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L810-MiniPCIe

Hardware User Manual

Version: 2.0.0

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Applicability Table

No.	Product model	Description
1	L810-GL-MiniPCIe	NA

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Version Record

Version	Update Date	Description
V1.0.0	2015-02-12	Initial Version
V1.0.1	2015-05-08	Update the structure chart to make the logo for the module location hole become much clearer ; Update SIM name in pin definition
V1.0.2	2015-08-25	Update the company logo
V2.0.0	2015-10-31	Adjust document content and format

Contents

1 Foreword

1.1 Introduction

The document describes the electrical characteristics, RF performance, dimensions and application environment, etc. of L810-MiniPCIe. With the assistance of the document and other instructions, developers can quickly understand the performance of L810-MiniPCIe and develop products.

1.2 Reference Standard

The design of the product complies with the following standards:

Mini PCI Express Card Electromechanical Specification Revision 1.0-2003

1.3 Reference Document

- L810 Module Hardware User Manual
- L810 Module Performance Testing Report
- Guidance for L8-Family System Drive Program
- RF Antenna Application Design Description
- EVK-GT8230 User Manual

2 Interface Description

The chapter gives a detailed introduction of the functional interface and antenna interface of L810-MiniPCIe.

2.1 Mini PCIe Interface

Except for 4 digital voice pins, L810-MiniPCIe module applies standard Mini PCIe interface. And the pin definition is as follows:

Pin	Pin name	I/O	Reset Value	Pin description	Type
Power input					
2	3.3VAUX	PI	-	3.3V input power	Power supply
24	3.3VAUX	PI	-	3.3V input power	Power supply
39	3.3VAUX	PI	-	3.3V input power	Power supply
41	3.3VAUX	PI	-	3.3V input power	Power supply
52	3.3VAUX	PI	-	3.3V input power	Power supply
4	GND	-	-	Ground	Power supply
9	GND	-	-	Ground	Power supply
15	GND	-	-	Ground	Power supply
18	GND	-	-	Ground	Power supply
21	GND	-	-	Ground	Power supply
26	GND	-	-	Ground	Power supply
27	GND	-	-	Ground	Power supply
29	GND	-	-	Ground	Power supply
34	GND	-	-	Ground	Power supply
35	GND	-	-	Ground	Power supply
37	GND	-	-	Ground	Power supply
43	GND	-	-	Ground	Power supply
50	GND	-	-	Ground	Power supply
SIM card interface					

Pin	Pin name	I/O	Reset Value	Pin description	Type
8	USIM_VCC	PO	-	Power supply for external USIM card	1.8V/3V
10	USIM_IO	I/O	L	USIM data signal	1.8V/3V
12	USIM_CLK	O	L	USIM clock signal	1.8V/3V
14	USIM_RST	O	L	USIM reset signal	1.8V/3V
USB					
36	USB_D-	I/O	T	USB D- signal	0.3---3V
38	USB_D+	I/O	T	USB D+ signal	0.3---3V
Other functions					
20	W_DISABLE	I	PU	Low effective, and enters Flight mode	3.3V
42	LPG	O	PU	Network status indicator, output signal	3.3V
17	WAKE_HOST	O	PU	Wake up host	3.3V
RESET					
22	PERST#	I	PU	External reset signal	3.3V
Digital voice					
45	I2S2_CLK	O	PD	I2S clock	CMOS 1.8V
47	I2S2_TX	O	PD	I2S data transmit	CMOS 1.8V
49	I2S2_RX	I	PD	I2S data receive	CMOS 1.8V
51	I2S_WA0	O	PD	I2S left and right channel clock (LRCK)	CMOS 1.8V
Serial port					
11	UART1_RX	I	PU	UART1 data receive signal	3.3V
13	UART1_TX	O	PU	UART1 data transmit signal	3.3V
23	UART1_CTS	I	PU	UART1 clear to send signal	3.3V
25	UART1_RTS	O	PU	UART1 request to send signal	3.3V
NC					
1		-			
3		-			
5		-			
6		-			

Pin	Pin name	I/O	Reset Value	Pin description	Type
7		-			
16		-			
19		-			
28		-			
30		-			
31		-			
32		-			
33		-			
40		-			
44		-			
46		-			
48		-			

PI: Power Input

H: High Voltage Level

L: Low Voltage Level

PD: Pull-Down

PU: Pull-Up

T: Tristate

OD: Open Drain

PP: Push-Pull

Note:

The unused pins can be left floating in case of circuit design.

2.2 Antenna Interface

L810-MiniPCIe antenna adopts 50 ohm RF interface and supports main and diversity antennas. It adopts HIROSE U.FL-R-SMT(01) antenna connector.

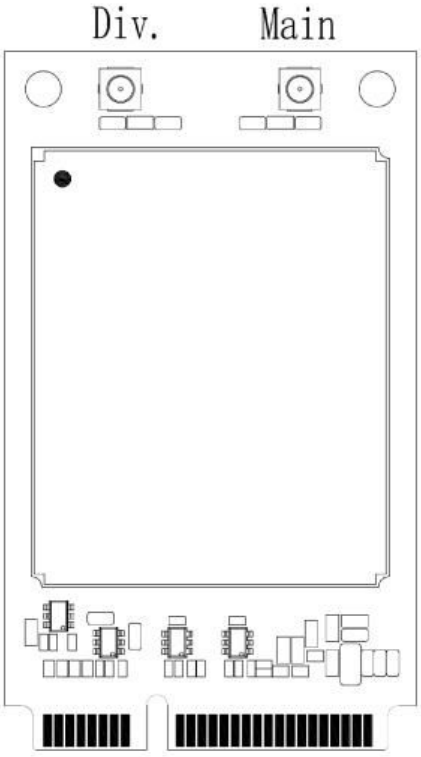


Figure2-1 Antenna Interface

Please refer to the following website for more information about RF connector:

http://www.hirose-connectors.com/

3 Power Supply

The circuit and PCB layout design for power supply are very important to the whole product, and the design shall be conducted in accordance with the recommended design requirements.

3.1 Power Supply Requirements

The 3.3VAUX power supply for the module should meet the requirement as follows:

Parameter	Minimum value	Typical value	Maximum value	Unit
Operating Voltage Range	3.0	3.3	3.6	V

Note:

The Operating Voltage Range MUST never be exceeded. If the power source is under the minimum value, the module will shutdown automatically; and may cause permanent hardware failure if it goes above 3.6V.

3.2 Power Supply Timing Requirement

3.2.1 Rising Time

As for the power supply to the module, the rising time for voltage after powering on is described in Figure 3-1:

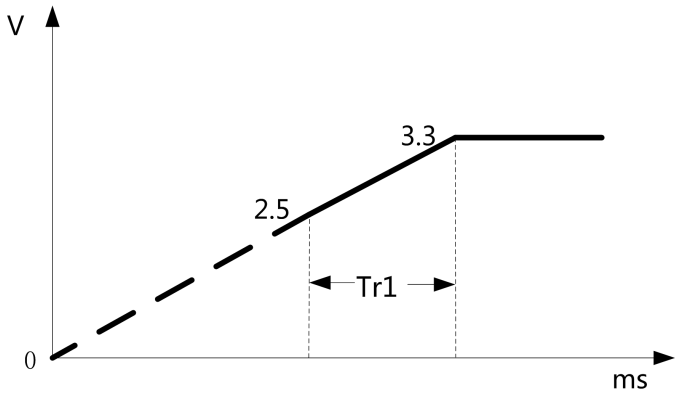


Figure3-1 Rising Time for Power Supply

	Timing description	Requirement
Tr1	Rising time from 2.5V to 3.3V	less than 5 ms

Note:

If the Tr1 is over spec., it will affect the module when starting up.

During the process of starting-up, PERST# shall keep high.

3.2.2 Falling Time

As for the power supply to the module, before the supply voltage rises again, the falling time for the power supply is shown in Figure 3-2:

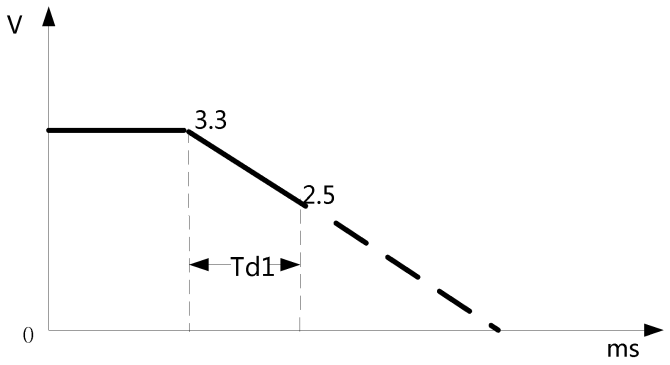


Figure 3-2 Falling Time for Power Supply

	Timing description	Requirement
Td1	Falling time from 3.3V to 2.5V	less than 45 ms

Note:

If the Td1 is over spec., it will affect the module next time when it starts up.

3.3 Logic Level

3.3VAUX is the power supply for the module, and it is the reference voltage level for indicating signals and digital signals.

The effective voltage ranges listed in the following tables:

Parameter	Minimum value	Recommended value	Maximum value	Unit
3.3VAUX	3.0	3.3	3.6	V
VIH	2.1	3.3	3.6	V
VIL	-0.5	0	0.8	V

3.4 Power Supply Filtering

Filter capacitor for the supply circuit of 3.3VAUX can be designed as follows:

Recommended capacitance	Application	Description
330uF	Capacitor for power supply	To reduce the power supply fluctuation during call
1uF,100nF	Digital signal noise	To filter out the interference from clock and digital signals
39pF,33pF	700MHz, 850/900MHz frequency band	To filter out the radio-frequency interference
18pF,8.2pF, 6.8pF	1700/1800/1900MHz, 2100/2300MHz, 2500/2600MHz frequency band	To filter out the radio-frequency interference

3.5 Power Consumption

Please refer to the Module's Hardware User Guide for the details.

GSM system adopts non-continuous emission method, which is 217Hz bursts and the maximum current will reach 2A. In case of circuit design, the power drop should be considered and withstand the maximum 2A current. In case of PCB design, the width of the power traces must be sufficient to support the maximum current. If the design requirements are not followed, the module might shutdown while it is working.

4 Radio Frequency

4.1 Frequency Band Partition

L810-MiniPCIe provides two radio frequency connectors for the master and diversity respectively, and the master is used to receive and transmit RF signal, and the diversity is used to receive the RF signal.

Antenna operating bands are listed in the following tables:

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	

4.2 Requirements for Antenna

Connection and design for antenna are very important to product, and the module provides two antenna connectors:

- Main antenna
- Diversity antenna

Main antenna requirements for L810-MiniPCIe	
Frequency range	The most proper antenna to adapt the frequencies should be used.
Bandwidth (GSM/EDGE)	GSM900: 80 MHz GSM1800(DCS): 170 MHz
Bandwidth (WCDMA)	WCDMA band 1(2100): 250 MHz WCDMA band 8(900): 80 MHz
Bandwidth (LTE)	LTE band 1(2100): 250 MHz LTE Band 3(1800): 170 MHz LTE band 5(850): 70 MHz LTE band 7(2600): 190 MHz LTE Band 8(900): 80 MHz LTE band 20(800): 71 MHz LTE band 38(2600): 50 MHz LTE Band 39(1900): 40 MHz LTE band 40(2300): 100 MHz LTE band 41(2500): 194 MHz
Bandwidth (TD-SCDMA)	TD-SCDMA A(2100):15 MHz TD-SCDMA F(1900):40MHz
Impedance	50Ohm
Input power	> 33dBm(2 W) peak power GSM > 23dBm average power WCDMA & LTE &TD-SCDMA
Recommended standing-wave ratio	≤ 2:1

The RF traces must have 50 Ohm impedance. If the impedance is not matched, the RF performance will reduce.

5 Interface Application

5.1 USB Interface

5.1.1 USB Interface Description

Pin	Pin name	I/O	Pin description	Voltage range
36	USB_D-	I/O	USB D- signal	0.3---3V
38	USB_D+	I/O	USB D+ signal	0.3---3V

L810-MiniPCIe supports USB 2.0 and is compatible with USB1.1. The corresponding USB driver shall be installed according to the Windows system before it can be used in PC.

After L810-MiniPCIe is inserted into PC, the USB driver will map 3 COM ports and 3 NCM ports on the Windows system, which are shown as follows:

- Two COM ports can be used to send AT Commands
- One COM port can be used to capture LOG information for debugging software
- Three NCM ports are virtual network ports, which can be used to initiate the data service

Note:

One COM port can be used for Modem COM port to initiate the data service. Since the speed of Modem COM port is not sufficient for the 150Mbps downlink speed requirement for LTE, so it's not recommended to be used. Modem COM port can only be used to initiate data service in the case that NCM port can't be used.

5.1.2 USB Interface Application

Reference circuit diagram is shown in Figure 5-1:

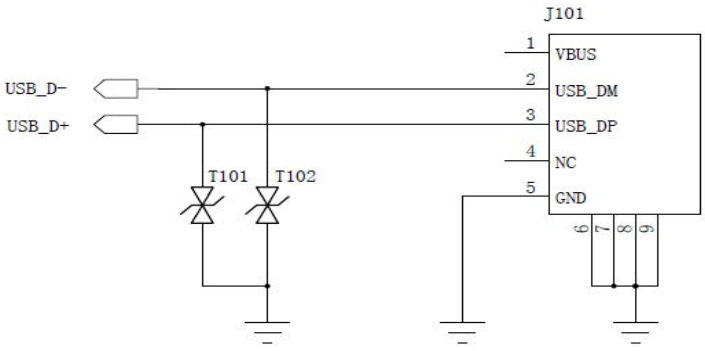


Figure 5-1 Reference Circuit Diagram for USB Interface

For T101 and T102, it is required to use 1pF TVS diodes or any with lower capacitance, it is recommended to use 0.5pF TVS diodes. USB_D+ and USB_D- are high speed differential signal lines, and the maximum transfer rate is 480Mbps, the following shall be noted in the case of PCB Layout:

- USB_D+ and USB_D- signal lines should have the equal length and should be parallel, and right angle wiring should be avoid.
- USB_D+ and USB_D- signal lines should be wrapped with GND at the ends.
- USB 2.0 differential signal lines should be routed on the layer that is next to the ground layer.
- The impedance of differential lines should be 90 Ohm.

5.2 USIM Interface

5.2.1 Signal Description for USIM Card

Pin	Pin name	I/O	Pin description	Voltage
8	USIM_VCC	O	Power supply for external USIM card	1.8V/3V
10	USIM_IO	I/O	USIM data signal	1.8V/3V
12	USIM_CLK	O	USIM clock signal	1.8V/3V
14	USIM_RST	O	USIM reset signal	1.8V/3V

5.2.2 USIM Interface Application Description

Recommended circuit diagram for USIM is shown in Figure 5-2:

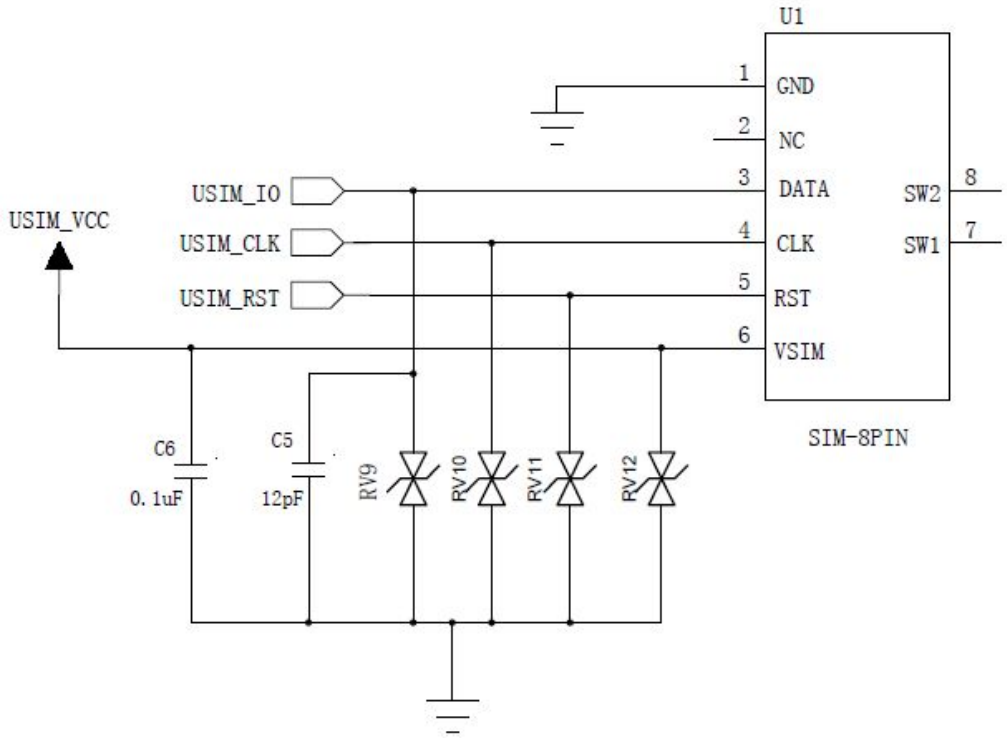


Figure 5-2 Recommended USIM Circuit Diagram

Note:

In order to improve the EMC performance, the SIM card slot should be placed close to the module. The filter capacitors on the signal lines should be placed close to SIM card pins. The ESD device (e.g. TVS diodes) shall be added close to the SIM card pins for ESD protection. The capacitance for ESD devices should be lower than 33pF.

5.3 Digital Audio Interface

5.3.1 Audio Interface

L810-MiniPCIe supports I2S digital audio interface, and it supports the ordinary I2S mode and PCM mode.

The signal level of the I2S interfaces is 1.8V.

Description for I2S signals is as follows:

Pin	Pin name	I/O	Pin description	Voltage
45	I2S2_CLK	O	I2S clock	CMOS 1.8V
47	I2S2_TX	O	I2S data transmit	CMOS 1.8V
49	I2S2_RX	I	I2S data receive	CMOS 1.8V
51	I2S_WA0	O	I2S left and right channel clock (LRCK)	CMOS 1.8V

5.3.2 I2S Application Description

L810-MiniPCIe	Signal direction	Audio CODEC I2S Port
I2S2_CLK	→	I2S_CLK
I2S2_TX	→	I2S_SDIN
I2S2_RX	←	I2S_SDOUT
I2S2_WA0	→	I2S_LRCK

Description:

- I2S interface can be configured as master or slave mode.
- It supports multiple audio sampling rates (44.1KHz, 32KHz, 24KHz, 16KHz, 8KHz).

5.3.3 Application Description for PCM Mode

L810-MiniPCIe	Signal flow direction	Audio CODEC PCM Port
I2S2_CLK(PCM_CLK, PCM clock signal)	→	PCM_CLK (PCM clock signal)
I2S2_TX(PCM_DOUT, PCM data output)	→	PCM_DIN (PCM data input)
I2S2_RX(PCM_DIN, PCM data input)	←	PCM_DOUT (PCM data output)
I2S2_WA0(PCM_SYNC, PCM frame sync signal)	→	PCM_SYNC (PCM frame sync signal)

Description:

- PCM mode interface can be configured as master or slave mode.
- It supports short frame sync for 16, 32, 48, and 64 bit mode.
- It supports burst and continuous transmission modes.
- It supports clock length trigger for frame sync signal and rising/falling edge trigger for data transmission.
- It supports various audio sampling rates (48KHz, 44.1KHz, 32KHz, 24KHz, 22.5KHz, 16KHz, 12KHz, 11.025KHz and 8KHz).

Note:

Because of the timing of I2S mode is simpler than PCM mode, it is recommended to use I2S mode for audio transmission. For PCM mode, the audio quality issues caused by the PCM timing adjusting must be avoided.

5.4 UART Interface

5.4.1 UART Interface Description

L810-MiniPCIe provides one four-line UART, and the user can receive and send AT command through UART1 and auto baud rate is supported.

Pin	Pin name	I/O	Pin description	Voltage
11	UART1_RX	I	UART1 data receive signal	3.3V
13	UART1_TX	O	UART1 data transmit signal	3.3V
23	UART1_CTS	I	UART1 clear to send signal	3.3V
25	UART1_RTS	O	UART1 request to send signal	3.3V

5.4.2 UART Interface Application

Uart Rx/Tx signal direction shows in the following tables::

MCU(DTE)	Signal flow direction	L810-MiniPCIe module (DCE)
RXD	←	UART1_TXD
TXD	→	UART1_RXD

Note:

The voltage level for L810-MiniPCIe UART is 3.3V, and voltage matching should be handled when connecting to DTE.

5.4.3 WAKE_HOST

WAKE_HOST signal is used to wake the host and indicate the incoming call and SMS or other data request. Description for WAKE_HOST signal is as follows:

Pin	Pin name	I/O	Pin description	Voltage
17	WAKE_HOST	O	Wake up the host.	3.3V

Function definition for WAKE_HOST signal is as follows:

Operating mode	Status
Non-ringing	High level
Ringing	1s low level, then change to high level (pulse signal)
No SMS	High level
Incoming SMS	1s low level, then change to high level (pulse signal)

5.5 Reset signal

L810-MiniPCIe supports external reset function, and the module can be reset to the initial status through PERST# signal. Description for PERST# signal is as follows:

Pin	Pin name	I/O	Pin description	Voltage
22	PERST#	I	External reset signal	3.3V

When PERST# signal keeps low for 100ms, the module will be reset. When MCU executes the reset function, the PMU remains its power inside the module. If the module is connected to the PC port, the virtual ports of PC will be restarted.

Note:

PERST# signal is a sensitive signal line, in the case of PCB Layout, RF interference shall be kept away and grounding shall be processed properly. It's recommended to add a filter capacitor nearby the module.

Requirements for PERST# pulse width are as follows:

Parameter	Minimum value	Typical value	Maximum value	Unit
Pulse width	7	100	1000	ms

The recommended design is shown in Figure 5-3:

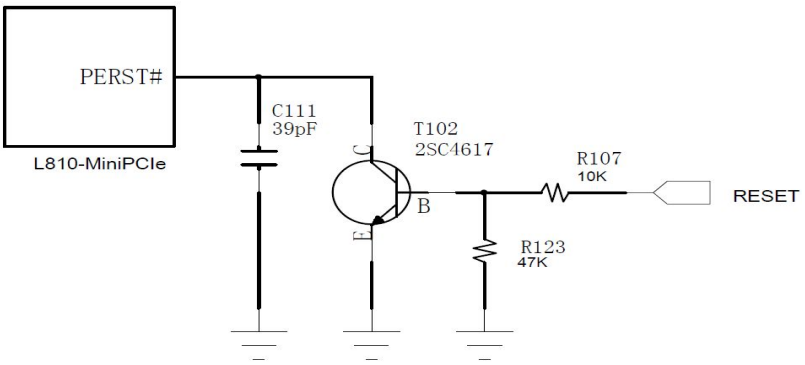


Figure 5-3 Recommended Design for RESET

5.6 LPG Signal

Description for LPG signal is as follows:

Pin	Pin name	I/O	Pin description	Voltage
42	LPG	O	Output signal for network status.	3.3V

Operating mode for LPG signal is as follows:

Status	Operating mode
Idle (unregistered)	Pulses with 600ms high then 600ms low.
Idle (registered)	Pulses with 75ms high then 3s low.
In voice call	Low level
In data transmission	Pulses with 75ms high then 75ms low.
Sleep (sleep mode)	High level

LPG timing is shown in Figure 5-4:

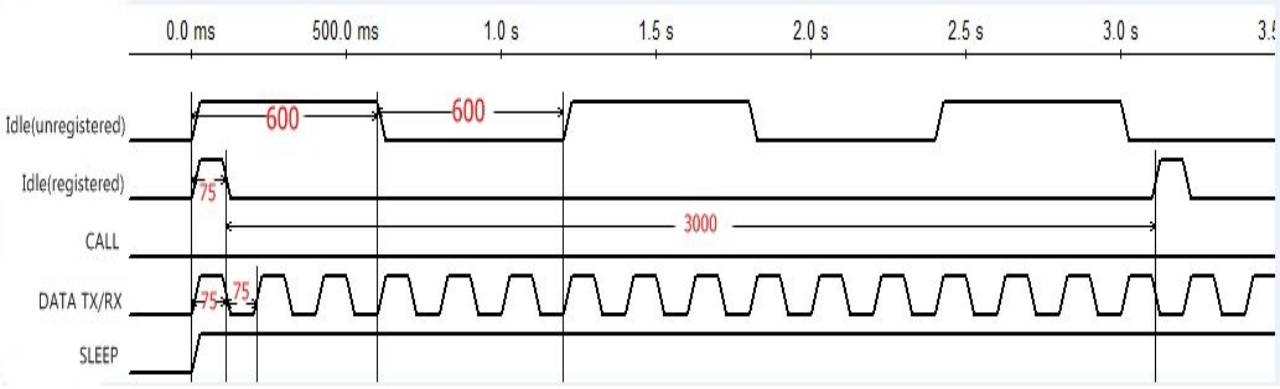


Figure 5-4 Time Sequence for LPG Signal

5.7 W_DISABLE Signal

L810-MiniPCIe provides a hardware pin to enable/disable WWAN RF functional, and the function can also be controlled by the AT command. The module enters Flight mode after RF function is disabled.

Description for W_DISABLE signal is as follows:

Pin	Pin name	I/O	Pin description	Voltage
20	W_DISABLE	I	Low active, the module enters the Flight mode	3.3V

Function definition for W_DISABLE signal is as follows:

W_DISABLE signal	Operating mode
Low	WWAN function is disabled, the module enters Flight mode
High	WWAN function is enabled, the module exits from the Flight mode
Floating	WWAN function is defined by the AT command, and it is enabled by default

6 Product Structure

6.1 Boundary Dimension

Structure size for L810-MiniPCIe is shown in Figure 6-1：

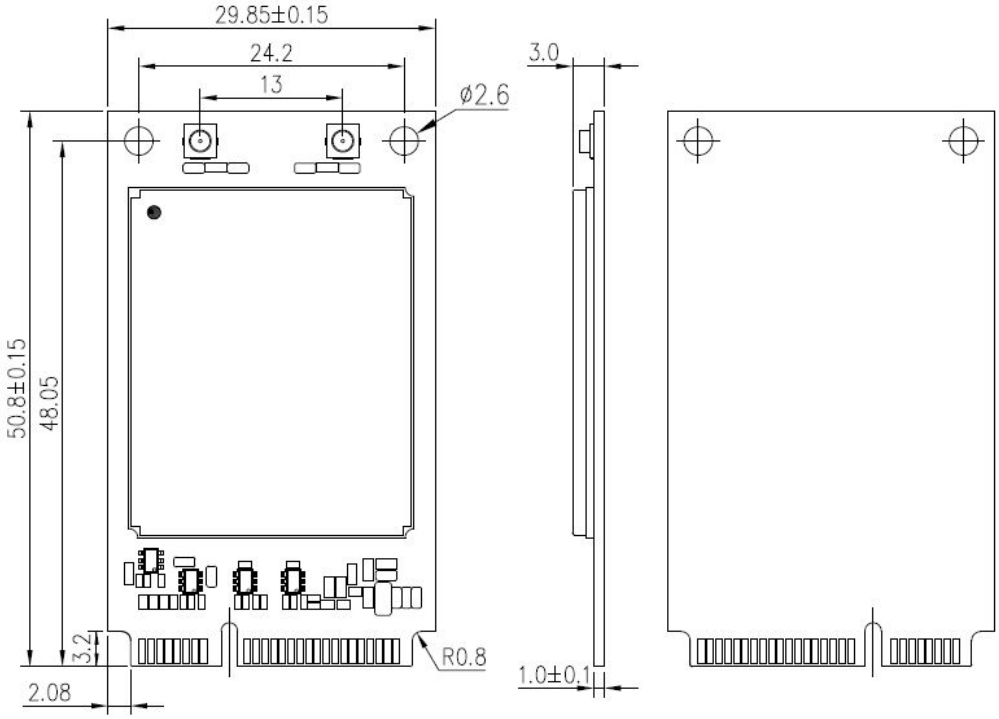


Figure 6-1 Boundary Dimension for L810-MiniPCIe

Note:

MiniPCIe connector applies 67910-0002 of molex, please refer to http://www.molex.com for specifications.

6.2 Product Weight

Weight for L810-MiniPCIe is about 9 grams.

6.3 Environmental Temperature

Parameter	Minimum value	Maximum value	Unit
Storage temperature	-40	+85	°C

7 Product Packaging

7.1 Palletizing process is shown in Figure 7-1：

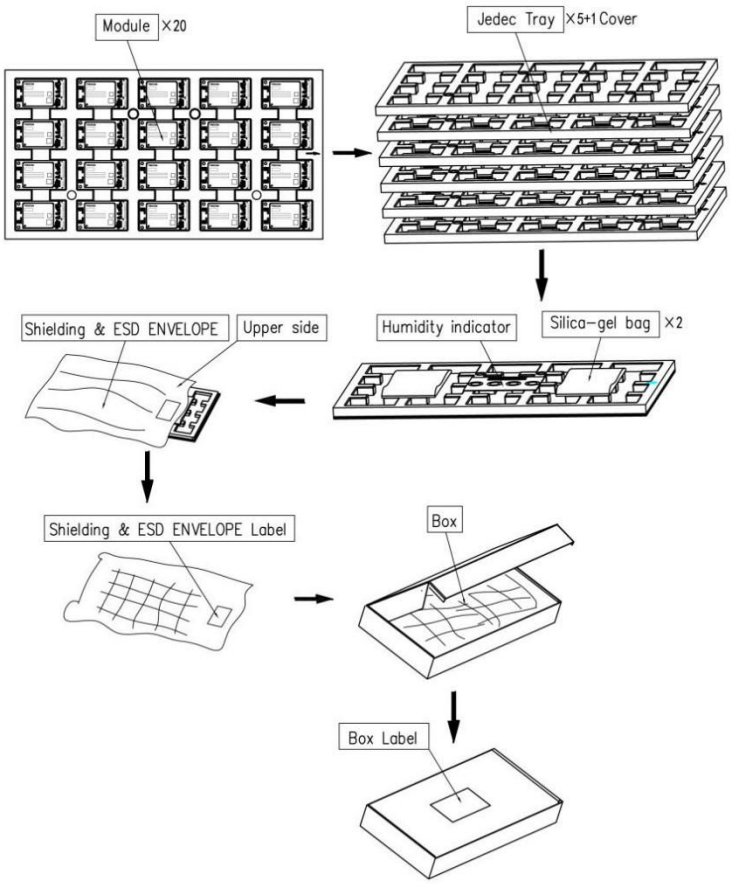
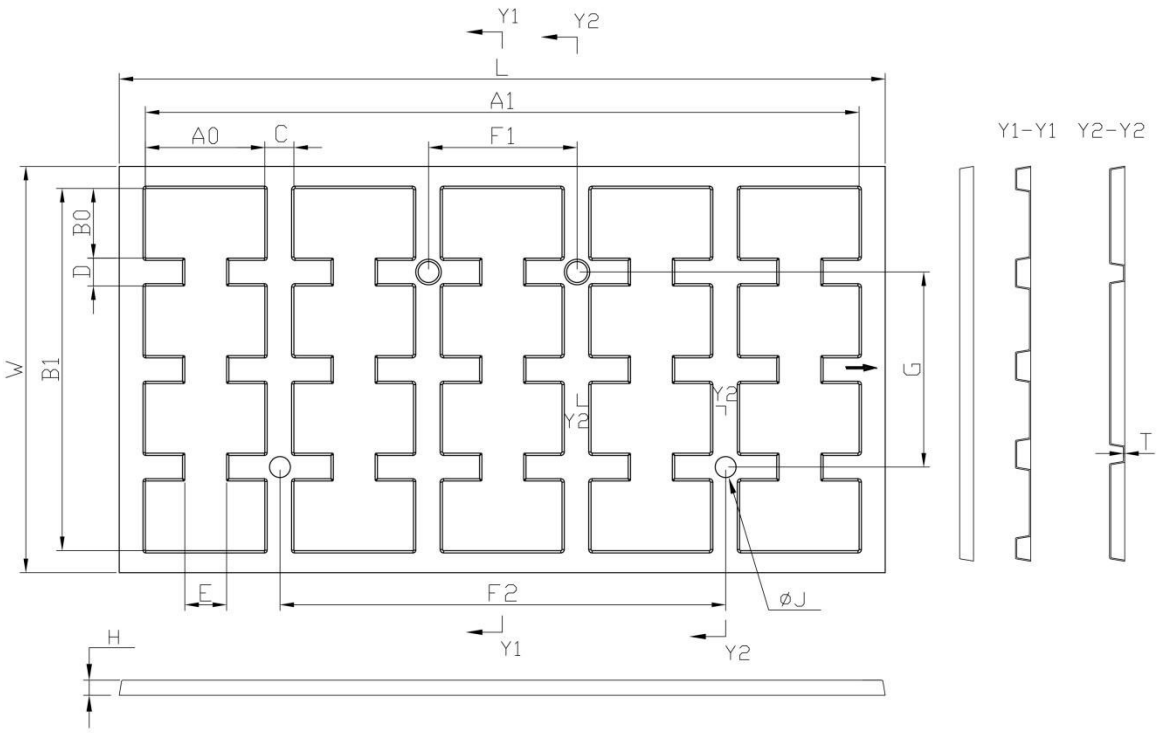


Figure 7-1 Palletizing Process

7.2 Pallet size

The pallet size is 260*175*6.5mm. 20pcs are packed in each pallet, with 5 pallets in each box and 6 boxes in each case; please refer to Figure 7-2:



ITEM	L	W	H	T	A0	B0
DIM	330.0±0.5	175.0±0.5	9.5±0.3	0.5±0.1	51.5±0.3	30.5±0.3
ITEM	A1	B1	C	D	E	F1
DIM	307.5±0.5	156.0±0.5	12.5±0.3	12.0±0.3	18.0±0.3	64.0±0.2
ITEM	**F2**	**G**	**J**			
DIM	192.0±0.2	84.0±0.2	9.0±0.2			

Figure 7-2 Pallet Size (Unit: mm)