



SIM65M Series Hardware Design

GNSS Module

SIMCom Wireless Solutions Limited

SIMCom Headquarters Building, Building 3, No. 289 Linhong
Road, Changning District, Shanghai P.R. China

Tel: 86-21-31575100

support@simcom.com

www.simcom.com

Document Title:	SIM65M Series Hardware Design
Version:	1.03
Data	2023-04-23
Status:	Released

GENERAL NOTES

SIMCOM OFFERS THIS INFORMATION AS A SERVICE TO ITS CUSTOMERS TO SUPPORT THE APPLICATION AND ENGINEERING EFFORTS THAT USE THE PRODUCTS DESIGNED BY SIMCOM. THE INFORMATION PROVIDED IS BASED ON THE REQUIREMENTS SPECIFICALLY FROM THE CUSTOMERS. SIMCOM HAS NOT UNDERTAKEN ANY INDEPENDENT SEARCH FOR ADDITIONAL RELEVANT INFORMATION, INCLUDING ANY INFORMATION THAT MAY BE IN THE CUSTOMER'S POSSESSION. FURTHERMORE, THE SYSTEM VALIDATION OF THE PRODUCT DESIGNED BY SIMCOM WITHIN A LARGER ELECTRONIC SYSTEM REMAINS THE RESPONSIBILITY OF THE CUSTOMER OR THE CUSTOMER'S SYSTEM INTEGRATOR. ALL SPECIFICATIONS SUPPLIED HEREIN ARE SUBJECT TO CHANGE WITHOUT NOTICE.

COPYRIGHT

THIS DOCUMENT CONTAINS THE PROPRIETARY TECHNICAL INFORMATION WHICH IS THE PROPERTY OF SIMCOM LIMITED, COPYING OF THIS DOCUMENT, GIVING IT TO OTHERS, THE USING OR COMMUNICATION OF THE CONTENTS THEREOF ARE FORBIDDEN WITHOUT THE OFFICIAL AUTHORITY BY SIMCOM. OFFENDERS ARE LIABLE TO THE PAYMENT OF THE DAMAGES. ALL RIGHTS ARE RESERVED IN THE EVENT OF GRANT OF A PATENT OR THE REGISTRATION OF A UTILITY MODEL OR DESIGN. ALL SPECIFICATIONS SUPPLIED HEREIN ARE SUBJECT TO CHANGE WITHOUT NOTICE.

SIMCom Wireless Solutions

SIMCom Headquarters Building, Building 3, No. 289 Linhong Road, Changning District, Shanghai P.R.China

Tel: +86 21 31575100

Email: simcom@simcom.com

For more information, please visit:

<https://www.simcom.com/download/list-863-en.html>

For technical support, or to report documentation errors, please visit:

<https://www.simcom.com/ask/> Or email to: support@simcom.com

Copyright © 2023 SIMCom Wireless Solutions Limited All Rights Reserved.

Version History

Date	Version	Description of change	Author
2022-06-08	V1.01	Origin	Qiu Lei Wentao Tan
2022-10-10	V1.02	Changed the functional framework diagram, as well as part of the module timing diagram Update EINT_IN description. The B1C frequency was increased	Xinao Liu Wentao Tan
2023-04-23	V1.03	<ol style="list-style-type: none"> 1. Revised the active antenna reference design and added the recommended material list for antenna TVS 2. Revised the description of sleep mode and RTC mode 4. Update the module process description 5. Increase the maximum absolute rating of IO pin voltage and other level maximum parameters 6. Modify the function description of the RESET pin 7. Change the GNSS operating frequency 8. Add 3.3V IO level SIM65M-U module 9. Update the current consumption data and add the current consumption data under different satellites 10. Increase REACH certification 	Qiu Lei Wentao Tan

Confidential

Contents

1	Introduction	7
1.1	Overview	8
1.2	Key Features	8
1.3	SIM65M Series Functional Diagram	9
1.4	GNSS Performance	10
1.5	General features	11
1.6	Power consumption	12
1.7	GNSS operating frequency	12
1.8	A-GPS	13
1.8.1	EPO™	13
1.8.2	EASY™ Mode	13
1.8.3	SBAS and RTCM	14
1.8.3.1	SBAS	14
1.8.3.2	RTCM	14
1.9	LOCUS	14
1.10	AIC	15
1.11	Firmware update	15
2	Package Information	16
2.1	Pin out Diagram	16
2.1.1	Pin Description	16
2.1.2	Package Dimensions	19
3	Application Interface	20
3.1	Power Management	20
3.1.1	Power Input	20
3.1.1.1	VCC supply requirements	20
3.1.1.2	Backup supply	21
3.1.2	Power on	21
3.1.2	Power off	22
3.1.3	Verification of SIM65M Series Start	22
3.1.4	Power Saving Modes	22
3.2	Operating Mode	23
3.2.1	Full on Mode	23
3.2.2	Sleep Mode	23
3.2.3	RTC mode	24
3.2.3.1	Software RTC Mode	24
3.2.3.2	Hardware RTC Mode	25
3.3	VCC_RF	26
3.4	WAKEUP_OUT Signal	26
3.5	EINT_IN Signal	27
3.6	UART Interface	27
3.7	I2C Interface*	28

3.8	Timemark Output	29
3.9	RESET_N	29
4	Antenna	31
4.1.1	Antenna Interface	31
4.1.2	Antenna Choice Consideration	31
4.1.2.1	Passive Antenna	32
4.1.2.2	Active Antenna	35
5	Electrical Characteristics	36
5.1	Absolute Maximum Ratings	36
5.2	Recommended Operating Conditions	36
5.3	Electro-Static Discharge	37
6	PCB Design	39
6.1	Top and bottom View of SIM65M Series	39
6.2	Layout Requirements	40
6.3	Welding resistance design	40
6.4	Recommended PCB Decal	40
6.5	Recommended SMT Stencil	41
7	Manufacturing	42
7.1	Assembly and Soldering	42
7.2	Humidity sensitivity level and moisture resistance requirement	43
7.3	Storage	45
7.4	Workshop life and temperature and humidity environment control	45
7.5	ESD handling precautions	46
7.6	Shipment	46
8	Reference Design	47
9	Appendix	48
9.1	Related Documents	48
9.2	Terms and Abbreviations	48
9.3	Safety Caution	49

Table Index

TABLE 1: GNSS PERFORMANCE	10
TABLE 2: GENERAL FEATURES	11
TABLE 3: CONSUMPTION DATA(TYPICAL)	12
TABLE 4: GNSS OPERATING FREQUENCIES	12
TABLE 5: I/O PARAMETER DEFINITION	16
TABLE 6: DESCRIPTION OF MODULE DIFFERENCES	17
TABLE 7: PIN DESCRIPTION	17
TABLE 8: RECOMMENDED D1 AND D2 LIST	21
TABLE 9: POWER SUPPLY AND CLOCK STATE ACCORDING TO OPERATION MODE	23
TABLE 10: HOST PORT MULTIPLEXED FUNCTION PINS	27
TABLE 11: ANTENNA SPECIFICATIONS	32
TABLE 12: TVS RECOMMENDED LIST	33
TABLE 13: ABSOLUTE MAXIMUM RATINGS	36
TABLE 14: SIM65M SERIES OPERATING CONDITIONS	36
TABLE 15: SIM65M SERIES STANDARD IO FEATURES	37
TABLE 16: THE ESD CHARACTERISTICS (TEMPERATURE: 25°C, HUMIDITY: 45 %)	37
TABLE 17: MOISTURE CLASSIFICATION LEVEL AND FLOOR LIFE	45
TABLE 18: RELATED DOCUMENTS	48
TABLE 19: TERMS AND ABBREVIATIONS	48
TABLE 20: SAFETY CAUTION	49

Figure Index

FIGURE 1: SIM65M SERIES FUNCTIONAL DIAGRAM	10
FIGURE 2: SIM65M SERIES PIN DIAGRAM (TOP VIEW)	16
FIGURE 3: SIM65M SERIES MECHANICAL DIMENSIONS (UNIT: MM)	19
FIGURE 4: POWER SUPPLY REFERENCE CIRCUIT	20
FIGURE 5: V_BACKUP INPUT REFERENCE CIRCUIT	21
FIGURE 6: TIMING SEQUENCE OF MODULE POWER-ON AND POWER-OFF	22
FIGURE 7: ENTER AND EXIT SOFTWARE RTC MODE	25
FIGURE 8: WAKEUP HOST	26
FIGURE 9: CONNECTION OF THE SERIAL INTERFACES	28
FIGURE 10: CONNECTION OF THE I2C INTERFACES	28
FIGURE 11: TIMEMARK APPLICATION CIRCUIT	29
FIGURE 12: RESET RECOMMENDED CIRCUIT	30
FIGURE 13: SIM65M SERIES PASSIVE ANTENNA DESIGN	33
FIGURE 14: SIM65M SERIES PASSIVE ANTENNA DESIGN (WITH EXTERNAL LNA AND SAW)	34
FIGURE 15: SIM65M SERIES PASSIVE ANTENNA DESIGN	34
FIGURE 16: SIM65M SERIES ACTIVE ANTENNA DESIGN	35
FIGURE 17: TOP AND BOTTOM VIEW OF SIM65M	39
FIGURE 18: TOP AND BOTTOM VIEW OF SIM65M-U	39
FIGURE 19: RECOMMENDED PCB DECAL (TOP VIEW) (UNIT: MM)	40
FIGURE 20: RECOMMENDED SMT STENCIL	41
FIGURE 21: THE RAMP-SOAK-SPIKE REFLOW PROFILE OF SIM65M SERIES	43
FIGURE 22: HUMIDITY CARD	44
FIGURE 23: REFER SCHEMATIC	47

1 Introduction

This document describes the hardware interface of the SIMCom module SIM65M Series, SIM65M Series is a high performance and reliable GNSS module. It is a GNSS module integrated with GPS & GLONASS & BEIDOU & Galileo & QZSS system in a LCC type with AIROHA's high sensitivity navigation engine, which allows customer to achieve industry's high level sensitivity, accuracy, and Time-to-First-Fix (TTFF) with lower power consumption..

1.1 Overview

SIM65M Series provides simultaneous GPS, BEIDOU, GLONASS, Galileo and QZSS open service L1 reception capability. With 33 tracking channels and 99 acquisition channels, SIM65M Series can acquire and track any mix of multiple satellite signals. Combining advanced AGPS called EASY™ (Embedded Assist System) with proven AlwaysLocate™ technology, SIM65M Series achieves the highest performance and fully meets the industrial standard..

1.2 Key Features

The module provides complete signal processing from antenna input to host port in NMEA messages. The module requires 2.8V to 4.3V power supply, which gives customers plenty of choices for the application circuit. The module communicates with the HOST through the UART interface. The SIM65M I/O interface level is 2.8V and the SIM65M-U I/O interface level is 3.3V.

SIM65M Series supports the following L1 GNSS band signals:

- GPS, BEIDOU, GLONASS, Galileo also supports QZSS , SBAS.

Besides, module provides the following services:

- Support WAAS/EGNOS/MSAS/GAGAN
- 12 multi-tone AIC in L1 band for removing unwanted signals
- RTCM ready
- Small footprint: 10.1x 9.7 x 2.5mm, 18-pin LCC package
- Support Jamming Removing (AIC)
- Low-noise amplifier has been integrated (LNA)
- Max fixed update rate up to 10 HZ¹
- Advanced software features
 1. Periodic mode/GLP mode for lower power consumption
 2. EPO™ orbit prediction

- 3. EASY™ self-generated orbit prediction
- 4. LOCUS™ logger function
- Pulse-per-second (PPS) GPS time reference
 - 1. Adjustable duty cycle
 - 2. Typical accuracy: +/- 10ns
- Interface²
 - 1. UART
 - 2. I2C
- Operating temperature: -40 ~ +85°C
- RoHS\REACH compliant

NOTE

- 1. Default is 1 HZ;
- 2. Different module interface configurations are different, please refer to the pin description for details

1.3 SIM65M Series Functional Diagram

The following figure shows a functional diagram of the SIM65M Series and illustrates the mainly functional parts:

- The main chip
- SAW filter
- Integrated LNA
- The antenna interface
- The communication interface
- The control signals

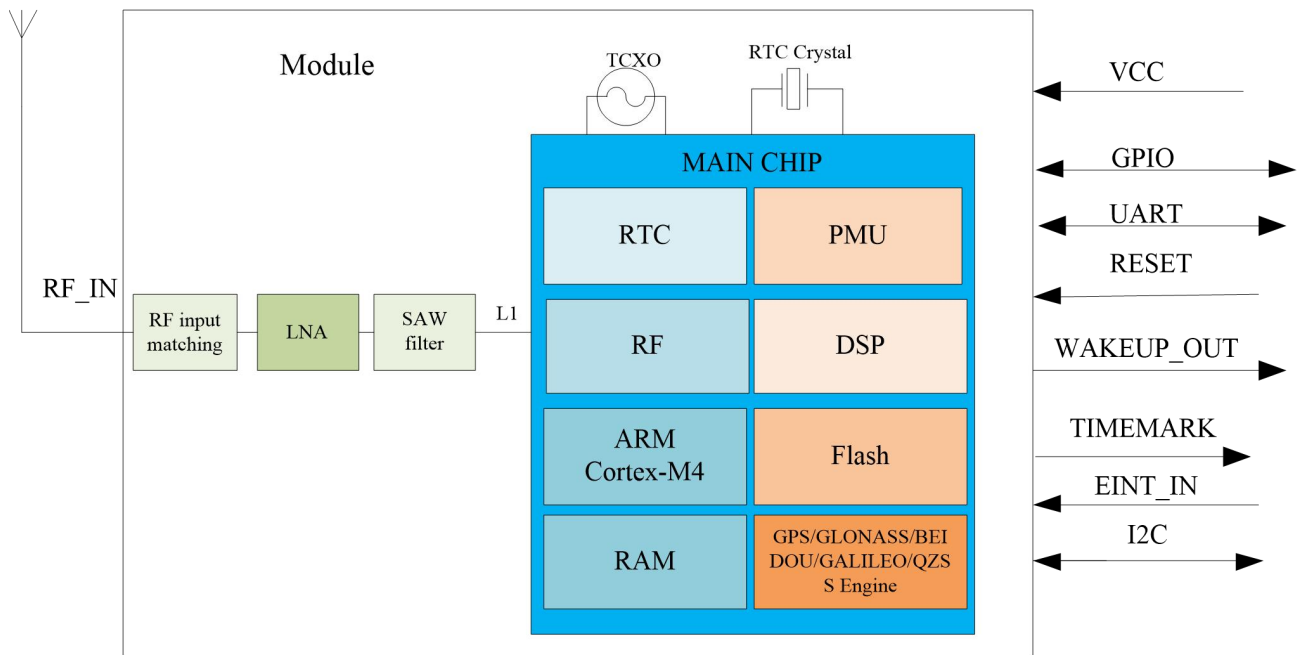


Figure 1: SIM65M Series functional diagram

1.4 GNSS Performance

Table 1: GNSS Performance

Parameter	Description	Performance			
		Min	Type	Max	Unit
Horizontal Position Accuracy ¹	Automatic position		1		m
Velocity Accuracy ²	Without Aid		0.1		m/s
	DGPS		0.05		m/s
Timing Accuracy			10		nS
Dynamic Performance	Maximum Altitude			18000	m
	Maximum Velocity			500	m/s
	Maximum Acceleration			4	G
TTFF with GPS (L1) and GLONASS and BEIDOU mode	Hot start		1.1		S
	Warm start		21.5		S
	Cold start		25.3		S
A-GPS TTFF(EPO in flash mode)	Cold start		3.5		S
Sensitivity with GPS (L1) and GLONASS and BEIDOU mode	Autonomous acquisition(cold start)		-147		dBm
	Re-acquisition		-157.5		dBm
	Tracking		-167		dBm
Receiver	Channels		L1:75		

Update rate	1	10	Hz
Tracking L1, CA Code			
Protocol	support		
NMEA,PAIR			

NOTE

1. 50% 24hr static, -130dBm;
2. 50% at 30m/s;
3. GPS signal level: -130dBm; GLONASS signal level: -130dBm; GALILEO signal level: -130dBm; BEIDOU signal level: -130dBm.

1.5 General features

Table 2: General features

Parameters	Value	
Supply voltage VCC	+2.8V~4.3V typical:3.3V	
Supply voltage ripple VCC	54 mV(RMS) max @ f = 0~3MHz 15 mV(RMS) max @ f > 3 MHz	
Storage temperature	-45°C~+95°C	
Operating temperature	-40°C~+85°C ¹	
DVDDIO=3.3V I/O signal levels(V)	V _{IL}	-0.3V~0.8V
	V _{IH}	2.4V~3.5V
	V _{OL}	Max: 0.4V
	V _{OH}	Min: 2.4V
DVDDIO=2.8V I/O signal levels(V)	V _{IL}	-0.3V~0.7V
	V _{IH}	2.1V~3.0V
	V _{OL}	Max: 0.35V
	V _{OH}	Min: 2.1V
I/O output sink/source capability	+/- 8mA max	
I/O input leakage	+/- 5 uA max	
Host port	UART0	
Other port	I2C, UART2	
Serial port protocol (UART)	NMEA; 8 bits, no parity, 1 stop bit; 115200 baud (configurable)	
TM output (1PPS)	3D-FIXED 1 pulse per second, synchronized at rising edge, The rising	

edge of the pulse is aligned with UTC seconds, with an accuracy of about 10nS
pulse length 100ms

1.6 Power consumption

Table 3: Consumption data(typcial)

Parameter	Description	GPS	GPS+GLO	GPS+GAL	GPS+GAL+BDS	GPS+GLO+GAL+BDS
Acquisition		10.5mA	12 mA	12 mA	11.5 mA	12.5 mA
Tracking		9mA	12 mA	11 mA	11.5 mA	12.5 mA
Sleep mode (UART enable)	SIM65M @VCC=3.3V,	2.4mA	2.4 mA	2.4 mA	2.4 mA	2.4 mA
Sleep mode (UART disable)	VIO=2.8V	250uA	250 uA	250 uA	250 uA	250 uA
Hardware RTC				36 uA		
Software RTC				15 uA		
Acquisition		10.5 mA	11.5 mA	11.5 mA	11.5 mA	11.5 mA
Tracking		8.5 mA	11 mA	10.5 mA	10.5 mA	11.5 mA
Sleep mode (UART enable)	SIM65M-U @VCC=3.3V,	2.0 mA	2.0 mA	2.0 mA	2.0 mA	2.0 mA
Sleep mode (UART disable)	VIO=3.3V	270 uA	270 uA	270 uA	270 uA	270 uA
Hardware RTC				36 uA		
Software RTC				15 uA		

1.7 GNSS operating frequency

The SIM65M series is a single-band, multi-galaxy GNSS positioning module that can receive and track multi-galaxy GNSS signals. The GNSS operating frequencies are shown in the following table:

Table 4: GNSS Operating frequencies

Type	Frequency
GPS L1	1575.42±1.023MHz
GLONASS G1	1601.7±6.75MHz
Galileo E1	1575.42±1.023MHz
BeiDou B1C	1575.42±16.368MHz
BeiDou B1I	1561.098±2.046MHz

1.8 A-GPS

A-GPS is the meaning of Assisted GPS, which is a system that can under certain conditions improve the startup performance, or time-to-first-fix (TTFF) of a GPS satellite-based positioning system. SIM65M Series module supports EPO file, EASY mode, SBAS and RTCM.

1.8.1 EPO™

The SIM65M 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.

The user should update the EPO files from the EPO server in the period of validity of EPO file through the internet. Then the EPO data should send to the SIM65M Series by the HOST side. SIM65M Series has the shorter cold TTFF and warm TTFF, when the A-GPS is used.

NOTE

For more information about EPO™, please contact SIMCom.

1.8.2 EASY™ Mode

EASY is the abbreviation of Embedded Assist System, it works as embedded software 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 GPS 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 standby condition. EASY assistance is going to be engaged when the GPS 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 PAIR command.

1.8.3 SBAS and RTCM

1.8.3.1 SBAS

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.

1.8.3.2 RTCM

SIM65M Series module supports soft 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 SIMCom for supporting.

1.9 LOCUS

The module supports LOCUS technology, which is a technology that supports autonomous recording of log information and can automatically store satellite navigation data in the internal flash of the module to facilitate users to accurately analyze satellite navigation data. In addition, when this function is enabled, the module can reduce power consumption, and the host does not need to receive NMEA information all the time.

NOTE

The LOCUS function is turned off by default, and the switch can be controlled by the PAIR command, please refer to the "SIM65M Series_NMEA Message_User Guide" for more information.

1.10 AIC

The module supports multi-tone AIC (Multi-tone AIC, Active Interference Cancellation) function, which can effectively suppress or eliminate RF noise harmonics such as Wi-Fi, Bluetooth, and 2/3/4/5G.

NOTE

AIC is enabled by default, users can use the PAIR command to control the switch, please refer to "SIM65M Series_NMEA Message_User Guide" for more information.

1.11 Firmware update

The module is shipped with firmware pre-installed. SIMCom may release firmware versions that contain bug fixes or performance optimizations, so it is important to implement a firmware upgrade mechanism in the client's system. A firmware upgrade is the process of transferring a binary image file to a receiver and storing it in flash. For details on firmware upgrades, refer to the firmware upgrade manual.

2 Package Information

2.1 Pin out Diagram

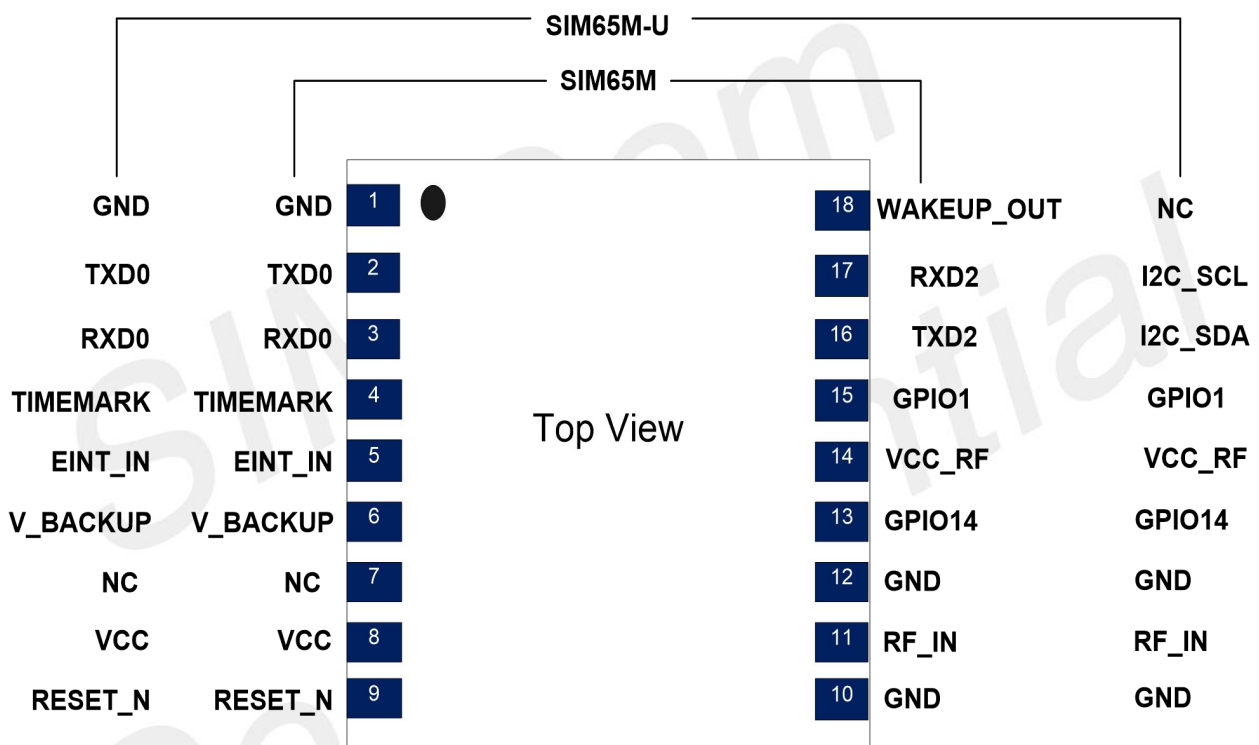


Figure 2: SIM65M Series pin diagram (Top view)

2.1.1 Pin Description

Table 5: I/O parameter definition

Type	Description
AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output

DIO	Digital Input/Output
PI	Power Input
PO	Power Output

Table 6: Description of module differences

Module	Description
SIM65M	IO interface level 2.8V, VCC_RF output 2.8V power supply, two UART interfaces
SIM65M-U	IO interface level 3.3V, VCC_RF output 3.3V power supply, One UART interface and one I2C interface

Table 7: Pin description

Pin name	Pin number	I/O	Description	Comment
Power supply				
VCC	8	PI	Main power input, which will be used to power the baseband and RF section internally. The input voltage range is 2.8V~4.3V, the typical value is 3.3V, and the supply current requirement can reach 100mA.	Provide clean and stable power source to this pin. Add a 4.7uF capacitor to this pin for decoupling.
VCC_RF	14	PO	Internal power output to power the active antenna SIM65M output 2.8V; The SIM65M-U outputs 3.3V Delivers a maximum of 100mA	If unused, keep open.
V_BACKUP	6	PI	The backup battery input power supply for RTC The input voltage range is 2.5V~3.6V, the typical value is 2.8V	Must be connected.
GND	1,10,12	-	Ground	GND
Communication interface				
TXD0	2	DO	NMEA serial output/ input	SIM65M 2.8V power domain
RXD0	3	DI		
TXD2/I2C_SDA	16	DO/ DIO	The default SIM65M is an UART of RTCM	SIM65M-U 3.3V power domain
RXD2/I2C_SCL	17	DI	The SIM65M-U defaults to the I2C interface	If unused, keep open.
System control				

RESET_N	9	I	Input pin, which is pulled below 0.4V and held for at least 100ms before being released, can reset the module	Internal default pulls 1.8V high and supports 1.8/3.3V input
GPIOs				
WAKEUP_OUT	18	O	GNSS chip wakeup host	SIM65M 2.8V power domain SIM65M-U default NC High active
TIMEMARK	4	O	Timemark outputs timing pulse related to receiver time	After successful positioning, the default output is 1Hz pulse. SIM65M 2.8V power domain SIM65M-U 3.3V power domain If unused, keep open.
EINT_IN	5	I	Wake up module UART, low active, default pull high	SIM65M 2.8V power domain SIM65M-U 3.3V power domain If unused, keep open.
GPIO1	15	I/O	General purpose input/output	SIM65M 2.8V power domain SIM65M-U 3.3V power domain If unused, keep open..
GPIO14	13	I/O	General purpose input/output	SIM65M 2.8V power domain SIM65M-U 3.3V power domain If unused, keep open..
NC	7	-	-	-
RF interface				
RF_IN	11	I	Radio antenna connection	Impedance must be controlled to 50Ω.

2.1.2 Package Dimensions

Following figure shows the Mechanical dimensions of SIM65M Series (top view, side view and bottom view).

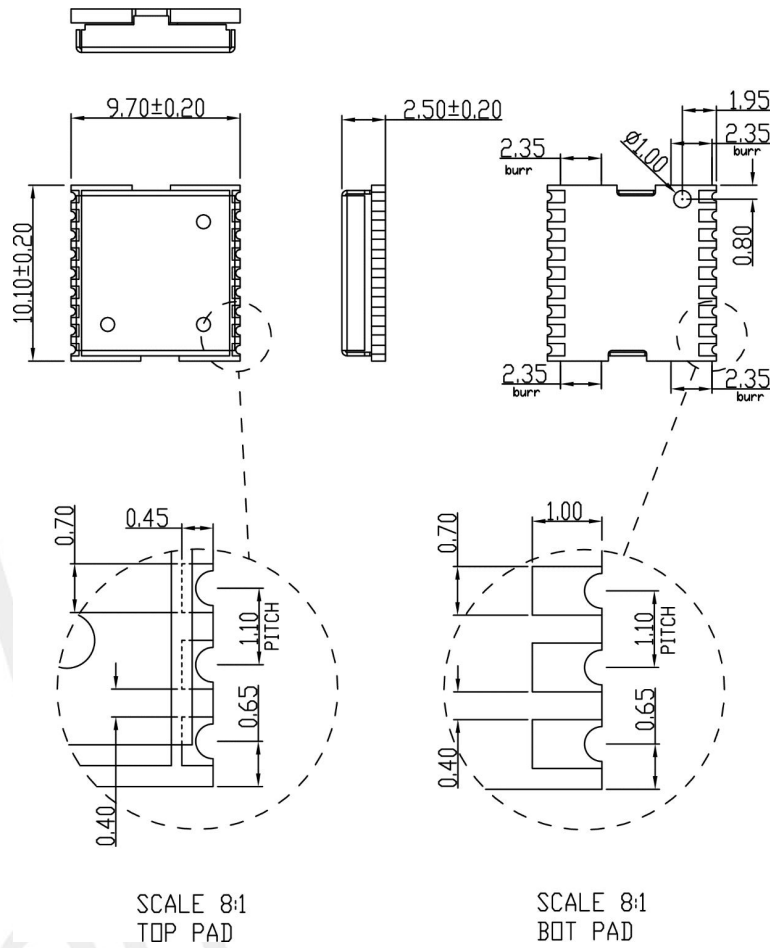


Figure 3: SIM65M Series mechanical dimensions (Unit: mm)

3 Application Interface

3.1 Power Management

3.1.1 Power Input

3.1.1.1 VCC supply requirements

The power supply range of SIM65M Series is from 2.8V to 4.3V, typical 3.3V. The power supply should be able to provide sufficient current up to 100mA. SIM65M Series positioning modules require a stable power supply, consider the following points:

- Wide power lines or even power planes are preferred.
- VCC supply needs to add a 4.7uF and 100nF multi-layer ceramic chip (MLCC) capacitors with low ESR in high frequency band, which can be used for EMC performance .
- The ripple of the VCC supply cannot be higher than 15mV.
- VCC supply needs a ESD and surge protection.

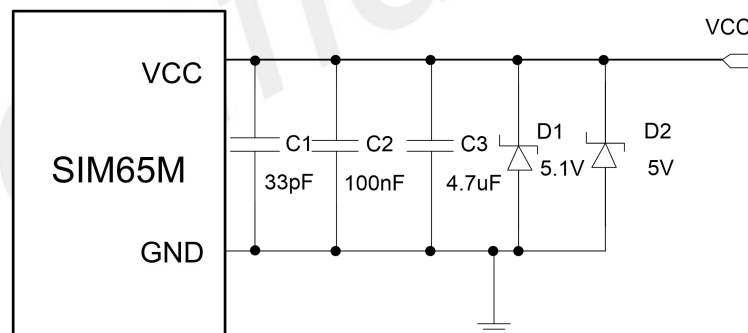


Figure 4: Power supply reference circuit

NOTE

D2 is used for ESD protection and D1 is used for surge protection.

Table 8: Recommended D1 and D2 list

No.	Manufacturer	Part number	VRWM	Package	Ref. Designator
1	JCET	ESDBW5V0A1	5V	DFN1006-2L	D2
2	WAYON	WS05DPF-B	5V	DFN1006-2L	
3	LRC	LEDZ5.1BT1G	5.1V	SOD-523	D1
4	Prisemi	PZ5D4V2H	5.1V	SOD-523	

3.1.1.2 Backup supply

The V_BACKUP pin is backup power, and the power supply range is 2.5V~3.6V. By using valid time and GNSS track data at start-up, the module enables hot (warm) start-up. When the module is turned on, the V_BACKUP should be connected to the power supply and maintain the power supply all the time; If RTC entry is required, power is maintained V_BACKUP VCC is maintained after sending a command to enter RTC mode¹.

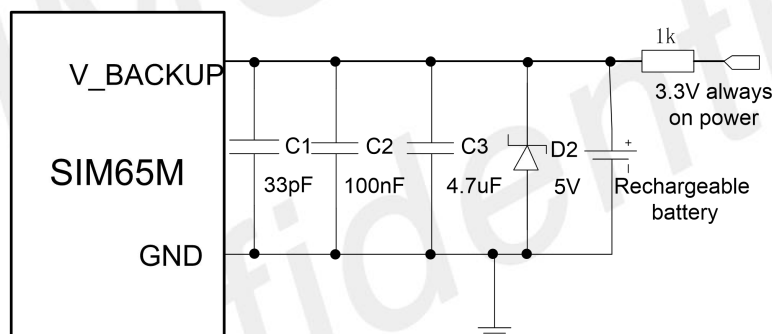


Figure 5: V_BACKUP input reference circuit

NOTE

1. The V_BACKUP voltage must not be lower than the minimum recommended operating voltage, otherwise the module may operate abnormally.
2. If a battery is connected, it is recommended to use a rechargeable battery, and please select the current limiting resistor according to the charging current requirements of the rechargeable battery

3.1.2 Power on

When power is first applied, SIM65M Series goes into operation mode. VCC should power up quickly within

50ms, and to ensure proper power-up sequencing, backup power should be started no later than VCC, so V_BACKUP must be powered up before or at the same time as VCC. The module power-up and disconnection timing diagram is shown in Figure 6.

3.1.2 Power off

When the power supply of the module VCC is disconnected, the voltage should be guaranteed to drop rapidly within 50ms. In order to ensure that the power-on sequence is abnormal when the module is powered on next time it is powered on and restarted, ensure that the module VCC is powered down to less than 1V and maintained for at least 5s, and then perform power-on restart.

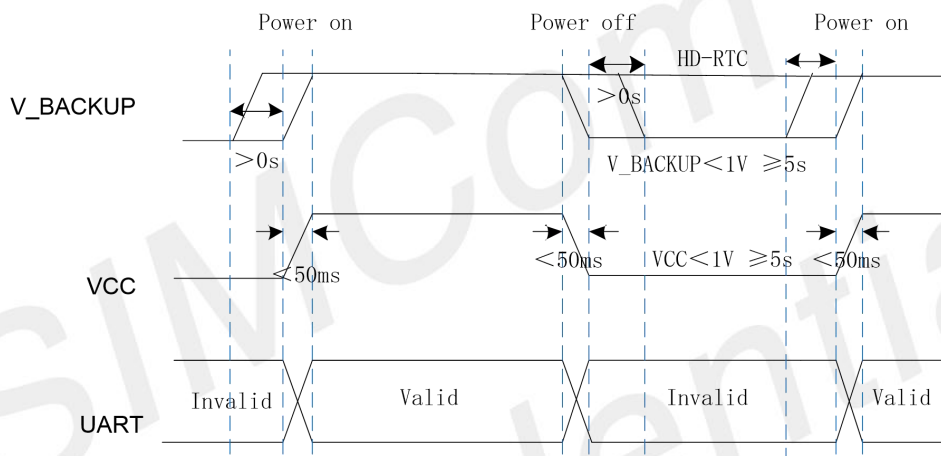


Figure 6: Timing sequence of module power-on and power-off

3.1.3 Verification of SIM65M Series Start

System activity indication depends upon the chosen serial interface:

When it is activated, SIM65M Series will output messages at the selected UART speed, and message types. The default baud rate is 115200bps.

3.1.4 Power Saving Modes

SIM65M Series supports power saving modes for reducing average power consumption like sleep mode, RTC mode.

- Sleep mode: In this mode, UART can send instructions normally. The host can wake up the module by sending a wake-up command..
- RTC mode: The host side sends instructions through the communication interface and enters the software RTC mode.

NOTE

The modes mentioned above are operated by PAIR commands, users can refer to “SIM65M Series_NMEA Message_User Guide” for more information.

3.2 Operating Mode

Table 9: Power supply and clock state according to operation mode

Mode	VCC	V_BACKUP	Internal LDO	Main clock	RTC clock
Full on	on	on	on	on	on
Sleep mode	on	on	on	off	on
RTC mode	off	on	off	off	on

3.2.1 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. This mode is also referenced as full on, full power or navigation mode.

First positioning (different CN value, different positioning time), can download complete ephemeris data 15 minutes after positioning.

Navigation is available and any configuration settings are valid as long as the VCC power supply is active. When the power supply is off, settings are reset to factory configuration and receiver performs a cold start on next power up.

3.2.2 Sleep Mode

Sleep mode means a low quiescent power state, non-volatile RTC, and backup RAM block is powered on. Other internal blocks like digital baseband and RF are internally sleeping. The PMU is changed to low power mode, The power supply input VCC shall be kept active all the time, even during sleep mode.

Commands can be sent through the UART interface to control the module entering/exiting sleep mode.

- Entering into sleep mode:

Send the command \$PAIR003*39\r\n, the module returns \$PAIR001,003,1*39\r\n,\$PAIR001,003,0*38\r\n, and then enter sleep mode.

- Exiting sleep mode:

Send the command \$PAIR002*38\r\n, the module returns \$PAIR001,002,1*38\r\n,\$PAIR001,002,0*39\r\n, and then exits sleep mode

NOTE

1. \$PAIR001,003,1*39\r\n indicates that the module is turning off the power, \$PAIR001,003,0*38\r\n indicates that the module is finished powering off.
2. \$PAIR001,002,1*38\r\n indicates that the module is turning on the power, \$PAIR001,002,0*39\r\n indicates that the module is finished powering on.
3. If you need to achieve lower current consumption in sleep mode, you can turn off the uart function, and the typical power consumption value is 240uA. Please refer to the "3.5 EINT_IN" section for details.

3.2.3 RTC mode

The module provides lower power consumption than sleep mode and is suitable for applications that are idle for long periods of time or where power consumption is sensitive. In RTC mode, the module stops capturing and tracking satellite signals, and only the backup domain remains active, continuing to record time.

3.2.3.1 Software RTC Mode

- Enter software RTC mode

1. Entering into RTC mode is controlled by UART interface, send \$PAIR650,0*25\r\n to enter RTC mode.
2. Receive \$PAIR001,650,0*38\r\n, Receive \$PAIR650,0*25\r\n
3. Disconnect the VCC separately and keep the V_BACKUP powered on after receiving \$PAIR650,0*25 at least 50ms.

- Exit software RTC Mode

1. Reconnect the VCC and module will exit RTC mode automatically.

3.2.3.2 Hardware RTC Mode

The current consumption in hardware RTC mode is twice as high as that in software RTC mode.

- Enter hardware RTC mode

1. Disconnect the VCC separately and keep the V_BACKUP powered.

- Exit hardware RTC Mode

1. Reconnect the VCC and module will exit RTC mode automatically.

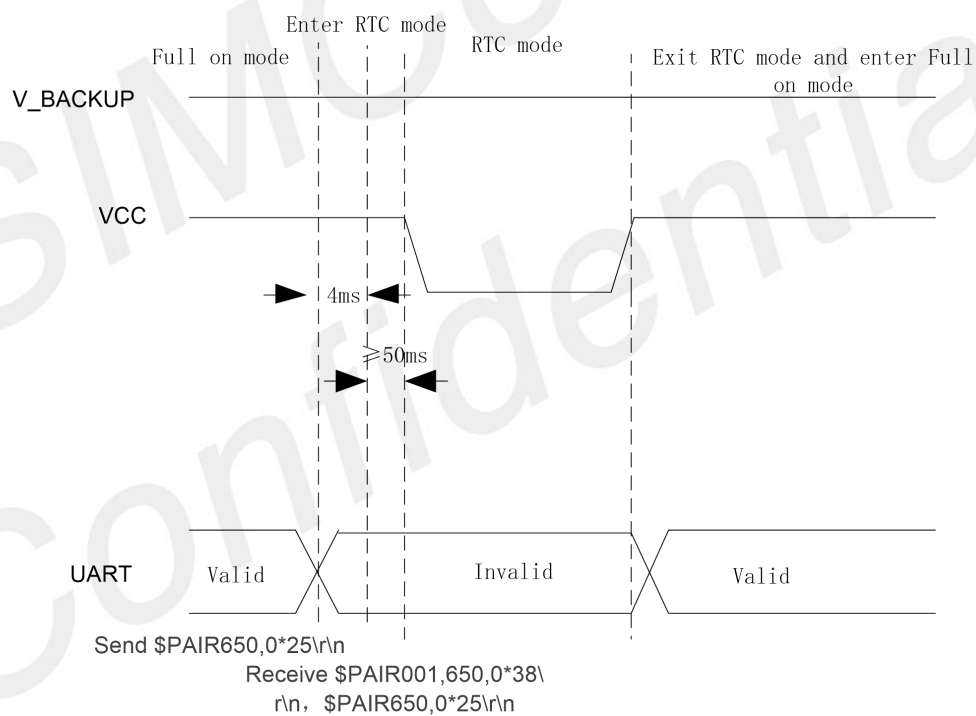


Figure 7: Enter and Exit software RTC Mode

NOTE

For command PAIR650, please refer to "SIM65M Series_NMEA Message_User Guide".

3.3 VCC_RF

VCC_RF is a 2.8V/3.3V output pin for powering an active antenna. For the detail usage of VCC_RF, customer can refer to section 9 for details.

NOTE

1. VCC_RF must be connected in series with a current limiting resistor of 10 ohm.
2. VCC_RF must be connected to a TVS outside the module.

3.4 WAKEUP_OUT Signal

SIM65M Series module WAKEUP_OUT pin can be used to wakeup host, when WAKEUP_OUT pull high 10ms that module will send a wake-up signal to the host chip before sending NMEA or other data(without command response).

1. enable external power source witch have to meeting power on sequence.
2. Pull up WAKEUP_OUT 10ms.
3. SIM65M Series module will wakeup host.

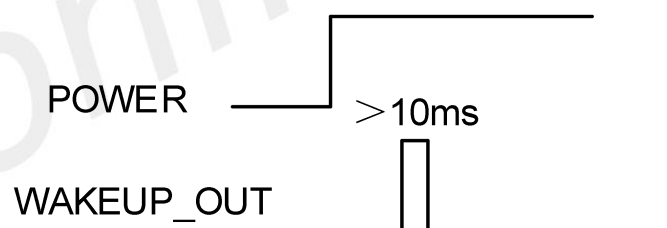


Figure 8: Wakeup host

NOTE

You can ignore this signal, if your host chip will not enter the sleep mode.

3.5 EINT_IN Signal

The module can be configured with UART sleep to reduce power consumption. ENIT_IN is used to wake up module from sleep.

Standard version firmware turns off this feature by default. If lower power consumption is required, you can send \$PAIR382,0*2F command to turn on the UART Sleep function. After turning on the UART sleep function, \$PAIR commands must be sent in the following timing:

1. Pull down "EINT_IN" pin at least 10ms, in the process of pulling down EINT 10ms, SIM65M Series will return \$PAIR012*39.
2. Send command within 100ms after returning \$PAIR012*39.

3.6 UART Interface

UART can provide the developers signal or message outputs. SIM65M Series includes three UART interfaces.

- UART0 interface for serial communication, and this UART support NMEA output and PAIR command input.
- UART2 is used for RTCM format data input/output for RTCM functions.

Table 10: Host port multiplexed function pins

Pin name	Pin number	I/O	Description	Comment
TXD2/SDA	16	DO	Default RTCM	SIM65M: 2.8V power domain
RXD2/SCL	17	DI	SIM65M-U is configured for I2C	SIM65M-U:3.3V power domain If unused, keep open.
TXD0	2	DO	Serial data output of NMEA	SIM65M: 2.8V power domain
RXD0	3	DI	Serial data input for firmware update	SIM65M-U:3.3V power domain 2.8V power domain

NOTE

1. The default baud rate is 115200, if other baud rate required please contact SIMCom.
2. If the IO voltage of the MCU does not match the module, a level shifting circuit must be added.

The following figure shows the connection between module and client (DTE).

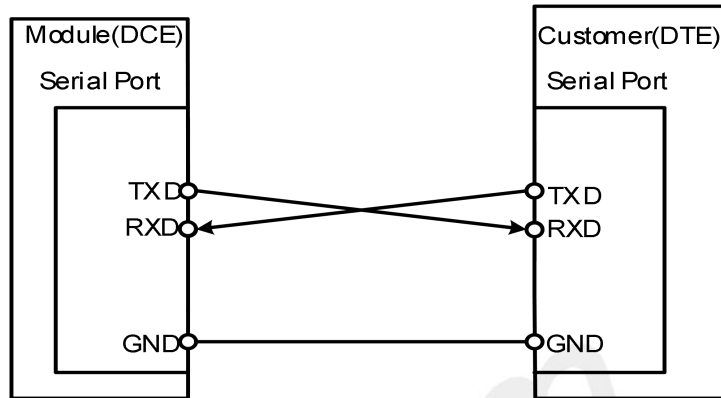


Figure 9: Connection of the serial interfaces

3.7 I2C Interface*

SIM65M-U supports one I2C interface and supports 400kHz and 1MHz modes.

The reference circuit is shown in the figure below:

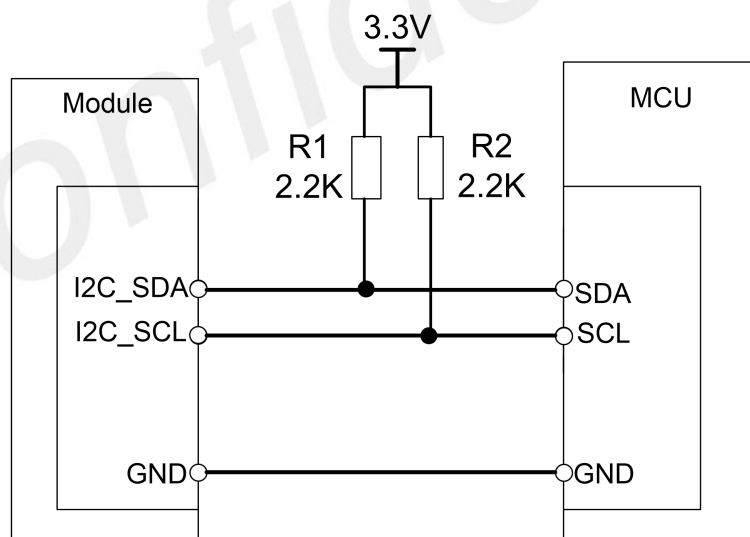


Figure 10: Connection of the i2c interfaces

NOTE

1. 2.2K resistor needs to be pulled up outside the module.
2. If the IO voltage of the MCU does not match the module, a level shifting circuit must be added.

3.8 Timemark Output

The Timemark pin outputs pulse-per-second (PPS) pulse signal for precise timing purposes after the position has been fixed. The Timemark 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.

PPS GPS time reference with adjustable duty cycle and +/- 10ns accuracy, support for time service application, which is achieved by the PPS vs NMEA feature.

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

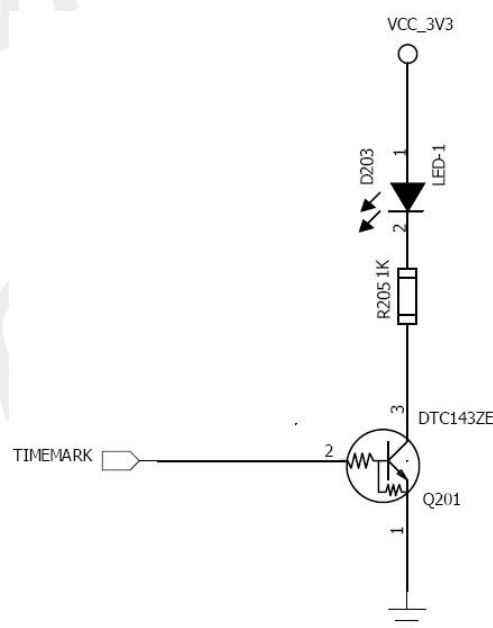


Figure 11: TIMEMARK application circuit

3.9 RESET_N

Input enable pin, pull this pin low for 100ms and then release it, which can reset the module and can be used to exit software RTC mode. This pin has been pulled up 10k resistors to 1.8V inside the module, eliminating the need to add pull-up resistors outside the module. The module has diodes inside to be

compatible with 1.8V/3.3V voltage inputs. The recommended circuit is as follows:

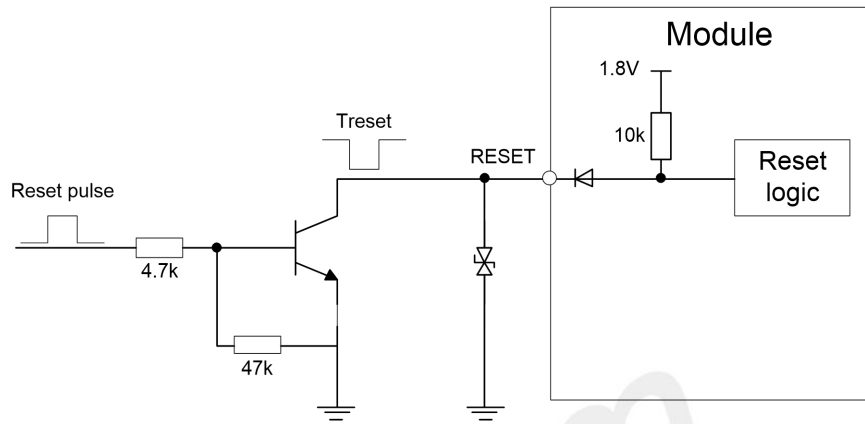


Figure 12: RESET recommended circuit

SIMCom
Confidential

4 Antenna

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

It is recommended to use an active GPS/GLONASS/BEIDOU/Galileo antenna. In a typical application, SIM65M Series with an active antenna can get a tracking sensitivity about 3dB better than SIM65M Series with a passive antenna.

4.1.1 Antenna Interface

The SIM65M Series receives L1 band signals from GPS/GLONASS/BEIDOU/Galileo satellites, The RF signal is connected to the RF_IN pin. And the trace from RF_IN to antenna should be controlled to 50Ω impedance.

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 (10) connector or I-PEX's 20279-001E-01 RF connector.
SMA connector.

4.1.2 Antenna Choice 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.

The total noise figure should be well below 3 dB.

If a patch antenna is the preferred antenna, choose a patch of at least 15x15x4 mm for standalone. GPS/QZSS, or choose a patch of at least 25x25x4 mm for GPS + GLONASS. For smaller antennas, an LNA with a noise figure <2 dB is recommended.

Make sure the antenna is not located close to noisy parts of the circuitry (e.g. micro-controller or High Power or display).

To optimize performance in environments with out-of-band jamming sources, use an additional SAW filter.

The micro strip must be 50 Ω and be routed in a section of the PCB where minimal interference from noise sources can be expected.

In case of a multi-layer PCB, use the thickness of the dielectric between the signal and the first GND layer (typically the 2nd layer) for the micro strip calculation.

If the distance between the micro strip and the adjacent GND area (on the same layer) does not exceed 5 times the track width of the micro strip.

Use an external LNA if your design does not include an active antenna when optimal performance is important.

The suggested active antenna should be chosen as following:

Table 11: Antenna Specifications

	Specification	Passive and active antenna
Active Antenna Recommendations	Frequency range L1	1560~1609MHz
	Polarization	RHCP
	Gain	>20dB (max 50 dB)
	Noise Figure	<1.5 dB

4.1.2.1 Passive Antenna

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

The most common antenna type for GPS/GLONASS/BEIDOU/Galileo application is the patch antenna. Patch antennas are flat, generally have a ceramic and metal body and are mounted on a metal base plate.

Figure 13 shows a minimal setup for a GPS/GLONASS/BEIDOU receiver with SIM65M Series module.

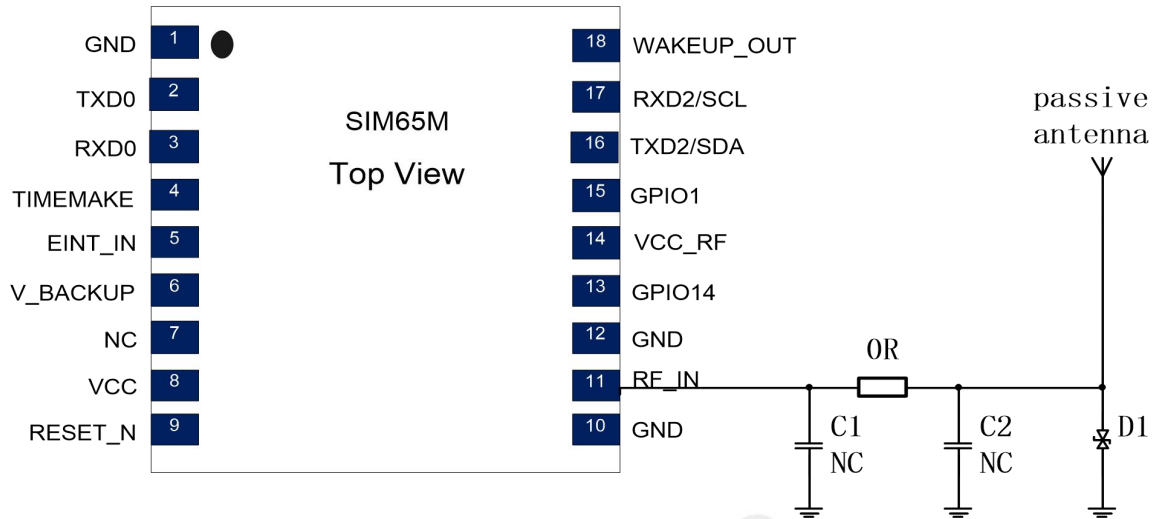


Figure 13: SIM65M Series passive antenna design

NOTE

TVS requires ultra-low junction capacitance, less than 0.2 pF is recommended.

Table 12: TVS recommended list

No	Vendor	Device	Clamping Voltage	Junction Capacitance	Package
1	Prisemi	PESDEC2XD5VBF	15V	0.15pF	DFN0603-2L
2	WAYON	WE05DGCF-B	20V	0.18pF	DFN0603-2L
3	WAYON	WE05DGCMS-BH	20V	0.15pF	DFN0603-2L
4	INPAQ	TVC5VB1SD-DFN0603-2L	4.7V	0.18pF	DFN0603-2L

For better performance with passive antenna designs user can use an external LNA to increase the sensitivity up 3~4 dB. Please see Figure 14.

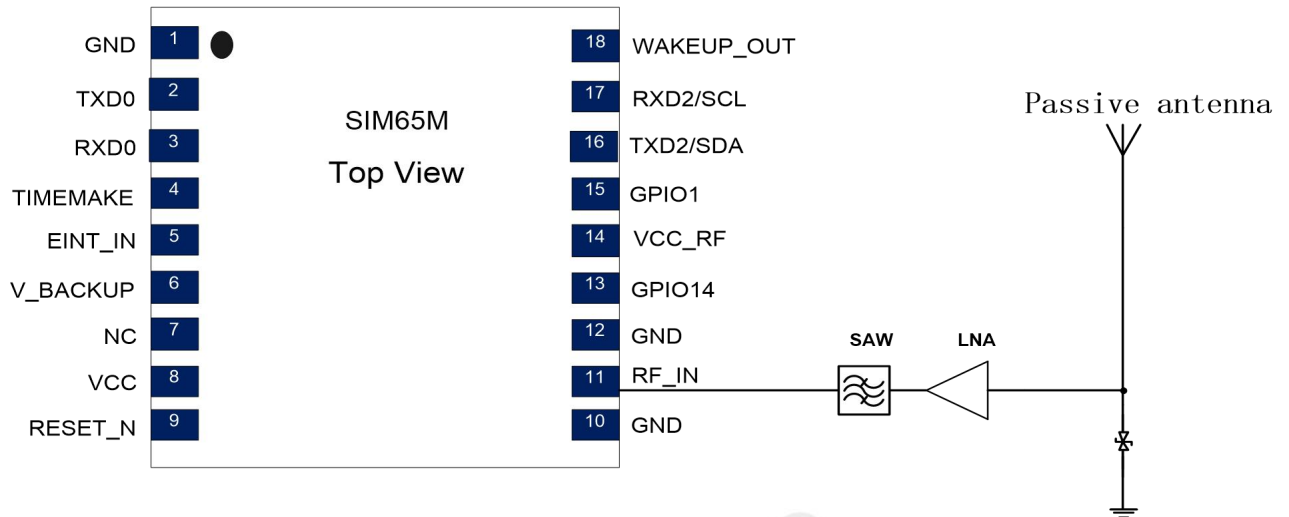


Figure 14: SIM65M Series passive antenna design (with external LNA and SAW)

For best performance, user can add an external saw based on Figure 11 design to avoid interference, please see Figure 15.

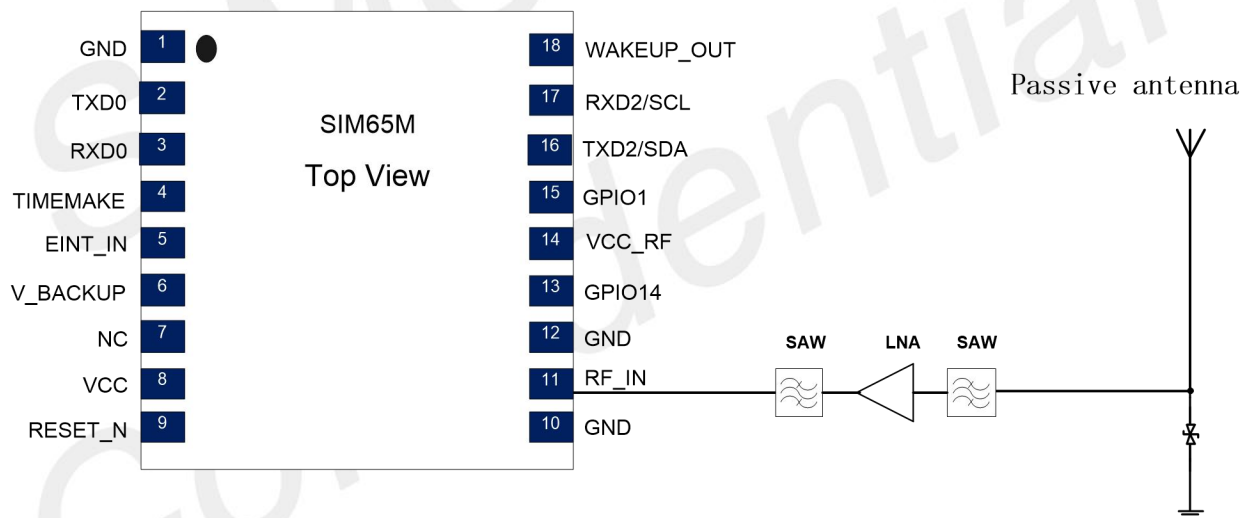


Figure 15: SIM65M Series passive antenna design

4.1.2.2 Active Antenna

Active antenna has an integrated Low-Noise Amplifier (LNA). Active antenna needs 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 16. The output voltage of PIN 14 is 2.8V. If the supply voltage of active antenna is 2.8V, PIN 14 VDD_ANT can be connected to RF_IN as figure 16 shows. If the active antenna is not 2.8V, other power should be connected to RF_IN.

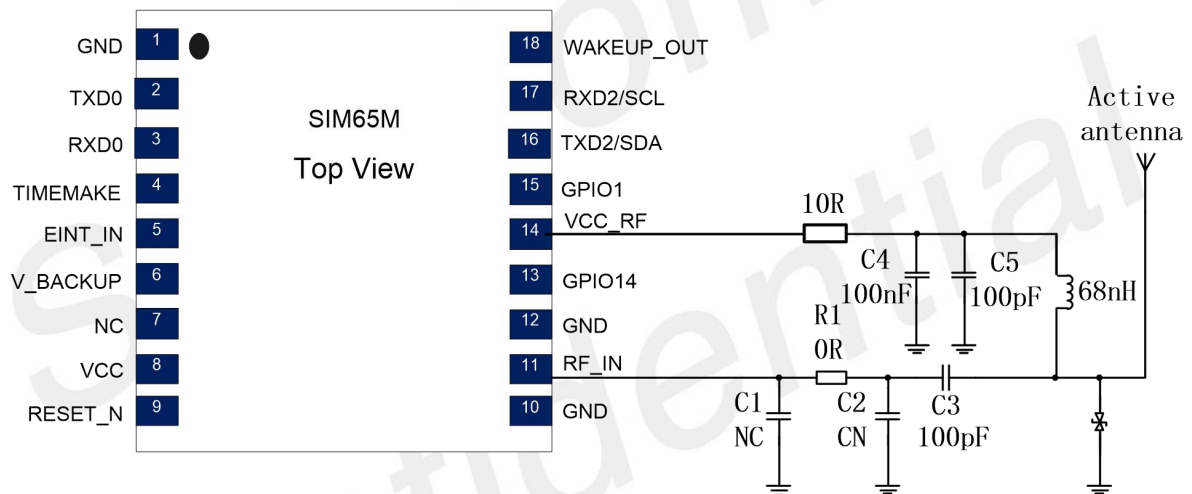


Figure 16: SIM65M Series active antenna design

If the customer's design is for automotive applications, then an active antenna can be used and located on top 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 Characteristics

5.1 Absolute Maximum Ratings

The absolute maximum ratings stated in Table 13 are stress ratings under non-operating conditions. Stresses beyond any of these limits will cause permanent damage to SIM65M Series.

Table 13: Absolute maximum ratings

Parameter	Min	Max	Unit	
VCC	-	4.5	V	
RF_IN	-	3.6	V	
V_BACKUP	-	3.6	V	
I/O pin voltage	@V _{IO} =2.8V	2.52	3.08	V
	@V _{IO} =3.3V	2.97	3.63	V
Storage temperature	-45	+95	°C	
Operating Temperature	-40	+85	°C	

NOTE

The absolute maximum rating of RF_IN please reference to the active antenna datasheet.

5.2 Recommended Operating Conditions

Table 14: SIM65M Series operating conditions

Parameter	Symbol	Min	Typ	Max	Unit
Operating temperature range		-40	+25	+85	°C
Main supply voltage	VCC	2.8	3.3	3.6	V
VCC_RF Active antenna supply voltage output	VCC_RF@SIM65M	2.7	2.8	2.9	V
	VCC_RF@SIM65M-U	3.2	3.3	3.4	V
	I _{max}			100	mA
Backup battery voltage	V_BACKUP	2.5	2.8	3.6	V

Table 15: SIM65M Series standard IO features

Parameter	Symbol	Min	Typ	Max	Unit
Low level output voltage Test conditions IOL = 2mA and 4.0mA@3.3V	V_{ol}	-		0.4	V
High level output voltage Test conditions IOL = 2mA and 4.0mA@3.3V	V_{oh}	2.4		-	V
Low level input voltage@3.3V	V_{il}	-0.3		0.8	V
High level input voltage@3.3V	V_{ih}	2.4		3.5	V
Low level output voltage Test conditions IOL = 2mA and 4.0mA@2.8V	V_{ol}	-		0.35	V
High level output voltage Test conditions IOL = 2mA and 4.0mA@2.8V	V_{oh}	2.1		-	V
Low level input voltage@2.8V	V_{il}	-0.3		0.7	V
High level input voltage@2.8V	V_{ih}	2.1		3.0	V
Input Pull-up resistance	RPU	40	75	190	K Ω
Input Pull-down resistance	RPD	40	75	190	K Ω
Input capacitance	C_{in}		5		pF
Load capacitance	C_{load}			8	pF
Tri-state leakage current	IOZ	-10		10	μ A

5.3 Electro-Static Discharge

The GPS engine is not protected against Electrostatic Discharge (ESD) in general. Therefore, it is subject to ESD handling precautions that typically apply to ESD sensitive components. Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application using a SIM65M Series module.

Table 16: The ESD characteristics (Temperature: 25°C, Humidity: 45 %)

Pin	Contact discharge	Air discharge
VCC	± 4 kV	± 8 kV
GND	± 4 kV	± 8 kV
VCC_RF	± 4 kV	± 8 kV
RF_IN	± 4 kV	± 8 kV

NOTE

Test conditions:

1. The external of the module has surge protection diodes and ESD protection diodes.
2. The data in Table 16 were tested using SIMCom EVB.

SIMCom
Confidential

6 PCB Design

6.1 Top and bottom View of SIM65M Series

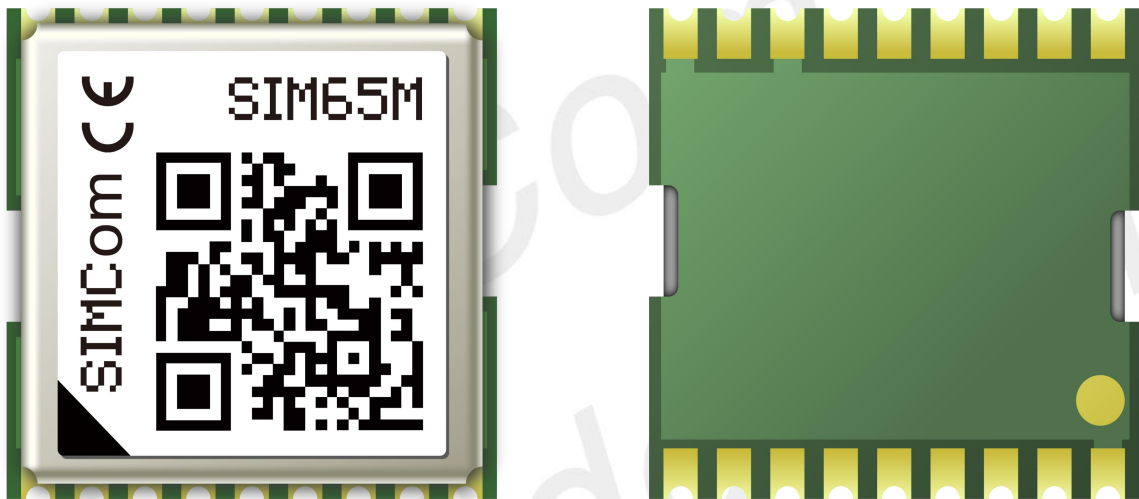


Figure 17: Top and bottom view of SIM65M

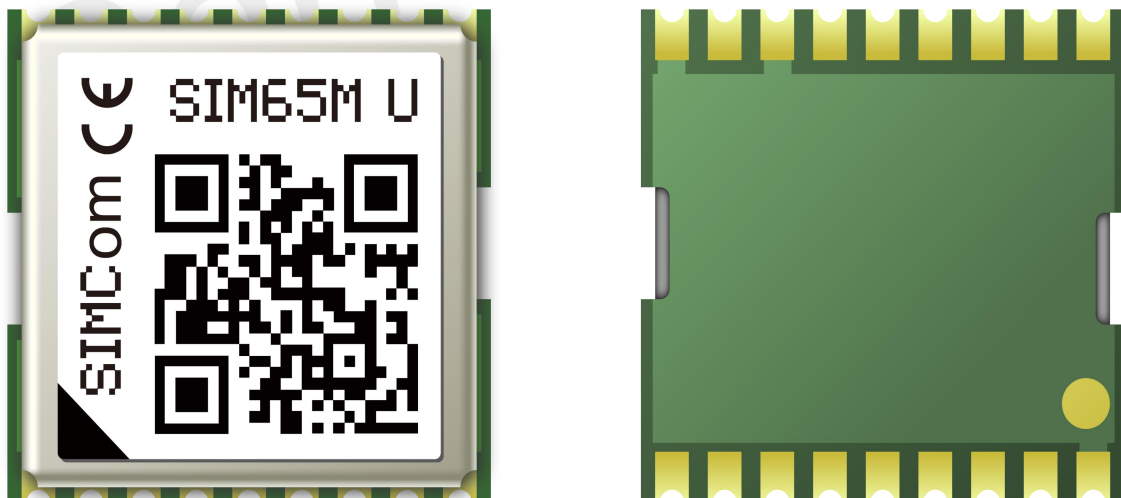


Figure 18: Top and bottom view of SIM65M-U

NOTE

The above is the design effect diagram of the module for reference. The actual appearance is subject to the actual product.

6.2 Layout Requirements

- Avoid placing other devices within 5mm around the module; In order to increase the repair space, the layout of other devices should be far away from the module.
- The minimum distance between the module and the PCB side is 5mm.
- PCB double-sided layout, the module should be processed on the second side.

6.3 Welding resistance design

- The PCB pad design can be either a resistance weld definition (SMD) or a non-resistance weld definition (NSMD).
- The non-resistance Welding definition (NSMD) is recommended. In addition, non-resistance welding definition pad design, resistance welding window larger than pad size, can improve the reliability of the welding spot.
- The welding window should be 100um-150um larger than the size of the pad, that is, the size of the unilateral pad is 50-75um larger than the size of the pad; According to PCB manufacturer's process.

6.4 Recommended PCB Decal

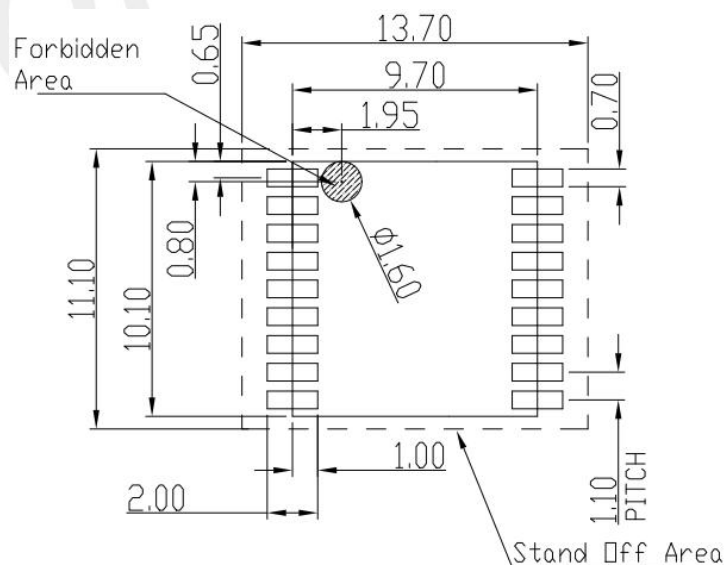


Figure 19: Recommended PCB decal (top view) (Unit: mm)

6.5 Recommended SMT Stencil

The following figure shows the SMT stencil of SIM65M Series, suggested solder paste stencil height is 150um minimum to ensure sufficient solder volume:

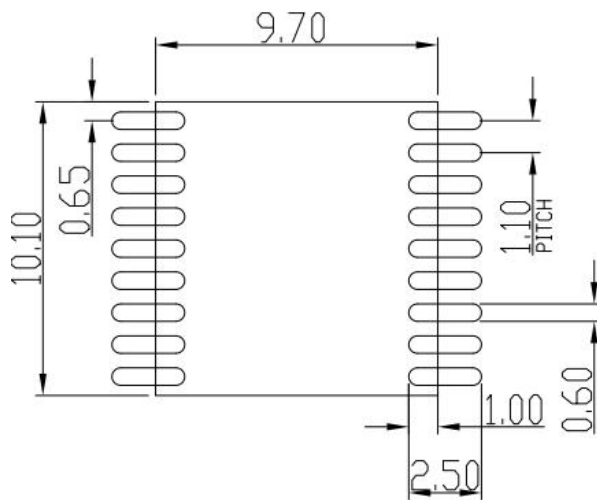


Figure 20: Recommended SMT stencil

SIMCom
Confidential

7 Manufacturing

7.1 Assembly and Soldering

The SIM65M 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.

1. It is recommended to use reflow welding equipment with A 10-temperature zone or above to achieve better welding effect.
2. When the furnace temperature is tested, hot couple test points should be connected to the module position. Module is recommended to be connected to 5 points, including bottom GND and 4 corners of the module. At the same time, the surface temperature of the shielding box is tested. At the same time, test the shielding frame solder spot position.
3. Fixtures must be used to support the reflow welding at the bottom of small modules. Our company does not recommend that modules pass through the reflow furnace at the bottom.
4. Recommend to make the furnace carrier, to prevent the PCB board deformation under high temperature, affecting the total welding Surface properties.
5. For the surface treatment type of the bottom pad, it is recommended to choose the same design as the gold plating type of the module pad and use the electroless nickel/gold plating process.
6. It is not recommended to use the surface treatment such as tin spraying and silver spraying

The following figure is the Ramp-Soak-Spike Reflow Profile of SIM65M Series:

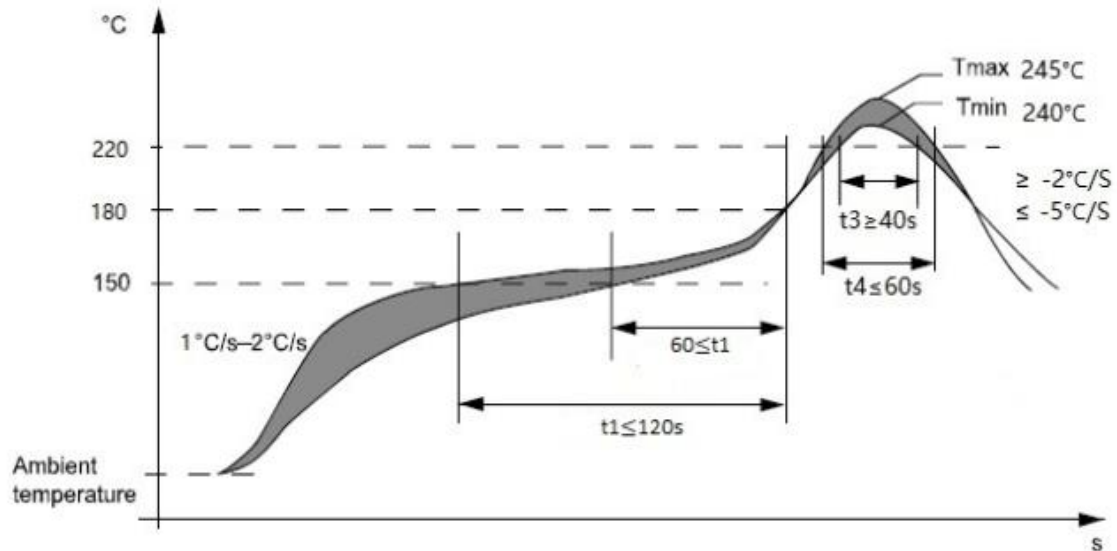


Figure 21: The Ramp-Soak-Spike reflow profile of SIM65M Series

SIM65M Series is Moisture Sensitive Devices (MSD), appropriate MSD handling instruction and precautions are summarized in Chapter 7.2.

SIM65M Series modules are also Electrostatic Sensitive Devices (ESD), handling SIM65M Series modules without proper ESD protection may destroy or damage them permanently.

Avoid ultrasonic exposure due to internal crystal and SAW components.

7.2 Humidity sensitivity level and moisture resistance requirement

SIM65M Series module is moisture sensitive at MSL level 3, dry packed according to IPC/JEDEC specification J-STD-020C.

Refer to IPC-JEDEC standard. The definition of SMD module humidity sensitivity grade (MSL) of SMD module of SMD is listed in Table 14 below. Before use, it is necessary to confirm whether the package is in good condition; After unpacking, check the status of humidity indicator card in vacuum bag (Figure 22). The module needs to be baked before use if any of the following conditions occur.

- Explanation Humidity indicator card: 30%, 40%, and 50% of any indicator circle has discoloring
- Explanation: The process is unsealed and the module exceeds the humidity sensitivity level corresponding to the exposed workshop time. For example, MSL=3 is 168 hours.

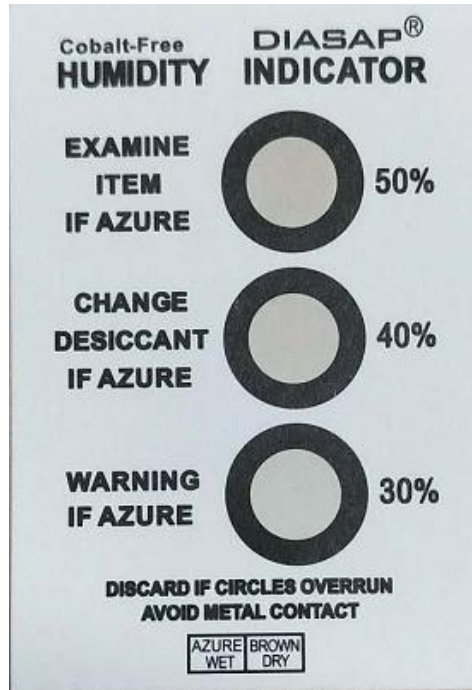


Figure 22: Humidity card

NOTE

1. For baking, bake at 120°C±5°C for 8 hours. Choose a nitrogen filled oven first
 2. Before baking, remove the module and place it on the high temperature anti-static appliance to avoid high temperature damage to the plastic tray and coil; Modules must be welded within 12 hours after baking, otherwise they must be stored in a drying oven and welded within 12 hours.
- If it is confirmed that the welding cannot be completed within 24 hours, it needs to be re-packed in vacuum or stored in a drying oven.

7.3 Storage

The moisture sensitivity (MSL) of the package represents its ability to withstand exposure when it is removed from the factory bag and waiting for the PCB to be installed in the factory. Low MSL levels are superior to high levels. Electronic products with low MSL are exposed for longer on the factory floor than those with high MSL.

- Recommended storage conditions: Temperature 23 °C ±5 °C, and relative humidity 35-60%.
- Storage life (sealed and vacuum packed) : Under recommended storage conditions, storage life is 12 months.

7.4 Workshop life and temperature and humidity environment control

If the workshop temperature is 23 °C ±5 °C and the relative humidity is less than 60%, the module shall be reflow or operated at high temperature within 168 hours after unpacking. Otherwise, the module shall be stored in an environment with relative humidity less than 10% (for example, a moisture-proof cabinet) to keep the product dry.

The IPC/JEDEC J-STD-033 standard specifies the humidity sensitivity grade and exposure Floor Life as follows:

Table 17: Moisture Classification Level and Floor Life

Level	Floor Life(out of bag)at factory ambient $\leq +30\text{ }^{\circ}\text{C}/60\%\text{RH}$ or as stated
1	Unlimited at $\leq +30\text{ }^{\circ}\text{C}/85\%\text{RH}$
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.

7.5 ESD handling precautions

SIM65M Series modules are Electrostatic Sensitive Devices (ESD). Observe precautions  for handling!

Failure to observe these precautions can result in severe damage to the GPS receiver!

GPS 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).

7.6 Shipment

SIM65M Series is designed and packaged to be processed in an automatic assembly line, and it is now packaged in SIM65M Series tray.

8 Reference Design

Following figure is the typical application of SIM65M Series with active antenna which supplied by VCC_RF. If customer applies other kind of active antenna, keep PIN 14 floating and connect other voltage to the R125.

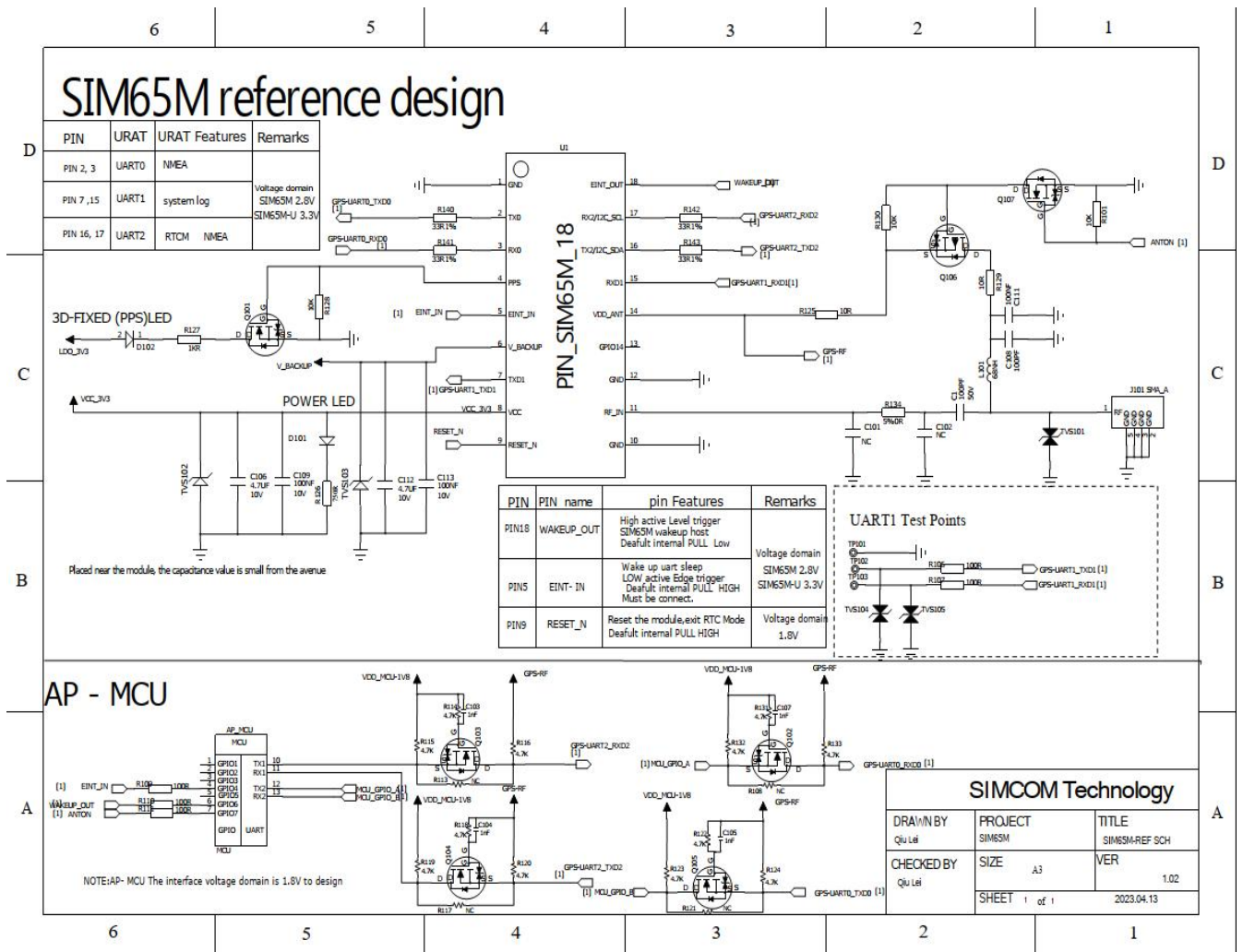


Figure 23: Refer schematic

NOTE

I/Os of SIM65M Series are 2.8V and 1.8V CMOS voltage level; attentions should be paid if the voltage level of the host controller not compatible.

9 Appendix

9.1 Related Documents

Table 18: Related documents

SN	Document name	Remark
[1]	SIM68D _EVB_ User Guide	
[2]	SIM65M Series_NMEA Message_ User Guide	
[3]	SIM65M REFERENCE DESIGN	
[4]	SIMCom GNSS Hardware Design Manual_V1.00	
[5]	Module Secondary SMT Process User Guide_V1.01	
[6]	SIMCom Standard module ESD surge protection design manual_V1.00	

9.2 Terms and Abbreviations







Table 19: Terms and abbreviations

Abbreviation	Description
A-GPS	Assisted- Global Positioning System
CMOS	Complementary Metal Oxide Semiconductor
DGPS	Difference Global Positioning System
EASY	Embedded Assist System
EEPROM	Electrically Erasable Programmable Read Only Memory
EGNOS	Euro Geostationary Navigation Overlay Service
EPO	Extended Prediction Orbit
ESD	Electrostatic Sensitive Devices
FSM	Finite State Machine
GAGAN	The GPS Aided Geo Augmented Navigation
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
I/O	Input/Output
IC	Integrated Circuit
Inorm	Normal Current
Imax	Maximum Load Current
kbps	Kilo bits per second
LNA	Low Noise Amplifier

MSAS	Multi-Functional Satellite Augmentation
MSL	moisture sensitive level
NMEA	National Marine Electronics Association
QZSS	Quasi-Zenith Satellites System
RTCM	Radio Technical Commission for Maritime Services
SBAS	Satellite Based Augmentation Systems
WAAS	Wide Area Augmentation System

9.3 Safety Caution

Table 20: Safety caution

Marks	Requirements
	When in a hospital or other health care facility, observe the restrictions about the use of mobiles. Switch the cellular terminal or mobile off, medical equipment may be sensitive and not operate normally due to RF energy interference.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it is switched off. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. Forgetting to think much of these instructions may impact the flight safety, or offend local legal action, or both.
	Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.
	Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.
	Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle.
	<p>Mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions, especially with a mobile fee or an invalid (U)SIM card. While you are in this condition and need emergent help, please remember to use emergency calls. In order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength.</p> <p>Some networks do not allow for emergency call if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may have to deactivate those features before you can make an emergency call.</p> <p>Also, some networks require that a valid (U)SIM card be properly inserted in the cellular terminal or mobile.</p>