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TEST REPORT

FCC Test for FR-R5GAO33ASUC
Certification

APPLICANT
FRTEK CO., LTD.

REPORT NO.
HCT-RF-2011-FC016-R2

DATE OF ISSUE
November 27, 2020

Tested by
Kyung Soo Kang

Technical Manager
Jong Seok Lee

HCT CO., LTD.
Soo Chan Lee
SooChan Lee / CEO

HCT CO., LTD.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA
Tel. +82 31 634 6300 F ax. +82 31 645 6401

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CUSTOMER SECRET

HCT Co., Ltd.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA
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Additional Model
-

Applicant	**FRTEK CO., LTD.** 11-25, Simin-daero 327beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, Republic of Korea
FCC ID	2AFEG-R5GAO33ASUC
Product Name	PrimAer SU_C28
Model Name	FR-R5GAO33ASUC
Date of Test	September 07, 2020 ~ November 26, 2020
Test Standard Used	CFR 47 Part 2, Part 30

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test results were applied only to the test methods required by the standard.

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	November 13, 2020	Initial Release
1	November 18, 2020	- Revised the 'Channel Bandwidths' on section 1.2. - Revised the 'Calibration Date' on section 4. - Remove the 'Mod.: 64QAM' on page 62.
2	November 27, 2020	- Revised test results and plots on section 5.6.

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

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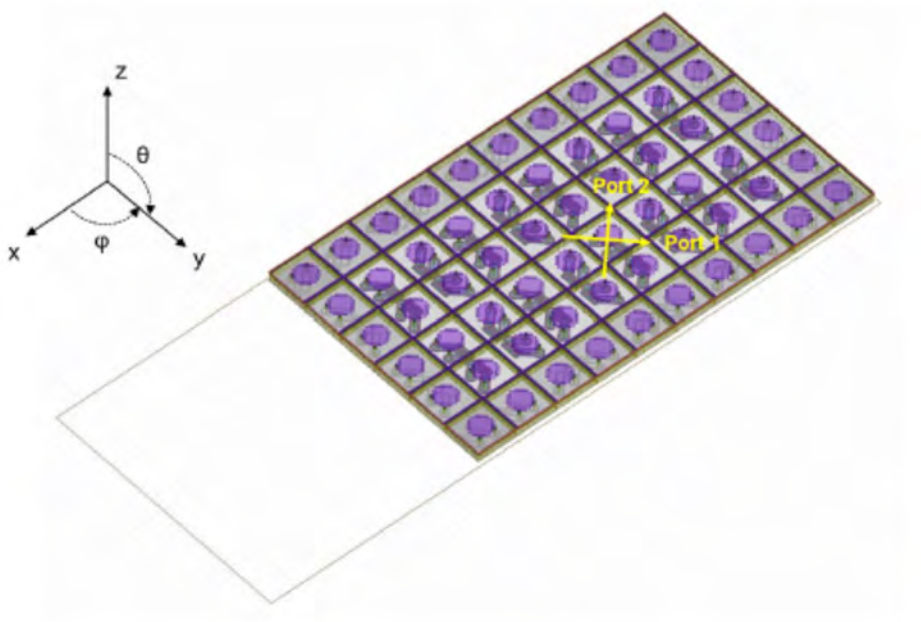
1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

Company Name	FRTEK CO., LTD.
Company Address	1001, Doosan Venture Digm, 415, Heungandaero, Dongan-Gu, Anyang-Si, Gyenggi-do, 431-755 Korea

1.2. PRODUCT INFORMATION

<table>
<tr><td>EUT Type</td><td>PrimAer SU_C28</td></tr>
<tr><td>Input Rating Power Port</td><td>-53.3 V, 1A</td></tr>
<tr><td>Power Supply</td><td>AC (100 ~ 240) V
DC -53.3 V</td></tr>
<tr><td>Frequency Range</td><td>27 500 MHz ~ 28 350 MHz</td></tr>
<tr><td>Output Power</td><td>
<table>
<tr><th rowspan="2">Mode</th><th>EIRP</th><th>Total (2 path)</th></tr>
<tr><th>(dBm)</th><th>(dBm)</th></tr>
<tr><td>1CC</td><td>38.0</td><td>41.0</td></tr>
<tr><td>8CC</td><td>38.0</td><td>41.0</td></tr>
</table>
</td></tr>
<tr><td>Max EIRP Density</td><td>
<table>
<tr><th>Mode</th><th>[W]</th></tr>
<tr><td>1CC</td><td>13.646</td></tr>
<tr><td>8CC</td><td>2.213</td></tr>
</table>
</td></tr>
<tr><td>Channel Bandwidths</td><td>1CC: 100 MHz
8CC: 800 MHz</td></tr>
</table>

<table>
<tr><td rowspan="6">Antenna Specification
(Antenna Array)</td><td colspan="2">A high-performance 32-element (8x4) integrated antenna array is included in the SOB</td></tr>
<tr><td>Maximum Gain:</td><td>18 dBi</td></tr>
<tr><td>Antenna pitch:</td><td>5.2 mm</td></tr>
<tr><td>Antenna Size:</td><td>Length: 8 x 5.2 mm = 41.6 mm
Width: 4 x 5.2 mm = 20.8 mm</td></tr>
<tr><td>Lattice:</td><td>Rectangular</td></tr>
<tr><td>Type:</td><td>Patch</td></tr>
<tr><td colspan="2"> 
</td></tr>
</table>

1.3. TEST INFORMATION

FCC Rule Parts	CFR 47 Part 2, Part 30
Measurement standards	KDB 935210 D05 v01r04, ANSI C63.26-2015, KDB 971168 D01 v03r01, KDB 662911 D01 v02r01, KDB 662911 D02 v01, KDB 842590 D01 v01r01
Place of Test	HCT CO., LTD. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4 (Version: 2014) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).

2.2. EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.
Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

3. TEST SPECIFICATIONS

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2, Part 30

Description	Reference	Results
AGC threshold	KDB 935210 D05 v01r04 3.2	Compliant
Out-of-band rejection	KDB 935210 D05 v01r04 3.3	Compliant
Occupied Bandwidth / Input-versus-output signal comparison	§ 2.1049	Compliant
EIRP Density	§ 30.202	Compliant
Equivalent Isotropic Radiated Power / Mean output power and amplifier/booster gain	§ 2.1046	Compliant
Band Edge	§ 2.1051, § 30.203	Compliant
Radiated Spurious Emissions	§ 2.1051, § 30.203	Compliant
Frequency Stability	§ 2.1055	N/A*

* The frequency stability measurement has been omitted in accordance with section 3.7 of KDB 935210 D05 v01r04.
: It can be confirmed through input-versus-output signal comparison test that EUT does not alter the input signal.

3.2. ADDITIONAL DESCRIPTIONS ABOUT TEST

- The test was generally based on the method of KDB 935210 D05 v01r04 and only followed ANSI C63.26-2015 if there was no test method in KDB standard.

- Except for the following cases, EUT was tested under normal operating conditions.
: Out-of-band rejection test requires maximum gain condition without AGC.

- All tests is performed by radiated measurement and applied below conditions.
: Used measurement distance with far field of test such as AGC threshold, Out-of-band rejection, OBW, EIRP and Band edge are as follow.

Wavelength = Speed of light / Measurement frequency = 30 / 2 835 = 0.01058

(2 X (EUT Antenna dimension)^2) / Wavelength = (2 X (0.04651)^2)/ 0.01058 = 0.41 ***m***

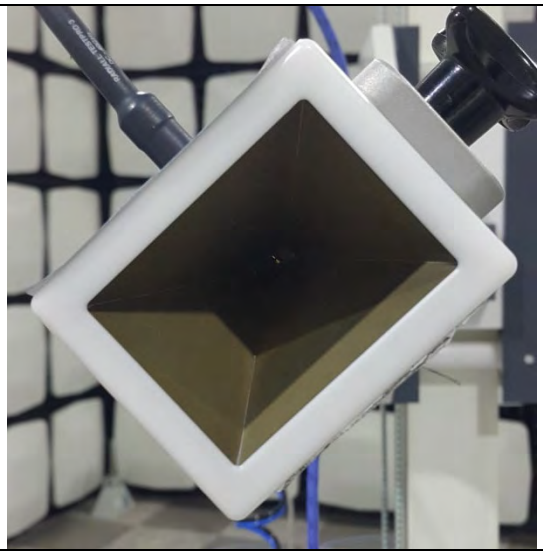
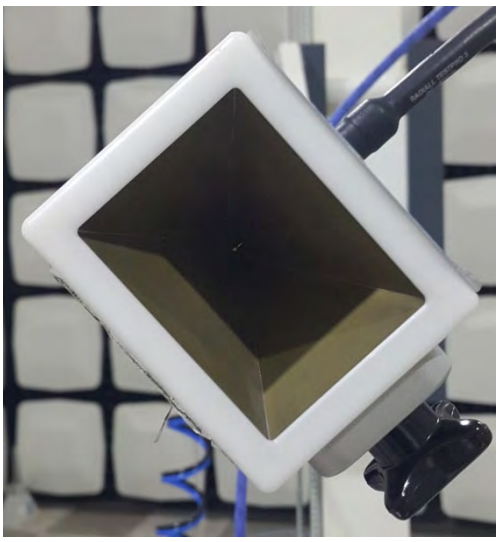
(2 X (Measurement Antenna dimension)^2) / Wavelength = (2 X (0.09605)^2)/ 0.01058 = 1.74 ***m***

In case of far-field distance for fundamental, we applied the measurement antenna dimension because the measurement antenna is bigger than the EUT antenna dimension. ***So, measurement distance is 2 m.***

: Spurious emissions measurement distance is shown in table below(Reference : Measurement Antenna Dimension).

Frequency Rage (GHz)	Wavelength (cm)	Far Field Distance (m)	Measurement Distance(m)
18 ~ 40	0.75	2.46	3.00
40 ~ 60	0.50	1.354	2.00
60 ~90	0.33	0.856	1.00
90 ~ 100	0.30	0.409	1.00

: Radiated test is performed on various angle of antenna and following location is worst test case.

135° (A)	45° (B)
	

- CC means component carriers and EUT support 1CC ~ 8CC.

- Test was performed the carrier 1 and 8 case having maximum output power and maximum PSD(It means the worst case.).

- Unwanted radiated emissions test was performed on state of all EUT antenna path is operated with a maximum output power level.

- Transmitter output signals are correlated.

- EUT was tested with following modulated signals provide by applicant.
: NR 100 MHz (1CC, 8CC)

- This EUT is supported power supply both of AC and DC. Test results are only attached worst cases.

3.3. MAXIMUM MEASUREMENTUNCERTAINTY

The value of the measurement uncertainty for the measurement of each parameter.

Coverage factor k = 2, Confidence levels of 95 %

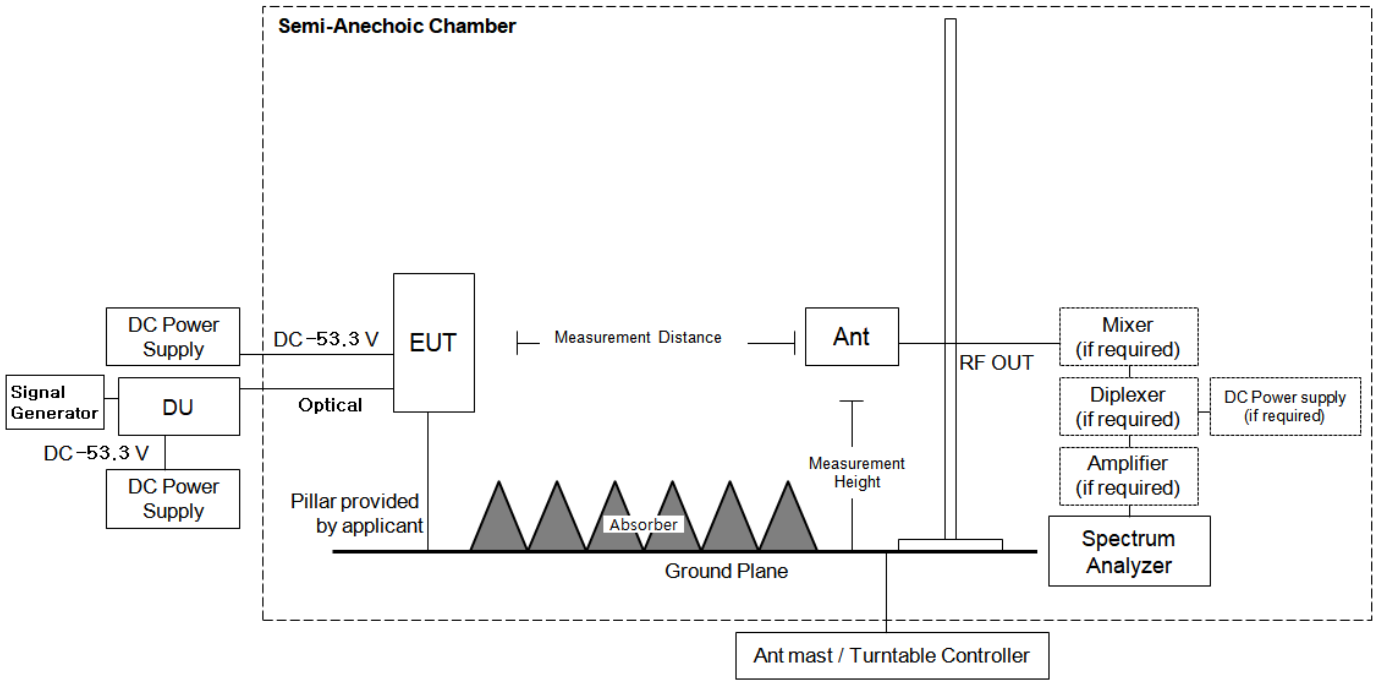
Description	Frequency	Uncertainty
AGC threshold	28 GHz	±0.87 dB
Out-of-band rejection		±0.58 MHz
Occupied Bandwidth / Input-versus-output signal comparison		± 0.31 MHz
EIRP Density		± 5.05 dB
Equivalent Isotropic Radiated Power / Mean output power and amplifier/booster gain		
Band Edge		
Radiated Spurious Emissions	9 kHz ~ 30 MHz	± 3.40 dB
	30 MHz ~ 1 GHz	± 4.80 dB
	1 GHz ~ 18 GHz	± 5.70 dB
	18 GHz ~ 40 GHz	± 5.05 dB
	40 GHz ~ 100 GHz	± 4.59 dB
Frequency Stability	28 GHz	69.61 kHz

3.4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

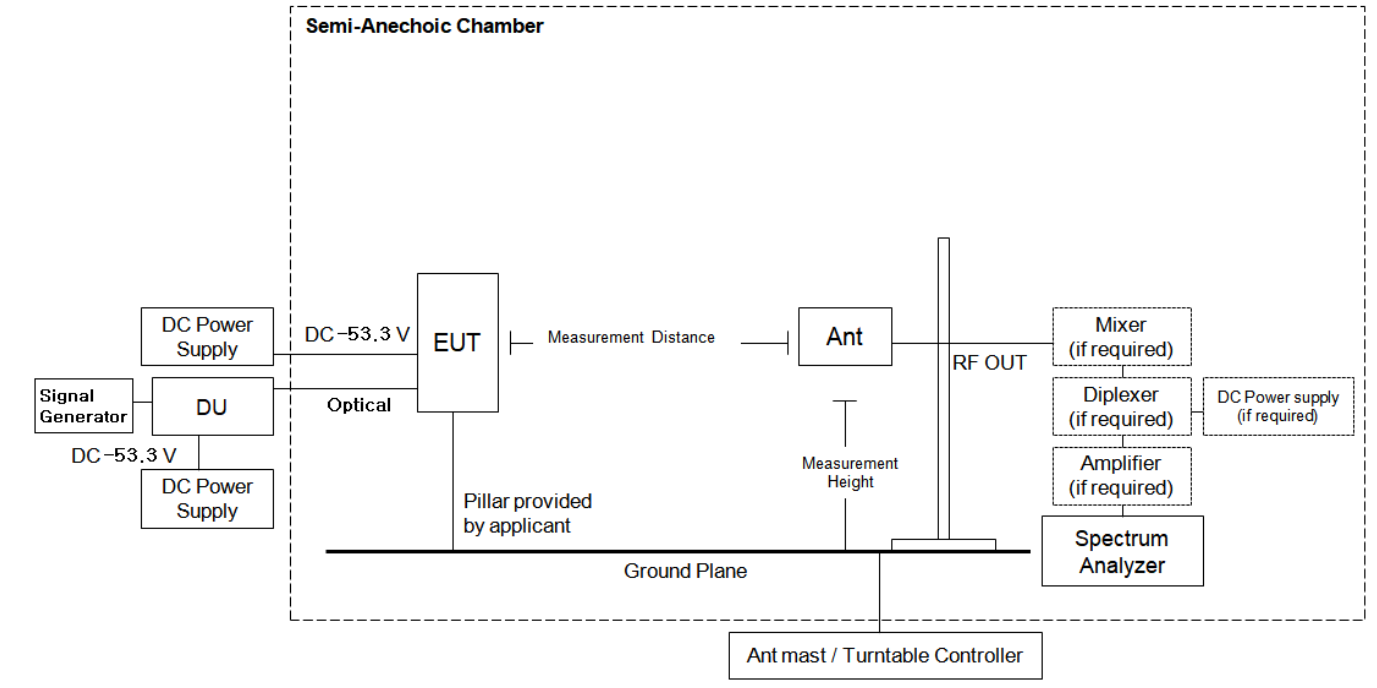
Temperature :	+15 °C to +35 °C
Relative humidity:	30 % to 60 %
Air pressure	860 mbar to 1 060 mbar

3.5. TEST DIAGRAMS

AGC / OOBR / Occupied Bandwidth / EIRP / Band Edge / Radiated Spurious Emissions in 1 GHz to 40 GHz



Radiated Spurious Emissions in other bands



4. TEST EQUIPMENTS

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Agilent	N9030A / PXA Signal Analyzer	04/09/2020	Annual	US51350313
Agilent	N9030B / PXA Signal Analyzer	06/04/2020	Annual	MY55480167
Rohde & Schwarz	SMB100A / Signal Generator	07/13/2020	Annual	177633
Rohde & Schwarz	SMW200A / Vector Signal Generator	07/07/2020	Annual	103856
KIKUSUI	PWR800L / DC Power Supply	02/19/2020	Annual	RE001149
KIKUSUI	E3632A / DC Power Supply	03/12/2020	Annual	RE001154
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
Innco system	MA4640/800-XP-EP / Antenna Position Tower	N/A	N/A	N/A
Emco	2090 / Controller	N/A	N/A	060520
Ets	Turn Table	N/A	N/A	N/A
Rohde&Schwarz	FSW / Spectrum Analyzer	09/09/2020	Annual	101256
CERNEX, Inc.	CBLU1183540B-01 / Broadband Bench Top LNA	03/12/2020	Annual	28548
Schwarzbeck	Loop Antenna	05/18/2020	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	09/04/2020	Biennial	9168-0895
Schwarzbeck	BBHA 9120D / Horn Antenna	05/19/2020	Biennial	02296
Schwarzbeck	BBHA 9170 / Horn Antenna	11/29/2019	Biennial	BBHA9170541
Schwarzbeck	BBHA 9170 / Horn Antenna	02/11/2020	Biennial	BBHA9170124
OML INC.	WR-19 Horn Antenna / Horn Antenna	04/23/2020	Biennial	M19RH-160419-2
OML INC.	WR-19 Horn Antenna / Horn Antenna	04/23/2020	Biennial	M19RH-160419-1
OML INC.	WR-12 Horn Antenna / Horn Antenna	04/23/2020	Biennial	M12RH-160419-1
OML INC.	WR-12 Horn Antenna / Horn Antenna	04/23/2020	Biennial	M12RH-160419-2
OML INC.	WR-08 Horn Antenna / Horn Antenna	04/23/2020	Biennial	M08RH-160419-2
OML INC.	WR-08 Horn Antenna / Horn Antenna	04/23/2020	Biennial	M08RH-160419-1
OML INC.	OML WR19 / Harmonic Mixer	09/09/2020	Annual	M19HWD
OML INC.	OML WR12 / Harmonic Mixer	09/09/2020	Annual	M12HWD
OML INC.	OML WR08 / Harmonic Mixer	09/09/2020	Annual	M08HWD
OML INC.	WR-19 / Source Module	09/09/2020	Annual	S19MS-A-160516-1
OML INC.	WR-12 / Source Module	09/09/2020	Annual	S12MS-A-160419-1
OML INC.	WR-08 / Source Module	09/09/2020	Annual	S08MS-A-160419-1
NANGYEUL CO., LTD.	NY-THR18750 / Temperature and Humidity Chamber	12/16/2019	Annual	NY-200912201A

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.

2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

5. TEST RESULT

5.1. AGC THRESHOLD

Test Requirement:

KDB 935210 D05 v01r04

Testing at and above the AGC threshold is required.

Test Procedures:

Measurements were in accordance with the test methods section 3.2 of KDB 935210 D05 v01r04.

In the case of fiber-optic distribution systems, the RF input port of the equipment under test (EUT) refers to the RF input of the supporting equipment RF to optical convertor; see also descriptions and diagrams for typical DAS booster systems in KDB Publication 935210 D02

Devices intended to be directly connected to an RF source (donor port) only need to be evaluated for any over-the-air transmit paths.

a) Connect a signal generator to the input of the EUT.
b) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.
c) The signal generator should initially be configured to produce either of the required test signals.
d) Set the signal generator frequency to the center frequency of the EUT operating band.
e) While monitoring the output power of the EUT, measured using the methods of ANSI C63.26-2015 subclause 5.2.4.4.1, increase the input level until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.
f) Record this level as the AGC threshold level.
g) Repeat the procedure with the remaining test signal.

Output power measurement in subclause 5.2.4.4.1 of ANSI C63.26

a) Set span to 2 × to 3 × the OBW.
b) Set RBW = 1% to 5% of the OBW.
c) Set VBW ≥ 3 × RBW.
d) Set number of measurement points in sweep ≥ 2 × span / RBW.
e) Sweep time: auto-couple
f) Detector = power averaging (rms).
g) If the EUT can be configured to transmit continuously, then set the trigger to free run.
h) Omit
i) Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over multiple symbols, it can be necessary to increase the number of traces to be averaged above 100 or, if using a manually configured sweep time, increase the sweep time.
j) Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band or channel power

measurement function, with the band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

Note:

1) Test distance is determined to 2.0 m by far field condition; see test descriptions on section 3.2.
2) The angle of antenna is set as maximum radiated power conditions.
3) EIRP is calculated from measured value according to section 5.2.7 of ANSI C63.26-2015, and the formula is as follow.

$$EIRP\ (dBm) = E\ (dB\mu V/m) + 20log(D) - 104.77$$

4) E (dBμV/m) value is considered Antenna Factor and Cable Loss (AFCL), and it as follow.

$$E\ (dB\mu V/m) = measurement\ value\ (dB\mu V) + AFCL$$

Test Results:

Path	CC	Center Frequency (GHz)	AGC Threshold Level (dBm)	Measured Level (dBuV)	Result (dBm)
A	1	27.925	-72.00	97.44	38.37
	8	27.925	-72.00	97.08	38.01
B	1	27.925	-72.00	97.38	38.31
	8	27.925	-72.00	96.14	37.07

5.2. OUT-OF-BAND REJECTION

Test Requirement:

KDB 935210 D05 v01r04

Out-of-band rejection required.

Test Procedures:

Measurements were in accordance with the test methods section 3.3 of KDB 935210 D05 v01r04.

A signal booster shall reject amplification of other signals outside of its passband. Adjust the internal gain control of the EUT (if so equipped) to the maximum gain for which equipment certification is sought.

a) Connect a signal generator to the input of the EUT.

b) Configure a swept CW signal with the following parameters:

1) Frequency range = ±250 % of the passband, for each applicable CMRS band.

2) Level = a sufficient level to affirm that the out-of-band rejection is > 20 dB above the noise floor and will not engage the AGC during the entire sweep.

3) Dwell time = approximately 10 ms.

4) Number of points = SPAN/(RBW/2).

c) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.

d) Set the span of the spectrum analyzer to the same as the frequency range of the signal generator.

e) Set the resolution bandwidth (RBW) of the spectrum analyzer to be 1 % to 5 % of the EUT passband, and the video bandwidth (VBW) shall be set to ≥ 3 × RBW.

f) Set the detector to Peak Max-Hold and wait for the spectrum analyzer's spectral display to fill.

g) Place a marker to the peak of the frequency response and record this frequency as f_0.

h) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the −20 dB down amplitude, to determine the 20 dB bandwidth.

i) Capture the frequency response of the EUT.

j) Repeat for all frequency bands applicable for use by the EUT.

Test Results:

Path A

Path B

5.3. OCCUPIED BANDWIDTH / INPUT-VERSUS-OUTPUT SIGNAL COMPARISON

Test Requirement:

§ 2.1049 Measurements required: Occupied bandwidth.

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the specified conditions of § 2.1049 (a) through (i) as applicable.

Test Procedures:

Measurements were in accordance with the test methods section 3.4 of KDB 935210 D05 v01r04.

A 26 dB bandwidth measurement shall be performed on the input signal and the output signal; alternatively, the 99% OBW can be measured and used. See KDB Publication 971168 [R8] for more information on measuring OBW.

a) Connect a signal generator to the input of the EUT.

b) Configure the signal generator to transmit the AWGN signal.

c) Configure the signal amplitude to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.

d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.

e) Set the spectrum analyzer center frequency to the center frequency of the operational band under test. The span range of the spectrum analyzer shall be between 2 times to 5 times the emission bandwidth (EBW) or alternatively, the OBW.

f) The nominal RBW shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be ≥ 3 × RBW.

g) Set the reference level of the instrument as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than [10 log (OBW / RBW)] below the reference level. Steps f) and g) may require iteration to enable adjustments within the specified tolerances.

h) The noise floor of the spectrum analyzer at the selected RBW shall be at least 36 dB below the reference level.

i) Set spectrum analyzer detection function to positive peak.

j) Set the trace mode to max hold.

k) Determine the reference value: Allow the trace to stabilize. Set the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value) and record the associated frequency as f0.

l) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the −26 dB down amplitude. The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two markers. If the spectral envelope crosses the −26 dB down amplitude at multiple points, the lowest or highest frequency shall be selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the −26 dB down amplitude point.

m) Repeat steps e) to l) with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).

n) Compare the spectral plot of the input signal (determined from step m) to the output signal (determined from step l) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and include plot(s) and descriptions in test report.

o) Repeat the procedure [steps e) to n)] with the input signal amplitude set to 3 dB above the AGC threshold.

p) Repeat steps e) to o) with the signal generator set to the narrowband signal.

q) Repeat steps e) to p) for all frequency bands authorized for use by the EUT.

Test Results:

Tabular Data of Output Occupied Bandwidth

Path	CC	Center Frequency (GHz)	99% OBW (MHz)
A	1	27.925	94.476
	8	27.925	782.74
B	1	27.925	94.432
	8	27.925	784.82

Tabular Data of Input Occupied Bandwidth

Path	CC	Center Frequency (GHz)	99% OBW (MHz)
A	1	27.925	94.268
	8	27.925	788.330
B	1	27.925	94.275
	8	27.925	788.430

Tabular Data of 3 dB above the AGC threshold Output Occupied Bandwidth

Path	CC	Center Frequency (GHz)	99% OBW (MHz)
A	1	27.925	94.178
	8	27.925	784.85
B	1	27.925	94.697
	8	27.925	784.19

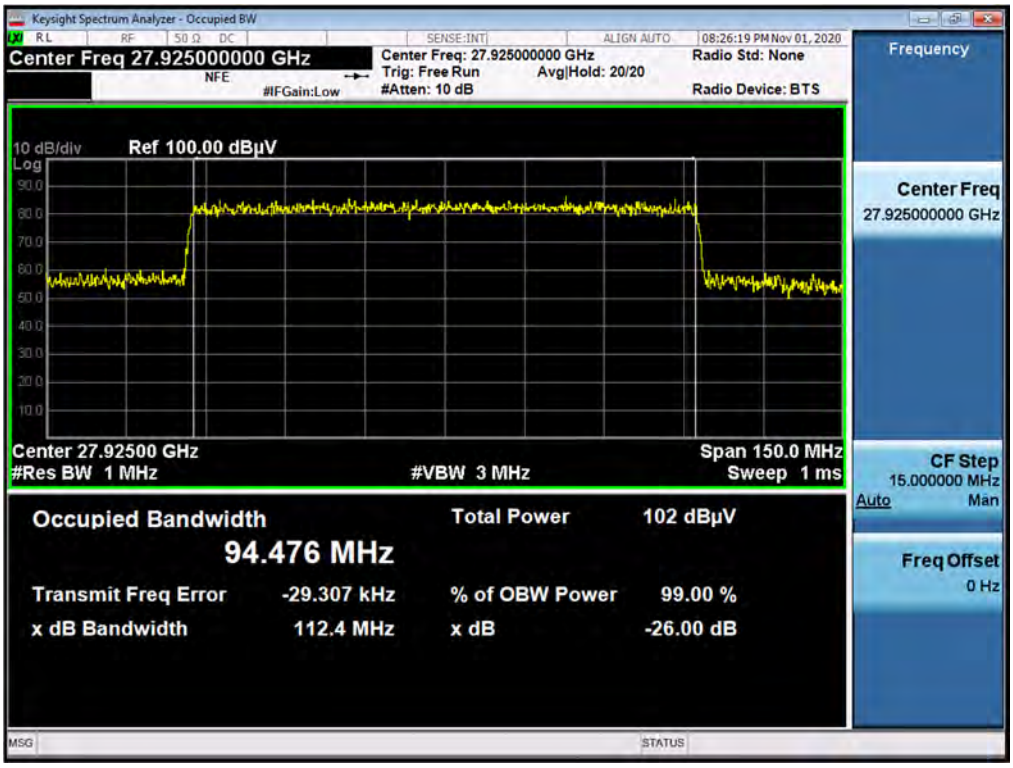
Measured Occupied Bandwidth Comparison

Path	CC	Variant of Input and output Occupied Bandwidth (%)	Variant of Input and 3 dB above the AGC threshold output Occupied Bandwidth (%)
A	1	0.221	-0.095
	8	-0.709	-0.442
B	1	0.167	0.448
	8	-0.458	-0.538

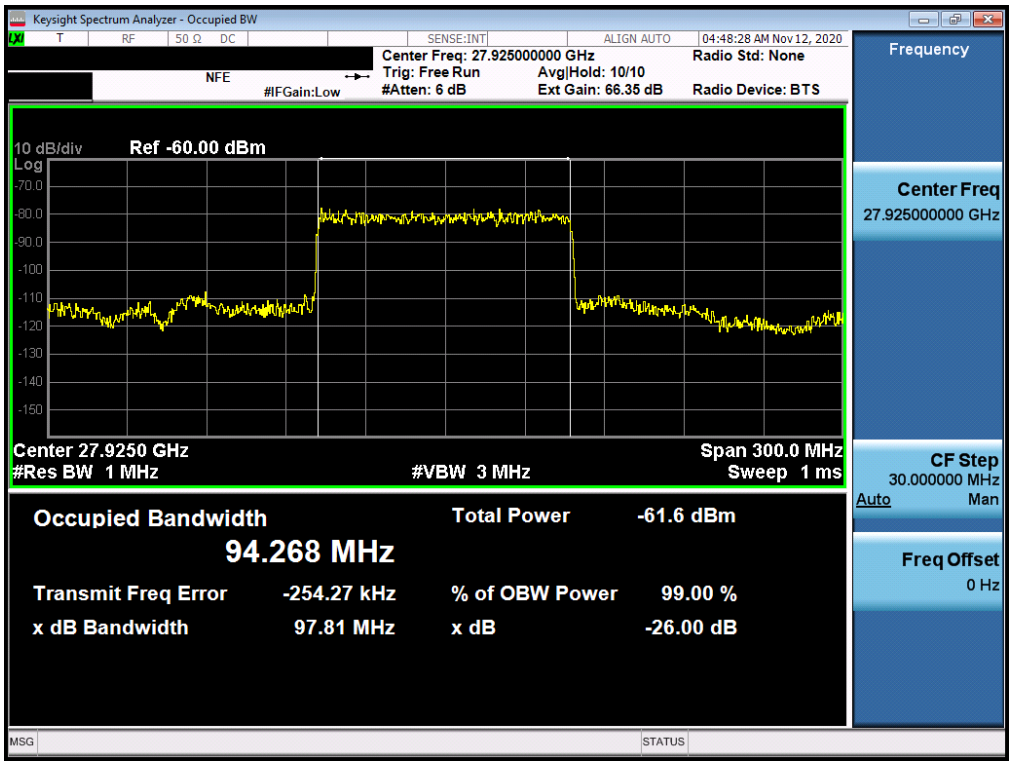
**** Change in input-output OBW is less than ±5 %.***

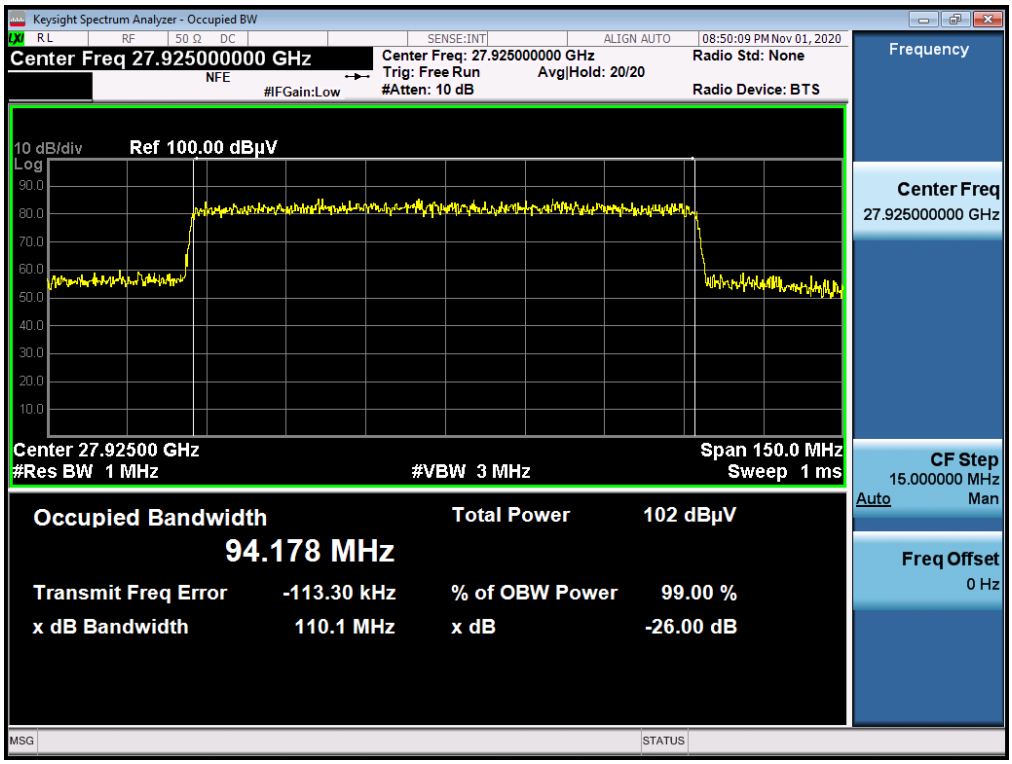
Plot Data of RF Occupied Bandwidth

Output / Path A / 1cc



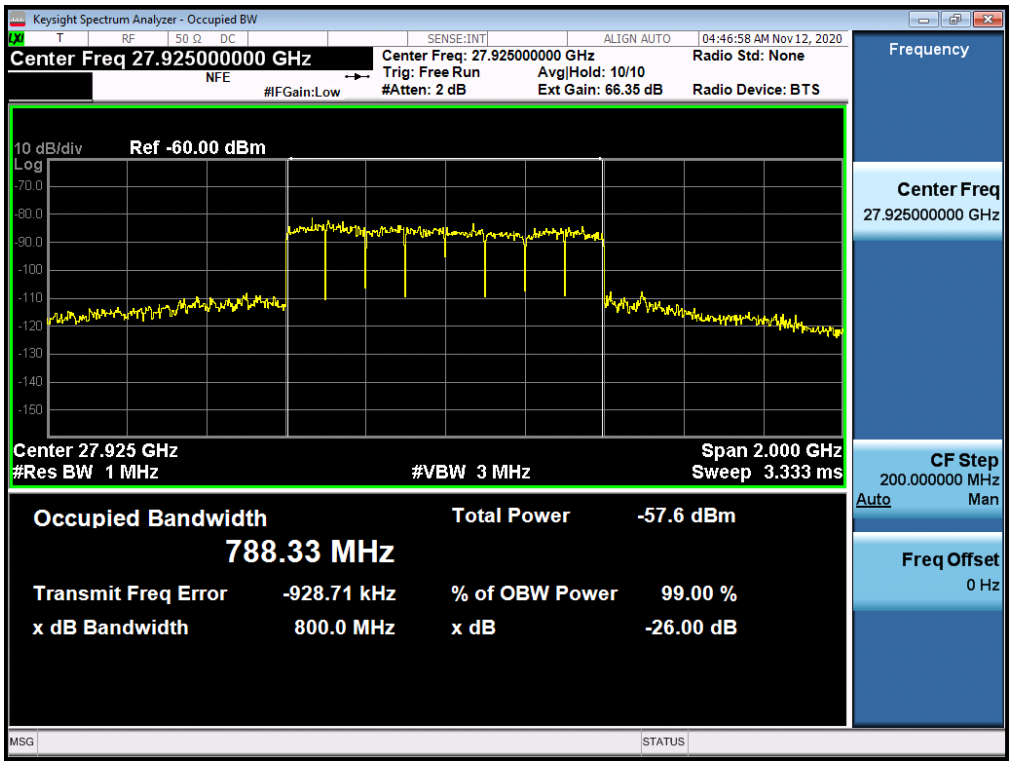
Input / Path A / 1cc



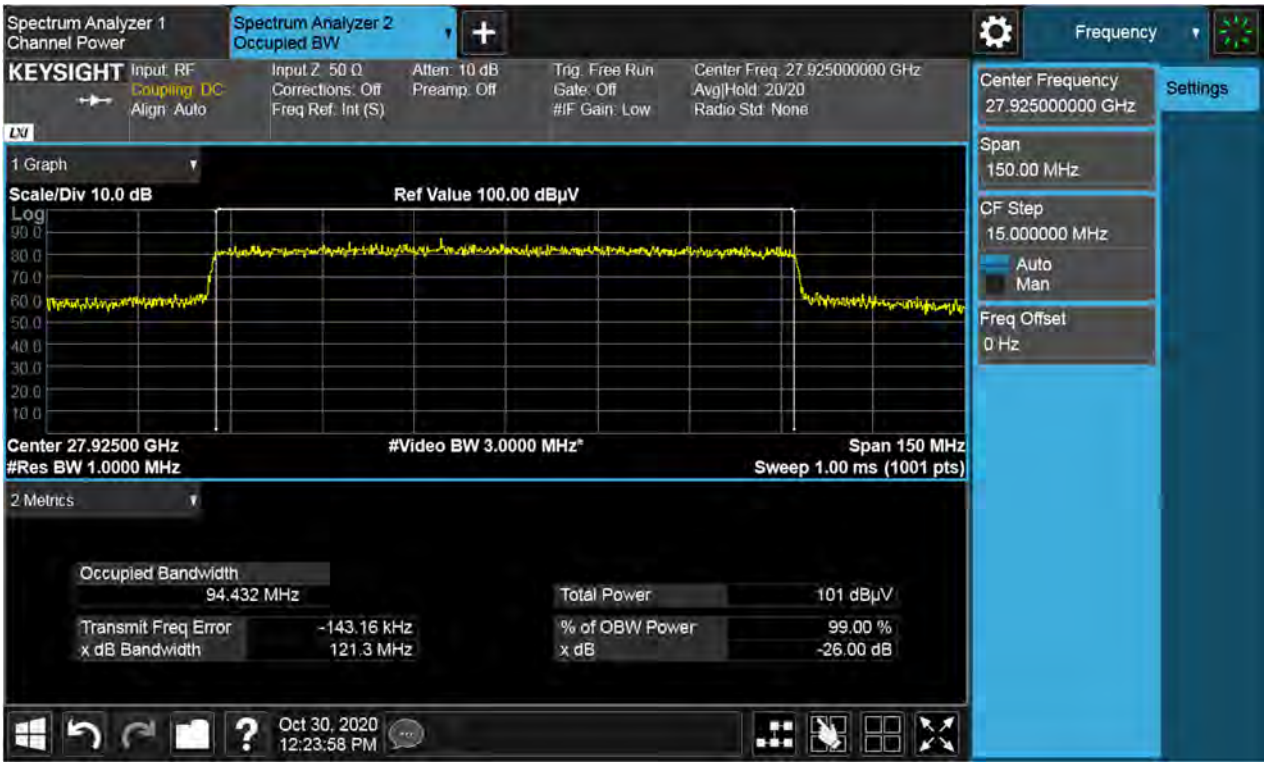
3 dB above the AGC threshold output / Path A / 1cc


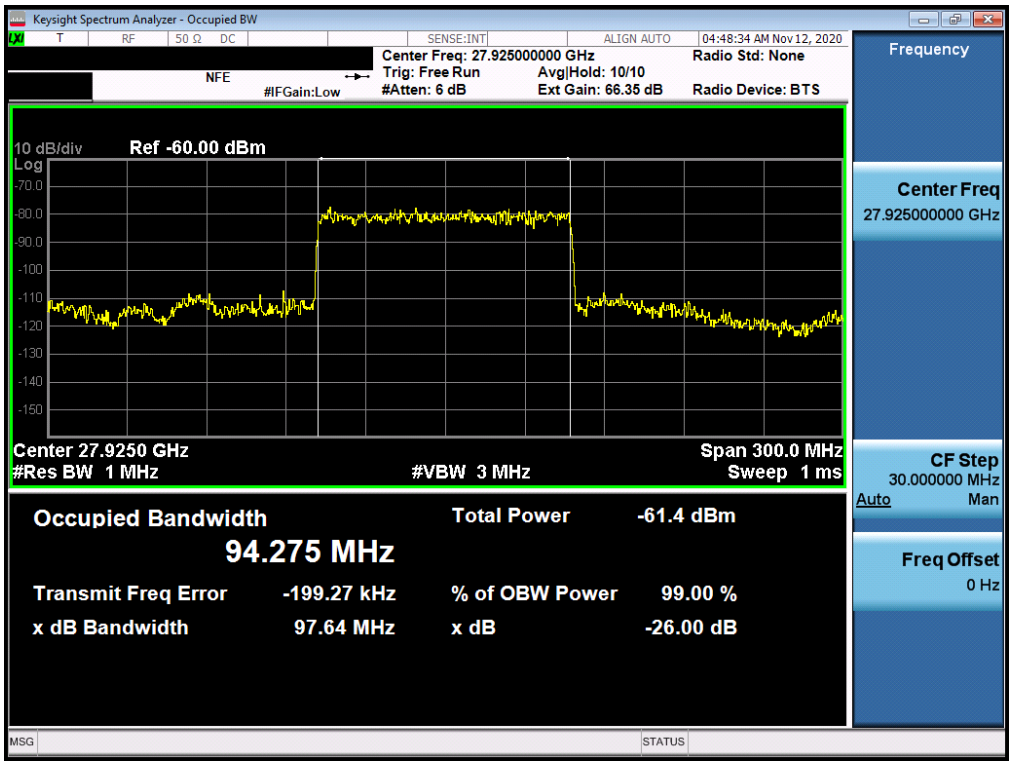
Output / Path A / 8cc

Input / Path A / 8cc



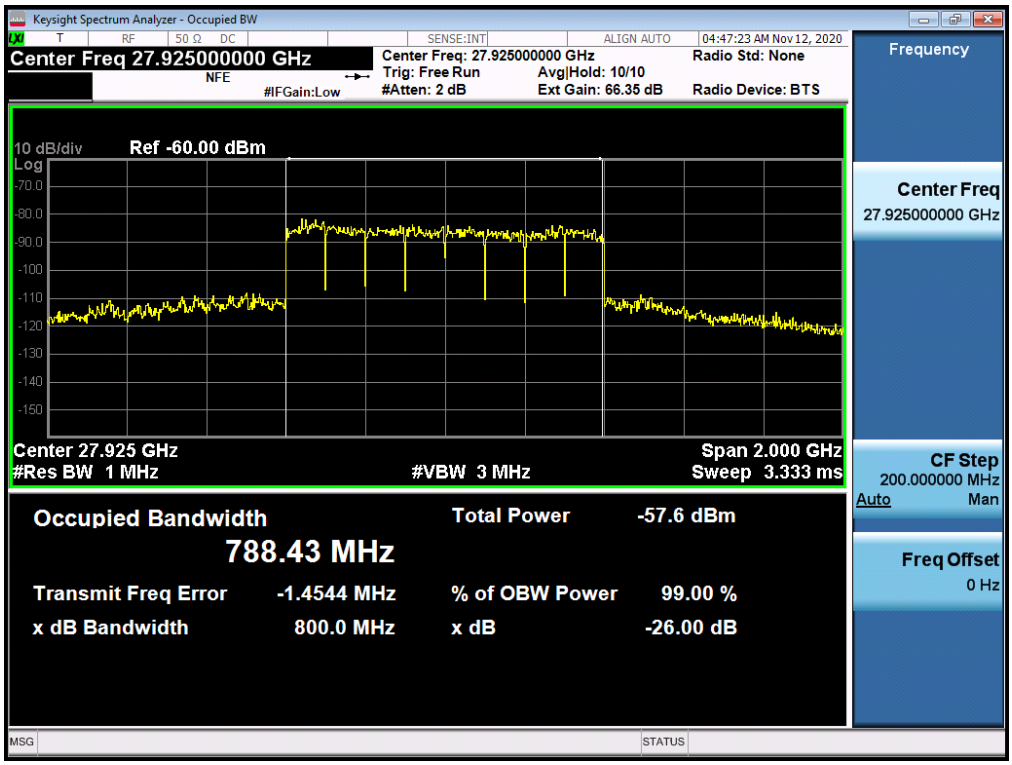
3 dB above the AGC threshold output / Path A / 8cc


Output / Path B / 1cc


Input / Path B / 1cc


3 dB above the AGC threshold output / Path B / 1cc


Output / Path B / 8cc


Input / Path B / 8cc


3 dB above the AGC threshold output / Path B / 8cc


5.4. EIRP DENSITY

Test Requirements:

§ 30.202 Power limits.

(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 isotopically radiated power (EIRP) density of +75dBm/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:

The measurement is performed in accordance with Section 5.2.4.4.2 of ANSI C63.26.

a) Set span to 2 × to 3 × the OBW.

b) Set RBW = 1% to 5% of the OBW.

c) Set VBW ≥ 3 × RBW.

d) Set number of measurement points in sweep ≥ 2 × span / RBW.

e) Sweep time:

1) Set = auto-couple, or

2) Set ≥ [10 × (number of points in sweep) × (transmission symbol period)] for single sweep (automation-compatible) measurement.

f) Detector = power averaging (rms).

g) Set sweep trigger to “free run.”

h) Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over the on and off time of the transmitter, it can be necessary to increase the number of traces to be averaged above 100, or if using a manually configured sweep time, increase the sweep time.

i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band or channel power measurement function with band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

j) Add 10 log (1/duty cycle) to the measured power level to compute the average power during continuous transmission.

Note:

1) Test distance is determined to 2.0 m by far field condition; see test descriptions on section 3.2.

2) The angle of antenna is set as maximum radiated power conditions.

3) EIRP is calculated from measured value according to section 5.2.7 of ANSI C63.26-2015, and the formula is as follows.

$$EIRP\ (dBm) = E\ (dB\mu V/m) + 20\log(D) - 104.77$$

4) E (dBμV/m) value is considered Antenna Factor and Cable Loss (AFCL), and it as follow.

$$E\ (dB\mu V/m) = measurement\ value\ (dB\mu V) + AFCL$$

5) The output tolerance of the EUT in the specification is ±2 dB and test result satisfies this condition.

Test Results:

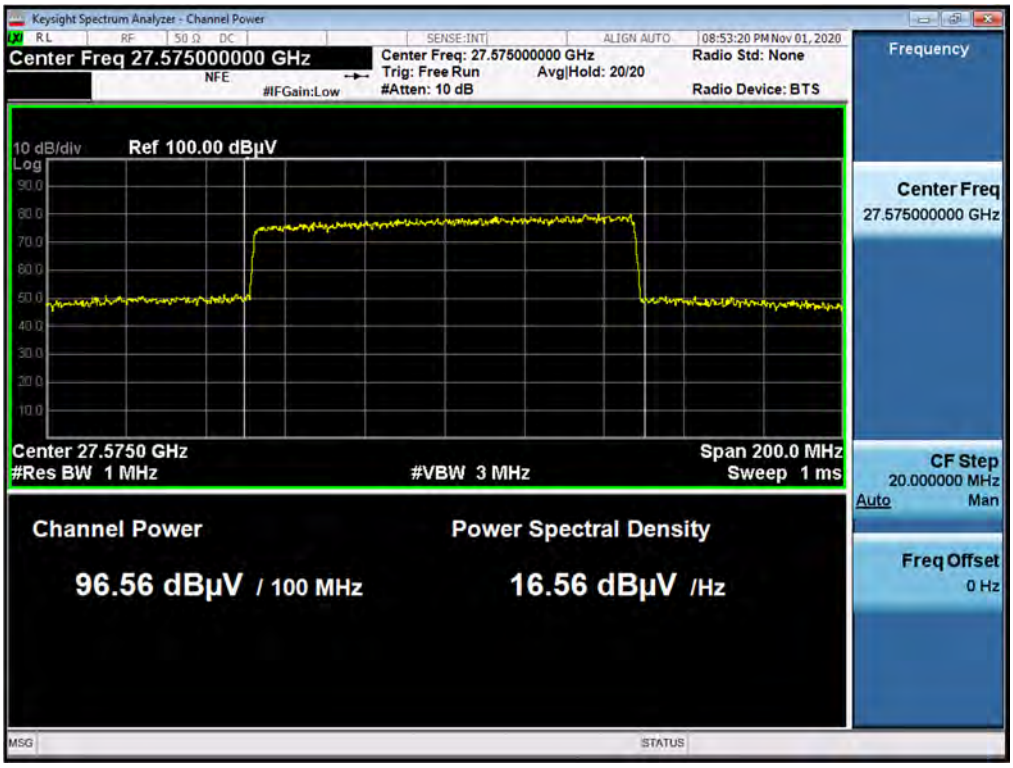
Tabular Data of EIRP Density per path

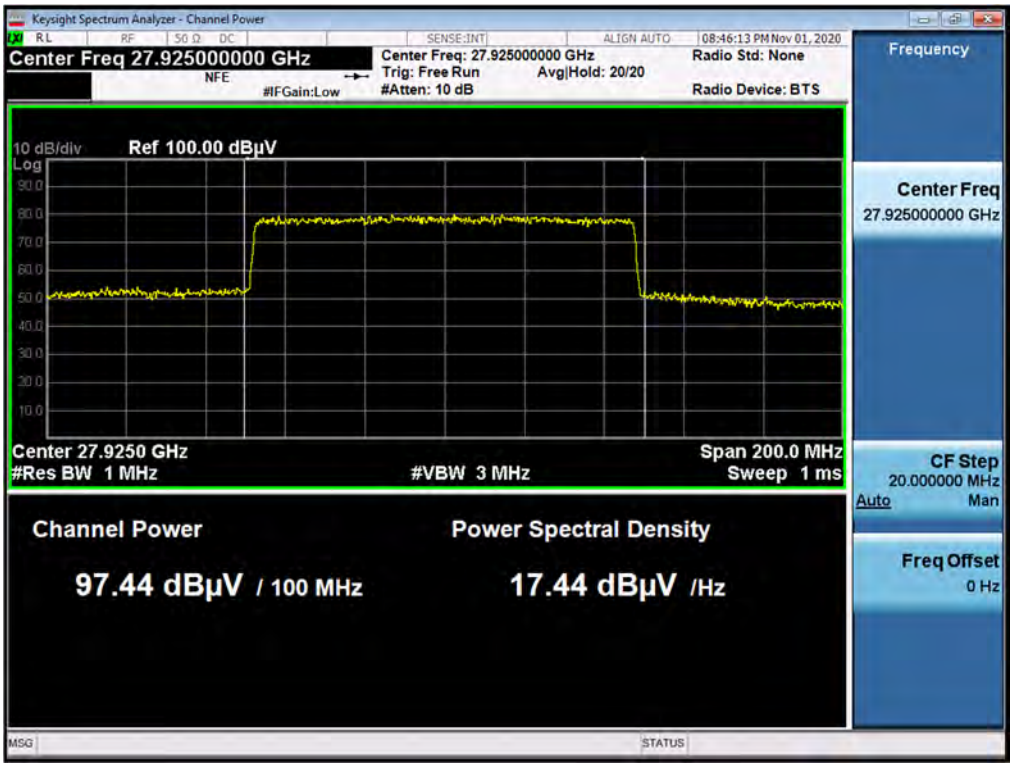
Path	CC	Channel	Frequency (GHz)	Measured Level (dBuV)	Calculated EIRP (dBm)
A	1	Low	27.575	96.56	37.26
		Middle	27.925	97.44	38.37
		High	28.275	96.70	37.79
	8	Middle	27.925	89.85	30.78
B	1	Low	27.575	95.80	36.50
		Middle	27.925	97.38	38.31
		High	28.275	96.51	37.60
	8	Middle	27.925	89.16	30.09

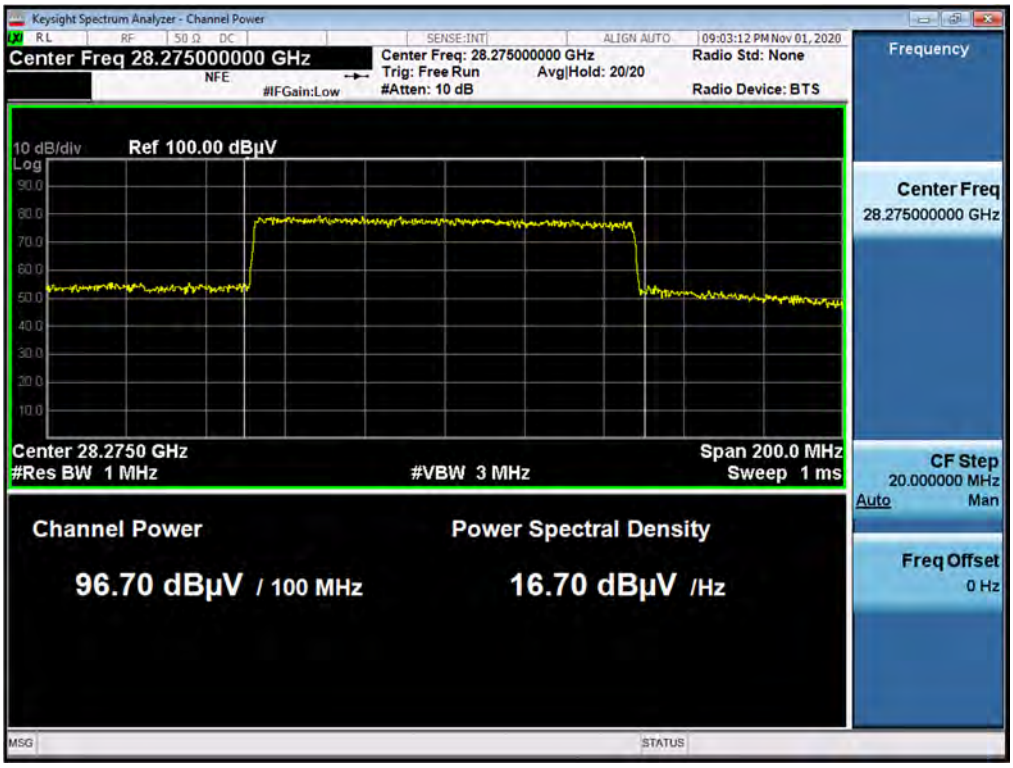
MIMO Tabular Data of EIRP Density

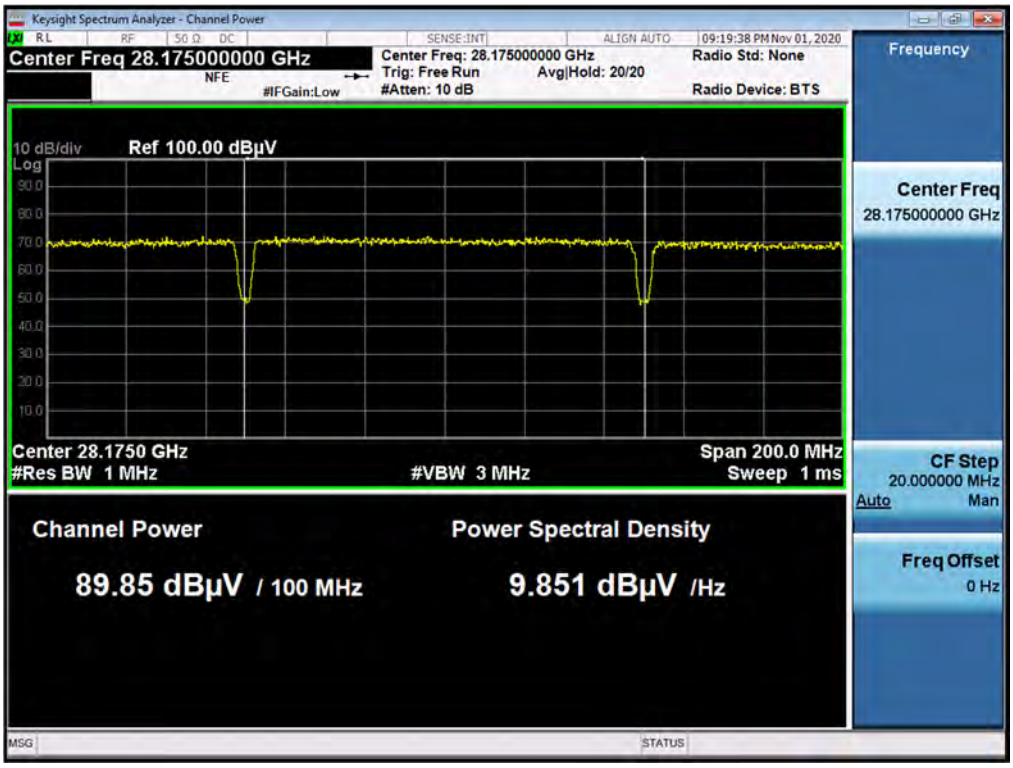
Path	CC	Channel	Path A EIRP (dBm)	Path B EIRP (dBm)	Calculated EIRP (dBm)
A+B	1	Low	37.26	36.50	39.90
		Middle	38.37	38.31	41.35
		High	37.79	37.60	40.71
	8	Middle	30.78	30.09	33.45

Plot Data of EIRP Density Tabular per path

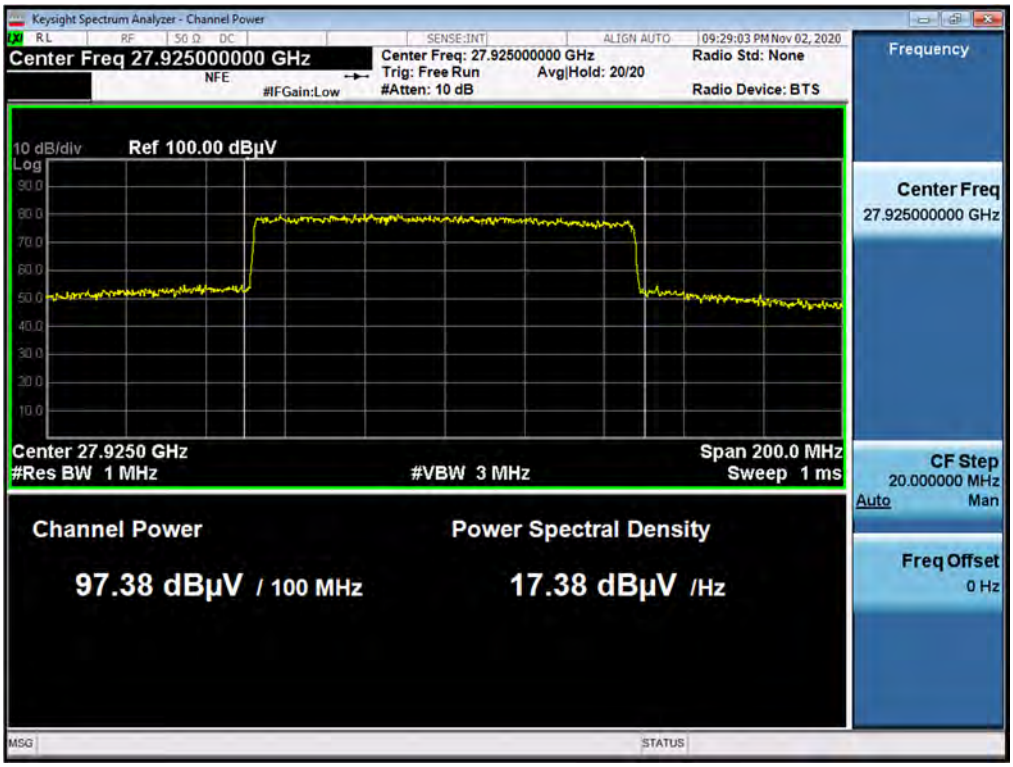
Path A / 1cc / Low


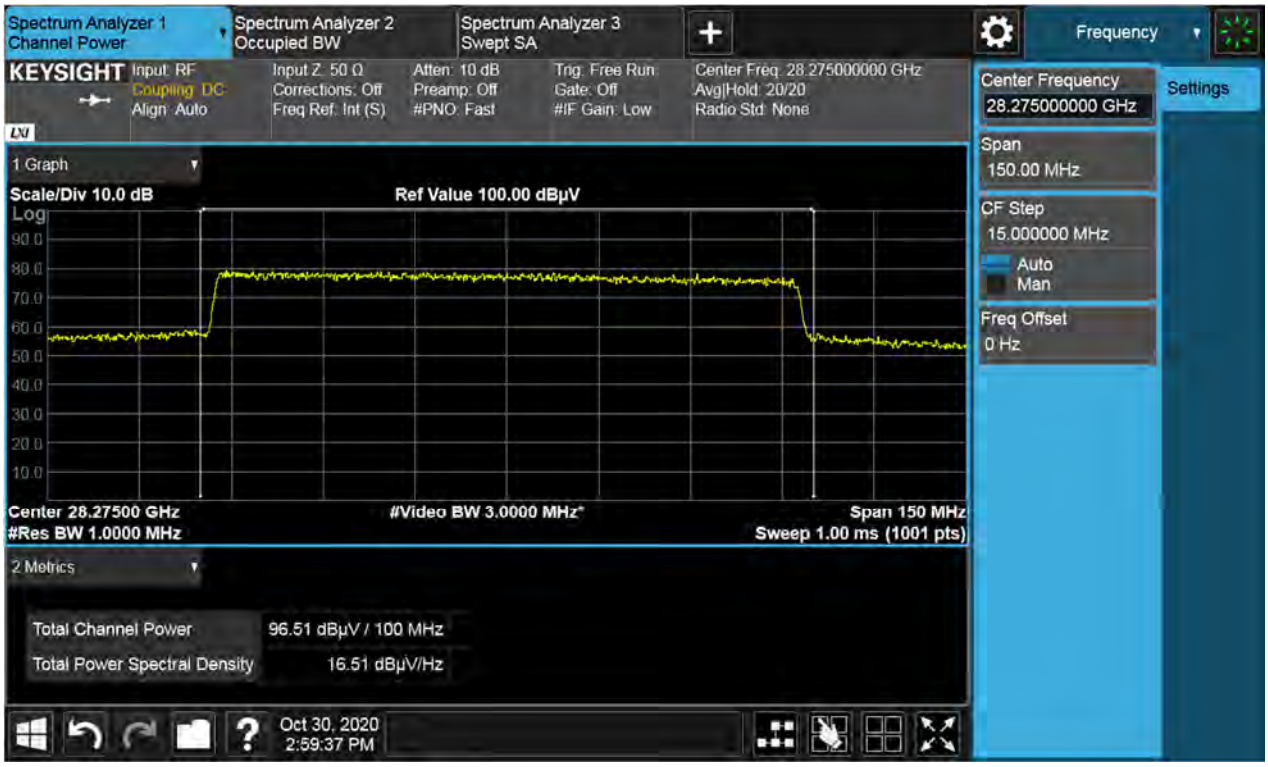
Path A / 1cc / Middle


Path A / 1cc / High


Path A / 8cc / Middle


Path B / 1cc / Low


Path B / 1cc / Middle


Path B / 1cc / High


Path B / 8cc / Middle


5.5. EQUIVALENT ISOTROPIC RADIATED POWER / MEAN OUTPUT POWER AND AMPLIFIER/BOOSTER GAIN

FCC Rules

Test Requirements:

§ 2.1046 Measurements required: RF power output.

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

Test Procedures:

Measurements were in accordance with the test methods section 3.5 of KDB 935210 D05 v01r04.

Adjust the internal gain control of the EUT to the maximum gain for which the equipment certification is being sought. Any EUT attenuation settings shall be set to their minimum value.

Input power levels (uplink and downlink) should be set to maximum input ratings while confirming that the device is not capable of operating in saturation (non-linear mode) at the rated input levels, including during the performance of the input/output power measurements.

3.5.2 Measuring the EUT mean input and output power

a) Connect a signal generator to the input of the EUT.

b) Configure to generate the test signal.

c) The frequency of the signal generator shall be set to the frequency f_0 as determined from out-of-band rejection test.

d) Connect a spectrum analyzer or power meter to the output of the EUT using appropriate attenuation as necessary.

e) Set the signal generator output power to a level that produces an EUT output level that is just below the AGC threshold, but not more than 0.5 dB below.

f) Measure and record the output power of the EUT; use ANSI C63.26-2015 subclause 5.2.4.4.1, for power measurement.

g) Remove the EUT from the measurement setup. Using the same signal generator settings, repeat the power measurement at the signal generator port, which was used as the input signal to the EUT, and record as the input power. EUT gain may be calculated as described in 3.5.5.

h) Repeat steps f) and g) with input signal amplitude set to 3 dB above the AGC threshold level.

i) Repeat steps e) to h) with the narrowband test signal.

j) Repeat steps e) to i) for all frequency bands authorized for use by the EUT.

3.5.5 Calculating amplifier, repeater, or industrial booster gain

After the input and output power levels have been measured as described in the preceding subclauses, the gain of the EUT can be determined from:

Gain (dB) = output power (dBm) − input power (dBm).

Report the gain for each authorized operating frequency band, and each test signal stimulus.

Note:

If f_0 that determined from out-of-band test is smaller or greater than difference of test signal's center frequency and operation band block, test is performed at the lowest or the highest frequency that test signals can be passed.

Test Results:

Tabular Data of Input & Output Power (E.I.R.P.) and Gain

Path	CC	f0 Frequency (MHz)	Input Power	Output Power		Gain (dB)
			Measured Level (dBm)	Measured Level (dBuV)	Calculated EIRP (dBm)	
A	1	28.131	-71.84	97.50	38.43	110.27
	8	27.925	-72.09	97.04	37.97	110.06
B	1	27.825	-71.95	97.54	38.47	110.42
	8	27.925	-72.19	96.65	37.58	109.77

MIMO Tabular Data of Input & Output Power (E.I.R.P.)

Path	CC	Path A EIRP (dBm)	Path B EIRP (dBm)	Calculated EIRP (dBm)
A+B	1	38.43	38.47	41.46
	8	37.97	37.58	40.78

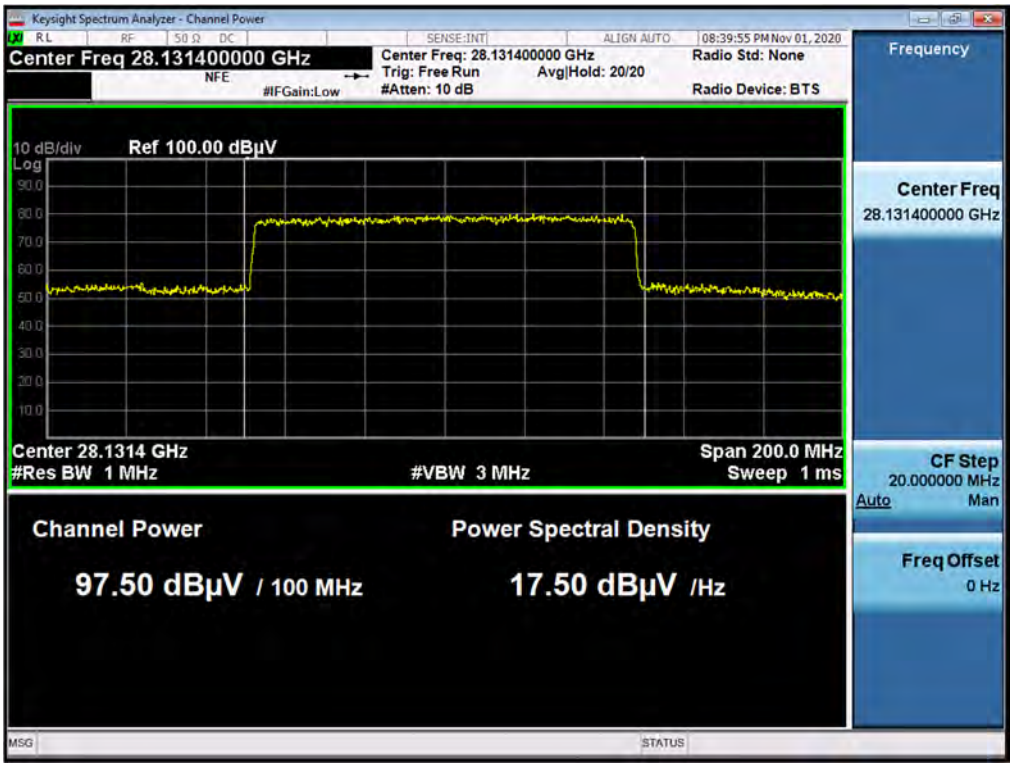
Tabular Data of 3 dB above AGC threshold Input & Output Power (E.I.R.P.)

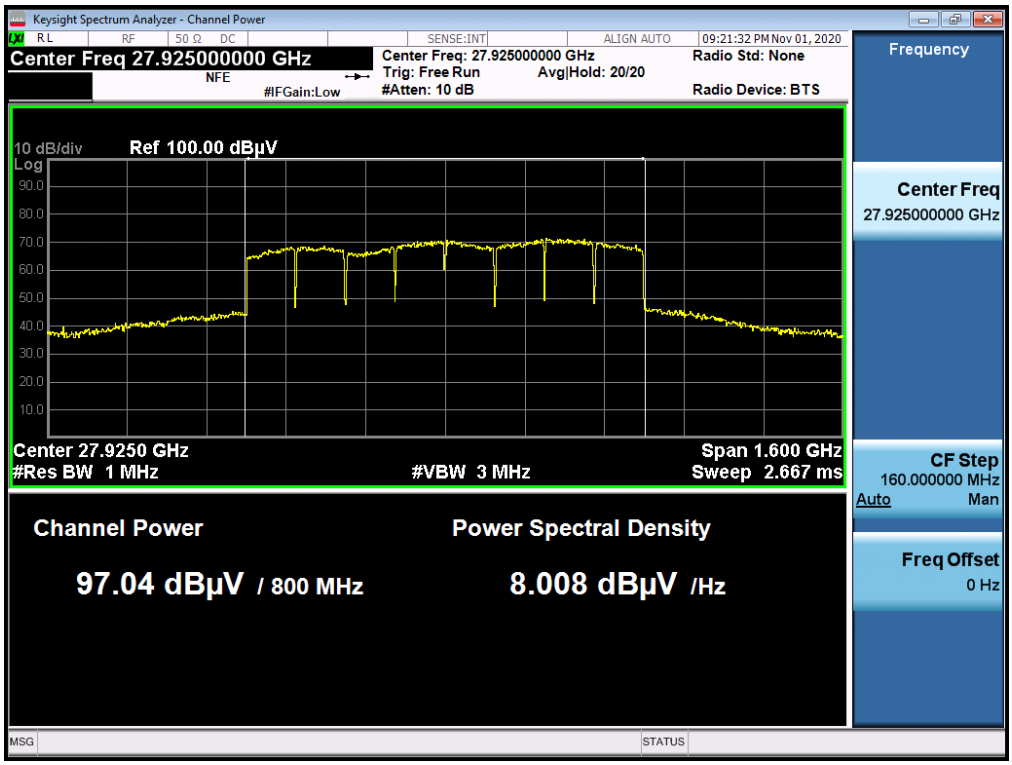
Path	CC	f0 Frequency (MHz)	Input Power	Output Power	
			Measured Level (dBm)	Measured Level (dBuV)	Calculated EIRP (dBm)
A	1	28.131	-68.84	97.42	38.35
	8	27.925	-69.09	97.10	38.03
B	1	27.825	-68.95	97.63	38.56
	8	27.925	-69.19	96.58	37.51

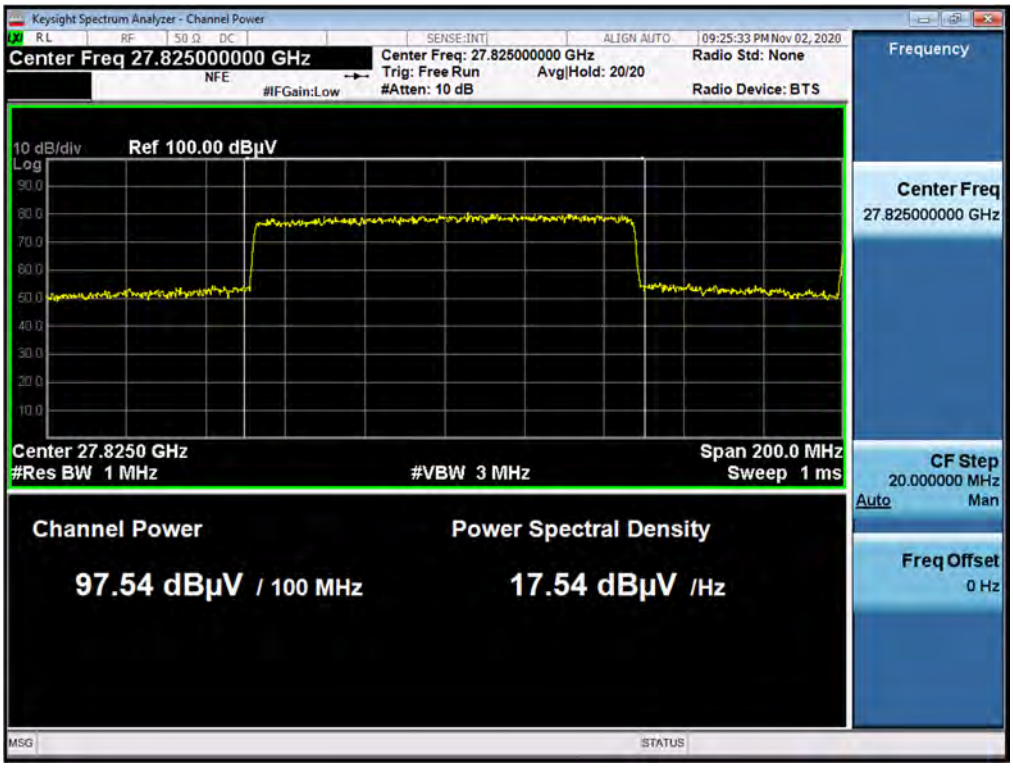
MIMO Tabular Data of 3 dB above AGC threshold Input & Output Power (E.I.R.P.)

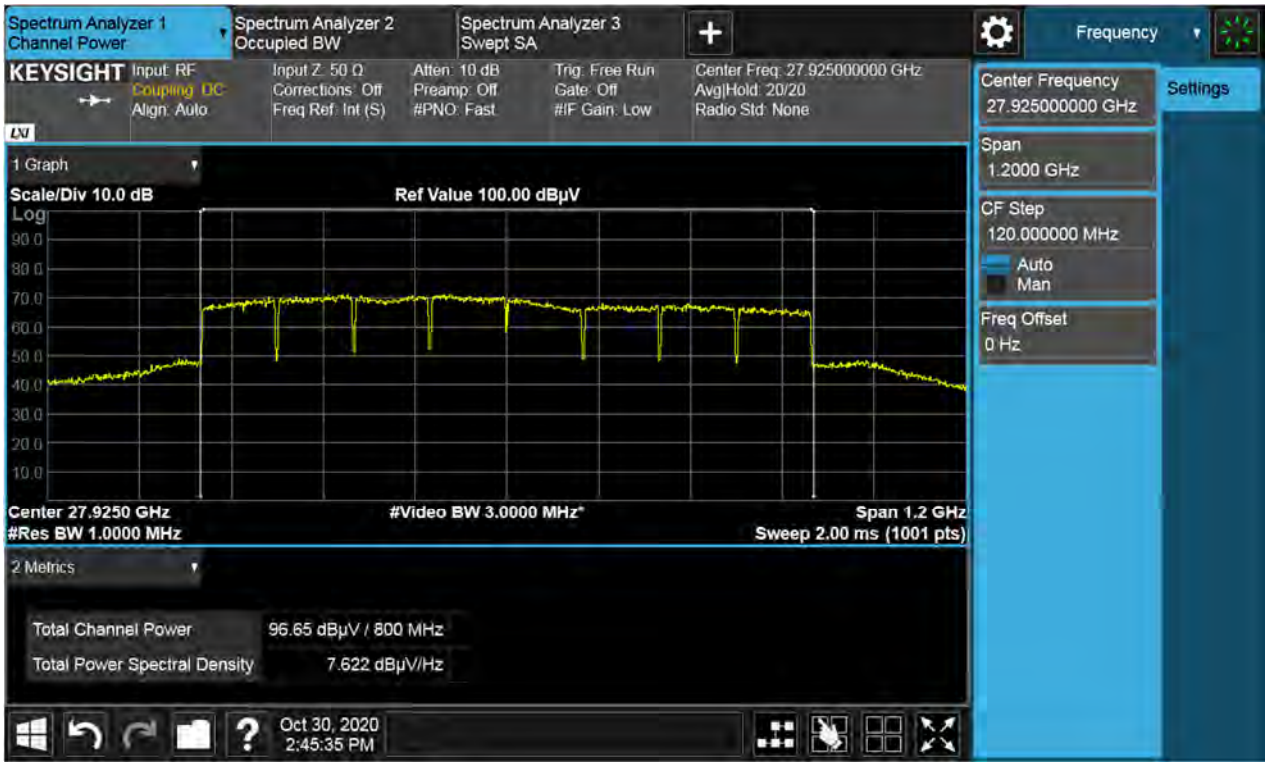
Path	CC	Path A EIRP (dBm)	Path B EIRP (dBm)	Calculated EIRP (dBm)
A+B	1	38.35	38.56	41.46
	8	38.03	37.51	40.78

Plot Data of Input & Output Power (E.I.R.P.)

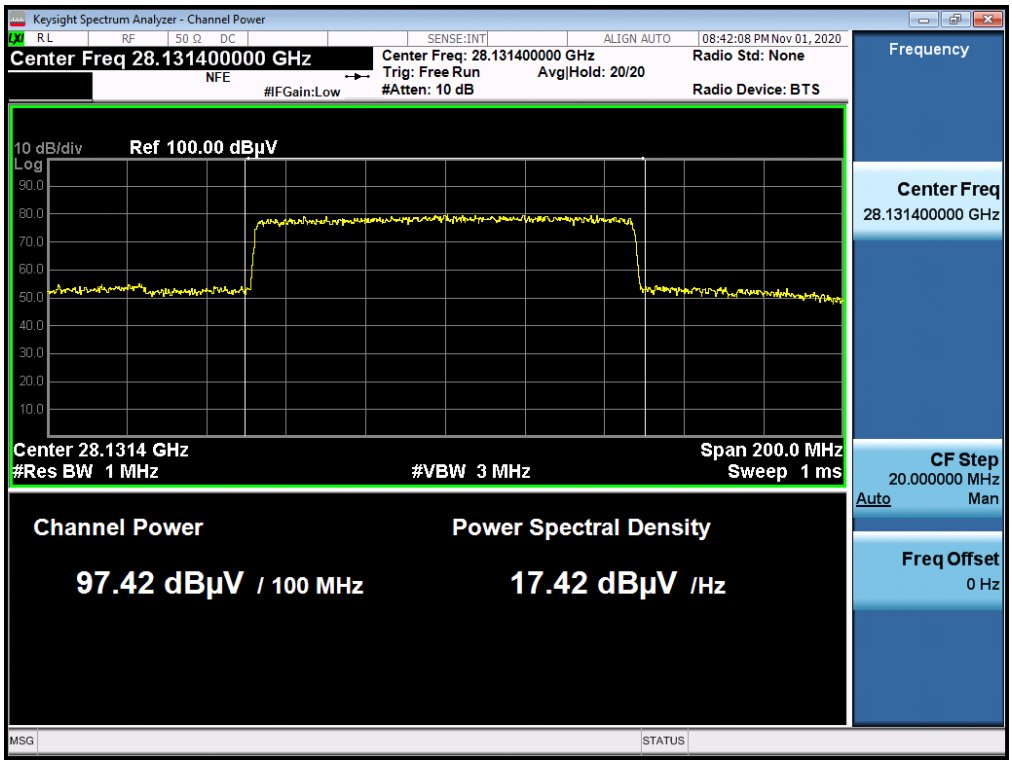
Path A / 1cc


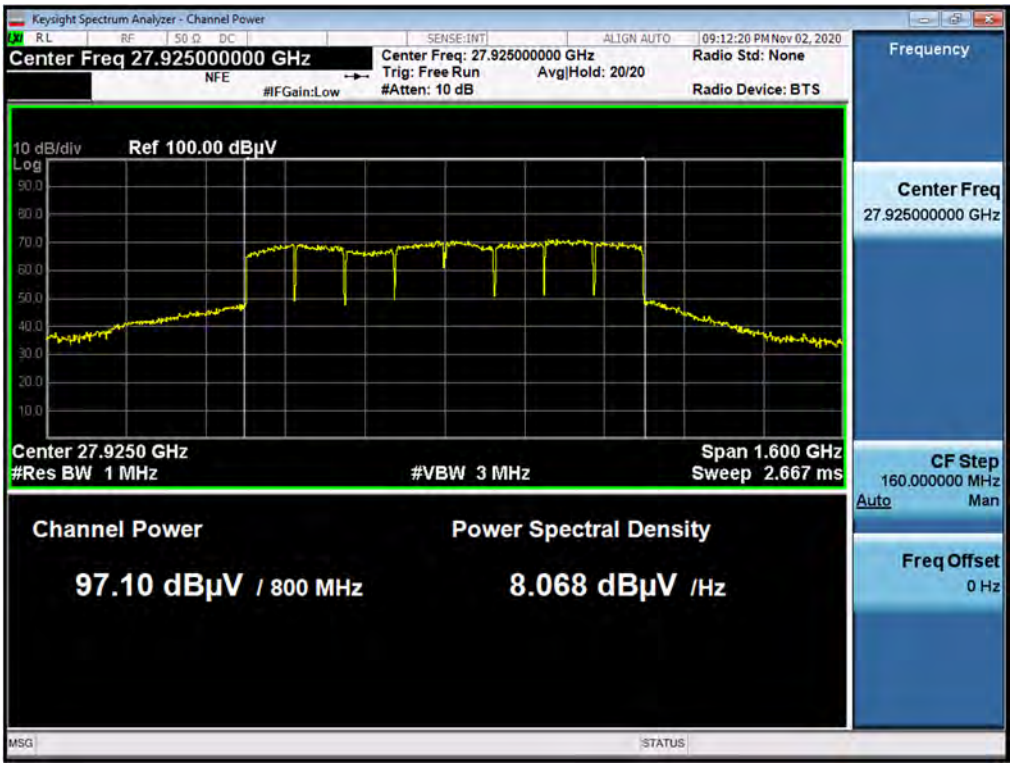
Path A / 8cc


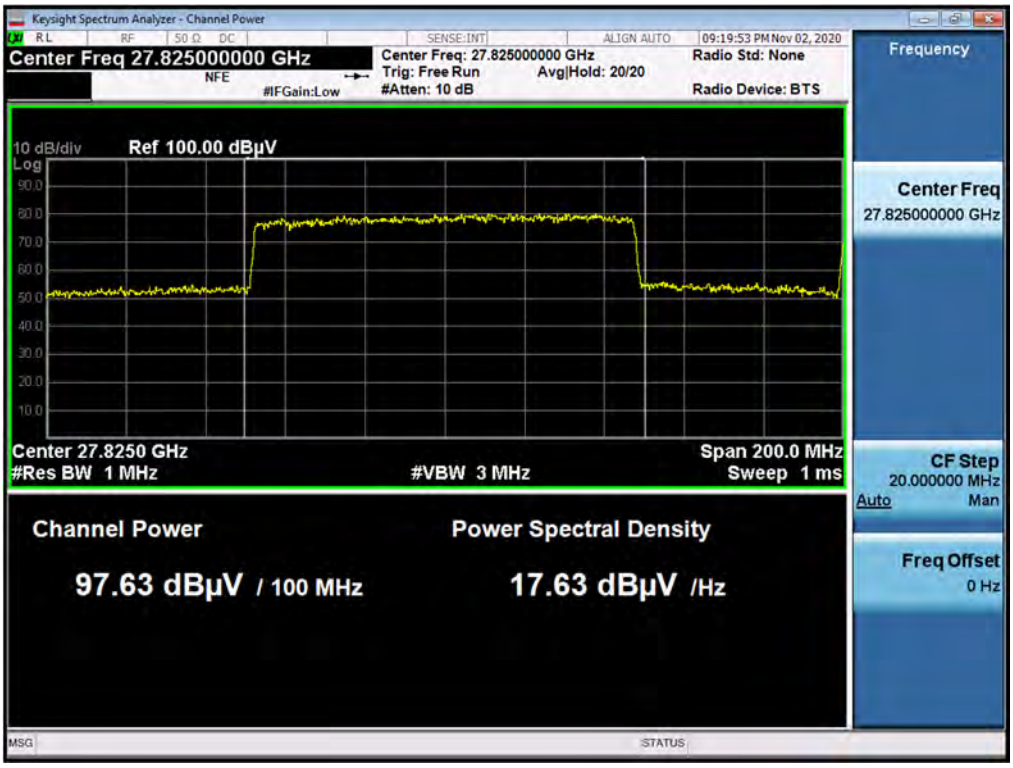
Path B / 1cc


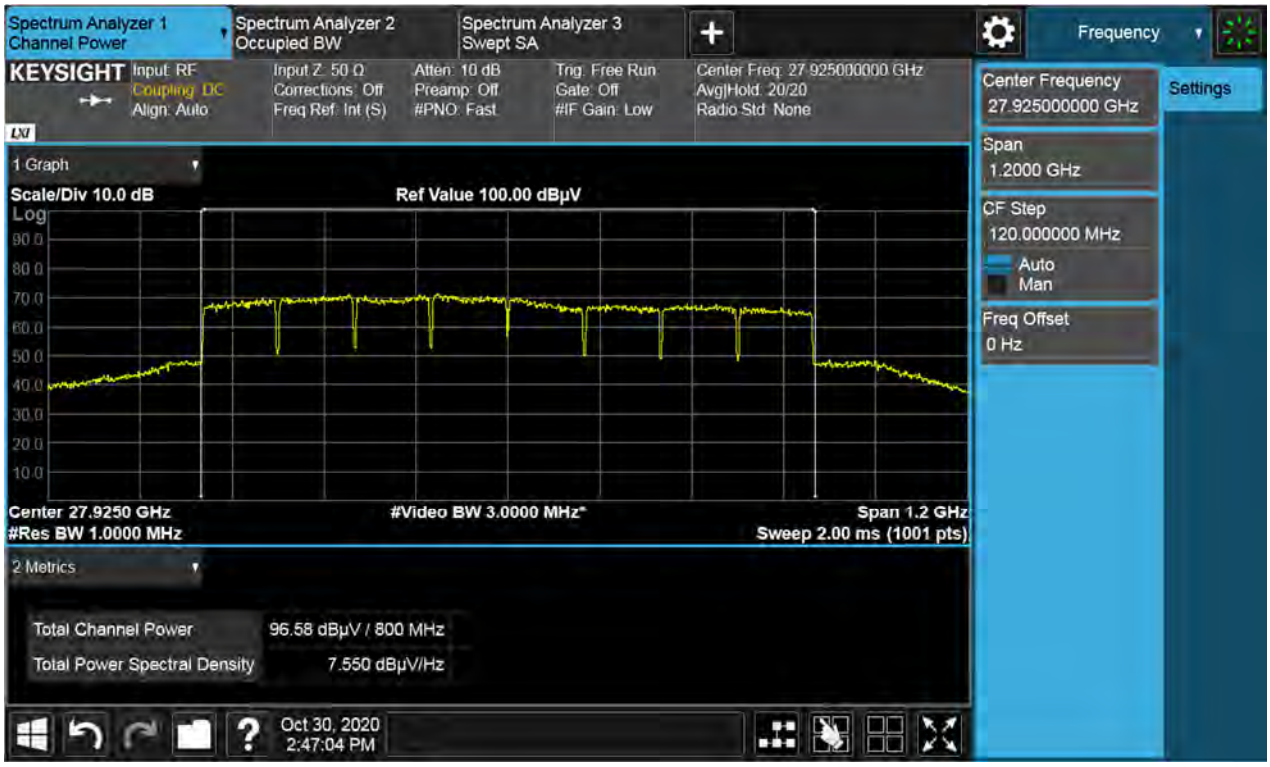
Path B / 8cc / Middle


Tabular Data of 3 dB above AGC threshold Input & Output Power (E.I.R.P.)

3 dB above AGC threshold Output Power (E.I.R.P.) / Path A / 1cc


3 dB above AGC threshold Output Power (E.I.R.P.) / Path A / 8cc


3 dB above AGC threshold Output Power (E.I.R.P.) / Path B / 1cc


3 dB above AGC threshold Output Power (E.I.R.P.) / Path B / 8cc


5.6. BAND EDGE / OUT-OF-BAND/OUT-OF-BLOCK EMISSIONS AND SPURIOUS EMISSIONS

Test Requirements:

§ 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 30.203 Emission limits.

(a) The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be −13 dBm/MHz or lower. However, in the bands immediately outside and adjacent to the licensee's frequency block, having a bandwidth equal to 10 percent of the channel bandwidth, the conductive power or the total radiated power of any emission shall be −5 dBm/MHz or lower.

(b) (1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater.

(2) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges as the design permits.

(3) The measurements of emission power can be expressed in peak or average values.

Test Procedures:

Measurements were in accordance with the test methods section 3.6 of KDB 935210 D05 v01r04.

Spurious emissions shall be measured using a single test signal sequentially tuned to the low, middle, and high channels or frequencies within each authorized frequency band of operation.

Out-of-band/out-of-block emissions (including intermodulation products) shall be measured under each of the following two stimulus conditions:

a) two adjacent test signals sequentially tuned to the lower and upper frequency band/block edges;

b) a single test signal, sequentially tuned to the lowest and highest frequencies or channels within the frequency band/block under examination.

NOTE—Single-channel boosters that cannot accommodate two simultaneous signals within the passband may be excluded from the test stipulated in step a).

The measurement is performed in accordance with Section 5.7.3 of ANSI C63.26.

5.7.3 Out-of-band unwanted emissions measurements

a) Set the spectrum analyzer center frequency to the block, band, or channel edge frequency.

b) Set the span wide enough to capture the fundamental emission closest to the authorized block or band edge, and to include all modulation products that spill into the immediately adjacent frequency band. In some cases, it may be possible to set the center frequency and span so as to encompass the fundamental emission and the unwanted out-of-band (band-edge)

emissions on either side of the authorized block, band, or channel. This can be accomplished with a single (slow) sweep, if adequate overload protection and sufficient dynamic range can be maintained.

c) Set the number of points in sweep ≥ 2 × span / RBW.

d) Sweep time should be auto for peak detection. For rms detection the sweep time should be set as follows:

1), 2) Omitted

3) If the device cannot be configured to transmit continuously (duty cycle < 98%) and a free running sweep must be used, set the sweep time so that the averaging is performed over multiple on/off cycles by setting the sweep time > (number of points in sweep) × (transmitter period) (i.e., the transmit on-time + the off-time). The spectrum analyzer readings shall subsequently be corrected by [10 log (1/duty cycle)]. This assumes that the transmission period and duty cycle is relatively constant (duty cycle variation ≤ ±2%).

4) Omitted

e) The test report shall include the plots of the measuring instrument display and the measured data.

f) See Annex I for example emission mask plots.

TRP Test Procedures:

The measurement is performed in accordance with Section 4.4.3.3.2 of KDB 842590 v01 (2019-04).

a) Align the EUT with a chosen xy-plane and the xz-plane of the antenna measurement coordinate system.

NOTE 1: For harmonics and spurious emission frequencies which are beamforming as identified in exploratory scan, it may be required to align the orthogonal cuts to include the peak based on exploratory scans.

b) Measure the EUT dimensions, i.e., depth (d), width (w), and height (h); see Figure A.1 in Appendix A.

c) Calculate the spherical and cylindrical diameters (D and Dcyl) using Equations (A.1) and (A.2) (see Appendix A).

d) For the highest frequency (smallest wavelength) of the frequency band measured, calculate the reference angular steps $\Delta\theta$ref and $\Delta\phi$ref using Equations (A.3) and (A.4).

e) Set the grid spatial sampling step $\Delta\theta \leq \Delta\theta$ref for the vertical angle and $\Delta\phi \leq \Delta\phi$ref for the horizontal cut.

f) For each emission frequency, measure the EIRP (as a sum of two orthogonal polarizations) at each spatial sampling step on the selected grid.

g) For each emission frequency, calculate the average EIRP for both the cuts separately, and then take the average of these two average values.

h) Add 2 dB as a correction factor to the averaged value computed in step g).

i) If the TRP limit is exceeded, a third orthogonal cut in the yz-plane and using the $\Delta\theta$ angular step, can be added. Now, calculate the average values in all three cuts separately, and then take the average value of these three average values.

j) Add 1.5 dB as a correction factor to the averaged value computed in step i).

k) Evaluate the pass/fail decision by comparing TRP from step h) or step j) against the applicable TRP limit.

Note:

1) In the band edge test of path A, B are individually operated and measured at the maximum emission position of each path, and the respective measurement results are summed.
2) Band edge value is calculated as follows.

Band Edge = Measured Value + AFCL + 20log(D) – 104.77 – Ant. Gain

3) Antenna Gain of the above formula was applied from actual measurement data of the radiation pattern document.

Test Results:

Tabular Data of Band Edge (Two Adjacent Test Signal)

Path	Distance (m)	cc	Channel	Pol.	Frequency (GHz)	Measured Level (dBuV)	EIRP (dBm)	Ant. Gain (dBi)	Limit (dBm/MHz)	Result (dBm)
Path A	2.00	1	Low	Co	27.498	50.070	-9.233	17.7	-5	-26.933
				Cross	27.465	35.873	-23.430	17.7		-41.130
			High	Co	28.366	51.751	-7.156	18.0		-25.156
				Cross	28.380	40.340	-18.567	18.0		-36.567

Path	Distance (m)	cc	Channel	Pol.	Frequency (GHz)	Measured Level (dBuV)	EIRP (dBm)	Ant. Gain (dBi)	Limit (dBm/MHz)	Result (dBm)
Path B	2.00	1	Low	Co	27.472	49.173	-10.130	17.7	-5	-27.830
				Cross	27.472	31.936	-27.367	17.7		-45.067
			High	Co	28.355	48.749	-10.158	18.0		-28.158
				Cross	28.356	35.374	-23.533	18.0		-41.533

MIMO Tabular Data of Band Edge (Two Adjacent Test Signal)

Mode	cc	Edge	Pol.	Result (dBm)
MIMO	1	Low	Co	-24.348
			Cross	-39.657
		High	Co	-23.392
			Cross	-35.365

Tabular Data of Band Edge (Single Test Signal)

Path	Distance (m)	cc	Channel	Pol.	Frequency (GHz)	Measured Level (dBuV)	EIRP (dBm)	Ant. Gain (dBi)	Limit (dBm/MHz)	Result (dBm)
Path A	1.00	1	Low	Co	27.492	49.676	-9.627	17.7	-5	-27.327
				Cross	27.500	35.487	-23.816	17.7		-41.516
			High	Co	28.353	51.679	-7.228	18.0		-25.228
				Cross	28.350	40.386	-18.521	18.0		-36.521
		8	Low	Co	27.494	48.445	-10.858	17.7		-28.558
				Cross	27.495	35.032	-24.271	17.7		-41.971
			High	Co	28.385	48.856	-10.051	18.0		-28.051
				Cross	28.387	37.700	-21.207	18.0		-39.207

Path	Distance (m)	cc	Channel	Pol.	Frequency (GHz)	Measured Level (dBuV)	EIRP (dBm)	Ant. Gain (dBi)	Limit (dBm/MHz)	Result (dBm)
Path B	1.00	1	Low	Co	27.495	51.014	-8.289	17.7	-5	-25.989
				Cross	27.499	33.926	-25.377	17.7		-43.077
			High	Co	28.351	50.283	-8.624	18.0		-26.624
				Cross	28.357	35.827	-23.080	18.0		-41.080
		8	Low	Co	27.500	47.315	-11.988	17.7		-29.688
				Cross	27.499	30.828	-28.475	17.7		-46.175
			High	Co	28.355	48.507	-10.400	18.0		-28.400
				Cross	28.362	34.517	-24.390	18.0		-42.390

MIMO Tabular Data of Band Edge (Single Test Signal)

Mode	cc	Edge	Pol.	Result (dBm)
MIMO	1	Low	V	-23.596
			H	-39.216
		High	V	-22.860
			H	-35.218
	8	Low	V	-26.076
			H	-40.573
		High	V	-25.212
			H	-37.503

Plot data of Band Edge

Two Adjacent Test Signal / MAX Ant. A Position / 1cc / Low / Co-Pol.


Two Adjacent Test Signal / MAX Ant. A Position / 1cc / Low / Cross-Pol.

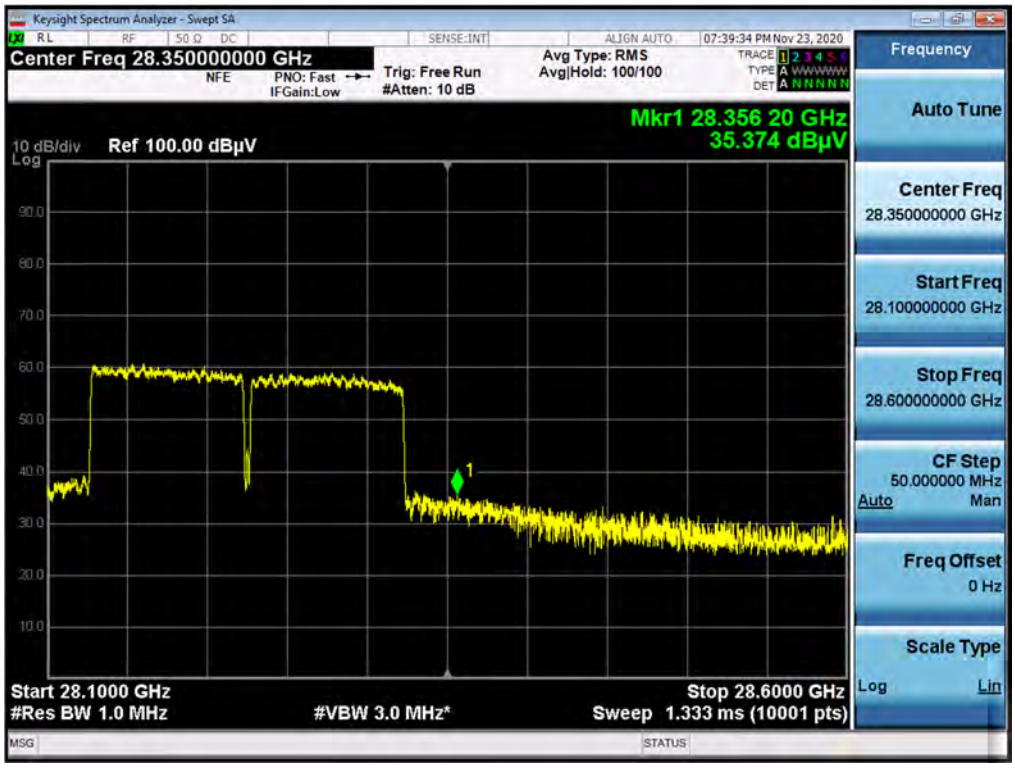

Two Adjacent Test Signal / MAX Ant. A Position / 1cc / High / Co-Pol.


Two Adjacent Test Signal / MAX Ant. A Position / 1cc / High / Cross-Pol.


Two Adjacent Test Signal / MAX Ant. B Position / 1cc / Low / Co-Pol.


Two Adjacent Test Signal / MAX Ant. B Position / 1cc / Low / Cross-Pol.


Two Adjacent Test Signal / MAX Ant. B Position / 1cc / High / Co-Pol.

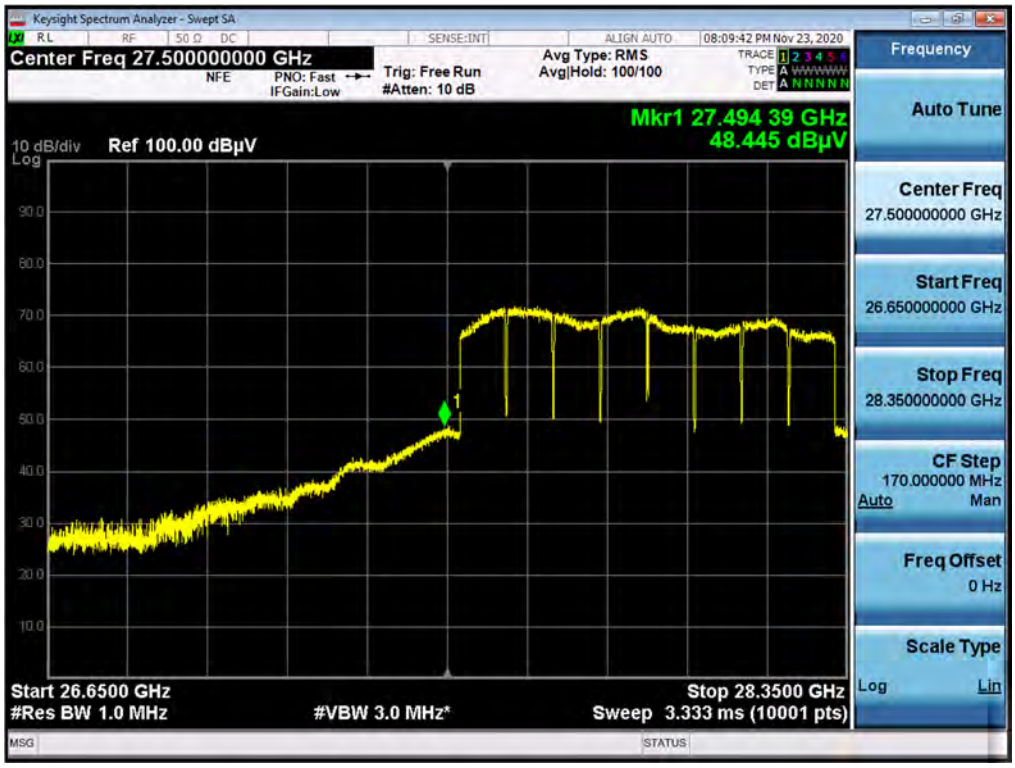

Two Adjacent Test Signal / MAX Ant. B Position / 1cc / High / Cross-Pol.


MAX Ant. A Position / 1cc / Low / Co-Pol.


MAX Ant. A Position / 1cc / Low / Cross-Pol.


MAX Ant. A Position / 1cc / High / Co-Pol.


MAX Ant. A Position / 1cc / High / Cross-Pol.

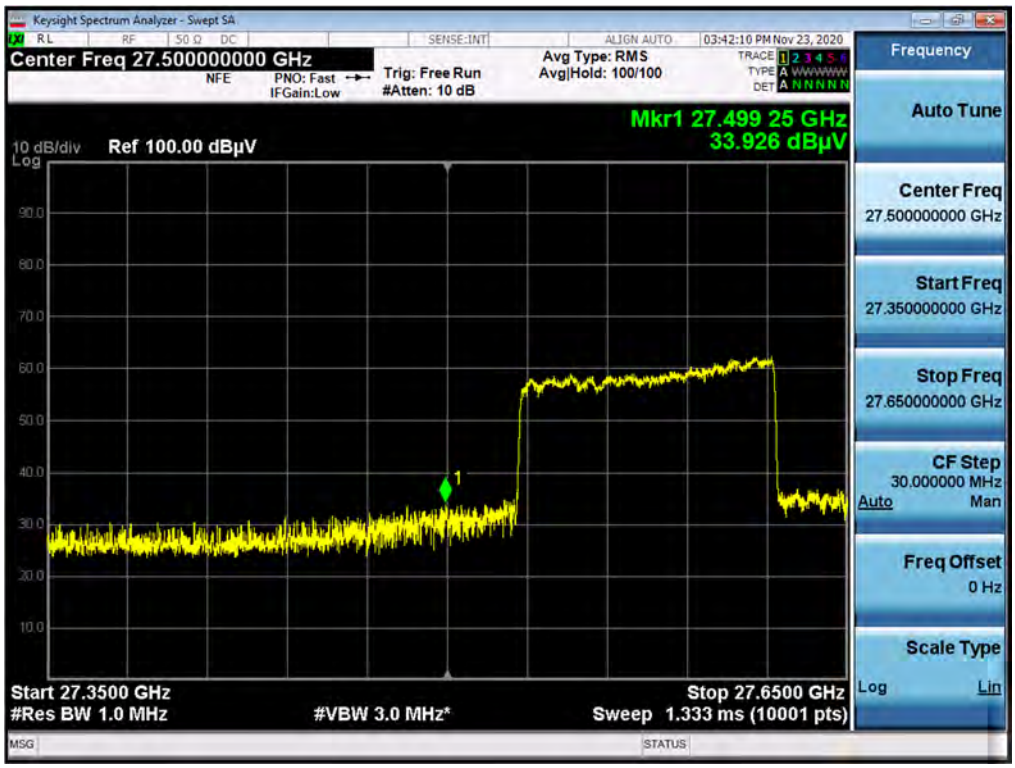

MAX Ant. A Position / 8cc / Low / Co-Pol.


MAX Ant. A Position / 8cc / Low / Cross-Pol.

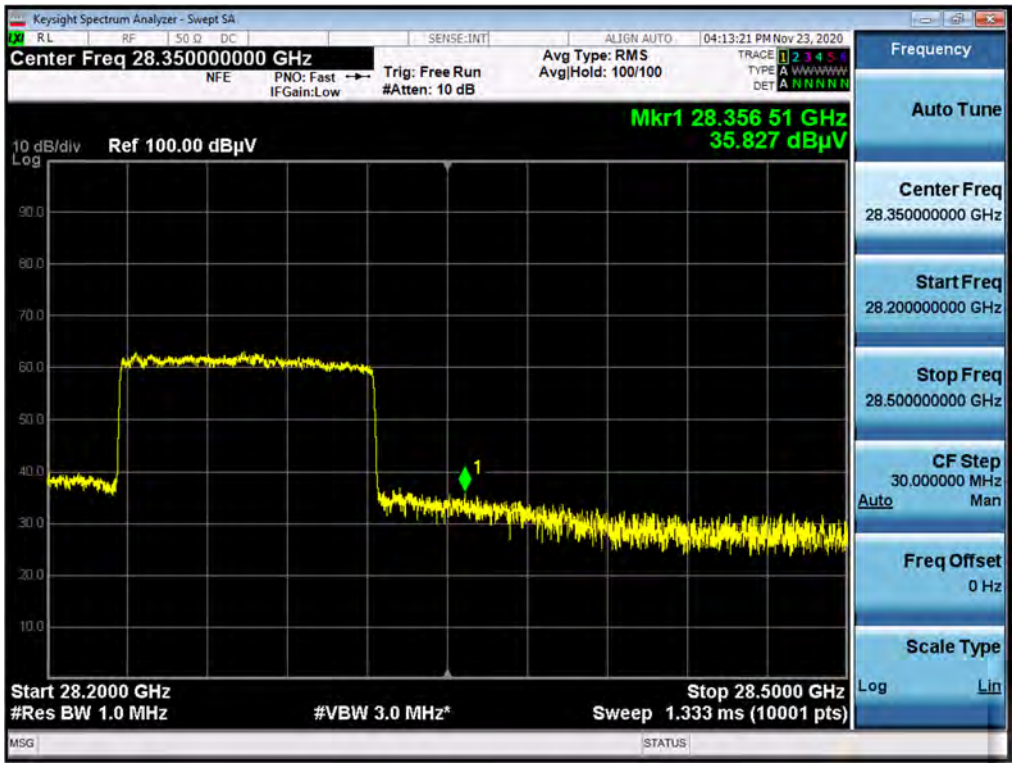

MAX Ant. A Position / 8cc / High / Co-Pol.

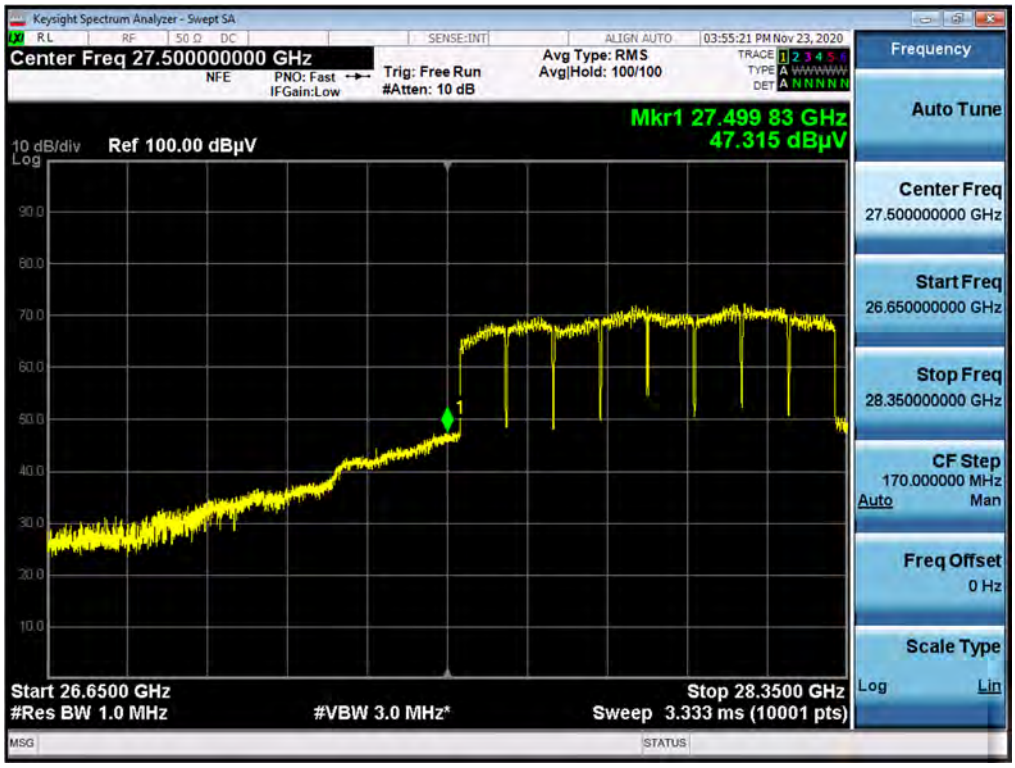

MAX Ant. A Position / 8cc / High / Cross-Pol.


MAX Ant. B Position / 1cc / Low / Co-Pol.

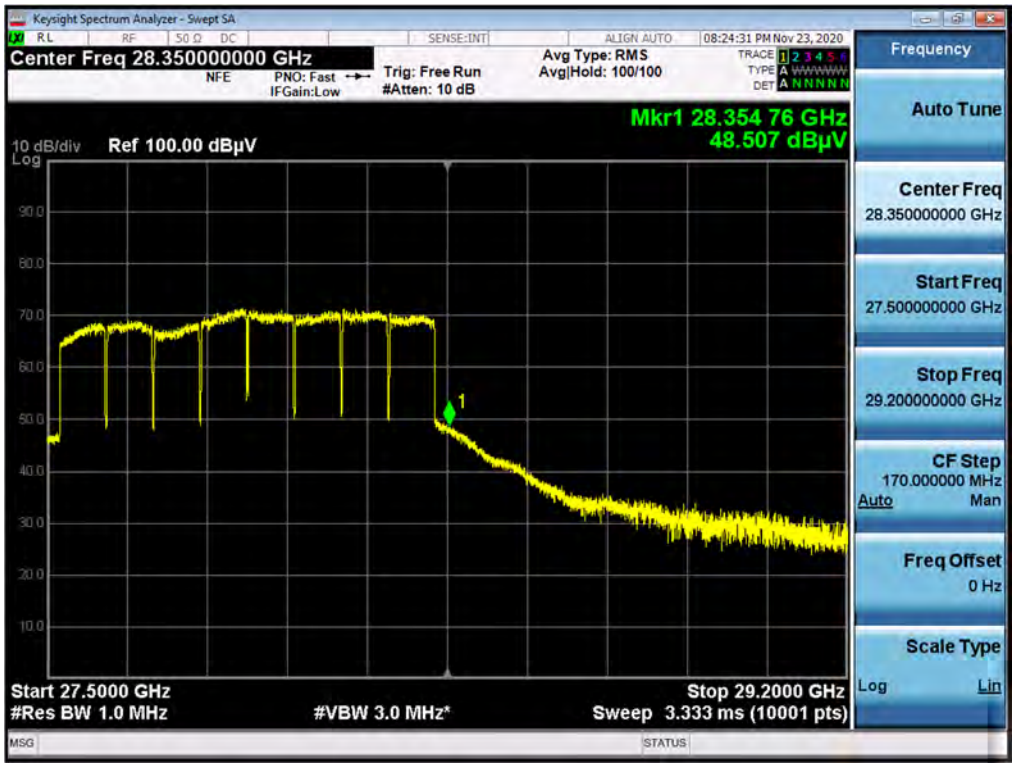

MAX Ant. B Position / 1cc / Low / Cross-Pol.


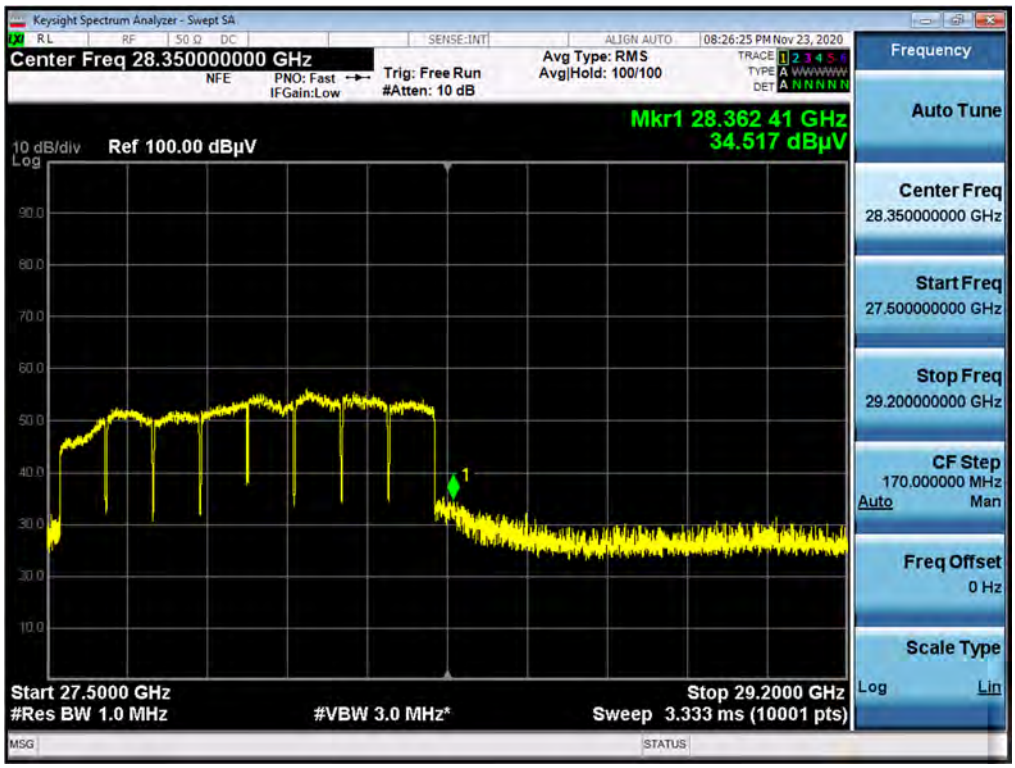
MAX Ant. B Position / 1cc / High / Co-Pol.


MAX Ant. B Position / 1cc / High / Cross-Pol.


MAX Ant. B Position / 8cc / Low / Co-Pol.


MAX Ant. B Position / 8cc / Low / Cross-Pol.


MAX Ant. B Position / 8cc / High / Co-Pol.


MAX Ant. B Position / 8cc / High / Cross-Pol.


5.7. RADIATED SPURIOUS EMISSIONS

FCC Rules

Test Requirements:

§ 2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 30.203 Emission limits.

(a) The conductive power or the total radiated power of any emission outside a licensee's frequency block shall be −13 dBm/MHz or lower. However, in the bands immediately outside and adjacent to the licensee's frequency block, having a bandwidth equal to 10 percent of the channel bandwidth, the conductive power or the total radiated power of any emission shall be −5 dBm/MHz or lower.

(b) (1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater.

(2) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges as the design permits.

(3) The measurements of emission power can be expressed in peak or average values.

Test Procedures:

The measurement is performed in accordance with Section 5.7.4 of ANSI C63.26.

5.7.4 Spurious unwanted emission measurements

a) Set the spectrum analyzer start frequency to the lowest frequency generated by the EUT, without going below 9 kHz, and the stop frequency to the lower frequency covered by the measurements previously performed in 5.7.3. As an alternative, the stop frequency can be set to the value specified in 5.1.1, depending on the EUT operating range, if the resulting plot can clearly demonstrate compliance for all frequencies not addressed by the out-of-band emissions measurements performed as per 5.7.3.

b) When using an average power (rms) detector, ensure that the number of points in the sweep ≥ 2 × (span / RBW). This may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the spectrum analyzer capabilities. This requirement does not apply to peak-detected power measurements. When average power is specified by the applicable regulation, a peak-detector can be utilized for preliminary measurements to accommodate wider frequency spans. Any emissions found in the preliminary measurement to exceed the applicable limit(s) shall be further examined using a power averaging (rms) detector with the minimum number of measurement points as defined above.

c) The sweep time should be set to auto-couple for performing peak-detector measurements. For measurements that use a power averaging (rms) detector, the sweep time shall be set as described for out-of-band emissions measurements in item d) of 5.7.3.

d) Identify and measure the highest spurious emission levels in each frequency range. It is not necessary to re-measure the out-of-band emissions as a part of this test. Record the frequencies and amplitudes corresponding to the measured emissions and capture the data plots.

e) Repeat step b) through step d) for the upper spurious emission frequency range if not already captured by a wide span measurement performed as per the alternative provided in step a). The upper frequency for this measurement is defined in 5.1.1 as a function of the EUT operating range.

f) Compare the results with the corresponding limit in the applicable regulation.

g) The test report shall include the data plots of the measuring instrument display and the measured data.

TRP Test Procedures:

The measurement is performed in accordance with Section 4.4.3.3.2 of KDB 842590 v01 (2019-04).

a) Align the EUT with a chosen xy-plane and the xz-plane of the antenna measurement coordinate system.
NOTE 1: For harmonics and spurious emission frequencies which are beamforming as identified in exploratory scan, it may be required to align the orthogonal cuts to include the peak based on exploratory scans.

b) Measure the EUT dimensions, i.e., depth (d), width (w), and height (h); see Figure A.1 in Appendix A.

c) Calculate the spherical and cylindrical diameters (D and Dcyl) using Equations (A.1) and (A.2) (see Appendix A).

d) For the highest frequency (smallest wavelength) of the frequency band measured, calculate the reference angular steps $\Delta\theta$ref and $\Delta\phi$ref using Equations (A.3) and (A.4).

e) Set the grid spatial sampling step $\Delta\theta \leq \Delta\theta$ref for the vertical angle and $\Delta\phi \leq \Delta\phi$ref for the horizontal cut.

f) For each emission frequency, measure the EIRP (as a sum of two orthogonal polarizations) at each spatial sampling step on the selected grid.

g) For each emission frequency, calculate the average EIRP for both the cuts separately, and then take the average of these two average values.

h) Add 2 dB as a correction factor to the averaged value computed in step g).

i) If the TRP limit is exceeded, a third orthogonal cut in the yz-plane and using the $\Delta\theta$ angular step, can be added. Now, calculate the average values in all three cuts separately, and then take the average value of these three average values.

j) Add 1.5 dB as a correction factor to the averaged value computed in step i).

k) Evaluate the pass/fail decision by comparing TRP from step h) or step j) against the applicable TRP limit.

Note:

1) Spurious emission test is performed up to 100 GHz frequency according to section 5.1.1 of ANSI C63.26 -2015.
2) Measurement distance is applied far field condition; see test descriptions on section 3.2.
3) In case of 9 kHz to 30 MHz and 30 MHz to 1 GHz, the reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
4) Test plot(30 MHz ~ 40 GHz) doesn't include any factors and all factors such as AFCL is calculated in tabular data.
5) We were performed the test in MIMO mode.
6) In this test, AFCL factor consists of antenna factor, cable loss, mixer loss, and amplifier gain.
7) Emissions value is first converted by distance factor as follow.

Converted value (dBm) = Measured Value (dBuV) + 20 LOG(D) - 104.77

8) Final spurious emissions result is calculated as follow.

Spurious Emissions = Converted Value (dBm) + AFCL

Test Results:

Tabular Data of Radiated Spurious Emissions

Freq.	Carrier	Distance (m)	Ant. Path	Frequency (MHz)	Measured (dBuV)	Limit (dBm)	Result (dBm)
9 kHz ~ 30 MHz	No critical peaks found						
30 MHz ~ 1 GHz	No critical peaks found						
1 GHz ~ 18 GHz	1	3.0	A	7.641	66.01	-13	-30.45
			B	7.641	65.92		-30.54
	8		A	7.641	66.12		-30.34
			B	7.641	66.04		-30.43

Note: Only peak value is recorded in this report.

Freq.	Ch.	Distance (m)	Ant. Path	Frequency (GHz)	Measured (dBuV)	Limit (dBm)	Result (dBm)	TRP (dBm)
18 GHz ~ Low Edge (1CC)	Low	3.0	A	27.489	48.63	-13	*-10.68	-20.50
			B	27.486	47.11		*-12.19	-23.75
	Middle		A	27.471	41.04		-18.27	-
			B	27.489	40.38		-18.93	-
	High		A	27.472	41.43		-17.87	-
			B	27.490	38.38		-20.93	-
18 GHz ~ Low Edge (8CC)	Middle	3.0	A	27.490	43.40		*-15.90	-25.09
			B	27.416	45.09		*-14.08	-24.02
High Edge ~ 40 GHz (1CC)	Low	3.0	A	28.362	40.00		-18.42	-
			B	28.395	41.74		-16.68	-
	Middle		A	28.360	41.04		-17.38	-
			B	28.390	43.17		*-15.25	-24.84
	High		A	28.363	49.74		*-8.68	-17.06
			B	28.363	49.08		*-9.34	-20.82
High Edge ~ 40 GHz (8CC)	Middle	3.0	A	28.381	42.60		*-15.82	-25.04
			B	28.433	46.08		*-12.34	-21.57

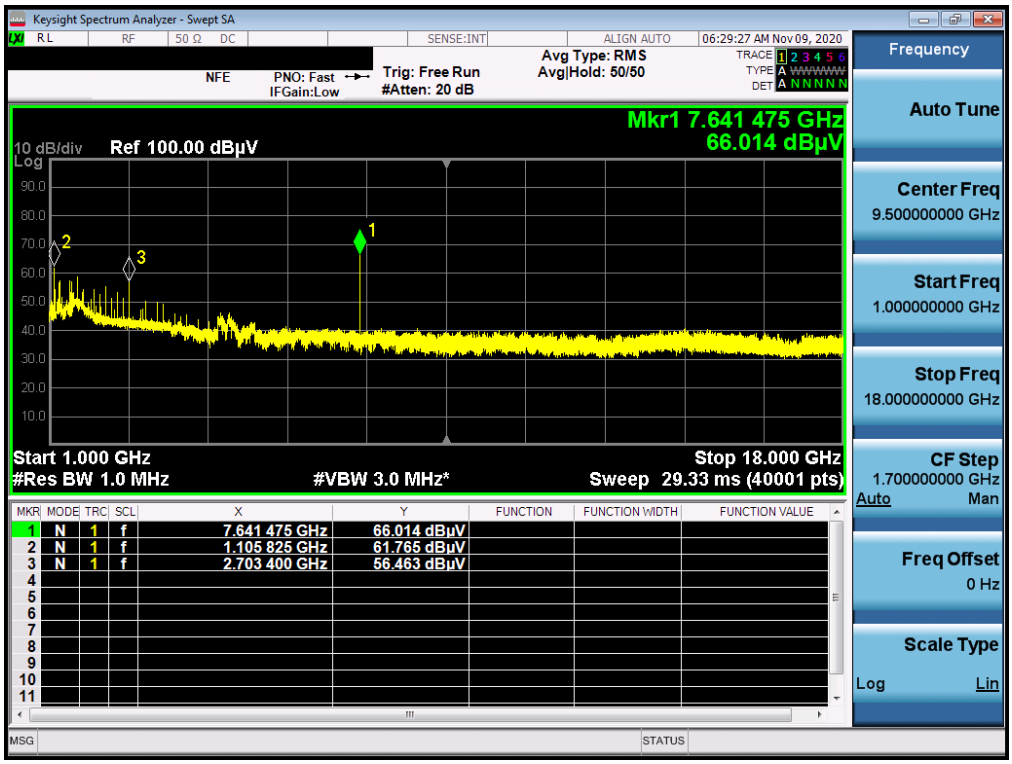
Note: '*' This checked frequency is measured by TRP, because Result value is fail or insufficient margin.

Freq.	Carrier	Distance (m)	Ant. Path	Frequency (GHz)	Measured (dBuV)	Limit (dBm)	Result (dBm)
40 GHz ~ 60 GHz	1	2.0	A	43.422	19.35	-13	-32.21
			B	45.898	19.72		-31.84
	8		A	46.041	19.29		-32.27
			B	43.404	19.33		-32.23
60 GHz ~ 90 GHz	1	1.0	A	66.558	13.92		-40.55
			B	66.974	14.86		-39.61
	8		A	68.394	14.35		-42.92
			B	63.635	13.86		-40.61
90 GHz ~ 100 GHz	1	1.0	A	90.279	24.48		-23.85
			B	91.658	24.71		-23.62
	8		A	93.044	24.99		-29.47
			B	92.389	24.47		-23.90

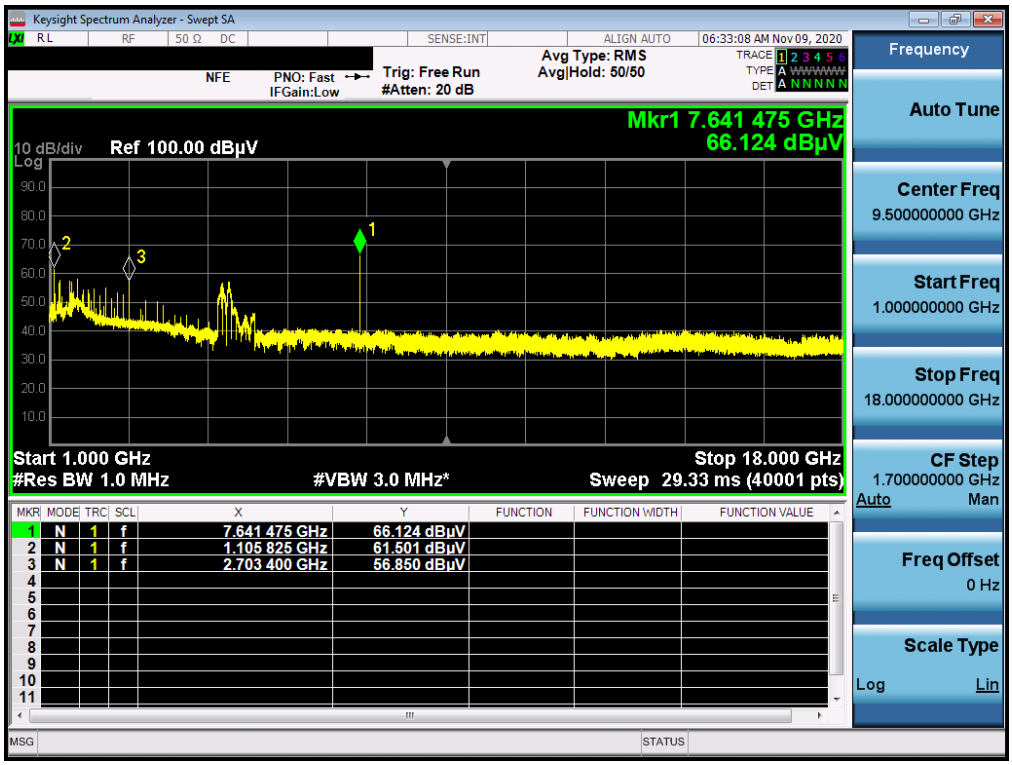
Note: Because of no critical emissions are detected in the test, only peak value is recorded in this report.

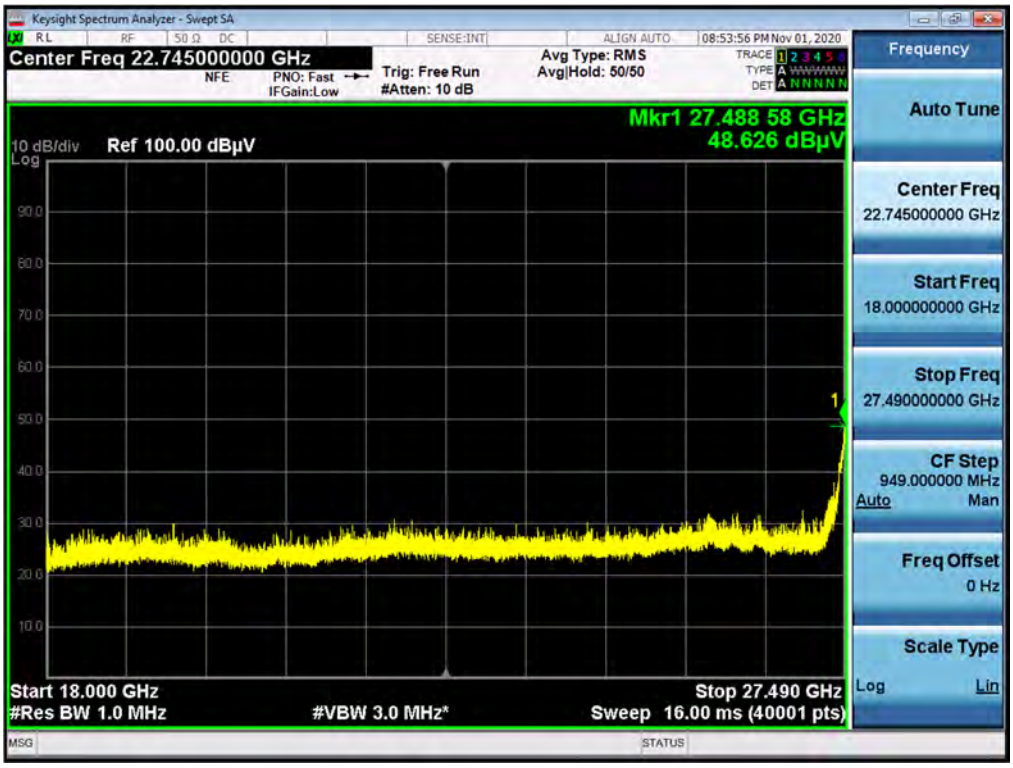
Plot data of Radiated Spurious Emissions

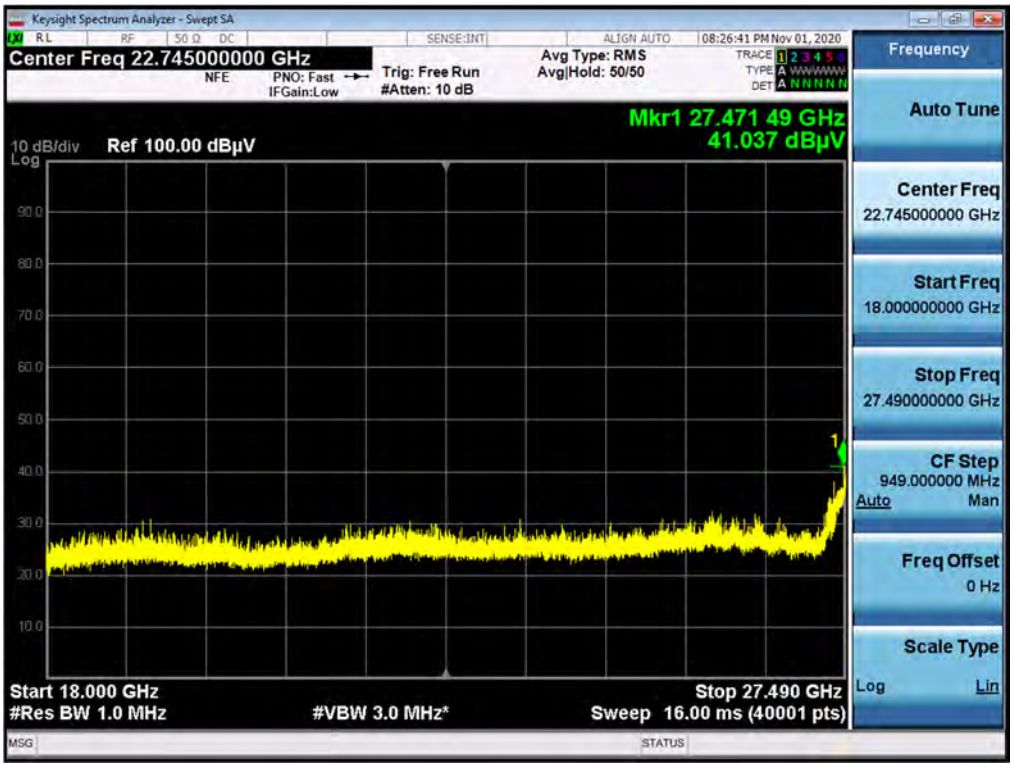
Path A / 1 GHz ~ 18 GHz / 1cc



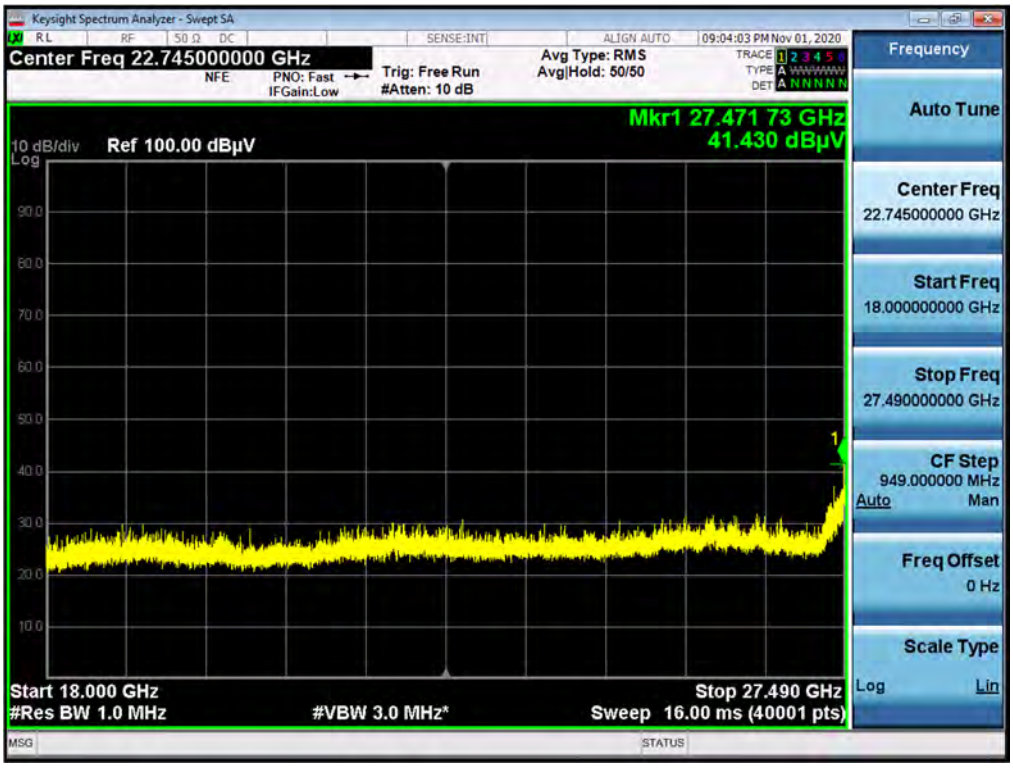
Path A / 1 GHz ~ 18 GHz / 8cc



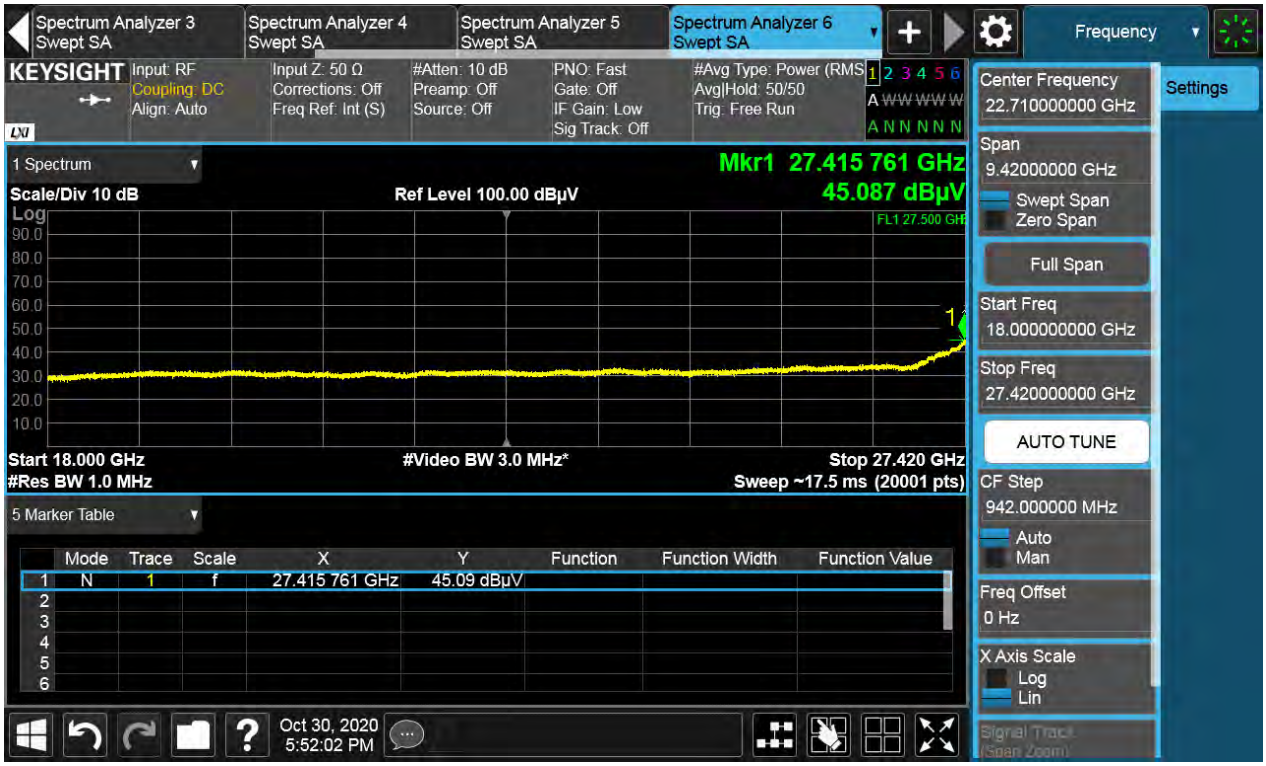
Path A / 18 GHz ~ Low Edge / 1cc / Low


Path A / 18 GHz ~ Low Edge / 1cc / Middle


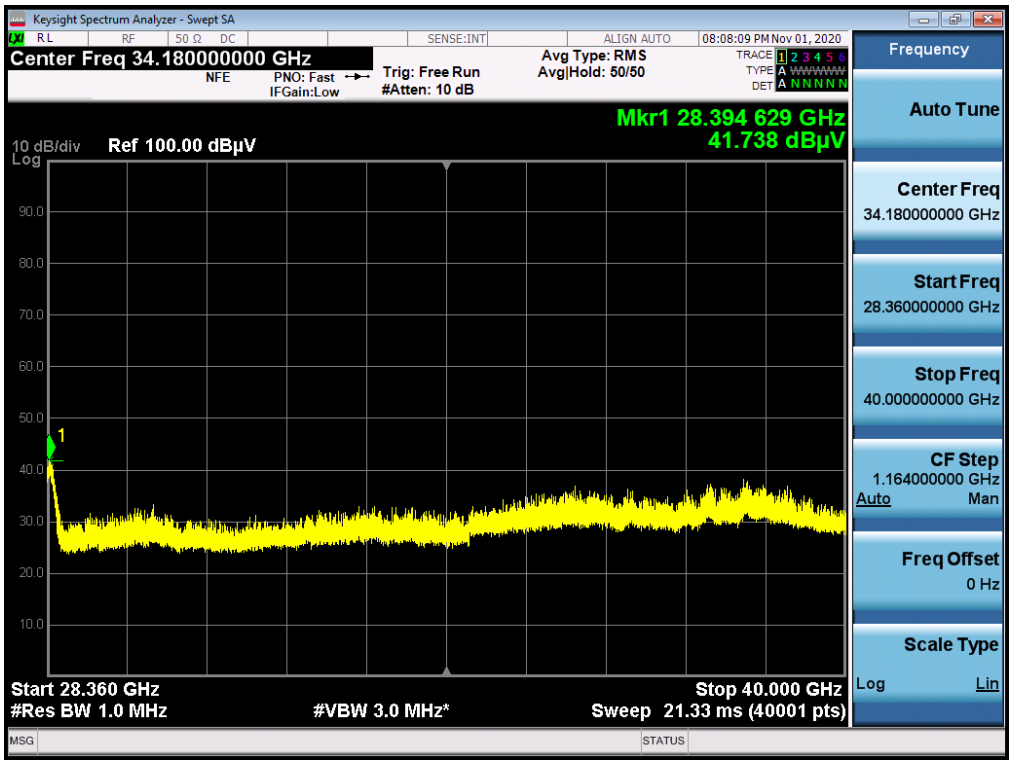
Path A / 18 GHz ~ Low Edge / 1cc / High



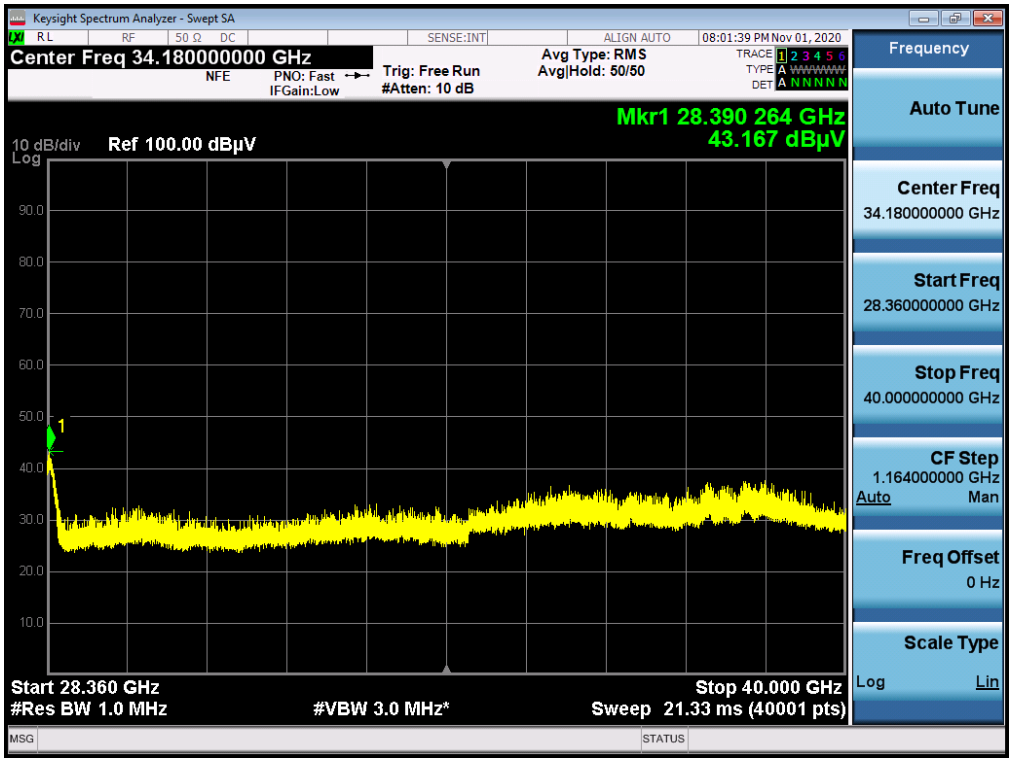
Path B/ 18 GHz ~ Low Edge / 8cc / Middle

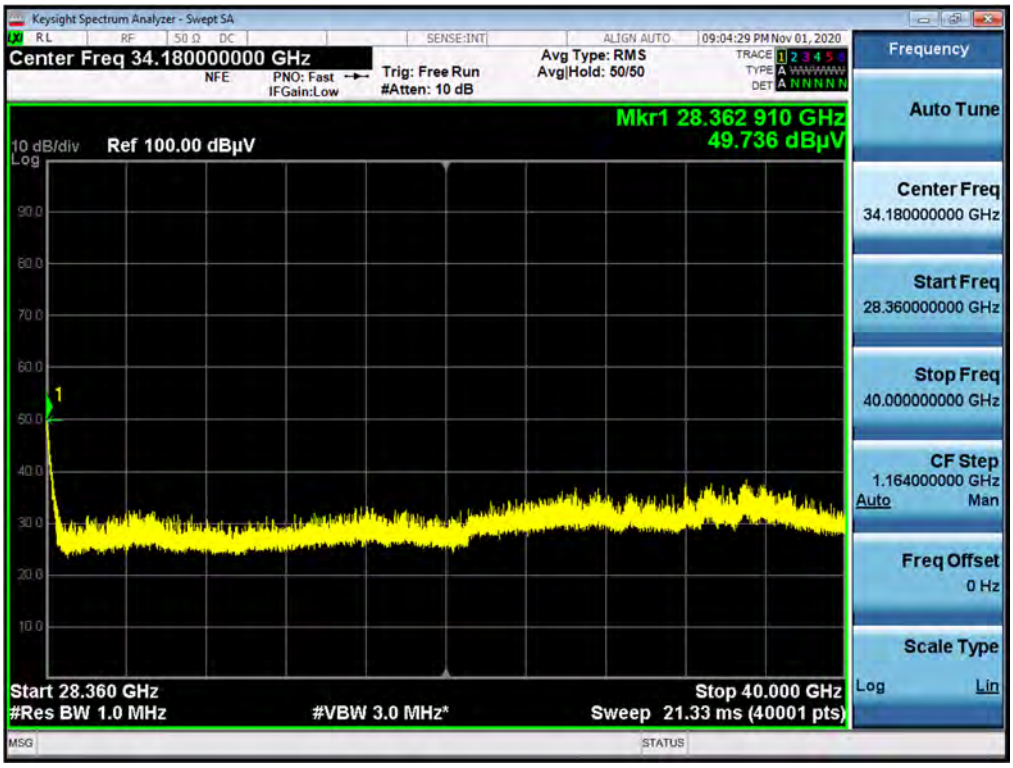


Path B / High Edge ~ 40 GHz / 1cc / Low

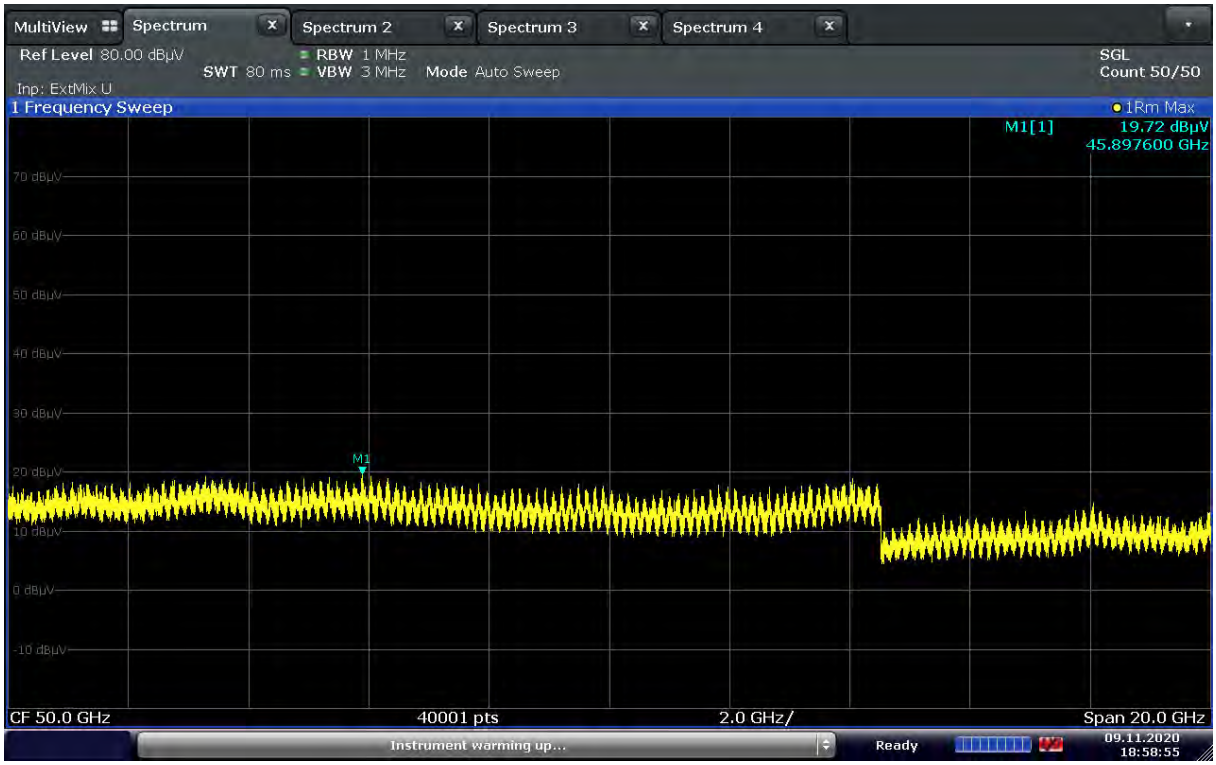


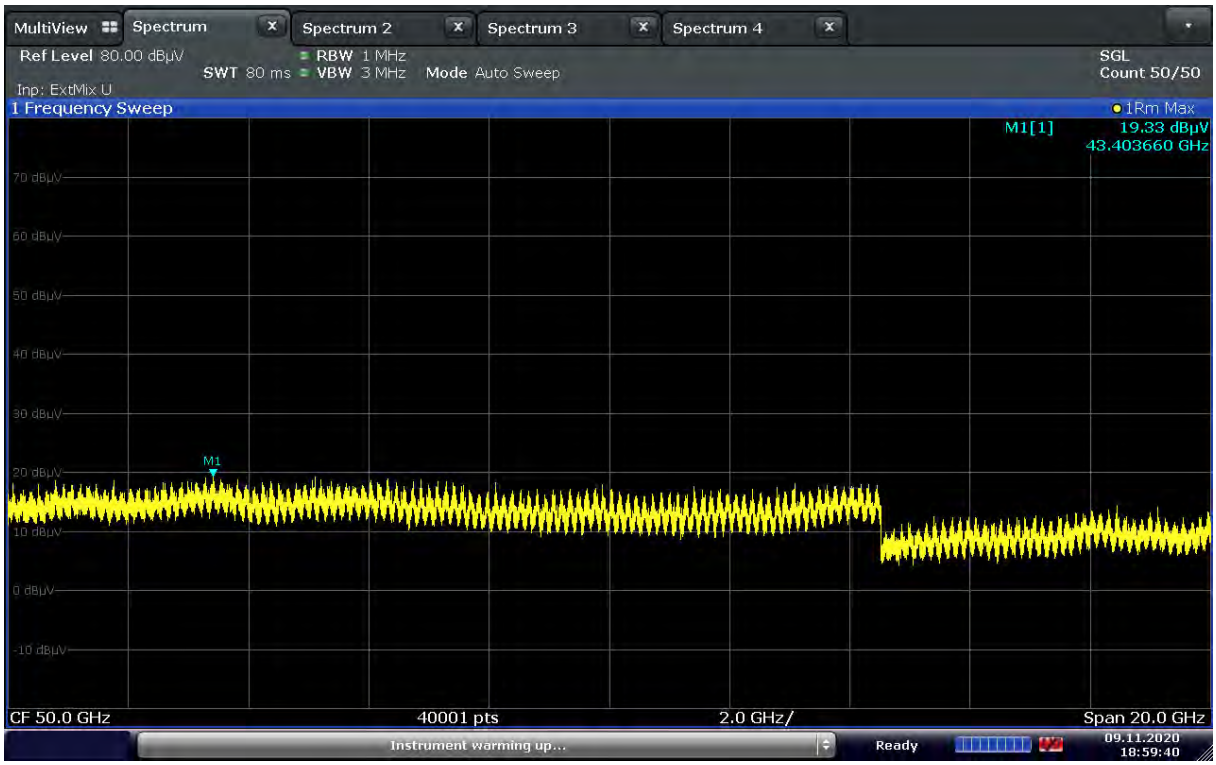
Path B / High Edge ~ 40 GHz / 1cc / Middle

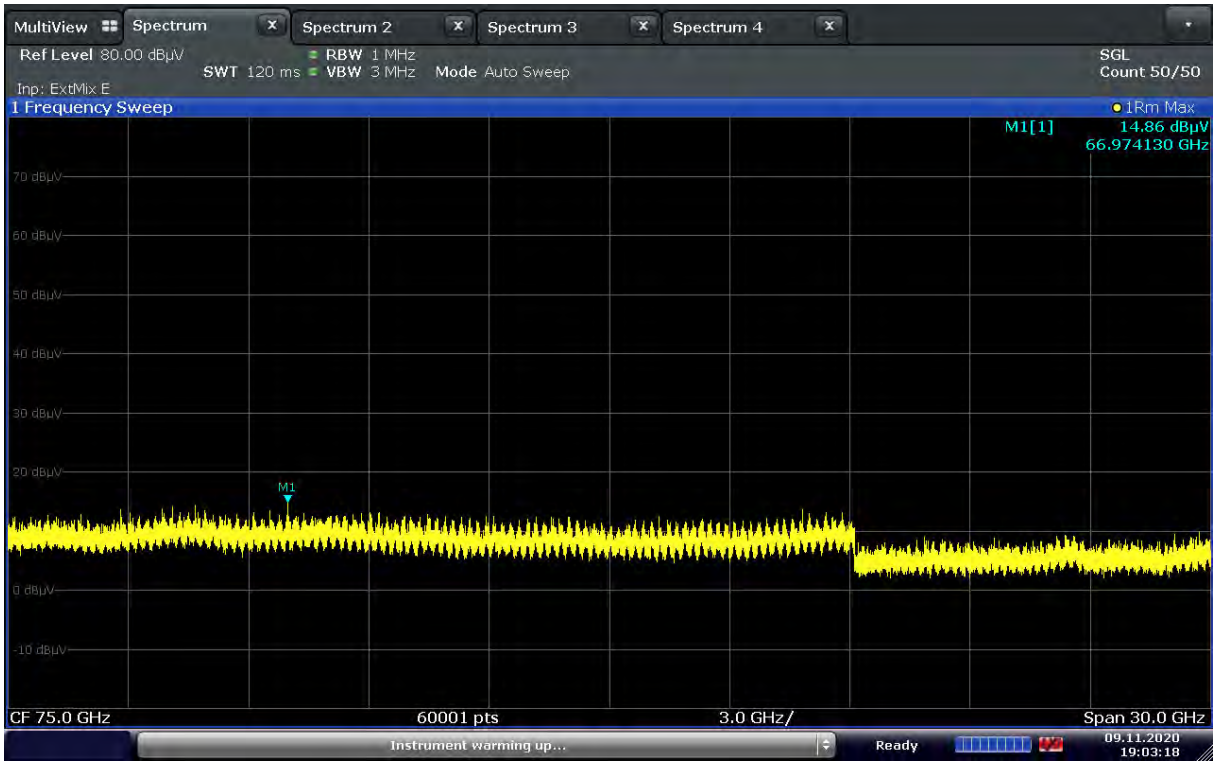


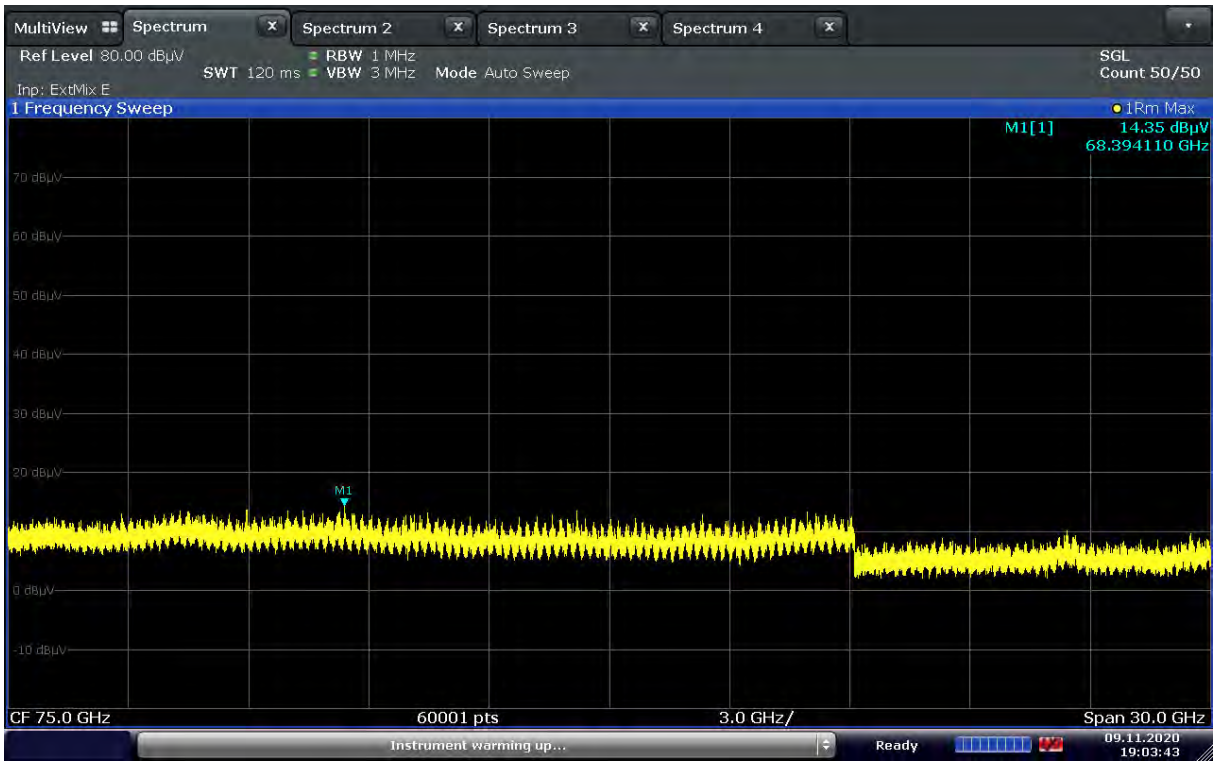
Path A / High Edge ~ 40 GHz / 1cc / High


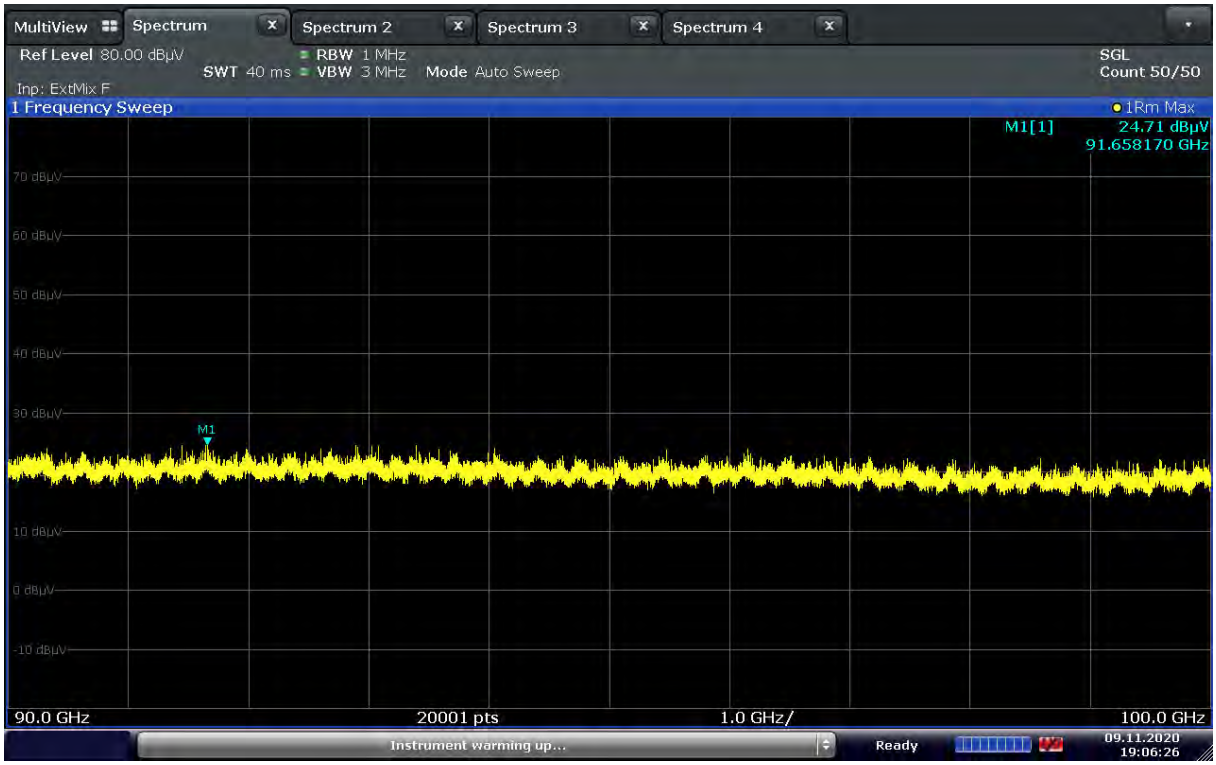
Path A / High Edge ~ 40 GHz / 8cc / Middle

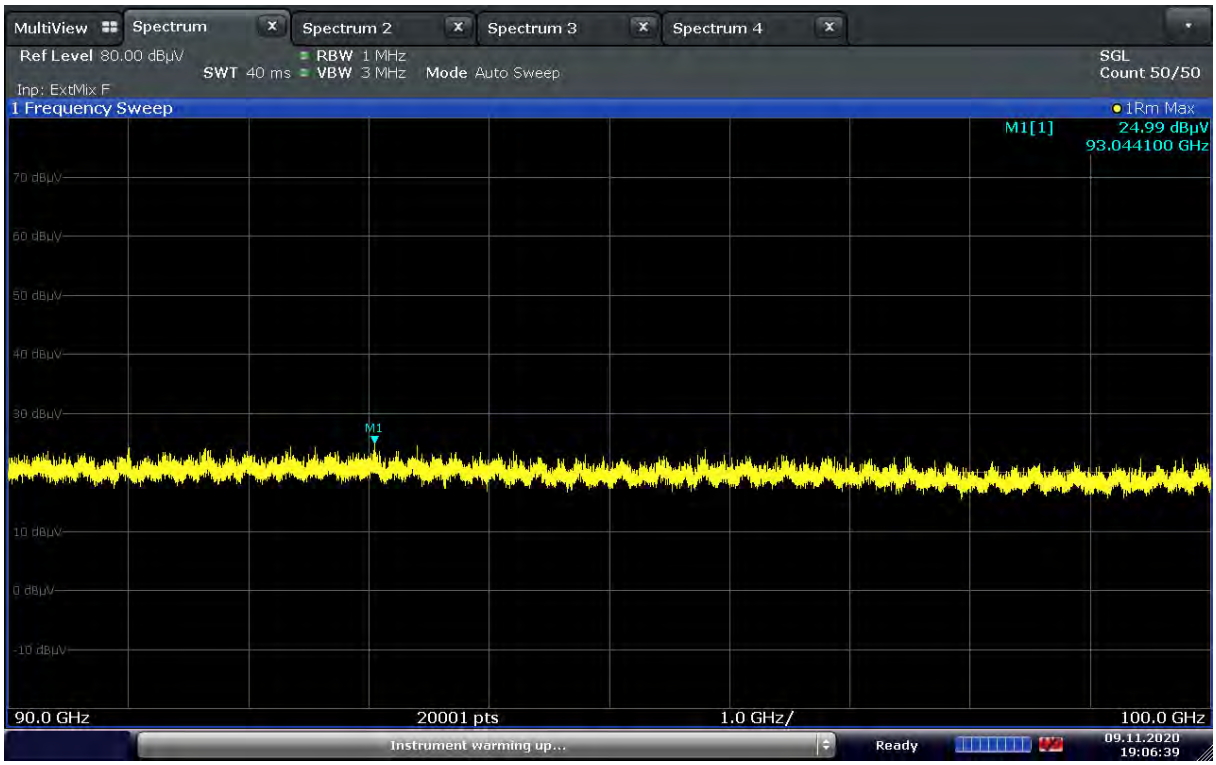

Path B / 40 GHz ~ 60 GHz / 1cc


Path B / 40 GHz ~ 60 GHz / 8cc


Path B / 60 GHz ~ 90 GHz / 1cc


Path A / 60 GHz ~ 90 GHz / 8cc


Path B / 90 GHz ~ 100 GHz / 1cc


Path A / 90 GHz ~ 100 GHz / 8cc


6. MIXER VERIFICATION CERTIFICATE & CHECK

열 람 용
This certificate may not be reproduced other than in full except with permission of the issuing laboratory.

교 정 성 적 서
CALIBRATION CERTIFICATE
경기도 이천시 마장면 서이천로 578번길 74
TEL : 031-645-6900, FAX : 031-645-6969

KOREA LABORATORY ACCREDITATION SCHEME KOLAS CALIBRATION NO KC20-011

성적서발급번호(Certificate No) : IC-2020-68829
교 정 번 호(Calibration No) : C-2020-080148

페이지(page) : 1 of 3

1. 의뢰자 (Client)
- 기관명 (Name) : (주)에이치시티
- 주소 (Address) : 경기도 이천시 마장면 서이천로 578번길 74

2. 측정기 (Calibration Subject) ◇ 등록번호 : 288234
- 기기명 (Description) : WR-19 HARMONIC MIXER
- 제작회사 및 형식(Manufacturer and Model Name) : OML / M19HWD
- 기기번호 (Serial Number) : 160429-1

3. 교정일자 (Date of Calibration) : 2020.09.09 **차기교정예정일자** : 2021.09.09 (The due date of next Calibration)

4. 교정환경 (Environment)
- 온도(Temperature) : (23.0 ± 0.6) ℃ - 습도(Humidity) : (50 ± 2) % R.H.
- 교정장소 (Location) : 고정표준실(Permanent Calibration Lab) (주소: 경기도 이천시 마장면 서이천로 578번길 74)

5. 측정표준의 소급성 (Traceability) ◇Field code : 40641(RF SPECTRUM ANALYZER)

교정방법 및 소급성 서술 (Calibration method and/or brief description)

상기 기기는 고주파 스펙트럼 분석기의 교정절차(HCT-CS-125-40641)에 따라 국가측정표준기관으로부터 측정의 소급성이 확보된 아래의 표준장비를 이용하여 교정 되었음.

교정에 사용한 표준장비 명세 (List of used standards/specifications)

기기명 (Description)	제작회사 및 형식 (Manufacturer and Model Name)	기기번호 (Serial Number)	차기교정예정일자 (The due date of next Calibration)	교정기관 (Calibration laboratory)
EXG ANALOG SIGNAL GENERATOR	KEYSIGHT N5173B	MY53270544	2021/06/23	(주)에이치시티
EPM SERIES POWER METER	AGILENT E4419B	GB42420565	2020/11/02	(주)에이치시티
POWER SENSOR	AGILENT 8487A	MY41092450	2021/01/15	Keysight Technologies
POWER SENSOR	KEYSIGHT V8486A	MY56330017	2021/01/03	Keysight Technologies
WR-19 MULTIPLIER SOURCE MODULE	OML S19MS-A	160516-1	2021/09/09	(주)에이치시티

6. 교정결과 (Calibration result) : **교정결과 참조** (Refer to attachment)

7. 측정불확도 (Measurement uncertainty) : **교정결과 참조** (Refer to attachment)
신뢰수준 약 95 %, k = 2 (Confidence level about 95 %, k = 2)

확 인 (affirmation)	작성자 (Measurements performed by)	승인자 (Approved by)
	성명 (Name) 박 민 지	직위 (Title) 기술책임자(Technical Cal. Manager) (정) 성명 (Name) 이 승 찬 (서명)

위 성적서는 국제시험기관인정협력체(International Laboratory Accreditation Cooperation) 상호인정협정(Mutual Recognition Arrangement)에 서명한 한국인정기구(KOLAS)로부터 공인 받은 분야의 교정결과입니다.

2020. 09. 10

한국인정기구 인정
Accredited by KOLAS, Republic of KOREA

㈜에이치시티 대표이사
President, HCT Co., Ltd.

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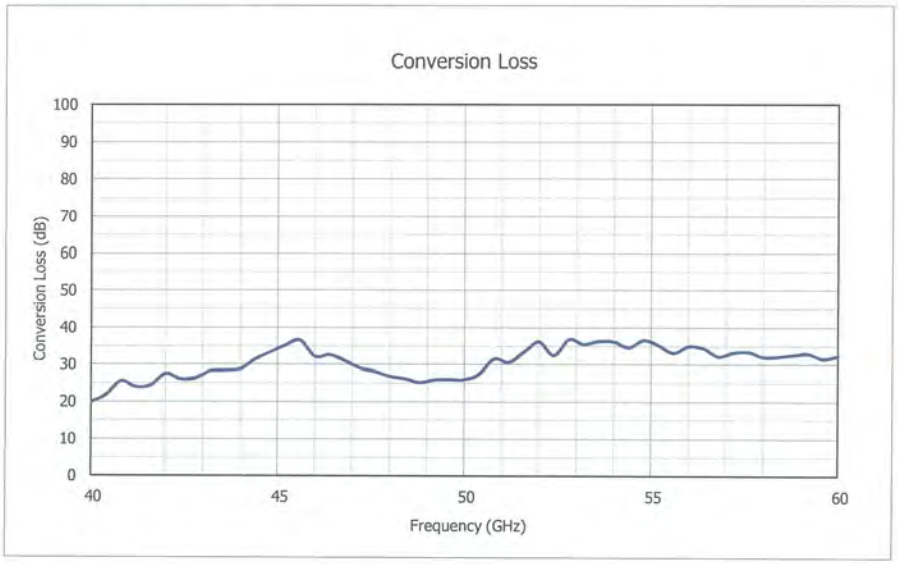
※ 고객전용사이트(http://www.callab.co.kr)에서 성적서의 진위여부 확인이 가능합니다.
※ 성적서의 원본은 상단에 HCT홀로그램이 들어간 위변조 방지 용지에 인쇄되어 발급되며, 원본 복사시에는 복사본이라는 표시가 처리됩니다.

F-02P-02-008 (Rev.02)

교 정 결 과
CALIBRATION RESULT

성적서발급번호(Certificate No) : IC-2020-68829
교 정 번 호(Calibration No) : C-2020-080148

1. Conversion Loss Graph



Note 1) R&S FSW (SN 104544)와 함께 교정된 결과임
Note 2) 측정 조건 : RF = -25 dBm, Harmonic Order = 4, L.O. Level = 15.5 dBm, Bias Value = 5.70 mA

F-02P-02-008 (Rev.02)

교 정 결 과
CALIBRATION RESULT

성적서발급번호(Certificate No) : IC-2020-68829
교 정 번 호(Calibration No) : C-2020-080148

2. Conversion Loss Data

Frequency (GHz)	Conversion Loss (dB)	Measurement Uncertainty (dB)	Frequency (GHz)	Conversion Loss (dB)	Measurement Uncertainty (dB)
40.0	19.8	0.8	50.4	27.4	0.8
40.4	21.7	0.8	50.8	31.4	0.8
40.8	25.5	0.8	51.2	30.5	0.8
41.2	23.9	0.8	51.6	33.4	0.8
41.6	24.4	0.8	52.0	36.1	0.8
42.0	27.5	0.8	52.4	32.4	0.8
42.4	26.0	0.8	52.8	36.7	0.8
42.8	26.3	0.8	53.2	35.4	0.8
43.2	28.2	0.8	53.6	36.3	0.8
43.6	28.3	0.8	54.0	36.1	0.8
44.0	28.7	0.8	54.4	34.6	0.8
44.4	31.4	0.8	54.8	36.5	0.8
44.8	33.3	0.8	55.2	35.2	0.8
45.2	35.1	0.8	55.6	33.1	0.8
45.6	36.5	0.8	56.0	34.9	0.8
46.0	32.1	0.8	56.4	34.4	0.8
46.4	32.6	0.8	56.8	32.1	0.8
46.8	30.9	0.8	57.2	33.2	0.8
47.2	29.0	0.8	57.6	33.4	0.8
47.6	28.1	0.8	58.0	32.0	0.8
48.0	26.8	0.8	58.4	32.1	0.8
48.4	26.2	0.8	58.8	32.5	0.8
48.8	25.2	0.8	59.2	32.9	0.8
49.2	25.8	0.8	59.6	31.5	0.8
49.6	26.0	0.8	60.0	32.3	0.8
50.0	25.9	0.8	-	-	-

끝.

F-02P-02-00B (Rev.02)

열 람 용
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교 정 성 적 서
CALIBRATION CERTIFICATE

경기도 이천시 마장면 서이천로 578번길 74
TEL : 031-645-6900, FAX : 031-645-6969

성적서발급번호(Certificate No) : IC-2020-68830
교 정 번 호(Calibration No) : C-2020-080149

1. 의뢰자 (Client)
- 기관명 (Name) : (주)에이치시티
- 주소 (Address) : 경기도 이천시 마장면 서이천로 578번길 74

2. 측정기 (Calibration Subject) ◇ 등록번호 : 288235
- 기기명 (Description) : WR-12 HARMONIC MIXER
- 제작회사 및 형식(Manufacturer and Model Name) : OML / M12HWD
- 기기번호 (Serial Number) : 160419-1

3. 교정일자 (Date of Calibration) : 2020.09.09 **차기교정예정일자** : 2021.09.09 (The due date of next Calibration)

4. 교정환경 (Environment)
- 온도(Temperature) : (23.0 ± 0.6) ℃ - 습도(Humidity) : (50 ± 2) % R.H.
- 교정장소 (Location) : 고정표준실(Permanent Calibration Lab) (주소: 경기도 이천시 마장면 서이천로 578번길 74)

5. 측정표준의 소급성 (Traceability) ◇Field code : 40641(RF SPECTRUM ANALYZER)

교정방법 및 소급성 서술 (Calibration method and/or brief description)

상기 기기는 고주파 스펙트럼 분석기의 교정절차(HCT-CS-125-40641)에 따라 국가측정표준기관으로부터 측정의 소급성이 확보된 아래의 표준장비를 이용하여 교정 되었음.

교정에 사용한 표준장비 명세 (List of used standards/specifications)

기기명 (Description)	제작회사 및 형식 (Manufacturer and Model Name)	기기번호 (Serial Number)	차기교정예정일자 (The due date of next Calibration)	교정기관 (Calibration laboratory)
EXG ANALOG SIGNAL GENERATOR	KEYSIGHT N5173B	MY53270544	2021/06/23	(주)에이치시티
EPM SERIES POWER METER	AGILENT E4419B	GB42420565	2020/11/02	(주)에이치시티
POWER SENSOR	KEYSIGHT V8486A	MY56330017	2021/01/03	Keysight Technologies
POWER SENSOR	KEYSIGHT W8486A	MY56370005	2020/12/30	Keysight Technologies
WR-12 MULTIPLIER SOURCE MODULE	OML S12MS-A	160419-1	2021/09/09	(주)에이치시티

6. 교정결과 (Calibration result) : **교정결과 참조** (Refer to attachment)

7. 측정불확도 (Measurement uncertainty) : **교정결과 참조** (Refer to attachment)
신뢰수준 약 95 %, k = 2 (Confidence level about 95 %, k = 2)

확 인 (affirmation)	작성자 (Measurements performed by)	승인자 (Approved by)
	성명 (Name) 박 민 지	직위 (Title) 기술책임자(Technical Cal. Manager) (정) 성명 (Name) 이 승 찬 (서명)

위 성적서는 국제시험기관인정협력체(International Laboratory Accreditation Cooperation) 상호인정협정(Mutual Recognition Arrangement)에 서명한 한국인정기구(KOLAS)로부터 공인 받은 분야의 교정결과입니다.

2020. 09. 10

한국인정기구 인정
Accredited by KOLAS, Republic of KOREA

㈜에이치시티 대표이사
President, HCT Co., Ltd.

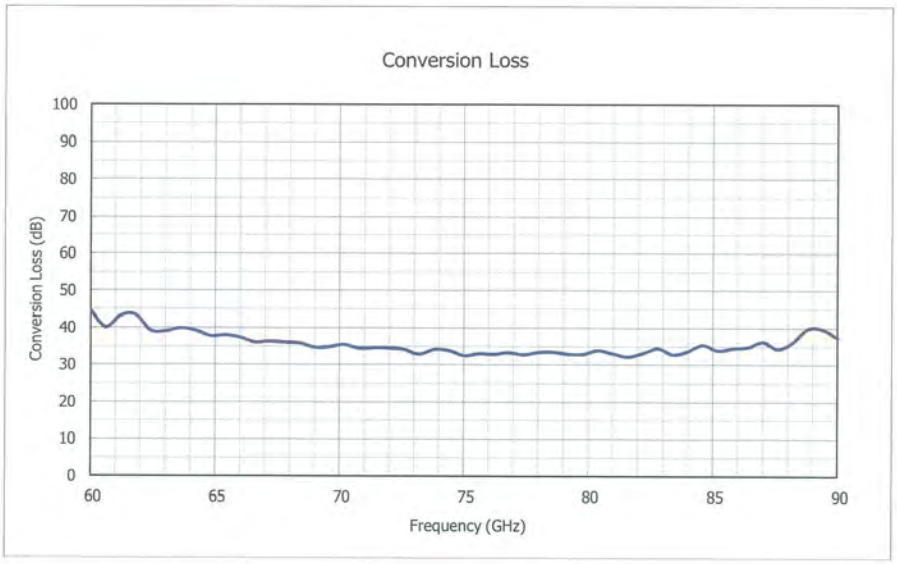
※ 이 성적서는 측정기의 정밀정확도에 영향을 미치는 요소(과부하, 온도, 습도 등)의 급격한 변화가 발생한 경우에는 무효가 됩니다.
※ 고객전용사이트(http://www.callab.co.kr)에서 성적서의 진위여부 확인이 가능합니다.
※ 성적서의 원본은 상단에 HCT홀로그램이 들어간 위변조 방지 용지에 인쇄되어 발급되며, 원본 복사시에는 복사본이라는 표시가 처리됩니다.

F-02P-02-008 (Rev.02)

교 정 결 과
CALIBRATION RESULT

성적서발급번호(Certificate No) : IC-2020-68830
교 정 번 호(Calibration No) : C-2020-080149

1. Conversion Loss Graph



Note 1) R&S FSW (SN 104544)와 함께 교정된 결과임
Note 2) 측정 조건 : RF = -25 dBm, Harmonic Order = 6, L.O. Level = 17 dBm, Bias Value = 4.98 mA

F-02P-02-008 (Rev.02)

교 정 결 과
CALIBRATION RESULT

성적서발급번호(Certificate No) : IC-2020-68830
교 정 번 호(Calibration No) : C-2020-080149

2. Conversion Loss Data

Frequency (GHz)	Conversion Loss (dB)	Measurement Uncertainty (dB)	Frequency (GHz)	Conversion Loss (dB)	Measurement Uncertainty (dB)
60.0	44.49	0.89	75.6	32.95	0.82
60.6	40.08	0.89	76.2	32.82	0.82
61.2	43.11	0.89	76.8	33.25	0.82
61.8	43.39	0.89	77.4	32.70	0.82
62.4	39.27	0.89	78.0	33.35	0.82
63.0	39.01	0.89	78.6	33.45	0.82
63.6	39.85	0.89	79.2	32.85	0.82
64.2	39.28	0.89	79.8	32.83	0.82
64.8	37.77	0.89	80.4	33.86	0.82
65.4	37.98	0.89	81.0	32.98	0.82
66.0	37.32	0.89	81.6	32.15	0.82
66.6	36.03	0.89	82.2	33.14	0.82
67.2	36.27	0.89	82.8	34.43	0.82
67.8	36.01	0.89	83.4	32.78	0.82
68.4	35.78	0.89	84.0	33.70	0.82
69.0	34.65	0.89	84.6	35.37	0.82
69.6	34.81	0.89	85.2	33.87	0.82
70.2	35.41	0.89	85.8	34.48	0.82
70.8	34.42	0.89	86.4	34.79	0.82
71.4	34.55	0.89	87.0	36.20	0.82
72.0	34.50	0.89	87.6	34.31	0.82
72.6	34.09	0.89	88.2	36.05	0.82
73.2	32.81	0.89	88.8	39.77	0.82
73.8	34.08	0.89	89.4	39.68	0.82
74.4	33.83	0.89	90.0	37.36	0.82
75.0	32.43	0.82	-	-	-

끝.

F-02P-02-008 (Rev.02)

Measurement Report

74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, Korea 17383
Tel :82-31-645-6900, www.hct.co.kr

보고서번호(Report No) : IC-2020-68833
측 정 번 호(Measurement No) : C-2020-080152

1. 의뢰자 (Client)
- 기관명 (Name) : (주)에이치시티
- 주소 (Address) : 경기도 이천시 마장면 서이천로 578번길 74

2. 대상품목 (Measurement Item) ◇ HCT 등록번호 : 366196
- 기기명 (Description) : WR-08 HARMONIC MIXER
- 제작회사 및 형식(Manufacturer and Model Name) : OML / M08HWD
- 기기번호 (Serial Number) : 160419-1

3. 측정일자 (Measurement date) : 2020.09.09

4. 측정환경 (Environment)
- 온도(Temperature) : (23.0 ± 0.6) ℃ - 습도(Humidity) : (50 ± 2) % R.H.

5. 측정방법 (Measurement method used)

상기 기기는 고주파 스펙트럼 분석기의 교정절차(HCT-CS-125-40641)에 따라 국가측정표준기관으로부터 측정의 소급성이 확보된 아래의 아래의 표준장비와 자체 점검된 장비를 이용하여 점검 되었음.

측정에 사용한 표준장비 명세 (List of used standards/specifications)

기기명 (Description)	제작회사 및 형식 (Manufacturer and Model Name)	기기번호 (Serial Number)	차기교정예정일자 (The due date of next Calibration)	교정기관 (Calibration laboratory)
EXG ANALOG SIGNAL GENERATOR	KEYSIGHT N5173B	MY53270544	2021/06/23	(주)에이치시티
ERICKSON POWER METER	VDI PM5	394V	측정	(주)에이치시티
WR-08 MULTIPLIER SOURCE MODULE	OML S08MS-A	160419-1	측정	(주)에이치시티

6. 측정결과 (Messurement result) **: 측정결과 참조** (Refer to attachment)

㈜ 이 측정결과는 의뢰자가 제시한 시료 및 시료명에만 한정됩니다.
The messuremen results shown in this report refer only to the sample(s) measured unless otherwise stated.

확 인 (Affirmation)	작성자 (Tested by) 성명 (Name) : 박 민 지	승인자 (Approved by) 직위 (Title) 기술책임자(Technical Manager) 성명 (Name) 이 승 찬 (서명)

이 성적서는 ILAC MRA 서명 기관인 KOLAS(Korea Laboratory Accreditation Scheme)와 A2LA (American Laboratory for Laboratory Accreditation)의 인정과 무관합니다. This calibration certificate is Not an accredited report by KOLAS(Korea Laboratory Accreditation Scheme) and A2LA(American Association for Laboratory Accreditation), a ILAC MRA signatory.

2020. 09. 10

㈜에이치시티 대표이사
President, HCT Co., Ltd.

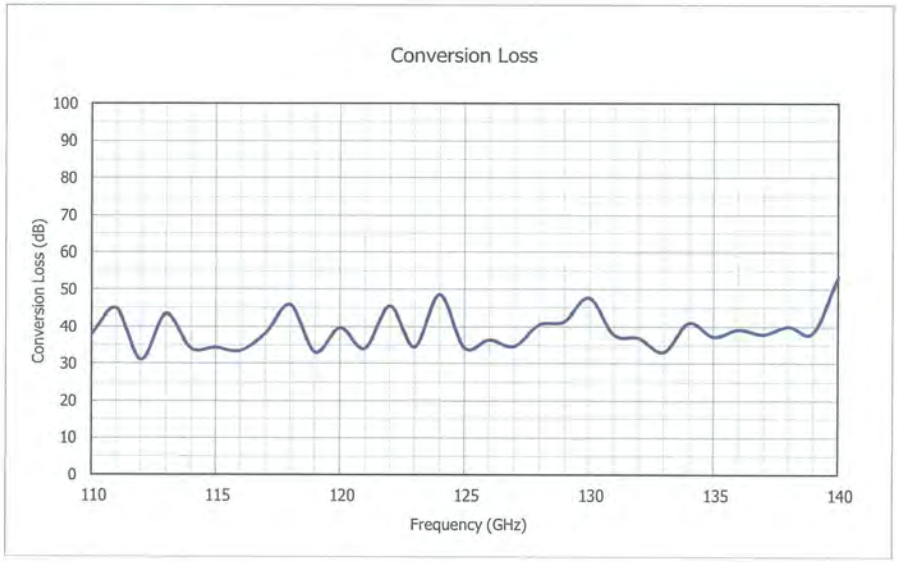
㈜ 측정결과는 측정기의 정밀정확도에 영향을 미치는 요소(과부하, 온도, 습도 등)의 급격한 변화가 발생한 경우에는 무효가 됩니다. If any significant instability or other adverse factor(overload, temperature, humidity etc.) manifests itself before, during or after calibration, and is likely to affect the validity of the calibration.

F-02P-02-010 (Rev.01)

MEASUREMENT RESULT

보고서번호(Report No) : IC-2020-68833 페이지(page) : 2 of 3
측 정 번 호(Measurement No) : C-2020-080152

1. Conversion Loss Graph



Note 1) R&S FSW (SN 104544)와 함께 교정된 결과임
Note 2) 측정 조건 : RF = -25 dBm, Harmonic Order = 10, L.O. Level = 17 dBm, Bias Value = 0.01 mA
Note 3) 110 GHz 초과 대역의 전력에 대해 국제적인 소급표준이 없으므로 HCT에서 자체 점검된 기준기로 점검되었음.
- In the absence of power standards above 110 GHz, power measurements above 110 GHz are to confirm operation functionality and traceable only to HCT.

F-02P-02-010 (Rev.01)

MEASUREMENT RESULT

보고서번호(Report No) : IC-2020-68833
측 정 번 호(Measurement No) : C-2020-080152

2. Conversion Loss Data

Frequency (GHz)	Conversion Loss (dB)	Measurement Uncertainty (dB)	Frequency (GHz)	Conversion Loss (dB)	Measurement Uncertainty (dB)
110.0	37.8	0.82	126.0	36.4	0.82
111.0	44.8	0.82	127.0	34.6	0.82
112.0	31.0	0.82	128.0	40.5	0.82
113.0	43.4	0.82	129.0	41.4	0.82
114.0	34.1	0.82	130.0	47.6	0.82
115.0	34.3	0.82	131.0	37.8	0.82
116.0	33.5	0.82	132.0	36.9	0.82
117.0	38.1	0.82	133.0	33.1	0.82
118.0	45.8	0.82	134.0	41.0	0.82
119.0	33.0	0.82	135.0	37.2	0.82
120.0	39.7	0.82	136.0	39.2	0.82
121.0	34.0	0.82	137.0	37.9	0.82
122.0	45.4	0.82	138.0	40.0	0.82
123.0	34.5	0.82	139.0	38.4	0.82
124.0	48.5	0.82	140.0	53.3	0.82
125.0	34.2	0.82	-	-	-

끝.

F-02P-02-010 (Rev.01)

7. Annex B_EUT AND TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2011-FC016-P