

TEST REPORT

Product Name: sensert base unit-cellular
FCC ID: 2A52ESST-BCA1HH
Trademark: N/A
Model Number: SST-BCA1HH
Prepared For: Automatic Timing and Controls Diversified Electronics
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Manufacturer: Automatic Timing and Controls Diversified Electronics
Address: 8019 Ohio River Blvd PO Box 305 Newell, WV 26050 USA
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Sample Received Date: Sep. 16, 2022
Sample tested Date: Sep. 16, 2022 to Sep. 23, 2022
Issue Date: Sep. 23, 2022
Report No.: CTB220923039RFX
Test Standards: FCC Part 2, 24E, 27
Test Results: PASS
Remark: This is LTE radio test report.

Compiled by:

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Reviewed by:

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Approved by:

Rita Xiao / Director

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(Note: N/A means not applicable)

1. VERSION

Report No.	Issue Date	Description	Approved
CTB220923039RFX	Sep. 23, 2022	Original	Valid

2. TEST SUMMARY

The Product has been tested according to the following specifications:

Test Item	Test Requirement	Test method	Result
Conducted output power #	Part 2.1046(a)	TIA-603-E-2016 & KDB 971168 D01v02r02	PASS
Effective Radiated Power of Transmitter(EIRP)	Part24.232(c)/ Part27.50(h)(2)	TIA-603-E-2016 & KDB 971168 D01v02r02	PASS
peak-to-average ratio #	Part24.232(d)/Part 27.50(d)	KDB 971168 D01v02r02	PASS
99% & 26dB Occupied Bandwidth #	Part 2.1049(h)	KDB 971168 D01v02r02	PASS
Band Edge at antenna terminals #	Part 2.1051/ Part 24.238(a) /Part 27.53(m) (4)	KDB 971168 D01v02r02	PASS
Spurious emissions at antenna terminals #	Part 2.1051/ Part 24.238(a) /Part 27.53(m) (4)	TIA-603-E-2016 & KDB 971168 D01v02r02	PASS
Field strength of spurious radiation	Part 2.1051/ Part 24.238(a) /Part 27.53(m) (4)	TIA-603-E-2016 & KDB 971168 D01v02r02	PASS
Frequency stability #	Part 2.1055/Part 27.54	TIA-603-E-2016 & KDB 971168 D01v02r02	PASS

Note: #: Please refer to CTB220527025RF report, FCC ID: 2A52ESST-BCA1HH.

3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Item	Uncertainty
Occupancy bandwidth	54.3kHz
Conducted output power Above 1G	0.9dB
Conducted output power below 1G	0.9dB
Power Spectral Density , Conduction	0.9dB
Conduction spurious emissions	2.0dB
Out of band emission	2.0dB
3m chamber Radiated spurious emission(30MHz-1GHz)	4.6dB
3m chamber Radiated spurious emission(1GHz-18GHz)	5.1dB
3m chamber Radiated spurious emission(18GHz-40GHz)	3.4dB
Receiver Reference Sensitivity level	1.9dB
humidity uncertainty	5.5%
Temperature uncertainty	0.63°C
frequency	1×10 ⁻⁷

4. PRODUCT INFORMATION AND TEST SETUP

4.1 Product Information

Model(s):	SST-BCA1HH
Model Description:	N/A
Hardware Version:	V1.0
Software Version:	V1.0
Operation Frequency:	FDD-LTE BAND 2: 1850-1910MHz FDD-LTE BAND 4: 1710-1755MHz FDD-LTE BAND 12: 699-716MHz
Max. RF output power:	FDD-LTE BAND 2: 20.86 dBm FDD-LTE BAND 4: 20.75 dBm FDD-LTE BAND 12: 22.13 dBm
Type of Modulation:	QPSK, 16QAM
Antenna installation:	External antenna
Antenna Gain:	4.98dBi
Ratings:	Terminal power supply DC9-30V

4.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP PHOTOGRAPHS for the actual connections between Product and support equipment.

4.3 Support Equipment

No.	Device Type	Brand	Model	Series No.	Note

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

4.4 Test Mode

Test Mode List		
Test Mode	Description	Remark
TM1	FDD-LTE BAND 2	Low, Middle, High Channels
TM2	FDD-LTE BAND 4	Low, Middle, High Channels
TM3	FDD-LTE BAND 12	Low, Middle, High Channels

4.5 Test Environment

Humidity(%):	55
Atmospheric Pressure(kPa):	101.1
Normal Voltage(AC):	120V
Normal Temperature(°C)	25
Low Temperature(°C)	0
High Temperature(°C)	40

5. TEST FACILITY AND TEST INSTRUMENT USED

5.1 Test Facility

All measurement facilities used to collect the measurement data are located at Floor 1&2, Building A, No. 26 of Xinhe Road, Xinqiao Street, Baoan District, Shenzhen China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

5.2 Test Instrument Used

Item	Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	Agilent	N9020A	MY52090073	2023.07.19
2	Power Sensor	Agilent	U2021XA	MY56120032	2023.07.19
3	Power Sensor	Agilent	U2021XA	MY56120034	2023.07.19
4	Communication test set	R&S	CMW500	108058	2023.07.19
5	Spectrum Analyzer	KEYSIGHT	N9020A	MY51289897	2023.07.19
6	Signal Generator	Agilent	N5181A	MY50140365	2023.07.19
7	Vector signal generator	Agilent	N5182A	MY47420195	2023.07.19
8	Communication test set	Agilent	E5515C	MY50102567	2023.07.19
9	2.4 GHz Filter	Shenxiang	MSF2400-2483.5MS-1154	20181015001	2023.07.19
10	5 GHz Filter	Shenxiang	MSF5150-5850 MS-1155	20181015001	2023.07.19
11	Filter	Xingbo	XBLBQ-DZA120	190821-1-1	2023.07.19
12	BT&WI-FI Automatic test software	Microwave	MTS8000	Ver. 2.0.0.0	/
13	Rohde & Schwarz SFU Broadcast Test System	R&S	SFU	101017	2022.10.30
14	Temperature humidity chamber	Hongjing	TH-80CH	DG-15174	2023.07.19
15	234G Automatic test software	Microwave	MTS8200	Ver. 2.0.0.0	/
16	966 chamber	C.R.T.	966	/	2024.08.11
17	Receiver	R&S	ESPI	100362	2023.07.19
18	Amplifier	HP	8447E	2945A02747	2023.07.19
19	Amplifier	Agilent	8449B	3008A01838	2023.07.19
20	TRILOG Broadband Antenna	Schwarzbeck	VULB 9168	00869	2023.07.22
21	Double Ridged Broadband Horn Antenna	Schwarzbeck	BBHA9120D	01911	2023.07.22

22	EMI test software	Fala	EZ-EMC	FA-03A2 RE	/
23	Loop Antenna	Schwarzbeck	FMZB 1519B	1519B-224	2023.07.23
24	loop antenna	ZHINAN	ZN30900A	GTS534	/
25	40G Horn antenna	A/H/System	SAS-574	588	2024.10.30
26	Amplifier	AEROFLEX	Aeroflex	097	2024.10.30

6. RF EXPOSURE

6.1 Standard Applicable

According to §1.1307 and §2.1091, §2.1093, the portable transmitter must comply the RF exposure requirements.

6.2 Test Result

This product complied with the requirement of the RF exposure, please see the RF Exposure report.

7. RF OUTPUT POWER

7.1 Standard Applicable

According to §22.913(a)(2), the ERP of mobile and portable stations transmitters and auxiliary test transmitters must not exceed 7 Watts.

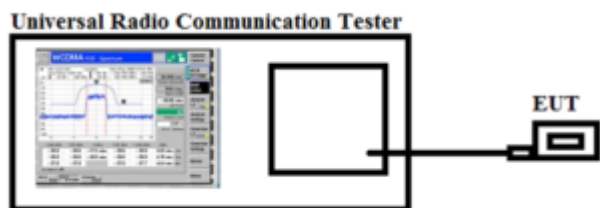
According to §24.232(c), mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

According to §27.50(d)(4), fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP.

According to §27.50(c)(10), portable stations (hand-held devices) in the 698-746 MHz band are limited to 3 watts ERP.

7.2 Test Procedure

Conducted output power test method:



Radiated power test method:

1. The setup of EUT is according with per ANSI/TIA Standard 603E and ANSI C63.26 measurement procedure.
2. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.
3. The frequency range up to tenth harmonic of the fundamental frequency was investigated.
4. Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

7.3 Summary of Test Results/Plots

Max. Radiated Power:

FDD-LTE Band 2

Channel Bandwidth: 1.4 MHz					
Modulation	Channel	Antenna Polar	ERP [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	20.45	<33.00	PASS
		H	20.06		
	MCH	V	19.57		PASS
		H	19.28		
	HCH	V	20.08		PASS
		H	21.00		
16QAM	LCH	V	20.11	<33.00	PASS
		H	19.50		
	MCH	V	20.88		PASS
		H	20.66		
	HCH	V	20.03		PASS
		H	19.50		
Channel Bandwidth: 3 MHz					
Modulation	Channel	Antenna Polar	E.i.r.p [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	20.20	<33.00	PASS
		H	20.07		
	MCH	V	20.26		PASS
		H	19.50		
	HCH	V	20.18		PASS
		H	20.02		
16QAM	LCH	V	19.75	<33.00	PASS
		H	20.55		
	MCH	V	20.24		PASS
		H	19.35		
	HCH	V	20.19		PASS
		H	19.21		
Channel Bandwidth: 5 MHz					
Modulation	Channel	Antenna Polar	E.i.r.p [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	19.76	<33.00	PASS
		H	21.02		
	MCH	V	20.52		PASS

	HCH	H	19.50		PASS
		V	19.31		
		H	20.06		
16QAM	LCH	V	20.96	<33.00	PASS
		H	19.64		
	MCH	V	20.47		PASS
		H	20.21		
	HCH	V	20.72		PASS
		H	19.98		
Channel Bandwidth: 10 MHz					
Modulation	Channel	Antenna Polar	E.i.r.p [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	19.42	<33.00	PASS
		H	20.67		
	MCH	V	19.99		PASS
		H	19.59		
	HCH	V	19.81		PASS
		H	21.06		
16QAM	LCH	V	21.17	<33.00	PASS
		H	20.83		
	MCH	V	21.08		PASS
		H	19.50		
	HCH	V	20.31		PASS
		H	21.08		
Channel Bandwidth: 15 MHz					
Modulation	Channel	Antenna Polar	E.i.r.p [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	21.05	<33.00	PASS
		H	20.11		
	MCH	V	19.69		PASS
		H	19.38		
	HCH	V	19.23		PASS
		H	21.12		
16QAM	LCH	V	19.99	<33.00	PASS
		H	21.04		
	MCH	V	19.32		PASS
		H	20.53		
	HCH	V	19.63		PASS
		H	19.70		
Channel Bandwidth: 20 MHz					

Modulation	Channel	Antenna Polar	E.i.r.p [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	21.31	<33.00	PASS
		H	19.54		
	MCH	V	19.70		PASS
		H	20.84		
	HCH	V	20.75		PASS
		H	20.78		
16QAM	LCH	V	19.78	<33.00	PASS
		H	19.81		
	MCH	V	21.26		PASS
		H	19.44		
	HCH	V	20.99		PASS

FDD-LTE Band 4

Channel Bandwidth: 1.4 MHz					
Modulation	Channel	Antenna Polar	E.i.r.p [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	18.76	<30.0	PASS
		H	19.01		
	MCH	V	18.32		PASS
		H	19.96		
	HCH	V	18.44		PASS
		H	18.24		
16QAM	LCH	V	18.67	<30.0	PASS
		H	19.49		
	MCH	V	18.67		PASS
		H	19.21		
	HCH	V	19.15		PASS
		H	19.69		
Channel Bandwidth: 3 MHz					
Modulation	Channel	Antenna Polar	E.i.r.p [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	18.54	<30.0	PASS
		H	19.48		
	MCH	V	18.94		PASS
		H	19.51		
	HCH	V	19.63		PASS
		H	19.43		
16QAM	LCH	V	18.96	<30.0	PASS
		H	19.13		

	MCH	V	18.48		PASS
		H	19.93		
	HCH	V	18.52		PASS
		H	19.75		
Channel Bandwidth: 5 MHz					
Modulation	Channel	Antenna Polar	E.i.r.p [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	18.13	<30.0	PASS
		H	18.48		
	MCH	V	18.45		PASS
		H	19.91		
	HCH	V	18.59		PASS
		H	19.76		
16QAM	LCH	V	18.86	<30.0	PASS
		H	18.37		
	MCH	V	18.22		PASS
		H	19.52		
	HCH	V	19.20		PASS
		H	19.12		
Channel Bandwidth: 10 MHz					
Modulation	Channel	Antenna Polar	E.i.r.p [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	19.27	<30.0	PASS
		H	19.32		
	MCH	V	18.84		PASS
		H	18.74		
	HCH	V	18.15		PASS
		H	19.49		
16QAM	LCH	V	19.61	<30.0	PASS
		H	18.39		
	MCH	V	18.75		PASS
		H	18.03		
	HCH	V	19.38		PASS
		H	18.85		
Channel Bandwidth: 15 MHz					
Modulation	Channel	Antenna Polar	E.i.r.p [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	18.61	<30.0	PASS
		H	18.37		
	MCH	V	19.58		PASS
		H	19.67		

	HCH	V	19.75		PASS
		H	18.99		
16QAM	LCH	V	19.00	<30.0	PASS
		H	18.34		
	MCH	V	19.62		PASS
		H	18.75		
	HCH	V	19.41		PASS
		H	18.36		
Channel Bandwidth: 20 MHz					
Modulation	Channel	Antenna Polar	E.i.r.p [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	19.21	<30.0	PASS
		H	19.55		
	MCH	V	20.10		PASS
		H	18.44		
	HCH	V	18.56		PASS
		H	18.60		
16QAM	LCH	V	19.99	<30.0	PASS
		H	19.28		
	MCH	V	19.79		PASS
		H	19.05		
	HCH	V	18.15		PASS
		H	18.82		

FDD-LTE Band 12

Channel Bandwidth: 1.4 MHz					
Modulation	Channel	Antenna Polar	ERP [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	20.77	<34.77	PASS
		H	20.80		
	MCH	V	20.17		PASS
		H	21.57		
	HCH	V	20.97		PASS
		H	21.80		
16QAM	LCH	V	20.82	<34.77	PASS
		H	20.84		
	MCH	V	21.93		PASS
		H	21.12		
	HCH	V	21.25		PASS
		H	21.19		

Channel Bandwidth: 3 MHz					
Modulation	Channel	Antenna Polar	ERP [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	20.15	<34.77	PASS
		H	21.26		
	MCH	V	20.63		PASS
		H	20.01		
	HCH	V	21.33		PASS
		H	20.33		
16QAM	LCH	V	21.18	<34.77	PASS
		H	20.28		
	MCH	V	21.97		PASS
		H	21.15		
	HCH	V	20.52		PASS
		H	21.11		
Channel Bandwidth: 5 MHz					
Modulation	Channel	Antenna Polar	ERP [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	20.77	<34.77	PASS
		H	20.14		
	MCH	V	21.42		PASS
		H	21.41		
	HCH	V	21.59		PASS
		H	21.21		
16QAM	LCH	V	21.42	<34.77	PASS
		H	20.23		
	MCH	V	20.94		PASS
		H	20.05		
	HCH	V	21.30		PASS
		H	20.77		
Channel Bandwidth: 10 MHz					
Modulation	Channel	Antenna Polar	ERP [dBm]	Limit (dBm)	Verdict
QPSK	LCH	V	20.03	<34.77	PASS
		H	21.75		
	MCH	V	20.62		PASS
		H	21.13		
	HCH	V	20.36		PASS
		H	21.12		
16QAM	LCH	V	21.99	<34.77	PASS
		H	20.07		

	MCH	V	21.40		PASS
		H	20.51		
	HCH	V	21.02		PASS
		H	21.03		

Max. Conducted Output Power

Please refer to Appendix A: Average Power Output Data

Test result: Pass

8. PEAK-TO-AVERAGE RATIO (PAR) OF TRANSMITTER

8.1 Standard Applicable

According to §24.232(d), power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51, in measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

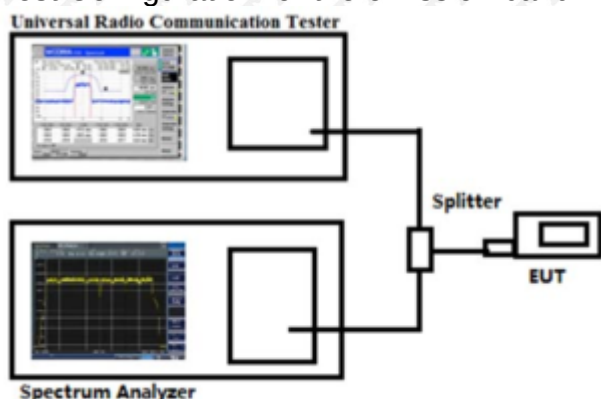
According to §27.50(B), the peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time or other Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

8.2 Test Procedure

According with KDB 971168

1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW > Emission bandwidth of signal
4. The signal analyzer was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analyzed. For continuous signals (>98% duty cycle), the measurement interval was set to 1ms. For burst transmissions, the spectrum analyzer is set to use an internal "RF Burst" trigger that is synced with an incoming pulse and the measurement interval is set to less than the duration of the "on time" of one burst to ensure that energy is only captured during a time in which the transmitter is operating at maximum power

Test Configuration for the emission bandwidth testing:



8.3 Summary of Test Results

Please refer to Appendix B: Peak-to-Average Ratio

Test result: Pass

9. EMISSION BANDWIDTH

9.1 Standard Applicable

According to §22.917(b), the emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

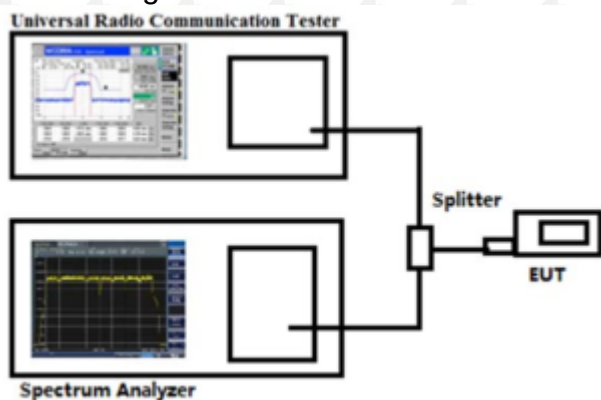
According to §24.238(b), the emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

According to §27.53, the emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

9.2 Test Procedure

According to § 22.917(b), the emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Test Configuration for the emission bandwidth testing:



9.3 Summary of Test Results/Plots

Please refer to Appendix C: 26dB Bandwidth and Occupied Bandwidth
Test result: Pass

10. OUT OF BAND EMISSIONS AT ANTENNA TERMINAL

10.1 Standard Applicable

According to §22.917(a), the power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

According to §24.238(a), the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

According to §27.53 (c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

- (1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;
- (2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;
- (3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $76 + 10 \log(P)$ dB in a 6.25 kHz band segment, for base and fixed stations;
- (4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $65 + 10 \log(P)$ dB in a 6.25 kHz band segment, for mobile and portable stations;
- (5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;
- (6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

According to §27.53 (f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

According to §27.53(h), the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ dB.

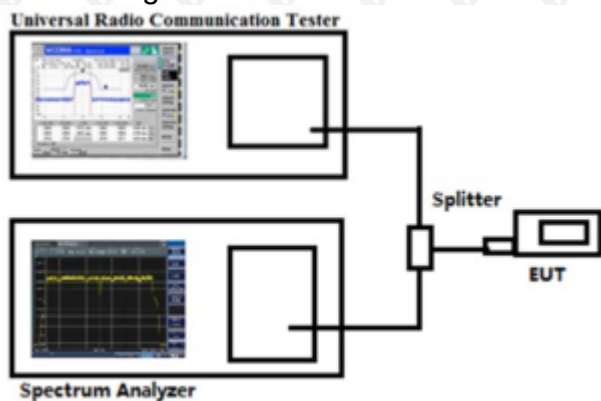
According to §27.53(g), for operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB.

According to §27.53(m)(4), for mobile digital stations, the attenuation factor shall be not less than $40 + 10 \log (P)$ dB on all frequencies between the channel edge and 5 megahertz from the channel edge, $43 + 10 \log (P)$ dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and $55 + 10 \log (P)$ dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less than $43 + 10 \log (P)$ dB on all frequencies between 2490.5 MHz and 2496 MHz and $55 + 10 \log (P)$ dB at or below 2490.5 MHz.

10.2 Test Procedure

The RF output terminal of the transmitter was connected to the input of the spectrum analyzer via a suitable attenuation. The RBW of the spectrum analyzer was set to 100kHz and 1MHz for the scan frequency from 30MHz to 1GHz and the scan frequency from 1GHz to up to 10 th harmonic.

Test Configuration for the out of band emissions testing:



10.3 Summary of Test Results/Plots

Please refer to Appendix D & E: Band Edge & Conducted Spurious Emission

Test result: Pass

11.SPURIOUS RADIATED EMISSIONS

11.1 Standard Applicable

According to § 22.917(a), the power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

According to § 24.238(a), the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

According to § 27.53 (c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

- (1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;
- (2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;
- (3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $76 + 10 \log(P)$ dB in a 6.25 kHz band segment, for base and fixed stations;
- (4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than $65 + 10 \log(P)$ dB in a 6.25 kHz band segment, for mobile and portable stations;
- (5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;
- (6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

According to § 27.53 (f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

According to § 27.53(h), the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ dB.

According to § 27.53(g) the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB.

11.2 Test Procedure

1. The setup of EUT is according with per ANSI/TIA-603-E and ANSI C63.4-2014 measurement procedure.
 2. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.
 3. The frequency range up to tenth harmonic of the fundamental frequency was investigated.
 4. Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.
- Spurious attenuation limit in dB = $43 + 10 \log_{10}(\text{power out in Watts})$

11.3 Summary of Test Results/Plots

- Note:
1. this EUT was tested in 3 orthogonal positions and the worst case position data was reported.
 2. All test modes (different bandwidth and different modulation) are performed, but only the worst case is recorded in this report.

Test Data:

QPSK

Band 2 18607 channel/BW 1.4(lowest channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1275.57	146	226	-55.68	-13	-42.68	Pass	H
1627.58	140	356	-52.47	-13	-39.47	Pass	H
3967.61	155	165	-48.94	-13	-35.94	Pass	H
5774.86	159	66	-46.12	-13	-33.12	Pass	H
6408.21	152	46	-47.31	-13	-34.31	Pass	H
7946.93	151	224	-50.31	-13	-37.31	Pass	H
1161.57	153	310	-58.13	-13	-45.13	Pass	V
1341.72	148	79	-59.51	-13	-46.51	Pass	V
3534.17	150	156	-50.80	-13	-37.80	Pass	V
3753.58	153	39	-50.06	-13	-37.06	Pass	V
5741.44	155	11	-44.07	-13	-31.07	Pass	V
6635.26	150	61	-50.77	-13	-37.77	Pass	V

Band 2 18900 channel/BW 1.4 (middle channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1302.00	150	126	-58.98	-13	-45.98	Pass	H
1724.37	146	292	-53.82	-13	-40.82	Pass	H
3812.94	150	93	-52.15	-13	-39.15	Pass	H
5886.53	146	128	-43.56	-13	-30.56	Pass	H
6402.95	149	295	-50.30	-13	-37.30	Pass	H
7929.57	151	88	-46.72	-13	-33.72	Pass	H
1196.36	149	174	-53.93	-13	-40.93	Pass	V
1365.58	148	34	-57.29	-13	-44.29	Pass	V
3504.78	147	186	-53.29	-13	-40.29	Pass	V
3899.02	148	260	-49.94	-13	-36.94	Pass	V
5802.09	150	224	-49.72	-13	-36.72	Pass	V
6517.31	150	53	-47.69	-13	-34.69	Pass	V

Band 2 19193 channel/BW 1.4 (highest channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1340.71	145	28	-56.73	-13	-43.73	Pass	H
1669.90	146	86	-52	-13	-39	Pass	H
3845.50	148	0	-45.66	-13	-32.66	Pass	H
5906.91	151	340	-40.96	-13	-27.96	Pass	H
6531.65	154	316	-42.47	-13	-29.47	Pass	H
8000.07	152	176	-44.74	-13	-31.74	Pass	H
1257.63	153	178	-56.49	-13	-43.49	Pass	V
1403.18	154	162	-56.84	-13	-43.84	Pass	V
3525.24	152	321	-52.79	-13	-39.79	Pass	V
3912.13	147	28	-48.59	-13	-35.59	Pass	V
5788.31	154	303	-43.05	-13	-30.05	Pass	V
6576.29	155	114	-47.76	-13	-34.76	Pass	V

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Band 2 18607 channel/BW 1.4(lowest channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1408.38	148	101	-58.03	-13	-45.03	Pass	H
1617.64	151	9	-48.30	-13	-35.30	Pass	H
3923.07	145	113	-49.54	-13	-36.54	Pass	H
5894.01	149	349	-43.86	-13	-30.86	Pass	H
6656.79	151	151	-41.98	-13	-28.98	Pass	H
7967.43	148	120	-40.14	-13	-27.14	Pass	H
1261.81	146	17	-54.92	-13	-41.92	Pass	V
1372.53	146	291	-58.00	-13	-45.00	Pass	V
3543.88	149	316	-48.62	-13	-35.62	Pass	V
3952.98	148	211	-52.61	-13	-39.61	Pass	V
5952.95	150	141	-44.31	-13	-31.31	Pass	V
6496.28	147	133	-46.57	-13	-33.57	Pass	V

Band 2 18900 channel/BW 1.4 (middle channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1249.05	149	58	-51.66	-13	-41.45	Pass	H
1784.58	148	111	-47.96	-13	-37.85	Pass	H
3915.03	145	10	-46.64	-13	-35.2	Pass	H
5983.89	145	194	-40.37	-13	-30.39	Pass	H
6445.59	153	50	-45.18	-13	-32.24	Pass	H
8139.13	146	72	-44.07	-13	-30.22	Pass	H
1098.43	155	253	-56.10	-13	-44.9	Pass	V
1467.19	146	345	-57.22	-13	-43.63	Pass	V
3576.86	146	10	-46.99	-13	-35.94	Pass	V
3832.92	149	174	-47.67	-13	-36.01	Pass	V
5854.75	153	156	-44.58	-13	-33.75	Pass	V
6606.43	147	133	-45.65	-13	-32.41	Pass	V

Band 2 19193 channel/BW 1.4 (highest channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1430.02	146	226	-56.89	-13	-43.89	Pass	H
1630.46	148	96	-47.41	-13	-34.41	Pass	H
3842.51	146	74	-43.41	-13	-30.41	Pass	H
5896.31	147	187	-39.15	-13	-26.15	Pass	H
6606.63	155	62	-40.29	-13	-27.29	Pass	H
8124.81	148	267	-42.36	-13	-29.36	Pass	H
1300.02	148	156	-53.63	-13	-40.63	Pass	V
1540.45	155	121	-59.82	-13	-46.82	Pass	V
3603.08	145	237	-46.83	-13	-33.83	Pass	V
3754.75	150	22	-50.68	-13	-37.68	Pass	V
5837.10	153	341	-47.54	-13	-34.54	Pass	V
6488.24	154	86	-44.63	-13	-31.63	Pass	V

Note:

1) Scan from 9kHz to 25GHz, the disturbance above 13GHz and below 1GHz are attenuated more than 20 dB below the applicable limit and not required to be reported, the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed.

2) Tested with all kind of bandwidth, RB Size and RB Offset, Found the 1.4MHz with full RB were the worst case; and then Only the worst case is recorded in the report.

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Band 4 19957 channel/BW 1.4(lowest channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1314.73	156	176	-55.45	-13	-42.45	Pass	H
1852.68	145	102	-53.16	-13	-40.16	Pass	H
3955.13	158	184	-48.48	-13	-35.48	Pass	H
5889.58	157	47	-44.19	-13	-31.19	Pass	H
6540.63	150	331	-45.56	-13	-32.56	Pass	H
7899.21	143	157	-48.31	-13	-35.31	Pass	H
1201.39	142	189	-54.91	-13	-41.91	Pass	V
1475.10	159	356	-58.58	-13	-45.58	Pass	V
3589.54	159	1	-55.16	-13	-42.16	Pass	V
3907.70	150	190	-50.90	-13	-37.90	Pass	V
5847.62	158	58	-46.16	-13	-33.16	Pass	V
6493.21	158	293	-46.86	-13	-33.86	Pass	V

Band 4 20175 channel/BW 1.4 (middle channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1237.36	150	331	-57.68	-13	-44.68	Pass	H
1811.48	146	70	-51.57	-13	-38.57	Pass	H
3834.37	150	243	-48.65	-13	-35.65	Pass	H
5773.80	146	186	-42.87	-13	-29.87	Pass	H
6520.17	149	213	-48.00	-13	-35.00	Pass	H
7977.62	151	315	-47.28	-13	-34.28	Pass	H
1277.91	149	135	-55.00	-13	-42.00	Pass	V
1453.63	148	18	-61.28	-13	-48.28	Pass	V
3543.08	147	343	-51.00	-13	-38.00	Pass	V
3833.26	148	57	-48.60	-13	-35.60	Pass	V
5911.44	150	45	-45.86	-13	-32.86	Pass	V
6482.43	150	344	-50.40	-13	-37.40	Pass	V

Band 4 20393 channel/BW 1.4 (highest channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1340.71	148	358	-56.73	-13	-43.73	Pass	H
1669.90	146	209	-52	-13	-39	Pass	H
3845.50	147	100	-45.66	-13	-32.66	Pass	H
5906.91	146	298	-40.96	-13	-27.96	Pass	H
6531.65	153	286	-42.47	-13	-29.47	Pass	H
8000.07	152	269	-44.74	-13	-31.74	Pass	H
1257.63	149	156	-56.49	-13	-43.49	Pass	V
1403.18	151	354	-56.84	-13	-43.84	Pass	V
3525.24	148	331	-52.79	-13	-39.79	Pass	V
3912.13	155	22	-48.59	-13	-35.59	Pass	V
5788.31	147	151	-43.05	-13	-30.05	Pass	V
6576.29	146	265	-47.76	-13	-34.76	Pass	V

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Band 4 19957 channel/BW 1.4(lowest channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1254.79	152	346	-57.93	-13	-44.93	Pass	H
1772.48	150	159	-48.72	-13	-35.72	Pass	H
3898.25	154	142	-51.42	-13	-38.42	Pass	H
5905.57	146	142	-45.87	-13	-32.87	Pass	H
6607.14	152	332	-45.99	-13	-32.99	Pass	H
8070.29	149	120	-43.76	-13	-30.76	Pass	H
1254.37	153	324	-52.10	-13	-39.10	Pass	V
1427.09	152	131	-55.00	-13	-42.00	Pass	V
3643.18	154	21	-54.37	-13	-41.37	Pass	V
3914.75	146	106	-48.92	-13	-35.92	Pass	V
5779.70	151	348	-45.87	-13	-32.87	Pass	V
6583.48	153	273	-46.84	-13	-33.84	Pass	V

Band 4 20175 channel/BW 1.4 (middle channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1387.22	150	346	-53.13	-13	-41.45	Pass	H
1692.28	146	332	-51.13	-13	-37.85	Pass	H
3777.64	146	175	-49.20	-13	-35.2	Pass	H
5889.77	154	78	-41.18	-13	-30.39	Pass	H
6425.38	148	227	-45.38	-13	-32.24	Pass	H
8003.49	145	157	-43.82	-13	-30.22	Pass	H
1164.93	151	209	-55.72	-13	-44.9	Pass	V
1308.81	152	241	-56.80	-13	-43.63	Pass	V
3574.03	151	126	-49.51	-13	-35.94	Pass	V
3853.83	150	288	-46.73	-13	-36.01	Pass	V
5869.86	148	248	-49.70	-13	-33.75	Pass	V
6492.68	148	178	-46.40	-13	-32.41	Pass	V

Band 4 20393 channel/BW 1.4 (highest channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1342.71	153	300	-57.01	-13	-44.01	Pass	H
1777.71	153	67	-52.17	-13	-39.17	Pass	H
3897.71	149	118	-42.56	-13	-29.56	Pass	H
5976.25	150	335	-42.11	-13	-29.11	Pass	H
6500.01	153	254	-43.72	-13	-30.72	Pass	H
8008.10	150	278	-47.18	-13	-34.18	Pass	H
1176.60	151	86	-54.89	-13	-41.89	Pass	V
1557.47	149	42	-56.65	-13	-43.65	Pass	V
3459.19	148	323	-51.70	-13	-38.70	Pass	V
3853.94	148	208	-49.24	-13	-36.24	Pass	V
5727.14	147	333	-47.47	-13	-34.47	Pass	V
6637.10	150	281	-42.88	-13	-29.88	Pass	V

Note:

1)Scan from 9kHz to 25GHz, the disturbance above 13GHz and below 1GHz are attenuated more than 20 dB below the applicable limit and not required to be reported, the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed.

2)Tested with all kind of bandwidth, RB Size and RB Offset, Found the 1.4MHz with full RB were the worst case; and then Only the worst case is recorded in the report.

QPSK

Band 12 23017 channel/BW 1.4(lowest channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1361.10	145	111	-54.30	-13	-41.30	Pass	H
1803.25	147	171	-50.11	-13	-37.11	Pass	H
3841.95	157	235	-51.46	-13	-38.46	Pass	H
5881.30	157	60	-44.90	-13	-31.90	Pass	H
6401.30	153	328	-43.09	-13	-30.09	Pass	H
7991.89	157	49	-49.53	-13	-36.53	Pass	H
1237.87	144	343	-55.74	-13	-42.74	Pass	V
1395.10	147	120	-59.17	-13	-46.17	Pass	V
3519.90	142	256	-54.68	-13	-41.68	Pass	V
3874.08	155	194	-49.67	-13	-36.67	Pass	V
5793.69	147	174	-43.88	-13	-30.88	Pass	V
6476.40	159	79	-48.08	-13	-35.08	Pass	V

Band 12 23095 channel/BW 1.4 (middle channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1305.02	150	37	-56.64	-13	-43.64	Pass	H
1656.98	146	187	-51.68	-13	-38.68	Pass	H
3829.96	150	283	-52.78	-13	-39.78	Pass	H
5871.86	146	205	-45.89	-13	-32.89	Pass	H
6409.32	149	145	-50.00	-13	-37.00	Pass	H
8071.57	151	166	-49.43	-13	-36.43	Pass	H
1234.94	149	80	-55.46	-13	-42.46	Pass	V
1420.92	148	60	-60.95	-13	-47.95	Pass	V
3542.31	147	231	-52.31	-13	-39.31	Pass	V
3857.50	148	339	-51.09	-13	-38.09	Pass	V
5735.29	150	60	-51.00	-13	-38.00	Pass	V
6504.72	150	280	-50.10	-13	-37.10	Pass	V

Band 12 23173 channel/BW 1.4 (highest channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1340.71	150	112	-56.73	-13	-43.73	Pass	H
1669.90	146	333	-52	-13	-39	Pass	H
3845.50	152	308	-45.66	-13	-32.66	Pass	H
5906.91	155	255	-40.96	-13	-27.96	Pass	H
6531.65	148	14	-42.47	-13	-29.47	Pass	H
8000.07	150	295	-44.74	-13	-31.74	Pass	H
1257.63	152	264	-56.49	-13	-43.49	Pass	V
1403.18	151	101	-56.84	-13	-43.84	Pass	V
3525.24	153	75	-52.79	-13	-39.79	Pass	V
3912.13	148	311	-48.59	-13	-35.59	Pass	V
5788.31	150	341	-43.05	-13	-30.05	Pass	V
6576.29	147	189	-47.76	-13	-34.76	Pass	V

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Band 12 23017 channel/BW 1.4(lowest channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1386.98	149	117	-57.28	-13	-44.28	Pass	H
1763.49	152	157	-47.55	-13	-34.55	Pass	H
3788.13	147	141	-51.69	-13	-38.69	Pass	H
5843.15	148	334	-44.05	-13	-31.05	Pass	H
6635.57	149	44	-47.10	-13	-34.10	Pass	H
8097.52	145	356	-43.86	-13	-30.86	Pass	H
1188.20	155	342	-55.34	-13	-42.34	Pass	V
1358.92	150	312	-56.98	-13	-43.98	Pass	V
3587.85	154	290	-50.18	-13	-37.18	Pass	V
3997.01	146	27	-48.85	-13	-35.85	Pass	V
5775.58	153	254	-44.30	-13	-31.30	Pass	V
6504.84	148	73	-46.54	-13	-33.54	Pass	V

Band 12 23095 channel/BW 1.4 (middle channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1399.68	154	158	-53.45	-13	-41.45	Pass	H
1694.54	153	198	-50.71	-13	-37.85	Pass	H
3794.77	147	205	-44.70	-13	-35.2	Pass	H
5939.31	149	46	-44.73	-13	-30.39	Pass	H
6580.36	149	219	-41.50	-13	-32.24	Pass	H
8129.37	149	173	-40.63	-13	-30.22	Pass	H
1282.06	154	171	-55.27	-13	-44.9	Pass	V
1464.57	151	211	-59.11	-13	-43.63	Pass	V
3625.38	153	52	-49.20	-13	-35.94	Pass	V
3882.81	146	47	-51.30	-13	-36.01	Pass	V
5812.12	150	330	-48.71	-13	-33.75	Pass	V
6533.74	150	152	-43.35	-13	-32.41	Pass	V

Band 12 23173 channel/BW 1.4 (highest channel)							
Frequency (MHz)	Height (cm)	Azimuth (deg)	Spurious Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	Antenna Polaxis.
1428.39	149	163	-58.43	-13	-45.43	Pass	H
1714.25	153	18	-51.65	-13	-38.65	Pass	H
3917.99	153	3	-45.74	-13	-32.74	Pass	H
5791.00	153	61	-45.29	-13	-32.29	Pass	H
6535.90	152	87	-43.09	-13	-30.09	Pass	H
8114.00	155	144	-46.17	-13	-33.17	Pass	H
1294.91	146	83	-52.60	-13	-39.60	Pass	V
1508.70	149	277	-56.80	-13	-43.80	Pass	V
3535.30	145	330	-51.61	-13	-38.61	Pass	V
3837.89	149	205	-47.19	-13	-34.19	Pass	V
5874.63	153	83	-48.22	-13	-35.22	Pass	V
6632.33	146	217	-47.41	-13	-34.41	Pass	V

Note:

1) Scan from 9kHz to 25GHz, the disturbance above 13GHz and below 1GHz are attenuated more than 20 dB below the applicable limit and not required to be reported, the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed.

2) Tested with all kind of bandwidth, RB Size and RB Offset, Found the 1.4MHz with full RB were the worst case; and then Only the worst case is recorded in the report.

12. FREQUENCY STABILITY

12.1 Standard Applicable

According to §22.355, §24.235, §27.54 the limit is 2.5ppm.

12.2 Test Procedure

According to §2.1055, the following test procedure was performed.

The Frequency Stability is measured directly with a Frequency Domain Analyzer. Frequency Deviation in ppm is calculated from the measured peak to peak value.

The Carrier Frequency Stability over Power Supply Voltage and over Temperature is measured with a

Frequency Domain Analyzer in histogram mode

12.3 Summary of Test Results/Plots

Note: 1.Normal Voltage NV=DC12.0V; Low Voltage LV=DC10.8V; High Voltage HV=DC13.2V

Please refer to Appendix F: Frequency Stability

Test result: Pass

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