SIM7000 Series_UART _Application Note

LPWA Module

Document Title:	SIM7000 Series_UART_Application Note
Version:	1.01
Date:	2020-07-29
Status:	Released

GENERAL NOTES

SIMCOM OFFERS THIS INFORMATION AS A SERVICE TO ITS CUSTOMERS, TO SUPPORT APPLICATION AND ENGINEERING EFFORTS THAT USE THE PRODUCTS DESIGNED BY SIMCOM. THE INFORMATION PROVIDED IS BASED UPON REQUIREMENTS SPECIFICALLY PROVIDED TO SIMCOM BY 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, SYSTEM VALIDATION OF THIS 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.

COPYRIGHT

THIS DOCUMENT CONTAINS PROPRIETARY TECHNICAL INFORMATION WHICH IS THE PROPERTY OF SIMCOM WIRELESS SOLUTIONS LIMITED COPYING, TO OTHERS AND USING THIS DOCUMENT, ARE FORBIDDEN WITHOUT EXPRESS AUTHORITY BY SIMCOM. OFFENDERS ARE LIABLE TO THE PAYMENT OF INDEMNIFICATIONS. ALL RIGHTS RESERVED　BY SIMCOM IN THE PROPRIETARY TECHNICAL INFORMATION ，INCLUDING BUT NOT LIMITED TO REGISTRATION GRANTING OF A PATENT , A UTILITY MODEL OR DESIGN. ALL SPECIFICATION SUPPLIED HEREIN ARE SUBJECT TO CHANGE WITHOUT NOTICE AT ANY TIME.

SIMCom Wireless Solutions Limited

Building B, SIM Technology Building, No.633 Jinzhong 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

About Document

Version History

Version	Date	Owner	What is new
V1.00	2017.12.05	Hongjun.Tu	First Release
V1.01	2020.07.28	Wenjie.Lai	All

Scope

This document applies to the following products

Name	Type	Size(mm)	Comments
SIM7000E/C/A/G	Cat-M1(/NB1/EGPRS)	24*24	
SIM7000E-N SIM7000C-N	NB1	24*24	

Contents

1 Introduction

1.1 Purpose of the document

Based on module AT command manual, this document will introduce UART application process.

Developers could understand and develop application quickly and efficiently based on this document.

1.2 Related documents

[1] SIM7000 Series_AT Command Manual

1.3 Conventions and abbreviations

Abbreviation	Description
UART	Universal Asynchronous Receiver/Transmitter
URC	Unsolicited Result Code
DTE	Data Terminal Equipment
DCE	Data Communication Equipment
SMS	Short Message Service

2 UART Introduction

This document describes the UART interface of SIMCom SIM7000 module. The UART port has several features:

● Support High-speed UART, the baud rate is up to 4Mbps, the communication baud rates include:0,300,600,1200,2400,4800,9600,19200,38400,57600,115200,230400,921600,2000000,2900000,3000000,3200000,3686400,4000000 bps. The rate 0bps mark auto baud rate.

● Support Hardware flow control.

● Support auto baud rate, but auto baud rate only supported 9600bps, 19200bps, 38400bps, 57600bps and 115200bps.

3 Connection

SIM7000 module is designed as a DCE (Data Communication Equipment). It provides a UART interface which is used for data transmission and sending AT commands.

The default baud rate is auto baud rate, data size is 8 bits, stop bits is 1 bit, and parity is none.

3.1　Hardware Interface

Table 1: Pin description

Pin type	Pin name	Pin Number	I/O	Active voltage	Default Status
UART	UART_RXD	10	I	Low	Pull- Down
	UART_TXD	9	O	Low	Pull-Up
	UART_RTS	8	I	Low	Pull- Down
	UART_CTS	7	O	Low	Pull- Down
	UART_DTR	3	I	Low	Pull-Up
	UART_DCD	5	O	Low	Pull-Up
	UART_RI	4	O	Low	Pull-Up

NOTE

For different devices, the name of RTS PIN may be confused as CTS PIN, and the name of CTS PIN may be confused as RTS PIN, the I/O direction of SIM7000 module's CTS PIN is OUT, and RTS PIN is IN, users can clear this confusion by the I/O direction.

Table 2: Logic level

Parameter	Min	Max	Unit
Logic low input	-0.3	0.65	V
Logic high input	1.17	1.8	V
Logic low output	-0.3	0.45	V
Logic high output	1.35	1.8	V

3.2   Connect to Host

When the module is used as 2-line UART for data transmission, only RXD and TXD signal PINs are used, the following figure shows the connection between SIM7000 module and DTE (customer's CPU).
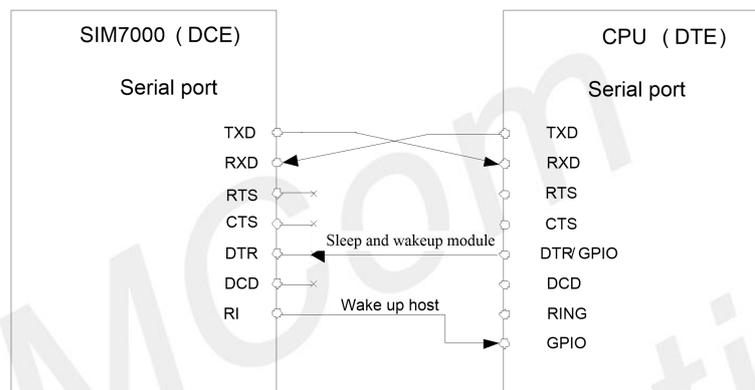
Figure 1: 2-line UART

When module is used as 7-line UART for data transmission, all the signal PINs should be connected, including TXD, RXD, RTS, CTS, DTR, DCD and RI, and the corresponding PINs should be configured as UART function. The following figure shows the connection between SIM7000 module and DTE (customer's CPU).
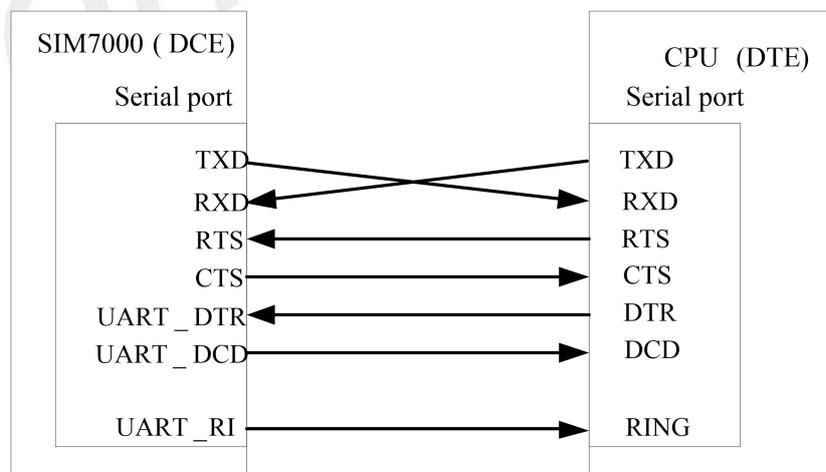
Figure 2: UART full modem

The SIM7000 UART is 1.8V voltage interface. If user's UART application circuit is 3.3V voltage interface,

the level shifter circuits should be used for voltage matching. The TXB0108RGYR provided by Texas Instruments is recommended. The following figure shows the voltage matching reference design.
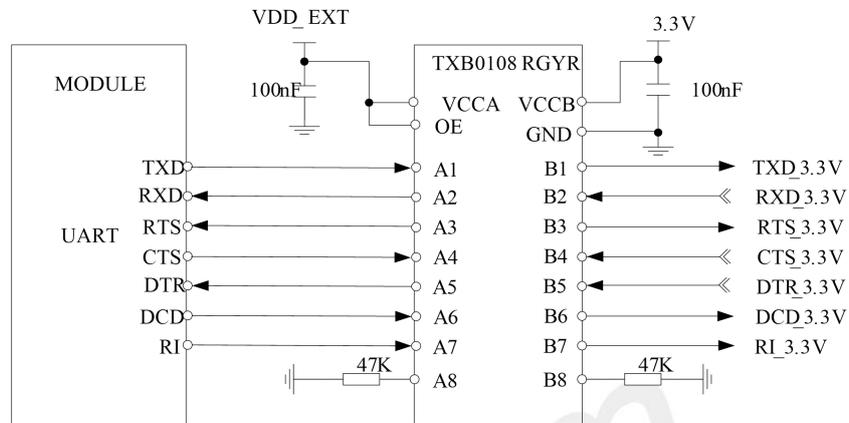

Figure 3: Reference circuit of level shift

4 Synchronize baud rate

SIM7000 supports auto baud rate, but the rate only supported on 9600, 19200, 38400, 57600, 115200. If users need to change to other baud rate, it needs to switch as AT command AT+IPR.

Auto baud rating allows SIM7000 module to automatically detect the baud rate based on the host device. Host device must synchronize the baud rate with SIM7000 module first before communication.

Host must send "AT" string to synchronize the module, if module matches the baud rate it will respond with response: "OK", if no response is reported, host must send the synchronize string again until the response is received.

The function is supported in "AT+IPR". When "AT+IPR" is set to 0，auto baud is activated. If TA sends "AT+IPR=0" command to the modem, then module will be saved as auto baud mode.

```
                    ┌─────────────────┐
                    │      Start      │
                    └────────┬────────┘
                             │
                             ▼
                    ┌─────────────────┐
                    │  Power on module │
                    └────────┬────────┘
                             │
                             ▼
                    ┌─────────────────┐
                    │ Send "at" to module │◄──────┐
                    └────────┬────────┘           │
                             │                    │
                             ▼                    │
                    ╱─────────────────╲      NO   │
                   ╱ Receive the respond :╲───────┘
                   ╲       OK          ╱
                    ╲─────────────────╱
                             │ YES
                             ▼
                    ┌─────────────────┐
                    │ Module set its baud rate │
                    │ according to the host │
                    │      device     │
                    └────────┬────────┘
                             │
                             ▼
                    ┌─────────────────┐
                    │       End       │
                    └─────────────────┘
```
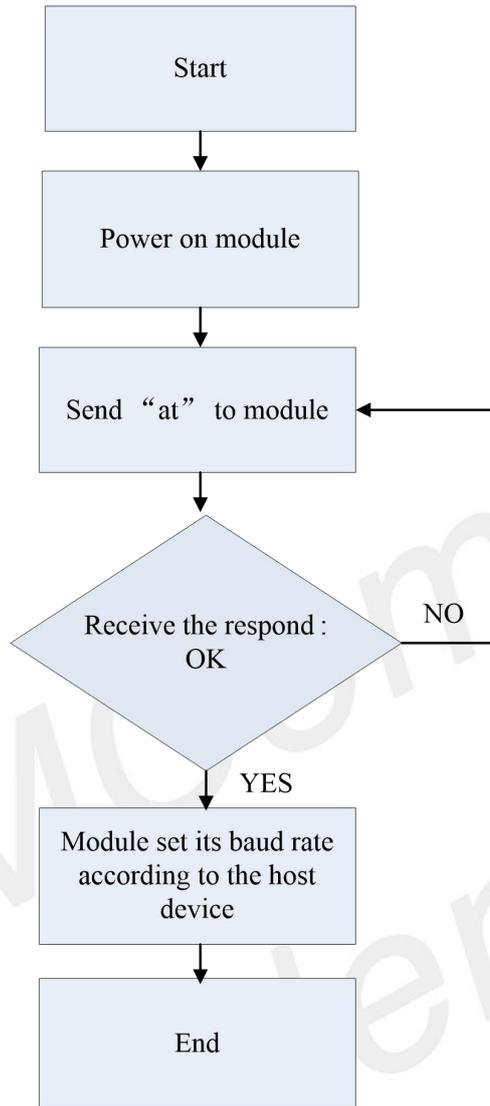
Baud rate synchronization chart

5 Flow Control

Flow control is very important during the transmission (large data) between the module (DCE) and the terminal device (DTE). When receiving buffer reaches its capacity, the receiving device should be capable of pause the sending device until it overflows. SIM7000 module is designed as no flow control by default, but users can enable this function by AT command.

5.1   Hardware flow control (RTS/CTS)

Hardware flow control achieves the data flow control by controlling the RTS/CTS line which follows the RS232 standard. The command "AT+IFC=2,2" can be used to enable hardware flow control, these settings can't be stored automatically.

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

6 Control Signals

6.1 RTS

When RTS pin is in hardware flow control mode, this signal is asserted (low level) to prepare the module (DCE) for accepting transmitted data from the DTE device.

DCE stop transmitting data if RTS pin is at high level, transmission begins or continues if RTS is at low level, if RTS goes high in the middle of transmission, the module (DCE) waits for a completed transmission before stop transmitting data.

This pin is in GPIO mode by default, user can switch it to flow control mode by "AT+IFC=2,2" command.

6.2 CTS

When this pin is in hardware flow control mode, the signal is asserted by the module (DCE) to inform the DTE device that transmission may begin.

The CTS pin outputs high level when the RX FIFO level of the module (DCE) is up to the threshold, when the RX FIFO level falls below the threshold, the CTS pin outputs low level.

This pin is in GPIO mode by default, user can switch to flow control mode by "AT+IFC=2,2" command.

6.3 DCD

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

The pin is used to control module into sleep mode or wakeup module. When users had set AT command "AT+CSCLK=1", then pulling up the pin DTR by host, Module will be into sleep mode. In sleep mode, module will never respond AT request.

If DTR pin was pulled down by host, module will be wake up.

If setting AT command "AT+CSCLK=0", Module will be never into sleep mode. And it will do nothing when the DTR pin is pulling up.

> **NOTE**
>
> If there has SMS during module sleep mode, there will be URC reported to host, and module will be waked up by this SMS. Once DTR is at high level, and there has no air data or UART communication, module will go back to sleep mode again.

6.5 RI

This pin is used to wakeup host when module has message to output, message could be SMS or DATA URC.

Table 3: RI Respond

State	RI respond
Standby	HIGH level
SMS	When receiving SMS, the RI PIN will be changed to LOW level for about 120ms, and then it is changed to HIGH level.
DATA URC	When receiving DATA URC, the RI PIN will be changed to LOW level for about 120ms, and then it is changed to HIGH level. This function can be enable/disable by "AT+CFGRI" command.

The RI pin can be used to interrupt output signal to inform the host controller such as application CPU. Before that, users must use AT command "AT+CFGRI=1" to enable this function.

Normally RI will keep high level until certain conditions such as receiving SMS, or a DATA URC report coming. Then it will output a low level pulse 120ms, in the end, it will become high level.
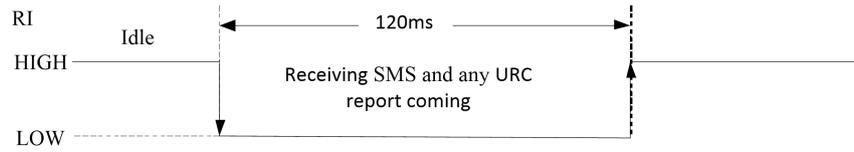
Figure 4: RI behaviour（SMS and DATA URC report