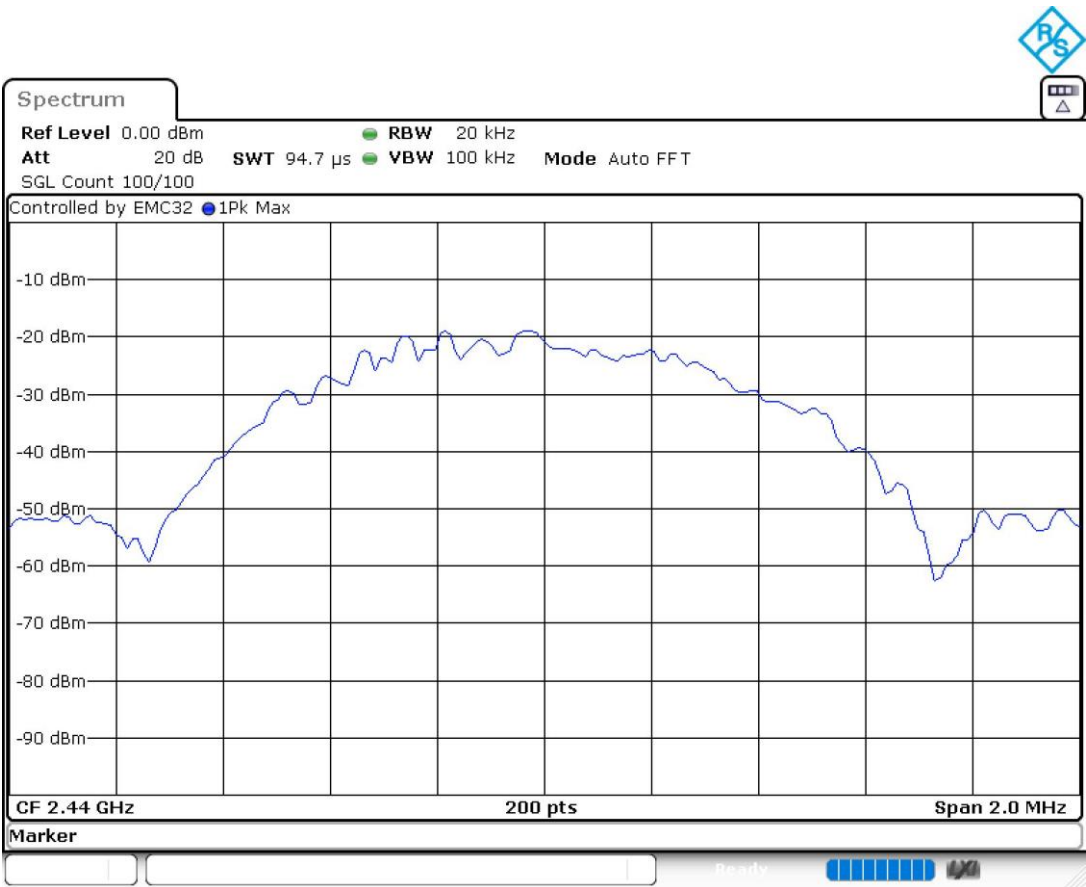
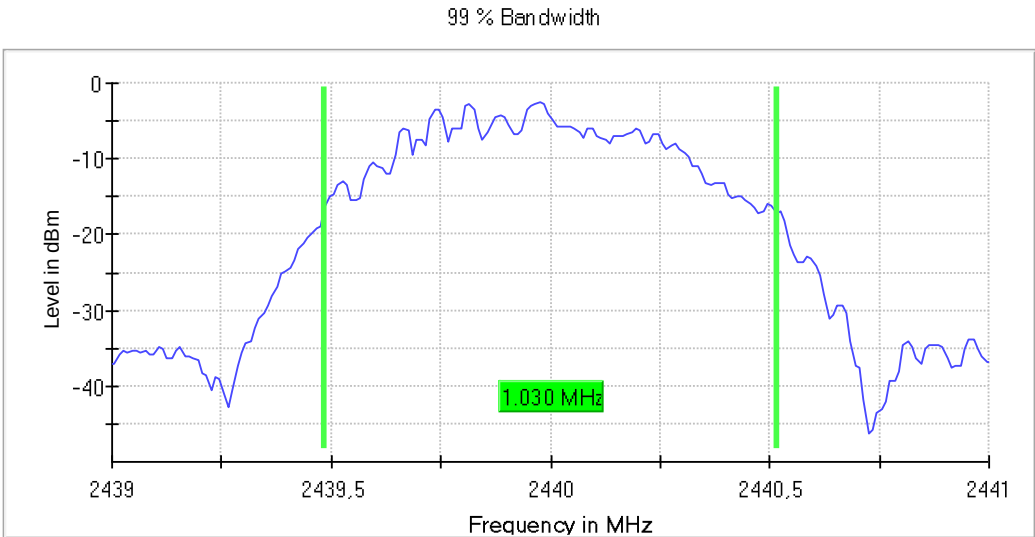


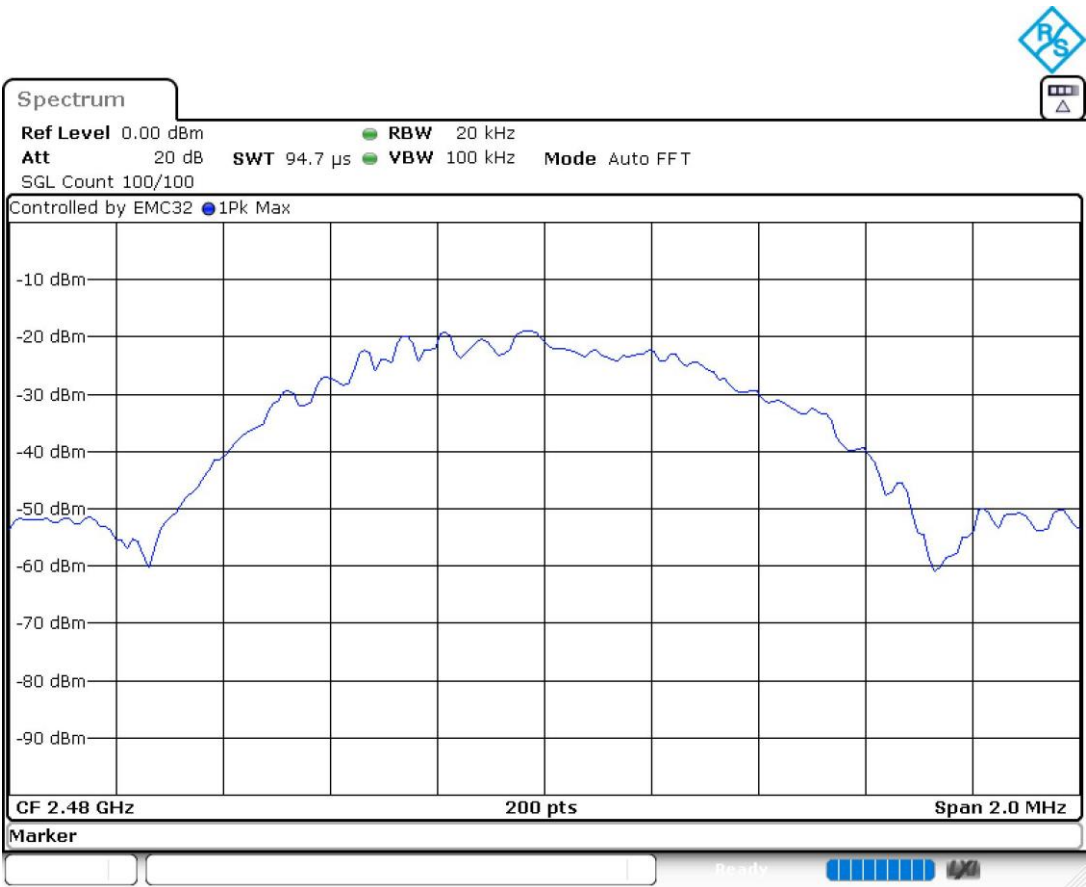
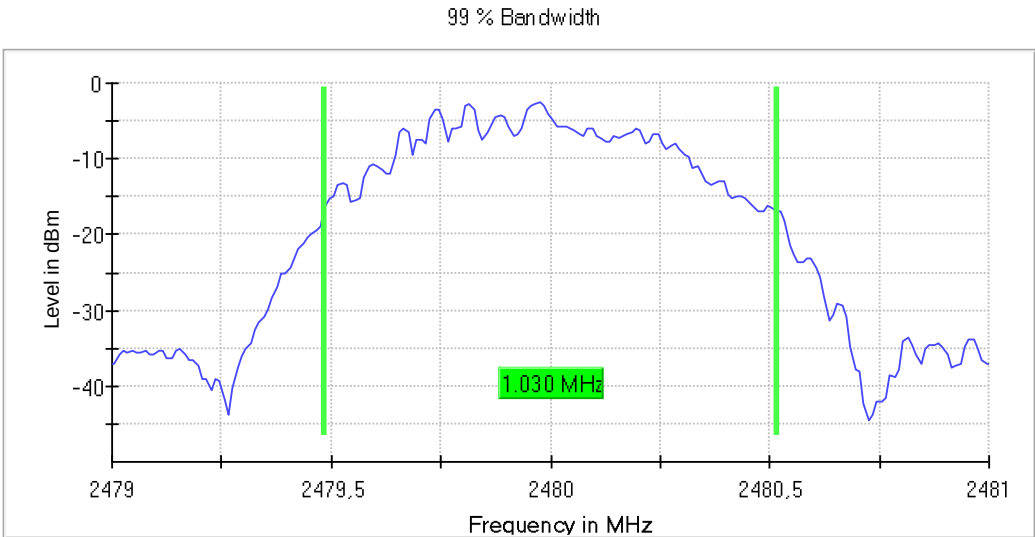
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2440.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Figures:



Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Figures:



FCC 15.247 (a)(2) / RSS-247 5.2 (a) 6 dB Bandwidth

Limits

The minimum 6 dB bandwidth shall be at least 500 kHz.

Results

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Frequency (MHz)	6 dB Bandwidth (MHz)
2402.00	0.733
2440.00	0.733
2480.00	0.733

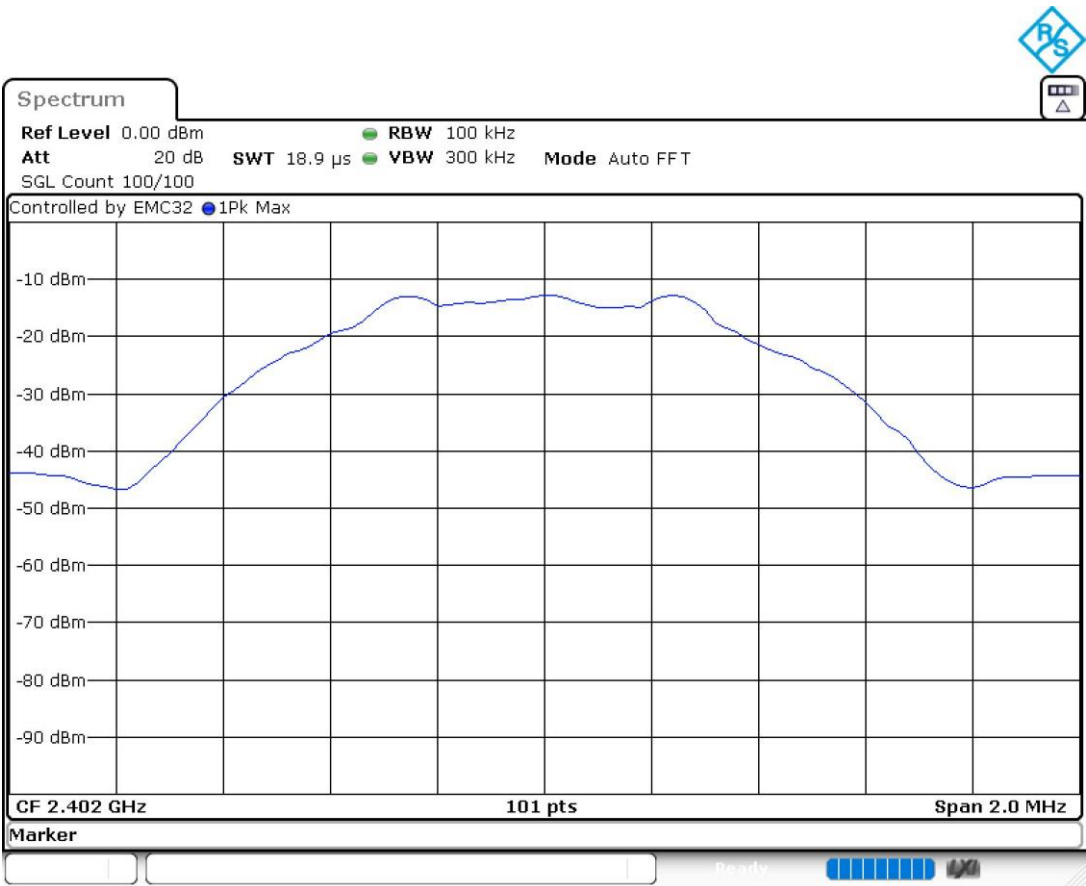
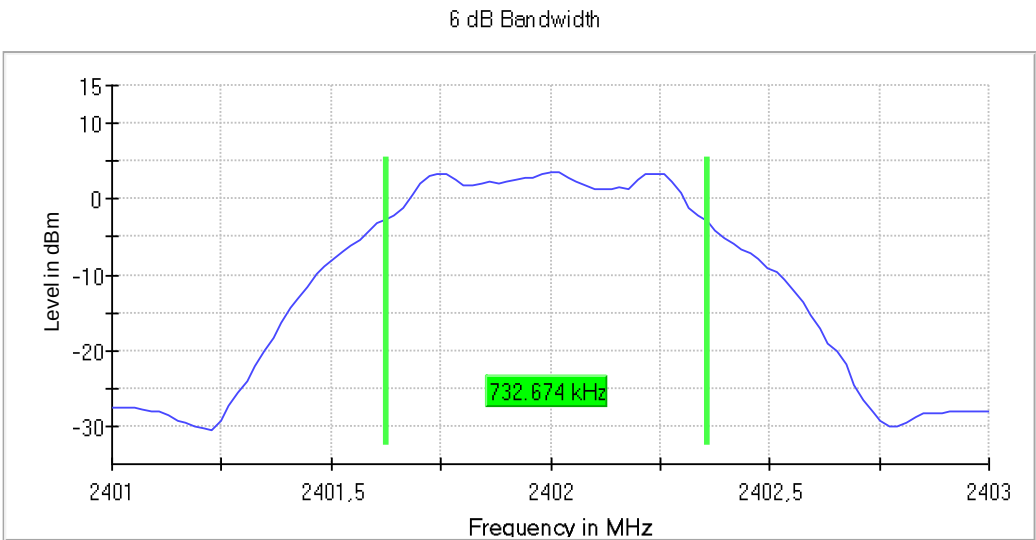
Verdict

Pass

Attachments

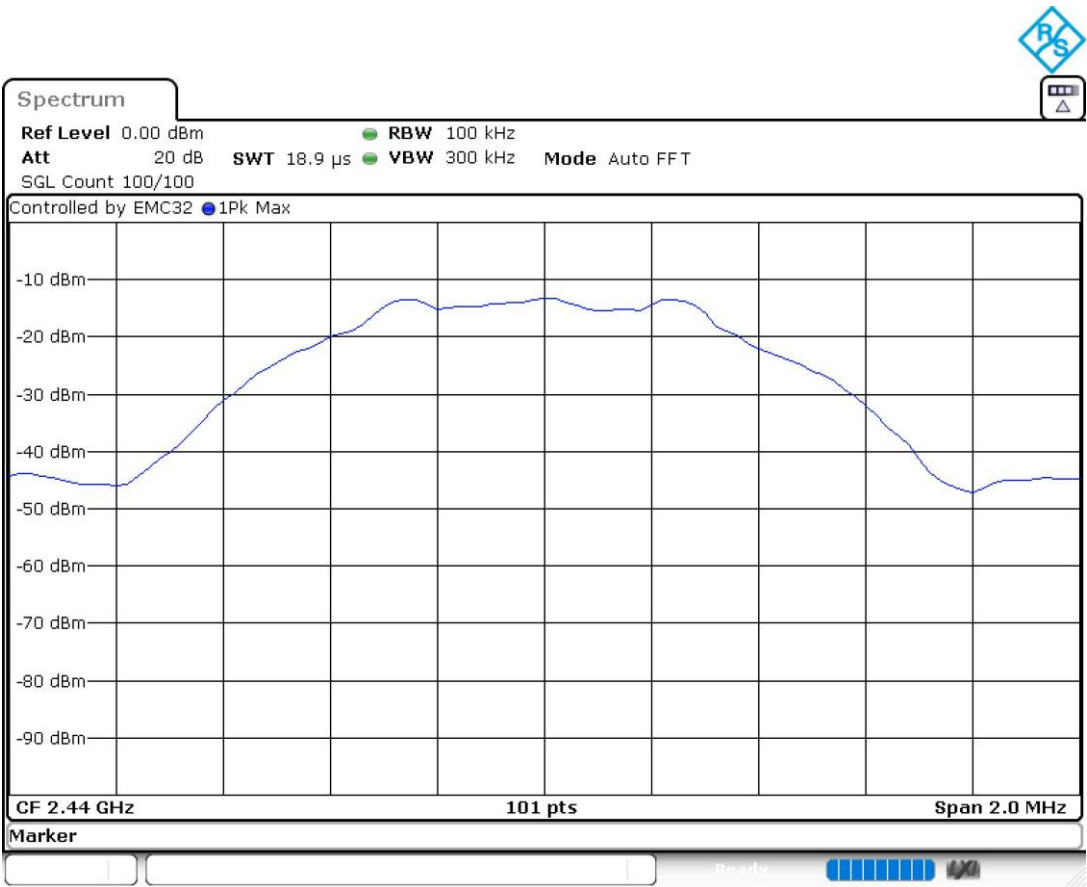
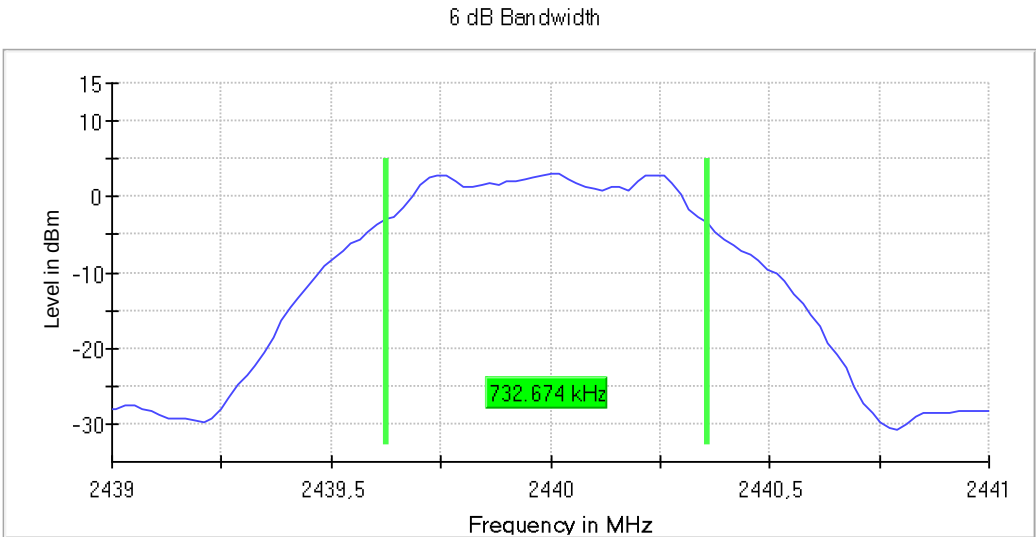
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Figures:



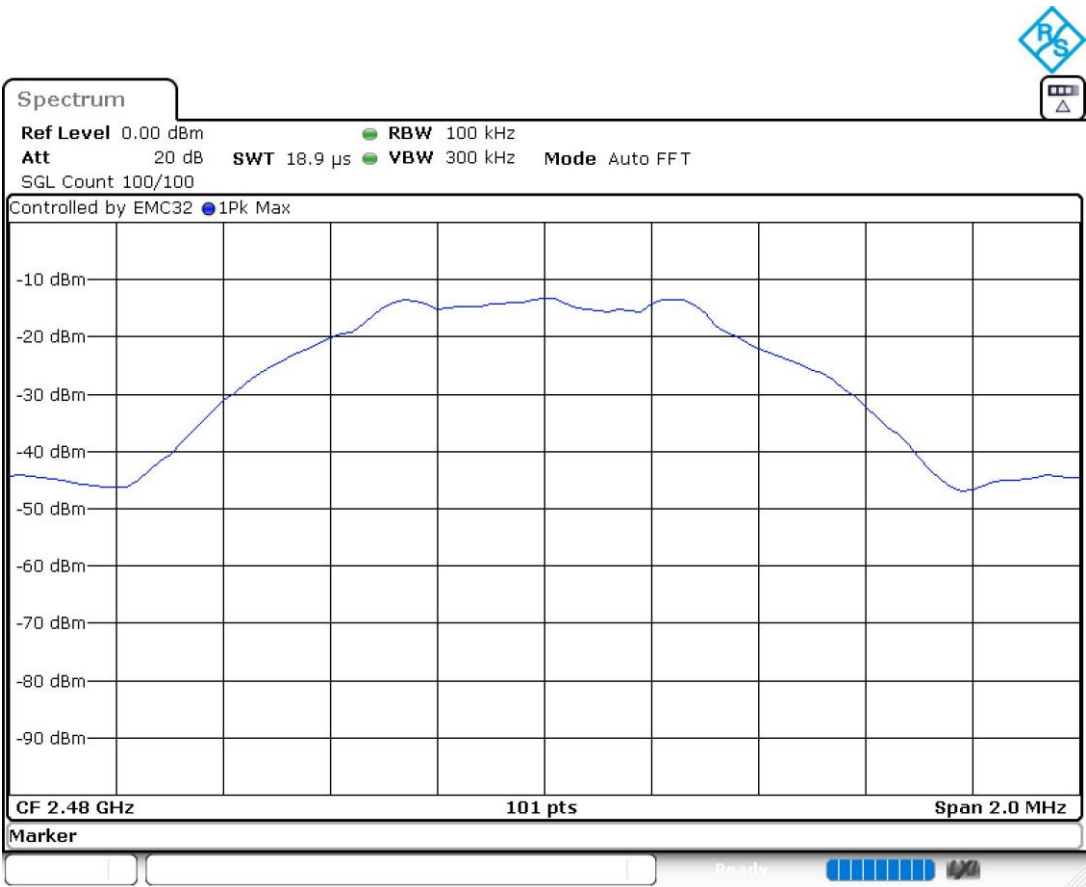
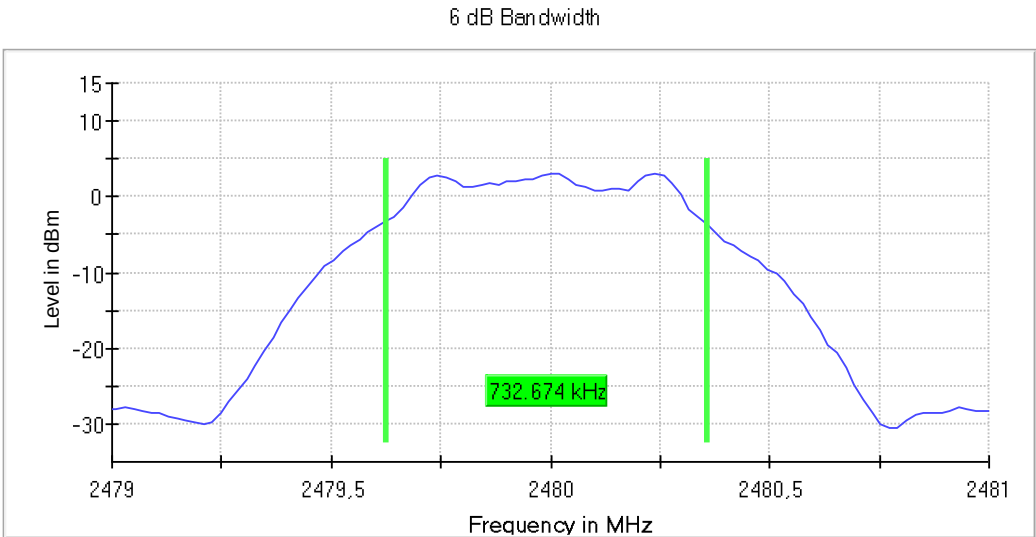
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2440.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Figures:



Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Figures:



FCC 15.247 (b) / RSS-247 5.4 (d) Maximum peak output power and antenna gain

Limits

For systems using digital modulation in the 2400-2483.5 MHz band: 1 watt (30 dBm).

RSS-247:

The e.i.r.p. shall not exceed 4 W.

Results

The maximum peak conducted output power level in the fundamental emission was measured using the method according to clause 11.9.1.1 "RBW $\geq$ DTS bandwidth" of ANSI C.63.10-2013.

The EIRP power (dBm) is calculated by adding the maximum declared antenna gain to the measured conducted power.

Maximum Declared Antenna Gain: +0.11 dBi

The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Peak Conducted Output Power (dBm)	4.207	3.795	3.767
Maximum EIRP Power (dBm)	4.317	3.905	3.877

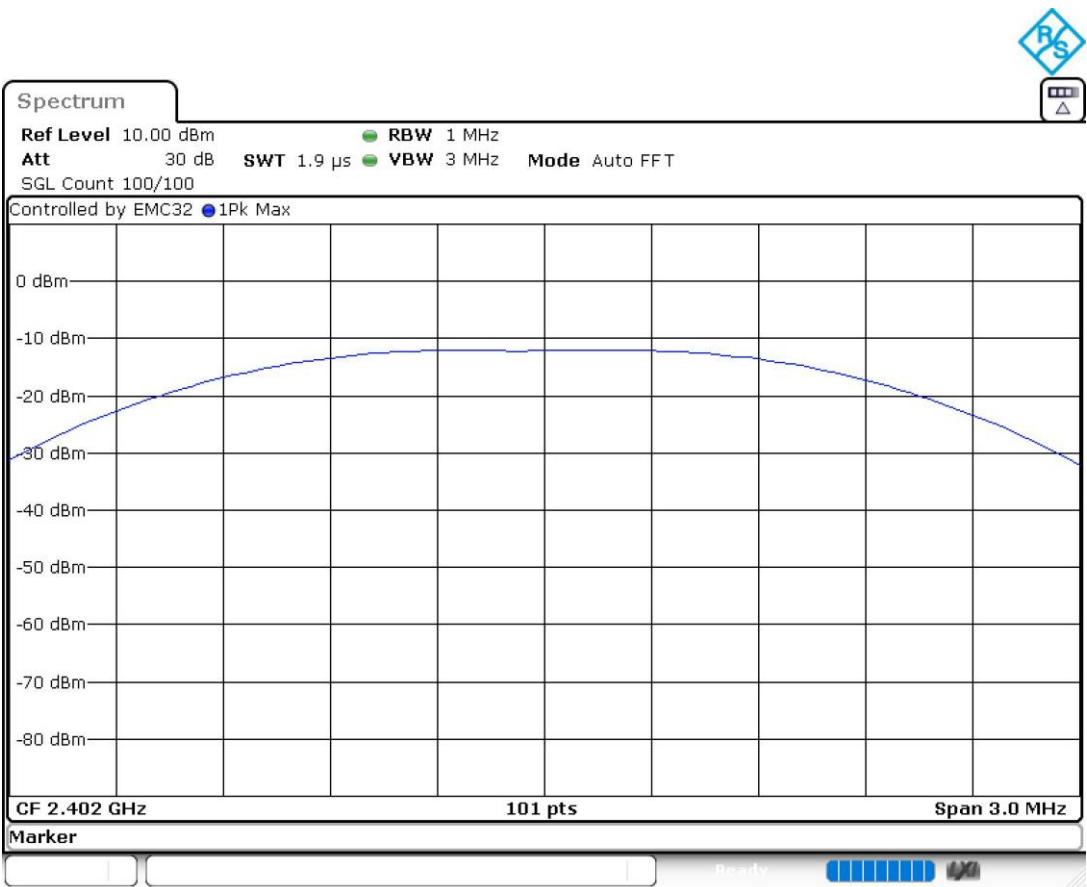
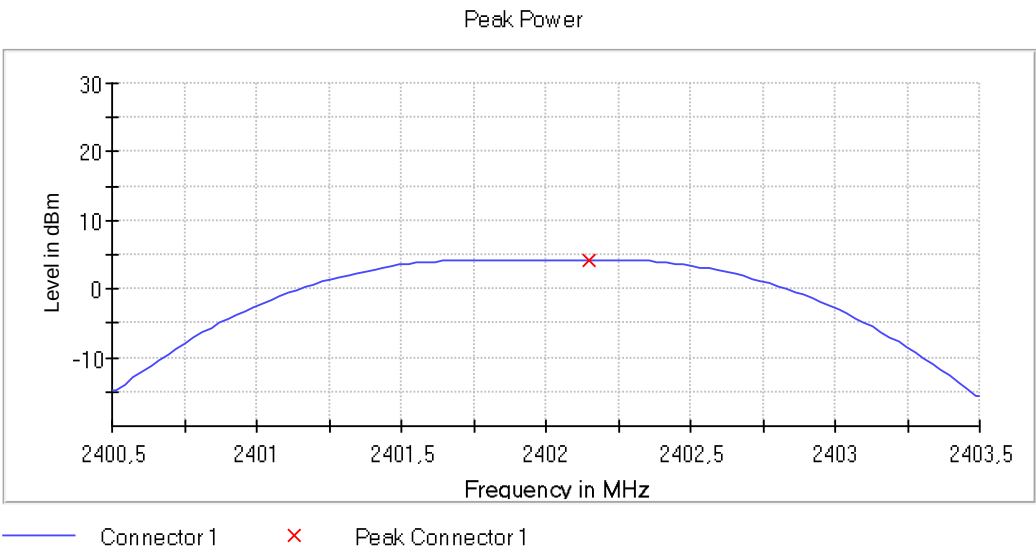
Verdict

Pass

Attachments

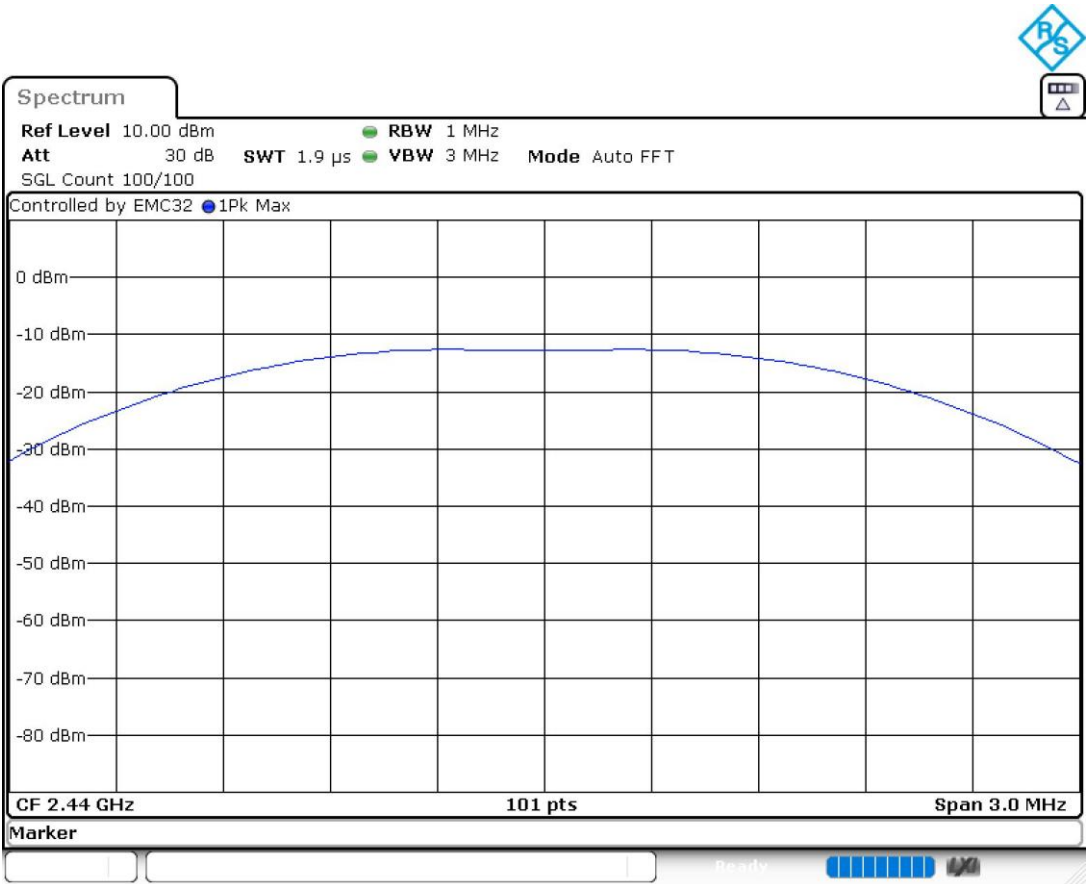
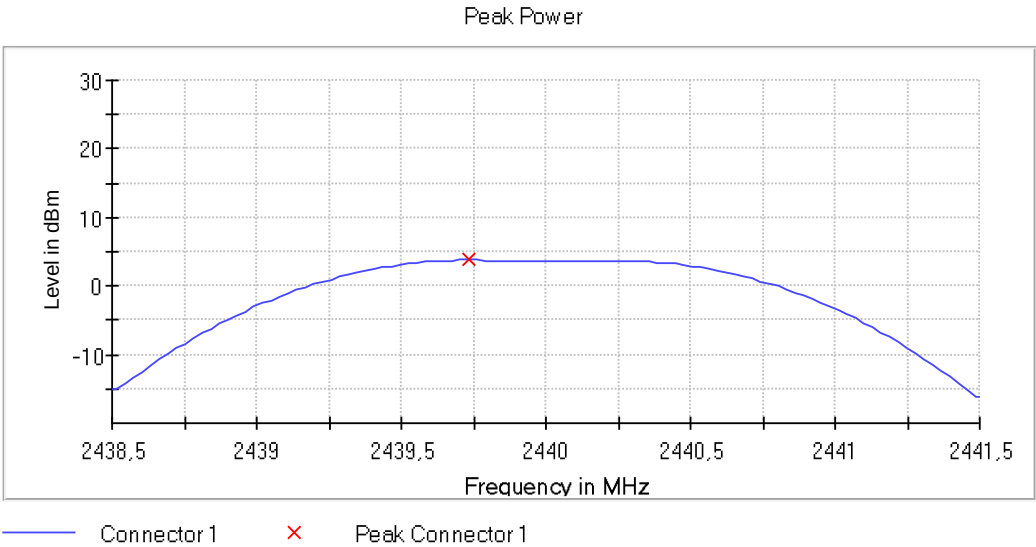
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Figures:



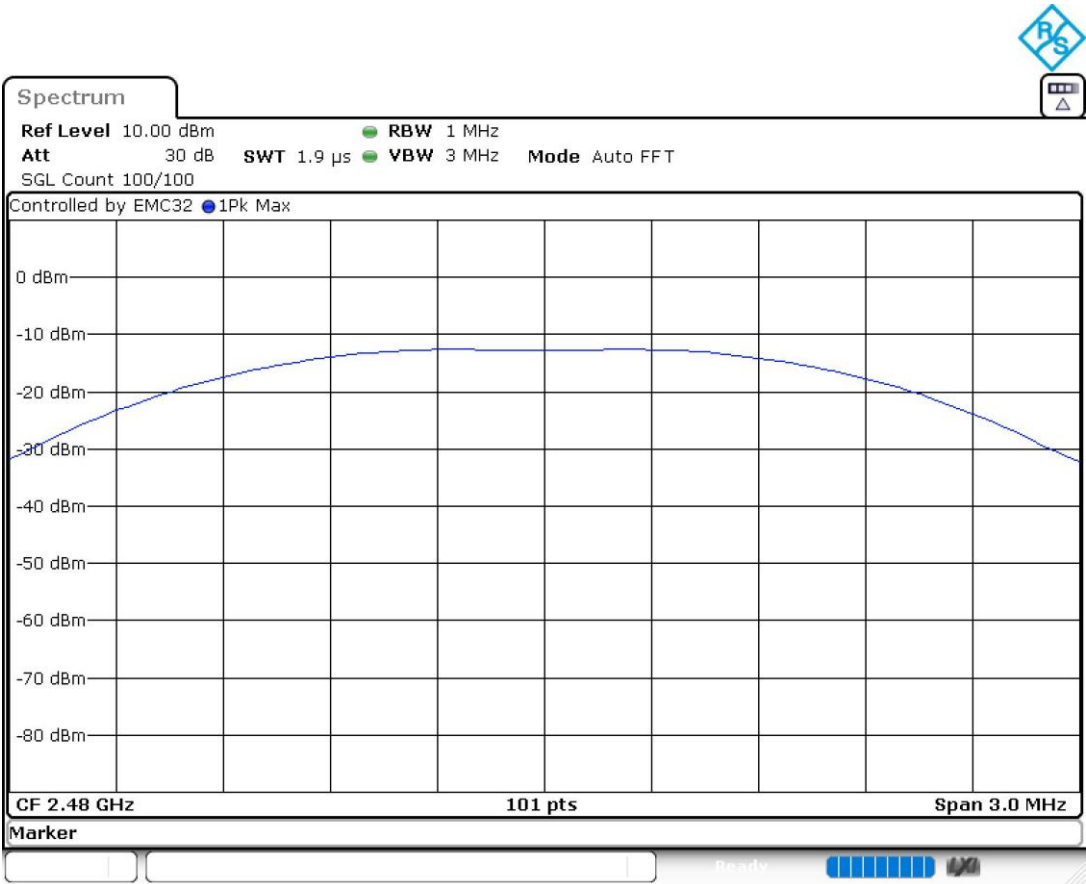
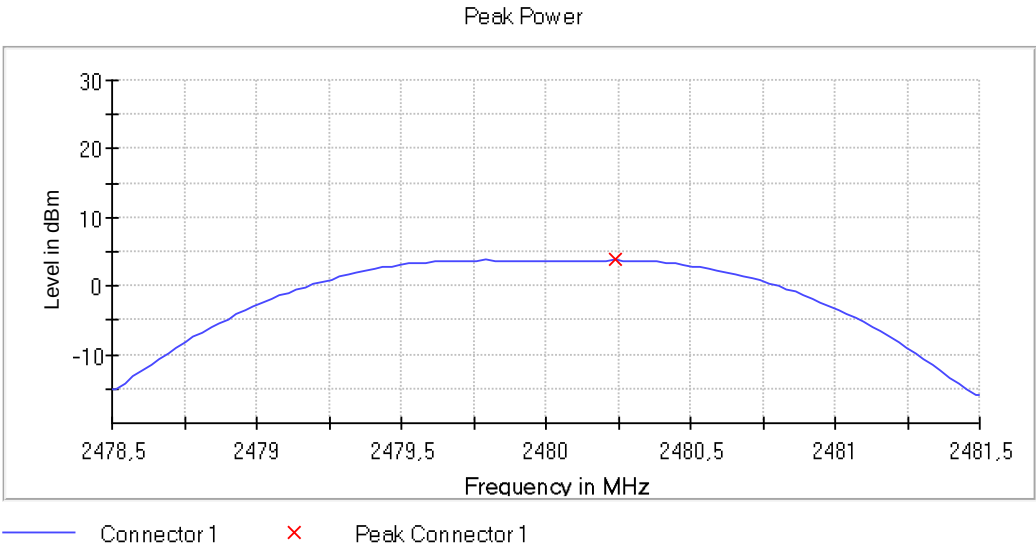
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2440.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Figures:



Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Figures:



FCC 15.247 (e) / RSS-247 5.2 (b) Power spectral density

Limits

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Results

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

The power spectral density was measured according to clause 11.10.2 “Method PKPSD (peak PSD)” of ANSI C63.10-2013.

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Peak Power Spectral Density (dBm)	-5.018	-5.205	-5.550

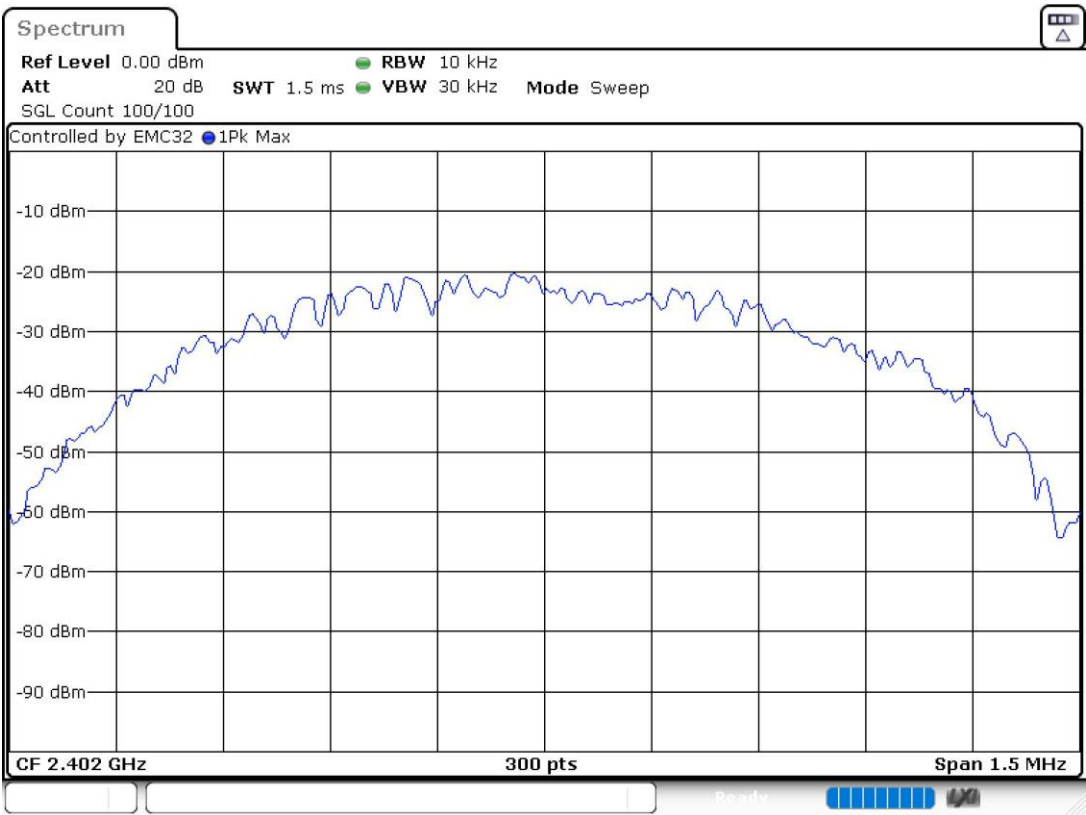
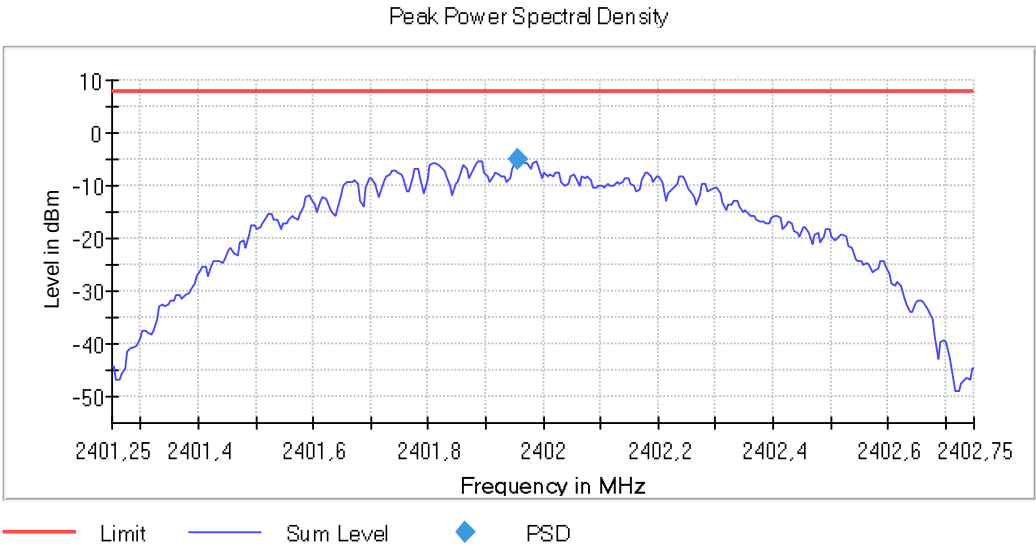
Verdict

Pass

Attachments

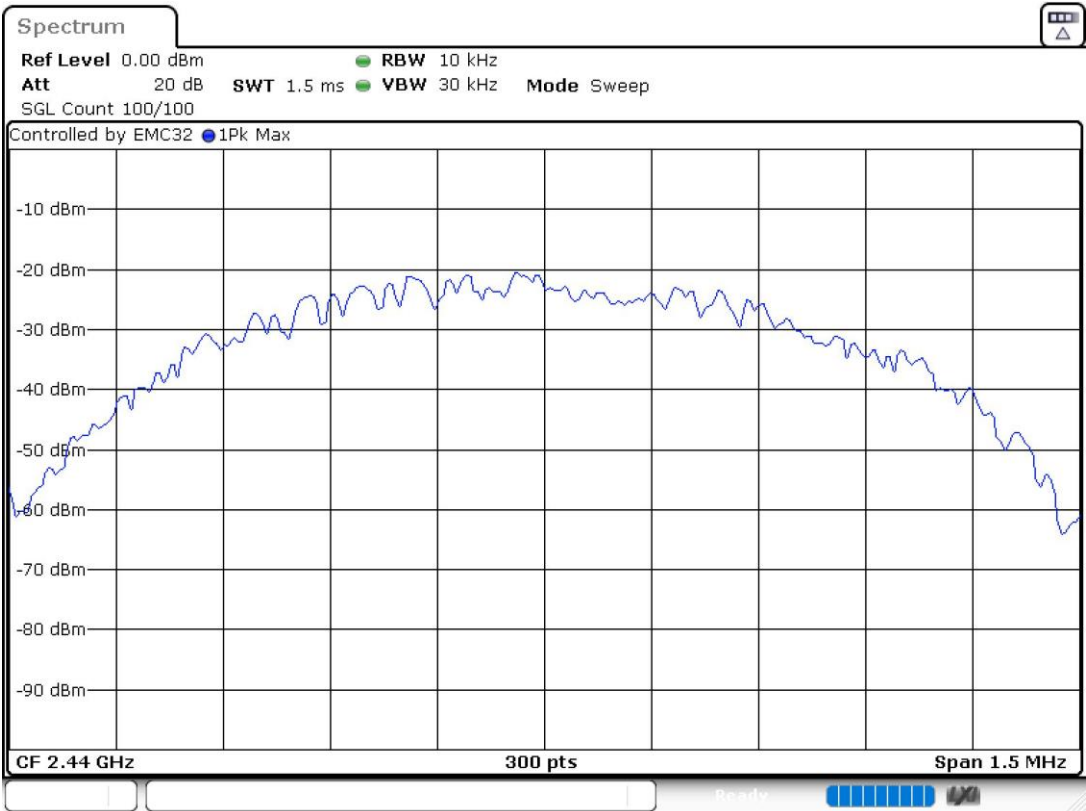
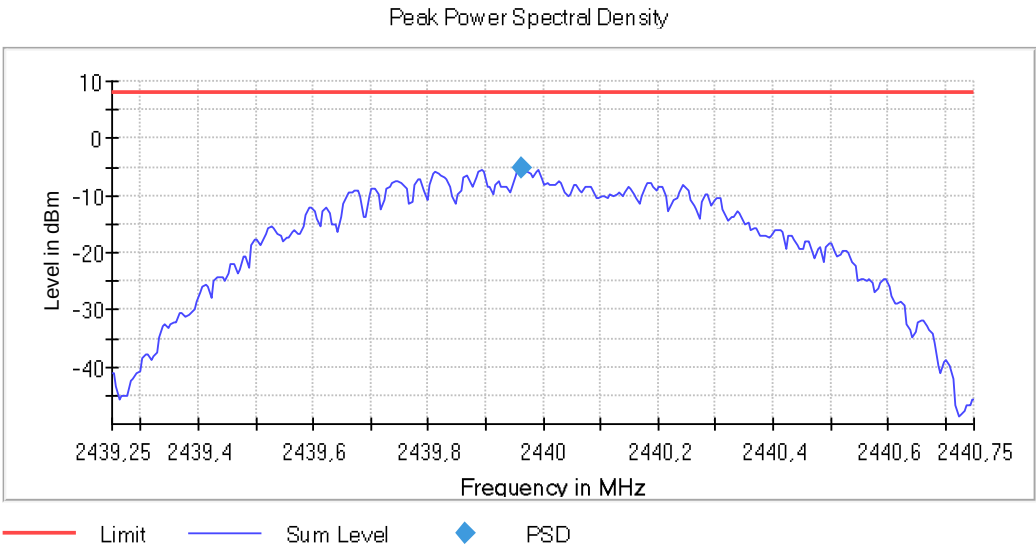
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Figures:



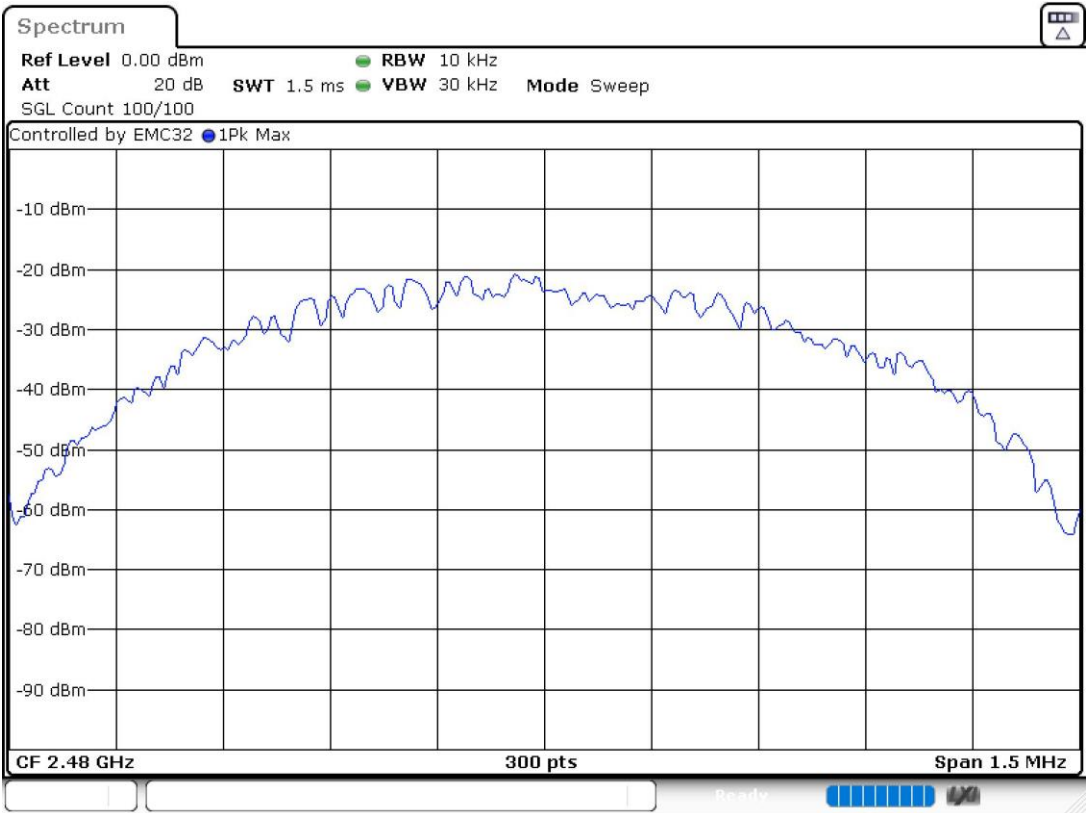
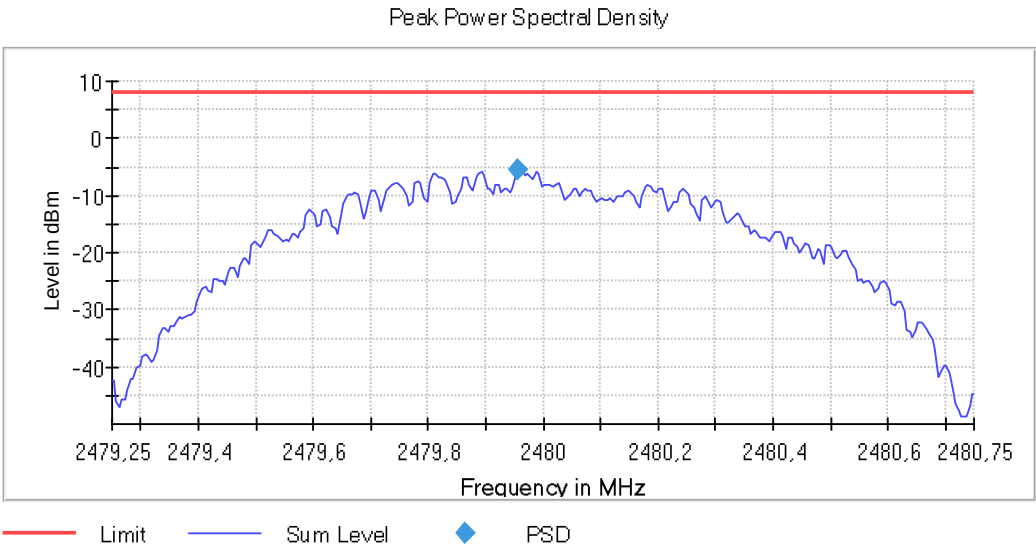
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2440.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Figures:



Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Figures:



FCC 15.247 (d) / RSS-247 5.5 Band-edge emissions compliance (Transmitter)

Limits

In any 100 kHz bandwidths outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Results

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Radiated measurements were used to show compliance with the limits in the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

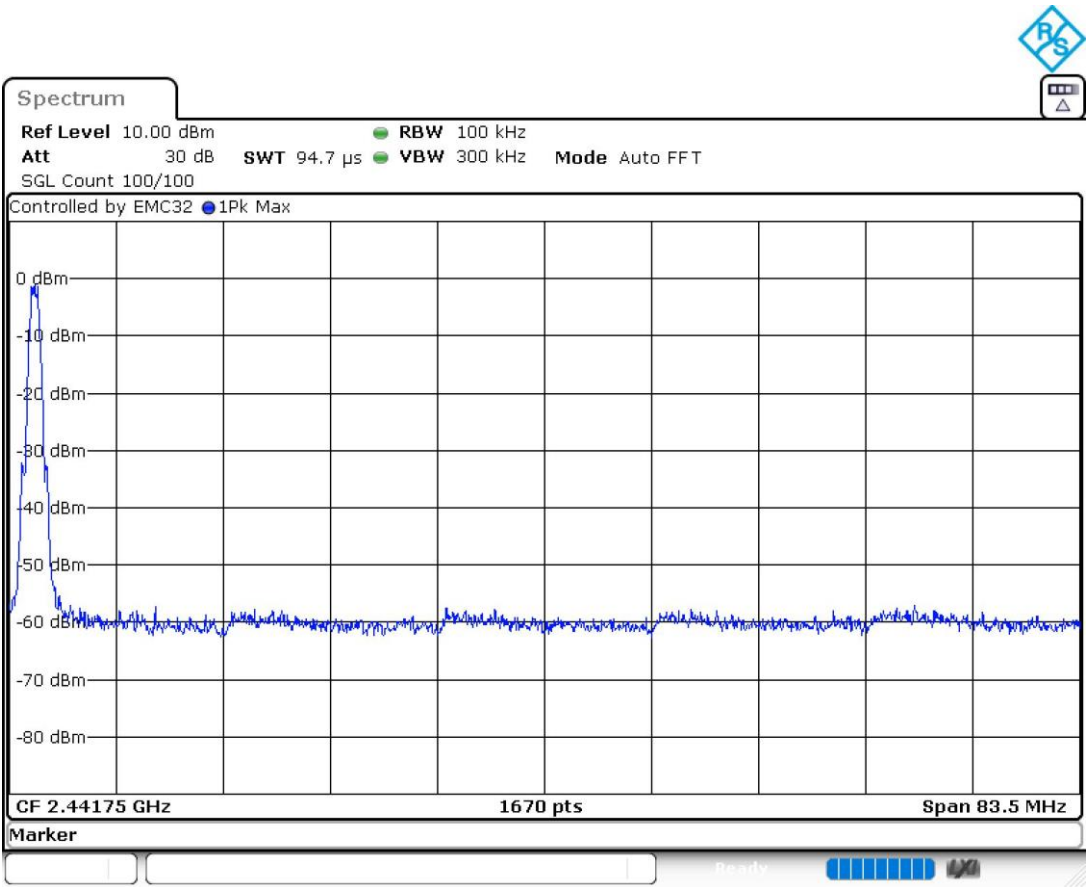
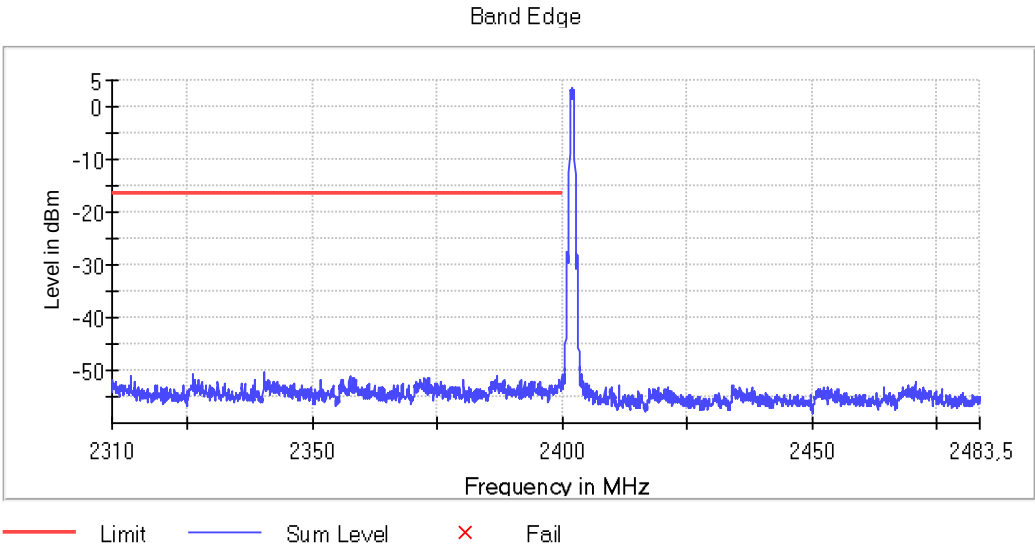
Verdict

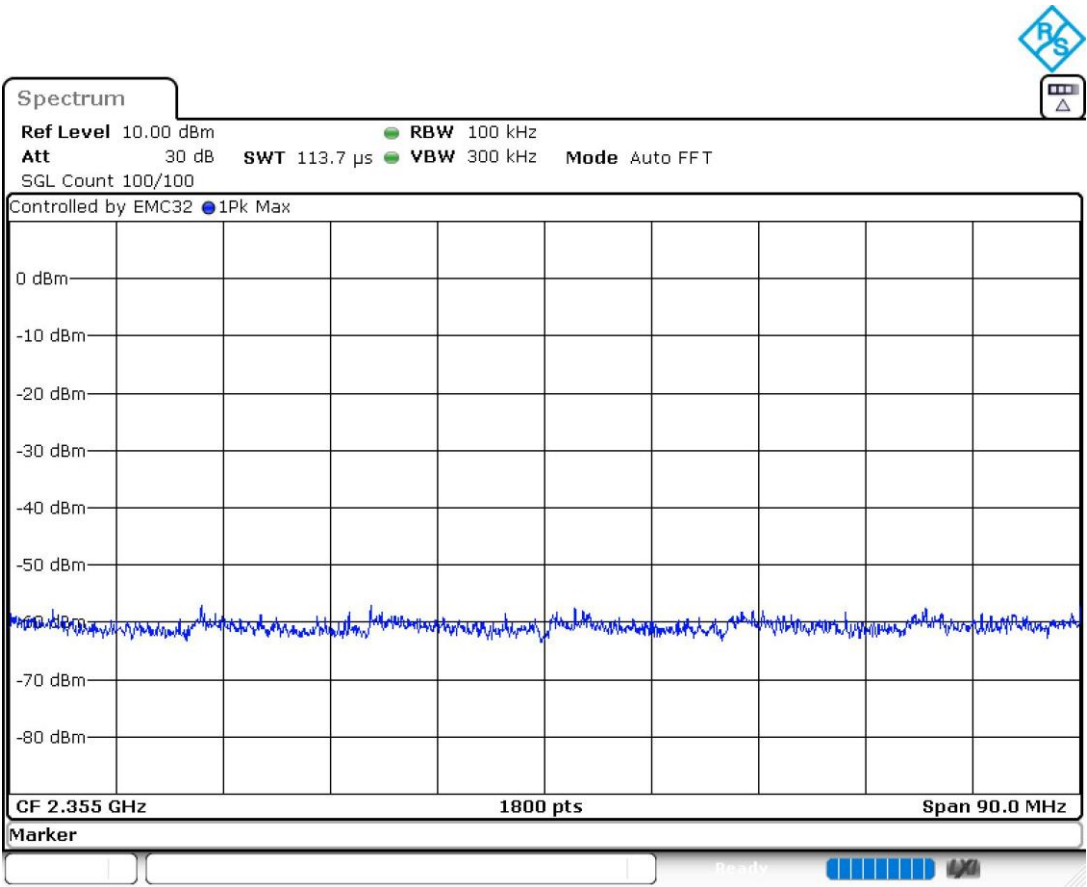
Pass

Attachments

Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

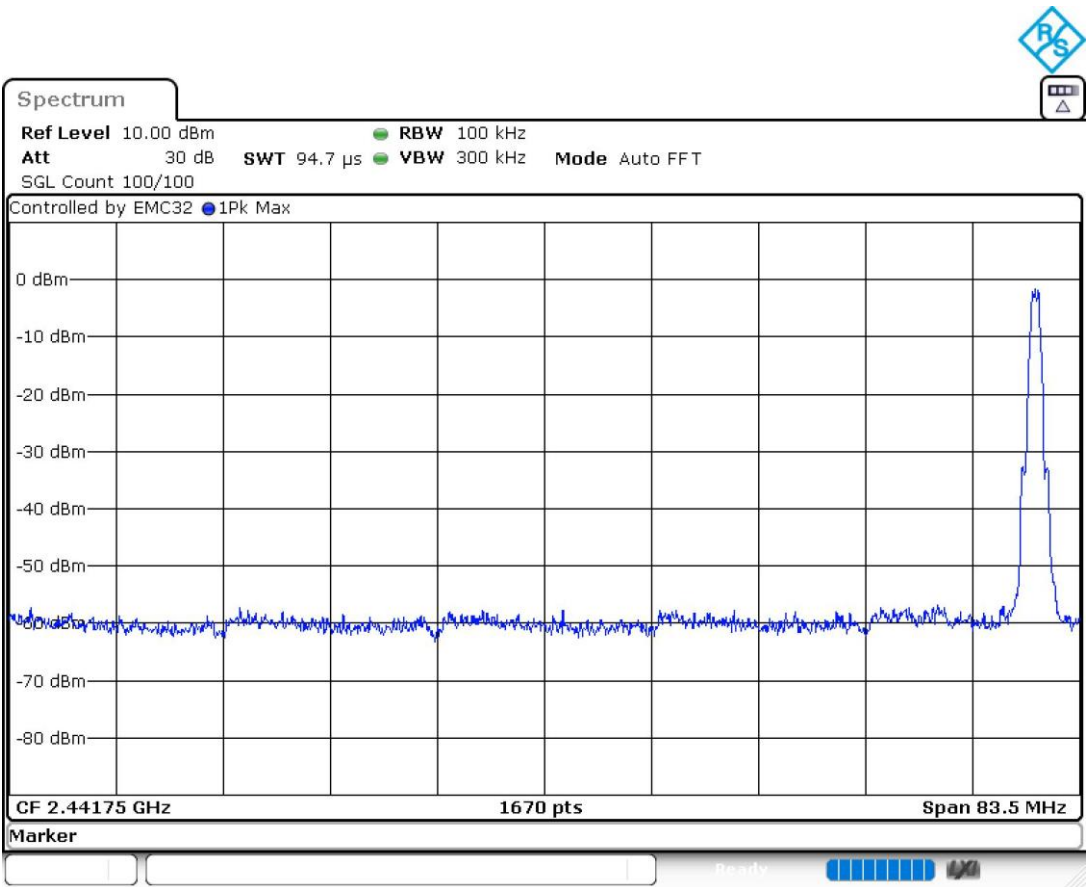
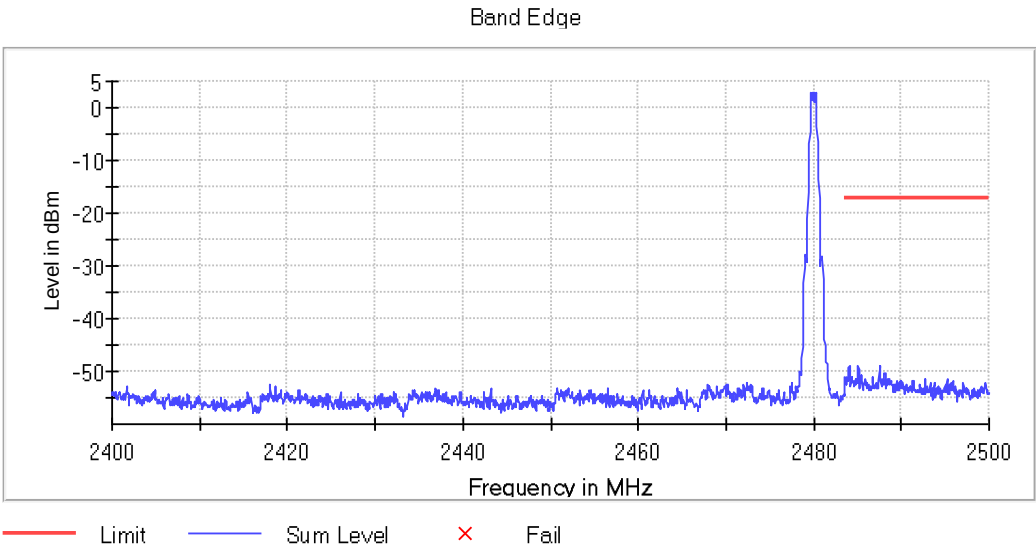
Figures:

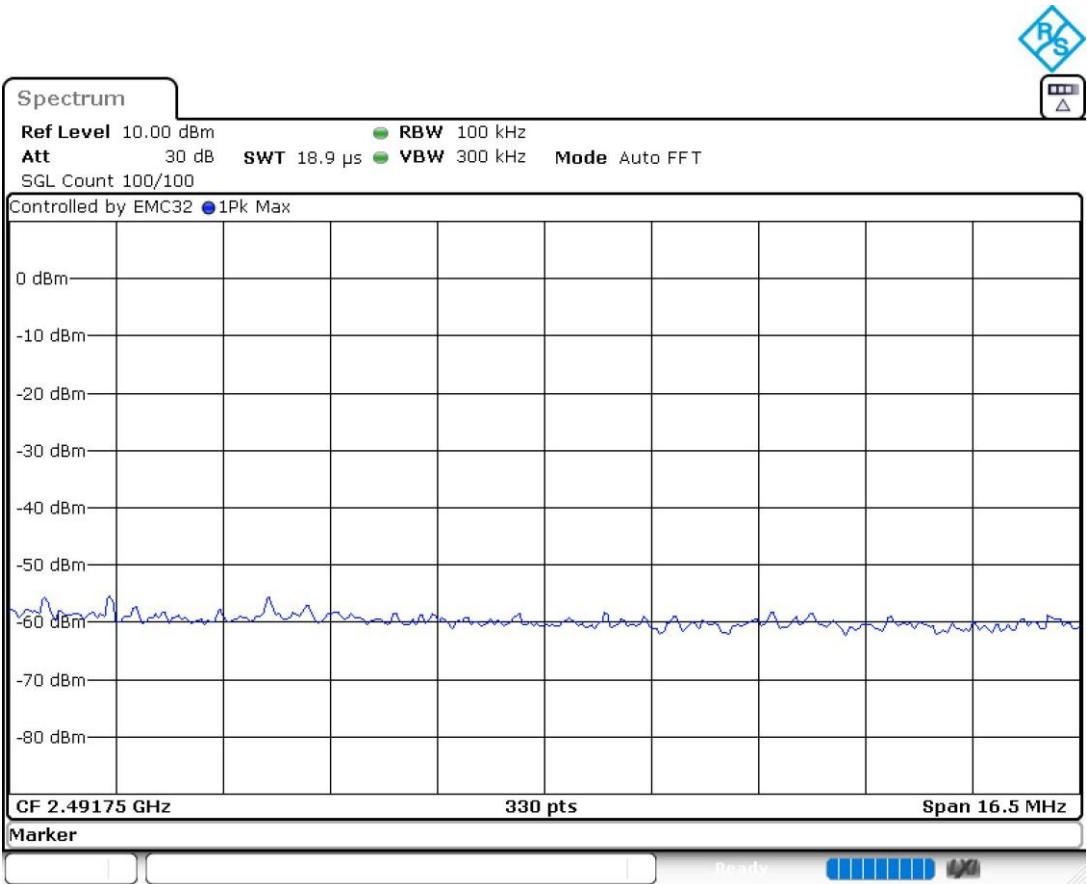




Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Figures:





FCC 15.247 (d) / RSS-247 5.5 Emission limitations radiated (Transmitter)

Limits

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c) / RSS-Gen):

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	-	300
0.490 - 1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table, specified when measuring with peak detector function.

RSS-247:

Attenuation below the general field strength limits specified in RSS-Gen is not required.

Results

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

The field strength is calculated by adding a correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss, pre-amplifiers gain and the distance correction factor for measurements above 17 GHz performed at 1.5-meter distance.

Frequency range 30 MHz - 1 GHz:

The spurious frequencies detected below 1 GHz do not depend on the operating channel selected in the EUT.

Spurious frequencies at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
224.970000	26.11	V	Quasi-peak
350.009063	27.18	H	Quasi-peak
374.986563	26.12	H	Quasi-peak

Frequency range 1 - 26 GHz:

The results below show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

Spurious frequencies with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

- Low Channel.

No spurious frequencies found close to the limit.

- Middle Channel.

No spurious frequencies found close to the limit.

- High Channel.

Spurious frequencies closest to the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Polarization	Detector
4960.420000	41.36	V	Peak

Verdict

Pass

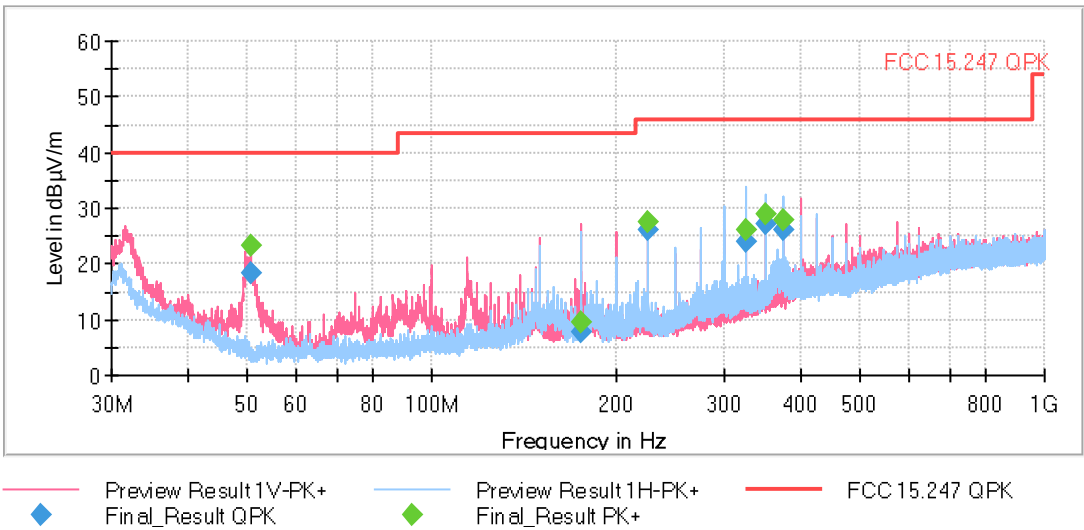
Attachments

Measurement settings:

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44] 30 MHz - 1 GHz	30,312 kHz	PK+	100 kHz	1 s	0 dB
Receiver: [ESW 44] 1 GHz - 3 GHz	30,769 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
Receiver: [ESW 44] 3 GHz - 17 GHz	140 kHz	PK+ ; AVG	1 MHz	1 s	30 dB
Receiver: [ESU 40] 17 GHz - 26 GHz	300 kHz	PK+ ; AVG	1 MHz	0,3 s	0 dB

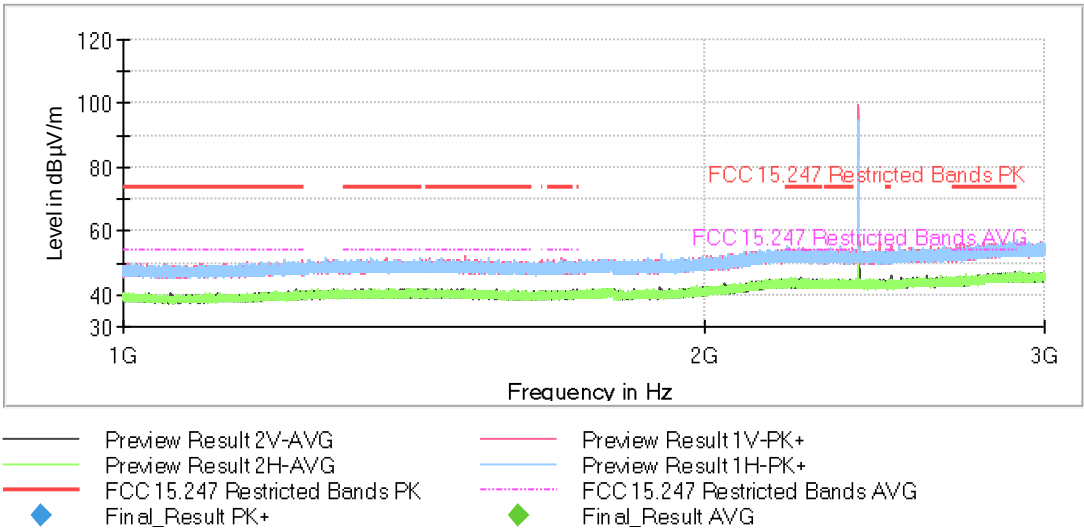
FREQUENCY RANGE 30 MHz - 1 GHz

This plot is valid for Low, Middle and High Channels.



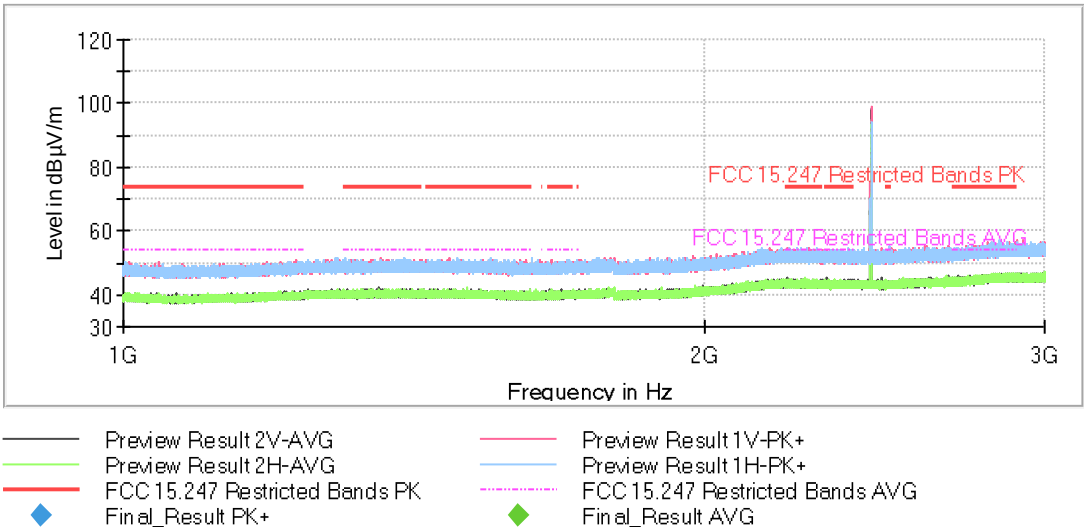
FREQUENCY RANGE 1 - 3 GHz

- Low Channel:



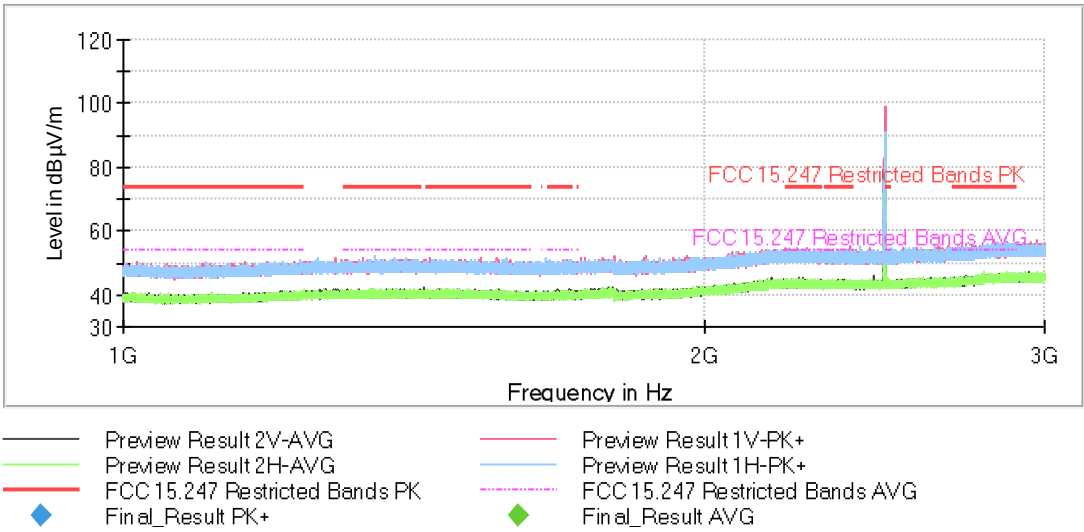
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

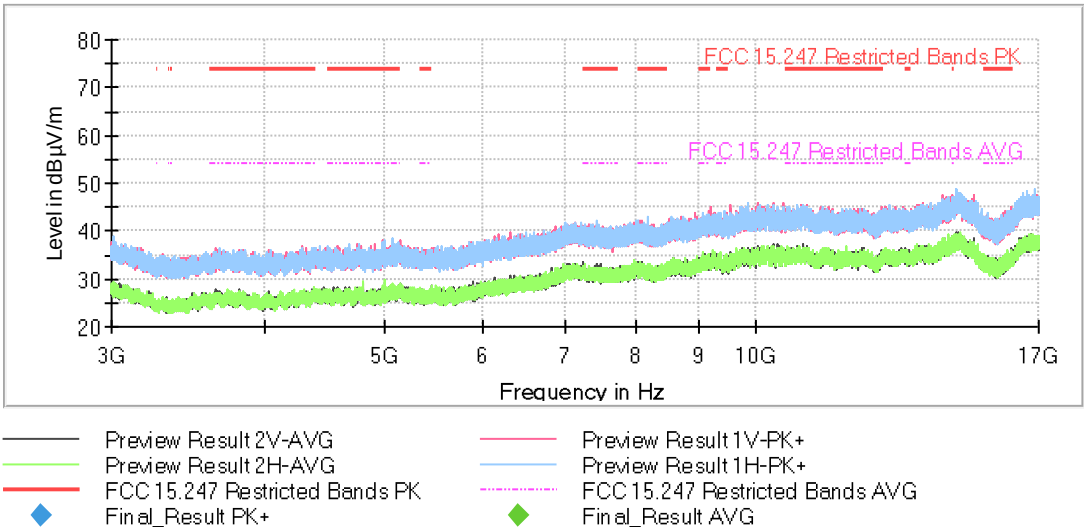
- High Channel:



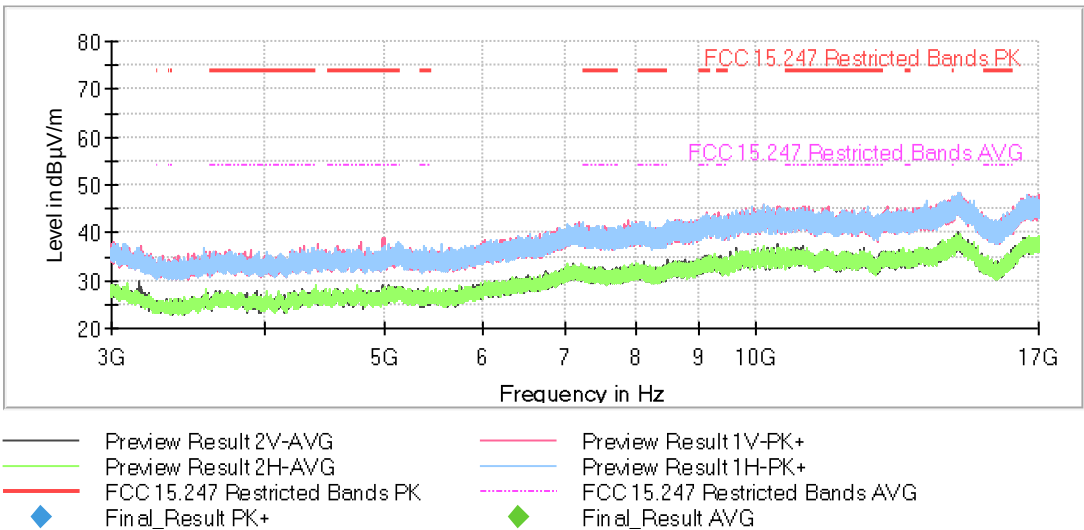
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz

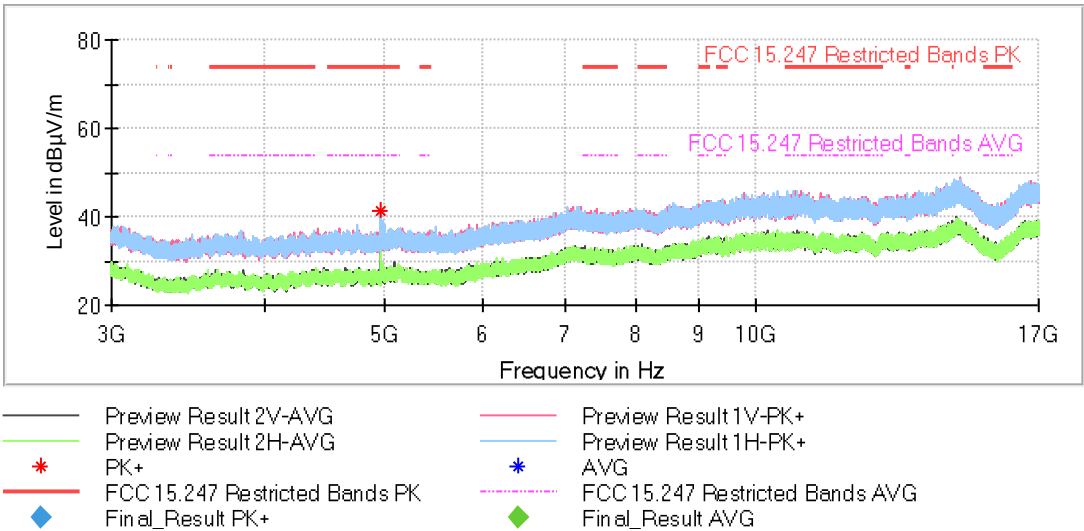
- Low Channel:



- Middle Channel:

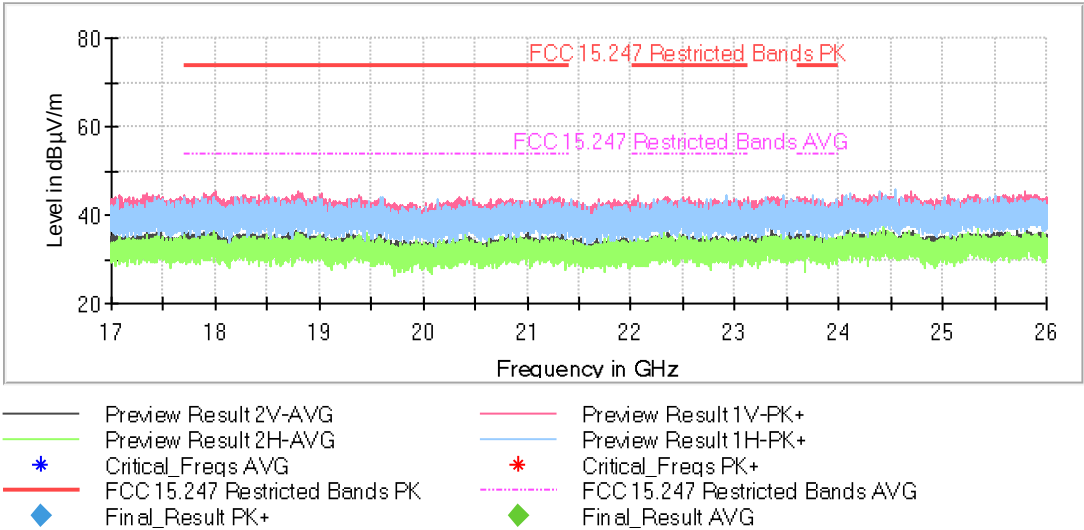


- High Channel:



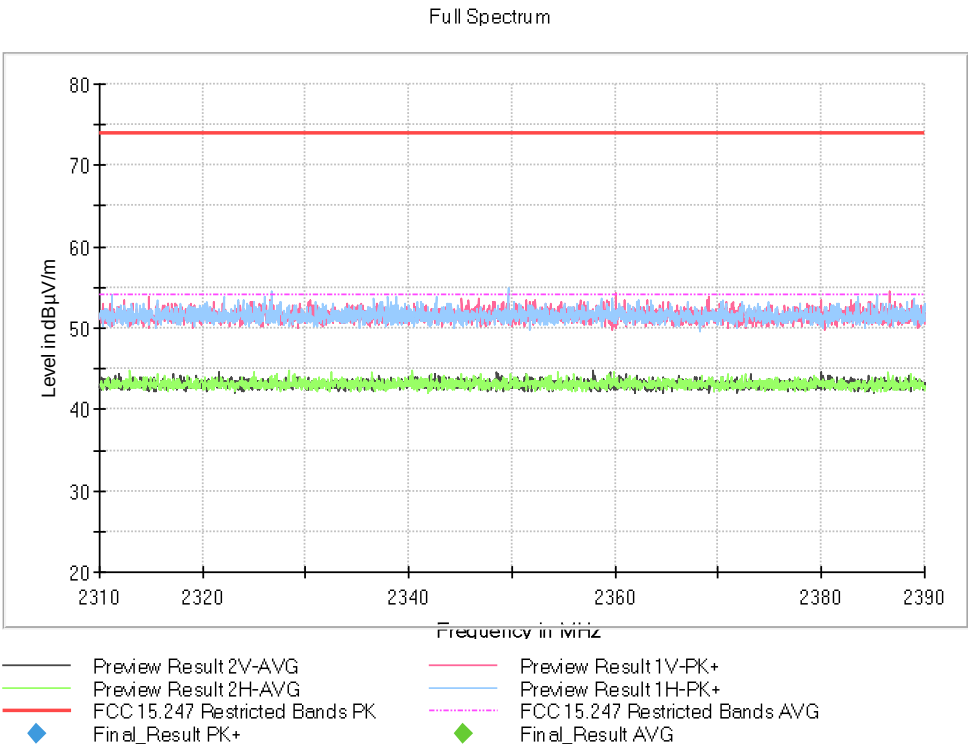
FREQUENCY RANGE 17 - 26 GHz

This plot is valid for Low, Middle and High Channels.

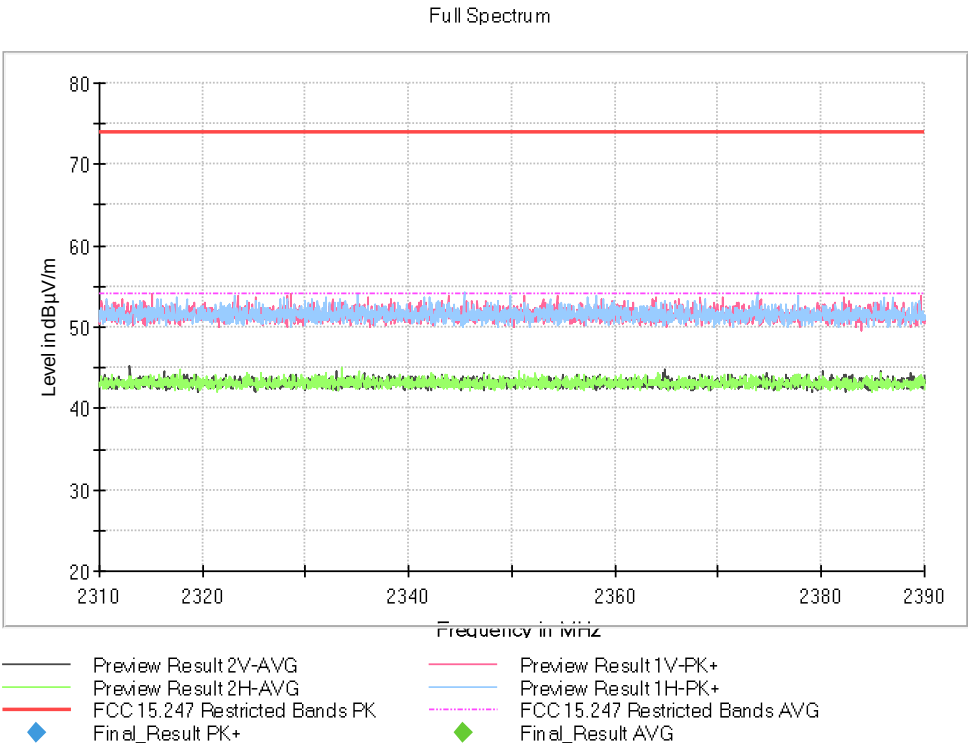


RESTRICTED BAND 2.31-2.39 GHz

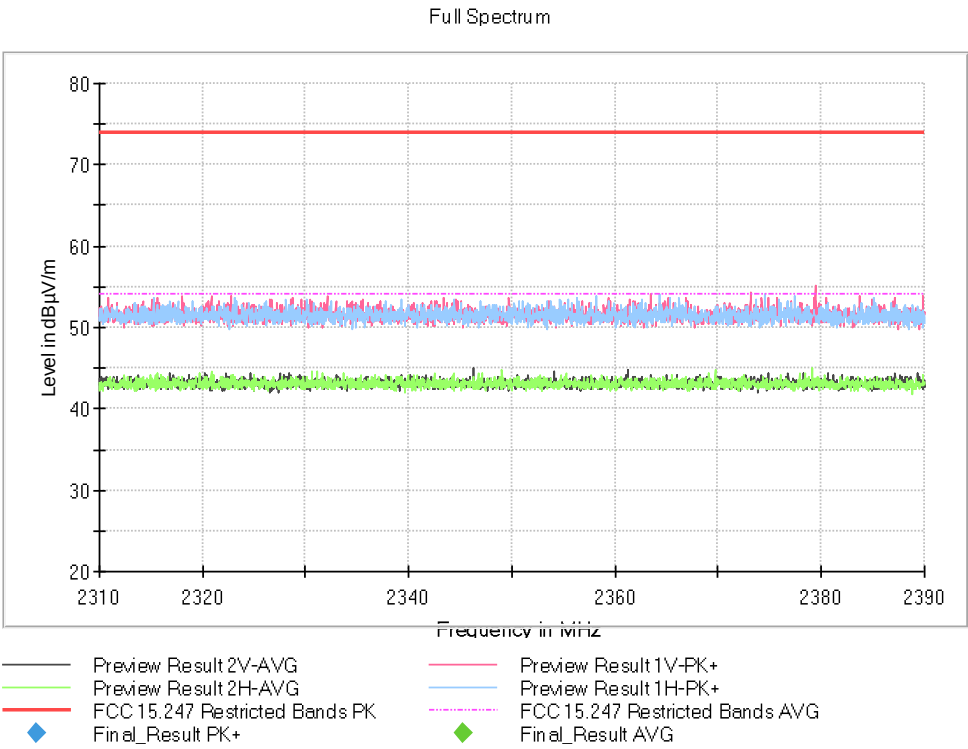
- Low Channel:



- Middle Channel:

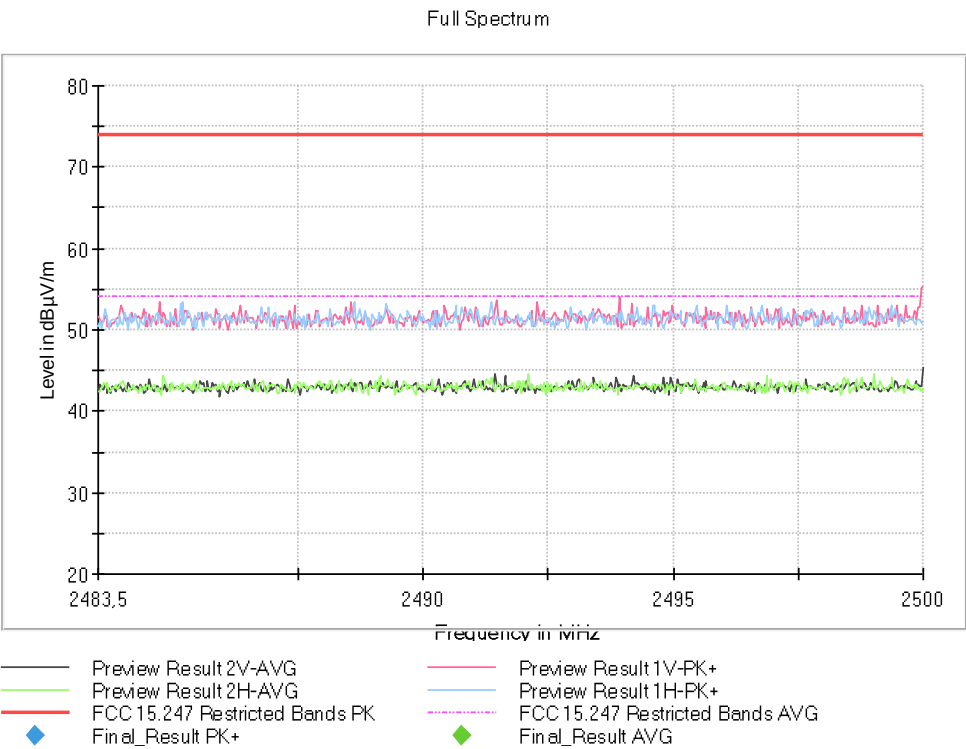


- High Channel:

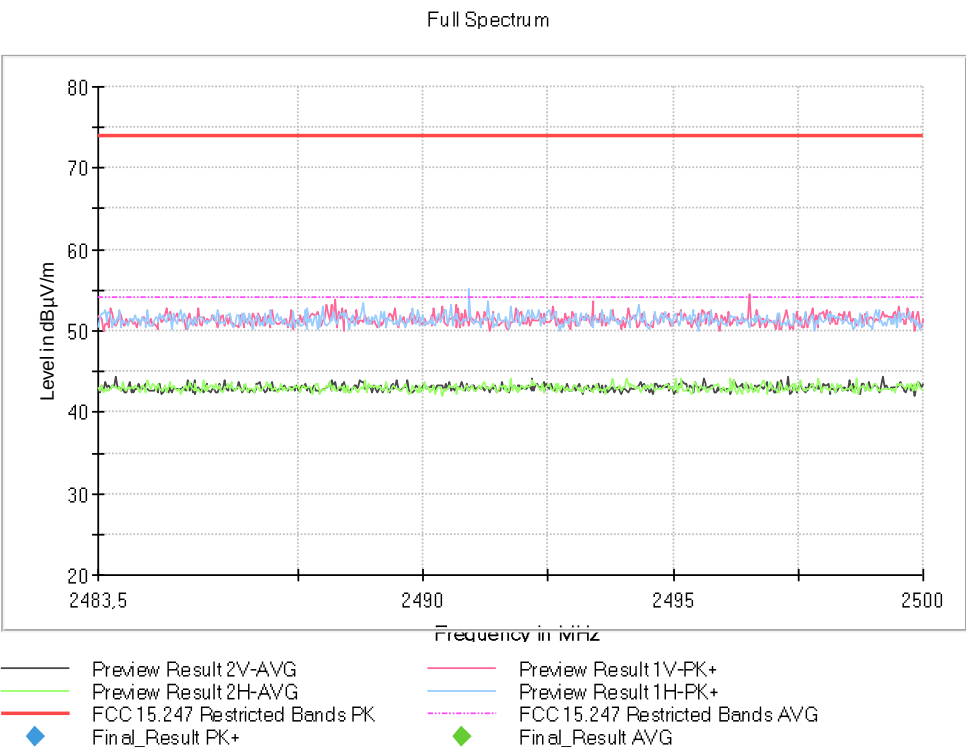


RESTRICTED BAND 2.4835-2.5 GHz

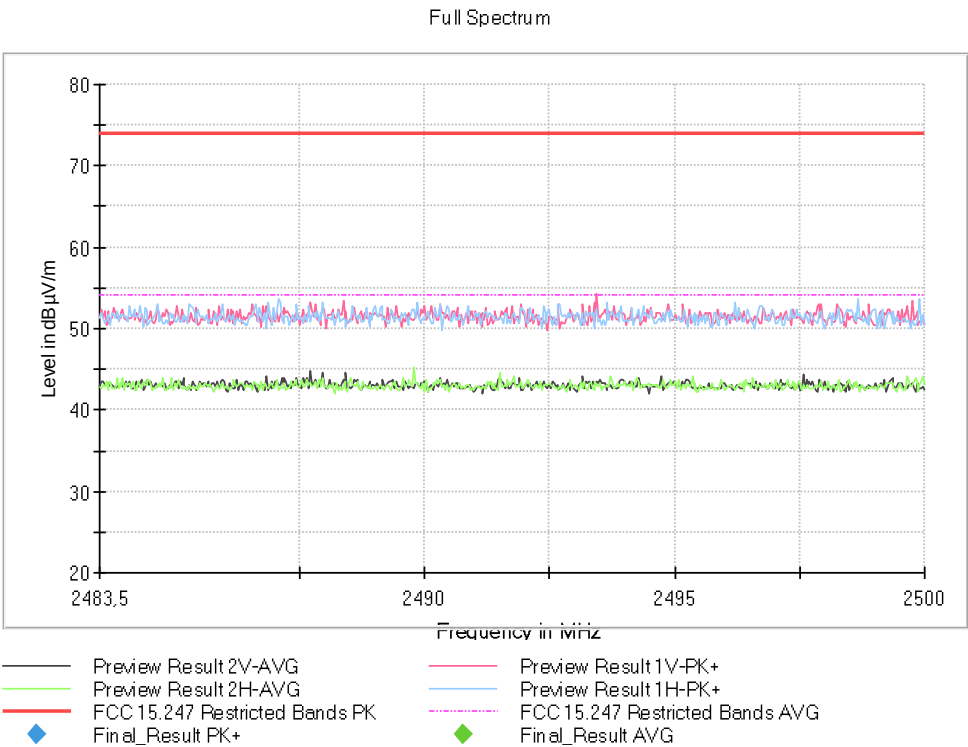
-Low Channel:



-Middle Channel:



- High Channel:



Appendix C: Test results. 802.11 b/g/n20 1x1

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TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

V nominal:	12 Vdc.
Type of Power Supply:	DC External (Car Battery).

ANTENNA (*):

Type of Antenna:	External.
Maximum Declared Antenna Gain:	+0.11 dBi

TEST FREQUENCIES (*):

Low Channel (1):	2412 MHz
Middle Channel (7):	2442 MHz
High Channel (11):	2462 MHz

During transmitter test the EUT was being controlled by the SW tool provided by the client to operate in a continuous transmit mode on the test channel as required and in each of the different modulation modes.

The EUT has four separate antennas which correspond to one port of the equipment.

The data rates of 1 Mbps for 802.11 b, 6 Mbps for 802.11 g, MCS0 for 802.11 n20 were selected based on preliminary testing that identified these rates as the worst cases in terms of output power and emission level at the band edges.

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and connected to the TS8997 test bench system using a low-loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.



The DC supply voltage is applied using an external power supply with a multimeter.

RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) and 1 GHz-18 GHz Double ridge horn antenna is situated at a distance of 3 m and a distance of 1.5 m for the frequency range 17 GHz-26 GHz (18 GHz-40 GHz horn antenna).

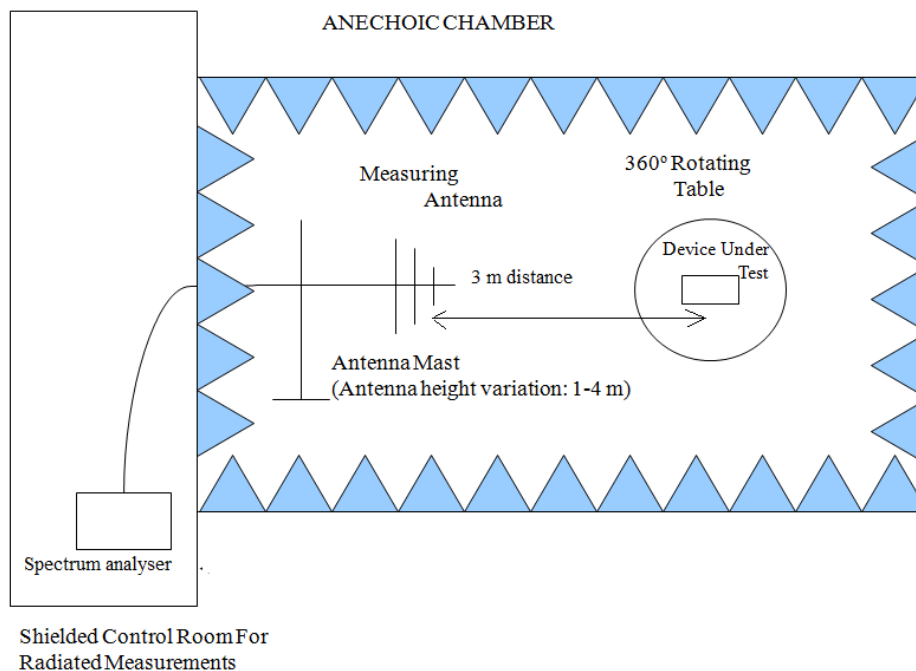
For radiated emissions in the range 17 GHz-26 GHz performed at a distance closer than the distance specified in the standard, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and its situation and orientation were varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission (up to 17 GHz).

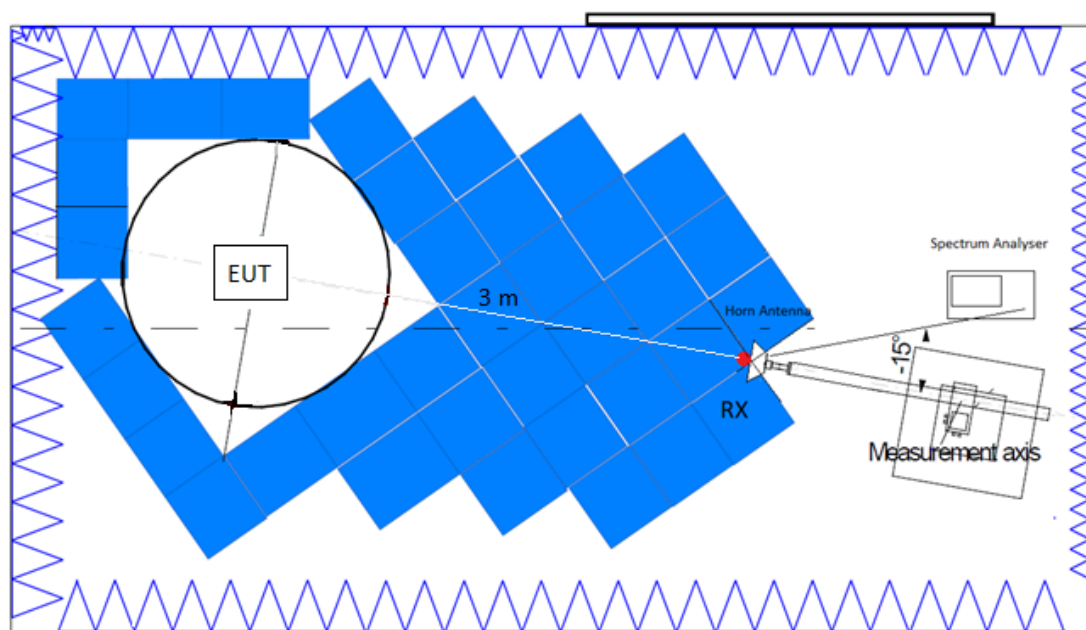
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

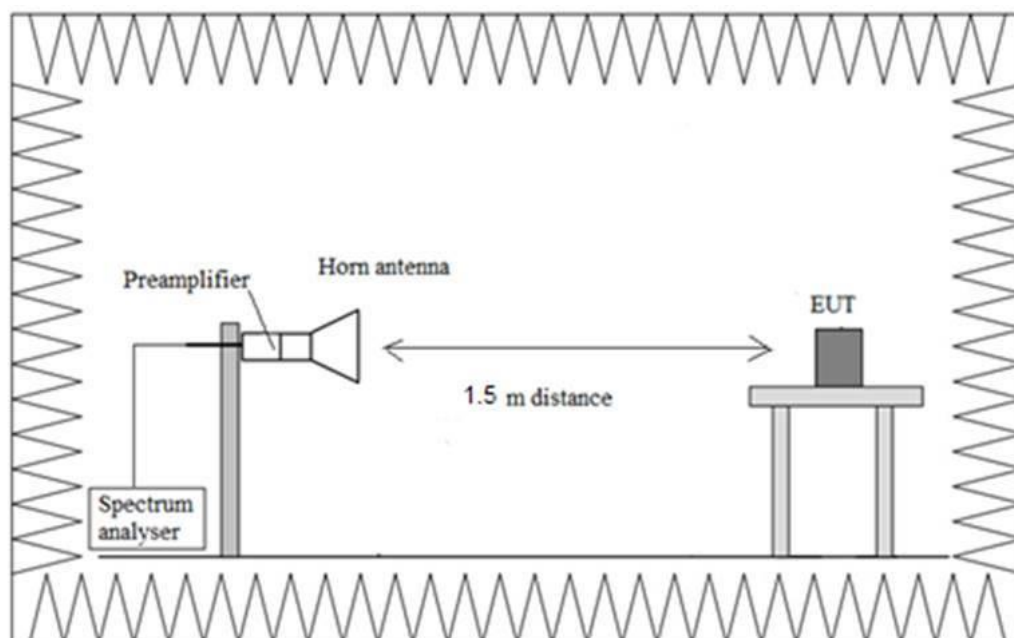
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



Occupied Bandwidth

Results

- **Mode 802.11 b:**

Frequency (MHz)	99% Occupied Channel Bandwidth (MHz)
2412.00	13.400
2442.00	13.200
2462.00	13.400

- **Mode 802.11 g:**

Frequency (MHz)	99% Occupied Channel Bandwidth (MHz)
2412.00	16.700
2442.00	16.700
2462.00	16.700

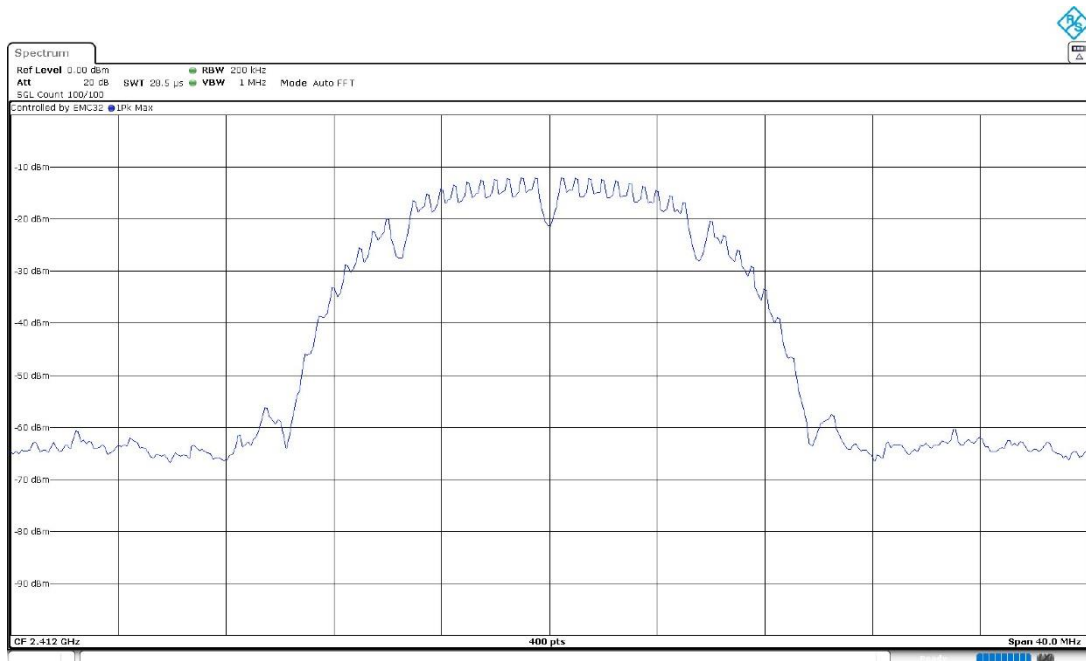
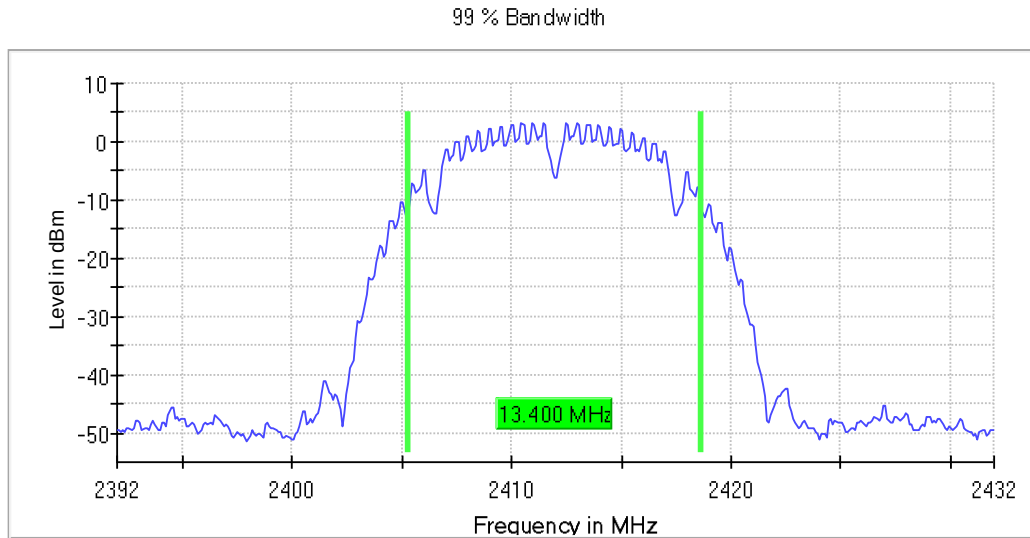
- **Mode 802.11 n20:**

Frequency (MHz)	99% Occupied Channel Bandwidth (MHz)
2412.00	17.700
2442.00	17.600
2462.00	17.700

Attachments

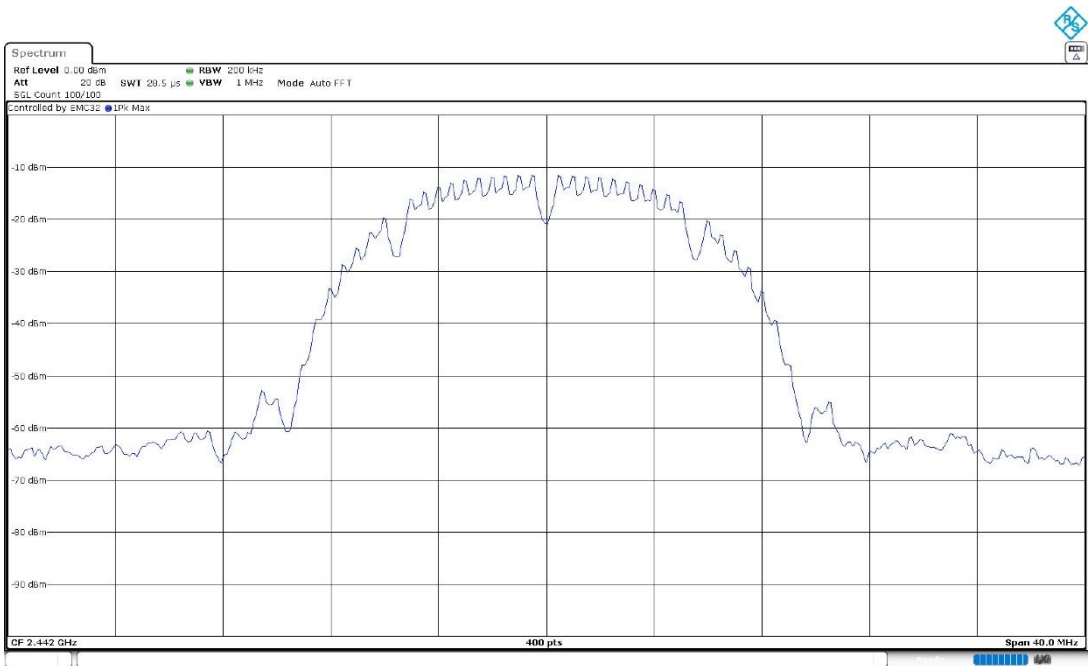
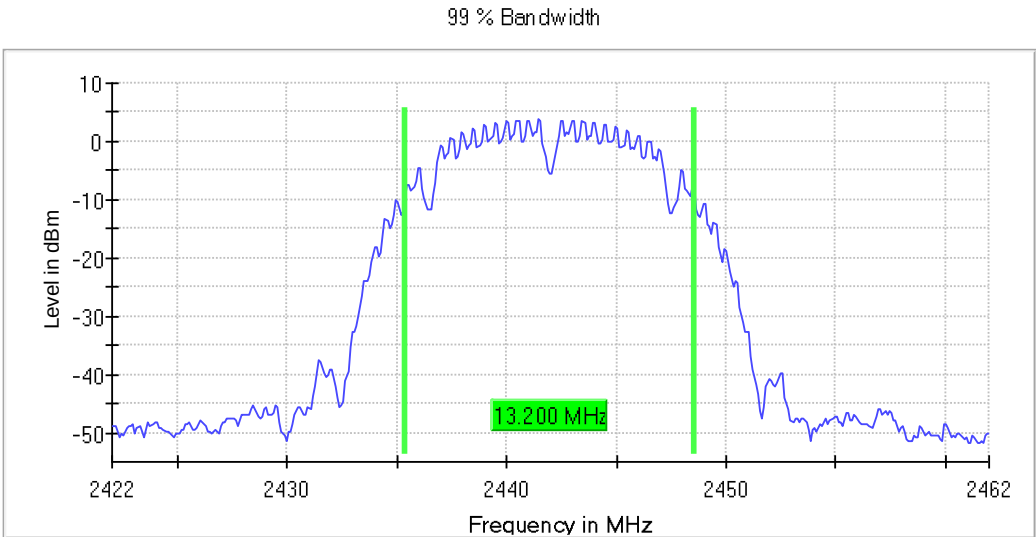
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2412.00, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11b (DSSS 1 Mbit/s)

Figures:



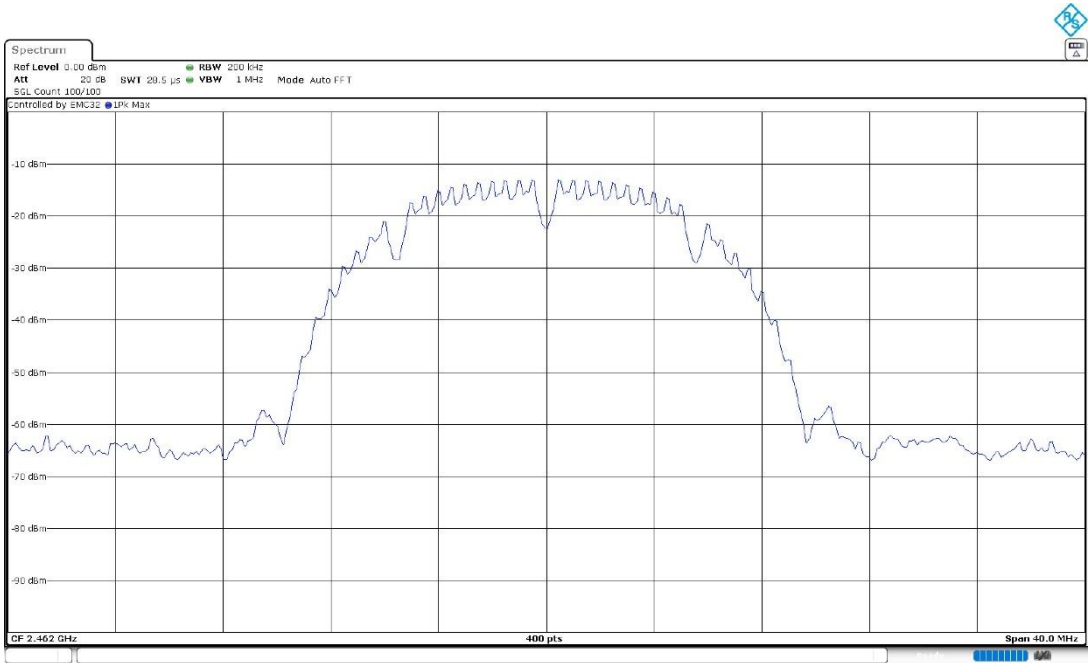
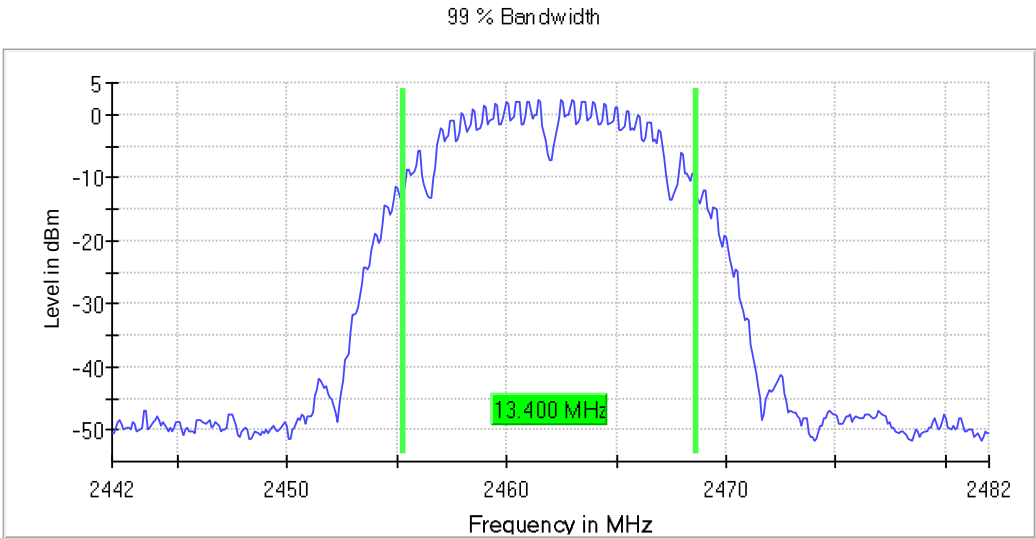
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2442.00, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11b (DSSS 1 Mbit/s)

Figures:



Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2462.00, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11b (DSSS 1 Mbit/s)

Figures:



Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2412.00, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11g (OFDM 6 Mbit/s)

Figures:

