FCC Radio Test Report

FCC ID: OMOLTV-R2

This report concerns (check one): ☒**Original Grant** ☐**Class II Change**

Project No.	: 1706C067
Equipment	: RAIN SENSOR
Test Model	: LTV-R2
Applicant	: La Crosse Technology Ltd.
Address	: 2809 Losey Blvd. S. La Crosse Wisconsin 54601 United States

Date of Receipt	: Jun. 07, 2017
Date of Test	: Jun. 07, 2017 ~ Jun. 16, 2017
Issued Date	: Jun. 17, 2017
Tested by	: BTL Inc.

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Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.

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REPORT ISSUED HISTORY

Issued No.	Description	Issued Date
BTL-FCCP-1-1706C067	Original Issue.	Jun. 17, 2017

1. CERTIFICATION

Equipment	:	RAIN SENSOR
Brand Name	:	La Crosse Technology
Model Name	:	LTV-R2
Applicant	:	La Crosse Technology Ltd.
Manufacturer	:	La Crosse Technology Ltd.
Address	:	2809 Losey Blvd. S. La Crosse Wisconsin 54601 United States
Factory	:	La Crosse Technology Ltd.
Address	:	2809 Losey Blvd. S. La Crosse Wisconsin 54601 United States
Date of Test	:	Jun. 07, 2017 ~ Jun. 16, 2017
Test Sample	:	Engineering Sample
Standard(s)	:	FCC Part15, Subpart C (15.249) / ANSI C63.10-2013

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.
The test data, data evaluation, and equipment configuration contained in our test report (Ref No. BTL-FCCP-1-1706C067) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of TAF according to the ISO-17025 quality assessment standard and technical standard(s).

2. SUMMARY OF TEST RESULTS

Test procedures according to the technical standard(s):

Applied Standard(s): FCC Part15, Subpart C (15.249)			
Standard(s) Section	Test Item	Judgment	Remark
15.207	Conducted Emission	N/A	NOTE (1)
15.209 15.249	Radiated Spurious Emissions	PASS	
-	Bandwidth	PASS	

NOTE:

(1)" N/A" denotes test is not applicable to this device.

(2) The EUT is used new battery.

2.1 TEST FACILITY

The test facilities used to collect the test data in this report is at the location of No.3, Jinshagang 1st Road, Shixia, Dalang Town, Dongguan, Guangdong, China.
BTL's test firm number for FCC: 319330

2.2 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in TR 100 028-1. The measurement instrumentation uncertainty considerations contained in TR 100 028-1.

The reported uncertainty of measurement **y** ± **U**, where expanded uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**, providing a level of confidence of approximately **95** %.

A. Radiated Measurement :

Test Site	Method	Measurement Frequency Range	Ant. H / V	U, (dB)
DG-CB03	CISPR	9KHz~30MHz	V	3.79
		9KHz~30MHz	H	3.57
		30MHz ~ 200MHz	V	3.82
		30MHz ~ 200MHz	H	3.78
		200MHz ~ 1,000MHz	V	4.10
		200MHz ~ 1,000MHz	H	4.06
		1GHz~18GHz	V	3.12
		1GHz~18GHz	H	3.68
		18GHz~40GHz	V	4.15
		18GHz~40GHz	H	4.14

Note: Unless specifically mentioned, the uncertainty of measurement has not been taken into account to declare the compliance or non-compliance to the specification.

3. GENERAL INFORMATION

3.1 DESCRIPTION OF EUT

Equipment	RAIN SENSOR	
Brand Name	La Crosse Technology	
Model Name	LTV-R2	
Model Difference	N/A	
Product Description	Operation Frequency	915 MHz
	Modulation Technology	FSK
	Bit Rate of Transmitter	9.6 bps
	Field Strength	91.76 dBuV/m
Power Source	Supplied from 2*1.5V AA battery.	
EUT Power Rating	DC 3V	

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

2. Channel List:

Channel	Frequency (MHz)
01	915

3. Table for Filed Antenna

Ant.	Brand	P/N	Antenna Type	Connector	Gain (dBi)
1	N/A	N/A	Internal	N/A	0

3.2 DESCRIPTION OF TEST MODES

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.

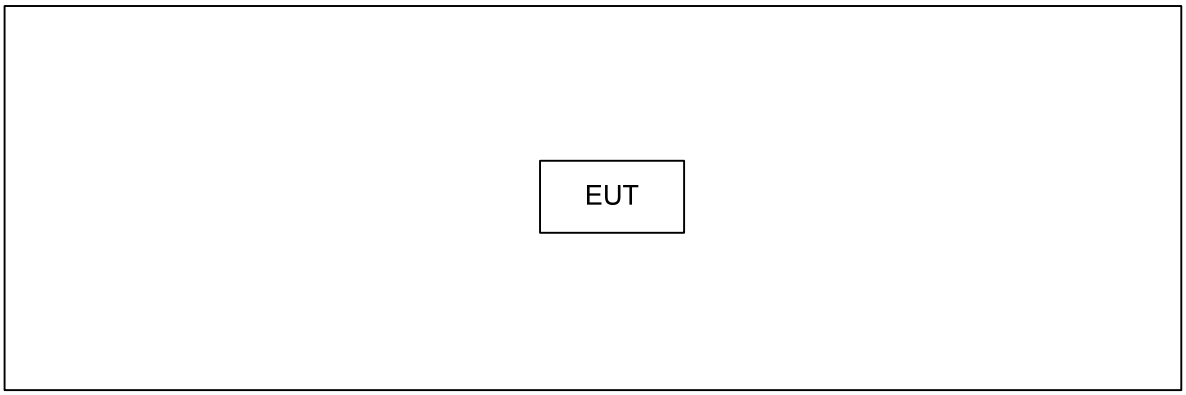
Pretest Mode	Description
Mode 1	TX Mode

The EUT system operated these modes were found to be the worst case during the pre-scanning test as following:

For Conducted Test	
Final Test Mode	Description
N/A	” N/A” denotes test is not applicable to this device.

For Radiated Test	
Final Test Mode	Description
Mode 1	TX Mode

3.4 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED



3.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	FCC ID	Series No.
-	-	-	-	-	-

Item	Shielded Type	Ferrite Core	Length	Note
-	-	-	-	-

4. EMC EMISSION TEST

4.1 CONDUCTED EMISSION MEASUREMENT

4.1.1 POWER LINE CONDUCTED EMISSION Limits (Frequency Range 150KHz-30MHz)

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 -0.	66 to 56*	56 to 46*
0.50 -5.0	56	46
5.0 -30.0	60	50

Note:

(1) The limit of " * " decreases with the logarithm of the frequency

(2) The test result calculated as following:
Measurement Value = Reading Level + Correct Factor
Correct Factor = Insertion Loss + Cable Loss - Amplifier Gain(if use)
Margin Level = Measurement Value - Limit Value

The following table is the setting of the receiver

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

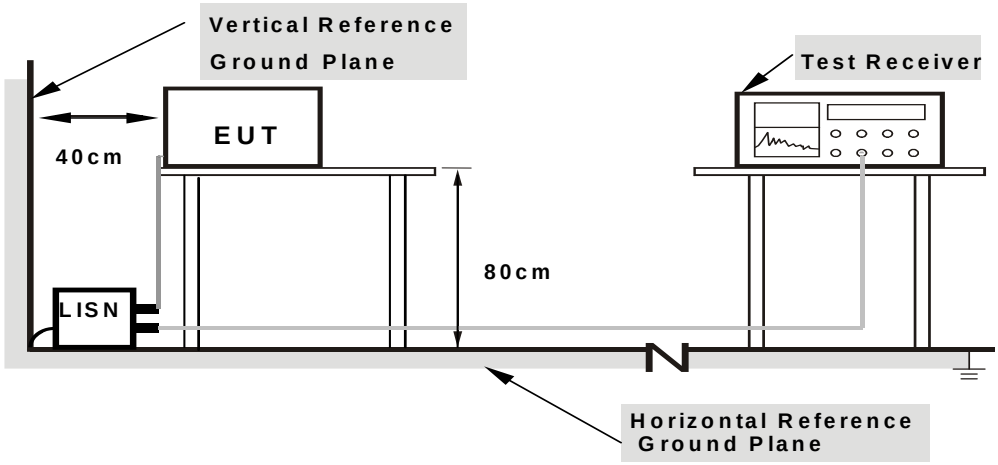
4.1.2 TEST PROCEDURE

a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
d. LISN at least 80 cm from nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.1.3 DEVIATION FROM TEST STANDARD

No deviation

4.1.4 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 from other units and other metal planes

4.1.5 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical function (as a customer would normally use it), EUT was programmed to be in continuously transmitting/receiving data or hopping on mode.

4.1.6 EUT TEST CONDITIONS

Temperature: N/A
Relative Humidity: N/A
Test Voltage: N/A

4.1.7 TEST RESULTS

Please refer to the Attachment A.

Remark:

(1) All readings are QP Mode value unless otherwise stated AVG in column of『Note』. If the QP Mode Measured value compliance with the QP Limits and lower than AVG Limits, the EUT shall be deemed to meet both QP & AVG Limits and then only QP Mode was measured, but AVG Mode didn't perform.In this case, a " * " marked in AVG Mode column of Interference Voltage Measured.
(2) Measuring frequency range from 150KHz to 30MHz.
(3) " N/A" denotes test is not applicable to this device.

4.2 RADIATED EMISSION MEASUREMENT

4.2.1 RADIATED EMISSION LIMITS (FCC 15.209 and 15.249)

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
960~1000	500	3

Harmonic emissions limits comply with below 54 dBuV/m at 3m. Other 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 comply with the radiated emissions limits specified in section15.209(a) limit in the table below has to be followed.

Fundamental Frequency	Field Strength of Fundamental (micorvolts/meter)	Field Strength of Harnibucs (micorvolts/meter)
902-928 MHz	50	500

LIMITS OF RADIATED EMISSION MEASUREMENT (FCC 15.209)

FREQUENCY (MHz)	(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).

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~90kHz for PK/AVG detector
Start ~ Stop Frequency	90kHz~110kHz for QP detector
Start ~ Stop Frequency	110kHz~490kHz for PK/AVG detector
Start ~ Stop Frequency	490kHz~30MHz for QP detector
Start ~ Stop Frequency	30MHz~1000MHz for QP detector
Start ~ Stop Frequency	Above 1GHz for AVG detector

DWELL TIME OF PERIODIC OPERATION MEASUREMENT

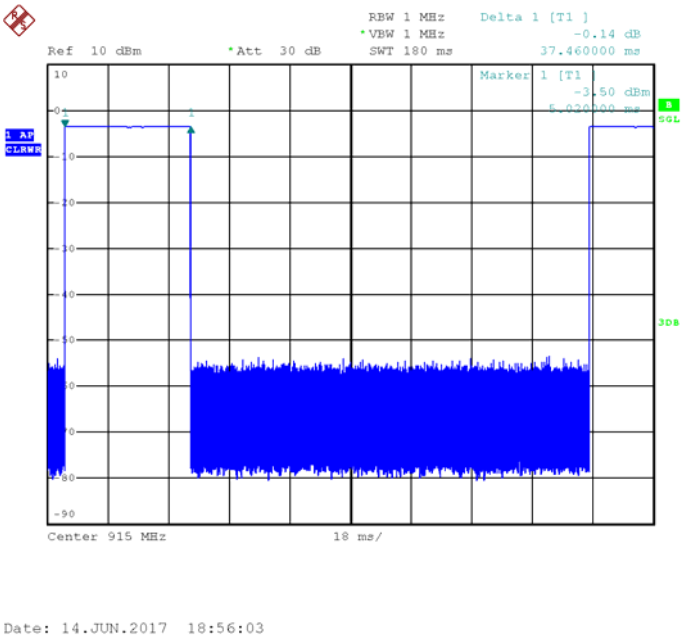
Duty Cycle = On Time/100

T_{ON}: 37.46 ms

Duty cycle=37.46/100= 37.46%

Average Reading = Peak value + 20log(Duty cycle) , AV=Peak-8.53

On Time



4.2.2 TEST PROCEDURE

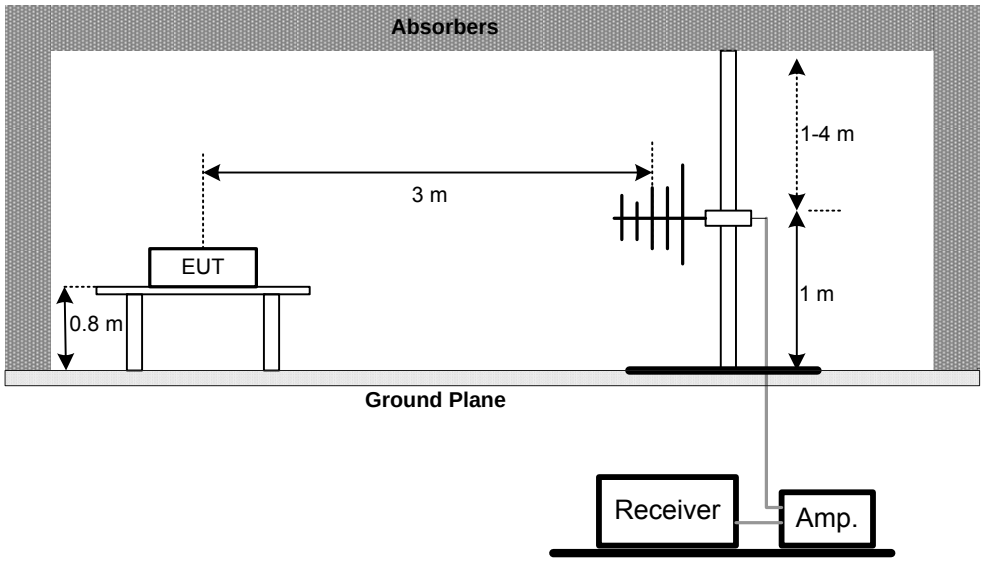
a. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(below 1GHz)
b. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 1.5 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(above 1GHz)
c. The height of the equipment or of the substitution antenna shall be 0.8 m or 1.5m, the height of the test antenna shall vary between 1 m to 4 m. 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 find the maximum reading (used Bore sight function).
e. The receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1GHz.
f. The initial step in collecting radiated emission data is a receiver peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
g. All readings are Peak unless otherwise stated QP in column of Note. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn‘t perform. (below 1GHz)
h. All readings are Peak Mode value unless otherwise stated AVG in column of Note. If the Peak Mode Measured value compliance with the Peak Limits and lower than AVG Limits, the EUT shall be deemed to meet both Peak & AVG Limits and then only Peak Mode was measured, but AVG Mode didn‘t perform. (above 1GHz)
i. For the actual test configuration, please refer to the related Item –EUT Test Photos.

4.2.3 DEVIATION FROM TEST STANDARD

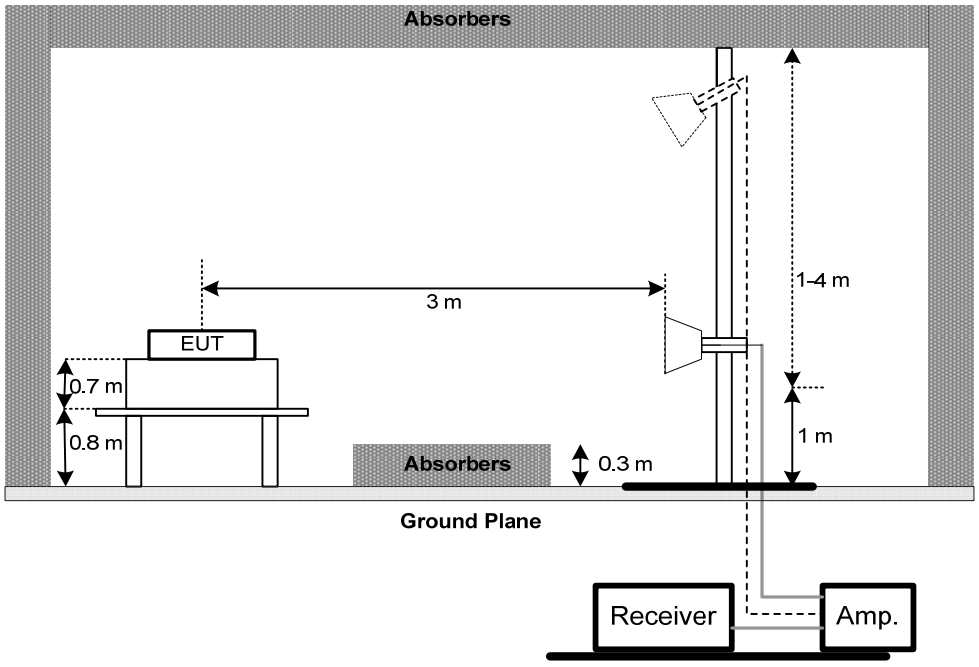
No deviation

4.2.4 TEST SETUP

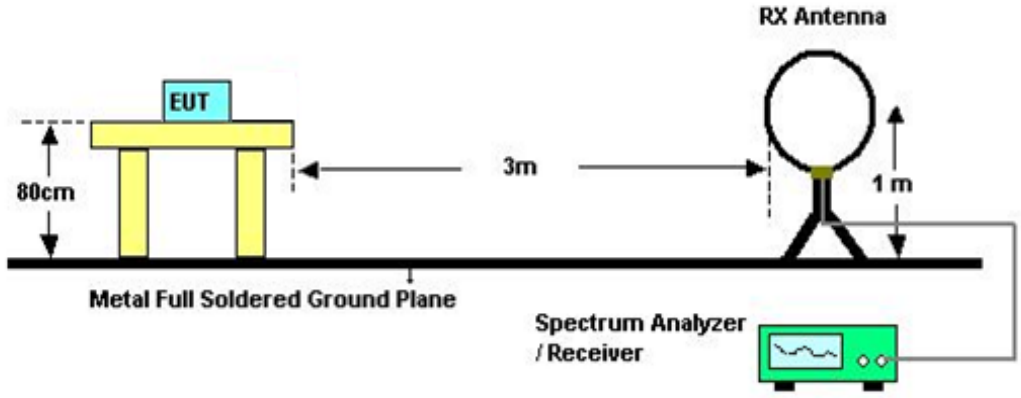
(A) Radiated Emission Test Set-Up Frequency Below 1 GHz



(B) Radiated Emission Test Set-Up Frequency Above 1 GHz



(C) For radiated emissions below 30MHz



4.2.5 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of **4.1.5** unless otherwise a special operating condition is specified in the follows during the testing.

4.2.6 EUT TEST CONDITIONS

Temperature: 25°C
Relative Humidity: 60%
Test Voltage: DC 3V

4.2.7 TEST RESULTS (9KHZ TO 30MHZ)

Please refer to the Attachment B

Remark:

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

4.2.8 TEST RESULTS (30MHZ TO 1000MHZ)

Please refer to the Attachment C.

Remark:

(1) Measuring frequency range from 30MHz to 1000MHz.
(2) If the peak scan value lower limit more than 20dB, then this signal data does not show in table.

4.2.9TEST RESULTS (ABOVE 1000 MHZ)

Please refer to the Attachment D.

Remark:

(1) Radiated emissions measured in frequency range above 1000MHz were made with an instrument using Peak detector mode and AV detector mode of the emission

(2) A preamp and high pass filter were used for this test in order to provide sufficient measurement sensitivity.

(3) EUT Orthogonal Axis:
"X" - denotes Laid on Table, "Y" - denotes Vertical Stand, "Z" - denotes Side Stand

(4) During the measurements above 1 GHz it is taken care of that the EUT is always within the 3 dB cone of radiation BW of the used antenna

(5) No limit: This is fundamental signal, the judgment is not applicable.
For fundamental signal judgment was referred to Peak output test.

5. BANDWIDTH TEST

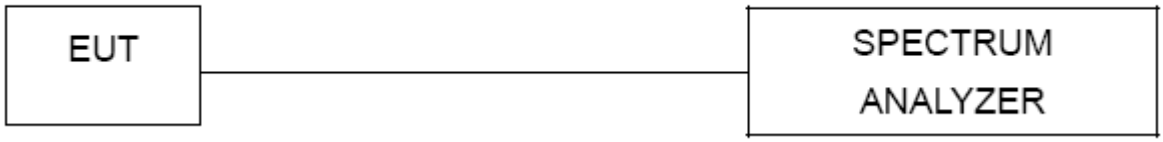
5.1 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Spectrum Setting: RBW= 100KHz, VBW=300KHz, Sweep time = Auto.

5.2 DEVIATION FROM STANDARD

No deviation.

5.3 TEST SETUP



5.4 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

5.5 EUT TEST CONDITIONS

Temperature: 25°C
Relative Humidity: 60%
Test Voltage: DC 3V

5.6 TEST RESULTS

Please refer to the Attachment E.

6. MEASUREMENT INSTRUMENTS LIST

Radiated Emission Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Antenna	Schwarbeck	VULB9160	9160-3232	Mar. 26, 2018
2	Amplifier	HP	8447D	2944A09673	Oct. 20, 2017
3	Receiver	AGILENT	N9038A	MY52130039	Sep. 04, 2017
4	Cable	emci	LMR-400(30MHz-1GHz) (8m+5m)	N/A	Jun. 27, 2017
5	Control	CT	SC100	N/A	N/A
6	Position Control	MF	MF-7802	MF780208416	N/A
7	Antenna	ETS	3115	00075789	Mar. 26, 2018
8	Amplifier	Agilent	8449B	3008A02274	Feb. 22, 2018
9	Receiver	AGILENT	N9038A	MY52130039	Sep. 04, 2017
10	Test Cable	emci	EMC104-SM-SM-10000(1GHz-26.5GHz)	C-68	Jun. 26, 2017
11	Controller	CT	SC100	N/A	N/A
12	Broad-Band Horn Antenna	Schwarzbeck	BBHA 9170	9170319	Apr. 22, 2018
13	Microwave Preamplifier With Adaptor	EMC INSTRUMENT	EMC2654045	980039 & HA01	Mar. 26, 2018
14	Active Loop Antenna	R&S	HFH2-Z2	830749/020	Sep. 06, 2017
15	Measurement Software	Farad	EZ-EMC Ver.NB-03A1-01	N/A	N/A

Bandwidth Measurement					
Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum Analyzer	R&S	FSP 40	100185	Sep. 04, 2017

Remark: ”N/A” denotes no model name, serial no. or calibration specified.
All calibration period of equipment list is one year.

7. EUT TEST PHOTO

Radiated Measurement Photos

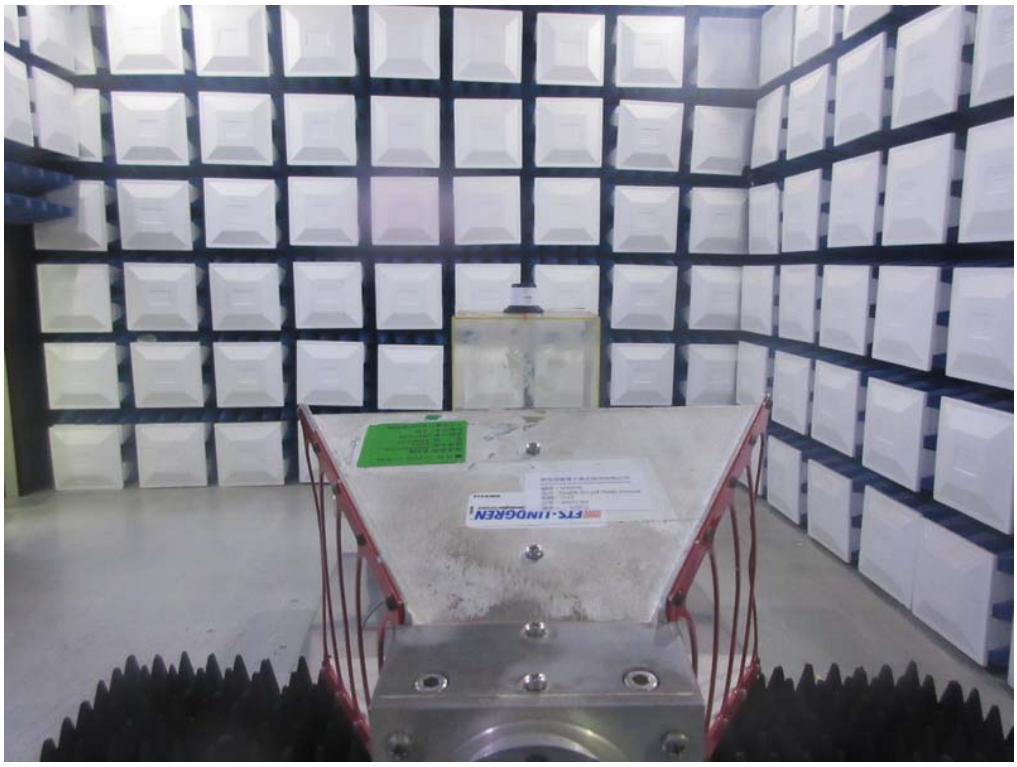
9KHz to 30MHz

Radiated Measurement Photos

30MHz to 1000MHz

Radiated Measurement Photos

Above 1000MHz



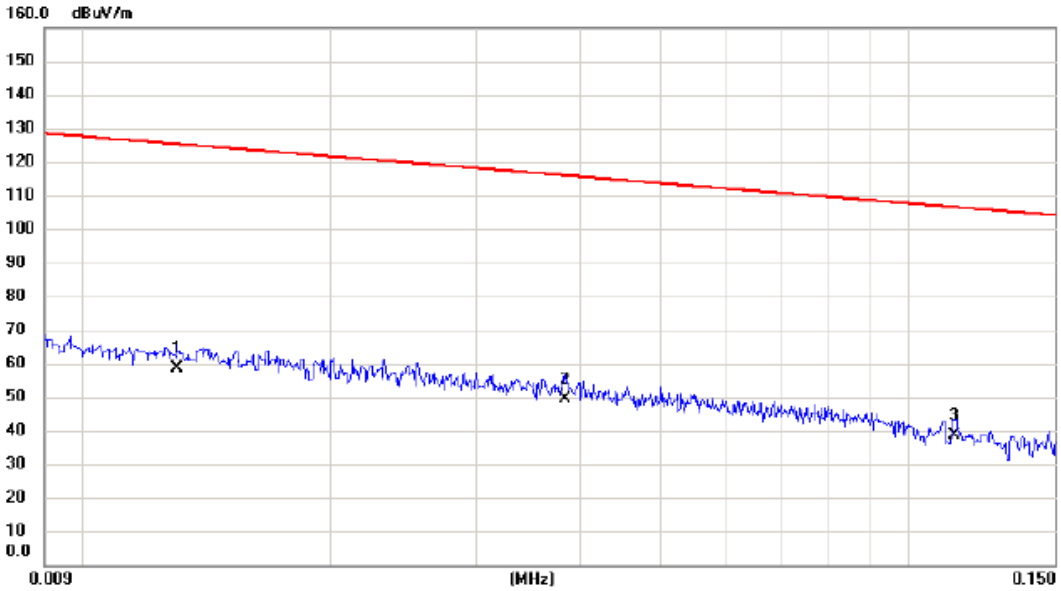
ATTACHMENT A - CONDUCTED EMISSION

Test Mode:	N/A
Note:	” N/A” denotes test is not applicable to this device.

ATTACHMENT B - RADIATED EMISSION (9KHZ TO 30MHZ)

Test Mode:	TX Mode

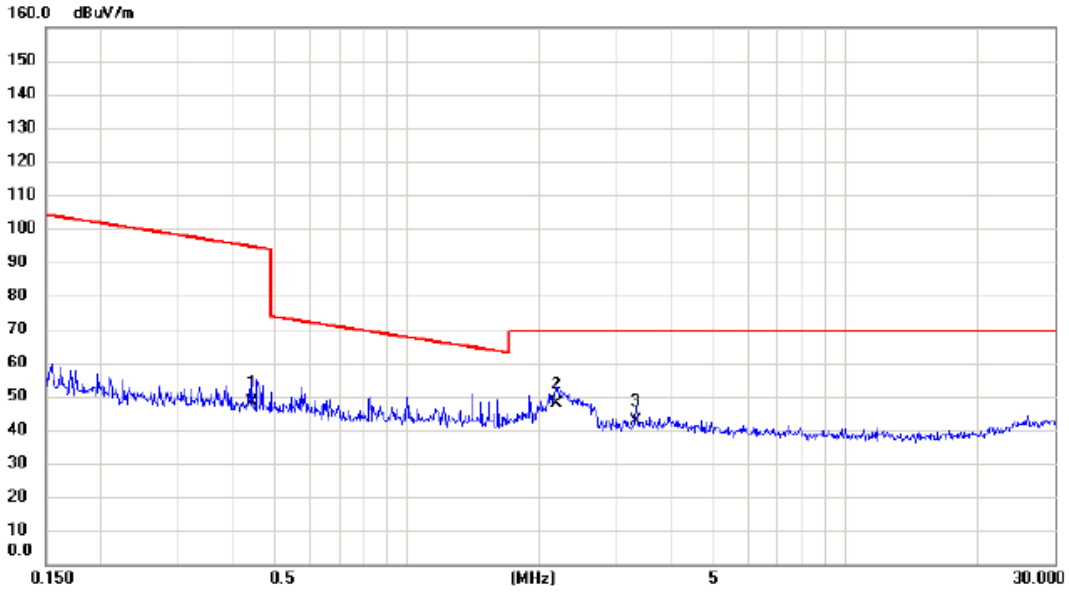
Ant 0°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		0.0130	38.15	20.53	58.68	125.33	-66.65	AVG	
2	*	0.0384	30.38	19.07	49.45	115.92	-66.47	AVG	
3		0.1135	21.13	17.44	38.57	106.51	-67.94	AVG	

Test Mode:	TX Mode

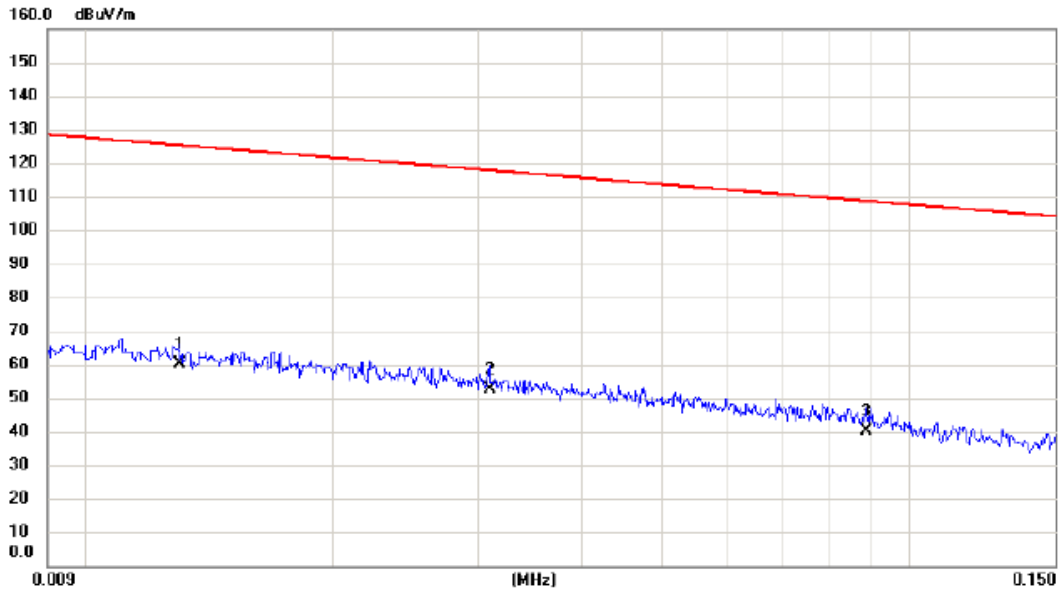
Ant 0°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		0.4421	31.57	16.52	48.09	94.69	-46.60	AVG	
2	*	2.1898	32.41	15.45	47.86	69.54	-21.68	QP	
3		3.3281	27.43	15.14	42.57	69.54	-26.97	QP	

Test Mode:	TX Mode

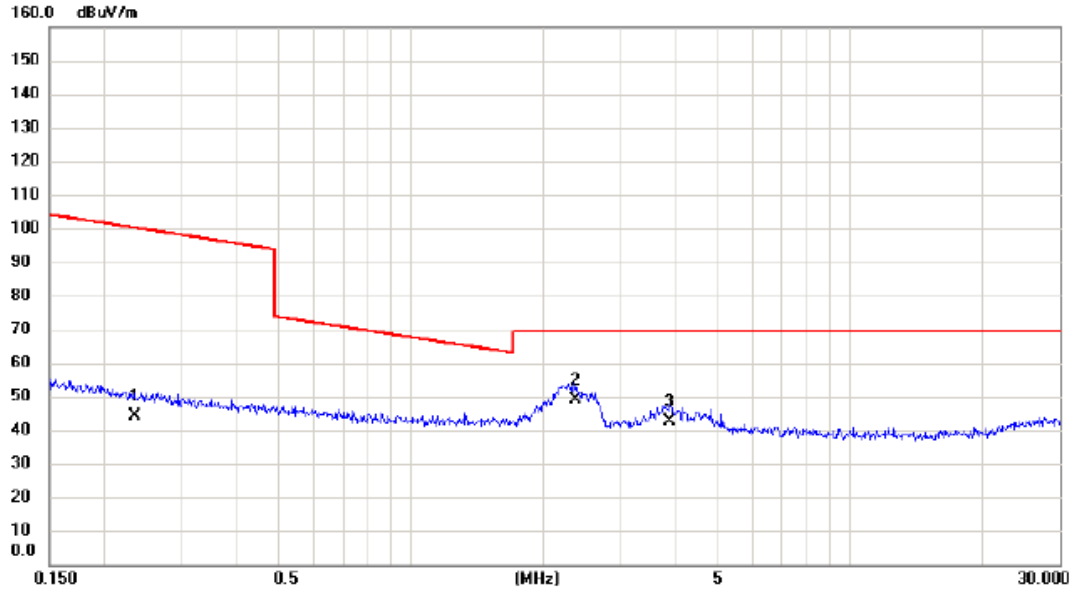
Ant 90°



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	0.0130	39.76	20.53	60.29	125.33	-65.04	AVG	
2		0.0310	33.41	19.29	52.70	117.78	-65.08	AVG	
3		0.0884	22.48	17.91	40.39	108.68	-68.29	AVG	

Test Mode:	TX Mode

Ant 90°

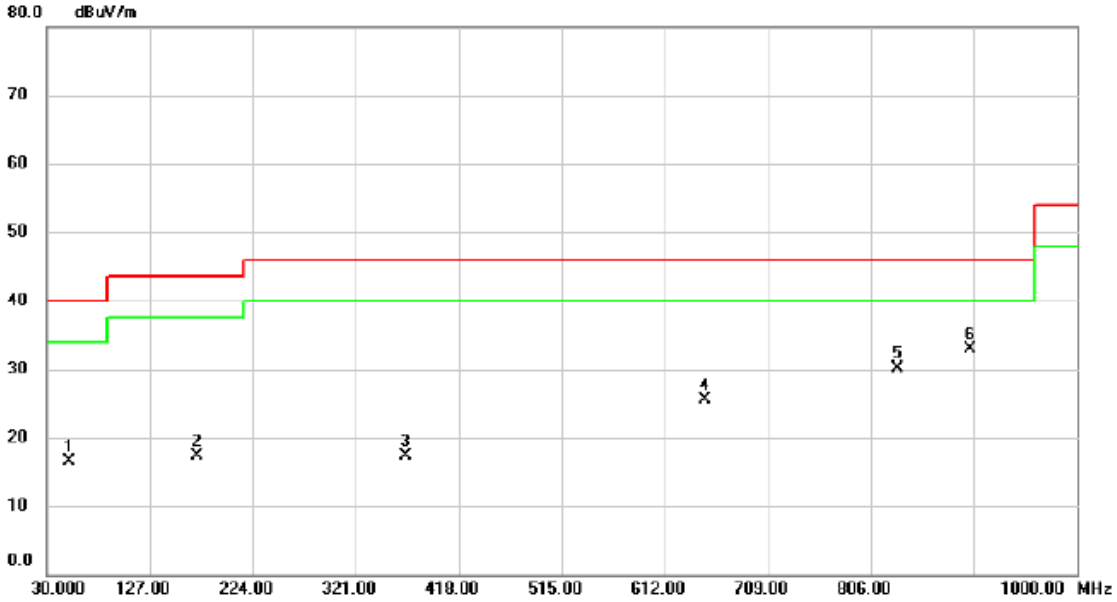


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		0.2341	27.48	16.70	44.18	100.22	-56.04	AVG	
2	*	2.3585	33.47	15.40	48.87	69.54	-20.67	QP	
3		3.8808	27.65	14.99	42.64	69.54	-26.90	QP	

ATTACHMENT C - RADIATED EMISSION (30MHZ TO 1000MHZ)

Test Mode:	TX Mode

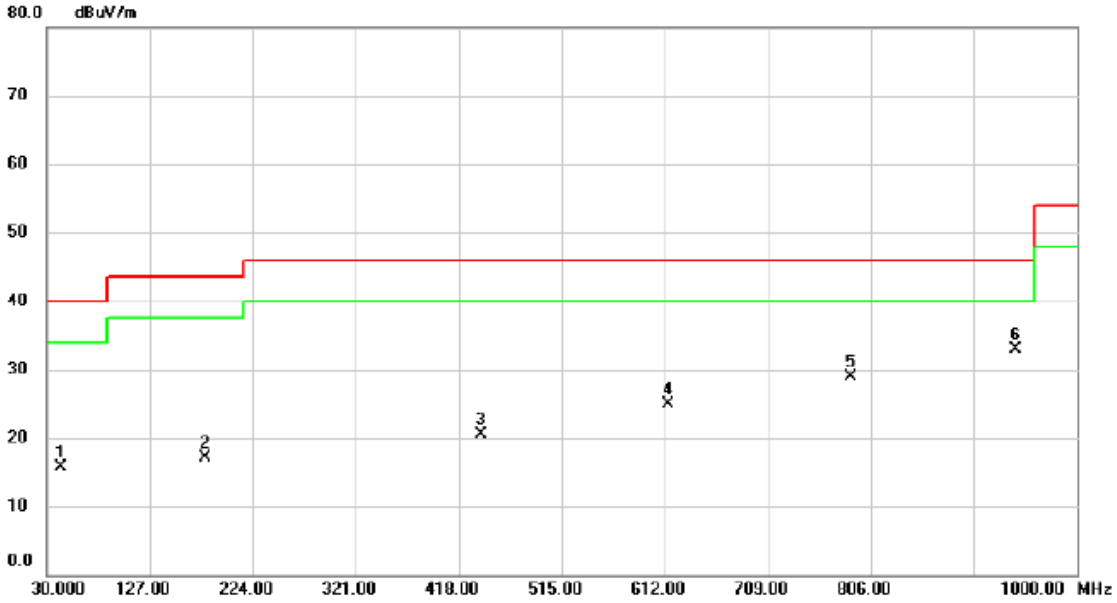
Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		51.340	29.87	-13.44	16.43	40.00	-23.57	peak	
2		171.620	29.30	-11.90	17.40	43.50	-26.10	peak	
3		367.560	28.50	-11.11	17.39	46.00	-28.61	peak	
4		649.830	30.00	-4.51	25.49	46.00	-20.51	peak	
5		831.220	29.45	0.59	30.04	46.00	-15.96	peak	
6	*	899.120	30.78	2.20	32.98	46.00	-13.02	peak	

Test Mode:	TX Mode

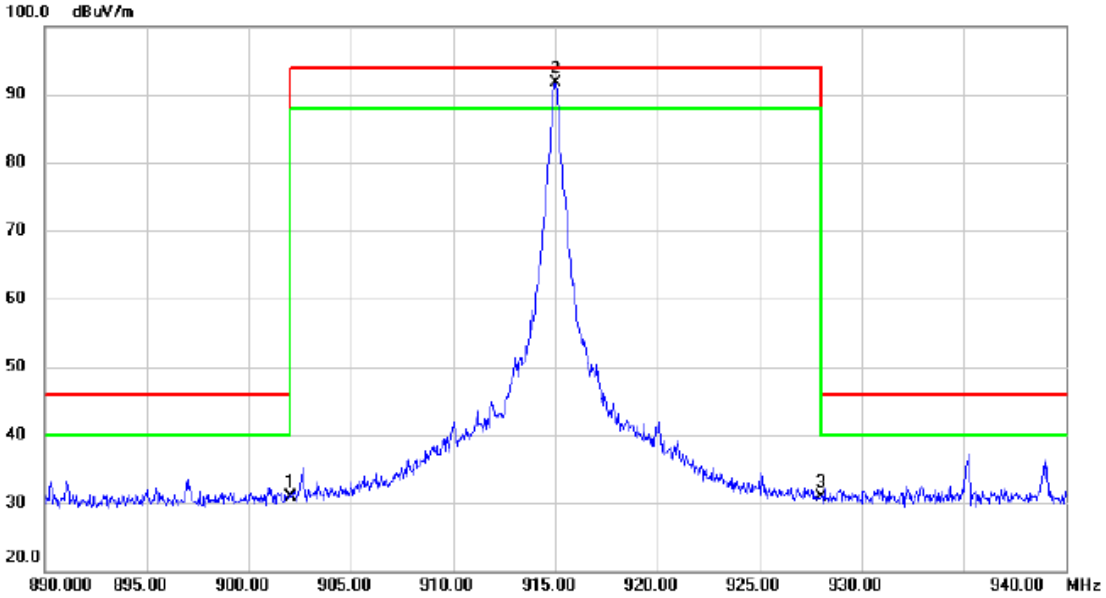
Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		43.580	29.03	-13.30	15.73	40.00	-24.27	peak	
2		179.380	28.80	-11.66	17.14	43.50	-26.36	peak	
3		439.340	30.00	-9.53	20.47	46.00	-25.53	peak	
4		614.910	30.07	-5.20	24.87	46.00	-21.13	peak	
5		787.570	29.46	-0.55	28.91	46.00	-17.09	peak	
6	*	941.800	29.91	3.04	32.95	46.00	-13.05	peak	

Test Mode	TX Mode_915 MHz

Vertical



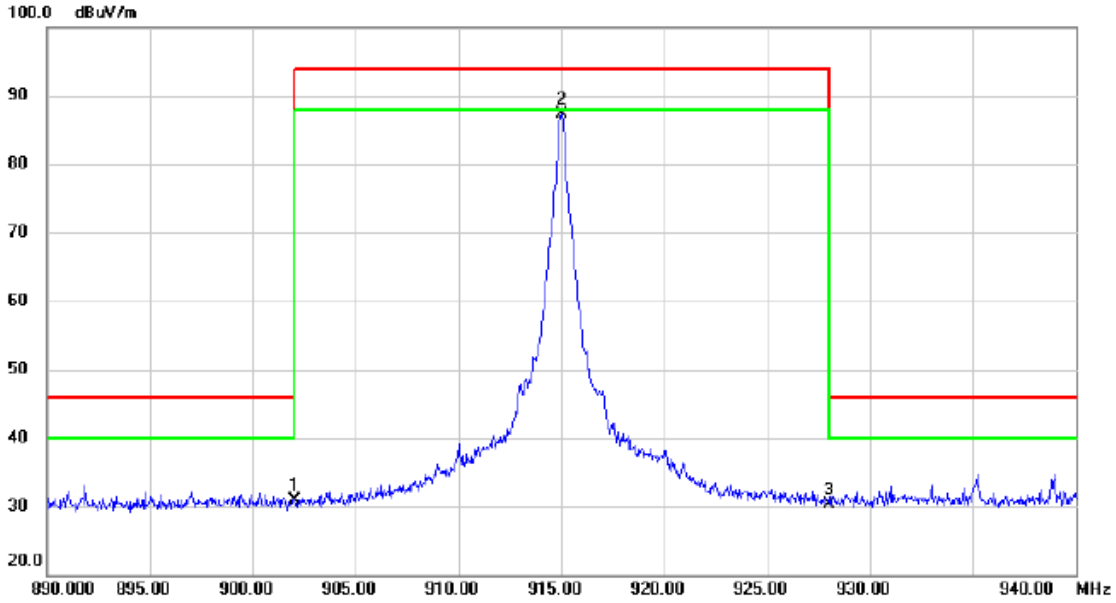
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		902.000	28.72	2.25	30.97	46.00	-15.03	peak	
2	*	915.000	89.25	2.51	91.76	94.00	-2.24	peak	
3		928.000	28.15	2.77	30.92	46.00	-15.08	peak	

(1) The QP value of fundamental frequency is:
QP Reading = Peak value + 20log(Duty cycle) , QP=Peak-8.53

Frequency (MHz)	Peak value (dBuV/m)	QP value (dBuV/m)	QP Limit (dBuV/m)	Result
915	91.76	83.23	94	PASS

Test Mode	TX Mode_915 MHz

Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		902.000	28.75	2.25	31.00	46.00	-15.00	peak	
2	*	915.000	84.77	2.51	87.28	94.00	-6.72	peak	
3		928.000	27.52	2.77	30.29	46.00	-15.71	peak	

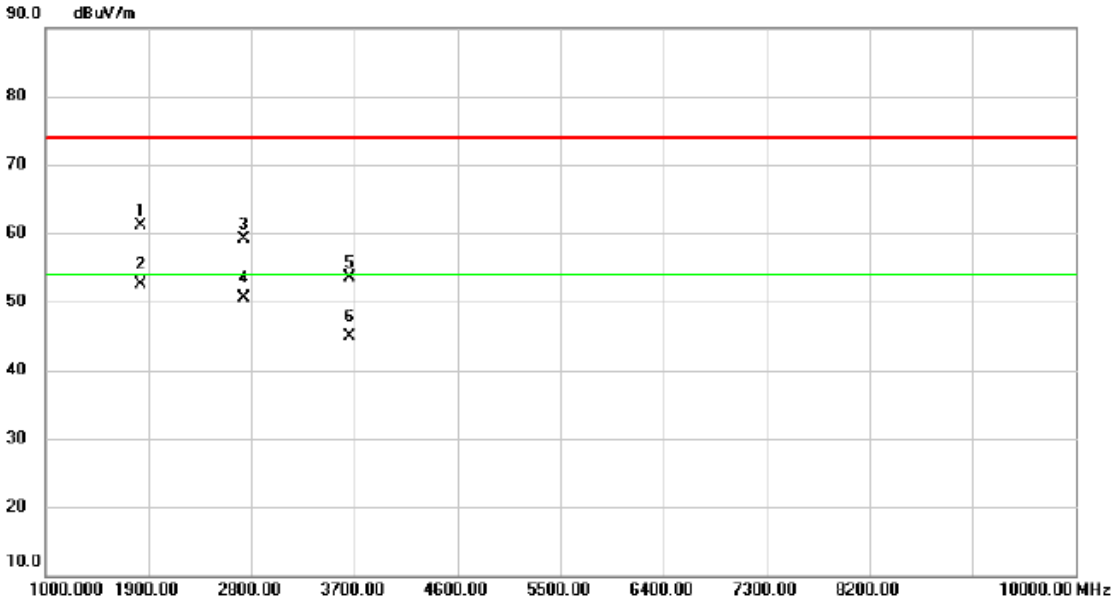
(1) The QP value of fundamental frequency is:
QP Reading = Peak value + 20log(Duty cycle) , QP=Peak-8.53

Frequency (MHz)	Peak value (dBuV/m)	QP value (dBuV/m)	QP Limit (dBuV/m)	Result
915	87.28	78.75	94	PASS

ATTACHMENT D - RADIATED EMISSION (ABOVE 1000MHZ)

Test Mode	TX Mode_915 MHz

Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		1828.000	64.67	-3.59	61.08	74.00	-12.92	peak	
2	*	1828.000	56.14	-3.59	52.55	54.00	-1.45	AVG	
3		2737.000	58.94	0.13	59.07	74.00	-14.93	peak	
4		2737.000	50.41	0.13	50.54	54.00	-3.46	AVG	
5		3655.000	50.96	2.54	53.50	74.00	-20.50	peak	
6		3655.000	42.43	2.54	44.97	54.00	-9.03	AVG	

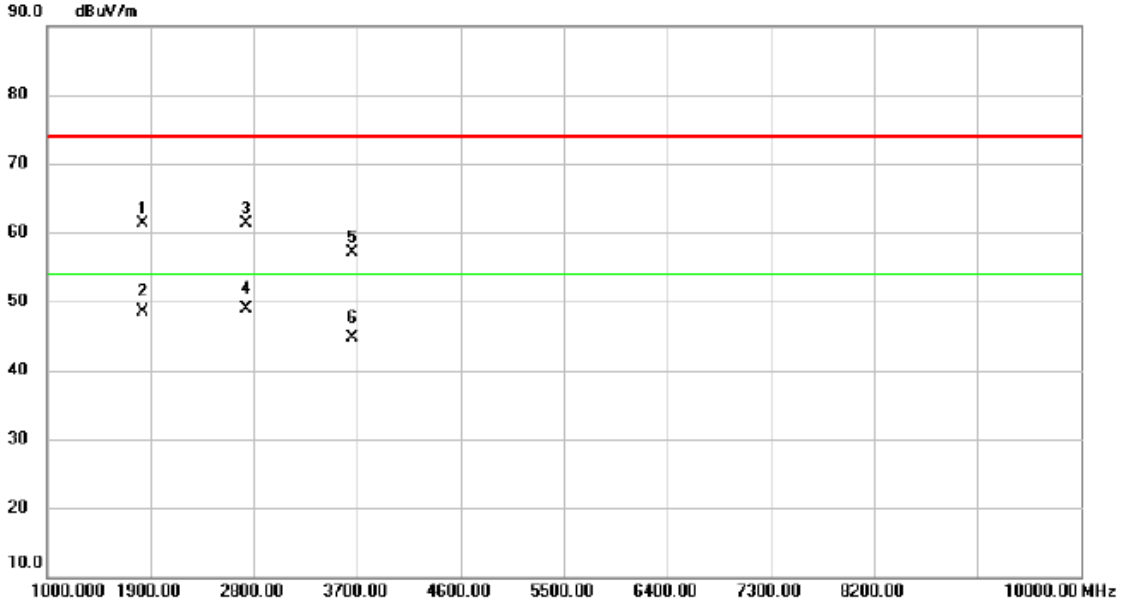
Remark:

(1) The average value of fundamental frequency is:
Average Reading = Peak value + 20log(Duty cycle) , AV=Peak-8.53

Frequency (MHz)	Peak value (dBuV/m)	AV value (dBuV/m)	AV Limit (dBuV/m)	Result
1828.00	61.08	52.55	54.00	PASS
2737.00	59.07	50.54	54.00	PASS
3655.00	53.50	44.97	54.00	PASS

Test Mode	TX Mode_915 MHz

Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1		1828.000	64.98	-3.59	61.39	74.00	-12.61	peak	
2		1828.000	52.04	-3.59	48.45	54.00	-5.55	AVG	
3		2737.000	61.09	0.13	61.22	74.00	-12.78	peak	
4	*	2737.000	48.70	0.13	48.83	54.00	-5.17	AVG	
5		3655.000	54.47	2.54	57.01	74.00	-16.99	peak	
6		3655.000	42.08	2.54	44.62	54.00	-9.38	AVG	

Remark:

(1) The average value of fundamental frequency is:
Average Reading = Peak value + 20log(Duty cycle) , AV=Peak-8.53

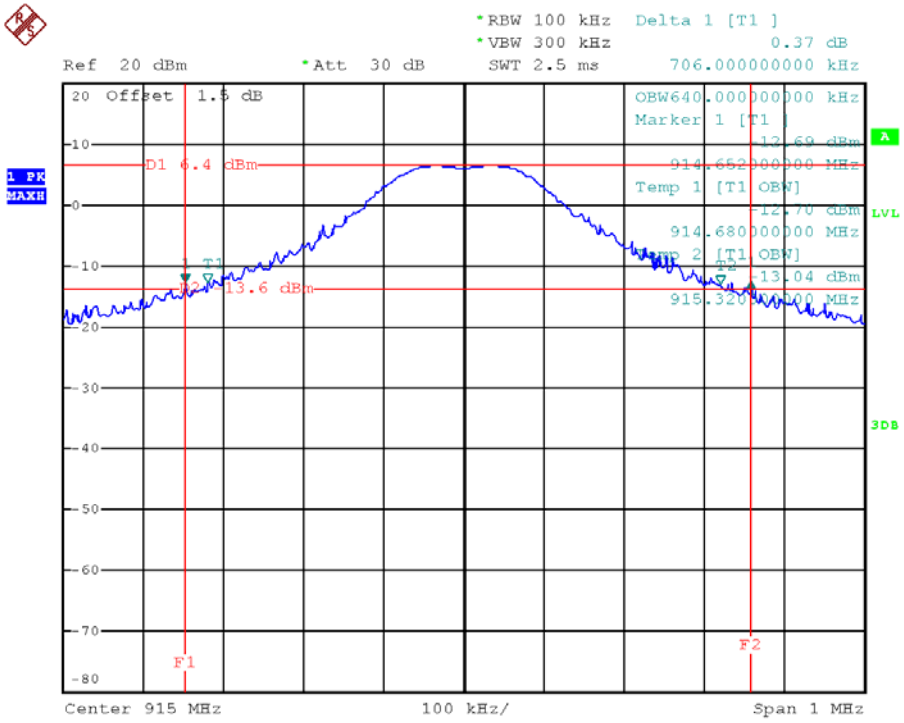
Frequency (MHz)	Peak value (dBuV/m)	AV value (dBuV/m)	AV Limit (dBuV/m)	Result
1828.00	61.39	52.86	54.00	PASS
2737.00	61.22	52.69	54.00	PASS
3655.00	57.01	48.48	54.00	PASS

ATTACHMENT E - BANDWIDTH

Test Mode:	TX Mode_915 MHz

Frequency (MHz)	20dB Bandwidth (MHz)	99% Occupied BW (MHz)
915	0.706	0.640

TX Mode_915 MHz



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