

5.7 Radiated Emission

5.7.1 Limit

Acc. To section 15.205,15.209, RSS-GEN 8.9, following table shall be applied.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 – 88	100	40
88 – 216	150	43.5
216 – 960	200	46
Above 960	500	24

5.7.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.6 Radiated emission measurements.

The radiated emissions measurements were on 3 m, semi-anechoic chamber. The EUT and other support equipment were placed on a non-conductive table 80 cm for below 1 GHz and 1.5 m for above 1 GHz above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 25 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

For measurement below 1 GHz, the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For peak emission measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz and for average measurement, resolution bandwidth is set to 1 MHz; and the video bandwidth is set to 10 Hz, when duty cycle is more than 98 %. If duty cycle is less than 98 %, the video bandwidth is set to $\geq 1/T$, where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz. The spectrum from 30 MHz to 25 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

5.7.3 Test Site Requirement for KDB 414788 D01

Acc. to KDB 414788 D01 Radiated Test Site v01, Semi Anechoic Chamber (SAC) shall be verified test results below 30 MHz with Open Area Test Site (OATS), so we compared test results between the measurements from our SAC and an OATS and found test results almost same, so we **declare test result for below 30 MHz from our SAC is valid and met the requirement acc. to KDB 414788 D01 Radiated Test Site v01.**

5.7.4 Measurement Uncertainty

Measurement uncertainties were not taken into account and following uncertainty levels have been estimated for tests performed on the apparatus. The measurement uncertainties are given with at least 95 % confidence.

Frequency Range	Uncertainty	Frequency Range	Uncertainty
9 kHz ~ 30 MHz	± 2.6 dB	30 MHz ~ 1 GHz	± 4.4 dB
1 GHz ~ 18 GHz	± 5.0 dB	18 GHz ~25 GHz	± 5.2 dB

5.7.5 Sample Calculated Example

At 80 MHz

Limit = 40.0 dBuV/m

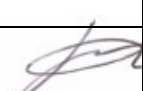
Result (dBuV/m)

= Receiver Reading (dBuV) + Antenna Factor (dB/m) - Pre-amplifier Gain (dB) + Cable Loss (dB) = 30

Margin = Limit – Result = 40 – 30 = 10

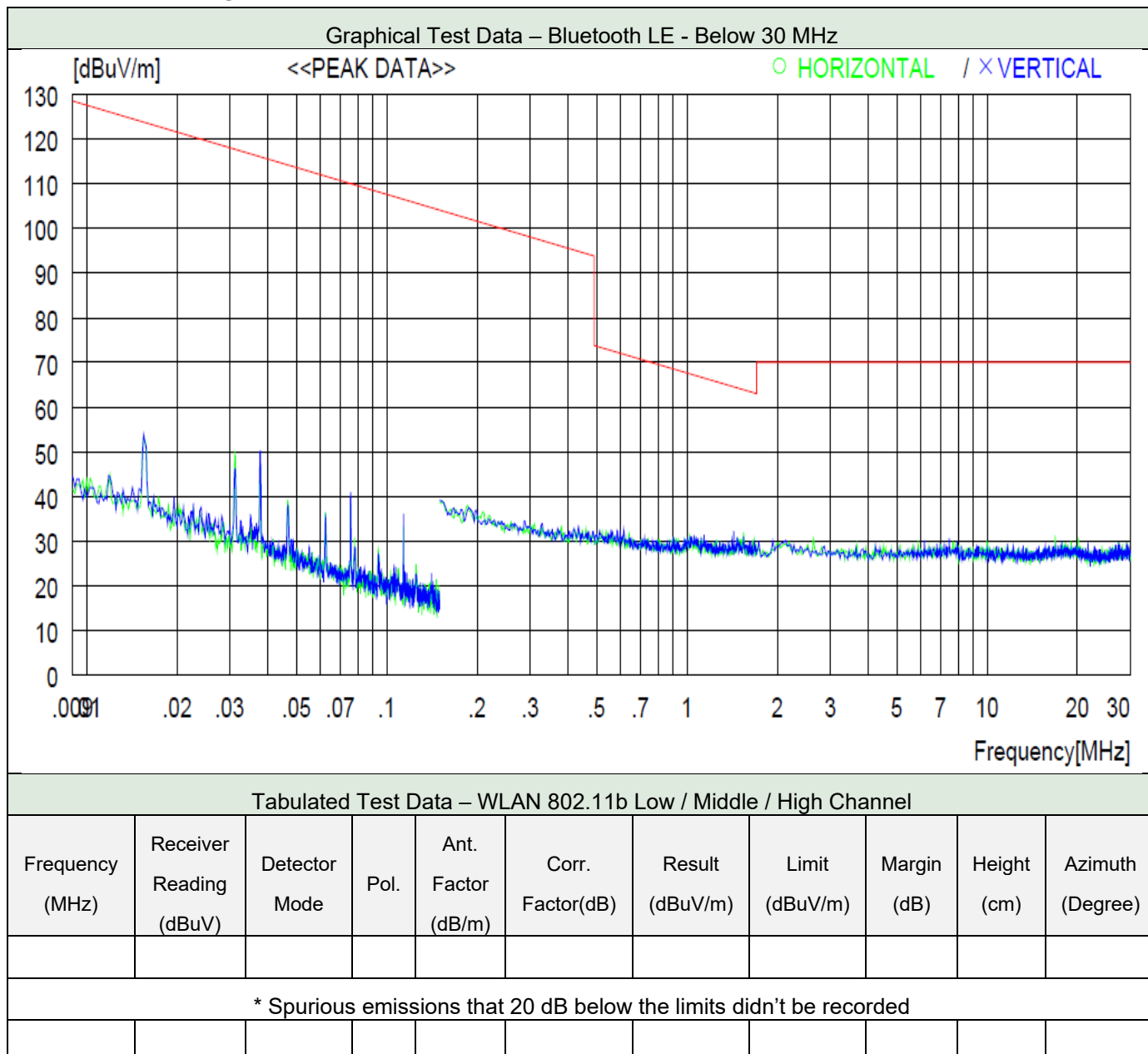
so the EUT has 10.0 dB margin at 80 MHz

5.7.6 Test Data

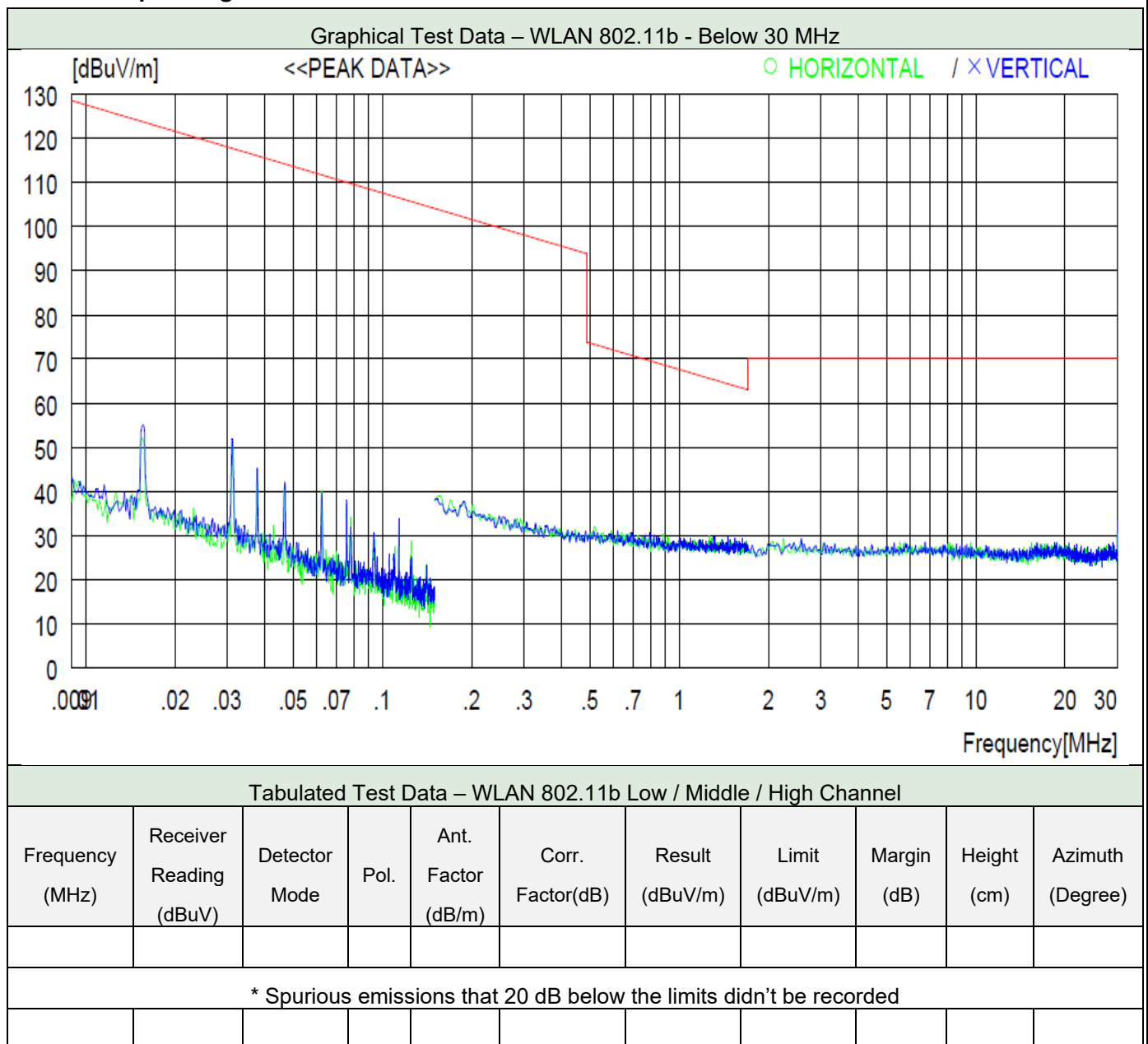
Date of Test	2020-03-16, 2020-03-31, 2020-04-09	Temperature		(20.0 ± 1.8) °C	
		Relative humidity		(39.1 ± 1.0) % R.H.	
Measurement Frequency Range		9 kHz ~ 25 GHz			
Test Result	PASS	Tested By		Do-heon Kim 	
Frequency range	Detector Mode	Resolution BW	Video BW	Video Filtering	Measurement distance
Below 30 MHz	Peak or Q.P.	9 kHz	100 kHz	-	3 m
30 MHz ~ 1 000 MHz	Peak or Q.P.	100 kHz	300 kHz	-	3 m
Above 1 GHz	Peak	1 MHz	3 MHz		3 m
	Average	1 MHz	3 MHz		3 m

5.7.6.1 Test Data below 30 MHz

5.7.6.1.1 Operating mode: Bluetooth LE



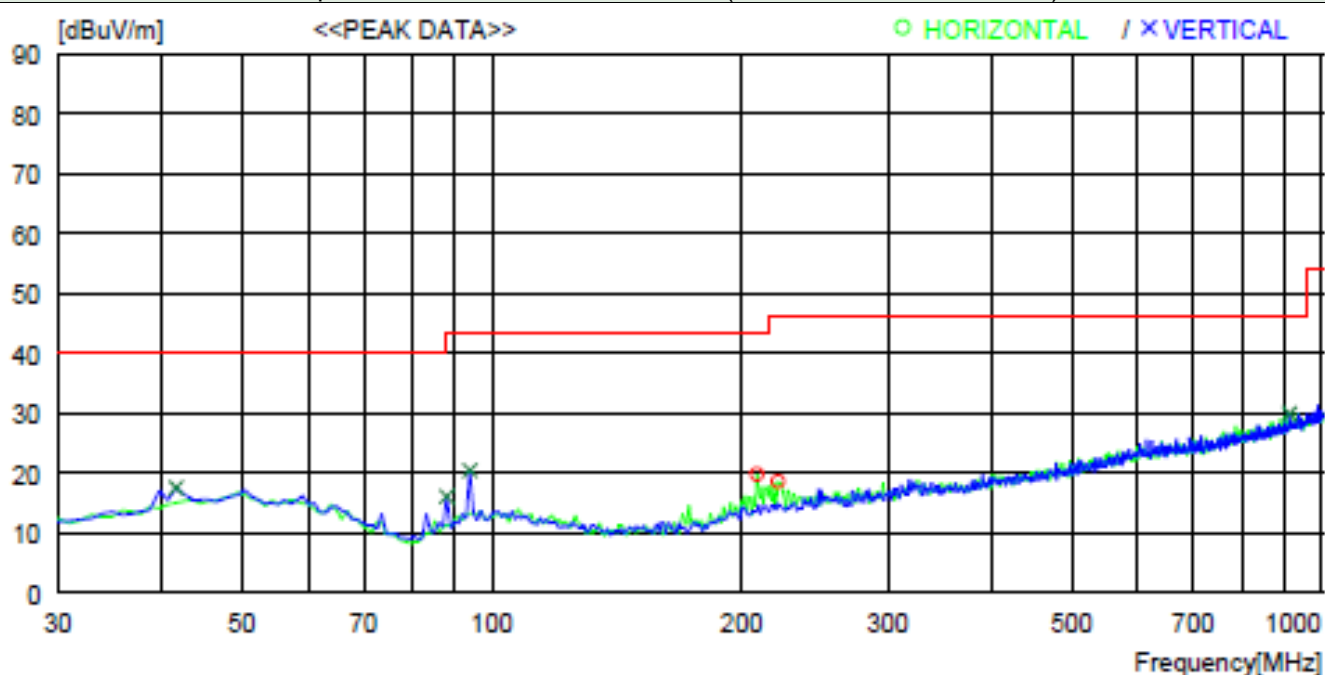
5.7.6.1.2 Operating mode: WLAN 802.11b



5.7.6.2 Test Data from 30 MHz to 1 GHz

5.7.6.2.1 Operating mode: Bluetooth LE

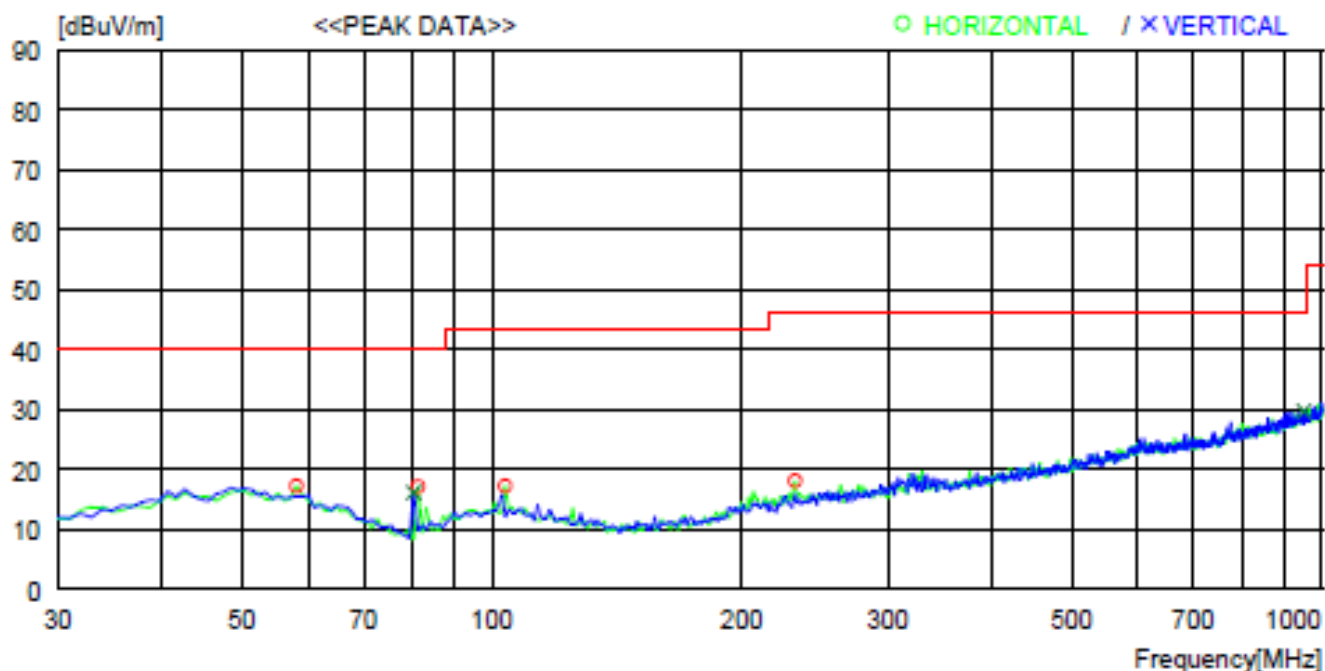
Graphical Test Data – Below 1 GHz – (Bluetooth LE, Low channel)



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	208.480	32.0	11.4	9.0	32.6	19.8	43.5	23.7	100	198
2	221.090	30.4	11.7	9.1	32.6	18.6	46.0	27.4	100	359
----- Vertical -----										
3	41.640	29.5	13.5	7.2	32.7	17.5	40.0	22.5	300	280
4	88.200	31.4	9.4	7.9	32.7	16.0	43.5	27.5	300	0
5	94.020	34.7	10.4	8.0	32.7	20.4	43.5	23.1	300	128
6	913.658	27.4	22.2	12.5	32.2	29.9	46.0	16.1	400	359

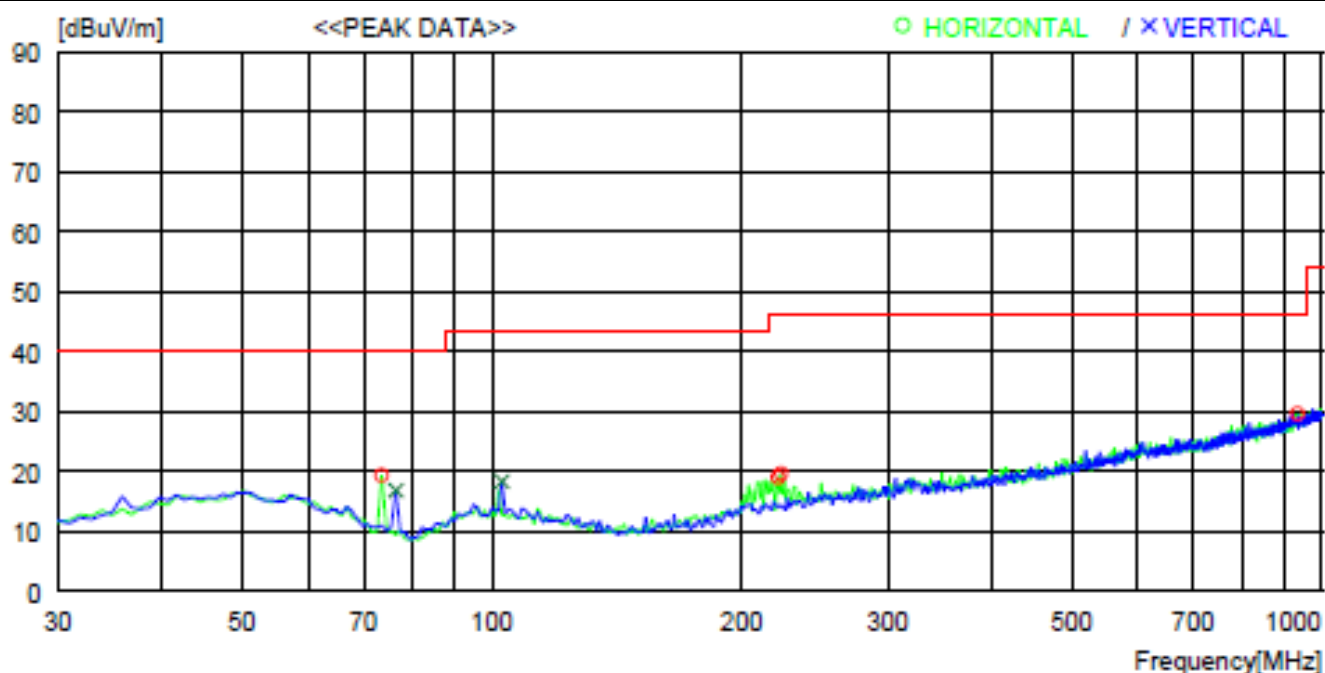
Note: "H" means Horizontal polarity, "V" means Vertical polarity.

Graphical Test Data – Below 1 GHz – (Bluetooth LE, Middle channel)



Note: "H" means Horizontal polarity, "V" means Vertical polarity.

Graphical Test Data – Below 1 GHz – (Bluetooth LE, High channel)

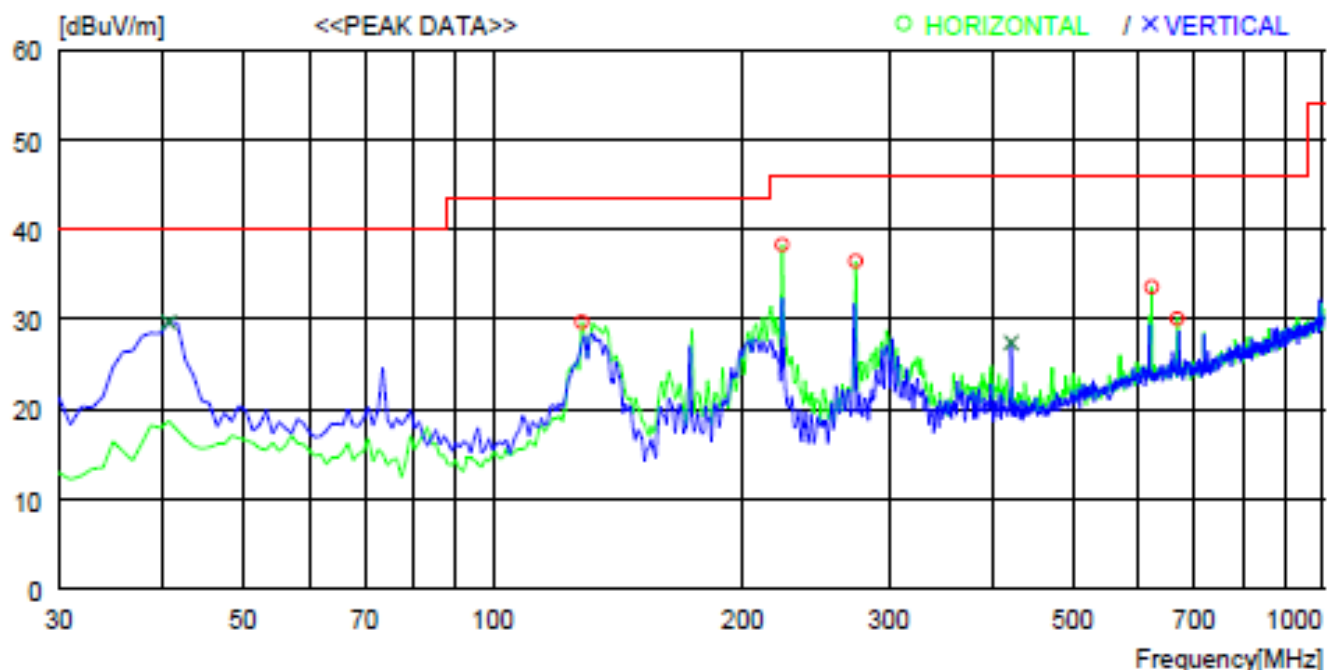


No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	73.650	35.6	8.7	7.7	32.7	19.3	40.0	20.7	200	359
2	221.090	30.8	11.7	9.1	32.6	19.0	46.0	27	100	0
3	223.030	31.4	11.7	9.1	32.6	19.6	46.0	26.4	100	0
4	934.028	26.9	22.2	12.6	32.1	29.6	46.0	16.4	200	358
----- Vertical -----										
5	76.560	33.9	7.9	7.7	32.7	16.8	40.0	23.2	400	0
6	102.750	32.0	11.0	8.0	32.7	18.3	43.5	25.2	300	160

Note: "H" means Horizontal polarity, "V" means Vertical polarity.

5.7.6.2.2 Operating mode: WLAN 802.11b

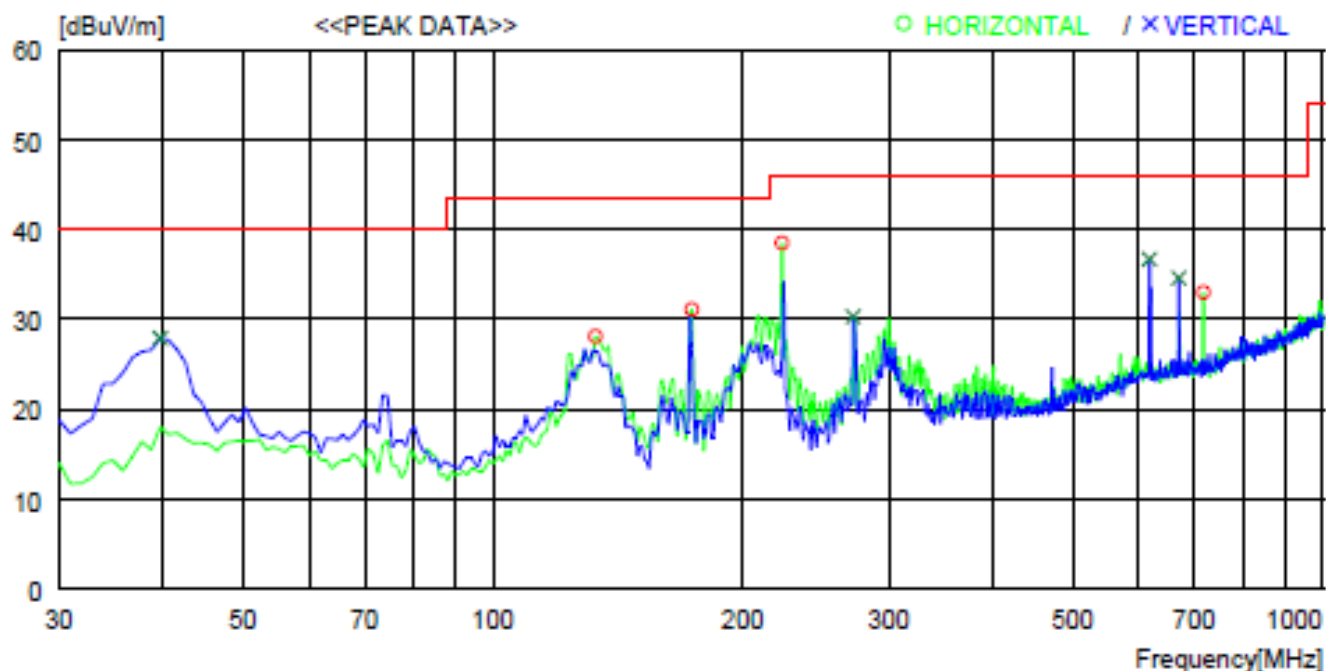
Graphical Test Data – Below 1 GHz – (WLAN 802.11b, **Low channel**)



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	127.970	45.1	8.9	8.3	32.6	29.7	43.5	13.8	200	0
2	223.030	50.1	11.7	9.1	32.6	38.3	46.0	7.7	200	334
3	273.470	46.9	12.8	9.4	32.6	36.5	46.0	9.5	100	359
4	621.697	35.7	19.5	11.4	33.0	33.6	46.0	12.4	200	11
5	667.286	31.8	19.7	11.6	33.0	30.1	46.0	15.9	400	86
----- Vertical -----										
6	40.670	41.9	13.3	7.2	32.7	29.7	40.0	10.3	100	302
7	420.911	33.7	16.0	10.4	32.7	27.4	46.0	18.6	200	204

Note: "H" means Horizontal polarity, "V" means Vertical polarity.

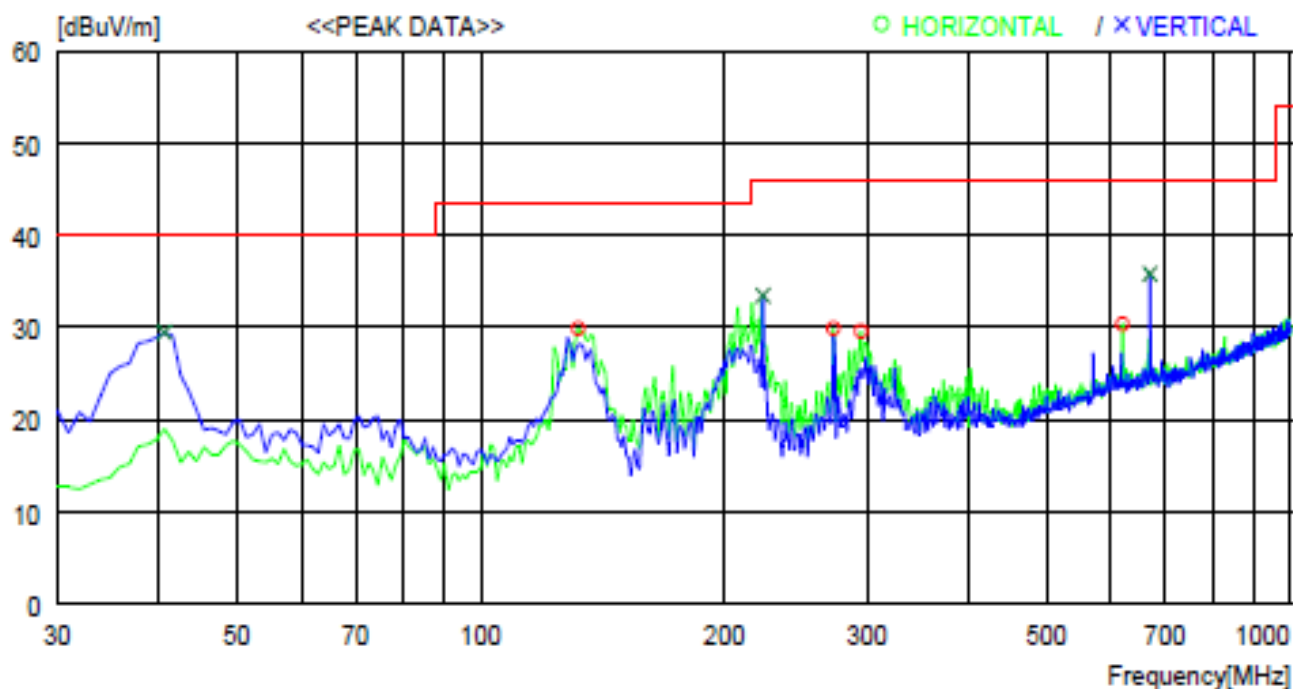
Graphical Test Data – Below 1 GHz – (WLAN 802.11b, **Middle channel**)



No.	FREQ [MHz]	READING [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	132.820	43.9	8.5	8.3	32.6	28.1	43.5	15.4	200	126
2	173.560	46.1	8.9	8.7	32.6	31.1	43.5	12.4	100	359
3	223.030	50.3	11.7	9.1	32.6	38.5	46.0	7.5	200	303
4	717.724	34.1	20.1	11.8	33.0	33.0	46.0	13	100	359
----- Vertical -----										
5	39.700	40.4	13.0	7.2	32.7	27.9	40.0	12.1	100	0
6	271.530	40.7	12.8	9.4	32.6	30.3	46.0	15.7	100	0
7	617.817	38.8	19.5	11.4	33.0	36.7	46.0	9.3	100	262
8	670.196	36.2	19.8	11.6	33.0	34.6	46.0	11.4	100	0

Note: "H" means Horizontal polarity, "V" means Vertical polarity.

Graphical Test Data – Below 1 GHz – (WLAN 802.11b, **High channel**)

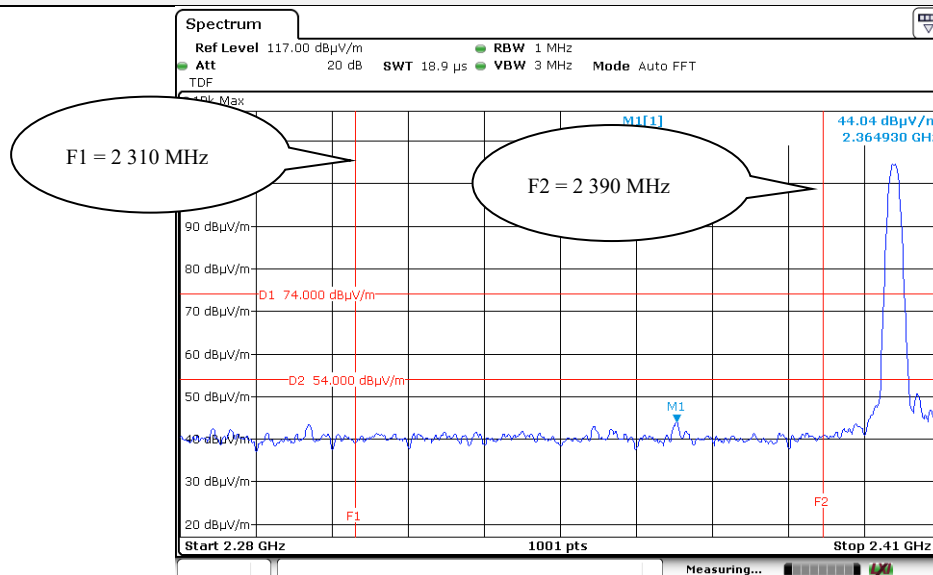


No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	131.850	45.6	8.6	8.3	32.6	29.9	43.5	13.6	200	296
2	272.500	40.3	12.8	9.4	32.6	29.9	46.0	16.1	100	158
3	294.810	39.5	13.1	9.6	32.6	29.6	46.0	16.4	200	125
4	619.757	32.5	19.5	11.4	33.0	30.4	46.0	15.6	300	181
----- Vertical -----										
5	40.670	41.7	13.3	7.2	32.7	29.5	40.0	10.5	100	0
6	223.030	45.3	11.7	9.1	32.6	33.5	46.0	12.5	100	101
7	670.196	37.4	19.8	11.6	33.0	35.8	46.0	10.2	100	0

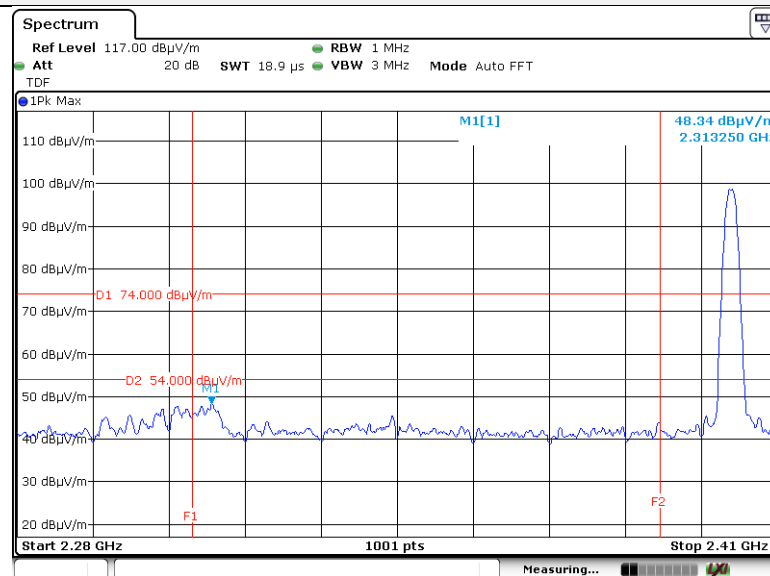
Band edge (Restricted band)

Graphical Test Data – Low Channel (Peak)

Horizontal



Vertical



Tabulated Test Data – Low Channel

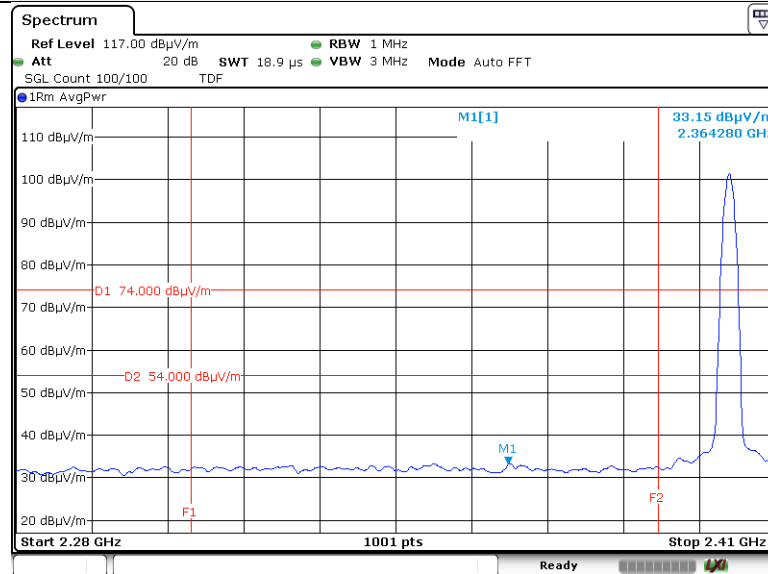
Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 364.9	Peak	H	44.04	-	44.04	74.00	29.96	180	73
2 313.3	Peak	V	48.34	-	48.34	74.00	25.66	100	131

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

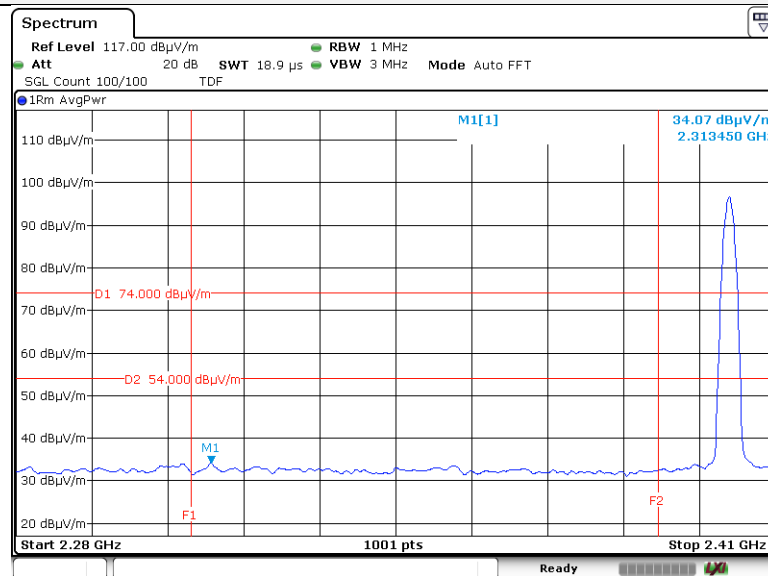
Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Graphical Test Data – Low Channel (Average)

Horizontal



Vertical



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 364.3	RMS	H	33.15	2.06	35.21	54.00	18.79	180	73
2 313.5	RMS	V	34.07	2.06	36.13	54.00	17.87	100	131

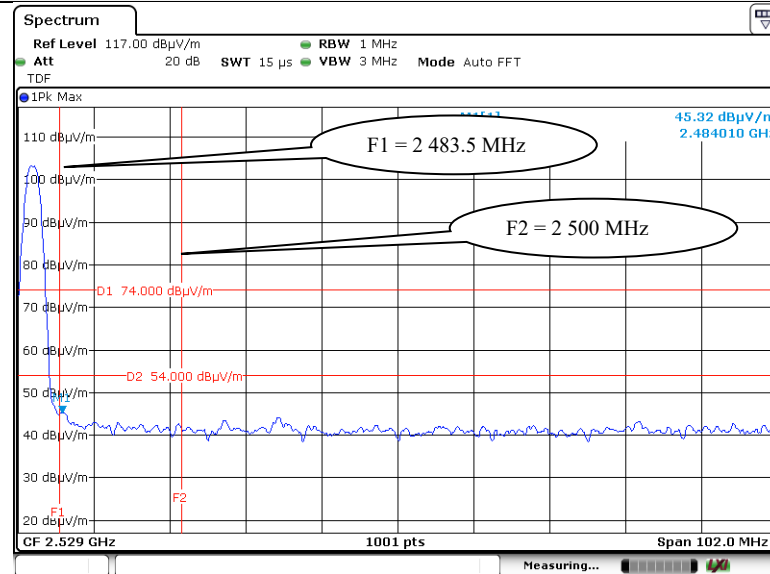
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

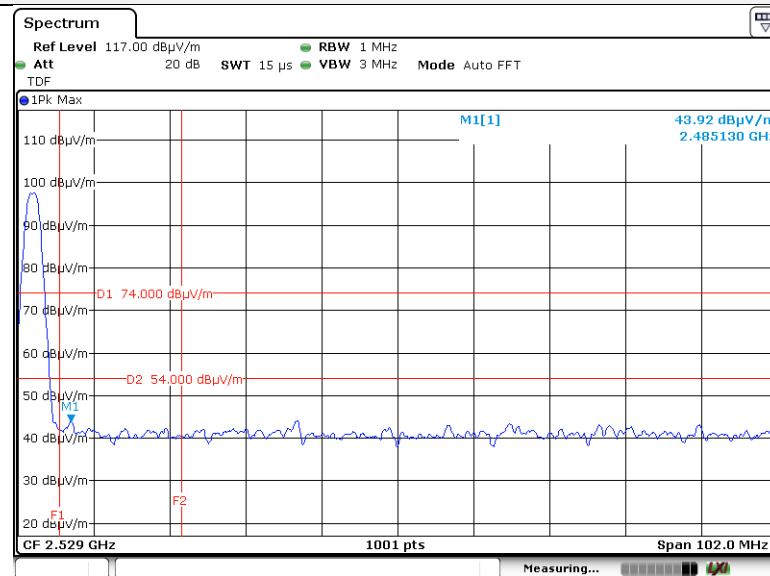
Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Peak)

Horizontal



Vertical



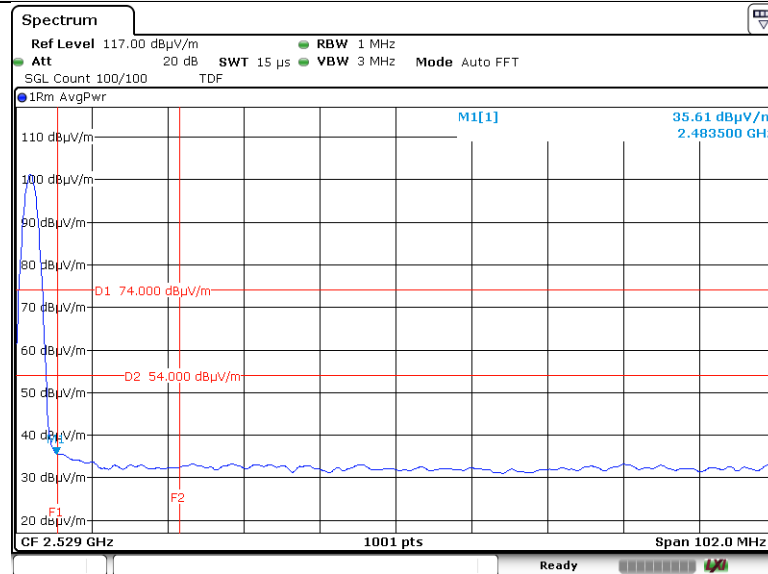
Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 484.0	Peak	H	45.32	-	45.32	74.00	28.68	180	73
2 485.1	Peak	V	43.92	-	43.92	74.00	30.08	100	131

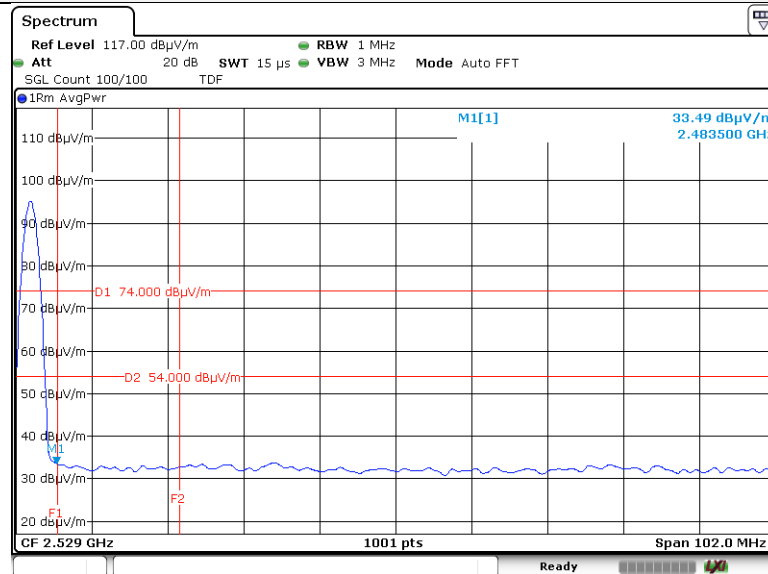
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Graphical Test Data – High Channel (Average)

Horizontal



Vertical



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	RMS	H	35.61	2.06	37.67	54.00	16.33	180	73
2 483.5	RMS	V	33.49	2.06	35.55	54.00	18.45	100	131

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

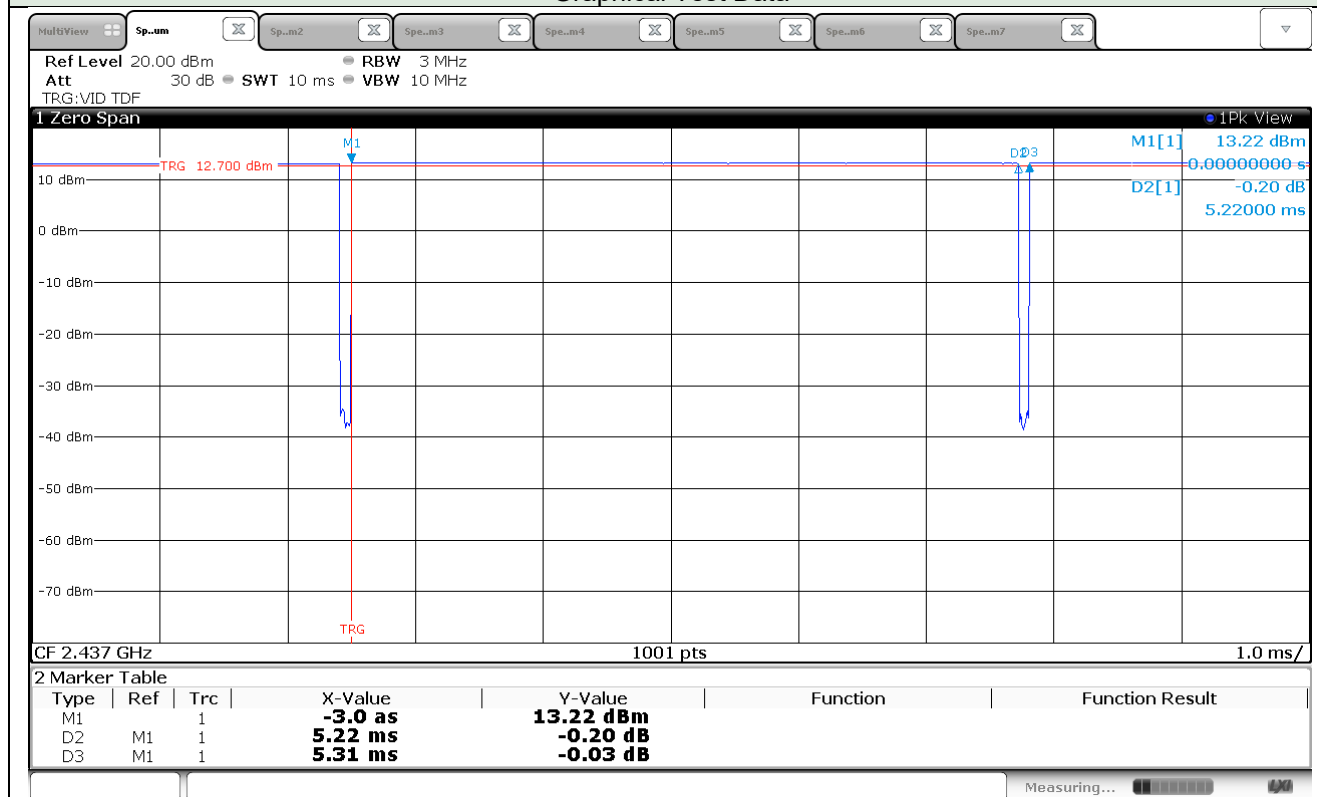
Result = Measured Value + Duty Factor

5.7.6.3.2 Operating mode: WLAN 802.11b

Duty Cycle

Date of Test	2020-03-24	Temperature	(21.0 ± 0.8) °C
		Relative humidity	(39.0 ± 0.9) % R.H.
Measurement Distance	3 m	Tested By	Do-heon Kim 
Detector Mode	Resolution BW	Video BW	Sweep Time
PEAK	1 MHz	3 MHz	Auto
AVERAGE	1 MHz	3 MHz	Auto

Graphical Test Data



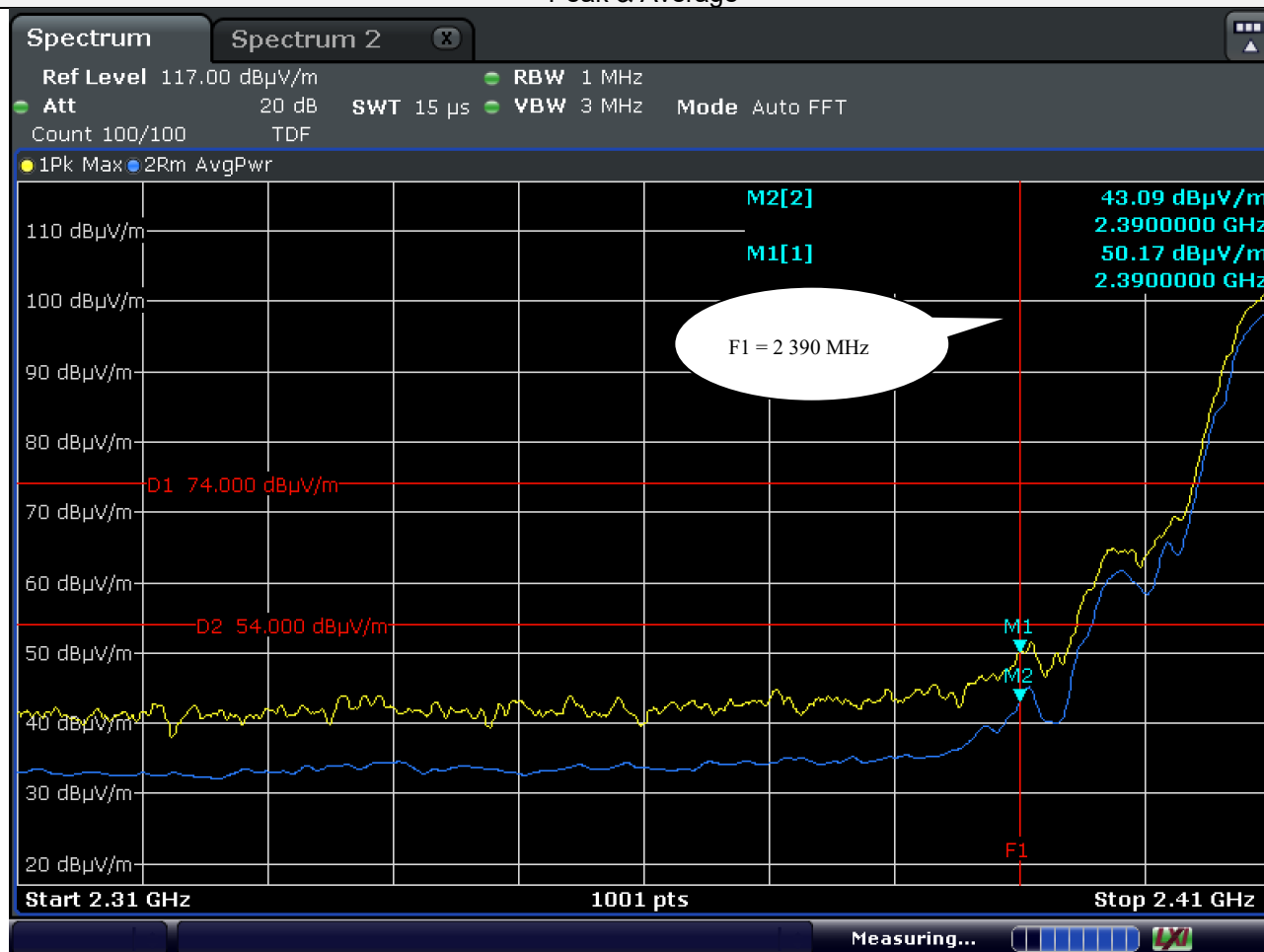
Tabulated Test Data

Operating Mode	On Time (ms)	On + Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)
WLAN 802.11b	5.22	5.31	98.31	0.07

Band edge (Restricted band)

Graphical Test Data – Low Channel (Horizontal)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	H	50.17	-	50.17	74.00	23.83	170	156
2 390.0	RMS	H	43.09	0.07	43.16	54.00	10.84	170	156

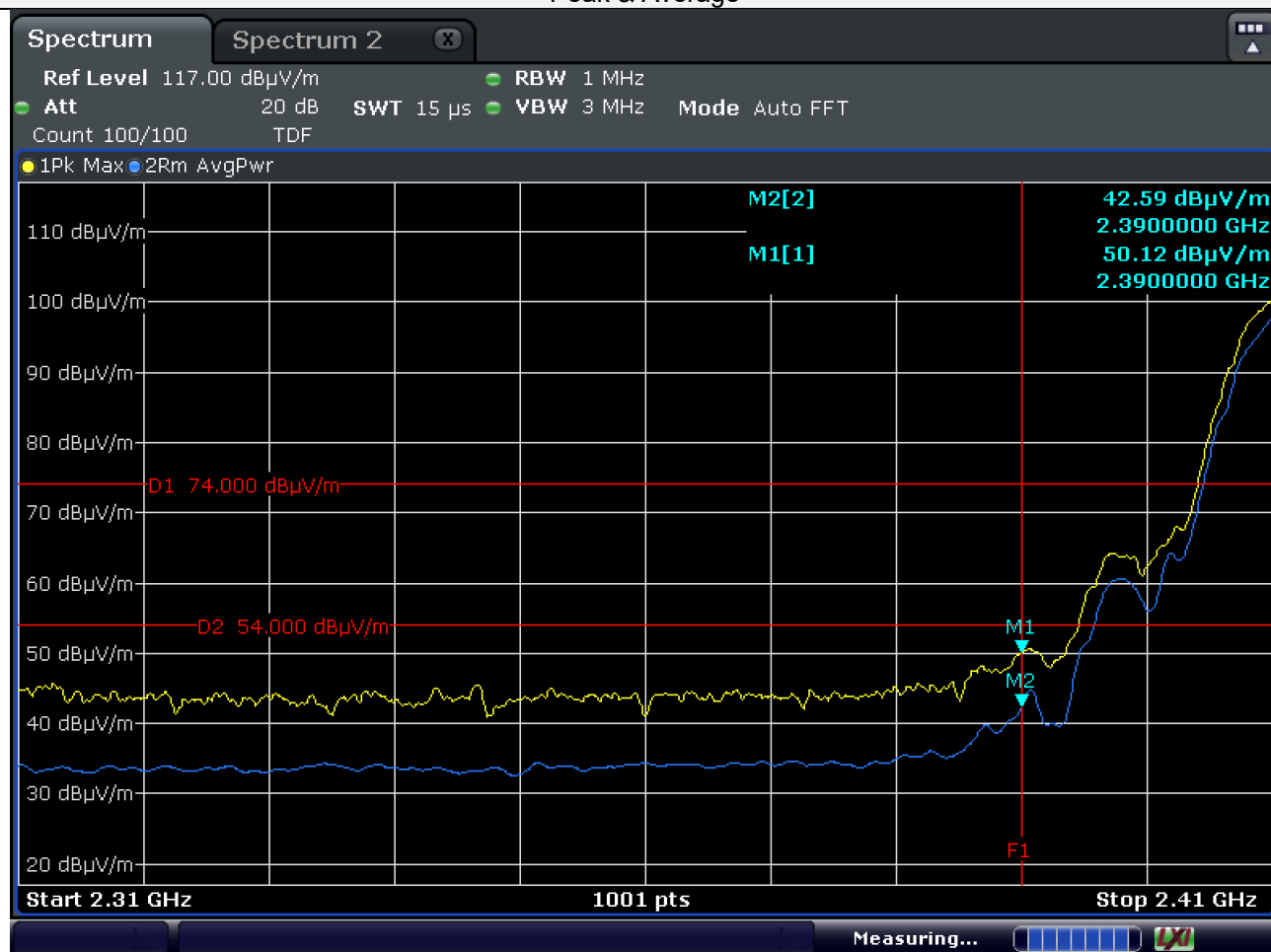
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – Low Channel (Vertical)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	V	50.12	-	50.12	74.00	23.88	100	159
2 390.0	RMS	V	42.59	0.07	42.66	54.00	11.34	100	159

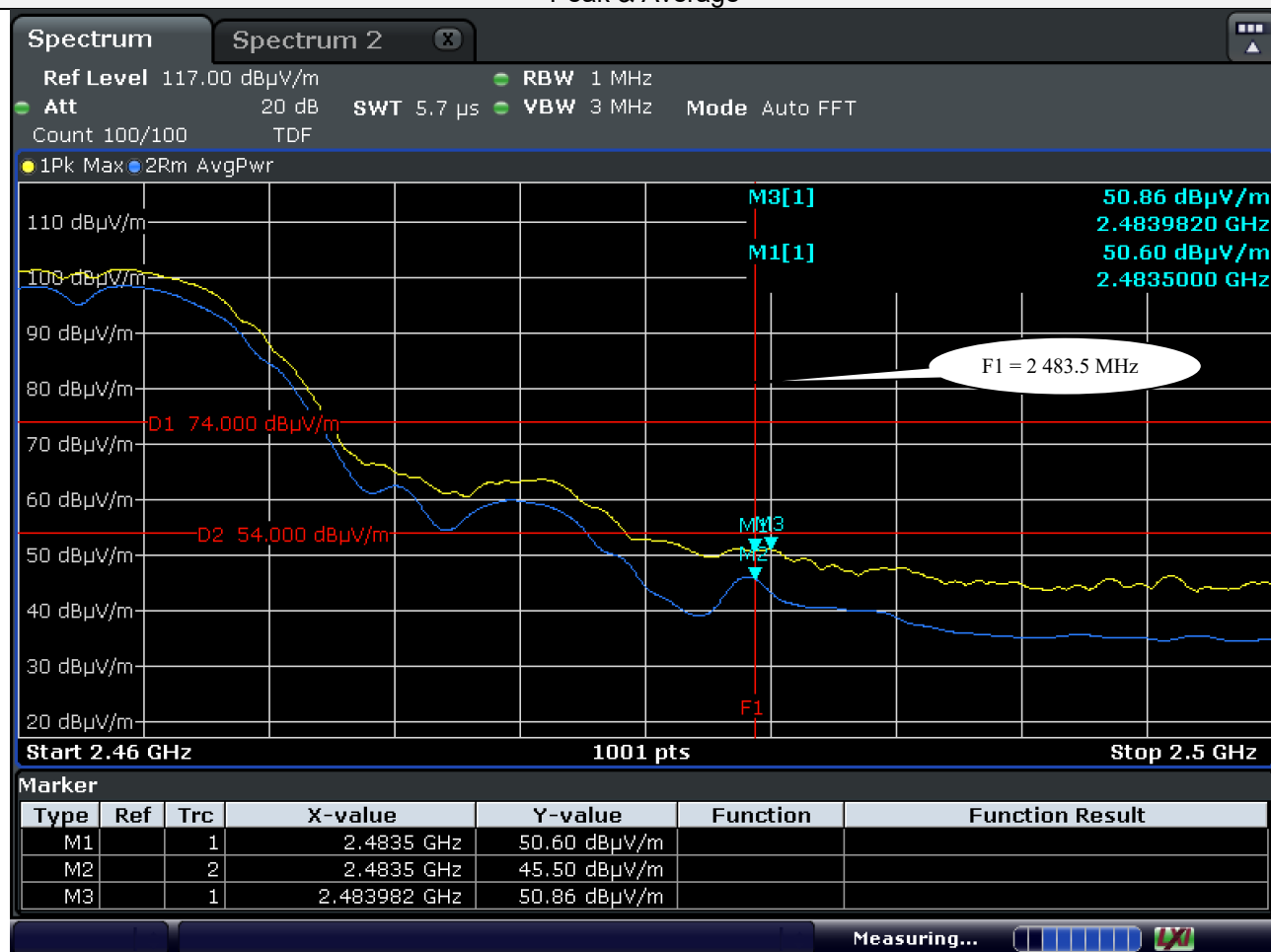
NOTE: "H" means Horizontal polarity, "V" means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Horizontal)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	H	50.60	-	50.60	74.00	23.40	167	158
2 483.9	Peak	H	50.86	-	50.86	74.00	23.14	167	158
2 483.5	RMS	H	45.50	0.07	45.57	54.00	8.43	167	158

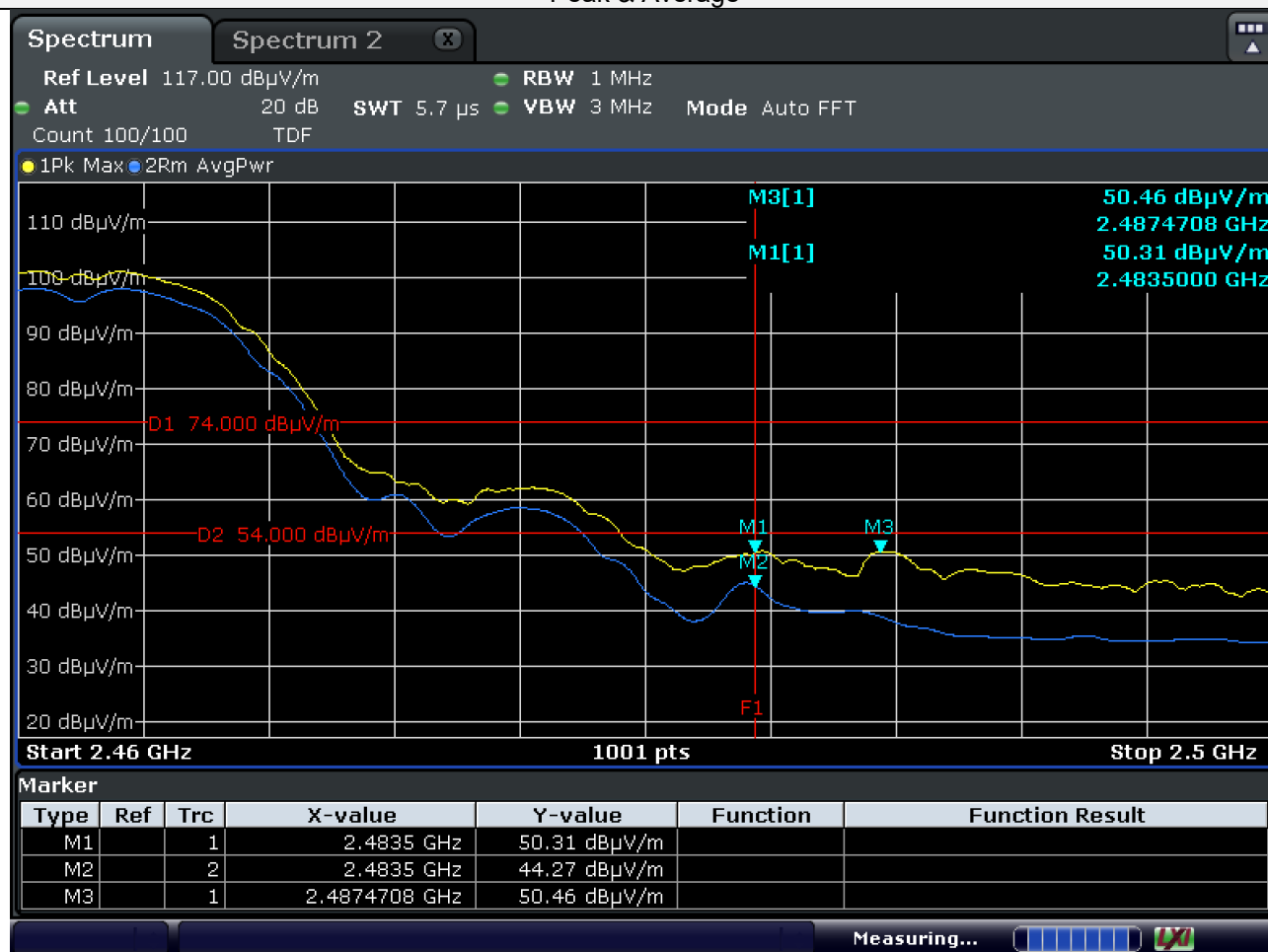
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Vertical)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	V	50.31	-	50.31	74.00	23.69	100	154
2 487.5	Peak	V	50.46	-	50.46	74.00	23.54	100	154
2 483.5	RMS	V	44.27	0.07	44.34	54.00	9.66	100	154

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

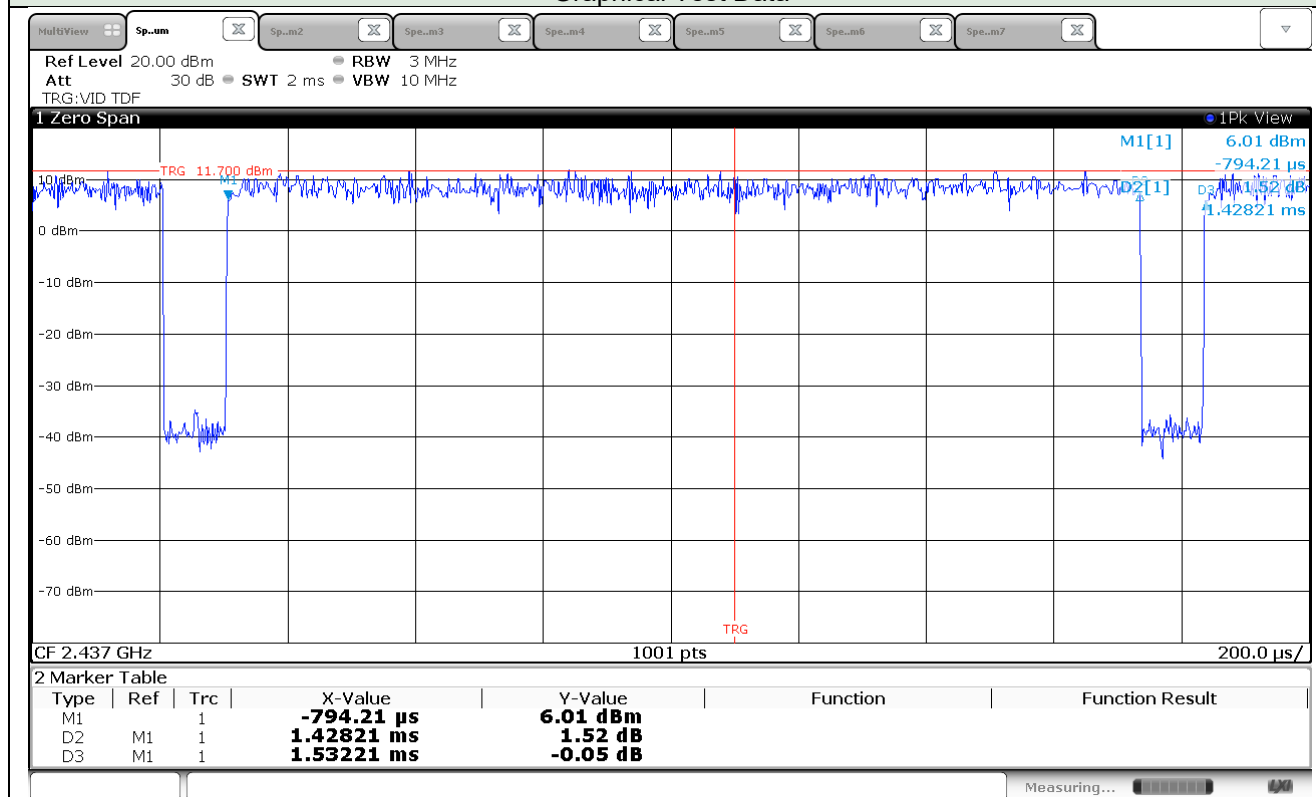
Result = Measured Value + Duty Factor

5.7.6.3.3 Operating mode: WLAN 802.11g

Duty Cycle

Date of Test	2020-03-24	Temperature	(21.0 ± 0.8) °C
		Relative humidity	(39.0 ± 0.9) % R.H.
Measurement Distance	3 m	Tested By	Do-heon Kim 
Detector Mode	Resolution BW	Video BW	Sweep Time
PEAK	1 MHz	3 MHz	Auto
AVERAGE	1 MHz	3 MHz	Auto

Graphical Test Data



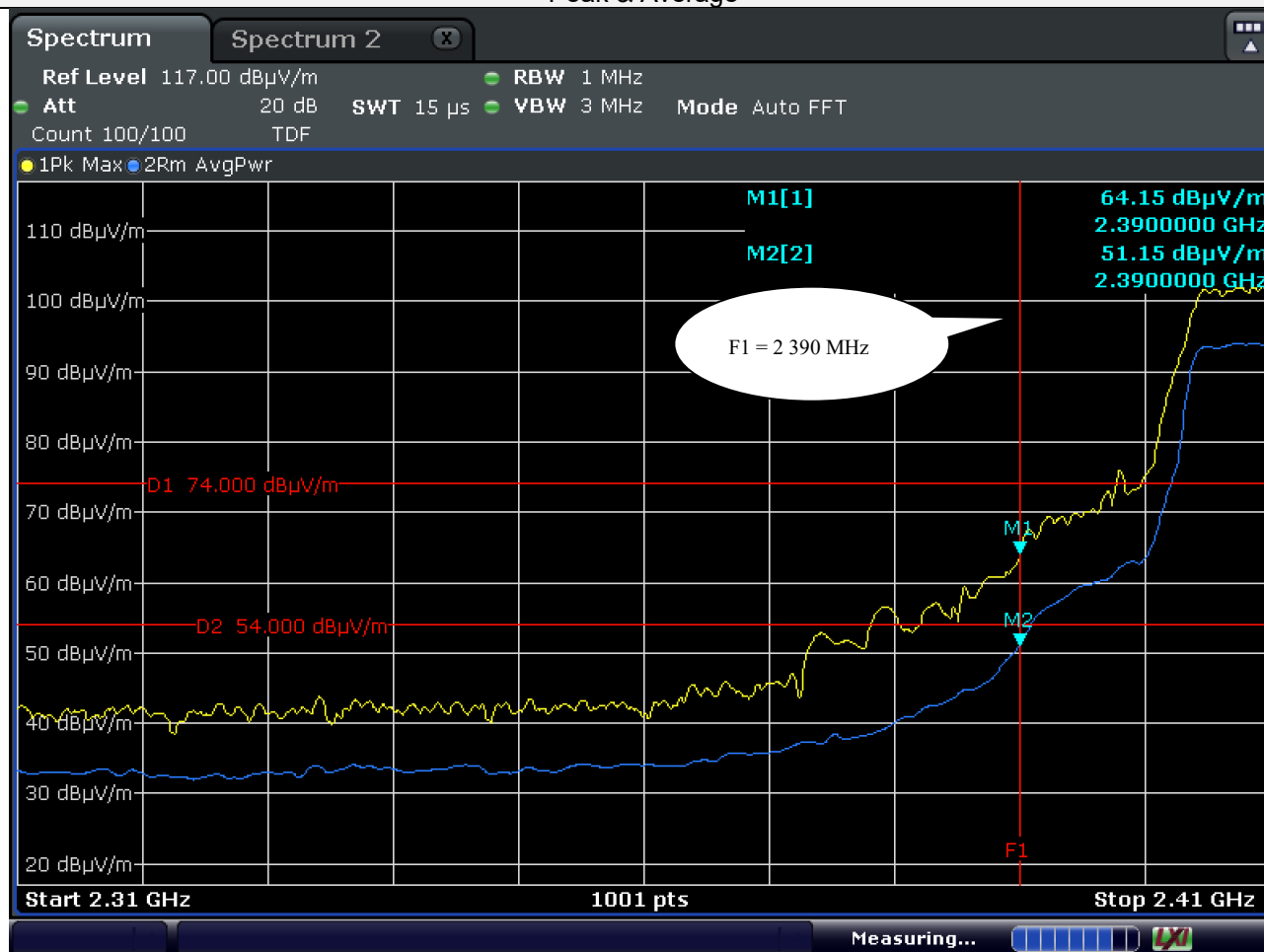
Tabulated Test Data

Operating Mode	On Time (ms)	On + Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)
WLAN 802.11g	1.42821	1.53221	93.21	0.31

Band edge (Restricted band)

Graphical Test Data – Low Channel (Horizontal)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	H	64.15	-	64.15	74.00	9.85	170	156
2 390.0	RMS	H	51.15	0.31	51.46	54.00	2.54	170	156

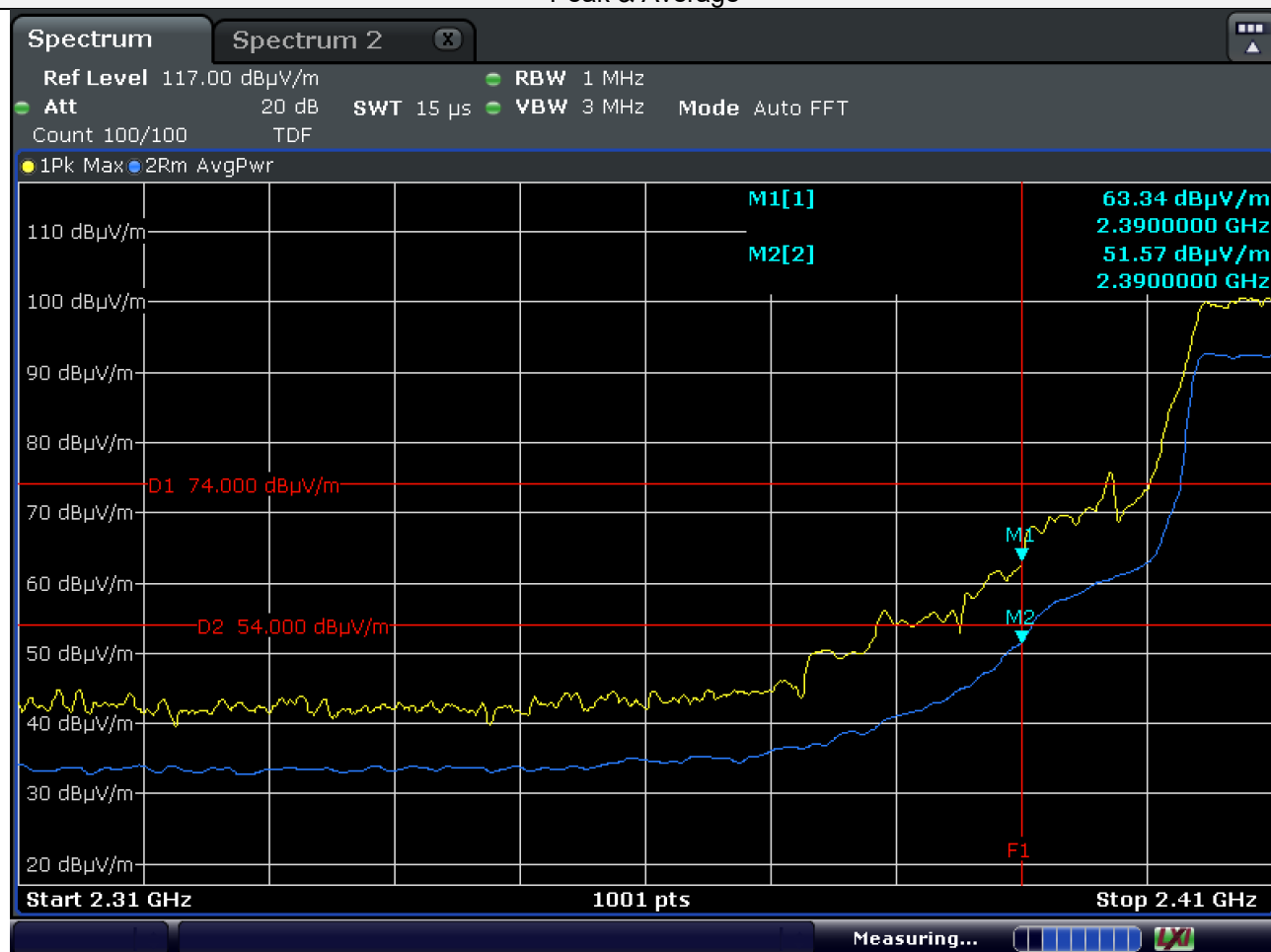
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – Low Channel (Vertical)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	V	63.34	-	63.34	74.00	10.66	100	159
2 390.0	RMS	V	51.57	0.31	51.88	54.00	2.12	100	159

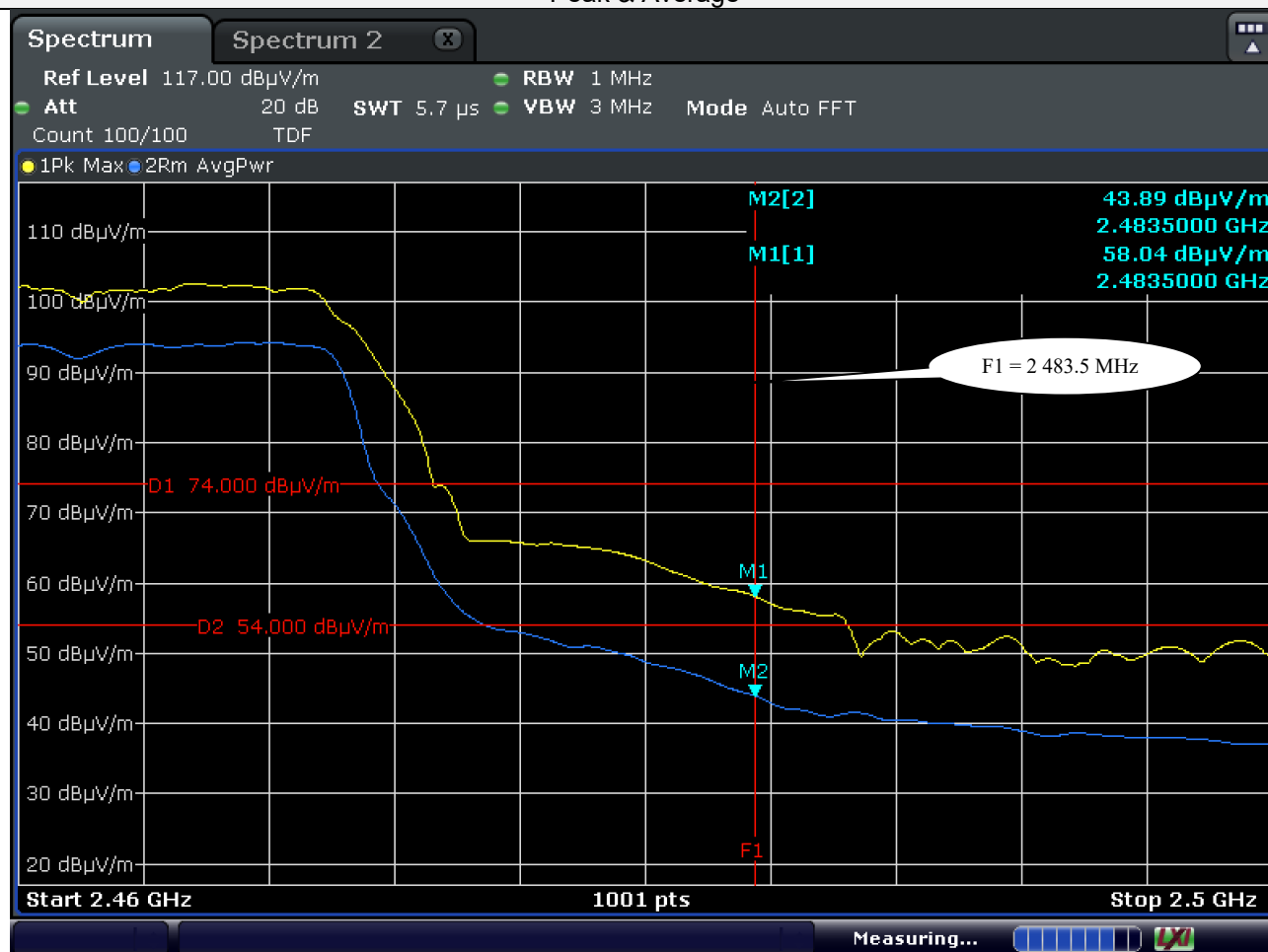
NOTE: "H" means Horizontal polarity, "V" means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Horizontal)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	H	58.04	-	58.04	74.00	15.96	167	158
2 483.5	RMS	H	43.89	0.31	44.20	54.00	9.80	167	158

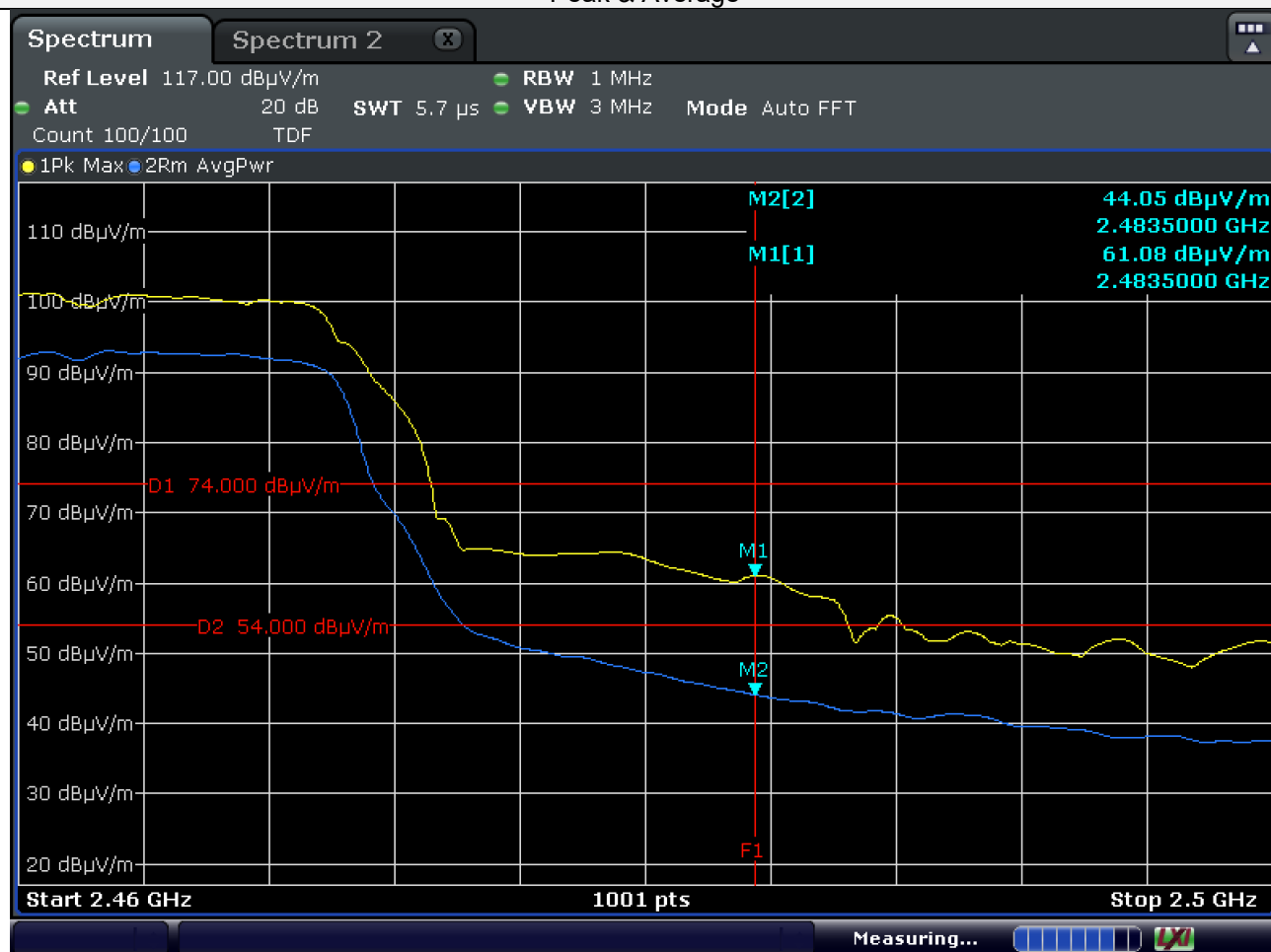
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Vertical)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	V	61.08	-	61.08	74.00	12.92	100	154
2 483.5	RMS	V	44.05	0.31	44.36	54.00	9.64	100	154

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

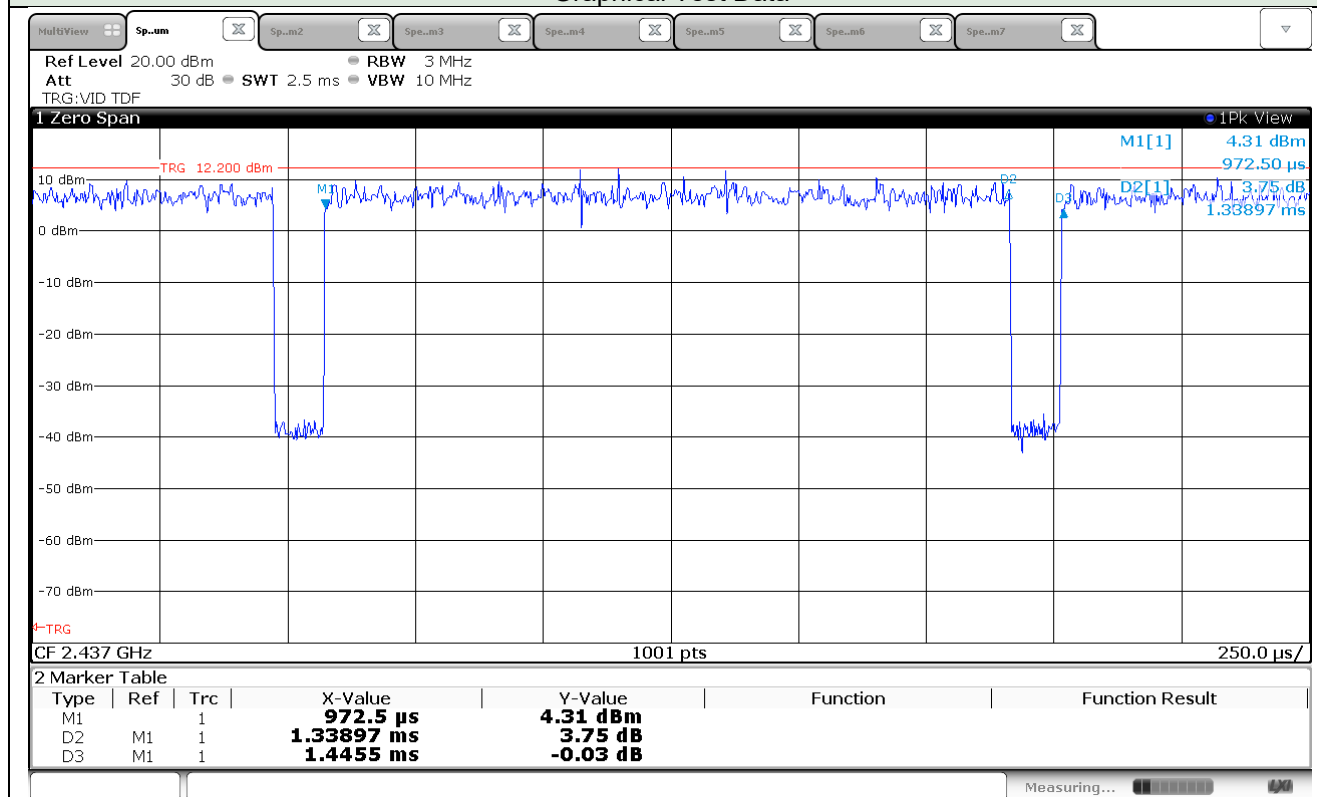
Result = Measured Value + Duty Factor

5.7.6.3.4 Operating mode: WLAN 802.11n HT20

Duty Cycle

Date of Test	2020-03-24	Temperature	(21.0 ± 0.8) °C
		Relative humidity	(39.0 ± 0.9) % R.H.
Measurement Distance	3 m	Tested By	Do-heon Kim
Detector Mode	Resolution BW	Video BW	Sweep Time
PEAK	1 MHz	3 MHz	Auto
AVERAGE	1 MHz	3 MHz	Auto

Graphical Test Data



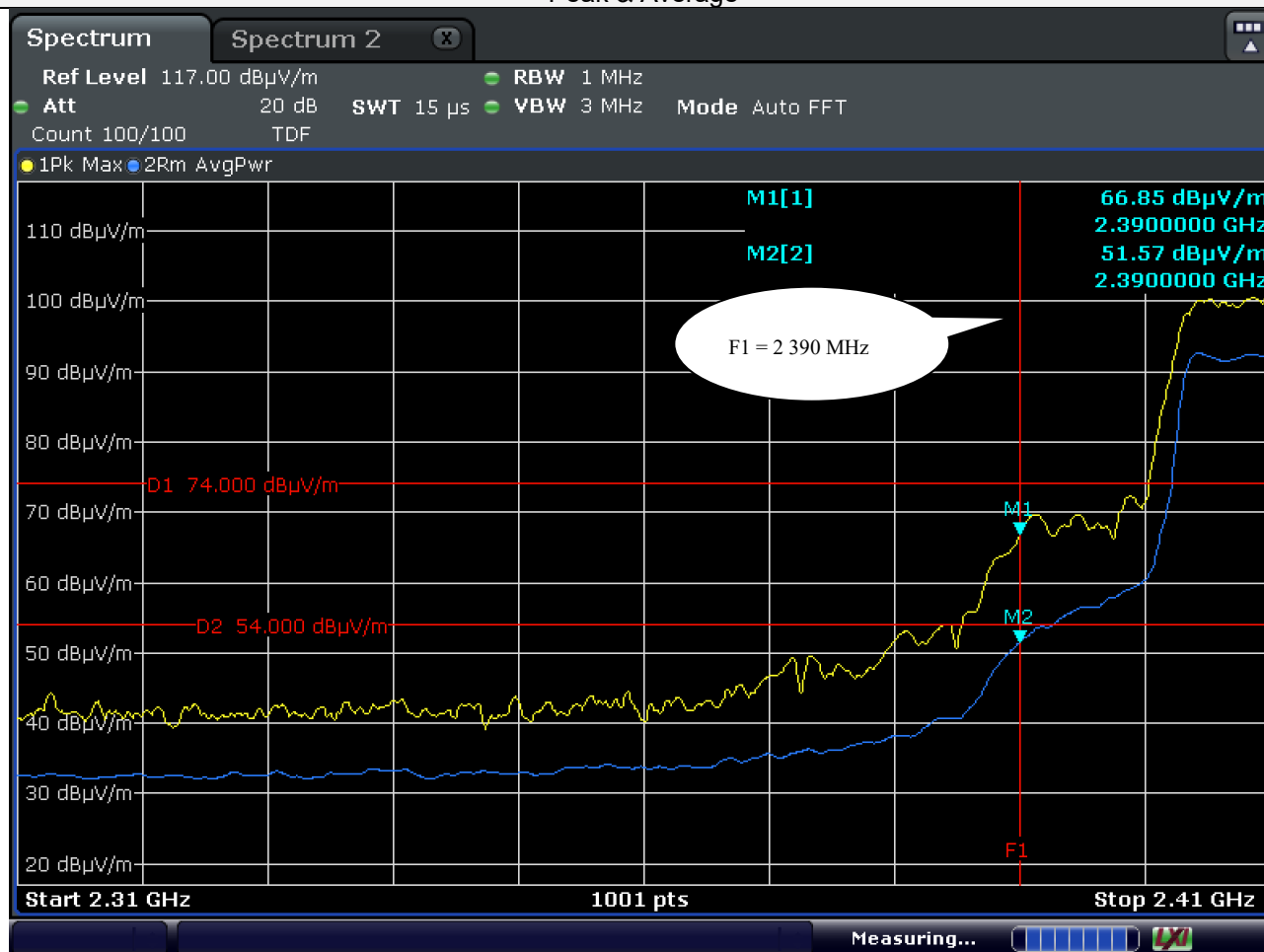
Tabulated Test Data

Operating Mode	On Time (ms)	On + Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)
WLAN 802.11n HT20	1.33897	1.4455	922.63	0.33

Band edge (Restricted band)

Graphical Test Data – Low Channel (Horizontal)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	H	66.85	-	66.85	74.00	7.15	170	156
2 390.0	RMS	H	51.57	0.33	51.90	54.00	2.10	170	156

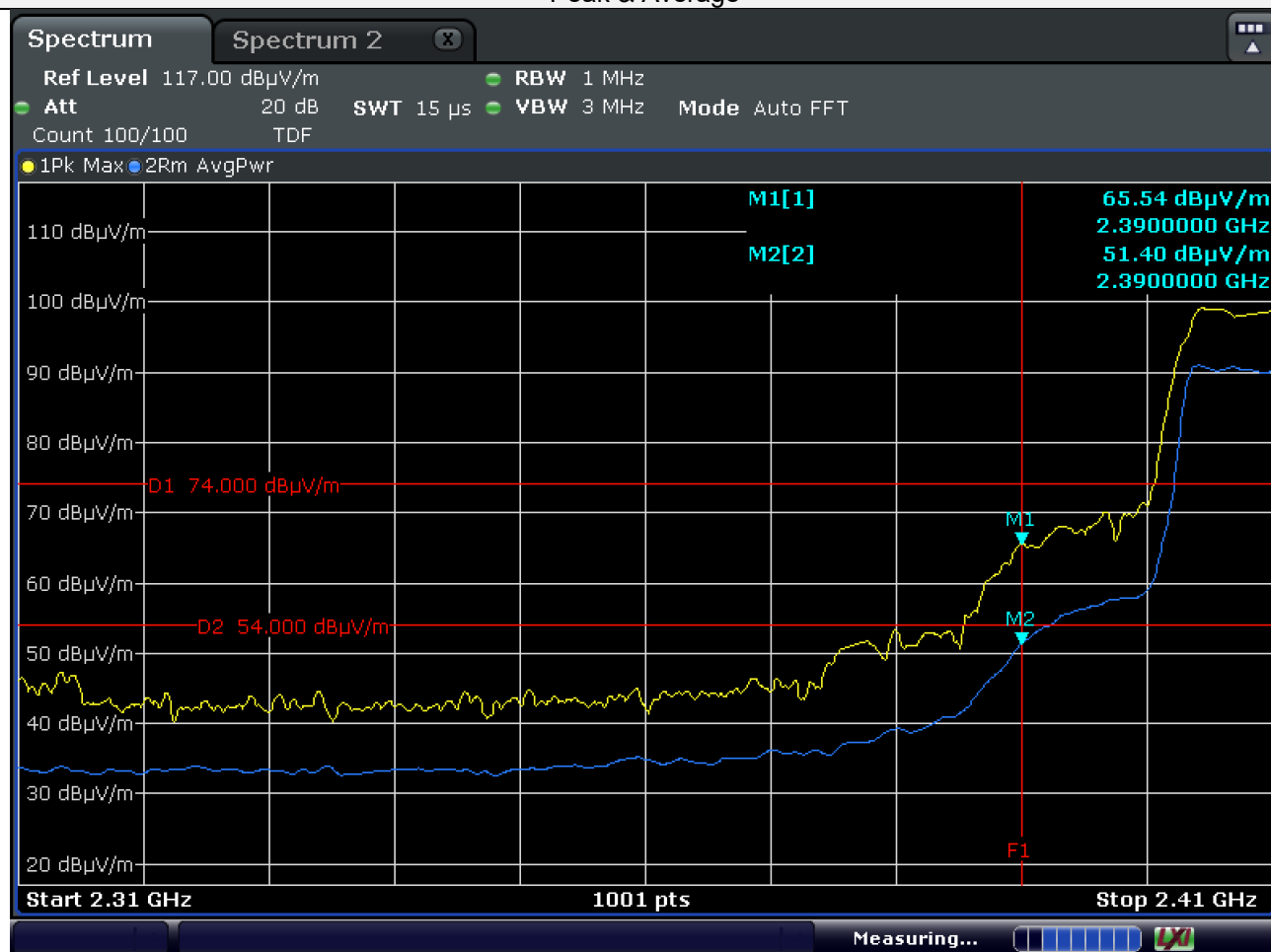
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – Low Channel (Vertical)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	V	65.54	-	65.54	74.00	8.46	100	159
2 390.0	RMS	V	51.40	0.33	51.73	54.00	2.27	100	159

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Horizontal)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	H	54.89	-	54.89	74.00	19.11	167	158
2 485.0	Peak	H	55.02	-	55.02	74.00	18.98	167	158
2 483.5	RMS	H	42.04	0.33	42.37	54.00	11.63	167	158

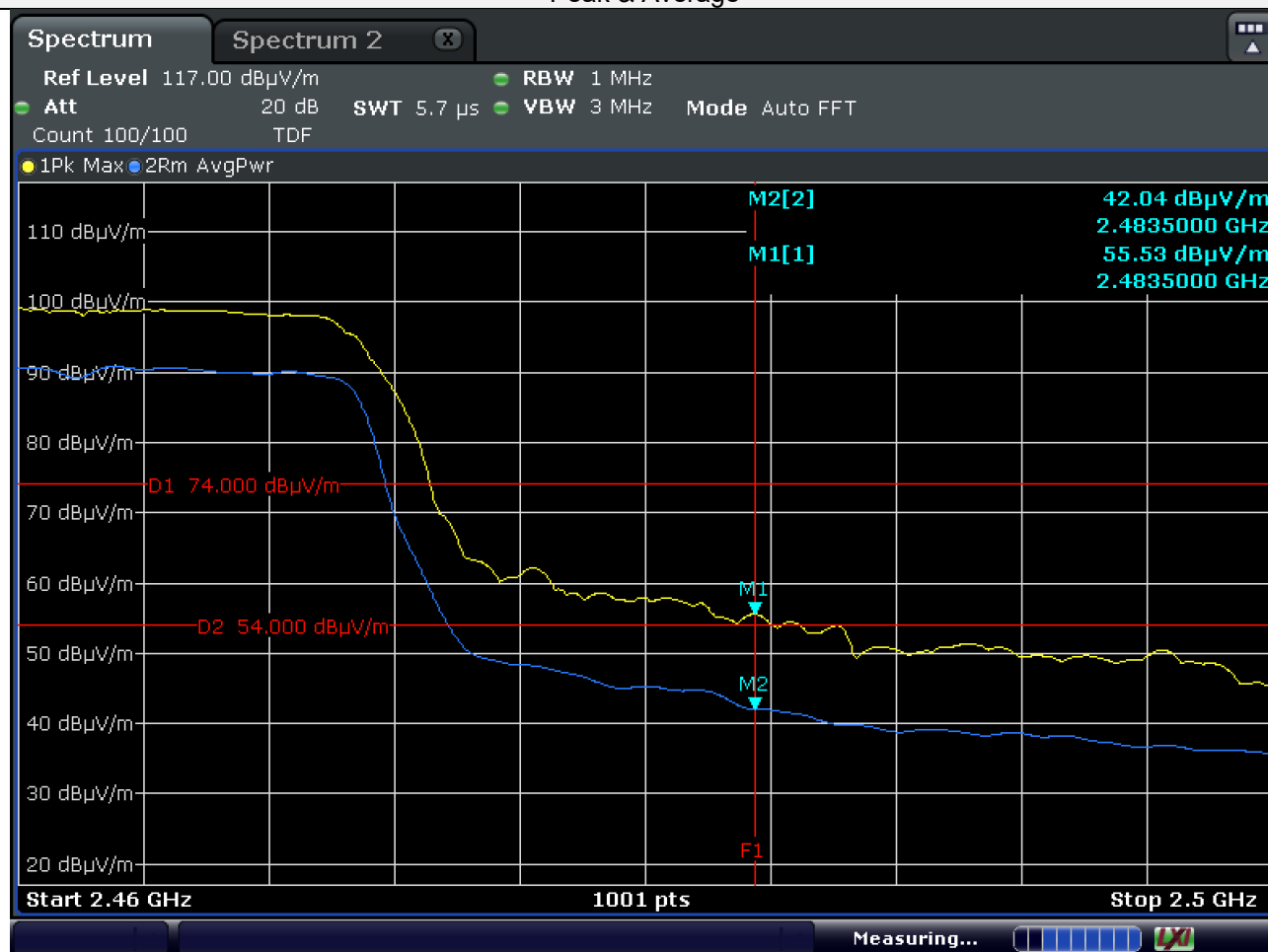
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Vertical)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	V	55.53	-	55.53	74.00	18.47	100	154
2 483.5	RMS	V	42.04	0.33	42.37	54.00	11.63	100	154

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

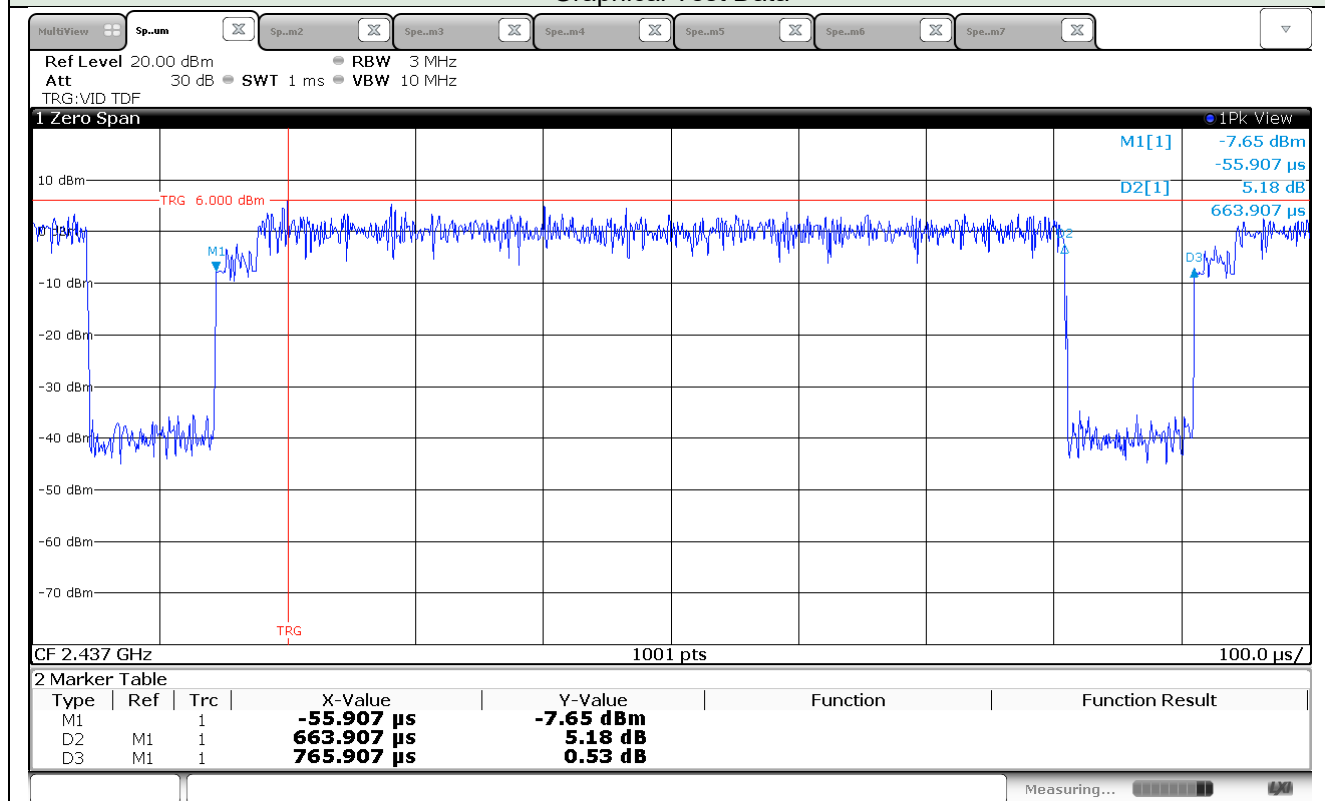
Result = Measured Value + Duty Factor

5.7.6.3.5 Operating mode: WLAN 802.11n HT40

Duty Cycle

Date of Test	2020-03-24	Temperature	(21.0 ± 0.8) °C
		Relative humidity	(39.0 ± 0.9) % R.H.
Measurement Distance	3 m	Tested By	Do-heon Kim 
Detector Mode	Resolution BW	Video BW	Sweep Time
PEAK	1 MHz	3 MHz	Auto
AVERAGE	1 MHz	3 MHz	Auto

Graphical Test Data



Tabulated Test Data

Operating Mode	On Time (ms)	On + Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)
WLAN 802.11n HT40	0.663907	0.765907	86.68	0.62

Band edge (Restricted band)

Graphical Test Data – Low Channel (Horizontal)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	H	63.86	-	63.86	74.00	10.14	170	156
2 389.2	Peak	H	65.02	-	65.02	74.00	8.98	170	156
2 390.0	RMS	H	51.95	0.62	52.57	54.00	1.43	170	156

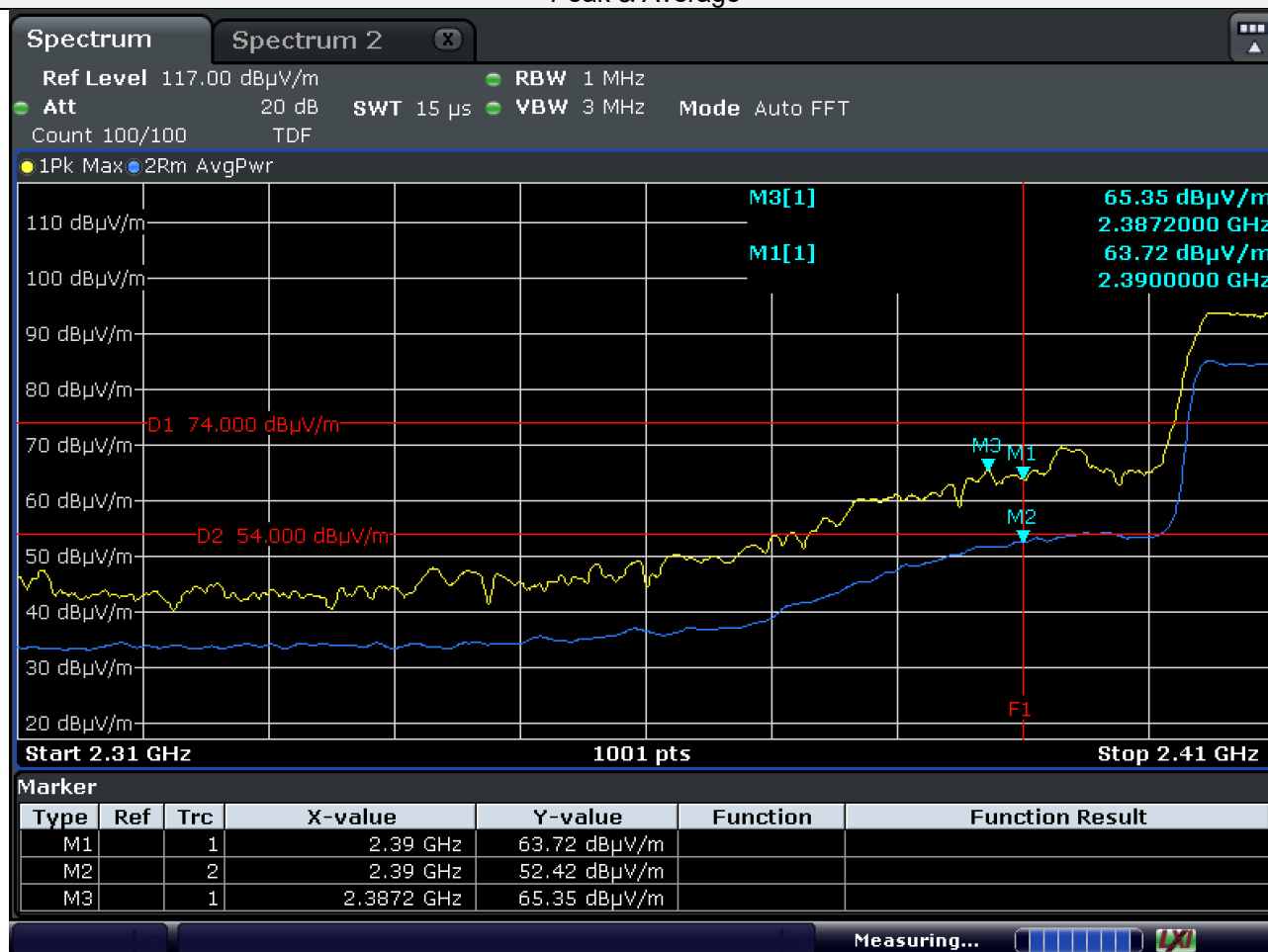
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – Low Channel (Vertical)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	V	63.72	-	63.72	74.00	10.28	100	159
2 387.2	Peak	V	65.35	-	65.35	74.00	8.65	100	159
2 390.0	RMS	V	52.42	0.62	53.04	54.00	0.96	100	159

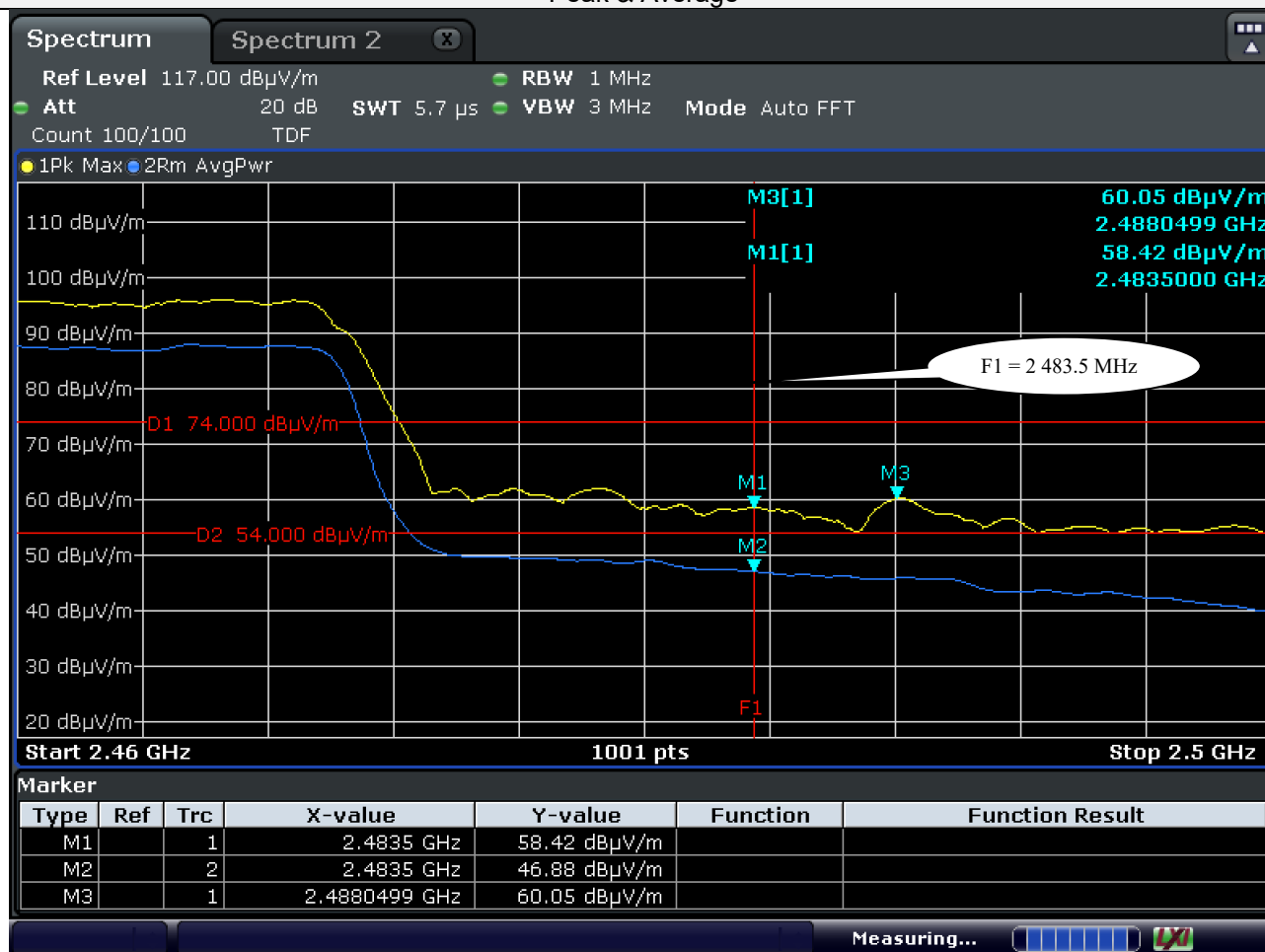
NOTE: "H" means Horizontal polarity, "V" means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Horizontal)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	H	58.42	-	58.42	74.00	15.58	167	158
2 488.0	Peak	H	60.05	-	60.05	74.00	13.95	167	158
2 483.5	RMS	H	46.88	0.33	46.88	54.00	7.12	167	158

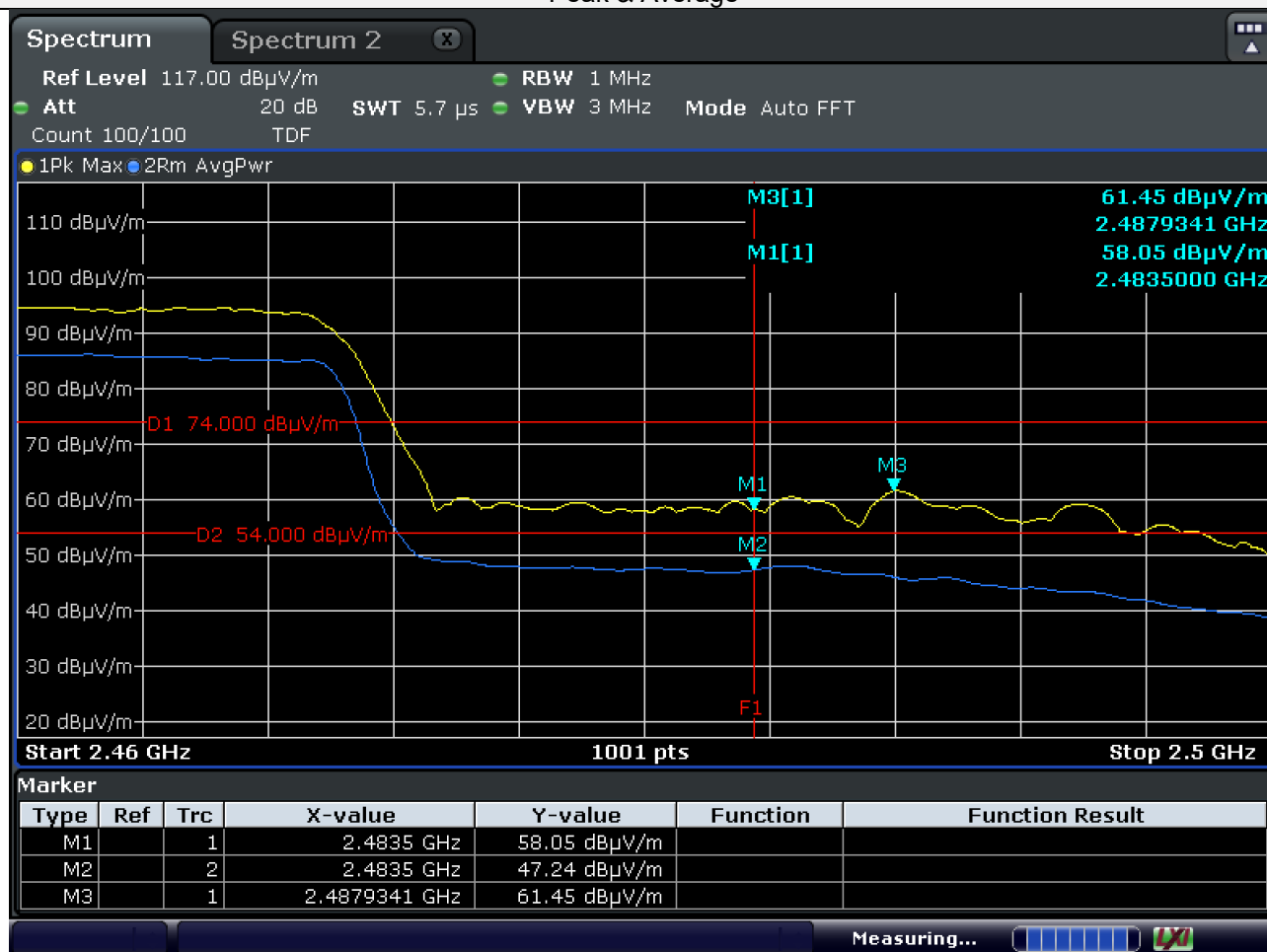
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Vertical)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	V	58.05	-	58.05	74.00	15.95	100	154
2 487.9	Peak	V	61.45	-	61.45	74.00	12.55	100	154
2 483.5	RMS	V	47.24	0.33	47.57	54.00	6.43	100	154

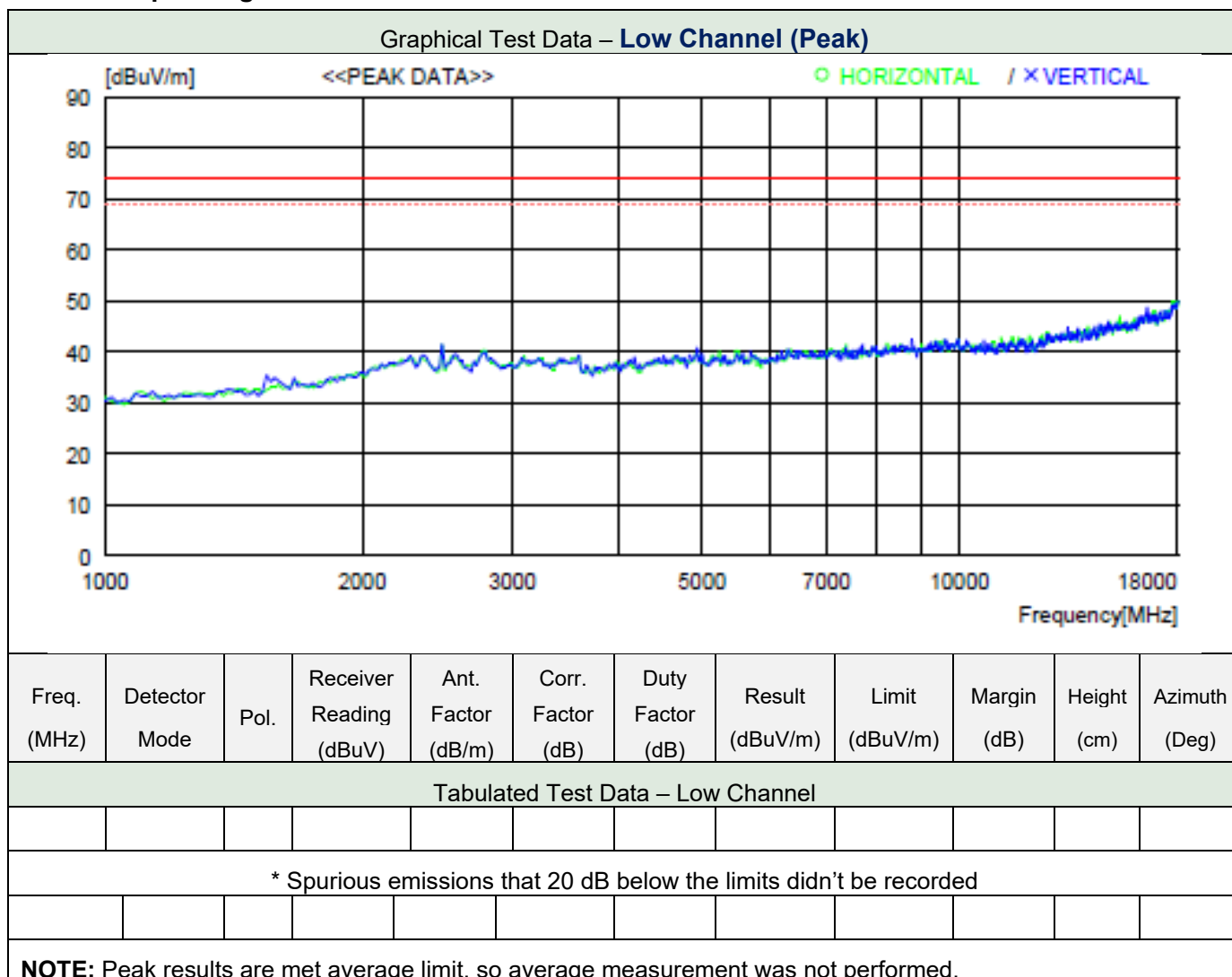
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

5.7.6.4 Test Data for Harmonic & Spurious emission (1 GHz to 18 GHz)

5.7.6.4.1 Operating mode: Bluetooth LE



Note. "H" means Horizontal polarity, "V" means Vertical polarity.

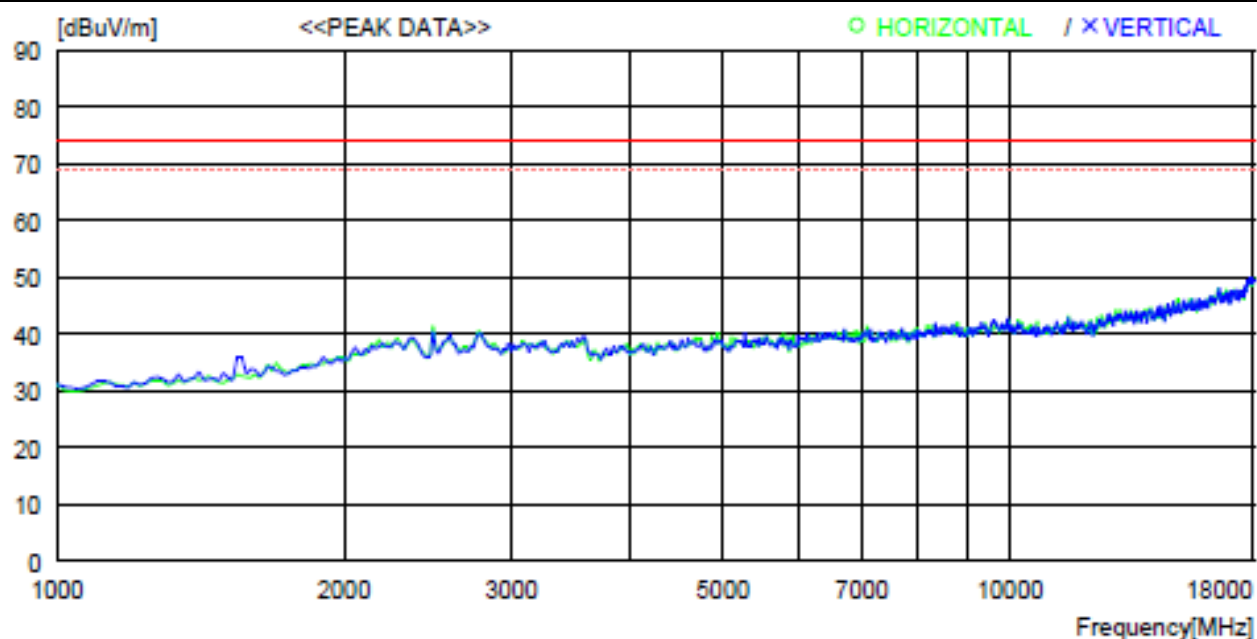
Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

Non-restricted band emission is not added duty factor.

Graphical Test Data – Middle Channel (Peak)



Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
Tabulated Test Data – Middle Channel											
* Spurious emissions that 20 dB below the limits didn't be recorded											

NOTE: Peak results are met average limit, so average measurement was not performed.

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

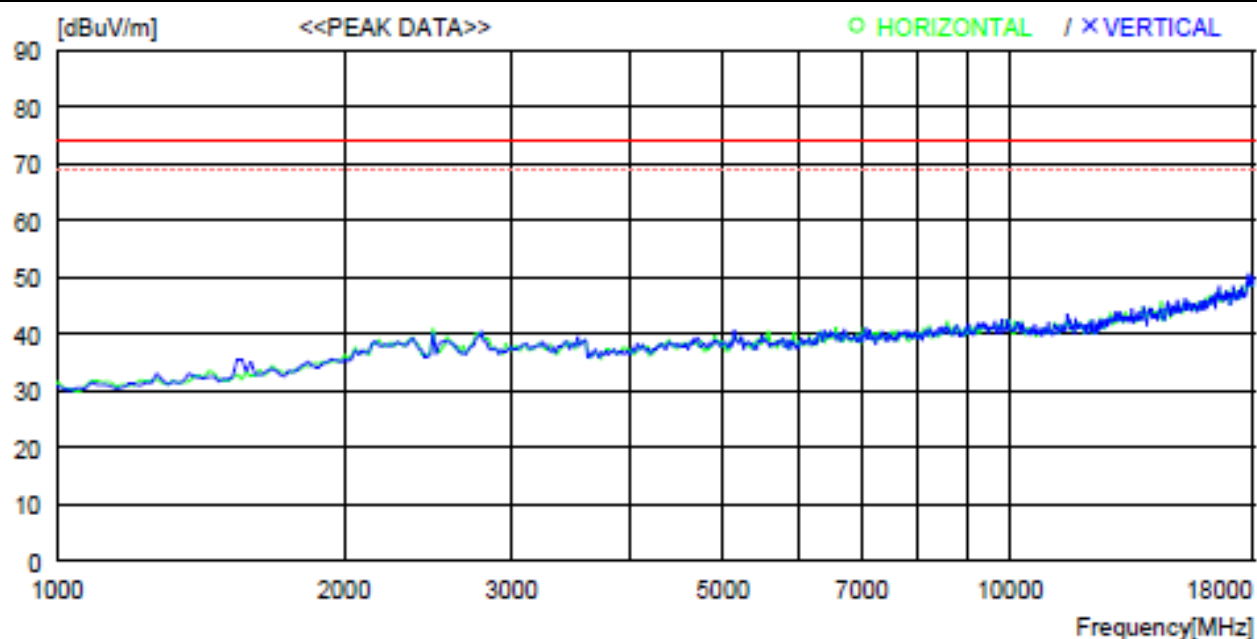
Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

Non-restricted band emission is not added duty factor.

Graphical Test Data – High Channel (Peak)



Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
Tabulated Test Data – High Channel											
* Spurious emissions that 20 dB below the limits didn't be recorded											

NOTE: Peak results are met average limit, so average measurement was not performed.

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

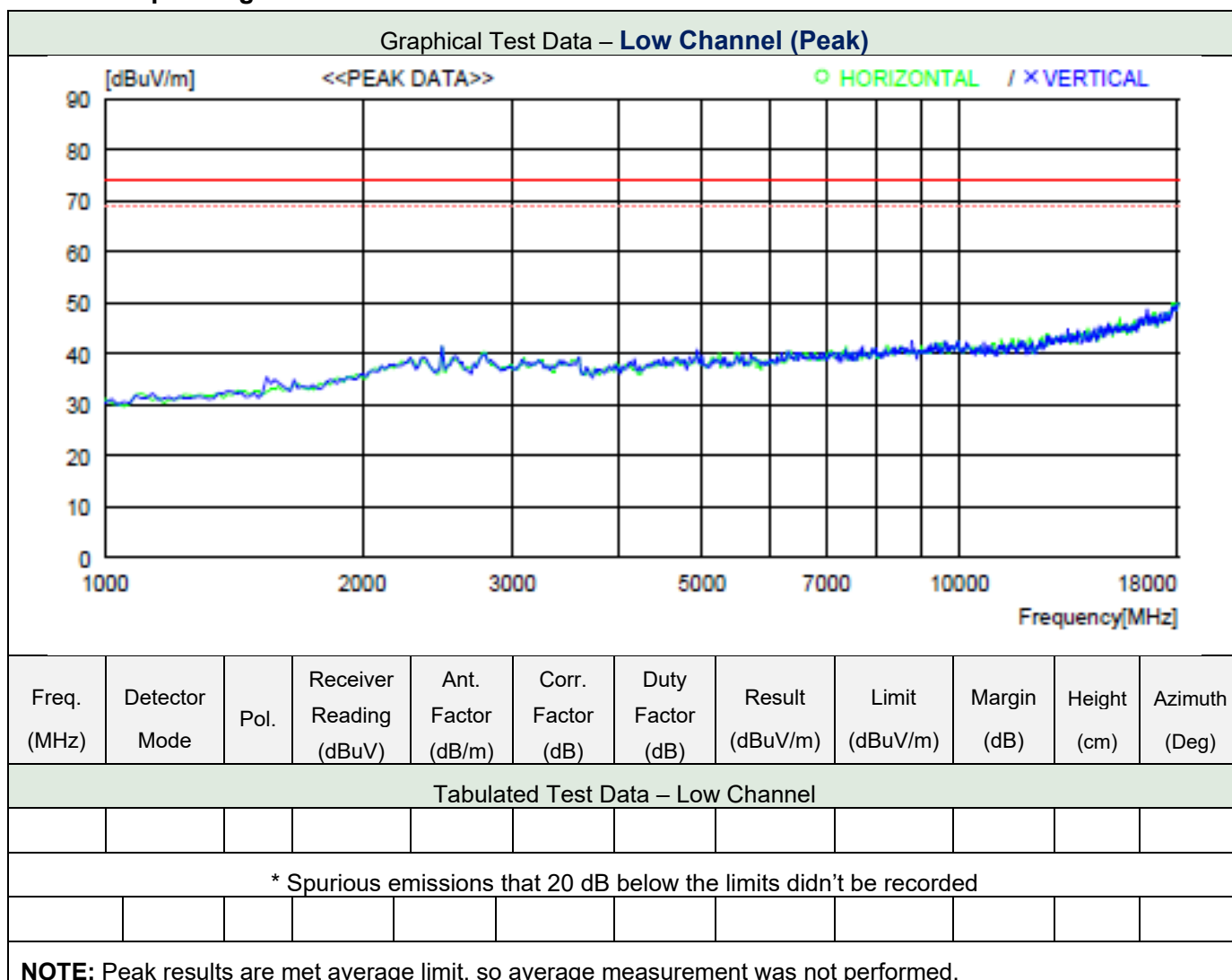
Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

Non-restricted band emission is not added duty factor.

5.7.6.4.1 Operating mode: WLAN 802.11b



Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

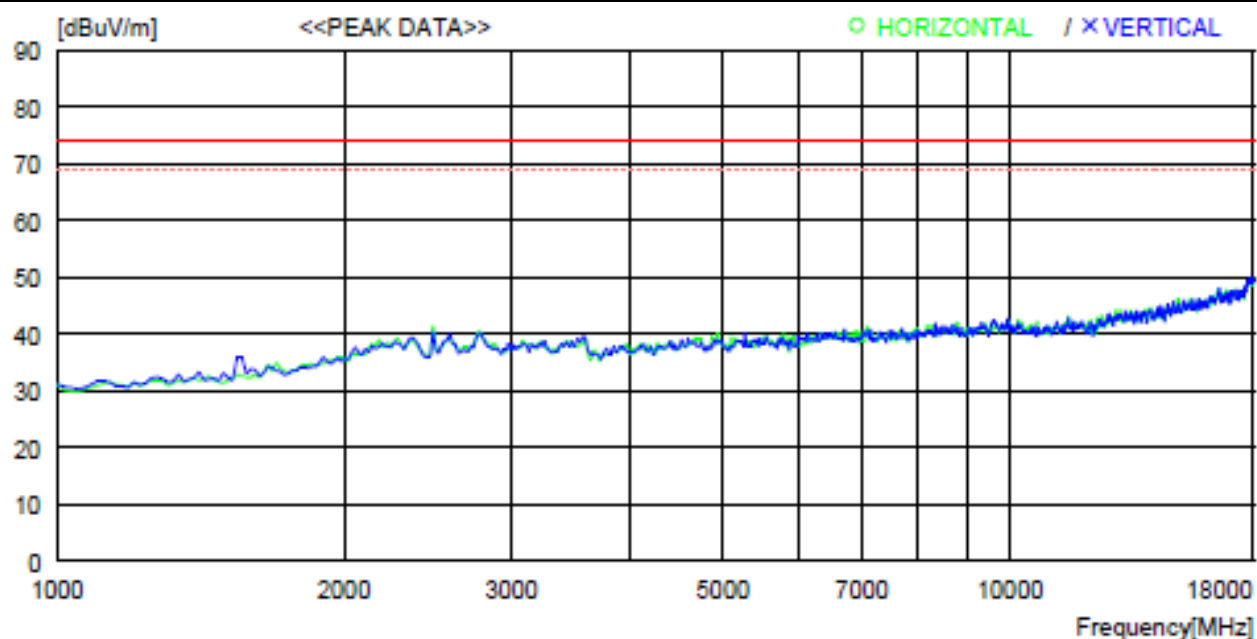
Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

Non-restricted band emission is not added duty factor.

Test plot of 802.11g/n HT20/n HT40 is almost same with middle channel at WLAN 802.11b, so the plot is not included.

Graphical Test Data – Middle Channel (Peak)



Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
Tabulated Test Data – Middle Channel											
* Spurious emissions that 20 dB below the limits didn't be recorded											

NOTE: Peak results are met average limit, so average measurement was not performed.

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

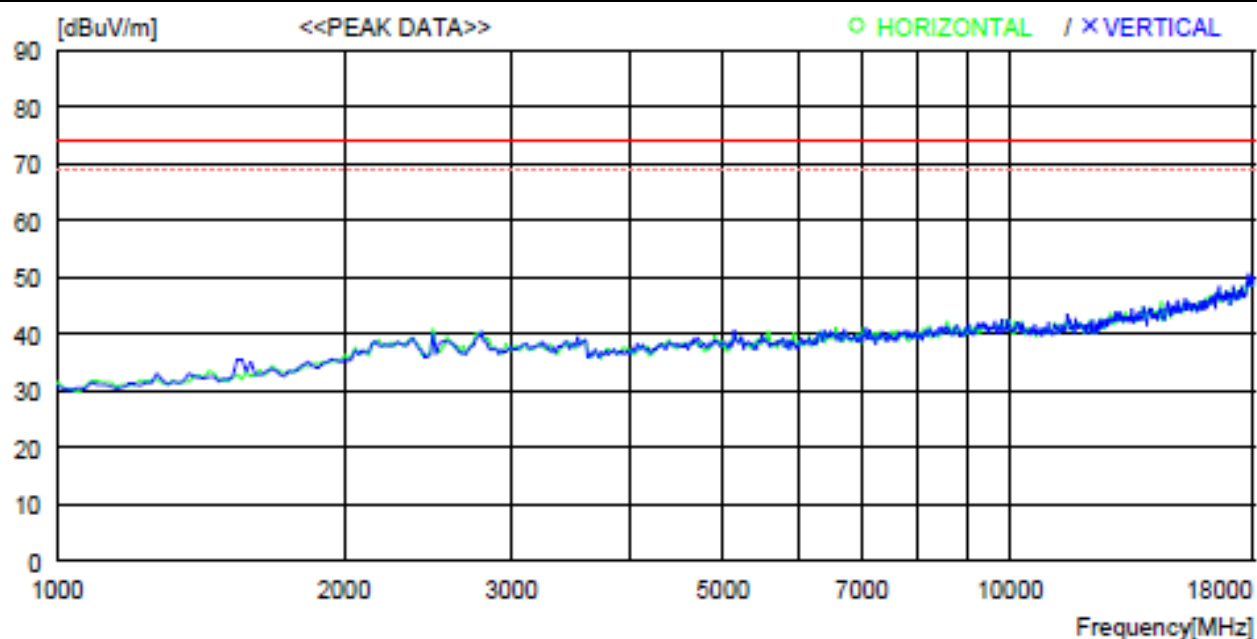
Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

Non-restricted band emission is not added duty factor.

Test plot of 802.11g/n HT20/n HT40 is almost same with middle channel at WLAN 802.11b, so the plot is not included.

Graphical Test Data – High Channel (Peak)



Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
Tabulated Test Data – High Channel											
* Spurious emissions that 20 dB below the limits didn't be recorded											

NOTE: Peak results are met average limit, so average measurement was not performed.

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

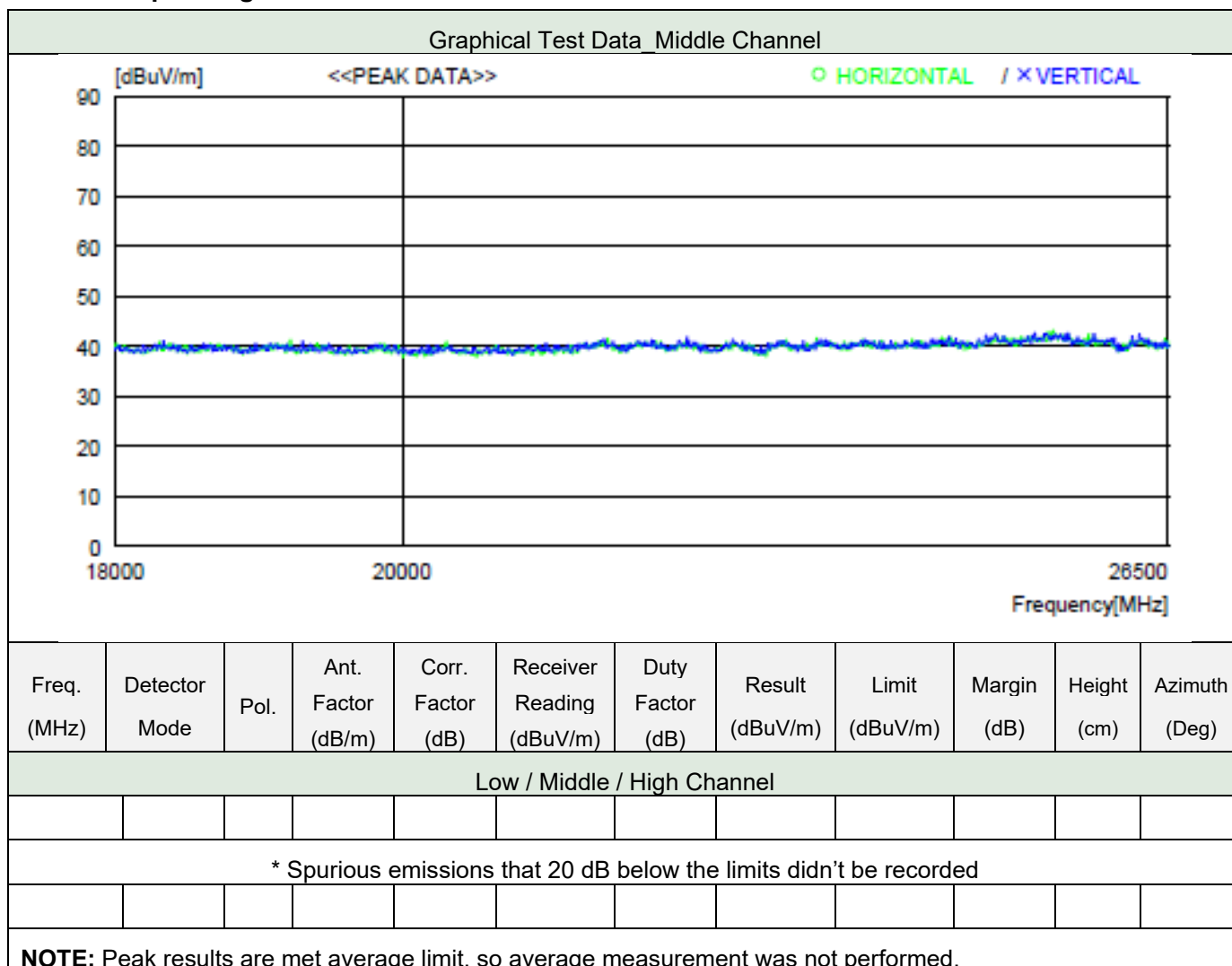
Margin = Limit – Result

Non-restricted band emission is not added duty factor.

Test plot of 802.11g/n HT20/n HT40 is almost same with middle channel at WLAN 802.11b, so the plot is not included.

5.7.6.5 Test Data for Harmonic & Spurious emission (18 GHz to 25 GHz)

5.7.6.5.1 Operating mode: Bluetooth LE

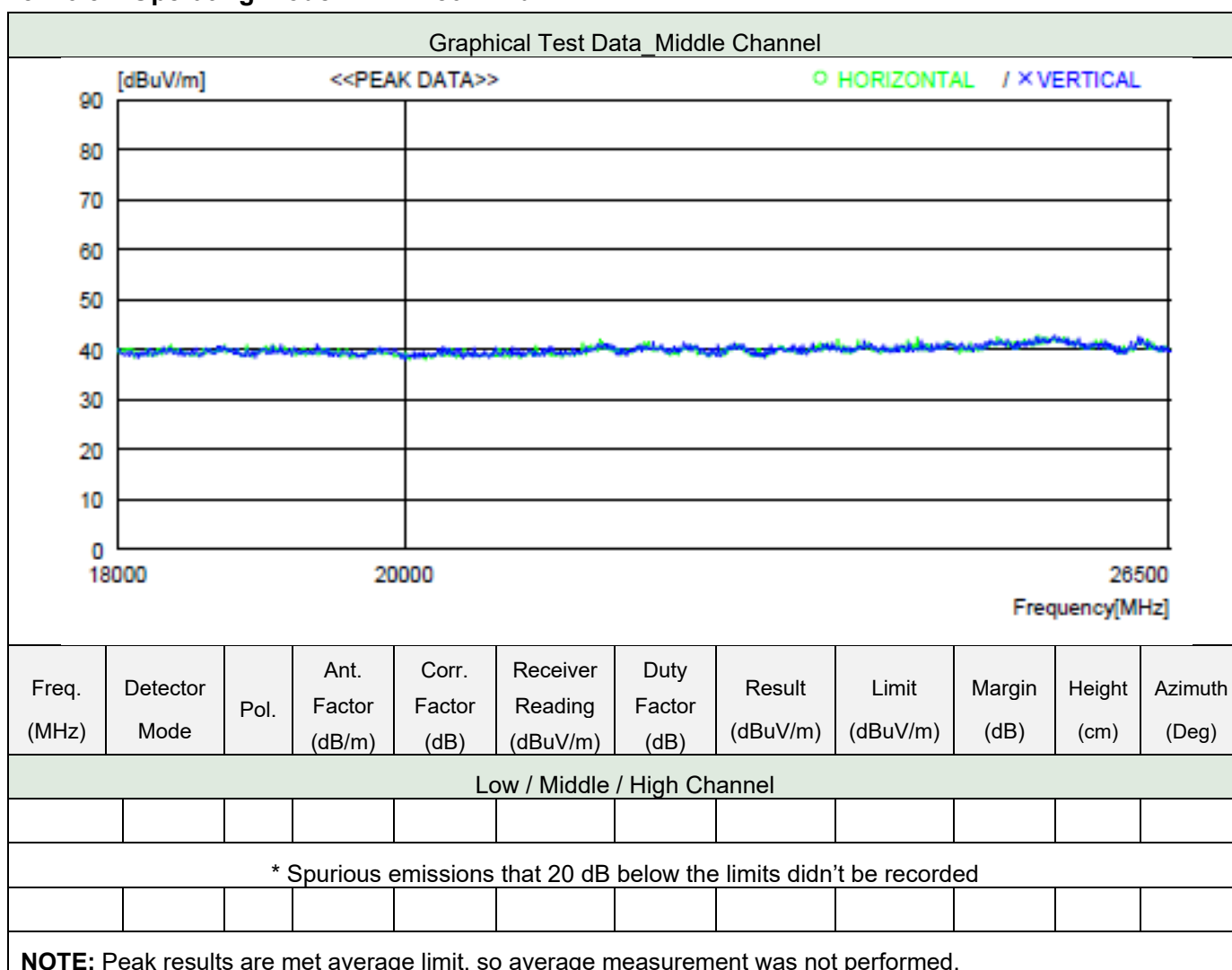


Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Middle channel at Bluetooth LE is worst case operating mode

Test data from the worst mode at middle channel was recorded.

5.7.6.5.2 Operating mode: WLAN 802.11b



Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Middle channel at WLAN 802.11b is worst case operating mode.

Test plots for 802.11g/n HT20/n HT40 are almost same with above test data, so the plots are not reported.

5.8 AC Power Line Conducted Emission

5.8.1 Limit

Acc. to section 15.207 (a), RSS-GEN 8.8 following table shall be applied.

Frequency Range (MHz)	Quasi-Peak (dBuV)	Average (dBuV)
0.15 - 0.5	66 to 56	56 to 46
0.5 - 5	56	46
5 - 30	60	50

5.8.2 Method of Measurement

The EUT was placed on a wooden table, 0.8 m height above the horizontal ground plane and 40 cm from the vertical ground plane. Power was fed to the EUT through a 50 Ω / 50 μ H + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

The test was performed for both Neutral and Hot lines.

5.8.3 Measurement Uncertainty

Measurement uncertainties were not taken into account and following uncertainty levels have been estimated for tests performed on the apparatus. The measurement uncertainties are given with at least 95 % confidence.

Frequency Range	Uncertainty	Frequency Range	Uncertainty
9 kHz ~ 150 kHz	$\pm$ 2.0 dB	150 kHz ~ 30 MHz	$\pm$ 2.0 dB

5.8.4 Sample Calculated Example

At 5.31 MHz

QP Limit = 60.0 dBuV

Correction Factor (C. Factor) of LISN, Pulse Limiter and cable loss at 5.31 MHz = 9.7 dB

Q.P Reading from the Test receiver = 20.8 dBuV

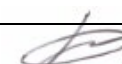
(Calculated value for system losses by software EMC32 manufactured by Rohde & Schwarz)

Therefore Q.P Margin = 60 - 20.8 = 39.2

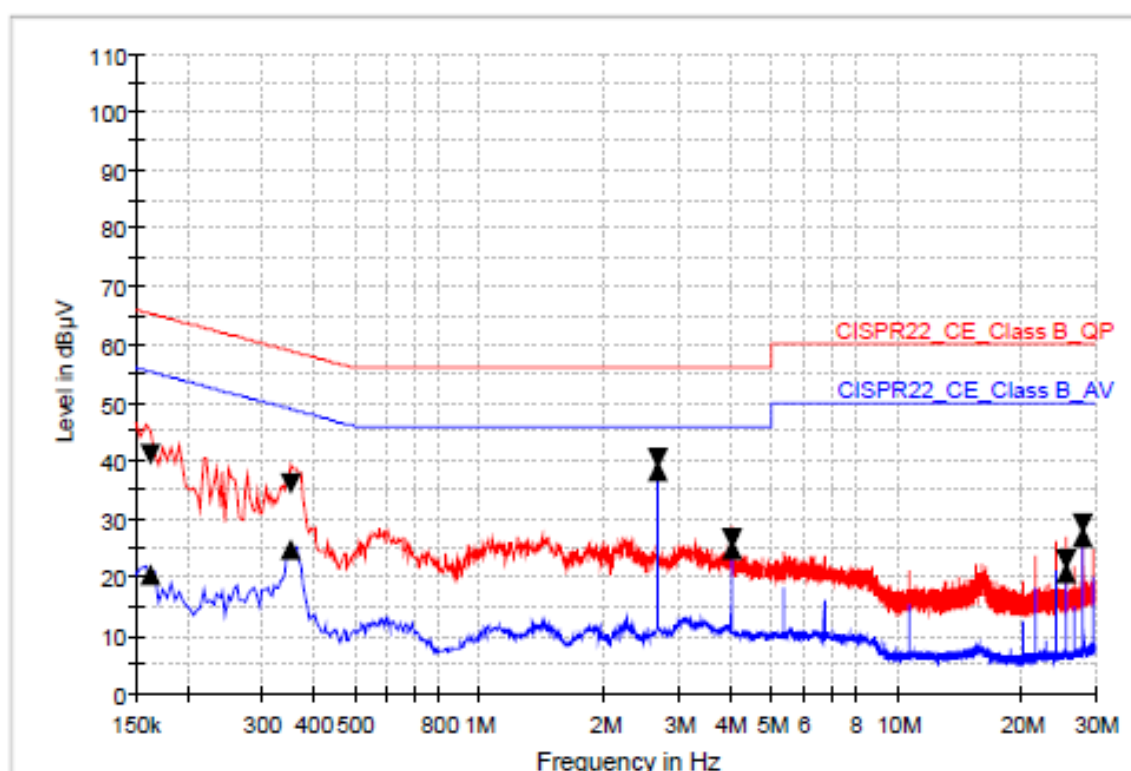
so the EUT has 39.2 dB margin at 5.31 MHz

5.8.5 Worst Case Test Data

5.8.5.1 Operating mode: Bluetooth LE

Date of Test	2020-04-21	Temperature	(21.3 ± 0.9) °C
		Relative humidity	(41.3 ± 0.8) % R.H.
Measurement Frequency Range		9 kHz ~ 30MHz	
Test Result	PASS	Tested By	Do-heon Kim 

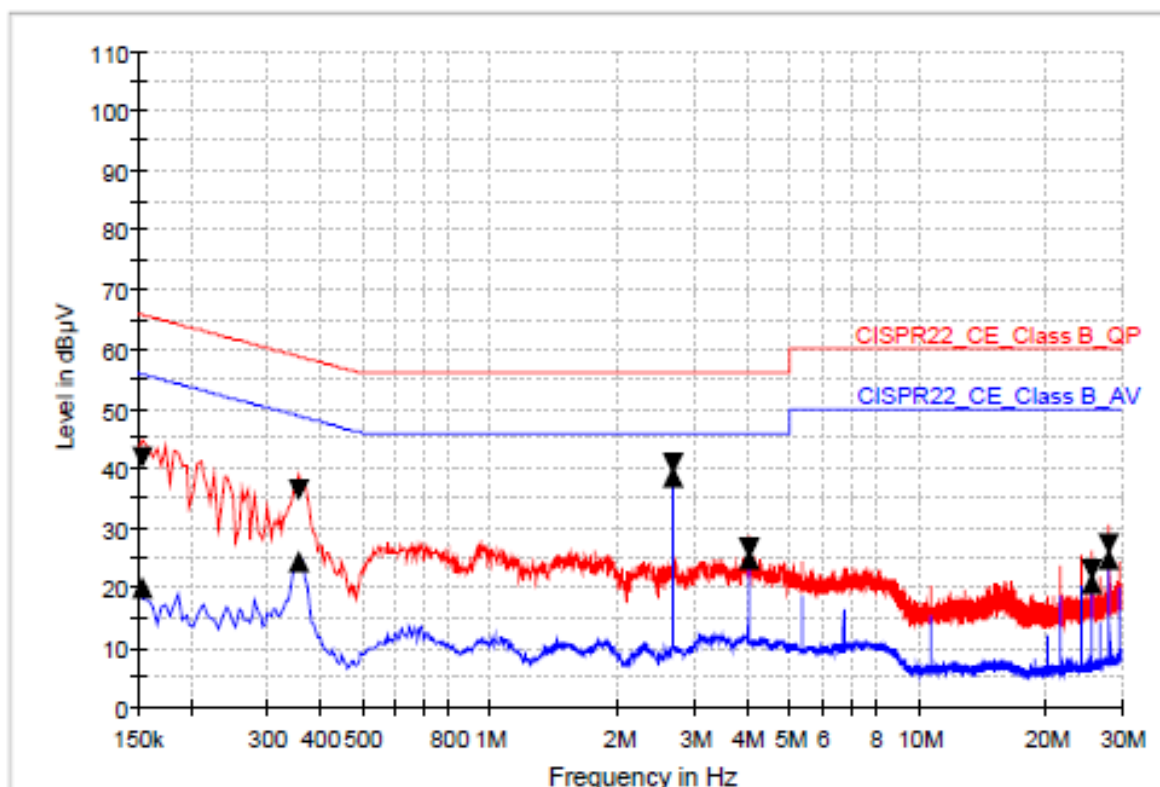
Hot Line



Limit and Margin1

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)	Margin - CAV (dB)	Limit - CAV (dBμV)
0.162000	41.2	20.5	9.000	L1	9.7	24.1	65.4	34.9	55.4
0.354000	35.9	24.7	9.000	L1	9.7	23.0	58.9	24.2	48.9
2.682000	40.4	38.3	9.000	L1	9.8	15.6	56.0	7.7	46.0
4.022000	26.6	24.9	9.000	L1	9.9	29.4	56.0	21.1	46.0
25.482000	23.0	20.8	9.000	L1	11.1	37.0	60.0	29.2	50.0
28.166000	29.0	27.0	9.000	L1	11.2	31.0	60.0	23.0	50.0

Neutral Line



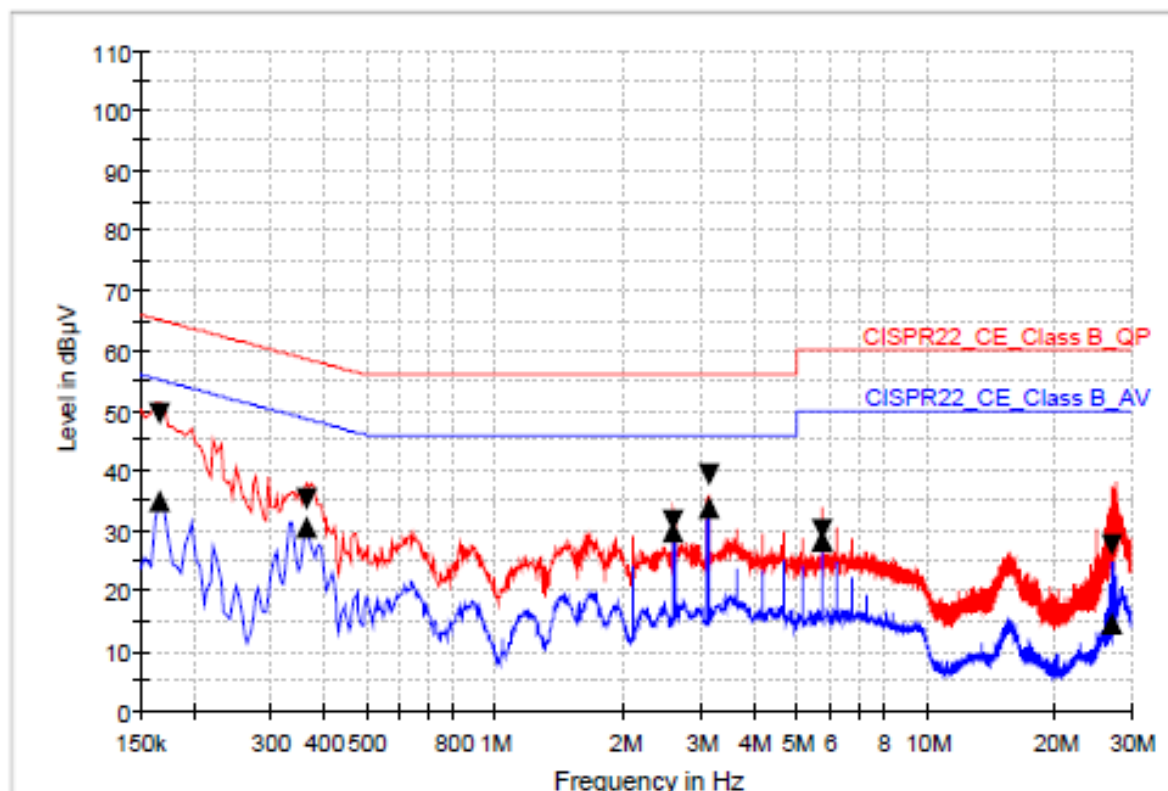
Limit and Margin1

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)	Margin - CAV (dB)	Limit - CAV (dBμV)
0.154000	42.1	19.9	9.000	N	9.7	23.7	65.8	35.9	55.8
0.358000	36.4	24.5	9.000	N	9.7	22.3	58.8	24.2	48.8
2.682000	40.7	38.6	9.000	N	9.8	15.3	56.0	7.4	46.0
4.022000	26.6	24.7	9.000	N	9.9	29.4	56.0	21.3	46.0
25.486000	22.9	20.7	9.000	N	11.1	37.1	60.0	29.3	50.0
28.170000	27.2	24.9	9.000	N	11.2	32.8	60.0	25.1	50.0

5.8.5.2 Operating mode: WLAN 802.11b

Date of Test	2020-04-21	Temperature	(21.3 ± 0.9) °C
		Relative humidity	(41.3 ± 0.8) % R.H.
Measurement Frequency Range		9 kHz ~ 30MHz	
Test Result	PASS	Tested By	Do-heon Kim 

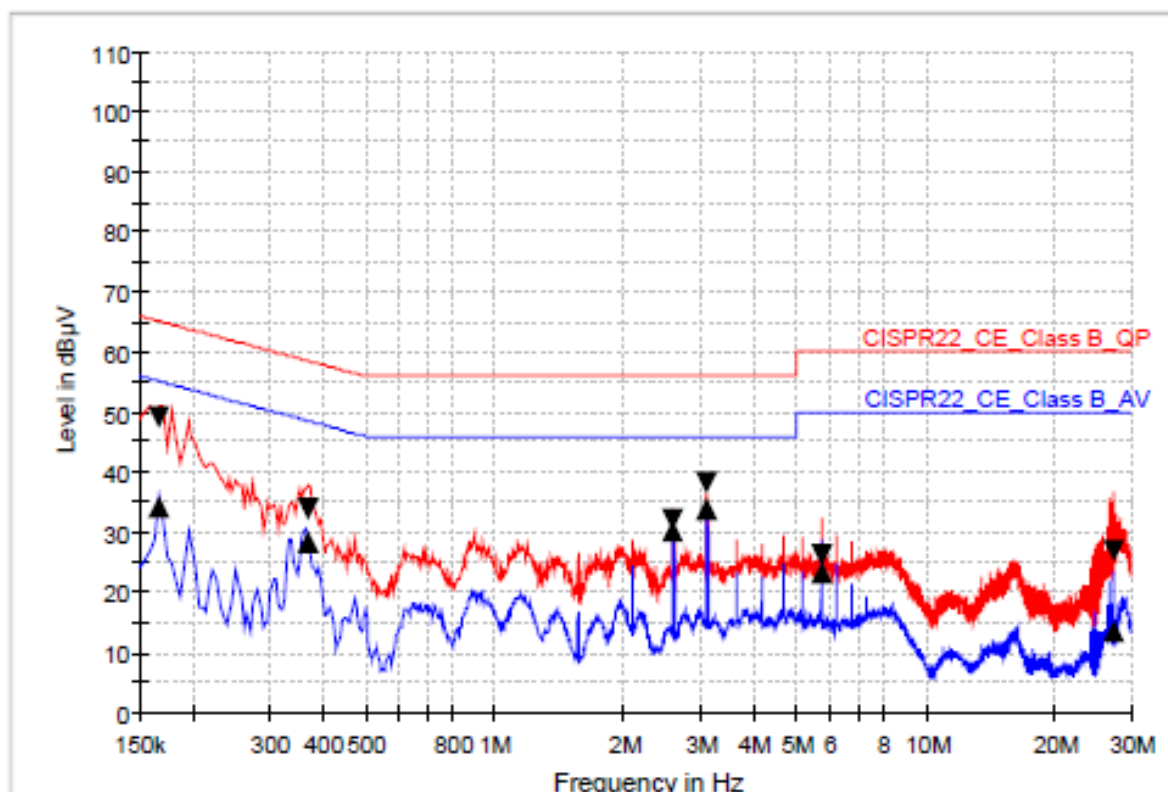
Hot Line



Limit and Margin1

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)	Margin - CAV (dB)	Limit - CAV (dBμV)
0.166000	49.4	34.9	9.000	L1	9.7	15.8	65.2	20.3	55.2
0.366000	35.3	30.8	9.000	L1	9.7	23.3	58.6	17.8	48.6
2.602000	31.8	29.7	9.000	L1	9.8	24.2	56.0	16.3	46.0
3.126000	39.2	33.9	9.000	L1	9.9	16.8	56.0	12.1	46.0
5.726000	30.3	28.4	9.000	L1	10.1	29.7	60.0	21.6	50.0
27.190000	27.7	14.7	9.000	L1	11.2	32.3	60.0	35.3	50.0

Neutral Line



Limit and Margin1

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)	Margin - CAV (dB)	Limit - CAV (dBμV)
0.166000	49.3	34.3	9.000	N	9.7	15.9	65.2	20.9	55.2
0.370000	34.0	28.6	9.000	N	9.7	24.5	58.5	19.9	48.5
2.602000	32.0	30.1	9.000	N	9.8	24.0	56.0	15.9	46.0
3.122000	38.4	33.7	9.000	N	9.9	17.6	56.0	12.3	46.0
5.722000	26.1	23.1	9.000	N	10.1	34.0	60.0	26.9	50.0
27.334000	27.1	13.4	9.000	N	11.2	32.9	60.0	36.6	50.0

Appendix I – Test Instrumentation

Description	Model No.	Serial No.	Manufacturer.	Due for Cal. Date	Cal. Interval
Signal & Spectrum Analyzer	FSW 43	100578	Rohde & Schwarz	2021-04-20	1 Y
Spectrum Analyzer	FSV 13	101243	Rohde & Schwarz	2021-01-16	1 Y
Signal Generator	SMF100A	257560	Rohde & Schwarz	2021-01-26	1 Y
Vector Signal Generator	SMBV100A	101441	Rohde & Schwarz	2021-01-26	1 Y
Power Module	OSP 120	101389	Rohde & Schwarz	2021-01-16	1 Y
Attenuator	56-10	58769	WEINSCHTEL	2021-01-20	1 Y
Attenuator	10 dB	ENG-1	Rohde & Schwarz	2021-01-16	1 Y
Test Receiver	ESU 26	100303	Rohde & Schwarz	2021-01-21	1 Y
Loop Antenna	HFH2-Z2	100341	Rohde & Schwarz	2021-06-21	2 Y
DC Power Supply	6032A	SG41000637	Agilent	2021-03-25	1 Y
TRILOG Broadband Antenna	VULB9163	9163.799	Schwarzbeck	2021-09-17	2 Y
Dipole Antenna	3121C	9001-509 9001-530	EMCO	2022-05-22	2Y
Dipole Antenna	UHA9105	N/A	Schwarzbeck	2022-05-22	2Y
Horn Antenna	HF 907	102426	Rohde & Schwarz	2020-11-20	2 Y
DOPPEL STEG Horn Antenna	HF 906	100332	Rohde & Schwarz	2021-02-14	2 Y
Horn Antenna	BBHA 9170	BBHA 9170 #783	Schwarzbeck	2020-11-26	2 Y
Notch Filter	BRM50702	G318	MICRO-TRONICS	2020-11-07	1 Y
Notch Filter	BRC50703	G139	MICRO-TRONICS	2020-11-07	1 Y
Notch Filter	BRC50704	G122	MICRO-TRONICS	2020-11-07	1 Y
Notch Filter	BRC50705	G126	MICRO-TRONICS	2020-11-07	1 Y
Attenuator	6dB	272.4110.50	Rohde & Schwarz	2021-01-16	1 Y
Pre-Amplifier	310N	344015	Sonoma Instrument	2021-01-16	1 Y
Pre-Amplifier	SCU 18D	19006450	Rohde & Schwarz	2021-04-17	1 Y
Pre-Amplifier	CBL18265035	28706	CERNEX	2021-03-24	1 Y
Pre-Amplifier	CBL26405040	28707	CERNEX	2021-03-24	1 Y

Turn Table	DT3000-3t	1310814	INNCO SYSTEM	-	N/A
Antenna Master	MA4000-EP	4600814	INNCO SYSTEM	-	N/A
Antenna Master	MA4000-XP-ET	-	INNCO SYSTEM	-	N/A
Camera Controller	HDCon4102	6531445048	PONTIS	-	N/A
CO3000 Controller	Co3000-4Port	CO3000/806/ 34130814/L	INNCO SYSTEM	-	N/A
CO3000 Controller	Co3000-4Port	CO3000/807/ 34130814/L	INNCO SYSTEM	-	N/A
EMI Test Receiver	ESCI 7	100722	Rohde & Schwarz	2021-01-16	1 Y
LISN	ENV216	100110	Rohde & Schwarz	2021-01-22	1 Y
Directional Coupler	AAMCS-UDC-0.5G-18G-SF	000757	AAMCS	2021-01-17	1 Y
Splitter	1580	SC321	WEINSCHEL	2021-01-20	1 Y
Splitter	ZFRSC-42-S+	UU90901305	Minicircuits	2021-01-17	1 Y
Attenuator	8496A	3308A3798S	HP	2021-01-16	1 Y
Attenuator	8494B	3308a38821	HP	2021-01-16	1 Y
Temperature & Humidity Chamber	SM-1.0-3800	38025	THERMOTRON	2020-08-21	1 Y
Bluetooth Tester	TC-3000C	3000C000534	TESCOM	2020-07-16	1 Y
Wireless Access Point	WAC720	4D7689EP000FB	NETGEAR		

The measuring equipment utilized to perform the tests documented in this test report has been calibrated in accordance with manufacturer's recommendations, and is traceable to recognized national standards.