

ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test Report No. : OT-196-RWD-033
AGR No. : A195A-013
Applicant : Samsung Electronics Co Ltd
Address : 1 Samsung-ro, Giheung-gu, Yongin-si Gyeonggi-do, South Korea
Manufacturer : Samsung Electronics Co Ltd
Address : 1 Samsung-ro, Giheung-gu, Yongin-si Gyeonggi-do, South Korea
Type of Equipment : IoT Module
FCC ID. : 2AR3A-ITM-D-BZ
Model Name : ITM-D-BZ
Serial number : N/A
Total page of Report : 93 pages (including this page)
Date of Incoming : June 05, 2019
Date of issue : June 17, 2019

SUMMARY

The equipment complies with the regulation; **FCC PART 15 SUBPART C Section 15.247**

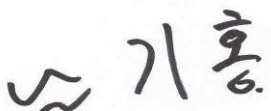
This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by:


 Tae-Ho, Kim / Senior Manager
 ONETECH Corp.

Approved by:


 Ki-Hong, Nam / Chief Engineer
 ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-196-RWD-033	June 17, 2019	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : Samsung Electronics Co Ltd
Address : 1 Samsung-ro, Giheung-gu, Yongin-si Gyeonggi-do, South Korea
Contact Person : Mounjin, Jang / Staff Engineer
Telephone No. : +070-7142-1361
FCC ID : 2AR3A-ITM-D-BZ
Model Name : ITM-D-BZ
Brand Name : -
Serial Number : N/A
Date : June 17, 2019

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	IoT Module
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 558074 D01 15.247 Meas Guidance v05r02
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (2)	Minimum 6 dB Bandwidth & 99 % Occupied Bandwidth	Met the Limit / PASS
15.247 (b) (3)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.247 (e)	Peak Power Spectral Density	Met the Limit / PASS
15.209	Radiated Emission Limits	Met the Limit / PASS
15.207	Conducted Limits	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.247.

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666 / T-1842

IC (Industry Canada) – Registration No. Site# 3736A-3

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The Samsung Electronics Co Ltd, Model ITM-D-BZ (referred to as the EUT in this report) is a IoT Module. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	IoT Module	
Temperature Range	-20 °C ~ 50 °C	
OPERATING FREQUENCY	Bluetooth	2 402 MHz ~ 2 480 MHz
	Zigbee	2 405 MHz ~ 2 480 MHz
MODULATION TYPE	Bluetooth	GFSK
	Zigbee	O-QPSK
RF OUTPUT POWER	Bluetooth	LE Coded_125 kbps: 8.75 dBm LE Coded_500 kbps: 8.50 dBm LE 1 M_1 Mbps: 8.75 dBm LE 2 M_2 Mbps: 7.85 dBm
	Zigbee	8.39 dBm
Number of Channel	Bluetooth	40 Channel
	Zigbee	16 Channel
ANTENNA TYPE		PCB Antenna
ANTENNA GAIN		3.6 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)		32 MHz

3.2 Alternative type(s)/model(s); also covered by this test report.

-. None

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	Samsung Electronics Co Ltd	ITM-D-BZ R0.2	N/A

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
ITM-D-BZ	Samsung Electronics Co Ltd	IoT Module (EUT)	-
ITM-D-BZ_EVK Rev0.2	Samsung Electronics Co Ltd	Jig Board	EUT
HP Pavilion g series	HP	Notebook PC	-
PPP009C	LIE-ON TECHNOLOGY (CHANGZHOU)CO.,LTD.	AC Adapter	-

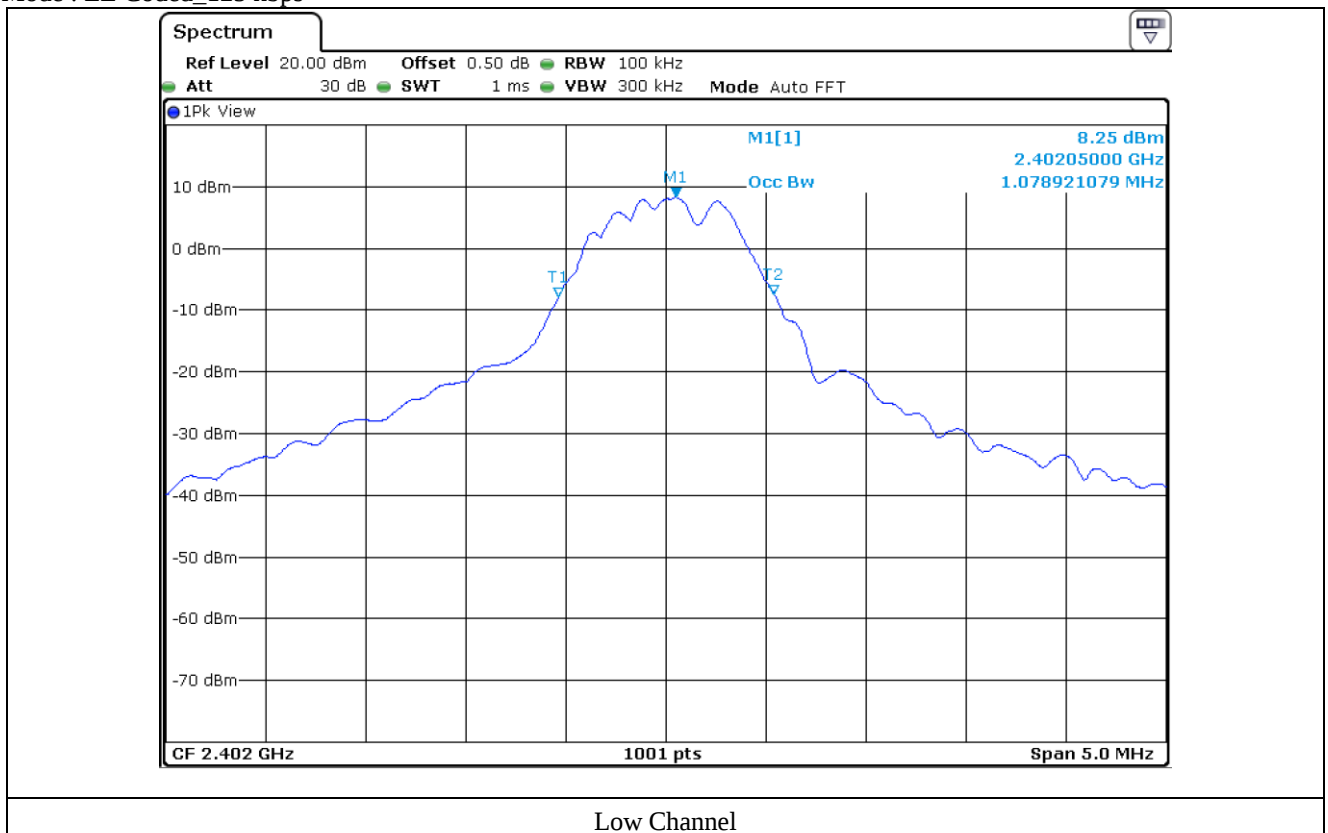
5.3 Mode of operation during the test

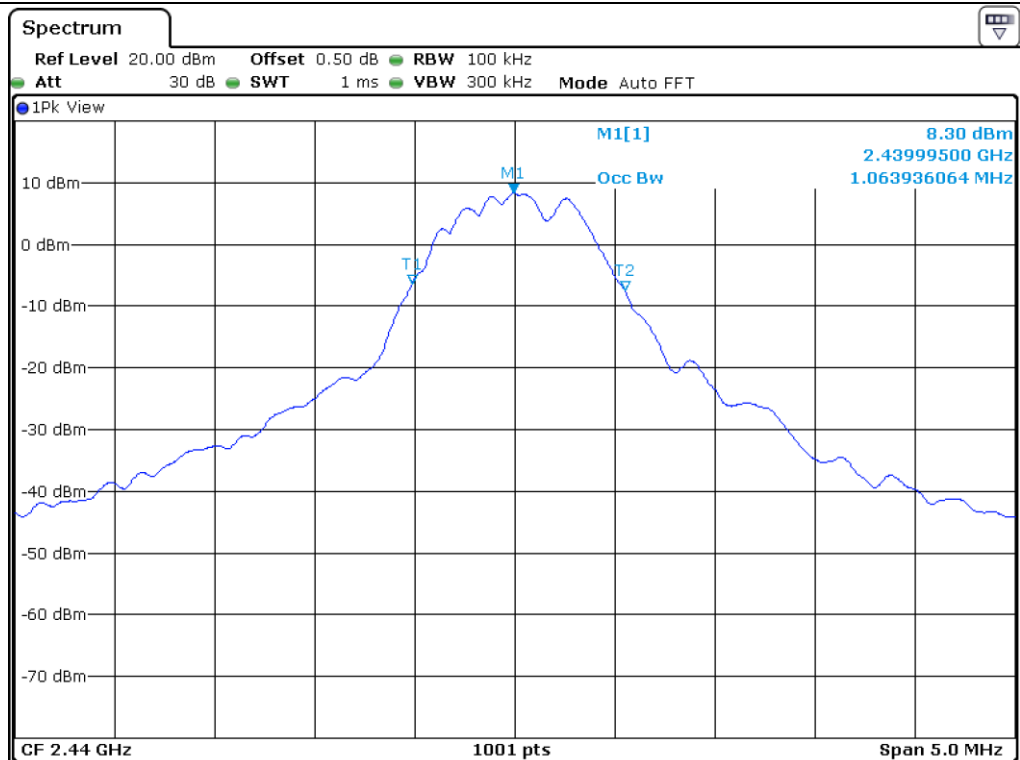
For the testing, software used to control the EUT for staying in continuous transmitting is programmed. For final testing, the EUT was set at 2 402 MHz, 2 440 MHz, and 2 480 MHz to get a maximum emission levels from the EUT. The EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XZ” axis, but the worst data was recorded in this report.

-. Occupied Bandwidth(99 %)

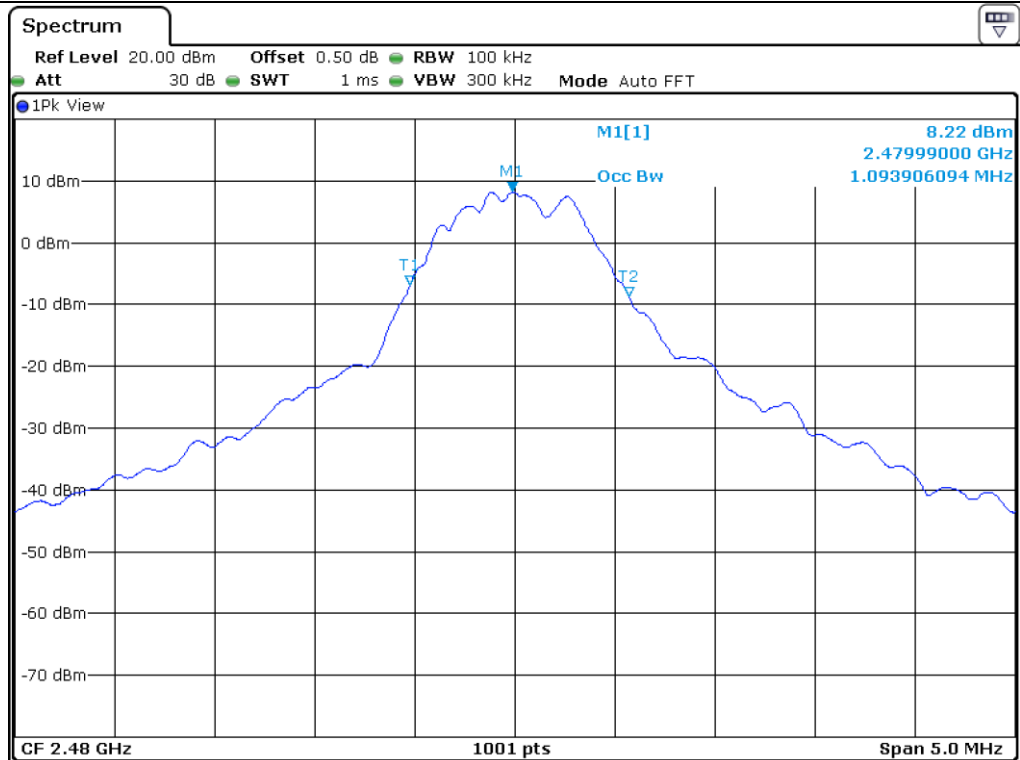
Mode	CHANNEL	FREQUENCY (MHz)	Occupied Bandwidth(MHz)
LE Coded_ 125 kbps	Low	2 402	1.08
	Middle	2 440	1.06
	High	2 480	1.09
LE Coded_ 500 kbps	Low	2 402	1.05
	Middle	2 440	1.05
	High	2 480	1.06
LE 1 M_ 1 Mbps	Low	2 402	1.02
	Middle	2 440	1.03
	High	2 480	1.05
LE 2 M_ 2 Mbps	Low	2 402	1.96
	Middle	2 440	1.96
	High	2 480	1.97

Mode : LE Coded_125 kbps



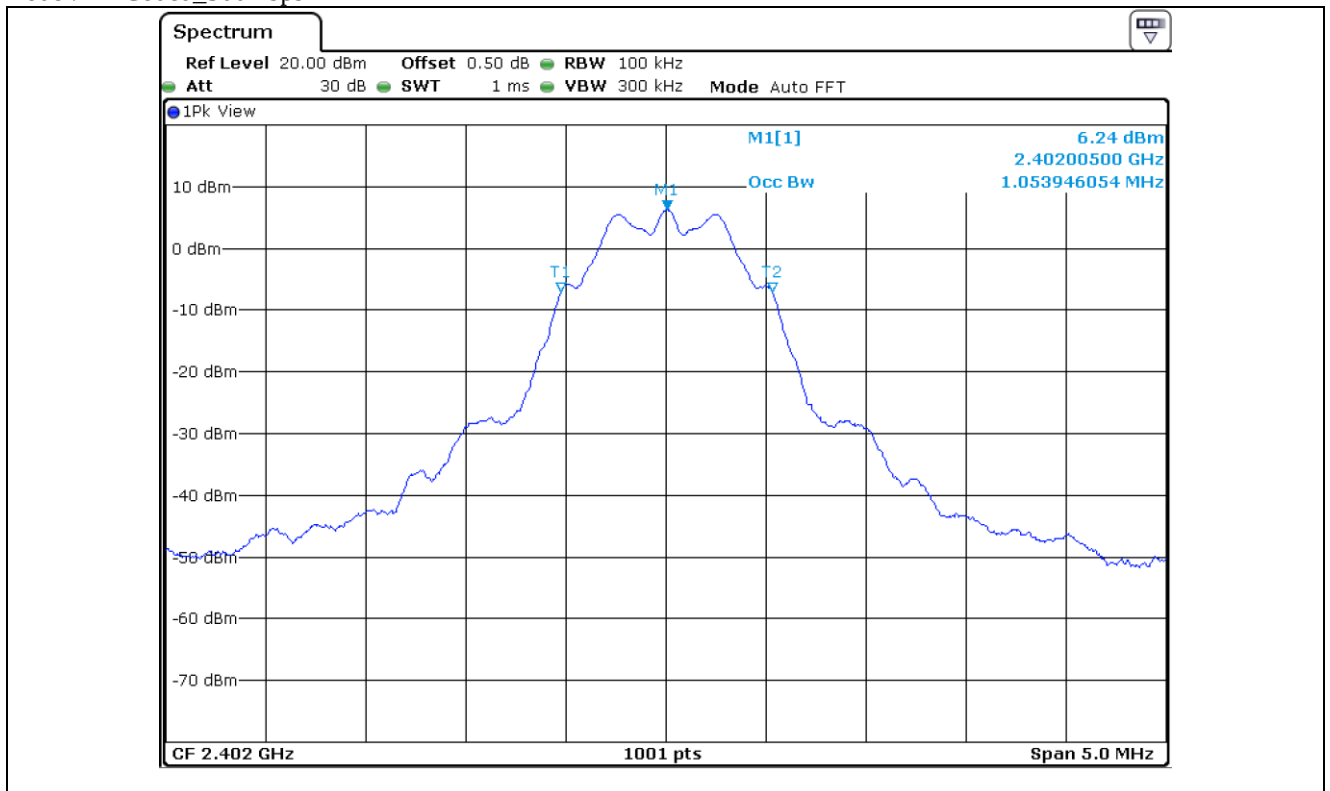


Middle Channel

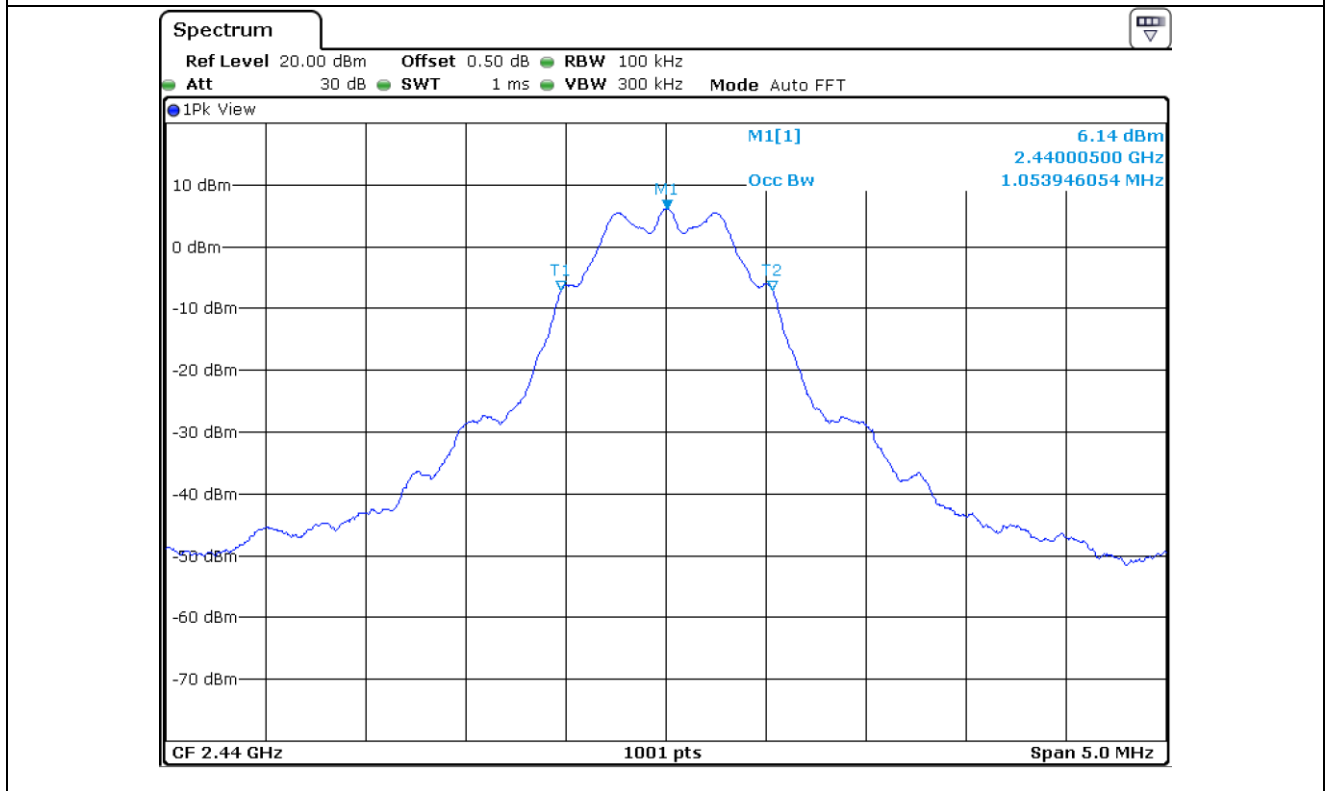


High Channel

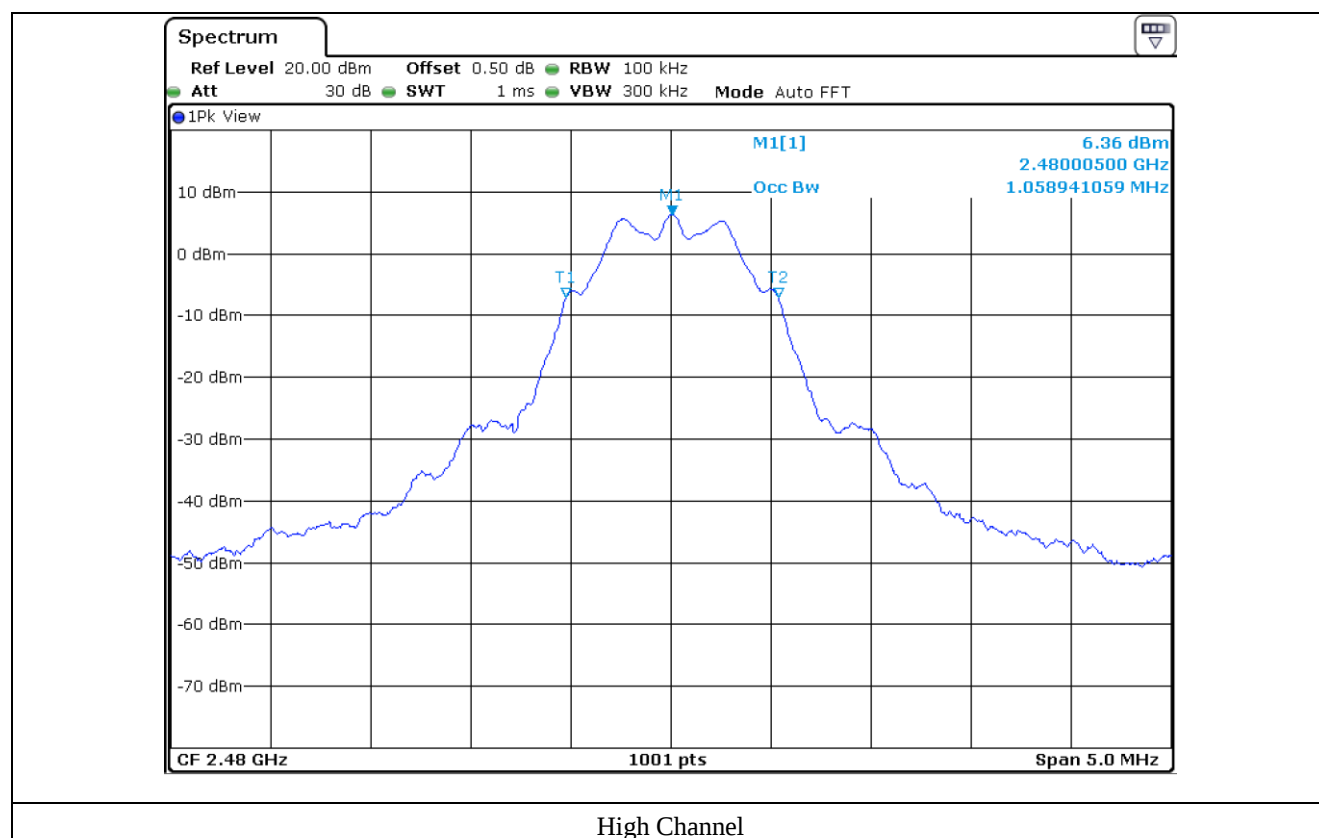
Mode : LE Coded_500 kbps



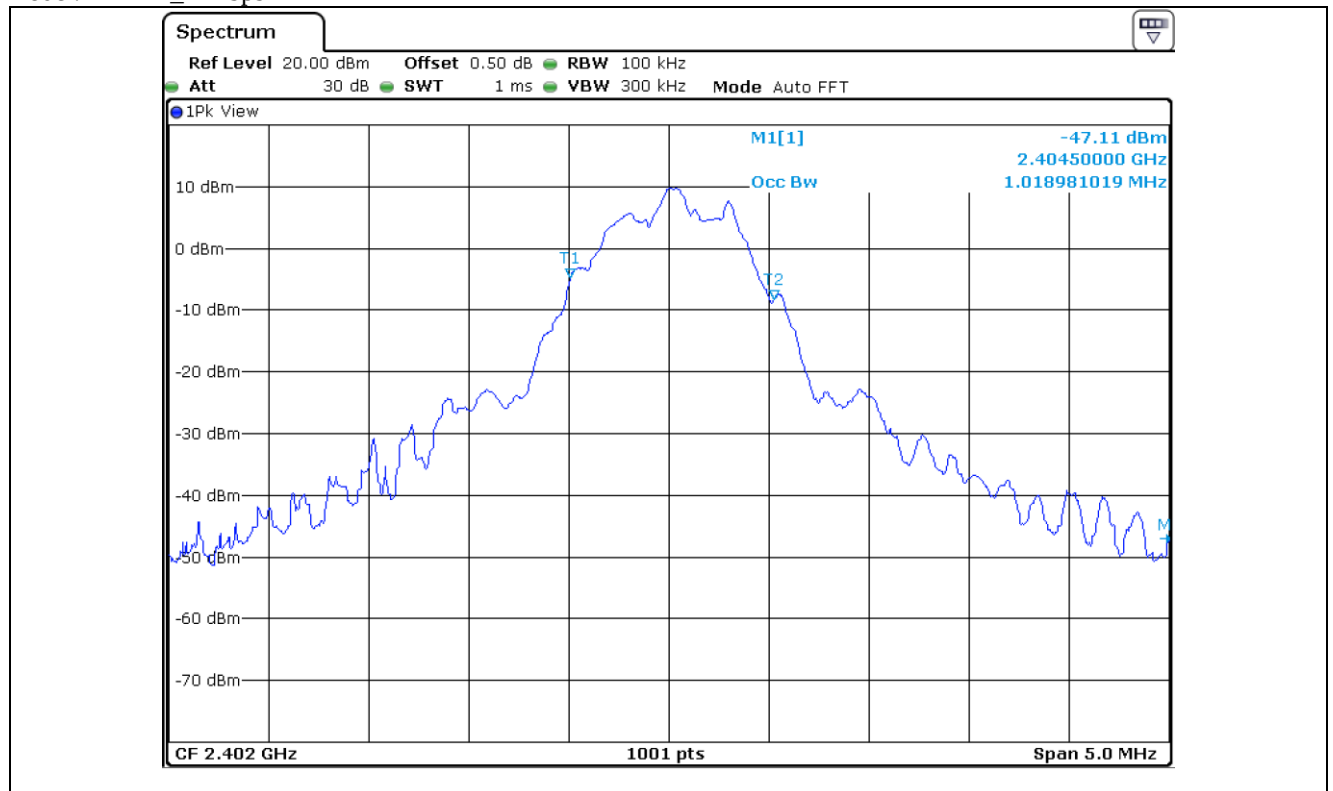
Low Channel



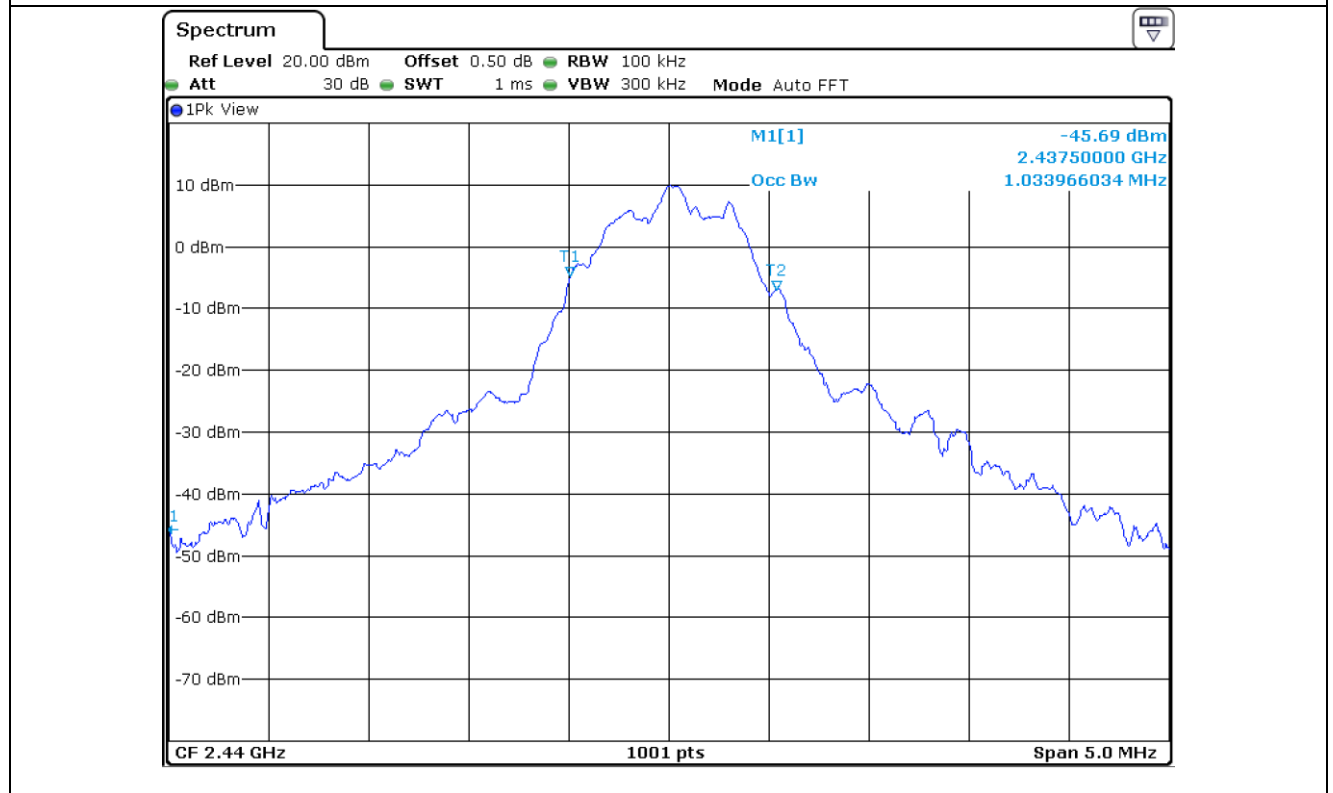
Middle Channel



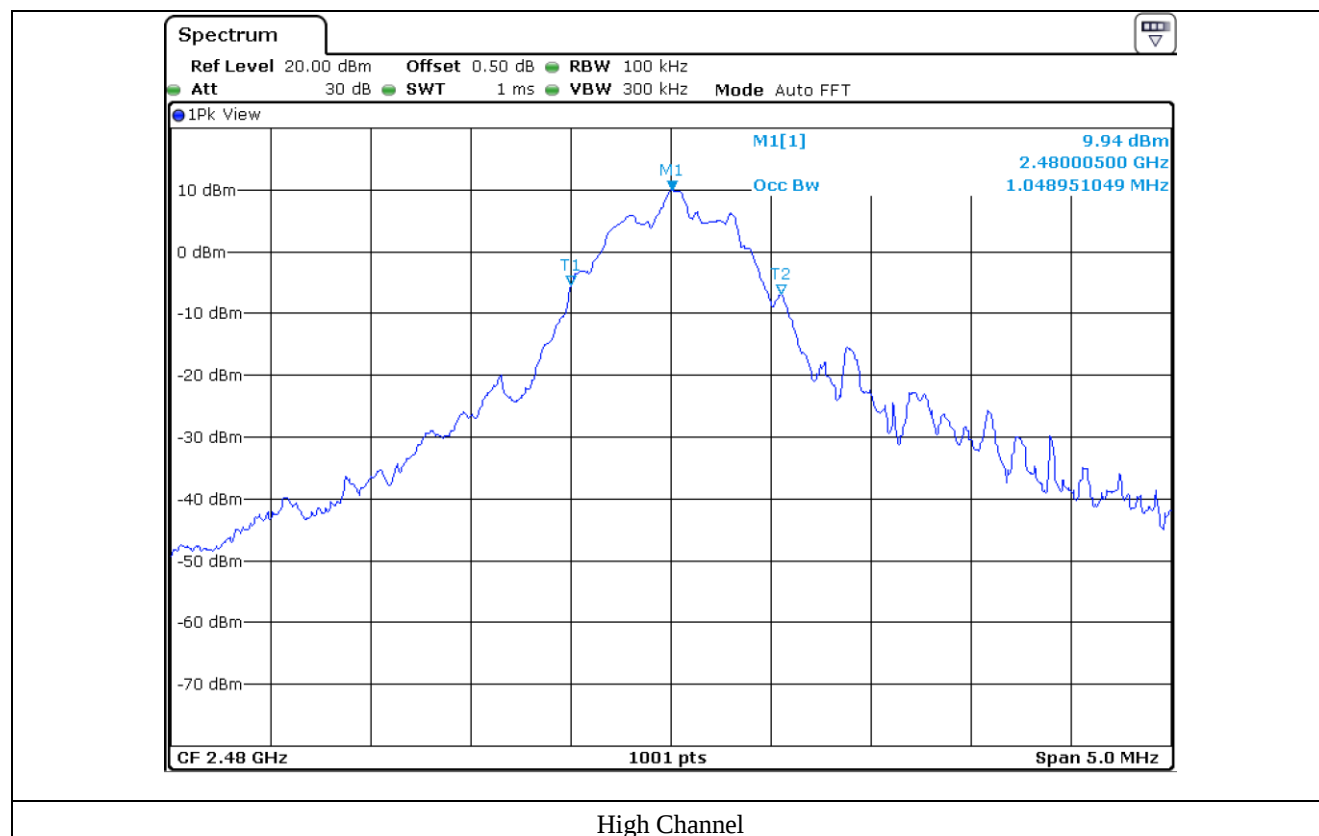
Mode : LE 1 M_1 Mbps



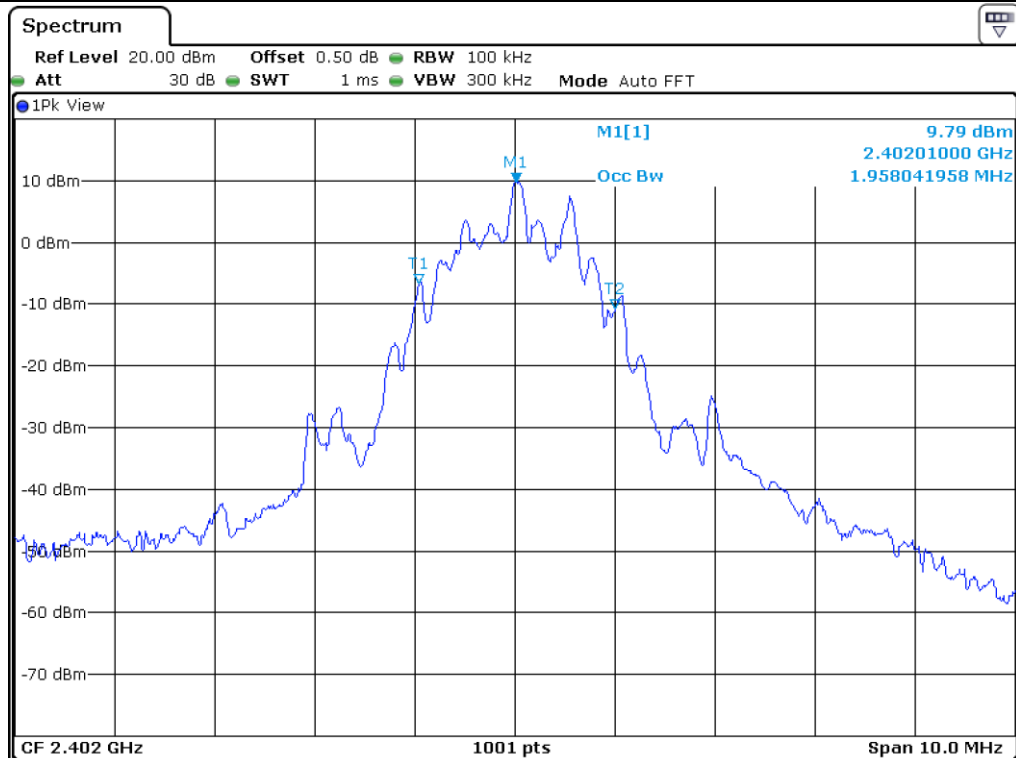
Low Channel



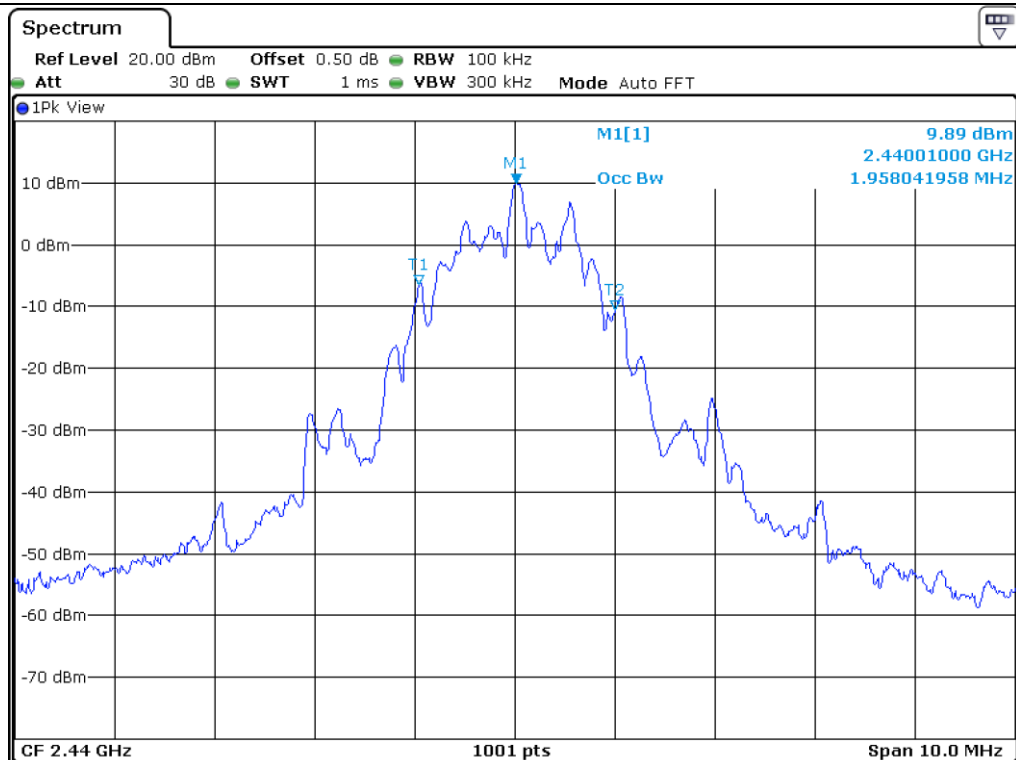
Middle Channel



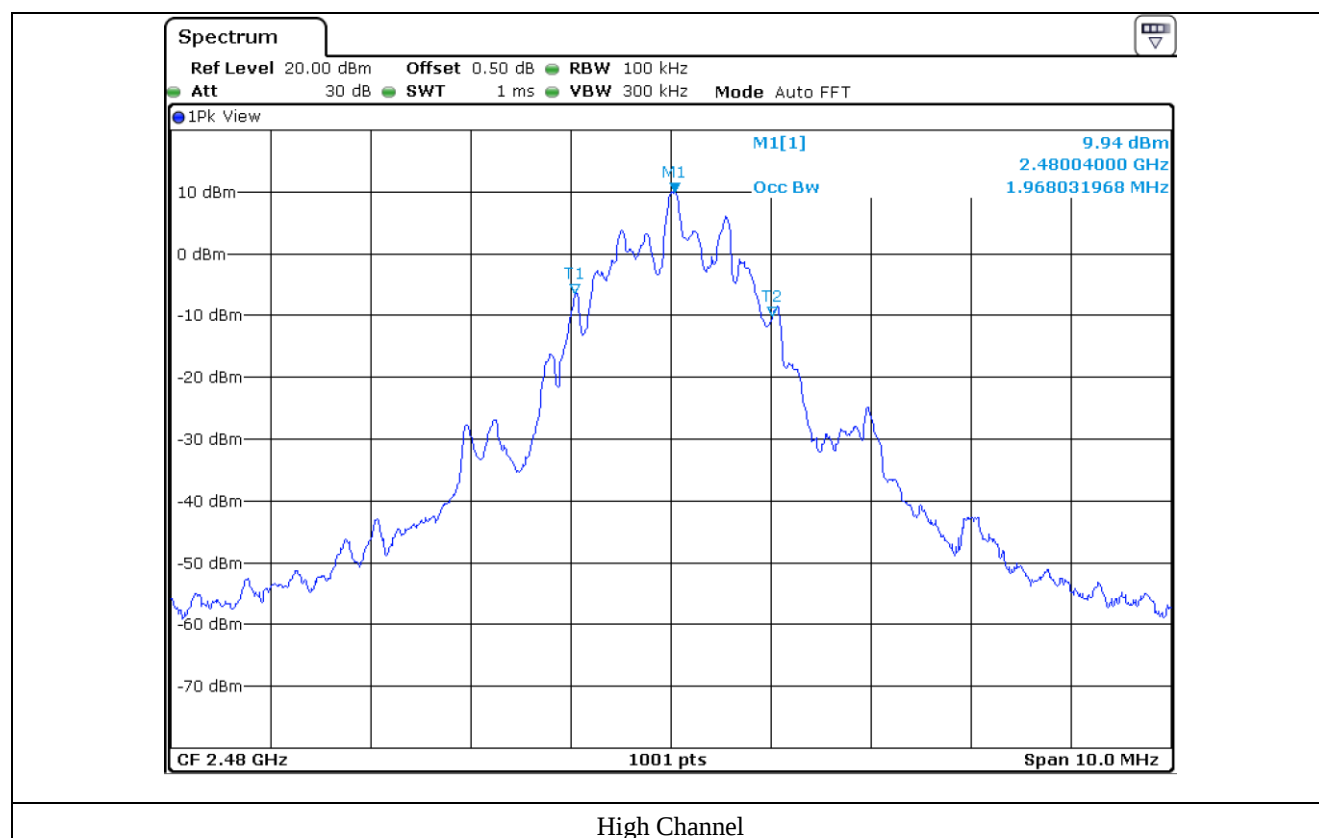
Mode : LE 2 M_2 Mbps



Low Channel



Middle Channel



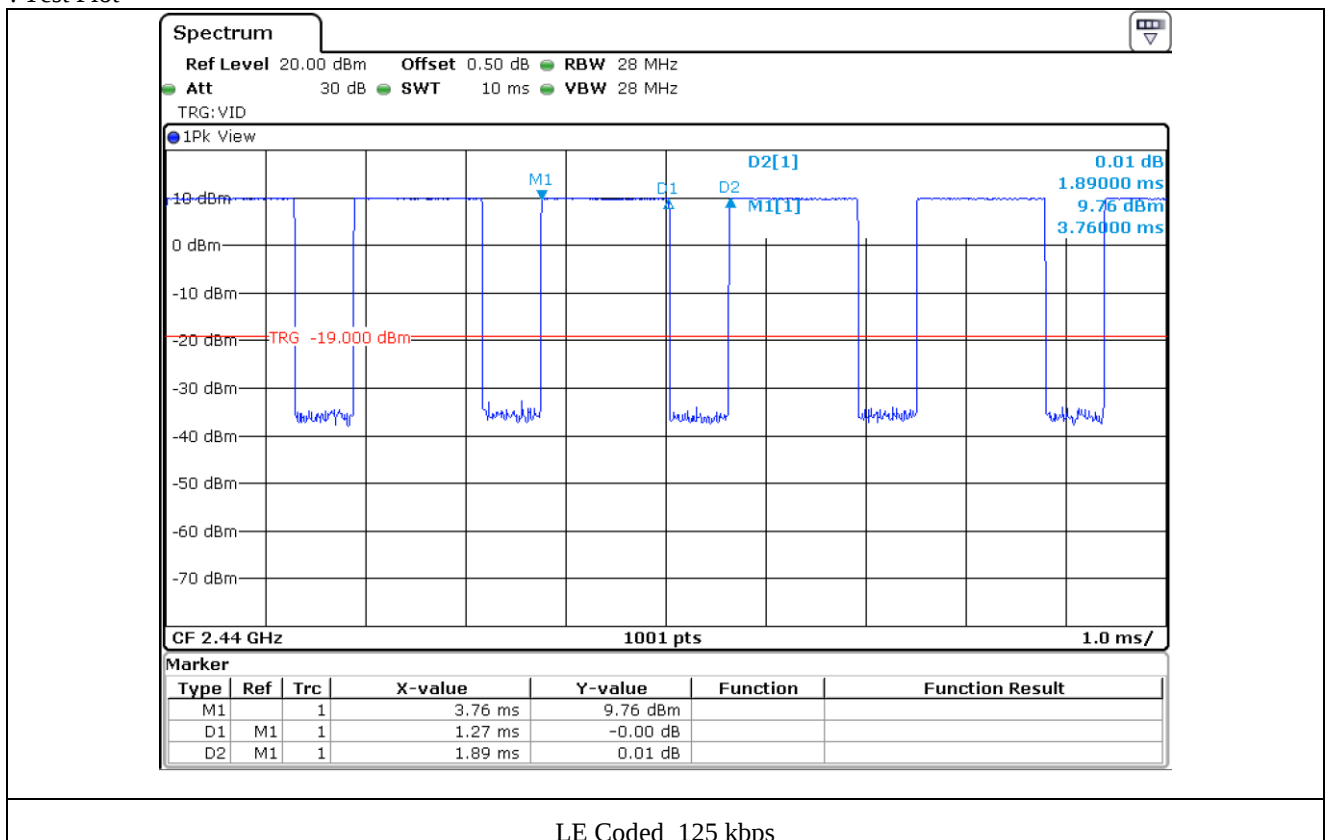
-. Duty Cycle

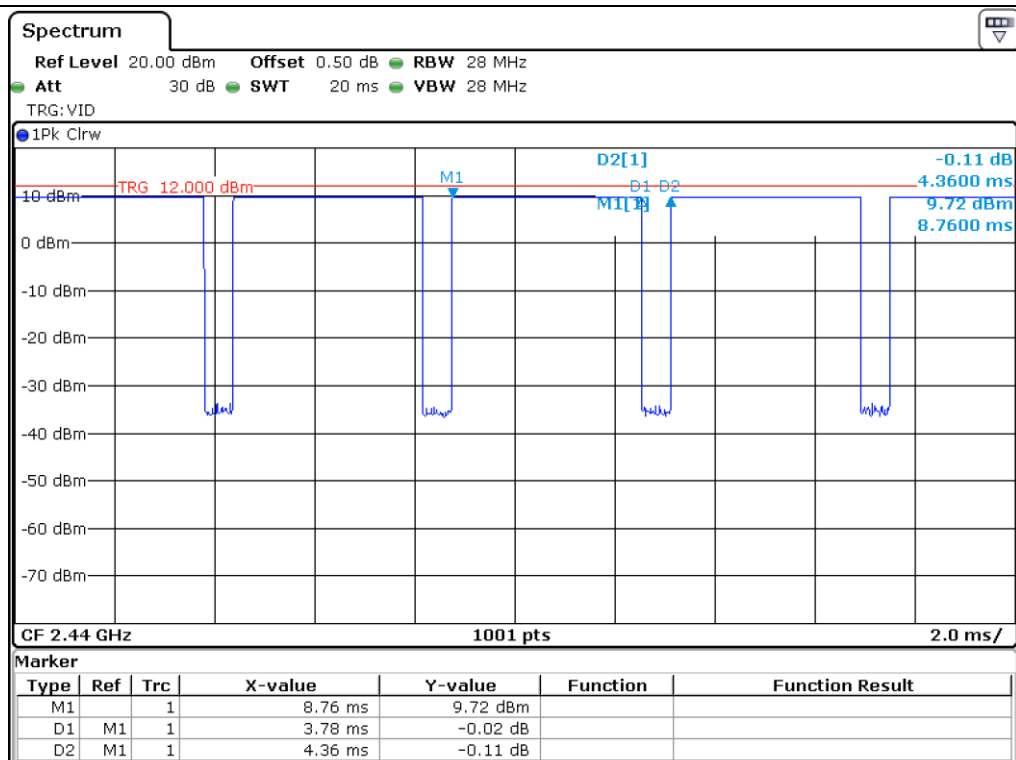
Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
LE Coded_ 125 kbps	1.270	0.620	67.20	1.73
LE Coded_ 500 kbps	3.780	0.580	86.70	0.62
LE 1 M_ 1 Mbps	0.429	0.200	68.42	1.65
LE 2 M_ 2 Mbps	0.244	0.380	38.92	4.10

Note – Duty Cycle : (Tx On Time / (Tx On Time + Tx Off Time)) * 100

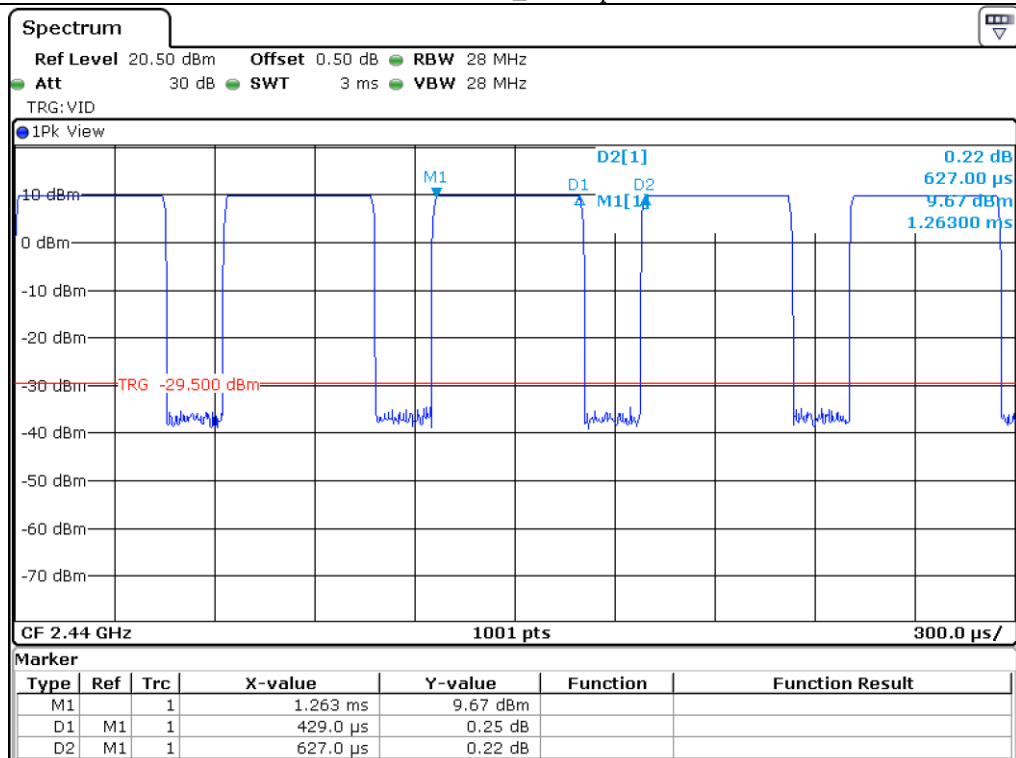
Correction Factor : 10 * Log(1 / (Duty Cycle / 100))

-. Test Plot

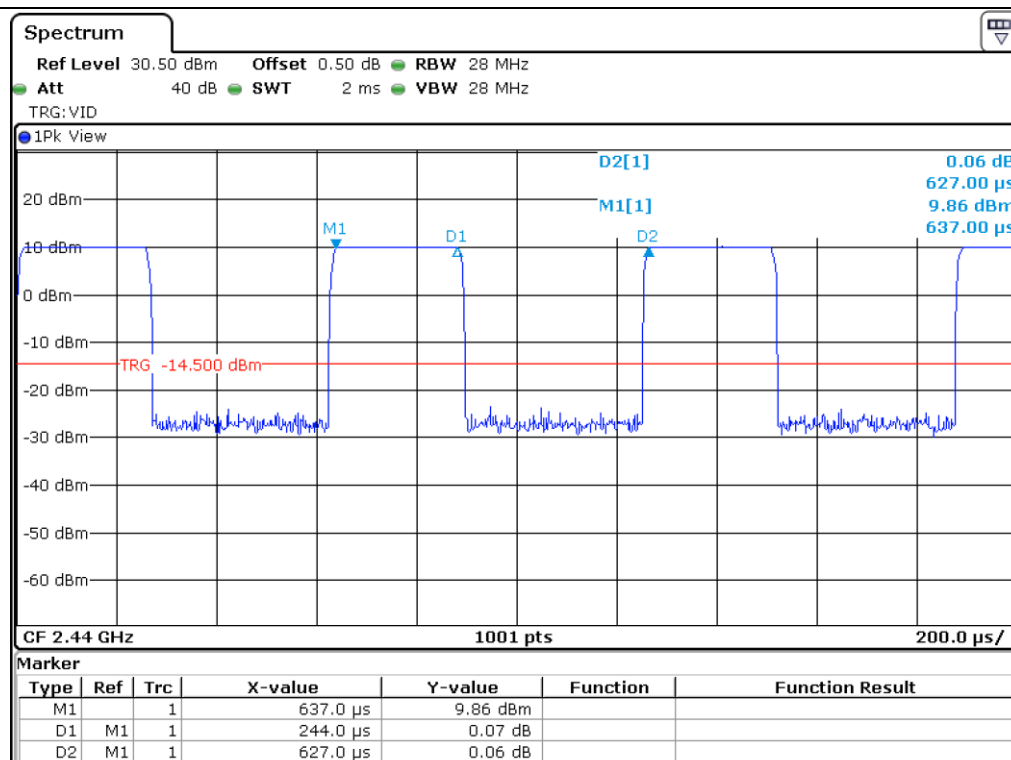




LE Coded_500 kbps



LE 1 M_1 Mbps



LE 2 M_2 Mbps

5.4 Configuration of Test System

Line Conducted Test: The EUT was connected to Jig Board and the power of USB was connected to Notebook PC. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter Semi Anechoic Chamber.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

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

Antenna Construction:

The antenna of the EUT is PCB Antenna on the main board in the EUT, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Test, the following operating mode was investigated.

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

6.2 General Radiated Emissions Tests

During Preliminary Test, the following operating mode was investigated.

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

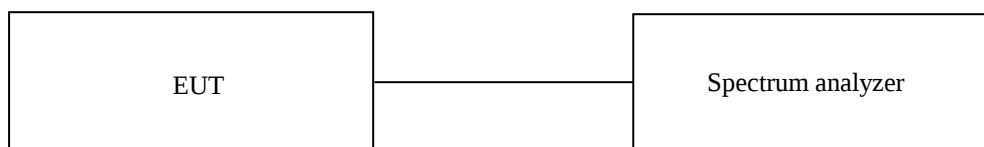
7. MINIMUM 6 dB BANDWIDTH

7.1 Operating environment

Temperature : 24.3 °C
Relative humidity : 43.9 % R.H.

7.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.



7.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

7.4 Test data for LE Coded_125 kbps

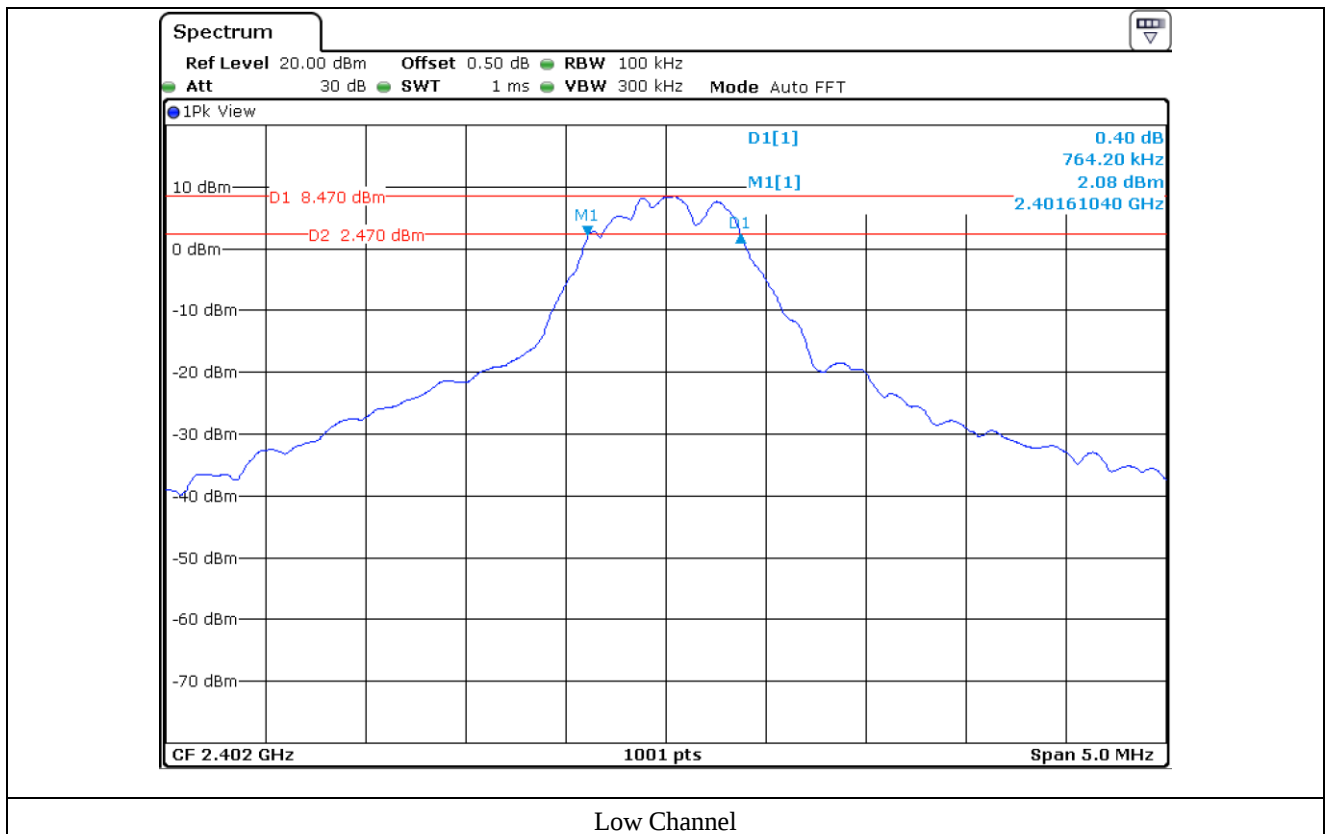
-. Test Date : June 05, 2019 ~ June 11, 2019

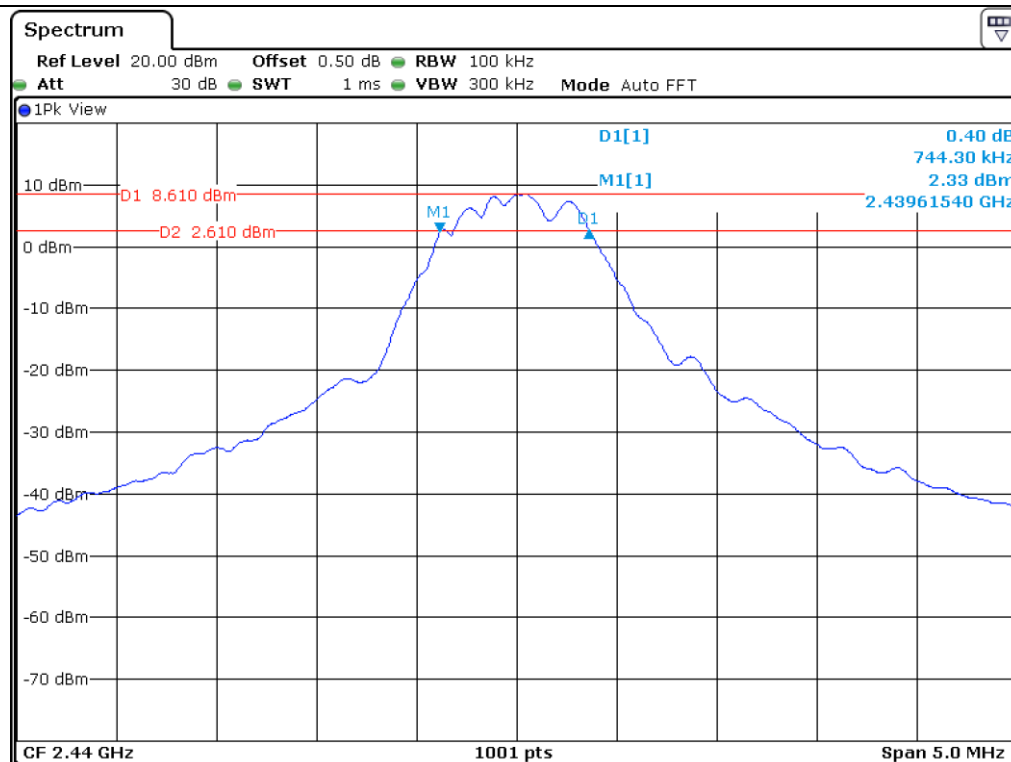
-. Test Result : Pass

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 402.00	764.20	500.00	264.20
Middle	2 440.00	744.30	500.00	244.30
High	2 480.00	749.30	500.00	249.30

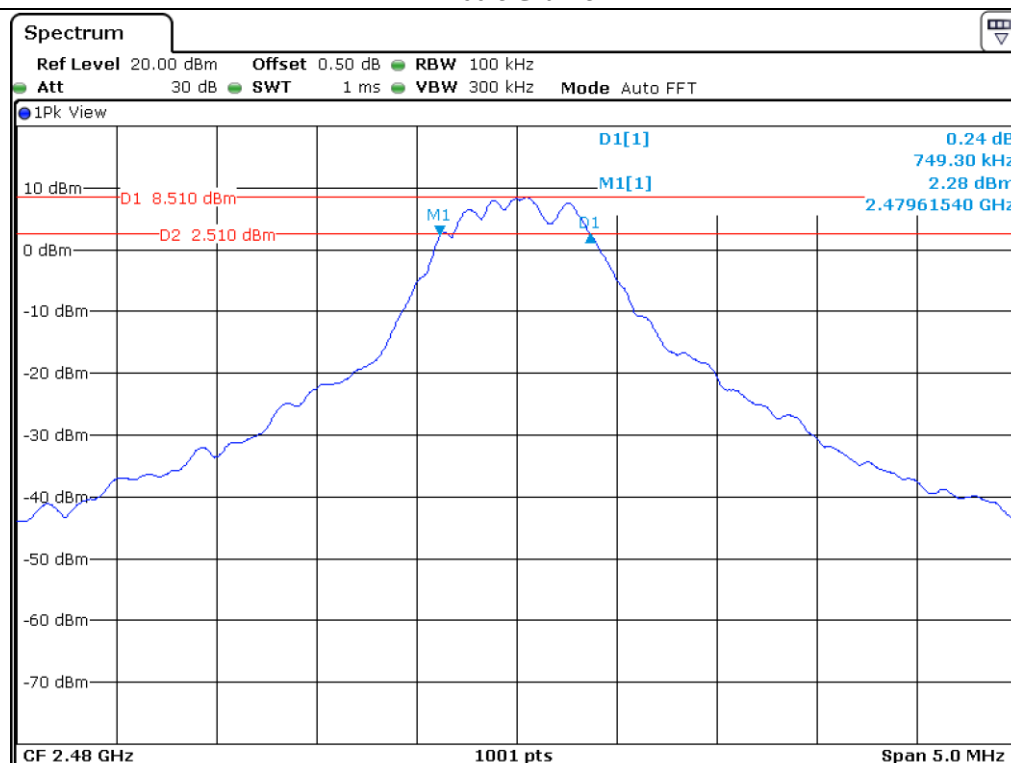
Remark. Margin = Measured Value – Limit

Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

7.5 Test data for LE Coded_500 kbps

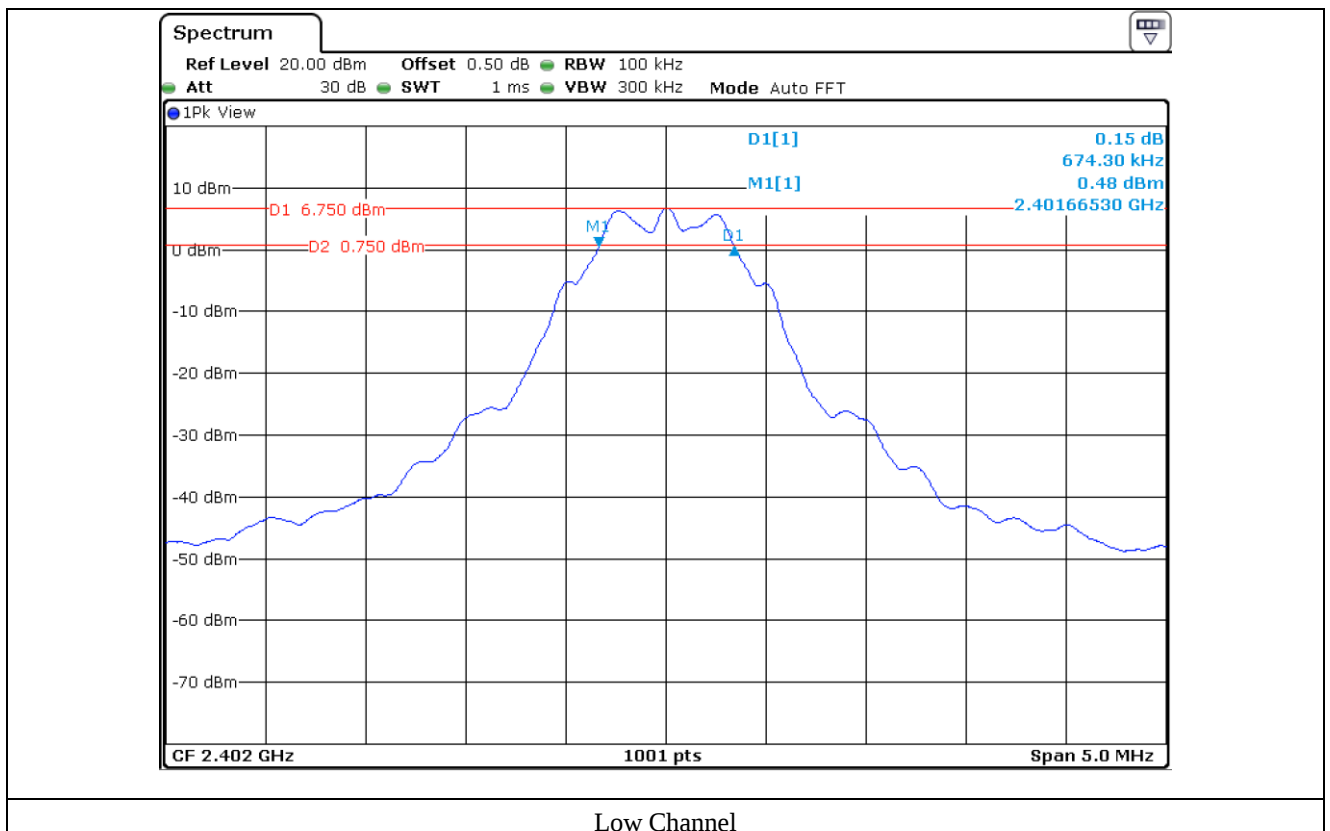
-. Test Date : June 05, 2019 ~ June 11, 2019

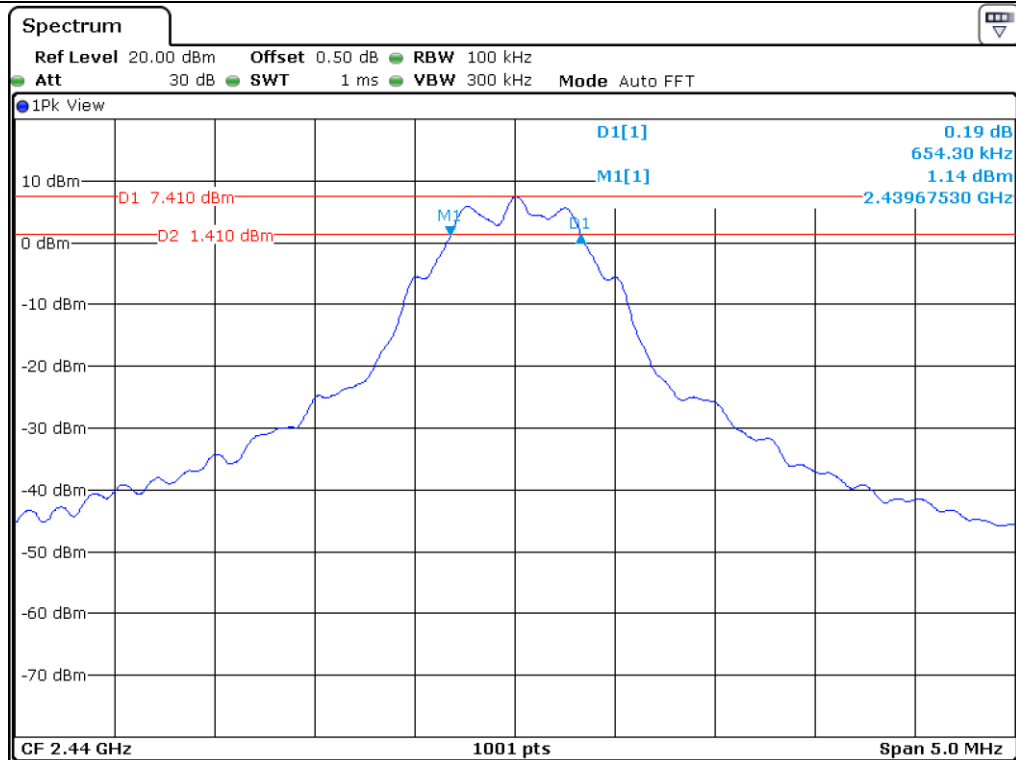
-. Test Result : Pass

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 402.00	674.30	500.00	174.30
Middle	2 440.00	654.30	500.00	154.30
High	2 480.00	674.30	500.00	174.30

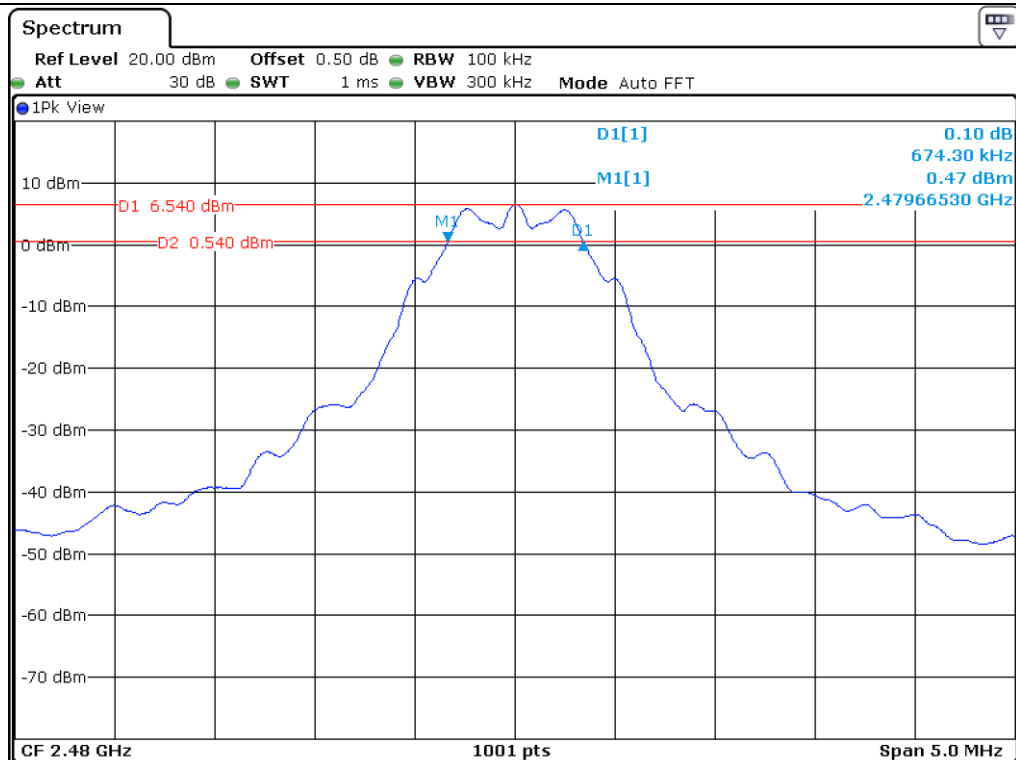
Remark. Margin = Measured Value – Limit

Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

7.6 Test data for LE 1 M_1 Mbps

-. Test Date : June 05, 2019 ~ June 11, 2019

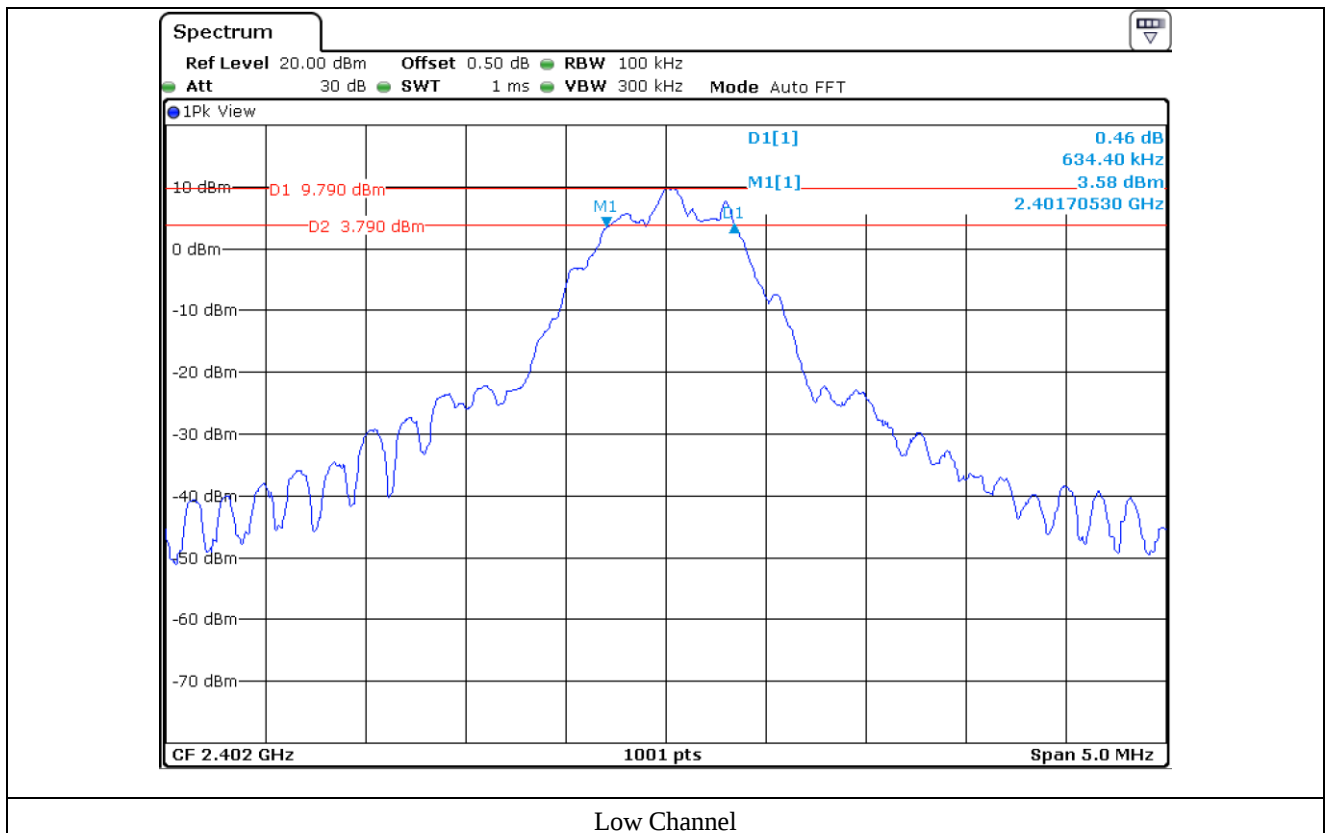
-. Test Result : Pass

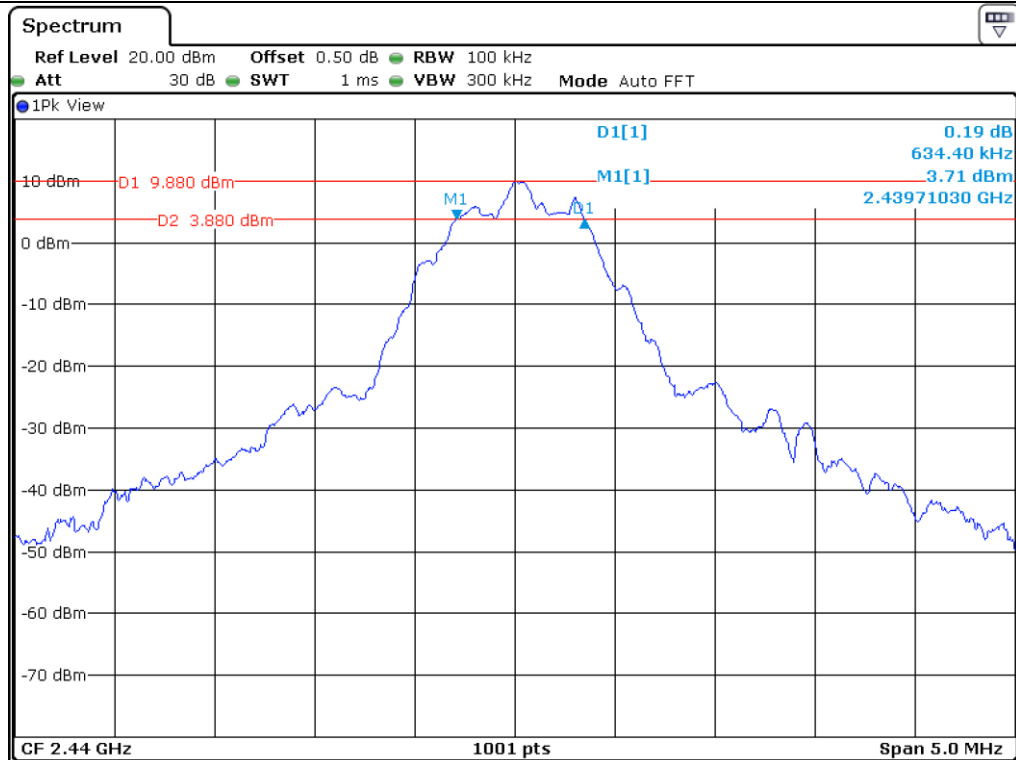
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 402.00	634.40	500.00	134.40
Middle	2 440.00	634.40	500.00	134.40
High	2 480.00	604.40	500.00	104.40

Remark. Margin = Measured Value – Limit

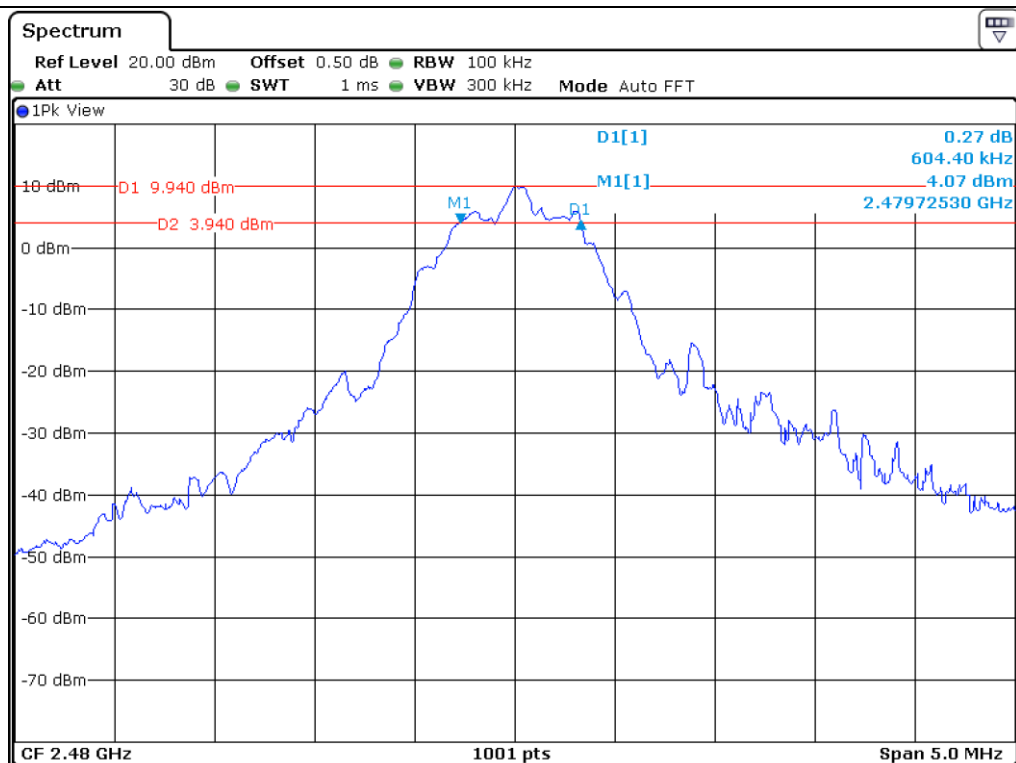


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

7.7 Test data for LE 2 M_2 Mbps

-. Test Date : June 05, 2019 ~ June 11, 2019

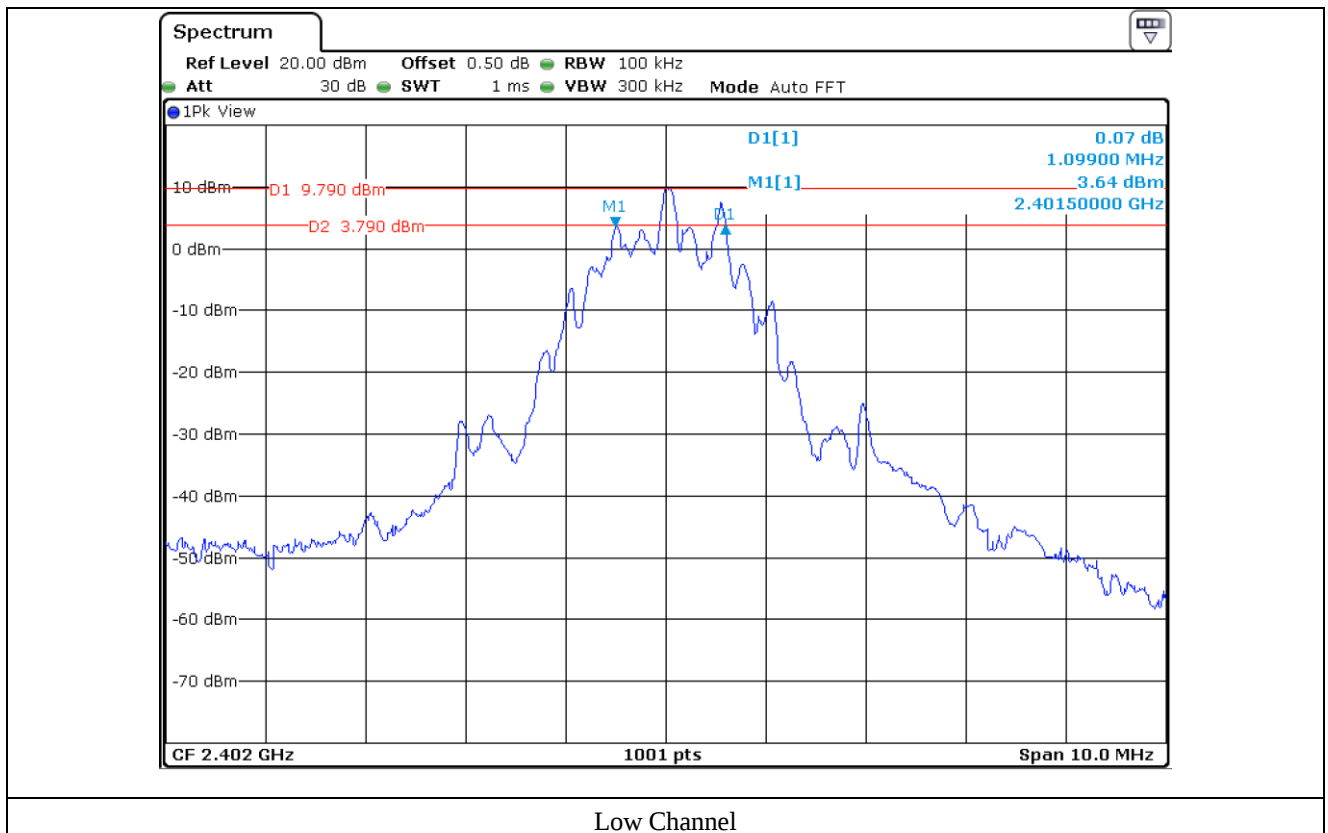
-. Test Result : Pass

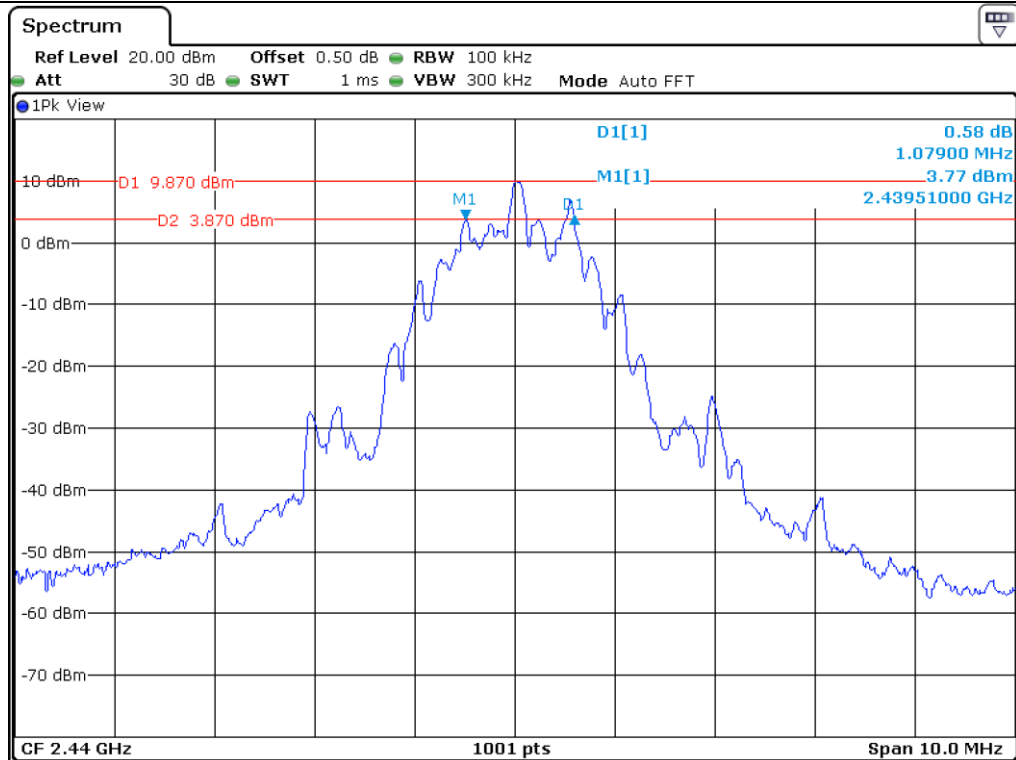
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (MHz)	LIMIT (MHz)	MARGIN (MHz)
Low	2 402.00	1.10	0.50	0.60
Middle	2 440.00	1.08	0.50	0.58
High	2 480.00	1.09	0.50	0.59

Remark. Margin = Measured Value – Limit



Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

8. MAXIMUM PEAK OUTPUT POWER

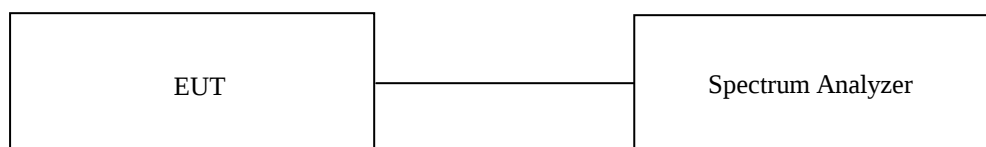
8.1 Operating environment

Temperature : 24.3 °C
Relative humidity : 43.9 % R.H.

8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer.

Uses trace averaging across ON and OFF times of the EUT transmissions, followed by duty cycle correction.



8.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data for LE Coded_125 kbps

-. Test Date : June 05, 2019 ~ June 11, 2019

-. Test Result : Pass

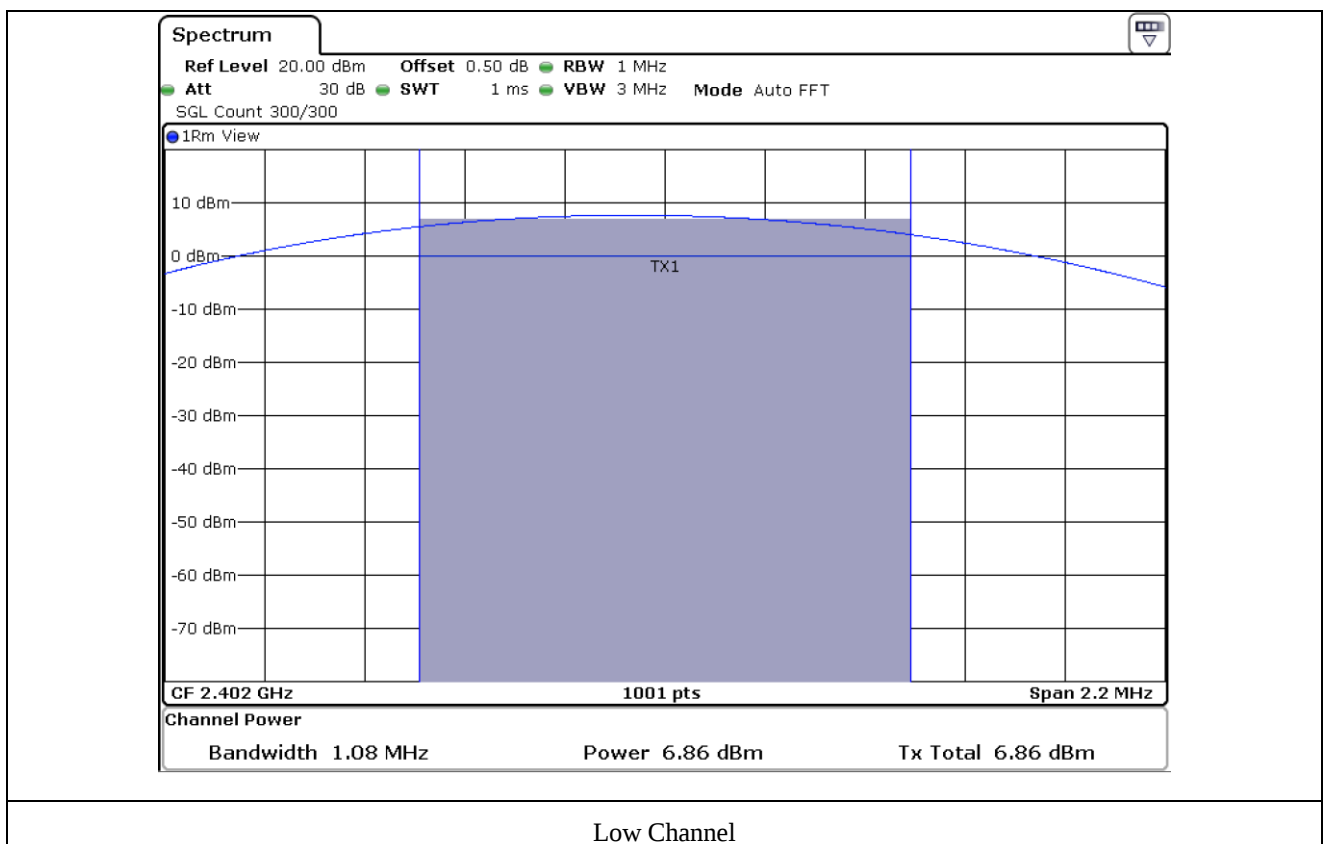
-. Duty Cycle : 67.20 %

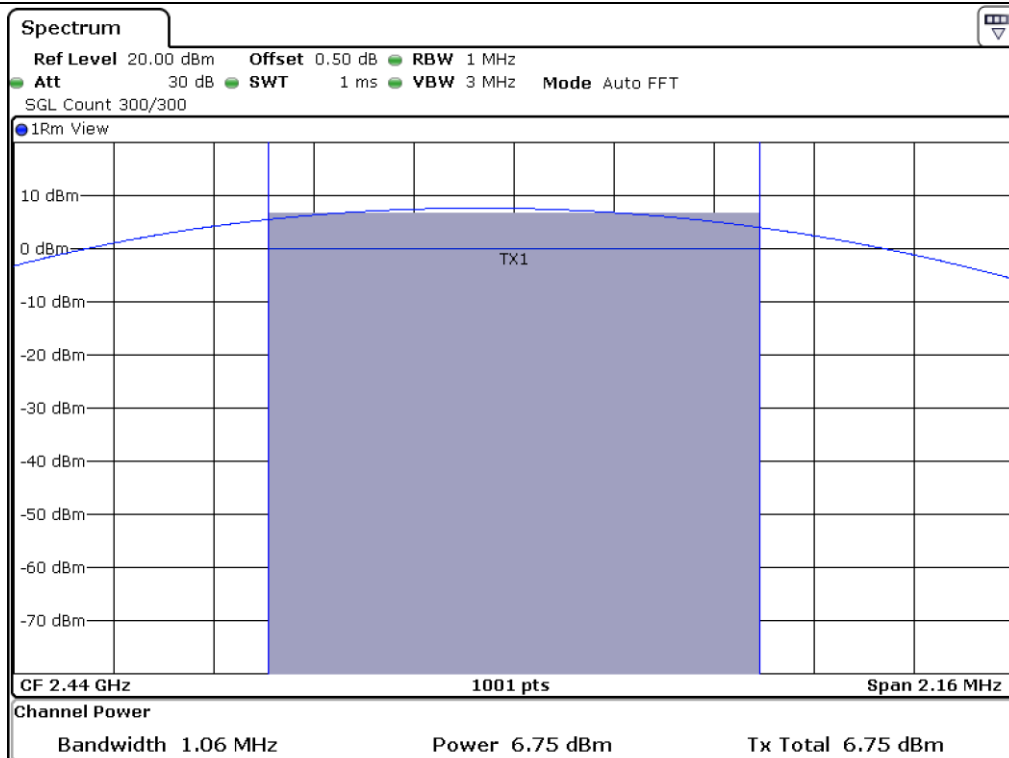
CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	CORRECTION FACTOR (dB)	RESULT (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	6.86	1.73	8.59	30.00	21.41
MIDDLE	2 440.00	6.75	1.73	8.48	30.00	21.52
HIGH	2 480.00	7.02	1.73	8.75	30.00	21.25

Remark : Margin = Limit – Result (= Measured Value + Correction Factor)

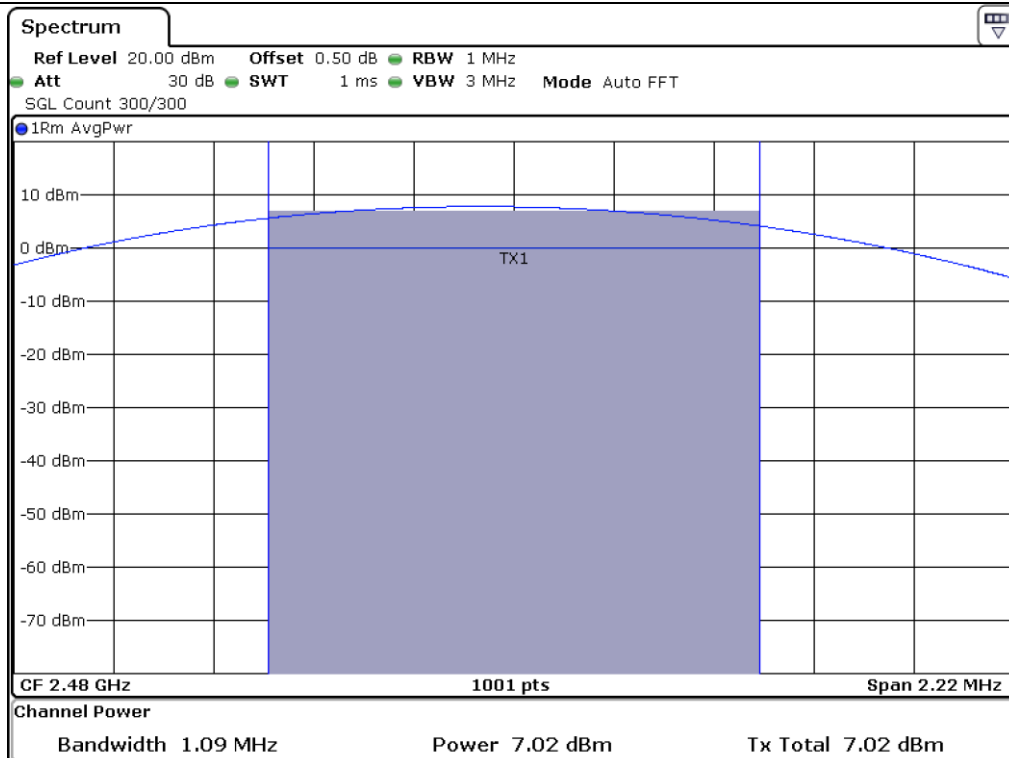


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

8.5 Test data for LE Coded_500 kbps

-. Test Date : June 05, 2019 ~ June 11, 2019

-. Test Result : Pass

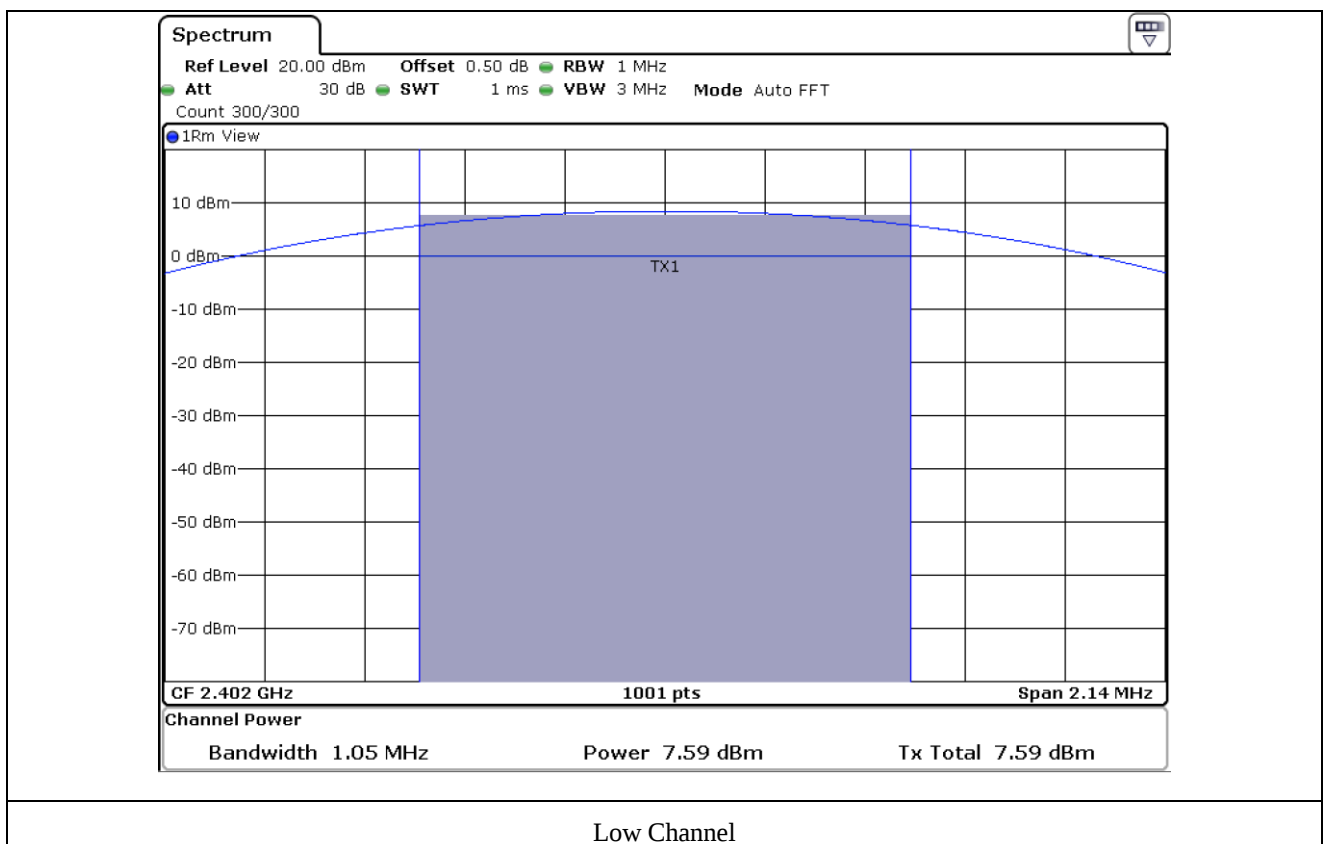
-. Duty Cycle : 86.70 %

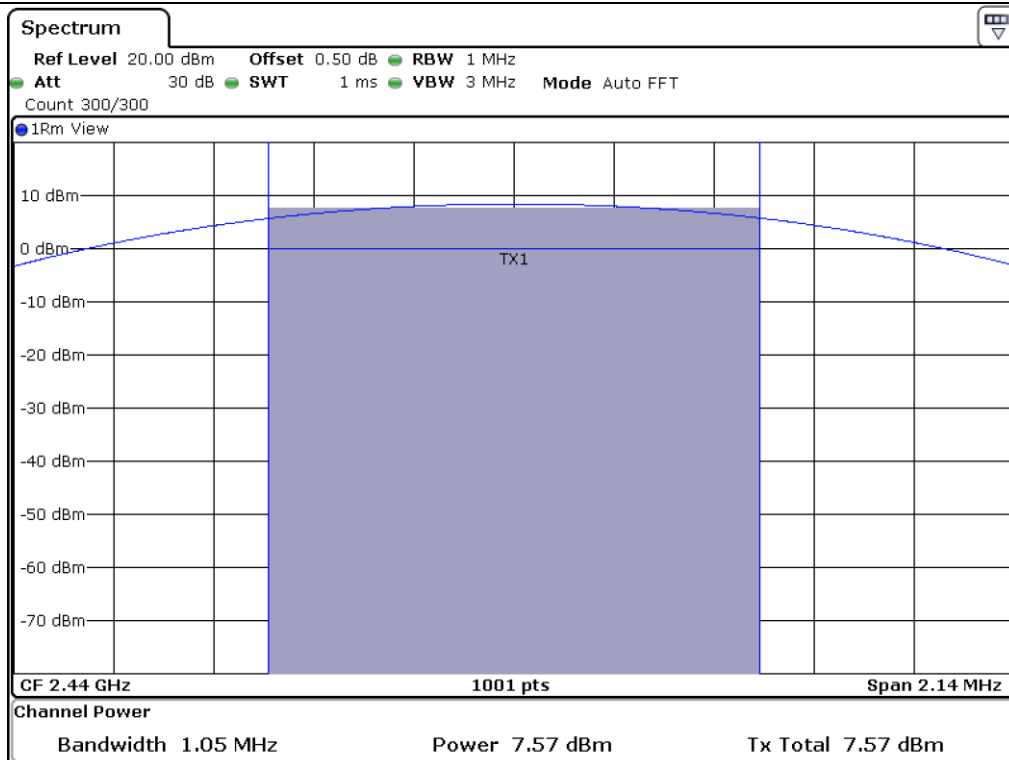
CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	CORRECTION FACTOR (dB)	RESULT (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	7.59	0.62	8.21	30.00	21.79
MIDDLE	2 440.00	7.57	0.62	8.19	30.00	21.81
HIGH	2 480.00	7.88	0.62	8.50	30.00	21.50

Remark : Margin = Limit – Result (= Measured Value + Correction Factor)

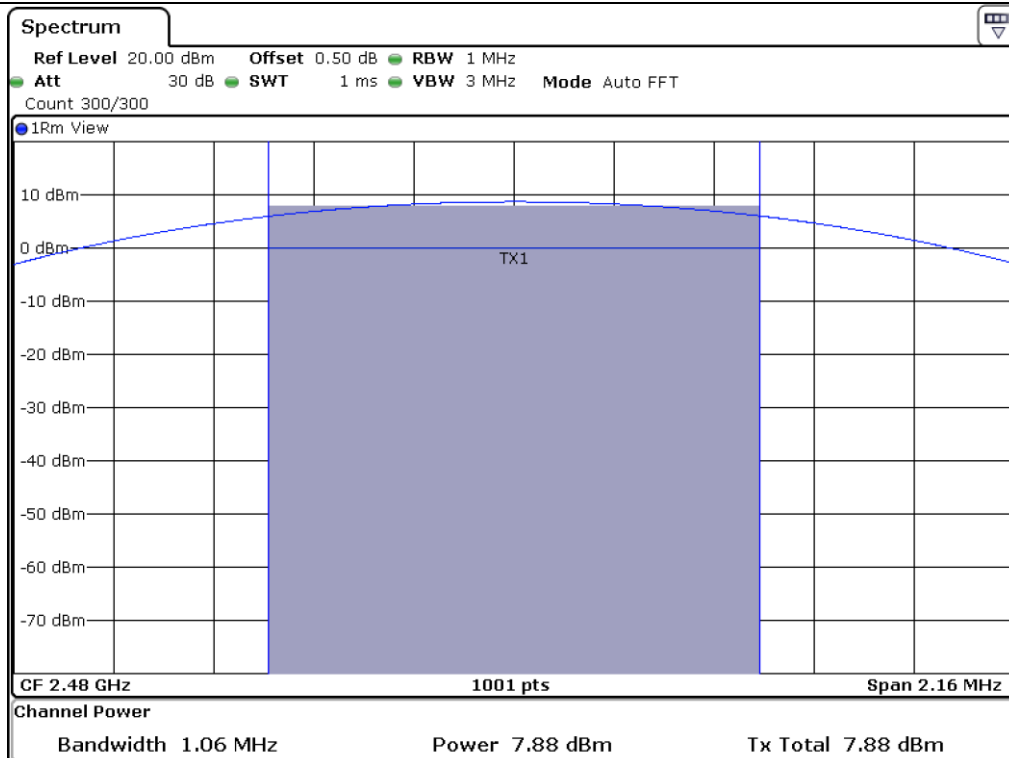


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

8.6 Test data for LE 1 M_1 Mbps

-. Test Date : June 05, 2019 ~ June 11, 2019

-. Test Result : Pass

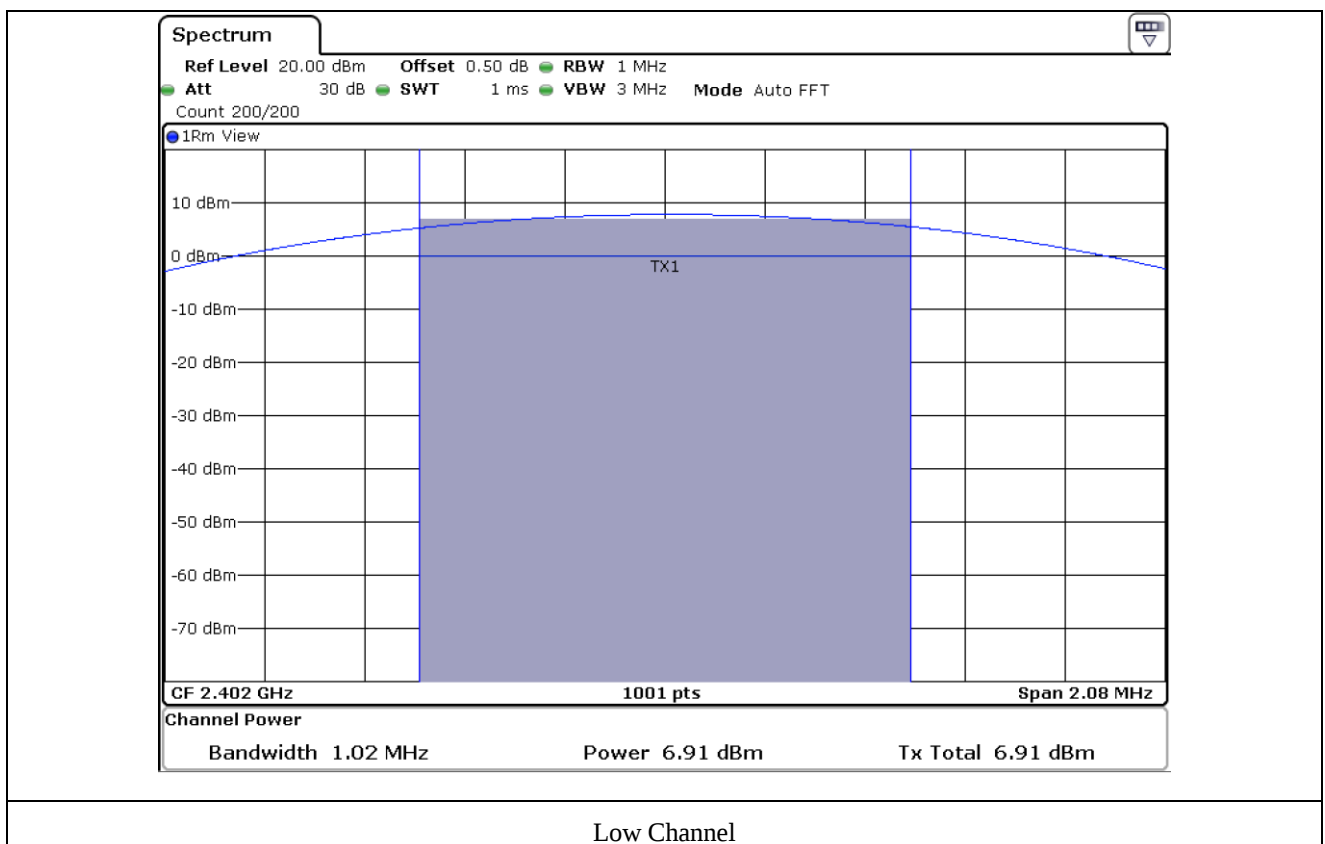
-. Duty Cycle : 68.42 %

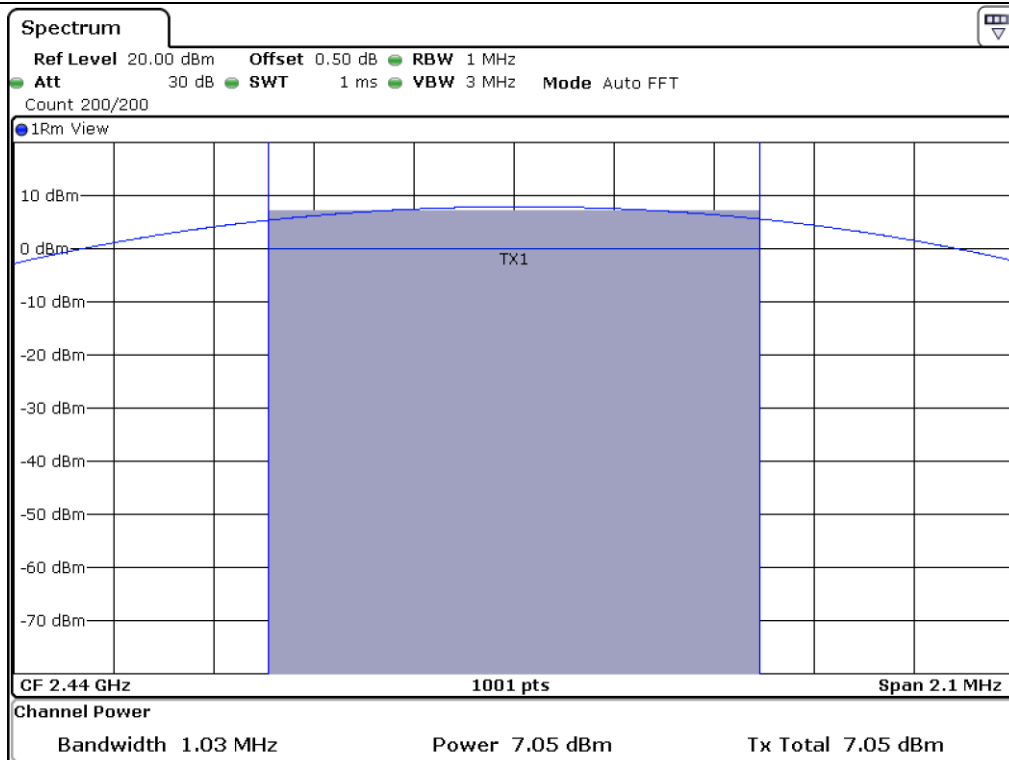
CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	CORRECTION FACTOR (dB)	RESULT (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	6.91	1.65	8.56	30.00	21.44
MIDDLE	2 440.00	7.05	1.65	8.70	30.00	21.30
HIGH	2 480.00	7.10	1.65	8.75	30.00	21.25

Remark : Margin = Limit – Result (= Measured Value + Correction Factor)

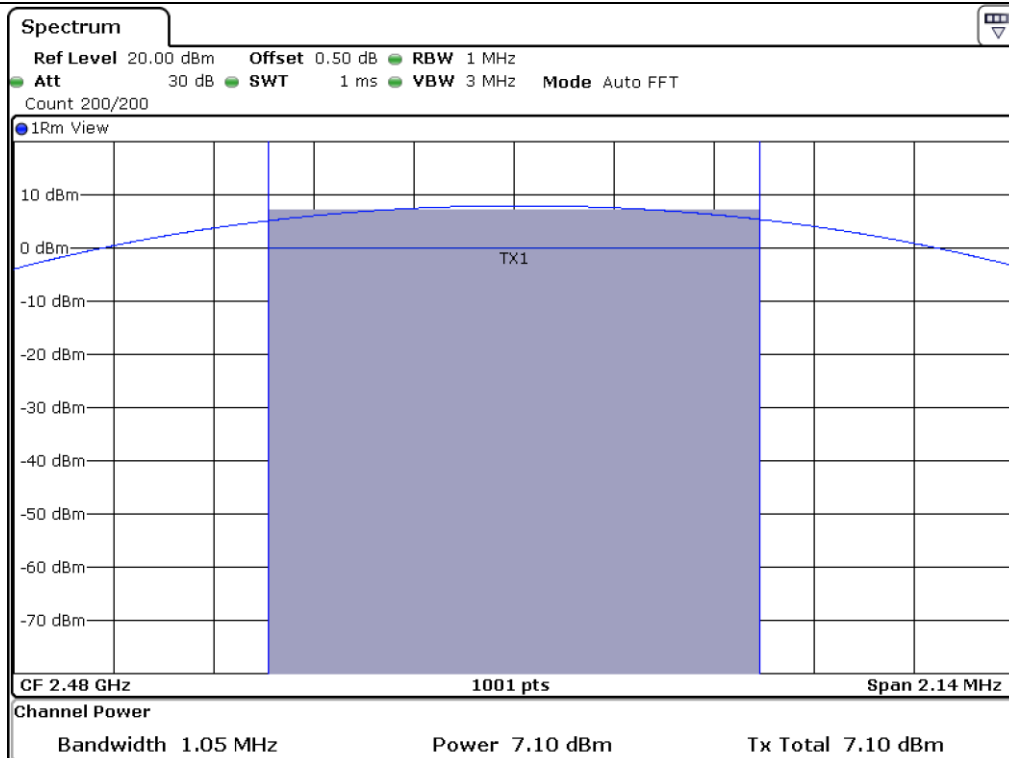


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

8.7 Test data for LE 2 M_2 Mbps

-. Test Date : June 05, 2019 ~ June 11, 2019

-. Test Result : Pass

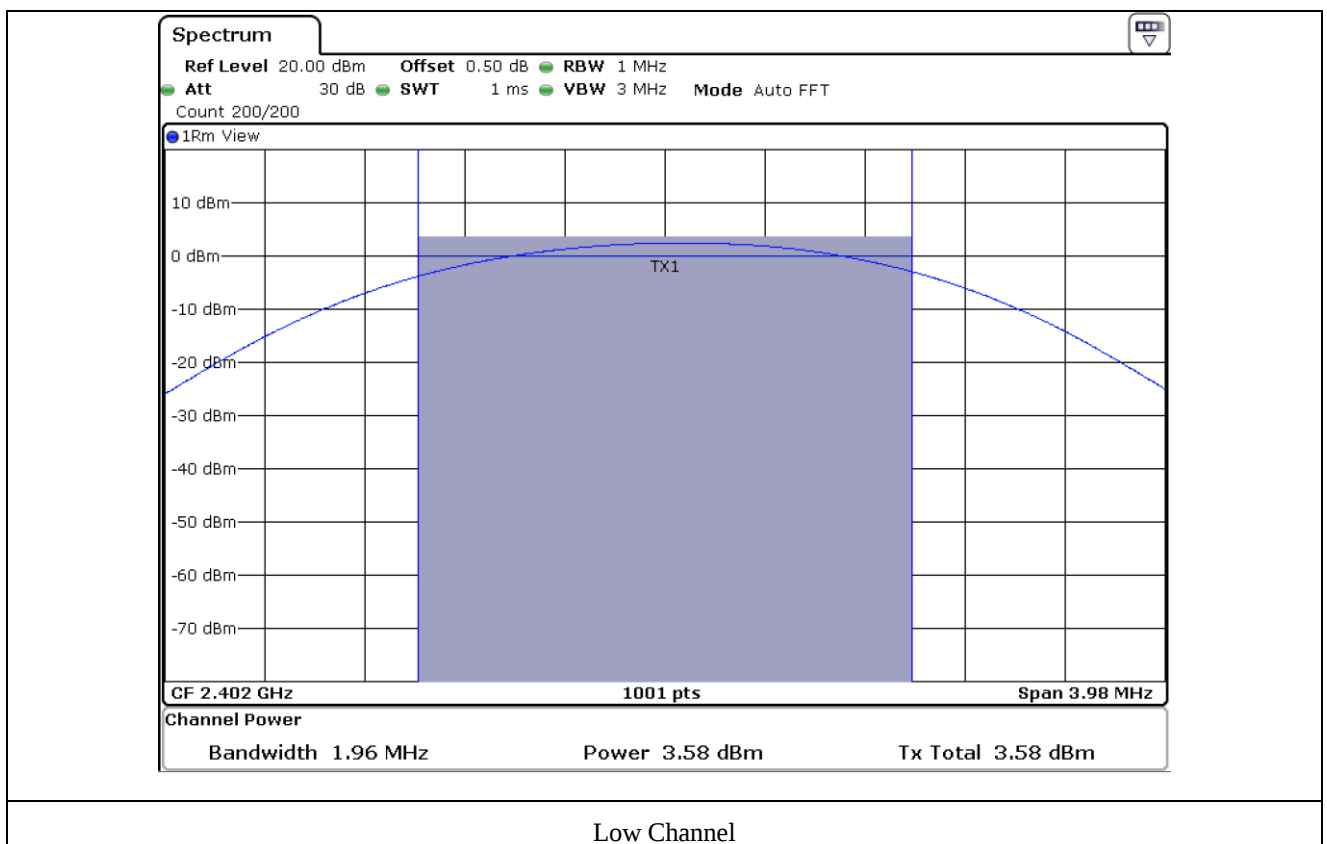
-. Duty Cycle : 38.92 %

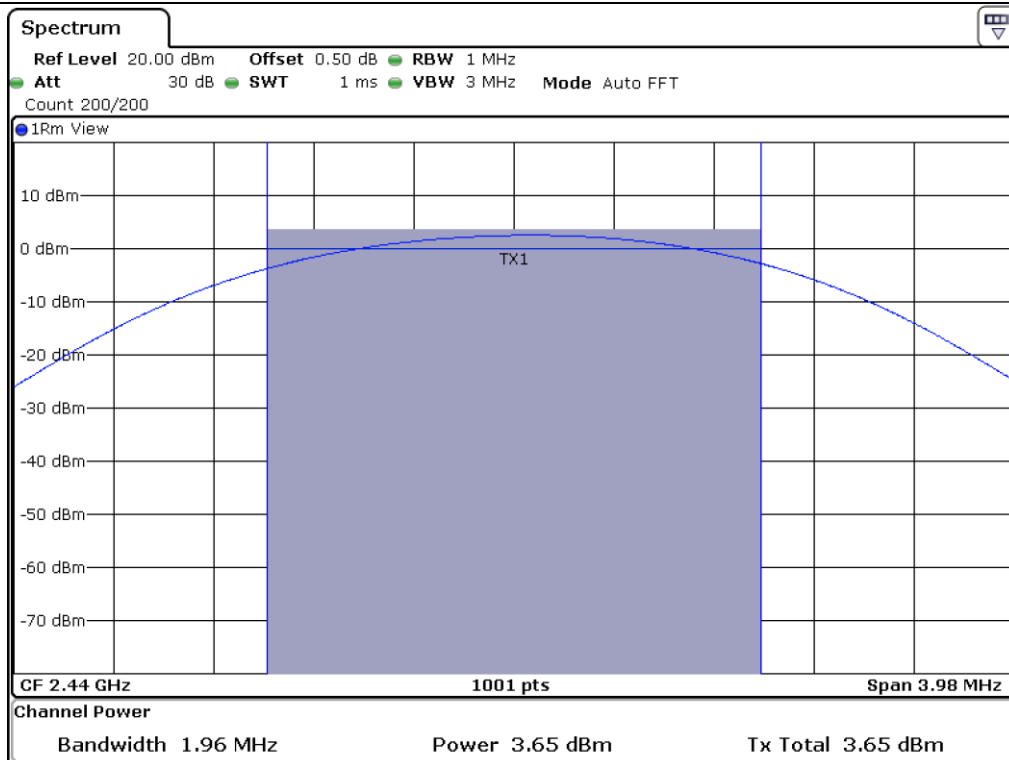
CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	CORRECTION FACTOR (dB)	RESULT (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402.00	3.58	4.10	7.68	30.00	22.32
MIDDLE	2 440.00	3.65	4.10	7.75	30.00	22.25
HIGH	2 480.00	3.75	4.10	7.85	30.00	22.15

Remark : Margin = Limit – Result (= Measured Value + Correction Factor)

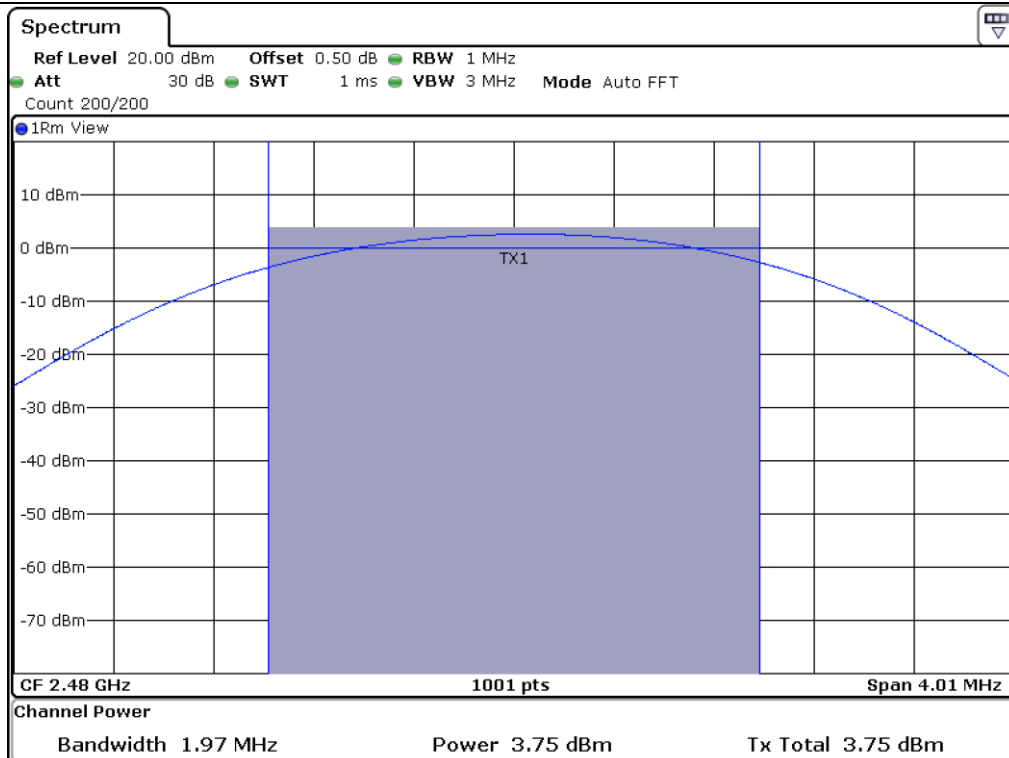


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel