FCC Test Report

FCC ID	:	**2AF4TWAPS232N**
Equipment	:	**RFID IOT Access Point**
Model No.	:	**WAPS-232N_AS**
Brand Name	:	**Synin**
Applicant	:	**Synin Corporation**
Address	:	**2F., No.14, Ln.123, Sec.6, Minquan E. Rd., Neihu Dist.,Taipei City 11490, Taiwan (R.O.C)**
Standard	:	**47 CFR FCC Part 15.247**
Received Date	:	**Oct. 13, 2015**
Tested Date	:	**Nov. 26 ~ Dec. 02, 2015**

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Approved & Reviewed by:

Gary Chang / Manager

Testing Laboratory
2732

Table of Contents

1 GENERAL DESCRIPTION 5

1.1 Information 5
1.2 Local Support Equipment List 6
1.3 Test Setup Chart 6
1.4 The Equipment List 7
1.5 Test Standards 8
1.6 Measurement Uncertainty 8

2 TEST CONFIGURATION 9

2.1 Testing Condition 9
2.2 The Worst Test Modes and Channel Details 9

3 TRANSMITTER TEST RESULTS 10

3.1 Conducted Emissions 10
3.2 6dB and Occupied Bandwidth 17
3.3 RF Output Power 20
3.4 Power Spectral Density 22
3.5 Unwanted Emissions into Restricted Frequency Bands 24
3.6 Emissions in Non-Restricted Frequency Bands 38

4 TEST LABORATORY INFORMATION 41

Release Record

Report No.	Version	Description	Issued Date
FR562201-01-2	Rev. 01	Initial issue	Dec. 15, 2015

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	[dBuV]: 0.433MHz 33.81 (Margin -13.39dB) - AV	Pass
15.247(d) 15.209	Radiated Emissions	[dBuV/m at 3m]: 2709.00MHz 52.87 (Margin -1.13dB) - AV	Pass
15.247(b)(3)	Maximum Output Power	Max Power [dBm]: 27.54	Pass
15.247(a)(2)	6dB Bandwidth	Meet the requirement of limit	Pass
15.247(e)	Power Spectral Density	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information						
Frequency Range (MHz)	Ch. Freq. (MHz)	Channel Number	Transmit Chains (N_{TX})	Data Rate (bit/sec)	Spread Factor	Channel Spacing (kHz)
902 ~ 928	903 ~ 924	5 ~ 86 [10]	1	1172 ~ 21875	12 ~ 7	500
Note 1: RF output power specifies thatMaximum Conducted (Average) Output Power. Note 2: The device uses CSS modulation.						

1.1.2 Antenna Details

Ant. No.	Brand	Model	Type	Gain (dBi)	Connector	Remark
1	TSKY Co., Ltd.	A8-A003-00108	Dipole	-0.4	N -Type Male	---

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	55Vdc from POE

1.1.4 Accessories

Accessories		
No.	Equipment	Description
1	POE	Brand: Microsemi Model: PD-9001GR/AC Power Rating: I/P: 100-240Vac, 50-60Hz, 0.67A O/P: 55Vdc, 0.6A

1.1.5 Channel List

Frequency band (MHz)		902 ~ 928	
Channel	Frequency(MHz)	Channel	Frequency(MHz)
5	903	50	911
14	904.6	59	912.6
23	906.2	68	914.2
32	907.8	79	922
41	909.4	86	924

1.1.6 Test Tool and Duty Cycle

Test Tool	Putty, Ver. 0.60.0.0	
Duty Cycle and Duty Factor	Duty cycle (%)	Duty factor (dB)
	100%	0

1.1.7 Power Setting

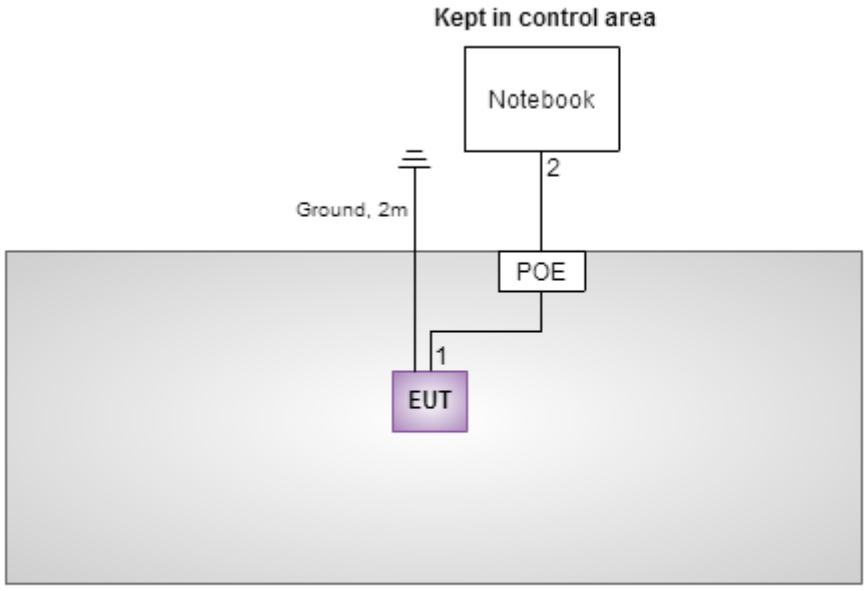
Modulation Mode	Test Frequency (MHz)	Power Set
CSS	903	13
	909.4	15
	924	15

1.2 Local Support Equipment List

Support Equipment List					
No.	Equipment	Brand	Model	FCC ID	Signal cable / Length (m)
1	Notebook	DELL	Latitude E6430	DoC	RJ45, 10m non-shielded.

1.3 Test Setup Chart

Test Setup Diagram



1. RJ45, 1.25m shielded.
2. RJ45, 10m non-shielded.

1.4 The Equipment List

Test Item	Conducted Emission				
Test Site	Conduction room 1 / (CO01-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
EMC Receiver	R&S	ESCS 30	100169	Oct. 21, 2015	Oct. 20, 2016
LISN	SCHWARZBECK	Schwarzbeck 8127	8127-667	Nov. 13, 2015	Nov. 12, 2016
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Dec. 31, 2014	Dec. 30, 2015
Measurement Software	AUDIX	e3	6.120210k	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emission				
Test Site	966 chamber1 / (03CH01-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101498	Dec. 09, 2014	Dec. 08, 2015
Receiver	R&S	ESR3	101658	Nov. 04, 2015	Nov. 03, 2016
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Aug. 20, 2015	Aug. 19, 2016
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 11, 2014	Dec. 10, 2015
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 04, 2015	Nov. 03, 2016
Loop Antenna	R&S	HFH2-Z2	11900	Nov. 16, 2015	Nov. 15, 2016
Preamplifier	Burgeon	BPA-530	SN:100219	Sep. 10, 2015	Sep. 09, 2016
Preamplifier	Agilent	83017A	MY39501308	Oct. 02, 2015	Oct. 01, 2016
Preamplifier	EMC	EMC184045B	980192	Sep. 01, 2015	Aug. 31, 2016
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Dec. 15, 2014	Dec. 14, 2015
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Dec. 15, 2014	Dec. 14, 2015
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16139/4	Dec. 15, 2014	Dec. 14, 2015
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Dec. 15, 2014	Dec. 14, 2015
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Dec. 15, 2014	Dec. 14, 2015
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101063	Feb. 03, 2015	Feb. 02, 2016
Power Meter	Anritsu	ML2495A	1241002	Sep. 21, 2015	Sep. 20, 2016
Power Sensor	Anritsu	MA2411B	1207366	Sep. 21, 2015	Sep. 20, 2016
Signal Generator	R&S	SMB100A	175727	Oct. 05, 2015	Oct. 04, 2016
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.247
ANSI C63.10-2013
FCC KDB 558074 D01 DTS Meas Guidance v03r03

1.6 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty	
Parameters	**Uncertainty**
Bandwidth	±34.134 Hz
Conducted power	±0.808 dB
Power density	±0.463 dB
Conducted emission	±2.670 dB
AC conducted emission	±2.90 dB
Radiated emission ≤ 1GHz	±3.72 dB
Radiated emission > 1GHz	±5.65 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
AC Conduction	CO01-WS	22°C / 49%	Peter Lin
Radiated Emissions	03CH01-WS	21-23°C / 61-65%	Aska Huang Warren Lee
RF Conducted	TH01-WS	22°C / 64%	Alex Huang

- FCC site registration No.: 657002
- IC site registration No.: 10807A-1

2.2 The Worst Test Modes and Channel Details

Test item	Test Frequency (MHz)	Modulation / SF	Test Configuration
Conducted Emissions	903 / 909.4 / 924	CSS / 12	---
Radiated Emissions ≤1GHz	903 / 909.4 / 924	CSS / 12	---
Radiated Emissions >1GHz Maximum Output Power 6dB bandwidth Power spectral density	903 / 909.4 / 924	CSS / 12	---

3 Transmitter Test Results

3.1 Conducted Emissions

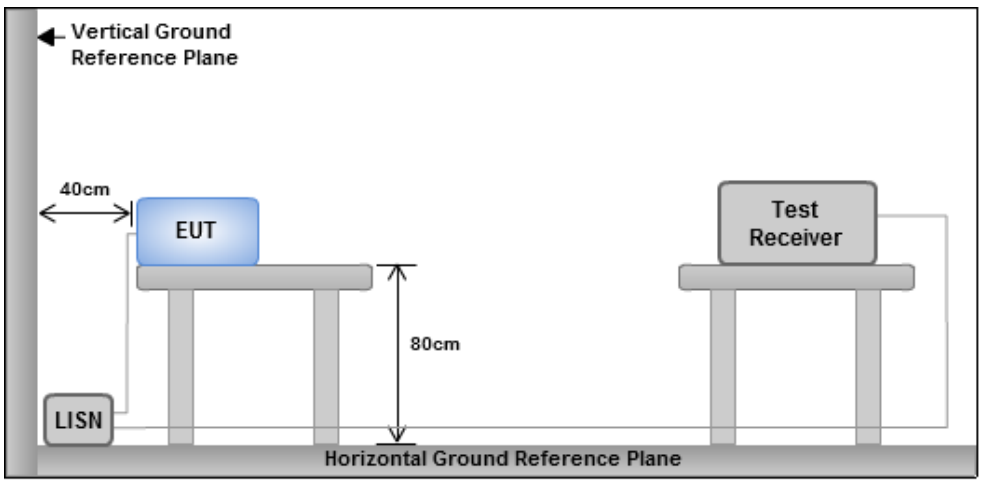
3.1.1 Limit of Conducted Emissions

Conducted Emissions Limit		
Frequency Emission (MHz)	**Quasi-Peak**	**Average**
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note 1: * Decreases with the logarithm of the frequency.		

3.1.2 Test Procedures

1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
4. This measurement was performed with AC 120V / 60Hz.

3.1.3 Test Setup

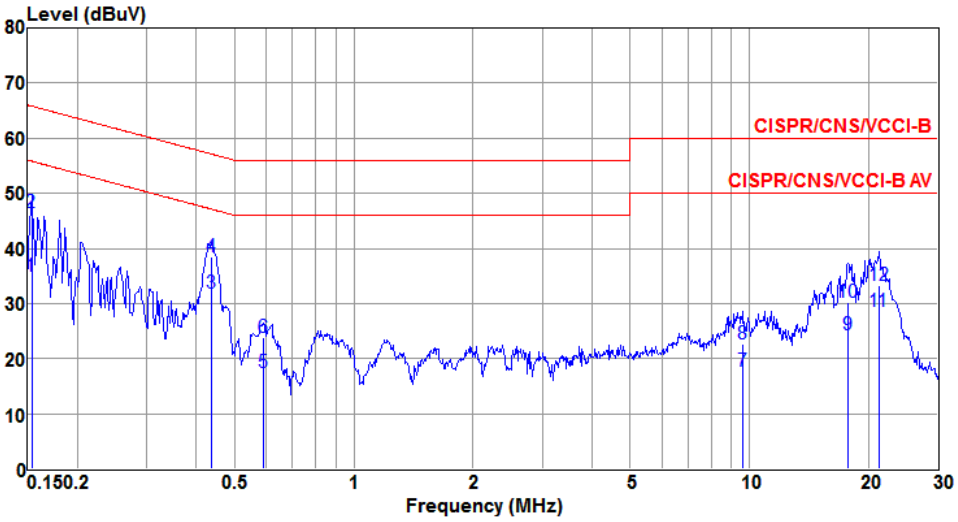


Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

3.1.4 Test Result of Conducted Emissions

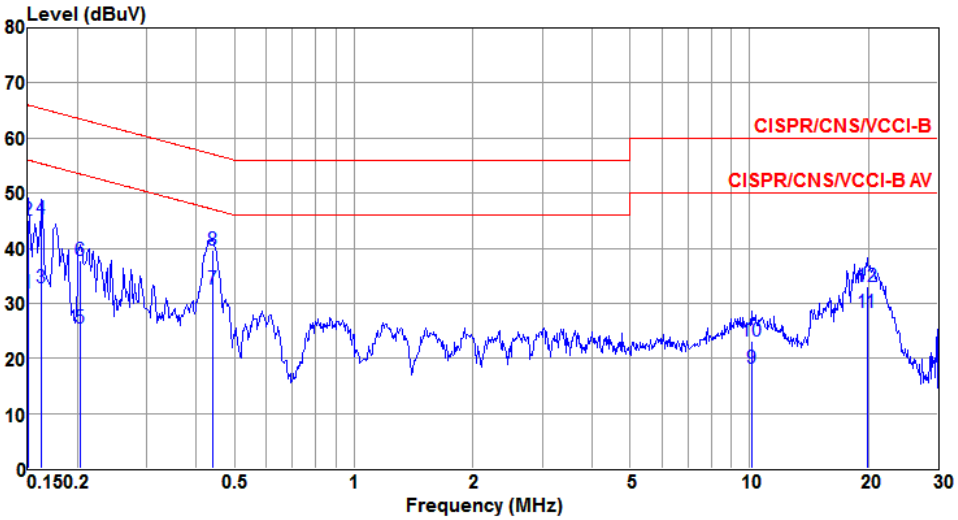
Modulation / SF	CSS / 12	Test Freq. (MHz)	903
Power Phase	Line		



	Freq	Level	Limit Line	Over Limit	Read Level	LISN factor	cable loss	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	dB	
1	0.153	34.97	55.82	-20.85	34.84	0.11	0.02	Average
2	0.153	46.47	65.82	-19.35	46.34	0.11	0.02	QP
3@	0.437	31.80	47.11	-15.31	31.64	0.13	0.03	Average
4	0.437	38.49	57.11	-18.62	38.33	0.13	0.03	QP
5	0.592	17.36	46.00	-28.64	17.19	0.13	0.04	Average
6	0.592	23.83	56.00	-32.17	23.66	0.13	0.04	QP
7	9.654	17.71	50.00	-32.29	17.31	0.24	0.16	Average
8	9.654	22.77	60.00	-37.23	22.37	0.24	0.16	QP
9	17.755	24.34	50.00	-25.66	23.80	0.35	0.19	Average
10	17.755	30.31	60.00	-29.69	29.77	0.35	0.19	QP
11	21.260	28.63	50.00	-21.37	28.06	0.38	0.19	Average
12	21.260	33.25	60.00	-26.75	32.68	0.38	0.19	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

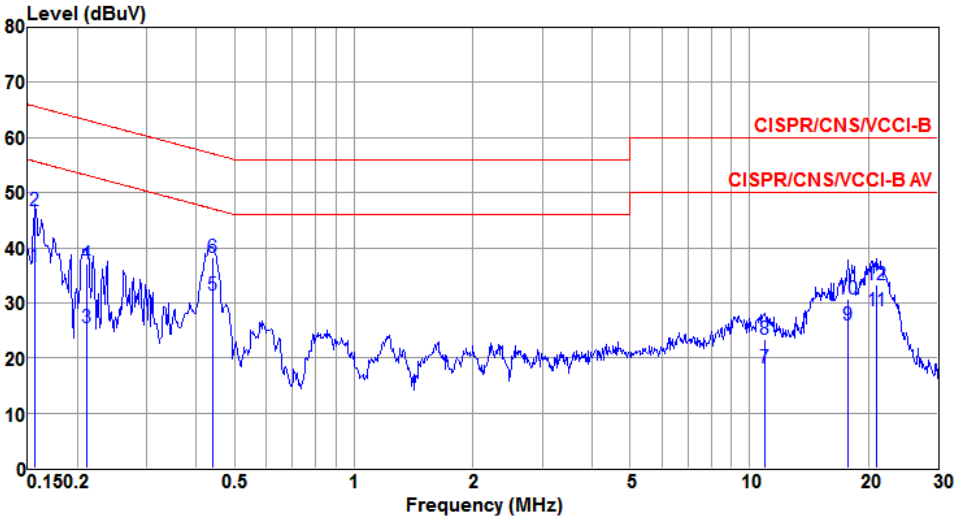
Modulation / SF	CSS / 12	Test Freq. (MHz)	903
Power Phase	Neutral		



	Freq	Level	Limit Line	Over Limit	Read Level	LISN factor	cable loss	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	dB	
1	0.150	31.76	56.00	-24.24	31.61	0.13	0.02	Average
2	0.150	45.18	66.00	-20.82	45.03	0.13	0.02	QP
3	0.162	32.77	55.34	-22.57	32.63	0.12	0.02	Average
4	0.162	45.34	65.34	-20.00	45.20	0.12	0.02	QP
5	0.204	25.51	53.45	-27.94	25.39	0.10	0.02	Average
6	0.204	37.70	63.45	-25.75	37.58	0.10	0.02	QP
7@	0.440	32.59	47.07	-14.48	32.42	0.14	0.03	Average
8	0.440	39.55	57.07	-17.52	39.38	0.14	0.03	QP
9	10.125	18.23	50.00	-31.77	17.80	0.27	0.16	Average
10	10.125	23.11	60.00	-36.89	22.68	0.27	0.16	QP
11	19.845	28.39	50.00	-21.61	27.82	0.40	0.17	Average
12	19.845	32.99	60.00	-27.01	32.42	0.40	0.17	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

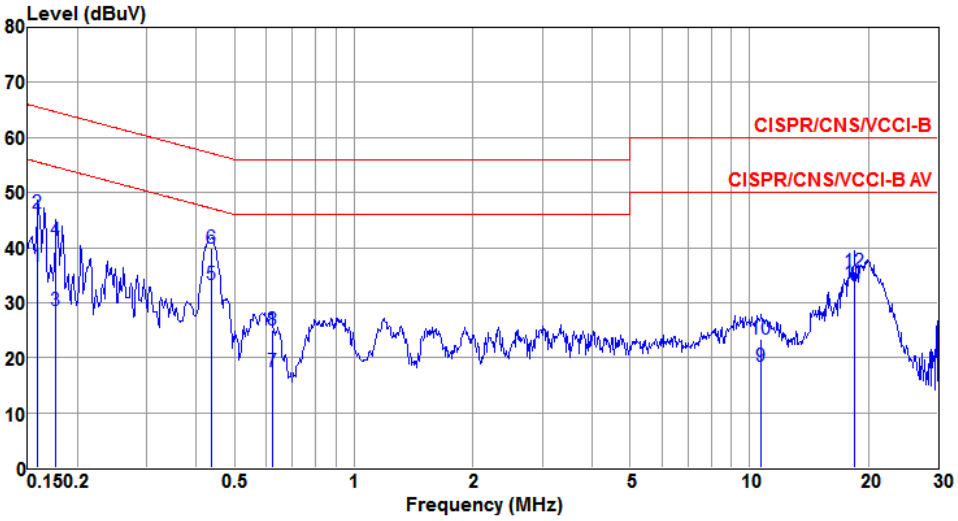
Modulation / SF	CSS / 12	Test Freq. (MHz)	909.4
Power Phase	Line		



	Freq	Level	Limit Line	Over Limit	Read Level	LISN factor	cable loss	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	dB	
1	0.156	36.66	55.65	-18.99	36.53	0.11	0.02	Average
2	0.156	46.66	65.65	-18.99	46.53	0.11	0.02	QP
3	0.211	25.44	53.18	-27.74	25.31	0.11	0.02	Average
4	0.211	37.15	63.18	-26.03	37.02	0.11	0.02	QP
5@	0.440	31.40	47.07	-15.67	31.24	0.13	0.03	Average
6	0.440	38.32	57.07	-18.75	38.16	0.13	0.03	QP
7	10.963	18.18	50.00	-31.82	17.75	0.26	0.17	Average
8	10.963	23.39	60.00	-36.61	22.96	0.26	0.17	QP
9	17.755	25.95	50.00	-24.05	25.41	0.35	0.19	Average
10	17.755	30.78	60.00	-29.22	30.24	0.35	0.19	QP
11	21.035	28.61	50.00	-21.39	28.04	0.38	0.19	Average
12	21.035	33.17	60.00	-26.83	32.60	0.38	0.19	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

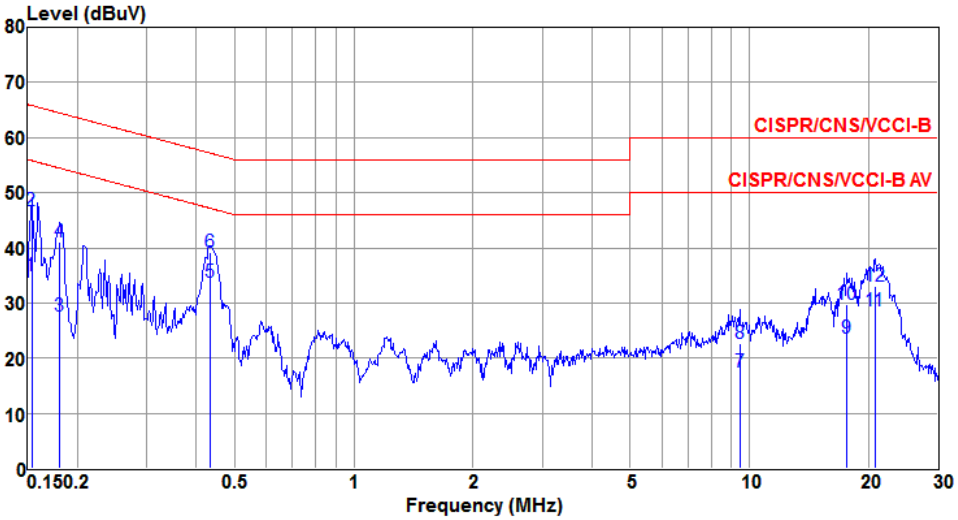
Modulation / SF	CSS / 12	Test Freq. (MHz)	909.4
Power Phase	Neutral		



	Freq	Level	Limit Line	Over Limit	Read Level	LISN factor	cable loss	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	dB	
1	0.159	36.57	55.52	-18.95	36.43	0.12	0.02	Average
2	0.159	46.26	65.52	-19.26	46.12	0.12	0.02	QP
3	0.177	28.59	54.64	-26.05	28.46	0.11	0.02	Average
4	0.177	41.38	64.64	-23.26	41.25	0.11	0.02	QP
5@	0.437	33.39	47.11	-13.72	33.22	0.14	0.03	Average
6	0.437	40.00	57.11	-17.11	39.83	0.14	0.03	QP
7	0.621	17.57	46.00	-28.43	17.39	0.14	0.04	Average
8	0.621	25.07	56.00	-30.93	24.89	0.14	0.04	QP
9	10.733	18.47	50.00	-31.53	18.02	0.28	0.17	Average
10	10.733	23.26	60.00	-36.74	22.81	0.28	0.17	QP
11	18.434	33.59	50.00	-16.41	33.03	0.38	0.18	Average
12	18.434	35.75	60.00	-24.25	35.19	0.38	0.18	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

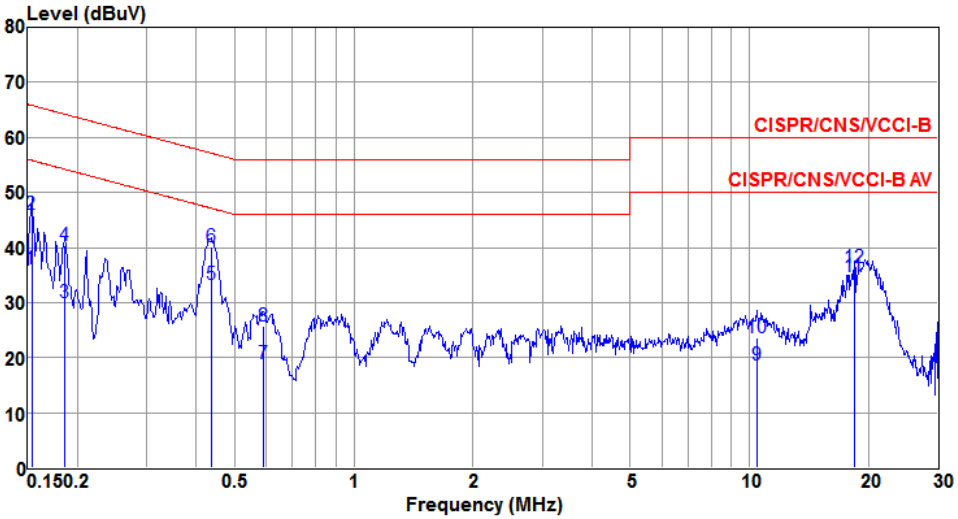
Modulation / SF	CSS / 12	Test Freq. (MHz)	924
Power Phase	Line		



	Freq	Level	Limit Line	Over Limit	Read Level	LISN factor	cable loss	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	dB	
1	0.153	34.91	55.82	-20.91	34.78	0.11	0.02	Average
2	0.153	46.63	65.82	-19.19	46.50	0.11	0.02	QP
3	0.181	27.69	54.46	-26.77	27.56	0.11	0.02	Average
4	0.181	41.12	64.46	-23.34	40.99	0.11	0.02	QP
5@	0.433	33.81	47.20	-13.39	33.65	0.13	0.03	Average
6	0.433	39.11	57.20	-18.09	38.95	0.13	0.03	QP
7	9.451	17.45	50.00	-32.55	17.05	0.24	0.16	Average
8	9.451	22.66	60.00	-37.34	22.26	0.24	0.16	QP
9	17.568	23.71	50.00	-26.29	23.17	0.35	0.19	Average
10	17.568	29.68	60.00	-30.32	29.14	0.35	0.19	QP
11	20.814	28.47	50.00	-21.53	27.91	0.38	0.18	Average
12	20.814	33.10	60.00	-26.90	32.54	0.38	0.18	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

Modulation / SF	CSS / 12	Test Freq. (MHz)	924
Power Phase	Neutral		



	Freq	Level	Limit Line	Over Limit	Read Level	LISN factor	cable loss	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	dB	
1	0.153	36.09	55.82	-19.73	35.94	0.13	0.02	Average
2	0.153	45.96	65.82	-19.86	45.81	0.13	0.02	QP
3	0.186	29.94	54.20	-24.26	29.81	0.11	0.02	Average
4	0.186	40.37	64.20	-23.83	40.24	0.11	0.02	QP
5@	0.437	33.39	47.11	-13.72	33.22	0.14	0.03	Average
6	0.437	40.02	57.11	-17.09	39.85	0.14	0.03	QP
7	0.592	18.98	46.00	-27.02	18.80	0.14	0.04	Average
8	0.592	25.68	56.00	-30.32	25.50	0.14	0.04	QP
9	10.452	18.74	50.00	-31.26	18.30	0.28	0.16	Average
10	10.452	23.52	60.00	-36.48	23.08	0.28	0.16	QP
11	18.433	34.69	50.00	-15.31	34.13	0.38	0.18	Average
12	18.433	36.38	60.00	-23.62	35.82	0.38	0.18	QP

Note 1: Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB).
2: Over Limit (dB) = Level (dBuV) – Limit Line (dBuV).

3.2 6dB and Occupied Bandwidth

3.2.1 Limit of 6dB Bandwidth

The minimum 6dB bandwidth shall be at least 500 kHz.

3.2.2 Test Procedures

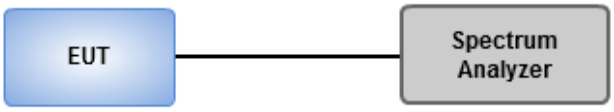
6dB Bandwidth

1. Set resolution bandwidth (RBW) = 100 kHz, Video bandwidth = 300 kHz.
2. Detector = Peak, Trace mode = max hold.
3. Sweep = auto couple, Allow the trace to stabilize.
4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

1. Set resolution bandwidth (RBW) = 10kHz, Video bandwidth = 30kHz.
2. Detector = Sample, Trace mode = max hold.
3 Sweep = auto couple, Allow the trace to stabilize.
4. Use the OBW measurement function of spectrum analyzer to measure the occupied bandwidth.

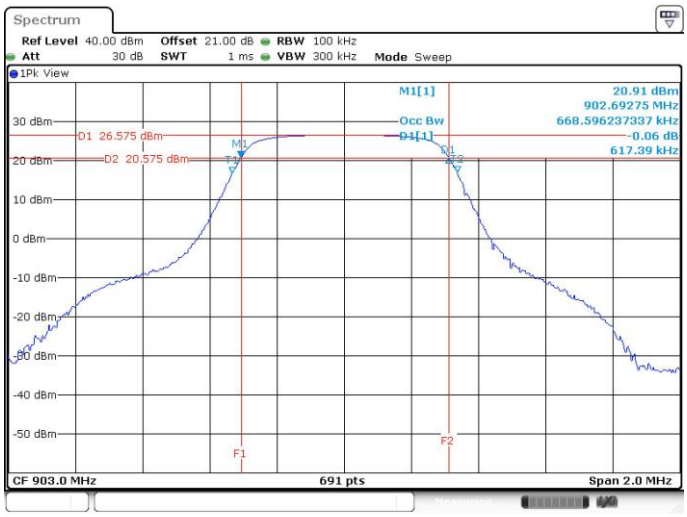
3.2.3 Test Setup



3.2.4 Test Result of 6dB and Occupied Bandwidth

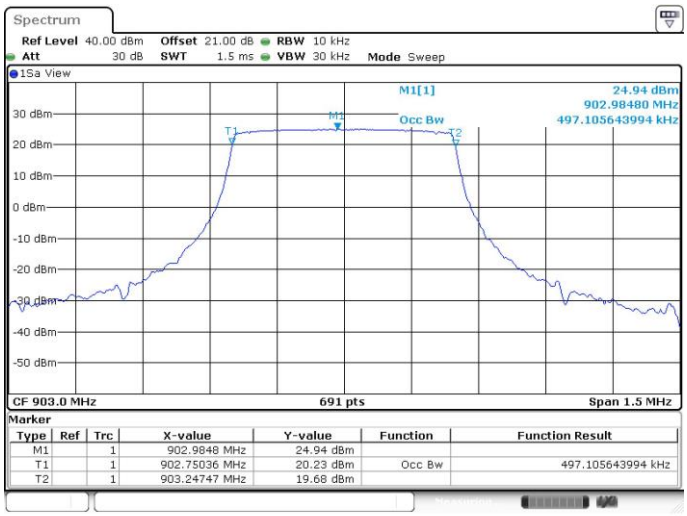
Modulation / SF	N_{TX}	Freq. (MHz)	6dB Bandwidth (MHz)				Limit (kHz)
			Chain 0	Chain 1	Chain 2	Chain 3	
CSS / 12	1	903	0.617	---	---	---	500
CSS / 12	1	909.4	0.632	---	---	---	500
CSS / 12	1	924	0.629	---	---	---	500

Worst Plot



Modulation / SF	N_{TX}	Freq. (MHz)	99% Occupied Bandwidth (MHz)			
			Chain 0	Chain 1	Chain 2	Chain 3
CSS / 12	1	903	0.497	---	---	---
CSS / 12	1	909.4	0.497	---	---	---
CSS / 12	1	924	0.497	---	---	---

Worst Plot



3.3 RF Output Power

3.3.1 Limit of RF Output Power

Conducted power shall not exceed 1Watt.

☒ Antenna gain <= 6dBi, no any corresponding reduction is in output power limit.

☐ Antenna gain > 6dBi

Transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi

3.3.2 Test Procedures

☐ Maximum Peak Conducted Output Power

☐ **Spectrum analyzer**

1. Set RBW = 1MHz, VBW = 3MHz, Detector = Peak.
2. Sweep time = auto, Trace mode = max hold, Allow trace to fully stabilize.
3. Use the spectrum analyzer channel power measurement function with the band limits set equal to the DTS bandwidth edges.

☐ **Power meter**

1. A broadband Peak RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.

☒ Maximum Conducted Output Power

☒ **Power meter**

1. A broadband Average RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.

3.3.3 Test Setup

3.3.4 Test Result of Maximum Output Power

Modulation / SF	N_{TX}	Freq. (MHz)	Output Power (mW)	Output Power (dBm)	Limit (dBm)
CSS / 12	1	903	470.977	26.73	30
CSS / 12	1	909.4	552.077	27.42	30
CSS / 12	1	924	567.545	**27.54**	30

3.4 Power Spectral Density

3.4.1 Limit of Power Spectral Density

Power spectral density shall not be greater than 8 dBm in any 3 kHz band.

3.4.2 Test Procedures

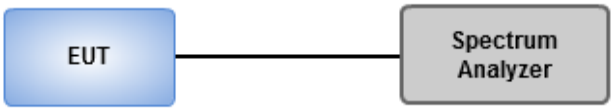
☒ Maximum peak conducted output power was used to demonstrate compliance to the fundamental output power limit.

1. Set the RBW = 3kHz, VBW = 10kHz.
2. Detector = Peak, Sweep time = auto couple.
3. Trace mode = max hold, allow trace to fully stabilize.
4. Use the peak marker function to determine the maximum amplitude level.

☐ Maximum (average) conducted output power was used to demonstrate compliance to the fundamental output power limit.

1. Set the RBW = 100kHz, VBW = 300 kHz.
2. Detector = RMS, Sweep time = auto couple.
3. Set the sweep time to: ≥ 10 x (number of measurement points in sweep) x (maximum data rate per stream).
4. Perform the measurement over a single sweep.
5. Use the peak marker function to determine the maximum amplitude level.

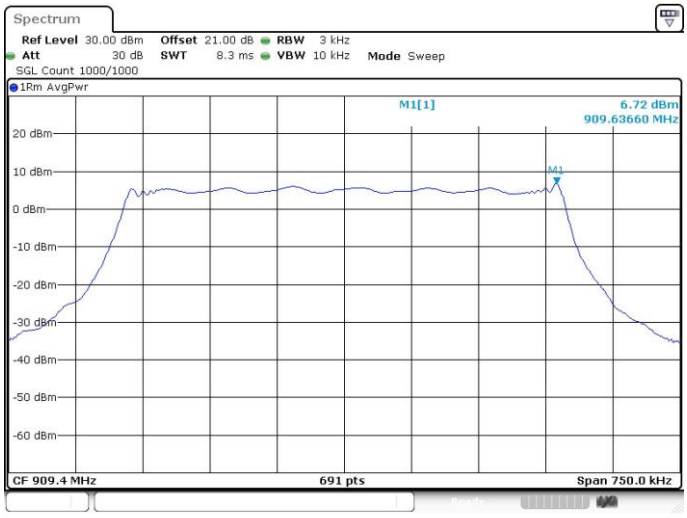
3.4.3 Test Setup



3.4.4 Test Result of Power Spectral Density

Modulation / SF	N_{TX}	Freq. (MHz)	Total Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
CSS / 12	1	903	5.29	8.00
CSS / 12	1	909.4	6.72	8.00
CSS / 12	1	924	6.55	8.00

Worst Plot



3.5 Unwanted Emissions into Restricted Frequency Bands

3.5.1 Limit of Unwanted Emissions into Restricted Frequency Bands

Restricted Band Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit
Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.5.2 Test Procedures

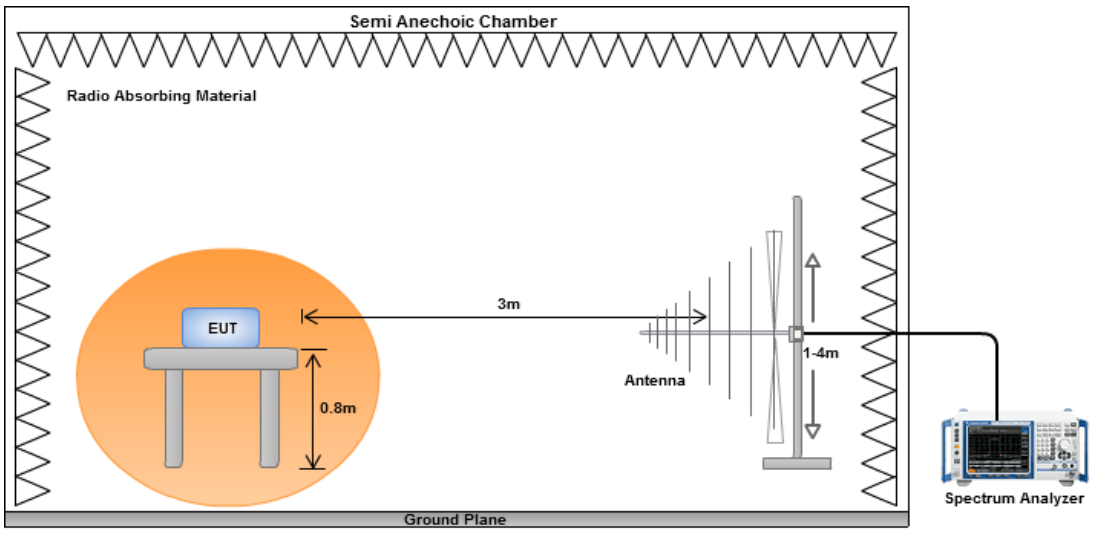
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

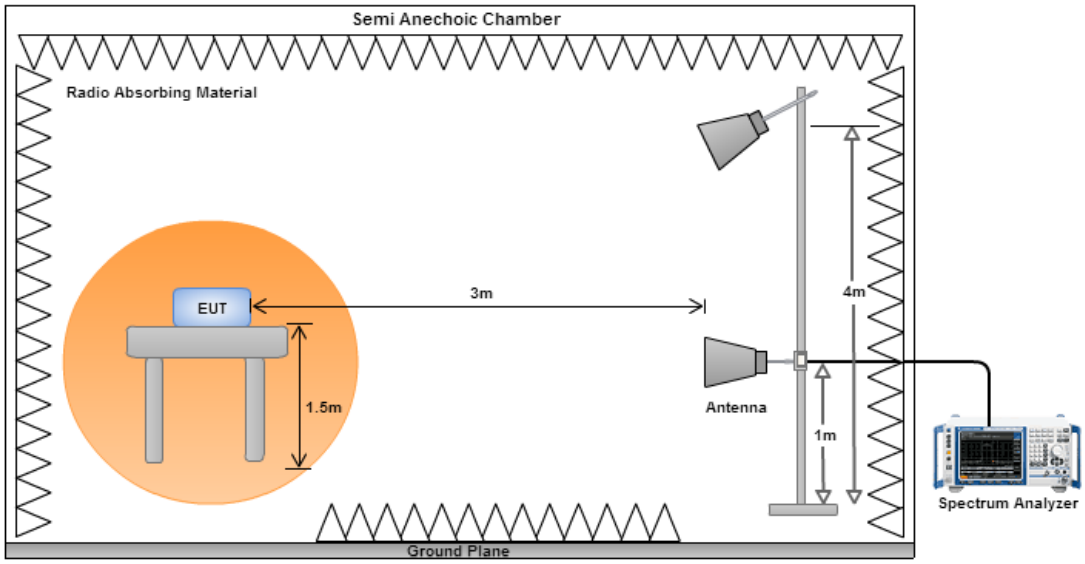
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

3.5.3 Test Setup

Radiated Emissions below 1 GHz

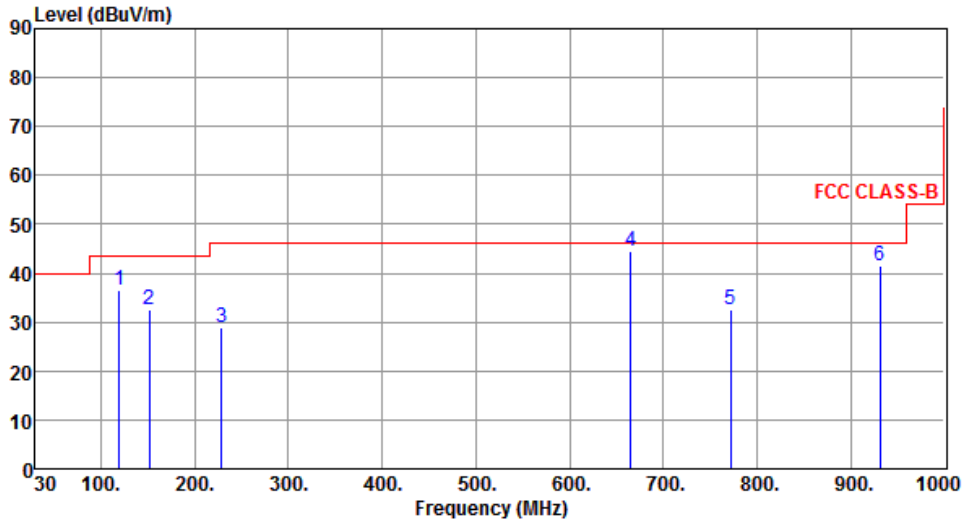


Radiated Emissions above 1 GHz



3.5.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

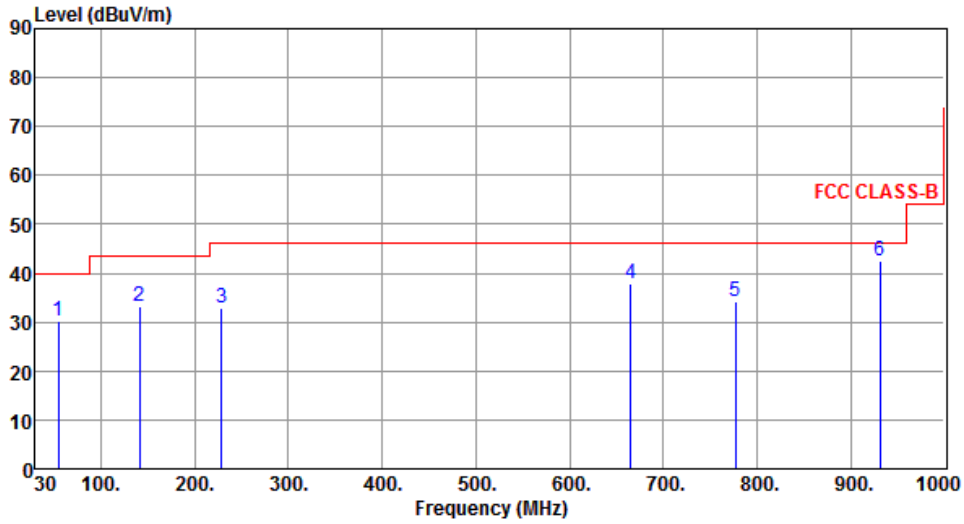
Modulation / SF	CSS / 12	Test Freq. (MHz)	903
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	119.24	36.49	43.50	-7.01	55.37	-18.88	Peak	---	---
2	151.25	32.45	43.50	-11.05	49.22	-16.77	Peak	---	---
3	228.85	29.04	46.00	-16.96	47.74	-18.70	Peak	---	---
4	665.00	44.35	46.00	-1.65	52.91	-8.56	Peak	---	---
5	772.05	32.66	46.00	-13.34	39.55	-6.89	Peak	---	---
6	931.13	41.53	46.00	-4.47	46.41	-4.88	QP	168	245

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

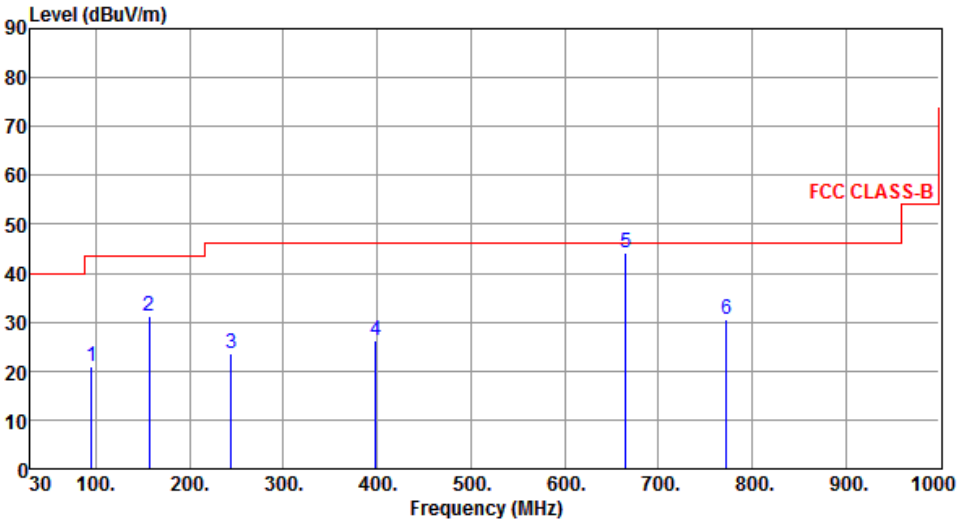
Modulation / SF	CSS / 12	Test Freq. (MHz)	903
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	54.25	30.26	40.00	-9.74	47.08	-16.82	Peak	---	---
2	141.55	33.15	43.50	-10.35	50.10	-16.95	Peak	---	---
3	228.85	32.98	46.00	-13.02	51.68	-18.70	Peak	---	---
4	665.35	37.88	46.00	-8.12	46.44	-8.56	Peak	---	---
5	776.90	34.34	46.00	-11.66	41.18	-6.84	Peak	---	---
6	931.13	42.45	46.00	-3.55	47.33	-4.88	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

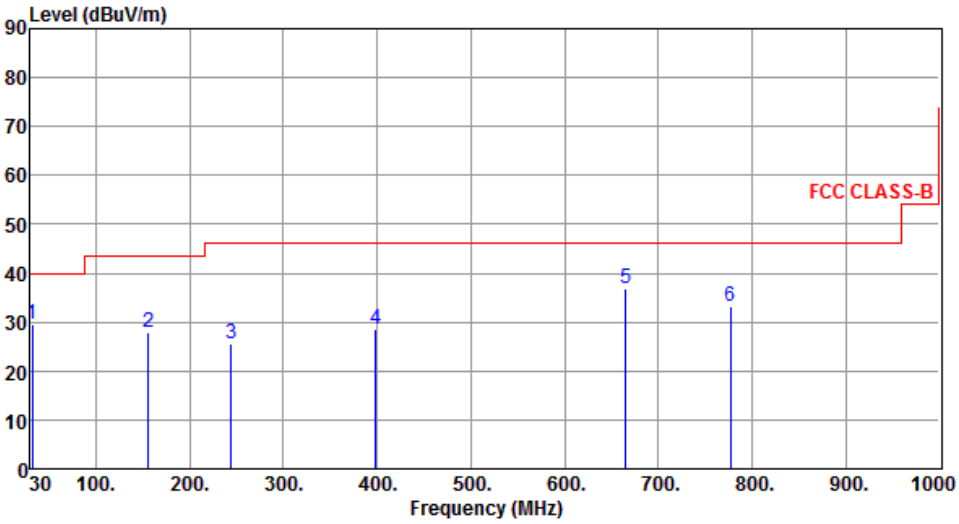
Modulation / SF	CSS / 12	Test Freq. (MHz)	909.4
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	94.99	20.78	43.50	-22.72	42.94	-22.16	Peak	---	---
2	157.07	31.29	43.50	-12.21	48.05	-16.76	Peak	---	---
3	244.37	23.63	46.00	-22.37	41.55	-17.92	Peak	---	---
4	398.60	26.16	46.00	-19.84	39.69	-13.53	Peak	---	---
5	665.35	44.32	46.00	-1.68	52.88	-8.56	Peak	---	---
6	773.02	30.60	46.00	-15.40	37.48	-6.88	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

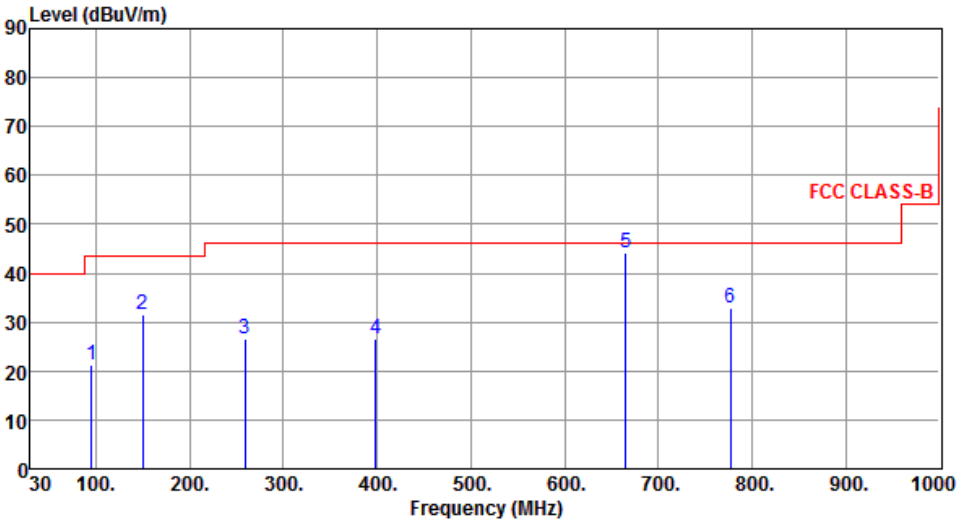
Modulation / SF	CSS / 12	Test Freq. (MHz)	909.4
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	31.94	29.50	40.00	-10.50	47.21	-17.71	Peak	---	---
2	156.10	27.99	43.50	-15.51	44.76	-16.77	Peak	---	---
3	244.37	25.49	46.00	-20.51	43.41	-17.92	Peak	---	---
4	398.60	28.67	46.00	-17.33	42.20	-13.53	Peak	---	---
5	665.35	36.99	46.00	-9.01	45.55	-8.56	Peak	---	---
6	776.90	33.11	46.00	-12.89	39.95	-6.84	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

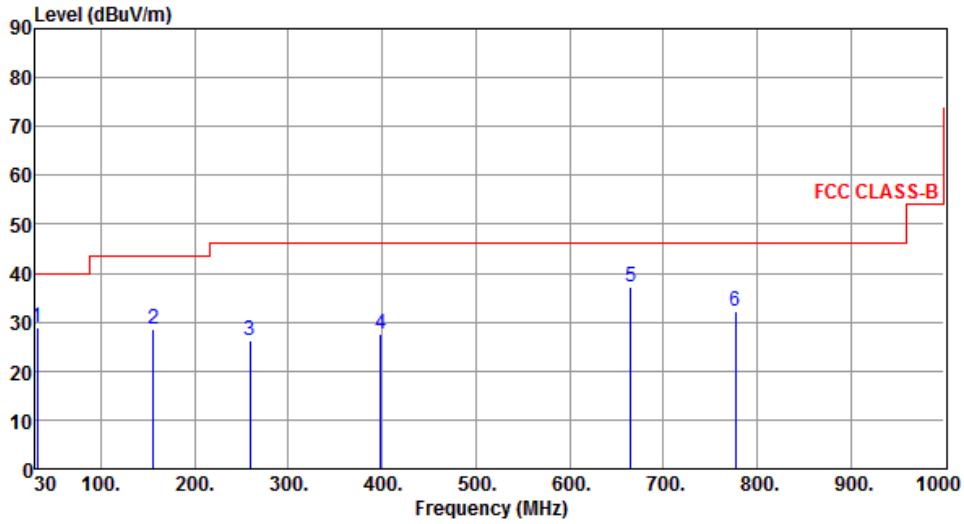
Modulation / SF	CSS / 12	Test Freq. (MHz)	924
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	94.99	21.37	43.50	-22.13	43.53	-22.16	Peak	---	---
2	150.28	31.57	43.50	-11.93	48.34	-16.77	Peak	---	---
3	258.92	26.61	46.00	-19.39	44.10	-17.49	Peak	---	---
4	398.60	26.51	46.00	-19.49	40.04	-13.53	Peak	---	---
5	665.35	44.33	46.00	-1.67	52.89	-8.56	Peak	---	---
6	776.90	32.74	46.00	-13.26	39.58	-6.84	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

Modulation / SF	CSS / 12	Test Freq. (MHz)	924
Polarization	Vertical		

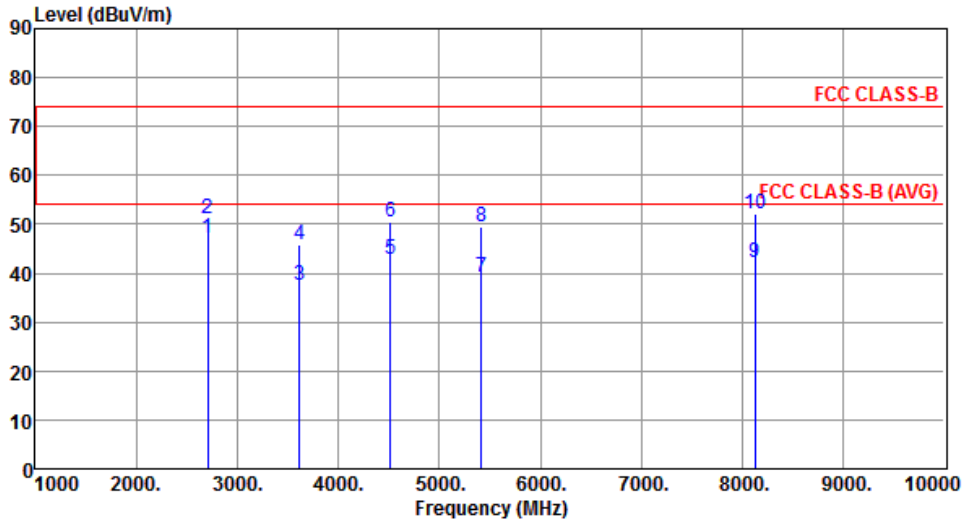


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	31.94	28.86	40.00	-11.14	46.57	-17.71	Peak	---	---
2	156.10	28.53	43.50	-14.97	45.30	-16.77	Peak	---	---
3	258.92	26.27	46.00	-19.73	43.76	-17.49	Peak	---	---
4	398.60	27.61	46.00	-18.39	41.14	-13.53	Peak	---	---
5	665.35	37.18	46.00	-8.82	45.74	-8.56	Peak	---	---
6	776.90	32.30	46.00	-13.70	39.14	-6.84	Peak	---	---

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).
Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

3.5.5 Transmitter Radiated Unwanted Emissions (Above 1GHz)

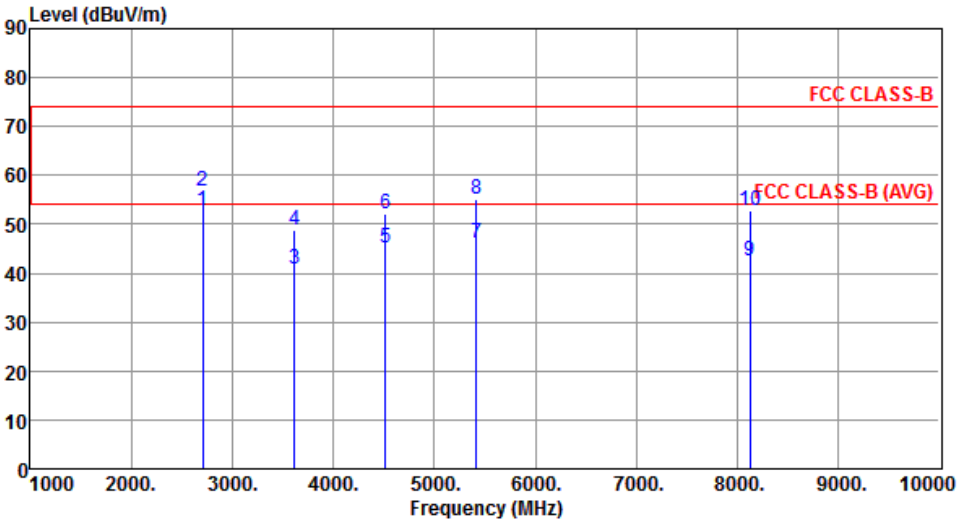
Modulation / SF	CSS / 12	Test Freq. (MHz)	903
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2709.00	47.28	54.00	-6.72	49.16	-1.88	Average	164	132
2	2709.00	51.25	74.00	-22.75	53.13	-1.88	Peak	164	132
3	3612.00	37.48	54.00	-16.52	37.47	0.01	Average	163	186
4	3612.00	45.95	74.00	-28.05	45.94	0.01	Peak	163	186
5	4515.00	42.88	54.00	-11.12	39.23	3.65	Average	131	291
6	4515.00	50.61	74.00	-23.39	46.96	3.65	Peak	131	291
7	5418.00	39.22	54.00	-14.78	33.51	5.71	Average	138	159
8	5418.00	49.57	74.00	-24.43	43.86	5.71	Peak	138	159
9	8127.00	42.06	54.00	-11.94	31.33	10.73	Average	156	212
10	8127.00	52.29	74.00	-21.71	41.56	10.73	Peak	156	212

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

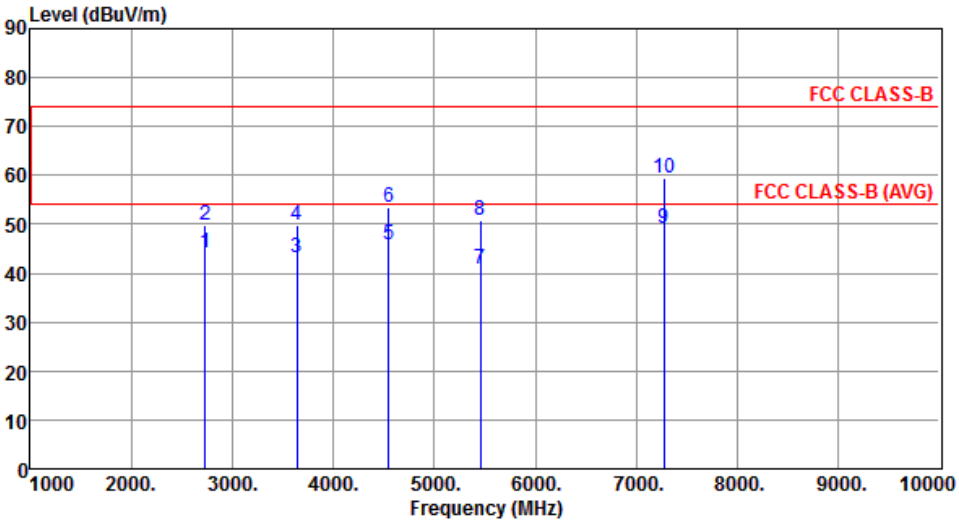
Modulation / SF	CSS / 12	Test Freq. (MHz)	903
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2709.00	52.87	54.00	-1.13	54.75	-1.88	Average	157	43
2	2709.00	56.91	74.00	-17.09	58.79	-1.88	Peak	157	43
3	3612.00	40.98	54.00	-13.02	40.97	0.01	Average	144	184
4	3612.00	48.86	74.00	-25.14	48.85	0.01	Peak	144	184
5	4515.00	45.02	54.00	-8.98	41.37	3.65	Average	139	121
6	4515.00	52.25	74.00	-21.75	48.60	3.65	Peak	139	121
7	5418.00	46.32	54.00	-7.68	40.61	5.71	Average	186	117
8	5418.00	54.98	74.00	-19.02	49.27	5.71	Peak	186	117
9	8127.00	42.41	54.00	-11.59	31.68	10.73	Average	162	212
10	8127.00	52.69	74.00	-21.31	41.96	10.73	Peak	162	212

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

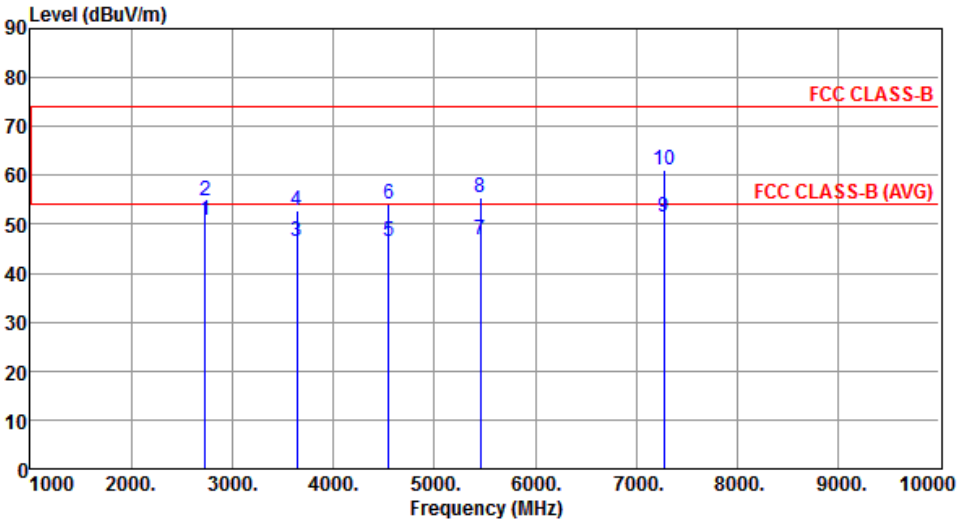
Modulation / SF	CSS / 12	Test Freq. (MHz)	909.4
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2728.20	44.03	54.00	-9.97	45.84	-1.81	Average	213	156
2	2728.20	49.80	74.00	-24.20	51.61	-1.81	Peak	213	156
3	3637.60	43.03	54.00	-10.97	42.87	0.16	Average	128	186
4	3637.60	49.66	74.00	-24.34	49.50	0.16	Peak	128	186
5	4547.00	45.92	54.00	-8.08	42.09	3.83	Average	140	270
6	4547.00	53.61	74.00	-20.39	49.78	3.83	Peak	140	270
7	5456.40	40.76	54.00	-13.24	35.04	5.72	Average	148	227
8	5456.40	50.78	74.00	-23.22	45.06	5.72	Peak	148	227
9	7275.20	49.19	54.00	-4.81	39.77	9.42	Average	139	147
10	7275.20	59.31	74.00	-14.69	49.89	9.42	Peak	139	147

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

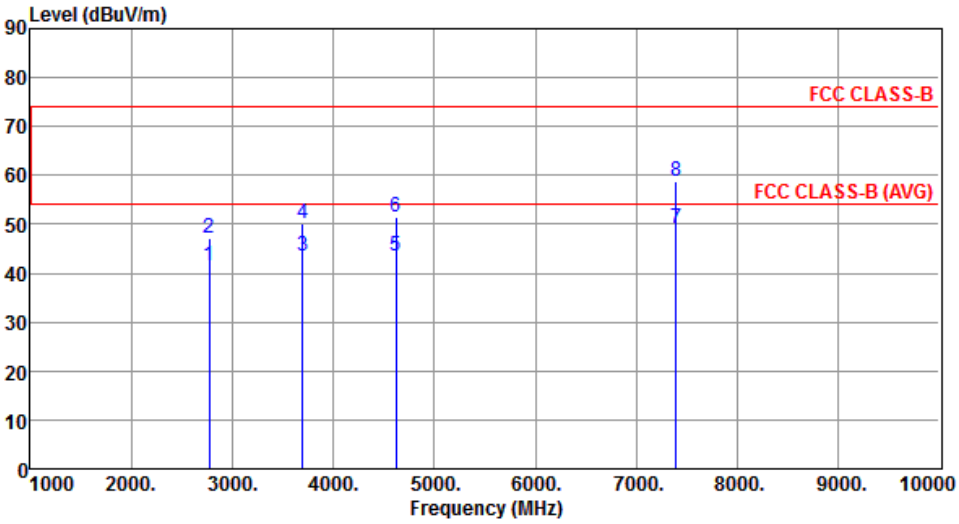
Modulation / SF	CSS / 12	Test Freq. (MHz)	909.4
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2728.20	50.86	54.00	-3.14	52.67	-1.81	Average	135	63
2	2728.20	54.63	74.00	-19.37	56.44	-1.81	Peak	135	63
3	3637.60	46.50	54.00	-7.50	46.34	0.16	Average	146	184
4	3637.60	52.81	74.00	-21.19	52.65	0.16	Peak	146	184
5	4547.00	46.61	54.00	-7.39	42.78	3.83	Average	149	160
6	4547.00	54.18	74.00	-19.82	50.35	3.83	Peak	149	160
7	5456.40	46.95	54.00	-7.05	41.23	5.72	Average	155	133
8	5456.40	55.56	74.00	-18.44	49.84	5.72	Peak	155	133
9	7275.20	51.51	54.00	-2.49	42.09	9.42	Average	188	196
10	7275.20	61.09	74.00	-12.91	51.67	9.42	Peak	188	196

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

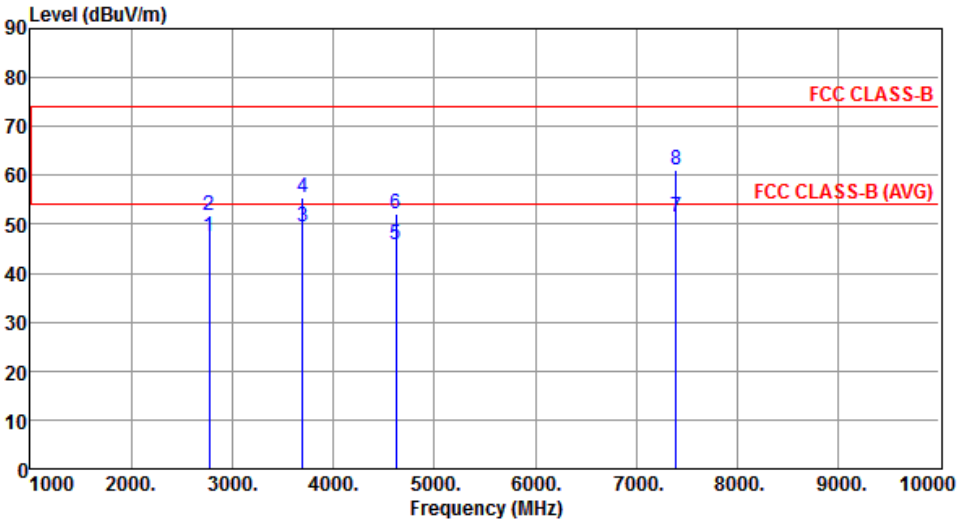
Modulation / SF	CSS / 12	Test Freq. (MHz)	924
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2772.00	41.59	54.00	-12.41	43.23	-1.64	Average	137	138
2	2772.00	47.32	74.00	-26.68	48.96	-1.64	Peak	137	138
3	3696.00	43.36	54.00	-10.64	42.82	0.54	Average	154	160
4	3696.00	50.14	74.00	-23.86	49.60	0.54	Peak	154	160
5	4620.00	43.52	54.00	-10.48	39.35	4.17	Average	155	130
6	4620.00	51.61	74.00	-22.39	47.44	4.17	Peak	155	130
7	7392.00	49.05	54.00	-4.95	39.43	9.62	Average	137	138
8	7392.00	58.88	74.00	-15.12	49.26	9.62	Peak	137	138

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Modulation / SF	CSS / 12	Test Freq. (MHz)	924
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2772.00	47.57	54.00	-6.43	49.21	-1.64	Average	176	38
2	2772.00	51.78	74.00	-22.22	53.42	-1.64	Peak	176	38
3	3696.00	49.43	54.00	-4.57	48.89	0.54	Average	155	183
4	3696.00	55.33	74.00	-18.67	54.79	0.54	Peak	155	183
5	4620.00	45.86	54.00	-8.14	41.69	4.17	Average	139	140
6	4620.00	52.30	74.00	-21.70	48.13	4.17	Peak	139	140
7	7392.00	51.56	54.00	-2.44	41.94	9.62	Average	177	221
8	7392.00	61.20	74.00	-12.80	51.58	9.62	Peak	177	221

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)
*Factor includes antenna factor , cable loss and amplifier gain
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

3.6 Emissions in Non-Restricted Frequency Bands

3.6.1 Emissions in Non-Restricted Frequency Bands Limit

Peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz

3.6.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.6.3 Test Procedures

Reference level measurement

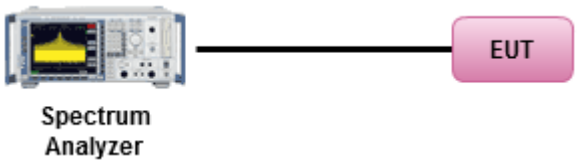
1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Use the peak marker function to determine the maximum PSD level

Emission level measurement

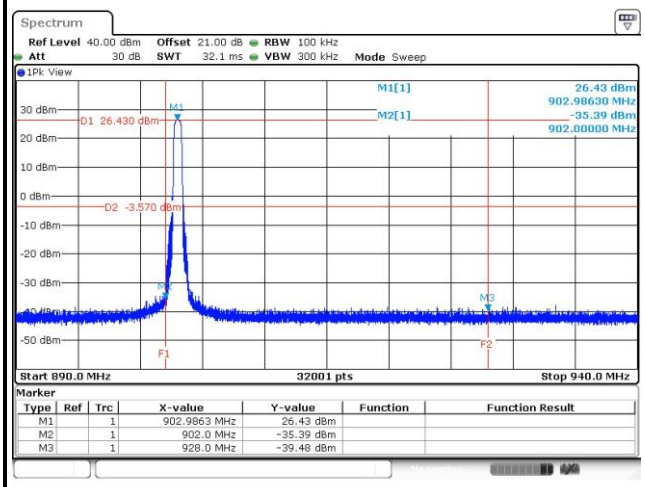
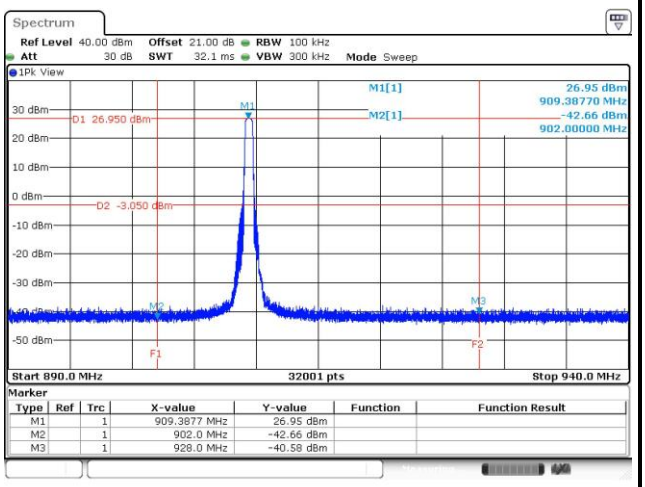
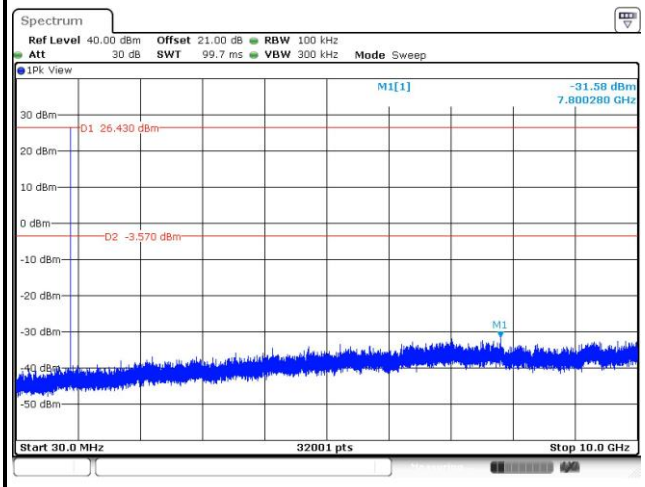
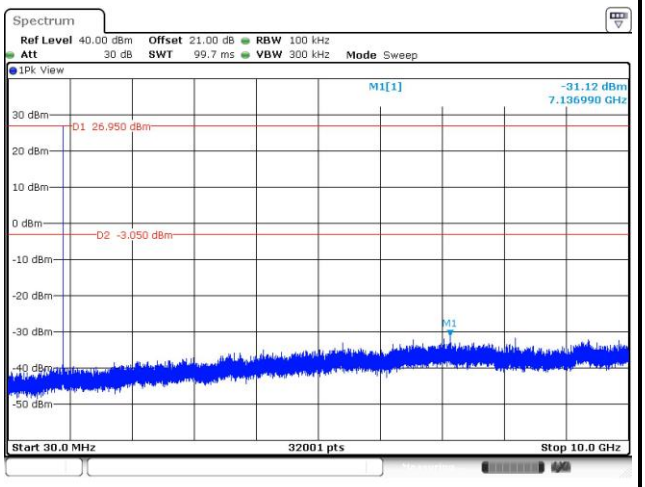
1. Set RBW=100kHz, VBW = 300kHz , Detector = Peak, Sweep time = Auto
2. Trace = max hold , Allow Trace to fully stabilize
3. Scan Frequency range is up to 10GHz
4. Use the peak marker function to determine the maximum amplitude level

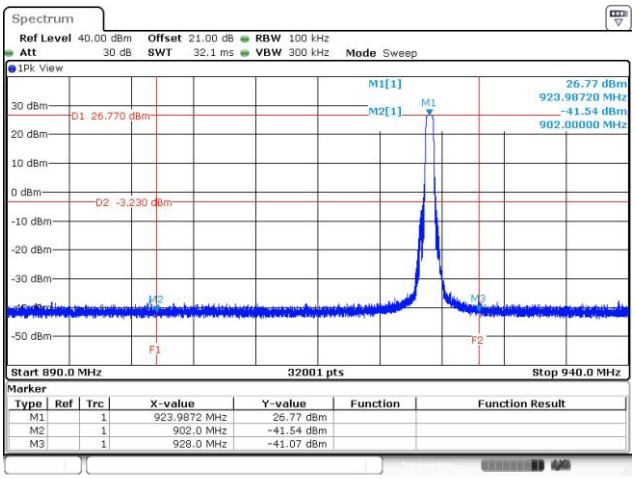
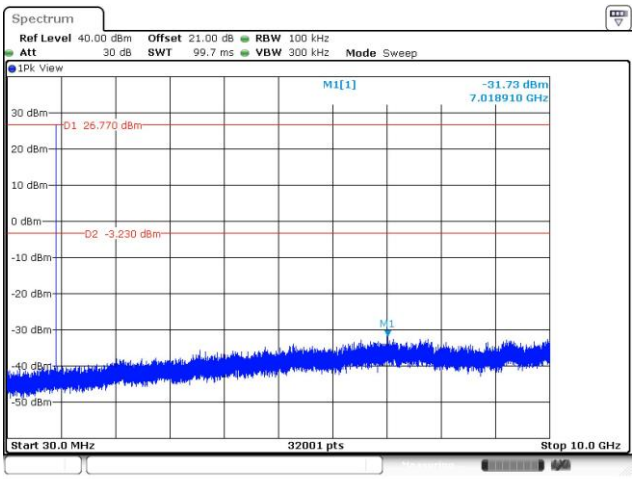
3.6.4 Test Setup

Transmitter Radiated Bandedge Emissions



3.6.5 Unwanted Emissions into Non-Restricted Frequency Bands

TX Freq 903MHz / 30MHz~10GHz (down 30dBc)	TX Freq 909.4MHz / 30MHz~10GHz (down 30dBc)
	
	

TX Freq 924MHz / 30MHz~10GHz (down 30dBc)	---
	---
	---

4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp, it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan Hsiang. Location map can be found on our website http://www.icertifi.com.tw.

Linkou	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan Hsiang, Tao Yuan Hsien 333, Taiwan, R.O.C.	No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan Hsiang, Tao Yuan Hsien 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information

Tel: 886-3-271-8666
Fax: 886-3-318-0155
Email: ICC_Service@icertifi.com.tw

==END==