Transom Post OpCo LLC
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United States

Title	**Bluetooth Module Dual Mode 5.2**
Module	IBTM24
Date	16 January 2025
Revision	D

Document History

Date	Version	Change
30 Dec 2022	A	Initial version
11 Oct 2024	B	Add schematic and antenna information
26 Nov 2024	C	Module specifications are dedicated for four products (Veritas 250BL, Veritas 1100BH, Veritas 2160BL, Veritas 2160BH) from Transom Post OPCO LLC.
16 Jan 2025	D	Module name change to IBTM24

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Federal Communication Commission Interference Statement

FCC NOTE (for U.S.A):
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.

The module is a limited module and complies with the requirement of FCC Part 15.207 and 15.209. According to FCC Part 15 Subpart C section 15.212, the radio elements must have the radio frequency circuitry shielded. However, due to there is no shield for this module, this module is granted as a Limited Modular Approval.

A C2PC is required for new host application. Only Grantees are permitted to make permissive changes. Please contact us for further process with Transom Post OPCO LLC.

The OEM integrators should follow the following C2PC test plan, based on Module RF report "DDT-RE24072701-1E03" and "DDT-RE24072701-1E04" under FCC ID: 2BC3VIBTM24.

For the host product installed this module exactly according to this guide, and did not make any hardware or software modifications to the module or modified the software but does not affect the radio characteristics, the host product will need to evaluate according to following for Radio:

- §15.207(a) AC Power Line Conducted Emissions Voltage for Bluetooth BR/EDR/ LE mode.
- §15.247(d) Band Edge and Radiated Emission Measurements for Bluetooth BR/EDR/ LE mode at Low / Mid / High transmit channels according to §15.205 and §15.209.

The host product shall be evaluated for ensuring the continuous compliance for the FCC rules that apply to the host product. Additional guidance for testing host products is provided in KDB Publication 996369 D02 and D04. This module was tested as a subsystem and its certification does not cover the FCC Part 15 Subpart B (unintentional radiator) rule requirement applicable to the final host. The host will still need to be reassessed for compliance to this portion of rule requirements.
For the host product is not installed according to this guide, the module certification will be invalid and a new grant certification will be required for the host product.

If the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: 2BC3VIBTM24 Or Contains FCC ID: 2BC3VIBTM24"

FCC and ISED Radiation Exposure Statement
The modular can be installed or integrated in mobile or fix devices only. This modular cannot be installed in any portable device, for example, USB dongle like transmitters is forbidden.
This modular complies with FCC and ISED If the FCC identification number is not visible
RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

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Labelling Information

This device complies with Part 15 of the FCC Rules [and contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS standard(s)]. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) This device must accept any interference received, including interference that may cause undesired operation.

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

Setup/Installation

The module is not sold, and is installed in the host during manufacturing. End products are sealed, and not allow the user to install the module. This module is limited to the specific host of Transom Post OPCO LLC, Model: Veritas 250BL, Veritas 1100BH, Veritas 2160BL , Veritas 2160BH

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CONTENT

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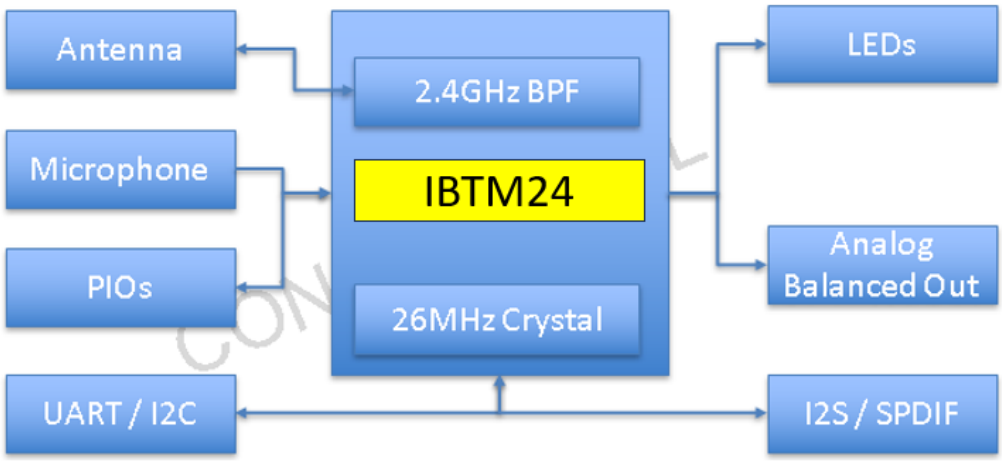
1. INTRODUCTION

The IBTM24 Bluetooth® module is based on the Beken BK32881 chip design, which is a highly integrated Bluetooth® 5.2 stereo receiving module. Furthermore, the module with external MCU is able to commuicate with other Bluetooth devices via UART/I2C interface.
It integrated an ultra-low-power DSP and application processor with on-chip ROM, RAM, and internal flash memory, a high-performance stereo codec, a power management subsystem, LED etc in the chip. DSP support 64 SIMD (Single Instruction Multiple Data) and execute dual 32-bit MAC (Multiply Accumulate) or quad 16-bit MAC in single cycle. It integrated RF Baseband controller, antenna, etc and provide UART interface, GPIO, stereo speaker output, microphone input, etc.

The detail information of IBTM24 Bluetooth® module is presented in this document below.

1.1 Block Diagram



1.2 Features

- Bluetooth Specification 5.2 (Dual Mode)
- Class 2 and Class 3 support
- Physical connection as SMD type
- Audio features:
  1) SBC and option AAC audio codecs
  2) TWS (TrueWireless™ Stereo), which allows two devices to be configured as a stereo pair
  3) Audio interfaces: analog stereo out (balanced), I2S in/out, and SPDIF in/out
- MCU serial interfaces: UART, I2C
- Integrated 26 MHz crystal
  On-board PCB PIFA antenna or i-pex connector for external antenna (depends on the product requirement)

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1.3 Bluetooth features (Component DID #s: D049870 and D050379)

- Bluetooth 5.2 specification support

BR / EDR Profile	Bluetooth Low Energy Profile
■ HFP 1.8 (Hands free Profile)	■ ATT 1.1 (Attribute Protocol)
■ A2DP 1.3.2 (Advanced Audio Distribution Profile)	■ GATT (Generic Attribute Profile)
■ AVRCP 1.6.2 (Audio/Video Remote Control Profile)	■ GAP (Generic Access Profile)
■ GAVDP 1.3 (Generic A/V Distribution Profile)	
■ SPP 1.2 (Serial Port Profile)	

1.4 General specification (will be updated after piolt run)

Module Name	IBTM24
Product Description	**Bluetooth 5.2 Class 2 Module**
Bluetooth Standard	Bluetooth 5.2 Dual Mode (BR/EDR/BLE)
Dimension	37mm × 21.5mm × 5.6mm
Operating Conditions	
Voltage	3.3 ± 0.2 VDC
Temperature	-40～+85 °C
Storage Temperature	-40～+105 °C
Electrical Specifications	
Frequency Range	2402 ~ 2480 MHz
Maximum Conduct RF Power	Class 2: 3 dBm
Crystal	26 MHz
Sensitivity @ 0.1% BER	-85 dBm
π/4 DQPSK Receive Sensitivity @ 0.01% BER	-90 dBm
8DPSK Receive Sensitivity @ 0.01% BER	-82 dBm

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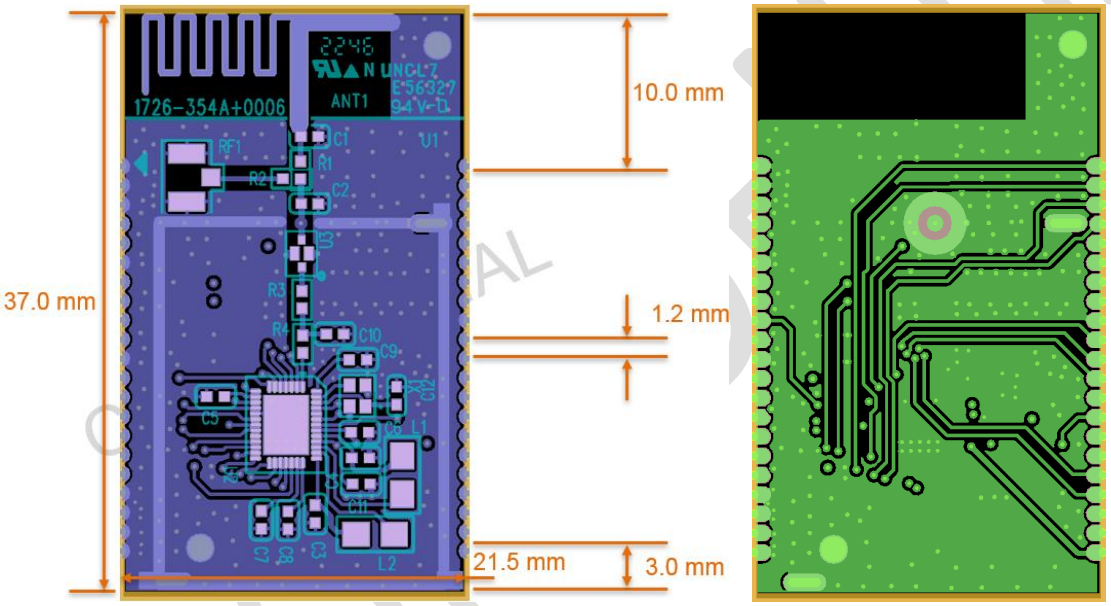
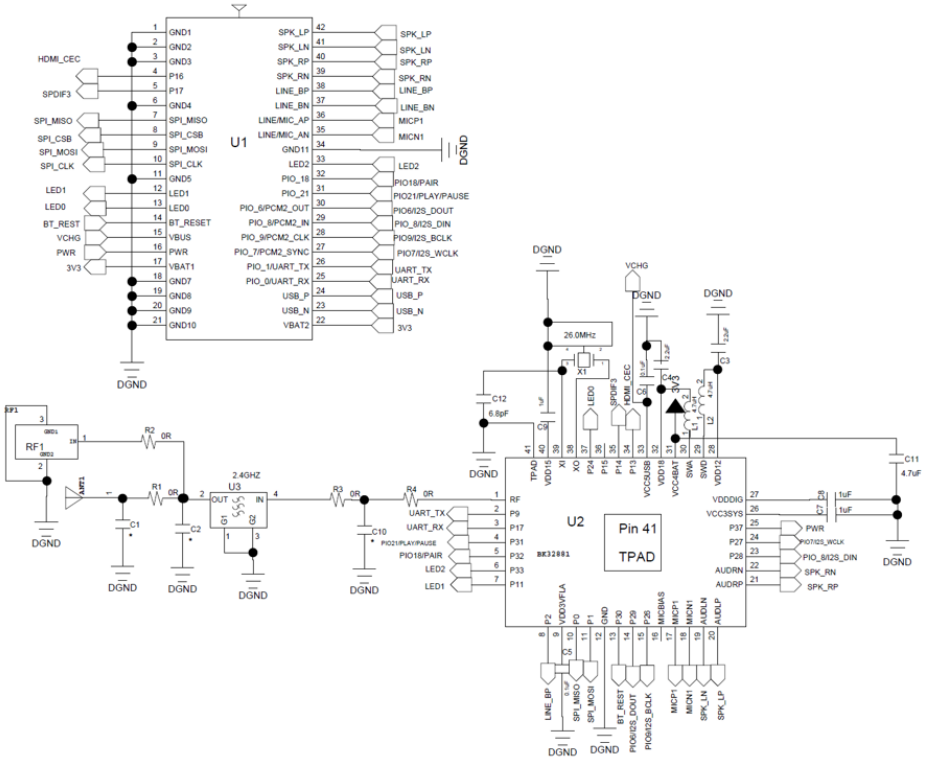
2. PHYSICAL CHARACTERISTIC

Top view. **Bottom view.**



Note: Tolerance w/o mark default ±0.05mm.

2.1 Schematic



2.2 Pin Description:

Pin#	Pin Name	Pad Type	Description
1	DGND	Ground	Digital Ground
2	DGND	Ground	Digital Ground
3	DGND	Ground	Digital Ground
4	PIO[16]	Digital/Analog	Connect to Pin #34 GPIO13 (HDMI_CEC)
5	PIO[17]	Digital/Analog	Connect to Pin #35 GPIO14 (SPDIF3)
6	DGND	Ground	Digital Ground
7	SPI_MISO	Digital/Analog	Previous pin assignment for Qualcomm SPI port (firmware download & RF test). Connect to Pin #10 GPIO0 (Flash Download TX, UART1_TXD, I2C1_SCL and USB_DN).
8	SPI_CSB	NC	No connection.
9	SPI_MOSI	Digital/Analog	Previous pin assignment for Qualcomm SPI port (firmware download & RF test). Connect to Pin #11 GPIO1 (Flash Download RX, UART1_RXD, I2C1_SDA and USB_DP).
10	SPI_CLK	NC	No connection.
11	DGND	Ground	Digital Ground.
12	LED[1]	Digital/Analog	Connect to Pin #7 GPIO11 (SPDIF1, ADC8)
13	LED[0]	Digital	Connect to Pin #37 GPIO24 (I2S_MCLK)
14	RST	Digital/Analog	Connect to Pin #13 GPIO30 (I2S3_BCLK, PWM6, QSPI_IO2, SPI3_SCK, Touch sensor: TD9).
15	VCHG	Power/Digital/Analog	Connect to Pin #33 VCC5USB (or DLP or 3.3V Reset input).
16	PWR	Digital/Analog	Connect to Pin #25 GPIO37 (ADC11, SPI3_SCK, 32 kHz output, ADC19, Touch sensor: TD2)
17	VBAT	Power	Connect to Pin #31 VCC4BAT (Max 4.2V).
18	DGND	Ground	Digital Ground
19	DGND	Ground	Digital Ground
20	DGND	Ground	Digital Ground
21	DGND	Ground	Digital Ground
22	VBAT	Power	Connect to Pin #31 VCC4BAT.

23	USB_N	NC	No connection
24	USB_P	NC	No connection
25	UART_RX	Digital	Connect to Pin #3 GPIO17 (I2C2_SDA, UART2_RXD)
26	UART _TX	Digital	Connect to Pin #2 GPIO16_GPIO9 (GPIO16: I2C2_SCL, UART2_TXD or GPIO9: TXEN)
27	PIO[7]	Digital	Connect to Pin #24 GPIO27 (I2S2_SCLK, PWM7, QSPI_RAM_CSN)
28	PIO[9]	Digital	Connect to Pin #15 GPIO26 (PWM6, I2S2_BCLK, QSPI_RAM_CLK)
29	PIO[8]	Digital/Analog	Connect to Pin #23 GPIO28 (I2S2_DIN, PWM8, QSPI_IO0, Touch sensor: TD11)
30	PIO[6]	Digital/Analog	Connect to Pin #14 GPIO29 (I2S2_DOUT, PWM9, QSPI_IO1, Touch sensor: TD10)
31	PIO[21]	Digital/Analog	Connect to Pin #4 GPIO31 (I2S3_SCLK, PWM7, QSPI_IO3, SPI3_CSN, ADC15, Touch senor: TD8)
32	PIO[18]	Digital/Analog	Connect to Pin #5 GPIO32 (I2S3_DIN, PWM8, QSPI_FLASH_CLK, SPI3_MISO, ADC16, Touch sensor: TD7)
33	LED[2]	Digital/Analog	Connect to Pin #6 GPIO33 (I2S3_DOUT1, PWM9, QSPI_FLASH_CSN, SPI3_MOSI, Touch sensor: TD6)
34	DGND	Ground	Digital Ground
35	Line_AN	Analog in	Connect to Pin #18 MICN1
36	Line_AP	Analog in	Connect to Pin #17 MICP1
37	Line_BN	NC	No Connection
38	Line_BP	Digital/Analog	Connect to Pin #8 GPIO12_GPIO2 (GPIO12 pull high: SPDIF2 or GPIO2: LINEIN1_L, IrDA RX)
39	SPK_RN	Analog out 1.1 V_{rms} @ 600 Ω 0.8 V_{rms} @ 16 Ω	Speaker output negative, right. Connect to Pin #22 AUDRN.
40	SPK_RP		Speaker output positive, right. Connect to Pin #21 AUDRP.
41	SPK_LN		Speaker output negative, left. Connect to Pin #19 AUDLN.
42	SPK_LP		Speaker output positive, left. Connect to Pin #20 AUDLP.

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3. ELECTRICAL CHARACTERISTIC

3.1 Recommended operation conditions

Rating	Min	Typical	Max	Unit
VCC4BAT	2.8	3.6	4.2	V
VCC5USB	4.75	5.0	5.5	V
VDD15	1.3	1.35	1.55	V
VCC3SYS	2.8	3.0	3.6	V
MICBIAS	1.8		2.4	V

3.2 GPIOs Recommended operation conditions (defined by VCC3SYS, 5 ~ 32 mA output drive capability)

Input Voltage	Min	Typical	Max	Unit
PIOs	1.70	1.80	3.6	V
LED[0:2]	1.10	3.30	4.25	V

3.3 RF characteristics (to be update after pilot run)

Receiver		dBm	Bluetooth Spec	Transmitter		dBm	Bluetooth spec.
Basic Rate Sensitivity @ 0.1% BER	2402 MHz	≤ -83	≤ -70 dBm	**Output Power [1][2]**	2402 MHz	Class 2: -2 ~ 2	Class 2: 4 dBm
	2441 MHz	≤ -85			2441 MHz	Class 2: -1 ~ 3	
	2480 MHz	≤ -84			2480 MHz	Class 2: -1 ~ 3	

[1] RF output power is adjusted according to FCC band-edge and spurious limits with antenna gain.

[2] Default RF power setting is Class 2.

3.4 Theoretical BLE Throughput

- 8 kbps for iOS @ 20 msec interval & 20 byte per packet
- 14.2 kbps for iOS over HID @11.25 msec interval & 20 byte per packet
- 21.3 kbps @ 7.5 msec interval & 20 byte per packet

3.5 Power Consumption

Operating Condition	Average current	Unit
Shutdown (Software sets shutdown mode, wake up from GPIO.)	0.9	µA
Standby (Software sets device into standby mode, wake up from GPIO and RTC timer.)	20	µA
Idle-Sniff (Idle state at Sniff mode.)	0.2	mA
Active (A2DP, 2DH5)	5	mA
Active (HFP, HV1)	6	mA
BLE RX	12	mA
BLE TX 0 dBm	15	mA
BLE TX 4 dBm	19	mA
BLE TX 10 dBm	28	mA

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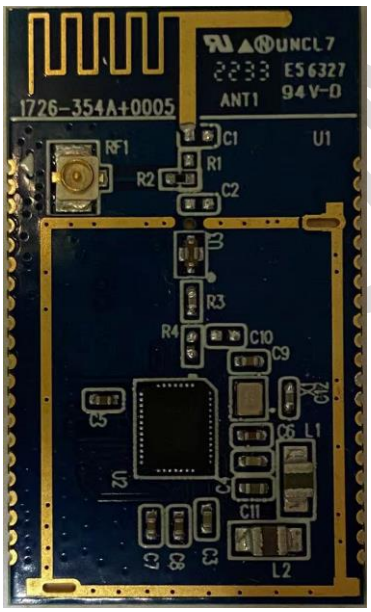
4. FACTORY SETTING OF SOFTWARE CONFIGURATION

1. Request special test-jig and programmer for firmware download.
2. Not allow the customer to change any RF parameters including frequency & power.

5. PCB INFORMATION

5.1 BLUETOOTH Module: IBTM24 Illustration

Top View (External Antenna)



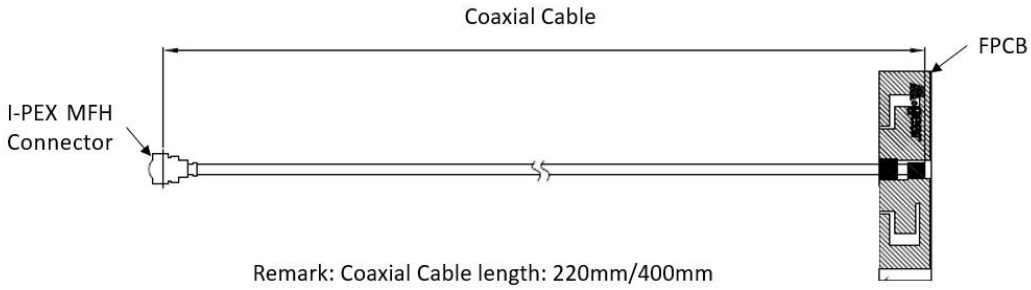
Top View (On-Board PIFA)

Bottom View

Antenna Config.	R1	R2	R3	R4	C1
External Antenna	DNP	0R	0.5P	2.4nH	DNP
On board PIFA	1.8nH	DNP	0.5P	2.4nH	1.2pF

6. ANTENNA INFORMATION

6.1 Antenna Drawing



6.2 Antenna Gain

Frequency (MHz)	Gain(dBil)	
	C4207-810023-A(SSR-2400194)-X3/ Coaxial cable length: 220mm	C4207-810024-A(SSR-2400191)-X3/ Coaxial cable length: 400mm
2400	1.45	0.85
2410	1.29	0.53
2420	1.33	0.40
2430	1.47	0.58
2440	1.49	0.72
2450	1.66	0.84
2460	1.72	0.62
2470	1.63	0.58
2480	1.42	0.79
2490	1.13	0.92
2500	1.24	1.29

C4207-810023-A(SSR-2400194)-X3 maximum gain is 1.72 at 2460MHz.

C4207-810024-A(SSR-2400191)-X3 maximum gain is 1.29 at 2500MHz

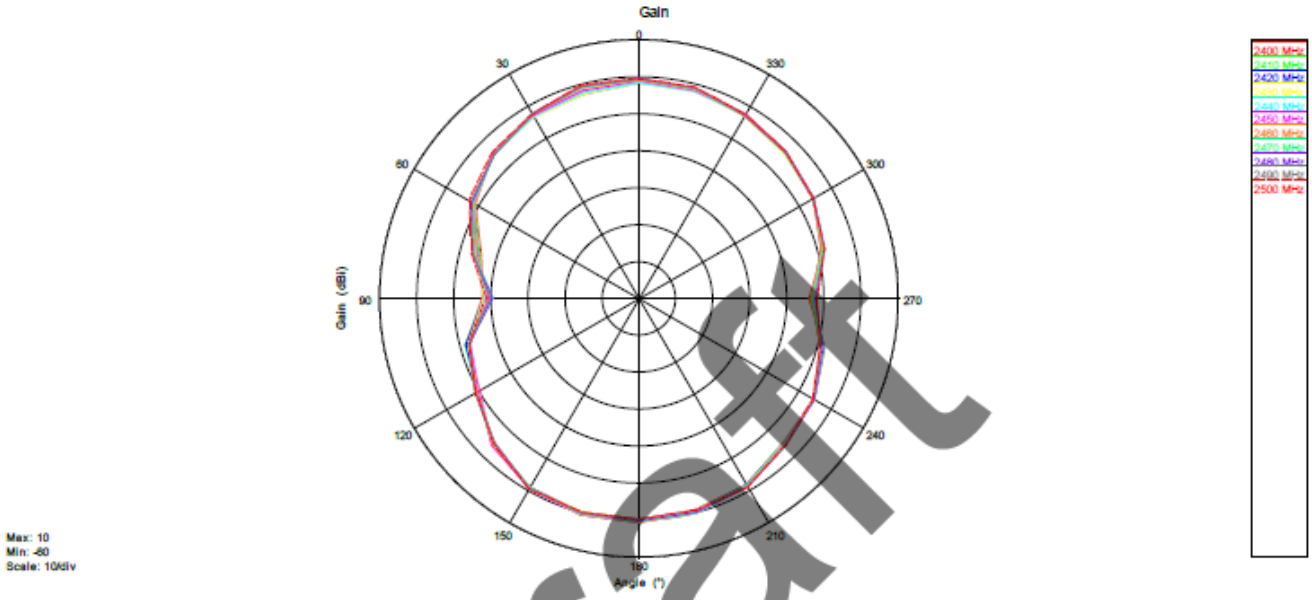
6.3 Antenna Return Loss

Frequency (MHz)	Return Loss(dB)	
	C4207-810023-A(SSR-2400194)-X3/ Coaxial cable length: 220mm	C4207-810024-A(SSR-2400191)-X3/ Coaxial cable length: 400mm
2400	-7.91	-8.56
2440	-8.38	-8.96
2480	-8.67	-9.63

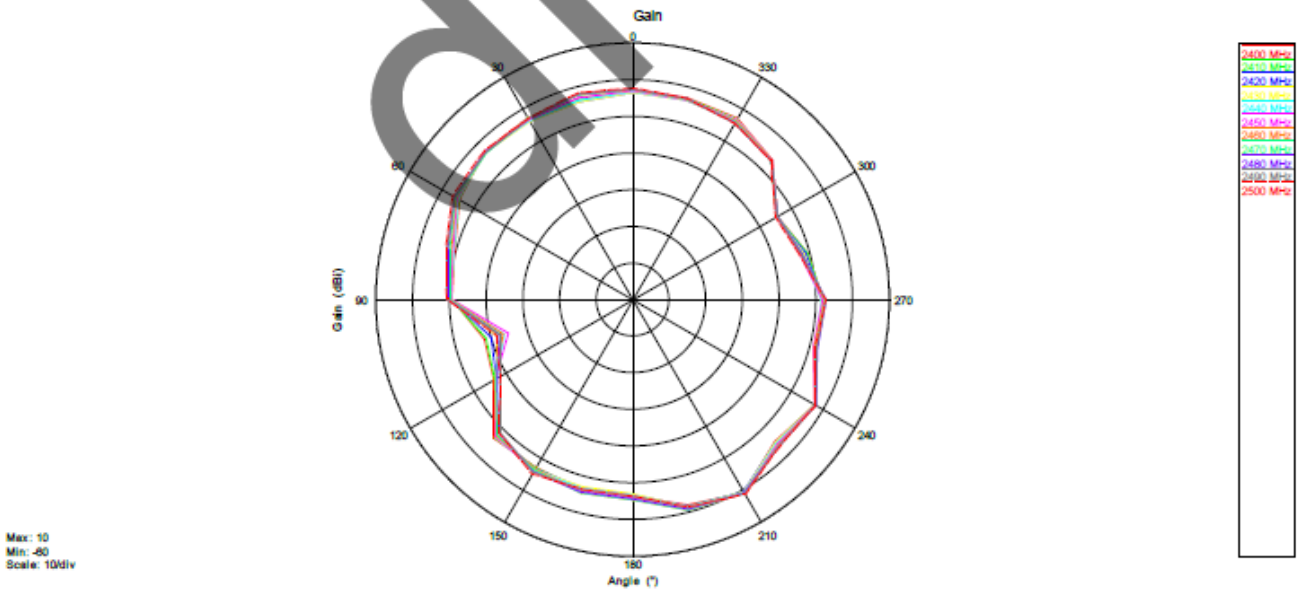
7. APPENDIX

2D Radiation Pattern

Phi=0°



C4207-810023-A(SSR-2400194)-X3



C4207-810024-A(SSR-2400191)-X3

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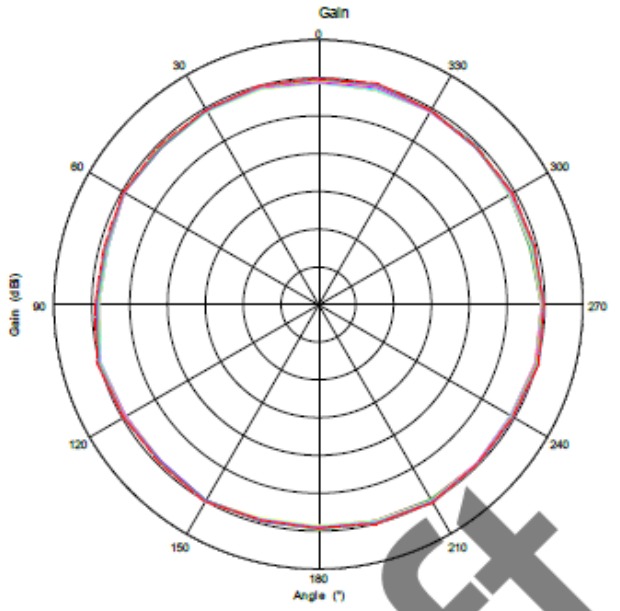
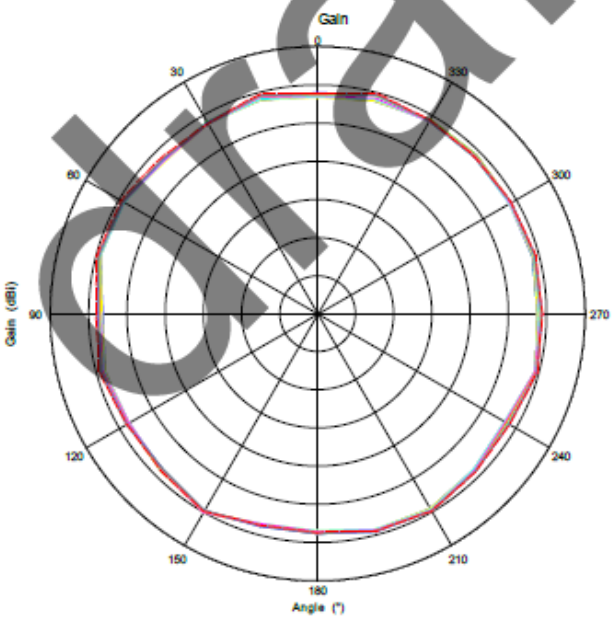
Phi=90°



Max: 10
Min: -80
Scale: 10/div

C4207-810023-A(SSR-2400194)-X3



Max: 10
Min: -80
Scale: 10/div

C4207-810024-A(SSR-2400191)-X3

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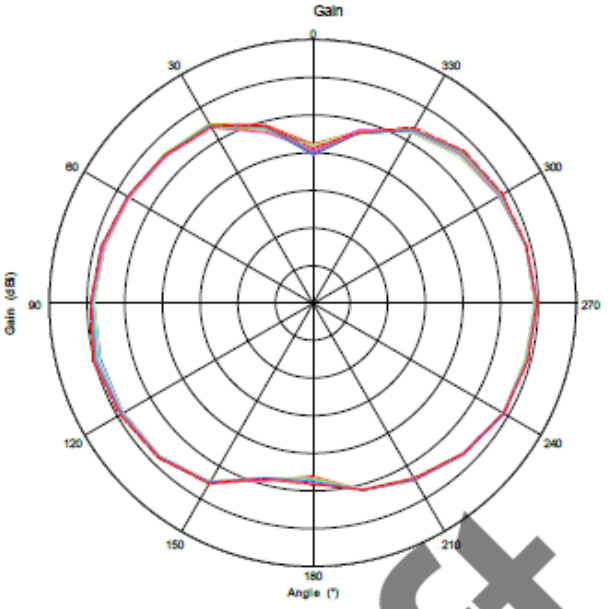
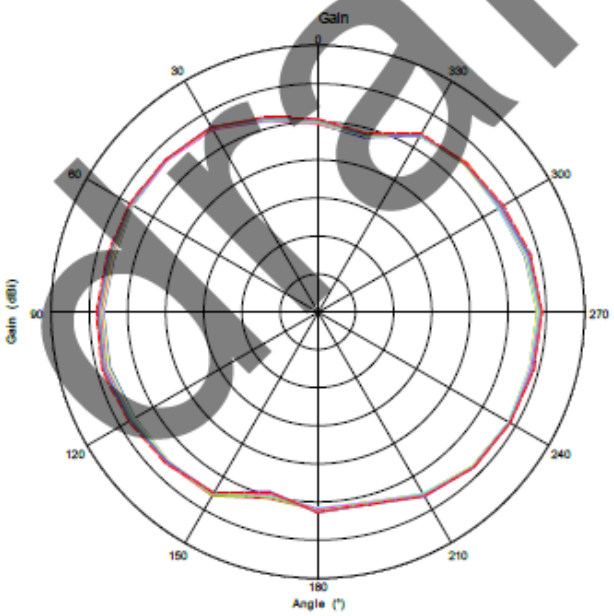
Theta=90°



Max: 10
Min: -60
Scale: 10/div

C4207-810023-A(SSR-2400194)-X3



Max: 10
Min: -60
Scale: 10/div

C4207-810024-A(SSR-2400191)-X3