FIBOCOM
Perfect Wireless Connection

L810 Mini PCIe Hardware User Manual

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Revision History

Version	Date	Remarks
V1.0.0	2015-02-12	Initial Version

Applicability Table

No.	Type	Note
1	L810-GL-MiniPCIe-00	

Content

1 Preface

1.1 Scope

This manual provides the electrical characteristics, RF performance, Structure, Size and Application environment of the L810 Mini PCIe. This document helps developers quickly understand the performance of the L810 Mini PCIe and develop product.

1.2 Standards

Mini PCI Express Card Electromechanical Specification Revision 1.0-2003

2 Overview

2.1 Description

L810 Mini PCI Express is designed based on FIBOCOM LTE wireless communication module--L810 series, widely used in vehicle and security fields.

2.2 Specifications

Feature	Description
Power Input	L810-GL-MiniPCIe-00
	VCC：3.0V ~ 3.6V (recommended value 3.3V)
Physical	Size ： 30mm x 50.95mm x 3.0 mm
	Weight ： <9g
Interface	Connection type ： Mini PCIe Interface
Environment	Operating temperature ： -30°C to +75°C
	Storage temperature ： -40°C to +85°C
Antenna interface	Support two antenna interfaces.
USB	USB 2.0
UART	4-wire UART
Reset Signal	Support external reset signal
Audio Interface	Digital audio Voice coding FR/HR/EFR/AMR-NB/AMR-WB VoLTE（not support yet）
Other Interfaces	1 x W_DISABLE 1 x LPG

3 Interface Description

This chapter describes the external interface and antenna interface of L810 Mini PCIe.

3.1 Mini PCIe Interface

L810 Mini PCIe interface pins are defined as following:

Pin#	Name	I/O	Description
1	NC		
2	VCC	I	Power input
3	NC		
4	GND	G	GND
5	NC		
6	NC		—
7	NC	O	
8	VSIM	O	USIM Card Power Output, 1.8V/3V signal
9	GND	G	GND
10	SIMIO	I/O	USIM data signal ， 1.8V/3V signal
11	UART1_RX	I	UART1 data reception ， 3.3V signal
12	SIMCLK	O	USIM clock signal ， 1.8V/3V signal
13	UART1_TX	O	UART1 data transmission ， 3.3V signal
14	SIMRST	O	USIM reset signal ， 1.8V/3V signal
15	GND	G	GND
16	NC		—
17	WAKE#	O	For awaking AP，3.3V signal
18	GND	G	GND
19	NC		—
20	W_DISABLE	I	Low level is available，get into flight modes, 3.3V signal
21	GND	G	GND
22	RESET	I	External reset signal input, 3.3V signal
23	UART1_CTS	I	UART1 allow sending data signal input，3.3V signal
24	VCC	I	Power input

25	UART1_RTS	O	UART1 accept ready ， 3.3V signal
26	GND	G	GND
27	GND	G	GND
28	NC		—
29	GND	G	GND
30	NC		—
31	NC		
32	NC		—
33	NC		
34	GND	G	GND
35	GND	G	GND
36	USB_D-	I/O	USB signal-
37	GND	G	GND
38	USB_D+	I/O	USB signal+
39	VCC	I	Power input
40	NC		—
41	VCC	I	Power input
42	LPG	O	Network status signal output，3.3V signal
43	GND	G	GND
44	NC		
45	I2S2_CLK	O	Bit clock ， 1.8V signal
46	NC		
47	I2S2_TX	O	Serial data output ， 1.8V signal
48	NC		—
49	I2S2_RX	I	Serial data input ， 1.8V signal
50	GND	G	GND
51	I2S_WA0	O	Left and right clock (LRCK) ， 1.8V signal
52	VCC	I	Power input

3.2 Antenna Interface

There is two antenna interfaces in L810 Mini PCIe which uses HIROSE U.FL-R-SMT(01) Connector. As shown in the following figure:

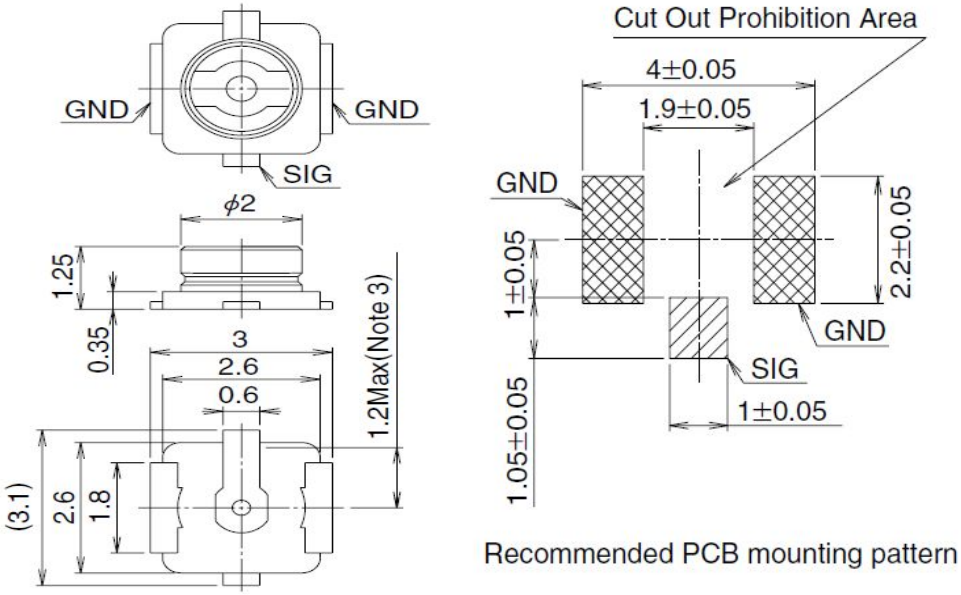

Figure 3-1 Dimension and PCB mounting pattern

The following table shows the RF working bands of L810 MiniPCIe module :

Operating Band	Description	Mode	Tx (MHz)	Rx (MHz)
Band 1	IMT 2100MHz	LTE FDD/WCDMA	1920 - 1980	2110 - 2170
Band 3	DCS 1800MHz	LTE FDD/GSM	1710 - 1785	1805 - 1880
Band 5	CLR 850MHz	LTE FDD/WCDMA/GSM	824 - 849	869 - 894
Band 7	IMT-E 2600Mhz	LTE FDD	2500 - 2570	2620 - 2690
Band 8	E-GSM 900MHz	LTE FDD/WCDMA/GSM	880 - 915	925 - 960
Band 20	EUDD 800MHz	LTE FDD	832 - 862	791 - 821
Band 34	IMT 2100MHz	TDSCDMA	2010 - 2025	
Band 38	IMT-E 2600MHz	LTE TDD	2570 - 2620	
Band 39	TDD 1900MHZ	LTE TDD/TDSCDMA	1880 - 1920	
Band 40	IMT 2300MHz	LTE TDD	2300 - 2400	
Band 41	BRS/EBS 2500MHZ	LTE TDD	2496 - 2690	

For different modes, L810 Mini PCIe module`s TX power for each band as listed below:

Mode	Band	Tx Power(dBm)	Note
GSM	GSM900	32.5	±1dBm
	DCS1800	29.5	±1dBm
WCDMA	Band 1	22.5	±1dBm
	Band 8	22.5	±1dBm
LTE FDD	Band 1	22.5	±1dBm
	Band 3	22.5	±1dBm
	Band 5	22.5	±1dBm
	Band 7	22.5	±1dBm
	Band 8	22.5	±1dBm
	Band 20	22.5	±1dBm
LTE TDD	Band 38	22.5	±1dBm
	Band 39	22.5	±1dBm
	Band 40	22.5	±1dBm
	Band 41	22.5	±1dBm
TD-SCDMA	Band 34	22.5	±1dBm
	Band 39	22.5	±1dBm

For different modes, L810 Mini PCIe module`s RX sensitivity for each band as listed below:

Mode	Band	Rx Sensitivity(dBm)	Note
GSM	GSM900	-108	BER<2.43%
	DCS1800	-108	BER<2.43%
WCDMA	Band 1	-109	BER<0.1%
	Band 8	-109	BER<0.1%
LTE FDD	Band 1	-100	10MHz Band width
	Band 3	-101	10MHz Band width
	Band 5	-102	10MHz Band width
	Band 7	-99	10MHz Band width
	Band 8	-101.5	10MHz Band width

	Band 20	-101	10MHz Band width
LTE TDD	Band 38	-100	10MHz Band width
	Band 39	-100	10MHz Band width
	Band 40	-99.5	10MHz Band width
	Band 41	-99.5	10MHz Band width
TD-SCDMA	Band 34	-109.5	BER<0.1%
	Band 39	-109.5	BER<0.1%

The above RX sensitivity values are tested in the condition of double Main+Diversity, if using the single antenna(without diversity), the sensitivity will drop about 3dbm.

4 Electrical Features

This chapter introduces the electrical features of L810 Mini PCIe.

4.1 Extreme Conditions

Parameter	Description	Minimum	Maximum	Unit
3.3VAUX	Module input voltage	0	3.6	V

4.2 Environment Temperature

Parameter	Minimum	Maximum	Unit
Operating Temperature	-30	+75	°C
Storage Temperature	-40	+85	°C

4.3 Power Sequence Requirements

4.3.1 Powered-up Time

The following figure shows the establish time of voltage when powered up:

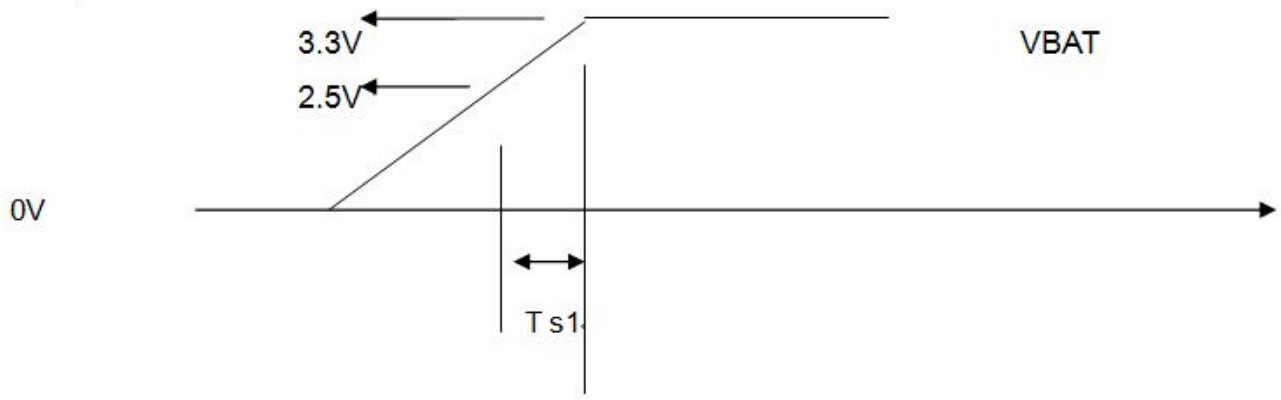

Figure 4- 1 Power on Sequence Diagram

	Description	Requirements
T s1	The time for the power voltage to change from 2.5V to 3.3V	lower than 5ms

Note: If it takes too long to rise the power voltage , the module may fail to power up.

4.3.2 Fall Time

The power voltage drops and then rise again, corresponds to the power down time of the module.

The following figure shows the time requirements:

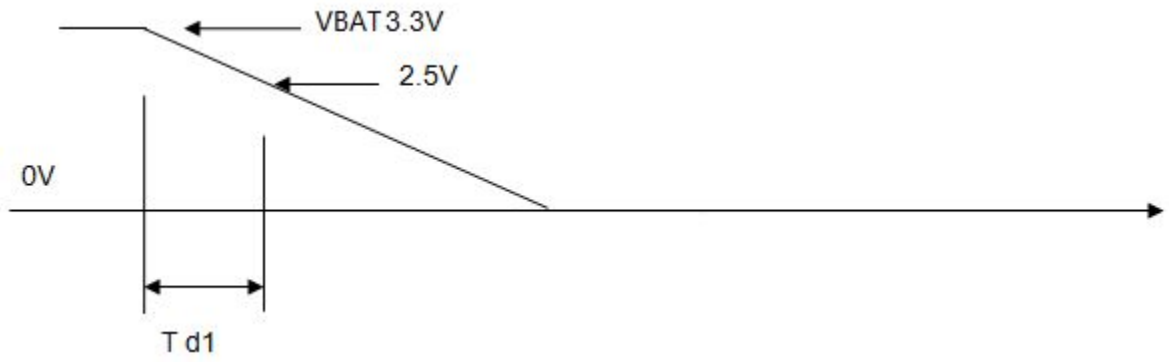

Figure 4- 2 Power off Sequence Diagram

	Description	Requirements
T d1	The time for the power voltage to change from 3.3V to 2.5V	lower than 45ms

4.4 Voltage effectiveness

3.3VAUX is the module`s power supply, meanwhile , the power supply can use for the index signal and reference level of digital signal.

The effectiveness of the reference level as listed below:

Parameters	Min	Recommended	Max	Unit
3.3VAUX	3.3-9%	3.3	3.3+9%	V
V_{IH}	2.0	3.3	3.6	V
V_{IL}	-0.5	0	0.8	V

5 Interface Application Notes

5.1 USB Interface

5.1.1 USB Interface Description

L810 Mini PCIe supports USB2.0, compatible with USB1.1, please install the USB driver before you use the USB interface.

While L810 wireless module plugged into the PC, the USB interface with the drive can map 3 COM ports and 4 NCM ports at PC end of Windows system, and for details as listed below:

Two COM ports for sending AT Commands.

One COM port for tracing LOG information.

Four NCM ports are VLAN ports, mainly used for initiating data services.

Note:The COM port can use as Modem COM port and initiate data services. But cause of the speed of Modem COM port is so slow, and cannot up to 100Mbpss, the uplink requirements of LTE. So it is not suggested. The Modem COM can be used to initiate data services temporarily only while the client`s NCM port is useless.

5.1.2 USB Interface Application

The following figure shows the reference circuit:

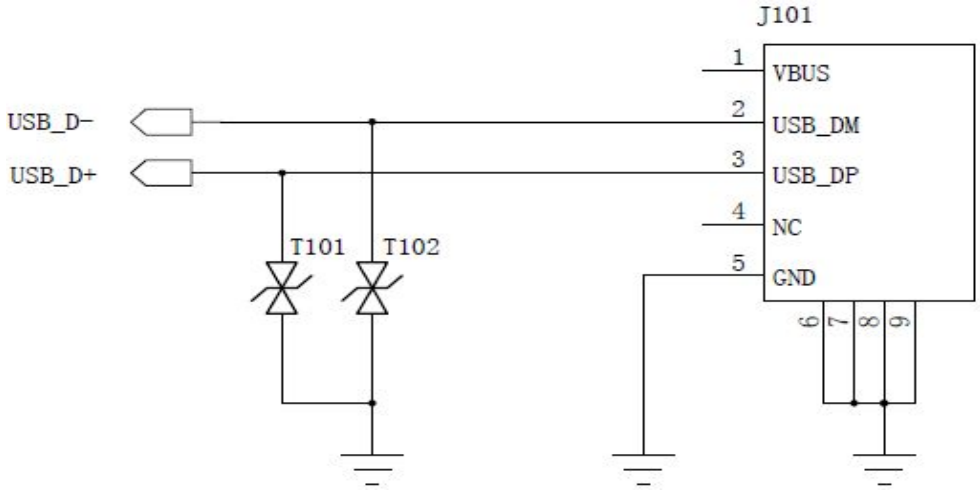

Figure 5-1 USB Interface Reference Circuit

T101 and T102 requires requires the selected capacitance values lower than 1pF following TVS diode. Recommend to use the TVS with 0.5pF.

USB_D+ and USB_D- is high-speed differential signal lines, the maximum transfer rate of 480Mbps, while PCB Layout must notice the following requirements:

USB_D+ and USB_D- signal lines require equal length and parallel. The left and right of the USB_D+

and USB_D- signal lines require good packaging with GND.

USB2.0 differential signal line fabric away from the strata nearest the signal layer.Good impedance matching, impedance requirement of 90 ohms.

5.2 USIM Interface

5.2.1 USIM Signal Pin Definition

Pin#	Name	I/O	Function Description
8	USIM_VCC	O	USIM Power Supply Signal
14	USIM_RST	O	USIM Reset Signal
12	USIM_CLK	O	USIM Clock Signal
10	USIM_IO	I/O	USIM Data Signal

5.2.2 USIM Interface Application Notes

Recommended USIM Design：

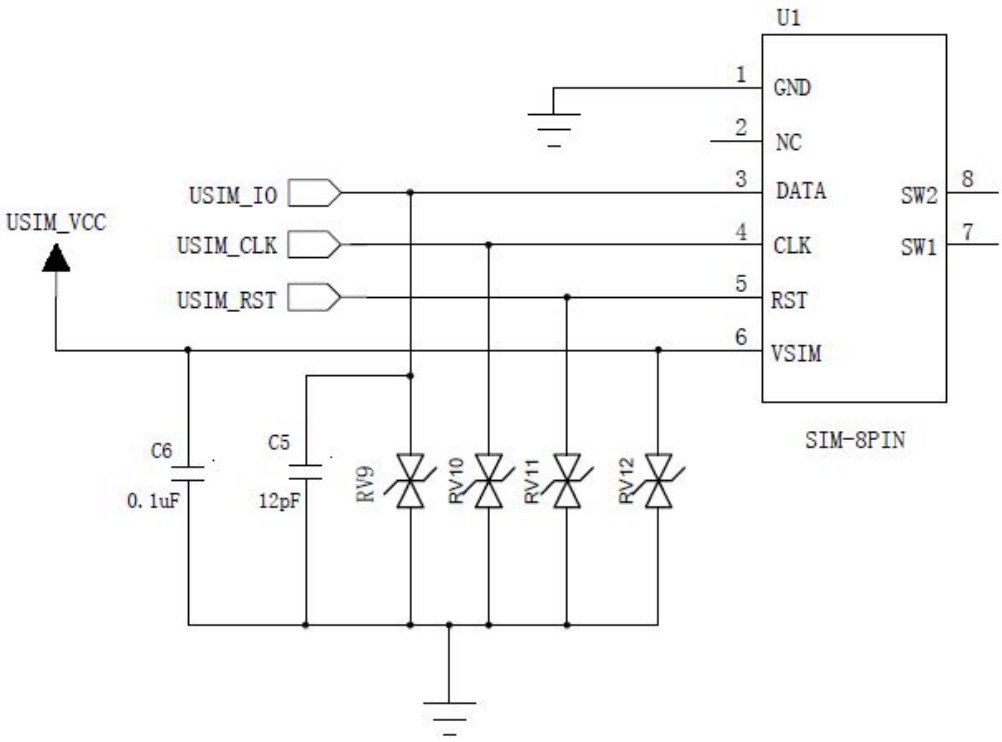

Figure 5-2 Recommended USIM Design

Note :

- To improve EMC performance, the SIM card holder should be close to the module.

- The SIM card signal filter capacitor should be close to the SIM card pin.
- SIM card signals the need to increase the ESD device (such as TVS diode) protection, ESD devices should be close to the SIM card pin placement.

5.3 Analog Audio Interface

5.3.1 Audio Interface Signals Definition

L810 Mini PCIe supports the 12S interface of digital audio, the interface supports common 12S modes and PCM mode data transmission, on average , the level of 12S interface signal is 1.8V.

The description of I2S signal as listed below:

Pin#	Name	I/O	Description
45	I2S2_CLK	O	Bit clock，1.8V signal
51	I2S2_WA0	O	Left and right clock (LRCK) ， 1.8V signal
47	I2S2_TX	O	Serial data output ， 1.8V signal
49	I2S2_RX	I	Serial data input ， 1.8V signal

5.3.2 I2S Interface

L810 Mini PCIe	Signal Direction	Audio CODEC I2S Port
I2S2_CLK0	→	I2S_CLK
I2S2_WA0	→	I2S_LRCK
I2S2_RX	←	I2S_SDOUT
I2S2_TX	→	I2S_SDIN

Note:

- I2S interfaces can be configured to master or slave modes .
- It supports various audio sample rates (48KHz, 44.1KHz, 32KHz, 24KHz, 22.5KHz, 16KHz, 12KHz, 11.025KHz, 8KHz).

5.3.3 PCM Interface

L810 Mini PCIe	Signal Direction	Audio CODEC PCM Port
I2S2_CLK0(PCM_CLK，PCM clock signal)	→	PCM_CLK（PCM clock signal）

I2S2_WA0(PCM_SYNC，PCM frame synchronization signal)	→	PCM_SYNC（PCM frame synchronization signal）
I2S2_RX(PCM_DIN，PCM data input)	←	PCM_DOUT（PCM data output）
I2S2_TX(PCM_DOUT，PCM data output)	→	PCM_DIN（PCM data input）

Note:

- PCM interfaces can be configured to master or slave modes.
- Supports short frame synchronization under16 bit, 32bit, 48bit and 64bit modes.
- Supports sending data in burst modes and continuous modes.
- Supports clock length of frame synchronization signal and rising edge/ falling edge trigger configuration of data transmission.
- Supports various audio sample rates(48KHz,44.1KHz,32KHz,24KHz,22.5KHz,16KHz,12KHz, 11.025KHz, 8KHz).

Note: Cause the timing of I2S modes is easier than PCM modes and easier to fit, recommend clients to use transmission audio of I2S mode. While transmission with PCM modes, the PCM timing sequence is difficult to fit to make the tone quality become bad.

5.4 UART Interface

5.4.1 UART Interface Pin Definition

L810 Mini PCIe supports a 4-wire UART , and the UART1 supports the AT commands, users can send and receive AT commands through UART1.

UART1 interface			
Pin#	**Pin Name**	**I/O**	**Description**
23	UART1_CTS	I	UART1 allow sending，3.3V signal
25	UART1_RTS	O	UART1 receive ready，3.3V signal
13	UART1_TXD	O	UART1 transmit data，3.3V signal
11	UART1_RXD	I	UART1 receive data，3.3V signal

5.4.2 UART Interface Application

While L810 Mini PCIe（DCE）UART1 connect with PC,the signal direction as listed below:

Applied MCU(DTE)	**Signal Direction**	**L810 Mini PCIe module (DCE)**
RXD	←	UART1_TXD
TXD	→	UART1_RXD

Note : the high level of the UART interface of L810 Mini PCIe wireless module is 3.3V.

5.4.3 WAKE_HOST

WAKEUPHOST signal uses for waking up the HOST while indicating the phone calling, SMS and other data request. The PIN definition of WAKE_HOST signal as listed below：

Pin#	Pin Name	I/O	Description
17	WAKEUP_HOST	O	The module wakes up Host（MCU），3.3V signal

The function definition of WAKE_HOST signal as listed below ：

Modes	Status
No ringing	High level
Ringing	1s low level，1s high level, cycling
No message	High level
Incoming message	1s low level，1s high level, cycling

5.5 RESET Signal

L810 Mini PCIe supports external reset; it can restore the module to default settings through Reset signal. The definition of RESET pins as listed below:

Pin#	Pin Name	I/O	Description
22	PERST#	I	External reset signal input, low level is available, 3.3V signal

When Reset signal is Active Low by 100ms, the module will reset. When users reset the module, PMU inside the module is still on. If the module is connected to PC, you can see PC Virtual port restarts.

Note: Reset signal is sensitive; please stay away from radio frequency interference when PCB layout, add debounce capacitor near the module end is recommended.

The following table shows the burst timing:

Parameter	Condition	Minimum Value	Typical Value	Maximum Value	Unit
Pulse Width		7	100	1000	ms

Recommended design :

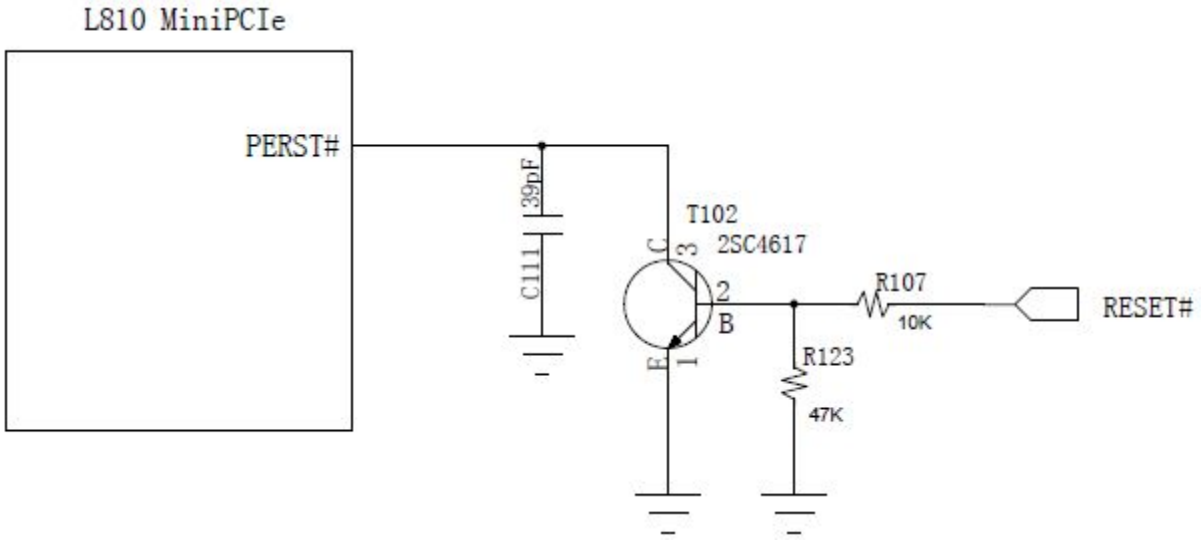

Figure 5- 3 Reset Recommended Design

5.6 LPG Signal

The PIN definition of LPG signal as listed below:

Pin#	Pin Name	I/O	Description
42	LED_WWAN#	O	LPG index，3.3V signal

The description of LPG signal as listed below:

Status	Mode
idle(unregistered)	600ms high level, 600ms low level
idle(registered)	75ms high level, 3S low level
Calling	low level
Data communicating	75ms high level, 75ms low level
Sleep(sleep mode)	high level

5.7 W_DISABLE signal

L810 MiniPCIe module provides the hardware on/off WWAN RF signal，this function can also controlled by AT commands, close the RF function, the module will get into flight mode,.

The PIN definition of W_DISABLE signal as listed below :

Pin#	Pin Name	I/O	Description
20	W_DISABLE#	I	打开关闭飞行模式，3.3V 信号

The function definition of W_DISABLE signal as listed below:

No.	W_DISABLE Signal	Working Modes
1	Low	WWAN closed，the module get into Flight mode
2	High	WWAN open，the module exit the Flight mode
3	Floating	The WWAN function is defined by soft AT commands, and keep open by default.

6 Mechanical Design

6.1 Dimensions

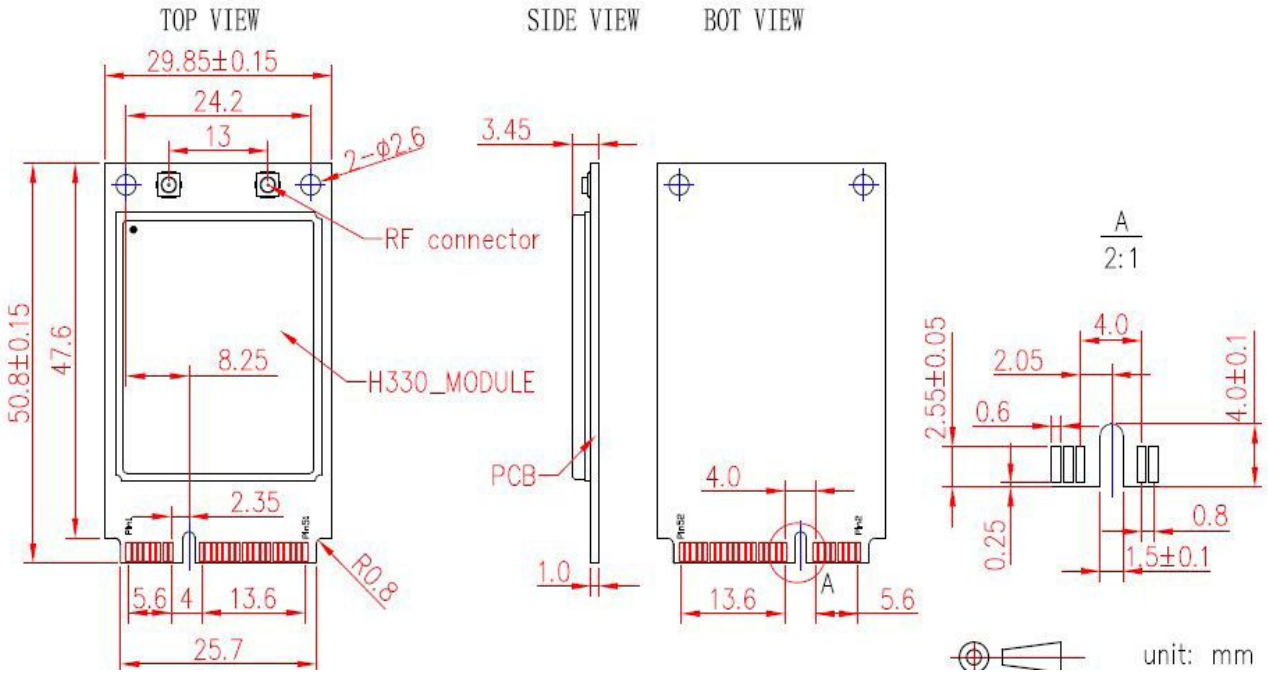

Figure 6- 1 L810-Mini PCIe-10

Please refer to Molex's Mini PCI Express connector, Model No.: MPC24-52K3311. As shown in the following figure:

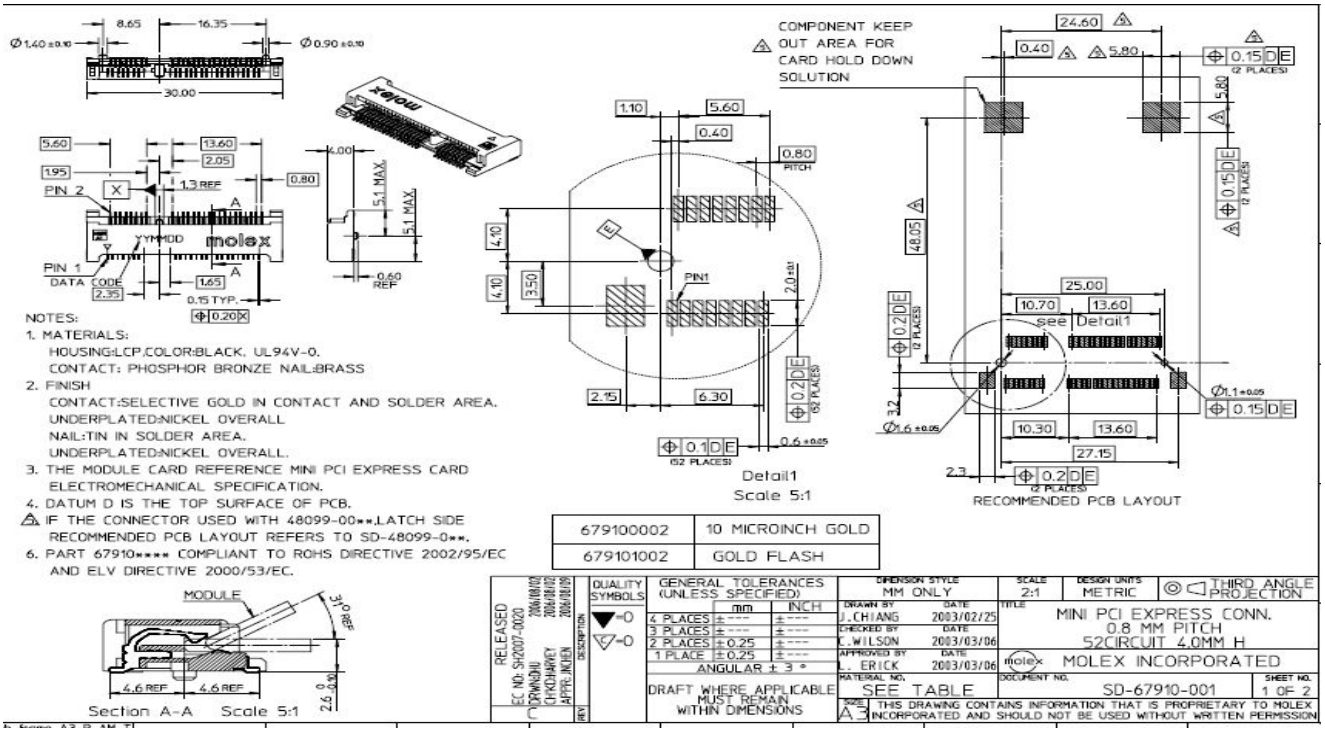

Figure 6- 2 MPC24-52K3311 Connector