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Version history

Date	Version	Description of change	Author
2013-08-01	1.00	New version	YangMing
2014-08-05	1.01	Chapter Scope, Add projects	ChenHaibing
		Chapter 6.5, Update the Table 3	ChenHaibing
		Chapter 7, Add dual serial function and AT+CMNRP	ChenHaibing

Scope

This document presents the AT command of Serial port operation and application examples. This document can apply to SIM800 series modules, including SIM800V, SIM840V, SIM800W, SIM840W, SIM800W16, SIM840W16, SIM800L, SIM800H, SIM800, SIM800M64, SIM800G and SIM808.

1 Introduction

This document describes the serial interface of the modules and how to take it into account in client's application design. This document can help user quickly understand serial interface of the modules.

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2 Connection

SIM800 series is designed as a DCE (Data Communication Equipment). It provides a full modem serial port which is used for data transmission and for sending AT commands. The serial port contains data lines TXD and RXD, hardware flow control lines RTS and CTS, status lines DTR, DCD and RI. Serial port interface is available which complies with 2.80 Volts interface.

When the module is used in full modem mode for data transmission, all the signal lines should be connected. The following figure shows the connection between module and client (DTE) in full modem mode.

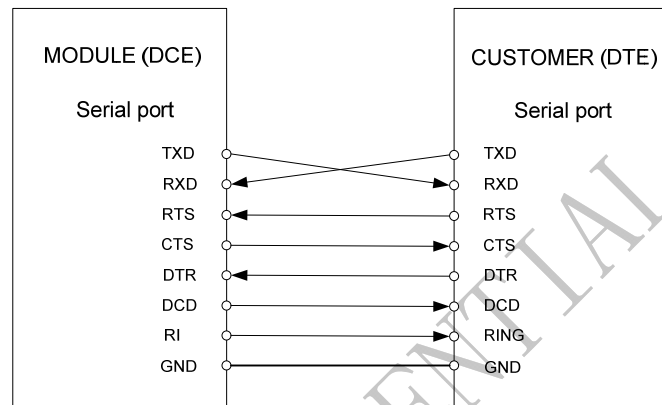


Figure 1: Connection of the serial interfaces in full modem mode

When the module is used in null modem (no handshaking) mode for data transmission, only RXD and TXD are used in user's application, other serial pins should be kept open. The following figure shows the connection between module and client (DTE) in null modem mode.

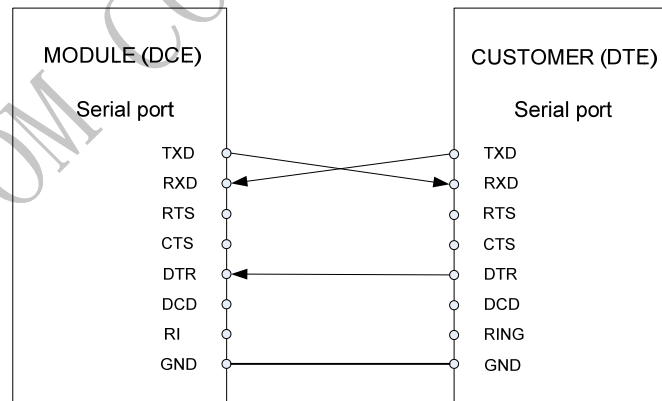


Figure 2: Connection of the serial interfaces in null modem mode

NOTE: The DTR signal must pulled to low level voltage when DTE is sending data to module. If DTR does not connect with DTE, DTR must be connected to GND via a 10K resistor.

3 Level Shifter

The significant levels are 0V (for low data bit or ON condition) and 2.80V (for high data bit or OFF condition). For electrical characteristics please refer to the following table.

Table 1: Logic levels of the serial port

Parameter	Min	Max	Unit
V _{IL}	0	0.4	V
V _{IH}	2.4	3.0	V
V _{OL}	0	0.1	V
V _{OH}	2.7	3.0	V

If user's MCU or PC's voltage is out of the range, lever shifter needs to be used.

3.1 Communication with MCU

The module can choose the lever shifter by buffer with open drain outputs (e.g. NC7WZ07) or transistor.

By buffer with open drain outputs:

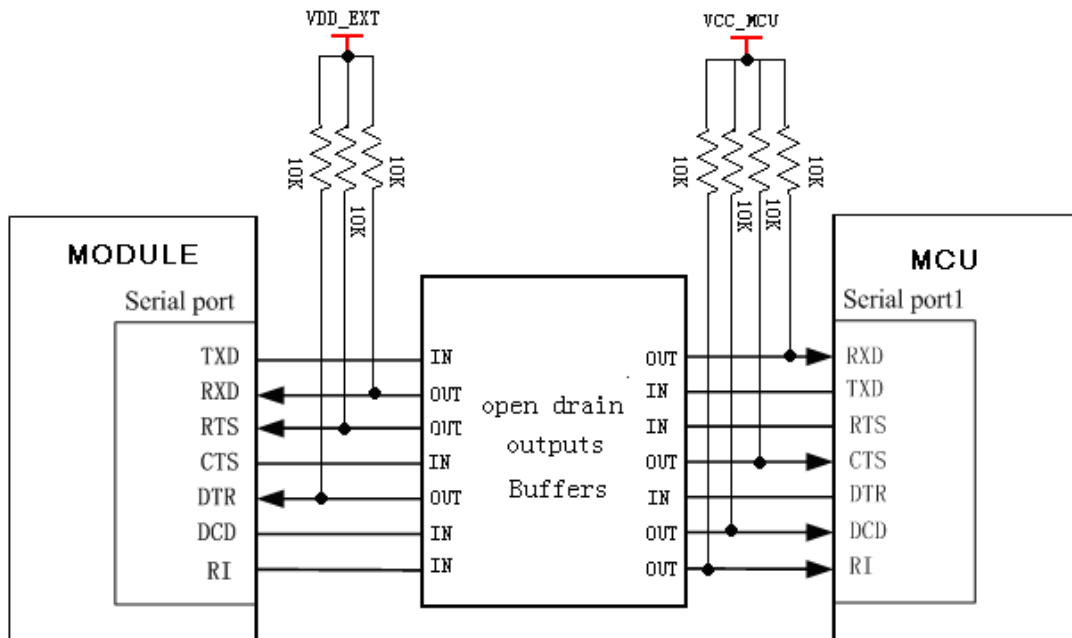


Figure 3: The lever shifter by buffer with open drain outputs

By transistor:

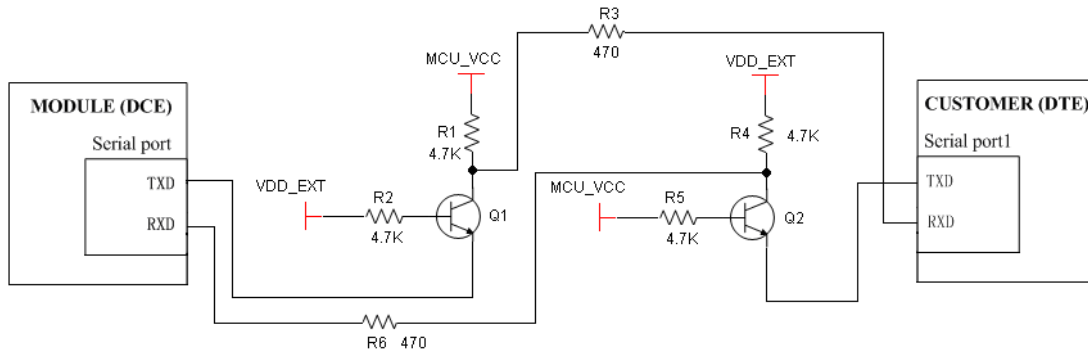


Figure 4: The level shifter by transistor for communication with MCU

Note: VDD_EXT is supplied by the module(2.80V), VCC_MCU is voltage of user UART interface.

3.2 Communication with PC (RS232)

Table 2: The voltage of RS232

Parameter	Transmitter capable	Receiver capable	Unit
Logic 0	+5...+15	+3...+25	V
Logic 1	-5... -15	-3...-25	V
Undefined	-	-3...+3	V

It is suggested doing the level shifter by RS-232 transceivers (e.g.SP3238E or MAX3221 etc.)

Connect all signals:

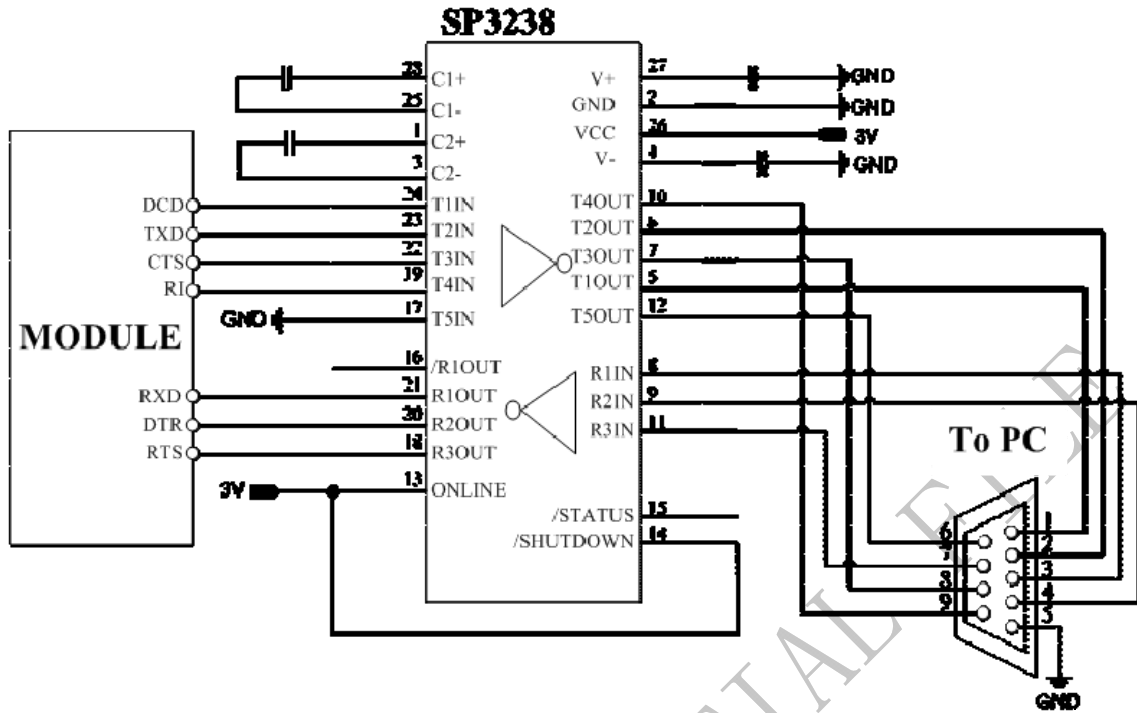


Figure 5: The level shifter by SP3238E for communication with PC

If just RXD and TXD are connected, MAX3221 can be chosen for the level shifter.

4 Synchronize Baud Rate

SIM800 series is designed in autobauding mode by default. Autobauding allows SIM800 series to automatically detect the baud rate of the host device. In application, host device must to synchronize the baud rate with SIM800 series. Host device must firstly send character “AT” or “at” to synchronize the baud rate. It is recommended to send “AT” until host device receives the “OK” response, which means host device and SIM800 series are correctly synchronized. Once the baud rate is synchronized, it is suggested to use AT command “AT+IPR” to set SIM800 series baud rate according the host baud rate. Following figure shows the flow of synchronization of baud rate between SIM800 series and host device.

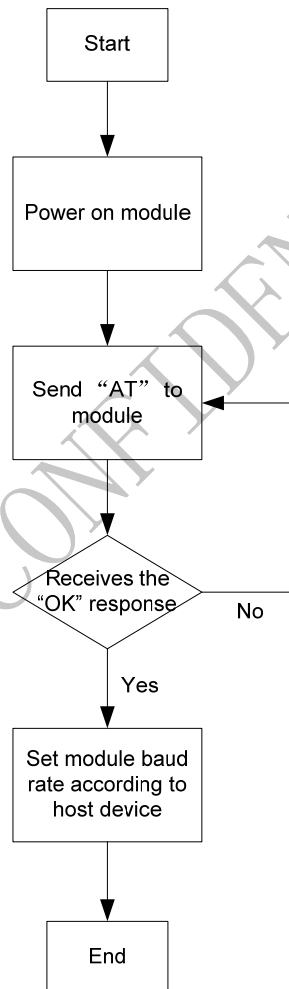


Figure 6: Synchronizing baud rate flow chart

5 Flow Control

Flow control is very important for correct communication between the module (DCE) and host device (DTE). In cases of a data or fax call, the sending device is transferring data faster than the receiving side is ready to accept. When the receiving buffer reaches its capacity, the receiving device should be capable to pause the sending device until it catches up.

SIM800 series is designed as no flow control by default. The AT command “AT+IFC” can be used to enable the hardware flow control or software flow control, which are basically two approaches to achieve data flow control.

5.1 Software Flow Control (XON/XOFF flow control)

Software flow control sends different characters to stop (XOFF, decimal 19) and resume (XON, decimal 17) data flow. It is quite useful in some applications that only use three wires on the serial interface.

The AT command “AT+IFC=1,1” can be used to enable software flow control in the DTE interface and within module. This setting is stored by AT&W.

Ensure that any communications software package (e.g. ProComm Plus, Hyper terminal or WinFax Pro) uses software flow control.

NOTE: Software Flow control should not be used for data calls where binary data will be transmitted or received (e.g. TCP/IP) as the DTE interface may interpret binary data as flow control characters.

5.2 Hardware Flow Control (RTS/CTS flow control)

Hardware flow control achieves the data flow control by controlling the RTS/CTS line. When the data transfer should be suspended, the CTS line is set inactive until the transfer from the receiving buffer has been completed. When the receiving buffer is OK to receive more data, CTS goes active once again.

The AT command “AT+IFC=2,2” can be used to enable hardware flow control in the DTE interface and within module. This setting is stored by AT&W.

To achieve hardware flow control, ensure that the RTS/CTS lines are present on user’s application platform.

NOTE: The DTR signal must be pulled to low level voltage when DTE is sending data to the

module. Otherwise, the CTS signal may always not be asserted by module and the handshaking will not be established.

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6 Control Signals

6.1 CTS

This signal is asserted by the module to inform the DTE device that transmission may begin. RTS and CTS are commonly used as handshaking signals to moderate the flow of data into the module.

6.2 RTS

This signal is asserted (low level) to prepare the module (DCE) for accepting transmitted data from the DTE device.

6.3 DCD

The AT command AT&C can be used to set DCD function mode. When set "AT&C0", DCD line is always ON (low). When set "AT&C1", DCD line is ON (low) only in the presence of data carrier.

6.4 DTR

Module will automatically go into SLEEP mode (set AT+CSCLK=1) if DTR is set to high level and there is no on air and no hardware interrupt (such as GPIO interrupt or data on serial port). In this case, the current consumption of module will reduce to the minimal level. During SLEEP mode, the module can still receive paging message and SMS from the system normally. If DTR Pin is pulled down to a low level, this signal will wake up module from SLEEP mode. The serial port will be active after DTR changes to low level about 50ms. DTR must be held low during the call.

The AT command "AT&D" can be used to set DTR function mode.

- When it is set to "AT&D0", TA ignores status on DTR.
- When it is set to "AT&D1", ON (low)->OFF (high) on DTR: module will be changed to command mode when the connected call is remained.
- When it is set to "AT&D2", ON->OFF on DTR and pull DTR to high more than the time that the setting value by AT+D2: call is disconnected, module is changed to command mode.

TCP/IP applications only support AT&D1 and AT&D0. In TCP/IP application (for more detail, please refer to TCP/IP application NOTE), DTR line of serial port can also be used to switch from data mode to command mode. To use this method, AT&D1 should be set firstly. Pull DTR line to ground for at least 1 second and then pull up, the module will switch from data mode to command mode and OK will be returned which indicates the module is in command mode.

6.5 RI

RI responds as table 3.

Table 3: RI responds

State	RI respond
Standby	HIGH
Calling (include Voice and Data) (NOT controlled by the setting of CFGRI)	<p>If the module is used as caller, the RI will maintain high. But when it is used as receiver, the responses of RI are listed in the following:</p> <p>Change to LOW, then:</p> <ol style="list-style-type: none"> (1) Change to HIGH when call is established; (2) Change to HIGH when ATH command is executed; (3) Change to HIGH when sender hangs up; (4) Change to HIGH when SMS is received.
SMS (NOT controlled by the setting of CFGRI)	<p>When receiving SMS, the RI will be changed to LOW and hold at low level for about 120 ms, then it is changed to HIGH; meanwhile the module will report following URCs:</p> <p>+CMTI: +CMT: +CDS:</p>
TCPIP (Controlled by the setting of CFGRI)	<p>When execute following TCPIP AT command, the RI will be changed to LOW and hold at low level for about 120 ms, then it is changed to HIGH.</p> <ol style="list-style-type: none"> (1) TCP activate the account by the AT+CIICR command (2) TCP deactivate the account by the AT+CIPSHUT command (3) TCP create the connect by AT+CIPSTART command (4) TCP close the connect by AT+CIPCLOSE command (5) TCP send data by AT+CIPSEND command (6) When receiving TCPIP data
FTP (Controlled by the setting of CFGRI)	<p>When FTP reports URCs, the RI will be changed to LOW and hold at low level for about 120 ms, then it is changed to HIGH.</p>
URC (controlled by the setting of CFGRI)	<p>When report following URCs, the RI will be changed to LOW and hold at low level for about 120 ms, then it is changed to HIGH.</p> <p>UNDER-VOLTAGE WARNNING OVER-VOLTAGE WARNNING Call Ready</p>

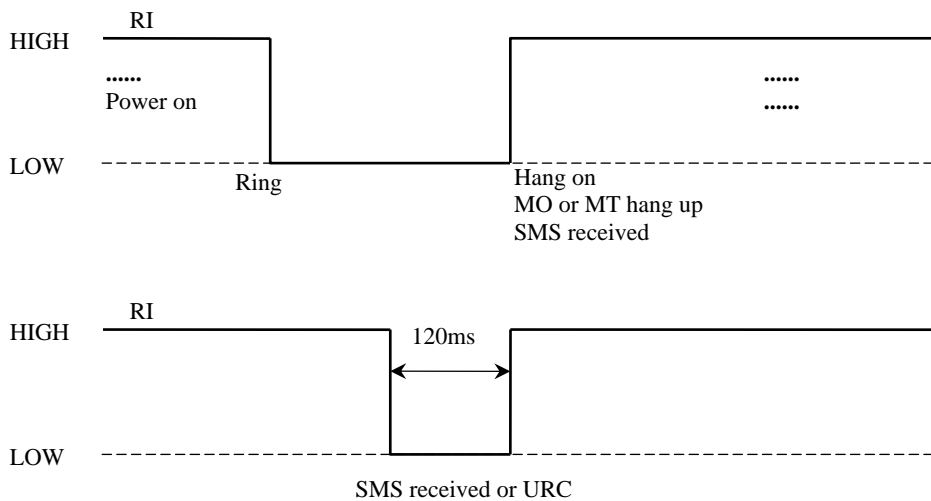


Figure 7: Behaviors of RI

Table 4: AT+CFGRI Indicate RI when using URC

AT+CFGRI Indicate RI when using URC	
Read command AT+CFGRI?	Response +CFGRI: <status> OK
	Parameters See set command
Write Command AT+CFGRI=<status>	Response OK ERROR
	Parameters <status> <u>0</u> off 1 on
Reference	Note

It's recommended connect the RI to an interrupt port of MCU. It can be used for waking up from power saving mode. That means the MCU will receive an interrupt while a falling edge coming on RI.

7 Dual Serial Port Function

7.1 Dual Serial Port Pin Definition

SM800H, SIM800L, SIM800 and SIM800M64 support the dual serial port function, the hardware will support one full serial port (UART2) and one 3-line serial port (UART1) at the same time. This dual serial port function must set by the AT command of “AT+CMNRP=1” on the UART1 port before using. If the customer needs the dual serial port function, the hardware must be designed as the following table:

Table 5: The dual serial pin of SIM800H and SIM800L

Serial port1	Name	Pin	Direction	Description
UART1_TXD	TXD	32	out	Used by update software
UART1_RXD	RXD	31	in	
Serial port2	Name	Pin	Direction	Description
UART2_TXD	RTS	33	out	
UART2_RXD	CTS	34	in	
UART2_RTS	UART_RI	68	in	Clear to send
UART2_CTS	UART_DCD	70	out	Require to send
UART2_DTR	UART_DTR	69	in	
UART2_RI	ROW4	63	out	
UART2_DCD	COL4	24	out	

Table 6: The dual serial pin of SIM800 and SIM800M64

Serial port1	Name	Pin	Direction	Description
UART1_TXD	TXD	9	out	Used by update software
UART1_RXD	RXD	10	in	
Serial port2	Name	Pin	Direction	Description
UART2_TXD	RTS	8	out	
UART2_RXD	CTS	7	in	
UART2_RTS	UART_RI	4	in	Clear to send
UART2_CTS	UART_DCD	5	out	Require to send
UART2_DTR	UART_DTR	3	in	
UART2_RI	ROW4	40	out	
UART2_DCD	COL4	47	out	

NOTE:

- 1: The dual serial port function needs two pin of COL4 and ROW4.
- 2: The AT command of AT+CMNRP" only can be executed on UART1.

3: Only B05 and later version support dual serial port function.

Table 7: Dual serial port feature

AT+CMNRP Dual serial port feature	
Test Command AT+CMNRP=?	Response +CMNRP: (0-1) OK Parameter See Write Command
Read Command AT+CMNRP?	Response +CMNRP: <mode> OK Parameter See Write Command
Write Command AT+CMNRP=<mode>	Response OK ERROR Parameter <mode> 0 single serial port mode, disable uart port 2. 1 dual serial port mode, enable uart port 2.
Parameter Saving Mode	AT&W_SAVE
Max Response Time	-
Reference	Note

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

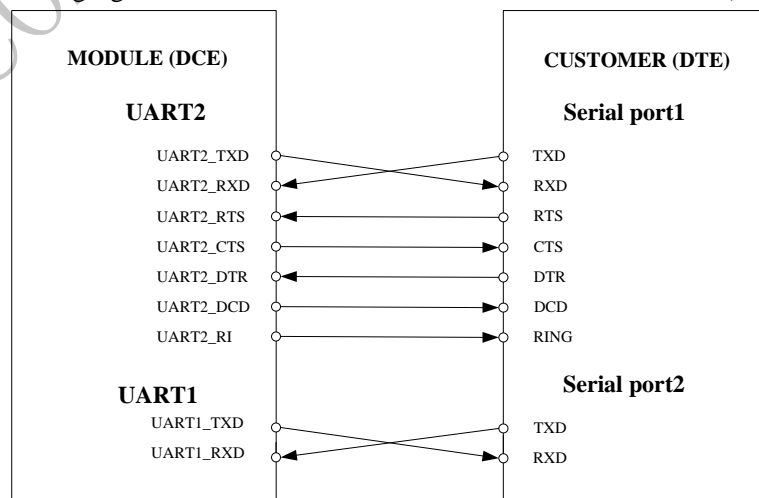


Figure 8: Connection of the serial interfaces

7.2 Restrictions of AT Command on Dual Serial Port Mode

When the module works on dual serial port mode, some of AT command can only be executed on one serial port, these AT commands list in following table:

Table 8: AT command restricted on dual serial port mode

AT command	UART1	UART2	Note
AT+IFC=2,2	Not support	Support	UART1 don't contain CTS and RTS pin
AT+CSCLK=1	Not support	Support	UART1 don't contain DTR pin
ATD*99# (PPP)	Not support	Support	UART1 will lost data after PPP connected
AT+CSCLK=2	Support	Not support	The RXD of UART2 can not be used as interruption
AT+CMNRP=0	Support	Not support	
AT+CMNRP=1	Support	Not support	

7.3 Sleep Mode of Dual Serial Port

On dual serial port mode, the UART1 and UART2 both are autobauding rate (the value of "AT+IPR" is 0). The module cannot enter sleep mode in the absence of synchronous serial port baud rate after module power on. Only the UART1 and UART2 have both synchronized baud rate, the module can enter sleep mode.

7.3.1 Enter Sleep via UART1

On dual serial port mode, UART1 only contain 3 lines (TXD, RXD, and GND). Only the sleep mode2 can be used. After setting "AT+CSCLK=2" command, the module will continuously monitor the serial port data signal. When there is no data transfer over 5 seconds on the serial port and there is no on air and hardware interrupts (such as GPIO interrupt), the module will enter sleep mode2 automatically. At this sleep mode, the module also can receive incoming call and new SMS from network.

7.3.2 Exit Sleep via UART1

When the module is in sleep mode2 (AT+CSCLK=2), the following methods can wake up it.

- Receive a voice or data call from network.
- Receive a SMS from network.
- Receive external interrupt.

- UART1 receive data (the first character will lose).

NOTE: AT command from UART2 can not wake up the module; pull down DTR pin of UART2 can not wake up the module too.

7.3.3 Enter Sleep via UART2

Customer can control the module to enter or exit the sleep mode1 (AT+CSCLK=1) by DTR signal. When DTR is in high level and without interrupt (on air and hardware such as GPIO interrupt or data on serial port), the module will enter sleep mode1 automatically. In this mode, the module can still receive paging or SMS from network but the serial port is not accessible.

7.3.4 Exit Sleep via UART2

When the module is in sleep mode1 (AT+CSCLK=1), the following methods can wake up it.

- Receive a voice or data call from network.
- Receive a SMS from network.
- Receive external interrupt.
- Pull down DTR pin.

After module has received incoming call or new SMS, serial port can report URC, but the serial port can not input AT command. Only after the DTR pin of UART2 pull to low level for 50ms, the serial port can input AT command.

NOTE: The AT command from UART1 can not wake up the module.

Appendix

A Related Documents

SN	Document name	Remark
[1]	SIM800 Series_AT Command Manual	
[2]	SIM800 Series_TCPIP_Application Note	

B Terms and Abbreviations

Abbreviation	Description
DCE	Data Communication Equipment
DTE	Data Terminal Equipment
UART	Universal Asynchronous Receiver and transmitter

Contact us:

Shanghai SIMCom Wireless Solutions Co.,Ltd.

Address: Building A, SIM Technology Building, No. 633, Jinzhong Road, Shanghai,
P. R. China 200335

Tel: +86 21 3252 3300

Fax: +86 21 3252 3020

URL: www.sim.com/wm

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