

Test Report for FCC & ISCED

FCC ID : ZNFTONET8Q
 IC ID : 2703C-TONET8Q

Report Number		ESTRFC2206-002		
Applicant	Company name	LG Electronics Inc.		
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Product	Product name	LG TONE FREE		
	Factory address	222 LG-ro Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do, Korea		
	Model No.	TONE-TF8Q	Manufacturer	LG Electronics Inc.
	Serial No.	NONE	Country of origin	KOREA
Test date	26-May-22 ~ 13-Jun-22		Date of issue	13-Jun-22
Testing location	140-16, Eongmali-ro, Majang-myeon, Icheon-si, Gyeonggi-do, Rep. of Korea			
Standard	FCC PART 15 Subpart C (15.247), ANSI C 63.10(2013), KDB 558074 D01v05r02, RSS-247(2017)			
Measurement facility registration number		FCC : 659627 , ISCED : 4475A		
Tested by	Senior Engineer H.G. Lee		(Signature)	
Reviewed by	Engineering Manager I.K Hong		(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 - This test report is not related to KOLAS accreditation - additional model name : TONE-UTF8Q(korea,UK,Australia)/ TONE-DTF8Q (Germany) only change model name.				

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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 : Suite 1015 World Meridian II, 123 Gasan Digital 2-ro, Geumcheon-gu, Seoul 153-759, R. O. Korea

EMC/Telecom/Safety Test Lab :140-16, Eongmalli-ro, Majang-myeon, Icheon-si,
Gyeonggi-do, Rep. of Korea

1.3 Official Qualification(s)

MSIP : 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

Modulation Type	: Bluetooth (GFSK)
Transfer Rate	: LE 2M
Number of Channel	: 40 ch
PEAK Output Power	: GFSK : 9.37 dBm
Rating	: Earbud: 5 Vd.c.; 136 mA; Class III; : Lithium ion coin battery of earbud: 3,7 Vd.c.; 68 mAh;
Receipt Date	: 27-Sep-21
X-tal list(s) or Frequencies generated	: The highest operating frequency is 2480 MHz(Bluetooth) : Bluetooth : 2.4 GHz

2.2 General descriptions of EUT

Category	Specification		
Device Type	Bluetooth Earbud		
Operating Frequency	2 402 MHz ~ 2 480 MHz		
RF Peak Power	Left earbud	GFSK	9.37 dBm
	Right earbud	GFSK	9.19 dBm
Number of Channel	40		
Antenna Type	Left earbud	Internal Antenna	
	Right earbud	Internal Antenna	
Antenna Gain	Left earbud	-4.98 dBi	
	Right earbud	-4.86 dBi	
Rating Supply Voltage	Earbud: 5 Vd.c.; 136 mA; Class III; Lithium ion coin battery of earbud: 3,7 Vd.c.; 68 mAh;		
HVIN	TONE-TF8Q, TONE-UTF8Q, TONE-DTF8Q		
FVIN	1.0		

3. Test Standards

Test Standard : FCC PART 15 Subpart C (15.247)& RSS-247

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 63.10 (2013) & KDB558074 D01v05r02

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 247				remark
Standard	Test Type	Result	Remark	Limit
15.207 & RSS-GEN	AC Power Conducted Emission	N/A	Meet the requirement	
15.205 & 15.209 & RSS-247	Restricted band / Intentional Radiated Emission	Pass	Meet the requirement	
15.247(a)(2) & RSS-247 & RSS-GEN	6 dB Bandwidth	Pass	Meet the requirement	Min. 500 kHz
	Occupied Bandwidth			
15.247(b)(3) & RSS-247	Maximum Peak /Average output power	Pass	Meet the requirement	Max. 30 dBm
15.209 & RSS-247	Transmitter Radiated Emission	Pass	Meet the requirement	Table 15.209
15.247(e) & RSS-247	Power Spectral Density	Pass	Meet the requirement	Max. 8 dBm
15.247(d) & RSS-247	Band Edge Measurement	Pass	Meet the requirement	20 dB less

4. Measurement Condition

4.1 EUT Operation

a. Channel

Ch.	Frequency	Ch.	Frequency
0	2402 MHz	...	...
1	2404 MHz	36	2474 MHz
2	2406 MHz	37	2476 MHz
3	2408 MHz	38	2478 MHz
...	...	39	2480 MHz
11	2428 MHz		
...	...		
19	2440 MHz		

b. Measurement Channel : Bluetooth : Low(2402 MHz), Middle(2440 MHz), High(2480 MHz)

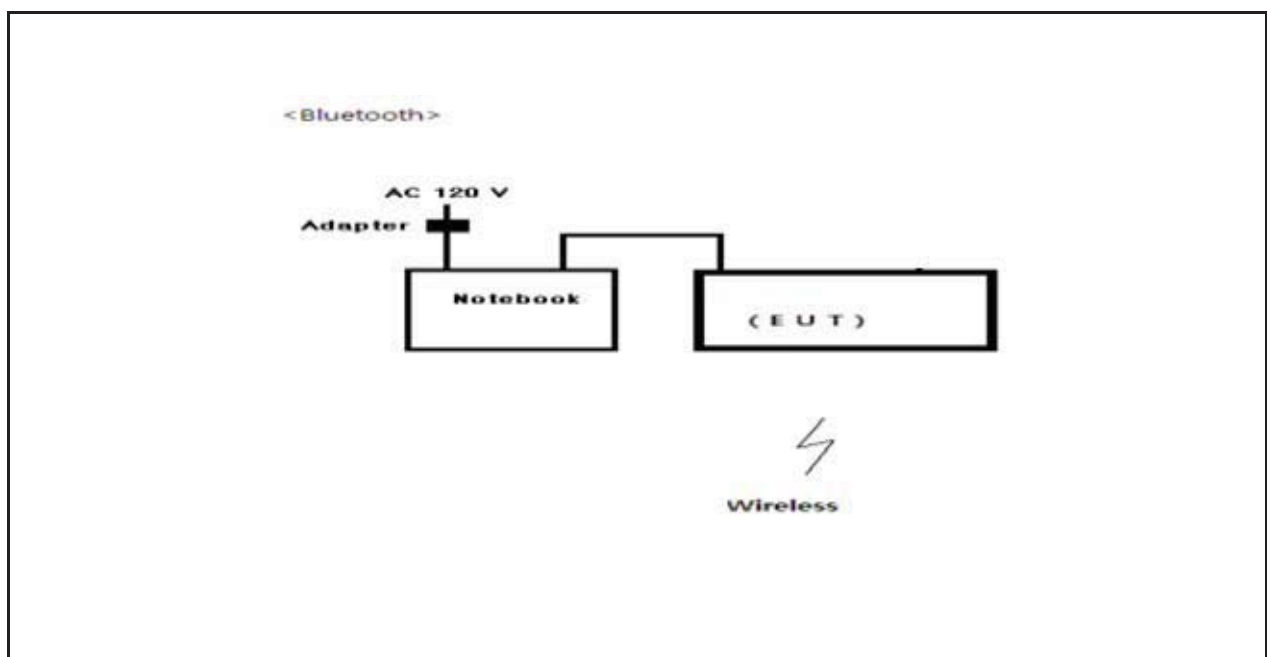
c. Test Mode : Continuous Output, GFSK

d. Test rate : 1 M,2 M

4.2 EUT Operation.

- The EUT was in the following operation mode during all testing
 - * Bluetooth operation check
 - * Transmit mode were measured each channels(Low, Middle, High)
 - * The EUT was measured up to tenth harmonic or 40 GHz of the highest operating frequencies.

4.3 Configuration and Peripherals



4.4 EUT and Support equipment

Equipment Name	Model Name	S/N	Manufacturer	Remark (FCC ID)
LG TONE FREE	TONE-TF8Q	NONE	LG Electronics Inc.	EUT

4.5 Cable Connecting

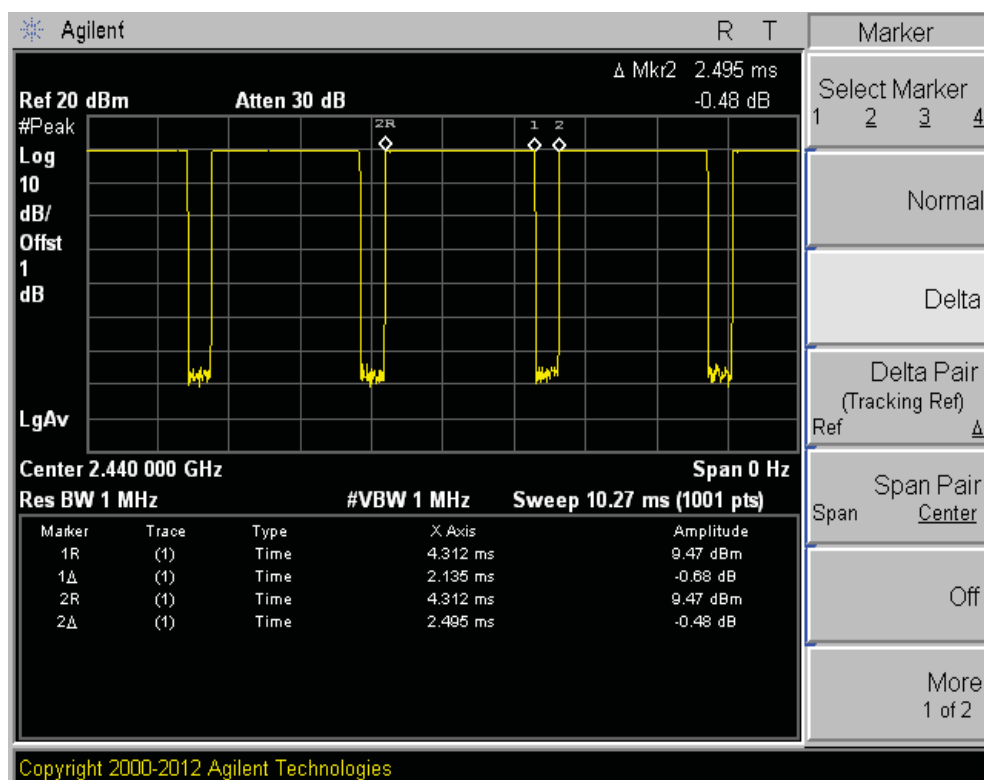
Start Equipment		End Equipment		Cable Standard		Remark
Name	I/O port	Name	I/O port	Length	Shielded	
Notebook	Power	Adapter	–	0.5	Unshielded	

4.6 DUTY CYCLE OF TEST SIGNAL

Duty cycle is < 98%, duty factor shall be considered.

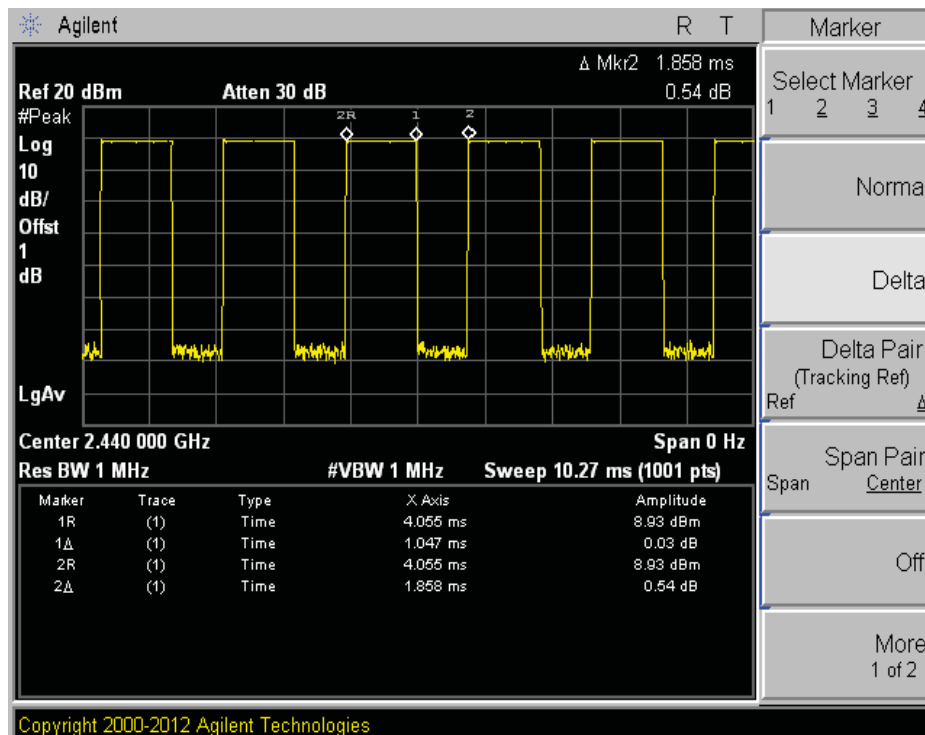
duty cycle = $2.135/2.495=0.856$, duty factor = $10*\log(1/0.856)=0.68$

Left_LE 1M



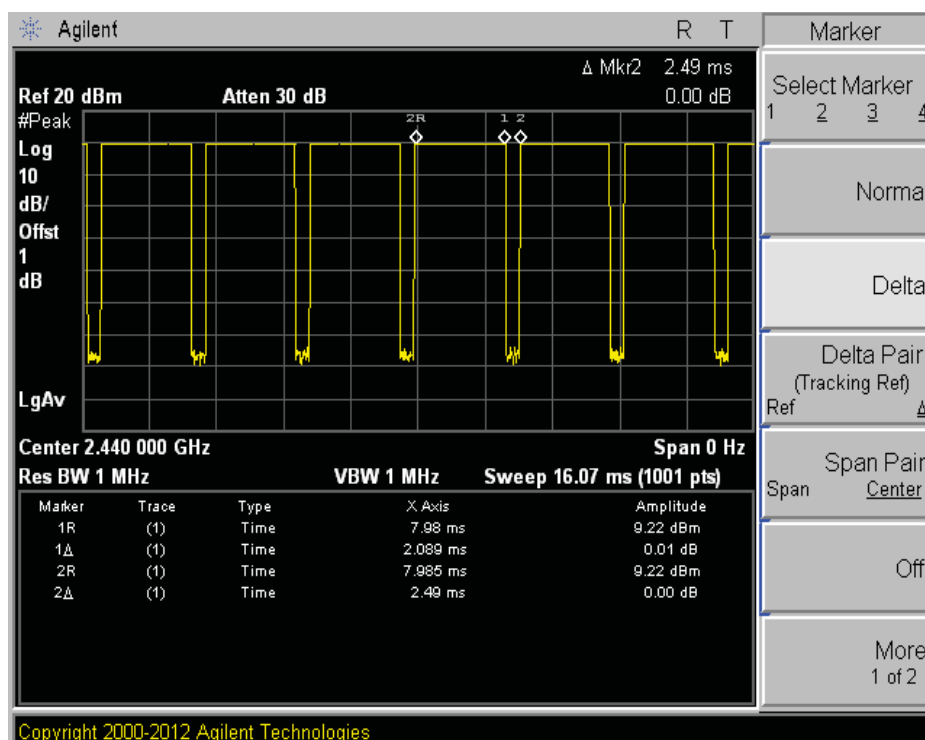
duty cycle = $1.047/1.858=0.564$, duty factor = $10*\log(1/0.564)=2.49$

Left_LE 2M



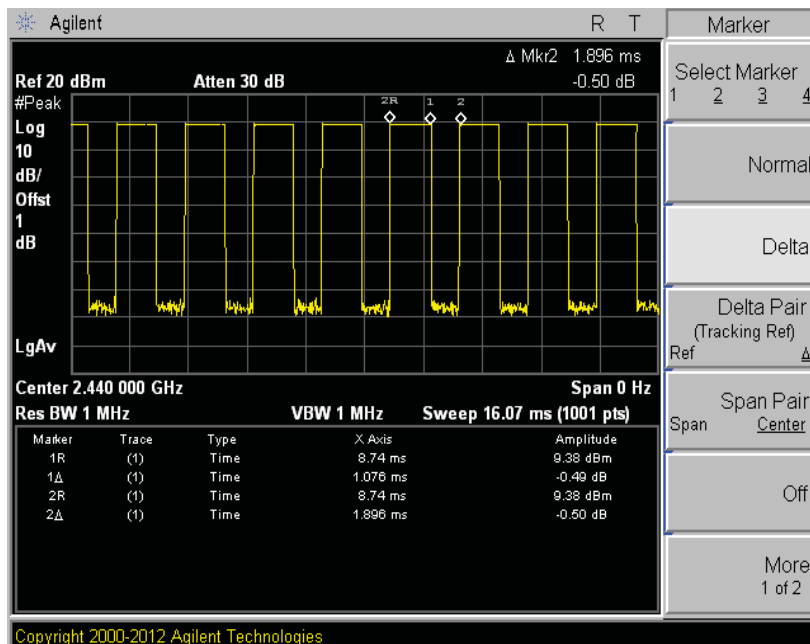
duty cycle = $2.089/2.49=0.839$, duty factor = $10*\log(1/0.839)=0.763$

Right_LE 1M



duty cycle = $1.076/1.896=0.568$, duty factor = $10*\log(1/0.568)=2.46$

Right_LE 2M



5. DTS bandwidth & 99 % Occupied Bandwidth

5.1 Test procedure

§ 15.247 (a)(2), RSS-247 §5.2, RSS-Gen §6.7

Systems using digital modulation techniques may operate in the 902–928MHz, 2400–2483.5MHz, and 5725–5850MHz bands. The minimum 6 dB bandwidth shall be at least 500 KHz.

5.2 Test instruments and measurement setup

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 = 1 % to 5 %, VBW $\geq$ 3 X 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 $\geq$ 6 dB.

6dB Bandwidth Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4440A	US42041291	2022-11-29
RF Cable	Length: 30 cm	–	
–Spectrum Analyzer $\Leftrightarrow$ EUT	Loss: 1 dB	–	

5.3 Measurement results

EUT	LG TONE FREE	MODEL	TONE-TF8Q
MODE	GFSK	ENVIRONMENTAL CONDITION	22.3 °C, 44.6 % R.H.
INPUT POWER	DC 3.7 V		

Left_LE 1M

Channel Frequency (MHz)	99 % Occupied Bandwidth(MHz)	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
2402	1.06	0.72	0.5	PASS
2440	1.06	0.75	0.5	PASS
2480	1.04	0.70	0.5	PASS

Left_LE 2M

Channel Frequency (MHz)	99 % Occupied Bandwidth(MHz)	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
2402	2.09	1.37	0.5	PASS
2440	2.08	1.25	0.5	PASS
2480	2.09	1.28	0.5	PASS

Right_LE 1M

Channel Frequency (MHz)	99 % Occupied Bandwidth(MHz)	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
2402	1.05	0.71	0.5	PASS
2440	1.05	0.72	0.5	PASS
2480	1.04	0.73	0.5	PASS

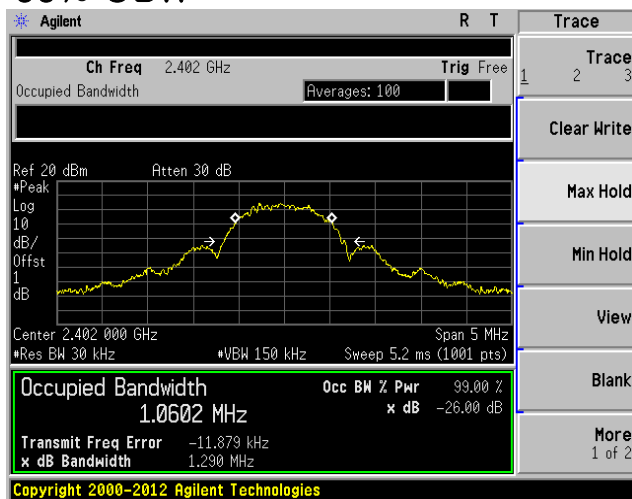
Right_LE 2M

Channel Frequency (MHz)	99 % Occupied Bandwidth(MHz)	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
2402	2.07	1.31	0.5	PASS
2440	2.09	1.32	0.5	PASS
2480	2.09	1.32	0.5	PASS

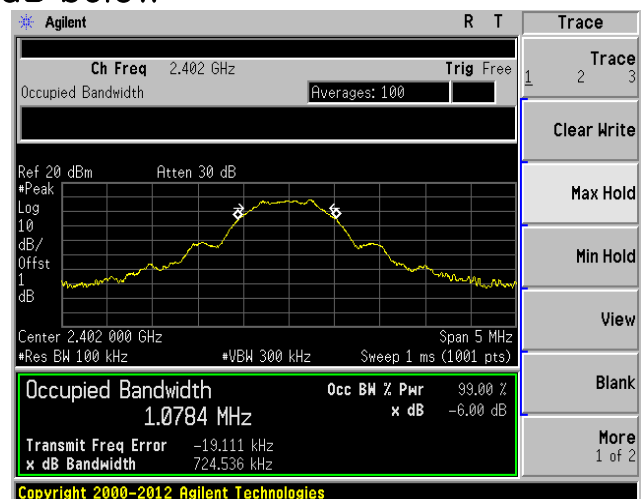
5.4 Trace data

Left_LE 1M (ch_0)

99% OBW

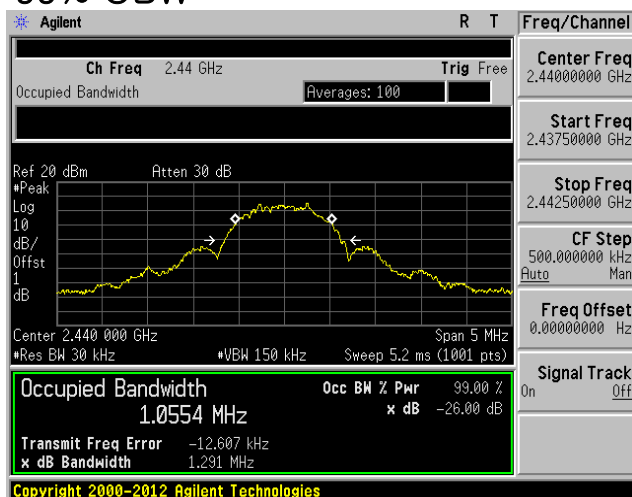


6dB below

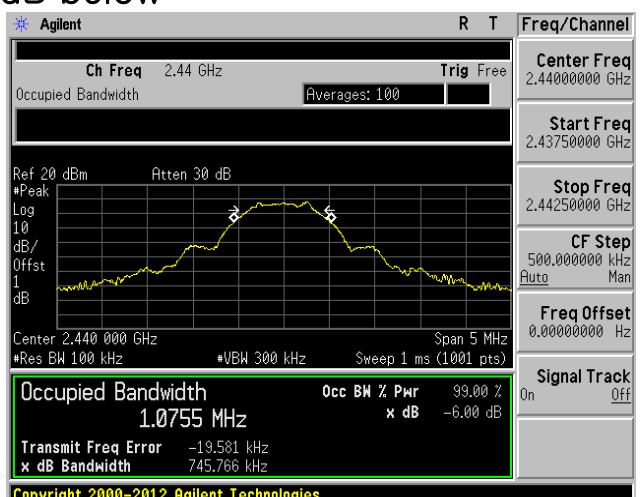


(ch_19)

99% OBW

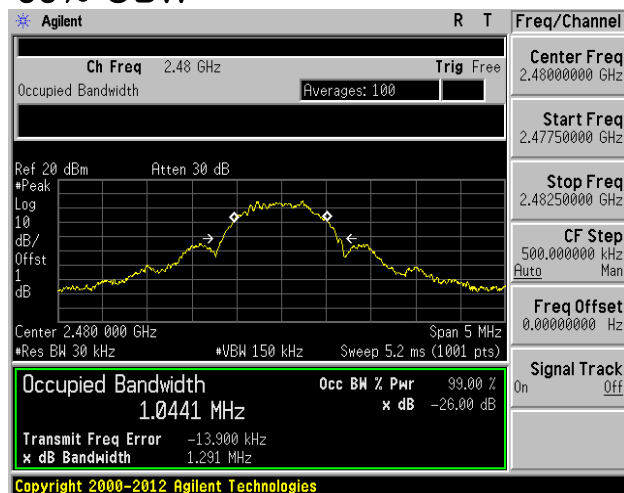


6dB below

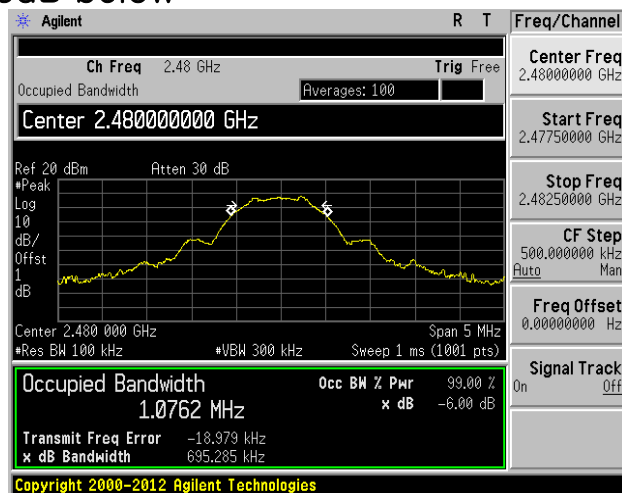


(ch_39)

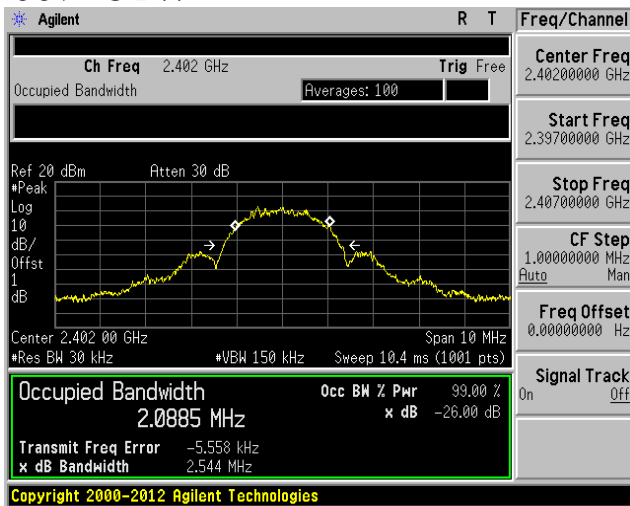
99% OBW



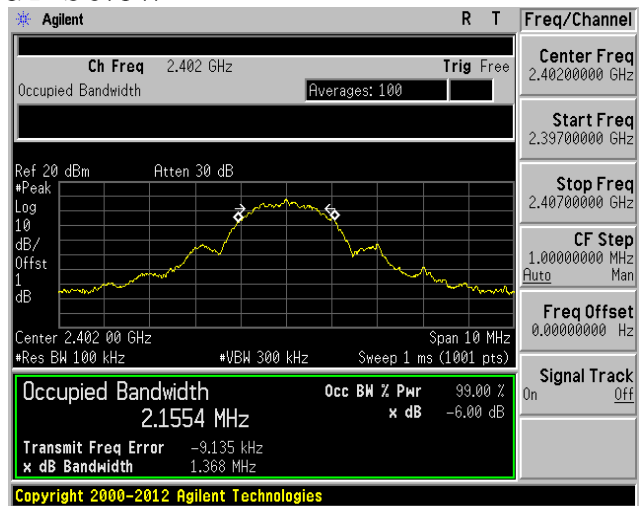
6dB below



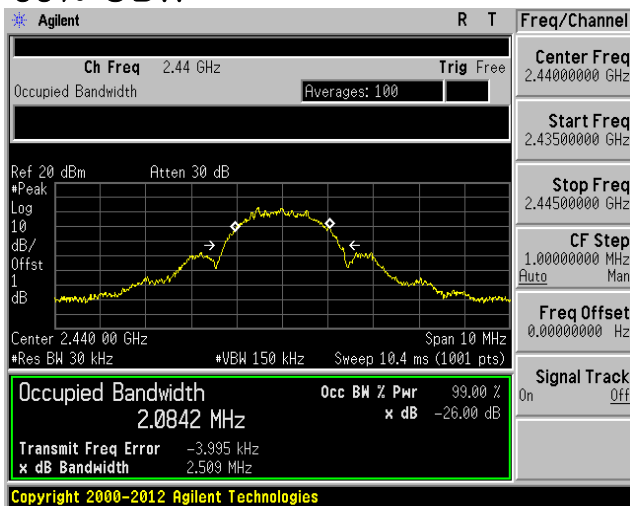
Left_LE 2M
(ch_0)
99% OBW



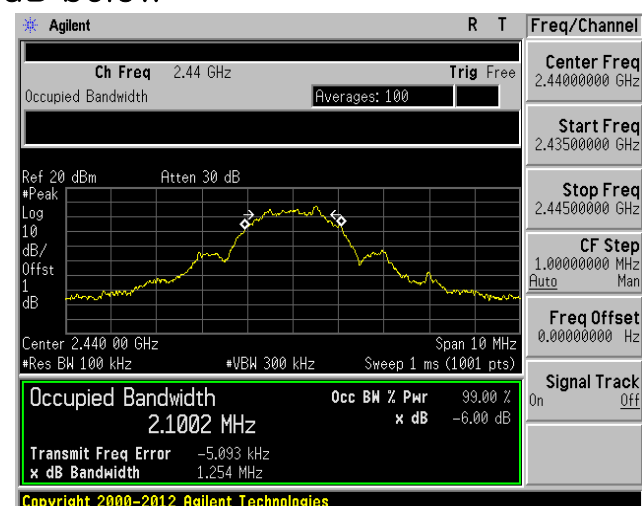
6dB below



(ch_19)
99% OBW

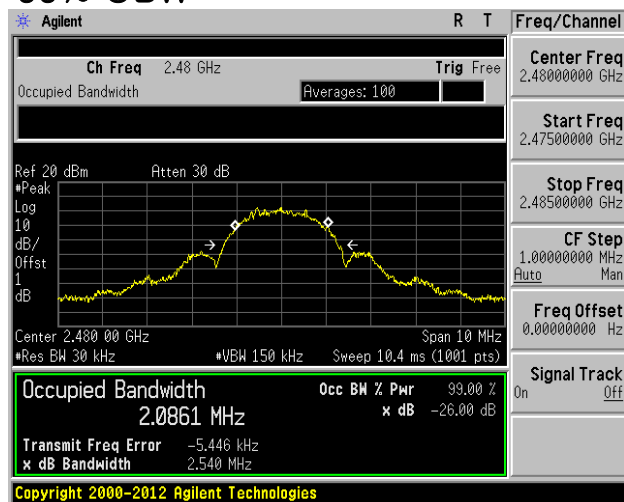


6dB below

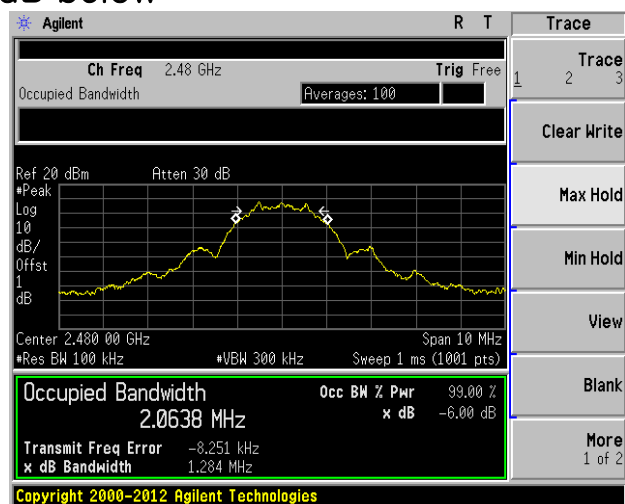


(ch_39)

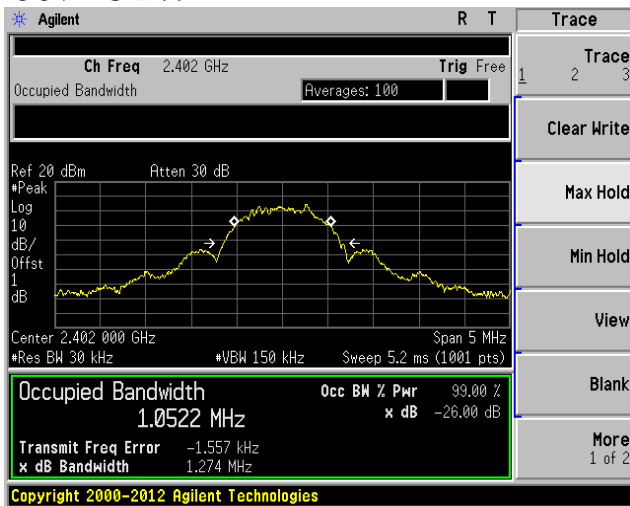
99% OBW



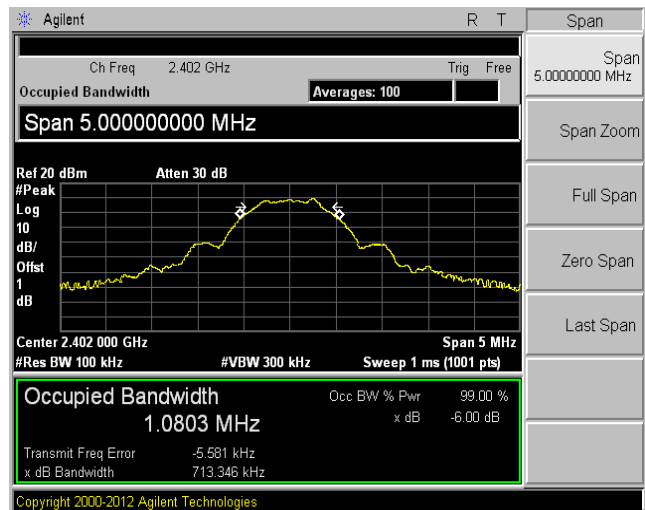
6dB below



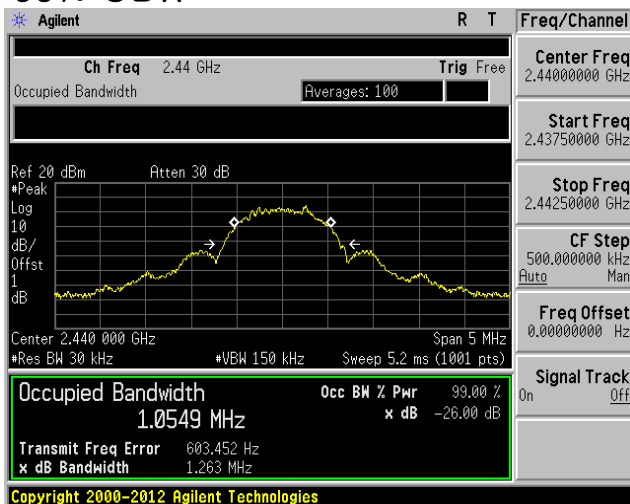
Right_LE 1M
(ch_0)
99% OBW



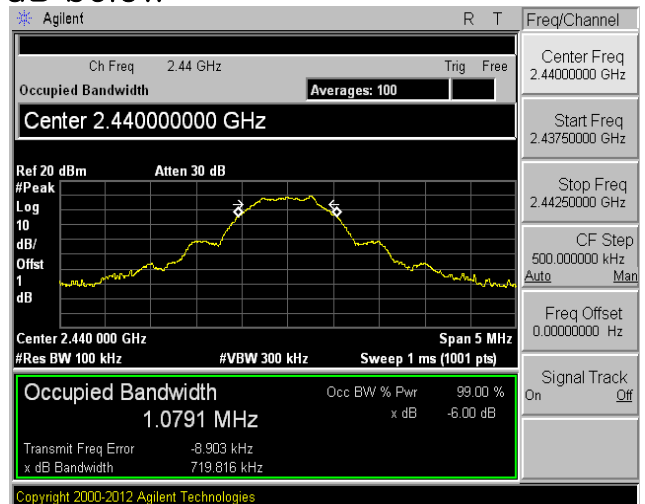
6dB below



(ch_19)
99% OBW

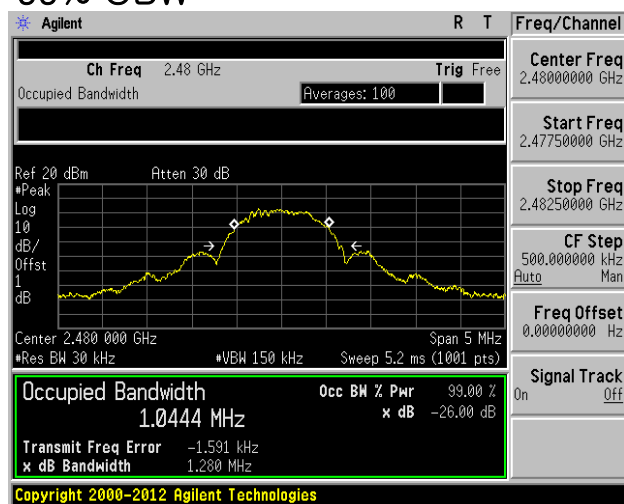


6dB below

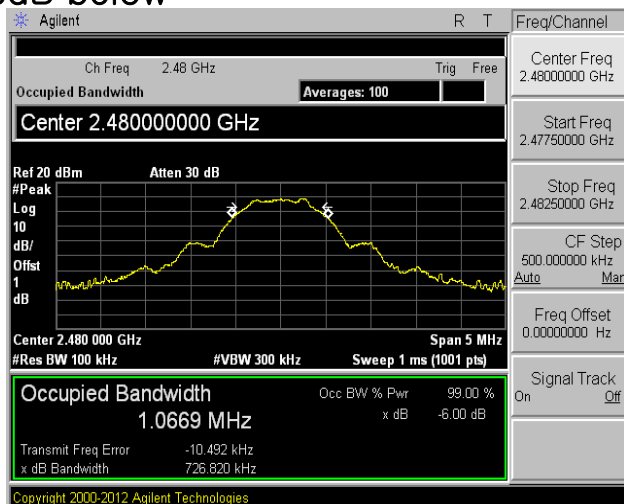


(ch_39)

99% OBW



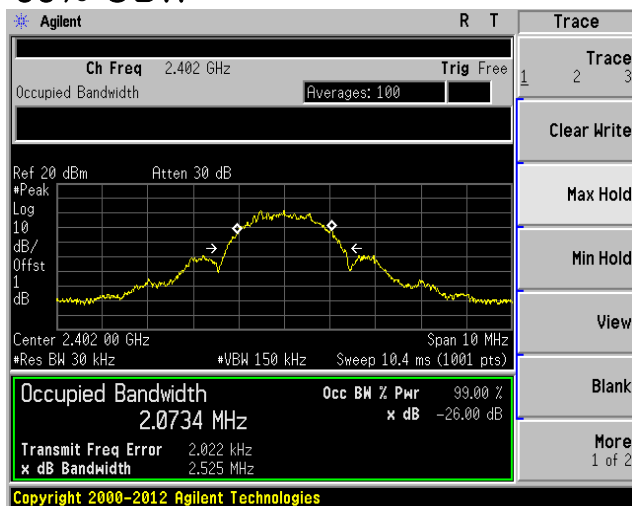
6dB below



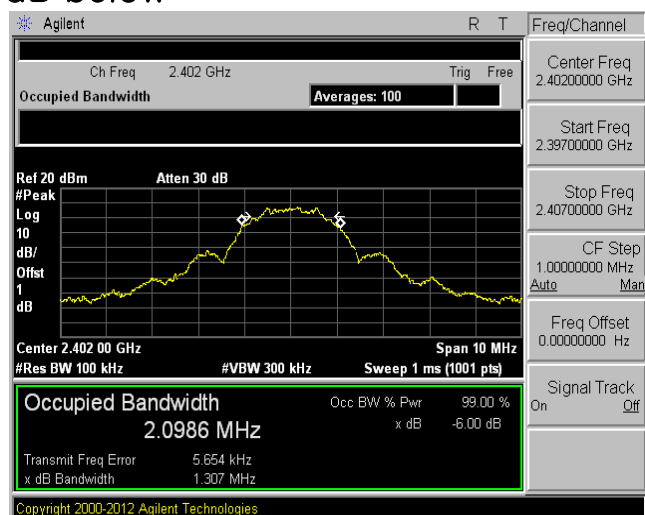
Right_LE 2M

(ch_0)

99% OBW

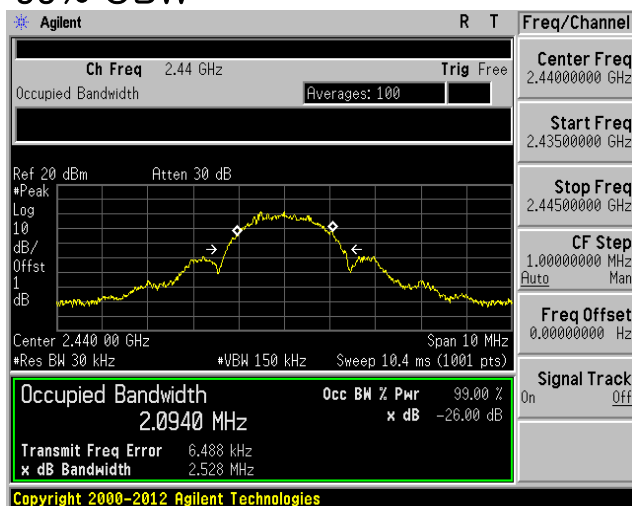


6dB below

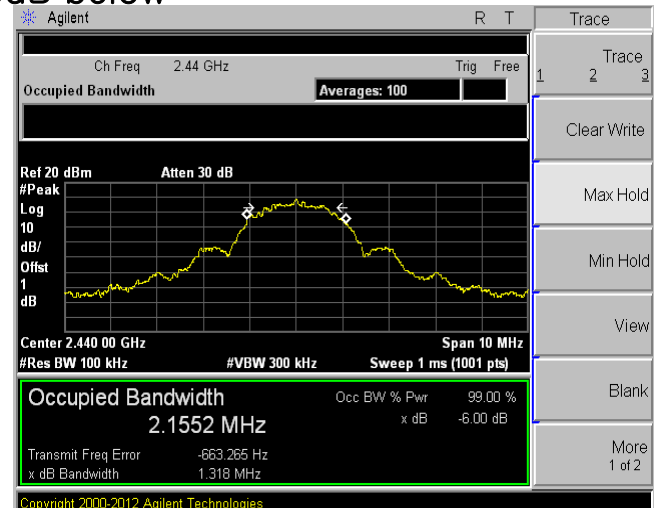


(ch_19)

99% OBW

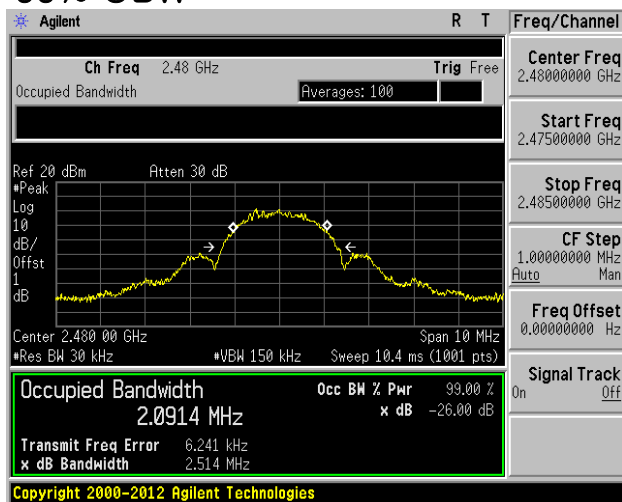


6dB below

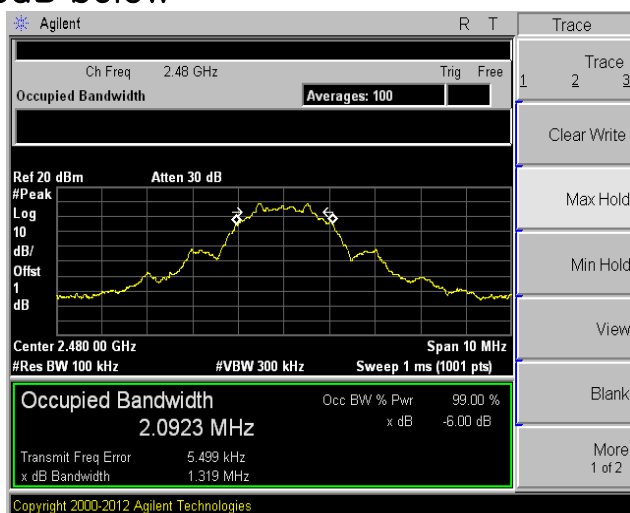


(ch_39)

99% OBW



6dB below



6. Maximum peak conducted output power

6.1 Test procedure

The transmitter antenna terminal is connected to the input of a Power Sensor. Measurement is made while EUT is operating in transmission mode at the appropriate center frequency. The maximum peak output power measurement is 30 dBm.

Limits : FCC§15.247 RSS 247 section 5.4 d

Maximum Peak Output Power Test Instruments

Description	Model	Serial Number	Cal. Due Date
Power Meter	N1921A	MY45100570	2022-12-02
Power Sensor	N1921A	MY45240427	2022-12-02
Power Meter <=> EUT	Loss: 1 dB	—	

6.2 Measurement results

EUT	LG TONE FREE	MODEL	TONE-TF8Q
MODE	GFSK	ENVIRONMENTAL CONDITION	22.3 °C, 44.6 % R.H.
INPUT POWER	DC 3.7 V		

Left_LE 1M

CHANNEL	Channel Requency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(mW)		
0	2 402	PEAK	9.16	8.24	30.0	PASS
19	2 440	PEAK	8.93	7.82	30.0	PASS
39	2 480	PEAK	8.99	7.93	30.0	PASS

Left_LE 2M

CHANNEL	Channel Frequency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(mW)		
0	2 402	PEAK	9.19	8.30	30.0	PASS
19	2 440	PEAK	8.95	7.85	30.0	PASS
39	2 480	PEAK	8.99	7.93	30.0	PASS

Right_LE 1M

CHANNEL	Channel Frequency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(mW)		
0	2 402	PEAK	9.36	8.63	30.0	PASS
19	2 440	PEAK	9.29	8.49	30.0	PASS
39	2 480	PEAK	9.26	8.43	30.0	PASS

Right_LE 2M

CHANNEL	Channel Frequency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(mW)		
0	2 402	PEAK	9.37	8.65	30.0	PASS
19	2 440	PEAK	9.29	8.49	30.0	PASS
39	2 480	PEAK	9.27	8.45	30.0	PASS

7. Maximum conducted (average) output power

7.1 Test procedure

The transmitter antenna terminal is connected to the input of a Power Sensor. Measurement is made while EUT is operating in transmission mode at the appropriate center frequency. The maximum Average output power measurement is 30 dBm.

Limits : FCC§15.247 & RSS 247 section 5.4 d

Maximum conducted (average) output power Test Instruments

Description	Model	Serial Number	Cal. Due Date
Power Meter	N1921A	MY45100570	2022-11-29
Power Sensor	N1921A	MY45240427	2022-11-29
Power Meter <=> EUT	Loss: 1 dB	–	

7.2 Measurement results

EUT	LG TONE FREE	MODEL	TONE-TF8Q
MODE	GFSK	ENVIRONMENTAL CONDITION	22.3 °C, 44.6 % R.H.
INPUT POWER	DC 3.7 V		

Left_LE 1M

CHANNEL	Channel Requency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(mW)
		Detector	(dBm)	Duty Cycle		
0	2 402	AVG	8.36	0.68	9.04	8.02
19	2 440	AVG	8.11	0.68	8.79	7.57
39	2 480	AVG	8.17	0.68	8.85	7.67

Left_LE 1M

CHANNEL	Channel Requency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(mW)
		Detector	(dBm)	Duty Cycle		
0	2 402	AVG	6.63	2.49	9.12	8.17
19	2 440	AVG	6.64	2.49	9.13	8.18
39	2 480	AVG	6.46	2.49	8.95	7.85

Right_LE 1M

CHANNEL	Channel Requency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(mW)
		Detector	(dBm)	Duty Cycle		
0	2 402	AVG	8.52	0.76	9.28	8.48
19	2 440	AVG	8.45	0.76	9.21	8.34
39	2 480	AVG	8.43	0.76	9.19	8.30

Right_LE 2M

CHANNEL	Channel Requency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(mW)
		Detector	(dBm)	Duty Cycle		
0	2 402	AVG	6.85	2.46	9.31	8.53
19	2 440	AVG	6.77	2.46	9.23	8.38
39	2 480	AVG	6.75	2.46	9.21	8.34

8. Maximum power spectral density level in the fundamental emission

8.1 Test procedure

KDB 558074 D01 DTS Meas Guidance V05r02 10.2 Method PKPSD (peak PSD) & RSS 247 section 5.2

8.2 Test instruments and measurement setup

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3 \times \text{RBW}$
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Limits FCC § 15.247

The peak power density Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E440A	US42041291	2022-11-29
RF Cable	Length: 30 cm	–	
–Spectrum Analyzer <=> EUT	Loss: 1 dB	–	

8.3 Measurement results

EUT	LG TONE FREE	MODEL	TONE-TF8Q
MODE	GFSK	ENVIRONMENTAL CONDITION	22.3 °C, 44.6 % R.H.
INPUT POWER	DC 3.7 V		

Left_LE 1M

CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
0	2 402	-7.26	8.0	15.26
19	2 440	-7.35	8.0	15.35
39	2 480	-7.52	8.0	15.52

Left_LE 2M

CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
0	2 402	-9.81	8.0	17.81
19	2 440	-9.94	8.0	17.94
39	2 480	-10.11	8.0	18.11

Right_LE 1M

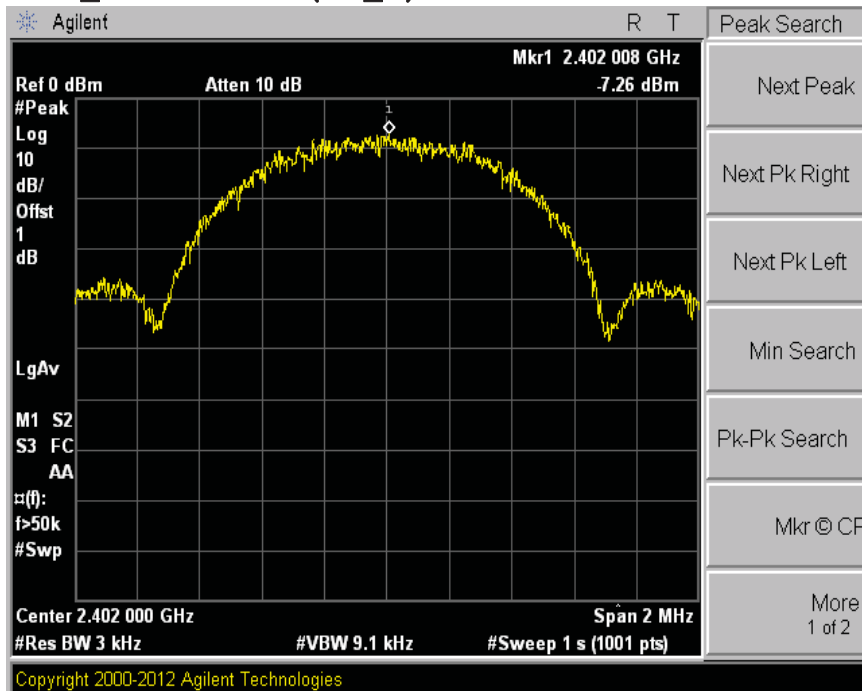
CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
0	2 402	-7.43	8.0	15.43
19	2 440	-7.68	8.0	15.68
39	2 480	-7.57	8.0	15.57

Right_LE 2M

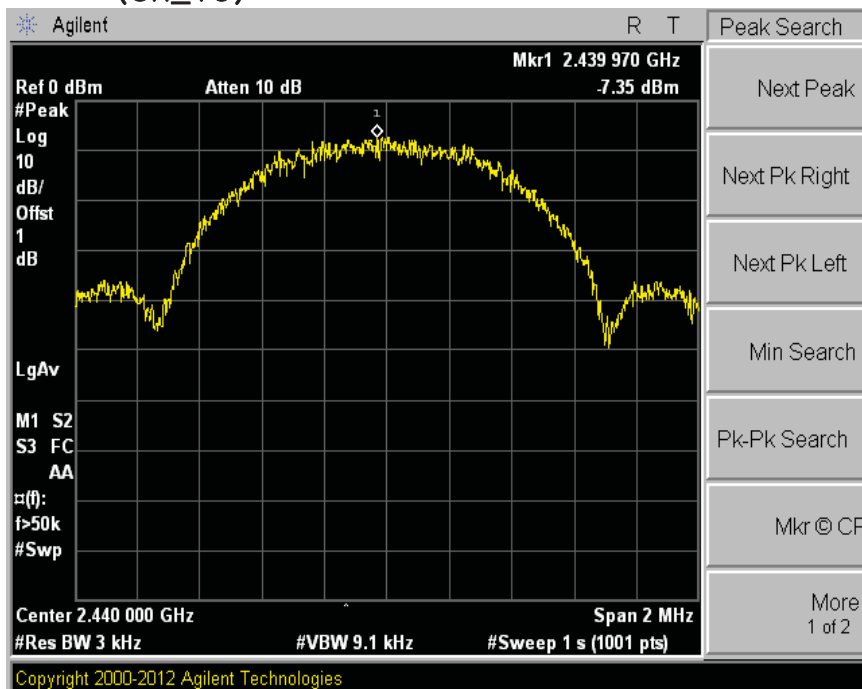
CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
0	2 402	-9.70	8.0	17.70
19	2 440	-9.98	8.0	17.98
39	2 480	-10.15	8.0	18.15

8.4 Trace data

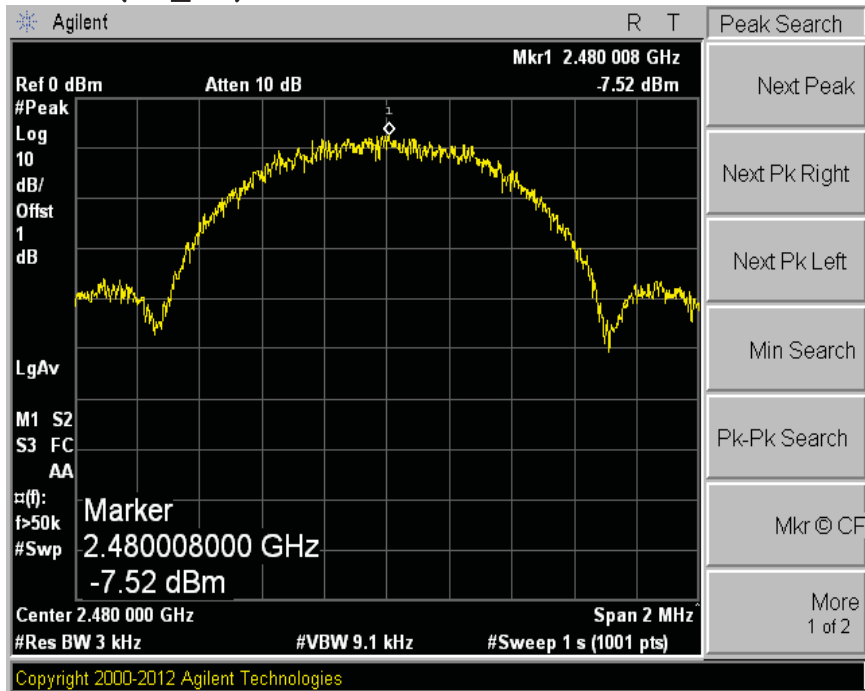
Left_LE 1M (ch_0)



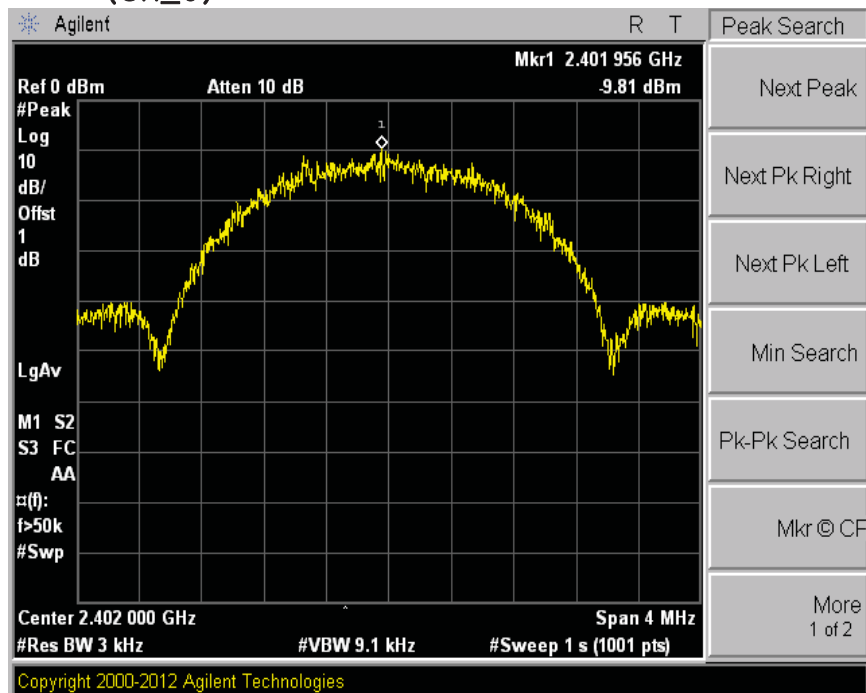
(ch_19)



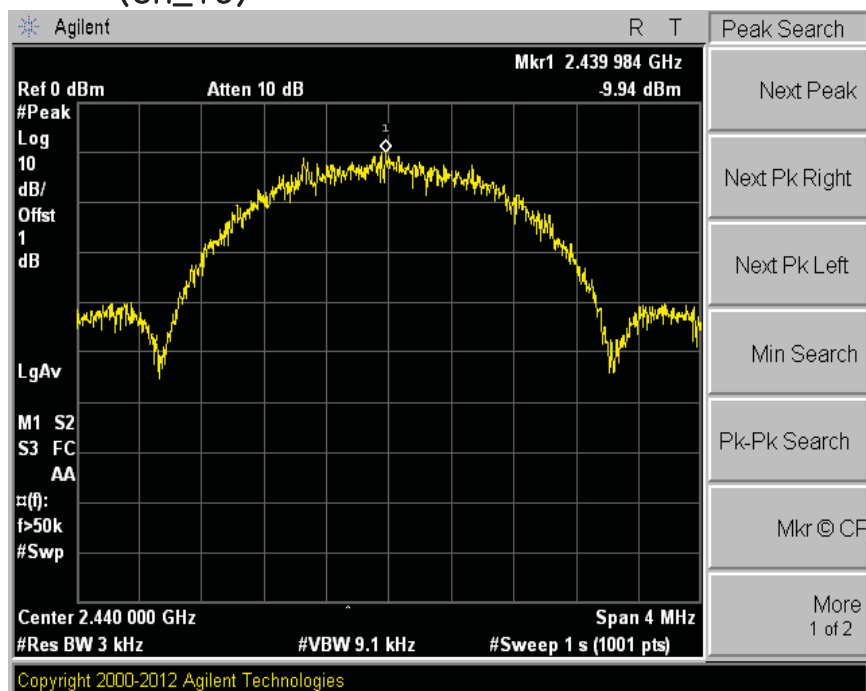
(ch_39)



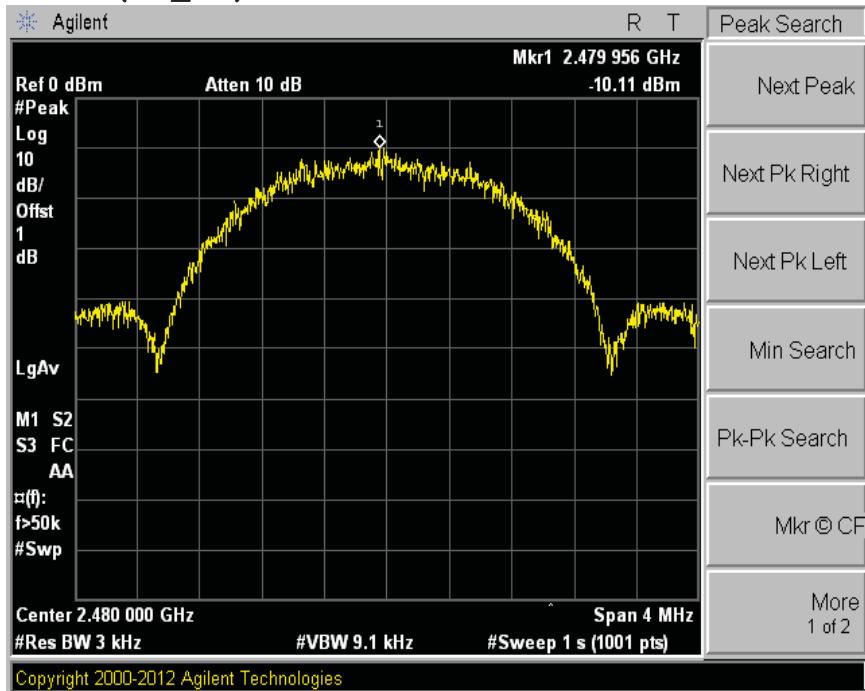
Left_LE 2M
(ch_0)



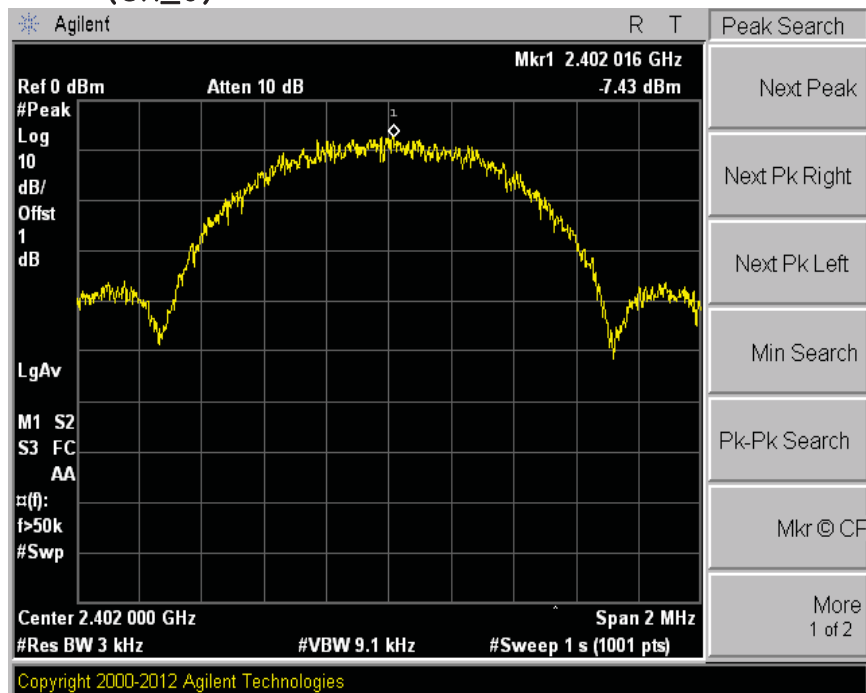
(ch_19)



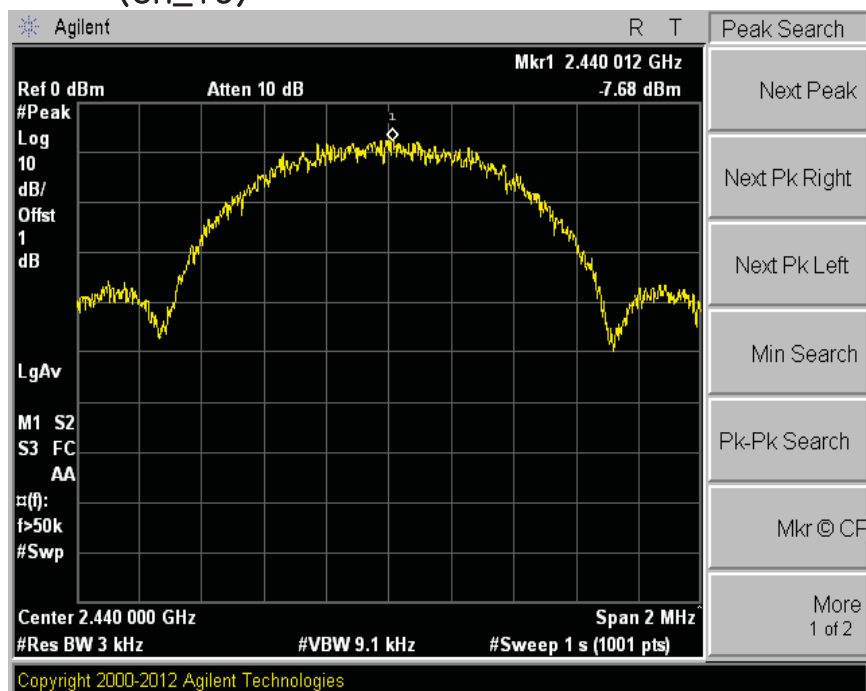
(ch_39)



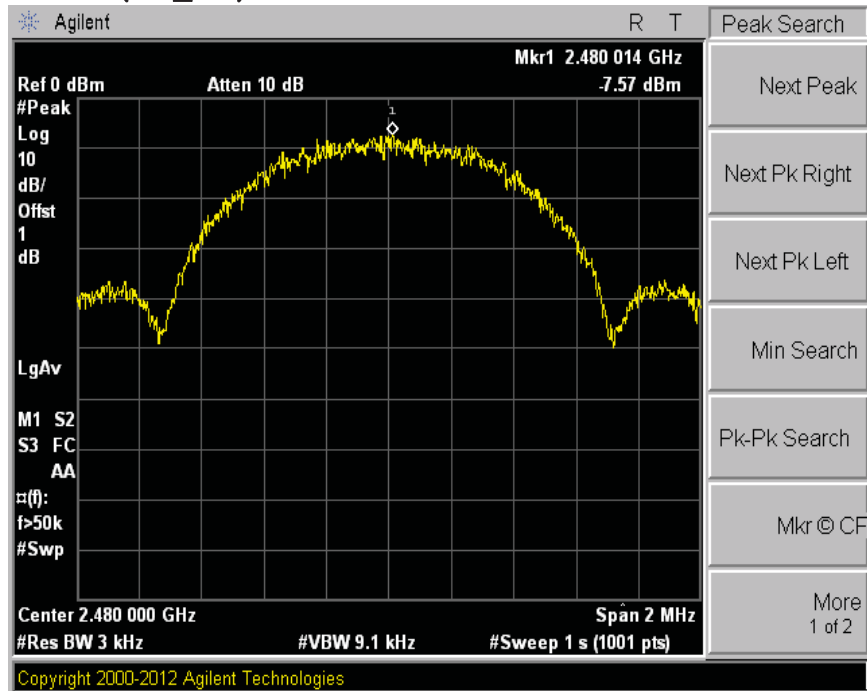
Right_LE 1M
(ch_0)



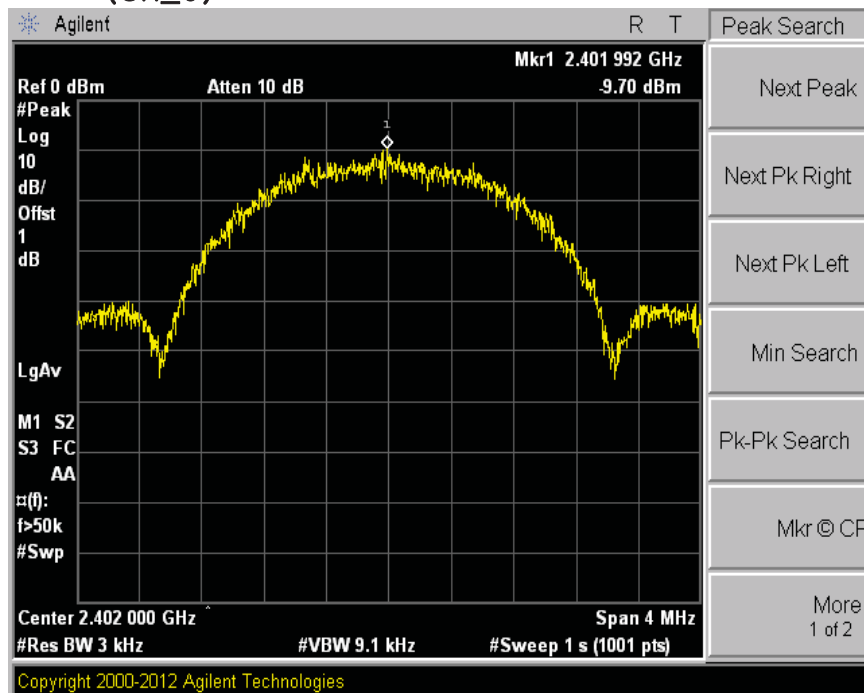
(ch_19)



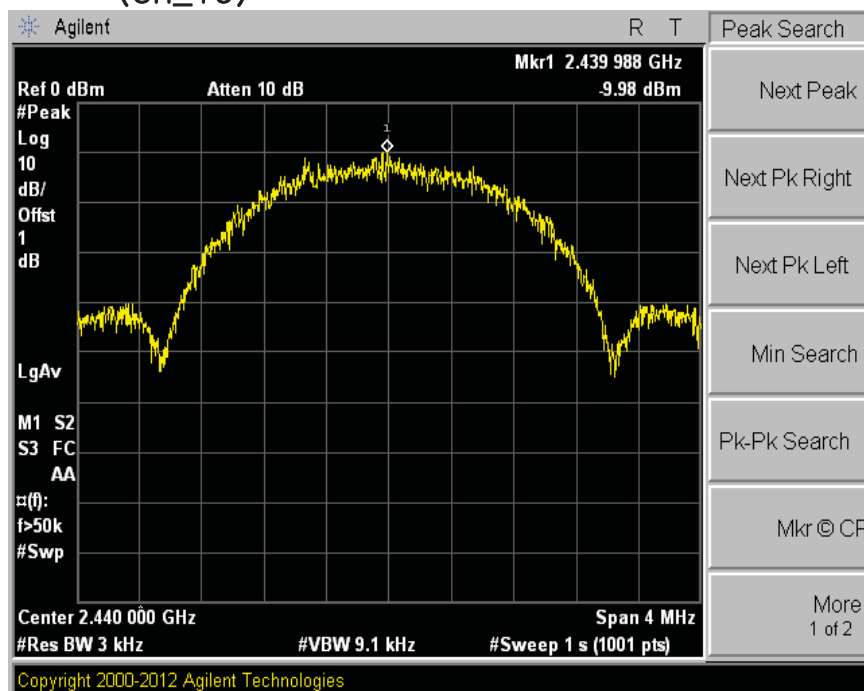
(ch_39)



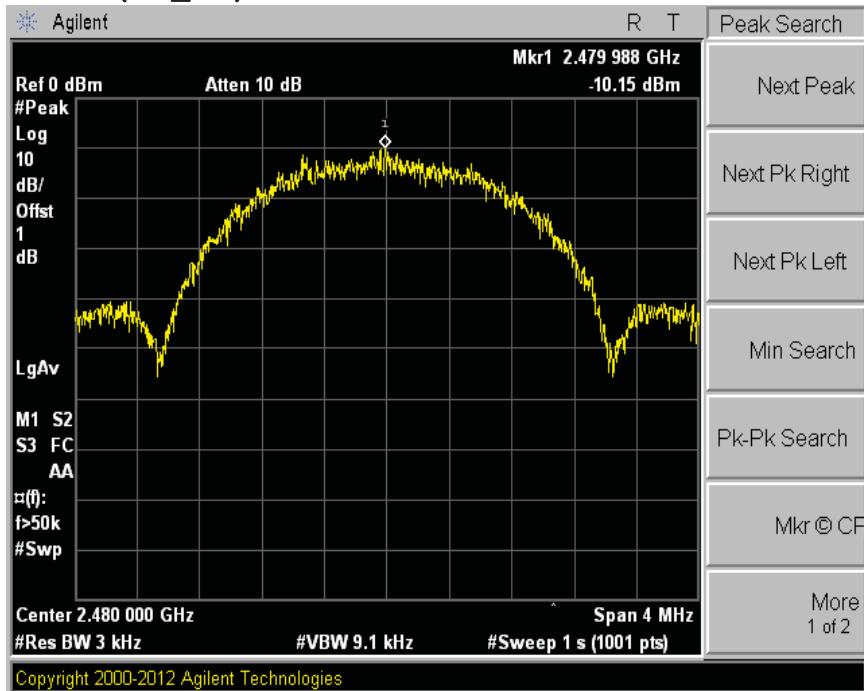
Right_LE 2M
(ch_0)



(ch_19)



(ch_39)



9. Emissions in non-restricted frequency bands

9.1 Test procedure

KDB 558074 D01 DTS Meas Guidance V05r02 & RSS-247 section 5.5

9.2 Test instruments and measurement setup

The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions(15.247(d))

- Set the center frequency and span to encompass frequency range to be measured.
- Set the RBW = 100 kHz.
- Set the VBW $\geq 3 \times$ 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.

Limits FCC § 15.247

Band Edge&Out of Emission Test Instruments

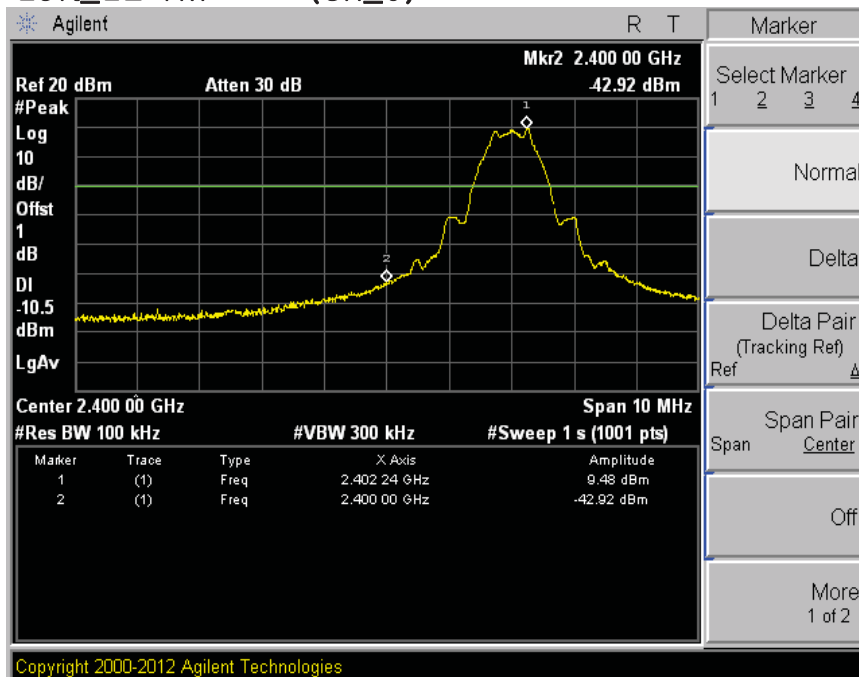
Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4440A	US42041291	2022-11-29
RF Cable	Length: 30 cm		–
–Spectrum Analyzer $\Leftrightarrow$ EUT	Loss: 1 dB		–

9.3 Measurement results of band-edge & out of emission

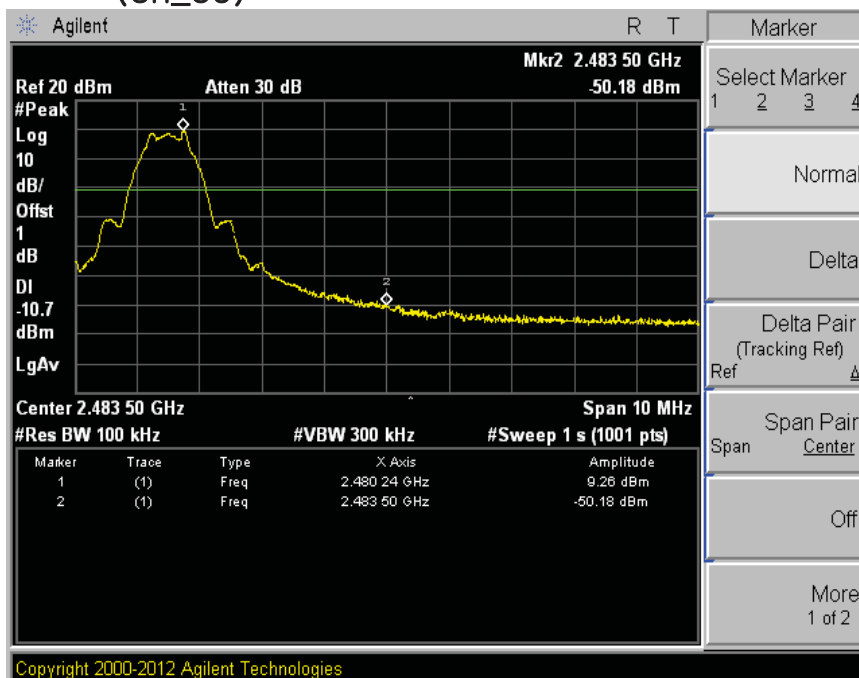
EUT	LG TONE FREE	MODEL	TONE-TF8Q
MODE	GFSK	ENVIRONMENTAL CONDITION	22.3 °C, 44.6 % R.H
INPUT POWER	DC 3.7 V		

CHANNEL	Channel Frequency (MHz)	limit	PASS/FAIL
0	2 402	20dBc	PASS
39	2 480	20dBc	PASS

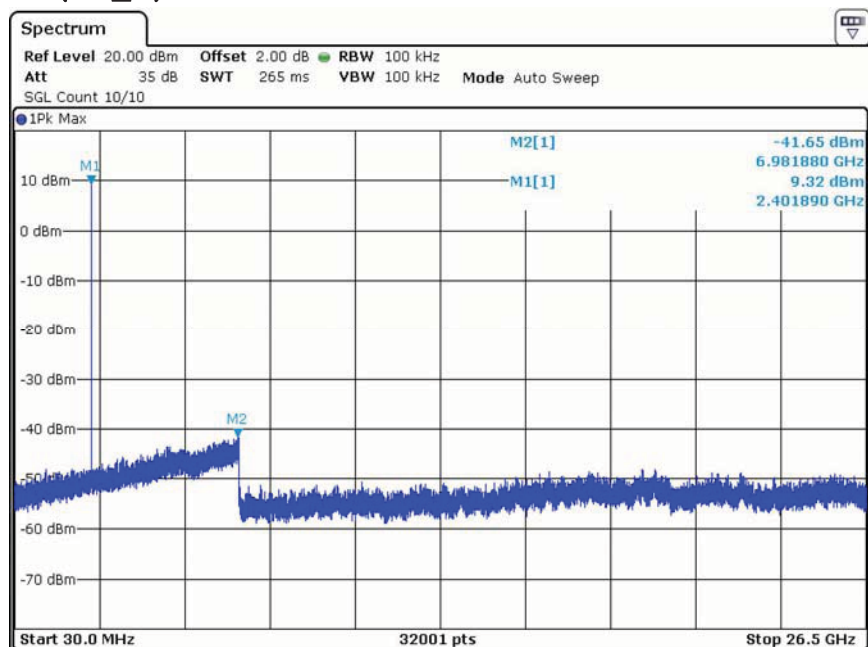
9.4 Trace data of band-edge & Out of Emission Left_LE 1M (ch_0)



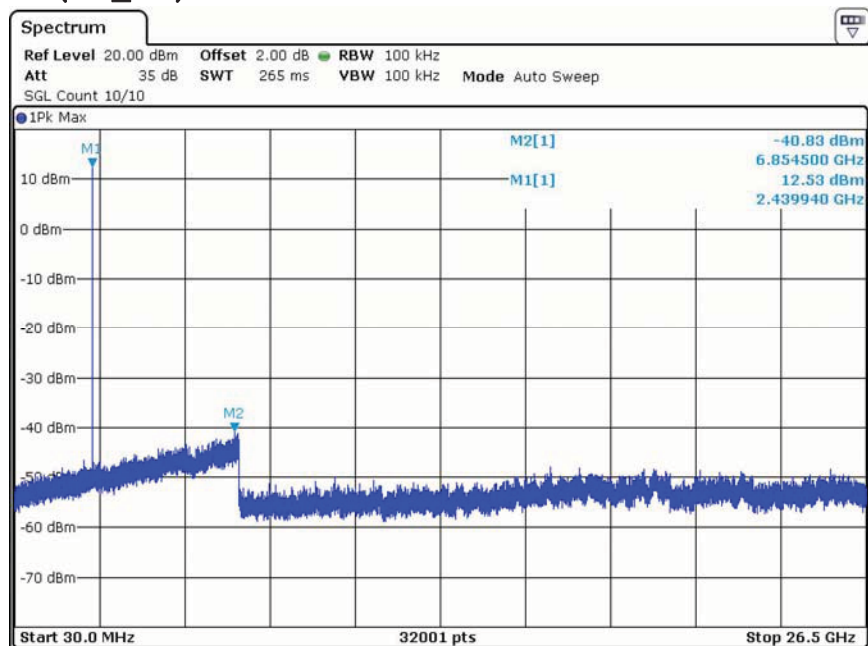
(ch_39)



(ch_0)



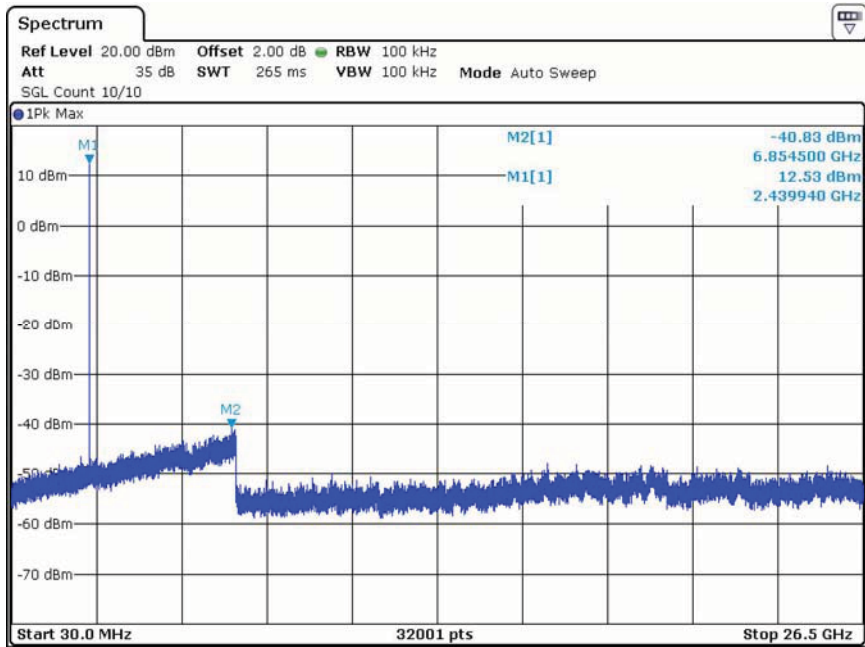
(ch_19)



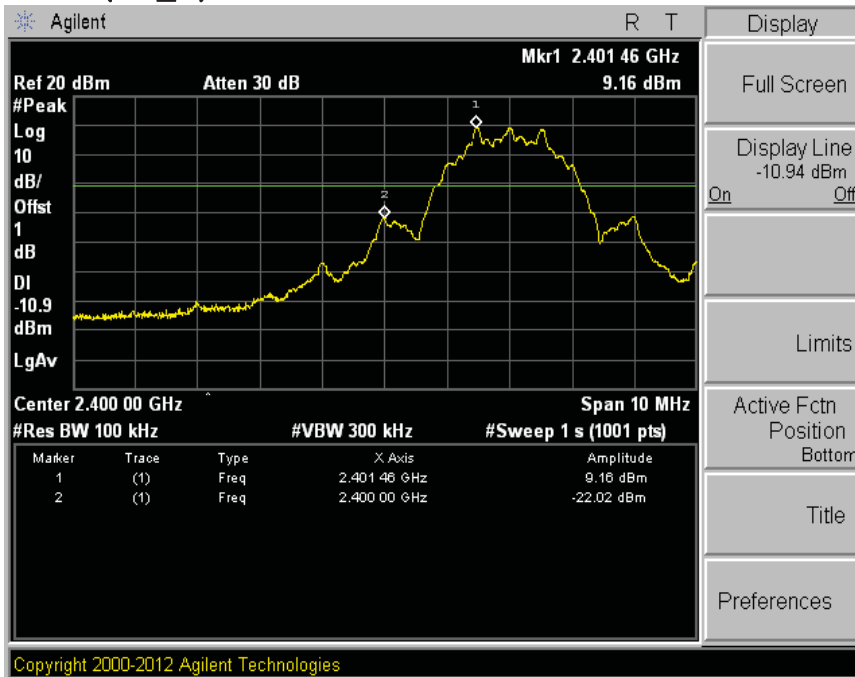


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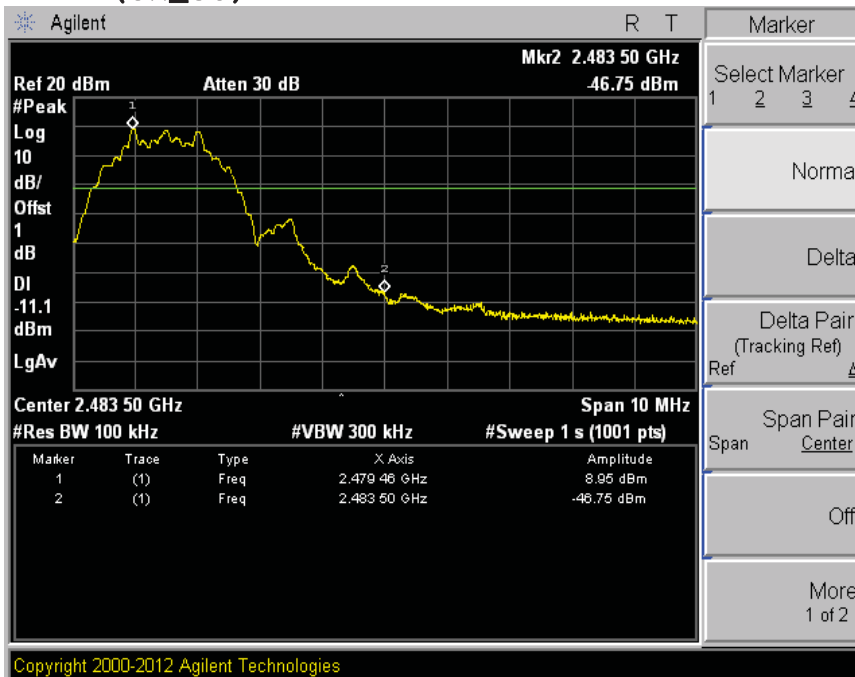
(ch_39)



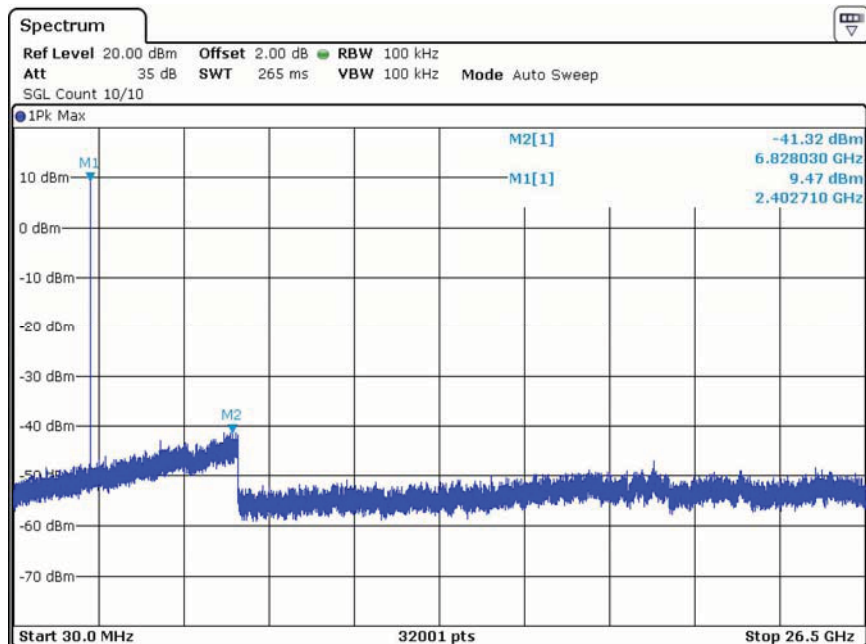
Left_LE 2M
(ch_0)



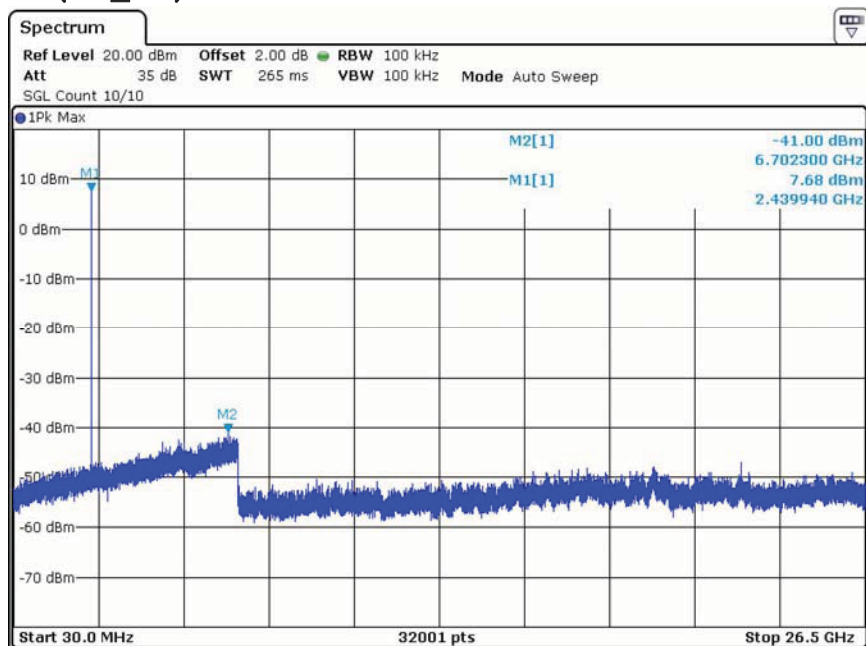
(ch_39)



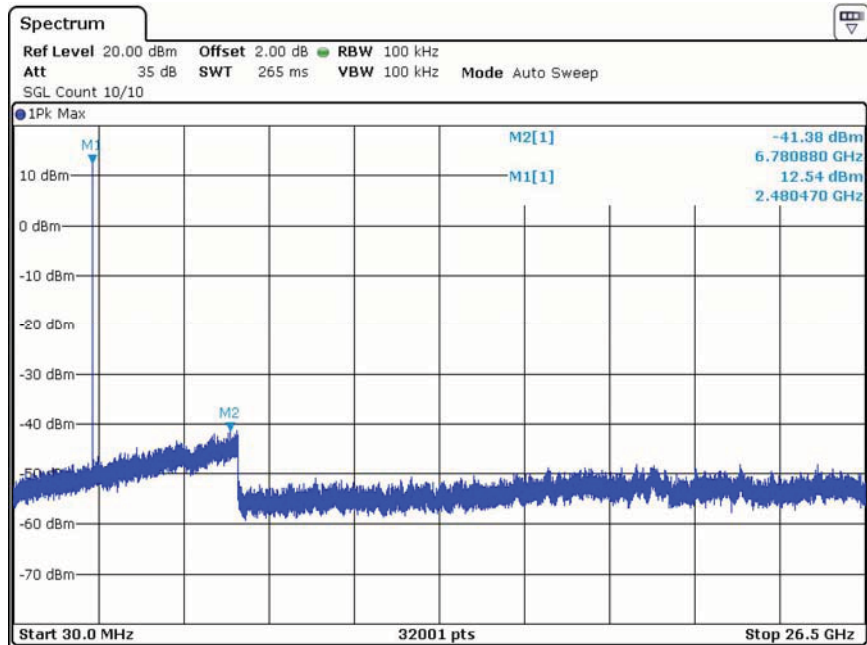
(ch_0)



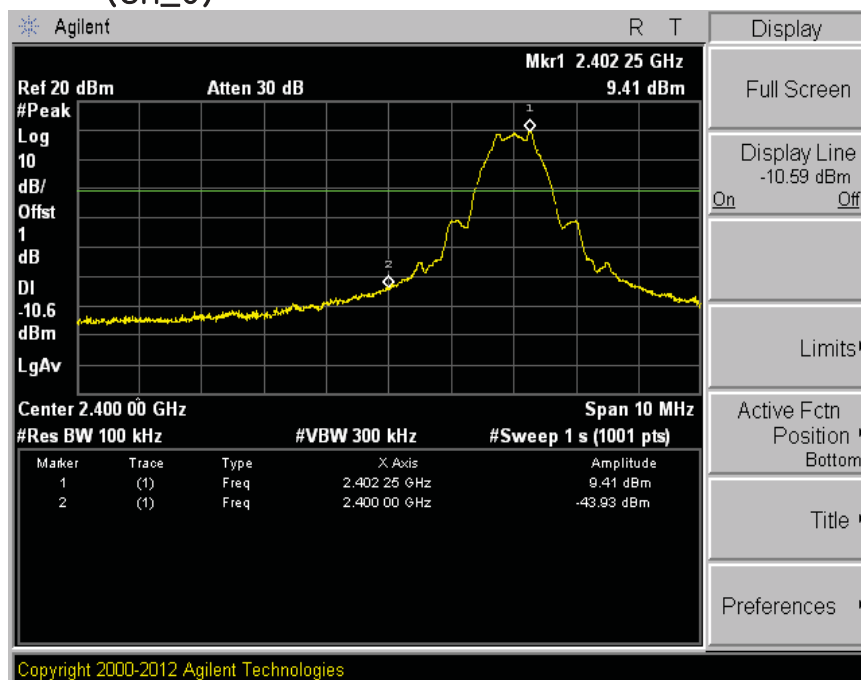
(ch_19)



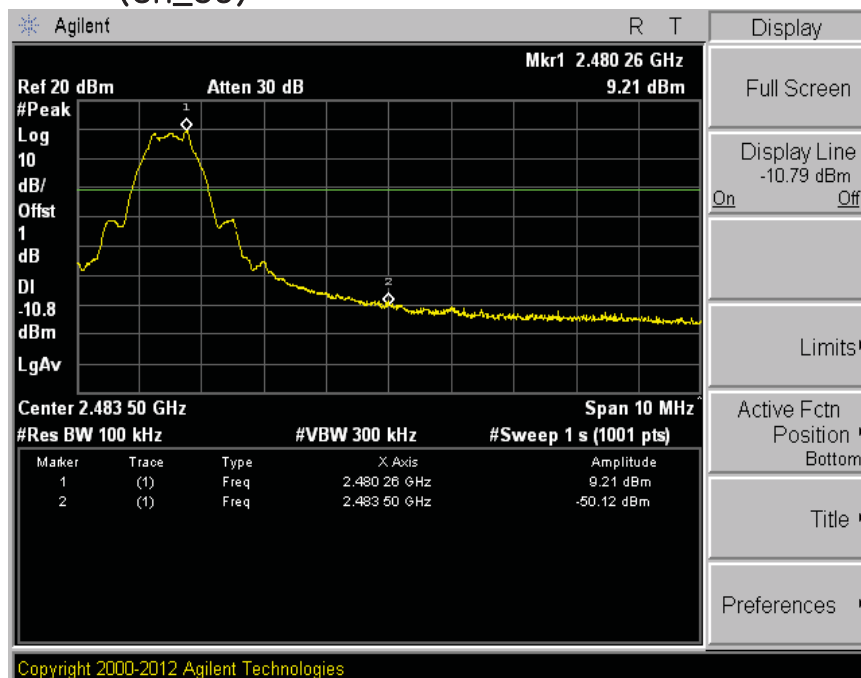
(ch_39)



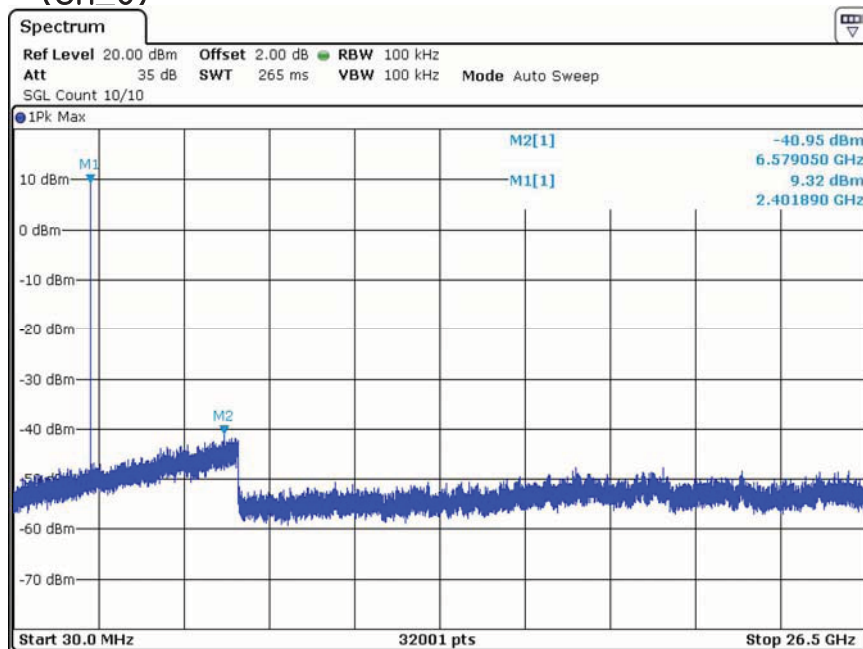
Right_LE 1M
(ch_0)



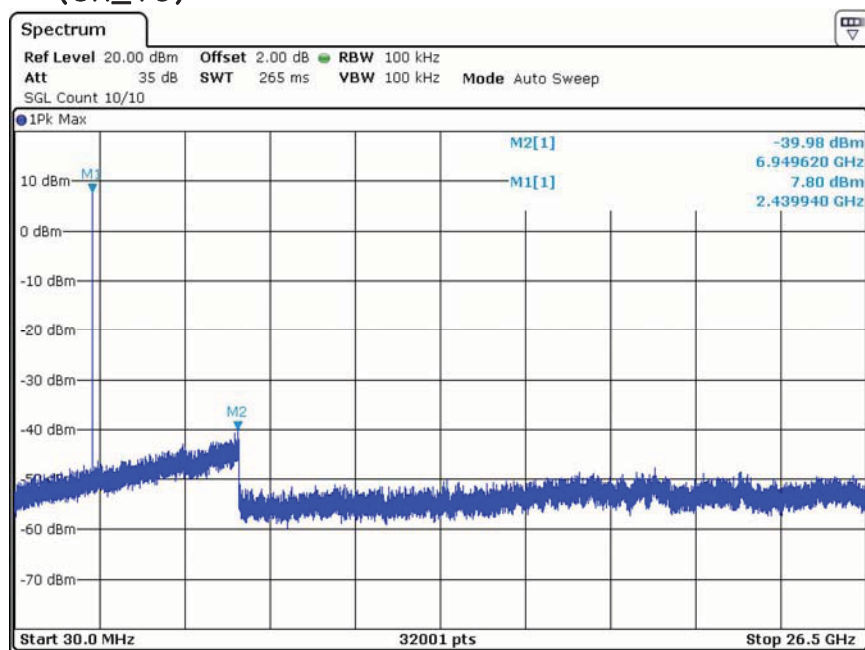
(ch_39)



(ch_0)



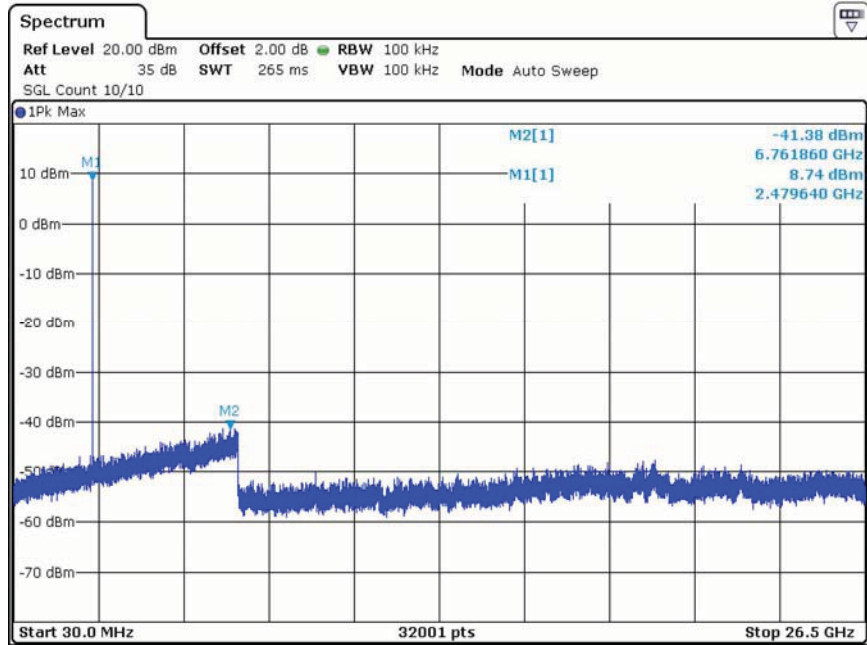
(ch_19)



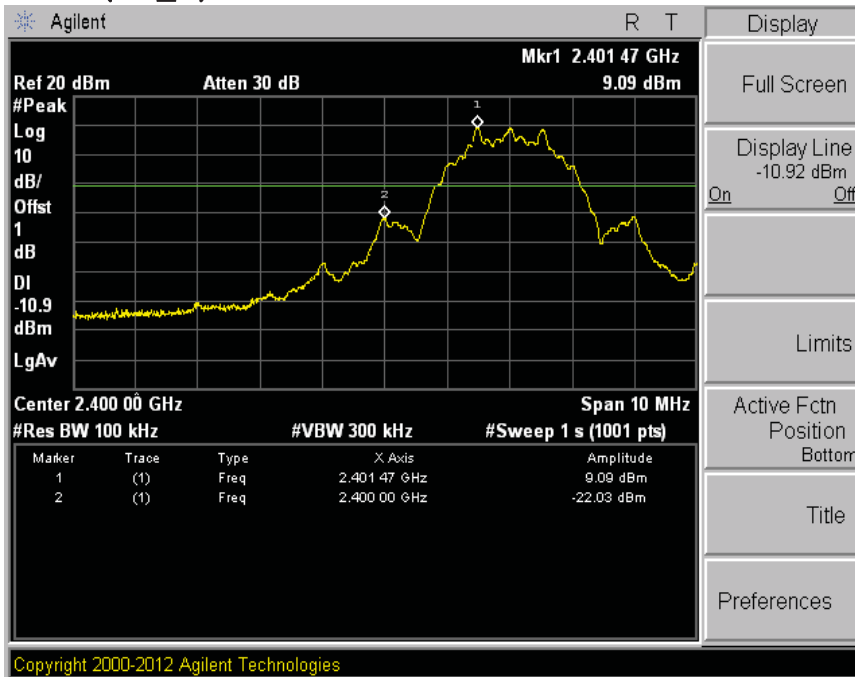


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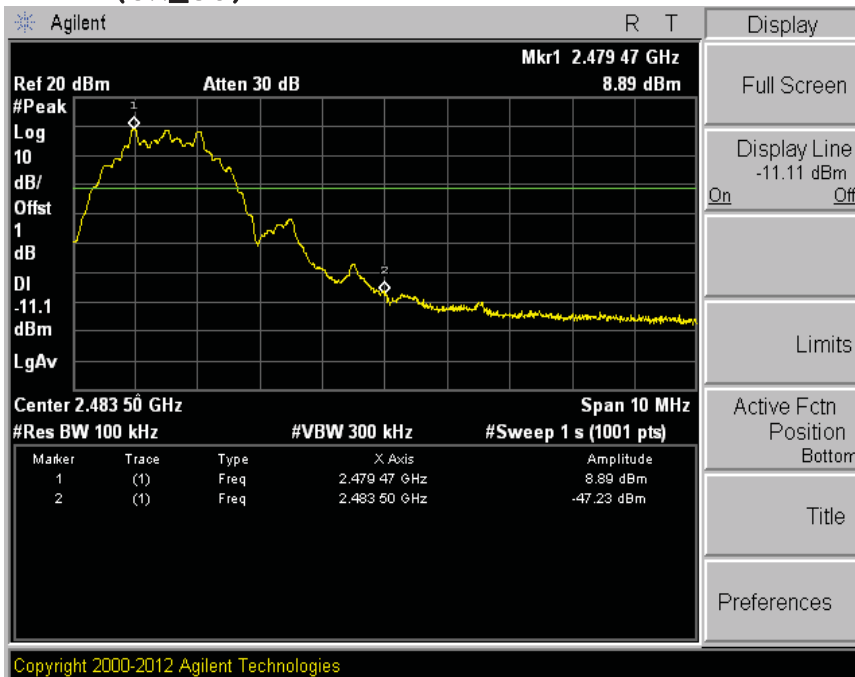
(ch_39)



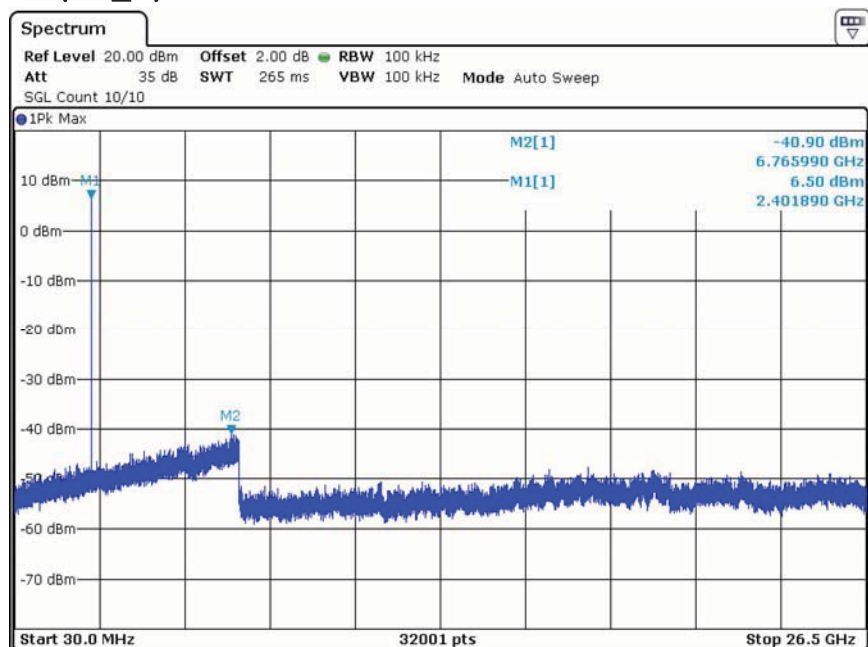
Right_LE 2M (ch_0)



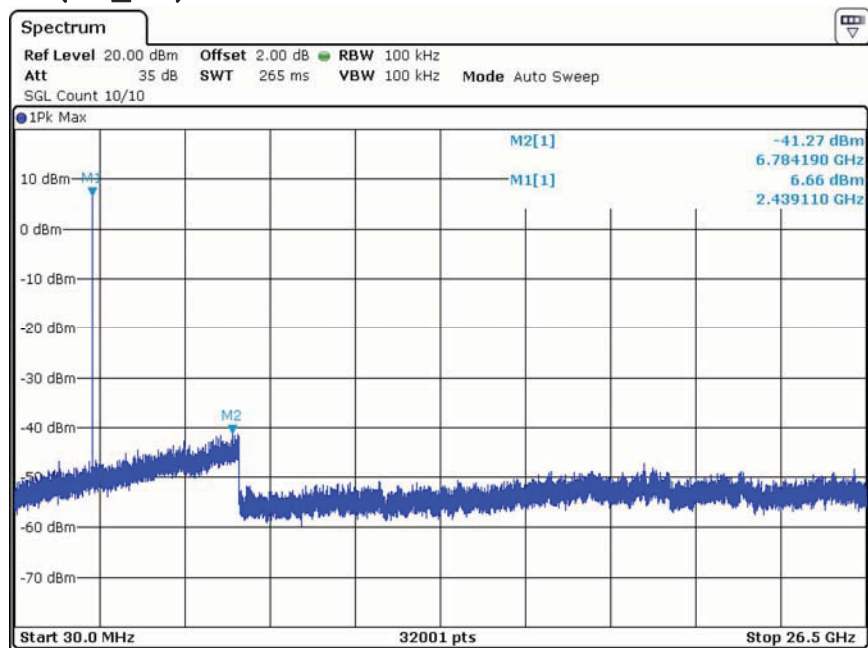
(ch_39)



(ch_0)



(ch_19)



(ch_39)

