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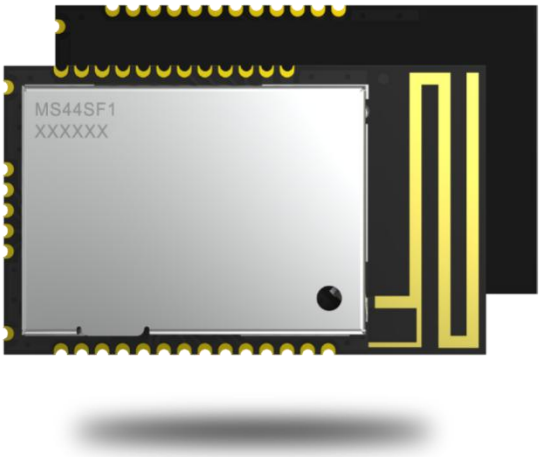

MS44SF1

Bluetooth Low Energy module

Specification V1.0

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Small-sized nRF52820 Module MS44SF1 Specification

MS44SF1 is a compact size(20 x 12 x 2.0 mm), cost effective ultra-low power wireless multi protocol BLE 5.2 module based on Nordic nRF52820 SoC. Supporting all Bluetooth Low Energy features, including Direction Finding, Long range, Bluetooth mesh, Thread and Zigbee mesh protocols. It can be supplied with a voltage from 1.7 to 5.5 V which enables powering the device from sources such as rechargeable batteries or via USB. Qualified for up to -40-105 ˚C industrial grade temperature and a range of analog and digital interfaces makes it the perfect choice for most wireless applictaions.

Features

1. 64 MHz Arm® Cortex-M4 with FPU
2. BLE 5 data rate: 2Mbps,1Mbps, 500 kbps,125kbps. IEEE 802.15.4 Thread and Zigbee data rate: 250kbps, Proprietary 2.4 GHz: 2 Mbps, 1 Mbps
3. 256 KB Flash/32 KB RAM
4. GPIO:18
5. 1×UART,2×SPI/TWI,USB 2.0,QDEC
6. SoC TX power: -40dB to +8dB
7. Operating temperature: -40˚C to +105˚C
8. Supply voltage: 1.7V to 5.5 V
9. Antenna: PCB
10. Module size: 20mm×12mm×2.0mm
11. Range: 125kbps: up to 600 meters in open space.

Application

1. Smart home
2. Smart wearables
3. Medical device
4. Human Interface device
5. Gaming
6. Industrial
7. Asset tracking and RTLS
8. Professional lighting

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1 Product Introduction

MS44SF1 module is an ultra-low power wireless multi protocl BLE 5.2 Module based on Nordic Semiconductor nRF52820 SoC. It features an 64 MHz Arm® Cortex-M4 with FPU processor, with 256 KB Flash and 32 KB RAM. Supplied voltage from 1.7 to 5.5 V and an extended temperature range of -40 to +105℃. Supports Bluetooth 5 Long Range with up to 600 meters over the air transfer distance, and Bluetooth 5.1 Direction Finding for AOA/AOD precising indoor location service.

1.1 Ordering information

Ordering number	Description
MS44SF1-1Y20AIR	nRF52820-QIAA BT 5.2 Module, PCB Antenna, Reel pack

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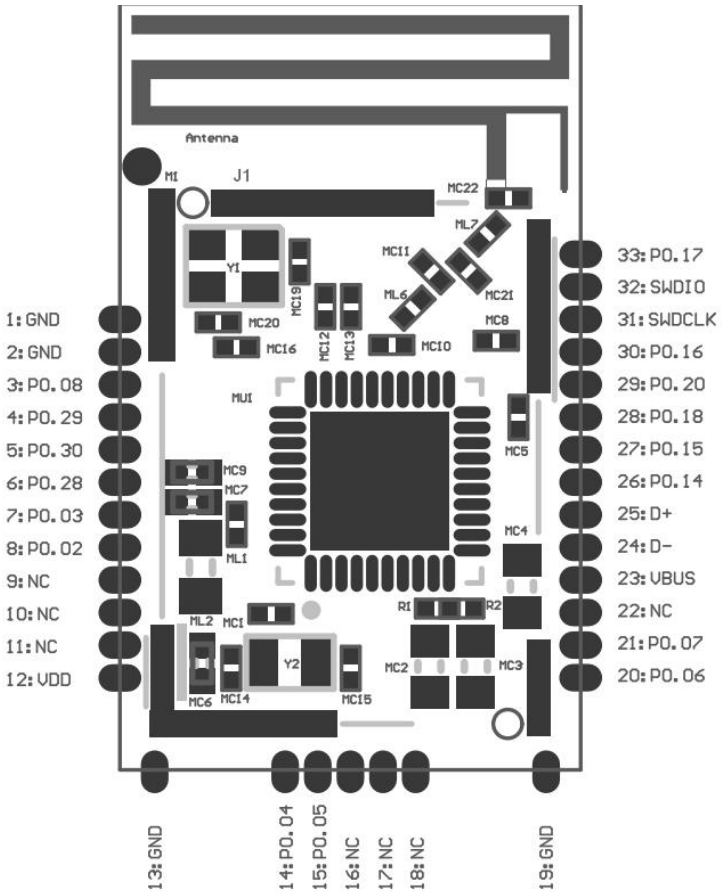
2 Pin Description

2.1 Pin assignment



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2.2 Pin definition

Symbol	Type	Description
VDD	Power	Power supply 1.7-3.6V
VBUS	Power	Power supply 2.5-5V
GND	Power	Ground
SWDCLK	Debug	Serial wire debug clock input for debug and programming
SWDIO	Debug	Serial wire debug I/O for debug and programming
P0.02	Digital I/O	General purpose I/O Analog input
P0.03	Digital I/O	General purpose I/O Analog input
P0.04	Digital I/O	General purpose I/O Analog input
P0.05	Digital I/O	General purpose I/O Analog input
P0.06	Digital I/O	General purpose I/O
P0.07	Digital I/O	General purpose I/O
P0.08	Digital I/O	General purpose I/O
P0.14	Digital I/O	General purpose I/O
P0.15	Digital I/O	General purpose I/O
P0.16	Digital I/O	General purpose I/O
P0.17	Digital I/O	General purpose I/O
P0.18	Digital I/O	General purpose I/O
P0.20	Digital I/O	General purpose I/O
P0.28	Digital I/O	General purpose I/O
P0.29	Digital I/O	General purpose I/O
P0.30	Digital I/O	General purpose I/O
D+	USB	USB D+
D-	USB	USB D-

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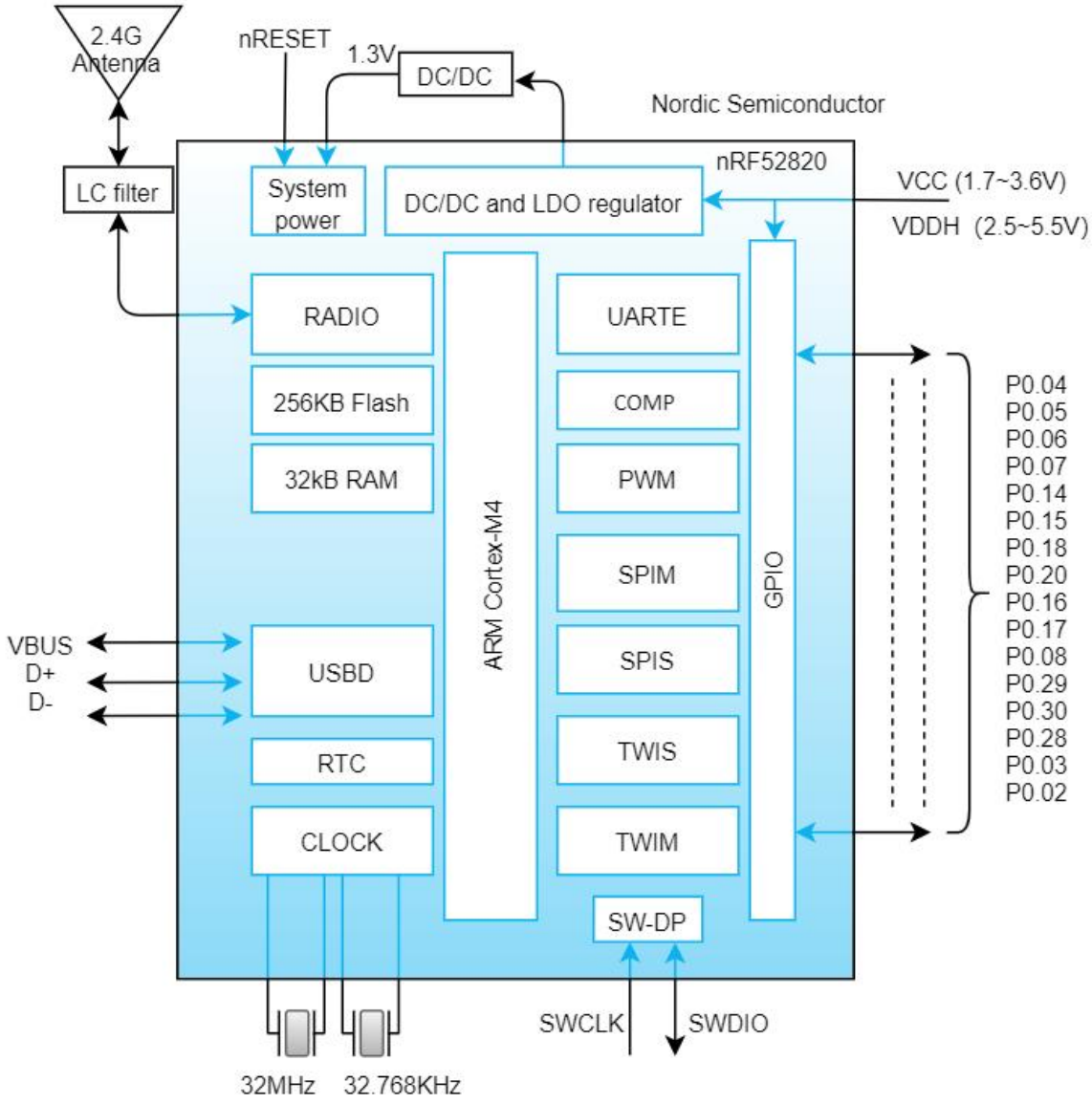
2.3 Block diagram



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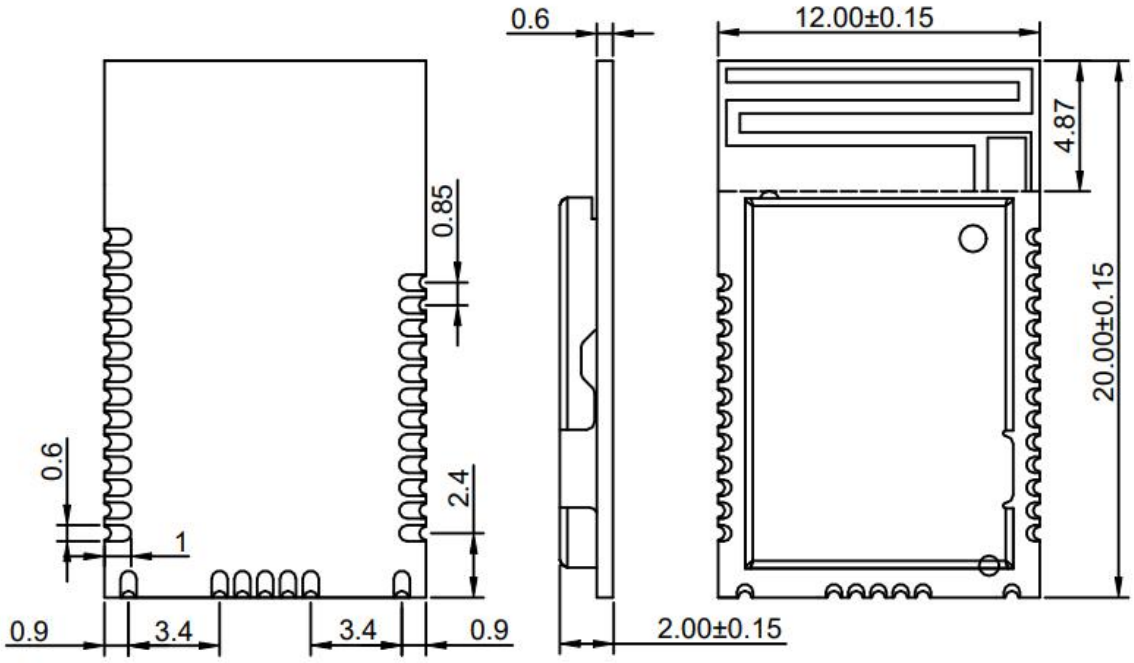
2.4 Mechanical Drawing



Important: Unit: mm Tolerance: +/- 0.1, default
Recommend solder pad size: 1.7*0.8mm
Recommend the pad extends out:0.5mm

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3 Electrical Specification

The electrical specifications of the module are directly related to the Nordic semiconductor Specifications for the nRF52820 chipset. The below information is only the extract from nRF52820 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

	Note	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
Environmental QFN40 package				
Storage temperature		-40	+125	°C
MSL	Moisture Sensitivity Level		2	
ESD HBM	Human Body Model		3	kV
ESD HBM Class	Human Body Model Class		2	
ESD CDM	Charged Device Model		1	kV
Environmental WLCSP 2.531 x 2.531 mm package				
Storage temperature		-40	+125	°C
MSL	Moisture Sensitivity Level		1	
ESD HBM	Human Body Model		3	kV
ESD HBM Class	Human Body Model Class		2	

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ESD CDM	Charged Device Model	1	kV

Flash memory

Endurance		10 000	write/erase cycles
Retention at 85 °C		10	years
Retention at 105 °C	Limited to 1000 write/erase cycles	3	years
Retention at 105 °C-85 °C, execution split	Limited to 1000 write/erase cycles 75% execution time at 85 °C or less	6.7	years

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.

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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
VDD_{POR}	VDD supply voltage needed during power-on reset	1.75			V
VDDH	VDDH supply voltage	2.5	3.7	5.5	V
VBUS	VBUS USB supply voltage	4.35	5.0	5.5	V
t_{R_VDD}	Supply rise time (0 V to 1.7 V)			60	ms
t_{R_VDDH}	Supply rise time (0 V to 3.7 V)			100	ms
TA	Operating temperature	-40	25	85	°C
TA_{EXT}	Extended operating temperature	85		105	°C
T_J	Junction temperature			110	°C

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

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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

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3.3.2 Radio current consumption (Transmitter)

Symbol	Description	Min.	Typ.	Max.	Units
$I_{TX,PLUS8dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = +8 dBm		14.0		mA
$I_{TX,PLUS8dBM}$	TX only run current P_{RF} = +8 dBm		30.0		mA
$I_{TX,PLUS4dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = +4 dBm		9.4		mA
$I_{TX,PLUS4dBM}$	TX only run current P_{RF} = +4 dBm		20.4		mA
$I_{TX,0dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = 0 dBm		4.9		mA
$I_{TX,0dBM}$	TX only run current P_{RF} = 0 dBm		10.4		mA
$I_{TX,MINUS4dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = -4 dBm		3.8		mA
$I_{TX,MINUS4dBM}$	TX only run current P_{RF} = -4 dBm		8.1		mA
$I_{TX,MINUS8dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = -8 dBm		3.4		mA
$I_{TX,MINUS8dBM}$	TX only run current P_{RF} = -8 dBm		7.1		mA
$I_{TX,MINUS12dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = -12 dBm		3.1		mA
$I_{TX,MINUS12dBM}$	TX only run current P_{RF} = -12 dBm		6.4		mA
$I_{TX,MINUS16dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = -16 dBm		2.9		mA
$I_{TX,MINUS16dBM}$	TX only run current P_{RF} = -16 dBm		6.0		mA
$I_{TX,MINUS20dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = -20 dBm		2.7		mA
$I_{TX,MINUS20dBM}$	TX only run current P_{RF} = -20 dBm		5.6		mA
$I_{TX,MINUS40dBM,DCDC}$	TX only run current DC/DC, 3 V, P_{RF} = -40 dBm		2.3		mA
$I_{TX,MINUS40dBM}$	TX only run current P_{RF} = -40 dBm		4.6		mA
$I_{START,TX,DCDC}$	TX start-up current DC/DC, 3 V, P_{RF} = 4 dBm		4.2		mA
$I_{START,TX}$	TX start-up current, P_{RF} = 4 dBm		8.8		mA

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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		4.7		mA
$I_{RX,1M}$	RX only run current LDO, 3 V, 1 Mbps/1 Mbps Bluetooth LE mode		9.8		mA
$I_{RX,2M,DCDC}$	RX only run current DC/DC, 3 V, 2 Mbps/2 Mbps Bluetooth LE mode		5.2		mA
$I_{RX,2M}$	RX only run current LDO, 3 V, 2 Mbps/2 Mbps Bluetooth LE mode		10.9		mA
$I_{START,RX,1M,DCDC}$	RX start-up current DC/DC, 3 V, 1 Mbps/1 Mbps Bluetooth LE mode		3.4		mA
$I_{START,RX,1M}$	RX start-up current 1 Mbps/1 Mbps Bluetooth LE mode		6.8		mA

3.3.4 Transmitter specification

Symbol	Description	Min.	Typ.	Max.	Units
P_{RF}	Maximum output power		8		dBm
P_{RFC}	RF power control range		28		dB
P_{RFCR}	RF power accuracy			±4	dB
$P_{RF1,1}$	1st Adjacent Channel Transmit Power 1 MHz (1 Mbps)		-25		dBc
$P_{RF2,1}$	2nd Adjacent Channel Transmit Power 2 MHz (1 Mbps)		-54		dBc
$P_{RF1,2}$	1st Adjacent Channel Transmit Power 2 MHz (2 Mbps)		-26		dBc
$P_{RF2,2}$	2nd Adjacent Channel Transmit Power 4 MHz (2 Mbps)		-54		dBc
E_{vm}	Error vector magnitude in IEEE 802.15.4 mode (Offset EVM)		2		%rms
$P_{harm2nd,\ IEEE\ 802.15.4}$	2nd harmonics in IEEE 802.15.4 mode		-49		dBm
$P_{harm3rd,\ IEEE\ 802.15.4}$	3rd harmonics in IEEE 802.15.4 mode		-54		dBm
$P_{ACP,R,\ IEEE\ 802.15.4}$	IEEE 802.15.4 Relative adjacent Channel Power, offset > 3.5MHz [1]		-42		dBc
$P_{ACP,A,\ IEEE\ 802.15.4}$	IEEE 802 15.4 Absolute adjacent Channel Power, offset > 3.5MHz [1]		-46		dBm

[1] Output power set to 8 dBm, resolution bandwidth (RBW) set to 100 kHz, and transmitter Duty-Cycle approximately 85%.

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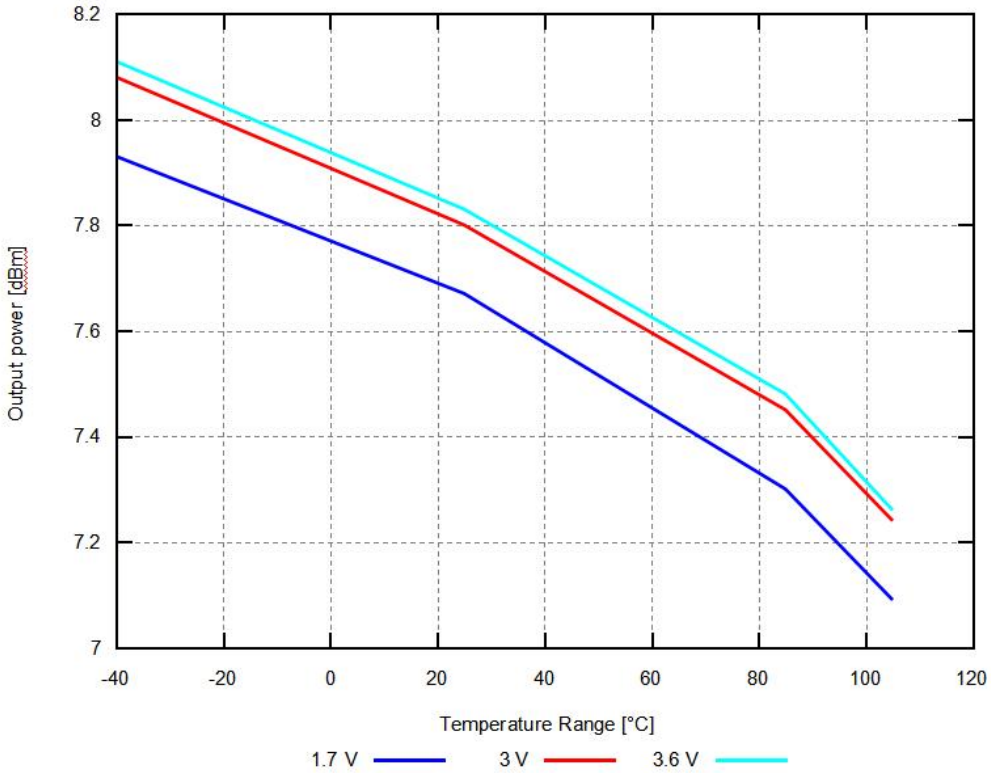
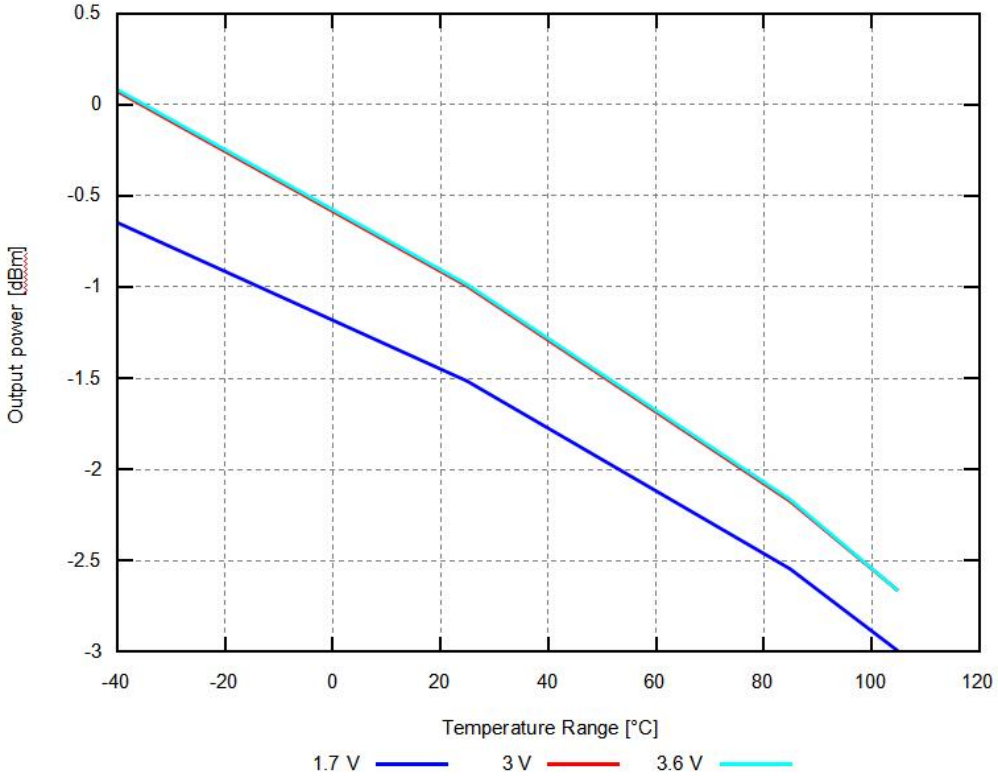


Note: *Output power, 1 Mbps Bluetooth low energy mode, at maximum TXPOWER setting (typical values)*



Note: *Output power, 1 Mbps Bluetooth low energy mode, at 0 dBm TXPOWER setting (typical values)*

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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[2]		-92		dBm
$P_{SENS,IT,2M}$	Sensitivity, 2 Mbps nRF mode ideal transmitter[2]		-89		dBm
$P_{SENS,IT,SP,1M,BLE}$	Sensitivity, 1 Mbps Bluetooth LE ideal transmitter, packet length ≤ 37 bytes BER = 1E-3[3]		-95		dBm
$P_{SENS,IT,LP,1M,BLE}$	Sensitivity, 1 Mbps Bluetooth LE ideal transmitter, packet length ≥ 128 bytes BER = 1E-4[4]		-94		dBm
$P_{SENS,IT,SP,2M,BLE}$	Sensitivity, 2 Mbps Bluetooth LE ideal transmitter, packet length ≤ 37 bytes		-92		dBm
$P_{SENS,IT,BLE\ LE125k}$	Sensitivity, 125 kbps Bluetooth LE mode		-103		dBm
$P_{SENS,IT,BLE\ LE500k}$	Sensitivity, 500 kbps Bluetooth LE mode		-98		dBm
$P_{SENS,IEEE\ 802.15.4}$	Sensitivity in IEEE 802.15.4 mode		-99		dBm

[2] 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.

[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

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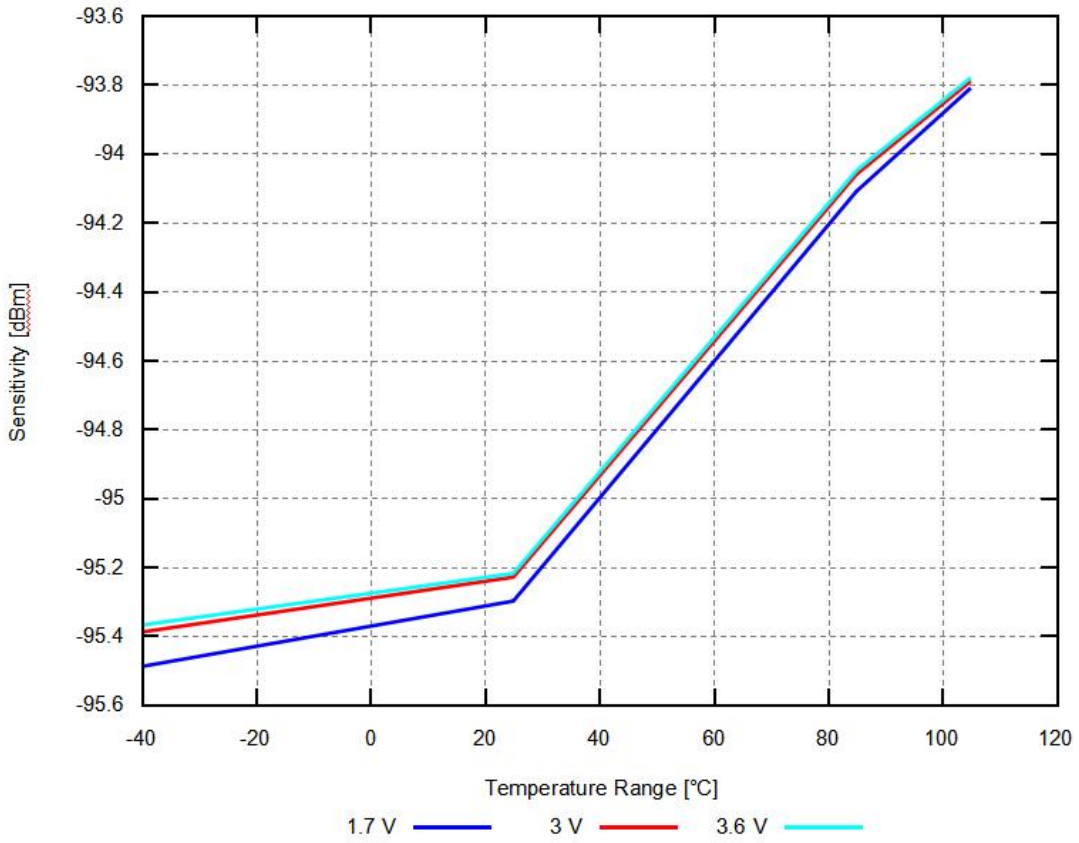

Notes:*Sensitivity, 1 Mbps Bluetooth low energy mode, Regulator = LDO (typical values)*

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3.3.6 RX selectivity

RX selectivity with equal modulation on interfering signal[5]

[5] Desired signal level at P_{IN} = -67 dBm. One interferer is used, having equal modulation as the desired signal. The input power of the interferer where the sensitivity equals BER = 1E-4 is presented.

Symbol	Description	Min.	Typ.	Max	Units
$C/I_{1M,co\text{-}channel}$	1Mbps mode, co-channel interference		10		dB
$C/I_{1M,-1MHz}$	1 Mbps mode, Adjacent (-1 MHz) interference		-5		dB
$C/I_{1M,+1MHz}$	1 Mbps mode, Adjacent (+1 MHz) interference		-14		dB
$C/I_{1M,-2MHz}$	1 Mbps mode, Adjacent (-2 MHz) interference		-25		dB
$C/I_{1M,+2MHz}$	1 Mbps mode, Adjacent (+2 MHz) interference		-45		dB
$C/I_{1M,-3MHz}$	1 Mbps mode, Adjacent (-3 MHz) interference		-40		dB
$C/I_{1M,+3MHz}$	1 Mbps mode, Adjacent (+3 MHz) interference		-46		dB
$C/I_{1M,\pm6MHz}$	1 Mbps mode, Adjacent (≥6 MHz) interference		-52		dB
$C/I_{1MBLE,co\text{-}channel}$	1 Mbps Bluetooth LE mode, co-channel interference		6		dB
$C/I_{1MBLE,-1MHz}$	1 Mbps Bluetooth LE mode, Adjacent (-1 MHz) interference		-2		dB
$C/I_{1MBLE,+1MHz}$	1 Mbps Bluetooth LE mode, Adjacent (+1 MHz) interference		-10		dB
C/I1MBLE,-2MHz	1 Mbps Bluetooth LE mode, Adjacent (-2 MHz) interference		-28		dB
C/I1MBLE,+2MHz	1 Mbps Bluetooth LE mode, Adjacent (+2 MHz) interference		-45		dB
C/I1MBLE,>3MHz	1 Mbps Bluetooth LE mode, Adjacent (≥3 MHz) interference		-54		dB
C/I1MBLE,image	Image frequency interference		-28		dB
C/I1MBLE,image,1MHz	Adjacent (1 MHz) interference to in-band image frequency		-37		dB
C/I2M,co-channel	2 Mbps mode, co-channel interference		10		dB
C/I2M,-2MHz	2 Mbps mode, Adjacent (-2 MHz) interference		-4		dB
C/I2M,+2MHz	2 Mbps mode, Adjacent (+2 MHz) interference		-16		dB
C/I2M,-4MHz	2 Mbps mode, Adjacent (-4 MHz) interference		-22		dB

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$C/I_{2M,+4MHz}$	2 Mbps mode, Adjacent (+4 MHz) interference	-46	dB
$C/I_{2M,-6MHz}$	2 Mbps mode, Adjacent (-6 MHz) interference	-39	dB
$C/I_{2M,+6MHz}$	2 Mbps mode, Adjacent (+6 MHz) interference	-48	dB
$C/I_{2M,\geq12MHz}$	2 Mbps mode, Adjacent (≥12 MHz) interference	-52	dB
$C/I_{2MBLE,co-channel}$	2 Mbps Bluetooth LE mode, co-channel interference	7	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	-12	dB
$C/I_{2MBLE,-4MHz}$	2 Mbps Bluetooth LE mode, Adjacent (-4 MHz) interference	-25	dB
$C/I_{2MBLE,+4MHz}$	2 Mbps Bluetooth LE mode, Adjacent (+4 MHz) interference	-46	dB
$C/I_{2MBLE,\geq6MHz}$	2 Mbps Bluetooth LE mode, Adjacent (≥6 MHz) interference	-54	dB
$C/I_{2MBLE,image}$	Image frequency interference	-25	dB
$C/I_{2MBLE,image,\ 2MHz}$	Adjacent (2 MHz) interference to in-band image frequency	-37	dB
$C/I_{125k\ BLE\ LR,co-channel}$	125 kbps Bluetooth LE LR mode, co-channel interference	3	dB
$C/I_{125k\ BLE\ LR,-1MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (-1 MHz) interference	-9	dB
$C/I_{125k\ BLE\ LR,+1MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (+1 MHz) interference	-16	dB
$C/I_{125k\ BLE\ LR,-2MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (-2 MHz) interference	-28	dB
$C/I_{125k\ BLE\ LR,+2MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (+2 MHz) interference	-54	dB
$C/I_{125k\ BLE\ LR,>3MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (≥3 MHz) interference	-60	dB
$C/I_{125k\ BLE\ LR,image}$	Image frequency interference	-28	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	-49	dB

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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		-34		dBm
$P_{IMD,5TH,1M,BLE}$	IMD performance, Bluetooth LE 1 Mbps, 5th offset channel,packet length ≤ 37 bytes		-32		dBm
$P_{IMD,5TH,2M}$	IMD performance, 2 Mbps, 5th offset channel, packet length≤ 37 bytes		-33		dBm
$P_{IMD,5TH,2M,BLE}$	IMD performance, Bluetooth LE 2 Mbps, 5th offset channel,packet length ≤ 37 bytes		-32		dBm

3.3.8 Radio timing

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

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$t_{TXDIS,IEEE\ 802.15.4}$	When in TX, delay between DISABLE task and DISABLED event (IEEE 802.15.4 mode)	21	μs
$t_{RXEN,IEEE\ 802.15.4}$	Time between the RXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode)	130	μs
$t_{RXEN,FAST,IEEE\ 802.15.4}$	Time between the RXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode with fast ramp-up)	40	μs
$t_{RXDIS,IEEE\ 802.15.4}$	When in RX, delay between DISABLE task and DISABLED event (IEEE 802.15.4 mode)	0.5	μs
$t_{RX\text{-}to\text{-}TX\ turnaround}$	Maximum TX-to-RX or RX-to-TX turnaround time in IEEE 802.15.4 mode	40	μs

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		μs
$RSSI_{SETTLE}$	RSSI settling time after signal level change		15		μs

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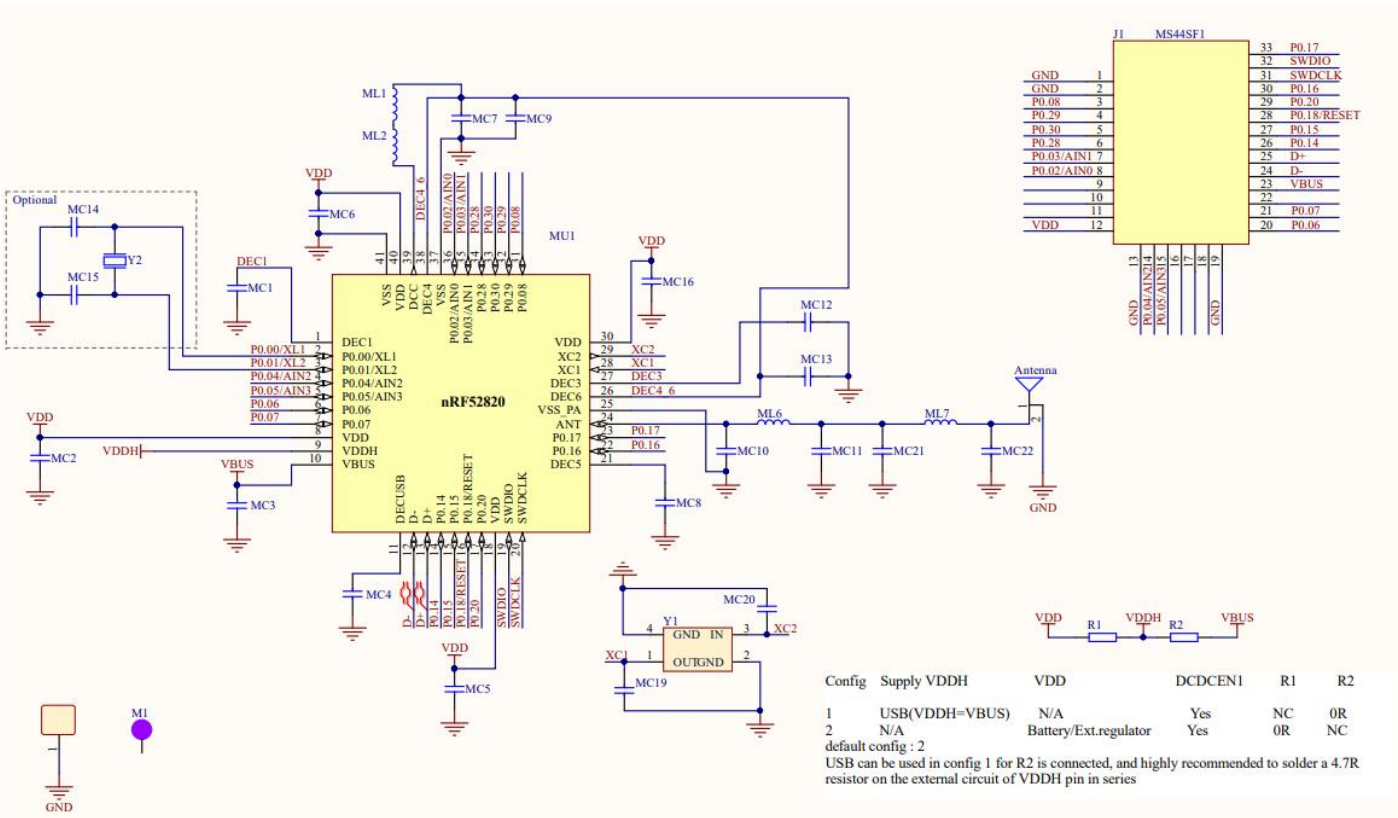
4 Electrical Schematic



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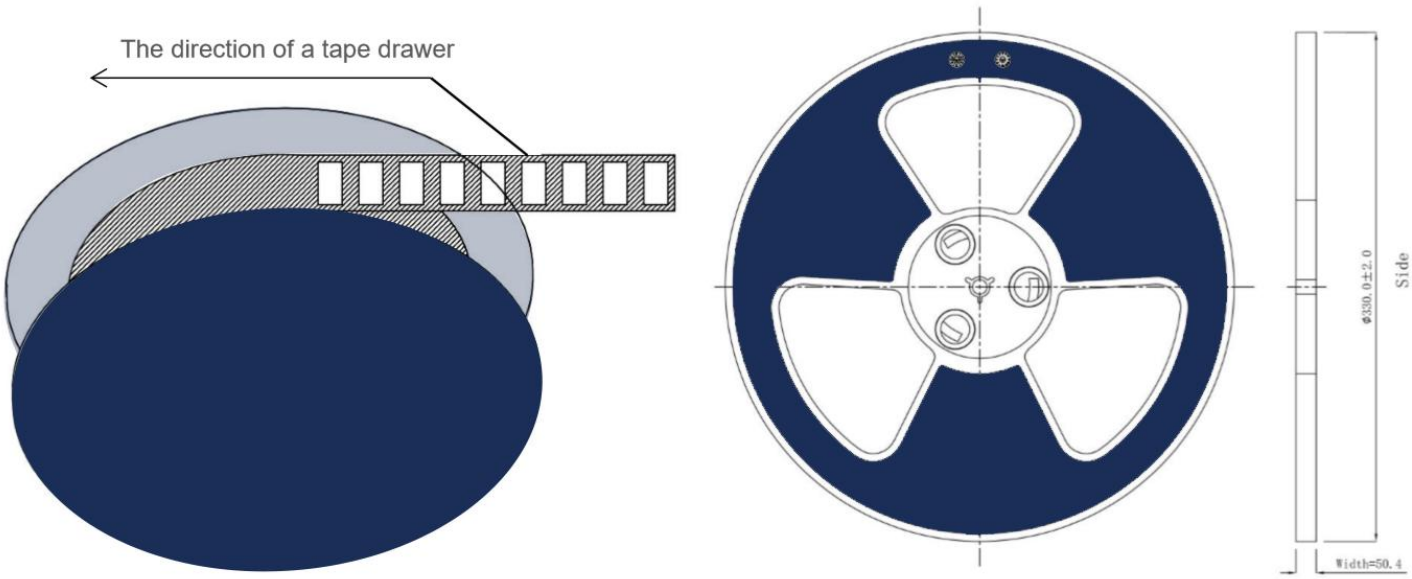
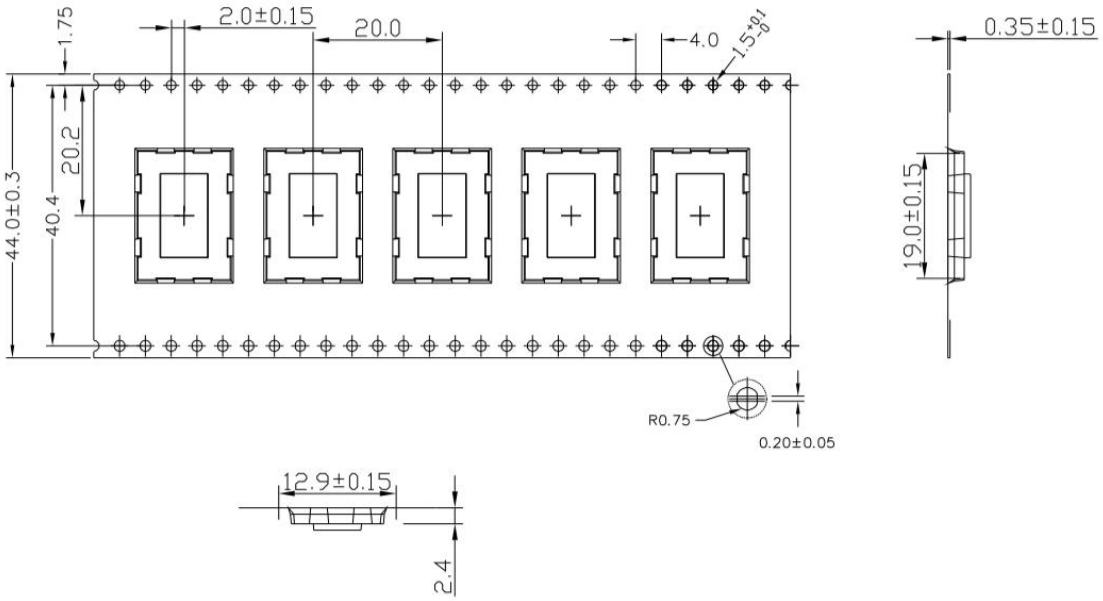
5 Package Information

5.1 Package dimension





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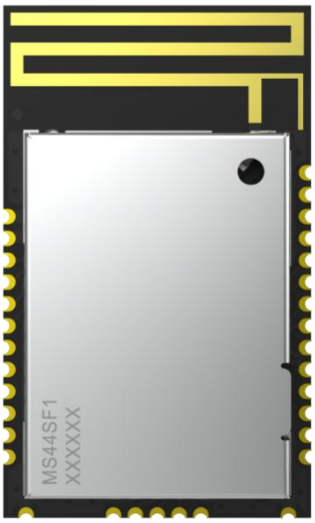
Details of Package Dimension:

Details	Reel-MS45SF1
Quantity(module)	850PCS
Tape Weight	525.9g
Single module Weight	0.666g
Gross Weight	1092g
Dimension	W: 44mm T:0.35mm

5.2 Mark on metal shield



*** NOTICES:**

The marking on the product shield will be updated with the change of certification. It will only be added on the basis of existing information. For the actual marking content, please refer to the final product you received.

In addition, the change of marking content will not affect the performance of product, and there will be no further notification from MinewSemi.

If you have customization requirments, please contact our sales for details.

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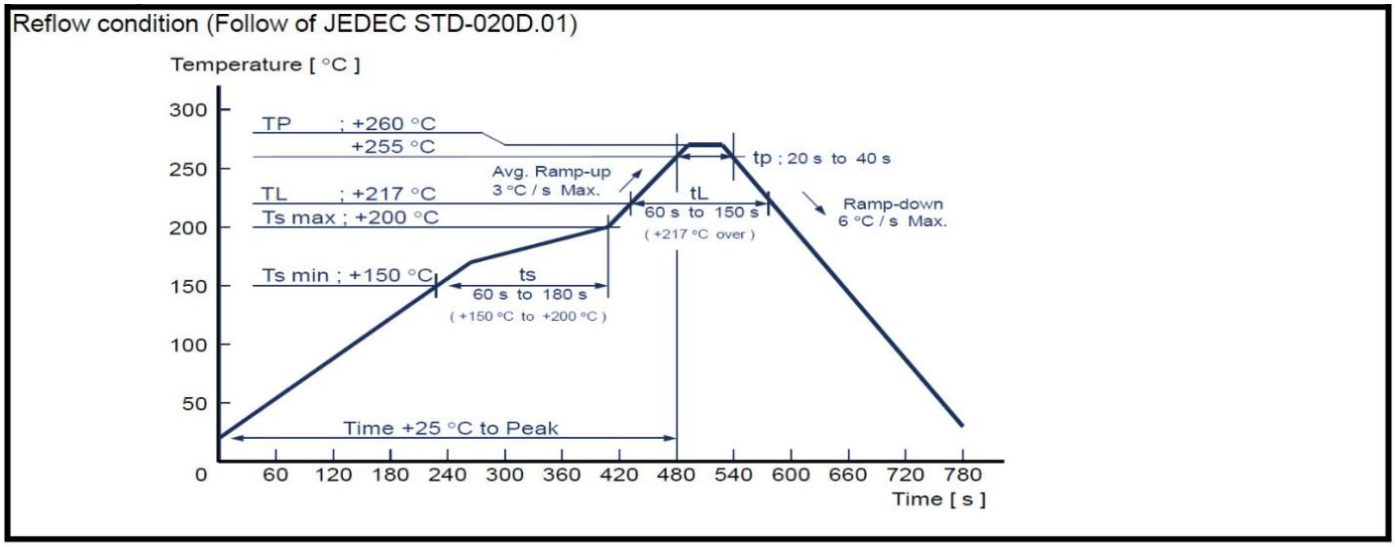
6 Reflow and Soldering



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.

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7 Notes & Cautions

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

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7.1 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.

7.2 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.

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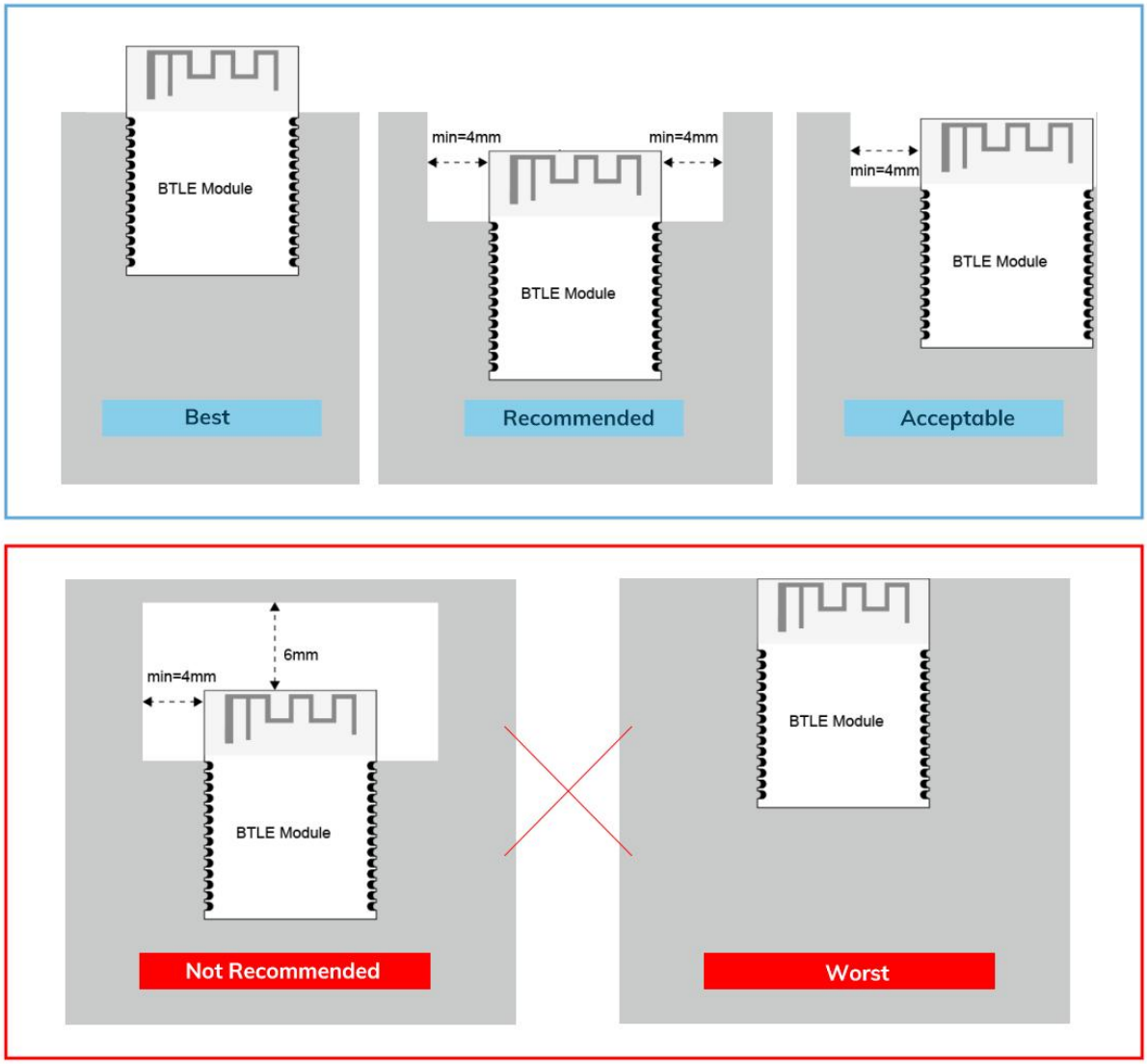

*The Grey area above is Carrier board.

7.3 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.

7.4 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.

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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,

7.5 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. Minewsemi is not responsible for compensation of any losses when applying modules under such application as described above.

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

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8 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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9 Revision History

Version	Date	Notes	Contributor(s)	Person of Approve
1.0	2022-06-27	First edition	Eddie/Ida	Coral

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