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FIBOCOM_NL668&NL652_Sleep_Awakening_Guidance

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Applicability type

No.	Product model	Description
1	NL668 series	NA
2	NL652 series	NA

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Versions

Version	Author	Assessor	Approver	Update Date	Description
V1.0.0	Chen Ning			2019-07-23	Initial version
V1.0.1	Chen Ning			2019-12-09	Modify english diction
V1.0.2	Chen Ning	Long Yiliang		2019-12-10	Modify connection graph

Content

1 Preface

This paper describes the sleeping wake-up operation guidance of NL668 module (including MiniPCI-E package) of Fibocom Company. This paper mainly focuses on testing, customer, R&D and other related personnel.

2 Brief Introduction to Sleep Awakening

In order to ensure that the battery loss is minimized, when the module is not used, it can enter the low power mode, so as to achieve the purpose of power saving. When the module is in low power mode, if there is a wake-up source, the corresponding module should also be waked up to normal working mode. Popular talk about sleep is designed to save electricity, wake-up is designed for sleep. Because of the logical relationship between the configuration of sleep and wake-up, there are many AT instructions involved. This paper elaborates these two aspects in detail, and describes the specific configuration of module sleep and wake-up.

3 Hardware Interface

3.1 NL668 Pin Assignment

The communication between NL668 module and host is mainly through USB and UART ports. In addition, some other IO and host are connected to control the power management of host and module.

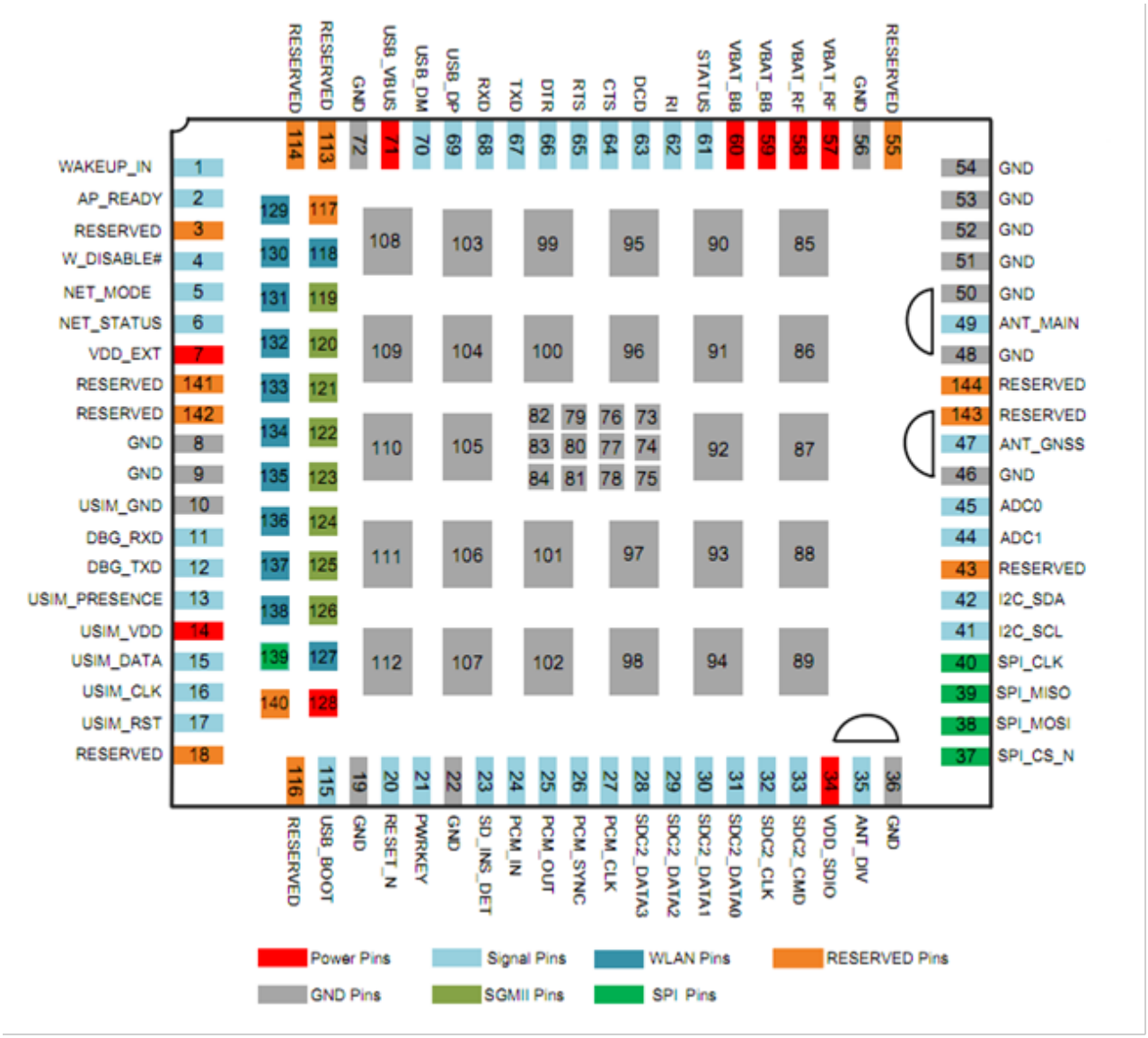


图 3-1-1 LCC Definition of Packing Pin

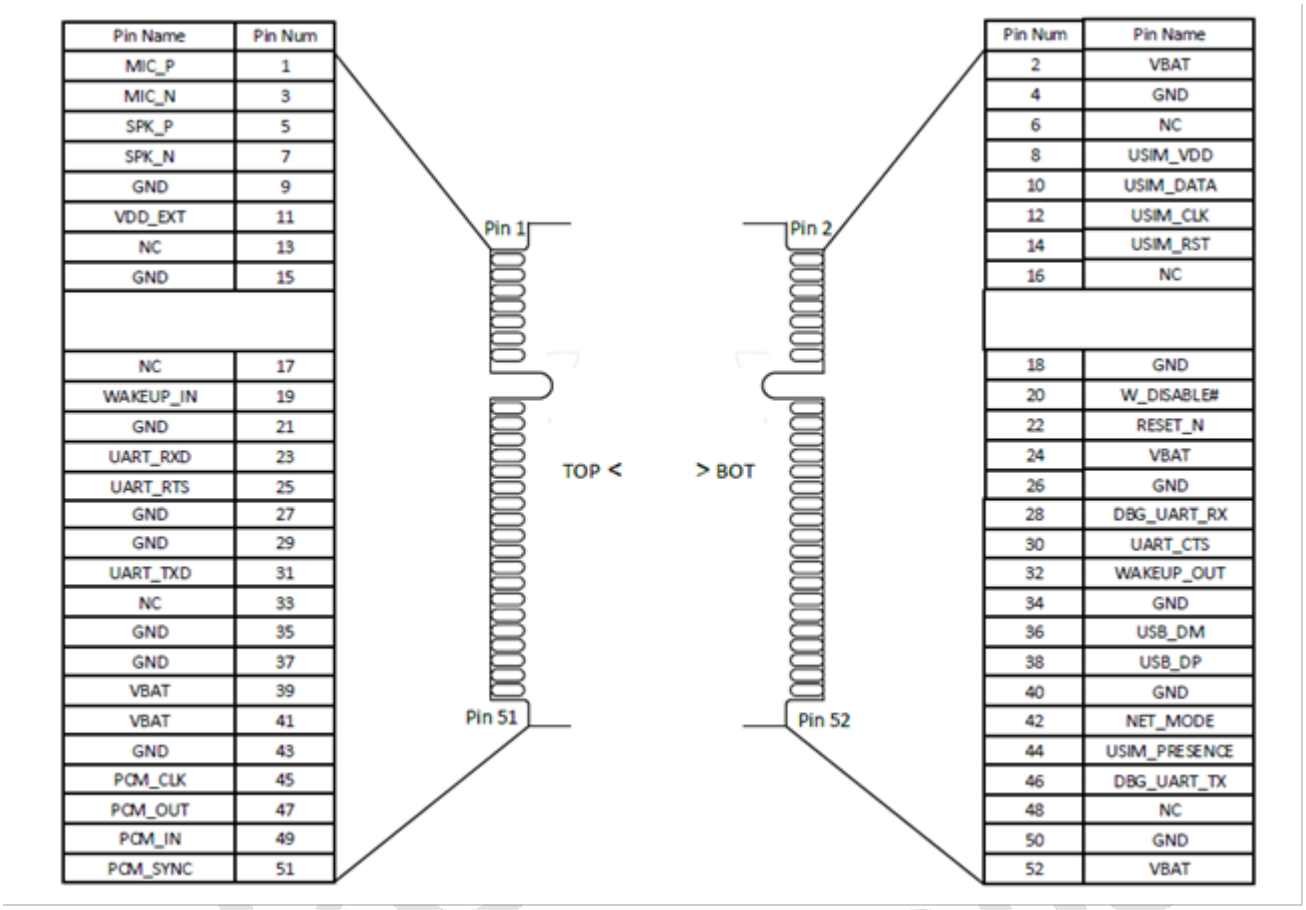
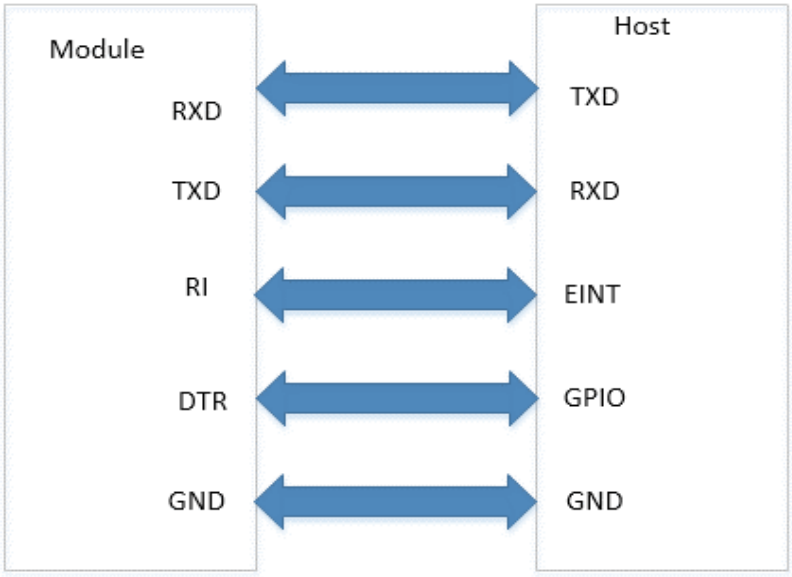


图 3-1-2 MiniPCIe Definition of Packing Pin

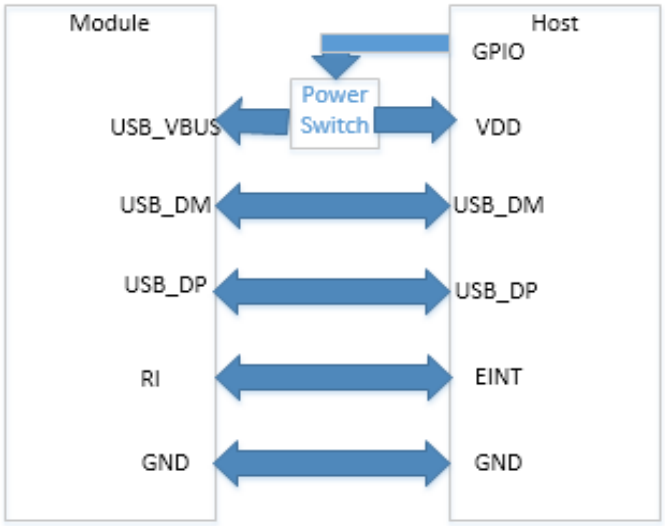
3.2 NL668 Modular Power Management Pin

Pin Name	O/I	Describe
DTR	Input	➢ UART Sleep Wake-up of NL668 Module Controlled by Host ➢ DTR internal pull-up
WAKEUP_IN	Input	Function is the same as DTR
RI	Output	➢ NL668 module notifies the host that there is a URC Report ➢ When there are telephone, short message and data, wake up the host through high-level or low-level pulse

LGA :

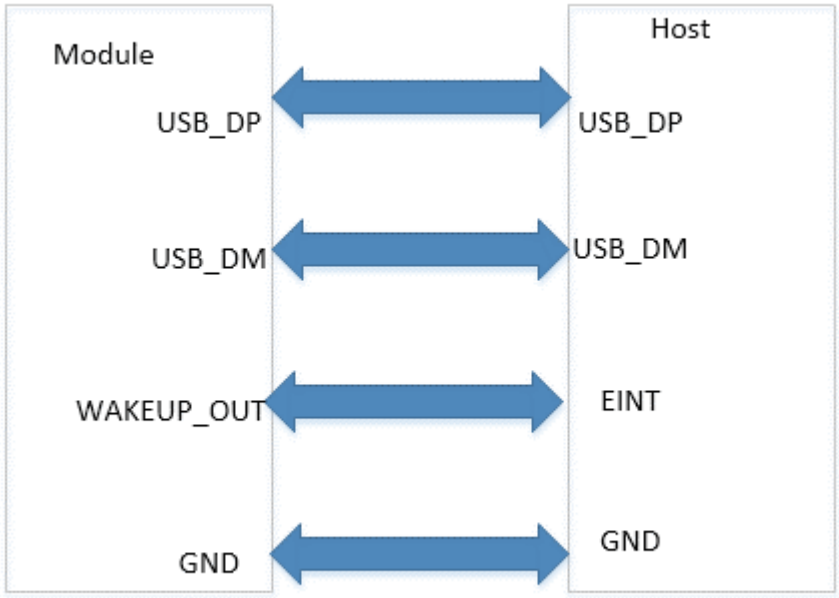


UART connect

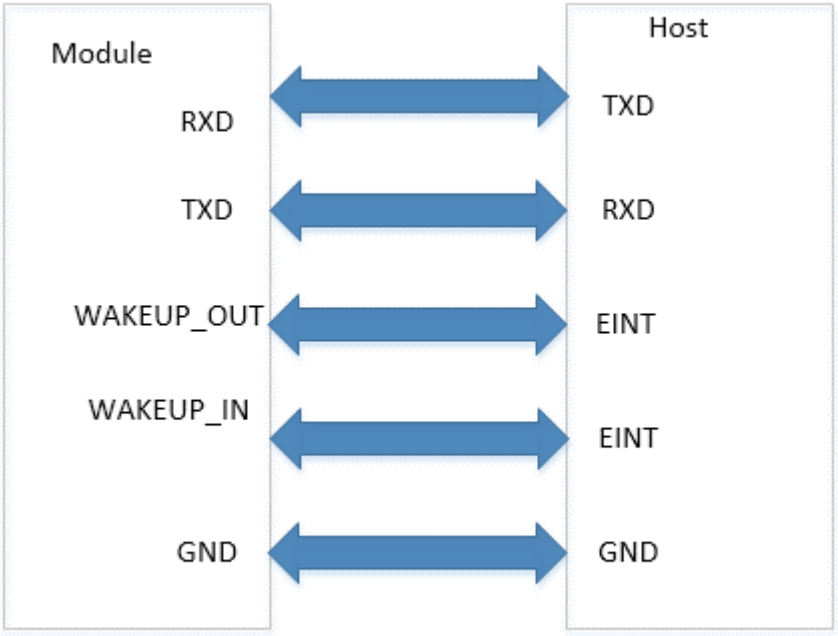


USB connect

MINIPCIE :



USB connect



UART connect

4 Module Sleep

4.1 Commands Involved in Sleep

ATS24

AT+GTLPMMODE

AT+GTUSBMODE

AT+CSCLK

AT+GTUSBSLEEPEN

Note:

For details of AT command parameters, please refer to 《FIBOCOM AT Commands User Manual_Sleep_V1.0.1.docx》

4.2 Introduction to Sleep

Hibernation can be divided into two parts, UART and USB. When USB and UART are dormant together, the module goes into sleep.

4.3 Sleep Configuration

4.3.1 UART Sleep

UART slepp can be configured by AT+GTLPMMODE in three ways: ATS24 sleep, DTR sleep and WAKEUP IN sleep.

Listing of Serial Sleeping AT Configuration

Num	Configuration commands	explain
1	AT+GTLPMMODE=0 ATS24=5	Choose ATS24 sleep mode Serial ports will go dormant without data interaction in 5S
2	AT+GTLPMMODE=1,0 AT+CSCLK=1	Select WAKEUP_IN sleep mode, raise the pin, module sleep Hibernating Master Switch
3	AT+GTLPMMODE=1,1 AT+CSCLK=1	Select WAKEUP_IN sleep mode, pull down the pin, module sleep Hibernating Master Switch
4	AT+GTLPMMODE=2,0 AT+CSCLK=1	Select DTR sleep mode, raise the pin, module sleep Hibernating Master Switch

Num	Configuration commands	explain
5	AT+GTLPMMODE=2,1 AT+CSCLK=1	Select DTR sleep mode, pull down the pin, module sleep Hibernating Master Switch

4.3.2 USB Sleep

USB Sleep can be divided into two main types:

A. One is the USB Vbus sleep (by operating VBUS to sleep)

B. One is USB protocol sleep;

4.3.2.1 USB_VBUS Disconnect

USB sleep or wake-up is controlled by operating the level of USB_VBUS (the host computer does not support UBS_suspend, which is usually chosen by the detection of USB_VUBS). This scenario requires VBUS detection by sending the following commands.

Configuration commands	explain
AT+GTUSBDETECTEN=1	Configuration detection USB_VBUS Level state

4.3.2.2 USB protocol Disconnect

By disconnecting or lowering the USB_DP/USB_DM pins, USB can enter the sleep mode (some products MiniPCIe does not have USB_VUBS detection, and does not support USB suspend. In this case, if you want to sleep USB, there can be no ADB port in the mode)

4.3.2.3 Turn off USB

By sending at command through serial port to close USB port, USB can enter dormant mode (module and host only connect UART).

Configuration commands	explain
AT+ GTUSBSLEEPEN =2,0	Close the USB port and sleep the USB

4.3.2.4 USB suspend

Because Linux-2.6.32 or more has its own selective suspend power management features, it is only necessary to turn on the power management switch and configure it by modifying the compilation configuration of the kernel (in the.Config file in the linux_src/directory).

CONFIG_USB_SUPPORT=y

CONFIG_USB =y

CONFIG_PM_RUNTIME=y

CONFIG_USB_SUSPEND=y

USB serial driver supports selective suspend power management. Adb port can not exist in the USB

mode of the module, otherwise the module can not enter the dormant mode.

The code was modified as follows:

linux_src/drivers/usb/serial/option.c

Add the following code to the option_probe function in the file：

```
/*
 * Enable NL668 to automatically sleep
 */
if (dev_desc->idVendor == cpu_to_le16(0x1508) &&
    dev_desc->idProduct == cpu_to_le16(0x1001))
    usb_enable_autosuspend(serial->dev);
```

The translation is as follows：

```
if (dev_desc->idVendor == cpu_to_le16(0x1508) &&
    dev_desc->idProduct == cpu_to_le16(0x1001))
    usb_enable_autosuspend(serial->dev);
```

4.3.3 Examples of Hibernation Configuration

Because the connection interface between module and host is mainly USB and UART, three kinds of usage scenarios are listed. For USB and UART sleep, they can be arranged and combined arbitrarily in 4.3.1 and 4.3.2.

4.3.3.1 UART

Configuration commands	explain
AT+GTLPMMODE=0,0	Use ats24 control module to enter sleep
AT+GTUSBSLEEPEN=0,0	Select USB to sleep;
ATS24=3	Select UART 3 seconds automatic sleep;

4.3.3.2 USB Connect

Configuration commands	explain
AT+GTLPMMODE=0,0	Use ats24 control module to enter sleep
ATS24=3	Select UART 3 seconds automatic sleep;
AT+GTUSBSLEEPEN=0,0	Select USB suspend to sleep

4.3.3.3 USB+UART Connect

Configuration commands	explain
AT+GTLPMMODE=2,1	Select DTR low-level sleep UART, high-level wake-up UART;
AT+CSCK=1	Enable UART sleep;

Configuration commands	explain
AT+GTUSBSLEEPEN=0,0	Select USB suspend to sleep

In this scenario, the DTR is set to low level and at + csclk = 1, which can sleep UART. If the host does not support USB suspend mode, you need to unplug the USB to make the USB sleep. The above mainly lists three kinds of usage scenarios for hibernation. For USB and UART hibernation, you can configure any arrangement and combination in AT command.

5 Module Wake-up

5.1 Directives Involved in Awakening

AT+GTWAKE

AT+GTPMTIME

AT+WRIM

5.2 Brief introduction to awakening

5.2.1 Wake-up module

If the module is dormant, it can be waked up to continue using the module as follows.

5.2.1.1 USB Wake-up

If the module is USB_VBUS entering sleep, USB_VBUS pulls up the USB and wakes up.
If the module is USB suspend dormant and sends data to the USB port, the USB is waked up.

5.2.1.2 UART Wake-up

If the module uses DTR/WAKEUP_IN to sleep, controlling DTR/WAKEUP_IN can wake up UART.
If the module uses ATS24 to automatically sleep and sends data to UART, UART will be awakened and automatically enter into sleep after the timeout.

5.2.1.3 URC Wake-up

Active reporting of URC wakes up USB and UART, and then the module automatically goes to sleep.

5.2.2 Wake Up Host

When the host is dormant, in order to detect the module's telephone, short message, data service and URC report, the module needs to output pulse waveform through RI pin to wake up the host. At this point, the host must configure the connection RI pins to the wake-up source.

5.3 Wake-up Configuration

Num	command	Example	explain
1	AT+GTWAKE	AT+GTWAKE=0	➢ RI defaults to high level. When the module has telephone, short message and data services, RI will output a low pulse waveform. ➢ Configuration of Pulse Width+WRIM
		AT+GTWAKE=2,0	➢ RI defaults to high level. When the module has telephone, short message and data services, RI will output a low pulse waveform. ➢ Configuration of Pulse with GTPMTIME
		AT+GTWAKE=2,1	➢ RI defaults to high level. When the module has telephone and short message data, RI pin will output a low pulse waveform. ➢ Configuration of Pulse Width+GTPMTIME
2	AT+GTPMTIME	AT+GTPMTIME=200,200,1000	➢ Configuration wake-up pulse width is 1.2s
3	AT+WRIM	AT+WRIM=0,1000	➢ By default, the RI pulse width of the incoming call is 1 s
		AT+WRIM=1,150	➢ By default, the RI pulse width of incoming short message is 150 ms ➢ The function of SMS wake-up depends on SMS reporting, using AT+CNMI configuration
		AT+WRIM=2,500	➢ By default, the RI pulse width of data traffic is 500 ms

Summary:

When AT+GTWAKE≠0, the change of pulse length is related to the configuration of GTPMTIME.

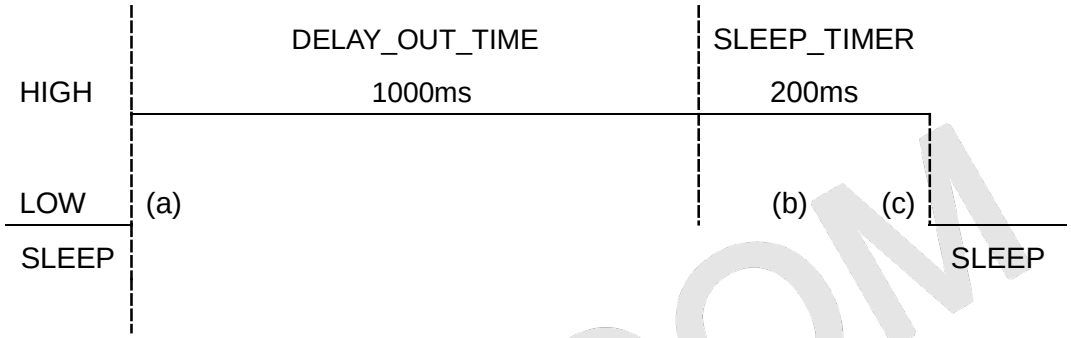
When AT+GTWAKE=0, the change of pulse length is related to WRIM configuration.

5.3.1 Examples of Wake-up Waveform Configuration

Example 1

Configuration commands	explain
AT+GTWAKE=2,0	RI feet will be raised when awakened
AT+GTPMTIME=1000,200,200	Configure RI pulse width to 1.2S

The specific output waveforms are as follows:：



(a) Start waking up the host and wait for a delay-out time;

(b) Start reporting URC and wait for sleeptime for a long time;

(c) Modules enter sleep mode;