L70

Quectel GPS Engine

Hardware Design

L70_HD_V1.0

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0. Revision history

Revision	Date	Author	Description of change
1.0	2012-07-10	King HAO	Initial

1. Introduction

This document defines and specifies L70 GPS module. It describes L70 hardware interface and its external application reference circuits, mechanical size and air interface.

This document can help customer quickly understand the interface specifications, electrical and mechanical details of L70 module. With the help of this document and other related documents, customer can use L70 module to design and set up applications easily.

1.1. Related documents

Table 1: Related documents

SN	Document name	Remark
[1]	L70_EVB _UGD	L70 EVB User Guide
[2]	L70_GPS_Protocol	L70 GPS Protocol Specification
[3]	L70_Reference_Design	L70 Reference Design

1.2. Terms and abbreviations

Table 2: Terms and abbreviations

Abbreviation	Description
AGPS	Assisted GPS
AIC	Active Interference Cancellation
CEP	Circular Error Probable
DGPS	Differential GPS
EASY	Embedded Assist System
EGNOS	European Geostationary Navigation Overlay Service
EMC	Electromagnetic Compatibility
EPO	Extended Prediction Orbit
ESD	Electrostatic Discharge
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
GGA	GPS Fix Data
GLL	Geographic Position – Latitude/Longitude
GSA	GNSS DOP and Active Satellites
GSV	GNSS Satellites in View
HDOP	Horizontal Dilution of Precision
IC	Integrated Circuit

I/O	Input /Output
Kbps	Kilo Bits Per Second
LNA	Low Noise Amplifier
MSAS	Multi-Functional Satellite Augmentation System
NMEA	National Marine Electronics Association
PDOP	Position Dilution of Precision
PMTK	MTK Proprietary Protocol
PPS	Pulse Per Second
PRN	Pseudo Random Noise Code
QZSS	Quasi-Zenith Satellite System
RHCP	Right Hand Circular Polarization
RMC	Recommended Minimum Specific GNSS Data
RTCM	Radio Technical Commission for Maritime Services
SBAS	Satellite-based Augmentation System
SAW	Surface Acoustic Wave
TTFF	Time To First Fix
UART	Universal Asynchronous Receiver & Transmitter
VDOP	Vertical Dilution of Precision
VTG	Course over Ground and Ground Speed, Horizontal Course and Horizontal Velocity
WAAS	Wide Area Augmentation System
Inom	Nominal Current
Imax	Maximum Load Current
Vmax	Maximum Voltage Value
Vnom	Nominal Voltage Value
Vmin	Minimum Voltage Value
VIHmax	Maximum Input High Level Voltage Value
VIHmin	Minimum Input High Level Voltage Value
VILmax	Maximum Input Low Level Voltage Value
VILmin	Minimum Input Low Level Voltage Value
VImax	Absolute Maximum Input Voltage Value
VImin	Absolute Minimum Input Voltage Value
VOHmax	Maximum Output High Level Voltage Value
VOHmin	Minimum Output High Level Voltage Value
VOLmax	Maximum Output Low Level Voltage Value
VOLmin	Minimum Output Low Level Voltage Value

2. Product concept

The L70 GPS module brings the high performance of the MTK positioning engine to the industrial applications. It is able to achieve the industry's highest level of sensitivity, accuracy and TTFF with the lowest power consumption in a small-footprint lead-free package. With 66 search channels and 22 simultaneous tracking channels, it acquires and tracks satellites in the shortest time even at indoor signal level. The embedded flash memory provides capacity for storing user-specific configurations and allows for future updates.

The L70 module combines with many advanced features including AlwaysLocate™ , EASY™, and AIC. These features are beneficial to reduce consumption and accelerate TTFF for L70 module. The module supports various location, navigation and industrial applications including autonomous GPS, SBAS (including WAAS, EGNOS, MSAS, and GAGAN), QZSS, and AGPS.

The L70 is an SMD type module with the compact 10.1mm x 9.7mm x 2.5mm form factor, which can be embedded in customer applications through the 18-pin pads. It provides necessary hardware interfaces between the module and customer's board.

The module is fully RoHS compliant to EU regulation.

2.1. Key features

Table 3: Module key features

Feature	Implementation
Power supply	Single supply voltage: 2.8V~4.3V typical : 3.3V
Power consumption (passive antenna)	● Acquisition 25mA@-130dBm ● Tracking 22mA@-130dBm ● Standby 0.5mA@VCC=3.3V
Receiver Type	● GPS L1 1575.42MHz C/A Code ● 66 search channels, 22 simultaneous tracking channels
Sensitivity	● Cold Start -145dBm ● Reacquisition -157 dBm ● Hot start -157 dBm ● Tracking -160 dBm
Sensitivity (with external LNA)	● Cold Start -148 dBm ● Reacquisition -160 dBm ● Hot Start -160 dBm ● Tracking -163 dBm
Time-To-First-Fix(EASY enabled)	● Cold Start 15s average@-130dBm ● Warm Start 5s average@-130dBm ● Hot Start 1s @-130dBm

Time-To-First-Fix(EASY disabled)	● Cold Start (Autonomous) 35s average@-130dBm ● Warm Start (Autonomous) 30s average@-130dBm ● Hot Start (Autonomous) 1s@-130dBm
Horizontal Position Accuracy(@-130dBm)	● <2.5 m CEP
Max Update Rate	● Up to 10Hz,1Hz by default
Accuracy of 1PPS Signal	● Typical accuracy <15ns (Not support time service) ● Time pulse width 100ms
Velocity Accuracy	● Without Aid 0.1 m/s
Acceleration Accuracy	● Without Aid 0.1 m/s^2
Dynamic Performance	● Maximum Altitude 18,000 m ● Maximum Velocity 515 m/s Maximum ● Acceleration 4 G
UART Port	● UART Port: TXD1 and RXD1 ● Supports baud rate from 4800bps to 115200bps，9600bps with default ● UART Port is used for NMEA output, MTK proprietary messages input and firmware upgrade
Temperature range	● Normal operation: -40℃ ~ +85℃ ● Storage temperature: -45℃ ~ +125℃
Physical Characteristics	Size: 10.1±0.15 x 9.7±0.15 x 2.5±0.15mm Weight: Approx. 0.6g

2.2. Block diagram

The following figure shows a block diagram of L70 module. It consists of a single chip GPS IC which includes RF part and Baseband part, a SAW filter, a TCXO and a crystal oscillator.

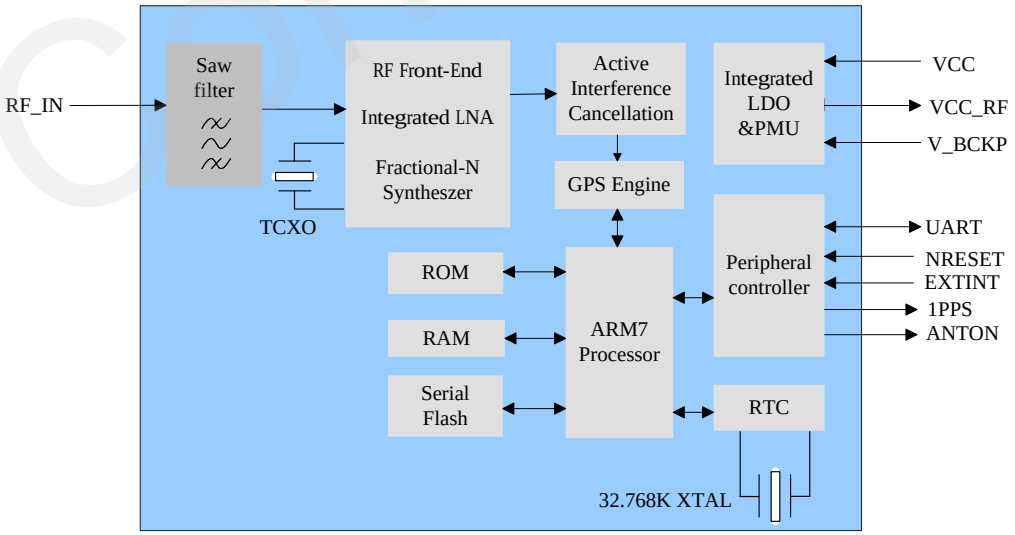


Figure 1: Module block diagram

2.3. Evaluation board

In order to help customers on the application of L70 module, Quectel supplies an Evaluation Board (EVB) with appropriate power supply, RS-232 serial cable, active antenna and other peripherals to test the module.

For more details, please refer to the ***document [1]***.

2.4. New technology

2.4.1. EASY technology

By Supplying aided information like ephemeris, almanac, rough last position and time, and satellite status，AGPS can help improve GPS receiver TTFF and the acquisition sensitivity. The L70 module supports EASY technology which is one kind of AGPS.

EASY works as an embedded software which can accelerate TTFF by predicting satellite navigation messages from received ephemeris. The GPS engine will calculate and predict orbit information automatically up to 3 days after first receiving the broadcast ephemeris, and saving the predicted information into the internal memory. GPS engine will use these information for positioning if no enough information from satellites, so the function will be helpful for positioning and TTFF improvement under indoor and urban condition.

The EASY function can reduce TTFF to 5s for warm start. In this case, the backup power which supplies power for the RTC circuit is necessary. If no backup power, L70 module cannot store the extended ephemeris information and predict orbit information, in other words, it will become the cold start. Although the EASY also can accelerate TTFF in cold start, the backup power is still strongly recommended.

In order to gain enough broadcast ephemeris information from GPS satellites, the GPS module should receive the information for at least 5 minutes in the good signal condition after it turned on.

EASY™ function is enabled by default. The command "$PMTK869,0*29" can be used to query the status of EASY. If EASY is enabled, the module returns " $PMTK869,2,1*36", else returns "$PMTK869,2,0*37".

2.4.2. AlwaysLocate™ mode

AlwaysLocate™ is an intelligent controller of L70 normal mode and sleep mode. It is one of the power saving modes. According to the environmental and motion conditions, L70 can adaptively adjust the on/off time to achieve the balance between positioning accuracy and power consumption.

The following picture has shown the rough relationship between power consumption and the different scenarios in daily life when the AlwaysLocate™ mode is enabled.

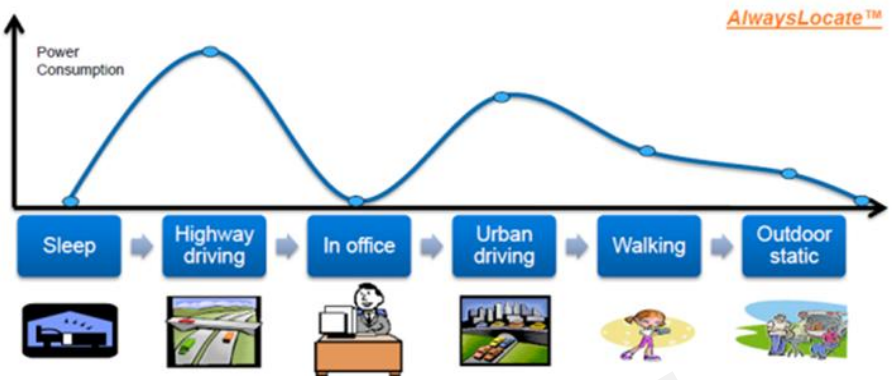


Figure 2: AlwaysLocate™ mode

The position accuracy in AlwaysLocate™mode will be somewhat degraded, especially in high speed. So this mode is not recommended in the applications of vehicle system.

AlwaysLocate™mode is disabled by default. Using the MTK proprietary commands can enable the AlwaysLocate™mode. Please refer to the following commands to set the AlwaysLocate™ mode.

Enable AlwaysLocate™ mode: $PMTK225,8*23； Return: $PMTK001,225,3*33
Back to normal mode: $PMTK225,0*2B

2.4.3. Multi-tone AIC

Up to 12 multi-tone AIC (Active interference Cancellation) can provide effective narrow-band interference and jamming elimination. The GPS signal could be recovered from the jammed signal, which can ensure better navigation quality.

Because different applications (Wi-Fi, GSM/GPRS, 3G/4G, Bluetooth) are integrated into navigation system, the harmonic of RF signal will influence the GPS reception. The multi-tone AIC can reject external RF interference which comes from other active components on the main board, to improve the capacity of GPS reception without any hardware change in the design.

AIC function is enabled by default. The following commands can be used to set AIC function.

Enable AIC function: $PMTK 286,1*23
Disable AIC function: $PMTK 286,0*22

2.5. Protocol

The module supports standard NMEA-0813 protocol and MTK proprietary protocol (PMTK messages) that can be used to provide extended capabilities for many applications. The module is capable of supporting the following NMEA formats: ***GGA, GSA, GLL, GSV, RMC, VTG*** .

Table 4: The protocol supported by the module

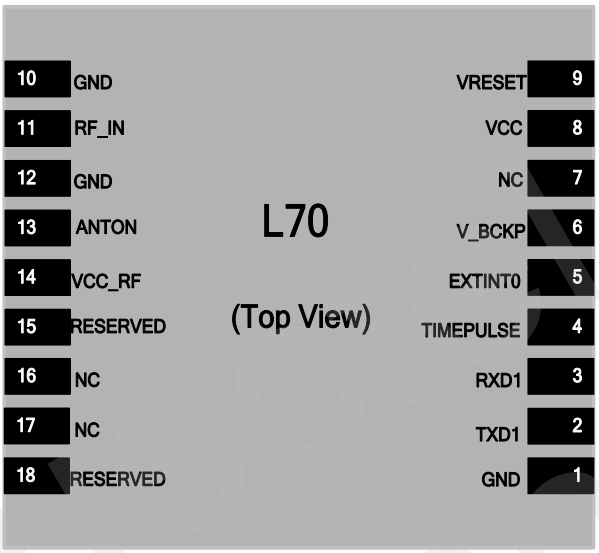
Protocol	Type
NMEA	Output, ASCII, 0183, 3.01
PMTK	Input, MTK proprietary protocol

Note: Please refer to document [2] about NMEA standard protocol and MTK proprietary protocol.

3. Application interface

The module is equipped with an 18-pin 1.1mm pitch SMT pad that connects to the user application platform. Sub-interfaces included in these pads are described in details in the following chapters.

3.1. Pin assignment of the module



3.2. Pin description

Table 5: Pin description

Power Supply					
PIN NAME	**PIN NO.**	**I/O**	**DESCRIPTION**	**DC CHARACTERISTICS**	**COMMENT**
VCC	8	I	Supply voltage	Vmax= 4.3V Vmin=2.8V Vnom=3.3V	Supply current of no less than 150mA.
V_BCKP	6	I	Backup voltage supply	Vmax=4.3V Vmin=2.0V Vnom=2.8V I_{BCKP}=7uA@Backup mode	Power supply for RTC domain when VCC does not supply for the system.
VCC_RF	14	O	Output voltage RF section	Vmax=4.3V Vmin=2.8V Vnom=3.3V Imax=50mA	Usually supply for external active antenna or LNA. If unused, keep this pin open. $V_{VCC\_RF} \approx V_{VCC}$
Reset					

PIN NAME	PIN NO.	I/O	DESCRIPTION	DC CHARACTERISTICS	COMMENT
VRESET	9	I	System reset, low level active.	VILmin=-0.3V VILmax=0.8V VIHmin=2.0V VIHmax=3.6V	If unused, keep this pin open or connect it to the VCC.
General purpose input/output					
PIN NAME	**PIN NO.**	**I/O**	**DESCRIPTION**	**DC CHARACTERISTICS**	**COMMENT**
EXTINT0	5	I	External interrupt input	VILmin=-0.3V VILmax=0.8V VIHmin=2.0V VIHmax= 3.6V	This pin can be used to enter or exit from the standby mode. If unused, keep this pin open. Internally pulled up.
TIMEPULSE	4	O	Time pulse	VOLmin=-0.3V VOLmax=0.4V VOHmin=2.4V VOHmax=3.1V	1 pulse per second (1PPS). Synchronized at rising edge, the pulse width is100ms. If unused, keep this pin open.
UART port					
PIN NAME	**PIN NO.**	**I/O**	**DESCRIPTION**	**DC CHARACTERISTICS**	**COMMENT**
RXD1	3	I	Receive data	VILmin=-0.3V VILmax=0.8V VIHmin=2.0V VIHmax= 3.6V	
TXD1	2	O	Transmit data	VOLmin=-0.3V VOLmax=0.4V VOHmin=2.4V VOHmax=3.1V	
RF interface					
PIN NAME	**PIN NO.**	**I/O**	**DESCRIPTION**	**DC CHARACTERISTICS**	**COMMENT**
RF_IN	11	I	GPS signal input	Characteristic impedance of 50Ω	Refer to chapter 4
ANTON	13	O	Active antenna or external LNA control pin in power standby mode	The typical value is 2.8V.	This pin can be used to control the power supply of the Active antenna or the enable pin of the external LNA in the standby mode. If unused, keep this pin open.

3.3. Operating modes

The table below briefly summarizes the various operating modes of L70 module.

Table 6: Overview of operating modes

Mode		Function
Acquisition mode		The module starts to search satellite, determine visible satellites and coarse carrier frequency and code phase of satellite signals. When the acquisition is completed, it switches to tracking mode automatically.
Tracking mode		The module refines acquisition's message, as well as keeps tracking and demodulating the navigation data from the specific satellites.
Power saving mode	Standby mode	Using EXTINT0 pin or PMTK command can make the module enter the standby mode. In this mode, the UART port is still accessible, but has no NEMA messages output, the current consumption of the module is also minimal.
	Backup mode	When cutting off the main power supply, the module will enter the backup mode. In this mode, the RTC (Real Time Clock) power supply is needed. It can supply power for backed-up memory which contains all the necessary GPS information for quick start-up and a small amount of user configuration variables.
	Periodic standby mode	Periodic standby mode is a periodic mode that can control the on/off time of L70 module periodically to reduce power consumption. It supports the module to switch automatically between normal mode and standby mode.
	AlwaysLocate™ standby mode	AlwaysLocate™ is an intelligent controller of L70 periodic mode. AlwaysLocate™ standby mode supports the module to switch automatically between normal mode and standby mode. According to the environmental and motion conditions, the module can adaptively adjust the on/off time to achieve the balance between positioning accuracy and power consumption.

3.4. Power supply

The main power supply is fed through the VCC pin. It is important that the system power supply circuitry is able to support the peak power. So the power supply must be able to provide sufficient current up to 150mA.

The power supply of RTC circuit is fed through the V_BCKP pin. For more details, please refer to ***chapter 3.6.2.***

3.5. Turn on and Turn off

3.5.1. Turn on

The module will be turned on when VCC is supplied.

3.5.2. Turn off

Shutting down the module's main power supply is the only way to turn off the module. In this case, if the backup power is still present, the module will enter the backup mode.

3.5.3. Restart

L70 module can be restarted by driving the VRESET to a low level voltage for a certain time and then releasing it. An OC driver circuit as shown below is recommended to control the VRESET.

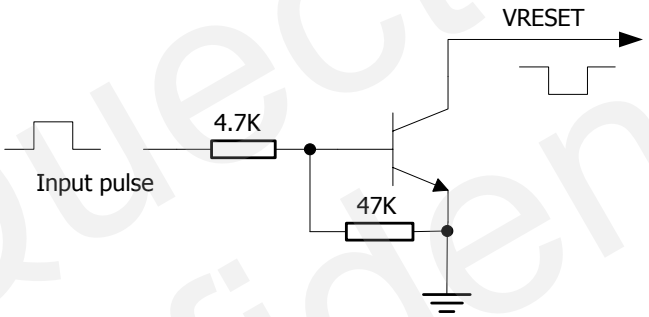


Figure 3: Reference reset circuit using OC circuit

The other way to control the VRESET pin is using a button directly. A TVS component needs to be placed close to the button for ESD protection. While pressing the key, ESD strike may generate from finger. A reference circuit is illustrated in Figure 4.

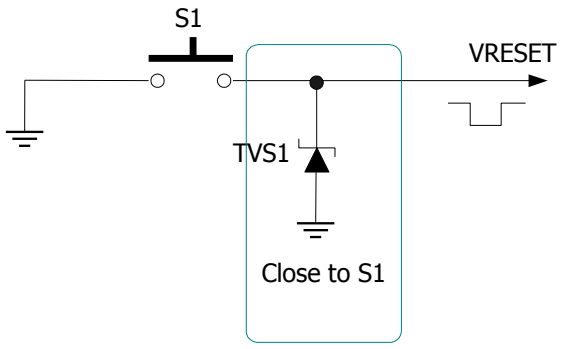


Figure 4: Reference reset circuit using button

The restart timing has been illustrated in Figure 5.

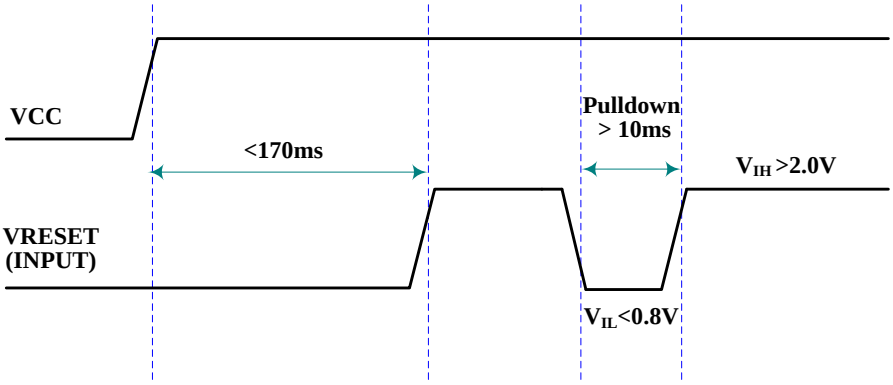


Figure 5: Timing of restarting system

3.6. Power saving modes

3.6.1. Standby mode

Standby mode is one of the power saving modes, in this mode, the UART serial port is still accessible, but has no NEMA messages output, the current consumption of the module is also minimal. The following table has shown the ways how to enter and exit from the standby mode.

Table 7: The ways of entering and exiting from standby mode

Mode	Operation
Enter the standby mode	Changing the level of EXTINT0 pin from high to low.
	Sending the MTK proprietary command “$PMTK l61,0*28 ”.
Exit from standby mode	Changing the level of EXTINT0 pin from low to high.
	Sending any byte through the UART port.

Note: Recommended to pull EXTINT0 pin high before turning on the module.

3.6.2. Back up mode

When cutting off the main power supply, the module will enter the backup mode. In this mode, the RTC (Real Time Clock) power supply is needed. It can supply power for backed-up memory which contains all the necessary GPS information for quick start-up and a small amount of user configuration variables. The RTC power supply of module can be directly provided by an external capacitor or battery (rechargeable or non-chargeable) through the V_BCKP pin.

Table 8: Pin definition of the V_BCKP pin

Name	Pin No.	Function
V_BCKP	6	Backup voltage supply

Note: The V_BCKP could not keep open. The V_BCKP pin should be connected to a battery or a capacitor for GPS module warm/hot start and AGPS.

Please refer to the following figure for RTC backup:

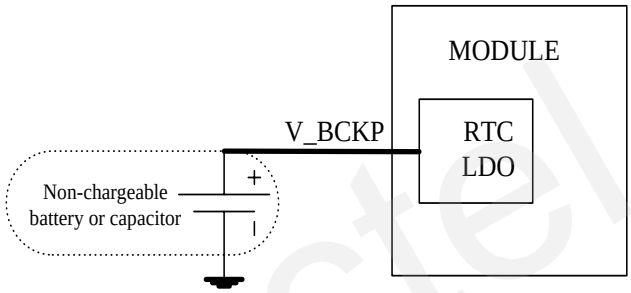


Figure 6: RTC supply from non-chargeable battery or capacitor

The V_BCKP pin does not implement charging for rechargeable battery. It is necessary to add a charging circuit for rechargeable battery, shown as the following figure:

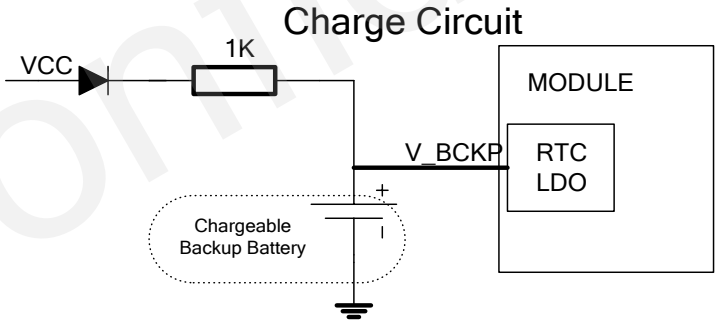


Figure 7: Reference charging circuit for chargeable battery

- **Coin-type Capacitor backup**

Coin-type Rechargeable Capacitor such as XH414H-IV01E from Seiko can be used.

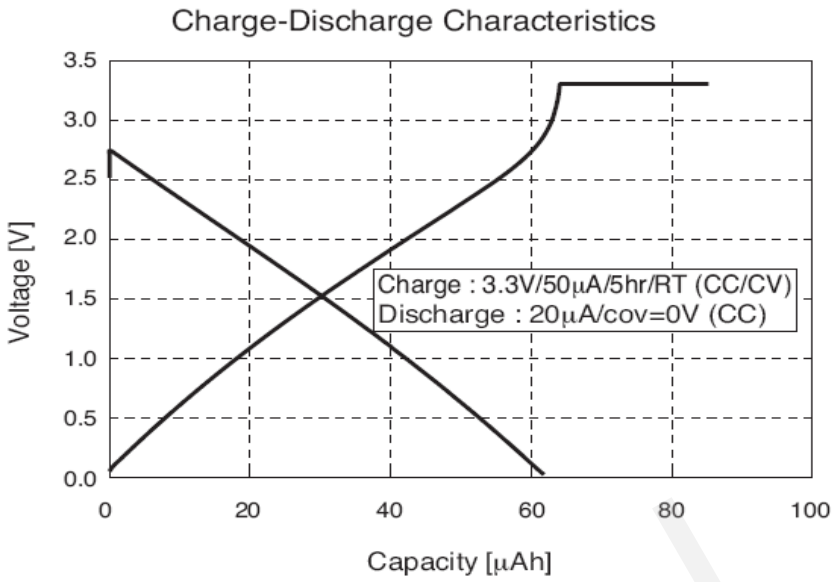


Figure 8: Seiko XH414H-IV01E charge characteristic

3.6.3. Periodic standby mode

Periodic standby mode is a periodic mode that can control the on/off time of L70 module periodically to reduce power consumption. It supports the module switches automatically between normal mode and standby mode. The following figure has shown the operation of periodic mode.

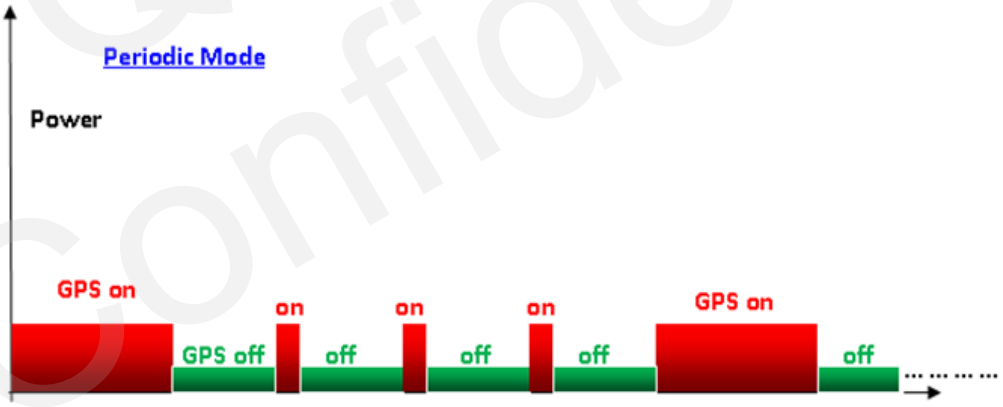


Figure 9: Periodic mode

Sending PMTK command can enter periodic standby mode. The ratio of run time and sleep time can be set by the command. For more details, please refer to ***document [2]*** about the MTK proprietary protocol.

3.6.4. AlwaysLocate™ standby mode

AlwaysLocate™ is an intelligent controller of L70 normal mode and standby mode. AlwaysLocate™ standby mode supports the module to switch automatically between normal mode and standby mode. According to the environmental and motion conditions, the module can adaptively adjust the on/off time to achieve the balance between positioning accuracy and power consumption.

For more details, please refer to ***chapter 2.4.2***.

3.7. UART interface

The module provides one universal asynchronous receiver & transmitter serial port. The module is designed as a DCE (Data Communication Equipment), following the traditional DCE-DTE (Data Terminal Equipment) connection. The module and the client (DTE) are connected through the following signal shown as Figure 10. It supports data baud-rate from 4800bps to 115200bps.

UART port
- TXD1: Send data to the RXD signal line of DTE
- RXD1: Receive data from the TXD signal line of DTE

Table 9: Pin definition of the UART interfaces

Interface	Name	Pin No.	Function
UART Port	TXD1	2	Transmit data
	RXD1	3	Receive data

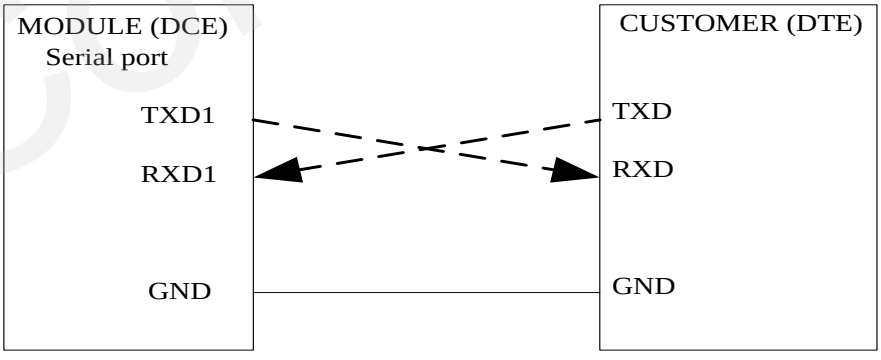


Figure 10: Connection of serial interfaces

This UART port has the following features:
- UART port can be used for firmware upgrade, NMEA output and PMTK proprietary messages

input.

The default output NMEA type setting is RMC, VTG, GGA, GSA, GSV, GLL.

- UART port supports the following data rates:
  4800, 9600, 14400, 19200, 38400, 57600, 115200.
  The default setting is 9600bps, 8 bits, no parity bit, 1 stop bit .
- Hardware flow control and synchronous operation are not supported.

The UART port does not support the RS-232 level but only supports the CMOS level. If the module's UART port is connected to the UART port of a computer, it is necessary to add a level shift circuit between the module and the computer. Please refer to the following figure.

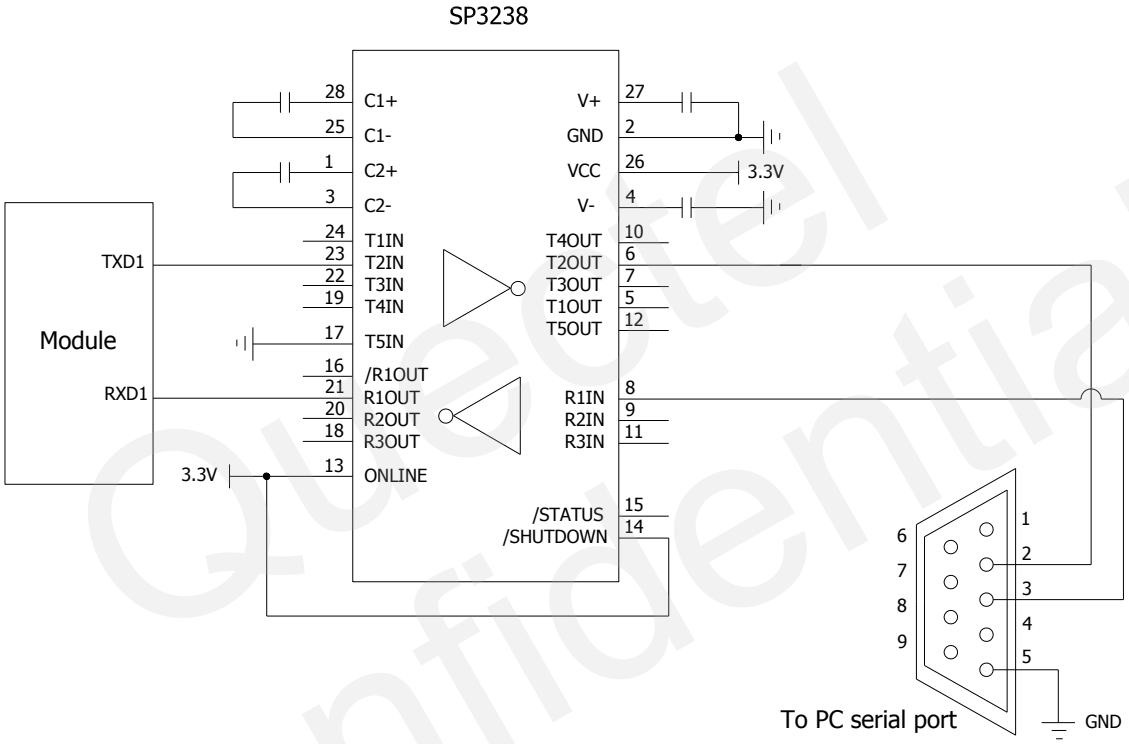


Figure 11: RS-232 level shift circuit

3.8. ANTON

The ANTON is an ***optional*** pin which can be used to control the power supply of active antenna or the enable pin of the external LNA. The recommended circuit diagram is shown in Figure 12. When L70 module enters the standby mode, the ANTON pin will be pulled down, the Q1 and Q2 are in high impedance state and the power supply for antenna is cut off. In normal mode, the voltage value of ANTON is about 2.8V, it will make Q1 and Q2 in the on-state, then VCC_RF will provide power supply for the active antenna. Figure 13 has shown the timing between the ANTON pin and the EXTINT0 pin.

Table 10: Pin definition of the ANTON

Name	Pin No.	Function
ANTON	13	Control the power supply of the active GPS antenna or the enable pin of the external LNA.

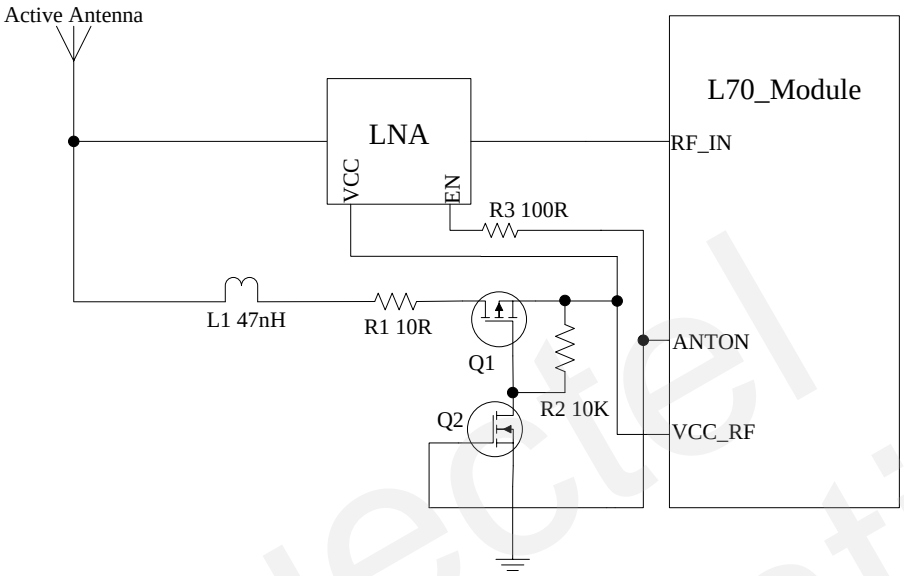


Figure 12: ANTON control circuit

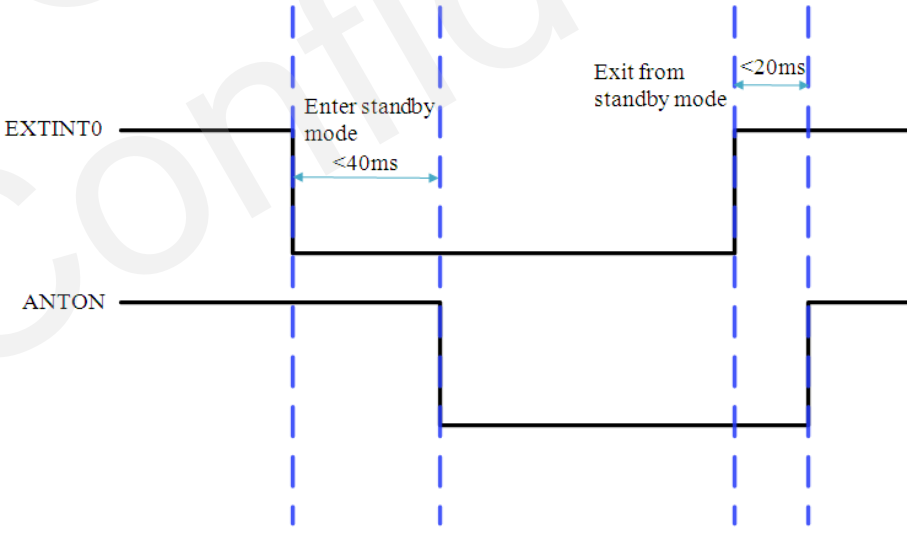


Figure 13: Timing of EXTINT0 and ANTON

4. Antenna interface

The L70 module receives L1 band signal from GPS satellites at a nominal frequency of 1575.42MHz. The RF signal is connected to the RF_IN pin. Customer should use a controlled impedance transmission line of 50 Ohm to connect to RF_IN.

4.1. Antenna

L70 module can be connected to passive or active antenna.

Table 11: Antenna specification for L70 module

Antenna type	Specification
Passive antenna	Center frequency: 1575.42 MHz Band Width: >20 MHz Gain: >0 dBi Polarization: RHCP or Linear
Active antenna	Center frequency: 1575.42 MHz Band Width: >5 MHz Minimum gain: 15-20dB(compensate signal loss in RF cable) Maximum noise figure: 1.5dB Maximum gain: 50dB Polarization: RHCP or Linear

4.2. Antenna supply

4.2.1. Passive antenna with external LNA

Typically a design using a passive antenna requires more attention regarding the layout of the RF section. An external LNA between the passive antenna and the L70 module is strongly recommended to add for improving receiver sensitivity. It is always beneficial to reserve a Π or L passive matching network between the passive antenna and the LNA. Figure14 is the rough reference design. For more details, please refer to ***document [3]***.

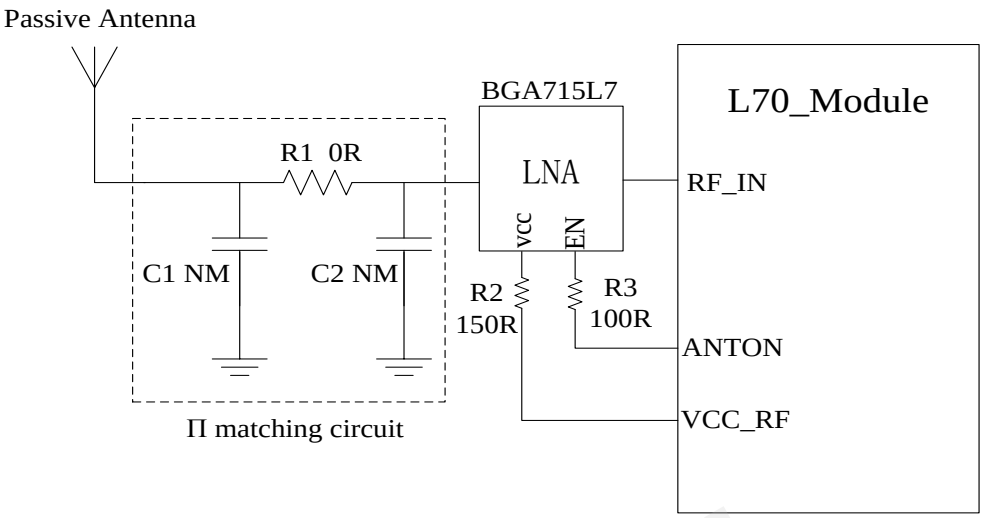


Figure 14: Reference design for passive antenna with LNA

Note: VCC_RF is directly connected to the power supply of L70 module internally. If VCC_RF is not suitable to the external LNA, using R2 as a divider or adding an external LDO circuit to get the required voltage. R3 is used as a current limiting resistor.

4.2.2. Active antenna without external LNA

Active antenna could be connected to RF_IN directly and you also can reserve a Π or L passive matching network between the active antenna and the L70 module. If an active antenna is connected to RF_IN, the integrated low-noise amplifier of the antenna must be powered by an external correct supply voltage. Generally, the supply voltage is fed to the antenna through the coaxial RF cable. An active antenna's loading current is between 5mA to 20mA. The inductor L1 outside of the module prevents the RF signal from leaking into the VCC_RF pin and routes the bias supply to the active antenna. Please refer to the reference circuit shown in Figure 15.

If the VCC_RF voltage does not meet the requirements for powering the active antenna, an external LDO could be used.

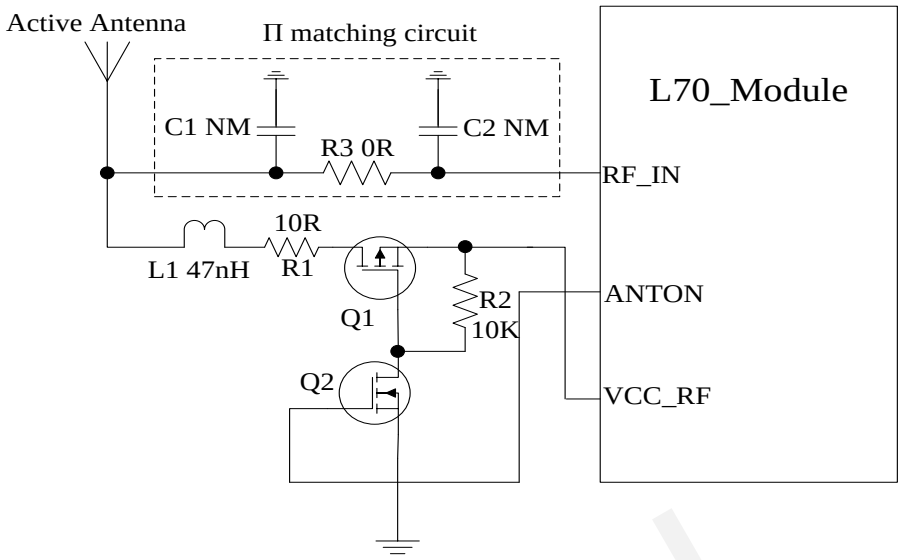


Figure 15: Reference design for active antenna without LNA

Note: The rated power of resistor R1 should be chosen no less than 1 watt in case active antenna is shorted unexpectedly. In order to reduce consumption, the value of resistor R2 is not recommended to choose too small.

4.2.3. Active antenna with external LNA

In order to obtain better receiver sensitivity, an active antenna and an external LNA are recommended. You also can reserve a Π or L passive matching network between the active antenna and the LNA. The rough reference circuit is shown in Figure16. For more details, please refer to ***document [3]***.

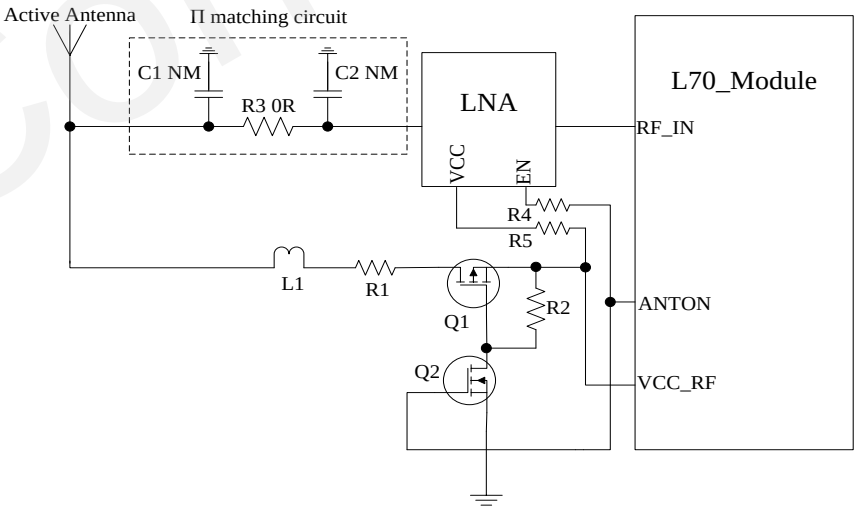


Figure 16: Reference design for active antenna with LNA

5. Electrical, reliability and radio characteristics

5.1. Absolute maximum ratings

Absolute maximum rating for power supply and voltage on digital pins of the module are listed in Table 12.

Table 12: Absolute maximum ratings

Parameter	Min	Max	Unit
Power supply voltage （VCC）	-0.3	4.3	V
Backup battery voltage (V_BCKP)	-0.3	4.3	V
Input voltage at digital pins	-0.3	3.6	V
VCC_RF output current (Ivccrf)		50	mA
Input power at RF_IN (Prfin)		0	dBm
Storage temperature	-45	125	℃

Note: Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. The product is not protected against over voltage or reversed voltage. If necessary, voltage spikes exceeding the power supply voltage specification, given in table above, must be limited to values within the specified boundaries by using appropriate protection diodes.

5.2. Operating conditions

Table 13: The module power supply ratings

Parameter	Description	Conditions	Min	Typ	Max	Unit
VCC	Supply voltage	Voltage must stay within the min/max values, including voltage drop, ripple, and spikes.	2.8	3.3	4.3	V
I_{VCCP}*	Peak supply current	VCC=3.3V			150	mA
V_BCKP	Backup voltage supply		2.0	3.3	4.3	V
VCC_RF	Output voltage RF section				VCC	V
I_{VCC_RF}	VCC_RF output current				50	mA
T_{OPR}	Normal Operating temperature		-40	25	85	℃

**** This figure can be used to determine the maximum current capability of power supply.***

Note: Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.

5.3. Current consumption

The values for current consumption are shown in Table 14.

Table 14: The module current consumption (passive antenna)

Parameter	Condition	Min	Typ	Max	Unit
Icc @Acquisition	@-130dBm		25		mA
Icc @Tracking	@-130dBm（For Cold Start, 10 minutes after First Fix. For Hot Start, 15 seconds after First Fix.）		22		mA
Icc @Standby	@VCC=3.3V		0.5		mA
I_{BCKP} @backup	@V_BCKP=3.3V		7		uA

Note: In the standby mode, the power supply to active antenna through VCC_RF is cut off. It will be re-activated when the module exits from the standby mode.

5.4. Electro-static discharge

L70 module is an ESD sensitive device. ESD protection precautions should still be emphasized. Proper ESD handing and packaging procedures must be applied throughout the processing, handing and operation of any application.

The ESD bearing capability of the module is listed in Table 15. Note that the customer should add ESD components to module pins in the particular application except RF_IN, VCC and GND pins.

Table 15: The ESD endurance table (Temperature: 25℃, Humidity: 45 %)

Pin	Contact discharge	Air discharge
RF_IN	±5KV	±10KV
VCC,GND	±5KV	±10KV
UART	±3KV	±6KV
Others	±2KV	±4KV

5.5. Reliability test

Table 16: Reliability test

Test term	Condition	Standard
Thermal shock	-30℃...+80℃, 144 cycles	GB/T 2423.22-2002 Test Na IEC 68-2-14 Na
Damp heat, cyclic	+55℃; >90% Rh 6 cycles for 144 hours	IEC 68-2-30 Db Test
Vibration shock	5~20Hz,0.96m^2/s^3;20~500Hz,0.96m^2/s^3-3dB/oct, 1hour/axis; no function	2423.13-1997 Test Fdb IEC 68-2-36 Fdb Test
Heat test	85 °C, 2 hours, Operational	GB/T 2423.1-2001 Ab IEC 68-2-1 Test
Cold test	-40 °C, 2 hours, Operational	GB/T 2423.1-2001 Ab IEC 68-2-1 Test
Heat soak	90 °C, 72 hours, Non-Operational	GB/T 2423.2-2001 Bb IEC 68-2-2 Test B
Cold soak	-45 °C, 72 hours, Non-Operational	GB/T 2423.1-2001 A IEC 68-2-1 Test

6. Mechanics

This chapter describes the mechanical dimensions of the module.

6.1. Mechanical view of the module

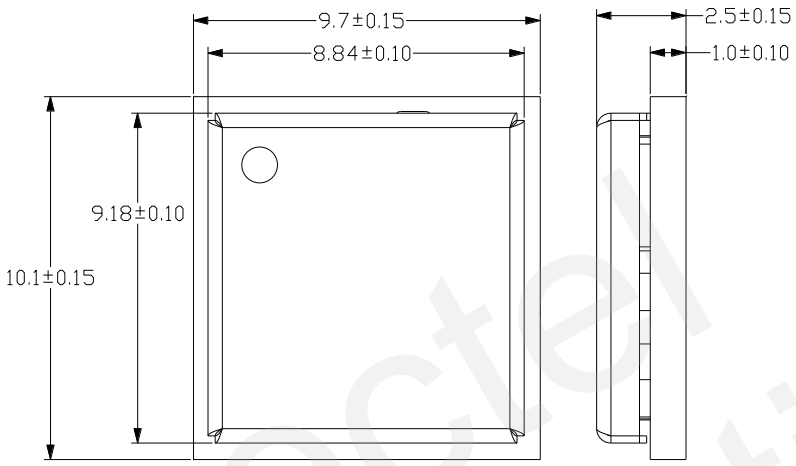


Figure 17: L70 Top view and Side view（Unit:mm）

6.2. L70 Bottom dimension and recommended footprint

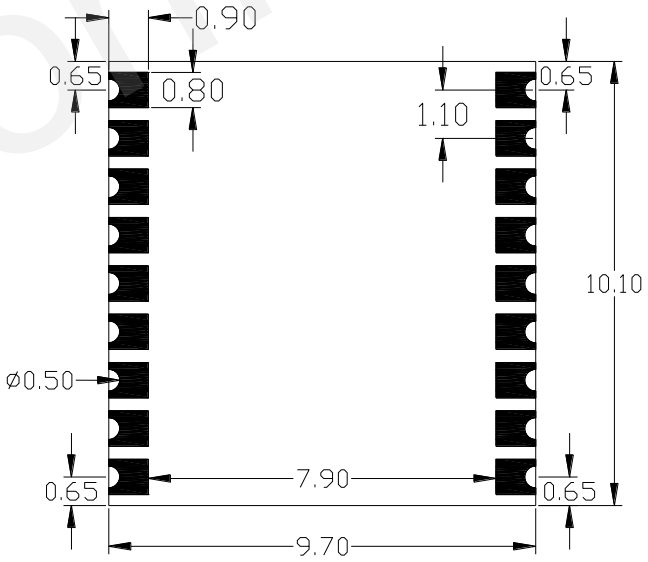


Figure 18: L70 Bottom dimension（Unit:mm）

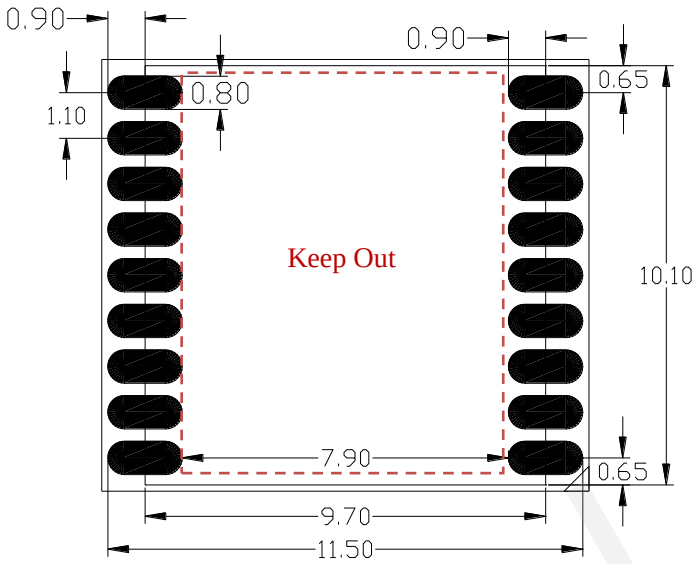


Figure 19: Footprint of recommendation（Unit:mm）

Notes：

1. The keep-out area should be covered by solder mask and top silk layer for isolation between the top layer of host board and the bottom layer of the module.

2. For easy maintenance of this module and accessing to these pads, please keep a distance of no less than 3mm between the module and other components in host board.

6.3. Top view of the module

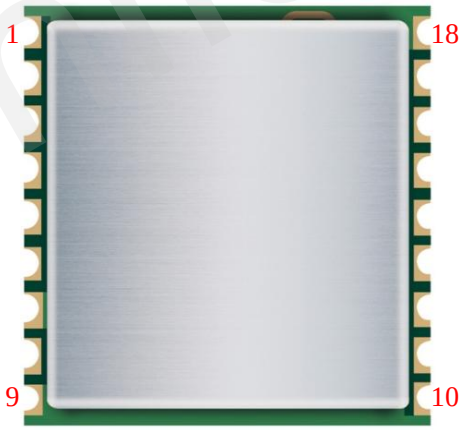


Figure 20: Top view of the module

6.4. Bottom view of the module

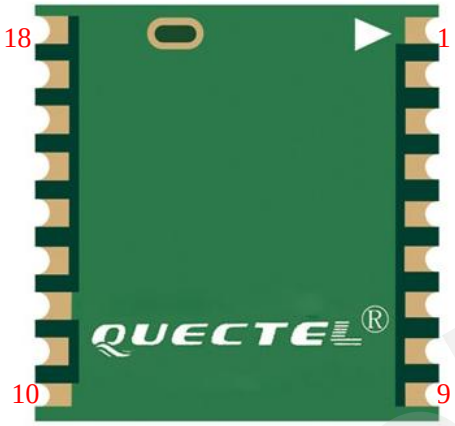


Figure 21: Bottom view of the module

7. Manufacturing

7.1. Assembly and soldering

L70 is intended for SMT assembly and soldering in a Pb-free reflow process on the top side of the PCB. It is suggested that the minimum height of solder paste stencil is 130um to ensure sufficient solder volume. Pad openings of paste mask can be increased to ensure proper soldering and solder wetting over pads. It is suggested that peak reflow temperature is 235~245℃ (for SnAg3.0Cu0.5 alloy). Absolute max reflow temperature is 260℃. To avoid damage to the module when it is repeatedly heated, it is suggested that the module should be mounted after the first panel has been reflowed. The following picture is the actual diagram which we have operated.

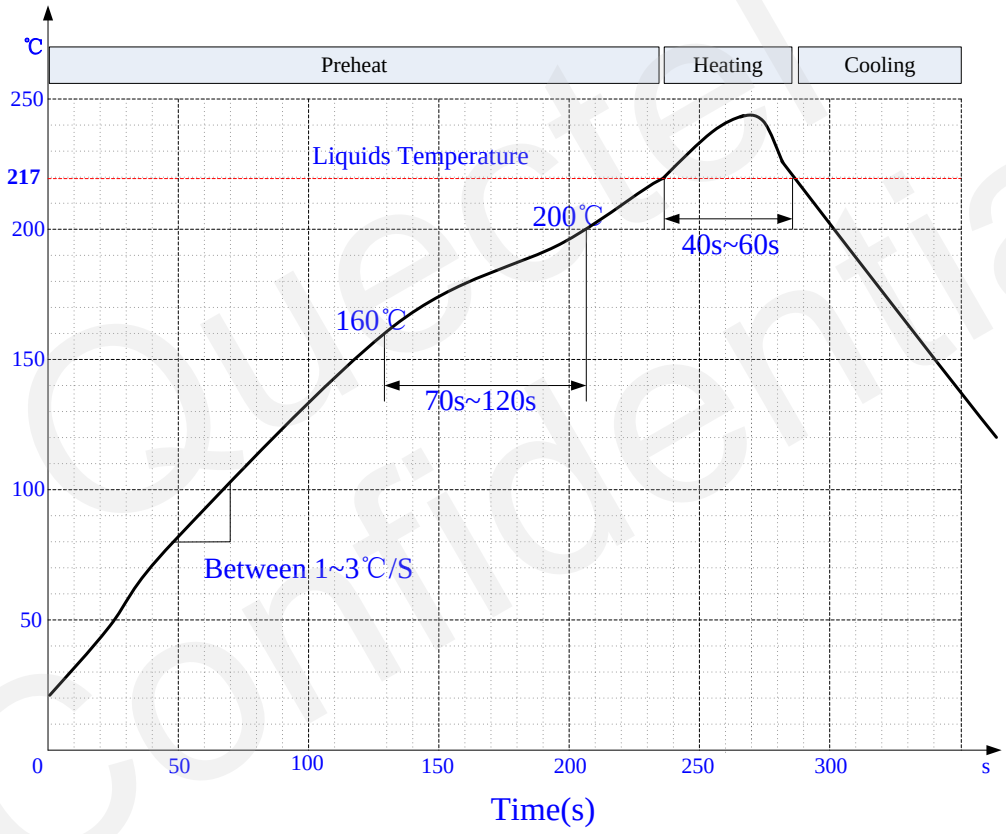


Figure 22: Ramp-soak-spike-reflow of furnace temperature

7.2. Moisture sensitivity

L70 is sensitivity to moisture absorption. To prevent L70 from permanent damage during reflow soldering, baking before reflow is required in following cases:

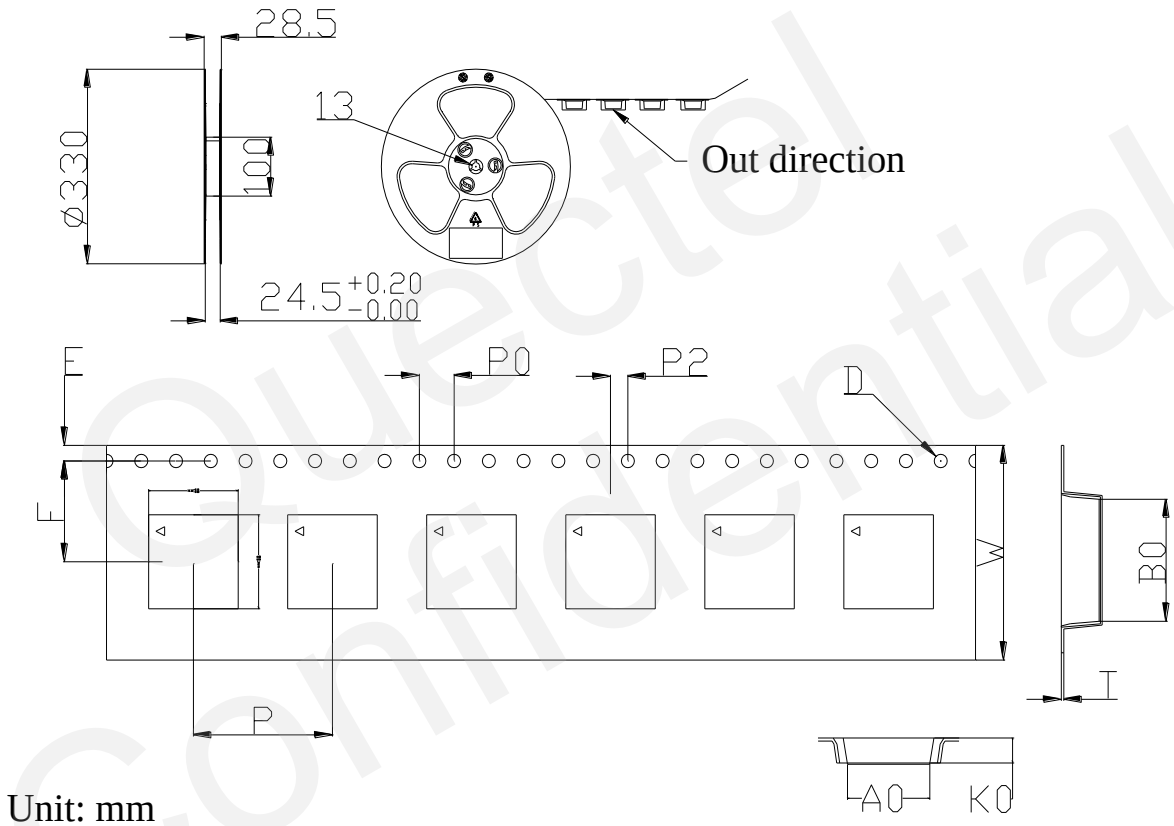
- Humidity indicator card: At least one circular indicator is no longer blue
- The seal is opened and the module is exposed to excessive humidity.

L70 should be baked for 192 hours at temperature 40℃+5℃/-0℃ and <5% RH in low-temperature containers, or 24 hours at temperature 125℃±5℃ in high-temperature containers. Care should be taken that plastic tray is not heat resistant. L70 should be taken out before preheating, otherwise, the tray maybe damaged by high-temperature heating.

7.3. ESD safe

L70 module is an ESD sensitive device and should be careful to handle.

7.4. Tape and reel



Unit: mm

ITEM	W	T	A0	B0	K0	P	F	E	D	P0	P2
DIM	24.0	0.30	10.3	10.5	2.8	16.0	11.5	1.75	1.5	4.0	2.0
TOLE	± 0.3	± 0.05	± 0.15	± 05	± 0.15	± 0.1	± 0.1	± 0.1	+0.10 −0.00	± 0.1	± 0.1

Figure 23: Tape and reel specification

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