

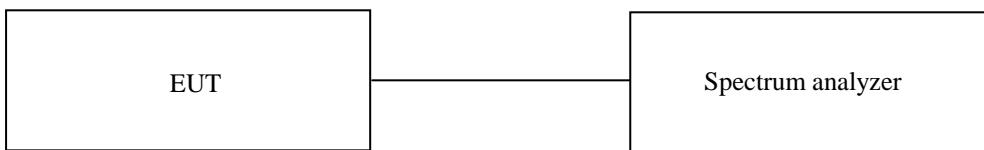
12. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

12.1 Operating environment

Temperature : 22.4 °C
 Relative humidity : 43.8 % R.H

12.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



12.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

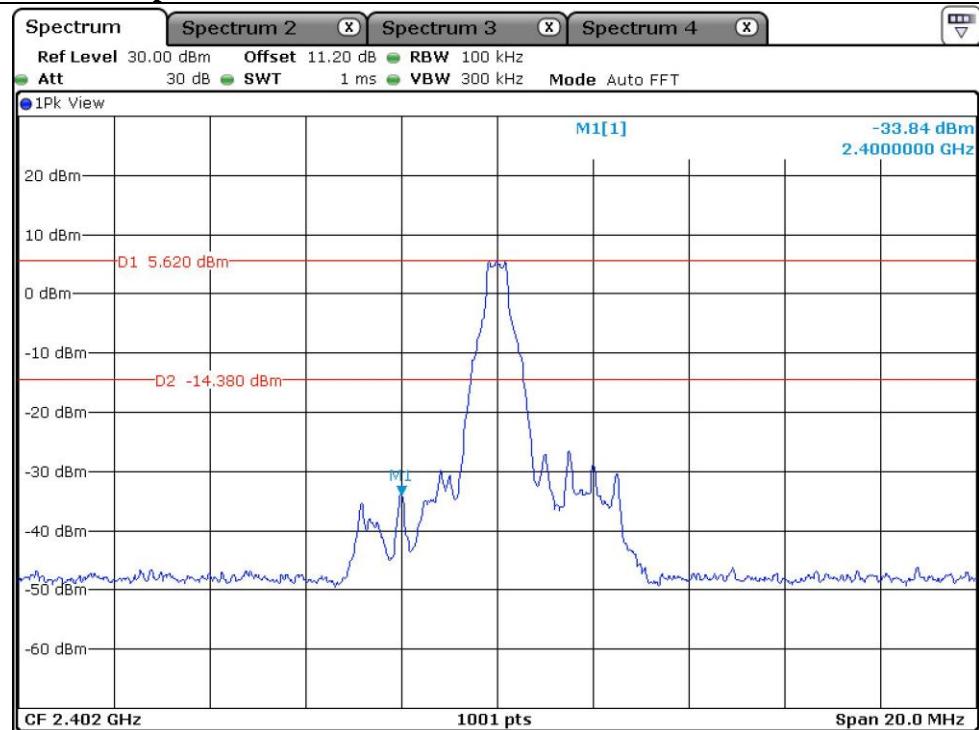
12.4 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (1Y)
■ - ESU	Rohde & Schwarz	EMI Test Receiver	100261	Mar. 29, 2018 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 28, 2018 (1Y)
■ - BBV9718	Schwarzbeck	Amplifier	310	Mar. 30, 2018 (1Y)
■ - SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Mar. 15, 2018 (1Y)
■ - DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ - MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ - VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-419	Aug. 05, 2016 (2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jul. 28, 2017 (2Y)
■ - TC-3000C	TESCOM	BLUETOOTH TESTER	3000C000634	Mar. 15, 2018 (1Y)

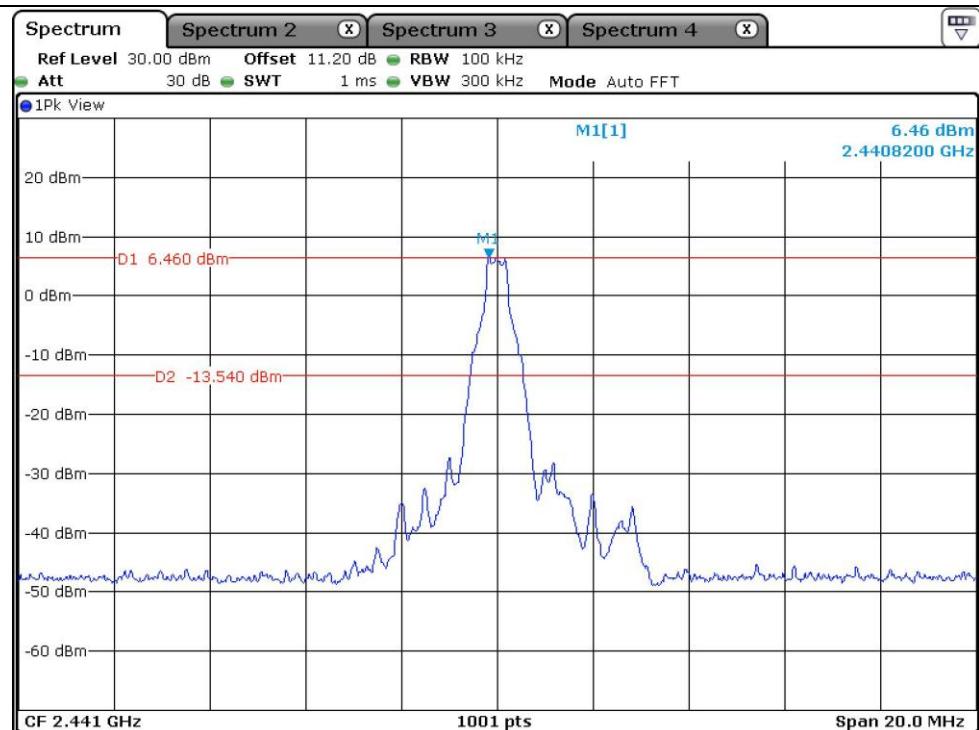
All test equipment used is calibrated on a regular basis.

12.5 Test data for conducted emission

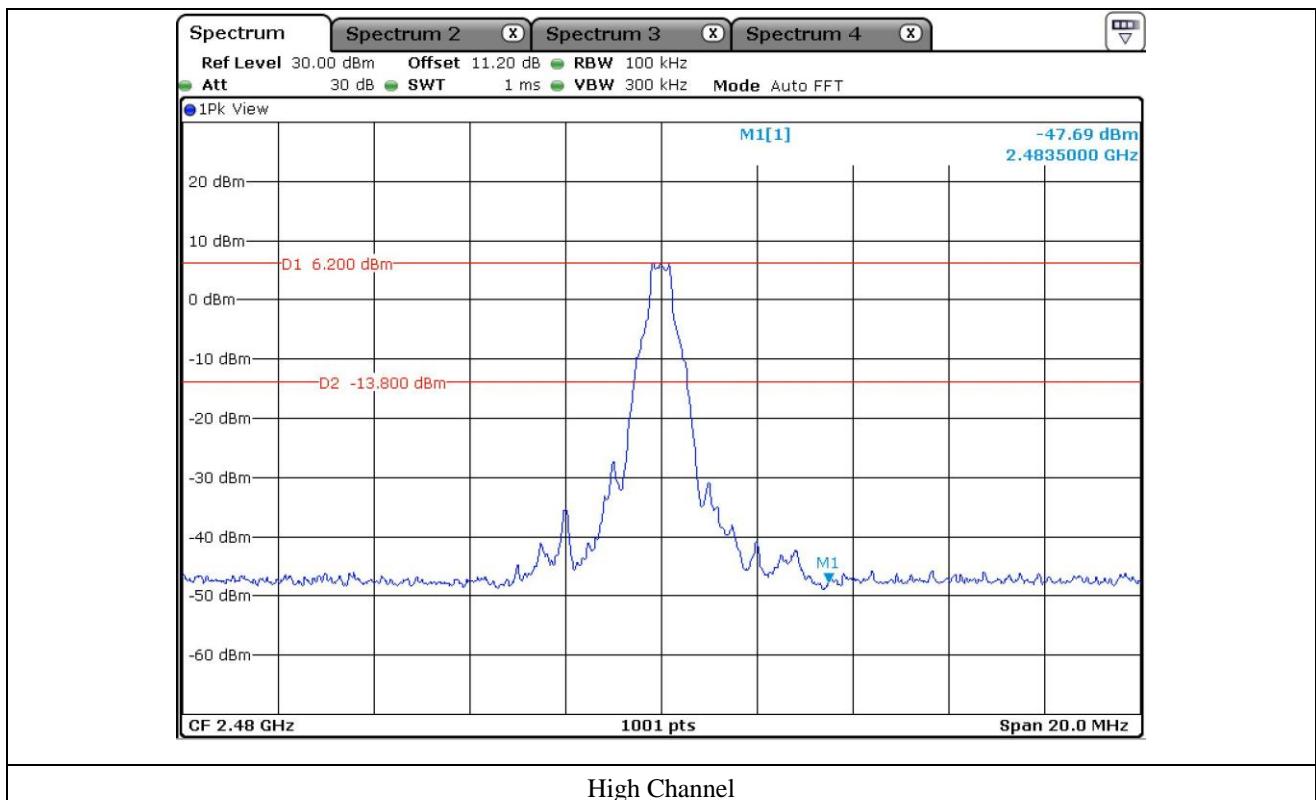
12.5.1 Test data for 1 Mbps

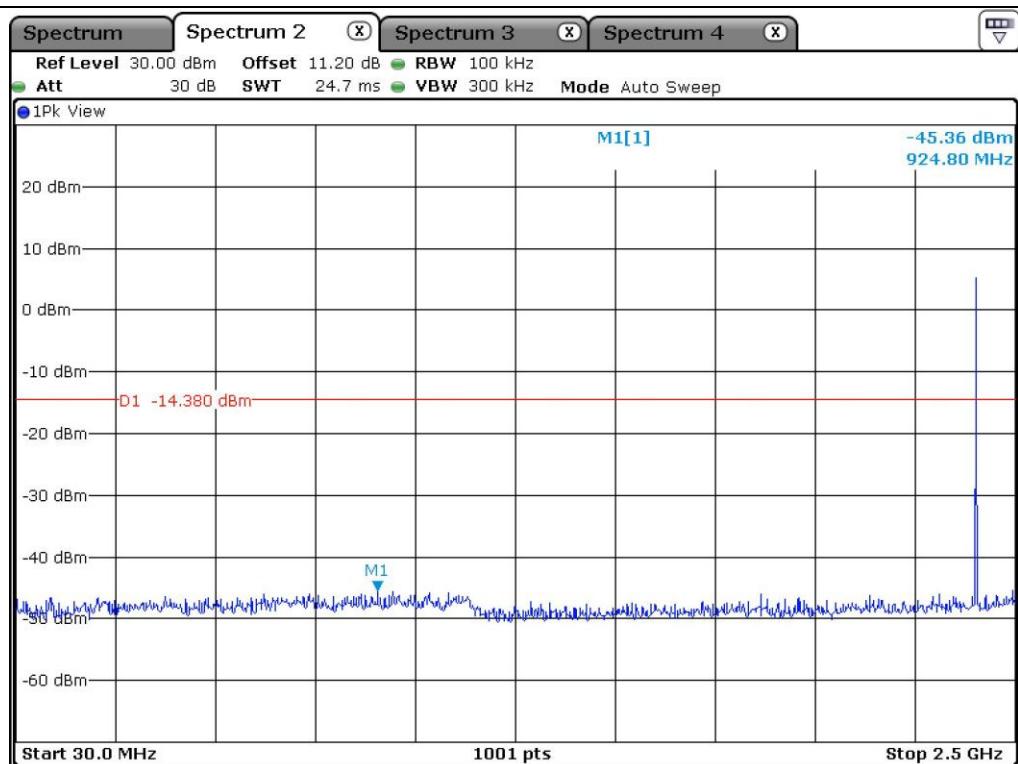


Low Channel

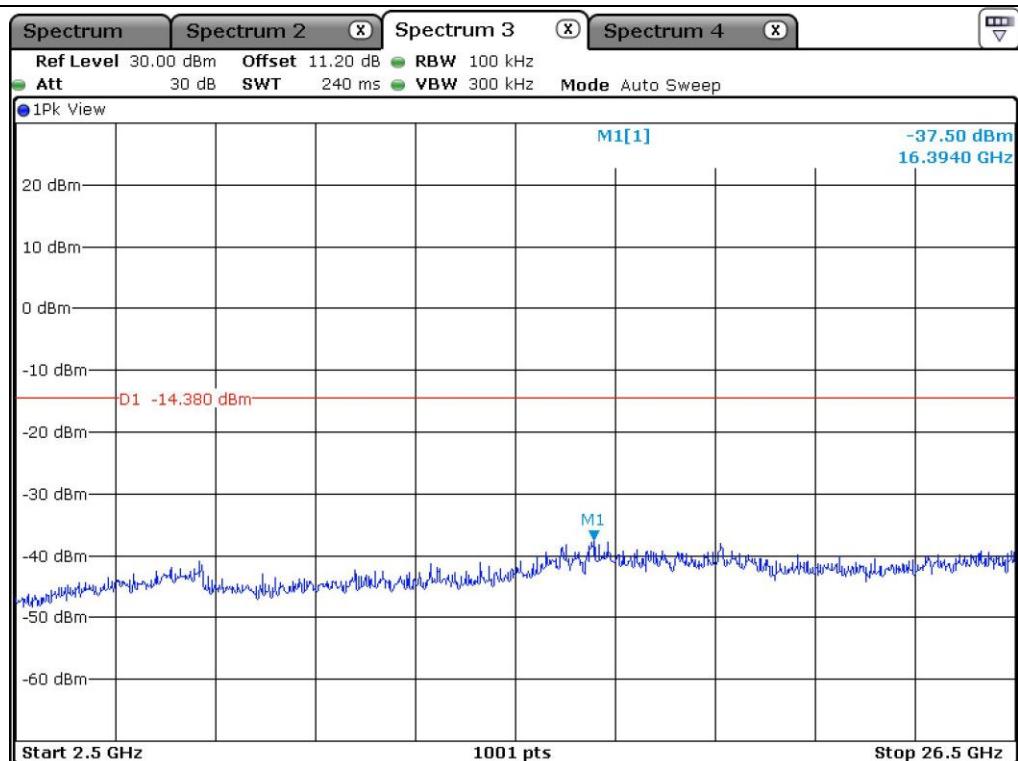


Middle Channel

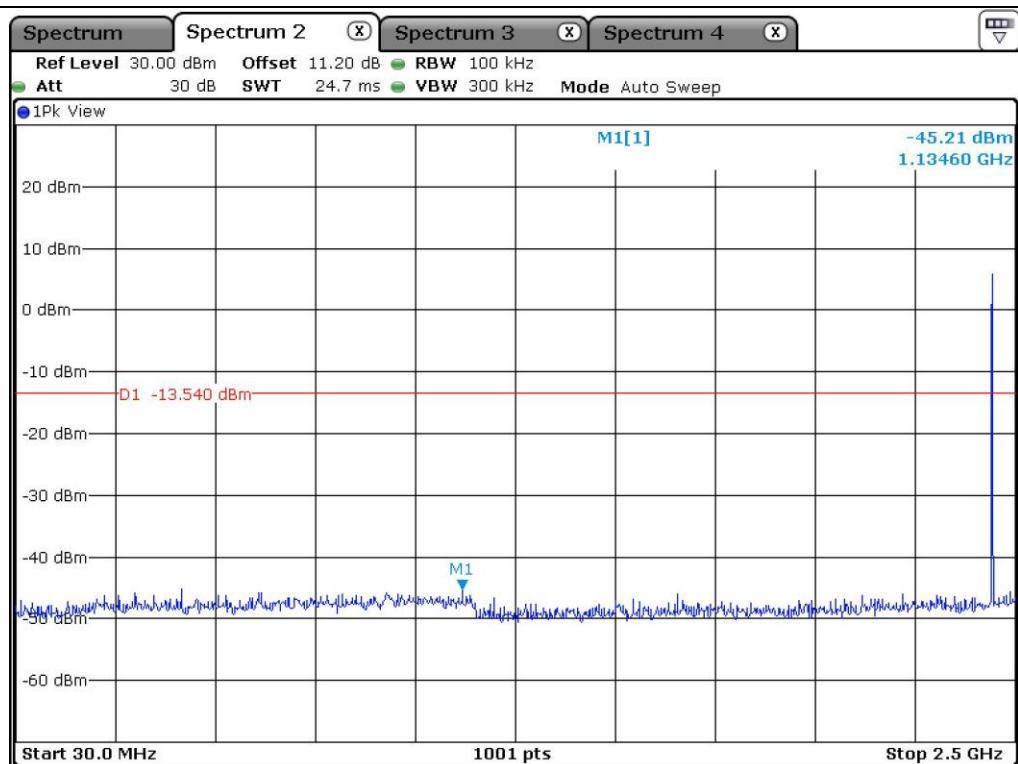
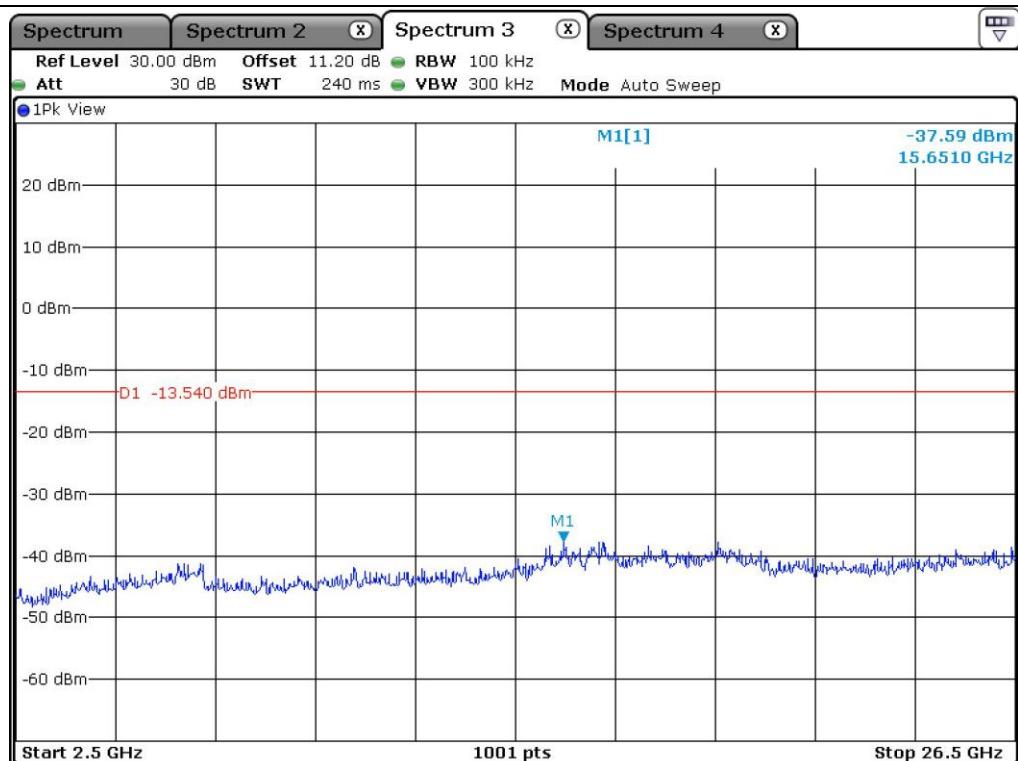


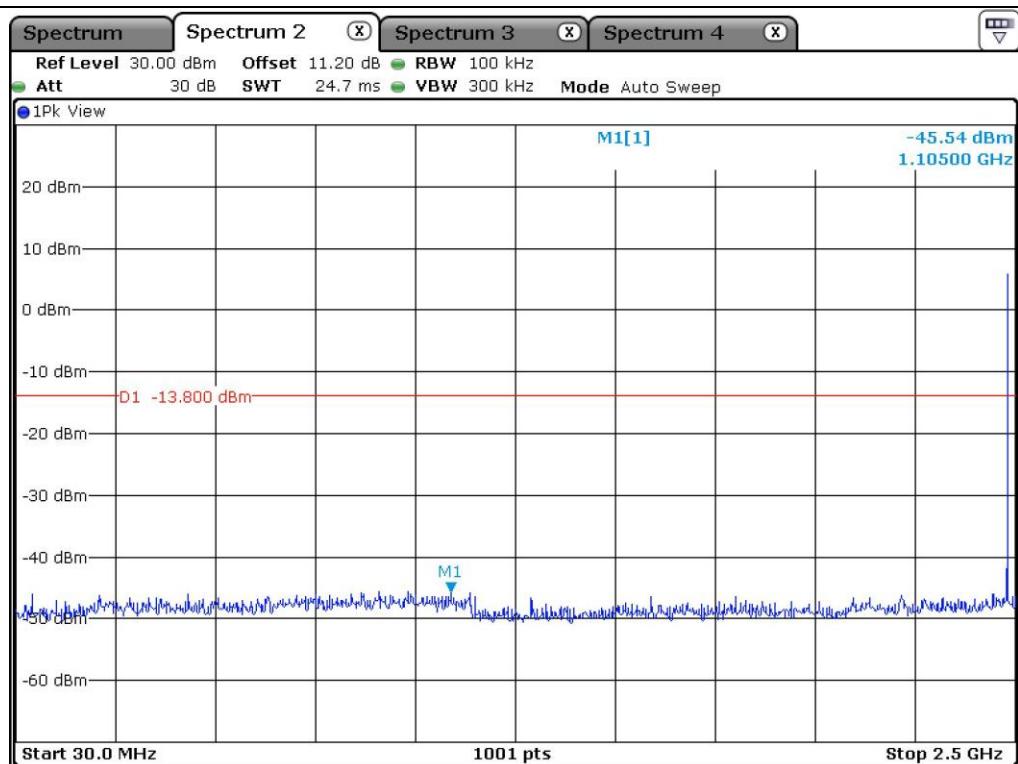


Low Channel

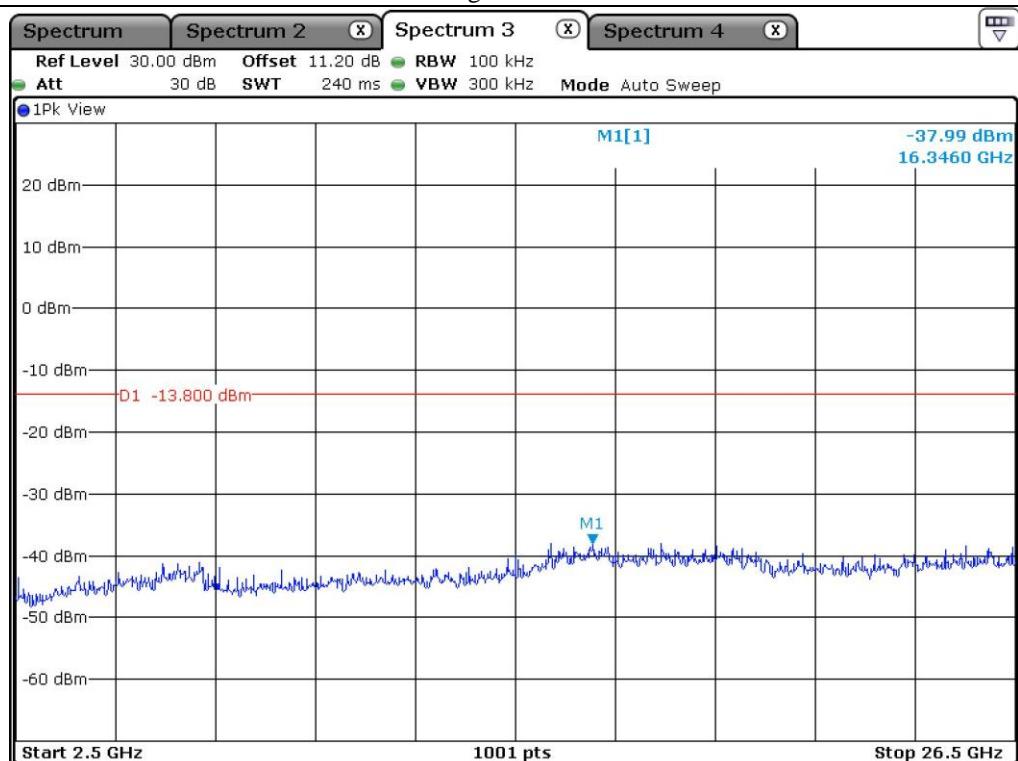


Low Channel

**Middle Channel****Middle Channel**

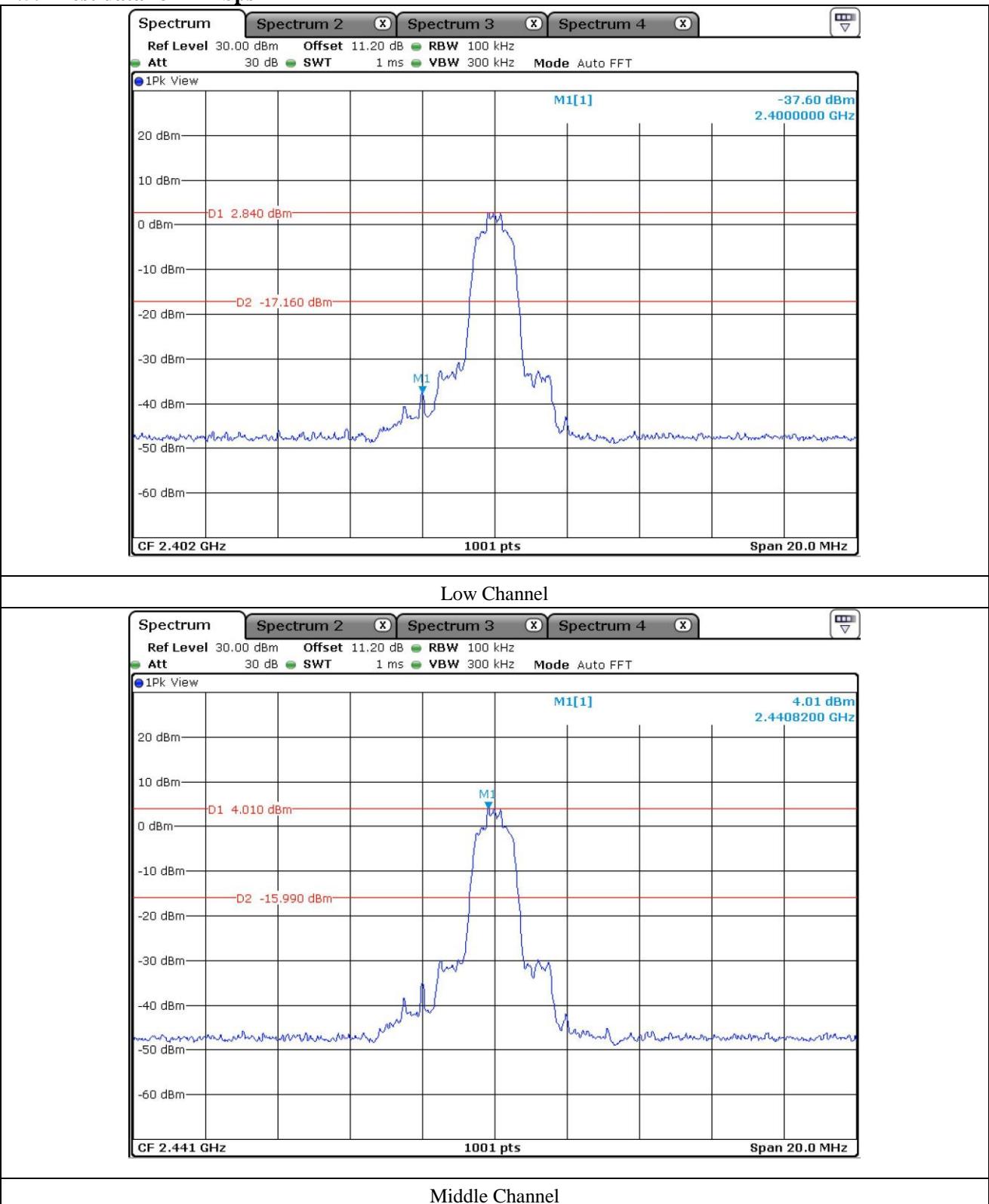


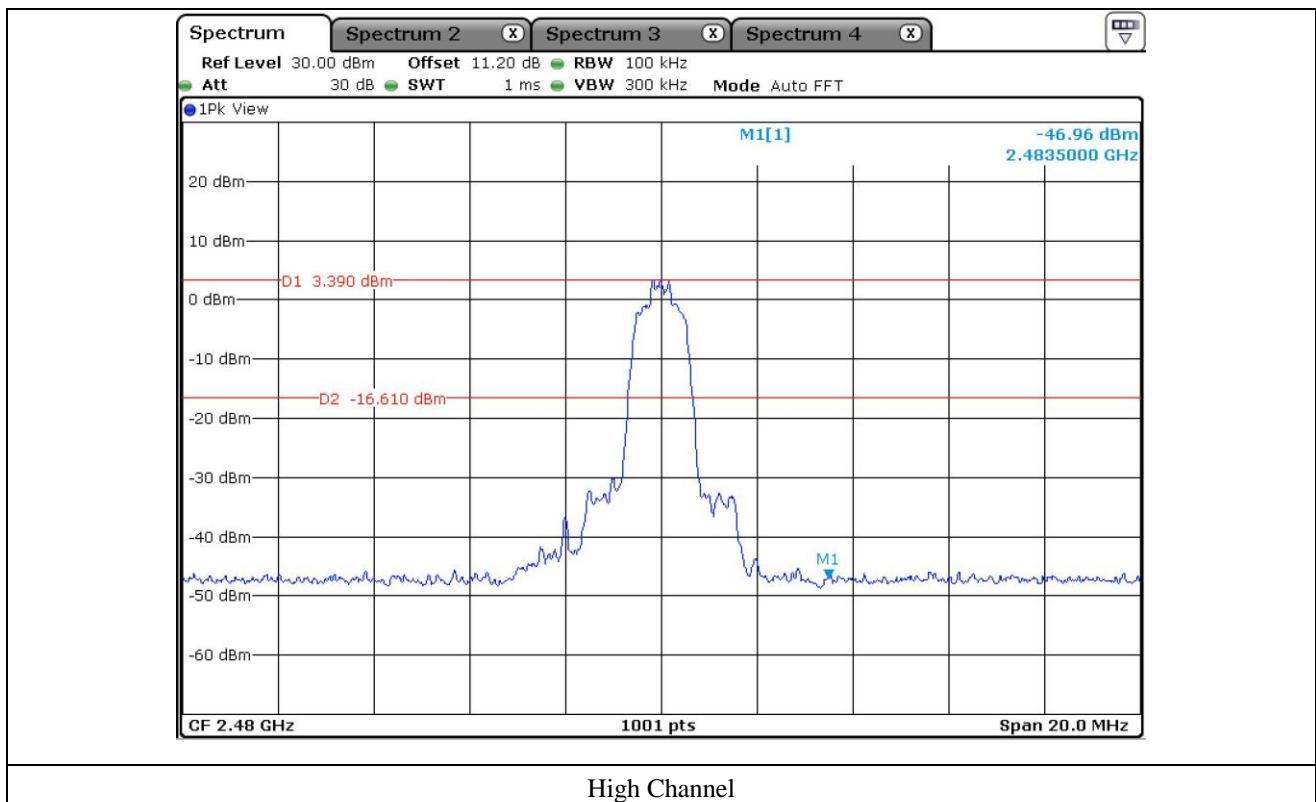
High Channel

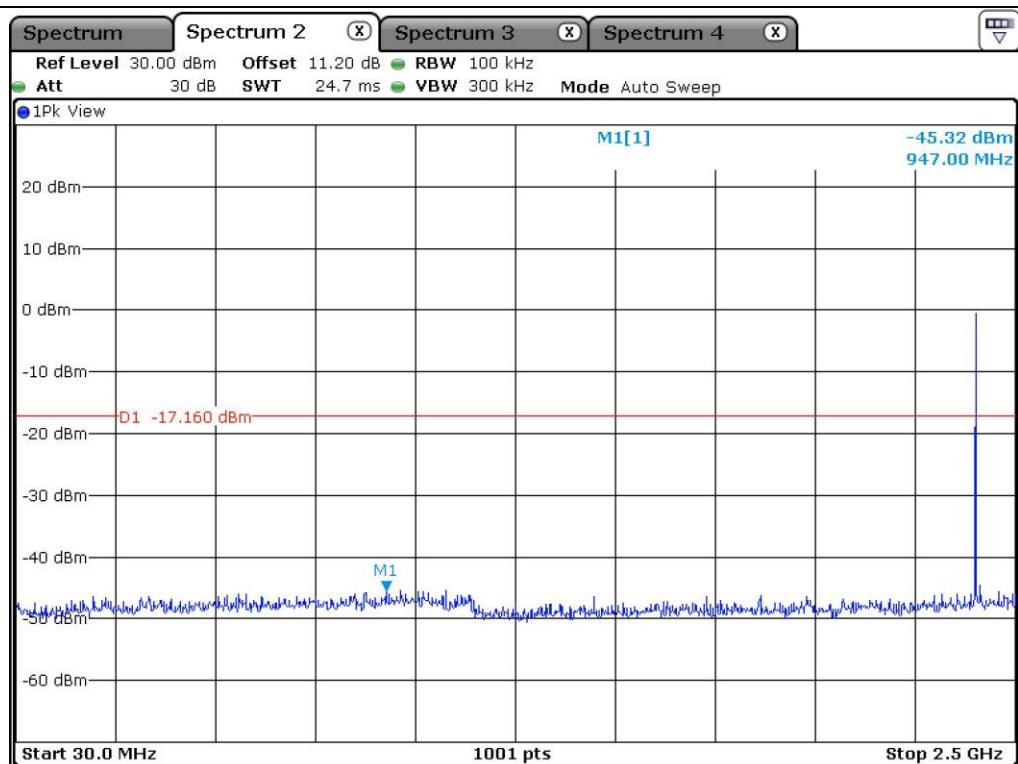


High Channel

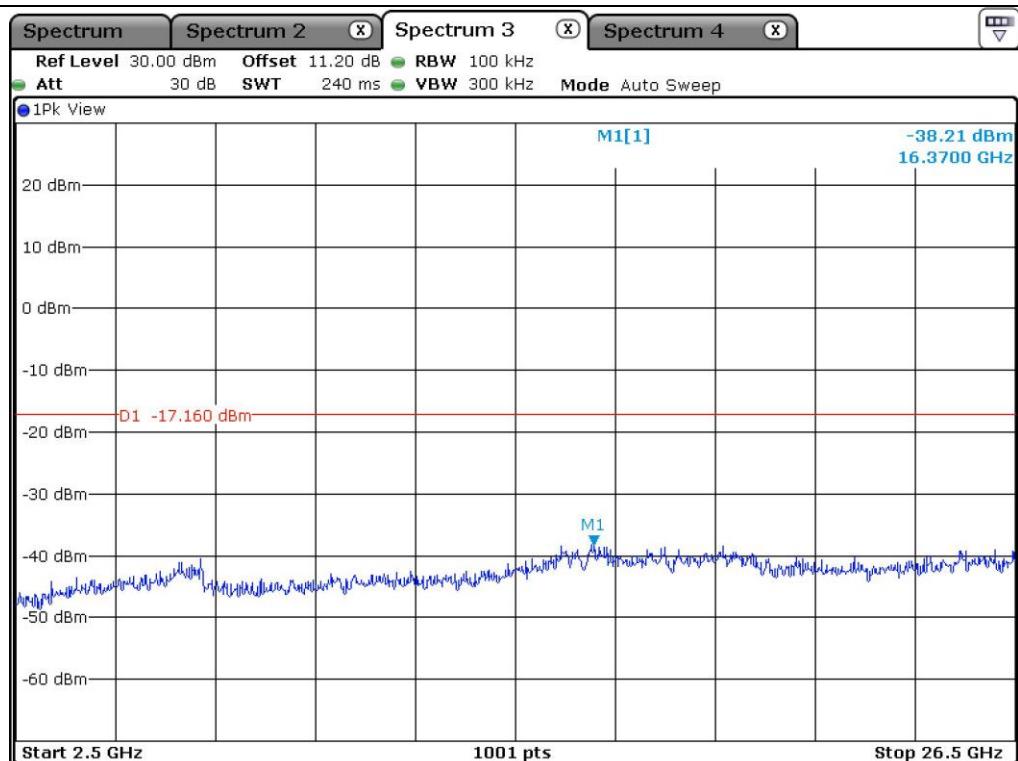
12.5.2 Test data for 2 Mbps



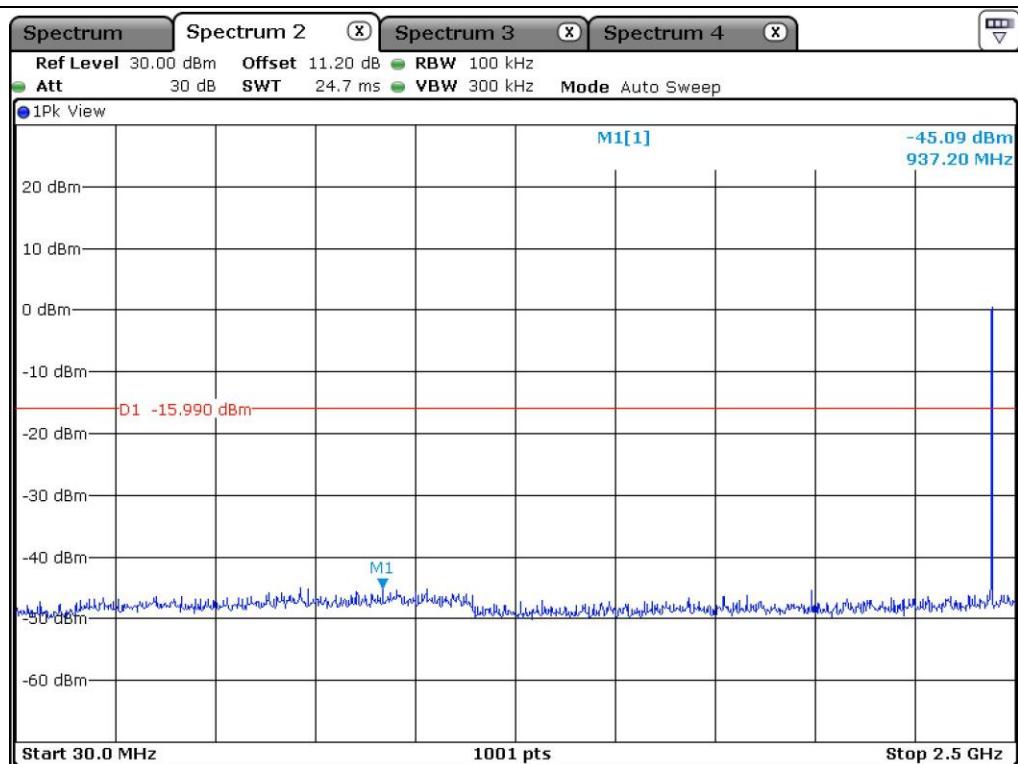




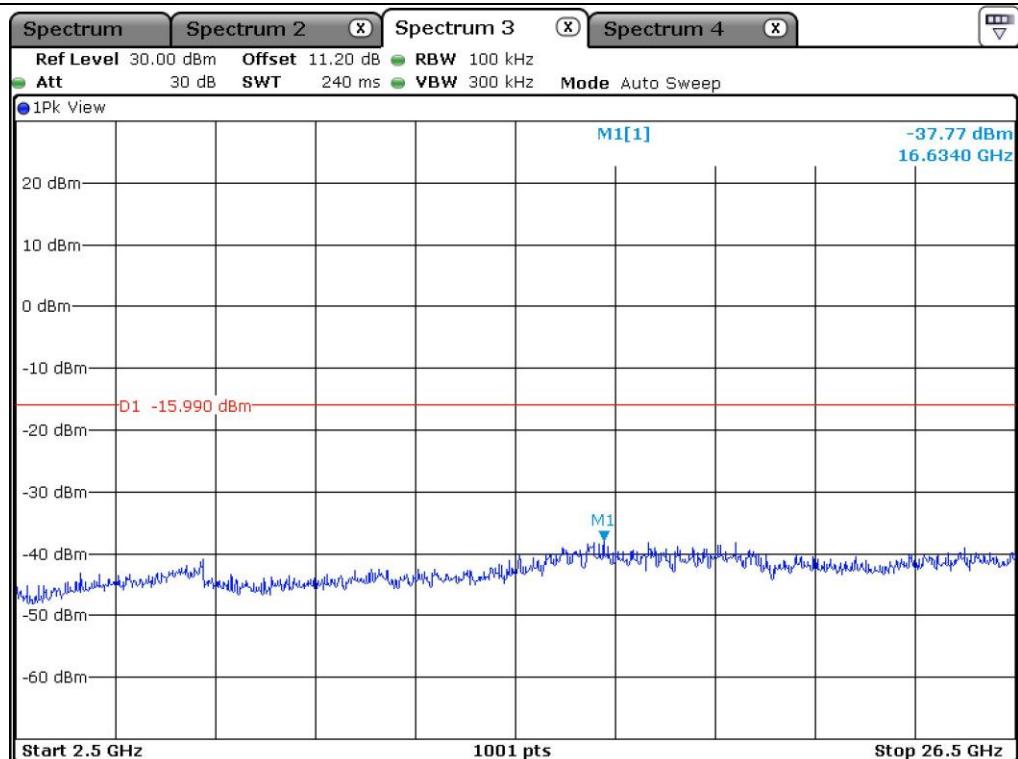
Low Channel



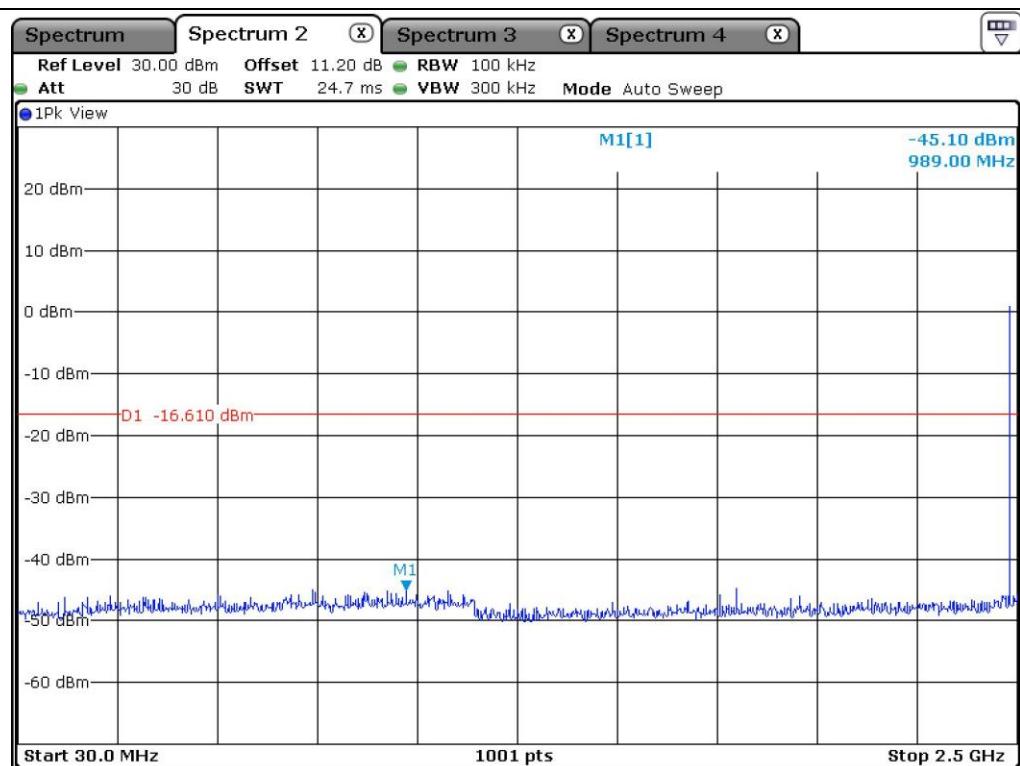
Low Channel



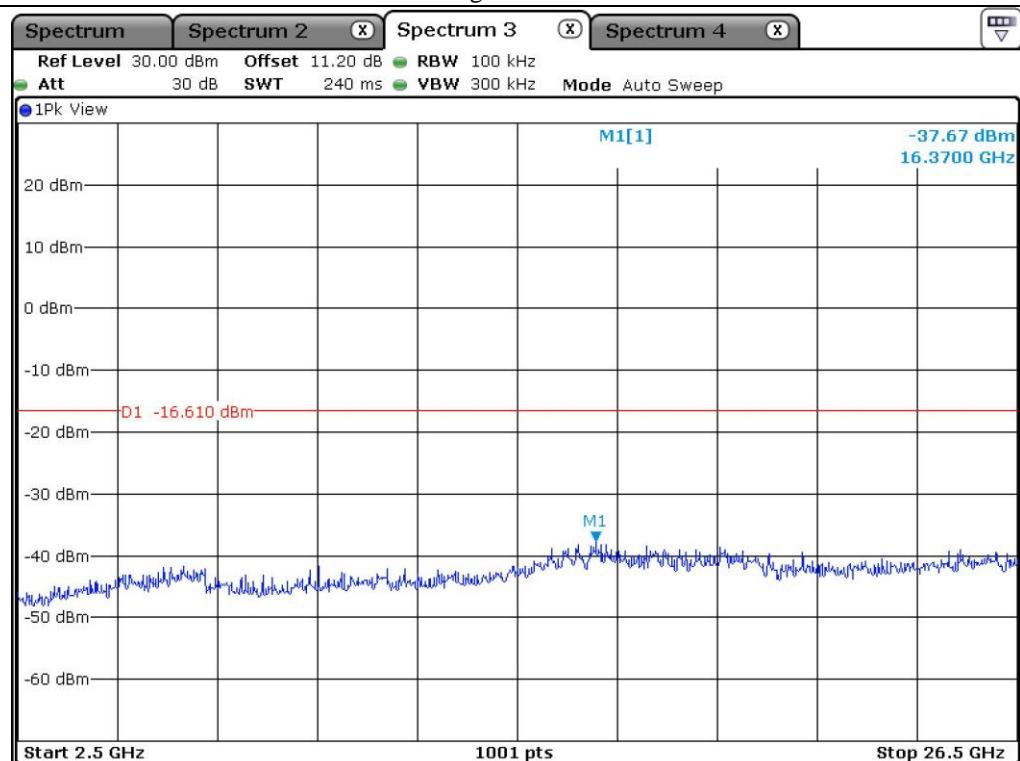
Middle Channel



Middle Channel

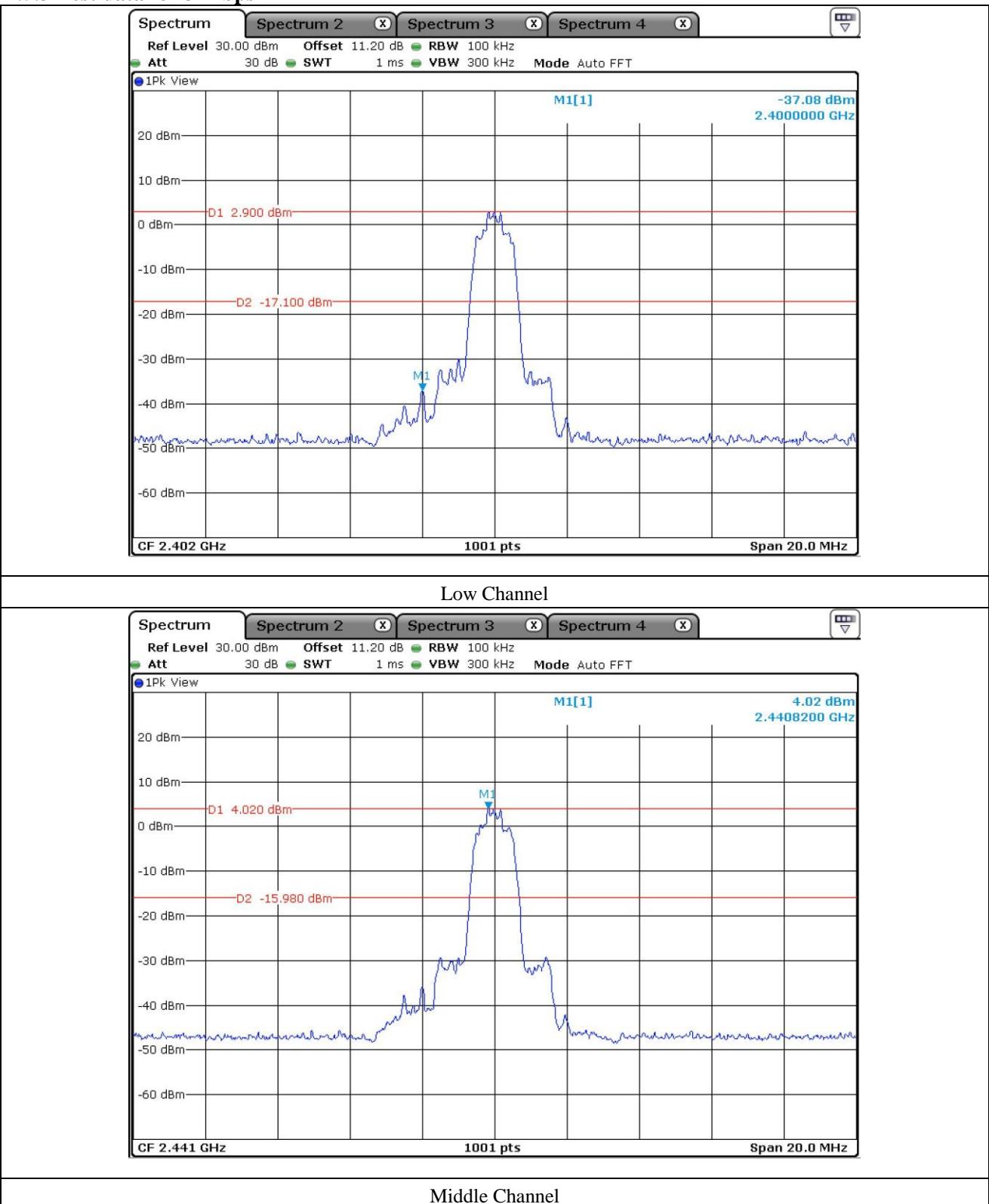


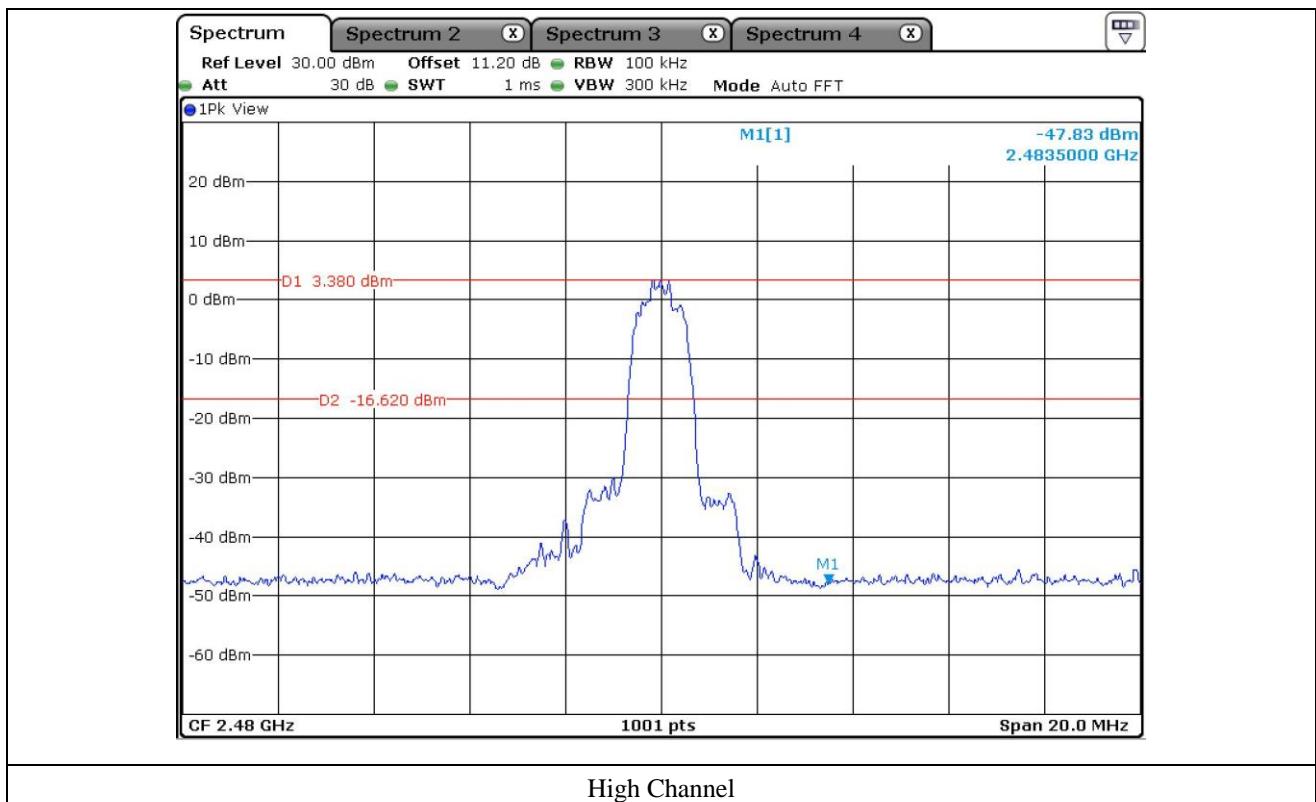
High Channel

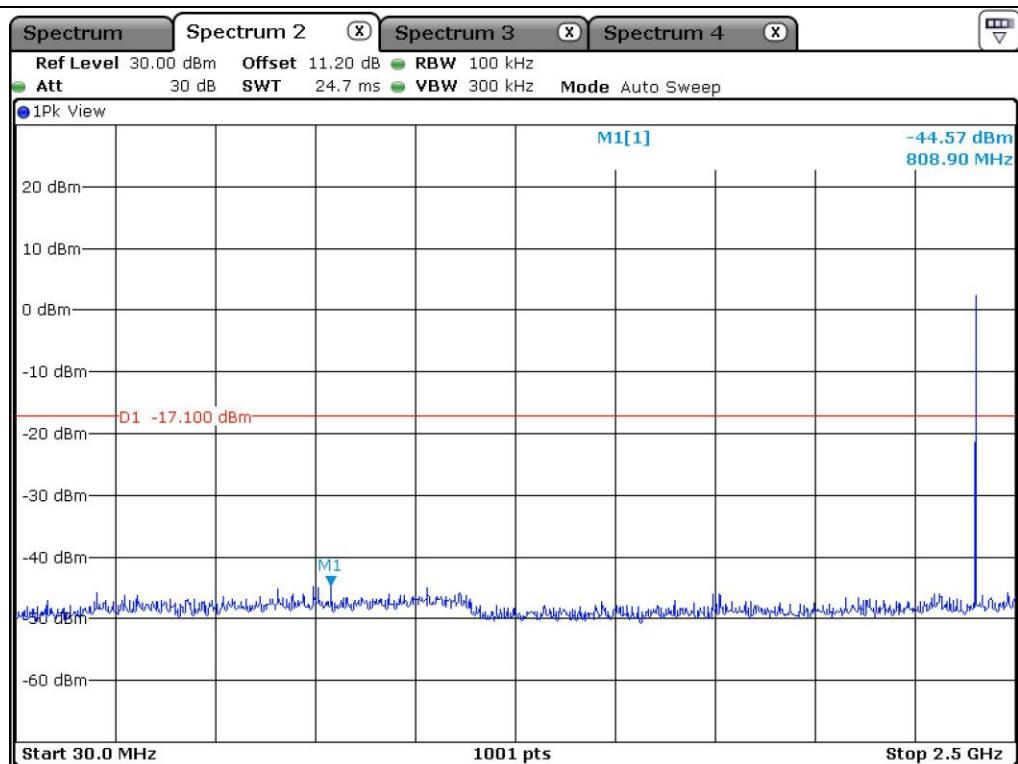


High Channel

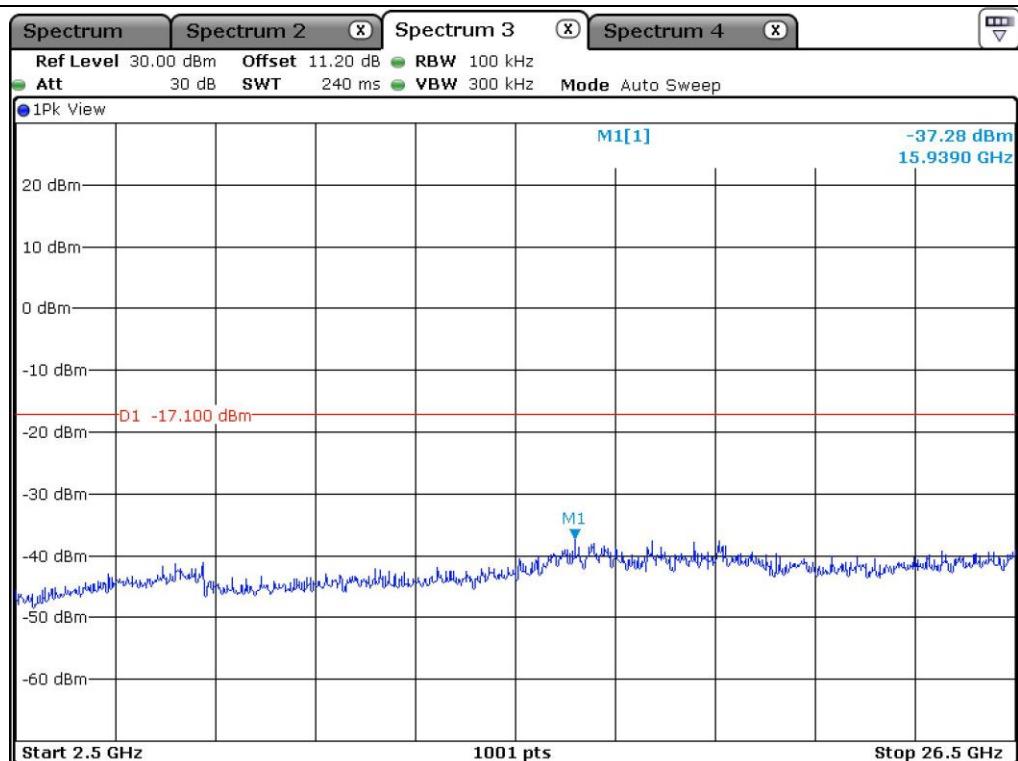
12.5.3 Test data for 3 Mbps



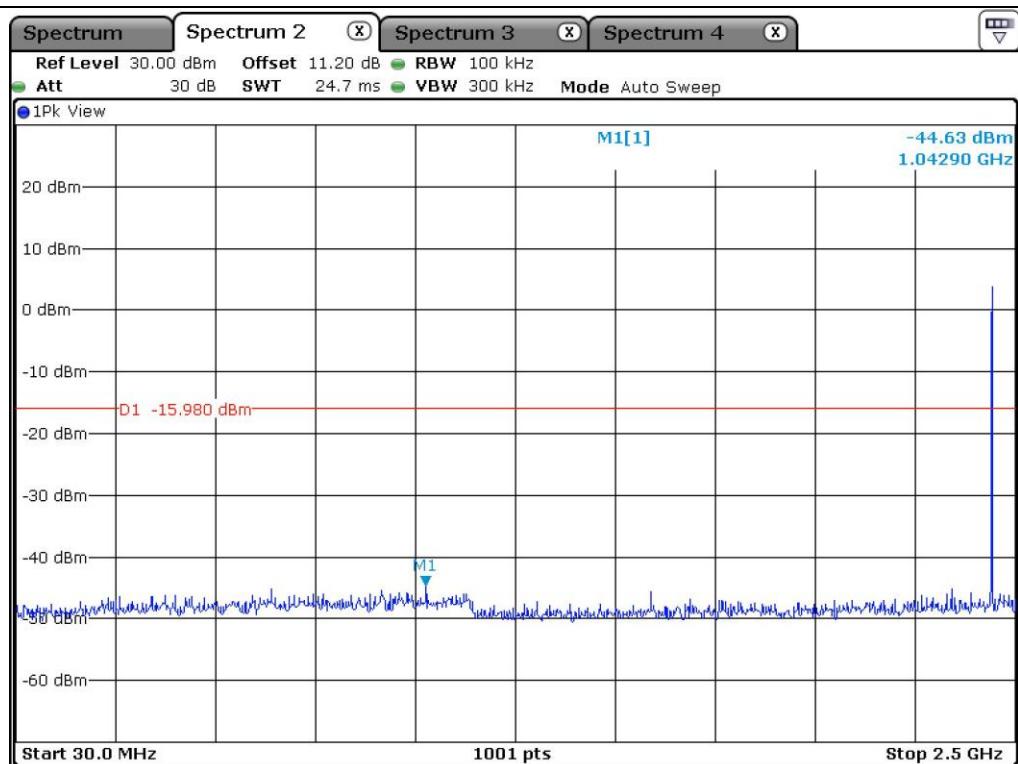




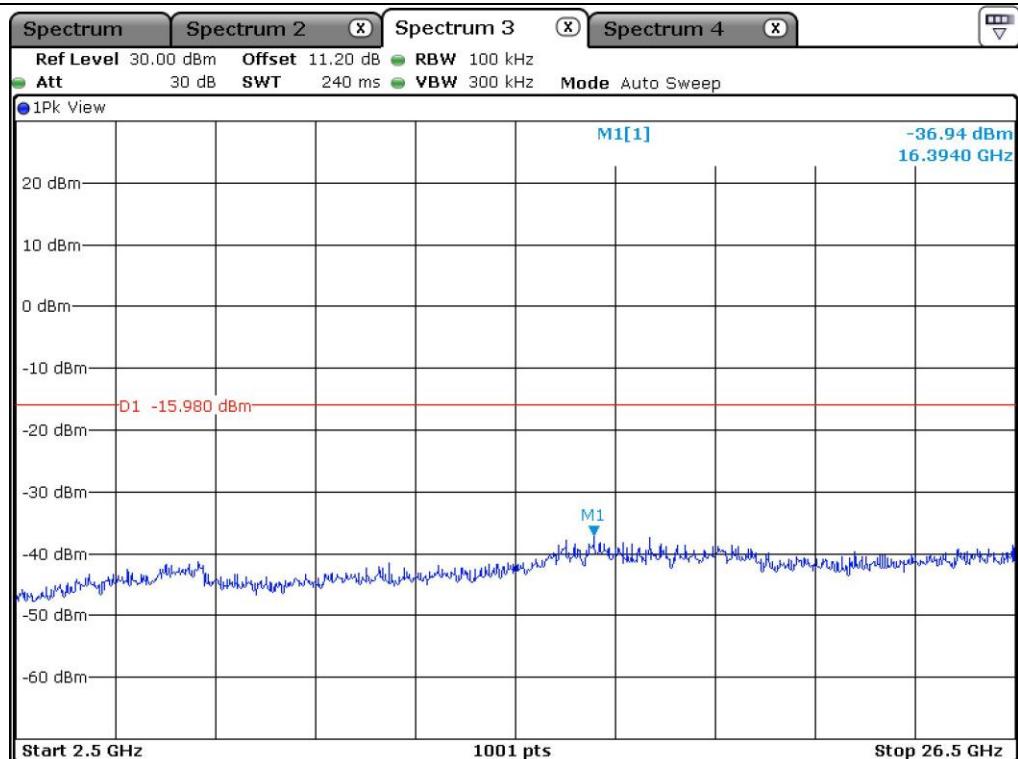
Low Channel



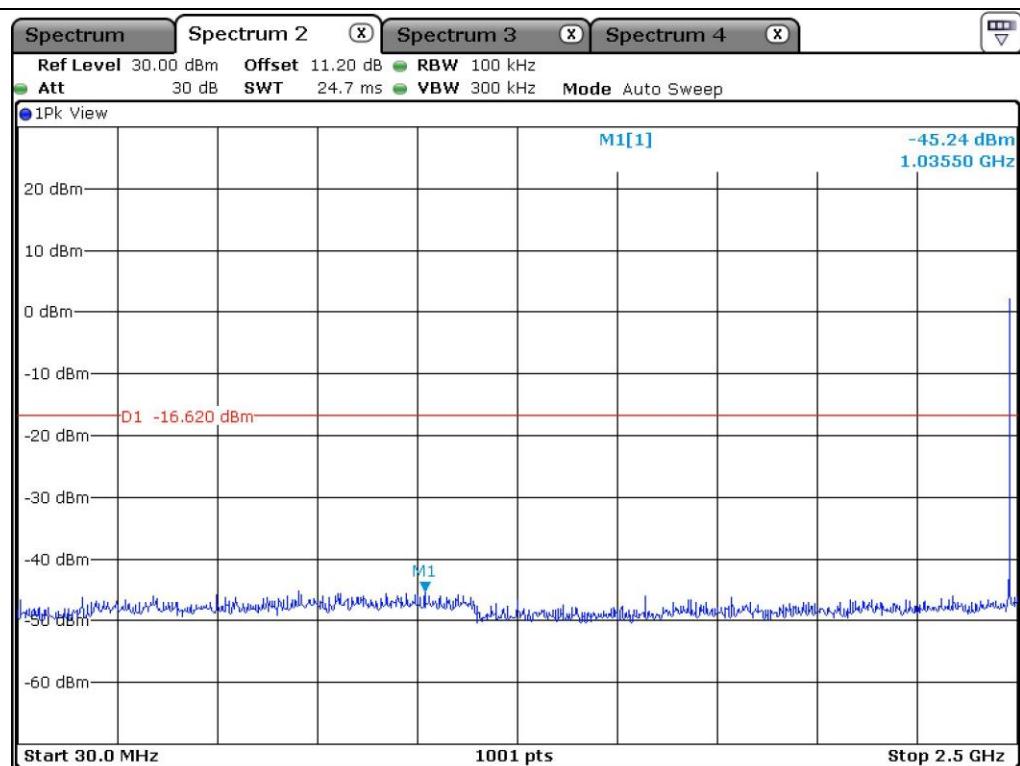
Low Channel



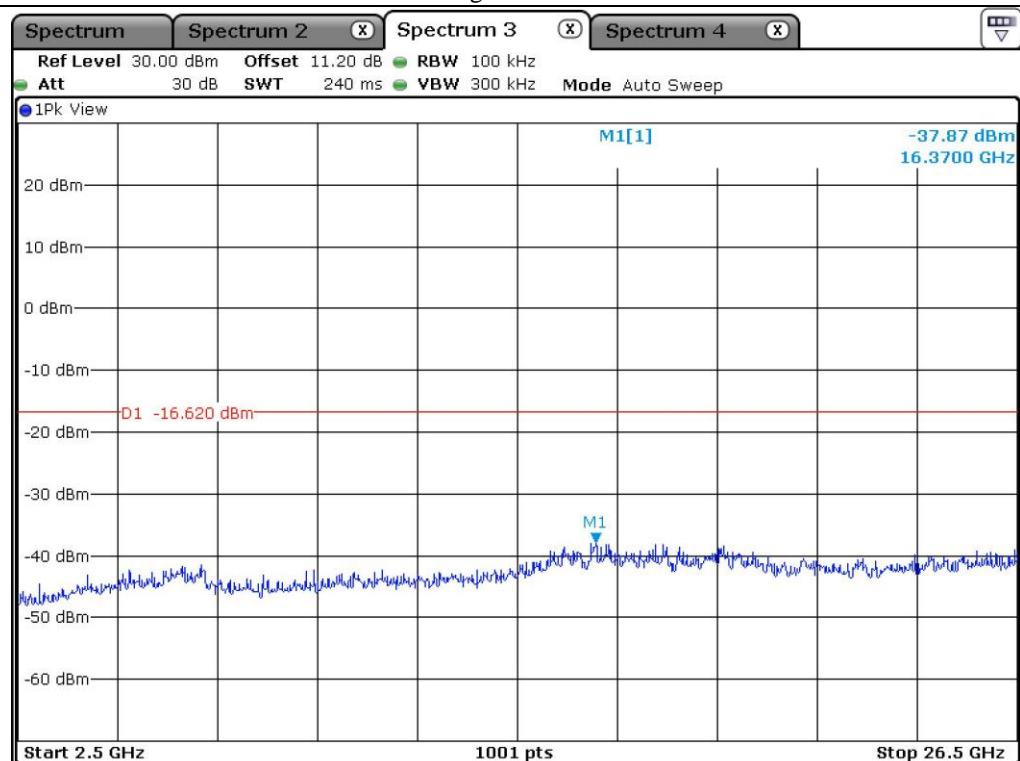
Middle Channel



Middle Channel



High Channel



High Channel

12.6 Test data for Transmitting mode radiated emission

12.6.1 Radiated Emission which fall in the Restricted Band

12.6.1.1 Test data for 1 Mbps

- Test Date : June 12, 2018 ~ June 15, 2018
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Result : PASSED

Frequency (MHz)	Reading (dB μ V)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Test Data for Low Channel									
2 390.22	45.60	Peak	H	26.94	9.20	34.76	46.98	74.00	27.02
2 390.56	33.21	Average	H				34.59	54.00	19.41
2 384.76	46.39	Peak	V				47.77	74.00	26.23
2 384.52	32.95	Average	V				34.33	54.00	19.67
Test Data for High Channel									
2 499.42	46.52	Peak	H	27.47	9.49	35.51	47.97	74.00	26.03
2 499.21	34.29	Average	H				35.74	54.00	18.26
2 499.89	47.21	Peak	V				48.66	74.00	25.34
2 499.99	36.24	Average	V				37.69	54.00	16.31

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical



Tested by: Tae-Ho, Kim / Senior Manager

12.6.1.2 Test data for 2 Mbps

- Test Date : June 12, 2018 ~ June 15, 2018
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Result : PASSED

Frequency (MHz)	Reading (dB μ V)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Test Data for Low Channel									
2 386.25	43.85	Peak	H	26.94	9.20	34.76	45.23	74.00	28.77
2 386.75	32.15	Average	H				33.53	54.00	20.47
2 388.36	45.21	Peak	V				46.59	74.00	27.41
2 387.24	33.54	Average	V				34.92	54.00	19.08
Test Data for High Channel									
2 494.21	41.52	Peak	H	27.47	9.49	35.51	42.97	74.00	31.03
2 494.68	32.07	Average	H				33.52	54.00	20.48
2 499.19	43.39	Peak	V				44.84	74.00	29.16
2 499.54	34.04	Average	V				35.49	54.00	18.51

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical



Tested by: Tae-Ho, Kim / Senior Manager

12.6.1.3 Test data for 3 Mbps

- Test Date : June 12, 2018 ~ June 15, 2018
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Result : PASSED

Frequency (MHz)	Reading (dB μ V)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Test Data for Low Channel									
2 387.54	43.52	Peak	H	26.94	9.20	34.76	44.90	74.00	29.10
2 387.21	32.02	Average	H				33.40	54.00	20.60
2 388.95	45.85	Peak	V				47.23	74.00	26.77
2 388.27	33.81	Average	V				35.19	54.00	18.81
Test Data for High Channel									
2 495.56	40.85	Peak	H	27.47	9.49	35.51	42.30	74.00	31.70
2 495.11	32.51	Average	H				33.96	54.00	20.04
2 498.85	42.28	Peak	V				43.73	74.00	30.27
2 498.45	33.96	Average	V				35.41	54.00	18.59

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical



Tested by: Tae-Ho, Kim / Manager

12.6.2 Spurious & Harmonic Radiated Emission above 1 GHz

12.6.2.1 Test data for 1 Mbps

- Test Date : June 12, 2018 ~ June 15, 2018
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band, 1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band 100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Result : PASSED

Frequency (GHz)	Reading (dB μ V)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Test Data for Low Channel									
4 804.00	43.51	Peak	H	30.84	12.31	35.74	50.92	74.00	23.08
	35.07	Average	H				42.48	54.00	11.52
	45.72	Peak	V				53.13	74.00	20.87
	36.09	Average	V				43.50	54.00	10.50
Test Data for Middle Channel									
4 882.00	43.85	Peak	H	30.01	12.43	35.80	50.49	74.00	23.51
	35.62	Average	H				42.26	54.00	11.74
	45.24	Peak	V				51.88	74.00	22.12
	36.10	Average	V				42.74	54.00	11.26
Test Data for High Channel									
4 960.00	43.95	Peak	H	31.15	12.81	35.96	51.95	74.00	22.05
	35.85	Average	H				43.85	54.00	10.15
	45.38	Peak	V				53.38	74.00	20.62
	36.28	Average	V				44.28	54.00	9.72

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "*" Frequency fall in restricted band



Tested by: Tae-Ho, Kim / Senior Manager

12.6.2.2 Test data for 2 Mbps

- Test Date : June 12, 2018 ~ June 15, 2018
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Result : PASSED

Frequency (GHz)	Reading (dB μ V)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Test Data for Low Channel									
4 804.00	42.11	Peak	H	30.84	12.31	35.74	49.52	74.00	24.48
	33.54	Average	H				40.95	54.00	13.05
	43.08	Peak	V				50.49	74.00	23.51
	34.17	Average	V				41.58	54.00	12.42
Test Data for Middle Channel									
4 882.00	42.56	Peak	H	30.01	12.43	35.80	49.20	74.00	24.80
	33.17	Average	H				39.81	54.00	14.19
	43.37	Peak	V				50.01	74.00	23.99
	34.34	Average	V				40.98	54.00	13.02
Test Data for High Channel									
4 960.00	42.36	Peak	H	31.15	12.81	35.96	50.36	74.00	23.64
	32.96	Average	H				40.96	54.00	13.04
	44.65	Peak	V				52.65	74.00	21.35
	34.82	Average	V				42.82	54.00	11.18

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "*" Frequency fall in restricted band



Tested by: Tae-Ho, Kim / Senior Manager

12.6.2.3 Test data for 3 Mbps

- Test Date : June 12, 2018 ~ June 15, 2018
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Result : PASSED

Frequency (GHz)	Reading (dB μ V)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Test Data for Low Channel									
4 804.00	41.25	Peak	H	30.84	12.31	35.74	48.66	74.00	25.34
	32.15	Average	H				39.56	54.00	14.44
	42.85	Peak	V				50.26	74.00	23.74
	34.68	Average	V				42.09	54.00	11.91
Test Data for Middle Channel									
4 882.00	41.35	Peak	H	30.01	12.43	35.80	47.99	74.00	26.01
	32.64	Average	H				39.28	54.00	14.72
	42.96	Peak	V				49.60	74.00	24.40
	34.16	Average	V				40.80	54.00	13.20
Test Data for High Channel									
4 960.00	41.62	Peak	H	31.15	12.81	35.96	49.62	74.00	24.38
	32.68	Average	H				40.68	54.00	13.32
	43.20	Peak	V				51.20	74.00	22.80
	34.24	Average	V				42.24	54.00	11.76

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical, "*" Frequency fall in restricted band



Tested by: Tae-Ho, Kim / Senior Manager

13. RADIATED EMISSION TEST

13.1 Operating environment

Temperature : 22.4 °C
Relative humidity : 43.8 % R.H

13.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive turntable 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 26.5 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.

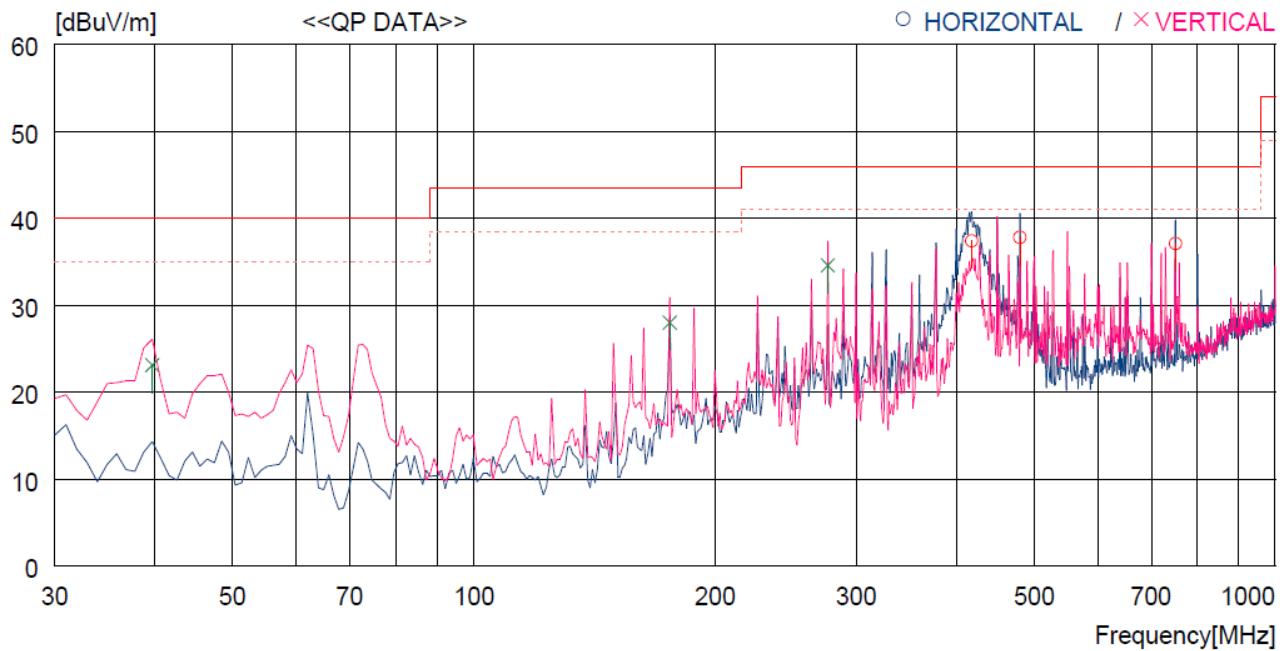
13.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 14, 2018 (1Y)
■ - ESU	Rohde & Schwarz	EMI Test Receiver	100261	Mar. 29, 2018 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 28, 2018 (1Y)
■ - BBV9718	Schwarzbeck	Amplifier	310	Mar. 30, 2018 (1Y)
■ - DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ - MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ - VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-419	Aug. 05, 2016 (2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jul. 28, 2017 (2Y)
■ - TC-3000C	TESCOM	BLUETOOTH TESTER	3000C000634	Mar. 15, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

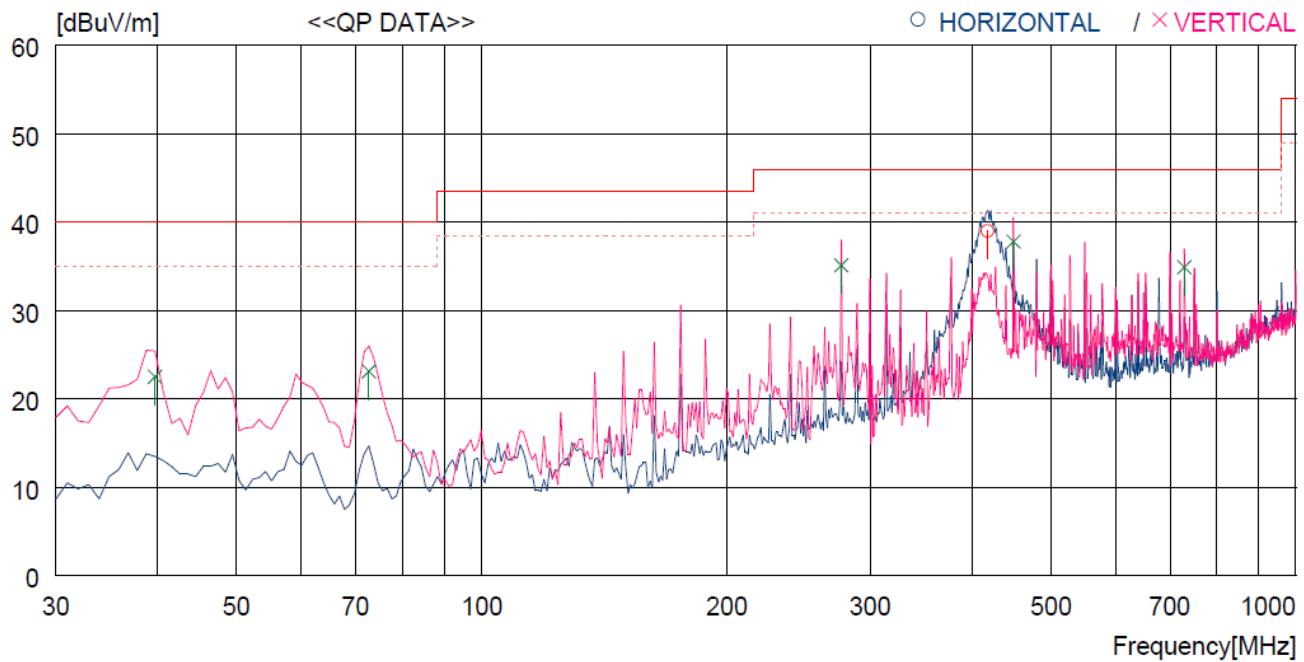
13.4 Test data for 30 MHz ~ 1 000 MHz

- Test Date : June 12, 2018 ~ June 15, 2018
- Resolution bandwidth : 120 kHz
- Frequency range : 30 MHz ~ 1 000 MHz
- Measurement distance : 3 m
- Operating condition : Low Channel



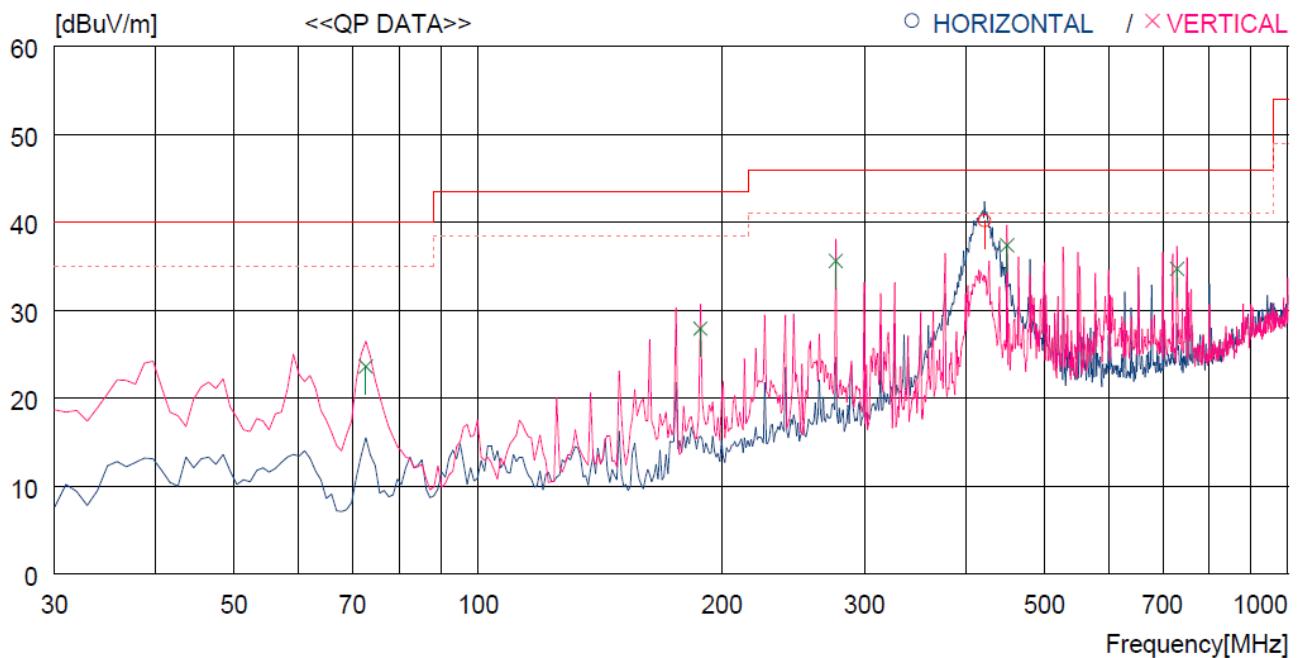
No.	FREQ [MHz]	READING QP	ANT FACTOR	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA TABLE	
									[cm]	[DEG]
----- Horizontal -----										
1	418.001	48.5	15.9	6.2	33.2	37.4	46.0	8.6	100	2
2	480.081	47.9	16.6	6.5	33.2	37.8	46.0	8.2	100	59
3	750.703	42.1	20.2	8.4	33.6	37.1	46.0	8.9	100	160
----- Vertical -----										
4	39.700	40.2	14.1	1.8	33.0	23.1	40.0	16.9	100	355
5	175.500	47.8	9.4	3.8	33.0	28.0	43.5	15.5	100	14
6	276.380	49.8	12.9	4.9	33.0	34.6	46.0	11.4	100	167

Operating condition : Middle Channel



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	QP	FACTOR		[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	418.001	50.1		15.9	6.2	33.2	39.0	46.0	7.0	100
----- Vertical -----										
2	39.700	39.6		14.1	1.8	33.0	22.5	40.0	17.5	100
3	72.680	44.9		8.8	2.5	33.1	23.1	40.0	16.9	100
4	276.380	50.3		12.9	4.9	33.0	35.1	46.0	10.9	100
5	450.011	48.5		16.1	6.4	33.2	37.8	46.0	8.2	100
6	729.364	40.1		20.0	8.3	33.5	34.9	46.0	11.1	100

Operating condition : High Channel



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	421.881	51.3	15.9	6.2	33.2	40.2	46.0	5.8	100	359
----- Vertical -----										
2	72.680	45.4	8.8	2.5	33.1	23.6	40.0	16.4	100	5
3	188.110	46.2	10.8	3.9	33.0	27.9	43.5	15.6	100	12
4	276.380	50.8	12.9	4.9	33.0	35.6	46.0	10.4	100	5
5	450.011	48.1	16.1	6.4	33.2	37.4	46.0	8.6	100	60
6	729.364	39.9	20.0	8.3	33.5	34.7	46.0	11.3	100	329



Tested by: Tae-Ho, Kim / Senior Manager

13.5 Test data for Below 30 MHz

- Test Date : June 12, 2018 ~ June 15, 2018
- Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- Frequency range : 9 kHz ~ 30 MHz
- Measurement distance : 3 m

Frequency (MHz)	Reading (dB μ V)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
It was not observed any emissions from the EUT.								

13.6 Test data for above 1 GHz

- Test Date : June 12, 2018 ~ June 15, 2018
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m

Frequency (MHz)	Reading (dB μ V)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
It was not observed any emissions from the EUT.								



Tested by: Tae-Ho, Kim / Senior Manager

14. CONDUCTED EMISSION TEST

14.1 Operating environment

Temperature : 22.4 °C
Relative humidity : 43.8 % R.H

14.2 Test set-up

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50Ω / $50 \mu\text{H}$ + 5Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

14.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - ESPI	Rohde & Schwarz	EMI Test Receiver	101278	Oct. 27, 2017 (1Y)
□ - ESHS10	Rohde & Schwarz	EMI Test Receiver	834467/007	Mar. 29, 2018 (1Y)
□ - NSLK8128	Schwarzbeck	AMN	8128-216	Mar. 29, 2018 (1Y)
■ - NSLK8126	Schwarzbeck	AMN	8126-404	Apr. 04, 2018 (1Y)
□ - 3825/2	EMCO	AMN	9109-1869	Apr. 11, 2018 (1Y)
■ - 3825/2	EMCO	AMN	9109-1867	Mar. 28, 2018 (1Y)
■ - TC-3000C	TESCOM	BLUETOOTH TESTER	3000C000634	Mar. 15, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

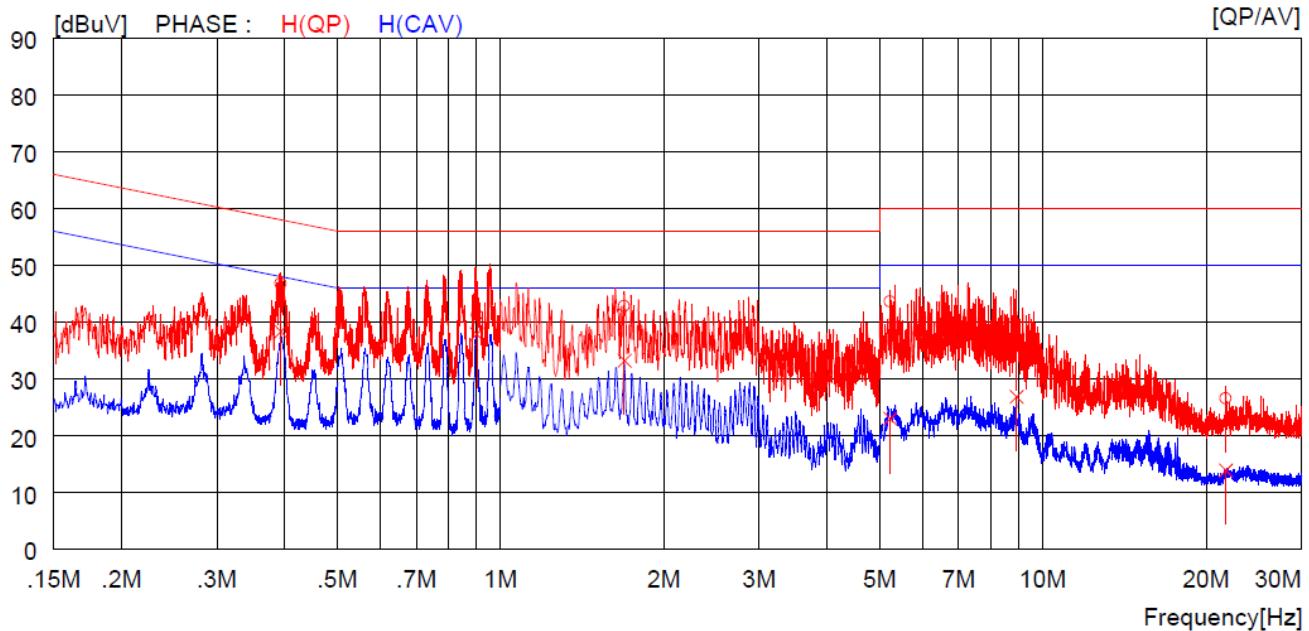
14.4 Test data

- Test Date : June 12, 2018 ~ June 15, 2018

- Resolution bandwidth : 9 kHz

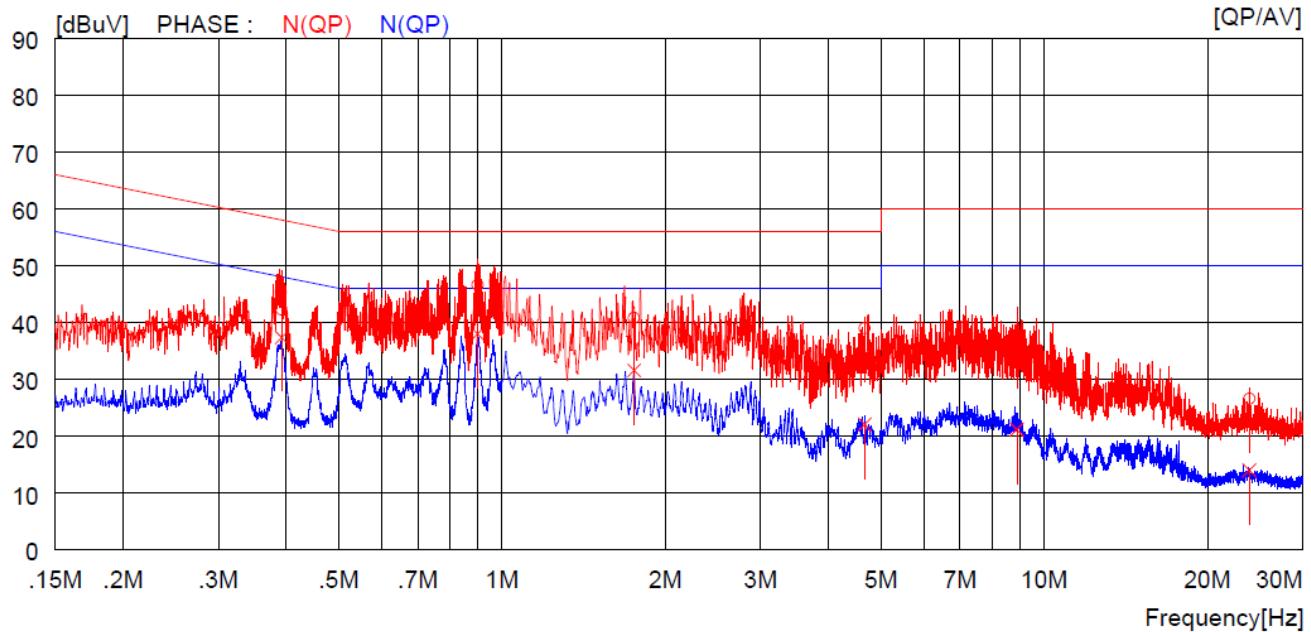
- Frequency range : 0.15 MHz ~ 30 MHz

- Tested Line : HOT LINE



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.39300	37.0	----	9.8	46.8	----	58.0	----	11.2	----	H (QP)
2	0.90400	31.3	----	9.9	41.2	----	56.0	----	14.8	----	H (QP)
3	1.69200	33.0	----	9.9	42.9	----	56.0	----	13.1	----	H (QP)
4	5.23000	33.6	----	10.1	43.7	----	60.0	----	16.3	----	H (QP)
5	8.94500	27.2	----	10.2	37.4	----	60.0	----	22.6	----	H (QP)
6	21.76000	15.9	----	10.7	26.6	----	60.0	----	33.4	----	H (QP)
7	0.39300	----	28.6	9.8	----	38.4	----	48.0	----	9.6	H (CAV)
8	0.90400	----	28.0	9.9	----	37.9	----	46.0	----	8.1	H (CAV)
9	1.69200	----	23.3	9.9	----	33.2	----	46.0	----	12.8	H (CAV)
10	5.23000	----	12.9	10.1	----	23.0	----	50.0	----	27.0	H (CAV)
11	8.94500	----	16.7	10.2	----	26.9	----	50.0	----	23.1	H (CAV)
12	21.76000	----	3.2	10.7	----	13.9	----	50.0	----	36.1	H (CAV)

- Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.39200	32.5	----	9.8	42.3	----	58.0	----	15.7	----	N (QP)
2	0.90200	36.7	----	9.9	46.6	----	56.0	----	9.4	----	N (QP)
3	1.75200	30.9	----	9.9	40.8	----	56.0	----	15.2	----	N (QP)
4	4.66800	28.9	----	10.1	39.0	----	56.0	----	17.0	----	N (QP)
5	8.90000	27.7	----	10.2	37.9	----	60.0	----	22.1	----	N (QP)
6	23.90000	15.9	----	10.7	26.6	----	60.0	----	33.4	----	N (QP)
7	0.39200	----	27.6	9.8	----	37.4	----	48.0	----	10.6	N (CAV)
8	0.90200	----	28.1	9.9	----	38.0	----	46.0	----	8.0	N (CAV)
9	1.75200	----	21.7	9.9	----	31.6	----	46.0	----	14.4	N (CAV)
10	4.66800	----	12.0	10.1	----	22.1	----	46.0	----	23.9	N (CAV)
11	8.90000	----	11.0	10.2	----	21.2	----	50.0	----	28.8	N (CAV)
12	23.90000	----	3.3	10.7	----	14.0	----	50.0	----	36.0	N (CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.



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