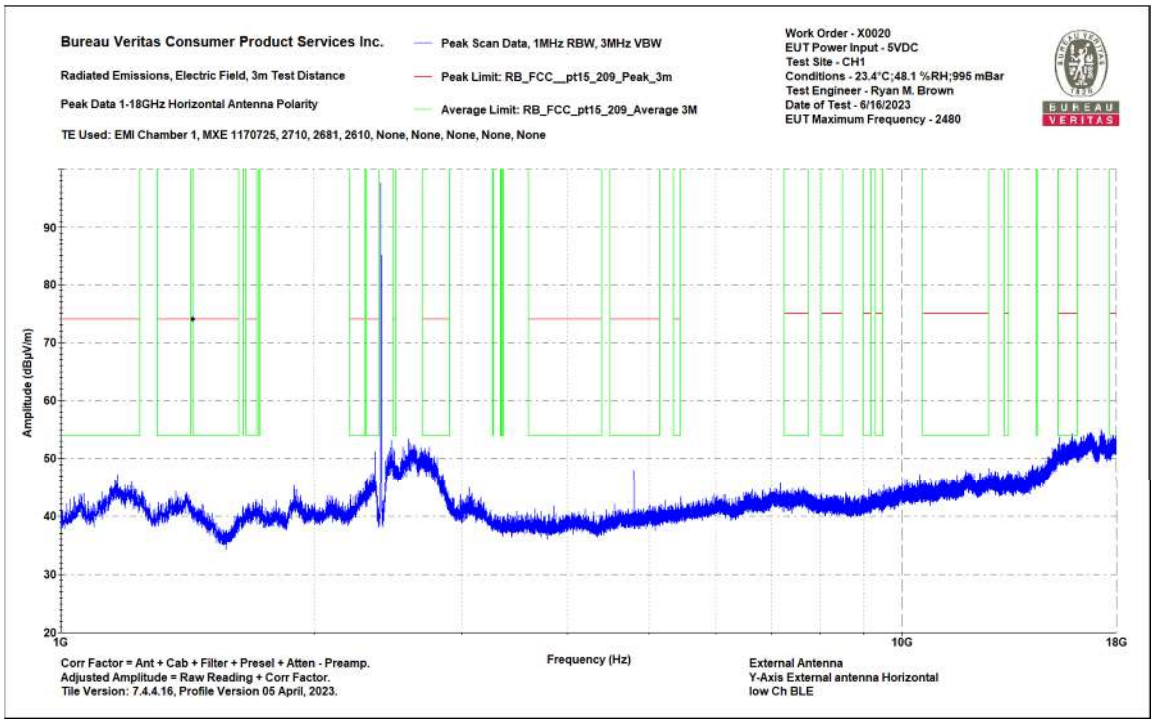
Bureau Veritas Consumer Product Services Inc.	Work Order - X0020
Radiated Emissions Electric Field 3m Distance	EUT Power Input - 5VDC
1-18GHz Horizontal Data	Test Site - CH1
Notes:	Conditions - 23.4°C;48.1 %RH;995 mBar
External Antenna	Test Engineer - Ryan M. Brown
Y-Axis External antenna Horizontal	Date of Test - 6/16/2023
low Ch BLE	

Frequency (MHz)	Raw Peak (dBµV)	Raw RMS Average (dBµV)	Correction Factor (dB/m)	Adjusted Peak (dBµV/m)	Adjusted RMS Average (dBµV/m)	Peak Limit FCC 15.209 (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	Peak Worst Margin (dB)	Average Limit FCC 15.209 (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)	Average Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1170	44.05	44.05	0.5	44.55	44.55	74	-29.45	PASS	--	54	-9.45	PASS	--	175	281
2365	37.6	37.6	7	44.6	44.6	74	-29.4	PASS	--	54	-9.4	PASS	--	199	46
4804.4	36.99	36.99	9.9	46.89	46.89	74	-27.11	PASS	--	54	-7.11	PASS	-7.11	168	120
15983	29.81	20.22	21.4	51.21	41.62	74	-22.79	PASS	--	54	-12.38	PASS	--	169	94
17854.9	30.22	19.89	22.5	52.72	42.39	74	-21.28	PASS	-21.28	54	-11.61	PASS	--	150	41

1-18GHz Horizontal Data Table



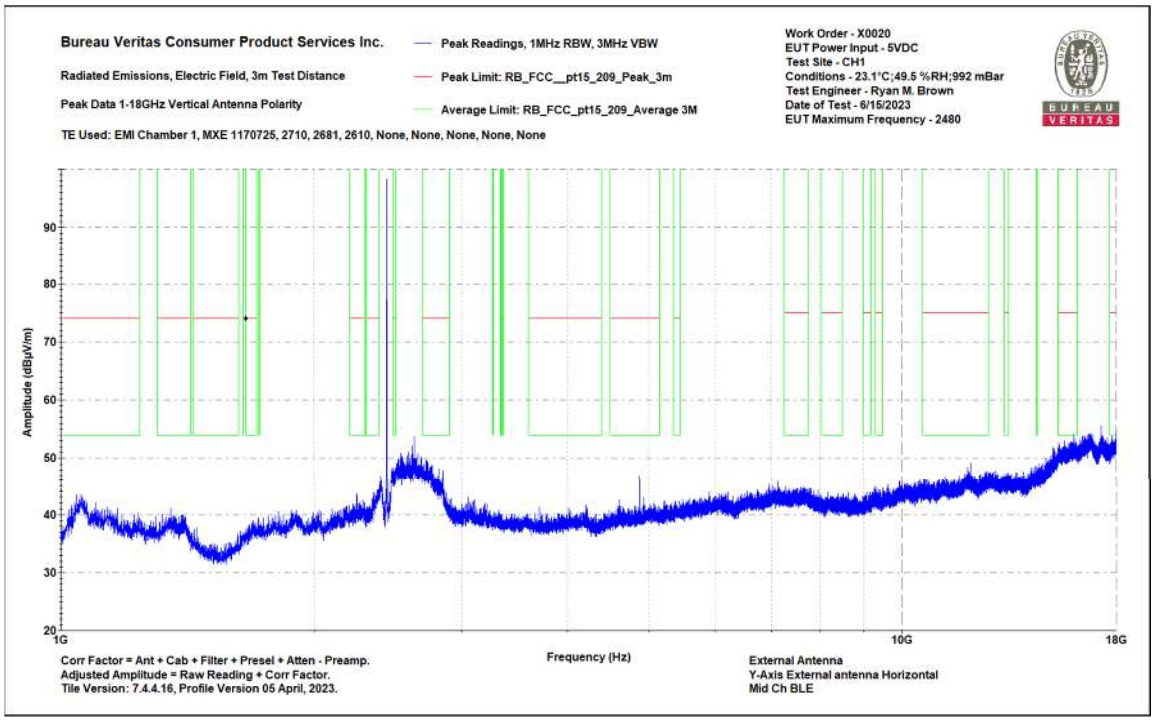
1-18GHz Horizontal Plot

Results for BLE 1Mbps GFSK Channel 19

Bureau Veritas Consumer Product Services Inc.	Work Order - X0020
Radiated Emissions Electric Field 3m Distance	EUT Power Input - 5VDC
1-18GHz Vertical Data	Test Site - CH1
Notes:	Conditions - 23.1°C;49.5 %RH;992 mBar
External Antenna	Test Engineer - Ryan M. Brown
Y-Axis External antenna Horizontal	Date of Test - 6/15/2023
Mid Ch BLE	

Frequency (MHz)	Raw Peak (dBµV)	Raw RMS Average (dBµV)	Correction Factor (dB/m)	Adjusted Peak (dBµV/m)	Adjusted RMS Average (dBµV/m)	Peak Limit FCC 15.209 (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	Peak Worst Margin (dB)	Average Limit FCC 15.209 (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)	Average Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
4880.5	36.96	36.2	10	46.96	46.2	74	-27.04	PASS	--	54	-7.8	PASS	--	200	268
9163.8	27.73	26.8	13.3	41.03	40.1	74	-32.97	PASS	--	54	-13.9	PASS	--	200	326
16039.8	29.95	19.96	21.4	51.35	41.36	74	-22.65	PASS	-22.65	54	-12.64	PASS	--	154	343
17988.4	28.69	24.4	22.6	51.29	47	74	-22.71	PASS	--	54	-7	PASS	-7	172	126

1-18GHz Vertical Data Table

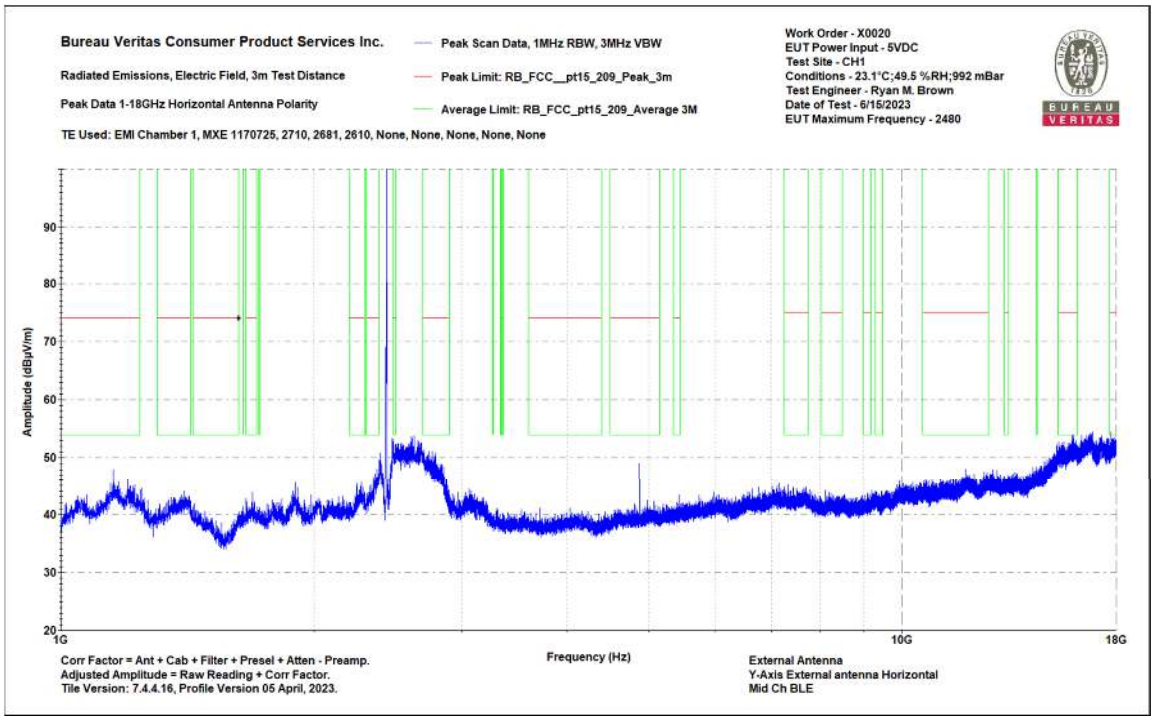


1-18GHz Vertical Plot

Bureau Veritas Consumer Product Services Inc.	Work Order - X0020
Radiated Emissions Electric Field 3m Distance	EUT Power Input - 5VDC
1-18GHz Horizontal Data	Test Site - CH1
Notes:	Conditions - 23.1°C;49.5 %RH;992 mBar
External Antenna	Test Engineer - Ryan M. Brown
Y-Axis External antenna Horizontal	Date of Test - 6/15/2023
Mid Ch BLE	

Frequency (MHz)	Raw Peak (dBµV)	Raw RMS Average (dBµV)	Correction Factor (dB/m)	Adjusted Peak (dBµV/m)	Adjusted RMS Average (dBµV/m)	Peak Limit FCC 15.209 (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	Peak Worst Margin (dB)	Average Limit FCC 15.209 (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)	Average Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1155.9	44.01	44.01	0.4	44.41	44.41	74	-29.59	PASS	--	54	-9.59	PASS	--	147	298
2275.7	37.67	37.67	6.6	44.27	44.27	74	-29.73	PASS	--	54	-9.73	PASS	--	200	49
4880.5	38.29	35.49	10	48.29	45.49	74	-25.71	PASS	--	54	-8.51	PASS	-8.51	118	316
17745.7	30.83	19.1	22.2	53.03	41.3	74	-20.97	PASS	-20.97	54	-12.7	PASS	--	112	330
17997.7	29.41	20.36	22.6	52.01	42.96	74	-21.99	PASS	--	54	-11.04	PASS	--	100	107

1-18GHz Horizontal Data Table



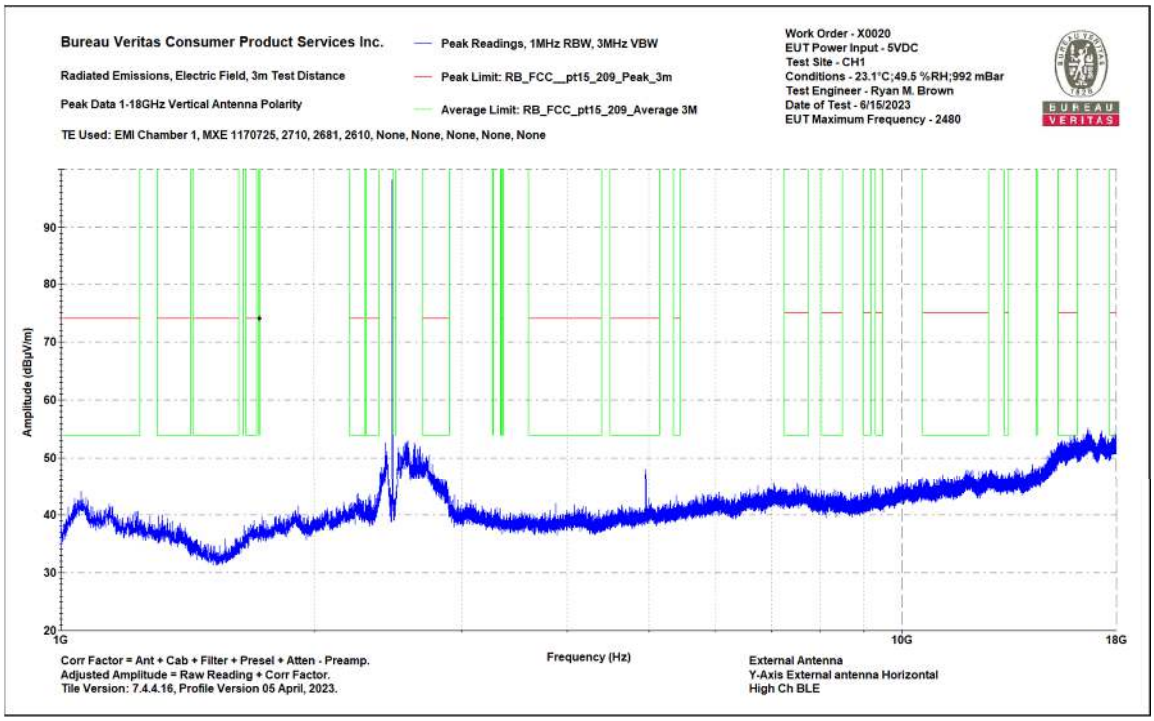
1-18GHz Horizontal Plot

Results for BLE 1Mbps GFSK Channel 39

Bureau Veritas Consumer Product Services Inc.	Work Order - X0020
Radiated Emissions Electric Field 3m Distance	EUT Power Input - 5VDC
1-18GHz Vertical Data	Test Site - CH1
Notes:	Conditions - 23.1°C;49.5 %RH;992 mBar
External Antenna	Test Engineer - Ryan M. Brown
Y-Axis External antenna Horizontal	Date of Test - 6/15/2023
High Ch BLE	

Frequency (MHz)	Raw Peak (dBµV)	Raw RMS Average (dBµV)	Correction Factor (dB/m)	Adjusted Peak (dBµV/m)	Adjusted RMS Average (dBµV/m)	Peak Limit FCC 15.209 (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	Peak Worst Margin (dB)	Average Limit FCC 15.209 (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)	Average Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1053.8	43.3	43.3	-0.9	42.4	42.4	74	-31.6	PASS	--	54	-11.6	PASS	--	116	94
4960.6	37.89	37.89	10.1	47.99	47.99	74	-26.01	PASS	--	54	-6.01	PASS	-6.01	182	207
17880.2	29.12	19	22.5	51.62	41.5	74	-22.38	PASS	--	54	-12.5	PASS	--	197	167
17961.2	30.24	19.1	22.5	52.74	41.6	74	-21.26	PASS	-21.26	54	-12.4	PASS	--	114	31
17999.6	29.76	19.1	22.6	52.36	41.7	74	-21.64	PASS	--	54	-12.3	PASS	--	191	58

1-18GHz Vertical Data Table

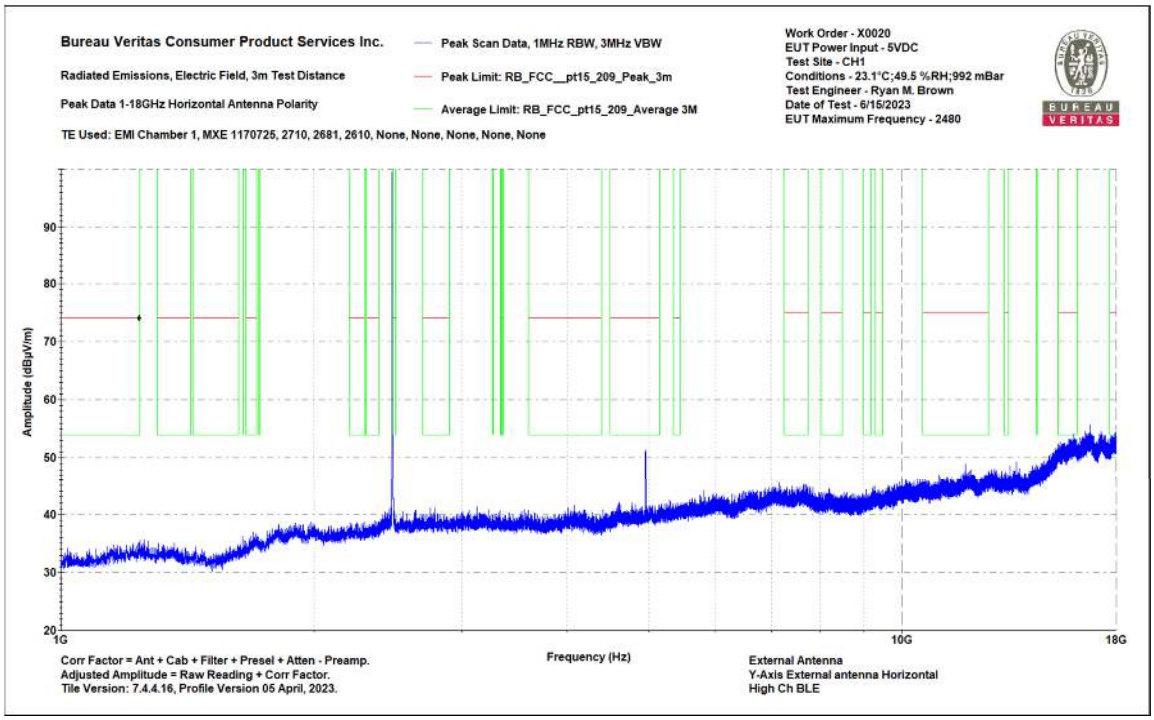


1-18GHz Vertical Plot

Bureau Veritas Consumer Product Services Inc.	Work Order - X0020
Radiated Emissions Electric Field 3m Distance	EUT Power Input - 5VDC
1-18GHz Horizontal Data	Test Site - CH1
Notes:	Conditions - 23.1°C;49.5 %RH;992 mBar
External Antenna	Test Engineer - Ryan M. Brown
Y-Axis External antenna Horizontal	Date of Test - 6/15/2023
High Ch BLE	EUT Maximum Frequency - 2480

Frequency (MHz)	Raw Peak (dBµV)	Raw RMS Average (dBµV)	Correction Factor (dB/m)	Adjusted Peak (dBµV/m)	Adjusted RMS Average (dBµV/m)	Peak Limit FCC 15.209 (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	Peak Worst Margin (dB)	Average Limit FCC 15.209 (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)	Average Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
4076.4	29.08	29.08	8.9	37.98	37.98	74	-36.02	PASS	--	54	-16.02	PASS	--	112	23
4959.5	40.9	33.21	10.1	51	43.31	74	-23	PASS	--	54	-10.69	PASS	-10.69	125	109
9066.3	27.73	27.73	13.2	40.93	40.93	74	-33.07	PASS	--	54	-13.07	PASS	--	125	44
16030.5	32.84	20.1	21.4	54.24	41.5	74	-19.76	PASS	-19.76	54	-12.5	PASS	--	109	18
17932.3	30.01	19.74	22.5	52.51	42.24	74	-21.49	PASS	--	54	-11.76	PASS	--	122	181
17970.8	29.89	19.59	22.5	52.39	42.09	74	-21.61	PASS	--	54	-11.91	PASS	--	200	206

1-18GHz Horizontal Data Table



1-18GHz Horizontal Plot

Radiated Emissions Table

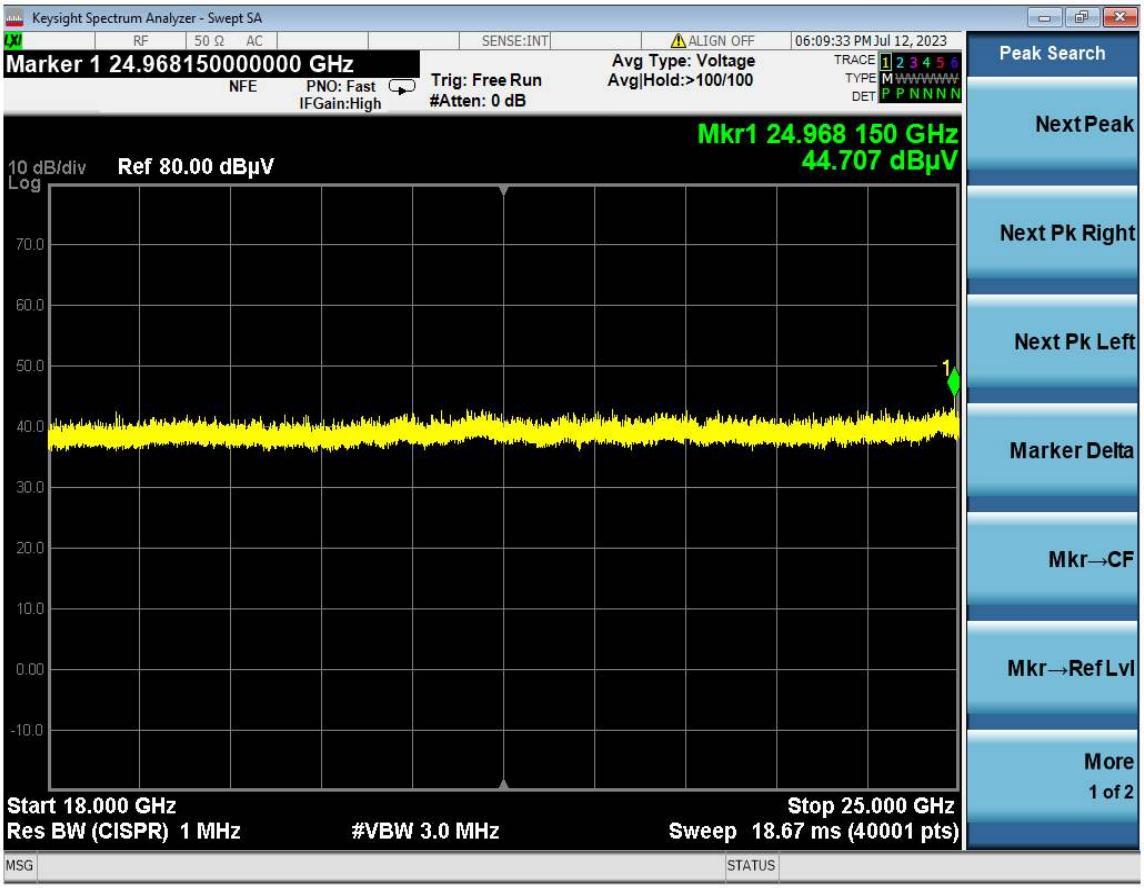
Date: 12-Jul-23 **Company:** Hayward **Work Order:** X0020
Engineer: Yunus Faziloglu **EUT Desc:** BT and 900 Wireless Module 2023 **EUT Operating Voltage/Frequency:** 3.3VDC
Temp: 23.7C **Humidity:** 55% **Pressure:** 1003mbar
Frequency Range: 18-25GHz **Measurement Distance:** 1 m
Notes: External antenna (Both positions: upright and 90deg bent) and 3 othogonal planes of the module (X,Y,Z) **EUT Max Freq:** 2480MHz
No emissions detected. Peak measurement. Worst case noise floor recorded below.
Measurement antenna H/V polarity showed no significant difference in noise floor.

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Antenna & Preamp Factor (dB)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC 15.209 - Peak			FCC 15.209- Average		
								Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
Highest Noise Floor	24968.0	44.7	44.7	4.8	3.7	53.2	53.2	83.5	-30.3	Pass	63.5	-10.3	Pass

Table Result: Pass by -10.3 dB ***Worst Freq:*** 24968.0 MHz

Test Site: EMI Chamber 1 **Cable:** Asset #2596
Analyzer: 1274541 **18-40GHz Horn with PreAmp:** Asset #2709
CSsoft Radiated Emissions Calculator v 1.017.225
Adjusted Reading = Reading + Antenna & Preamp Factor + Cable Factor

18-25GHz Data Table



18-25GHz Plot

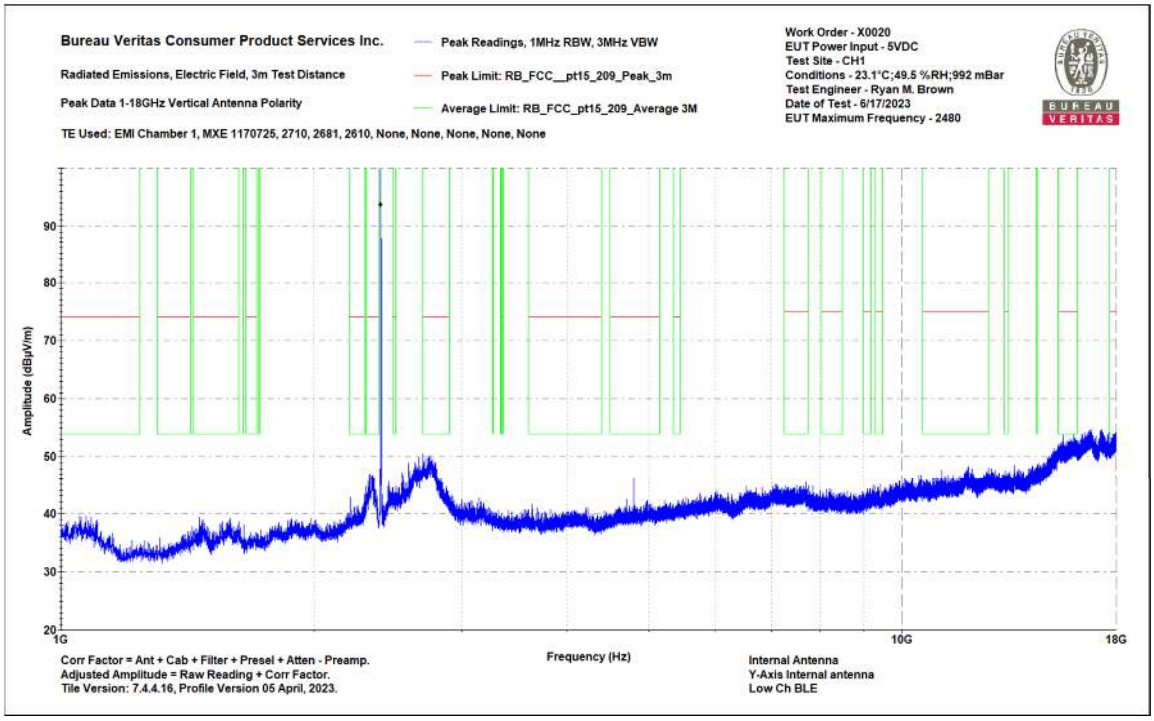
Internal Antenna

Results for BLE 1Mbps GFSK Channel 0

Bureau Veritas Consumer Product Services Inc.	Work Order - X0020
Radiated Emissions Electric Field 3m Distance	EUT Power Input - 5VDC
1-18GHz Vertical Data	Test Site - CH1
Notes:	Conditions - 23.1°C;49.5 %RH;992 mBar
Internal Antenna	Test Engineer - Ryan M. Brown
Y-Axis Internal antenna	Date of Test - 6/17/2023
Low Ch BLE	

Frequency (MHz)	Raw Peak (dBµV)	Raw RMS Average (dBµV)	Correction Factor (dB/m)	Adjusted Peak (dBµV/m)	Adjusted RMS Average (dBµV/m)	Peak Limit FCC 15.209 (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	Peak Worst Margin (dB)	Average Limit FCC 15.209 (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)	Average Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
2694.2	39.7	39.7	7.7	47.4	47.4	74	-26.6	PASS	--	54	-6.6	PASS	-6.6	133	83
4804.7	36.1	36.1	9.9	46	46	74	-28	PASS	--	54	-8	PASS	--	200	234
9108.7	29.7	29.7	13.2	42.9	42.9	74	-31.1	PASS	--	54	-11.1	PASS	--	117	67
17960.2	29.35	20.5	22.5	51.85	43	74	-22.15	PASS	-22.15	54	-11	PASS	--	200	300
17988	29.18	19.87	22.6	51.78	42.47	74	-22.22	PASS	--	54	-11.53	PASS	--	153	153

1-18GHz Vertical Data Table

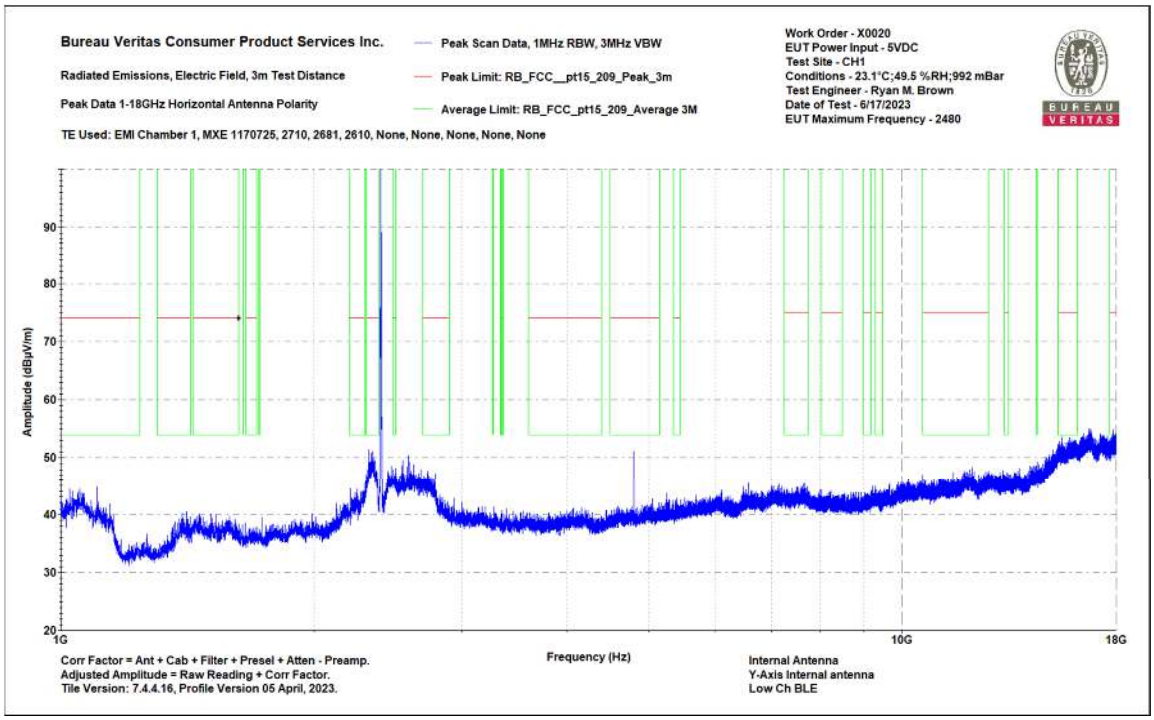


1-18GHz Vertical Plot

Bureau Veritas Consumer Product Services Inc.	Work Order - X0020
Radiated Emissions Electric Field 3m Distance	EUT Power Input - 5VDC
1-18GHz Horizontal Data	Test Site - CH1
Notes:	Conditions - 23.1°C;49.5 %RH;992 mBar
Internal Antenna	Test Engineer - Ryan M. Brown
Y-Axis Internal antenna	Date of Test - 6/17/2023
Low Ch BLE	

Frequency (MHz)	Raw Peak (dBµV)	Raw RMS Average (dBµV)	Correction Factor (dB/m)	Adjusted Peak (dBµV/m)	Adjusted RMS Average (dBµV/m)	Peak Limit FCC 15.209 (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	Peak Worst Margin (dB)	Average Limit FCC 15.209 (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)	Average Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1103.9	45.35	43.5	-0.6	44.75	42.9	74	-29.25	PASS	--	54	-11.1	PASS	--	147	224
4803.6	41.22	33.8	9.9	51.12	43.7	74	-22.88	PASS	--	54	-10.3	PASS	-10.3	150	210
17813.8	29.26	20.02	22.5	51.76	42.52	74	-22.24	PASS	--	54	-11.48	PASS	--	135	225
17859.6	29.18	19.84	22.5	51.68	42.34	74	-22.32	PASS	--	54	-11.66	PASS	--	101	58
17878.1	31.76	19.91	22.5	54.26	42.41	74	-19.74	PASS	-19.74	54	-11.59	PASS	--	175	84
17951.3	28.42	20.13	22.5	50.92	42.63	74	-23.08	PASS	--	54	-11.37	PASS	--	150	41

1-18GHz Horizontal Data Table



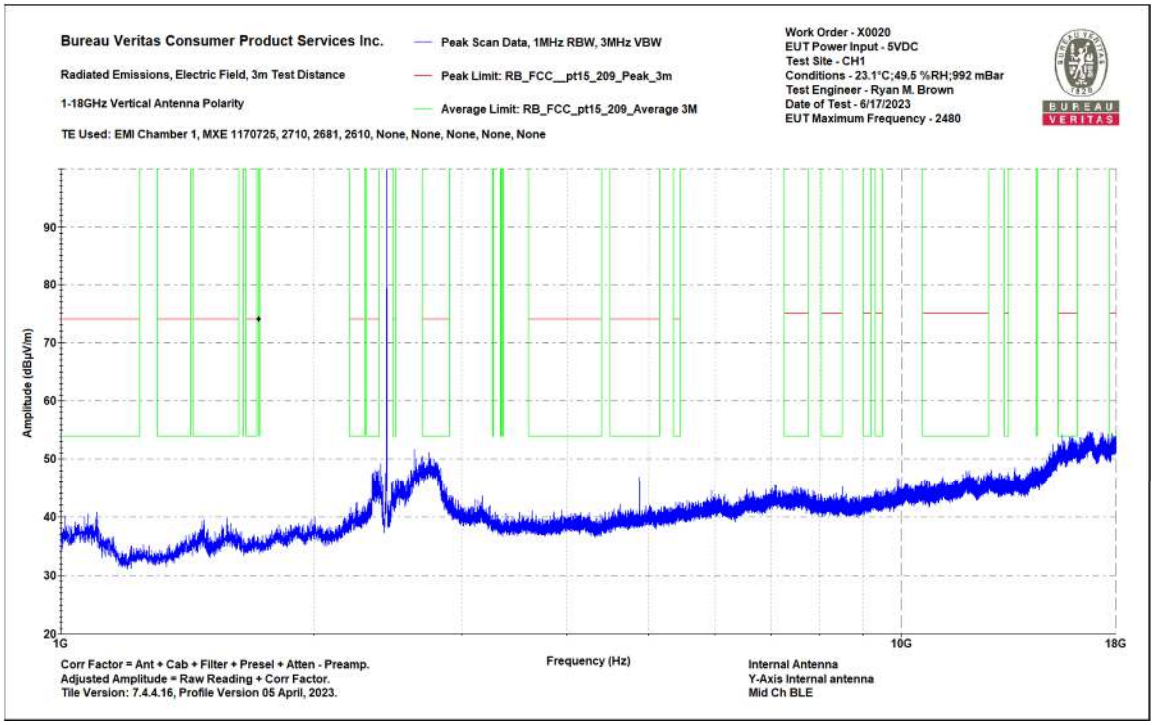
1-18GHz Horizontal Plot

Results for BLE 1Mbps GFSK Channel 19

Bureau Veritas Consumer Product Services Inc.	Work Order - X0020
Radiated Emissions Electric Field 3m Distance	EUT Power Input - 5VDC
1-18GHz Vertical Data	Test Site - CH1
Notes:	Conditions - 23.1°C;49.5 %RH;992 mBar
Internal Antenna	Test Engineer - Ryan M. Brown
Y-Axis Internal antenna	Date of Test - 6/17/2023
Mid Ch BLE	

Frequency (MHz)	Raw Peak (dBµV)	Raw RMS Average (dBµV)	Correction Factor (dB/m)	Adjusted Peak (dBµV/m)	Adjusted RMS Average (dBµV/m)	Peak Limit FCC 15.209 (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	Peak Worst Margin (dB)	Average Limit FCC 15.209 (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)	Average Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
2248.4	35.76	35.76	6.6	42.36	42.36	74	-31.64	PASS	--	54	-11.64	PASS	--	200	237
4880.6	34.94	34.94	10	44.94	44.94	74	-29.06	PASS	--	54	-9.06	PASS	-9.06	100	6
15544.5	29.44	20.04	21.2	50.64	41.24	74	-23.36	PASS	--	54	-12.76	PASS	--	200	31
16197.2	29.42	20.22	21	50.42	41.22	74	-23.58	PASS	--	54	-12.78	PASS	--	100	9
17805.3	31.85	20.15	22.5	54.35	42.65	74	-19.65	PASS	-19.65	54	-11.35	PASS	--	116	213

1-18GHz Vertical Data Table

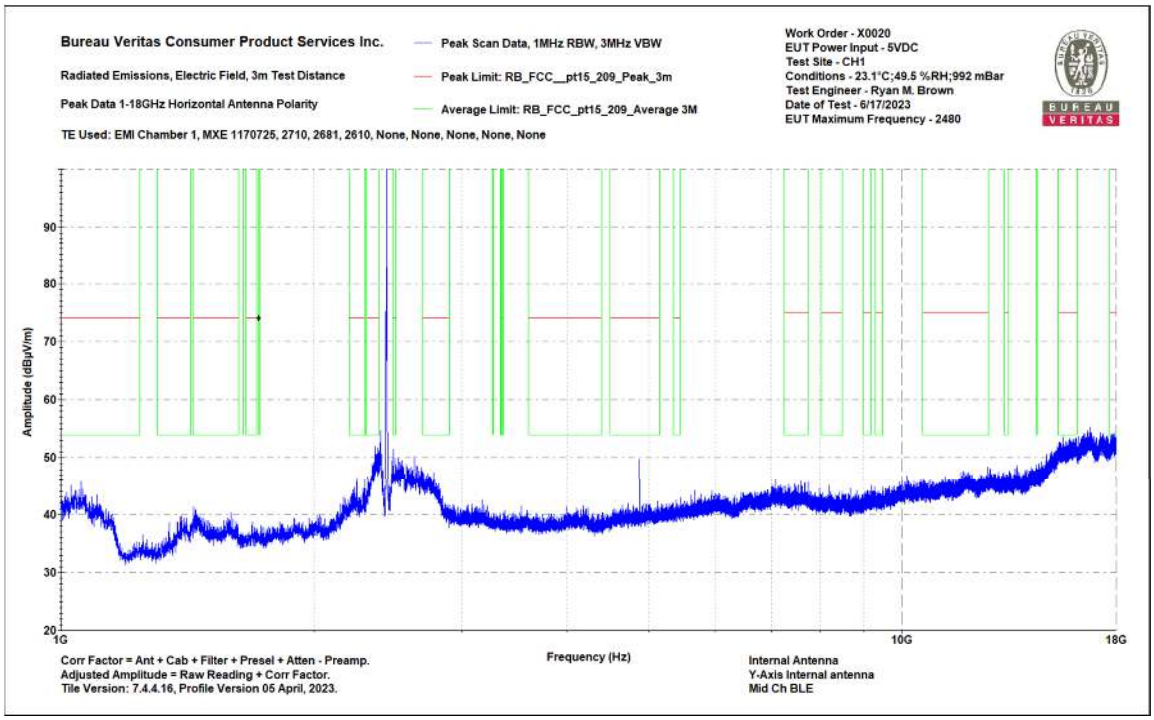


1-18GHz Vertical Plot

Bureau Veritas Consumer Product Services Inc.	Work Order - X0020
Radiated Emissions Electric Field 3m Distance	EUT Power Input - 5VDC
1-18GHz Horizontal Data	Test Site - CH1
Notes:	Conditions - 23.1°C;49.5 %RH;992 mBar
Internal Antenna	Test Engineer - Ryan M. Brown
Y-Axis Internal antenna	Date of Test - 6/17/2023
Mid Ch BLE	

Frequency (MHz)	Raw Peak (dBµV)	Raw RMS Average (dBµV)	Correction Factor (dB/m)	Adjusted Peak (dBµV/m)	Adjusted RMS Average (dBµV/m)	Peak Limit FCC 15.209 (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	Peak Worst Margin (dB)	Average Limit FCC 15.209 (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)	Average Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
2248	39.87	38.4	6.6	46.47	45	74	-27.53	PASS	--	54	-9	PASS	-9	150	164
4879.5	39.81	32.98	10	49.81	42.98	74	-24.19	PASS	--	54	-11.02	PASS	--	101	3
16197.9	29	20.44	21	50	41.44	74	-24	PASS	--	54	-12.56	PASS	--	200	148
17802.6	29.3	20.04	22.5	51.8	42.54	74	-22.2	PASS	--	54	-11.46	PASS	--	200	247
17850.3	29.07	20.31	22.5	51.57	42.81	74	-22.43	PASS	--	54	-11.19	PASS	--	111	0
17927.5	31.79	20.2	22.5	54.29	42.7	74	-19.71	PASS	-19.71	54	-11.3	PASS	--	107	303

1-18GHz Horizontal Data Table



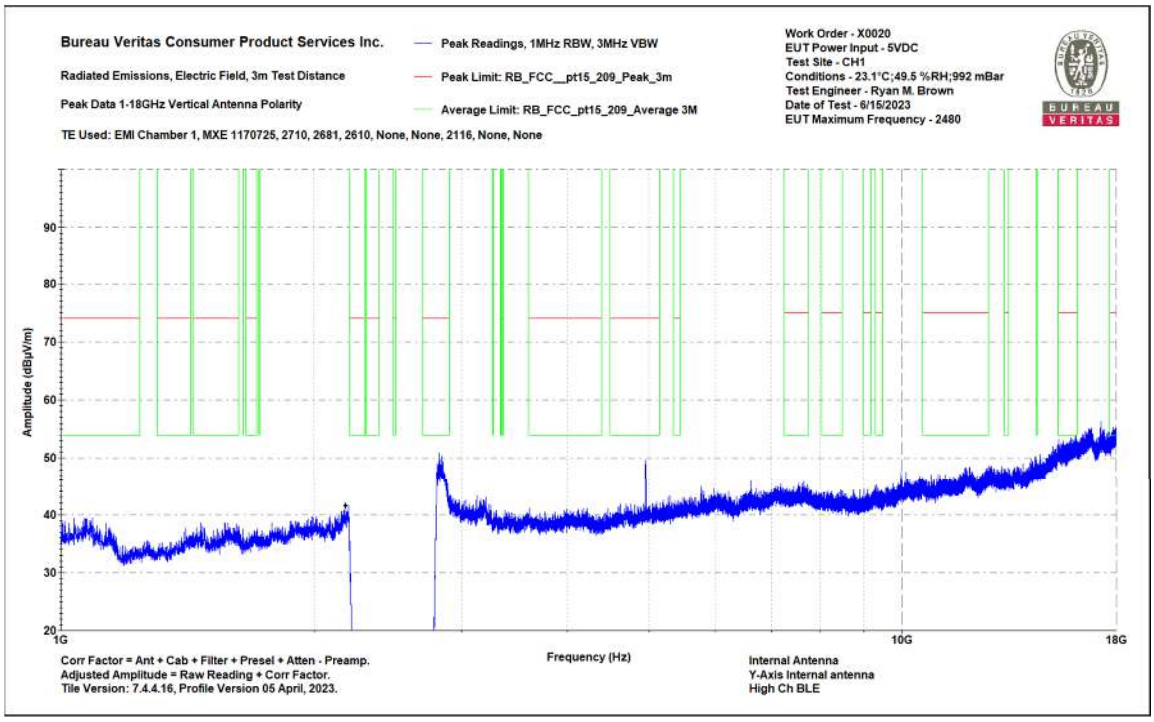
1-18GHz Horizontal Plot

Results for BLE 1Mbps GFSK Channel 39

Bureau Veritas Consumer Product Services Inc.	Work Order - X0020
Radiated Emissions Electric Field 3m Distance	EUT Power Input - 5VDC
1-18GHz Vertical Data	Test Site - CH1
Notes:	Conditions - 23.1°C;49.5 %RH;992 mBar
Internal Antenna	Test Engineer - Ryan M. Brown
Y-Axis Internal antenna	Date of Test - 6/15/2023
High Ch BLE	

Frequency (MHz)	Raw Peak (dBµV)	Raw RMS Average (dBµV)	Correction Factor (dB/m)	Adjusted Peak (dBµV/m)	Adjusted RMS Average (dBµV/m)	Peak Limit FCC 15.209 (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	Peak Worst Margin (dB)	Average Limit FCC 15.209 (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)	Average Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
2820.7	34.52	34.52	12.7	47.22	47.22	74	-26.78	PASS	--	54	-6.78	PASS	-6.78	101	95
4960.5	39.08	32.07	10.5	49.58	42.57	74	-24.42	PASS	--	54	-11.43	PASS	--	189	175
9108.8	28.45	28.45	13.6	42.05	42.05	74	-31.95	PASS	--	54	-11.95	PASS	--	118	70
17852.4	29.86	20.25	23.9	53.76	44.15	74	-20.24	PASS	--	54	-9.85	PASS	--	118	118
17950.8	29.62	19.78	23.9	53.52	43.68	74	-20.48	PASS	--	54	-10.32	PASS	--	115	192
17983.3	31.03	20.38	24	55.03	44.38	74	-18.97	PASS	-18.97	54	-9.62	PASS	--	139	347

1-18GHz Vertical Data Table

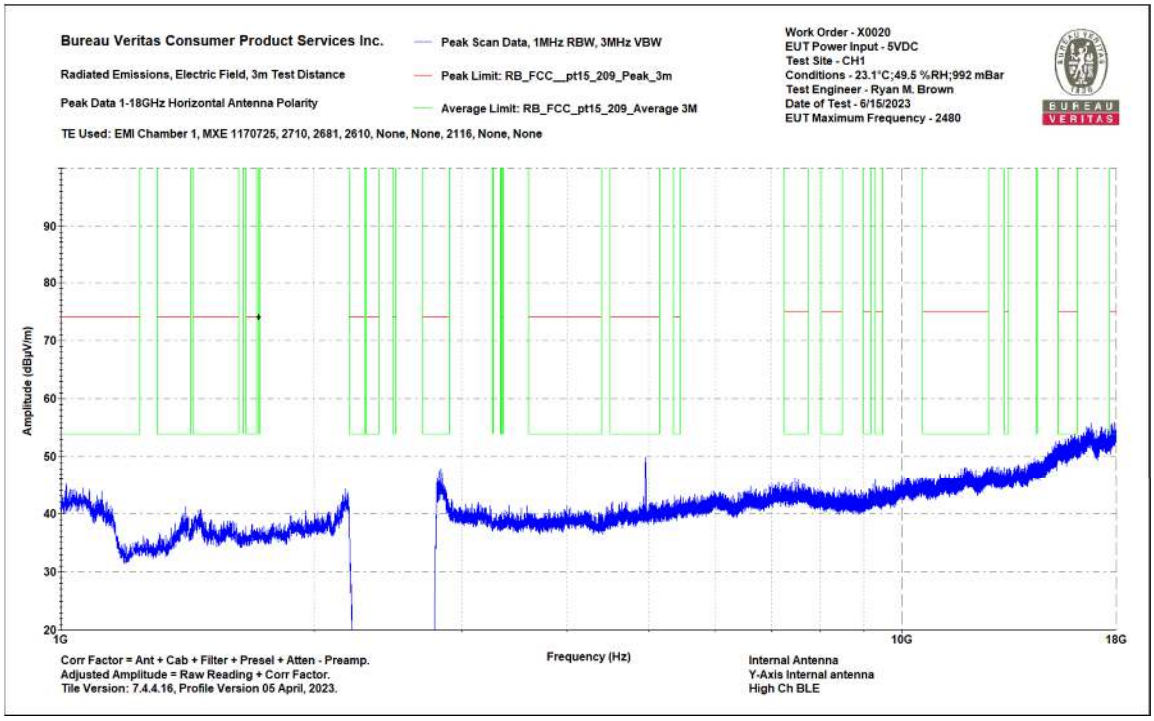


1-18GHz Vertical Plot

Bureau Veritas Consumer Product Services Inc.	Work Order - X0020
Radiated Emissions Electric Field 3m Distance	EUT Power Input - 5VDC
1-18GHz Horizontal Data	Test Site - CH1
Notes:	Conditions - 23.1°C;49.5 %RH;992 mBar
Internal Antenna	Test Engineer - Ryan M. Brown
Y-Axis Internal antenna	Date of Test - 6/15/2023
High Ch BLE	EUT Maximum Frequency - 2480

Frequency (MHz)	Raw Peak (dBµV)	Raw RMS Average (dBµV)	Correction Factor (dB/m)	Adjusted Peak (dBµV/m)	Adjusted RMS Average (dBµV/m)	Peak Limit FCC 15.209 (dBµV/m)	Peak Margin (dB)	Peak Result (Pass/Fail)	Peak Worst Margin (dB)	Average Limit FCC 15.209 (dBµV/m)	Average Margin (dB)	Average Result (Pass/Fail)	Average Worst Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1012.6	44.52	44.52	-0.7	43.82	43.82	74	-30.18	PASS	--	54	-10.18	PASS	--	195	232
2831.2	34.3	34.3	12.3	46.6	46.6	74	-27.4	PASS	--	54	-7.4	PASS	-7.4	175	236
4959.6	39.33	35.55	10.5	49.83	46.05	74	-24.17	PASS	--	54	-7.95	PASS	--	133	196
16070.9	31.79	20.26	21.6	53.39	41.86	74	-20.61	PASS	--	54	-12.14	PASS	--	199	170
16199.2	30.35	20.52	21.5	51.85	42.02	74	-22.15	PASS	--	54	-11.98	PASS	--	125	150
17735.8	29.5	20.04	23.3	52.8	43.34	74	-21.2	PASS	--	54	-10.66	PASS	--	128	231
17773.5	30.26	19.46	23.7	53.96	43.16	74	-20.04	PASS	--	54	-10.84	PASS	--	150	68
17806.8	29.23	19.64	23.9	53.13	43.54	74	-20.87	PASS	--	54	-10.46	PASS	--	151	19
17934.3	28.3	20.17	23.9	52.2	44.07	74	-21.8	PASS	--	54	-9.93	PASS	--	198	157
17999	30.95	19.74	24.1	55.05	43.84	74	-18.95	PASS	-18.95	54	-10.16	PASS	--	100	91

1-18GHz Horizontal Data Table



1-18GHz Horizontal Plot

Radiated Emissions Table

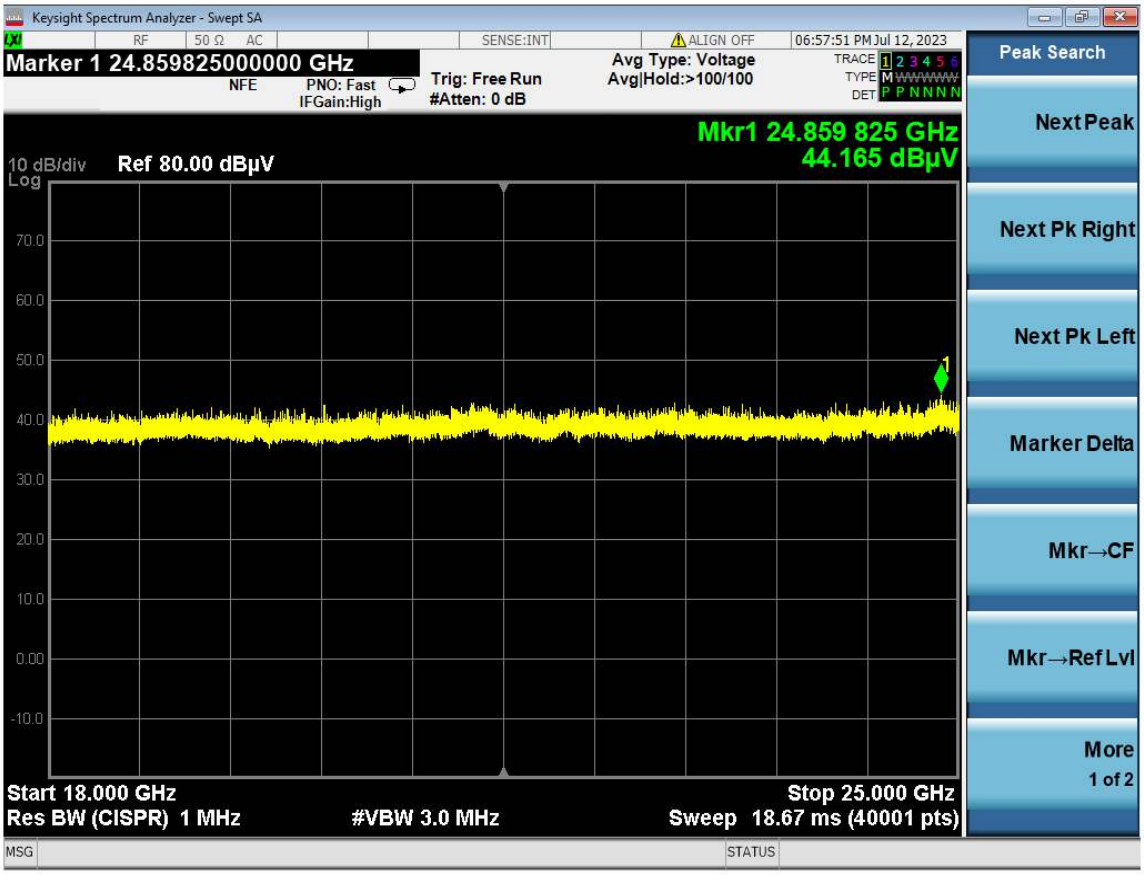
Date: 12-Jul-23 **Company:** Hayward **Work Order:** X0020
Engineer: Yunus Faziloglu **EUT Desc:** BT and 900 Wireless Module 2023 **EUT Operating Voltage/Frequency:** 3.3VDC
Temp: 23.7C **Humidity:** 55% **Pressure:** 1003mbar
Frequency Range: 18-25GHz **Measurement Distance:** 1 m
Notes: Internal antenna, 3 othogonal planes of the module (X,Y,Z) **EUT Max Freq:** 2480MHz
No emissions detected. Peak measurement. Worst case noise floor recorded below.
Measurement antenna H/V polarity showed no significant difference in noise floor.

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Antenna & Preamp Factor (dB)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC 15.209 - Peak Limit (dBµV/m)	FCC 15.209 - Peak Margin (dB)	FCC 15.209 - Peak Result (Pass/Fail)	FCC 15.209- Average Limit (dBµV/m)	FCC 15.209- Average Margin (dB)	FCC 15.209- Average Result (Pass/Fail)
Highest Noise Floor	24860.0	44.2	44.2	4.7	3.7	52.6	52.6	83.5	-30.9	Pass	63.5	-10.9	Pass

Table Result: Pass by -10.9 dB ***Worst Freq:*** 24860.0 MHz

Test Site: EMI Chamber 1 **Cable:** Asset #2596
Analyzer: 1274541 **18-40GHz Horn with PreAmp:** Asset #2709
CSsoft Radiated Emissions Calculator v 1.017.225
Adjusted Reading = Reading + Antenna & Preamp Factor + Cable Factor

18-25GHz Data Table



18-25GHz Plot

BLE 1Mbps GFSK Radiated Band-edge:

External Antenna

Radiated Emissions Table

Date: 15-Jun-23 **Company:** Hayward **Work Order:** X0020
Engineer: Ryan M. Brown **EUT Desc:** BT923 **EUT Operating Voltage/Frequency:** 5VDC
Temp: 22.7C **Humidity:** 51% **Pressure:** 1001mbar
Frequency Range: Band Edge **Measurement Distance:** 3 m
Notes: External Antenna **EUT Max Freq:** 2480
RMS Trace Averaging over 200 traces were used for all average measurements.

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class B High Frequency - Peak Limit (dBµV/m)	FCC Class B High Frequency - Peak Margin (dB)	FCC Class B High Frequency - Peak Result (Pass/Fail)	FCC Class B High Frequency - Average Limit (dBµV/m)	FCC Class B High Frequency - Average Margin (dB)	FCC Class B High Frequency - Average Result (Pass/Fail)
Band Edge Low X-Axis External Antenna Vertical				---	---	---	---	---	---	---	---	---	---	---
V	2390.0	45.6	35.0	0.0	3.9	3.2	52.7	42.1	74.0	-21.3	Pass	54.0	-11.9	Pass
H	2390.0	45.2	35.3	0.0	3.9	3.2	52.3	42.4	74.0	-21.7	Pass	54.0	-11.6	Pass
Band Edge Low X-Axis External Antenna Horizontal				---	---	---	---	---	---	---	---	---	---	---
V	2390.0	46.1	35.3	0.0	3.9	3.2	53.2	42.4	74.0	-20.8	Pass	54.0	-11.6	Pass
H	2390.0	45.7	35.6	0.0	3.9	3.2	52.8	42.7	74.0	-21.2	Pass	54.0	-11.3	Pass
Band Edge High X-Axis External antenna Vertical				---	---	---	---	---	---	---	---	---	---	---
V	2483.5	47.0	35.6	0.0	3.9	3.0	53.9	42.5	74.0	-20.1	Pass	54.0	-11.5	Pass
H	2483.5	46.0	35.4	0.0	3.9	3.0	52.9	42.3	74.0	-21.1	Pass	54.0	-11.7	Pass
Band Edge High X-Axis External antenna Horizontal				---	---	---	---	---	---	---	---	---	---	---
V	2483.5	46.2	36.3	0.0	3.9	3.0	53.1	43.2	74.0	-20.9	Pass	54.0	-10.8	Pass
H	2483.5	47.1	37.0	0.0	3.9	3.0	54.0	43.9	74.0	-20.0	Pass	54.0	-10.1	Pass
Band Edge Low Y-Axis External Antenna Vertical				---	---	---	---	---	---	---	---	---	---	---
V	2390.0	45.9	35.1	0.0	3.9	3.2	53.0	42.2	74.0	-21.0	Pass	54.0	-11.8	Pass
H	2390.0	46.0	35.4	0.0	3.9	3.2	53.1	42.5	74.0	-20.9	Pass	54.0	-11.5	Pass
Band Edge Low Y-Axis External Antenna Horizontal				---	---	---	---	---	---	---	---	---	---	---
V	2390.0	46.2	35.2	0.0	3.9	3.2	53.3	42.3	74.0	-20.7	Pass	54.0	-11.7	Pass
H	2390.0	45.6	35.0	0.0	3.9	3.2	52.7	42.1	74.0	-21.3	Pass	54.0	-11.9	Pass
Band Edge High Y-Axis External Antenna Vertical				---	---	---	---	---	---	---	---	---	---	---
V	2483.5	47.3	35.4	0.0	3.9	3.0	54.2	42.3	74.0	-19.8	Pass	54.0	-11.7	Pass
H	2483.5	45.9	35.8	0.0	3.9	3.0	52.8	42.7	74.0	-21.2	Pass	54.0	-11.3	Pass
Band Edge High Y-Axis External Antenna Horizontal				---	---	---	---	---	---	---	---	---	---	---
V	2483.5	46.8	35.6	0.0	3.9	3.0	53.7	42.5	74.0	-20.3	Pass	54.0	-11.5	Pass
H	2483.5	47.9	36.5	0.0	3.9	3.0	54.8	43.4	74.0	-19.2	Pass	54.0	-10.6	Pass
Band Edge Low Z-Axis External Antenna Vertical				---	---	---	---	---	---	---	---	---	---	---
V	2390.0	46.9	35.0	0.0	3.9	3.2	54.0	42.1	74.0	-20.0	Pass	54.0	-11.9	Pass
H	2390.0	46.4	35.4	0.0	3.9	3.2	53.5	42.5	74.0	-20.5	Pass	54.0	-11.5	Pass
Band Edge Low Z-Axis External Antenna Horizontal				---	---	---	---	---	---	---	---	---	---	---
V	2390.0	46.6	35.4	0.0	3.9	3.2	53.7	42.5	74.0	-20.3	Pass	54.0	-11.5	Pass
H	2390.0	46.5	35.1	0.0	3.9	3.2	53.6	42.2	74.0	-20.4	Pass	54.0	-11.8	Pass
Band Edge High Z-Axis External antenna Vertical				---	---	---	---	---	---	---	---	---	---	---
V	2483.5	46.1	35.6	0.0	3.9	3.0	53.0	42.5	74.0	-21.0	Pass	54.0	-11.5	Pass
H	2483.5	45.8	35.2	0.0	3.9	3.0	52.7	42.1	74.0	-21.3	Pass	54.0	-11.9	Pass
Band Edge High Z-Axis External Antenna Horizontal				---	---	---	---	---	---	---	---	---	---	---
V	2483.5	47.0	35.6	0.0	3.9	3.0	53.9	42.5	74.0	-20.1	Pass	54.0	-11.5	Pass
H	2483.5	44.9	36.5	0.0	3.9	3.0	51.8	43.4	74.0	-22.2	Pass	54.0	-10.6	Pass

Table Result: Pass by -10.1 dB ***Worst Freq:*** 2483.5 MHz

Test Site: EMI Chamber 1 **Cable 1:** Asset #2681 **Cable 2:** Asset #2610 **Cable 3:** ---
Analyzer: 1170725 **Preamp:** None **Antenna:** Asset #2710 **Preselector:** ---

CSsoft Radiated Emissions Calculator v 1.017.225
Adjusted Reading = Reading - Preamp Factor + Antenna Factor + Cable Factor

Internal Antenna

Radiated Emissions Table

Date: 17-Jun-23 **Company:** Hayward **Work Order:** X0020
Engineer: Ryan M. Brown **EUT Desc:** BT923 **EUT Operating Voltage/Frequency:** 5VDC
Temp: 22.7C **Humidity:** 51% **Pressure:** 1001mbar
Frequency Range: Band Edge **Measurement Distance:** 3 m
Notes: Internal Antenna **EUT Max Freq:** 2480

RMS Trace Averaging over 200 traces were used for "Band Edge High Y-Axis – Horizontal" only. For other positions RMS average was not necessary since their Adjusted Peak were below the average limits.

Antenna Polarization (H / V)	Frequency (MHz)	Peak Reading (dBµV)	Average Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Peak Reading (dBµV/m)	Adjusted Avg Reading (dBµV/m)	FCC Class B High Frequency - Peak			FCC Class B High Frequency - Average		
									Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
Band Edge Low X-Axis				---	---	---	---	---	---	---	---	---	---	---
V	2390.0	34.9	34.9	0.0	3.9	3.2	42.0	42.0	74.0	-32.0	Pass	54.0	-12.0	Pass
H	2390.0	33.7	33.7	0.0	3.9	3.2	40.8	40.8	74.0	-33.2	Pass	54.0	-13.2	Pass
Band Edge High X-Axis				---	---	---	---	---	---	---	---	---	---	---
V	2483.5	40.5	40.5	0.0	3.9	3.0	47.4	47.4	74.0	-26.6	Pass	54.0	-6.6	Pass
H	2483.5	33.7	33.7	0.0	3.9	3.0	40.6	40.6	74.0	-33.4	Pass	54.0	-13.4	Pass
Band Edge Low Y-Axis				---	---	---	---	---	---	---	---	---	---	---
V	2390.0	34.9	34.9	0.0	3.9	3.2	42.0	42.0	74.0	-32.0	Pass	54.0	-12.0	Pass
H	2390.0	37.2	37.2	0.0	3.9	3.2	44.3	44.3	74.0	-29.7	Pass	54.0	-9.7	Pass
Band Edge High Y-Axis				---	---	---	---	---	---	---	---	---	---	---
V	2483.5	37.0	37.0	0.0	3.9	3.0	43.9	43.9	74.0	-30.1	Pass	54.0	-10.1	Pass
H	2483.5	43.9	33.9	0.0	3.9	3.0	50.8	40.8	74.0	-23.2	Pass	54.0	-13.2	Pass
Band Edge Low Z-Axis				---	---	---	---	---	---	---	---	---	---	---
V	2390.0	33.5	33.5	0.0	3.9	3.2	40.6	40.6	74.0	-33.4	Pass	54.0	-13.4	Pass
H	2390.0	37.7	37.7	0.0	3.9	3.2	44.8	44.8	74.0	-29.2	Pass	54.0	-9.2	Pass
Band Edge High Z-Axis				---	---	---	---	---	---	---	---	---	---	---
V	2483.5	34.4	34.4	0.0	3.9	3.0	41.3	41.3	74.0	-32.7	Pass	54.0	-12.7	Pass
H	2483.5	39.2	39.2	0.0	3.9	3.0	46.1	46.1	74.0	-27.9	Pass	54.0	-7.9	Pass

Table Result: Pass by -6.6 dB ***Worst Freq:*** 2483.5 MHz

Test Site: EMI Chamber 1 **Cable 1:** Asset #2681 **Cable 2:** Asset #2610 **Cable 3:** ---
Analyzer: 1170725 **Preamp:** **Antenna:** Asset #2710 **Preselector:** ---
CSsoft Radiated Emissions Calculator v 1.017.225
Adjusted Reading = Reading - Preamp Factor + Antenna Factor + Cable Factor

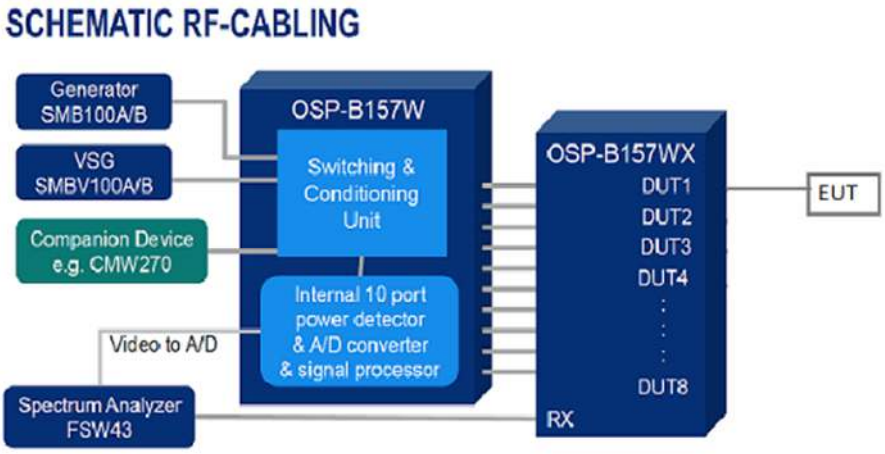
Notch filter range (used for internal antenna high channel): 2.2GHz to 2.8GHz notch filter range was checked for emissions and no emissions were found. No differences observed between horizontal or vertical antenna polarizations.

4.3 6dB CHANNEL BANDWIDTH & 99% OBW

4.3.1 LIMITS

The minimum 6 dB bandwidth shall be 500 kHz.

4.3.2 TEST SETUP



4.3.3 TEST EQUIPMENT USED

Equipment	Manufacturer	Asset No.	Model No.	Serial No.	Last Cal.	Next Cal.
Cable	Carlisle	2595	UTiFLEX	N/A	1/17/2023	1/17/2024
Signal Analyzer	Rohde-Schwarz	2200	FSV 40	101551	10/09/2023	10/09/2024
OSP-B157W8	Rohde-Schwarz	2558	OSP_B157W8	100955	8/26/2021	2/26/2024
10dB Attenuator	Min Circuits	10dB-01-Brown	N/A	N/A	2/13/23	2/13/24
30dB 20W Atten	Weinschel Associates	2121	89-30-11	703	2/13/23	2/13/24

4.3.4 TEST PROCEDURES

6dB CHANNEL BANDWIDTH

a. Set RBW = 100 kHz.
b. Set the video bandwidth (VBW) ≥ 3 RBW.
c. Detector = Peak.
d. Trace mode = max hold.
e. Sweep = auto couple.
f. Allow the trace to stabilize.

g. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

99% OBW

a. The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

b. The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

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

d. Step a) through step c) might require iteration to adjust within the specified range.

e. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

f. Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

4.3.5 DEVIATIONS

No deviations from the standard.

4.3.6 EUT OPERATING CONDITIONS

EUT was operated according to manufacturer’s specifications.

4.3.7 TEST RESULTS

BLE (GFSK) 1Mbps

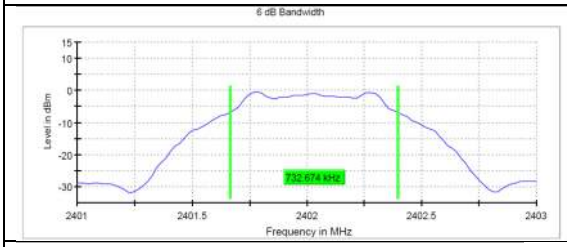
External Antenna

Test date: 12/7/2023

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BANDWIDTH (MHz)	99% OBW (MHz)	PASS / FAIL
0	2402	0.732674	1.080000	Pass
19	2440	0.732674	1.080000	Pass
39	2480	0.712872	1.080000	Pass

CH0

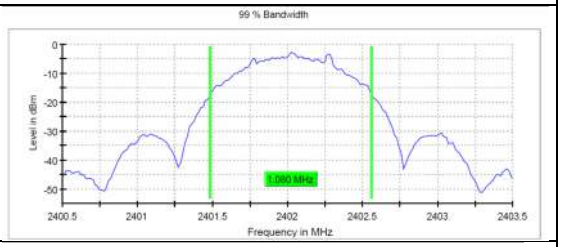
6dB Bandwidth



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
Sweeptime	18.938 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	10 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.27 dB	0.50 dB

99% OBW

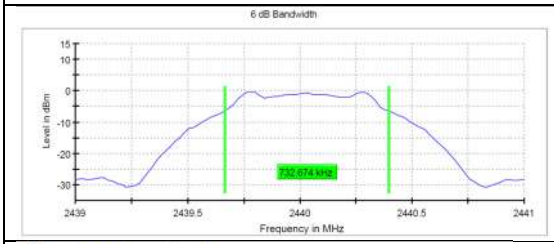


Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40050 GHz	2.40050 GHz
Stop Frequency	2.40350 GHz	2.40350 GHz
Span	3.000 MHz	3.000 MHz
RBW	30.000 kHz	>= 30.000 kHz
VBW	100.000 kHz	>= 100.000 kHz
SweepPoints	200	~ 200
Sweeptime	63.151 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	25 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.14 dB	0.30 dB

CH19

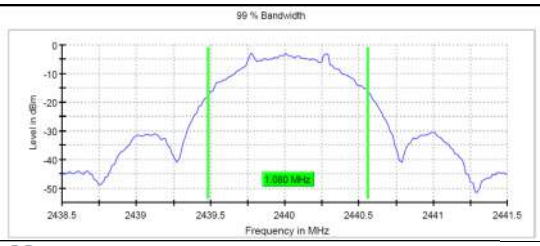
6dB Bandwidth



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.43900 GHz	2.43900 GHz
Stop Frequency	2.44100 GHz	2.44100 GHz
Span	2.000 MHz	2.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
Sweeptime	18.938 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	13 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.11 dB	0.50 dB

99% OBW

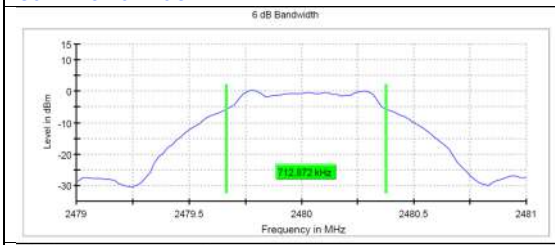


Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.43850 GHz	2.43850 GHz
Stop Frequency	2.44150 GHz	2.44150 GHz
Span	3.000 MHz	3.000 MHz
RBW	30.000 kHz	>= 30.000 kHz
VBW	100.000 kHz	>= 100.000 kHz
SweepPoints	200	~ 200
Sweeptime	63.151 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	26 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.19 dB	0.30 dB

CH39

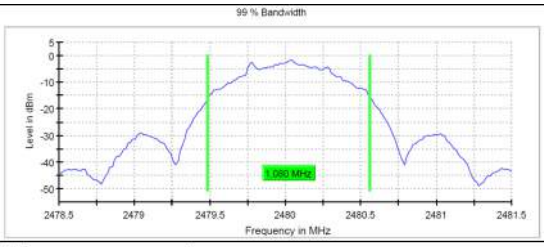
6dB Bandwidth



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47900 GHz	2.47900 GHz
Stop Frequency	2.48100 GHz	2.48100 GHz
Span	2.000 MHz	2.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
Sweeptime	18.938 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	10 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.40 dB	0.50 dB

99% OBW



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47850 GHz	2.47850 GHz
Stop Frequency	2.48150 GHz	2.48150 GHz
Span	3.000 MHz	3.000 MHz
RBW	30.000 kHz	>= 30.000 kHz
VBW	100.000 kHz	>= 100.000 kHz
SweepPoints	200	~ 200
Sweeptime	63.151 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	25 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.29 dB	0.30 dB

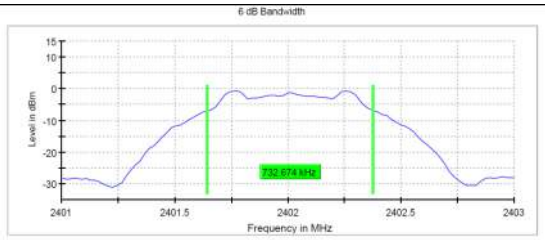
Internal Antenna

Test date: 12/4/2023

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BANDWIDTH (MHz)	99% OBW (MHz)	PASS / FAIL
0	2402	0.732674	1.095000	Pass
19	2440	0.752476	1.080000	Pass
39	2480	0.712872	1.095000	Pass

CH0

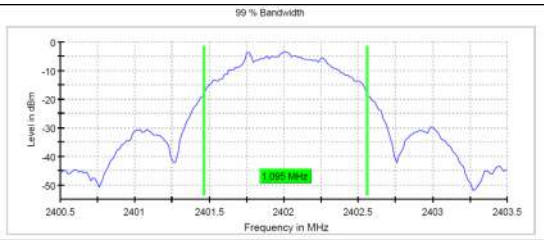
6dB Bandwidth



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40100 GHz	2.40100 GHz
Stop Frequency	2.40300 GHz	2.40300 GHz
Span	2.000 MHz	2.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
Sweeptime	18.938 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	15 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.10 dB	0.50 dB

99% OBW

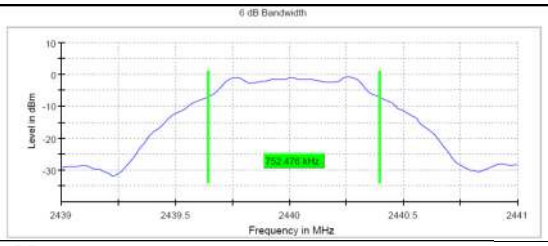


Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40050 GHz	2.40050 GHz
Stop Frequency	2.40350 GHz	2.40350 GHz
Span	3.000 MHz	3.000 MHz
RBW	30.000 kHz	>= 30.000 kHz
VBW	100.000 kHz	>= 100.000 kHz
SweepPoints	200	~ 200
Sweeptime	63.151 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	20 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.06 dB	0.30 dB

CH19

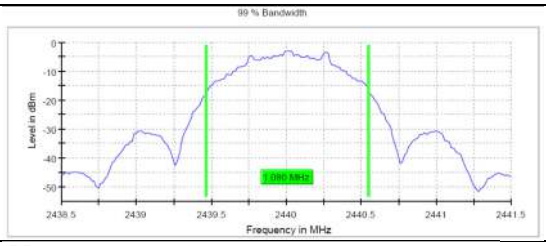
6dB Bandwidth



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.43900 GHz	2.43900 GHz
Stop Frequency	2.44100 GHz	2.44100 GHz
Span	2.000 MHz	2.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
Sweeptime	18.938 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	9 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.19 dB	0.50 dB

99% OBW

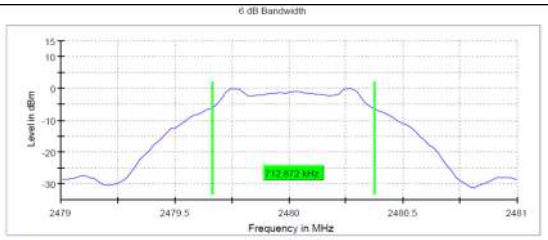


Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.43850 GHz	2.43850 GHz
Stop Frequency	2.44150 GHz	2.44150 GHz
Span	3.000 MHz	3.000 MHz
RBW	30.000 kHz	>= 30.000 kHz
VBW	100.000 kHz	>= 100.000 kHz
SweepPoints	200	~ 200
Sweeptime	63.151 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	27 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.30 dB

CH39

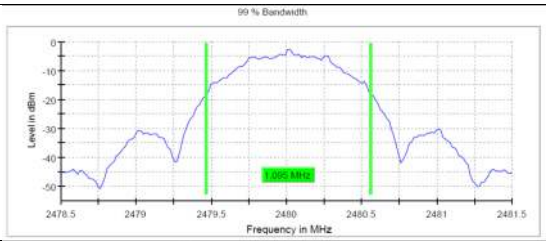
6dB Bandwidth



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47900 GHz	2.47900 GHz
Stop Frequency	2.48100 GHz	2.48100 GHz
Span	2.000 MHz	2.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
Sweeptime	18.938 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	13 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.25 dB	0.50 dB

99% OBW



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47850 GHz	2.47850 GHz
Stop Frequency	2.48150 GHz	2.48150 GHz
Span	3.000 MHz	3.000 MHz
RBW	30.000 kHz	>= 30.000 kHz
VBW	100.000 kHz	>= 100.000 kHz
SweepPoints	200	~ 200
Sweeptime	63.151 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	15 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.30 dB

4.4 CONDUCTED OUTPUT POWER

4.4.1 LIMITS

For systems using digital modulation in the 2400–2483.5 MHz band: 1 Watt (30dBm)

4.4.2 TEST SETUP

Refer to section 4.3.2.

4.4.3 TEST EQUIPMENT USED

Refer to section 4.3.3.

4.4.4 TEST PROCEDURES

Average conducted output power was measured in accordance with ANSI C63.10 - 2013 Section 11.9.2.3.2 (Method AVGPM-G).

4.4.5 DEVIATIONS

No deviations from the standard.

4.4.6 EUT OPERATING CONDITIONS

EUT was operated according to manufacturer's specifications

4.4.7 TEST RESULTS

BLE (GFSK) 1Mbps:

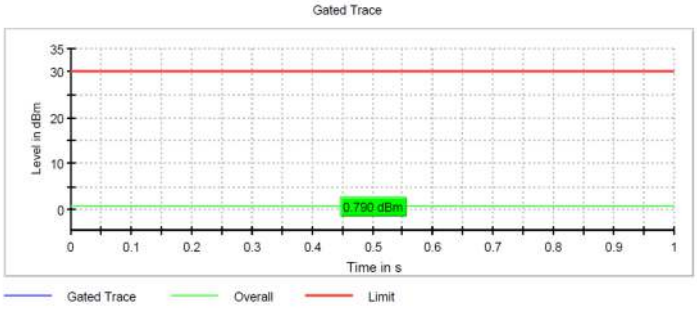
External Antenna

Test date: 12/7/2023

CHANNEL	CHANNEL FREQUENCY (MHz)	AVG POWER (dBm)	AVG POWER (mW)	AVG POWER LIMIT (W)	PASS/FAIL
0	2402	0.790	1.20	1	PASS
19	2440	1.164	1.31	1	PASS
39	2480	1.706	1.48	1	PASS

Note: Power measurements are final and compensated for all the path losses (attenuator and cable losses) within the measurement setup.

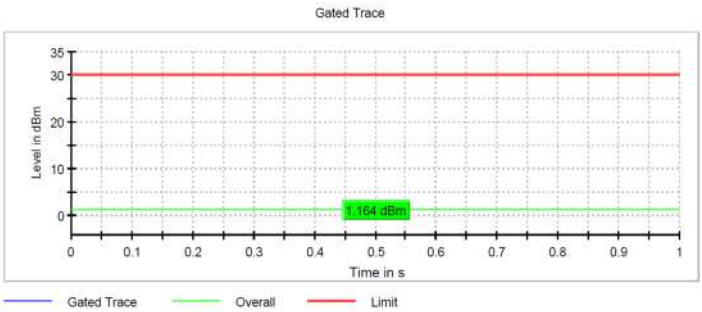
CH0



OSP PowerMeter settings

Setting	Instrument Value	Target Value
Measurement Time	1.000 s	1.000 s
Points	1000000	1000000
Time resolution	1.000 µs	1.000 µs

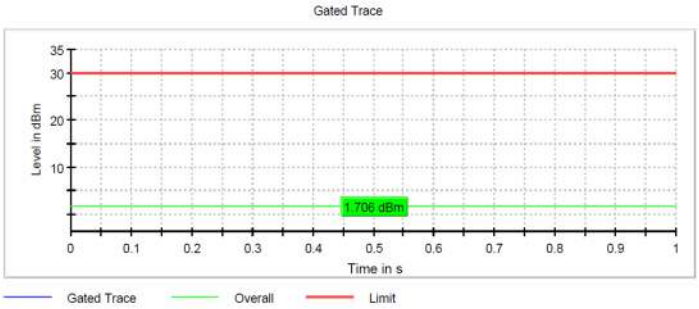
CH19



OSP PowerMeter settings

Setting	Instrument Value	Target Value
Measurement Time	1.000 s	1.000 s
Points	1000000	1000000
Time resolution	1.000 µs	1.000 µs

CH39



OSP PowerMeter settings

Setting	Instrument Value	Target Value
Measurement Time	1.000 s	1.000 s
Points	1000000	1000000
Time resolution	1.000 µs	1.000 µs

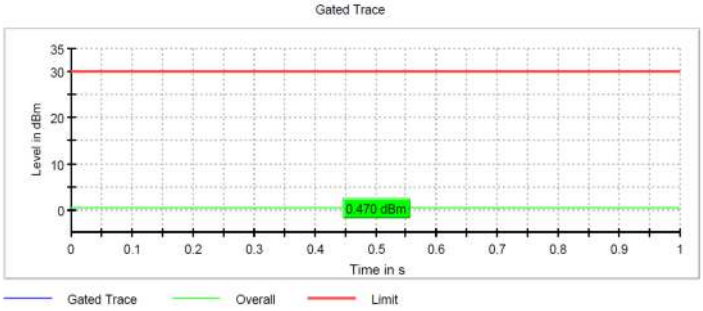
Internal Antenna

Test date: 12/4/2023

CHANNEL	CHANNEL FREQUENCY (MHz)	AVG POWER (dBm)	AVG POWER (mW)	AVG POWER LIMIT (W)	PASS/FAIL
0	2402	0.470	1.11	1	PASS
19	2440	0.898	1.23	1	PASS
39	2480	1.124	1.30	1	PASS

Note: Power measurements are final and compensated for all the path losses (attenuator and cable losses) within the measurement setup.

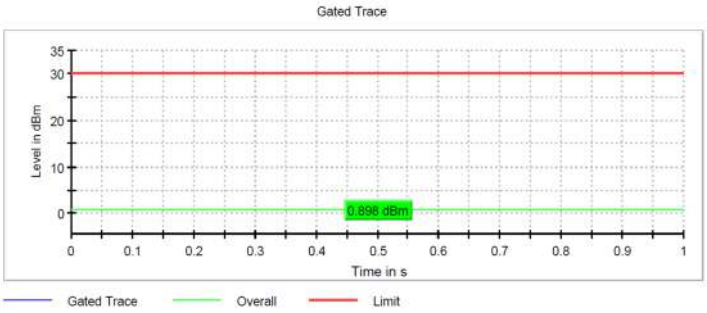
CH0



OSP PowerMeter settings

Setting	Instrument Value	Target Value
Measurement Time	1.000 s	1.000 s
Points	1000000	1000000
Time resolution	1.000 µs	1.000 µs

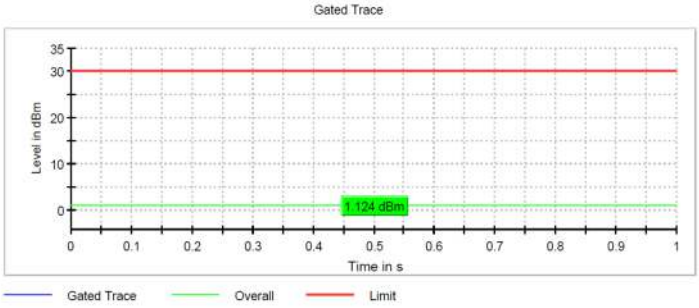
CH19



OSP PowerMeter settings

Setting	Instrument Value	Target Value
Measurement Time	1.000 s	1.000 s
Points	1000000	1000000
Time resolution	1.000 µs	1.000 µs

CH39



OSP PowerMeter settings

Setting	Instrument Value	Target Value
Measurement Time	1.000 s	1.000 s
Points	1000000	1000000
Time resolution	1.000 µs	1.000 µs

4.5 POWER SPECTRAL DENSITY

4.5.1 LIMITS

The limit for Power Spectral Density is 8dBm/3KHz.

4.5.2 TEST SETUP

Refer to section 4.3.2.

4.5.3 TEST EQUIPMENT USED

Refer to section 4.3.3.

4.5.4 TEST PROCEDURES

Power Spectral Density was measured in accordance with ANSI C63.10 - 2013 Section 11.10.2 (Method PKPSD (Peak PSD)).

1. Set the span to 1.5 times the DTS bandwidth
2. Set the RBW = 10 kHz, VBW ≥ 3 x RBW, Detector = peak.
3. Sweep time = auto couple, Trace mode = max hold, allow trace to fully stabilize.
4. Use the peak marker function to determine the maximum amplitude level.

4.5.5 DEVIATIONS

No deviations from the standard.

4.5.6 EUT OPERATING CONDITIONS

EUT was operated according to manufacturer's specifications.

4.5.7 TEST RESULTS

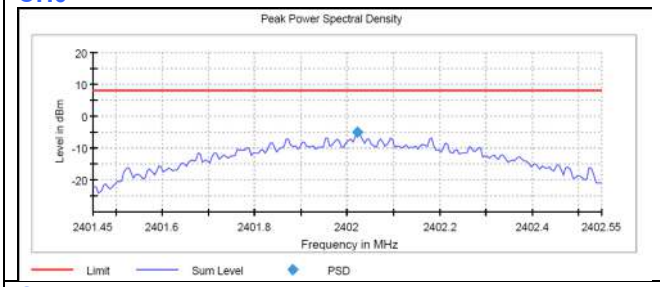
BLE (GFSK) 1Mbps:

External Antenna

Test date: 12/7/2023

Channel	FREQ. (MHz)	Peak PSD (dBm)	Limit (dBm)	PASS /FAIL
0	2402	-4.885	8	PASS
19	2440	-4.736	8	PASS
39	2480	-6.072	8	PASS

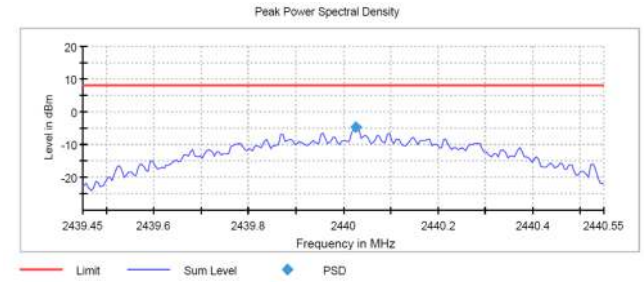
CH0



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40145 GHz	2.40145 GHz
Stop Frequency	2.40255 GHz	2.40255 GHz
Span	1.099 MHz	1.099 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	220	~ 220
Sweeptime	1.100 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	23 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.00 dB	0.50 dB

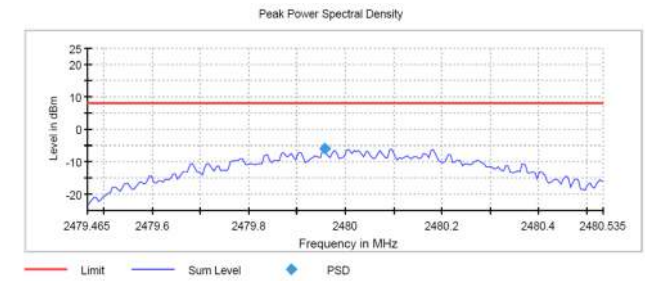
CH19



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.43945 GHz	2.43945 GHz
Stop Frequency	2.44055 GHz	2.44055 GHz
Span	1.099 MHz	1.099 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	220	~ 220
Sweeptime	1.100 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	13 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.44 dB	0.50 dB

CH39



Measurement

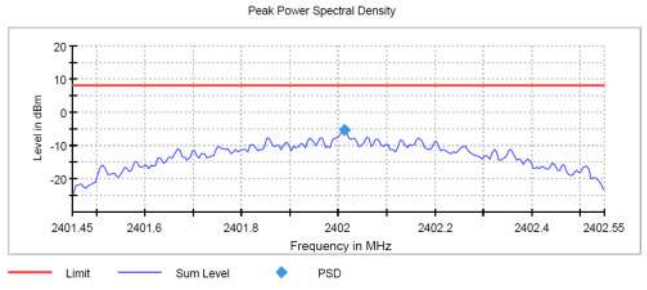
Setting	Instrument Value	Target Value
Start Frequency	2.47947 GHz	2.47947 GHz
Stop Frequency	2.48053 GHz	2.48053 GHz
Span	1.069 MHz	1.069 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	214	~ 214
Sweeptime	1.070 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	16 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.38 dB	0.50 dB

Internal Antenna

Test date: 12/4/2023

Channel	FREQ. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	PASS /FAIL
0	2402	-5.415	8	PASS
19	2440	-4.900	8	PASS
39	2480	-4.806	8	PASS

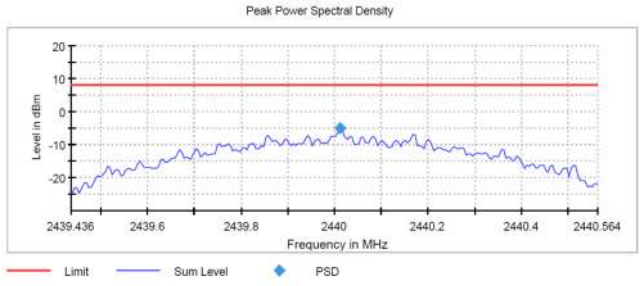
CH0



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.40145 GHz	2.40145 GHz
Stop Frequency	2.40255 GHz	2.40255 GHz
Span	1.099 MHz	1.099 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	220	~ 220
Sweeptime	1.100 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	23 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.22 dB	0.50 dB

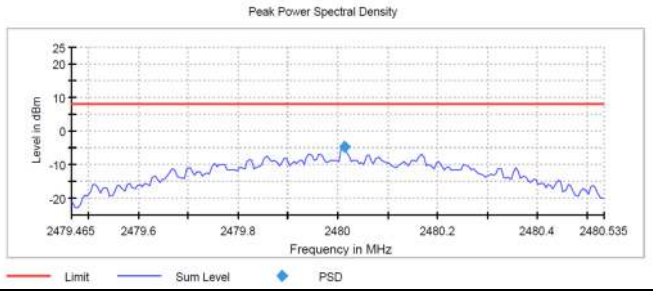
CH19



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.43944 GHz	2.43944 GHz
Stop Frequency	2.44056 GHz	2.44056 GHz
Span	1.129 MHz	1.129 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	226	~ 226
Sweeptime	1.130 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	19 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.17 dB	0.50 dB

CH39



Measurement

Setting	Instrument Value	Target Value
Start Frequency	2.47947 GHz	2.47947 GHz
Stop Frequency	2.48053 GHz	2.48053 GHz
Span	1.069 MHz	1.069 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	214	~ 214
Sweeptime	1.070 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	16 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.45 dB	0.50 dB

4.6 CONDUCTED SPURIOUS EMISSIONS AND BAND-EDGES

4.6.1 LIMITS

30dB below the highest emission level in the operating band (in 100kHz RBW).

4.6.2 TEST SETUP

Refer to section 4.3.2.

4.6.3 TEST EQUIPMENT USED

Refer to section 4.3.3.

4.6.4 TEST PROCEDURES

Conducted spurious emissions were measured in accordance with ANSI C63.10 - 2013 section 11.11.

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW ≥ 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOBE

1. Set RBW = 100 kHz.
2. Set VBW ≥ 300 kHz.
3. Set span to encompass the spectrum to be examined
4. Detector = peak.
5. Trace Mode = max hold.
6. Sweep = auto couple.

4.6.5 DEVIATIONS

No deviations from the standard.

4.6.6 EUT OPERATING CONDITIONS

EUT was operated according to manufacturer's specifications.

4.6.7 TEST RESULTS

BLE (GFSK) 1Mbps Conducted Spurious Emissions:

External Antenna

Test date: 12/7/2023

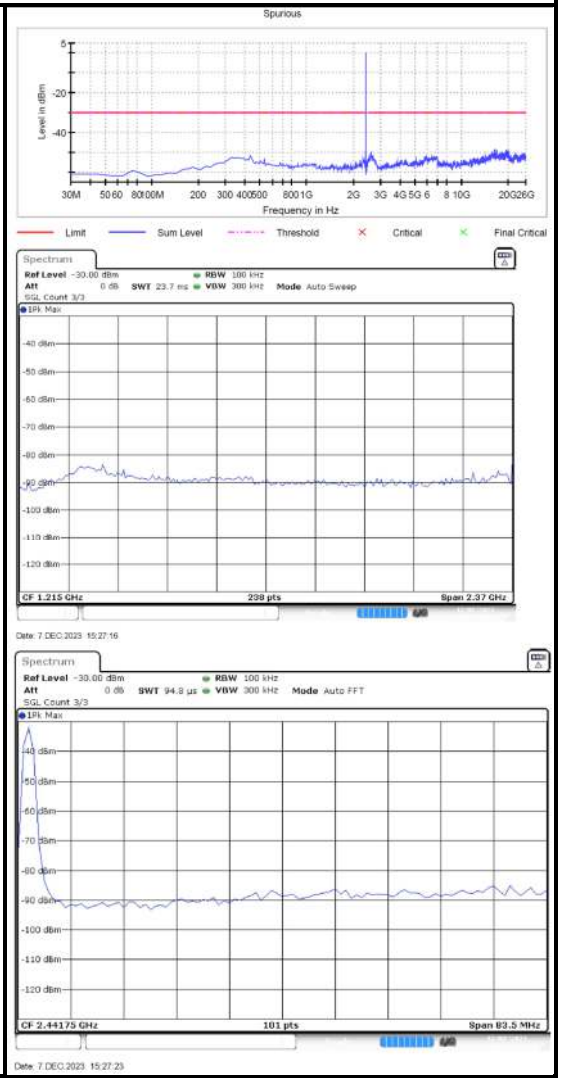
CH 0

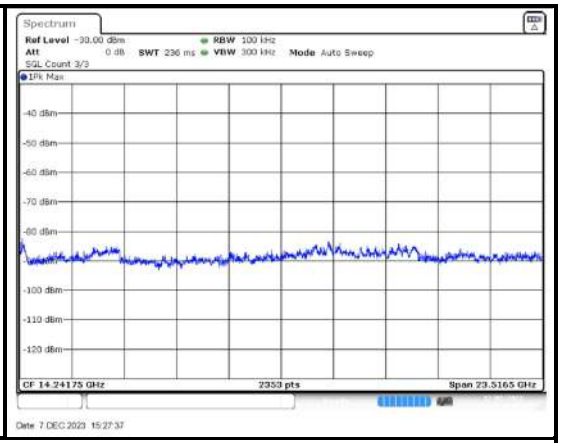
Inband Peak

Frequency (MHz)	Level (dBm)
2402.066832	0.0

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2395.021008	-47.6	17.6	-30.0
16390.516468	-48.6	18.6	-30.0
16340.545155	-48.9	18.9	-30.0
16900.223863	-49.0	19.0	-30.0
19498.732150	-49.0	19.0	-30.0
16350.539418	-49.2	19.2	-30.0
19548.703464	-49.2	19.2	-30.0
19838.537080	-49.4	19.4	-30.0
16400.510731	-49.4	19.4	-30.0
19858.525606	-49.5	19.5	-30.0
19198.904271	-49.6	19.6	-30.0
16370.527943	-49.6	19.6	-30.0
2598.434020	-49.7	19.7	-30.0
18119.523906	-49.7	19.7	-30.0
15850.826286	-49.7	19.7	-30.0





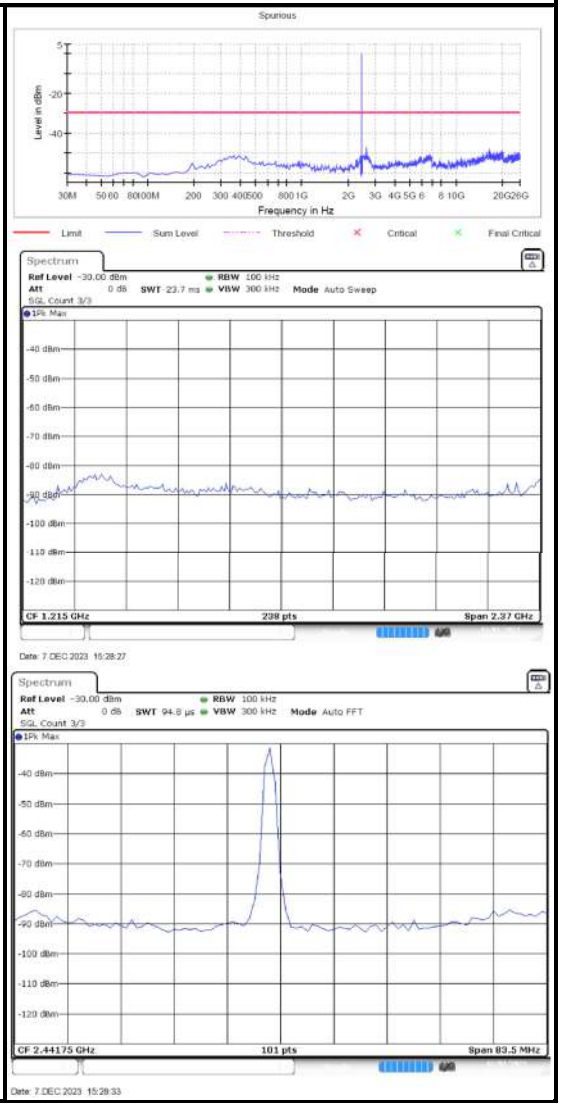
CH 19

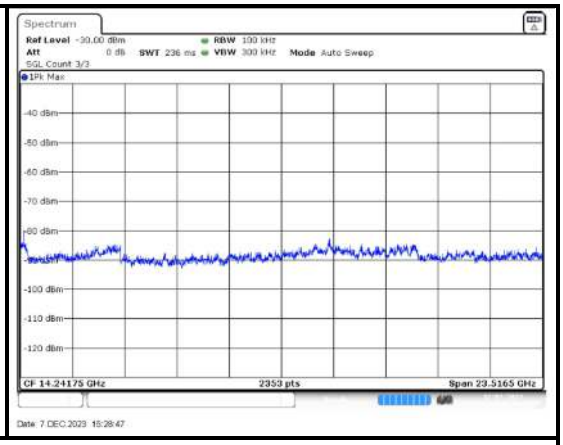
Inband Peak

Frequency (MHz)	Level (dBm)
2440.096535	0.3

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2628.416808	-47.2	17.5	-29.7
16410.504994	-48.0	18.3	-29.7
16390.516468	-48.2	18.5	-29.7
16370.527943	-49.1	19.4	-29.7
19858.525606	-49.2	19.5	-29.7
16340.545155	-49.3	19.6	-29.7
19468.749363	-49.4	19.7	-29.7
16360.533680	-49.4	19.7	-29.7
16430.493519	-49.5	19.8	-29.7
25735.152040	-49.5	19.8	-29.7
17829.690289	-49.6	19.9	-29.7
16400.510731	-49.7	19.9	-29.7
19738.594454	-49.7	20.0	-29.7
20088.393646	-49.7	20.0	-29.7
16330.550892	-49.7	20.0	-29.7





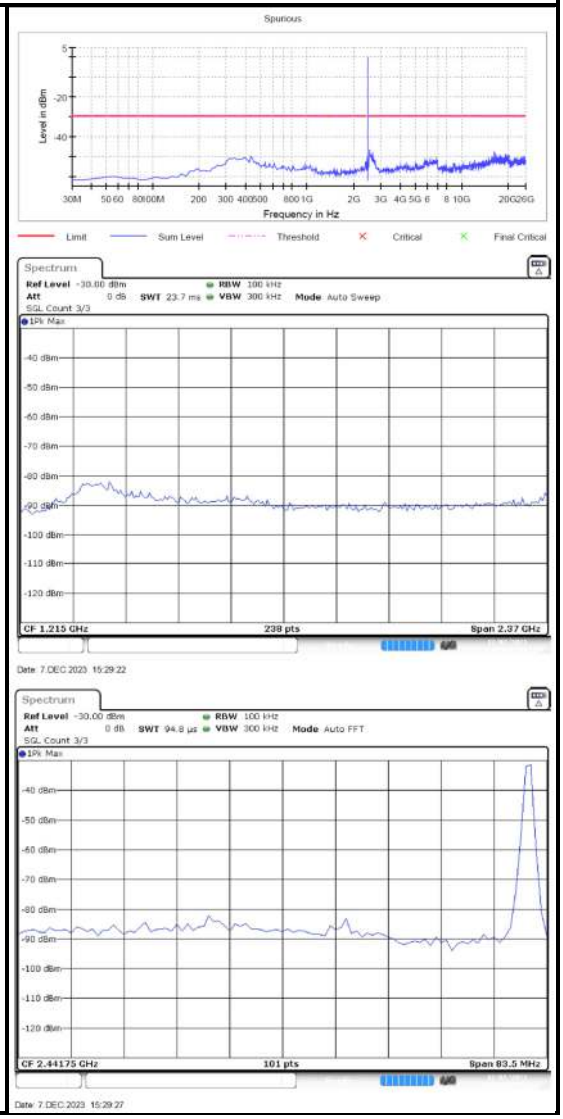
CH 39

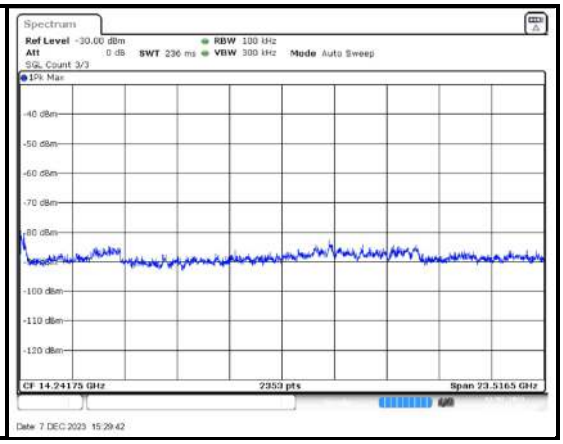
Inband Peak

Frequency (MHz)	Level (dBm)
2480.606436	0.3

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2528.474182	-46.7	17.0	-29.7
2668.393859	-47.8	18.1	-29.7
16350.539418	-47.9	18.2	-29.7
2558.456970	-48.5	18.8	-29.7
16360.533680	-48.6	18.9	-29.7
19248.875584	-49.0	19.3	-29.7
16420.499256	-49.1	19.4	-29.7
17879.661602	-49.1	19.4	-29.7
20238.307586	-49.2	19.5	-29.7
20258.296111	-49.3	19.5	-29.7
16380.522206	-49.3	19.5	-29.7
16460.476307	-49.4	19.7	-29.7
19428.772312	-49.4	19.7	-29.7
2548.462707	-49.4	19.7	-29.7
16440.487782	-49.5	19.8	-29.7





Internal Antenna

Test date: 12/4/2023

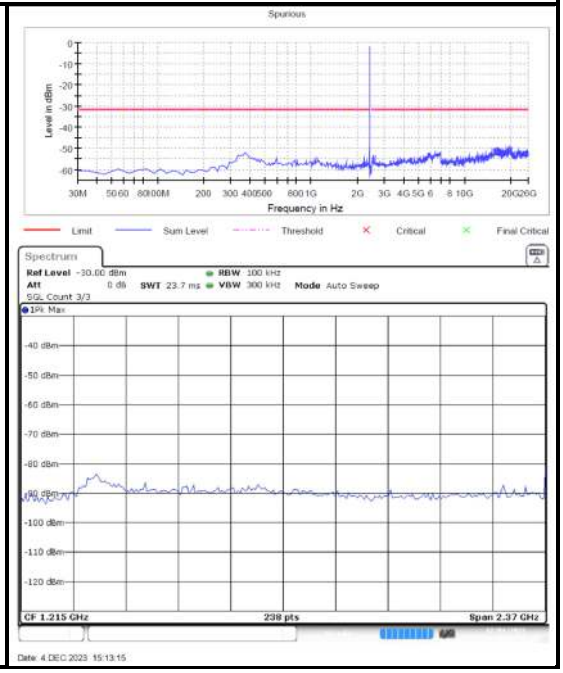
CH 0

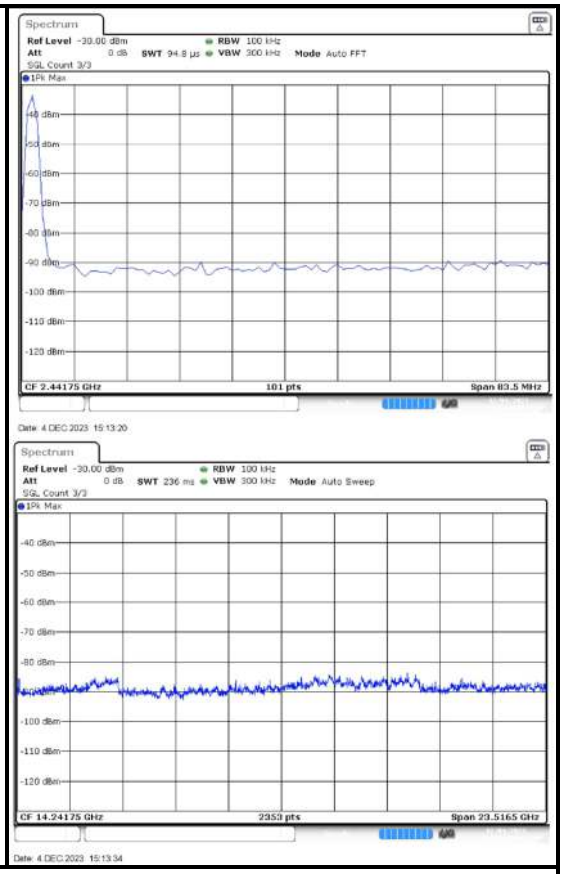
Inband Peak

Frequency (MHz)	Level (dBm)
2402.066832	-1.6

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
2395.021008	-48.3	16.8	-31.6
19838.537080	-48.3	16.8	-31.6
16340.545155	-49.2	17.6	-31.6
19548.703464	-49.3	17.7	-31.6
20188.336273	-49.3	17.8	-31.6
19138.938695	-49.4	17.8	-31.6
20198.330535	-49.5	17.9	-31.6
16830.264025	-49.6	18.0	-31.6
18759.156715	-49.7	18.2	-31.6
16390.516468	-49.8	18.2	-31.6
15770.872184	-49.8	18.2	-31.6
16360.533680	-49.8	18.2	-31.6
22267.142903	-49.8	18.3	-31.6
19888.508394	-49.9	18.3	-31.6
17809.701764	-49.9	18.4	-31.6





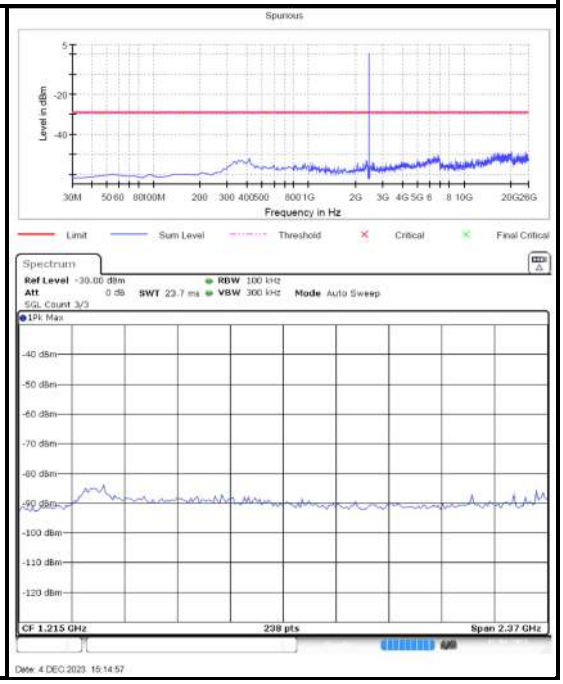
CH 19

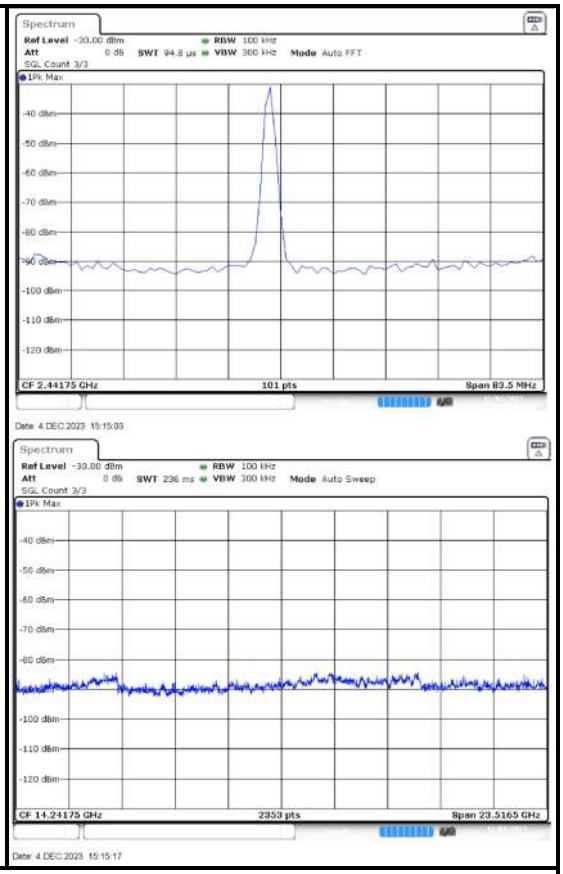
Inband Peak

Frequency (MHz)	Level (dBm)
2440.096535	0.8

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
24975.588079	-48.8	19.6	-29.2
20288.278899	-49.0	19.8	-29.2
20278.284637	-49.2	19.9	-29.2
16370.527943	-49.3	20.1	-29.2
15810.849235	-49.3	20.1	-29.2
20098.387909	-49.5	20.2	-29.2
19798.560030	-49.6	20.3	-29.2
20198.330535	-49.6	20.3	-29.2
19158.927221	-49.6	20.4	-29.2
22297.125691	-49.7	20.5	-29.2
15770.872184	-49.8	20.5	-29.2
19468.749363	-49.8	20.6	-29.2
19568.691989	-49.9	20.6	-29.2
19768.577242	-49.9	20.6	-29.2
16460.476307	-49.9	20.7	-29.2





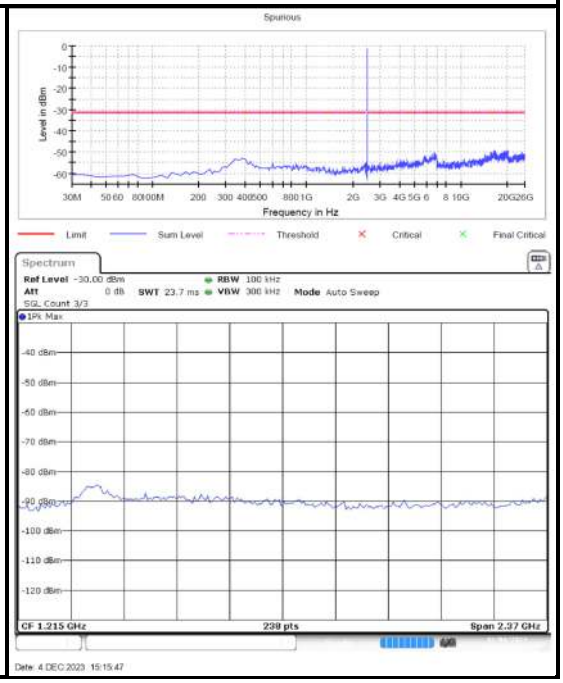
CH 39

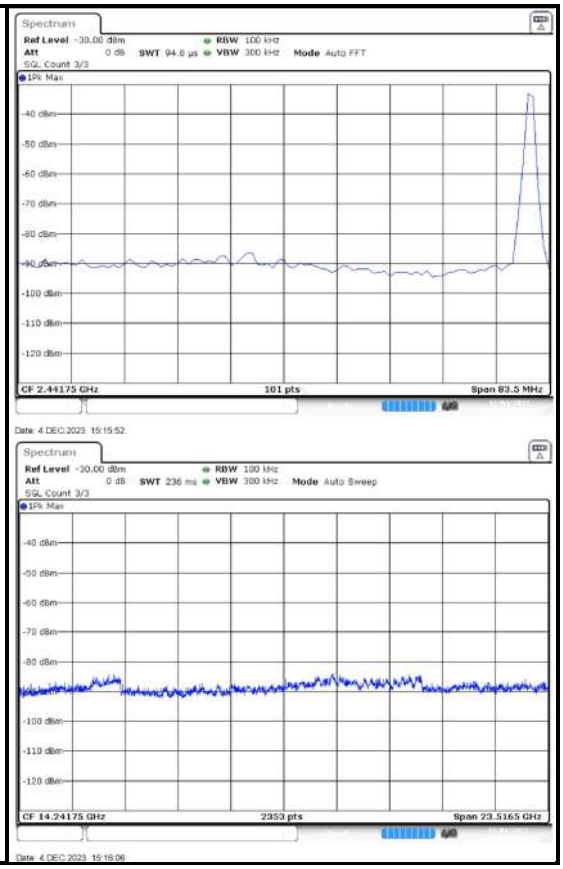
Inband Peak

Frequency (MHz)	Level (dBm)
2479.779703	-1.3

Pre Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
19798.560030	-49.0	17.7	-31.3
16380.522206	-49.1	17.7	-31.3
16730.321398	-49.3	17.9	-31.3
16440.487782	-49.3	18.0	-31.3
20278.284637	-49.3	18.0	-31.3
20098.387909	-49.4	18.1	-31.3
20328.255950	-49.5	18.1	-31.3
16750.309924	-49.5	18.2	-31.3
19808.554292	-49.5	18.2	-31.3
19148.932958	-49.7	18.3	-31.3
20348.244475	-49.7	18.4	-31.3
19528.714938	-49.7	18.4	-31.3
19818.548555	-49.7	18.4	-31.3
16370.527943	-49.8	18.4	-31.3
20268.290374	-49.8	18.4	-31.3





BLE (GFSK) 1Mbps Conducted Bandedges:

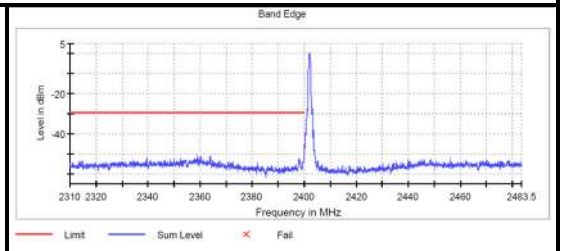
External Antenna

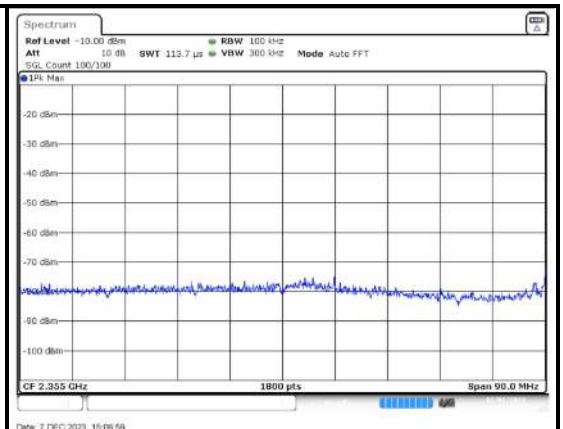
Test date: 12/7/2023

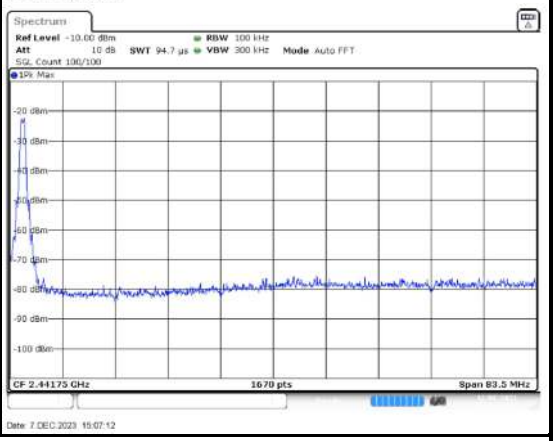
CH 0

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.975000	-47.5	18.0	-29.5	PASS
2399.925000	-49.9	20.5	-29.5	PASS
2363.825000	-51.2	21.8	-29.5	PASS
2399.875000	-51.3	21.8	-29.5	PASS
2363.775000	-51.4	21.9	-29.5	PASS
2363.875000	-51.5	22.0	-29.5	PASS
2360.225000	-51.5	22.0	-29.5	PASS
2358.825000	-51.7	22.2	-29.5	PASS
2358.775000	-51.7	22.2	-29.5	PASS
2360.175000	-51.9	22.4	-29.5	PASS
2360.275000	-51.9	22.5	-29.5	PASS
2357.975000	-52.4	22.9	-29.5	PASS
2363.725000	-52.5	23.0	-29.5	PASS
2399.825000	-52.7	23.2	-29.5	PASS
2358.025000	-52.7	23.2	-29.5	PASS



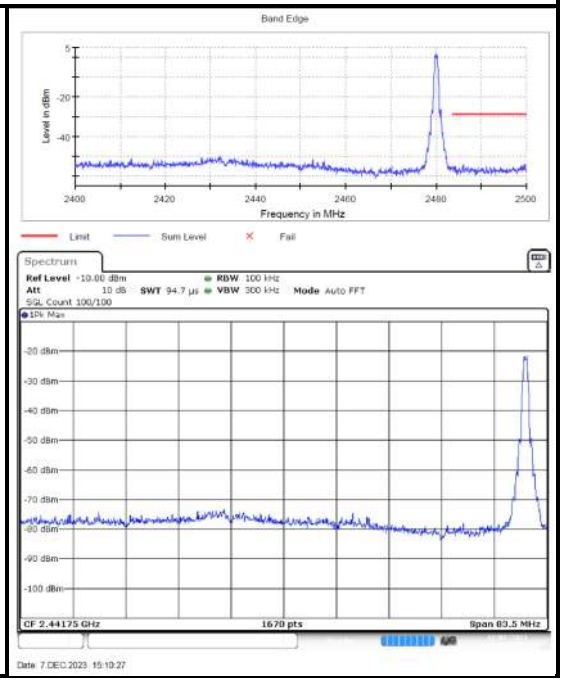


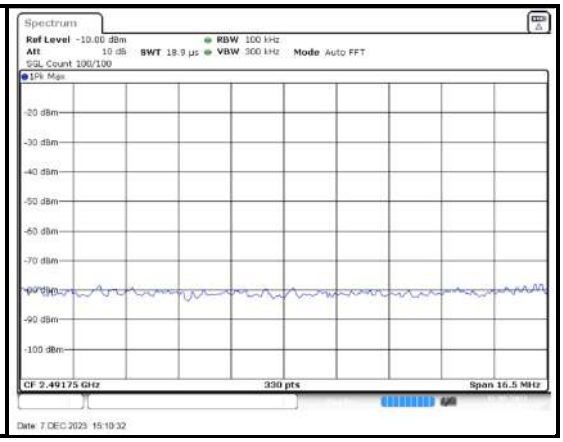


CH 39

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2499.825000	-54.1	25.3	-28.7	PASS
2499.625000	-54.1	25.4	-28.7	PASS
2499.775000	-54.1	25.4	-28.7	PASS
2499.575000	-54.4	25.7	-28.7	PASS
2485.975000	-54.6	25.9	-28.7	PASS
2499.275000	-54.9	26.2	-28.7	PASS
2486.025000	-55.0	26.3	-28.7	PASS
2498.725000	-55.2	26.5	-28.7	PASS
2499.025000	-55.2	26.5	-28.7	PASS
2484.075000	-55.2	26.5	-28.7	PASS
2484.125000	-55.3	26.5	-28.7	PASS
2499.325000	-55.3	26.5	-28.7	PASS
2498.675000	-55.3	26.6	-28.7	PASS
2499.725000	-55.3	26.6	-28.7	PASS
2487.025000	-55.4	26.6	-28.7	PASS





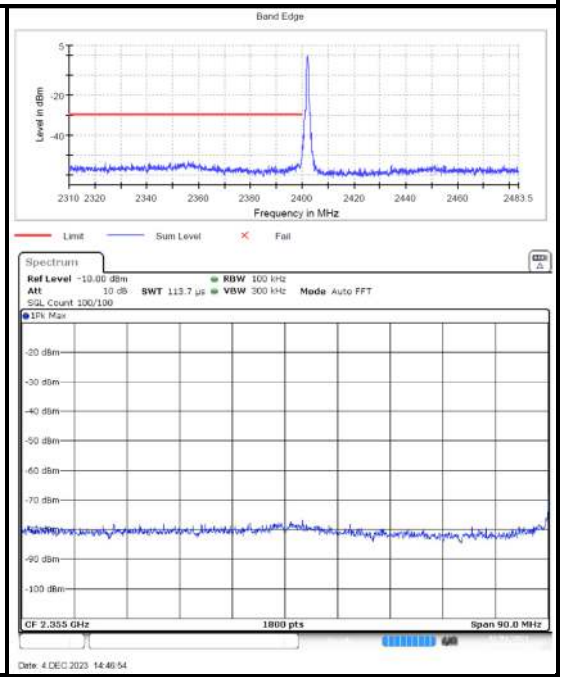
Internal Antenna

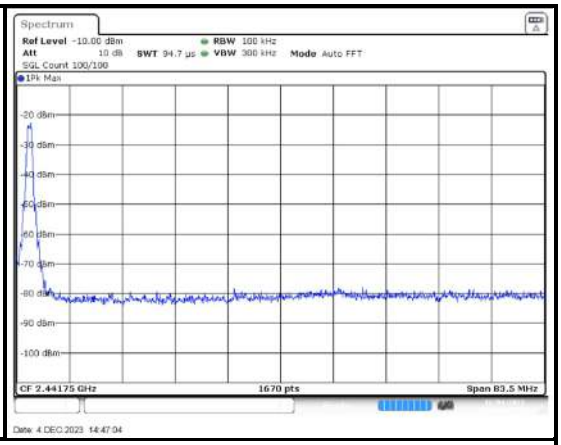
Test date: 12/4/2023

CH 0

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.975000	-45.0	15.2	-29.8	PASS
2399.925000	-47.9	18.2	-29.8	PASS
2399.875000	-50.3	20.5	-29.8	PASS
2399.825000	-50.5	20.7	-29.8	PASS
2399.675000	-52.3	22.6	-29.8	PASS
2399.575000	-52.5	22.8	-29.8	PASS
2399.625000	-52.6	22.8	-29.8	PASS
2399.775000	-52.9	23.1	-29.8	PASS
2357.975000	-53.0	23.2	-29.8	PASS
2399.725000	-53.3	23.6	-29.8	PASS
2357.925000	-53.4	23.6	-29.8	PASS
2355.975000	-53.5	23.7	-29.8	PASS
2399.525000	-53.5	23.8	-29.8	PASS
2355.925000	-53.7	23.9	-29.8	PASS
2356.075000	-53.9	24.1	-29.8	PASS

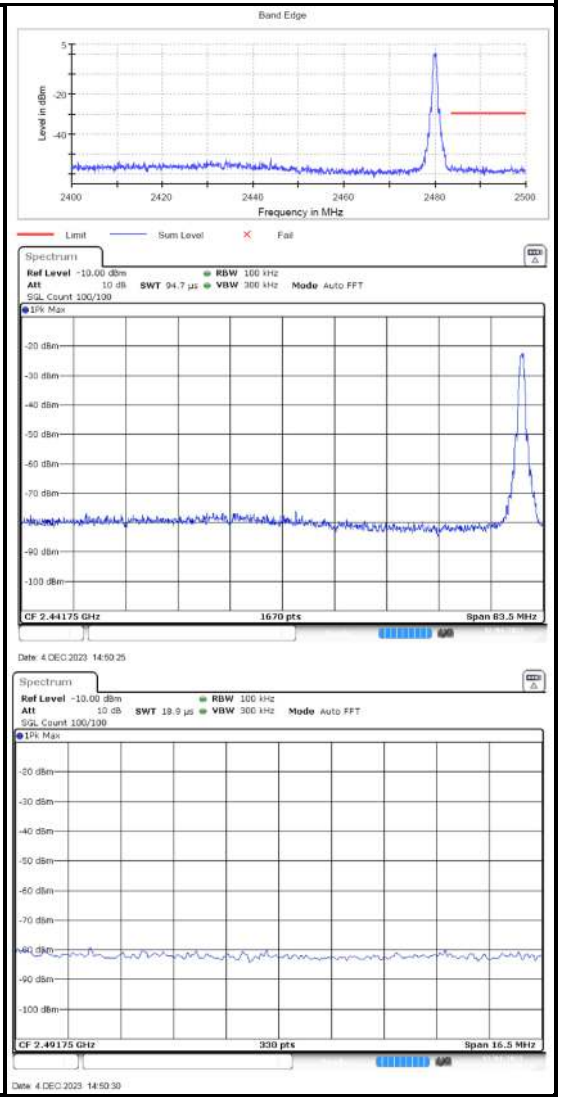




CH 39

Measurements

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2485.875000	-55.6	26.1	-29.4	PASS
2485.825000	-55.7	26.3	-29.4	PASS
2483.575000	-56.0	26.6	-29.4	PASS
2487.475000	-56.2	26.7	-29.4	PASS
2483.775000	-56.2	26.8	-29.4	PASS
2487.525000	-56.3	26.8	-29.4	PASS
2483.625000	-56.3	26.9	-29.4	PASS
2483.875000	-56.4	26.9	-29.4	PASS
2484.425000	-56.4	26.9	-29.4	PASS
2484.375000	-56.4	27.0	-29.4	PASS
2491.375000	-56.5	27.0	-29.4	PASS
2483.725000	-56.5	27.0	-29.4	PASS
2496.925000	-56.5	27.1	-29.4	PASS
2490.625000	-56.5	27.1	-29.4	PASS
2496.975000	-56.6	27.1	-29.4	PASS



5 PHOTOGRAPHS OF THE TEST CONFIGURATIONS

Please refer to the Test Setup Photos exhibit.

6 MODIFICATIONS TO THE EUT DURING TESTING

None.

---END OF REPORT---