BCTC

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TEST REPORT

Report No.:	BCTC2408884469E
Applicant:	SHENZHEN MINEWSEMI CO., LTD
Product Name:	LoRa Module
Test Model.:	MS21SF1
Tested Date:	2024-07-09 to 2024-07-17
Issued Date:	2024-08-27

Shenzhen BCTC Testing Co., Ltd.

SHENZHEN BCTC TESTING CO., LTD. APPROVED Report Seal

FCC ID:2BDJ6-MS21SF1

Product Name:	LoRa Module
Trademark:	MINEWSEMI
Model/Type Ref.:	MS21SF1 MS21SF13
Prepared For:	SHENZHEN MINEWSEMI CO., LTD
Address:	3rd Floor,I Building, Gangzhilong Science Park, NO.6, Qinglong Road,Longhua District, Shenzhen,China
Manufacturer:	SHENZHEN MINEWSEMI CO., LTD
Address:	3rd Floor,I Building, Gangzhilong Science Park, NO.6, Qinglong Road,Longhua District, Shenzhen
Prepared By:	Shenzhen BCTC Testing Co., Ltd.
Address:	1-2/F., Building B, Pengzhou Industrial Park, No.158, Fuyuan 1st Road, Tangwei, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China
Sample Received Date:	2024-07-08
Sample tested Date:	2024-07-09 to 2024-07-17
Report No.:	BCTC2408884469E
Test Standards:	FCC Part15.249 ANSI C63.10-2013
Test Results:	PASS

Tested by:

Tang Changyu/ Project Handler

Approved by:

Zero Zhou/Reviewer

The test report is effective only with both signature and specialized stamp. This result(s) shown in this report refer only to the sample(s) tested. Without written approval of Shenzhen BCTC Testing Co., Ltd, this report can't be reproduced except in full. The tested sample(s) and the sample information are provided by the client.

Table of Content

1. Version

Report No.	Issue Date	Description	Approved
BCTC2408884469E	2024-08-27	Original	Valid

2. Test Summary

The Product has been tested according to the following specifications:

No.	Test Parameter	Clause No	Results
1	Conducted Emission	15.207	PASS
2	20dB Bandwidth	15.215	PASS
3	Fundamental &Radiated Spurious Emission Measurement	15.249	PASS
4	Band Edge Emission	15.205	PASS
5	Antenna Requirement	15.203	PASS
NOTE1: N/A (Not Applicable) NOTE2: The report use radiated measurements in the restricted frequency bands. In addition, the radiated test is also performed to ensure the emissions emanating from the device cabinet also comply with the applicable limits.			

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.

No.	Item	Uncertainty
1	3m chamber Radiated spurious emission(9kHz-30MHz)	U=3.7dB
2	3m chamber Radiated spurious emission(30MHz-1GHz)	U=4.3dB
3	3m chamber Radiated spurious emission(1GHz-18GHz)	U=4.5dB
4	3m chamber Radiated spurious emission(18GHz-40GHz)	U=3.34dB
5	Conducted Emission(150kHz-30MHz)	U=3.20dB
6	Conducted Adjacent channel power	U=1.38dB
7	Conducted output power uncertainty Above 1G	U=1.576dB
8	Conducted output power uncertainty below 1G	U=1.28dB
9	humidity uncertainty	U=5.3%
10	Temperature uncertainty	U=0.59℃

4. Product Information and Test Setup

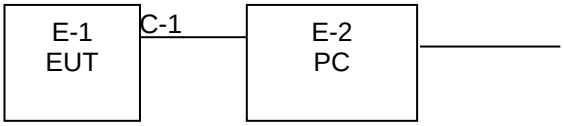
4.1 Product Information

Model/Type Ref.:	MS21SF1 MS21SF13
Model differences:	The following models of units we produce are identical in electrical, mechanical and physical structure;The difference is only in the model name, we finally have MS21SF1 as test model.
Hardware Version:	N/A
Software Version:	N/A
Operation Frequency:	902.3MHz-927.5MHz
Type of Modulation:	FSK
Number Of Channel	72 Channel
Antenna installation:	RP-SMA antenna
Antenna Gain:	0.98dBi
Remark:	The antenna gain of the product comes from the antenna report provided by the customer, and the test data is affected by the customer information.
Ratings:	Input:DC3.3V,0.5A

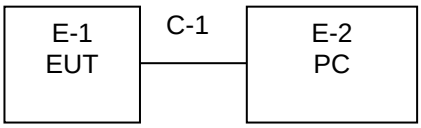
4.2 Test Setup Configuration

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

Conducted Emission:



Radiated Spurious Emission



4.3 Support Equipment

No.	Device Type	Brand	Model	Series No.	Note
E-1	LoRa Module	N/A	MS21SF1	N/A	EUT
E-2	PC	N/A	N/A	N/A	Auxiliary

Item	Shielded Type	Ferrite Core	Length	Note
N/A	N/A	N/A	N/A	

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 Channel List

CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)
0	902.3	1	902.5	2	902.7	3	902.9
4	903.1	5	903.3	6	903.5	7	903.7
8	903.9	9	904.1	10	904.3	11	904.5
12	904.7	13	904.9	14	905.1	15	905.3
16	905.5	17	905.7	18	905.9	19	906.1
20	906.3	21	906.5	22	906.7	23	906.9
24	907.1	25	907.3	26	907.5	27	907.7
28	907.9	29	908.1	30	908.3	31	908.5
32	908.7	33	908.9	34	909.1	35	909.3
36	909.5	37	909.7	38	909.9	39	910.1
40	910.3	41	910.5	42	910.7	43	910.9
44	911.1	45	911.3	46	911.5	47	911.7
48	911.9	49	912.1	50	912.3	51	912.5
52	912.7	53	912.9	54	913.1	55	913.3
56	913.5	57	913.7	58	913.9	59	914.1
60	914.3	61	914.5	62	914.7	63	914.9
64	923.3	65	923.9	66	924.5	67	925.1
68	925.7	69	926.3	70	926.9	71	927.5

4.5 Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Test Mode	Low channel	Middle channel	Middle channel	High channel
Mode 1	902.3MHz	909.5MHz	914.90MHz	927.5MHz
Mode 2	Transmitting			

Note:

(1) The measurements are performed at the available channels.

4.6 Table Of Parameters Of Text Software Setting

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters

Test software Version	**sscom5.13.1**			
Frequency	902.30MHz	909.50MHz	914.90MHz	927.50MHz
Parameters	DEF	DEF	DEF	DEF

5. Test Facility and Test Instrument Used

5.1 Test Facility

All measurement facilities used to collect the measurement data are located at Shenzhen BCTC Testing Co., Ltd. Address:1-2/F., Building B, Pengzhou Industrial Park, No.158, Fuyuan 1st Road, Zhancheng, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.
FCC Test Firm Registration Number: 712850
A2LA certificate registration number is: CN1212
ISED Registered No.: 23583
ISED CAB identifier: CN0017

5.2 Test Instrument Used

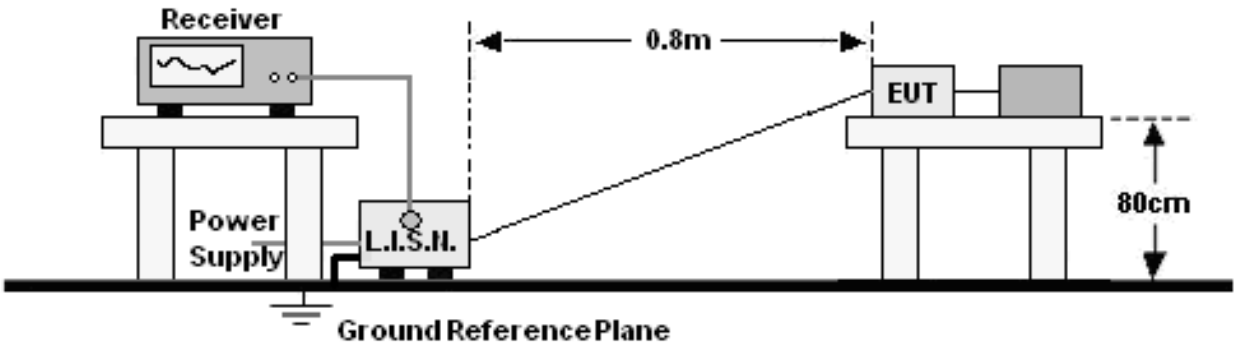
Conducted Emissions Test					
Equipment	**Manufacturer**	**Model#**	**Serial#**	**Last Cal.**	**Next Cal.**
Receiver	R&S	ESR3	102075	May 16, 2024	May 15, 2025
LISN	R&S	ENV216	101375	May 16, 2024	May 15, 2025
Software	Frad	EZ-EMC	EMC-CON 3A1	\	\
Pulse limiter	Schwarzbeck	VTSD9561-F	01323	May 16, 2024	May 15, 2025

RF Conducted Test					
Equipment	**Manufacturer**	**Model#**	**Serial#**	**Last Cal.**	**Next Cal.**
Power meter	Keysight	E4419	\	May 16, 2024	May 15, 2025
Power Sensor (AV)	Keysight	E9300A	\	May 16, 2024	May 15, 2025
Signal Analyzer20kHz-26.5GHz	Keysight	N9020A	MY49100060	May 16, 2024	May 15, 2025
Spectrum Analyzer9kHz-40GHz	R&S	FSP40	100363	May 16, 2024	May 15, 2025

Radiated Emissions Test (966 Chamber01)					
Equipment	**Manufacturer**	**Model#**	**Serial#**	**Last Cal.**	**Next Cal.**
966 chamber	ChengYu	966 Room	966	May 16, 2024	May 15, 2025
Receiver	R&S	ESR3	102075	May 16, 2024	May 15, 2025
Receiver	R&S	ESRP	101154	May 16, 2024	May 15, 2025
Amplifier	Schwarzbeck	BBV9744	9744-0037	May 16, 2024	May 15, 2025
TRILOG Broadband Antenna	Schwarzbeck	VULB9163	942	May 21, 2024	May 20, 2025
Loop Antenna(9KHz -30MHz)	Schwarzbeck	FMZB1519B	00014	May 21, 2024	May 20, 2025
Amplifier	SKET	LAPA_01G18G-45dB	SK2021040901	May 16, 2024	May 15, 2025
Horn Antenna	Schwarzbeck	BBHA9120D	1541	May 21, 2024	May 20, 2025
Amplifier(18GHz-40GHz)	MITEQ	TTA1840-35-HG	2034381	May 16, 2024	May 15, 2025
Horn Antenn(18GHz-40GHz)	Schwarzbeck	BBHA9170	00822	May 21, 2024	May 20, 2025
Spectrum Analyzer9kHz-40GHz	R&S	FSP40	100363	May 16, 2024	May 15, 2025
Software	Frad	EZ-EMC	FA-03A2 RE	\	\

6. Conducted Emissions

6.1 Block Diagram Of Test Setup



6.2 Limit

FREQUENCY (MHz)	Limit (dBuV)	
	Quas-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

Notes:
1. *Decreasing linearly with logarithm of frequency.
2. The lower limit shall apply at the transition frequencies.

6.3 Test Procedure

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

a. The Product was placed on a nonconductive table 0.8 m above the horizontal ground reference plane, and 0.4 m from the vertical ground reference plane, and connected to the main through Line Impedance Stability Network (L.I.S.N).

b. The RBW of the receiver was set at 9 kHz in 150 kHz ~ 30MHz with Peak and AVG detector in Max Hold mode. Run the receiver's pre-scan to record the maximum disturbance generated from Product in all power lines in the full band.

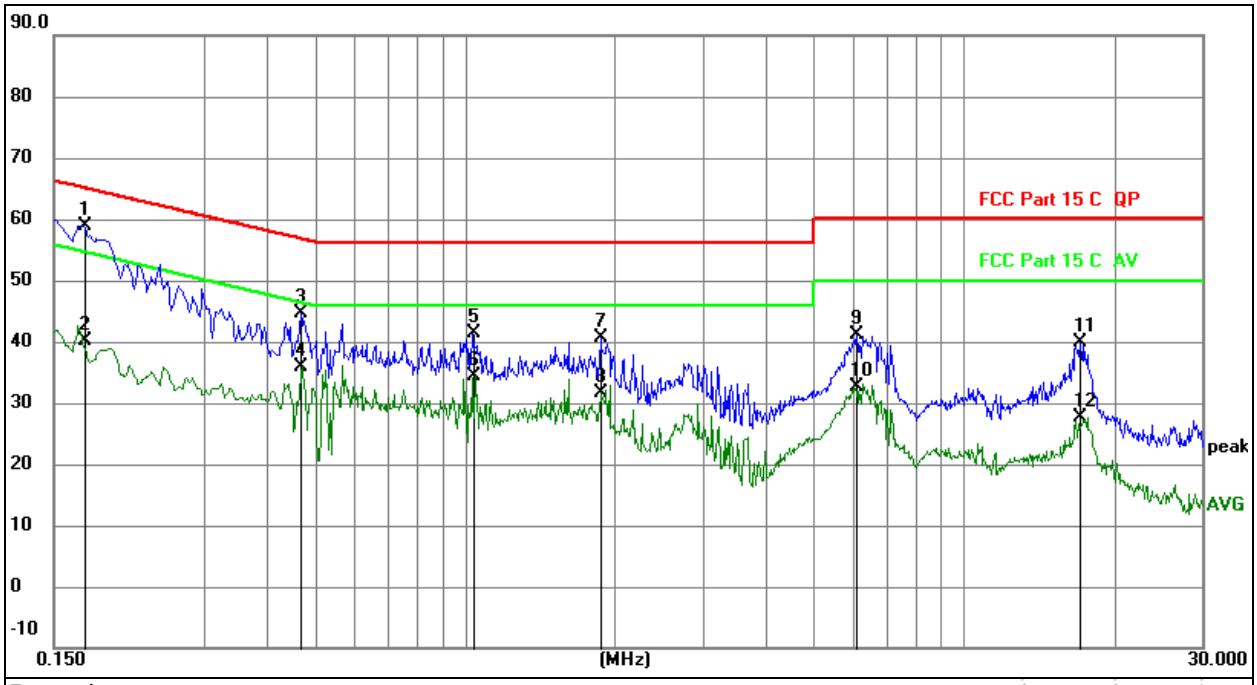
c. For each frequency whose maximum record was higher or close to limit, measure its QP and AVG values and record.

6.4 EUT Operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

6.5 Test Result

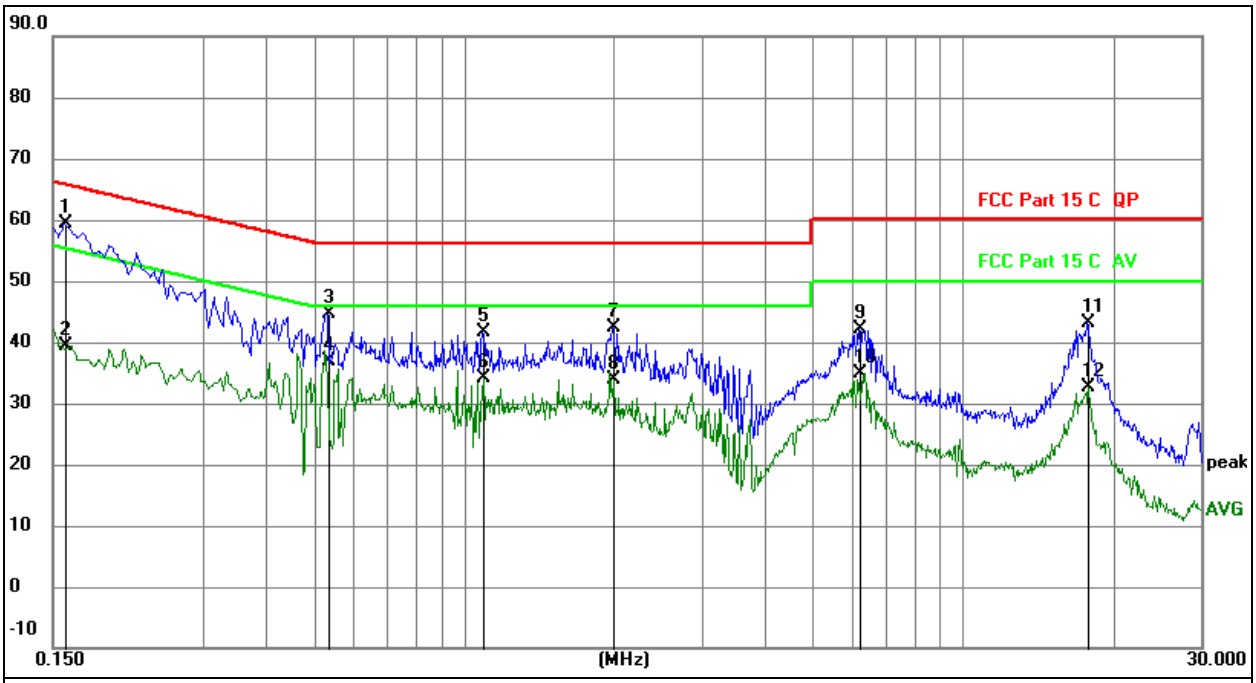
Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	101KPa	Phase :	L
Test Mode:	Mode 2	Test Voltage :	AC 120V/60Hz



Remark:
1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.
3. Measurement = Reading Level + Correct Factor
4. Over = Measurement - Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz		dB	dBuV	dBuV	dB	Detector
1	*	0.1722	38.89	20.07	58.96	64.85	-5.89	QP
2		0.1722	20.00	20.07	40.07	54.85	-14.78	AVG
3		0.4686	24.43	20.08	44.51	56.54	-12.03	QP
4		0.4686	15.80	20.08	35.88	46.54	-10.66	AVG
5		1.0375	21.17	20.09	41.26	56.00	-14.74	QP
6		1.0375	14.33	20.09	34.42	46.00	-11.58	AVG
7		1.8680	20.43	20.10	40.53	56.00	-15.47	QP
8		1.8680	11.49	20.10	31.59	46.00	-14.41	AVG
9		6.0885	21.00	20.15	41.15	60.00	-18.85	QP
10		6.0885	12.49	20.15	32.64	50.00	-17.36	AVG
11		17.1084	19.50	20.32	39.82	60.00	-20.18	QP
12		17.1084	7.31	20.32	27.63	50.00	-22.37	AVG

Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	101KPa	Phase :	N
Test Mode:	Mode 2	Test Voltage :	AC 120V/60Hz



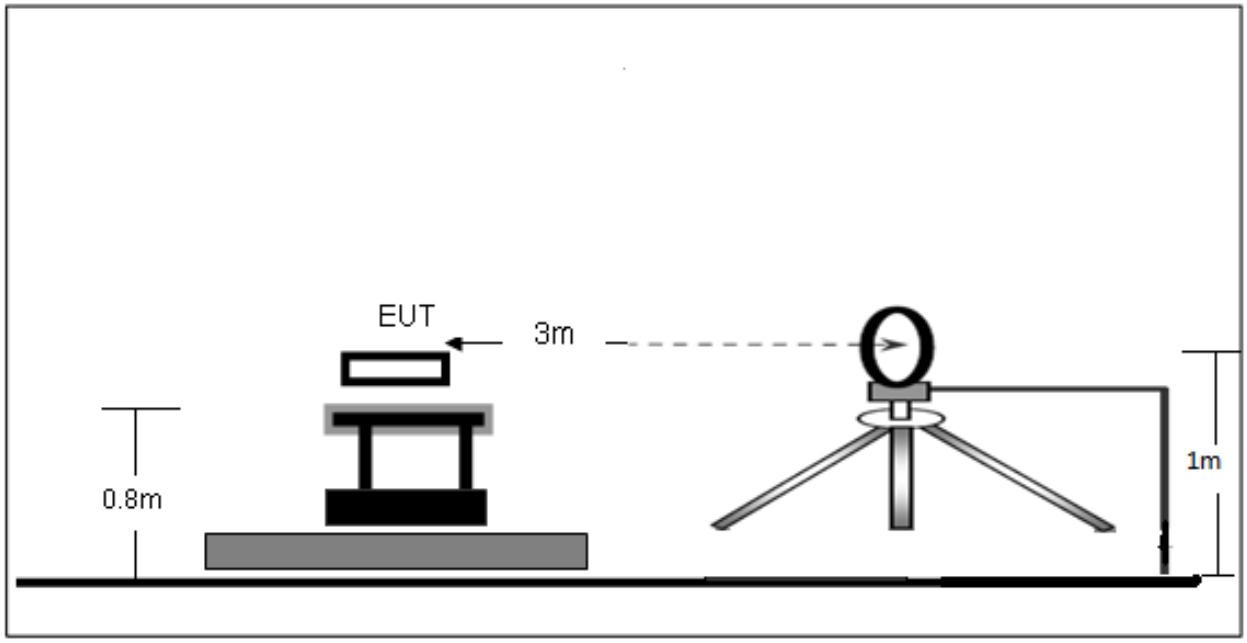
Remark:
1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.
3. Measurement = Reading Level + Correct Factor
4. Over = Measurement - Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz		dB	dBuV	dBuV	dB	Detector
1	*	0.1590	39.26	20.07	59.33	65.52	-6.19	QP
2		0.1590	19.41	20.07	39.48	55.52	-16.04	AVG
3		0.5325	24.54	20.08	44.62	56.00	-11.38	QP
4		0.5325	16.92	20.08	37.00	46.00	-9.00	AVG
5		1.0905	21.62	20.09	41.71	56.00	-14.29	QP
6		1.0905	13.94	20.09	34.03	46.00	-11.97	AVG
7		1.9815	22.28	20.10	42.38	56.00	-13.62	QP
8		1.9815	13.66	20.10	33.76	46.00	-12.24	AVG
9		6.2160	22.07	20.15	42.22	60.00	-17.78	QP
10		6.2160	14.64	20.15	34.79	50.00	-15.21	AVG
11		17.8305	22.93	20.32	43.25	60.00	-16.75	QP
12		17.8305	12.20	20.32	32.52	50.00	-17.48	AVG

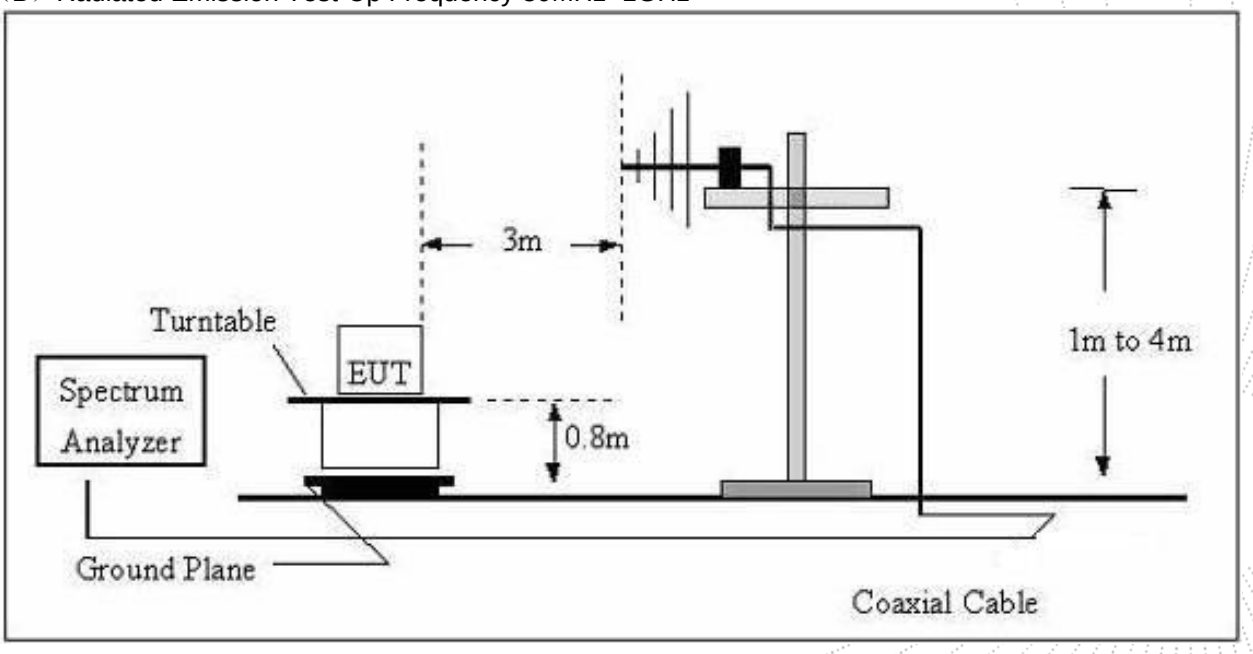
7. Radiated Emissions

7.1 Block Diagram Of Test Setup

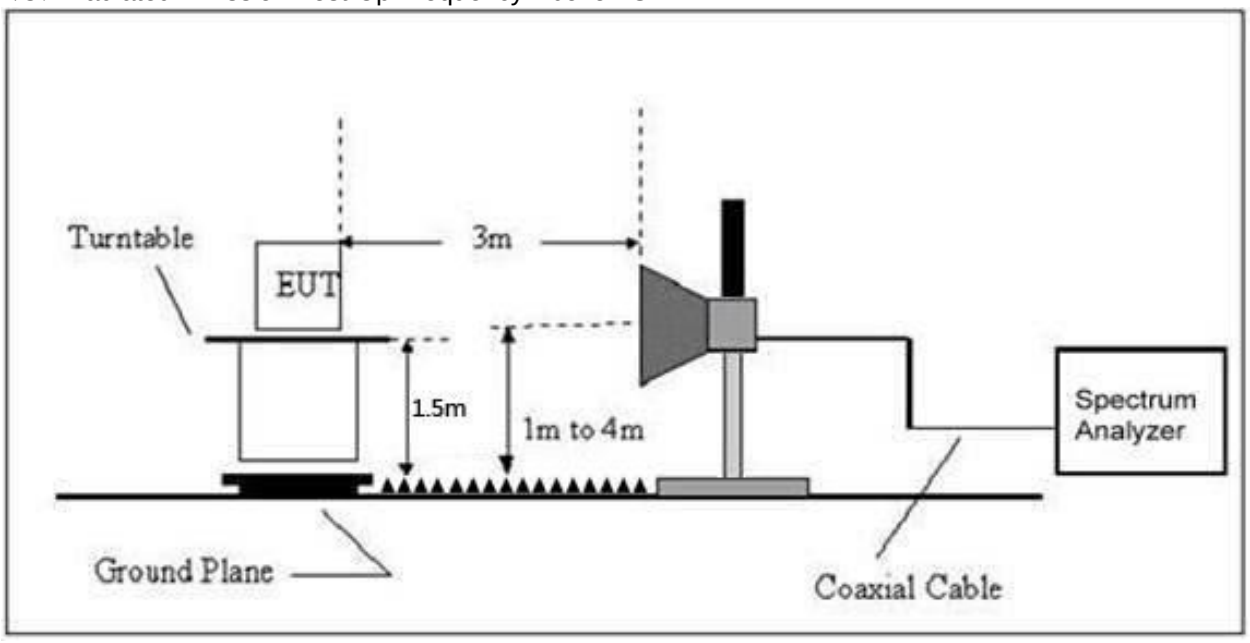
（A）Radiated Emission Test-Up Frequency Below 30MHz



（B）Radiated Emission Test-Up Frequency 30MHz~1GHz



（C）Radiated Emission Test-Up Frequency Above 1GHz



7.2 Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequency	Field Strength	Distance	Field Strength Limit at 3m Distance	
(MHz)	uV/m	(m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))}$ + 80
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))}$ + 40
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)}$ + 40
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50(94 dBV/m)	500(54 dBV/m)
2400-2483.5 MHz	50(94 dBV/m)	500(54 dBV/m)
5725-5875 MHz	50(94 dBV/m)	500(54 dBV/m)
24.0-24.25 GHz	250(108 dBV/m)	2500(68 dBV/m)

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	Limit (dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:
(1)The limit for radiated test was performed according to FCC PART 15C.
(2)The tighter limit applies at the band edges.
(3) Emission level (dBuV/m)=20log Emission level (uV/m).

FREQUENCY RANGE OF RADIATED MEASUREMENT (For unintentional radiators)

Highest frequency generated or Upper frequency of measurement used in the device or on which the device operates or tunes (MHz)	Range (MHz)
Below 1.705	30
1.705 – 108	1000
108 – 500	2000
500 – 1000	5000
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower

7.3 Test Procedure

Spectrum Parameter	**Setting**
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / *10Hz* for Average

Receiver Parameter	**Setting**
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

Below 1GHz test procedure as below:

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Above 1GHz test procedure as below:

g. Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 metre to 1.5 metre(Above 18GHz the distance is 1 meter and table is 1.5 metre).

h. Test the EUT in the lowest channel ,the middle channel ,the Highest channel.

Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

Above 1GHz test procedure as below:

a.The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.

b.The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c.The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d.For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.

e.The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g.Test the EUT in the lowest channel,the Highest channel.

Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

7.4 EUT Operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

7.5 Test Result

Below 30MHz

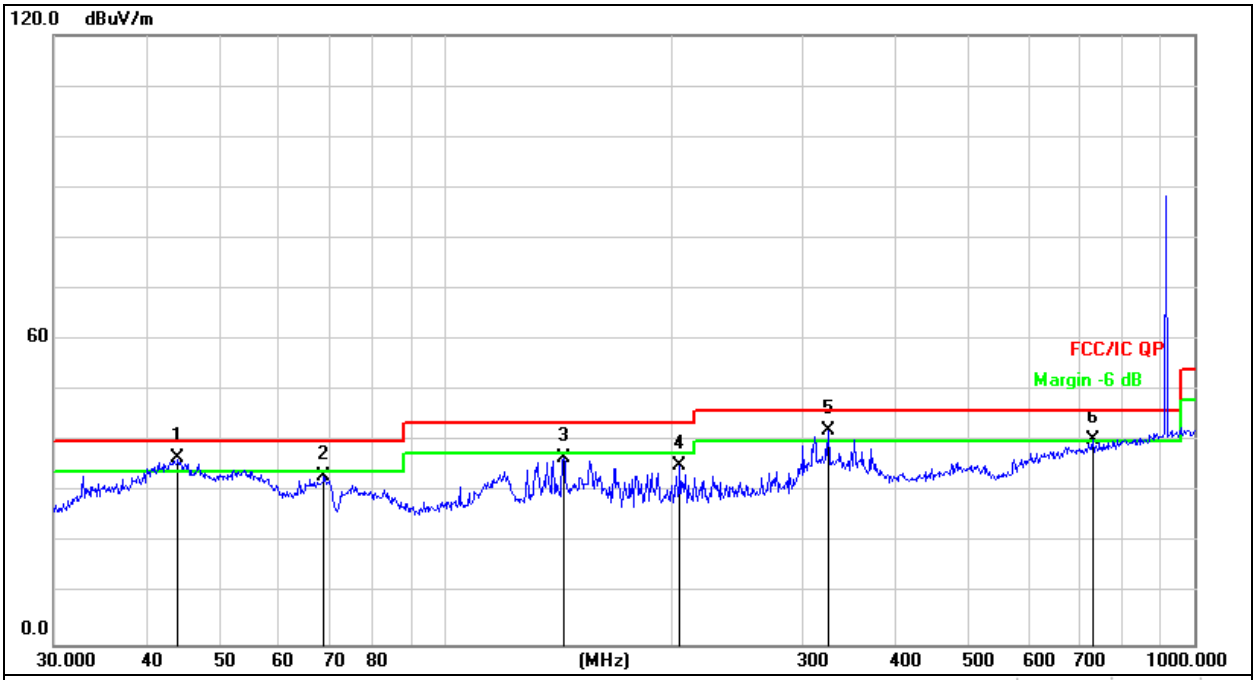
Temperature:	26℃	Relative Humidtity:	24%
Pressure:	101 kPa	Test Voltage :	AC 120V/60Hz
Test Mode :	Mode 2	Polarization :	--

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	PASS
--	--	--	--	PASS

Note:
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
Distance extrapolation factor =40 log (specific distance/test distance)(dB);
Limit line = specific limits(dBuv) + distance extrapolation factor.

Between 30MHz – 1GHz

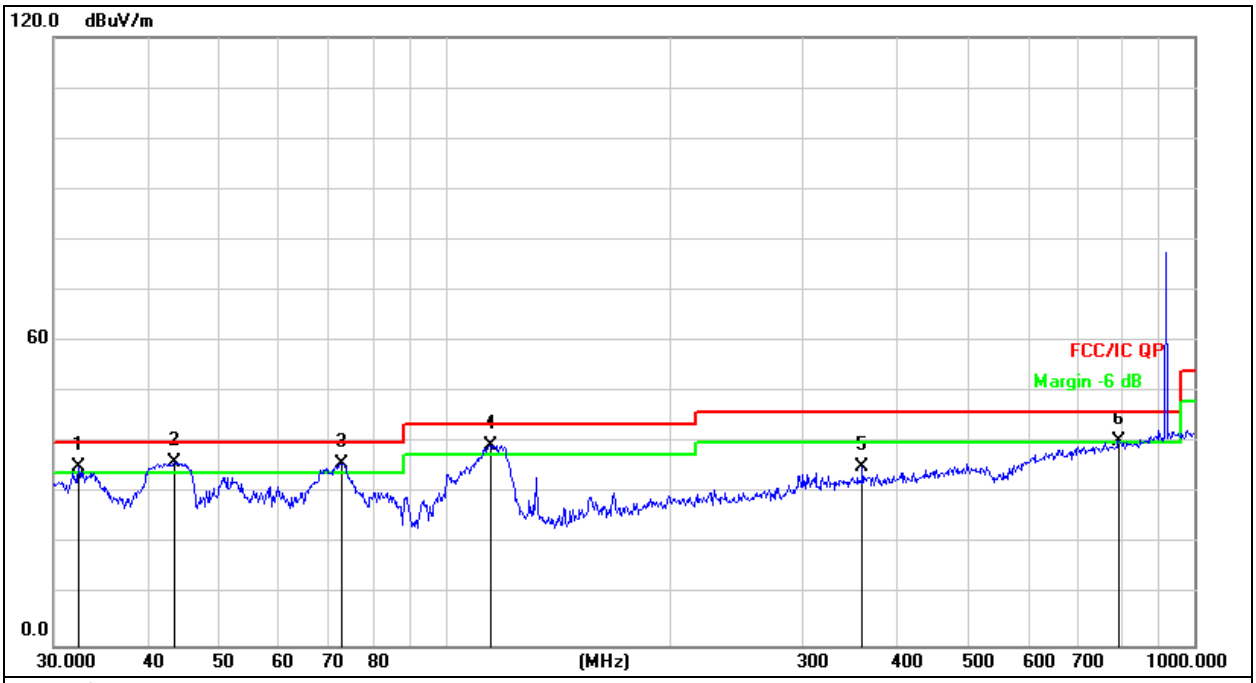
Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	101KPa	Phase :	Horizontal
Test Mode:	Mode 2	Test Voltage :	AC 120V/60Hz



Remark:
1.Factor = Antenna Factor + Cable Loss – Pre-amplifier
2. Measurement=Reading Level+ Correct Factor
3. Over=Measurement-Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	*	43.9658	50.99	-14.39	36.60	40.00	-3.40	QP
2		68.8721	50.72	-17.69	33.03	40.00	-6.97	QP
3		143.8293	55.71	-19.00	36.71	43.50	-6.79	QP
4		205.6750	50.88	-15.56	35.32	43.50	-8.18	QP
5	!	324.4560	54.43	-12.38	42.05	46.00	-3.95	QP
6	!	731.9202	45.70	-5.25	40.45	46.00	-5.55	QP

Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	101KPa	Phase :	Vertical
Test Mode:	Mode 2	Test Voltage :	AC 120V/60Hz



Remark:
1.Factor = Antenna Factor + Cable Loss – Pre-amplifier.
2. Measurement=Reading Level+ Correct Factor
3. Over=Measurement-Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	!	32.4059	51.34	-16.19	35.15	40.00	-4.85	QP
2	*	43.5056	50.53	-14.43	36.10	40.00	-3.90	QP
3	!	72.5916	54.41	-18.45	35.96	40.00	-4.04	QP
4	!	114.9167	56.45	-16.97	39.48	43.50	-4.02	QP
5		360.4476	46.59	-11.35	35.24	46.00	-10.76	QP
6	!	793.3958	44.90	-4.48	40.42	46.00	-5.58	QP

(Above 1000 MHz)
902.30MHz

Polar (H/V)	Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
	(MHz)	(dBuV)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
V	1804.60	80.02	-26.99	53.03	74.00	-20.97	PK
V	1804.60	70.48	-26.99	43.49	54.00	-10.51	AV
V	2706.90	75.41	-24.41	51.00	74.00	-23.00	PK
V	2706.90	66.30	-24.41	41.89	54.00	-12.11	AV
V	3609.20	72.37	-22.32	50.05	74.00	-23.95	PK
V	3609.20	62.95	-22.32	40.63	54.00	-13.37	AV
H	1804.60	75.05	-26.99	48.06	74.00	-25.94	PK
H	1804.60	65.69	-26.99	38.70	54.00	-54.00	AV
H	2706.90	74.05	-24.41	49.64	74.00	-24.36	PK
H	2706.90	65.57	-24.41	41.16	54.00	-12.84	AV
H	3609.20	70.76	-22.32	48.44	74.00	-25.56	PK
H	3609.20	62.32	-22.32	40.00	54.00	-14.00	AV

Remark:
Absolute Level= ReadingLevel+ Factor, Margin= Limit- Absolute Level
Other harmonics emissions are lower than 20dB below the allowable limit.

909.50MHz

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
V	1819.00	79.04	-26.99	52.05	74.00	-21.95	PK
V	1819.00	68.77	-26.99	41.78	54.00	-12.22	AV
V	2728.50	75.92	-24.41	51.51	74.00	-22.49	PK
V	2728.50	65.52	-24.41	41.11	54.00	-12.89	AV
V	3638.00	71.60	-22.32	49.28	74.00	-24.72	PK
V	3638.00	61.19	-22.32	38.87	54.00	-15.13	AV
H	1819.00	75.92	-26.99	48.93	74.00	-25.07	PK
H	1819.00	65.26	-26.99	38.27	54.00	-15.73	AV
H	2728.50	73.45	-24.41	49.04	74.00	-24.96	PK
H	2728.50	65.85	-24.41	41.44	54.00	-12.56	AV
H	3638.00	70.88	-22.32	48.56	74.00	-25.44	PK
H	3638.00	62.36	-22.32	40.04	54.00	-13.96	AV

Remark:
Absolute Level= ReadingLevel+ Factor, Margin= Limit- Absolute Level
Other harmonics emissions are lower than 20dB below the allowable limit.

914.90MHz

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
V	1829.80	78.82	-26.99	51.83	74.00	-22.17	PK
V	1829.80	70.81	-26.99	43.82	54.00	-10.18	AV
V	2744.70	75.53	-24.41	51.12	74.00	-22.88	PK
V	2744.70	64.86	-24.41	40.45	54.00	-13.55	AV
V	3659.60	70.94	-22.32	48.62	74.00	-25.38	PK
V	3659.60	61.84	-22.32	39.52	54.00	-14.48	AV
H	1829.80	73.01	-26.99	46.02	74.00	-27.98	PK
H	1829.80	63.53	-26.99	36.54	54.00	-17.46	AV
H	2744.70	73.42	-24.41	49.01	74.00	-24.99	PK
H	2744.70	65.17	-24.41	40.76	54.00	-13.24	AV
H	3659.60	70.30	-22.32	47.98	74.00	-26.02	PK
H	3659.60	62.66	-22.32	40.34	54.00	-13.66	AV

Remark:
Absolute Level= ReadingLevel+ Factor, Margin= Limit- Absolute Level
Other harmonics emissions are lower than 20dB below the allowable limit.

927.50MHz

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
V	1855.00	80.20	-26.99	53.21	74.00	-20.79	PK
V	1855.00	71.37	-26.99	44.38	54.00	-9.62	AV
V	2782.50	76.81	-24.41	52.40	74.00	-21.60	PK
V	2782.50	65.88	-24.41	41.47	54.00	-12.53	AV
V	3710.00	72.06	-22.32	49.74	74.00	-24.26	PK
V	3710.00	61.20	-22.32	38.88	54.00	-15.12	AV
H	1855.00	77.47	-26.99	50.48	74.00	-23.52	PK
H	1855.00	66.75	-26.99	39.76	54.00	-14.24	AV
H	2782.50	75.24	-24.41	50.83	74.00	-23.17	PK
H	2782.50	68.01	-24.41	43.60	54.00	-10.40	AV
H	3710.00	73.06	-22.32	50.74	74.00	-23.26	PK
H	3710.00	65.83	-22.32	43.51	54.00	-10.49	AV

Remark:
Absolute Level= ReadingLevel+ Factor, Margin= Limit- Absolute Level
Other harmonics emissions are lower than 20dB below the allowable limit.

■ Field Strength of the fundamental signal

902.30MHz:

Temperature:	26℃	Relative Humidity:	54%
Pressure:	101kPa	Polarization :	Horizontal
Test Voltage :	AC 120V/60Hz		
Test Mode :	Mode 1		

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
902.30	92.05	-3.11	88.94	114	-25.06	Peak
902.30	92.05	-3.11	88.94	94	-5.06	Average
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. All interfaces was connected, and TX mode						

Temperature:	26℃	Relative Humidity:	54%
Pressure:	101kPa	Polarization :	Vertical
Test Voltage :	AC 120V/60Hz		
Test Mode :	Mode 1		

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
902.30	82.85	-3.11	79.74	114	-34.26	Peak
902.30	82.85	-3.11	79.74	94	-14.26	Average
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. All interfaces was connected, and TX mode						

909.50MHz:

Temperature:	26℃	Relative Humidity:	54%
Pressure:	101kPa	Polarization :	Horizontal
Test Voltage :	AC 120V/60Hz		
Test Mode :	Mode 1		

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
909.50	93.09	-3.09	90.00	114	-24.00	Peak
909.50	93.09	-3.09	90.00	94	-4.00	Average
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. All interfaces was connected, and TX mode						

Temperature:	26℃	Relative Humidity:	54%
Pressure:	101kPa	Polarization :	Vertical
Test Voltage :	AC 120V/60Hz		
Test Mode :	Mode 1		

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
909.50	82.59	-3.09	79.50	114	-34.50	Peak
909.50	82.59	-3.09	79.50	94	-14.50	Average
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. All interfaces was connected, and TX mode						

914.90MHz:

Temperature:	26℃	Relative Humidity:	54%
Pressure:	101kPa	Polarization :	Horizontal
Test Voltage :	AC 120V/60Hz		
Test Mode :	Mode 1		

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
914.90	91.22	-3.07	88.15	114	-25.85	Peak
914.90	91.22	-3.07	88.15	94	-5.85	Average
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. All interfaces was connected, and TX mode						

Temperature:	26℃	Relative Humidity:	54%
Pressure:	101kPa	Polarization :	Vertical
Test Voltage :	AC 120V/60Hz		
Test Mode :	Mode 1		

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
914.90	80.31	-3.07	77.24	114	-36.76	Peak
914.90	80.31	-3.07	77.24	94	-16.76	Average
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. All interfaces was connected, and TX mode						

927.5MHz:

Temperature:	26℃	Relative Humidity:	54%
Pressure:	101kPa	Polarization :	Horizontal
Test Voltage :	AC 120V/60Hz		
Test Mode :	Mode 1		

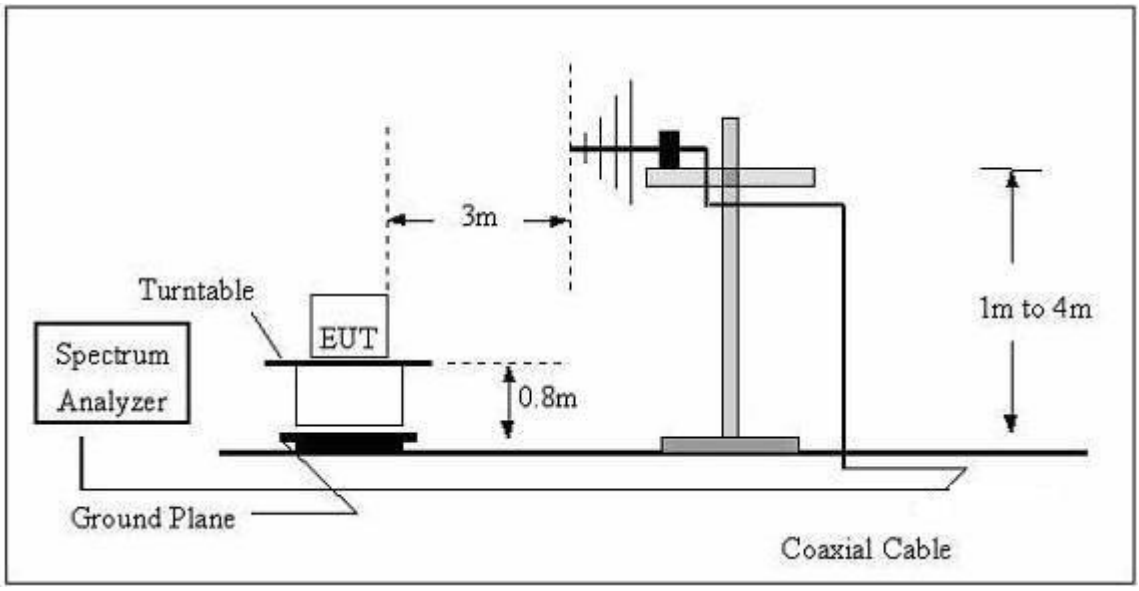
Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
927.50	90.10	-3.02	87.08	114	-26.92	Peak
927.50	90.10	-3.02	87.08	94	-6.92	Average
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. All interfaces was connected, and TX mode						

Temperature:	26℃	Relative Humidity:	54%
Pressure:	101kPa	Polarization :	Vertical
Test Voltage :	AC 120V/60Hz		
Test Mode :	Mode 1		

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
927.50	79.33	-3.02	76.31	114	-37.69	Peak
927.50	79.33	-3.02	76.31	94	-17.69	Average
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. All interfaces was connected, and TX mode						

8. 100 KHz Bandwidth Of Frequency Band Edge

8.1 Block Diagram Of Test Setup



8.2 Applicable Standard

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation

8.3 Test Procedure

a.Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

b.Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.

c.VBW for Peak, Quasi-peak, or Average Detector Function: 3 × RBW

d.Repeat above procedures until all measured frequencies were complete.

Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

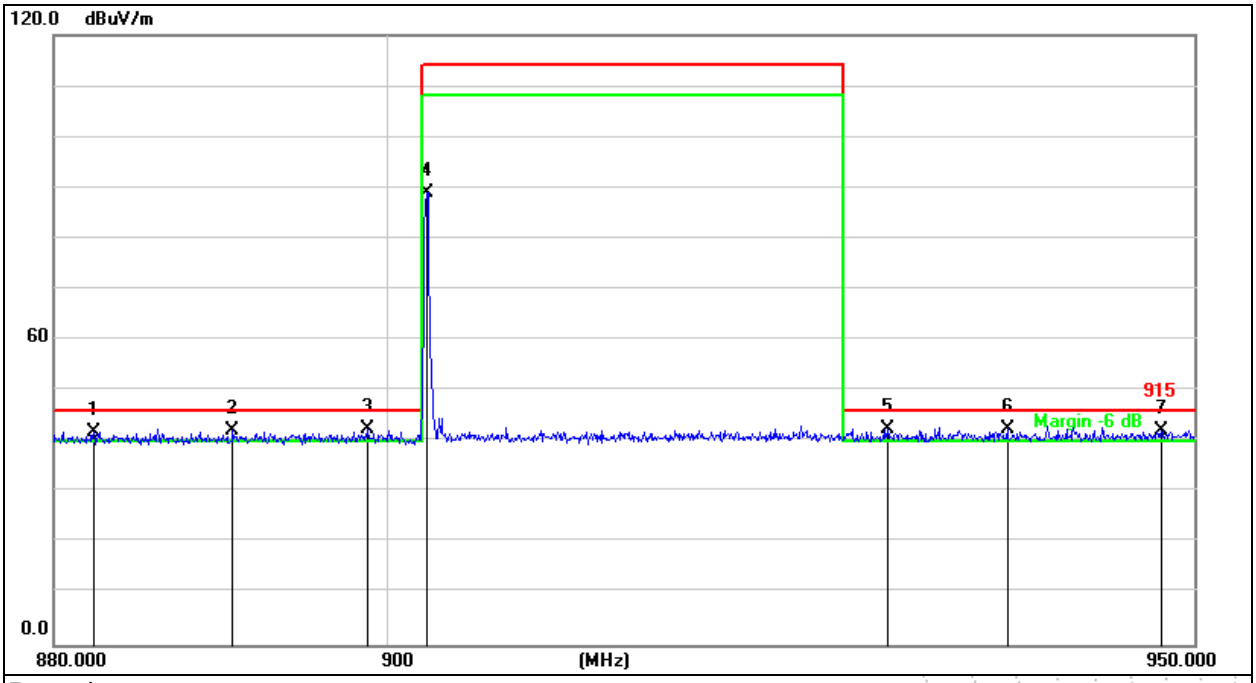
8.4 EUT Operating Conditions

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

8.5 Test Result

Temperature:	26 ℃	Relative Humidity:	54%
Pressure:	101 kPa	Test Voltage :	AC 120V/60Hz
Test Mode :	Mode 1		

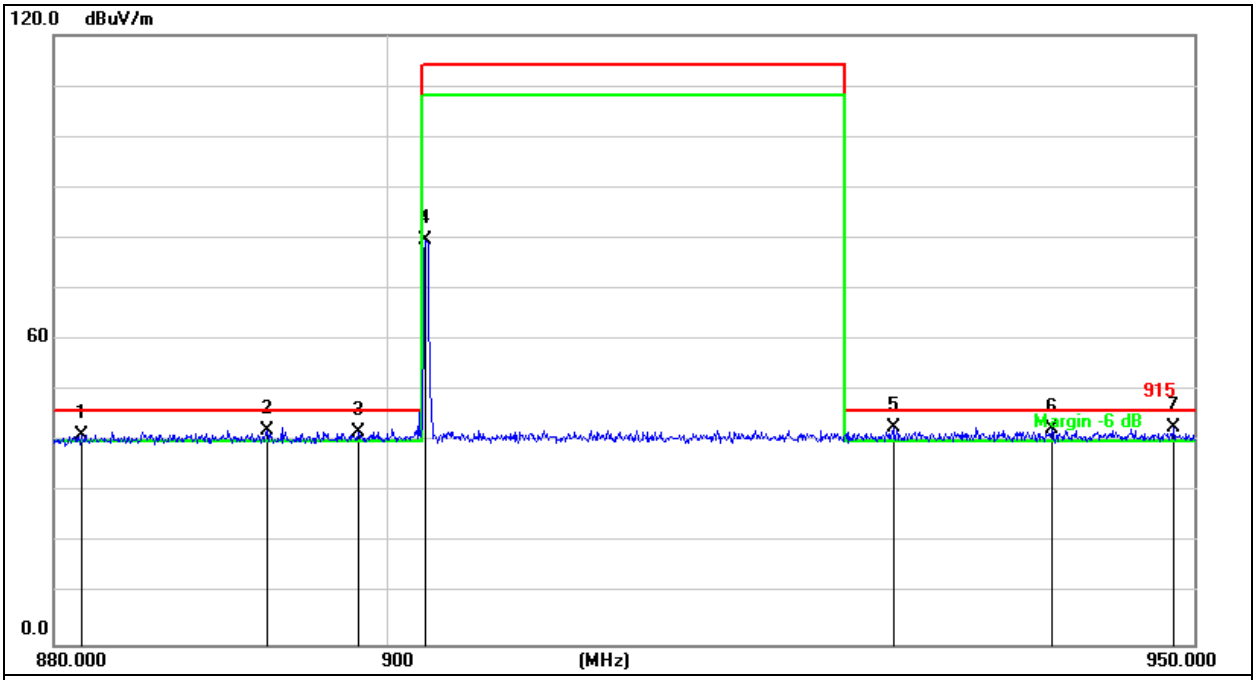
902.30 MHz Horizontal



Remark:
1.Factor = Antenna Factor + Cable Loss – Pre-amplifier.
2. Measurement=Reading Level+ Correct Factor
3. Over=Measurement-Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	!	882.3800	45.30	-3.42	41.88	46.00	-4.12	QP
2	!	890.6400	45.54	-3.28	42.26	46.00	-3.74	QP
3	!	898.7600	45.51	-3.14	42.37	46.00	-3.63	QP
4		902.3300	92.05	-3.11	88.94	114.0	-25.06	peak
5	*	930.6800	45.43	-3.01	42.42	46.00	-3.58	QP
6	!	938.1700	45.36	-2.98	42.38	46.00	-3.62	QP
7	!	947.9000	45.14	-2.95	42.19	46.00	-3.81	QP

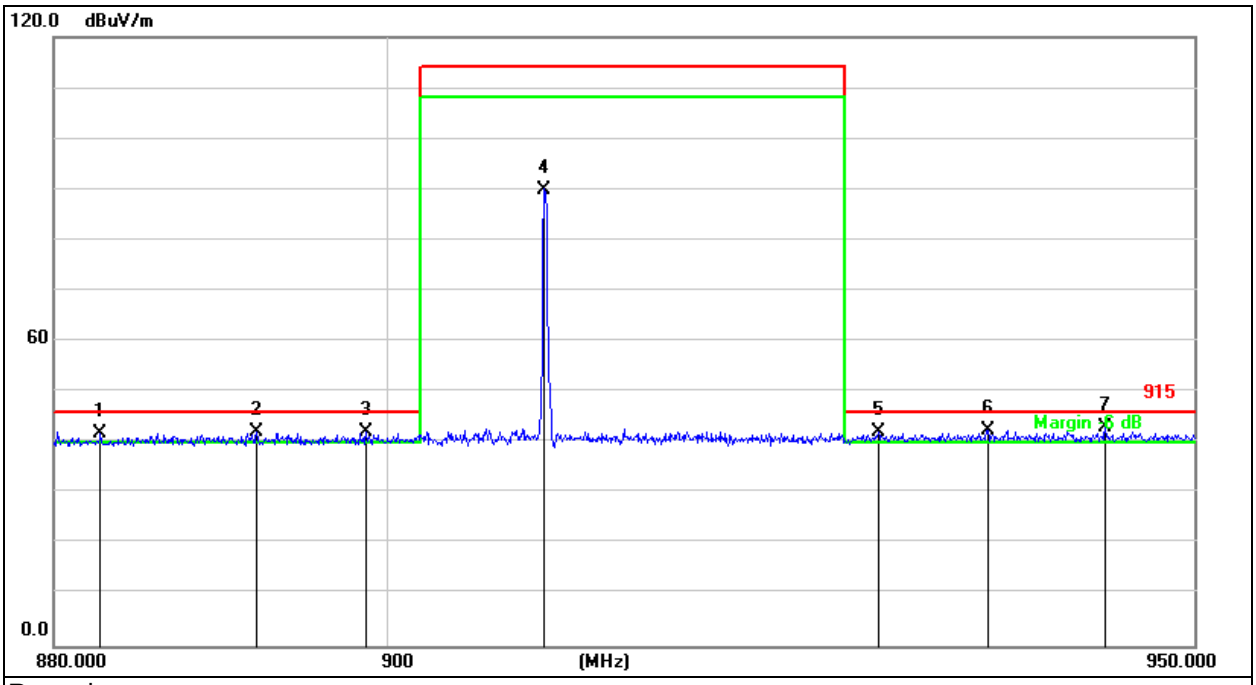
902.30 MHz Vertical



Remark:
1.Factor = Antenna Factor + Cable Loss – Pre-amplifier.
2. Measurement=Reading Level+ Correct Factor
3. Over=Measurement-Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	!	881.6800	44.76	-3.44	41.32	46.00	-4.68	QP
2	!	892.7400	45.32	-3.24	42.08	46.00	-3.92	QP
3	!	898.2000	44.91	-3.15	41.76	46.00	-4.24	QP
4		902.2600	82.85	-3.11	79.74	114.0	-34.26	peak
5	!	931.0300	45.71	-3.01	42.70	46.00	-3.30	QP
6	!	940.9700	45.50	-2.97	42.53	46.00	-3.47	QP
7	*	948.7400	45.83	-2.94	42.89	46.00	-3.11	QP

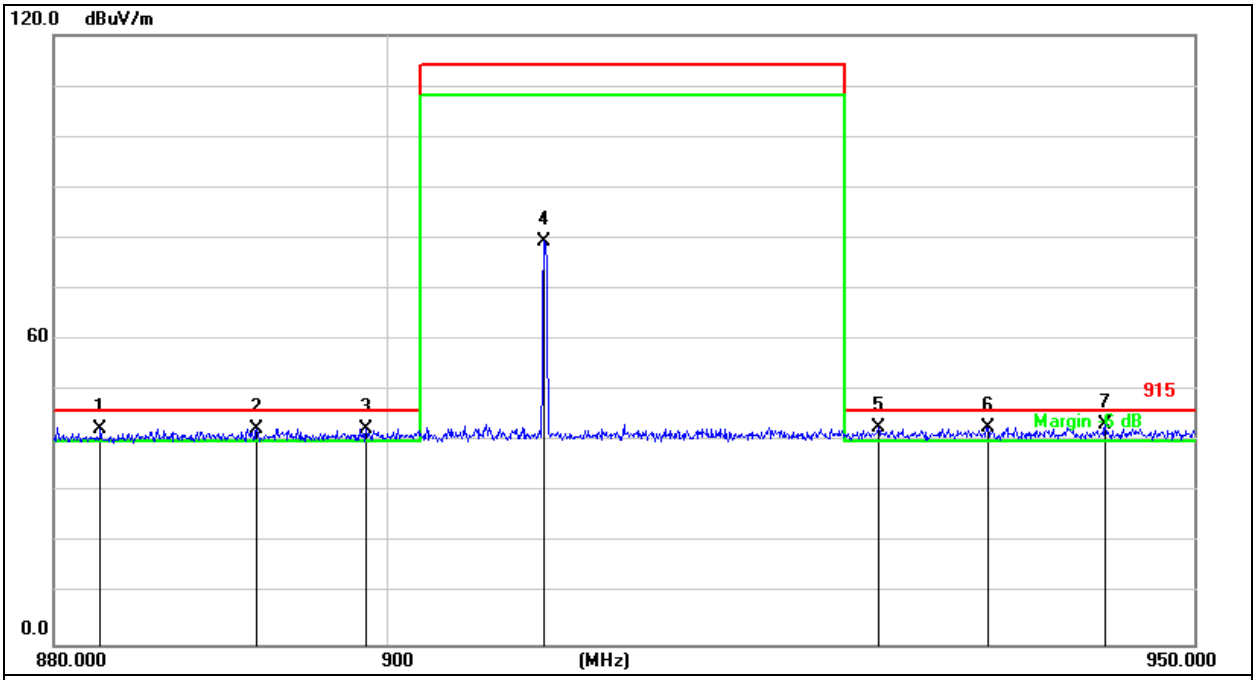
909.50 MHz Horizontal



Remark:
1.Factor = Antenna Factor + Cable Loss – Pre-amplifier.
2. Measurement=Reading Level+ Correct Factor
3. Over=Measurement-Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	!	882.7998	45.29	-3.42	41.87	46.00	-4.13	QP
2	!	892.1100	45.30	-3.26	42.04	46.00	-3.96	QP
3	!	898.6900	45.21	-3.14	42.07	46.00	-3.93	QP
4		909.4700	93.09	-3.09	90.00	114.0	-24.00	peak
5	!	930.1200	45.14	-3.01	42.13	46.00	-3.87	QP
6	!	936.9800	45.36	-2.99	42.37	46.00	-3.63	QP
7	*	944.3999	45.92	-2.96	42.96	46.00	-3.04	QP

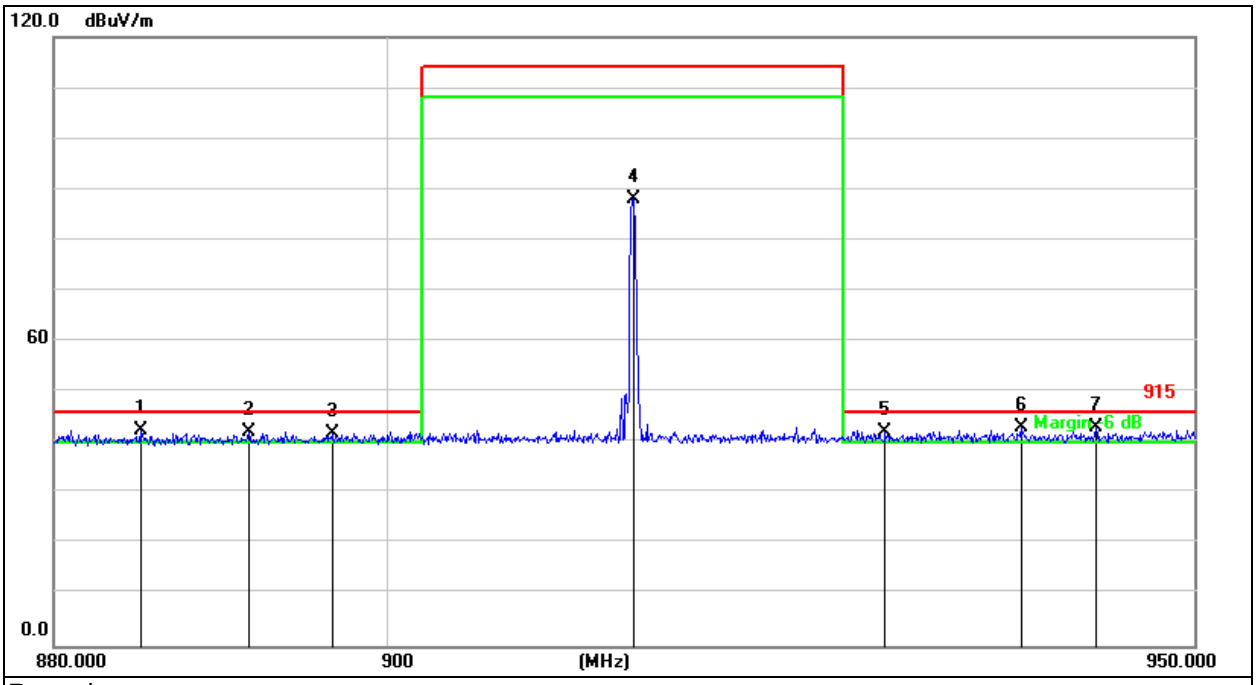
909.50 MHz Vertical



Remark:
1.Factor = Antenna Factor + Cable Loss – Pre-amplifier.
2. Measurement=Reading Level+ Correct Factor
3. Over=Measurement-Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	!	882.8000	45.79	-3.42	42.37	46.00	-3.63	QP
2	!	892.1100	45.80	-3.26	42.54	46.00	-3.46	QP
3	!	898.6900	45.71	-3.14	42.57	46.00	-3.43	QP
4		909.4700	82.59	-3.09	79.50	114.0	-34.50	peak
5	!	930.1200	45.64	-3.01	42.63	46.00	-3.37	QP
6	!	936.9800	45.86	-2.99	42.87	46.00	-3.13	QP
7	*	944.4000	46.42	-2.96	43.46	46.00	-2.54	QP

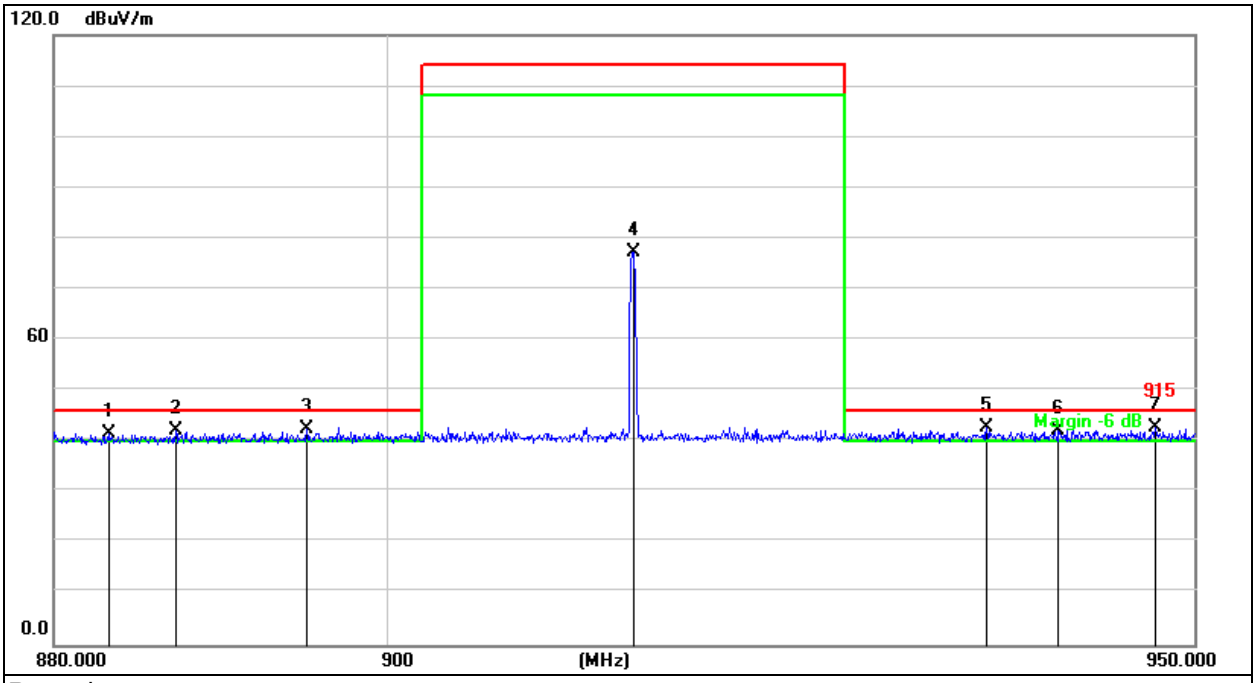
914.90 MHz Horizontal



Remark:
1.Factor = Antenna Factor + Cable Loss – Pre-amplifier.
2. Measurement=Reading Level+ Correct Factor
3. Over=Measurement-Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	!	885.1800	45.89	-3.37	42.52	46.00	-3.48	QP
2	!	891.6200	45.48	-3.26	42.22	46.00	-3.78	QP
3	!	896.5900	45.16	-3.18	41.98	46.00	-4.02	QP
4		914.9300	91.22	-3.07	88.15	114.0	-25.85	peak
5	!	930.5400	45.26	-3.01	42.25	46.00	-3.75	QP
6	*	939.0800	46.14	-2.98	43.16	46.00	-2.84	QP
7	!	943.7700	45.90	-2.96	42.94	46.00	-3.06	QP

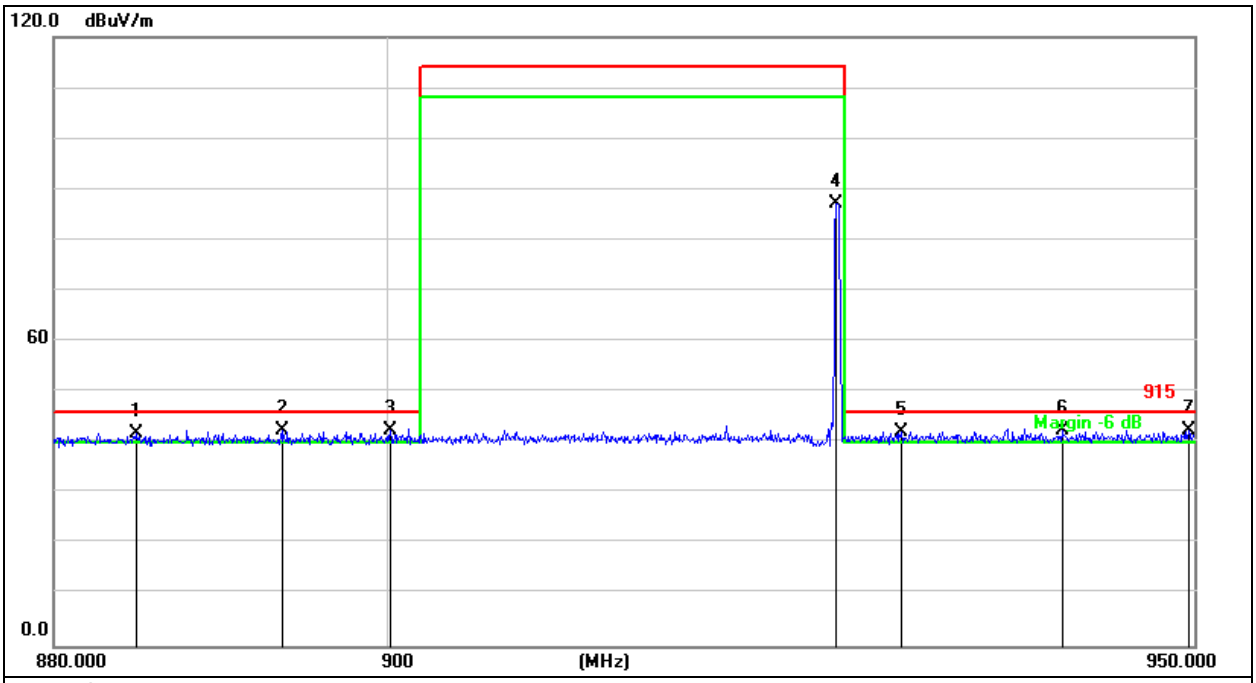
914.90 MHz Vertical



Remark:
1.Factor = Antenna Factor + Cable Loss – Pre-amplifier.
2. Measurement=Reading Level+ Correct Factor
3. Over=Measurement-Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	!	883.2899	45.02	-3.41	41.61	46.00	-4.39	QP
2	!	887.2799	45.41	-3.34	42.07	46.00	-3.93	QP
3	!	895.1200	45.60	-3.20	42.40	46.00	-3.60	QP
4		914.9299	80.31	-3.07	77.24	114.0	-36.76	peak
5	*	936.9099	45.87	-2.99	42.88	46.00	-3.12	QP
6	!	941.3899	45.21	-2.97	42.24	46.00	-3.76	QP
7	!	947.5499	45.64	-2.95	42.69	46.00	-3.31	QP

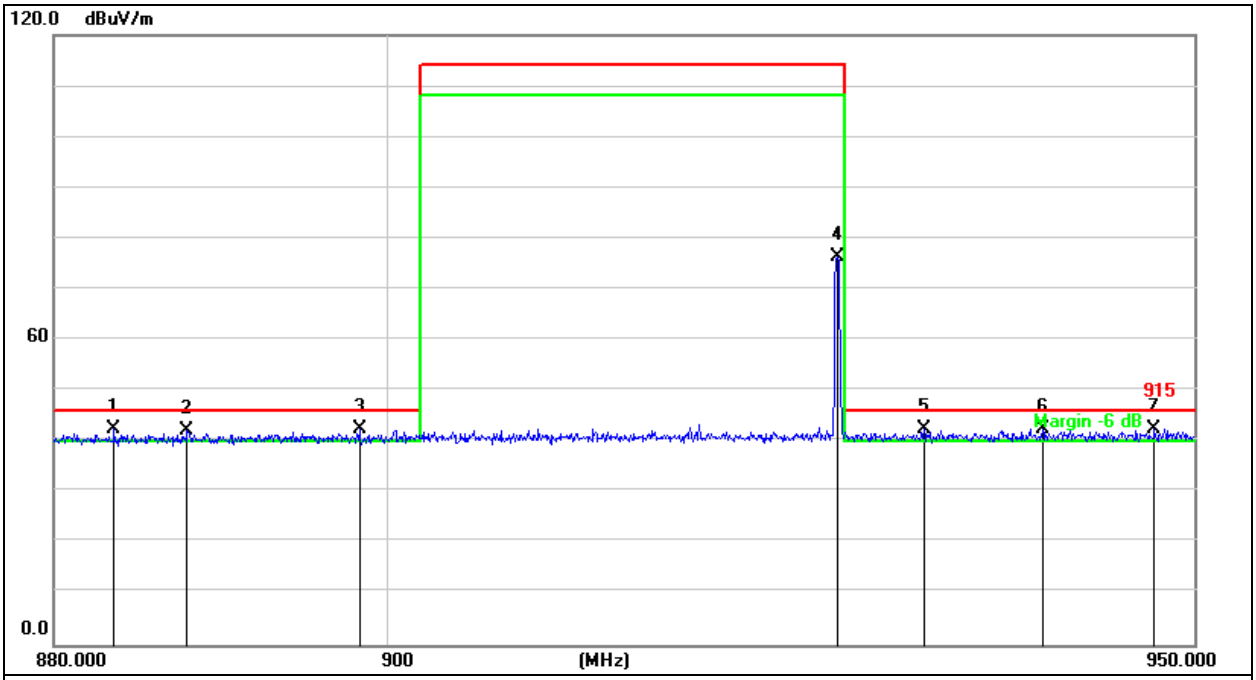
927.50 MHz Horizontal



Remark:
1.Factor = Antenna Factor + Cable Loss – Pre-amplifier.
2. Measurement=Reading Level+ Correct Factor
3. Over=Measurement-Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	!	884.9000	45.15	-3.38	41.77	46.00	-4.23	QP
2	!	893.5800	45.74	-3.23	42.51	46.00	-3.49	QP
3	!	900.1600	45.56	-3.12	42.44	46.00	-3.56	QP
4		927.4600	90.10	-3.02	87.08	114.0	-26.92	peak
5	!	931.5200	45.29	-3.01	42.28	46.00	-3.72	QP
6	!	941.6700	45.32	-2.97	42.35	46.00	-3.65	QP
7	*	949.6500	45.46	-2.94	42.52	46.00	-3.48	QP

927.50 MHz Vertical

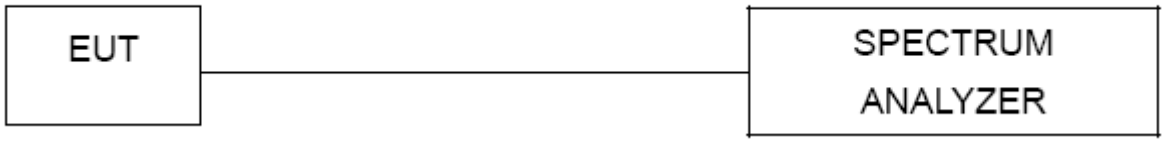


Remark:
1.Factor = Antenna Factor + Cable Loss – Pre-amplifier.
2. Measurement=Reading Level+ Correct Factor
3. Over=Measurement-Limit

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	!	883.6400	45.95	-3.40	42.55	46.00	-3.45	QP
2	!	887.9800	45.45	-3.33	42.12	46.00	-3.88	QP
3	!	898.2700	45.53	-3.15	42.38	46.00	-3.62	QP
4		927.5300	79.33	-3.02	76.31	114.0	-37.69	peak
5	!	932.9900	45.38	-3.00	42.38	46.00	-3.62	QP
6	!	940.4100	45.36	-2.97	42.39	46.00	-3.61	QP
7	*	947.4800	45.54	-2.95	42.59	46.00	-3.41	QP

9. 20 DB Bandwidth

9.1 Block Diagram Of Test Setup



9.2 Limit

FCC Part15 (15.249) , Subpart C			
Section	Test Item	Frequency Range (MHz)	Result
15.249	Bandwidth	902~928	PASS

9.3 Test Procedure

1. Set resolution bandwidth (RBW) = 1-5%
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. 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 20 dB relative to the maximum level measured in the fundamental emission.

9.4 EUT Operation Conditions

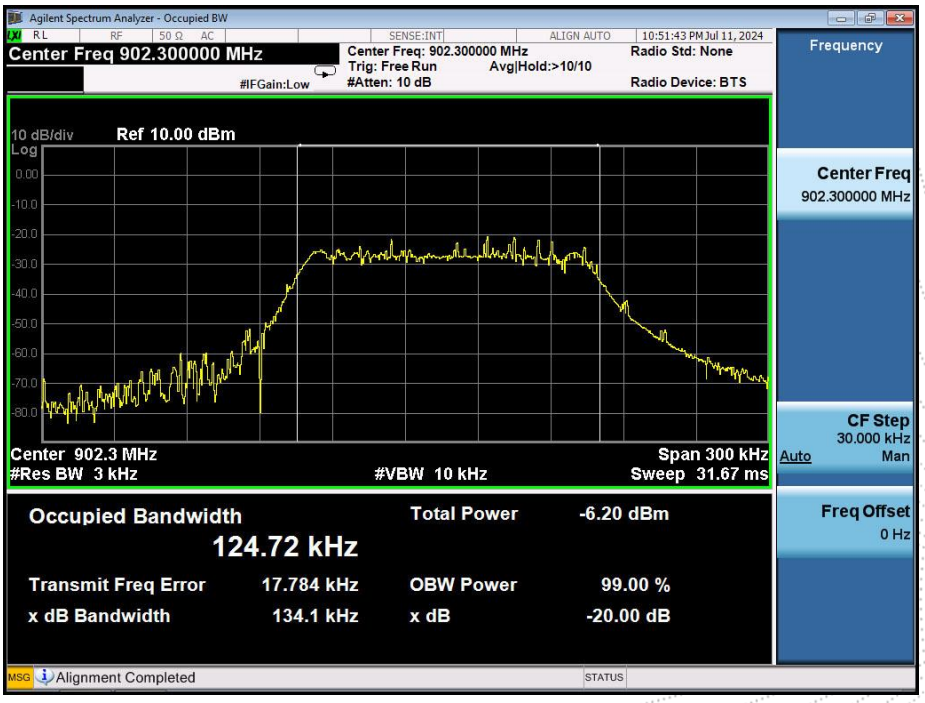
The EUT tested system was configured as the statements of 2.4 unless otherwise a special operating condition is specified in the follows during the testing.

9.5 Test Result

Temperature:	26℃	Relative Humidity:	54%
Test Voltage :	AC 120V/60Hz	Remark	N/A

Channel	Frequency (MHz)	20dB bandwidth (KHz)
00	902.30	134.1
36	909.50	138.1
63	914.90	135.6
71	927.50	135.3

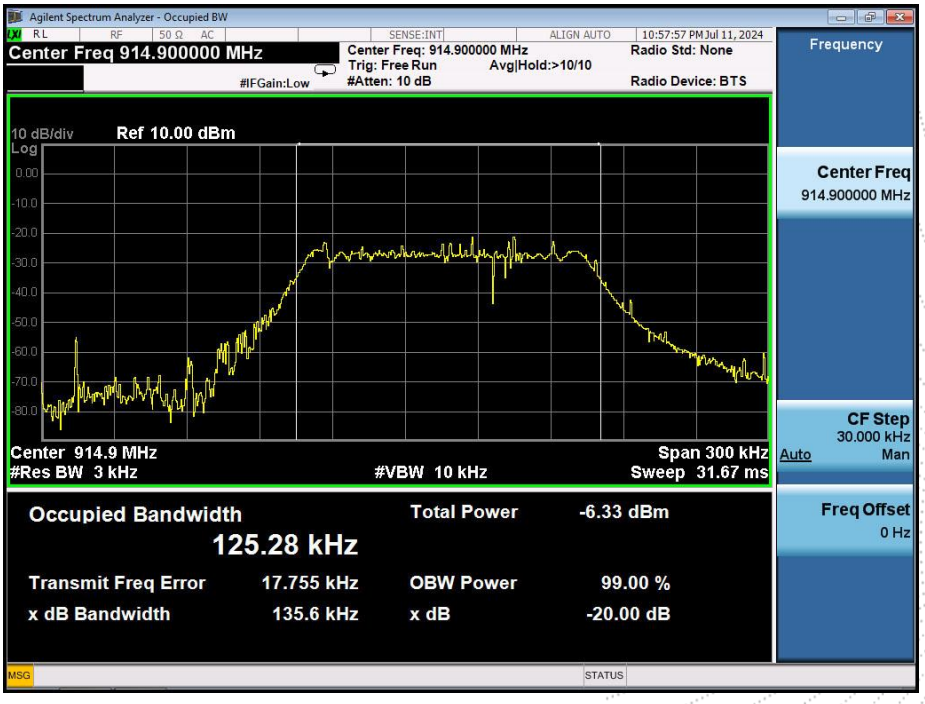
CH 00



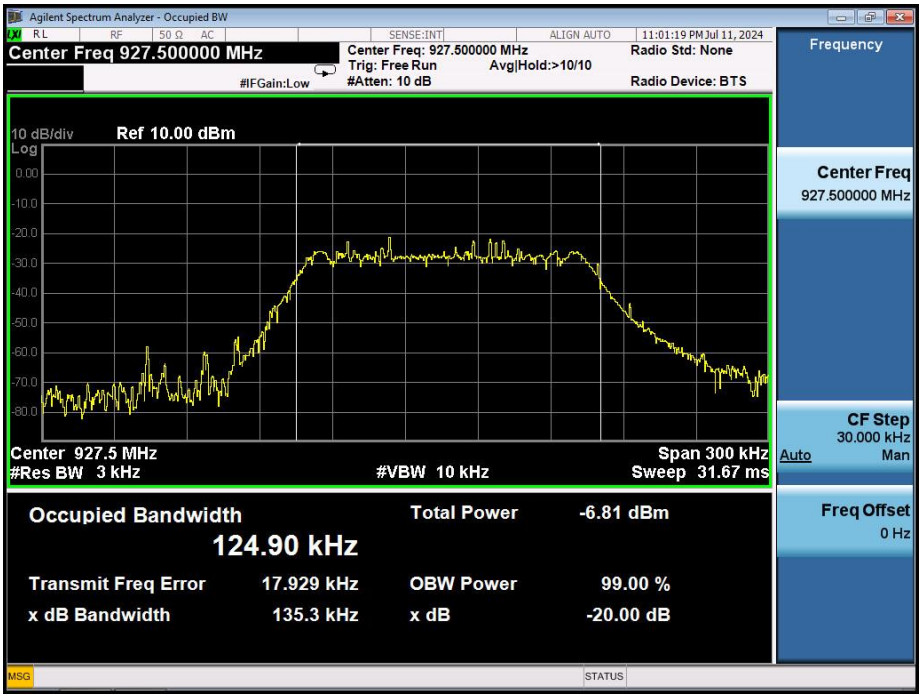
CH 36


Agilent Spectrum Analyzer - Occupied BW
Center Freq 909.500000 MHz
Center Freq: 909.500000 MHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 10 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
10:57:46 PM Jul 11, 2024
Frequency
10 dB/div
Log
Ref 10.00 dBm
Center Freq
909.500000 MHz
Center 909.5 MHz
#Res BW 3 kHz
#VBW 10 kHz
Span 300 kHz
Sweep 31.67 ms
CF Step
30.000 kHz
Auto
Man
Occupied Bandwidth
126.54 kHz
Total Power
-2.37 dBm
Transmit Freq Error
17.593 kHz
OBW Power
99.00 %
x dB Bandwidth
138.1 kHz
x dB
-20.00 dB
Freq Offset
0 Hz
MSG
STATUS

CH 63


Agilent Spectrum Analyzer - Occupied BW
Center Freq 914.900000 MHz
Center Freq: 914.900000 MHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 10 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
10:57:57 PM Jul 11, 2024
Frequency
10 dB/div
Log
Ref 10.00 dBm
Center Freq
914.900000 MHz
Center 914.9 MHz
#Res BW 3 kHz
#VBW 10 kHz
Span 300 kHz
Sweep 31.67 ms
CF Step
30.000 kHz
Auto
Man
Occupied Bandwidth
125.28 kHz
Total Power
-6.33 dBm
Transmit Freq Error
17.755 kHz
OBW Power
99.00 %
x dB Bandwidth
135.6 kHz
x dB
-20.00 dB
Freq Offset
0 Hz
MSG
STATUS

CH 71


Agilent Spectrum Analyzer - Occupied BW
Center Freq 927.500000 MHz
Center Freq: 927.500000 MHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 10 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
11:01:19 PM Jul 11, 2024
Frequency
10 dB/div
Log
Ref 10.00 dBm
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
Center Freq
927.500000 MHz
CF Step
30.000 kHz
Auto
Man
Center 927.5 MHz
#Res BW 3 kHz
#VBW 10 kHz
Span 300 kHz
Sweep 31.67 ms
Occupied Bandwidth
124.90 kHz
Total Power
-6.81 dBm
Transmit Freq Error
17.929 kHz
OBW Power
99.00 %
x dB Bandwidth
135.3 kHz
x dB
-20.00 dB
Freq Offset
0 Hz
MSG
STATUS

10. Antenna Requirement

10.1 Limit

15.203 requirement: For intentional device, according to 15.203: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

10.2 Test Result

The EUT antenna is RP-SMA antenna and meets the requirements in this section.

11. EUT Test Setup Photographs

Conducted emissions

Radiated Measurement Photos

STATEMENT

1. The equipment lists are traceable to the national reference standards.

2. The test report can not be partially copied unless prior written approval is issued from our lab.

3. The test report is invalid without the "special seal for inspection and testing".

4. The test report is invalid without the signature of the approver.

5. The test process and test result is only related to the Unit Under Test.

6. Sample information is provided by the client and the laboratory is not responsible for its authenticity.

7. The quality system of our laboratory is in accordance with ISO/IEC17025.

8. If there is any objection to this test report, the client should inform issuing laboratory within 15 days from the date of receiving test report.

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※※※※※ END ※※※※※