3.6 Spurious Emission, Band edge and Restricted Bands

3.6.1 Regulation

§15.247(d) : In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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)).

§15.209(a) : Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
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**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

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

§15.205(a) : Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

[1]Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2]Above 38.6

§15.205 (b) : Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

3.6.2 Test Procedure

Band-edge Compliance for RF Conducted Emissions

These procedures are applicable for determining compliance at authorized-band band-edges where the requirements are expressed as a value relative to the in-band signal level. Procedures for determining compliance with field strength limits at or close to the band-edges are given in 6.10.6 (see also Table A.2).

Band-edge tests are typically performed as a conducted test but may be performed as radiated measurements on a test site meeting the specifications in 5.2, at the measurement distances specified in 5.3. The instrumentation shall meet the requirements in 4.1.1 using the bandwidths and detectors specified in 4.1.4.2.

When performing radiated measurements, the measurement antenna(s) shall meet the specifications in 4.3. The EUT shall be connected to an antenna and operated at the highest power settings following procedures in 6.3.

For other than frequency-hopping devices, this test sequence shall be performed once. For devices that support frequency hopping, this test sequence shall be performed twice: once with the hopping function turned OFF and then repeated with the hopping function turned ON. The purpose of the test with the hopping function turned on is to confirm that the RF power remains OFF while the device is changing frequencies, and that the oscillator stabilizes at the new frequency before RF power is turned back ON. Overshoot of any oscillator, including phase-lock-loop stabilized oscillators, can cause the device to be temporarily tuned to frequencies outside the authorized band, and it is important that no transmissions occur during such temporary periods. Particular attention to the hopping sequence requirements specified below is needed in the case of adaptive frequency-hopping devices:

a) Connect the EMI receiver or spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described in step e) (be sure to enter all losses between the unlicensed wireless device output and the spectrum analyzer).

b) Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).

c) Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent “normalmode of operation” as specified in 6.10.3.

d) If using the radiated method, then use the applicable procedure(s) of 6.4, 6.5, or 6.6, and orient the EUT and measurement antenna positions to produce the highest emission level.

e) Perform the test as follows:

    1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.

    2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

    3) Attenuation: Auto (at least 10 dB preferred).

    4) Sweep time: Coupled.

    5) Resolution bandwidth: 100 kHz.

    6) Video bandwidth: 300 kHz.

    7) Detector: Peak.

    8) Trace: Max hold.

f) Allow the trace to stabilize. For the test with the hopping function turned ON, this can takeseveral minutes to achieve a reasonable probability of intercepting any emissions due to oscillator overshoot.

g) Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

h) Repeat step c) through step e) for every applicable modulation.

i) Set the EUT to the highest frequency channel (for the hopping on test, the hopping sequence shall include the highest frequency channel) and repeat step c) through step d).

j) The band-edge measurement shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Spurious RF Conducted Emissions

Conducted spurious emissions shall be measured for the transmit frequency, per 5.5 and 5.6, and at the maximum transmit powers.

Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results,account for all losses between the unlicensed wireless device output and the spectrum analyzer. The instrument shall span 30 MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector. The band 30 MHz to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered.

Spurious Radiated Emissions

1. The preliminary radiated measurement were performed to determine the frequency producing the maximum emissions in an semi-anechoic chamber at a distance of 3 meters.

2. The EUT was placed on the top of the 0.8-meter height, 1 x 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360^{o}.

3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, and from 30 to 1000 MHz using the Bi-Log antenna, and from 1000 MHz to 26500 MHz using the horn antenna.

4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 x 4 meter in an semi-anechoic chamber. The EUT was tested at a distance 3 meters.

5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector fuction with specified bandwidth.

6. The 0.8 m height is for below 1 GHz testing, and 1.5 m is for above 1GHz testing.

- Procedure for unwanted emissions measurements below 1 000 MHz

The procedure for unwanted emissions measurements below 1 000 MHz is as follows:

a) Follow the requirements in 12.7.4.

b) Compliance shall be determined using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.

- Procedure for peak unwanted emissions measurements above 1 000 MHz

The procedure for peak unwanted emissions measurements above 1 000 MHz is as follows:

a) Follow the requirements in 12.7.4.

b) Peak emission levels are measured by setting the instrument as follows:

1) RBW = 1 MHz.

2) VBW ≥ [3 × RBW].

3) Detector = peak.

4) Sweep time = auto.

5) Trace mode = max hold.

6) Allow sweeps to continue until the trace stabilizes. Note that if the transmission is not ontinuous, then the time required for the trace to stabilize will increase by a factor of pproximately 1 / D, where D is the duty cycle. For example, at 50 % duty cycle, the easurement time will increase by a factor of two, relative to measurement time for ontinuous transmission.

- Procedure for average unwanted emissions measurements above 1 000 MHz

Option 1)
Method VB-A is averaging using reduced video bandwidth. The procedure for this method is as follows:

a) RBW = 1 MHz.

b) Video bandwidth:

1) If the EUT is configured to transmit with D ≥ 98 %, then set VBW ≤ RBW / 100 (i.e., 10 kHz), but not less than 10 Hz.

2) If the EUT D is < 98%, then set VBW ≥ 1 / T, where T is defined in item a1) of 12.2.

c) Video bandwidth mode or display mode:

1) The instrument shall be set with video filtering applied in the power domain. Typically, this requires setting the detector mode to RMS (power averaging) and setting the average-VBW type to power (rms).

2) As an alternative, the instrument may be set to linear detector mode. Video filtering shall be applied in linear voltage domain (rather than in a log or dB domain). Some instruments require linear display mode to accomplish this. Others have a setting for average-VBW type, which can be set to "voltage" regardless of the display mode.

d) Detector = peak.

e) Sweep time = auto.

f) Trace mode = max hold.

g) Allow max hold to run for at least 50 traces if the transmitted signal is continuous or has at least 98 % duty cycle. For lower duty cycles, increase the minimum number of traces by a factor of 1/x, where D is the duty cycle. For example, use at least 200 traces if the duty cycle is 25 %. (If a specific emission is demonstrated to be continuous—i.e., 100 % duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 50 traces should be averaged.)

Option 2)
From the peak value of the emission :
The measured peak value in dBµV/m is corrected by 20log(maximum dwell time in 100 ms / 100)

- Sample Calculation

- Field Strength Level [dBµV/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m] + Duty Cycle Correction [dB]
- AFCL [dB/m] = Antenna Factor [dB/m] + Cable loss [dB]
- Margin [dB] = Field Strength Level [dBµV/m] – Limit [dBµV/m]

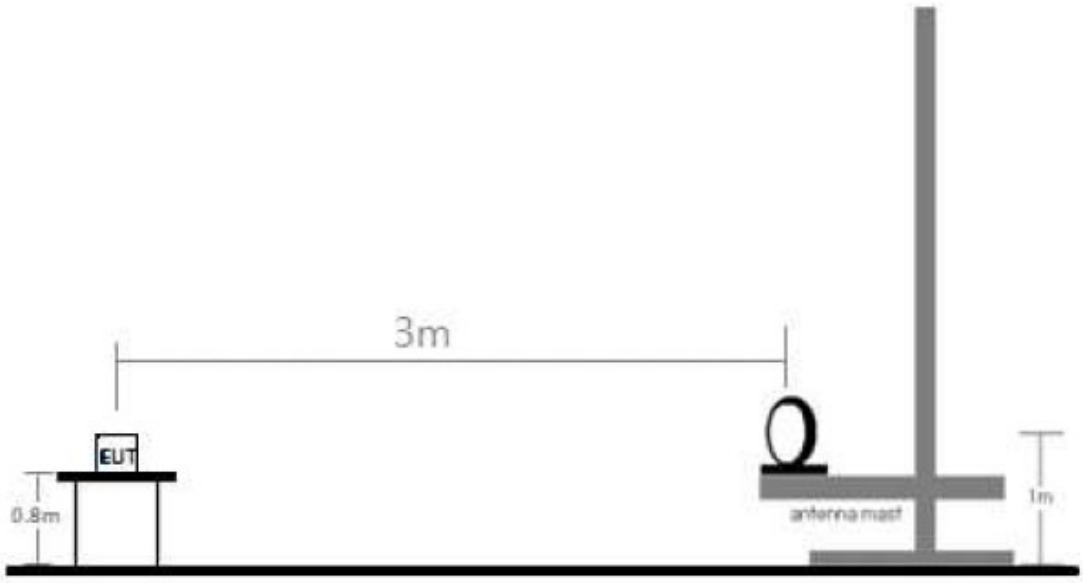
- Duty Cycle Correction Factor Calculation - worst

- Channel hop rate = 800 hops/second
- Adjusted channel hop rate for DH5 mode = 133.33 hops/second
- Time per channel hop = 1 / 133.33 hops/second = 7.50 ms
- Time to cycle through all channels = 7.50 x 20 channels = 150 ms
- Number of times transmitter hits on one channel = 100 ms / 150 ms = 1 time(s)
- Worst case dwell time = 7.5 ms
- Duty cycle correction factor = $20\log_{10}(7.5 \text{ ms} / 100 \text{ ms}) = -22.5$ dB

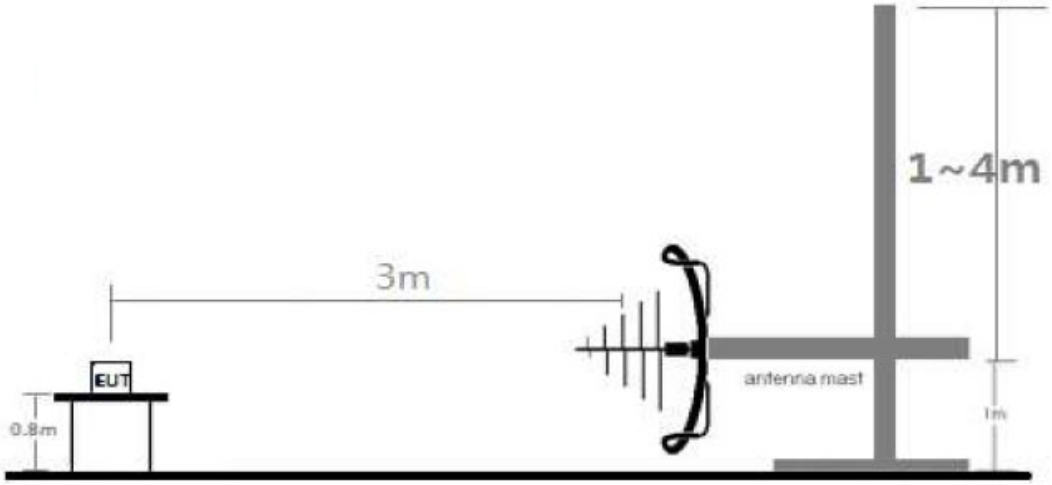
3.6.3 Deviation from Test Standard

No deviation.

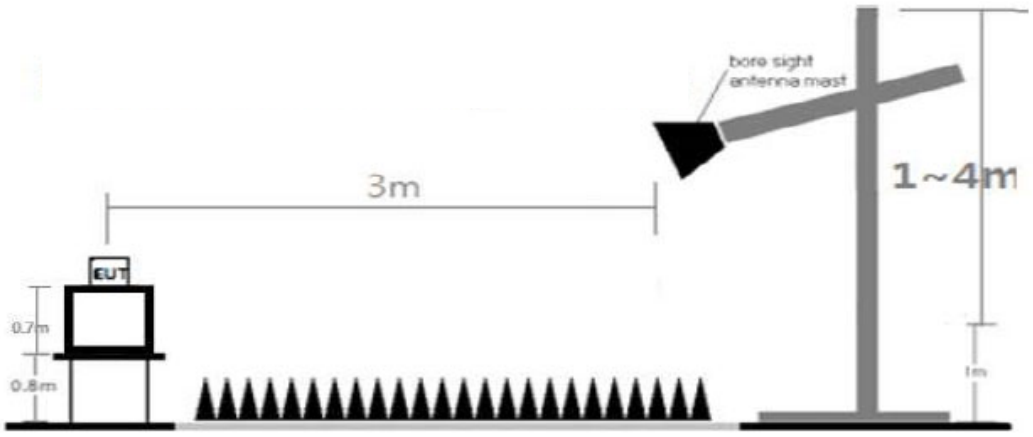
3.6.4 Test Setup

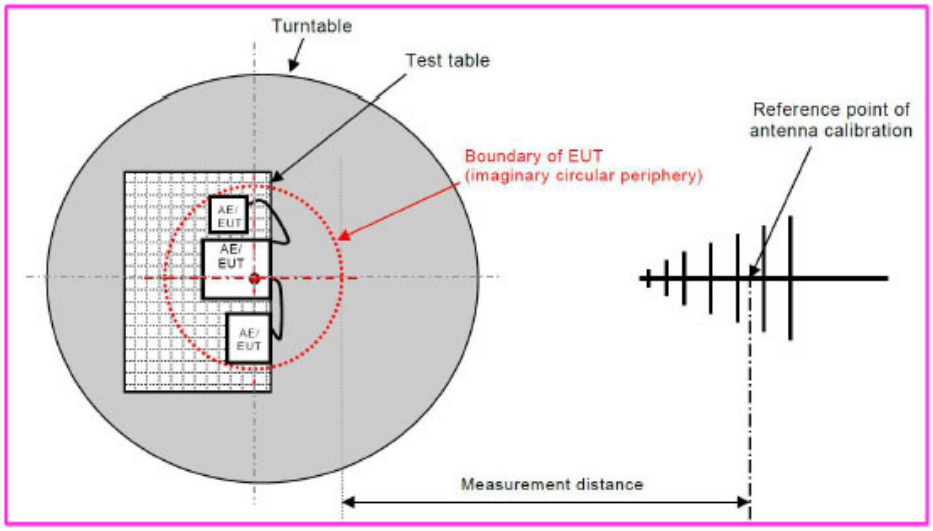


[Radiated Emission Test Setup Below 30 MHz]

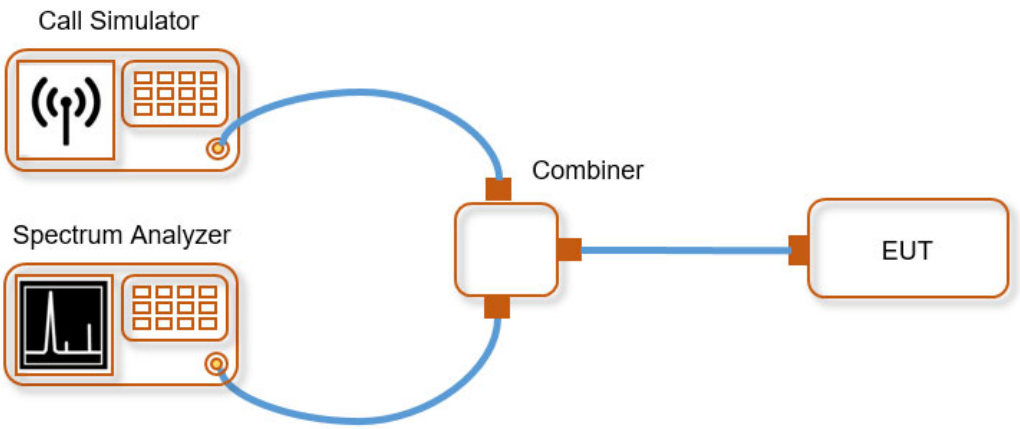


[Radiated Emission Test Setup Below 1 GHz]





[Radiated Emission Test Setup Above 1 GHz]

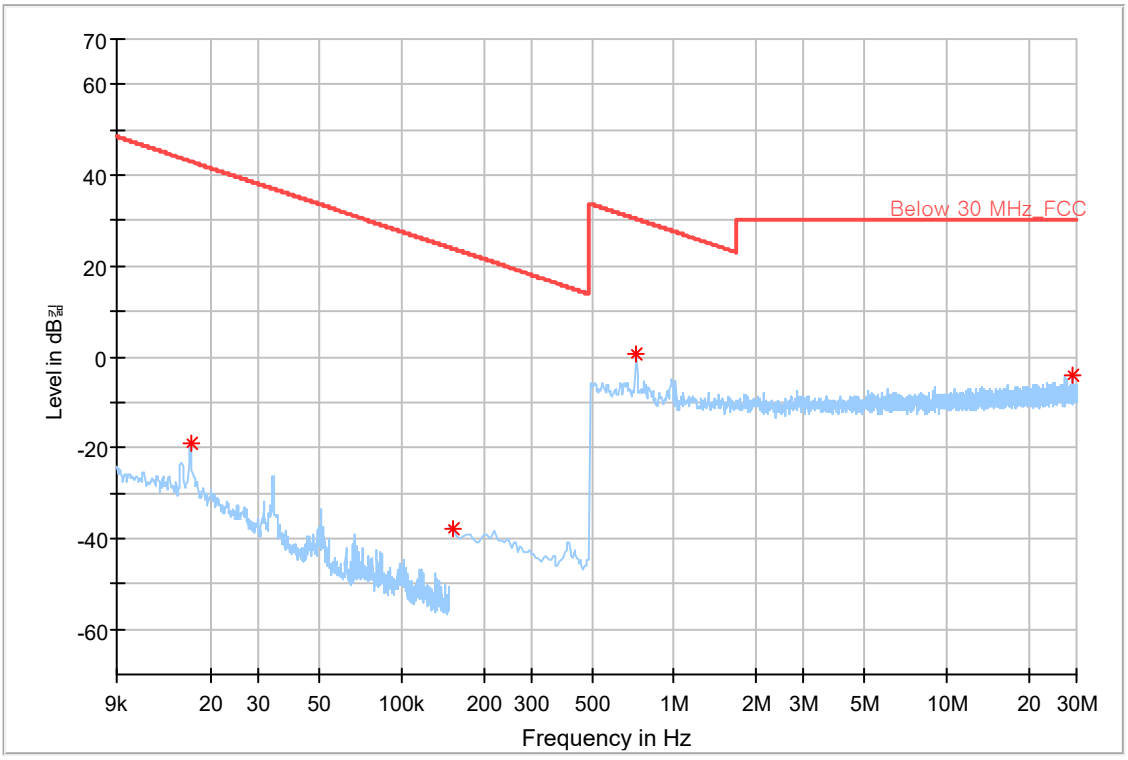


[Conducted Spurious Emission]

3.6.5 Test Result of Radiated Spurious Emission

3.6.5.1 Radiated Emissions (Below 30 MHz)

Worst case - RSE(Below 30 MHz)_BDR_GFSK_2 441 MHz



FCC

Frequency [MHz]	QuasiPeak Reading Value [dBuV]	QuasiPeak [dBuV/m]	Distance Correction Factor [dB]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Correction Factor [dB/m]
0.02	40.40	-19.10	-80.00	43.06	62.16	100.00	Parallel	159.00	-59.50
0.73	19.81	0.61	-40.00	30.36	29.75	100.00	Parallel	187.00	-19.20
28.81	12.19	-4.11	-40.00	30.00	34.11	100.00	Parallel	45.00	-16.30

IC

Frequency [MHz]	QuasiPeak Reading Value [dBuA]	QuasiPeak [dBuA/m]	Distance Correction Factor [dB]	Limit [dBuA/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Correction Factor [dB/m]
0.02	-11.10	-70.60	-80.00	-8.44	62.16	100.00	Parallel	159.00	-59.50
0.73	-31.69	-50.89	-40.00	-21.14	29.75	100.00	Parallel	187.00	-19.20
28.81	-39.31	-55.61	-40.00	-21.50	34.11	100.00	Parallel	45.00	-16.30

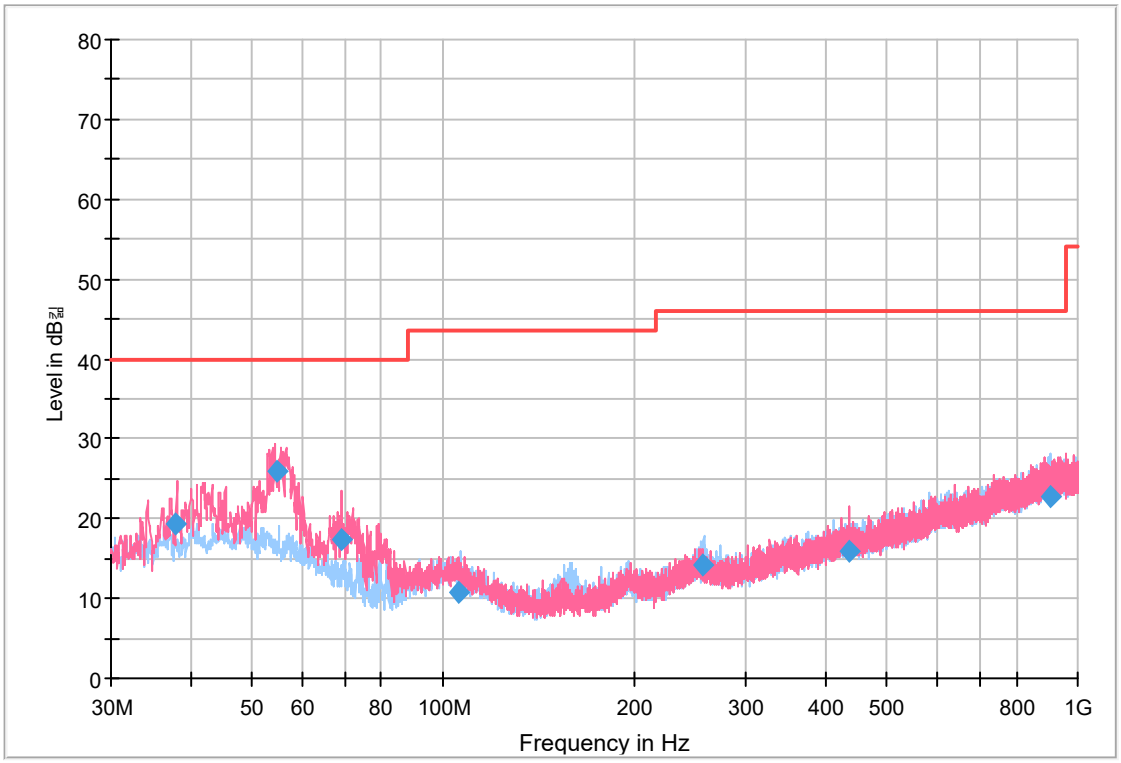
Remarks

1. Quasi Peak(dBuV/m) = QP Reading Value(dBµV/m) + Correction Factor(dB) + Distance Factor(dB)
2. Correction Factor(dB) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin(dB) = (Quasi Peak) Limit (dBµV/m) – (Quasi Peak) Result (dBµV/m)
4. dBuA/m = dBuV/m – 51.5 dB

5. We tested three kind of Antenna Pol (Parallel, Perpendicular, Ground parallel) and reported worst case antenna Pol.

3.6.5.2 Radiated Emissions (Below 1 GHz)

Worst case - RSE(Below 1 GHz)_BDR_GFSK_2 441 MHz

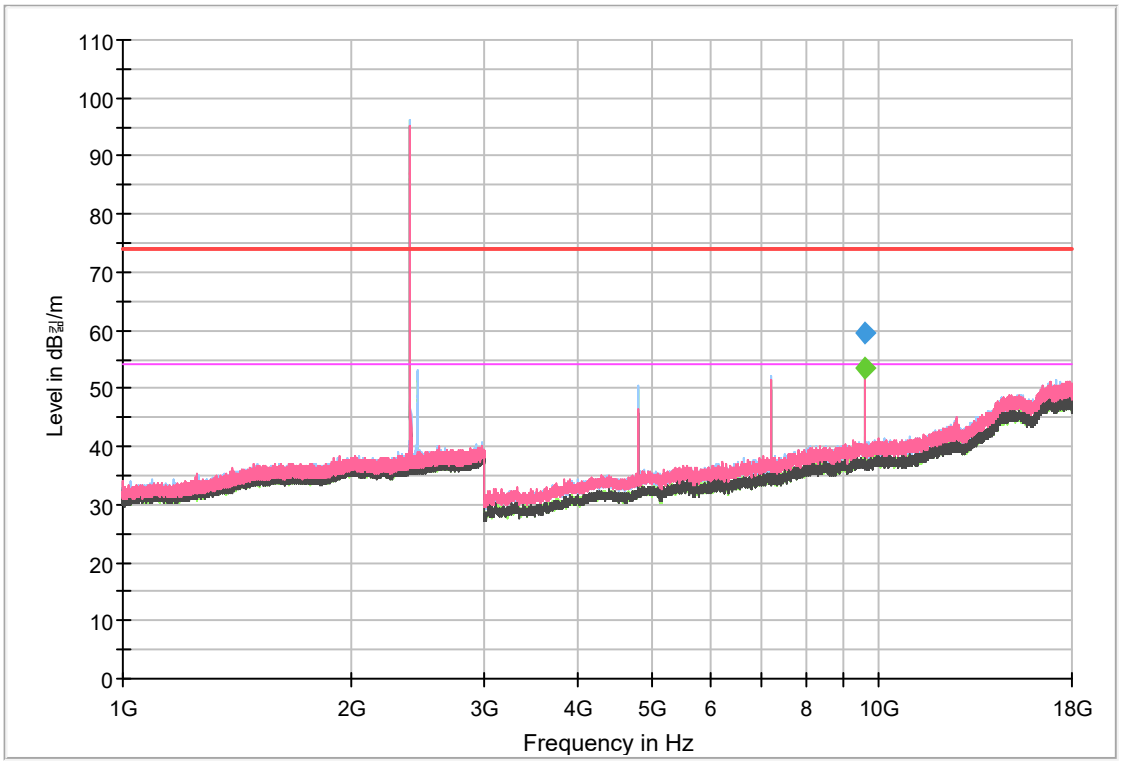


Frequency [MHz]	Quasi Reading Value [dBuV]	Quasi Peak [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Pol	Azimuth [deg]	Correction Factor [dB/m]
54.92	45.73	25.93	40.00	14.07	110	V	358	-19.80
69.01	40.98	17.38	40.00	22.62	150	V	358	-23.60
106.16	32.66	10.76	43.50	32.74	316	H	135	-21.90
257.08	34.76	14.26	46.00	31.74	115	H	-7	-20.50
437.55	32.00	15.80	46.00	30.20	110	V	-44	-16.20
903.92	31.93	22.73	46.00	23.27	104	H	211	-9.20

Remarks
1. Quasi Peak(dBµV/m) = Quasi Peak Reading Value(dBµV/m) + Correction Factor(dB)
2. Correction Factor(dB) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin(dB) = (Quasi Peak) Limit (dBµV/m) – (Quasi Peak) Result (dBµV/m)

3.6.5.3 Radiated Emissions (Above 1 GHz)

RSE BDR_GFSK_2 402 MHz

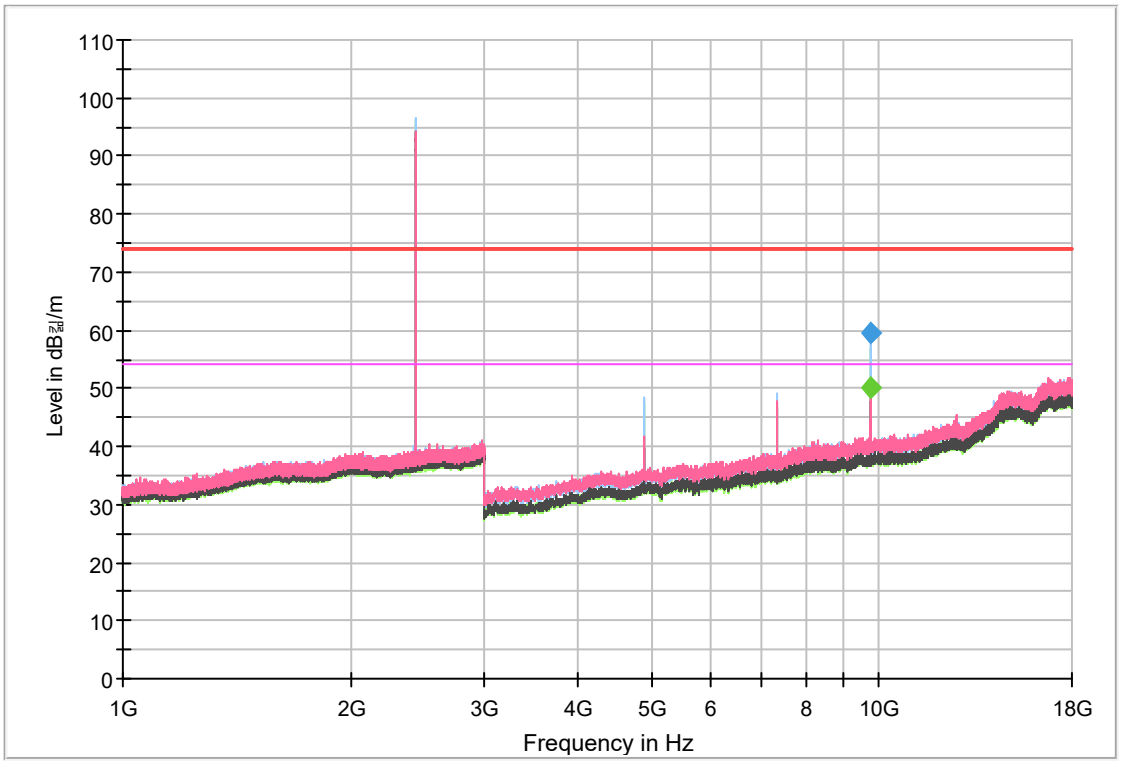


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
9 607.89	49.11	59.61	---	---	---	110	H	300	10.50	14.39	74.00	---	---
9 607.89	---	---	---	37.11	-22.50	110	H	300	10.50	---	---	16.89	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = Peak Result(dBuV/m) + DCCF
3. DCCF(Duty Cycle Correction Factor) = 20 x Log(worst dwell time/100 ms)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Limit (dBuV/m) – (Peak/AVG) Result (dBuV/m)
6. * - indicates frequency in Restricted Band.

RSE BDR_GFSK_2 441 MHz

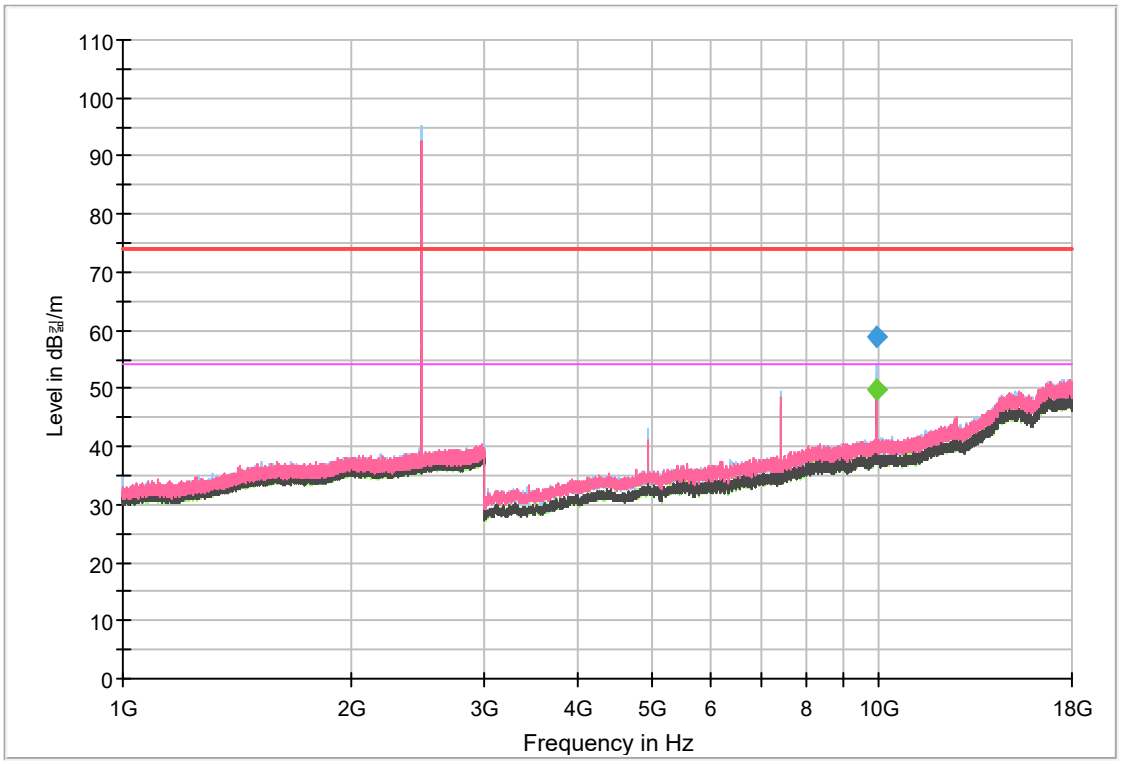


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
9 763.89	48.79	59.49	---	---	---	100	H	241	10.70	14.51	74.00	---	---
9 763.89	---	---	---	36.99	-22.50	100	H	241	10.70	---	---	17.01	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = Peak Result(dBuV/m) + DCCF
3. DCCF(Duty Cycle Correction Factor) = 20 x Log(worst dwell time/100 ms)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Limit (dBuV/m) – (Peak/AVG) Result (dBuV/m)
6. * - indicates frequency in Restricted Band.

RSE BDR_GFSK_2 480 MHz

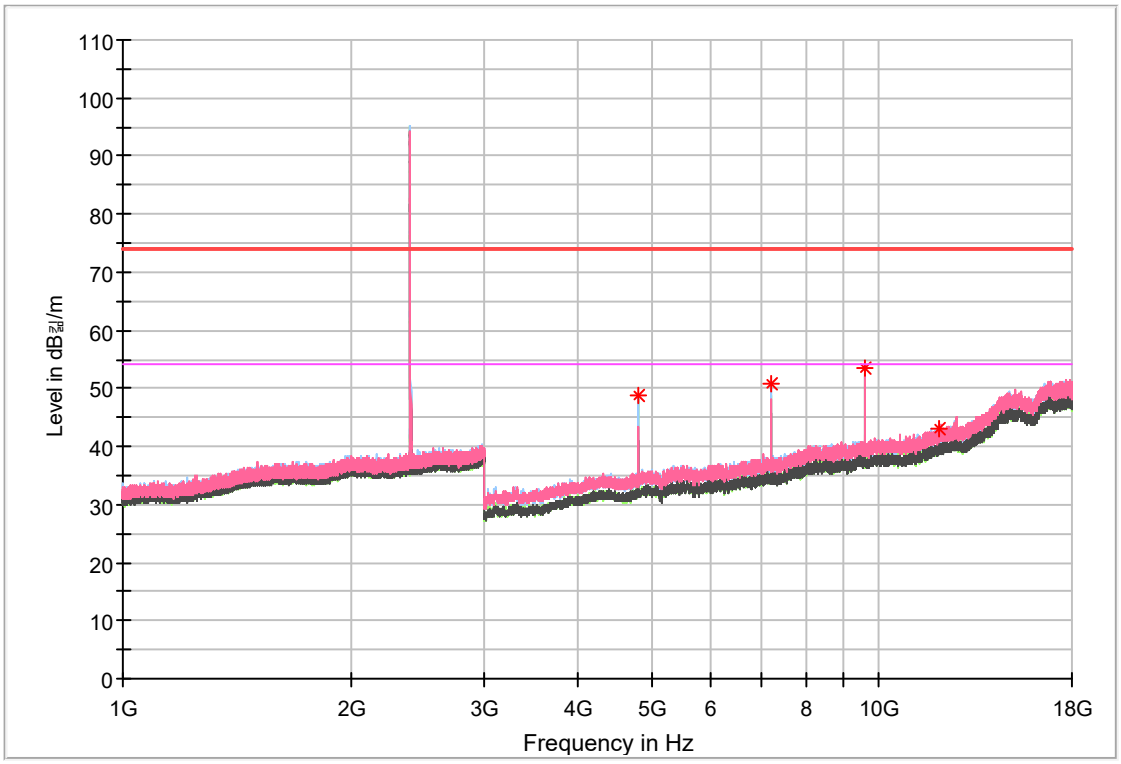


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
9 919.97	47.72	58.82	---	---	---	364	H	238	11.10	15.18	74.00	---	---
9 919.97	---	---	---	36.32	-22.50	364	H	238	11.10	---	---	17.68	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = Peak Result(dBuV/m) + DCCF
3. DCCF(Duty Cycle Correction Factor) = 20 x Log(worst dwell time/100 ms)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Limit (dBuV/m) – (Peak/AVG) Result (dBuV/m)
6. * - indicates frequency in Restricted Band.

RSE EDR_8DPSK_2 402 MHz

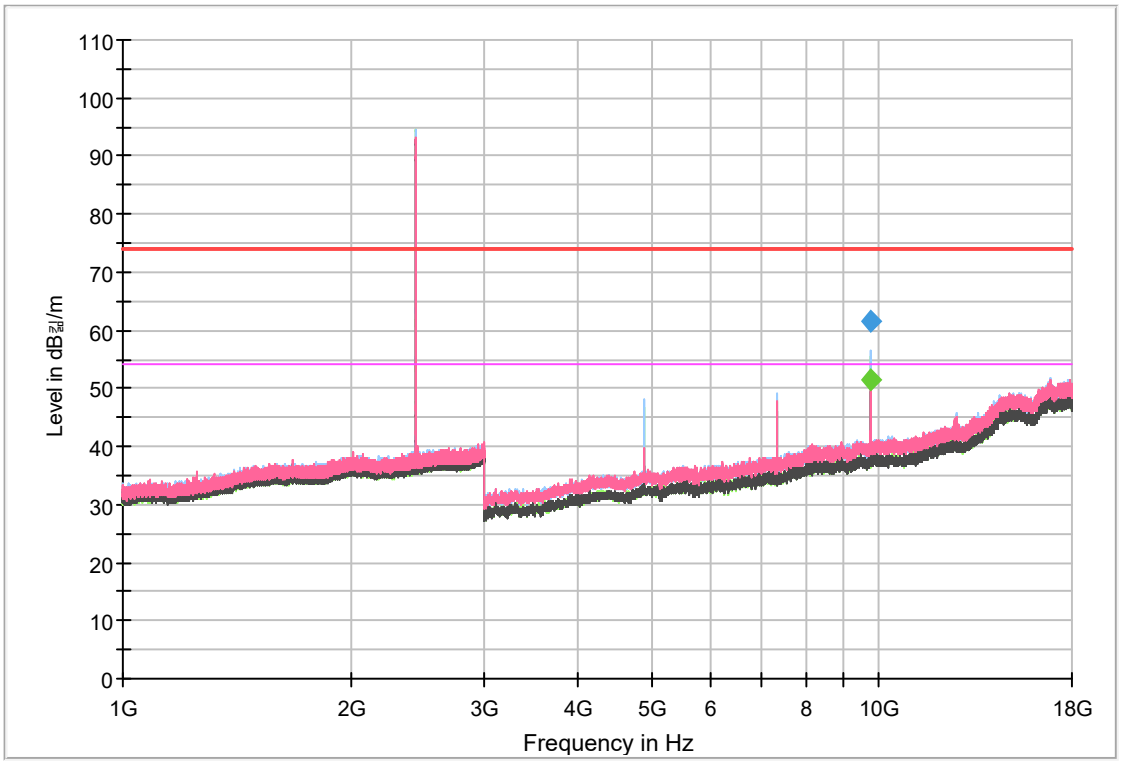


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
4 803.75	45.96	48.76	-	-	-	200	H	2	2.80	25.24	74.00	-	-
7 206.09	43.32	50.72	-	-	-	400	H	110	7.40	23.28	74.00	-	-
9 607.97	42.88	53.38	-	-	-	200	H	258	10.50	20.62	74.00	-	-

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = Peak Result(dBuV/m) + DCCF
3. DCCF(Duty Cycle Correction Factor) = 20 x Log(worst dwell time/100 ms)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Limit (dBuV/m) – (Peak/AVG) Result (dBuV/m)
6. * - indicates frequency in Restricted Band.

RSE EDR_8DPSK_2 441 MHz

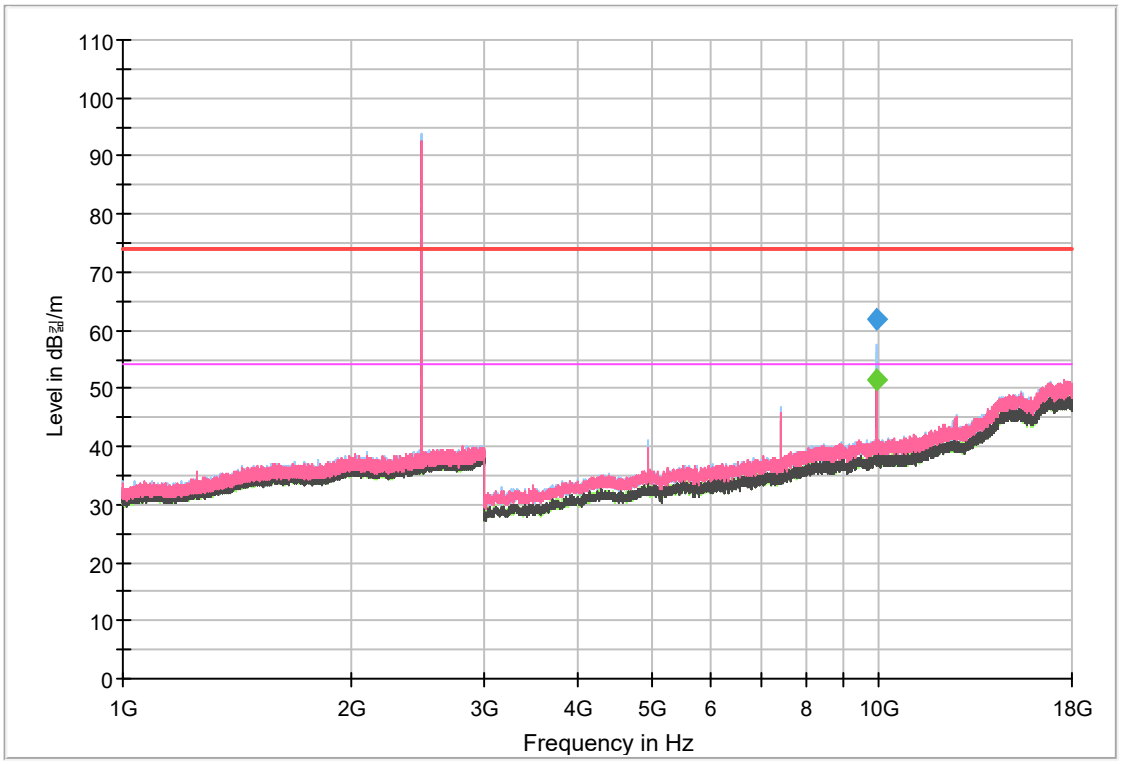


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
9 763.80	50.87	61.57	---	---	---	101	H	238	10.70	12.43	74.00	---	---
9 763.80	---	---	---	39.07	-22.50	101	H	238	10.70	---	---	14.93	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = Peak Result(dBuV/m) + DCCF
3. DCCF(Duty Cycle Correction Factor) = 20 x Log(worst dwell time/100 ms)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Limit (dBuV/m) – (Peak/AVG) Result (dBuV/m)
6. * - indicates frequency in Restricted Band.

RSE EDR_8DPSK_2 480 MHz

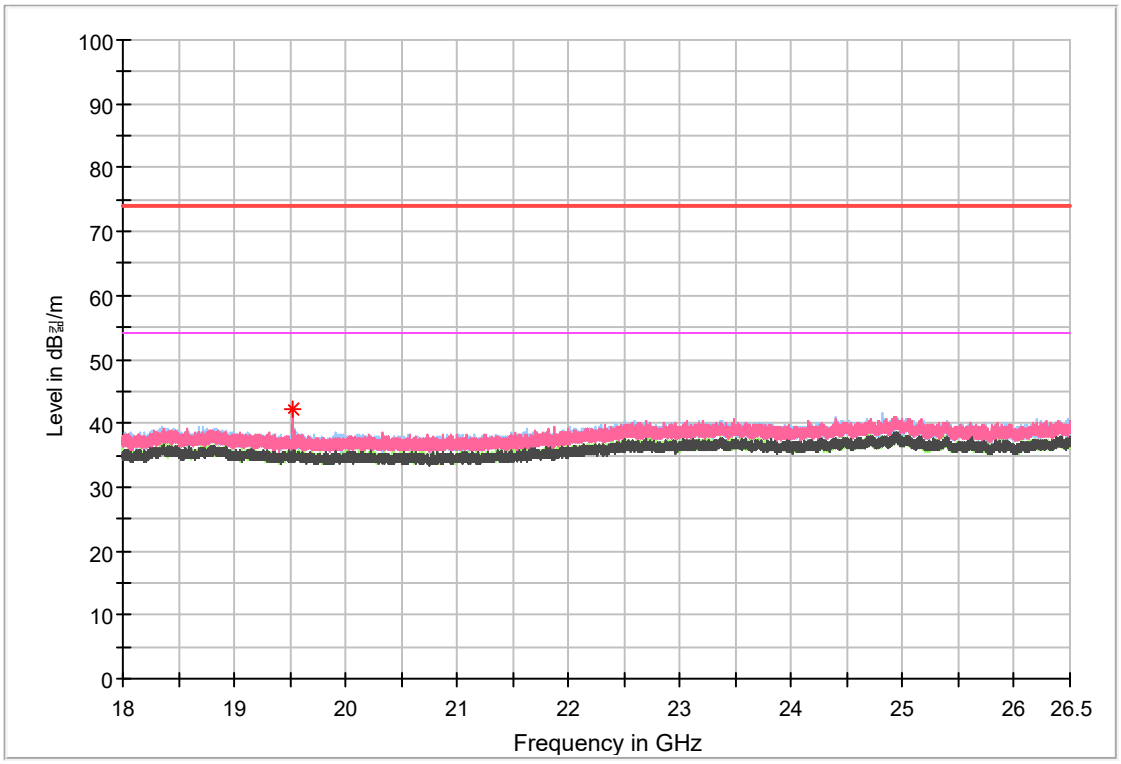


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
9 919.80	50.66	61.76	---	---	---	107	H	240	11.10	12.24	74.00	---	---
9 919.80	---	---	---	39.26	-22.50	107	H	240	11.10	---	---	14.74	54.00

Remarks
1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = Peak Result(dBuV/m) + DCCF
3. DCCF(Duty Cycle Correction Factor) = 20 x Log(worst dwell time/100 ms)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Limit (dBuV/m) – (Peak/AVG) Result (dBuV/m)
6. * - indicates frequency in Restricted Band.

3.6.5.4 Radiated Emissions (Above 18 GHz)

Worst Case - RSE(Above 18 GHz)_BDR_GFSK_2 441 MHz

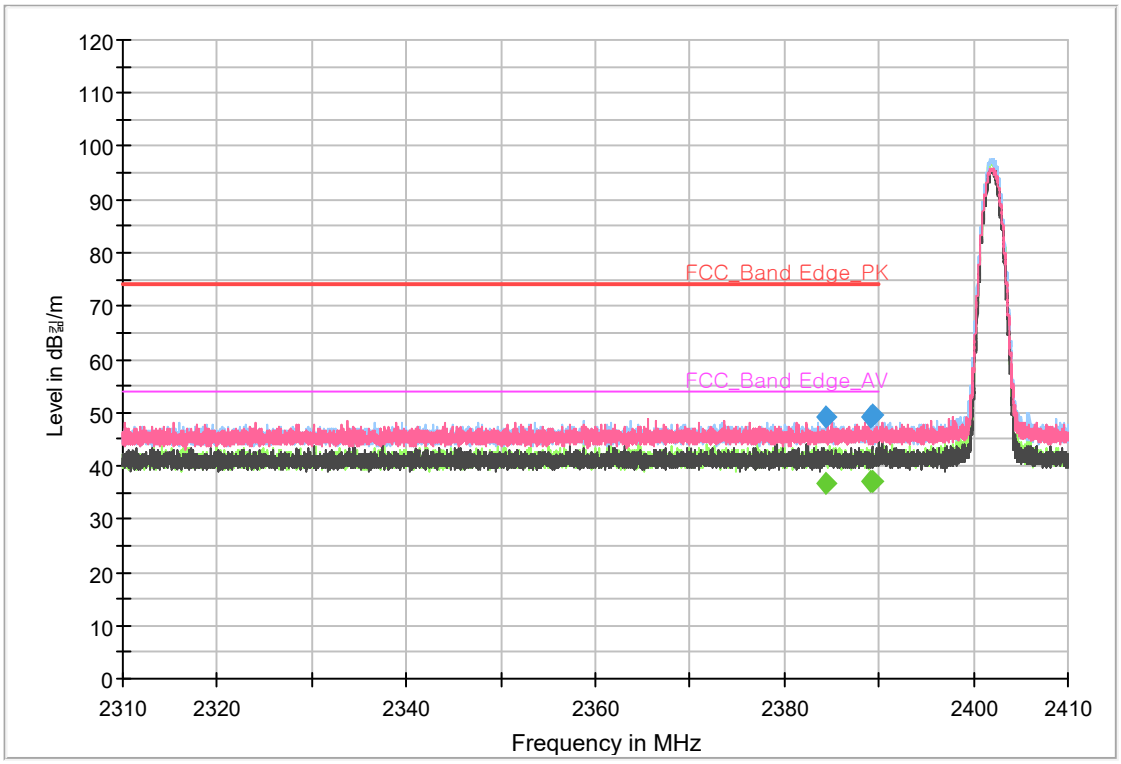


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
19 519.91	43.16	42.06	-	-	-	300	V	101	-1.10	31.94	74.00	-	-

Remarks
1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = Peak Result(dBuV/m) + DCCF
3. DCCF(Duty Cycle Correction Factor) = 20 x Log(worst dwell time/100 ms)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Limit (dBuV/m) – (Peak/AVG) Result (dBuV/m)
6. * - indicates frequency in Restricted Band.

3.6.5.5 Restricted Band Edge Measurements

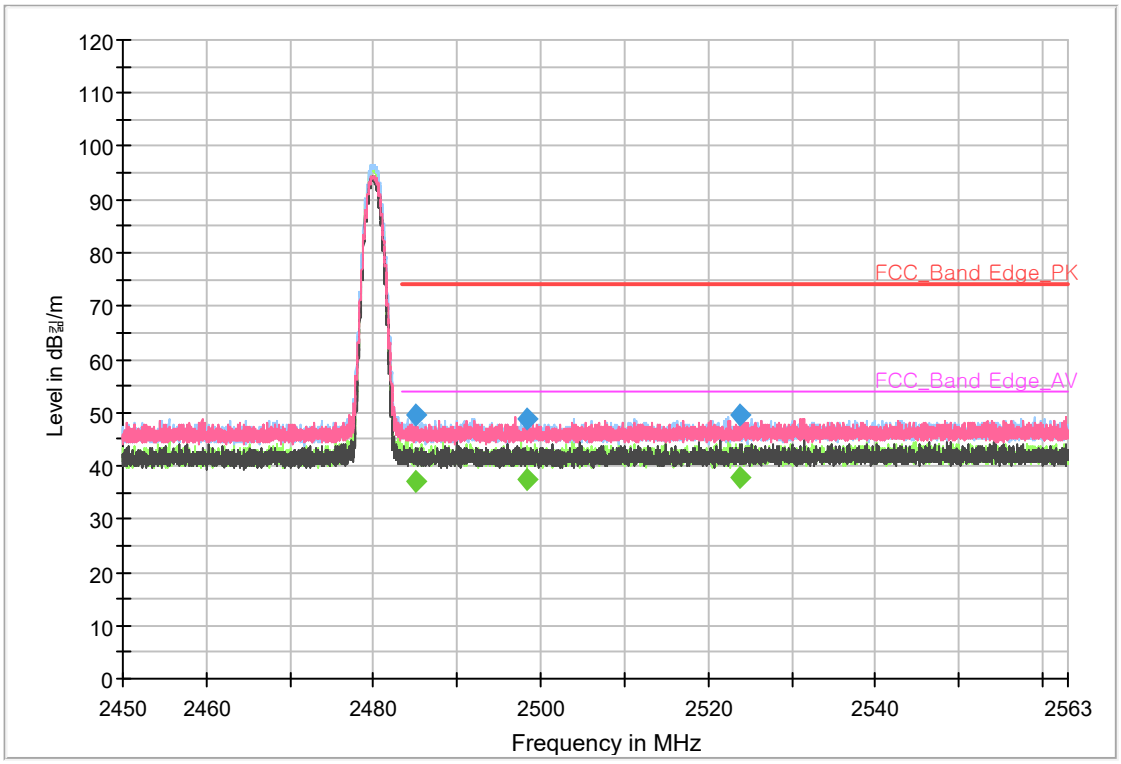
Band Edge_BDR_GFSK_2 402 MHz



Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
2 384.34	45.80	49.10	---	---	---	150	V	120	3.30	24.90	74.00	---	---
2 384.34	---	---	---	26.60	-22.50	150	V	120	3.30	---	---	27.40	54.00
2 389.23	45.92	49.22	---	---	---	260	V	-13	3.30	24.78	74.00	---	---
2 389.23	---	---	---	26.72	-22.50	260	V	-13	3.30	---	---	27.28	54.00
2 389.30	46.28	49.58	---	---	---	229	H	10	3.30	24.42	74.00	---	---
2 389.30	---	---	---	27.08	-22.50	229	H	10	3.30	---	---	26.92	54.00

Remarks
1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = Peak Result(dBuV/m) + DCCF
3. DCCF(Duty Cycle Correction Factor) = 20 x Log(worst dwell time/100 ms)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Limit (dBuV/m) – (Peak/AVG) Result (dBuV/m)

Band Edge_BDR_GFSK_2 480 MHz

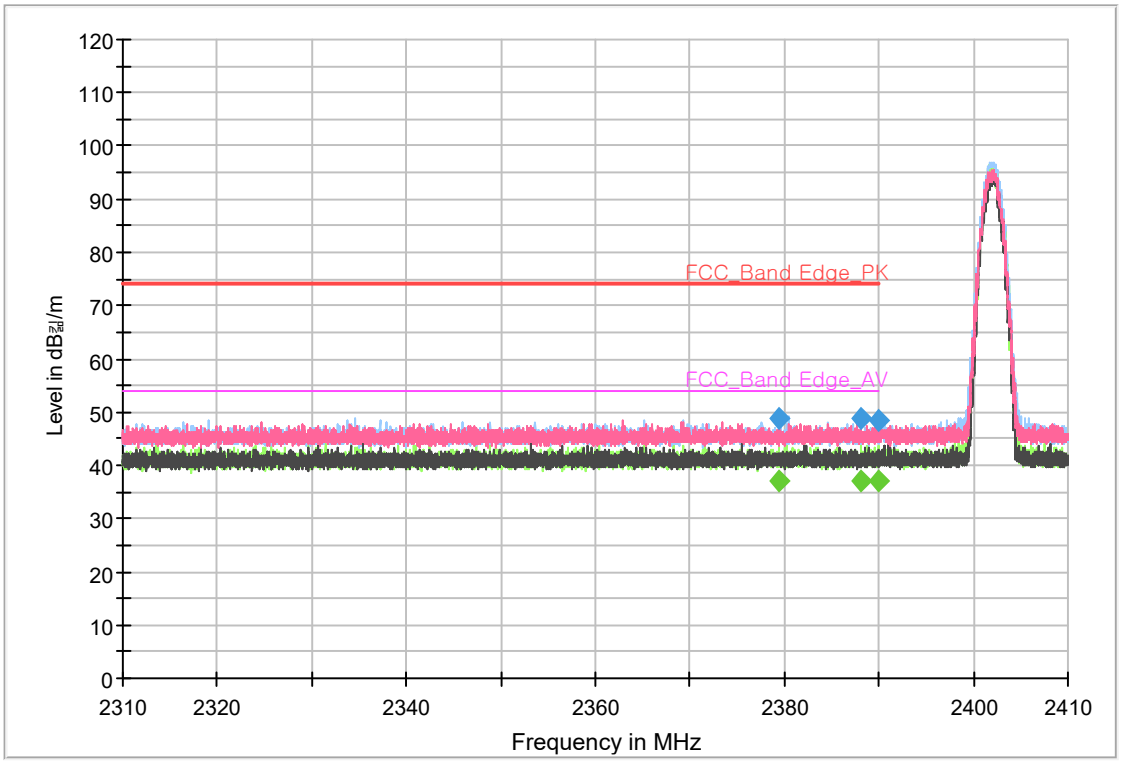


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
2 485.10	45.82	49.52	---	---	---	199	V	353	3.70	24.48	74.00	---	---
2 485.10	---	---	---	27.02	-22.50	199	V	353	3.70	---	---	26.98	54.00
2 498.23	45.12	48.92	---	---	---	291	V	350	3.80	25.08	74.00	---	---
2 498.23	---	---	---	26.42	-22.50	291	V	350	3.80	---	---	27.58	54.00
2 523.73	45.81	49.71	---	---	---	185	H	20	3.90	24.29	74.00	---	---
2 523.73	---	---	---	27.21	-22.50	185	H	20	3.90	---	---	26.79	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = Peak Result(dBuV/m) + DCCF
3. DCCF(Duty Cycle Correction Factor) = 20 x Log(worst dwell time/100 ms)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Limit (dBuV/m) – (Peak/AVG) Result (dBuV/m)

Band Edge_ EDR_8DPSK _2 402 MHz

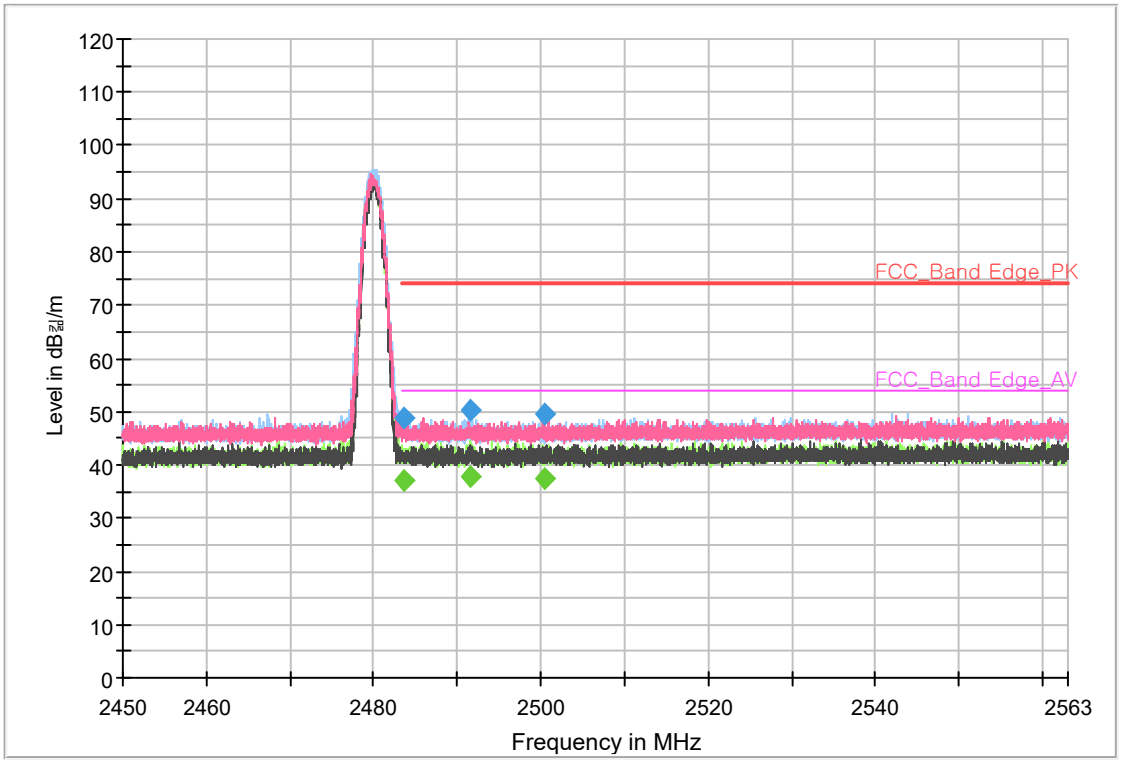


Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
2 379.47	45.57	48.87	---	---	---	250	H	19	3.30	25.13	74.00	---	---
2 379.47	---	---	---	26.37	-22.50	250	H	19	3.30	---	---	27.63	54.00
2 388.18	45.43	48.73	---	---	---	327	V	89	3.30	25.27	74.00	---	---
2 388.18	---	---	---	26.23	-22.50	327	V	89	3.30	---	---	27.77	54.00
2 389.96	45.30	48.60	---	---	---	250	H	347	3.30	25.40	74.00	---	---
2 389.96	---	---	---	26.10	-22.50	250	H	347	3.30	---	---	27.90	54.00

Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = Peak Result(dBuV/m) + DCCF
3. DCCF(Duty Cycle Correction Factor) = 20 x Log(worst dwell time/100 ms)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Limit (dBuV/m) – (Peak/AVG) Result (dBuV/m)

Band Edge_ EDR_8DPSK _2 480 MHz



Frequency [MHz]	Peak Reading Value [dBuV]	Peak Result [dBuV/m]	AVG Reading Value [dBuV]	AVG Result [dBuV/m]	DCCF [dB]	Height [cm]	Pol [H/V]	Azimuth [deg]	Correction Factor [dB/m]	Peak Margin [dB]	Peak Limit [dBuV/m]	AVG Margin [dB]	AVG Limit [dBuV/m]
2 483.73	44.93	48.63	---	---	---	277	V	243	3.70	25.37	74.00	---	---
2 483.73	---	---	---	26.13	-22.50	277	V	243	3.70	---	---	27.87	54.00
2 491.61	46.54	50.34	---	---	---	279	H	189	3.80	23.66	74.00	---	---
2 491.61	---	---	---	27.84	-22.50	279	H	189	3.80	---	---	26.16	54.00
2 500.37	45.65	49.45	---	---	---	150	V	-4	3.80	24.55	74.00	---	---
2 500.37	---	---	---	26.95	-22.50	150	V	-4	3.80	---	---	27.05	54.00

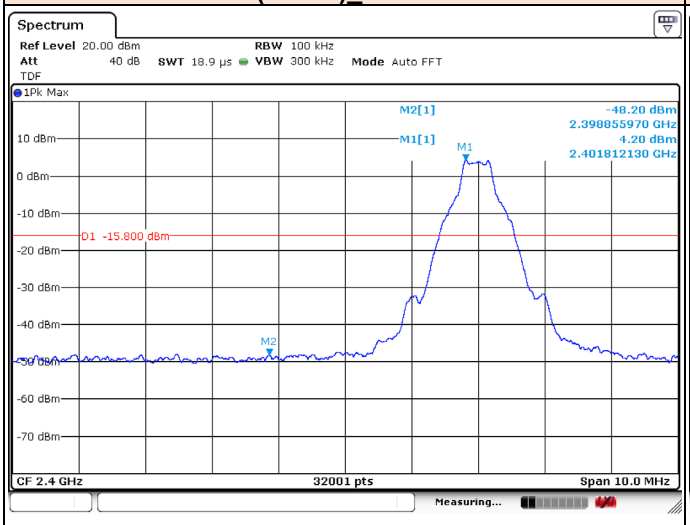
Remarks

1. Peak Result(dBuV/m) = Peak Reading Value(dBuV) + Correction Factor(dB/m)
2. AVG Result(dBuV/m) = Peak Result(dBuV/m) + DCCF
3. DCCF(Duty Cycle Correction Factor) = 20 x Log(worst dwell time/100 ms)
4. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB) + Distance Factor (dB)
5. Margin(dB) = (Peak/AVG) Limit (dBuV/m) – (Peak/AVG) Result (dBuV/m)

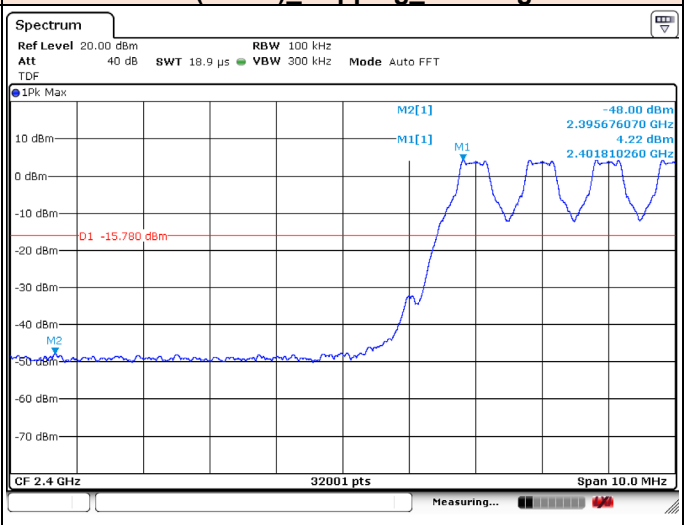
3.6.6 Test Result of Conducted Spurious Emission

Band Edge - BDR(GFSK)

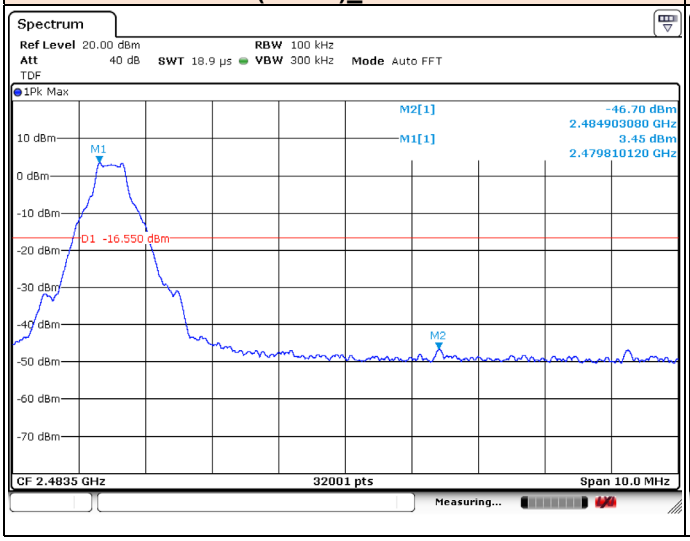
BDR(GFSK)_2 402 MHz



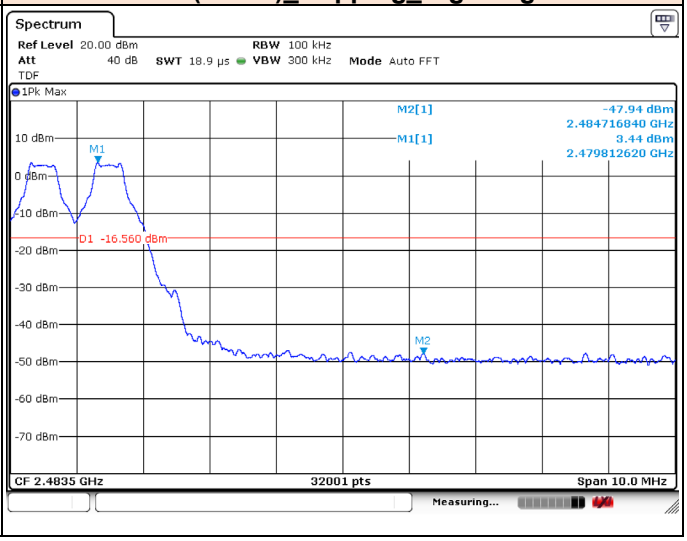
BDR(GFSK)_Hopping_Low edge

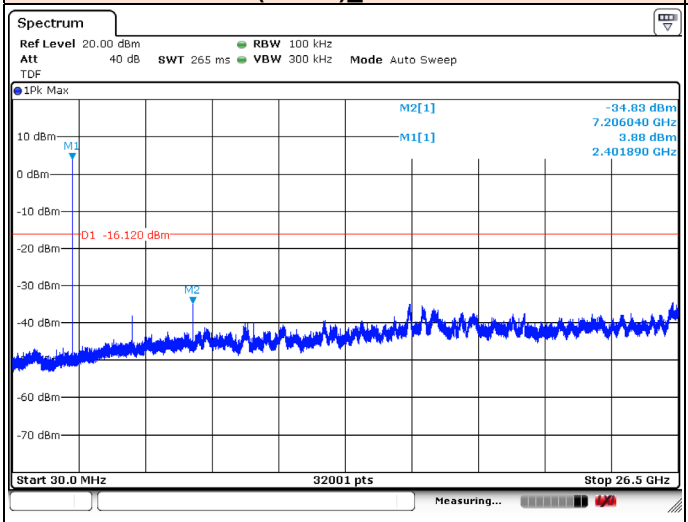
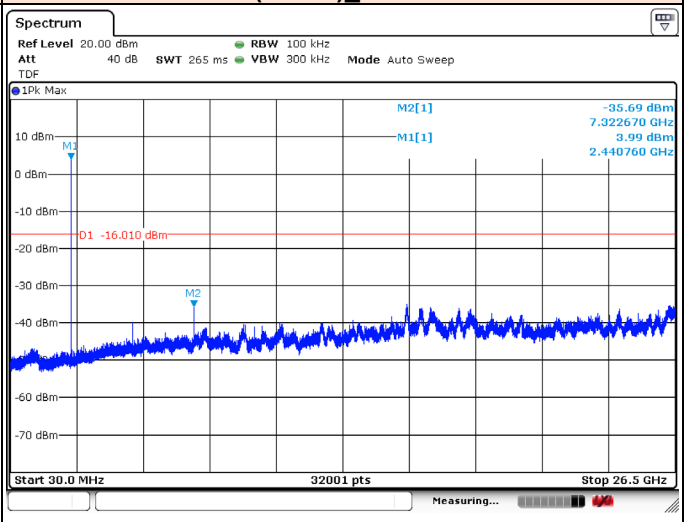
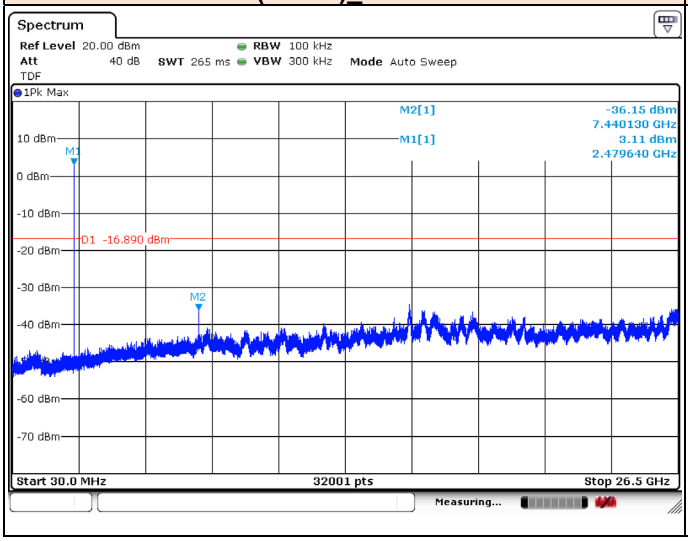


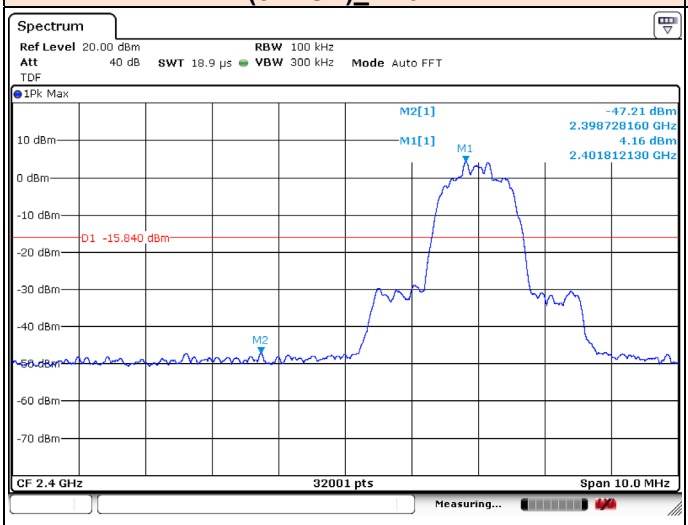
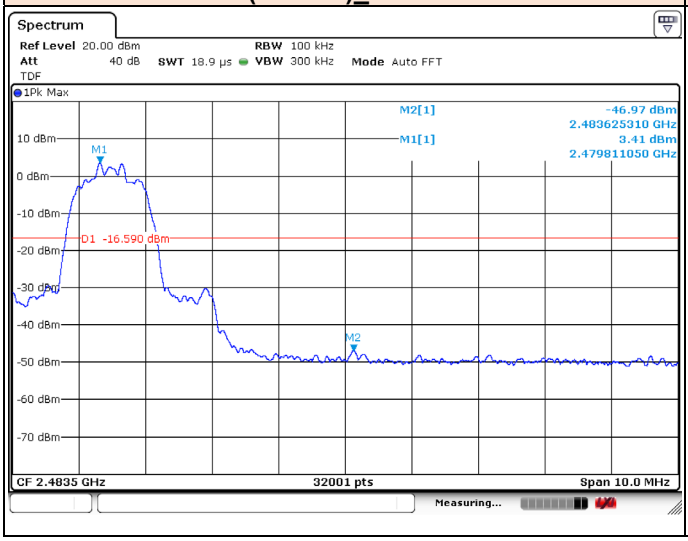
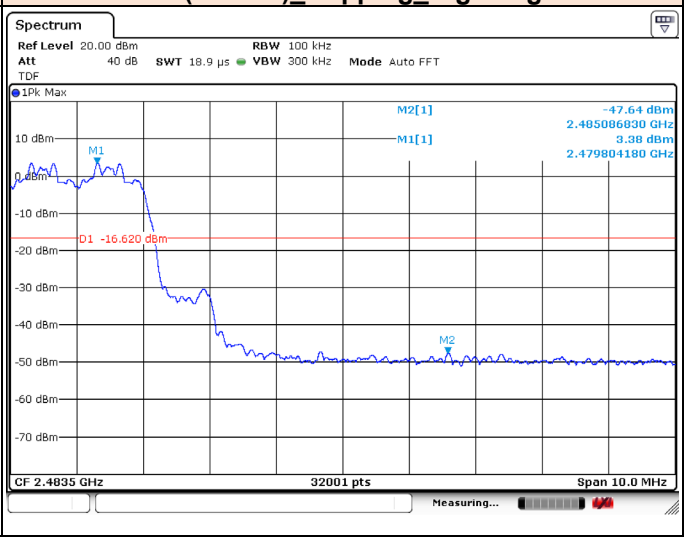
BDR(GFSK)_2 480 MHz

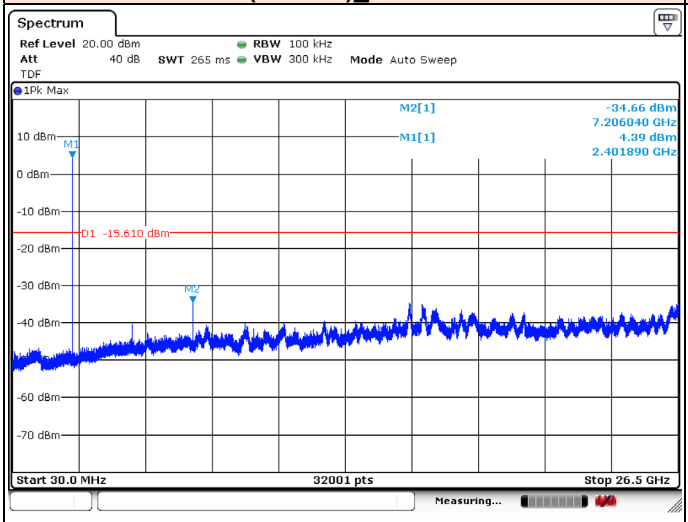
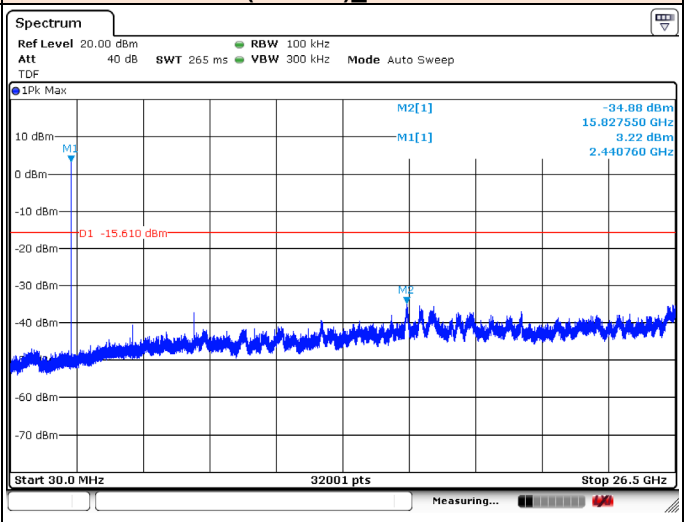
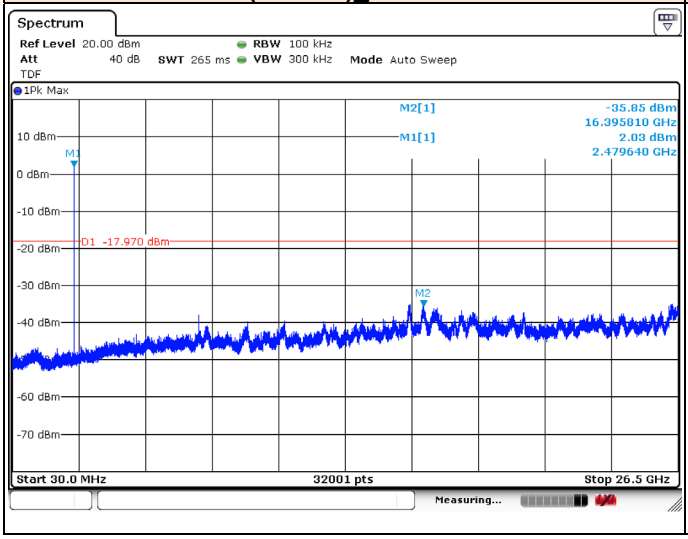


BDR(GFSK)_Hopping_High edge



Spurious - BDR(GFSK)	
BDR(GFSK)_2 402 MHz	**BDR(GFSK)_2 441 MHz**
	
BDR(GFSK)_2 480 MHz	
	

Band Edge - EDR(8DPSK)	
EDR(8DPSK)_2 402 MHz	EDR(8DPSK)_Hopping_Low edge
	
EDR(8DPSK)_2 480 MHz	EDR(8DPSK)_Hopping_High edge
	

Spurious - EDR(8DPSK)	
EDR(8DPSK)_2 402 MHz	EDR(8DPSK)_2 441 MHz
	
EDR(8DPSK)_2 480 MHz	
	

3.7 AC Conducted Emissions (150 kHz to 30 MHz)

3.7.1 Regulation

§15.207(a) : Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

	Conducted limit (dBµV)	
Frequency of emission (MHz)	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.

3.7.2 Test Procedure

a) The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm / 50 µH of coupling impedance for the measuring instrument.

b) Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

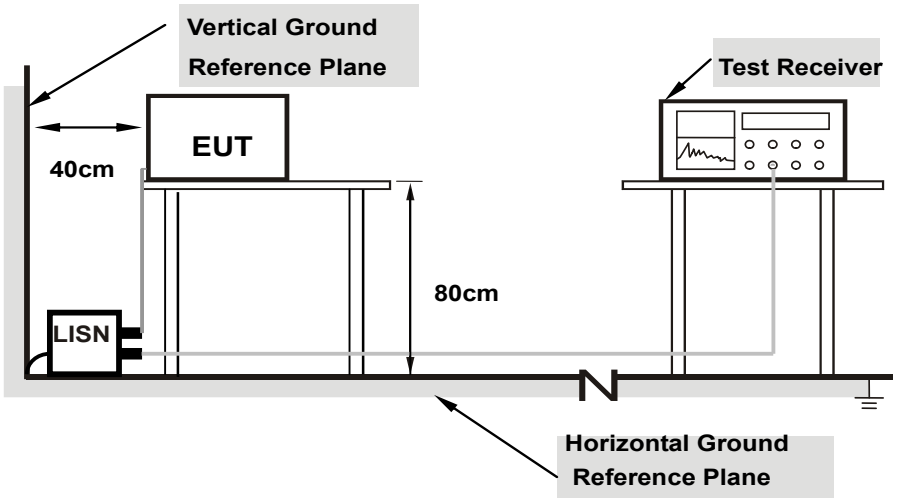
c) The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

Remark : The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz – 30 MHz.

3.7.3 Deviation from Test Standard

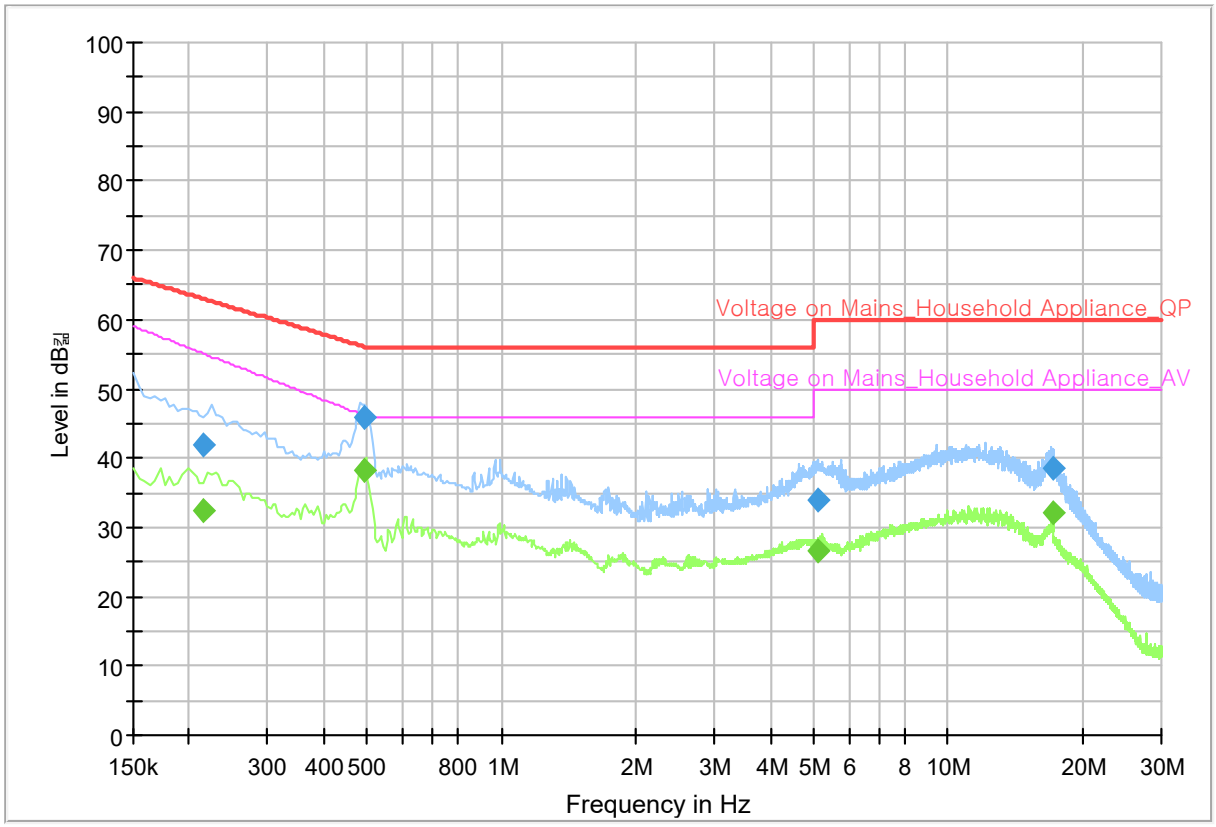
No deviation.

3.7.4 Test Setup



3.7.5 Test Result

Worst Case - BDR_GFSK_2 402 MHz



Frequency [MHz]	Quasi Peak Reading Value [dBuV]	Quasi Peak Result [dBuV]	CAV Reading Value [dBuV]	CAV Result [dBuV]	Line	Correction Factor [dB/m]	Quasi Peak Margin [dBuV]	Quasi Peak Limit [dBuV]	CAV Margin [dBuV]	CAV Limit [dBuV]
0.22	32.29	41.99	---	---	N	9.70	22.56	64.55	---	---
0.22	---	---	22.57	32.27	N	9.70	---	---	22.39	54.66
0.50	36.18	45.88	---	---	N	9.70	10.12	56.00	---	---
0.50	---	---	28.42	38.12	N	9.70	---	---	7.88	46.00
5.11	24.07	33.87	---	---	N	9.80	22.13	56.00	---	---
5.11	---	---	16.69	26.49	N	9.80	---	---	19.51	46.00
17.15	28.09	38.39	---	---	L1	10.30	17.61	56.00	---	---
17.15	---	---	21.72	32.02	L1	10.30	---	---	13.98	46.00

Remarks

1. Final Value (QP and/or CAV) = Reading Value (QP and/or CAV) + Corr. (LISN Insertion Loss + Cable Loss)
Margin (QP and/or CAV) = Limit – Final Value (QP and/or CAV)
QP = Quasi-Peak, CAV = CISPR-Average, Corr. = Correction Factor
2. Two graphs measured for both Live (L1) and Neutral (N) of the LISN are combined into one graph.

Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services Korea. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

Test Firm Name : BV CPS ADT Korea Ltd.

Main Address :Innoplex No.2 106, Sinwon-ro 306, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675 KOREA

Satellite Address : Bureau Veritas Bldg, HeungAn-daero 49, DongAn-gu, Anyang-si, Gyeonggi-do, 14119, KOREA

FCC

Designation Number : KR0158
Test Firm Registration Number : 666061

ISED

Designation Number : KR0158
Test Firm Registration Number : 25944 (Main)
Test Firm Registration Number : 26316 (Satellite)

If you have any comments, please feel free to contact us at the following:

Email: Meyer.Shin@bureauveritas.com
Web Site: www.bureauveritas.co.kr/cps/eaw

The address and road map of all our labs can be found in our web site also.

- End of report -