

10.5 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

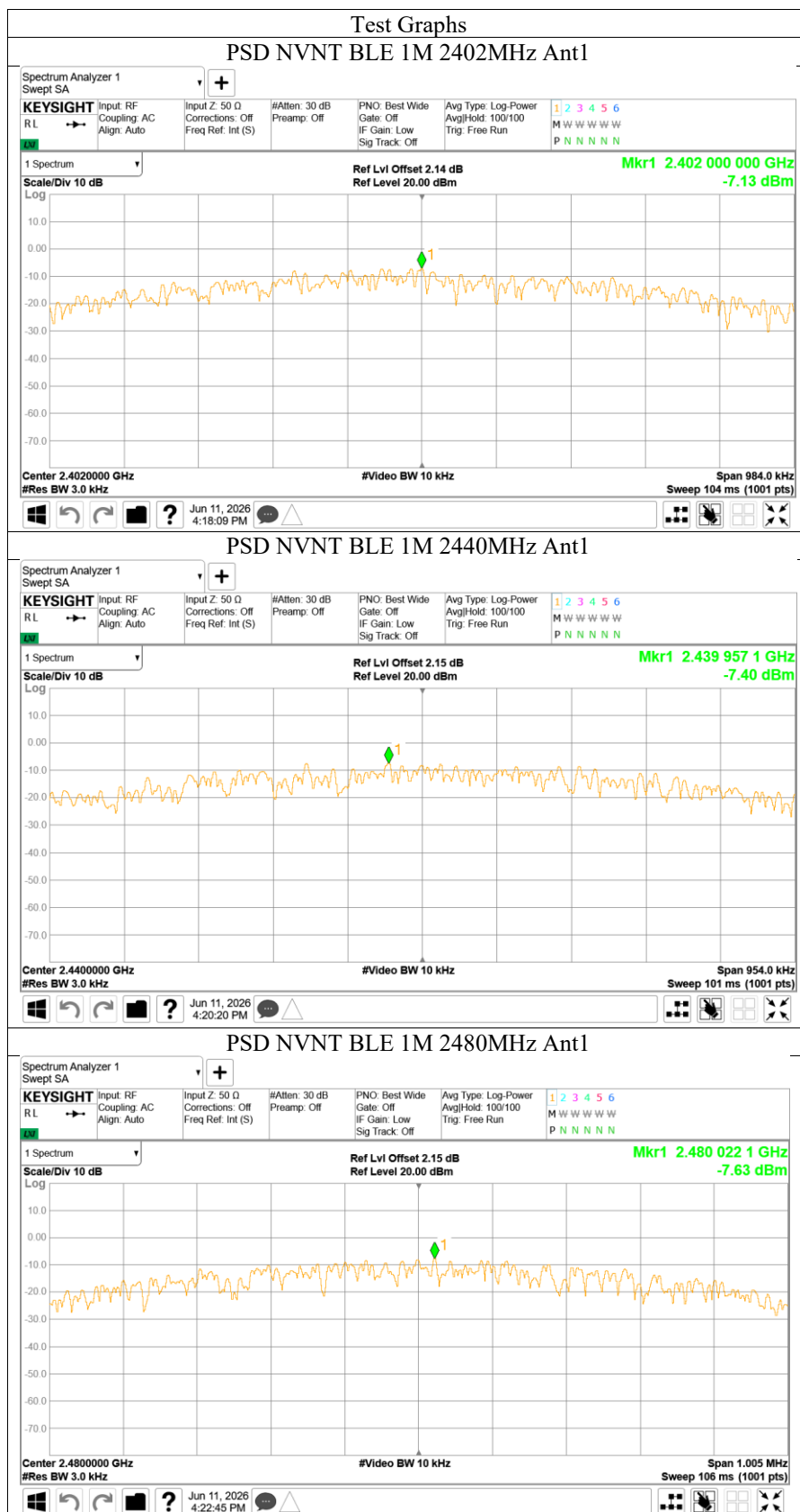
1. The RF output of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
4. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW $\geq$ 3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
5. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
6. Repeat above procedures until other frequencies measured were completed.

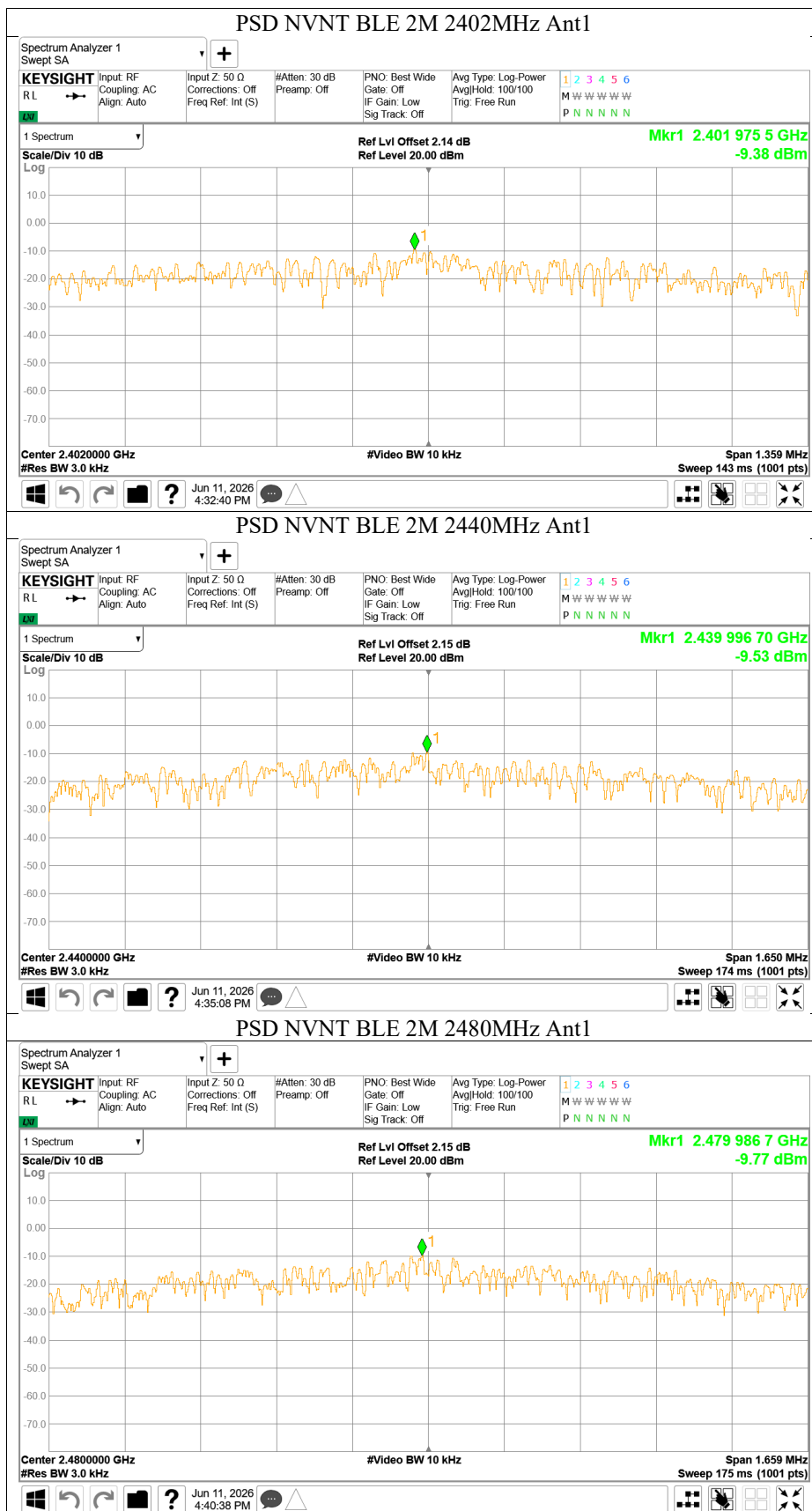
Limit

Limit [dBm/3KHz]
 ≤ 8

Test result

Data transmission rate	Frequency	Power spectral density	Result
1Mbps	MHz	dBm/3kHz	
	Top channel 2402MHz	-7.13	Pass
	Middle channel 2440MHz	-7.4	Pass
	Bottom channel 2480MHz	-7.63	Pass
2Mbps	Top channel 2402MHz	-9.38	Pass
	Middle channel 2440MHz	-9.53	Pass
	Bottom channel 2480MHz	-9.77	Pass

Test Graph



10.6 Spurious RF conducted emissions

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100 kHz, VBW $\geq$ 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
5. The level displayed must comply with the limit specified in this Section. Submit these plots.
6. Repeat above procedures until all frequencies measured were complete.

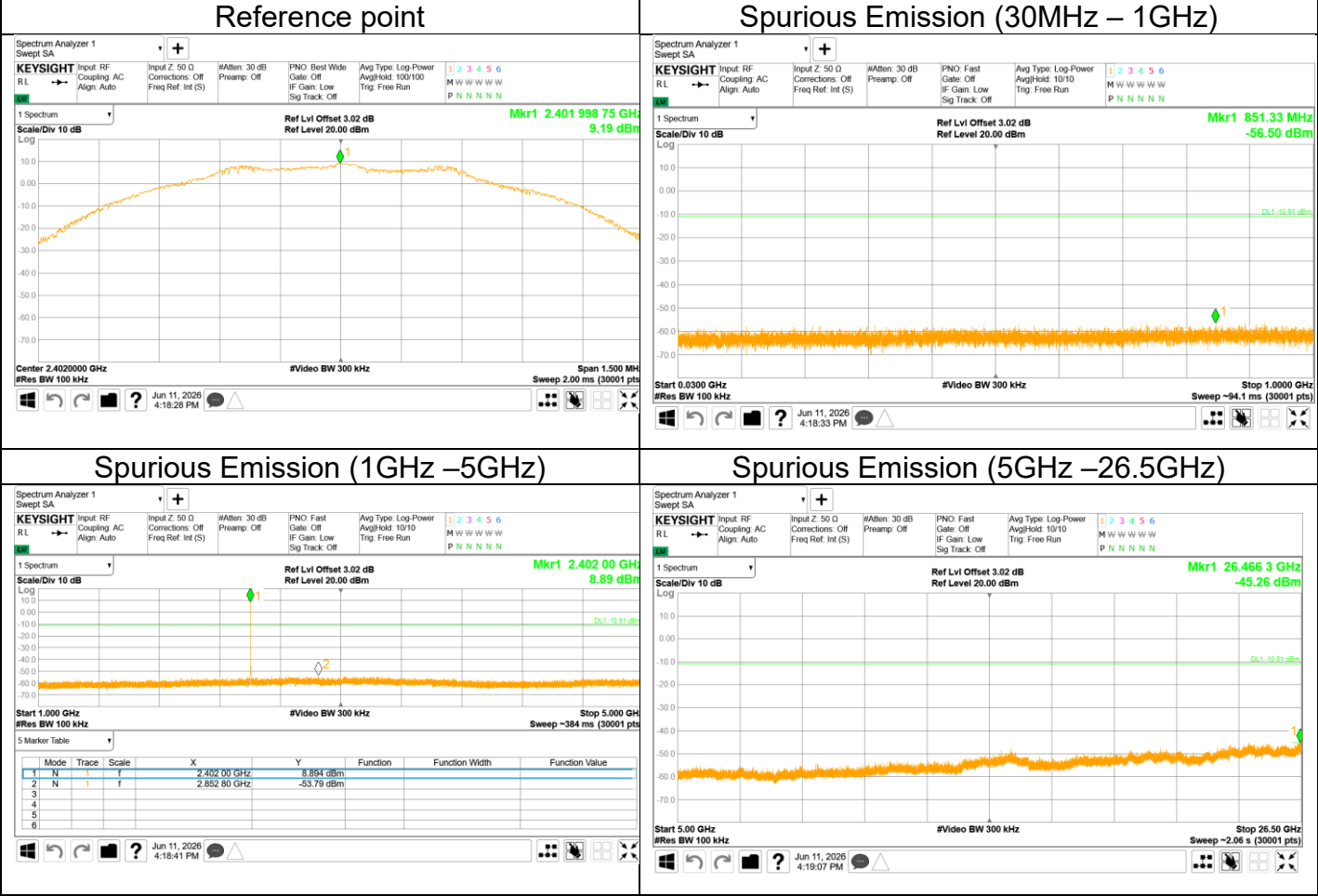
Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20



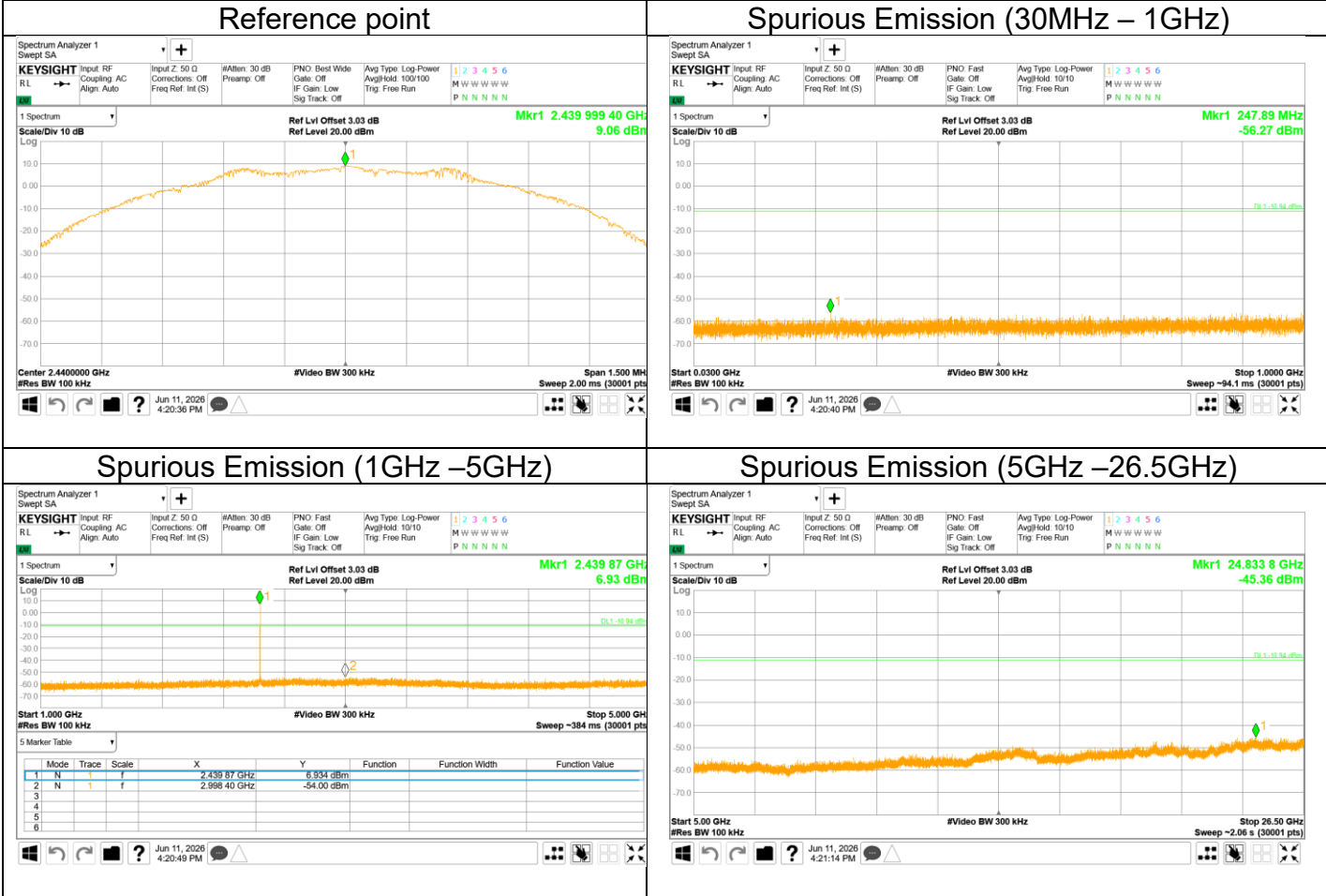
Spurious RF conducted emissions

Out-of-Band Emissions (1Mbps)
Channel 0 (2402MHz)



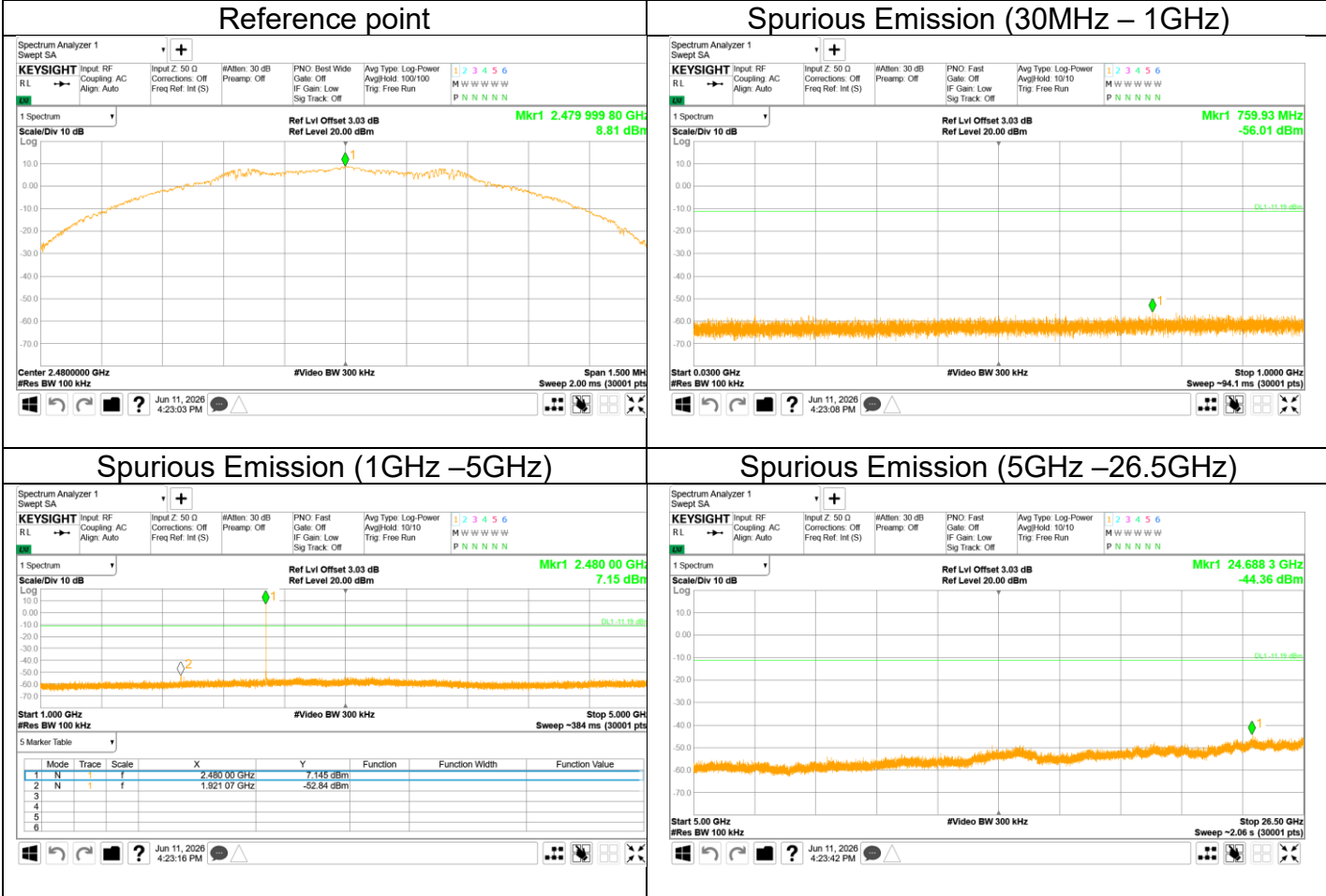


Out-of-Band Emissions (1Mbps)
Channel 19 (2440MHz)





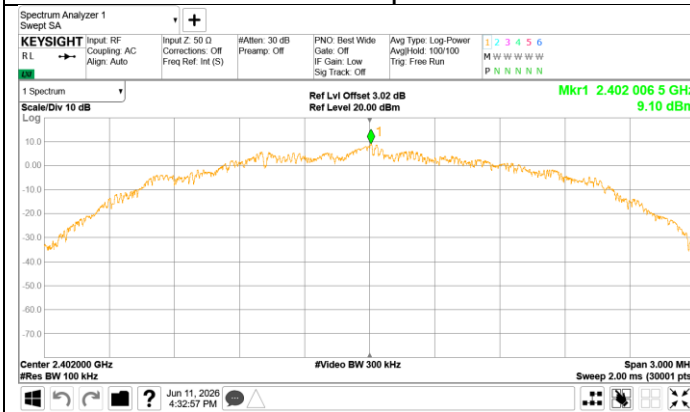
Out-of-Band Emissions (1Mbps)
Channel 39 (2480MHz)



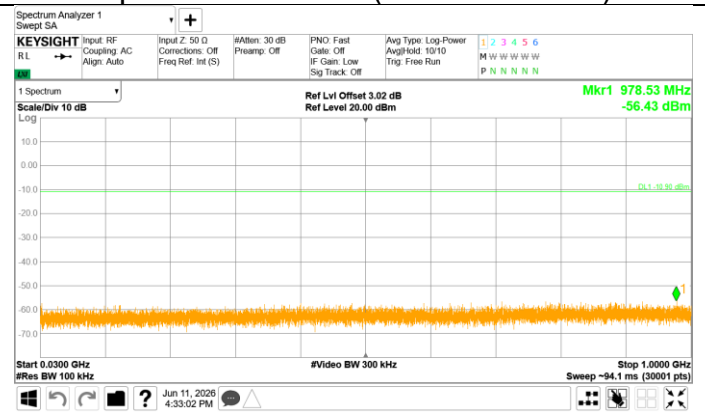
Out-of-Band Emissions (2 Mbps)

Channel 0 (2402MHz)

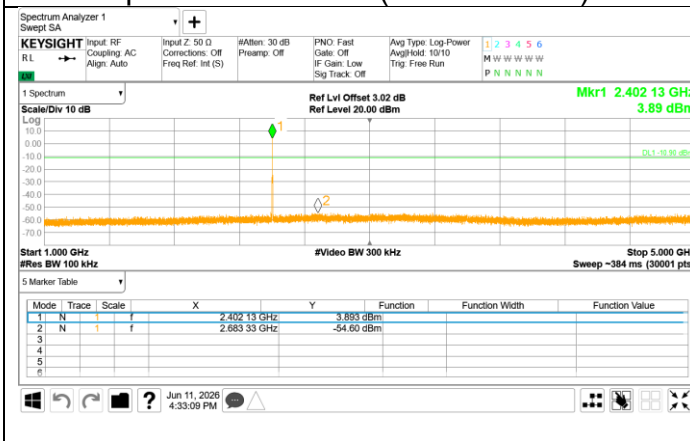
Reference point



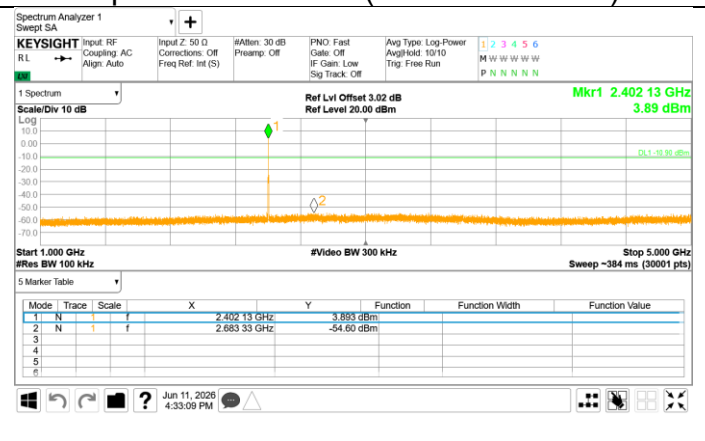
Spurious Emission (30MHz – 1GHz)



Spurious Emission (1GHz –5GHz)

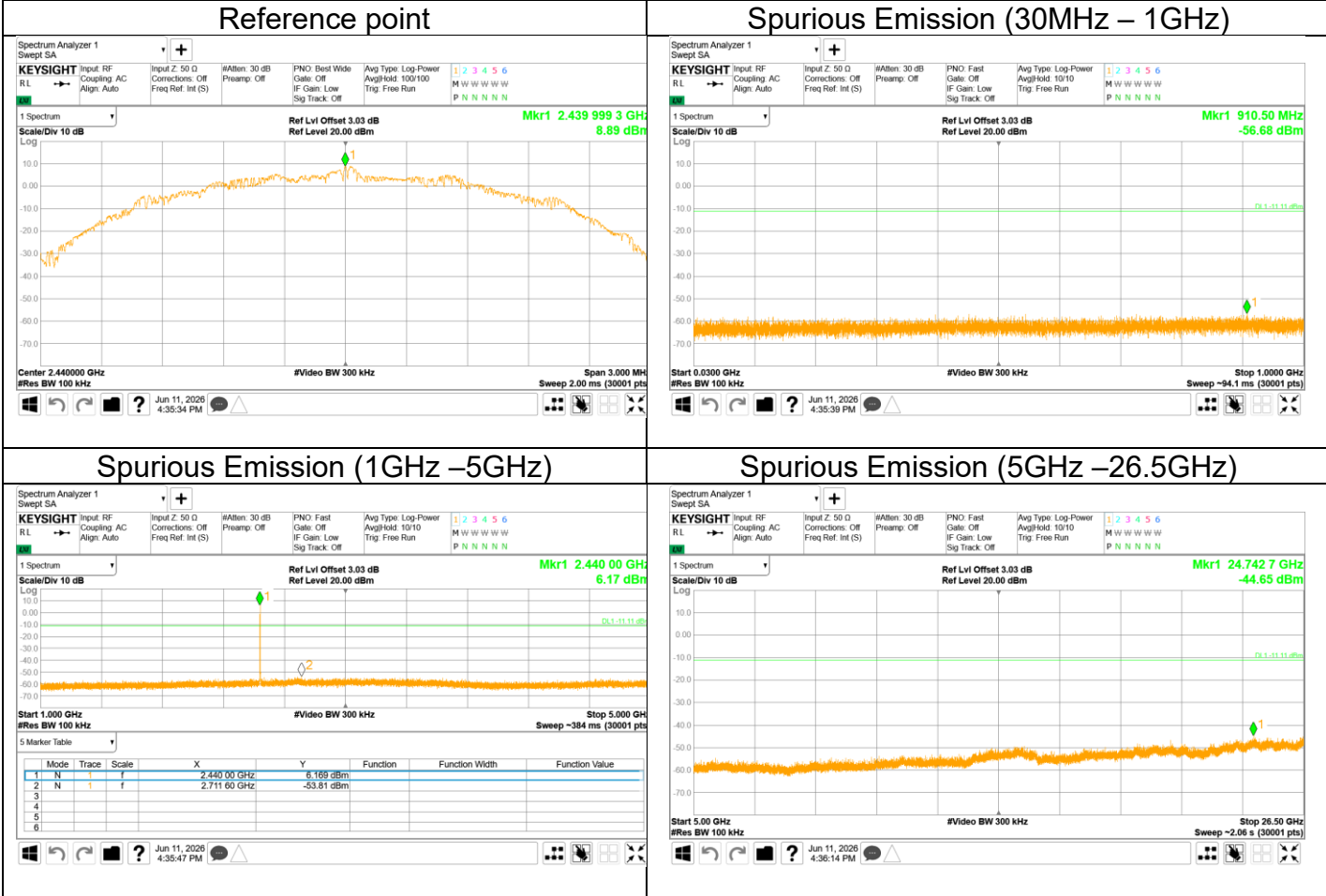


Spurious Emission (5GHz –26.5GHz)



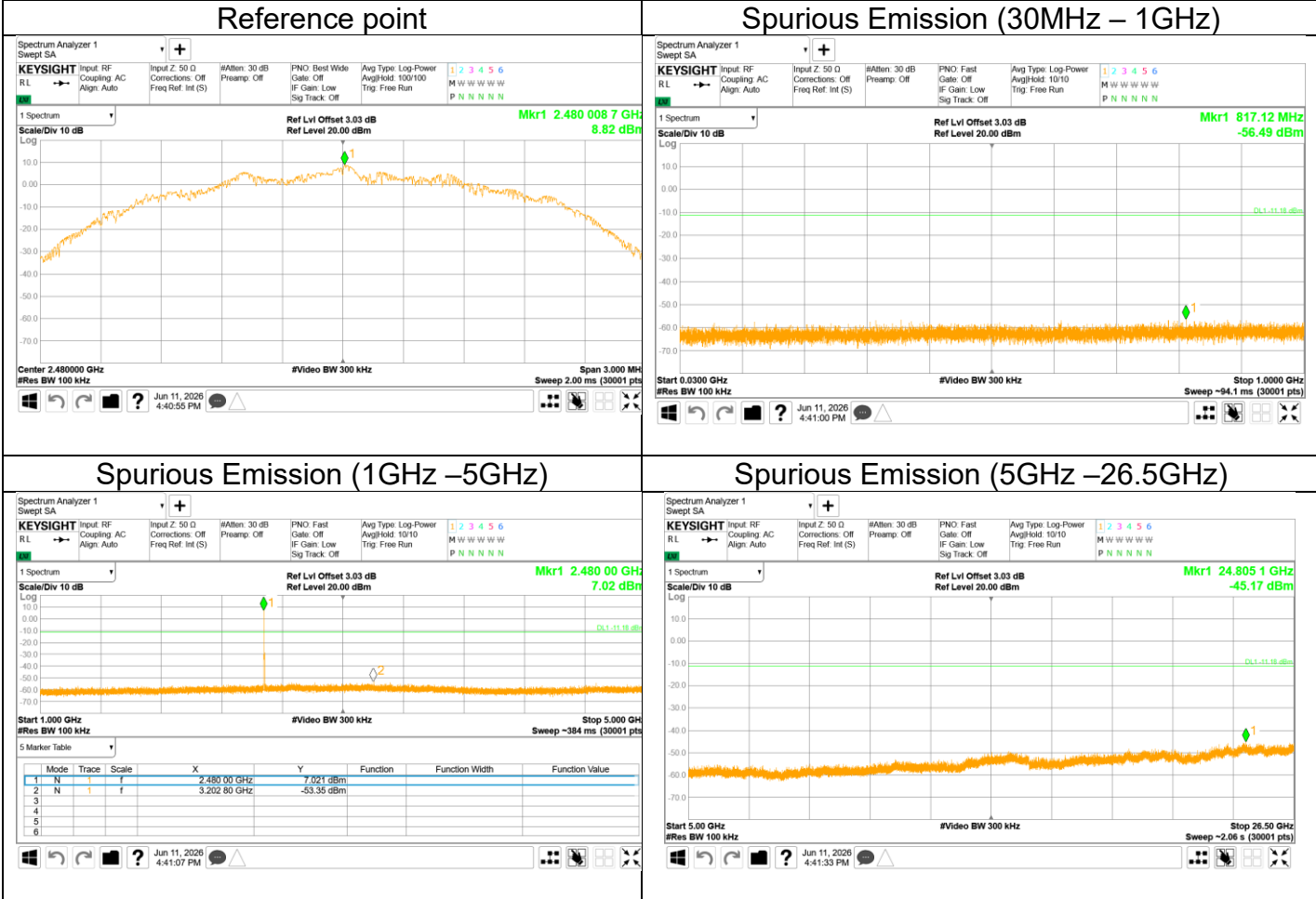


Out-of-Band Emissions (2 Mbps)
Channel 19 (2440MHz)





Out-of-Band Emissions (2 Mbps)
Channel 39 (2480MHz)



10.7 Band edge

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW $\geq$ 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize, use the peak and delta measurement to record the result.
5. The level displayed must comply with the limit specified in this Section.
6. Repeat above procedures until all frequencies measured were complete and submit all the plots.

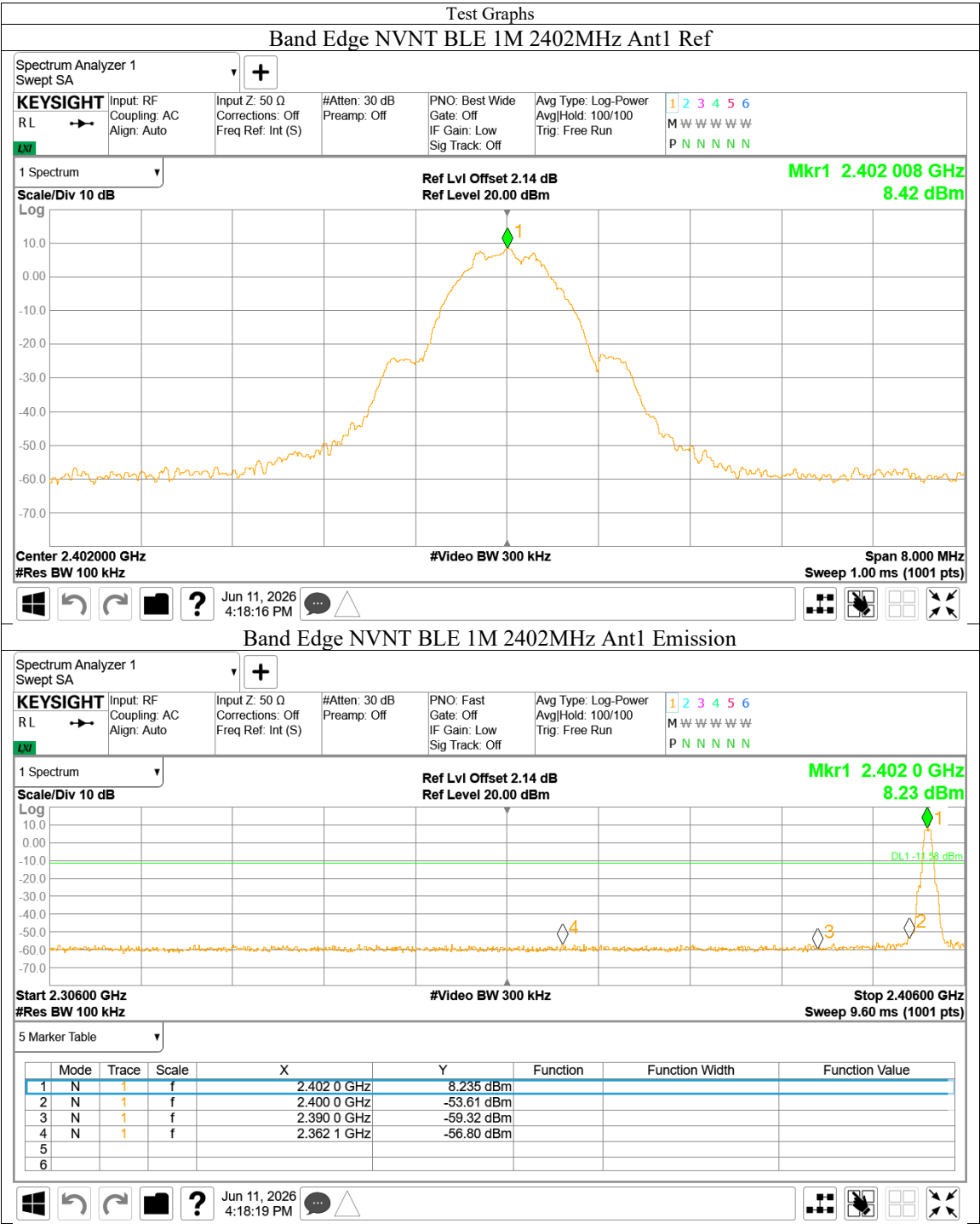
Limit:

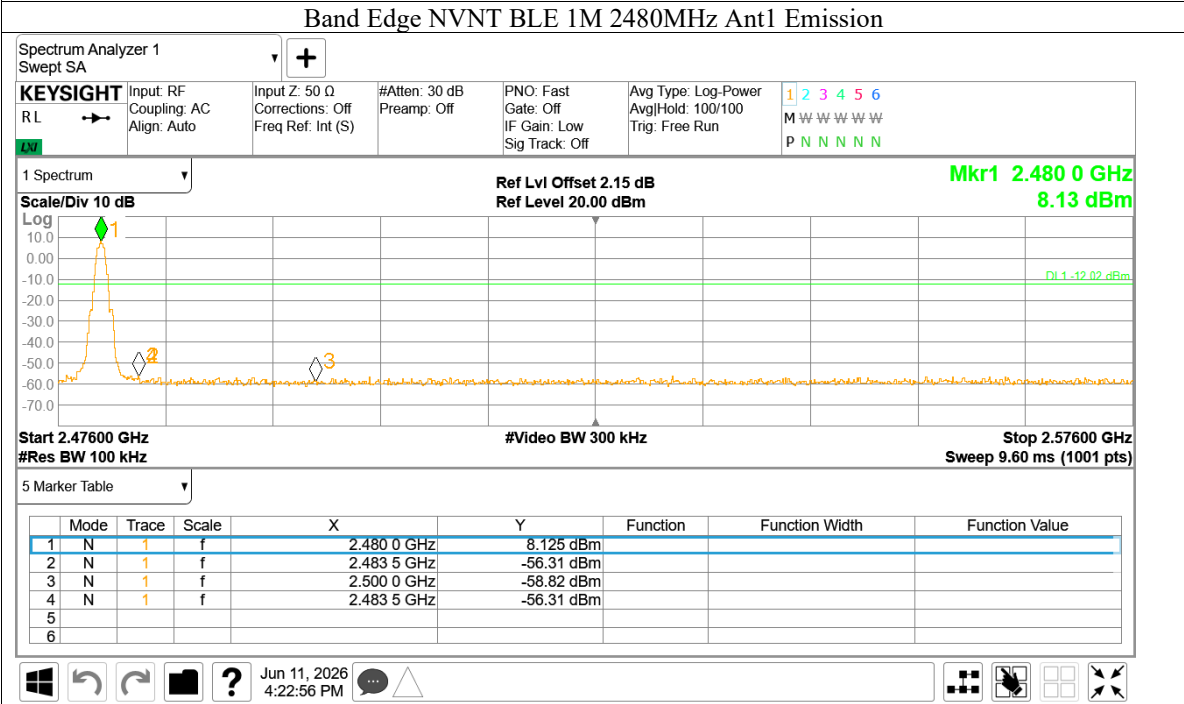
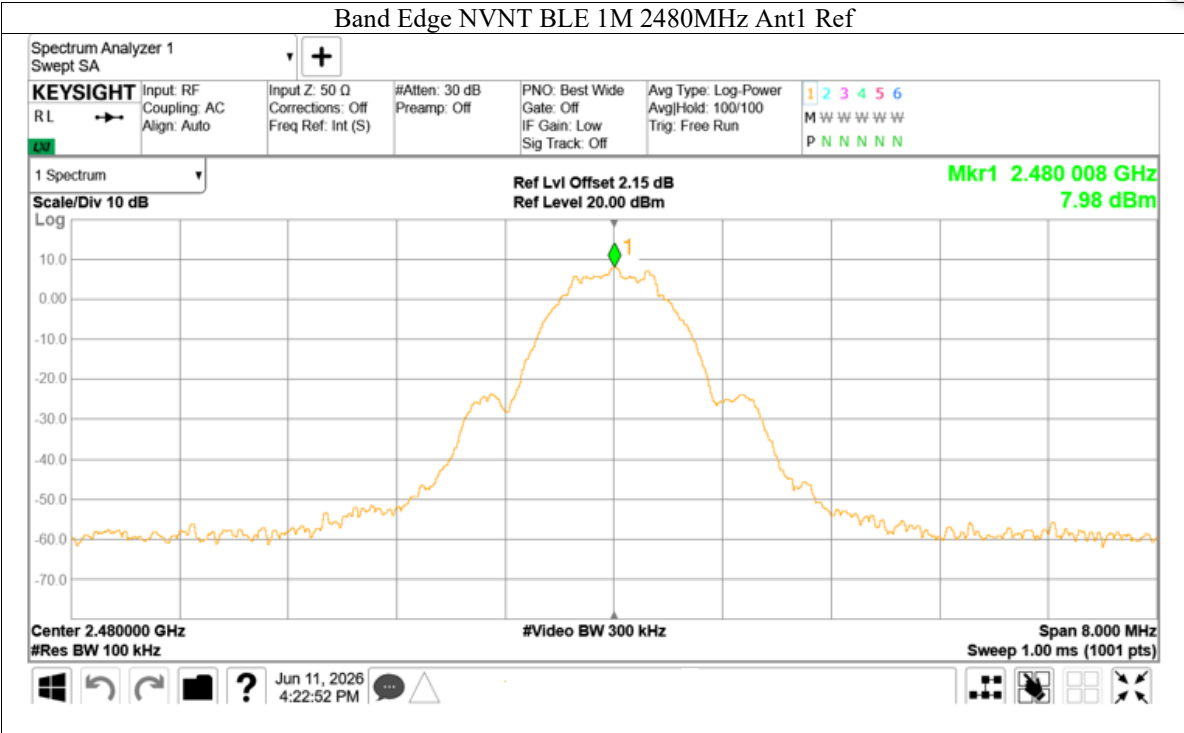
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that 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 § 15.247(b)(3) and RSS-247 section 6.3.2, the attenuation required shall be 30 dB instead of 20 dB.

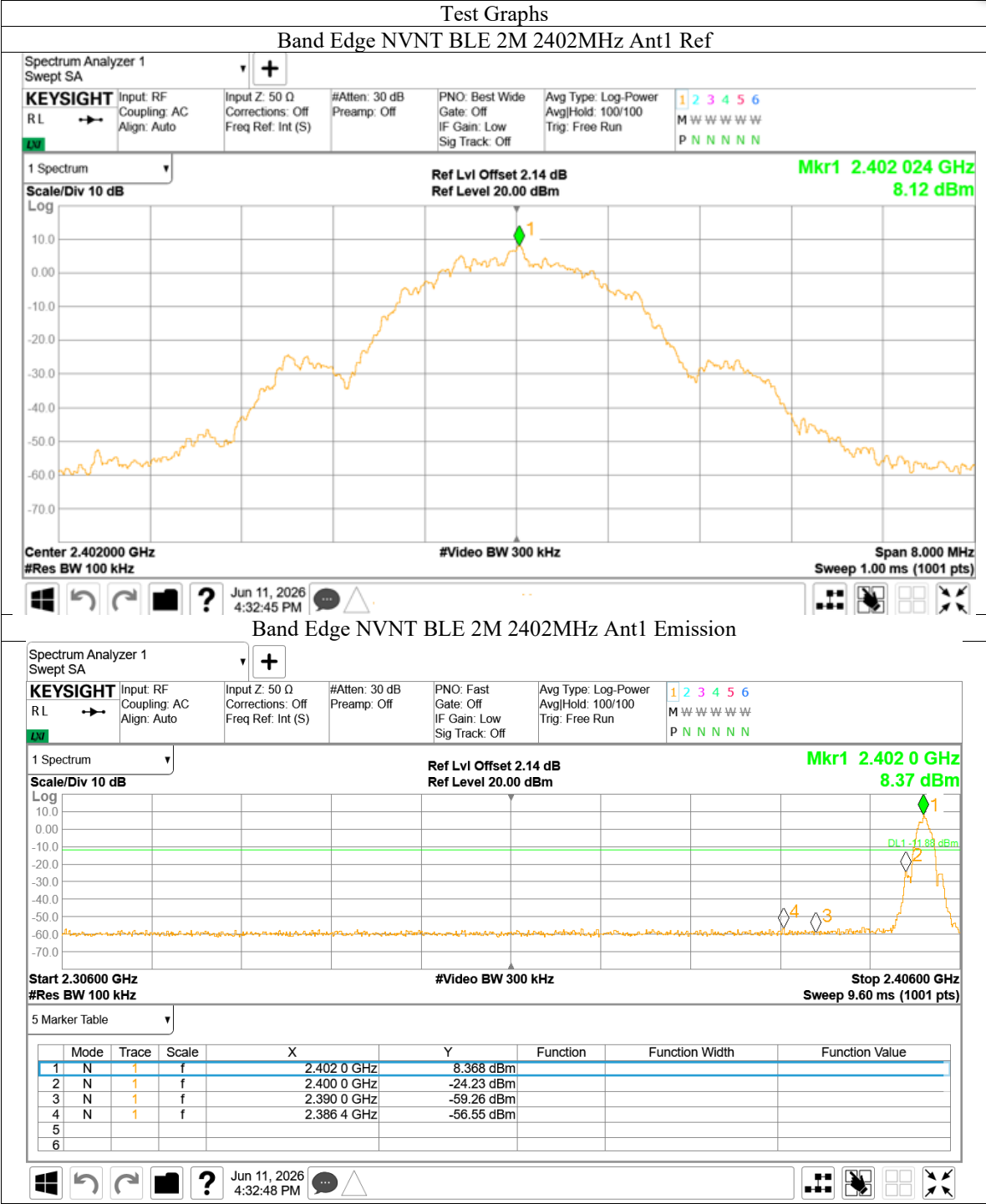
Frequency Range MHz	Limit (dBc)
30-25000	-20

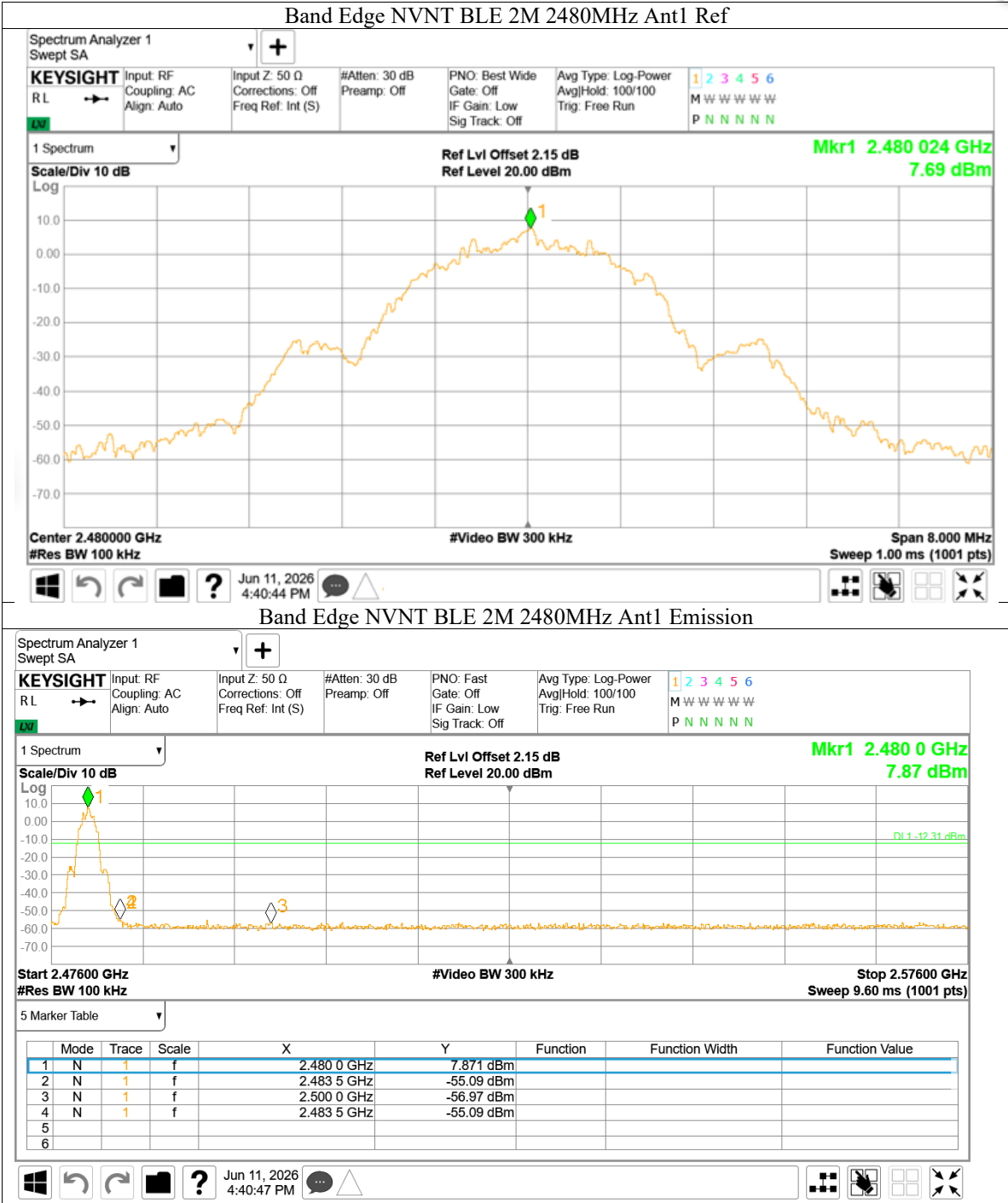


Test result









10.8 Spurious radiated emissions for transmitter

Test Method

1. The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. Use the following spectrum analyzer settings According to C63.10
 - 1) Procedure for Unwanted Emissions Measurements Below 1000 MHz
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz to 120kHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.
 - 2) For Peak unwanted emissions Above 1GHz:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW ≥ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.
Procedures for average unwanted emissions measurements above 1GHz
 - a) RBW = 1MHz.
 - b) VBW \ [3 × RBW].
 - c) Detector = RMS (power averaging), if [span / (# of points in sweep)] \ RBW / 2.
Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
 - d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
 - e) Sweep time = auto.
 - f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (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 100 traces shall be averaged.)
 - g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
 - 1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is $[10 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.

2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is $[20 \log (1 / D)]$, where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.

3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission (AV) at frequency above 1GHz.

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that 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 § 15.247(b)(3) and RSS-247 section 6.3.2, the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in § 15.209(a) and RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a) and RSS-Gen section 8.9, must also comply with the radiated emission limits specified in § 15.209(a) and RSS-Gen section 8.10.

Below 30MHz

§15.247(d) & §15.209 & §15.205

Frequency MHz	Field Strength uV/m	Detector	Measured Distance Meters
0.009~0.090	2400/F (kHz)	AV	300
0.090~0.110	2400/F (kHz)	QP	300
0.110~0.490	2400/F (kHz)	AV	300
0.490~1.705	24000/F (kHz)	QP	30
1.705~30	30	QP	30

Note 1: Limit 3m(dBµV/m)=Limit 300m(dBµV/m)+40Log(300m/3m) (Below 30MHz)

Note 2: Limit 3m(dBµV/m)=Limit 30m(dBµV/m)+40Log(30m/3m) (Below 30MHz)

Note 3: dBµV/m = 20log(µV/m)

RSS-247 & RSS-Gen 8.9

Frequency MHz	Field Strength uA/m	Detector	Measured Distance Meters
0.009~0.090	6.37/F (kHz)	AV	300
0.090~0.110	6.37/F (kHz)	QP	300
0.110~0.490	6.37/F (kHz)	AV	300
0.490~1.705	63.7/F (kHz)	QP	30
1.705~30	0.08	QP	30

Note 1: Limit 3m(dBµV/m)=Limit 300m(dBµV/m)+40Log(300m/3m) (Below 30MHz)

Note 2: Limit 3m(dBµV/m)=Limit 30m(dBµV/m)+40Log(30m/3m) (Below 30MHz)

Note 3: dBµV/m = 20log(µV/m), dBµA/m = 20log(µA/m)

When the limit is in terms of magnetic field, the following equation applies:

$$H[\text{dB}(\mu\text{A/m})] = V[\text{dB}(\mu\text{V})] + L_c [\text{dB}] - G_{PA} [\text{dB}] + A F^E [\text{dB}(\text{m}^{-1})] - 51.5 [\text{dB}\Omega]$$

When the limit is in terms of electric field, the following equation applies:

$$E[\text{dB}(\mu\text{V/m})] = V[\text{dB}(\mu\text{V})] + L_c[\text{dB}] - G_{PA}[\text{dB}] + A_F^E [\text{dB}(\text{m}^{-1})]$$

The magnetic field limit is converted to the electric field limit by the equation:

$$E_{\text{limit}}[\text{dB}(\mu\text{V/m})] = H_{\text{limit}} [\text{dB}(\mu\text{A/m})] + 51.5 [\text{dB}\Omega]$$

where

H is the magnetic field strength (to be compared with the limit),

V is the voltage level measured by the receiver or spectrum analyzer.

L_c is the cable loss.

G_{PA} is the gain of the preamplifier (if used), and A_{FH} is the magnetic antenna factor.

Above 30MHz

§15.247(d) & §15.209 & §15.205

RSS-247 & RSS-Gen 8.9 & 8.10

Frequency MHz	Field Strength uV/m	Field Strength dBμV/m	Detector	Measured Distance Meters
30-88	100	40	QP	3
88-216	150	43.5	QP	3
216-960	200	46	QP	3
960-1000	500	54	QP	3
Above 1000	500	54	AV	3
Above 1000	5000	74	PK	3

Test result

Worst case Radiated Emission 9KHz-30MHz

0.009-30MHz Radiated Emission

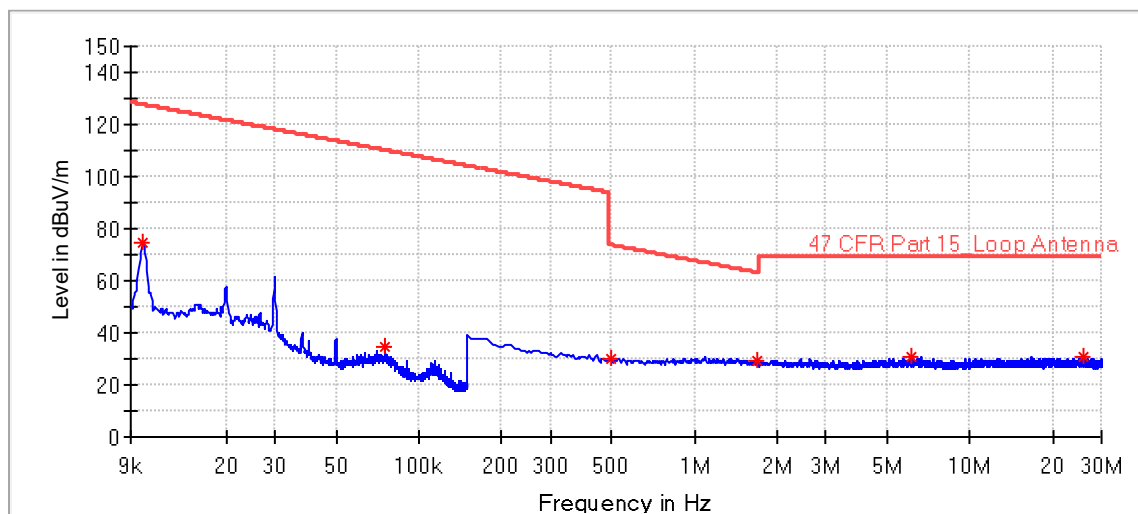
EUT Information

EUT Name:	Smart Kit
Model:	MDWBRCU2D
Client:	Hangzhou Tuya Information Technology Co., Ltd
Op Cond:	Power on, TX_2402MHz at 2Mbps
Operator:	Doujun XU
Test Spec:	FCC Part 15.209
Sample No:	SHA-1041093-2

Sweep Setup: RE_Loop E_pre [EMI radiated]

Hardware Setup:	RE_Loop Antenna V
Receiver:	[ESR 3]
Level Unit:	dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamplifier
9 kHz - 150 kHz	88.125 Hz	PK+	200 Hz	0.01 s	0 dB
150 kHz - 30 MHz	4.39 kHz	PK+	9 kHz	0.01 s	0 dB

**Limit and Margin**

Frequency (MHz)	MaxPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol	Azimuth (deg)	Corr. (dB/m)
0.009969	74.81	127.63	52.82	X	1.0	19.6
0.075711	34.35	110.02	75.67	X	92.0	18.9
0.501177	29.98	73.60	43.62	X	73.0	18.8
1.677618	29.49	63.11	33.62	X	339.0	19.0
6.093662	30.91	69.54	38.63	X	355.0	18.9
25.676140	30.74	69.54	38.80	X	131.0	19.5

0.009-30MHz Radiated Emission

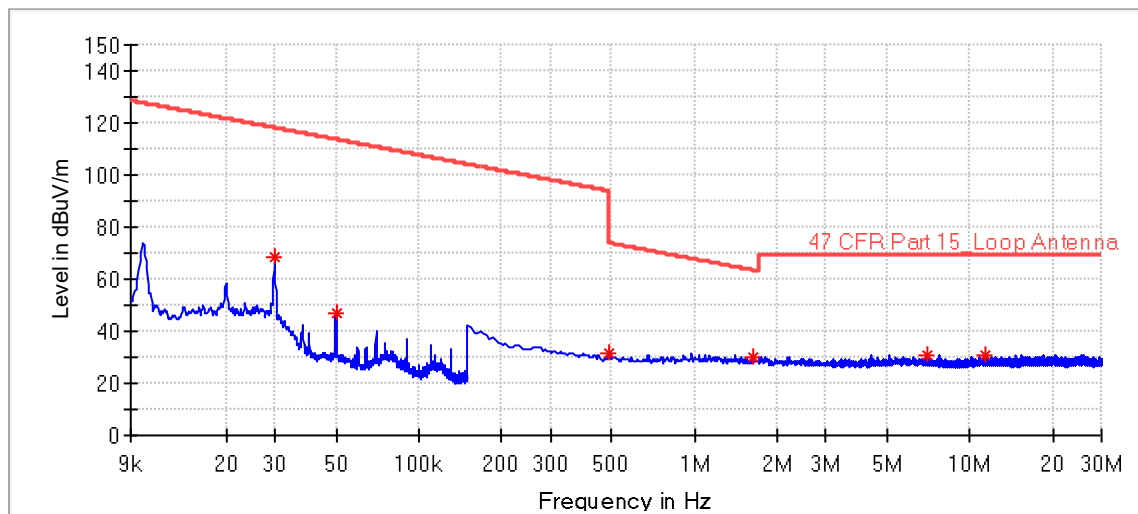
EUT Information

EUT Name: Smart Kit
 Model: MDWBRCU2D
 Client: Hangzhou Tuya Information Technology Co., Ltd
 Op Cond: Power on, TX_2402MHz at 2Mbps
 Operator: Doujun XU
 Test Spec: FCC Part 15.209
 Sample No: SHA-1041093-2

Sweep Setup: RE_Loop E_pre [EMI radiated]

Hardware Setup: RE_Loop Antenna V
 Receiver: [ESR 3]
 Level Unit: dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
9 kHz - 150 kHz	88.125 Hz	PK+	200 Hz	0.01 s	0 dB
150 kHz - 30 MHz	4.39 kHz	PK+	9 kHz	0.01 s	0 dB



Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol	Azimuth (deg)	Corr. (dB/m)
0.029974	68.08	118.07	49.99	Y	128.0	19.0
0.049978	47.05	113.63	66.58	Y	29.0	19.0
0.492397	31.54	73.76	42.22	Y	355.0	18.8
1.620552	30.34	63.41	33.07	Y	225.0	19.0
6.975993	30.74	69.54	38.81	Y	359.0	18.8
11.378868	30.79	69.54	38.75	Y	213.0	18.9

0.009-30MHz Radiated Emission

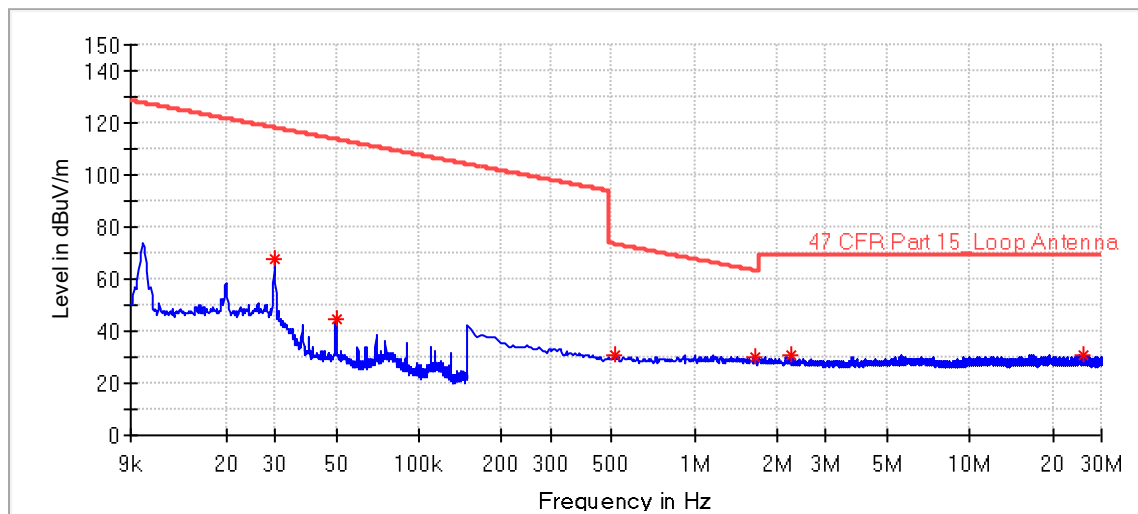
EUT Information

EUT Name: Smart Kit
 Model: MDWBRCU2D
 Client: Hangzhou Tuya Information Technology Co., Ltd
 Op Cond: Power on, TX_2402MHz at 2Mbps
 Operator: Doujun XU
 Test Spec: FCC Part 15.209
 Sample No: SHA-1041093-2

Sweep Setup: RE_Loop E_pre [EMI radiated]

Hardware Setup: RE_Loop Antenna V
 Receiver: [ESR 3]
 Level Unit: dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
9 kHz - 150 kHz	88.125 Hz	PK+	200 Hz	0.01 s	0 dB
150 kHz - 30 MHz	4.39 kHz	PK+	9 kHz	0.01 s	0 dB



Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol	Azimuth (deg)	Corr. (dB/m)
0.029974	67.40	118.07	50.67	Z	201.0	19.0
0.049978	44.71	113.63	68.92	Z	57.0	19.0
0.514346	30.61	73.38	42.77	Z	198.0	18.8
1.651280	30.19	63.25	33.06	Z	261.0	19.0
2.243890	30.86	69.54	38.68	Z	212.0	19.1
25.777103	31.02	69.54	38.52	Z	238.0	19.5

Worst case Radiated Emission 30MHz-1GHz

30-1000MHz Radiated Emission

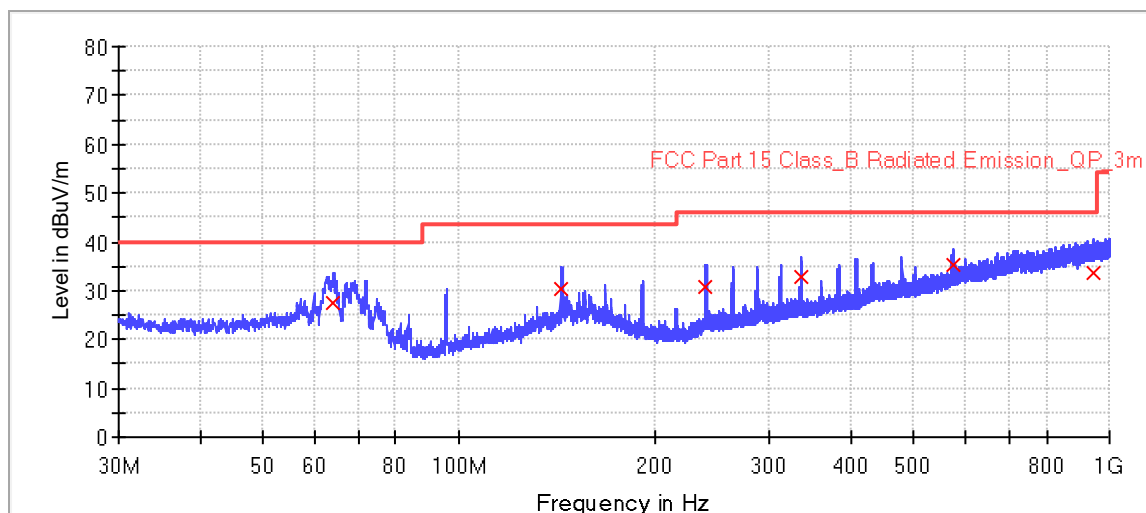
EUT Information

EUT Name: Smart Kit
 Model: MDWBRCU2D
 Client: Hangzhou Tuya Information Technology Co., Ltd
 Op Cond: Power on, TX_2402MHz at 2Mbps
 Operator: Doujun XU
 Test Spec: FCC Part 15.209
 Sample No: SHA-1041093-2

Sweep Setup: RE_VULB9168_pre_Cont_30-1000 [EMI radiated]

Hardware Setup: RE_VULB9168
 Receiver: [ESR 3]
 Level Unit: dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamplifier
30 MHz - 1 GHz	48.5 kHz	PK+	120 kHz	0.2 s	20 dB



Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
64.240000	27.3	1000.0	120.000	100.0	H	141.0	19.8	12.7	40.0
143.720000	30.5	1000.0	120.000	150.0	H	241.0	20.7	13.0	43.5
239.600000	30.7	1000.0	120.000	200.0	H	153.0	19.6	15.3	46.0
336.280000	32.9	1000.0	120.000	300.0	H	265.0	22.8	13.1	46.0
576.360000	35.2	1000.0	120.000	250.0	H	218.0	28.3	10.8	46.0
944.800000	33.7	1000.0	120.000	100.0	H	312.0	34.2	12.3	46.0

30-1000MHz Radiated Emission

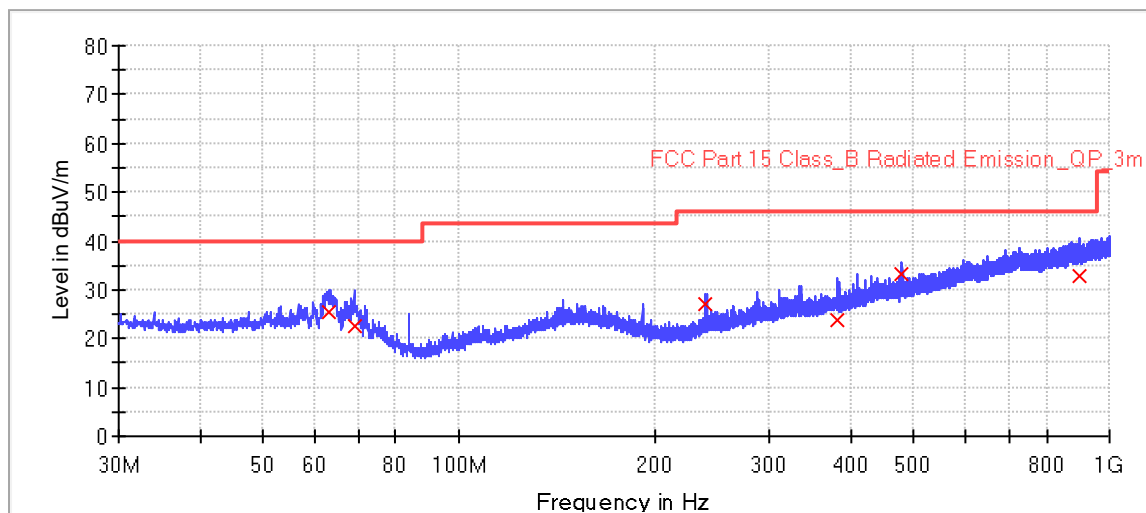
EUT Information

EUT Name: Smart Kit
 Model: MDWBRCU2D
 Client: Hangzhou Tuya Information Technology Co., Ltd
 Op Cond: Power on, TX_2402MHz at 2Mbps
 Operator: Doujun XU
 Test Spec: FCC Part 15.209
 Sample No: SHA-1041093-2

Sweep Setup: RE_VULB9168_pre_Cont_30-1000 [EMI radiated]

Hardware Setup: RE_VULB9168
 Receiver: [ESR 3]
 Level Unit: dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
30 MHz - 1 GHz	48.5 kHz	PK+	120 kHz	0.2 s	20 dB

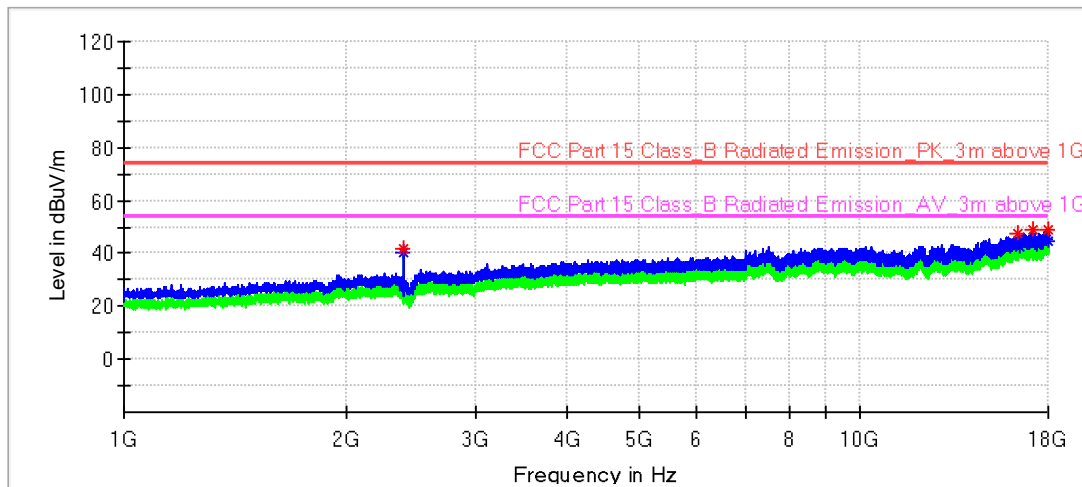


Limit and Margin

Frequency (MHz)	QuasiPeak (dBuV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBuV/m)
63.280000	25.4	1000.0	120.000	200.0	V	125.0	20.0	14.6	40.0
69.000000	22.4	1000.0	120.000	150.0	V	234.0	18.9	17.6	40.0
239.600000	27.1	1000.0	120.000	250.0	V	158.0	19.6	18.9	46.0
381.760000	24.0	1000.0	120.000	300.0	V	267.0	23.9	22.0	46.0
480.360000	33.1	1000.0	120.000	100.0	V	145.0	26.4	12.9	46.0
900.920000	33.0	1000.0	120.000	210.0	V	291.0	33.3	13.1	46.0

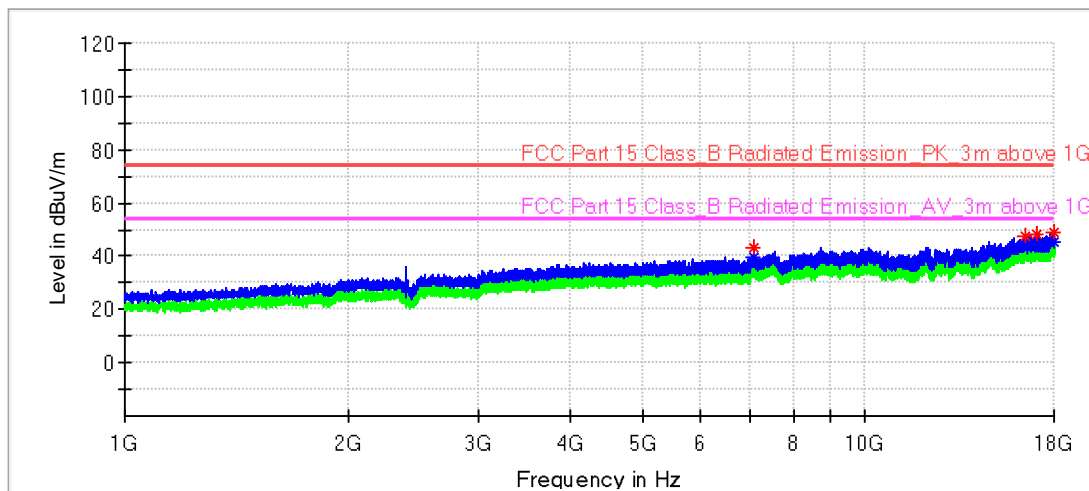
Radiated Emission 1-18 GHz at 1Mbps

Frequency: 2402MHz at 1Mbps



Limit and Margin

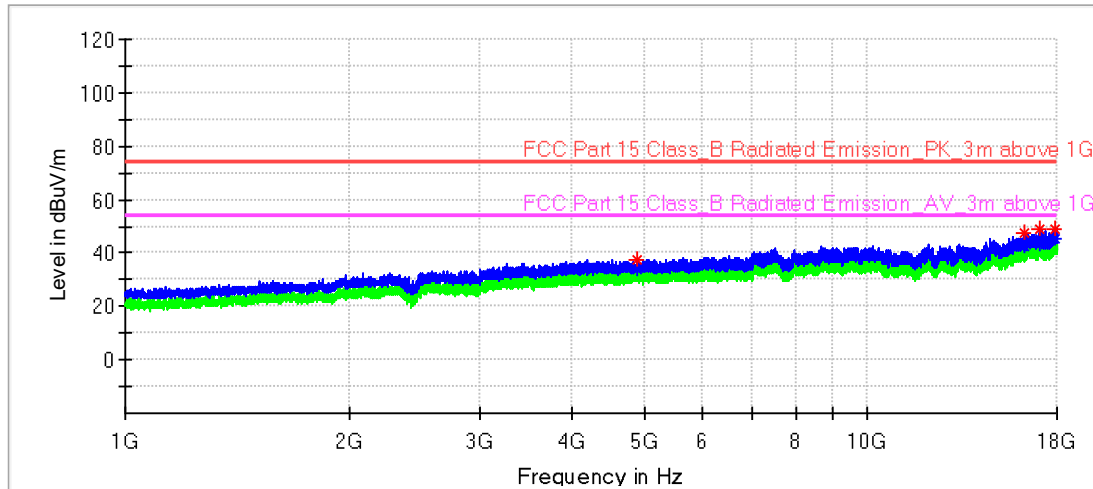
Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2401.968750	42.01	---	74.00	31.99	378.0	H	292.0	-12.2
2401.968750	---	40.29	54.00	13.71	244.0	H	292.0	-12.2
16388.718750	47.27	---	74.00	26.73	208.0	H	82.0	9.2
16446.093750	---	42.42	74.00	31.58	220.0	H	88.0	9.3
17140.968750	49.11	---	74.00	24.89	172.0	H	316.0	10.9
17909.156250	---	45.38	54.00	8.62	173.0	H	104.0	12.3
17947.406250	48.94	---	74.00	25.06	192.0	H	138.0	12.3
17954.843750	---	44.57	74.00	29.43	337.0	H	110.0	12.3



Limit and Margin

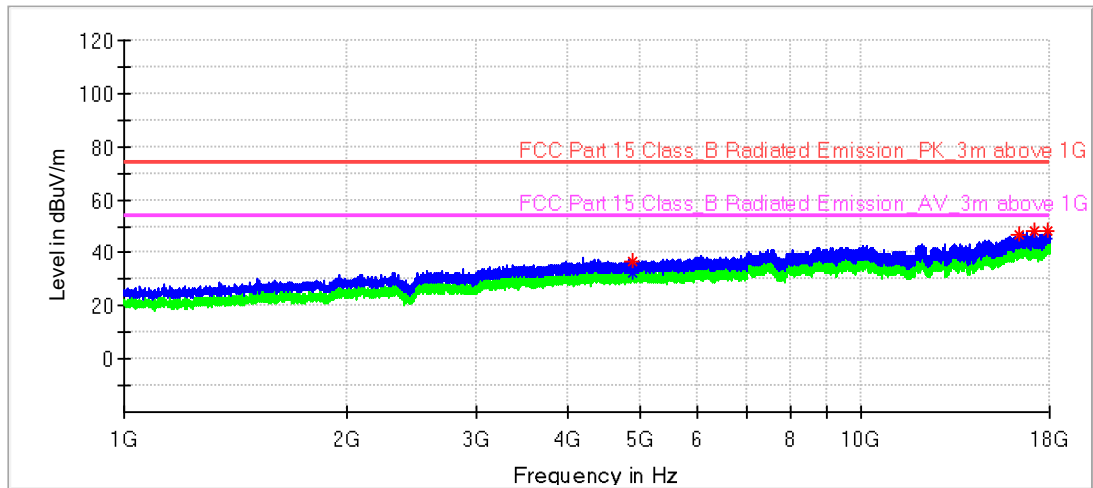
Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
7081.750000	---	39.73	74.00	16.07	259.0	V	204.0	-0.6
7081.750000	43.26	---	74.00	30.74	348.0	V	343.0	-0.6
16415.281250	47.21	---	74.00	26.79	175.0	V	304.0	9.2
16542.250000	---	43.49	74.00	30.51	292.0	V	315.0	9.7
17101.125000	48.27	---	74.00	25.73	355.0	V	69.0	10.8
17109.093750	---	44.05	74.00	29.95	111.0	V	0.0	10.8
17965.468750	---	45.52	54.00	8.48	384.0	V	210.0	12.4
17965.468750	48.62	---	74.00	25.38	116.0	V	210.0	12.4

Frequency: 2440MHz at 1Mbps



Limit and Margin

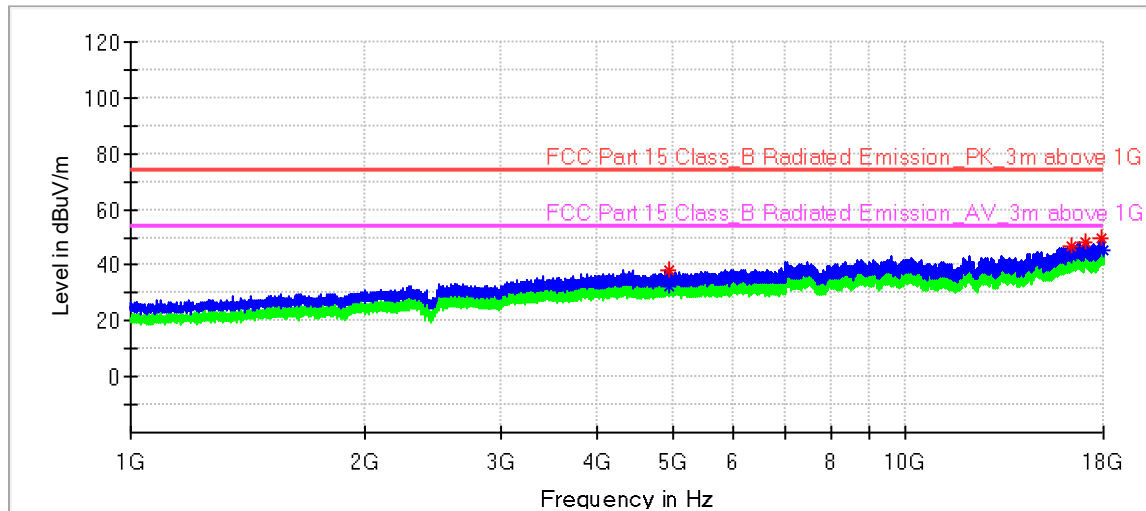
Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4880.156250	---	33.56	54.00	20.44	376.0	H	343.0	-1.6
4880.187500	37.74	---	74.00	36.26	140.0	H	163.0	-1.3
16249.531250	47.25	---	74.00	26.75	236.0	H	197.0	8.8
16263.875000	---	42.41	74.00	31.59	326.0	H	294.0	8.8
17092.625000	---	43.53	74.00	30.47	107.0	H	32.0	10.8
17092.625000	49.08	45.31	74.00	28.69	227.0	H	10.0	10.8
17915.000000	49.03	---	74.00	24.97	210.0	H	331.0	12.3
17933.062500	---	45.57	54.00	8.43	145.0	H	260.0	12.3



Limit and Margin

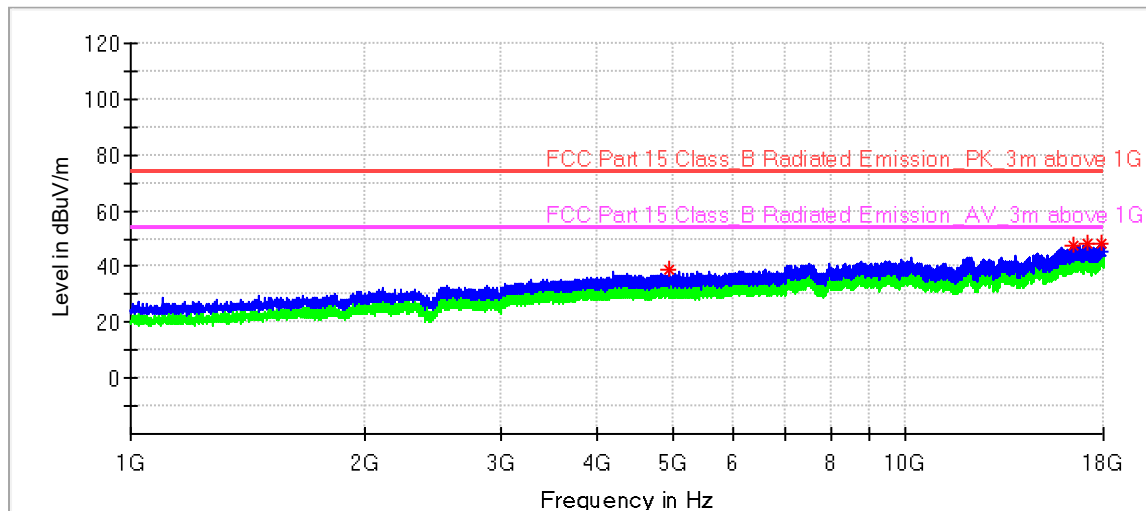
Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4880.343750	36.67	---	74.00	37.33	168.0	V	319.0	-1.8
4880.687500	---	32.67	54.00	21.33	262.0	V	23.0	-2.7
16358.437500	---	44.06	74.00	29.94	244.0	V	136.0	9.1
16392.437500	46.88	---	74.00	27.12	301.0	V	181.0	9.2
17103.250000	---	44.40	74.00	29.60	344.0	V	23.0	10.8
17123.968750	47.87	---	74.00	26.13	390.0	V	319.0	10.8
17761.468750	---	45.12	54.00	8.88	158.0	V	164.0	12.0
17916.593750	48.12	---	74.00	25.88	375.0	V	102.0	12.3

Frequency: 2480MHz at 1Mbps



Limit and Margin

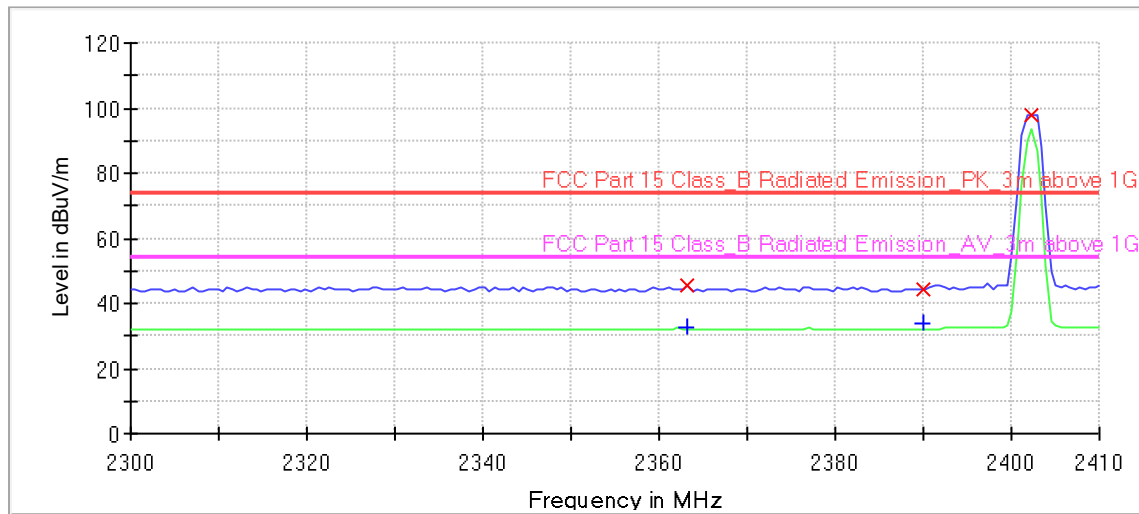
Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4959.406250	---	32.70	54.00	21.30	337.0	H	325.0	-1.0
4959.406250	38.03	---	74.00	35.97	325.0	H	295.0	-2.1
16373.312500	46.94	---	74.00	27.06	298.0	H	289.0	9.1
16378.625000	---	43.04	74.00	30.96	298.0	H	91.0	9.1
17073.500000	48.39	---	74.00	25.61	273.0	H	153.0	10.7
17113.875000	---	45.08	54.00	8.92	103.0	H	344.0	10.8
17920.312500	49.54	---	74.00	24.46	236.0	H	103.0	12.3
17970.250000	---	45.06	74.00	28.94	285.0	H	147.0	12.4



Limit and Margin

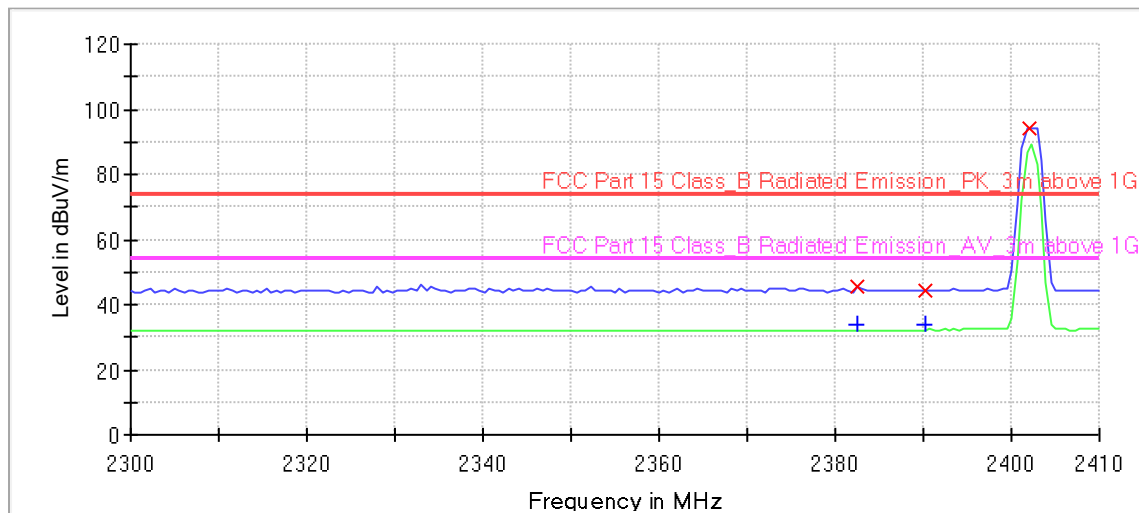
Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4960.218750	38.68	---	74.00	35.32	259.0	V	287.0	-1.1
4960.250000	---	34.63	54.00	19.37	230.0	V	181.0	-2.0
16467.875000	47.47	---	74.00	26.53	328.0	V	88.0	9.4
16504.000000	---	43.54	74.00	30.46	313.0	V	292.0	9.5
17129.812500	48.53	---	74.00	25.47	269.0	V	0.0	10.9
17142.031250	---	44.45	74.00	29.55	225.0	V	122.0	10.9
17935.718750	48.29	---	74.00	25.71	190.0	V	176.0	12.3
17945.281250	---	45.54	54.00	8.46	140.0	V	116.0	12.3

Band Edge at 1Mbps



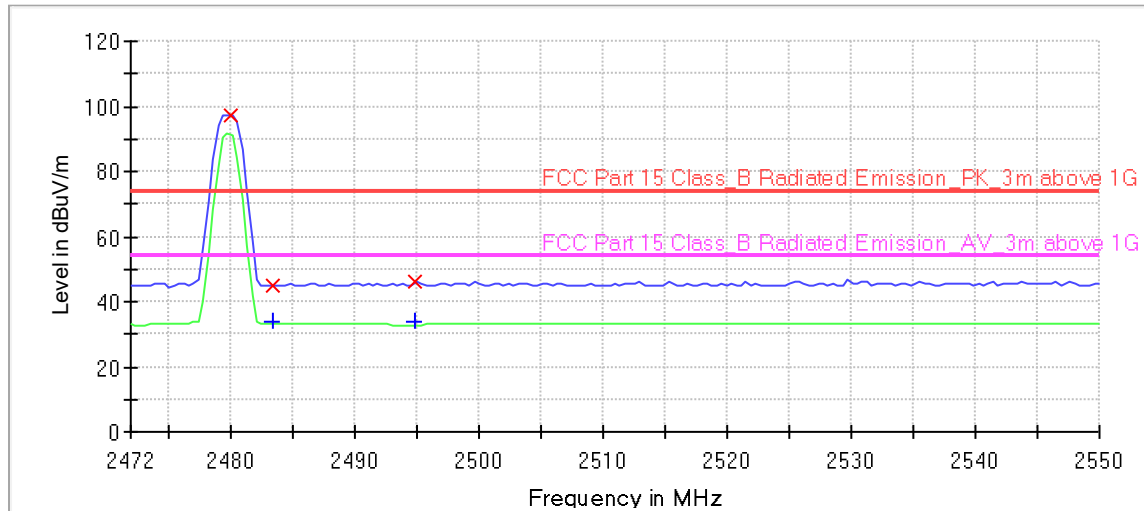
Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	RMS (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - RMS (dB)	Limit - RMS (dBuV/m)
2363.200000	45.4	32.9	300.0	H	241.0	-2.0	28.6	74.0	21.1	54.0
2390.000000	44.5	33.6	100.0	H	130.0	-1.9	29.5	74.0	20.4	54.0
2402.200000	97.8	---	150.0	H	294.0	-1.8	---	---	---	---



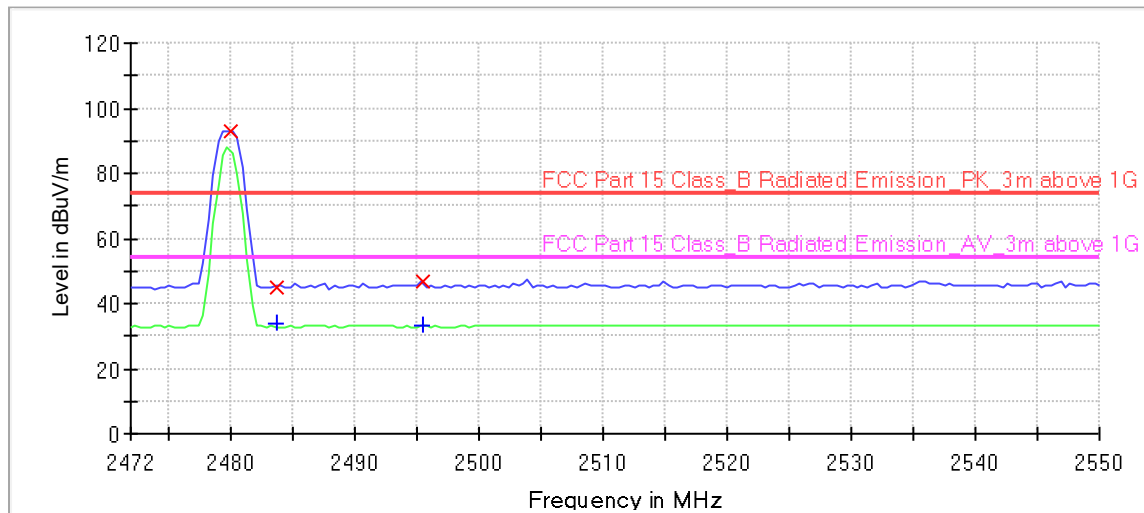
Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	AV (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - AV (dB)	Limit - AV (dBuV/m)
2382.400000	45.6	33.6	200.0	V	187.0	-12.0	28.4	74.0	20.4	54.0
2390.200000	44.2	34.1	200.0	V	124.0	-12.0	29.8	74.0	19.9	54.0
2402.000000	94.4	---	150.0	V	268.0	-1.8	---	---	---	---



Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	AV (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - AV (dB)	Limit - AV (dBuV/m)
2480.000000	97.4	---	100.0	H	241.0	-11.5	---	---	---	---
2483.500000	45.2	34.1	250.0	H	153.0	-11.4	28.8	74.0	19.9	54.0
2494.900000	45.9	33.8	200.0	H	268.0	-11.4	28.1	74.0	20.2	54.0

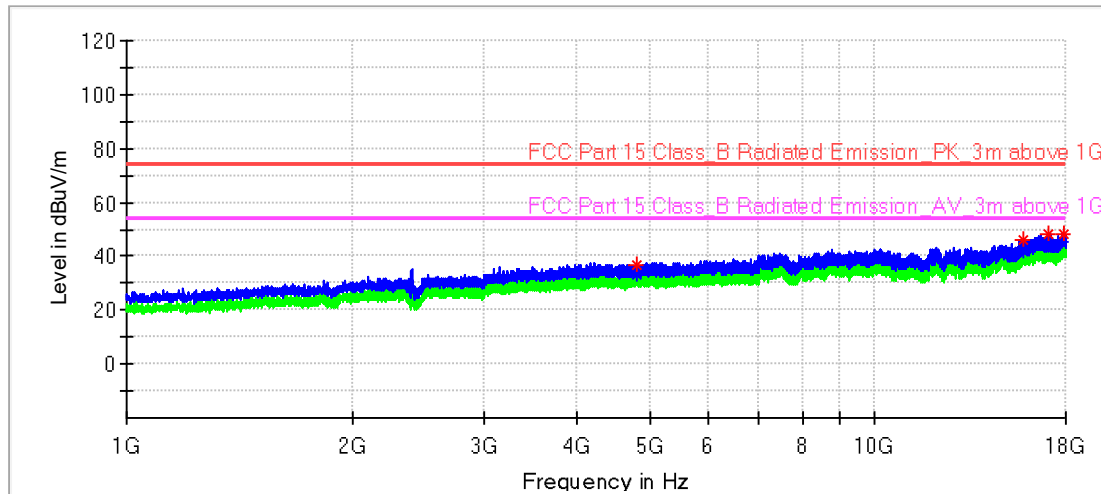


Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	AV (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - AV (dB)	Limit - AV (dBuV/m)
2480.000000	93.2	---	300.0	V	224.0	-1.4	---	---	---	---
2483.800000	45.2	33.8	100.0	V	124.0	-11.4	28.8	74.0	20.2	54.0
2495.500000	46.9	33.5	100.0	V	169.0	-11.4	27.1	74.0	20.5	54.0

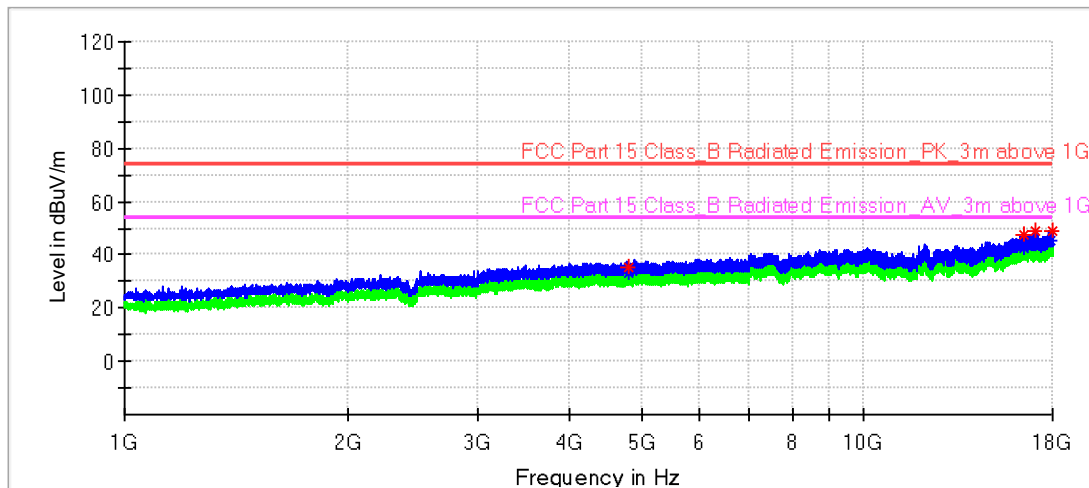
Radiated Emission 1-18 GHz at 2Mbps

Frequency: 2402MHz at 2Mbps



Limit and Margin

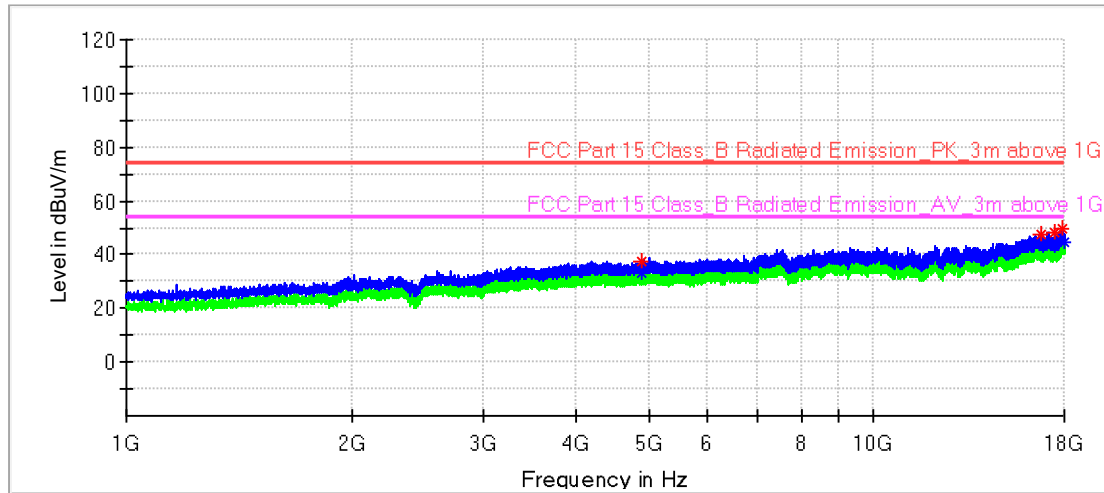
Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4804.156250	36.61	---	74.00	37.39	168.0	H	306.0	-1.0
4804.156250	---	33.44	54.00	20.56	175.0	H	7.0	-1.0
15762.375000	46.00	---	74.00	28.00	138.0	H	242.0	7.7
15812.312500	---	41.76	74.00	32.24	336.0	H	185.0	7.8
17015.593750	48.18	---	74.00	25.82	299.0	H	288.0	10.7
17037.375000	---	44.40	74.00	29.60	190.0	H	185.0	10.7
17819.375000	---	45.15	54.00	8.85	315.0	H	325.0	12.1
17888.968750	48.43	---	74.00	25.57	108.0	H	271.0	12.2



Limit and Margin

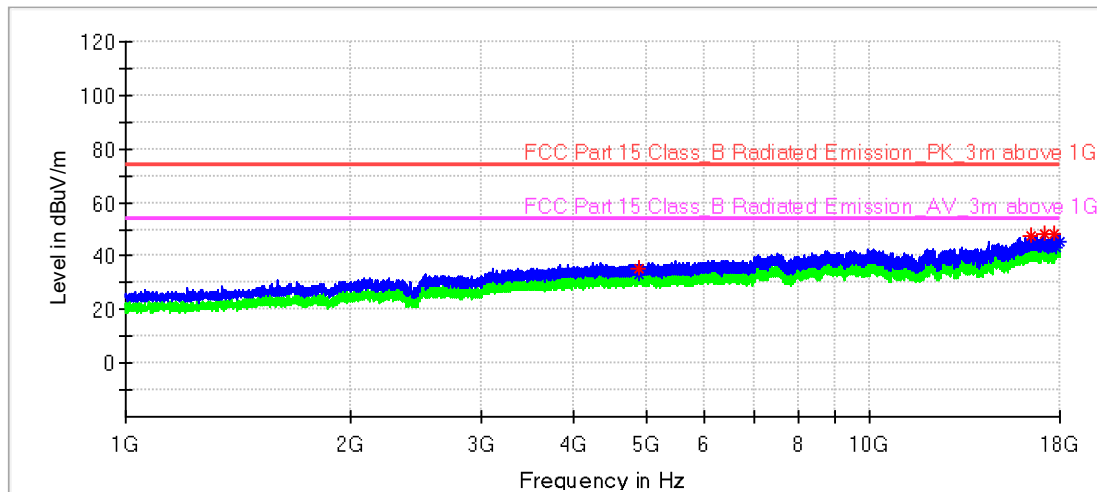
Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4804.218750	35.37	---	74.00	38.63	341.0	V	46.0	-1.1
4804.218750	---	32.80	54.00	21.20	186.0	V	46.0	-1.1
16434.406250	47.81	---	74.00	26.19	326.0	V	337.0	9.3
16455.125000	---	42.43	74.00	31.57	195.0	V	157.0	9.4
17082.000000	48.85	---	74.00	25.15	226.0	V	326.0	10.8
17085.718750	---	43.62	74.00	30.38	311.0	V	52.0	10.8
17915.531250	---	45.66	74.00	28.34	332.0	V	33.0	12.3
17964.937500	49.26	---	74.00	24.74	363.0	V	359.0	12.4

Frequency: 2440MHz at 2Mbps



Limit and Margin

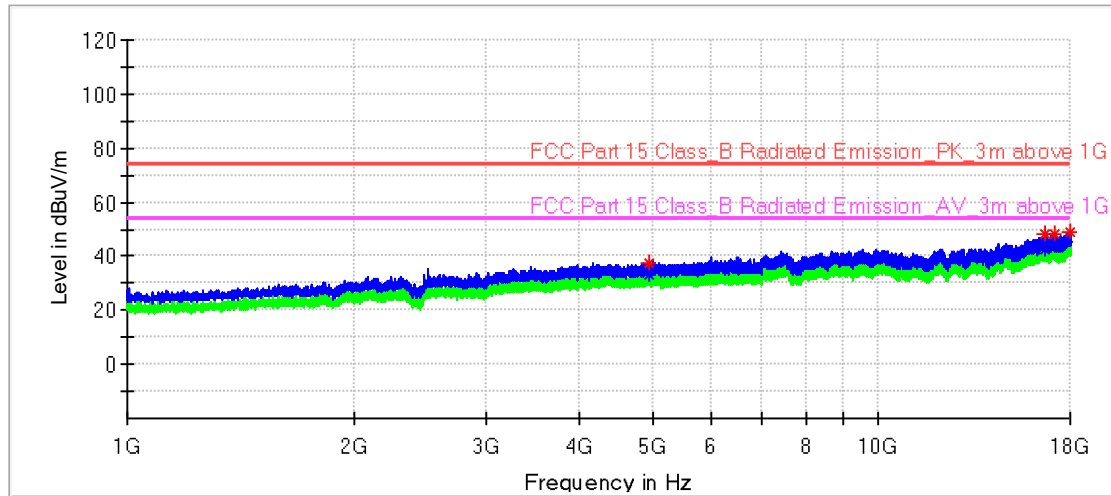
Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4880.500000	---	32.94	54.00	21.06	337.0	H	11.0	-1.6
4880.781250	37.29	---	74.00	36.71	157.0	H	209.0	-1.0
16782.375000	47.18	---	74.00	26.82	390.0	H	290.0	10.2
16824.343750	---	43.14	74.00	30.86	376.0	H	67.0	10.2
17426.781250	48.11	---	74.00	25.89	360.0	H	266.0	11.4
17451.218750	---	43.48	74.00	30.52	171.0	H	125.0	11.4
17911.812500	49.60	---	74.00	24.40	204.0	H	131.0	12.3
17977.156250	---	44.89	74.00	29.11	347.0	H	158.0	12.4



Limit and Margin

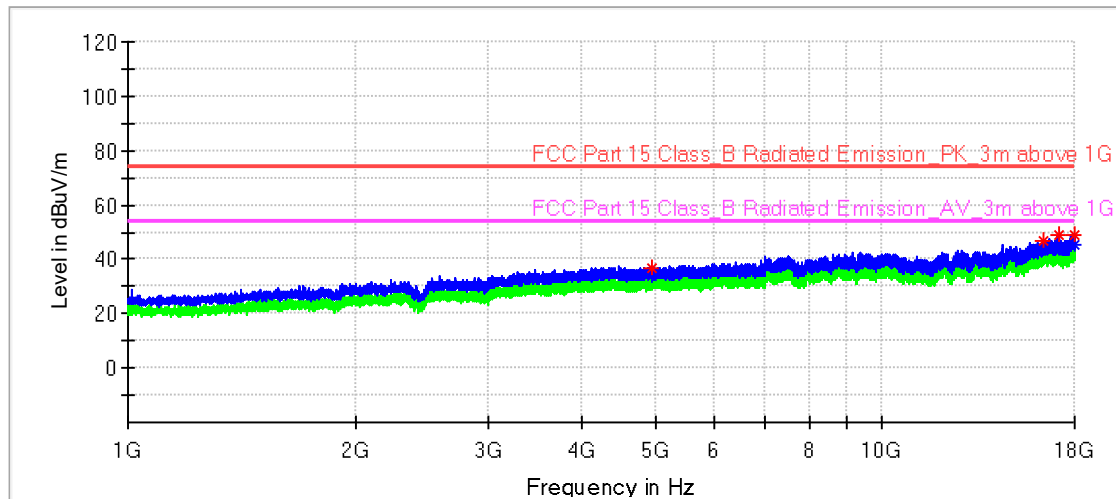
Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4880.000000	---	33.13	54.00	29.13	309.0	V	179.0	-1.0
4880.000000	35.55	---	74.00	38.45	216.0	V	106.0	-1.7
16425.906250	47.74	---	74.00	26.26	298.0	V	313.0	9.3
16431.750000	---	44.33	74.00	29.67	331.0	V	280.0	9.3
17134.593750	---	44.89	74.00	29.11	307.0	V	346.0	10.9
17161.687500	48.07	---	74.00	25.93	201.0	V	17.0	10.9
17725.875000	48.49	---	74.00	25.51	122.0	V	0.0	11.9
17752.437500	---	42.88	74.00	31.12	281.0	V	274.0	12.0
17953.781250	---	45.21	54.00	8.79	255.0	V	268.0	12.3

Frequency: 2480MHz at 2Mbps



Limit and Margin

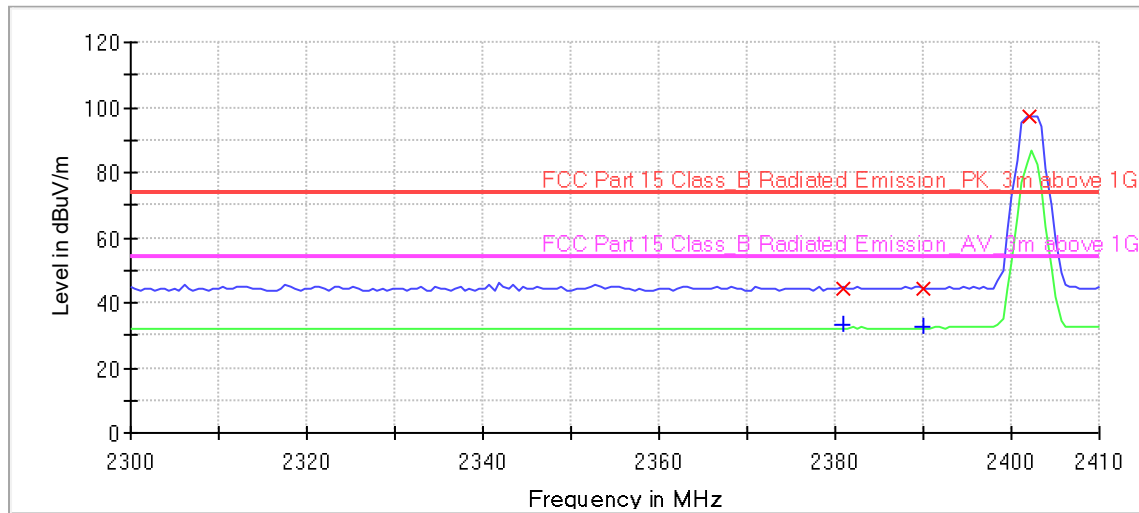
Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4960.062500	---	33.38	54.00	20.62	335.0	H	0.0	-1.2
4960.468750	37.33	---	74.00	36.67	144.0	H	140.0	-1.3
16676.656250	48.38	---	74.00	25.62	145.0	H	128.0	10.2
16678.781250	---	42.35	74.00	31.65	293.0	H	18.0	10.2
17149.468750	---	43.98	74.00	30.02	235.0	H	84.0	10.9
17151.593750	48.52	---	74.00	25.48	154.0	H	312.0	10.9
17790.156250	---	45.66	54.00	8.34	138.0	H	301.0	12.1
17977.156250	49.16	---	74.00	24.84	196.0	H	271.0	12.4



Limit and Margin

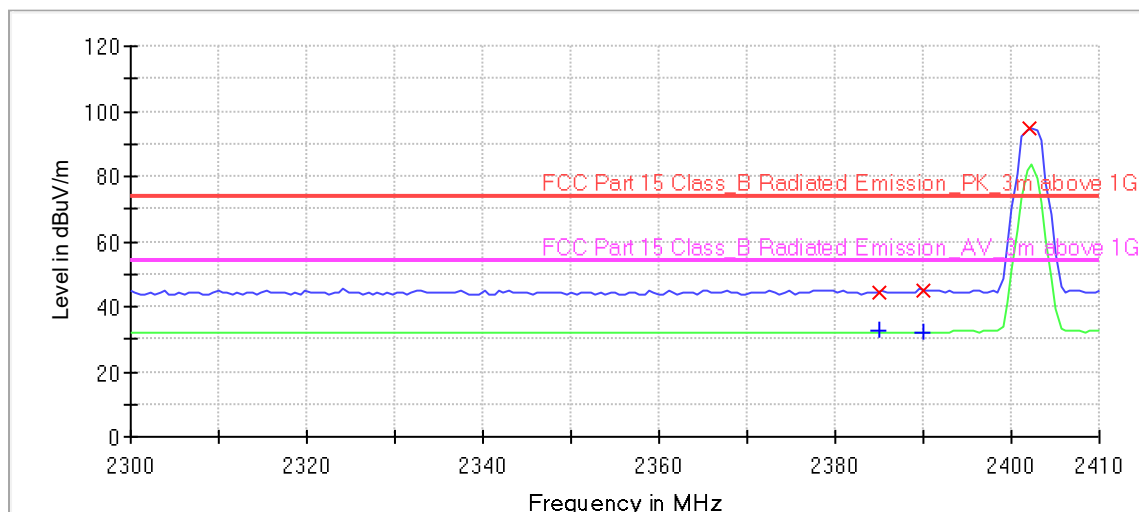
Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
4960.218750	37.03	---	74.00	36.97	291.0	V	206.0	-1.6
4960.281250	---	33.69	54.00	20.31	357.0	V	64.0	-1.7
16378.625000	---	43.56	74.00	30.44	125.0	V	309.0	9.1
16393.500000	46.73	---	74.00	27.27	253.0	V	156.0	9.2
17132.468750	48.74	---	74.00	25.26	351.0	V	22.0	10.9
17152.656250	---	44.29	74.00	29.71	229.0	V	94.0	10.9
17946.875000	---	45.18	54.00	8.82	232.0	V	47.0	12.3
17946.875000	49.02	---	74.00	24.98	372.0	V	47.0	12.3

Band Edge at 2Mbps



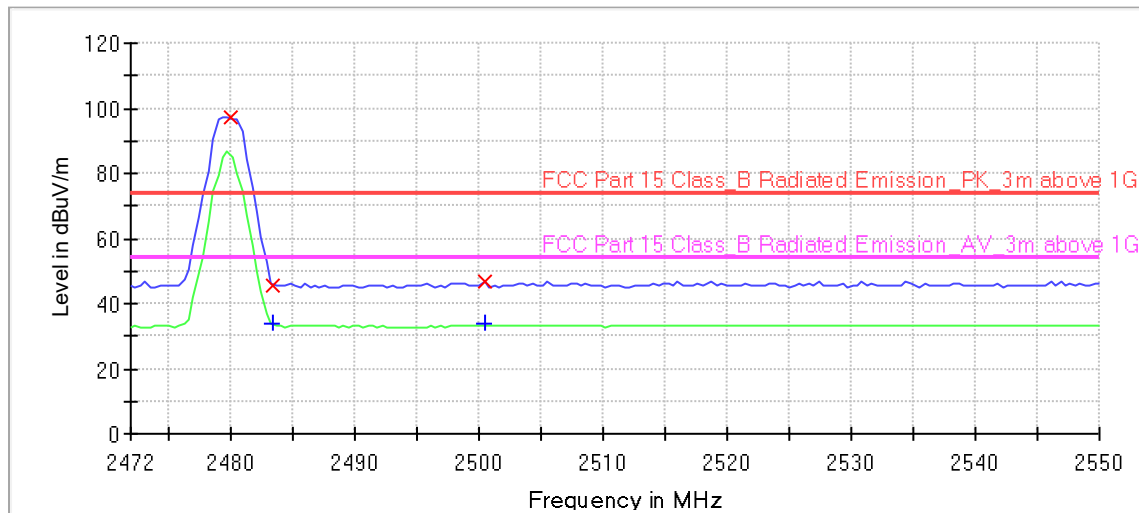
Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	AV (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - AV (dB)	Limit - AV (dBuV/m)
2380.900000	44.5	33.4	150.0	H	156.0	-1.9	29.5	74.0	20.6	54.0
2390.000000	44.3	32.9	250.0	H	165.0	-1.9	29.7	74.0	21.1	54.0
2402.000000	97.5	---	300.0	H	115.0	-1.8	---	---	---	---



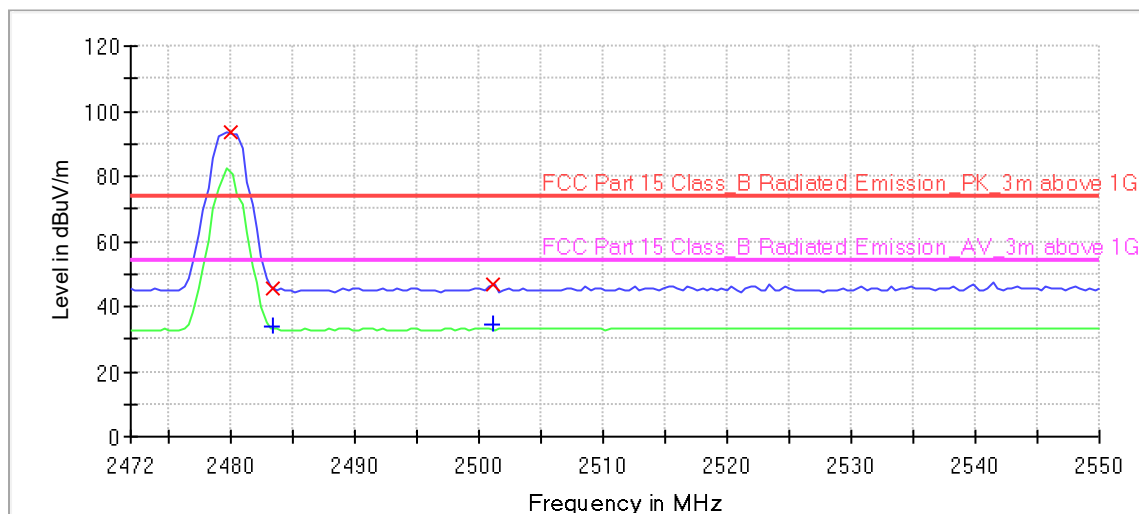
Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	AV (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - AV (dB)	Limit - AV (dBuV/m)
2385.100000	44.5	32.6	300.0	V	225.0	-1.9	29.5	74.0	21.4	54.0
2390.000000	45.2	32.2	350.0	V	245.0	-1.8	28.8	74.0	21.8	54.0
2402.000000	94.8	---	100.0	V	193.0	-1.8	---	---	---	---



Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	AV (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - AV (dB)	Limit - AV (dBuV/m)
2480.000000	97.1	---	250.0	H	234.0	-1.4	---	---	---	---
2483.500000	45.4	34.1	150.0	H	152.0	-1.3	28.6	74.0	19.9	54.0
2500.600000	47.0	33.9	150.0	H	148.0	-1.3	27.0	74.0	20.1	54.0



Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	AV (dBuV/m)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBuV/m)	Margin - AV (dB)	Limit - AV (dBuV/m)
2480.000000	93.3	---	220.0	V	142.0	-1.4	---	---	---	---
2483.500000	45.7	33.9	100.0	V	135.0	-1.3	28.3	74.0	20.1	54.0
2501.200000	46.6	34.2	240.0	V	254.0	-1.3	27.4	74.0	19.8	54.0

The worst case of Radiated Emission Above 18GHz

18-40GHz Radiated Emission

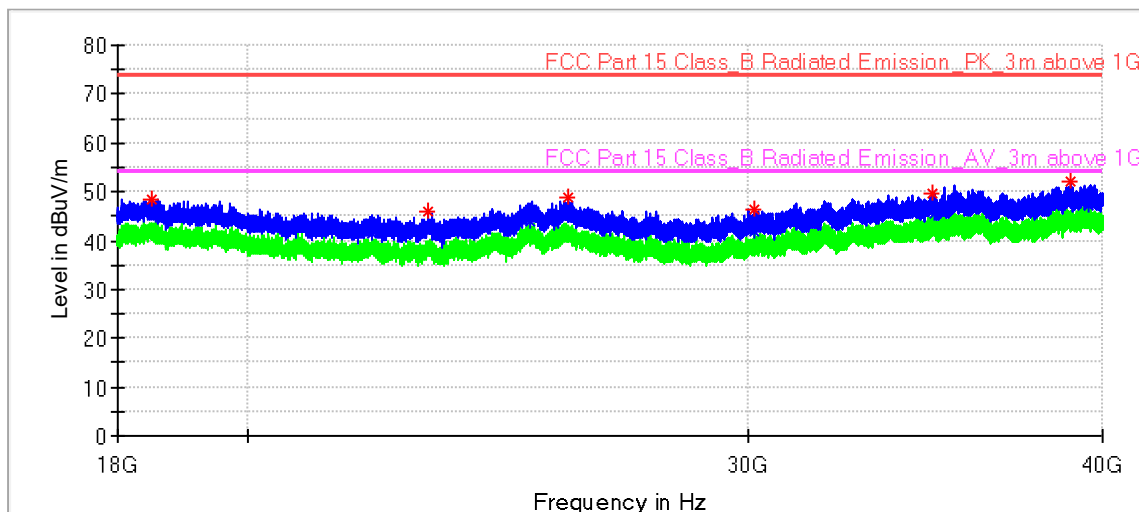
EUT Information

EUT Name: Smart Kit
 Model: MDWBRCU2D
 Client: Hangzhou Tuya Information Technology Co., Ltd
 Op Cond: TX_2402MHz at 2Mbps
 Operator: Doujun XU
 Test Spec: FCC Part 15.209
 Sample No: SHA-1041093-2

Sweep Setup: RE_3116C_pre [EMI radiated]

Hardware Setup: RE_3116C
 Receiver: [FSV 40]
 Level Unit: dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamplifier
18 GHz - 40 GHz	500 kHz	PK+ ; AVG	1 MHz	0.05 s	0 dB



Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18500.500000	48.52	---	74.00	25.48	100.0	H	0.0	8.1
18556.187500	---	44.95	54.00	9.05	100.0	H	127.0	8.1
22133.937500	---	41.49	54.00	12.51	100.0	H	339.0	8.8
23165.187500	45.80	---	74.00	28.20	100.0	H	268.0	8.9
25146.562500	---	43.81	54.00	10.19	100.0	H	19.0	9.1
25939.937500	48.63	---	74.00	25.37	100.0	H	73.0	9.7
30153.625000	---	41.72	54.00	12.28	100.0	H	40.0	10.1
30153.625000	46.33	---	74.00	27.67	100.0	H	40.0	10.1
34849.937500	49.75	---	74.00	24.25	100.0	H	0.0	12.2
34901.500000	---	45.43	54.00	8.57	100.0	H	207.0	12.3
39005.875000	51.98	---	74.00	22.02	100.0	H	0.0	13.4
39540.750000	---	47.24	54.00	6.76	100.0	H	159.0	13.7

18-40GHz Radiated Emission

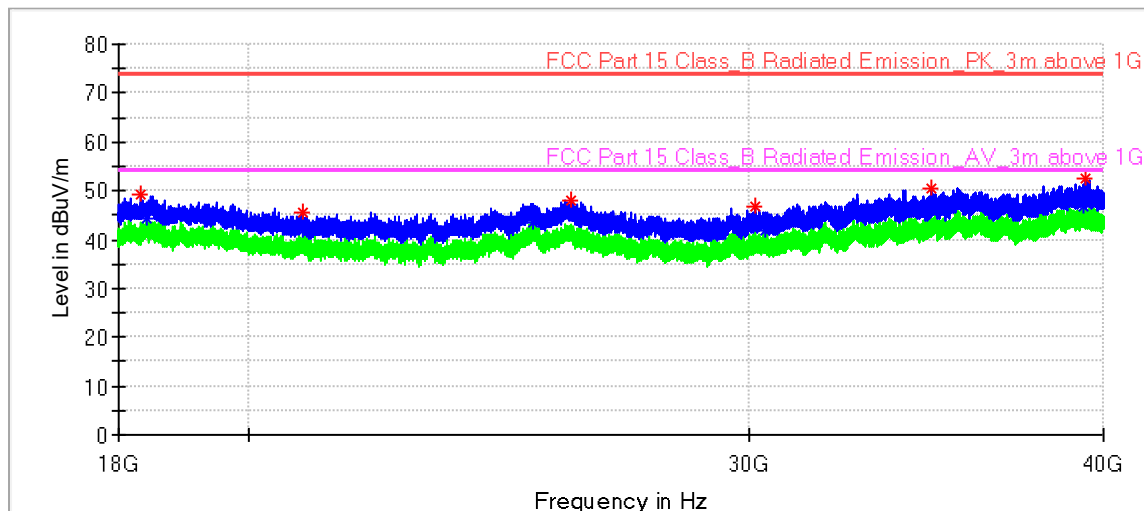
EUT Information

EUT Name: Smart Kit
 Model: MDWBRCU2D
 Client: Hangzhou Tuya Information Technology Co., Ltd
 Op Cond: TX_2402MHz at 2Mbps
 Operator: Doujun XU
 Test Spec: FCC Part 15.209
 Sample No: SHA-1041093-2

Sweep Setup: RE_3116C_pre [EMI radiated]

Hardware Setup: RE_3116C
 Receiver: [FSV 40]
 Level Unit: dBuV/m

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamplifier
18 GHz - 40 GHz	500 kHz	PK+ ; AVG	1 MHz	0.05 s	0 dB



Limit and Margin

Frequency (MHz)	MaxPeak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18333.437500	49.10	---	74.00	24.90	100.0	V	91.0	8.1
18404.250000	---	44.14	54.00	9.86	100.0	V	236.0	8.1
20882.687500	45.56	---	74.00	28.44	100.0	V	248.0	8.5
20889.562500	---	41.81	54.00	12.19	100.0	V	137.0	8.5
25183.000000	---	43.52	54.00	10.48	100.0	V	127.0	9.2
25966.750000	48.11	---	74.00	25.89	100.0	V	97.0	9.7
30140.562500	46.78	---	74.00	27.22	100.0	V	0.0	10.1
30421.062500	---	41.98	54.00	12.02	100.0	V	60.0	10.2
34010.500000	---	45.80	54.00	8.20	100.0	V	66.0	11.2
34796.312500	50.61	---	74.00	23.39	100.0	V	137.0	12.1
39338.625000	---	46.96	54.00	7.04	100.0	V	355.0	13.6
39399.812500	52.33	---	74.00	21.67	100.0	V	262.0	13.7

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
 Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

11 Test Equipment List

List of Test Instruments
Test Site1

	Description	Manufacturer	Model no.	Serial no.	CAL. DATE	CAL. DUE DATE
C	Signal spectrum analyzer	Agilent	N9020B	MY59050168	2026-2-24	2027-2-23
	RF automatic control unit	MWRFTtest	MW100-RFCB	MW211122-28	2025-10-9	2026-10-8
	RF_Cable	UCWAVE ELECTRONIC	UCA500-NJWSM-1.5M	---	2025-8-1	2026-7-31
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2025-8-1	2026-7-31
	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2025-8-1	2026-7-31
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	961	2026-6-25	2027-6-24
	Double-ridged waveguide horn antenna	Rohde & Schwarz	HF907	102393	2026-4-14	2027-4-13
	Pre-amplifier	Shenzhen HzEMC	HPA-081843	HYP A23026	2026-4-14	2027-4-13
	Loop antenna	Rohde & Schwarz	HFH2-Z2	100443	2026-6-25	2027-6-24
	Double Ridged Horn Antenna	ETS-Lindgren	3116C	000222727	2026-6-25	2027-6-24
	RE_Cable_01 Coaxial Cable	JUNFLON	MWX221	1906S057	2025-8-1	2026-7-31
	RE_Cable_02 Coaxial Cable	HUBER+SUHNER	RG214	1358176	2025-8-1	2026-7-31
	RE_Cable_03 Coaxial Cable	JUNFLON	MWX221	J12J102482	2025-8-1	2026-7-31
	RE_Cable_04 Coaxial Cable	PASTERNAK	PE360	2233	2025-8-1	2026-7-31
	3m Semi-anechoic chamber	TDK	9X6X6	----	2024-5-8	2027-5-7
	Band reject filter	Wainwright	WRCGV10-2382-2402-2480-2500-52SS	38	2025-8-1	2026-7-31
	10dB Attenuator	Aeroflex Weinschel	CG-4689	93459	2026-2-24	2027-2-23
CE	EMI Test Receiver	Rohde & Schwarz	ESR3	101907	2025-8-1	2026-7-31
	LISN	Rohde & Schwarz	ENV216	101924	2025-8-1	2026-7-31
	CE_Cable_01 Coaxial Cable	HUBER+SUHNER	RG400	1002115055	2025-8-1	2026-7-31

Measurement Software Information			
Test Item	Software	Manufacturer	Version
C	MTS 8310	MWRFTtest	3.0.0.0
RE	EMC 32	Rohde & Schwarz	V10.50.40
CE	EMC 32	Rohde & Schwarz	V9.15.03



C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth and 99% Occupied Bandwidth
- Power spectral density
- Spurious RF conducted emissions
- Band edge



12 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

Items	Extended Uncertainty
Conducted Disturbance at Mains Terminals	150kHz to 30MHz, LISN, 3.16dB
Radiated Disturbance	9kHz to 30MHz, 3.52dB 30MHz to 1GHz, 5.03dB (Horizontal) 5.12dB (Vertical) 1GHz to 18GHz, 5.49dB 18GHz to 40GHz, 5.63dB
RF Conducted Measurement	Power related: 1.16dB Frequency related: 6.00×10^{-8}

Measurement Uncertainty Decision Rule:

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2023, clause 4.3.3.



13 Photographs of Test Set-ups

Refer to the < Test Setup photos >.



14 Photographs of EUT

Refer to the < External Photos > & < Internal Photos >.

-----End of Test Report-----