FCC PART 30

TEST REPORT

For

Corning Optical Communication Wireless

8253 1st Ave., Vienna, Virginia 22182, USA

FCC ID: OJFRN520

Report Type:	**Product Type:**
Original Report	Small Cell Radio Node

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ACCREDITED
CERTIFICATE #3297.02

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2102038	Original Report	2021-04-05
1	R2102038	Upated TCB reviewer's comments	2021-04-23
2	R2102038 Rev A	Updated applicable RF Exposure requirement	2021-05-28

1 General Description

1.1 Product Description for Equipment under Test (EUT)

This test report was prepared on behalf of *Corning Optical Communication Wireless*, and their product model: SCRN-520-28, FCC ID: OJFRN520 or the "EUT" as referred to in this report. It is a 5G mmWave TDD SmallCell support 2x2 MIMO operating in NR band n261. The device is a Fixed Base Station Device.

1.2 Mechanical Description of EUT

SCRN-520-28 measures approximately 270 mm (Length) x 270 mm (Width) x 80 mm (High), and weighs approximately 4.6kg.

The data gathered are from two production samples provided by Corning Optical Communication SN: 123456789A

1.3 Objective

This report was prepared on behalf of Corning Optical Communications in accordance with FCC Part 30.

The objective was to determine compliance with FCC Part 30 rules for EIRP, RF Exposure, 99% Bandwidth, Frequency Stability, Out of Band Emissions at the Band-edge, Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.26-2015, American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services, and FCC KDB 842590 D01 Upper Microwave Flexible Use Service v01r01.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 º C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.7 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02)*****,** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical

Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes & Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)

- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
  - Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 EUT Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.26-2015 and FCC KDB 842590 D01 Upper Microwave Flexible Use Service v01r01.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

The worst-case data rates are determined by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The test software used was QRCT. The software is compliant with the standard requirements being tested against.

Beam ID tested was selected based on customer's declaration for worst case. Please refer to the following power setting table.

Bandwidth (MHz)	Polarity	Beam ID	Mode	Channel No.	Frequency (MHz)	Power Settings
100 (1CC)	Vertical	11	QPSK	2071666	27550	430
				2077916	27925	430
				2084166	28300	430
			64QAM	2071666	27550	430
				2077916	27925	430
				2084166	28300	430
	Horizontal	139	QPSK	2071666	27550	430
				2077916	27925	430
				2084166	28300	430
			64QAM	2071666	27550	430
				2077916	27925	430
				2084166	28300	430
400 (4CC)	Vertical	11	QPSK	2074166	27700.02	430
				2077918	27925.14	430
				2081666	28150.02	430
			64QAM	2074166	27700.02	430
				2077918	27925.14	430
				2081666	28150.02	430
	Horizontal	139	QPSK	2074166	27700.02	430
				2077918	27925.14	430
				2081666	28150.02	430
			64QAM	2074166	27700.02	430
				2077918	27925.14	430
				2081666	28150.02	430

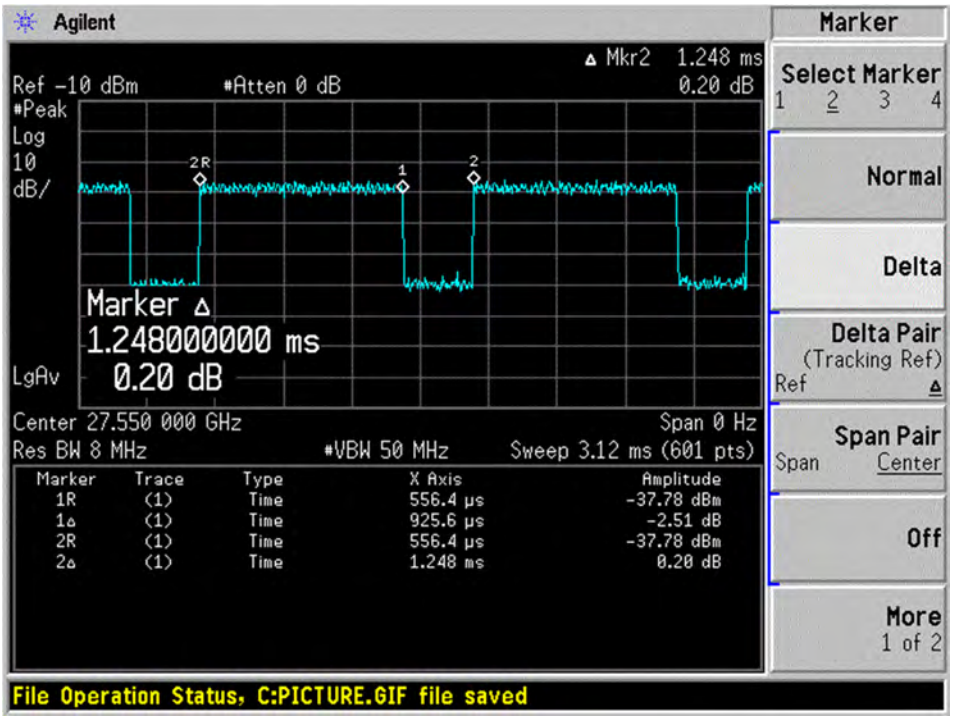
2.3 Duty Cycle Correction Factor

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
1CC-QPSK	0.9256	1.248	74.17	1.30
1CC-64QAM	0.9256	1.248	74.17	1.30
4CC-QPSK	0.9308	1.253	74.29	1.29
4CC-64QAM	0.9256	1.248	74.17	1.30

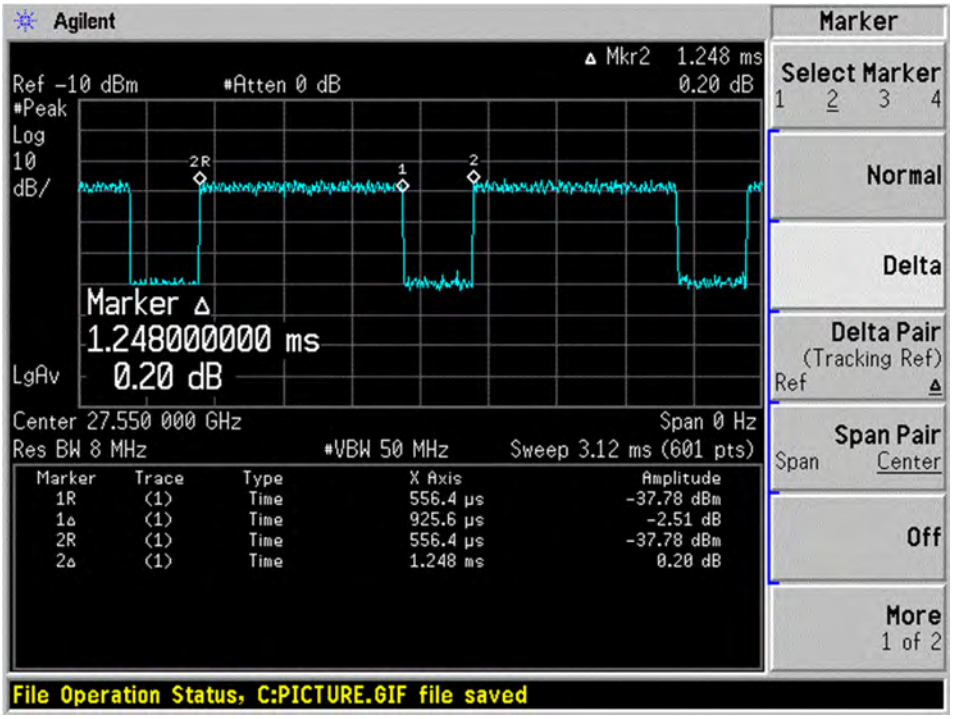
Note: Duty Cycle = On Time (ms)/ Period (ms)
Note: Duty Cycle Correction Factor = 10*log(1/duty cycle)

Please refer to the following plots.

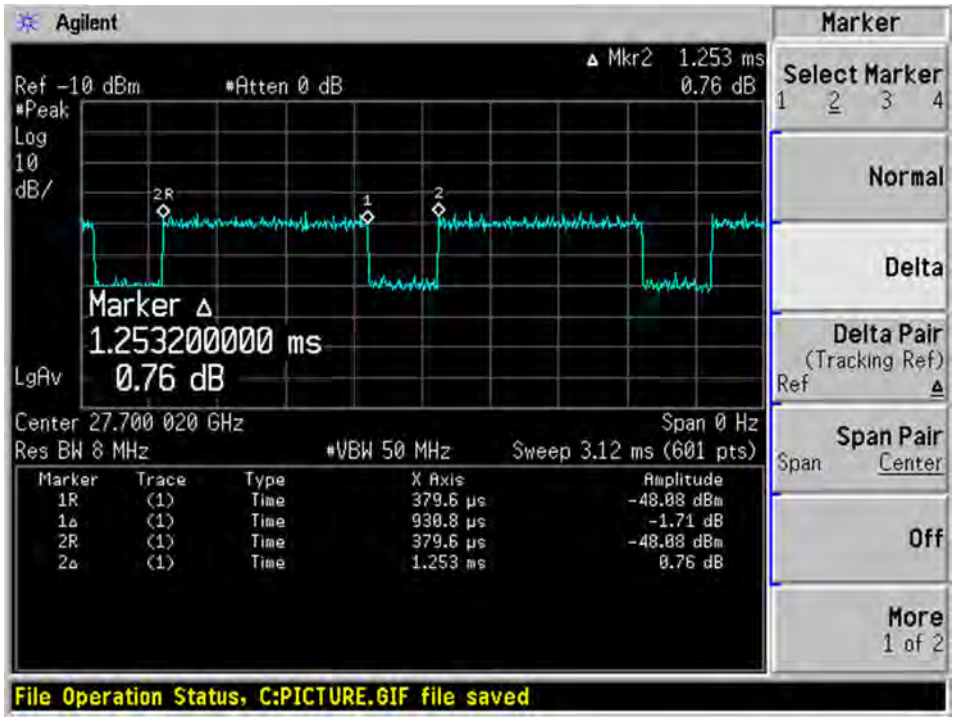
1CC-QPSK



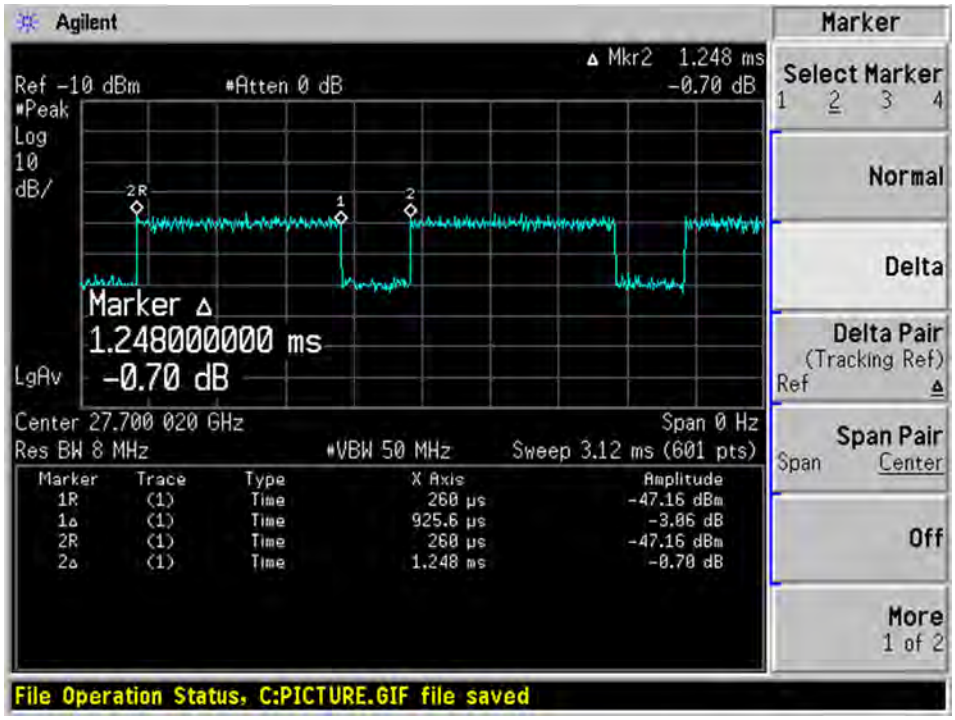
1CC – 64QAM



4CC – QPSK



4CC – 64QAM



2.4 Equipment Modifications

None

2.5 Local Support Equipment

None

2.6 Remote Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E5520
MikroTik	10 Gigabit SFP+ Switch	CRS305-1G-4S+IN

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
Ethernet Cable	1m	Laptop	Switch
Power Cable	> 5m	EUT	Power Source
Fiber Cable	> 10 m	EUT	Switch

3 Summary of Test Results

FCC Rules	Description of Test	Result
§2.1047	Modulation Characteristics	Compliant
§1.1307, §1.1310	RF Exposure	Compliant
§2.1047	Antenna Requirement	Compliant
§2.1053, §30.203	Radiated Spurious Emissions	Compliant
§2.1049	99% Bandwidth	Compliant
§2.1051, §30.202(a)	EIRP	Compliant
§2.1053, §30.203	Out of Band Emission at the Band-edge	Compliant
§2.1055	Frequency Stability	Compliant

4 FCC §2.1047 - Modulation Characteristics

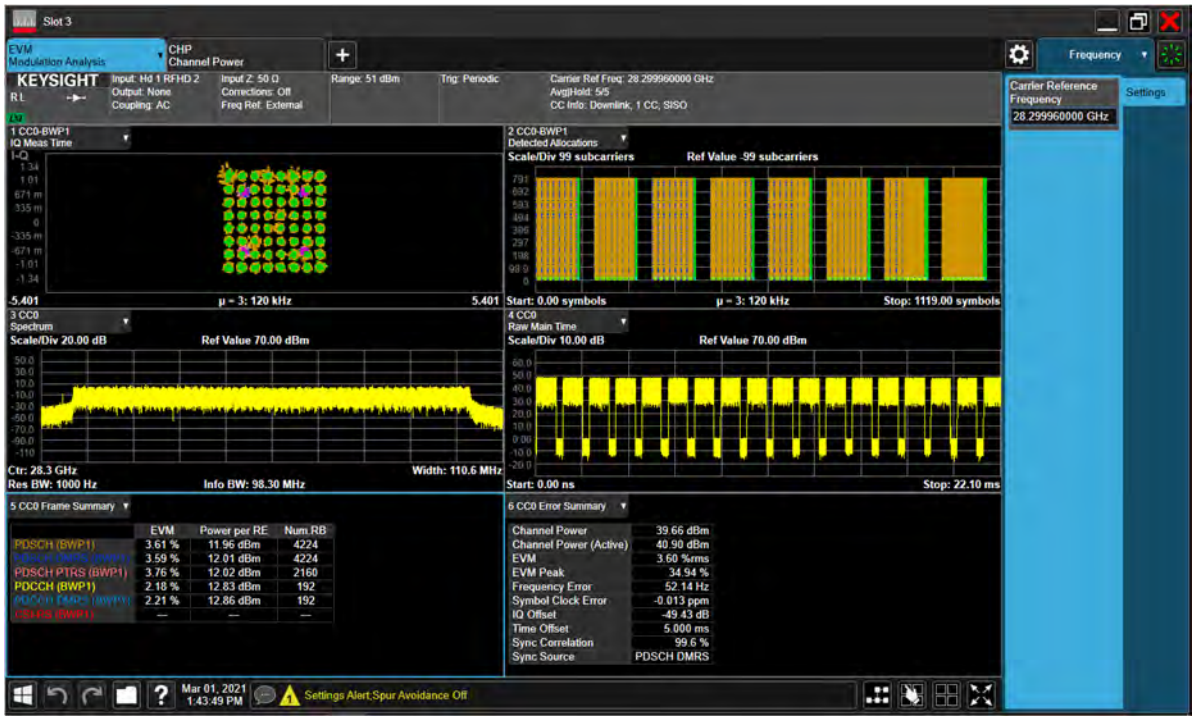
4.1 Applicable Standards

According to FCC §2.1047:
(a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.
(b) Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.
(c) Single sideband and independent sideband radiotelephone transmitters which employ a device or circuit to limit peak envelope power. A curve showing the peak envelope power output versus the modulation input voltage shall be supplied. The modulating signals shall be the same in frequency as specified in paragraph (c) of §2.1049 for the occupied bandwidth tests.
(d) Other types of equipment. A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

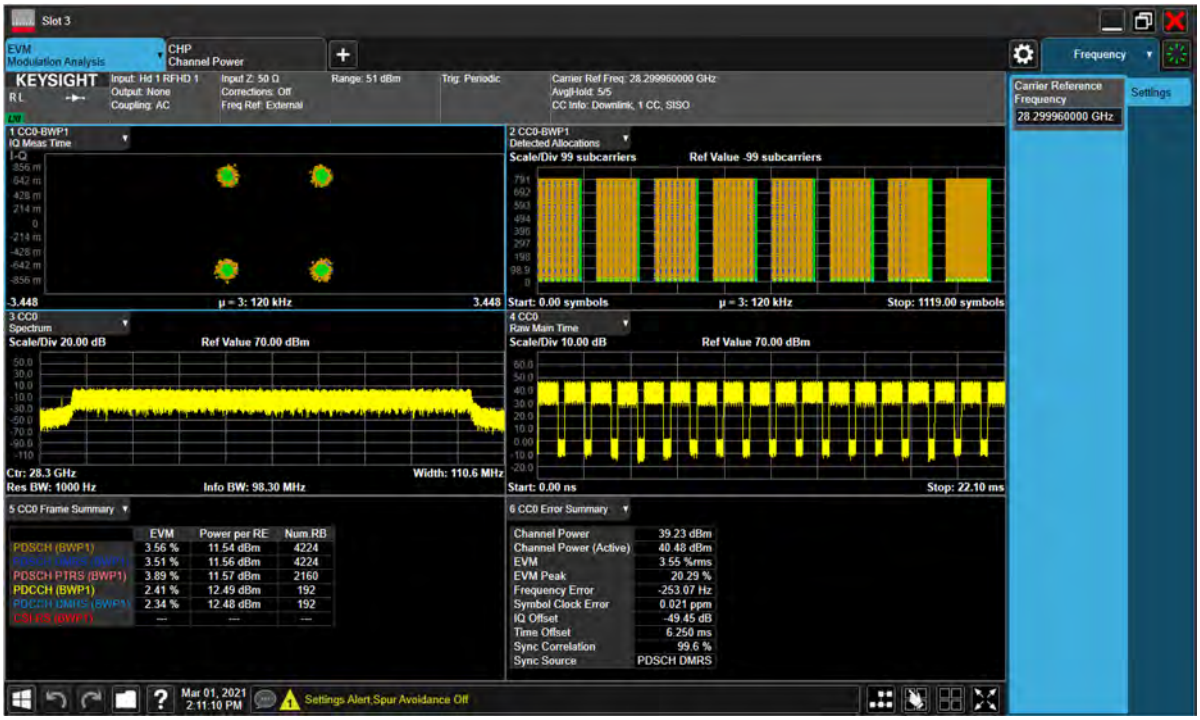
4.2 Test Results

QPSK-High Chanel Horizontal

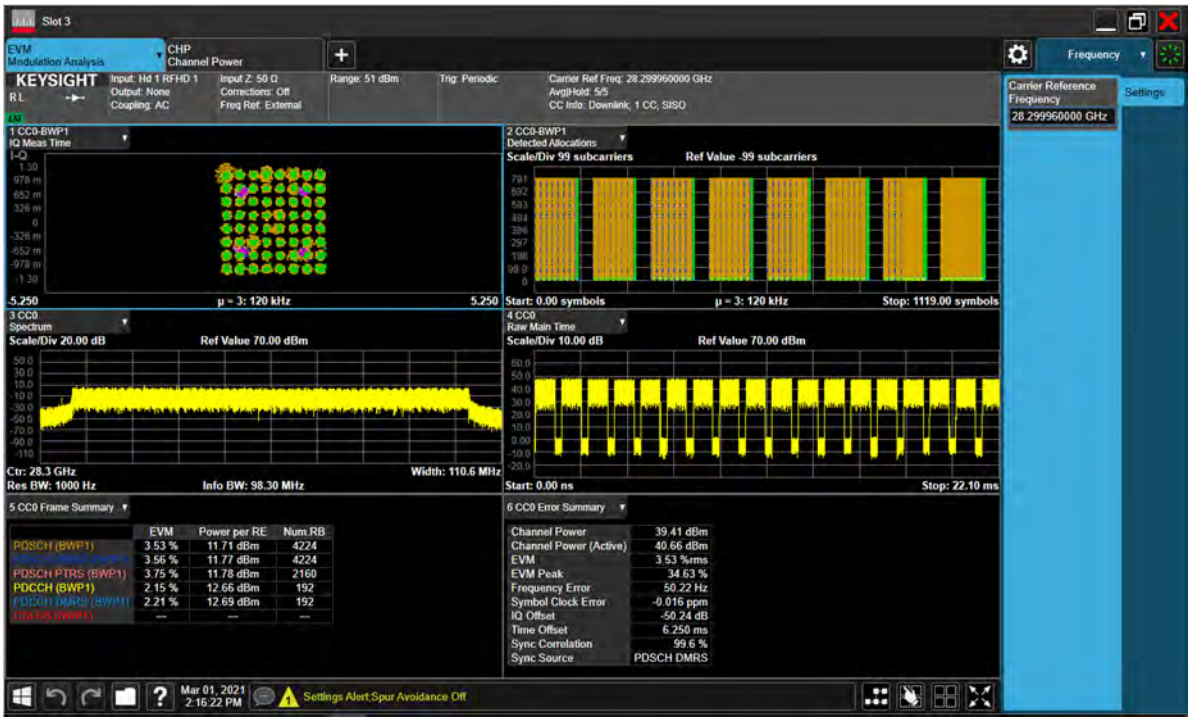
64QAM-High Channel Horizontal



QPSK-High Channel Vertical



64QAM-High Channel Vertical



5 FCC §1.1307 & §1.1310 - RF Exposure

5.1 Applicable Standards

FCC §1.1307 & §1.1310.

According to FCC §1.1310 (e)(1), the following table sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* ($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

Where: f = frequency in MHz
* = Plane-wave equivalent power density

5.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

5.3 MPE Results

Worst Case: 4CC-QPSK Middle Channel, 27925 MHz

Maximum EIRP(dBm):	43.42
Maximum EIRP(mW):	21978.60
Prediction frequency (MHz):	27925.14
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
Prediction distance (cm):	41.82

In order to meet the RF exposure requirements for general population, the device must be installed to maintain separation distance of at least 41.82 cm. This device is clarified as fixed station.

6 FCC §2.1047 - Antenna Requirements

6.1 Applicable Standards

According to FCC §2.1047:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

6.2 Antenna List

Model No.	Frequency Range (MHz)	Antenna Type	Maximum Antenna Gain (dBi)
QTM10028	27500-28350	Patch Array	22.5

Note: the antenna gain was provided by manufacturer.

7 FCC §2.1053 & §30.203 - Radiated Spurious Emissions

7.1 Applicable Standard

(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.

(c) For fixed point-to-point and point-to-multipoint limits see § 30.404.

7.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.26-2015. The specification used was the FCC part 30 limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

7.3 Test Procedure

For the radiated emissions test, the EUT, and all support equipment power cords were connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meters away from the testing antenna, which is varied from 1-4 meters, and the EUT is placed on a turntable, which is 0.8 meter or 1.5 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver was set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 3MHz / Sweep = 100ms
(2) Average: RBW = 1MHz / VBW = 3MHz / Sweep = Auto

Record the measured emission amplitude level and frequency using the appropriate RBW. Repeat previeous steps for each emission frequency with the measurement antenna oriented in both the horizontal and vertical polarizations to determine the orientation that gives the maximum emissions amplitude.

For emissions below 40 GHz, signal substitution method was used:

Connect a signal generator to the substitution antenna; locate the signal generator so as to minimize any potential influences on the measurement results. Set the signal generator to the frequency where emissions are detected, and set an output power level such that the radiated signal can be detected by the measurement instrument, with sufficient dynamic range relative to the noise floor.

For each emission that was detected:

1. Vary the measurement antenna height between 1 m to 4 m to maximize the received (measured) signal amplitude.

2. Adjust the signal generator output power level until the amplitude detected by the measurement instrument equals the amplitude level of the emission previously measured.

3. Record the output power level of the signal generator when equivalence is achieved.

Calculate the emission power in dBm referenced to a half-wave dipole using the following equation:

$$Pe = Ps(dBm) - \text{cable loss (dB)} + \text{antenna gain (dBd)}$$

where
Pe = equivalent isotropic emission power in dBm
Ps = source (signal generator) power in dBm

Correct the antenna gain of the substitution antenna if necessary to reference the emission power to a half-wave dipole. When using measurement antennas with the gain specified in dBi, the equivalent dipole-referenced gain can be determined from: gain (dBd) = gain (dBi) − 2.15 dB. If necessary, the antenna gain can be calculated from calibrated antenna factor information.

For emissions above 40 GHz, field strength method was used:

EIRP (dBm) = E (dB μ V/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m.

E (dBuV/m) is the corrected reading in field strength.
EIRP (dBm) is the corrected reading in power.
D is the measurement distance. (1meter in this test)

7.4 Corrected Amplitude and Margin Calculation

For emissions from 30 MHz to 40 GHz:

Using signal substitution method to measure the emission level, the "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit

Margin = Pe (Absolute Level) – Limit

For the emissions from 40 GHz and above

The Corrected Reading (CR) is calculated by adding the Conversion Factor (CF), Distance Factor (DF) and the basic equation is as follows:

CR (dBuV/m) = SA + CF
CR (dBm) =CR (dBuV/m) + 20log(d) – 104.7

For example, a corrected amplitude of -23.33 dBm = S.A. Reading (33.16 dBuV) + Conversion Factor (35.21 dB) + 20*log (1) – 104.7

d is the test distance. 1 meter was used in the example above.

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Reading – Limit

7.5 Far Field Distance Calculation

Note: Measurements were taken in the far field distance R based on the firmular $R \geq 2D^2/\lambda$, where D is the antenna length, λ is the wavelength. Wavelength = v/f, where v is the speed of light (3×10^9 m/s).

EUT antenna dimension 44mm, TX range: 27500 MHz – 28350 MHz
R range: 0.0355 m to 0.0366 m.

Receiving antenna frequency range and dimension are shown in the following table:

Frequency (GHz)	Antenna Model	Dimension (Length) (mm)	Far Field Range (m)
18 – 26.5	ARH-2823-01	93	0.104 – 0.153
26.5 – 40	ARH-2823-02	66	0.077 – 0.116
40-60	WR-19	47	0.059 - 0.088
60 – 90	WR-12	31	0.038 – 0.058
90 - 100	WR-08	20	0.024 – 0.027

Note: The test distance below 40 GHz is at 3 meters, the test distance above 40 GHz is at 1 meter.

7.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer 44 GHz	E4446A	US44300386	2019-08-24	2 years
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100337	2021-03-10	2 years
BACL	5m3 Sensitivity Box	1	2	2020-10-27	1 year
Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
Sunol Sciences	Biconilog Antenna	JB3	A020106-2	2019-11-20	2 years
COM-POWER	Antenna, Dipole	AD-100 DB-4	721033DB1,721033DB2,721033DB3,521921	2019-03-06	2.5 years
ETS Lindgren	Horn Antenna	3117	00218973	2019-02-13	2.5 years
EMCO	Antenna, Horn	3115	9511-4627	2020-10-12	2 years
Wisewave	Antenna, Horn	ARH-4223-02	10555-01	2020-02-27	2 years
Wisewave	Antenna, Horn	ARH-2823-02	10555-02	2020-02-27	2 years
Wisewave	Antenna, Horn	ARH-4223-01	10555-01	2020-02-05	2 years
Wisewave	Antenna, Horn	ARH-2823-01	10555-02	2020-02-05	2 years
Insulted Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2021-03-03	1 year
IW Microwave	157 Series Cable Armored with 2.92mm Male Plugs	KPS-1571AN-2400	DC 1922	2020-06-06	1 year
MDP Digital	Times Microwave LMR 400 UltraFex Coaxial Cable 35\'	LMR400UF	BACL1904161	2020-05-20	1 year
AH Systems	Preamplifier	PAM 1840 VH	170	2020-11-09	1 year
Agilent	Preamplifier	8449B	3147A00400	2021-03-02	1 year
HP	Pre Amplifier	8447D	2944A07030	2020-08-17	1 year
HP	Signal Generator	83650B	3614A00276	2020-06-04	1 year
OML	Harmonic Mixer	M03HWA; M05HWA; M08HWA; M12HWA; M19HWA	170615-1	N/R	N/A
-	SMA cable	-	-	Each time[1]	N/A

Note[1]: cables and attenuators included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

7.7 Test Environmental Conditions

Temperature:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Tri Pham from 2021-03-15 to 2021-03-19 and Zhao Zhao on 2021-04-19 in 5m chamber 3.

7.8 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Part 30 standards' radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-3.753	37148	H	High Channel, 1CC-QPSK, Beam ID=139 (Horizontal)

7.9 Radiated Emissions Test Result

SISO Configuration

1) 30 MHz – 40 GHz at 3m

1CC-QPSK

Low Channel – Beam ID=11 (Vertical)

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
250	33.6	147	100	V	250	-69.83	1.6	0.61	-68.84	-13	-55.84
250	30.39	139	300	H	250	-71.37	1.6	0.61	-70.38	-13	-57.38
675	36.9	170	100	V	675	-57.17	2.1	1.05	-56.12	-13	-43.12
675	33.22	150	250	H	675	-62.85	2.1	1.05	-61.8	-13	-48.8
1085	39.72	0	100	V	1085	-69.64	5.881	0.15	-63.909	-13	-50.909
1085	39.31	0	100	H	1085	-69.87	5.881	0.15	-64.139	-13	-51.139
5732	35.48	0	100	V	5732	-60.64	11.429	1.83	-51.041	-13	-38.041
5732	34.9	0	100	H	5732	-60.43	11.429	1.83	-50.831	-13	-37.831
27490	23.72	0	164	V	27490	-34.58	20.566	6.9	-20.914	-13	-7.914
27490	22.73	0	150	H	27490	-34.87	20.566	6.9	-21.204	-13	-8.204
37148	37.71	0	100	V	37148	-32.78	20.667	8.52	-20.633	-13	-7.633
37148	38.07	0	100	H	37148	-29.19	20.667	8.52	-17.043	-13	-4.043

Note: emission at the lower band-edge was evaluated as the out-of-band emissions, and reported in Section 9.5 of this report.

Middle Channel – Beam ID=11 (Vertical)

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
250	33.95	147	100	V	250	-69.48	1.6	0.61	-68.49	-13	-55.49
250	29.31	139	300	H	250	-72.45	1.6	0.61	-71.46	-13	-58.46
675	37.23	170	100	V	675	-56.84	2.1	1.05	-55.79	-13	-42.79
675	33.57	150	250	H	675	-62.5	2.1	1.05	-61.45	-13	-48.45
1085	39.68	0	100	V	1085	-69.68	5.881	0.15	-63.949	-13	-50.949
1085	39.4	0	100	H	1085	-69.78	5.881	0.15	-64.049	-13	-51.049
5732	34.86	0	100	V	5732	-61.26	11.429	1.83	-51.661	-13	-38.661
5732	35.14	0	100	H	5732	-60.19	11.429	1.83	-50.591	-13	-37.591
27500	22.53	0	100	V	27490	-35.77	20.566	6.9	-22.104	-13	-9.104
27500	22.41	0	100	H	27490	-35.19	20.566	6.9	-21.524	-13	-8.524
37148	38.07	0	100	V	37148	-32.42	20.667	8.52	-20.273	-13	-7.273
37148	37.77	0	100	H	37148	-29.49	20.667	8.52	-17.343	-13	-4.343

High Channel – Beam ID=11 (Vertical)

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
250	34.07	147	100	V	250	-69.36	1.6	0.61	-68.37	-13	-55.37
250	29.83	139	300	H	250	-71.93	1.6	0.61	-70.94	-13	-57.94
675	36.83	170	100	V	675	-57.24	2.1	1.05	-56.19	-13	-43.19
675	33.12	150	250	H	675	-62.95	2.1	1.05	-61.9	-13	-48.9
1085	39.26	0	100	V	1085	-70.1	5.881	0.15	-64.369	-13	-51.369
1085	39.21	0	100	H	1085	-69.97	5.881	0.15	-64.239	-13	-51.239
5732	35.13	0	100	V	5732	-60.99	11.429	1.83	-51.391	-13	-38.391
5732	34.99	0	100	H	5732	-60.34	11.429	1.83	-50.741	-13	-37.741
28350	22.32	0	100	V	27490	-35.98	21.625	7.3	-21.655	-13	-8.655
28350	22.12	0	100	H	27490	-35.48	21.625	7.3	-21.155	-13	-8.155
37148	38.17	0	100	V	37148	-32.32	20.667	8.52	-20.173	-13	-7.173
37148	37.91	0	100	H	37148	-29.35	20.667	8.52	-17.203	-13	-4.203

Low Channel – Beam ID=139 (Horizontal)

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
250	37.67	72	100	V	250	-65.76	1.6	0.61	-64.77	-13	-51.77
250	30.46	0	100	H	250	-71.3	1.6	0.61	-70.31	-13	-57.31
675	36.71	170	100	V	675	-57.36	2.1	1.05	-56.31	-13	-43.31
675	32.82	143	250	H	675	-63.25	2.1	1.05	-62.2	-13	-49.2
1085	39.47	0	100	V	1085	-69.89	5.881	0.15	-64.159	-13	-51.159
1085	39.3	0	100	H	1085	-69.88	5.881	0.15	-64.149	-13	-51.149
5732	34.74	0	100	V	5732	-61.38	11.429	1.83	-51.781	-13	-38.781
5732	35.05	0	100	H	5732	-60.28	11.429	1.83	-50.681	-13	-37.681
27490	22.58	0	150	V	27490	-35.72	20.566	6.9	-22.054	-13	-9.054
27490	24.14	0	150	H	27490	-33.46	20.566	6.9	-19.794	-13	-6.794
37148	37.74	0	100	V	37148	-32.75	20.667	8.52	-20.603	-13	-7.603
37148	38.2	0	100	H	37148	-29.06	20.667	8.52	-16.913	-13	-3.913

Note: emission at the lower band-edge was evaluated as the out-of-band emissions, and reported in Section 9.5 of this report.

Middle Channel – Beam ID=139 (Horizontal)

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
250	37.42	72	100	V	250	-66.01	1.6	0.61	-65.02	-13	-52.02
250	30.69	0	100	H	250	-71.07	1.6	0.61	-70.08	-13	-57.08
675	36.89	170	100	V	675	-57.18	2.1	1.05	-56.13	-13	-43.13
675	32.91	143	250	H	675	-63.16	2.1	1.05	-62.11	-13	-49.11
1085	39.4	0	100	V	1085	-69.96	5.881	0.15	-64.229	-13	-51.229
1085	38.91	0	100	H	1085	-70.27	5.881	0.15	-64.539	-13	-51.539
5732	34.79	0	100	V	5732	-61.33	11.429	1.83	-51.731	-13	-38.731
5732	34.8	0	100	H	5732	-60.53	11.429	1.83	-50.931	-13	-37.931
27500	22.84	0	100	V	27490	-35.46	20.566	6.9	-21.794	-13	-8.794
27500	22.43	0	100	H	27490	-35.17	20.566	6.9	-21.504	-13	-8.504
37148	37.74	0	100	V	37148	-32.75	20.667	8.52	-20.603	-13	-7.603
37148	38.02	0	100	H	37148	-29.24	20.667	8.52	-17.093	-13	-4.093

High Channel – Beam ID=139 (Horizontal)

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
250	37.76	72	100	V	250	-65.67	1.6	0.61	-64.68	-13	-51.68
250	30.54	0	100	H	250	-71.22	1.6	0.61	-70.23	-13	-57.23
675	36.85	170	100	V	675	-57.22	2.1	1.05	-56.17	-13	-43.17
675	33.01	143	250	H	675	-63.06	2.1	1.05	-62.01	-13	-49.01
1085	38.91	0	100	V	1085	-70.45	5.881	0.15	-64.719	-13	-51.719
1085	39.01	0	100	H	1085	-70.17	5.881	0.15	-64.439	-13	-51.439
5732	34.92	0	100	V	5732	-61.2	11.429	1.83	-51.601	-13	-38.601
5732	35.25	0	100	H	5732	-60.08	11.429	1.83	-50.481	-13	-37.481
28350	22.02	0	100	V	27490	-36.28	21.625	7.3	-21.955	-13	-8.955
28350	22.1	0	100	H	27490	-35.5	21.625	7.3	-21.175	-13	-8.175
37148	37.7	0	100	V	37148	-32.79	20.667	8.52	-20.643	-13	-7.643
37148	**38.36**	**0**	**100**	**H**	**37148**	**-28.9**	**20.667**	**8.52**	**-16.753**	**-13**	**-3.753**

4CC-QPSK

Low Channel – Beam ID=11 (Vertical)

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
250	33.89	147	100	V	250	-69.54	1.6	0.61	-68.55	-13	-55.55
250	30.63	139	300	H	250	-71.13	1.6	0.61	-70.14	-13	-57.14
675	36.87	170	100	V	675	-57.2	2.1	1.05	-56.15	-13	-43.15
675	33.42	150	250	H	675	-62.65	2.1	1.05	-61.6	-13	-48.6
1085	39.61	0	100	V	1085	-69.75	5.881	0.15	-64.019	-13	-51.019
1085	39.45	0	100	H	1085	-69.73	5.881	0.15	-63.999	-13	-50.999
5732	35.19	0	100	V	5732	-60.93	11.429	1.83	-51.331	-13	-38.331
5732	35.06	0	100	H	5732	-60.27	11.429	1.83	-50.671	-13	-37.671
27490	22.04	0	150	V	27490	-36.26	20.566	6.9	-22.594	-13	-9.594
27490	22.25	0	150	H	27490	-35.35	20.566	6.9	-21.684	-13	-8.684
37148	37.91	0	100	V	37148	-32.58	20.667	8.52	-20.433	-13	-7.433
37148	37.72	0	100	H	37148	-29.54	20.667	8.52	-17.393	-13	-4.393

Note: emission at the lower band-edge was evaluated as the out-of-band emissions, and reported in Section 9.5 of this report.

Middle Channel – Beam ID=11 (Vertical)

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
250	33.89	147	100	V	250	-69.54	1.6	0.61	-68.55	-13	-55.55
250	30.55	139	300	H	250	-71.21	1.6	0.61	-70.22	-13	-57.22
675	37.15	170	100	V	675	-56.92	2.1	1.05	-55.87	-13	-42.87
675	33.47	150	250	H	675	-62.6	2.1	1.05	-61.55	-13	-48.55
1085	39.68	0	100	V	1085	-69.68	5.881	0.15	-63.949	-13	-50.949
1085	39.34	0	100	H	1085	-69.84	5.881	0.15	-64.109	-13	-51.109
5732	34.76	0	100	V	5732	-61.36	11.429	1.83	-51.761	-13	-38.761
5732	35.06	0	100	H	5732	-60.27	11.429	1.83	-50.671	-13	-37.671
27500	22.54	0	100	V	27490	-35.76	20.566	6.9	-22.094	-13	-9.094
27500	22.66	0	100	H	27490	-34.94	20.566	6.9	-21.274	-13	-8.274
37148	37.67	0	100	V	37148	-32.82	20.667	8.52	-20.673	-13	-7.673
37148	37.51	0	100	H	37148	-29.75	20.667	8.52	-17.603	-13	-4.603

High Channel – Beam ID=11 (Vertical)

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
250	34.07	147	100	V	250	-69.36	1.6	0.61	-68.37	-13	-55.37
250	30.13	139	300	H	250	-71.63	1.6	0.61	-70.64	-13	-57.64
675	36.38	170	100	V	675	-57.69	2.1	1.05	-56.64	-13	-43.64
675	33.21	150	250	H	675	-62.86	2.1	1.05	-61.81	-13	-48.81
1085	39.24	0	100	V	1085	-70.12	5.881	0.15	-64.389	-13	-51.389
1085	39.12	0	100	H	1085	-70.06	5.881	0.15	-64.329	-13	-51.329
5732	35.43	0	100	V	5732	-60.69	11.429	1.83	-51.091	-13	-38.091
5732	34.89	0	100	H	5732	-60.44	11.429	1.83	-50.841	-13	-37.841
28350	22.16	0	100	V	27490	-36.14	21.625	7.3	-21.815	-13	-8.815
28350	22.05	0	100	H	27490	-35.55	21.625	7.3	-21.225	-13	-8.225
37148	38.1	0	100	V	37148	-32.39	20.667	8.52	-20.243	-13	-7.243
37148	38	0	100	H	37148	-29.26	20.667	8.52	-17.113	-13	-4.113

Low Channel – Beam ID=139 (Horizontal)

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
250	37.74	72	100	V	250	-65.69	1.6	0.61	-64.7	-13	-51.7
250	30.43	0	100	H	250	-71.33	1.6	0.61	-70.34	-13	-57.34
675	36.7	170	100	V	675	-57.37	2.1	1.05	-56.32	-13	-43.32
675	33	143	250	H	675	-63.07	2.1	1.05	-62.02	-13	-49.02
1085	39.57	0	100	V	1085	-69.79	5.881	0.15	-64.059	-13	-51.059
1085	39.32	0	100	H	1085	-69.86	5.881	0.15	-64.129	-13	-51.129
5732	34.74	0	100	V	5732	-61.38	11.429	1.83	-51.781	-13	-38.781
5732	34.91	0	100	H	5732	-60.42	11.429	1.83	-50.821	-13	-37.821
27490	22	0	150	V	27490	-36.3	20.566	6.9	-22.634	-13	-9.634
27490	22.49	0	150	H	27490	-35.11	20.566	6.9	-21.444	-13	-8.444
37148	37.79	0	100	V	37148	-32.7	20.667	8.52	-20.553	-13	-7.553
37148	38.02	0	100	H	37148	-29.24	20.667	8.52	-17.093	-13	-4.093

Note: emission at the lower band-edge was evaluated as the out-of-band emissions, and reported in Section 9.5 of this report.

Middle Channel – Beam ID=139 (Horizontal)

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
250	37.42	72	100	V	250	-66.01	1.6	0.61	-65.02	-13	-52.02
250	30.69	0	100	H	250	-71.07	1.6	0.61	-70.08	-13	-57.08
675	36.89	170	100	V	675	-57.18	2.1	1.05	-56.13	-13	-43.13
675	32.91	143	250	H	675	-63.16	2.1	1.05	-62.11	-13	-49.11
1085	39.4	0	100	V	1085	-69.96	5.881	0.15	-64.229	-13	-51.229
1085	38.91	0	100	H	1085	-70.27	5.881	0.15	-64.539	-13	-51.539
5732	34.79	0	100	V	5732	-61.33	11.429	1.83	-51.731	-13	-38.731
5732	34.8	0	100	H	5732	-60.53	11.429	1.83	-50.931	-13	-37.931
27500	22.8	0	100	V	27490	-35.5	20.566	6.9	-21.834	-13	-8.834
27500	22.14	0	100	H	27490	-35.46	20.566	6.9	-21.794	-13	-8.794
37148	37.65	0	100	V	37148	-32.84	20.667	8.52	-20.693	-13	-7.693
37148	37.9	0	100	H	37148	-29.36	20.667	8.52	-17.213	-13	-4.213

High Channel – Beam ID=139 (Horizontal)

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
250	37.92	72	100	V	250	-65.51	1.6	0.61	-64.52	-13	-51.52
250	30.63	0	100	H	250	-71.13	1.6	0.61	-70.14	-13	-57.14
675	36.44	170	100	V	675	-57.63	2.1	1.05	-56.58	-13	-43.58
675	33.01	143	250	H	675	-63.06	2.1	1.05	-62.01	-13	-49.01
1085	39.15	0	100	V	1085	-70.21	5.881	0.15	-64.479	-13	-51.479
1085	38.95	0	100	H	1085	-70.23	5.881	0.15	-64.499	-13	-51.499
5732	35.62	0	100	V	5732	-60.5	11.429	1.83	-50.901	-13	-37.901
5732	35.25	0	100	H	5732	-60.08	11.429	1.83	-50.481	-13	-37.481
28350	22.4	0	100	V	27490	-35.9	21.625	7.3	-21.575	-13	-8.575
28350	22.92	0	100	H	27490	-34.68	21.625	7.3	-20.355	-13	-7.355
37148	37.77	0	100	V	37148	-32.72	20.667	8.52	-20.573	-13	-7.573
37148	38.14	0	100	H	37148	-29.12	20.667	8.52	-16.973	-13	-3.973

2) 40 GHz – 100 GHz at 1m

1CC-QPSK

Beam ID=11 (Vertical)

Freq. (GHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Conv. Loss (dB)	Pre-amp (dB)	Cord Reading (dBuV/m)	Cord Reading (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)						
Low Channel										
40.23	25.38	0	100	H	33.64	0	59.02	-45.68	-13	-32.68
40.37	25.12	0	100	V	33.64	0	58.76	-45.94	-13	-32.94
60.62	25.88	0	100	H	43.98	0	69.86	-34.84	-13	-21.84
60.07	25.59	0	100	V	45.62	0	71.21	-33.49	-13	-20.49
92.34	26.95	0	100	H	51.24	0	78.19	-26.51	-13	-13.51
92.59	27.21	0	100	V	47.52	0	74.73	-29.97	-13	-16.97
Mid Channel										
41.57	25.05	0	100	H	33.64	0	58.69	-46.01	-13	-33.01
40.30	25.34	0	100	V	33.64	0	58.98	-45.72	-13	-32.72
61.20	26.16	0	100	H	44.88	0	71.04	-33.66	-13	-20.66
60.84	25.15	0	100	V	43.98	0	69.13	-35.57	-13	-22.57
92.53	26.54	0	100	H	47.52	0	74.06	-30.64	-13	-17.64
92.50	27.69	0	100	V	47.52	0	75.21	-29.49	-13	-16.49
High Channel										
40.37	24.95	0	100	H	33.64	0	58.59	-46.11	-13	-33.11
40.40	25.42	0	100	V	33.64	0	59.06	-45.64	-13	-32.64
60.57	26.25	0	100	H	43.98	0	70.23	-34.47	-13	-21.47
60.84	26.37	0	100	V	43.98	0	70.35	-34.35	-13	-21.35
92.62	27.05	0	100	H	47.52	0	74.57	-30.13	-13	-17.13
92.50	27.67	0	100	V	47.52	0	75.19	-29.51	-13	-16.51

1CC-QPSK

Beam ID=139 (Horizontal)

Freq. (GHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Conv. Loss (dB)	Cord Reading (dBuV/m)	Cord Reading (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)					
Low Channel									
40.27	25.45	0	100	H	33.64	59.09	-45.61	-13	-32.61
40.33	25.82	0	100	V	33.64	59.46	-45.24	-13	-32.24
61.13	26.13	0	100	H	44.88	71.01	-33.69	-13	-20.69
61.13	26.13	0	100	V	44.88	71.01	-33.69	-13	-20.69
92.34	26.9	0	100	H	51.24	78.14	-26.56	-13	-13.56
92.51	26.89	0	100	V	47.52	74.41	-30.29	-13	-17.29
Mid Channel									
40.20	25.03	0	100	H	33.64	58.67	-46.03	-13	-33.03
40.23	25.23	0	100	V	33.64	58.87	-45.83	-13	-32.83
60.56	25.63	0	100	H	43.98	69.61	-35.09	-13	-22.09
65.14	25.88	0	100	V	39.33	65.21	-39.49	-13	-26.49
92.47	26.05	0	100	H	51.24	77.29	-27.41	-13	-14.41
92.57	**27.81**	**0**	**100**	**V**	**47.52**	**75.33**	**-29.37**	**-13**	**-16.37**
High Channel									
40.33	25.56	0	100	H	33.64	59.2	-45.5	-13	-32.5
40.30	25.41	0	100	V	33.64	59.05	-45.65	-13	-32.65
61.19	25.9	0	100	H	44.88	70.78	-33.92	-13	-20.92
60.71	25.84	0	100	V	44.88	70.72	-33.98	-13	-20.98
92.62	26.83	0	100	H	47.52	74.35	-30.35	-13	-17.35
92.59	27.01	0	100	V	47.52	74.53	-30.17	-13	-17.17

4CC-QPSK

Beam ID=11 (Vertical)

Freq. (GHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Conv. Loss (dB)	Cord Reading (dBuV/m)	Cord Reading (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)					
Low Channel									
40.33	25.57	0	100	H	33.64	59.21	-45.49	-13	-32.49
40.30	24.59	0	100	V	33.64	58.23	-46.47	-13	-33.47
60.70	26.11	0	100	H	43.98	70.09	-34.61	-13	-21.61
60.85	**26.51**	**0**	**100**	**V**	**43.98**	**70.49**	**-34.21**	**-13**	**-21.21**
92.60	26.57	0	100	H	47.52	74.09	-30.61	-13	-17.61
92.21	25.94	0	100	V	51.24	77.18	-27.52	-13	-14.52
Mid Channel									
40.30	25.38	0	100	H	33.64	59.02	-45.68	-13	-32.68
40.30	24.61	0	100	V	33.64	58.25	-46.45	-13	-33.45
60.85	25.81	0	100	H	43.98	69.79	-34.91	-13	-21.91
61.35	26.07	0	100	V	44.88	70.95	-33.75	-13	-20.75
92.50	26.38	0	100	H	47.52	73.9	-30.8	-13	-17.8
92.52	26.18	0	100	V	47.52	73.7	-31	-13	-18
High Channel									
40.30	**26.14**	**0**	**100**	**H**	**33.64**	**59.78**	**-44.92**	**-13**	**-31.92**
40.27	25.09	0	100	V	33.64	58.73	-45.97	-13	-32.97
60.55	25.73	0	100	H	43.98	69.71	-34.99	-13	-21.99
60.80	25.91	0	100	V	43.98	69.89	-34.81	-13	-21.81
92.55	26.73	0	100	H	47.52	74.25	-30.45	-13	-17.45
92.58	27.48	0	100	V	47.52	75	-29.7	-13	-16.7

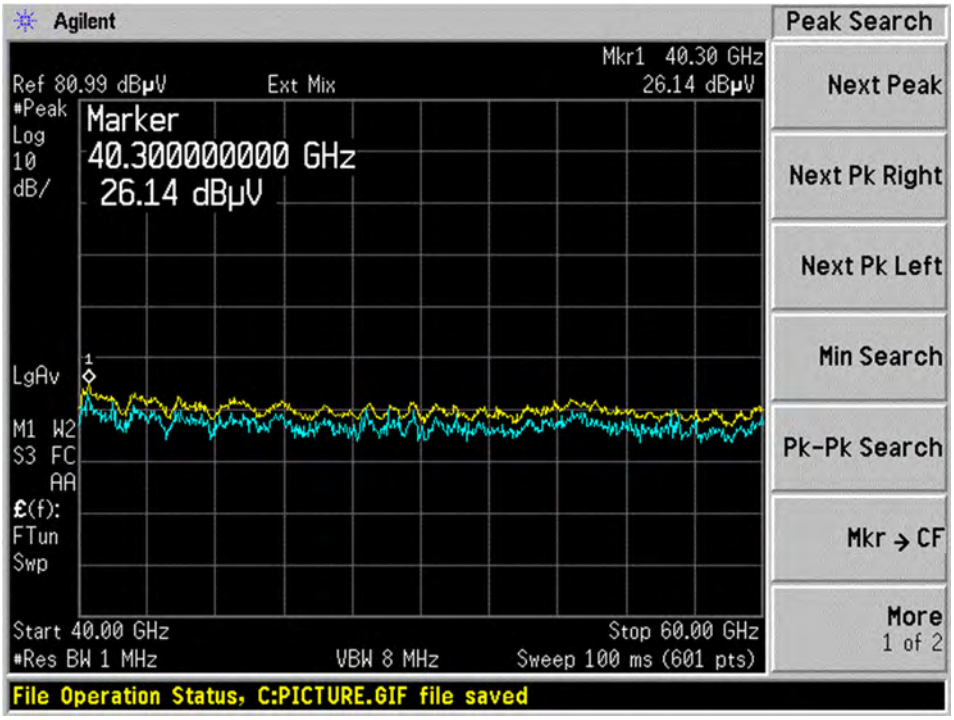
4CC-QPSK

Beam ID=139 (Horizontal)

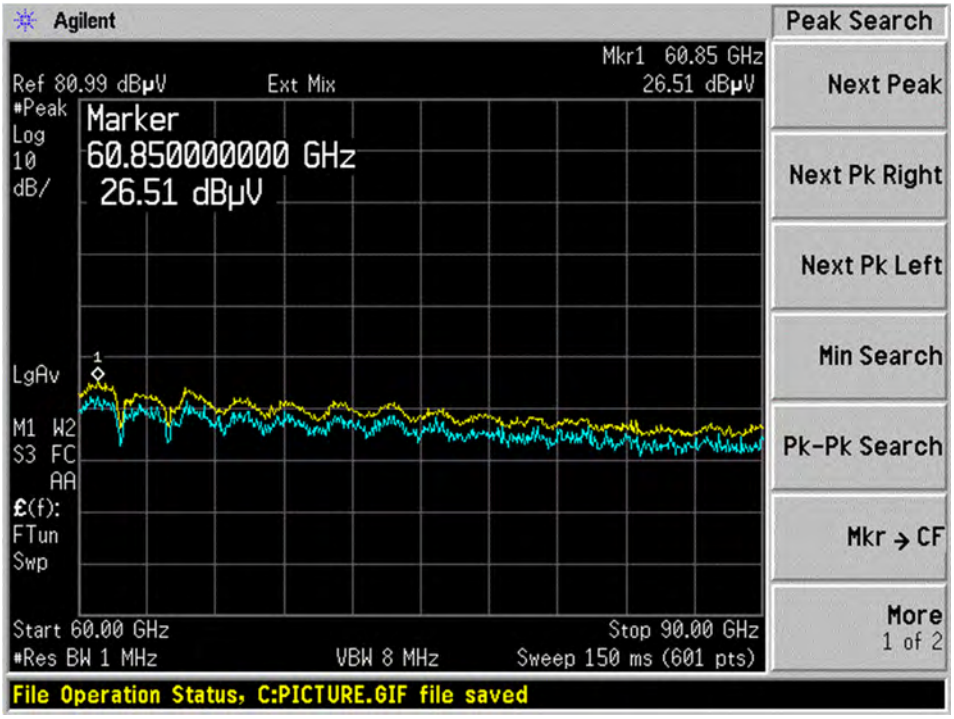
Freq. (GHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Conv. Loss (dB)	Cord Reading (dBuV/m)	Cord Reading (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)					
Low Channel									
40.23	25.58	0	100	H	33.64	59.22	-45.48	-13	-32.48
40.30	25.32	0	100	V	33.64	58.96	-45.74	-13	-32.74
60.63	26.01	0	100	H	43.98	69.99	-34.71	-13	-21.71
60.78	25.91	0	100	V	43.98	69.89	-34.81	-13	-21.81
92.44	25.82	0	100	H	51.24	77.06	-27.64	-13	-14.64
92.41	26.83	0	100	V	51.24	78.07	-26.63	-13	-13.63
Mid Channel									
40.37	24.78	0	100	H	33.64	58.42	-46.28	-13	-33.28
40.30	24.54	0	100	V	33.64	58.18	-46.52	-13	-33.52
60.46	26.37	0	100	H	43.98	70.35	-34.35	-13	-21.35
60.52	26.08	0	100	V	43.98	70.06	-34.64	-13	-21.64
92.80	26.28	0	100	H	47.52	73.8	-30.9	-13	-17.9
92.41	26.74	0	100	V	51.24	77.98	-26.72	-13	-13.72
High Channel									
40.37	24.37	0	100	H	33.64	58.01	-46.69	-13	-33.69
40.33	25.11	0	100	V	33.64	58.75	-45.95	-13	-32.95
61.42	25.78	0	100	H	44.88	70.66	-34.04	-13	-21.04
61.09	25.69	0	100	V	44.88	70.57	-34.13	-13	-21.13
92.74	27.73	0	100	H	47.52	75.25	-29.45	-13	-16.45
92.45	27.65	0	100	V	51.24	78.89	-25.81	-13	-12.81

Please refer to the following plots for worst case results**,**

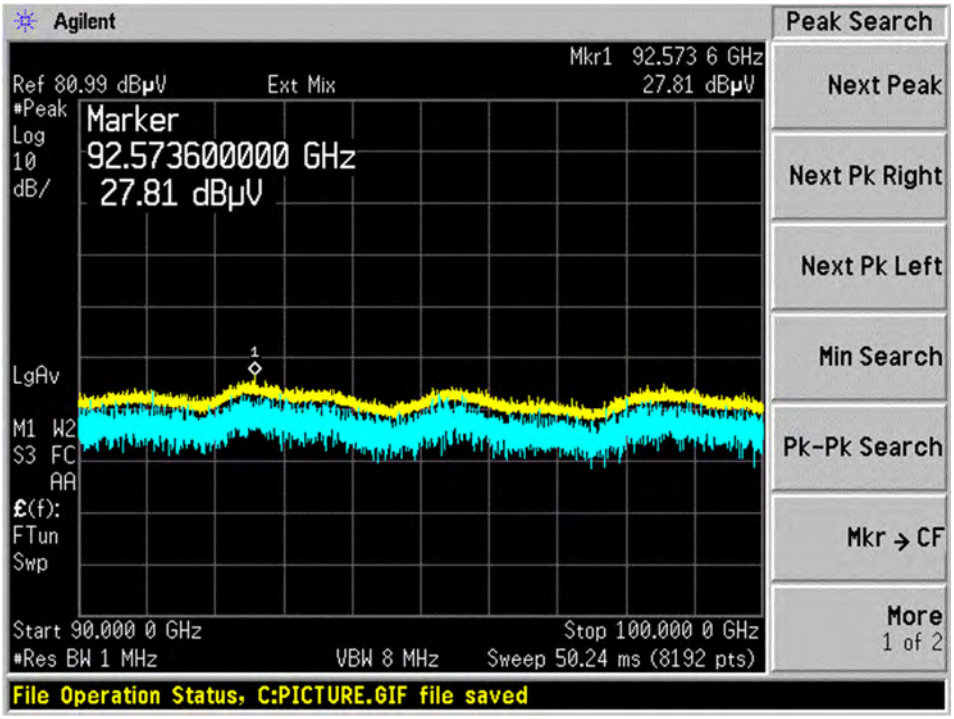
40 GHz – 60 GHz



60 GHz – 90 GHz



90GHz – 100 GHz



Measurement plots shown above do not include correction factors. The measurement was evaluated by comparing the highest raw data with the limit substracting the maximum conversion factor. The evaluation results are shown in the table below, and the detailed conversion factors are included in the following pages.

Freq. (GHz)	Max Conv. Loss (dB/m)	EIRP Limit (dBm)	Worst Case Limit Line (dBuV)	Highest Emission Level (dBuV)	Margin (dB)
40 - 60	43.12	-13	48.68	26.14	-22.86
60 - 90	47.78	-13	44.02	26.51	-17.51
90 - 100	51.24	-13	40.56	27.81	-12.75

Note: The test distance was at 1 meter, therefore the worst case limit line (dBuV) = EIRP limit (-13 dBm) + 104.8 - 20log(D) – conversion loss (dB/m) where D is the measurement distance (in the far field region) in m.

Note: The Margin (dB) = Highest Emission Level (dBuV) – Worst Case Limit Line (dBuV). Therefore, negative margin shows compliance.

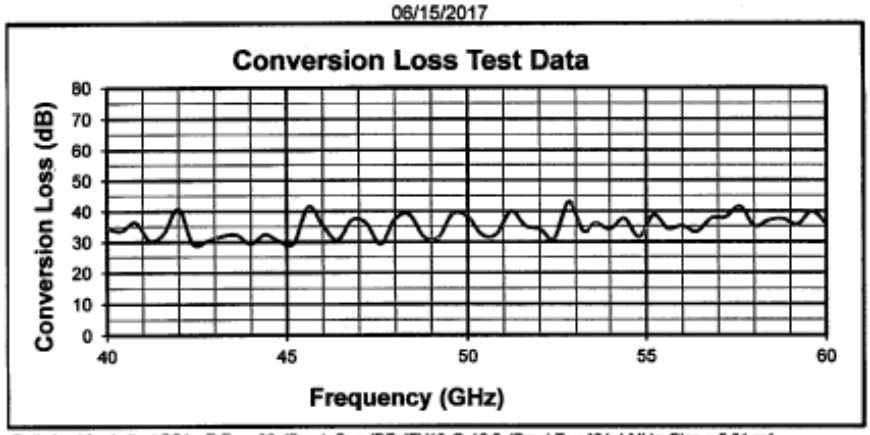
Conversion Loss of the harmonic mixer with standard gain horn antenna:

Model M19HWA
Ser No. 170615-1
06/15/2017
Conversion Loss Test Data

Frequency (GHz)	Conversion Loss (dB)
40.00	34.47
40.40	33.64
40.80	36.33
41.20	30.41
41.60	32.89
42.00	40.94
42.40	29.52
42.80	30.29
43.20	31.82
43.60	32.32
44.00	29.52
44.40	32.43
44.80	30.22
45.20	29.70
45.60	41.65
46.00	35.48
46.40	30.56
46.80	37.06
47.20	36.17
47.60	29.34
48.00	37.51
48.40	38.89
48.80	31.62
49.20	31.53
49.60	39.27
50.00	**38.21**
50.40	32.28
50.80	32.52
51.20	40.05
51.60	35.21
52.00	34.10
52.40	31.02
52.80	43.12
53.20	33.49
53.60	35.98
54.00	34.12
54.40	37.55
54.80	31.48
55.20	38.76
55.60	34.31
56.00	35.21
56.40	33.28
56.80	37.60
57.20	38.04
57.60	41.61
58.00	35.09
58.40	36.96
58.80	37.42
59.20	35.63
59.60	39.90
60.00	**35.76**

OML INC. Traceability only available ≤ 110 GHz 4208417A
Morgan Hill, CA 95037

Model M19HWA
Ser No. 170615-1
06/15/2017



Optimized for Agilent PSA: R.F. = -30 dBm, L.O. = (RF+IF)/10 @ 15.5 dBm, I.F. = 321.4 MHz, Bias = 5.81 mA

OML INC. 4208417A
Morgan Hill, CA 95037

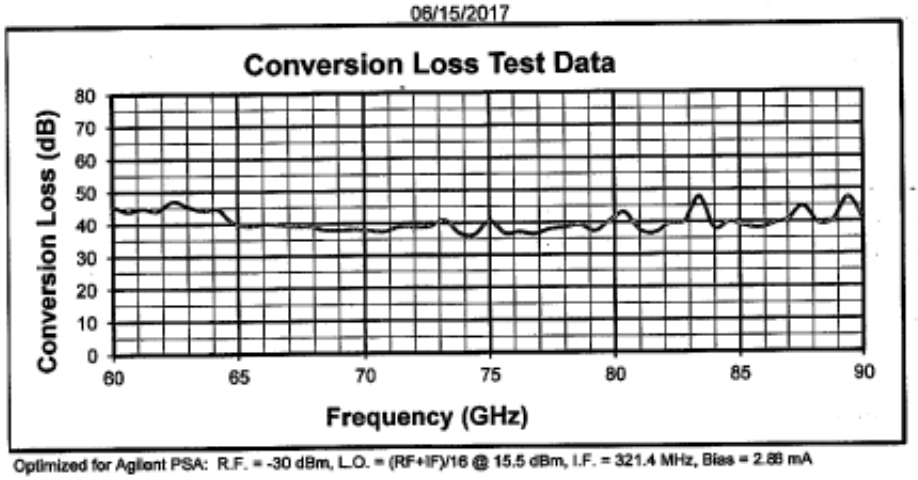
Model M12HWA
Ser No. 170615-1
06/15/2017

Conversion Loss Test Data

Frequency (GHz)	Conversion Loss (dB)
60.00	**45.62**
60.60	43.98
61.20	44.88
61.80	44.14
62.40	47.13
63.00	45.47
63.60	44.18
64.20	44.54
64.80	40.52
65.40	39.33
66.00	39.95
66.60	39.80
67.20	39.21
67.80	39.19
68.40	38.03
69.00	37.92
69.60	38.08
70.20	37.76
70.80	37.45
71.40	38.92
72.00	38.78
72.60	38.96
73.20	40.92
73.80	36.79
74.40	36.38
75.00	**40.58**
75.60	36.67
76.20	37.10
76.80	36.47
77.40	37.94
78.00	38.47
78.60	39.23
79.20	37.29
79.80	40.49
80.40	42.94
81.00	37.51
81.60	36.76
82.20	39.56
82.80	40.29
83.40	47.78
84.00	38.09
84.60	39.98
85.20	38.74
85.80	38.00
86.40	39.55
87.00	40.63
87.60	44.74
88.20	39.58
88.80	40.39
89.40	47.32
90.00	**40.59**

OML INC. Traceability only available ≤ 110 GHz 4208417B
Morgan Hill, CA 95037

Model M12HWA
Ser No. 170615-1
06/15/2017



Optimized for Agilent PSA: R.F. = -30 dBm, L.O. = (RF+IF)/16 @ 15.5 dBm, I.F. = 321.4 MHz, Bias = 2.88 mA

OML INC. 4208417B
Morgan Hill, CA 95037

Model M08HWA
Ser No. 170615-1
06/15/2017

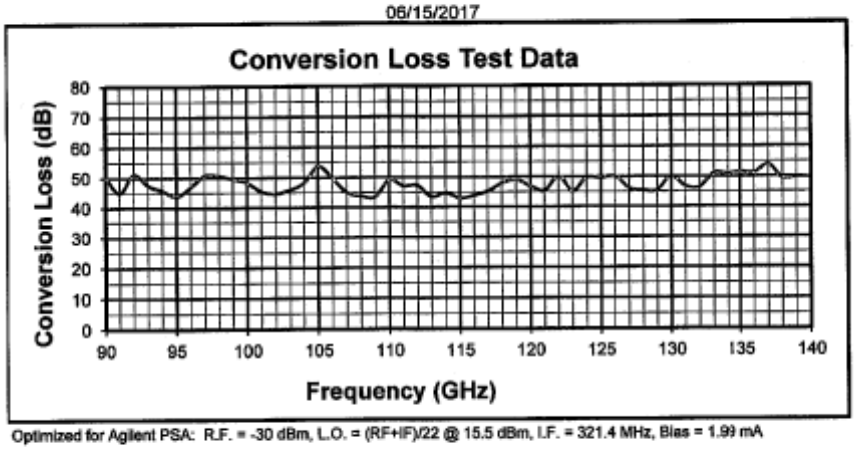
Conversion Loss Test Data

Frequency (GHz)	Conversion Loss (dB)
90.00	**50.07**
91.00	45.08
92.00	51.24
93.00	47.52
94.00	45.81
95.00	43.92
96.00	46.92
97.00	50.86
98.00	50.76
99.00	49.62
100.00	48.33
101.00	45.48
102.00	44.71
103.00	46.00
104.00	48.29
105.00	53.79
106.00	49.64
107.00	45.03
108.00	43.86
109.00	43.55
110.00	49.23
111.00	47.12
112.00	47.27
113.00	43.52
114.00	44.86
115.00	**42.97**
116.00	43.89
117.00	45.27
118.00	47.93
119.00	49.08
120.00	46.86
121.00	45.43
122.00	50.21
123.00	45.17
124.00	49.80
125.00	49.58
126.00	50.20
127.00	46.09
128.00	45.44
129.00	45.54
130.00	50.08
131.00	46.72
132.00	46.50
133.00	51.03
134.00	50.75
135.00	51.38
136.00	51.18
137.00	53.89
138.00	49.28
139.00	49.92
140.00	**49.78**

OML INC. Traceability only available ≤ 110 GHz 4208417C

Morgan Hill, CA 95037

Model M08HWA
Ser No. 170615-1
06/15/2017



Optimized for Agilent PSA: R.F. = -30 dBm, L.O. = (RF+IF)/22 @ 15.5 dBm, I.F. = 321.4 MHz, Bias = 1.99 mA

OML INC. 4208417C

Morgan Hill, CA 95037

MIMO Configuration

Pre-scanned 1CC and 4CC MIMO configurations, 1CC low channel was the worst case MIMO configuration. 1CC QPSK MIMO (Beam 11 + Beam 139) at low channel was slected for full testing.

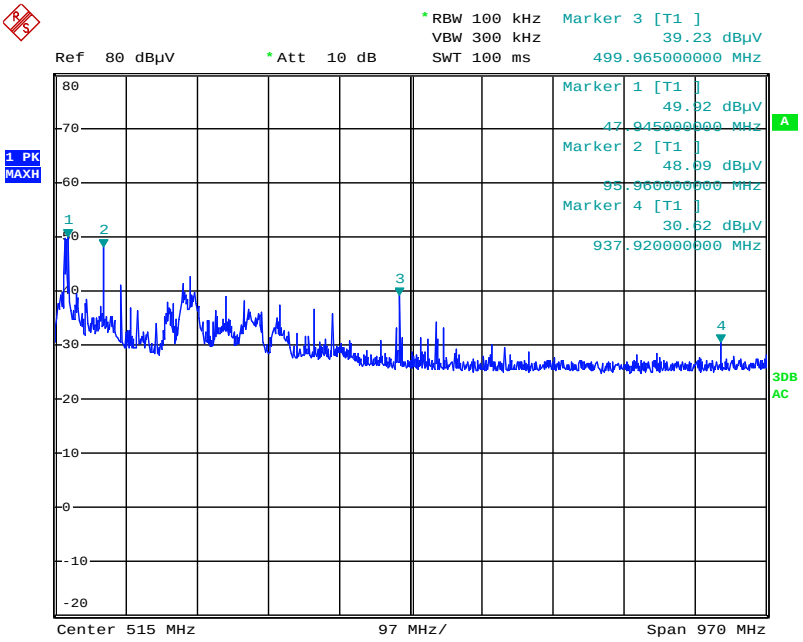
1) 30 MHz – 40 GHz measured at 3m

Freq. (MHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Substitution				Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)	Freq. (MHz)	S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
47.95	49.92	54	141	H	47.95	-59.72	2.00	0.26	-57.98	-13.00	-44.98
95.96	41.23	33	122	V	95.96	-68.41	2.00	0.31	-66.72	-13.00	-53.72
95.96	48.09	7	105	H	95.96	-61.55	2.00	0.31	-59.86	-13.00	-46.86
191.99	37.4	36	109	V	191.99	-72.24	1.50	0.33	-71.07	-13.00	-58.07
499.97	39.23	170	246	H	499.97	-57.31	1.20	0.42	-56.53	-13.00	-43.53
499.97	37.49	199	121	V	499.97	-59.05	1.20	0.42	-58.27	-13.00	-45.27
937.92	30.62	44	132	H	937.92	-62.67	1.50	0.37	-61.54	-13.00	-48.54
937.92	28.42	154	147	V	937.92	-64.87	1.50	0.37	-63.74	-13.00	-50.74
1087.20	37.064	0	100	H	1087.20	-69.53	6.09	0.43	-63.87	-13.00	-50.87
1422.57	36.867	0	100	V	1422.57	-69.72	7.66	0.43	-62.49	-13.00	-49.49
9803.64	33.549	0	100	H	9803.64	-57.11	11.32	2.58	-48.38	-13.00	-35.38
9416.90	33.832	0	100	V	9416.90	-56.83	10.53	2.58	-48.88	-13.00	-35.88
15612.16	33.815	0	100	H	15612.16	-50.52	15.35	1.73	-36.89	-13.00	-23.89
15658.43	32.668	0	100	V	15658.43	-51.66	15.40	1.73	-37.99	-13.00	-24.99
18062.30	23.52	0	100	H	18062.30	-65.03	21.55	2.94	-46.42	-13.00	-33.42
18057.10	23.612	0	100	V	18057.10	-64.94	21.55	2.94	-46.33	-13.00	-33.33
23499.10	25.952	0	100	H	23499.10	-56.38	22.20	3.02	-37.20	-13.00	-24.20
23408.90	26.209	0	100	V	23408.90	-56.12	22.31	3.02	-36.83	-13.00	-23.83
25230.00	27.262	0	100	H	25230.00	-53.01	22.10	2.51	-33.42	-13.00	-20.42
25081.80	26.968	0	100	V	25081.80	-53.30	22.26	2.51	-33.55	-13.00	-20.55
27202.03	26.642	0	162	H	27202.03	-52.66	20.48	2.68	-34.86	-13.00	-21.86
27028.60	24.921	0	162	V	27028.60	-52.68	20.48	2.68	-34.88	-13.00	-21.88
33677.00	31.761	0	100	H	33677.00	-48.05	20.61	3.66	-31.10	-13.00	-18.10
33660.64	32.993	0	100	V	33660.64	-46.82	20.61	3.66	-29.87	-13.00	-16.87
38695.30	37.736	0	100	H	38695.30	-42.75	20.73	4.20	-26.23	-13.00	-13.23
38514.09	38.359	0	100	V	38514.09	-38.90	20.73	4.20	-22.37	-13.00	-9.37

Please refer to the following plots.

30 MHz – 1 GHz

Horizontal



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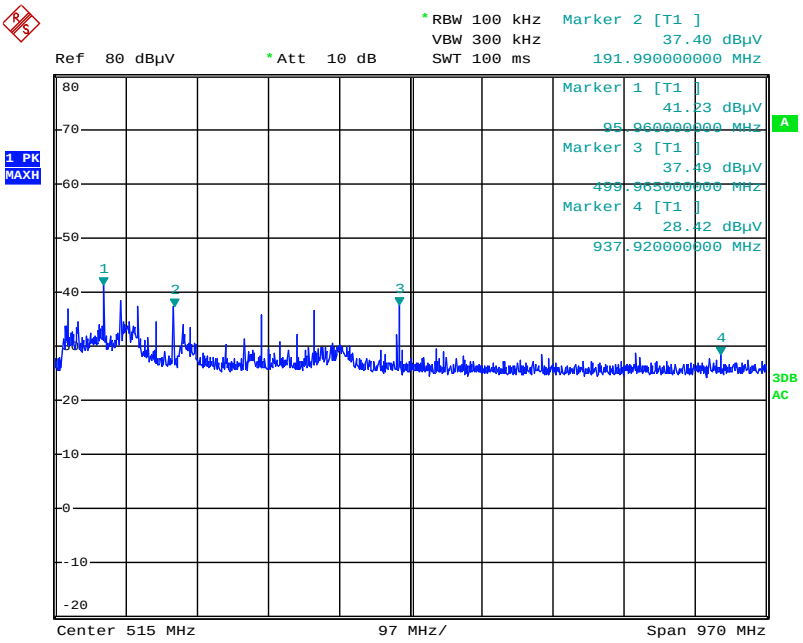
Vertical



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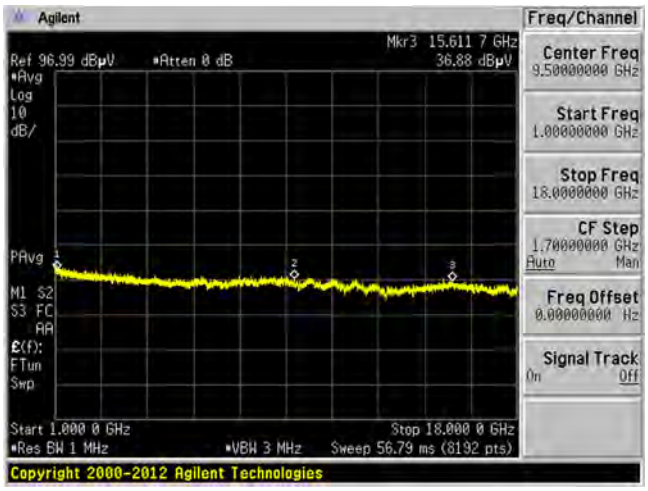
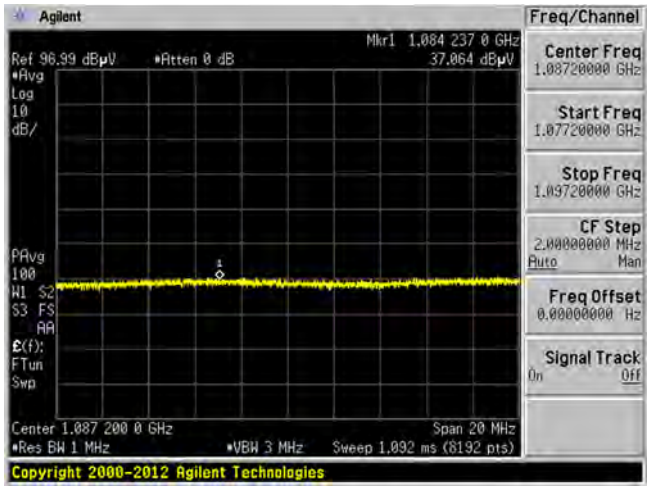
1 GHz – 18 GHz

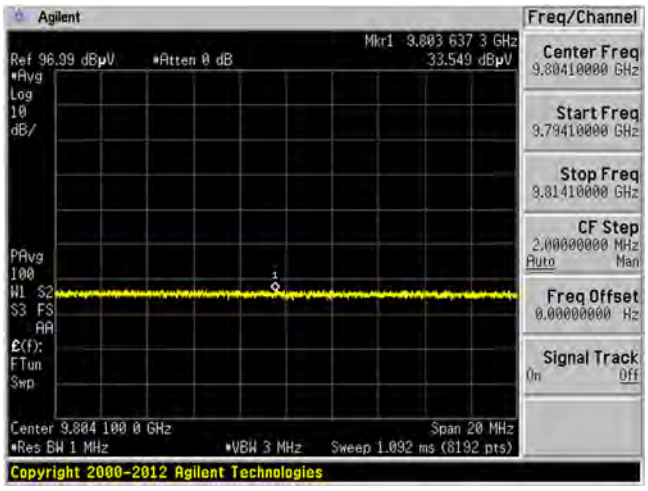
Horizontal



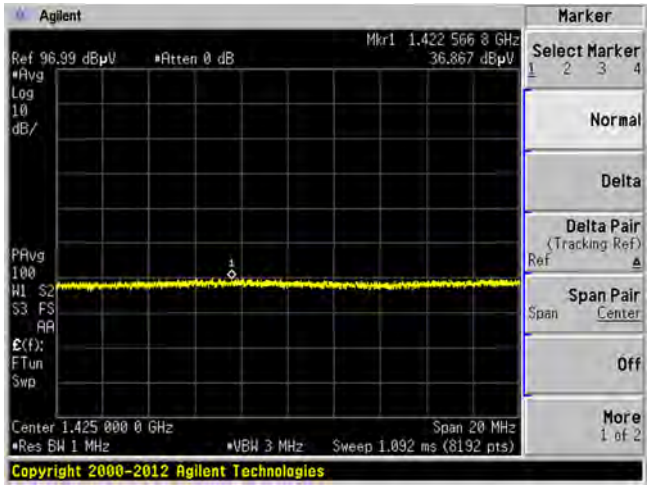
Horizontal Maker 1 Zoom



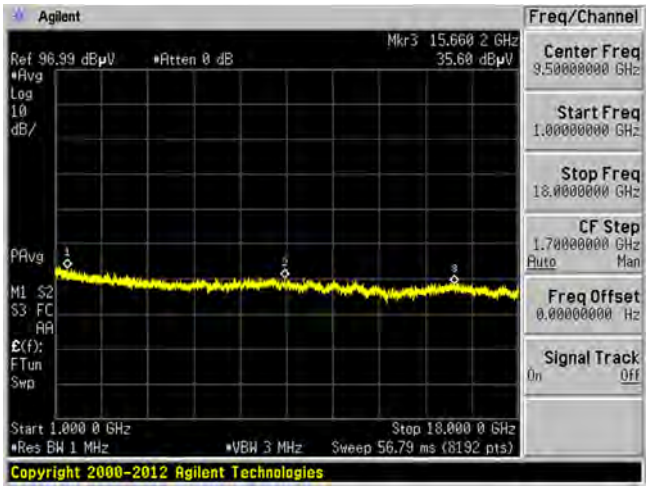
Horizontal Maker 2 Zoom



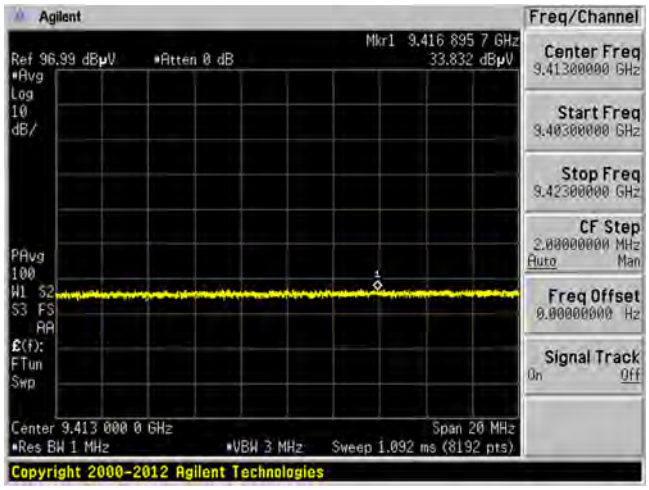
Horizontal Maker 3 Zoom



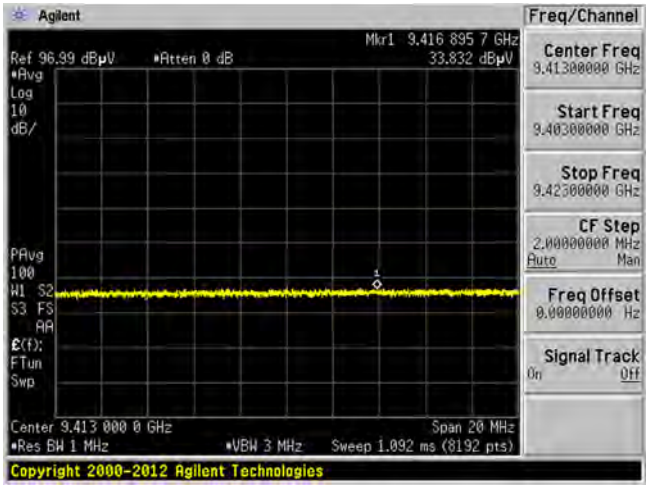
Vertical



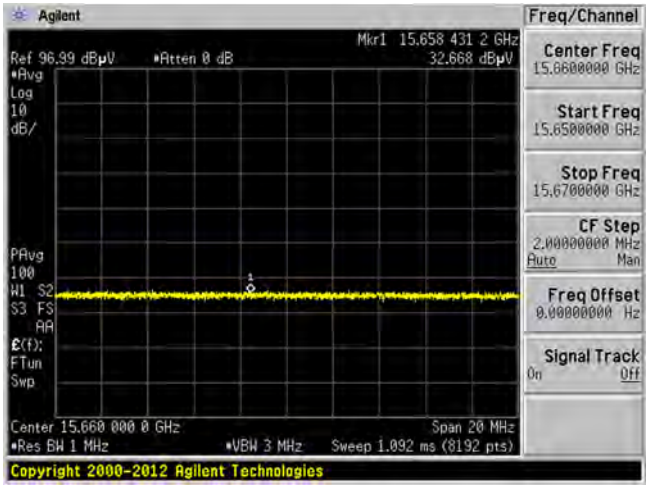
Vertical Maker 1 Zoom



Vertical Maker 2 Zoom

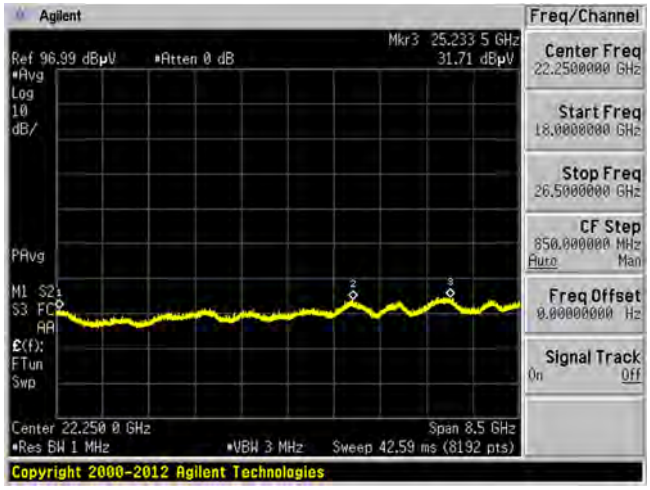


Vertical Maker 3 Zoom

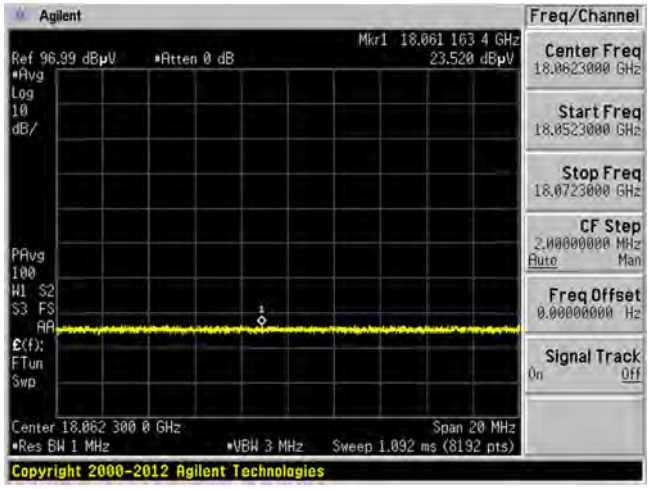


18 GHz – 26.5 GHz

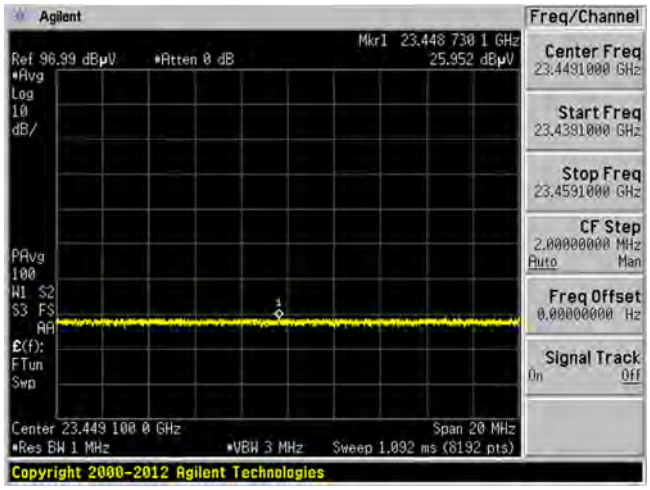
Horizontal



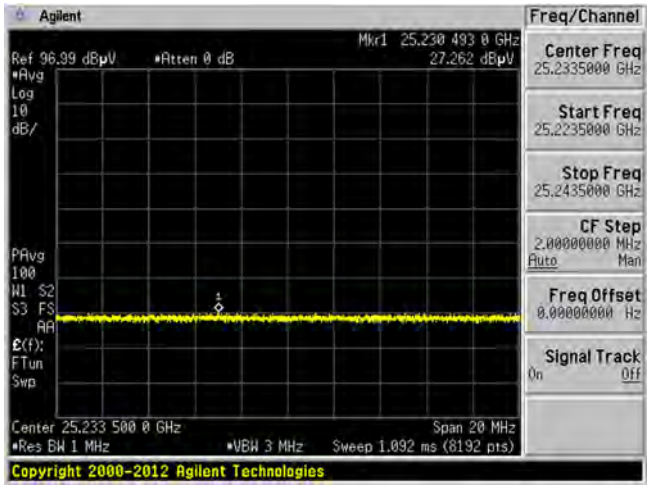
Horizontal Maker 1 Zoom



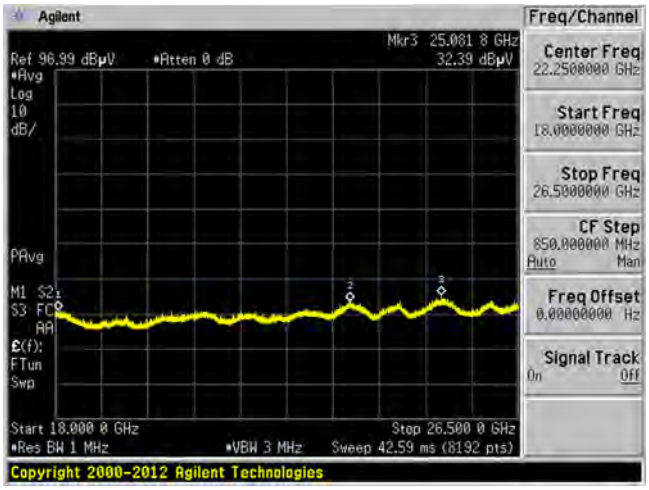
Horizontal Maker 2 Zoom



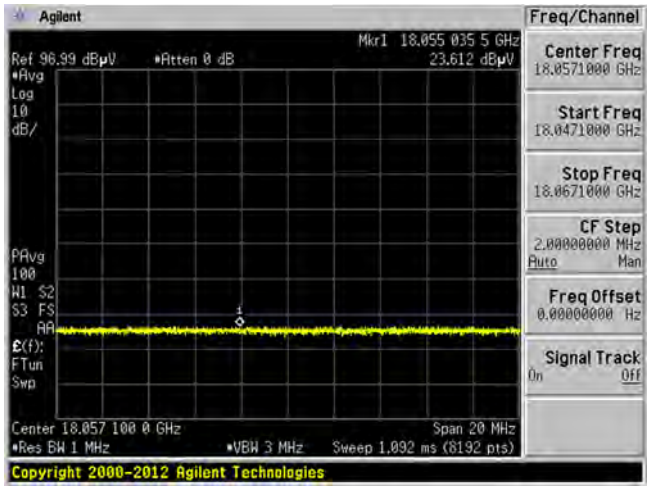
Horizontal Maker 3 Zoom



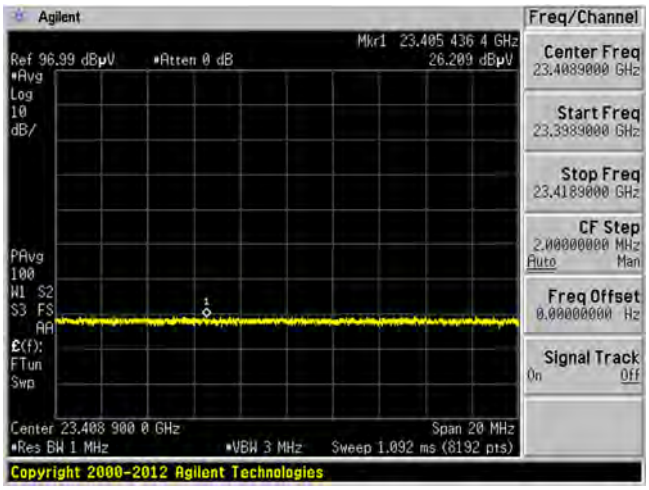
Vertical



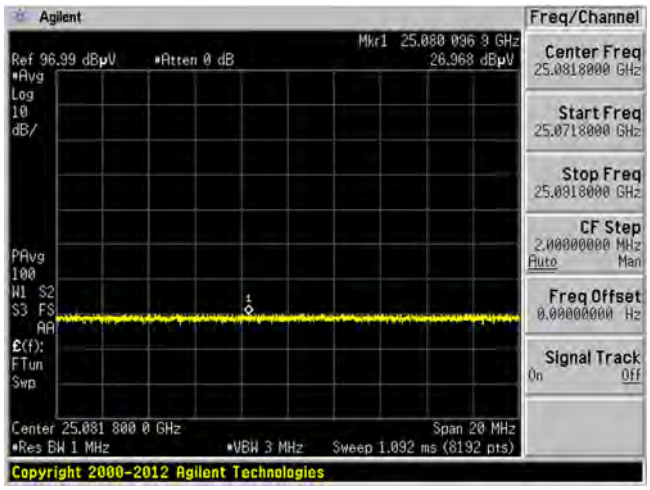
Vertical Maker 1 Zoom



Vertical Maker 2 Zoom

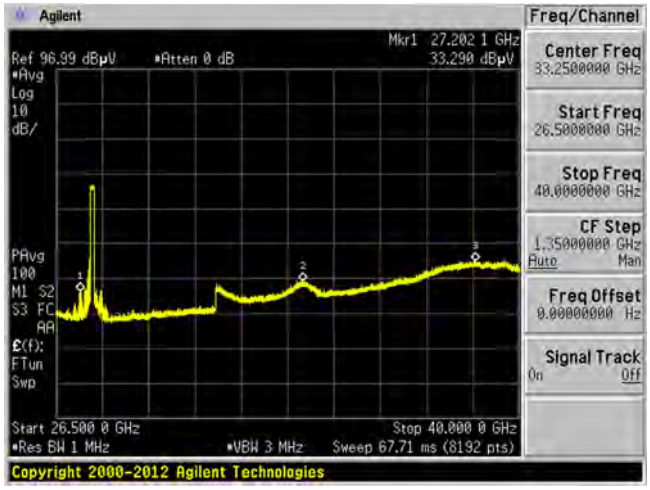


Vertical Maker 3 Zoom

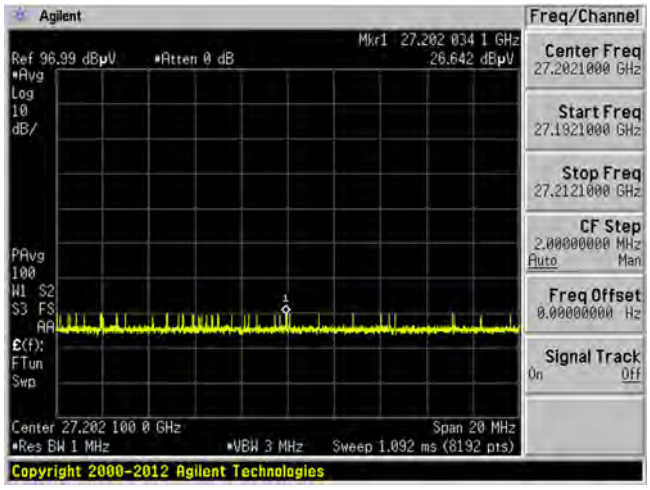


26.5 GHz – 40 GHz

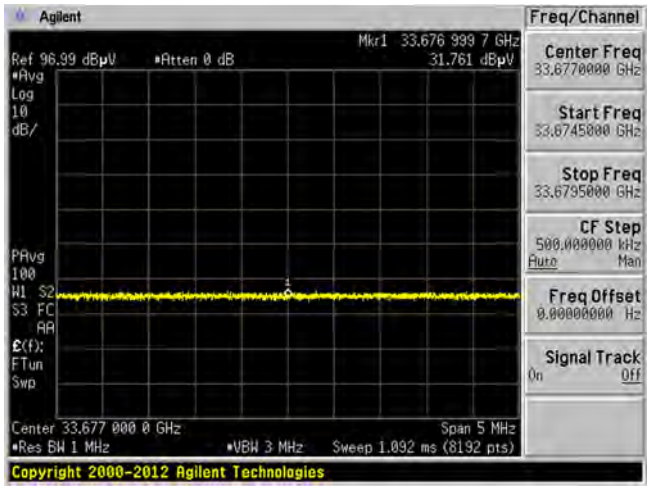
Horizontal



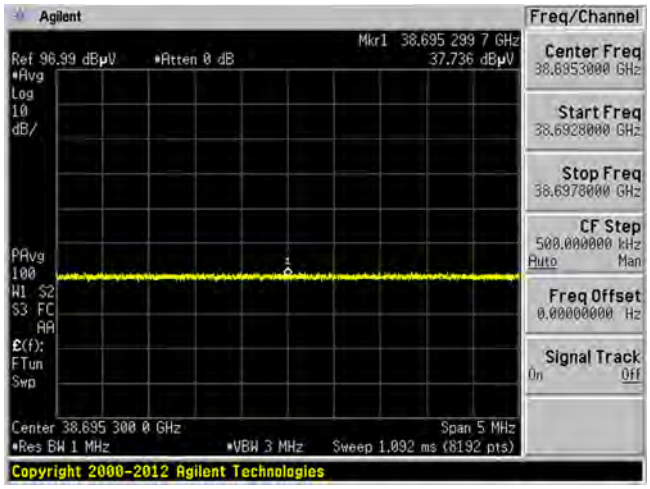
Horizontal Maker 1 Zoom



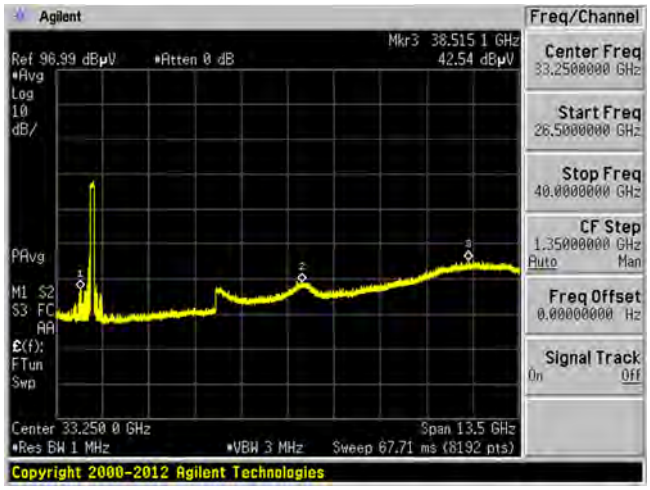
Horizontal Maker 2 Zoom



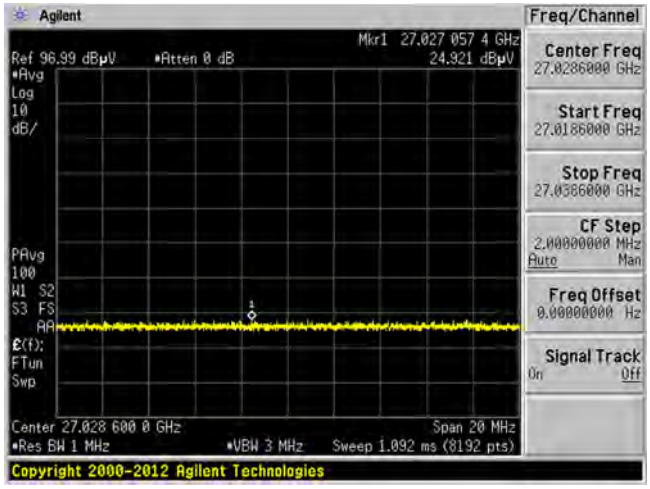
Horizontal Maker 3 Zoom



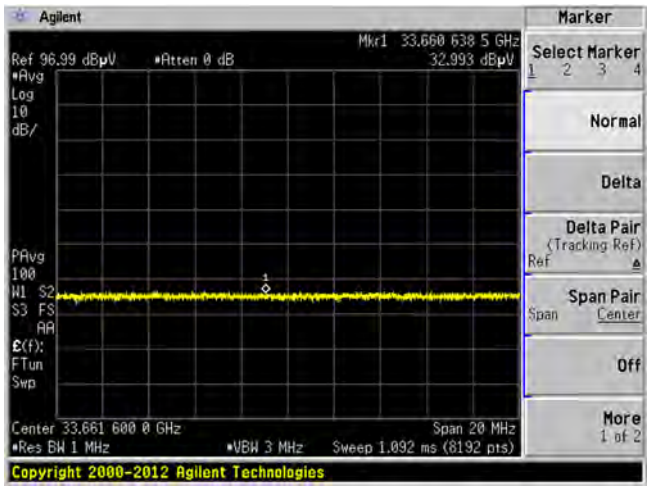
Vertical



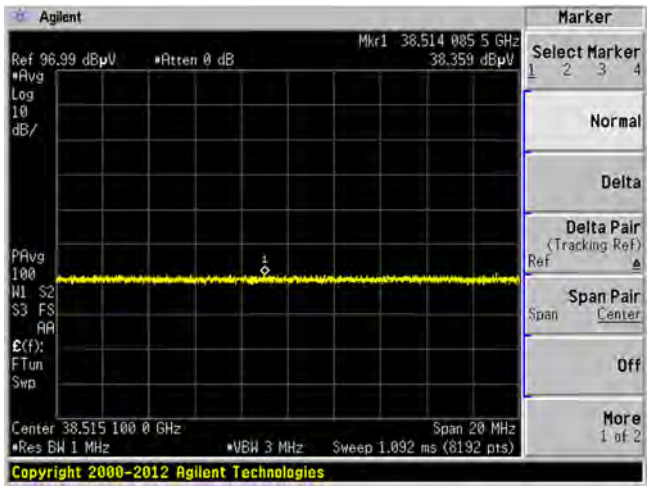
Vertical Maker 1 Zoom



Vertical Maker 2 Zoom



Vertical Maker 3 Zoom

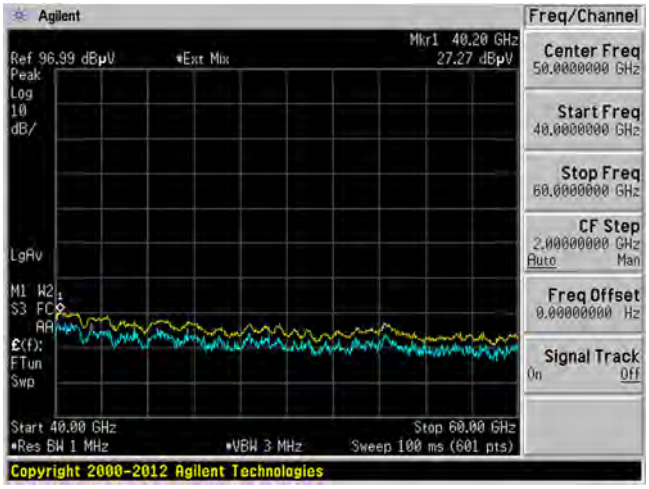


2) 40 GHz – 100 GHz measured at 1m

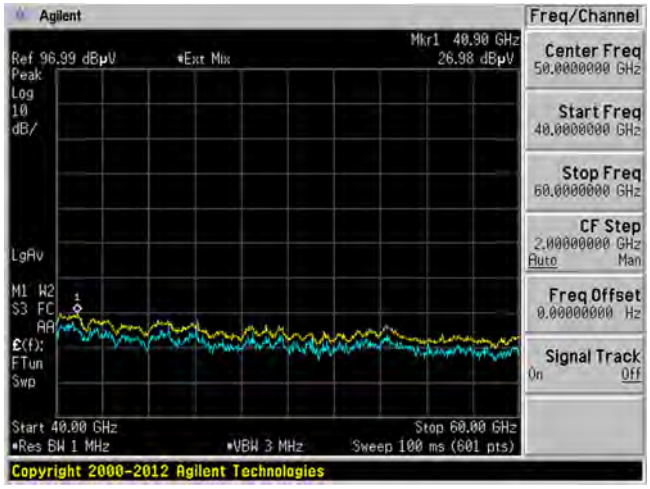
Freq. (GHz)	S.A. Amp. (dBµV)	Table Azimuth (Degrees)	Test Antenna		Conv. Loss (dB)	Cord Reading (dBuV/m)	Cord Reading (dBm)	Limit (dBm)	Margin (dB)
			Height (cm)	Polar (H/V)					
40.2	27.27	0	100	H	34.47	61.74	-42.96	-13	-29.96
40.9	26.98	0	100	V	36.33	63.31	-41.39	-13	-28.39
60.1	27.06	0	100	H	45.62	72.68	-32.02	-13	-19.02
60.95	26.71	0	100	V	45.62	72.33	-32.37	-13	-19.37
93.417	28.14	0	100	H	47.52	75.66	-29.04	-13	-16.04
92.433	28.77	0	100	V	51.24	80.01	-24.69	-13	-11.69

Please refer to the following plots for worst case results.

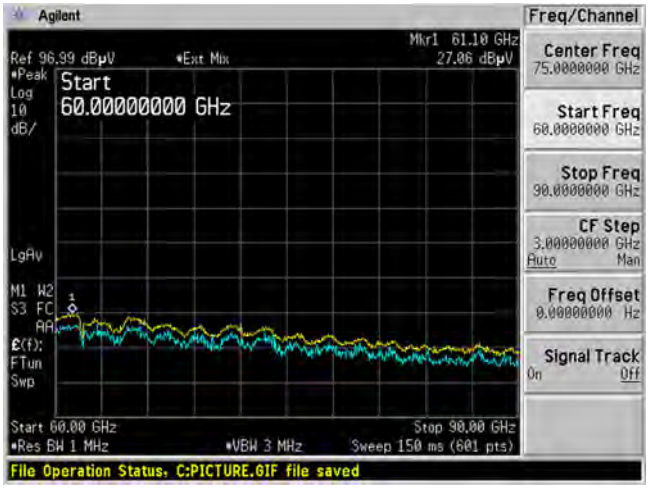
40 GHz – 60 GHz Horizontal



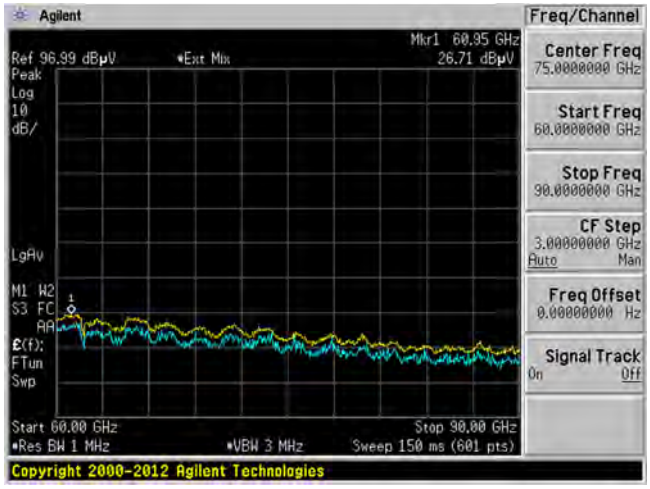
40 GHz – 60 GHz Vertical



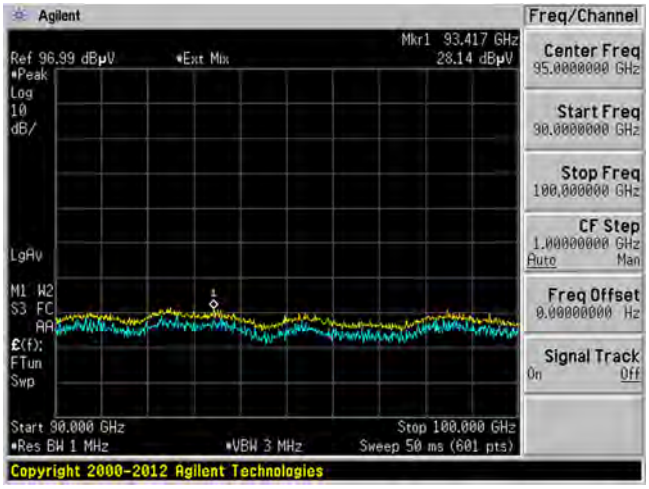
60 GHz – 90 GHz Horizontal



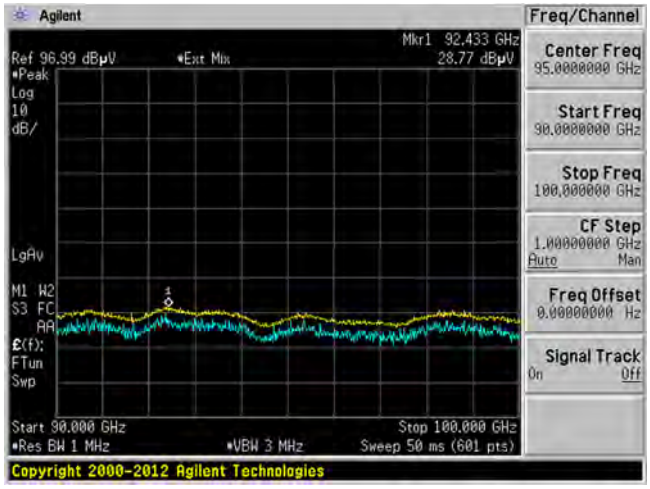
60 GHz – 90 GHz Vertical



90 GHz – 100 GHz Horizontal



90 GHz – 100 GHz Vertical



Measurement plots shown above do not include correction factors. The measurement was evaluated by comparing the highest raw data with the limit substracting the maximum conversion factor. The evaluation results are shown in the table below, and the detailed conversion factors are included in SISO configuration.

Freq. (GHz)	Max Conv. Loss (dB/m)	EIRP Limit (dBm)	Worst Case Limit Line (dBuV)	Highest Emission Level (dBuV)	Margin (dB)
40 - 60	43.12	-13	48.68	27.27	-21.41
60 - 90	47.78	-13	44.02	27.06	-16.96
90 - 100	51.24	-13	40.56	28.77	-11.79

Note: The test distance was at 1 meter, therefore the worst case limit line (dBuV) = EIRP limit (-13 dBm) + 104.8 - 20log(D) – conversion loss (dB/m) where D is the measurement distance (in the far field region) in m.

Note: The Margin (dB) = Highest Emission Level (dBuV) – Worst Case Limit Line (dBuV). Therefore, negative margin shows compliance.

8 FCC §2.1049 - Occupied Bandwidth

8.1 Applicable Standards

As per FCC §2.1049, Occupied bandwidth of tranmissions falls within authorized bands

8.2 Measurement Procedure

1. The spectrum analyzer's automatic bandwidth measurement function was used to perform the 99% occupied bandwidth measurement.

2. Set the RBW =1~5% of the anticipated OBW, and the VBW≥3 x RBW.

3. Set spectrum analyzer detection mode to peak, and the trace mode to max hold.

4. Sweep = auto couple.

5. Record the test plots and test results.

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer 44 GHz	E4446A	US44300386	2019-08-24	2 years
-	RF Cable	-	-	Each Time	-
Wisewave	Antenna, Horn	ARH-2823-02	10555-02	2020-02-27	2 years

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

8.4 Test Environmental Conditions

Temperature:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Tri Pham on 2021-03-09 at 5m3 chamber.

8.5 Test Results

Please refer to the following tables and plots.

Beam ID: 11 (Vertical)

Band	Component Carriers	Modulation	Channel	Occupied Bandwidth (MHz)
n261	1CC	QPSK	Low	94.6192
			Middle	94.5564
			High	94.7544
		64QAM	Low	94.7568
			Middle	94.9219
			High	94.8542
	4CC	QPSK	Low	393.2073
			Middle	393.7464
			High	395.3236
		64QAM	Low	394.21
			Middle	394.6432
			High	394.2368

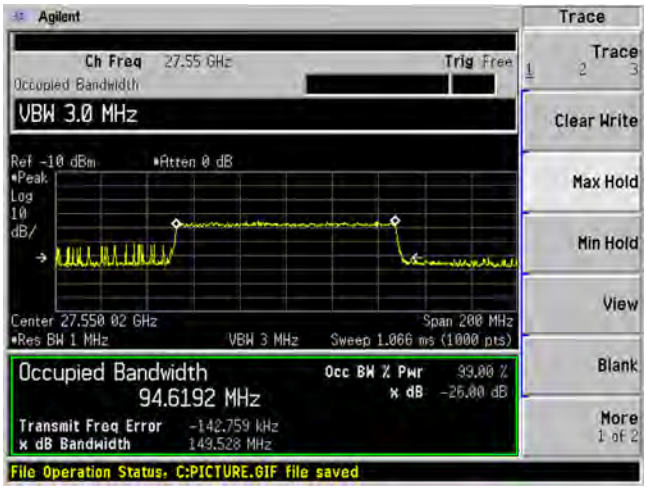
Beam ID: 139 (Horizontal)

Band	Component Carriers	Modulation	Channel	Occupied Bandwidth (MHz)
n261	1CC	QPSK	Low	95.074
			Middle	94.8383
			High	95.1335
		64QAM	Low	95.5888
			Middle	94.6581
			High	94.8903
	4CC	QPSK	Low	393.6937
			Middle	393.9205
			High	394.1949
		64QAM	Low	394.9707
			Middle	394.4024
			High	393.5748

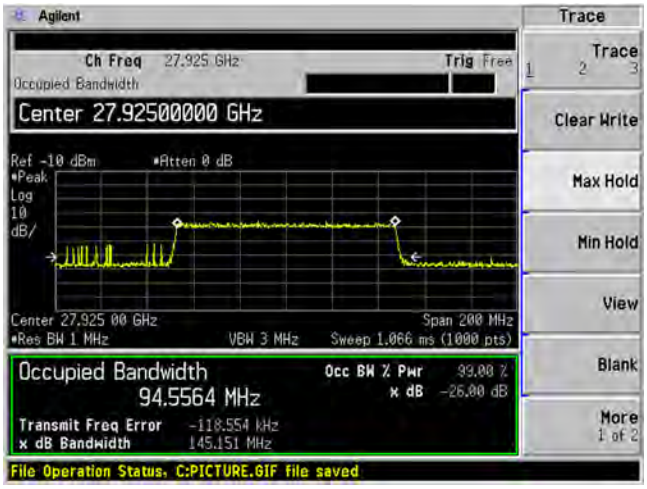
Beam ID: 11 (Vertical)

1CC - QPSK

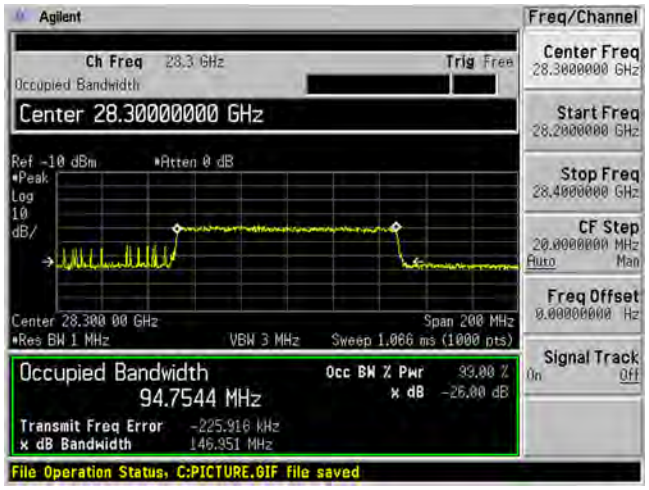
Low Channel



Middle Channel



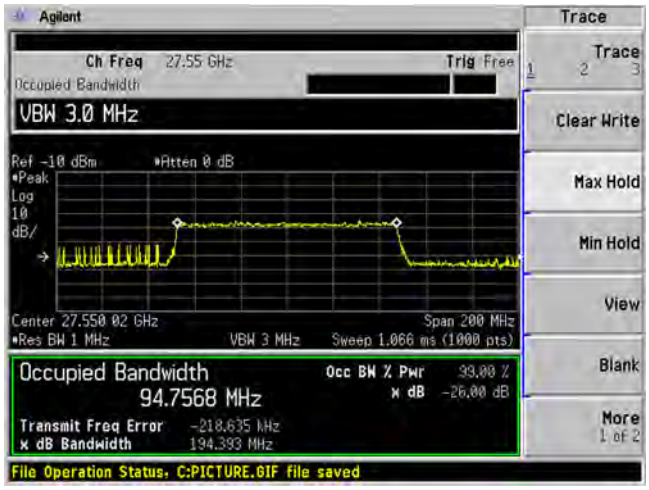
High Channel



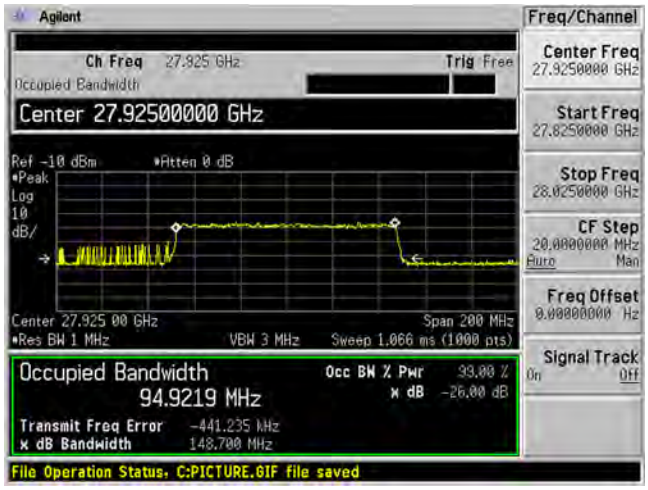
Beam ID: 11 (Vertical)

1CC – 64QAM

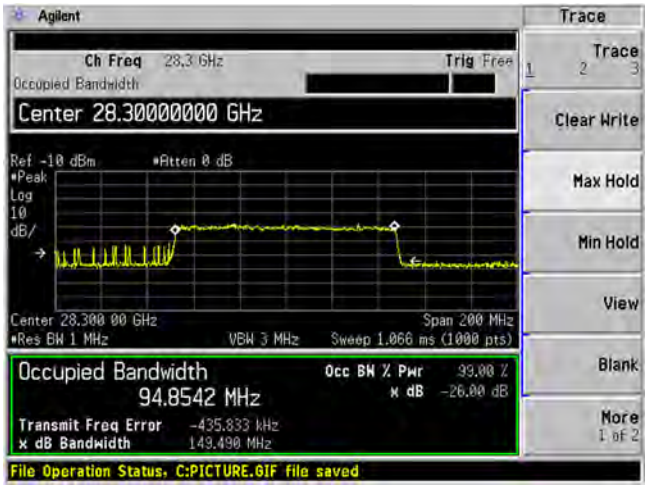
Low Channel



Middle Channel



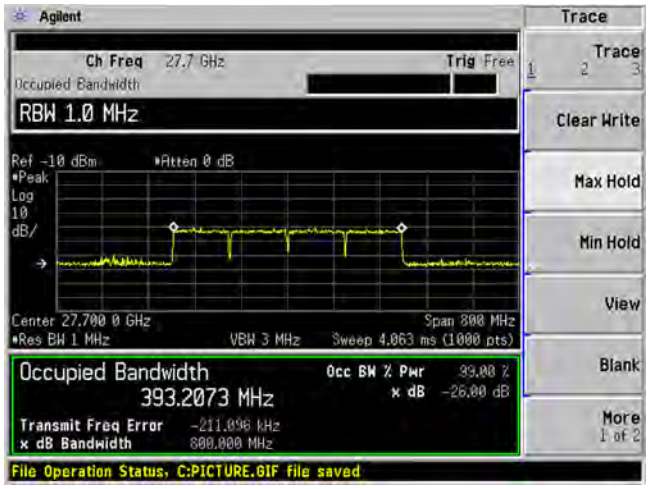
High Channel



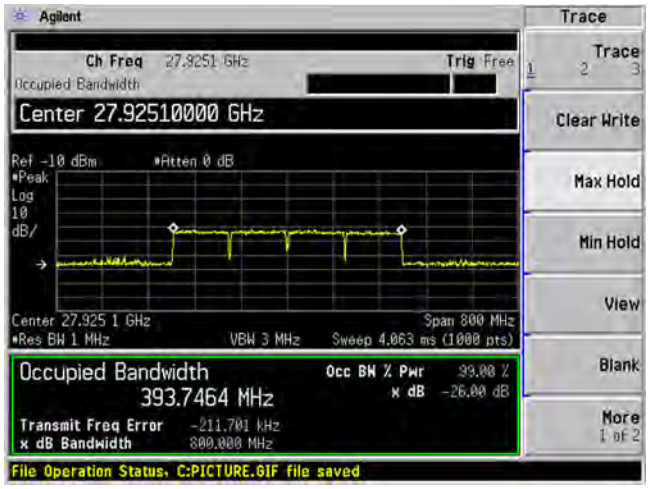
Beam ID: 11 (Vertical)

4CC – QPSK

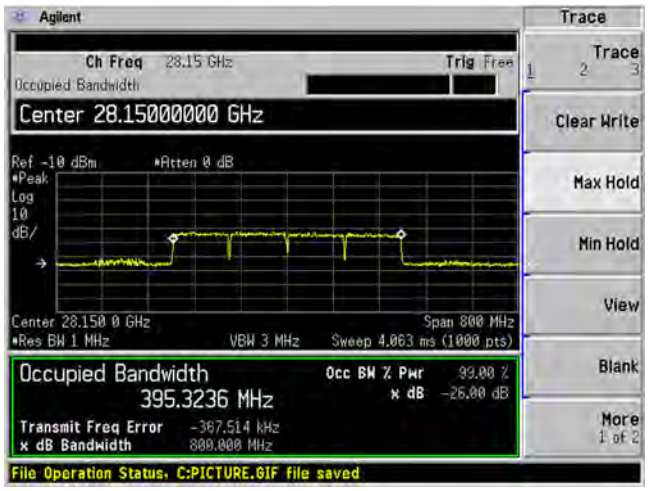
Low Channel



Middle Channel



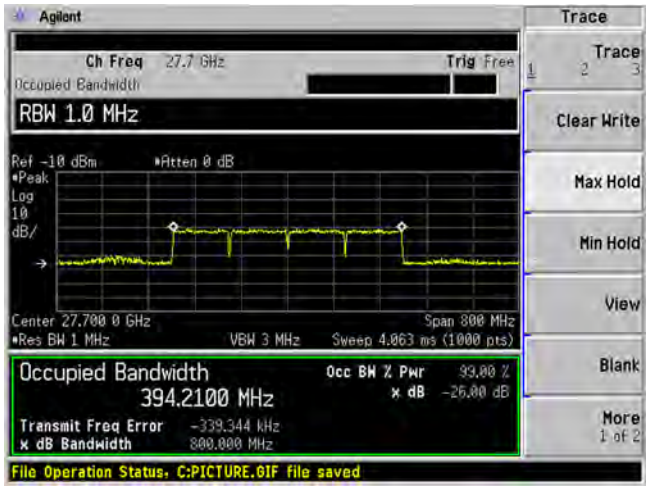
High Channel



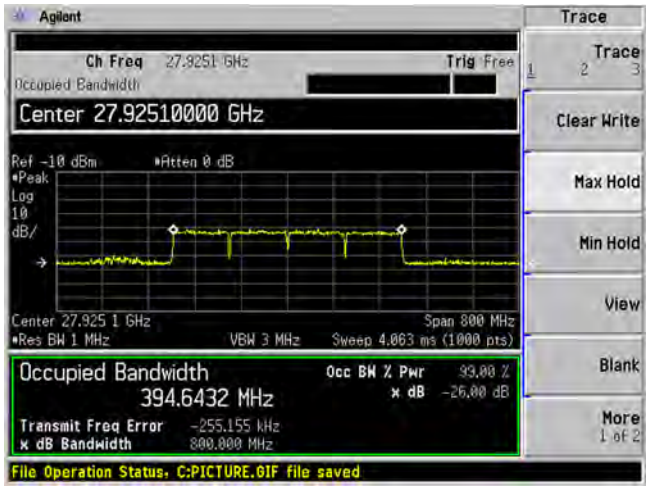
Beam ID: 11 (Vertical)

4CC – 64QAM

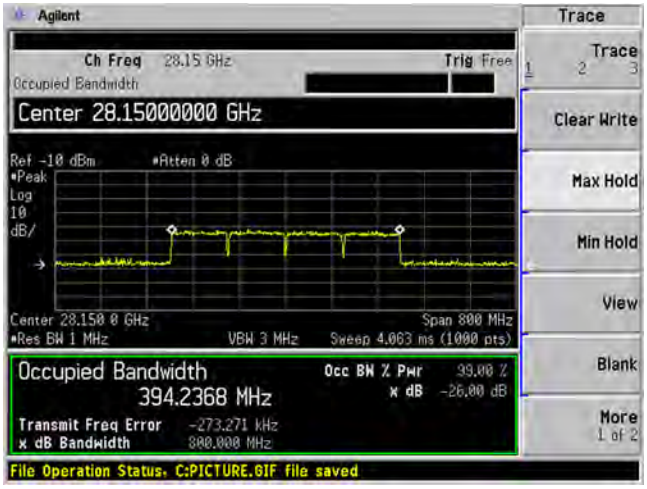
Low Channel



Middle Channel



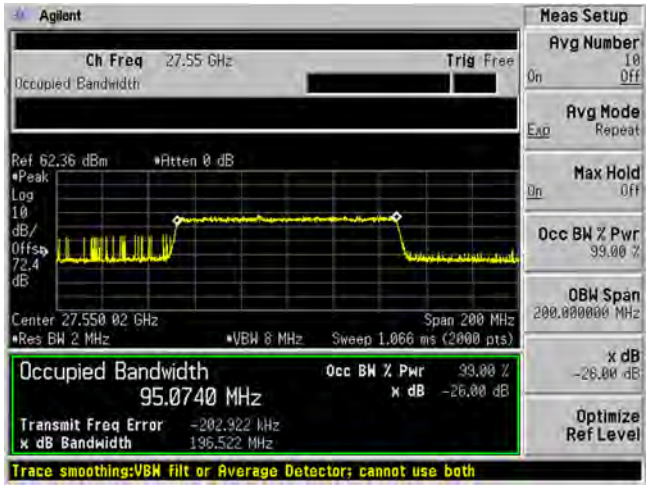
High Channel



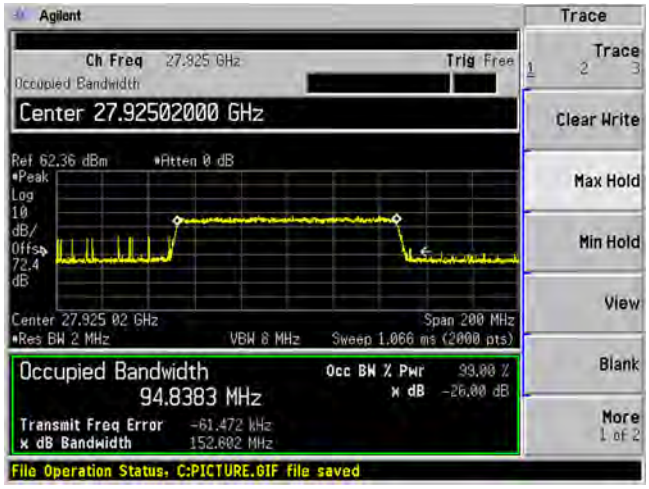
Beam ID: 139 (Horizontal)

1CC – QPSK

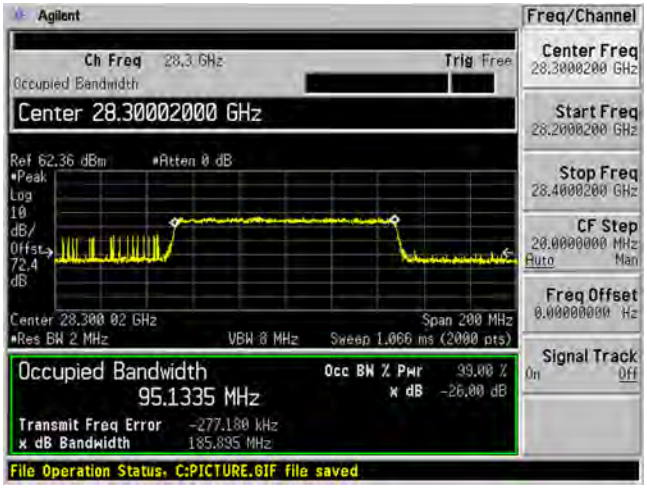
Low Channel



Middle Channel



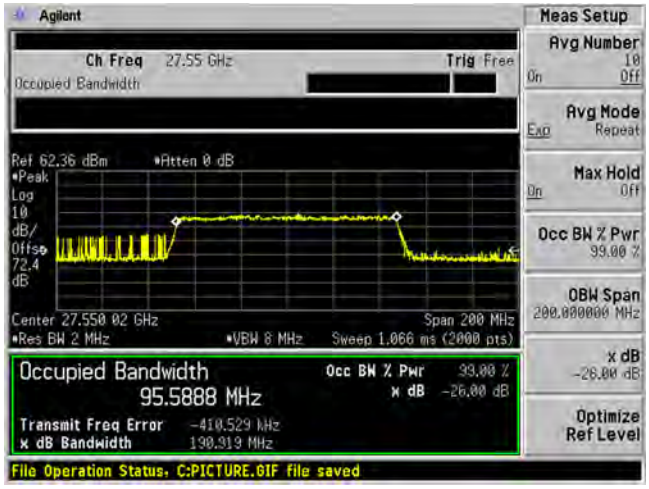
High Channel



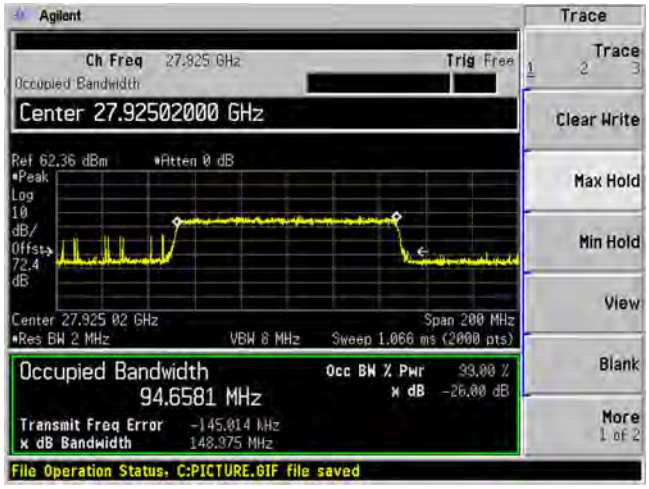
Beam ID: 139 (Horizontal)

1CC – 64QAM

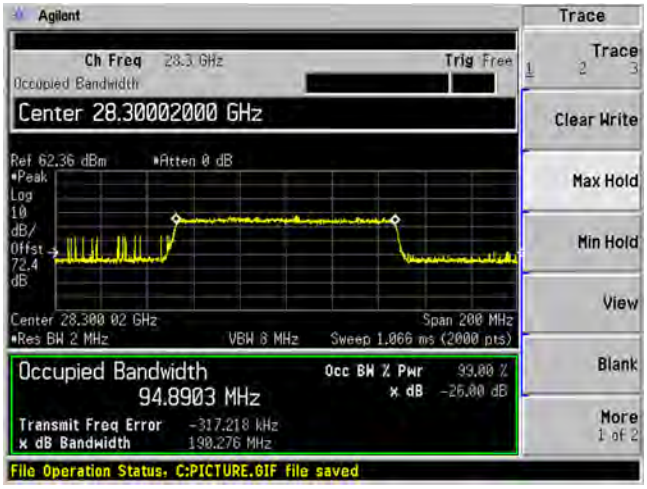
Low Channel



Middle Channel



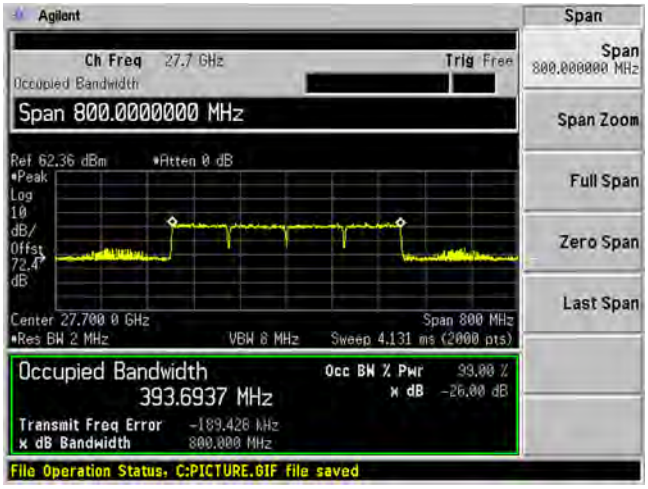
High Channel



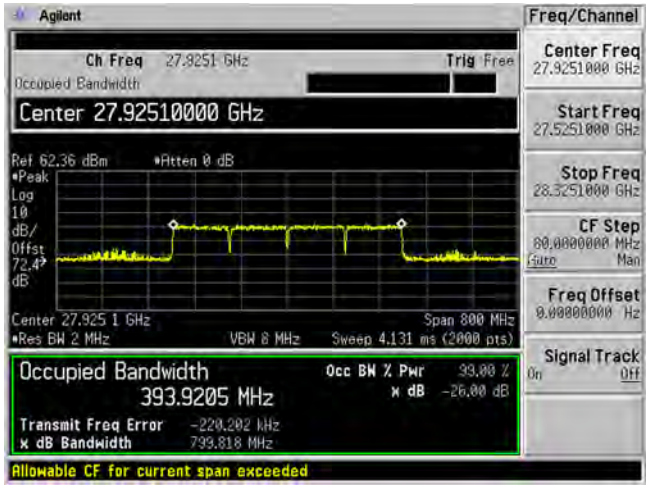
Beam ID: 139 (Horizontal)

4CC – QPSK

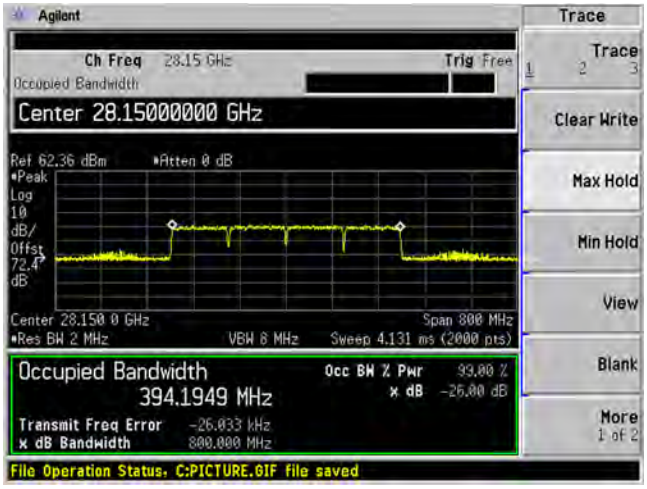
Low Channel



Middle Channel



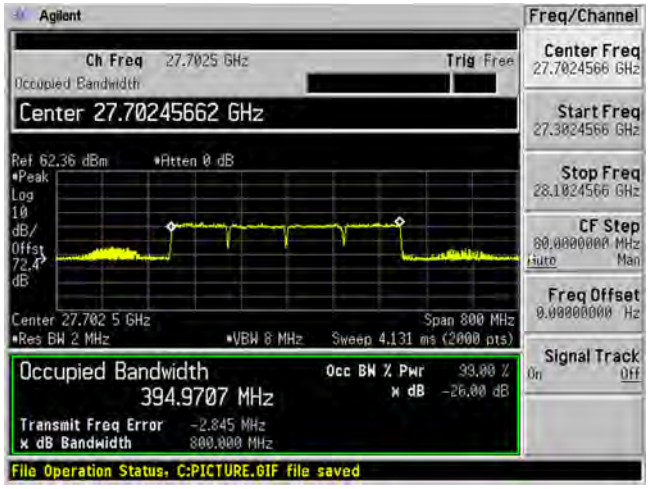
High Channel



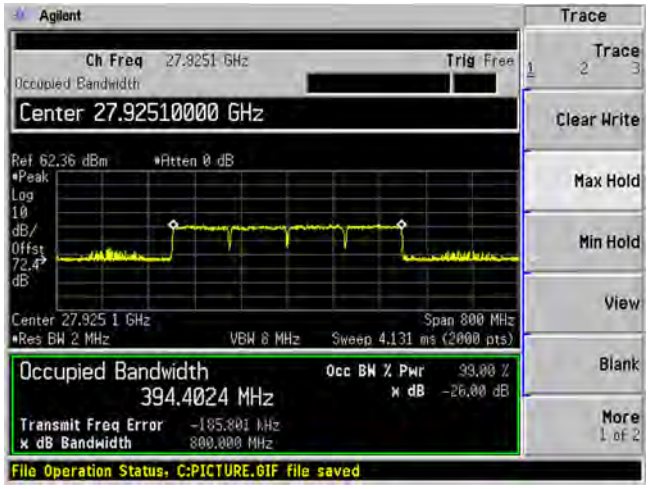
Beam ID: 139 (Horizontal)

4CC – 64QAM

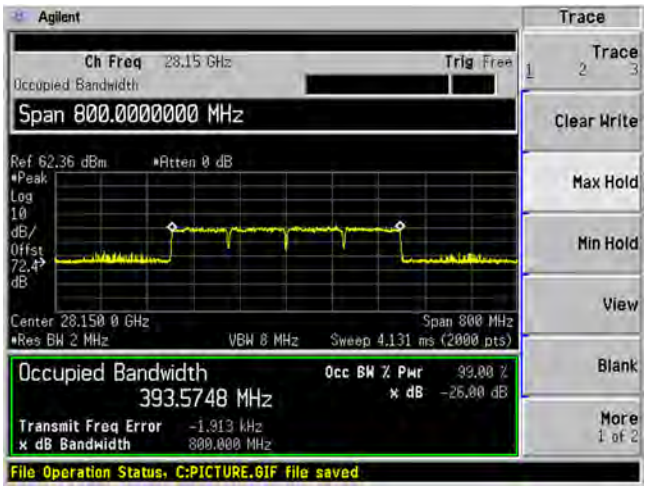
Low Channel



Middle Channel



High Channel



9 FCC §30.202 (a) & §2.1051 - Power Limits

9.1 Applicable Standards

According to FCC §30.202:

(a) For fixed and base stations operating in connection with mobile systems, the average power of the sum of all antenna elements is limited to an equivalent 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.

9.2 Measurement Procedure

EIRP Measurement

According to ANSI C63.26-2015 section 5.2.7 Radiated power measurements

E (dBμV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m).

EIRP (dBm) = E (dBμV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m.

Based on both equations above, the offset should equal to Antenna Factor(dB/m) + Cable Loss(dB) + 107 + 20log(D) -104.8 when set the unit to dBm on the PSA. The duty cycle correction factor in section 2.3 was also added in the offset for average measurement.

9.3 Far Field Distance Calculation

Note: Measurements were taken in the far field distance R based on the firmular $R \geq 2D^2/\lambda$, where D is the antenna length, λ is the wavelength. Wavelength = v/f, where v is the speed of light (3×10^9 m/s).

EUT antenna dimension 44mm, TX range: 27500 MHz – 28350 MHz
R range: 0.0355 m to 0.0366 m.

Receiving antenna frequency range and dimension are shown in the following table:

Frequency (GHz)	Antenna	Dimension (Length) (mm)	Far Field Range (m)
26.5 – 40	ARH-2823-02	66	0.077 – 0.116

Note: measurement was made at 3 meters.

9.4 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer 44 GHz	E4446A	US44300386	2019-08-24	2 years
-	RF Cable	-	-	Each Time	-
Wisewave	Antenna, Horn	ARH-2823-02	10555-02	2020-02-27	2 years

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

9.5 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Tri Pham from 2021-02-29 to 2021-03-09 in 5m3 Chamber.

9.6 Test Results

1CC

Modulation	Channel Frequency (MHz)	EIRP Horizontal (dBm/100MHz)	EIRP Vertical (dBm/100MHz)	H + V (MIMO) (dBm/100MHz)	Limit (dBm/100MHz)	Margin (dB)
QPSK	27550	40.27	39.81	43.06	75	-31.94
	27925	40.38	39.52	42.98	75	-32.02
	28300	39.73	39.32	42.54	75	-32.46
64QAM	27550	40.53	39.82	43.2	75	-31.8
	27925	40.44	39.7	43.1	75	-31.9
	28300	39.89	39.11	42.53	75	-32.47

4CC

Modulation	Channel	CC Frequency (MHz)	EIRP Horizontal (dBm/100MHz)	EIRP Vertical (dBm/100MHz)	H + V (MIMO) (dBm/100MHz)	Limit (dBm/100MHz)	Margin (dB)
QPSK	Low	27550.08	34.28	34.22	37.26	75	-37.74
		27650.04	33.34	33.4	36.38	75	-38.62
		27750	33.92	34	36.97	75	-38.03
		27849	34.28	34.04	37.17	75	-37.83
	Middle	27750.2	34.1	33.84	36.98	75	-38.02
		27875.16	34.15	34.49	37.33	75	-37.67
		27975.12	34.27	34.02	37.16	75	-37.84
		28075.08	34.49	33.39	36.99	75	-38.01
	High	28000.08	33.56	33.73	36.66	75	-38.34
		28100.04	34.22	34.07	37.16	75	-37.84
		28200	33.8	33.3	36.57	75	-38.43
		28299.96	34.4	33.22	36.86	75	-38.14
64QAM	Low	27550.08	34.31	34.31	37.32	75	-37.68
		27650.04	33.81	33.69	36.76	75	-38.24
		27750	33.37	33.99	36.7	75	-38.3
		27849	33.34	33.99	36.69	75	-38.31
	Middle	27750.2	34.18	34.35	37.28	75	-37.72
		27875.16	34.12	34.3	37.22	75	-37.78
		27975.12	34.77	33.5	37.19	75	-37.81
		28075.08	34.5	33.86	37.2	75	-37.8
	High	28000.08	33.69	34.11	36.92	75	-38.08
		28100.04	34.39	34.42	37.42	75	-37.58
		28200	34.47	33.57	37.05	75	-37.95
		28299.96	33.99	33.82	36.92	75	-38.08

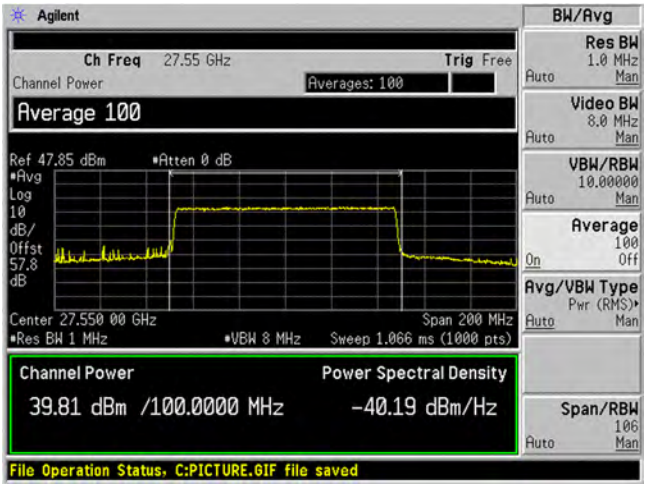
4CC Total EIRP across 400 MHz Bandwidth

Modulation	Channel Frequency (MHz)	EIRP Horizontal (dBm/400MHz)	EIRP Vertical (dBm/400MHz)	H + V (MIMO) (dBm/400MHz)
QPSK	27700.02	40.46	40.30	43.39
	27925.14	40.46	40.36	43.42
	28150.02	40.43	39.73	43.10
64QAM	27700.02	40.25	40.32	43.30
	27925.14	40.10	39.55	42.84
	28150.02	40.28	39.20	42.78

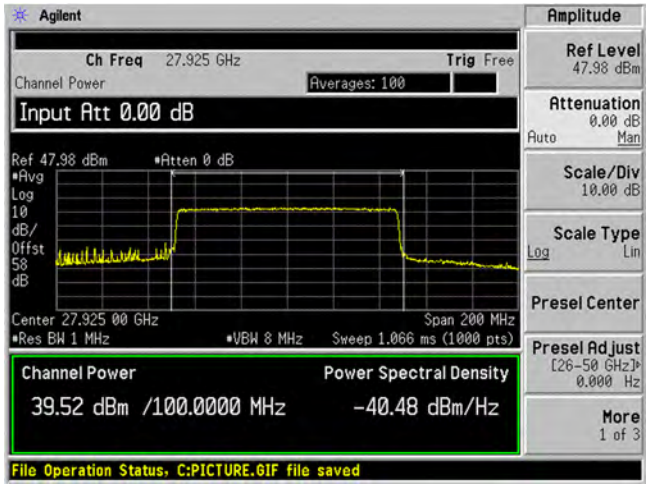
Beam ID: 11 (Vertical)

1CC – QPSK

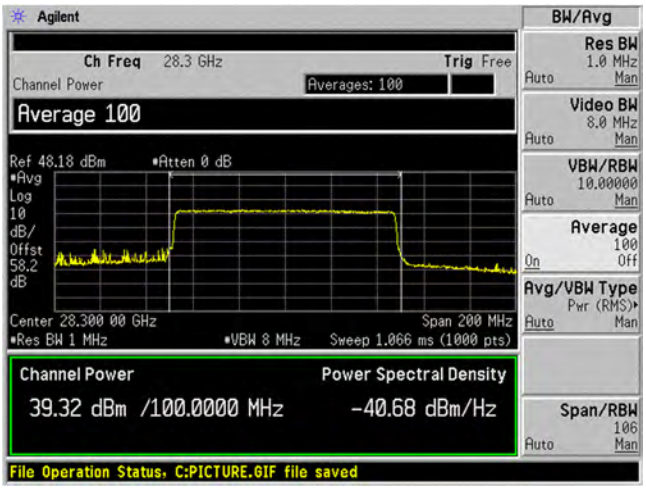
Low Channel



Middle Channel



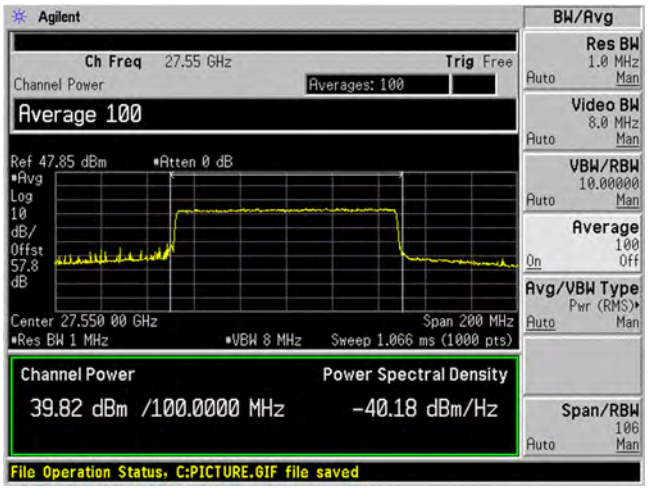
High Channel



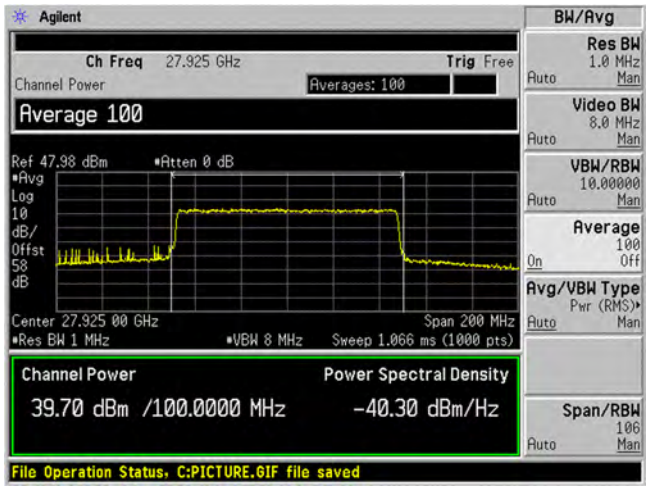
Beam ID: 11 (Vertical)

1CC – 64QAM

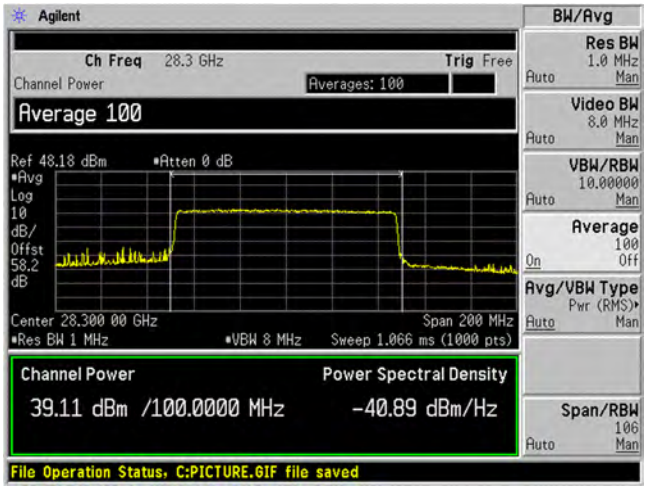
Low Channel



Middle Channel



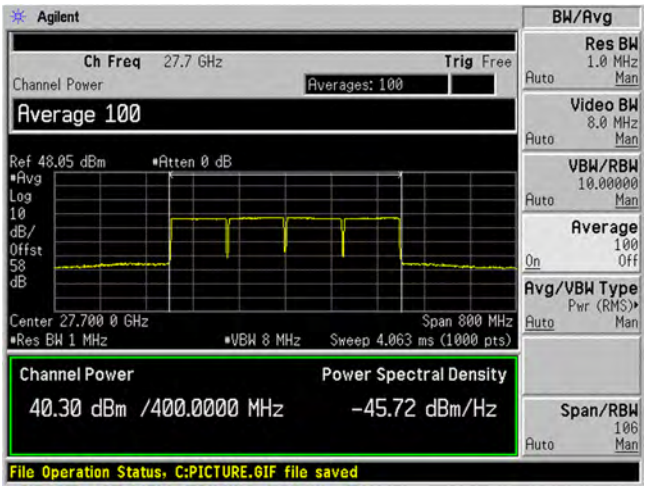
High Channel



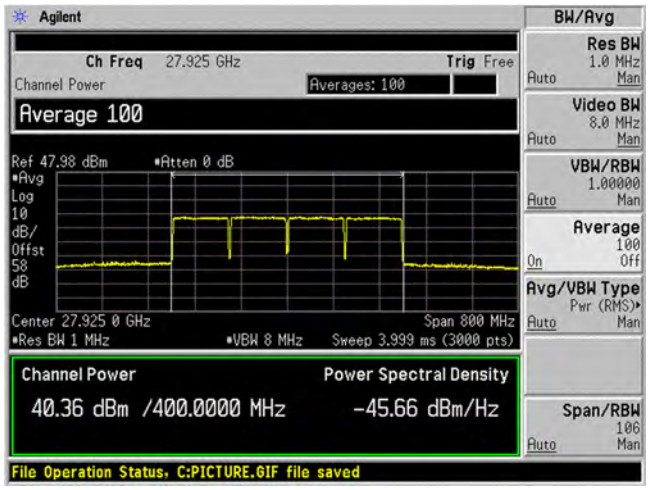
Beam ID: 11 (Vertical)

4CC – QPSK

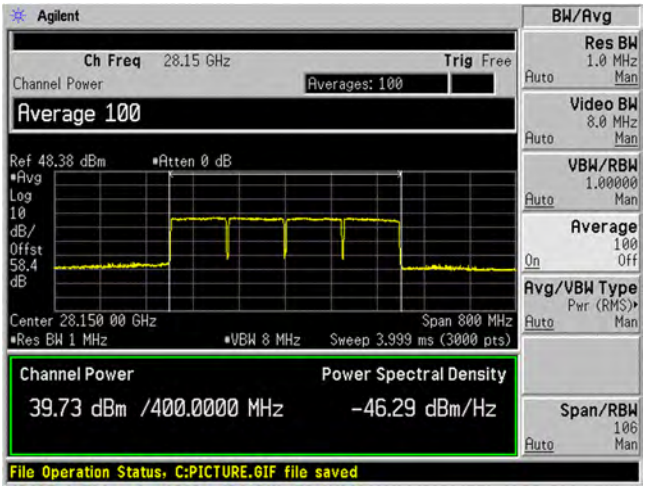
Low Channel



Middle Channel



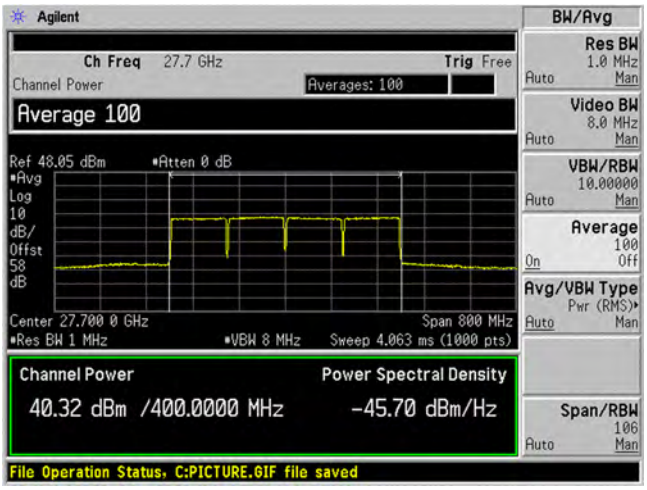
High Channel



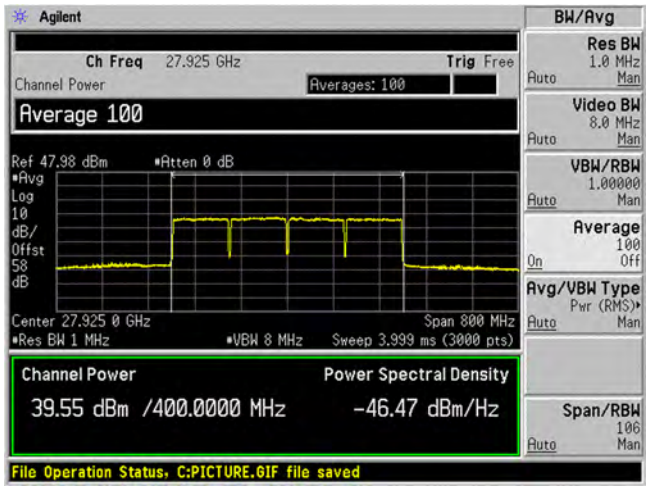
Beam ID: 11 (Vertical)

4CC – 64QAM

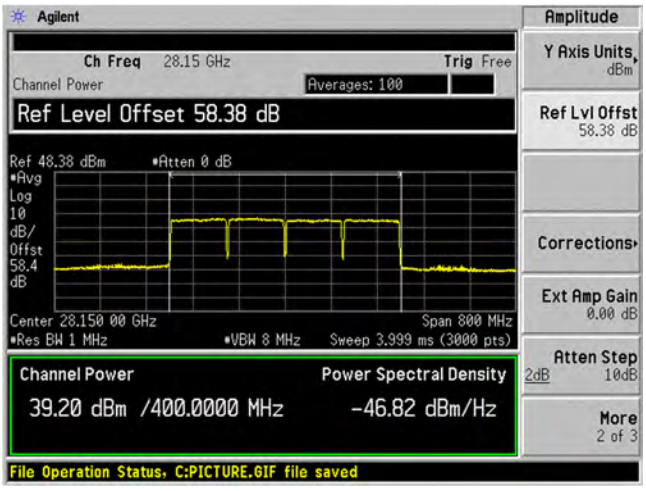
Low Channel



Middle Channel



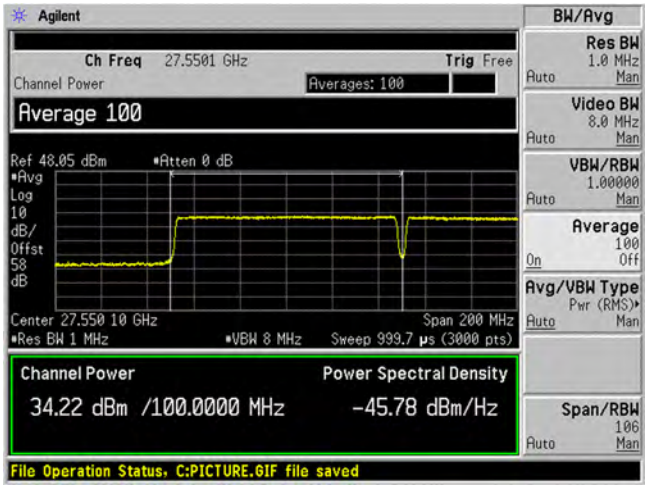
High Channel



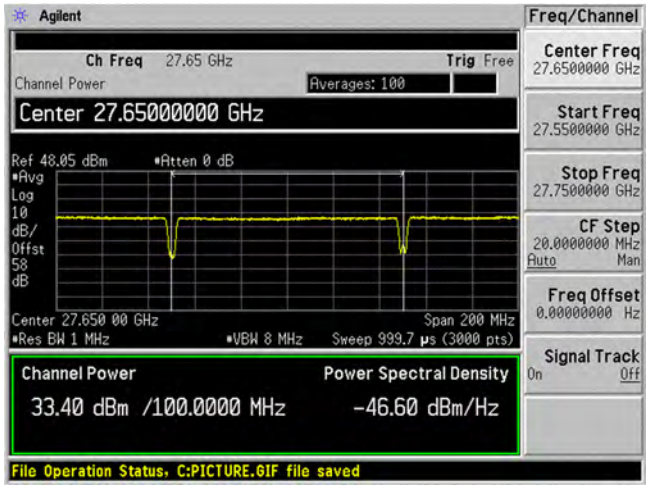
Beam ID: 11 (Vertical)

4CC – QPSK – Low Channel

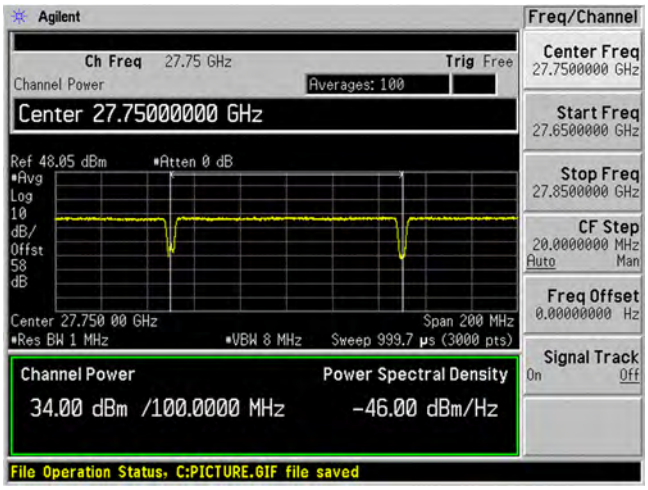
1st Carrier



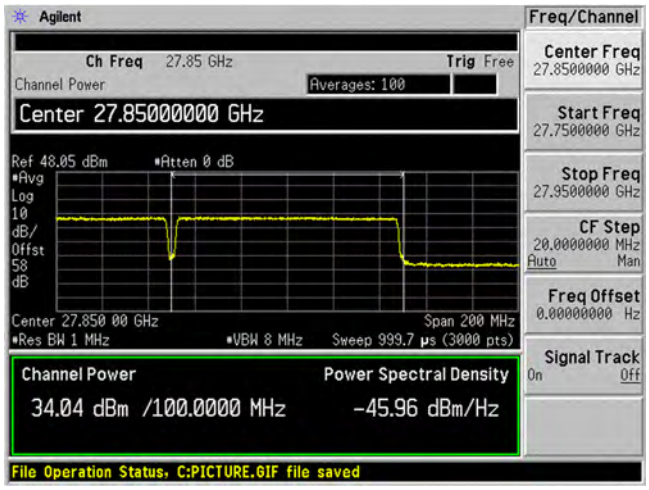
2nd Carrier



3rd Carrier



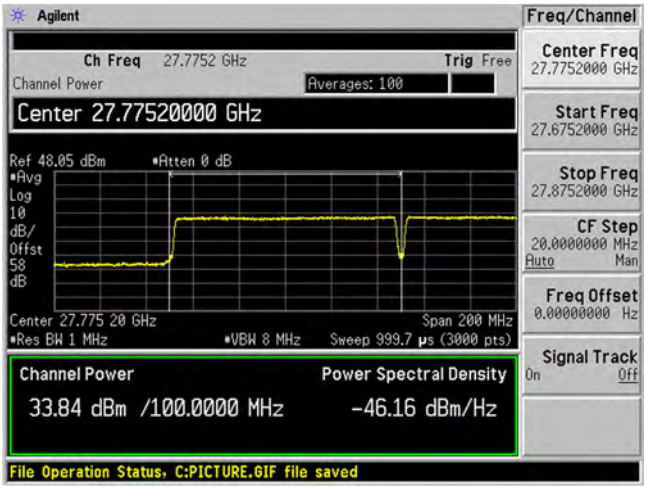
4th Carrier



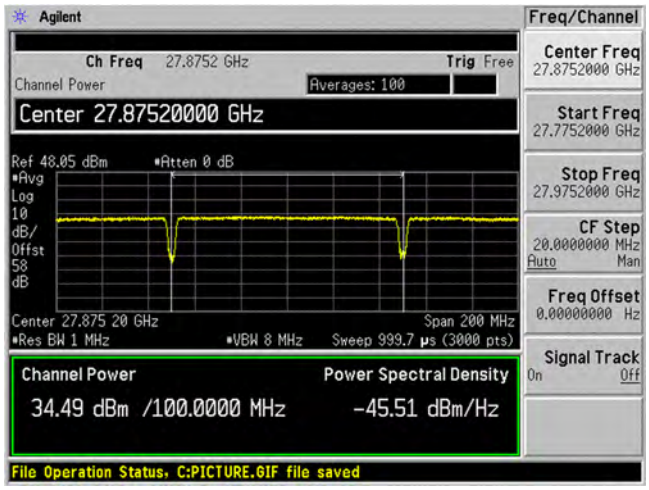
Beam ID: 11 (Vertical)

4CC – QPSK – Middle Channel

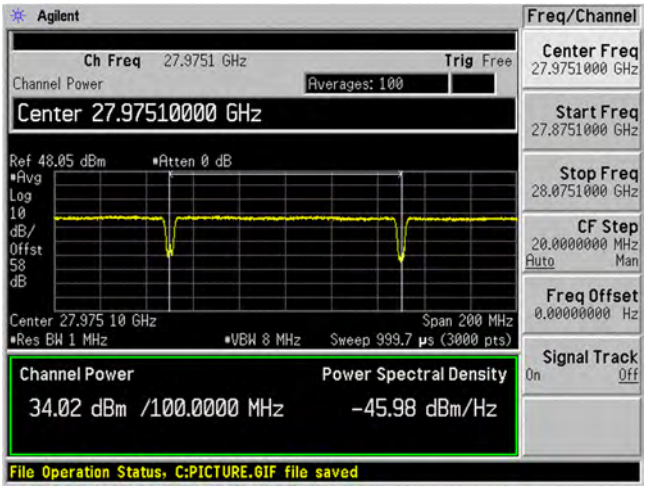
1st Carrier



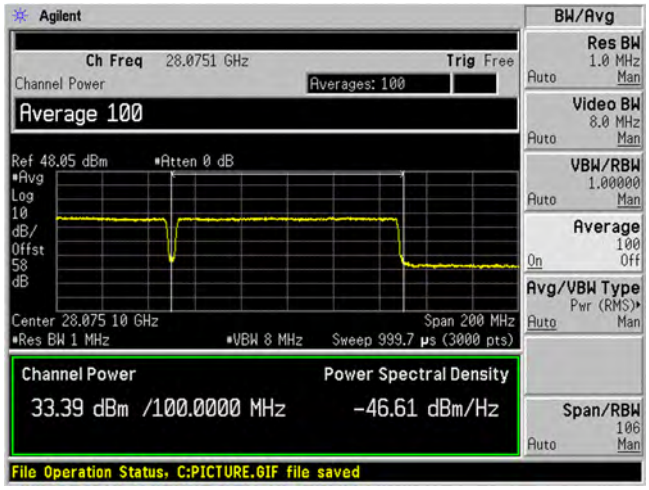
2nd Carrier



3rd Carrier



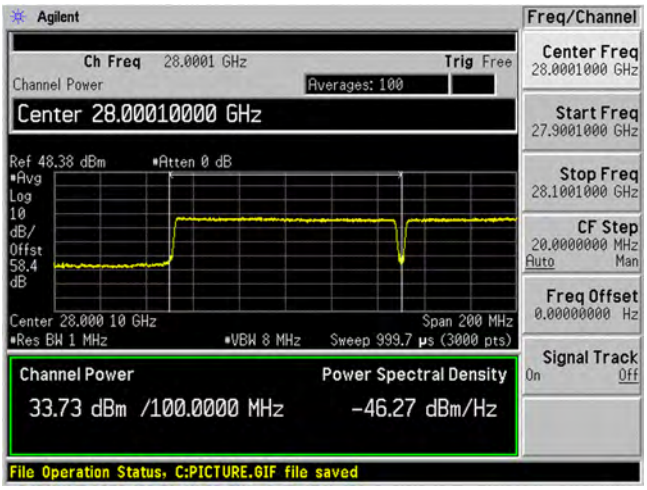
4th Carrier



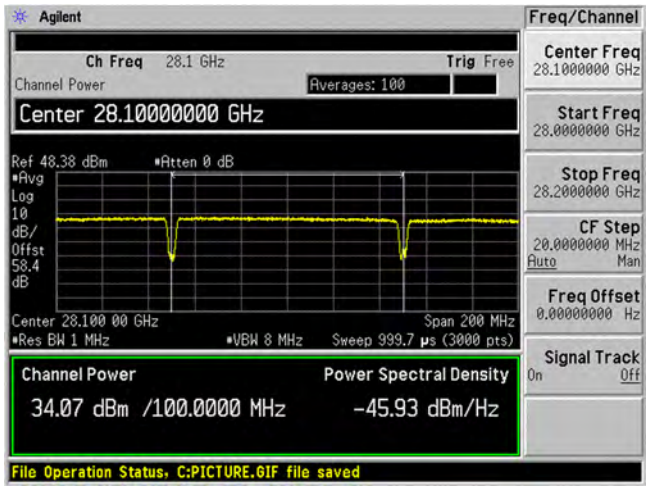
Beam ID: 11 (Vertical)

4CC – QPSK – High Channel

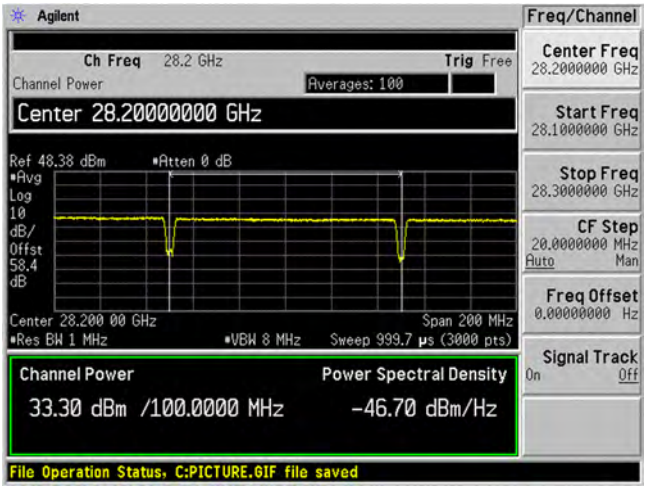
1st Carrier



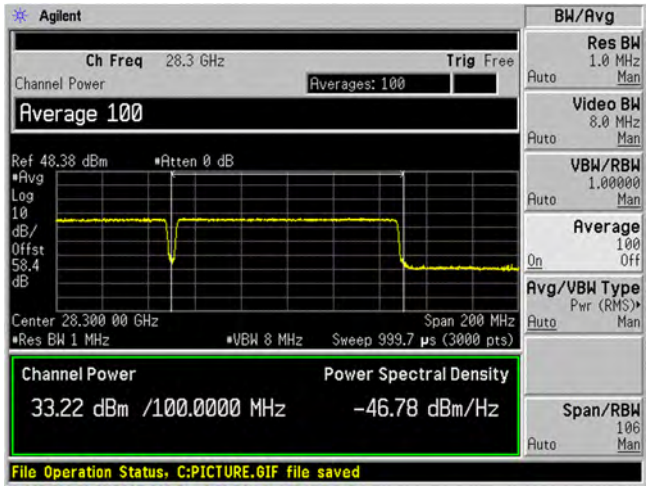
2nd Carrier



3rd Carrier



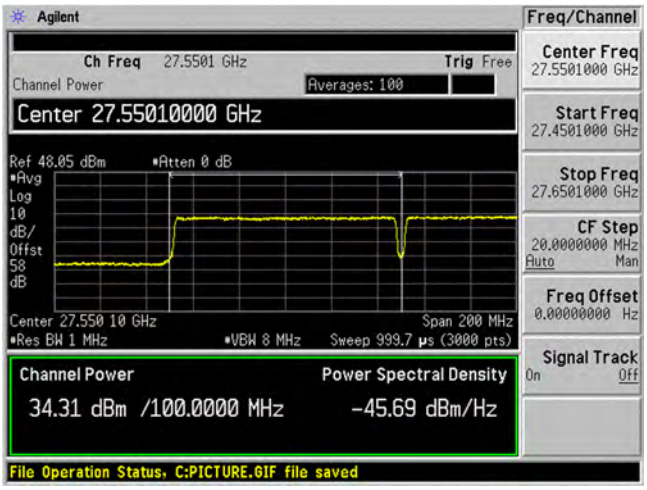
4th Carrier



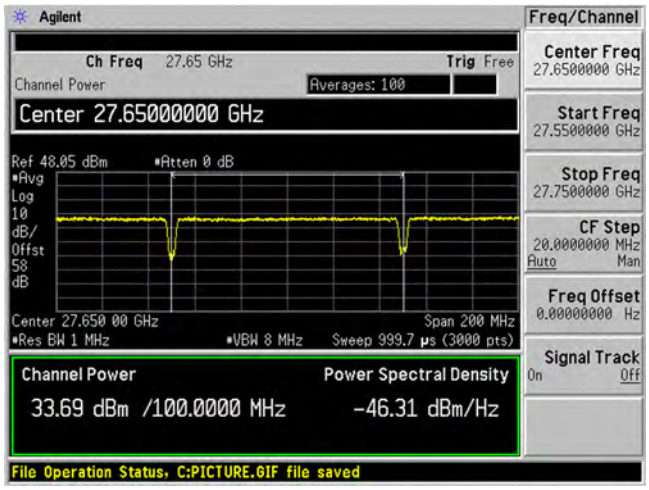
Beam ID: 11 (Vertical)

4CC – 64QAM – Low Channel

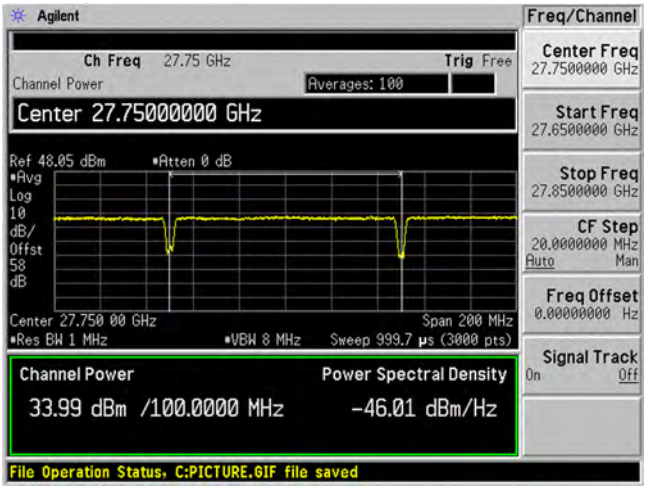
1st Carrier



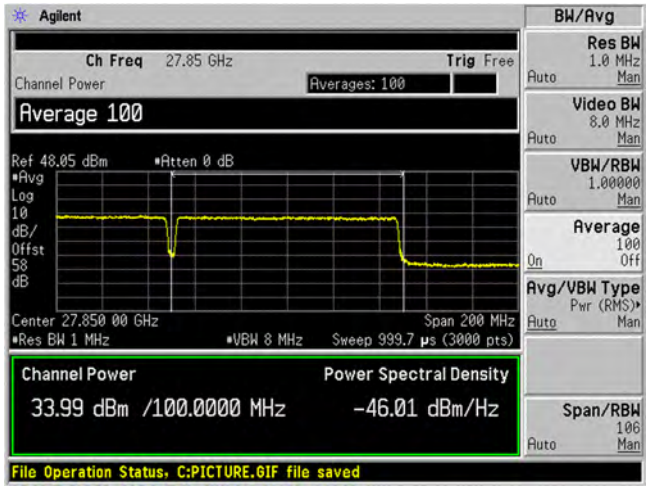
2nd Carrier



3rd Carrier



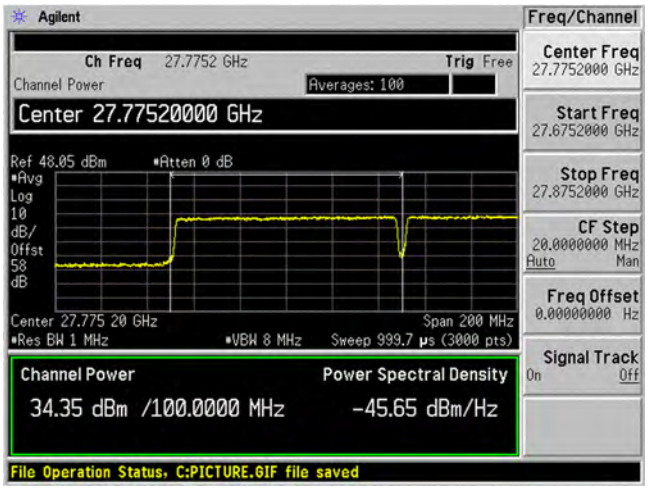
4th Carrier



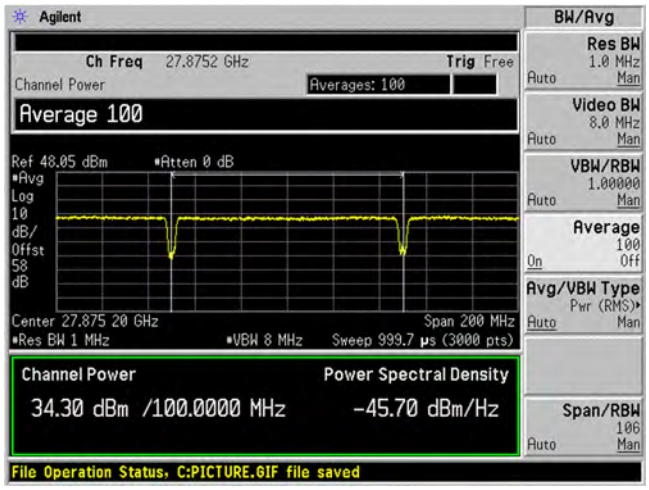
Beam ID: 11 (Vertical)

4CC – 64QAM – Middle Channel

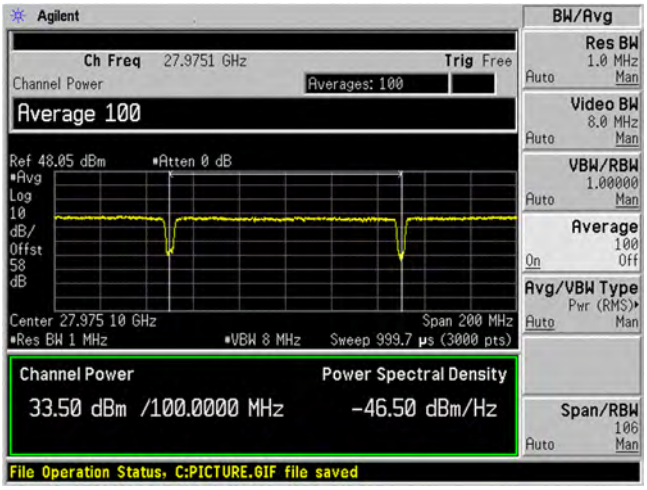
1st Carrier



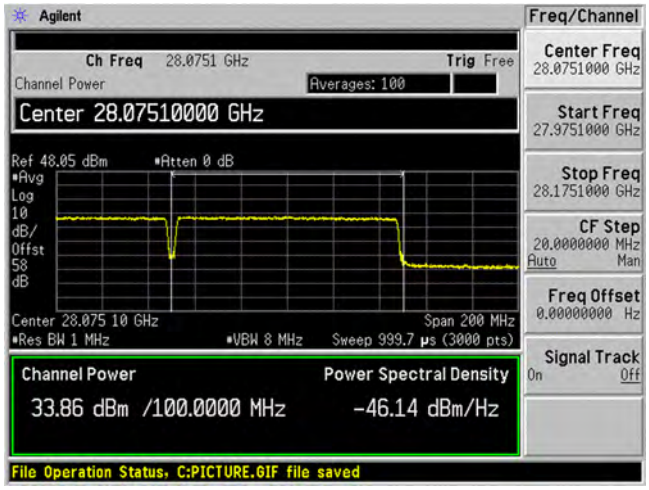
2nd Carrier



3rd Carrier



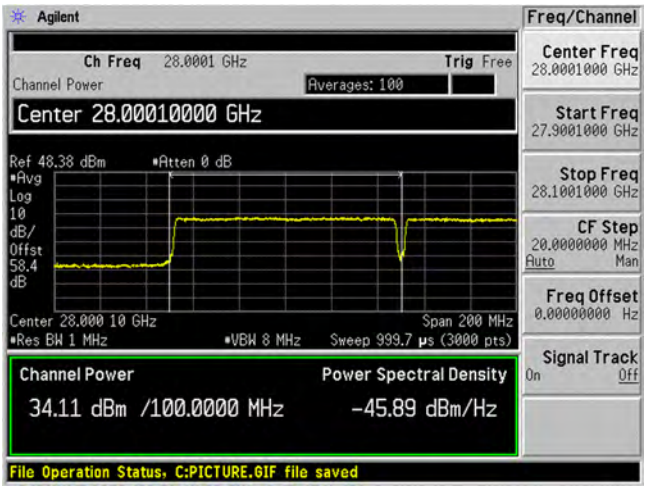
4th Carrier



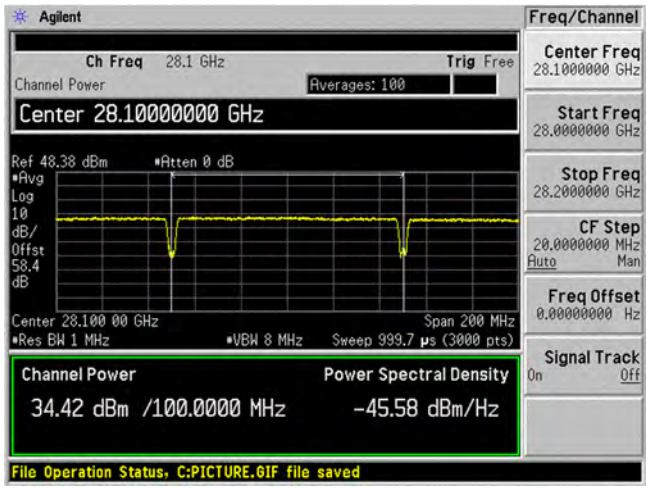
Beam ID: 11 (Vertical)

4CC – 64QAM – High Channel

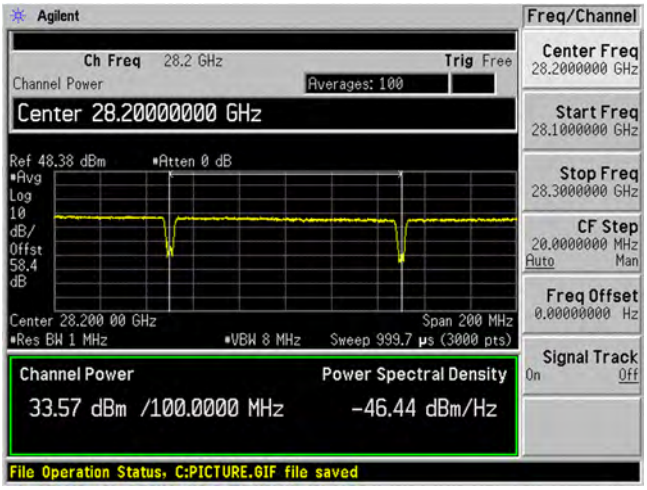
1st Carrier



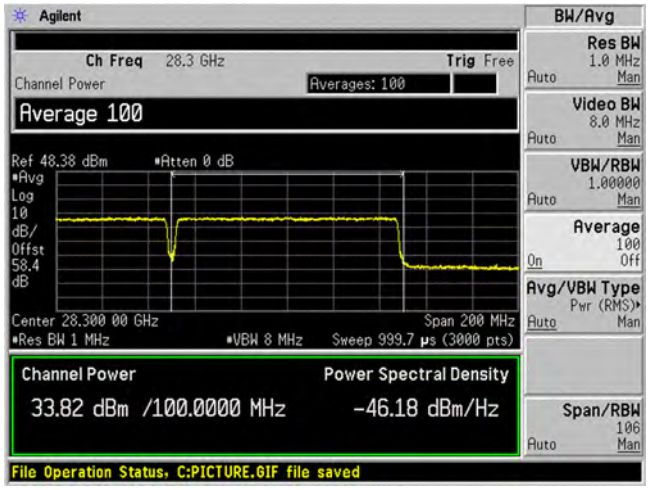
2nd Carrier



3rd Carrier



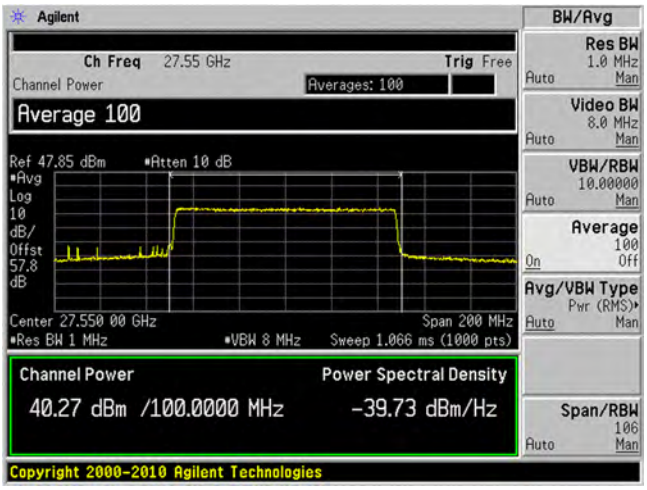
4th Carrier



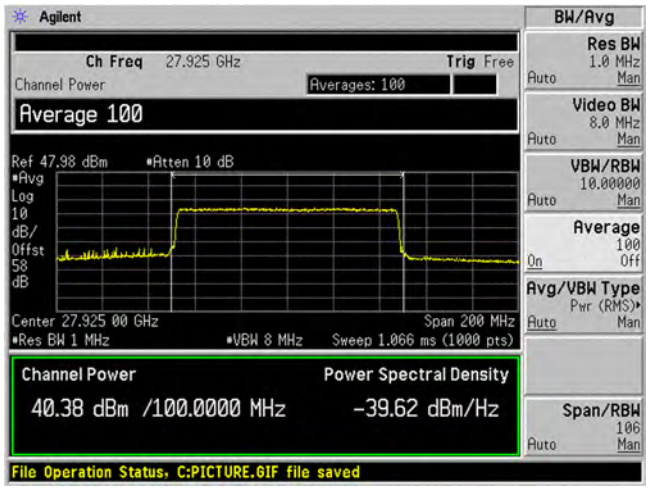
Beam ID: 139 (Horizontal)

1CC – QPSK

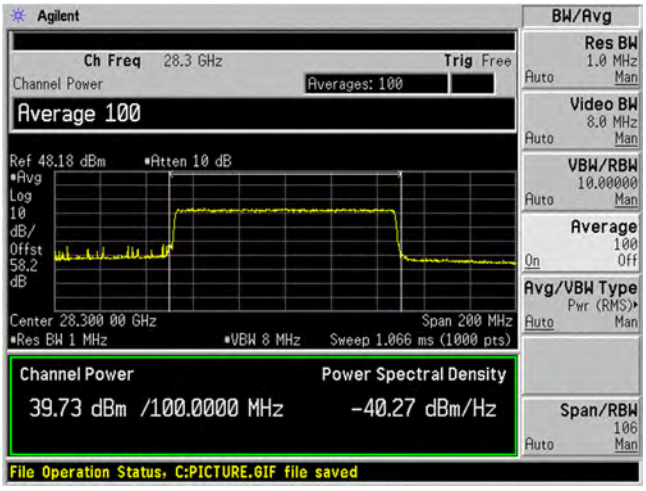
Low Channel



Middle Channel



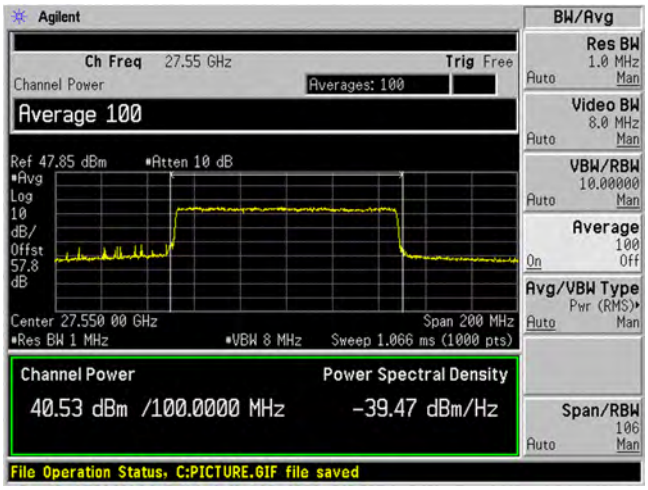
High Channel



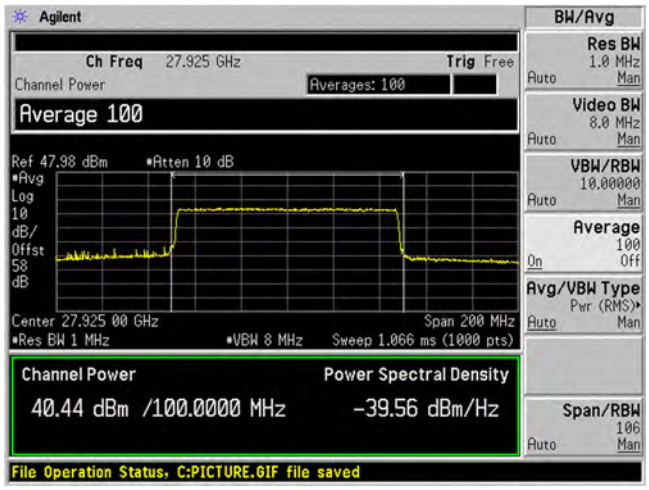
Beam ID: 139 (Horizontal)

1CC – 64QAM

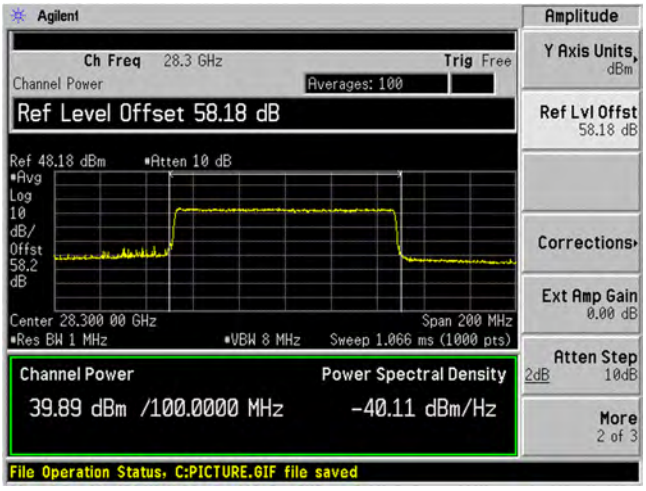
Low Channel



Middle Channel



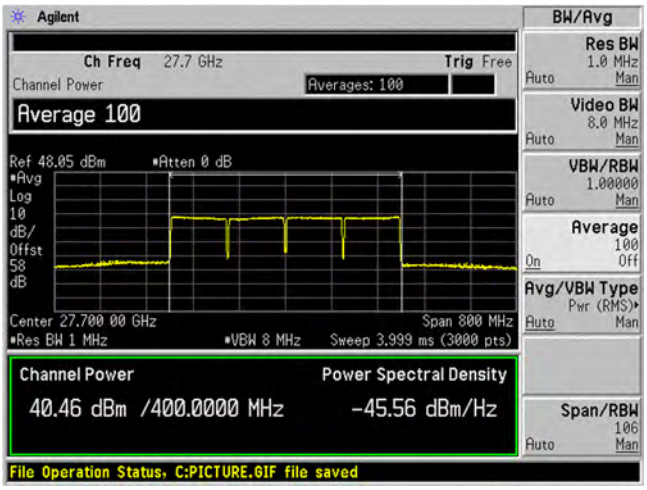
High Channel



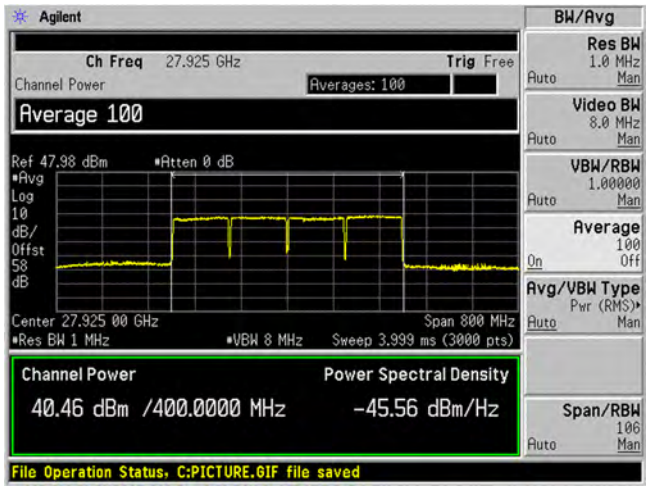
Beam ID: 139 (Horizontal)

4CC – QPSK

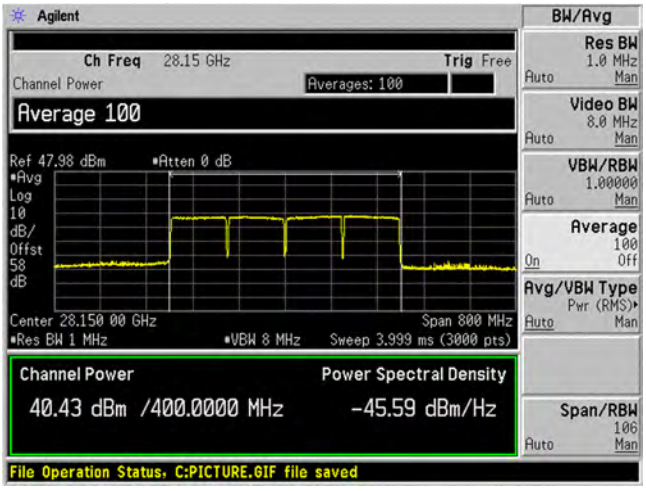
Low Channel



Middle Channel



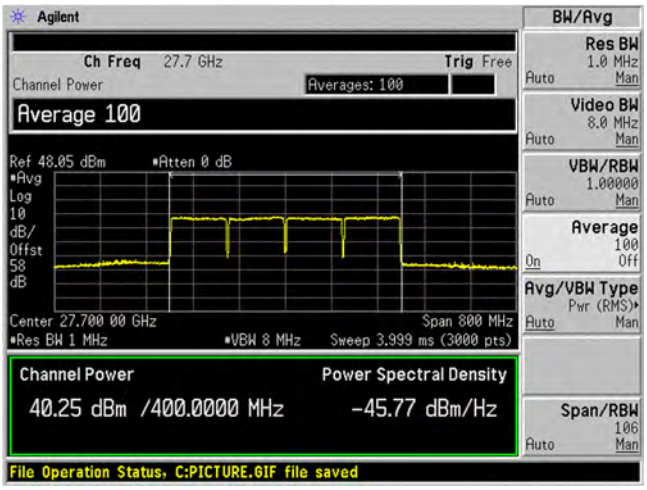
High Channel



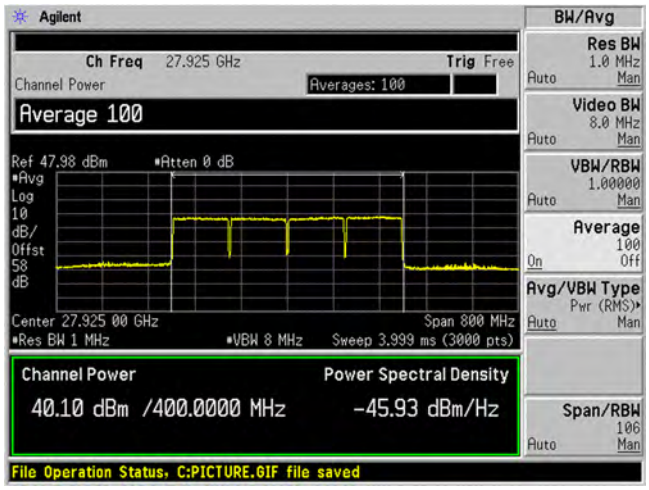
Beam ID: 139 (Horizontal)

4CC – 64QAM

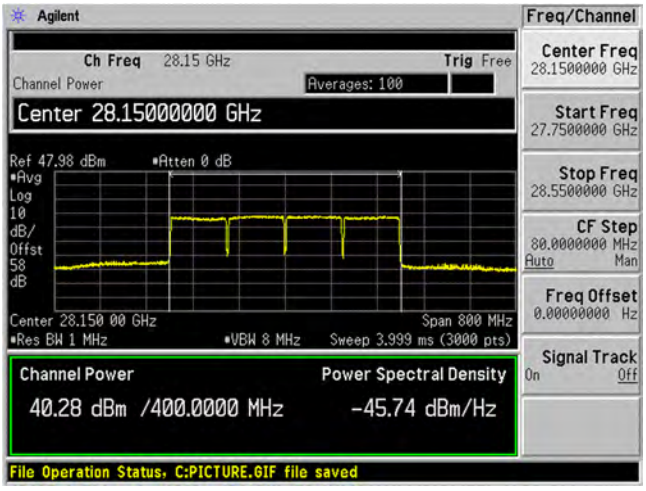
Low Channel



Middle Channel



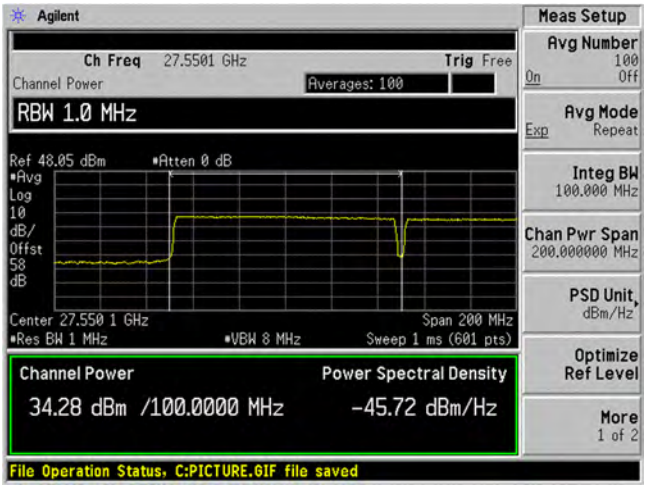
High Channel



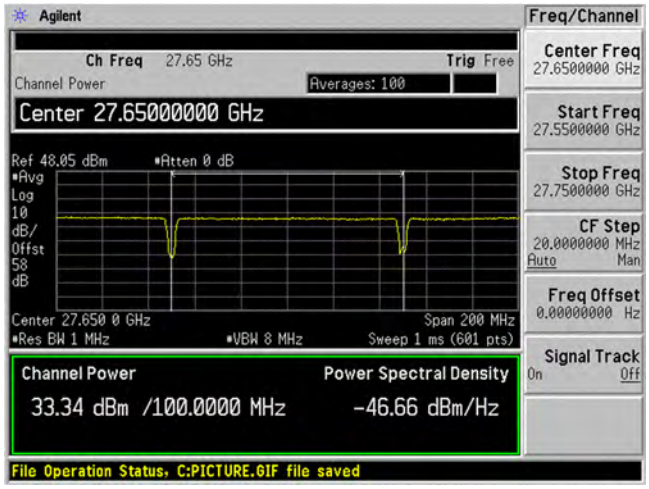
Beam ID: 139 (Horizontal)

4CC – QPSK – Low Channel

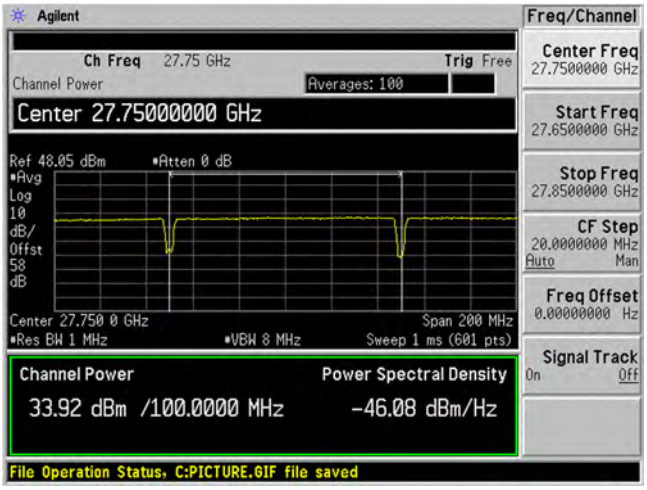
1st Carrier



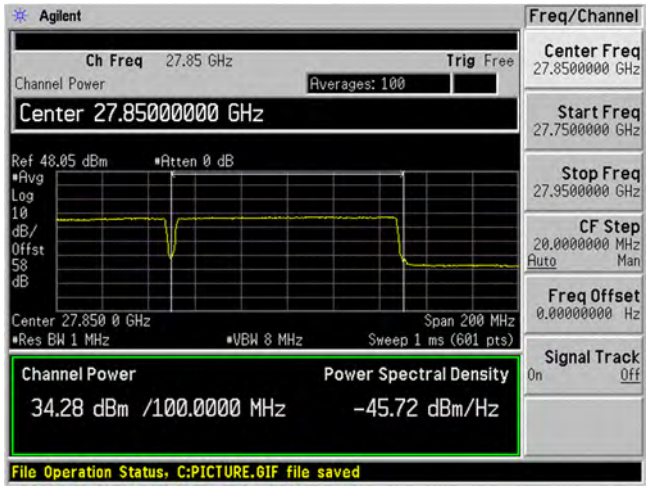
2nd Carrier



3rd Carrier



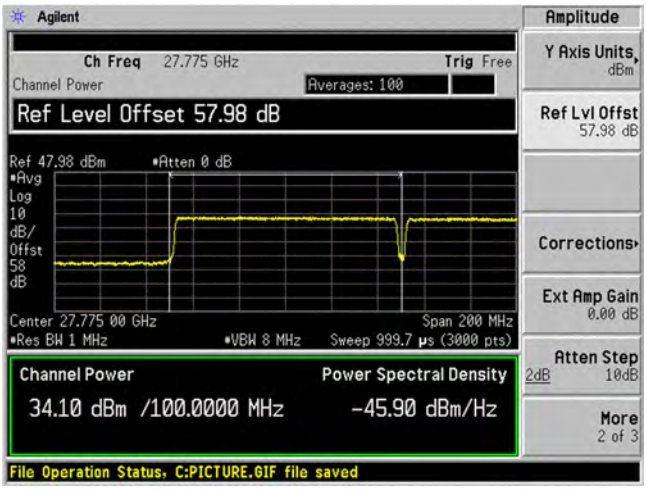
4th Carrier



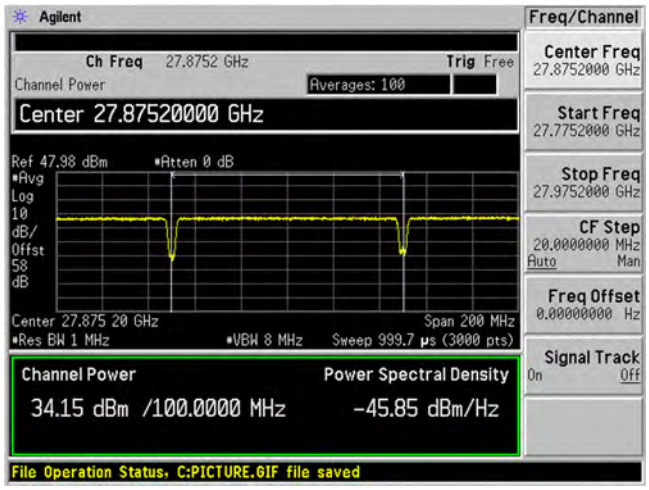
Beam ID: 139 (Horizontal)

4CC – QPSK – Middle Channel

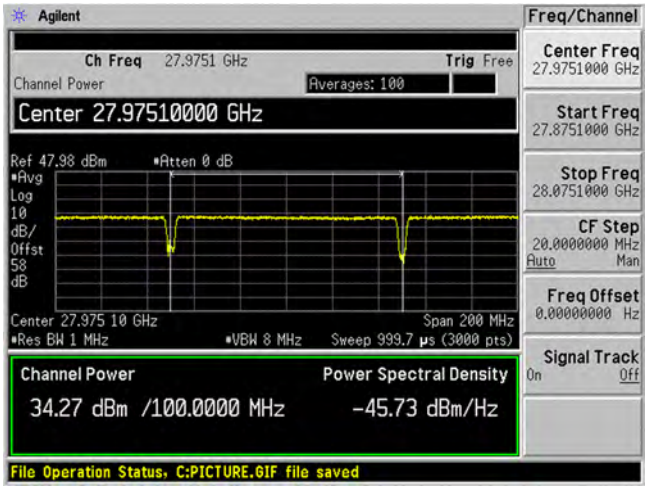
1st Carrier



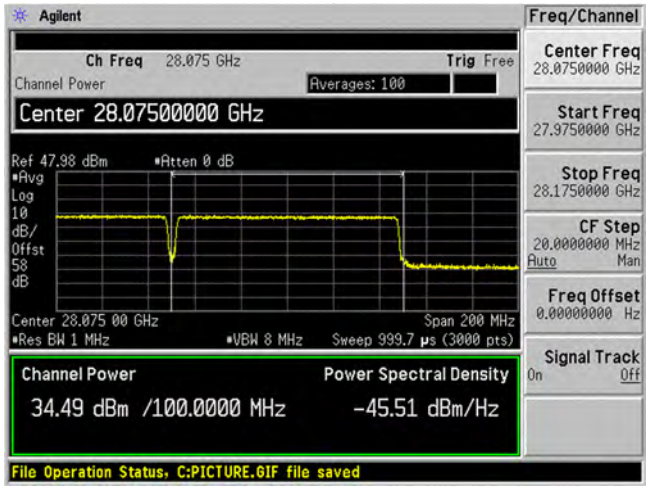
2nd Carrier



3rd Carrier



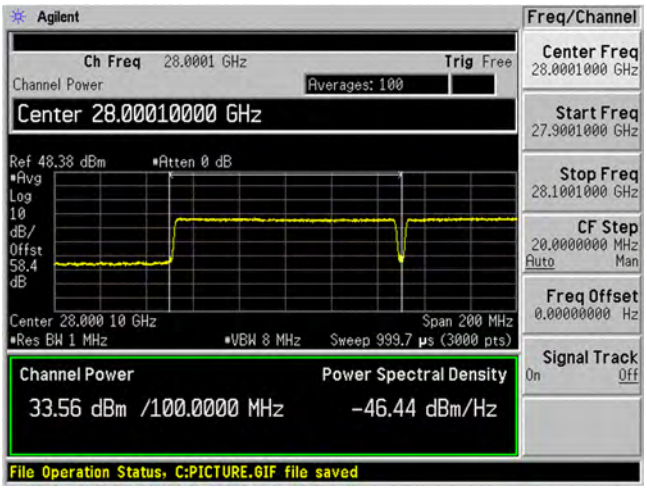
4th Carrier



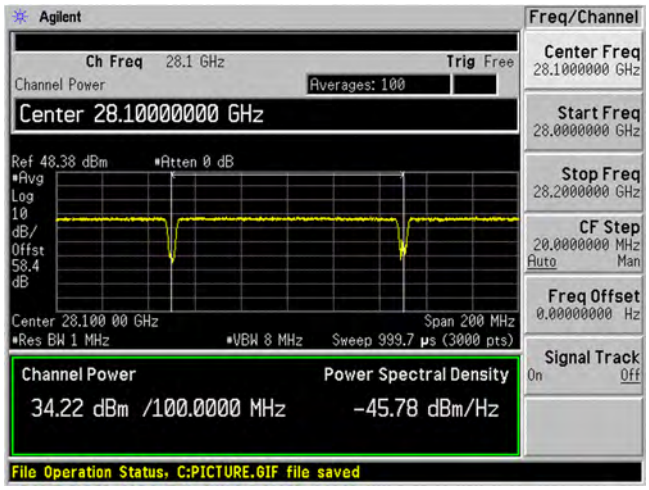
Beam ID: 139 (Horizontal)

4CC – QPSK – High Channel

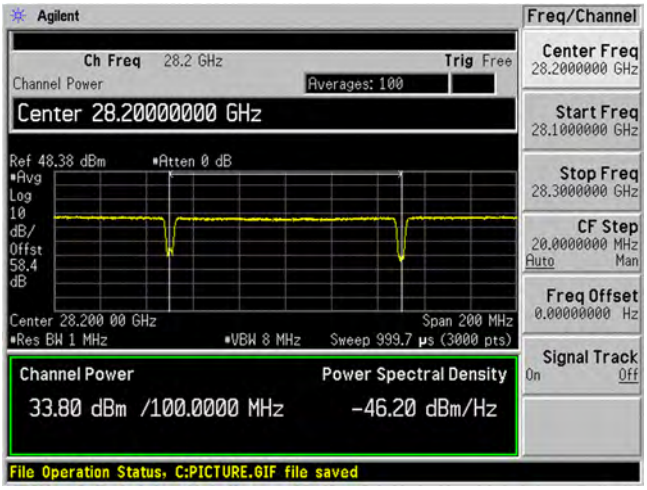
1st Carrier



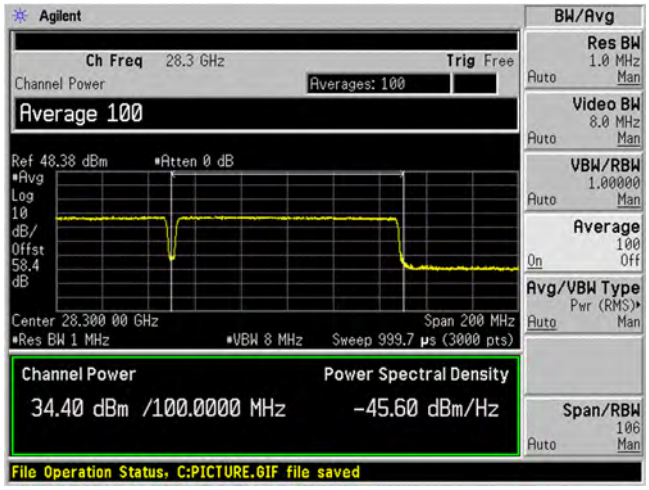
2nd Carrier



3rd Carrier



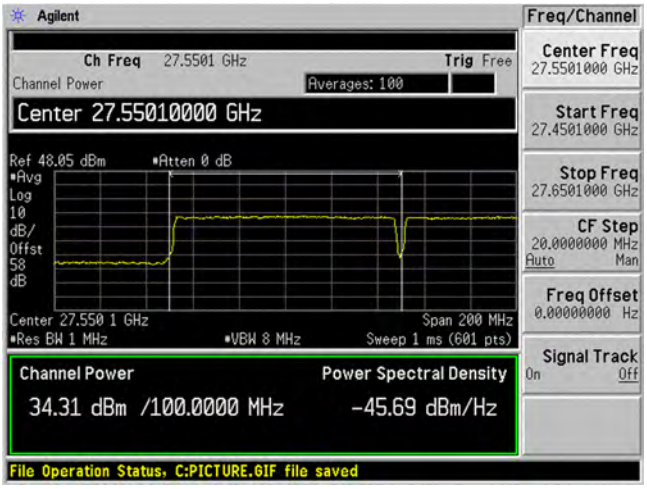
4th Carrier



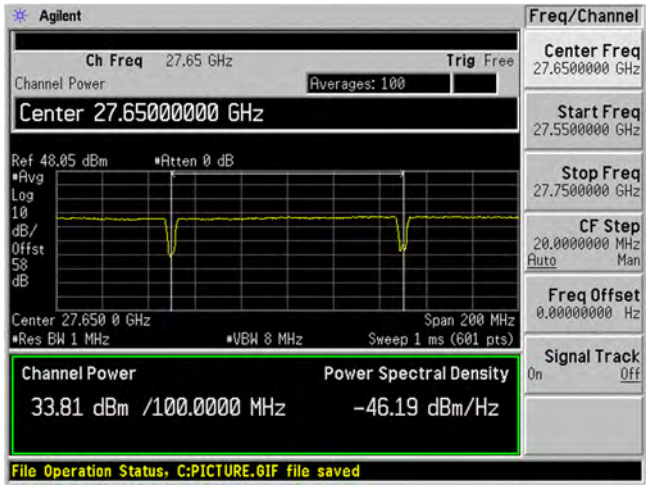
Beam ID: 139 (Horizontal)

4CC – 64QAM – Low Channel

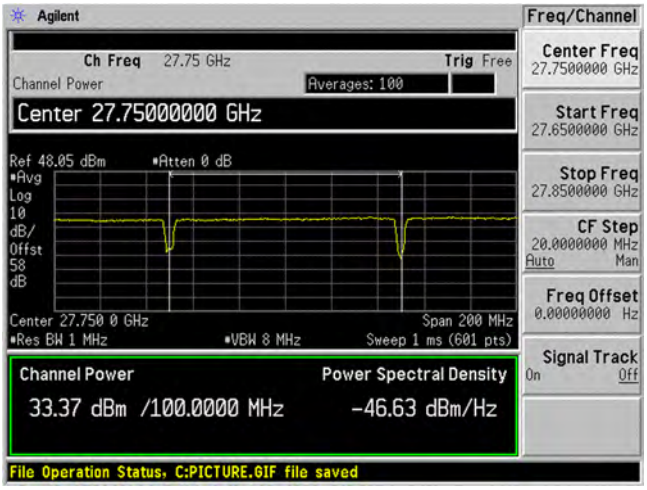
1st Carrier



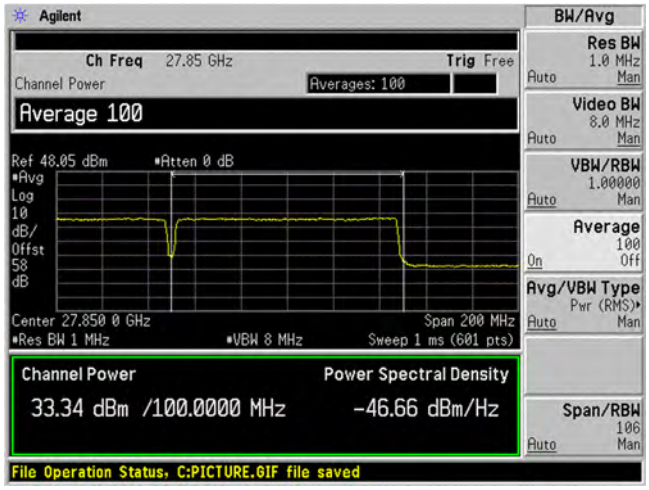
2nd Carrier



3rd Carrier



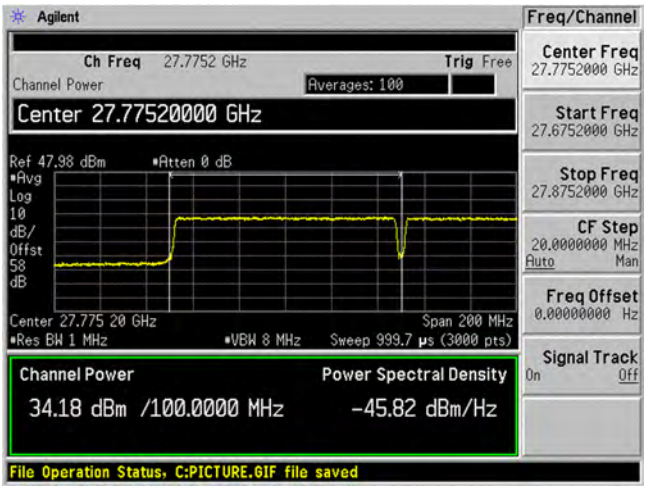
4th Carrier



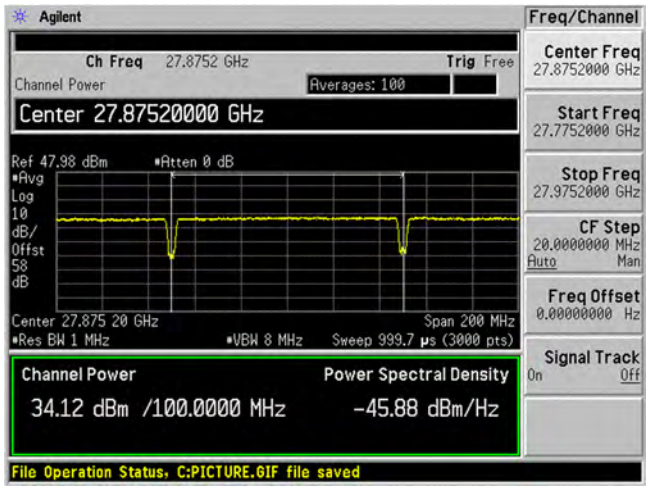
Beam ID: 139 (Horizontal)

4CC – 64QAM – Middle Channel

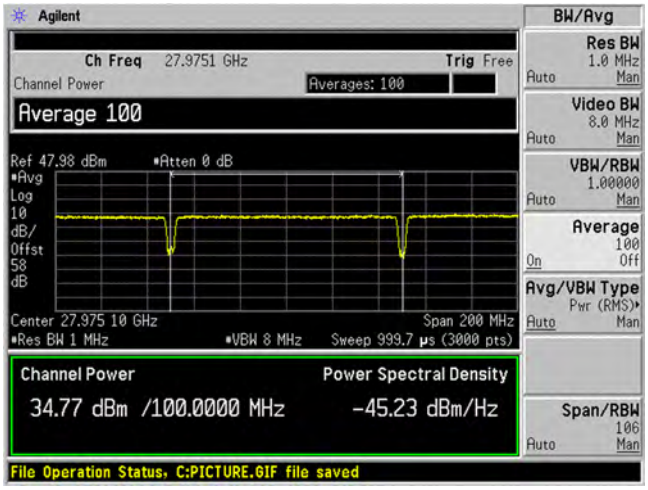
1st Carrier



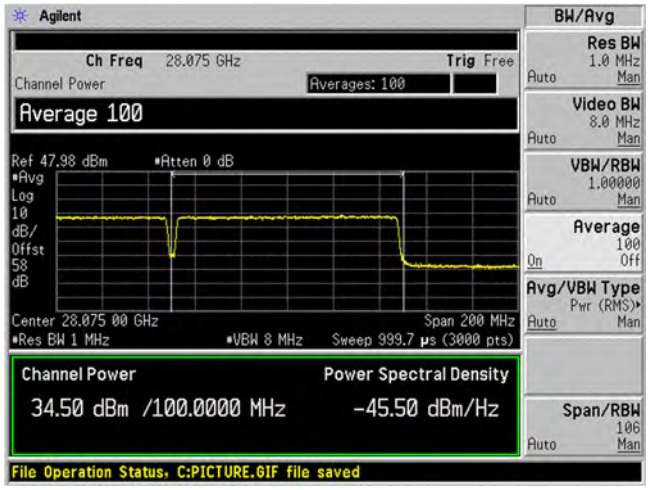
2nd Carrier



3rd Carrier



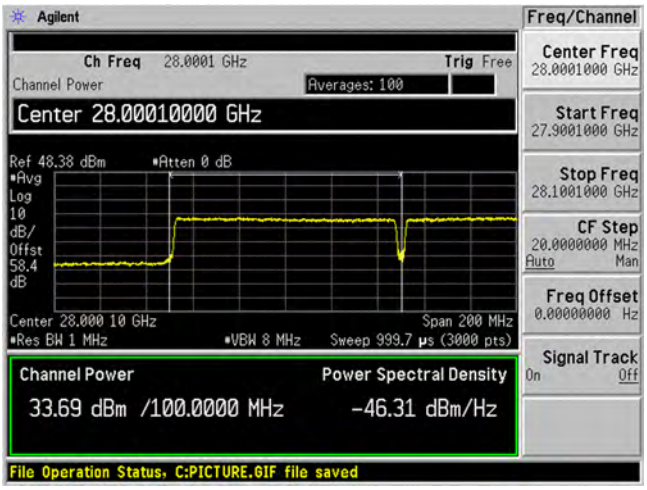
4th Carrier



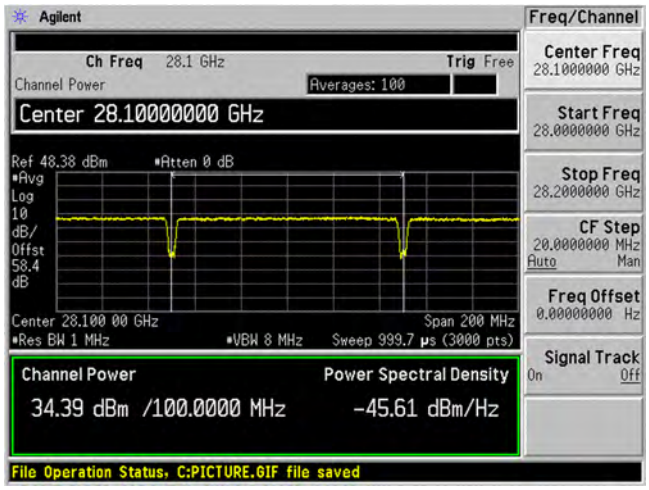
Beam ID: 139 (Horizontal)

4CC – 64QAM – High Channel

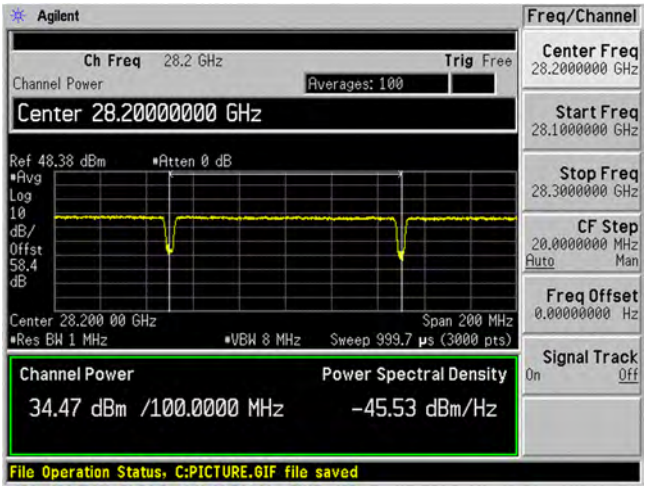
1st Carrier



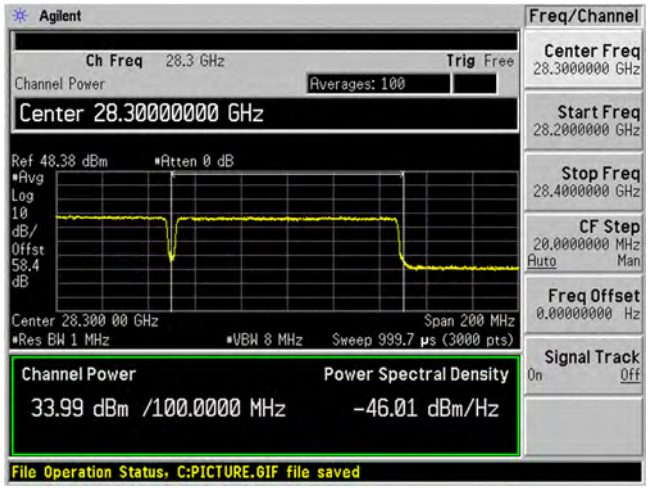
2nd Carrier



3rd Carrier



4th Carrier



10 FCC §30.203 & §2.1053 - Out of Band Emissions at the Band-edge

10.1 Applicable Standards

According to FCC §30.203

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.

10.2 Measurement Procedure

Unwanted Emission Measurement:

According to ANSI C63.26-2015 section 5.2.7 Radiated power measurements

E (dBμV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m).

EIRP (dBm) = E (dBμV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m.

Based on both equations above, the offset should equal to Antenna Factor(dB/m) + Cable Loss(dB) + 107 + 20log(D) -104.8 when set the unit to dBm on the PSA. The duty cycle correction factor in section 2.3 was also added in the offset for average measurement.

Maximum emission levels are measured by setting the analyzer as follows:

i. RBW = 1 MHz
ii. VBW ≥ 3 MHz
iii. Detector = RMS(average)
iv. Sweep time = auto
v. Trace mode = max hold to present worst case

Note: Lower limit -13dBm was selected to show compliance
Note: EUT antenna gain 22.5 dBi was subtracted in the offset for the conductive power measurement.

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer 44 GHz	E4446A	US44300386	2019-08-24	2 years
-	RF Cable	-	-	Each Time	-
Wisewave	Antenna, Horn	ARH-2823-02	10555-02	2020-02-27	2 years

Note[1]: equipment included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

10.4 Test Environmental Conditions

Temperature:	22-24º C
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Tri Pham from 2021-03-09 to 2021-03-10 in 5m3 Chamber.

10.5 Test Results

1CC

Channel	Modulation	Conducted Emission (dBm/MHz)		Total Conducted Emission (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
		Horizontal	Vertical			
Low	QPSK	-23.02	-25.50	-21.08	-5	-16.08
		-26.39	-28.35	-24.25	-13	-11.25
High		-31.12	-34.39	-29.44	-5	-24.44
		-38.00	-39.33	-35.60	-13	-22.60
Low	64QAM	-23.46	-26.32	-21.65	-5	-16.65
		-26.73	-28.31	-24.44	-13	-11.44
High		-29.73	-33.57	-28.23	-5	-23.23
		-37.31	-39.45	-35.24	-13	-22.24

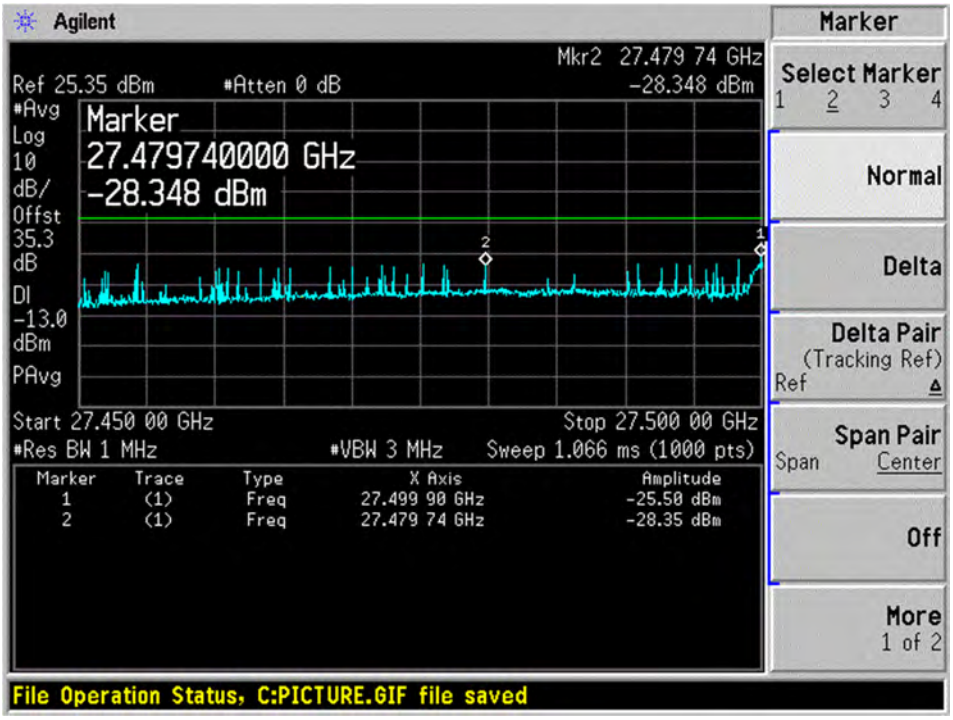
4CC

Channel	Modulation	Conducted Emission (dBm/MHz)		Total Conducted Emission (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
		Horizontal	Vertical			
Low	QPSK	-34.07	-34.69	-31.36	-5	-26.36
		-39.04	-35.55	-33.94	-13	-20.94
High		-36.07	-36.82	-33.42	-5	-28.42
		-36.95	-37.96	-34.42	-13	-21.42
Low	64QAM	-33.73	-35.20	-31.39	-5	-26.39
		-38.47	-36.04	-34.08	-13	-21.08
High		-36.74	-37.50	-34.09	-5	-29.09
		-37.35	-38.38	-34.82	-13	-21.82

Please refer to the following plots

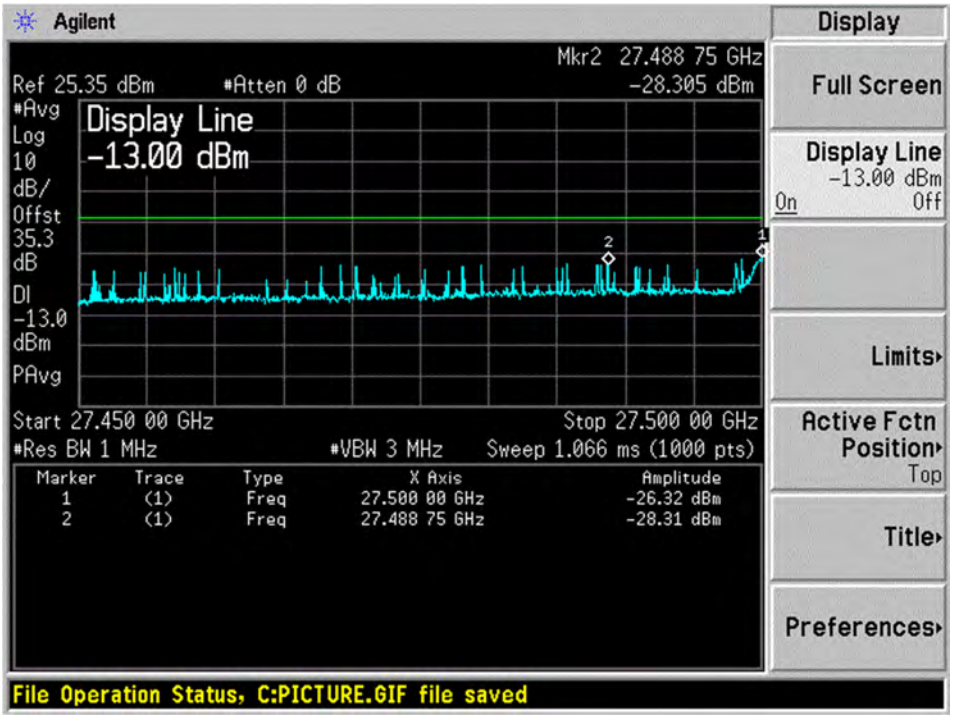
1CC-QPSK

Low Channel – Beam ID=11 (Vertical)



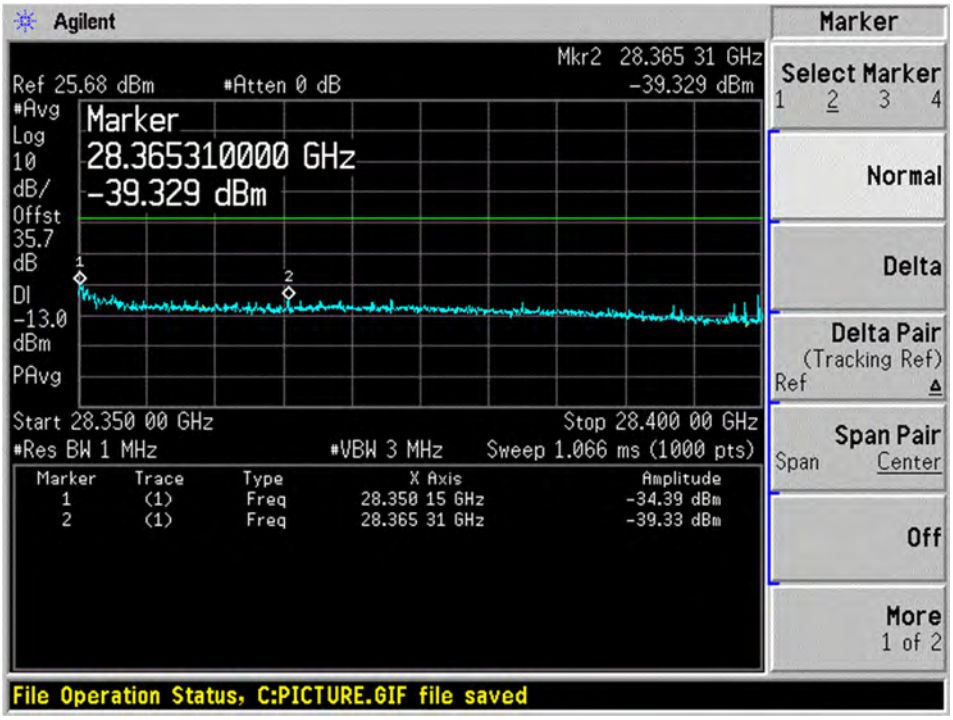
1CC-64QAM

Low Channel – Beam ID=11 (Vertical)



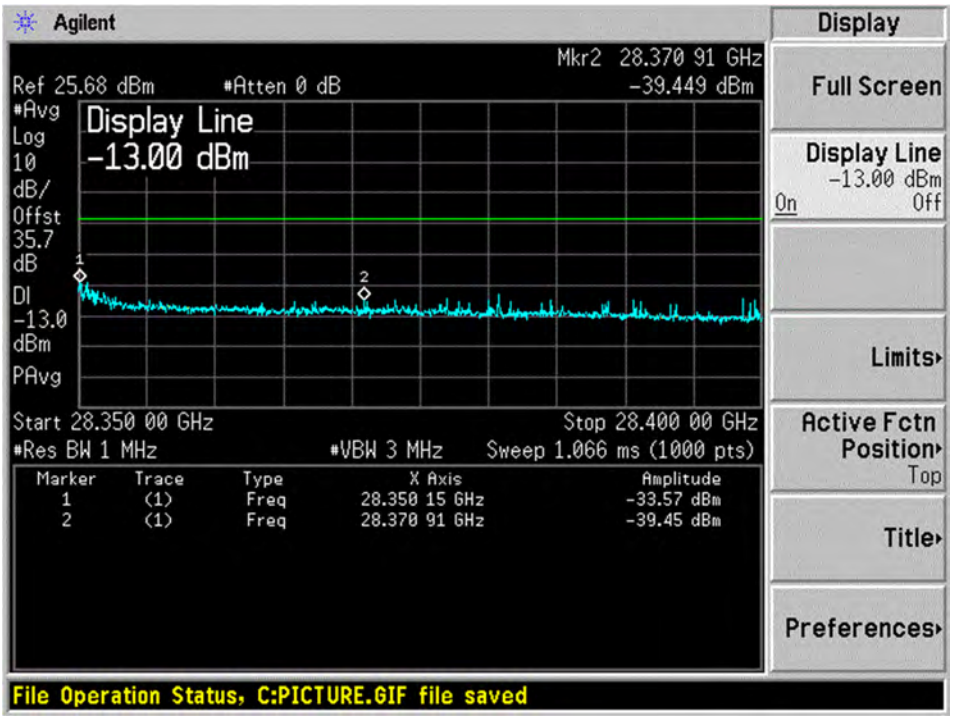
1CC-QPSK

High Channel – Beam ID=11 (Vertical)



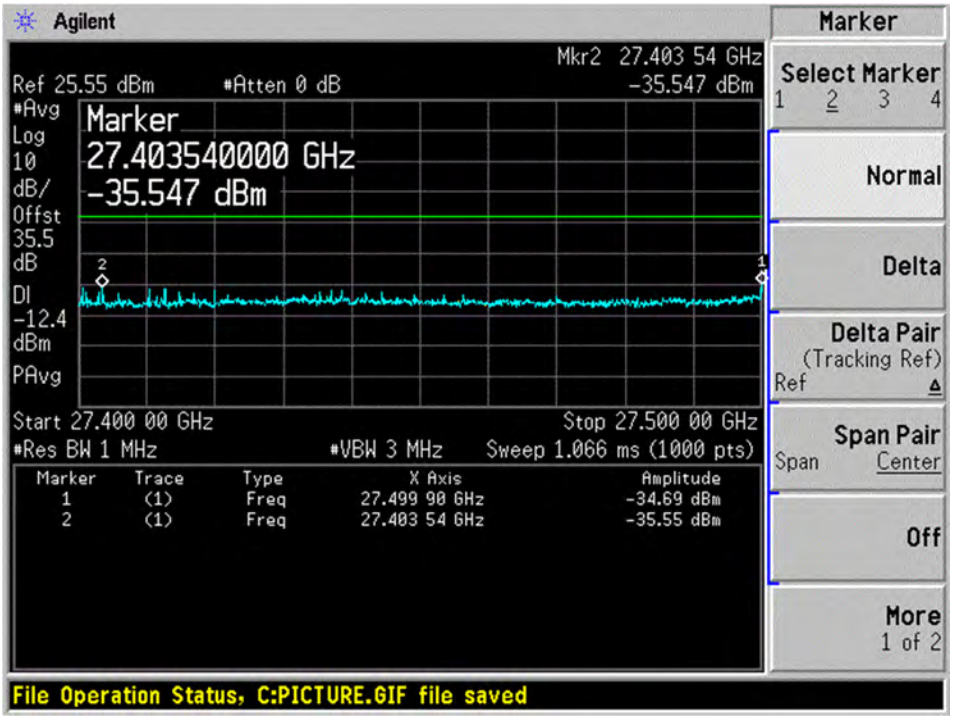
1CC-64QAM

High Channel – Beam ID=11 (Vertical)



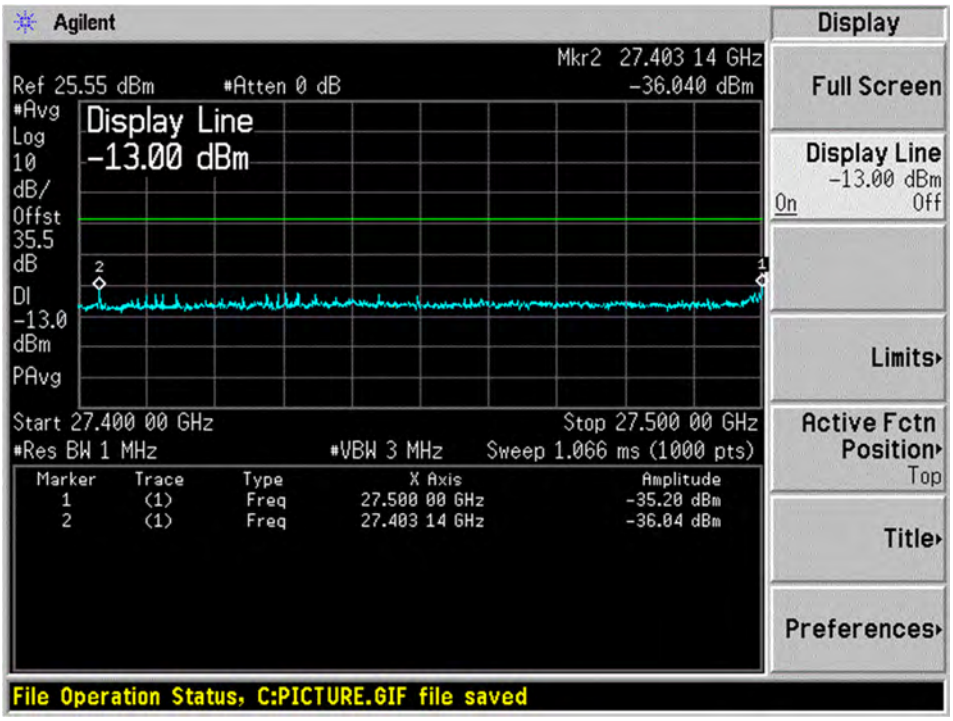
4CC-QPSK

Low Channel – Beam ID=11 (Vertical)



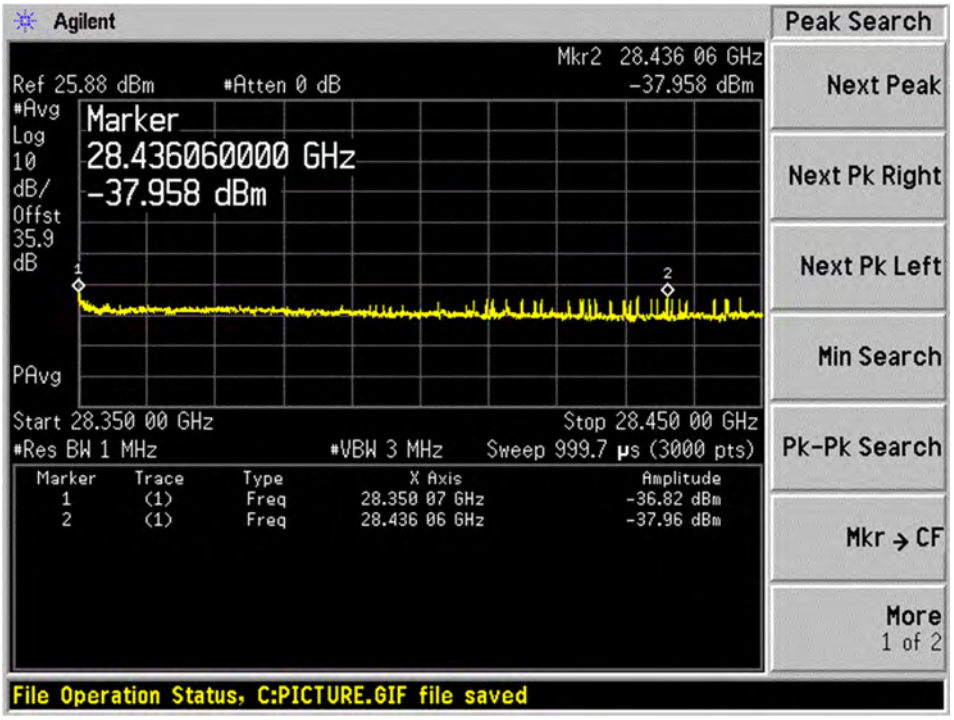
4CC -64QAM

Low Channel – Beam ID=11 (Vertical)



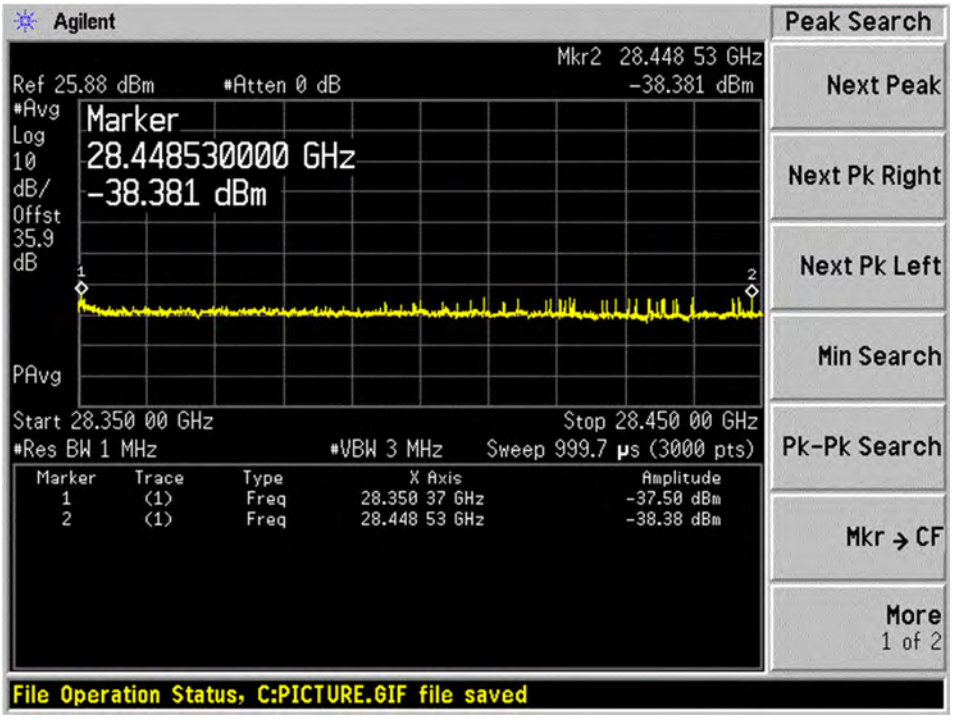
4CC-QPSK

High Channel – Beam ID=11 (Vertical)



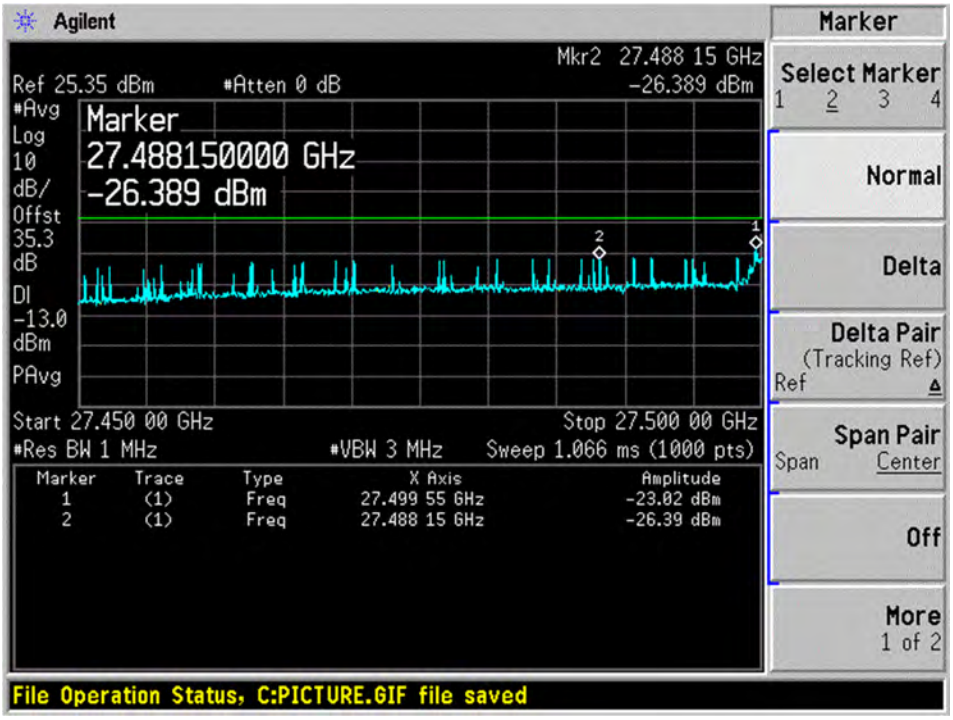
4CC -64QAM

High Channel – Beam ID=11 (Vertical)



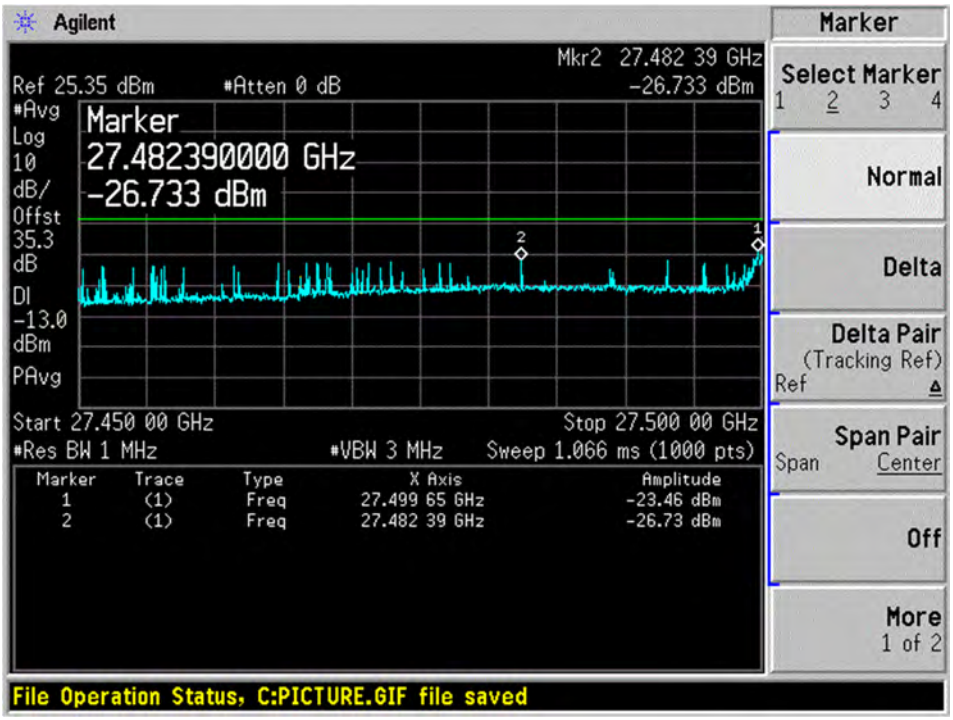
1CC-QPSK

Low Channel – Beam ID=139 (Horizontal)



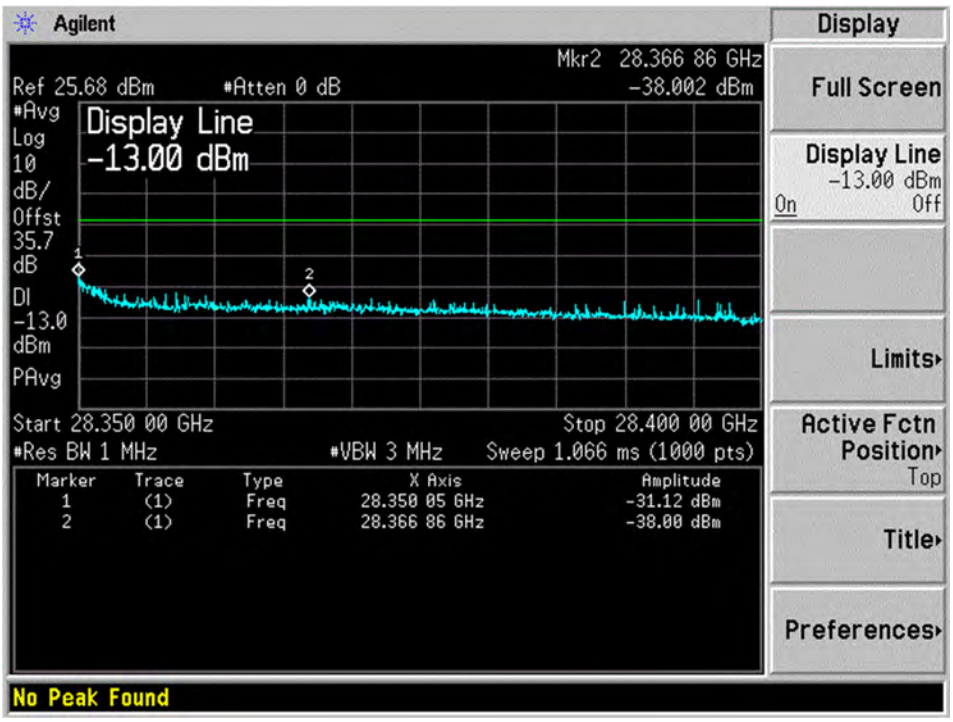
1CC-64QAM

Low Channel – Beam ID=139 (Horizontal)



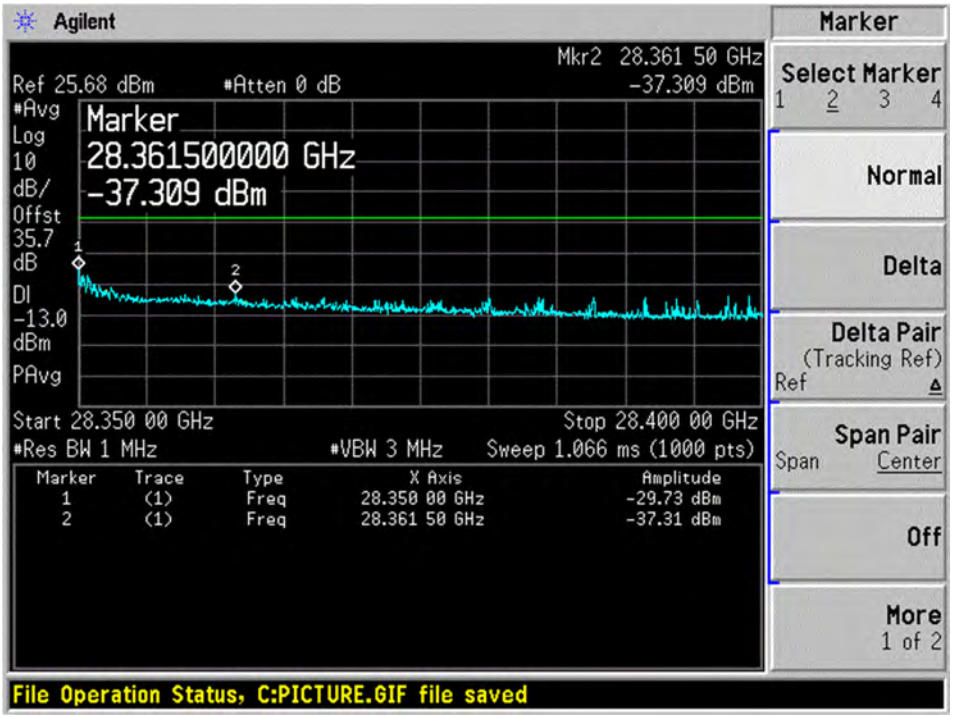
1CC-QPSK

High Channel – Beam ID=139 (Horizontal)



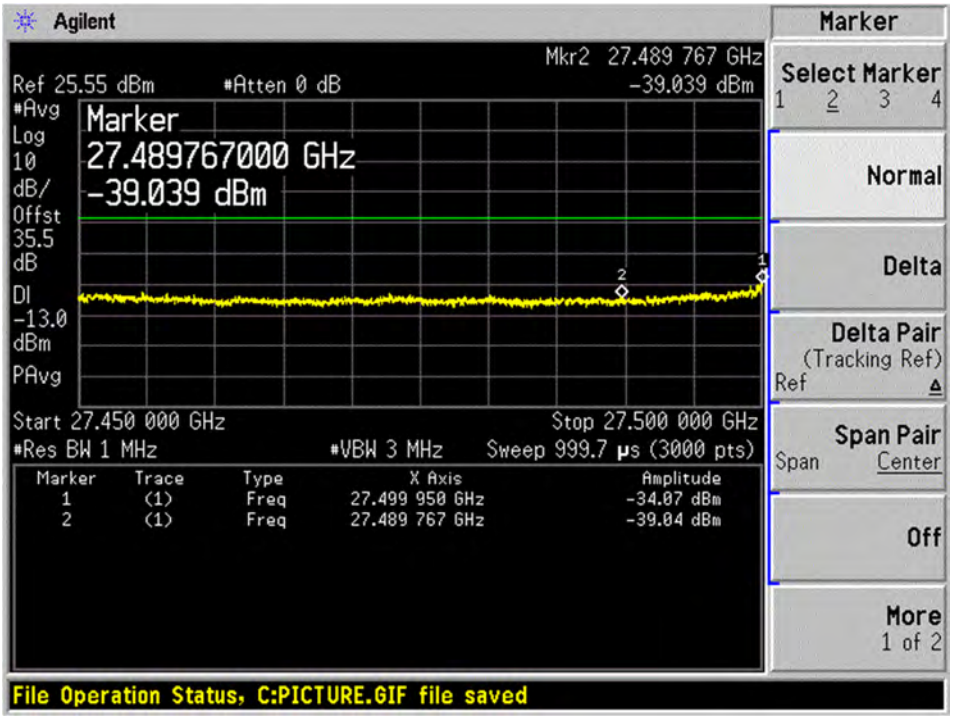
1CC-64QAM

High Channel – Beam ID=139 (Horizontal)



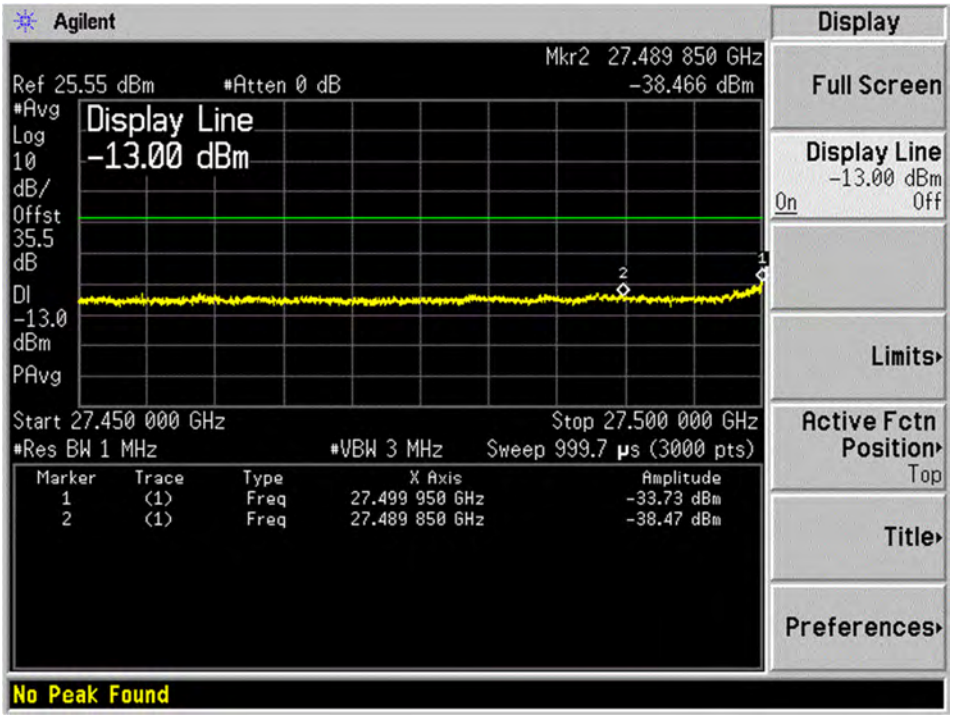
4CC-QPSK

Low Channel – Beam ID=139 (Horizontal)



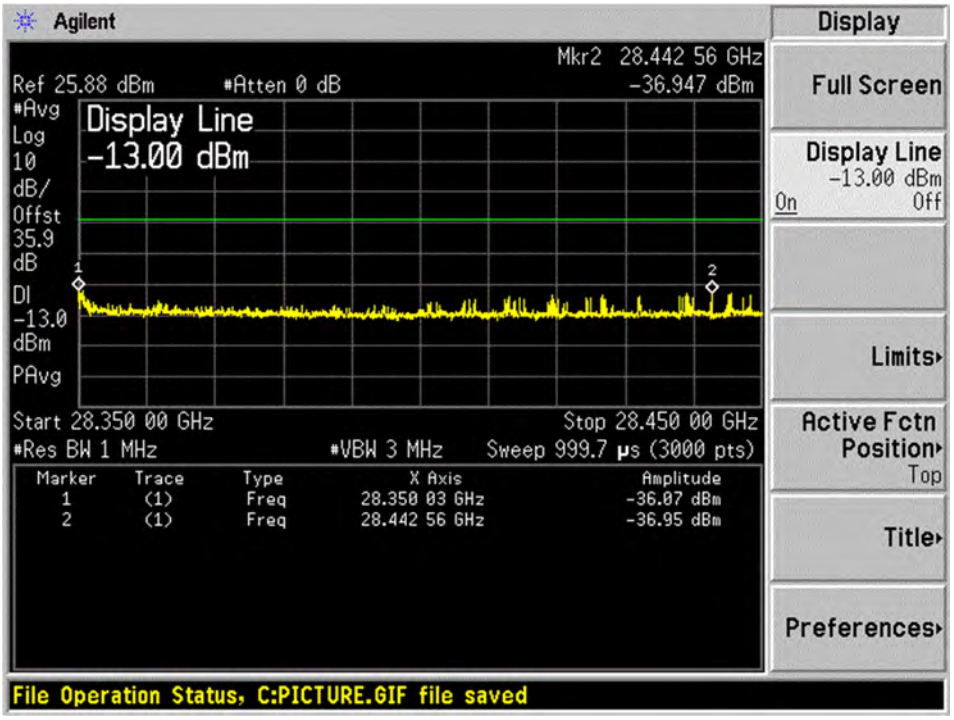
4CC -64QAM

Low Channel – Beam ID=139 (Horizontal)



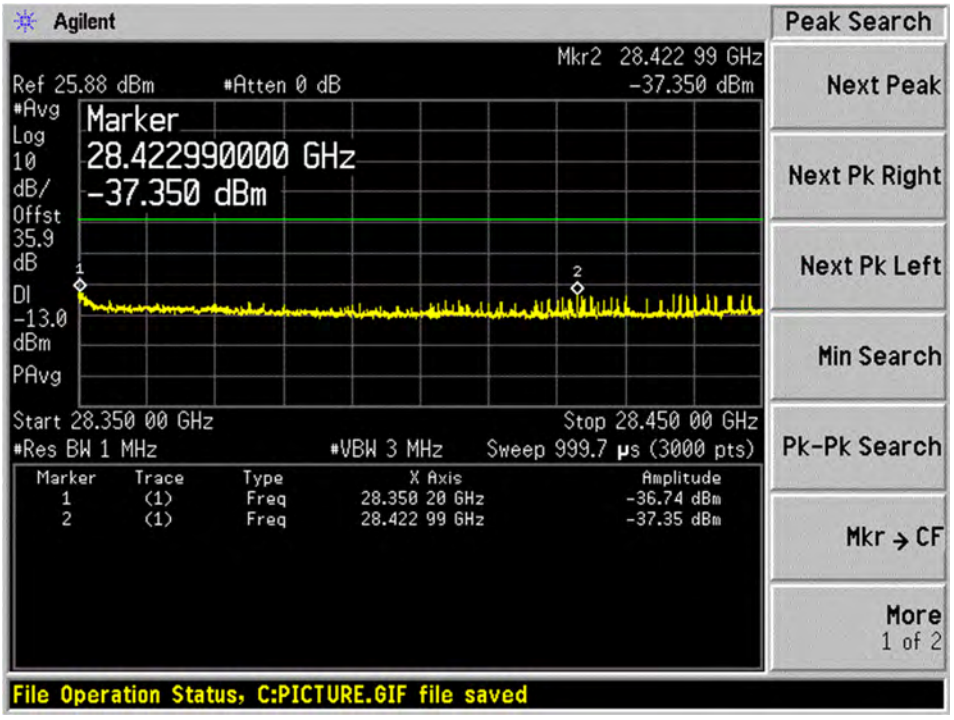
4CC-QPSK

High Channel – Beam ID=139 (Horizontal)



4CC -64QAM

High Channel – Beam ID=139 (Horizontal)



11 FCC §2.1055 - Frequency Stability

11.1 Applicable Standards

As per FCC §2.1055, the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency band.

11.2 Measurement Procedure

a. Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.

b. EUT is connected the external power supply to control the AC input power. The test voltage range is from minimum to maximum working voltage. Each step shall be recording the frequency error rate.

c. The temperature range step is 10 degrees in this test items. All temperature levels shall be holding the ±0.5 ℃ during the measurement testing. Each temperature step shall be at least 0.5 hours, consider the

EUT could be test under the stability condition.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer 44 GHz	E4446A	US44300386	2019-08-24	2 years
-	RF Cable	-	-	Each Time	-
Wisewave	Antenna, Horn	ARH-2823-02	10555-02	2020-02-27	2 years
BACL	Temp and Humi Chamber	BTH-150-40	30078	2020-06-25	1 year
Interpower	Power Source	85510510	39711	-	-

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

11.4 Test Environmental Conditions

Temperature:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Tri Pham on 2021-03-12 at RF Site.

11.5 Test Results

Frequency Error vs. Voltage

Voltage (Vac)	Measured Frequency (MHz)	Norminal Frequency (MHz)	Frequency Error (ppm)	Result
132	27924.89848	27925	-3.635	Pass
120	27924.89842	27925	-3.638	Pass
108	27924.89823	27925	-3.644	Pass

Frequency Error vs. Temperature

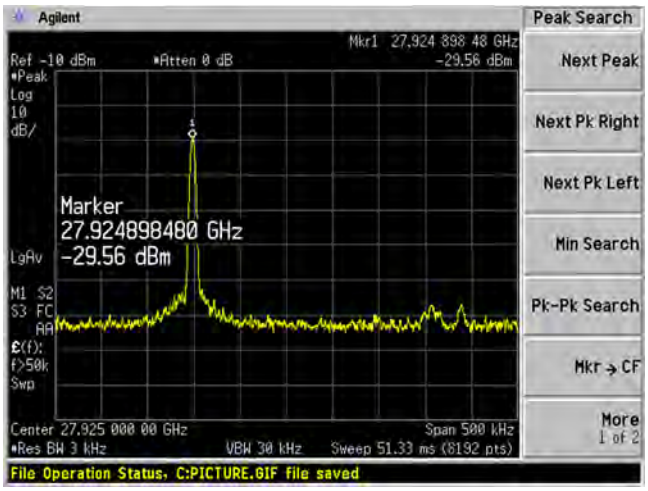
Temperature (°C)	Measured Frequency (MHz)	Norminal Frequency (MHz)	Frequency Error (ppm)	Result
0	27924.8979	27925	-3.656	Pass
10	27924.8984	27925	-3.638	Pass
20	27924.8984	27925	-3.638	Pass
30	27924.8987	27925	-3.628	Pass
40	27924.8996	27925	-3.595	Pass
45	27924.9012	27925	-3.538	Pass

Note: Carrier wave for middle channel was selected to perform stability test.

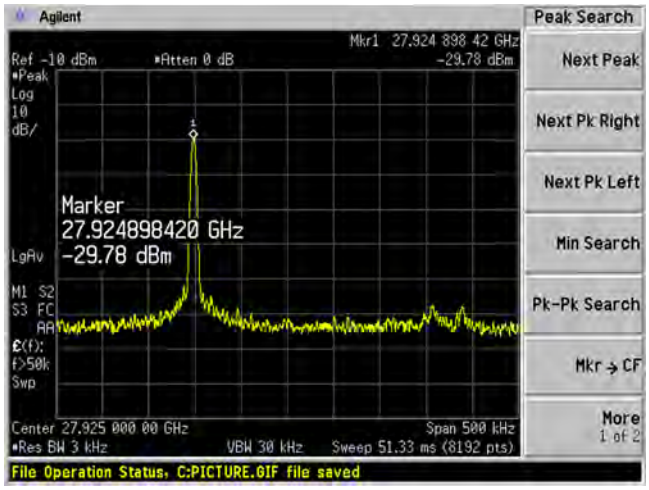
Please refer to the following plots.

Frequency vs. Voltage

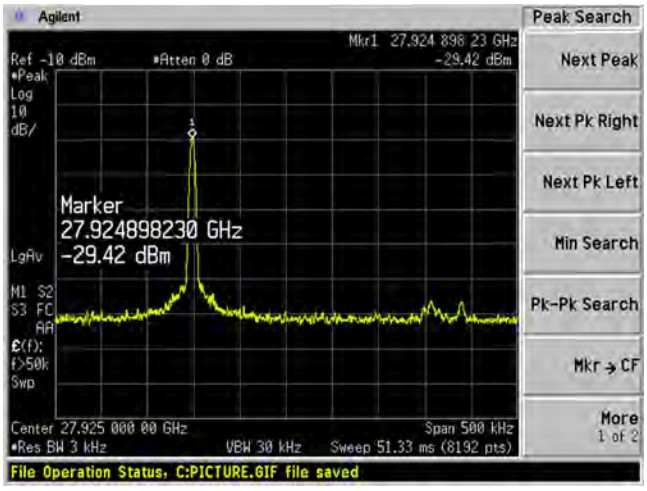
Low Voltage (138V)



Normal Voltage (120V)

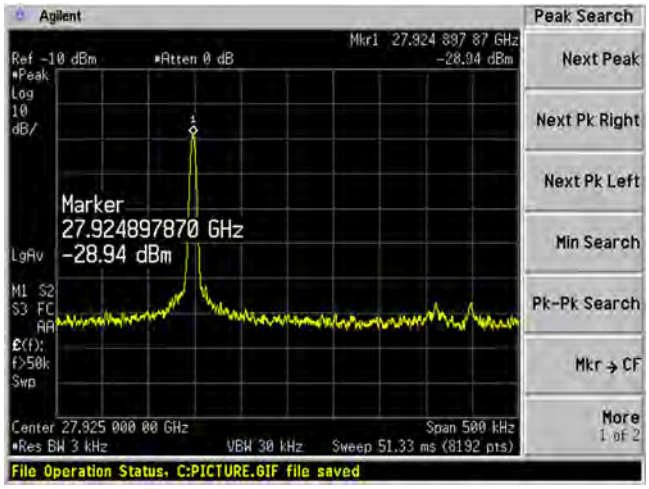


High Voltage (108V)

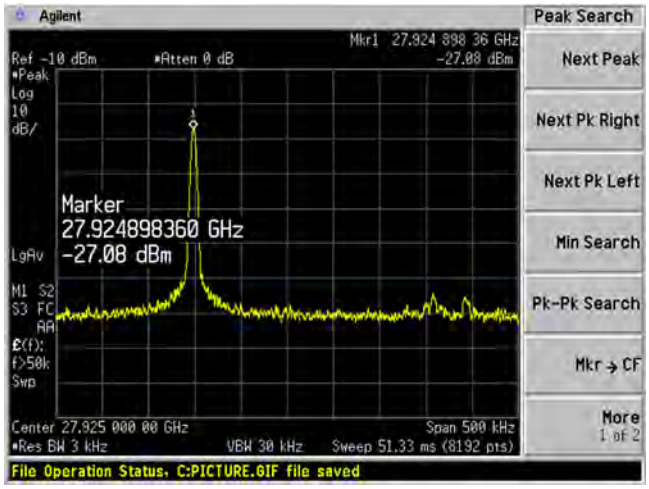


Frequency vs. Temperature

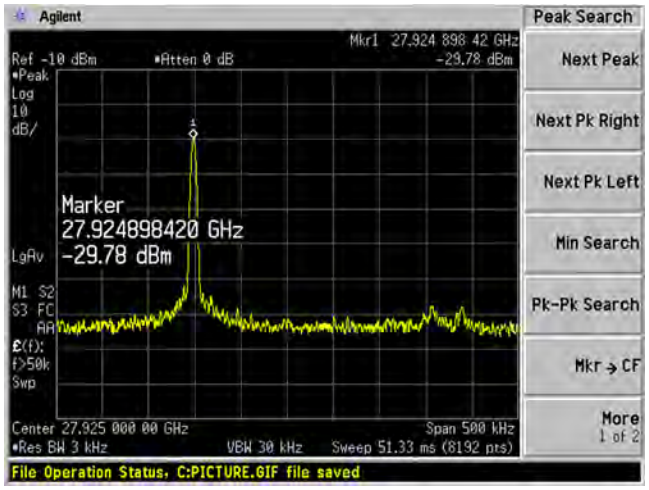
At 0°C



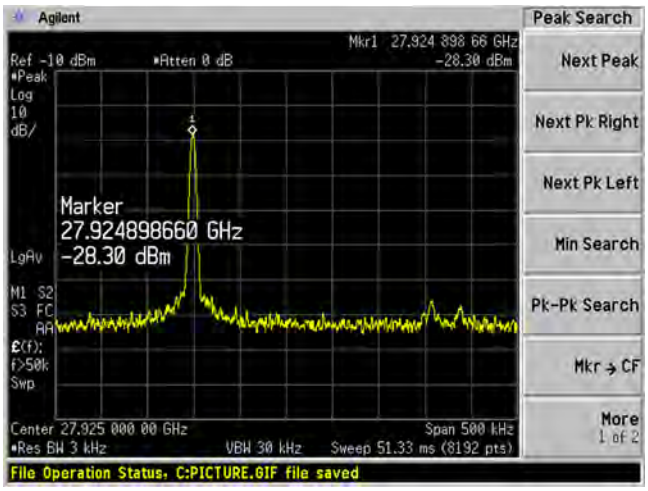
At 10°C



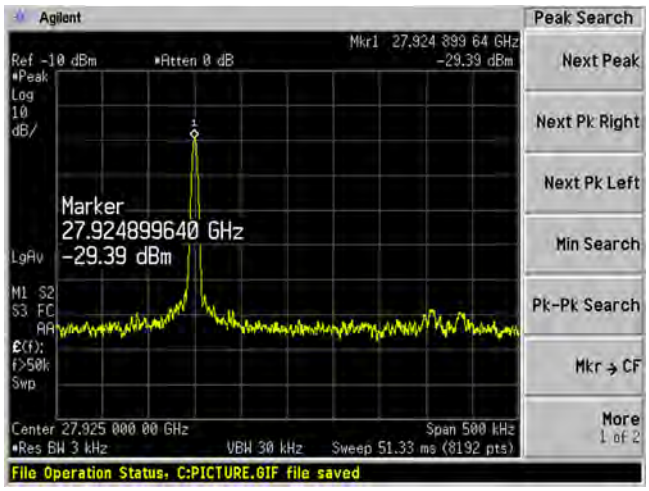
At 20°C



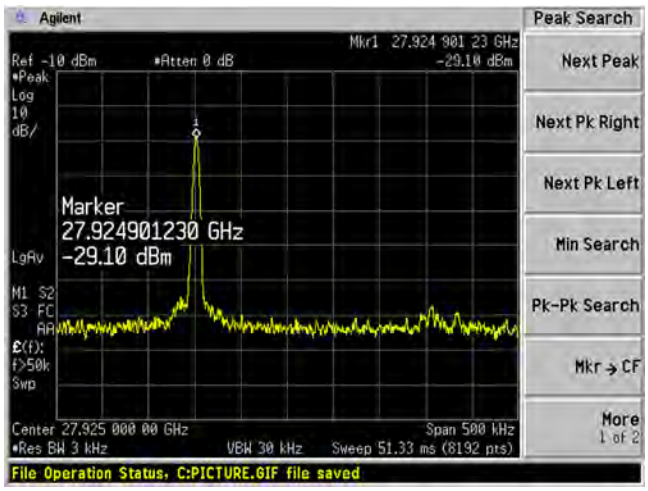
At 30°C



At 40°C



At 45°C



12 Annex A (Normative) - EUT Test Setup Photographs

Please refer to the attachment.

13 Annex B (Normative) - EUT External Photographs

Please refer to the attachment.

14 Annex C (Normative) - EUT Internal Photographs

Please refer to the attachment.

15 Annex D (Normative) - Equipment Calibration Certificates

Please refer to the attachment.

16 Annex E (Normative) - Accredited Test Firm Scope

OET Accredited Test firm scope List

Test Firm: Bay Area Compliance Laboratories Corporation

Scope	FCC Rule Parts	Maximum Assessed Frequency in Mhz	Status	Expiration Date	Recognition Date
Unintentional Radiators	FCC Part15, Subpart B	40000.00	Approved	09-30-2022	12-15-2020
Industrial, Scientific, and Medical Equipment	FCC Part 18	325000.00	Approved	09-30-2022	12-15-2020
Intentional Radiators	FCC Part 15 Subpart C	200000.00	Approved	09-30-2022	12-15-2020
UPCS	FCC Part 15, Subpart D	200000.00	Approved	09-30-2022	12-15-2020
U-NII without DFS Intentional Radiators	FCC Part 15, Subpart E	200000.00	Approved	09-30-2022	12-15-2020
U-NII with DFS Intentional Radiators	FCC Part 15, Subpart E	200000.00	Approved	09-30-2022	12-15-2020
UWB Intentional Radiators	FCC Part 15, Subpart F	200000.00	Approved	09-30-2022	12-15-2020
BPL Intentional Radiators	FCC Part 15, Subpart G	40000.00	Approved	09-30-2022	12-15-2020
White Space Device Intentional Radiators	FCC Part 15, Subpart H	200000.00	Approved	09-30-2022	12-15-2020
Commercial Mobile Services	Part 22 (cellular), Part 24, Part 25 (below 3 GHz), Part 27	200000.00	Approved	09-30-2022	12-15-2020
General Mobile Radio Services	Part 22 (non-cellular), Part 90 (below 3 GHz), Part 95 (below 3 GHz), Part 97 (below 3 GHz),Part 101 (below 3 GHz)	200000.00	Approved	09-30-2022	12-15-2020
Citizens Broadband Radio Services	Part 96	200000.00	Approved	03-31-2022	12-15-2020
Maritime and Aviation Radio Services	Part 80, Part 87	200000.00	Approved	09-30-2022	12-15-2020
Microwave and Millimeter Bands Radio Services	Part 25 (above 3 GHz), Part 30, Part 74, Part 90 (above 3 GHz), Part 95 (above 3 GHz), Part 97 (above 3 GHz) Part 101	200000.00	Approved	09-30-2022	12-15-2020
Broadcast Radio Services	Part 73, Part 74 (below 3 GHz)	200000.00	Approved	09-30-2022	12-15-2020
RF Exposure		6000.00	Approved	09-30-2022	12-15-2020
Hearing Aid Compatibility	Part 20	6000.00	Approved	09-30-2022	12-15-2020
Signal Boosters	Part 20, Part 90.219	200000.00	Approved	09-30-2022	12-15-2020

17 Annex F (Normative) - A2LA Electrical Testing Certificate

Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets A2LA *R222 - Specific Requirements EPA ENERGY STAR Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 10th day of March 2021.

Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2022

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

Please follow the web link below for a full ISO 17025 scope

https://www.a2la.org/scopepdf/3297-02.pdf

--- END OF REPORT ---