



RAYTAC

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Approval Sheet

(產品承認書)

產品名稱	(Product)	<u>Bluetooth Low Energy Module</u>
解決方案	(Solution)	<u>Nordic nRF54L15 WLCSP Package</u>
產品型號	(Model No.)	<u>AN54LV (Chip Antenna)</u>

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Full list of Raytac's WiFi modules.....	錯誤! 尚未定義書籤。
Full list of Raytac's Bluetooth modules.....	錯誤! 尚未定義書籤。
Release Note	錯誤! 尚未定義書籤。

1. Overall introduction

Raytac's AN54LV family us a Bluetooth® 6.0 stack (Bluetooth low energy or BLE) modules designed based on **Nordic nRF54L15 SoC solution**, which incorporates: **GPIO**, **QSPI (emulated)**, **SPI**, **UART**, **I2C**, **I2S**, **PDM**, **PWM**, **ADC** and **NFC** interfaces for connecting peripherals and sensors.

Product Character:

1. MCU (Microcontroller Unit) featuring a 128 MHz Arm Cortex-M33 processor.
2. Embedded **1524 KB** NVM and up to **256 KB** RAM.
3. An integrated RISC-V coprocessor.
4. The multiprotocol 2.4 GHz radio modes are supported based on customer preference.
5. Compact size with **(L) 8.4 x (W) 6.4 x (H) 1.5mm**
6. Wide supply voltage range **1.7V to 3.6V**.
7. Operation temperature from **-40°C to 105°C**.
8. Up to **32** GPIOs.

1.1. Application

- IoT
 - Smart home sensors and actuators
 - Industrial sensors and actuators
 - Gateways and hubs
- Advanced computer peripherals and I/O devices
 - Keyboard
 - Mouse
 - Stylus
- Interactive entertainment devices
 - Remote controls
 - Gaming controllers
- Safety and security
 - Access control
 - Asset tracking
- Wearable health and fitness monitoring
- Lighting control

1.2. Features

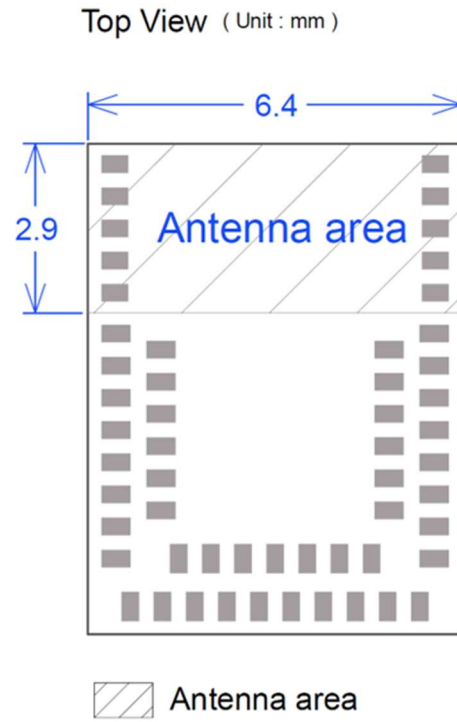
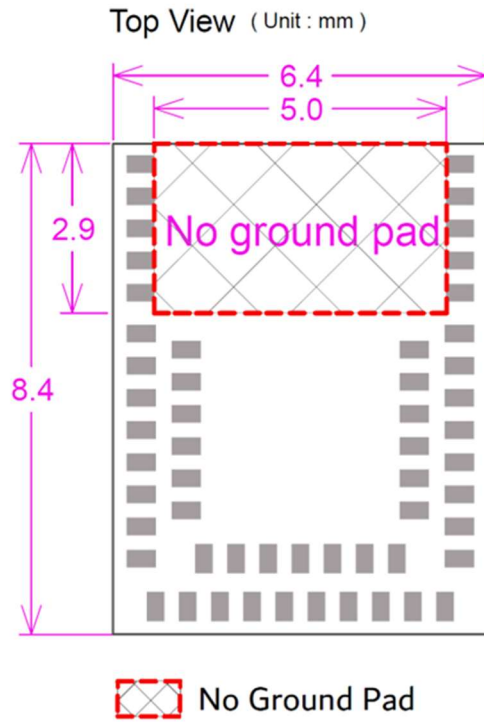
- Multi-protocol 2.4GHz radio
- 128MHz Arm Cortex-M33 with Thumb-2 (16/32-bit instruction set)
- 1524KB flash programmed memory and 256KB RAM
- 128-bit AES / ECB / CCM / AAR co-processor
- Up to +7dBm configurable output power
- RSSI (1dB resolution)

Peripherals

- 128 MHz RISC-V coprocessor which is a fast, lightweight peripheral processor (FLPR)
- Timer counter
 - 7 x 32-bit
 - 2 x 24-bit RTC
- Fully featured serial interface with EasyDMA support including:
 - One high-speed SPI up to 32 MHz, four up to 8 MHz
 - One high-speed UART up to 4 Mbps, four up to 1 Mbps
 - I²C up to 400 kHz
- Three pulse width modulator (PWM) units with EasyDMA
- I²S two channel Inter-IC sound interface
- ADC with up to eight programmable gain channels.
- Pulse density modulation (PDM) interface
- Near field communication (NFC)
- Quadrature decoders(QDEC)
- Temperature sensor

2.2. Recommended layout of solder pad

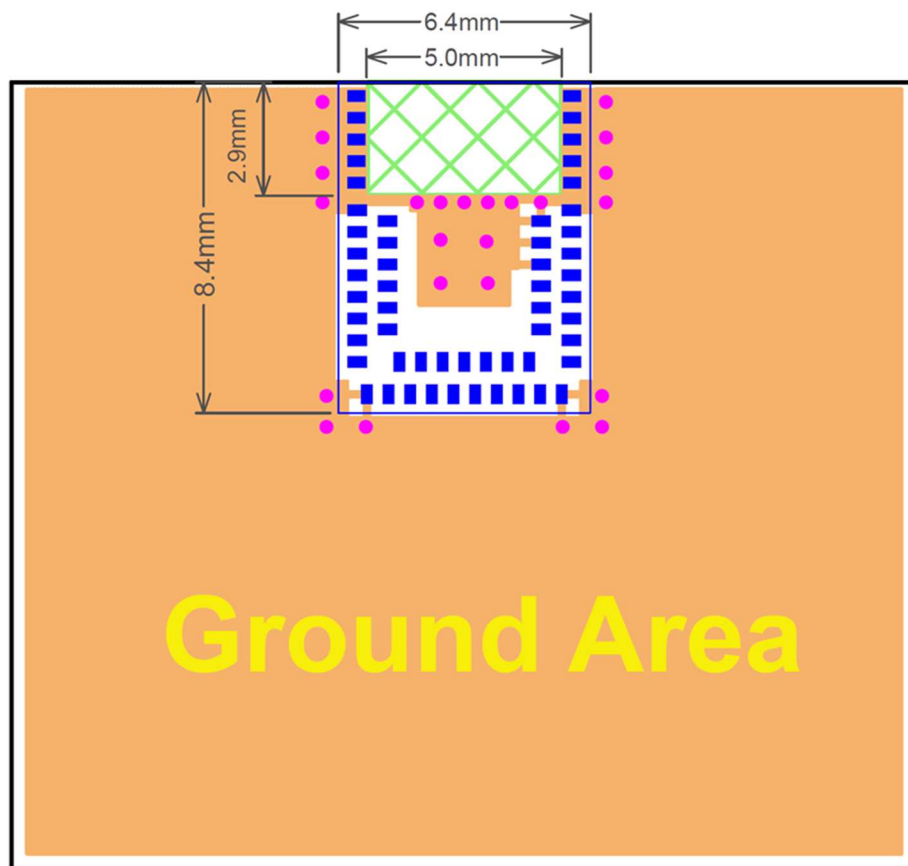
Graphs are all in Top View, Unit in mm.



2.3. RF layout suggestion (AKA, antenna keep-out area)

Please ensure that no ground pad overlaps the “No Ground-Pad Area”, as shown in the images below. This is important to maintain antenna performance and to prevent potential short circuits within the module.

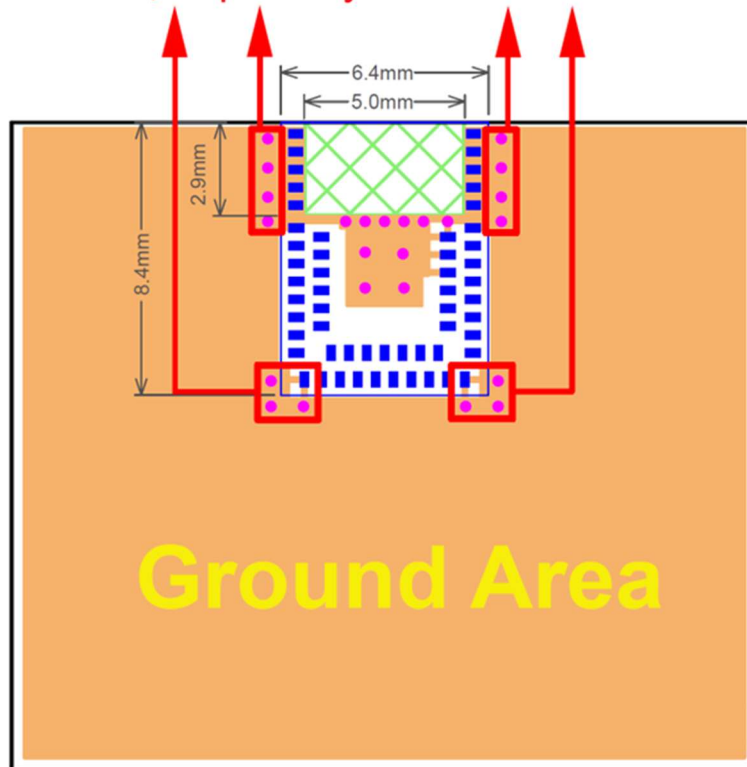
You are welcome to send us your design files for review at sales@raytac.com or to your Raytac contact with email subject titled: “Layout Review – Raytac Model No. – Your company name”.



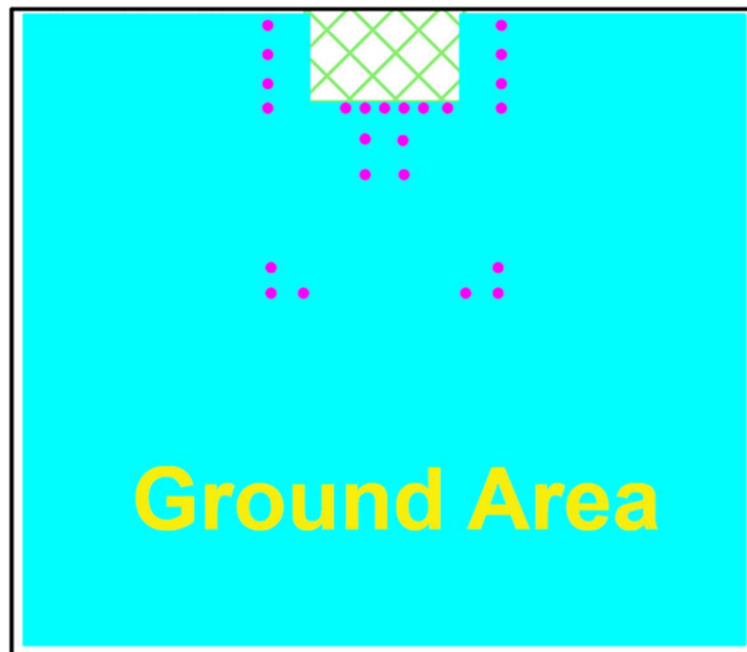
Top View

 No Ground Pad Area

Please add via holes in GROUND area as many as possible, especially around the four corners.



Top View



Perspective View

 No Ground Pad Area

2.4. Footprint & design guide

Please visit "[Support](#)" page of our website to download. The package includes footprint, 2D/3D drawing, reflow graph and recommended spec for external 32.768KHz.

2.5. Pin assignment

Pin No.	Name	Pin function	Description
(1)	GND	Ground	The pad must be connected to a solid ground plane
(2)	P0.04	Digital I/O	General-purpose digital I/O
(3)	P0.03	Digital I/O	General-purpose digital I/O
(4)	P0.01	Digital I/O	General-purpose digital I/O
(5)	P0.00	Digital I/O	General-purpose digital I/O
(6)	P2.10	Digital I/O	General-purpose digital I/O
(7)	P0.02	Digital I/O	General-purpose digital I/O
(8)	P2.08	Digital I/O	General-purpose digital I/O
(9)	SWDIO	Digital I/O	Serial Wire debug I/O for debug and programming
(10)	P2.05	Digital I/O	General-purpose digital I/O
(11)	SWDCLK	Digital input	Serial Wire debug clock input for debug and programming
(12)	P2.00	Digital I/O	General-purpose digital I/O
(13)	P2.09	Digital I/O	General-purpose digital I/O
(14)	P2.04	Digital I/O	General-purpose digital I/O
(15)	GND	Ground	The pad must be connected to a solid ground plane
(16)	P2.06	Digital I/O	General-purpose digital I/O
(17)	P2.01	Digital I/O	General-purpose digital I/O
(18)	P2.07	Digital I/O	General-purpose digital I/O
(19)	P1.08	Digital I/O	General-purpose digital I/O
(20)	VDD_NRF	Power	Power-supply pin
(21)	P1.07	Digital I/O	General-purpose digital I/O
	AIN3	Analog input	SAADC input
(22)	P1.06	Digital I/O	General-purpose digital I/O
	AIN2	Analog input	SAADC input
(23)	P1.05	Digital I/O	General-purpose digital I/O
	AIN1	Analog input	SAADC input
(24)	P2.02	Digital I/O	General-purpose digital I/O
(25)	P1.04	Digital I/O	General-purpose digital I/O
	AIN0	Analog input	SAADC input
(26)	P2.03	Digital I/O	General-purpose digital I/O

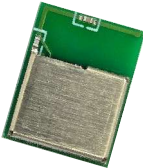
Pin No.	Name	Pin function	Description
(27)	P1.03	Digital I/O	General-purpose digital I/O
	NFC2	NFC input	NFC antenna connection
(28)	DCC	Power	DC/DC converter output pin
(29)	P1.02	Digital I/O	General-purpose digital I/O
	NFC1	NFC input	NFC antenna connection
(30)	DECD	Digital I/O	0.9 V regulator supply decoupling
(31)	GND	Ground	The pad must be connected to a solid ground plane
(32)	P1.01	Digital I/O	General-purpose digital I/O
	XL2	Analog input	Connection to 32.768khz crystal (LFXO)
(33)	P1.00	Digital I/O	General-purpose digital I/O
	XL1	Analog input	Connection to 32.768khz crystal (LFXO)
(34)	P1.15	Digital I/O	General-purpose digital I/O
(35)	P1.13	Digital I/O	General-purpose digital I/O
	AIN6	Analog input	SAADC input
(36)	P1.14	Digital I/O	General-purpose digital I/O
	AIN7	Analog input	SAADC input
(37)	P1.12	Digital I/O	General-purpose digital I/O
	AIN5	Analog input	SAADC input
(38)	P1.09	Digital I/O	General-purpose digital I/O
(39)	P1.11	Digital I/O	General-purpose digital I/O
	AIN4	Analog input	SAADC input
(40)	GND	Ground	The pad must be connected to a solid ground plane
(41)	P1.10	Digital I/O	General-purpose digital I/O
(42)	GND	Ground	The pad must be connected to a solid ground plane
(43)	NRESET	Reset	Configurable as system RESET pin
(44)	GND	Ground	The pad must be connected to a solid ground plane
(45)	GND	Ground	The pad must be connected to a solid ground plane
(46~55)	GND	Ground	The pad must be connected to a solid ground plane (Only for AN54LV-15 Model)

3. Main chip solution

RF IC	Crystal Frequency
Nordic NRF54L15 / WLCSP	32MHz

32MHz crystal is already inside the module. The module does NOT include external capacitor for 32MHz crystal. Load capacitance use default value without change now.

4. Shipment packaging information

Model	Antenna	Photo
AN54LV	Chip/Ceramic	
AN54LV-P	PCB/Printed	

4.1. Order code

Each model has two options of packaging. Please use following part no. when placing order to us.

Model	Tray
AN54LV	MD-240A8-007
AN54LV-P	MD-240A8-008

5. Specification

Any technical spec shall refer to Nordic's official documents as final reference. Contents below are from "[nRF54L15 Product Specification v0.10](#)", please click to download full spec.

5.1. Recommended operating conditions

Symbol	Parameter	Min.	Nom.	Max.	Units
VDD	VDD supply voltage	1.7		3.6	V
VDD _{EXT}	VDD supply voltage under extended operating temperature	1.7		3.4	V
VDD _{POR}	VDD supply voltage needed during power-on reset	1.75			V
TA	Operating temperature	-40	25	85	°C
TA _{EXT}	Extended operating temperature	85		105	°C
T _{RST}	Recommended storage temperature			40	°C
RH _{RST}	Recommended storage relative humidity			90	%

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

5.2. Radio specifications

5.2.1. General radio characteristics

Symbol	Description	Min.	Typ.	Max.	Units
f _{OP}	Operating frequencies	2400		2500	MHz
f _{PLL,CH,SP}	Channel spacing		1.0		MHz
f _{DELTA,1M}	Frequency deviation @ 1 Mbps		±160		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
f _{DELTA,4M}	Frequency deviation @ 4 Mbps		±1000		kHz
f _{skBPS}	On-the-air data rate	125		4000	kbps
f _{chip, IEEE 802.15.4}	Chip rate in IEEE 802.15.4 mode		2000		kchip/s

5.2.2. Radio current consumption (Transmitter)

Symbol	Description	Min.	Typ.	Max.	Units
$I_{TX,MaxdBm,QFN}$	TX only run current for QFN package, P_{RF} at maximum power setting		9.1		mA
$I_{TX,MaxdBm,CSP}$	TX only run current for CSP package, P_{RF} at maximum power setting		9.7		mA
$I_{TX,0dBm}$	TX only run current, $P_{RF} = 0$ dBm		3.7		mA
$I_{TX,MINUS4dBm}$	TX only run current $P_{RF} = -4$ dBm		2.8		mA
$I_{TX,MINUS8dBm}$	TX only run current $P_{RF} = -8$ dBm		2.2		mA
$I_{TX,MINUS12dBm}$	TX only run current $P_{RF} = -12$ dBm		1.9		mA
$I_{TX,MINUS16dBm}$	TX only run current $P_{RF} = -16$ dBm		1.7		mA
$I_{TX,MINUS40dBm}$	TX only run current $P_{RF} = -40$ dBm		1.2		mA
$I_{START,TX}$	TX start-up current, $P_{RF} = 4$ dBm		..		mA

5.2.3. Radio current consumption (Receiver)

Symbol	Description	Min.	Typ.	Max.	Units
$I_{RX,1M}$	RX only run current, 1 Mbps/1 Mbps Bluetooth LE mode		2.1		mA
$I_{RX,2M}$	RX only run current, 2 Mbps/2 Mbps Bluetooth LE mode		2.1		mA
$I_{START,RX,1M}$	RX start-up current, 1 Mbps/1 Mbps Bluetooth LE mode		1.6		mA

5.2.4. Transmitter specification

Symbol	Description	Min.	Typ.	Max.	Units
P _{RF,QFN}	Maximum output power for QFN package		7		dBm
P _{RF,CSP}	Maximum output power for CSP package		8		dBm
P _{RFCR}	RF power accuracy	-2		2	dB
P _{RF1,BLE1M,2MHZ}	Adjacent Channel Transmit Power 2 MHz (1 Mbps Bluetooth LE mode)		-48		dBc
P _{RF1,BLE1M,3MHZ}	Adjacent Channel Transmit Power 3 MHz (1 Mbps Bluetooth LE mode)		-54		dBc
P _{RF1,BLE2M,4MHZ}	Adjacent Channel Transmit Power 4 MHz (2 Mbps Bluetooth LE mode)		-51		dBc
P _{RF1,BLE2M,6MHZ}	Adjacent Channel Transmit Power 6 MHz (2 Mbps Bluetooth LE mode)		-56		dBc
E _{vm}	Error vector magnitude in IEEE 802.15.4 mode		2		%rms
P _{harm2nd, IEEE 802.15.4}	2nd harmonics in IEEE 802.15.4 mode		-63		dBm
P _{harm3rd, IEEE 802.15.4}	3rd harmonics in IEEE 802.15.4 mode		-68		dBm

5.2.5. 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 ⁴		-93		dBm
P _{SENS,IT,2M}	Sensitivity, 2 Mbps nRF mode ideal transmitter ⁴		-90		dBm
P _{SENS,IT,4M}	Sensitivity, 4 Mbps nRF mode ideal transmitter ⁴		-90		dBm
P _{SENS,IT,SP,1M,BLE}	Sensitivity, 1 Mbps Bluetooth LE ideal transmitter, packet length ≤ 37 bytes BER = 1E-3 ⁵		-96 ⁶		dBm
P _{SENS,IT,LP,1M,BLE}	Sensitivity, 1 Mbps Bluetooth LE ideal transmitter, packet length ≥ 128 bytes BER = 1E-4		-95		dBm
P _{SENS,IT,SP,2M,BLE}	Sensitivity, 2 Mbps Bluetooth LE ideal transmitter, packet length ≤ 37 bytes		-94		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		-99		dBm
P _{SENS,IEEE 802.15.4}	Sensitivity in IEEE 802.15.4 mode		-102		dBm

⁴ Typical sensitivity applies when RXADDRESS.ADDR0 is used for receiver address. When RXADDRESS.ADDR[1...7] are used for receiver address, the typical sensitivity for this mode is degraded by 3 dB.

⁵ As defined in the *Bluetooth Core Specification v4.0 Volume 6: Core System Package (Low Energy Controller Volume)*.

⁶ QFN package sensitivity is degraded by approximately 1 dB compared to the provided value

5.2.6. RX selectivity

Symbol	Description	Min.	Typ.	Max.	Units
$C/I_{1M,co-channel}$	1Mbps mode, co-channel interference		9		dB
$C/I_{1M,-1MHz}$	1 Mbps mode, Adjacent (-1 MHz) interference		-4		dB
$C/I_{1M,+1MHz}$	1 Mbps mode, Adjacent (+1 MHz) interference		-9		dB
$C/I_{1M,-2MHz}$	1 Mbps mode, Adjacent (-2 MHz) interference		-28		dB
$C/I_{1M,+2MHz}$	1 Mbps mode, Adjacent (+2 MHz) interference		-40		dB
$C/I_{1M,-3MHz}$	1 Mbps mode, Adjacent (-3 MHz) interference		-39		dB
$C/I_{1M,+3MHz}$	1 Mbps mode, Adjacent (+3 MHz) interference		-43		dB
$C/I_{1M,\pm 6MHz}$	1 Mbps mode, Adjacent (≥ 6 MHz) interference		-48		dB
$C/I_{1MBLE,co-channel}$	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		-6		dB
$C/I_{1MBLE,-2MHz}$	1 Mbps Bluetooth LE mode, Adjacent (-2 MHz) interference		-29		dB
$C/I_{1MBLE,+2MHz}$	1 Mbps Bluetooth LE mode, Adjacent (+2 MHz) interference		-43		dB
$C/I_{1MBLE,>3MHz}$	1 Mbps Bluetooth LE mode, Adjacent (≥ 3 MHz) interference		-46		dB
$C/I_{1MBLE,image}$	Image frequency interference		-29		dB
$C/I_{1MBLE,image,1MHz}$	Adjacent (1 MHz) interference to in-band image frequency		-39		dB
$C/I_{2M,co-channel}$	2 Mbps mode, co-channel interference		10		dB
$C/I_{2M,-2MHz}$	2 Mbps mode, Adjacent (-2 MHz) interference		-5		dB
$C/I_{2M,+2MHz}$	2 Mbps mode, Adjacent (+2 MHz) interference		-9		dB
$C/I_{2M,-4MHz}$	2 Mbps mode, Adjacent (-4 MHz) interference		-27		dB
$C/I_{2M,+4MHz}$	2 Mbps mode, Adjacent (+4 MHz) interference		-42		dB
$C/I_{2M,-6MHz}$	2 Mbps mode, Adjacent (-6 MHz) interference		-38		dB
$C/I_{2M,+6MHz}$	2 Mbps mode, Adjacent (+6 MHz) interference		-45		dB
$C/I_{2M,\geq 12MHz}$	2 Mbps mode, Adjacent (≥ 12 MHz) interference		-50		dB
$C/I_{2MBLE,co-channel}$	2 Mbps Bluetooth LE mode, co-channel interference		6		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		-6		dB
$C/I_{2MBLE,-4MHz}$	2 Mbps Bluetooth LE mode, Adjacent (-4 MHz) interference		-29		dB
$C/I_{2MBLE,+4MHz}$	2 Mbps Bluetooth LE mode, Adjacent (+4 MHz) interference		-44		dB
$C/I_{2MBLE,\geq 6MHz}$	2 Mbps Bluetooth LE mode, Adjacent (≥ 6 MHz) interference		-46		dB

RX selectivity with equal modulation on interfering signal⁷

⁷ 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 = 0.1% is presented.

Symbol	Description	Min.	Typ.	Max.	Units
$C/I_{4M,co-channel}$	4 Mbps mode, co-channel interference		6		dB
$C/I_{4M,-4MHz}$	4 Mbps mode, Adjacent (-4 MHz) interference		-4		dB
$C/I_{4M,+4MHz}$	4 Mbps mode, Adjacent (+4 MHz) interference		-11		dB
$C/I_{4M,-8MHz}$	4 Mbps mode, Adjacent (-8 MHz) interference		-27		dB
$C/I_{4M,+8MHz}$	4 Mbps mode, Adjacent (+8 MHz) interference		-46		dB
$C/I_{4M,-12MHz}$	4 Mbps mode, Adjacent (-12 MHz) interference		-40		dB
$C/I_{4M,+12MHz}$	4 Mbps mode, Adjacent (+12 MHz) interference		-50		dB
$C/I_{4M,\geq 24MHz}$	4 Mbps mode, Adjacent (≥ 24 MHz) interference		-56		dB
$C/I_{2MBLE,image}$	Image frequency interference		-29		dB
$C/I_{2MBLE,image, 2MHz}$	Adjacent (2 MHz) interference to in-band image frequency		-38		dB
$C/I_{125k BLE LR,co-channel}$	125 kbps Bluetooth LE LR mode, co-channel interference		1		dB
$C/I_{125k BLE LR,-1MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (-1 MHz) interference		-13		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		-36		dB
$C/I_{125k BLE LR,+2MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (+2 MHz) interference		-52		dB
$C/I_{125k BLE LR,>3MHz}$	125 kbps Bluetooth LE LR mode, Adjacent (≥ 3 MHz) interference		-55		dB
$C/I_{125k BLE LR,image}$	Image frequency interference		-36		dB
$C/I_{IEEE 802.15.4,-5MHz}$	IEEE 802.15.4 mode, Adjacent (-5 MHz) rejection		-35		dB
$C/I_{IEEE 802.15.4,+5MHz}$	IEEE 802.15.4 mode, Adjacent (+5 MHz) rejection		-38		dB
$C/I_{IEEE 802.15.4,\pm 10MHz}$	IEEE 802.15.4 mode, Alternate (± 10 MHz) rejection		-50		dB

5.2.7. 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		-19		dBm
$P_{IMD,5TH,2M}$	IMD performance, 2 Mbps, 5th offset channel, packet length ≤ 37 bytes				dBm
$P_{IMD,5TH,2M,BLE}$	IMD performance, Bluetooth LE 2 Mbps, 5th offset channel, packet length ≤ 37 bytes		-16		dBm

RX intermodulation. Desired signal level at $P_{IN} = -64$ dBm. Two interferers with equal input power are used. The interferer closest in frequency is not modulated, the other interferer is modulated equal with the desired signal. The input power of the interferers where the sensitivity equals $BER = 1E-3$ is presented.

5.2.8. Radio timing parameters

Symbol	Description	Min.	Typ.	Max.	Units
$t_{TXEN,BLE,1M}$	Time between TXEN task and READY event after channel FREQUENCY configured (1 Mbps Bluetooth LE and 150 μ s TIFS)		140		μ s
$t_{TXEN,FAST,BLE,1M}$	Time between TXEN task and READY event after channel FREQUENCY configured (1 Mbps Bluetooth LE with fast ramp-up and 150 μ s TIFS)		40		μ s
$t_{TXDIS,BLE,1M}$	When in TX, delay between DISABLE task and DISABLED event for MODE = Nrf_1Mbit and MODE = Ble_1Mbit		2		μ s
$t_{RXEN,BLE,1M}$	Time between the RXEN task and READY event after channel FREQUENCY configured (1 Mbps Bluetooth LE)		134		μ s
$t_{RXEN,FAST,BLE,1M}$	Time between the RXEN task and READY event after channel FREQUENCY configured (1 Mbps Bluetooth LE with fast ramp-up)		40		μ s
$t_{RXDIS,BLE,1M}$	When in RX, delay between DISABLE task and DISABLED event for MODE = Nrf_1Mbit and MODE = Ble_1Mbit		1		μ s
$t_{TXDIS,BLE,2M}$	When in TX, delay between DISABLE task and DISABLED event for MODE = Nrf_2Mbit and MODE = Ble_2Mbit		2		μ s
$t_{RXDIS,BLE,2M}$	When in RX, delay between DISABLE task and DISABLED event for MODE = Nrf_2Mbit and MODE = Ble_2Mbit		1		μ s
$t_{TXEN,IEEE\ 802.15.4}$	Time between TXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode)		130		μ s
$t_{TXEN,FAST,IEEE\ 802.15.4}$	Time between TXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode with fast ramp-up)		40		μ s
$t_{TXDIS,IEEE\ 802.15.4}$	When in TX, delay between DISABLE task and DISABLED event (IEEE 802.15.4 mode)		18		μ s
$t_{RXEN,IEEE\ 802.15.4}$	Time between the RXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode)		130		μ s
$t_{RXEN,FAST,IEEE\ 802.15.4}$	Time between the RXEN task and READY event after channel FREQUENCY configured (IEEE 802.15.4 mode with fast ramp-up)		40		μ s
$t_{RXDIS,IEEE\ 802.15.4}$	When in RX, delay between DISABLE task and DISABLED event (IEEE 802.15.4 mode)		0.2		μ s
$t_{RX\text{-}to\text{-}TX\text{ turnaround, IEEE 802.15.4}}$	Maximum RX-to-TX turnaround time in IEEE 802.15.4 mode		17		μ s

5.2.9. RSSI specifications

Symbol	Description	Min.	Typ.	Max.	Units
RSSI _{ACC}	RSSI accuracy in the range -90 to -30 dBm		± 2		dB
RSSI _{RESOLUTION}	RSSI resolution		1		dB
RSSI _{PERIOD}	RSSI sampling time from RSSISTART task		0.25		μ s
RSSI _{SETTLE}	RSSI settling time after signal level change		15	20	μ s

5.3. Absolute maximum ratings

	Parameter	Min.	Max.	Unit
Supply voltage				
VDD	VDD supply voltage	-0.3	3.9	V
VDD _{EXT}	VDD supply voltage under extended operating temperature	-0.3	3.7	V
I/O pin voltage				
V _{I/O} , VDD ≤ 3.6 V	IO voltage	-0.3	VDD + 0.3	V
V _{I/O} , VDD > 3.6 V	IO voltage	-0.3	3.9	V
V _{I/O,EXT} , VDD _{EXT} ≤ 3.4 V	IO voltage under extended operating temperature	-0.3	VDD + 0.3	V
V _{I/O,EXT} , VDD _{EXT} > 3.4 V	IO voltage under extended operating temperature	-0.3	3.7	V
Radio				
RF input level			10	dBm
RRAM memory				
Endurance		10,000		Write/ rewrite cycles
Retention at 85°C		10		y
Retention at 105°C		2		y

	Note	Min.	Max.	Unit
Environmental QFN package types				
Storage temperature		-40	+125	°C
Reflow soldering temperature	Reflow cycle time is 30 seconds with 3 maximum reflow cycles.		260	°C
Moisture Sensitivity Level (MSL)			2	
ESD Human Body Model (HBM)			1	kV
ESD Charged Device Model (CDM)			500	V
Environmental CSP package types				
Storage temperature	Recommended storage condition is < 40°C and < 90% RH (relative humidity)	-40	+125	°C
Reflow soldering temperature	Reflow cycle time is 30 seconds with 3 maximum reflow cycles.		260	°C
Moisture Sensitivity Level (MSL)			1	
ESD Human Body Model (HBM)			3	kV
ESD Charged Device Model (CDM)			250	V

6. Reference circuit

Module is pre-programmed with Raytac's testing code. Default is using "DC-DC mode". The Nordic NCS firmware is set to use external 32.768KHz so please add it to make module work.

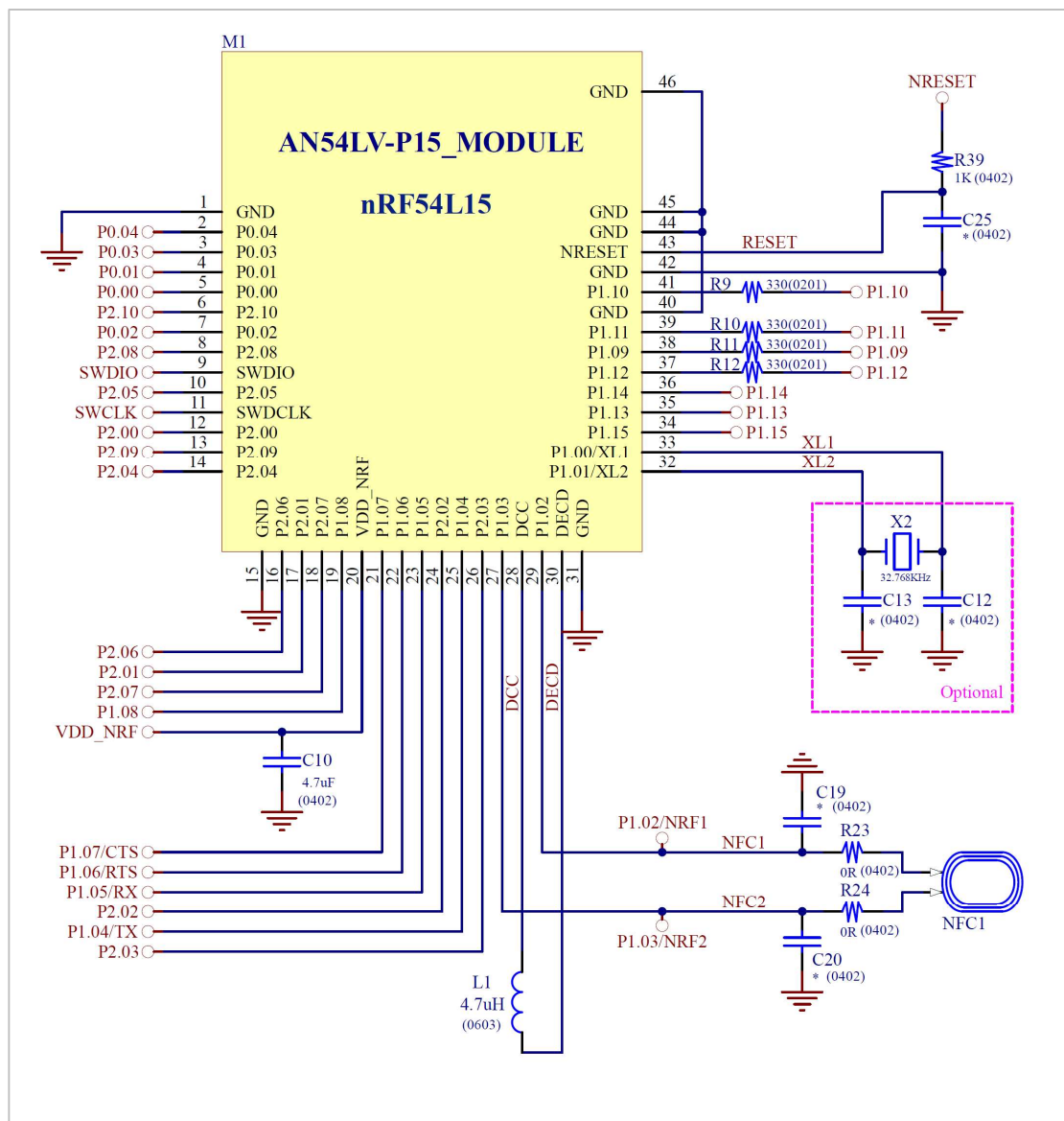
REMARK:

**** DECD decoupling capacitor (2.2μF) is already inside the module. ****

*****When enabling the DC/DC regulator, the device checks if an inductor (L1) is connected to the DCC pin. If L1 is not detected, the device remains in LDO mode.*****

**** When NOT using NFC, please remove NFC1 / C19 / C20. ****

**** When using internal 32.768KHz RC oscillator, please remove X2 / C12 / C13. ****



7. Useful links

- Nordic Infocenter: <https://docs.nordicsemi.com/>
All the necessary technical files and software development kits of Nordic's chip are on this website.
- Nordic DevZone: <https://devzone.nordicsemi.com/questions/>
A highly recommended website for firmware developer. Interact with other developers and Nordic's employees will help with your questions. The site also includes tutorials in detail to help you get started.
- Official page of nRF54L15 : <https://www.nordicsemi.com/Products/nRF54L15>
A brief introduction to nRF54L15 and download links for Nordic's developing software and SoftDevices.

