Macaron N Series

SM-MSN09-C01

NFC Controller Module with Integrated Antenna

Datasheet Version 1.0

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FEDERAL COMMUNICATIONS COMMISSION INTERFERENCE STATEMENT

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/ TV technician for help.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

CAUTION:

Any 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.

Canadian Compliance Statement

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

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

Cet appareil est conforme aux norms CNR exemptes de licence d'Industrie Canada. Le fonctionnement est soumis aux deux conditions suivantes:

- cet appareil ne doit pas provoquer d'interférences et
- cet appareil doit accepter toute interférence, y compris celles susceptibles de provoquer un fonctionnement non souhaité de l'appareil.

經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、 加大功率或變更原設計之特性及功能。 低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前項合法通信，指依電信法規定作業之無線電通信。低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

Information for the OEMs and Integrators

The following statement must be included with all versions of this document supplied to an OEM or integrator, but should not be distributed to the end user.

1) This device is intended for OEM integrators only.

2) Please see the full Grant of Equipment document for other restrictions.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains FCC ID: JCK-MSN09C01" and "Contains IC: 6655A-MSN09C01"

Revision History

This section describes the changes that were implemented in this document. The changes are listed by revision, starting with the most current publication.

Revision 1.0

Revision 1.0 of this datasheet was published in June 2014. This was the first publication of the document.

Contents

Figure Contents

Table Contents

1 Introduction

This document consists of descriptions and specifications for both functional and physical aspects of the SM-MSN09-C01 NFC reader / writer module.

In addition to the datasheet, Smart Approach maintains and extensive device-specific library of support and collateral materials that you may find useful in your application. Depending upon the Smart Approach device, this library may include:

- Presentations highlighting the operational features and specifications of the device to assist in developing your own product road map.

- Application notes that provide detailed descriptions of the use of the particular Smart Approach product to solve real-world problems.

Revision 1.0 June 2014

2 Product Overview

SM-MSN09-C01 is full featured NFC controllers designed for integration in portable equipment. It is optimized for low power consumption with fully host controllable power states and for small footprint for portable equipment applications.

The module's compact, flexible design with and exposed pad is optimal for size-sensitive applications, assures robust performance.

The following illustration shows a high-level, generic view of a SM-MSN09-C01 application.
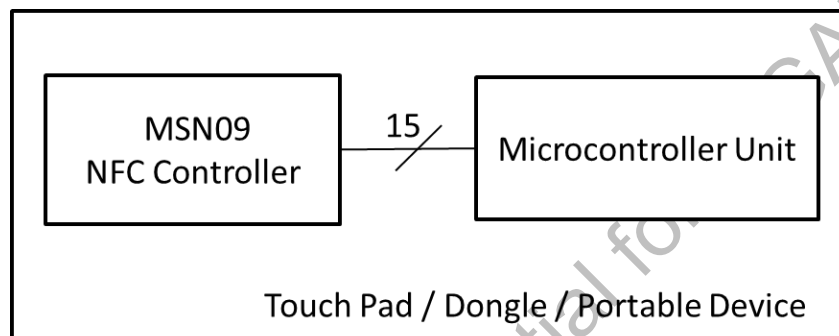
Figure 1 Typical Application

2.1 Features

This section Tables key aspects of the SM-MSN09-C01 module functionality and design that distinguish it from similar products:

- NXP NPC100 NFC Controller
- Full featured NFC controller industry's low power consumption.
- Compliant with ISO/IEC 14443 A/B
- Compliant with 15693/18092
- Antenna pairing could be customized
- I^{2}C interface
- The maximum of thickness is 1.5 mm.

2.2 Application

Suggested applications for the SM-MSN09-C01 module include:

- NFC writer
- NFC reader
- NFC peer to peer controller
- NFC payment
- NFC identification
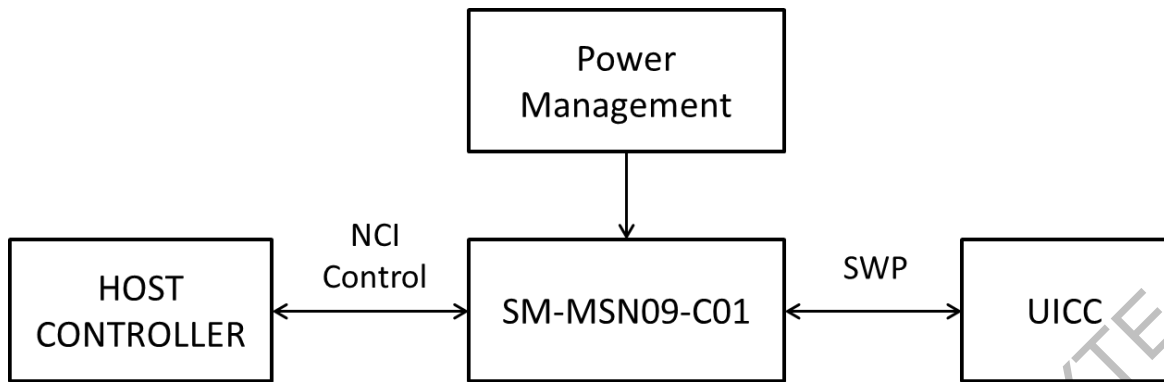
Figure 2 Typical Application II

SM-MSN09-C01 can be connected on a host controller through I^2C-bus interfaces. The logical interface towards the host base band is NCI-compliant with additional command set for SA specific product features. SM-MSN09-C01 can be connected to a UICC through an SWP interface. The SWP physical interface is compliant with ETSI/SCP SWP and HCI.

Moreover, SM-MSN09-C01 provides flexible and integrated power management unit in order to preserve energy supporting Powered by the Field and Power Off mode. It also allows various power schemes for the UICC.

3 Functional Descriptions

This section provides detailed information about how SM-MSN09-C01 module works, what configurations and operational features are available.

The following illustration shows the primary functional blocks of SM-MSN09-C01 module.
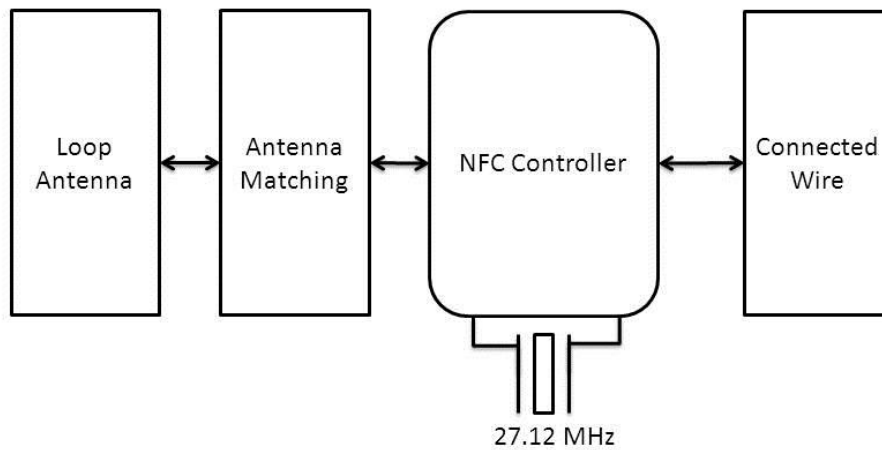
Figure 3 Module Block Diagram

Loop Antenna is Smart Approach customize solution, Antenna size of SM-MSN09-C01 is 40mm x 50 mm. Antenna matching is also a customize solution. NFC controller includes NXP NPC100 chipset, and has an I^2C control interface through the connector to mother board.

NFC FORUM NFC-IP MODES	READER (PCD - VCD)	CARD (PICC - VICC)
READER FOR NFC FORUM TAGS 1 TO 4	ISO/IEC 14443 A	ISO/IEC 14443 A
P2P ACTIVE 106 TO 424 kbps INITIATOR AND TARGET	ISO/IEC 14443 B	ISO/IEC 14443 B
P2P PASSIVE 106 TO 424 kbps INITIATOR AND TARGET	ISO/IEC 15693	MIFARE 1K / 4K
	MIFARE 1K / 4K	MIFARE DESFire
	MIFARE DESFire	Sony FeliCa
	Sony FeliCa	

Figure 4 Transmission Modes

For contactless card functionality, SM-MSN09-C01 can act autonomously if previously configured by the host in such a manner. PICC functionality can be supported without device being turned on or even with battery removed.

3.1 Communication overview for ISO/IEC 14443A / MIFARE Controller

The contactless coprocessor and the on-chip CPU of SM-MSN09-C01 handle the complete ISO/IEC 14443A/MIFARE RF-protocol, nevertheless a dedicated external host has to handle the application layer communication.

4 Electrical Specifications

This section provides the DC characteristics, AC characteristics, recommended operating conditions. It includes information on the various timing functions of the module.

4.1 Pin Description

The following Table shows the pin description for SM-MSN09-C01 module.
The connection ground is internally connected and should be connected to GND on the main board as well.

Table 1 Module Pin Description

PIN No.	Name	Description	Power Reference	P/I/O
1	V_{BAT}	+3.3V power supply input	3.3V	P
2	MOD_GND	Module Ground	GND	P
3	SWP	SWP data line to UICC/SIM, Input / Output	$PMUV_{CC}$	I/O
4	RFU	Unused pin could be floating	-	-
5	IRQ	Interrupt to host, High: Interrupt; Low: Normal	VDD_IO	O
6	$PMUV_{CC}$	Power supply to UICC/SIM, input, + 1.8V	1.8V	P
7	I^2C_SDA	I^2C Data Line	VDD_IO	I/O
8	I^2C_SCL	I^2C Clock	VDD_IO	I
9	MOD_GND	Module Ground	GND	P
10	V_{EN}	Wake up the module from standby mode or reset the module	V_{BAT}	I
11	DWL_REQ	Firmware download control: Active High	VDD_IO	I
12	$SIMV_{CC}$	The power rail used to power UICC / SIM, output pin	$PMUV_{CC}$	P(O)
13	V_{BAT}	+3.3V Power Supply	3.3V	P
14	VDD_IO	+1.8V or +3.3V for host IO reference voltage	1.8V/3.3V	P
15	MOD_GND	Module Ground	GND	P

4.2 I²C Address

SM-MSN09-C01 I²C 7bit address is defined to 0x28. To write data, this module is addressed using 0x50, to read data, this module is addressed using 0x51.

Table 2 I²C Address

I2C address (R/W=0, write)	I2C address (R/W=1, read)
0x50	0x51

4.3 Temperature Maximum Ratings

Thermal specifications for this module have been modeled using a two-layer test board.

Table 3 Temperature Maximum Ratings

Symbol	Definition	Value		Units
		Min	Max	
T	Operating Temperature	-20	80	℃
T$_S$	Storage Temperature	-40	100	℃

4.4 DC Electrical Parameters

DC Electrical specifications for this module have been modeled using a two-layer test board.

Table 4 DC Electrical Specification

Symbol	Definition	Value			Units
		Min	Typ	Max	
V$_{BAT}$	Power Supply	3.1	3.3	5.5	Volts
I$_{VBAT}$	DC Current			170	mA

4.5 Antenna Specifications

Antenna specifications for this module have been modeled using a two-layer test board.

Table 5 Antenna Specifications

Item	Value			Unit	Note
	Min	Typ	Max		
DC Resistance	0.5	1	2	Ω	
AC Impedance		50		Ω	
Frequency	13.06	13.56	14.06	MHz	VSWR <2
Q factor	25	30	35		
Antenna Type	FPC Loop Coil				Add the Ferrite sheet
Size	Normal: (40 ±0.5) X (50±0.5)			mm	

4.6 Power Consumption

Table 6 Current Consumption

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{HPD}	Hard power down current	V_{BAT}=3.6V, V_{EN}=0V	-	10.5	12	µA
I_{STBY}	Standby state current	V_{BAT}=3.6V	-	-	20	µA
I_{ACT}	Active state current	V_{BAT}=3.6V	-	6	-	mA
I_{TVDD}	Transmitter supply current	V_{BAT}=3.1V	-	30	100	mA
I_{PMUVCC}	PMUVCC supply	Class B	-	1.5	3	µA
		Class C	-	1	2	µA

4.7 Thermal Protection

Table 7 Thermal Protection

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$T_{OVERTEMP}$	Temperature protection trigger		120	125	130	^0C

4.8 System power modes

Table 8 System Power Modes Description

Mode	Description
Full power mode	The battery supply (V_{BAT}) as well as the pad supply (VDD_IO) is available, all use cases can be executed
Low-power mode	The pad supply (VDD_IO) is not available. Only the Card Emulation mode use cases via SWP are allowed
Powered by the Field	The battery supply (V_{BAT}) and pad supply (VDD_IO) are not available. The system is powered via PbF interface. Only Card Emulation use cases via SWP are allowed.
Power Off mode	The system is not supplied from any source or the system is kept Hard Power Down (HPD)

Table 9 Power Mode Configuration

V_{BAT}	VDD_IO	V_{EN}	Power mode
Off	Off	X	Power Off mode
On	X	Off	Power Off mode
On	Off	On	Low Power Mode
On	On	On	Full power mode

Note: X: Don't care

4.9 Reset and download concept

To enter reset there are 2 ways:

- Pulling V_{EN} low (Hard Power Down state)
- If V_{BAT} monitor is enabled: lowering V_{BAT} below the monitor threshold (monitor mode, if V_{EN} is kept above 1.1 V)This reset mode can be left if PbF is enabled when the field is high enough (RF field detected) to enter PbF mode.

To get out of reset, there are 2 ways:

- Pulling V_{EN} high with V_{BAT} above V_{BAT} monitor threshold if enabled
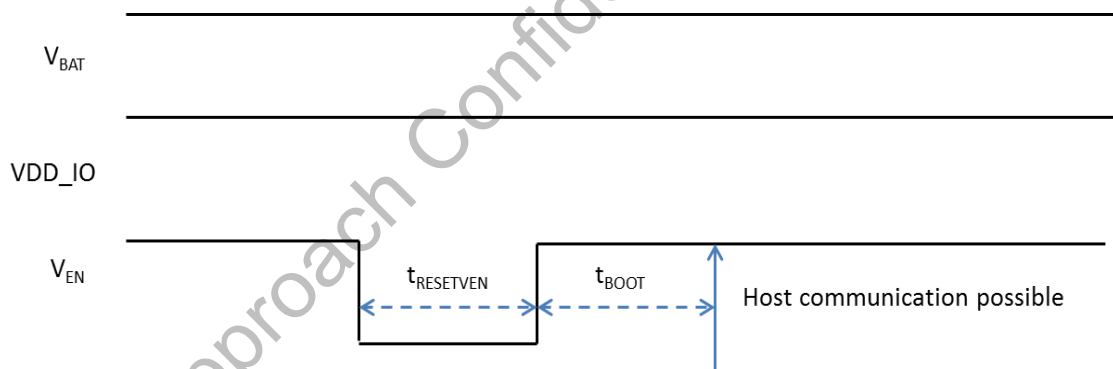- Entering a field strong enough to power the IC

Figure 5 Reset via V_{EN} pin

Table 10 Reset Timing

Symbol	Parameter	Condition	Min	Typ	Max	Unit
$t_{RESETVEN}$	V_{EN} pulse width to reset		3			µ s
t_{BOOT}	Boot time				10	ms

4.10 NFC Connection Recommendation

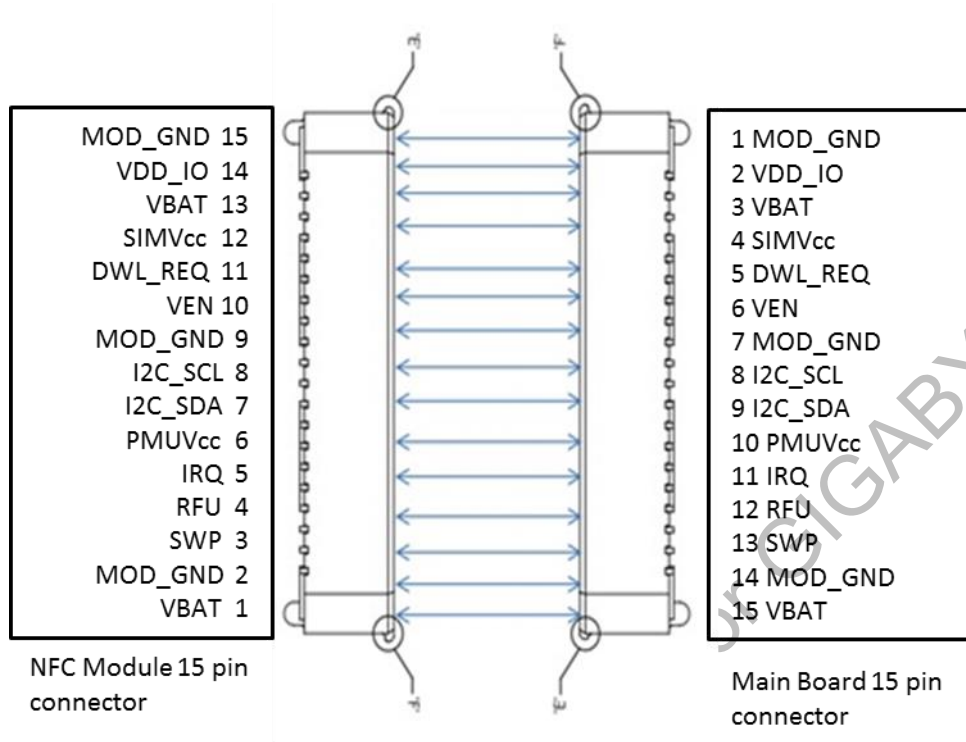| NFC Module 15 pin connector	Main Board 15 pin connector
MOD_GND 15	1 MOD_GND
VDD_IO 14	2 VDD_IO
VBAT 13	3 VBAT
SIMVcc 12	4 SIMVcc
DWL_REQ 11	5 DWL_REQ
VEN 10	6 VEN
MOD_GND 9	7 MOD_GND
I2C_SCL 8	8 I2C_SCL
I2C_SDA 7	9 I2C_SDA
PMUVcc 6	10 PMUVcc
IRQ 5	11 IRQ
RFU 4	12 RFU
SWP 3	13 SWP
MOD_GND 2	14 MOD_GND
VBAT 1	15 VBAT

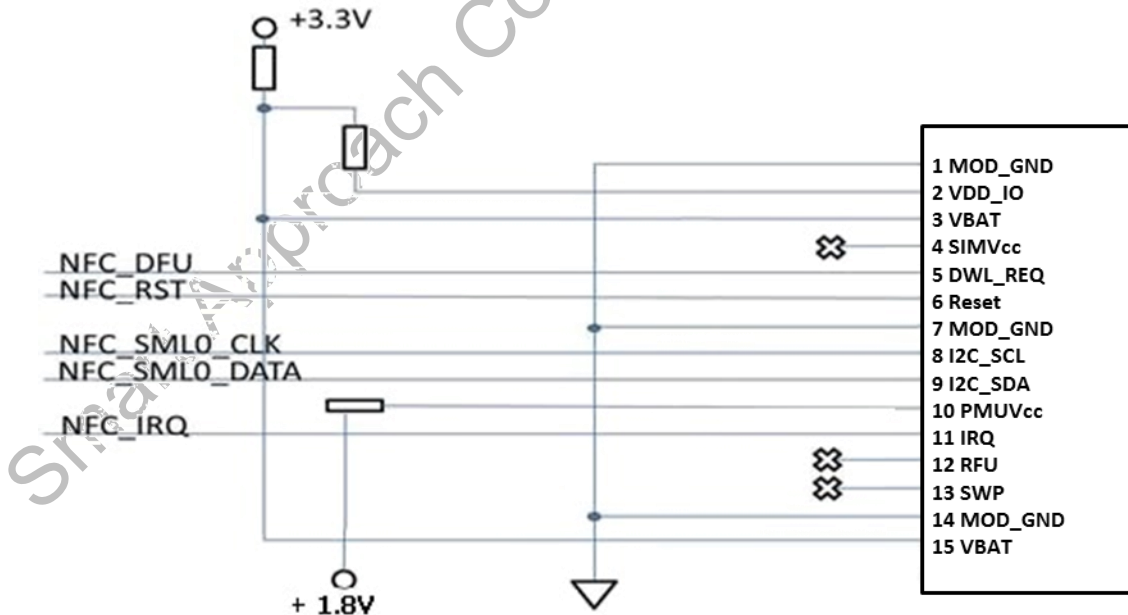Figure 6 Connection Recommendation

4.11 Main Board Design Reference

Figure 7 Main Board Design W/O UICC Reference

5 Ordering Information

Table 11 Ordering Information Table

Order Number	Descriptions
SM-MSN09-C01	NFC Macaron Module (NXP NPC100) with Integrated Antenna
Dimension	Module: 40x50x1.5 mm

6 Reliability Verification

Table 12 Reliability Item Table

No.	Item	Condition	Benchmark	Result	Qty
1	Low Temperature Storage Test	-40°C	IEC60068-2-1	Pass	5
2	High Temperature Storage Test	80°C, Humidity: 95%	IEC60068-2-78	Pass	5
3	Low Temperature Operation Test	-20°C	IEC60068-2-1	Pass	5
4	High Temperature Operation Test	80°C	IEC60068-2-2	Pass	5
5	High Temperature Operation Test	65°C, Humidity: 95%	IEC60068-2-78	Pass	5
6	Salt Test	PH: 3.0 ~ 3.2 ,50℃, 72 hrs, Density: 5%±1%	ASTM B368	Pass	5
7	RoHS	Normal	Compliance	Pass	5
8	HF	Normal	Compliance	Pass	5

Revision 1.0 June 2014

7 NFC Module Outline

The following illustration shows the package drawing for SM-MSN09-C01 module. The drawing contains the detail views, dimensions, tolerances, and notes.
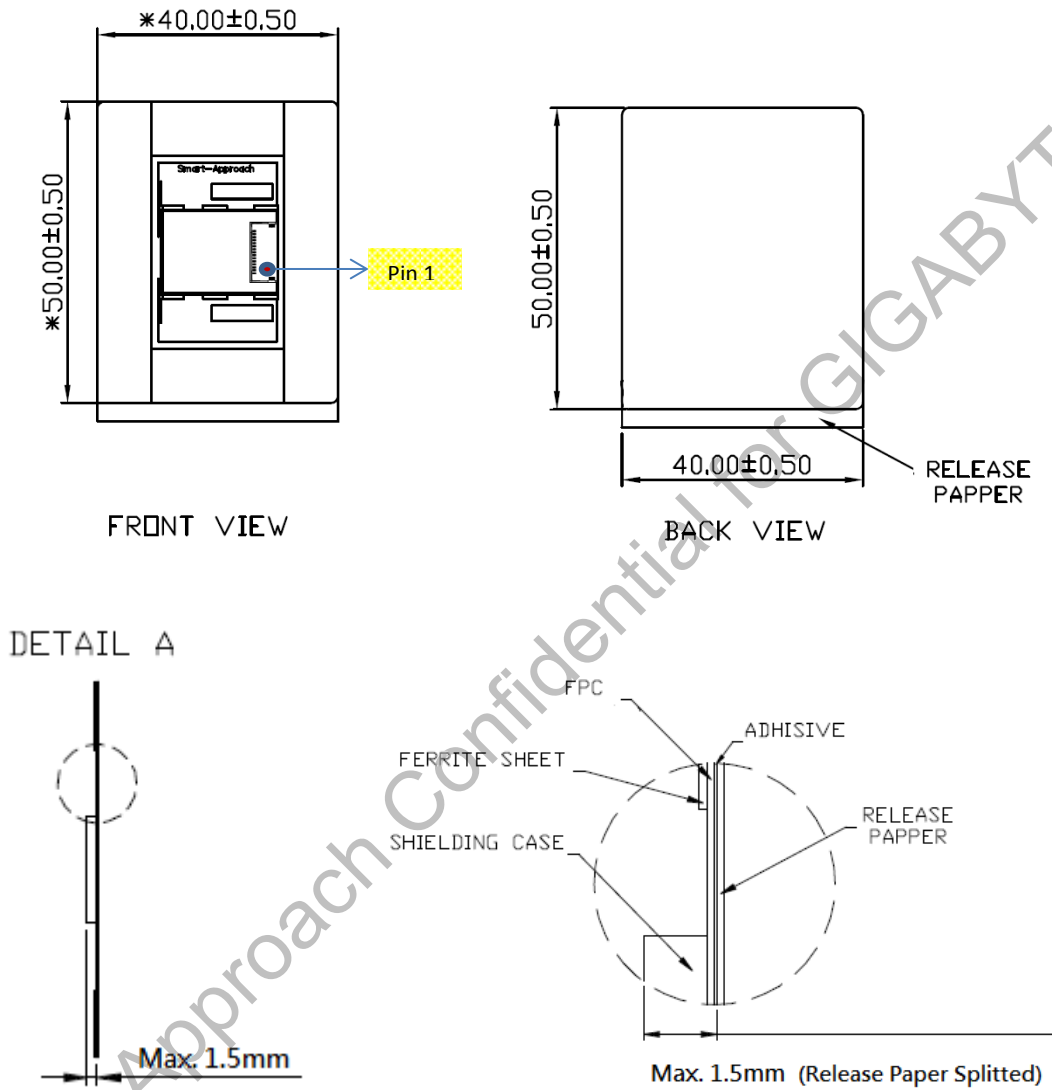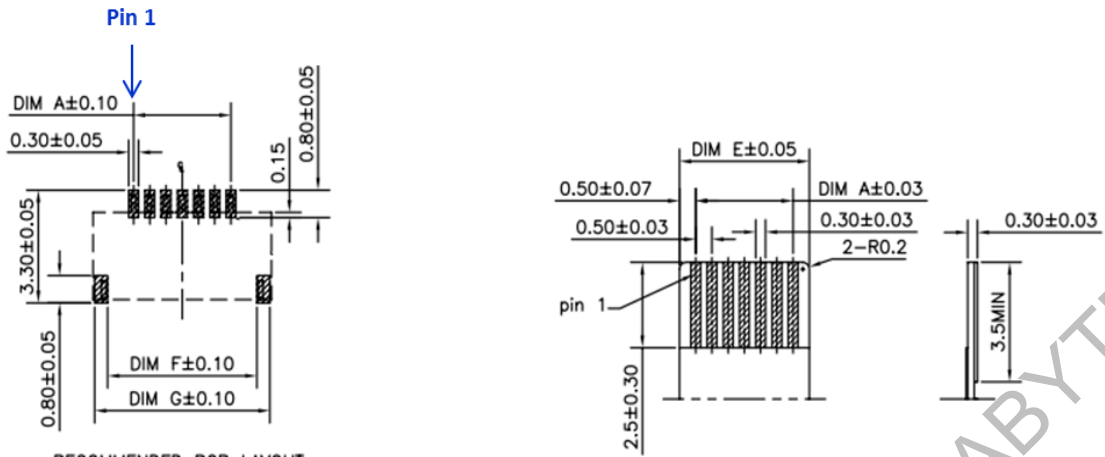

Figure 8 Antenna Module Drawing

Figure 9 Module FPC Connection Footprint (Button Contact)

CKT	DIM A	DIM B	DIM C	DIM D	DIM E	DIM F	DIM G	DIM H	DIM J	DIM K
10	4.50	7.00	5.57	6.33	5.50	6.10	6.90			
11	5.00	7.50	6.07	6.83	6.00	6.60	7.40			
12	5.50	8.00	6.57	7.33	6.50	7.10	7.90			
13	6.00	8.50	7.07	7.83	7.00	7.60	8.40			
14	6.50	9.00	7.57	8.33	7.50	8.10	8.90			
15	7.00	9.50	8.07	8.83	8.00	8.60	9.40			

Figure 10 FPC Wire Dimension