiver stays at full on power state. When this mode that can be wake up by the host sends the command through the communication interface.

- **Backup mode**: In this mode ($PMTK225,4*2F) the N10 series must be supplied by the VCC_BACKUP pin and the VCC power should be cut off. The module could not achieve this mode through PMTK commands.

- **Periodic mode**: In this mode the N10 series enters tracking and sleep or Backup mode according to the interval configured.

Table 4-1 PMTK225 Command Format

| **Format: $PMTK225,<Type>,<Run_time>,<Sleep_time>,<2nd_run_time>,<2nd_sleep_time>*<checksum><CR><LF>** | | |
|---|---|---|
| **Parameter** | **Format** | **Description** |
| Type | Decimal | 0:full on mode<br>1:Periodic Backup Mode<br>2:Periodic standby Mode<br>4: Backup Mode |
| Rum_time | Decimal | Full on mode period |
| Sleep_time | Decimal | Standby/Backup mode period |
| 2nd_run_time | Decimal | Full on mode period for 2nd acquisition when module acquisition fails during the Run_time |
| 2nd_sleep_time | Decimal | Standby/Backup mode period for 2nd sleep when module acquisition fails during the Run_time |
| Checksum | Hexadecimal | Hexadecimal checksum |

### 4.1.5 Operating Mode

Table 4-2 Power supply and clock state according to operation mode

| **Mode** | **VCC** | **VCC_BACKUP** | **Internal LDO** | **Main clock** | **RTC clock** |
|---|---|---|---|---|---|
| Full on | on | on | on | on | on |

| | | | | | |
|---|---|---|---|---|---|
| Sleep | on | on | on | off | on |
| Backup | off | on | off | off | on |

#### 4.1.5.1 Full on Mode

The module will enter full on mode after first power up with factory configuration settings. Power consumption will vary depending on the amount of satellite acquisitions and number of satellites in track.

#### 4.1.5.2 Standby Mode

Standby mode means a low quiescent (340uA type.) power state, non-volatile RTC, and backup RAM block is powered on. Other internal blocks like digital baseband and RF are internally powered off. The power supply input VCC shall be kept active all the time, even during sleep mode.

Entering into sleep mode is sent PMTK command through the communication interface by host side.

Waking up from standby mode is sent any byte through the communication interface by host side.

#### 4.1.5.3 Backup Mode

This connects to the backup power of the module. Power source (such as battery or cap) connected to VCC_BACKUP pin will help the chipset in keeping its internal RTC running when the VCC power source is turned off. The voltage should be kept between 2.0~4.3V, Typical 3.0V. It is recommended to power VCC_BACKUP through a battery, which can ensure the module EASY™ and improves TTFF after next restart.

The VCC_BACKUP power should be kept active all the time, the module will perform a quick start every time it is power-on.

You can send PMTK command to enter into backup mode through the communication interface. The only way to wake up the module from backup mode is pulling the FORCE_ON high.

#### 4.1.5.4 Periodic Mode

In this mode the N10 series enters tracking and sleep or Backup mode according to the interval configured by users in the commands.

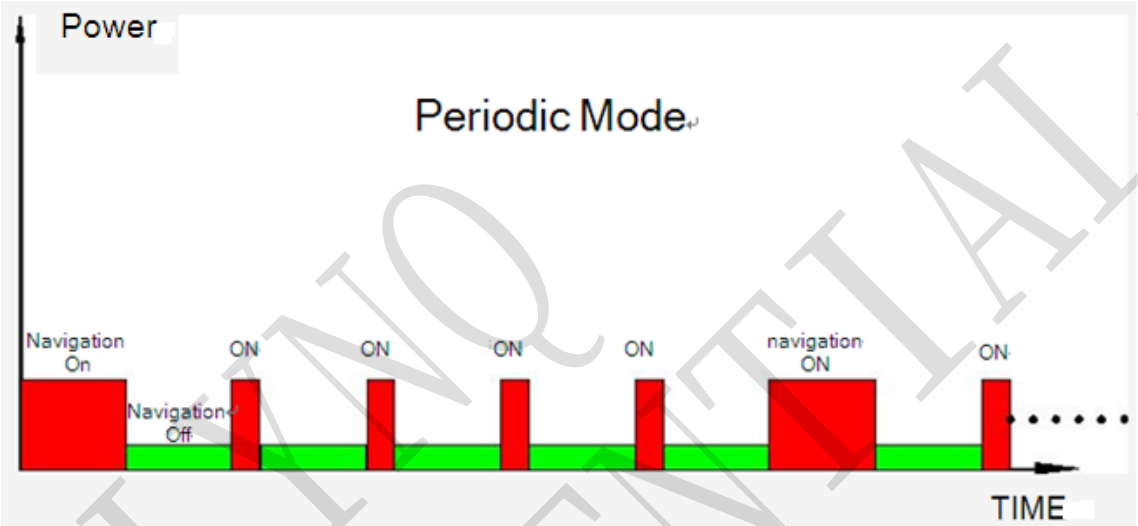


Figure 4-1 Periodic mode

### 4.1.6 VCC_RF

Power supply for active antenna or external LNA, the power domain is VCC.

### 4.1.7 ANTON

2.8V power output for active antenna or external LNA control pin for power save. See the following table for details.

Table 4-3 ANTON status

| Mode | ANTON |
|---|---|
| Full on | 2.8V power output |
| Sleep | no power output |
| Backup | no power output |

## 4.2 UART Interface

N10 series includes two UART (UART0 and UART1) interface for serial communication. The UART0 is as NMEA output and PMTK command input. The receiver (RXD0) and transmitter (TXD0) side of every port contains a 16-byte FIFO and has 256 bytes URAM. UART can provide the developers signal or message outputs. The baud rates are selectable and ranging from 9.6 to 115.2kbps through PMTK commands. UART1 is as RTCM input.

## 4.3 RESET Input

The RESET pin (active low) is used to reset the system, normally external control of RESET is not necessary. The signal can be left floating, if not used.

When RESET signal is used, it will force volatile RAM data loss. Note that Non-Volatile backup RAM content is not cleared and thus fast TTFF is possible. The input has internal pull up.

## 4.4 PPS Output

The PPS pin outputs one pulse-per-second (1PPS) pulse signal for precise timing purposes. The PPS signal can be provided through designated output pin for many external applications. This pulse is not only limited to be active every second but also allowed to set the required duration, frequency, and active high/low by programming user-defined settings.

The following figure is the typical application of the PPS function.

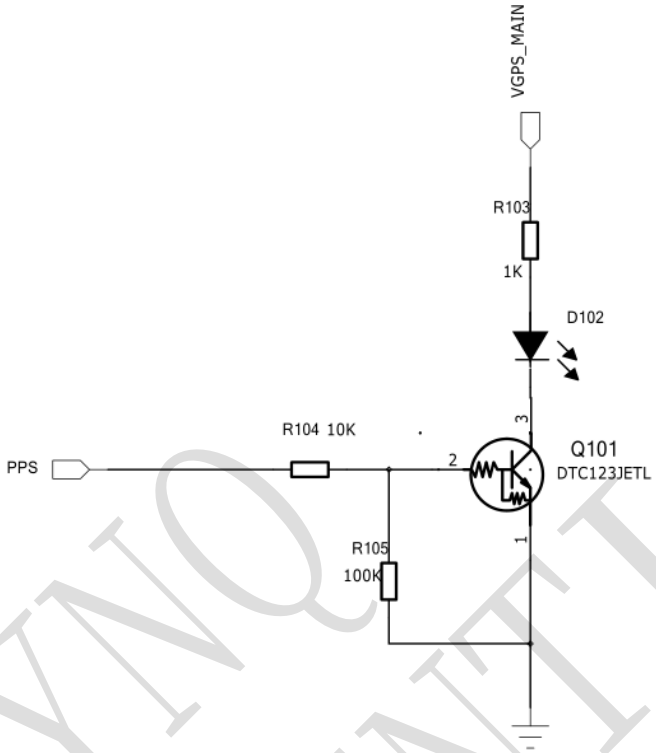


Figure 4-2 PPS application circuit

## 4.5 AGPS and DGPS

A-GPS is the meaning of Assisted GPS, which is a system that can improve the startup performance and time-to-first-fix (TTFF) of a GPS satellite-based positioning under certain conditions. N10 series module supports EPO file, EASY™ mode.

### 4.5.1 EPO

The N10 series supports the EPO (Extended Prediction Orbit) data service. The EPO data service is supporting 7/14/30-day orbit predictions to customers. It needs occasional download from EPO server. Supply of aiding information like ephemeris, almanac, rough last position and time and satellite status and an optional time synchronization signal will reduce time to first fix significantly and improve the acquisition sensitivity.

The user should update the EPO files from the EPO server daily through the internet. Then the EPO data should send to the N10 series by the HOST side. N10 series has the short cold TTFF and warm

TTFF, when the A-GPS is used.

**Note: For more information about EPO, please contact MOBILETEK sales. Users can refer to document [2] for more information**

### 4.5.2 EASY™ MODE

EASY™ is the abbreviation of Embedded Assist System, it works as embedded firmware which accelerates TTFF by predicting satellite navigation messages from received ephemeris.

No additional computing interval for EASY™ task. EASY™ is efficiently scheduled and computed in free time of every second after GNSS navigation solution.

EASY™ function is conceptually designed to automatically engage for predicting after first receiving the broadcast ephemeris. After a while (generally tens of seconds), 3-day extensions will be completely generated then all EASY™ functions will be maintained at a sleep condition. EASY™ assistance is going to be engaged when the GNSS requests in new TTFF condition or re-generates again with another new received ephemeris. Meanwhile, TTFF will be benefited by EASY™ assistance.

**Note: EASY™ function is default open and can be closed by PMTK command.**

### 4.5.3 DGPS

SBAS is the abbreviation of Satellite Based Augmentation System. The SBAS concept is based on

the transmission of differential corrections and integrity messages for navigation satellites that are within sight of a network of reference stations deployed across an entire continent. SBAS messages are broadcast via geostationary satellites able to cover vast areas.

Several countries have implemented their own satellite-based augmentation system. Europe has the European Geostationary Navigation Overlay Service (EGNOS) which covers Western Europe and beyond. The USA has its Wide Area Augmentation System (WAAS). Japan is covered by its

Multi-functional Satellite Augmentation System (MSAS). India has launched its own SBAS program named GPS and GEO Augmented Navigation (GAGAN) to cover the Indian subcontinent.

N10 series module supports SBAS and RTCM, but only one mode can be applied at one time, and SBAS is the default feature, customers who want to apply RTCM in the design can contact Mobiletek sales for supporting

## 4.6 GNSS Antenna

The antenna is a critical item for successful GNSS reception in a weak signal environment. Proper choice of the antenna will ensure that satellites at all elevations can be seen, and therefore, accurate fix measurements are obtained.

User can choose an appropriate antenna for better performance, like active antenna or passive antenna.

### 4.6.1 Antenna Interface

The N10 series receives L1 band signals from GPS and L1 band signals from Glonass or B1 band signals from BD2 satellites at a nominal frequency of 1558～1607MHz .The RF signal is connected to the GNSS_ANT pin. And the trace from the GNSS_ANT pin to antenna should be 50Ω controlled.

To suit the physical design of individual applications the RF interface pad can lead to two alternatives:

Recommended approach: solderable RF coaxial cable assembly antenna connector, such as

- HRS' U.FL-R-SMT connector or I-PEX's 20279-001E-01 RF connector.
- SMA connector.

### 4.6.2 Antenna Choice and RF Design Consideration

To obtain excellent GNSS reception performance, a good antenna will always be required. Proper choice and placement of the antenna will ensure that satellites at all elevations can be seen, and

therefore, accurate fix measurements are obtained.

Compare the active antenna and passive antenna as follow:

Table 4-4 Antenna Specifications

| Parameter | Specification | |
|---|---|---|
| Passive Antenna Recommendations | Frequency range | 1558-1607MHz |
| | Polarization | RHCP & Linear |
| | Gain | >0dBi |
| Active Antenna Recommendations | Frequency range | 1558-1607MHz |
| | Polarization | RHCP & Linear |
| | Noise Figure | <1.5dB |
| | Gain | >10dBi |

**Passive Antenna**

Passive antenna contains only the radiating element, e.g. the ceramic patch, the helix structure, and chip antenna. Sometimes it also contains a passive matching network to match the electrical connection to 50Ω impedance.

The most common antenna type for GNSS applications is the patch antenna. Patch antennas are flat, generally have a ceramic and metal body and are mounted on a metal base plate.

Figure 4-3 shows a minimal setup for a GNSS receiver with N10 series module.

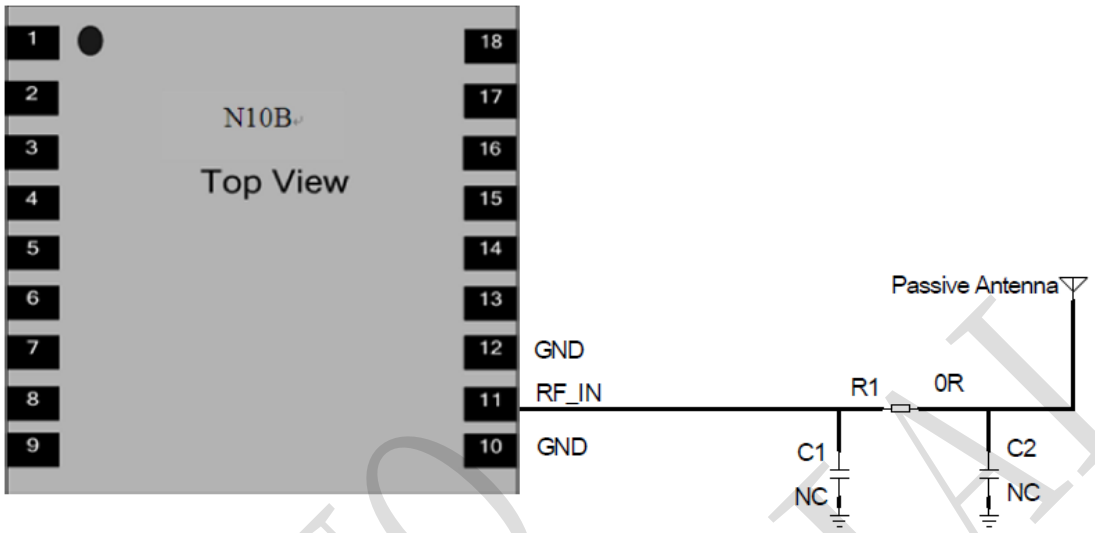


Figure 4-3 N10 series passive antenna design

If the electromagnetic environment of module is very complicated,e.g. coexisted with GSM, UMTS, WLAN and Bluetooth,user can use a saw (IL<1.4dB) to increase the sensitivity. Please see Figure 4-4.

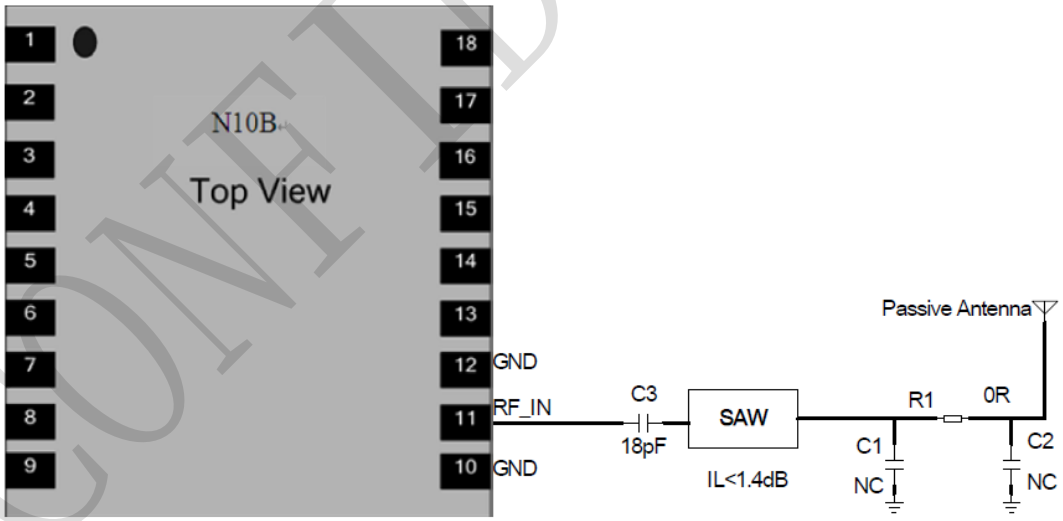


Figure 4-4 N10 series passive antenna design(with external SAW)

If the passive antenna is far away from N10 series, and the path loss is over 3dB, customers can use an external LNA to get a better performance. Please see Figure 4-5. This design is not recommended, it is recommended that the customer antenna close to the module placement.

 

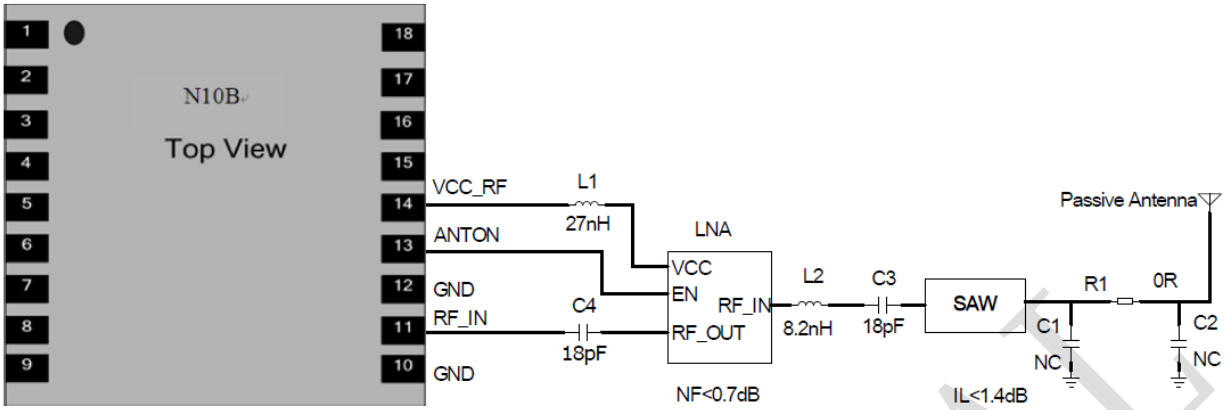


Figure 4-5 N10 series passive antenna design(with external LNA and saw)

## Active Antenna

Active antennas have an integrated Low-Noise Amplifier (LNA). Active antennas need a power supply that will contribute to GNSS system power consumption.

Usually, the supply voltage is fed to the antenna through the coaxial RF cable shown as Figure 10. The output voltage domain of PIN 14 is VCC. If the supply voltage domain of active antenna is VCC, PIN 14 VCC_RF can be connected to RF_IN as figure 4-6 shows. If the supply voltage domain of active antenna is not VCC, other power should be connected to RF_IN.

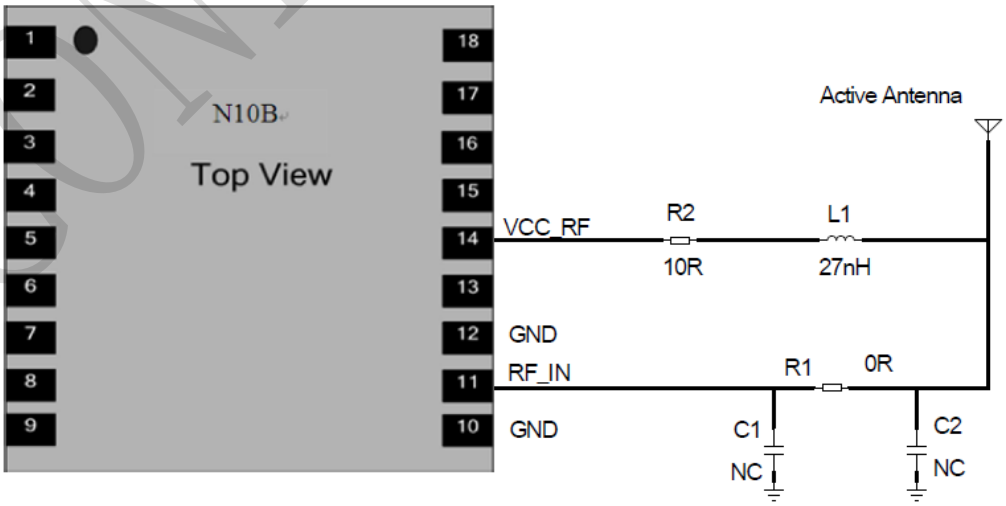


Figure 4-6 N10 series active antenna design

User can use PIN13 ANTION to disable the power supply for external active antenna, which could decrease the power consumption when N10 series in sleep mode. Please see Figure 4-7.

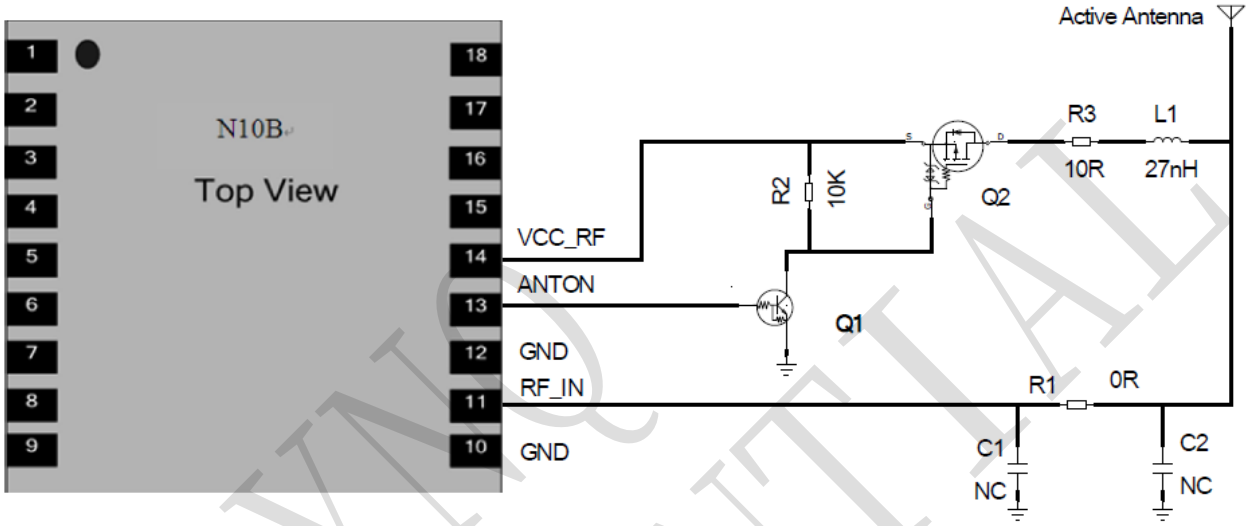


Figure 4-7 N10 series active antenna design for low power consumption

If the customer's design is for automotive applications, then an active antenna can be used and located on C of the car in order to guarantee the best signal quality.

GNSS antenna choice should base on the designing product and other conditions. For detailed Antenna designing consideration, please refer to related antenna vendor's design recommendation. The antenna vendor will offer further technical support and tune their antenna characteristic to achieve successful GNSS reception performance depending on the customer's design.

# 5. Electrical Reliability and Radio Characteristics

## 5.1 Absolute Maximum Ratings

The absolute maximum ratings stated in Table 5-1 are stress ratings under non-operating conditions.

Stresses beyond any of these limits will cause permanent damage to N10 series.

Table 5-1 Absolute maximum rating

| Parameter | Min | Max | Unit |
|---|---|---|---|
| VCC | | 4.3 | V |
| VCC_RF | | VCC | V |
| ANTON | | +2.9 | V |
| Input Power at GNSS_ANT | | -12 | dBm |
| VCC_BACKUP | | 4.3 | V |
| I/O pin voltage | | 3.6 | V |
| Storage temperature | -40 | +85 | ℃ |
| Operating Temperature | -40 | +85 | ℃ |

## 5.2 Recommended Operating Conditions

Table 5-2 N10 series operating conditions

| Parameter | Symbol | Min | Type | Max | Unit |
|---|---|---|---|---|---|
| Operating temperature range | | -40 | +25 | +85 | ℃ |
| Main supply voltage | VCC | 3.0 | 3.3 | 4.3 | V |

| | | | | | |
|---|---|---|---|---|---|
| Backup battery voltage | VCC_BACKUP | 2.0 | 3 | 4.3 | V |

Table 5-3 N10 series standard IO feature

| Parameter | Symbol | Min | Type | Max | Unit |
|---|---|---|---|---|---|
| Low level output voltage<br>Test conditions IOL = 2mA and 4.0mA | $V_{OL}$ | | 0 | 0.40 | V |
| High level output voltage<br>Test conditions IOL = 2mA and 4.0mA | $V_{OH}$ | 2.4 | 2.8 | | V |
| Low level input voltage | $V_{IL}$ | -0.3 | | 0.8 | V |
| High level input voltage | $V_{IH}$ | 2.0 | | 3.6 | V |
| Input Pull-up resistance | $R_{PU}$ | 40 | | 190 | KΩ |
| Input Pull-down resistance | $R_{PD}$ | 40 | | 190 | KΩ |
| Input capacitance | $C_{IN}$ | | 5 | | pF |
| Load capacitance | $C_{load}$ | | | 8 | pF |
| Tri-state leakage current | $I_{OZ}$ | -10 | | 10 | uA |

## 5.3 Electro-Static Discharge

The GNSS engine is not protected against Electrostatic Discharge (ESD) in general. Therefore, it is subject to ESD handing precautions that typically apply to ESD sensitive components. Proper ESD handing and packaging procedures must be applied throughout the processing, handing and operation of any application using a N10 series module. The ESD test results are shown in the following table.

Table 5-4 The ESD characteristics(Temperature:25℃,Humidity:45%)

| Pin | Contact discharge | Air discharge |
|---|---|---|
| VCC | ±5KV | ±10KV |
| RF_ANT | ±5KV | ±10KV |

| | | |
|---|---|---|
| VCC_BACKUP | ±5KV | ±10KV |
| ANTON | ±5KV | ±10KV |
| VCC_RF | ±5KV | ±10KV |
| GND | ±5KV | ±10KV |
| RXD0,TXD0 | ±4KV | ±8KV |
| RESET | ±4KV | ±8KV |
| PPS | ±4KV | ±8KV |



 

# 6. Manufacturing

## 6.1 Top and Bottom View of N10 Series

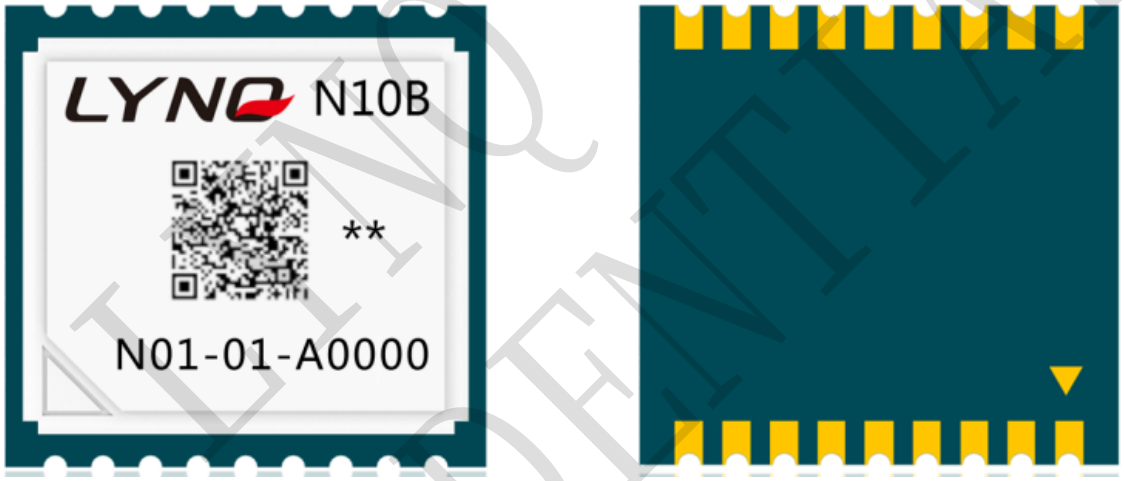


Figure 6-1 Top and Bottom View of N10 series

## 6.2 Product labeling


Figure 6-2 Label of N10 series

Table 6-1 Description of module label

| Item | Description |
|---|---|
| A | Logo of company |
| B | QR code --- include hardware and software edition, date of manufacture, and baud rate, etc. |
| C | Pin1 mark |
| D | Module name |
| E | Satellite system and baud rate; Example B:GPS+BD2 G:GPS+Glonass,M:GPS+BD2,9:9600 ,1:115200 ; |
| F | PID number |

## 6.3 Assembly and Soldering

The N10 series module is intended for SMT assembly and soldering in a Pb-free reflow process on the top side of the PCB. Suggested solder paste stencil height is 150um minimum to ensure sufficient solder volume. If required paste mask pad openings can be increased to ensure proper soldering and solder wetting over pads.

The following figure is the Ramp-Soak-Spike Reflow Profile of N10 series:

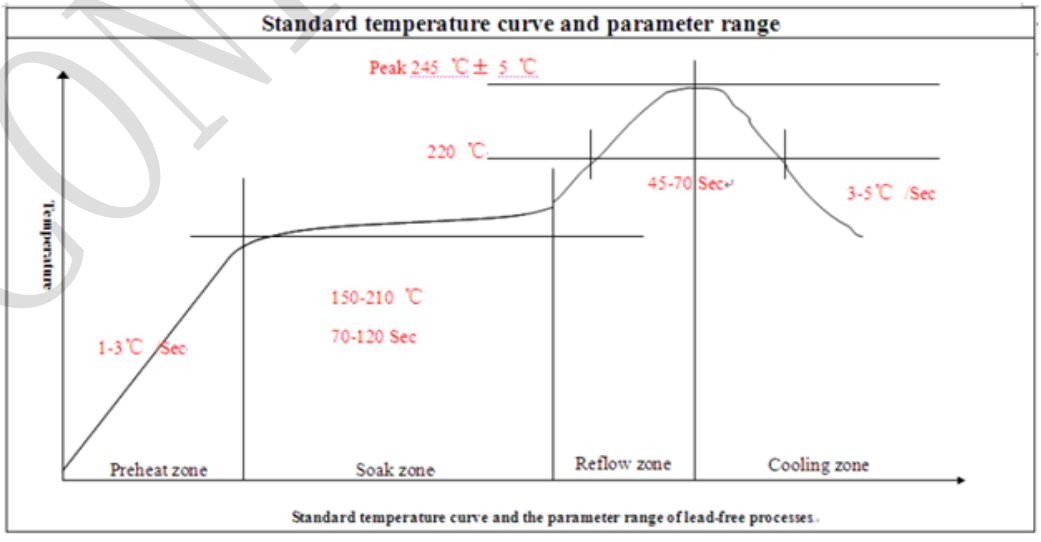


Figure 6-3 The Ramp-Soak-Spike reflow profile of N10 series

N10 series is moisture sensitive devices (MSD), appropriate MSD handling instruction and precautions are summarized in Chapter 6.3.

N10 series modules are also Electrostatic Sensitive Devices (ESD), handling N10 series modules without proper ESD protection may destroy or damage them permanently.

Avoid ultrasonic exposure due to internal crystal and SAW components.

## 6.4 Moisture Sensitivity

N10 series module is moisture sensitive at MSL 3, dry packed according to IPC/JEDEC specification J-STD-020C. The calculated shelf life for dry packed SMD packages is a minimum of 6 months from the bag seal date, when stored in a non condensing atmospheric environment of <40°C/90% RH.

Table 12 lists floor life for different MSL levels in the IPC/JDEC specification:

Table 6-2 Moisture classification level and floor life

| **Level** | **Floor Life(out of bag)at factory ambient≦+30℃/60%RH or as stated** |
|---|---|
| 1 | Unlimited at≦+30℃/85% RH |
| 2 | 1 year |
| 2a | 4 weeks |
| 3 | 168 hours |
| 4 | 72 hours |
| 5 | 48 hours |
| 5a | 24 hours |
| 6 | Mandatory bake before use. After bake, module must be reflowed within the time limit specified on the label. |

Factory floor life is 1 week for MSL 3, N10 series must be processed and soldered within the time. If this time is exceeded, the devices need to be pre-baked before the reflow solder process.

Both encapsulate and substrate materials absorb moisture. IPC/JEDEC specification J-STD-020 must be observed to prevent cracking and delamination associated with the "popcorn" effect during reflow soldering. The popcorn effect can be described as miniature explosions of evaporating moisture. Baking before processing is required in the following case:

- Floor life or environmental requirements after opening the seal have been exceeded, e.g. exposure to excessive seasonal humidity.

Refer to Section 4 of IPC/JEDEC J-STD-033 for recommended baking procedures.

**Notes: Oxidation Risk: Baking SMD packages may cause oxidation and/or inter metallic growth of the terminations, which if excessive can result in solder ability problems during board assembly. The temperature and time for baking SMD packages are therefore limited by solder ability considerations. The cumulative bake time at a temperature greater than 90°C and up to 125°C shall not exceed 96 hours.**

## 6.5 ESD Handling Precautions

N10 series modules are Electrostatic Sensitive Devices (ESD). Observe precautions for handling! Failure to observe these precautions can result in severe damage to the GNSS receiver!

GNSS receivers are Electrostatic Sensitive Devices (ESD) and require special precautions when handling. Particular care must be exercised when handling patch antennas, due to the risk of electrostatic charges. In addition to standard ESD safety practices, the following measures should be taken into account whenever handling the receiver:

Unless there is a galvanic coupling between the local GND (i.e. the work Table) and the PCB GND, then the first point of contact when handling the PCB shall always be between the local GND and PCB GND.

Before mounting an antenna patch, connect ground of the device

When handling the RF pin, do not come into contact with any charged capacitors and be careful when contacting materials that can develop charges (e.g. patch antenna ~10pF, coax cable ~50-80pF/m, soldering iron)

To prevent electrostatic discharge through the RF input, do not touch the mounted patch antenna.

When soldering RF connectors and patch antennas to the receiver's RF pin, the user must make sure to use an ESD safe soldering iron (tip).

## 6.6 Shipment

N10 series is designed and packaged to be processed in an automatic assembly line, and it is now packaged tray and reel.

# 7. Reference Design

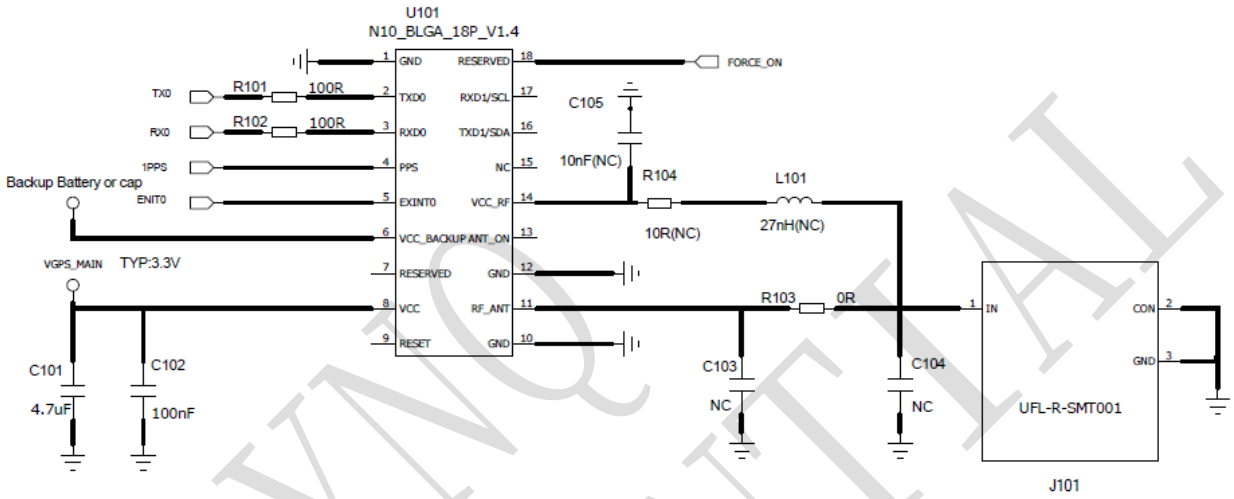


Figure 7-1 Application schematics

# 8. Safety Information

For the reasonable usage of the module, please comply with all these safety notices of this page. The product manufacturers should send followed safety information to user, operator or product's spec.

The devices using the module may disturb some electronic equipment. Put the module away from the phone, TV, radio and automation equipment to avoid the module and the equipment to interfere with each other.

Shut down the mobile device or change to flying mode before boarding. The Using of wireless appliances in an aircraft is forbidden to avoid the interference, or else cause to unsafe flying, even violate the law.

In hospital or health care center, switch off the mobile devices. RF interference may damage the medical devices, like hearing-aid, cochlear implant and heart pacemaker etc.


Mobile devices can't guarantee to connect in all conditions, like no fee or with an invalid SIM card. When you need emergent help, please remember using emergency calls and make sure your device power on in an area with well signal.

Put the module away from inflammable gases. Switch off the mobile device when close to gas station, oil depot, chemical plant etc.

The module is not water proof. Please don't use the module in the area with high humidity like bathroom, which will decelerate the physical performance, insulation resistance and mechanical strength.

Non-professionals can't teardown the module which will damage it. Refer to the specification or communicate the related staffs to repair and maintain it.

Please switch on the module before cleaning. The staffs should be equipped with anti-ESD clothing and gloves.

The users and product manufacturers should abide by the national law of wireless modules and devices. If not, Mobiletek will not respond the related damages.

# Appendix

## Related Documents

Table 6-3 Related documents

| SN | Document name | Remark |
|---|---|---|
| [1] | LYNQ_GNSS_ SDK_ Commands_ Manual | |
| [2] | EPO-II Format Protocol Customer | |

## Terms and Abbreviations

| Abbreviation | Description |
|---|---|
| A-GPS | Assisted Global Positioning System |
| CMOS | Complementary Metal Oxide Semiconductor |
| CEP | Circular Error Probable |
| DGPS | Difference bal Positioning System |
| EEPROM | Electrically Erasable Programmable Read Only Memory |
| EPO | Extended Prediction Orbit |
| ESD | Electrostatic Sensitive Devices |
| EASY | Embedded Assist System |
| EGNOS | European Geostationary Navigation Overlay Service |
| GPS | Global Positioning System |
| GAGAN | The GPS Aided Geo Augmented Navigation |
| I/O | Input / Output |
| IC | Integrated Circuit |
| Inorm | Normal Current |

| | |
|---|---|
| Imax | Maximum Load Current |
| kbps | Kilo bits per second |
| MSL | moisture sensitive level |
| MSAS | Multi-Functional Satellite Augmentation System |
| NMEA | National Marine Electronics Association |
| PRN | Pseudo Random Noise Code |
| QZSS | Quasi-Zenith Satellites System |
| SBAS | Satellite Based Augmentation Systems |
| WAAS | Wide Area Augmentation System |