MS45SF1

Dual-core/Multi-Protocol
Bluetooth Low Energy module

Specification V1.0

Dual-core/Multi-potocol nRF5340 Module MS45SF1 Specification

MS45SF1 is a compact size(18.5 x 12.5 x 2.0 mm), most advance, powerful, secure, ultra-low power wireless Dual-core/Multi-protocol BLE 5.3 Module based on nRF5340 SoCs. Supporting Bluetooth Low Energy, Bluetooth mesh, Thread, Matter, makes it an ideal choice for LE Audio, professional lighting, advanced wearables, smart home and other complex IoT applications.

Features

1. Two ARM ® Cortex ® -M33 128/64 MHz processor
2. BLE 5 data rate: 2Mbps,1Mbps, 500 kbps,125kbps. IEEE 802.15.4 Thread Proprietary 2.4 GHz: 2 Mbps, 1 Mbps
3. High-performance Application Processor: 1 MB Flash/512 KB Flash
4. Fully-programmable Network Processor: 256 KB Flash/64 KB Flash
5. GPIO:48
6. 2×UART/4×SPI masters/3×SPI slaves
7. SoC TX power: -20dB to +3dB
8. Operating temperature: -40℃ to +85℃
9. Antenna: PCB
10. Module size: 18.5mm×12.5mm×2.0mm
11. Range: 125kbps: up to 250 meters in open space.

Application

1. Medical devices
2. Heart rate monitor
3. Blood pressure monitor
4. Blood glucose meter
5. Thermometer
6. Sport facilities
7. Weighing machine
8. Sports and fitness sensors
9. Accessories
10. 3D glasses and gaming controller
11. Mobile accessories
12. Remote controllers / Toys
13. Electronic devices
14. Cycle computer
15. Audio Device

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1 Product Introduction

MS45SF1 module is the most advance, compact size(18.5mm×12.5mm×2.0mm), highest performance, secure ultra-low power wireless dule-core/multi protocl BLE 5.3 Module based on nRF5340 SoCs. It combines two flexible Arm Cortex-M33 processors, a 1 MB flash memory, 512 KB RAM application processor, and a 256 KB Flash and 64 KB RAM network processor.

It's a all-in-one module including a superset of the most prominent nRF52® Series features. An extensive range of wireless protocols are supported: Bluetooth 5.1 AOA/AOD, Bluetooth 5.2 LE Audio, Long Range, Bluetooth mesh, Thread can be run concurrently with Bluetooth LE, enabling applications using Matter or HomeKit. ANT, 802.15.4 and 2.4 GHz proprietary protocols are also supported.

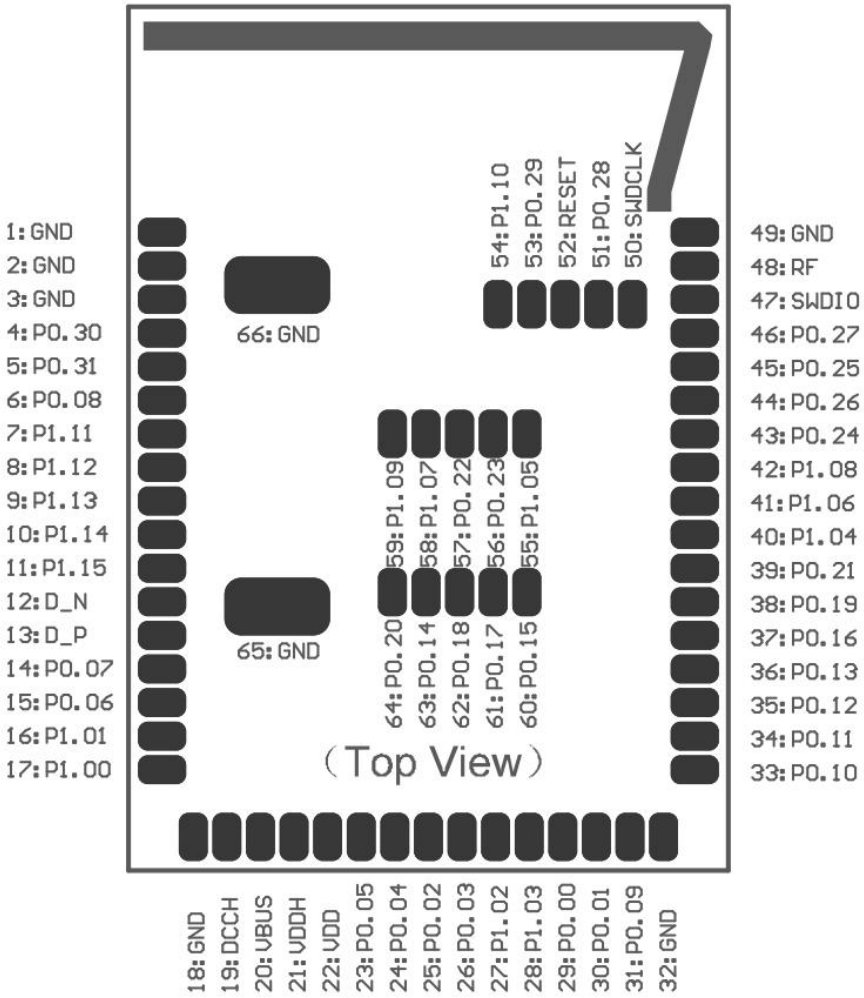
MS45SF1 brings out all features of Nordic nRF5340 Soc, which meets the most complex and security-conscious applications, it allow faster time to market with highest performance, ultra low power management and reduced development cost with multi certifications acquired. MS45SF1 module speed up your IoT solution and make it easier and reliable.

1.1 Ordering information

Ordering number	Description
MS45SF1-1Y40AIR	nRF5340-QIAA BT 5.3 Module, PCB Antenna, Reel pack

2 Pin Description

2.1 Pin assignment



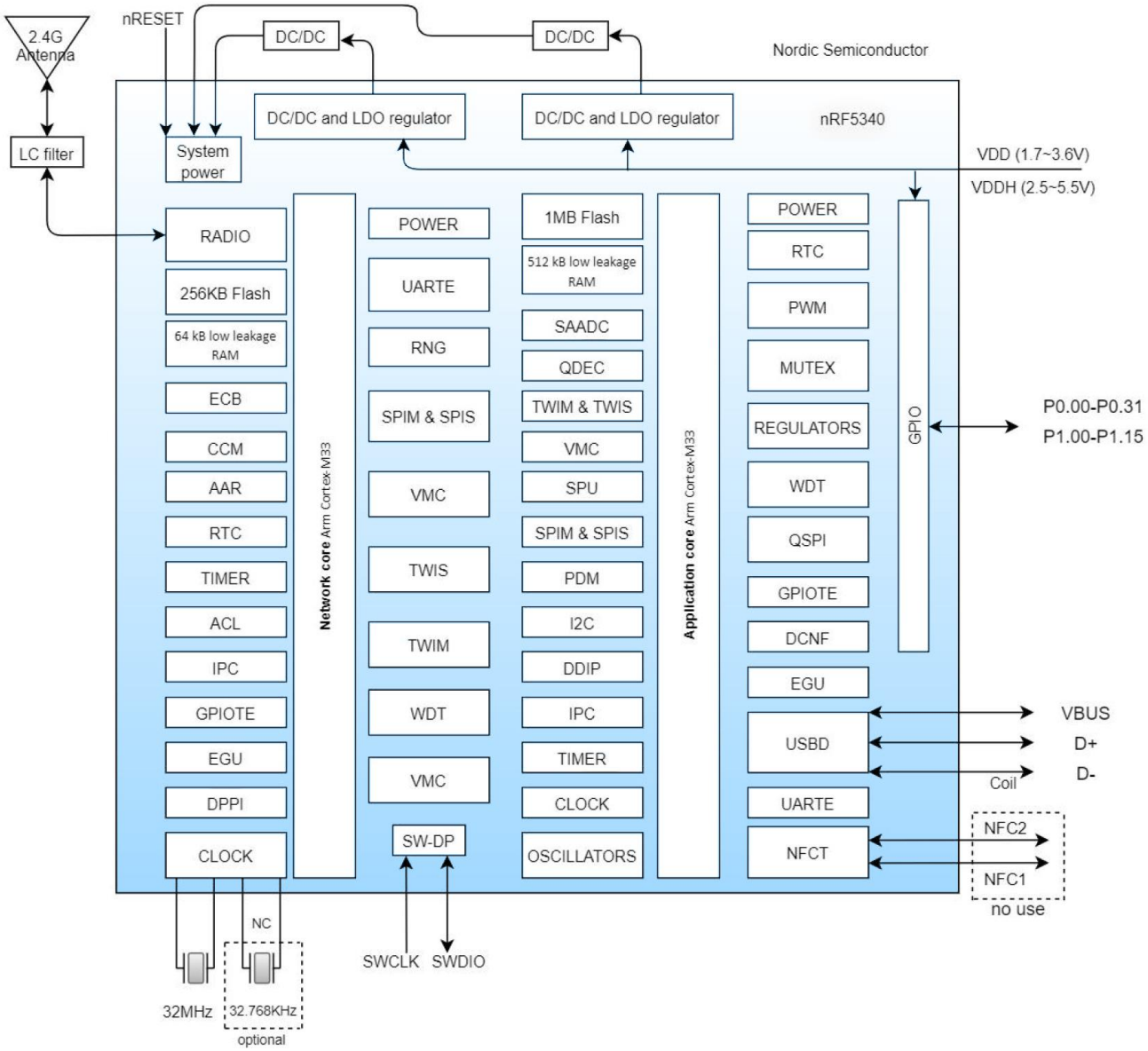
2.2 Pin definition

Symbol	Type	Description
VBUS	Power	5 V input for USB 3.3 V regulator
P1.13	Digital I/O	General purpose I/O
D_P	USB	USB D+
D_N	USB	USB D-
P1.15	Digital I/O	General purpose I/O
P1.14	Digital I/O	General purpose I/O
P1.12	Digital I/O	General purpose I/O
P1.11	Digital I/O	General purpose I/O
P0.31	Digital I/O	General purpose I/O
P0.30	Digital I/O	General purpose I/O
VDD	Power	Power supply
VDDH	Power	Power supply
GND	Power	Ground
DCCH	Power	DC/DC converter output
RF	ANT	Single-ended antenna connection
P1.00	Digital I/O	General purpose I/O
P0.00 XL1	Digital I/O Analog input	General purpose I/O Connection for 32 kHz crystal
P1.01	Digital I/O	General purpose I/O
P0.01 XL2	Digital I/O Analog input	General purpose I/O Connection for 32 kHz crystal
P1.10	Digital I/O	General purpose I/O
P0.29	Digital I/O	General purpose I/O
P0.04 AIN0	Digital I/O Analog input	General purpose I/O Analog input
P0.02 NFC1	Digital I/O NFC input	General purpose I/O NFC antenna connection

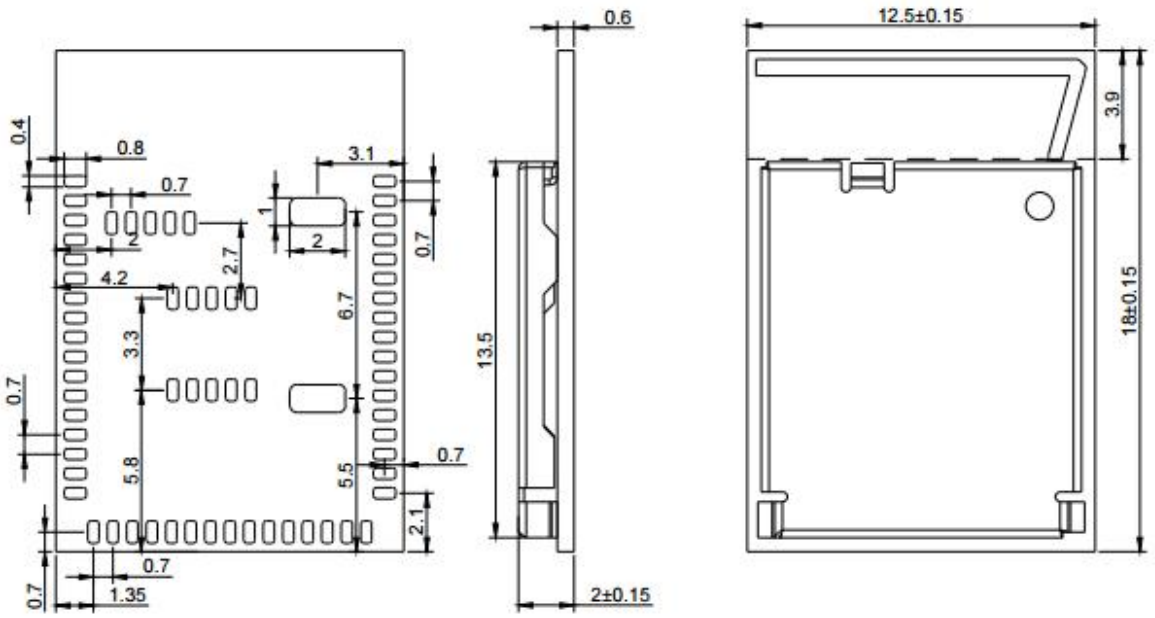
SWDCLK	Debug	Serial wire debug clock input for debug and programming	
P0.05 AIN1	Digital I/O Analog input	General purpose I/O Analog input	
P0.03 NFC2	Digital I/O NFC input	General purpose I/O NFC antenna connection	
SWDIO	Debug	Serial wire debug I/O for debug and programming	
P0.06 AIN2	Digital I/O Analog input	General purpose I/O Analog input	
nRESET	Reset	Pin RESET with internal pull-up resistor	
P0.07 AIN3	Digital I/O Analog input	General purpose I/O Analog input	
P1.02 TWI	Digital I/O TWI 1 Mbps	General purpose I/O High-speed pin for 1 Mbps TWI	TWI
P0.28 AIN7	Digital I/O Analog input	General purpose I/O Analog input	
P1.03 TWI	Digital I/O TWI 1 Mbps	General purpose I/O High-speed pin for 1 Mbps TWI	TWI
P0.08 TRACEDATA3 SCK	Digital I/O Trace data SCK for SPIM4	General purpose I/O Trace buffer TRACEDATA[3] Dedicated pin for high-speed SPI	Trace, SPIM4
P0.09 TRACEDATA2 MOSI	Digital I/O Trace data MOSI for SPIM4	General purpose I/O Trace buffer TRACEDATA[2] Dedicated pin for high-speed SPI	Trace, SPIM4
P0.10 TRACEDATA1 MISO	Digital I/O Trace data MISO for SPIM4	General purpose I/O Trace buffer TRACEDATA[1] Dedicated pin for high-speed SPI	Trace, SPIM4
P0.11 TRACEDATA0 CSN	Digital I/O Trace data CSN for SPIM4	General purpose I/O Trace buffer TRACEDATA[0] Dedicated pin for high-speed SPI	Trace, SPIM4
P0.12 TRACECLK DCX	Digital I/O Trace clock DCX for SPIM4	General purpose I/O Trace buffer clock Dedicated pin for high-speed SPI	Trace, SPIM4
P0.14 IO1	Digital I/O IO1 for QSPI	General purpose I/O Dedicated pin for Quad SPI	QSPI
P0.15 IO2	Digital I/O IO2 for QSPI	General purpose I/O Dedicated pin for Quad SPI	QSPI
P0.17 SCK	Digital I/O SCK for QSPI	General purpose I/O Dedicated pin for Quad SPI	QSPI

P0.18 CSN	Digital I/O CSN for QSPI	General purpose I/O Dedicated pin for Quad SPI	QSPI
P0.20	Digital I/O	General purpose I/O	
P0.22	Digital I/O	General purpose I/O	
P0.23	Digital I/O	General purpose I/O	
P1.05	Digital I/O	General purpose I/O	
P1.07	Digital I/O	General purpose I/O	
P1.09	Digital I/O	General purpose I/O	
P0.25 AIN4	Digital I/O Analog input	General purpose I/O Analog input	
P0.27 AIN6	Digital I/O Analog input	General purpose I/O Analog input	
P0.13 IO0	Digital I/O IO0 for QSPI	General purpose I/O Dedicated pin for Quad SPI	QSPI
P0.16 IO3	Digital I/O IO3 for QSPI	General purpose I/O Dedicated pin for Quad SPI	QSPI
P0.19	Digital I/O	General purpose I/O	
P0.21	Digital I/O	General purpose I/O	
P1.04	Digital I/O	General purpose I/O	
P1.06	Digital I/O	General purpose I/O	
P1.08	Digital I/O	General purpose I/O	
P0.24	Digital I/O	General purpose I/O	
P0.26 AIN5	Digital I/O Analog input	General purpose I/O Analog input	

2.3 Block diagram



2.4 Mechanical Drawing



Important: Unit: mm Tolerance: +/- 0.1, default
Recommend pad size for general I/O : 0.4*1.0mm
Recommend pad size for I/O 65/66: 1.2*2.2mm

3 Electrical Specification

The electrical specifications of the module are directly related to the Nordic semiconductor Specifications for the nRF5340 chipset. The below information is only the extract from nRF5340 specification. For more detailed information, please refer to the up-to-date specification of the chipset available on the Nordic semiconductor website.

3.1 Absolute maximum ratings

	Min.	Max.	Unit
Supply voltages			
VDD	-0.3	+3.9	V
VDDH	-0.3	+5.8	V
VBUS	-0.3	+5.8	V
VSS		0	V
I/O pin voltage			
$V_{I/O}$, VDD ≤ 3.6 V	-0.3	VDD + 0.3	V
$V_{I/O}$, VDD > 3.6 V	-0.3	3.9	V
NFC antenna pin current			
$I_{NFC1/2}$		80	mA
Radio			
RF input level		10	dBm
Environmental aQFN package			
Storage temperature	-40	+125	℃
Moisture Sensitivity Level(MSL)		2	kV
ESD Human Body Model(HBM)		2(all pins except DECR and DECN, rated at 1.4 kV)	KV
ESD Charged Device Model(CDM)		500	V
Flash memory			
Endurance	10 000 write/erase cycles		
Retention	10 years at 40°C		

Important: Maximum ratings are the extreme limits to which the chip can be exposed for a limited amount of time without permanently damaging it. Exposure to absolute maximum ratings for prolonged periods of time may affect the reliability of the device.

3.2 Recommended operating conditions

The operating conditions are the physical parameters that the chip can operate within.

Symbol	Parameter	Min.	Nom.	Max.	Units
VDD	VDD supply voltage, independent of DCDC enable	1.7	3.0	3.6	V
VDDH	VDDH supply voltage,independent of DCDC enable	2.5	3.7	5.5	V
VBUS	VBUS USB supply voltage	4.35	5.0	5.5	V
TA	Operating temperature	-40	25	85	°C

Important: The on-chip power-on reset circuitry may not function properly for rise times longer than the specified maximum.

3.3 Electronic characteristic

3.3.1 General radio characteristics

Symbol	Description	Min.	Typ.	Max.	Units
f_{OP}	Operating frequencies	2360		2500	MHz
$f_{PLL,CH,SP}$	PLL channel spacing		1.0		MHz
$f_{DELTA,1M}$	Frequency deviation @ 1 Mbps		±170		kHz
$f_{DELTA,BLE,1M}$	Frequency deviation @ Bluetooth LE 1 Mbps		±250		kHz
$f_{DELTA,2M}$	Frequency deviation @ 2 Mbps		±320		kHz
$f_{DELTA,BLE,2M}$	Frequency deviation @ Bluetooth LE 2 Mbps		±500		kHz
fsk_{BPS}	On-the-air data rate	125		2000	kbps
$f_{chip,\ IEEE\ 802.15.4}$	Chip rate in IEEE 802.15.4 mode		2000		kchip/s

3.3.2 Radio current consumption (Transmitter)

Symbol	Description	Min.	Typ.	Max.	Units
$I_{TX,PLUS3dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = +3 dBm		5.1		mA
$I_{TX,PLUS3dBM}$	TX only run current P_{RF} = +3 dBm		11.3		mA
$I_{TX,0dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = 0 dBm		3.4		mA
$I_{TX,0dBM}$	TX only run current P_{RF} = 0 dBm		9.1		mA
$I_{TX,MINUS4dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = -4 dBm		2.7		mA
$I_{TX,MINUS4dBM}$	TX only run current P_{RF} = -4 dBm		7.2		mA
$I_{TX,MINUS8dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = -8 dBm		2.2		mA
$I_{TX,MINUS8dBM}$	TX only run current P_{RF} = -8 dBm		5.8		mA
$I_{TX,MINUS12dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = -12 dBm		2.0		mA
$I_{TX,MINUS12dBM}$	TX only run current P_{RF} = -12 dBm		5.0		mA
$I_{TX,MINUS16dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = -16 dBm		1.8		mA
$I_{TX,MINUS16dBM}$	TX only run current P_{RF} = -16 dBm		4.5		mA
$I_{TX,MINUS20dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = -20 dBm		1.7		mA
$I_{TX,MINUS20dBM}$	TX only run current P_{RF} = -20 dBm		4.2		mA
$I_{TX,MINUS40dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = -40 dBm		1.5		mA
$I_{TX,MINUS40dBM}$	TX only run current P_{RF} = -40 dBm		3.8		mA
$I_{START,TX,DCDC}$	TX start-up current DC/DC, 3 V, P_{RF} = 3 dBm		2.4		mA
$I_{START,TX}$	TX start-up current, P_{RF} = 3 dBm		5.4		mA

3.3.3 Radio current consumption (Receiver)

Symbol	Description	Min	Typ.	Max.	Units
$I_{RX,1M,DCDC}$	RX only run current DC/DC, 3 V, 1 Mbps/1 Mbps Bluetooth LE mode		2.7		mA
$I_{RX,1M}$	RX only run current LDO, 3 V, 1 Mbps/1 Mbps Bluetooth LE mode		6.7		mA
$I_{RX,2M,DCDC}$	RX only run current DC/DC, 3 V, 2 Mbps/2 Mbps Bluetooth LE mode		3.1		mA
$I_{RX,2M}$	RX only run current LDO, 3 V, 2 Mbps/2 Mbps Bluetooth LE mode		7.9		mA
$I_{START,RX,1M,DCDC}$	RX start-up current DC/DC, 3 V, 1 Mbps/1 Mbps Bluetooth LE mode		2.1		mA
$I_{START,RX,1M}$	RX start-up current 1 Mbps/1 Mbps Bluetooth LE mode		5.3		mA

3.3.4 Transmitter specification

Symbol	Description	Min.	Typ.	Max.	Units
P_{RF}	Maximum output power		3.0		dBm
P_{RFC}	RF power control range		23.0		dB
P_{RFCR}	RF power accuracy		±2		dB
$P_{RF1,1}$	1st Adjacent Channel Transmit Power 1 MHz (1 Mbps)		-24		dBc
$P_{RF2,1}$	2nd Adjacent Channel Transmit Power 2 MHz (1 Mbps)		-52		dBc
$P_{RF1,2}$	1st Adjacent Channel Transmit Power 2 MHz (2 Mbps)		-25		dBc
$P_{RF2,2}$	2nd Adjacent Channel Transmit Power 4 MHz (2 Mbps)		-50		dBc
E_{VM}	Error vector magnitude in IEEE 802.15.4 mode		..	..	%rms
$P_{harm2nd,IEEE\ 802.15.4}$	2nd harmonics in IEEE 802.15.4 mode		-51		dBm
$P_{harm3rd,IEEE\ 802.15.4}$	3rd harmonics in IEEE 802.15.4 mode		-51		dBm
$P_{ACP,R,\ IEEE\ 802.15.4}$	IEEE 802.15.4 Relative adjacent Channel Power, offset > 3.5 MHz		-36		dBc
$P_{ACP,A,\ IEEE\ 802.15.4}$	IEEE 802 15.4 Absolute adjacent Channel Power, offset > 3.5 MHz		-36		dBm

3.3.5 Receiver operation

Symbol	Description	Min.	Typ.	Max.	Units
$P_{RX,MAX}$	Maximum received signal strength at < 0.1% PER		0		dBm
$P_{SENS,IT,1M}$	Sensitivity, 1 Mbps nRF mode ideal transmitter [1]		-95		dBm
$P_{SENS,IT,2M}$	Sensitivity, 2 Mbps nRF mode ideal transmitter [2]		-92		dBm
$P_{SENS,IT,SP,1M,BLE}$	Sensitivity, 1 Mbps Bluetooth LE ideal transmitter, packet length ≤ 37 bytes BER = 1E-3[3]		-98		dBm
$P_{SENS,IT,LP,1M,BLE}$	Sensitivity, 1 Mbps Bluetooth LE ideal transmitter, packet length ≥ 128 bytes BER = 1E-4[4]		-97		dBm
$P_{SENS,IT,SP,2M,BLE}$	Sensitivity, 2 Mbps Bluetooth LE ideal transmitter, packet length ≤ 37 bytes		-95		dBm
$P_{SENS,IT,BLE\ LE125k}$	Sensitivity, 125 kbps Bluetooth LE mode		-104		dBm
$P_{SENS,IT,BLE\ LE500k}$	Sensitivity, 500 kbps Bluetooth LE mode		-100		dBm
$P_{SENS,IEEE\ 802.15.4}$	Sensitivity in IEEE 802.15.4 mode		-101		dBm

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[1] Typical sensitivity applies when ADDR0 is used for receiver address correlation. When ADDR[1...7] are used for receiver address correlation, the typical sensitivity for this mode is degraded by 3dB.

[2] Desired signal level at PIN = -67 dBm. One interferer is used, having equal modulation as the desired signal. The input power of the interferer where the sensitivity equals BER = 0.1% is presented.

[3] As defined in the Bluetooth Core Specification v4.0 Volume 6: Core System Package (Low Energy Controller Volume)

[4] Equivalent BER limit < 10E-04

3.3.6 RX selectivity

Symbol	Description	Min.	Typ.	Max.	Units
$C/I_{1M,co\text{-}channel}$	1Mbps mode, co-channel interference	..	..	..	dB
$C/I_{1M,-1MHz}$	1 Mbps mode, Adjacent (-1 MHz) interference	..	..	..	dB
$C/I_{1M,+1MHz}$	1 Mbps mode, Adjacent (+1 MHz) interference	..	..	..	dB
$C/I_{1M,-2MHz}$	1 Mbps mode, Adjacent (-2 MHz) interference	..	..	..	dB
$C/I_{1M,+2MHz}$	1 Mbps mode, Adjacent (+2 MHz) interference	..	..	..	dB
$C/I_{1M,-3MHz}$	1 Mbps mode, Adjacent (-3 MHz) interference	..	..	..	dB
$C/I_{1M,+3MHz}$	1 Mbps mode, Adjacent (+3 MHz) interference	..	..	..	dB
$C/I_{1M,\pm6MHz}$	1 Mbps mode, Adjacent (≥6 MHz) interference	..	..	..	dB
$C/I_{1MBLE,co\text{-}channel}$	1 Mbps Bluetooth LE mode, co-channel interference		6.9		dB
$C/I_{1MBLE,-1MHz}$	1 Mbps Bluetooth LE mode, Adjacent (-1 MHz) interference		-2.6		dB
$C/I_{1MBLE,+1MHz}$	1 Mbps Bluetooth LE mode, Adjacent (+1 MHz) interference		-8.5		dB
$C/I_{1MBLE,-2MHz}$	1 Mbps Bluetooth LE mode, Adjacent (-2 MHz) interference		-27		dB
$C/I_{1MBLE,+2MHz}$	1 Mbps Bluetooth LE mode, Adjacent (+2 MHz) interference		-45		dB
$C/I_{1MBLE,>3MHz}$	1 Mbps Bluetooth LE mode, Adjacent (≥3 MHz) interference		-50		dB
$C/I_{1MBLE,image}$	Image frequency interference		-27		dB
$C/I_{1MBLE,image,1MHz}$	Adjacent (1 MHz) interference to in-band image frequency		-41		dB
$C/I_{2M,co\text{-}channel}$	2 Mbps mode, co-channel interference	..	..	..	dB
$C/I_{2M,-2MHz}$	2 Mbps mode, Adjacent (-2 MHz) interference	..	..	..	dB
$C/I_{2M,+2MHz}$	2 Mbps mode, Adjacent (+2 MHz) interference	..	..	..	dB
$C/I_{2M,-4MHz}$	2 Mbps mode, Adjacent (-4 MHz) interference	..	..	..	dB
$C/I_{2M,+4MHz}$	2 Mbps mode, Adjacent (+4 MHz) interference	..	..	..	dB
$C/I_{2M,-6MHz}$	2 Mbps mode, Adjacent (-6 MHz) interference	..	..	..	dB

$C/I_{2M,+6MHz}$	2 Mbps mode, Adjacent (+6 MHz) interference	..	..	..	dB
$C/I_{2M,\geq12MHz}$	2 Mbps mode, Adjacent (≥12 MHz) interference	..	..	..	dB
$C/I_{2MBLE,co\text{-}channel}$	2 Mbps Bluetooth LE mode, co-channel interference		7.1		dB
$C/I_{2MBLE,-2MHz}$	2 Mbps Bluetooth LE mode, Adjacent (-2 MHz) interference		-2		dB
$C/I_{2MBLE,+2MHz}$	2 Mbps Bluetooth LE mode, Adjacent (+2 MHz) interference		-11		dB
$C/I_{2MBLE,-4MHz}$	2 Mbps Bluetooth LE mode, Adjacent (-4 MHz) interference		-22		dB
$C/I_{2MBLE,+4MHz}$	2 Mbps Bluetooth LE mode, Adjacent (+4 MHz) interference		-47		dB
$C/I_{2MBLE,\geq6MHz}$	2 Mbps Bluetooth LE mode, Adjacent (≥6 MHz) interference		-54		dB
$C/I_{2MBLE,image}$	Image frequency interference		-22		dB
$C/I_{2MBLE,image,\ 2MHz}$	Adjacent (2 MHz) interference to in-band image frequency		-42		dB
$C/I_{125k\ BLE\ LR,co\text{-}channel}$	125 kbps Bluetooth LE LR mode, co-channel interference	..	..	..	dB
$C/I_{125k\ BLE\ LR,-1MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (-1 MHz) interference	..	..	..	dB
$C/I_{125k\ BLE\ LR,+1MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (+1 MHz) interference	..	..	..	dB
$C/I_{125k\ BLE\ LR,-2MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (-2 MHz interference	..	..	..	dB
$C/I_{125k\ BLE\ LR,+2MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (+2 MHz) interference	..	..	..	dB
$C/I_{125k\ BLE\ LR,>3MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (≥3 MHz) interference	..	..	..	dB
$C/I_{125k\ BLE\ LR,image}$	Image frequency interference	..	..	..	dB
$C/I_{IEEE\ 802.15.4,-5MHz}$	IEEE 802.15.4 mode, Adjacent (-5 MHz) rejection		-33		dB
$C/I_{IEEE\ 802.15.4,+5MHz}$	IEEE 802.15.4 mode, Adjacent (+5 MHz) rejection		-38		dB
$C/I_{IEEE\ 802.15.4,\pm10MHz}$	IEEE 802.15.4 mode, Alternate (±10 MHz) rejection		-50		dB

3.3.7 RX intermodulation

Symbol	Description	Min.	Typ.	Max.	Units
$P_{IMD,5TH,1M}$	IMD performance, 1 Mbps, 5th offset channel, packet length ≤ 37 bytes		..	..	dBm
$P_{IMD,5TH,1M,BLE}$	IMD performance, Bluetooth LE 1 Mbps, 5th offset channel, packet length ≤ 37 bytes		-26		dBm
$P_{IMD,5TH,2M}$	IMD performance, 2 Mbps, 5th offset channel, packet length ≤ 37 bytes		..	..	dBm

3.3.8 Radio timing

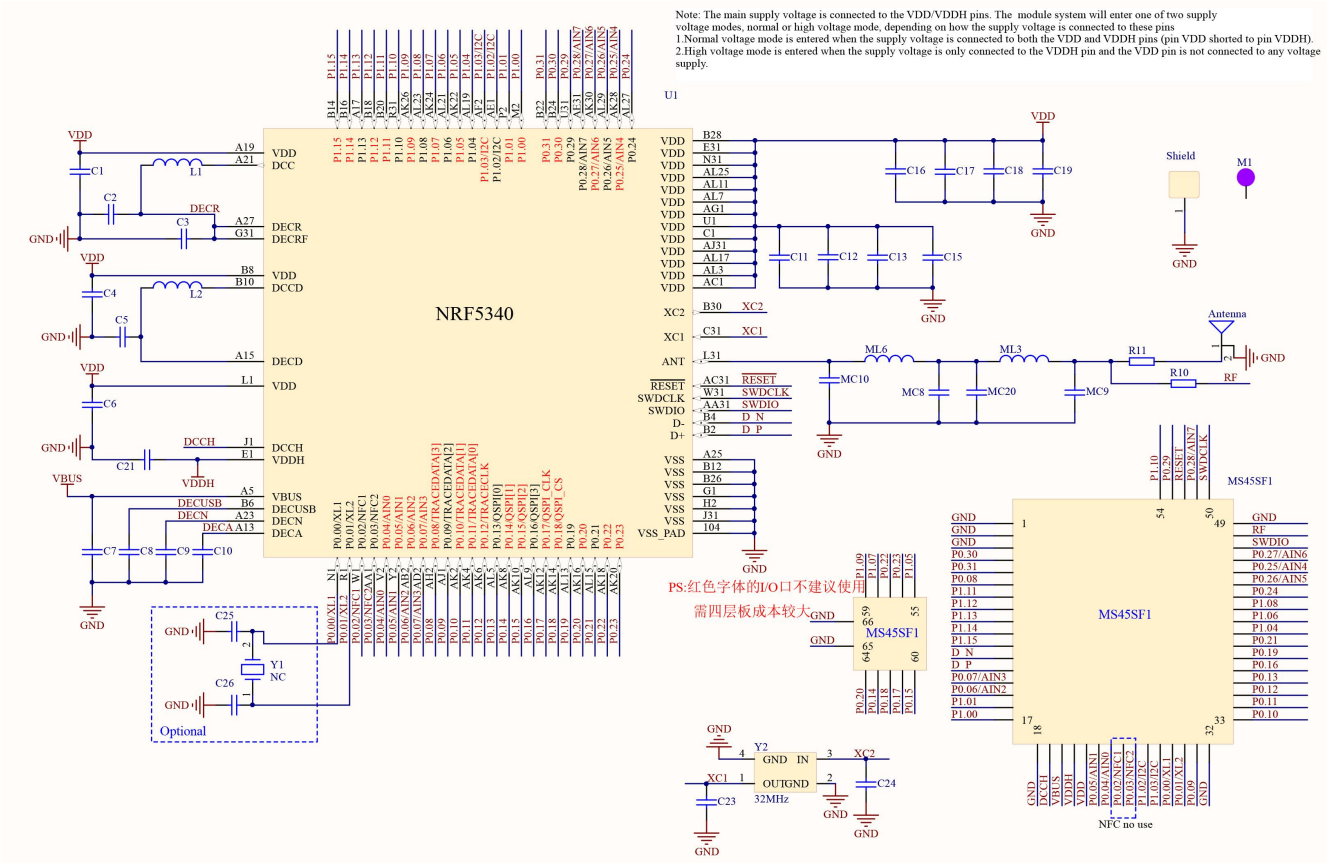
Symbol	Description	Min.	Typ.	Max.	Units
$t_{TXEN,BLE,1M}$	Time between TXEN task and READY event after channel FREQUENCY configured (1Mbps Bluetooth LE and 150 μsTIFS)		140		μs
$t_{TXEN,FAST,BLE,1M}$	Time between TXEN task and READY event after channel FREQUENCY configured (1Mbps Bluetooth LE with fast ramp-up and 150 μs TIFS)		40		us
$t_{TXDIS,BLE,1M}$	When in TX, delay between DISABLE task and DISABLED event for MODE = Nrf_1Mbit and MODE =Ble_1Mbit		6		us
$t_{RXEN,BLE,1M}$	Time between the RXEN task and READY event after channel FREQUENCY configured (1 Mbps Bluetooth LE)		140		us
$t_{RXEN,FAST,BLE,1M}$	Time between the RXEN task and READY event after channel FREQUENCY configured (1 Mbps Bluetooth LE with fast ramp-up)		40		us
$t_{RXDIS,BLE,1M}$	When in RX, delay between DISABLE task and DISABLED event for MODE = Nrf_1Mbit and MODE = Ble_1Mbit		0		us
$t_{TXDIS,BLE,2M}$	When in TX, delay between DISABLE task and DISABLED event for MODE = Nrf_2Mbit and MODE = Ble_2Mbit		4		us
$t_{RXDIS,BLE,2M}$	When in RX, delay between DISABLE task and DISABLED event for MODE = Nrf_2Mbit and MODE = Ble_2Mbit		0		us
$t_{TXEN,IEEE\ 802.15.4}$	Time between TXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode)		130		us
$t_{TXEN,FAST,IEEE\ 802.15.4}$	Time between TXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode with fast ramp-up)		40		us
$t_{TXDIS,IEEE\ 802.15.4}$	When in TX, delay between DISABLE task and DISABLED event (IEEE 802.15.4 mode)		21		us
$t_{RXEN,IEEE\ 802.15.4}$	Time between the RXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode)		130		us

$t_{RXEN,FAST,IEEE\ 802.15.4}$	Time between the RXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode with fast ramp-up)	40	us
$t_{RXDIS,IEEE\ 802.15.4}$	When in RX, delay between DISABLE task and DISABLED event (IEEE 802.15.4 mode)	0.5	us
$t_{RX\text{-}to\text{-}TX\ turnaround}$	Maximum TX-to-RX or RX-to-TX turnaround time in IEEE 802.15.4 mode	40	us

3.3.9 Received signal strength indicator (RSSI) specifications

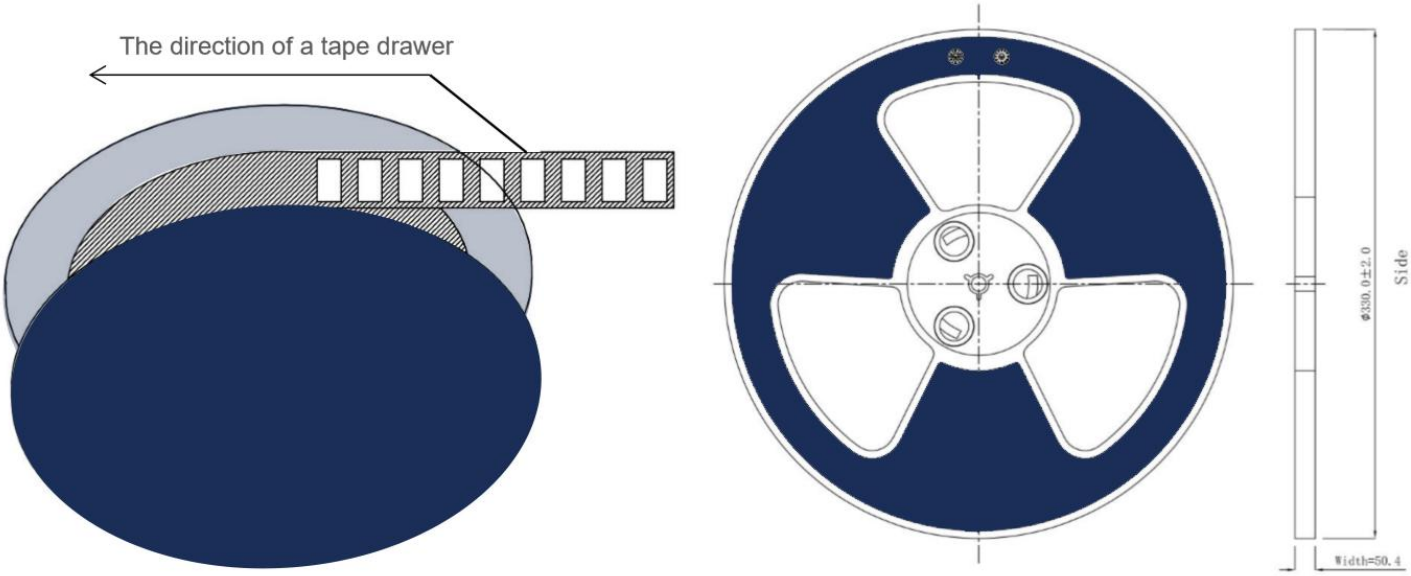
Symbol	Description	Min	Typ.	Max.	Units
$RSSI_{ACC}$	RSSI Accuracy		±2		dB
$RSSI_{RESOLUTION}$	RSSI resolution		1		dB
$RSSI_{PERIOD}$	RSSI sampling time from RSSI_START task		0.25		us
$RSSI_{SETTLE}$	RSSI settling time after signal level change		15		dBm

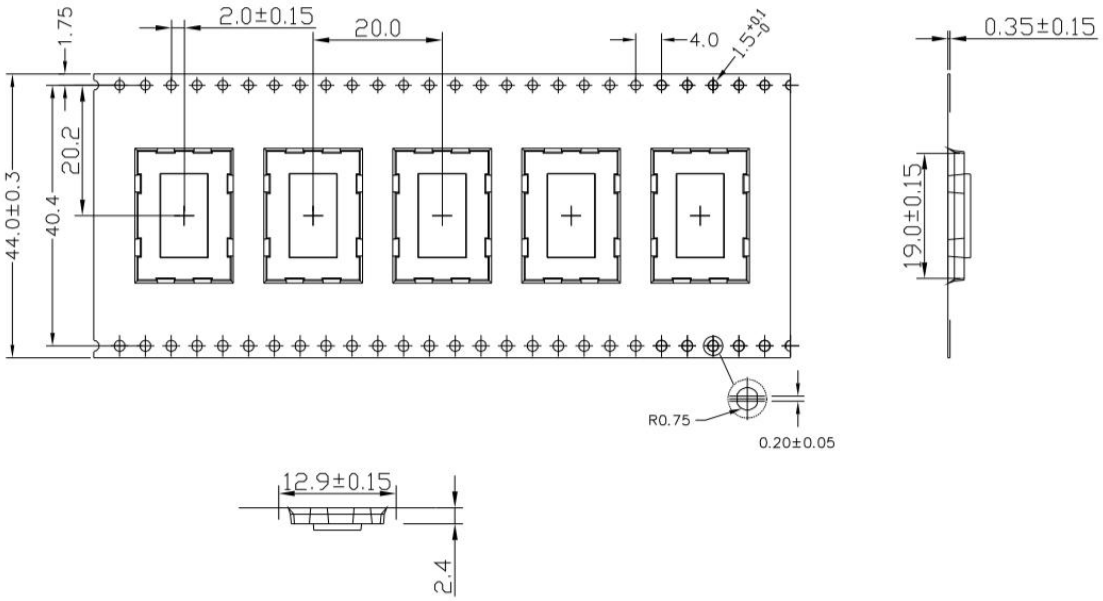
4 Electrical Schematic



5 Package Information

5.1 Package dimension

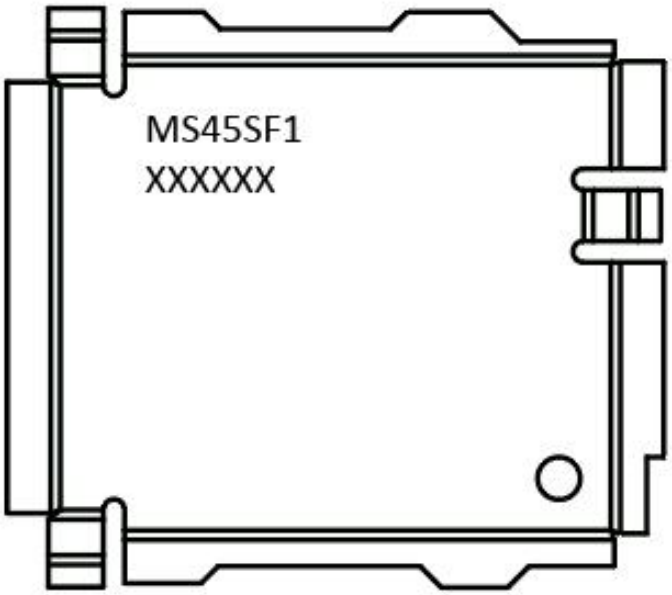




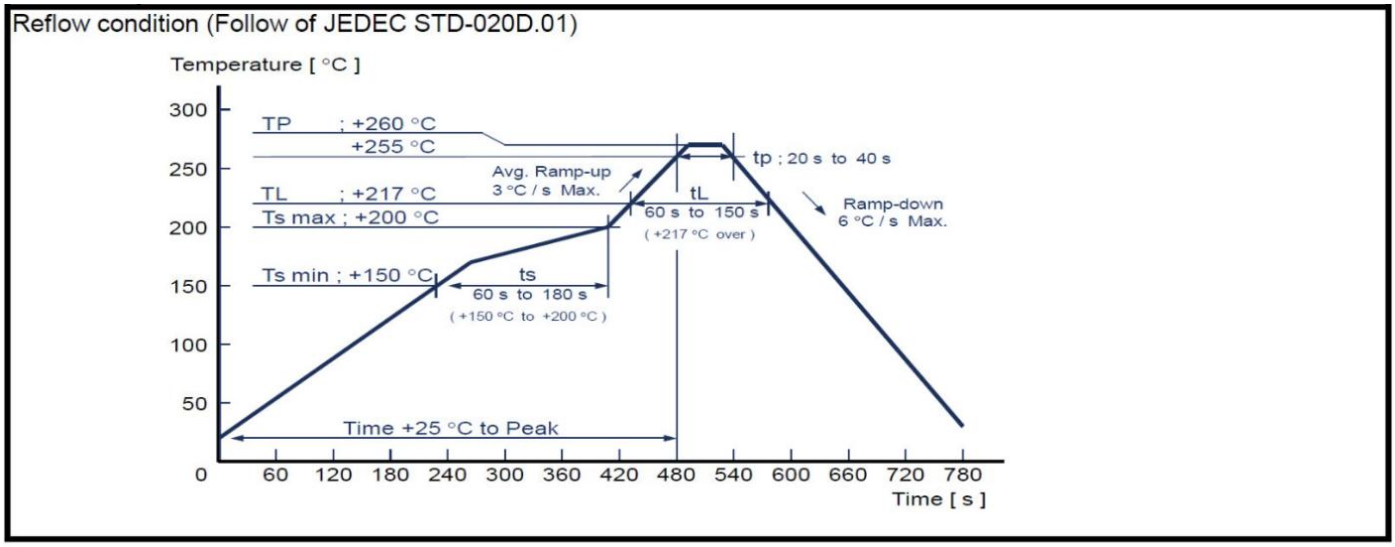
Details of Package Dimension:

Details	Reel-MS45SF1
Quantity(module)	850PCS
Tape Weight	723g
Single module Weight	0.54g
Gross Weight	1183g
Dimension	W: 44mm T: 0.35mm

5.2 Mark on metal shield



6 Reflow and Soldering



Profile Feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min (Tsmin)	100°C	150°C
Preheat Temperature max (Tsmax)	150°C	200°C
Preheat Time (Tsmin to Tsmax)(ts)	60-120 sec	60-120 sec
Average ramp-up rate (Tsmax to Tp)	3°C/second max	3°C/second max
Liquidous Temperature (TL)	183°C	217°C
Time (tL)Maintained Above (TL)	60-90 sec	30-90 sec
Peak Temperature (Tp)	220-235°C	230-250°C
Average ramp-down rate (Tp to Tsmax)	6°C/second max	6°C/second max
Time 25°C to peak temperature	6 minutes max	8 minutes max

Important:

- When SMT involves double-sided patch, it is recommended that the module surface be reflowed only once.
- For module SMT, it is recommended to make a partial stepped stencil with a thickness of 0.2mm, and the stencil hole should be extended by 0.8mm size.
- After opening the package, it should be stored in vacuum environment. Module should not be exposed to the air for a long time to prevent moisture and pad oxidation. If there is an interval of 7 to 30 days during SMT process, it is recommended to bake it with reel at 65-70 degrees for 24 hours before using for SMT again.

7 Certification

7.1 FCC Certification

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

The MS45SF1 is an BT Module with GFSK modulation. It operates on the 2402MHz~2480MHz band and, therefore, is within U.S. FCC part 15.247 standard

2.3 Specific operational use conditions

The EUT is a BT Module

BLE:

Operation Frequency: 2402-2480MHz for BLE;

Modulation Type: GFSK

Number Of Channel: 40 channels

Antenna Designation: PCB Antenna

Antenna Gain: -0.18 dBi

2.4 Limited module procedures

not applicable; Single Modular Approval Request

2.5 Trace antenna designs

Not applicable;

2.6 RF exposure considerations

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction

2.7 Antennas

The MS45SF1 is an BT Module beams signals and communicates with its antenna, which is PCB

Antenna. The PCB Antenna gain is -0.18 dBi. Antenna could not be in no-load state when module is working. During debugging, it is suggested to add 50 ohms load to the antenna port to avoid damage or performance degradation of the module under long-time no-load condition.

2.8 Label and compliance information

The final end product must be label in a visible area with the following

Host must Contains FCC ID: 2ABU6-MS45SF1. If the size of the end product is larger than

24x16mm, then the following FCC part 15.19 statement has to also be available on the label: 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.

2.9 Information on test modes and additional testing requirements

Data transfer module demo board can control the EUT work in RF test mode at specified test channel.

2.10 Additional testing, Part 15 Subpart B disclaimer

The module without unintentional-radiator digital circuit, so the module does not required an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.

ATTENTION

This device is intended only for OEM integrators under the following conditions:

1) The antenna must be installed such that 5 mm is maintained between the antenna and users, and

2) This device and its antenna(s) must not be co - located with any other transmitters except in accordance with FCC multi - transmitter product procedures. Referring to the multi - transmitter policy, multiple transmitter(s) and module(s) can be operated simultaneously without C2P.

3) For all products market in US, OEM has to limit the Operating Frequency: 2402-2480MHz by supplied firmware programming tool. OEM shall not supply any tool or info to the end - user regarding to Regulatory Domain change.

USERS MANUAL OF THE END PRODUCT:

In the user manual of the end product, the end user has to be informed to keep at least 5mm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio - frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: 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 WARNING

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

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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 generate, 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.

8 Notes & Cautions

We cannot assure that the specification has no errors and omission even though this specification is under collate and check strictly.

This specification is under the protection of laws and regulations of copyright, please do not copy and duplicate at any form, or do not transmit part or full of this specification in any wire and wireless network in any form, or do not edit or translate to any other format, word, code, etc.

8.1 Design notes

- It is critical to following the recommendations of this document to ensure the module meets the specifications.
- The module should be placed at the edge of the circuit board as far as possible to keep away from other circuits.
- Antenna should be kept away from other circuits. It can prevent low radiation efficiency and the normal use of other circuits from being affected.
- The landing of components should be appropriate and that is better for reducing the parasitic inductance.
- Please refuse to supply voltage that is not within the range of specification.

- Please make sure the module or its surface may not suffer from the physical shock or extreme stress.

8.2 Layout notes

To make sure wireless performance is at its best condition, please layout the MS45SF1 module on the carrier board as below instructions and picture.

a) Placement of the antenna

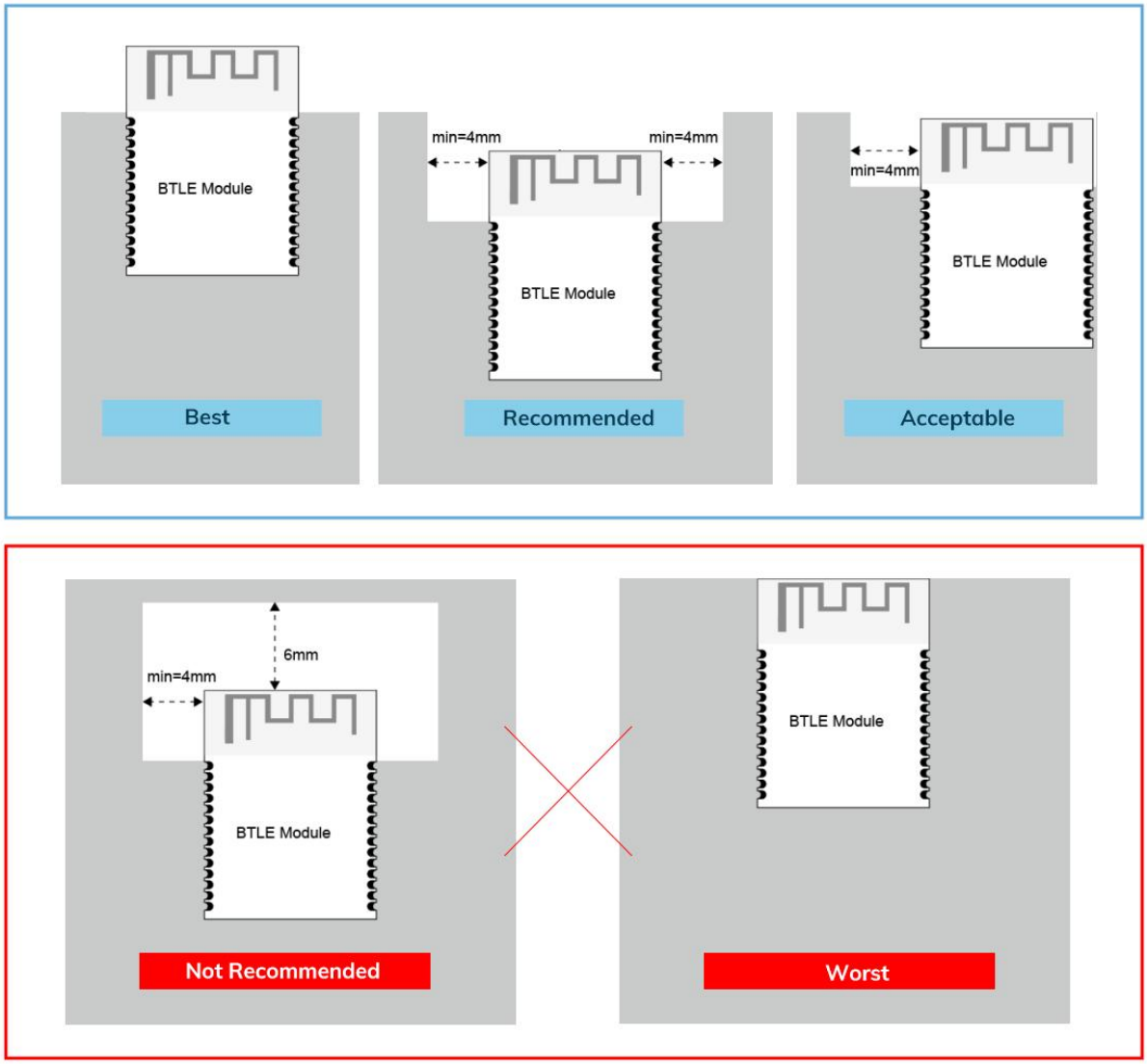
The antenna area of module shall lay clearance completely and should not be blocked by the metal. Otherwise it will have effect on antenna performance (As the picture indicated below).

b) Placement of top-layer

The placement of top-layer in carrier board shall be lay copper completely to reduce the signal line in carrier board or other interference.

c) Clearance

The upper and below area of antenna (including the case) shall have 4mm or more than 4mm clearance to reduce the influences for antenna.



*The Grey area above is Carrier board.

8.3 Installation and soldering

Please do not lay copper under the module antenna. It can prevent the influence of signal radiation and the transmission distance from being affected.

8.4 Handling and storage

a) Due to the fact that CMOS components are included in the module, it is better to eliminate static electricity at any methods when transporting or working with the module. Moreover, it is strongly recommended adding anti-ESD components to circuit design to hinder damage from real-life ESD events. Anti-ESD methods can be also used in mechanical design.

b) Please store the modules within -40℃ to +125℃ before and after installation and make sure the modules is away from the direct sunlight exposure for a long duration. Modules should be far away from humid and salty air conditions, and any corrosive gasses or substances.

c) Please not to wash the module. No-Clean Paste is used in production. The metal shield may be oxidized by the washing process and may lead to chemistry reaction with No-Clean Paste. If modules goes through the washing process, functions of the module may not guaranteed.

d) After opening the package, it should be stored in vacuum environment. Module should not be exposed to the air for a long time to prevent moisture and pad oxidation. If there is an in terval of 7 to 30 days during SMT process,

8.5 Life support applications

a) The module is not design for life support device or system and not allowed to be used in destructive devices or system in any direct, or indirect ways. Minew is not responsible for compensation of any losses when applying modules under such application as described above.

b) Minew shall not responsible for the customer's products or application.

9 Disclaimer

The factory has passed the ISO9001 quality management system, ISO14001 environmental management system and OAHS18001 occupational health and safety assessment . Each product has been rigorously tested (transmission power test, sensitivity test, power consumption test, stability test, aging test, etc.).

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- All other trademarks listed herein are owned by their respective owners.
- All specifications are subject to change without notice.
- Please do not use this specification for produce, sell or illegal purpose without Minew's authorization.
- Minew have right to interpret all the items above.

10 Revision History

Version	Date	Notes	Contributor(s)	Person of Approve
1.0	2022-03-22	First edition	Eddie	Coral

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