



FCC / IC Test Report

FOR:

Xirgo Technologies Inc.

Model Number:

XT4970D

Product Description:

Vehicle Solar harvesting GPS/Cellular Tracker with BT/ZGB Tech

FCC ID: GKM-XT4970D

IC ID: 10281A-XT4970D

Per:

47 CFR Part 15.247

RSS-247 Issue 1 & RSS-Gen Issue 4

REPORT #: EMC_XIR_111_15001_15.247_DTS_BTLE_v1.2

DATE: 02-17-2016



**FCC Recognized
A2LA Accredited
IC recognized # 3462E-1**

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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant IC standard RSS-247.

No deviations were ascertained during the course of testing performed.

Company	Description	Model #
Xirgo Technologies Inc.	Vehicle Solar harvesting GPS/Cellular Tracker with BT/ZGB Tech	XT4970D

Responsible for Testing Laboratory:

02-17-2016	Compliance	Heiko Strehlow (VP RC&EMC)	
Date	Section	Name	Signature

Responsible for the Report:

02-17-2016	Compliance	Franz Engert (Compliance Manager)	
Date	Section	Name	Signature

The test results of this test report relate exclusively to the test item specified in Section 3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

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2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Address:	6370 Nancy Ridge Drive Suite 101-102 San Diego, CA 92121 U.S.A.
Telephone:	+1 (858) 362 2400
Fax:	+1 (408) 588 4809
Manager Compliance Services:	Franz Engert
Responsible Project Leader:	Anthony Planinac

2.2 Identification of the Client

Clients Name:	Xirgo Technologies Inc.
Clients Address:	188 Camino Ruiz
City/Zip Code	Camarillo, CA 93012
Country	USA
Contact Person:	Johnny Chen
Phone No.	805-338-2204
Fax:	
e-mail:	Jchen@xirgotech.com

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as client.
Manufacturers Address:	
City/Zip Code	
Country	

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3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	XT4970D
HW Version :	XT4970D-001
SW Version :	XT4970D-01
FCC-ID :	GKM-XT4970D
IC-ID:	10281A-XT4970D
HVIN:	XT4970D
PMN:	CXT4970D
Product Description:	Vehicle Solar harvesting GPS/Cellular Tracker with BT/ZGB Tech
Regulatory Band	Lower band edge 2400MHz – upper band edge 2483.5MHz
Channels Used	BT: 2402 – 2480, 40 channels ZIGBEE: 2405 – 2480, 16 channels
Type(s) of Modulation:	BT-LE: GFSK BT-BDR: GFSK BT-EDR: DQPSK BT-EDR: 8DPSK ZIGBEE: OQPSK
Antenna Type:	2.45 GHz Ceramic Chip Antenna
Max. declared antenna gain	1.5dBi
Max. declared conducted output power + tune-up	12dBm, for BT and for ZigBee
Max. measured output power	13.2dBm EIRP
Power Supply	Dedicated Accumulator Pack that can be charged through solar panel and external power supply via DC-DC converter.
Rated Operating Voltage Range:	Vmin: 8.0V dc/ Vnom: 12.0V dc / Vmax: 24.0V dc
Operating Temperature Range	-40 °C to 70 °C

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Other Radios included in the device:	ublox TOBY-L201: UMTS FDD II: 1850 - 1910MHz UMTS FDD V: 824 - 849MHz LTE Band 2: 1850 - 1910MHz LTE Band 4: 1710 - 1755MHz LTE Band 5: 824 - 849MHz LTE Band 13: 777 - 787MHz LTE Band 17: 704 - 716MHz
Sample Revision	☐ Prototype; ☐ Production; ☒ Pre-Production

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	XT4970D SN1	XT4970D-001	XT4970D-01	Radiated Unit

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	Power Supply	Protek -3003B	NA	NA

3.1 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1	The radio of the EUT was stimulated directly in a test mode not accessible by the end user. The internal antenna was connected.

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4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT per the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 of Industry Canada.

The XT4970D contains a technically identical implementation of BT 4.0 as the forerunner product XT6350 (FCC-ID: GKM-XT6350, IC: 10281A-XT6350) based on TI's CC2564 chipset. Full compliance to the above standards for XT6350 has been attested in the reports:

- Intertek 101978620LEX-002 for BT-LE
- Intertek 101978620LEX-003 for BT-BDR/EDR

The XT4970D contains a technically identical implementation of ZigBee as the forerunner product XT4860G5 (FCC ID: GKM-XT4800, IC ID: 10281A-XT4800) based on a TI's CC2530 with CC2591 LNA/PA. Full compliance to the above standards for XT4860G5 has been attested in the report:

- CETECOM Inc. EMC_XIRGO-080-14001_DTS_rev2.pdf

All reports referenced above are still valid under current rules for FCC and IC rules.

The intention of this report is to verify the attested product portion equality of the applicant in a sport check.

This test report is to support a request for new equipment authorization under the
FCC ID: GKM-XT4970D
IC ID: 10281A-XT4970D

Testing procedures are based on
558074 D01 DTS Meas Guidance v03r03
ANSI C63.10 2013

All results are based on the EUT operating at its maximum declared peak envelope power including Tune Up tolerance as specified in 3.1 for all implemented radios.

5 Measurement Results Summary

5.1 BT-LE

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(e) RSS247 5.2(2)	Power Spectral Density	Nominal	GFSK	☐	☐	☐	■	Complies
§15.247(a)(1) RSS247 5.2(1)	Emission Bandwidth	Nominal	GFSK	☐	☐	☐	■	Complies
§15.247(b)(1) RSS247 5.4(4)	Maximum Conducted Output Power	Nominal	GFSK	☐	☐	☐	■	Complies
§15.247(b)(1) RSS247 5.4(4)	EIRP	Nominal	GFSK	■	☐	☐	☐	Complies
§15.247/15.209/ 15.205 RSS-Gen 8.9/ 8.10	Band edge compliance- Restricted Band Edges	Nominal	GFSK	☐	☐	☐	■	Complies
§15.247(d) RSS247 5.5	Band edge compliance- Unrestricted Band Edges	Nominal	GFSK	☐	☐	☐	■	Complies
§15.247(d) §15.209 RSS-Gen 6.13	TX Spurious emissions- Radiated	Nominal	GFSK	■	☐	☐	☐	Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	GFSK	☐	☐	■	☐	

Note: NA= Not Applicable as EUT cannot be connected to AC-mains

Note: NP= Not Performed. Compliance attested in reports referenced under 4.

5.1 BT-BDR/EDR

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(b)(1) RSS-247 5.4 (2)	Maximum Peak Conducted Output Power and EIRP	Nominal	GFSK QPSK 8DPSK	☐	☐	☐	■	Complies
§15.247(b)(1) RSS-247 5.4 (2)	EIRP	Nominal	GFSK	■	☐	☐	☐	Complies
§15.247(d) RSS-247 5.5 RSS-Gen 8.10	Band Edge Compliance	Nominal	GFSK 8DPSK	☐	☐	☐	■	Complies
§15.247(a)(1) RSS-247 5.1 (1)	Spectrum Bandwidth	Nominal	GFSK QPSK 8DPSK	☐	☐	☐	■	Complies
§15.247(a)(1) RSS-247 5.1 (1)	Carrier Frequency Separation	Nominal	GFSK 8DPSK	☐	☐	☐	■	Complies
§15.247(a)(1) RSS-247 5.1 (4)	Number of Hopping Channels	Nominal	GFSK 8DPSK	☐	☐	☐	■	Complies
§15.247(a)(1)(iii) RSS-247 5.1 (4)	Time of occupancy	Nominal	GFSK QPSK 8DPSK	☐	☐	☐	■	Complies
§15.247(d) §15.209 (a) RSS-Gen 6.13	TX Spurious emissions- Radiated	Nominal	GFSK	■	☐	☐	☐	Complies
§15.207(a) RSS-Gen 8.8	AC Conducted Emissions <30MHz	Nominal	GFSK 8DPSK	☐	☐	■	☐	Complies

Note: NA= Not Applicable as EUT cannot be connected to AC-mains

Note: NP= Not Performed. Compliance attested in reports referenced under 4.

5.2 ZigBee

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(e) RSS247 5.2(2)	Power Spectral Density	Nominal	OQPSK Low, Mid and High channel	☐	☐	☐	■	Complies
§15.247(a)(1) RSS247 5.2(1)	Emission Bandwidth	Nominal	OQPSK Mid channel only	☐	☐	☐	■	Complies
§15.247(b)(1) RSS247 5.4(4)	Maximum Conducted Output Power and EIRP	Nominal	OQPSK Mid channel	☐	☐	☐	■	Complies
§15.247(b)(1) RSS247 5.4(4)	EIRP	Nominal	OQPSK Mid channel	■	☐	☐	☐	Complies
§15.247/15.209/ 15.205 RSS-Gen 8.9/ 8.10	Band edge compliance- Restricted Band Edges	Nominal	OQPSK channels closest to relevant band edge	☐	☐	☐	■	Complies
§15.247(d) RSS247 5.5	Band edge compliance- Unrestricted Band Edges	Nominal	OQPSK channels closest to relevant band edge	☐	☐	☐	■	Complies
§15.247(d) §15.209 RSS-Gen 6.13	TX Spurious emissions- Radiated	Nominal	OQPSK Mid channel	■	☐	☐	☐	Complies
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	OQPSK Low, Mid and High channel	☐	☐	■	☐	

Note: NA= Not Applicable as EUT cannot be connected to AC-mains.

Note: NP= Not Performed. Compliance attested in reports referenced under 4.

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6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated Measurement Uncertainty: ± 2.5 dB

7 Environmental Conditions During Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20 to 25°C
- Humidity: 40 to 60%

8 Dates of Testing:

2015-11-26 to 2015-12-17

9 Measurement Procedures

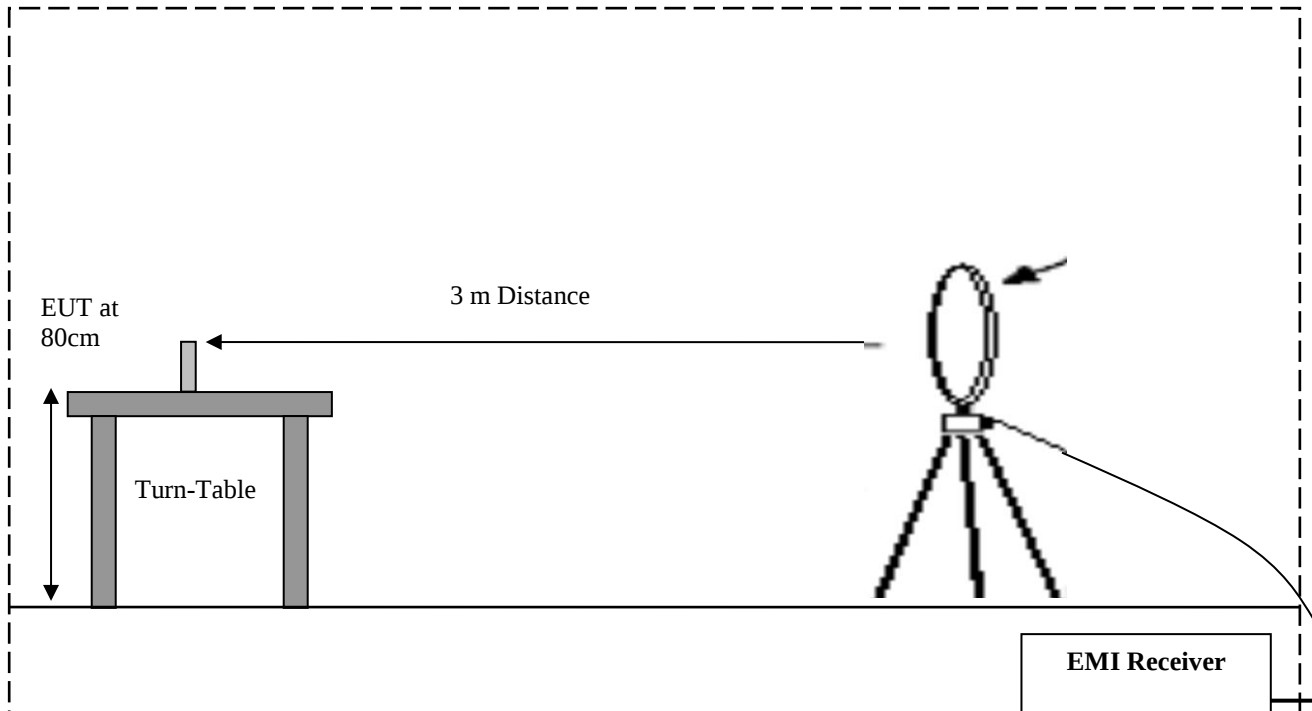
9.1 Radiated Measurement

The radiated measurement is performed according to:

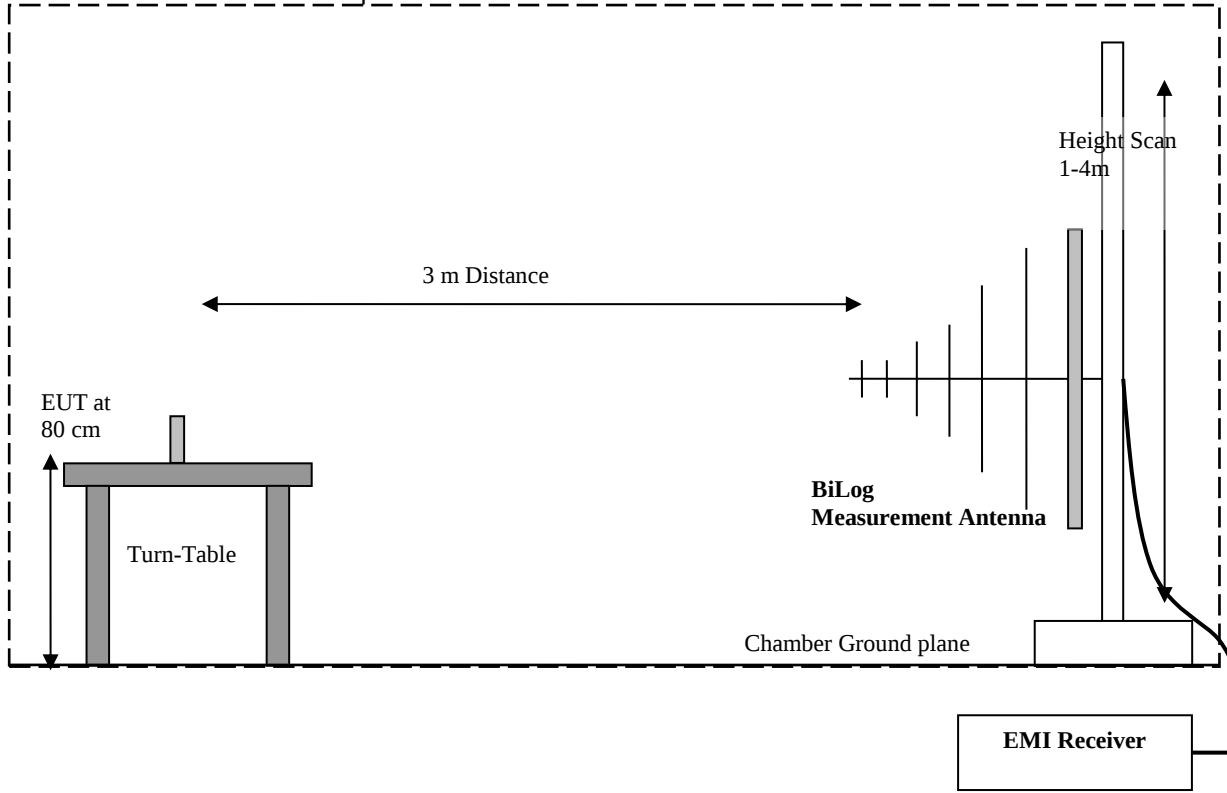
ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running sweeps at 1 and 4m antenna heights over the required frequency range with R&S Test-SW EMC32 for both antenna polarizations. During each frequency scan the turntable rotates by no more than 10deg.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then again maximized through a fine search in frequency domain, maximized in the 360deg range of the turntable, and maximized over antenna height between 1m and 4m and for positioning of the EUT.
- The above procedure is repeated for transmission low mid and high channel.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

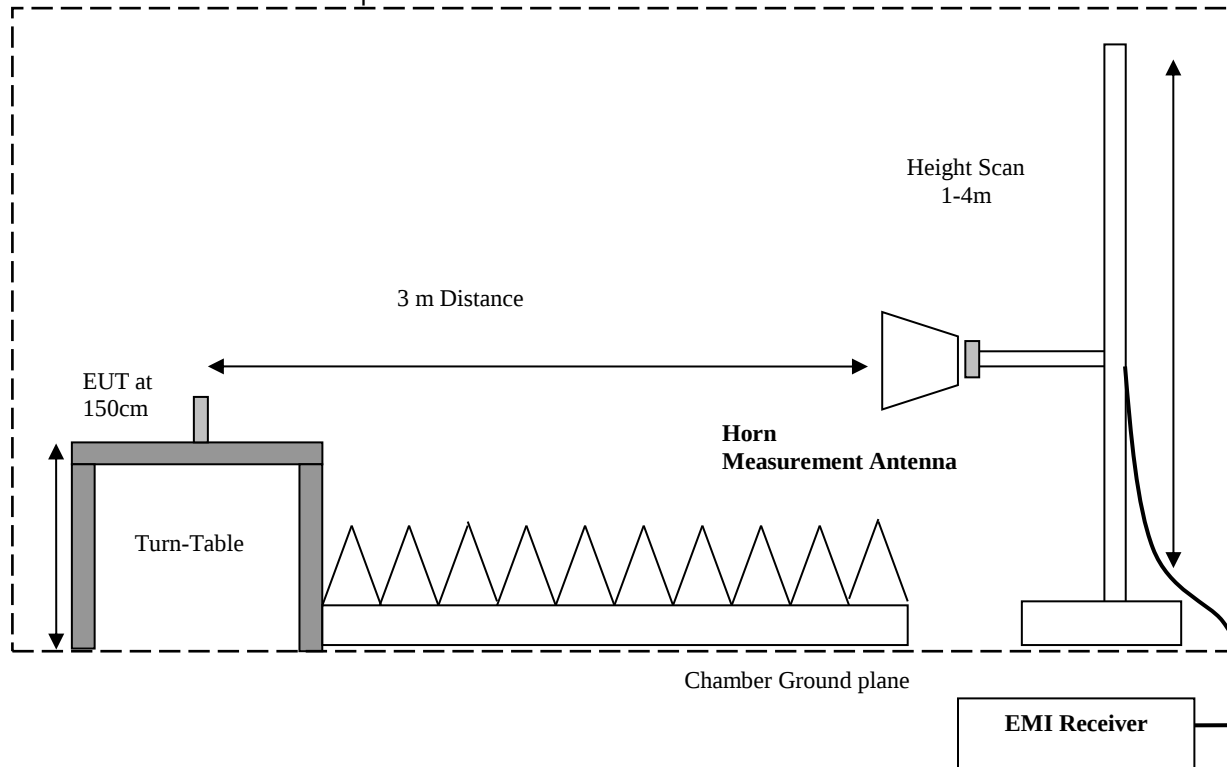
Radiated Emissions Test Setup Below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup Above 1GHz Measurements



9.2 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

1. Measured reading in dB μ V
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

$$FS \text{ (dB}\mu\text{V/m)} = \text{Measured Value on SA (dB}\mu\text{V)} - \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

Example:

Frequency (MHz)	Measured SA (dB μ V)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dB μ V/m)
1000	80.5	3.5	14	98.0

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10 Maximum Peak Output Power

10.1 Measurement according to FCC KDB 558074 D01 V03R03

Spectrum Analyzer settings:

Span = approximately 5 times the 20 dB bandwidth

RBW > the 20 dB bandwidth of the emission being measured

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Use the marker-peak function to set the marker to the peak of the emission.

10.2 Limits

Maximum Peak Output Power:

FCC §15.247 (b)(1): 1W

IC RSS-247: 1W

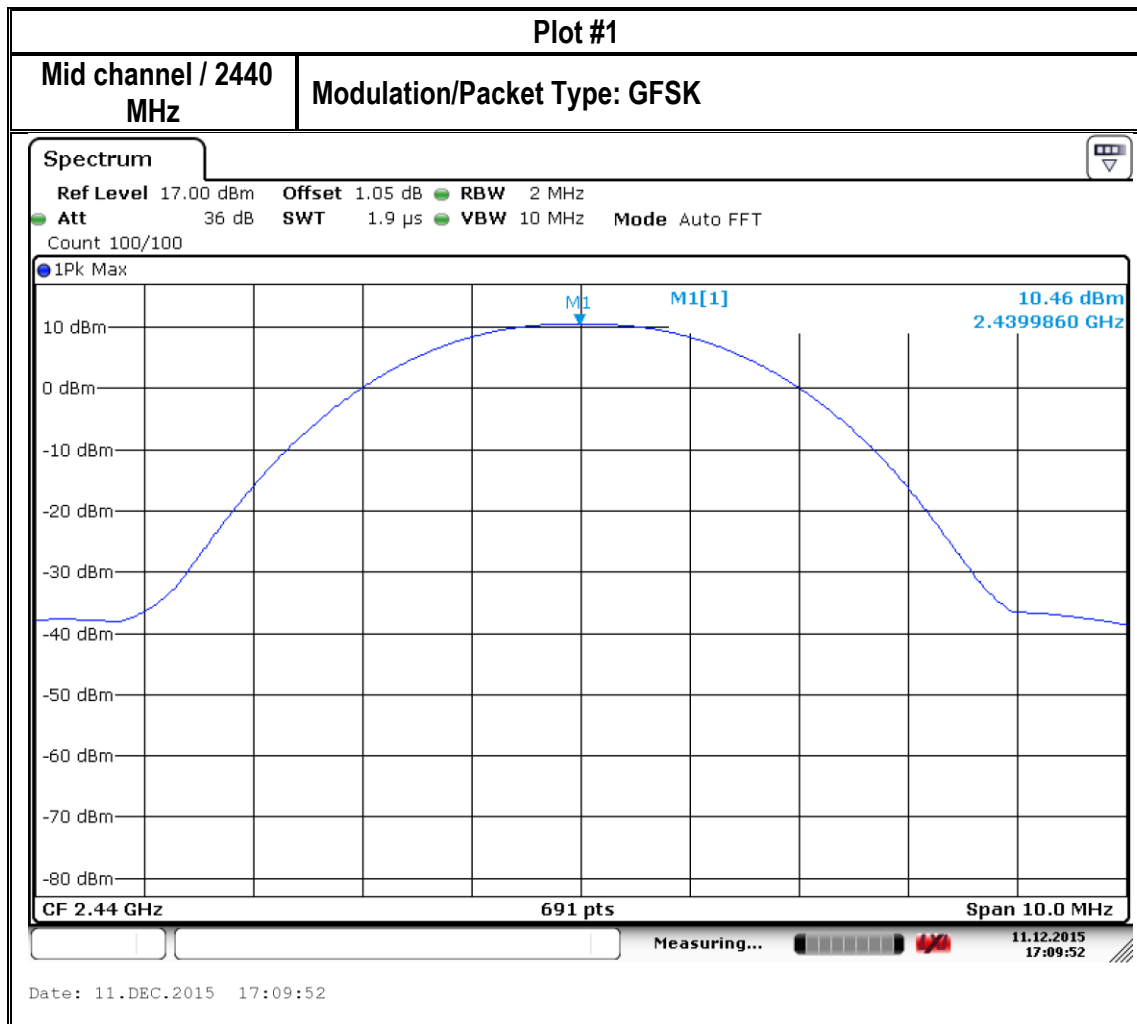
EIRP:

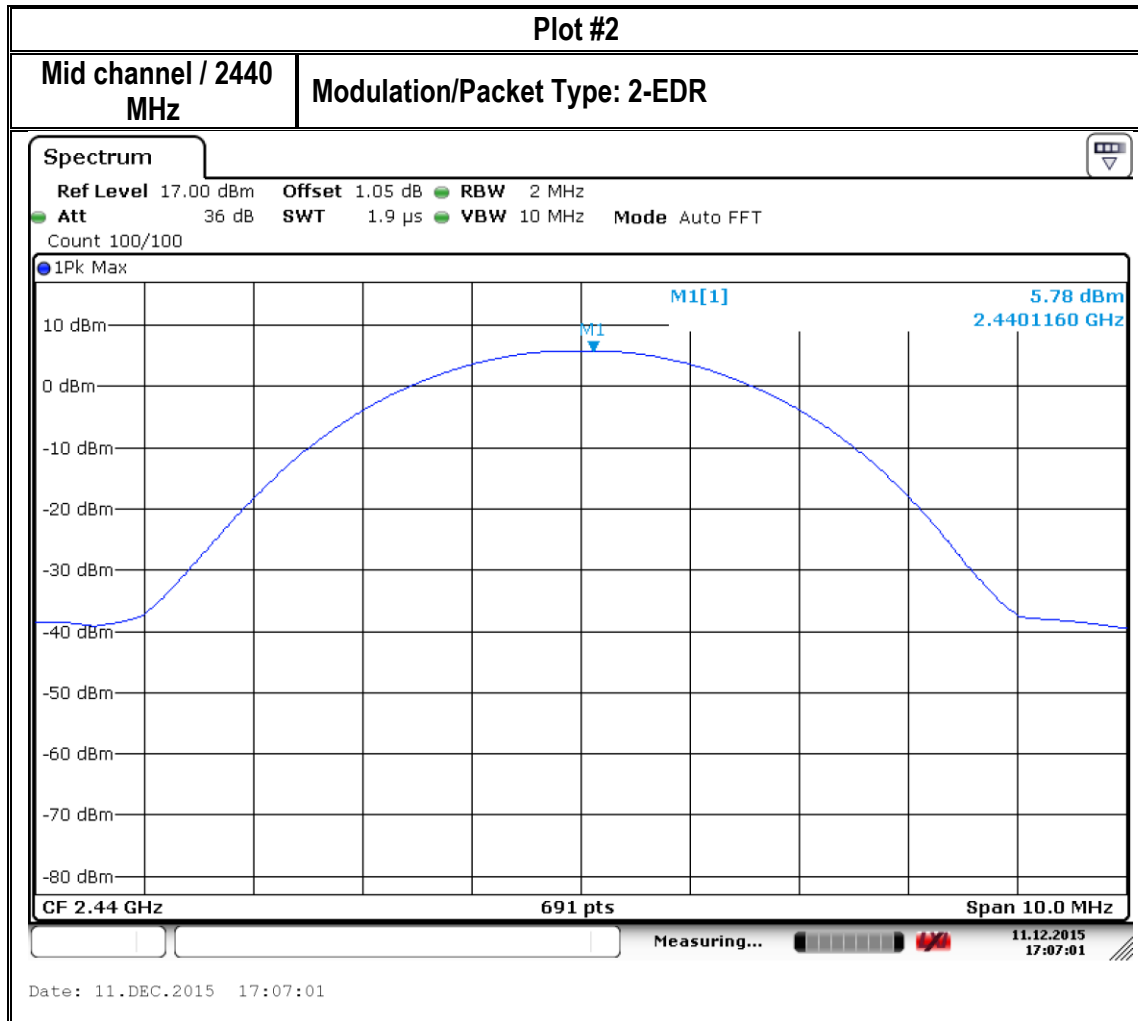
IC RSS-247: 4W

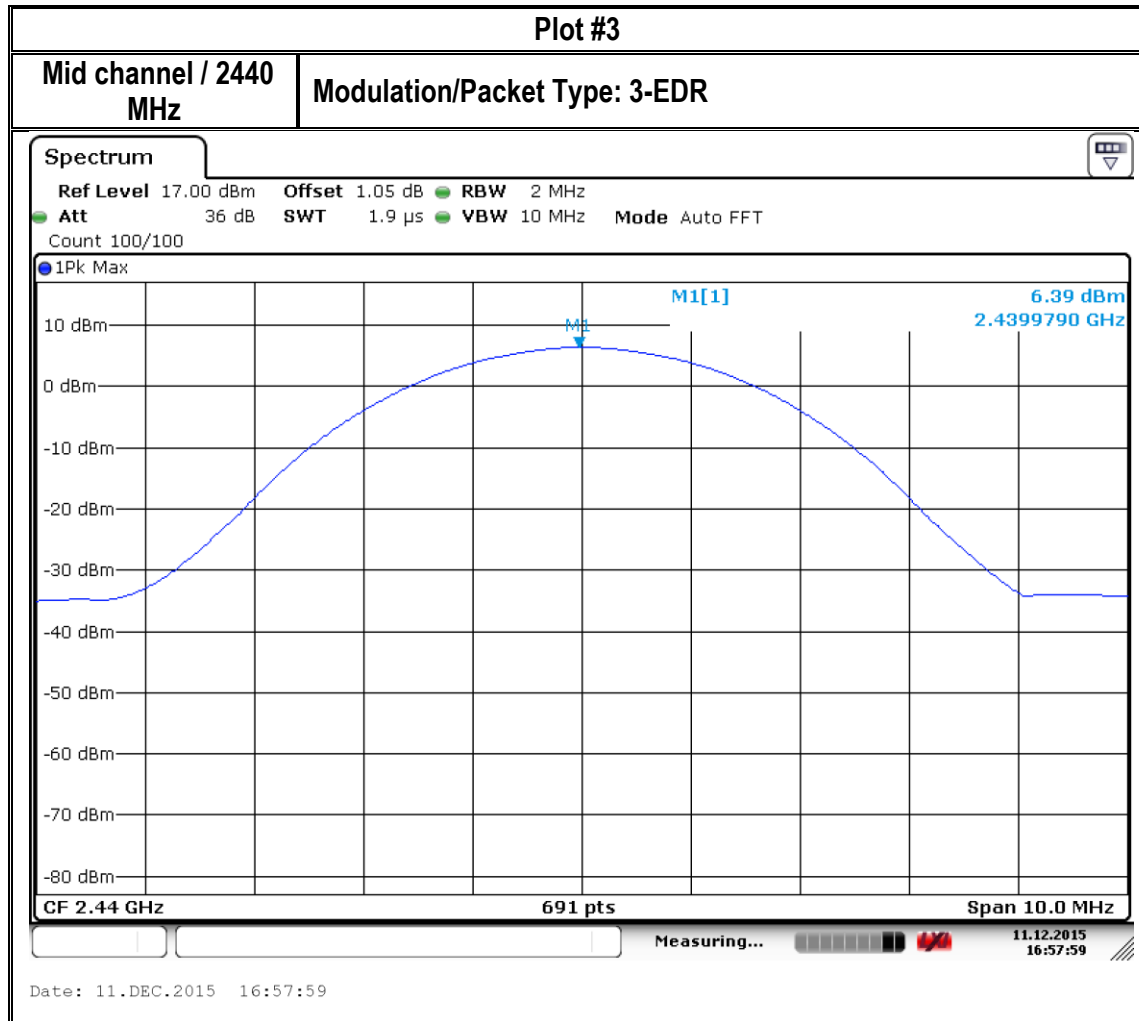
10.3 Worst case modulation verification for Bluetooth

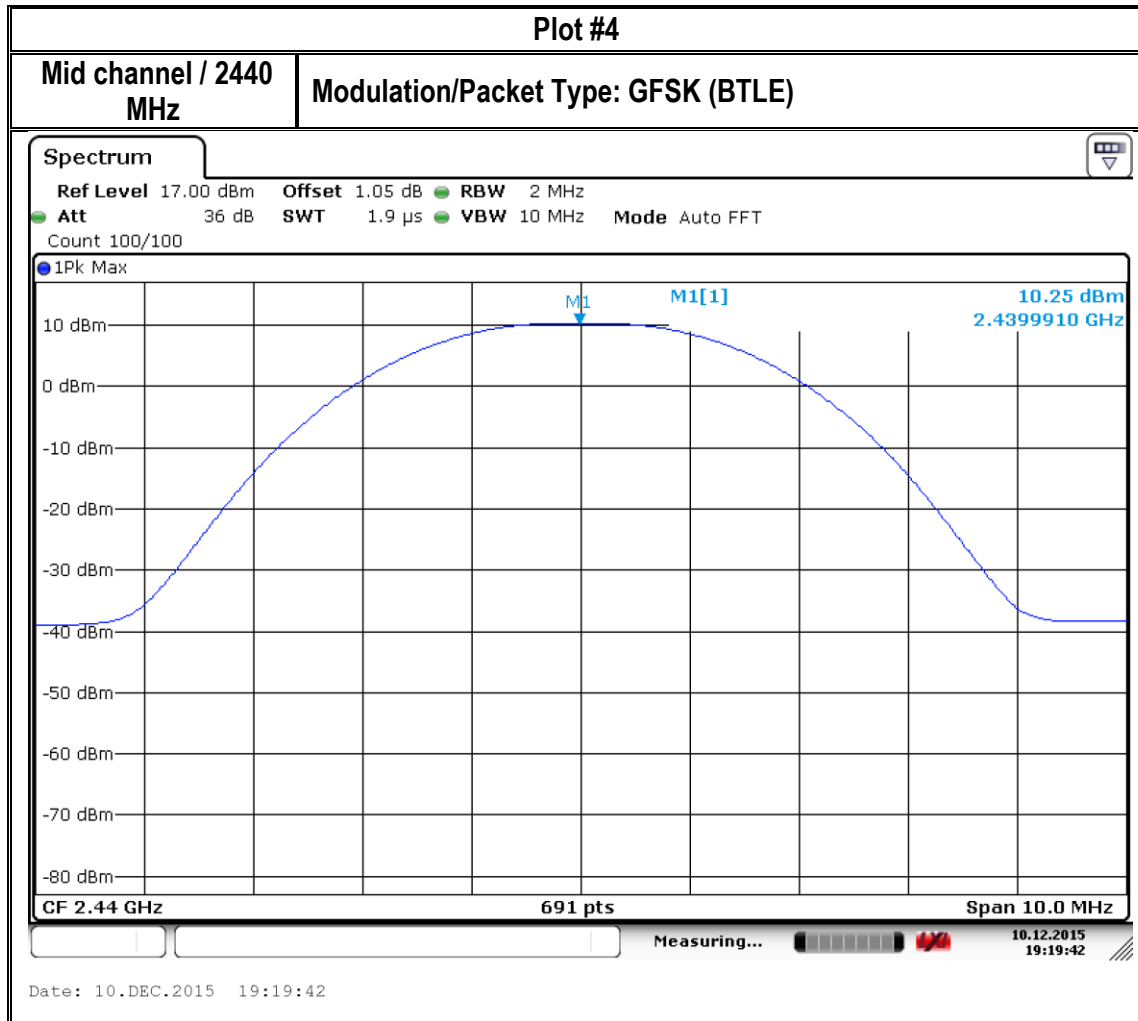
The different modulations for BT 4.0 have been compared to identify the modulation yielding the highest output power for all further measurements. The measurements have been performed on a conducted unit via a SME pigtail connection. The highest power has been measured for BT BDR with 10.46dBm.

Modulation	Conducted Power on Mid channel
BT BDR GFSK	10.46dBm
BT EDR DQPSK	5.78dBm
BT EDR 8DPSK	6.39dBm
BT LE GFSK	10.25dBm









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10.4 Test conditions and setup:

As verified above in 10.3 BT-BDR GFSK delivers the highest output powers.

For BT-BDR GFSK radio of the EUT was radio was stimulated with the following commands through a serial interface:

Tpm=0
 Mci=7,1
 Mci=8,0
 mB
 Bpm=1
 Bhc=fd84,1,3,19,f
 Bhc=fd80,ff,ffffff,1

For the ZIGBEE the EUT s radio was stimulated with the following commands through a serial interface:

Tpm=0
 Zpm=1
 Zpi
 Zrt=3,2430,0xB5

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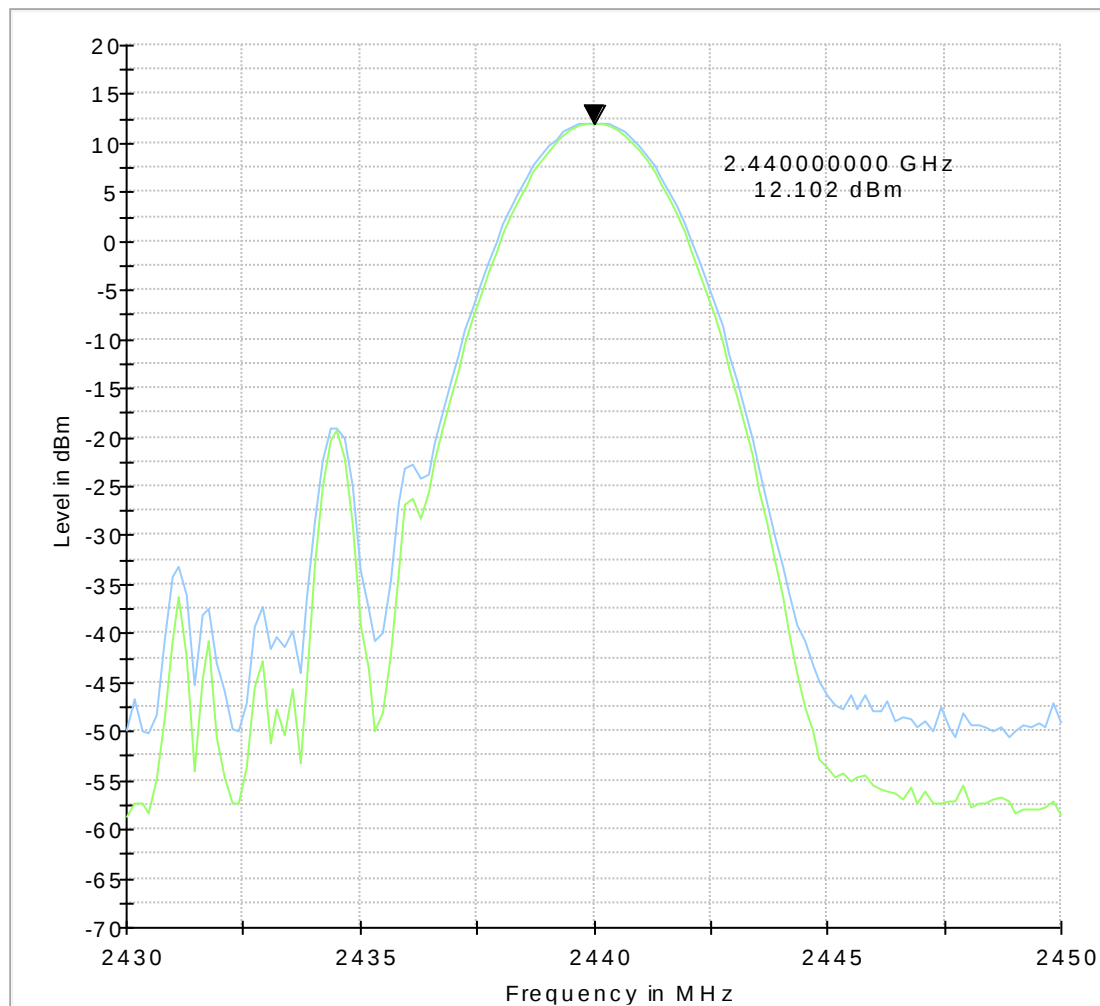
10.5 Measurement result: Radiated Spot Check Mid Band

Plot #	Frequency (MHz)	Mode	Maximum Peak Radiated Output Power (dBm)	Certifying Limit (dBm)	Result
1	2440	BT-BDR GFSK	12.102	30(conducted) / 36(EIRP)	Pass
2	2430	ZB	13.186	30(conducted) / 36(EIRP)	Pass

10.6 Measurement Plots:

ZIGBEE on mid channel:

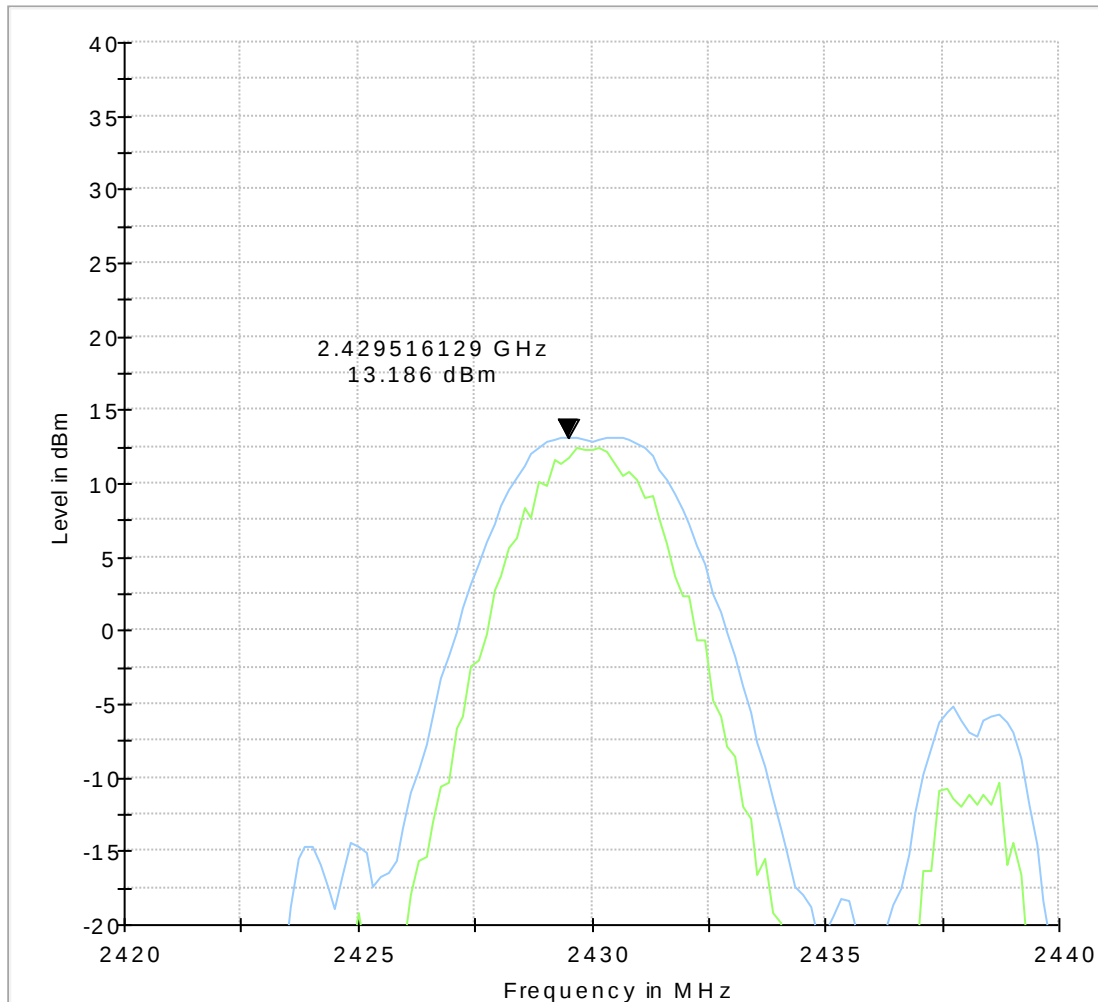
FCC_15_247_EIRP_1GHz_3GHz



— Preview Result 1-PK+ — Preview Result 2-AVG

BT-BDR GFSK on mid channel:

FCC_15_247_EIRP_1GHz_3GHz



— Preview Result 1-PK+ — Preview Result 2-AVG

11 Radiated Transmitter Spurious Emissions and Restricted Bands

11.1 Measurement according to ANSI C63.10 (2013)

Analyzer Settings:

Frequency > 1 GHz

Detector = Peak / Average

RBW= 1MHz

Plots reported here represent the worst case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT. Unless mentioned otherwise, the emissions outside the limit lines in the plots are from the transmit signal.

11.2 Limits: §15.247/15.205/15.209 & RSS-Gen 8.9/ 8.10 (restricted bands)

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)
13.36 - 13.41			

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

*PEAK LIMIT= 74dBµV/m

*AVG. LIMIT= 54dBµV/m

Table 1:

Frequency of emission (MHz)	Field strength @ 3m (μV/m)	Field strength @ 3m (dBμV/m)
30–88	100	40dBμV/m
88–216	150	43.5 dBμV/m
216–960	200	46 dBμV/m
Above 960	500	54 dBμV/m

Table 2:

Frequency of emission (MHz)	Field strength (μV/m) / (dBuV/m)	Measurement Distance (m)
0.009–0.490	2400/F(kHz) / -----	300
0.490–1.705	24000/F(kHz) / -----	30
1.705–30.0	30 / (29.5)	30

Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements described in 5.4.

The highest (or worst-case) data rate shall be recorded for each measurement.

For testing at distance other than the specified in the standard, the limit conversion is calculated by using 40 dB/decade extrapolation factor as follow:

$$\text{Conversion factor (CF)} = 40 \log (D/d) = 40 \log (300\text{m} / 3\text{m}) = 80\text{dB}$$

11.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode
25°C	1	BTLE
25°C	1	ZigBee

For the BT measurement, use the following case-sensitive commands in a hyperterminal screen:

```
Tpm=0
Mci=7,1
Mci=8,0
mB
Bpm=1
Bhc=fd84,1,3,19,f
Bhc=fd80,ff,ffffff,1
```

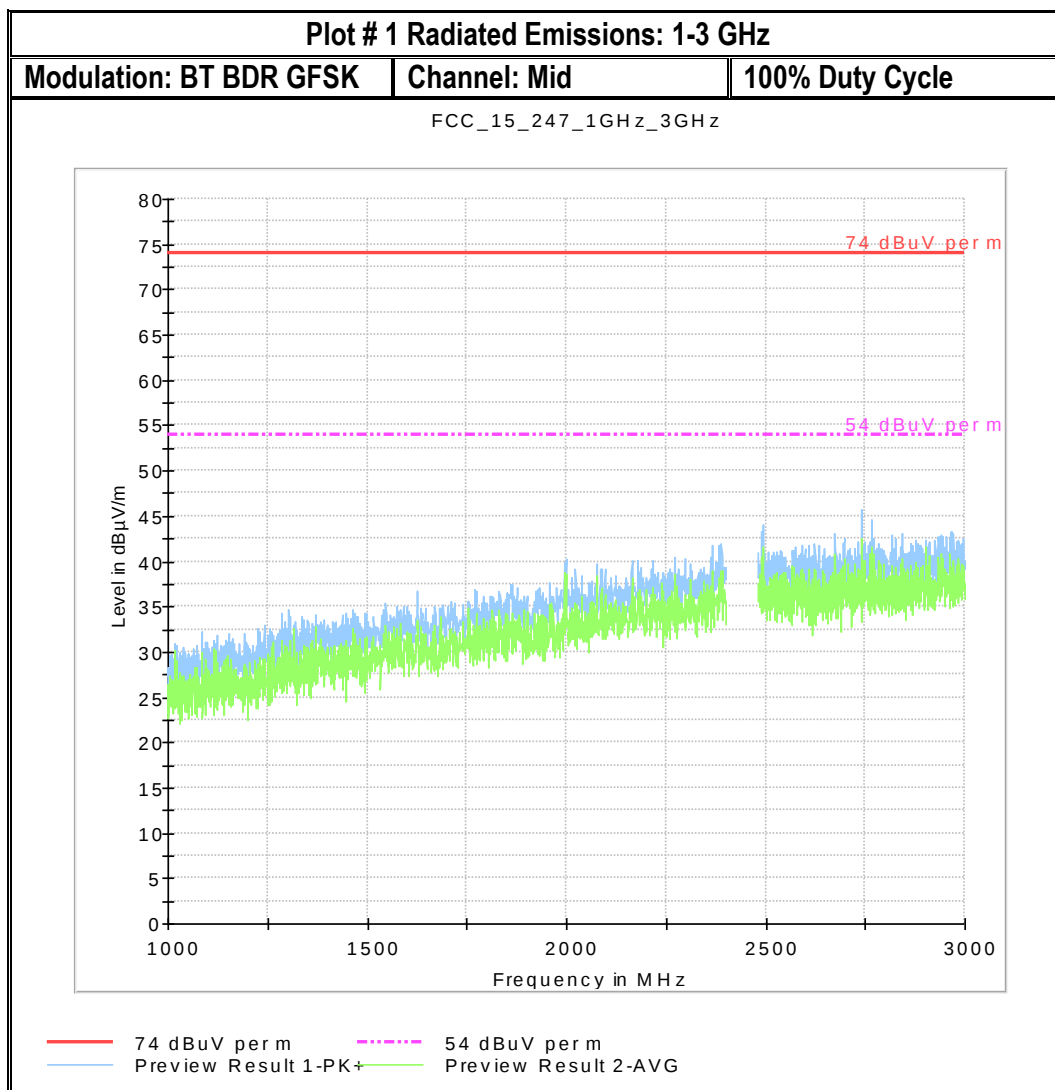
For the ZigBee measurement, use the following case-sensitive commands in a hyperterminal screen:

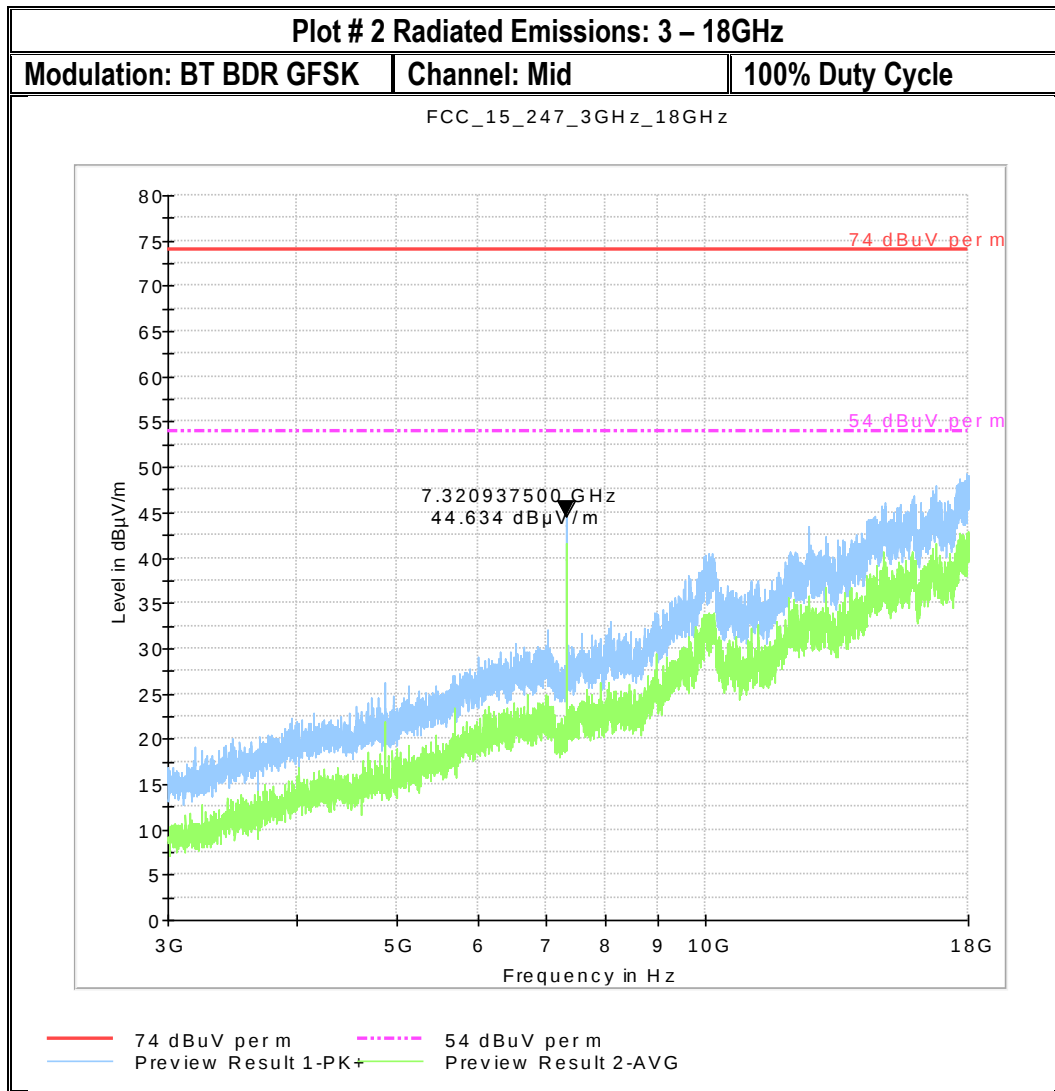
```
Tpm=0
Zpm=1
Zpi
Zrt=3,2430,0xB5
```

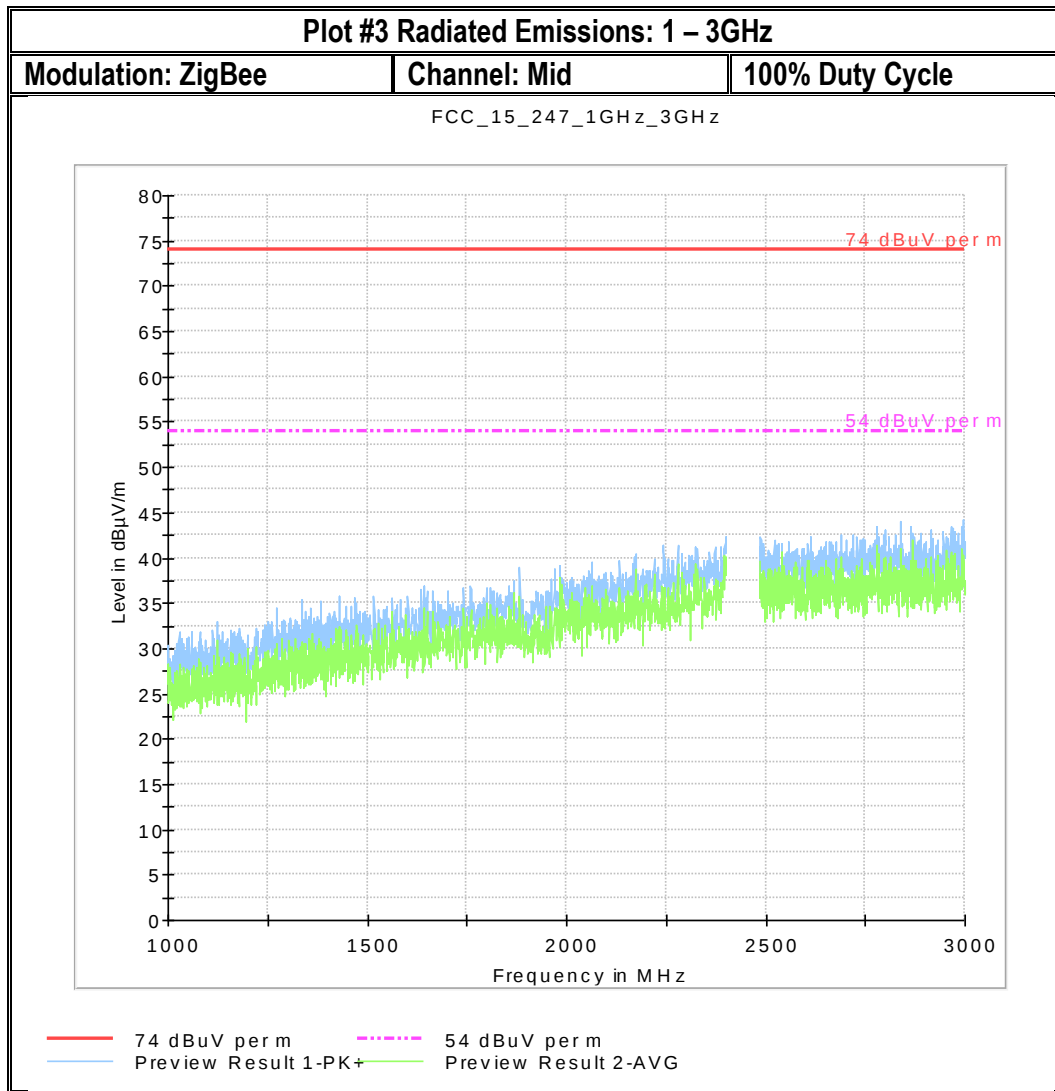
11.4 Measurement result:

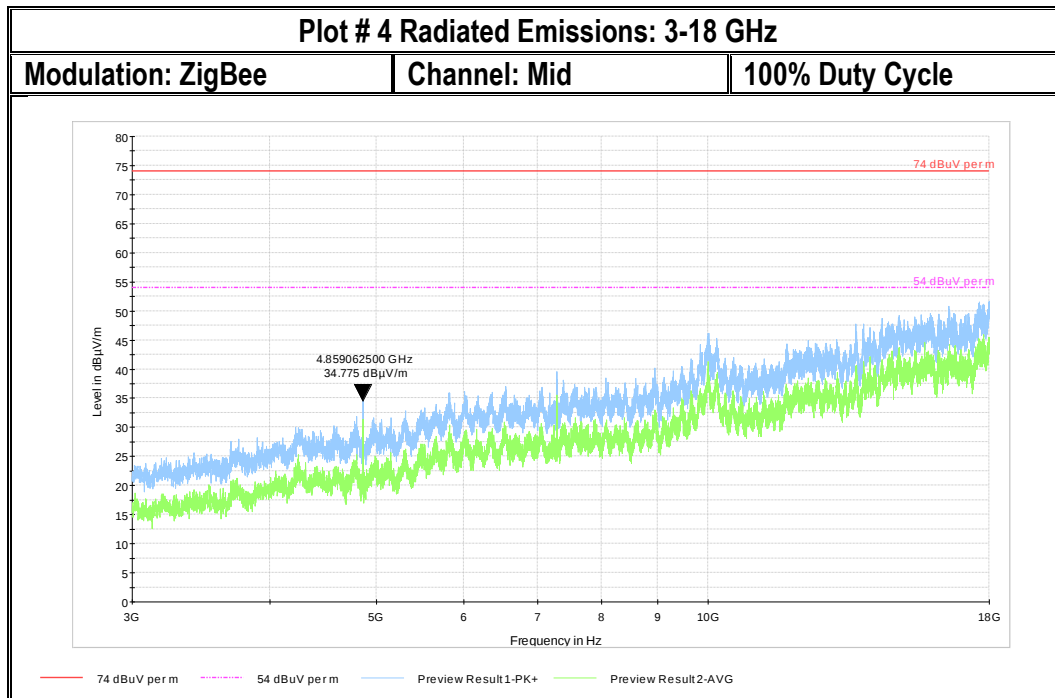
Plot #	Mode	Channel #	Scan Frequency	Limit	Result
1	BT-BDR GFSK	Mid	1GHz – 3GHz	On plot	Pass
2	BT-BDR GFSK	Mid	3GHz – 18GHz	On plot	Pass
3	ZB	Mid	1GHz – 3GHz	On plot	Pass
4	ZB	Mid	3GHz – 18GHz	On plot	Pass

11.5 Measurement Plots:









12 Test Equipment And Ancillaries Used For Testing

Equipment Name	Manufacturer	Type/Model	Serial No.	Cal Date	Cal Interval	Next cal date
3m Semi- Anechoic Chamber:						
Spectrum Analyzer	Rohde und Schwarz	FSV40	101022	7/2014	3 years	7/2017
Receiver	Rohde und Schwarz	ESR3	101663	7/2015	3 years	7/2018
LISN	Rohde und Schwarz	ESV 216	101129	7/2015	3 years	7/2018
Radiocommunication Tester	Rohde and Schwarz	CMU 200	121672	7/2015	3 years	7/2018
Log Periodic Antenna	Rohde and Schwarz	HL 050	100515	4/2013	3 year	4/2016
Ultralog Antenna	Rohde and Schwarz	HL 562	100495	5/2015	3 year	5/2018
Double-ridge Horn Antenna (1G-18G)	ETS-Lindgren	3117-PA	00167061	7/2014	3 year	7/2017
Double-ridge Horn Antenna (18G-40G)	ETS-Lindgren	3116C-PA	00166821	7/2014	3 year	7/2017
Loop Antenna	ETS-Lindgren	6512	00164698	7/2014	3 year	7/2017
Open Switch Control Unit	Rohde and Schwarz	OPS 130	10085	n/a		
Extension Unit Open Switch Control Unit	Rohde and Schwarz	OSP 150	10086	n/a		
Turn Table TT	Maturo	1.5 SI	TT 1.5SI/204/607 0910	n/a		
Compact antenna Mast	Maturo	CAM 4.0-P	CAM4.0- P/067/600091 0	n/a		
Multiple Control Unit	Maturo	MCU	2140910	n/a		
Pre-Amplifier	Rohde and Schwarz	TS-PR 18	100072	Part of the system calibration		
High Pass Filter	Mini-Circuits	SHP-1200+	RUU1120122 4			
High Pass Filter	Wainwright Instr.	WHKX 3.0/18	109			

Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.

Calibration due dates, unless defined specifically, falls on the last day of the month.

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Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

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13 Revision History

Date	Report Name	Changes to the report	Report prepared by
01-27-2016	EMC_XIR_111_15001_15.247_DTS_BTLE_v1.0	release	Tony Planinac
02-09-2016	EMC_XIR_111_15001_15.247_DTS_BTLE_v1.1	Added EIRP spot check results to compare to declared values in 10. Added references to full reports of module and predecessor product in 4.	Franz Engert
02-17-2016	EMC_XIR_111_15001_15.247_DTS_BTLE_v1.2	Add analysis to which BT 4.0 modulation yields the highest powers	Franz engert