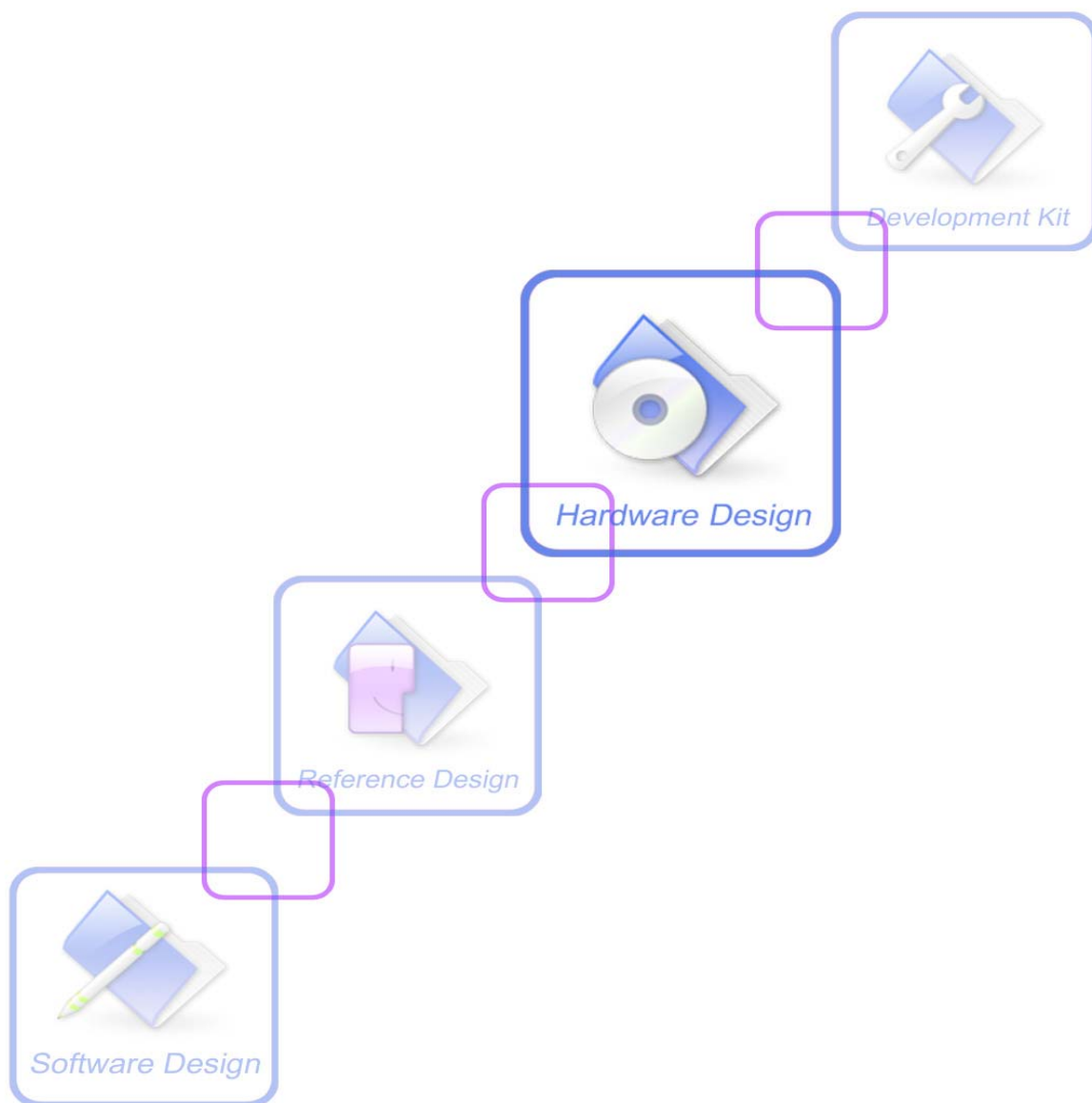




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Antenna Detecting Reference Design_V1.01



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Version history

Date	Version	Description of change	Author
2011-12-5	1.00	Origin	Plato Chen
2012-01-10	1.01	Add active antenna supervisor	Honggang .Ma

SCOPE

This document describes how to design antenna supervisor for SIMCom module, both the GSM antenna and GPS antenna are applied, care should be taken because active antenna is a little different for the LNA inside the antenna, so the AT commands and the detecting theory are also different.

Customers can also contact SIMCom FAE to confirm.

This document is subject to change without notice at any time.

1 Introduction

This document aims to support customers with antenna detecting design, for the different structure of passive and active antenna, the document mainly divided to two parts---passive antenna and active antenna.

Passive antenna is applied to GSM antenna and passive GPS antenna, the module must have ADC function and the antenna must be customized; Active GPS antenna is applied to active antenna supervisor, see following chapter for details.

2 Passive antenna supervisor

2.1 Passive antenna supervisor

The following figure shows the reference circuit of passive antenna supervisor, it is also applied to GSM antenna, but the antenna must be customized, as the following figure shows, a resistance would be in serials between RF line and antenna ground.

For this circuit, the module must have ADC function to implement the function, and the software needs to be customized, customer can contact SIMCom FAE for details.

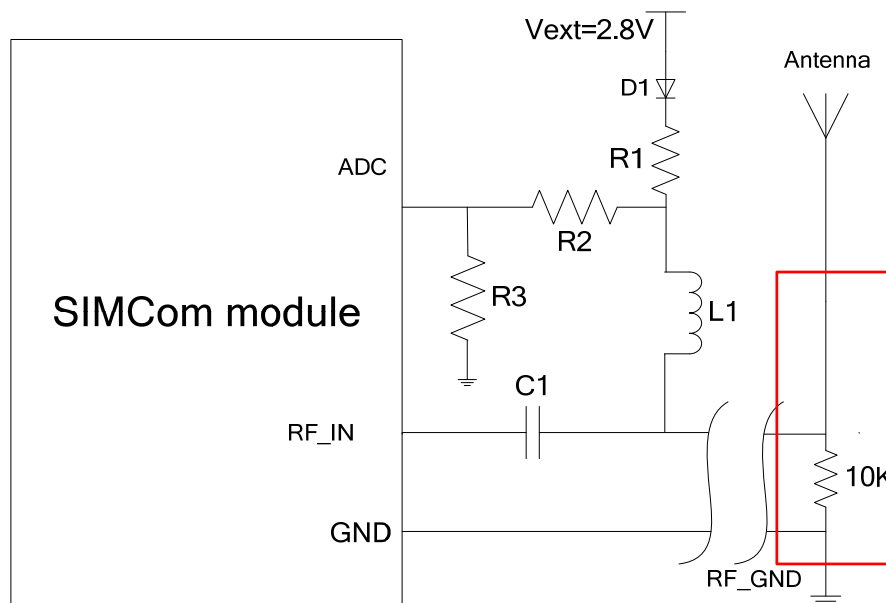


Figure 1: Passive antenna supervisor reference circuit

Table 1: BOM of passive antenna supervisor circuit

References	Value	Tolerance	Description	Remarks
R1,R2	15K	±1%	Resistor, min 0.063 W	
R3	3.3K	±1%		
D1	RB060M-30		Schottky barrier diode	
L1	47nH			
C1	33pF/50V	±5%		

(1) Pins introduction

ADC: Input Voltage range: 0—2.8V.

(2) Antenna States:

① Connected normally

The sampling voltage at ADC should be : $V = (2.8 - 0.15)V \cdot \left[\frac{(R2 + R3) // 10K}{[(R2 + R3) // 10K + R1]} \cdot R3 \div (R2 + R3) \right]$
 $= 2.65 \cdot [6.466 \div (6.466 + 15)] \cdot 3.3 \div 18.3$
 $= 0.144V$

② Not connected

The sampling voltage at ADC should be : $V = (2.8 - 0.15)V \cdot [R3 \div (R1 + R2 + R3)]$
 $= 2.65 \cdot (3.3 \div 33.3)$
 $= 0.263V$

③ Connected to GND

The sampling voltage at ADC should be: $V = 0V$

④ Connected to other Power source V_O :

The sampling voltage at ADC should be $V = V_O \cdot [R3 \div (R2 + R3)]$
 $= V_O \cdot (3.3 \div 18.3)$

If V_O is 6V, then the V_{adc} is 1.082V, and V_{adc} is 2.164 when V_O is 12 V.

Note: This function needs to be supported by customized firmware.

2.2 Related AT Commands

Table 2: Related AT Commands

AT+CANT	Antenna Detecting
Test Command AT+CANT=?	Response +CANT: (list of supported <mode>s), (list of supported <UrcEnable>s), (list of supported <timer>s) OK +CME ERROR: <err>

	Parameters See Write Command
Read Command AT+CANT?	Response +CANT: <mode>, <UrcEnable>, <timer> OK +CME ERROR: <err>
	Parameters See Write Command
Write Command AT+CANT= <mode>, [<UrcEnable>], [<UrcEnable>]	Response OK +CME ERROR: <err>
	Parameters <mode> <u>0</u> Disable the antenna detecting function 1 Enable the antenna detecting function <UrcEnable> <u>0</u> Disable reporting antenna state by URC 1 Enable reporting antenna state by URC <timer> Reporting timer in units of seconds, range: 0—3600. Set timer to 0 will close detect, the recommend value is 10.

2.3 Summary

Table 3: Urc report for the supervisor

ADC voltage (Unit: mV)	Antenna States	URC
< 15 (typical 7)	Connected to GND	+CANT:1
15-135	Connected to other power source	+CANT:2
135-160 (typical 144)	Connected normally	+CANT: 0
160-255	Connected to other power source	+CANT:2
255-280 (typical 263)	Not connected	+CANT:3
> 280	Connected to other power source	+CANT:2

A design using a passive antenna requires more attention regarding the layout of the RF section. Typically a passive antenna is located near electronic components; therefore care should be taken to reduce electrical noise that may interfere with the antenna performance. Passive antennas do not require a DC bias voltage and can be directly connected to the RF input pin RF_IN. Sometimes, they may also need a passive matching network to match the impedance to 50 Ohms.

3 Active antenna supervisor

3.1 Active antenna Introduction

Active antenna has integrated with a low-noise amplifier (LNA). It can be directly connected to RF_IN. If an active antenna is used, a proper supply should be fed to the pin VCC_ANT, the pin VCC_ANT has connected to the RF_IN via a bead that used to separate the high frequency noise, Customers must pay attention to the supply of VCC_ANT, clean and pure voltage is recommended. The power consumption of the active antenna is about 5 to 20mA, the following figure is the typical diagram of active antenna.

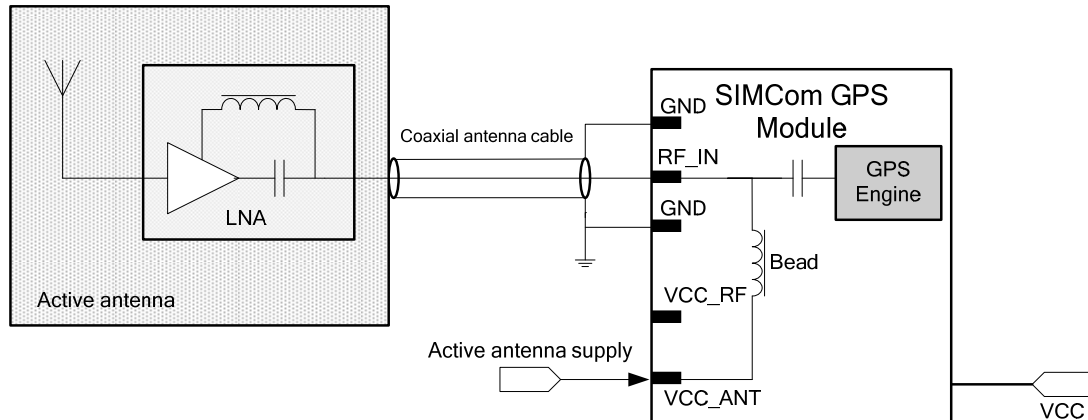


Figure 2: typical active antenna (external supply)

Usually, GPS modules from SIMCom have reserved a supply VCC_RF for active antenna, customers can confirm the voltage in HD document, if the VCC_RF match with the active antenna (see antenna datasheet to confirm), then the following diagram is the typical circuit.

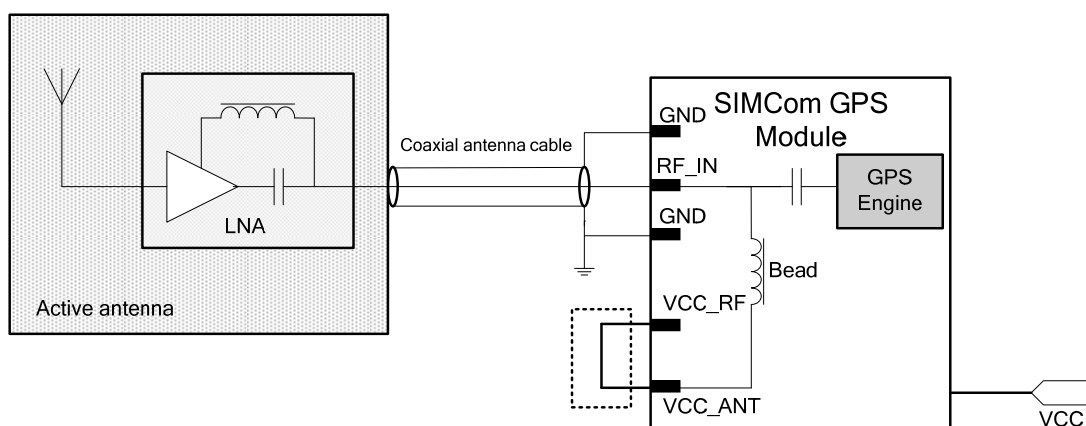


Figure 3: typical active antenna (internal supply)

Notes: this circuit doesn't support short-circuit protection, when the antenna shorted to GND, the supply can't be cut off.

3.2 Active antenna supervisor block diagram

The supervisor circuit should detect and indicate all situations (short circuit, open circuit, normal connected), and when short circuit happens, the supply of the antenna should be turned off to protect GPS receiver. Especially, the supervisor can re-establish the active antenna when the wrong situation was corrected, every time a change appears, there will be an Urc reporting. The following figure is the block diagram of the supervisor circuit. (SIM900B and SIM18 are the typical module from SIMCom, sure other module applied to the supervisor also).

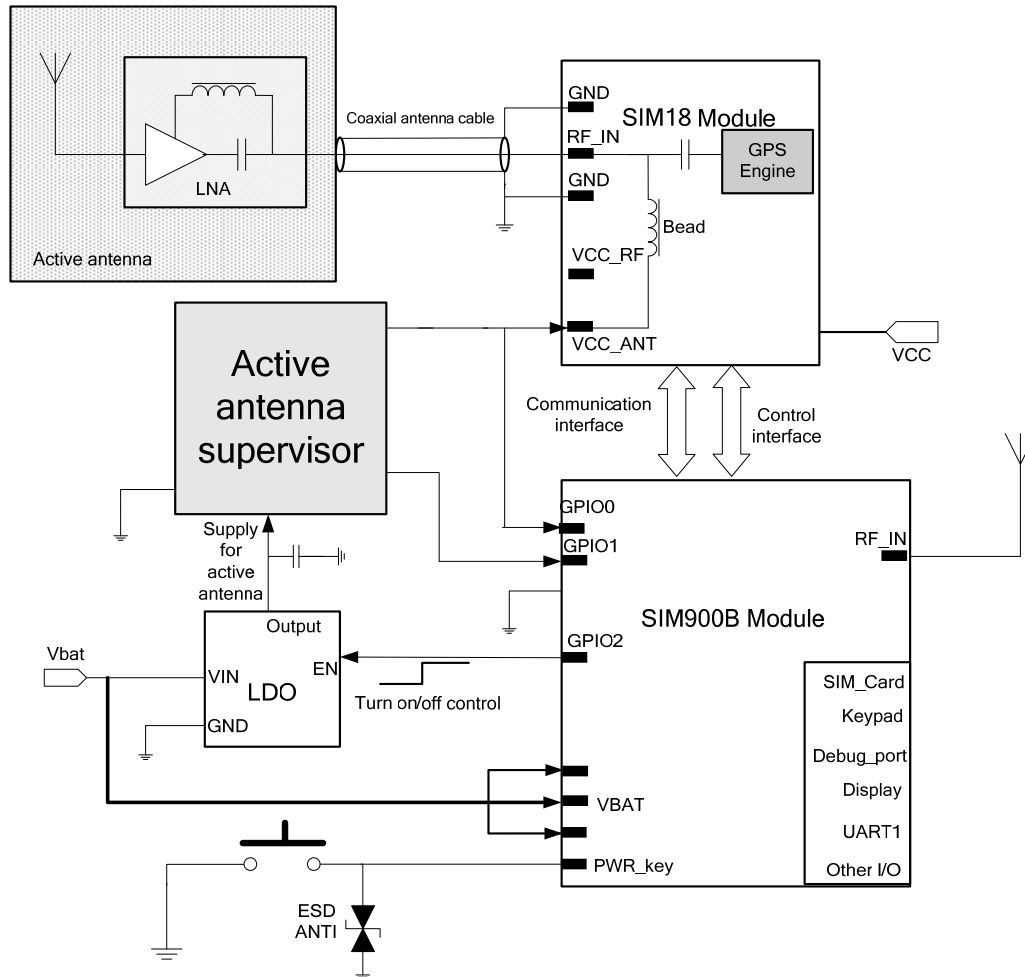


Figure 4: Function block diagram

Notes: the LDO output should match the active antenna. SIMCom suggest customers to use 3V active antenna. Sure 1.8V is also applied but the voltage level should be taken into consideration.

Table 4: GPIOs of the supervisor

GPIO number in the Supervisor	GPIO in the SIM900B	
	Pin name	Pin number
GPIO0	DISP_CLK	20
GPIO1	DISP_CS	22
GPIO2	DISP_DATA	18

Notes: The recovery time can be set by AT Command provided by SIMCom, the default is 60s. See Table 5 for details.

Table 5: BOM of supervisor circuit

References	Value	Tolerance	Description	Remarks
C1	2.2 μ F	10%	Capacitor, X7R, min 10 V	
C2	100 nF	10%	Capacitor, X7R, min 10 V	
R1	15 OHM	10%	Resistor, min 0.063 W	
R2	10 OHM	10%	Resistor, min 0.250 W	
R3, R4	10 KOHM	10%	Resistor, min 0.063 W	
R5	33 KOHM	10%	Resistor, min 0.063 W	
T1, T2	PNP		PNP Transistor BC856B	e.g. Philips Semiconductors

If the value of GPIO0 is not low, then SIM900B will judge the status of GPIO1, for details please refer to table 7.

If the 1.8V active antenna is introduced, customer needs to shift the voltage to 2.8V so that the GPIO of SIM900B can realize the INT event. The following figure is the typical level shift circuit implemented by NPN transistor.

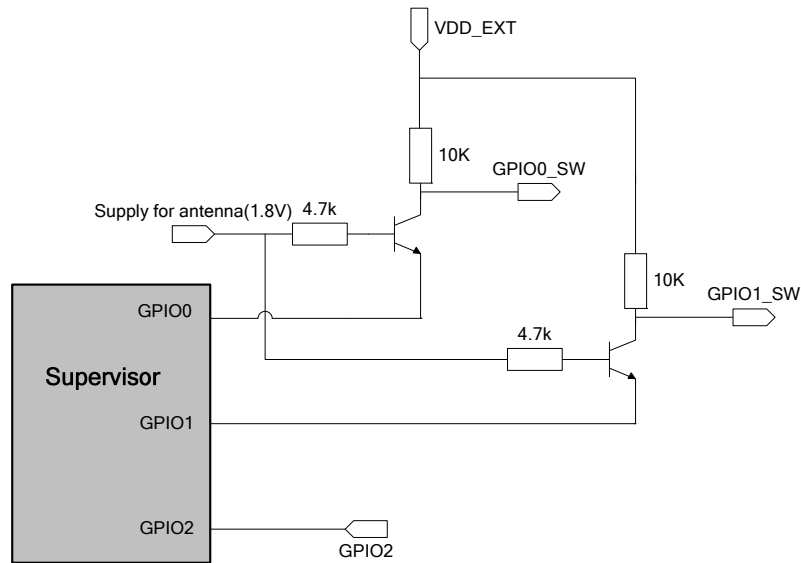


Figure 6: level shift for the 1.8V active antenna

3.3.1 State diagram

The active antenna supervisor provides the methods to check the active antenna for open and short circuit, and to shut off the antenna supply if a short circuit detected. As the Figure 6 shows, if an antenna connected, the initial state after power-up is “Active Antenna OK”.

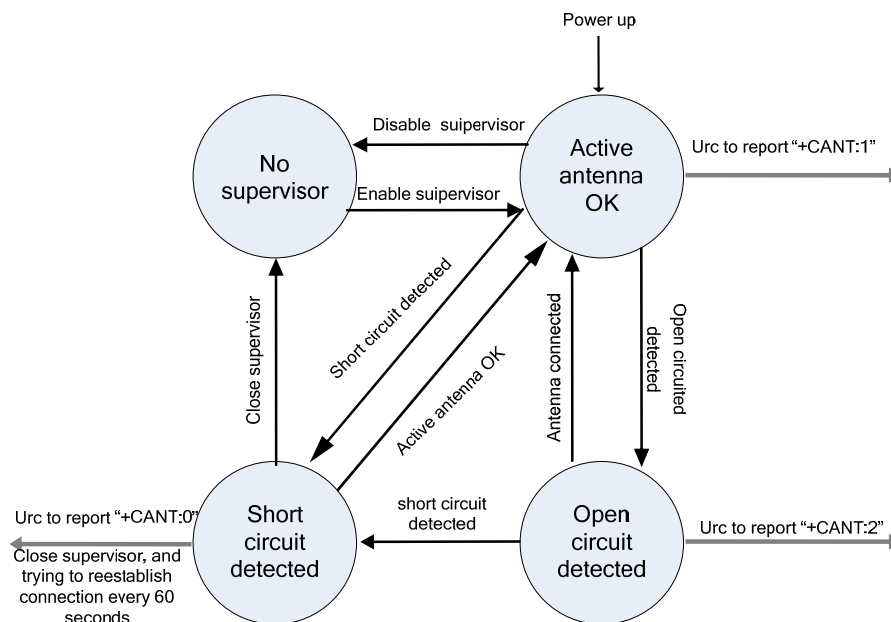


Figure 7: State diagram of active antenna supervisor

3.4 Related AT Commands

SIMCom module firmware supports an active antenna supervisor circuit, the default is closed, and customers need to active it by AT commands provided by SIMCom, as table 5 shows:

Table 6: AT Commands for active antenna supervisor

AT+CANT	Antenna Detecting
Test Command AT+CANT=?	<p>Response</p> <p>+CANT: (list of supported <Enable>s, <Timer>)</p> <p>OK</p> <p>+CME ERROR: <err></p> <p>Parameters</p> <p>See Write Command</p>
Read Command AT+CANT?	<p>Response</p> <p>+CANT: <Enable>, <Timer></p> <p>OK</p> <p>+CME ERROR: <err></p> <p>Parameters</p> <p><Enable> 0 Disable the antenna detecting function</p> <p> 1 Enable the antenna detecting function</p> <p><Timer> 1-1000s can be set by user, the supervisor will try to reestablish the connection every <i>Timer</i> time when the short happened.</p>
Read Command AT+CANTSTATUS?	<p>Response</p> <p>+ CANTSTATUS: < Status></p> <p>OK</p> <p>+CME ERROR: <err></p> <p>Parameters</p> <p><Status></p> <p> 0 The supply of the active antenna shorted to GND</p> <p> 1 The antenna equipped normally</p> <p> 2 Open circuit happens</p> <p> 3 unknown, the supervisor doesn't open</p>
Write Command AT+CANT=<Enable>, <Timer>	<p>Response</p> <p>OK</p> <p>+CME ERROR: <err></p> <p>Parameters</p> <p><Enable> 0 Disable the antenna detecting function</p> <p> 1 Enable the antenna detecting function</p> <p><Timer> 1-1000s can be set by user, the supervisor will try to reestablish the connection every <i>Timer</i> time after the short happened.</p>

3.5 Status reporting

After SIM900B powered up, customers need to use AT commands to enable the supervisor circuit, then the supervisor circuit begins to work, and SIM900B will output messages to indicate the status of the active antenna every time the status got change.

As figure 4 shows, SIM900B watch the GPIO0 and GPIO1, the logic relationship as the following table shows:

Table 7: Relationship of the key parameter

item	GPIO0 0	GPIO1	GPIO2	Urc report	Status
Value	0	/	Pull down	+CANT: 0	Short circuit
	1	1	Keep up	+CANT:2	Open
	1	0	Keep up	+CANT:1	Normal

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