FIBOCOM
Perfect Wireless Connection

H350 LGA Serials Module Hardware User Manual

Version: V1.0.1

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Revision History

Version	Date	Remarks
V1.0.0	2013-09-11	Initial Version
V1.0.1	2013-10-23	Update descriptions for ADC, POWER OFF and RESET. Update dimensions and PCB layout design.

Applicability Table

No.	Type	Note
1	H350-A50-00	
2	H350-A30-00	

Here are the module comparisons:

Model No.	GSM/GPRS/EDGE Band(MHz)	WCDMA Band(MHz)	HSDPA (Mbps)	HSUPA (Mbps)
H350-A50-10	900/1800	900/2100	21	5.76
H350-A30-10	900/1800	900/2100	7.2	5.76

Contents

1 Preface

1.1 Scope

This manual provides the electrical, mechanical and environmental requirements for properly integrating the H350 serials wireless communications module. This manual gives a complete set of hardware features and functions that may be provided by H350, ensures the users can quickly and conveniently develop wireless communications using H350 Module.

1.2 Standards

- 3GPP TS 27.007 -v6.9.0: AT command set for User Equipment (UE)
- 3GPP TS 27.005 -v6.0.1: Use of Data Terminal Equipment -Data Circuit terminating Equipment (DTE-DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
- 3GPP TS 23.040 -v6.9.0: Technical realization of Short Message Service (SMS)
- 3GPP TS 24.011 -v6.1.0: Point- to - Point (PP) Short Message Service (SMS) support on mobile radio interface
- 3GPP TS 27.010 -v6.0.0: Terminal Equipment to User Equipment (TE-UE) multiplexer protocol
- 3GPP TS 27.060 -v6.0.0: Packet domain; Mobile Station (MS) supporting Packet Switched services
- 3GPP TS 25.304-v6.10.0: User Equipment (UE) procedures in idle mode and procedures for cell reselection in connected mode
- 3GPP TS 25.308 -v6.4.0: High Speed Downlink Packet Access (HSDPA); Overall description; Stage 2
- 3GPP TS 25.309 -v6.6.0: FDD enhanced uplink; Overall description; Stage 2
- 3GPP TS 23.038 -v6.1.0: Alphabets and language - specific information
- 3GPP TS 21.111 -v6.3.0: USIM and IC card requirements
- 3GPP TS 31.111 -v6.11.0 "USIM Application Toolkit (USAT)"
- 3GPP TS 45.002 -v6.12.0: Multiplexing and multiple access on the radio path
- 3GPP TS 51.014 -v4.5.0: Specification of the SIM Application Toolkit for the Subscriber Identity Module - Mobile Equipment (SIM-ME) interface
- 3GPP TS 51.010 -1 -v6.7.0: Mobile Station (MS) conformance specification; Part 1: Conformance specification.
- 3GPP TS 22.004 -v6.0.0: General on supplementary services
- 3GPP TS 23.090 -v6.1.0: Unstructured Supplementary Service Data (USSD); Stage 2

- 3GPP TS 24.008 v6.19, Mobile radio interface Layer 3 specification;

2 Introduction

2.1 Description

H350 serials are highly integrated 3G wireless communication modules, support GSM / GPRS / EDGE and UMTS / HSDPA / HSUPA / HSPA+.

2.2 Specifications

Specifications	
Bands	UMTS (WCDMA/FDD): 900/2100MHz
	GSM/GPRS/EDGE: 900/1800MHz
Data	UMTS/HSDPA/HSUPA 3GPP release 7
	HSUPA 5.76Mbps (Cat 6)
	HSDPA 21Mbps (Cat 14) or 7.2Mbps (Cat 8)
	GSM 3GPP release 7
	EDGE (E-GPRS) multi-slot class 33(296kbps DL, 236.8kbps UL)
	GPRS multi-slot class 33(67kbps DL, 53.6kbps UL)
Physical	Dimension: 29.8mm x 17.8mm x 2.00mm
	Interface: LGA
	Weight: 2.5 grams
Environment	Operating Temperature: -30℃ ~ +85℃
	Storage Temperature: -40℃ ~ +85℃
Performance	
Operating Voltage	Voltage: 3.3V ~ 4.5V Normal: 3.8V
Operating Current (Typical Value)	2mA (Sleep Mode)
	3G Idle: 13mA
	3G Talk: 500mA
	2G Talk: 260mA (GSM PCL5)
Tx Power (Typical Value)	Class 4 (2W)：900 MHz, GSM
	Class 1 (1W)：1800 MHz, GSM
	Class E2 (0.5W)： 900 MHz, EDGE
	Class E2 (0.4W)：1800 MHz, EDGE
	Class 3 (0.25W)： 900/2100 MHz, WCDMA

Rx Sensitivity (Typical Value)	UMTS/HSPA: -109dBm
	GSM: -108dBm
Interfaces	
RF Interface	Antenna
Connectivity	1 x USB 2.0
	2 x UART
	MUX Over UART1
	Multiple Profiles over USB
	SPI Support
	I2C Support
	I2S Support
	PCM, HSIC, GPIO, A/D, RTC
Data Features	
Protocol Stack	Embedded TCP/IP and UDP/IP protocol stack
EDGE	Multi-slot class 33(5 Down; 4 Up; 6 Total)
	Coding Scheme MCS1~9
GPRS	Multi-slot class 33(5 Down; 4 Up; 6 Total)
	Coding Scheme CS1~4
CSD	UMTS(14.4kbps), GSM(9.6kbps)
USSD	Support
SMS	MO / MT Text and PDU modes
	Cell broadcast
Voice Features	Digital Audio
	Voice coders: EFR/HR/FR/AMR
Audio Control	Gain Control
Character Set	IRA
	GSM
	UCS2
	HEX
AT Commands	FIBOCOM proprietary AT commands
	GSM 07.05

	GSM 07.07
Accessories	Firmware Loader Tool over USB/UART
	User Manual
	Developer Kit

2.3 Appearance

The following picture shows the H350 Wireless Communication Module.

Top view:

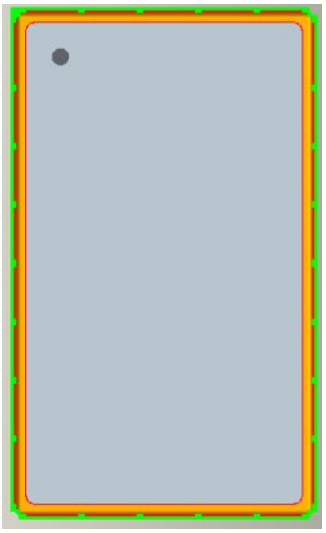


Figure 2- 1 Top View

Bottom view:

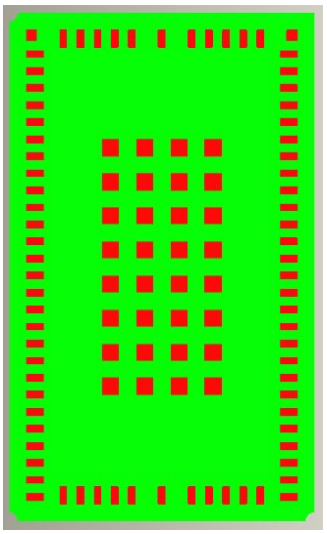


Figure 2- 2 Bottom View

3 Mechanical

3.1 Dimensions

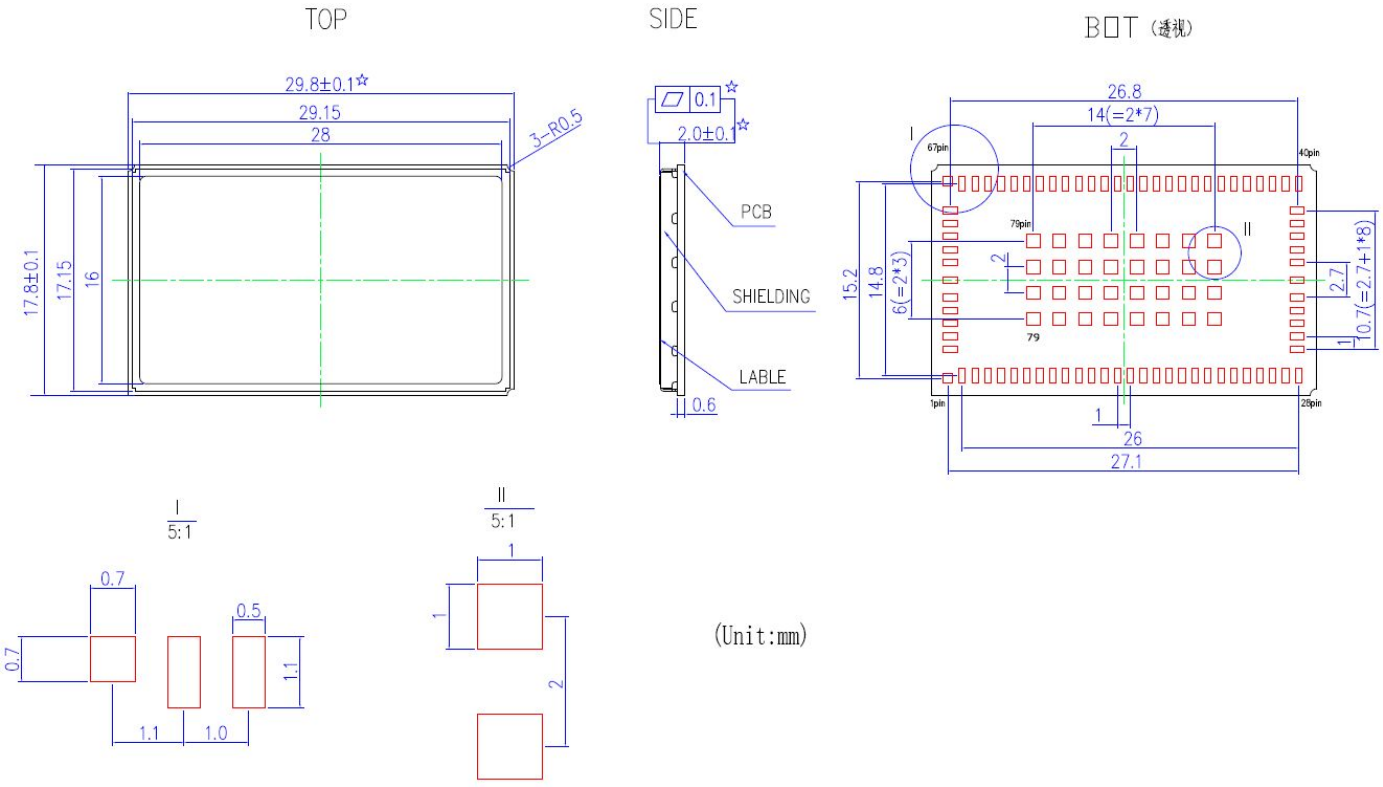


Figure 3- 1 Mechanical Specifications

3.2 PCB Layout Design

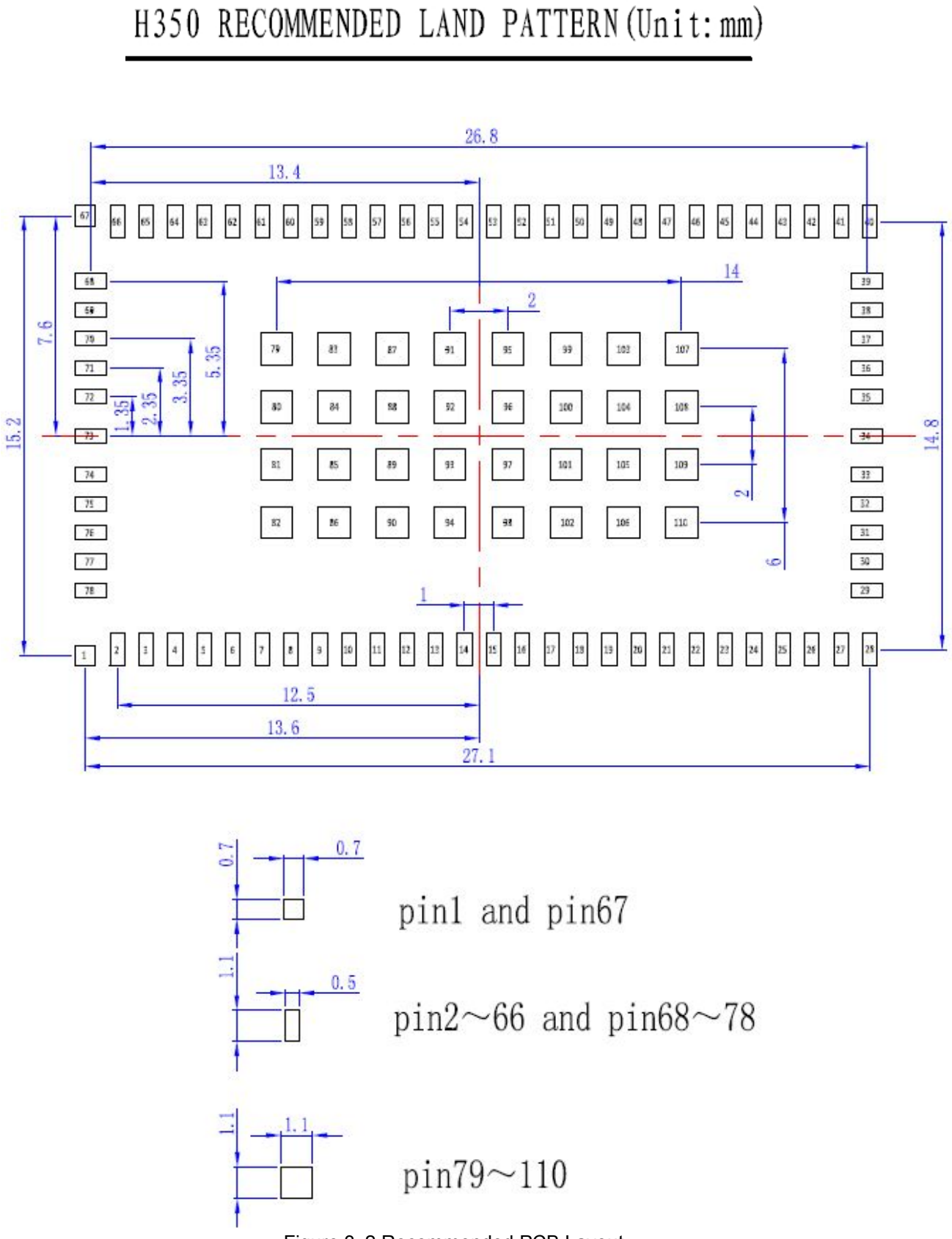


Figure 3- 2 Recommended PCB Layout

4 Hardware Overview

4.1 Block Diagram

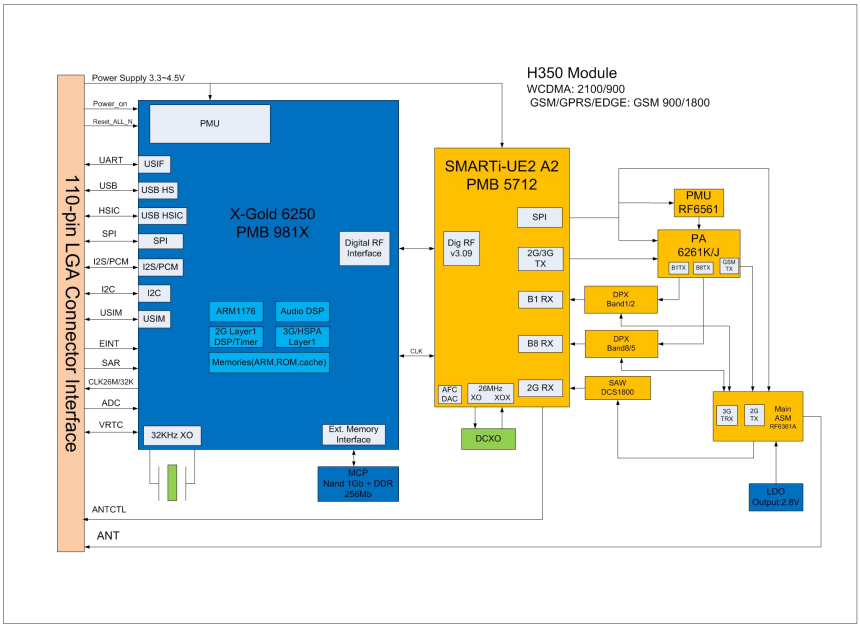
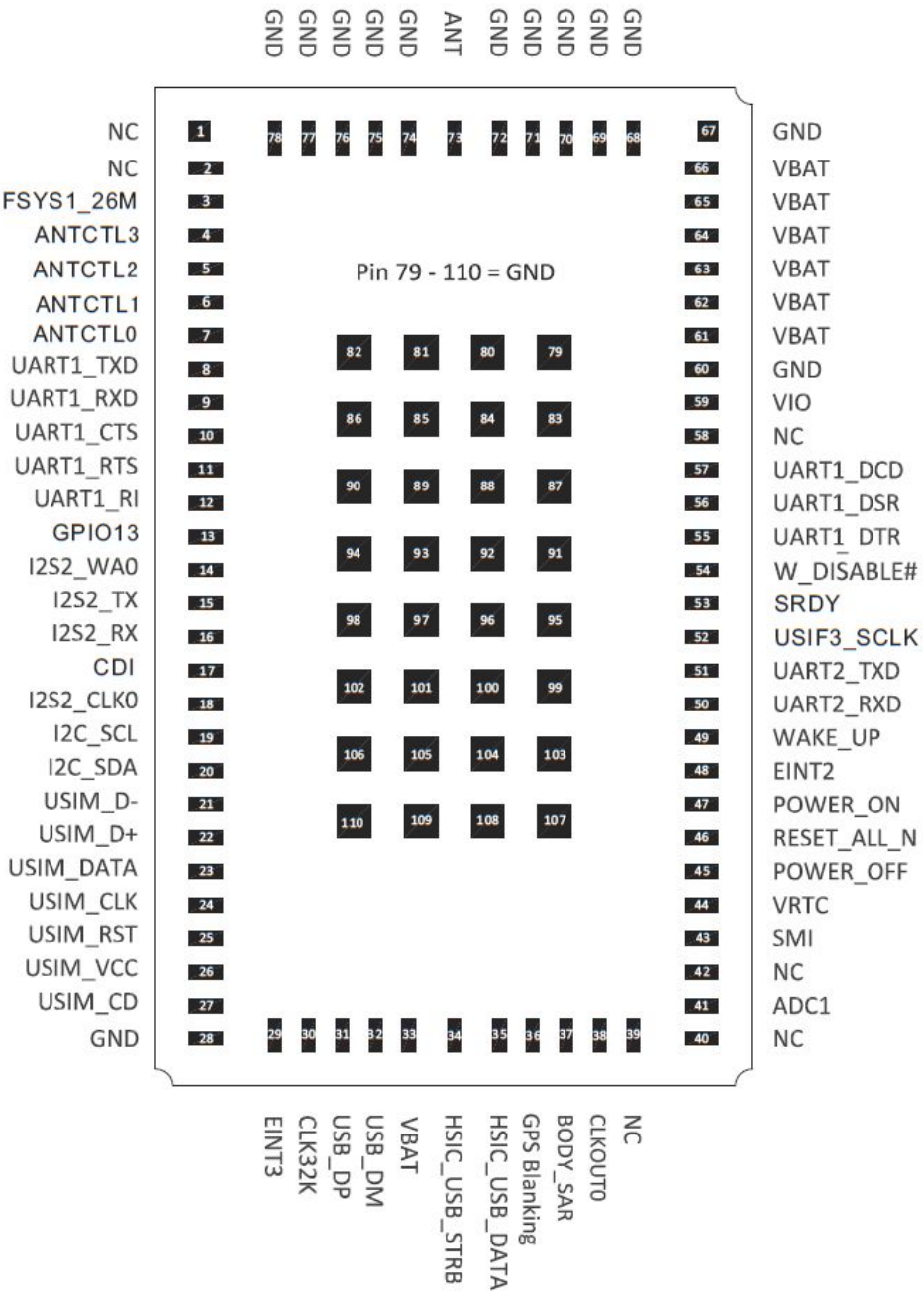


Figure 4- 1 Block Diagram

4.2 Pin Definition

4.2.1 Pin Map



TOP (View)

Figure 4- 2 Pin Definition

4.2.2 Pin Description

The logic electrical lever of H350 is 1.8V. The following table shows H350 pin description:

Pin#	Pin Name	I/O	Description
Power Supply			
61	VBAT	I	Module main power input, voltage range: 3.3V ~ 4.2V
62	VBAT	I	
63	VBAT	I	
64	VBAT	I	
65	VBAT	I	
66	VBAT	I	
59	VIO	O	1.8V voltage output inside module
44	VRTC	I/O	Backup battery power input.
Power ON/OFF Signal			
45	POWER_OFF	I	Power off signal
47	POWER_ON	I	Power on signal
Reset Signal			
46	RESET_ALL_N	I	External reset signal
USIM			
27	USIM_CD	I	USIM card insert detected. Low level activated
26	USIM_VCC	O	USIM card supplies the power, 1.8V or 3.3V
25	USIM_RST	O	USIM card reset
24	USIM_CLK	O	USIM card clock
23	USIM_DATA	I/O	USIM card data
High Speed SIM			
22	USIM_D+		High speed SIM card USB data line+(not support)
21	USIM_D-		High speed SIM card USB data line- (not supported)

I²S Interface			
17	I2S2_CLK1	O	I2S2 I Clock SCLK1
18	I2S2_CLK0	O	I2S2 I Clock SCLK0 (I2S2 use CLK0 by default)
14	I2S2_WA0	O	I2S2 word alignment select
15	I2S2_TX	O	I2S2 transmit line
16	I2S2_RX	I	I2S2 receive line
USB Interface			
31	USB_DP	I/O	USB data line+
32	USB_DM	I/O	USB data line -
30	USB_ID	—	USB ID line
33	VBAT	I	USB Power Input
29	USB_TEST	—	USB TEST line
I²C Interface			
20	I2C_SDA	I/O	I2C data line，
19	I2C_SCL	O	I2C clock line
UART1			
12	UART1_RI	O	UART1 Ring Indicator
56	UART1_DSR	I	UART1 DTE Ready
55	UART1_DTR	O	UART1 DCE Ready
57	UART1_DCD	O	UART1Carrier Detect
10	UART1_CTS	I	UART1 Clear To Send
11	UART1_RTS	O	UART1 Request To Send
8	UART1_TXD	O	UART1 Transmitted Data
9	UART1_RXD	I	UART1 Received Data
UART2			
51	UART2_TXD	O	UART2 Transmitted Data
50	UART2_RXD	I	UART2 Received Data

ADC			
41	ADC1	I	Analog digital converter 1
EINT			
49	WAKE_UP	I	External wake-up interrupt, low activity
48	EINT2	I	External interrupt, low activity
USB HSIC			
35	HSIC_USB_DATA		HSIC USB data signal (not supported)
34	HSIC_USB_STRB		HSIC USB pulse signal (not supported)
Antenna			
73	ANT	I/O	antenna interface, 50 ohm Impedance
Others			
38	CLKOUT0	O	Digital audio clock output
43	SMI	O	Sleep Mode Indicator
54	LPG	O/I	Status Indicator
52	MIPI_HSI_RX_RDY	I/O	MIPI signal (not supported)
53	MIPI_HSI_TX_DATA	O	MIPI data (not supported)
Not Connect			
1	NC		
2	NC		
3	NC		
4	NC		
5	NC		
6	NC		
7	NC		
13	NC		
36	NC		

37	NC		
39	NC		
40	NC		
42	NC		
58	NC		
GND			
28	GND		
60	GND		
67	GND		
68	GND		
69	GND		
70	GND		
71	GND		
72	GND		
74	GND		
75	GND		
76	GND		
77	GND		
78	GND		
79	GND		
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96	GND		
97	GND		
98	GND		
99	GND		
100	GND		
101	GND		
102	GND		
103	GND		
104	GND		
105	GND		
106	GND		
107	GND		
108	GND		
109	GND		
110	GND		

5 Hardware Interface

5.1 Power Interface

5.1.1 VBAT

H350 module requires a 3.3 V~ 4.2V DC power supply to provide 2A as GSM transmitter maximum current.

Input power supply requirements:

Parameter	Minimum Value	Recommended Value	Maximum Value	Unit
VBAT	3.3	3.8	4.2	V

Note:

1. Supply voltage fluctuations need to be lower than 300mV.

2. Supply voltage drop minimum value needs to be higher than 3.3V.

Filter capacitor description:

Recommended capacitor	Application	Description
1000uF	GSM Transmit current serge	Minimizes power supply losses during transmit bursts. Use high capacitance value as possible as you can.
10nF, 100nF	Digital signal noise	Filtering interference from clock and data sources
8.2pF, 10pF	1800/1900/2100 MHz bands	Filters transmission EMI.
33pF, 39pF	850/900 MHz bands	Filters transmission EMI.

5.1.2 Power Consumption

Parameter	Description	Condition		Typical Value	Unit
I OFF	RTC mode			68.0	uA
I IDLE	Idle mode(GSM)	MFRMS	5	12.1	mA
	WCDMA	DRX	8	12.5	mA
I SLEEP	Low power mode (GSM)	DRX	2	1.9	mA
			5	1.5	mA
			9	1.5	mA
	Low power mode (WCDMA)	DRX	6	1.8	mA
			8	1.8	mA
			9	1.7	mA

I GSM-RMS	GSM voice - 1 TX slot 1 RX slot Peak current During TX slot	EGSM850 PCL	5	246.7	mA
			10	91.9	mA
			15	61.2	mA
			19	57.2	mA
		DCS1800 PCL	0	172.2	mA
			5	82.1	mA
			10	60.3	mA
			15	57.9	mA
IGSM-MAX	Peak current During TX slot	EGSM900 PCL	5	1738.8	mA
			10	415.9	
			15	135.3	
			19	124.2	
		DCS1800 PCL	0	1012.9	
			5	348.7	
			10	141.5	
			15	110.3	
GPRS	EGSM900 PCL=5	GSM voice - 1Rx slot TX slot	1	247.9	mA
			4	373.7	
	EGSM900 PCL=10	GSM voice - 1Rx slot TX slot	1	89.0	
			4	220.3	
	DCS1800 PCL=0	GSM voice - 1Rx slot TX slot	1	172.4	
			4	259.8	
	DCS1800 PCL=10	GSM voice - 1Rx slot TX slot	1	60.3	
			4	101.2	
EGPRS-RMS	EGSM900 PCL=8	DCS1800 PCL	1	165.2	mA
			4	493.2	
	EGSM900 PCL=15	GSM voice - 1Rx slot TX slot	1	61.5	
			4	107.7	
	DCS1800 PCL=2	GSM voice - 1Rx slot TX slot	1	174.9	
			4	514.3	

	DCS1800 PCL=10	GSM voice - 1Rx slot TX slot	1	67.7	
			4	109.6	
IWCDMA-RMS	WCDMA	Band1	24dBm	442.0	mA
			0dBm	131.2	
			-24dBm	120.6	
			-50dBm	118.7	
		Band8	24dBm	421.9	
			0dBm	128.6	
			-24dBm	121.8	
			-50dBm	120.2	

5.1.3 VIO

VIO is power supply for the digital portion of the circuit inside of the module; it can be used for indicating signal of the module. VIO can be used as a reference level of the module digital signal.

Parameter	Minimum Value	Recommended Value	Maximum Value	Unit
VIO @working	1.773	1.8	1.827	V

5.1.4 VRTC

VRTC supplies power for RTC clock inside the module, can be connected to external RTC battery.

Parameter	Minimum Value	Recommended Value	Maximum Value	Unit
VRTC output voltage	1.71	1.8	1.89	V
VRTC input voltage (RTC is working)	0.5	1.8	1.89	V
VRTC input current (RTC is working)			1.0	uA

VRTC Reference design:

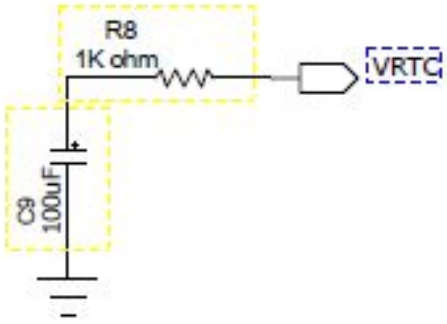

Figure 5- 1 VRTC Reference Design

Note:

- R8 is the current-limiting resistance in order to ensure VRTC working normally. R8 ≥1kohm
- VRTC Current consumption < 2uA;
- C9 value can affect RTC hold time
- You can refer to the following formula to calculate the RTC hold time: T= (1.8-0.5)*C/1=1.3C, unit: s

  For example: If C9 use 100uF capacitance, the RTC can hold about 130s.

5.2 ON/OFF and Reset

5.2.1 Pin Definition

H350 wireless communication module has three control signals: power on, off and reset the module.

Pin Definition:

Pin#	Pin Name	Electrical Level	Description
45	POWER_OFF	CMOS 1.8V	Power off signal
47	POWER_ON	CMOS 1.8V	Power on signal
46	RESET_ALL_N	CMOS 1.8V	External reset signal input

5.2.2 Power ON Signal

After the module is powered on, users can lower down the POWER_ON signal, then module boots up.

The following table shows the burst timing:

Parameter	Condition	Minimum Value	Typical Value	Maximum Value	Unit
Pulse Width		100	300	3000	ms

Timing control:

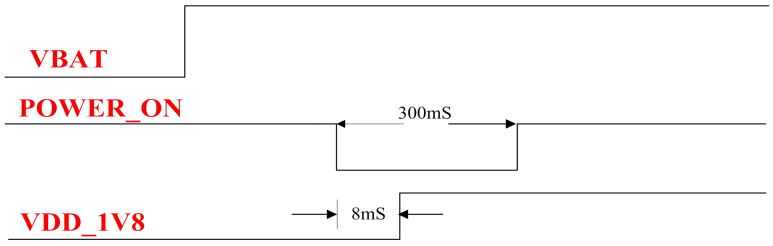

Figure 5-2 Timing Control

Reference design:

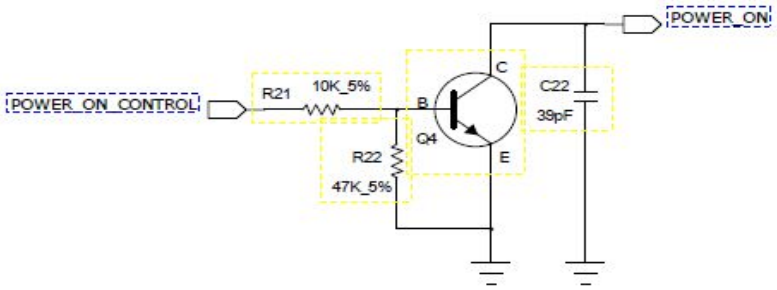

Figure 5-3 POWER_ON Reference Design

5.2.3 Power off Signal

After lower down POWER_OFF signal, the power manage unit (PMU) of module is reset, module changes to shutdown status.

Parameter	Condition	Minimum Value	Typical Value	Maximum Value	Unit
Pulse Width		100	300	3000	ms

Timing control:

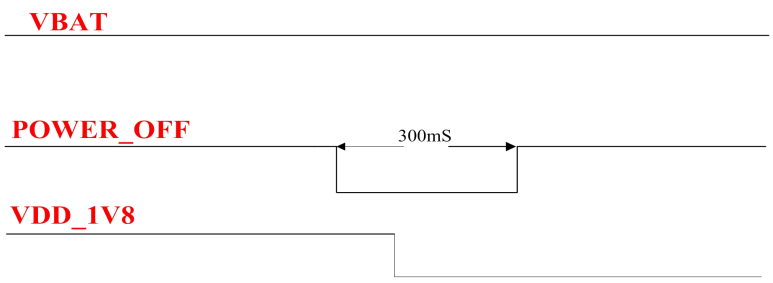

Figure 5-4 Timing Control

Reference design:

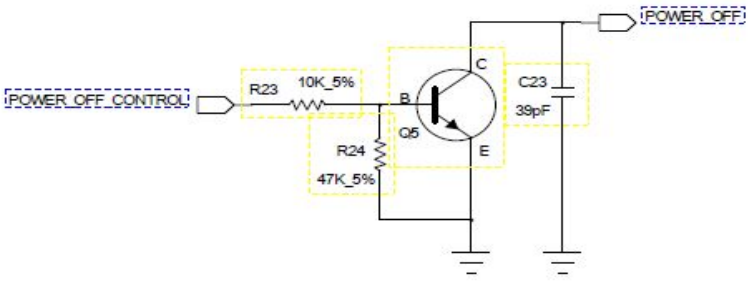

Figure 5- 5 POWER_OFF Reference Design

5.2.4 Reset Signal

H350 wireless communication module supports external reset; it can restore the module to default settings through Reset signal.

When Reset signal is Active Low by 100ms, the module will reset and restart. When users reset the module, PMU inside the module is still on.

Note: Reset signal is sensitive, when PCB layout, please keep it away from radio frequency interference, add debouncing capacitor near the module end is recommended. Don't trace the Reset signal in PCB edge or surface, it may reset ESD.

Pulse Timing requirements:

Parameters	Condition	Minimum Value	Typical Value	Maximum Value	Unit
Pulse Width		100	300	3000	ms

Recommended design:

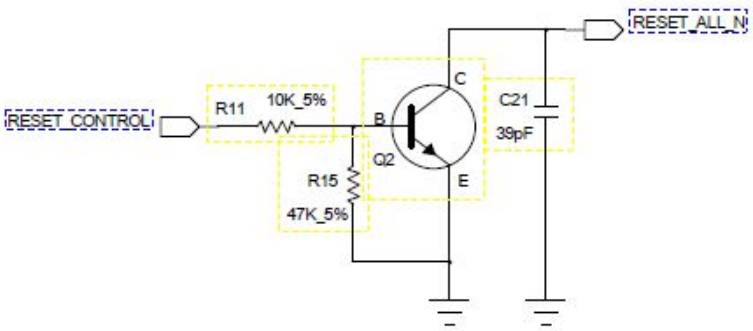

Figure 5- 6 Reset Recommended Design

5.3 Indicator Signal

5.3.1 Pin Description

Pin#	Pin Name	Description
54	LPG	Work mode indicator
43	SMI	Sleep Mode Indicator
49	WAKE_UP	Wake up module

5.3.2 Indicator Description

5.3.2.1 LPG Signal

LPG signal description:

Status	Mode
idle(unregistered)	600ms high level, 600ms low level
idle(registered)	75ms high level, 3S low level
Call	low level
Data communicating	75ms high level, 75ms low level
Sleep	high level

Note: High level voltage is 1.8V.

5.3.2.2 SMI

Module Mode	Mode
Sleep Mode	2.5S High level; 100ms Low level alternate change
Other Mode	low level

5.3.2.3 WAKE_UP

Module Mode	WAKE_UP Signal	Description
Sleep	Low level	Wake up module, switch from Sleep to Idle
	High level	Stay in Sleep mode
Idle/Call	Low level	Keep mode, no affect
	High level	Module cannot set to Sleep mode

5.4 USB Interface

5.4.1 USB Interface Description

Pin#	Pin Name	I/O	Description
31	USB_DP	I/O	USB signal+
32	USB_DM	I/O	USB signal -
30	USB_ID	—	USB ID signal (NC is recommended)
33	VUSB	I	USB power input
29	USB_TEST	—	USB TEST signal (NC is recommended)

H350 wireless communication module supports USB 2.0. Install the corresponding USB driver before use on PC. After H350 wireless communication module plugged into the PC, the USB can map seven ports:

- One 3G Modem/AT port for data operation
- Three ports for sending AT Command
- One port for trace
- Two ports are reserved

5.4.2 USB Interface Application

Reference Design:

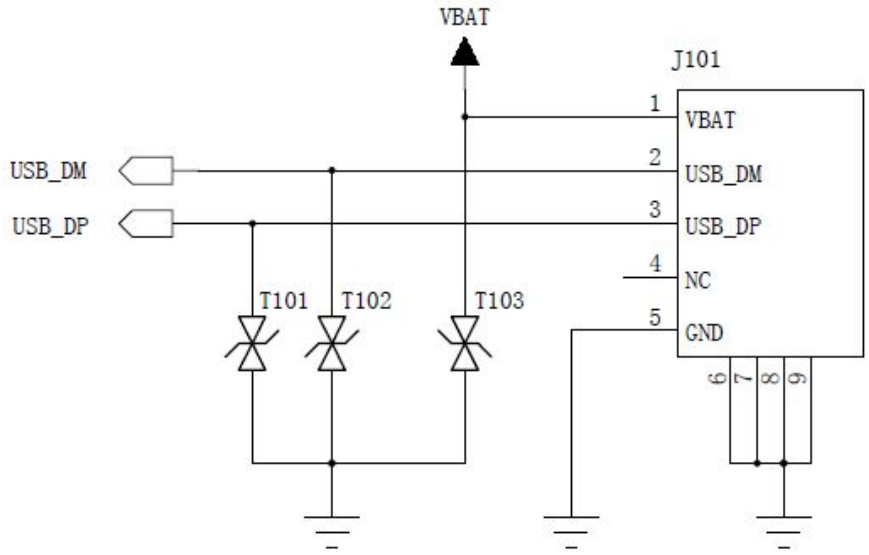

Figure 5-7 USB Interface Reference Design

T101 and T102 should be low capacitor TVS, it is below 1pF. No special requirement for T103.

VUSB is USB power supply, Recommend power supply range is 2.5V ~ 5.25V.

VUSB VUSB should be connect to a level (2.5V ~ 5.25V) or USB cannot be recognized.

USB_DP and USB_DM are high speed lines, the highest transmit speed is 480 Mbps.

PCB Layout Note:

- USB_DP and USB_DM lines need equal length, parallel, as short as possible.
- The input and output need GND isolation.
- The layout design of this circuit on the AP board should comply with the USB 2.0 high speed protocol, With differential lining and impedance control to 90 ohm.

5.5 UART Interface

5.5.1 UART Interface Description

H350 wireless communication module provides two UART, one is 8 wire serial bus interface, and the other is a 2 wire serial bus interface.

8 wire serial bus interface (UART1) supports flow control; users can download software or send/receive AT through UART1. 2 wire serial bus interface (UART2) supports a few AT Commands.

Note:

- UART2 only supports some common query functions.
- UART2 doesn't support hardware flow control, no CTS, RTS, DTR, DSR, DCD, RI pin.
- UART2 support MUX as SPI interface.

UART1 and UART2 signal description:

UART1			
Pin#	**Pin Name**	**I/O**	**Description**
12	UART1_RI	O	UART1 Ring Indicator
56	UART1_DSR	I	UART1 DTE Ready
55	UART1_DTR	O	UART1 DCE Ready
57	UART1_DCD	O	UART1 Carrier Detect
10	UART1_CTS	I	UART1 Clear to send
11	UART1_RTS	O	UART1 Request to send
8	UART1_TXD	O	UART1 Transmitted Data
9	UART1_RXD	I	UART1 Received Data

UART2			
Pin#	**Pin Name**	**I/O**	**Description**
50	UART2_RXD	I	UART2 Transmitted Data
51	UART2_TXD	O	UART2 Received Data

5.5.2 UART Design

The following table show the signal direction when H350 wireless communication module (DCE) UART1 connects to PC (DTE):

Application MCU(DTE)	Signal Direction	H350 Module (DCE)
RXD	←	UART1_TXD
TXD	→	UART1_RXD
RTS	→	UART1_CTS
CTS	←	UART1_RTS
DSR	←	UART1_DTR
DTR	→	UART1_DSR
RI	←	UART1_RI
DCD	←	UART1_DCD

The following table shows the signal direction when H350 wireless communication module (DCE) UART2 connects to PC (DTE):

Application MCU(DTE)	Signal Direction	H350 Module (DCE)
RXD	←	UART2_TXD
TXD	→	UART2_RXD

Note: Module UART high level is 1.8V, please use external level shifter if connect to 2.8V or 3.3V IO interface.

When you design:

Level shift from 1.8V to 3.3V, SN74LVC2G07 is recommended.

When UART1 communicating with PC, first translates from 1.8V to 3.3V, and then uses SP3238 to translate.

When UART2 communicating with PC, first translates from 1.8V to 3.3V, and then uses SPIEX3232EEA to translate level. Notice the signal direction when translate level.

5.5.3 Ring Indicator

UART1_R1 is used for indicating incoming call and SMS, sending pulse to host application program.

Operation Mode	Status
Default mode	Low level
Ringing	1s high level, 1s low level, cycling
Incoming message	150ms pulse

5.6 USIM

H350 wireless communication module supports USIM and high speed SIM card, does not support 8 line smart USIM yet.

5.6.1 USIM Interface

Pin#	Pin Name	I/O	Description
26	USIM_VCC	O	USIM power supply output
25	USIM_RST	O	USIM Reset signal
24	USIM_CLK	O	USIM clock signal
23	USIM_IO	I/O	USIM data signal
28	GND	GND	USIM ground
27	USIM_CD	I	USIM insert detect signal Low level indicates SIM card is not inserted High level indicates SIM card is inserted

5.6.2 USIM

Reference Design:

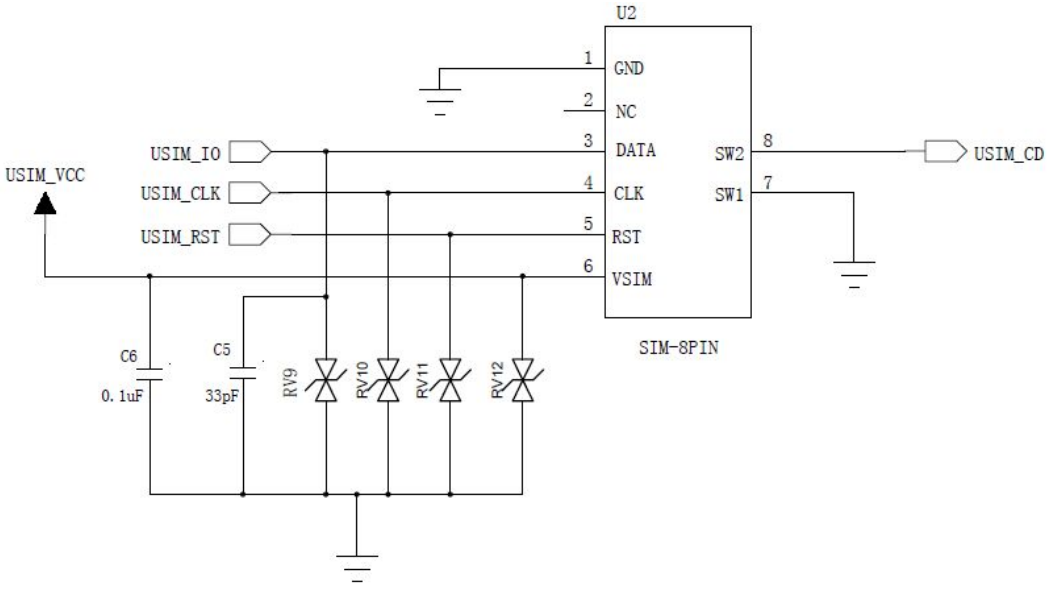

Figure 5- 8 USIM Interface Reference Circuit

Note:

- For better EMC performance, SIM card holder should be close to module
- Filtering capacitor should be close to SIM card pin
- The interface need add ESD protection, ESD should be close to SIM card pin
- USIM_IO is already pulled up inside the module

  USIM_CD support SIM hot plug, high level activated default (detect level can be changed by AT command). If high level is detected, it means SIM card is inserted.

5.6.3 USIM Design Notice

The SIM interface and signals design is extremely important.

There are several design guidelines that must be followed:

- The layout signals of the SIM card should be away from any possible EMI interference sources, such as the RF antenna and digital switching signals.
- To ensure signal integrity, the length between SIM interface signals and module should not exceed 100 mm
- To avoid crosstalk between USIM_CLK and USIM_IO, it is recommended to route them separately on the application board, and preferably isolated by a surrounding ground plane.
- The SIM card signals should be protected from ESD using very low capacitance protective elements

(like Zener diode). The recommended part no of ESD is AVR-M1005C080MTAAB (TDK). ESD component should layout with SIM hold closely.

5.6.4 USIM Hot Plug

H350 supports SIM hot plug.

5.6.4.1 Hardware Connection

SIM hot plug function interacts with USIM_CD signal.

When no SIM card, USIM_CD is low level; insert SIM, USIM_CD is high level.

As shown in Figure 5-8, USIM_CD connects Pin8 (SW2) of U2, Pin7 (SW1) connects GND.

When there is no SIM card, SW2 is high level; Insert SIM, SW2 connect SW1, USIM_CD is pulled down.

5.6.4.2 Software Configuration

“+MSMPD” AT command defines the SIM card status detection feature.

When set AT+MSMPD=0, the SIM detected feature deactivated. Module does not detect USIM_CD signal.

When set AT+MSMPD=1, the SIM detected feature activated. USIM_CD pin can test whether SIM card is onsite or not.

SIM_CD is High level, SIM card is onsite, and module registers the network automatically.

SIM_CD is Low level or not connected, SIM card is offsite and module drops out the network.

Note: The +MSMPD default value is “0”.

5.7 Digital Audio

H350 supports digital audio I2S interface, this interface supports normal I2S mode and PCM mode. The level of I2S interface is 1.8V.

I2S signal description:

Pin#	Pin Name	I/O	Description
18	I2S2_CLK0	O	Bit Clock
14	I2S2_WA0	O	Frame clock(LRCK)
15	I2S2_TX	O	Serial data output
16	I2S2_RX	I	Serial data input
20	I2C_DATA	I/O	I2C data line
19	I2C_SCL	O	I2C clock line
38	CLKOUT0	O	26MHz clock output

5.7.1 I2S

H350	Signal Direction	Audio CODEC I2S Port
I2S2_CLK0	→	I2S_CLK
I2S2_WA0	→	I2S_LRCK
I2S2_RX	←	I2S_SDIN
I2S2_TX	→	I2S_SDOUT
CLKOUT0	→	I2S_MCLK

5.7.2 I2C

H350	Signal Direction	Audio CODEC I2C Port
I2C_SDA	↔	I2C_SDA
I2C_SCL	→	I2C_SCL

Note:

- I2S can work in master mode or slave mode
- It supports various audio sample rates (48 KHz, 44.1 KHz, 32 KHz, 24 KHz, 22.5 KHz, 16 KHz, 12 KHz, 11.025 KHz and 8 KHz).

5.7.3 PCM Mode Interface

H350	Signal Direction	Audio CODEC PCM Port
I2S2_CLK0 (PCM_CLK, PCM clock signal)	→	PCM_CLK (PCM clock signal)
I2S2_WA0 (PCM_SYNC, PCM frame synchronization signal)	→	PCM_SYNC (PCM frame synchronization signal)
I2S2_RX (PCM_DIN, PCM data input)	←	PCM_DOUT (PCM data output)
I2S2_TX (PCM_DOUT, PCM data output)	→	PCM_DIN (PCM data input)

Note:

- PCM mode can configured to master mode and slave mode
- It supports short frame synchronization for 16 bit, 32bit, 48bit and 64bit.
- Supports sending data in burst mode and continuous mode

- It supports various audio sample rates (48 KHz, 44.1 KHz, 32 KHz, 24 KHz, 22.5 KHz, 16 KHz, 12 KHz, 11.025 KHz and 8 KHz).

5.8 ADC Interface

H350 supports ADC detection, with accuracy to 10 bit. The input voltage requirement for ADC: 0~1.2V.

The following table shows the ADC signal description:

Pin#	Pin Name	I/O	Description
41	ADC1	I	ADC input

5.9 Others

The module does not support GPIO、MIPI yet.

6 Electrical and Environmental Features

6.1 Electrical Features

This table shows the electrical features range of H350.

Parameter	Minimum Value	Maximum Value	Unit
VBAT	0	4.2	V
Digital Signal	0	1.9	V

6.2 Environmental Features

This table shows the environmental features of H350.

Parameter	Minimum Value	Maximum Value	Unit
Operational Temperature	-30	+85	°C
Storage Temperature	-40	+85	°C

7 RF Interface

7.1 Operation Frequency Band

7.1.1 Main Antenna

Operating Band	Tx	Rx
UMTS 2100 (Band I IMT)	1920–1980 MHz	2110–2170 MHz
UMTS 900 (Band VIII GMS)	880–915 MHz	925–960 MHz
GSM 900	880–915 MHz	925–960 MHz
DCS 1800	1710–1785 MHz	1805–1880 MHz

7.2 RF PCB Design

7.2.1 Layout Guideline

As H350 does not have a RF connector, so for RF line, microstrip line is recommended. The shorter the better, insert loss is less than 0.2dB; impedance is less than 50ohm.

It is recommended to mount H350 module and antenna connector to the same side of layout.

Add a π-type circuit (two parallel device ground pin directly to the main land) for antenna matching.

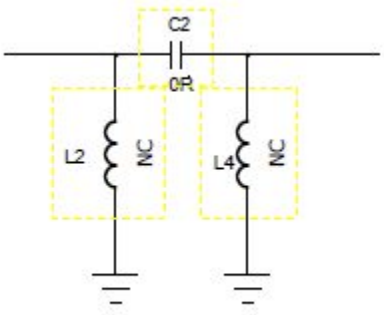

Figure 7- 1π-type Circuit

7.2.2 Impedance

The RF lines impedance should not exceed 50 ohm.

7.3 Antenna Design

7.3.1 Main Antenna Design Requirements

(1) Antenna Efficiency

Antenna efficiency is the ratio between antenna input power and radiation power. The radiation power of an antenna is always lower than the input power due to the following factors: return loss, material loss,

and coupling loss.

Efficiency of the master antenna > 40% (–4dB)

(2) S11 or VSWR

S11 (return loss) indicates the degree to which the input impedance of an antenna matches the reference impedance (50 ohm). S11 shows the resonance feature and impedance bandwidth of an antenna. Voltage standing wave ratio (VSWR) is another expression of S11. S11 relates to the antenna efficiency. S11 can be measured by vector analyzer.

S11 of the master antenna < –10 dB

(3) Polarization

The polarization of an antenna is the orientation of the electric field vector that rotates with time in the direction of maximum radiation.

Linear polarization is recommended: it would be better if the polarization direction of diversity antenna is different from main antenna.

(4) Radiation Pattern

Radiation pattern refers to the directional dependence of the strength of the radio waves from the antenna or other source.

The radiation pattern of half wave dipole antennas is the best for wireless terminals. If it is built-in antenna, PIFA antenna is recommended:

Antenna area (H x W x L): 6mm x 10mm x 100mm. PIFA or IFA antenna is recommended.

Radiation Pattern: Omni-directional

(5) Gain and Directivity

The directivity of the antenna is the electromagnetic field strength of the electromagnetic wave in each direction. An antenna's power gain is a key performance figure which combines the antenna’s directivity and electrical efficiency.

Recommended antenna gain ≤ 2.5dBi

(6) Interference

Besides the antenna performance, the interference on the PCB board also affects the radio performance (especially the TIS) of the module. To guarantee high performance of the module, the interference sources on the user board must be properly controlled. On the PCB board, there are various interference sources that can affect the module, such as the speaker, LCD, CPU, FPC trace and audio circuits, the power supply should be far away from antenna, notice isolation, shield and filtering processing issues.

(7) TRP/TIS

TRP (Total Radiated Power):

- W900/W2100>19dBm
- GSM900>28dBm
- DCS1800>25dBm

TIS (Total Isotropic Sensitivity) :

- W900<-102dBm
- W2100<-103dBm
- GSM900<-102dBm
- DCS1800<-102dBm