User manual

DA14580 Range extender v.2 reference application

UM-B-045

Abstract

This document describes the Bluetooth Range Extender v.2 module, based on the DA14580 SoC. Target hardware: 580 RD QFN40 Module_RF PA_vC – Board Number: 078-56-C.

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1   Terms and definitions

BLE	Bluetooth Low Energy
BOM	Bill Of Materials
DUT	Device Under Test
ERP	Effective Radiated Power
FW	Firmware
LPF	Low Pass Filter
PA	Power Amplifier
PCBA	Printed Circuit Board Assembled
PCB	Printed Circuit Board
RF	Radio Frequency
SoC	System on Chip
SPDT	Single Pole Double Throw

2   References

1. DA14580 Low Power Bluetooth Smart SoC, Datasheet, Dialog Semiconductor
2. SKY66111-11 Datasheet
3. AN-B-020 End product testing and programming guidelines.(*This document is susceptible to be replaced*)
4. UM-B-012 DA14580/581/583 Creation of a secondary boot loader

3   Introduction

The DA14580 Range Extender v.2 module design is based on the Dialog Semiconductor DA14580 BLE Smart SoC, where enhanced RF transmitted power is presented. This module serves as reference design to potential customers requesting BLE functionality with Nominal RF Output power up to +9.3 dBm (Peak RF Output Power +9.8 dBm). From physical perspective, the module is a two layer PCBA where the digital and power interfaces of the DA14580 are accessible to the user. This document presents the system, technical specifications, physical dimensions and test results.

Figure 1: DA14580 Range Extender v.2 module

4   System overview

4.1   Features

- Highly integrated Dialog Semiconductor DA14580 *Bluetooth ® Smart SoC*
- Module can be used as either stand-alone or as a data pump on a system with an external processor
- Module satisfies all Bluetooth requirements
- No external crystal or additional passive components are required for module operation, as the module is equipped with two crystal oscillators one at 16MHz (XTAL16M) and a second at 32.738KHz (XTAL32K). The 32.738 KHz is used as the clock of Extended/ Deep Sleep modes.
- Access to processor via JTAG, SPI, UART or I2C
- 22 GPIOs available on module at a 1.27 mm pitch, suitable for keyboard designs
- Operating voltage: 2.4 V to 3.3 V. Suitable for operation from a single coin cell battery.
- On-board printed inverted F-type antenna (Figure 1)
- RF connector for conducted measurements(Figure 1)
- Up to +9.3 dBm Nominal Maximum Output Power (+9.8dBm Peak Maximum Output Power).
- Rx sensitivity: better than -90 dBm
- *Supply current:*
    - -Tx : less than 17 mA peak current @ 3.0 V
    - -Rx: less than 6 mA peak current @ 3.0 V
    - -Extended - Sleep current: less than 1.6μA @ 3.0 V
- 15.25 mm x 24 mm, 37 pins, two layer PCBA
- Operating temperature: –40 $^\circ$C to +85 $^\circ$C
- Test FW based on DA14580_581_583_SDK_3.0.10.1

Table 1: Electrical characteristics

Characteristic	Value	Comments
Battery voltage (V_{BAT_3V})	2.4 V to 3.3 V	Specification tested at typical voltage of 3.0 V
Operating frequency range	2400 MHz to 2483.5 MHz	
Conducted output power	+9.3 dBm	V_{BAT_3V} = 3 V, T_A = +15 to +35 °C
Maximum bypass loss	0.6 dB	V_{BAT_3V} = 3 V, T_A = +15 to +35 °C
Receiver sensitivity	Better than -90 dBm	V_{BAT_3V} = 3 V, T_A = +15 to +35 °C
Peak Tx current	<17mA	Tx Power = +9.3 dBm, V_{BAT_3V} = 3 V, T_A = +15 to +35 °C
Peak extended-sleep current	<1.6μA	V_{BAT_3V} = 3 V, T_A = +15 to +35 °C

4.2   General description

The system consists of the DA14580 Bluetooth Low power SoC, the SKY6611-11 Front-end module and a discrete low pass filter. The radio front end is connected to a PCB trace antenna as Figure 2 shows.

The power amplifier is controlled by the CTRL1 and CTRL2 signals. CTRL1 is generated from pin P0_3 and CTRL2 is generated from P0_2 of the DA14580. On pin P0_3 and pin P0_2 the internal Radio_TXEN and Radio_RXEN signals are software allocated.
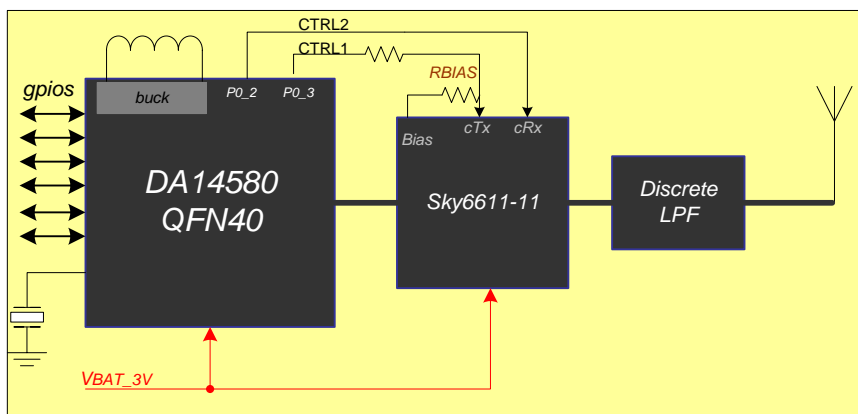
Figure 2: Block diagram

The amplifier circuit is the SKY66111-11 from Skyworks. The CTX pin is used as the TX control signal and amplifier bias voltage. CTX pin is connected to the amplifier BIAS pin via resistor RBIAS. The resistor value is adjusted in order to get a Nominal RF Output Power of +9.3 dBm. More information for the power output adjustment can be found in Sky66111-11 datasheet[2].
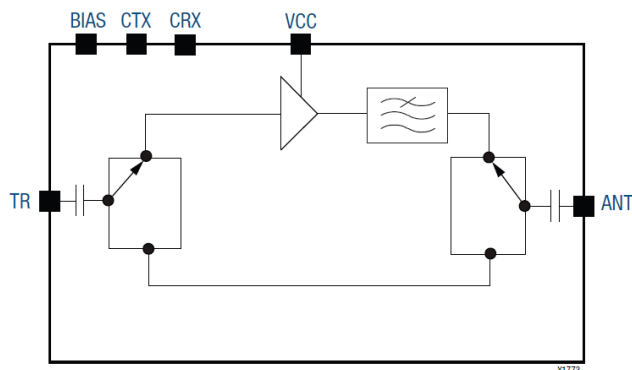
Figure 3: Sky66111-11 Power Amplifier

4.3　Bluetooth SoC

The DA14580 integrated circuit has a fully integrated radio transceiver and baseband processor for B*luetooth ® Smart*. It can be used as an application processor as well as a data pump in systems with an external processor.

The DA14580 contains an embedded One-Time-Programmable (OTP) memory for storing Bluetooth profiles as well as custom application code. The qualified *Bluetooth® Smart* protocol stack, which is stored in a dedicated ROM, and the customer application software which is stored in system RAM, run on the embedded ARM Cortex M0 processor. Low leakage Retention RAM is used to store sensitive data and connection information while in Deep Sleep mode.

The Radio Transceiver implements the RF part of the Bluetooth Smart protocol. Together with the Bluetooth 4.0 PHY layer, it provides a 93 dB RF link budget for reliable wireless communication. All RF blocks are supplied by on-chip low drop out regulators (LDOs). The RF port is single ended 50 Ω, so no external balun is required.

The DA14580 has dedicated hardware for the Link Layer implementation of *Bluetooth® Smart* and interface controllers for enhanced connectivity capabilities.

The reset line of the DA14580 (pin RST) is active high. On this module the RST pin is available on module pin 21.

Main debug port for the DA14580 is the JTAG. JTAG consists of two signals, SWDIO and SWCLK.

The frequency tolerance specification for BLE is 50 ppm. In order to compensate ageing and offset effects, an external crystal shall have an accuracy of ±15 ppm or better. The DA14580 crystal (Y1) has a fundamental frequency of 16 MHz and load capacitance not higher than 10 pF. The crystal is located on the module itself. Also, an internal programmable capacitance bank is available in the DA14580. In this way, the crystal oscillator frequency can be tuned.

For sleep mode the on chip RCX oscillator is utilized. In addition, a 32 kHz crystal (Y2) with a tolerance of 50 ppm (500 ppm max) can be assembled on the module. The crystal load capacitance shall not be higher than 10 pF.

The external digital interfaces available for the module are:

● 2 UARTs with hardware flow control up to 1 MBd

● SPI interface

● I2C bus at 100 kHz, 400 kHz

● 3-axis capable Quadrature Decoder

There is also a 4-channel 10-bit ADC available externally to the module.

The module includes 22 GPIOs (including JTAG signals) that are available externally. The interfaces are multiplexed with the GPIOs and can be enabled by appropriate programming.

The DA14580 is equipped with a DC-DC converter that can be configured as either Buck or Boost. For this module, the DC-DC converter is configured as a Buck converter (C5, C2, L1, C3).

The DA14580 is available in three packages: WLCSP34, QFN40 and QFN48. In this reference application the QFN40 has been used.
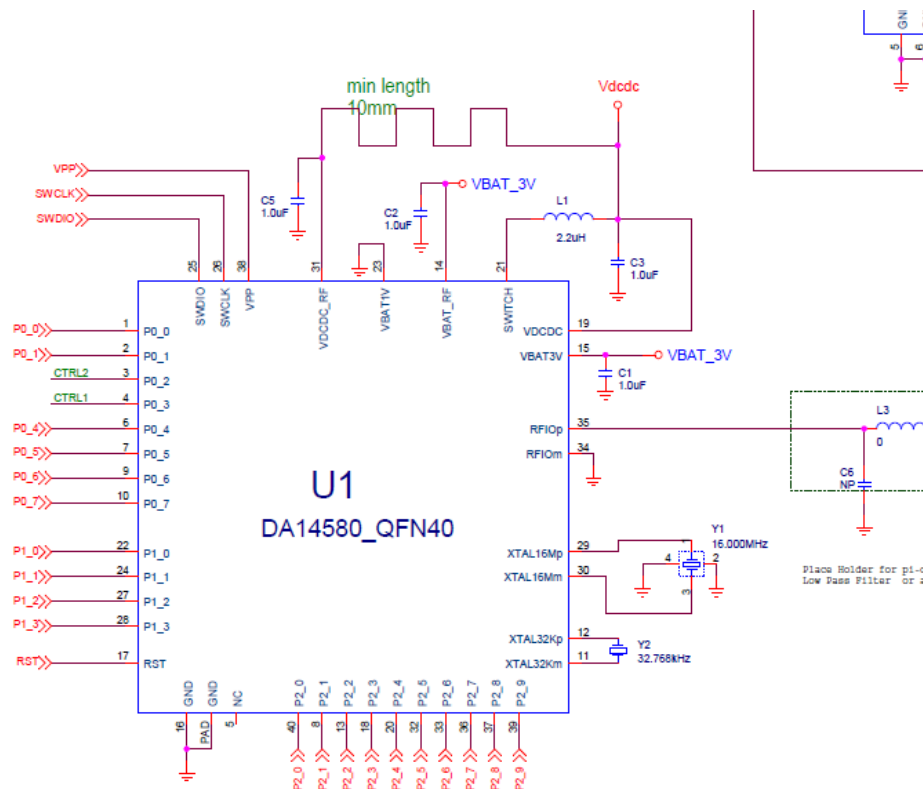
Figure 4: DA14580 QFN40 SoC, Range Extender ver.2 module

4.4   RF front end

This part of the design is implementing the amplification of the RF transmitted signal while the transmitted harmonics as well as the Tx spurious emissions remain within the FCC/ETSI specification.

The operation of the RF front end is controlled by the DA14580. There are two RF paths: one through the amplifier and one bypass path. The amplifier path is enabled during transmission. The RF signal passes through the PA, the low pass filter and the RF matching network. In the bypass path, the RF signal received at the antenna is driven directly to the BLE transceiver.
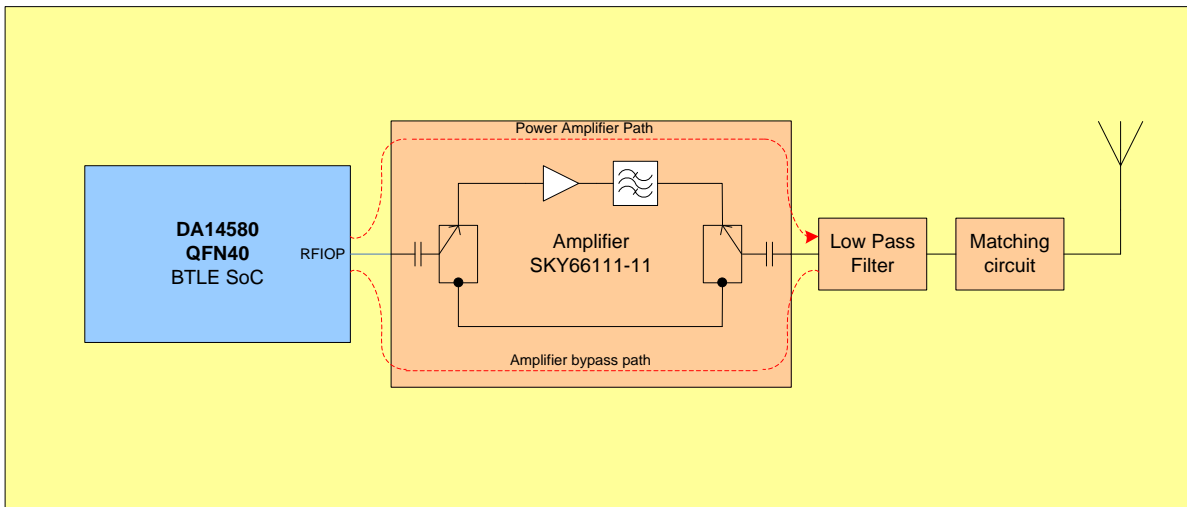
Figure 5: RF front end signal paths
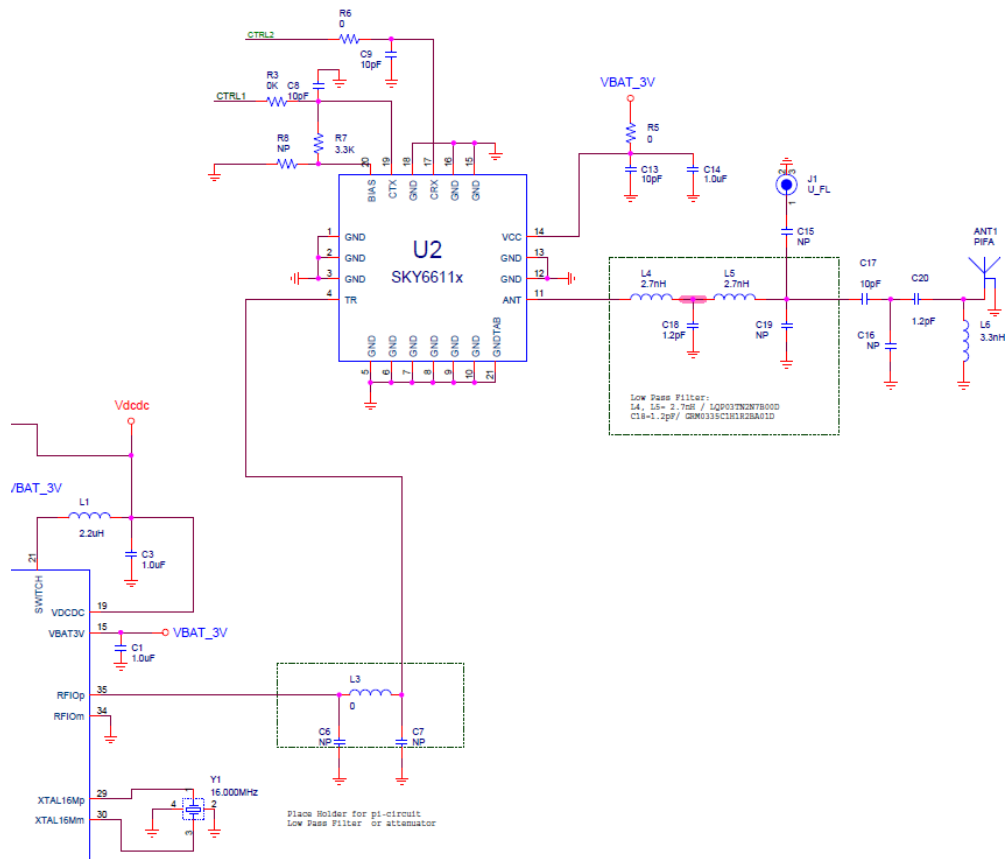
Figure 6: RF front end schematic

4.4.1   Radio front end control signals

4.4.1.1   Radio front end control signals

In general, three different radio control signal can be extracted from DA14580:

- extrc_txen, it can be used as Tx_En control signal of the RF front end.

- extrc_rxen or radcntl_rxen radio. Both signals are of the same duration. They can be used as Rx_En control signals for the RF front end.

- event_in_process that can be used for wlan co-existence signal.

The signals are extracted by using the BLE diagnostic port. Two registers need to be programmed:

- BLE_DIAGCNTL_REG where it is defined which signals will be extracted from each port. Register specification of BLE_ DIAGCNTL_REG :

Table 2: BLE_ DIAGCNTL_REG (0x40000050) register specification

Bit	Mode	Symbol	Description	Reset
31	R/W	DIAG3_EN	0: Disable diagnostic port 3 output. All outputs are set to 0. 1: Enable diagnostic port 3 output.	0x0
30	-	-	Reserved	0x0
29:24	R/W	DIAG3	Only relevant when DIAGEN3 = 1. Selection of the outputs that must be driven to the diagnostic port 3.	0x0
23	R/W	DIAG2_EN	0: Disable diagnostic port 2 output. All outputs are set to 0. 1: Enable diagnostic port 2 output.	0x0
22	-	-	Reserved	0x0
21:16	R/W	DIAG2	Only relevant when DIAGEN2 = 1. Selection of the outputs that must be driven to the diagnostic port 2. See chapter 2.15 for a detailed description.	0x0
15	R/W	DIAG1_EN	0: Disable diagnostic port 1 output. All outputs are set to 0. 1: Enable diagnostic port 1 output.	0x0
14	-	-	Reserved	0x0
13:8	R/W	DIAG1	Only relevant when DIAGEN1 = 1. Selection of the outputs that must be driven to the diagnostic port 1. See chapter 2.15 for a detailed description.	0x0
7	R/W	DIAG0_EN	0: Disable diagnostic port 0 output. All outputs are set to 0. 1: Enable diagnostic port 0 output.	0x0
6	-	-	Reserved	0x0
5:0	R/W	DIAG0	Only relevant when DIAGEN0 = 1. Selection of the outputs that must be driven to the diagnostic port 0.	0x0

- BLE_CNTL2_REG where the BLE diagnostic port is enabled and the straight or reverse pin assignment is defined. This function is controlled by two register bit-fields, DIAGPORT_SEL and DIAGPORT_REVERSE. Description presented below on Table 3.

Table 3: BLE_CNTL2_REG (0x40000200) register specification

Bit	Mode	Symbol	Description	Reset
5	R/W	DIAGPORT_REVERSE	BLE/RADIO Diagnostic Port Reverse order. When this bit is "1", the mapping of the diagnostic bus DIAGPORT[7:0] (controlled by DIAGPORT_SEL) to GPIOs (controlled by Pxy_MODE_REG[PID]) is reversed. The mapping is: If "0" then DIAGPORT[7] is mapped to P0[7], etc. DIAGPORT[4] is mapped to P0[4], DIAGPORT[3] is mapped to P0[3] and P1[3], etc. and DIAGPORT[0] is mapped to P0[0] and P1[0]. If "1" then DIAGPORT[7] is mapped to P0[0] and P1[0], etc. DIAGPORT[4] is mapped to P0[3] and P1[3], DIAGPORT[3] is mapped to P0[4], etc. and DIAGPORT[0] is mapped to P0[7].	0
4:3	R/W	DIAGPORT_SEL	BLE/RADIO Diagnostic Port Selection. Controls the multiplexing of the internal diagnostic signals towards the 8-bit diagnostic bus DIAGPORT[7:0]. The DIAGPORT[7:0] bit order may or may not be reversed by using the DIAGPORT_REVERSE bitfield and then it will be directed to the GPIOs P0[7:0] and P1[3:0]. (Note that the P1[3:0] diagnostic signals are the same with P0[3:0] signals.) The DIAGPORT[7:0] value, depending on the DIAGPORT_SEL value, is: 00: {BLE_DIAG2[7:5], BLE_DIAG1[4:3], BLE_DIAG0[2:0]} 01: {BLE_DIAG2[7:5], BLE_DIAG1[4:3], BLE_DIAG0[2] , wakeup_lp_irq, deep_sleep_stat_32k} 10: RADIO_DIAG0[7:0] 11: RADIO_DIAG1[7:0]	0x0

In BLE_CNTL2_REG the port and the pins assignment order is defined. Only port 0 (P0_[0:7]) and port 1 (P1_[0:3]) of the chip can be utilized.
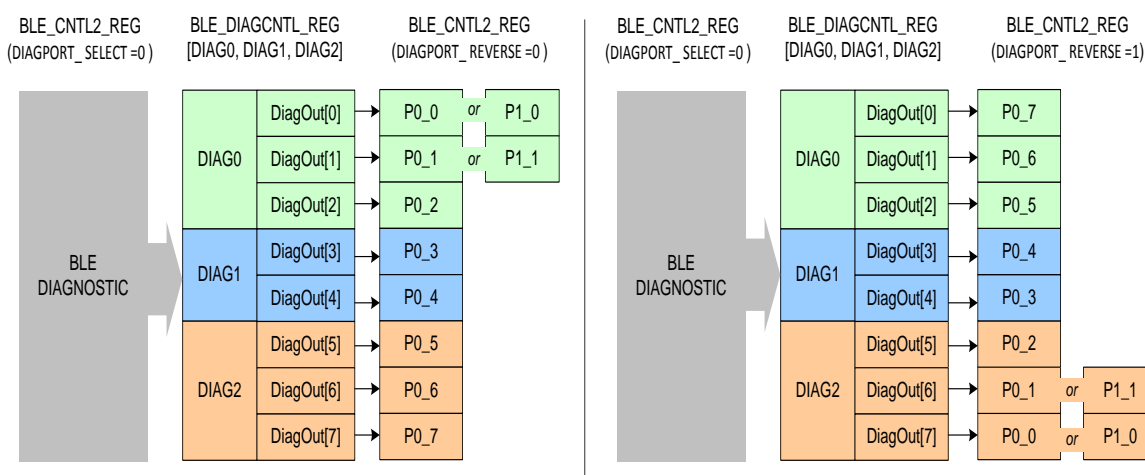
Figure 7: Diagnostic port to pins assignment and register settings

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For having all pins extracted in parallel, a combination of register setting and pin availability must be arranged. For example it is preferable to avoid assigning P0_4 and P0_5 to RF control signals. P0_4 and P0_5 are used for UART ports in testing and production tests.

The available pins are presented below:

Table 4: Diagnostic port availability and settings for control pins

Function	Diagnostic port settings		DA14580 assigned Pins	
	BLE_DIAGCNTL_REG		BLE_CNTL2_REG	
	DIAG port	DIAGx	DIAGPORT_ REVERSE = **0**	DIAGPORT_ REVERSE = **1**
Tx_Enable	DIAG1	0x28	P0_3	P0_4
Rx_Enable	DIAG1	0x28	P0_4	P0_3
	DIAG2	0x08	P0_5	P0_2
	DIAG2	0x0c	P0_6	P0_1, P1_1
	DIAG0	0x1F	P0_2	P0_5
Wlan coexist	DIAG2	0x08	P0_7	P0_0, P1_0
	DIAG2	0x0D	P0_7	P0_0, P1_0
	DIAG2	0x1F	P0_6	P0_1, P1_1

4.4.1.2   Suggested pin assignment

A suggested pin assignment for extracting all rf control signals at the same time is presented below:

Table 5: Suggested pin assignment for extracting all RF control signals

function	Signal used	Diagnostic port settings		DA14580 assigned Pins
		BLE_DIAGCNTL_REG		BLE_CNTL2_REG
		DIAG port	DIAGx	DIAGPORT_ REVERSE = **0**
PA_**Tx** Enable	extrc_txen	DIAG1	0x28	P0_3
PA_**Rx** Enable	radcntl_rxen	DIAG0	0x1F	P0_2
Wlan coexist	event_in_ process	DIAG2	0x08	P0_7

For more options on the pin assignment please read paragraph 4.8: Development mode-peripheral pin mapping.

Below, screenshots from the radio control signals during operation are presented. The proximity reporter_fh application was used.
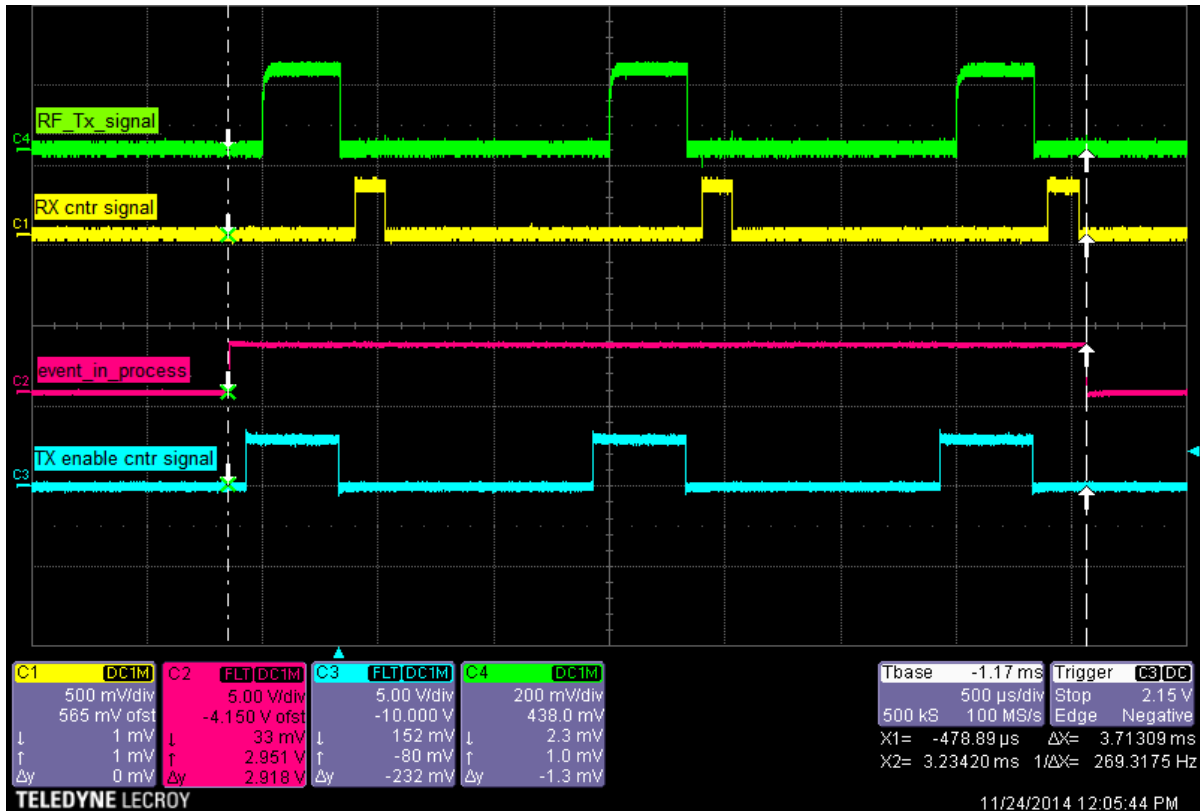
Figure 8: The RF control signals
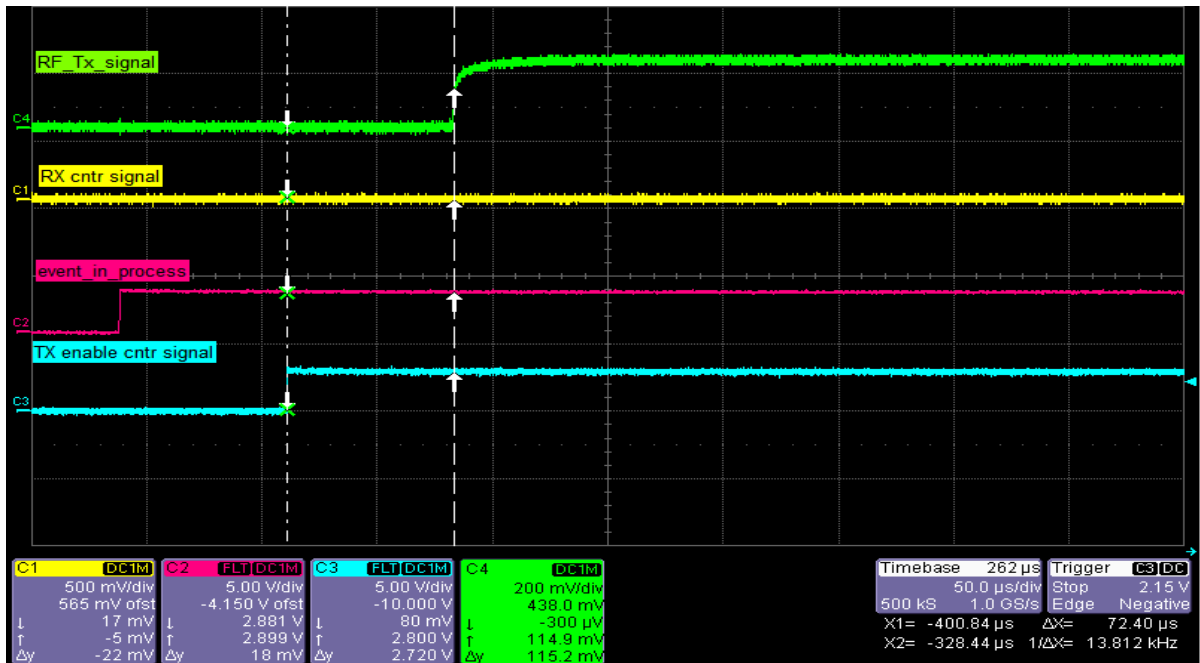
Figure 9: Rising edge of Tx_En control signal

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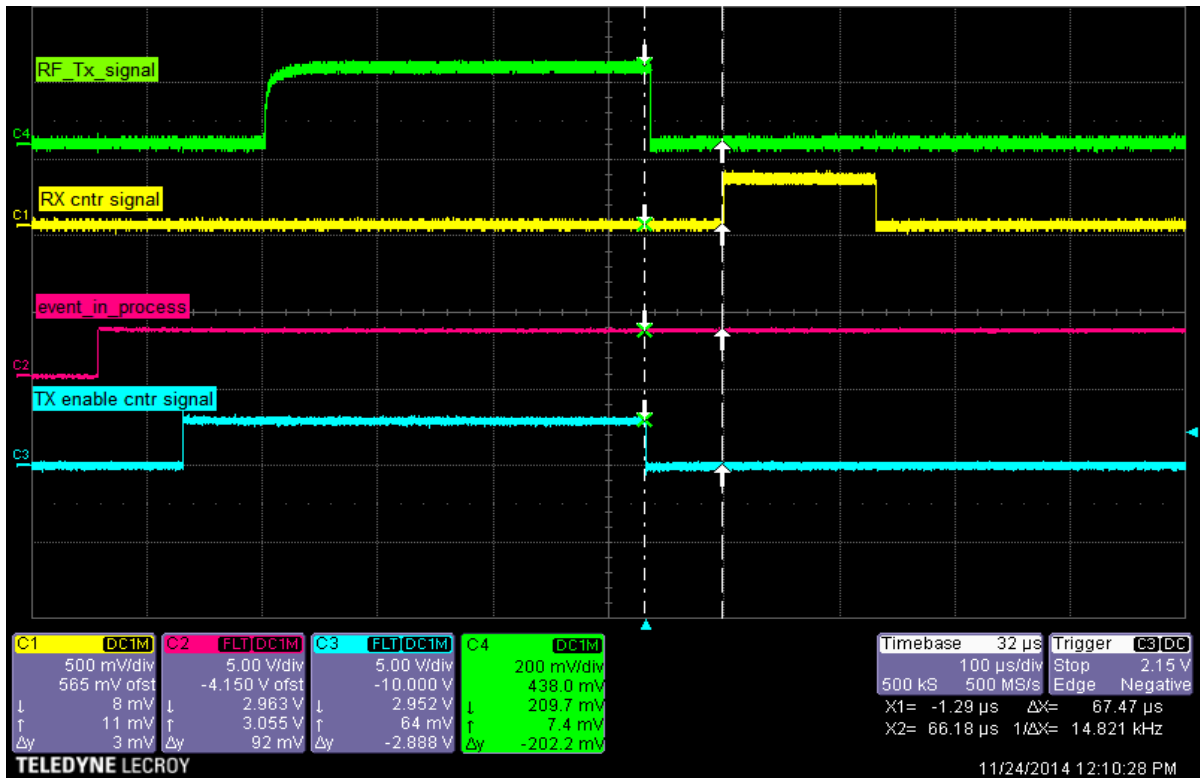
Figure 10: Detail from Tx_En to Rx_En signal

4.4.2 Power amplifier

The amplifier circuit is the SKY66111-11[2] from Skyworks. The VBIAS pin is connected to the bias voltage via resistor R7. The resistor value is adjusted so that the +9.3 dBm output power is achieved at maximum 16.15 mA current consumption.

There are two Low Pass Filters options for the power amplifier. The first one is at the input of the Skyworks amplifier and is formed by C6, C7 and L3 and the second is at the output of the Skyworks amplifier and is formed by L4, L5, C18 and C19. The second LPF is used in the current design.

The power amplifier is supplied from pin VBAT_3V directly.

4.4.3   Low pass filter

The low pass filter is placed after the amplifier matching network in order to suppress the harmonics generated due to the amplifier's nonlinearity. The filter presents low losses in the 2.4 GHz to 2.5 GHz frequency range (max. loss: 0.5 dB). The ripple on the pass band was chosen equal to 0.1dB.
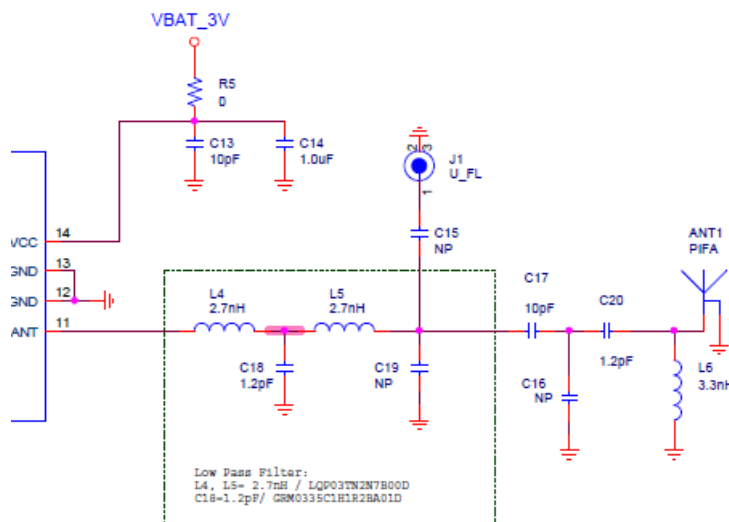
Figure 11: Low pass filter
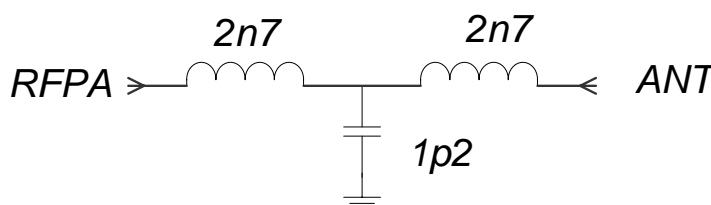
Figure 12: T- shaped, 3-poles, Low Pass Filter

The filter is a T- type Chebyshev 3rd order low pass filter. The filter configuration is presented in Figure 12.

Component value:

- 2,7nH : LQG15HN2N7S02 / Murata
- 1.2pF: GRM1555C1H1R2CZD1/ Murata

Frequency response measurements are presented in Figure 13 below.
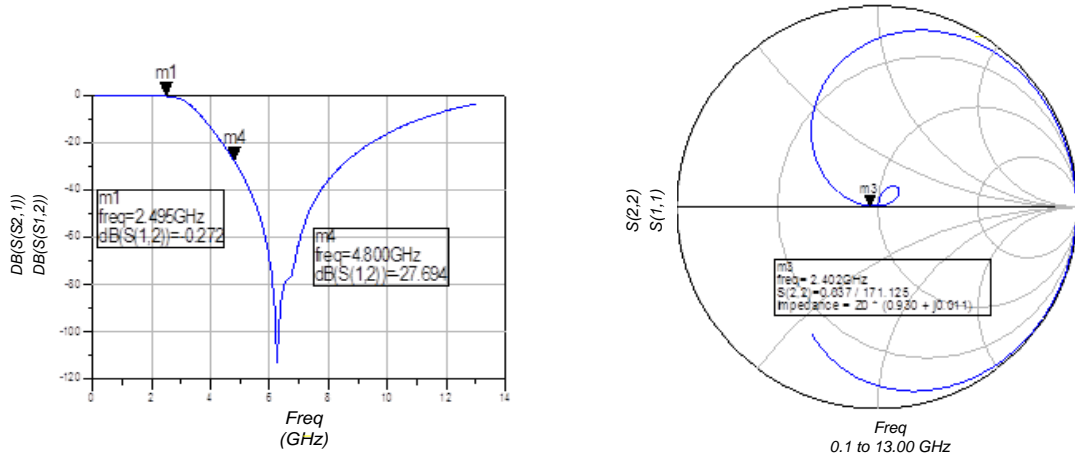
Figure 13: Simulation results of LPF response

4.4.4   Antenna

4.4.4.1   Range Extender v.2 on Interposer

The antenna is a printed Inverted F Antenna (IFA). The antenna was designed according to the size of the module and the available antenna space (15.24 mm x 24 mm). The measurements for the characterization of the antenna radiation pattern were performed with Range Extender v.2 module mounted on an interposer board. The matching components values for the antenna measurement are: C20= 1.2pF and L6=3.3nH.

Figure 14: Range Extender v.2 on interposer

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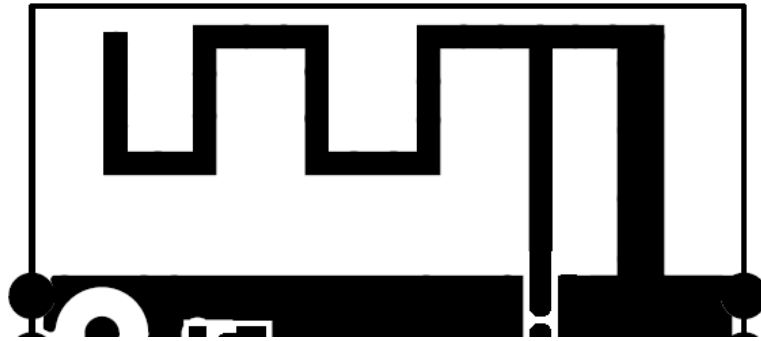
Figure 15: Antenna geometry on Range Extender v.2
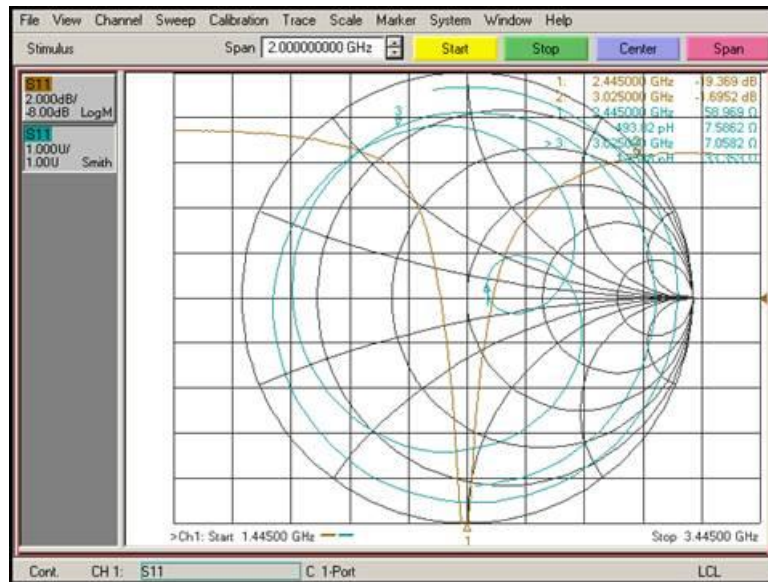
Figure 16: Measured S11 paramater for IFA

Gain measurements were performed in an anechoic chamber. The maximum gain was measured at 0 dBi.

Table 6: Antenna gain Range Extender v.2 with interposer

Parameter	G (dBi)
Maximum gain	0
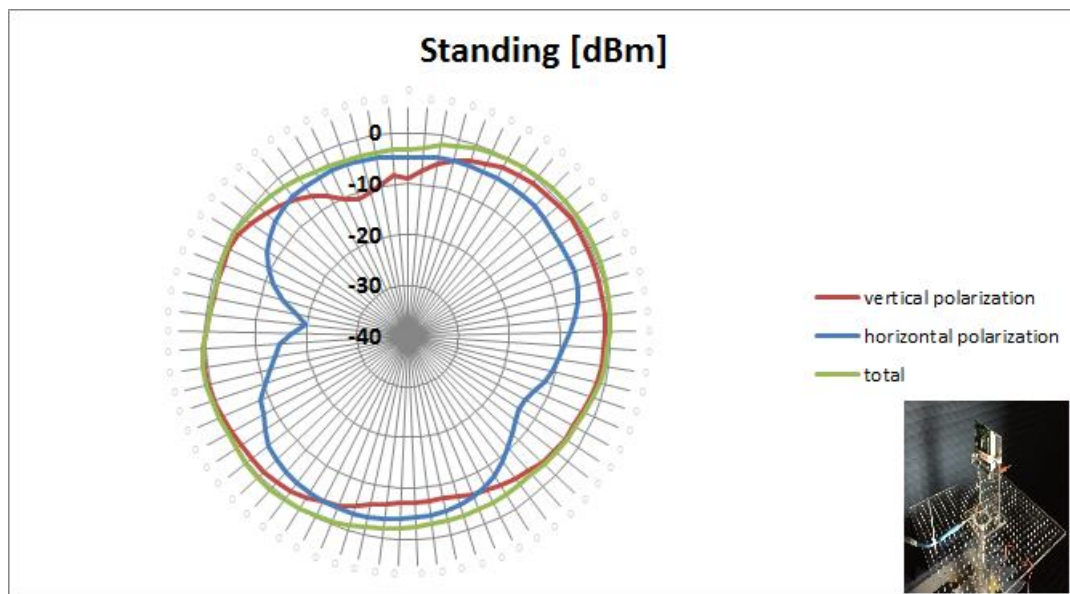
Figure 17: Radiation diagram for the board placed vertically on the short edge
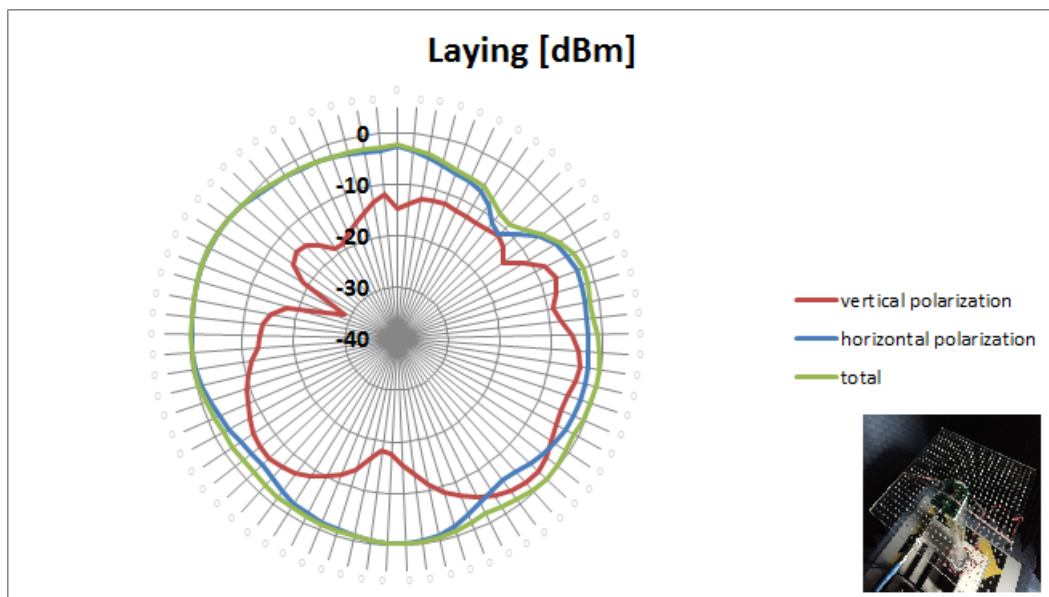
Figure 18: Radiation diagram for the board placed horizontally

4.4.4.2 Range Extender v.2 stand alone

Measurements for the characterization of the antenna radiation pattern were also performed with Range Extender v.2 not soldered on interposer. In this case the matching components values differ from the values of the module on the interposer. The matching values of the components are: C20= 1.2pF and C16=1pF.

Figure 19: Range Extender v.2 stand-alone

Gain measurements were performed in an anechoic chamber. The maximum gain was measured at -10 dBi.

Table 7: Antenna gain Range Extender v.2 stand-alone

Parameter	G (dBi)
Maximum gain	-10
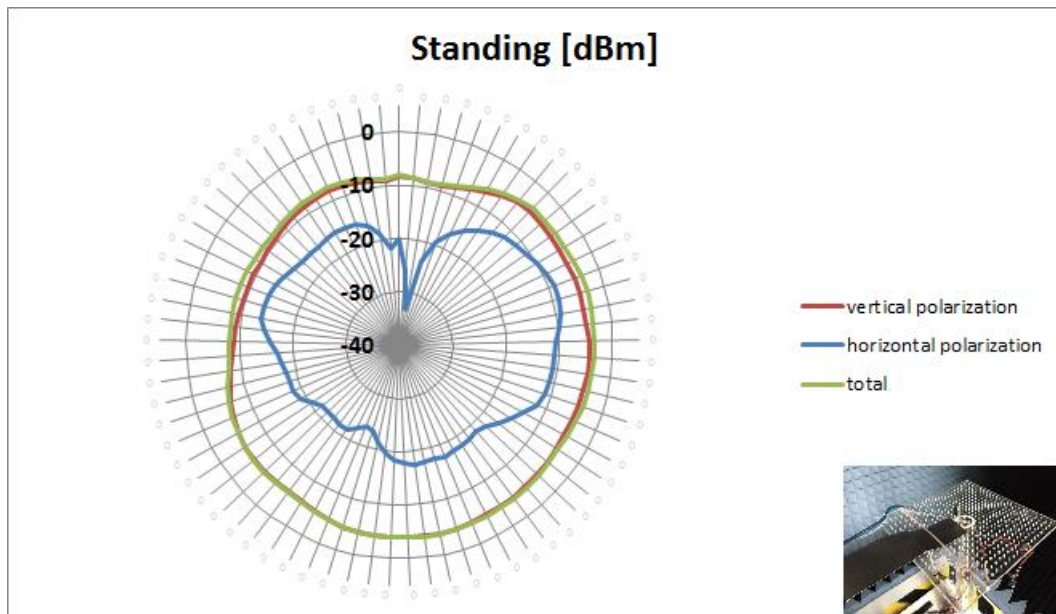
Figure 20: Radiation diagram for the board placed vertically on the short edge
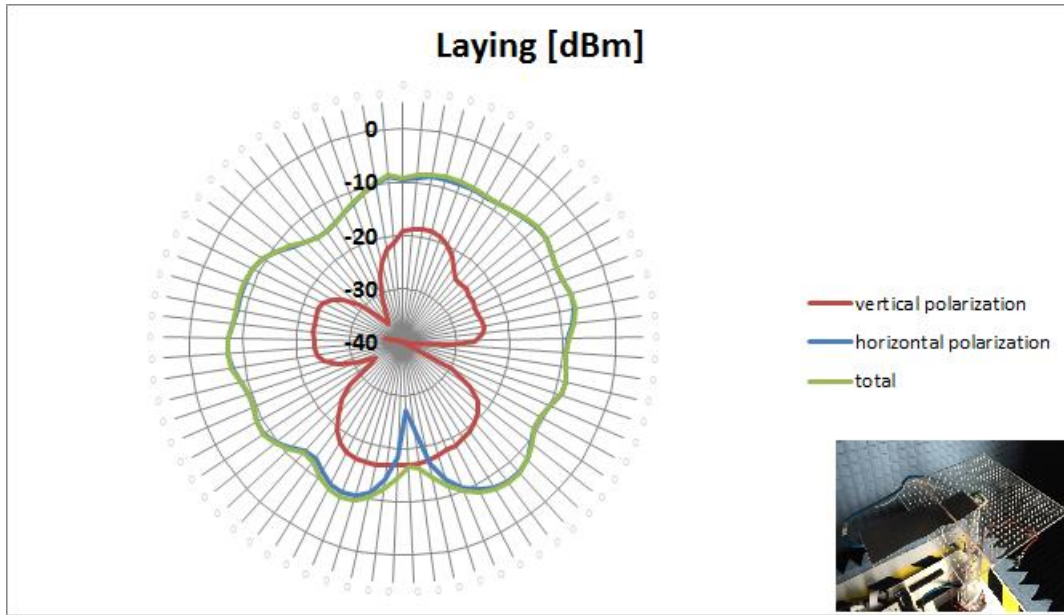
Figure 21: Radiation diagram for the board placed horizontally

The stand-alone board presents lower antenna gain than the board mounted on the interposer. This is explained due the small ground size of the board. It is recommended for Range Extender v.2 to be mounted on a pcb with bigger ground surface or when embedded to a new design to follow the dimensions in Figure 22.
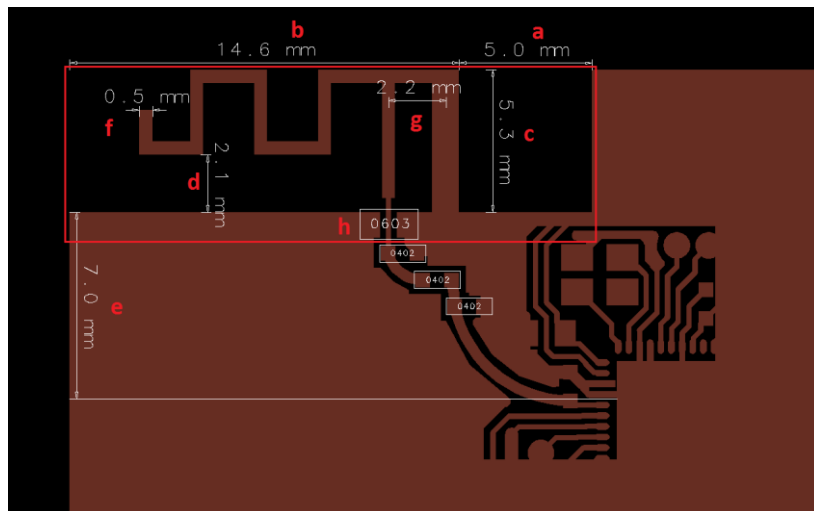
Figure 22: IFA antenna implementation

The dimensions above are given for a typical FR1 PCB substrate, 1mm thick. The antenna length is adjusted for resonance including a 1mm plastic enclosure placed in contact with the PCB antenna. The red outline indicates the antenna footprint, i.e. required allocation of PCB space. The footprint of the antenna is available per request in dxf format.

Legend (Figure 22):

Clearance between antenna arm and GND plane right a.

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Antenna width b.

Antenna height c.

Clearance between the antenna arm and GND plane below d.

Minimum GND plane size required for correct operation of the antenna e.

Antenna traces width f.

4.5 Power system and requirements

The Range Extender v.2 module is supplied by a single power supply through pins VBAT_3V. For the DA14580 SoC, the VBAT_3V voltage variations are handled by the internal DC-DC converter. The DC-DC converter's external components are an inductor L1 (2.2 uH) and three capacitors C3, C1 and C2 (all three capacitors are equal to 1 uF).

The RF power amplifier and its circuitry are supplied directly from the external power source. The module is intended for use with a +3 V coin cell battery (e.g CR2450 type). The V_{BAT_3V} voltage range is 2.4 V to 3.0 V, whereas the absolute maximum voltage is 3.6 V.

The overall current consumption in Tx mode does not exceed 17 mA @ 3.0 V supply. The current consumption by the front end circuits (amplifier) does not exceed 11 mA, whereas in extended- sleep mode the consumption of the system is expected to be in less than 1.6 uA.
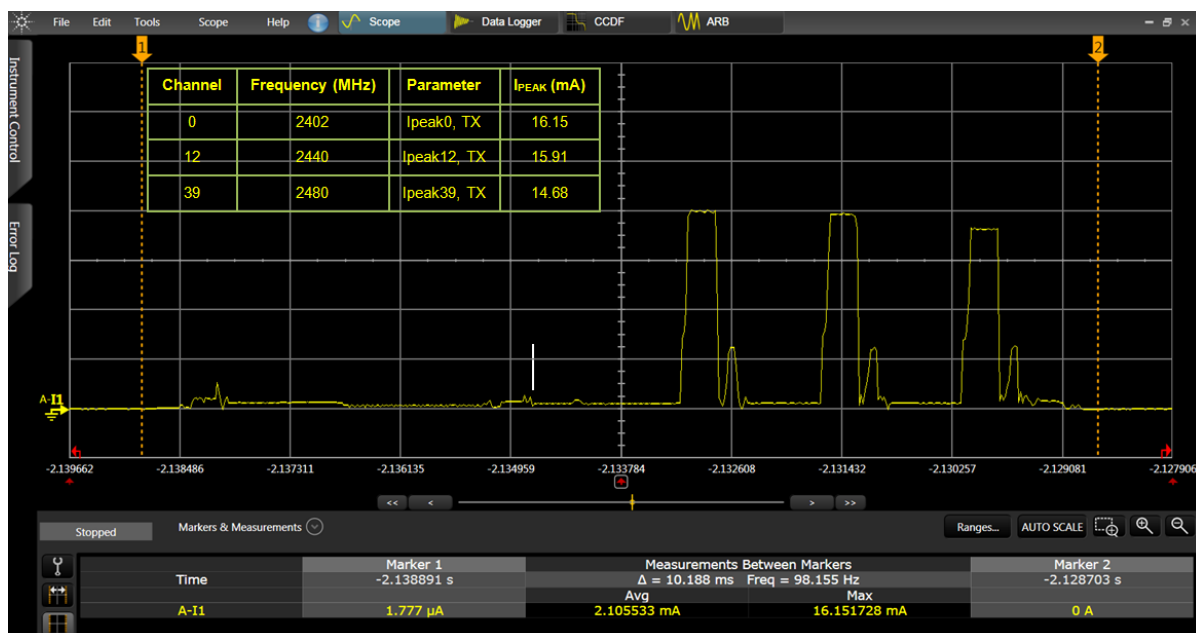
Figure 23: Current consumption for Advertisement frame

4.6 Trimming the 16MHz Xtal

For ensuring best operation of the Module, the 16MHz XTAL must be trimmed. The frequency is trimmed by two on-chip variable capacitor banks. Both capacitor banks are controlled by the same register. For trimming the XTAL apply procedure described on AN-B-020[3]: End product testing and programming guidelines.

4.7 PCBA

A 2-layer FR4 PCB with 1.024 mm standard thickness is used. The PCB size is 15.25x24 mm. There are 37 connection pads which are made as castellation (1/2 open drill) with 1.27 mm pitch.

The connection pad assignment is shown in Table 8 below. The pin numbering is counter clockwise, as seen from the PCB top starting in the top left corner.

Schematic and BOM are presented in Figure 25 and Table 9.
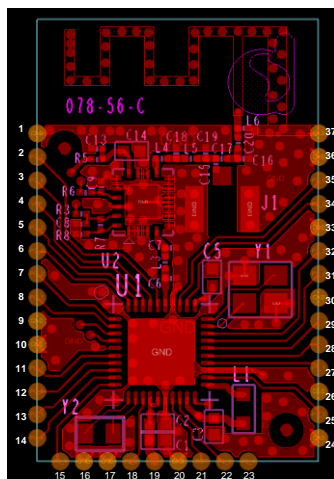
Figure 24: Top view of PCBA

Table 8: Module Pin assignment

Pin	Signal name (Left side of the PCB seen from the top)	Pin	Signal name (Bottom side of the PCB seen from the top)	Pin	Signal name (Right side of the PCB seen from the top)
1	GND	15	P0_7	29	SWCLK
2	P2_7	16	GND	30	GND
3	P2_8	17	GND	31	P1_2
4	VPP	18	P2_2	32	P1_3
5	P2_9	19	VBAT_3V	33	GND
6	P2_0	20	GND	34	P2_5
7	P0_0	21	RST	35	P2_6
8	P0_1	22	P2_3	36	GND
9	GND	23	P2_4	37	GND
10	GND	24	GND		
11	P0_4	25	P1_0		
12	P0_5	26	GND		
13	P2_1	27	P1_1		
14	P0_6	28	SWDIO		

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Figure 25: Schematic of DA14580 Range Extender v.2 Module

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Table 9: Bill of Materials

Ref.	Value	Description	Manuf.	MPN	Footpr.
U1	DA14580_QFN40	BT Low Energy System on a Chip	Dialog Semiconductor	DA14580-01AT1	QFN40
U2	SKY66111	Front-End Module, 2.4GHz-2.485GHz	Skyworks Solutions, Inc.	SKY66111-11	MCM
L3, R3, R5, R6	0	RES 0.0 OHM 1/20W 0201 SMD	Vishay/Dale	CRCW02010000Z0ED	0201
R7	3.3K	RES 3.3K OHM 50mW 1% 0201 SMD	Vishay/Dale	CRCW02013K30FKED	0201
Y1	16.000MHz	CRYSTAL 16MHZ 10PF SMD	TXC Corporation	7M-16.000MEEQ-T	
Y2	32.768kHz	CRYSTAL 32.768KHZ 7PF SMD	Abracon Corporation	ABS07-32.768KHZ-7-T	
C1, C2, C3, C5, C14	1.0uF	CAP MLCC 1.0uF 10V X5R 10%	TDK Corporation	C1005X5R1A105K050BB	0402
C8, C9, C13, C17	10pF	CAP MLCC 0201 10pF 25volts C0G	Murata	GRM0335C1E100JA01D	0201
C18, C20	1.2pF	CAP MLCC 0201 1.2pF 25volts C0G +/-0.25pF	Murata	GRM0335C1E1R2CA01D	0201
L1	2.2uH	INDUCTOR Power 2.2uH, 500mA, 400MHz	Taiyo Yuden	BRL1608T2R2M	0603
L4,L5	2.7nH	Fixed Inductors 2.7 NH +-.1NH	Murata	LQP03TN2N7B00D	0201
L6	3.3nH	Fixed Inductors 3.3nH 0.1nH 500MHz	Murata	LQP03TN3N3B02D	0201
J1	NP	RF Connectors / Coaxial Connectors UMC STRT JACK RECEP SURFACE MOUNT	Johnson / Cinch Connectivity Solutions	128-0711-201	UMC
Not Populated Components					
Ref.	Value	Description	Manuf.	MPN	Footpr.
C6,C7,C15,C16,C19	NP	Capacitors			
R8	NP	Resistors			
ANT1		Printed Antenna			
TP1,TP2		Test Points			

4.8   Development Mode-Peripheral Pin Mapping

On the following table the pins used for development/ testing are described.

Table 10: Development/ testing mode pin mapping

SoC Pin #	DA14580 assigned Pins	Function	SoC Pin #	DA14580 assigned Pins	Function
1	P0_0	Available External Use	21	SWITCH	Connection for the external DCDC-converter inductor.
2	P0_1	Available External Use	22	P1_0	Available External Use
3	P0_2	PA_Rx Enable	23	VBAT1V	
4	P0_3	PA_Tx Enable	24	P1_1	Available External Use
5	NC		25	P1_5	SWDIO
6	P0_4	UART TX	26	P1_4	SWCLK
7	P0_5	UART RX	27	P1_2	Available External Use
8	P2_1	Available External Use	28	P1_3	Available External Use
9	P0_6	Available External Use	29	XTAL16Mp	
10	P0_7	WLAN coexist	30	XTAL16Mm	
11	XTAL32Km		31	VDCDC_RF	
12	XTAL32Kp		32	P2_5	Available External Use
13	P2_2	Available External Use	33	P2_6	Available External Use
14	VBAT_RF		34	RFIOm	
15	VBAT3V		35	RFIOp	
16	GND		36	P2_7	Available External Use
17	RST	RESET	37	P2_8	Available External Use
18	P2_3	Available External Use	38	VPP	
19	VDCDC		39	P2_9	Available External Use
20	P2_4	Available External Use	40	P2_0	Available External Use
*Note: Any available pin can be used for interfacing external SPI data Flash. See secondary boot loader document for further details[4]					

By default in the secondary boot loader[4] all the SPI GPIO signals are assigned to Port0. However as it has been mentioned in paragraph 4.4.1, P0_2 and P0_3 pins are utilized to extract the radio control signals. So if SPI communication with a peripheral is needed, a modification in the configuration settings for the peripherals contained in header file periph_setup.h can be made.

```
// SPI Flash settings
// SPI Flash Manufacturer and ID
#define W25X10CL_MANF_DEV_ID (0xEF10)       // W25X10CL Manufacturer and ID
#define W25X20CL_MANF_DEV_ID (0xEF11)       // W25X10CL Manufacturer and ID
// SPI Flash options
#define W25X10CL_SIZE 131072                // SPI Flash memory size in bytes
#define W25X20CL_SIZE 262144                // SPI Flash memory size in bytes
#define W25X10CL_PAGE 256                   // SPI Flash memory page size in bytes
#define W25X20CL_PAGE 256                   // SPI Flash memory page size in bytes
#define SPI_FLASH_DEFAULT_SIZE 131072       // SPI Flash memory size in bytes
#define SPI_FLASH_DEFAULT_PAGE 256          // SPI Flash memory page size in bytes
//SPI initialisation parameters
#define SPI_WORD_MODE   SPI_8BIT_MODE
#define SPI_SMN_MODE    SPI_MASTER_MODE
#define SPI_POL_MODE    SPI_CLK_INIT_HIGH
#define SPI_PHA_MODE    SPI_PHASE_1
#define SPI_MINT_EN     SPI_NO_MINT
#define SPI_CLK_DIV     SPI_XTAL_DIV_2
// UART GPIOs assignment
#define UART_GPIO_PORT  GPIO_PORT_0
#define UART_TX_PIN     GPIO_PIN_4
#define UART_RX_PIN     GPIO_PIN_5
#define UART_BAUDRATE   baudrate_57K6
// SPI GPIO assignment
#define SPI_GPIO_PORT   GPIO_PORT_0
#define SPI_CS_PIN      GPIO_PIN_3
#define SPI_CLK_PIN     GPIO_PIN_0
#define SPI_DO_PIN      GPIO_PIN_6
#define SPI_DI_PIN      GPIO_PIN_5
// EEPROM GPIO assignment
#define I2C_GPIO_PORT   GPIO_PORT_0
#define I2C_SCL_PIN     GPIO_PIN_2
#define I2C_SDA_PIN     GPIO_PIN_3
```

Figure 26: DA14580/581/583 configuration settings for peripherals, periph_setup.h

4.9 Software

The following instructions are based DA14580_581_583_SDK_3.0.10.1. Instructions are valid for both Keil 4 and Keil 5 projects. Screenshots shown are in Keil 5.

Inserting in a project (example in proximity reporter)

1. Copy `app_range_extender` folder to `dk_apps\src\modules\app\src\app_utils`

2. Open the project and add `app_range_extender.c` in app group of the keil project

Right click 'apps' and select "Add existing files to Group 'app' ". Add `app_range_extender.c`
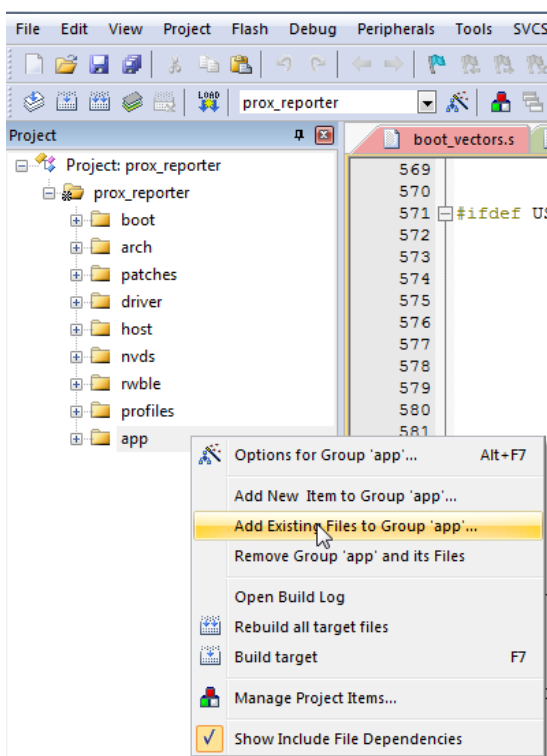
Figure 27: Step 2 of adding app_range_extender

3. Add the app_range_extender folder in the compiler include paths.
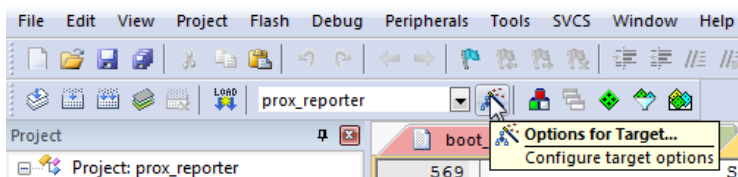
Figure 28: Step 3a of adding app_range_extender

In the target options, select the C/C++ tab and in the end add:
`.\..\..\..\..\ src\modules\app\src\app_utils\app_range_extender`
(separate from the previous path with a semicolon)
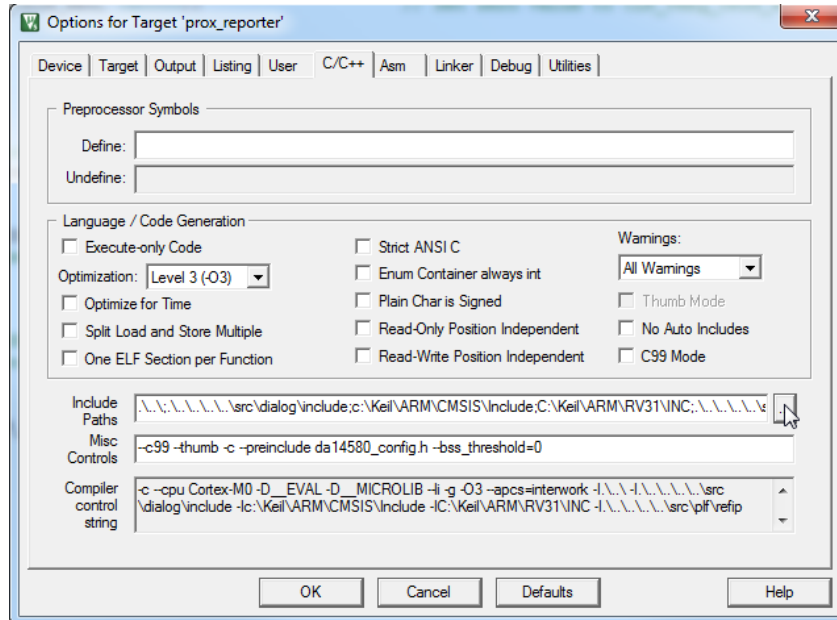
Figure 29: Step 3b of adding app_range_extender

4. In `app_<project>_proj` file, add the line:

   `#include "app_range_ext.h"` in the Include files section
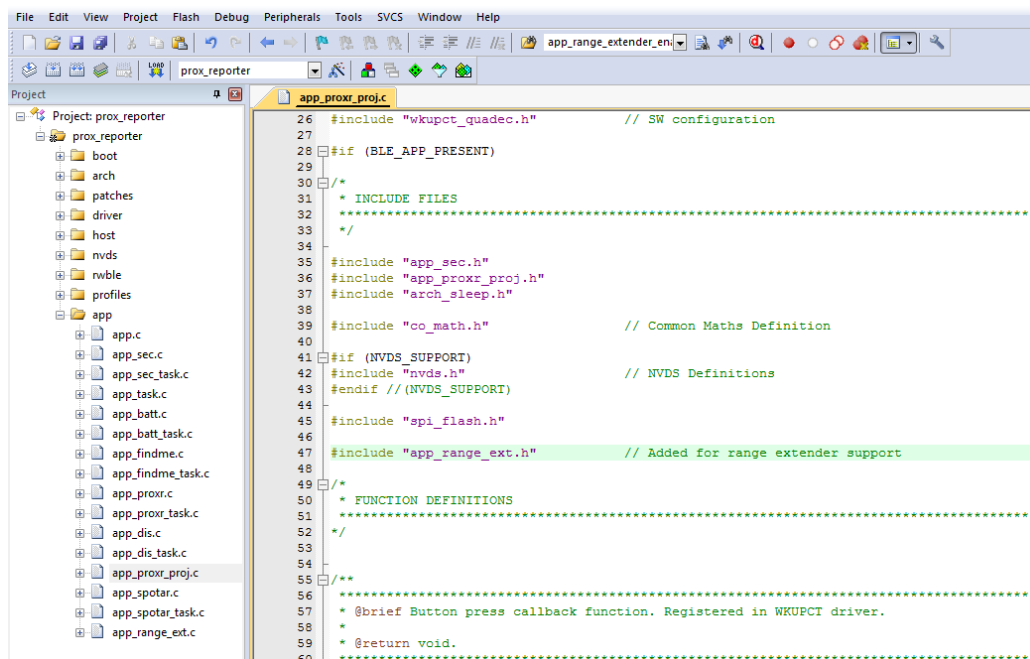
Figure 30: Step 4a of adding app_range_extender

and call `app_range_extender_enable()` in `app_init_func()`
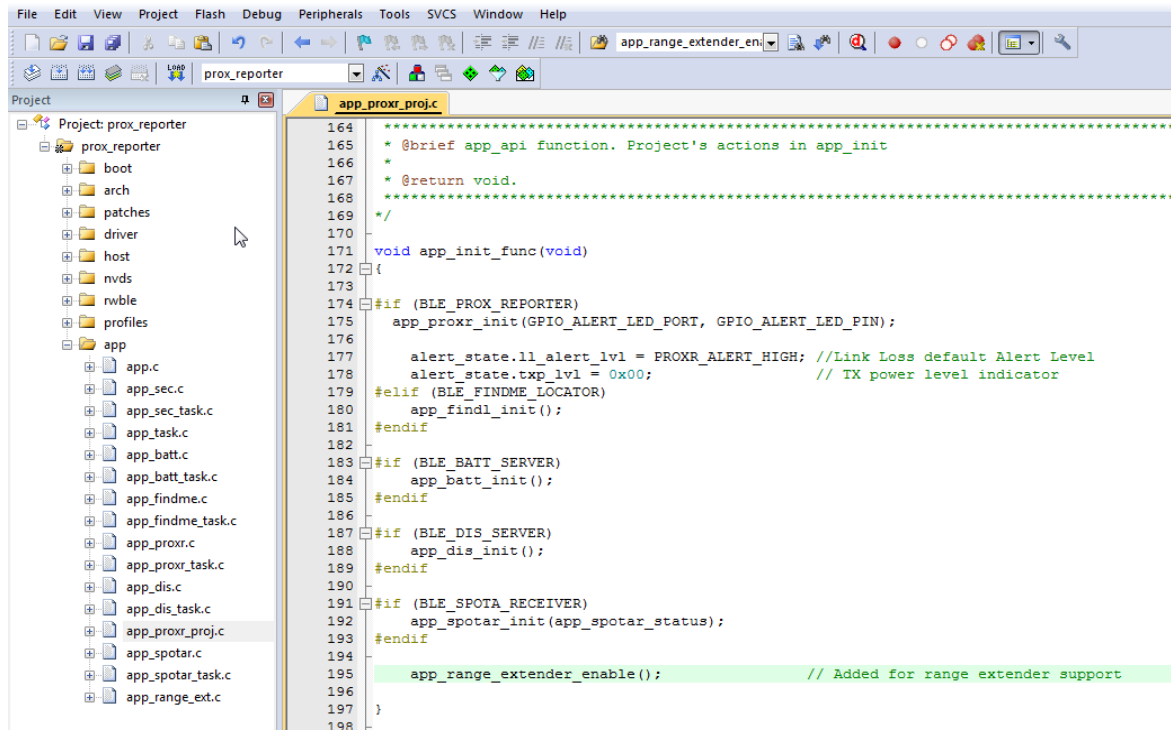
Figure 31: Step 4b of adding app_range_extender

5. In `periph_setup.c`, add the line:

```
#include "app_range_ext.h" in the Include files section
```
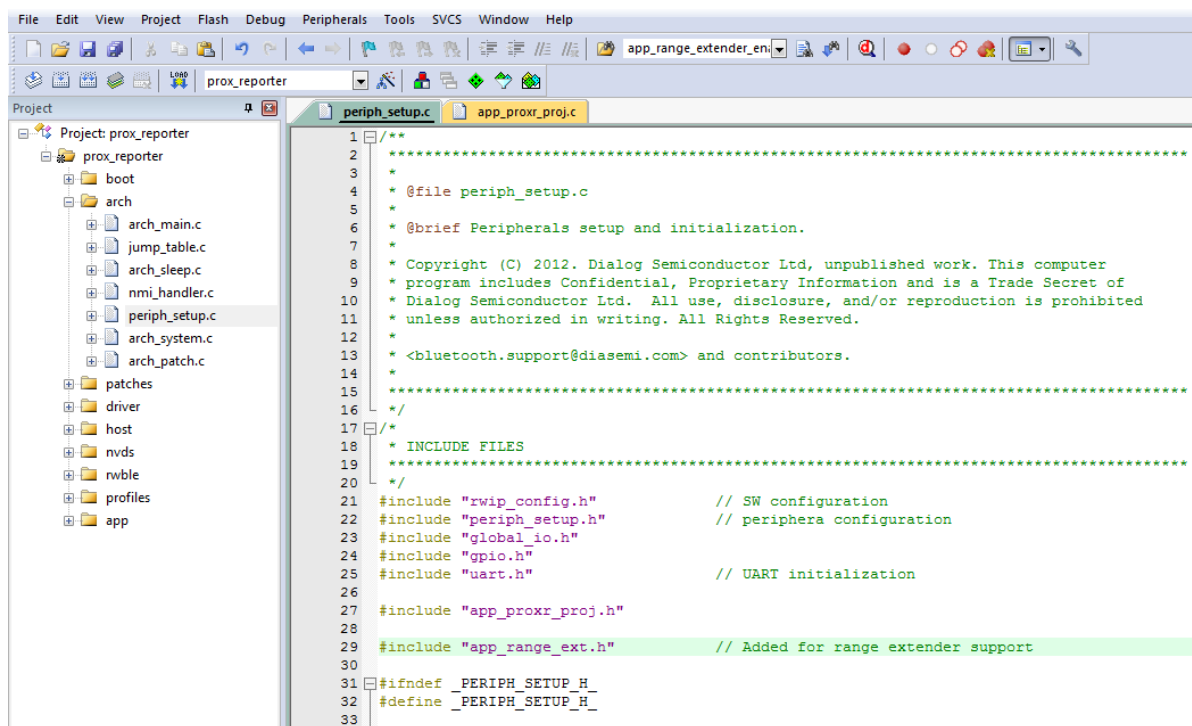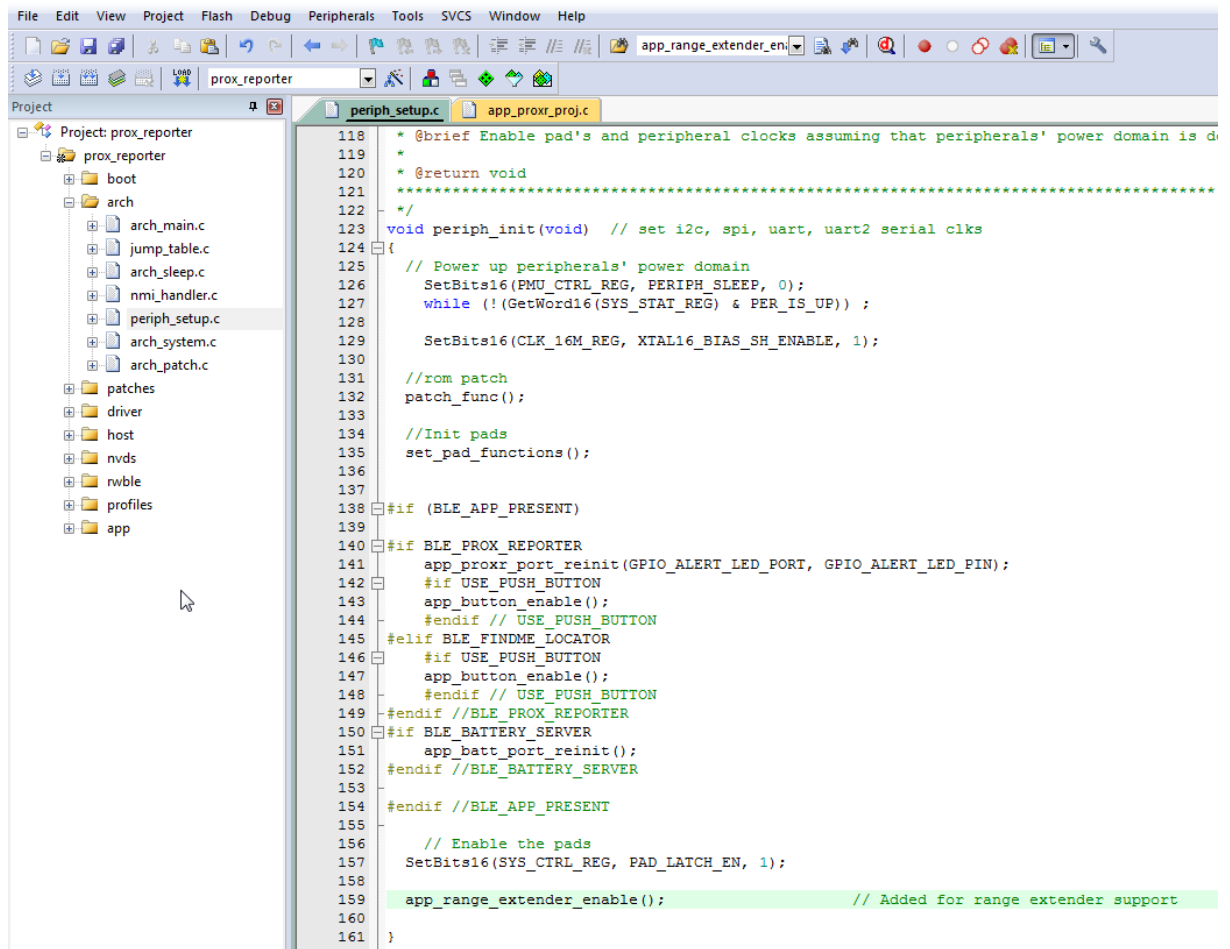

Figure 32: Step 5a of adding app_range_extender

and call `app_range_extender_enable()` at the end of `periph_init()`

Figure 33: Step 5b of adding app_range_extender

Inserting in the production test tool

1. Follow above steps **1-3**

2. In `custom_gtl_hci.c`, add the line:

> `#include "app_range_ext.h"` in the Include files section
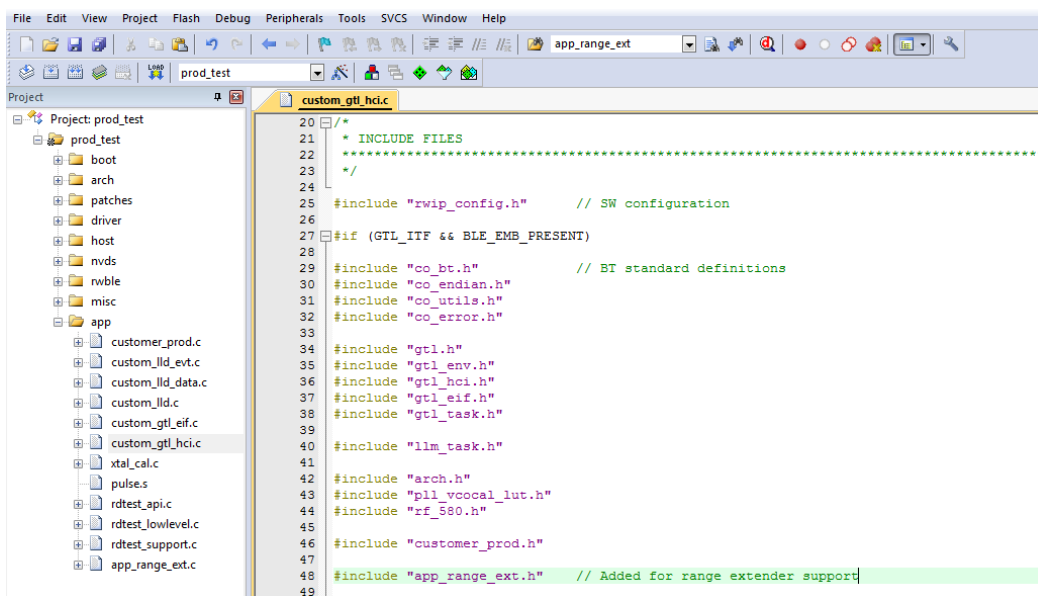
and call `app_range_extender_enable()` in `gtl_hci_rx_header_func()`
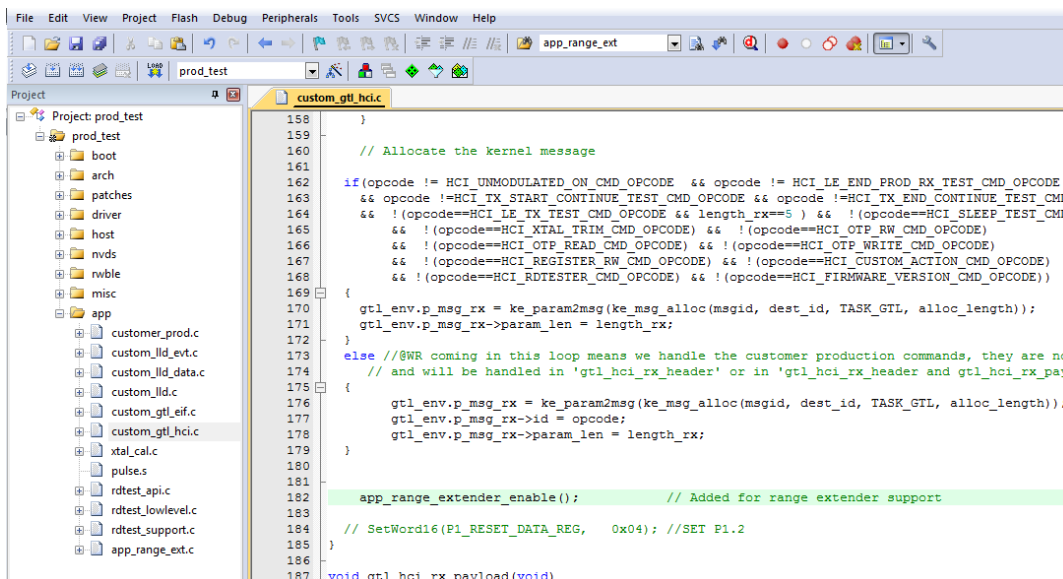
Figure 34: Inserting app_range_extender in the production test tool

5 Measurements

5.1 Basic performance measurements

5.1.1 Receiver sensitivity (conducted)

5.1.1.1 Test description

In this test the Rx sensitivity of Range Extender v.2 Module was measured.

5.1.1.2 Test setup

The Range Extender v.2 Module was mounted on a DK Development Board with the use of an intermediate interposer board. The R&S®CBT Bluetooth® Tester from Rohde & Schwarz was used. An RF cable assembly was connected to J1 connector (UMC RF Series) and at the other end through an attenuator to the R&S®CBT Bluetooth® Tester from Rohde & Schwarz. The results from a dirty transmitter on one of the boards are reported below.

5.1.1.3 Test results

The conducted RF sensitivity with dirty transmitter shows that the sensitivity is better than -90 dBm for the most of the channels.

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Table 11: Conducted Rx sensitivity

Bluetooth Low Energy PER Search

TX Start Level: -96.0 dBm, Packets: 1500, Payload: PRBS 9, Length: 37 Bytes, Dirty Transmitter: specification table

Channelscan: from Ch. 00 to Ch. 39, with detailed values

RX Level @ Ch: 00, PER: 28.93%, Count: 13	-91.40 dBm	✔
RX Level @ Ch: 01, PER: 29.33%, Count: 06	-91.40 dBm	✔
RX Level @ Ch: 02, PER: 30.33%, Count: 12	-91.40 dBm	✔
RX Level @ Ch: 03, PER: 31.20%, Count: 07	-90.60 dBm	✔
RX Level @ Ch: 04, PER: 30.60%, Count: 07	-91.50 dBm	✔
RX Level @ Ch: 05, PER: 29.67%, Count: 11	-91.40 dBm	✔
RX Level @ Ch: 06, PER: 31.53%, Count: 08	-91.40 dBm	✔
RX Level @ Ch: 07, PER: 31.47%, Count: 09	-91.10 dBm	✔
RX Level @ Ch: 08, PER: 31.07%, Count: 06	-91.40 dBm	✔
RX Level @ Ch: 09, PER: 28.93%, Count: 09	-91.10 dBm	✔
RX Level @ Ch: 10, PER: 31.13%, Count: 11	-91.00 dBm	✔
RX Level @ Ch: 11, PER: 32.47%, Count: 10	-90.70 dBm	✔
RX Level @ Ch: 12, PER: 29.93%, Count: 12	-91.10 dBm	✔
RX Level @ Ch: 13, PER: 28.80%, Count: 09	-91.10 dBm	✔
RX Level @ Ch: 14, PER: 28.93%, Count: 09	-91.10 dBm	✔
RX Level @ Ch: 15, PER: 31.60%, Count: 14	-89.20 dBm	✔
RX Level @ Ch: 16, PER: 29.27%, Count: 13	-91.20 dBm	✔
RX Level @ Ch: 17, PER: 29.33%, Count: 09	-91.10 dBm	✔
RX Level @ Ch: 18, PER: 31.40%, Count: 12	-91.30 dBm	✔
RX Level @ Ch: 19, PER: 29.40%, Count: 09	-90.40 dBm	✔
RX Level @ Ch: 20, PER: 30.07%, Count: 10	-91.20 dBm	✔
RX Level @ Ch: 21, PER: 29.60%, Count: 05	-91.20 dBm	✔
RX Level @ Ch: 22, PER: 29.33%, Count: 09	-91.20 dBm	✔
RX Level @ Ch: 23, PER: 29.00%, Count: 11	-90.80 dBm	✔
RX Level @ Ch: 24, PER: 29.80%, Count: 05	-91.20 dBm	✔
RX Level @ Ch: 25, PER: 31.53%, Count: 06	-91.40 dBm	✔
RX Level @ Ch: 26, PER: 29.93%, Count: 10	-90.90 dBm	✔
RX Level @ Ch: 27, PER: 29.93%, Count: 09	-90.40 dBm	✔
RX Level @ Ch: 28, PER: 29.40%, Count: 18	-90.90 dBm	✔
RX Level @ Ch: 29, PER: 30.20%, Count: 11	-91.00 dBm	✔
RX Level @ Ch: 30, PER: 29.73%, Count: 18	-90.90 dBm	✔
RX Level @ Ch: 31, PER: 28.87%, Count: 06	-88.80 dBm	✔
RX Level @ Ch: 32, PER: 31.00%, Count: 09	-91.10 dBm	✔
RX Level @ Ch: 33, PER: 29.93%, Count: 05	-91.20 dBm	✔
RX Level @ Ch: 34, PER: 29.33%, Count: 10	-90.90 dBm	✔
RX Level @ Ch: 35, PER: 29.53%, Count: 07	-90.60 dBm	✔
RX Level @ Ch: 36, PER: 31.13%, Count: 05	-91.20 dBm	✔
RX Level @ Ch: 37, PER: 29.40%, Count: 11	-91.00 dBm	✔
RX Level @ Ch: 38, PER: 31.13%, Count: 12	-91.10 dBm	✔
RX Level @ Ch: 39, PER: 29.07%, Count: 10	-90.30 dBm	✔

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5.1.2   Transmitter output power (conducted)

5.1.2.1   Test description

In this test the conducted RF output power of Range Extender v.2 Module was measured.

5.1.2.2   Test setup

The Range Extender v.2 Module was mounted on a DK Development Board with the use of an intermediate interposer board. In order to evaluate the TX output power, production test firmware was used. Conducted transmitted output power was measured by using the R&S®CBT Bluetooth® Tester from Rohde & Schwarz. An RF cable assembly was connected to J1 connector (UMC RF Series) and at the other end through an attenuator to the R&S®CBT Bluetooth® Tester. Bursts of 10 packets were transmitted by the DA14580. The packet length was 37 and the pattern was "01010101". Three channels were recorded, channels 0, 19 and 39.

5.1.2.3   Test results

Measurements were performed on a number of samples.

Red: maximum

Blue: average

Green: minimum

Figure 35: Nominal conducted output power per channel

Annex: Peak Power Graphic

Mode: Channelscan, Start Channel: 00, Stop Channel: 39, Average: blue, Min: green, Max: red

Red: maximum

Blue: average

Green: minimum
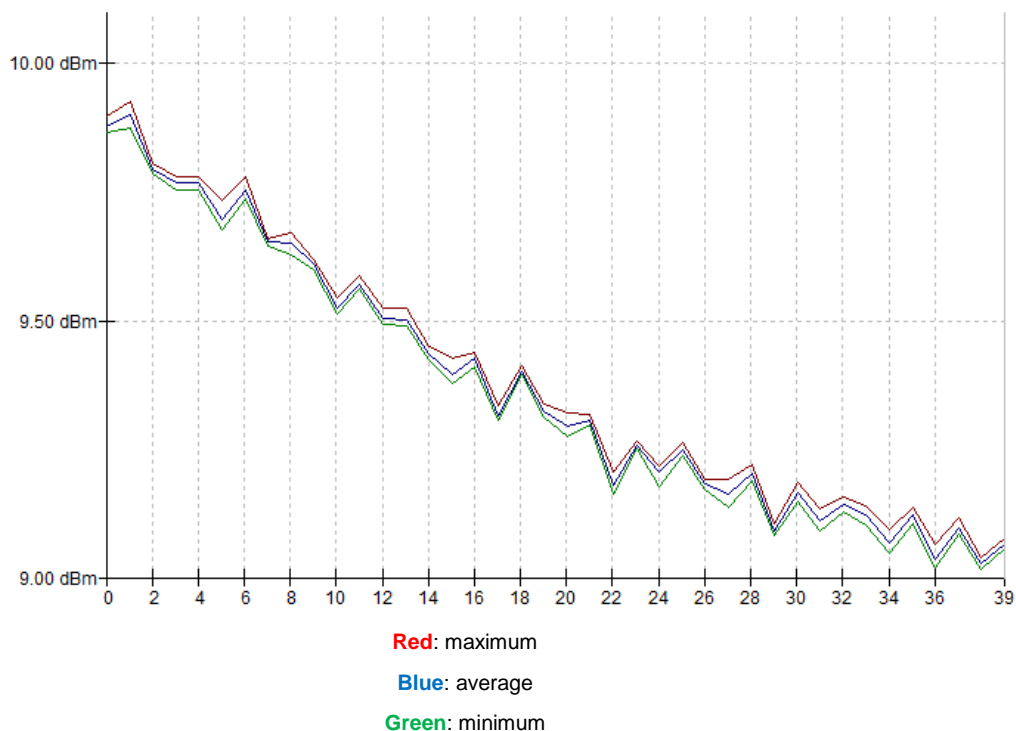
Figure 36: Peak conducted output power per channel

Table 12: Tx output power

Parameter	V_{BAT_3V} (V)	P_{OUT} (dBm)		
		CH00	CH19	CH39
Nominal Tx output power, average	+3.0	9.35	8.87	8.57
Peak Tx output power, average	+3.0	9.88	9.34	9.03

5.1.3 Current consumption

5.1.3.1 Test setup

The board used in the test presented optimal RF performance. The integrated printed antenna was used to perform the measurements.

Following instruments were used for the test:

- Multimeter
- 3 V, 100 mA power source
- Agilent N6705B

The current profiles were evaluated using proximity reporter firmware with embedded PA control. During this test the Advertisement, Connection and Extended Sleep modes were evaluated.

5.1.3.2 Advertisement mode

For this measurement the DUT was supplied by 3 V. FW was downloaded and the JTAG programmer and then it was disconnected.

Table 13: Peak current during Advertisement mode

Channel	Frequency (MHz)	Parameter	I_{PEAK} (mA)
0	2402	Ipeak0, TX	16.15
12	2440	Ipeak12, TX	15.91
39	2480	Ipeak39, TX	14.68
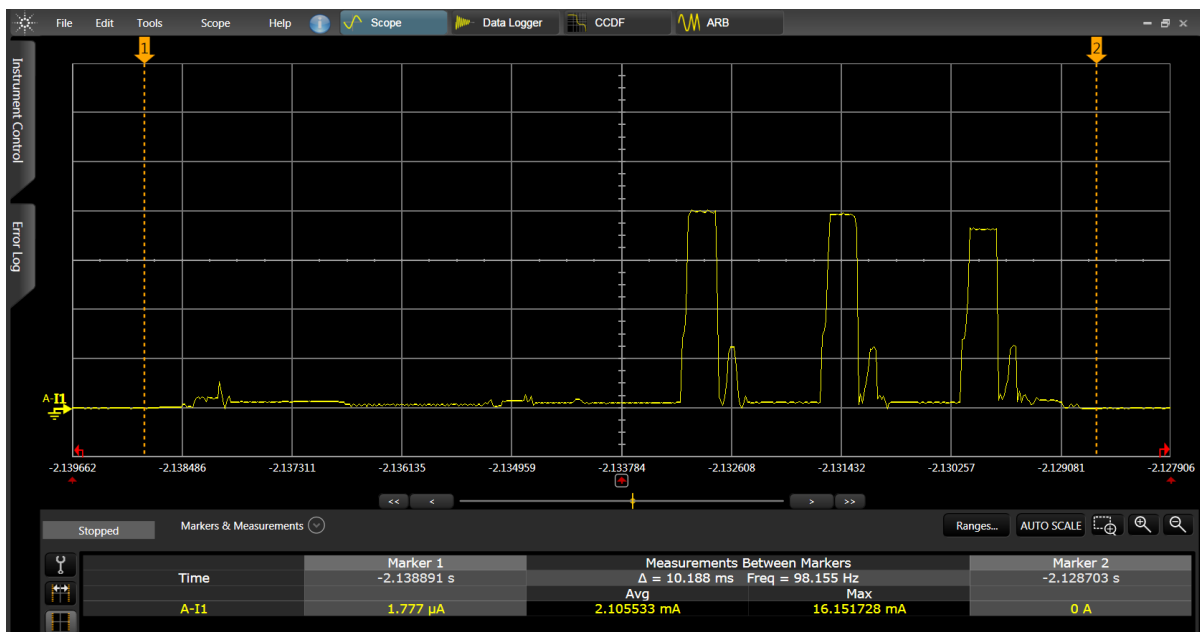
Figure 37: Supplu current during an Advertisement frame

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5.1.3.3 Connection mode

For this measurement the DUT was supplied by 3 V. FW was downloaded and the JTAG programmer was disconnected and connection with an iPhone 4S was established.

Table 14: Peak current during Connection mode

Parameter	I_{PEAK} (mA)
Ipeak, TX	16.74

Figure 38: Supply current during a Connection frame

5.1.3.4 Extended sleep mode

For this measurement the DUT was supplied by 3 V. FW was downloaded and the JTAG programmer was disconnected. FW was setting the RF path to Rx.

Table 15: Average current in Extended Sleep mode

Parameter	I_{AV} (µA)
Imean	1.58

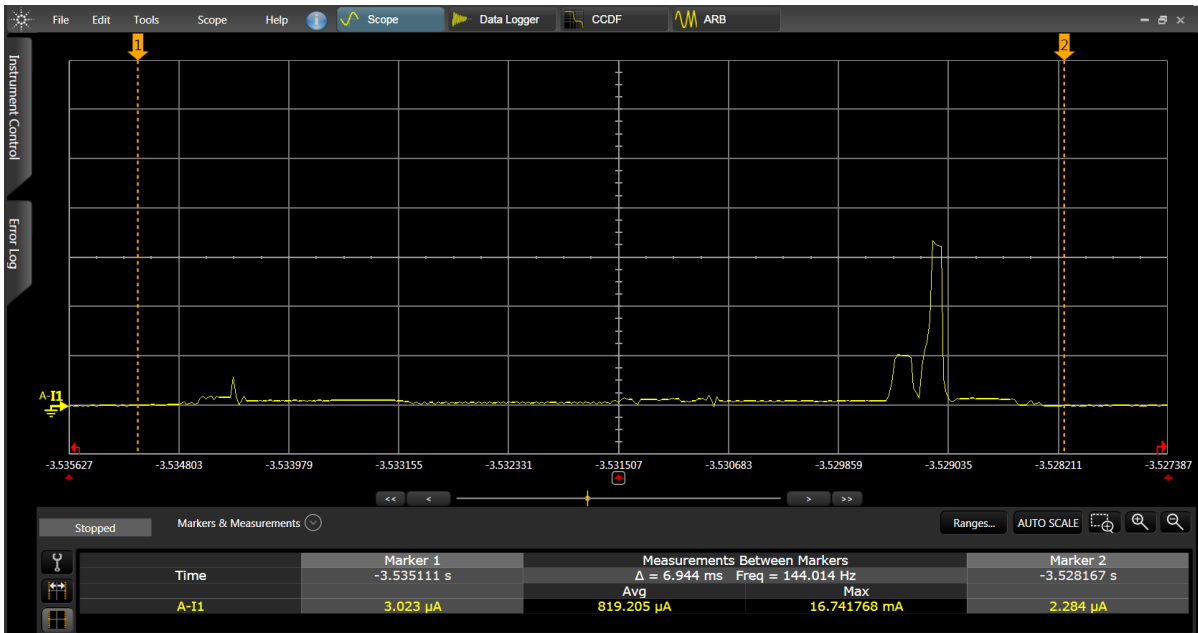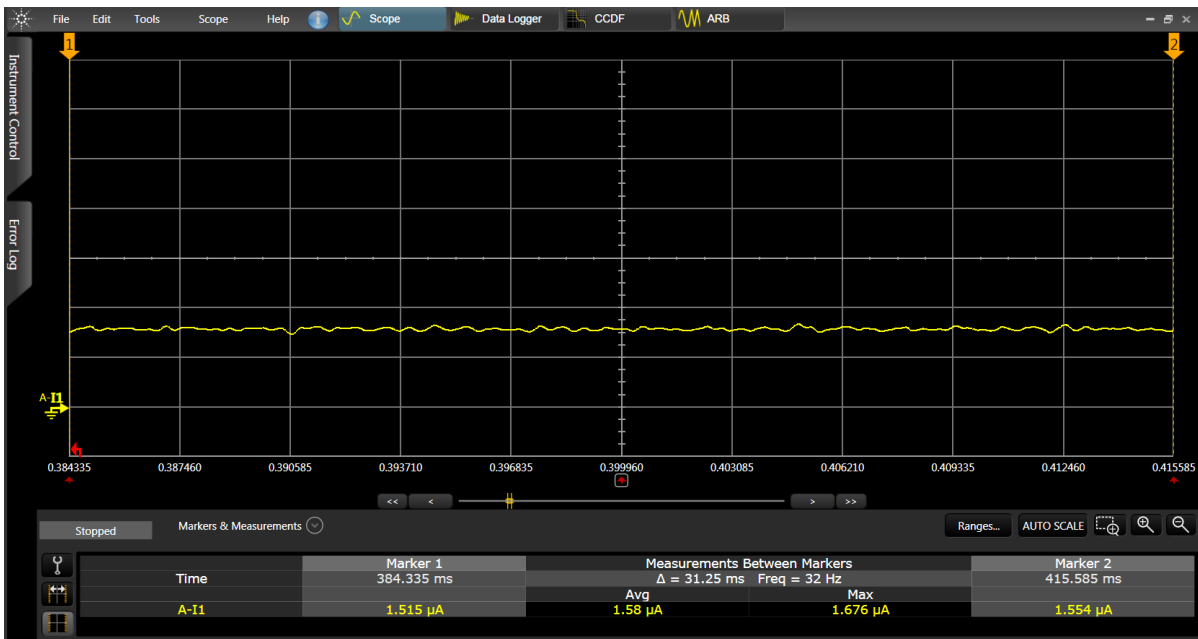**Figure 39: Supply current during Extended Sleep mode**

5.3 FCC/ ETSI Measurements

5.3.1 Emission limitation conducted (transmitter)

5.3.1.1 Test description

In this test the level of the harmonics produced by the Tx path was measured.

5.3.1.2 Test setup

The Range Extender v.2 Module was mounted on a DK Development Board with the use of an intermediate interposer board. In order to evaluate the harmonics levels production, the production test firmware with embedded PA signal control was used. The boards under test, were set into continuous transmit mode. An RF cable assembly was connected to J1 connector (UMC RF Series) and in the other end were connected to the spectrum analyser. Three channels were tested, channels 0, 19 and 39.

5.3.1.3 Test results

Table 16: Conducted Tx harmonics at V_{BAT_3V} = 3.0 V @ CH00, CH19, CH39

Parameter (dBm)	CH00 – 2402MHz	CH19 – 2440MHz	CH39 – 2480 MHz
2nd harmonic power	-52.40	-52.56	-52.40
3rd harmonic power	-58.54	-58.04	-56.76
4th harmonic power	-55.70	-55.64	-56.81
5th harmonic power	-59.52	-58.06	-56.66

All measurements comply with the limits specified in FCC 15.247/ Sub clause (d). Please note that the 2nd harmonic power is has a 11.2 dBm margin to the FCC limits (-41.2 dBm).

5.3.2 Emission limitation radiated (transmitter)

5.3.2.1 Test description

In this test the level of radiated spurious emissions produced in the Tx mode was measured in the certified semi-anechoic RF chamber at AT4W labs.

5.3.2.2 Test setup

For the measurements, the device under test comes with its OTP preloaded with the production test firmware with embedded PA signal control. This software can be configured to generate the required test patterns. The hardware configuration for the test is shown in Figure 40.
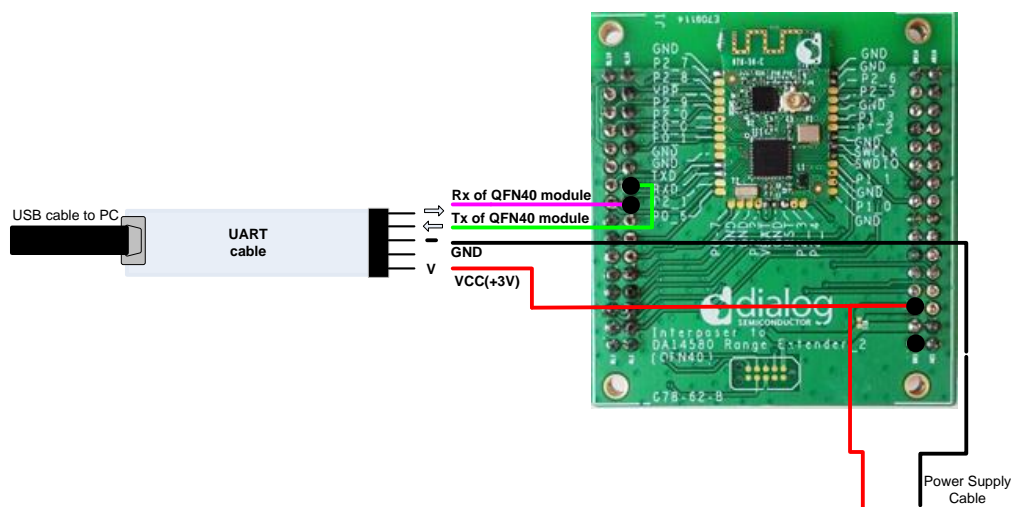
Figure 40: Range Extender v.2 mounted on the interposer board for radiated measurements

The board was set to continuous transmission mode with a 100% duty cycle.

The measurements were conducted for the range of 30 to 1000MHz, 1 GHz to 3 GHz and from 3GHz to 18 GHz according to FCC Part 15C and for the range of 30 to 1000 MHz and 1 to 12.75 GHz for ETSI EN 300 328 1.8.1.

A board with Nominal RF Output Power equal to +9.3 dBm was used for this test.

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Measurements were made in both horizontal and vertical planes of polarization. All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-1000 MHz and at distance of 1m for the frequency ranges above 1 GHz.

5.3.2.3   Test results

The results of the radiated measurements are given on Figure 41 to Figure 53. All measured FCC values comply with the emission limits specified in FCC 14.247/ Sub-clause (d). Additionally radiated emissions limits which fall in restricted bands, as defined in FCC 15.205(a) also comply with the radiated emissions limits specified in 15.209.

As far as ETSI transmitter unwanted emission in the spurious domain, they all comply to the limits described in ETSI 300 328 1.8.1 paragraph 4.3.1.9.2.

FREQUENCY RANGE 30 MHz-1000 MHz.

Highest Channel.
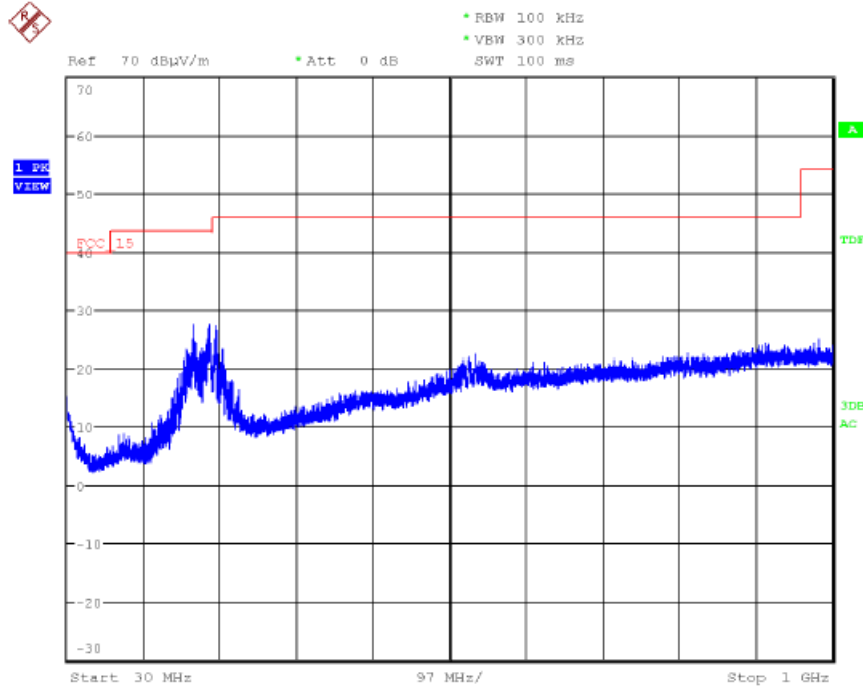
Figure 41: FCC, Frequency Range from 30MHz to 1 GHz, CH39

FREQUENCY RANGE 1 GHz to 3 GHz.
CHANNEL: Lowest (2402 MHz).
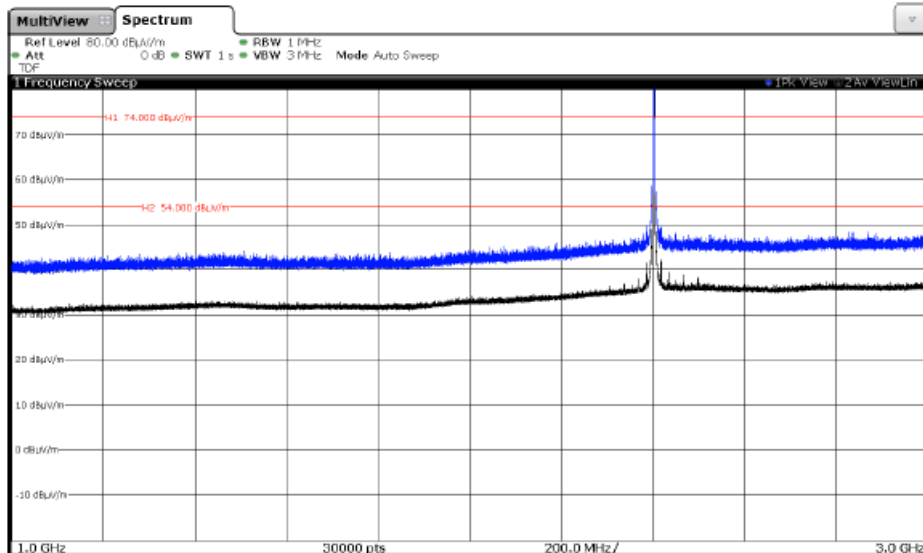
Note: The peak shown in the plot above the limit is the carrier frequency.

Figure 42: FCC, Frequency from 1GHz to 3GHz, CH00

CHANNEL: Middle (2440 MHz).
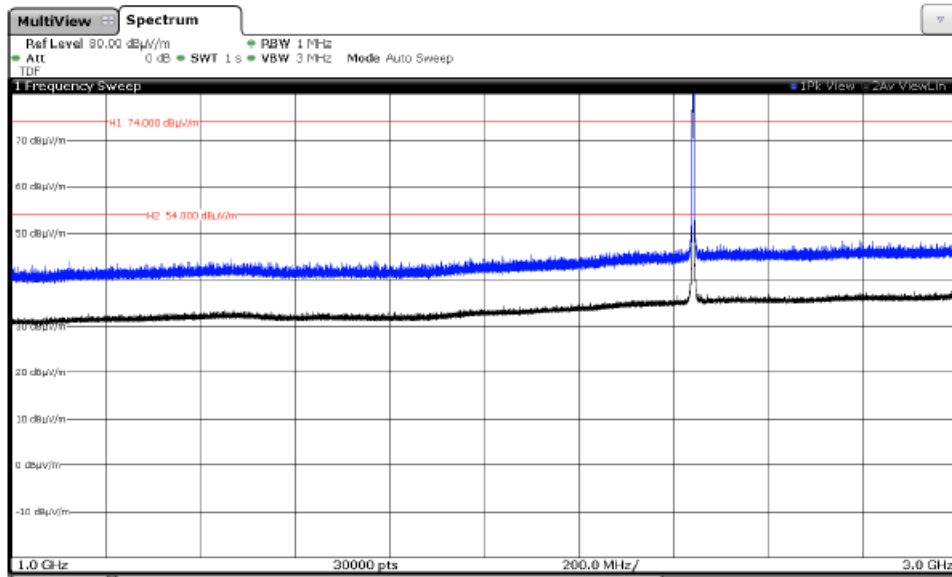
Note: The peak shown in the plot above the limit is the carrier frequency.

Figure 43: FCC, Frequency from 1GHz to 3GHz, CH19

CHANNEL: Highest (2480 MHz).
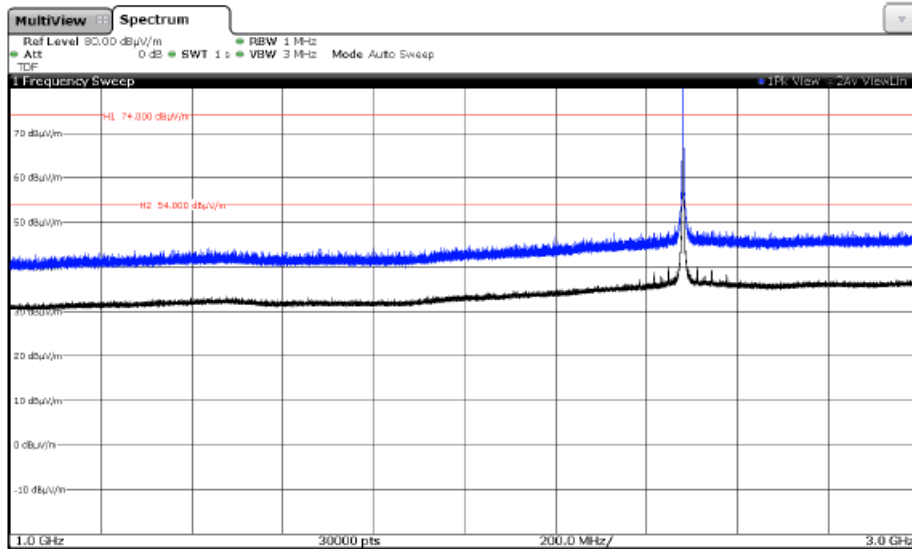
Note: The peak shown in the plot above the limit is the carrier frequency.

Figure 44: FCC, Frequency from 1GHz to 3GHz, CH39

FREQUENCY RANGE 3 GHz to 18 GHz.
CHANNEL: Lowest (2402 MHz).
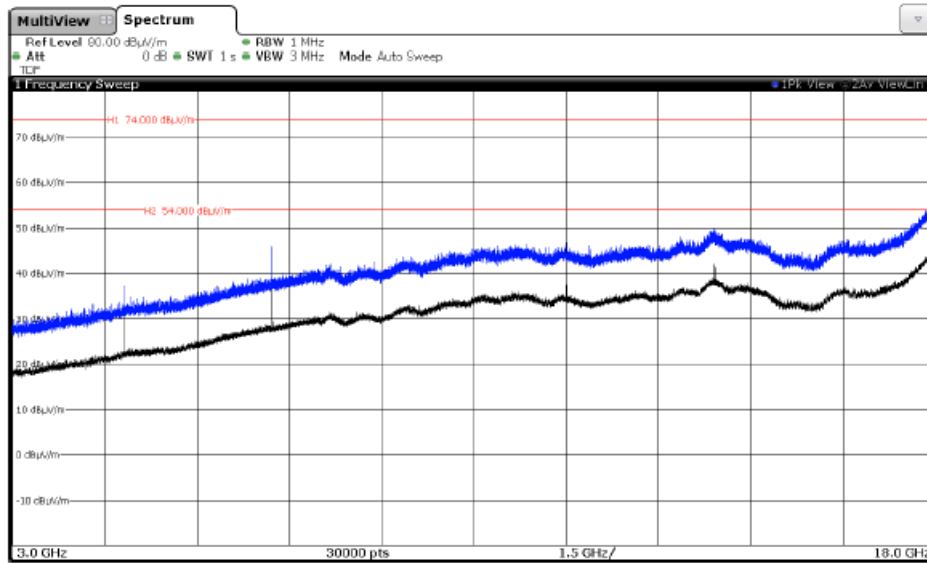
Figure 45: FCC, Frequency from 3GHz to 18GHz, CH00

CHANNEL: Middle (2440 MHz).
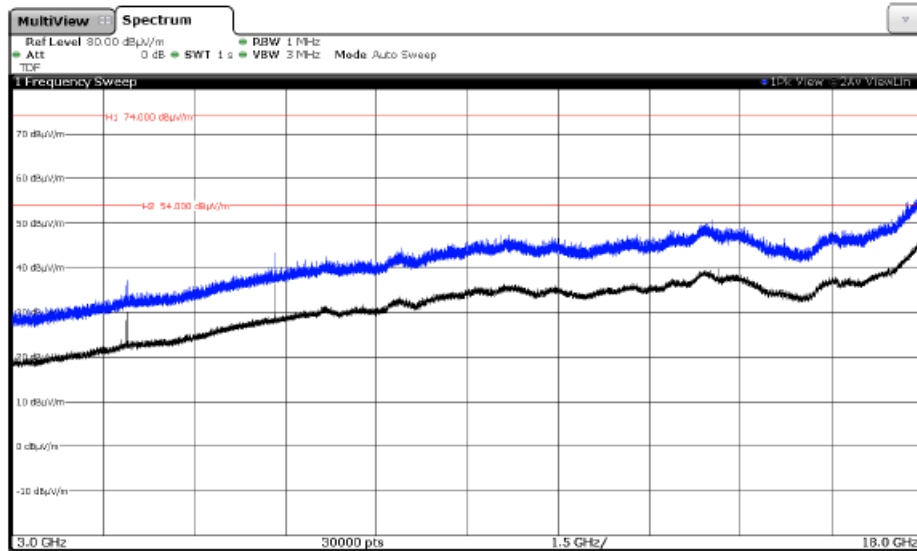
Figure 46: FCC, Frequency from 3GHz to 18GHz, CH19

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CHANNEL: Highest (2480 MHz).
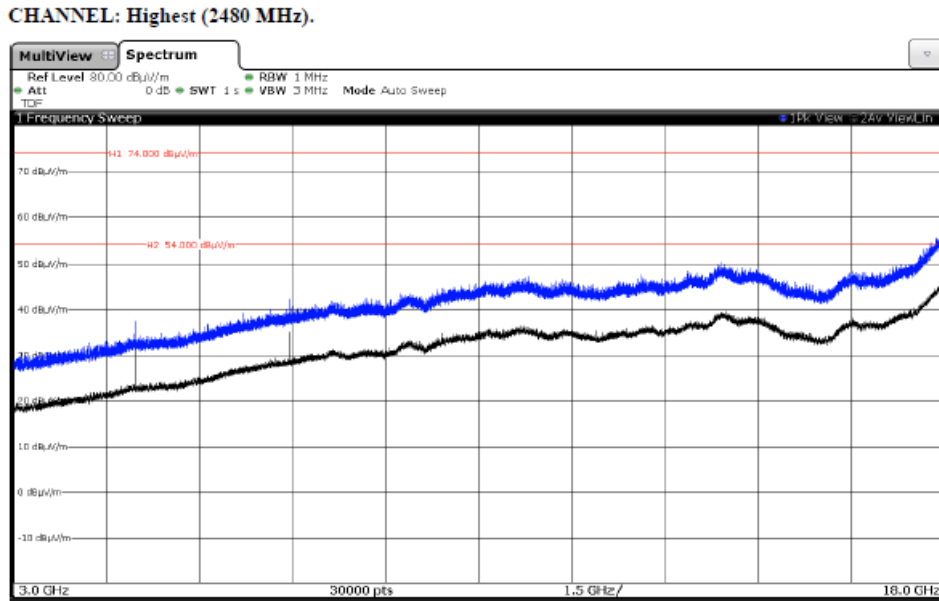
Figure 47: FCC, Frequency from 3GHz to 18GHz, CH39

FREQUENCY RANGE 2.31 GHz to 2.39 GHz. (RESTRICTED BAND)

CHANNEL: Lowest (2402 MHz).
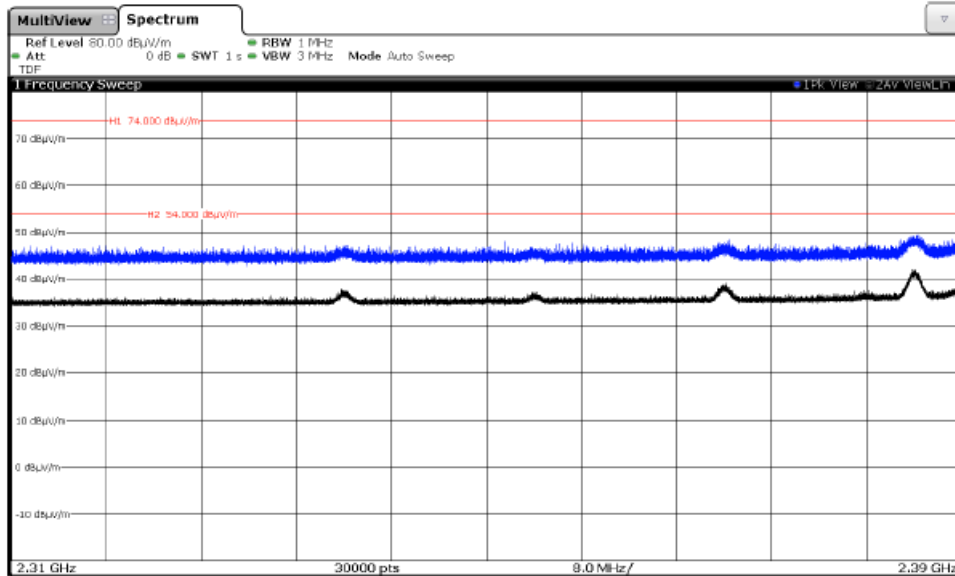
Figure 48: FCC, Frequency Range 2.31 GHz to 2.39 GHz (Restricted band- CH00)

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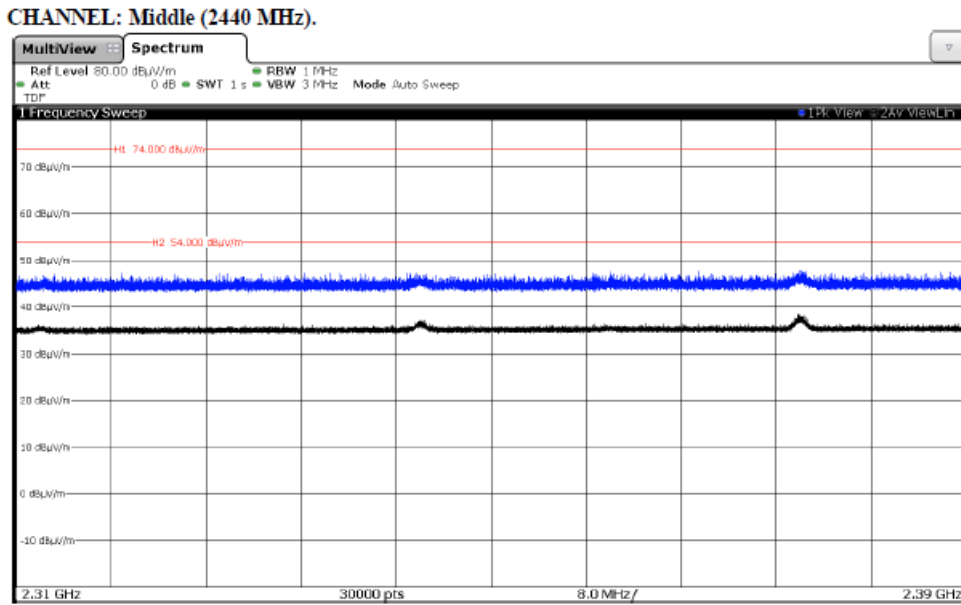
Figure 49: FCC, Frequency Range 2.31 GHz to 2.39 GHz (Restricted band- CH19)
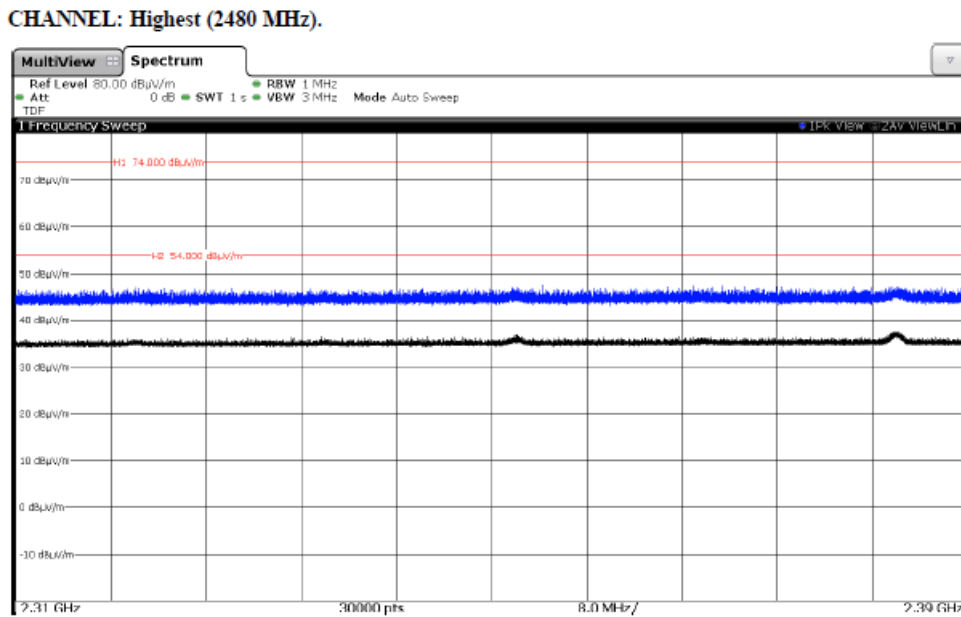
Figure 50: FCC, Frequency Range 2.31 GHz to 2.39 GHz (Restricted band- CH39)

FREQUENCY RANGE 2.4835 GHz to 2.5 GHz. (RESTRICTED BAND)

CHANNEL: Lowest (2402 MHz).
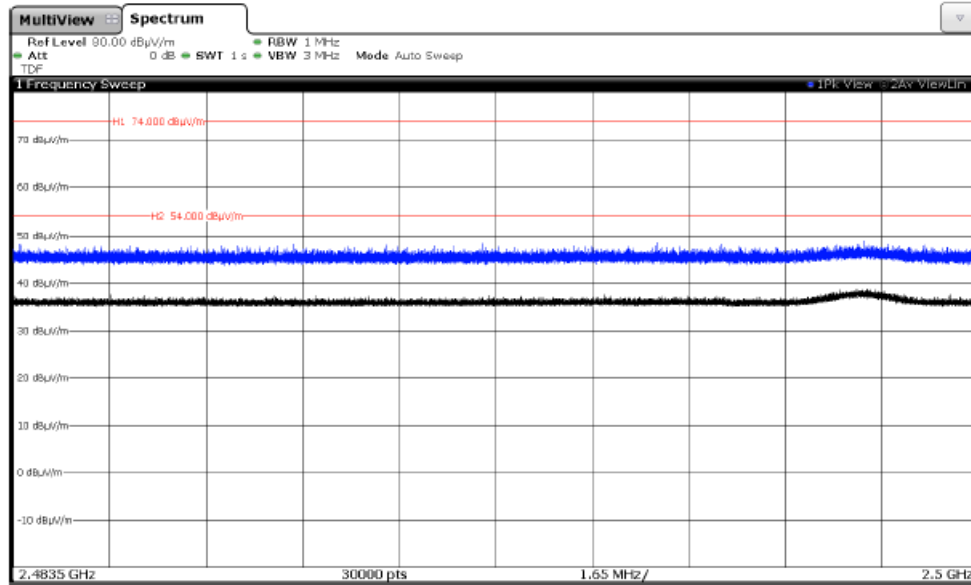
Figure 51: FCC, Frequency Range 2.4385 GHz to 2.5 GHz (Restricted band- CH00)

CHANNEL: Middle (2440 MHz).
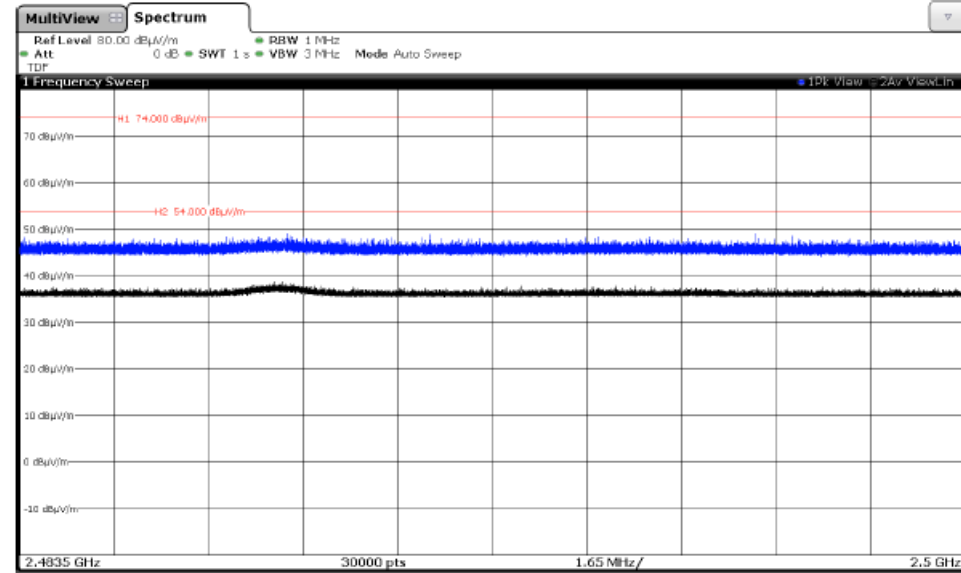
Figure 52: FCC, Frequency Range 2.4385 GHz to 2.5 GHz (Restricted band- CH19)

CHANNEL: Highest (2480 MHz).

Figure 53: FCC, Frequency Range 2.4385 GHz to 2.5 GHz (Restricted band-CH39)

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6 FCC/IC Certification and CE marking

6.1 Standards and conformity assessment

The Range Extender v.2 module was tested and found compliant by a qualified laboratory to the following standards:

For FCC/IC certification:

- Complete RF testing according to FCC part 15.247, 15.209.
- FCC Rules and Regulations 47 CFR Chapter I Part 15 Subpart B (10-01-12 Edition) and ICES-003 ISSUE 5. This covers:
  - Continuous Conducted Emission of Power Leads, frequency range 0.15 ÷ 30 MHz.
  - Radiated Emission – Electromagnetic field, frequency range 30 MHz ÷ 26 GHz

For CE marking:

- Complete RF testing according to ETSI EN 300 328 v1.8.1
- EMC testing according to EN 301 489-1 V.1.9.2 & EN 301 489-17 V2.2.1
  - Radiated Emission- Electromagnetic Field measure. Frequency Range 30 MHz ÷ 6 GHz. Test standard EN 55022 (2010)/ AC (2011).
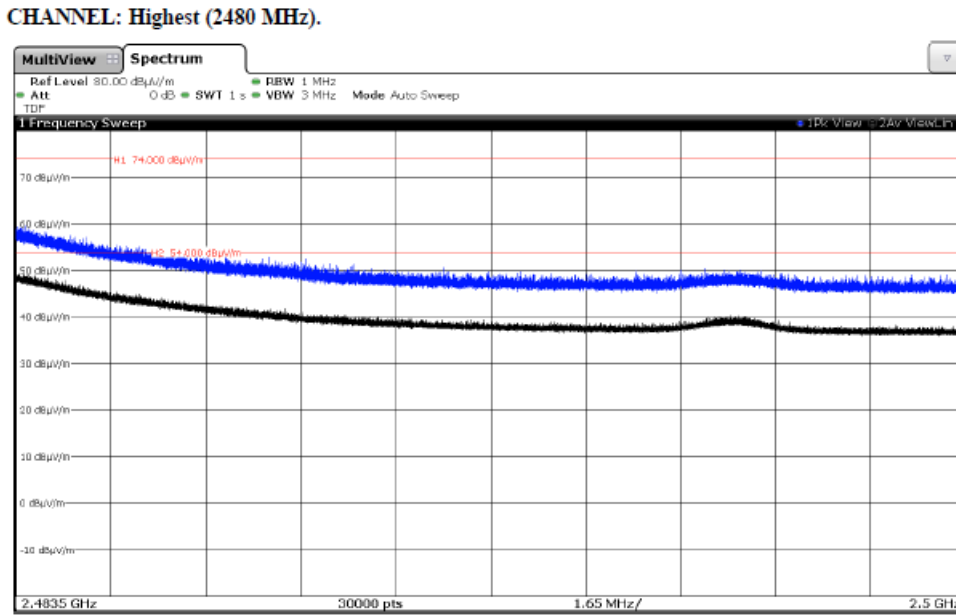 - Radiated RF Electromagnetic Field Immunity Test. Frequency Range 80 MHz ÷ 2.7 GHz. Test standard, EN 61000-4-3 (2006) / A1 (2008) / A2 (2010).
- Electrical Safety testing according to EN 61010-1: 2010
  - Electrostatic Discharge Immunity Test. Test standard EN 61000-4-2
- RoHS 2011/65/CE (includes screening for 20 elements).

6.2 FCC/IC Regulatory notices

Dialog Semiconductor has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment.

Dialog Semiconductor n'approuve aucune modification apportée à l'appareil par l'utilisateur, quelle qu'en soit la nature. Tout changement ou modification peuvent annuler le droit d'utilisation de l'appareil par l'utilisateur.

This device complies with Part 15 of the FCC Rules and Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This device complies with FCC/IC radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines and RSS-102 of the IC radio frequency (RF) Exposure rules. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

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Le présent appareil est conforme à l'exposition aux radiations FCC / IC définies pour un environnement non contrôlé et répond aux directives d'exposition de la fréquence de la FCC radiofréquence (RF) et RSS-102 de la fréquence radio (RF) IC règles d'exposition. L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur.

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

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

CAN ICES-3 (B) / NMB-3 (B)

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de classe B est conforme à la norme canadienne NMB-003.

6.3 1999/5/EC Directive regulatory notices

This device has been evaluated against the essential requirements of the 1999/5/EC Directive.

Bulgarian	С настоящето Dialog Semiconductor декларира, че DA14580 RANGE EXTENDER отговаря на съществените изисквания и другите приложими изисквания на Директива 1999/5/EC.
Croatian	Ovime Dialog Semiconductor ", izjavljuje da je ovaj DA14580 RANGE EXTENDER je u skladu s osnovnim zahtjevima i drugim relevantnim odredbama Direktive 1999/5/EC.
Czech	Dialog Semiconductor tímto prohlašuje, že tento DA14580 RANGE EXTENDER je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.
Danish	Undertegnede Dialog Semiconductor erklærer herved, at følgende udstyr DA14580 RANGE EXTENDER overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF.
Dutch	Hierbij verklaart Dialog Semiconductor dat het toestel DA14580 RANGE EXTENDER in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG.
English	Hereby, Dialog Semiconductor, declares that this DA14580 RANGE EXTENDER is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

Estonian	Käesolevaga kinnitab Dialog Semiconductor seadme DA14580 RANGE EXTENDER vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.
German	Hiermit erklärt Dialog Semiconductor, dass sich das Gerät DA14580 RANGE EXTENDER in Übereinstimmung mit den grundlegenden Anforderungen und den übrigen einschlägigen Bestimmungen der Richtlinie 1999/5/EG befindet.
Greek	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Dialog Semiconductor ΔΗΛΩΝΕΙ ΟΤΙ DA14580 RANGE EXTENDER ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/ΕΚ.
Hungarian	Alulírott, Dialog Semiconductor nyilatkozom, hogy a DA14580 RANGE EXTENDER megfelel a vonatkozó alapvetõ követelményeknek és az 1999/5/EC irányelv egyéb elõírásainak.
Finnish	Dialog Semiconductor vakuuttaa täten että NAME OF PRODUCT tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
French	Par la présente Dialog Semiconductor déclare que l'appareil DA14580 RANGE EXTENDER est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE.
Icelandic	Hér með lýsir Dialog Semiconductor yfir því að DA14580 RANGE EXTENDER er í samræmi við grunnkröfur og aðrar kröfur, sem gerðar eru í tilskipun 1999/5/EC
Italian	Con la presente Dialog Semiconductor dichiara che questo DA14580 RANGE EXTENDER è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Latvian	Ar šo Dialog Semiconductor deklarē, ka DA14580 RANGE EXTENDER atbilst Direktīvas 1999/5/EK būtiskajām prasībām un citiem ar to saistītajiem noteikumiem.
Lithuanian	Šiuo Dialog Semiconductor deklaruoja, kad šis DA14580 RANGE EXTENDER atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.
Maltese	Hawnhekk, Dialog Semiconductor, jiddikjara li dan DA14580 RANGE EXTENDER jikkonforma mal-ħtiġijiet essenzjali u ma provvedimenti oħrajn relevanti li hemm fid-Dirrettiva 1999/5/EC.
Norwegian	Dialog Semiconductor erklærer herved at utstyret DA14580 RANGE EXTENDER er i samsvar med de grunnleggende krav og øvrige relevante krav i direktiv 1999/5/EF.
Polish	Niniejszym Dialog Semiconductor oświadcza, że DA14580 RANGE EXTENDER jest zgodny z zasadniczymi wymogami oraz pozostałymi stosownymi postanowieniami Dyrektywy 1999/5/EC
Portuguese	Dialog Semiconductor declara que este DA14580 RANGE EXTENDER está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.
Slovak	Dialog Semiconductor týmto vyhlasuje, že DA14580 RANGE EXTENDER spĺňa základné požiadavky a všetky príslušné ustanovenia Smernice 1999/5/ES.
Slovenian	Dialog Semiconductor izjavlja, da je ta DA14580 RANGE EXTENDER v skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 1999/5/ES.
Spanish	Por medio de la presente Dialog Semiconductor declara que DA14580 RANGE EXTENDER cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE.
Swedish	Härmed intygar Dialog Semiconductor att denna DA14580 RANGE EXTENDER står I överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.

In order to satisfy the essential requirements of 1999/5/EC Directive, the product is compliant with the following standards:

RF spectrum use (R&TTE art. 3.2)	EN 300 328 v1.8.1
EMC (R&TTE art. 3.1b)	EN 301 489-1 V1.9.2 + EN 301 489-17 V2.2.1
Health & Safety (R&TTE art. 3.1a)	EN 60950-1:2006 +A11:2009+ A12:2011 + A1:2010 + AC:2011 + A2: 2013

The conformity assessment procedure referred to in Article 10 and detailed in Annex IV of Directive 1999/5/EC has been followed with the involvement of the following Notified Body:

AT4 wireless, S.A.
Parque Tecnologico de Andalucía
C/ Severo Ochoa 2
29590 Campanillas – Málaga
SPAIN
Notified Body No: 1909

Thus, the following marking is included in the product:

C E 1909

There is no restriction for the commercialization of this device in all the countries of the European Union.

7   Appendix A: Range Extender v.2 with SPI Data Flash

Range Extender v.2 can be used with external SPI Data Flash Memory. Any available pins can be used to interface the external data Flash. The appropriate configuration settings for peripherals must be set in secondary boot loader as described in paragraph 4.8. The following application example schematic contains Range Extender v.2 with external SPI Data Flash.
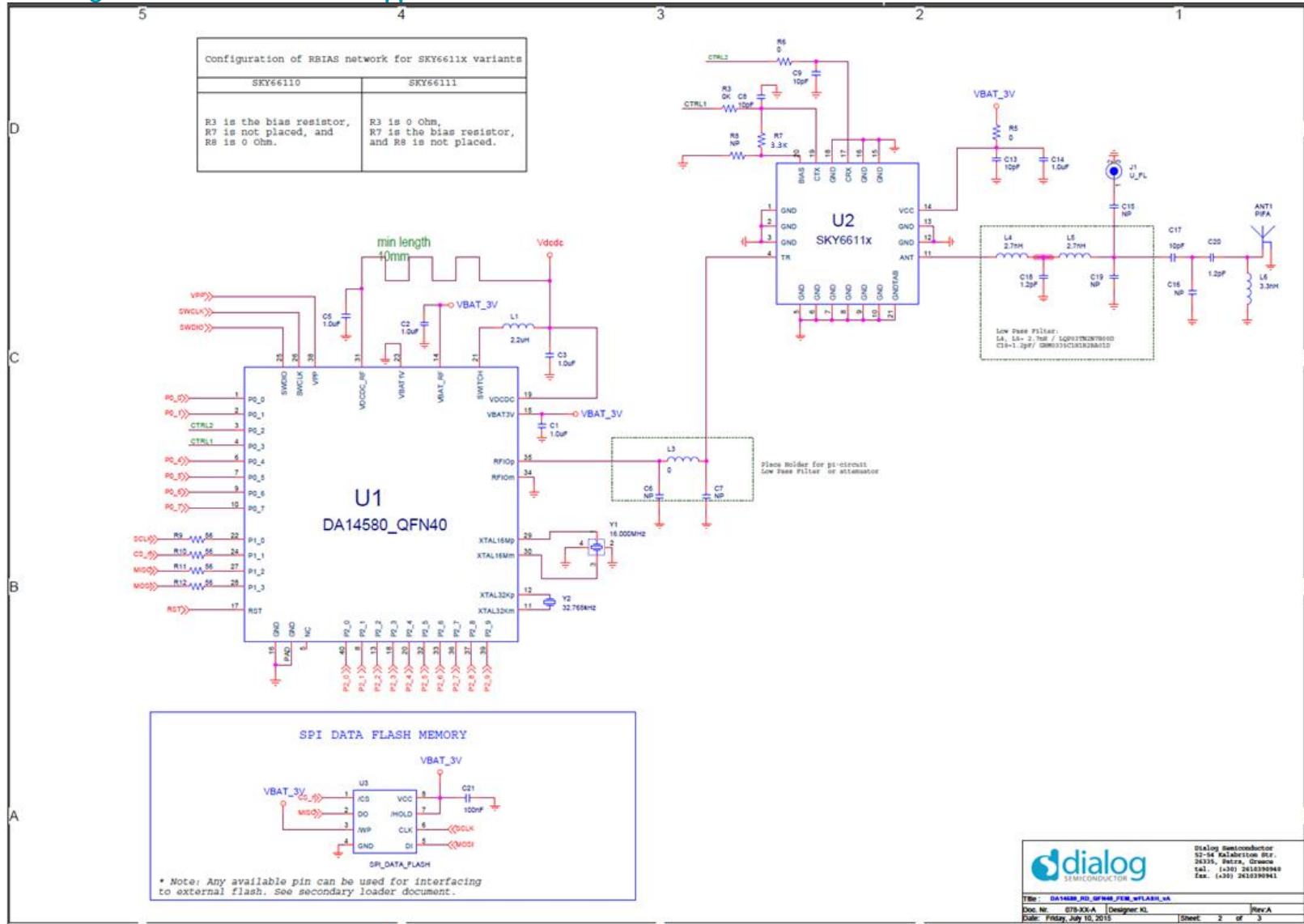
Figure 54: Range Extender v.2 Module with external SPI Flash

8   Revision history

Revision	Date	Description
1.0	16-07-2015	**Initial version**. *FCC/ETSI final certification reports pending for end of September 2015. All measurement regarding compliance to FCC/ETSI will be updated from the final certification reports. All FCC/ ETSI tests have been found to pass.*
1.1	14-09-2015	**Initial version:** *modification related to reduction of the output power.*
2.0	With final FCC/ETSI reports	**The document will be updated in the following sections.** - Chapter 4.9: Software: upgrade with version SDK 5.02 - Chapter 4.10: Test platform (future chapter): PRO DK Interposer Description - Chapter 5.3: FCC/ETSI Measurements: upgrade with final results - Chapter 6: FCC/IC Certification and CE marking

Status definitions

Status	Definition
DRAFT	The content of this document is under review and subject to formal approval, which may result in modifications or additions.
APPROVED or unmarked	The content of this document has been approved for publication.

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RoHS Compliance

Dialog Semiconductor complies with European Directive 2001/95/EC and from 2 January 2013 onwards to European Directive 2011/65/EU concerning Restriction of Hazardous Substances (RoHS/RoHS2).
Dialog Semiconductor's statement on RoHS can be found on the customer portal https://support.diasemi.com/. RoHS certificates from our suppliers are available on request.

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