NFC Smartcard Module

Installation Manual

1. Introduction

This document describes the hardware of the NFC smartcard module (NSM). The readers of this document would benefit if they have prior knowledge of the specifications mentioned in References section.

2. References

The readers of this document shall have knowledge on the following specifications

USB CCID rev1.1 : Specification for Integrated Circuit Cards Interface Devices

ISO/IEC 14443-2 : Radio frequency power and signal interface

ISO/IEC 14443-3 : Initialisation and anti-collision

ISO/IEC 14443-4 : Transmission protocol

Mifare contactless card (Classic 1K, Classic 4K and Ultralight) datasheets

ISO/IEC 7816-3 : Electronic signals and transmission protocols

ISO/IEC 7816-4 : Inter-Industry commands for interchange

NSM USB/Serial software reference manual

3. FCC Statement

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.

No changes shall be made to the equipment without the manufacturer's permission as this may void the user's authority to operate the equipment

It is the responsibility of the product manufacturer to ensure compliance with FCC Part 15B with the NFC Smart Module integrated into their product.

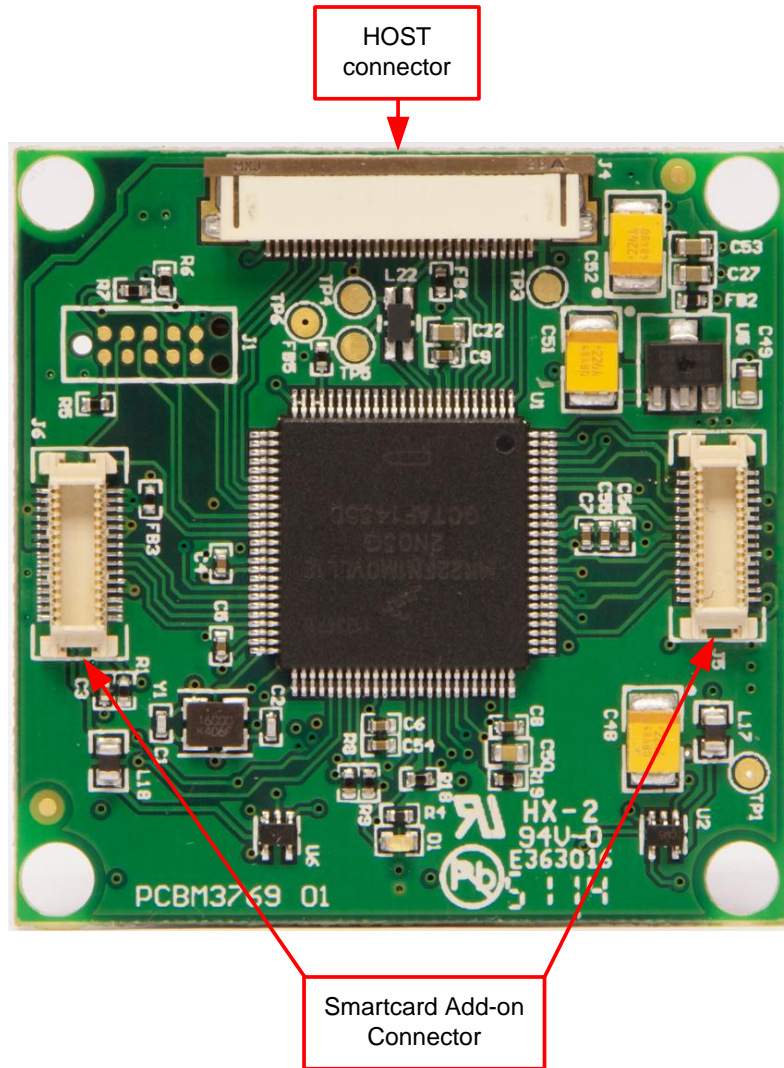The host product using NSM module shall have the following text on a permanent label.

Contains FCC ID : ZERNSM01

The label should be on a visible location outside the enclosure of the product.

4. Product pictures

4.1. Contactless NSM board – Top view

HOST connector

Smartcard Add-on Connector

NOTE: The host connector connects to a 30 way FFC cable from the host system. This connector has the USB D+/- signals, Serial interface TX/RX signals and the Power and Ground. For more information on this connector pinout see Host connector section. The user can configure which interface the NSM shall use to communicate with the host. For more information on host interface selection see Host Interface Selection section.
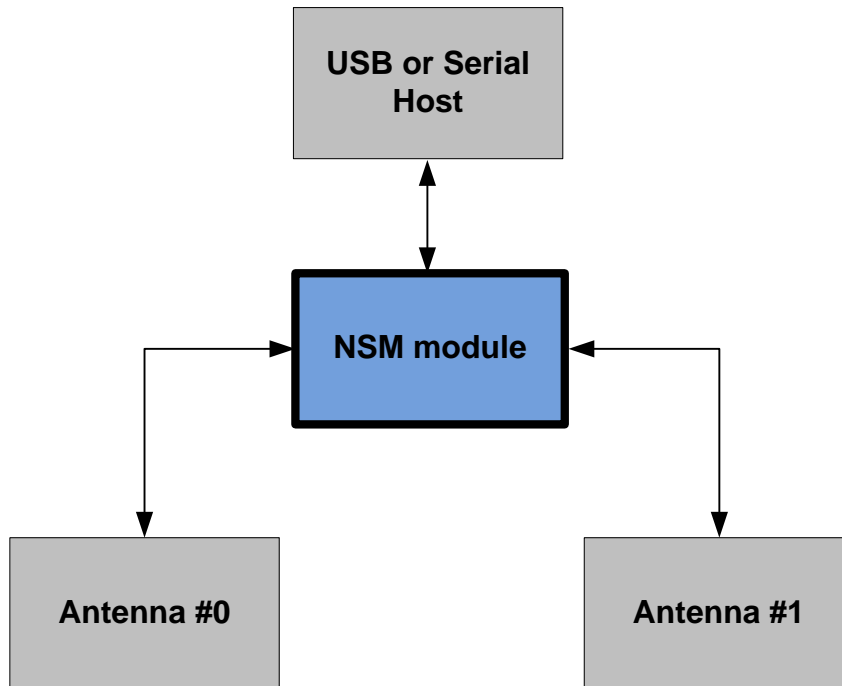
4.2. Contactless NSM board

Antenna connectors
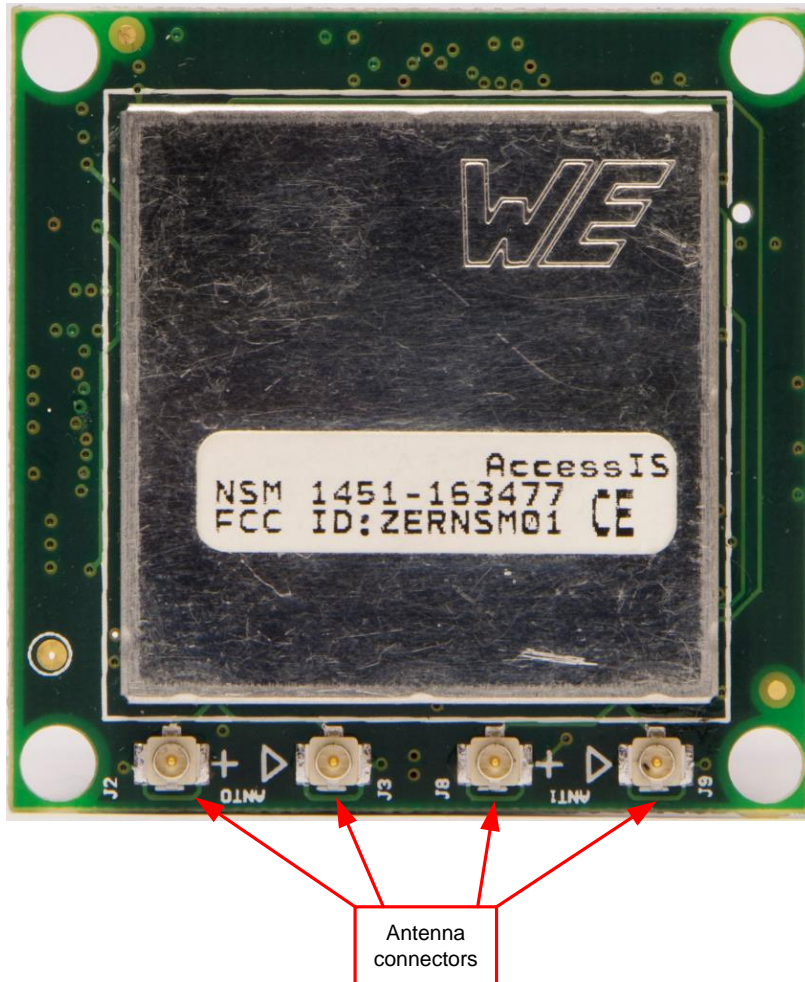
4.3. Typical Hardware Setup

The following diagram and pictures shows a typical setup for NSM module.

```
              ┌─────────────────┐
              │  USB or Serial  │
              │      Host       │
              └─────────────────┘
                       ↕
              ┌─────────────────┐
      ┌──────▶│   NSM module    │◀──────┐
      │       └─────────────────┘       │
      ▼                                 ▼
┌─────────────┐                 ┌─────────────┐
│ Antenna #0  │                 │ Antenna #1  │
└─────────────┘                 └─────────────┘
```

The following pictures show a typical setup. Note that the antenna and the Serial/USB host shown in the pictures are for illustration only. The actual size and shape of the user's antenna and host system may vary.
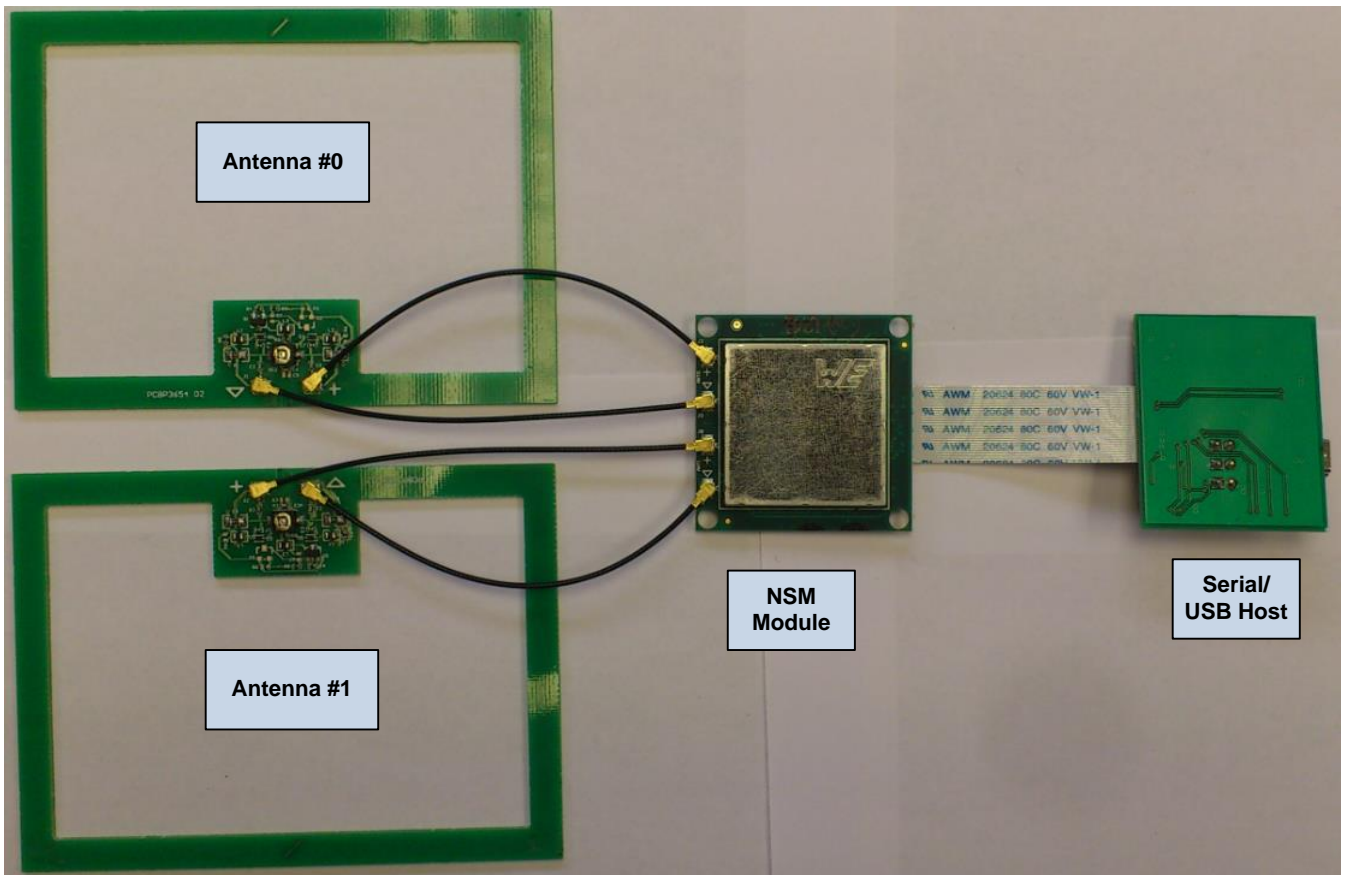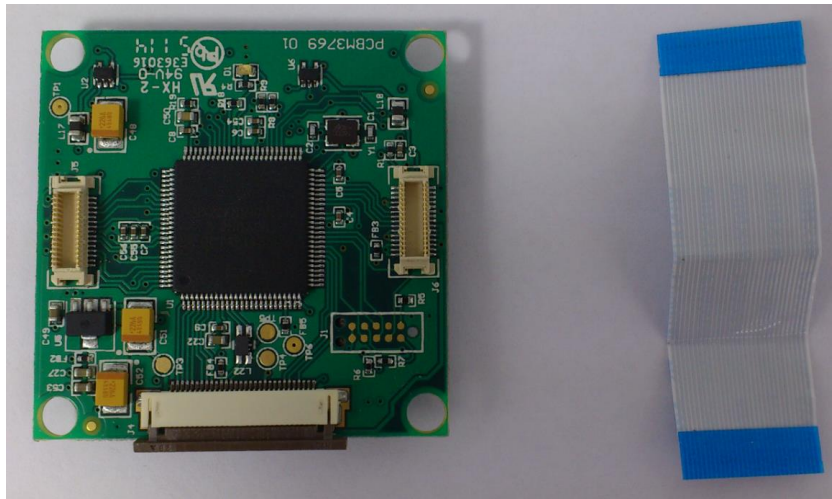
5. Installation

5.1.   Hardware Prerequisites

The following section shows the hardware required for the installation.

- Serial or USB host system where the NSM module will connect to.
- NFC module and 30 way host FFC cable

- Antenna and two U.FL coax cables – If two antennas are used then there will be two set of antenna boards and four coax cables
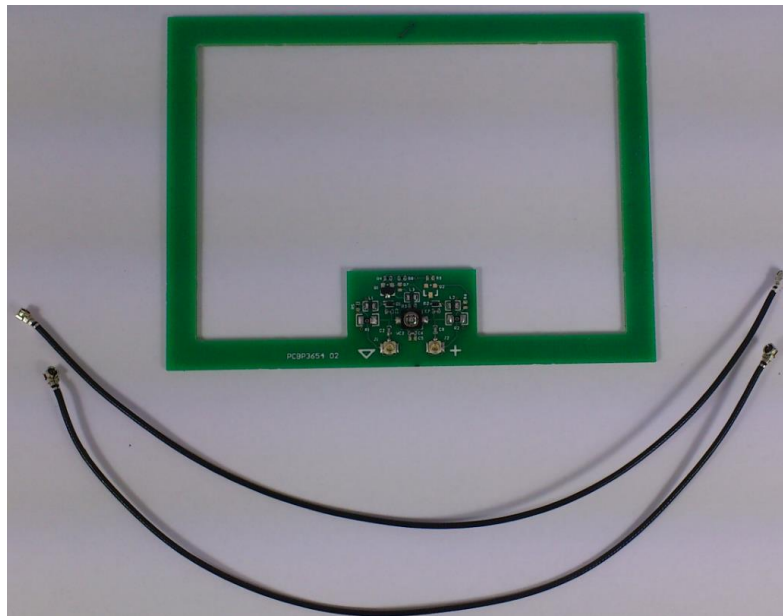
NOTE: The Antenna and the U.FL coax cables can be supplied by Access IS or the user can design the antenna using the support provided by Access IS. U.FL cables are widely available from electronics stores like RS/Farnell.

5.2. Hardware Installation Steps

The following details the installation steps with diagrams.

1, Turn OFF power for the host system before starting the installation

2, Connect the host system to the NFC module using the 30 way FCC cable as shown below. Please refer to Host connector section for the connector location and its pinouts.
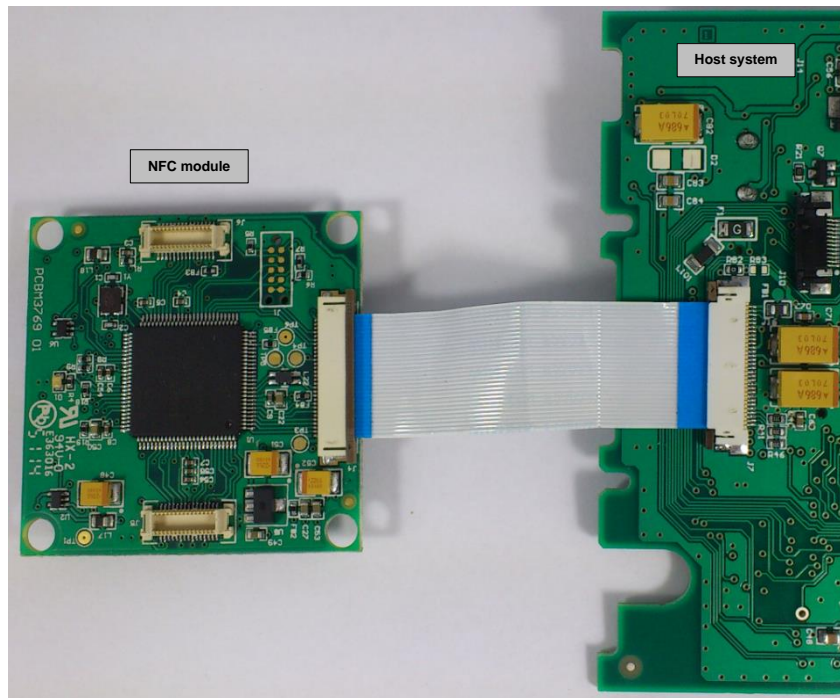
3, Connect the antenna to the NFC module using the coax cables.

NOTE : Antenna coax cables are polarised. Connect the corresponding connectors with +ve markings and ground (triangle) markings on the antenna and NSM module

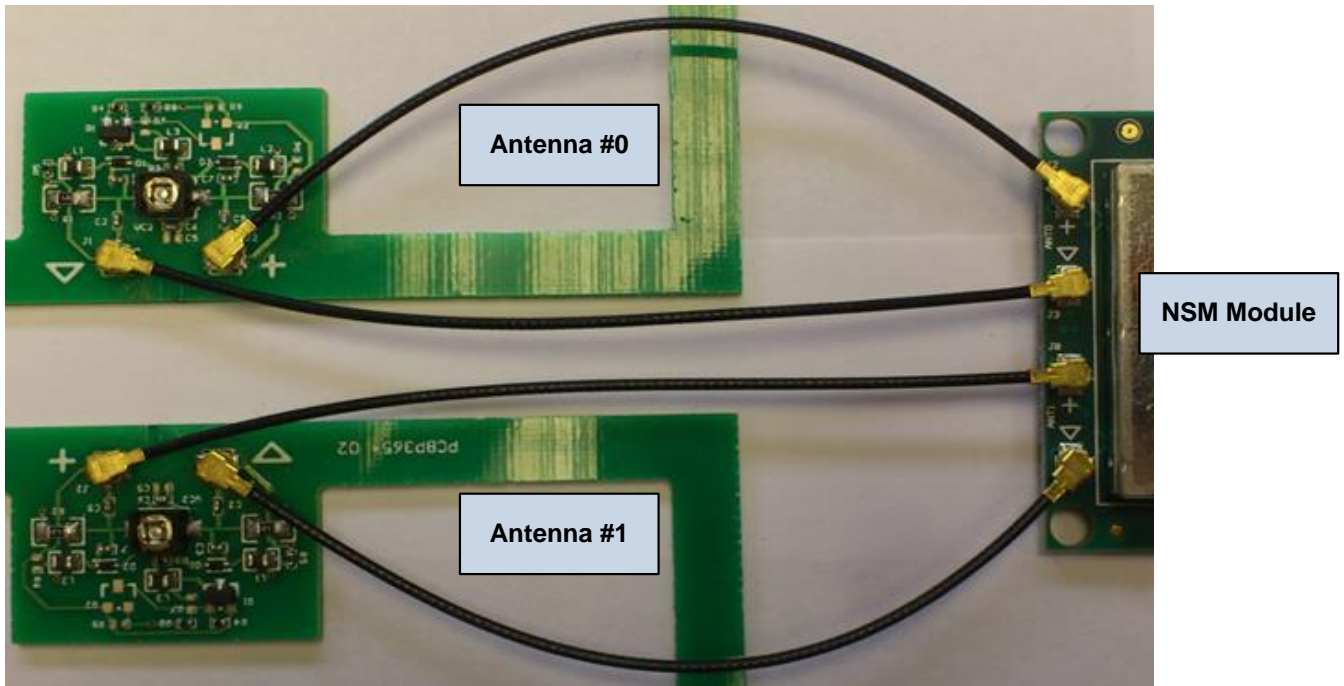NOTE : If single antenna operation is enabled, then firmware uses only Ant #1 – Port J8 and J9. Ant #0, port J2 and J3 are disabled.

4, After the connections are done, select/verify the correct host interface selection on HOST_IFSEL_IO pins. Please refer to Host Interface Selection for HOST_IFSEL_IO pin settings.

5, If the product using the NSM module has a host cable, then a ferrite is required to be attached to the host cable. Please refer Cable Ferrite Specification for the characteristics of the required ferrite and the location of the ferrite on the host cable.

NOTE : The cable ferrite is required to meet the FCC emissions requirement. The user should ensure that the cable ferrite is fitted in accordance to the specifications outlined in this manual. Failure to do so might void the FCC certification.

6, Power up the host system or connect the host adapter to the USB/Serial port. Now, the NFC module and the smart card module should start working. If the host interface is USB, then NSM module shall start enumerating as a HID device and a smartcard reader as shown below.
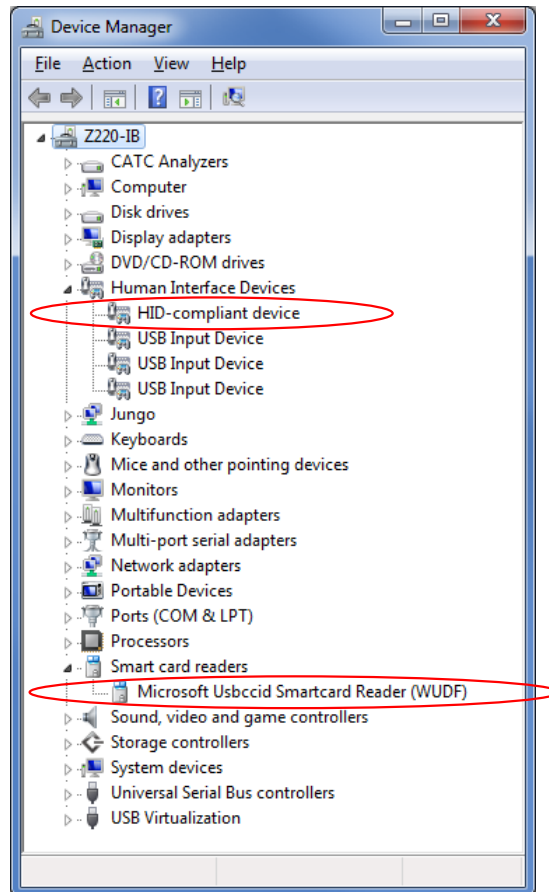
7, Application software can now communicate to NSM module through USB interface or through serial communication (See Serial Communication Settings).

5.3. Software Setup

Depending on the host interface selected, please refer USB or Serial software reference manual.

6. Cable Ferrite Specification

Each NSM module is shipped with a cable ferrite. This ferrite is required on the host cable (if any) to get the emissions levels within the acceptable limits. The cable is passed through the ferrite without any loops. The electrical specification of the ferrite is given below.
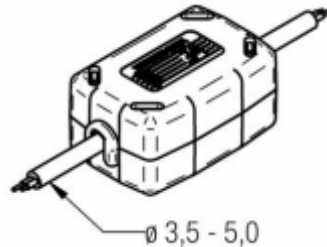
Properties	Test conditions		Value	Unit	Tol.
Impedance @ 25 MHz 1 turn	25 MHz	Z	175	Ω	±25%
Impedance @ 100 MHz 1 turn	100 MHz	Z	320	Ω	±25%
Impedance @ 25 MHz 2 turns	25 MHz	Z	770	Ω	typ.
Impedance @ 100 MHz 2 turns	100 MHz	Z	800	Ω	typ.

The recommended ferrite is from Wurth electronics, Part number – 74 271 111.

The ferrite should be located close to the device (using the NSM module) and it should be spaced 100mm from the device. The position of the ferrite can be critical with regards to the attenuation of radiated emissions. The following diagram shows a typical installation.
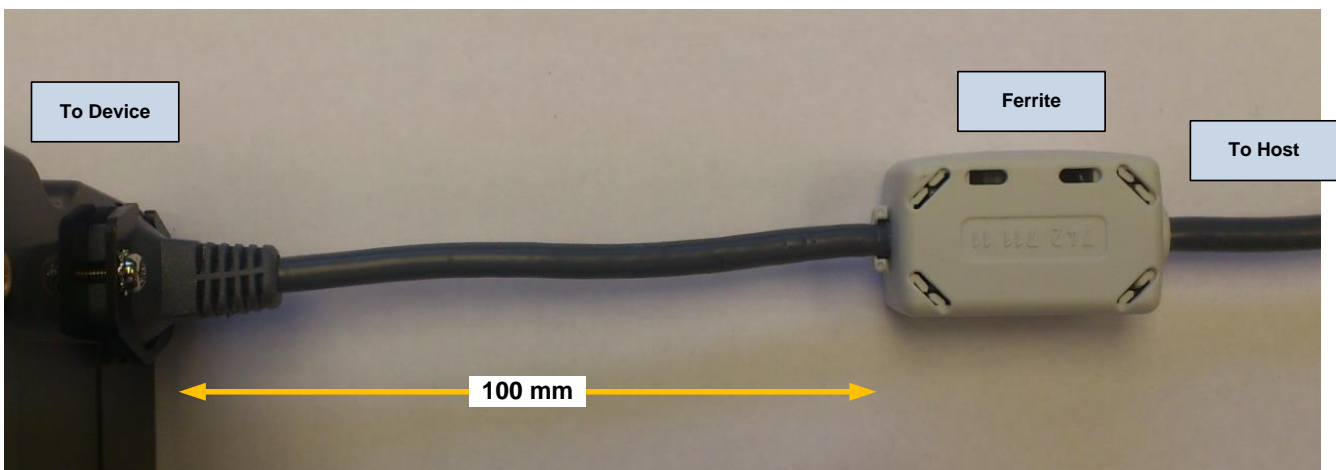
7. Hardware Connections and Pinouts

There are three connectors that provides interface to the NSM module. Each of these connectors are described in detail on the following sections.

7.1. Host connector

The host connector provides interface to the NSM host. Further, it also has additional signals that are brought out of the module for host mode selection and for future expansion. The following diagram shows the location of the 30 way FFC host connector and the pin#1 location.
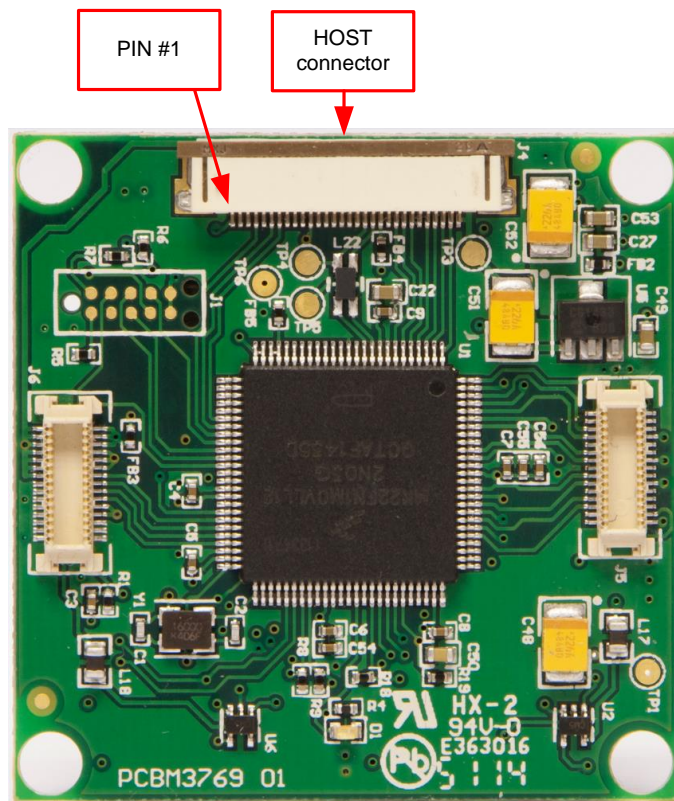
The following table shows the pinouts for the host connector.

Pin #	Signal Type	Signal	Description
1	Ground	GND	Ground signal
2	3V3 CMOS input	HOST_IFSEL_IO2	Host interface selection input – sampled during reset
3	3V3 CMOS input	HOST_IFSEL_IO1	Host interface selection input – sampled during reset
4	3V3 CMOS input	HOST_IFSEL_IO0	Host interface selection input – sampled during reset
5	Ground	GND	Ground signal
6	3V3 CMOS input	CAN1_RX	CAN host receiver line – Not used
7	3V3 CMOS output	CAN1_TX	CAN host transmitter line – Not used
8	Ground	GND	Ground signal
9	Open collector output/input	I2C0_SCL	External I2C interface – Not used
10	Open collector	I2C0_SDA	External I2C interface – Not used

	output/input		
11	Ground	GND	Ground signal
12	3V3 CMOS output	SPI0_CS1	External SPI interface slave select 1 – Not used
13	3V3 CMOS output	SPI0_CS0	External SPI interface slave select 0 – Not used
14	3V3 CMOS output	SPI0_SCK	External SPI interface clock – Not used
15	3V3 CMOS output	SPI0_MOSI	External SPI interface MOSI – Not used
16	3V3 CMOS input	SPI0_MISO	External SPI interface MISO – Not used
17	Power input	5V0	5V power input
18	USB data lines	USB D-	USB D- signal
19	USB data lines	USB D+	USB D+ signal
20	Power input	5V0	5V power input
21	3V3 CMOS output	DEBUG_UART_RTS_n	Debug UART RTS signal, active low
22	3V3 CMOS input	DEBUG_UART_CTS_n	Debug UART CTS signal, active low
23	3V3 CMOS input	DEBUG_UART_RX	Debug UART Receiver line
24	3V3 CMOS output	DEBUG_UART_TX	Debug UART Transmitter line
25	Power input	5V0	5V power input
26	3V3 CMOS output	HOST_UART_RTS_n	Serial host UART RTS signal, active low
27	3V3 CMOS input	HOST_UART_CTS_n	Serial host UART CTS signal, active low
28	3V3 CMOS input	HOST_UART_RX	Serial host UART Receiver line
29	3V3 CMOS output	HOST_UART_TX	Serial host UART Transmitter line
30	Power input	5V0	5V power input

7.2. Host Interface Selection

The NSM module will select the host interface depending on the HOST_IFSEL_IOx signal values during reset. The following table shows the different modes of operation based on the HOST_IFSEL_IOx signal.

HOST_IFSEL_IO2 Host adapter – J9	HOST_IFSEL_IO1 Host adapter – J8	HOST_IFSEL_IO0 Host adapter – J7	Operating mode
0	0	0	USB mode
0	0	1	Serial mode
0	1	0	USB mode
0	1	1	USB mode
1	0	0	USB mode
1	0	1	USB mode
1	1	0	Serial Bootloader mode –Used for firmware update
1	1	1	USB Bootloader mode – Used for firmware update

If host adapter board is used, then the "0" in the above table denotes jumper installed and "1" denotes jumper removed.

Note that if any of the HOST_IFSEL_IO pins are left floating, then the module reads that pin as "1".

7.3. Serial Communication Settings

In serial mode, the module by default uses the following serial communication settings.

Parameter	Value
Baud Rate	115200
Data format	8 bits
Parity	None
Stop bits	1
Flow Control	RTS/CTS

7.4. NFC connectors

The NSM module can be configured to use dual antenna or single antenna. The antenna ports are shown in the table below.

Connector	Description
J2	Antenna #0 Positive end
J3	Antenna #0 Ground end
J8	Antenna #1 Positive end
J9	Antenna #1 Ground end

If one of the antennas is not available, then, the pair of ports for that antenna can be left unconnected. There is no need for port termination.
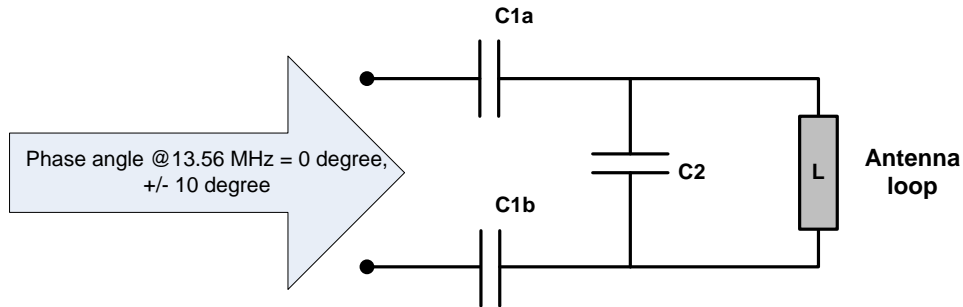
If the module is configured for single antenna, then Antenna #0 is disabled. (Ports J2 and J3 are disabled). The module uses Antenna #1 (Ports J8 and J9) for NFC communication.
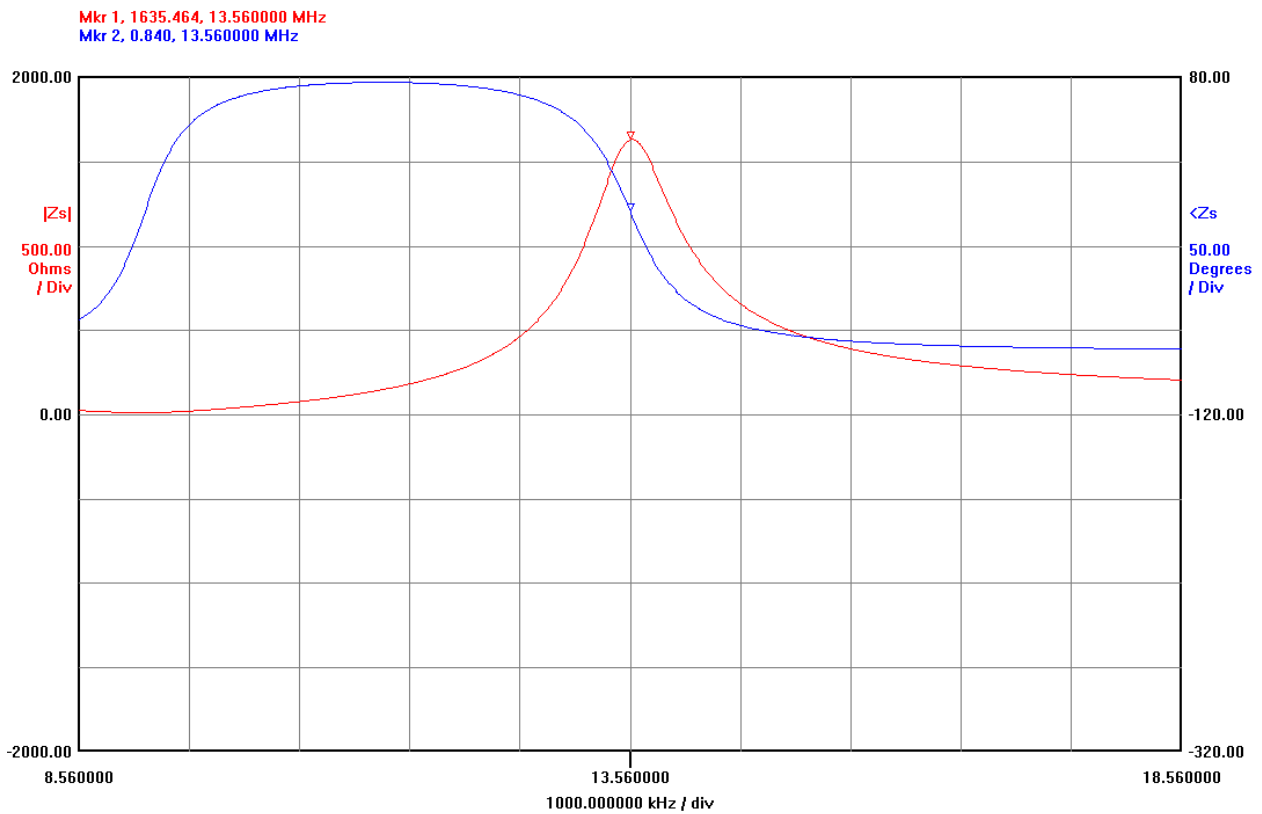
7.5. NFC Antenna

The NFC antenna is a simple LC circuit tuned to 13.56MHz. The following diagram show the circuit of the antenna

The Antenna is tuned to resonate at 13.56MHz with a phase angle tolerance of +/-10 degrees. The following graph shows the impedance and phase for a typical antenna tuned to 13.56MHz.

The following table provides information on the maximum and minimum values for the NFC antenna parameters.

Parameter	Minimum	Typical	Maximum
Impedance @13.56MHz	800 Ohms	1500 Ohms	-
Phase @ 13.56MHz	-10 Degrees	0 Degrees	+10 Degrees
Antenna Coil inductance	700nH	1200nH	2000nH
Antenna Coil Q	15	25	35
Antenna Gain	0.6 (-2.21 dB)	0.7 (-1.54 dB)	0.8 (-0.96 dB)
Antenna maximum size	-	-	11cm x 15cm

8. Revision

Revision	Description
0.0	Initial version
0.1	Antenna tuning and dimensions added
0.2	Installation section added
0.2.0	NFC only version
0.2.1	Pictures updated UL review comments incorporated
0.2.2	Changed wording on Cable Ferrite specification
0.2.3	Cable ferrite added into installation and its location shown