

Prüfbericht-Nr.: Test report no.:	ULR- TC568820300000067F	Auftrags-Nr.: Order no.:	166501392 10	Seite 1 von 57 Page 1 of 57
Kunden-Referenz-Nr.: Client reference no.:	NA	Auftragsdatum: Order date:	2020-11-24	
Auftraggeber: Client:	HONEYWELL INTERNATIONAL INC HONEYWELL SAFETY AND PROUDCTIVITY SOLUTIONS 9680 Old Bailes Road, Fort Mill, SC 29707-7539, USA			
Prüfgegenstand: Test item:	IM11-PRT RFID MODULE			
Bezeichnung: Identification:	IM11-PRT			
Auftrags-Inhalt: Order content:	Testing & issue of FCC and IC grant certificate			
Prüfgrundlage: Test specification:	FCC Part 15 Subpart C 15.247, 15.207 RSS 247 Issue 2, RSS Gen Issue 5			
Wareneingangsdatum: Date of sample receipt:	2020-11-12			
Prüfmuster-Nr. & Serien -Nr.: Test sample no & Serial no.:	A002948490-006 & 203400069			
Prüfzeitraum: Testing period:	2020-11-13 - 2020-11-17			
Ort der Prüfung: Place of testing:	Wireless laboratory, Bangalore			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (India) Pvt.Ltd.,27/B, 2nd Cross, ElectronicCityPhase1 Bangalore – 560 100, India FCC Test Site Registration No: 496599			
Prüfergebnis*: Test result*:	Pass			
geprüft von: tested by:	genehmigt von: authorized by:			
Datum: Date: 2020-12-08		Ausstellatum: Issue date: 2020-12-30		
Stellung / Position:	Rajesh M Gowda Engineer	Stellung / Position:	Mahammadgouse Kaladagi Assistant Manager	
Sonstiges / Other:	FCC ID : HD5-IM11R IC : 1693B-IM11R			
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:	Prüfmuster vollständig und unbeschädigt Test item complete and undamaged			
* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	4 = ausreichend N/A = nicht anwendbar
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory F(ail) = failed a.m. test specification(s)	4 = sufficient N/A = not applicable
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.				

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TEST SUMMARY

Test Item	FCC	IC	Result
Maximum conducted (Peak) output power	15.247 (b)(2)	RSS-247 issue 2 5.4 (a)	Pass
Occupied bandwidth	15.247 (a) (1) (i)	RSS-247 issue 2 5.1 (c)	Pass
Number of Hopping channels	15.247 (a) (1) (i)	RSS-247 issue 2 5.1 (c)	Pass
Carrier Frequency Separation	15.247 (a) (1)	RSS-247 issue 2 5.1 (b)	Pass
Time of Occupancy (Dwell Time)	15.247 (a) (1) (i)	RSS-247 issue 2 5.1 (c)	Pass
Emissions in non-restricted frequency bands and Conducted Spurious Emission	15.247 (d)	RSS-247 issue 2 5.5	Pass
Spurious Radiated Emissions and Restricted Bands of Operation	15.247 (d) / (15.209 & 15.205)	RSS-GEN issue 5 Clause 8.9, 8.10	Pass
Conducted Emissions on Power Lines	FCC 15.207	RSS-Gen Issue 5, Section 8.8	Pass

Product Category: Electronics Testing
Test Discipline: EMC Test Facility

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REVISION HISTORY OF THIS REPORT

Report Number	Version	Description	Issue date
ULR-TC568820300000067F	01	Initial issue of report	2020-12-30

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1 GENERAL REMARKS

1.1 Attachments

All attachments are part of this test report and are issued in separate document

1. TEST SETUP PHOTOS
2. EUT EXTERNAL PHOTOS
3. EUT INTERNAL PHOTOS
4. FCC LABEL AND LABEL LOCATION
5. BLOCK DIAGRAM
6. SPECIFICATION OF EUT
7. SCHEMATIC DIAGRAMS
8. BILL OF MATERIAL
9. USER MANUAL
10. Maximum Permissible Exposure Information

2 TEST SITES

2.1 Testing Facilities

- | | |
|--|---|
| <p>1. TÜV Rheinland (India) Pvt.Ltd.,
27/B, 2nd Cross,
ElectronicCityPhase1
Bangalore – 560 100,
India</p> | <p>2. TUV Rheinland (India) Private Limited
108 , Beside ISBR Business School,
Electronic city Phase I
Bangalore - 560 100.
India</p> |
|--|---|

2.2 List of Test and Measurement Instruments

Table 1: List of test and measurement instruments

Equipment	Manufacturer	Model Name	Serial Number	Firmware Versions	Calibration Due Date	Periodicity	Test Facility
Active loop antenna	Schwarzbeck	FMZB 1519 B	1519B-00111	-	31.01.2021	Yearly	Radiated Spurious Emission
Baloon and Biconical Antenna	Schwarzbeck mess-elektronik	VHBB-9124 / BBA-9106	01028	-	16.01.2021	Yearly	
Log - Periodical Antenna	Schwarzbeck mess-elektronik	VUSLP-9111B	9111B-111	-	17.01.2021	Yearly	
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA 9170-0904	-	29.01.2021	Yearly	
Horn Antenna	Schwarzbeck	BBHA 9120 D	9120D-1944	-	30.01.2021	Yearly	
Semi Anechoic Chamber	Frankonia	-	-	-	-	-	
Fully Anechoic Chamber	Albatross	-	-	-	-	-	
EMI Receiver	Rohde & Schwarz	ESU 40	100288	4.73.SP5	09.06.2021	Yearly	Antenna-Port Conducted test
Spectrum Analyser	Agilent Technologies	E4407B	US41192 772	A.14.06	10.08.2021	Yearly	
Signal Analyser	Rohde & Schwarz	FSV7	101644	3.40	27/12/2020	Yearly	
30dB Attenuator	Mini-Circuits	BW-N30W5 +	938	-	06-07-2021	Yearly	
RF Cable	H+S Electronics Pvt. Ltd	ST18/SM Am/SMA m/36	-	-	09.10.2021	Yearly	
EMI Receiver	Rohde & Schwarz	ESW 44	101732	-	10.12.2020	Yearly	AC Power line conducted emission
LISN	Rohde & Schwarz	ENV 216	100022	-	04.08.2021	Yearly	
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100811	-	04.09.2021	Yearly	

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Table 2: Instrument application Software versions

SL. No.	Test Type	Application software	Version
1	Radiated spurious emission measurement in SAC	EMC 32	10.60.00
2	Radiated spurious emission measurement in FAC	EMC 32	10.60.00

3 GENERAL PRODUCT INFORMATION

3.1 Product Function and Intended Use

IM11 module enables adding UHF RFID to nearly any product but is especially suited for use in mobile computers and tablets, fixed position readers, handheld scanners, and diagnostic equipment. With an enhanced radio frequency (RF) design, the Intermec IM11 is one of the smallest and most cost-effective high-performance UHF reader modules available today. Providing RF output power up to 1 Watt (30 dBm) and superior receiver performance, the IM11 offers exceptional flexibility for medium to long-range applications

3.2 Ratings and System Details of Equipment under Test

Table 3: Ratings and System Details as declared by Client*

Protocol		RFID
Operating Frequency Range		902MHz to 928MHz
No. of Channels		50 (Refer Table 5)
Channel Spacing		500kHz
Transmitted Power		30dBm
Maximum Measured Power (Conducted)		29.76 at 927.25MHz
Modulation & Data rate		PR-ASK & 320kbps
Number of antennas		3
Antenna mode of operation		SISO using either Antenna output 1 or Antenna output 2
Antenna type and gain		Compact yagi antenna : +6 dBi
		Microstrip antenna coupler : -19.96 dBi
		Microstrip antenna coupler : -24.0 dBi
Supply Voltage to Product		2.8 VDC to 5.2 VDC and nominal 3.7 V DC
Environmental conditions	Storage	-40° to 70° C (-40° to 158° F), 25 °C to 60 °C, 0% to 95% relative humidity, noncondensing
	Operating	-20° to 60° C (-4° to 140° F) 25 °C to 60 °C, 0% to 95% relative humidity, noncondensing
EUT Dimension		50.95mm (L)x 30mm(W)x 4.78mm(H)

***Disclaimer:** The information/data is supplied by the client and the same is considered to arrive at the final value. Any changes made apart from the specified specification, can directly impact on the tests results. Refer the products user manual for more details.

3.3 Measurement Uncertainty:

Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k = 2$

Table 4: Measurement Uncertainty

Parameter	Uncertainty
Occupied Channel Bandwidth	$\pm 5 \%$
RF output power, conducted	$\pm 1.5 \text{ dB}$
Power Spectral Density, conducted	$\pm 3 \text{ dB}$
Unwanted Emissions, conducted	$\pm 3 \text{ dB}$
All emissions, radiated	$\pm 6 \text{ dB}$
Temperature	$\pm 3 \text{ }^{\circ}\text{C}$
Supply Voltages	$\pm 3 \%$
Time	$\pm 5 \%$

Note: The Listed Measurement Uncertainties are the worst-case uncertainty, for the respective test cases. Above Table is for reporting purpose only and not used in determining Final Pass/Fail verdict.

4 TEST SET-UP AND OPERATION MODE

4.1 Principle of Configuration Selection

Transmission was enabled with highest possible duty cycle transmission on low, mid and high channel

4.2 Test Operation and Test Software

Hardware Version of EUT: 145-549-006, Rev B
Carrier board used: IP30C
Hardware Version of Carrier board: 145-572-002, Rev A

Software Version of EUT: U-Boot 2009.11-dity
Software Name of EUT: iM11_U-Boot_bin
Software Name of EUT:

4.3 Special Accessories and Auxiliary Equipment

- Test laptop, USB cable, DC Power Supply

4.4 Countermeasures to achieve EMC Compliance

- None

4.5 List of frequencies

Frequency Band (GHz)	Channel No.	Frequency (MHz)
Sub-GHz (902.2 MHz – 927.25 MHz)	4	902.75
	:	:
	30	915.25
	:	:
	54	927.25

Table 5: List of SubGHz Center frequencies

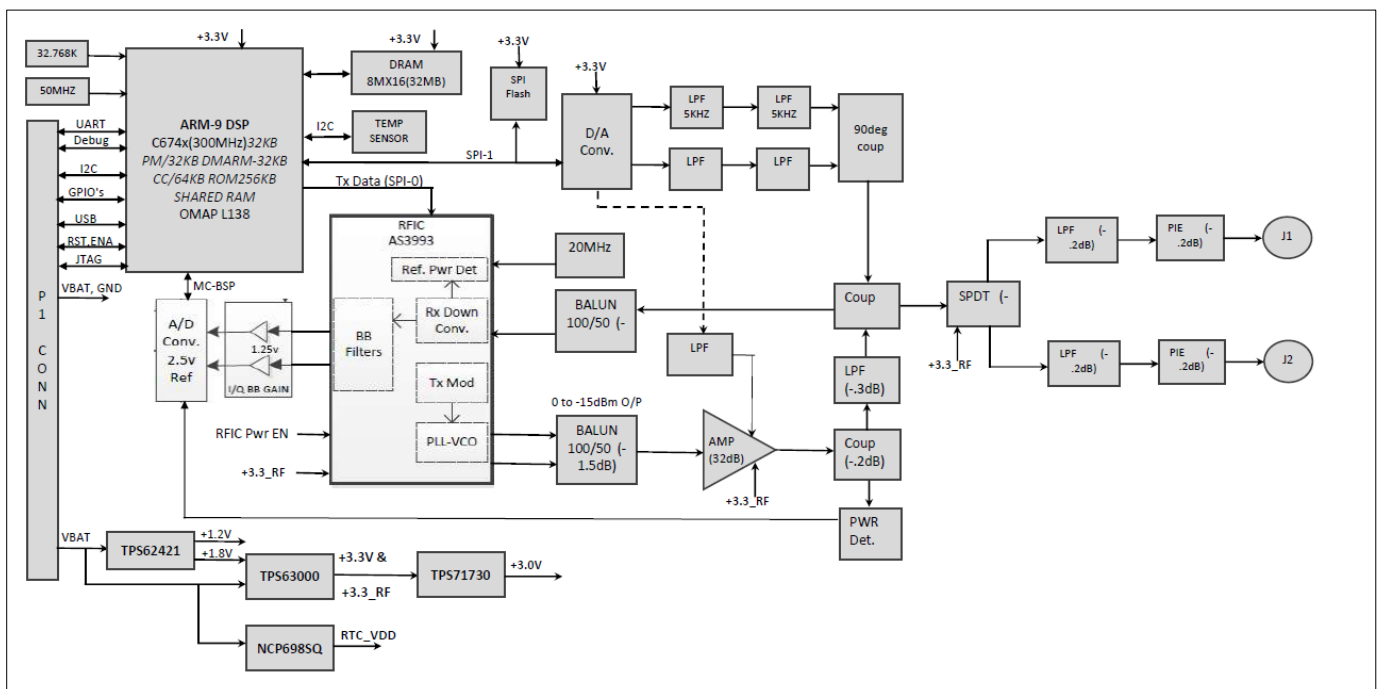
4.6 TUV Sample Identification number:

A002948490-005 – Radiated and Conducted test Sample

5 Operational Description

The module supports a full 1 Watt of output power, twice as much as many small form factor competitive modules. The IM11 module is based on the latest RF technology to provide a superior read rate with low power consumption and low-voltage operation, helping to extend the battery life of mobile devices. The IM11 also supports a wide frequency range, 860-928 MHz, enabling the module to be certified in nearly any regulatory region

6 Block Diagram



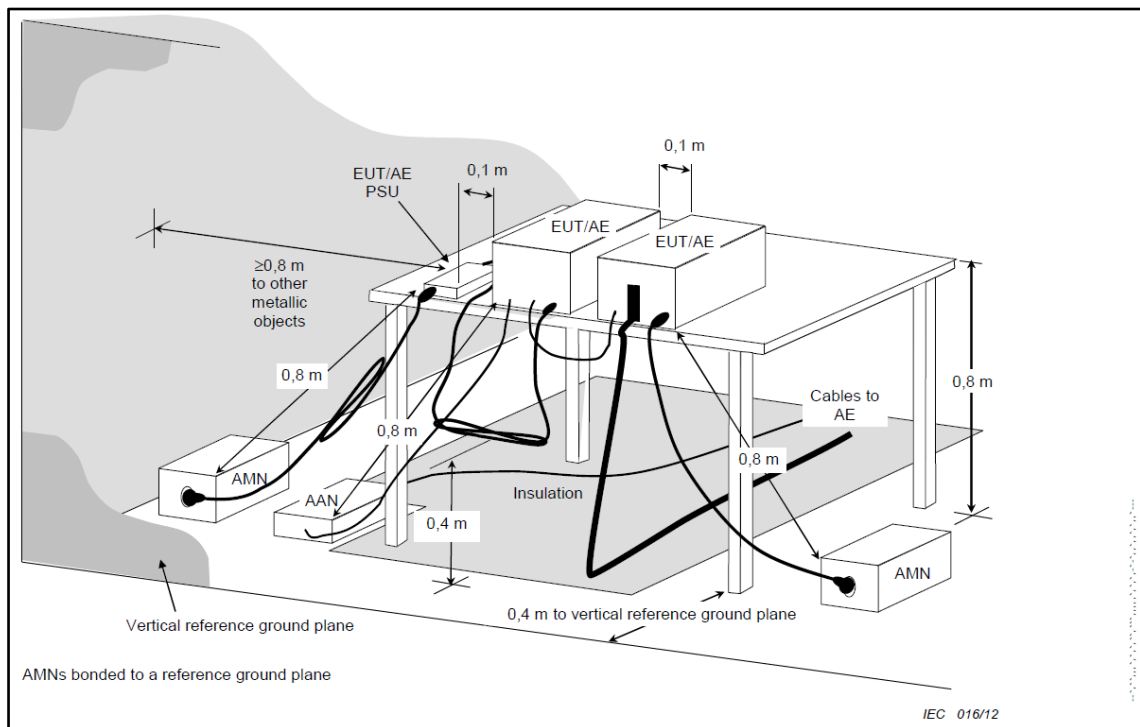
7 TEST METHODOLOGY

7.1 Conducted Spurious Emission Test on AC Power Line

Measured levels of ac power-line conducted emission across the 50Ω LISN port (to which the EUT is connected). All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer.

The device is placed on the test table, raised 80cm above the reference ground plane. The vertical conducting plane is located 40cm to the rear of the device. AC Conducted emission measurement is made over frequency range from 150kHz to 30MHz, this measurement was performed with EUT powered with an AC to DC adaptor with 110V AC 60Hz supply.

7.1.1 Test Setup Configuration



7.2 Radiated Emission Test

The radiated emission measurement was performed according to the procedures in ANSI C63.10-2013. The equipment under test (EUT) was placed at the middle of the 80 cm high turntable for below 1 GHz & 1.5 m height for above 1 GHz measurement, and the EUT is 3 meters far from the measuring antenna. The turntable was rotated 360° for obtaining the maximum emission. The height of the measuring antennas was scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained. The measurement above 1000 MHz was performed by horn antenna, The measurement below 30 MHz was performed by loop antenna, Measurement from 30 MHz to 200 MHz was performed by Baloon and Biconical Antenna, and measurement from 200 MHz to 1 GHz was performed by Log-Periodic Antenna.

The EUT was rotated around the X-, Y-, and Z-Axis and the results from worst case axis are recorded

7.2.1 Test Setup Configuration

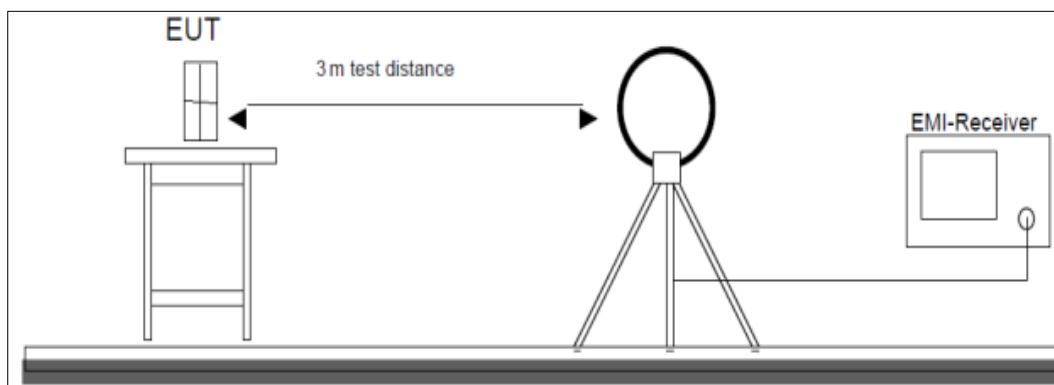


Figure 1: Frequency Range 9 kHz- 30 MHz

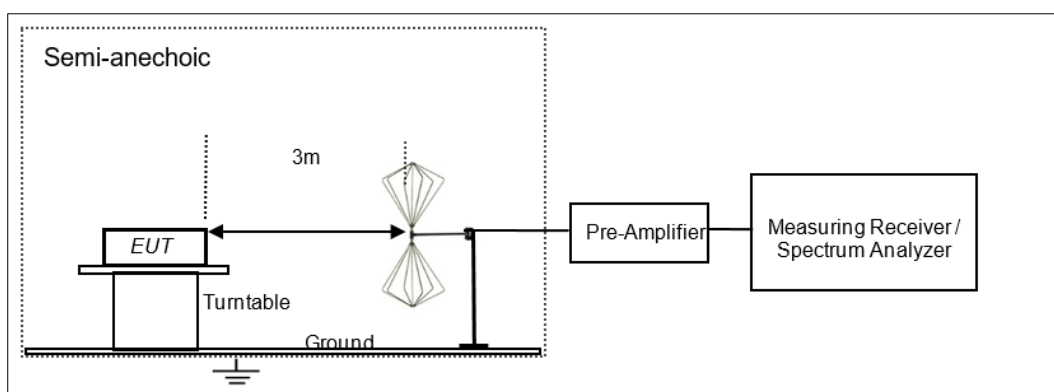


Figure 2: Frequency Range 30 MHz – 200 MHz

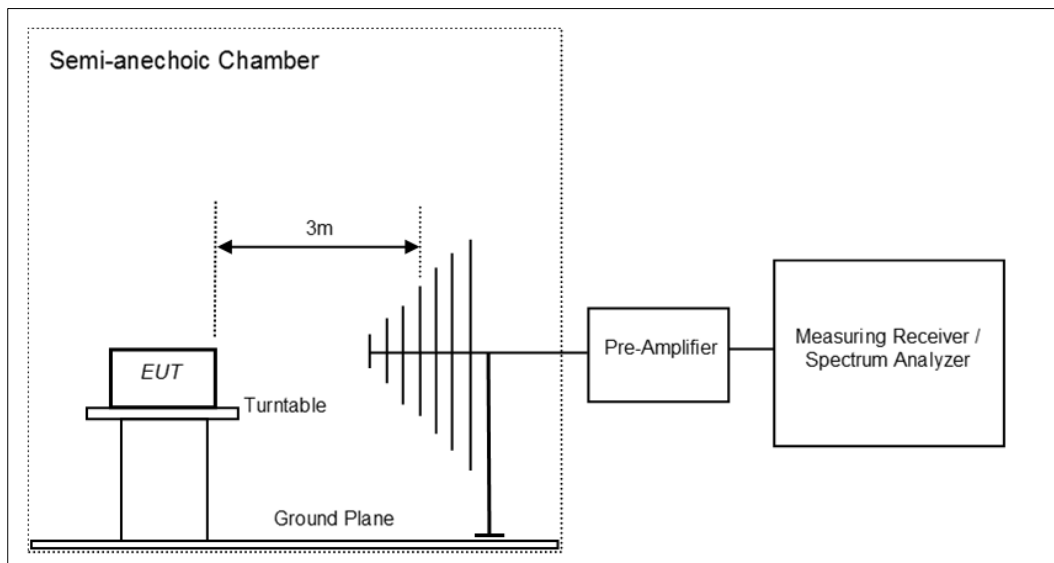


Figure 3: Frequency Range 200 MHz - 1GHz

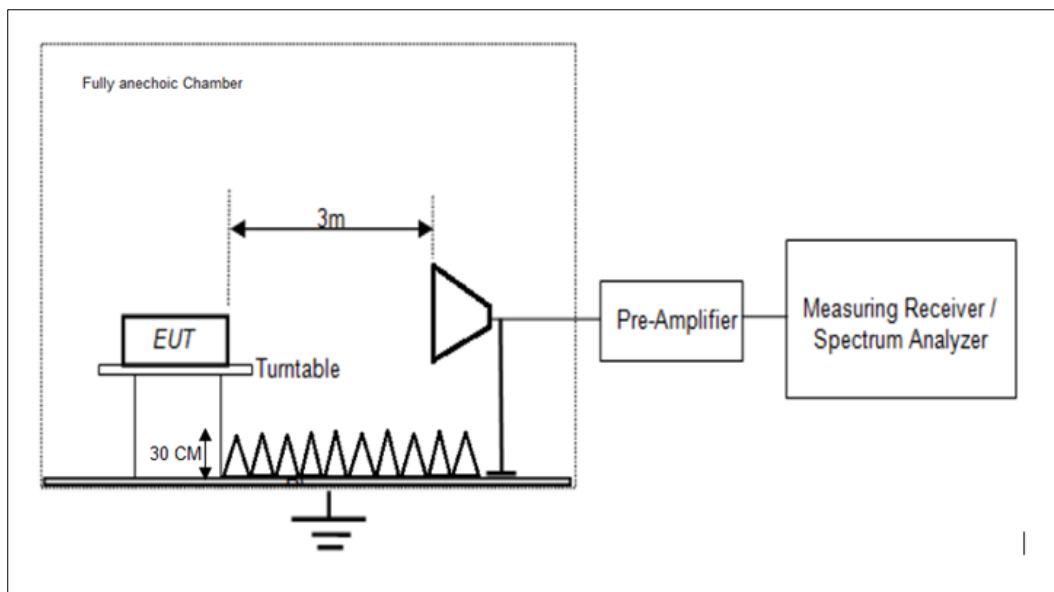


Figure 4: Frequency Range above 1 GHz

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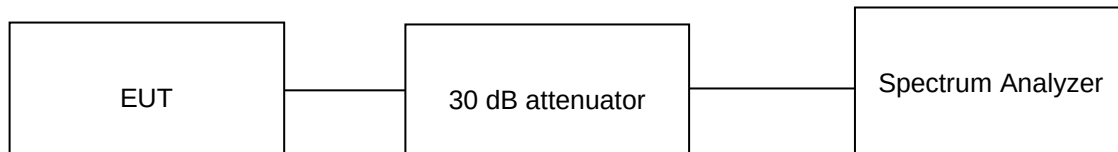
8 TEST RESULTS FOR RFID

8.1 Maximum Peak Conducted Output Power

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (b)(2) / RSS-247 issue 2 5.4 (a)
Test Method	Section 9(b) in KDB 558074 D01 15.247 Measurement Guidance v05r02 & Subclause 7.8.5 of ANSI C63.10
Measurement Bandwidth	300 kHz
Detector	Peak
Port of testing	Antenna port
Requirement	Power ≤ 1 W (30 dBm) & e.i.r.p ≤ 4 W (36dBm)



Test Condition

Normal Test Condition:

Temperature (Norm) = + 23.5 °C Voltage = 3.7VDC through DC Power supply Relative humidity: 63%

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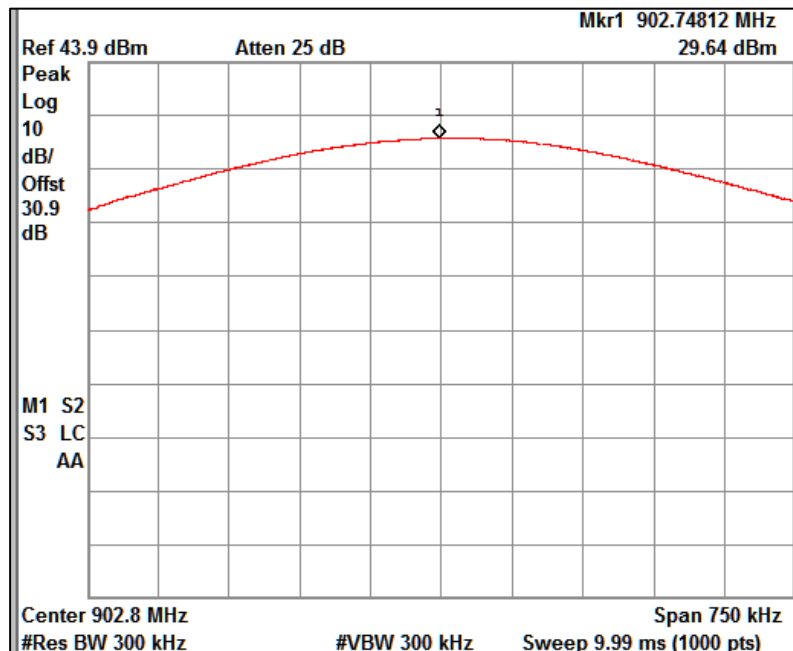
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Test results:

Note:

1. All the losses are included during measurement and final values are mentioned in the test report.
2. Total Peak Output power (dBm) = Measured Peak power (dBm) + Attenuator factor (30dB) + Cable loss (0.9dB)
3. This product do not support additional beamforming gain / directional gain, it uses signal antenna and hence directional gain of the single antenna is listed under section 3.2 of this report, only highest gain of 6 dBi is considered as worst case
4. Product do not support MIMO and co-location with multiple antenna, both antenna port are connected to single module output chain using an electronic switch, either one port and single antenna can be connected, only SISO operation supported by this module
5. Maximum (e.i.r.p) = Maximum Peak output power (dBm) + antenna gain (6 dBi)

Channel Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)	Maximum (e.i.r.p) (dBm)	Power Limit (dBm)	e.i.r.p Limit (dBm)
902.75	29.64	35.64	30	36
915.25	29.58	35.58	30	36
927.25	29.76	35.76	30	36

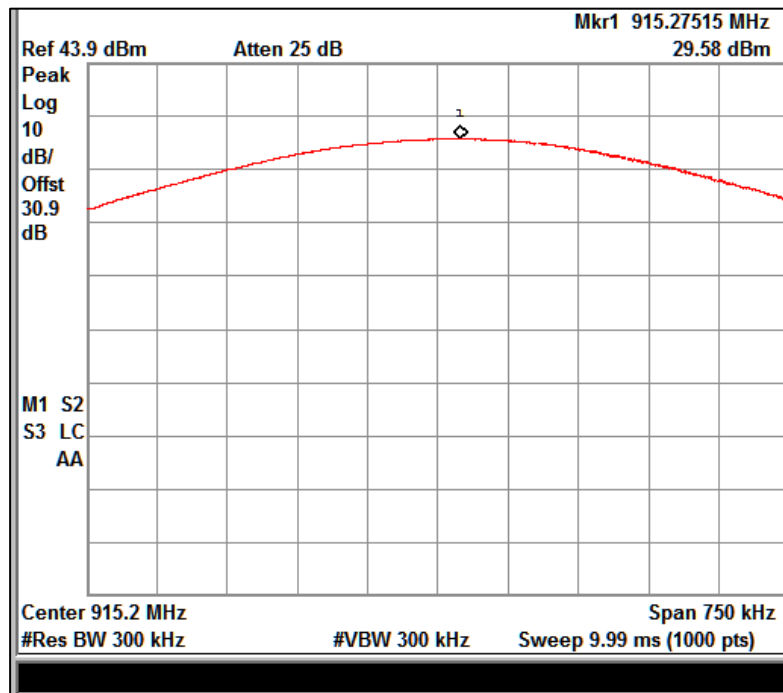


Channel Frequency:902.75MHz

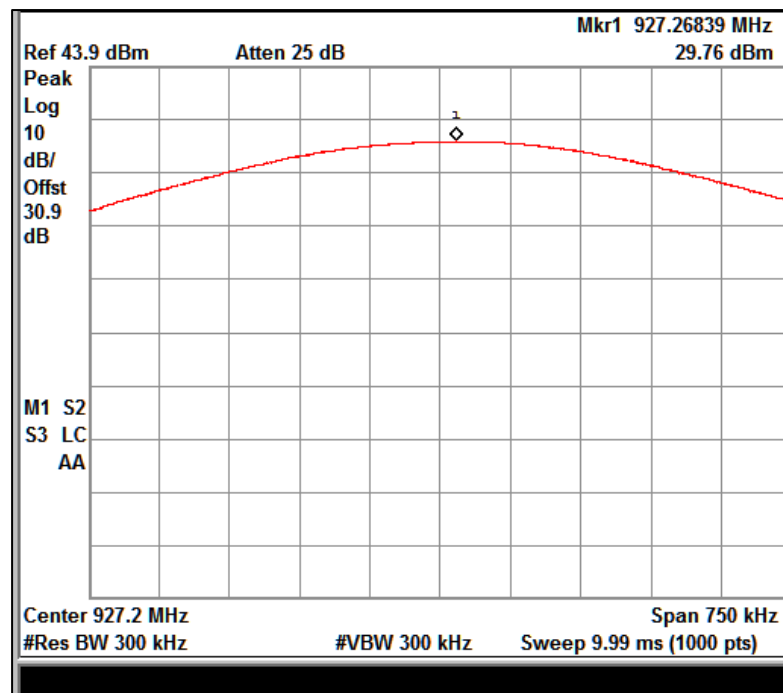
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Channel Frequency: 915.25MHz



Channel Frequency: 927.25MHz

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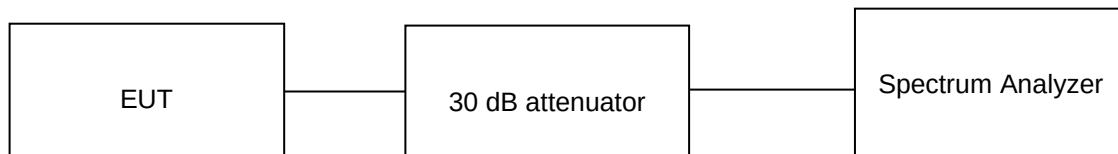
8.2 Occupied bandwidth

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (a) (1) (i) / RSS-247 issue 2 5.1 (c)
Test Method	Section 9(b) in KDB 558074 D01 15.247 Measurement Guidance v05r02 & Subclause 7.8.7 of ANSI C63.10
Measurement Bandwidth	3 kHz
Detector	Peak
Port of testing	Antenna port
Requirement	The minimum 20 dB bandwidth of the hopping channel is 250 kHz use at least 50 hopping frequencies

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 23.5 °C

Voltage = 3.7VDC through DC Power Supply

Relative humidity: 63%

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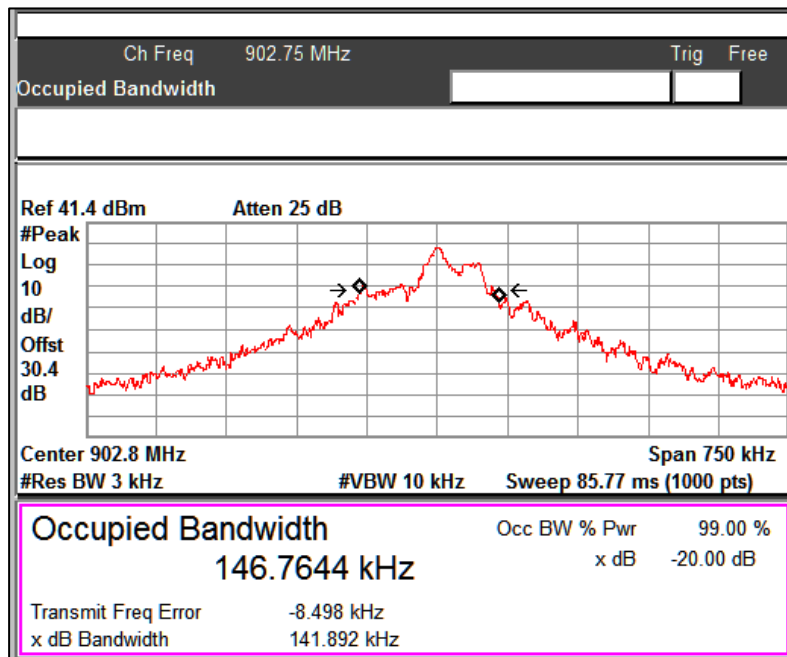
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Test results:

Note:

1. All the losses are included during measurement and final values are mentioned in the test report.
2. Total Peak Output power (dBm) = Measured Peak power (dBm) + Attenuator factor (30dB) + Cable loss (0.4dB)

Channel Frequency (MHz)	20 dB Bandwidth (kHz)	99% OBW (kHz)	Maximum Limit (kHz)
902.75	141.89	146.76	250
915.25	131.50	130.58	250
927.25	130.79	130.08	250

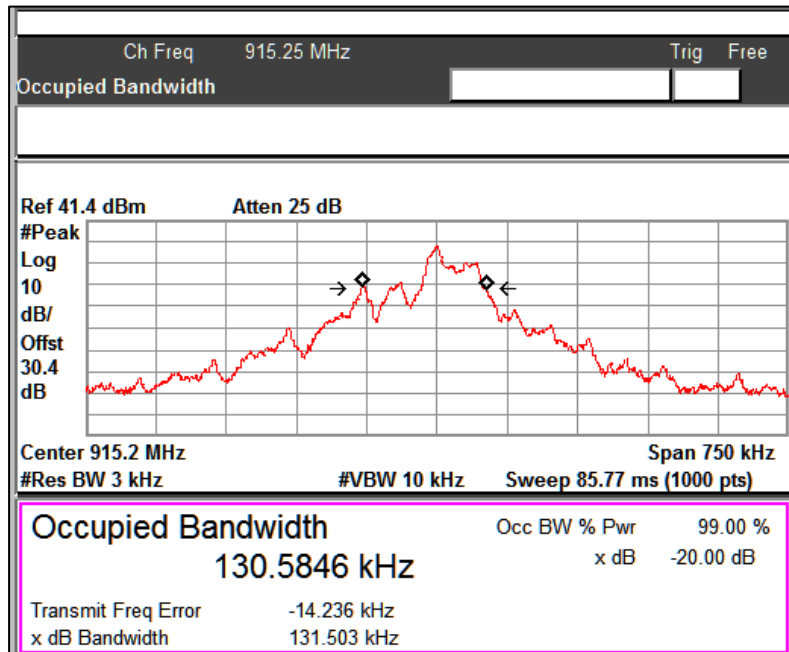


Channel Frequency: 902.75MHz

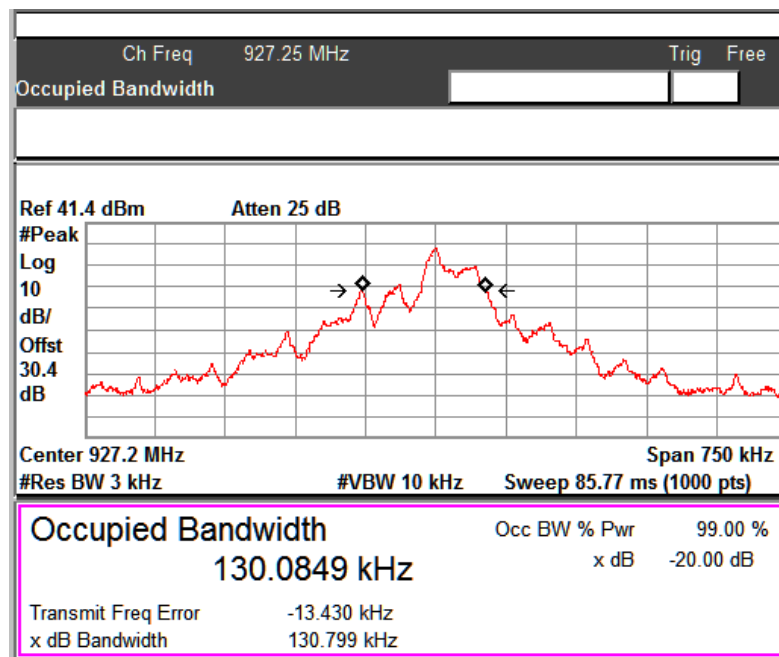
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Channel Frequency: 915.25MHz



Channel Frequency: 927.25MHz

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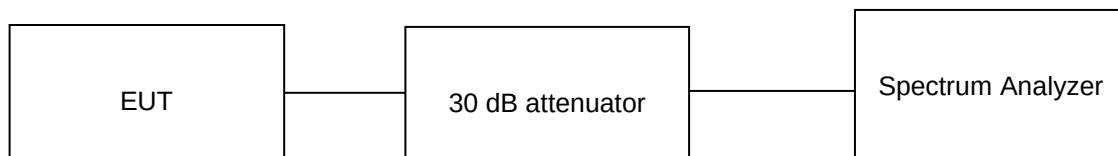
8.3 Number of Hopping Channels

Result

Pass

Test Specification	FCC Part 15 Subpart C Section 15.247 (a) (1) (i) / RSS-247 issue 2 5.1 (c)
Test Method	Section 9(b) in KDB 558074 D01 15.247 Measurement Guidance v05r02 & Subclause 7.8.3 of ANSI C63.10
Measurement Bandwidth	100 kHz *
Detector	Peak
Port of testing	Antenna port
Requirement	Frequency hopping systems operating in the band 902-928 MHz shall use at least 50 hopping channels if the minimum 20 dB bandwidth is less than 250 kHz

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 23.5 °C Voltage = 3.7V DC Through PowerSupply Relative humidity: 63%

*Note: The RBW is set to 100 kHz, which is sufficient to identify clearly the individual channels;

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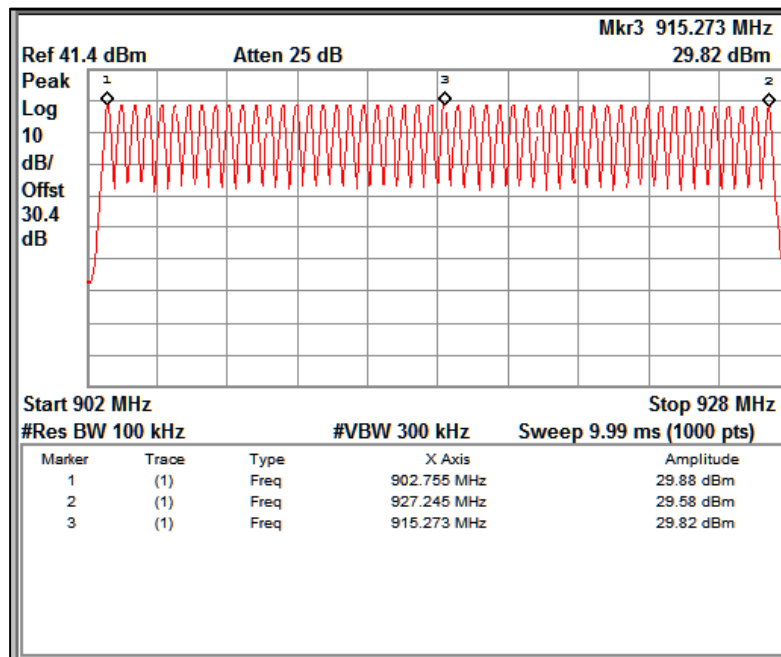
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Test results:

Note:

1. All the losses are included during measurement and final values are mentioned in the test report.
2. Total Peak Output power (dBm) = Measured Peak power (dBm) + Attenuator factor (30dB) + Cable loss (0.4dB)



No: of Hopping Frequencies:50

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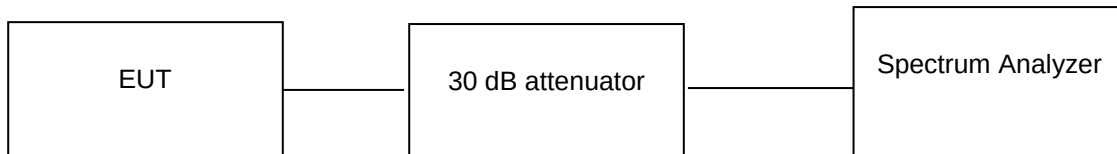
8.4 Carrier Frequency Separation

Result

Pass

Test Specification	FCC Part 15 Subpart C Section 15.247 (a) (1) / RSS-247 issue 2 5.1 (b)
Test Method	Section 9(b) in KDB 558074 D01 15.247 Measurement Guidance v05r02 & Clause 7.8.2 of ANSI C63.10
Measurement Bandwidth	100 kHz *
Detector	Peak
Port of testing	Antenna port
Requirement	Frequency hopping systems shall have hopping channel carrier frequency separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 23.5 °C Voltage = 3.7V DC through Power Supply Relative humidity: 63%

*Note: The RBW is set to 100 kHz, which is sufficient to identify the center of each individual channel;

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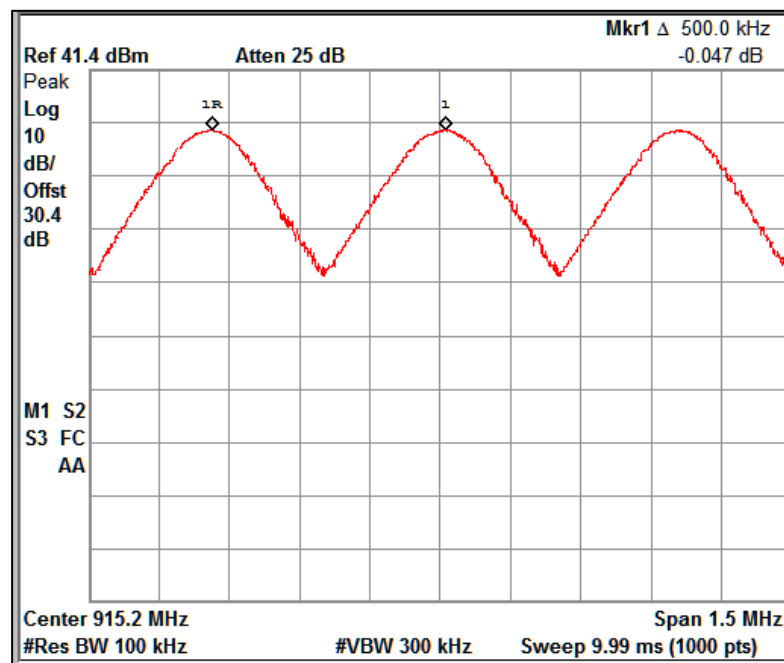
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Test results:

Note:

1. All the losses are included during measurement and final values are mentioned in the test report.
2. Total Peak Output power (dBm) = Measured Peak power (dBm) + Attenuator factor (30dB) + Cable loss (0.4dB)

Channel Frequency (MHz)	20 dB Bandwidth (kHz)	Measured Carrier Frequency separation (kHz)
902.75	141.89	500
915.25	131.50	500
927.25	130.79	500



Channel spacing

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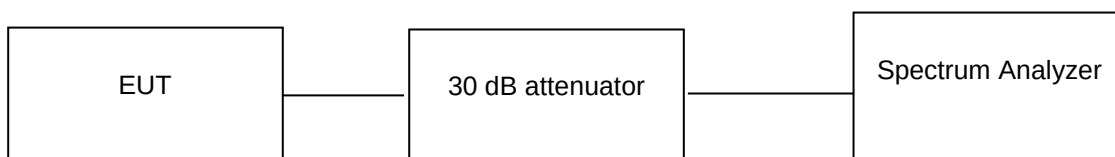
8.5 Time of Occupancy (Dwell Time)

Result

Pass

Test Specification	FCC Part 15 Subpart C Section 15.247 (a) (1) (i) / RSS-247 issue 2 5.1 (c)
Test Method	Section 9(b) in KDB 558074 D01 15.247 Measurement Guidance v05r02 & Clause 7.8.4 of ANSI C63.10
Measurement Bandwidth	100 kHz
Detector	Peak
Port of testing	Antenna port
Requirement	The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 20 seconds

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 23.5 °C

Voltage = 3.7V DC through Power Supply

Relative humidity: 63%

Test results:

Note:

- All the losses are included during measurement and final values are mentioned in the test report.
- Total Peak Output power (dBm) = Measured Peak power (dBm) + Attenuator factor (30dB) + Cable loss (0.4dB)

Frequency	Measured Dwell time for single Bin	Observation period	Measred Bins	Measured Dwell time for 27 bins	Allowed Limit	Results
915.2 MHz	0.00947 s	20.00 s	27	0.25569 s	0.40 s	Pass

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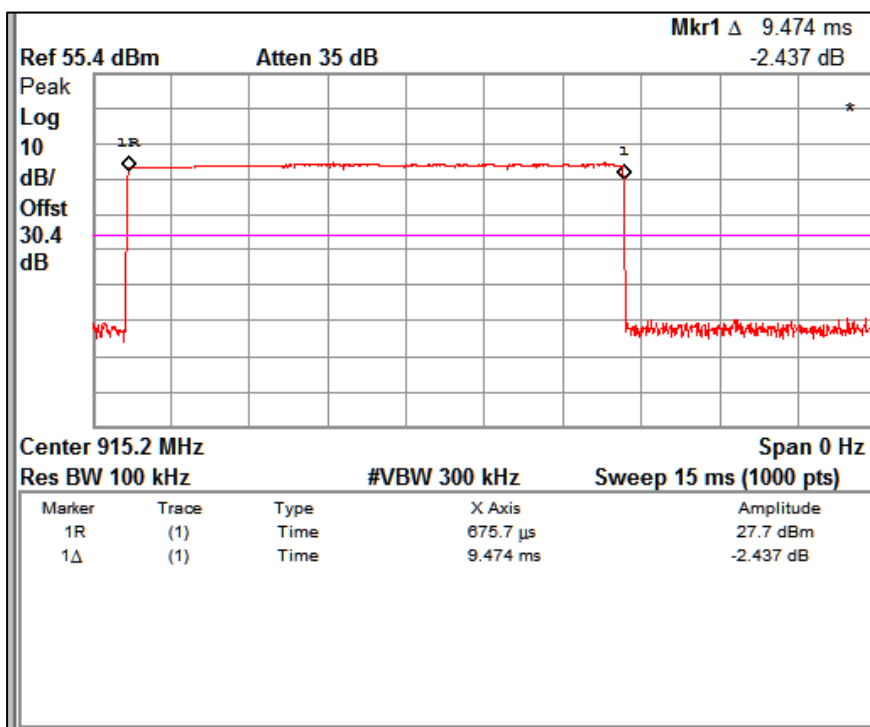
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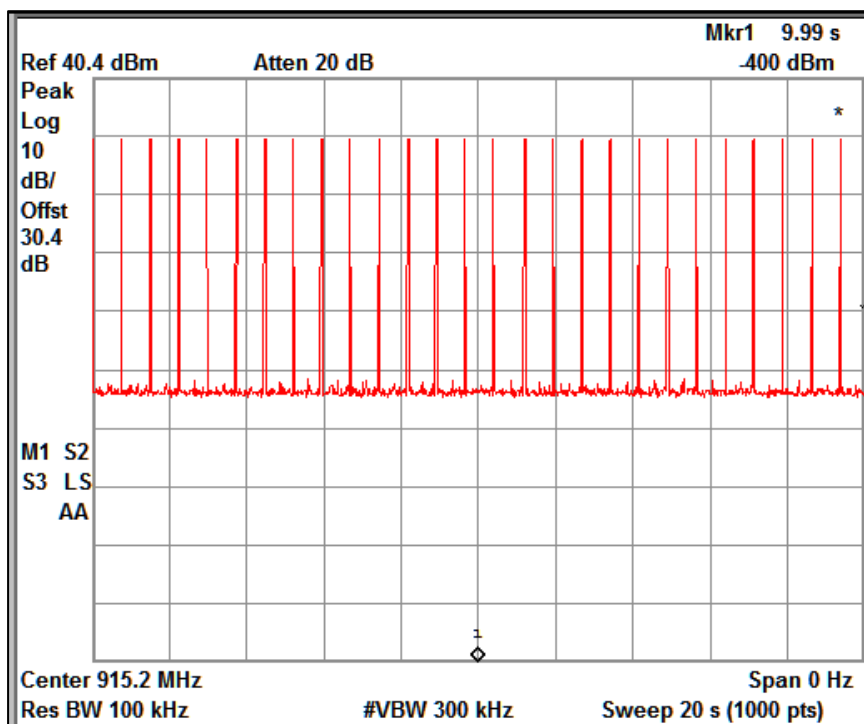
Duty Cycle measurement :

Observation period : 20s
Total ON period : 0.256 s
Measured Duty cycle : 1.28 %

*Note : Customer declared maximum duty cycle is 25 %, hence time-average power calculation used for RF exposure evaluation is considered with maximum duty cycle of 25 %.



Dwell Time – Single bin



Number of Bins in total observation period

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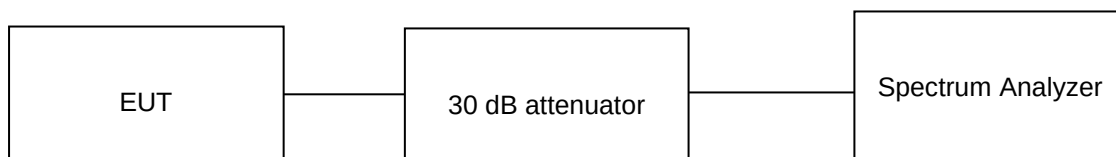
8.6 Emissions in non-restricted frequency bands and Conducted Spurious Emission

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (d) / RSS-247 issue 2 clause 5.5
Test Method	Section 9(b) in KDB 558074 D01 15.247 Measurement Guidance v05r02 & Subclause 7.8.8 of ANSI C63.10
Measurement Bandwidth	100 kHz
Detector	Peak
Port of testing	Antenna port
Requirement	In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 23.5 °C

Voltage = 3.7V DC Supply

Relative humidity: 63%

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Test results:

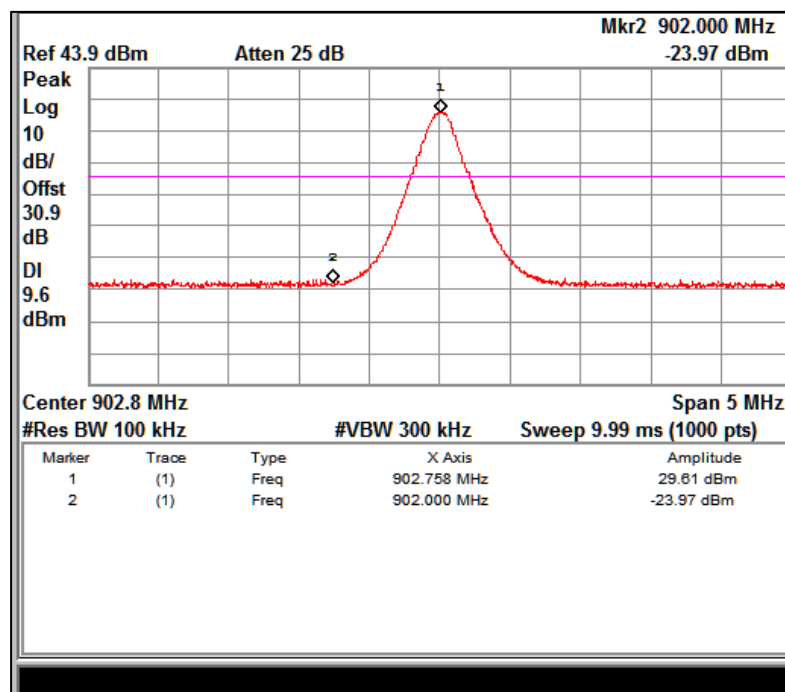
Note:

1. All the losses are included during measurement and final values are mentioned in the test report.
2. Final Value (dBm) = Measured Value (dBm) + Attenuator factor (10dB) + Cable loss (0.4dB)
3. Conducted spurious emission is performed for both Hopping mode enabled and disabled, but only worst case emission of hopping mode disabled are reported

8.6.1 Band edge and reference plots

Hopping Mode disabled:

Channel Frequency (MHz)	Reference Value (B) (dBm)	Band edge Frequency (MHz)	Value at Band edge (A) (dBm)	A-B (dBc)	Minimum Limit (dBc)
902.75	29.61	902	-23.97	-53.58	-20.00
927.25	29.75	928	-22.96	-52.71	-20.00

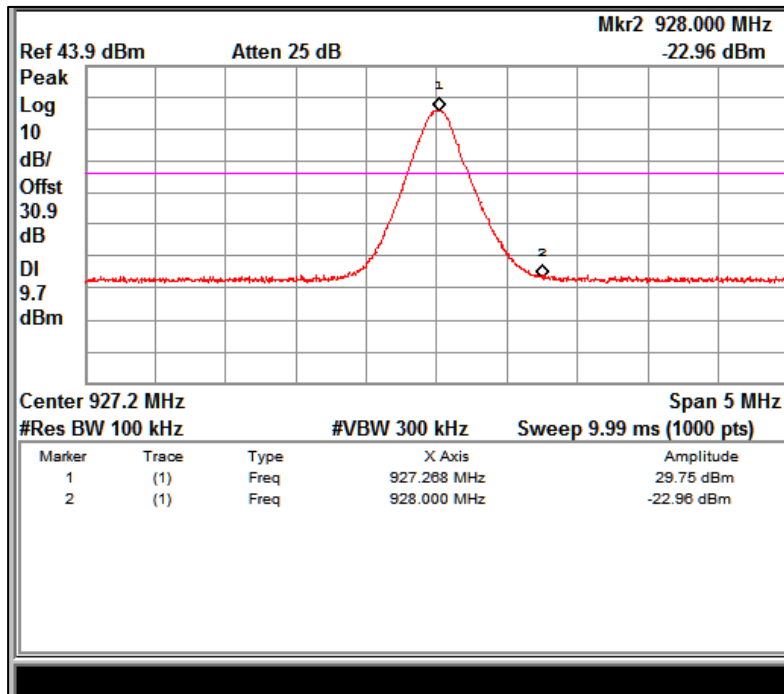


Channel Frequency 902.75MHz

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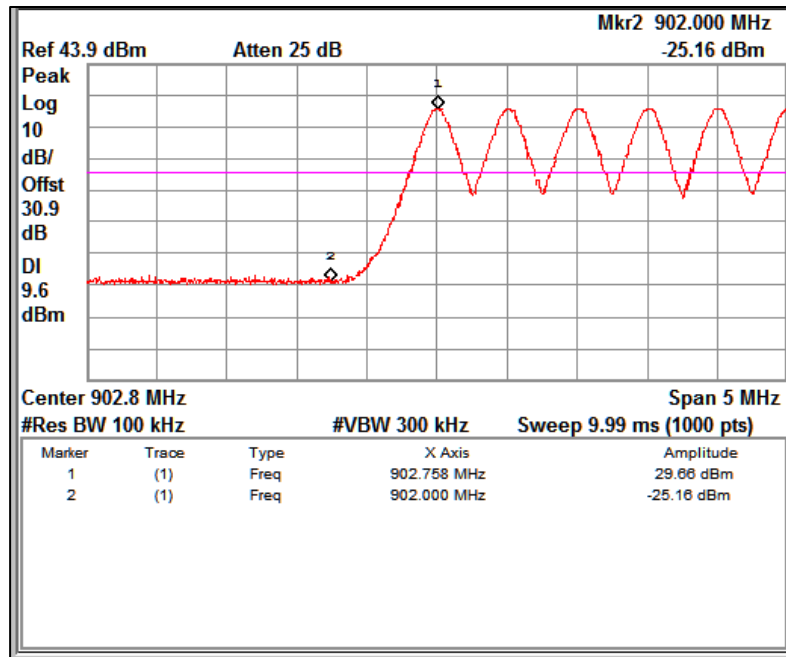
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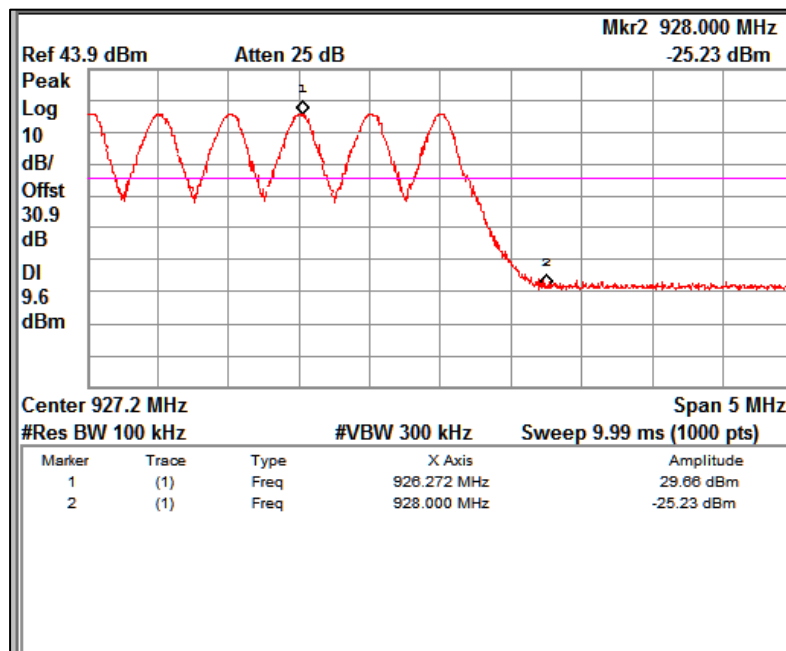
Channel Frequency 927.25MHz

Hopping Mode enabled:

Channel Frequency (MHz)	Reference Value (B) (dBm)	Band edge Frequency (MHz)	Value at Band edge (A) (dBm)	A-B (dBc)	Minimum Limit (dBc)
902.75	29.66	902	-25.16	-54.82	-20
927.25	29.66	928	-25.23	-54.89	-20



Channel Frequency 902.75MHz



Channel Frequency 927.25MHz

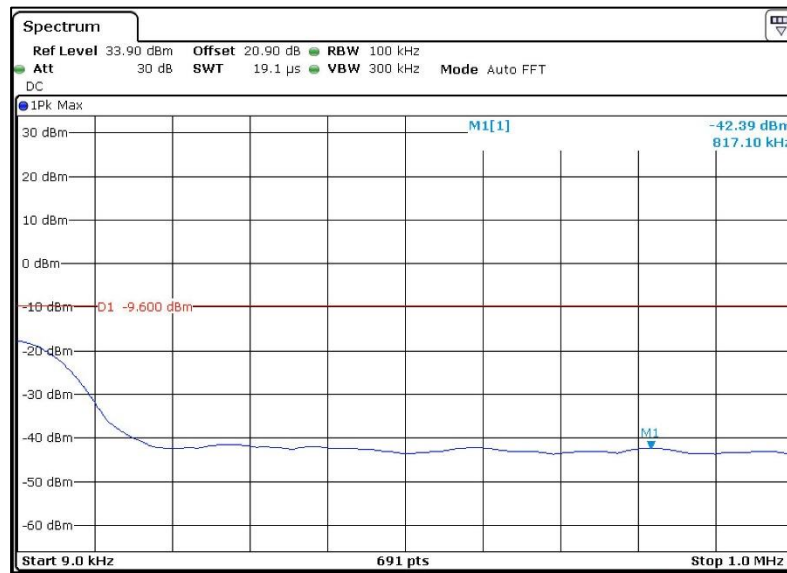
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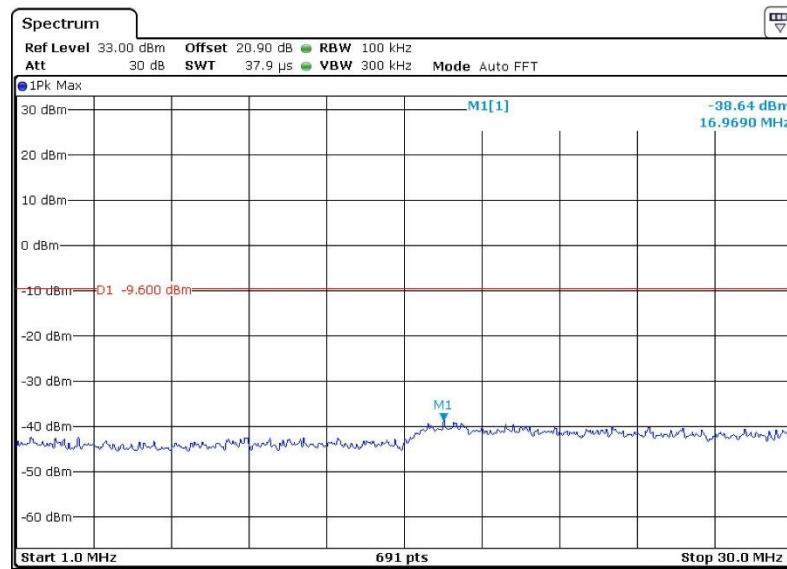
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8.6.2 Conducted Spurious Emissions

Reported only with Hopping Mode disabled



Channel Frequency: 902.75MHz Frequency range: 9k-1MHz

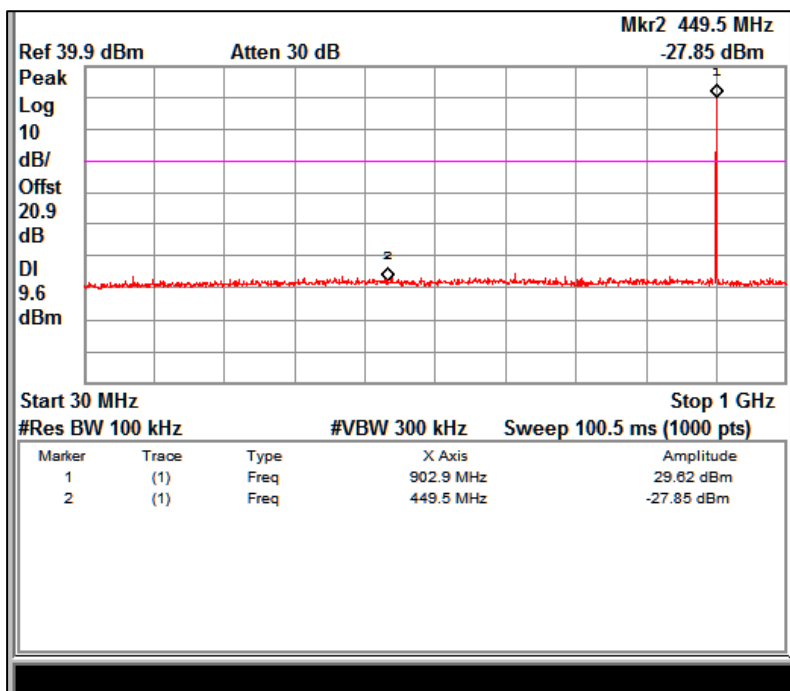


Channel Frequency: 902.75MHz Frequency range: 1MHz-30MHz

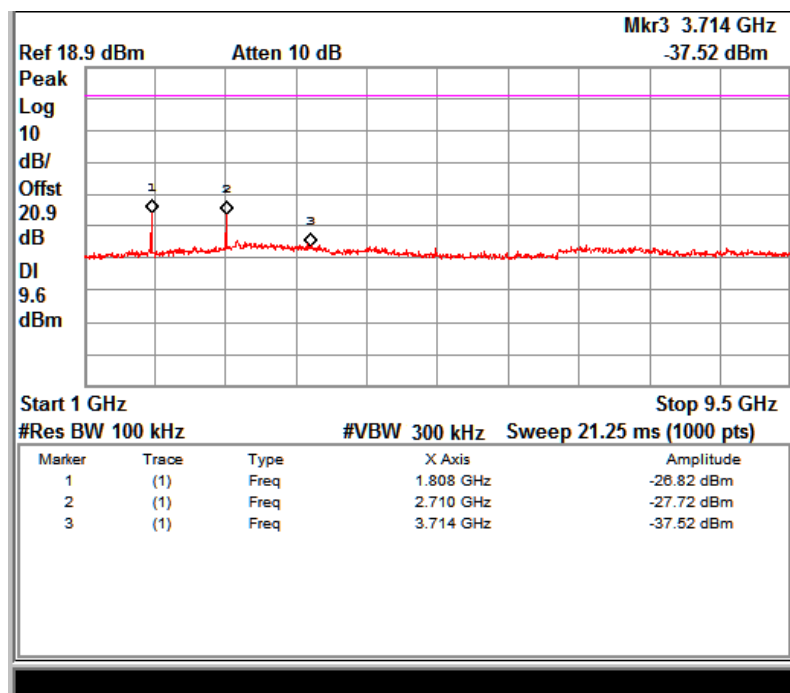
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Channel Frequency 902.75MHz Frequency Range 30MHz-1GHz



Channel Frequency 902.75MHz Frequency Range 1GHz – 9.5GHz

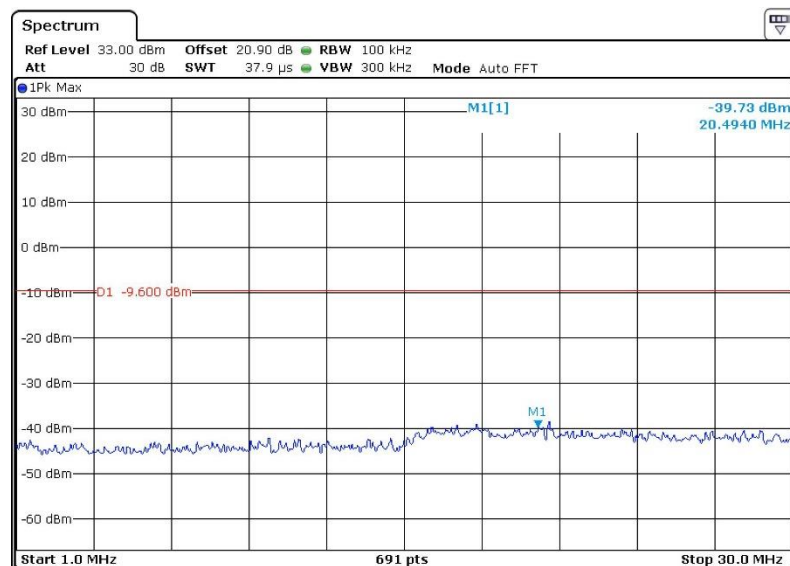
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Channel Frequency 915.25MHz Frequency Range 9kHz – 1MHz

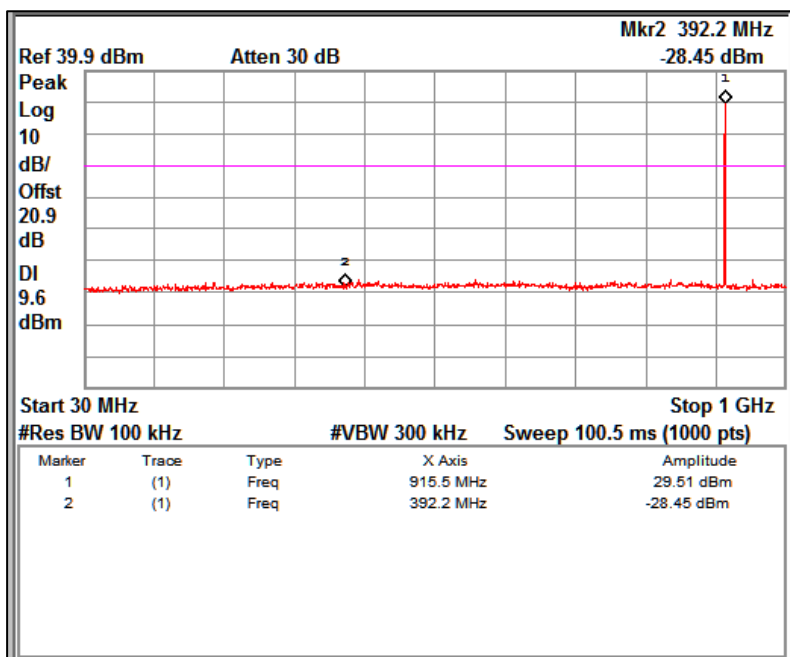


Channel Frequency 915.25MHz Frequency Range :1MHz-30MHz

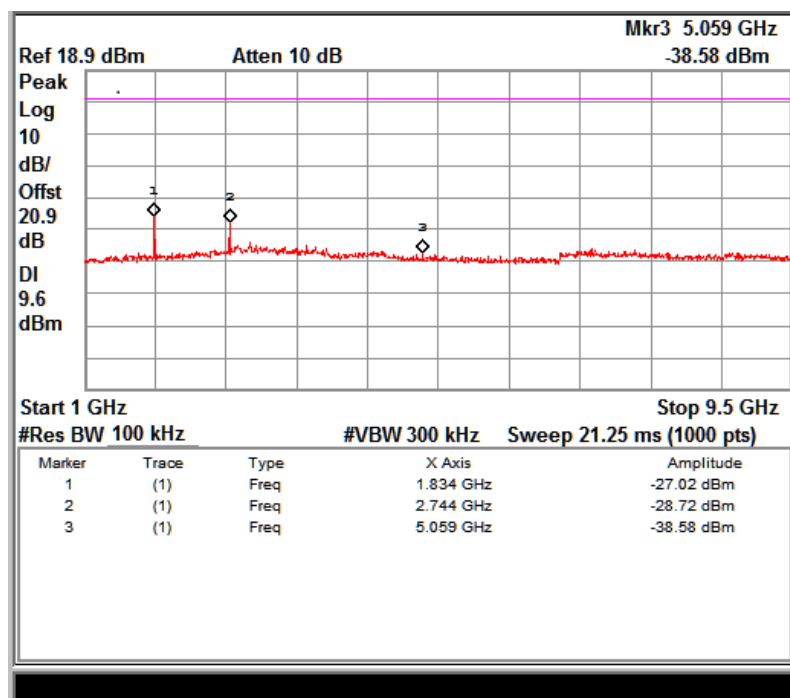
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Channel Frequency 915.25MHz Frequency Range 30MHz - 1GHz

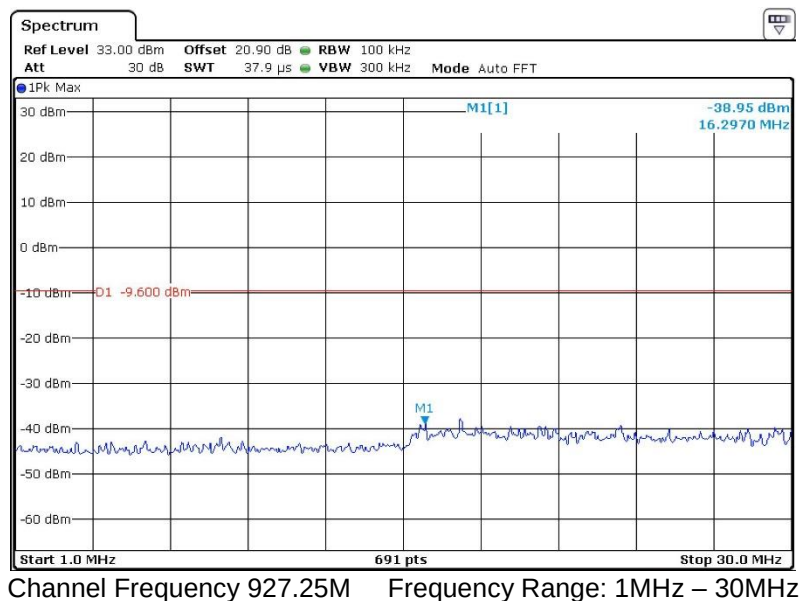
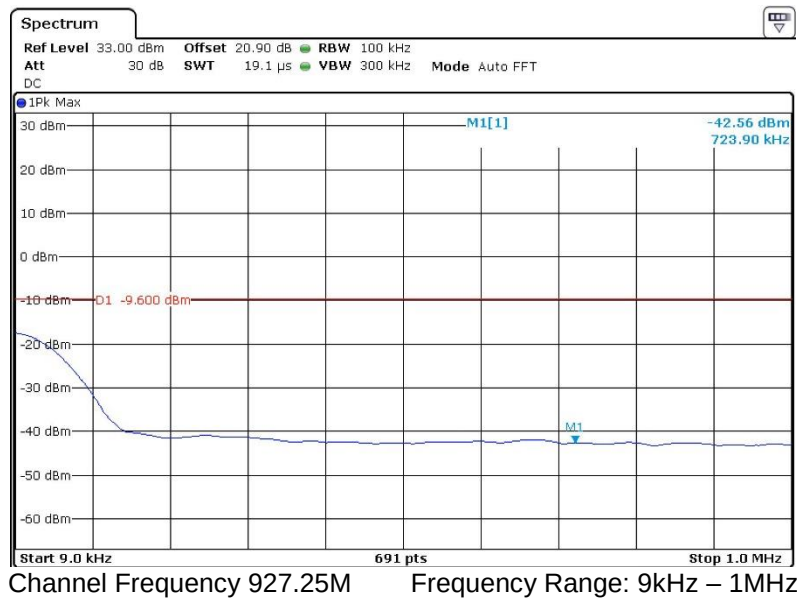


Channel Frequency 915.25MHz Frequency Range 1GHz – 9.5GHz

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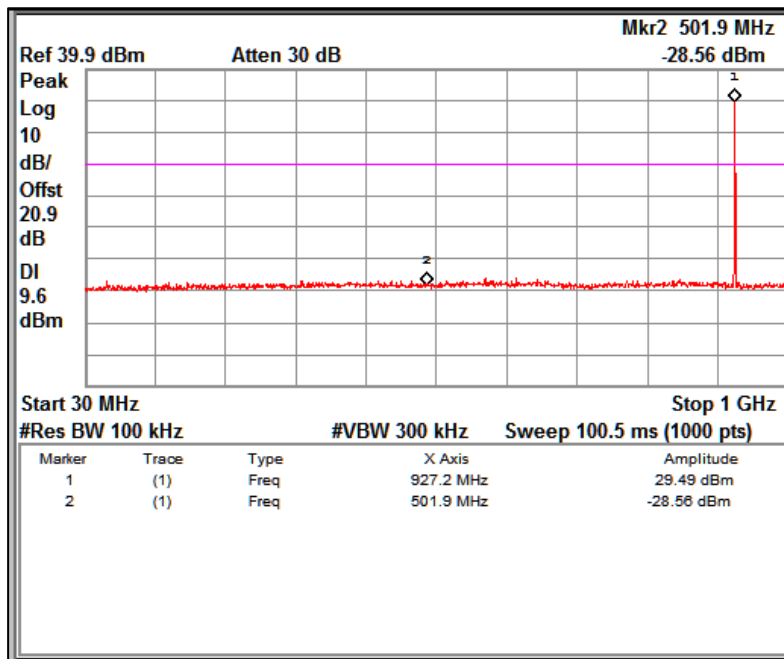
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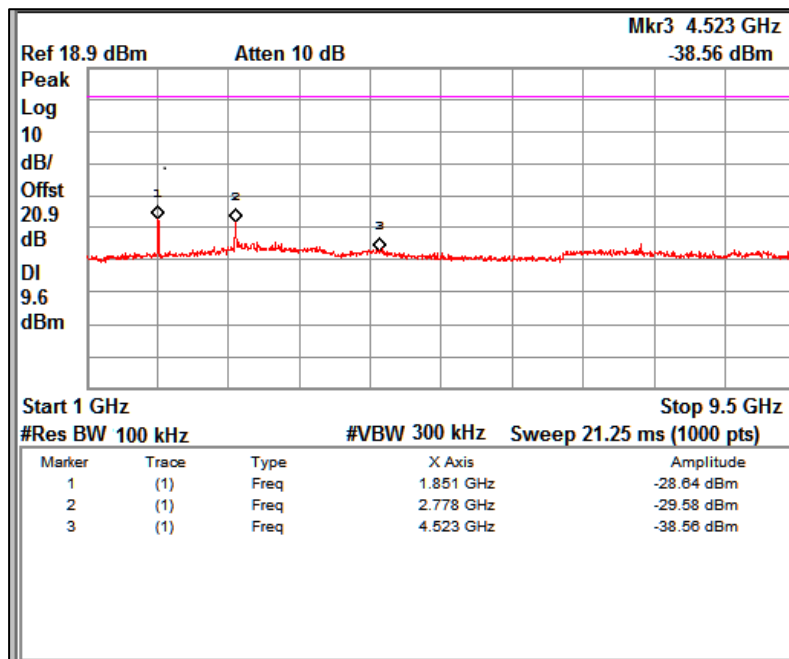
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Channel Frequency 927.25M Frequency Range 30MHz - 1GHz



Channel Frequency 927.25MHz Frequency Range 1GHz – 9.5GHz

8.7 Spurious Radiated Emissions & Restricted Bands of Operation

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (d) / (15.209 & 15.205) / RSS-GEN Clause 8.9, 8.10
Test Method	ANSI C63.10
Measurement Location	Semi Anechoic Chamber 30MHz - 1 GHz Fully Anechoic Chamber 1 GHz – 9.5GHz
Measurement Bandwidth	100 kHz for frequency range < 1GHz 1 MHz for Frequency range >1GHz
Detector	Refer remarks below *
Measuring Distance	3 m
Requirement	As per the limits mentioned in the below table
Test setup	Refer TEST METHODOLOGY

Table 6: Transmitter limits for Radiated emission

Frequency (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Distance of Measurement (m)
0.009 – 0.490	2400/F(kHz)	48.50 – 13.80	300*
0.490 – 1.705	24000/F(kHz)	33.80 – 23.00	30*
1.705 -30	30	29.54	30*
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

*Remark: The limit shows in the table above of frequency range 0.009 – 0.490, 0.490 – 1.705 MHz and 1.705-30MHz is at 300 meter, 30 meter and 30 meter range respectively, which corresponds to 128.51 – 93.80, 73.80 – 62.96 and 69.54 dBμV/m at 3m range by extrapolation calculation and the measurement of loop antenna.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector.

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Test Conditions:

Temperature (Norm) = + 23.5 °C Voltage = 3.7VDC Through PowerSupply Relative humidity: 63%

Test results:

Note: All the losses are included during measurement and final values are mentioned in the test report. Refer TEST METHODOLOGY for more details

Test results for frequency range 9kHz – 30MHz

No emissions found in frequency range 9 kHz to 30 MHz, and measured levels are below 20dB from the limit line, hence not reported

Test results for frequency range 30MHz – 200MHz

Antenna Type: Compact yagi antenna

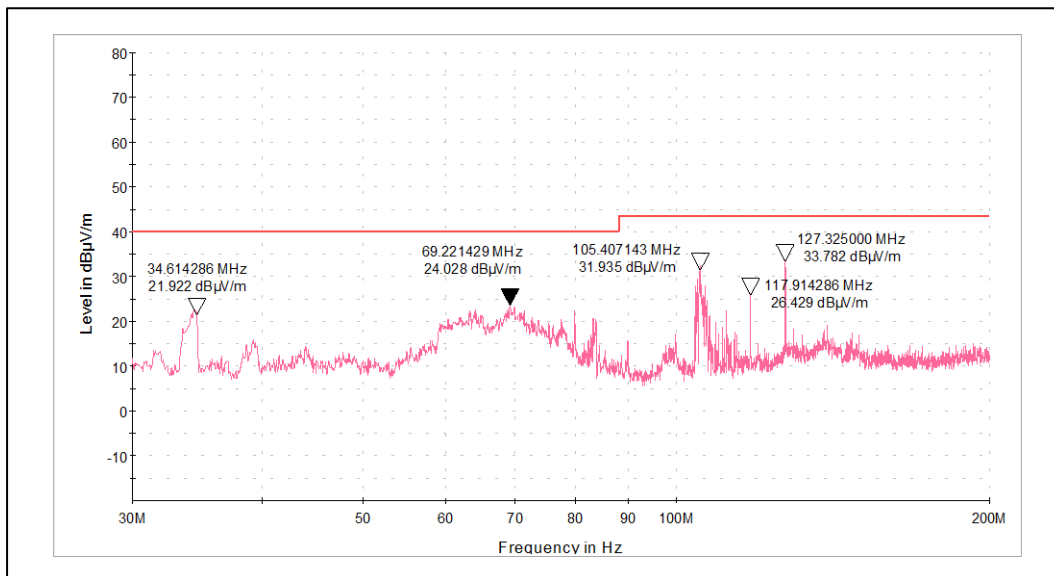
Antenna Polarization	Measured Frequency (MHz)	Measured Peak Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	34.61	21.92	40.00	-18.08
	69.22	24.02	40.00	-15.98
	105.40	31.93	43.50	-11.57
	117.91	26.42	43.50	-17.08
	127.32	33.78	43.50	-9.72
Horizontal	50.88	21.69	40.00	-18.31
	50.09	24.53	40.00	-15.47
	79.84	23.51	40.00	-16.49
	129.75	23.65	43.50	-19.85
	141.59	25.52	43.50	-17.98

Antenna Type: Microstrip antenna coupler

Antenna Polarization	Measured Frequency (MHz)	Measured Peak Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	43.47	32.47	40.00	-7.53
	84.06	29.26	40.00	-10.74
	107.94	21.60	43.50	-21.90
	168.00	20.66	43.50	-22.84
Horizontal	45.00	21.36	40.00	-18.64
	72.09	29.81	40.00	-10.19
	83.94	33.39	40.00	-6.61
	108.09	23.80	43.50	-19.70
	120.03	24.89	43.50	-18.61

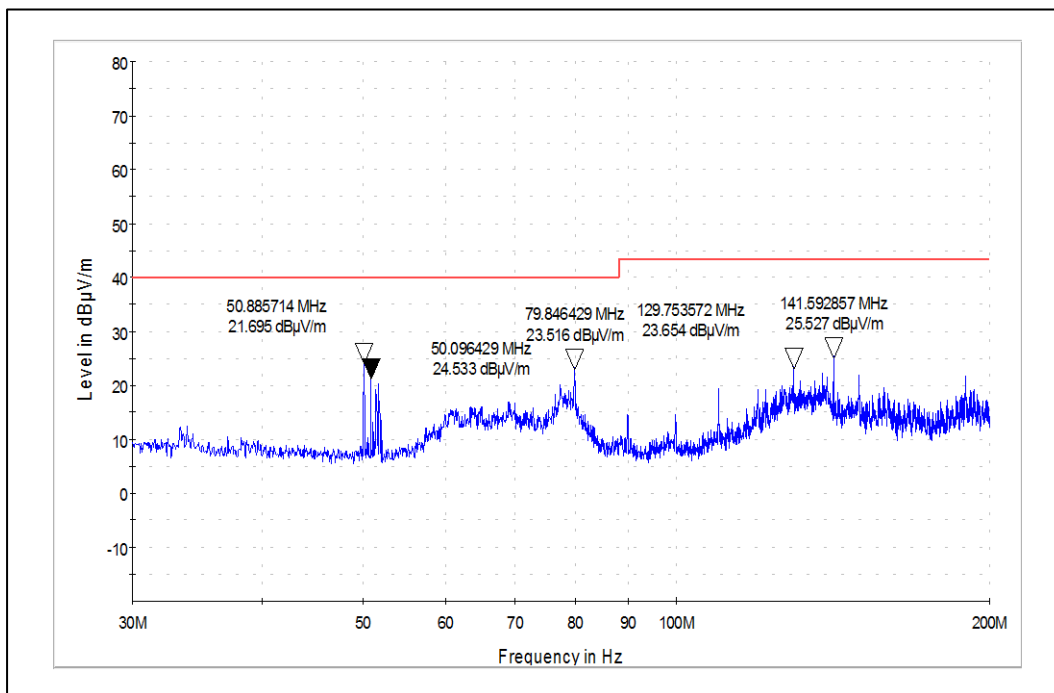
Test Plots:

Antenna Type: Compact yagi antenna



Channel Frequency 30MHz – 200MHz

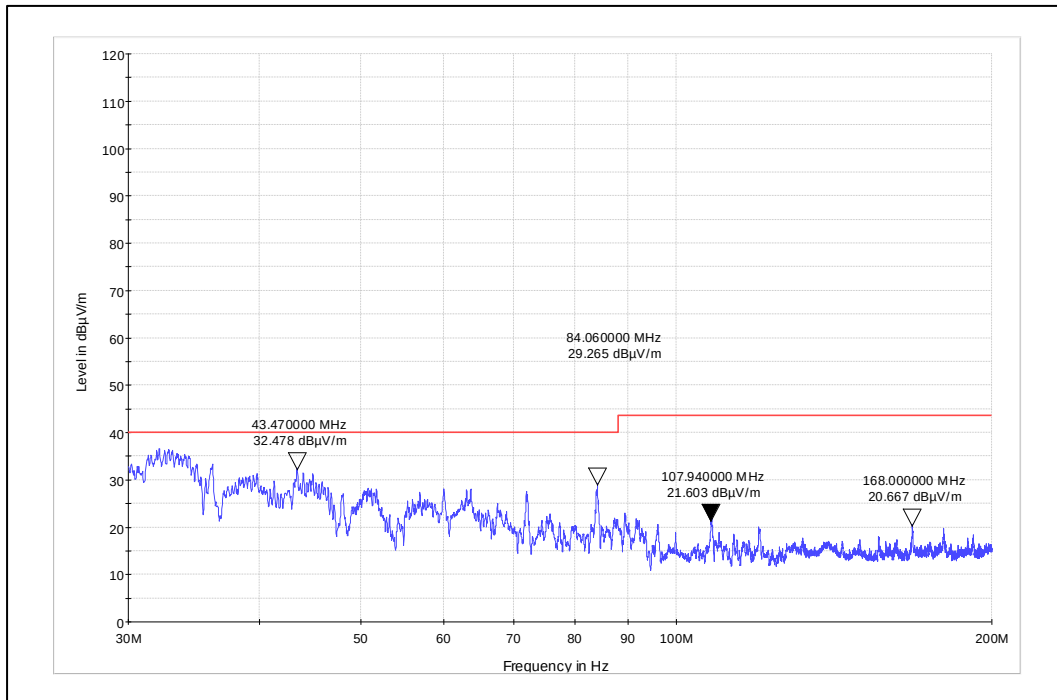
Polarization Vertical



Channel Frequency 30MHz – 200MHz

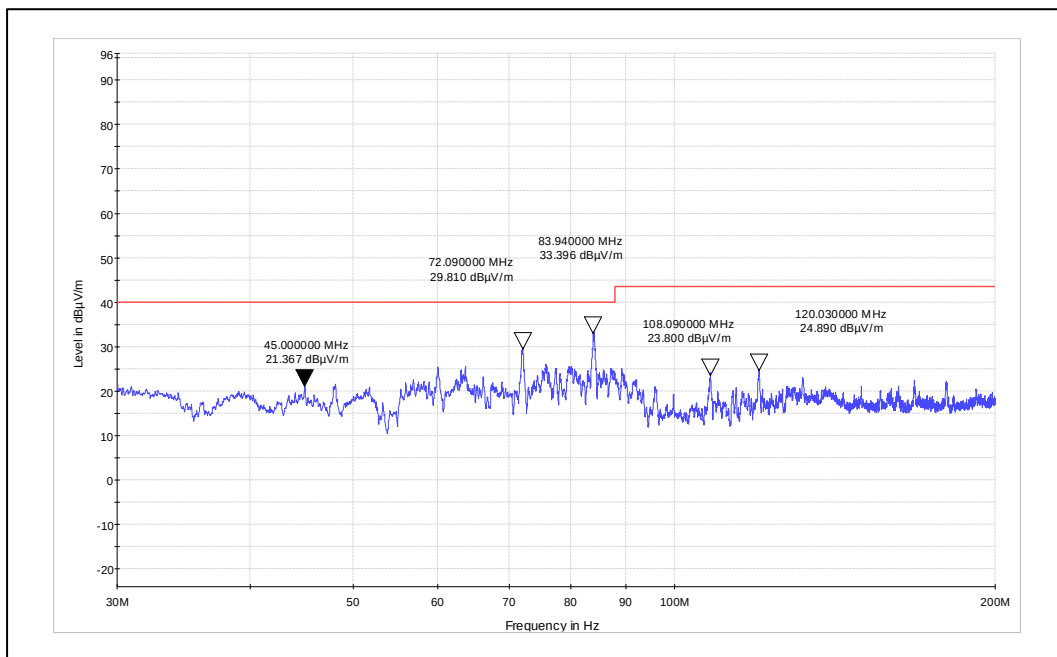
Polarization Horizontal

Antenna type: Microstrip antenna coupler



Channel Frequency 30MHz – 200MHz

Polarization Vertical



Channel Frequency 30MHz – 200MHz

Polarization Horizontal

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Test results for frequency range 200MHz – 1GHz

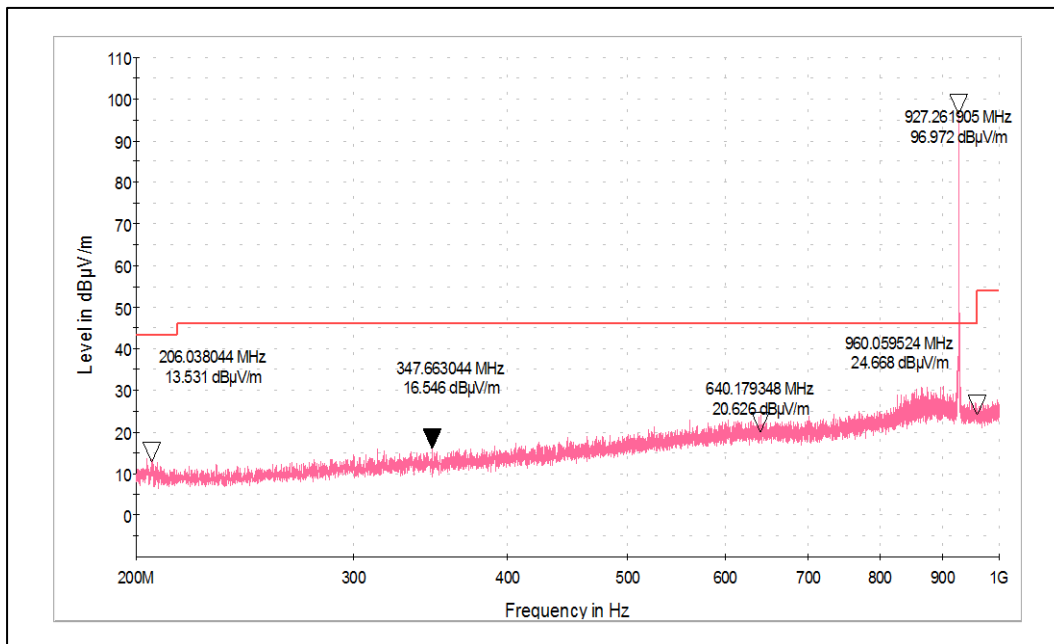
Antenna type: Compact yagi antenna

Antenna Polarization	Measured Frequency (MHz)	Measured Peak Value (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Vertical	206.03	13.53	43.50	-29.97
	347.66	16.54	46.00	-29.46
	640.17	20.62	46.00	-25.38
	960.05	24.66	54.00	-29.34
Horizontal	202.45	19.64	43.50	-23.86
	362.07	20.22	46.00	-25.78
	640.00	19.98	46.00	-26.02
	960.00	28.88	54.00	-25.12

Antenna Type: Microstrip antenna coupler

Antenna Polarization	Measured Frequency (MHz)	Measured Peak Value (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Vertical	215.99	19.92	43.50	-23.58
	262.52	23.95	46.00	-22.05
	524.93	29.62	46.00	-16.38
	788.66	69.72	46.00	23.72
Horizontal	263.99	26.76	46.00	-19.24
	461.63	27.03	46.00	-18.97
	790.85	29.24	46.00	-16.76

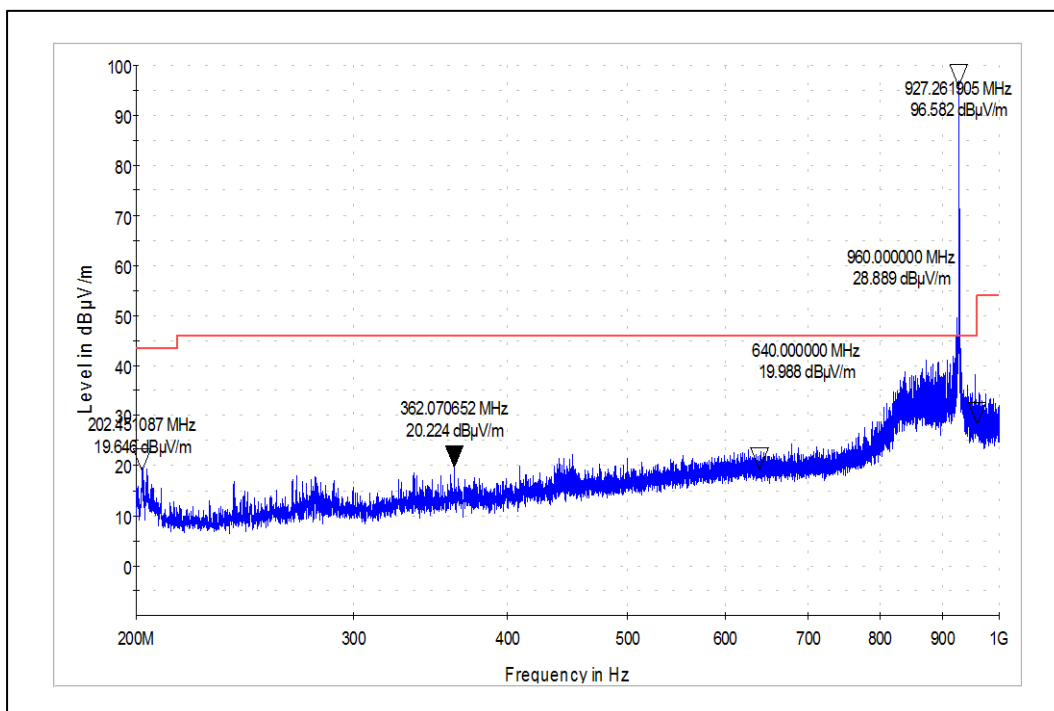
Antenna type: Compact yagi antenna



Channel Frequency 200MHz – 1GHz

Polarization Vertical

Note: radiated spurious emission outside 908 MHz – 928 MHz band is within the limit

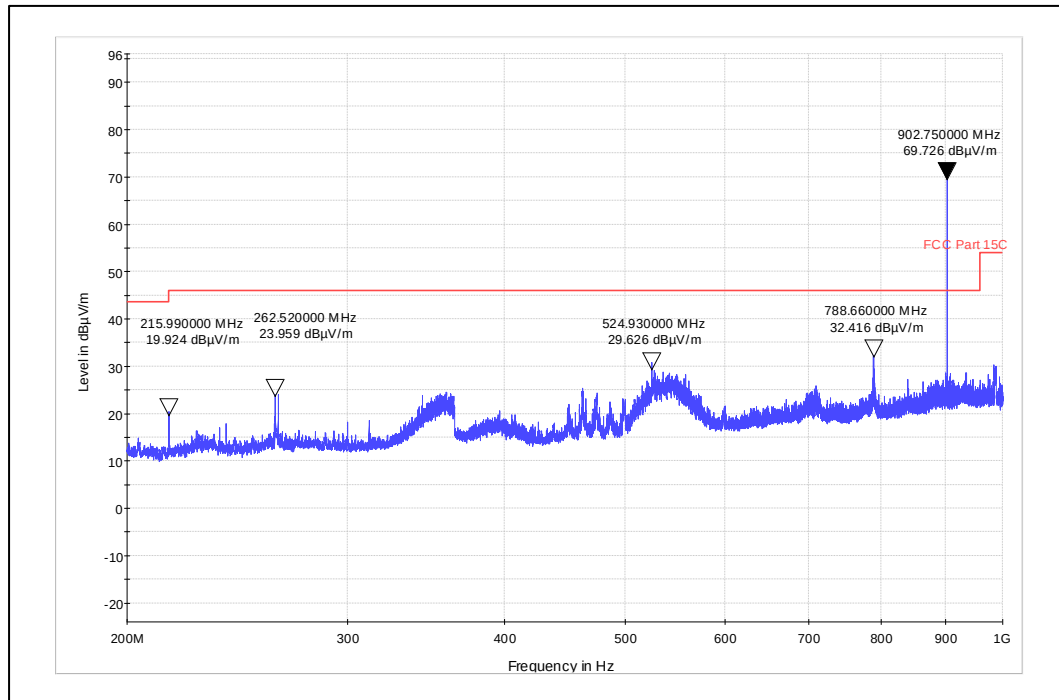


Channel Frequency 200MHz – 1GHz

Polarization Horizontal

Note: radiated spurious emission outside 908 MHz – 928 MHz band is within the limit

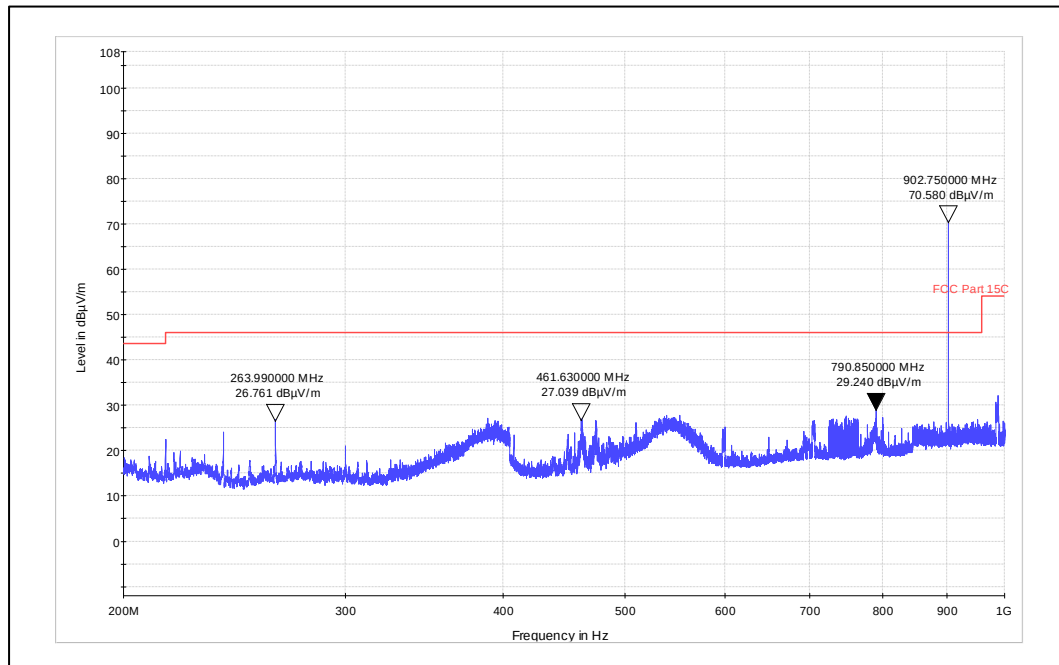
Antenna Type: Micro strip Coupler Antenna



Channel Frequency 200MHz – 1GHz

Polarization Vertical

Note: radiated spurious emission outside 908 MHz – 928 MHz band is within the limit



Channel Frequency 200MHz – 1GHz

Polarization Horizontal

Note: radiated spurious emission outside 908 MHz – 928 MHz band is within the limit

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Test results for the frequencies above 1GHz

Note :

1. Upper Frequency range of measurement is 10th harmonic of highest fundamental frequency (upto 9.5 GHz)
2. Test as performed both the antenna types refer clause 3.2 of this report, test graphs are reported for only compact yagi antenna.

Antenna Type: Compact yagi antenna

Channel Frequency (MHz)	Antenna Polarization	Measured Frequency (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
902.75	Vertical	1805.50(Pk)	44.31	74.00	-29.69
		1805.50(Av)	32.76	54.00	-21.24
		2708.25(Pk)	44.88	74.00	-29.12
		2708.25(Av)	36.42	54.00	-17.58
		3611.00(Pk)	49.29	74.00	-24.71
		3611.00(Av)	41.96	54.00	-12.04
		6319.25(Pk)	50.29	74.00	-23.71
		6319.25(Av)	41.82	54.00	-12.18
		7222.00(Pk)	55.89	74.00	-18.11
		7222.00(Av)	48.43	54.00	-5.57
		9027.50(Pk)	54.81	74.00	-19.19
		9027.50(Av)	45.15	54.00	-8.85
	Horizontal	1805.50(Pk)	45.51	74.00	-28.49
		1805.50(Av)	34.65	54.00	-19.35
		2708.25(Pk)	46.46	74.00	-27.54
		2708.25(Av)	38.79	54.00	-15.21
		3611.00(Pk)	45.41	74.00	-28.59
		3611.00(Av)	37.15	54.00	-16.85
		6319.25(Pk)	46.47	74.00	-27.53
		6319.25(Av)	35.91	54.00	-18.09
		7222.00(Pk)	51.81	74.00	-22.19
		7222.00(Av)	42.64	54.00	-11.36
		9027.50(Pk)	53.71	74.00	-20.29
		9027.50(Av)	43.47	54.00	-10.53

Pk: Peak Detector;
Av: Average Detector

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Channel Frequency (MHz)	Antenna Polarization	Measured Frequency (MHz)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
915.25	Vertical	1830.50(Pk)	50.11	74.00	-23.89
		1830.50(Av)	40.31	54.00	-13.69
		3661.00(Pk)	48.03	74.00	-25.97
		3661.00(Av)	40.59	54.00	-13.41
		4576.25(Pk)	55.42	74.00	-18.58
		4576.25(Av)	47.38	54.00	-6.62
		5491.50(Pk)	52.95	74.00	-21.05
		5491.50(Av)	45.45	54.00	-8.55
		6406.75(Pk)	47.05	74.00	-26.95
		6406.75(Av)	36.74	54.00	-17.26
		7322.00(Pk)	53.82	74.00	-20.18
		7322.00(Av)	45.16	54.00	-8.84
		9152.50(Pk)	52.55	74.00	-21.45
		9152.50(Av)	40.94	54.00	-13.06
	Horizontal	1830.50(Pk)	50.01	74.00	-23.99
		1830.50(Av)	39.6	54.00	-14.4
		2745.75(Pk)	47.68	74.00	-26.32
		2745.75(Av)	39.69	54.00	-14.31
		3661.00(Pk)	47.66	74.00	-26.34
		3661.00(Av)	35.13	54.00	-18.87
		4576.25(Pk)	55.68	74.00	-18.32
		4576.25(Av)	47.38	54.00	-6.62
		5491.50(Pk)	52.95	74.00	-21.05
		5491.50(Av)	45.45	54.00	-8.55
		6406.75(Pk)	46.03	74.00	-27.97
		6406.75(Av)	36.57	54.00	-17.43
		7322.00(Pk)	53.68	74.00	-20.32
		7322.00(Av)	45.48	54.00	-8.52
		9152.50(Pk)	53.88	74.00	-20.12
		9152.50(Av)	43.82	54.00	-10.18

Pk: Peak Detector;
Av: Average Detector

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Channel Frequency (MHz)	Antenna Polarization	Measured Frequency (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
927.25	Vertical	1854.50(Pk)	45.70	74.00	-28.30
		1854.50(Av)	37.48	54.00	-16.52
		2781.75(Pk)	48.19	74.00	-25.81
		2781.75(Av)	41.38	54.00	-12.62
		3709.00(Pk)	48.89	74.00	-25.11
		3709.00(Av)	41.47	54.00	-12.53
		4636.25(Pk)	48.86	74.00	-25.14
		4636.25(Av)	40.99	54.00	-13.01
		6487.25(Pk)	45.68	74.00	-28.32
		6487.25(Av)	35.45	54.00	-18.55
		7414.00(Pk)	54.69	74.00	-19.31
		7414.00(Av)	46.67	54.00	-7.33
		9267.25(Pk)	54.36	74.00	-19.64
		9267.25(Av)	43.93	54.00	-10.07
	Horizontal	1854.50(Pk)	46.01	74.00	-27.99
		1845.50(Av)	37.45	54.00	-16.55
		2781.75(Pk)	47.07	74.00	-26.93
		2781.75(Av)	40.12	54.00	-13.88
		3709.00(Pk)	46.54	74.00	-27.46
		3709.00(Av)	38.72	54.00	-15.28
		7418.00(Pk)	54.59	74.00	-19.41
		7418.00(Av)	46.40	54.00	-7.60
		9267.75(Pk)	53.87	74.00	-20.13
		9267.75(Av)	43.16	54.00	-10.84

Pk: Peak Detector;
Av: Average Detector

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Antenna type: Microstrip antenna coupler

Channel Frequency (MHz)	Antenna Polarization	Measured Frequency (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
902.75	Vertical	1805.5(Pk)	40.99	74.00	-33.01
		1805.5(Av)	35.61	54.00	-18.39
		2708.25(Pk)	51.12	74.00	-22.88
		2708.25(Av)	47.33	54.00	-6.67
		3611.00(Pk)	46.30	74.00	-27.70
		3611.00(Av)	39.84	54.00	-14.16
		4513.75(Pk)	46.18	74.00	-27.82
		4513.75(Av)	37.11	54.00	-16.89
		5416.5(Pk)	48.46	74.00	-25.54
		5416.5(Av)	41.57	54.00	-12.43
		6319.25(Pk)	52.45	74.00	-21.55
		6319.25(Av)	46.68	54.00	-7.32
		7222.00(Pk)	56.24	74.00	-17.76
		7222.00(Av)	50.31	54.00	-3.69
		8124.75(Pk)	53.95	74.00	-20.05
		8124.75(Av)	46.79	54.00	-7.21
		9027.50(Pk)	54.68	74.00	-19.32
		9027.50(Av)	47.13	54.00	-6.87
	Horizontal	1805.5(Pk)	45.14	74.00	-28.86
		1805.5(Av)	39.63	54.00	-14.37
		2708.25(Pk)	48.23	74.00	-25.77
		2708.25(Av)	43.84	54.00	-10.16
		3611(Pk)	45.12	74.00	-28.88
		3611(Av)	39.07	54.00	-14.93
		5416.5(Pk)	48.24	74.00	-25.76
		5416.5(Av)	41.75	54.00	-12.25
		6319.25(Pk)	49.12	74.00	-24.88
		6319.25(Av)	42.21	54.00	-11.79
		7222(Pk)	50.33	74.00	-23.67
		7222(Av)	40.35	54.00	-13.65
		8124.75(Pk)	52.89	74.00	-21.11
		8124.75(Av)	44.79	54.00	-9.21
		9027.50(Pk)	53.48	74.00	-20.52
		9027.50(Av)	45.58	54.00	-8.42

Pk: Peak Detector;
Av: Average Detector

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Channel Frequency (MHz)	Antenna Polarization	Measured Frequency (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
915.25	Vertical	1830.5(Pk)	38.19	74.00	-35.81
		1830.5(Av)	30.24	54.00	-23.76
		2745.75(Pk)	45.77	74.00	-28.23
		2745.75(Av)	40.92	54.00	-13.08
		3661(Pk)	44.07	74.00	-29.93
		3661(Av)	36.20	54.00	-17.80
		4576.25(Pk)	45.84	74.00	-28.16
		4576.25(Av)	38.22	54.00	-15.78
		5491.5(Pk)	45.96	74.00	-28.04
		5491.5(Av)	38.27	54.00	-15.73
		6406.75(Pk)	52.67	74.00	-21.33
		6406.75(Av)	47.20	54.00	-6.80
		7322(Pk)	57.60	74.00	-16.40
		7322(Av)	52.31	54.00	-1.69
		8237.25(Pk)	52.09	74.00	-21.91
		8237.25(Av)	43.20	54.00	-10.80
		9152.5(Pk)	54.67	74.00	-19.33
		9152.5(Av)	47.21	54.00	-6.79
	Horizontal	1830.5(Pk)	44.83	74.00	-29.17
		1830.5(Av)	40.03	54.00	-13.97
		2745.75(Pk)	50.44	74.00	-23.56
		2745.75(Av)	46.66	54.00	-7.34
		3661(Pk)	46.11	74.00	-27.89
		3661(Av)	37.95	54.00	-16.05
		4576.25(Pk)	45.47	74.00	-28.53
		4576.25(Av)	35.87	54.00	-18.13
		5491.5(Pk)	44.55	74.00	-29.45
		5491.5(Av)	35.21	54.00	-18.79
		6406.75(Pk)	48.10	74.00	-25.90
		6406.75(Av)	41.61	54.00	-12.39
		7322(Pk)	51.59	74.00	-22.41
		7322(Av)	44.22	54.00	-9.78
		8237.25(Pk)	50.73	74.00	-23.27
		8237.25(Av)	40.78	54.00	-13.22
		9152.5(Pk)	53.68	74.00	-20.32
		9152.5(Av)	46.46	54.00	-7.54

Pk: Peak Detector;
Av: Average Detector

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Channel Frequency (MHz)	Antenna Polarization	Measured Frequency (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
927.25	Vertical	1854.5(Pk)	39.11	74.00	-34.89
		1854.5(Av)	31.79	54.00	-22.21
		2781.75(Pk)	53.45	74.00	-20.55
		2781.75(Av)	49.83	54.00	-4.17
		3709(Pk)	43.98	74.00	-30.02
		3709(Av)	37.59	54.00	-16.41
		4636.25(Pk)	48.42	74.00	-25.58
		4636.25(Av)	42.23	54.00	-11.77
		5563.5(Pk)	48.25	74.00	-25.75
		5563.5(Av)	42.01	54.00	-11.99
		6490.75(Pk)	52.92	74.00	-21.08
		6490.75(Av)	47.27	54.00	-6.73
		7418(Pk)	55.89	74.00	-18.11
		7418(Av)	50.69	54.00	-3.31
		8345.25(Pk)	52.39	74.00	-21.61
		8345.25(Av)	44.77	54.00	-9.23
		9272.5(Pk)	55.61	74.00	-18.39
		9272.5(Av)	48.09	54.00	-5.91
	Horizontal	1854.5(Pk)	42.97	74.00	-31.03
		1854.5(Av)	38.81	54.00	-15.19
		2781.75(Pk)	51.32	74.00	-22.68
		2781.75(Av)	47.48	54.00	-6.52
		3709(Pk)	44.04	74.00	-29.96
		3709(Av)	37.40	54.00	-16.60
		4636.25(Pk)	45.58	74.00	-28.42
		4636.25(Av)	37.13	54.00	-16.87
		5563.5(Pk)	44.58	74.00	-29.42
		5563.5(Av)	35.61	54.00	-18.39
		6490.75(Pk)	49.40	74.00	-24.60
		6490.75(Av)	42.72	54.00	-11.28
		7418(Pk)	50.91	74.00	-23.09
		7418(Av)	42.58	54.00	-11.42
		8345.25(Pk)	51.40	74.00	-22.60
		8345.25(Av)	43.63	54.00	-10.37
		9272.5(Pk)	52.70	74.00	-21.30
		9272.5(Av)	44.34	54.00	-9.66

Pk: Peak Detector;
Av: Average Detector

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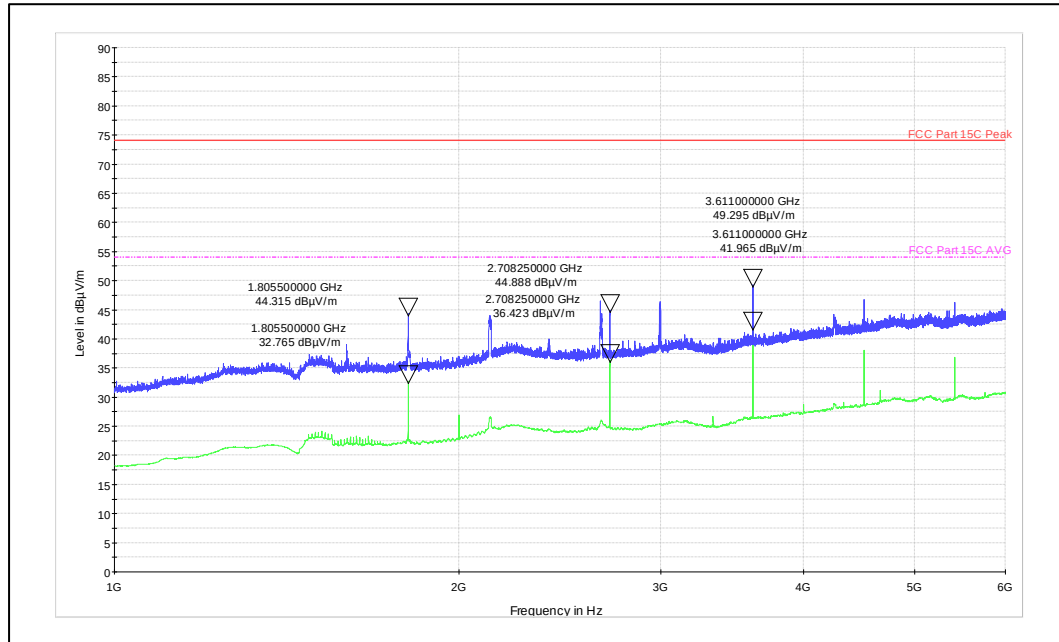
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Worst case Test Plots

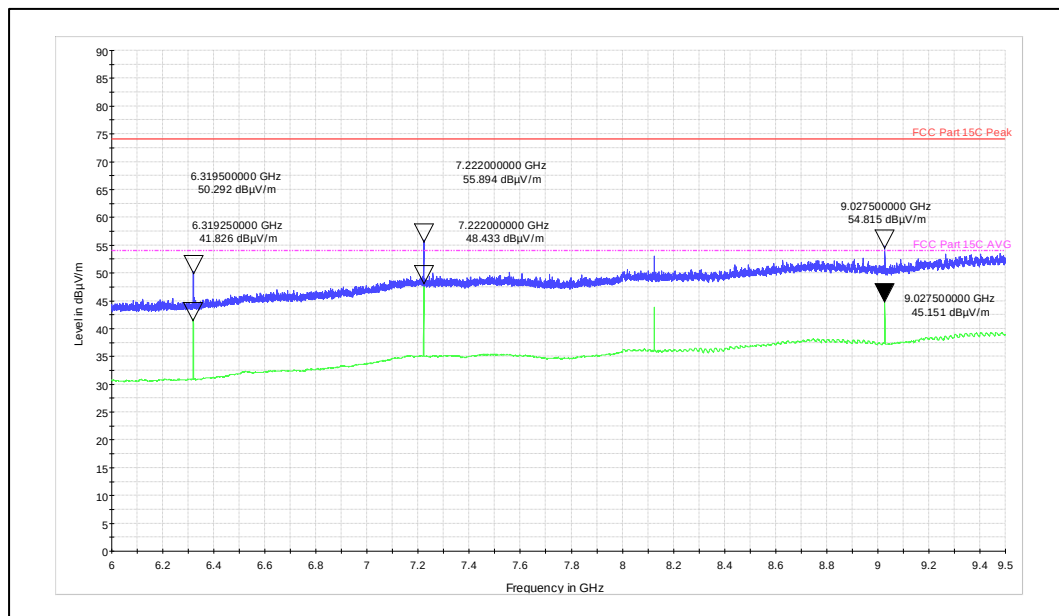
Antenna type: Compact yagi antenna

Channel Frequency 902.75MHz



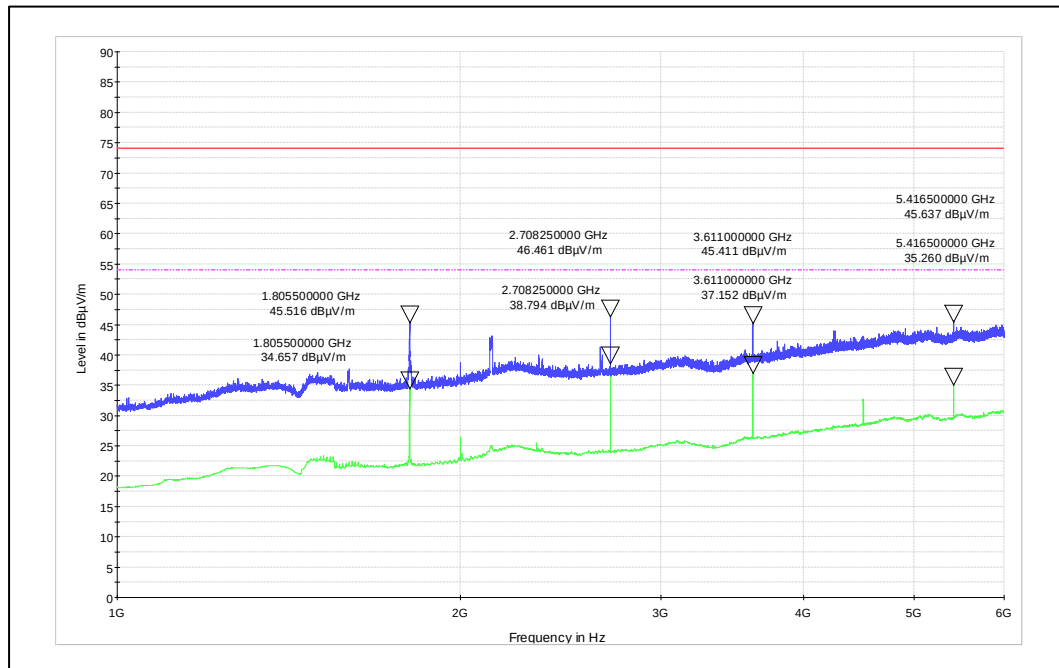
Channel Frequency: 1GHz – 6GHz

Polarization: Vertical



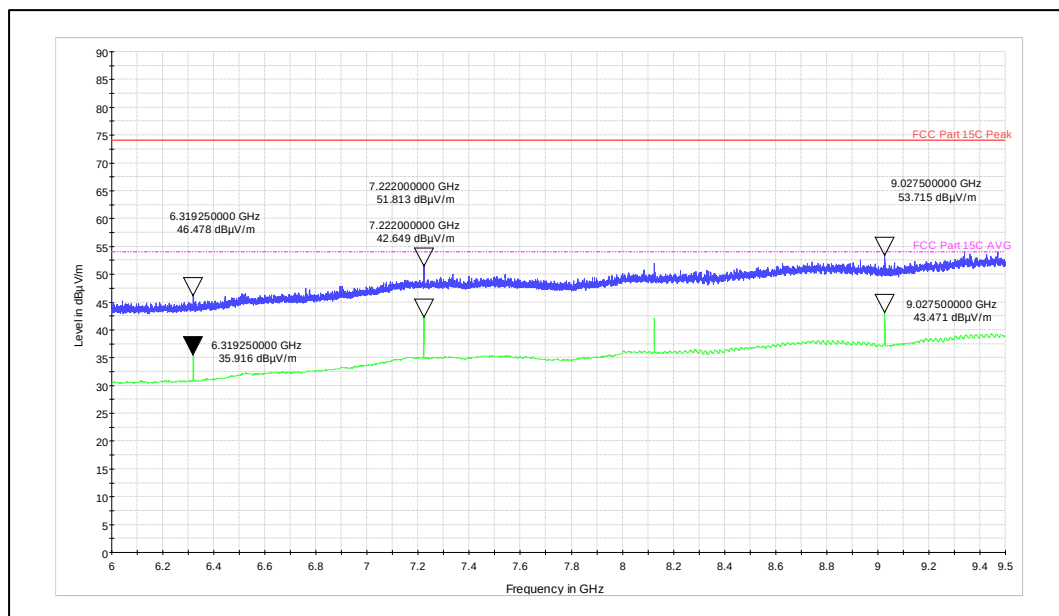
Channel Frequency: 6GHz – 9.5GHz

Polarization: Vertical



Channel Frequency: 1GHz -6GHz

Polarization: Horizontal

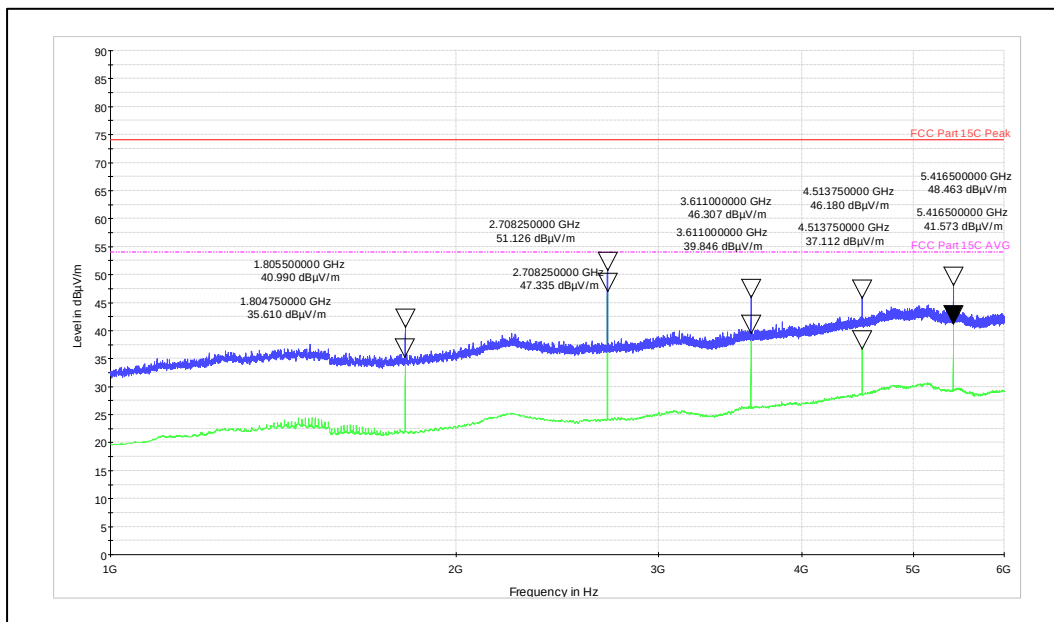


Channel Frequency: 6GHz -9.5GHz

Polarization: Horizontal

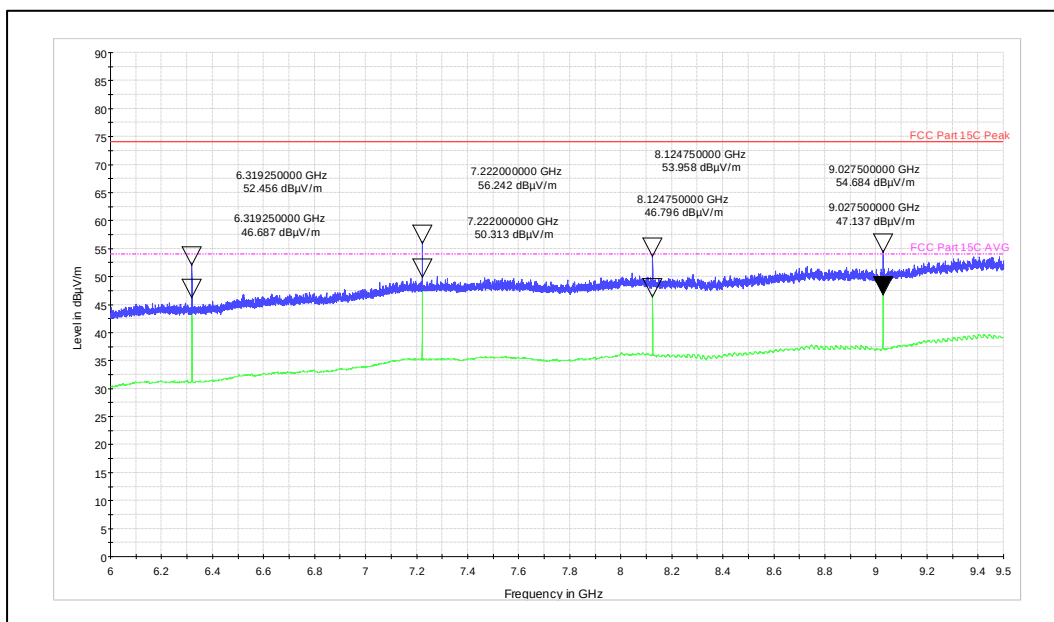
Antenna type: Microstrip antenna coupler

Channel Frequency 902.75MHz



Channel Frequency: 1GHz – 6GHz

Polarization: Vertical



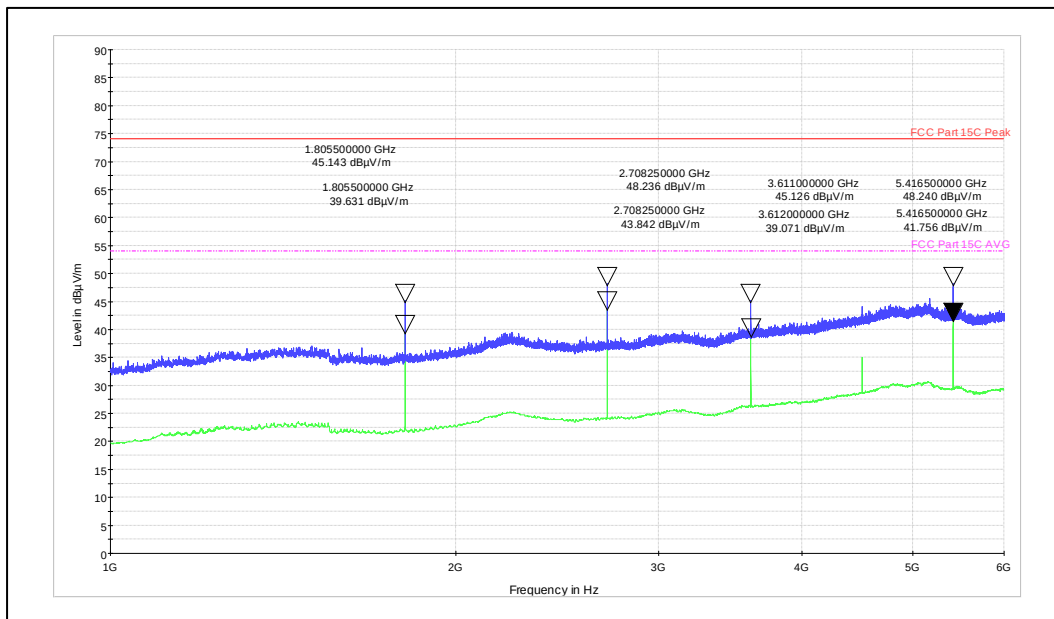
Channel Frequency: 6GHz – 9.5GHz

Polarization: Vertical

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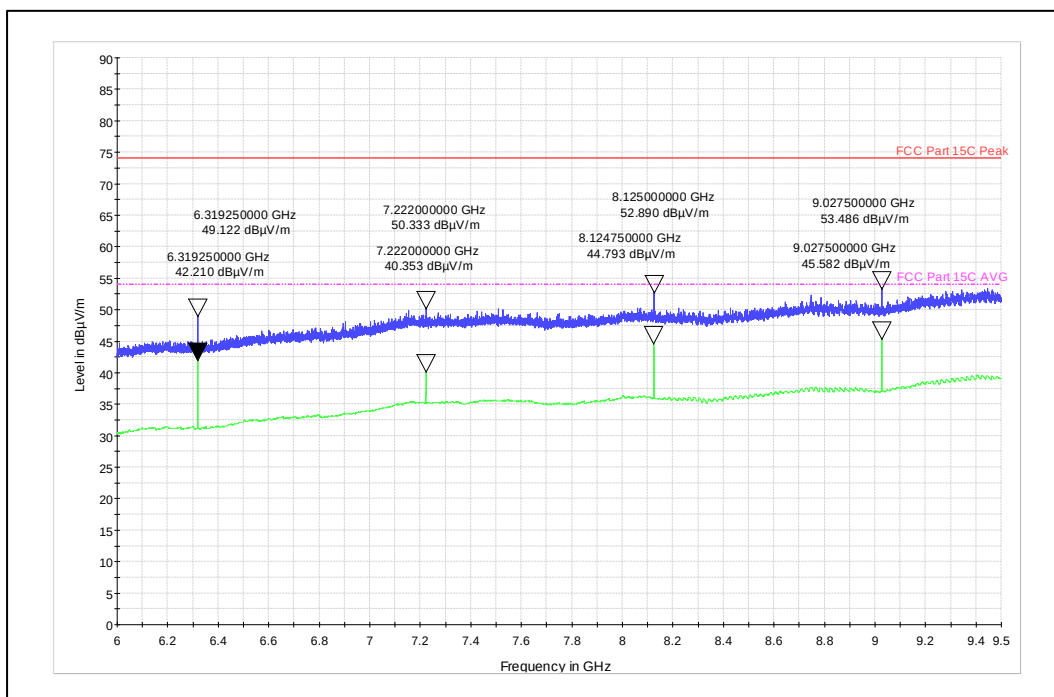
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Channel Frequency: 1GHz -6GHz

Polarization: Horizontal



Channel Frequency: 6GHz -9.5GHz

Polarization: Horizontal

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8.8 Conducted Spurious Emission Test on AC Power Line

Result

Pass

Test Specification : FCC Part 15 Section 15.207 / RSS Gen Issue 5 Section 8.8
Test Method : ANSI C 63.10-2013
Testing Location : Screened room
Measurement Bandwidth : 9kHz
Frequency Range : 150kHz – 30MHz
Supply Voltage : 110VAC,60Hz
Test Method : Refer TEST METHODOLOGY

***Note: The product has tested with AC to DC adapter and Wireless Qi charger**

Table 7: Limits for Conducted poweline emission

Frequency of emission (MHz)	QP Limit (dBμV)	AV Limit (dBμV/m)
0.15 – 0.5	66 – 56*	56 – 46*
0.5 – 5	56	46
5 – 30	60	50

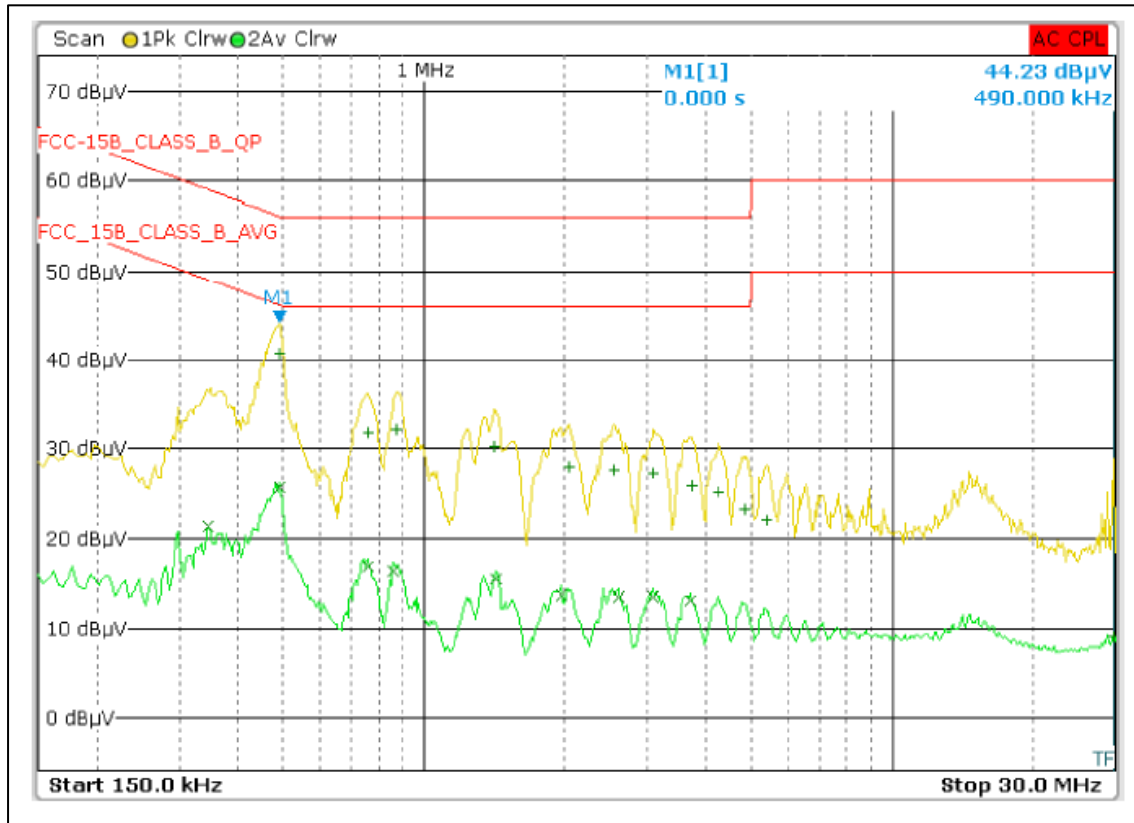
* Decreases with the logarithm of the frequency

Test Conditions:

Temperature (Norm) = +24 °C Voltage = 110V AC (Through AC to DC Adapter) Relative humidity: 64%

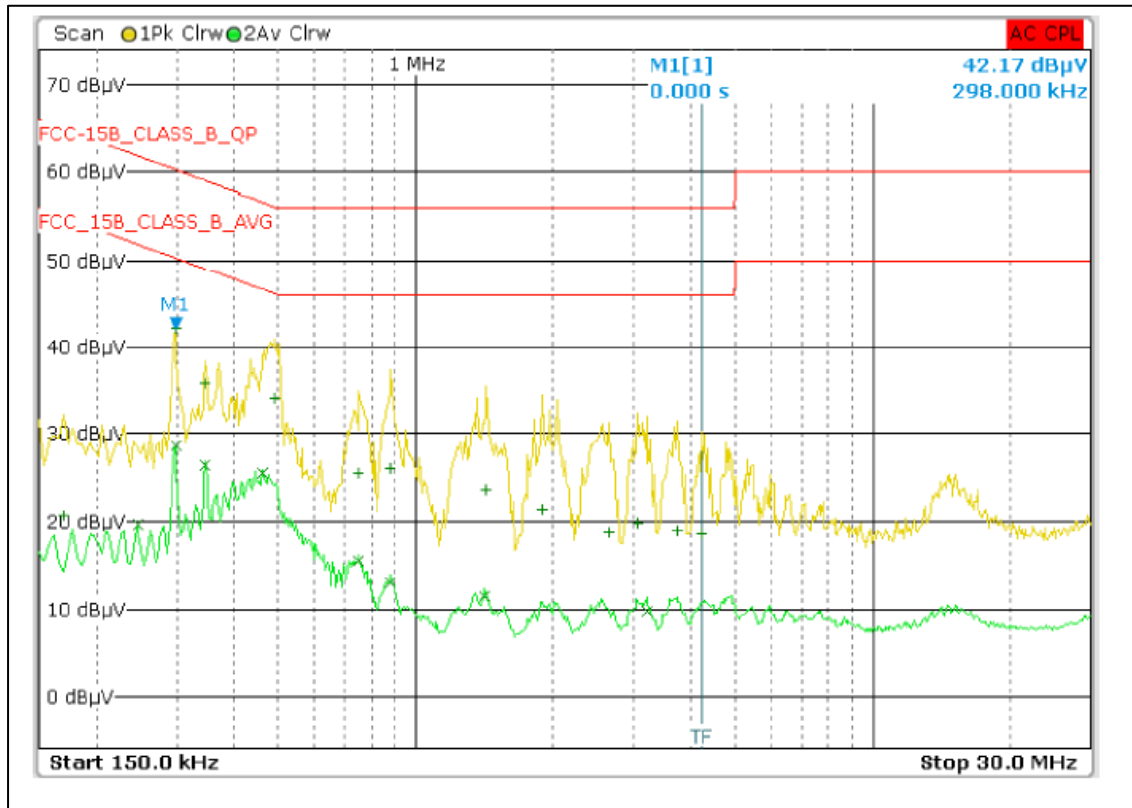
Test results:

110VAC-60Hz-Line



Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
1	490.000000000 kHz	40.70		Quasi Peak	-15.47
2	490.000000000 kHz	25.72		Average	-20.45
1	874.000000000 kHz	32.23		Quasi Peak	-23.77
1	758.000000000 kHz	31.77		Quasi Peak	-24.23
1	1.418000000 MHz	30.33		Quasi Peak	-25.67
2	346.000000000 kHz	21.37		Average	-27.69
1	2.038000000 MHz	27.96		Quasi Peak	-28.04
1	2.546000000 MHz	27.61		Quasi Peak	-28.39
1	3.090000000 MHz	27.37		Quasi Peak	-28.63
2	758.000000000 kHz	16.84		Average	-29.16
2	862.000000000 kHz	16.39		Average	-29.61
1	3.734000000 MHz	25.82		Quasi Peak	-30.18
2	1.426000000 MHz	15.45		Average	-30.55
1	4.254000000 MHz	25.16		Quasi Peak	-30.84
2	1.962000000 MHz	13.69		Average	-32.31
2	3.078000000 MHz	13.59		Average	-32.41
2	2.602000000 MHz	13.53		Average	-32.47
1	4.866000000 MHz	23.22		Quasi Peak	-32.78
2	3.702000000 MHz	13.22		Average	-32.78
1	5.406000000 MHz	21.99		Quasi Peak	-38.01
1	29.874000000 MHz	9.14		Quasi Peak	-50.86

110VAC-60Hz-Neutral



Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
1	298.000000000 kHz	42.05		Quasi Peak	-18.25
2	462.000000000 kHz	25.56		Average	-21.10
2	298.000000000 kHz	28.69		Average	-21.61
1	490.000000000 kHz	34.06		Quasi Peak	-22.11
2	346.000000000 kHz	26.49		Average	-22.57
1	346.000000000 kHz	35.79		Quasi Peak	-23.27
1	882.000000000 kHz	26.01		Quasi Peak	-29.99
1	750.000000000 kHz	25.63		Quasi Peak	-30.37
2	750.000000000 kHz	15.39		Average	-30.61
1	1.430000000 MHz	23.70		Quasi Peak	-32.30
2	246.000000000 kHz	19.56		Average	-32.33
2	882.000000000 kHz	13.13		Average	-32.87
2	1.418000000 MHz	11.64		Average	-34.36
1	1.894000000 MHz	21.39		Quasi Peak	-34.61
2	3.198000000 MHz	9.91		Average	-36.09
1	3.062000000 MHz	19.87		Quasi Peak	-36.13
1	3.746000000 MHz	18.88		Quasi Peak	-37.12
1	2.642000000 MHz	18.69		Quasi Peak	-37.31
1	4.238000000 MHz	18.49		Quasi Peak	-37.51
1	170.000000000 kHz	20.58		Quasi Peak	-44.38

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**** End of Test Report****