

Prüfbericht-Nr.: Test report no.:	ULR-TC568821300000089F	Auftrags-Nr.: Order no.:	166571640 0010	Seite 1 von 26 Page 1 of 26
Kunden-Referenz-Nr.: Client reference no.:	2115186	Auftragsdatum: Order date:	2020.11.27	
Auftraggeber: Client:	Minda Corporation Limited D6-11, Sector-59, Noida – 201301 (Uttar Pradesh)			
Prüfgegenstand: Test item:	Electronic Kit Keyless System			
Bezeichnung: Identification .:	KEYFOB			
Auftrags-Inhalt: Order content:	Testing and issue of Test Report and Grant Certificate			
Prüfgrundlage: Test specification:	FCC Part 15 Subpart C Section 15.231,15.205 & 15.209 RSS 210 Issue 10,RSS GEN Issue 9			
Wareneingangsdatum: Date of sample receipt:	2021.09.03			
Prüfmuster-Nr & Serien-Nr.: Test sample no & serial no.:	A003122697-001 A003122697-002 & FOB(ER-365001A) & SCU(EC-360001A)			
Prüfzeitraum: Testing period:	2021.09.03 - 2021.09.21			
Ort der Prüfung: Place of testing:	Wireless laboratory, Bangalore			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (India) Pvt. Ltd. 27/B,2nd cross road, Electronic city Phase1, Bangalore-560100, India FCC Test Site Registration No: 496599 ISED Test Site Registration No.: 3466E-1			
Prüfergebnis*: Test result*:	Pass			
geprüft von: tested by:	genehmigt von: authorized by:			
Datum: Date: 2021.09.03	Ausstellatum: Issue date: 2021.11.04			
Stellung / Position: M.V.Naveen Kumar Engineer	Stellung / Position: Mahammadgouse Kaladagi Assistant Manager			
Sonstiges / Other:	FCC ID: 2A29L-365001A			
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 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet * Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested				
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	ISED	Result
Field Strength of Emissions from Intentional radiator & Restricted band of Operation	15.231(b)	RSS 210 Section A.1.2 (b) RSS-Gen, Sections 8.10	Pass
Duty Cycle Determination	15.231(b)(2)	RSS 210 Section A.1.1 (a)	Pass
Field Strength of Spurious emission	15.231(b)(3)	RSS 210 Section A.1.4 (d) RSS-Gen, Sections 8.9	Pass
Bandwidth of emission	15.231(c)	RSS 210 Section A.1.3	Pass

Note:

1. The Product Electronic kit wireless system has 2 separate parts namely as Supervisory Control Unit (SCU) and Key Fob. SCU part has 125 KHz LF Transmitter and 315MHz RF Receiver. And Key Fob part has 315MHz RF Transmitter and 125 KHz Receiver.
2. This Test report covers the KEYFOB section 315MHz Transmitters test cases
3. This device transmits UHF Frequency(315 MHz) & receives LF Frequency(125kHz) by KEYFOB
4. This device transmits LF Frequency (125kHz) & receives UHF frequency (315MHz) by SCU
5. This Test report covers the KEYFOB section 315MHz Transmitters test cases
6. Transmitter test cases for LF 125kHz by SCU is reported under test report number ULR-TC568821300000090F issued by TUV Rheinland India Pvt Ltd.

Discipline: Electronics Testing
Group: EMC Test Facility

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REVISION HISTORY OF THIS REPORT

Report Number	Version	Description	Issue date
ULR-TC568821300000089F	01	Testing & Issue of Test report	2021.11.04

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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 DIAGRAM
- 8: BILL OF MATERIAL
- 9: USER MANUAL
- 10: MAXIMUM PERMISSIBLE EXPOSURE INFORMATION

2 TEST SITES

2.1 Testing Facilities

- | | |
|--|---|
| <p>1. TÜV Rheinland (India) Private Limited
27/B, 2nd Cross Road,
Electronic City Phase 1,
Bangalore – 560 100.
India</p> | <p>2. TÜV Rheinland (India) Private Limited
108, Beside ISBR Business School,
Electronic City Phase 1,
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
EMI Receiver	Rohde & Schwarz	ESW44	101732	4.73 SP5	19.05.2022	Yearly	Radiated Spurious Emission
EMI Receiver	Rohde & Schwarz	ESW44	101773	1.72SP1	27.01.2022	Yearly	
Active loop antenna	Schwarzbeck	FMZB 1519 B	1519B-00111	-	27.04.2022	Yearly	
Balun & Biconical Antenna	Schwarzbeck Mess-Elektronik	BBA 9106+V HBB 9124	9124-1117	-	25.02.2022	Yearly	
Log - Periodical Antenna	Schwarzbeck Mess-Elektronik	VUSLP 9111B	9111B-324	-	24.02.2022	Yearly	
Horn Antenna	Schwarzbeck	BBHA 9120 D	9120D-1944	-	11.05.2022	Yearly	
Semi Anechoic Chamber	Frankonia	-	-	-	-	-	
Fully Anechoic Chamber	Albatross	-	-	-	-	-	
Signal Analyser	Rohde & Schwarz	FSV7	1321.300 8K07/101 644	3.40	15.01.2022	Yearly	Antenna port Measurement

Table 2: Instrument application Software versions

Sl. No	Test Type	Application software	Version
1	Radiated spurious emission measurement- 3 meter Fully Anechoic Chamber	EMC 32	10.60.00
2	Radiated spurious emission measurement in SAC	BAT EMC	3.20.0.17

3 GENERAL PRODUCT INFORMATION

3.1 Product Function and Intended Use

Smart Control Unit Features

- Operates All the Four Turn Indicators and Indication Sign on Instrument Cluster
- Retracts solenoid to allow the lock bar to operate (If authentication successful)
- Operates the seat Actuator (if authentication successful)
- Operates Fuel Tank Actuator (if authentication successful)
- Communicates with Engine ECU (If authentication successful)
- Transmits LF signals (125 KHz) to wake up and request authenticate the key FOB
- Receives & demodulates the UHF signals (315MHz) to authenticate the key FOB.

FOB Assembly Features

- Switching ON/OFF Smart communication feature using a switch
- Finder / Seat Open /Ft open operation using a switch
- Senses LF Signal (125KHz)
- Transmits RF Signal (315MHz)
- Measures the strength of the LF signal

3.2 Ratings and System Details

Table 3: Ratings and System Details as declared by the client

Product Identification		KEYFOB
Application of the RF module		SRD(315MHz)
Operating Frequency Range		315MHz(Single Frequency)
Channel Spacing		200kHz
No. of Channels		1
Modulation		FSK
Number of antennas		1
Antenna Type		PCB Loop Antenna
Antenna Gain		-20dBi
Supply Voltage to product		3 VDC (Through Battery)
Environmental conditions	Storage	-30°C to +85°C (Without Battery)
	Operating	-20°C to +55°C
EUT Dimension(LxBxH) in mm		L(77) x B(35) x H(10) in mm

***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	$\pm 3 \text{ dB}$
FAC, radiated measurement	$\pm 6 \text{ dB}$
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 on single frequency.

4.2 Operation and Software of the EUT

Software Name & Version SCU : SMIT_VAS_030_20_Piaggio_Smart_Key_SW_V0_7_TLck_All_In_One.hex

Software Name & Version FOB : SMIT_VAS_030_20_Smart_Key_System_FOB_V0.2.bat

Hardware Name & Version SCU : SMIT_VAS_030_20_V1.0

Hardware Name & Version FOB : AT_400008_F-V1.4

4.3 Test Modes – Data rates and modulations

In this product having a 315MHz of RF Transmission and 125 kHz of LF Receiver

4.4 Special Accessories and Auxiliary Equipment

None

4.5 Countermeasures to achieve EMC Compliance

None

4.6 Report Reference

The Product Electronic kit wireless system has 2 separate parts namely as Supervisory Control Unit (SCU) and Key Fob. SCU part has 125 KHz LF Transmitter and 315MHz RF Receiver. And Key Fob part has 315MHz RF Transmitter and 125 KHz Receiver.

Product Name	Test Report Number
SUPERVISORY CONTROL UNIT	ULR-TC568821300000090F
KEYFOB	(ULR-TC568821300000089F) This Report

4.7 Sample identification

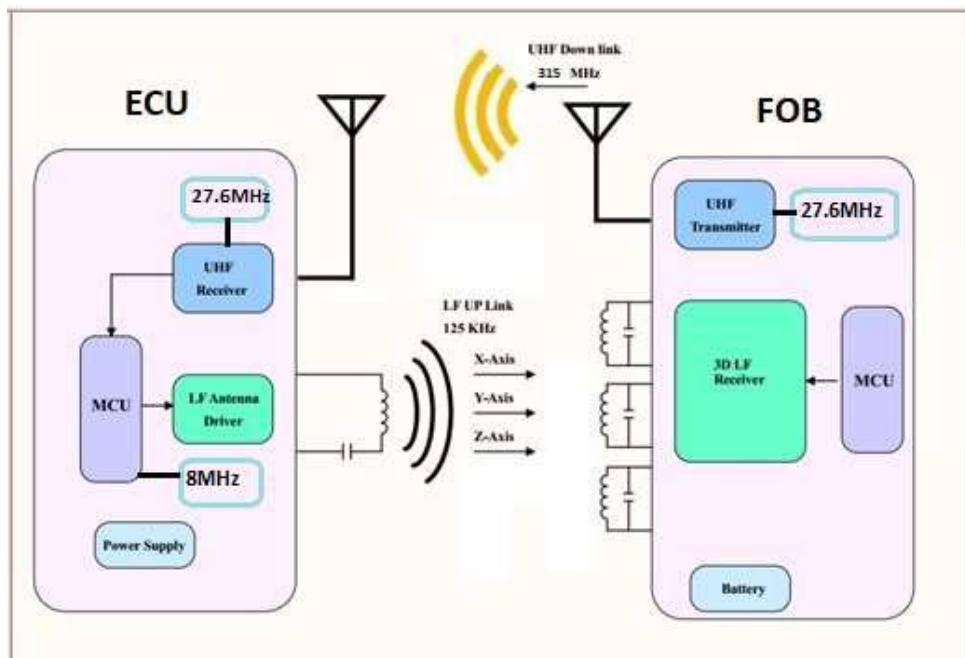
TUV Sample Identification number : A003122697-001 → Conducted Sample

A003122697-002 → Radiated sample

5 Operational Description

This product is applicable for the LOCK / UNLOCKS operation of the handle lock when authorized user (with key FOB) within distance of 1.5 meter distance. Authorized user can open the fuel cap and seat from vehicle within distance of 1.5 meter distance. In addition it has a vehicle locator finder, seat, FT open function from the FOB when authorized user (with key FOB) within distance of 50 meter from the vehicle. Vehicle finder indication take place over the flasher. ECU is communicating with Engine ECU over the CAN for the status of authentication & DTC.LED and IMMO LED provided on dashboard for the indication of authentication status. The developed system suitable for two wheelers for the smart key system.

6 Block Diagram



7 TEST METHODOLOGY

7.1 Radiated Emission Test

The radiated emission measurement was performed according to the procedures in ANSI C63.4-2014. 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.

7.1.1 Test Setup Configuration

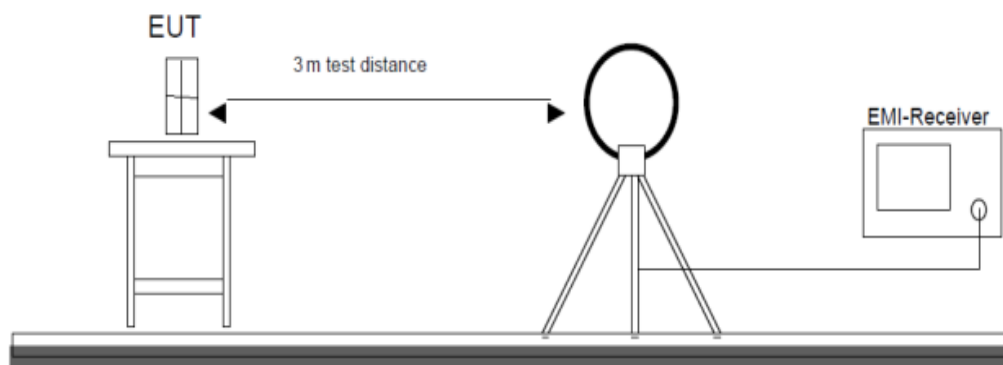


Figure 1: Frequency Range 9 kHz- 30 MHz

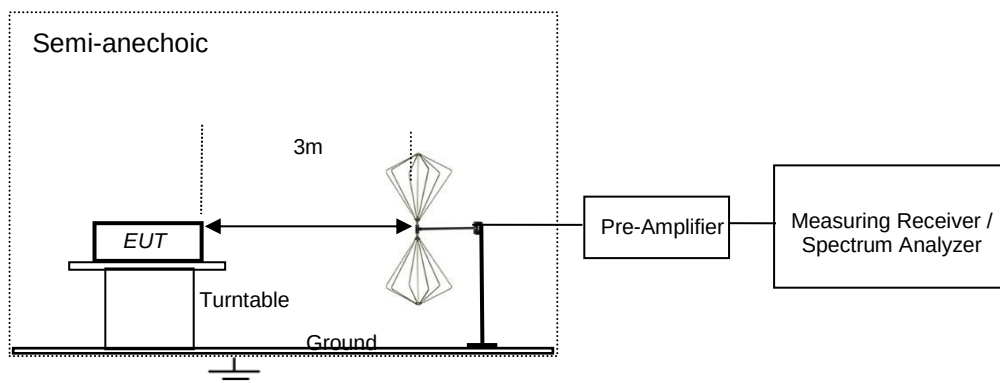


Figure 2: Frequency Range 30 MHz – 200 MHz

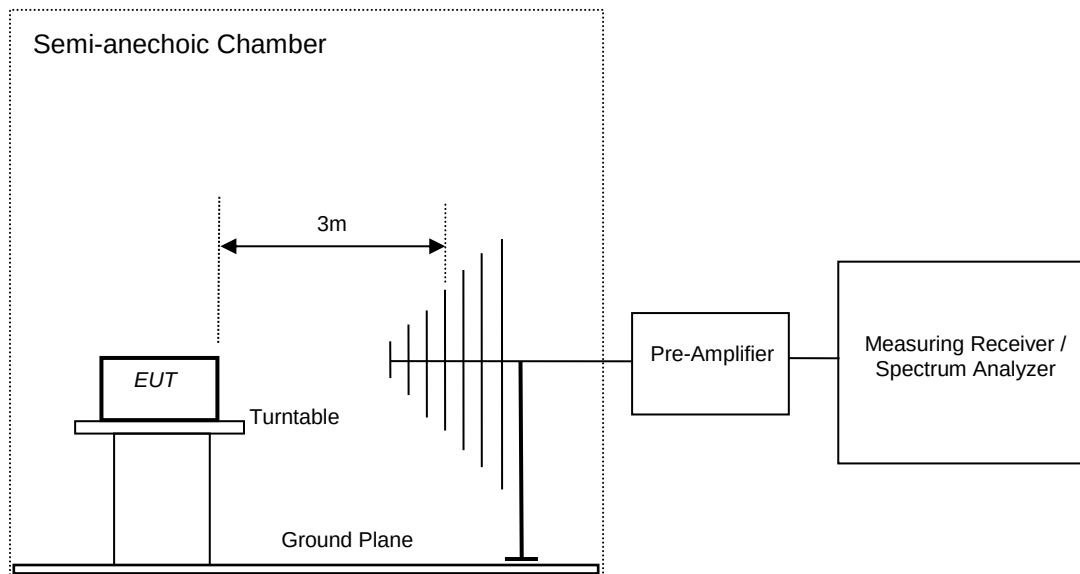


Figure 3: Frequency Range 200 MHz - 1GHz

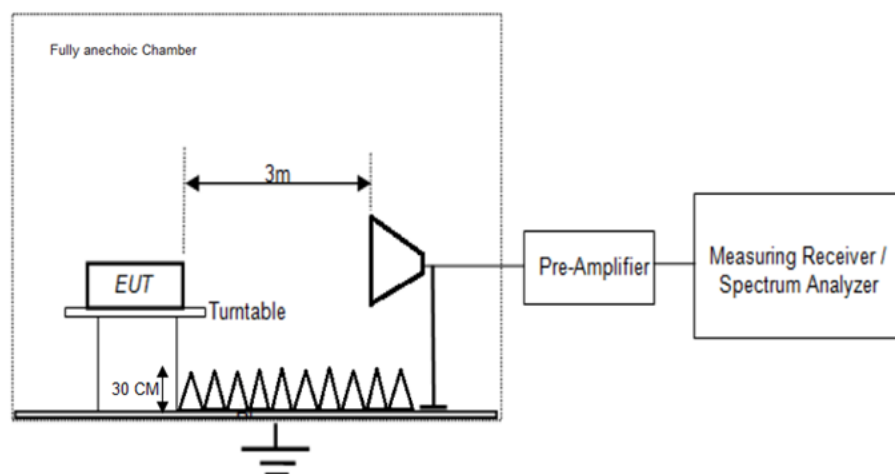


Figure 4: Frequency Range 1GHz - 4GHz

8 Field Strength of Emissions from Intentional Radiator & Restricted Band of Operation

Result

Pass

Test Specification	FCC part 15 Subpart C 15.231(b), 15.205(a) RSS 210 Issue 10 A.1.2, RSS-Gen, Sections 8.10
Test Method	ANSI C63.10-2013
Measurement Location	Semi Anechoic Chamber 30MHz - 1 GHz
Measurement Bandwidth	100 kHz for frequency range < 1GHz
Measuring Distance	3 m
Requirement	As per the limits mentioned in the below table
Test setup	Refer TEST METHODOLOGY

Table 5: Transmitter Field strength Limits

Fundamental Frequency (MHz)	Field strength of Fundamental $\mu\text{V/m}$ @3mtr	Field strength of spurious emissions $\mu\text{V/m}$ @3mtr
260-470MHz	3750 to 12500**	375 to 1250**

Note: ** Linear interpolations

For 260MHz to 470MHz: FS ($\mu\text{V/m}$) = (41.67 * F) - 7083

The fundamental & harmonic emission limits for a device operating at 315MHz listed in below

Fundamental Frequency (MHz)	Field strength of Fundamental $\mu\text{V/m}$ @3mtr	Field strength of Fundamental $\text{dB}\mu\text{V/m}$ @3mtr
315MHz	6043.05	75.62

Results:

The fundamental & Harmonics field strength didn't exceed the limits specified in Table 2 at a distance of 3mtr taken with an average detector

Conversion Formula: $20 \cdot \log(\mu\text{V/m})$

Test Conditions:

Temperature (Norm) = + 24 °C
Voltage = powered by key fob (powered by 3VDC through battery)
Relative humidity = 62 %

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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 Intentional Radiator as per 15.231(b)

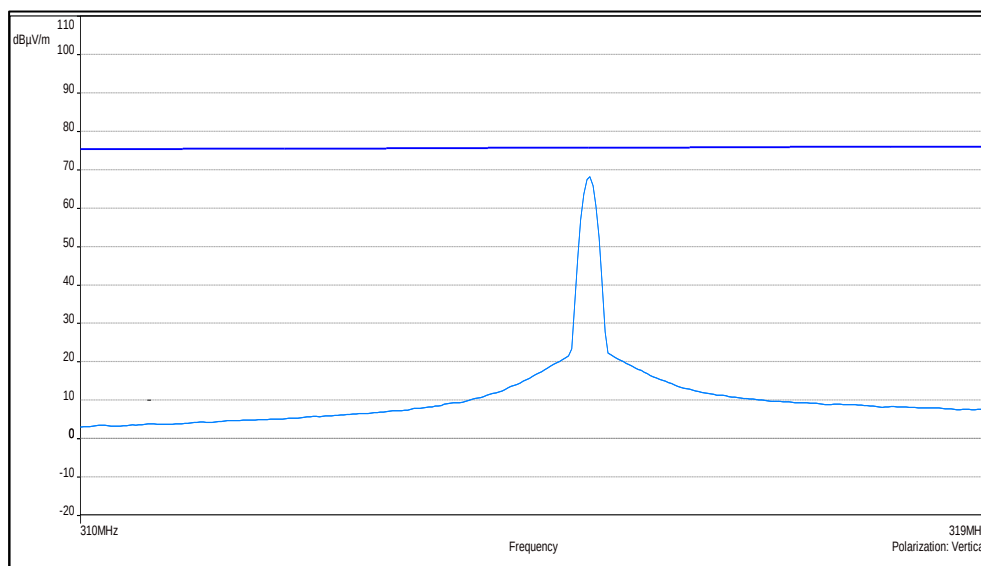
Polarization	Measured Frequency(MHz)	Measured Intentional Radiator of Emission (dBμV/m)	Limit(dBμV/m)	Margin(dB)
Vertical	315.01	68.08	75.74	-7.66
Horizontal	315.01	71.10	75.74	-4.64

Test Results for Restricted bands of Operation as per 15.205

Polarization	Measured frequency (MHz)	Mesaured Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Vertical	314.68	31.72	49.95	-18.23
	315.31	32.78	49.97	-17.19
Horizontal	314.74	35.36	49.95	-14.59
	315.28	35.82	49.97	-14.15

Note: Limits considered as per 15.231

Test Plots:

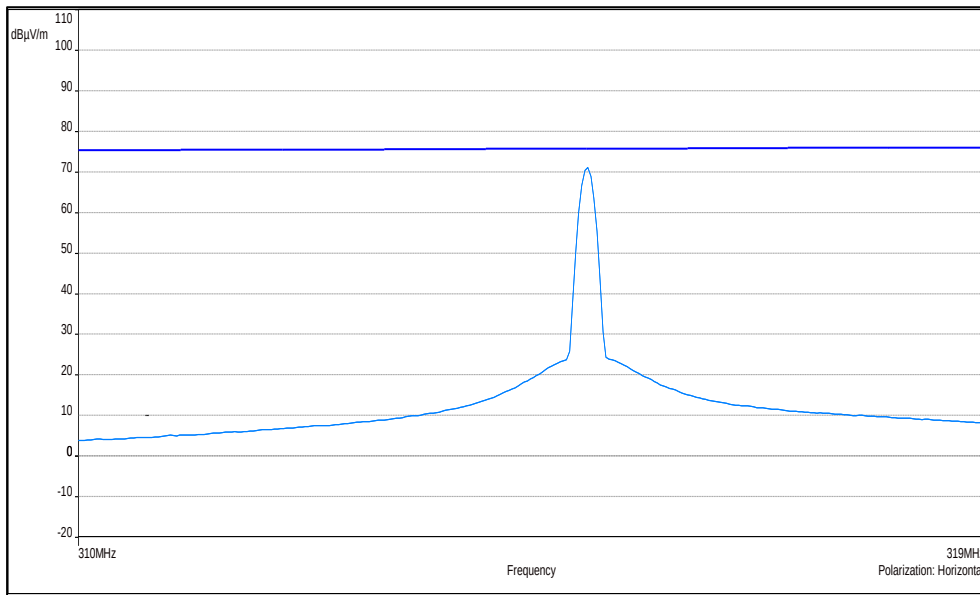


Polarization: Vertical

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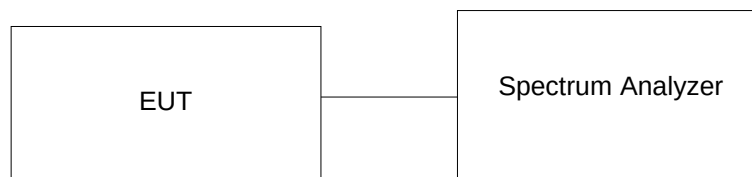


Polarization: Horizontal

9 Duty Cycle Determination

Test Specification	FCC part 15 Subpart C 15.231(a)(1) RSS-210 Issue 10 A.1.1 (a)
Test Method	ANSI C63.10-2013
Requirement	A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released

Test Method



Test Conditions:

Temperature (Norm) = + 24 °C

Voltage = powered by key fob (powered by 3VDC through battery)

Relative humidity = 62 %

Results:

Transmitting Frequency (MHz)	Transmitting time (sec)	Limit (sec)	Remarks
315	0.693	5	Pass

Prüfbericht - Nr.:

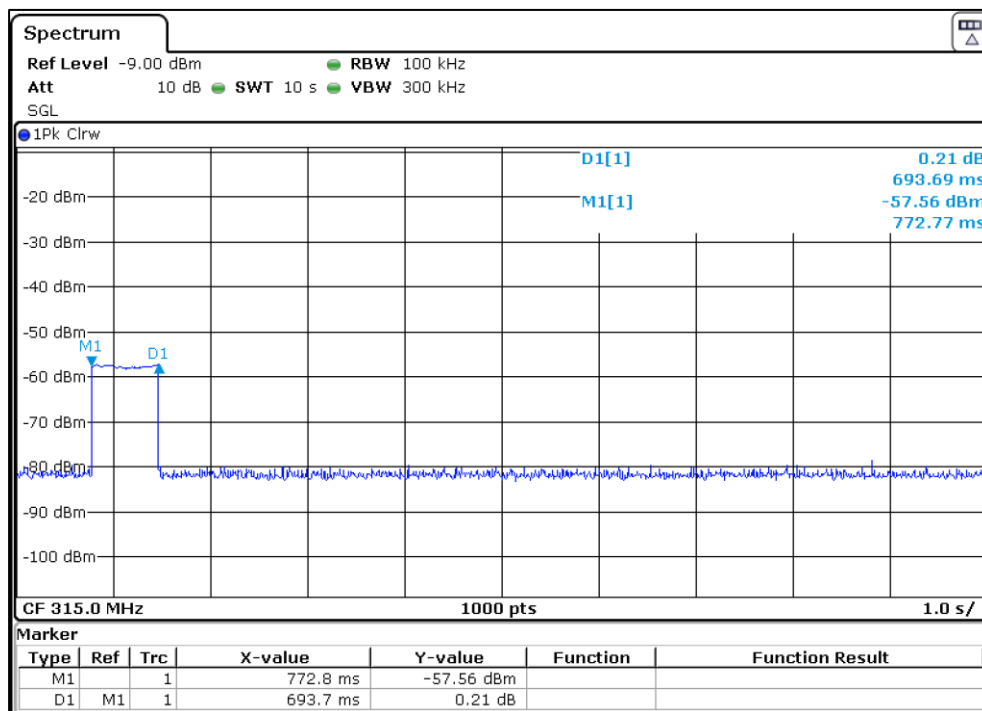
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Test Plots:



10 Field Strength of Spurious emission

Result

Pass

Test Specification	FCC part 15 Subpart C 15.231(b), 15.209(a) RSS 210 Issue 10 A.1.4 (d), RSS-Gen, Sections 8.9
Test Method	ANSI C63.4-2014
Measurement Location	Semi Anechoic Chamber 30MHz - 1 GHz Full Anechoic Chamber 1GHz – 4GHz
Measurement Bandwidth	100 kHz for frequency range < 1GHz 1 MHz for frequency range > 1GHz
Measuring Distance	3 m
Requirement	As per the limits mentioned in the below table
Test setup	Refer TEST METHODOLOGY

The Harmonic emission limits as per 15.231

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2250	225
70-130	1250	125
130-174	1250 to 3750	125 to 375
174-260	3750	375
260-470	3750 to 12500	375 to 1250
Above 470	12500	1250

The Harmonic emission limits for rest of the frequencies as per 15.209

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*
30-40.66	100	40.0	3
40.70-88	100	40.0	3
88-130	150	43.5	3

Note:

The Harmonics field strength didn't exceed the limits specified in Table 2 at a distance of 3mtr taken with an average detector

Conversion Formula: $20 \cdot \log(\mu\text{V/m})$

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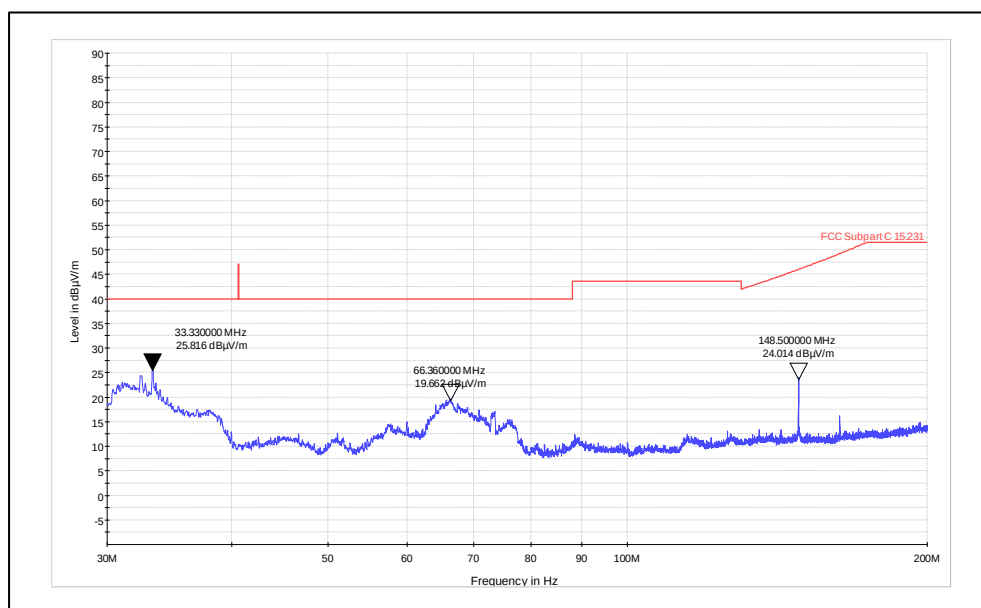
Test Results:

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

Frequency range of 30MHz – 200MHz:

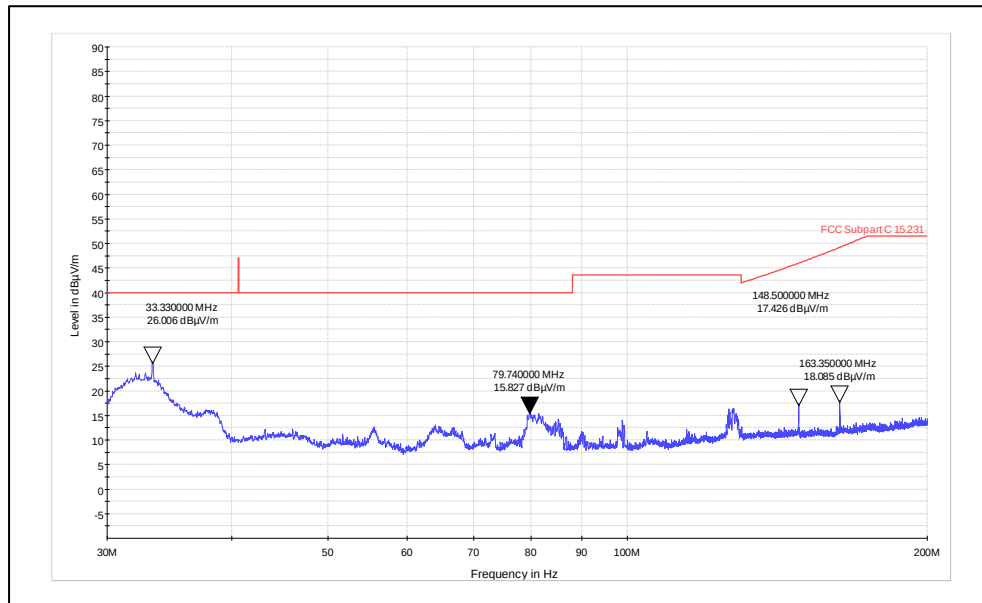
Antenna Polarization	Measured Frequency (MHz)	Measured Spurious Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Vertical	33.33	25.81	40.00	-14.19
	66.36	19.66	40.00	-20.34
	148.50	24.01	45.02	-21.01
Horizontal	33.33	26.00	40.00	-14.00
	79.74	15.82	40.00	-24.18
	148.50	17.42	45.02	-27.60
	163.35	18.08	47.02	-28.94

Test Plots:



Frequency range: 30MHz to 200MHz

Polarization: Vertical



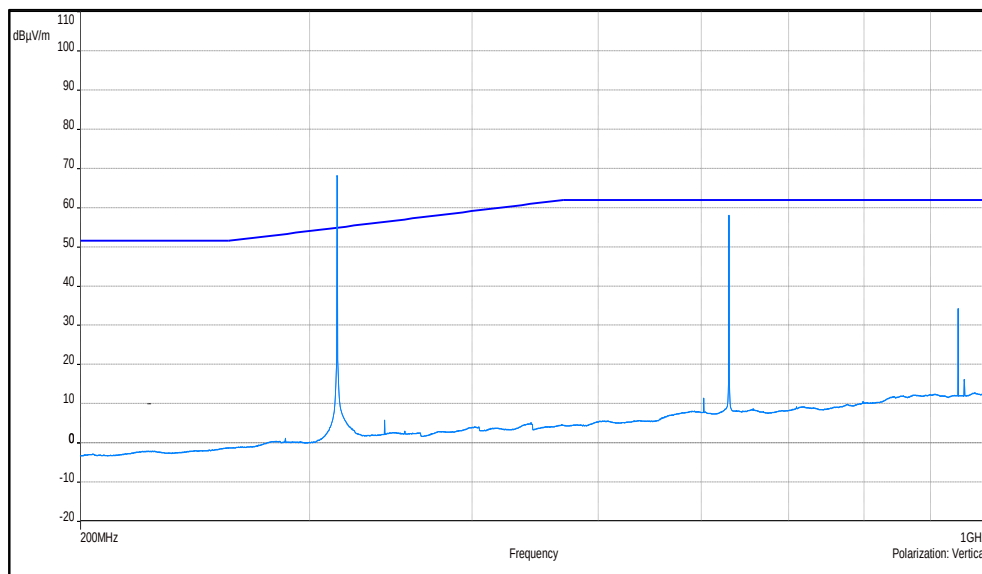
Frequency range: 30MHz to 200MHz

Polarization: Horizontal

Frequency range of 200MHz to 1GHz:

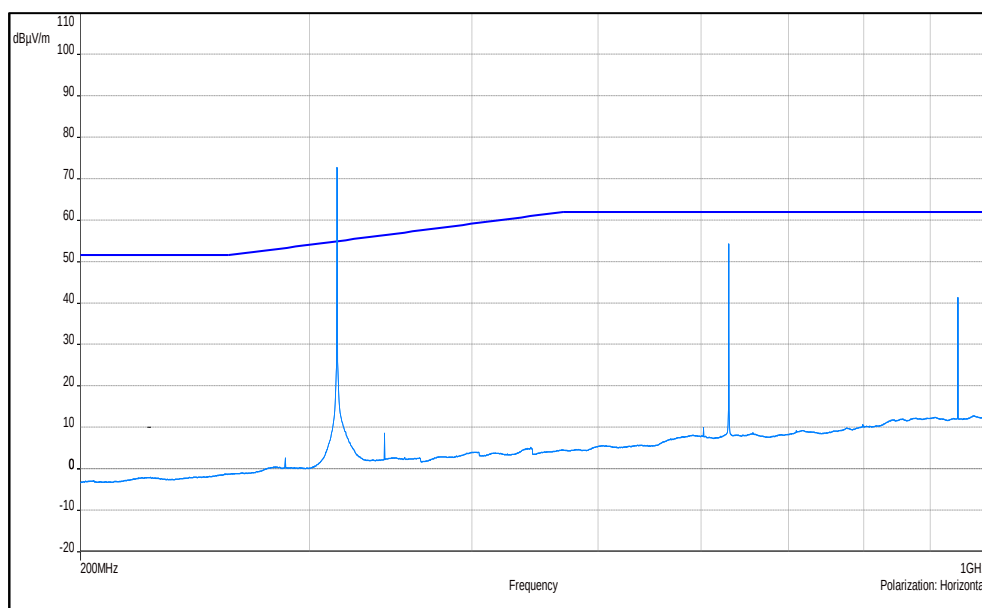
Antenna Polarization	Measured Frequency (MHz)	Measured Spurious Emission (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	314.99	68.16	-	*
	629.99	58.01	61.93	-3.92
	944.99	34.16	61.93	-27.77
Horizontal	314.99	72.71	-	*
	629.99	54.27	61.93	-7.66
	945.02	41.3	61.93	-20.63

Note: -* → indicates the Nominal frequency (315MHz)



Frequency range: 200MHz to 1GHz

Polarization: Vertical



Frequency range: 200MHz to 1GHz

Polarization: Horizontal

Note: The Frequency 315MHz which is in the above graph is a nominal Frequency

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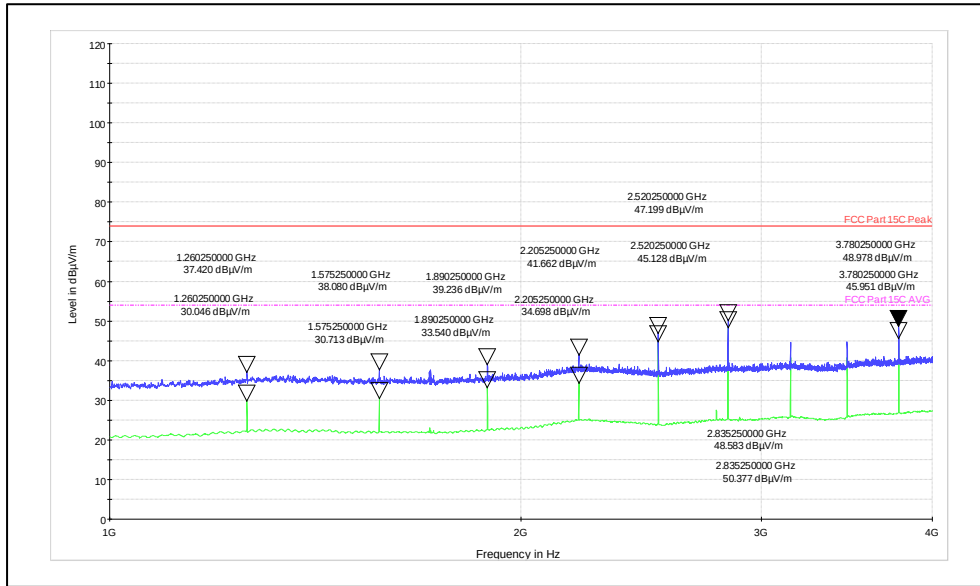
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Frequency range of 1GHz to 4GHz:

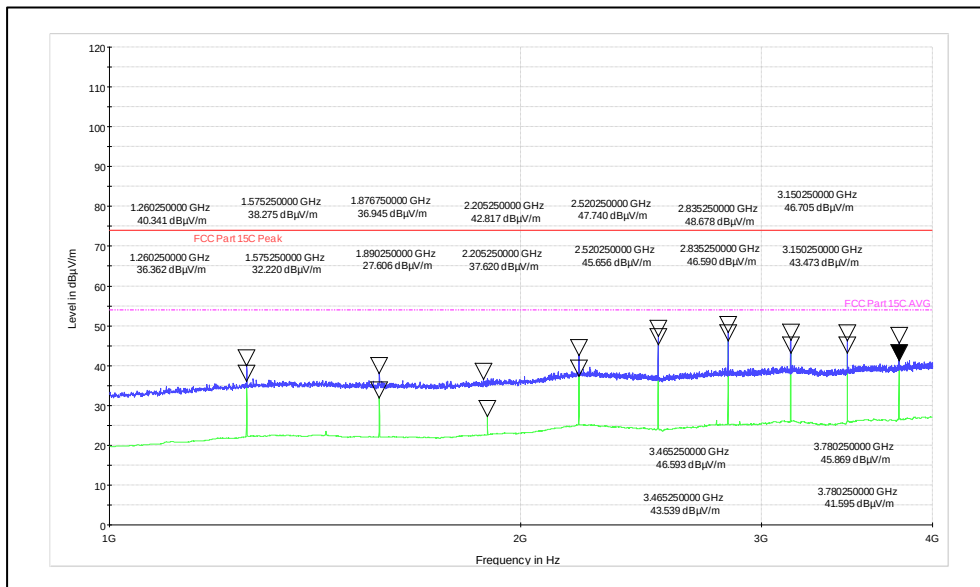
Antenna Polarization	Measured Frequency (MHz)	Measured Emission value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	1260(pk)	37.42	74.00	-36.58
	1260(Av)	30.04	54.00	-23.96
	1575(Pk)	38.08	74.00	-35.92
	1575(Av)	30.71	54.00	-23.29
	1890(Pk)	39.23	74.00	-34.77
	1890(Av)	33.54	54.00	-20.46
	2205(Pk)	41.66	74.00	-32.34
	2205(Av)	34.69	54.00	-19.31
	2520(PK)	47.19	74.00	-26.81
	2520(Av)	45.12	54.00	-8.88
	2835(pk)	48.58	74.00	-25.42
	2835(Av)	50.37	54.00	-3.63
Horizontal	1260(pk)	40.34	74.00	-33.66
	1260(Av)	36.36	54.00	-17.64
	1575(Pk)	38.27	74.00	-35.73
	1575(Av)	32.22	54.00	-21.78
	1890(Pk)	36.94	74.00	-37.06
	1890(Av)	27.60	54.00	-26.40
	2205(Pk)	42.81	74.00	-31.19
	2205(Av)	37.62	54.00	-16.38
	2520(Pk)	47.74	74.00	-26.26
	2520(Av)	45.65	54.00	-8.35
	2835(pk)	48.67	74.00	-25.33
	2835(Av)	46.59	54.00	-7.41
	3150(Pk)	46.70	74.00	-27.30
	3150(Av)	43.47	54.00	-10.53
	3465(PK)	46.59	74.00	-27.41
	3465(Av)	43.53	54.00	-10.47
	3780(Pk)	45.86	74.00	-28.14
	3780(Av)	41.59	54.00	-12.41

Note: Measurements has taken up to 10th harmonics of a Nominal frequency (315MHz).



Frequency range: 1GHz to 4GHz

Polarization: Vertical



Frequency range: 1GHz to 4GHz

Polarization: Horizontal

Note: Testing Performed with the limits of 15.209 and compared to 15.231 limits also it is well & with in the limits.

Prüfbericht - Nr.:

Test Report No.:

ULR-TC568821300000089F

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11 20dB Bandwidth

Test Specification

FCC part 15 Subpart C 15.231(C)
RSS-210 Issue 10 A.1.3

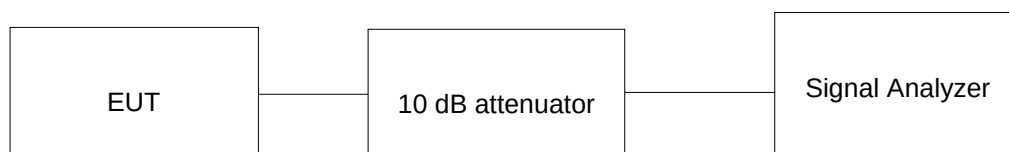
Test Method

Refer the below

Requirement

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Test Method



Test Conditions:

Temperature (Norm) = + 24 °C

Voltage = powered by key fob (powered by 3VDC through battery)

Relative humidity = 62 %

Results:

Channel Frequency (MHz)	99% Measured Bandwidth (MHz)	20dB Bandwidth (MHz)	Limit (MHz)
315	0.033	0.041	0.787

Prüfbericht - Nr.:

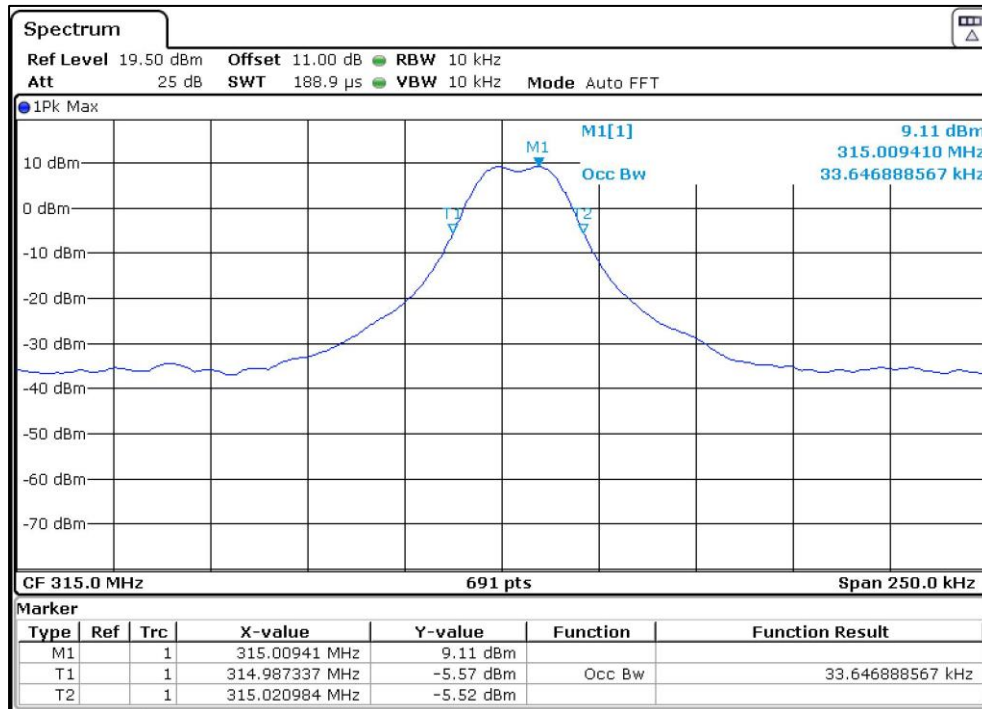
Test Report No.:

ULR-TC568821300000089F

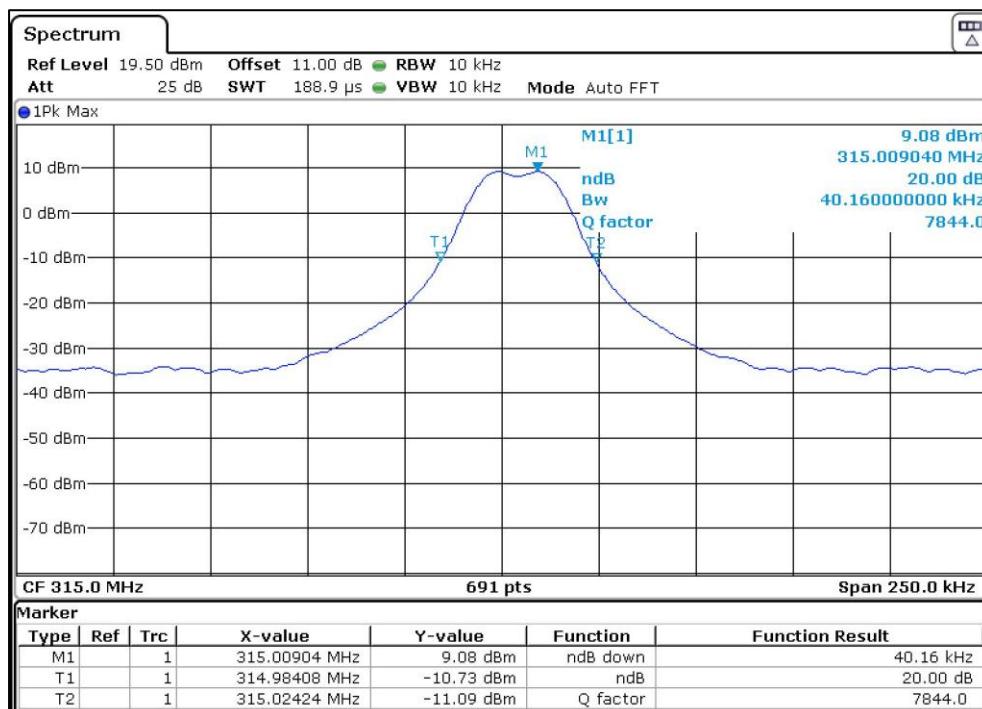
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Test Plots:



99% Bandwidth



20dB Bandwidth

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*****END OF TEST REPORT*****