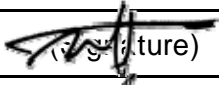
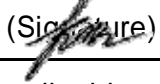


	ESTECH Co., Ltd. Pm 1015, World Venture Center 11, 426-5 Gasan-dong, Guncheon-gu, Seoul, 153-600, Korea	   	Electromagnetic Interference Test Report

Test Report for FCC

FCC ID : 2ABUY-BHA-WC100

Report Number		ESTF151402-003		
Applicant	Company name	EMW Co., Ltd.		
	Address	80B-4L, 680-3, Gojan-Dong, Namdong-Gu, Incheon, Korea		
	Telephone	82-2-2107-5615		
Product	Product name	Wired&Wireless IP Camera		
	Model No.	BHA-WC100	Manufacturer	EMW Co., Ltd.
	Serial No.	NONE	Country of origin	KOREA
Test date	2014-01-12~ 2014-01-14		Date of issue	11-Feb-14
Testing location	ESTECH Co., Ltd. 97-1, Hooeok-ri, Majang-myeon, Icheon-si, Gyeonggi-do, Korea			
Standard	FCC PART 15 Subpart C (15.247):2010 , ANSI C 63.4(2009) , KDB 558074 D01(2013)			
Measurement facility registration number		915135		
Tested by	Engineer J.H.Kim  (Signature)			
Reviewed by	Engineering Manager J.M.Yang  (Signature)			
Abbreviation	OK, Pass = Passed, Fail = Failed, N/A = not applicable			

* Note

- This test report is not permitted to copy partly without our permission
- This test result is dependent on only equipment to be used
- This test result based on a single evaluation of one sample of the above mentioned

Contents

1. Laboratory Information	3
2. Description of EUT	4
3. Test Standards	5
4. Measurement condition	8
5. DTS bandwidth	9
5.1 Test procedure	9
5.2 Test instruments and measurement setup	9
5.3 Measurement results	9
5.4 Trace data	11
6. Maximum Peak Output Power	15
6.1 Test procedure	15
6.2 Test instruments and measurement setup	15
6.3 Measurement results	15
6.4 Trace data	15
7. Maximum conducted (average) output power	18
7.1 Test procedure	16
7.2 Test instruments and measurement setup	16
7.3 Measurement results	16
7.4 Trace data	18
8. Maximum power spectral density level in the fundamental emission	25
8.1 Test procedure	25
8.2 Test instruments and measurement setup	25
8.3 Measurement results	25
8.4 Trace data	27
9. Emissions in non-restricted frequency bands	31
9.1 Test procedure	31
9.2 Test instruments and measurement setup	31
9.3 Measurement results	31
9.4 Trace data of band-edge & out of emission	33
10. Measurement of radiated emission	41
10.1 Measurement equipment	41
10.2 Environmental conditions	41
10.3 Measurement Instrument setting for Radiated Emission	42
10.4 Test Data for Wi-Fi Binary CDMA(2.4 GHz).....	43
10.5 Test Data for Wi-Fi Binary CDMA (5.8 GHz).....	47
11. Measurement of conducted emission	51
11.1 Measurement equipment	51
11.2 Environmental conditions	51
11.3 Test Data for Wi-Fi Binary CDMA (2.4 GHz)	52
11.4 Test Data for Wi-Fi Binary CDMA (5.8 GHz)	53
12. Photographs of test setup	54
12.1. Setup for Radiated Test : (30 ~ 1 000) MHz	54
12.2. Setup for Radiated Test : Above GHz	55
12.3. Setup for Conducted Test : (0.15 ~ 30) MHz.....	56
12.4. Photographs of EUT	57
Appendix 1. Special diagram	
Appendix 2. Antenna Requirement	

1. Laboratory Information

1.1 General

This EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards and is tested in accordance with the measurement procedures as indicated in this report.

ESTECH Lab attests to accuracy of test data. All measurement reported herein were performed by ESTECH Co., Ltd.

ESTECH Lab assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

1.2 Test Lab.

Corporation Name : ESTECH Co., Ltd.

Head Office : Rm 1015, World Venture Center II, 426-5, Gasan-dong, Geumcheon-gu, Seoul, Korea

EMC/Telecom/Safety Test Lab : 97-1, Hooeok-ri, Majang-myeon, Icheon-si, Gyeonggi-do, Korea

1.3 Official Qualification(s)

KCC : Granted Accreditation from Ministry of Information & Communication for EMC, Safety and Telecommunication

KOLAS : Accredited Lab By Korea Laboratory Accreditation Schema base on CENELEC requirements

FCC : Conformity Assessment Body(CAB) with registration number 659627 under APEC TEL MRA between the RRA and the FCC

VCCI : Granted Accreditation from Voluntary Control Council for Interference from ITE

2. Description of EUT

2.1 Summary of Equipment Under Test (Wi-Fi Binary CDMA)

Modulation Type	: Wi-Fi Binary CDMA
Transfer Rate	: up to 65 Mbps
Number of Channel	: 2.4 GHz : 5 ch , 5 GHz : 15 ch
PEAK Output Power	: 2.4 GHz: 0.184 W , 5.8 GHz : 0.079 W
Rating	: INPUT : (100 - 240) Va.c., (50 - 60) Hz, 1.2 A : OUTPUT : 12 Vd.c., 1.5 A
X-tal list(s) or Frequencies generated	The highest operating frequency is 5815 MHz(Wi-Fi Binary CDMA) : XTAL : 32.768 kHz , OSC : 22 MHz, 25 MHz, 26 MHz, 24 MHz, 18.432 MHz Wi-Fi Binary CDMA : 5815 MHz

2.2 General descriptions of EUT

Specification		
Video	Resolution (NTSC/PAL)	SD (720X480) HD (1280X720)
	Frame Rate	@30 fps (MAX)
	Compression	H.264/AVC Baseline, Main, High Profile Support
	Scanning	Deinterlace Scan
Audio	Duplex	Full-Duplex Audio In/Out
	MIC/Speaker	MIC In/Speaker Out
	Compression	PCM Coding
Network	Ethernet	RJ-45 (10/100BASE-T)
	★ Wireless	ISC/IEC 24771 KOINONIA Binary CDMA Compliant
	IP	IPv4
	UPnP	UPnP Support
	Protocol	TCP/IP, UDP/IP, RTP, VTF, DHCP, FTP, SMTP, ICMP, DNS, DDNS, HTTP
	Viewer OS	Windows XP, Windows Vista, Windows 7, Android, iOS
Function	USB (Option)	USB 2.0 Host Support (Wireless LAN Module Interface)
	HDMI (Option)	HDMI 1.3 Support (720p, 1080i, 1080p) – NTSC, PAL
	Motion Detection	On/Off Area Motion Detection
	Alarm Notice	SMS, E-Mail, Warning Sound
	Firmware	Auto Firmware Update
	I/O	RS232/485, PTZ, Sensor 2ch, Relay 2ch
Dimensions		132mm (L) x 40mm (W) x 66mm (H)

3. Test Standards

Test Standard : FCC PART 15 Subpart C (15.247) : 2010 & IC RSS-210 Issue8 : 2010

This Standard sets out the regulations under which an intentional, unintentional, or incidental radiator may be operated without an individual license. It also contains the technical specifications, administrative requirements and other conditions relating to the marketing of Part 15 devices.

Test Method : ANSI C 63.4 (2009) & KDB558074 D01(2013)

This standard sets forth uniform methods of measurement of radio-frequency (RF) signals and noise emitted from both unintentional and intentional emitters of RF energy in the frequency range 9 kHz to 40 GHz. Methods for the measurement of radiated and AC power-line conducted radio noise are covered and may be applied to any such equipment unless otherwise specified by individual equipment requirements. These methods cover measurement of certain devices that deliberately radiate energy, such as intentional emitters, but does not cover licensed transmitters. This standard is not intended for certification/approval of avionic equipment or for industrial, scientific, and medical (ISM) equipment. These methods apply to the measurement of individual units or systems comprised of multiple units.

Summary of Test Results

Applied Standard : 47 CFR Part 15 Subpart C & RSS 210-Part I and II					remark
Standard	IC Standard	Test Type	Result	Remark	Limit
15.207	RSS-Gen 7.2.2	AC Power Conducted Emission	Pass	Meet the requirement	
15.205 & 15.209	A8.5	Restricted band / Intentional Radiated Emission	Pass	Meet the requirement	
15.247(a)(2)	A8.2(a)	6 dB Bandwidth	Pass	Meet the requirement	Min. 500 kHz
	RSS-Gen 4.6.1	99 % Bandwidth			
15.247(b)(3)	A8.4(4)	Maximum Peak/average output power	Pass	Meet the requirement	Max. 30 dBm
15.247(c)	A8.5	Transmitter Radiated Emission	Pass	Meet the requirement	Table 15.209
15.247(e)	A8.2(b)	Power Spectral Density	Pass	Meet the requirement	Max. 8 dBm
15.247(d)	A8.5	Band Edge Measurement	Pass	Meet the requirement	20 dB less
15.107	RSS-Gen 7.2.2	Receiver conducted Emission	Pass	Meet the requirement	
15.109	RSS-Gen 7.2.3.2	Receiver radiated emission	Pass	Meet the requirement	

4. Measurement Condition

4.1 EUT Operation(For 2.4 GHz and 5.8 GHz)

a. Channel

Ch.	Frequency	Ch.	Frequency
0	2410 MHz		
1	2426 MHz		
2	2442 MHz		
3	2458 MHz		
4	2474 MHz		
12	5735 MHz		
13	5751 MHz	16	5799 MHz
14	5767 MHz	17	5815 MHz
15	5783 MHz		

b. Measurement Channel : WLAN: Low(2410 MHz), Middle(2442 MHz),High(2474 MHz)
 ,Low(5735MHz),Middle(5783 MHz),High(5815 MHz)

c. Test Mode : Continuous Output, Wi-Fi Binary CDMA

d. Test rate : the worst case of rate Wi-Fi Binary CDMA 2.4 GHz(1 Mbps) , 5.8 GHz (6 Mbps),

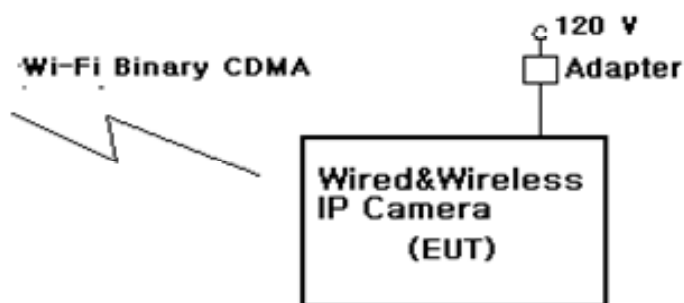
e. This device is satisfied with frequency stability

4.2 EUT Operation.

- * The EUT was in the following operation mode during all testing
- * The operational conditions of the EUT was determined by the manufacturer according to emission
- * Execute a RF test program to enable EUT under transmission/receiving condition continuously at specific channel frequency.
- *. Transmit mode and receive mode was each test.
- *. Highest frequency of the EUT is above 1 GHz, the measurement shall be made up to 10 th the highest frequency or 40 GHz, But the EUT wasn't Detected from 3th any other spurings and harmonic emissions.

4.3 Configuration and Peripherals

Test setup for Wi-Fi Binary CDMA



4.4 EUT and Support equipment

Equipment Name	Model Name	S/N	Manufacturer	Remark (FCC ID)
Wired&Wireless IP Camera	BHA - WC100	NONE	EMW Co., Ltd.	EUT
Adapter	ZF120A -1201500	NONE	Shenzhen Zhen Huan Electronic Co., Ltd.	

4.5 Cable Connecting

Start Equipment		End Equipment		Cable Standard		Remark
Name	I/O port	Name	I/O port	Length	Shielded	
Wired&Wireless IP Camera	POWER	ADAPTER	-	2.0	Unshielded	

5. DTS bandwidth

5.1 Test procedure

558074 D01 DTS Meas Guidance v03 8.2 Option 2 :The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW = 3 RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be 6 dB.

5.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

- . RBW= 100 KHz
- . VBW= 1 MHz
- . Span= 40 MHz
- . Sweep= suitable duration based on the EUT specification.

Limits : FCC § 15.247(a)(2) , IC RSS -210 A8.2(a)

6dB Bandwidth Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4440A	US42041281	2015-01-23
RF Cable	Length: 6cm	-	
-Spectrum Analyzer <=> EUT	Loss: 0.5dB	-	

5.3 Measurement results

EUT	Wired&Wireless IP Camera	MODEL	BHA -WC100
MODE	Wi -Fi Binary CDMA	ENVIRONMENTAL CONDITION	24 , 44 % R.H.
INPUT POWER	120 Va.c., 60 Hz		

(2.4 GHz)

Channel Frequency (MHz)	Emission bandwidth	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
2410	12.34	9.08	0.5	PASS
2442	12.75	11.49	0.5	PASS
2474	12.76	11.74	0.5	PASS

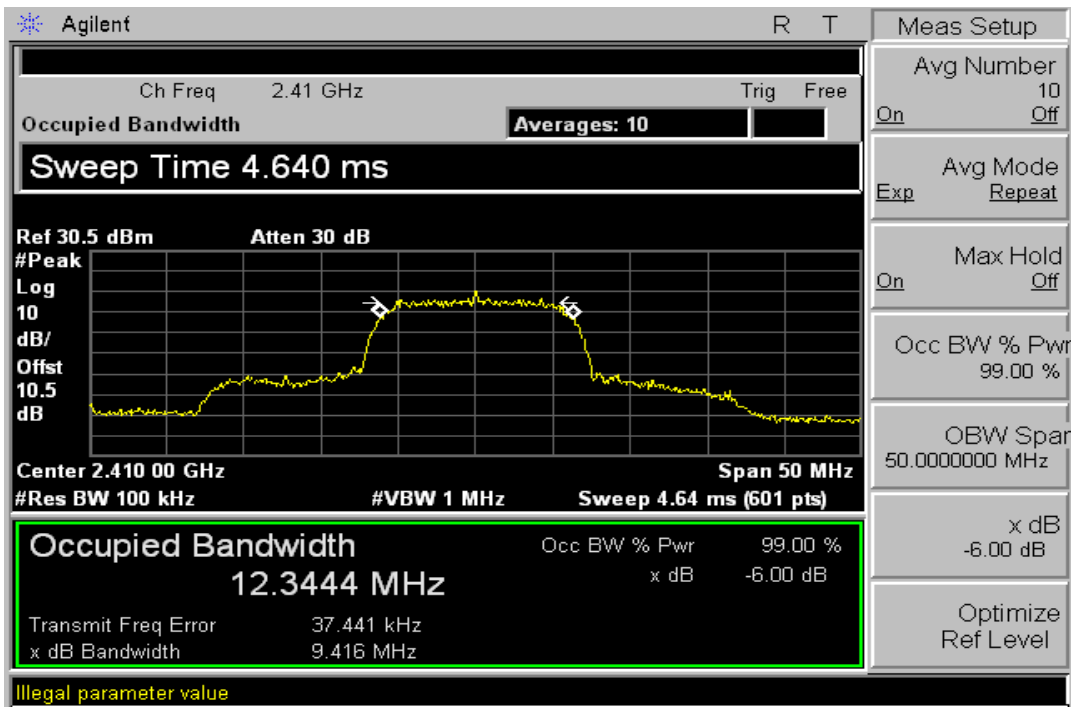
EUT	Wired&Wireless IP Camera	MODEL	BHA -WC100
MODE	Wi -Fi Binary CDMA	ENVIRONMENTAL CONDITION	24 , 44 % R.H.
INPUT POWER	120 Va.c., 60 Hz		

(5.8 GHz)

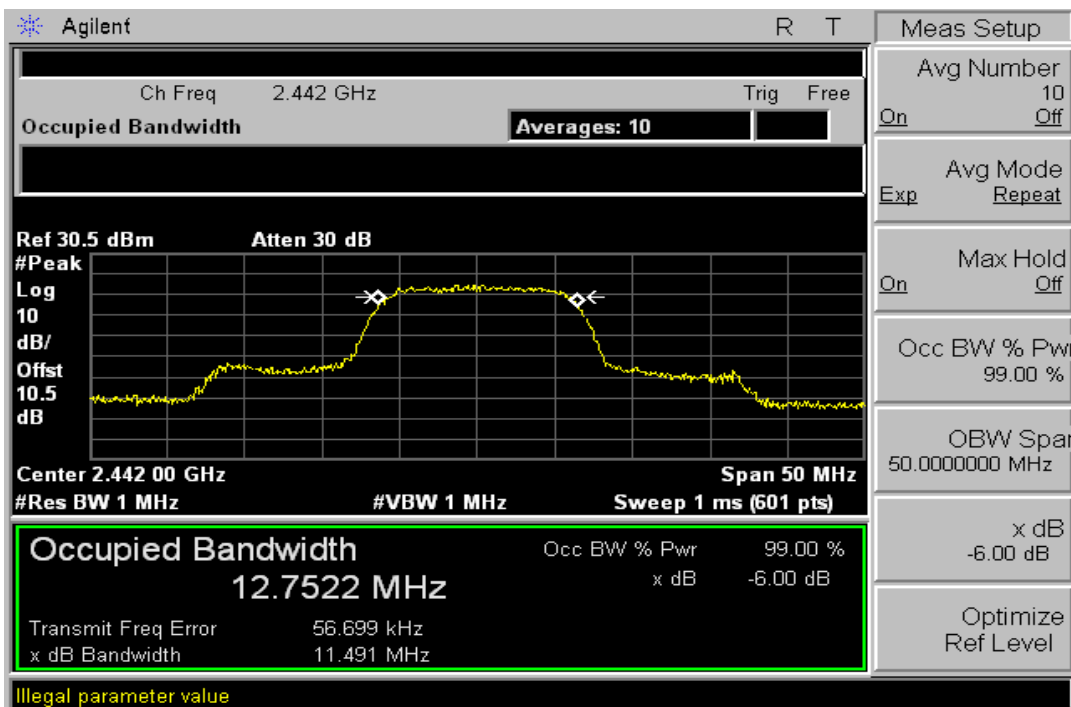
Channel Frequency (MHz)	Emission bandwidth	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
5735	12.71	11.30	0.5	PASS
5783	12.78	11.45	0.5	PASS
5815	12.74	11.65	0.5	PASS

5.4 Trace data (2.4 GHz)

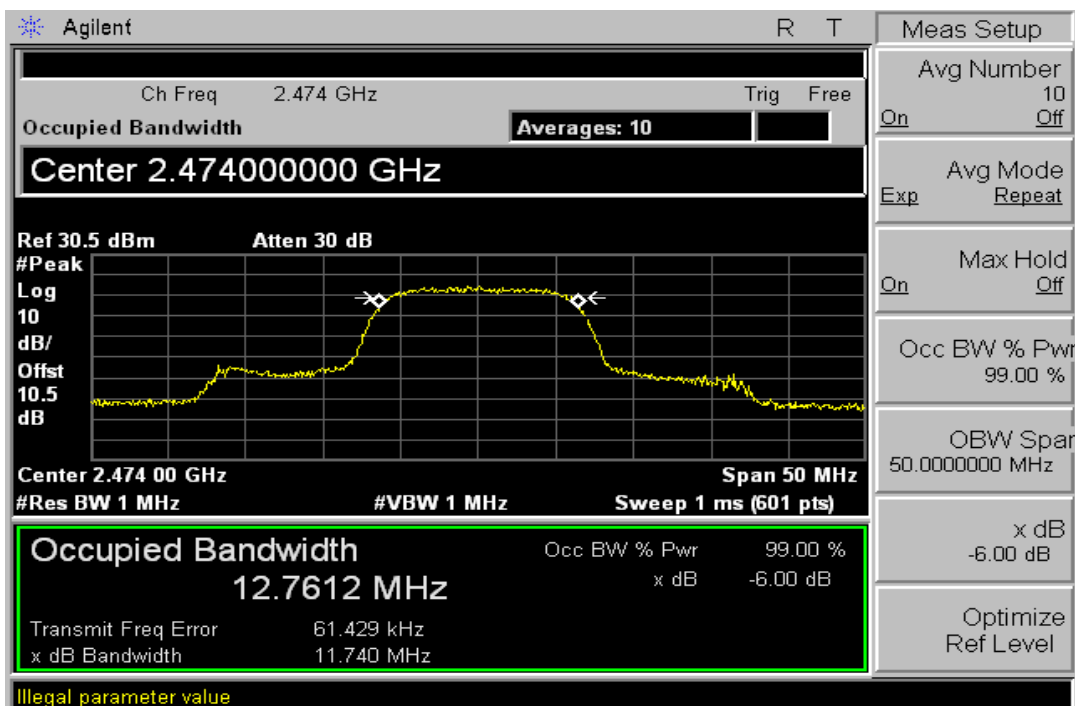
2410MHz



2442MHz

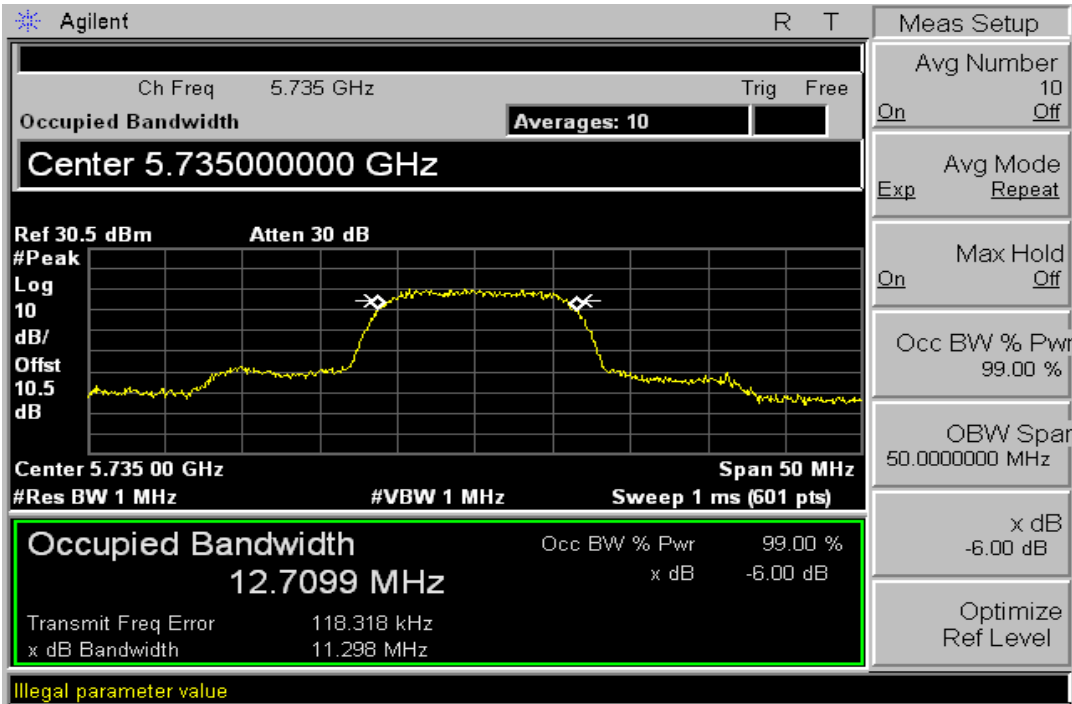


2474MHz

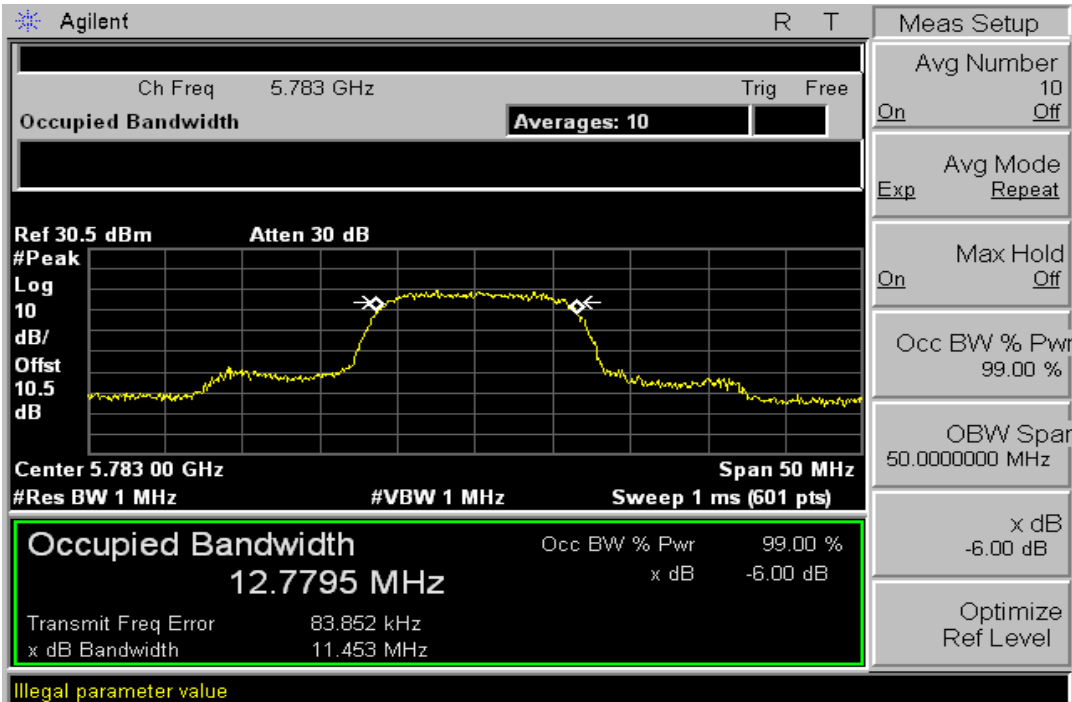


(5.8 GHz)

5735MHz



5783MHz



6. Maximum peak conducted output power

6.1 Test procedure

KDB 558074 D01 DTS Meas Guidance V03r01 9.1.2 Integrated band power method

6.2 Test instruments and measurement setup

- Set the RBW = 1 MHz.
- Set the VBW 3 RBW
- Set the span 1.5 x DTS bandwidth.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some instruments, this may require a manual override to select peak detector). If the instrument does not have a band power function,

Limits : FCC § 15.247 , IC RSS -210 A8.4

Maximum Peak Output Power Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	FSV40	100939	2015-01-23
Spectrum Analyzer	4440A	US42041281	2015-01-23
RF Cable	Length: 6cm	-	
-Spectrum Analyzer <=> EUT	Loss: 0.5 dB	-	

6.3 Measurement results

EUT	Wired&Wireless IP Camera	MODEL	BHA -WC100
MODE	Wi-Fi Binary CDMA	ENVIRONMENTAL CONDITION	24 , 43 % R.H.
INPUT POWER	120 Va.c., 60 Hz		

(2.4 GHz)

CHANNEL	Channel frequency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(W)		
LOW	2410	PEAK	22.64	0.184	30.0	PASS
MID	2442	PEAK	22.44	0.175	30.0	PASS
HI	2474	PEAK	22.52	0.179	30.0	PASS

(5.8 GHz)

EUT	Wired&Wireless IP Camera	MODEL	BHA -WC100
MODE	Wi-Fi Binary CDMA	ENVIRONMENTAL CONDITION	24 , 43 % R.H.
INPUT POWER	120 Va.c., 60 Hz		

CHANNEL	Channel Frequency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(W)		
LOW	5735	PEAK	18.96	0.079	30.0	PASS
MID	5783	PEAK	18.02	0.063	30.0	PASS
HI	5815	PEAK	17.48	0.056	30.0	PASS

7. Maximum conducted (average) output power

7.1 Test procedure

KDB 558074 D01 DTS Meas Guidance V03r01 9.2.2.4 Method AVGSA -2 (trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction)

7.2 Test instruments and measurement setup

- Measure the duty cycle, x , of the transmitter output signal as described in 6.0.
- Set span to at least 1.5 times the OBW.
- Set RBW = 1 -5% of the OBW, not to exceed 1 MHz.
- Set VBW = 3 x RBW.
- Number of points in sweep = 2 span / RBW. (This gives bin-to-bin spacing = RBW/2, so that narrowband signals are not lost between frequency bins.)
- Sweep time = auto.
- Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- Do not use sweep triggering. Allow the sweep to "free run".
- Trace average at least 100 traces in power averaging (i.e., RMS) mode; however, the number of traces to be averaged shall be increased above 100 as needed such that the average accurately represents the true average over the on and off periods of the transmitter.
- Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
- Add $10 \log (1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add $10 \log (1/0.25) = 6$ dB if the duty cycle is 25 %.

Maximum Peak Output Power Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	4440A	US42041281	2015-01-23
RF Cable	Length: 6cm	-	
-Spectrum Analyzer <=> EUT	Loss: 0.5 dB	-	

7.3 Measurement results

EUT	Wired&Wireless IP Camera	MODEL	BHA -WC100
MODE	Wi-Fi Binary CDMA	ENVIRONMENTAL CONDITION	24 , 43 % R.H.
INPUT POWER	120 Va.c., 60 Hz		

(2.4 GHz)

CHANNEL	Channel frequency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(mW)
		Detector	(dBm)	Duty Cycle		
LOW	2410	AVG	16.56	0.000	16.560	45.290
MID	2442	AVG	16.45	0.000	16.450	44.157
HI	2474	AVG	16.12	0.000	16.120	40.926

EUT	Wired&Wireless IP Camera	MODEL	BHA -WC100
MODE	Wi-Fi Binary CDMA	ENVIRONMENTAL CONDITION	24 , 43 % R.H.
INPUT POWER	120 Va.c., 60 Hz	Duty Cycle	100%

(5.8 GHz)

CHANNEL	Channel frequency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(mW)
		Detector	(dBm)	Duty Cycle		
LOW	5735	AVG	11.83	0.000	11.830	15.241
MID	5783	AVG	10.77	0.000	10.770	11.940
HI	5815	AVG	10.57	0.000	10.570	11.402



ESTECH Co., Ltd.

No. 1015, World Venture Center II,
426-5 Gasan-dong, Guncheon-gu,
Seoul, 158-806, Korea

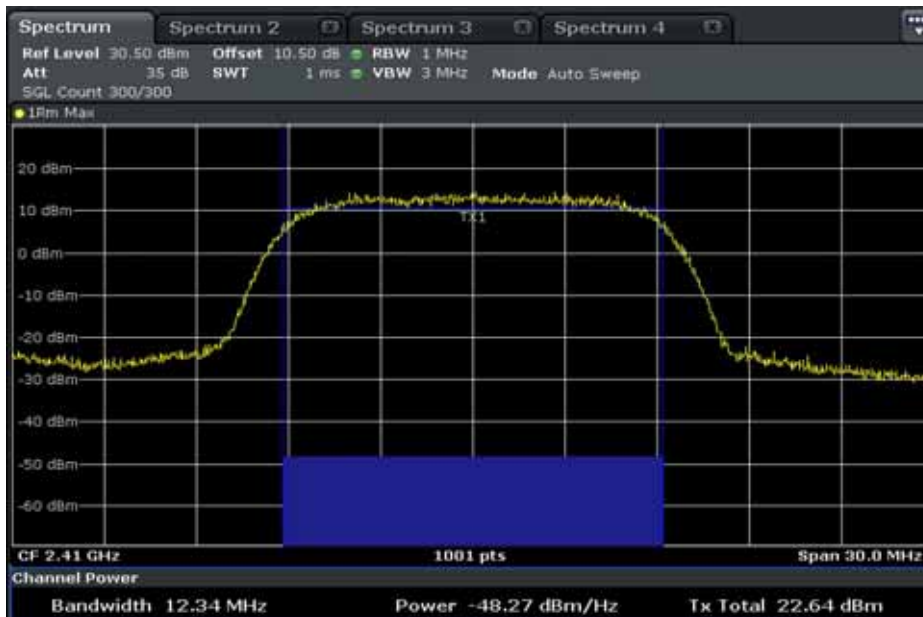


**Electromagnetic
Interference
Test Report**

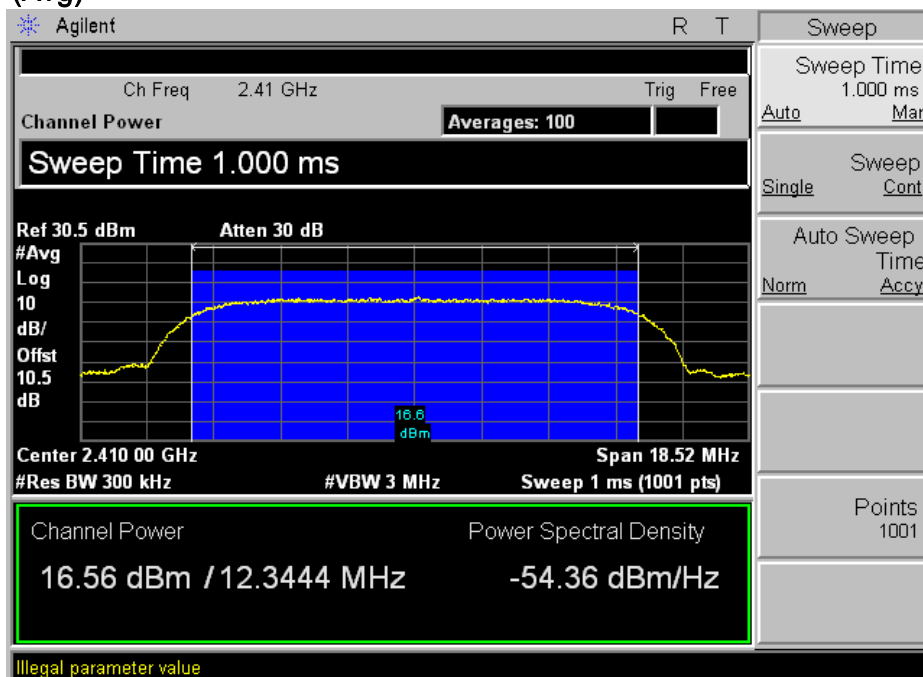
6.4 Trace data

LOW

(Peak)



(Avg)





ESTECH Co., Ltd.

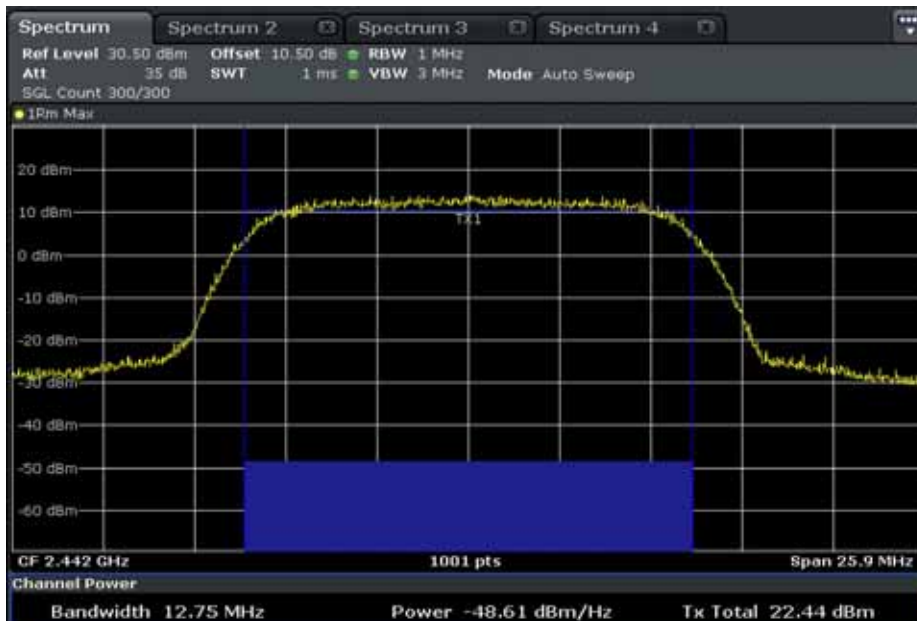
No. 1015, World Venture Center II,
426-5 Gasan-dong, Guncheon-gu,
Seoul, 158-800, Korea



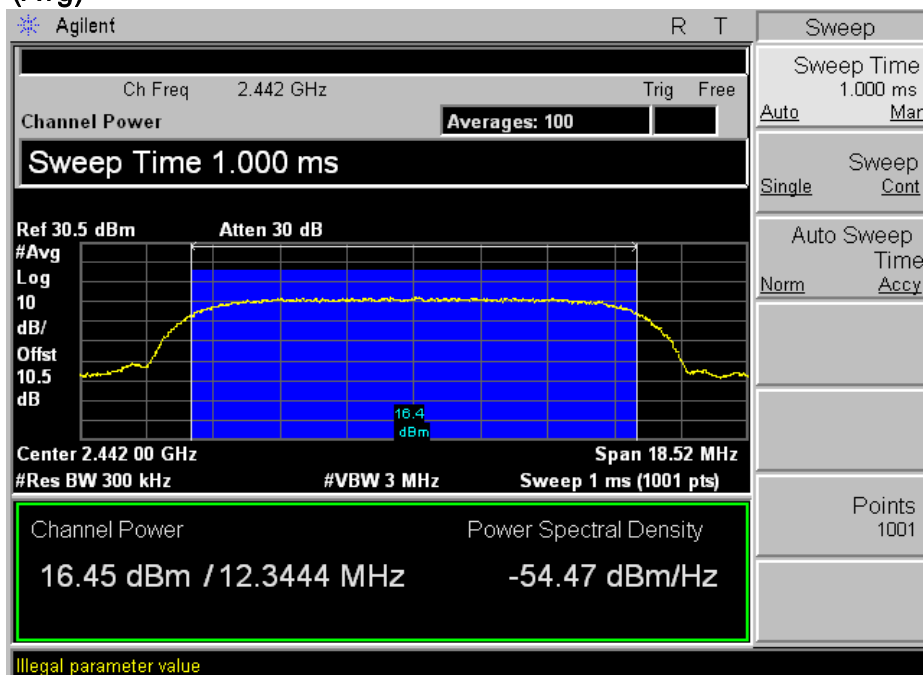
**Electromagnetic
Interference
Test Report**

MID

(Peak)



(Avg)





ESTECH Co., Ltd.

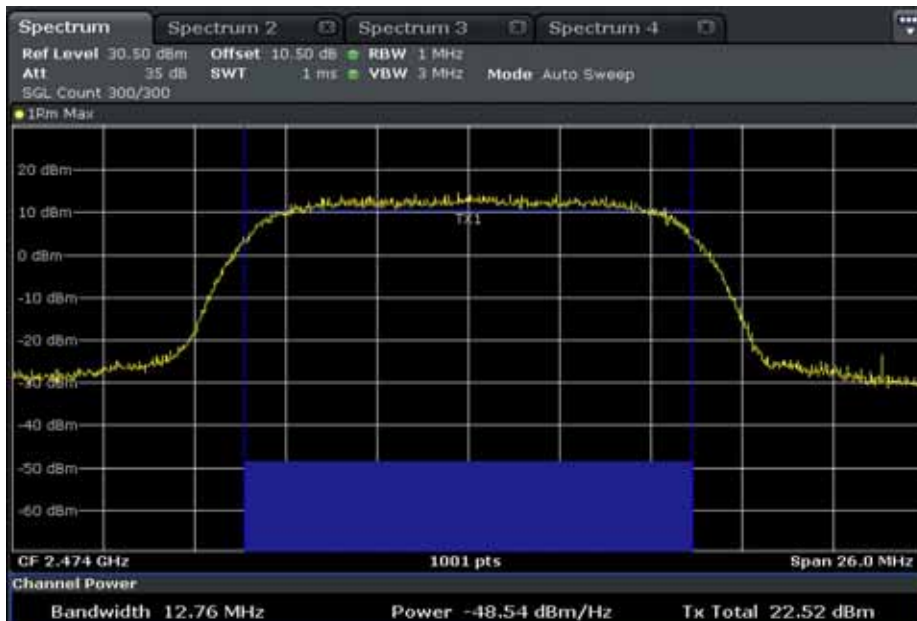
No. 1015, World Venture Center II,
426-5 Gasan-dong, Guncheon-gu,
Seoul, 150-800, Korea



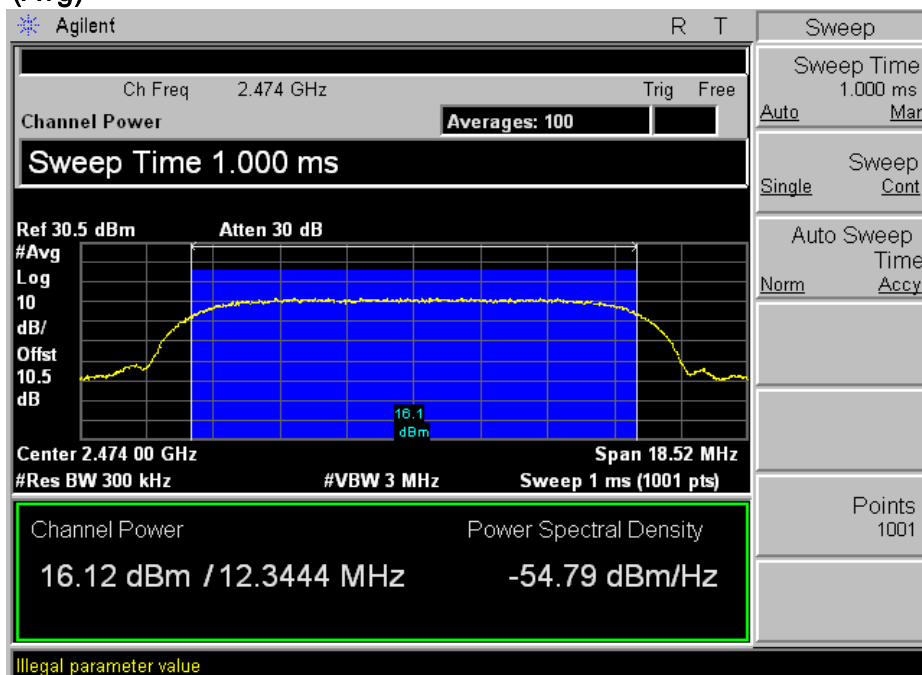
**Electromagnetic
Interference
Test Report**

HI

(Peak)



(Avg)





ESTECH Co., Ltd.

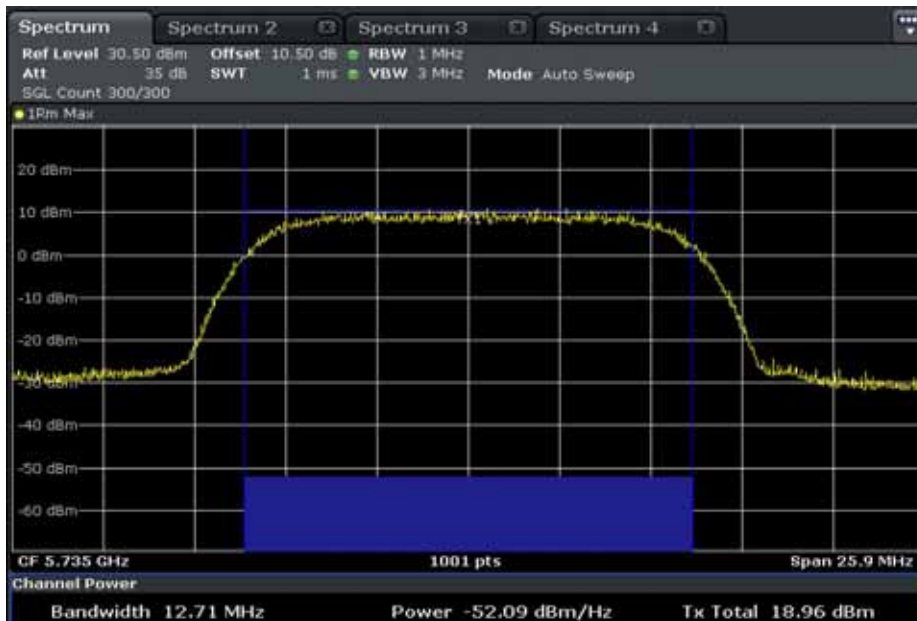
No. 1015, World Venture Center II,
426-5 Gasan-dong, Guncheon-gu,
Seoul, 150-803, Korea



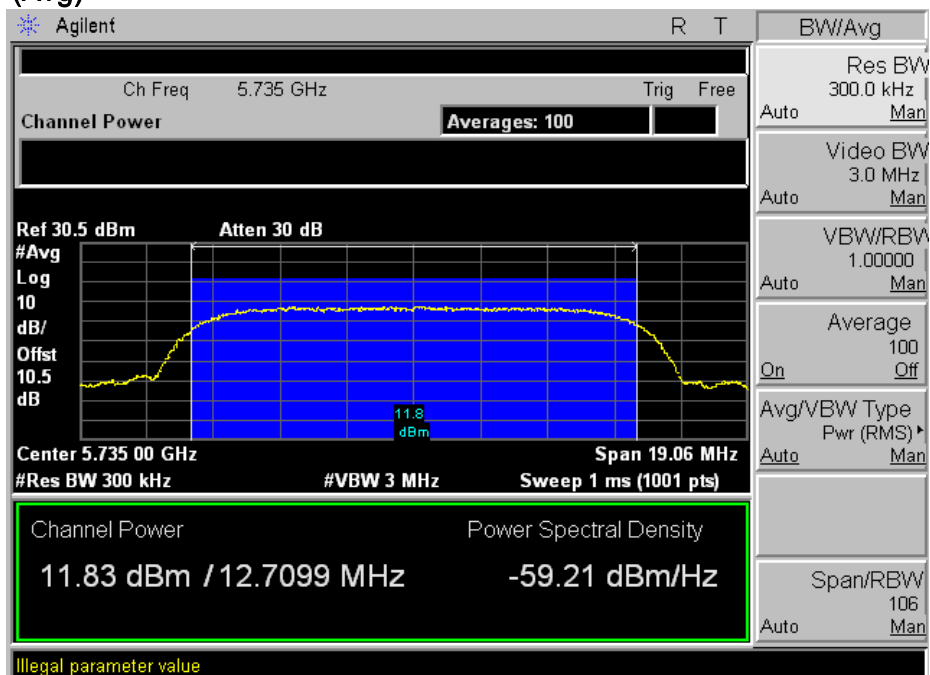
**Electromagnetic
Interference
Test Report**

LOW

(Peak)



(Avg)





ESTECH Co., Ltd.

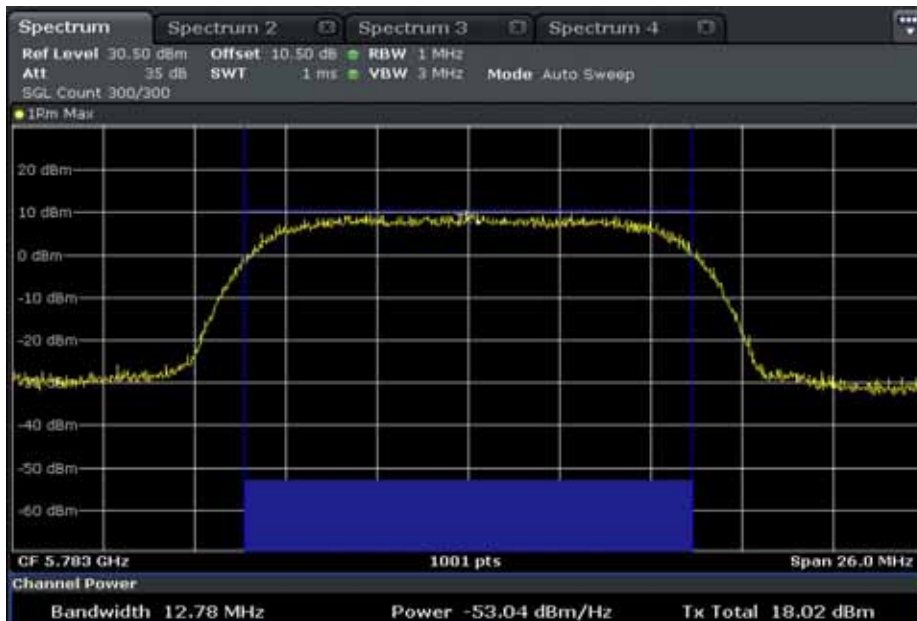
No. 1015, World Venture Center II,
426-5 Gasan-dong, Guncheon-gu,
Seoul, 158-806, Korea



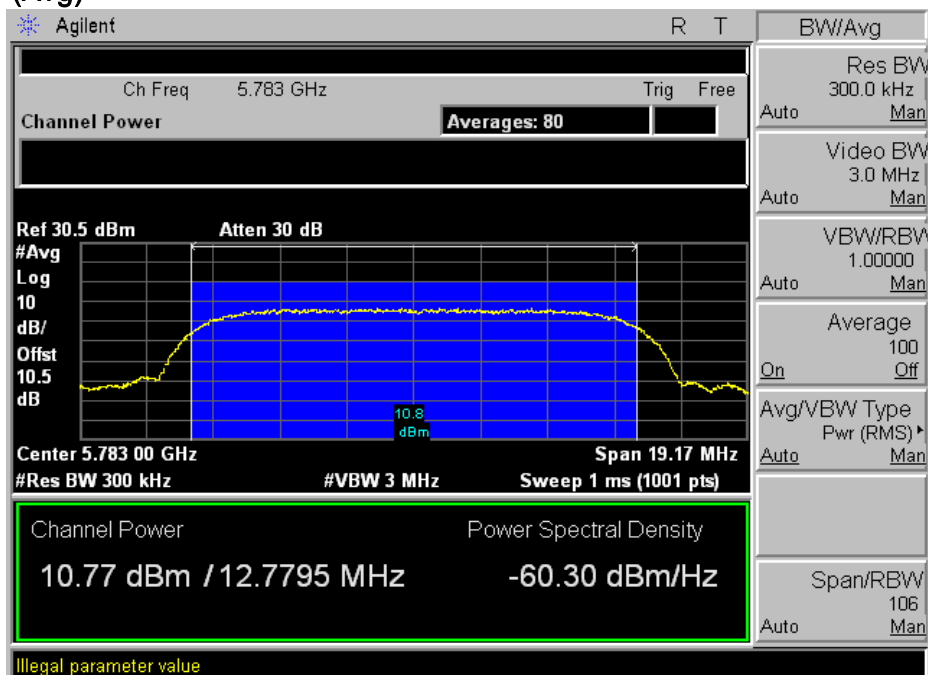
**Electromagnetic
Interference
Test Report**

MID

(Peak)



(Avg)





ESTECH Co., Ltd.

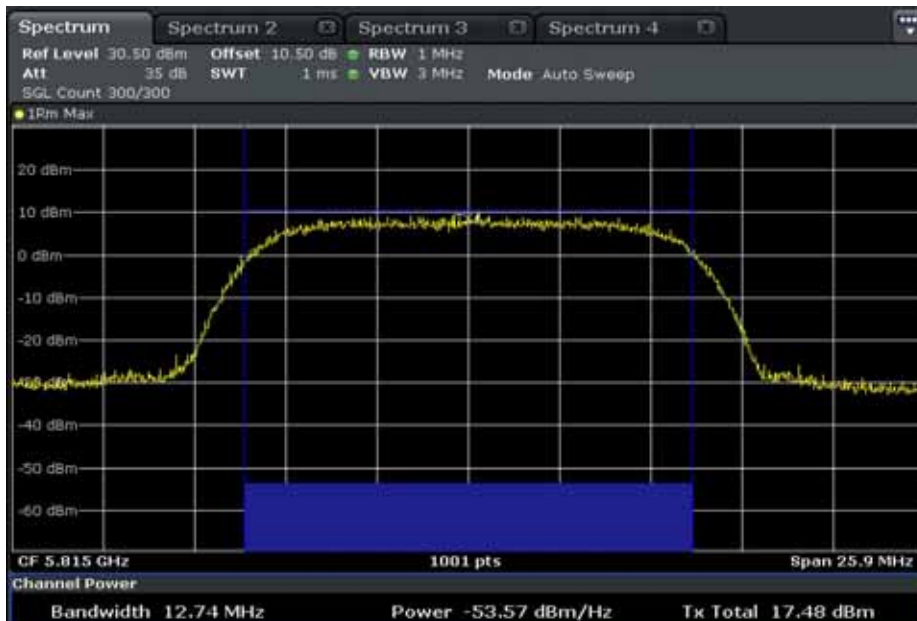
No. 1015, World Venture Center II,
426-5 Gasan-dong, Guecheon-gu,
Seoul, 150-803, Korea



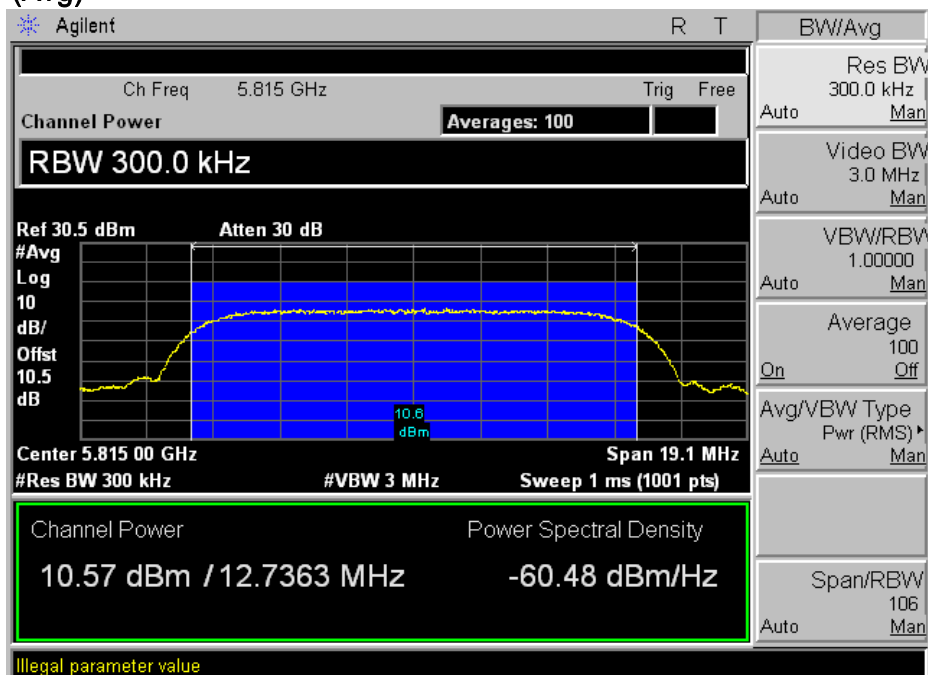
**Electromagnetic
Interference
Test Report**

HI

(Peak)



(Avg)



8. Maximum power spectral density level in the fundamental emission

8.1 Test procedure

KDB 558074 D01 DTS Meas Guidance V03r01 10.2 Method PKPSD (peak PSD)

8.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: 3 kHz RBW 100 kHz.
- Set the VBW 3 RBW.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Limits FCC § 15.247 , IC RSS -210 A8.2

The peak power density Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E440A	US42041281	2015-01-23
RF Cable	Length: 6cm	-	
-Spectrum Analyzer <=> EUT	Loss: 0.4 dB	-	

8.3 Measurement results

EUT	Wired&Wireless IP Camera	MODEL	BHA -WC100
MODE	Wi-Fi Binary CDMA	ENVIRONMENTAL CONDITION	23 , 43 % R.H.
INPUT POWER	120 Va.c., 60 Hz		

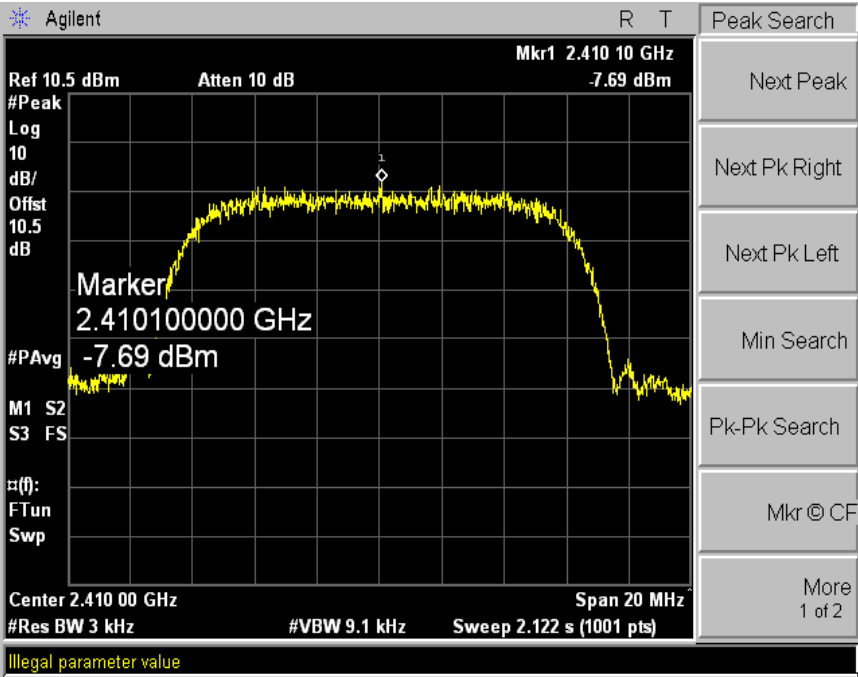
CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
LOW	2410	-7.68	8.0	15.68
MID	2442	-6.76	8.0	14.76
HI	2474	-8.93	8.0	16.93

EUT	Wired&Wireless IP Camera	MODEL	BHA -WC100
MODE	Wi-Fi Binary CDMA	ENVIRONMENTAL CONDITION	23 , 43 % R.H.
INPUT POWER	120 Va.c., 60 Hz		

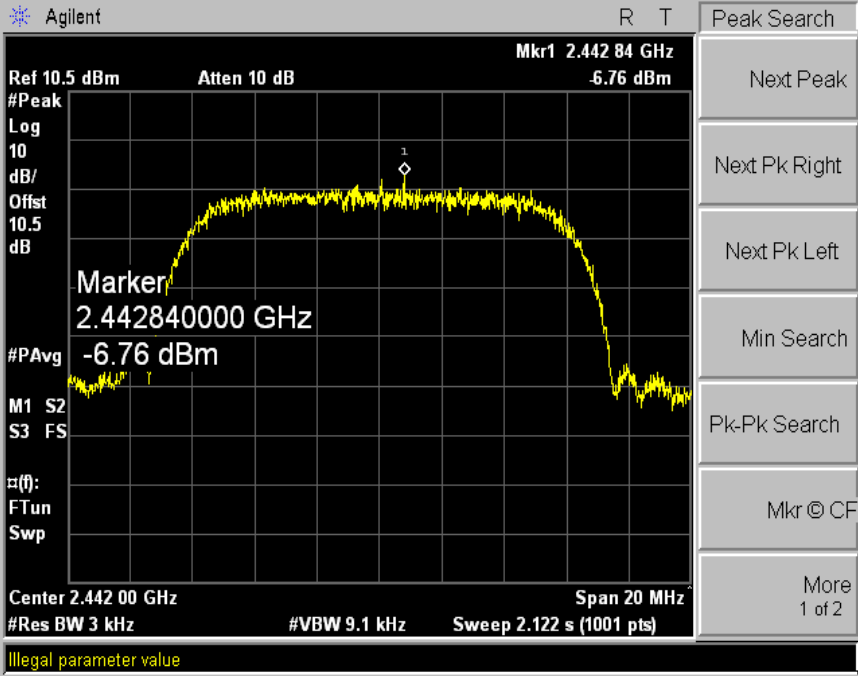
(5.8 GHz)

CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
LOW	5735	-12.51	8.0	20.51
MID	5783	-13.15	8.0	21.15
HI	5815	-14.77	8.0	22.77

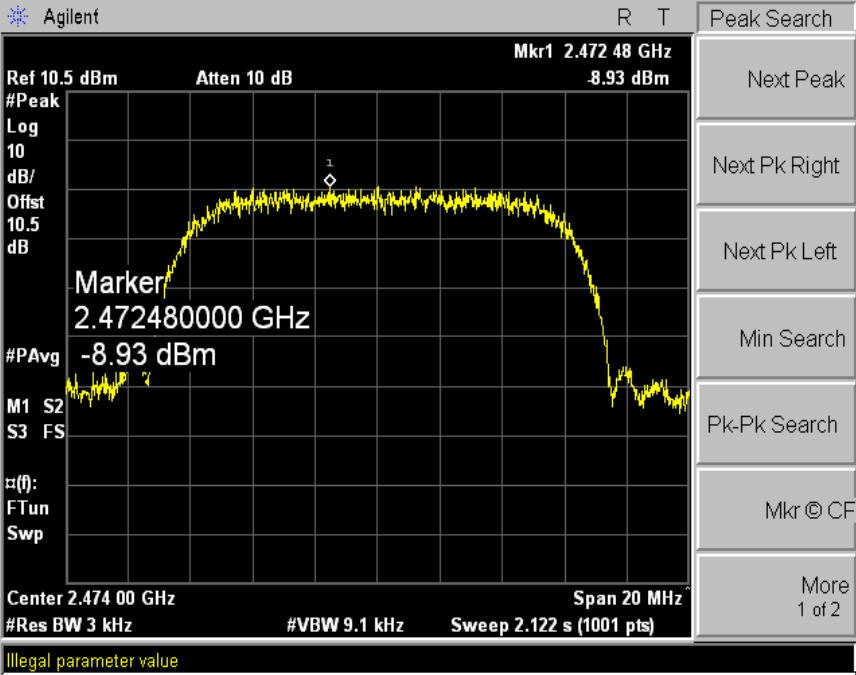
8.4 Trace data
LOW



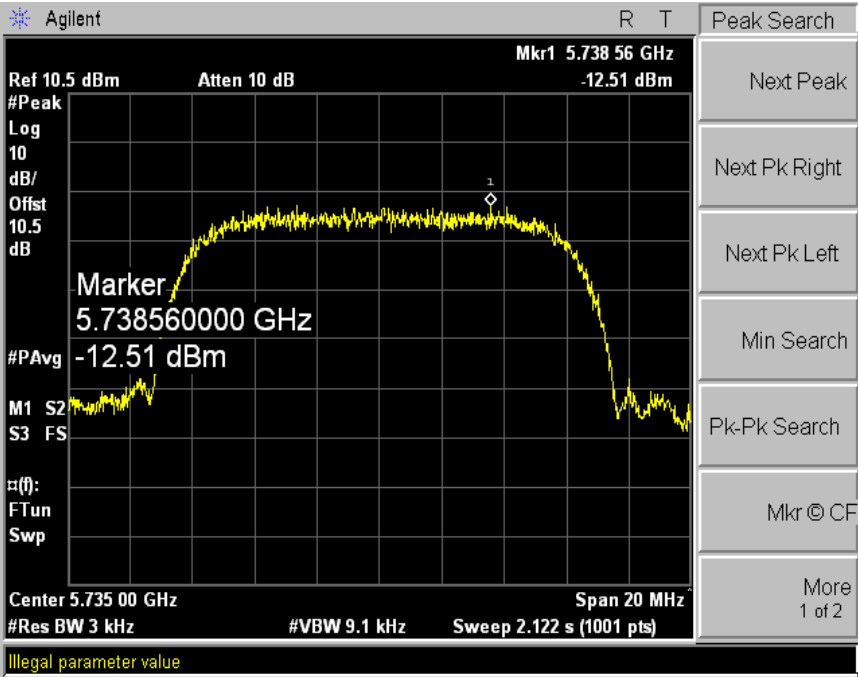
MID



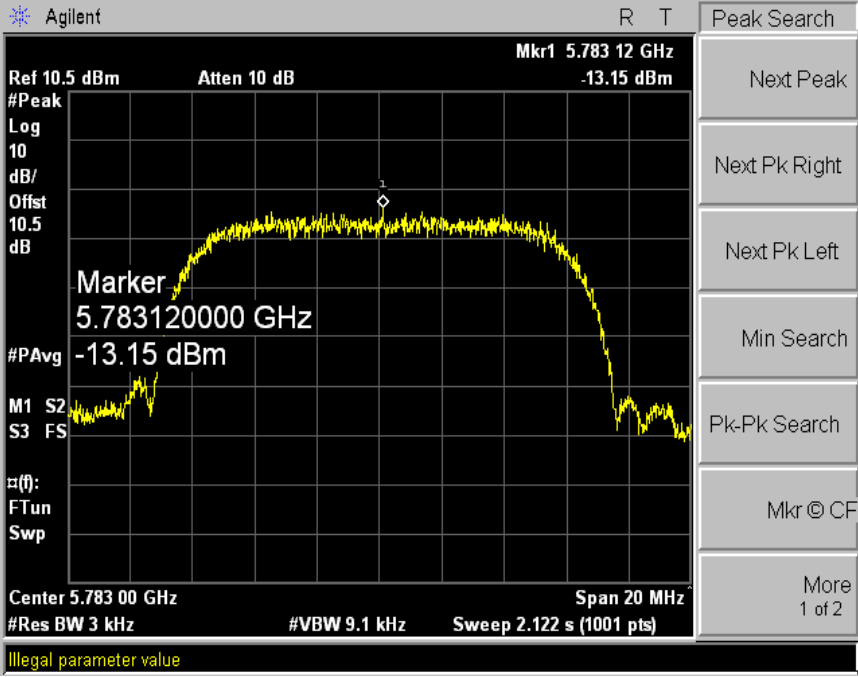
HI



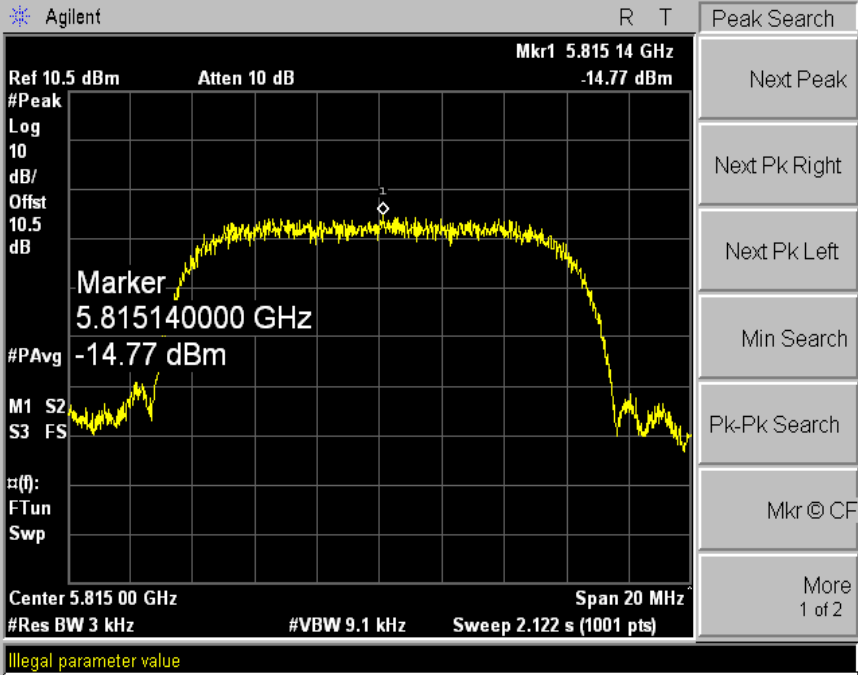
8.4 Trace data
LOW



MID



HI



9. Emissions in non-restricted frequency bands

9.1 Test procedure

KDB 558074 D01 DTS Meas Guidance V03r01 11.0 Emissions in non-restricted frequency

9.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

- Set the center frequency and span to encompass frequency range to be measured.
- Set the RBW = 100 kHz)
- Set the VBW = 3 x RBW)
- Detector = peak.
- Ensure that the number of measurement points = span/RBW
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

Limits FCC § 15.247 , IC RSS -210 A8.5

Band Edge&Out of Emission Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4440A	US42041281	2015-01-23
Spectrum Analyzer	FSV40	100939	2015-01-23
RF Cable	Length: 6cm		-
-Spectrum Analyzer <=> EUT	Loss: 1.5dB		-

9.3 Measurement results of band-edge & out of emission

EUT	Wired&Wireless IP Camera	MODEL	BHA -WC100
MODE	Wi-Fi Binary CDMA	ENVIRONMENTAL CONDITION	23 , 43 % R.H.
INPUT POWER	120 Va.c., 60 Hz		

2GHz

CHANNEL	Channel Frequency (MHz)	limit	PASS/FAIL
LOW	2410	20dBc	PASS
HI	2474	20dBc	PASS

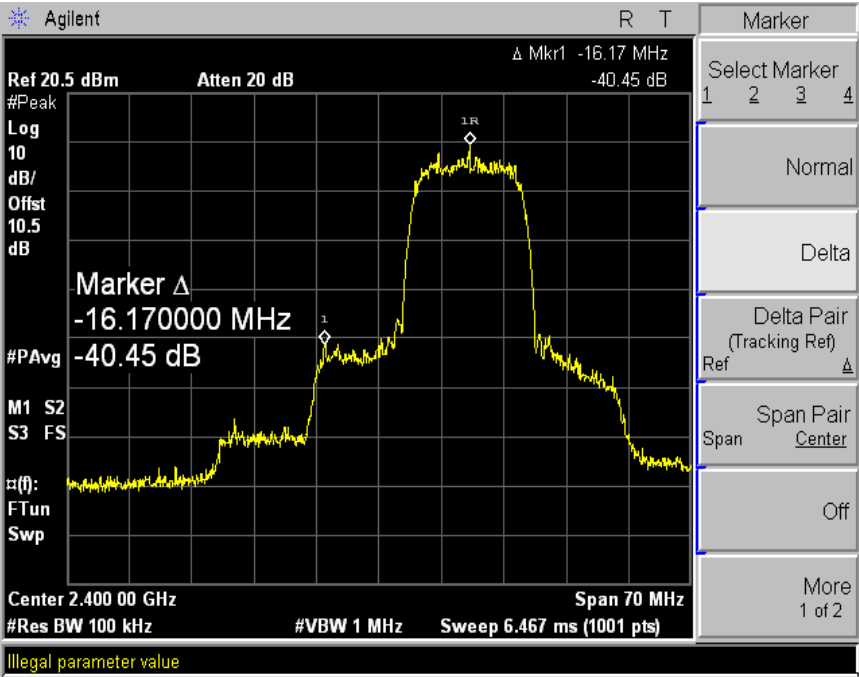
9.3 Measurement results of band-edge & out of emission

EUT	Wired&Wireless IP Camera	MODEL	BHA -WC100
MODE	Wi -Fi Binary CDMA	ENVIRONMENTAL CONDITION	23 , 43 % R.H.
INPUT POWER	120 Va.c., 60 Hz		

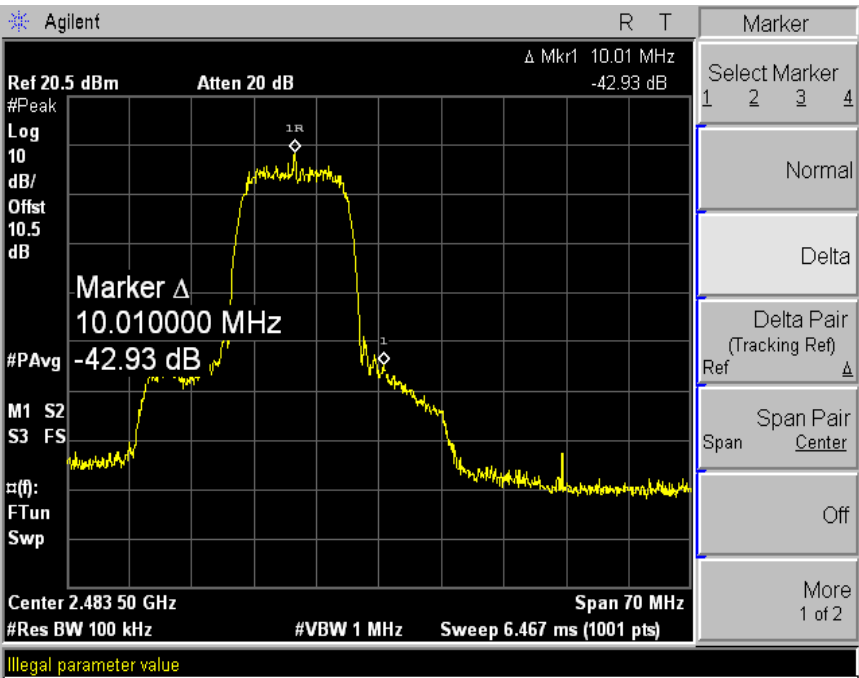
5.8 GHz

CHANNEL	Channel Frequency (MHz)	limit	PASS/FAIL
LOW	5735	20dBc	PASS
HI	5815	20dBc	PASS

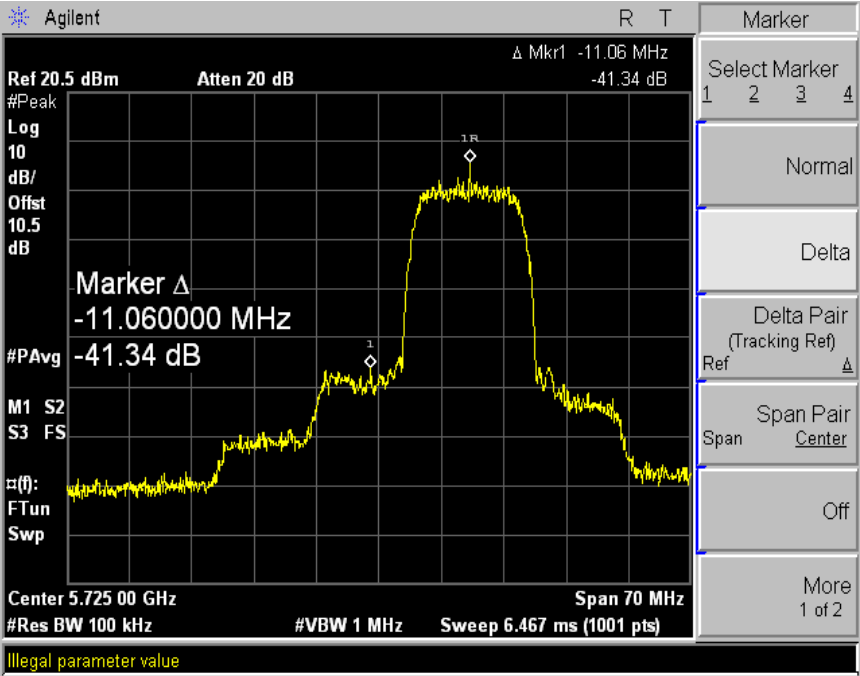
9.4 Trace data of band-edge & Out of Emission
LOW



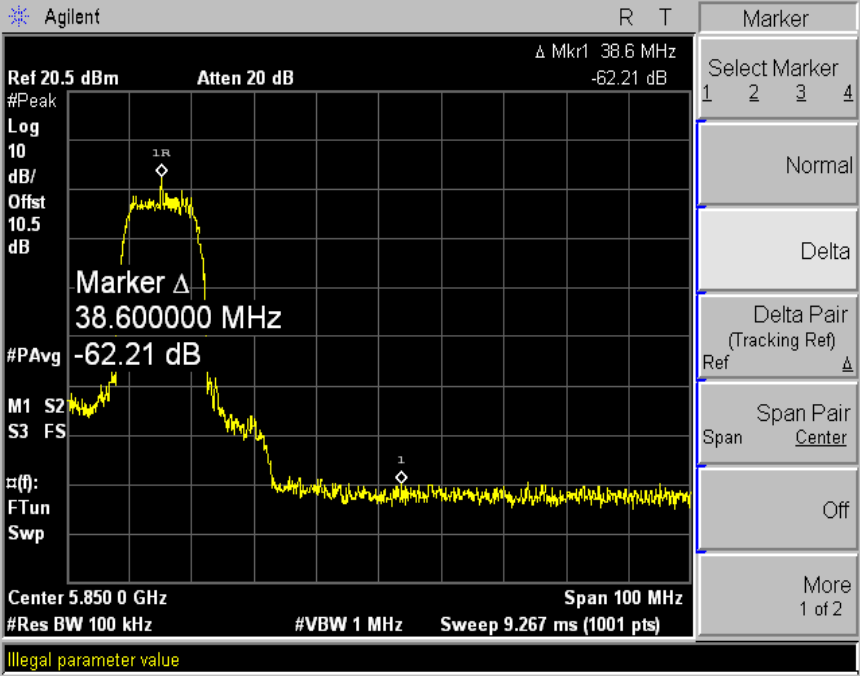
HI



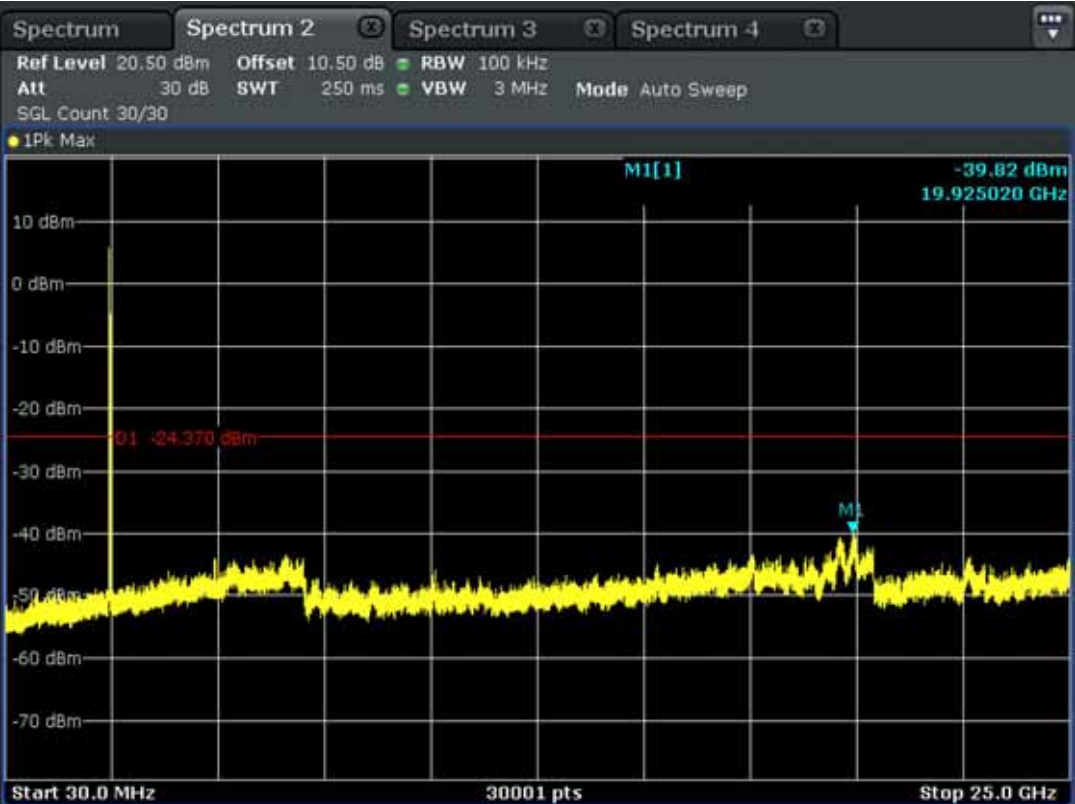
LOW



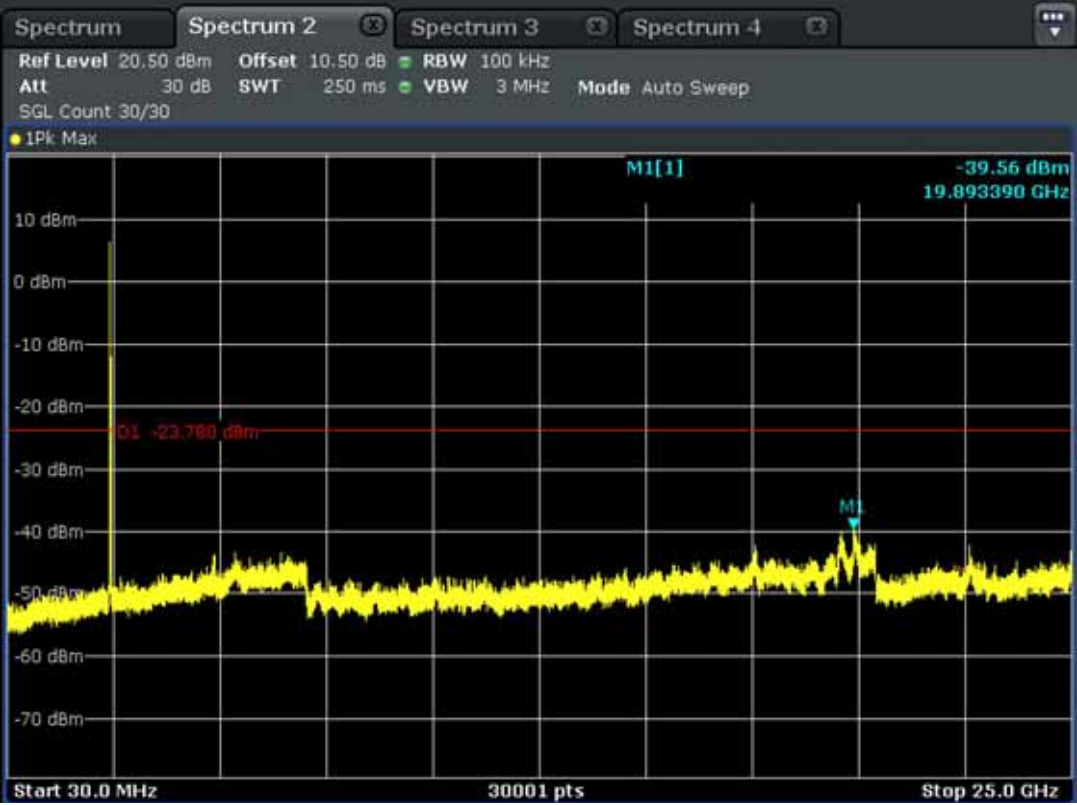
HI



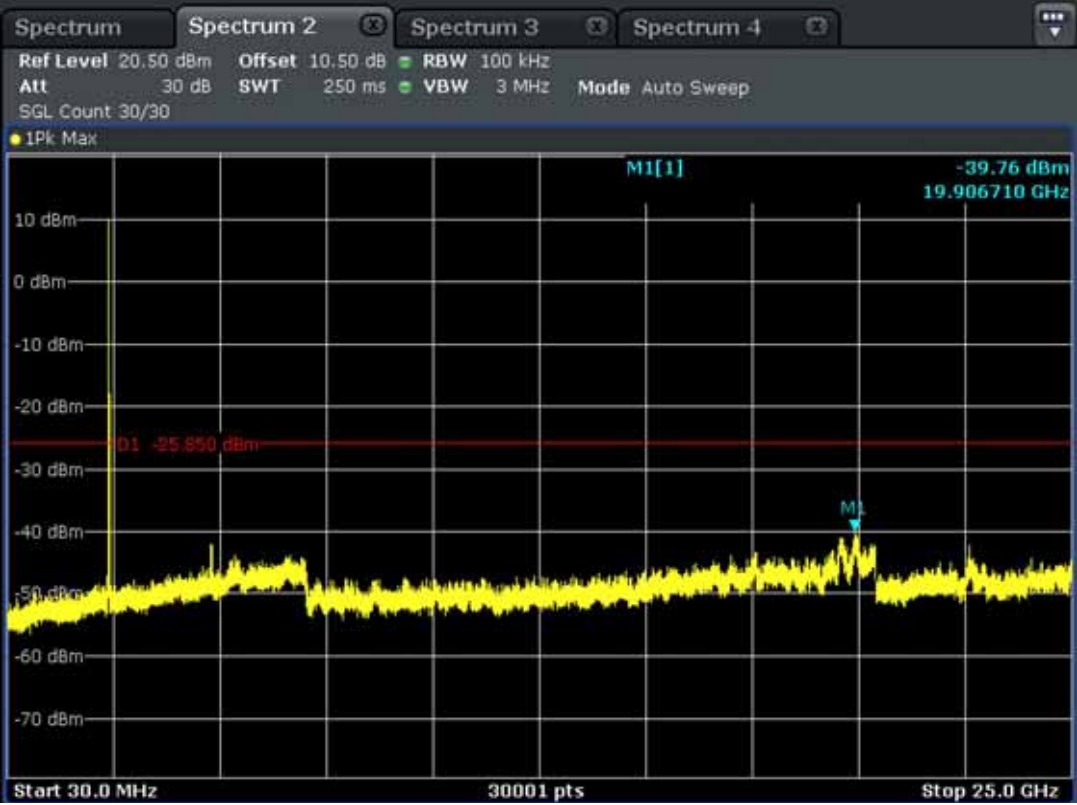
HI



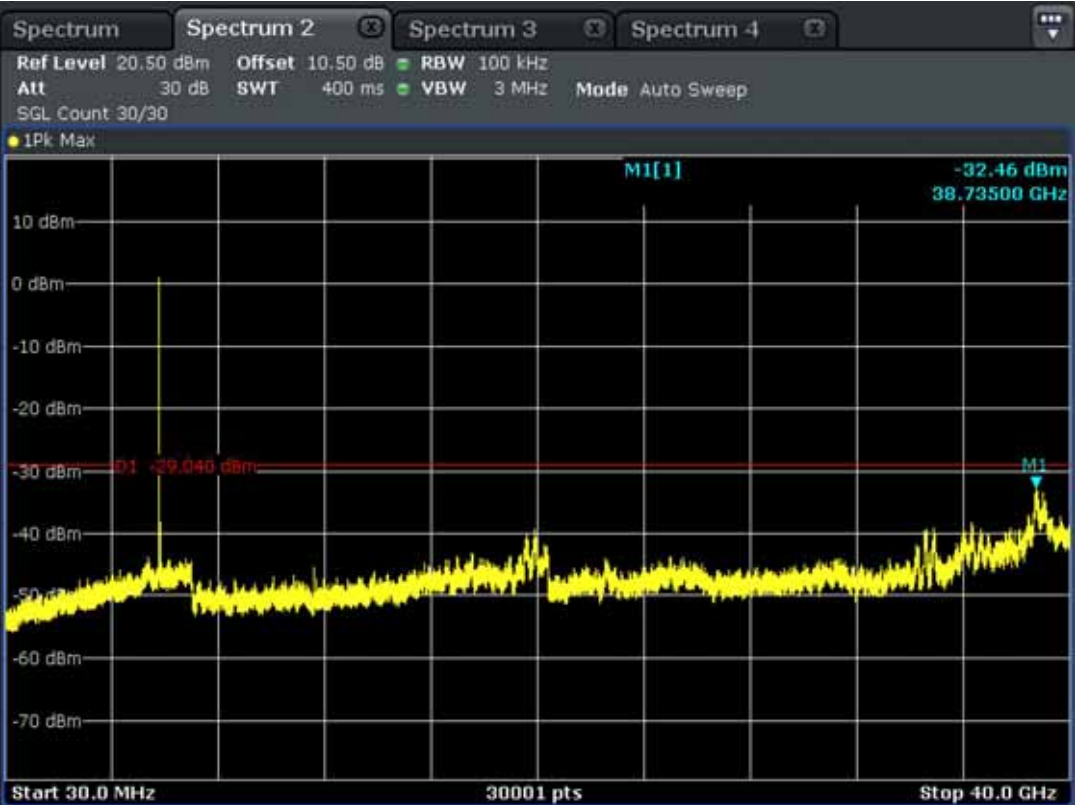
MID



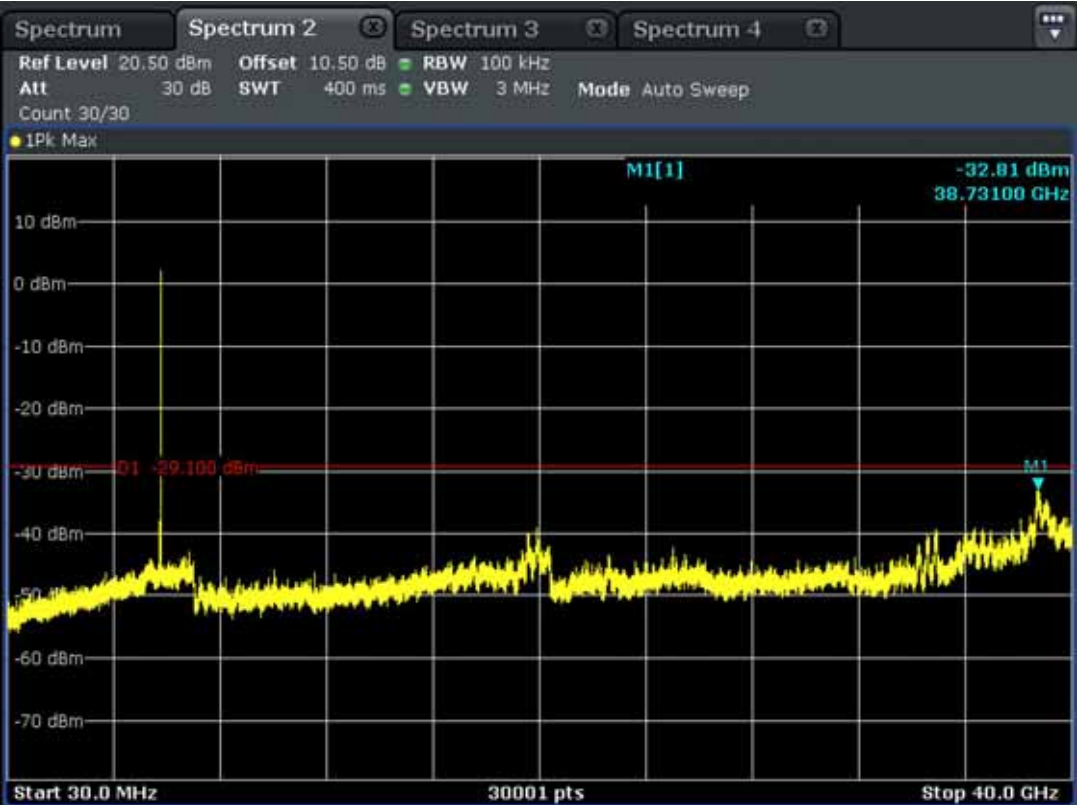
LOW



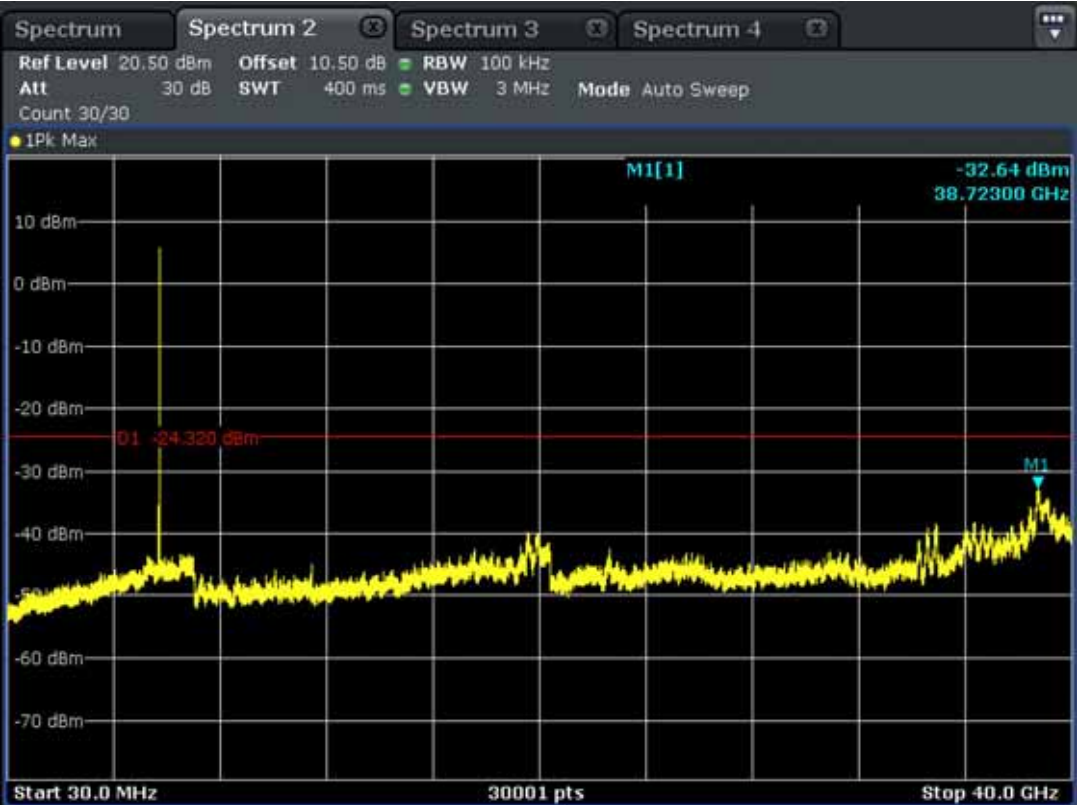
HI



MID



LOW



10. Measurement of radiated disturbance

Above 30 MHz Electric Field strength was measured in accordance with FCC PART 15.205, 15.209 & IC RSS-210 (A8.5). The test setup was made according to ANSI C 63.4 (2009) & KDB 558074 D01 Semi-anechoic chamber, which allows a 3 m distance measurement. The EUT was placed in the center of styrofoam. turntable. The height of this table was 0.8 m. The measurement was conducted with both horizontal and vertical antenna polarization. The turntable has fully rotated. For further description of the configuration refer to the picture of the test setup.

10.1 Measurement equipments

Equipment Name	Type	Manufacturer	Serial No.	Next Calibration date
TEST Receiver	ESC17	ROHDE & SCHWARZ	1166.5950.07	13-Jan-15
Logbicon Antenna	VULB 9168	SCHWARZBECK	237	13-Jan-15
Turn Table	DT3000-2t	Innco System GmbH	N/A	-
Antenna Mast	MA4000-EP	Innco System GmbH	N/A	-
PREAMPLIFIER	8449B	AGILENT	3008A00595	13-Jan-15
Horn Antenna	BBHA9120D	SCHWARZBECK	469	11-Nov-14
Test Receiver	ESPI7	ROHDE & SCHWARZ	100185	13-Jan-15
Spectrum Analyzer	R3273	ADVANTEST	110600592	13-Jan-15
Turn Table	DT1500-S	Innco System GmbH	N/A	-
Antenna Mast	MA4000-EP	Innco System GmbH	N/A	-
Pyramidal Horn Antenna	3160-09-01	EST-LINDGREN	102642	14-Nov-14
Antenna Master & Turn table controller	C02000-P	Innco System GmbH	CO2000/642 /28051111/L	-
Spectrum Analyzer	FSV40	ROHDE & SCHWARZ	100939	23-Jan-15
Double Ridged Horn Antenna	SAS-574	A.H.SYSTEMS	154	20-Mar-14
PREAMPLIFIER	83051A	AGILENT	3950M00201	13-Jan-15

10.2 Environmental Condition

Below 1 GHz - Test Place : 10 m Semi-anechoic chamber

2.4 GHz Mode

Temperature (°C) : 22.2
Humidity (% R.H.) : 48.2 % R.H.

5.8 GHz Mode

Temperature (°C) : 22.2
Humidity (% R.H.) : 48.2 % R.H.

Above 1 GHz-Test Place : 3 m Semi-anechoic chamber

2.4 GHz Mode

Temperature (°C) : 21.2
Humidity (% R.H.) : 50.4 % R.H.

5.8 GHz Mode

Temperature (°C) : 22.1
Humidity (% R.H.) : 51.2 % R.H.

10.3 Measurement Instrument setting for Radiated Emission

10.3.1 Frequency range below 1 GHz

RBW: 120 kHz , VBW: 3 x RBW , Detector: Quasi Peak

10.3.2 Frequency range above 1 GHz

Peak Power Measurement Procedure (KDB 558074 section 12.2.4)

- a. RBW: 1 MHz , VBW: 3 MHz
- b. Trace mode = max hold
- c. Detector: Peak
- d. Sweep time = auto

Average Power Measurement Procedures (KDB 558074 section 12.2.5.2)

- a. Set analyzer center frequency to the frequency associated with the emission
- b. RBW: 1 MHz , VBW: 3 MHz
- c. Detector : power average (RMS) detector
- d. Sweep time = auto

Note

Band	Duty cycle(%)	Ton (ms)	Ton + Toff (ms)	DCF=10*log(1/Duty) (dB)
2.4 GHz	100.0		0.000	0.00
5.8 GHz	100.0		0.000	0.00

*If the EUT can be configured or modified to transmit continuously (duty cycle 98 percent then the average emission levels shall be measured using the following method (with EUT transmitting continuously).

10.4 Test Data for Wi-Fi Binary CDMA 2.4 GHz

Test Date : 12-Jan-14

Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
70.50	6.97	H	3.1	11.00	1.38	40.00	19.34	-20.66
84.80	19.14	V	1.0	8.61	1.54	40.00	29.29	-10.71
89.80	11.36	H	3.1	7.74	1.58	43.50	20.68	-22.82
90.50	25.78	V	1.0	7.73	1.58	43.50	35.10	-8.40
145.40	15.48	V	1.0	12.32	1.95	43.50	29.76	-13.74
154.00	11.07	H	2.6	12.66	1.99	43.50	25.73	-17.77
264.00	10.27	H	1.6	11.92	2.56	46.00	24.75	-21.25
352.00	17.27	H	1.3	14.57	2.94	46.00	34.78	-11.22
396.00	11.04	H	1.3	15.70	3.12	46.00	29.86	-16.14
440.00	16.05	H	1.2	16.56	3.27	46.00	35.88	-10.12
484.00	9.62	H	1.0	17.40	3.41	46.00	30.42	-15.58
764.60	5.80	H	1.0	21.81	4.32	46.00	31.94	-14.06
Remark	<p>H : Horizontal, V : Vertical TEST MODE : 2.4 GHz-CH2(2442 MHz)</p> <p>*Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position)</p> <p>*CL = Cable Loss(In case of below 1000 MHz)</p> <p>*Result Value = Reading + Ant Factor + Cable loss</p> <p>*The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz.</p>							

10.4 - 1 Test Data for Wi-Fi Binary CDMA 2.4 GHz

Test Date 12-Jan-14

Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction(dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
2316.0	53.20	H	1.1	26.78	-28.15	0.00	74.00	51.83	-22.17
2316.0	52.85	V	1.2	26.78	-28.15	0.00	74.00	51.48	-22.52
2385.0	53.98	H	1.0	26.97	-28.09	0.00	74.00	52.86	-21.14
2385.0	53.95	V	1.0	26.97	-28.09	0.00	74.00	52.83	-21.17
4820.0	45.60	H	1.0	31.50	-23.90	0.00	74.00	53.20	-20.80
4820.0	49.32	V	1.1	31.50	-23.90	0.00	74.00	56.92	-17.08
AV(RBW: 1 MHz VBW: 3 MHz)									
2316.0	43.66	H	1.1	26.78	-28.15	0.00	54.00	42.29	-11.71
2316.0	42.24	V	1.2	26.78	-28.15	0.00	54.00	40.87	-13.13
2385.0	43.22	H	1.0	26.97	-28.09	0.00	54.00	42.10	-11.90
2385.0	44.21	V	1.0	26.97	-28.09	0.00	54.00	43.09	-10.91
4820.0	36.65	H	1.0	31.50	-23.90	0.00	54.00	44.25	-9.75
4820.0	40.14	V	1.1	31.50	-23.90	0.00	54.00	47.74	-6.26
Remark	H : Horizontal, V : Vertical TEST MODE : 2.4 GHz-CH0(2410 MHz)								
	*The TX signal wasn't detected from 3th harmonics.								
	*Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position)								
	*Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction								

10.4-2 Test Data for Wi-Fi Binary CDMA 2.4 GHz

Test Date 12-Jan-14

Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction(dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
4884.0	45.53	H	1.0	31.63	-23.72	0.00	74.00	53.43	-20.57
4884.0	49.58	V	1.1	31.63	-23.72	0.00	74.00	57.48	-16.52
AV(RBW: 1 MHz VBW: 3 MHz)									
4884.0	35.21	H	1.0	31.63	-23.72	0.00	54.00	43.11	-10.89
4884.0	40.53	V	1.1	31.63	-23.72	0.00	54.00	48.43	-5.57
Remark	H : Horizontal, V : Vertical TEST MODE : 2.4 GHz-CH2(2442 MHz)								
	*The TX signal wasn't detected from 3th harmonics.								
	*Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position)								
	*Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction								

10.4-3 Test Data for Wi-Fi Binary CDMA 2.4 GHz

Test Date 12-Jan-14

Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction(dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
2485.0	53.22	H	1.1	27.25	-27.84	0.00	74.00	52.63	-21.37
2485.0	54.35	V	1.2	27.25	-27.84	0.00	74.00	53.76	-20.24
2490.0	55.56	H	1.1	27.27	-27.83	0.00	74.00	55.00	-19.00
2490.0	56.24	V	1.2	27.27	-27.83	0.00	74.00	55.68	-18.32
4948.0	45.60	H	1.1	31.76	-23.45	0.00	74.00	53.91	-20.09
4948.0	49.32	V	1.0	31.76	-23.45	0.00	74.00	57.63	-16.37
AV(RBW: 1 MHz VBW: 3 MHz)									
2485.0	44.58	H	1.1	27.25	-27.84	0.00	54.00	43.99	-10.01
2485.0	45.99	V	1.2	27.25	-27.84	0.00	54.00	45.40	-8.60
2490.0	45.55	H	1.1	27.27	-27.83	0.00	54.00	44.99	-9.01
2490.0	45.81	V	1.2	27.27	-27.83	0.00	54.00	45.25	-8.75
4948.0	36.65	H	1.1	31.76	-23.45	0.00	54.00	44.96	-9.04
4948.0	41.61	V	1.0	31.76	-23.45	0.00	54.00	49.92	-4.08
Remark	H : Horizontal, V : Vertical TEST MODE : 2.4 GHz-CH2(2442 MHz)								
	*The TX signal wasn't detected from 3th harmonics.								
	*Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position)								
	*Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction								

10.5 Test Data for Wi-Fi Binary CDMA 5.8 GHz

Test Date : 13-Jan-14

Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
54.80	15.39	H	1.0	12.57	1.24	40.00	29.20	-10.80
70.50	6.84	H	3.1	11.00	1.38	40.00	19.21	-20.79
89.60	11.34	H	2.9	7.78	1.58	43.50	20.70	-22.80
145.40	14.42	H	1.0	12.32	1.95	43.50	28.70	-14.80
154.00	11.07	H	2.0	12.66	1.99	43.50	25.73	-17.77
264.00	10.32	H	1.3	11.92	2.56	46.00	24.80	-21.20
352.00	17.27	H	1.2	14.57	2.94	46.00	34.78	-11.22
396.00	11.09	H	1.0	15.70	3.12	46.00	29.91	-16.09
440.00	16.28	H	1.0	16.56	3.27	46.00	36.11	-9.89
704.10	10.45	H	1.0	20.79	4.16	46.00	35.40	-10.60
764.60	5.25	H	1.0	21.81	4.32	46.00	31.39	-14.61
Remark	H : Horizontal, V : Vertical TEST MODE : 5.8 GHz -CH12 (5735 MHz) *Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position) *CL = Cable Loss(In case of below 1000 MHz) *Result Value = Reading + Ant Factor + Cable loss *The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz.							

10.5-1 Test Data for Wi-Fi Binary CDMA 5.8 GHz

Test Date 13-Jan-14

Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction(dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
5460.0	44.20	H	1.1	32.10	-22.79	0.00	74.00	53.51	-20.49
5460.0	44.30	V	1.2	32.10	-22.79	0.00	74.00	53.61	-20.39
5320.0	43.80	H	1.1	32.03	-22.99	0.00	74.00	52.84	-21.16
5320.0	44.34	V	1.0	32.03	-22.99	0.00	74.00	53.38	-20.62
11470.0	44.34	H	1.1	39.98	-16.26	0.00	74.00	68.06	-5.94
11470.0	43.29	V	1.0	39.98	-16.26	0.00	74.00	67.01	-6.99
AV(RBW: 1 MHz VBW: 3 MHz)									
5460.0	33.21	H	1.1	32.10	-22.79	0.00	54.00	42.52	-11.48
5460.0	33.12	V	1.2	32.10	-22.79	0.00	54.00	42.43	-11.57
5320.0	32.90	H	1.1	32.03	-22.99	0.00	54.00	41.94	-12.06
5320.0	32.91	V	1.0	32.03	-22.99	0.00	54.00	41.95	-12.05
11470.0	23.56	H	1.1	39.98	-16.26	0.00	54.00	47.28	-6.72
11470.0	23.11	V	1.0	39.98	-16.26	0.00	54.00	46.83	-7.17
Remark	H : Horizontal, V : Vertical TEST MODE : 5.8 GHz -CH12 (5735 MHz)								
	*The TX signal wasn't detected from 3th harmonics.								
	*Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position)								
	*Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction								

10.5-2 Test Data for Wi-Fi Binary CDMA 5.8 GHz

Test Date 13-Jan-14

Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction(dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
11566.0	43.21	V	1.0	39.86	-16.17	0.00	74.00	66.89	-7.11
11566.0	42.65	H	1.1	39.86	-16.17	0.00	74.00	66.33	-7.67
AV(RBW: 1 MHz VBW: 3 MHz)									
11566.0	23.55	V	1.0	39.86	-16.17	0.00	54.00	47.23	-6.77
11566.0	22.95	H	1.1	39.86	-16.17	0.00	54.00	46.63	-7.37
Remark	H : Horizontal, V : Vertical TEST MODE : 5.8 GHz-CH15 (5783. MHz)								
	*The TX signal wasn't detected from 3th harmonics.								
	*Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position)								
	*Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction								

10.5-3 Test Data for Wi-Fi Binary CDMA 5.8 GHz

Test Date 13-Jan-14

Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction(dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
11630.0	42.11	H	1.1	39.77	-16.04	0.00	74.00	65.84	-8.16
11630.0	42.65	V	1.0	39.77	-16.04	0.00	74.00	66.38	-7.62
AV(RBW: 1 MHz VBW: 3 MHz)									
11630.0	23.56	H	1.1	39.77	-16.04	0.00	54.00	47.29	-6.71
11630.0	22.65	V	1.0	39.77	-16.04	0.00	54.00	46.38	-7.62
Remark	H : Horizontal, V : Vertical TEST MODE : 5.8 GHz -CH17(5815 MHz)								
	*The TX signal wasn't detected from 3th harmonics.								
	*Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position)								
	*Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction								

11. Measurement of conducted disturbance

The continuous disturbance voltage of AC Mains in the frequency from 0.15 MHz to 30 MHz was measured in accordance to FCC PART 15.207 & IC RSS-Gen 7.2.2. The test setup was made according to ANSI C 63.4 (2009) in a shielded room. The EUT was placed on a non-conductive table at least 0.8 m above the ground plan. A grounded vertical reference plane was positioned in a distance of 0.4 m from the EUT. The distance from the EUT to other metal surfaces was at least 0.8 m. The EUT was only earthen by its power cord through the line impedance stabilizing network. The power cord has been bundled to a length of 1.0 m. The test receiver with Quasi Peak detector complies with CISPR 16.

11.1 Measurement equipments

Equipment Name	Type	Manufacturer	Serial No.	Next Calibration date
EMI TEST Receiver	ESPI	Rohde & Schwarz	100005	13-Jan-15
LISN	ENV216	Rohde & Schwarz	101231	24-Aug-14
LISN	ESH3-Z5	Rohde & Schwarz	838979/010	13-Jan-15
Pulse Limiter	ESH3Z2	Rohde & Schwarz	NONE	13-Jan-15

11.2 Environmental Condition

Test Place : Shielded Room

Wireless 2.4 GHz Mode

Temperature (°C) : 21.9

Humidity (% R.H.) : 47.9 % R.H.

Wireless 5..8 GHz Mode

Temperature (°C) : 22.1

Humidity (% R.H.) : 48.9 % R.H.

11.3 Test Data for Wi-Fi Binary CDMA 2.4 GHz

Test Date : 14-Jan-14

Frequency (MHz)	Correction Factor		Line (H/N)	Quasi-peak Value			Average Value		
	Lisn (dB)	Cable (dB)		Limit (dBμV)	Reading (dBμV)	Result (dBμV)	Limit (dBμV)	Reading (dBμV)	Result (dB)
0.15	0.13	0.17	N	66.00	43.53	43.83	56.00	21.18	21.48
0.17	0.13	0.17	N	64.91	44.10	44.40	54.91	28.90	29.20
0.21	0.13	0.16	N	63.21	37.42	37.71	53.21	22.55	22.84
0.24	0.13	0.16	H	61.99	48.15	30.99	51.99	15.18	15.47
4.15	0.18	0.36	H	56.00	22.89	23.43	46.00	10.69	11.23
5.31	0.20	0.33	H	60.00	25.30	25.83	50.00	13.66	14.19
24.16	0.78	0.47	N	60.00	20.95	22.20	50.00	14.90	16.15
Remark	TEST MODE : 2.4 GHz - CH 2(2442 MHz) H : Hot Line, N : Neutral Line *Correction Factor = Lisn + Cable *Result = Correction Factor + Reading								

11.4 Test Data for Wi-Fi Binary CDMA 5.8 GHz

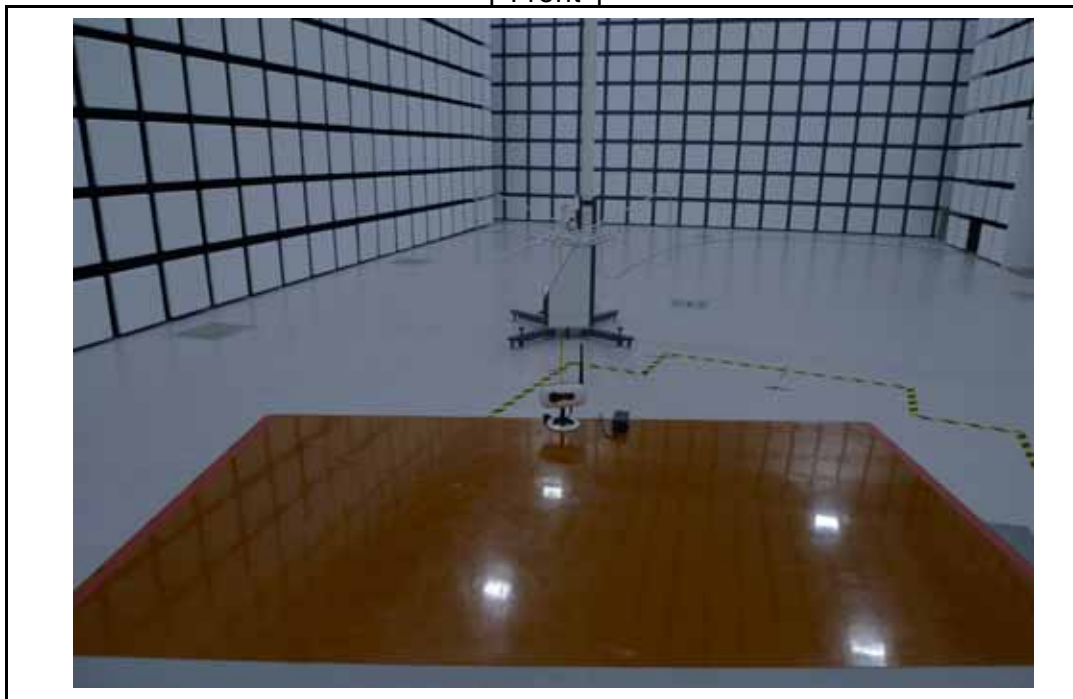
Test Date : 14-Jan-14

Frequency (MHz)	Correction Factor		Line (H/N)	Quasi-peak Value			Average Value		
	Lisn (dB)	Cable (dB)		Limit (dBμV)	Reading (dBμV)	Result (dBμV)	Limit (dBμV)	Reading (dBμV)	Result (dB)
0.15	0.13	0.17	N	66.00	47.81	48.11	56.00	22.78	23.08
0.17	0.13	0.17	H	64.77	45.53	45.83	54.77	29.12	29.42
0.25	0.13	0.16	N	61.89	32.07	32.36	51.89	14.97	15.26
4.06	0.18	0.36	N	56.00	29.30	29.84	46.00	12.46	13.00
5.42	0.20	0.34	H	60.00	30.42	30.95	50.00	15.78	16.31
24.48	0.79	0.48	N	60.00	26.38	27.65	50.00	15.85	17.12
Remark	TEST MODE : 5.8 GHz-CH15 (5783 MHz) H : Hot Line, N : Neutral Line *Correction Factor = Lisn + Cable *Result = Correction Factor + Reading								

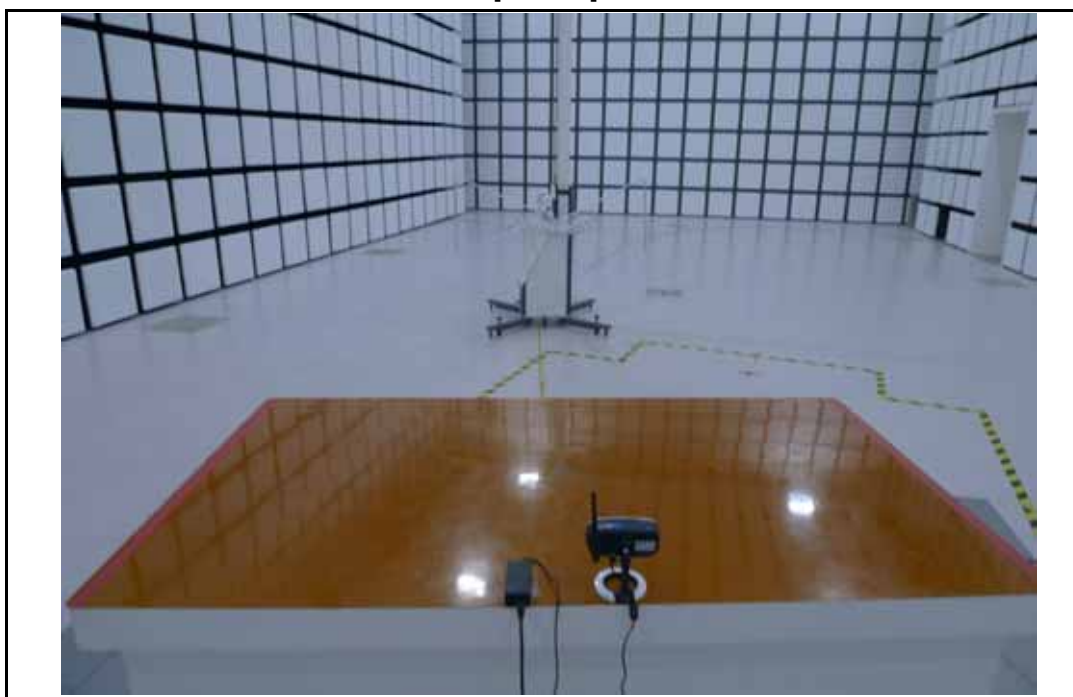
12. Photographs of test setup

12.1. Setup for Radiated Test : (30 ~ 1 000) MHz

[Front]

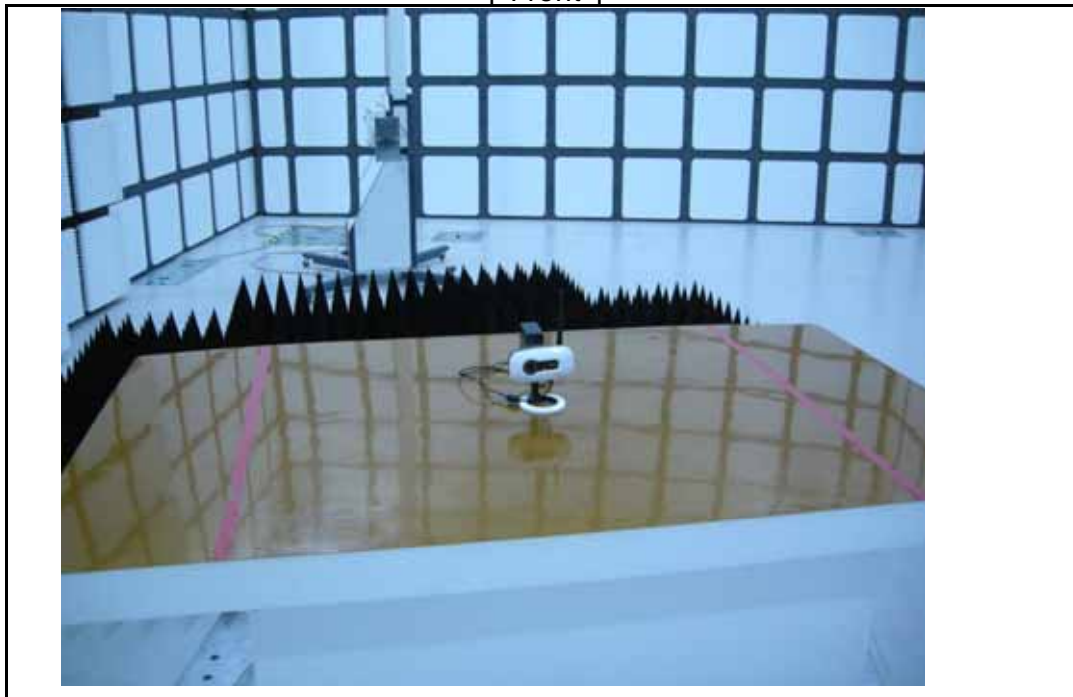


[Rear]

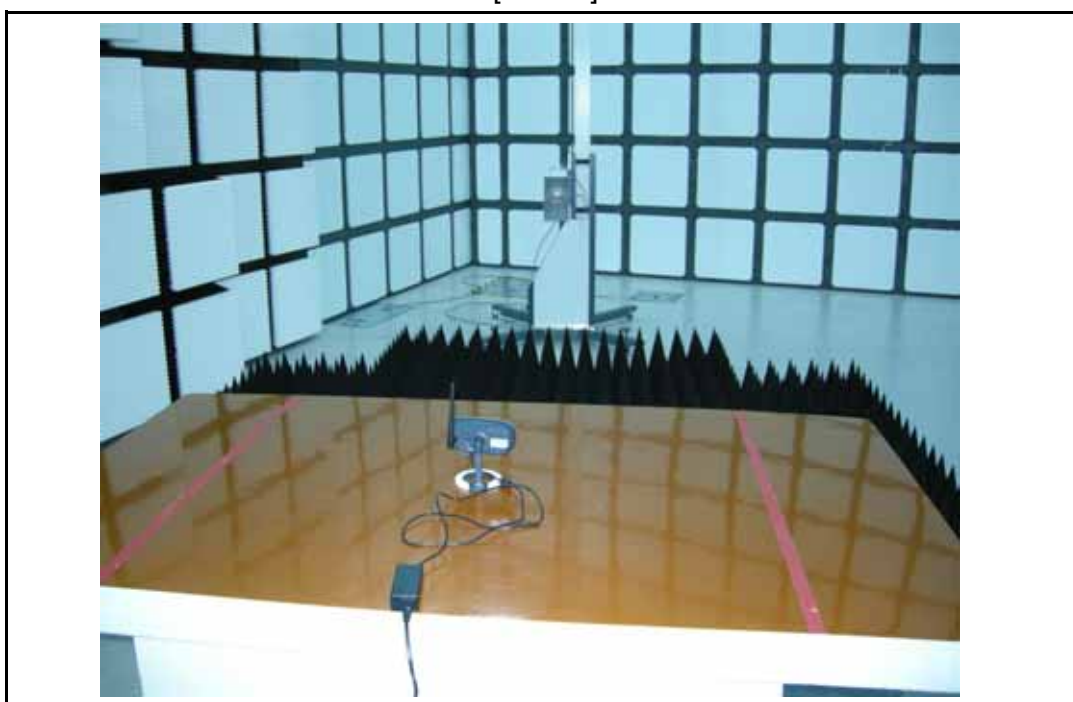


12.2. Setup for Radiated Test : Above 1 GHz

[Front]



[Rear]



12.3. Setup for Conducted Test : (0.15 ~ 30) MHz

[Front]



[Rear]



12.4. Photographs of EUT

[Front]



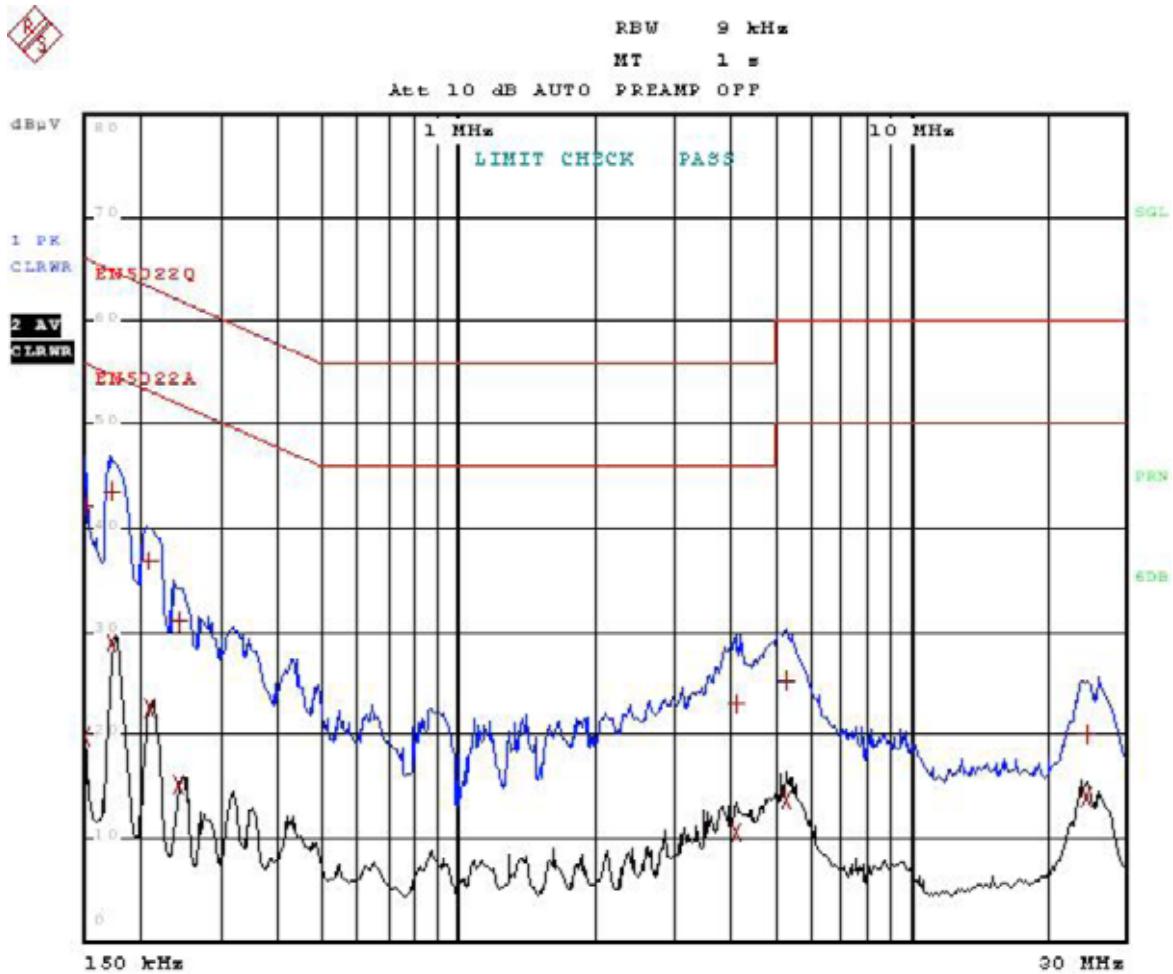
[Rear]



Appendix 1. Special diagram for Wireless LAN

2.4 GHz 2CH

*HOT



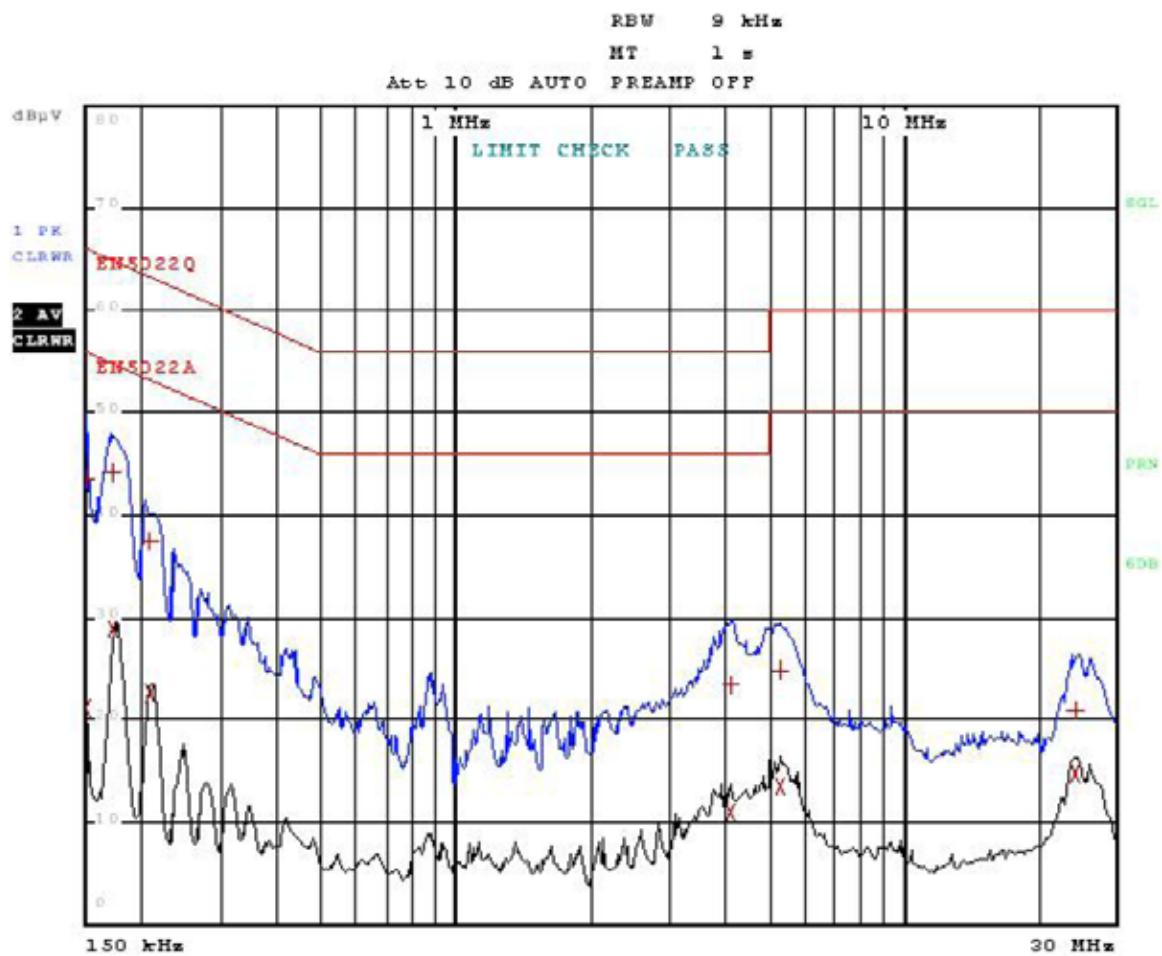
Comment: BHA-WC100 2.4 GHz HOT

Date: 14.JAN.2014 11:58:41

Special diagram for Wireless LAN

2.4 GHz 2CH

*NEUTRAL

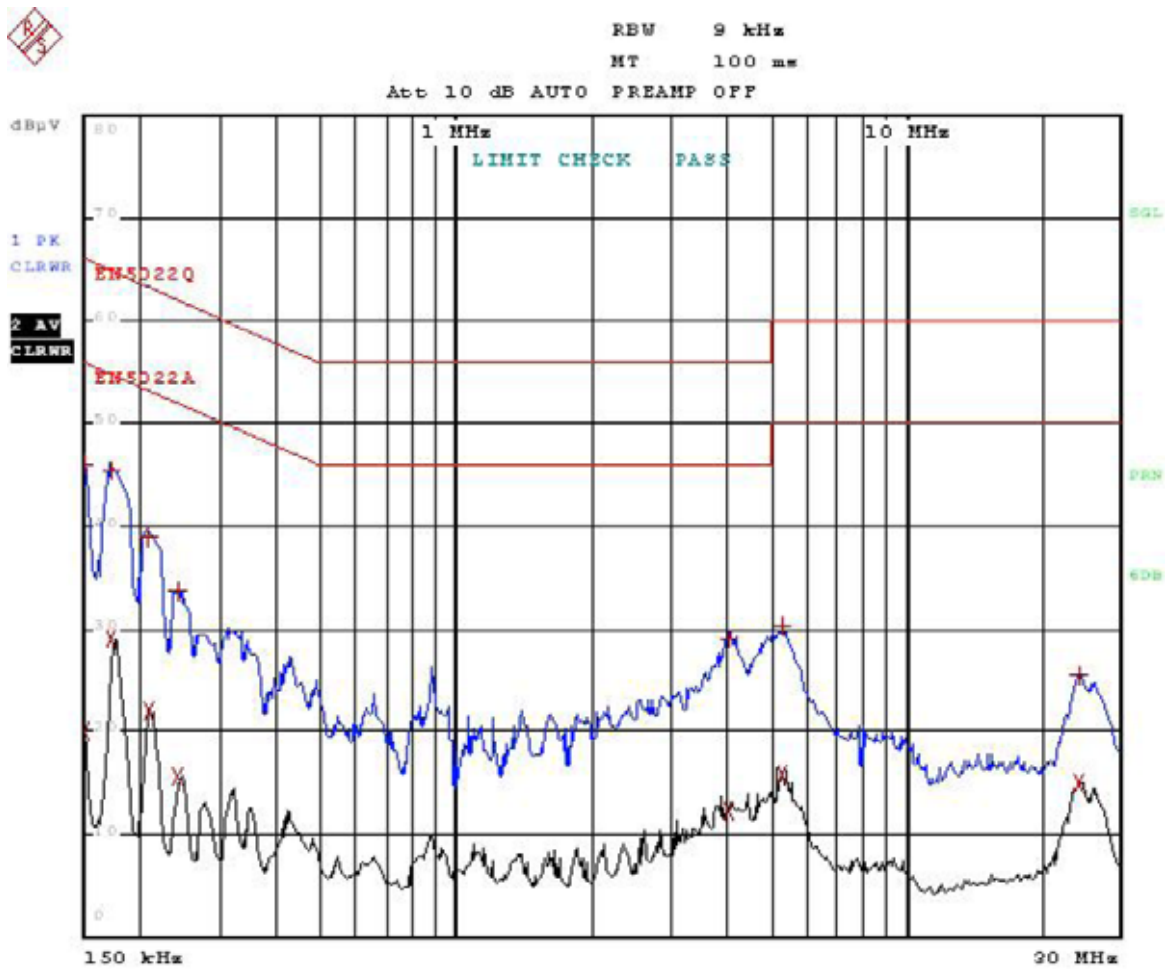


Comment: BHA-WC100 2.4 GHz NEUTRAL
Date: 14.JAN.2014 11:53:03

Special diagram for Wireless LAN

5.8 GHz cf 15CH

*HOT



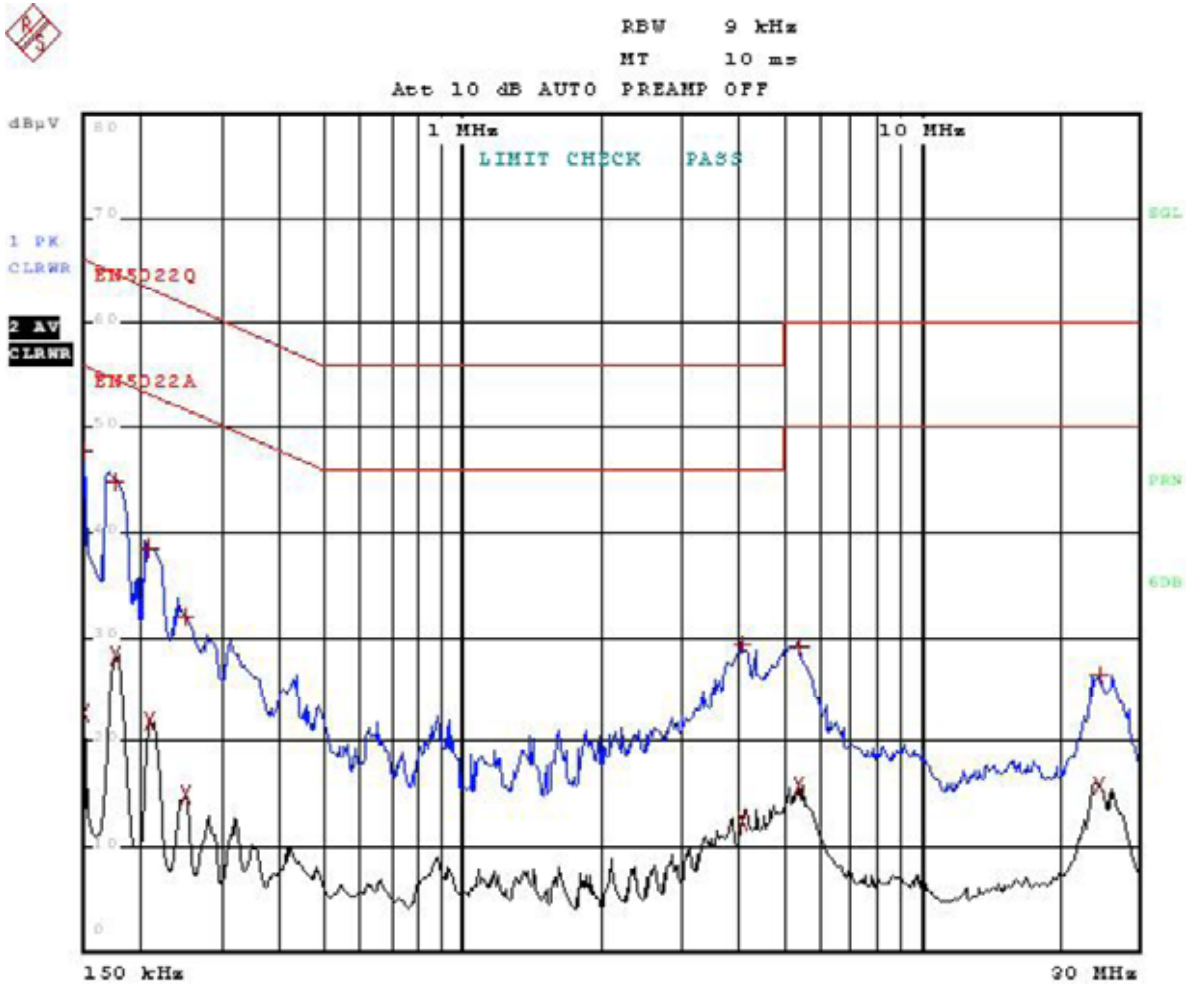
Comment: BHA-WC100 5.8 GHz HOT

Date: 15.JAN.2014 12:03:31

Special diagram for Wireless LAN

5.8 GHz 15 CH

*NEUTRAL



Comment: BHA-WC100 5.8 GHz NEUTRAL

Date: 15.JAN.2014 12:07:58

Appendix 2. Antenna Requirement

1. Antenna Requirement

1.1 Standard Applicable

Antenna restrictions

The transmitter must be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device (section 15.203). Either the antenna must be integrated, permanently attached, or a unique connector must be used. The connector could be a reverse

This device has been tested with Reverse Polarity SMA connectors with the antennas.

1.2 Antenna Connected Construction

The antenna types used in this product are Dipole Antenna . The maximum Gain of this antenna of 2.4 GHz is 3.21 dBi and 5 GHz is 2.5 dBi.