SIMCOM WCDMA Wireless Module

SIM5xxx PCM Application Note

Revision Note

FAQ

Application Note

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VERSION HISTORY

Date	Version	Description of change	Author
2010-03-23	1.00	Origin	zhongming
2010-06-16	1.02	Modify PCM slot , PCM timing description and software PCM description.	libing
2011-08-26	1.03	Add SIM5320 description.	libing

1 Introduction

SIM5XXX provides 2 PCM interface: hardware and software. This document describes the PCM interface of SIMCOM WCDMA wireless module. (SIM5XXX represents the series which is stated below.)

2 Scope of the document

This document is intended for the following versions of the SIMCom modules

    SIM5215

     SIM5216

    SIM5218

    SIM5320

3 SIM5XXX PCM overview

3.1 Hardware PCM

SIM5XXX provides hardware PCM interface for external codec.   **PCM interface pins are multiplex on GPIOs.**
Use AT+CPCM command to enable PCM function and configure the mode you want. The PCM interface is a 4 pin, digital interface that enables PCM communication between the Module and an external codec. SIM5XXX supports 3 PCM formats: 8 bits (υ-law or A-law) and 16 bits (linear). The table below shows the hardware PCM interface of different SIMCOM WCDMA wireless modules.

Module	AT Command	PIN	Note
SIM5215 SIM5216 SIM5218 SIM5320	AT+CSDVC=4 AT+CPCM=1	PCM_DIN/GPIO0 PCM_SYNC/GPIO2 PCM_CLK/GPIO3 PCM_DOUT/GPIO5	PCM interface are multiplex with GPIOs.

Table 1: PCM interface of SIMCOM WCDMA wireless modules

Table 2:PCM pin assignment

Pins	PCM functionality	I/O Dir	Note
PCM_CLK	PCM_CLK	O(Master)/I(Slave)	VIHmin=0.7*VDD_EXT*
PCM_SYNC	PCM_SYNC	O(Master)/I(Slave)	VIHmax= VDD_EXT+0.3
PCM_DIN	PCM_DIN	I	VOLmin=GND
PCM_DOUT	PCM_DOUT	O	VOLmax=0.2V VOHmin= VDD_EXT-0.2 VOHmax= VDD_EXT
Note: module internal reference supply power: VDD_Ext=2.6V. Please note our module PCM interface electric level must match to your codec or MCU.			

4 Hardware PCM interface

4.1 PCM mode

PCM mode	SYNC	CLK	MODE	Format	Slot

Auxiliary	8KHz	128KHz	Master	A-law(8 bits) υ-law(8 bits) linear(16 bits)	Only slot 0
Primary	8KHz	2.048MHz	Slave/Master		0~15(Changed by AT command：at+cpcmslot) Default：slot 0

Table 3: PCM mode

The default PCM interface on power up is the auxiliary PCM interface.   Under PCM, the data is output on the rising edge of PCM_CLK and sampled at the falling edge of PCM_CLK. Primary PCM is disabled at power up or when RESET is asserted, but you can use AT command to enable the primary PCM mode.

PCM Interface can be operated in Master and Slave mode.   When the PCM interface is configured, PCM Tx data will be routed from the external codec Mic through the DSP encode path in the Module.   PCM Rx data will be routed through the DSP decode path to the external codec speaker.   When using the PCM Interface, the Module can be set either into Master Mode or Slave Mode.

In Master Mode, the Module drives the clock and sync signals that are sent out to the external codec via the PCM Interface.   When in Slave Mode, the external codec drives the clock and sync signals that are sent to the Module.

Configuration Mode can be selected either primary or auxiliary.   Primary configuration mode uses 2.048MHz clock and 8kHz short sync clock, and auxiliary configuration mode uses 128kHz clock and 8kHz long sync clock.   One important consideration is that Slave mode is only available for use with Primary configuration Mode. PCM formats can also be chosen by AT command.

All data is 8 kHz and 16 bits with the following PDM bit format:

```
Tx (external codec →SIM5XXX ) – SDDD DDDD DDDD DDVV
Rx (SIM5XXX → external codec) – SDDD DDDD DDDD DDVV
```

Where:

```
S – Signed bit
D – Data
V – Volume padding
```

4.2 Auxiliary PCM

The auxiliary PCM interface enables communication with an external codec to support hands-free applications.   u -law codec are supported by the auxiliary PCM interface.

The auxiliary codec port operates with standard long-sync timing and a 128 kHz clock.   The AUX_PCM_SYNC runs at 8 kHz with 50% duty cycle.   Most u -law codec support the 128 kHz clock.
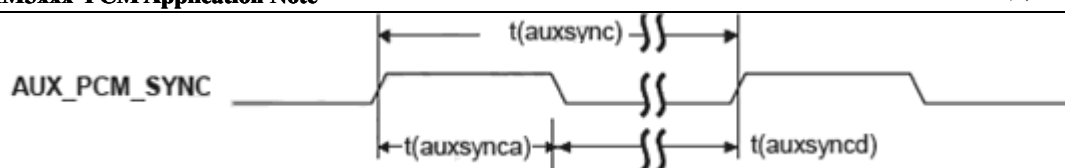
Figure 1：AUX_PCM_SYNC timing
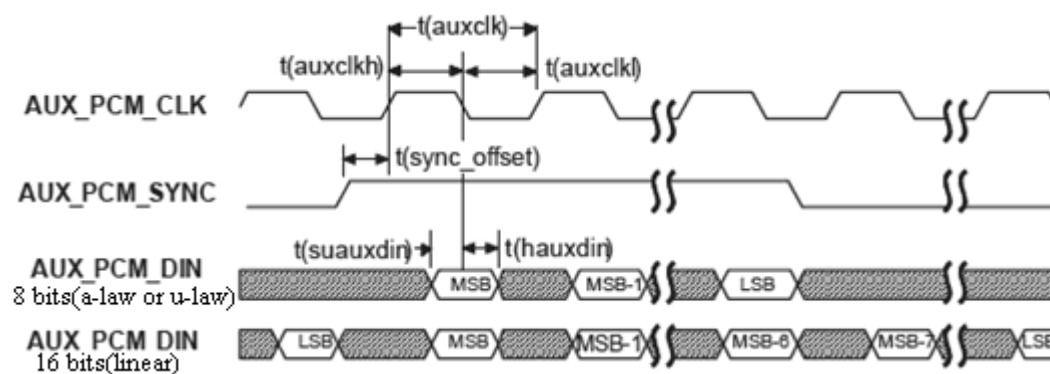
Figure 2：AUX_PCM_CODEC to SIM5XXX timing
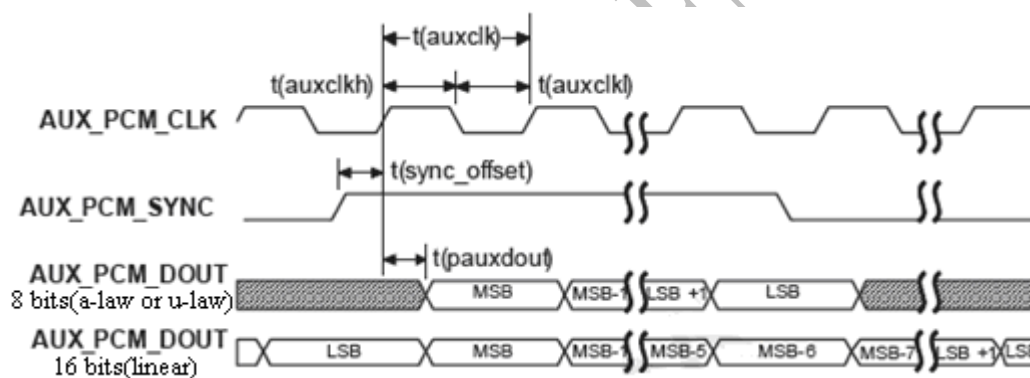
Figure 3：SIM5XXX to AUX_PCM_CODEC timing

Table 4 : AUX_CODEC timing parameters

Parameter	Description	Min	Typical	Max	Unit	Note
t(auxsync)	AUX_PCM_SYNC cycle time	–	125	–	μs	
t(auxsynca)	AUX_PCM_SYNC asserted time	–	62.5	–	μs	1
t(auxsyncd)	AUX_PCM_SYNC de-asserted time	–	62.5	–	μs	1
t(auxclk)	AUX_PCM_CLK cycle time	–	7.8	–	μs	2
t(auxclkh)	AUX_PCM_CLK high time	–	3.9	–	μs	3
t(auxclkl)	AUX_PCM_CLK low time	–	3.9	–	μs	3
t(sync_offset)	AUX_PCM _SYNC offset time to AUX_PCM_CLK rising	–	1.95	–	μs	4
t(suauxdin)	AUX_PCM_DIN setup time to	60	–	–	ns	

	AUX_PCM_CLK falling					
t(hauxdin)	AUX_PCM_DIN hold time after AUX_PCM_CLK falling	60	–	–	ns	
t(pauxdout)	Propagation delay from AUX_PCM_CLK AUX_PCM_DOUT valid	–	–	60	ns	

Note:

1. t(auxsync)/2 ± 10 ns.   2. t(auxclk) = 1/(128 kHz).

3. t(auxclk)/2 ± 10 ns.   4. t(auxclk)/4 ± 10 ns.

4.3 Primary PCM

The aux codec port also supports 2.048 MHz PCM data and sync timing for u -law codec that matches the sync timing — this is called the primary PCM interface (or just PCM interface). You can use AT+CPCM command to change the mode you want. Primary mode can support a 16-bit linear or an 8-bit μ/A-law PCM format.

Figure 4：PRIM_PCM_SYNC timing
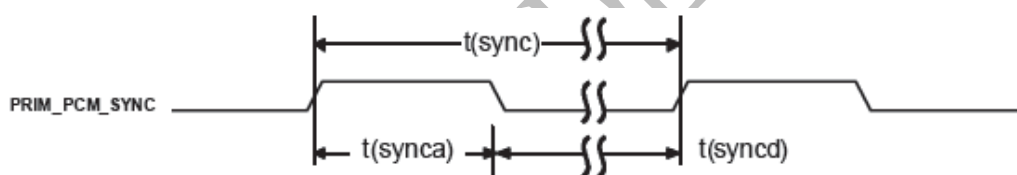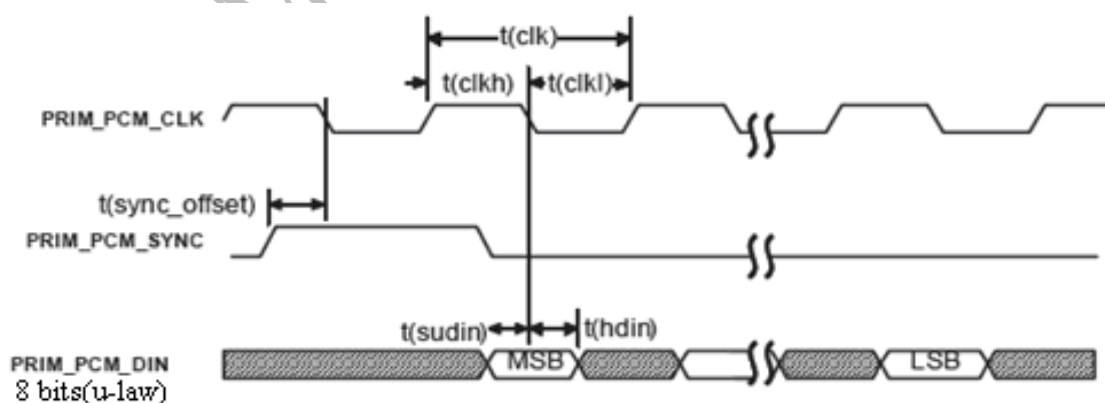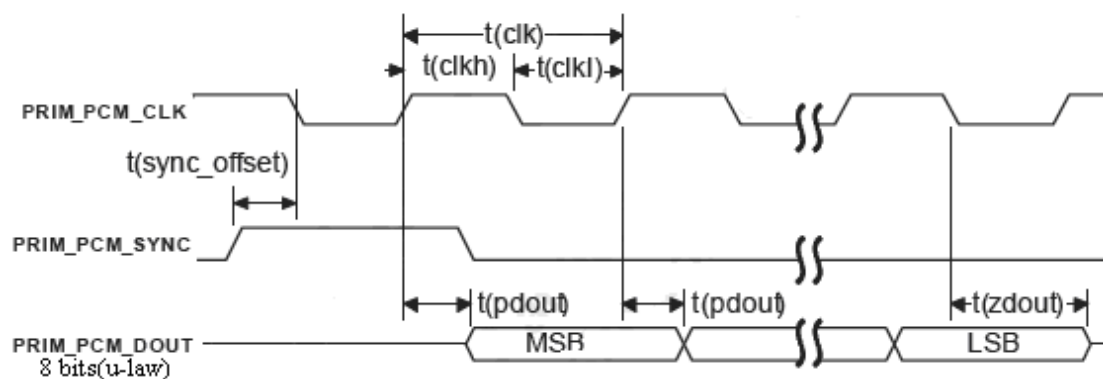

Figure 5：PRIM_PCM_CODEC to SIM5XXX **timing**

Figure 6：SIM5XXX to PRIM_PCM_CODEC timing

Table 5: SIM5218 PIM_PCM_CODEC timing parameters

Parameter	Description	Min	Typical	Max	Unit	Note
t(sync)	PCM_SYNC cycle time	–	125	–	μs	
t(synca)	PCM_SYNC asserted time	–	–	–	ns	
t(syncd)	PCM_SYNC de-asserted time	–	–	–	μs	
t(clk)	PCM_CLK cycle time	–	–	–	ns	
t(clkh)	PCM_CLK high time	–	–	–	ns	
t(clkl)	PCM_CLK low time	–	–	–	ns	
t(sync_offset)	PCM_SYNC offset time to PCM_CLK falling	–	122	–	ns	1
	PCM_SYNC offset time to PCM_CLK falling	–	–	–	ns	
t(sudin)	PCM_DIN setup time to PCM_CLK falling	60	–	–	ns	
t(hdin)	PCM_DIN hold time after PCM_CLK falling	60	–	–	ns	
t(pdout)	Delay from PCM_CLK rising to PCM_DOUT valid	–	–	60	ns	
t(zdout)	Delay from PCM_CLK falling to PCM_DOUT High-Z	5	–	60	ns	

Table 6: Other SIM5XXX PIM_PCM_CODEC timing parameters

Parameter	Description	Min	Typical	Max	Unit	Note
t(sync)	PCM_SYNC cycle time	–	125	–	μs	
t(synca)	PCM_SYNC asserted time	400	500	–	ns	
t(syncd)	PCM_SYNC de-asserted time	–	124.5	–	μs	
t(clk)	PCM_CLK cycle time	–	488	–	ns	
t(clkh)	PCM_CLK high time	–	244	–	ns	
t(clkl)	PCM_CLK low time	–	244	–	ns	
t(sync_offset)	PCM_SYNC offset time to PCM_CLK falling	–	122	–	ns	1
	PCM_SYNC offset time to PCM_CLK falling	–	–	–	ns	
t(sudin)	PCM_DIN setup time to PCM_CLK falling	50	–	–	ns	

t(hdin)	PCM_DIN hold time after PCM_CLK falling	10	–	–	ns	
t(pdout)	Delay from PCM_CLK rising to PCM_DOUT valid	–	–	350	ns	
t(zdout)	Delay from PCM_CLK falling to PCM_DOUT High-Z	–	160	–	ns	

Note: 1. PCM_SYNC offset time = t(clk)/4

5 AT command about PCM

5.1 AT+CSDVC   Switch voice channel device

Description

The command is used to switch voice channel device. After changing current voice channel device and if there is a connecting voice call, it will use the settings of previous device (loudspeaker volume level, mute state of loudspeaker and microphone, refer to AT+CLVL, AT+VMUTE, and AT+CMUT.

NOTE   Use AT+CPCM command to enable PCM function and configure the mode that you want before setting AT+CSDVC=4.

SIM PIN	References
NO	Vendor

Syntax

Test Command	Responses
AT+CSDVC=?	+CSDVC: (list of supported <dev>s) OK

Read Command	Responses
AT+CSDVC?	+CSDVC: <dev> OK

Write Command	Responses
AT+CSDVC= <dev>[,<save>]	OK

Defined values

<dev>
1 – handset
2 – headset
3 – speaker phone

4	–	PCM interface

\<save\>

<u>0</u>	–	temporary voice device setting, after reboot it will be resumed.
1	–	permanent voice device setting.

NOTE If subparameter \<save\> is omitted, voice device setting is temporary.

Examples

AT+CSDVC=2
OK
AT+CSDVC?
+CSDVC:2
OK
AT+CSDVC=1,1
OK

5.2 AT+CPCM   External PCM codec mode configuration

Description

The command will enable PCM or disable PCM function. And configure different PCM mode. Because the PCM pins are multiplex on GPIO, it will switch the function between GPIO and PCM.

SIM PIN	References
NO	Vendor

Syntax

Test Command	Responses
AT+CPCM=?	+CPCM: (list of supported \<arg_1\>s), (list of supported \<arg_2\>s) OK
Read Command	Responses
AT+CPCM?	+CPCM: \<arg_1\>,\<arg_2\> OK
Write Command	Responses
AT+CPCM=\<arg_1\>[,\<arg_2\>]	OK

Defined values

\<arg_1\>
0 – disable PCM, switch to common GPIOs.   1 – enable PCM, switch to PCM function.
\<arg_2\>
0 – Auxiliary master PCM, 128K clock and 8K synchronize clock.   1 – Primary master PCM, 2M clock and 8K synchronize clock...

2 – Primary slave PCM, clock provided by external codec.

Examples

AT+CPCM=1
OK
AT+CPCM=?
+CPCM : (0-1),(0-2) *OK*
AT+CPCM?
+CPCM : 1,1 *OK*

5.3 AT+CPCMFMT   Change the PCM format

Description

The command allows to change the current PCM format, there are 3 formats currently supported: linear, u-law, a-law

SIM PIN	References
NO	Vendor

Syntax

Test Command	Responses
AT+CPCMFMT=?	+CPCMFMT: (list of supported <format>s) OK

Read Command	Responses
AT+CPCMFMT?	+CPCMFMT: <format> OK

Write Command	Responses
AT+CPCMFMT=<format>	OK
	ERROR

Defined values

<format>	
0	u-law
1	a-law
2	linear

Examples

AT+CPCMFMT=?

+CPCMFMT: (0-2)

OK

AT+CPCMFMT?

+CPCMFMT: 1

OK

AT+CPCMFMT=2

OK

5.4 AT+ DSWITCH   Change diagnostics or NEMA port mode

Description

The command is used to change diagnostics port (SIM5218/SIM53202) or NEMA port (SIM 5215/ SIM 5216) mode. The default mode of diagnostics port is debug mode. You can switch it from debug mode to data mode or from data mode to debug mode. In data mode, you can send and receive PCM data.

SIM PIN	References
NO	Vendor

Syntax

Test Command	Responses
AT+DSWITCH=?	+DSWITCH: (list of supported <mode>s) OK

Read Command	Responses
AT+DSWITCH?	+DSWITCH: <mode> OK

Write Command	Responses
AT+DSWITCH =<mode>	OK
	ERROR

Defined values

<mode>
Pamameter shows the settings of diagnostics port
<u>0</u>   Switch from data mode to debug mode
1   Switch from debug mode to data mode

Examples

AT+DSWITCH=?

+DSWITCH: (0-1)

OK

AT+DSWITCH?

+DSWITCH: 0

OK

AT+DSWITCH=1

OK

5.5 AT+CPCMREG   Control PCM data transfer by diagnostics or NEMA port

Description

The command is used to control PCM data transfer by diagnostics port (SIM5218/SIM5320) or NEMA port (5215/5216). First you should set diagnostics or NEMA port as data mode by AT+DSWITCH.

SIM PIN	References
NO	Vendor

Syntax

Test Command	Responses
AT+CPCMREG=?	+CPCMREG: (list of supported <n>s) OK

Read Command	Responses
AT+CPCMREG?	+CPCMREG: <n> OK

Write Command	Responses
AT+CPCMREG=<n>	OK
	ERROR

Defined values

<n>
Switch PCM data transfer by diagnostics port or NEMA port on/off
0   Disable PCM data transfer by diagnostics port or NEMA port
1   Enable PCM data transfer by diagnostics port or NEMA port

Examples

AT+CPCMREG=?

+CPCMREG: (0-1)

OK

AT+CPCMREG?

+CPCMREG: 0

OK

AT+CPCMREG=1

OK

5.6 AT+CPCMSLOT   Change PCM data time slot

Description

The command allows to change the current PCM timt-slot, there are 1 parameter supported.

SIM PIN	References
NO	Vendor

Syntax

Test Command	Responses
AT+CPCMSLOT=?	+CPCMSLOT: (list of supported (0-15) OK

Read Command	Responses
AT+CPCMSLOT?	+ CPCMSLOT: <n> OK

Write Command	Responses
AT+CPCMSLOT=<n>	OK
	ERROR

Defined values

<n>
Switch PCM data time slot channel
0-15   time slot channel 0-15.

Examples

AT+CPCMSLOT=?
+CPCMSLOT: (0-15)
OK
AT+CPCSLOT?
+CPCMSLOT: 0
OK
AT+CPCMSLOT=1
OK

6 PCM codec selecting guide

Before one select the PCM codec for SIM5XXX, one should check whether the codec is compatible with SIM5XXX PCM mode, which is shown Table 3.PCM CLK of some codec can not support 128KHz. So if one want to use auxiliary PCM mode, one should check the codec PCM CLK.

PCM slot of SIM5XXX should be same with that of PCM codec.

PCM format can also be set by AT command.

Before one open the PCM part of SIM5XXX, AT+CSDVC=4, AT+CPCM=1 should be entered to turn on the PCM CLK. Then when calling is setup, the PCM data can transmit by hard PCM interface.