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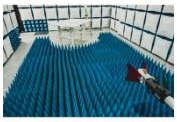

PART 20 & 30 MEASUREMENT REPORT

Applicant Name:
Pivotal Commware
10801 120th Ave NE #200,
Kirkland, WA 98033
United States

Date of Testing:
02/24/2022-04/14/2022
Test Report Issue Date:
04/18/2022
Test Site/Location:
Element Lab., Columbia, MD, USA
Test Report Serial No.:
1M2202210020-02.2AUVU

FCC ID:	**2AUVU-ESB261**
APPLICANT:	**Pivotal Commware**

Application Type:	Certification
Model:	ESBoost-n261
EUT Type:	5G mmWave Repeater
FCC Classification(s):	Part 20 Industrial Booster (CMRS) (B2I)
FCC Rule Part(s):	2, 20, 30
Test Procedure(s):	ANSI C63.26-2015, KDB 842590 D01 v01r02, KDB 935210 D02 v04r02, KDB 935210 D05 v01r04

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in §2.947. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

RJ Ortanez
Executive Vice President

ACCREDITED
CERT #2041.01

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PART 20 & 30 MEASUREMENT REPORT

Band	Ant. Pol.	Bandwidth (MHz)	CCs Active	FCC Rule Part	Tx Frequency (MHz)	EIRP		Emission Designator	Modulation
						Max. Power (W)	Max. Power (dBm)		
n261	MIMO	50	1	30	27500 - 28350	0.586	27.68	46M1G7D	QPSK
n261	MIMO	50	1	30	27500 - 28350	0.531	27.25	46M0W7D	16QAM
n261	MIMO	100	4	30	27500 - 28350	0.624	27.95	398MG7D	QPSK
n261	MIMO	100	4	30	27500 - 28350	0.527	27.22	398MW7D	16QAM

EUT Overview (Band n261 - IDU)

Band	Ant. Pol.	Bandwidth (MHz)	CCs Active	FCC Rule Part	Tx Frequency (MHz)	EIRP		Emission Designator	Modulation
						Max. Power (W)	Max. Power (dBm)		
n261	H	50	1	30	27500 - 28350	1.377	31.39	46M0G7D	QPSK
n261	V	50	1	30	27500 - 28350	1.303	31.15	46M0W7D	16QAM
n261	H	100	4	30	27500 - 28350	1.122	30.50	398MG7D	QPSK
n261	V	100	4	30	27500 - 28350	1.107	30.44	396MW7D	16QAM

EUT Overview (Band n261 - ODU)

1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission.

1.2 Element Test Location

These measurement tests were conducted at the Element Laboratory located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at Element Lab located in Columbia, MD 21046, U.S.A.

- Element Washington DC LLC is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element Washington DC LLC TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- Element Washington DC LLC facility is a registered (2451B) test laboratory with the site description on file with ISED.

- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutual Recognition Agreement.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Pivotal Commware 5G mmWave Repeater FCC ID: 2AUVU-ESB261**. The test data contained in this report pertains only to the emissions due to the EUT's 5G mmWave function.

The EUT is a two-unit repeater system consisting of an Outdoor Unit (ODU) and an Indoor Unit (IDU). Each unit is mounted on opposite sides of low emissivity glass. Both units are required for operation as neither can be operated in a standalone mode.

Both units are capable of transmitting boosted 5G mmWave signals. For transmission of such signals, the ODU has a holographic beam-forming antenna and the IDU has an open-ended waveguide horn antenna. For each unit, the antenna configuration is comprised of two separate linearly polarized antenna feeds: one for horizontally polarized transmission and one for vertically polarized transmission. For IDU 5G mmWave transmission, the input feeds are located on the ODU. These feeds are labelled as "H-DL" and "V-DL." For ODU 5G mmWave transmission, the input feeds are located on the IDU and are labelled as "H-UL" and "V-UL."

The EUT supports any combination of bandwidths, number of carriers, and modulations as input signals. It will transmit all signals within the 5G NR n261 band that are received.

Test Device Serial No.: 600024, 700027

2.2 Device Capabilities

This device contains the following capabilities:

5G FR2 (NR Band n261), LTE Cat M1 (Band 13), Bluetooth, BLE

The integrated modules providing LTE Cat M1 capability (FCC ID: 2AUVU-UBR410M) and Bluetooth/BLE capability (FCC ID: Z64-WL18SBMOD) have been authorized in separate filings.

2.3 Test Configuration

The EUT was tested per the guidance of ANSI C63.26-2015 and KDB 842590 D01 and KDB 935210 D05. See Section 7.0 of this test report for a description of the conducted and radiated tests.

All conducted testing was performed using a signal generator connected via coaxial cable to waveguide adapters on the input port of one unit of the EUT and measured via adapter connected to coaxial cable from the output port of the other unit. All radiated testing was performed by using a signal generator connected to a horn antenna to transmit to one unit of the EUT and then measuring the radiated output transmission from other unit.

For both conducted and radiated testing, the signal generator was set to transmit representative 5G mmWave NR signals in various sized bandwidths and modulations.

2.4 Software and Firmware

The test was conducted with firmware version 1.6.0 installed on the EUT.

2.5 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

3.0 DESCRIPTION OF TESTS

3.1 Measurement Procedure

The measurement procedures described in the document titled "American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services" (ANSI C63.26-2015) and the guidance provided in KDB 842590 D01 v01r02 were used in the measurement of the EUT. KDB 935210 D05 v01r04 was referenced for testing the EUT as well.

3.2 Radiated Power and Radiated Spurious Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary for radiated emissions measurements in the spurious domain. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m for measurements above 1GHz.

If direct measurements of radiated power (EIRP) were required, they were performed in a full anechoic chamber (FAC) conforming to the site validation requirements of CISPR 16-1-4. Radiated spurious emission measurements from 30MHz - 18GHz were performed in a semi anechoic chamber (SAC) conforming to the site validation requirements of CISPR 16-1-4. A positioner was used to manipulate the EUT through several positions in space by rotating about the roll axis as shown in the figure below. The positioner was mounted on top of a turntable bringing the total EUT height to 1.5m.

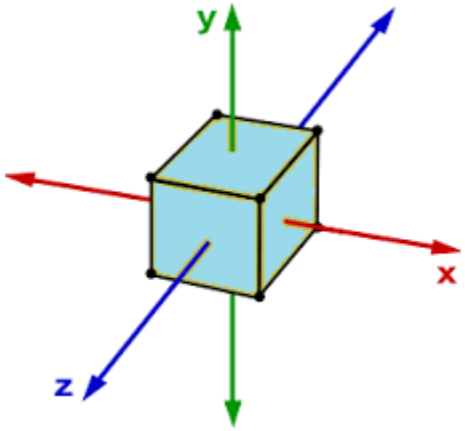


Figure 3-1. Rotation of the EUT Through Three Orthogonal Planes

The equipment under test was transmitting while connected to its patch or HBF antenna and is placed on a positioner. The measurement antenna is in the far field of the EUT per formula $2D^2/\lambda$ where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT. In this case, "D" is the largest dimension of the measurement antenna. The EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

Frequency Range (GHz)	Wavelength(cm)	Far Field Distance (m)	Measurement Distance (m)
18-40	0.749	0.54	1.00
40-60	0.500	1.39	1.50
60-90	0.333	0.91	1.00
90-140	0.214	0.58	1.00
140-200	0.150	0.39	1.00

Table 3-1. Far-Field Distance & Measurment Distance per Frequency Range

If direct measurements of radiated power levels are required, the power levels are investigated while the receive antenna is rotated through all angles to determine the worst case (i.e. maximized) polarization/positioning. The maximized power level is recorded using the spectrum analyzer's "Channel Power" function with the integration bandwidth set to at least the emissions' occupied bandwidth. The EIRP is calculated from the raw power level measured with the spectrum analyzer using the formulas shown below.

Effective Isotropic Radiated Power Sample Calculation

The measured e.i.r.p is converted to E-field in V/m. Then, the distance correction is applied before converting back to calculated e.i.r.p, as explained in ANSI C63.26-2015.

Field Strength [dBμV/m] = Measured Value [dBm] + AFCL [dB/m] + 107

= - 32.74 dBm + (40.7dB/m + 8.78dB) + 107 = 123.74dBuV/m

= 10^(123.74/20)/1000000 = 1.54 V/m

e.i.r.p. [dBm] = 10 * log((E-Field*D_m)^2/30) + 30dB

= 10*log((1.54V/m * 1.00m)^2/30) + 30dB

= 18.98 dBm e.i.r.p.

3.3 Industrial Booster Test Cases

Per the requirements of KDB 935210 D05 v01r04, the following test cases shall be investigated for Industrial Boosters under FCC Part 20.21:

1. AGC Threshold Level
2. Out-of-Band Rejection
3. Input-versus-Output Signal Comparison
4. Mean Output Power and Amplifier/Booster Gain
5. Out-of-Band/Out-of-Block Emissions and Spurious Emissions
6. Frequency Stability
7. Radiated Spurious Emissions

3.4 Environmental Conditions

The temperature is controlled within range of 15ºC to 35ºC. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

5.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to an accredited ISO/IEC 17025 calibration facility. Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
N/A	ETS-001	EMC Cable and Switch System	12/9/2021	Annual	12/9/2022	ETS-001
N/A	ETS-002	EMC Cable and Switch System	12/10/2021	Annual	12/10/2022	ETS-002
Sunol Sciences	JB5	Bi-Log Antenna (30M-5GHz)	7/27/2020	Biennial	7/27/2022	A051107
ETS-Lindgren	3117	1-18 GHz DRG Horn (Medium)	4/20/2021	Biennial	4/20/2023	00125518
EMCO	3116	Horn Antenna (18-40GHz)	7/20/2021	Biennial	7/20/2023	9203-2178
Narda	180-422-KF	Horn (Small)	11/5/2020	Biennial	11/5/2022	U157403-01
Virginia Diodes, Inc.	SAX679	SAX Module (40 - 60GHz)	8/28/2020	Biennial	8/28/2022	SAX679
Virginia Diodes, Inc.	SAX680	SAX Module (60 - 90GHz)	8/14/2020	Biennial	8/14/2022	SAX680
Virginia Diodes, Inc.	SAX681	SAX Module (90 - 140GHz)	10/22/2020	Biennial	10/22/2022	SAX681
OML, Inc.	M19RH	Horn Antenna (40 - 60GHz)	10/12/2021	Biennial	10/12/2023	17111701
OML, Inc.	M12RH	Horn Antenna (60 - 90GHz)	11/16/2021	Biennial	11/16/2023	17111701
OML, Inc.	M08RH	Horn Antenna (90 - 140GHz)	10/6/2021	Biennial	10/6/2023	17111701
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	8/3/2021	Annual	8/3/2022	100342
Rohde & Schwarz	FSV40-N	Spectrum Analyzer	1/14/2021	Annual	4/14/2022	101814
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	8/25/2021	Annual	8/25/2022	103200
Rohde & Schwarz	SMW200A	Vector Signal Generator	N/A			109456
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	N/A			165450

Table 5-1. Test Equipment

Notes:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

6.0 SAMPLE CALCULATIONS

Emission Designator

π/2 BPSK/ QPSK Modulation

Emission Designator = 800MG7D

BW = 800 MHz
G = Phase Modulation
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

QAM Modulation

Emission Designator = 802MW7D

BW = 802 MHz
W = Amplitude/Angle Modulated
7 = Quantized/Digital Info
D = Data transmission, telemetry, telecommand

7.0 TEST RESULTS

7.1 Summary

Company Name: Pivotal Commware

FCC ID: 2AUVU-ESB261

FCC Classification(s): Part 20 Industrial Booster (CMRS) (B2I)

Mode(s): TDD

FCC Part Section(s)	KDB 935210 D05 Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1049, 20.21	3.4	Input-Versus-Output Signal Comparison	N/A	CONDUCTED	PASS	Section 7.2
20.21	3.3	Out-of-band Rejection	N/A		PASS	Section 7.3
2.1046, 20.21	3.2, 3.5	Measuring AGC Threshold Level, Mean Output Power & Amplifier/Booster Gain	N/A		PASS	Section 7.4
2.1049	-	Occupied Bandwidth	N/A		PASS	Section 7.5
2.1046, 30.202(c)	-	Conducted Power & Equivalent Isotropic Radiated Power	≤ 55 dBm		PASS	Section 7.6
2.1051, 20.21, 30.203	3.6	Band Edge / Out-of-Band Emissions	≤ -5dBm/MHz from the band edge up to 10% of the channel BW ≤-13dBm/MHz for all out-of-band emissions		PASS	Section 7.8
2.1055, 20.21	3.7	Frequency Stability	Fundamental emissions stay within authorized frequency block		PASS	Section 7.9
2.1051, 20.21, 30.203	3.8	Radiated Spurious Emissions	≤ -13 dBm/MHz for spurious emissions	RADIATED	PASS	Section 7.7

Table 7-1. Summary of Radiated Test Results

Notes:

1. Per 2.1057(a)(2), spurious emissions were investigated up to 100GHz.

2. Testing was completed with a signal generator creating a representative mmWave 5G NR signal, using DFT-s-OFDM and CP-OFDM schemes, various modulations including QPSK, and QAM, 120kHz subcarrier spacing, 50MHz-single carrier, 50MHz-dual carrier, and 100MHz-four carrier bandwidths, and full and single resource block allocations.

3. The input signal was fed from the signal generator to the EUT via a coaxial cable and it was set at a level so as to produce the maximum output power of the AGC range.

4. Based upon investigations of all possible modulations, testing was mainly performed with QPSK modulation.

5. Unless otherwise specified, triggering from the signal generator was used in order to more accurately gate on the TDD signal with the analyzer.

6. For conducted testing only, the EUT was fitted with waveguide-to-coax RF adapters that allowed for direct measurements. With the exception of radiated spurious emissions, all measurements were performed in a conducted test setup.

7. Per the guidance of KDB 644041, conducted spurious emission measurements were not applicable due to the design of the device with frequency-restrictive waveguides.

7.2 Input-Versus-Output Signal Comparison

Test Overview

The Input-versus-Output Signal Comparison checks for the change in occupied bandwidth of the output signal from the booster at 3dB above the AGC threshold level and just below the AGC threshold level while not more than 0.5dB below the threshold level. All modes of operation were investigated and the worst case configuration results are reported in this section. Per KDB 935210 D05 clause 3.4, this is to be measured on both the input signal and the output signal.

Test Procedure Used

ANSI C63.26-2015 – Section 5.4.3
KDB 935210 D05 – Section 3.4

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize

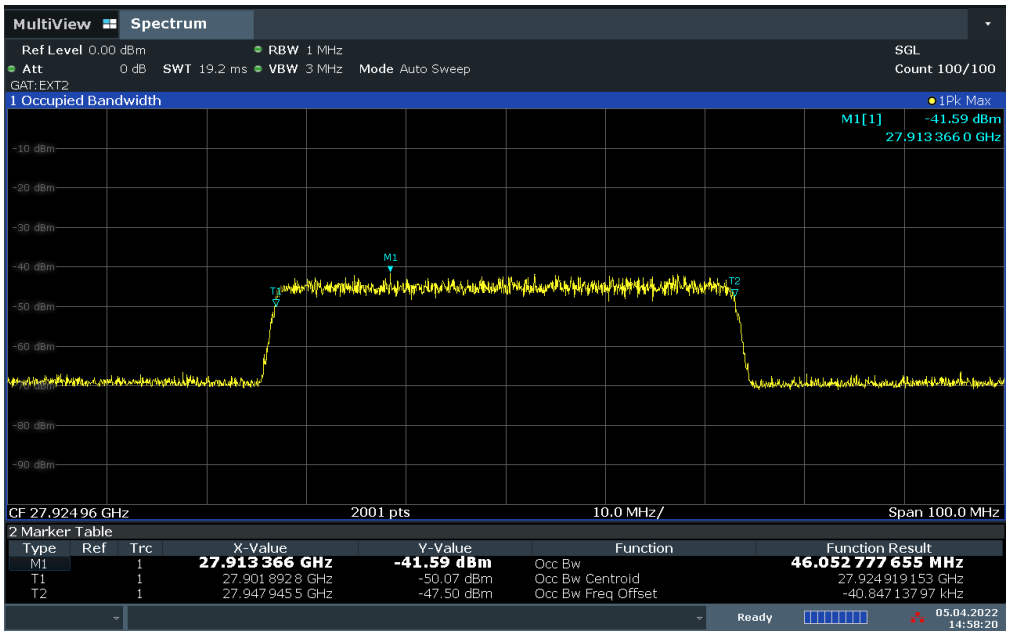
Test Notes

1. Per the guidance of KDB 644041, a 50MHz 5G NR mmWave signal was used as the input signal as opposed to the 4.1MHz AWGN required in KDB 935210 D05.

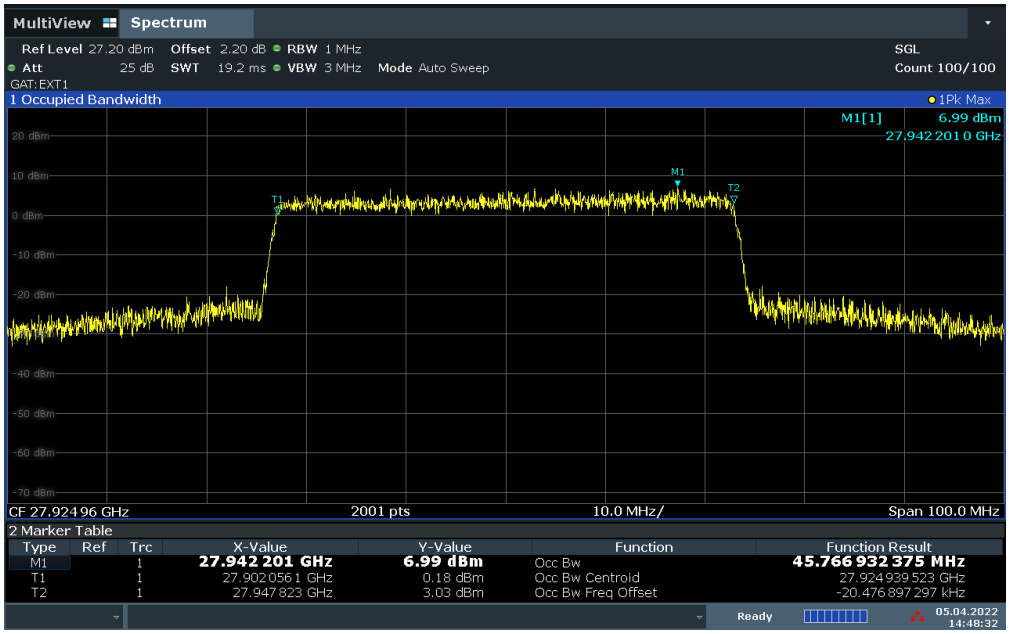
Band n261 - IDU

AGC Threshold Level	EUT Antenna Polarization	Channel	Bandwidth [MHz]	Modulation	Input OBW [MHz]	Output OBW [MHz]
0.5dB below Threshold	H-DL	Mid	50	QPSK	46.05	45.77
3dB above Threshold	H-DL	Mid	50	QPSK	45.82	46.10
0.5dB below Threshold	V-DL	Mid	50	QPSK	46.05	45.75
3dB above Threshold	V-DL	Mid	50	QPSK	45.82	45.89

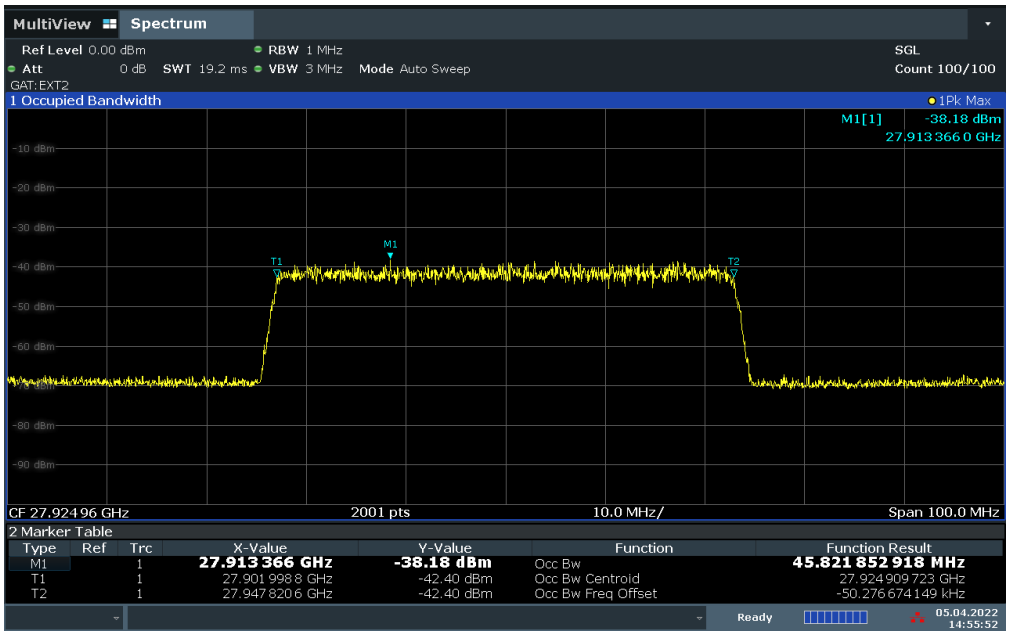
Table 7-2. n261 Occupied Bandwidth by AGC Threshold Level – IDU



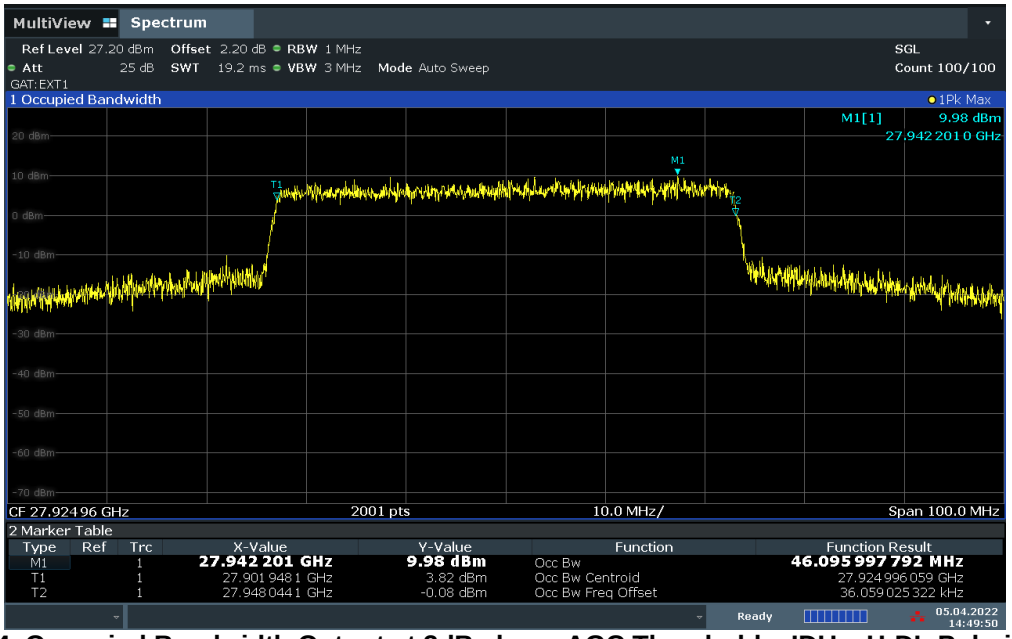
Plot 7-1. Occupied Bandwidth Input at 0.5dB below AGC Threshold – IDU – H-DL Polarization.



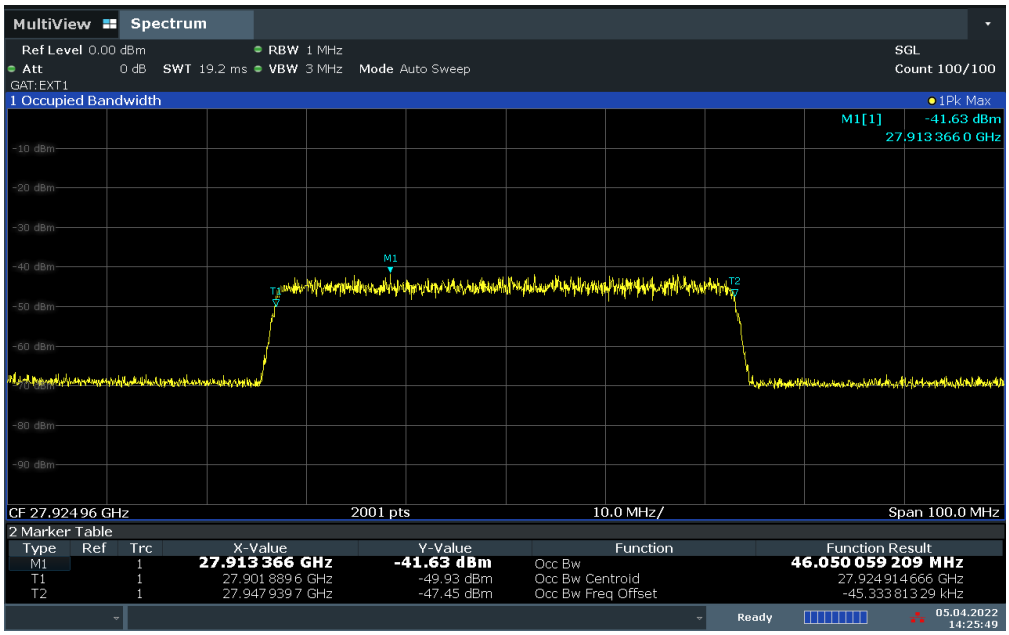
Plot 7-2. Occupied Bandwidth Output at 0.5dB below AGC Threshold – IDU – H-DL Polarization.



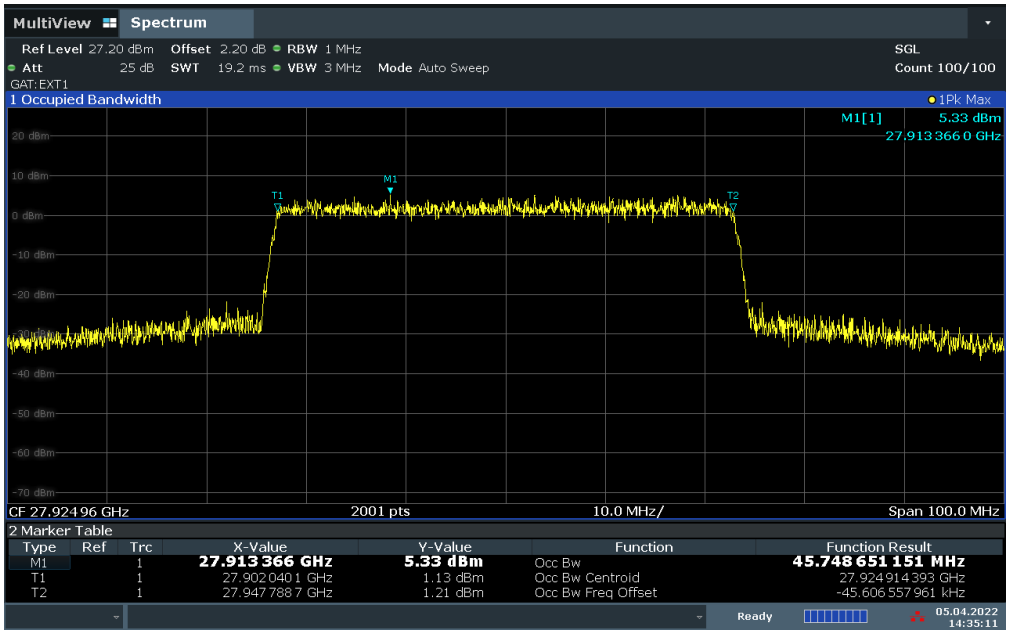
Plot 7-3. Occupied Bandwidth Input at 3dB above AGC Threshold – IDU – H-DL Polarization.



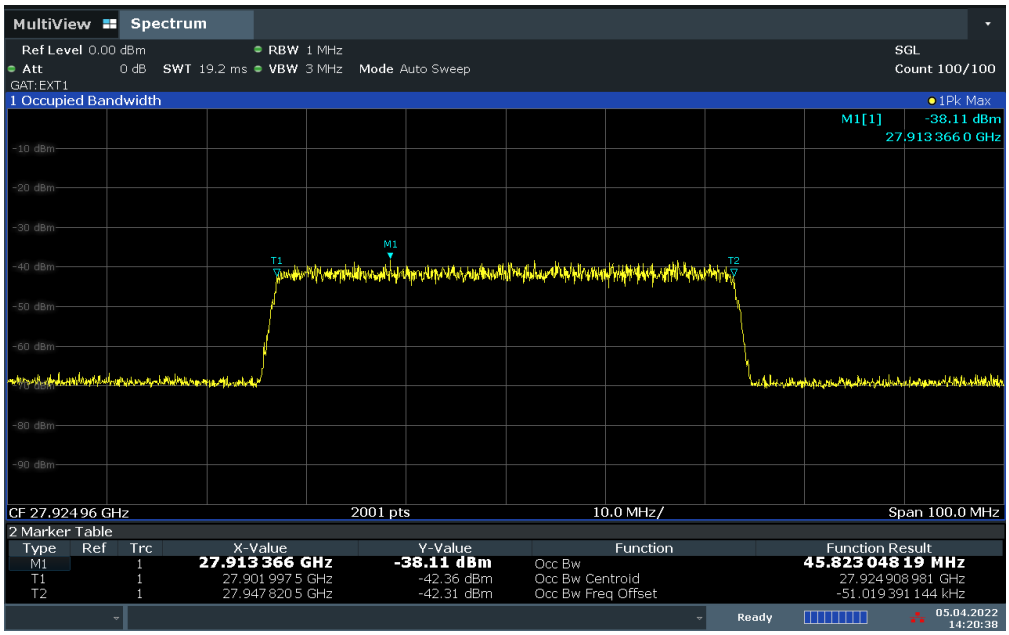
Plot 7-4. Occupied Bandwidth Output at 3dB above AGC Threshold – IDU – H-DL Polarization.



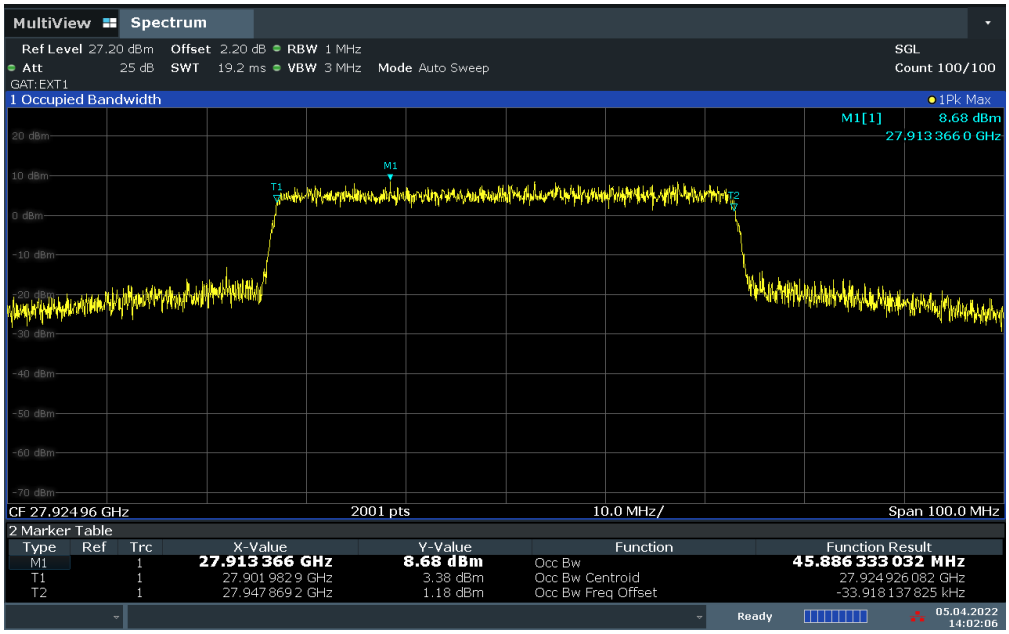
Plot 7-5. Occupied Bandwidth Input at 0.5dB below AGC Threshold – IDU – V-DL Polarization.



Plot 7-6. Occupied Bandwidth Output at 0.5dB below AGC Threshold – IDU – V-DL Polarization.



Plot 7-7. Occupied Bandwidth Input at 3dB above AGC Threshold – IDU – V-DL Polarization.

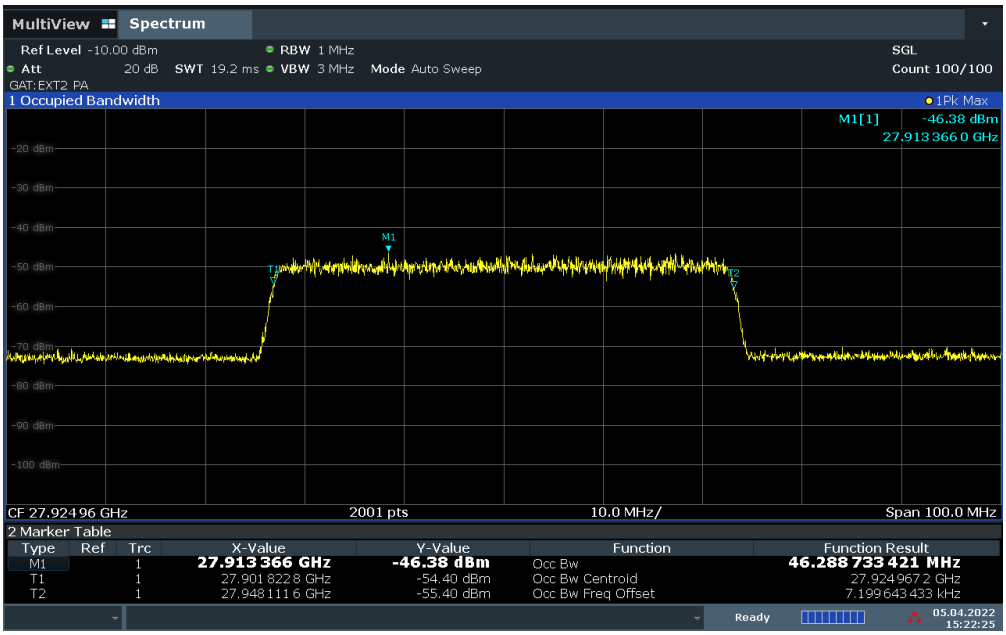


Plot 7-8. Occupied Bandwidth Output at 3dB above AGC Threshold – IDU – V-DL Polarization.

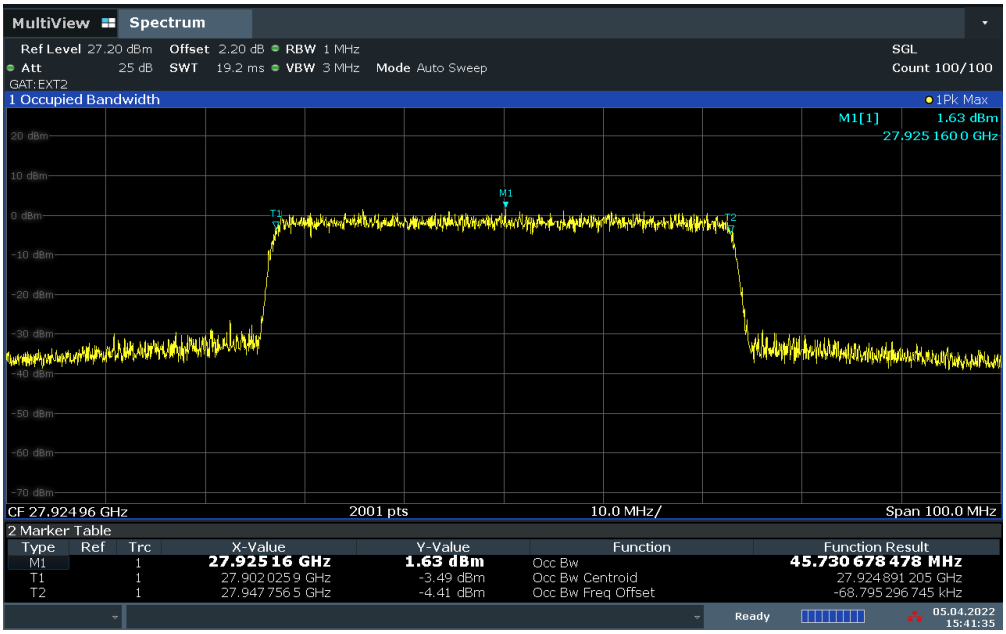
Band n261 - ODU

AGC Threshold Level	EUT Antenna Polarization	Channel	Bandwidth	Modulation	Input OBW [MHz]	Output OBW [MHz]
0.5dB below Threshold	H-UL	Mid	50	QPSK	46.29	45.73
3dB above Threshold	H-UL	Mid	50	QPSK	46.44	45.74
0.5dB below Threshold	V-UL	Mid	50	QPSK	46.57	45.77
3dB above Threshold	V-UL	Mid	50	QPSK	46.66	45.78

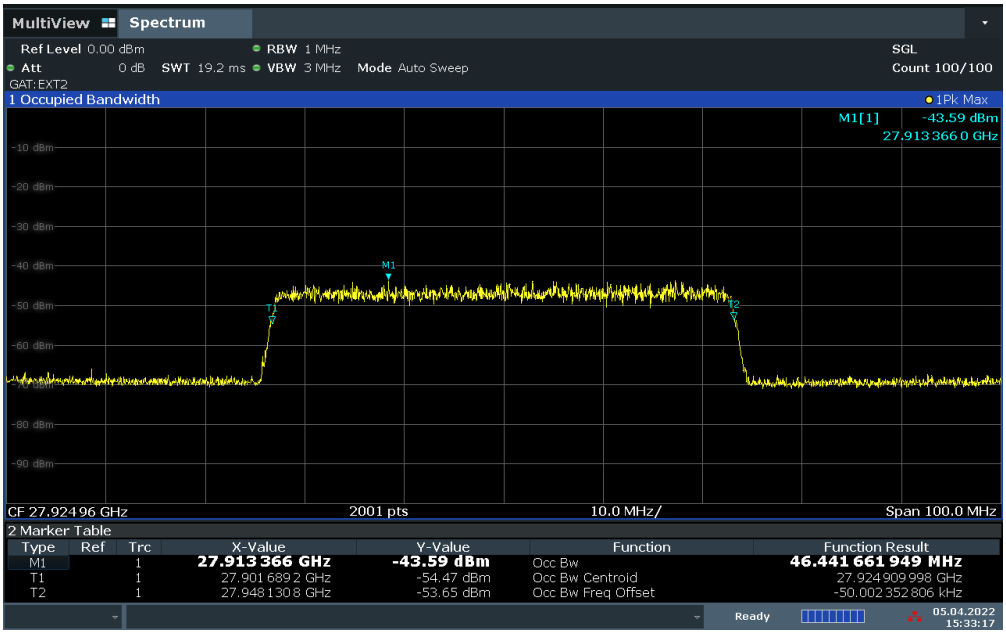
Table 7-3. n261 Occupied Bandwidth by AGC Threshold Level – ODU



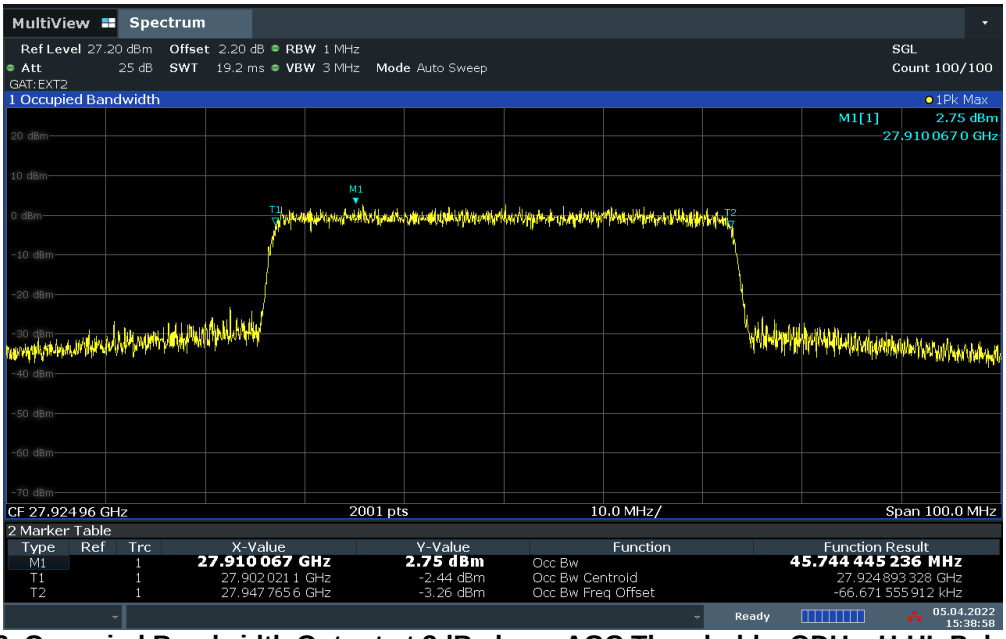
Plot 7-9. Occupied Bandwidth Input at 0.5dB below AGC Threshold – ODU – H-UL Polarization.



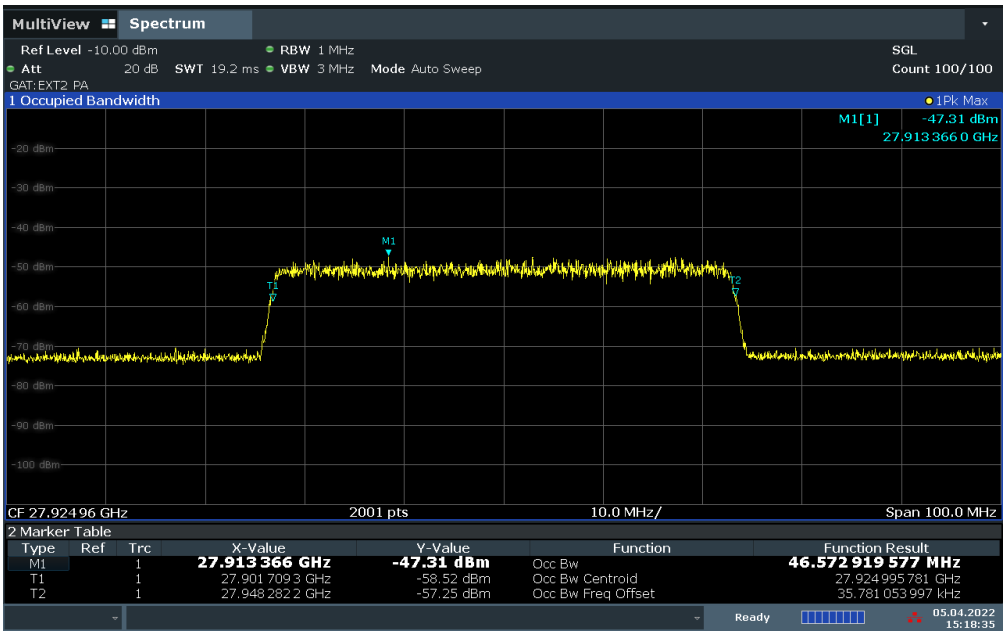
Plot 7-10. Occupied Bandwidth Output at 0.5dB below AGC Threshold – ODU – H-UL Polarization.



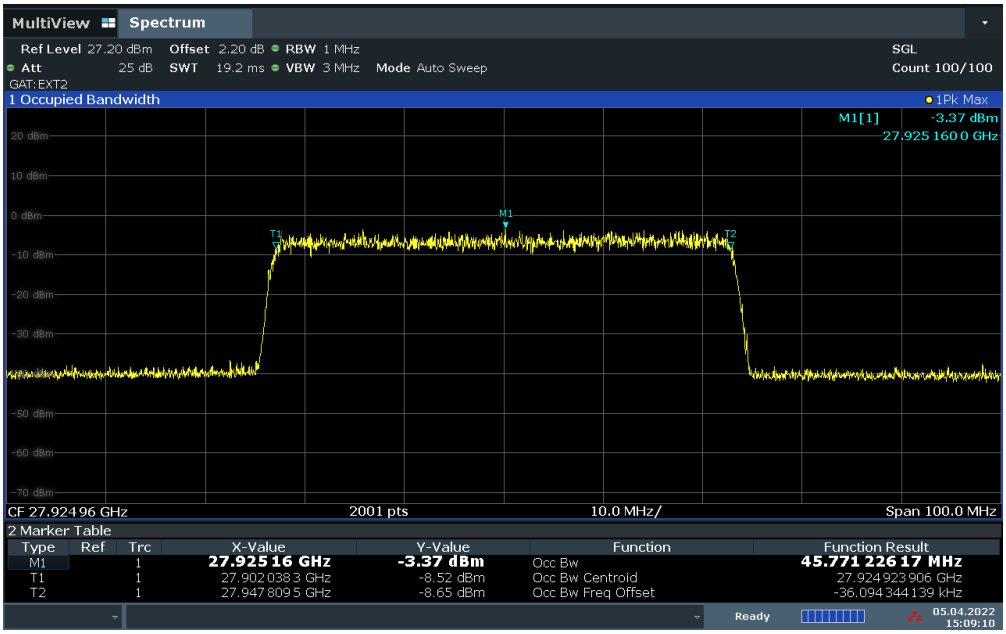
Plot 7-11. Occupied Bandwidth Input at 3dB above AGC Threshold – ODU – H-UL Polarization.



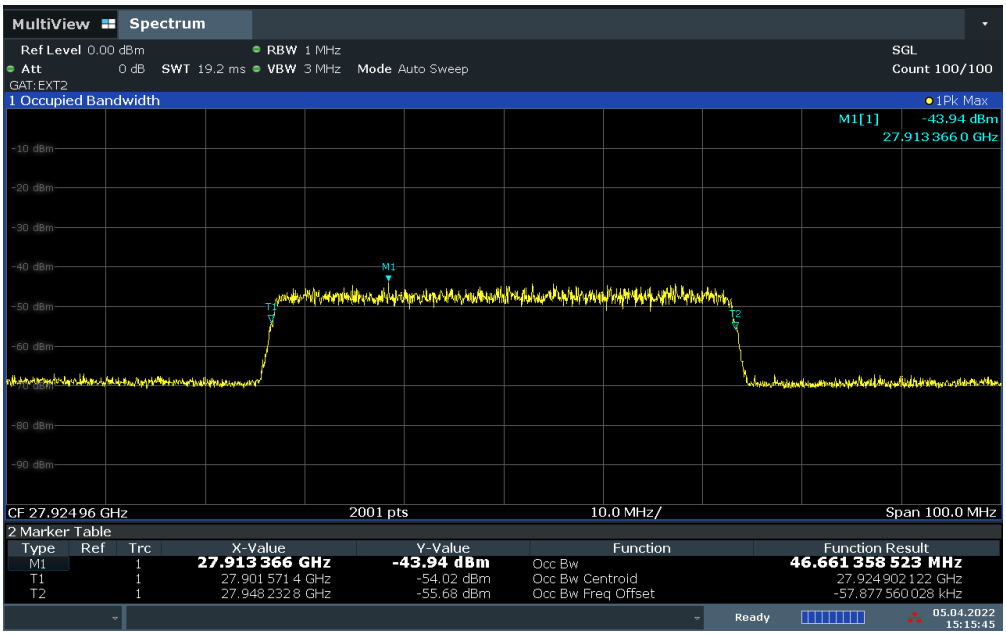
Plot 7-12. Occupied Bandwidth Output at 3dB above AGC Threshold – ODU – H-UL Polarization.



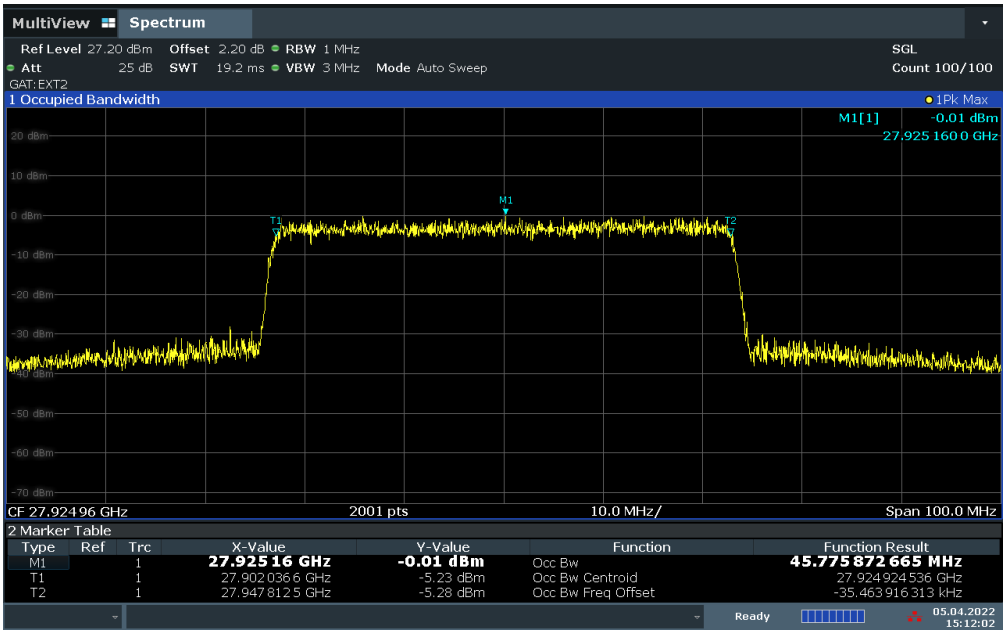
Plot 7-13. Occupied Bandwidth Input at 0.5dB below AGC Threshold – ODU – V-UL Polarization.



Plot 7-14. Occupied Bandwidth Output at 0.5dB below AGC Threshold – ODU – V-UL Polarization.



Plot 7-15. Occupied Bandwidth Input at 3dB above AGC Threshold – ODU – V-UL Polarization.



Plot 7-16. Occupied Bandwidth Output at 3dB above AGC Threshold – ODU – V-UL Polarization.

7.3 Out-of-band Rejection

Test Overview

A signal generator is set to the input port of the EUT, and the output of the EUT shall be connected to a spectrum analyzer. Per KDB 935210 D05 Section 3.3, the signal generator will sweep a CW signal to ± 250 % of the passband. Per FCC Part 20, an industrial booster shall have its 20dB bandwidth analyzed in order to assess the pass band of the booster.

Test Procedure Used

KDB 935210 D05 v01r04 – Section 3.3

Test Settings

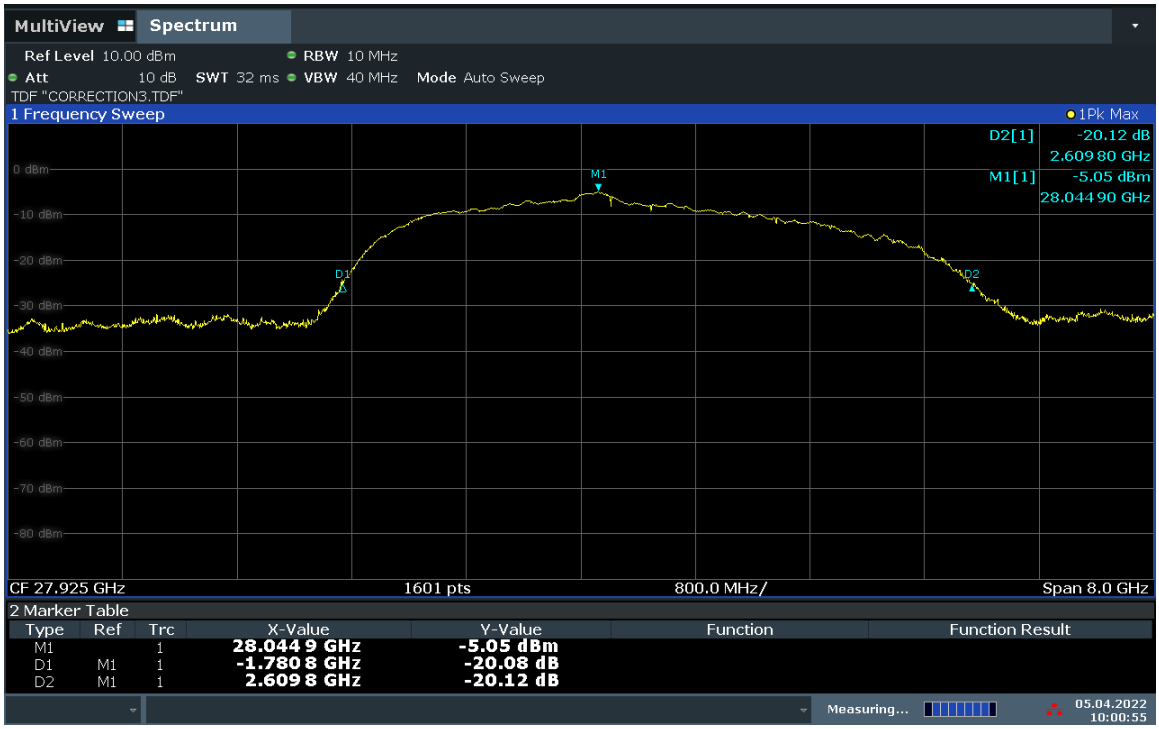
1. Start and stop frequency of the signal generator shall be ± 250 % of the passband, for each applicable CMRS band
2. Span same as the frequency range of the signal generator
3. RBW ≥ 1 % to 5 % of the EUT passband
4. VBW ≥ 3 x RBW
5. Detector = Peak/Max Hold
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Notes

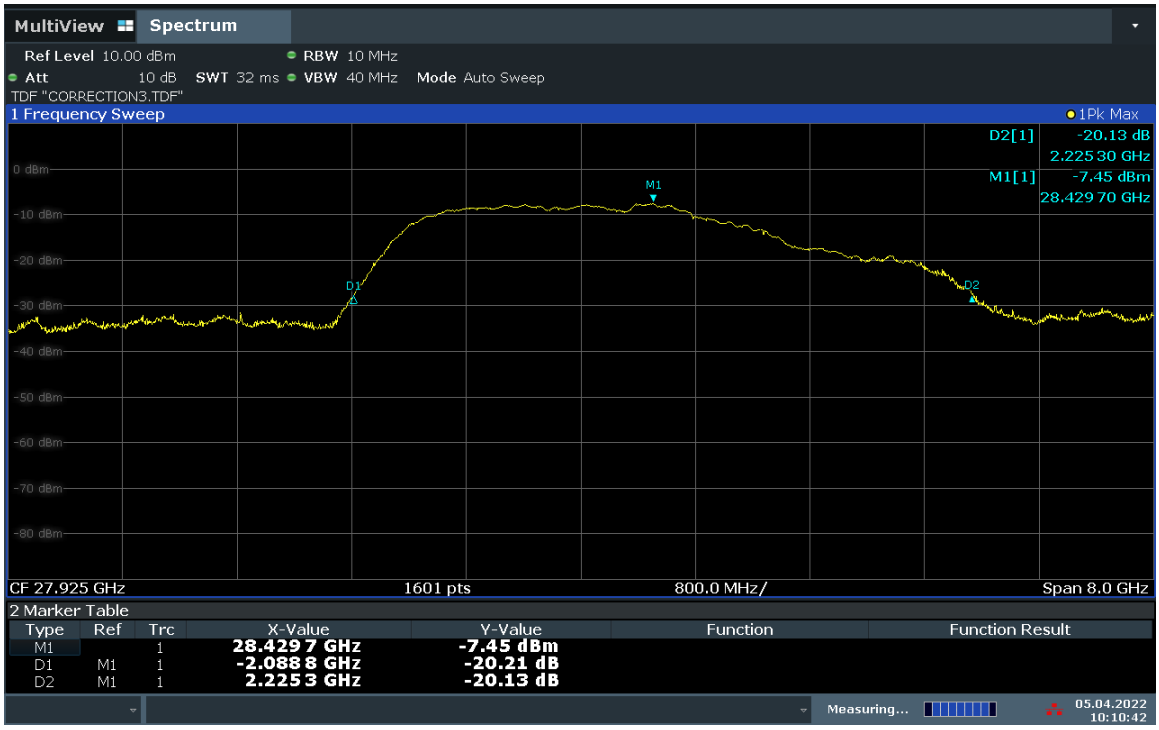
1. The spectrum plots in this section show a CW signal sweeping across each input feed of each unit of the EUT. Per the guidance from Section 3.3 of KDB 935210 D05, the frequency range of the sweep should be from 25.375GHz to 30.475GHz [250% x (28.35GHz–27.5GHz) = 2.125GHz below and above lower and upper band edges, respectively]. However, in order to more clearly display the 20dB bandwidth, a larger frequency range is displayed in the these plots.

2. In each plot, the marker “M1” is used to display the peak of the output frequency response. The “D1” and “D2” markers are provided to indicate the approximate lower and upper bounds of the 20dB bandwidth of the output frequency response.

Band n261 - IDU

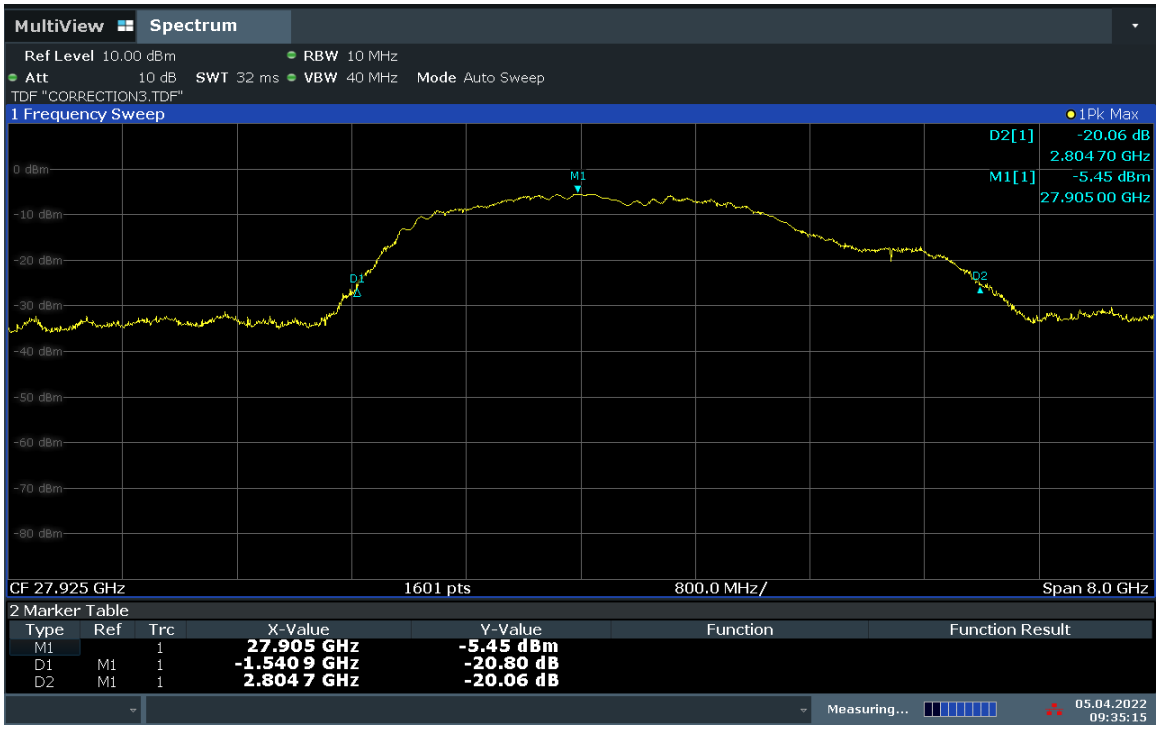


Plot 7-17. Out-Of-Band Rejection – IDU – H-DL Polarization

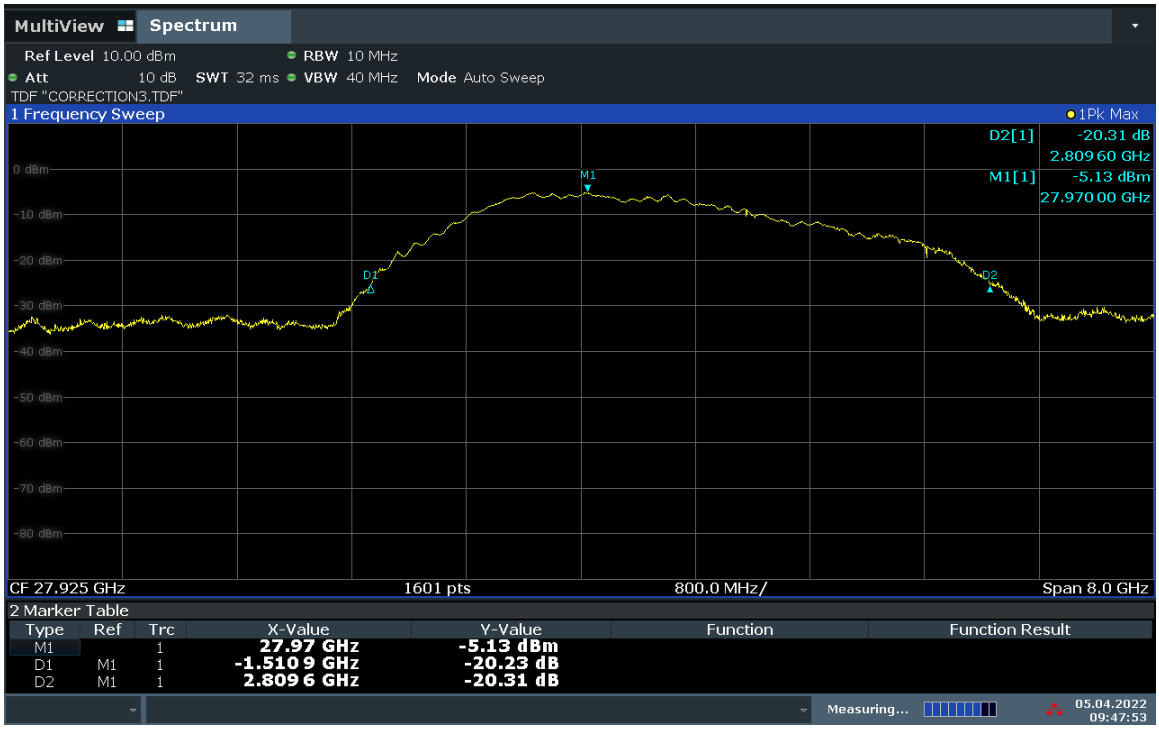


Plot 7-18. Out-Of-Band Rejection – IDU – V-DL Polarization

Band n261 - ODU



Plot 7-19. Out-Of-Band Rejection – ODU – H-UL Polarization



Plot 7-20. Out-Of-Band Rejection – ODU – V-UL Polarization

7.4 Measuring AGC Threshold Level, Mean Output Power & Amplifier/Booster Gain

Test Overview

A signal generator supplies a 5G NR mmWave signal directly into the input port of the device. The output port of the EUT is connected to the input of a signal analyzer. The AGC threshold level is measured by output power of the EUT until a 1dB increase in the input signal power no longer causes a 1dB increase in the output signal power. The Booster Gain is measured by calculating the gain between the input and the output power of the EUT at the signal generator level just below the AGC threshold level, but not more than 0.5dB below.

Test Procedures Used

KDB 935210 D05 V01R04 – Section 3.2 - Measuring AGC threshold level
KDB 935210 D05 V01R04 – Section 3.5 - Mean output power and amplifier/booster gain

Test Settings

1. Conducted power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
2. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz
3. VBW ≥ 3 x RBW
4. Span = 2x to 3x the OBW
5. No. of sweep points > 2 x span / RBW
6. Detector = RMS
7. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
8. Trace mode = trace averaging (RMS) over 100 sweeps

Test Notes

1. Per the guidance of KDB 644041, a 50MHz 5G NR mmWave signal was used as the input signal as opposed to the 4.1MHz AWGN required in KDB 935210 D05.

Band n261 - IDU

Bandwidth [MHz]	Frequency [MHz]	Channel	Modulation	RB Size / Offset	EUT Input Power Level [dBm]	Conducted Power [dBm]	Output Power Step [dB]	Calculated Gain [dB]
50	27924.96	Mid	QPSK	Full RB	-40.30	11.91	0.97	52.21
50	27924.96	Mid	QPSK	Full RB	-39.33	12.88	0.97	52.21
50	27924.96	Mid	QPSK	Full RB	-38.32	13.82	0.94	52.14
50	27924.96	Mid	QPSK	Full RB	-37.33	14.77	0.95	52.10
50	27924.96	Mid	QPSK	Full RB	-36.34	15.69	0.92	52.03
50	27924.96	Mid	QPSK	Full RB	-35.32	16.57	0.88	51.89
50	27924.96	Mid	QPSK	Full RB	-34.33	17.42	0.85	51.75
50	27924.96	Mid	QPSK	Full RB	-33.33	18.20	0.78	51.53

Table 7-4. Full RB AGC Threshold and Booster Gain – 50MHz 1CC – IDU – H-DL Polarization

Note: AGC Threshold is found at **-35.32dBm** EUT Input Power Level.

Bandwidth [MHz]	Frequency [MHz]	Channel	Modulation	RB Size / Offset	EUT Input Power Level [dBm]	Conducted Power [dBm]	Output Power Step [dB]	Calculated Gain [dB]
100	27924.96	Mid	QPSK	Full RB	-41.03	11.50	0.95	52.53
100	27924.96	Mid	QPSK	Full RB	-40.03	12.47	0.97	52.50
100	27924.96	Mid	QPSK	Full RB	-39.06	13.41	0.94	52.47
100	27924.96	Mid	QPSK	Full RB	-38.05	14.34	0.93	52.39
100	27924.96	Mid	QPSK	Full RB	-37.07	15.24	0.90	52.31
100	27924.96	Mid	QPSK	Full RB	-36.06	16.14	0.90	52.20
100	27924.96	Mid	QPSK	Full RB	-35.07	16.95	0.81	52.02
100	27924.96	Mid	QPSK	Full RB	-34.08	16.56	-0.39	50.64
100	27924.96	Mid	QPSK	Full RB	-33.08	17.03	0.47	50.11

Table 7-5. Full RB AGC Threshold and Booster Gain – 100MHz 4CC – IDU – H-DL Polarization

Note: AGC Threshold is found at **-35.07dBm** EUT Input Power Level.

Bandwidth [MHz]	Frequency [MHz]	Channel	Modulation	RB Size / Offset	EUT Input Power Level [dBm]	Conducted Power [dBm]	Output Power Step [dB]	Calculated Gain [dB]
50	27924.96	Mid	QPSK	Full RB	-39.38	10.87	0.94	50.25
50	27924.96	Mid	QPSK	Full RB	-38.40	11.84	0.97	50.24
50	27924.96	Mid	QPSK	Full RB	-37.39	12.81	0.97	50.20
50	27924.96	Mid	QPSK	Full RB	-36.41	13.77	0.96	50.18
50	27924.96	Mid	QPSK	Full RB	-35.41	14.72	0.95	50.13
50	27924.96	Mid	QPSK	Full RB	-34.42	15.64	0.92	50.06
50	27924.96	Mid	QPSK	Full RB	-33.41	16.56	0.92	49.97
50	27924.96	Mid	QPSK	Full RB	-32.41	17.42	0.86	49.83
50	27924.96	Mid	QPSK	Full RB	-31.42	17.47	0.05	48.89
50	27924.96	Mid	QPSK	Full RB	-30.42	17.68	0.21	48.10

Table 7-6. Full RB AGC Threshold and Booster Gain – 50MHz 1CC – IDU – V-DL Polarization

Note: AGC Threshold is found at **-32.41dBm** EUT Input Power Level.

Bandwidth [MHz]	Frequency [MHz]	Channel	Modulation	RB Size / Offset	EUT Input Power Level [dBm]	Conducted Power [dBm]	Output Power Step [dB]	Calculated Gain [dB]
100	27924.96	Mid	QPSK	Full RB	-39.83	9.87	0.95	49.70
100	27924.96	Mid	QPSK	Full RB	-38.83	10.83	0.96	49.66
100	27924.96	Mid	QPSK	Full RB	-37.83	11.80	0.97	49.63
100	27924.96	Mid	QPSK	Full RB	-36.84	12.75	0.95	49.59
100	27924.96	Mid	QPSK	Full RB	-35.86	13.70	0.95	49.56
100	27924.96	Mid	QPSK	Full RB	-34.85	14.62	0.92	49.47
100	27924.96	Mid	QPSK	Full RB	-33.88	15.56	0.94	49.44
100	27924.96	Mid	QPSK	Full RB	-32.88	15.51	-0.05	48.39
100	27924.96	Mid	QPSK	Full RB	-31.88	16.18	0.67	48.06
100	27924.96	Mid	QPSK	Full RB	-30.88	16.00	-0.18	46.88

Table 7-7. Full RB AGC Threshold and Booster Gain – 100MHz 4CC – IDU – V-DL Polarization

Note: AGC Threshold is found at **-32.88dBm** EUT Input Power Level.

Band n261 - ODU

Bandwidth [MHz]	Frequency [MHz]	Channel	Modulation	RB Size / Offset	EUT Input Power Level [dBm]	Conducted Power [dBm]	Output Power Step [dB]	Calculated Gain [dB]
50	27924.96	Mid	QPSK	Full RB	-45.34	4.28	0.99	49.62
50	27924.96	Mid	QPSK	Full RB	-44.37	5.28	1.00	49.65
50	27924.96	Mid	QPSK	Full RB	-43.40	6.27	0.99	49.67
50	27924.96	Mid	QPSK	Full RB	-42.42	7.26	0.99	49.68
50	27924.96	Mid	QPSK	Full RB	-41.49	8.23	0.97	49.72
50	27924.96	Mid	QPSK	Full RB	-40.49	9.20	0.97	49.69
50	27924.96	Mid	QPSK	Full RB	-39.50	10.14	0.94	49.64
50	27924.96	Mid	QPSK	Full RB	-38.50	11.10	0.96	49.60
50	27924.96	Mid	QPSK	Full RB	-37.50	11.27	0.17	48.77
50	27924.96	Mid	QPSK	Full RB	-36.53	11.35	0.08	47.88

Table 7-8. Full RB AGC Threshold and Booster Gain – 50MHz 1CC – ODU – H-UL Polarization

Note: AGC Threshold is found at **-37.50dBm** EUT Input Power Level.

Bandwidth [MHz]	Frequency [MHz]	Channel	Modulation	RB Size / Offset	EUT Input Power Level [dBm]	Conducted Power [dBm]	Output Power Step [dB]	Calculated Gain [dB]
100	27924.96	Mid	QPSK	Full RB	-46.04	3.51	0.98	49.55
100	27924.96	Mid	QPSK	Full RB	-45.08	4.50	0.99	49.58
100	27924.96	Mid	QPSK	Full RB	-44.13	5.49	0.99	49.62
100	27924.96	Mid	QPSK	Full RB	-43.13	6.48	0.99	49.61
100	27924.96	Mid	QPSK	Full RB	-42.17	7.46	0.98	49.63
100	27924.96	Mid	QPSK	Full RB	-41.20	8.42	0.96	49.62
100	27924.96	Mid	QPSK	Full RB	-40.20	9.37	0.95	49.57
100	27924.96	Mid	QPSK	Full RB	-39.21	10.34	0.97	49.55
100	27924.96	Mid	QPSK	Full RB	-38.22	10.22	-0.12	48.44
100	27924.96	Mid	QPSK	Full RB	-37.23	10.33	0.11	47.56

Table 7-9. Full RB AGC Threshold and Booster Gain – 100MHz 4CC – ODU – H-UL Polarization

Note: AGC Threshold is found at **-38.22dBm** EUT Input Power Level.

Bandwidth [MHz]	Frequency [MHz]	Channel	Modulation	RB Size / Offset	EUT Input Power Level [dBm]	Conducted Power [dBm]	Output Power Step [dB]	Calculated Gain [dB]
50	27924.96	Mid	QPSK	Full RB	-45.34	5.53	0.97	50.87
50	27924.96	Mid	QPSK	Full RB	-44.37	6.49	0.96	50.86
50	27924.96	Mid	QPSK	Full RB	-43.40	7.50	1.01	50.90
50	27924.96	Mid	QPSK	Full RB	-42.42	8.47	0.97	50.89
50	27924.96	Mid	QPSK	Full RB	-41.49	9.37	0.90	50.86
50	27924.96	Mid	QPSK	Full RB	-40.49	10.31	0.94	50.80
50	27924.96	Mid	QPSK	Full RB	-39.50	11.22	0.91	50.72
50	27924.96	Mid	QPSK	Full RB	-38.50	11.30	0.08	49.80
50	27924.96	Mid	QPSK	Full RB	-37.50	11.41	0.11	48.91

Table 7-10. Full RB AGC Threshold and Booster Gain – 50MHz 1CC – ODU – V-UL Polarization

Note: AGC Threshold is found at **-38.50dBm** EUT Input Power Level.

Bandwidth [MHz]	Frequency [MHz]	Channel	Modulation	RB Size / Offset	EUT Input Power Level [dBm]	Conducted Power [dBm]	Output Power Step [dB]	Calculated Gain [dB]
100	27924.96	Mid	QPSK	Full RB	-47.01	3.70	1.00	50.71
100	27924.96	Mid	QPSK	Full RB	-46.04	4.67	0.97	50.71
100	27924.96	Mid	QPSK	Full RB	-45.08	5.62	0.95	50.70
100	27924.96	Mid	QPSK	Full RB	-44.13	6.57	0.95	50.70
100	27924.96	Mid	QPSK	Full RB	-43.13	7.53	0.96	50.66
100	27924.96	Mid	QPSK	Full RB	-42.17	8.45	0.92	50.62
100	27924.96	Mid	QPSK	Full RB	-41.20	9.38	0.93	50.58
100	27924.96	Mid	QPSK	Full RB	-40.20	10.05	0.67	50.25
100	27924.96	Mid	QPSK	Full RB	-39.21	9.93	-0.12	49.14

Table 7-11. Full RB AGC Threshold and Booster Gain – 100MHz 4CC – ODU – V-UL Polarization

Note: AGC Threshold is found at **-40.20dBm** EUT Input Power Level.

7.5 Occupied Bandwidth

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers measured are each equal to 0.5 percent of the total mean power measured for a given emission. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

ANSI C63.26-2015 – Section 5.4.3

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

Test Notes

1. The OBW was measured for multiple transmission schemes and modulations and the worst case results have been included in the report.
2. The plots shown in this section include the appropriate offsets to correct for the frequency-dependent cable loss of the coaxial cable that connects the output port of the EUT to the spectrum analyzer.

Band n261 - IDU

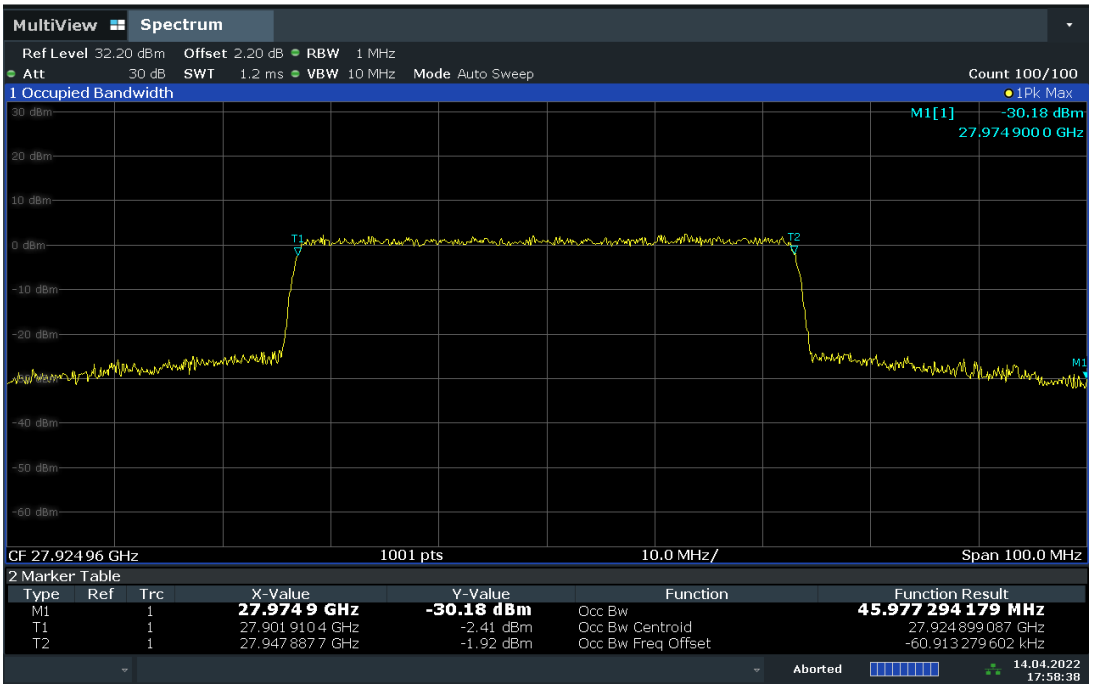
Channel	Ant Pol.	Bandwidth [MHz]	CCs Active	Modulation	OBW [MHz]
Mid	H-DL	50	1	QPSK	45.98
				16QAM	45.98
		100	4	QPSK	398.25
				16QAM	398.20
	V-DL	50	1	QPSK	46.15
				16QAM	46.18
		100	4	QPSK	398.35
				16QAM	398.05

Table 7-12. Summary of IDU Occupied Bandwidths

ACLRResults

Plot 7-21. Occupied Bandwidth Plot – IDU – H-DL Polarization (50MHz-1CC – QPSK – Mid Channel)

ACLRResults

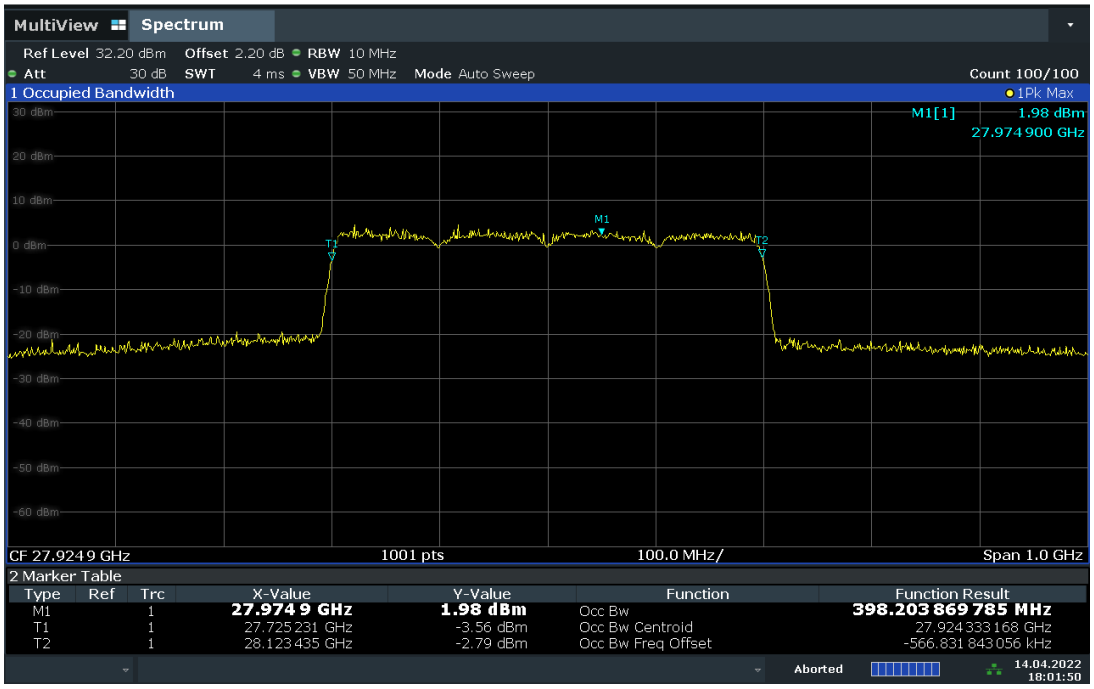


Plot 7-22. Occupied Bandwidth Plot – IDU – H-DL Polarization (50MHz-1CC – 16QAM – Mid Channel)

ACLRResults

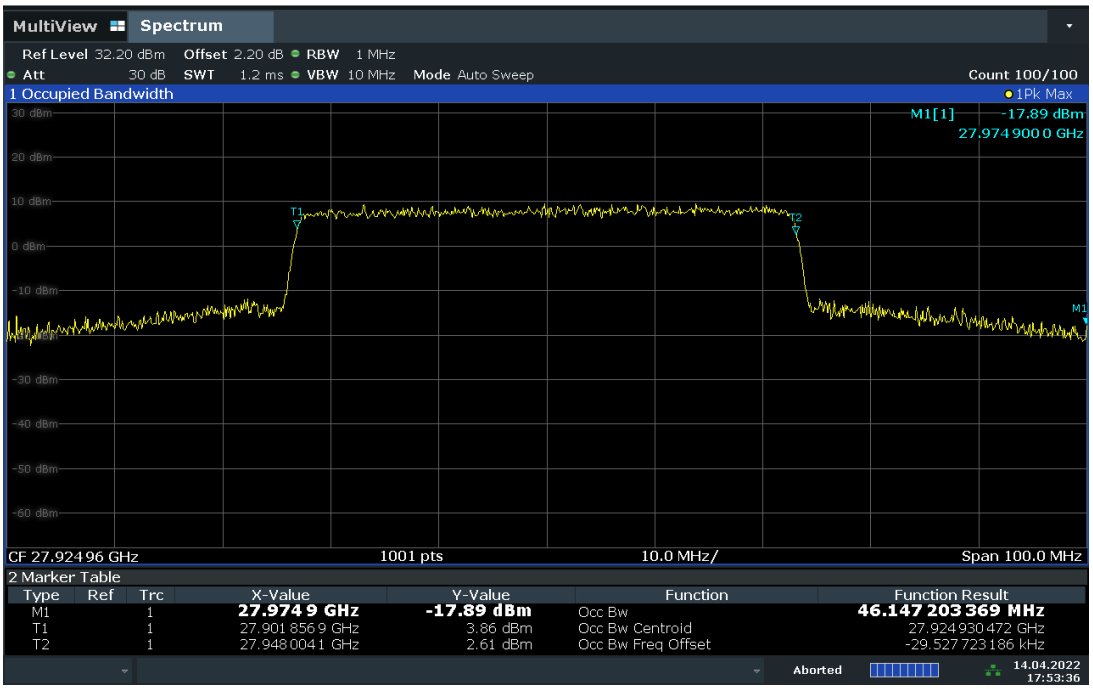
Plot 7-23. Occupied Bandwidth Plot – IDU – H-DL Polarization (100MHz-4CC – QPSK – Mid Channel)

ACLRResults



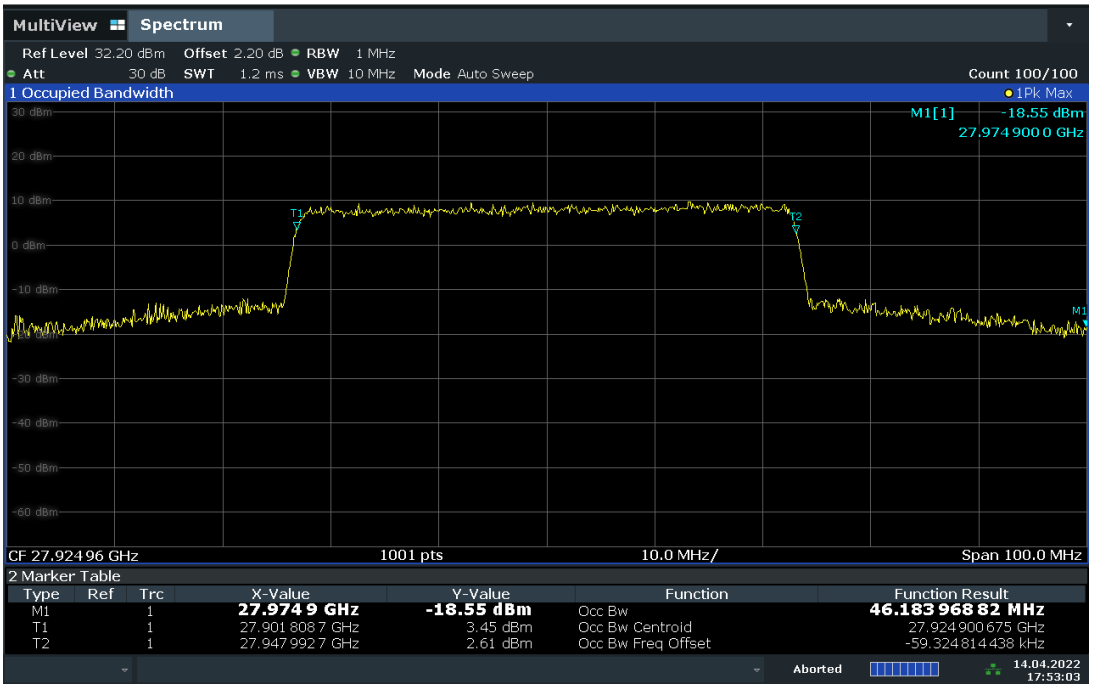
Plot 7-24. Occupied Bandwidth Plot – IDU – H-DL Polarization (100MHz-4CC – 16QAM – Mid Channel)

ACLRResults



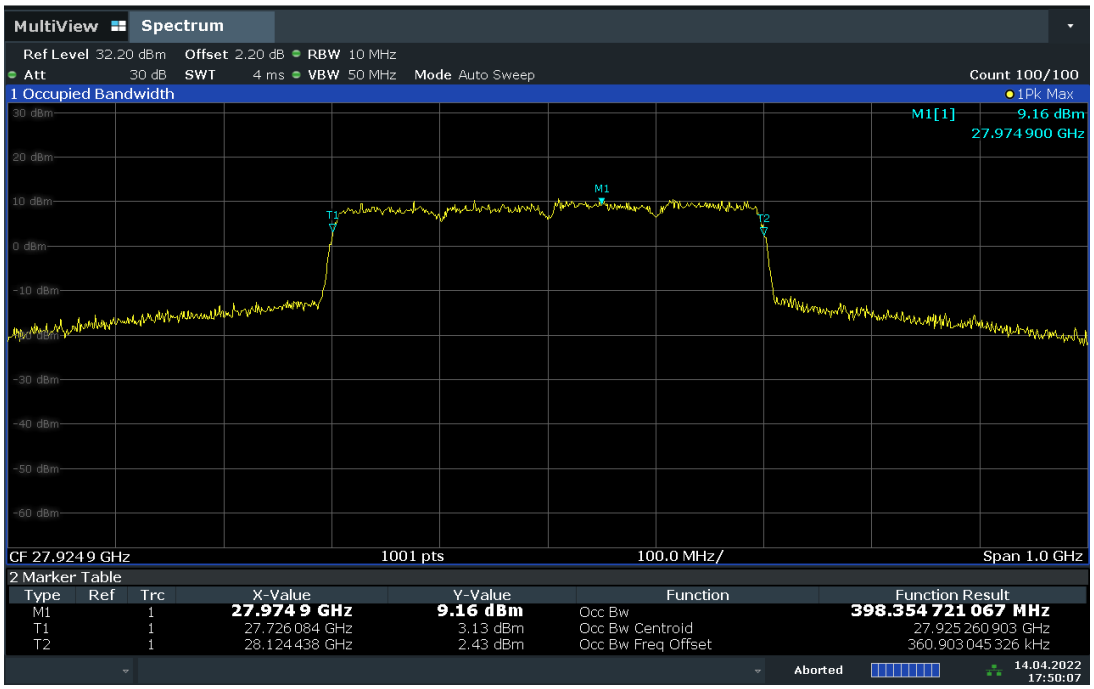
Plot 7-25. Occupied Bandwidth Plot – IDU – V-DL Polarization (50MHz-1CC – QPSK – Mid Channel)

ACLRResults



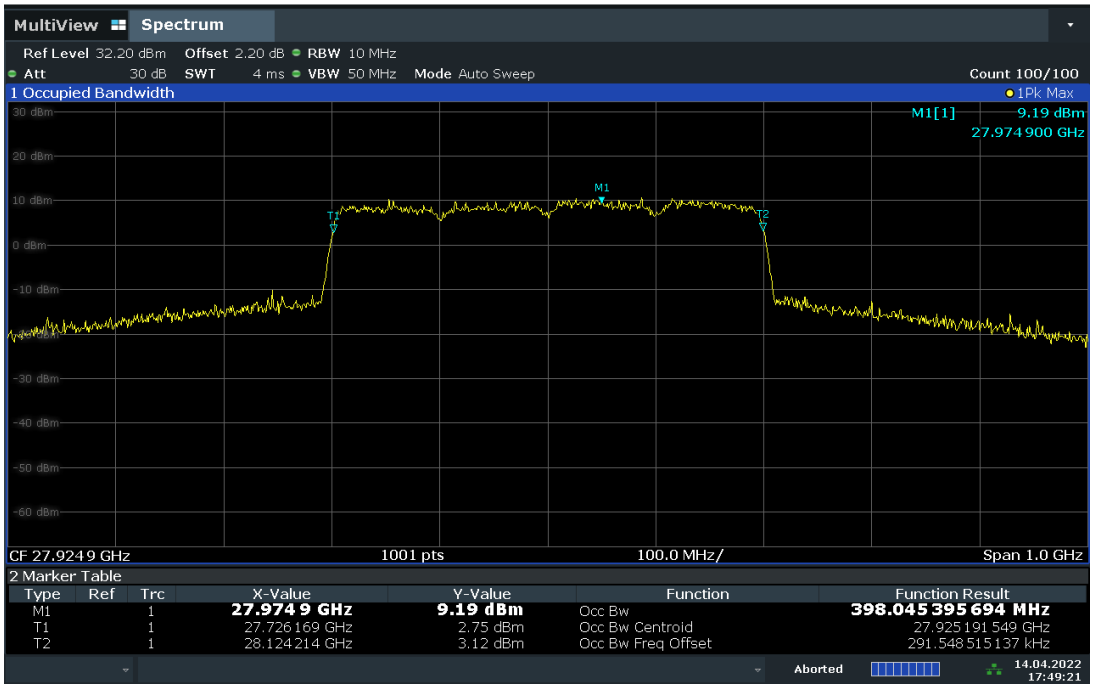
Plot 7-26. Occupied Bandwidth Plot – IDU – V-DL Polarization (50MHz-1CC – 16QAM – Mid Channel)

ACLRResults



Plot 7-27. Occupied Bandwidth Plot – IDU – V-DL Polarization (100MHz-4CC – QPSK – Mid Channel)

ACLRResults



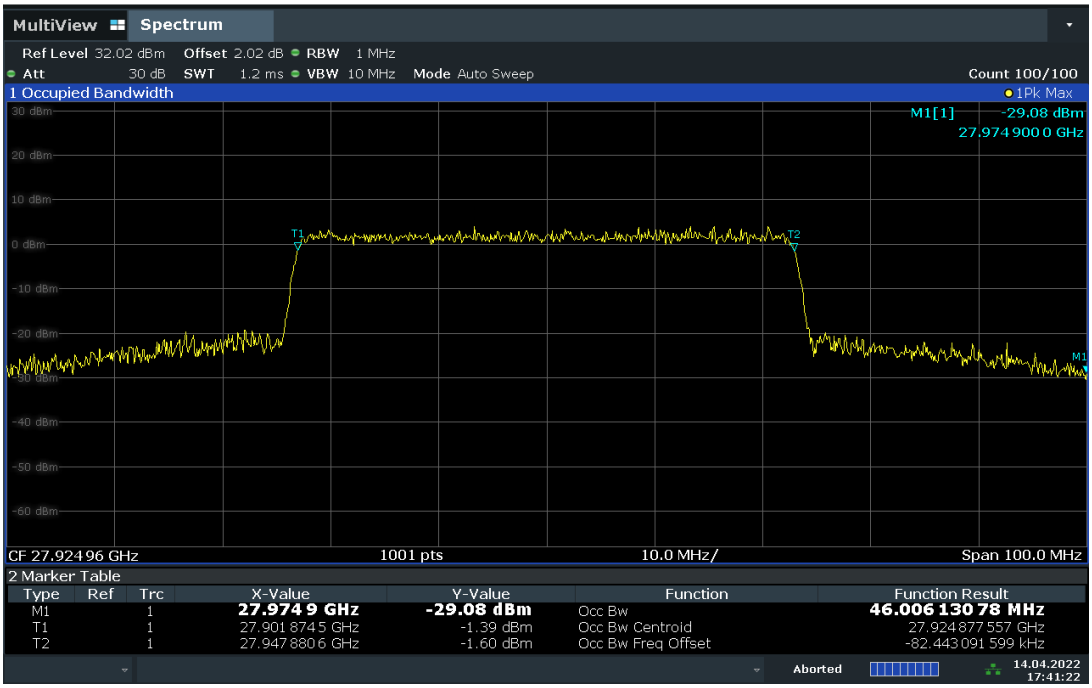
Plot 7-28. Occupied Bandwidth Plot – IDU – V-DL Polarization (100MHz-4CC – 16QAM – Mid Channel)

Band n261 - ODU

Channel	Ant Pol.	Bandwidth [MHz]	CCs Active	Modulation	OBW [MHz]
Mid	H-UL	50	1	QPSK	46.01
				16QAM	46.04
		100	4	QPSK	397.96
				16QAM	397.64
	V-UL	50	1	QPSK	45.91
				16QAM	45.95
		100	4	QPSK	395.64
				16QAM	396.14

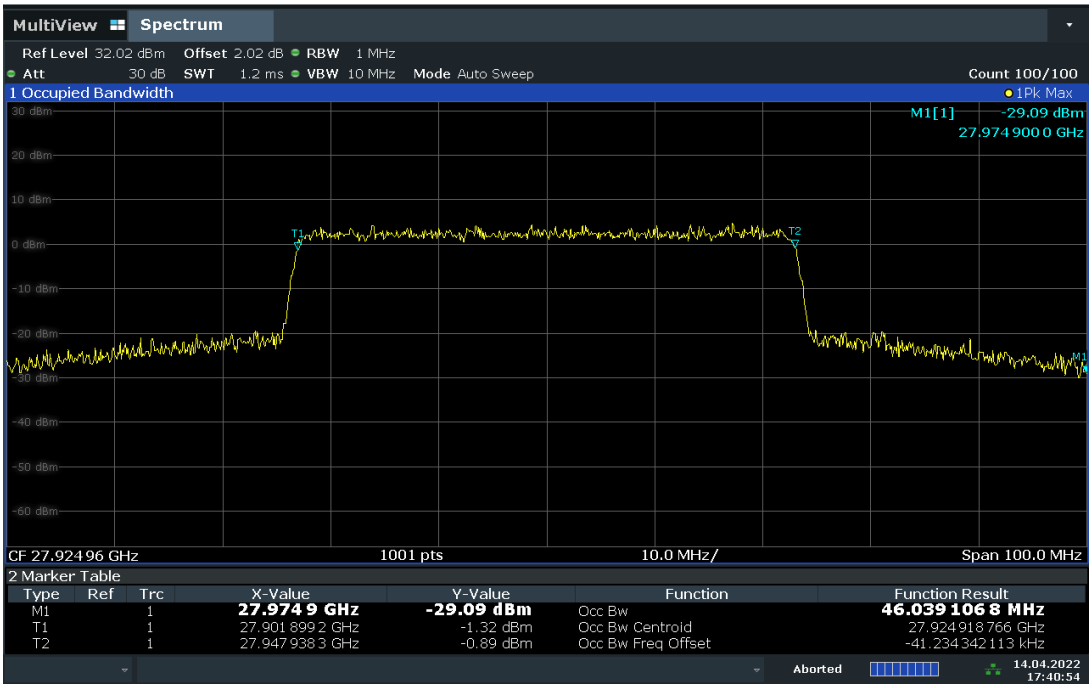
Table 7-13. Summary of ODU Occupied Bandwidths

ACLRResults



Plot 7-29. Occupied Bandwidth Plot – ODU – H-UL Polarization (50MHz-1CC – QPSK – Mid Channel)

ACLRResults

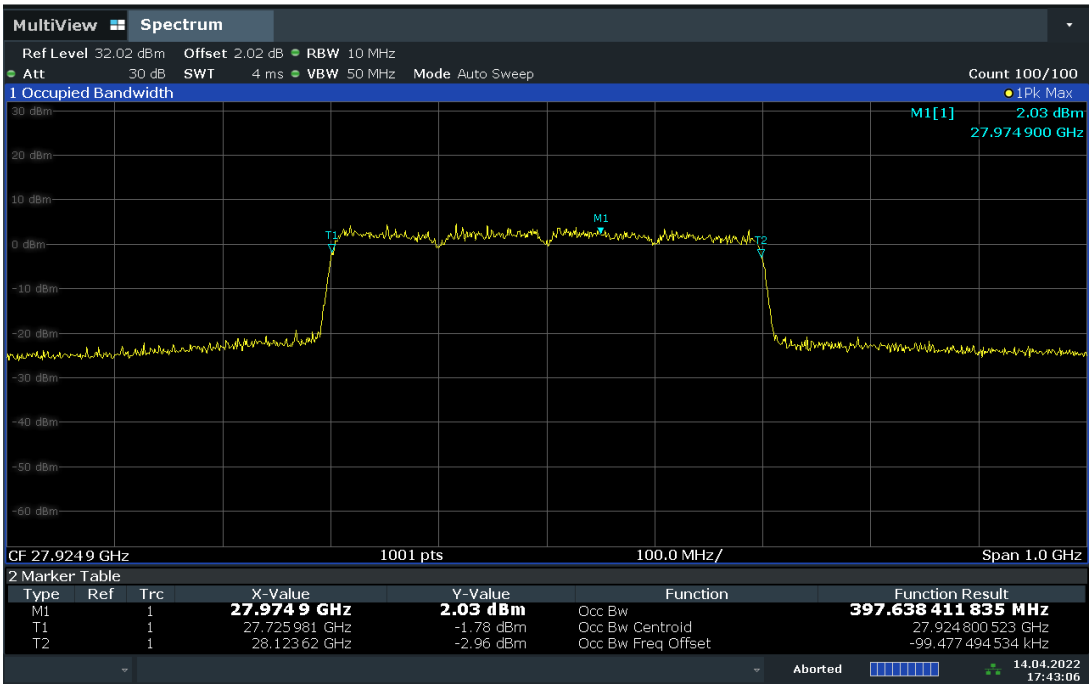


Plot 7-30. Occupied Bandwidth Plot – ODU – H-UL Polarization (50MHz-1CC – 16QAM – Mid Channel)

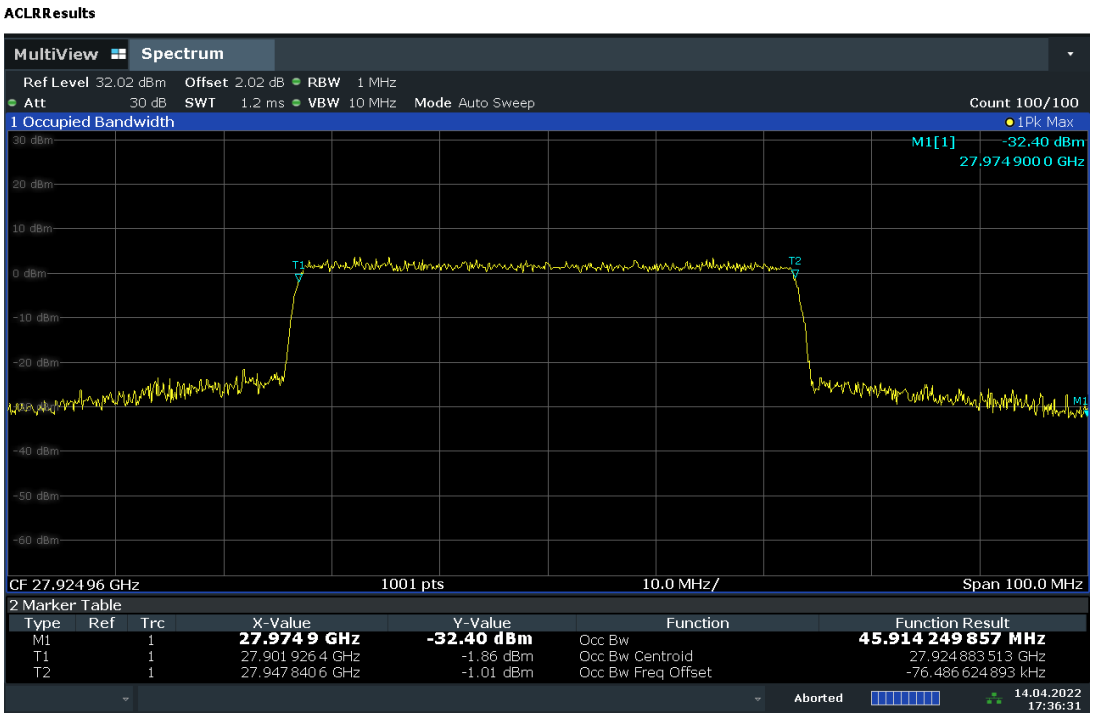
ACLRResults

Plot 7-31. Occupied Bandwidth Plot – ODU – H-UL Polarization (100MHz-4CC – QPSK – Mid Channel)

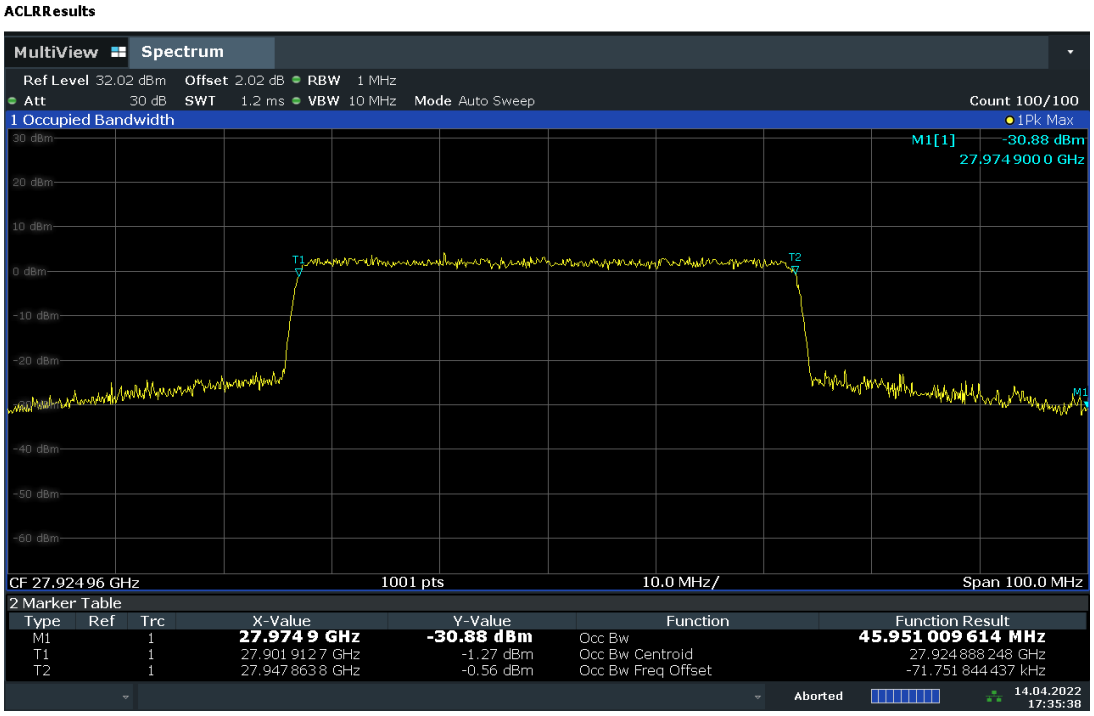
ACLRResults



Plot 7-32. Occupied Bandwidth Plot – ODU – H-UL Polarization (100MHz-4CC – 16QAM – Mid Channel)



Plot 7-33. Occupied Bandwidth Plot – ODU – V-UL Polarization (50MHz-1CC – QPSK – Mid Channel)



Plot 7-34. Occupied Bandwidth Plot – ODU – V-UL Polarization (50MHz-1CC – 16QAM – Mid Channel)

ACLRResults

Plot 7-35. Occupied Bandwidth Plot – ODU – V-UL Polarization (100MHz-4CC – QPSK – Mid Channel)

ACLRResults

Plot 7-36. Occupied Bandwidth Plot – ODU – V-UL Polarization (100MHz-4CC – 16QAM – Mid Channel)

7.6 Conducted Power & Equivalent Isotropic Radiated Power

Test Overview

A transmitter port of the EUT is connected to the input of a signal analyzer. A signal generator supplies a 5G NR signal directly into the input port of the device. All measurements are performed as RMS average measurements while the EUT is operating at the appropriate frequencies with the max power condition as specified by the AGC software of the EUT. The Equivalent Isotripic Radiated Power (EIRP) is then calculated using these conducted power measurements.

The average power of the sum of all antenna elements is limited to a maximum EIRP of +55 dBm.

Test Procedures Used

ANSI C63.26-2015 Section 5.2.4.4.1

Test Settings

1. Conducted power measurements are performed using the signal analyzer's "channel power" measurement capability.
2. For pulsed signals, triggering was set to enable measurements only during full power bursts, with the sweep time set less than or equal to the transmission burst duration. For continuously transmitted signals, triggering was set to Free Run.
3. RBW = 1 – 5% of the expected OBW, not to exceed 1MHz
4. VBW ≥ 3 x RBW
5. Span = 2x to 3x the OBW
6. No. of sweep points ≥ 2 x span / RBW
7. Detector = RMS
8. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation.
9. Trace mode = trace averaging (RMS) over 100 sweeps
10. The trace was allowed to stabilize.

Test Notes

1) The EUT was tested with all possible input signal configurations. The worst case emissions are reported with the regards to modulations, RB sizes and offsets, and channel bandwidth configurations as shown in the tables below. It was determined that full RB allocations provided the worst case results.

2) As the IDU is only designed to boost 5G NR downlink signals, its power levels were only investigated with CP-OFDM transmission schemes. The power levels of the ODU, which is designed to boost 5G NR uplink signals, were investigated with both CP-OFDM and DFT-s-OFDM transmission schemes.

3) The input signal to the EUT was set in order to produce the maximum power allowed by the AGC software of the EUT.

4) The MIMO Conducted Powers were calculated by using the "measure and sum the spectral maxima across the outputs" technique specified in Section 6.4.3.2.3 of ANSI C63.26-2015. The spectra were summed linearly and converted to dBm for comparison with the limit.

5) The MIMO Conducted Powers shown in the tables in this section are the mathematical summations (in linear units) of the measured conducted powers of the horizonally polarized and vertically polarized antenna feeds of an individual unit (i.e either the IDU or ODU).

6) The single-polarization EIRP levels shown in the tables in this section are the mathematical summations (in logarithmic units) of the corresponding single-polarization conducted powers and the gain of the transmit antenna for that polarization.

7) Per the guidance of ANSI C63.26-2015 Section 6.4.5.3.3(a) for cross-polarized antennas, the MIMO EIRP levels shown in the tables in this section are the mathematical summations (in logarithmic units) of the corresponding MIMO conducted powers and the gain of an individual transmit antenna.

8) The gain of the transmit antenna for each unit is provided by the manufacturer.

9) The conducted power plots shown in this section include the appropriate offsets to correct for the frequency-dependent cable loss of the coaxial cable that connects the output port of the EUT to the spectrum analyzer.

Sample Conducted MIMO Calculation:

Antenna 1 + Antenna 2 = MIMO

(21.32dBm + 21.39dBm) = (135.52mW + 137.72mW) = 273.24mW = 24.37dBm

Sample EIRP Calculation:

Conducted Power + Antenna Gain = EIRP

12.57dBm + 10.50dBi = 23.07dBm

Band n261 - IDU

Center Frequency [MHz]	Ant.Pol.	Transmission Scheme	Modulation	Bandwidth [MHz]	# of Carriers [CCs]	RB Size/Offset	Conducted Power [dBm]	Tx Ant Gain [dBi]	EIRP [dBm]
27525.00	H-DL	CP-OFDM	QPSK	50	1	Full	18.05	7.00	25.05
27924.96	H-DL	CP-OFDM	QPSK	50	1	Full	18.00	7.00	25.00
27924.96	H-DL	CP-OFDM	QPSK	50	1	1 / 16	13.52	7.00	20.52
28324.92	H-DL	CP-OFDM	QPSK	50	1	Full	17.92	7.00	24.92
27525.00	H-DL	CP-OFDM	16-QAM	50	1	Full	17.84	7.00	24.84
27700.08	H-DL	CP-OFDM	QPSK	100	4	Full	18.39	7.00	25.39
27924.96	H-DL	CP-OFDM	QPSK	100	4	Full	18.09	7.00	25.09
27924.96	H-DL	CP-OFDM	QPSK	100	4	1 / 33	15.76	7.00	22.76
28149.96	H-DL	CP-OFDM	QPSK	100	4	Full	18.17	7.00	25.17
27700.08	H-DL	CP-OFDM	16-QAM	100	4	Full	17.60	7.00	24.60

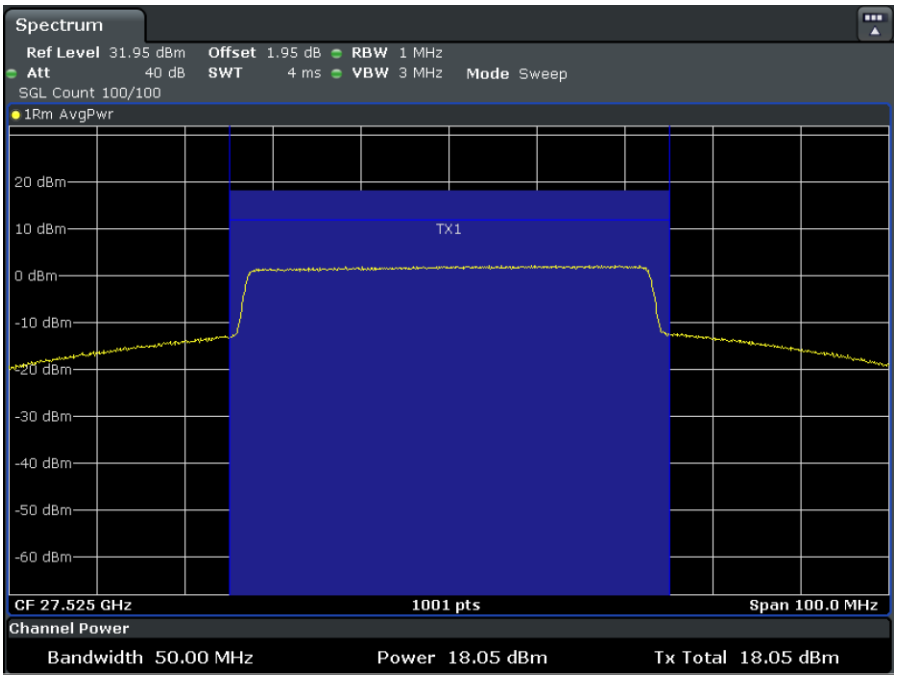
Table 7-14. NR Band n261 - Conducted Power and EIRP – IDU – H-DL Polarization

Center Frequency [MHz]	Ant.Pol.	Transmission Scheme	Modulation	Bandwidth [MHz]	# of Carriers [CCs]	RB Size/Offset	Conducted Power [dBm]	Tx Ant Gain [dBi]	EIRP [dBm]
27525.00	V-DL	CP-OFDM	QPSK	50	1	Full	17.22	7.00	24.22
27924.96	V-DL	CP-OFDM	QPSK	50	1	Full	17.31	7.00	24.31
27924.96	V-DL	CP-OFDM	QPSK	50	1	1 / 16	13.18	7.00	20.18
28324.92	V-DL	CP-OFDM	QPSK	50	1	Full	16.23	7.00	23.23
27924.96	V-DL	CP-OFDM	16-QAM	50	1	Full	16.55	7.00	23.55
27700.08	V-DL	CP-OFDM	QPSK	100	4	Full	17.44	7.00	24.44
27924.96	V-DL	CP-OFDM	QPSK	100	4	Full	17.05	7.00	24.05
27924.96	V-DL	CP-OFDM	QPSK	100	4	1 / 33	14.29	7.00	21.29
28149.96	V-DL	CP-OFDM	QPSK	100	4	Full	16.67	7.00	23.67
27700.08	V-DL	CP-OFDM	16-QAM	100	4	Full	16.77	7.00	23.77

Table 7-15. NR Band n261 - Conducted Power and EIRP – IDU – V-DL Polarization

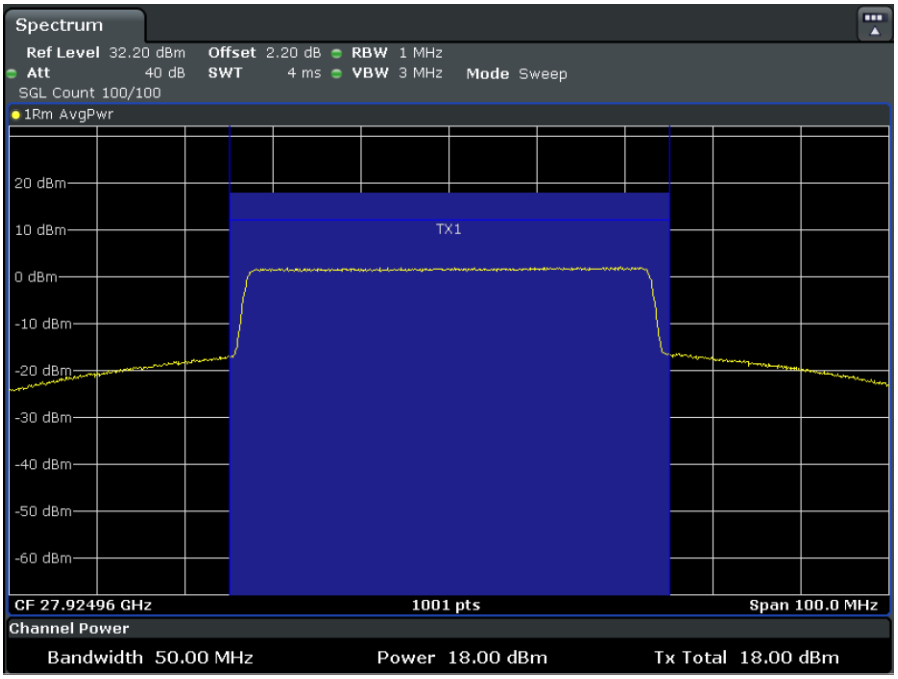
Center Frequency [MHz]	Ant.Pol.	Transmission Scheme	Modulation	Bandwidth [MHz]	# of Carriers [CCs]	RB Size/Offset	MIMO Conducted Power [dBm]	Tx Ant Gain [dBi]	MIMO EIRP [dBm]
27525.00	MIMO	CP-OFDM	QPSK	50	1	Full	20.67	7.00	27.67
27924.96	MIMO	CP-OFDM	QPSK	50	1	Full	20.68	7.00	27.68
27924.96	MIMO	CP-OFDM	QPSK	50	1	1 / 16	16.36	7.00	23.36
28324.92	MIMO	CP-OFDM	QPSK	50	1	Full	20.17	7.00	27.17
27924.96	MIMO	CP-OFDM	16-QAM	50	1	Full	20.25	7.00	27.25
27700.08	MIMO	CP-OFDM	QPSK	100	4	Full	20.95	7.00	27.95
27924.96	MIMO	CP-OFDM	QPSK	100	4	Full	20.61	7.00	27.61
27924.96	MIMO	CP-OFDM	QPSK	100	4	1 / 33	18.10	7.00	25.10
28149.96	MIMO	CP-OFDM	QPSK	100	4	Full	20.49	7.00	27.49
27700.08	MIMO	CP-OFDM	16-QAM	100	4	Full	20.22	7.00	27.22

Table 7-16. NR Band n261 - Conducted Power – IDU – MIMO



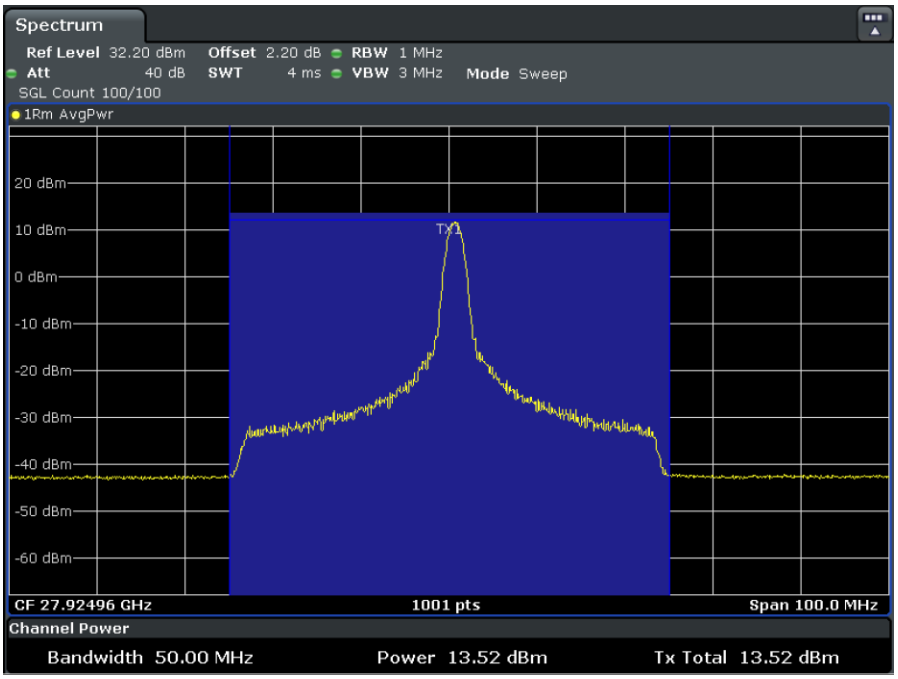
Date: 4.MAR.2022 04:48:00

Plot 7-37. Conducted Power Plot – IDU – H-DL Polarization (50MHz-1CC − QPSK – Low Ch. – Full RB)



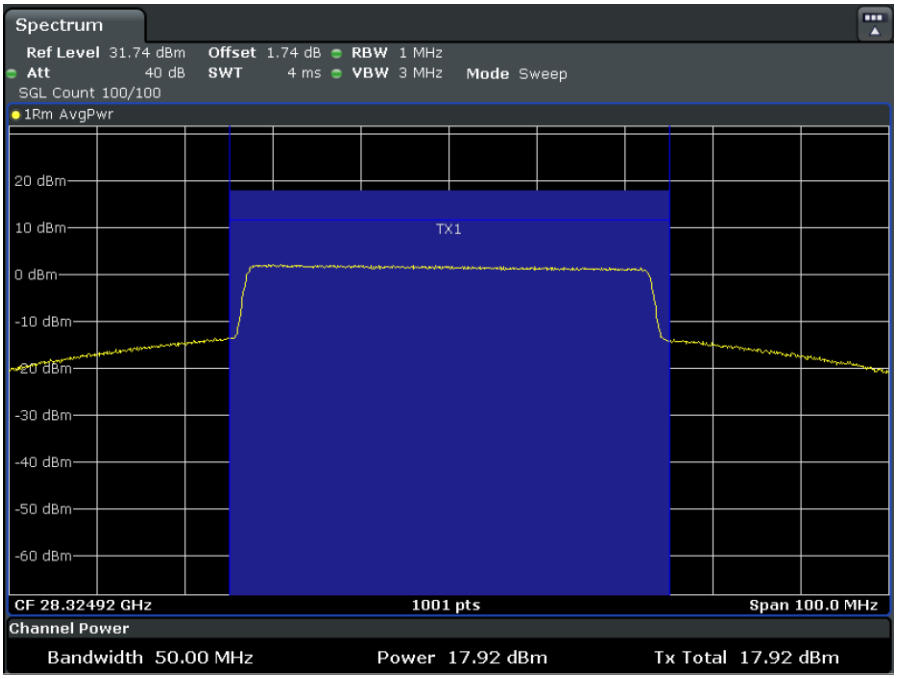
Date: 4.MAR.2022 04:38:06

Plot 7-38. Conducted Power Plot – IDU – H-DL Polarization (50MHz-1CC − QPSK – Mid Ch. – Full RB)



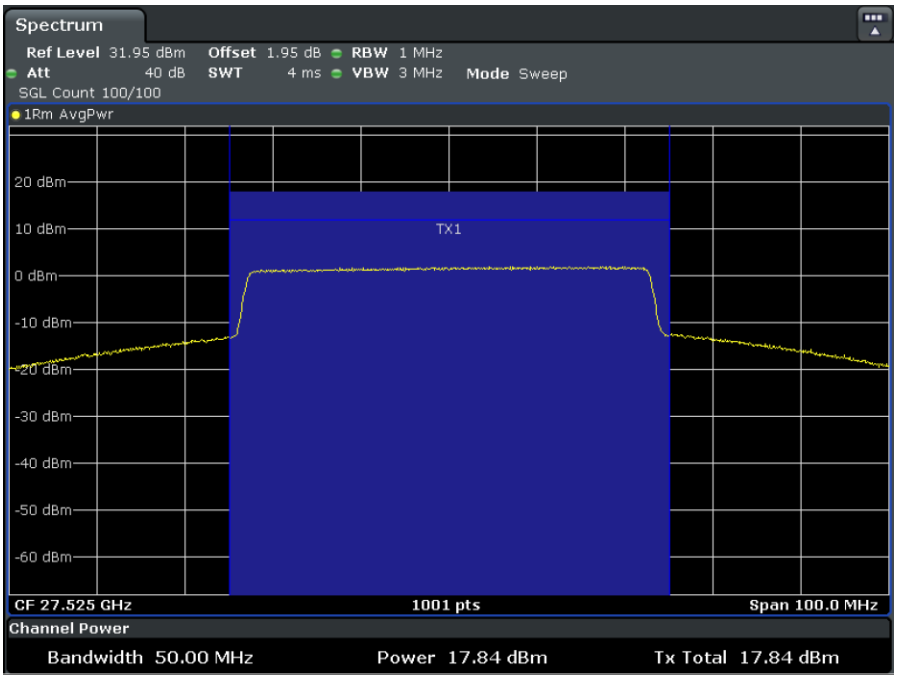
Date: 4.MAR.2022 04:41:10

Plot 7-39. Conducted Power Plot – IDU – H-DL Polarization (50MHz-1CC − QPSK – Mid Ch. – 1RB)



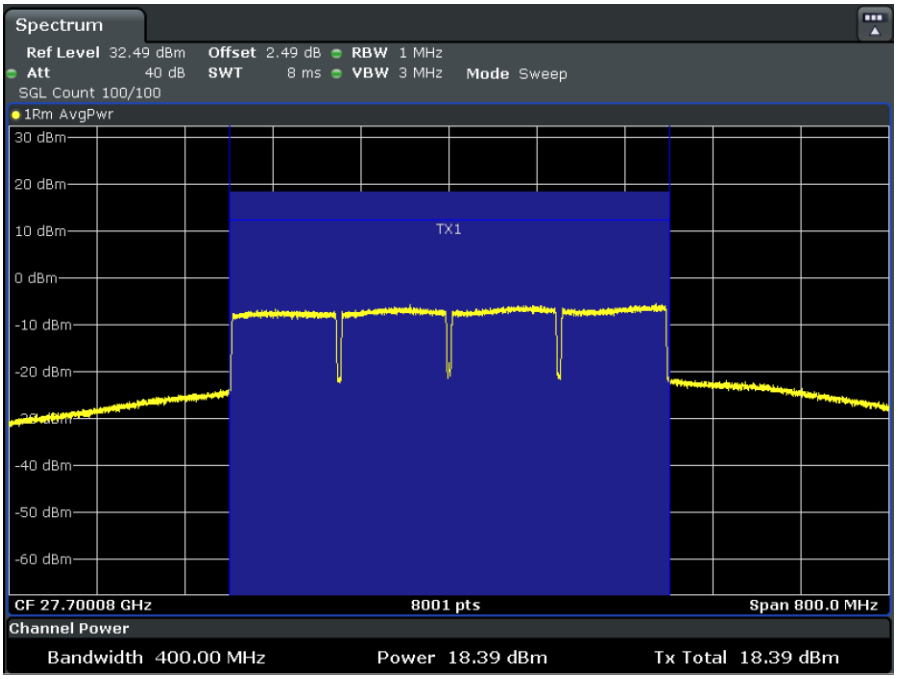
Date: 4.MAR.2022 04:52:52

Plot 7-40. Conducted Power Plot – IDU – H-DL Polarization (50MHz-1CC − QPSK – High Ch. – Full RB)



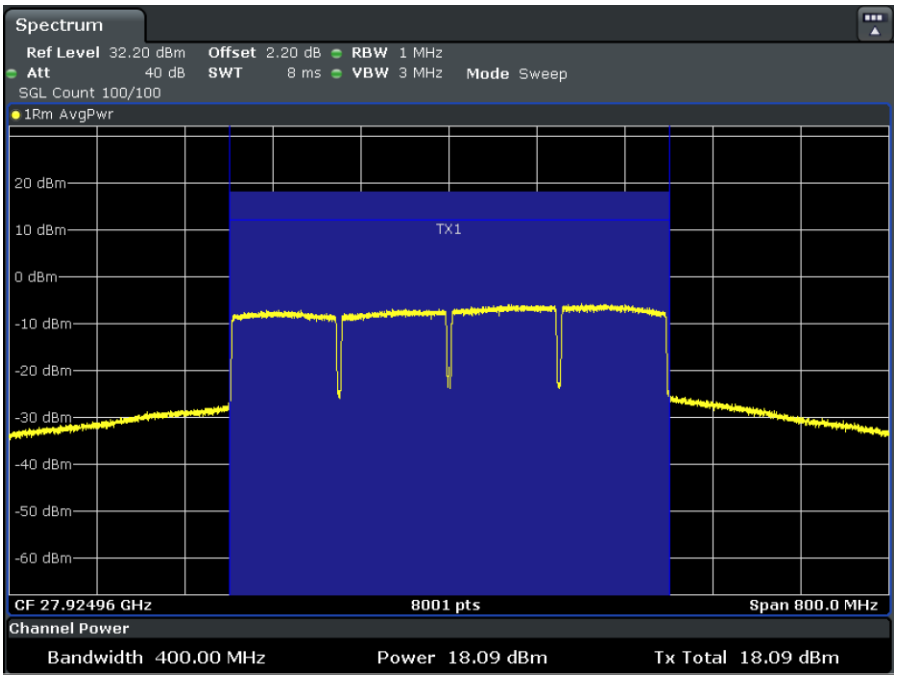
Date: 4.MAR.2022 05:03:40

Plot 7-41. Conducted Power Plot – IDU – H-DL Polarization (50MHz-1CC – 16QAM – Low Ch. – Full RB)



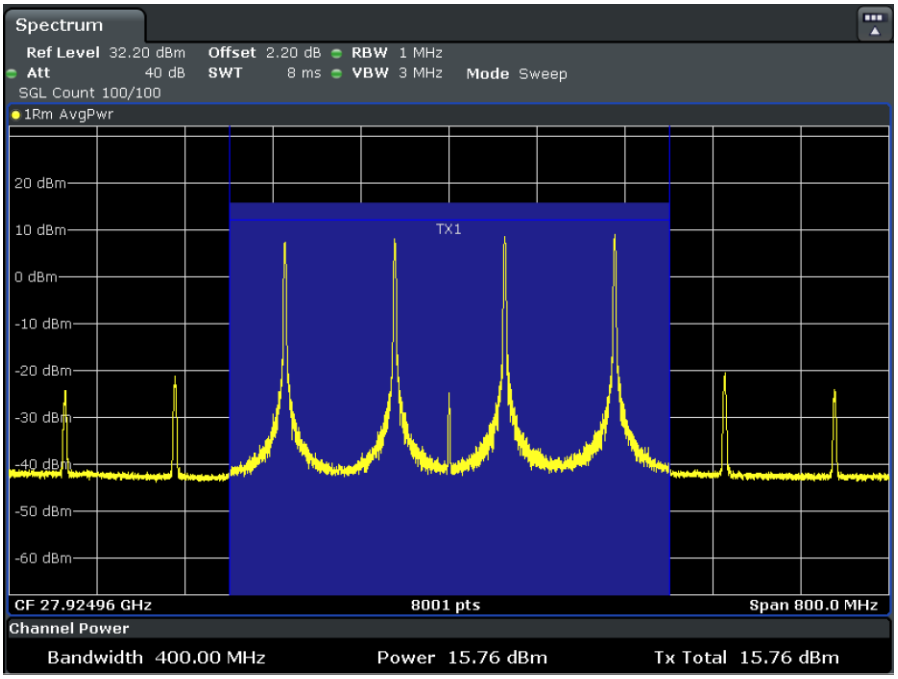
Date: 4.MAR.2022 07:43:31

Plot 7-42. Conducted Power Plot – IDU – H-DL Polarization (100MHz-4CC − QPSK – Low Ch. – Full RB)



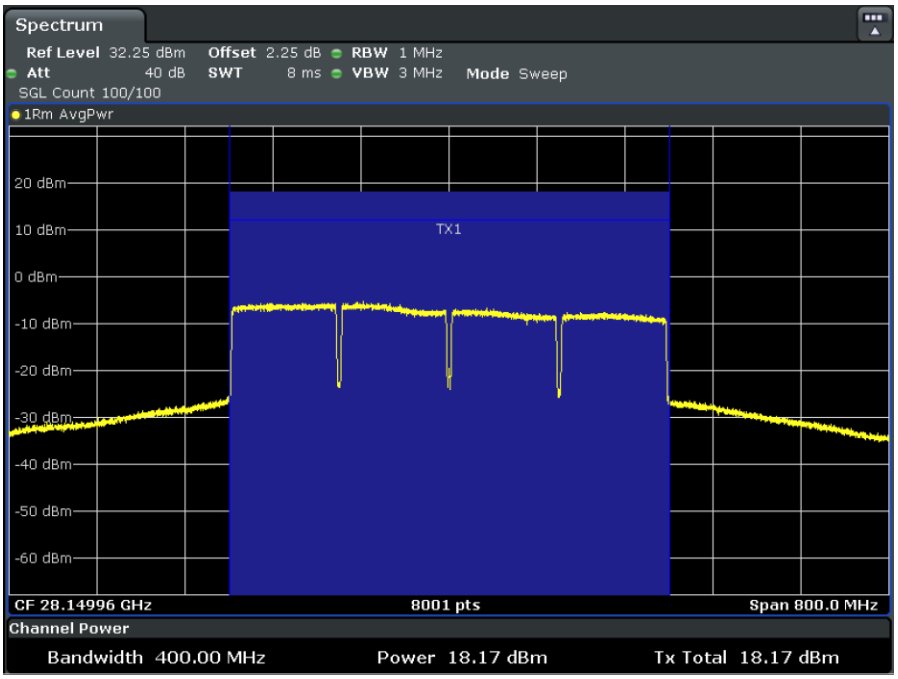
Date: 4.MAR.2022 07:28:54

Plot 7-43. Conducted Power Plot – IDU – H-DL Polarization (100MHz-4CC − QPSK – Mid Ch. – Full RB)



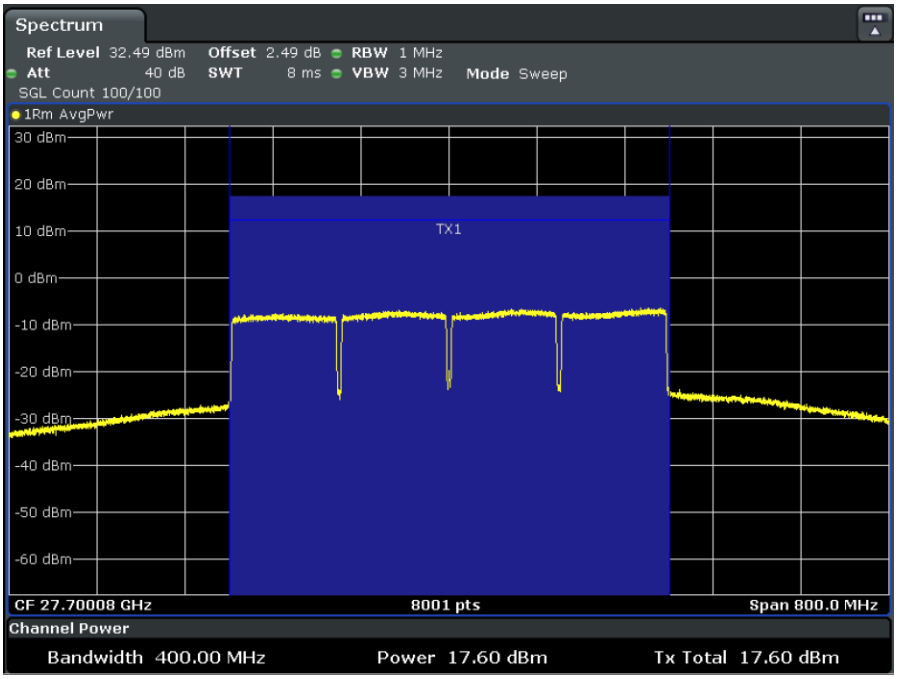
Date: 4.MAR.2022 07:32:16

Plot 7-44. Conducted Power Plot – IDU – H-DL Polarization (100MHz-4CC − QPSK – Mid Ch. – 1RB)



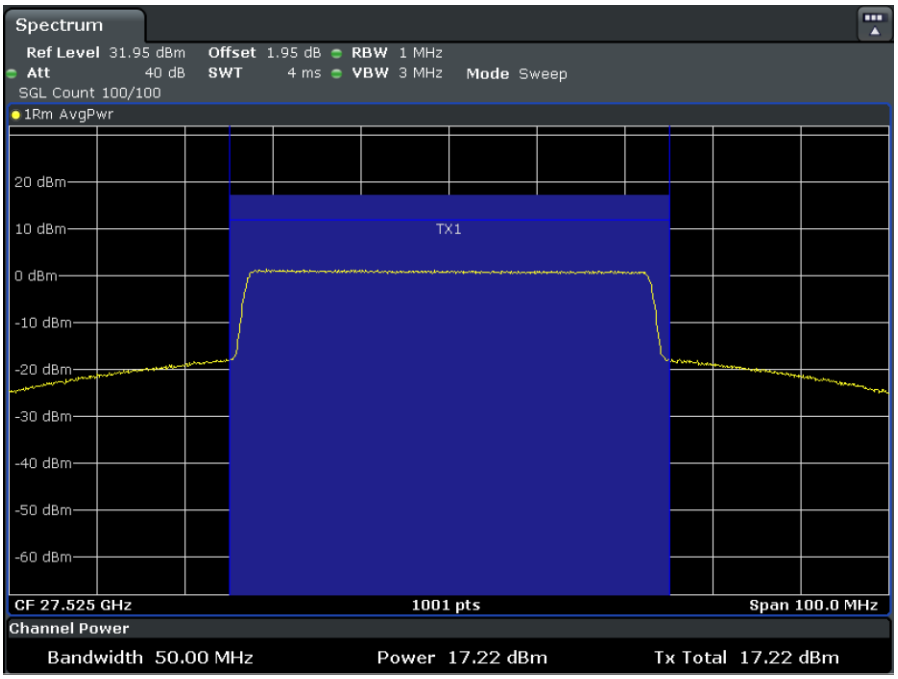
Date: 4.MAR.2022 07:46:08

Plot 7-45. Conducted Power Plot – IDU – H-DL Polarization (100MHz-4CC − QPSK – High Ch. – Full RB)



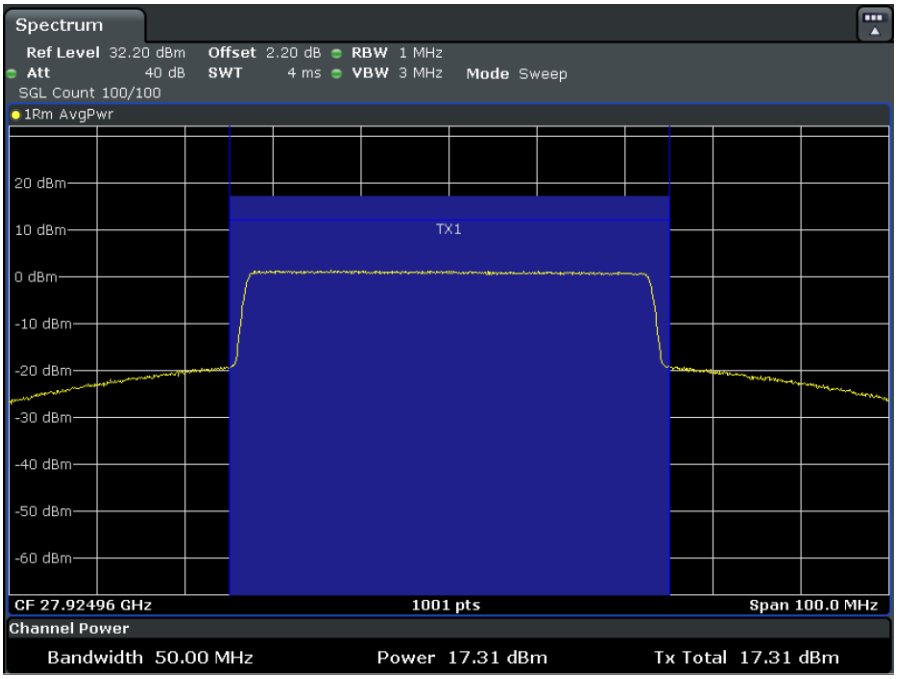
Date: 4.MAR.2022 07:50:13

Plot 7-46. Conducted Power Plot – IDU – H-DL Polarization (100MHz-4CC – 16QAM – Low Ch. – Full RB)



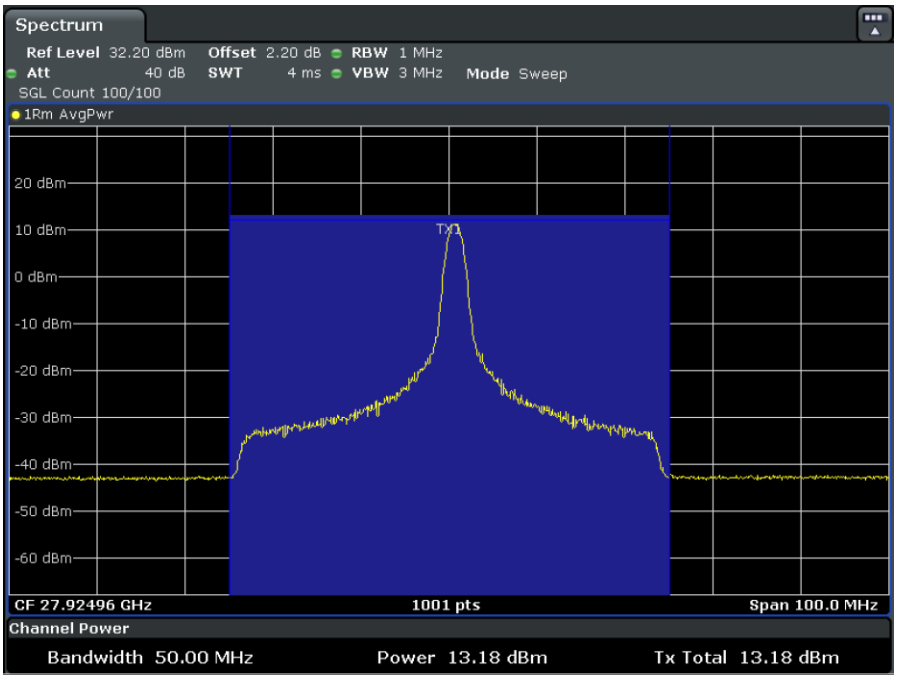
Date: 3.MAR.2022 06:40:14

Plot 7-47. Conducted Power Plot – IDU – V-DL Polarization (50MHz-1CC − QPSK – Low Ch. – Full RB)



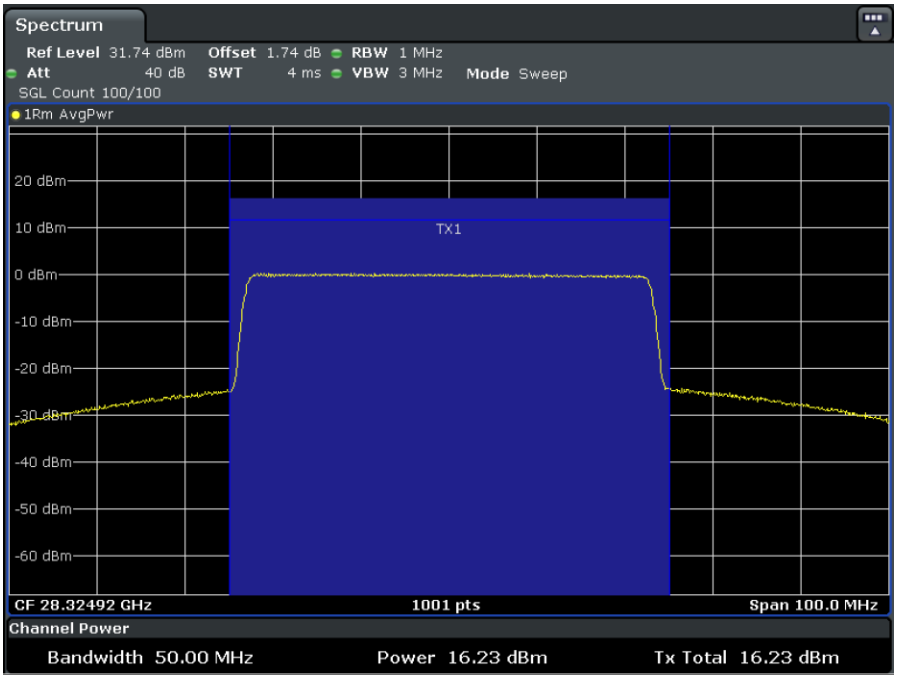
Date: 3.MAR.2022 07:17:14

Plot 7-48. Conducted Power Plot – IDU – V-DL Polarization (50MHz-1CC − QPSK – Mid Ch. – Full RB)



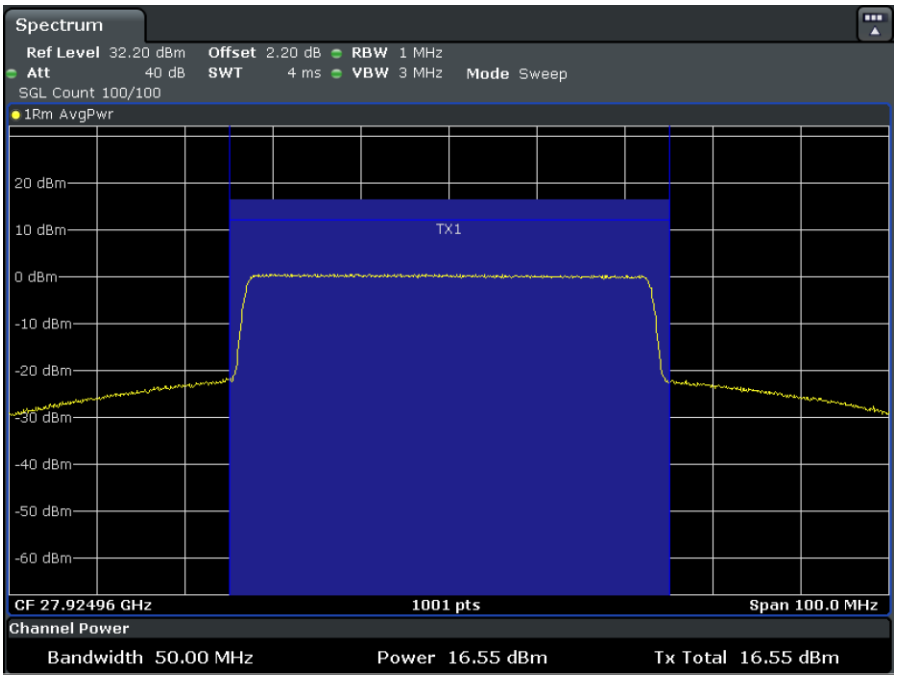
Date: 3.MAR.2022 07:11:38

Plot 7-49. Conducted Power Plot – IDU – V-DL Polarization (50MHz-1CC − QPSK – Mid Ch. – 1RB)



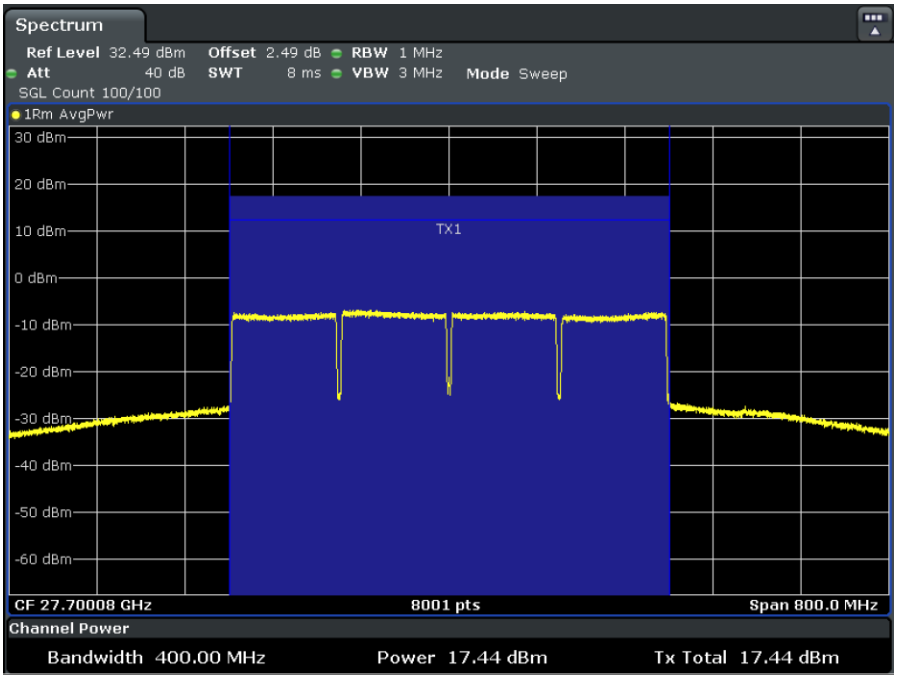
Date: 3.MAR.2022 07:14:24

Plot 7-50. Conducted Power Plot – IDU – V-DL Polarization (50MHz-1CC − QPSK – High Ch. – Full RB)



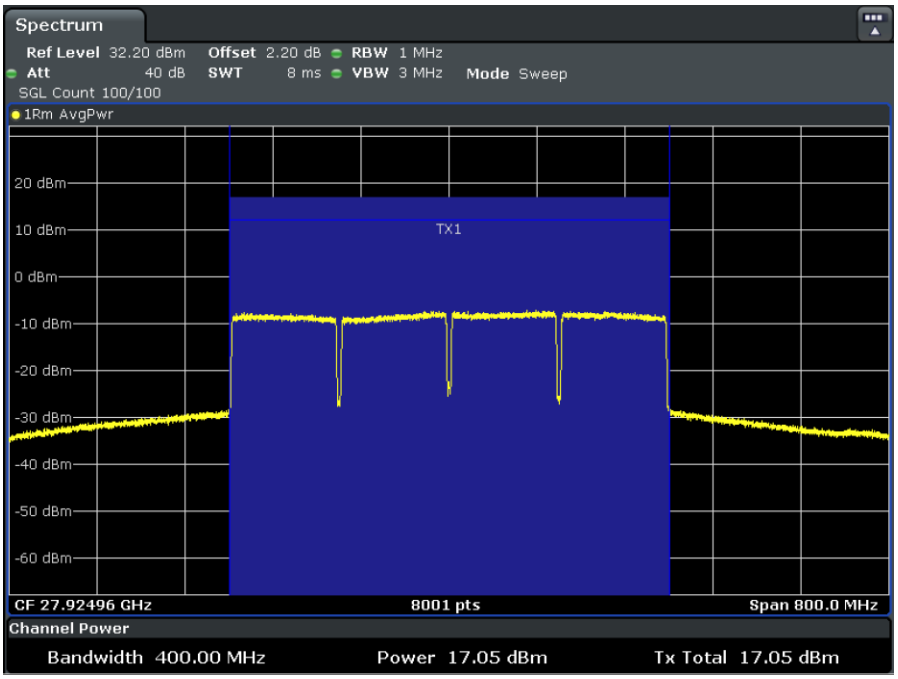
Date: 3.MAR.2022 07:18:20

Plot 7-51. Conducted Power Plot – IDU – V-DL Polarization (50MHz-1CC – 16QAM – Mid Ch. – Full RB)



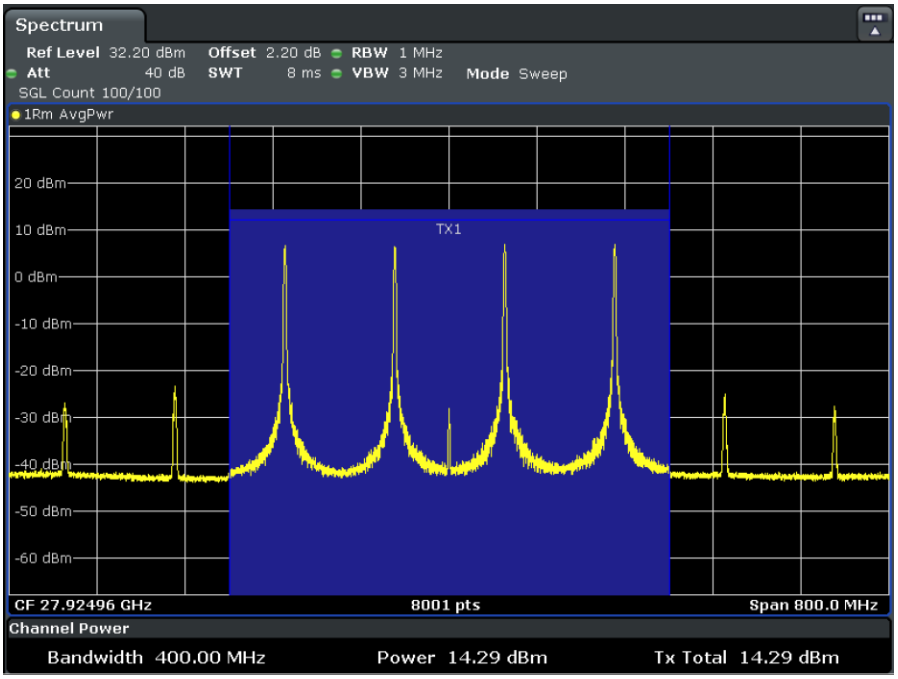
Date: 3.MAR.2022 07:40:43

Plot 7-52. Conducted Power Plot – IDU – V-DL Polarization (100MHz-4CC − QPSK – Low Ch. – Full RB)



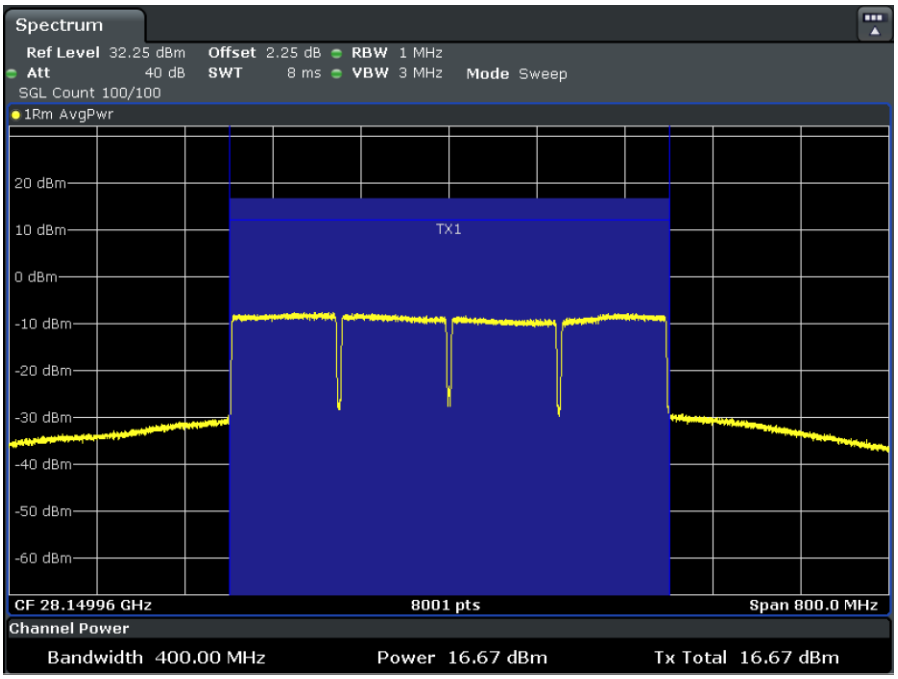
Date: 3.MAR.2022 07:42:49

Plot 7-53. Conducted Power Plot – IDU – V-DL Polarization (100MHz-4CC − QPSK – Mid Ch. – Full RB)



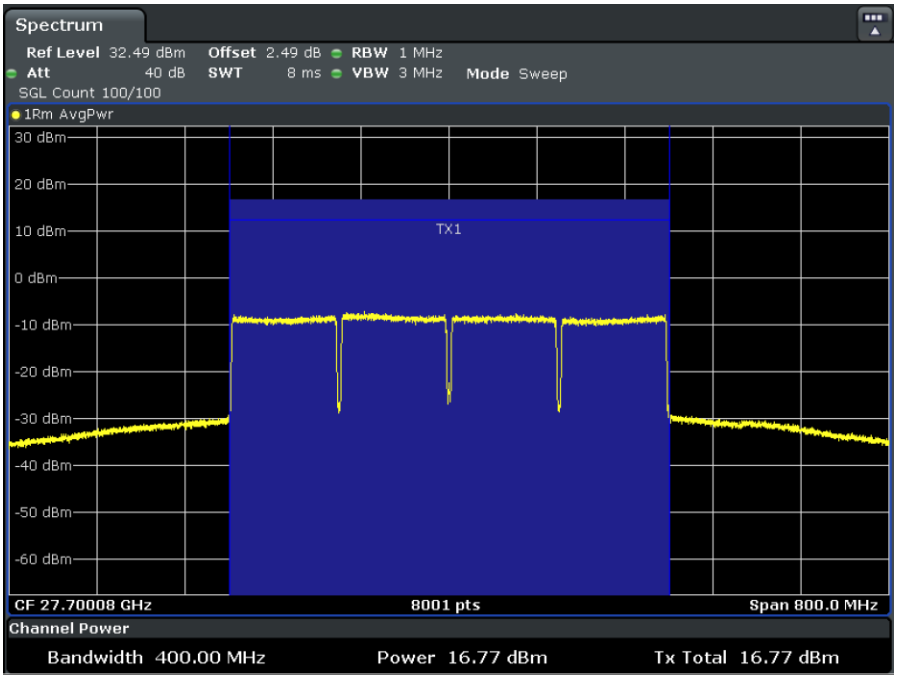
Date: 3.MAR.2022 07:44:38

Plot 7-54. Conducted Power Plot – IDU – V-DL Polarization (100MHz-4CC − QPSK – Mid Ch. – 1RB)



Date: 3.MAR.2022 07:48:47

Plot 7-55. Conducted Power Plot – IDU – V-DL Polarization (100MHz-4CC − QPSK – High Ch. – Full RB)



Date: 3.MAR.2022 07:53:18

Plot 7-56. Conducted Power Plot – IDU – V-DL Polarization (100MHz-4CC – 16QAM – Low Ch. – Full RB)

Band n261 - ODU

Center Frequency [MHz]	Ant.Pol.	Transmission Scheme	Modulation	Bandwidth [MHz]	# of Carriers [CCs]	RB Size/Offset	Conducted Power [dBm]	Tx Ant Gain [dBi]	EIRP [dBm]
27525.00	H-UL	DFT-s-OFDM	QPSK	50	1	Full	11.40	17.00	28.40
27924.96	H-UL	DFT-s-OFDM	QPSK	50	1	Full	11.47	17.00	28.47
27924.96	H-UL	DFT-s-OFDM	QPSK	50	1	1 / 16	11.01	17.00	28.01
28324.92	H-UL	DFT-s-OFDM	QPSK	50	1	Full	11.00	17.00	28.00
27924.96	H-UL	DFT-s-OFDM	16-QAM	50	1	Full	11.15	17.00	28.15
27700.08	H-UL	DFT-s-OFDM	QPSK	100	4	Full	10.45	17.00	27.45
27924.96	H-UL	DFT-s-OFDM	QPSK	100	4	Full	10.14	17.00	27.14
27924.96	H-UL	DFT-s-OFDM	QPSK	100	4	1 / 33	9.79	17.00	26.79
28149.96	H-UL	DFT-s-OFDM	QPSK	100	4	Full	10.67	17.00	27.67
28149.96	H-UL	DFT-s-OFDM	16-QAM	100	4	Full	10.41	17.00	27.41

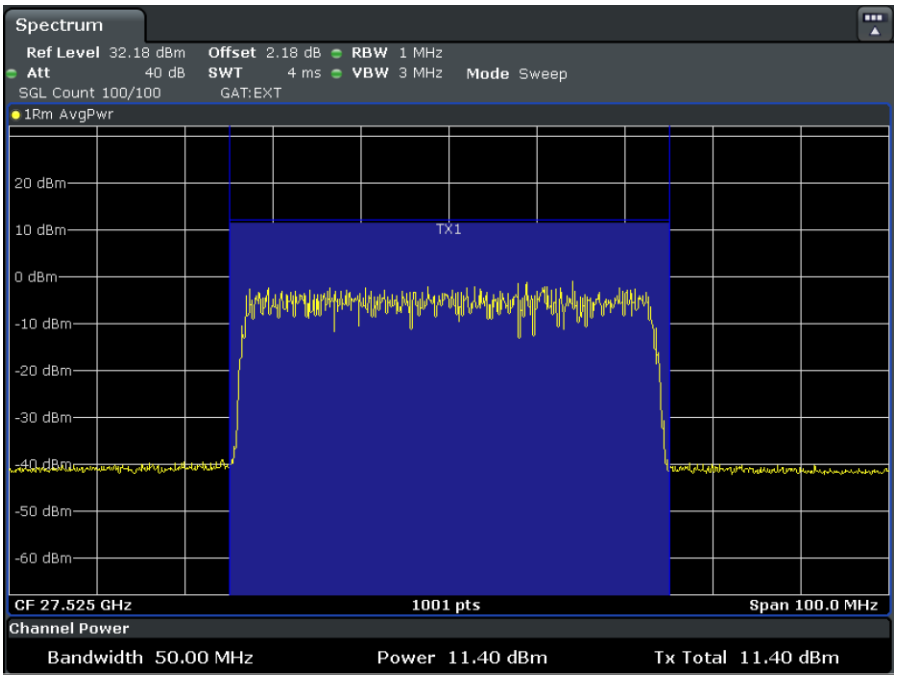
Table 7-17. NR Band n261 - Conducted Power and EIRP – ODU – H-UL Polarization

Center Frequency [MHz]	Ant.Pol.	Transmission Scheme	Modulation	Bandwidth [MHz]	# of Carriers [CCs]	RB Size/Offset	Conducted Power [dBm]	Tx Ant Gain [dBi]	EIRP [dBm]
27525.00	V-UL	DFT-s-OFDM	QPSK	50	1	Full	10.94	17.00	27.94
27924.96	V-UL	DFT-s-OFDM	QPSK	50	1	Full	11.28	17.00	28.28
27924.96	V-UL	DFT-s-OFDM	QPSK	50	1	1 / 16	10.68	17.00	27.68
28324.92	V-UL	DFT-s-OFDM	QPSK	50	1	Full	11.01	17.00	28.01
27924.96	V-UL	DFT-s-OFDM	16-QAM	50	1	Full	11.13	17.00	28.13
27700.08	V-UL	DFT-s-OFDM	QPSK	100	4	Full	10.53	17.00	27.53
27924.96	V-UL	DFT-s-OFDM	QPSK	100	4	Full	9.71	17.00	26.71
27924.96	V-UL	DFT-s-OFDM	QPSK	100	4	1 / 33	9.42	17.00	26.42
28149.96	V-UL	DFT-s-OFDM	QPSK	100	4	Full	9.89	17.00	26.89
27700.08	V-UL	DFT-s-OFDM	16-QAM	100	4	Full	10.44	17.00	27.44

Table 7-18. NR Band n261 - Conducted Power and EIRP – ODU – V-UL Polarization

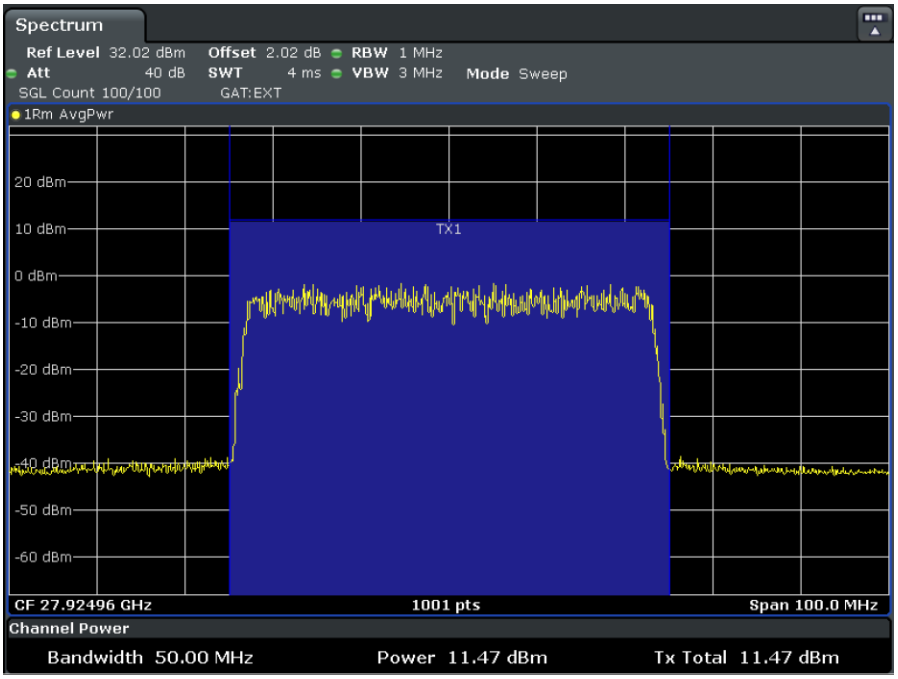
Center Frequency [MHz]	Ant.Pol.	Transmission Scheme	Modulation	Bandwidth [MHz]	# of Carriers [CCs]	RB Size/Offset	MIMO Conducted Power [dBm]	Tx Ant Gain [dBi]	MIMO EIRP [dBm]
27525.00	MIMO	DFT-s-OFDM	QPSK	50	1	Full	14.19	17.00	31.19
27924.96	MIMO	DFT-s-OFDM	QPSK	50	1	Full	14.39	17.00	31.39
27924.96	MIMO	DFT-s-OFDM	QPSK	50	1	1 / 16	13.86	17.00	30.86
28324.92	MIMO	DFT-s-OFDM	QPSK	50	1	Full	14.02	17.00	31.02
27924.96	MIMO	DFT-s-OFDM	16-QAM	50	1	Full	14.15	17.00	31.15
27700.08	MIMO	DFT-s-OFDM	QPSK	100	4	Full	13.50	17.00	30.50
27924.96	MIMO	DFT-s-OFDM	QPSK	100	4	Full	12.94	17.00	29.94
27924.96	MIMO	DFT-s-OFDM	QPSK	100	4	1 / 33	12.62	17.00	29.62
28149.96	MIMO	DFT-s-OFDM	QPSK	100	4	Full	13.31	17.00	30.31
27700.08	MIMO	DFT-s-OFDM	16-QAM	100	4	Full	13.44	17.00	30.44

Table 7-19. NR Band n261 - Conducted Power – ODU – MIMO



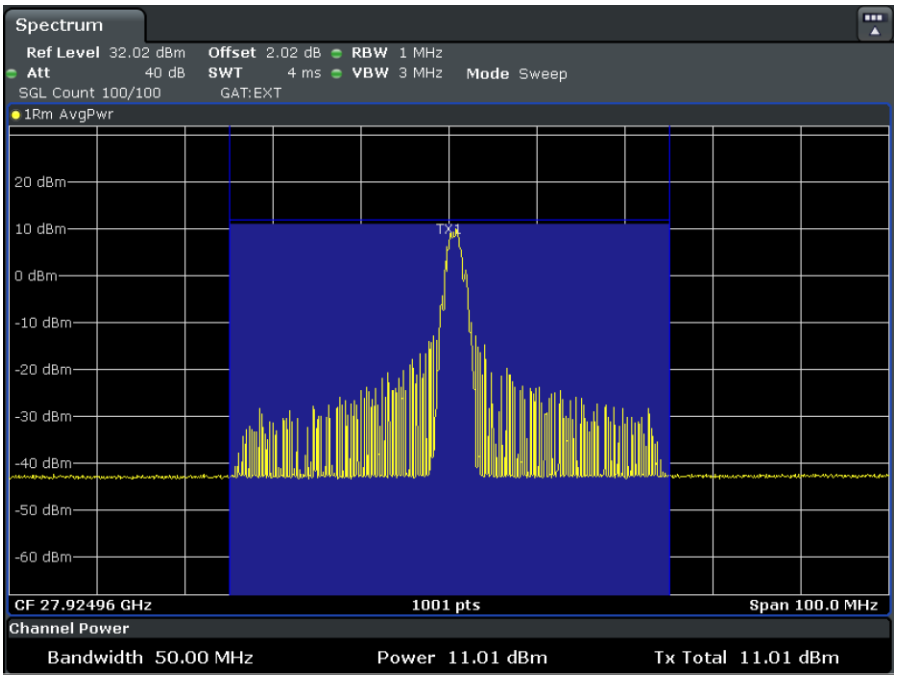
Date: 10.MAR.2022 12:28:55

Plot 7-57. Conducted Power Plot – ODU – H-UL Polarization (50MHz-1CC − QPSK – Low Ch. – Full RB)



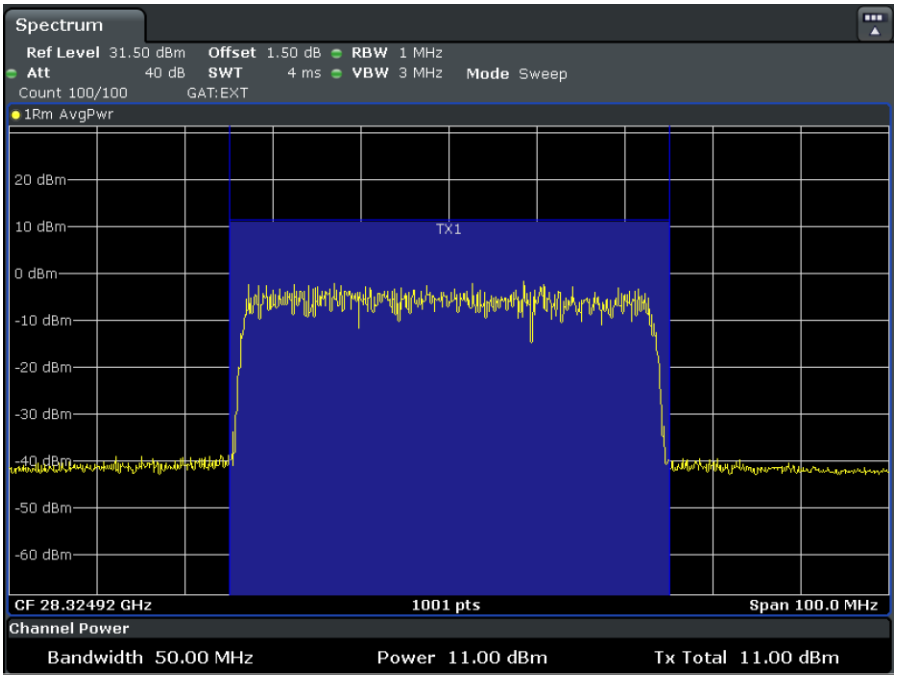
Date: 10.MAR.2022 12:21:10

Plot 7-58. Conducted Power Plot – ODU – H-UL Polarization (50MHz-1CC − QPSK – Mid Ch. – Full RB)



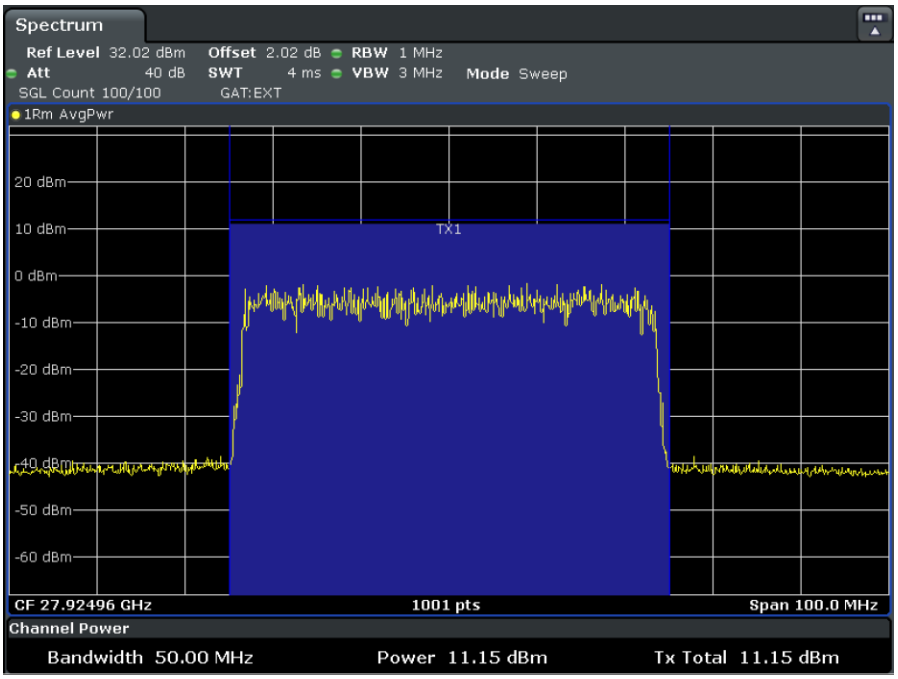
Date: 10.MAR.2022 12:22:35

Plot 7-59. Conducted Power Plot – ODU – H-UL Polarization (50MHz-1CC − QPSK – Mid Ch. – 1RB)



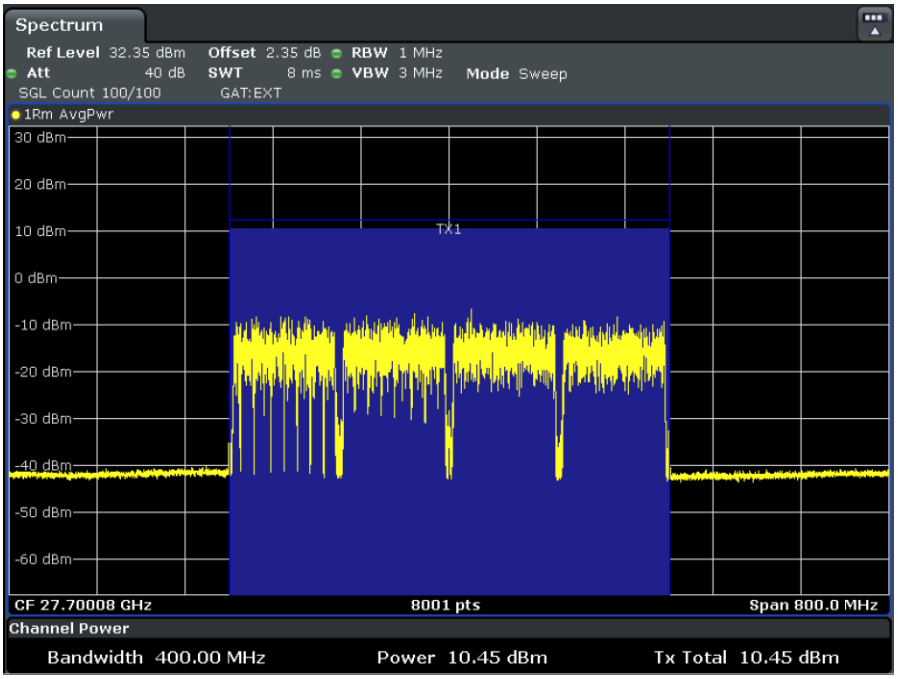
Date: 10.MAR.2022 12:27:43

Plot 7-60. Conducted Power Plot – ODU – H-UL Polarization (50MHz-1CC − QPSK – High Ch. – Full RB)



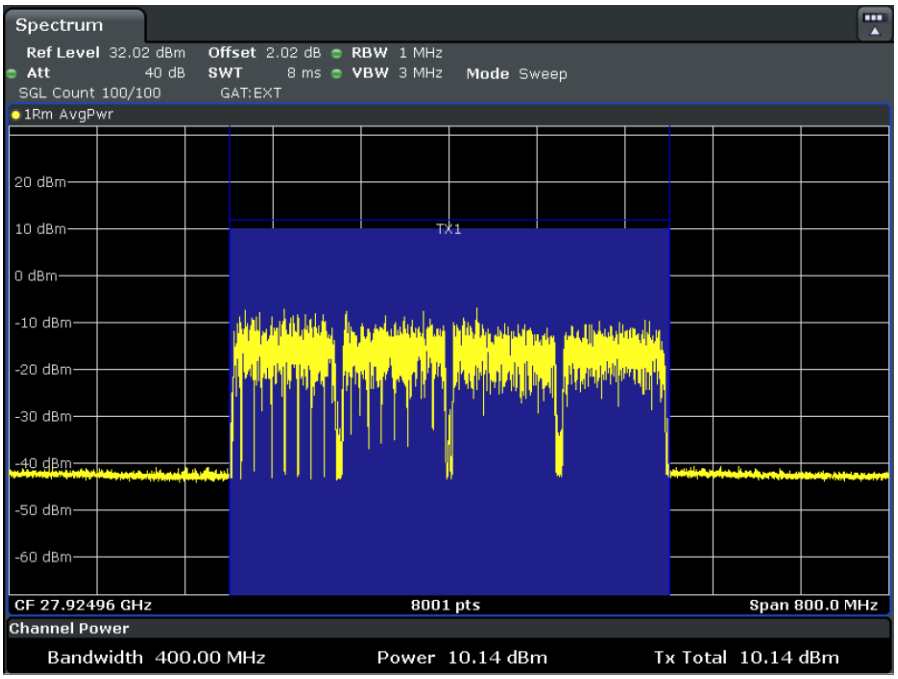
Date: 10.MAR.2022 12:24:51

Plot 7-61. Conducted Power Plot – ODU – H-UL Polarization (50MHz-1CC – 16QAM – Mid Ch. – Full RB)



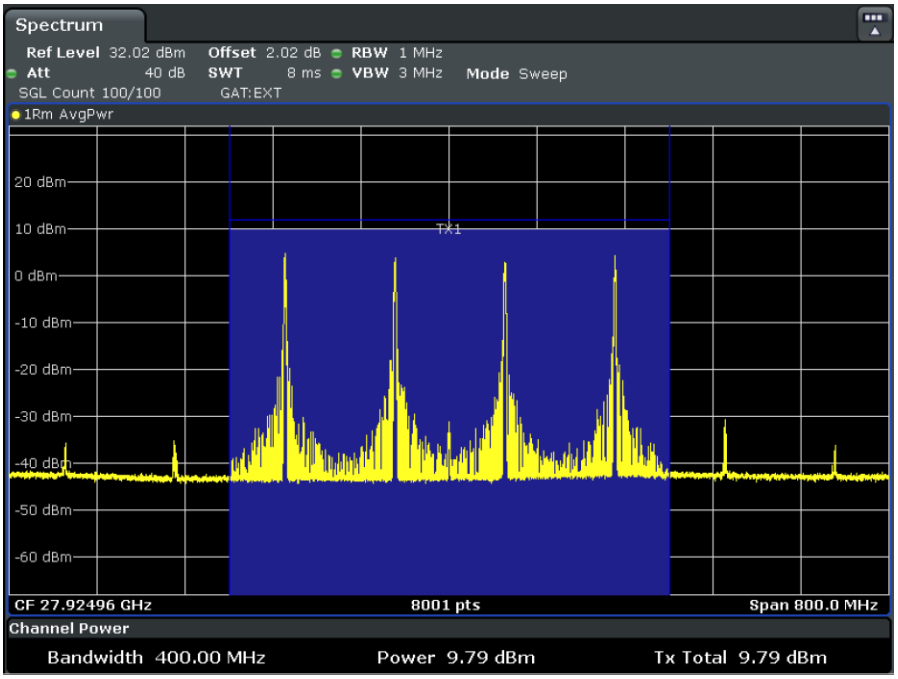
Date: 10.MAR.2022 11:46:46

Plot 7-62. Conducted Power Plot – ODU – H-UL Polarization (100MHz-4CC − QPSK – Low Ch. – Full RB)



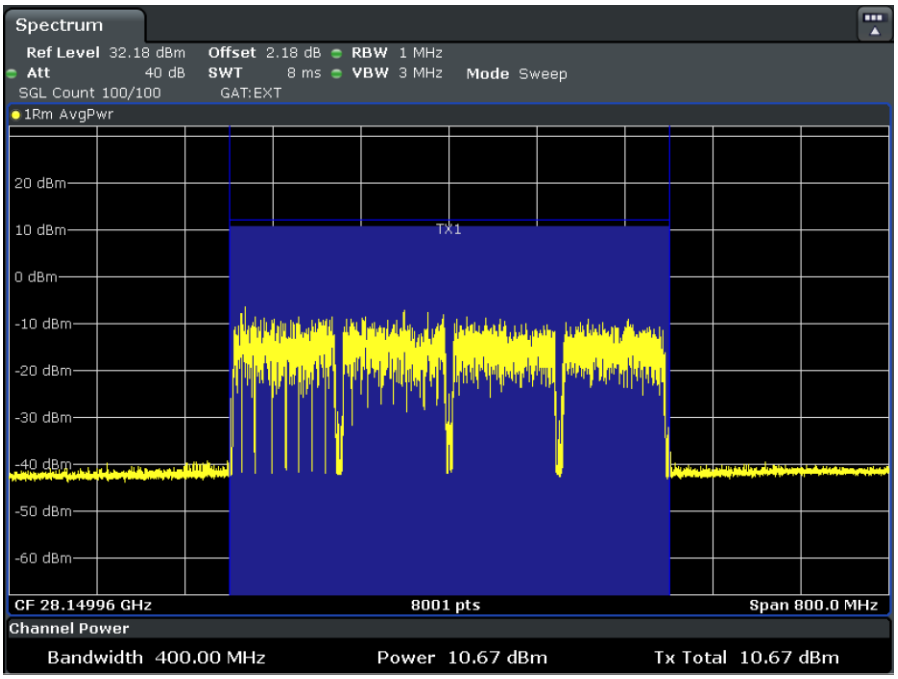
Date: 10.MAR.2022 11:48:06

Plot 7-63. Conducted Power Plot – ODU – H-UL Polarization (100MHz-4CC − QPSK – Mid Ch. – Full RB)



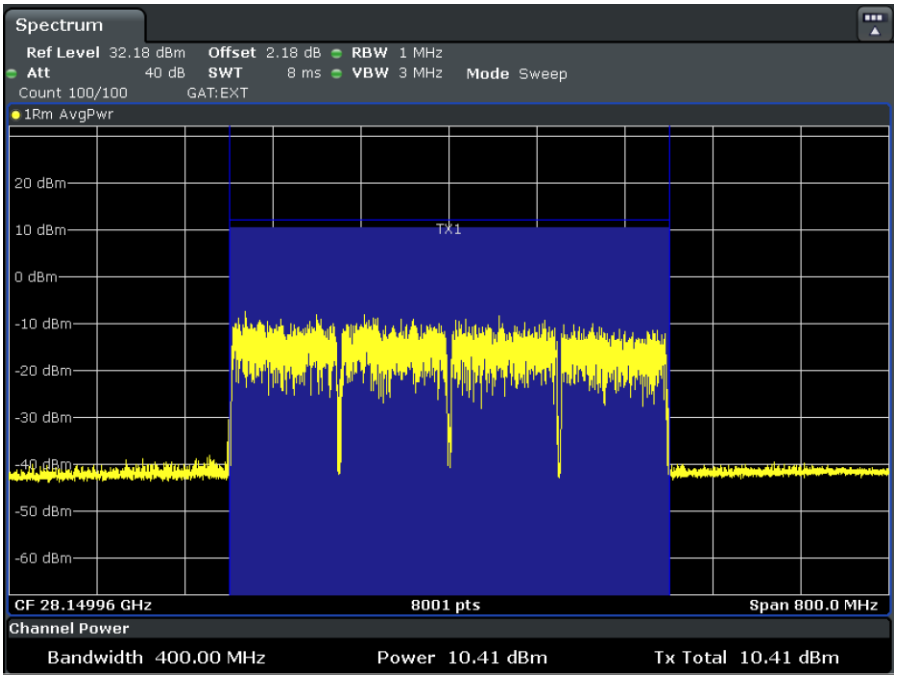
Date: 10.MAR.2022 11:54:16

Plot 7-64. Conducted Power Plot – ODU – H-UL Polarization (100MHz-4CC − QPSK – Mid Ch. – 1RB)



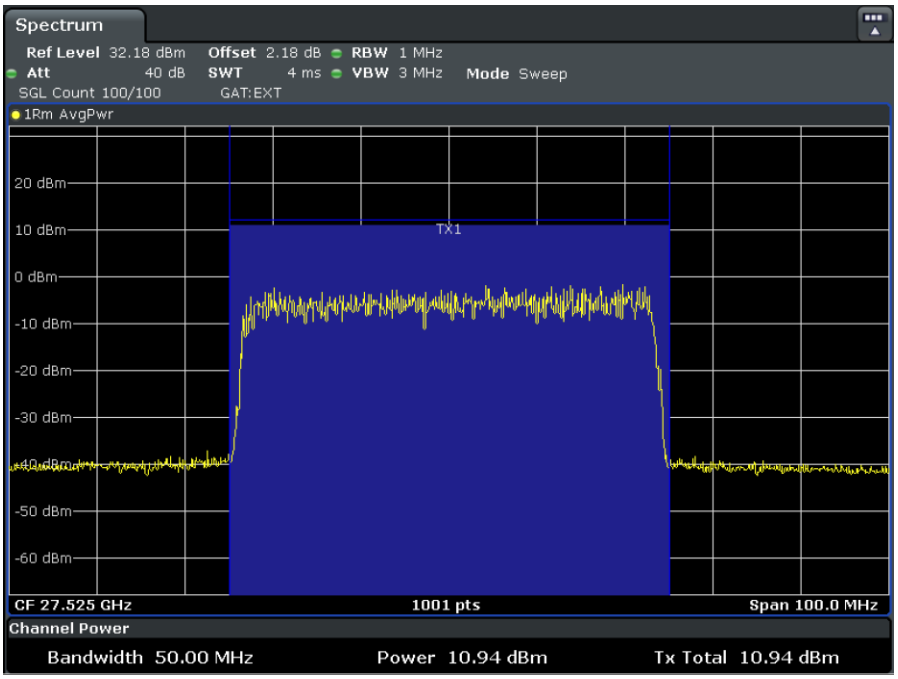
Date: 10.MAR.2022 11:51:42

Plot 7-65. Conducted Power Plot – ODU – H-UL Polarization (100MHz-4CC − QPSK – High Ch. – Full RB)



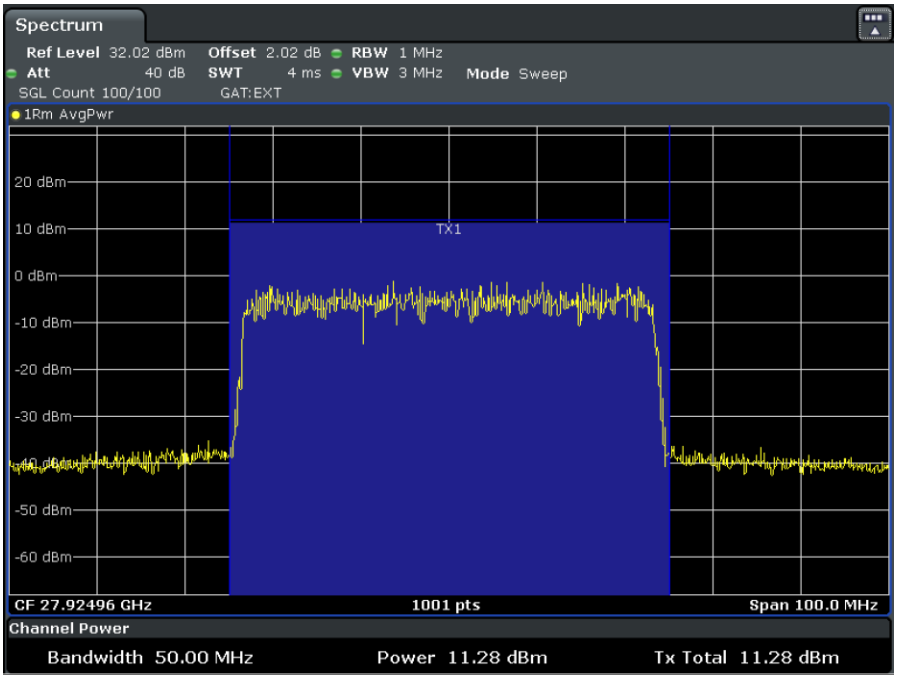
Date: 8.APR.2022 21:23:10

Plot 7-66. Conducted Power Plot – ODU – H-UL Polarization (100MHz-4CC – 16QAM – High Ch. – Full RB)



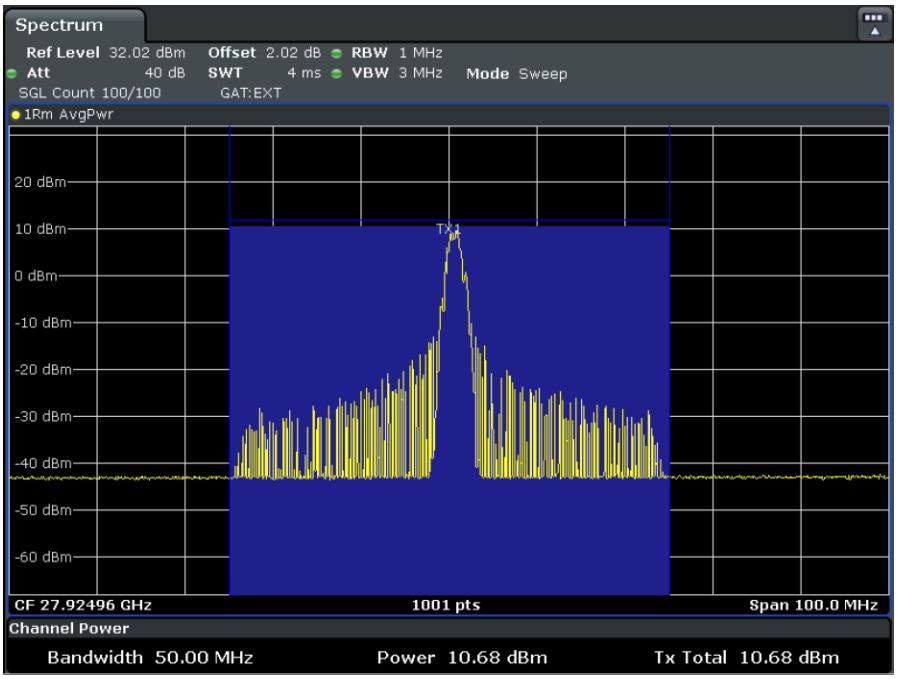
Date: 9.MAR.2022 23:00:07

Plot 7-67. Conducted Power Plot – ODU – V-UL Polarization (50MHz-1CC − QPSK – Low Ch. – Full RB)



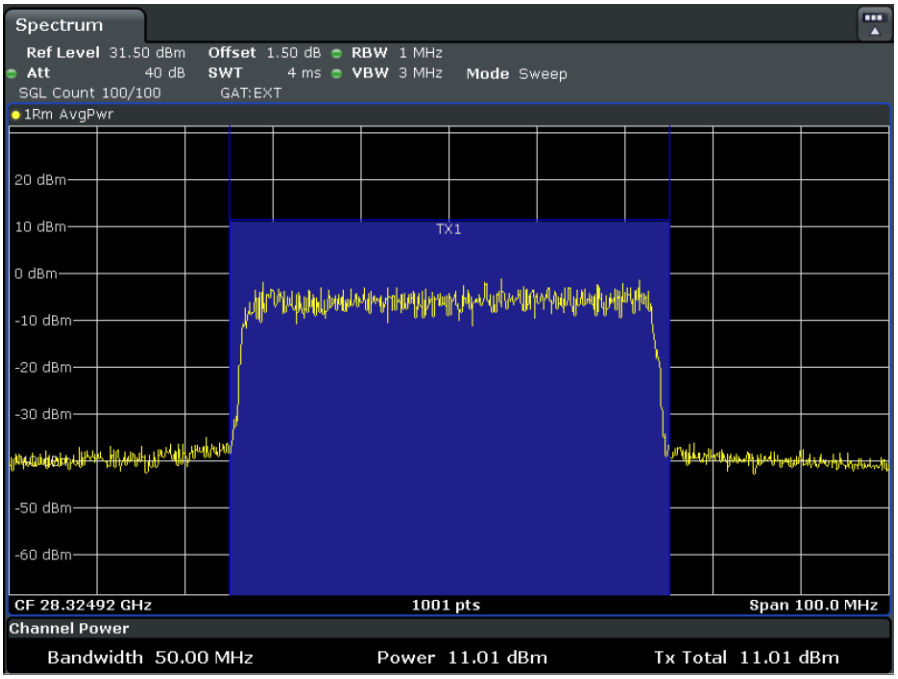
Date: 9.MAR.2022 22:27:08

Plot 7-68. Conducted Power Plot – ODU – V-UL Polarization (50MHz-1CC − QPSK – Mid Ch. – Full RB)



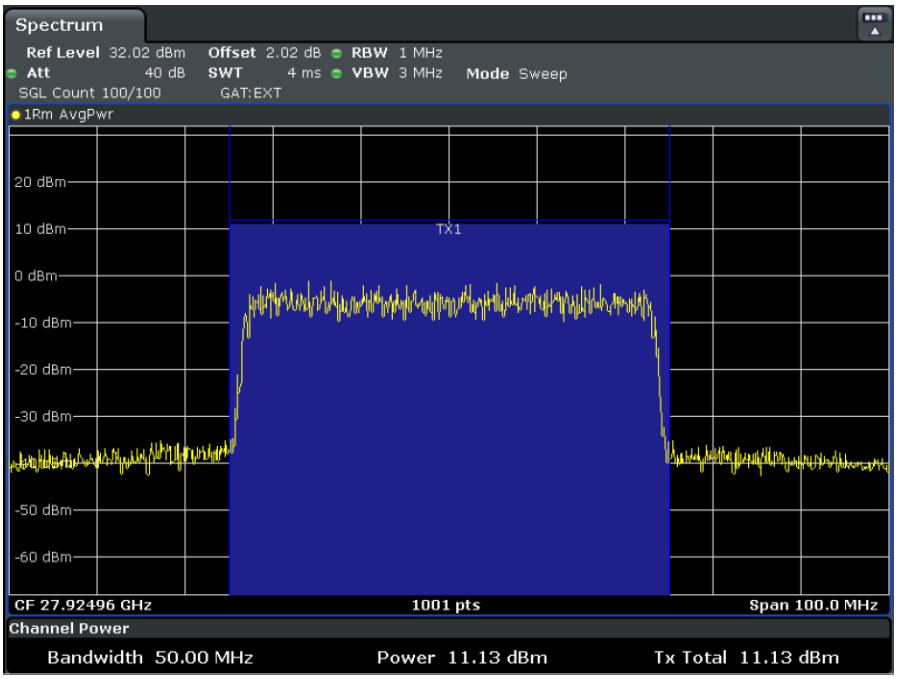
Date: 9.MAR.2022 22:57:17

Plot 7-69. Conducted Power Plot – ODU – V-UL Polarization (50MHz-1CC − QPSK – Mid Ch. – 1RB)



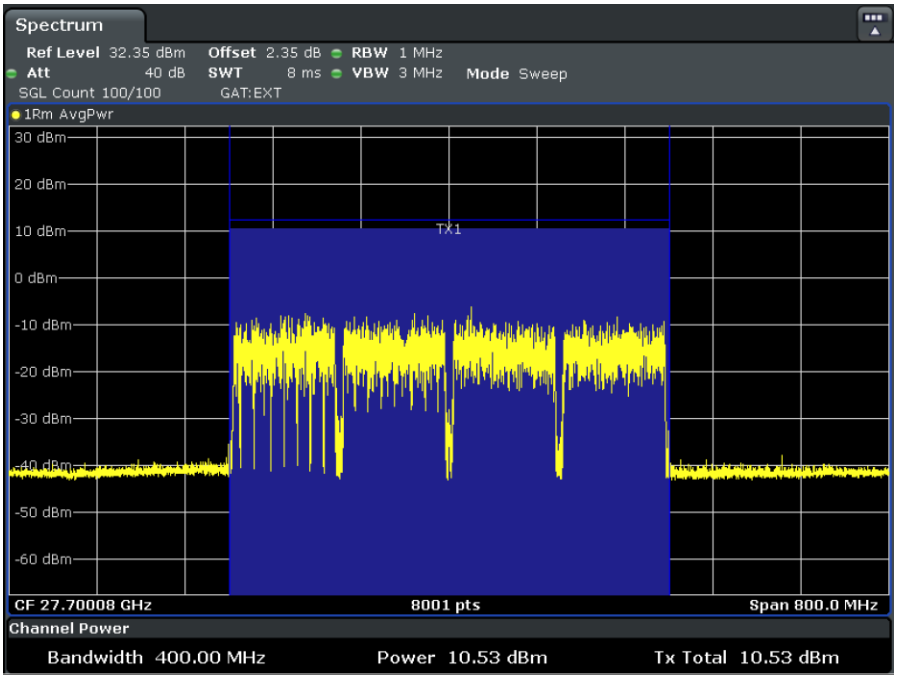
Date: 9.MAR.2022 23:01:29

Plot 7-70. Conducted Power Plot – ODU – V-UL Polarization (50MHz-1CC − QPSK – High Ch. – Full RB)



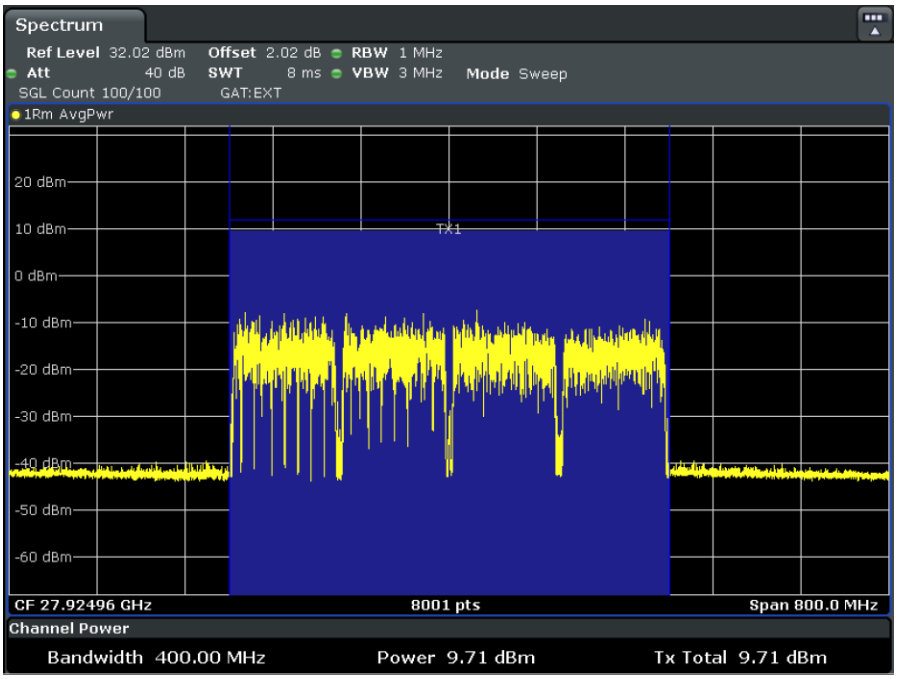
Date: 9.MAR.2022 23:03:12

Plot 7-71. Conducted Power Plot – ODU – V-UL Polarization (50MHz-1CC – 16QAM – Mid Ch. – Full RB)



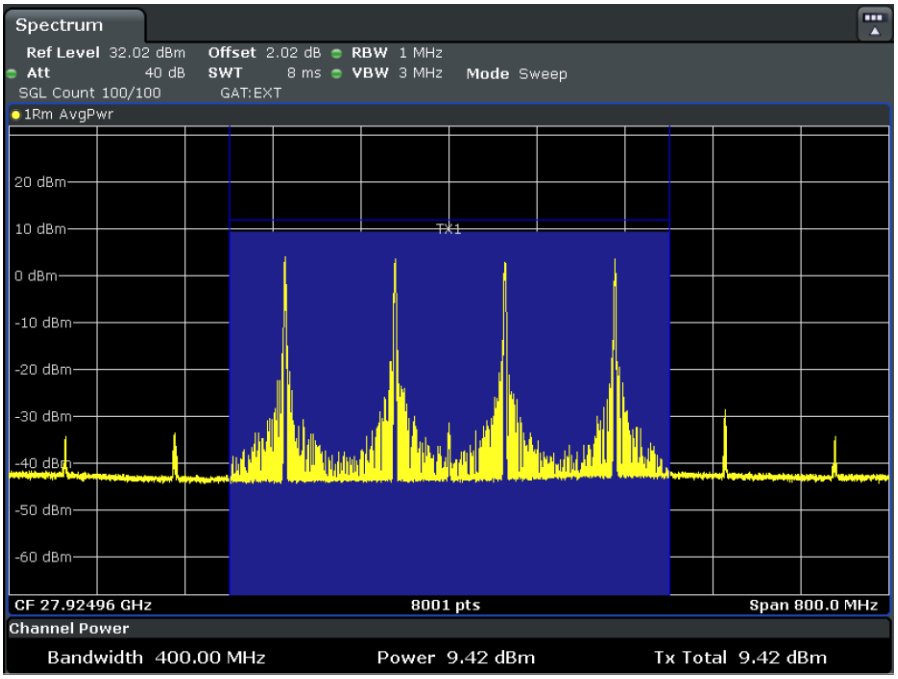
Date: 10.MAR.2022 11:31:11

Plot 7-72. Conducted Power Plot – ODU – V-UL Polarization (100MHz-4CC − QPSK – Low Ch. – Full RB)



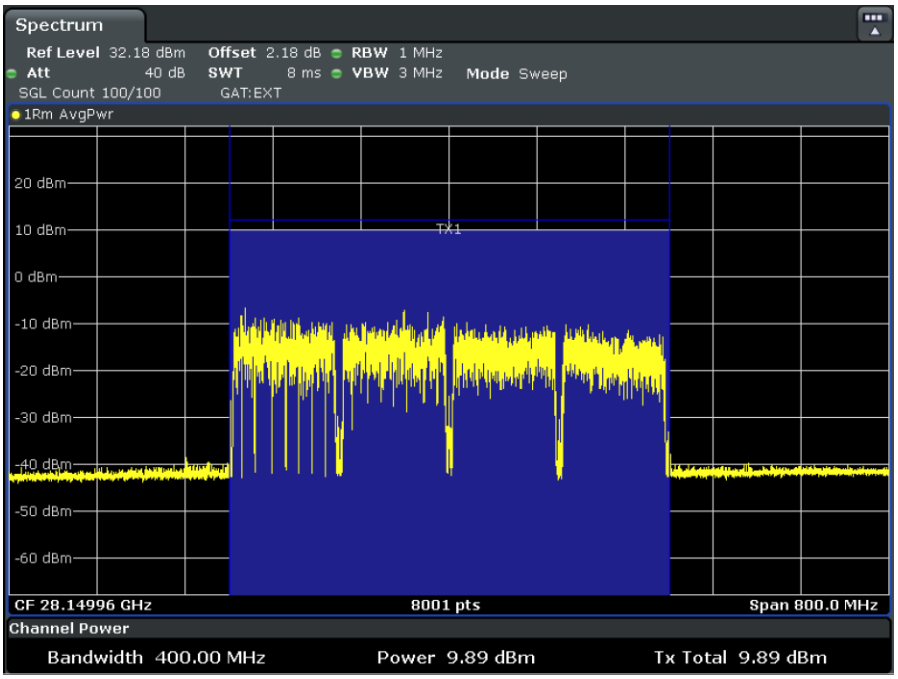
Date: 10.MAR.2022 11:27:06

Plot 7-73. Conducted Power Plot – ODU – V-UL Polarization (100MHz-4CC − QPSK – Mid Ch. – Full RB)



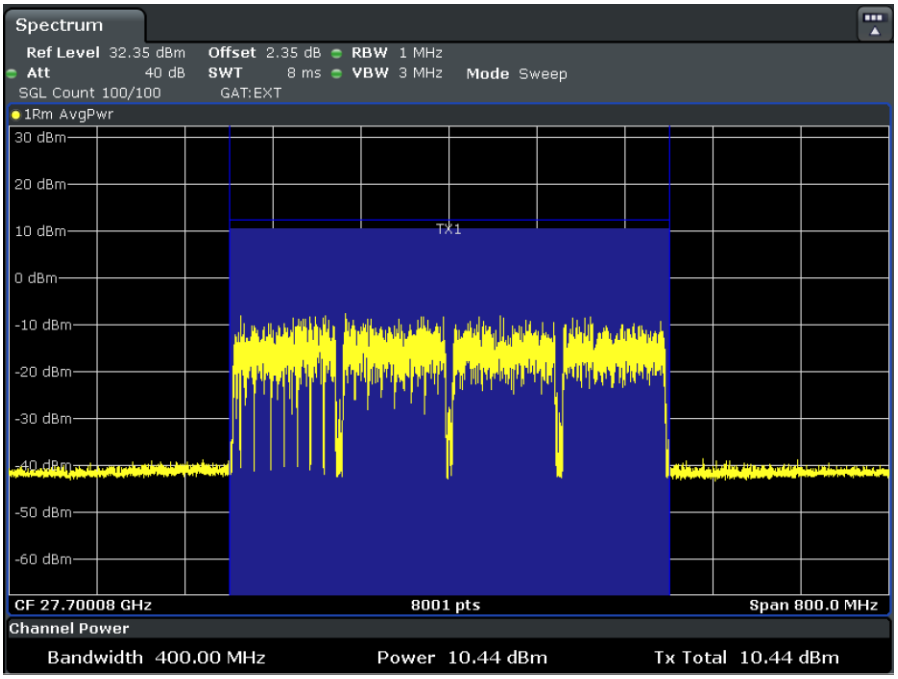
Date: 10.MAR.2022 11:28:37

Plot 7-74. Conducted Power Plot – ODU – V-UL Polarization (100MHz-4CC − QPSK – Mid Ch. – 1RB)



Date: 10.MAR.2022 11:33:07

Plot 7-75. Conducted Power Plot – ODU – V-UL Polarization (100MHz-4CC − QPSK – High Ch. – Full RB)



Date: 10.MAR.2022 11:34:49

Plot 7-76. Conducted Power Plot – ODU – V-UL Polarization (100MHz-4CC – 16QAM – Low Ch. – Full RB)

7.7 Radiated Spurious and Harmonic Emissions

Test Overview

Radiated spurious emissions measurements are performed using the field strength conversion method described in ANSI C63.26-2015 with the EUT transmitting into an integral antenna. Measurements on signals operating below 1GHz are performed using hybrid (biconical/log) antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as RMS measurements while the EUT is operating at maximum power, and at the appropriate frequencies.

The conductive power or total radiated power of any emissions outside a licensee's frequency block shall be -13dBm/1MHz.

Test Procedure Used

ANSI C63.26-2015 – Section 5.5.4
KDB 842590 D01 – Section 4.4.3

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 100 GHz . Several plots are used to show investigations in this entire span.
2. Trace / Detector =
    a. Average / RMS – for all emissions
    b. MaxHold / Peak – for emissions solely due to unlicensed transmitters (in addition to part a)
3. For measurements made with Trace Averaging:
    a. These measurements were averaged over at least 100 traces.
    b. For signals with continuous operation, triggering was set to "free run" and the sweep time was set to "auto". For pulsed signals, triggering was set to enable measurements only during full power bursts with the sweep time set less than or equal to the transmission burst duration.
4. Number of sweep points ≥ 2 x Span/RBW
5. The trace was allowed to stabilize
6. RBW = 1MHz, VBW = 3MHz

Test Notes

1) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst-case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below. The worst case found was 50MHz-1CC bandwidth/component carrier, QPSK Modulation, with 1RB. The EUT was tested under such signaling conditions.

2) All radiated spurious emissions were measured as EIRP to compare with the §30.203 TRP limits.

3) The plots in this section were taken with the analyzer set to max hold. All final measurements shown in the tables that accompany the plots were taken with trace averaging performed over 100 sweeps while the analyzer was triggering on a specific emission of interest.

4) The plots from 1 – 100GHz show corrected average EIRP levels. The average EIRP reported below is calculated per section 5.2.7 of ANSI C63.26-2015 which states: EIRP (dBm) = E (dBµV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m. The field strength E is calculated E (dBµV/m) = Spectrum Analyzer Level (dBm) + Antenna Factor (dB/m) + Cable Loss (dB) + Harmonic Mixer Conversion Loss (dB) + 107. All appropriate Antenna Factors and Cable Losses have been applied in the spectrum analyzer for each measurement. For measurements > 40GHz, a Harmonic Mixer Conversion Loss was also applied to the spectrum analyzer.

5) Emissions below 18GHz were measured at a 3 meter test distance, while emissions above 18GHz were measured at the appropriate far field distance. The far field of the mmWave signal is based on formula: R > 2D^2/wavelength, where D is the larger between the dimension of the measurement antenna and the transmitting antenna of the EUT. In this case, D is the largest dimension of the measurement antenna.

Frequency Range (GHz)	Wavelength(cm)	Far Field Distance (m)	Measurement Distance (m)
18-40	0.749	0.54	1.00
40-60	0.500	1.39	1.50
60-90	0.333	0.91	1.00
90-140	0.214	0.58	1.00
140-200	0.150	0.39	1.00

Table 7-20. Far-Field Distance & Measurement Distance per Frequency Range

6) All emissions from 30MHz - 40GHz were measured using a spectrum analyzer with an internal preamplifier. Emissions >40GHz were measured using a harmonic mixer with the spectrum analyzer.

7) To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and Bluetooth module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. Therefore, the EUT is simultaneously transmitting: the 5G NR Band n261 mmWave signal, Bluetooth LE at 2440MHz, and an LTE Cat M1 Band 13 signal.

8) The spectrum scan plots in this section are used for the purpose of signal identification. Each emission is subject to a unique limit based on the rule under which the transmitter operates. For instances where an emission is the product of co-located transmitters (i.e. an intermodulation product), the limit on that emission is the least strict between the rule parts under which each transmitter operates.

9) The limit lines on the spectrum scan plots in this section are displayed in regards to the part 30 limits for n261 mmWave spurious emissions. The limits for spurious emissions solely due to the other transmitters are not displayed on the plots. Instead, the applicable limits are displayed in the accompanying tables.

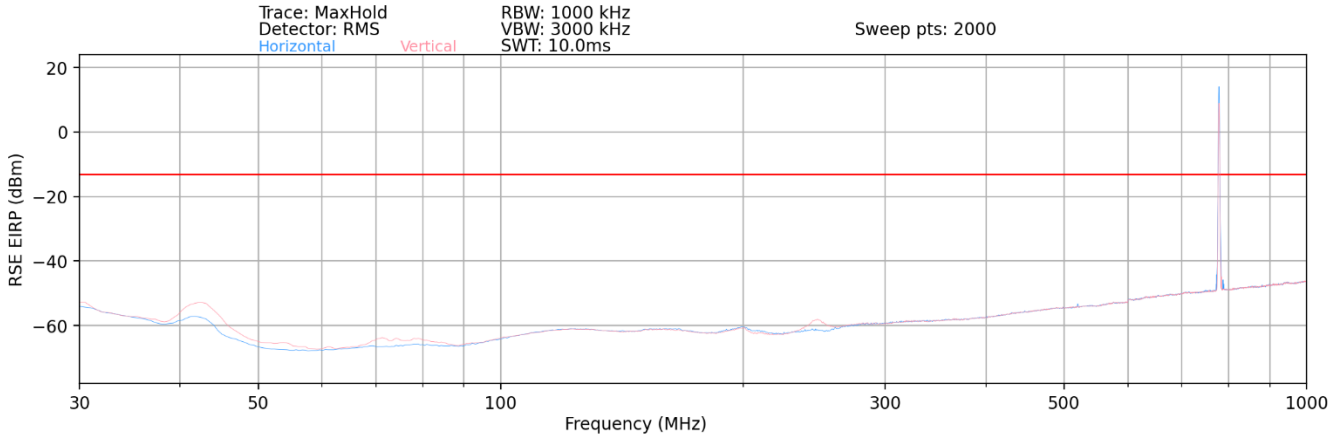
10) The fundamental emissions from multiple co-located transmitters may appear on spectrum scan plots. These are not investigated as spurious emissions.

11) None of the observed spurious emissions were due the unlicensed transmitter. That is, the Bluetooth module (FCC ID: Z64-WL18SBMOD) yielded no measurable harmonics nor any measurable intermodulation products. Therefore, all final Spurious Emission Levels presentend in the tables of the section were measured with an RMS detector and trace averaging.

12) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

Band n261 – IDU

30MHz - 1GHz



Plot 7-77. n261 Radiated Spurious Plot (1CC QPSK Mid Channel) - IDU

Spurious Emissions ERP Sample Calculation (n261)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE ERP level is calculated by applying the additional factors shown below for a test distance of 3 meter.

RSE ERP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8 – 2.15 (dB)

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Antenna Height [cm]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
73.50	Low	50	MIMO	QPSK	V	-	-	-61.28	-13.00	-48.28
77.47	Mid	50	MIMO	QPSK	V	-	-	-61.26	-13.00	-48.26
200.25	High	50	MIMO	QPSK	V	-	-	-58.30	-13.00	-45.30

Table 7-21. n261 Radiated Spurious Emissions Table (30MHz - 1GHz) - IDU

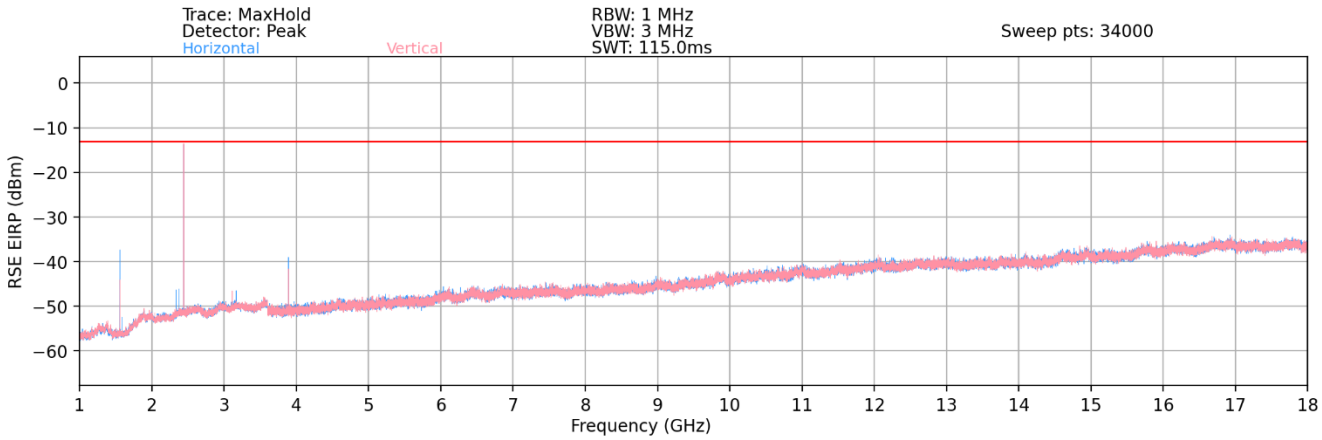
Notes

1. The RSE ERP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 3 meters.

2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and Bluetooth module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting Bluetooth LE at 2440MHz simultaneously with the LTE Cat M1 Band 13 signal.

3. The emission at 778MHz is the fundamental signal from the LTE module and, as such, it is not investigated as a spurious emission.

1GHz - 18GHz



Plot 7-78. n261 Radiated Spurious Plot (1CC QPSK Mid Channel) - IDU

Spurious Emissions EIRP Sample Calculation (n261)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 3 meter.

RSE EIRP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Antenna Height [cm]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1556.40	Low	50	MIMO	QPSK	H	225	151	-44.90	-13.00	-31.90
1583.90	Low	50	MIMO	QPSK	H	258	142	-53.76	-40.00	-13.76
2334.60	Mid	50	MIMO	QPSK	H	237	247	-56.64	-13.00	-43.64
2376.60	Mid	50	MIMO	QPSK	H	247	258	-50.06	-13.00	-37.06
3112.60	High	50	MIMO	QPSK	H	139	275	-58.81	-13.00	-45.81
3891.20	High	50	MIMO	QPSK	H	207	398	-44.29	-13.00	-31.29

Table 7-22. n261 Radiated Spurious Emissions Table (1GHz - 18GHz) - IDU

Notes

1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 3 meters.

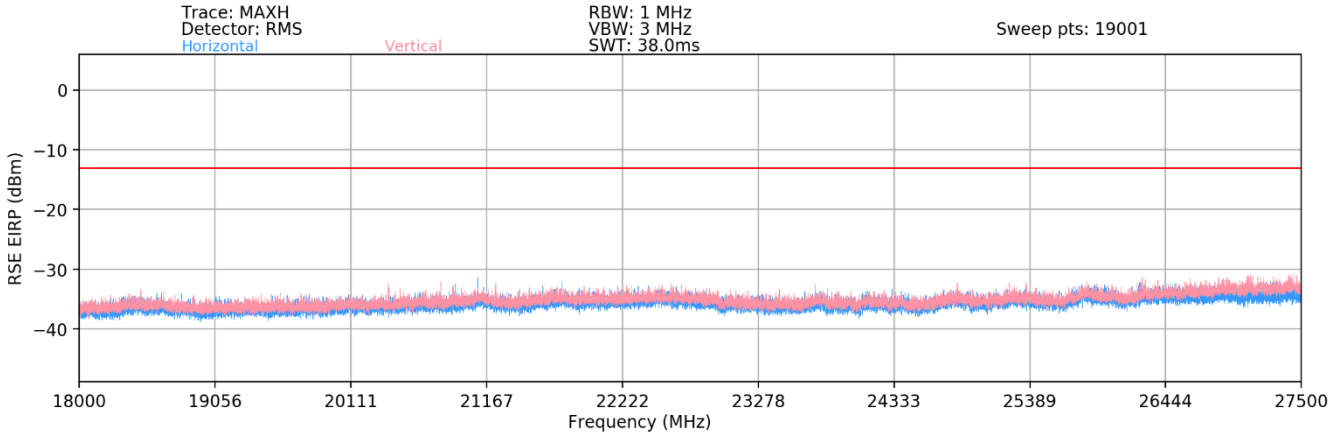
2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and Bluetooth module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting Bluetooth LE at 2440MHz simultaneously with the LTE Cat M1 Band 13 signal.

3. The emission at 2440MHz is the fundamental signal from the Bluetooth module and, as such, it is not investigated as a spurious emission.

4. The emission at 1583.90MHz is assumed to be due to the LTE Cat M1 Band 13 transmission. Therefore, it is investigated as if it is subject to the spurious emission limits indicated in FCC Part 27 Subpart C (§27.53f).

5. It was verified that none of the spurious emissions present were due to the unlicensed transmitter. Therefore, all final measurements displayed in the table above were performed with trace averaging and an RMS detector.

18GHz - 27.5GHz



Plot 7-79. n261 Radiated Spurious Plot (1CC QPSK Mid Channel) – IDU

Spurious Emissions EIRP Sample Calculation (n261)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

RSE EIRP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Positioner Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
19622.56	Low	50	MIMO	QPSK	V	-	-	-42.76	-13.00	-29.76
23329.59	Mid	50	MIMO	QPSK	V	-	-	-41.55	-13.00	-28.55
26419.37	High	50	MIMO	QPSK	V	-	-	-40.46	-13.00	-27.46

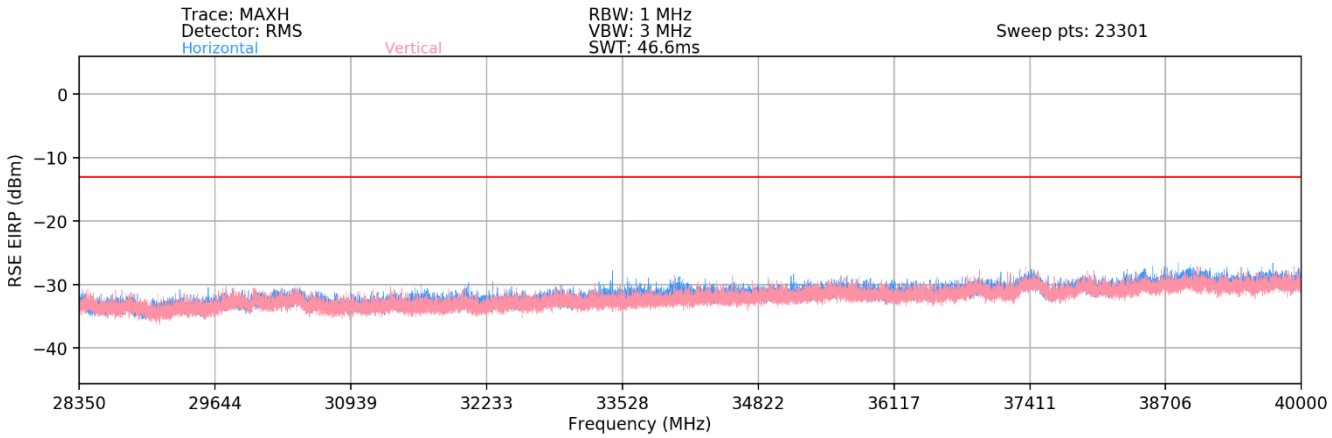
Table 7-23. n261 Radiated Spurious Emissions Table (18GHz - 27.5GHz) - IDU

Notes

1. The RSE ERP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 1 meter.

2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and Bluetooth module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting Bluetooth LE at 2440MHz simultaneously with the LTE Cat M1 Band 13 signal.

28.35GHz - 40GHz



Plot 7-80 n261 Radiated Spurious Plot (1CC QPSK Mid Channel) - IDU

Spurious Emissions EIRP Sample Calculation (n261)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

RSE EIRP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Positioner Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
30491.73	Low	50	MIMO	QPSK	V	-	-	-36.73	-13.00	-23.73
34155.57	Mid	50	MIMO	QPSK	V	-	-	-36.52	-13.00	-23.52
38351.28	High	50	MIMO	QPSK	V	-	-	-34.49	-13.00	-21.49

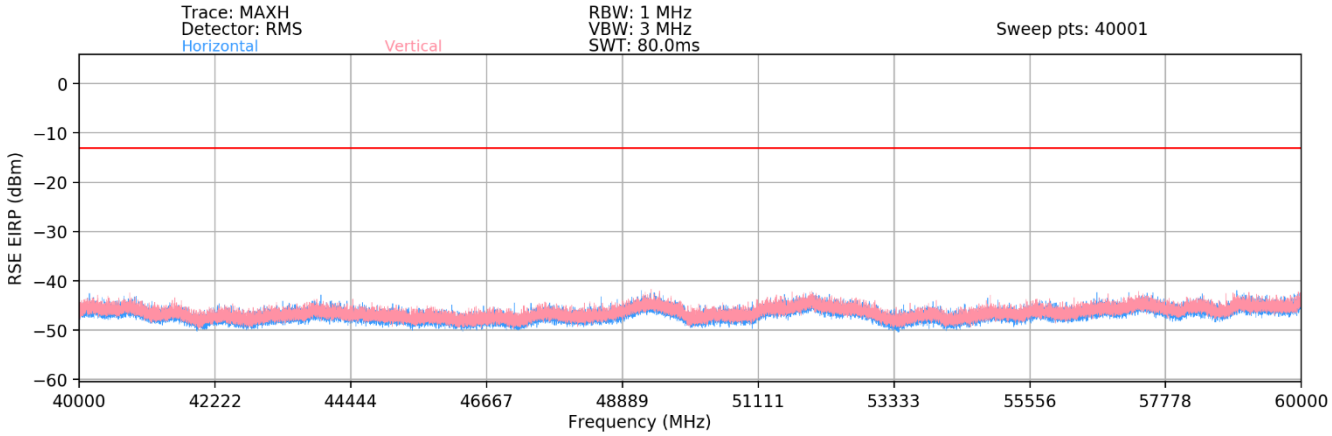
Table 7-24. n261 Radiated Spurious Emissions Table (28.35GHz - 40GHz) - IDU

Notes

1. The RSE ERP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 1 meter.

2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and Bluetooth module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting Bluetooth LE at 2440MHz simultaneously with the LTE Cat M1 Band 13 signal.

40GHz - 60GHz



Plot 7-81. n261 Radiated Spurious Plot (1CC QPSK Mid Channel) - IDU

Spurious Emissions EIRP Sample Calculation (n261)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1.5 meter.

RSE EIRP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8 + Harmonic Mixer Conversion Loss [dB]

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Positioner Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
55050.00	Low	50	MIMO	QPSK	V	-	-	-50.46	-13.00	-37.46
55849.92	Mid	50	MIMO	QPSK	V	-	-	-50.11	-13.00	-37.11
56649.84	High	50	MIMO	QPSK	V	-	-	-49.63	-13.00	-36.63

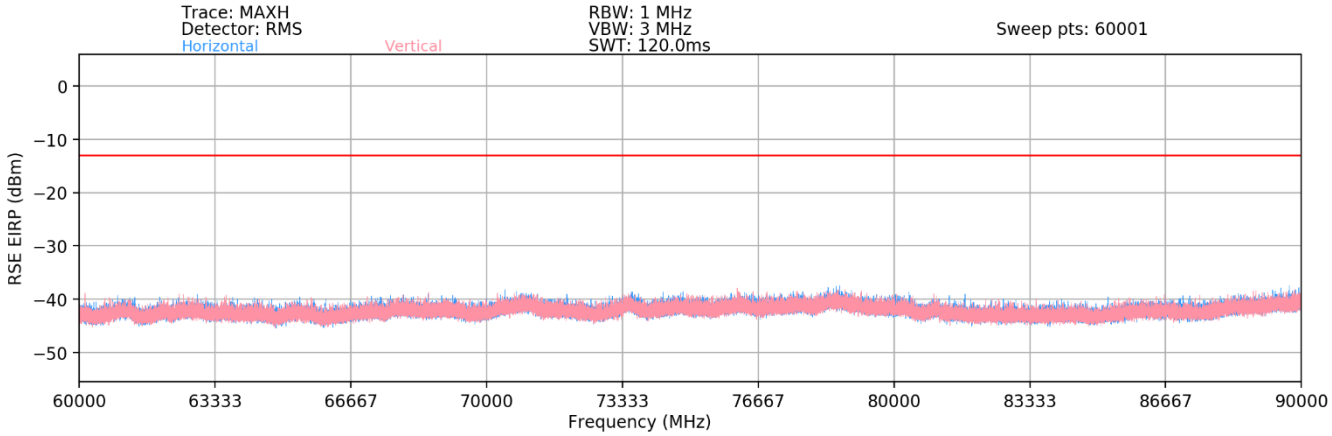
Table 7-25. n261 Radiated Spurious Emissions Table (40GHz - 60GHz) - IDU

Notes

1. The RSE ERP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 1.5 meters.

2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and Bluetooth module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting Bluetooth LE at 2440MHz simultaneously with the LTE Cat M1 Band 13 signal.

60GHz - 90GHz



Plot 7-82. n261 Radiated Spurious Plot (1CC QPSK Mid Channel) - IDU

Spurious Emissions EIRP Sample Calculation (n261)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

RSE EIRP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8 + Harmonic Mixer Conversion Loss [dB]

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Positioner Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
82575.00	Low	50	MIMO	QPSK	V	-	-	-47.24	-13.00	-34.24
83774.88	Mid	50	MIMO	QPSK	V	-	-	-47.33	-13.00	-34.33
84974.76	High	50	MIMO	QPSK	V	-	-	-47.54	-13.00	-34.54

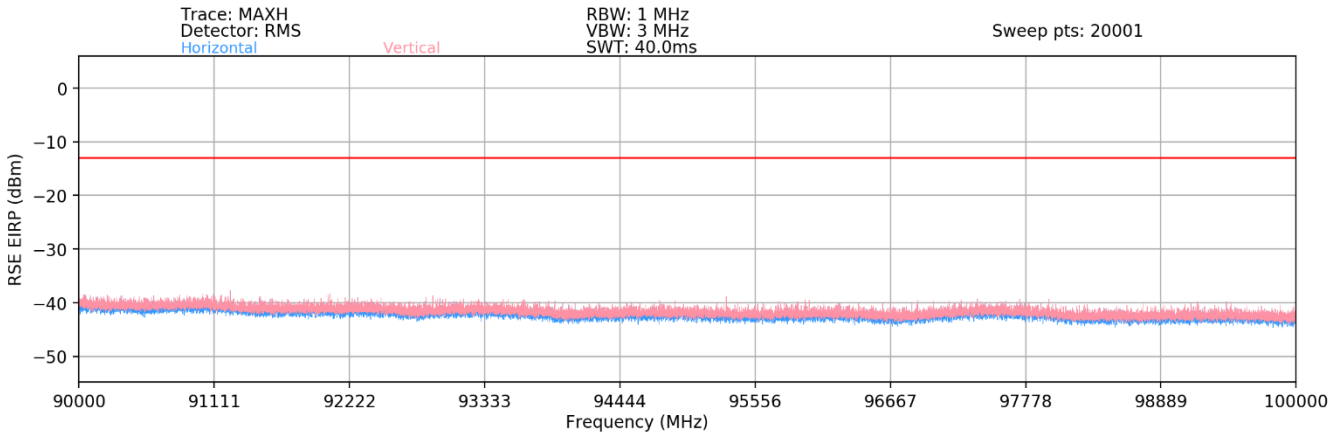
Table 7-26. n261 Radiated Spurious Emissions Table (60GHz - 90GHz) - IDU

Notes

1. The RSE ERP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 1 meter.

2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and Bluetooth module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting Bluetooth LE at 2440MHz simultaneously with the LTE Cat M1 Band 13 signal.

90GHz - 100GHz



Plot 7-83. n261 Radiated Spurious Plot (1CC QPSK Mid Channel) - IDU

Spurious Emissions EIRP Sample Calculation (n261)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

RSE EIRP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8 + Harmonic Mixer Conversion Loss [dB]

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Positioner Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
92454.45	Low	50	MIMO	QPSK	V	-	-	-46.18	-13.00	-33.18
95501.25	Mid	50	MIMO	QPSK	V	-	-	-47.13	-13.00	-34.13
98298.88	High	50	MIMO	QPSK	V	-	-	-47.48	-13.00	-34.48

Table 7-27. n261 Radiated Spurious Emissions Table (90GHz - 100GHz) - IDU

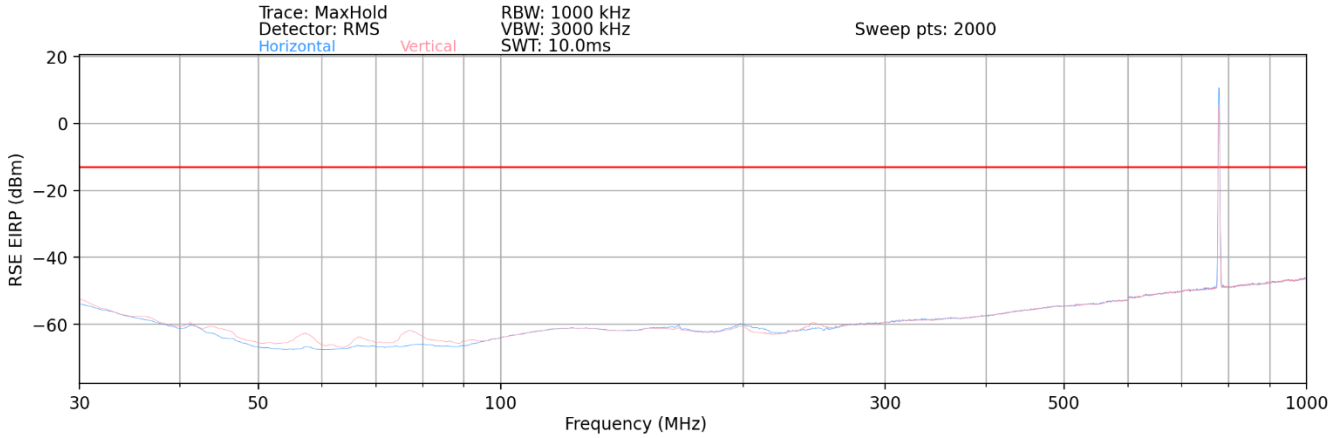
Notes

1. The RSE ERP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 1 meter.

2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and Bluetooth module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting Bluetooth LE at 2440MHz simultaneously with the LTE Cat M1 Band 13 signal.

Band n261 – ODU

30MHz - 1GHz



Plot 7-84. n261 Radiated Spurious Plot (1CC QPSK Mid Channel) - ODU

Spurious Emissions ERP Sample Calculation (n261)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE ERP level is calculated by applying the additional factors shown below for a test distance of 3 meter.

RSE ERP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8 – 2.15 (dB)

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Antenna Height [cm]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
76.70	Low	50	MIMO	QPSK	V	-	-	-60.24	-13.00	-47.24
201.63	Mid	50	MIMO	QPSK	V	-	-	-58.60	-13.00	-45.60
249.31	High	50	MIMO	QPSK	V	-	-	-58.13	-13.00	-45.13

Table 7-28. n261 Radiated Spurious Emissions Table (30MHz - 1GHz) - ODU

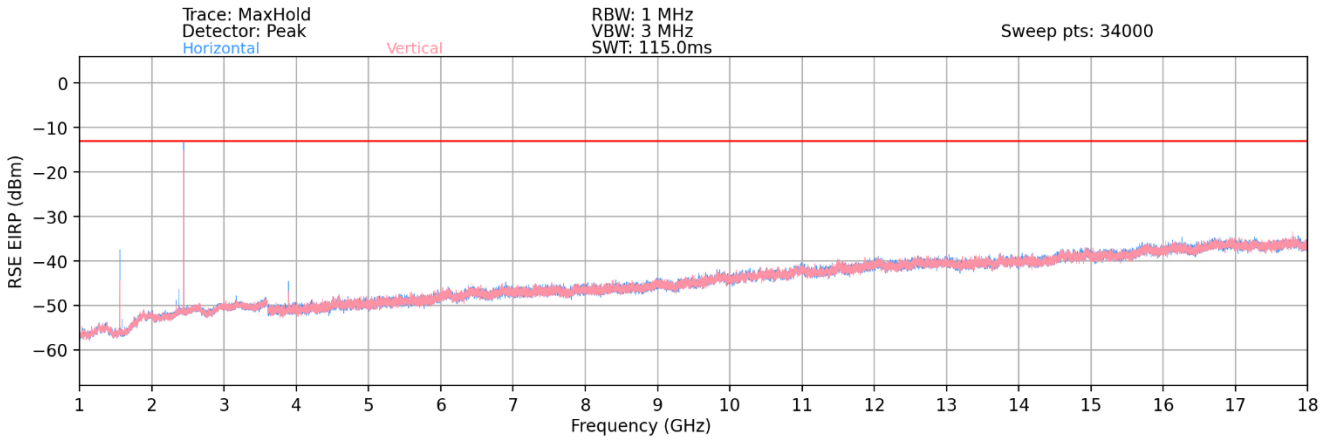
Notes

1. The RSE ERP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 3 meters.

2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and Bluetooth module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting Bluetooth LE at 2440MHz simultaneously with the LTE Cat M1 Band 13 signal.

3. The emission at 778MHz is the fundamental signal from the LTE module and, as such, it is not investigated as a spurious emission.

1GHz - 18GHz



Plot 7-85. n261 Radiated Spurious Plot (1CC QPSK Mid Channel) - ODU

Spurious Emissions EIRP Sample Calculation (n261)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 3 meter.

RSE EIRP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Antenna Height [cm]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1556.40	Low	50	MIMO	QPSK	H	4	153	-42.10	-13.00	-29.10
1583.90	Low	50	MIMO	QPSK	H	77	178	-53.55	-40.00	-13.55
2334.60	Mid	50	MIMO	QPSK	H	53	131	-59.53	-13.00	-46.53
2376.10	Mid	50	MIMO	QPSK	H	331	149	-48.53	-13.00	-35.53
3891.20	High	50	MIMO	QPSK	H	27	389	-51.73	-13.00	-38.73

Table 7-29. n261 Radiated Spurious Emissions Table (1GHz - 18GHz) - ODU

Notes

1. The RSE EIRP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 3 meters.

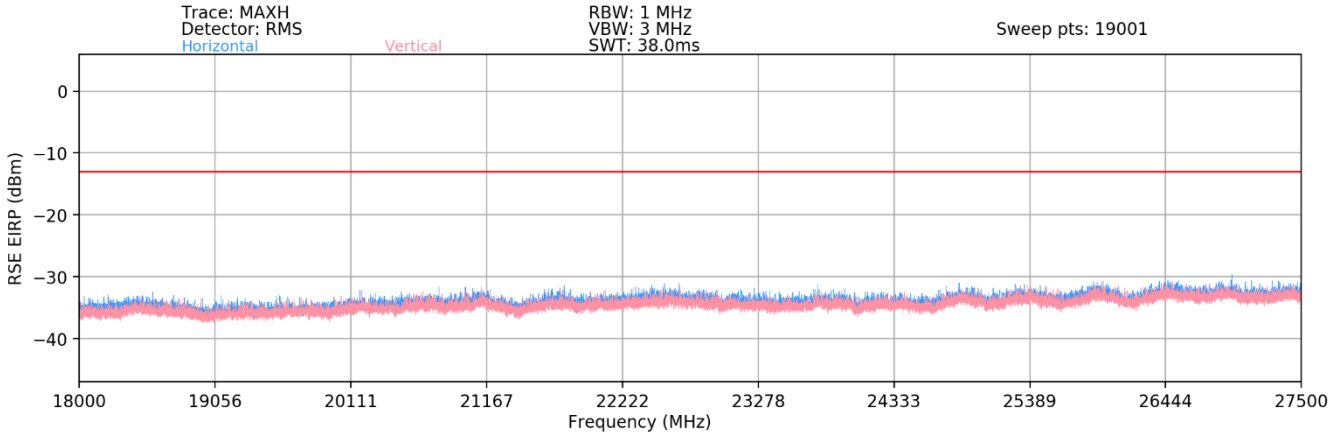
2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and Bluetooth module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting Bluetooth LE at 2440MHz simultaneously with the LTE Cat M1 Band 13 signal.

3. The emission at 2440MHz is the fundamental signal from the Bluetooth module and, as such, it is not investigated as a spurious emission.

4. The emission at 1583.90MHz is assumed to be due to the LTE Cat M1 Band 13 transmission. Therefore, it is investigated as if it is subject to the spurious emission limits indicated in FCC Part 27 Subpart C (§27.53f).

5. It was verified that none of the spurious emissions present were due to the unlicensed transmitter. Therefore, all final measurements displayed in the table above were performed with trace averaging and an RMS detector.

18GHz - 27.5GHz



Plot 7-86. n261 Radiated Spurious Plot (1CC QPSK Mid Channel) – ODU

Spurious Emissions EIRP Sample Calculation (n261)

The raw radiated spurious level is converted to field strength in dBuV/m. Then, the RSE EIRP level is calculated by applying the additional factors shown below for a test distance of 1 meter.

RSE EIRP (dBm) = Analyzer Level (dBm) + 107 + AFCL (dB/m) + 20Log(Dm) – 104.8

Frequency [MHz]	Channnel	Bandwidth (MHz)	EUT Beam Pol.	Modulation	Antenna Polarization [H/V]	Turntable Azimuth [degrees]	Positioner Azimuth [degrees]	Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
21145.23	Low	50	MIMO	QPSK	V	-	-	-40.97	-13.00	-27.97
24576.11	Mid	50	MIMO	QPSK	V	-	-	-40.40	-13.00	-27.40
27061.82	High	50	MIMO	QPSK	V	-	-	-38.46	-13.00	-25.46

Table 7-30. n261 Radiated Spurious Emissions Table (18GHz - 27.5GHz) - ODU

Notes

1. The RSE ERP level is taken directly from the spectrum analyzer which includes the appropriate antenna factors, cable losses. Measurements were performed at a distance of 1 meter.

2. To cover the simultaneous transmissions, both the LTE module (FCC ID: 2AUVU-UBR410M) and Bluetooth module (FCC ID: Z64-WL18SBMOD) are set to transmit at the same time as the mmWave functionality of the host. EUT is transmitting Bluetooth LE at 2440MHz simultaneously with the LTE Cat M1 Band 13 signal.