

CERTIFICATION TEST REPORT

Report Number. : 4790976580-E6V1

- Applicant : SAMSUNG ELECTRONICS CO., LTD. 129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI, GYEONGGI-DO, 16677, KOREA
 - Model : SC-51E, SCG25
 - FCC ID : A3LSMS921JPN
- **EUT Description** : GSM/WCDMA/LTE 5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax, NFC and WPT
- Test Standard(s) : FCC 47 CFR PART 15 SUBPART C

Date Of Issue: 2024-01-22

Prepared by:

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Revision History

Rev.	Issue Date	Revisions	Revised By		
V1	2024-01-22	Initial issue	Dexter(Hyunsik) Yun		

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.

EUT DESCRIPTION: GSM/WCDMA/LTE 5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax, NFC and WPT

MODEL NUMBER: SC-51E, SCG25

SERIAL NUMBER: R3CWB0FGWAL, R3CWB0FGWFP (CONDUCTED); R3CWB0FGX5Z, R3CWB0FGXEX (RADIATED);

DATE TESTED:

2023-12-12 ~ 2024-01-22

APPLICABLE STANDARDS					
STANDARD TEST RESULTS					
47 CFR Part 15 Subpart C Complies					

UL KOREA LTD. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL KOREA LTD. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL KOREA LTD. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL KOREA LTD. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For UL KOREA LTD. By:

Seokhwan Hong Suwon Lab Engineer UL KOREA LTD. Tested By:

Dexter(Hyunsik) Yun Suwon Lab Engineer UL KOREA LTD.

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2. TEST METHODOLOGY

- 1. FCC 47 CFR Part 2.
- 2. FCC 47 CFR Part 15.
- 3. KDB 558074 D01 15.247 Meas Guidance v05r02.
- 4. KDB 662911 D01 v02r01
- 5. ANSI C63.10-2013.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea. Line conducted emissions are measured only at the 218 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

218 Maeyeong-ro				
Chamber 1(3m semi-anechoic chamber)				
Chamber 2(3m semi-anechoic chamber)				
Chamber 3(3m semi-anechoic chamber)				
Chamber 4(3m Full-anechoic chamber)				
Chamber 5(3m Full-anechoic chamber)				

UL KOREA LTD. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at <u>https://www.iasonline.org/wp-content/uploads/2017/05/TL-637-cert-New.pdf</u>.

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4. DECISION RULES AND MEASUREMENT UNCERTAINTY

4.1. METROLOGICAL TRACEABILITY

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB) 28.9 dBuV/m = 36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB

AC Corrected Reading (dBuV) = Measured Voltage (dBuV) + Extension Cord Loss (dB) + Cable Loss (dB) 44.72 dBuV = 34.72 dBuV + 9.9 dB + 0.1 dB

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	2.80 dB
Radiated Disturbance, 30 MHz to 1 GHz	3.92 dB
Radiated Disturbance, 1 GHz to 18 GHz	5.06 dB
Radiated Disturbance, 18 GHz to 40 GHz	6.02 dB

Uncertainty figures are valid to a confidence level of 95%.

4.4. DECISION RULES

Decision rule for statement(s) of conformity is based on Procedure 2, Clause 4.4.3 in IEC Guide 115:2021.

5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is a GSM/WCDMA/LTE 5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax, NFC and WPT. This test report addresses the DTS (BLE) operational mode.

Representative	Difference	Derivative model	
model	Difference	SCG25	
SC-51E	Hardware	Same as SC-51E	
30-91E	Software	Different UI	

The model SC-51E was used for final testing and is representative of the test results in this report.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range[MHz]	Mode	Power Mode	Output Power [dBm]	Output Power [mW]	
	1 Mbps (37pkt) 2Mbps	Peak	10.570	11.402	
2 402 ~ 2 480		Average	10.215	10.508	
2 402 ~ 2 400		Peak	10.600	11.482	
	(37 pkt)	Average	9.932	9.845	

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5.3. DESCRIPTION OF AVAILABLE ANTENNAS

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The internal antenna was Permanently attached. Therefore this E.U.T Complies with the requirement of §15.203.

The radio utilizes a internal antenna, with a maximum gain of:

Frequency	ANT1 Gain	ANT2 Gain	Correlated Chains	
Band[MHz]	[dBi]	[dBi]	Directional Gain[dBi]	
DTS 2400 – 2483.5	-2.44	-3.89	-0.12	

Directional gain for the MIMO operations is determined using KDB 662911 D01 Multiple Transmitter Output section F (2)(d)(1) for *Unequal antenna gains, with equal transmit powers*. The gain is calculated using the formula for correlated transmissions across the two transmit antennas.

Directional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + ... + 10^{GN/20})^2 / N_{ANT}] dBi.$ Sample calculation for this device with $N_{ANT} = 2$ Directional gain = $10 \log[(10^{-3.5/20} + 10^{-7.1/20})^2 / 2] = -2.1 dBi$

"BT/WIFI #1_2.4GHz (SUB6_Ant H)" and "BT/WIFI #2_2.4GHz (SUB6_Ant J)" as indicated in antenna specification are written as ANT1 and ANT2 in this report.

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5.4. WORST-CASE CONFIGURATION AND MODE

Both Bluetooth LE Diversity mode has been investigated and confirmed.

The fundamentals of the EUT were investigated in three orthogonal orientations X, Y and Z. It was determined that below table's orientation was the worst-case orientation.

ANT1	ANT2			
X				

For conducted power test, Diversity mode was verified and reported. Diversity mode test was performed on SISO iPA mode.

Radiated and power line conducted tests were performed with EUT connected to AC power adapter as the worst-case configuration. Radiated harmonics spurious 1~18 GHz Low/Mid/High channels,18-26GHz were performed with the EUT set at the Diversity mode. Radiated emission below 1GHz and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

For Radiated band-edge and spurious test, tests were performed on Diversity mode.

All radiated and power line conducted tests were performed attached with travel adapter for the worst-case condition mode.

Due to modulation characteristics, 125 kbps data is worse than 1Mbps in the RBW 3kHz PSD setting. However, based on the RBW (1MHz) when measuring radiated spurious, the PSD of 1Mbps is higher, so 1Mbps was selected as the worst case to suit the radiation test environment.

For 6 dB bandwidth, 125 kbps 6dB bandwidth was measured(for PSD span setting purpose).

Power verification

The Output Power of all data rate are all investigated, the 1 Mbps(37 pkt) and 2 Mbps(37 pkt) power is the worst case for symbol rate. All tests were performed in these two modes.

Symbol Rate	Mode	Freq.	Conducted	Symbol Rate	Mode	Freq.	Conducted
[Ms/s]		[MHz]	Burst Avg [dBm]	[Ms/s]		[MHz]	Burst Avg [dBm]
	1 Mbps 37 pkt	2 402	10.215		2 Mbps 37 pkt ANT1	2 402	9.932
		2 440	10.102			2 440	9.908
	ANT1	2 480	9.379			2 480	9.040
	1 Mbps	2 402	8.272		2 Mbps	2 402	8.081
	37 pkt	2 440	9.067		37 pkt	2 440	8.680
1	ANT2	2 480	7.943	2	ANT2	2 480	7.773
1	1 Mbps	2 402	10.121	∠	2 Mbps	2 402	9.910
	255 pkt	2 440	10.029		255 pkt	2 440	9.859
	ANT1	2 480	9.293		ANT1	2 480	9.125
	1 Mbps 255 pkt ANT2	2 402	8.256		2 Mbps 255 pkt ANT2	2 402	8.102
		2 440	8.835			2 440	8.901
		2 480	7.916			2 480	7.760
	125 kbps 37 pkt ANT1	2 402	10.150		500 kbps 37 pkt ANT1	2 402	10.028
		2 440	10.051			2 440	10.078
		2 480	9.322			2 480	9.212
	125 kbps	2 402	8.278	•	500 kbps 37 pkt ANT2	2 402	8.299
	37 pkt	2 440	9.071			2 440	9.092
1	ANT2	2 480	7.951	1		2 480	7.975
Coded S=8	125 kbps	2 402	10.082	Coded S=2	500 kbps 255 pkt ANT1	2 402	10.105
	255 pkt ANT1	2 440	9.992			2 440	10.013
		2 480	9.263			2 480	9.284
	125 kbps 255 pkt ANT2	2 402	8.249		500 kbps - 255 pkt	2 402	8.265
		2 440	8.840			2 440	9.059
		2 480	8.013		ANT2	2 480	7.926

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5.5. **DESCRIPTION OF TEST SETUP**

SUPPORT EQUIPMENT

Support Equipment List							
Description Manufacturer Model Serial Number FCC ID							
Charger	SAMSUNG	EP-TA800	R37W61WENTASEA	N/A			
Data Cable	SAMSUNG	EP-DN980	GH39-02117A	N/A			

I/O CABLE

	I/O Cable List						
Cable No.	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks	
1	DC Power	1	С Туре	Shielded	1.0 m	N/A	

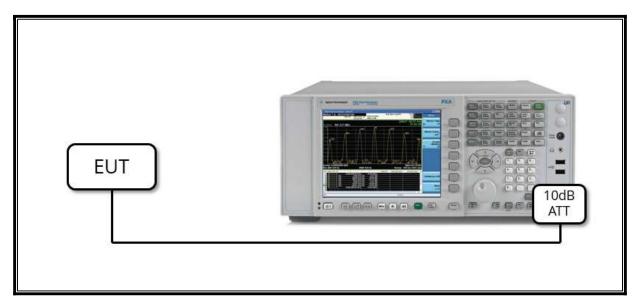
TEST SETUP

The EUT is a stand-alone unit during the tests. Test software in hidden menu exercised the EUT to enable BLE mode.

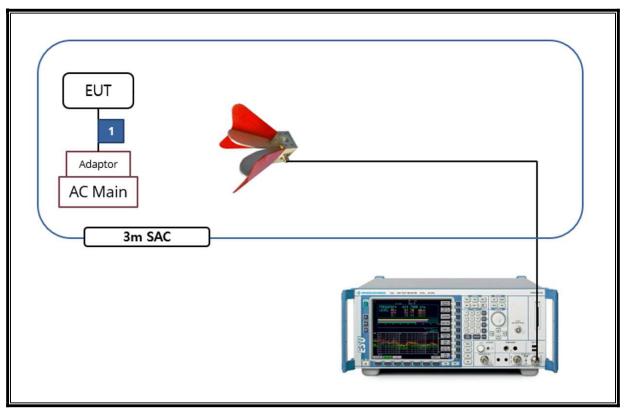
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SETUP DIAGRAM FOR TESTS (CONDUCTED TEST SETUP)



SETUP DIAGRAM FOR TESTS (RADIATED TEST SETUP)



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6. MEASUREMENT METHOD

<u>6 dB BW</u> : ANSI C63.10-2013, Section 11.8.2 Option 2

<u>OUTPUT POWER</u> : ANSI C63.10-2013, Section 11.9.1.1 RBW ≥ DTS bandwidth

POWER SPECTRAL DENSITY : ANSI C63.10-2013, Section 11.10.2 Method PKPSD (peak PSD)

<u>Out-of-band Emissions (Conducted)</u> : ANSI C63.10-2013, Section 11.11 Emissions in nonrestricted frequency bands

<u>Out-of-band Emissions in Non-restricted Bands</u>: ANSI C63.10-2013, Section 11.11 Emissions in nonrestricted frequency bands

<u>Out-of-band Emissions in Restricted Bands</u> : ANSI C63.10-2013, Section 11.12 Emissions in restricted frequency bands

AC Power Line Conducted Emission : ANSI C63.10-2013, Section 6.2

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7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List						
Description	Manufacturer	Model	S/N	Cal Due		
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	750	2024-08-15		
Antenna, Horn, 18 GHz	ETS	3117	00168717	2024-08-21		
Antenna, Horn, 40 GHz	ETS	3116C	00166155	2024-08-02		
Preamplifier	ETS	3116C-PA	00168841	2024-07-25		
Preamplifier, 1000 MHz	Sonoma	310N	341282	2024-07-24		
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	2029169	2024-07-24		
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	2024-07-25		
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	2024-07-24		
Spectrum Analyzer, 44 GHz	KEYSIGHT	N9040B	MY60080268	2025-01-03		
Average Power Sensor	Agilent / HP	U2000A	MY54270007	2024-07-23		
Average Power Sensor	Agilent / HP	U2000A	MY54260010	2024-07-24		
Attenuator	PASTERNACK	PE7087-10	A001	2024-07-23		
Attenuator	PASTERNACK	PE7087-10	A008	2024-07-27		
EMI Test Receive, 40 GHz	R&S	ESU40	100439	2024-07-23		
EMI Test Receive, 40 GHz	R&S	ESU40	100457	2024-07-24		
EMI Test Receive, 3 GHz	R&S	ESR3	101832	2024-07-23		
Low Pass Filter 5GHz	Micro-Tronics	LPS17541	009	2024-07-23		
High Pass Filter 3GHz	Micro-Tronics	HPM17543	010	2024-07-23		
High Pass Filter 6GHz	Micro-Tronics	HPS17542	021	2024-07-24		
LISN	R&S	ENV-216	101837	2024-07-23		
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	2025-09-06		
UL Software						
Description	Manufacturer	Model	Version			
Radiated software	UL	UL EMC	Ve	er 9.5		
AC Line Conducted software	UL	UL EMC	Ve	er 9.5		

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8. TEST RESULTS SUMMARY

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result
15.247 (a)(2)	Occupied Bandwidth(6dB)	> 500kHz		Complies
2.1051, 15.247(d)	Band Edge / Conducted Spurious Emission	-20 dBc	Conducted	Complies
15.247 (b)(3)	TX conducted output power	< 30 dBm	Conducted	Complies
15.247(e)	PSD	< 8 dBm/3kHz		Complies
15.207(a)	AC Power Line conducted emissions	Section 11	Power Line conducted	Complies
15.205, 15.209	Radiated Spurious Emission	< 54dBuV/m(Av)	Radiated	Complies

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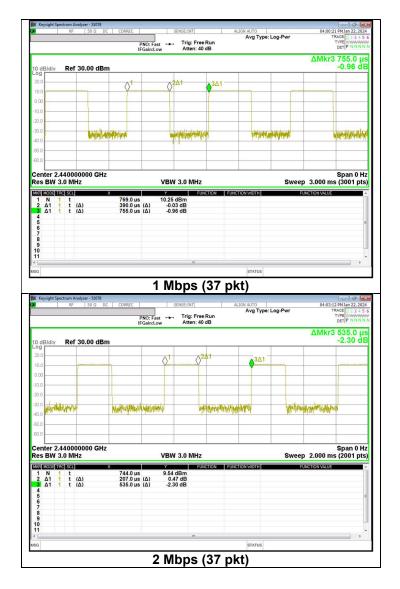
9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

Mode	On time [msec]	Period [msec]	Duty cycle x [Linear]	Duty Cycle [%]	Duty Cycle Correction Factor [dB]	1/T Minimum VBW [kHz]		
	2 400 ~ 2 483.5 MHz Bands							
1 Mbps [37pkt]	0.390	0.755	0.517	51.656	2.87	2.56		
2 Mbps [37pkt]	0.207	0.535	0.387	38.692	4.12	4.83		



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9.2. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

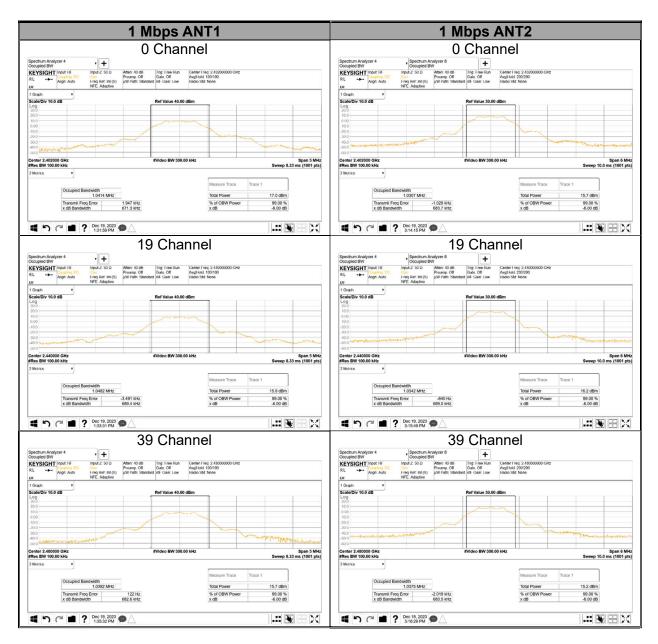
RESULTS

9.2.1. Test data

Mada	Antonno	Channel	Frequency	6 dB Bandwidth	Minimum Limit	
wode	Mode Antenna		[MHz]	[kHz]	[kHz]	
		0	2 402	671.3		
	ANT1	19	2 440	689.4		
1 Mbps		39	2 480	682.6		
(37pkt)		0	2 402	683.7		
	ANT2	19	2 440	689.0		
		39	2 480	683.5		
	ANT1	0	2 402	617.1		
		ANT1	19	2 440	617.8	
125 kbps		39	2 480	608.3	500.0	
(37pkt)		0	2 402	612.2	500.0	
	ANT2	19	2 440	612.8		
		39	2 480	609.4		
		0	2 402	1 139.0		
	ANT1	19	2 440	1 147.0		
2 Mbps		39	2 480	1 141.0		
(37pkt)		0	2 402	1 146.0		
	ANT2	19	2 440	1 151.0		
		39	2 480	1 149.0		
		Worst		608.3	500.0	

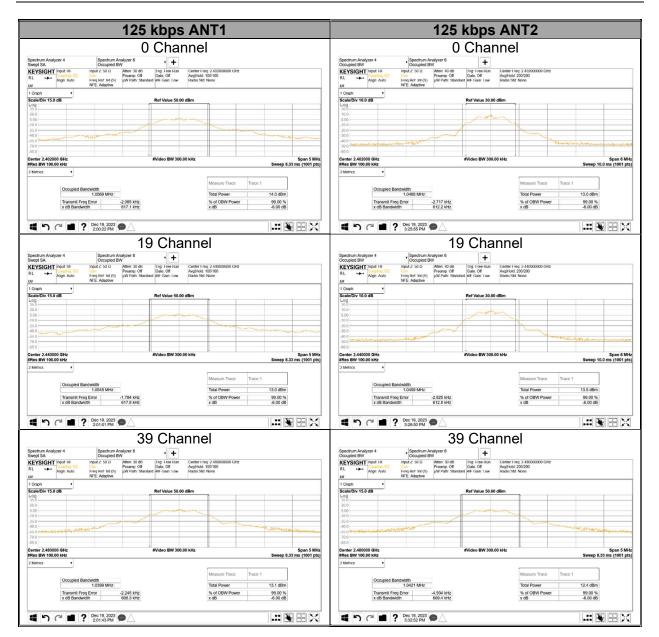
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9.2.2. 6 dB BANDWIDTH PLOTS

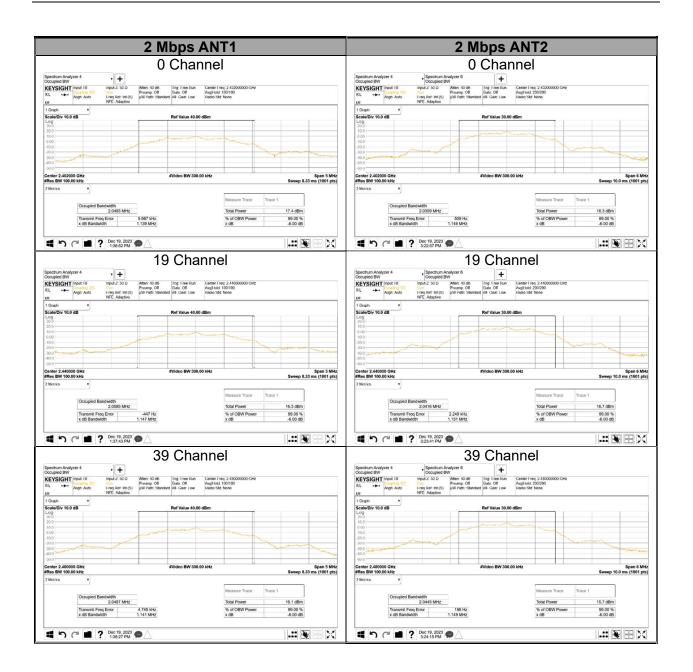


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9.3. OUTPUT POWER

<u>LIMITS</u>

FCC §15.247 (b) (3)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

Peak power is measured using ANSI C63.10(2013) under section 11.9.1.1 utilizing spectrum analyzer(RBW \geq DTS bandwidth).

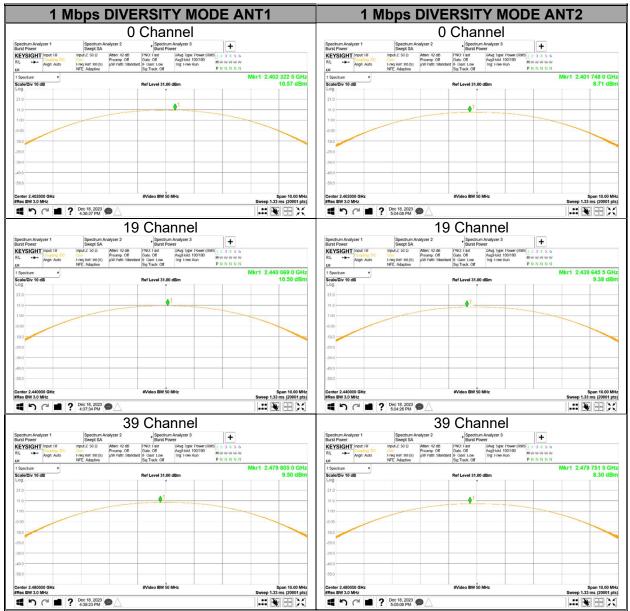
<u>RESULTS</u>

Mode	Mode Antenna		Frequency	Peak Output Power	Limit	Margin
			[MHz]	[dBm]	[dBm]	[dB]
		0	2 402	10.57		-19.43
	ANT1	19	2 440	10.50		-19.50
1 Mbps		39	2 480	9.50		-20.50
(37 pkt)	ANT2	0	2 402	8.71	30.000	-21.29
		19	2 440	9.38		-20.62
		39	2 480	8.30		-21.70
		0	2 402	10.60		-19.40
	ANT1	19	2 440	10.46		-19.54
2 Mbps		39	2 480	9.50		-20.50
(37 pkt)		0	2 402	8.73		-21.27
	ANT2	19	2 440	9.59		-20.41
		39	2 480	8.31		-21.69
Worst			10.60		-19.40	

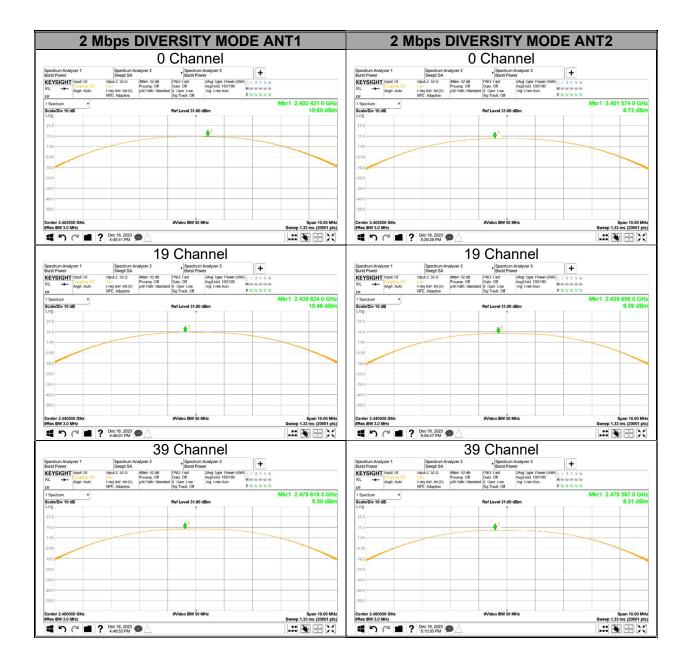
9.3.1. DIVERSITY MODE TEST DATA

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9.3.2. PEAK POWER PLOTS



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9.4. AVERAGE POWER

<u>LIMITS</u>

None; for reporting purposes only.

TEST PROCEDURE

Measurements perform using a wideband RF frame average power sensor.

The cable assembly insertion loss and duty cycle correction factor were entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Mode	Antenna	Channel	Frequency [MHz]	Average Output Power [dBm]	Average Output Power [mW]
		0	2 402	10.215	10.508
	ANT1	19	2 440	10.102	10.238
1 Mbps		39	2 480	9.379	8.668
(37pkt)	ANT2	0	2 402	8.272	6.718
		19	2 440	9.067	8.066
		39	2 480	7.943	6.227
	ANT1 ANT2	0	2 402	9.932	9.845
		19	2 440	9.908	9.790
2 Mbps (37 pkt)		39	2 480	9.040	8.016
		0	2 402	8.081	6.428
		19	2 440	8.680	7.380
		39	2 480	7.773	5.988

9.4.1. DIVERSITY MODE TEST DATA

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9.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

TEST PROCEDURE

ANSI C63.10-2013, Section 11.10.2 Method PKPSD (peak PSD)

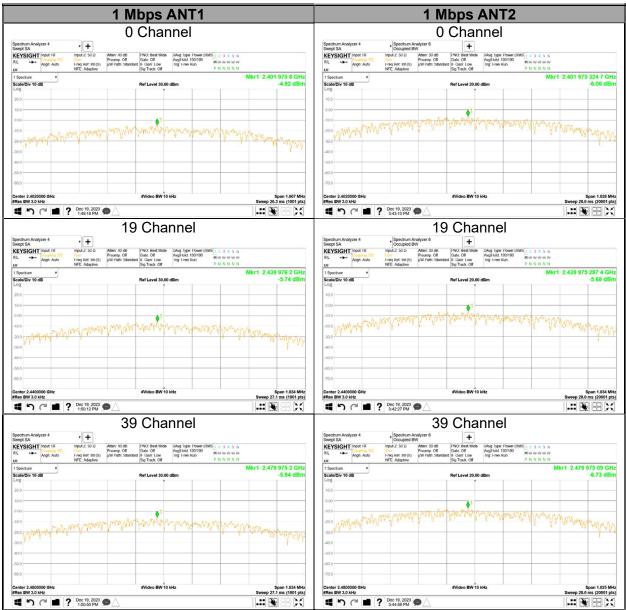
RESULTS

Mode	Antenna	Channel	Frequency [MHz]	PSD [dBm/3kHz]	Limit [dBm/3kHz]	Margin [dB]
		0	2 402	-4.92		-12.92
	ANT1	19	2 440	-5.74		-13.74
1 Mbps		39	2 480	-5.94] [-13.94
(37pkt)		0	2 402	-6.06] [-14.06
	ANT2	19	2 440	-5.68] [-13.68
		39	2 480	-6.73] [-14.73
	ANT1 ANT2	0	2 402	4.55	8.00	-3.45
		19	2 440	3.26		-4.74
125 kbps		39	2 480	3.11		-4.89
(37pkt)		0	2 402	3.01		-4.99
		19	2 440	3.34		-4.66
		39	2 480	2.35		-5.65
		0	2 402	-7.24		-15.24
	ANT1	19	2 440	-7.90		-15.90
2 Mbps		39	2 480	-8.03		-16.03
(37 pkt)		0	2 402	-8.23		-16.23
	ANT2	19	2 440	-7.82		-15.82
		39	2 480	-8.93		-16.93
	V	Vorst		4.55] [-3.45

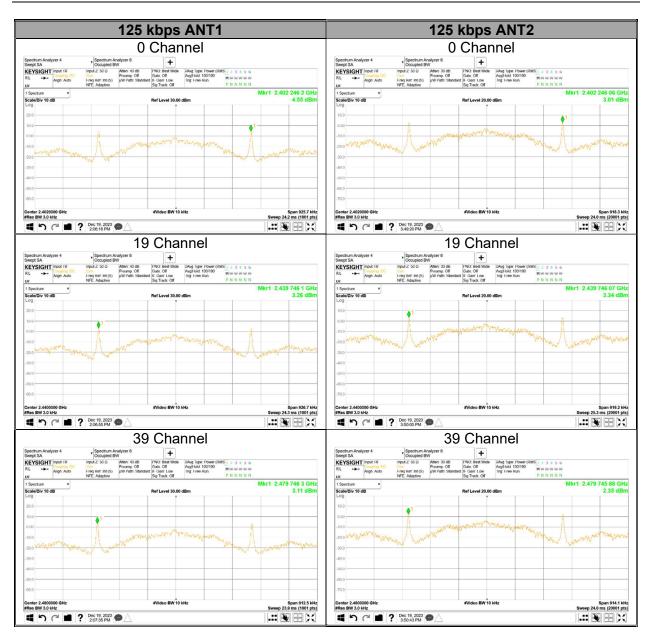
9.5.1. Test data

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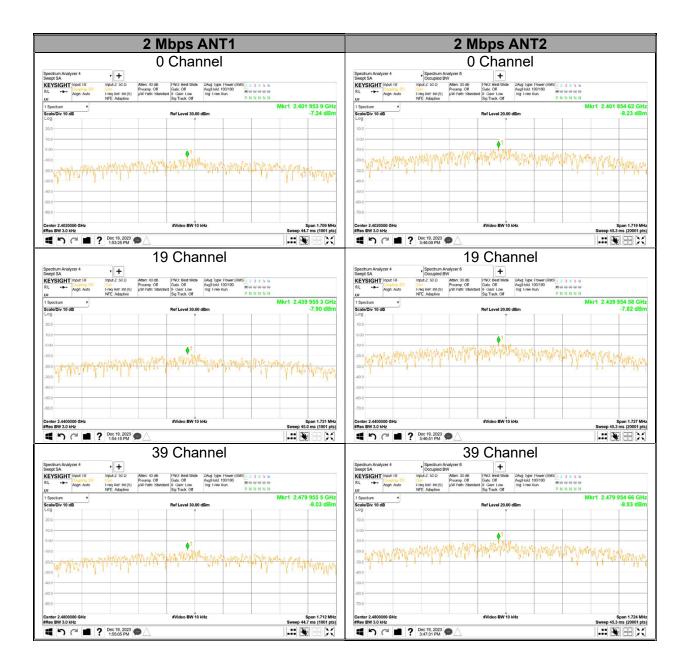
9.5.2. PSD TEST PLOTS



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9.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

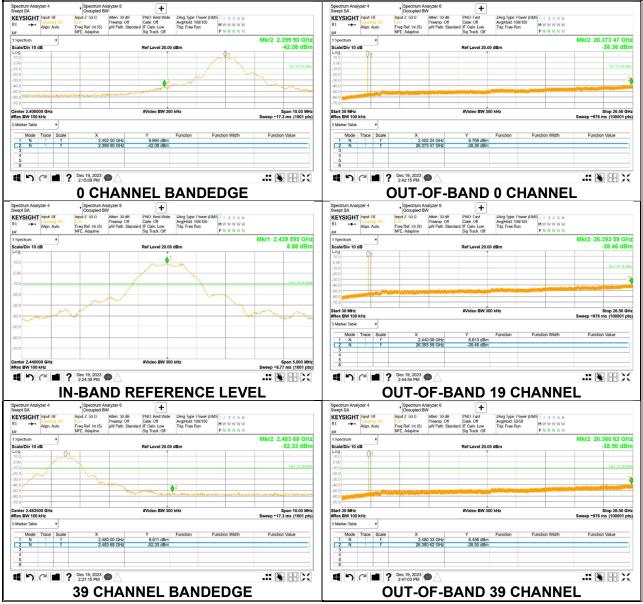
FCC §15.247 (d)

Output power was measured based on the use of a peak measurement. Therefore, spurious emissions are required to be 20 dBc.

RESULTS

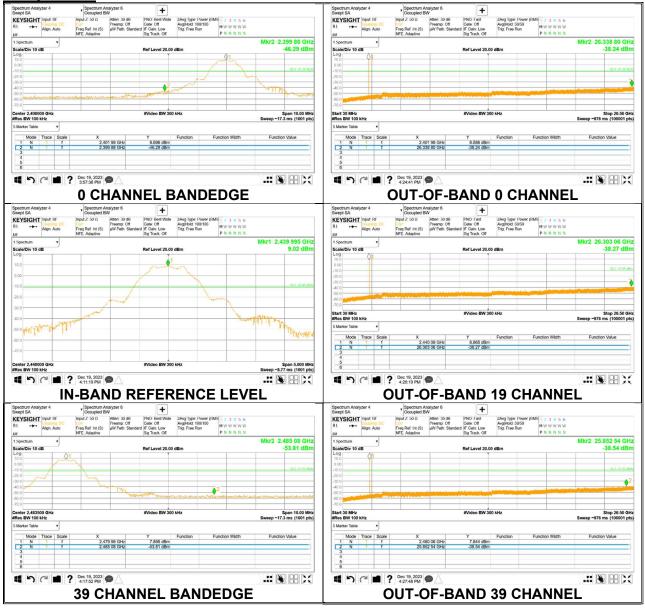
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<u>1 Mbps ANT1</u>

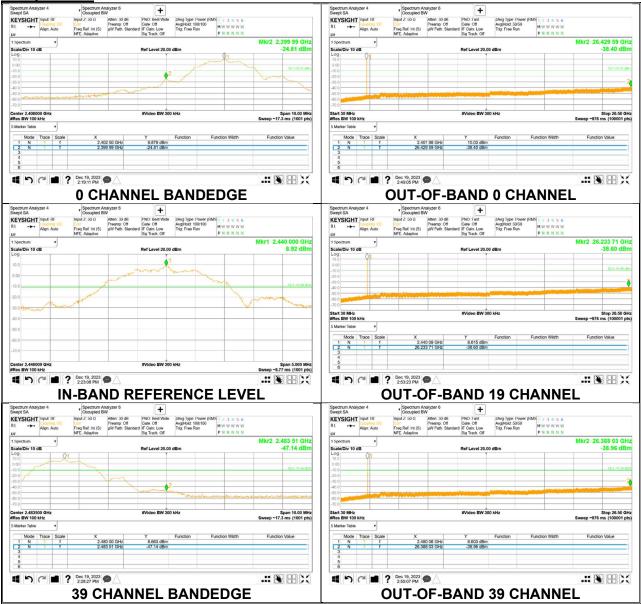


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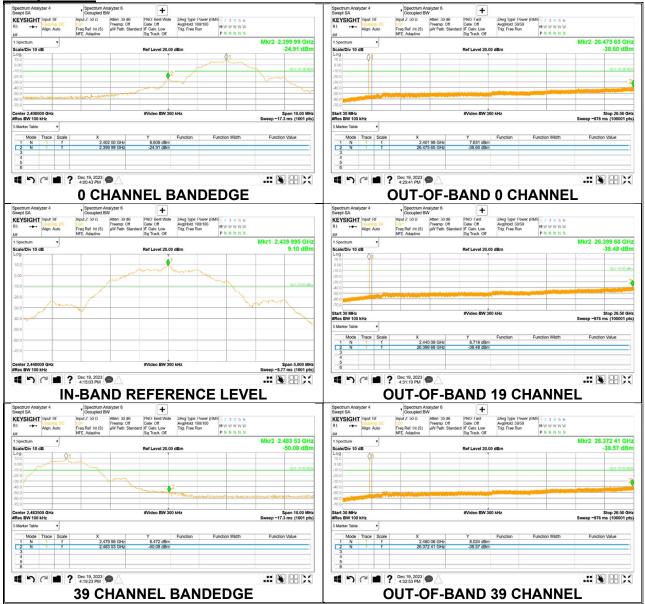
1 Mbps ANT2



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10. RADIATED TEST RESULTS

10.1. LIMITS AND PROCEDURE

<u>LIMITS</u>

FCC §15.205 and §15.209

Limits for radiated disturbance of an intentional radiator						
Frequency range (MHz)	Limits (µV/m)	Measurement Distance (m)				
0.009 - 0.490	2400 / F (kHz)	300				
0.490 – 1.705	24000 / F (kHz)	30				
1.705 – 30.0	30	30				
30 - 88	100**	3				
88 - 216	150**	3				
216 – 960	200**	3				
Above 960	500	3				

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

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