

TEST REPORT

Applicant Name & Address : Kaz USA, INC.
250 Turnpike Road, Southborough, MA01772

Sample Description
Product : Thermometer
FCC ID : 2ABRGVDT985
Model No. : VDT985
Electrical Rating : 3VDC

Date Received : 27 Jan., 2015
Date Test Conducted : 27 Jan., 2015 –12 Feb., 2015
Test standards : 47 CFR PART 15 Subpart C: 2014 section 15.249

Test Result : Pass

Conclusion : The submitted samples complied with the above rules/standards.

Remark : None.

*****End of Page*****

Prepared and Checked By:

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27 April 2015 *Date*

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Report No.: 150127027GZU-001
Issued: 27 April 2015

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1.0 Summary of Test

TEST	TEST REQUIREMENT	TEST METHOD	RESULT
Antenna Requirement	FCC PART 15 C Section 15.203	FCC PART 15 C Section 15.203	PASS
Occupied Bandwidth	FCC PART 15 C section 15.215(c)	ANSI C63.10: Clause 6.9	PASS
Radiated Emission	FCC PART 15 C section 15.249 (a), (d)	ANSI C63.10: Clause 6.4, 6.5 & 6.6	PASS
Band Edges Measurement	FCC PART 15 C section 15.249 (d)	ANSI C63.10: Clause 6.10	PASS
Conducted Emissions at Mains Terminals	FCC PART 15 C section 15.207	ANSI C63.10: Clause 6.2	N/A
Remark:			
<p>N/A: not applicable. Refer to the relative section for the details. EUT: In this whole report EUT means Equipment Under Test. Tx: In this whole report Tx (or tx) means Transmitter. Rx: In this whole report Rx (or rx) means Receiver. RF: In this whole report RF means Radio Frequency. ANSI C63.10: the detail version is ANSI C63.10:2009 in the whole report.</p>			

2.0 General Description

2.1 Product Description

Operating Frequency	2402 MHz to 2480 MHz
Type of Modulation:	GFSK
Number of Channels	40 Channels
Channel Separation:	2 MHz
Antenna Type	Integral
Antenna gain:	5 dBi
Speciality:	Bluetooth 4.0 with BLE (Bluetooth Low Energy)
Function:	Thermometer with BT function to transmit data
Power Supply:	3VDC

EUT modulation and data packet during test:

The EUT has been tested on the Modulation of GFSK with 1 Mbps data rate.

EUT channels and frequencies list:

Test frequencies are lowest channel 0: 2402 MHz, middle channel 19: 2440 MHz and highest channel 39: 2480 MHz.

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	14	2430	28	2458
1	2404	15	2432	29	2460
2	2406	16	2434	30	2462
3	2408	17	2436	31	2464
4	2410	18	2438	32	2466
5	2412	19	2440	33	2468
6	2414	20	2442	34	2470
7	2416	21	2444	35	2472
8	2418	22	2446	36	2474
9	2420	23	2448	37	2476
10	2422	24	2450	38	2478
11	2424	25	2452	39	2480
12	2426	26	2454	/	/
13	2428	27	2456	/	/

2.2 Related Submittal(s) Grants

This is an application for certification of:
DTS- Digital Transmission Systems

Remaining portions are subject to the following procedures:

1. Receiver portion of BLE: exempt from technical requirement of this Part.
2. The Thermometer function: Verification Procedure.

2.3 Test Methodology

Radiated emission measurements was performed according to the procedures in ANSI C63.10:2009. Radiated emission measurement was performed in semi-anechoic chamber. For radiated emission measurement, preliminary scans and final tests were performed in the semi-anechoic chamber to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise.

2.4 Test Facility

All of the tests are performed at:
Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City,
GETDD Guangzhou, China.

This test facility and site measurement data have been fully placed on file with the FCC, test firm registration number is 549654.

3.0 System Test Configuration

3.1 Justification

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, it was powered by 3VDC supply.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. The spurious emissions more than 20 dB below the permissible value are not reported.

For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in the following table:

Frequency range of radiated emission measurements

Lowest frequency generated in the device	Upper frequency range of measurement
9 kHz to below 10 GHz	10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower
At or above 10 GHz to below 30 GHz	5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower
At or above 30 GHz	5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified

Number of fundamental frequencies to be tested in EUT transmit band

Frequency range in which device operates	Number of frequencies	Location in frequency range of operation
1 MHz or less	1	Middle
1 MHz to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top, 1 near middle and 1 near bottom



3.2 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

Uncertainty and Compliance – Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value.

3.3 Equipment Modification

Any modifications installed previous to testing by Kaz USA, INC. will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Guangzhou Branch.

3.4 Support Equipment List and Description

Equipment	Model	Manufacturer	Serial No.
Ipod	A1421	Apple	CCQN25Y3G22Y
Software	VKSTK-8-0-2	Kaz USA, INC.	/

4.0 Measurement Results

4.1 Antenna Requirement:

Standard requirement

15.203 requirement:

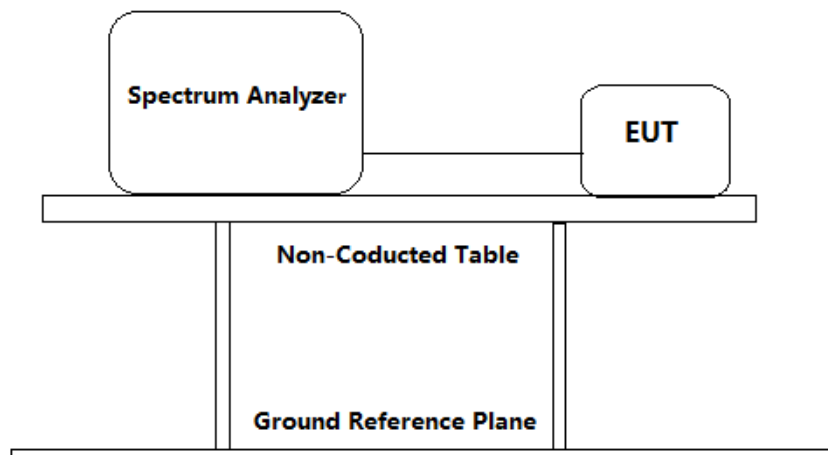
For intentional device. According to 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

EUT Antenna

The antenna is an integral antenna and no consideration of replacement. The best case gain of the antenna is 5 dBi.

4.2 Occupied Bandwidth:

- Test Requirement: FCC PART 15 C section 15.215(c)
(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated
- Test Method: ANSI C63.10: Clause 6.9
- Test Status: Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). The highest, middle and the lowest channels were selected for the final test as listed below.
- Test Configuration:



Test Procedure:

The transmitter was operated at its maximum carrier power measured under normal test conditions.

- a) The instrument center frequency was set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer was between 1.5 times and 5.0 times the OBW(20 dB Bandwidth).

- b) The nominal IF filter bandwidth (3 dB RBW) was in the range of 1% to 5% of the OBW, and VBW was approximately three times the RBW.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope was more than $[10 \log (OBW/RBW)]$ below the reference level.
- d) Step a) through step c) might require iteration to adjust within the specified range.
- e) The dynamic range of the instrument at the selected RBW was more than 10 dB below the target “-20 dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW was at least 30 dB below the reference value.
- f) Peak detection and max hold mode (until the trace stabilizes) was used.
- g) Used the 20dB bandwidth function of the instrument and reported the measured bandwidth.
- h) The occupied bandwidth was reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division was clearly labeled. Tabular data was reported in addition to the plot(s).

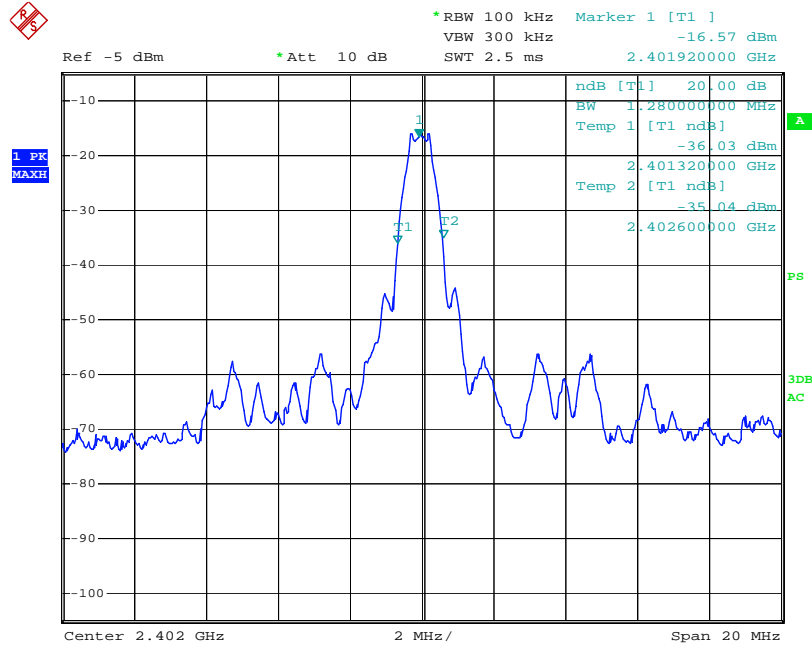
20 dB bandwidth:

Channel No.	Frequency (MHz)	Measured 20 dB bandwidth (MHz)	Limit (kHz)	Result
0	2402	1.28	/	Pass
19	2440	1.28		Pass
39	2480	1.28		Pass

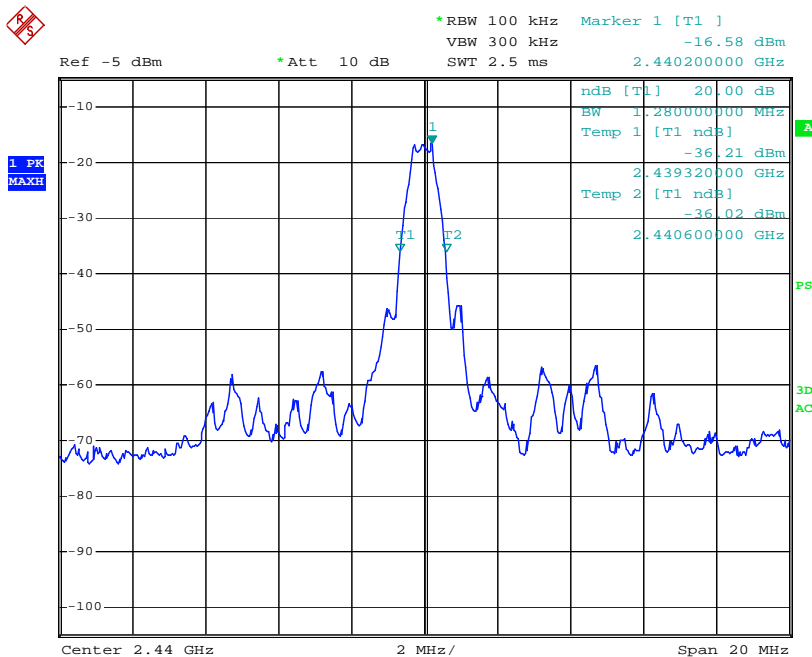
20dB bandwidth:

Result plot as follows:

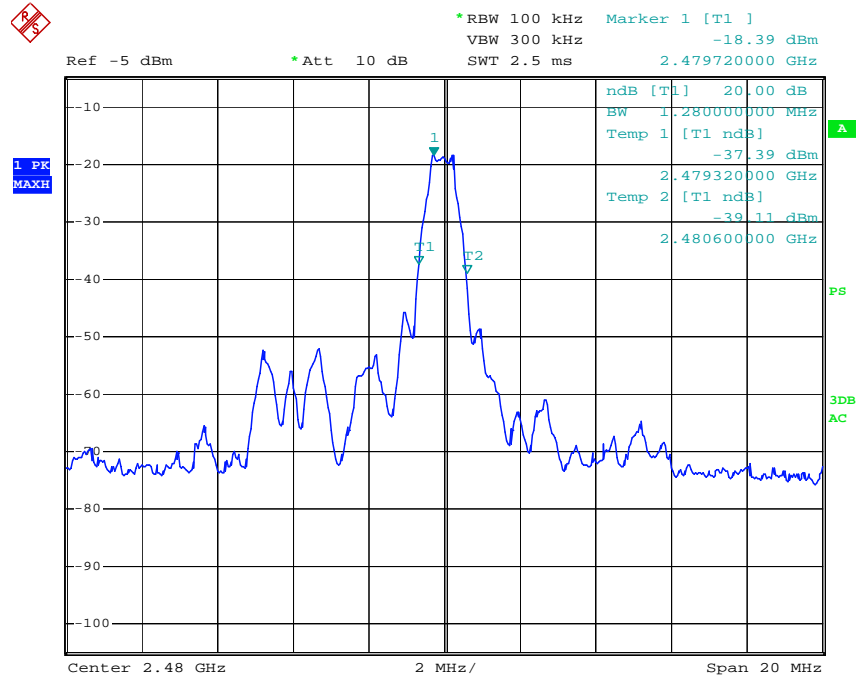
Lowest channel (2.402 GHz):



Middle Channel (2.440 GHz):



Highest Channel (2.480 GHz):



4.7 Radiated Emission

Test Requirement:

FCC PART 15 C section 15.249 (a), (d)

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (dB μ V/m @ 3m)	Field Strength of Harmonics (dB μ V/m @ 3m)
902 to 928	94.0	54.0
2400 to 2483.5	94.0	54.0
5725 to 5875	94.0	54.0

Note: The limits shown in the above table are based on measurements using an average detector, except for the fundamental emission in the frequency band 902-928 MHz, which is based on measurements using a CISPR quasi-peak detector.

(d) 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.

Test Method:

ANSI C63.10: Clause 6.4, 6.5 and 6.6

Test Status:

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). The lowest, middle and the lowest channels were selected for the final test as listed below.

Test site:

Measurement Distance: 3m (Semi-Anechoic Chamber)

Limit:

The field strength of radiated emission outside of the specified frequency bands, except for harmonics at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field Strength (dB μ V/m @ 3m)
30-88	40.0
88-216	43.5
216-960	46.0
Above 960	54.0

Detector:

For Peak and Quasi-Peak value:

200 Hz for 9 kHz to 150 kHz

9 kHz for 150 kHz to 30 MHz

120 kHz for 30 MHz to 1GHz

RBW = 1 MHz for $f \geq 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak for $f \geq 1$ GHz, QP for $f < 1$ GHz

Trace = max hold

According 15.35(c), when the field strength (or envelope power) is not constant or it is in pulses, and an average detector is specified to be used, the value of field strength or power shall be determined by averaging over one complete pulse train, including blanking intervals within the pulse train, as long as the pulse train does not exceed 0.1 seconds. In cases where the pulse train exceeds 0.1 second, the average value of field strength or output power shall be determined during a 0.1 second interval during which the field strength or power is at its maximum value.

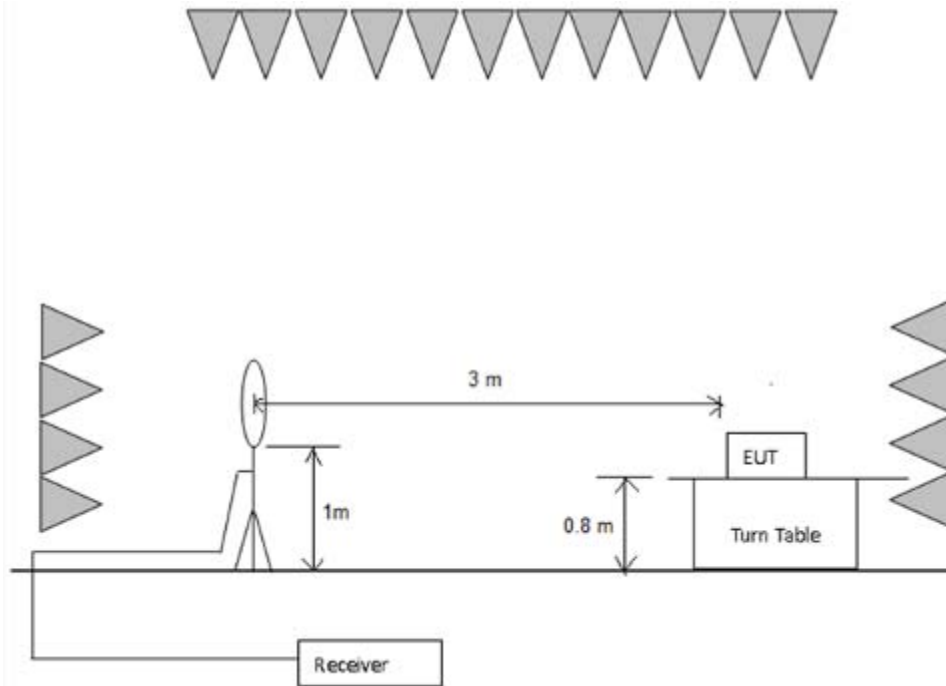
The average correction factor was computed by analyzing the on time in 100ms over one complete pulse train. Analysis of the remote transmitter on time in one complete pulse train, therefore the average value of fundamental frequency was: Average = Peak value + 20log (Duty cycle), As the Peak value in the Radiated Emission test was below AV limit, no duty factor was test.

Section 15.205 Restricted bands of operation.

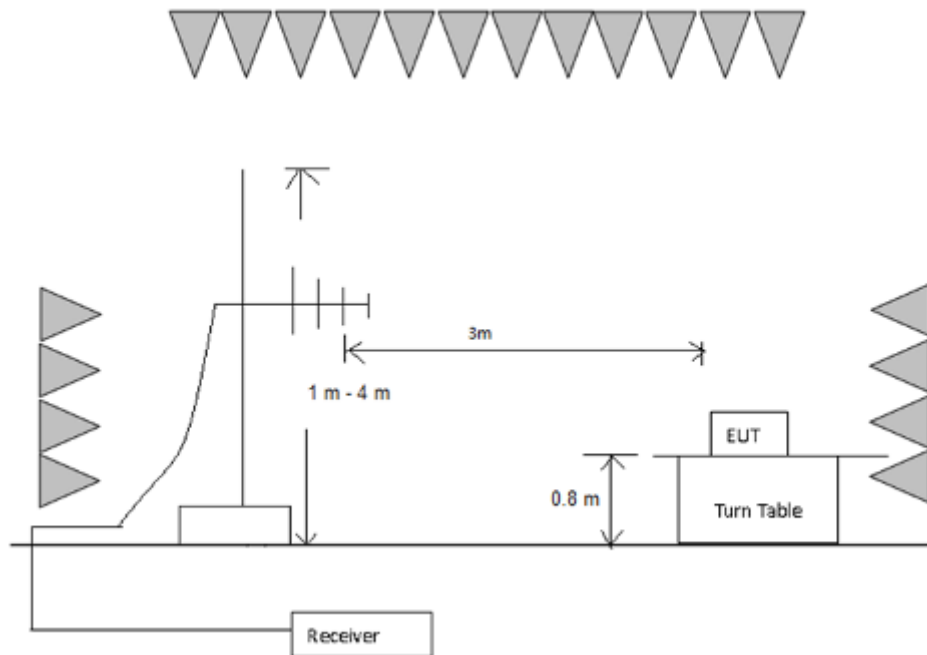
MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.69475 -	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.69525	960 - 1240	7.25 - 7.75
4.125 - 4.128	16.80425 -	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	16.80475	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	25.5 - 25.67	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	37.5 - 38.25	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	73 - 74.6	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	74.8 - 75.2	2200 - 2300	14.47 - 14.5
8.291 - 8.294	108 - 121.94	2310 - 2390	15.35 - 16.2
8.362 - 8.366	123 - 138	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	149.9 - 150.05	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.52475 -	3260 - 3267	23.6 - 24.0
12.29 - 12.293	156.52525	3332 - 3339	31.2 - 31.8
12.51975 -	156.7 - 156.9	3345.8 - 3358	36.43 - 36.5
12.52025	162.0125 - 167.17	3600 - 4400	
12.57675 -	167.72 - 173.2		
12.57725	240 - 285		
13.36 - 13.41	322 - 335.4		

Test Configuration:

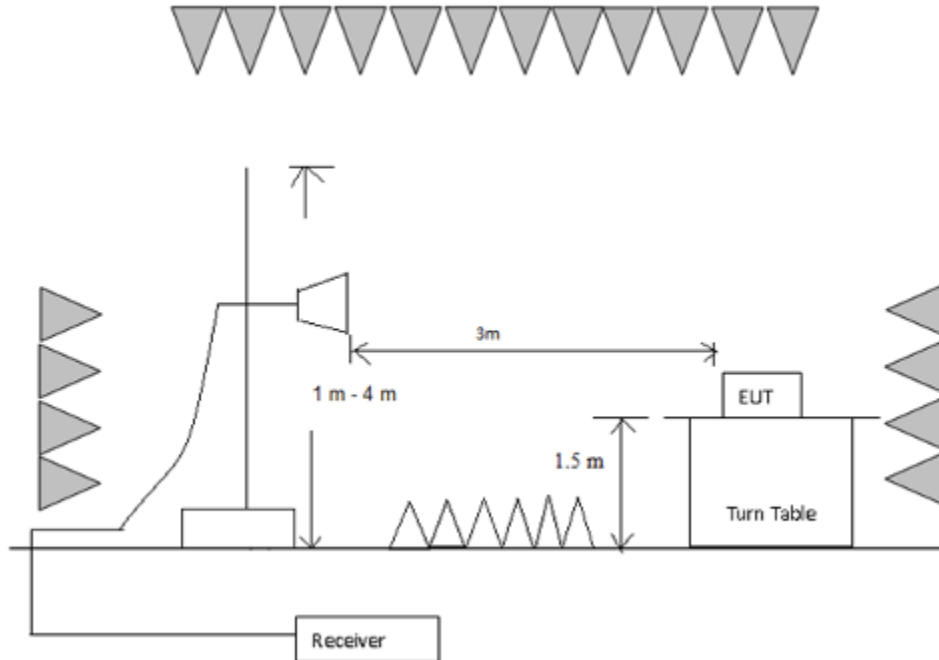
- 1) 9 kHz to 30 MHz emissions:



- 2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 40 GHz emissions:



Test Procedure:

1) 9 kHz to 30 MHz emissions:

For testing performed with the loop antenna. The centre of the loop was positioned 1 m above the ground and positioned with its plane vertical at the special distance from the EUT. During testing the loop was rotated about its vertical axis for maximum response at each azimuth and also investigated with the loop positioned in the horizontal plane.

2) 30 MHz to 1 GHz emissions:

For testing performed with the bi-log type antenna. The measurement is performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

3) 1 GHz to 25 GHz emissions:

Test site with RF absorbing material covering the ground plane that met the site validation criterion called out in CISPR 16-1-4:2007 was used to perform radiated emission test above 1 GHz.

For testing performed with the horn antenna. The measurement is performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

4) The receiver was scanned from 9 kHz to 25 GHz. When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.

9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement
 The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

Radiated Emissions (Below 1GHz)

Operation Frequency: 2402MHz

Antenna Polarization	Frequency [MHz]	Measured Net at 3m [dB(μV/m)]	Limit at 3m [dB(μV/m)]
Horizontal	200.000	<33	43.5
Horizontal	400.000	<36	46.0
Horizontal	800.000	<36	46.0
Vertical	200.000	<33	43.5
Vertical	400.000	<36	46.0
Vertical	800.000	<36	46.0

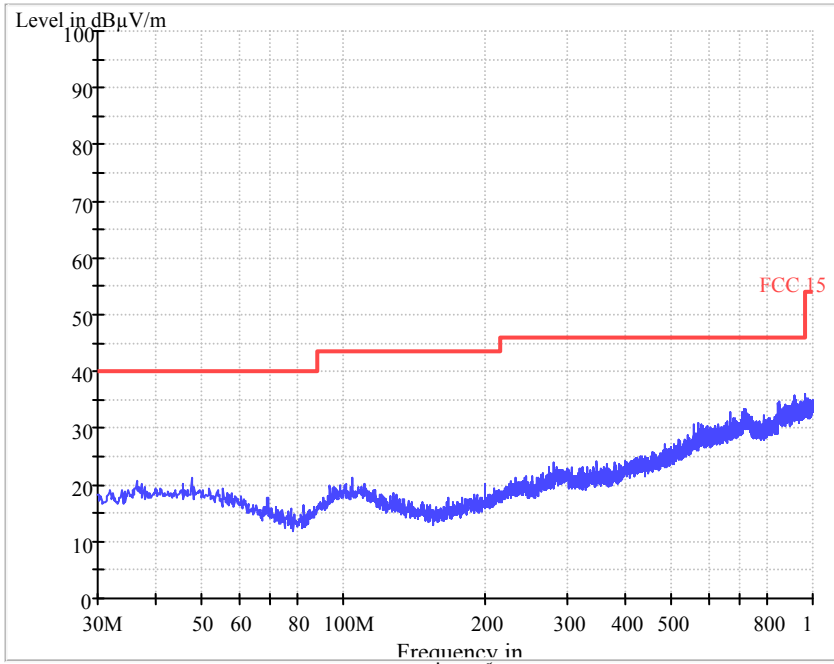
Operation Frequency: 2440MHz

Antenna Polarization	Frequency [MHz]	Measured Net at 3m [dB(μV/m)]	Limit at 3m [dB(μV/m)]
Horizontal	200.000	<33	43.5
Horizontal	400.000	<36	46.0
Horizontal	800.000	<36	46.0
Vertical	200.000	<33	43.5
Vertical	400.000	<36	46.0
Vertical	800.000	<36	46.0

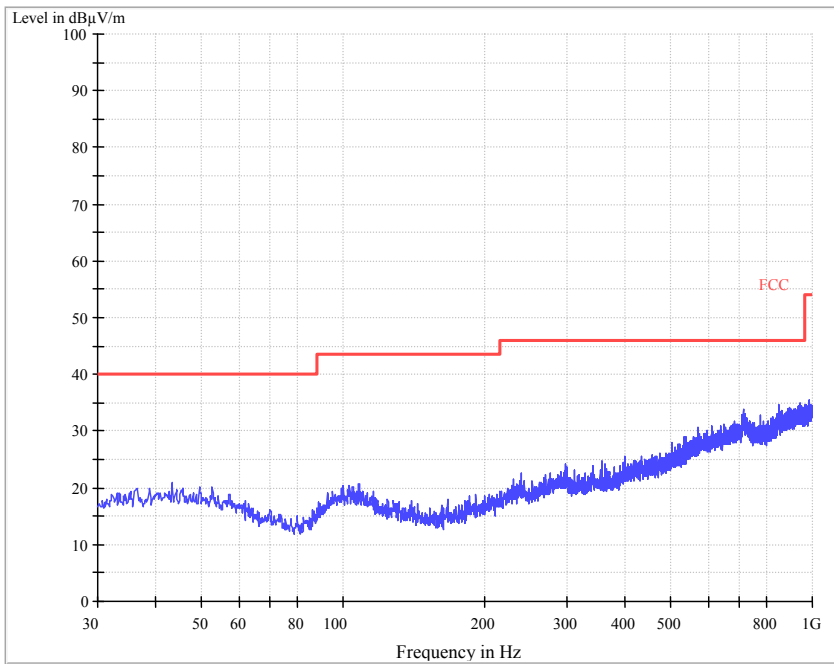
Operation Frequency: 2440MHz

Antenna Polarization	Frequency [MHz]	Measured Net at 3m [dB(μV/m)]	Limit at 3m [dB(μV/m)]
Horizontal	200.000	<33	43.5
Horizontal	400.000	<36	46.0
Horizontal	800.000	<36	46.0
Vertical	200.000	<33	43.5
Vertical	400.000	<36	46.0
Vertical	800.000	<36	46.0

Test Curve:
Operation Frequency: 2402MHz
Horizontal:

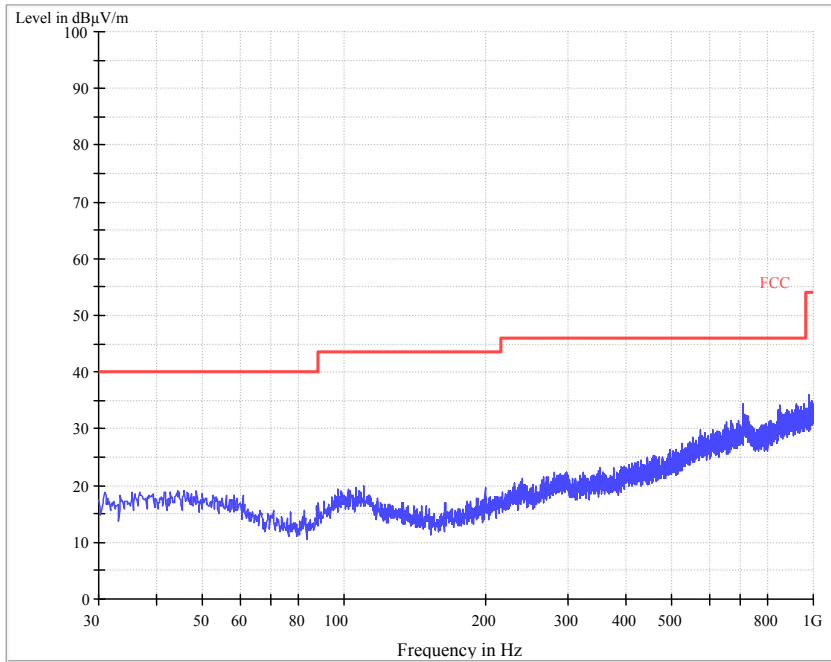


Vertical:

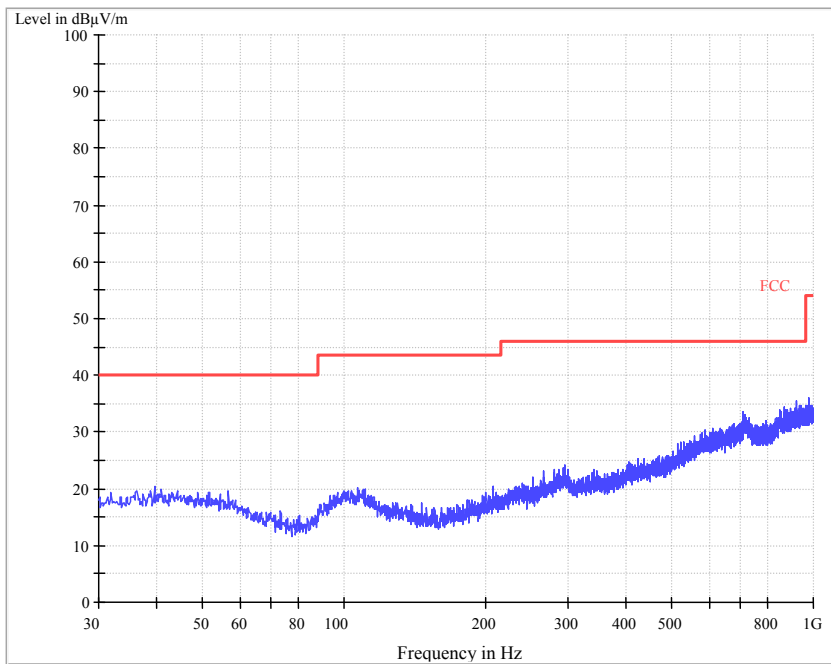


Operation Frequency: 2440MHz

Horizontal:



Vertical:

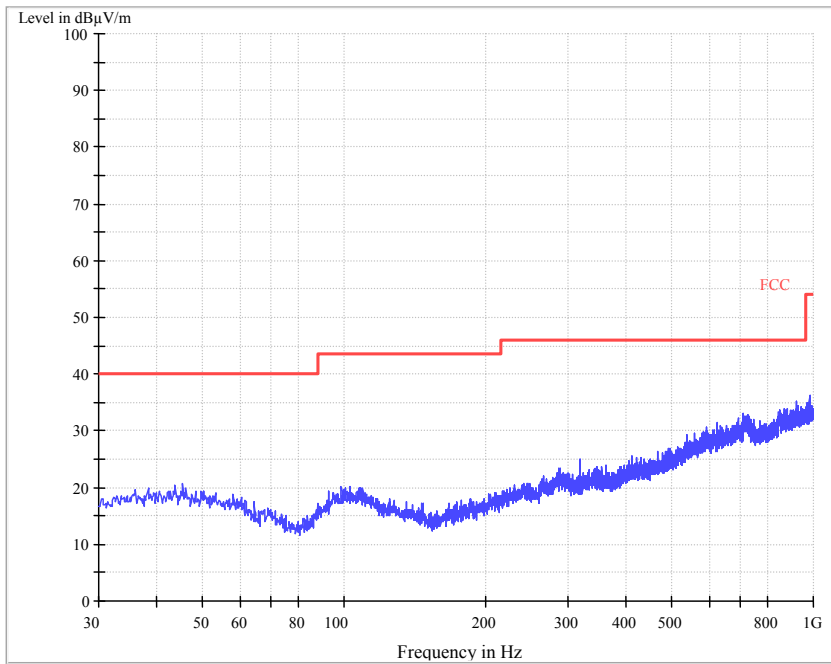




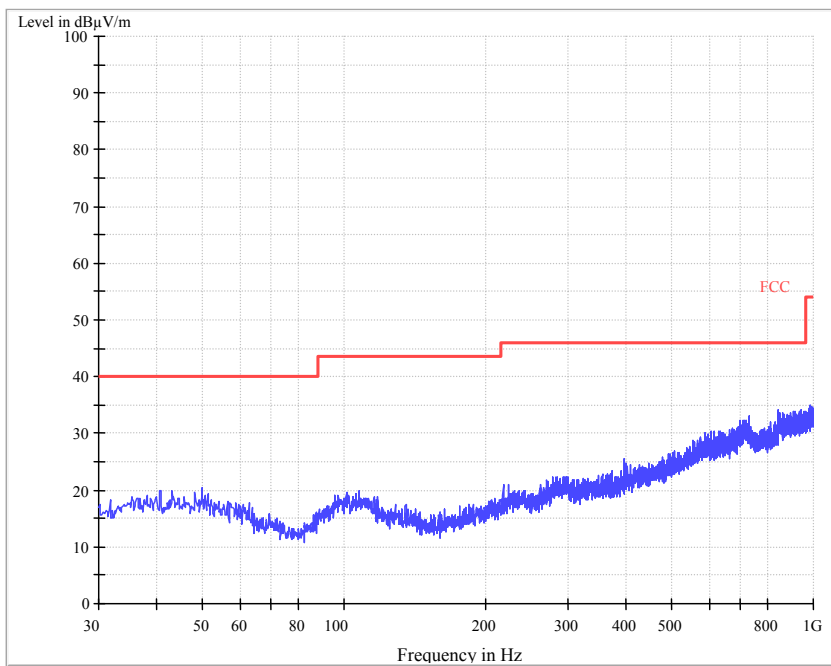
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Operation Frequency: 2480MHz

Horizontal:



Vertical:





Radiated Emissions (Above 1GHz)

Operation Frequency: 2402MHz:

Polarization	Frequency (MHz)	PK Reading (dB μ V)	Correction Factor (dB)	PK Net at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
Horizontal	2402.400	85.8	-7.3	78.5	94.0	-15.5
Horizontal	4803.600	49.4	-0.4	49.0	54.0	-5.0
Vertical	2400.400	88.7	-7.3	81.4	94.0	-12.6
Vertical	4803.600	50.0	-0.4	49.6	54.0	-4.4

Operation Frequency: 2440MHz:

Polarization	Frequency (MHz)	PK Reading (dB μ V)	Correction Factor (dB)	PK Net at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
Horizontal	2438.800	82.6	-7.1	75.5	94.0	-18.5
Horizontal	4880.400	48.0	-0.4	47.6	54.0	-6.4
Vertical	2438.800	86.5	-7.1	79.4	94.0	-14.6
Vertical	4880.400	48.7	-0.4	48.3	54.0	-5.7

Operation Frequency: 2480MHz:

Polarization	Frequency (MHz)	PK Reading (dB μ V)	Correction Factor (dB)	PK Net at 3m (dB μ V/m)	Average Limit at 3m (dB μ V/m)	Margin (dB)
Horizontal	2479.200	83.6	-7.0	76.6	94.0	-17.4
Horizontal	4958.800	46.6	-0.4	46.2	54.0	-7.8
Vertical	2479.200	86.7	-7.0	79.7	94.0	-14.3
Vertical	4958.800	46.3	-0.4	45.9	54.0	-8.1

- Notes:
1. AT frequencies equal to or less than 1000MHz, quasi-peak detector was used, above 1000MHz, Peak detector was used.
 2. All measurements were made at 3 meter.
 3. Negative value in the margin column shows emission below limit.
 4. Horn antenna is used for the emission over 1000MHz.
 5. When Peak emission level was below AV limit, the AV emission level did not be recorded.

4.8 Band Edges Requirement

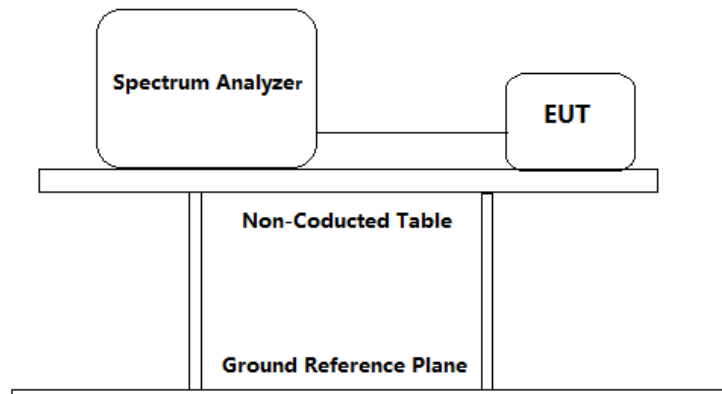
Test Requirement: FCC PART 15 C section 15.249 (d)
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

Frequency Band: 2400 MHz to 2483.5 MHz

Test Method: ANSI C63.10: Clause 6.10

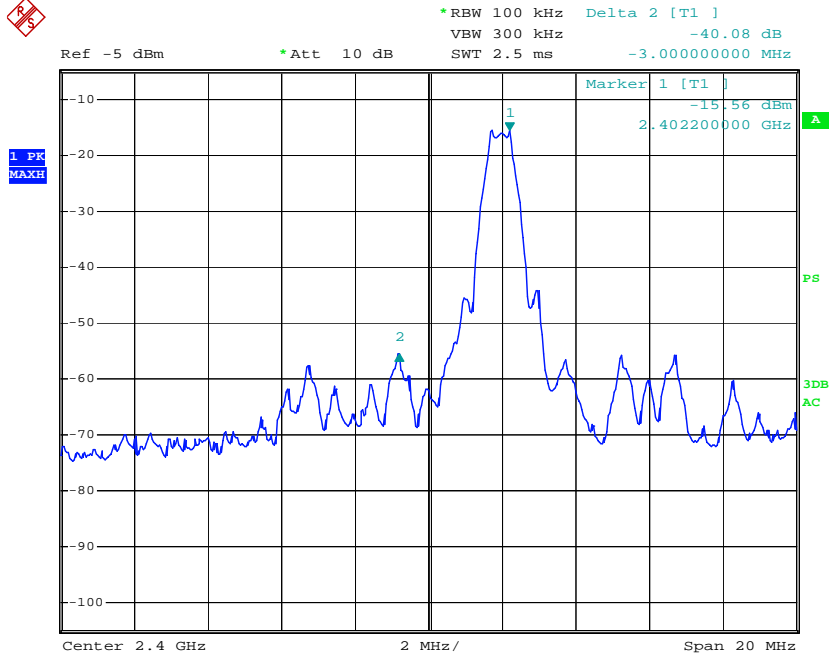
Test Status: Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). The lowest, middle and the highest channels were selected for the final test as listed below.

Test Configuration:

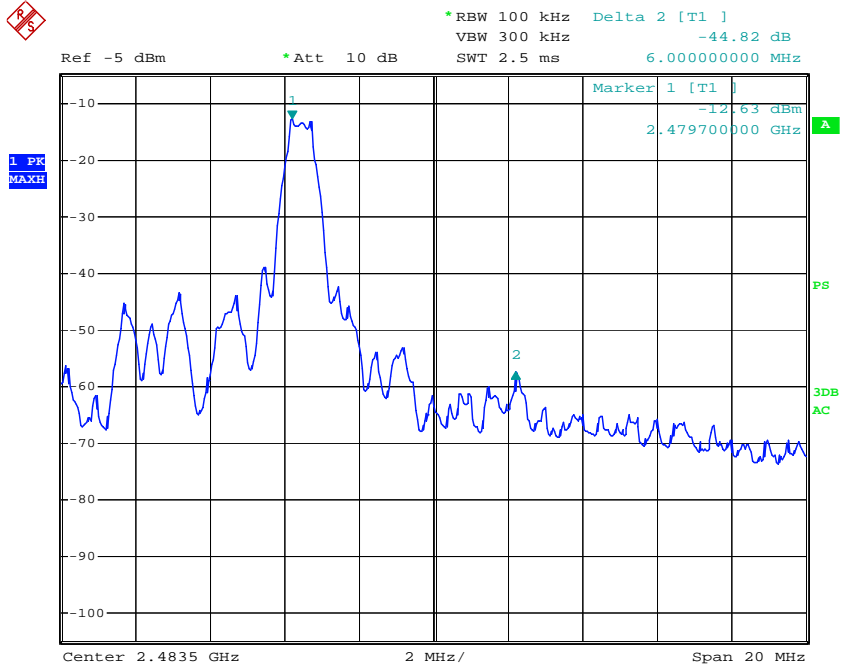


Test result with plots as follows:
Result plot as follows:

Channel 0: 2.402 GHz



Channel 39: 2.480 GHz



Peak Measurement

Band-edge compliance is determined by applying marker-delta method, i.e (Band-edge Plot).

(i) Lower band-edge:

Peak Resultant field strength

=Fundamental emissions (peak value) – delta from the band-edge plot

= 81.4dB μ v/m – 40.08dB

= 41.32dB μ v/m

(ii) Upper band-edge:

Peak Resultant field strength

=Fundamental emissions (peak value) – delta from the band-edge plot

= 79.7dB μ v/m – 44.82dB

= 34.88dB μ v/m

The Peak resultant field strength meets the general radiated emission AV limit 54dB μ v/m in RSS-Gen, so it complies with the requirement.

5.0 Test Equipment List

Radiated Emission

Equipment No.	Equipment	Model	Manufacturer	Cal. Due date (YYYY-MM-DD)	Calibration Interval
EM030-01	3m Semi-Anechoic Chamber	9×6×6 m ³	ETS•LINDGREN	2014-04-02	1Y
EM030-02	Control room for 3m Semi-Anechoic Chamber	4×4×3 m ³	ETS•LINDGREN		
EM031-02	EMI Test Receiver (9 kHz~7 GHz)	R&S ESR7	R&S	2014-06-03	1Y
SZ056-03	Spectrum Analyzer	FSP30	R&S	2014-03-10	1Y
EM031-03	Signal and Spectrum Analyzer (10 Hz~40 GHz)	R&S FSV40	R&S	2014-06-03	1Y
EM011-04	Loop antenna (9 kHz-30 MHz)	HFH2-Z2	R&S	2014-05-25	1Y
EM061-03	TRILOG Super Broadband test Antenna (30 MHz-1.5 GHz)	VULB 9161	SCHWARZBECK	2014-05-25	1Y
EM033-02	Bouble-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)	R&S HF907	R&S	2014-05-25	1Y
EM033-03	High Frequency Antenna & preamplifier (18 GHz~26.5 GHz)	R&S SCU-26	R&S	2014-05-25	1Y
EM033-04	High Frequency Antenna & preamplifier (26 GHz-40 GHz)	R&S SCU-40	R&S	2014-05-25	1Y
EM031-02-01	Coaxial cable(9 kHz-1 GHz)	/	R&S	2014-06-03	1Y
EM033-02-02	Coaxial cable(1 GHz-18 GHz)	/	R&S	2014-06-09	
EM033-04-02	Coaxial cable (18~40) GHz	/	R&S	2014-06-09	
EM022-03	2.45 GHz Filter	BRM 50702	Micro-Tronics	2014-05-06	1Y