Title:

PCI Express Half mini card WLAN module

SX-PCEAC-DB

Drawing Type :	User's manual
Date :	March 18, 2016

Revision History

Rev.	Description	Date	Prepared	Checked	Approved
1	The first edition.	Mar. 18, 16	K. Yoshikawa	Y. Shibuya	T. Kometani

Date : March 18, 2016

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Table of Contents

1. Introduction

This document describes about hardware specifications of "SX-PCEAC-DB".

2. Overview

SX-PCEAC-DB is the radio module which supports Dual Band IEEE802.11ac/a/b/g/n and PCI express 1.1. This module complies with EU RoHS Directive 2011/65/EC(Lead Free). This module is made up of an Chipset QCA9880-BR4A (Qualcomm Atheros) which contains a MAC/BBP, 2.4GHz RF front end circuits and a 5GHz RF front end module AWL9581(Anadigics). Also this module supports high speed 3x3 SU-MIMO and 80MHz bandwidth.

Features

❑ IEEE 802.11ac/a/b/g/n conformity (2.4GHz & 5GHz)

❑ Supports the 3 streams 3 x 3 SU-MIMO system and 80MHz band width for 5GHz.
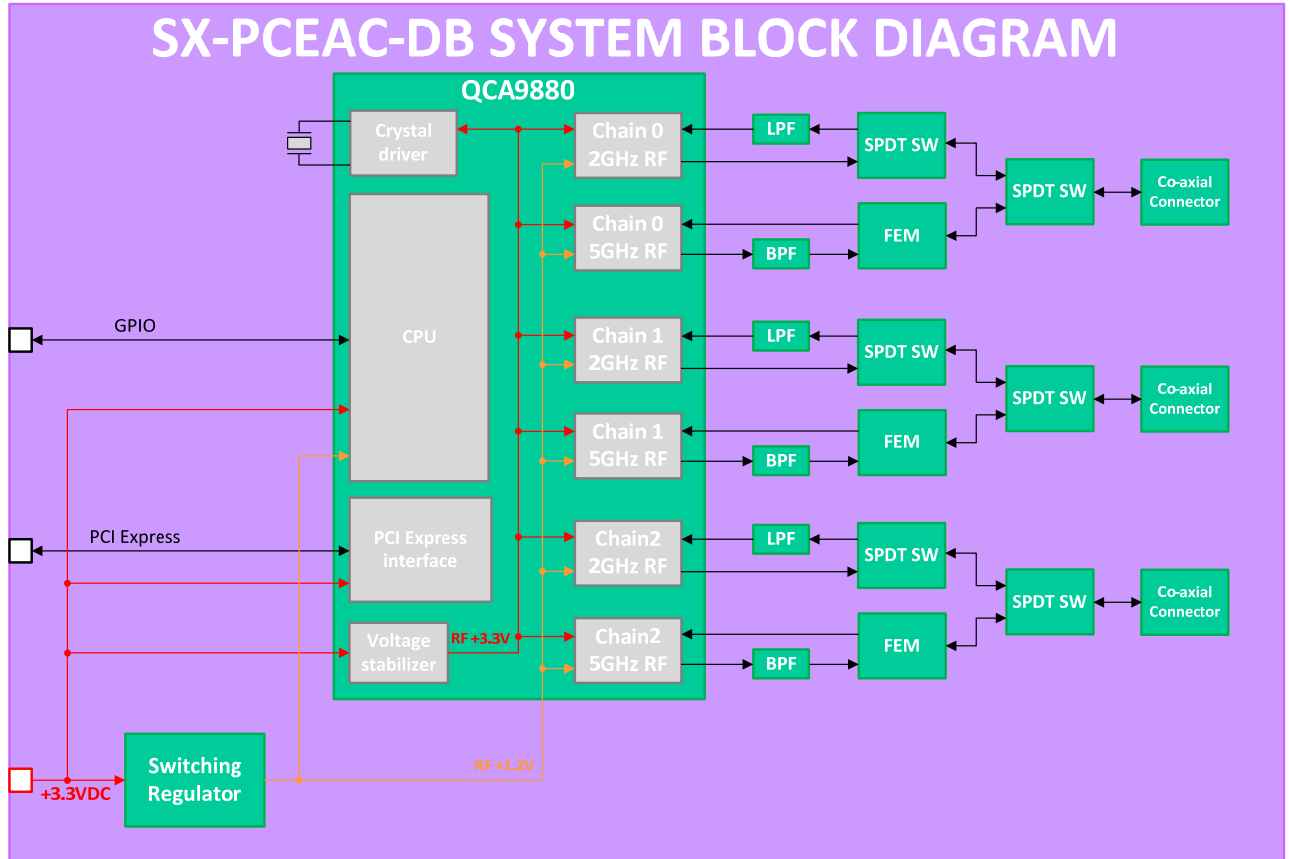   (Throughput up to 1300Mbps)

❑ Data rates of 1 – 54 Mbps for 802.11b/g, 6 – 54 Mbps for 802.11a, MCS0-7 for 802.11n and MCS0-9 for 802.11ac.

❑ Supports IEEE802.11e, IEEE 802.11h and IEEE 802.11i.

❑ Supports PCI express 1.1 as the host IF of wireless LAN

* Not supported MU-MIMO and 160MHz bandwidth.

3. Hardware system block diagram

SX-PCEAC-DB SYSTEM BLOCK DIAGRAM

①	QCA9880	Wireless Lan base band IC. Generates base band signal.
②	Low pass filter	Cuts off signal above 2.5GHz.
③	Band pass filter	Cuts off signal under 5GHz and above 6GHz.
④	Single pole double throw switch	Switches Tx and Rx of 2.4GHz.
⑤	Fron end module	Integrates a 5GHz power amplifier, a 5GHz low noise and Tx/Rx select swtich.
⑥	Single pole double throw switch	Switches 2.4GHz and 5GHz.
⑦	Co-axial connector NOTE1	Antenna port. MHF4 type.
⑧	Crystal driver	Generates 40MHz system clock.
⑨	Voltage stabilizer NOTE2	Stabilize +3.3VDC for RF.
⑩	Switching regulator NOTE2	Coverts +3.3VDC to +1.2VDC.

NOTE1
Any signals of 1 stream data, 2 stream data and 3 stream data is output from three antennas.

NOTE2
Any voltage source for RF parts are generated/stabilized on the module. (RF +3.3V, RF +1.2V)
RF performance shown in the product spec is not affected by any behaviors of external +3.3V supply.

4. Board specifications

4.1. General specifications

Items	Specifications	Units	Remarks
Connector Type	PCI express mini card edge	—	
Antenna connectors	MHF4 Alternative connector x 3	pcs	
Device Interfaces	PCI Express Mini Card v1.2	—	Signal definitions : PCI Express v1.1
RF Interface	IEEE802.11ac/a/b/g/n	–	
MTBF	90,000	h	Min.

4.2. Environmental specifications

Items	Specifications			Units	Remarks
	Min.	Typ.	Max.		
Operating Temperature	-20	—	+60	℃	Case temperature After assembled with powered
Operating humidity	20	—	80	%RH	Non condensing After assembled with powered
Assembled storage temperature	-20	—	+85	℃	After assembled with no-powered
Storage humidity	20	—	85	%RH	Non condensing After assembled with no-powered

4.3. Electrical specifications

Absolute Maximum Ratings (Ta=+25℃)

Items	Specifications			Units	Remarks
	Min.	Typ.	Max.		
Main Power supply voltage (VDD)	−0.3	—	+3.6	V	

Recommended Operating Conditions (Ta=+25℃)

Items	Specifications			Units	Remarks
	Min.	Typ.	Max.		
Main Power supply voltage (VDD)	+3.135	+3.3	+3.465	V	

Digital logic signal level (Ta=+25℃)

Items	Parameters	Specifications				Units	Remarks
		Sink current	Min.	Typ.	Max.		
V_{IH}	Input High Voltage		$0.7 \times V_{DD}$	—	—	V	
V_{IL}	Input Low Voltage		—	—	$0.3 \times V_{DD}$	V	
V_{OH}	Output High Voltage		$0.9 \times V_{DD}$	—	—	V	
V_{OL}	Output Low Voltage		—	—	$0.1 \times V_{DD}$	V	

※All voltage source for the analog RF power supply is internally regulated in the module, and RF performance described in this document is not affected by any variation for external power source.

4.4. Wireless LAN general specifications

Items	Specifications		Units	Remarks
Chipset	QCA9880-BR4A (Qualcomm Atheros)		—	
Country code	US		—	
Center frequency	11a/11nHT20/11acVHT20	5180 – 5825	MHz	US:W52/W53/W56/W58
	11n HT40/11ac VHT40	5190 – 5795		
	11ac VHT80	5210 – 5775		
	11b	2412 – 2462	MHz	US:2412-2462MHz
	11g	2412 – 2462	MHz	
	11ng HT20	2412 – 2462	MHz	
	11ng HT40	2422 – 2452	MHz	
Channel spacing	11a/11nHT20/11acVHT20	20	MHz	
	11nHT40/11acVHT40	40		
	11acVHT80	80		
	11b/11g/11ngHT20/11ngHT40	5		
Link rate	11b	1, 2, 5.5L, 5.5S, 11L, 11S	Mbps	
	11a/g	6, 9, 12, 18, 24, 36, 48, 54	Mbps	
	11ng/na/ac 1-3 Stream	MCS0, 1, 2, 3, 4, 5, 6, 7, 8, 9	—	
Modulation type	11b	DSSS(CCK, DQPSK, DBPSK)	—	
	11a/11g	OFDM (64QAM, 16QAM, QPSK, BPSK)		
	11na/11ng/11ac	OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)		
Hardware encryption engine	WiFi	RC4(64-128bit)	—	
		AES(128-256bit)	—	

Usable channel list

11b	Ch. 1, Ch. 2, Ch. 3, Ch. 4, Ch. 5, Ch. 6, Ch. 7, Ch. 8, Ch. 9, Ch. 10, Ch. 11
11g	Ch. 1, Ch. 2, Ch. 3, Ch. 4, Ch. 5, Ch. 6, Ch. 7, Ch. 8, Ch. 9, Ch. 10, Ch. 11
11ng HT20	Ch. 1, Ch. 2, Ch. 3, Ch. 4, Ch. 5, Ch. 6, Ch. 7, Ch. 8, Ch. 9, Ch. 10, Ch. 11
11ng HT40	Ch. 3, Ch. 4, Ch. 5, Ch. 6, Ch. 7, Ch. 8, Ch. 9
11a	Ch. 36, Ch. 40, Ch. 44, Ch. 48, Ch. 52, Ch. 56, Ch. 60, Ch. 64 Ch. 100, Ch. 104, Ch. 108, Ch. 112, Ch. 116, Ch. 120, Ch. 124, Ch. 128, Ch. 132, Ch. 136, Ch140 Ch. 145, Ch. 149, Ch. 153, Ch. 157, Ch. 161, Ch. 165
11n HT20 11ac VHT20	Ch. 36, Ch. 40, Ch. 44, Ch. 48, Ch. 52, Ch. 56, Ch. 60, Ch. 64 Ch. 100, Ch. 104, Ch. 108, Ch. 112, Ch. 116, Ch. 120, Ch. 124, Ch. 128, Ch. 132, Ch. 136, Ch140 Ch. 145, Ch. 149, Ch. 153, Ch. 157, Ch. 161, Ch. 165
11n HT40 11ac VHT40	Ch. 38, Ch. 46, Ch. 54, Ch. 62 Ch. 102, Ch. 110, Ch. 118, Ch. 126, Ch. 134 Ch. 151, Ch. 159
11ac VHT80	Ch. 42, Ch. 58 Ch. 106, Ch. 122 Ch. 155

- Above region code relating channel list is programmed in the module by module manufacturer (Silex).
- Since programmed region code and channel list is binary data and user cannot know the structure of program, any customers cannot change usable channels.

Operation theory

Client mode (Station)

Operation frequencies			Active/Passive	ad-hoc mode
2.4GHz band	11b/g/n	2412-2462MHz	Active scan	No
W52	11a/an/ac	5180-5240MHz	Active scan	No
W53	11a/an/ac	5260-5320MHz	Passive scan	No
W56	11a/an/ac	5500-5700MHz ※IC:5600-5650MHz disable	Passive scan	No
W58	11a/an/ac	5745-5825MHz	Active scan	No

Compliance with FCC requirement 15.407(c)

 Data transmission is always initiated by software, which is the passed down through the MAC, through the digital and analog baseband, and finally to the RF chip. Several special packets are initiated by the MAC. These are the only ways the digital baseband portion will turn on the RF transmitter, which it then turns off at the end of the packet. Therefore, the transmitter will be on only while one of the aforementioned packets is being transmitted. In other words, this device automatically discontinue transmission in case of either absence of information to transmit or operational failure.
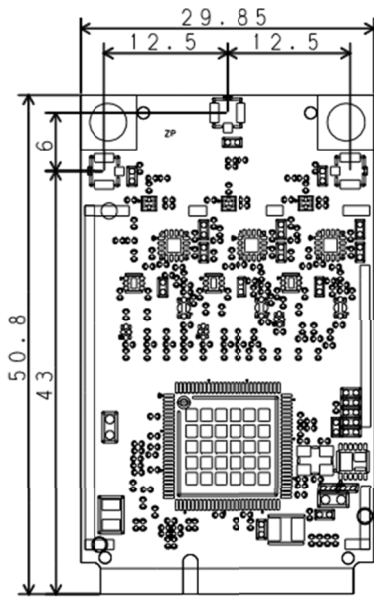
5. Connector interface specifications

5.1. PCI Express Mini Card edge pin assignments

Pin Numbers	Pin Names	Types	Descriptions
1	RESERVED	OD	WAKE_L
2	+3.3Vaux	PWR	
3	RESERVED	IO	Connected to GPIO.
4	GND	GND	
5	RESERVED	IO	Connected to GPIO.
6	RESERVED	NC	
7	RESERVED	OD	CLKREQ_L
8	RESERVED	NC	
9	GND	GND	
10	RESERVED	NC	
11	REFCLK-	IA	PCI Express differential reference clock (100MHz)
12	RESERVED	NC	
13	REFCLK+	IA	PCI Express differential reference clock (100MHz)
14	RESERVED	NC	
15	GND	GND	
16	RESERVED	NC	
			Mechanical key
17	RESERVED	NC	
18	GND	GND	
19	RESERVED	NC	
20	RESERVED	IO	Disable wireless module. On board Pull-up(10kohm)
21	GND	GND	
22	PERST_L	IL	Express reset. Internal weak pull-down
23	PERn0	OA	Module : Differential data transmit
24	+3.3Vaux	PWR	
25	PERp0	OA	Module : Differential data transmit

Pin Numbers	Pin Names	Types	Descriptions
26	GND	GND	
27	GND	GND	
28	RESERVED	NC	
29	GND	GND	
30	RESERVED	NC	
31	PETn0	IA	Module : Differential data receive
32	RESERVED	NC	
33	PETp0	IA	Module : Differential data receive
34	GND	GND	
35	GND	GND	
36	RESERVED	NC	
37	RESERVED	NC	
38	RESERVED	NC	
39	RESERVED	NC	Connected to pin 41 internally
40	GND	GND	
41	RESERVED	NC	Connected to pin 39 internally
42	RESERVED	NC	
43	RESERVED	GND	Connected to GND
44	RESERVED	IO	Connected to GPIO.
45	RESERVED	IO	Connected to GPIO
46	RESERVED	NC	
47	RESERVED	IO	Connected to GPIO.
48	RESERVED	NC	
49	RESERVED	NC	
50	GND	GND	
51	RESERVED	NC	
52	+3.3V	PWR	

NC   : No Connection.
IO   : Digital bidirectional pin.
IA   : Analog input signal.
OA   : Analog output signal.
OD   : Digital output signal with open drain.
IL   : Input signal with weak internal pull-down.
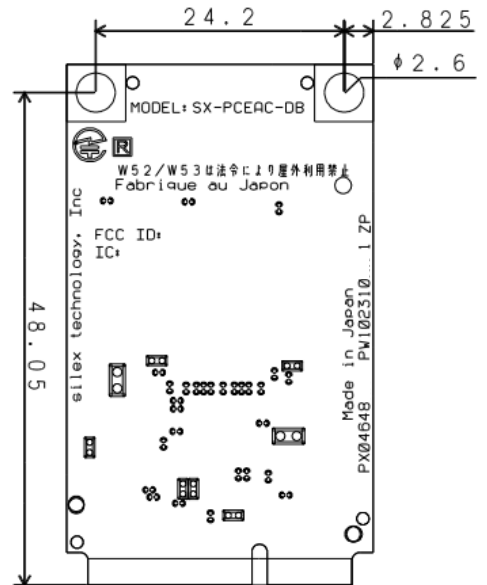PWR   : Power signal.
GND   : Ground signal.

6.   Mechanical Specifications
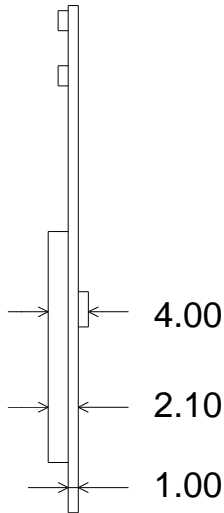
TOP View

*Solder thickness=0.1mm

SIDE View

BOTTOM View

MODEL: SX-PCEAC-DB

W52/W53は法令により屋外利用禁止
Fabrique au Japon

FCC ID:
IC:

Made in Japan
PX04648   PW102310 1ZP

silex technology, Inc

+/-0.15mm
Thickness +/-0.25mm

All dimension tolerances are +/-0.15 mm, unless otherwise specified.

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7. System requirements and quick start guide

1) System requirements
   Prepare the host CPU board whose spec requirements are shown below.

System pecifications

Items	Descriptions
MCU (CPU)	ARM based 1.0GHz or greater SoC from any companies. Eg. Freescale i.MX6SX - 1200MHz
Memory size	ROM : 512MB, RAM : 1GB or greater
OS	Linux any kernel distribution
Host interface	PCI Express 1.1

2) Install the driver which is provided by Silex to the CPU board.
   Any other 3rd party's software shall be rejected due to Subsystem ID mismatch.

3) Install the SX-PCEAC-DB board to the CPU board.
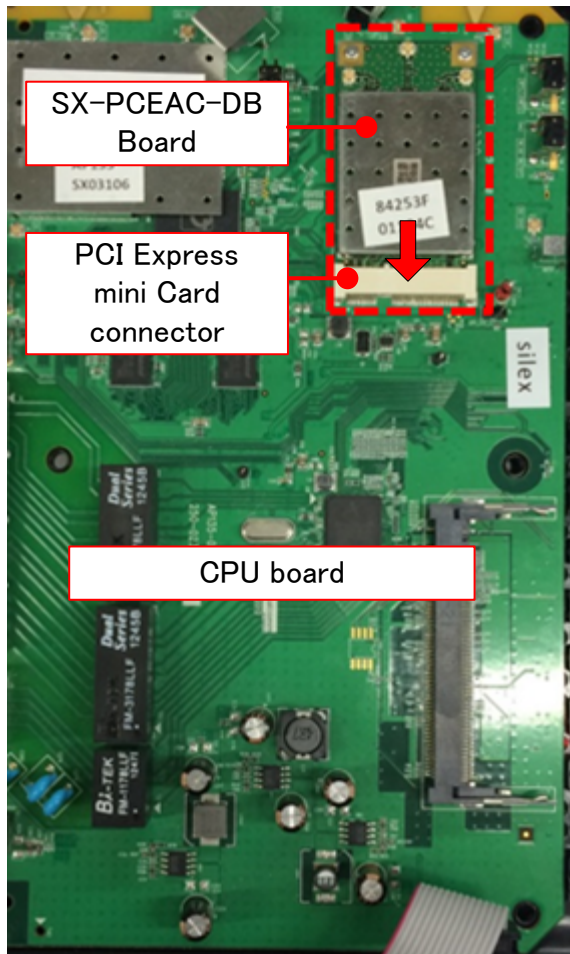
System block diagram
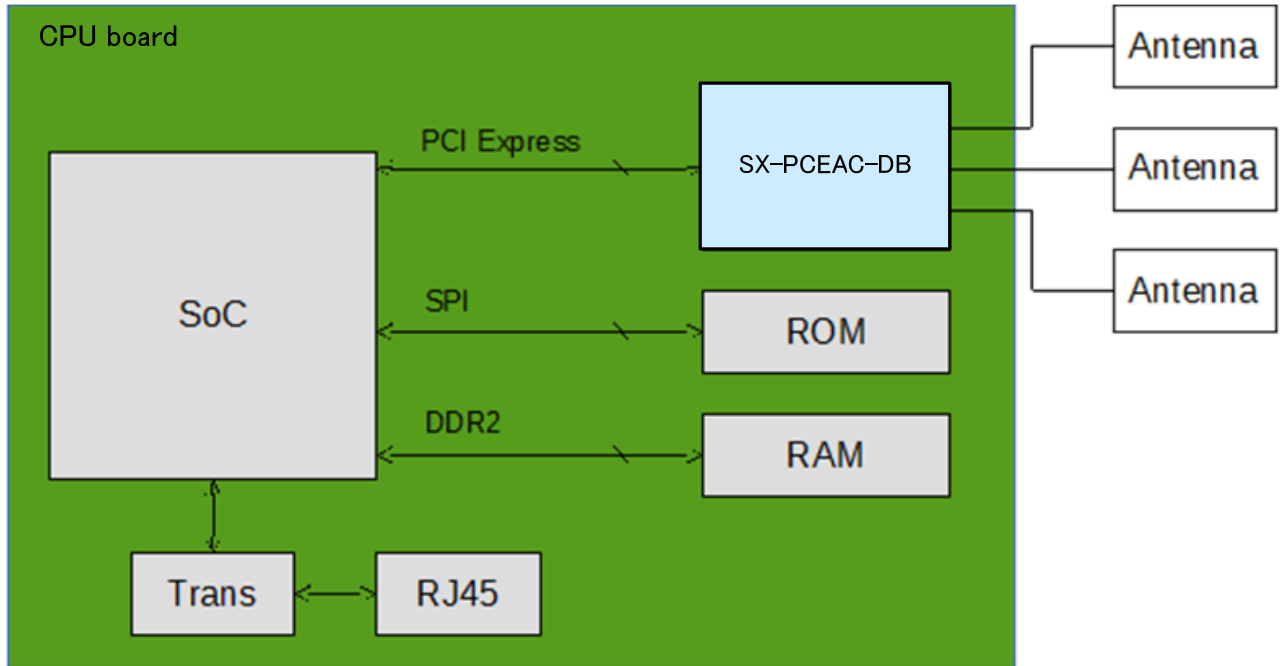
4) Antenna location

Attach the antenas to the co-axial connectors on the SX-PCEAC-DB board. This product doesn't include the CPU board and the plastic case. The figure below is an assumed example of embedded system. Both the baseboard and the case does not affect to RF performance including Antenna performance as long as distance between each antenna is farther than 30mm. Installater must keep this distance when installing this module.
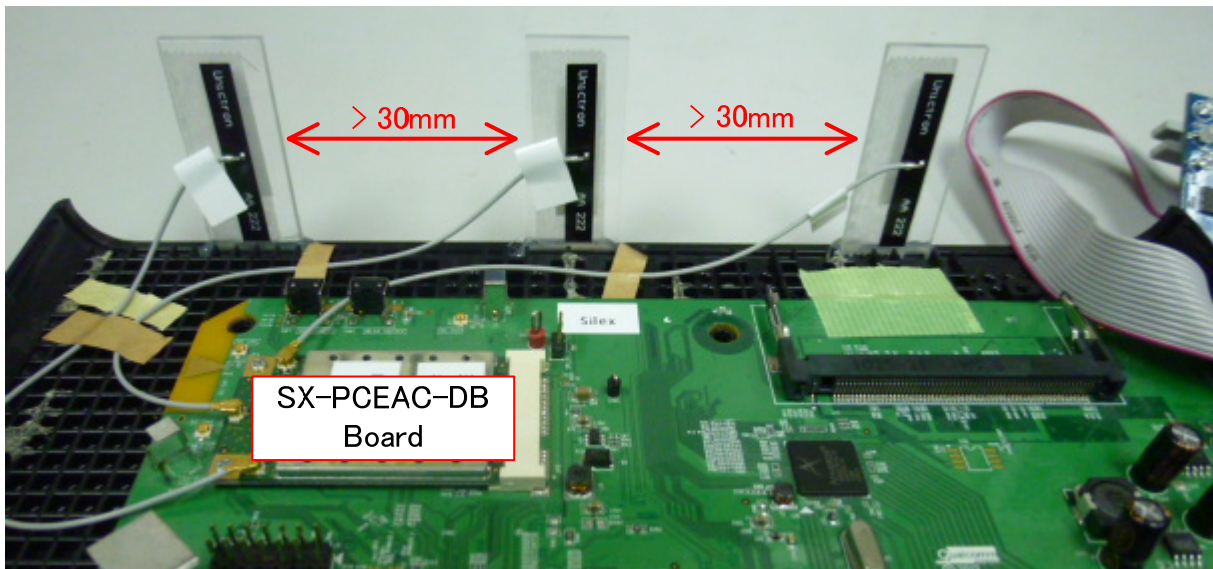
8. Notifications

```
FCCID  : N6C-SXPCEACDB
IC     : 4908A-SXPCEACDB
```

<u>Regulatory notice</u>

Channel Selection
For product available in the USA/Canada market, only channel 1~11 can be operated. Selection of other channels is not possible.

Fcc Rules Part 15
FCC CAUTION
Changes or modifications not expressly approved by the party responsible for compliance could void the user's
authority to operate the equipment.

FCC Rules, Part 15 §15.19(a)(3) / IC RSS Gen §8.4
Below sentences must be indicated on the final product which contains this module inside.

This device complies with part 15 of FCC Rules and Industry Canada's licence-exempt RSSs. Operation is subject
to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : 1) l'appareil ne doit pas produire de brouillage; 2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

FCC Rules Part 15 Subpart C §15.247 and Subpart E / IC RSS-102 §2.6
This equipment complies with FCC/IC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines and RSS-102 of the IC radio frequency (RF) Exposure rules. This equipment should be installed and operated keeping the radiator at least 20cm or more away from person's body.

Cet équipement est conforme aux limites d'exposition aux rayonnements énoncées pour un environnement non contrôlé et respecte les règles les radioélectriques (RF) de la FCC lignes directrices d'exposition et d'exposition aux fréquences radioélectriques (RF) CNR-102 de l'IC. Cet équipement doit être installé et utilisé en gardant une distance de 20 cm ou plus entre le radiateur et le corps humain.

FCC Rules Part 15 Subpart E §15.407(c)
 Compliance with FCC requirement 15.407(c)

Data transmission is always initiated by software, which is the passed down through the MAC, through the digital and analog baseband, and finally to the RF chip. Several special packets are initiated by the MAC. These are the only ways the digital baseband portion will turn on the RF transmitter, which it then turns off at the end of the packet. Therefore, the transmitter will be on only while one of the aforementioned packets is being transmitted. In other words, this device automatically discontinue transmission in case of either absence of information to transmit or operational failure.

FCC Rules Part 15 Subpart E §15.407(g)

 Frequency Tolerance: +/-20 ppm

FCC Rules Part 15 Subpart C §15.247(g) / Subpart E

 This device and its antenna(s) must not be co-located or operation in conjunction with any other antenna or transmitter.

RSS-Gen §8.3
 This radio transmitter 4908A-SXPCEACDB has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

 Le numéro IC du présent émetteur radio 4908A-SXPCEACDB a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué pour ce type, sont strictement interdits pour l'exploitation avec cet appareil.

Certified antenna list

Part number	Vendor	Antenna Gain					
		2.4GHz	W52	W53	W56	W58	Units
146153	Molex	+3.25	+5.00	+5.00	+5.00	+5.00	dBi
H2B1PC1A1C (AA258)	Unictron	+2.90	+4.40	+4.40	+4.40	+4.40	dBi
H2B1PD1A1C (AA222)	Unictron	+2.80	+4.20	+4.20	+4.20	+4.20	dBi

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RSS-247 Issue 1 May 2015

Radio Standards Specification RSS-247, Issue 1, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, is a new standard to replace annexes 8 and 9 of RSS-210, Issue 8, Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.

At the date of publication of this standard, devices covered under the scope of this document will no longer be certified under RSS-210, Issue 8.

Le Cahier des normes radioélectriques 247, 1re édition, Les systèmes de transmission numérique (STN), les systèmes à sauts de fréquence (SSF) et les dispositifs de réseaux locaux exempts de licence (RL-EL), remplace les annexes 8 et 9 du CNR-210, 8e édition, Appareils radio exempts de licence (pour toutes les bandes de fréquences) : matériel de catégorie I.

À la date de publication de la présente norme, les dispositifs visés par ce document ne seront plus certifiés conformément au CNR-210, 8e édition.

Frequency Band 5150 – 5250 MHz

LE-LAN devices are restricted to indoor operation only in the band 5150-5250 MHz.

Les dispositifs LAN-EL sont restreints à une utilisation à l'intérieur, dans la bande 5150-5250MHz.

High-power radars are allocated as primary users (i.e. priority users) of the bands 5250-5350 MHz and 5650-5850 MHz and that these radars could cause interference and/or damage to LE-LAN devices.

Les radars de haute puissance sont désignés comme utilisateurs principaux (c'est-à dire utilisateurs prioritaires) pour les bandes 5250-5350 MHz et 5650-5850 MHz, et que ces radars peuvent provoquer du brouillage et/ou des dommages aux dispositifs LAN-EL.

<u>WARNING</u> :
 The FCC / The Industry Canadaregulations provide that changes or modifications not expressly approved by the party responsible for compliance could void the user'sauthority to operate the equipment.

<u>Manual and Product Labeling information To The End User</u>
 The end user manual shall include all required regulatory information/warning as show in this manual. And when this module is installed in the host product, you must include a "Contain FCC ID : N6C-SXPCEACDB"and a "Contain IC: 4908A- SXPCEACDB" in the label of the host product.

  This module is designed for embedded purpose into the general electric devices, and is not designed for high reliability demands like aircraft instruments, nuclear control instruments, high reliability medical instruments, high reliability security instruments or any other devices required extremely high reliability and quality.

・As this module communicates by radio wave, it is strongly recommended to use some security system to prevent unexpected information leakage to others.

・This module is a radio module for embedded purpose. Please understand functions and features of this module, and evaluate as the final product which has this module embedded. Also, as evaluation of EMC conformity of this module has not been performed, EMC conformity evaluation and application must be performed with the final product which this module is embedded.

・This module will effect to some other device or be affected by the some other device using the same frequency band. Please investigate the environment to use this module beforehand.

・Disassembling or modifying the radio module leads to punishment based on radio law.

・This module is the embedded module that has the exposed connectors or some devices. Please be careful for electro static, condensing, and other dusts.

・"The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module."

IMPORTANT NOTE: In the event that these conditions cannot be met (for example co-location with another transmitter), then the FCC / IC authorization is no longer considered valid and the FCC / IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for reevaluating the end product (including the transmitter) and obtaining a separate FCC / IC authorization. As long as a condition above is met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.