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Dates of Tests: Mar 09 ~19, 2012
Test Report S/N: LR500111203E
Test Site : LTA CO., LTD.

CERTIFICATION OF COMPLIANCE

FCC ID.

AZXHDK-2000

APPLICANT

COREWILL CO., LTD.

Equipment Class	:	Part 15 Spread Spectrum Transmitter (DSS)
Manufacturing Description	:	HD Karaoke System (Main Station)
Manufacturer	:	COREWILL CO., LTD.
Model name	:	HDK-2000
Test Device Serial No.:	:	Identical prototype
Rule Part(s)	:	FCC Part 15.247 Subpart C; ANSI C-63.4-2003
Frequency Range	:	2402 ~ 2478MHz
RF power	:	11.49 dBm - Conducted
Data of issue	:	Mar 20, 2012

This test report is issued under the authority of:

Kyu-Hyun Lee, Manager

The test was supervised by:

Ki-Hun Cho, Test Engineer

This test result only responds to the tested sample. It is not allowed to copy this report even partly without the allowance of the test laboratory. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.



NVLAP LAB Code.: 200723-0

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1. General information's

1-1 Test Performed

Company name : LTA Co., Ltd.
 Address : 243, Jubug-ri, Yangji-Myeon, Youngin-Si, Kyunggi-Do, Korea. 449-822
 Web site : <http://www.ltalab.com>
 E-mail : chahn@ltalab.com
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 Facsimile : +82-31-323-6010

Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the “General requirements for the competents of calibration and testing laboratory”.

1-2 Accredited agencies

LTA Co., Ltd. is approved to perform EMC testing by the following agencies:

Agency	Country	Accreditation No.	Validity	Reference
NVLAP	U.S.A	200723-0	2012-09-30	ECT accredited Lab.
RRL	KOREA	KR0049	2013-04-24	EMC accredited Lab.
FCC	U.S.A	610755	2014-04-27	FCC filing
FCC	U.S.A	649054	2013-04-13	FCC CAB
VCCI	JAPAN	R2133(10m), C2307	2014-06-21	VCCI registration
VCCI	JAPAN	T-2009	2013-12-23	VCCI registration
IC	CANADA	IC5799	2012-05-14	IC filing

2. Information's about test item

2-1 Client & Manufacturer

Company name : COREWILL CO., LTD.
 Address : 602, London Bldg, 1484-1, Sillim-dong, Gwanak-gu,
 Seoul, 151-894, Korea.
 Tel / Fax : +82-2-863-0155 / +82-2-863-0154

2-2 Equipment Under Test (EUT)

Trade name : HD Karaoke System (Main Station)
 FCC ID : AZXHDK-2000
 Model name : HDK-2000
 Serial number : Identical prototype
 Date of receipt : Mar 5, 2012
 EUT condition : Pre-production, not damaged
 Antenna type : Dipole Antenna Max Gain 3.29 dBi (M/N: AN2400-5320BO)
 Frequency Range : 2402 ~ 2478MHz
 RF output power : Max. 11.49dBm - Conducted
 Number of channels : 16
 Channel spacing : 5MHz
 Channel Access Protocol : Frequency Hopping
 Type of Modulation : GFSK
 Power Source : 9Vdc (by AC/DC Adaptor: M/N : PS18K1901600U5)
 Firmware version : V1.0.0

2-3 Tested frequency

	LOW	MID	HIGH
Frequency (MHz)	2402	2440	2478

2-4 Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer
-	-	-	-

3. Test Report

3.1 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
15.247(a)	Carrier Frequency Separation	> 25 kHz	Conducted	C
15.247(a)	Number of Hopping Frequencies	> 15 hops		C
15.247(a)	20 dB Bandwidth	> 1.5 MHz		C
15.247	Dwell Time	< 0.4 seconds		C
15.247(b)	Transmitter Output Power	< 250 mWatt		C
15.247(d)	Conducted Spurious emission	> 20 dBc		C
15.247(d)	Band Edge	> 20 dBc		C
15.249 / 15.209	Field Strength of Harmonics	< 54 dBuV (at 3m)	Radiated	C
15.109	Field Strength	-		C
15.207 / 15.107	AC Conducted Emissions	EN 55022	Line Conducted	C
15.203	Antenna requirement	-	-	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: The data in this test report are traceable to the national or international standards.

→ Antenna Requirement

The COREWILL CO., LTD. FCC ID: AZXHDK-2000 unit complies with the requirement of §15.203. The antenna is connected to inside of EUT. And type is Dipole antenna.

The sample was tested according to the following specification:

FCC Parts 15.247, ANSI C-63.4-2003

3.2 Transmitter requirements

3.2.1 Carrier Frequency Separation

Procedure:

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to:

Span = 15 MHz (wide enough to capture the peaks of two adjacent channels)

RBW = 30 kHz

Sweep = auto

VBW = 30 kHz

Detector function = peak

Trace = max hold

Measurement Data:

Test Results	
Carrier Frequency Separation (MHz)	Result
4.993	Complies

- See next pages for actual measured spectrum plots.

Minimum Standard:

The EUT shall have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of 20dB bandwidth of the hopping channel, whichever is greater.

Measurement Setup

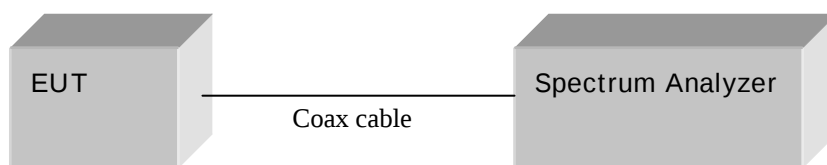
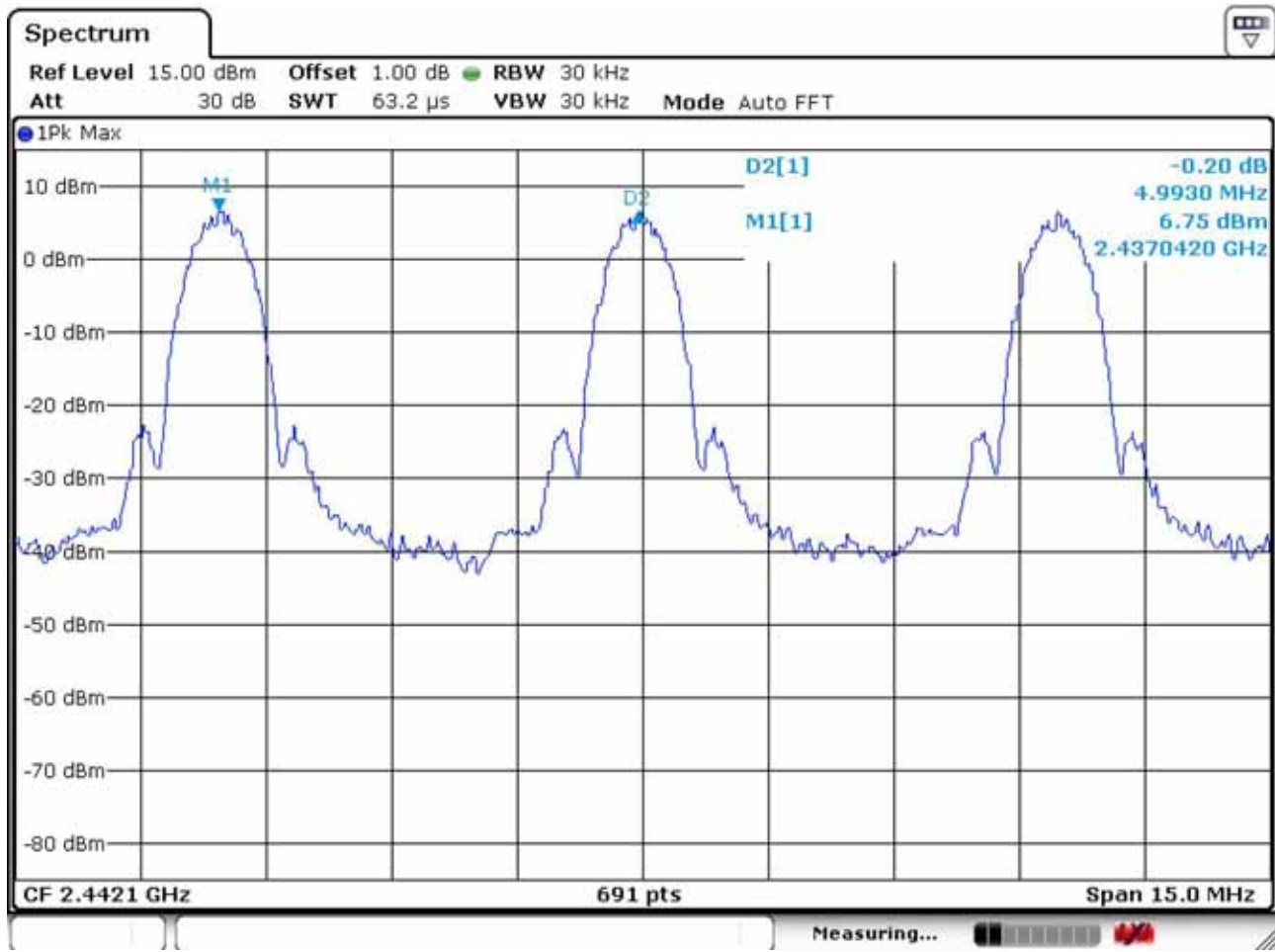
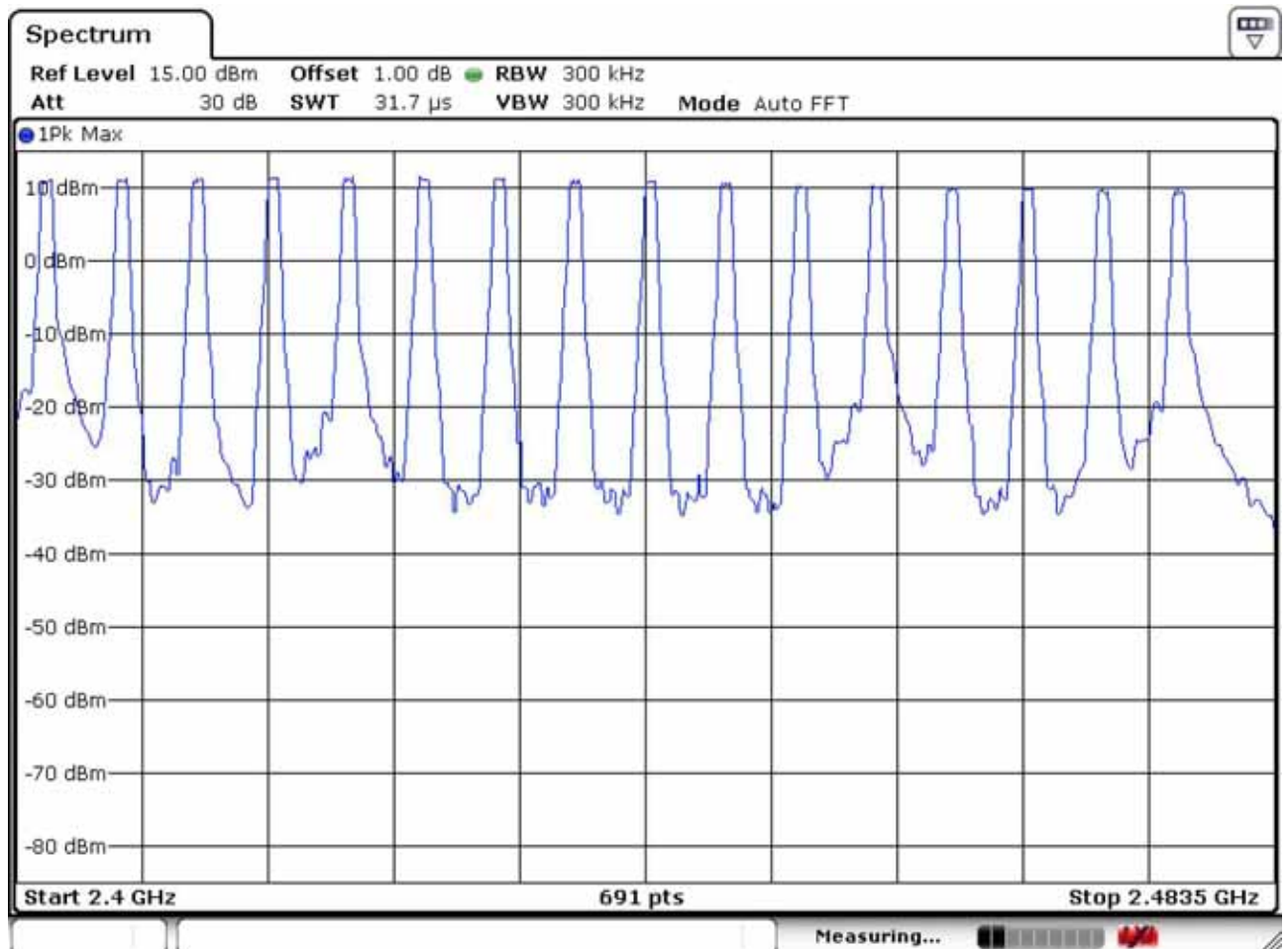


Figure 1: Measurement setup for the carrier frequency separation

Carrier Frequency Separation



Number of Hopping Frequencies



3.2.3 20 dB Bandwidth

Procedure:

The bandwidth at 20 dB below the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels..

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

Span = 5 MHz (approximately 2 or 3 times of the 20 dB bandwidth)

RBW = 30 kHz

Sweep = auto

VBW = 30 kHz (VBW $\geq$ RBW)

Detector function = peak

Trace = max hold

Measurement Data: Basic Mode

Frequency (MHz)	Channel No.	Test Results(MHz)
		20dB Bandwidth
2402	1	1.1867
2440	8	1.1650
2478	16	1.1722

- See next pages for actual measured spectrum plots.

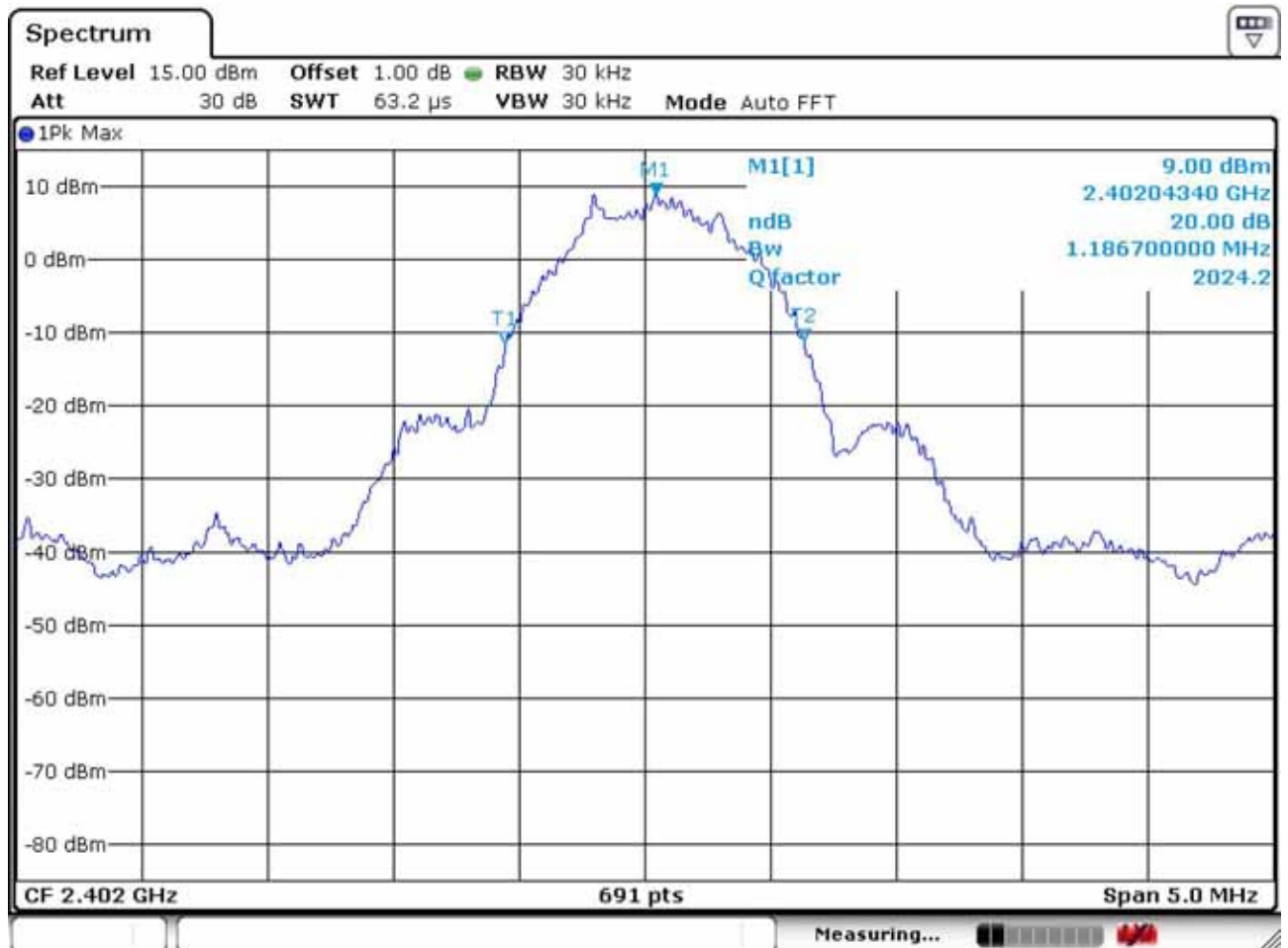
Minimum Standard:

N/A

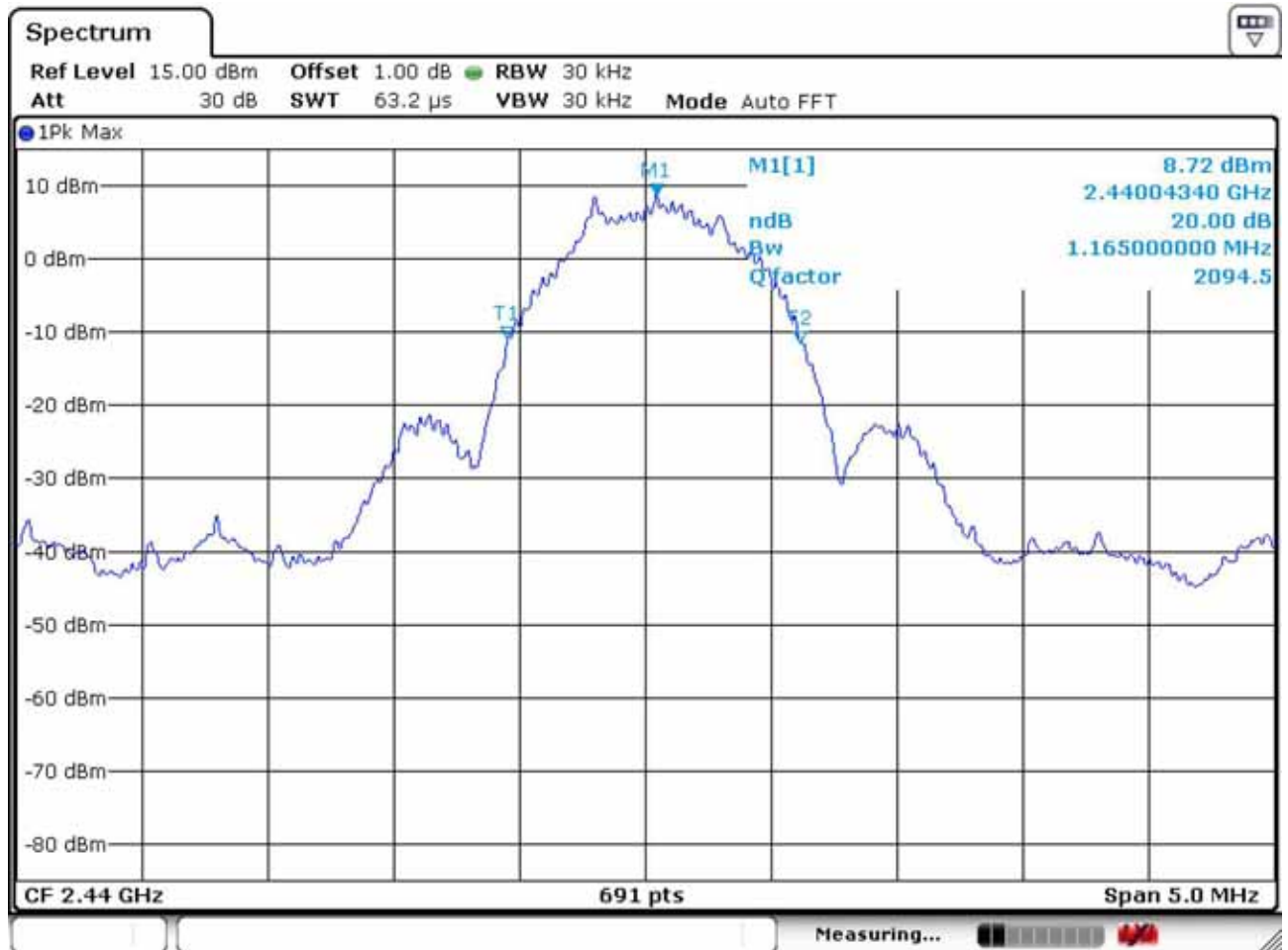
Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

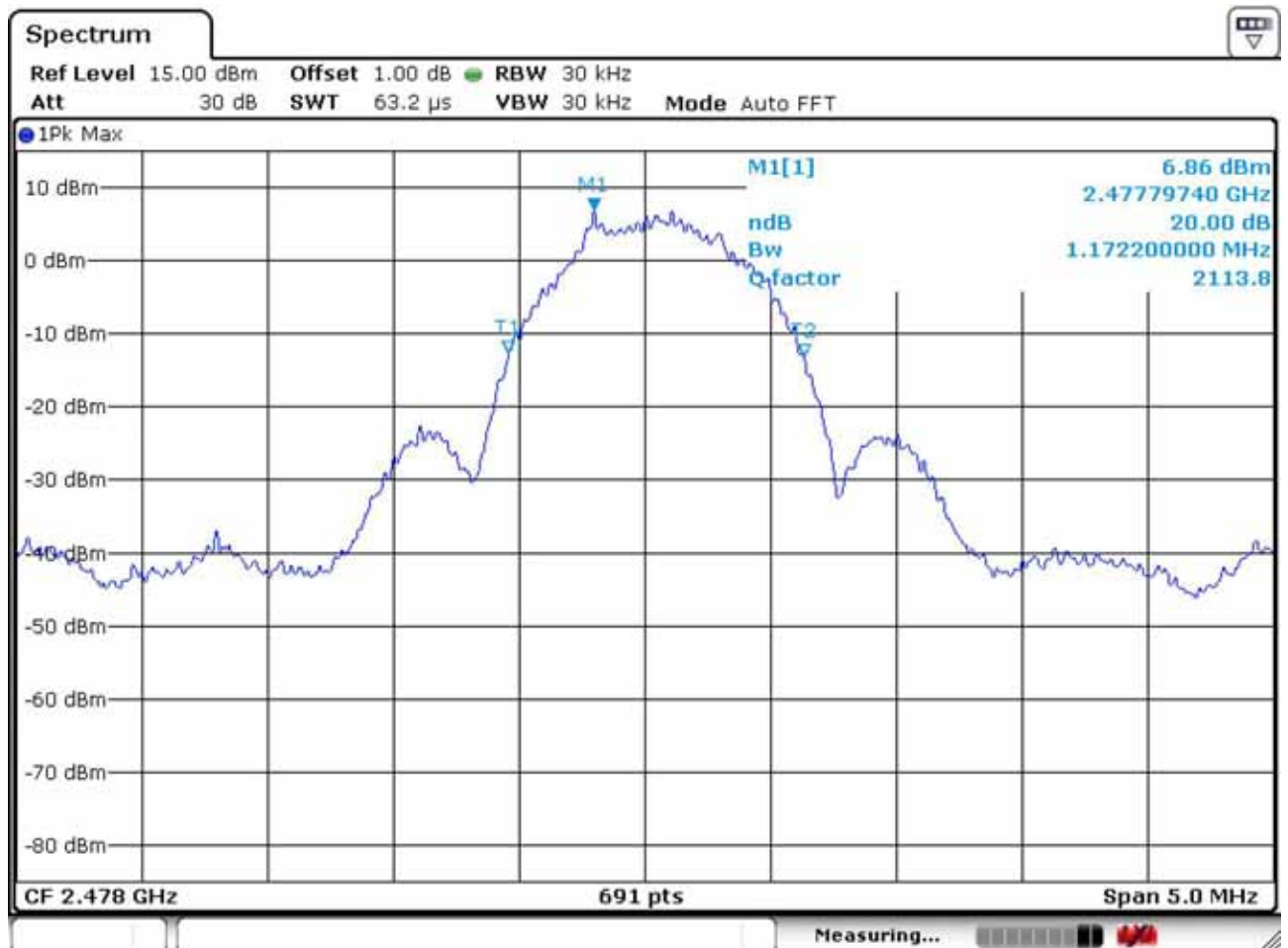
Channel 1
20 dB Bandwidth



Channel 8
20 dB Bandwidth



Channel 16
20 dB Bandwidth



3.2.4 Time of Occupancy (Dwell Time)

Procedure:

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to:

Center frequency = 2438 MHz

Span = zero

RBW = 1 MHz

VBW = 1 MHz (VBW $\geq$ RBW)

Trace = Single Sweep

Detector function = peak

Measurement Data:

Number of transmission in 6.4s (16Hopping*0.4)	Length of Transmission Time (msec)	Result (msec)	Limit (msec)
(Times/6.4sec) = 161	0.518	83.398	400

- See next pages for actual measured spectrum plots.
- dwell time = {(number of hopping per second / number of slot) x duration time per channel} x 0.4 ms

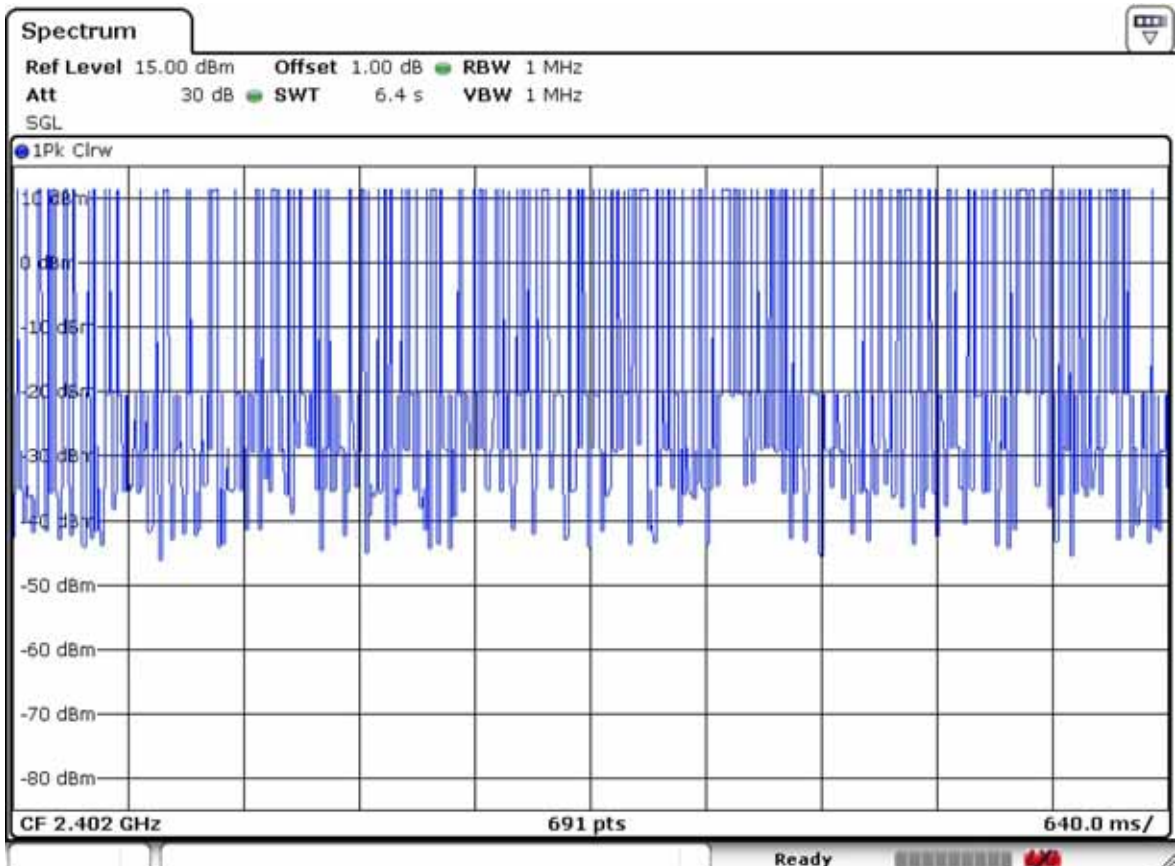
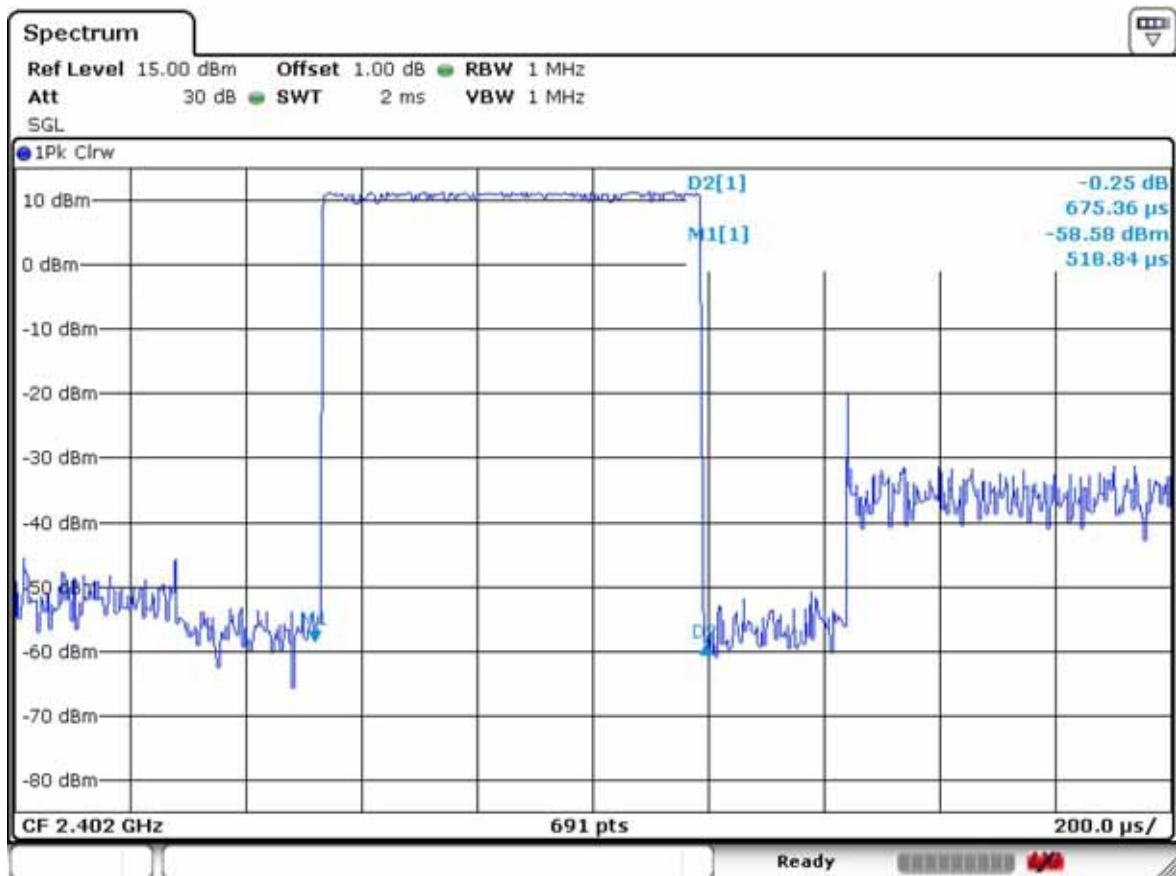
Minimum Standard:

0.4 seconds within a 30 second period per any frequency

Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

Time of Occupancy for PACKET



3.2.5 Transmitter Output Power

Procedure:

The peak output power was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels..

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

Span = 10 MHz (approximately 5 times of the 20 dB bandwidth)

RBW = 3 MHz (greater than the 20dB bandwidth of the emission being measured)

VBW = 3 MHz (VBW $\geq$ RBW)

Detector function = peak

Trace = max hold

Sweep = auto

Measurement Data

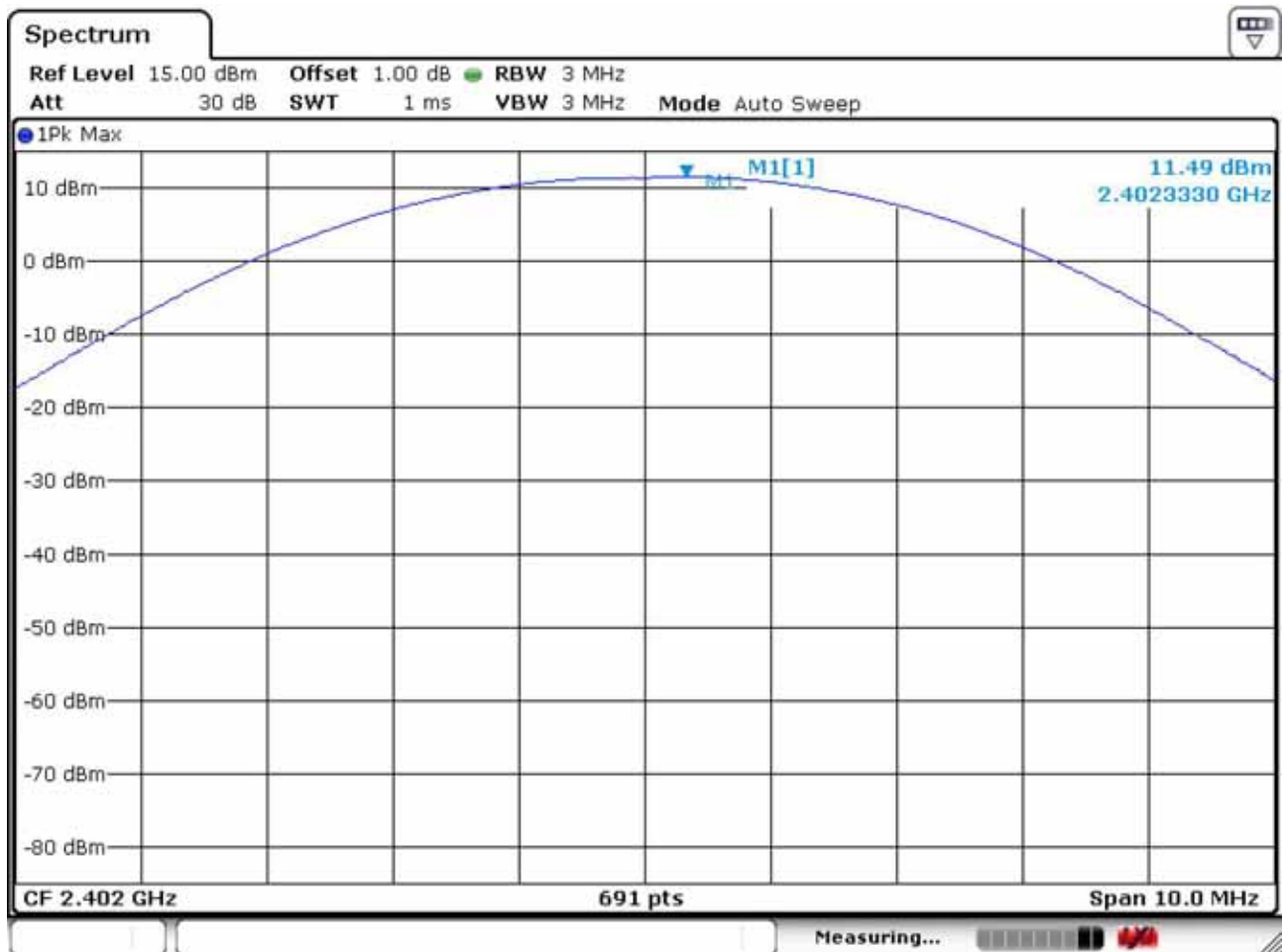
Frequency (MHz)	Ch.	Test Results		
		dBm	mW	Result
2402	1	11.49	14.09	Complies
2440	8	11.20	13.18	Complies
2478	16	9.94	9.86	Complies

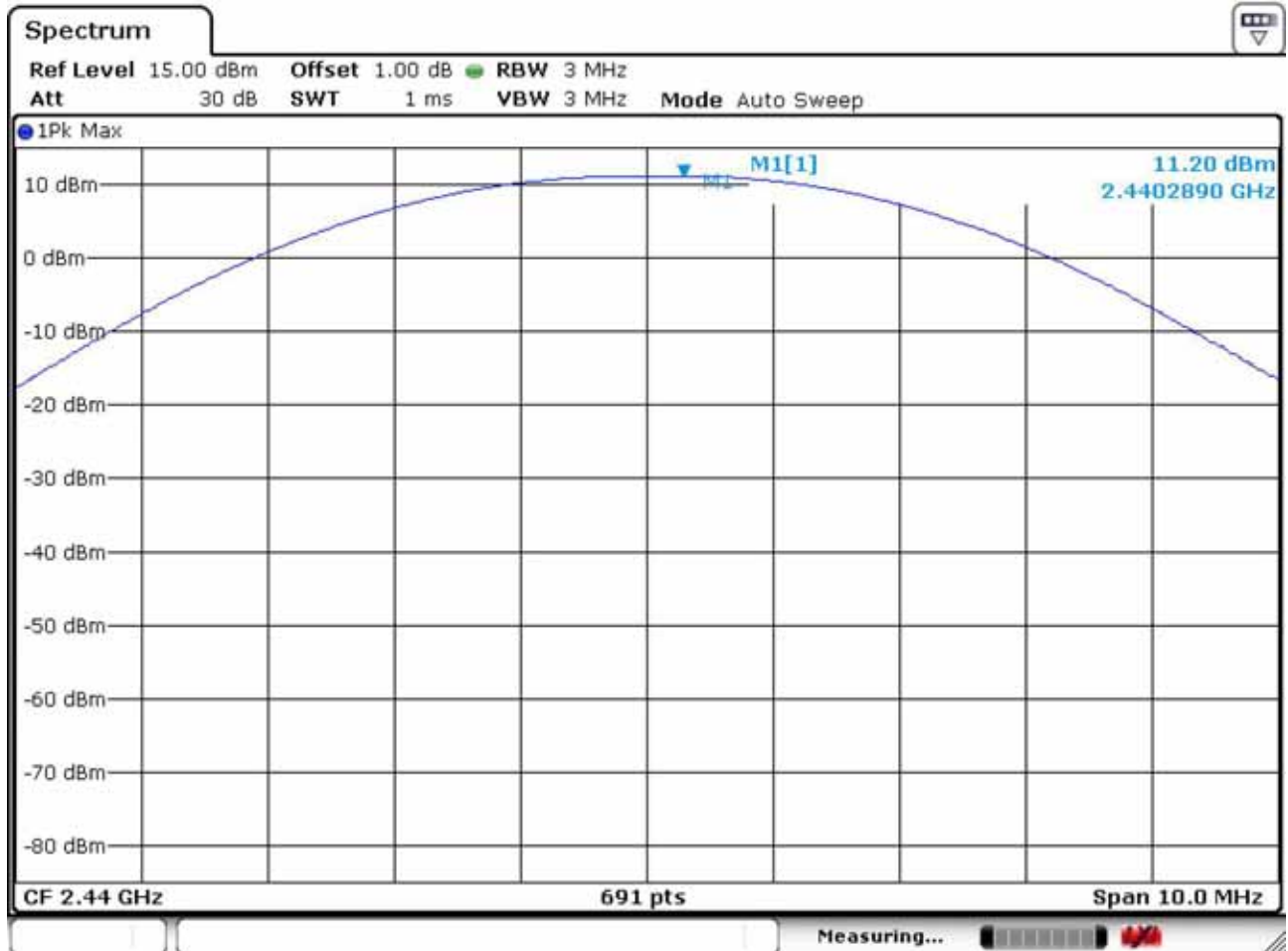
- See next pages for actual measured spectrum plots.

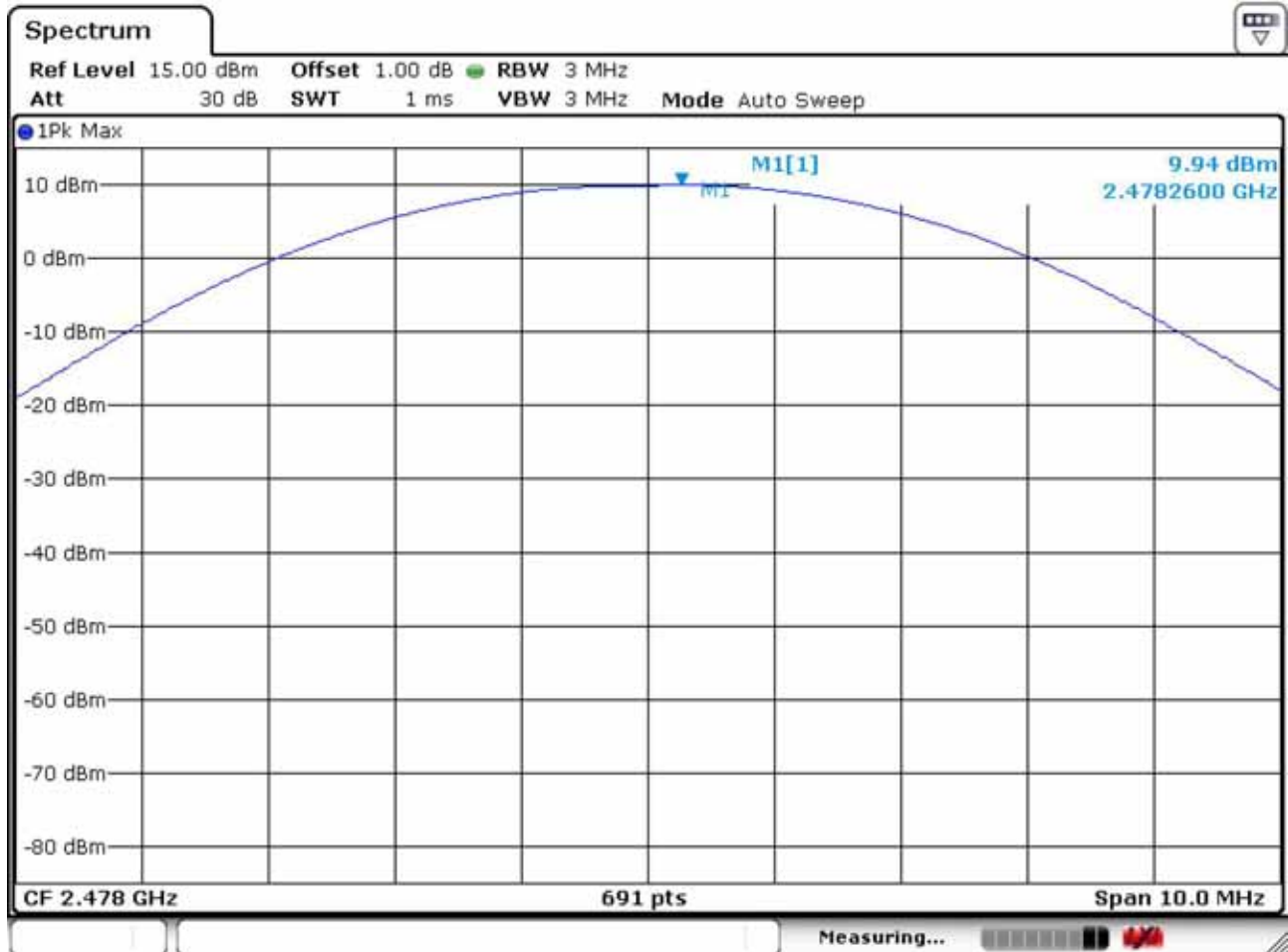
Minimum Standard:	< 250 mW
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Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

Channel 1

Channel 8

Channel 16

3.2.6 Band Edge

Procedure:

The bandwidth at 20dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels.

After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz

VBW = 100 kHz

Span = 20 MHz

Detector function = peak

Trace = max hold

Sweep = auto

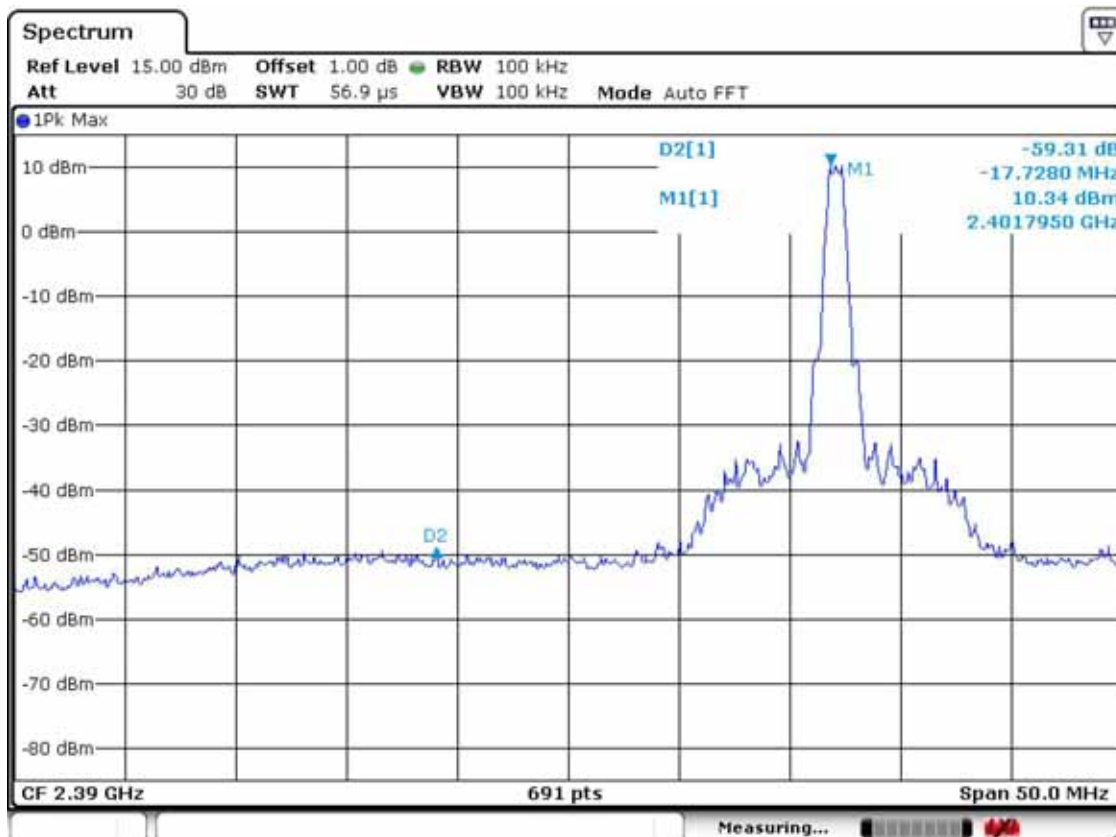
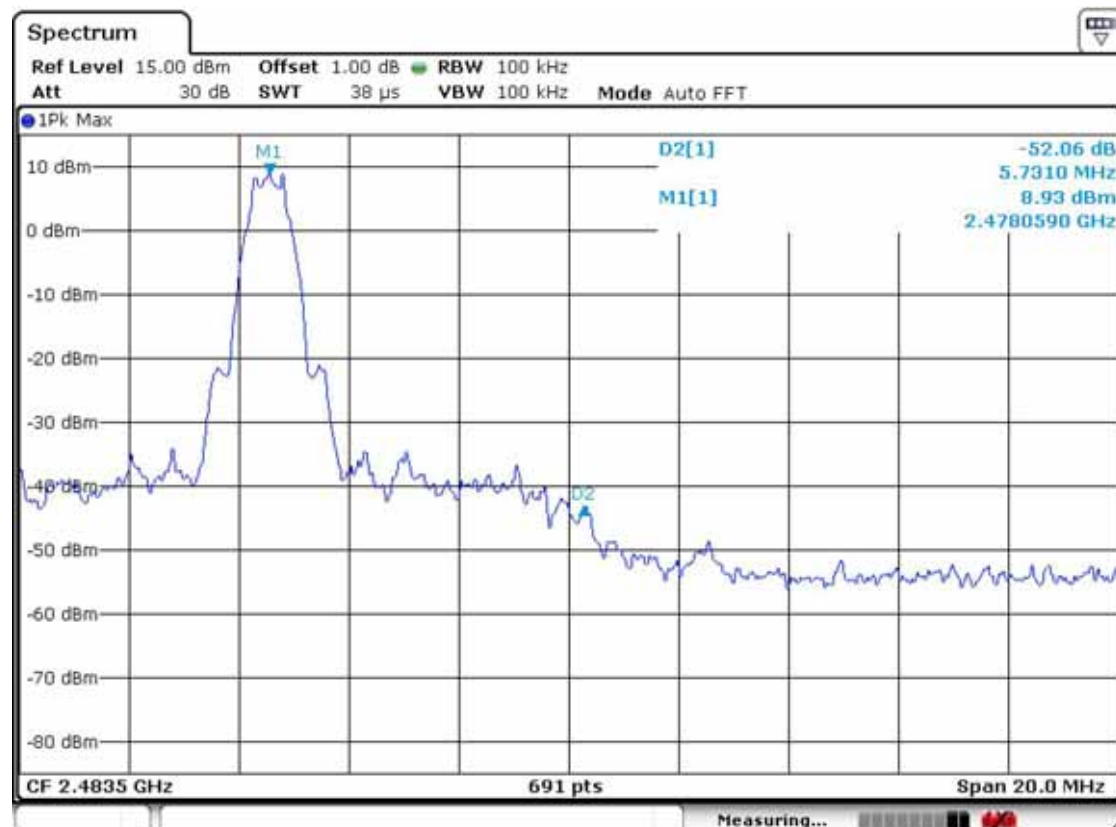
Measurement Data: Complies

- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.
- See next pages for actual measured spectrum plots.

Minimum Standard:	> 20 dBc
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Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

Band – edge of Basic Mode**Lower edge****Upper edge**

Band-edges in the restricted band 2310-2390 MHz measurement

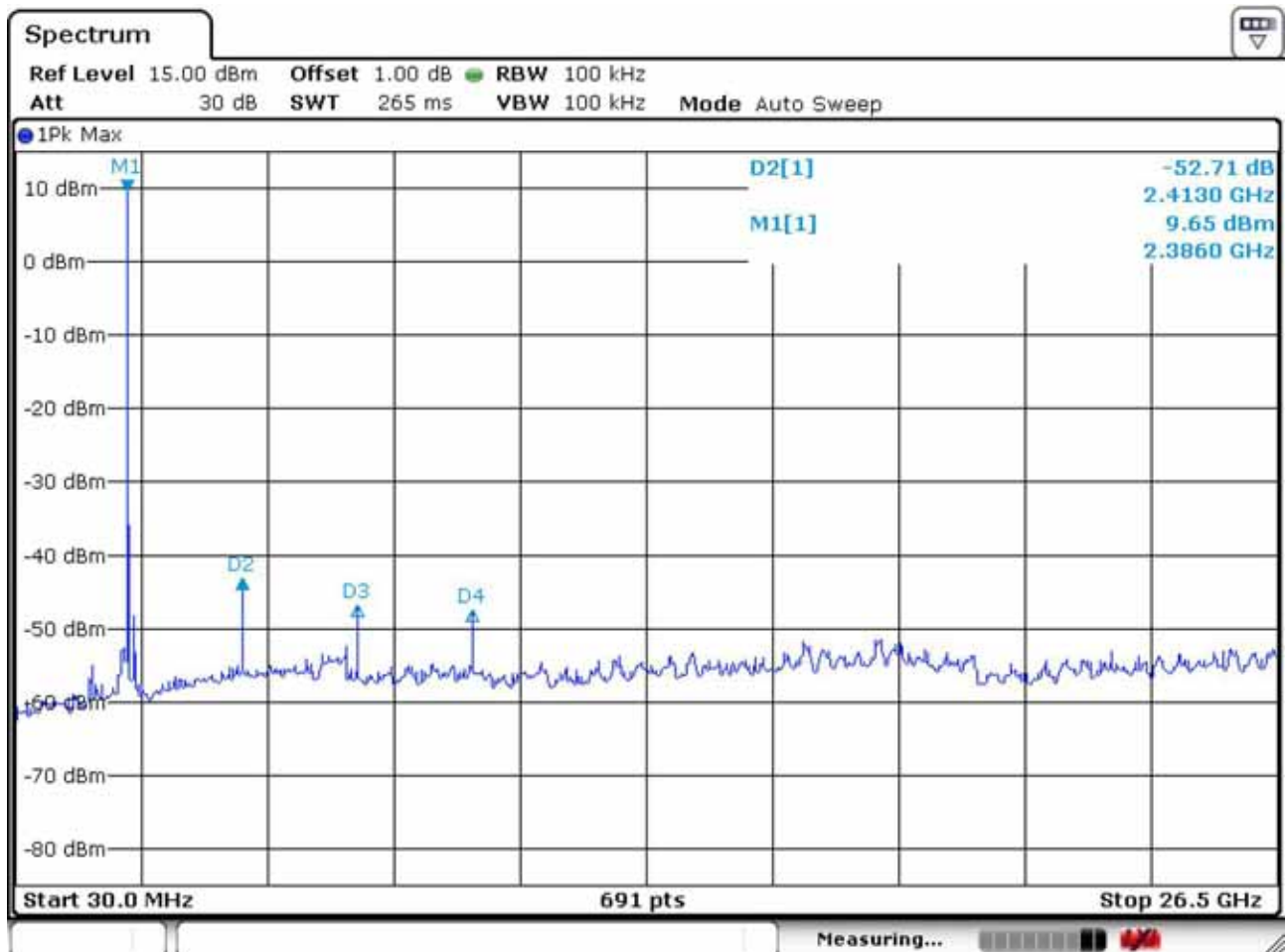
Frequency	Reading		Pol.	Correction			Limits		Result		Margin	
	[dBuV / m]			Factor			[dBuV / m]		[dBuV / m]		[dB]	
[MHz]	AV / Peak			Antenna	Amp. Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
2390.0	39.0	51.8	V	25.4	37.1	4.0	54.0	74.0	31.3	44.1	22.7	30.0

Band-edges in the restricted band 2483.5-2500 MHz measurement

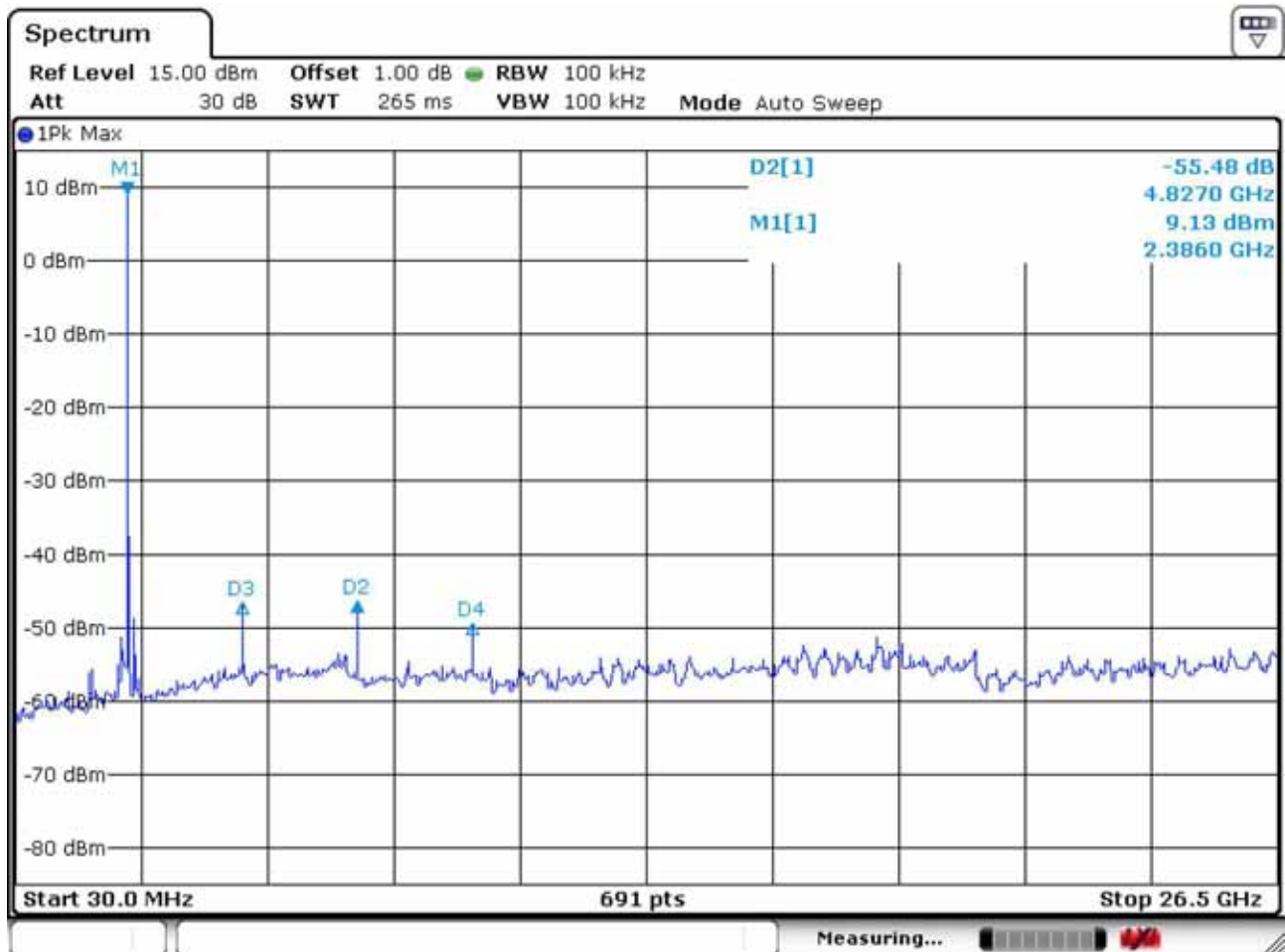
Frequency	Reading		Pol.	Correction			Limits		Result		Margin	
	[dBuV / m]			Factor			[dBuV / m]		[dBuV / m]		[dB]	
[MHz]	AV / Peak			Antenna	Amp. Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
2484.1	34.1	46.4	V	25.4	37.1	4.0	54.0	74.0	26.4	38.7	27.7	35.3

Note : This EUT was tested in 3 orthogonal positions and the worst-case data was presented.

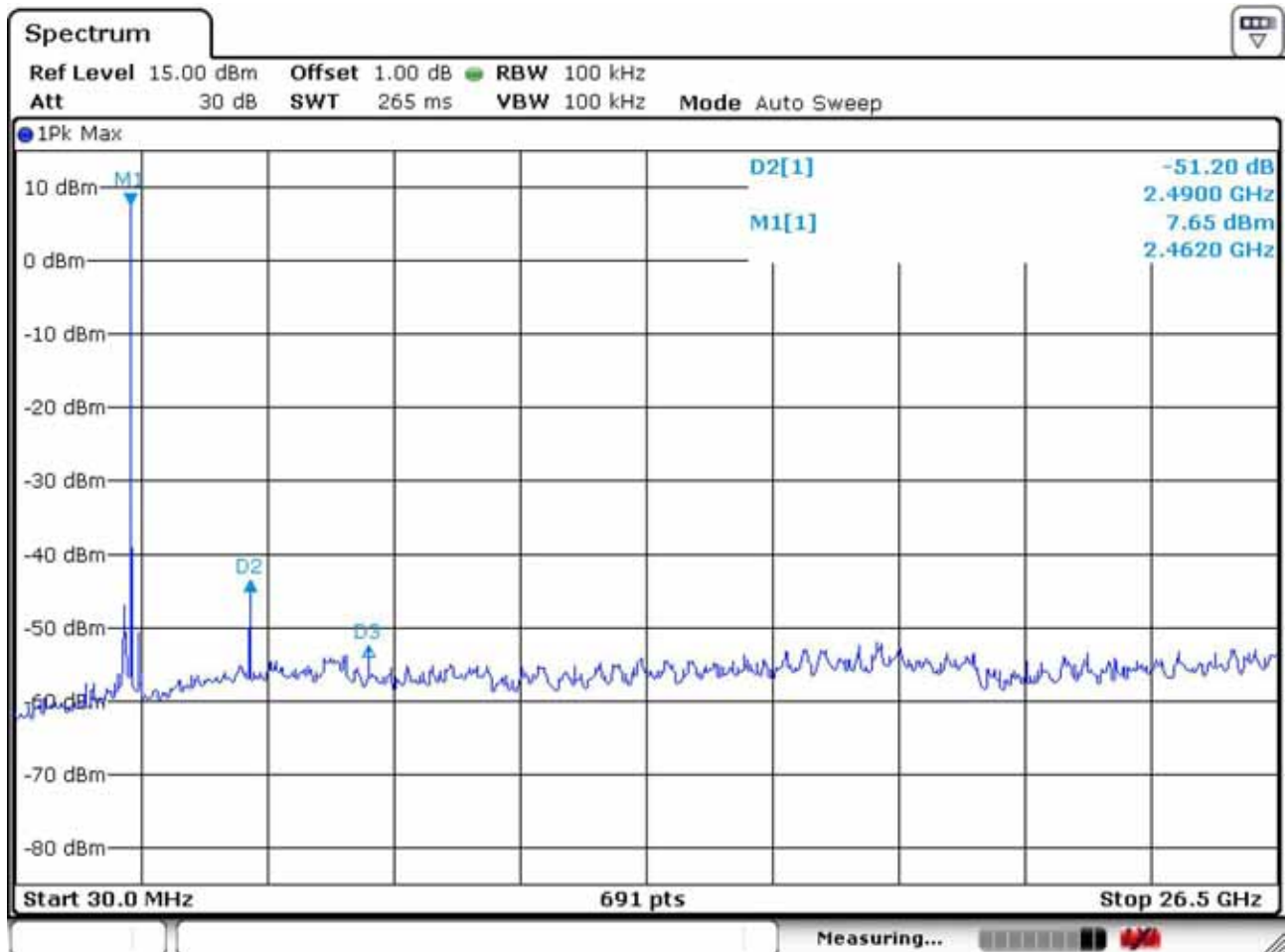
Unwanted Emission – Low channel
Frequency Range = 30 MHz ~ 26.5 GHz



Unwanted Emission – Middle channel
Frequency Range = 30 MHz ~ 26.5 GHz



Unwanted Emission – High channel
Frequency Range = 30 MHz ~ 26.5 GHz



3.2.7 Field Strength of Harmonics

Procedure:

The EUT was placed on a 0.8m high wooden table inside a shielded enclosure. An antenna was placed near the EUT and measurements of frequencies and amplitudes of field strengths were recorded for reference during final measurements. For final radiated testing, measurements were performed in OATS. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions.

The spectrum analyzer is set to:

Center frequency = the worst channel

Frequency Range = 30 MHz ~ 10th harmonic.

RBW = 100 kHz (30MHz ~ 1 GHz)

= 1 MHz (1 GHz ~ 10th harmonic)

Span = 100 MHz

Trace = max hold

Peak:VBW ≥ RBW

Average:VBW=10Hz

Detector function = Peak and Average

Sweep = auto

Measurement Data: Complies

- Refer to the next page.
- No other emissions were detected at a level greater than 20dB below limit include from 9KHz to 30MHz.
- The three antennas were used with this EUT during the Testing.
- The used antenna is “R-AN2400-1901RS” and it gave the worse case emissions.

Minimum Standard: FCC Part 15.209(a)

Frequency (MHz)	Limit (uV/m) @ 3m
0.009 ~ 0.490	2400/F(kHz) (@ 300m)
0.490 ~ 1.705	24000/F(kHz) (@ 30m)
1.705 ~ 30	30(@ 30m)
30 ~ 88	100 **
88 ~ 216	150 **
216 ~ 960	200 **
Above 960	500

** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88MHz, 174-216MHz or 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

Measurement Data:

Frequency		Reading		Pol.	Correction			Limits		Result		Margin	
		[dBuV / m]			Factor			[dBuV / m]		[dBuV / m]		[dB]	
[MHz]		AV / Peak			Antenna	Amp.Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
4803.0		34.4	46.4	V	31.4	36.5	5.7	54.0	74.0	35.1	47.1	18.9	26.9
-		-	-	-	-	-	-	-	-	-	-	-	-
-		-	-	-	-	-	-	-	-	-	-	-	-
-		-	-	-	-	-	-	-	-	-	-	-	-
Frequency		Reading		Pol.	Correction			Limits		Result		Margin	
		[dBuV / m]			Factor			[dBuV / m]		[dBuV / m]		[dB]	
[MHz]		AV / Peak			Antenna	Amp.Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
4880.0		33.8	45.6	V	31.4	36.5	5.7	54.0	74.0	34.4	46.3	19.6	27.7
-		-	-	-	-	-	-	-	-	-	-	-	-
-		-	-	-	-	-	-	-	-	-	-	-	-
-		-	-	-	-	-	-	-	-	-	-	-	-
Frequency		Reading		Pol.	Correction			Limits		Result		Margin	
		[dBuV / m]			Factor			[dBuV / m]		[dBuV / m]		[dB]	
[MHz]		AV / Peak			Antenna	Amp.Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
4956.0		35.1	47.0	V	31.4	36.5	5.7	54.0	74.0	35.8	47.7	18.2	26.3
-		-	-	-	-	-	-	-	-	-	-	-	-
-		-	-	-	-	-	-	-	-	-	-	-	-
-		-	-	-	-	-	-	-	-	-	-	-	-

No other emissions were detected at a level greater than 20dB below limit.

Radiated Emissions – Sync + Play mode

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Gyeonggi-do 449-822 Korea
Tel +82-31-3236008,9
Fax: +82-31-3236010

EUT/Model No.: HDK-2000

TEST MODE: Sync+Play mode

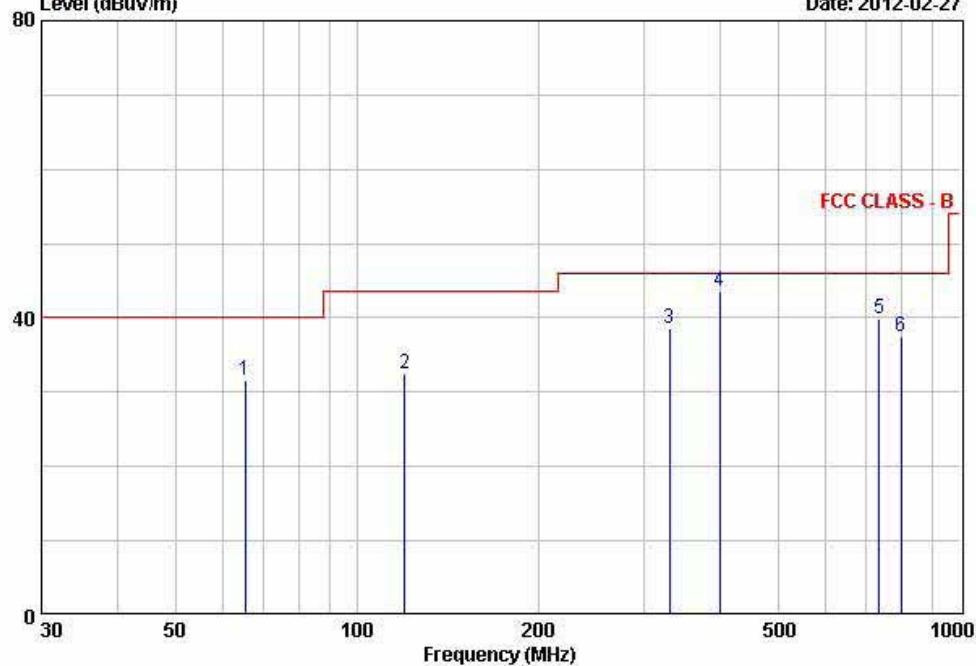
Temp Humi : 20 / 42

Tested by: PARK.H.W

Data: 15

Level (dBuV/m)

Date: 2012-02-27



	Freq	Reading	C.F	Result	Limit	Margin	Height	Angle	Polarity
	MHz	dBuV/m	dB/m	dBuV/m	QP dBuV/m	dB	cm	deg	
1	65.33	48.00	-16.49	31.51	40.00	8.49	100	254	VERTICAL
2	120.01	49.30	-16.72	32.58	43.50	10.92	286	250	HORIZONTAL
3	330.12	48.70	-10.09	38.61	46.00	7.39	296	14	HORIZONTAL
4	399.97	52.30	-8.73	43.57	46.00	2.43	285	187	HORIZONTAL
5	735.06	39.90	-0.01	39.89	46.00	6.11	251	229	HORIZONTAL
6	800.05	36.30	1.29	37.59	46.00	8.41	196	125	VERTICAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

3.2.8 AC Conducted Emissions

Procedure:

The conducted emissions are measured in the shielded room with a spectrum analyzer in peak hold. While the measurement, EUT had its hopping function disabled at the middle channels in line with Section 15.31(m). Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation and Exerciser operation. The highest emissions relative to the limit are listed.

Measurement Data: Complies

- See next pages for actual measured spectrum plots.
- No emissions were detected at a level greater than 20dB below limit.

Minimum Standard: FCC Part 15.207(a)/EN 55022

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

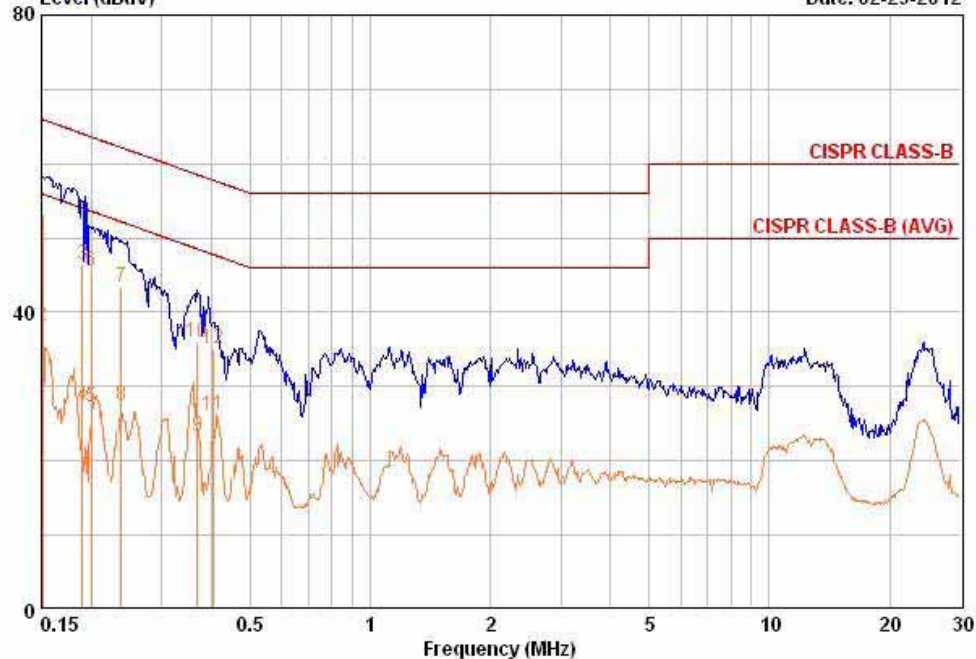
* Decreases with the logarithm of the frequency

AC Conducted Emissions– Sync + Play mode - Line

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Fax:+82-31-3236010

EUT / Model No. :	HDK-2000	Phase :	LINE
Test Mode :	Sync+Play mode	Test Power :	120 / 60
Temp./Humi. :	22 / 39	Test Engineer :	PARK H W

Data: 245 File: C:\Conducted Data\2012\LTA_Conduction_1202-2.EMI (245) Date: 02-29-2012



Freq	RD	RD	C.F	Result	Result	Limit	Limit	Margin	Margin
MHz	QP	AV		QP	AV	QP	AV	QP	AV
	dBuV	dBuV	dB	dBuV	dBuV	dBuV	dBuV	dB	dB
0.151	43.54	28.54	9.67	53.21	38.21	65.94	55.94	12.74	17.74
0.190	36.74	17.94	9.62	46.36	27.56	64.04	54.04	17.68	26.48
0.200	36.04	17.64	9.61	45.65	27.25	63.61	53.61	17.96	26.36
0.238	33.83	17.83	9.58	43.41	27.41	62.17	52.17	18.75	24.75
0.369	26.33	13.73	9.62	35.95	23.35	58.52	48.52	22.58	25.18
0.405	25.53	16.63	9.63	35.16	26.26	57.75	47.75	22.59	21.49

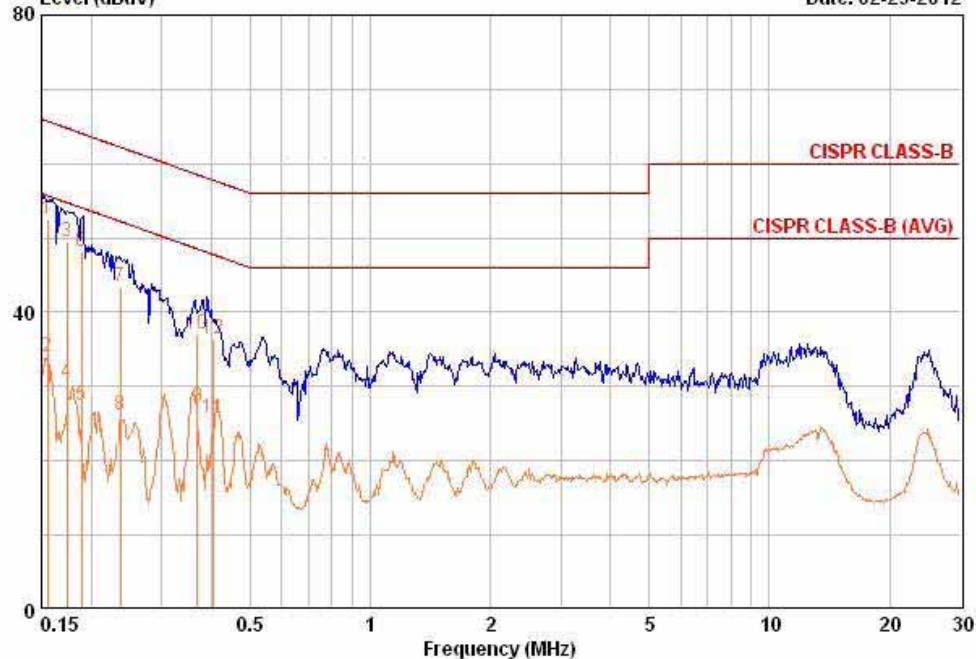
Remarks: C.F (Correction Factor) = Insertion loss + Cable loss

AC Conducted Emissions –Sync + Play mode - Neutral

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EUT / Model No. : HDK-2000	Phase : NEUTRAL
Test Mode : Sync+Play mode	Test Power : 120 / 60
Temp./Humi. : 22 / 39	Test Engineer : PARK H W

Data: 247 File: C:\Conducted Data\2012\LTA_Conduction_1202-2.EMI (247) Date: 02-29-2012



Freq	RD	RD	C.F	Result	Result	Limit	Limit	Margin	Margin
MHz	QP	AV		QP	AV	QP	AV	QP	AV
	dBuV	dBuV	dB	dBuV	dBuV	dBuV	dBuV	dB	dB
0.155	43.04	24.34	9.59	52.63	33.93	65.73	55.73	13.10	21.80
0.174	39.84	21.04	9.55	49.39	30.59	64.77	54.77	15.37	24.17
0.189	38.54	17.84	9.53	48.07	27.37	64.08	54.08	16.01	26.71
0.237	33.83	16.53	9.63	43.46	26.16	62.20	52.20	18.74	26.04
0.369	27.43	17.53	9.63	37.06	27.16	58.52	48.52	21.47	21.37
0.403	26.73	16.03	9.66	36.39	25.69	57.79	47.79	21.40	22.10

Remarks: C.F (Correction Factor) = Insertion loss + Cable loss

APPENDIX

TEST EQUIPMENT USED FOR TESTS

	Description	Model No.	Serial No.	Manufacturer	Interval	Last Cal. Date
1	Spectrum Analyzer (~30GHz)	FSV-30	100757	R&S	1 year	2012-01-10
2	Signal Generator (~3.2GHz)	8648C	3623A02597	HP	1 year	2011-03-30
3	Signal Generator (1~20GHz)	83711B	US34490456	HP	1 year	2011-03-30
4	Attenuator (3dB)	8491A	37822	HP	2 year	2010-10-08
5	Attenuator (10dB)	8491A	63196	HP	2 year	2010-10-08
6	Attenuator (30dB)	8498A	3318A10929	HP	2 year	2011-01-05
7	Test Receiver (~30MHz)	ESHS10	828404/009	R&S	1 year	2011-03-30
8	EMI Test Receiver (~1GHz)	ESCI7	100722	R&S	1 year	2011-10-07
9	RF Amplifier (~1.3GHz)	8447D	2439A09058	HP	2 year	2010-10-08
10	RF Amplifier (1~18GHz)	8449B	3008A02126	HP	2 year	2010-03-29
11	Horn Antenna (1~18GHz)	BBHA 9120D	9120D122	SCHWARZBECK	2 year	2010-12-24
12	Horn Antenna (18 ~ 40GHz)	SAS-574	154	Schwarzbeck	2 year	2010-11-25
13	Horn Antenna (18 ~ 40GHz)	SAS-574	155	Schwarzbeck	2 year	2010-11-25
14	TRILOG Antenna	VULB 9160	9160-3172	SCHWARZBECK	2 year	2010-10-07
15	Dipole Antenna	VHA9103	2116	SCHWARZBECK	2 year	2010-11-25
16	Dipole Antenna	VHA9103	2117	SCHWARZBECK	2 year	2010-11-25
17	Dipole Antenna	VHA9105	2261	SCHWARZBECK	2 year	2010-11-25
18	Dipole Antenna	VHA9105	2262	SCHWARZBECK	2 year	2010-11-25
19	Hygro-Thermograph	THB-36	0041557-01	ISUZU	2 year	2010-04-12
20	Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-	-
21	Power Divider	11636A	6243	HP	2 year	2010-10-08
22	DC Power Supply	6622A	3448A03079	HP	-	-
23	Frequency Counter	5342A	2826A12411	HP	1 year	2011-03-30
24	Power Meter	EPM-441A	GB32481702	HP	1 year	2011-03-30
25	Power Sensor	8481A	US41030291	HP	1 year	2011-10-07
26	Audio Analyzer	8903B	3729A18901	HP	1 year	2011-10-07
27	Modulation Analyzer	8901B	3749A05878	HP	1 year	2011-10-07
28	TEMP & HUMIDITY Chamber	YJ-500	LTAS06041	JinYoung Tech	1 year	2011-10-07
29	Stop Watch	HS-3	601Q09R	CASIO	2 year	2010-03-31
30	LISN	ENV216	100408	R&S	1 year	2011-10-07
31	UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	106243	R&S	2 year	2010-05-13
32	Highpass Filter	WHKX1.5/15G-10SS	74	Wainwright Instruments	-	-
33	Highpass Filter	WHKX3.0/18G-10SS	118	Wainwright Instruments	-	-
34	Loop Antenna	FMZB 1516	151602/94	SCHWARZBECK	2 year	2011-04-05