silex SDMAH SDMAH Embedded Wireless Module User Manual

silex SDMAH SDMAH Embedded Wireless Module

Contents

Application

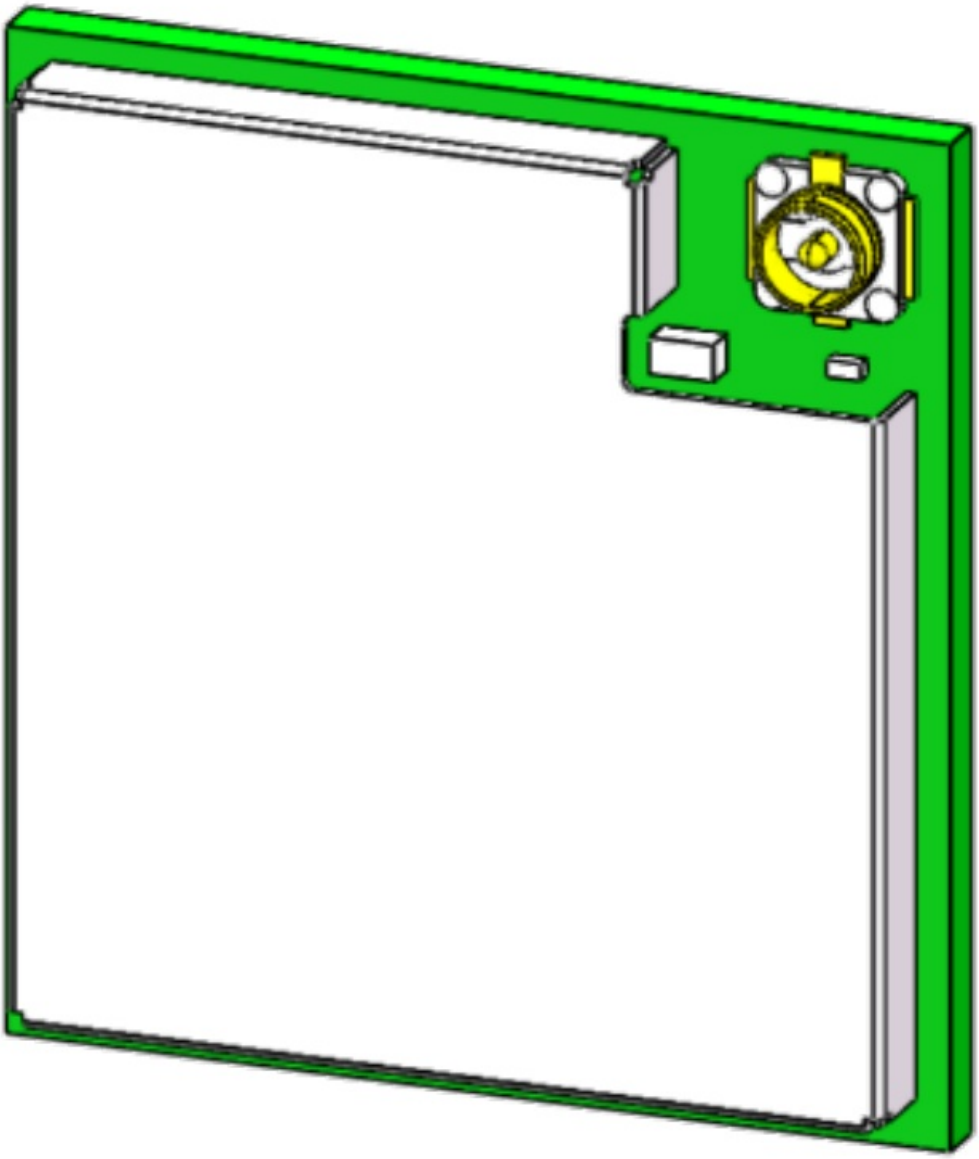
This document describes the detail of hardware specifications for the SX-SDMAH(US).

Introduction

The SX-SDMAH(US) is a 915MHz ISM band IEEE802.11ah WLAN module based on Morse Micro MM6108 chipset. This module includes MAC/BBP/RF/RF-Front-End, Power regulators and clock sources. Its formfactor is Surface Mount Technology (SMT) type, and it has 50ohm MHF antenna connector.

(Features)

- IEEE802.11ah (915MHz ISM band / Region2)
- IEEE802.11ah compliant (915MHz ISM band / Region2)
- 1 spatial data stream system (1T1R)
- Modulation Bandwidth: 1, 2, 4, 8MHz (PHY datarate 150kbps to 32.5Mbps)
- Host Interface: SDIO v2.0 / SPI



Specifications

General Specifications

Items	Description	Units	Note
Connection with the host board	60-pin Land Grid Array (Direct solder)	–	
Antenna port	MHF1 connector x1	pcs	
Antenna port characteristics	50	Ω	SWR < 2.0
Host interface	SDIO/SPI	–	
RF interface	IEEE802.11ah		
Weight	1.6	g	Typ.
Dimensions	W x H x D : 17.0 x 18.0 x 2.65	mm	
MTTF	90,000	H	Min.
Antenna connector Desorption number of times	10	Times	Max. I-PEX 90224-001 Use I-PEX 90224-00 1
Reflow number of times	2	Times	Max. *NOTE1
ESD resistance	+/- 2000	V	Max. Human body model at RF port

NOTE1	In the case of removing the module from the board for the analysis, need to follow JEDEC J-STD-33 Clause 6 BOARD REWORK. Both re-assemblying the removed module and removing the module after reflow 2 times won't be guaranteed since above actions may be counted as the number of reflow.

Environmental Specifications

Items	Specifications			Units	Note
	Min	Typ	Max		
Recommended operating temperature	-40	–	+85	℃	Ambient temperature *NOTE1 After assembled with powered
Recommended operating humidity	15	–	95	%	No condensing After assembled with powered
Recommended storage temperature (After assembly)	-40	–	+85	℃	After assembled with no- powered
Recommended storage humidity (After assembly)	15	–	95	%	No condensing After assembled with no- powered
Recommended storage temperature (In the warehouse, before assembly)	+5	–	+35	℃	MSL *NOTE2 Packaged. Apply MSL after unpackaged. *NOTE2
Recommended storage temperature (In the warehouse, before assembly)	20	–	60	%	No condensing MSL Packaged. Apply MSL after unpackaged.
Moisture Sensitivity Level (MSL)	3			–	IPC/JEDEC J-STD-020D *NOTE3 See standard for handling IPC/JEDEC J-STD-033C *NOTE3

<table>
<tr><td>NOTE1</td><td>The case temperature (Tc), however, must not exceed below value.
<table>
<tr><th>Point</th><th>Tc (Max.)</th><th>Unit</th></tr>
<tr><td>①</td><td>110</td><td>℃</td></tr>
</table>

</td></tr>
<tr><td>NOTE2</td><td>This is condition to keep the product in the warehouse for long term (1 year after shipping from silex). In case of unpacked of the dry pack, humidity of inside shall be keep less than 10%RH. To know whether humidity in the dry pack is exceed 10%RH or not, please check out the humidity indication card (HIC). After 1 year from shipping or in case it might be exceeded this condition due to transportation, checking HIC or checking solderability before production is strongly recommended.</td></tr>
<tr><td>NOTE3</td><td>Recommended baking conditions
Board only 125°C+10/-0°C 24 hours
With reel 40°C+5/-0°C ≦5%RH 13 days
In case ≦30°C/60%RH with handling rule of JEDEC J-STD-033 and floor time is exceeded 168hrs, baking must be necessary. Even before unpacking the dry pack, baking must be necessary if color of HIC is changed to color of 10%RH or more.</td></tr>
</table>

Electrical Specifications

Absolute maximum rating

Specifications				Units	Note
Items	**Min**	**Typ**	**Max**		
VDD Main power supply	-0.5	–	+3.8	V	
VDDIO IO power supply voltage	-0.5	–	+3.8	V	
VDDFEM RF FEM RF FEM power supply voltage	-0.3	–	+5.5	V	

Recommended operating conditions

Specifications				Units	Note
Items	**Min**	**Typ**	**Max**		
VDD33 Main power supply	+3.0	+3.3	+3.6	V	
VDDIO IO power supply voltage	+1.62	–	VDD33	V	※1
VDDFEM RF FEM RF FEM power supply voltage	+3.0	+5.0	+5.25	V	

※1 VDDIO VDD33
VDDIO must be lower than VDD33.

Current consumption specifications

Mode: Test Mode
VDD33(3.3V)

modes	MCS	BW(MHz)	Freq(MHz)	TXP(dBm)	Typ(mA)	Max(mA)
Tx	10	1	903.5	24	50	100
	0	2	905	24	60	110
	0	4	910	24	60	110
	0	8	916	24	80	130
	7	1	903.5	16	40	90
	7	2	905	16	50	100
	7	4	910	16	50	100
	7	8	916	16	70	130
Rx	–	–	–	–	40	50

VDDFEM(3.3V)/(5.0V)

modes	MCS	BW(MHz)	Freq(MHz)	TXP(dBm)	Current (3.3V)		Current (5.0V)	
					Typ(mA)	Peak(mA)	Typ(mA)	Peak(mA)
Tx	10	1	903.5	24	340	550	480	950
	0	2	905	24	340	550	480	950
	0	4	910	24	340	550	480	950
	0	8	916	24	340	550	480	950
	7	1	903.5	16	270	330	320	500
	7	2	905	16	270	330	320	500
	7	4	910	16	270	330	320	500
	7	8	916	16	270	330	320	500
Rx	–	–	–	–	0	0	0	0

VDDIO(3.3V)

Modes	MCS	BW(MHz)	Freq(MHz)	TXP(dBm)	VDD33	
					Typ(mA)	Max(mA)
Tx	10	1	903.5	24	3	10
	0	2	905	24	3	10
	0	4	910	24	3	10
	0	8	916	24	3	10
	7	1	903.5	16	3	10
	7	2	905	16	3	10
	7	4	910	16	3	10
	7	8	916	16	3	10
Rx	–	–	–	–	3	10

RF functional specifications

Items	Description	Units	Note
Chipset	MM6108	–	
Region	USA/Canada	–	
Standard	IEEE802.11ah	–	
Operating Frequency	**BW1MHz:** 903.5, 904.5, 905.5, 906.5, 907.5, 908.5, 909.5, 910.5, 911.5, 912.5, 913.5, 914.5, 915.5, 916.5, 917.5, 918.5, 919.5, 920.5, 921.5, 922.5, 923.5, 924.5, 925.5, 926.5 **BW2MHz:** 905, 907, 909, 911, 913, 915, 917, 919, 921, 923, 925 **BW4MHz:** 910, 914, 918, 922 **BW8MHz:** 908, 916	MHz	
Channel spacing	1, 2, 4, 8	MHz	
Data rate	MCS10, 0, 1, 2, 3, 4, 5, 6, 7	–	
Modulation type	OFDM	–	
Encryption	AES-CCMP	–	

RF Transmitter Specifications

BW	Freq	Data Rates	VDDFEM:5.0V at +25℃			
	[MHz]	MCS	Min	Typical	Max	Units
1MHz	903.5 ~ 926.5	0-2, 10	21.5	24.0	26.5	dBm
		3-4	18.5	21.0	23.5	dBm
		5	17.5	20.0	22.5	dBm
		6	15.5	18.0	20.5	dBm
		7	13.5	16.0	18.5	dBm
2MHz	905 ~ 925	0-2	21.5	24.0	26.5	dBm
		3-4	18.5	21.0	23.5	dBm
		5	17.5	20.0	22.5	dBm
		6	15.5	18.0	20.5	dBm
		7	13.5	16.0	18.5	dBm
4MHz	910 ~ 922	0-2	21.5	24.0	26.5	dBm
		3-4	18.5	21.0	23.5	dBm
		5	17.5	20.0	22.5	dBm
		6	15.5	18.0	20.5	dBm
		7	13.5	16.0	18.5	dBm
8MHz	908	0-5	17.5	20.0	22.5	dBm
		6	15.5	18.0	20.5	dBm
		7	13.5	16.0	18.5	dBm
	916	0-2	21.5	24.0	26.5	dBm
		3-4	18.5	21.0	23.5	dBm
		5	17.5	20.0	22.5	dBm
		6	15.5	18.0	20.5	dBm
		7	13.5	16.0	18.5	dBm

NOTE1	VDDFEM:3.3V When VDDFEM:3.3V, the transmission specification is -1dB at all rates.

Transmit power uncertainty (Operating temperature)

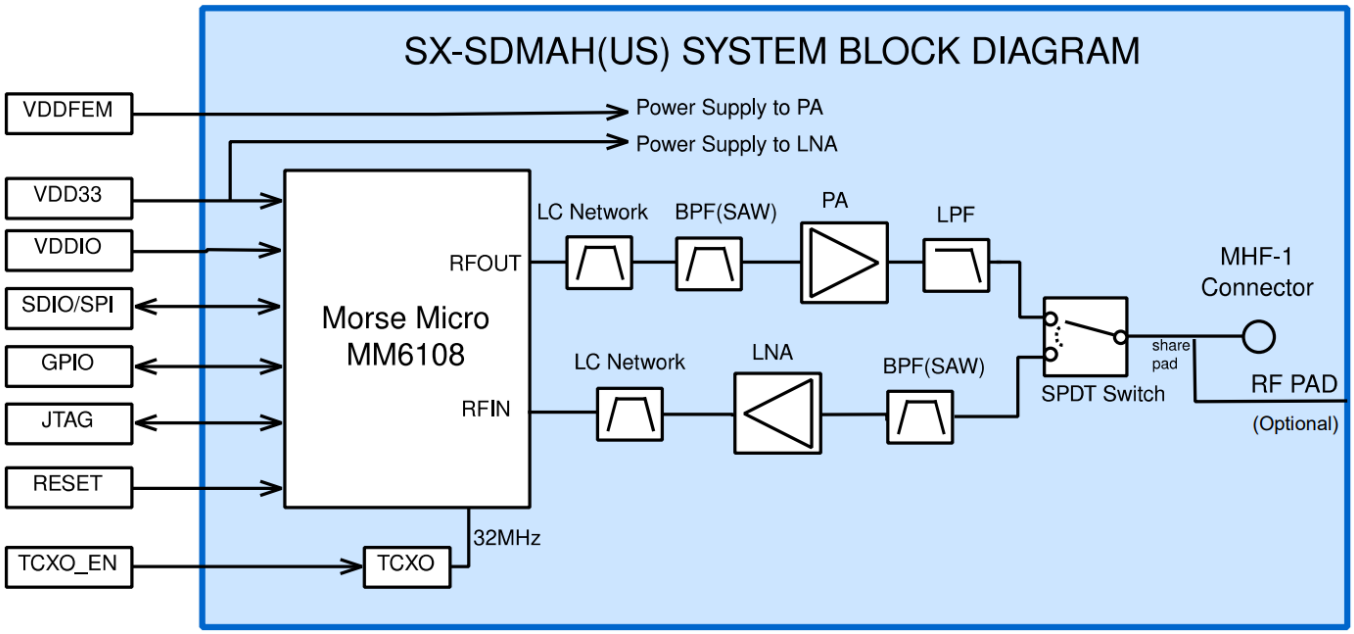
Specifications							
Items	**Modes**		**Min.**	**Typ.**	**Max.**	**Units**	**Remarks**
Power uncertainty due to environmental conditions Temperature, Power supply	BW1MHz	MCS0-7,10	-2.0		+2.0	dB	
	BW2MHz	MCS0-7	-2.0		+2.0	dB	
	BW4MHz	MCS0-7	-2.0		+2.0	dB	
	BW8MHz	MCS0-7	-2.0		+2.0	dB	

RF Receiver Specifications

BW	**Modulation**	**Data Rates**	**Rx input with IEEE 802.11 Rx Minimum Sensitivity at -40°C ~ +85°C**			
		Index	**Min**	**Typical**	**Max**	**Units**
1MHz	BPSK	MCS10	–	-105	-98	dBm
	BPSK	MCS0	–	-103	-95	dBm
	QPSK	MCS1	–	-101	-92	dBm
	QPSK	MCS2	–	-98	-90	dBm
	16 QAM	MCS3	–	-96	-87	dBm
	16 QAM	MCS4	–	-92	-83	dBm
	64 QAM	MCS5	–	-88	-79	dBm
	64 QAM	MCS6	–	-86	-78	dBm
	64 QAM	MCS7	–	-85	-77	dBm
2MHz	BPSK	MCS0	–	-101	-92	dBm
	QPSK	MCS1	–	-98	-89	dBm
	QPSK	MCS2	–	-96	-87	dBm
	16 QAM	MCS3	–	-92	-84	dBm
	16 QAM	MCS4	–	-90	-80	dBm
	64 QAM	MCS5	–	-86	-76	dBm
	64 QAM	MCS6	–	-84	-75	dBm
	64 QAM	MCS7	–	-83	-74	dBm
	BPSK	MCS0	–	-100	-89	dBm
	QPSK	MCS1	–	-97	-86	dBm
	QPSK	MCS2	–	-94	-84	dBm
	16 QAM	MCS3	–	-92	-81	dBm

4MHz	16 QAM	MCS4	–	-88	-77	dBm
	64 QAM	MCS5	–	-84	-73	dBm
	64 QAM	MCS6	–	-83	-72	dBm
	64 QAM	MCS7	–	-81	-71	dBm
8MHz	BPSK	MCS0	–	-96	-86	dBm
	QPSK	MCS1	–	-93	-83	dBm
	QPSK	MCS2	–	-90	-81	dBm
	16 QAM	MCS3	–	-87	-78	dBm
	16 QAM	MCS4	–	-84	-74	dBm
	64 QAM	MCS5	–	-79	-70	dBm
	64 QAM	MCS6	–	-78	-69	dBm
	64 QAM	MCS7	–	-76	-68	dBm

Block Diagram



Standards compliance

Standards conformity

- IEEE802.11ah

Law Regulation compliance

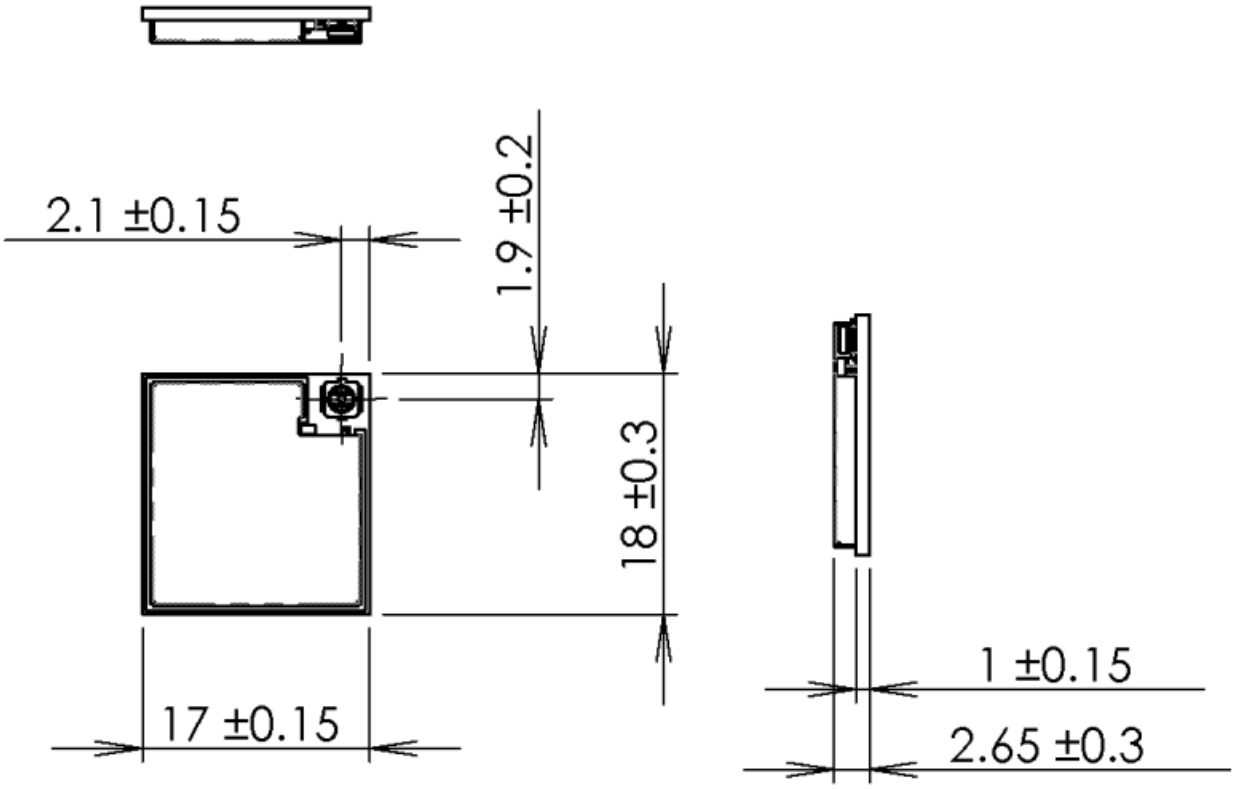
- FCC Part 15.247
  ID: N6C-SDMAH
- ISED RSS-247

ID: 4908A-SDMAH

RoHS Directive

This product is compliant with the EU’s RoHS directive (2011/65/EU) and (EU) 2015/863 This product is compliant with the UK’s RoHS regulations 2012 (S.I.2012/3032)

Outside Drawing



Thickness

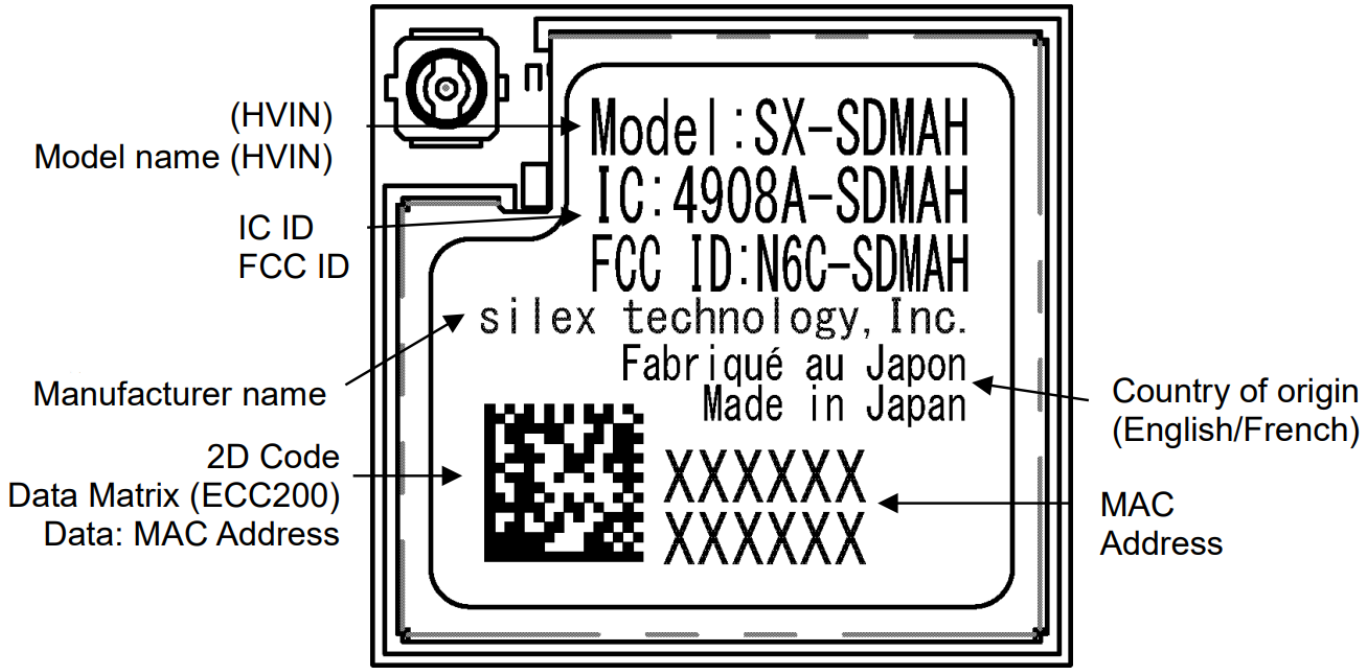
Item	Thickness	Description
SMT (A simple substance)	2.65mm +/- 0.3mm	

PCB Thickness

Item	Thickness	Description
SMT (PCB)	1.00 mm +/- 0.15 mm	

All dimension tolerances are ±0.15mm, unless otherwise specified.

Indication specifications



Notifications

Standards compliance

- Specifications of this module are compliant to law regulations of §8. Standards Compliance, but this shall not apply with below cases.
- In case this module is used in the different country from the list of §8. Standards Compliance.
- In case the certification must be renewed.
- This module uses 915MHz band radio.

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 (Class III, IV), high reliability security instruments or any other devices required extremely high reliability and quality. In the case embedded into the medical instrument, please ask to silex despite the medical class.

- 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.
- In the case using the other wireless devices using same frequency band around this product, please take care below. (See IEEE802.11-2012)
- The module is possibly interfered when strong signal is input. The other wireless system should be enough far

from this module.

- Input level from the opponent device must be -10dBm or less with including antenna gain.
- Firmware of this product shall be updated with the advance notice. If you have special request on firmware updating, you can contact to silex before purchase contracting.

Federal Communication Commission Interference Statement

The following statements must be described on the user manual of the host device of this module;

This device complies with Part 15 of FCC Rules. 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.

FCC Notice;

This module is intended for OEM integrators only. Per FCC KDB 996369 D03 OEM Manual v01 guidance, the following conditions must be strictly followed when using this certified module:

KDB 996369 D03 OEM Manual v01 rule sections:

1. **List of applicable FCC rules**
   This module has been tested for compliance to FCC Part 15 Subpart C
2. **Summarize the specific operational use conditions**
   This module designed for mounting inside of the end product by end product manufacturer professionally. Therefore, it complies with the antenna and transmission system requirements of §15.203.
3. **Limited module procedures**
   This module is certified as limited modular approval as it does not have its own power supply regulator, therefore regulated 3.3V/5.0V must be supplied by a host device using voltage regulator, e.g. NCV1117STAT3G or equivalent. The antenna must be installed inside the host device by a professional installer. Also, the antenna connector must be installed in such a way that it cannot be touched by the general public.
4. **Trace antenna designs**
   Not applicable.
5. **RF exposure considerations**
   This transmitter must not be co-located or operated in conjunction with any other antenna or transmitter except for SX-SDMAX FCC ID: N6C-SDMAX .
   The following statements must be described on the user manual of the host device of this module;
   This equipment complies with FCC mobile radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator & your body. If the module is installed in a portable host, a separate SAR evaluation is required to confirm compliance with relevant FCC portable RF exposure rules.
6. **Antennas**
   The following antennas have been certified for use with this module; antennas of the same type with equal or lower gain may also be used with this module. The antenna must be installed such that 20 cm can be maintained between the antenna and users.

Antenna Type	Antenna Gain
Rod	+3.4dBi

The antenna must be installed inside the host device by a professional installer. Also, the antenna connector must be installed in such a way that it cannot be touched by the general public.

7. **Label and compliance information**
   The final end product must be labeled in a visible area with the following: “Contains FCC ID: N6C-SDMAH”. The grantee’s FCC ID can be used only when all FCC compliance requirements are met.
   FCC CAUTION
   Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment. This device complies with part 15 of the FCC Rules. 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.
8. **Information on test modes and additional testing requirements**
   This transmitter is tested in a standalone mobile RF exposure condition and any co-located or simultaneous transmission with other transmitter(s) not allowed or portable use will require a separate class II permissive change re-evaluation or new certification.
9. **Additional testing, Part 15 Subpart B disclaimer**
   This transmitter module is tested as a subsystem and its certification does not cover the FCC Part 15 Subpart B (unintentional radiator) rule requirement applicable to the final host. The final host will still need to be reassessed for compliance to this portion of rule requirements if applicable.
10. **Note EMI Considerations**
    We recommend to use “best practice” RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties. The host manufacturer is responsible for ensuring compliance with the applicable FCC rules for the transmitters operating individually and simultaneously. This includes compliance for the summation of all emissions from all outputs occupying the same or overlapping frequency ranges, as defined by the applicable rules.
11. **How to make changes**
    Only the grantee is permitted to make permissive changes. Please contact us at Silex Technology, Inc.

As long as all conditions above are 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.

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

Manual Information To the End User

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. The end user manual shall include all required regulatory information/warning as show in this manual.

OEM/Host manufacturer responsibilities

OEM/Host manufacturers are ultimately responsible for the compliance of the Host and Module. The final product must be reassessed against all the essential requirements of the FCC rule such as FCC Part 15 Subpart B before it can be placed on the US market. This includes reassessing the transmitter module for compliance with the Radio and EMF essential requirements of the FCC rules. This module must not be incorporated into any other device or system without retesting for compliance as multi-radio and combined equipment.

Prohibited for control of or communications with unmanned aircraft systems, including drones.

Innovation, Science and Economic Development Canada statement

The following statements must be described on the user manual of the host device of this module;

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s).

Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Limited module procedures

This module is certified as limited modular approval as it does not have its own power supply regulator, therefore regulated 3.3V/5.0V must be supplied by a host device using voltage regulator, e.g. NCV1117STAT3G or equivalent.

The antenna must be installed inside the host device by a professional installer. Also, the antenna connector must be installed in such a way that it cannot be touched by the general public.

Label and compliance information

The following information must be indicated on the host device of this module.

Contains Transmitter Module IC: 4908A-SDMAH
Or
Contains IC: 4908A-SDMAH

Data transmission

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.

RF exposure considerations

The following statements must be described on the user manual of the host device of this module;
This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment and meets RSS-102 of the ISED 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.

Antenna Type

This radio transmitter (4908A-SDMAH) has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna Type	Antenna Gain	Impedance
Rod Antenna	+3.4dBi	50ohms

Documents / Resources

	silex SDMAH SDMAH Embedded Wireless Module [pdf] User Manual SDMAH SDMAH Embedded Wireless Module, SDMAH, SDMAH Embedded Wireless Module, Embedded Wireless Module, Wireless Module, Module

References

- User Manual