TEST REPORT

Report Number:		R14753279-E3V3
Customer	**:**	Starry Inc 38 Chauncy St, Suite 200 Boston, MA, 02111, USA
Model	**:**	800-00192R00
FCC ID	**:**	2AGZ3S01711
EUT Model	**:**	Comet37 2.0 Radio
Test Standard	**:**	FCC CFR 47 PART 30

Date Of Issue:
2023-12-01

Prepared by:
UL LLC
12 Laboratory Dr.
Research Triangle Park, NC 27709 U.S.A.
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ilac-MRA

ACCREDITED
CERT #0751.06

Revision History

Rev.	Issue Date	Revisions	Issued By
V1	2023-09-14	Initial Release	Michael Heckrotte
V2	2023-11-27	Updated Radiated Spurious Emissions data in the 26.5 - 36.6 GHz and 40.4 - 43.0 GHz ranges, Low Channel	Mike Antola
V3	2023-12-01	Editorial update	Mike Antola

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1. ATTESTATION OF TEST RESULTS

CUSTOMER NAME:	Starry Inc 38 Chauncy St, Suite 200 Boston, MA, 02111, USA
EUT DESCRIPTION:	Comet37 2.0 Radio
MODEL:	800-00192R00
SERIAL NUMBER:	2329000001
SAMPLE RECEIVE DATE:	2023-07-21, 2023-11-15
DATE TESTED:	2023-07-21 to 2023-09-08, 2023-11-15 to 2023-11-16

APPLICABLE STANDARDS

STANDARD	TEST RESULTS
FCC PART 30 (For 5G Base Station Transmitter)	Complies

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document.

Approved & Released For
UL LLC By:

Michael Heckrotte
Principal Engineer
Consumer Technology Division
UL LLC

Prepared By:

Henry Lindbo
Laboratory Engineer
Consumer Technology Division
UL LLC

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with the following standards.

1. FCC CFR 47 Part 2
2. FCC CFR 47 Part 30
3. ANSI C63.26-2015
4. KDB 842590 D01 Upper Microwave Flexible Use Service v01r02
5. KDB 971168 D01 Power Meas. License Digital Systems v03r01

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Dr., RTP, NC 27709, USA and 2800 Perimeter Park Dr., Suite B, Morrisville, NC 27560, USA. 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.

2800 Perimeter Park Dr.	12 Laboratory Dr.*
☒ Chamber 3 - mmWave	☐ Chamber A
☐ Chamber 1	☐ Chamber C
☒ Chamber 2	
☐ Chamber 4	

*-In order to maintain far-field separation based on maximum EUT antenna dimension, all in-band measurements were made at an outdoor test site located on the campus of 12 Laboratory Dr.

UL LLC is accredited by A2LA, Cert. No. 751.06, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
☒	12 Laboratory Drive Research Triangle Park, NC 27709, U.S.A.	US0067	2180C	825374
☒	2800 Perimeter Dr., Suite B, Morrisville, NC 27560, U.S.A.		27265	

Chamber 3 is a fully anechoic chamber dedicated to perform TRP measurements from 18-40 GHz, and field strength, EIRP and TRP measurements at and above 40 GHz. The measurement antenna is nominally 1.5 m high in accordance with C63.10-2013 procedures and applicable FCC KDB documents. The absorber reflectivity fully supports chamber performance over this frequency range. The dimensions of the chamber are approximately 6.7m (L) by 3.7m (W) by 3.1m (H).

4. CALIBRATION AND UNCERTAINTY

4.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

4.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	U_{LAB}
Radiated Disturbance, Worst-case Below 40 GHz	6.0 dB
Radiated Disturbance Above 40 GHz	2.9 dB
Temperature	0.3 %

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

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The Starry Comet37 2.0 is a customer terminal transmitter / receiver radio for use on Starry's 37 - 40 GHz millimeter-wave (mmWave) network. The Comet37 2.0 utilizes the U-NII-3 5GHz band as a secondary link as well as BLE for provisioning and installation. The system is equipped with a GPS receiver to facilitate precise timing control.

As a transmitter, Comet37 2.0 operates by converting data from multiple customers (g.hn Coax) to 802.11 WiFi, then up-converting to a specified mmWave channel in the 37 - 40 GHz frequency range. Data is sent wirelessly in up to 160 MHz channels to a mmWave base station. As a receiver, data flows in the opposite direction from the base station to Comet, then downstream to a splitter.

Comet37 2.0 utilizes an electronically steered phased array antenna for two-axis aim assist for optimizing the link budget. The phased array consists of 64 driven elements, per polarization (horizontal and vertical), for both transmit and receive.

The various internal oscillator signals within Comet37 2.0 consist of low-frequency timing control reference oscillators utilized to generate the high-frequency local oscillator frequencies for frequency conversion. All oscillator circuits are shielded to avoid unwanted leakage and radiation. The signals most likely to radiate are measured and verified to be compliant with FCC out-of-band (OOB) criteria.

The Comet37 2.0 is typically pole-mounted or building-mounted, and power and grounding is provided through cable routing to the serving internet connection. Lightning, moisture, and sun shielding are also addressed in the design.

5.2. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 7/14/2023 Nightly Development.
The test utility software used during testing was fcc (Starry Python module) == 7.0.0.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The EUT utilizes an integrated 8 x 8 patch antenna array with several optional parabolic reflectors (320 mm diameter heated, 320 mm diameter unheated, 515 mm diameter heated, and 515 mm diameter unheated). The antenna dimensions of the antenna on the base radio are 39.0 x 42.7 mm with a nominal gain of 23 dBi at 37 GHz; the 320 mm reflectors add an additional 10.5 dB to this gain, and the 515 mm reflectors add an additional 15.5 dB.

5.4. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Description	Manufacturer	Model	Serial Number
NUC	Jetway	JBC313U591W-31ACB	19CF319X002872
GNSS Simulator	Racelogic	LabSat	--
Starry Link	Starry	S00812	--
Bias-T	Starry	850-00128	--
Ethernet Switch	TP-Link	TL-SG108	22241J3004251
Monitor	Viewsonic	VS15453	V1X203841229
Keyboard	Dell	SK-8120	CN-04G481-71616-34R-099U-A00

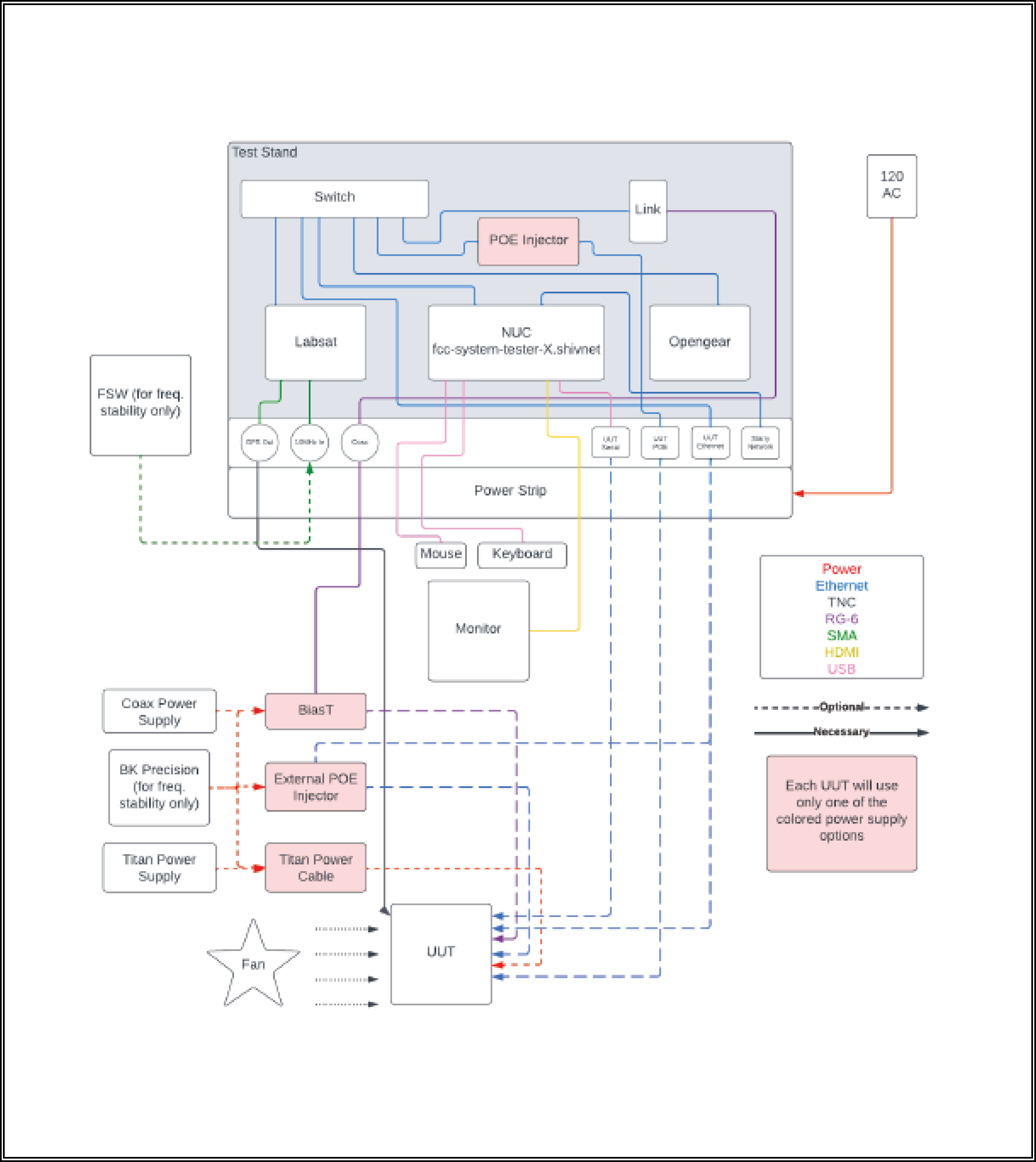
I/O CABLES

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	SMA	1	SMA	SMA	>3M	Provides GPS to EUT
2	RG-6	1	RG-6	RG-6	>3M	Provides power, ground & communication to EUT

TEST SETUP

All testing was performed using FTM (Factory Test Mode) software at continuous Tx operation (with a duty cycle of 100%).

SETUP DIAGRAM FOR TESTS



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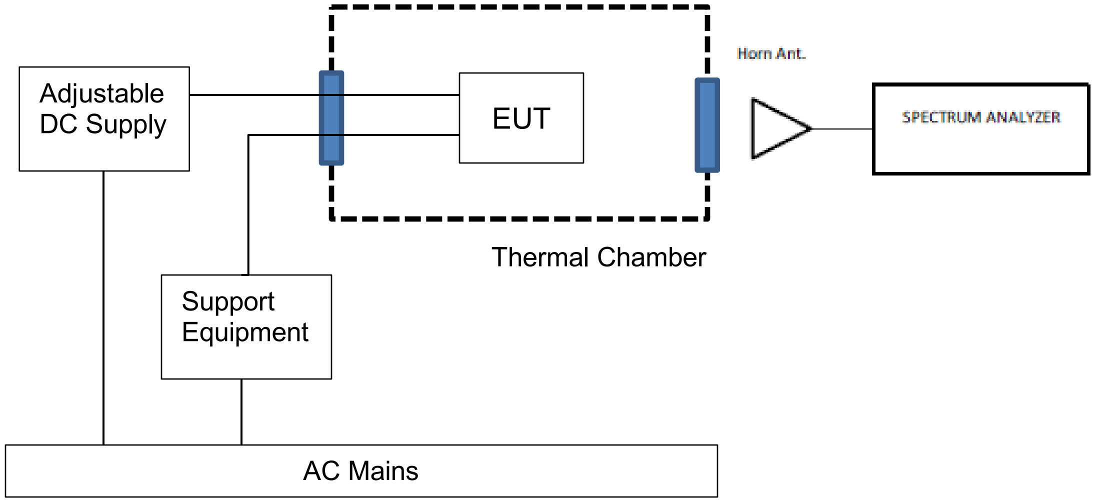
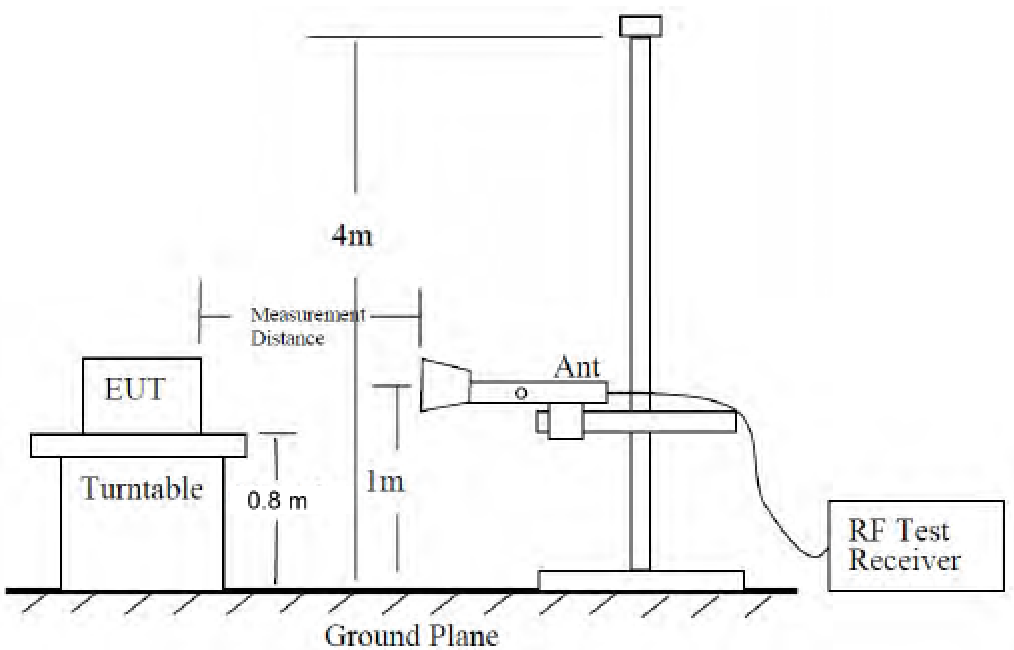
FREQUENCY STABILITY



TEST SITE DIAGRAM – Below 1 GHz



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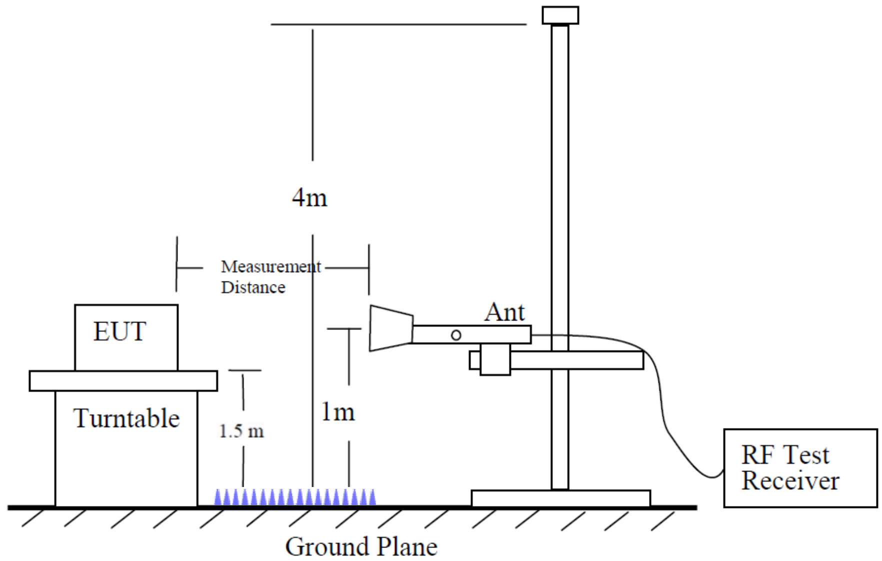
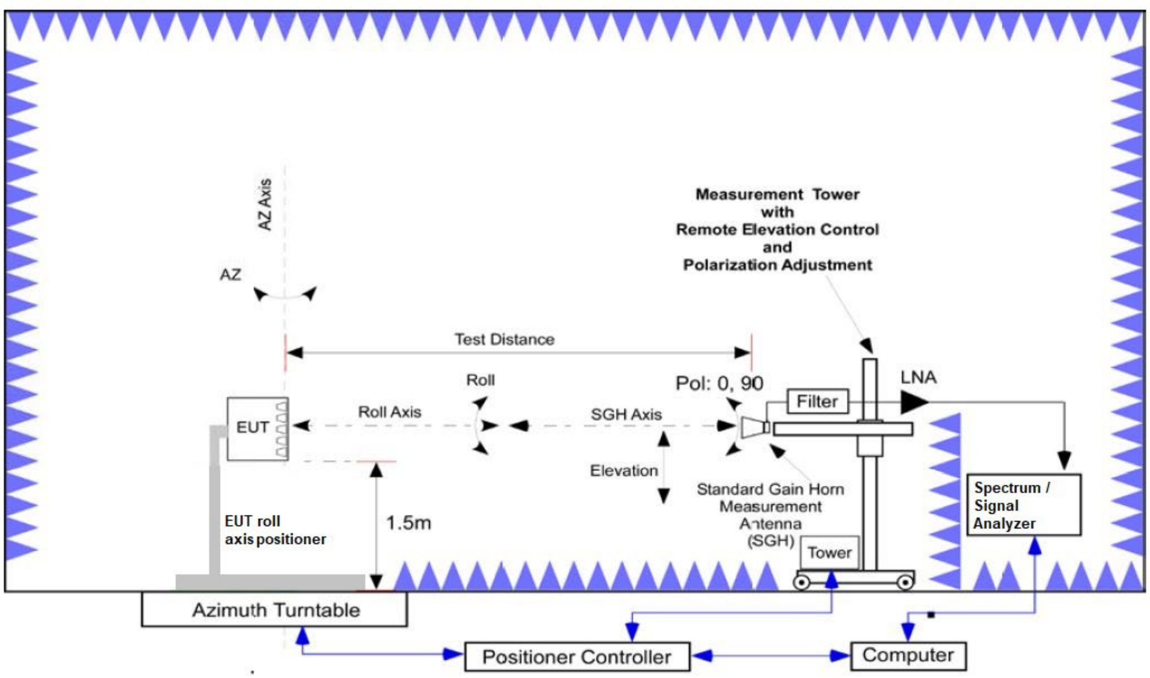
TEST SITE DIAGRAM – 1-18 GHz



TEST SITE DIAGRAM – TRP Above 18 GHz



6. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville – Chamber 1)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	1-18 GHz				
206211	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2023-04-06	2024-04-06
	Gain-Loss Chains				
91979	Gain-loss string: 1-18GHz	Various	Various	2023-05-16	2024-05-16
	Receiver & Software				
197954	Spectrum Analyzer	Rohde & Schwarz	ESW44	2023-02-02	2024-02-02
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
200539	Environmental Meter	Fisher Scientific	15-077-963	2022-10-05	2023-10-05

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville – Chamber 2)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz				
135144	Active Loop Antenna	ETS-Lindgren	6502	2023-01-17	2024-01-17
	30-1000 MHz				
90627	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2022-09-07	2023-09-07
	1-18 GHz				
88761	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2022-09-13	2023-09-13
	Gain-Loss Chains				
91975	Gain-loss string: 0.009-30MHz	Various	Various	2023-06-06	2024-06-06
91978	Gain-loss string: 25-1000MHz	Various	Various	2023-06-06	2024-06-06

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
91977	Gain-loss string: 1-18GHz	Various	Various	2023-06-06	2024-06-06
	Receiver & Software				
206496	Spectrum Analyzer	Rohde & Schwarz	ESW44	2023-03-24	2024-03-24
90416	Spectrum Analyzer	Keysight	N9030A	2023-06-09	2024-06-30
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
200540	Environmental Meter	Fisher Scientific	15-077-963	2022-10-05	2023-10-05

Test Equipment Used - mmWave Test Equipment (Morrisville – Chamber 3)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	18-40 GHz				
204907	Horn Antenna, 18-26.5GHz	Com Power	AH-826	2023-02-14	2024-02-29
204908	Horn Antenna, 26.5-40GHz	Com Power	AH-640	2023-02-14	2024-02-29
	40-50 GHz				
206209	Standard Gain Horn, 40-50GHz	Custom Microwave Inc.	HO22R	2023-02-14	2024-02-29
205910	Low Noise Amplifier	Eravant	SBL-3335033040-2222-E1	2023-02-02	2024-02-29
222197	Band Pass Filter	Eravant	SWF-46308340-22-B1	2023-02-02	2024-02-29
	50-75 GHz				
206203	Standard Gain Horn, 50-75GHz	Custom Microwave Inc.	HO15R	2023-02-14	2024-02-29
206607	WR15 Downconverter	VDI	WR15.0SAX-F	2023-04-06	2024-04-06
205911	Low Noise Amplifier	Eravant	SBL-5037531850-1515-E1	2023-02-07	2024-02-29
	75-110 GHz				
206222	Standard Gain Horn, 75-110GHz	Custom Microwave Inc.	HO10R	2023-02-14	2024-02-29
207249	WR10 Downconverter	VDI	WR10.0SAX-F	2023-04-06	2024-04-06
205913	Low Noise Amplifier	Eravant	SBL-7531142050-1010-E1	2023-02-08	2024-02-29
	110-170 GHz				
206242	Standard Gain Horn, 110-170GHz	Custom Microwave Inc.	HO6R	2023-02-14	2024-02-29

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Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
206555	WR6.5 Downconverter	VDI	WR6.5SAX-F	2023-04-06	2024-04-06
205912	Low Noise Amplifier	Eravant	SBL-1141741860-0606-E1	2023-02-09	2024-02-29
	170-260 GHz				
206244	Standard Gain Horn, 170-260GHz	Custom Microwave Inc.	HO4R	2023-02-14	2024-02-29
206556	WR4.3 Downconverter	VDI	WR4.3SAX-F	2023-04-06	2024-04-06
	Receiver & Software				
214284	Spectrum Analyzer	Rohde & Schwarz	FSW50	2023-01-24	2024-01-24
mmWave	mmWave Software	UL	V2022.7.29		
	Additional Equipment used				
210643	Environmental Meter	Fisher Scientific	15-077-963	2021-08-16	2023-08-16

Test Equipment Used - Wireless Conducted Measurement Equipment

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Conducted Room 1				
207726	Temp/Humid Chamber	Thermotron	SM-32-8200	2023-01-20	2024-01-20
179892	Environmental Meter	Fisher Scientific	15-077-963	2023-07-26	2024-06-31
	Additional Equipment used				
236852	CW-AC Power Source	Ametek	CW2501	NA	NA
214284	Spectrum Analyzer	Rohde & Schwarz	FSW50	2023-01-24	2024-01-24
204908	Horn Antenna, 26.5-40GHz	Com Power	AH-640	2023-02-14	2024-02-29

Test Equipment Used - mmWave Test Equipment (Outdoor Test Site)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	18-40 GHz				
204705	Horn Antenna, 26.5-40GHz	Com Power	AH-640	2023-07-20	2025-07-20
212231	Horn Antenna, 26.5-40GHz	Com Power	AH-640	2023-02-14	2024-02-29
214284	Spectrum Analyzer	Rohde & Schwarz	FSW50	2023-01-24	2024-01-24
207161	Signal Generator	Rohde & Schwarz	SMA100B	2023-06-27	2024-06-27

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7. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result
2.1049	Occupied Bandwidth	N/A	Radiated	Compliant
2.1046 30.202	Equivalent Isotropic Radiated Power (EIRP)	+75 dBm / 100 MHz EIRP	Radiated	Compliant
2.1051 30.203	Out-of-Band Emissions at the Band Edge	-13 dBm/MHz for All out-of-band emissions. -5 dBm/MHz from the band edge up to 10% of the channel BW	Radiated	Compliant
2.1051 30.203	Spurious Emissions	-13 dBm/MHz for all out-of-band emissions	Radiated	Compliant
2.1055	Frequency Stability	N/A	Radiated	Compliant

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8. APPLICABLE LIMITS AND TEST RESULTS

8.1. FAR-FIELD DISTANCE AND MEASUREMENT DISTANCE

The equipment under test was transmitting while connected to its integral antenna and is mounted to a roll-axis positioner, placed on a turntable.

The measurement distance is in the far field per formula $2D^2/\lambda$ where D is the larger dimension of the EUT antenna for in-band measurements and receive antenna for all other measurements.

For fundamental & band edge emissions, the largest far-field distance of the EUT antenna was used. The largest dimension of the largest antenna configuration is approximately 515 mm, which yields a far field measurement distance of approximately 70.73 meters at 40 GHz. As such, all in-band testing was performed at a 71-meter distance.

For above 18 GHz spurious emissions, the far-field distance is based on the measurement antenna. The EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest EIRP reading on the receive spectrum analyzer.

Frequency Range (GHz)	Wavelength (m)	Far Field Distance (m)	Measurement Distance Used (m)
18-26.5	0.0113	2.10	3.00
26.5-40	0.0075	1.66	3.00
40-50	0.0060	0.59	3.00
50-75	0.0040	0.39	3.00
75-110	0.0027	0.26	3.00
110-170	0.0018	0.16	3.00
170-200	0.0015	0.11	3.00

Radiated power levels are investigated while the receive antenna was rotated through all polarization angles to determine the worst-case polarization/positioning.

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8.2. WORST CASE CONFIGURATION AND MODE

The EUT is available in the following configurations:

- Base Radio
- Base Radio with 515mm heated reflector
- Base Radio with 515mm unheated reflector
- Base Radio with 320mm heated reflector
- Base Radio with 320mm unheated reflector

For all 5G NR FR2 Bands, the worst-case scenario for all measurements is based on the EIRP measurement investigation results, comparing to TRP limits to demonstrate compliance. Testing was performed at all of the supported bandwidth configurations (20MHz, 40MHz, 80MHz, 160MHz), the worst-case MCS level (MCS0 for all configurations), and the highest gain antenna configuration (base unit with 515mm unheated reflector). The worst-case MCS level was declared by the manufacturer. Preliminary measurements showed that the 515mm unheated reflector yielded worst-case results over the 515mm heated reflector.

For Bandedge and spurious emissions the EIRP is compared to the TRP limit to demonstrate compliance.

The fundamental and radiated spurious emission were investigated in all orthogonal orientations X (landscape), Y (portrait), Z (flatbed) and Roll, where applicable. The final optimum position resulting in the highest EIRP for the frequency or band under investigation is placed on an open-air fixture allowing no blockage of the signal as measured by the receiving antenna.

The EUT was tested with the following maximum power settings:

Modulation	Power Setting	Worst Case Channel	Worst Case Power (dBm)
20 MHz	50	Mid	67.69
40 MHz	50	Mid	67.72
80 MHz	50	Low	67.15
160 MHz	50	Low	67.64

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8.3. OCCUPIED BANDWITH

RULE PART

FCC: §2.1049

LIMIT

For reporting purposes only

TEST PROCEDURES

99% bandwidth measurement function of the signal analyzer was used to measure 99% occupied.

- RBW = 1 – 5% of OBW
- VBW ≥ 3 x RBW
- Detector = Peak
- Trace mode = Max Hold
- Sweep = Auto Couple
- The trace was allowed to stabilize

KDB 842590 D01 Upper Microwave Flexible Use Service v01 Section 4.3
ANSI C63.26-2015 Clause 5.4.3.

All supported bandwidths were tested at low, middle, and high channels.

RESULTS

Full results are summarized in the following table, followed by a representative plot.

TESTED BY

Employee IDs: 23854
Test Dates: 2023-07-31
Test Location: Chamber 3

8.3.1. OCCUPIED BANDWIDTH RESULTS

Antenna Configuration	Modulation	Channel	Frequency (GHz)	Channel BW (MHz)	Meas Distance (m)	Measured OBW (MHz)
Base Unit	OFDM, MCS0	Low	37.1	160	3	160.146
		Mid	38.5	160	3	158.424
		High	39.9	160	3	158.007
		Low	37.1	80	3	77.838
		Mid	38.5	80	3	78.406
		High	39.9	80	3	77.27
		Low	37.1	40	3	39.914
		Mid	38.5	40	3	42.812
		High	39.9	40	3	39.148
		Low	37.1	20	3	21.982
		Mid	38.5	20	3	22.239
		High	39.9	20	3	20.986

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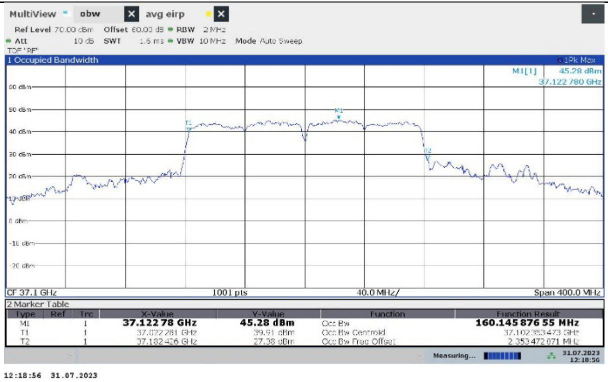
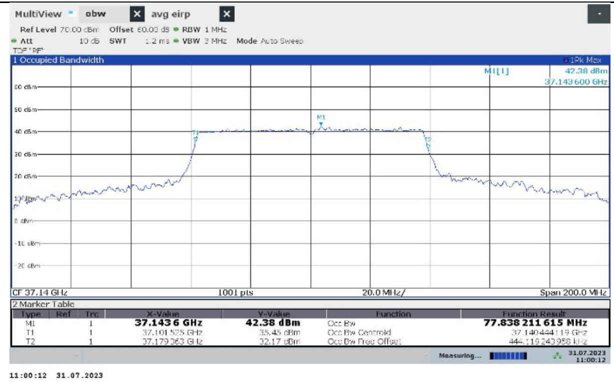
Occupied Bandwidth Results

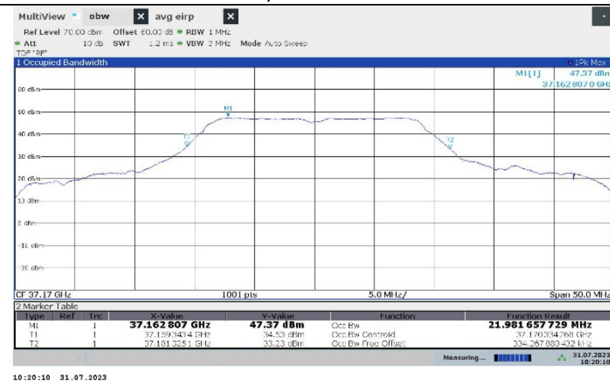


Low Channel, 160 MHz Bandwidth



Low Channel, 80 MHz Bandwidth

Low Channel, 40 MHz Bandwidth



Low Channel, 20 MHz Bandwidth

8.4. OUTDOOR SITE SUBSTITUTION MEASUREMENTS

EIRP was measured and calculated using the equations in ANSI C63.26-2015 Annex C.5.2 then compared to TRP limits. The total correction factors of horn antenna gain, cable loss and far-field path loss were calculated using equations C.8 and C.9, and pre-loaded into the spectrum analyzer.

Sample calculation:

Total Correction Factor for Radiated RF Output Power = Cable Loss (dB) – Horn Ant Gain (dBi) + Path Loss @ 71m (dB)
= 5.26 – 23.31 + 100.89
= 82.84 dB

EIRP = $P_{measured}$ (dBm), where Total Correction Factor preloaded.

Total Correction Factor for Band Edge Conducted Output Power = Cable Loss (dB) – Horn Ant Gain (dBi) + Path Loss @ 71m (dB) – EUT Antenna Gain (dBi)
= 5.26 – 23.31 + 100.89 – 15.5
= 67.34 dB

Conducted Power = $P_{measured}$ (dBm), where Total Correction Factor preloaded.

As the anechoic chamber meets applicable validation requirements in KDB 842590, the theoretical path loss value is used for 3-meter testing in accordance with C63.26 Clause 5.5.4.

The substitution measurement method per C63.26 Clause 5.5.3 was used for the 71-meter outdoor measurements. In lieu of the theoretical calculated free space propagation path loss (see C63.26 Equation C.9), substitution measurements were performed to determine the actual free space path loss of the test site at the measurement distance. The delta between the theoretical and actual path loss is then accounted for in the EIRP and Band Edge summary tables in the applicable sections below.

Derivation of the Measured Path Loss:

EIRP = $P_T + G_T – L_C$ C63.26 Equation (C.3)

Where,

P_T = transmitter output power
G_T = gain of transmitting antenna
L_C = signal loss in connecting cable between transmitter and antenna

EIRP = $P_R + L_P$ C63.26 Equation (C.7)

Where,

P_R = adjusted received power level
L_P = basic free-space propagation path loss

$P_R – P_{meas} – G_R + L_C + L_{atten} – G_{amp}$ C63.26 Equation (C.8)

Where,

P_{meas} = measured power level
G_R = gain of receive antenna
L_C = signal loss in measurement cable
L_{atten} = value of external attenuation (if used)*
G_{amp} = value of external amplification (if used)*

*-External attenuation or amplification not used for these measurements

Combining Equations. C.3, C.7 and C.8 yields:

Pt + Gtx – Lctx = Pmeas – Grx + Lcrx + Latten – Gamp + Lp

Re-arranging to express path loss as a function of the other parameters:

Lp = Pt + Gtx – Lctx - Pmeas + Grx - Lcrx - Latten + Gamp

Calculation for 37 GHz:

L_P = 15 + 22.65 – 5.22 – (-48.75) + 23.31 – 5.26 – 0 + 0

$L_{PMeasured}$ = 99.23 dB

Free Space Path Loss (Theoretical):

$L_P = 20\log F + 20\log d – 27.5$

Where,

L_P = free space propagation path loss, in dB
F = center frequency of radiated EUT signal, in MHz
d = measurement distance, in m

Example Calculation:

L_P = 20log(37000) + 20log(71) – 27.5

L_P = 91.36 + 37.03 – 27.5

$L_{PTheoretical}$ = 100.89 dB

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TESTED BY

Employee IDs: 23854, 11322
Test Dates: 2023-09-08
Test Locations: RTP Outdoor Test Site

The following table shows the results of the substitution measurements to derive the actual free space propagation path loss value, and the delta to the theoretical free space propagation loss.

Channel	Freq (GHz)	Meas Distance (m)	P_T (dBm)	L_C (Rx) (dB)	L_C (Tx) (dB)	G_T (Rx) (dBi)	G_T (Tx) (dBi)	Measured Power, P_{meas} (dBm)	Measured Path Loss, L_P (dB)	Theoretical Path Loss, L_P (dB)	Path Loss Delta (dB)
Low BE	37.00	71.00	15.00	5.22	5.26	23.31	22.65	-48.75	99.23	100.89	-1.66
Low Channel	37.10	71.00	15.00	5.26	5.26	23.35	22.69	-49.12	99.64	100.91	-1.27
Mid Channel	38.50	71.00	15.00	5.47	5.48	23.19	22.57	-52.60	102.41	101.23	1.18
High Channel	39.90	71.00	15.00	5.54	5.52	23.36	22.45	-46.91	96.66	101.54	-4.88
High BE	40.00	71.00	15.00	5.59	5.69	23.39	22.34	-46.61	96.05	101.57	-5.51

Furthermore, knowing the EIRP of the base unit and the gain of the additional reflector enables a calculation of the predicted EIRP with the reflector. The 71-meter measured value is compared to this predicted value as a sanity check.

Channel	Freq (GHz)	Base Radio Measured EIRP At 3m (dBm)	Expected Additional Gain From Reflector (dB)	Predicted EIRP With Reflector	Measured EIRP With Reflector at 71m (dBm)	Measured vs Predicted EIRP Delta (dB)
Low, 160 MHz BW	37.1	51.97	15.5	67.47	65.43	-2.04

Additionally, a spot test of the base unit at 71 meters was made to validate the gain of the reflector.

Channel	Freq (GHz)	Base Radio Measured EIRP At 71m (dBm)	Expected Additional Gain From Reflector (dB)	Predicted EIRP With Reflector	Measured EIRP With Reflector at 71m (dBm)	Measured vs Predicted EIRP Delta (dB)
Low, 160 MHz BW	37.1	49.93	15.5	65.43	65.43	0.0

8.5. EQUIVALENT ISOTROPIC RADIATED POWER

RULE PART(S)

FCC: §2.1046, §30.202

LIMIT

30.202 (a) – For fixed and base stations operating in connection with mobile systems, the average power of the sum of all antenna elements is limited to an equivalent isotropic radiated power (EIRP) density of +75 dBm/100 MHz. For channel bandwidths less than 100 megahertz the EIRP must be reduced proportionally and linearly based on the bandwidth relative to 100 megahertz.

TEST PROCEDURES

Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.

- RBW = 1 – 5% of the OBW
- VBW ≥ 3 x RBW
- Span = 2x to 3x the OBW
- Number of measurement points in sweep > 2 x span / RBW
- Sweep time = auto-couple
- Detector = RMS
- Trace mode = Average over 100 sweeps

KDB 842590 D01 Upper Microwave Flexible Use Service v01 Section 4.2
ANSI C63.26-2015 Clause 5.2, Clause 5.5, Clause 6.4, and Annex C.5.2

EIRP measurements were performed at the far field test distance listed in Section 8.1.

EIRP was calculated using the equations in ANSI C63.26-2015 Annex C.5.2, as described above in "OUTDOOR SITE SUBSTITUTION MEASUREMENTS".

To properly display signal levels on the plots, the pre-loaded correction factors were intentionally lowered by 70, 60, or 50 dB and an offset factor of 70, 60, or 50 dB (respectively) was applied on the spectrum analyzer to compensate the true correction factors across the frequency range of measurement.

Radiated power levels are investigated while the receive antenna was rotated through all angles to determine the worst-case polarization/positioning.

Worse-Case Configurations

All supported bandwidths were tested at low, middle, and high channels. All channels were tested at power setting 50. Testing was performed with the worst-case / highest gain reflector only as this resulted in the highest possible EIRP.

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RESULTS

See the following pages.

TESTED BY

Employee IDs: 23854, 11322
Test Dates: 2023-08-11
Test Locations: RTP Outdoor Test Site

8.5.1. EIRP RESULTS

Antenna Configuration*	Modulation	Channel	Frequency (GHz)	Channel BW (MHz)	Meas Distance (m)	Meas OBW (MHz)	Meas Avg EIRP (dBm)	Avg EIRP Limit** (dBm/ 100MHz)	Margin (dB)
Base Unit Only	OFDM, MCS0	Low	37.1	160	3	160.146	51.97	75	-23.03
		Mid	38.5	160	3	158.424	50.53	75	-24.47
		High	39.9	160	3	158.007	51.46	75	-23.54
		Low	37.1	80	3	77.838	51.16	74	-22.87
		Mid	38.5	80	3	78.406	50.46	74	-23.57
		High	39.9	80	3	77.27	48.38	74	-25.65
		Low	37.1	40	3	39.914	51.11	71	-19.91
		Mid	38.5	40	3	42.812	50.78	71	-20.24
		High	39.9	40	3	39.148	48.41	71	-22.61
		Low	37.1	20	3	20.982	51.79	68	-16.22
		Mid	38.5	20	3	22.239	50.23	68	-17.78
		High	39.9	20	3	20.986	48.28	68	-19.73

** For channels with a bandwidth less than 100MHz, the limit is reduced proportionally and linearly based on the bandwidth relative to 100MHz. i.e., EIRP Limit = 75 – 10*log(100 / channel BW [MHz])

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Antenna Configuration*	Modulation	Channel	Frequency (GHz)	Channel BW (MHz)	Meas Distance (m)	Meas OBW (MHz)	Meas Avg EIRP (dBm)	L_P Delta (dB)	Corrected Avg EIRP (dBm)	Avg EIRP Limit** (dBm/ 100MHz)	Margin (dB)
Base Unit + 515mm Unheated Reflector	OFDM, MCS0	Low	37.1	160	71	160.146	66.7	-1.27	65.43	75	-9.57
		Mid	38.5	160	71	158.424	66.46	1.18	67.64	75	-7.36
		High	39.9	160	71	158.007	66.29	-4.88	61.41	75	-13.59
		Low	37.1	80	71	77.838	66.18	-1.27	64.91	74	-9.12
		Mid	38.5	80	71	78.406	65.97	1.18	67.15	74	-6.88
		High	39.9	80	71	77.27	63.69	-4.88	58.81	74	-15.22
		Low	37.1	40	71	39.914	66.53	-1.27	65.26	71	-5.76
		Mid	38.5	40	71	42.812	66.54	1.18	67.72	71	-3.30
		High	39.9	40	71	39.148	63.92	-4.88	59.04	71	-11.98
		Low	37.1	20	71	20.982	66.38	-1.27	65.11	68	-2.90
		Mid	38.5	20	71	22.239	66.51	1.18	67.69	68	-0.32
		High	39.9	20	71	20.986	63.2	-4.88	61.93	68	-6.08
Base Unit		Low	37.1	160	71	160.146	51.21	-1.27	49.93	75	-25.07

A measurement of the Base Unit without Reflector at 71-meter is provided to correlate the 3-meter measurement.

* All antenna configurations were investigated and the base unit with unheated 515 mm reflector was found to be worst-case. As such, full testing was done on this antenna configuration only.

** For channels with a bandwidth less than 100MHz, the limit is reduced proportionally and linearly based on the bandwidth relative to 100MHz. i.e., EIRP Limit = 75 – 10*log(100 / channel BW [MHz])

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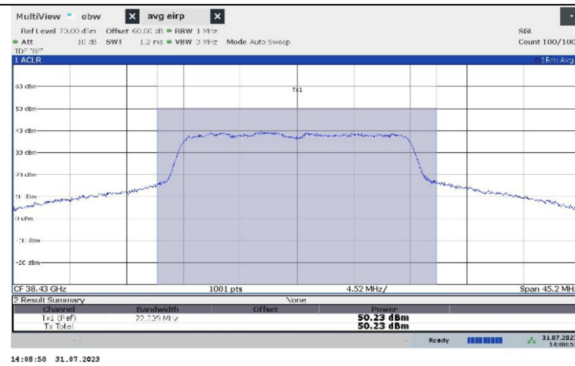
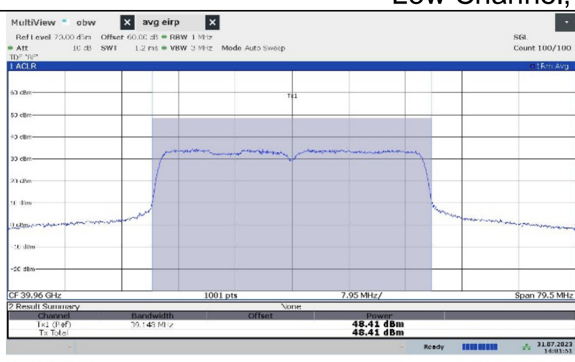
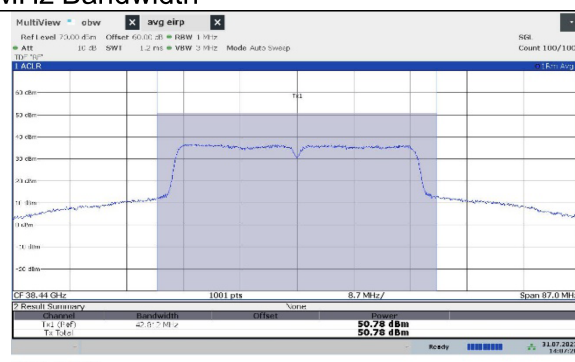
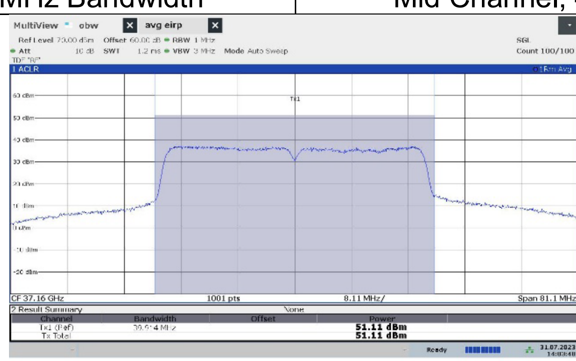
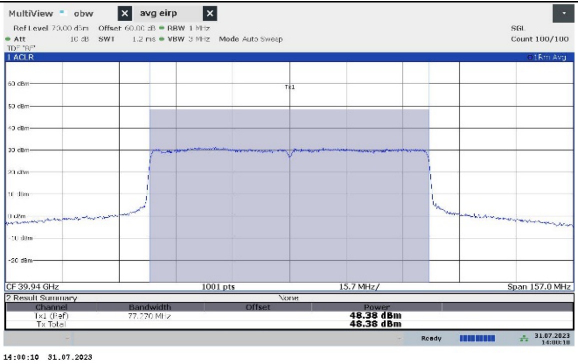
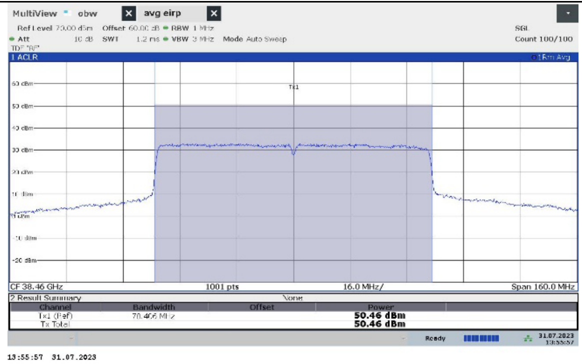
Anechoic Chamber Measurements (3-meter)	
 High Channel, 20 MHz Bandwidth	 Mid Channel, 20 MHz Bandwidth
 Low Channel, 20MHz Bandwidth	
 High Channel, 40 MHz Bandwidth	 Mid Channel, 40 MHz Bandwidth
 Low Channel, 40MHz Bandwidth	



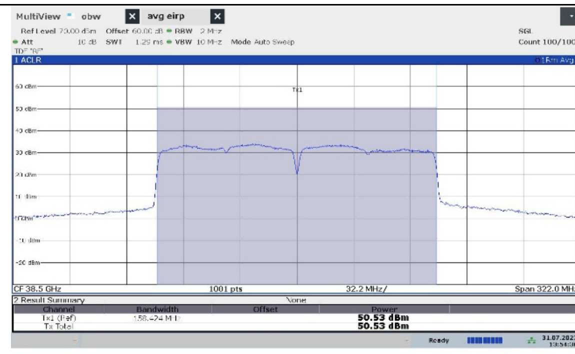
High Channel, 80 MHz Bandwidth



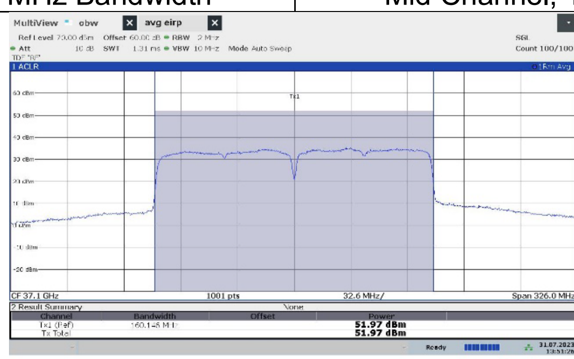
Mid Channel, 80 MHz Bandwidth

Low Channel, 80MHz Bandwidth

High Channel, 160 MHz Bandwidth

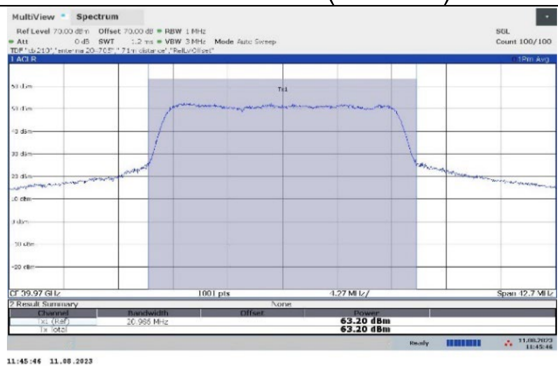


Mid Channel, 160 MHz Bandwidth

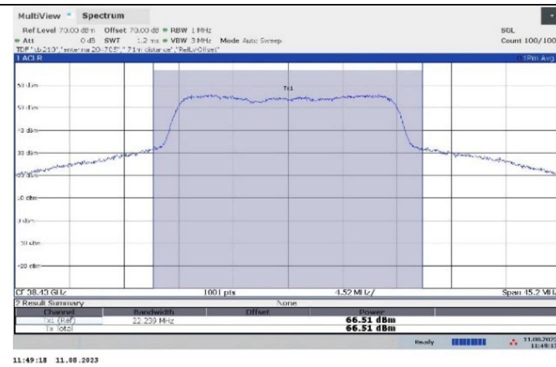


Low Channel, 160MHz Bandwidth

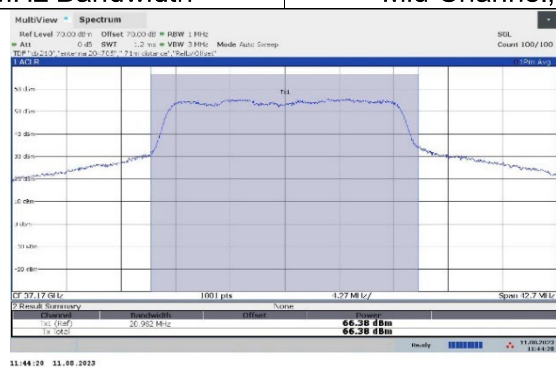
Outdoor Site Measurements (71-meter)



High Channel, 20 MHz Bandwidth

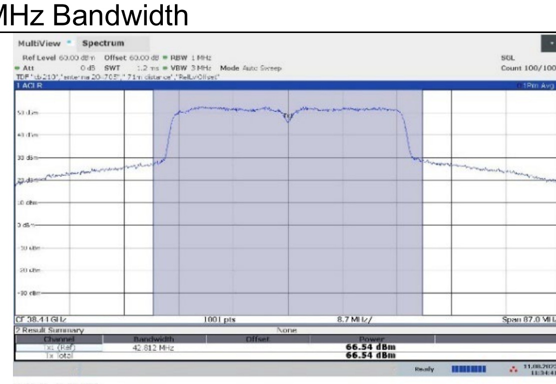


Mid Channel, 20 MHz Bandwidth

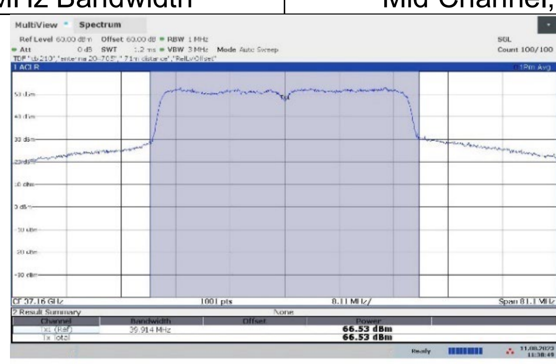


Low Channel, 20MHz Bandwidth

High Channel, 40 MHz Bandwidth



Mid Channel, 40 MHz Bandwidth



Low Channel, 40MHz Bandwidth

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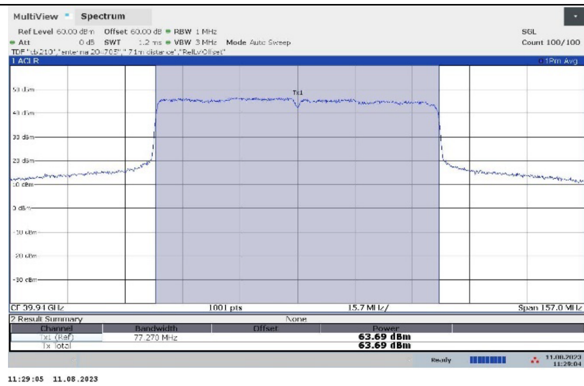
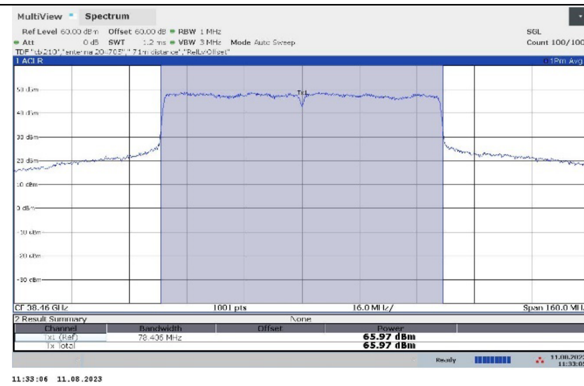
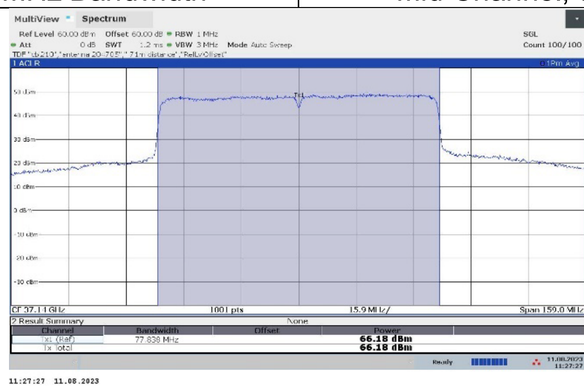


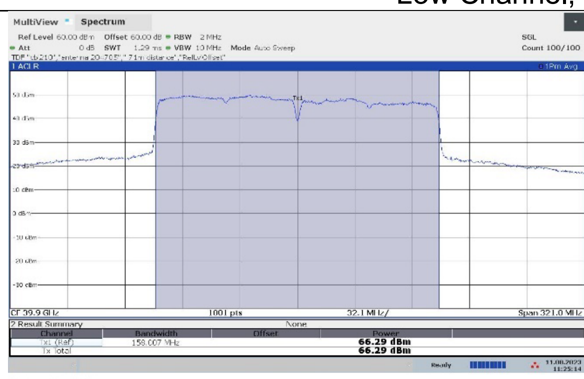
High Channel, 80 MHz Bandwidth



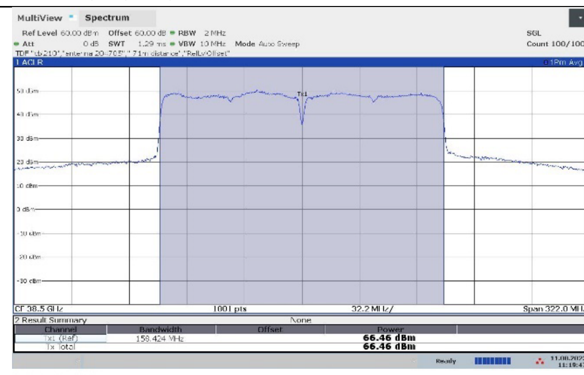
Mid Channel, 80 MHz Bandwidth



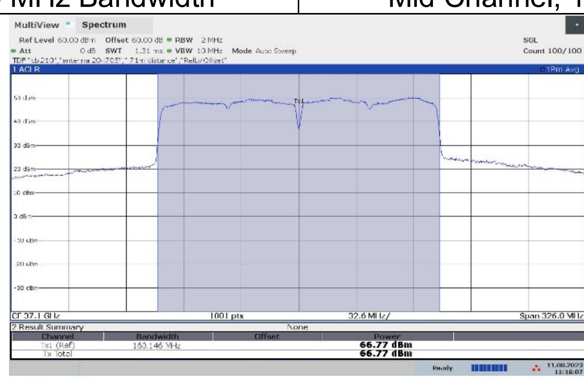
Low Channel, 80MHz Bandwidth



High Channel, 160 MHz Bandwidth



Mid Channel, 160 MHz Bandwidth



Low Channel, 160MHz Bandwidth

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