RF TEST REPORT

SIEMIC
A Bureau Veritas Group Company

Report No.: FCC_SL18010801-PHA-001 Ver1.0
Supersede Report No.: N/A

Applicant	:	Phazr Inc.
Product Name	:	RABACK 5GAC 28GHz Base Station
Model No.	:	RBK6028
Test Standard	:	Part 30, ANSI C63.26-2015
Test Method	:	ANSI C63.26-2015 KDB 971168 D01 v03
FCC ID	:	2AOHB-R00015A
Dates of test	:	04/17/2018 – 04/20/2018
Issue Date	:	04/20/2018
Test Result	:	☒ Pass ☐ Fail
Equipment complied with the specification [X] Equipment did not comply with the specification [ ]		

This Test Report is Issued Under the Authority of:	
	
Cipher	**Chen Ge**
Test Engineer	Engineer Reviewer
This test report may be reproduced in full only **Test result presented in this test report is applicable to the tested sample only**	

Issued By:
SIEMIC Laboratories
775 Montague Expressway, Milpitas, 95035 CA

ilac-MRA
A2LA ACCREDITED
TESTING CERT # 2742-01

Laboratory Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.

In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

Accreditations for Conformity Assessment

Country/Region	Accreditation Body	Scope
USA	FCC, A2LA	EMC, RF/Wireless, Telecom
Canada	IC, A2LA, NIST	EMC, RF/Wireless, Telecom
Taiwan	BSMI, NCC, NIST	EMC, RF, Telecom, Safety
Hong Kong	OFTA, NIST	RF/Wireless, Telecom
Australia	NATA, NIST	EMC, RF, Telecom, Safety
Korea	KCC/RRA, NIST	EMI, EMS, RF, Telecom, Safety
Japan	VCCI, JATE, TELEC, RFT	EMI, RF/Wireless, Telecom
Mexico	NOM, COFETEL, Caniety	Safety, EMC, RF/Wireless, Telecom
Europe	A2LA, NIST	EMC, RF, Telecom, Safety
Israel	MOC, NIST	EMC, RF, Telecom, Safety

Accreditations for Product Certifications

Country	Accreditation Body	Scope
USA	FCC TCB, NIST	EMC, RF, Telecom
Canada	IC FCB, NIST	EMC, RF, Telecom
Singapore	iDA, NIST	EMC, RF, Telecom
EU	NB	EMC & R&TTE Directive
Japan	MIC (RCB 208)	RF, Telecom
Hong Kong	OFTA (US002)	RF, Telecom

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1 Report Revision History

Report No.	Report Version	Description	Issue Date
FCC_SL18010801-PHA-001	None	Original	04/20/2018
FCC_SL18010801-PHA-001 Ver1.0	Ver 1.0	Update Above 40G plots	07/26/2018

2 Executive Summary

The purpose of this test program was to demonstrate compliance of following product

Company: Phazr Inc.
Product: RABACK 5GAC 28GHz Base Station
Model: RBK6028

against the current Stipulated Standards. The specified model product stated above has demonstrated compliance with the Stipulated Standard listed on 1st page.

3 Customer information

Applicant Name	:	Phazr Inc.
Applicant Address	:	8 Prestige Cir, STE 104, Allen, TX 75002
Manufacturer Name	:	Phazr Inc.
Manufacturer Address	:	8 Prestige Cir, STE 104, Allen, TX 75002

4 Test site information

Lab performing tests	SIEMIC Laboratories
Lab Address	775 Montague Expressway, Milpitas, CA 95035
FCC Test Site No.	881796
IC Test Site No.	4842D-2
VCCI Test Site No.	A0133

5 Modification

Index	Item	Description	Note
-	-	-	-

6 EUT Information

6.1 EUT Description

Product Name	:	RABACK 5GAC 28GHz Base Station
Model No.	:	RBK6028
Trade Name	:	Phazr Inc.
Serial No.	:	RBK000005
Input Power	:	110V/240V AC or -48V DC Maximum Power Consumption 240W
Power Adapter Manu/Model	:	N/A
Power Adapter SN	:	N/A
Product Hardware version	:	810-00015 REV 3
Product Software version	:	RBK Software 1.00.000 (Part Number 510-00009 REV 1)
Date of EUT received	:	03/19/2018
Remark	:	This device has 2 power config. AC to DC and DC to DC.

6.2 Radio Description

Radio Type	Point to Multipoint, Outdoor, Fixed Installation, Operating in 28GHz Band Downlink 5GHz Band Uplink
Operating Frequency	27.5GHz – 28.35GHz
Antenna Type	Integrated Multi-element Antenna Arrays
Antenna Gain (Peak)	28GH Antenna Gain (TX): 19dBi 5GHz Antenna Gain (RX): 11dBi
Antenna Connector Type	No connector; Fully integrated
Note	6 Subsystems per unit, 2 subsystems in each 40 degree sector can transmit simultaneously.
Supported Bandwidth per Hypercore (sub-sector)	160 MHz + 160 MHz 160 MHz + 80 MHz 160 MHz + 40 MHz 160 MHz + 20 MHz 80 MHz + 80 MHz 80 MHz + 40 MHz 80 MHz + 20 MHz 40 MHz + 40 MHz 40 MHz + 20 MHz 20 MHz + 20 MHz
Supported Modulation	BPSK QPSK 16QAM 64QAM 256QAM

7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	Laptop	E7240	8906079	Dell	-
2	Switch	DGS-1510-20	RZC01EC000268	D-Link	-

7.2 Cabling Description

Name	Connection Start		Connection Stop		Length / shielding Info		Note
	From	I/O Port	To	I/O Port	Length (m)	Shielding	
RJ45	Switch	RJ45	Laptop	RJ45	>1	1	Unshielded
Fiber Cable	EUT	Fiber Cable	Switch	Fiber Cable	>10	1	Unshielded

7.3 Test Software Description

Test Item	Software	Description
RF Testing	LABTOOL	Set the EUT to transmit continuously in diferent test modes and channels

8 Test Summary

Test Item	Test standard		Test Method/Procedure	Pass / Fail
Occupied Bandwidth	FCC	2.1049	ANSI C63.26-2015 KDB 971168 D01 v03	☒ Pass ☐ N/A
EIRP Density	FCC	30.202	ANSI C63.26-2015 KDB 971168 D01 v03	☒ Pass ☐ N/A
RF Output Power	FCC	30.405	ANSI C63.26-2015 KDB 971168 D01 v03	☒ Pass ☐ N/A
Out-of-Band Spurious Emissions	FCC	2.1051 30.203	ANSI C63.26-2015 KDB 971168 D01 v03	☒ Pass ☐ N/A
Out-of-Band Emissions at the Band Edge	FCC	2.1051 30.203	ANSI C63.26-2015 KDB 971168 D01 v03	☒ Pass ☐ N/A
Frequency Stability	FCC	2.1055	ANSI C63.26-2015 KDB 971168 D01 v03	☒ Pass ☐ N/A
AC Conducted Emissions	FCC	15.207(a)	ANSI C63.10:2013	☒ Pass ☐ N/A

Remark	1. All measurement uncertainties are not taken into consideration for all presented test result. 2. The applicant shall ensure frequency stability by showing that an emission is maintained within the band of operation under all normal operating conditions as specified in the user's manual. 3. All modes of operation and modulations were investigated. The test results shown in the following sections represent the worst case emissions. 4. Per 2.1057(a)(2), spurious emissions were investigated up to 100GHz. 5. All radiated emission measurements in the band edge and in the out-of-band spurious domain are convered to an equivalent conductive power by subtracting the known antenna gain from the EIRP measured at each frequency of interest. These emissions are compared to the 30.203 spurious emission limits as conductive power levels. 6. All 3 Hypercores are transmiting simultaneously during testing.

9 Measurement Uncertainty

9.1 Conducted Emissions

The test is to measure the conducted emissions to the mains port of the EUT.

Some error sources that can contribute to the total uncertainty:
- Uncertainty of the receiver
- Uncertainty of the LISN
- Uncertainty of cables
- Uncertainty due to the mismatches
- Etc, see the below table for details

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Filter Insertion Loss	0.25	Normal	2	1	0.125
LISN Insertion Loss	0.40	Normal	2	1	0.20
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.86605081
PRF Response	1.5	Rectangular	1.732	1	0.86605081
Mismatch LISN - Receiver	0.25	U-Shape	1.414	1	0.1768033
LISN Impedance	2.5	Triangular	2.449	1	1.0208248
Combined Standard Uncertainty					1.928133
Expanded Uncertainty (K=2)					**3.856266**

The total derived measurement uncertainty is +/- 3.86 dB.

9.2 Radiated Emissions (30MHz to 1GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:
- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- NSA Calibration
- Etc., details see the below table

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Filter Insertion Loss	0.25	Normal	2	1	0.125
Antenna Factor	0.65	Normal	2	1	0.325
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.86605081
PRF Response	1.5	Rectangular	1.732	1	0.86605081
Mismatch Filter - Receiver	0.25	U-Shape	1.414	1	0.1768033
NSA Calibration	4.0	U-Shape	1.414	1	2.8288543
Combined Standard Uncertainty					3.0059131
Expanded Uncertainty (K=2)					**6.0118262**

The total derived measurement uncertainty is +/- 6.00 dB.

9.3 Radiated Emissions (1GHz to 100GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:
- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- VSWR Calibration
- Etc., details see the below table

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.0692840
Cable Insertion Loss	0.21	Normal	2	1	0.1050000
Filter Insertion Loss	0.25	Normal	2	1	0.1250000
Antenna Factor	0.65	Normal	2	1	0.3250000
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.8660508
PRF Response	1.5	Rectangular	1.732	1	0.8660508
Mismatch Filter - Receiver	0.25	U-Shape	1.414	1	0.1768033
VSWR Calibration	2.0	U-Shape	1.414	1	1.4144272
Combined Standard Uncertainty					4.2363
Expanded Uncertainty (K=2)					**8.4726**

The total derived measurement uncertainty is +/- 8.47 dB.

9.4 RF conducted measurement

The test is to measure the RF output power from the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the Reference Level Uncertainty
- Uncertainty of variable attenuators
- Uncertainty of cables
- Uncertainty due to the mismatches

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Reference Level	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Attenuator	0.25	Normal	2	1	0.125
Mismatch	0.25	U-Shape	1.414	1	0.1768033
Combined Standard Uncertainty					0.476087
Expanded Uncertainty (K=2)					**0.952174**

The total derived measurement uncertainty is +/- 0.95 dB.

10 Measurements, Examination and Derived Results

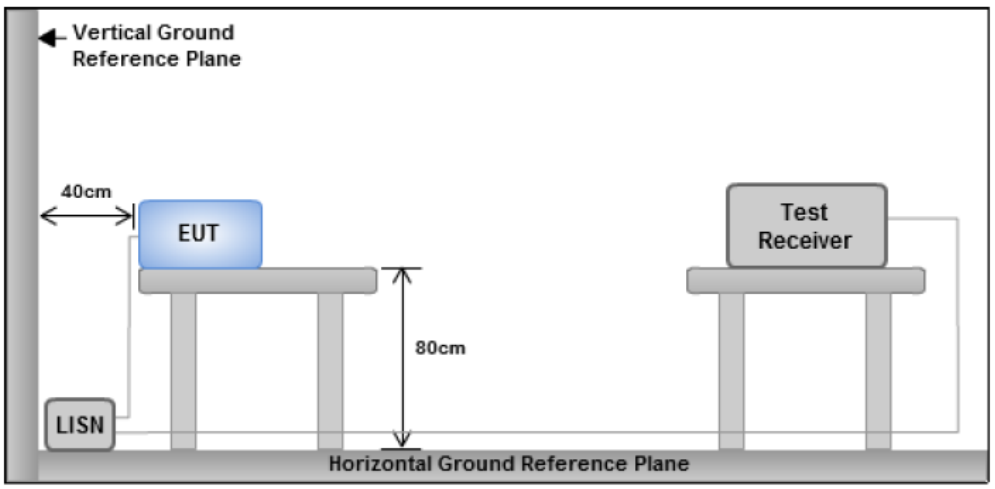
10.1 Conducted Emissions

Conducted Emission Limit

Frequency ranges (MHz)	Limit (dBuV)	
	QP	Average
0.15 ~ 0.5	66 – 56	56 – 46
0.5 ~ 5	56	46
5 ~ 30	60	50

Spec	Item	Requirement	Applicable
FCC 15.207	a)	For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequency ranges.	☒

Test Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

Procedure

- The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table, as shown in Annex B.
- The power supply for the EUT was fed through a 50Ω/50µH EUT LISN, connected to filtered mains.
- The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
- All other supporting equipment was powered separately from another main supply.

Remark: N/A

Result: ☒ Pass ☐ Fail

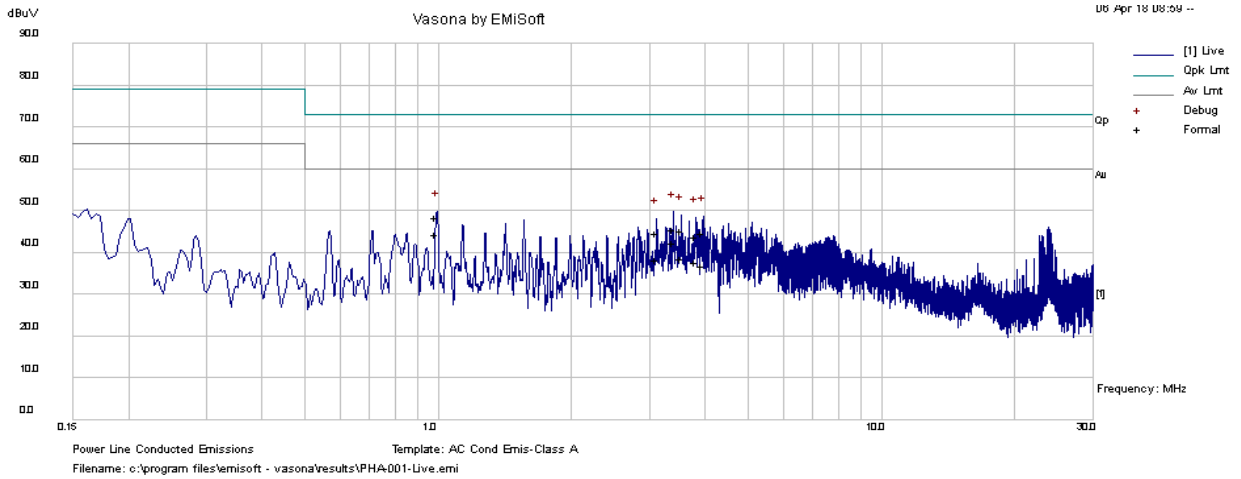
Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Anish Kumar at Conducted Emission test site.

Conducted Emission Test Results

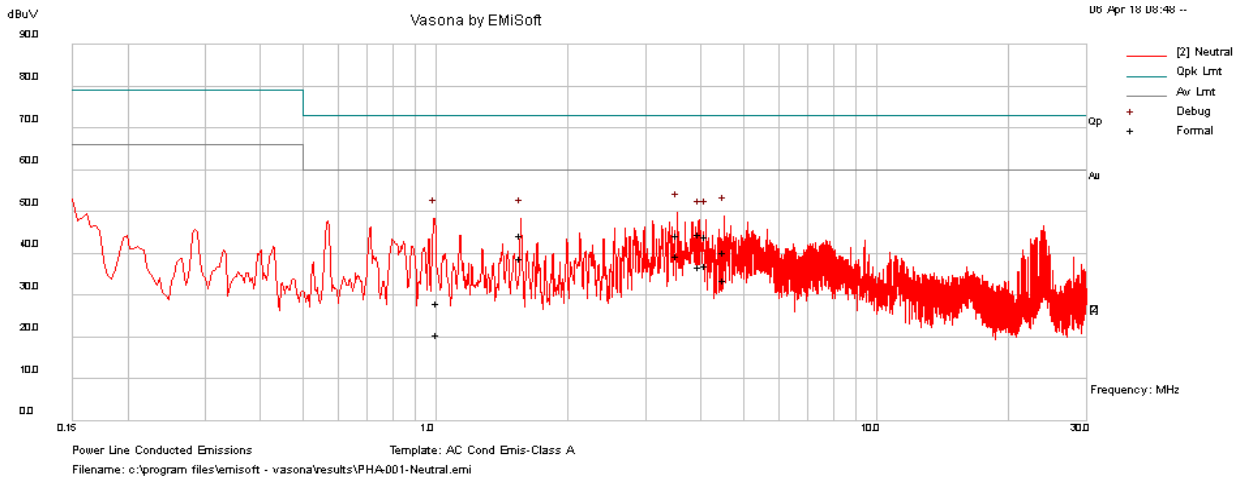
Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	21	Result:	☒ Pass ☐ Fail
	Humidity (%):	42		
	Atmospheric(mbar):	1021		
Mains Power:	120Vac, 60Hz			
Tested by:	Anish Kumar			
Test Date:	04/17/2018-04/20/2018			
Remarks	Conducted @ Live			



Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
0.99	39	9.33	0.04	48.37	Quasi Peak	Live	73	-24.63	Pass
3.39	36.19	9.34	0.07	45.6	Quasi Peak	Live	73	-27.4	Pass
3.53	35.82	9.34	0.07	45.24	Quasi Peak	Live	73	-27.76	Pass
3.95	35.13	9.34	0.07	44.54	Quasi Peak	Live	73	-28.46	Pass
3.82	34.38	9.34	0.07	43.79	Quasi Peak	Live	73	-29.21	Pass
3.11	35.26	9.34	0.07	44.67	Quasi Peak	Live	73	-28.33	Pass
0.99	34.91	9.33	0.04	44.28	Average	Live	60	-15.72	Pass
3.39	32.99	9.34	0.07	42.4	Average	Live	60	-17.6	Pass
3.53	29.28	9.34	0.07	38.69	Average	Live	60	-21.31	Pass
3.95	27.54	9.34	0.07	36.96	Average	Live	60	-23.04	Pass
3.82	28.39	9.34	0.07	37.8	Average	Live	60	-22.2	Pass
3.11	28.89	9.34	0.07	38.3	Average	Live	60	-21.7	Pass

Conducted Emission Test Results

Test specification:	Conducted Emissions			
Environmental Conditions:	Temp(°C):	21	Result:	☒ Pass ☐ Fail
	Humidity (%):	42		
	Atmospheric(mbar):	1021		
Mains Power:	120Vac, 60Hz			
Tested by:	Anish Kumar			
Test Date:	04/17/2018-04/20/2018			
Remarks	Conducted @ Neutral			

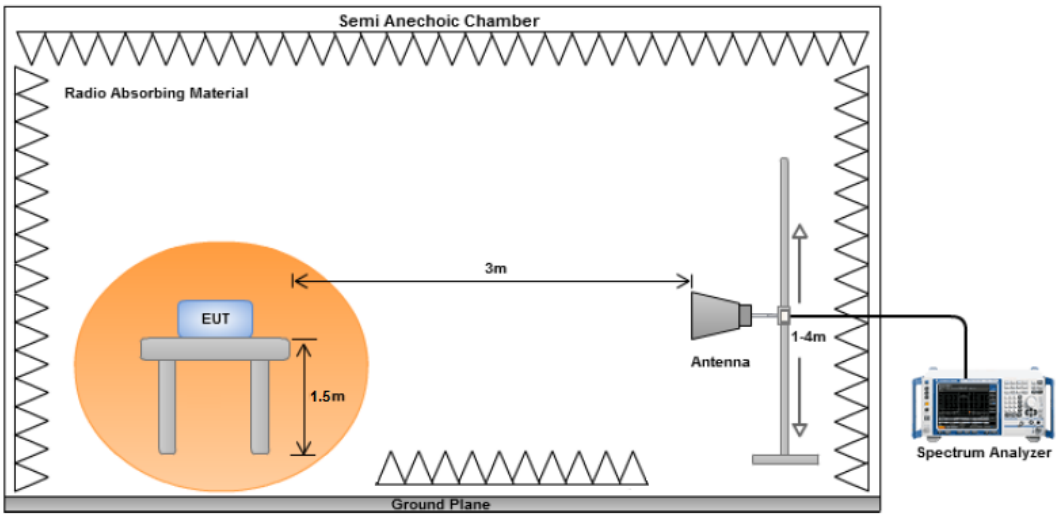


Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	Factors (dB)	Level (dBuV)	Measurement Type	Line / Neutral	Limit (dBuV)	Margin (dB)	Pass /Fail
3.53	35.08	9.34	0.07	44.49	Quasi Peak	Neutral	73	-28.51	Pass
4.52	30.99	9.35	0.08	40.42	Quasi Peak	Neutral	73	-32.58	Pass
1.56	34.92	9.34	0.06	44.32	Quasi Peak	Neutral	73	-28.68	Pass
1.01	18.87	9.33	0.04	28.24	Quasi Peak	Neutral	73	-44.76	Pass
3.96	35.34	9.34	0.07	44.76	Quasi Peak	Neutral	73	-28.24	Pass
4.10	34.55	9.34	0.07	43.97	Quasi Peak	Neutral	73	-29.03	Pass
3.53	30.07	9.34	0.07	39.48	Average	Neutral	60	-20.52	Pass
4.52	24.11	9.35	0.08	33.53	Average	Neutral	60	-26.47	Pass
1.56	29.48	9.34	0.06	38.88	Average	Neutral	60	-21.12	Pass
1.01	11.24	9.33	0.04	20.61	Average	Neutral	60	-39.39	Pass
3.96	27.49	9.34	0.07	36.9	Average	Neutral	60	-23.1	Pass
4.10	27.7	9.34	0.07	37.11	Average	Neutral	60	-22.89	Pass

10.2 Occupied Bandwidth

Requirement(s):

Spec	Requirement	Applicable
2.1049	The occupied bandwidth, that is the frequency such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.	☒

Test Setup	
Procedure	ANSI C63.25-2015 Section 5.4.3 - The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied banwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission. - RBW = 1-5% of the expected OBW. - VBW ⩾ 3 x RBW. - Detector = Peak. - Trace mode = max hold. - Sweep = auto couple. - Allow the trace to stabilize.

Test Date	04/17/2018-04/20/2018	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	23°C 42% 1021mbar
Remark	N/A.			
Result	☒ Pass ☐ Fail			

Test Data ☒ Yes (See below) ☐ N/A
Test Plot ☒ Yes (See below) ☐ N/A

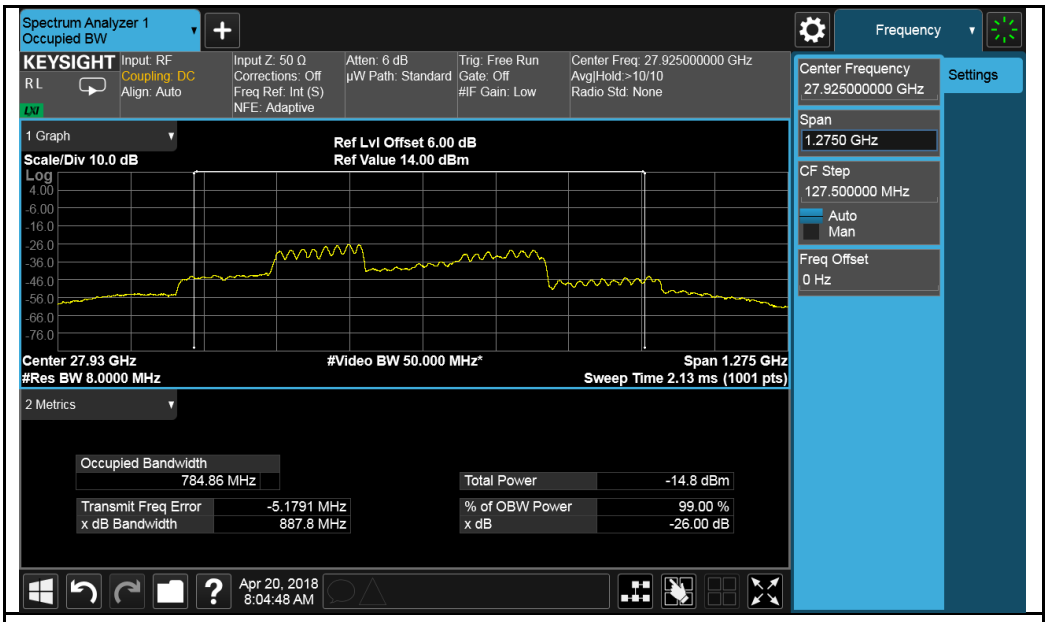
Test was done by Cipher at 10m chamber.

Occupied Bandwidth measurement result

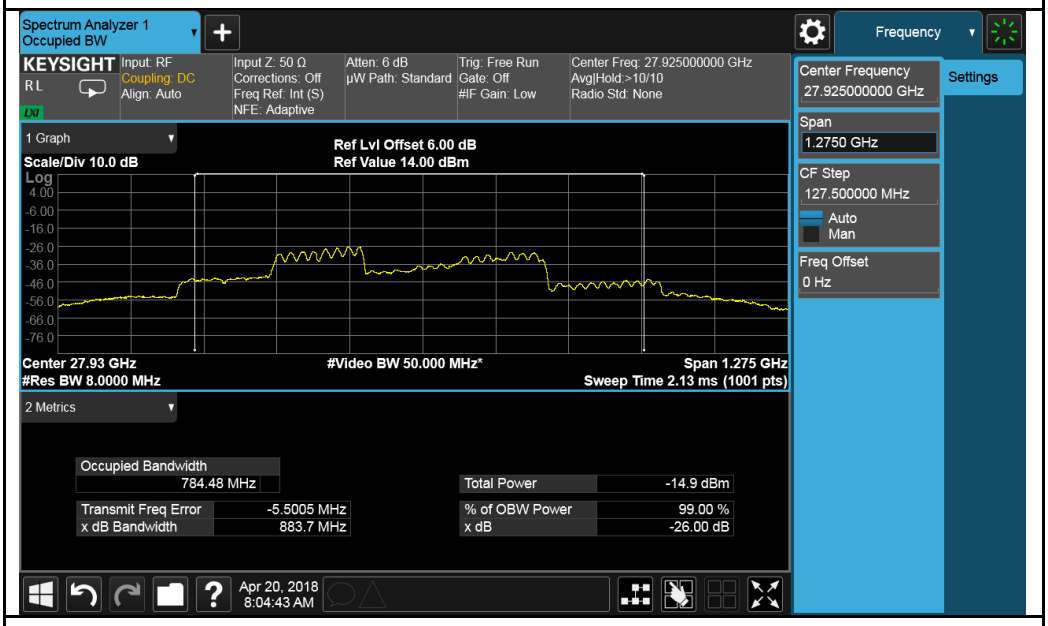
Modulation	Freq (GHz)	Bandwidth (MHz)	Result (MHz)	Limit (MHz)
BPSK	27.93	800	784.86	N/A
QPSK	27.93	800	784.48	N/A
16QAM	27.93	800	785.2	N/A
64QAM	27.93	800	784.88	N/A
256QAM	27.93	800	785.71	N/A

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case per Hypercore. Raback unit has 3 Hypercores (40 degree sub-sectors) and each Hypercore with two polarization (H and V).

Test Plots



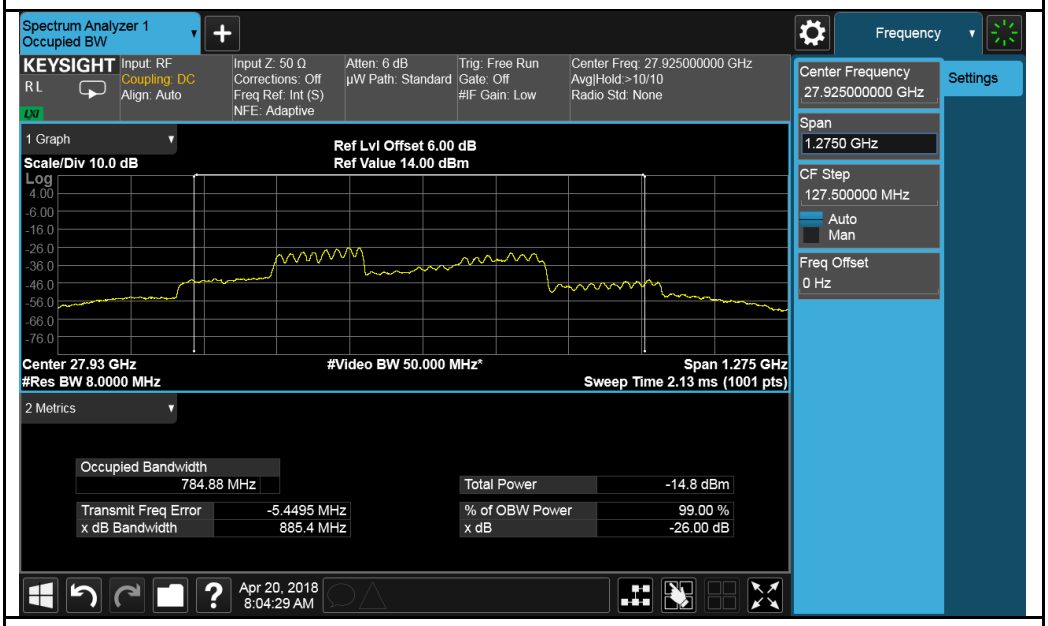
BPSK



QPSK


Spectrum Analyzer 1
Occupied BW
Frequency
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 6 dB
µW Path: Standard
Trig: Free Run
Gate: Off
#IF Gain: Low
Center Freq: 27.925000000 GHz
Avg|Hold:>10/10
Radio Std: None
Center Frequency
27.925000000 GHz
Settings
Span
1.2750 GHz
CF Step
127.500000 MHz
Auto
Man
Freq Offset
0 Hz
1 Graph
Ref Lvl Offset 6.00 dB
Scale/Div 10.0 dB
Ref Value 14.00 dBm
Log
4.00
-6.00
-16.0
-26.0
-36.0
-46.0
-56.0
-66.0
-76.0
Center 27.93 GHz
#Res BW 8.0000 MHz
#Video BW 50.000 MHz*
Span 1.275 GHz
Sweep Time 2.13 ms (1001 pts)
2 Metrics
Occupied Bandwidth
785.20 MHz
Total Power
-14.8 dBm
Transmit Freq Error
-5.5579 MHz
% of OBW Power
99.00 %
x dB Bandwidth
868.7 MHz
x dB
-26.00 dB
Apr 20, 2018
8:04:35 AM

16QAM


Spectrum Analyzer 1
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Ref Value 14.00 dBm
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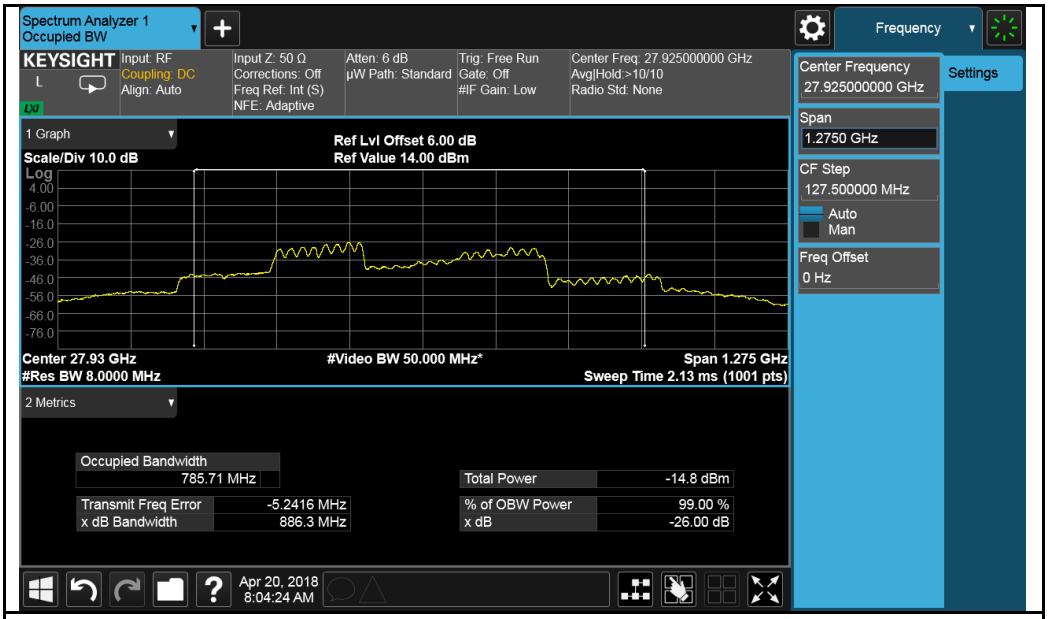
4.00
-6.00
-16.0
-26.0
-36.0
-46.0
-56.0
-66.0
-76.0
Center 27.93 GHz
#Res BW 8.0000 MHz
#Video BW 50.000 MHz*
Span 1.275 GHz
Sweep Time 2.13 ms (1001 pts)
2 Metrics
Occupied Bandwidth
784.88 MHz
Total Power
-14.8 dBm
Transmit Freq Error
-5.4495 MHz
% of OBW Power
99.00 %
x dB Bandwidth
885.4 MHz
x dB
-26.00 dB
Apr 20, 2018
8:04:29 AM

64QAM


Spectrum Analyzer 1
Occupied BW
Frequency
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 6 dB
µW Path: Standard
Trig: Free Run
Gate: Off
#IF Gain: Low
Center Freq: 27.925000000 GHz
Avg|Hold:>10/10
Radio Std: None
Center Frequency
27.925000000 GHz
Settings
Span
1.2750 GHz
CF Step
127.500000 MHz
Auto
Man
Freq Offset
0 Hz
1 Graph
Ref Lvl Offset 6.00 dB
Ref Value 14.00 dBm
Scale/Div 10.0 dB
Log
4.00
-6.00
-16.0
-26.0
-36.0
-46.0
-56.0
-66.0
-76.0
Center 27.93 GHz
#Res BW 8.0000 MHz
#Video BW 50.000 MHz*
Span 1.275 GHz
Sweep Time 2.13 ms (1001 pts)
2 Metrics
Occupied Bandwidth
785.71 MHz
Total Power
-14.8 dBm
Transmit Freq Error
-5.2416 MHz
% of OBW Power
99.00 %
x dB Bandwidth
886.3 MHz
x dB
-26.00 dB
Apr 20, 2018
8:04:24 AM

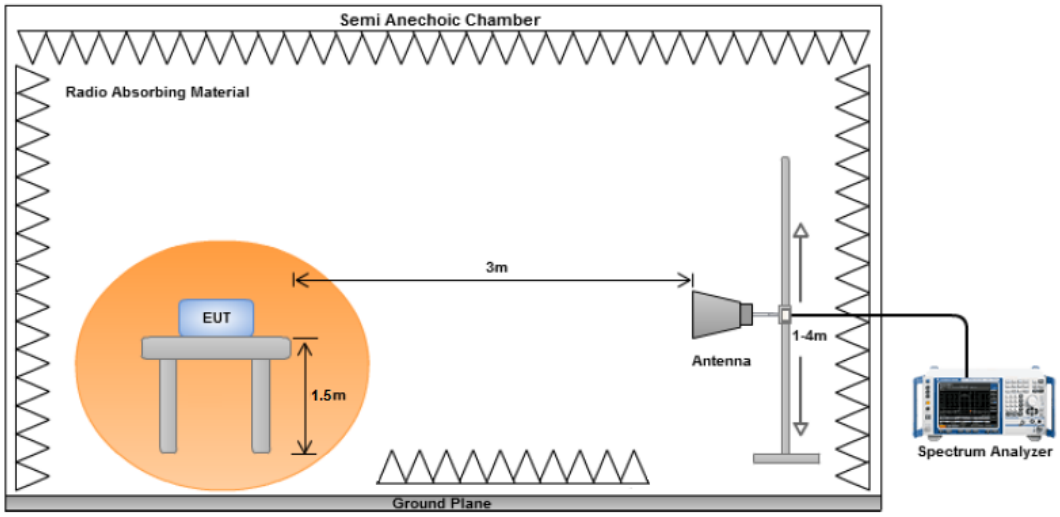
256QAM

10.3 Equivalent Isotropic Radiated Power (EIRP) Density

Requirement(s):

Spec		Applicable
2.1046 30.202	Equivalent Isotropic Radiated Power (EIRP) measurements are performed using broadband horn antennas. All measurements are performed as RMS average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. The average power of the sum of all antenna elements is limited to an equivalent isotopically radiated power (EIRP) density of +75dBm/100MHz.	☒

Test Setup



Test Procedure

ANSI C63.26-2015 Section 5.2.4.4..1
ANSI C63.26-2015 Section 6.4

- Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation.
- RBW = 1-5% of the expected OBW
- VBW >= 3 * RBW
- Span = 2 * to 3 * the OBW
- Detector = RMS
- Trigger is set to "free run"
- Trace mode = trace averaging (RMS) over 100 sweeps
- Allow trace to fully stabilize.

Test Date	04/17/2018-04/20/2018	Environmental condition	Temperature	22ºC
			Relative Humidity	46%
			Atmospheric Pressure	1020mbar

Remark

The average EIRP reported below is calculated per formula specifiec in d) of ANSI C63.26-2015 Section 5.2.7
EIRP (dBm) = E (dBuV/m) + 20log(D) -104.8, where D is the measurement distance (in the far field region) in m.
For this section, all EIRP density measurments were performed at a distance of 3m, so the effective correction is:
EIRP (dBm) = E (dBuV/m) – 95.26dB
= Analyzer Level (dBm) + AFCL (dB/m) + 107dB -95.26dB
= Analyzer Level (dBm) + AFCL (dB/m) + 11.74dB
Conducted Average PSD (dBm) = Average EIRP Density (dBm) – Antenna Gain (dBi)
Per ANSI C63.26-2015 Section 6.4, individual EIRPs are also summed before compared to the limit.
The angle of the horn antenna was rotated to maximize and find the worst case emissions. Worst case EIRP is reported below.

Result

☒ Pass ☐ Fail

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

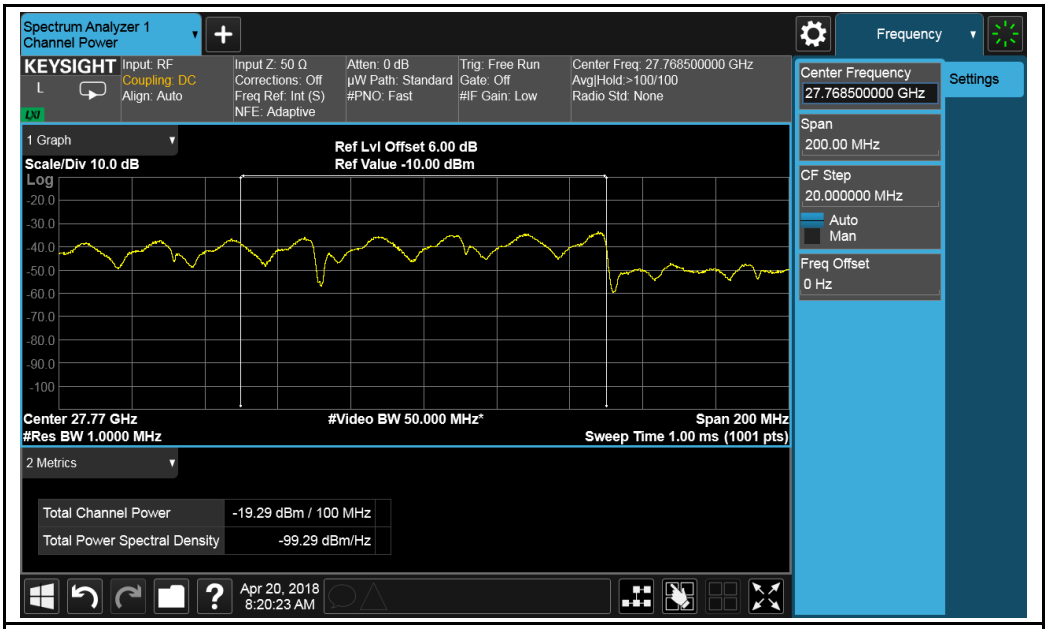
Test was done by Cipher at 10m chamber.

EIRP Density results

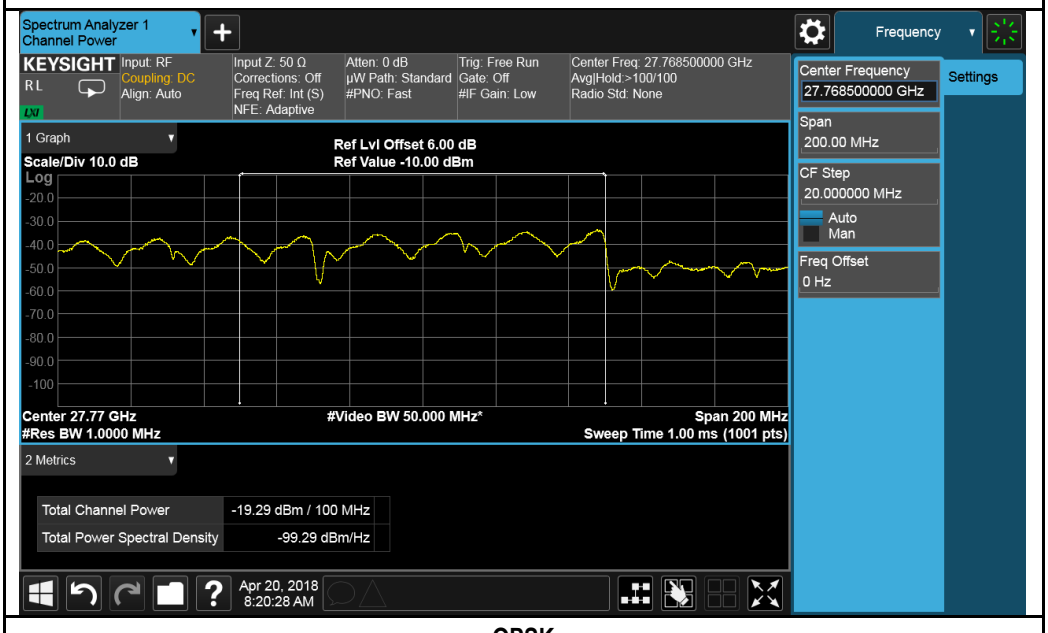
Modulation	Horn Polarity	Horn Height (cm)	Turntable Azimuth (degrees)	Analyzer Level (dBm)	AFCL (dB/m)	EUT Antenna Gain (dBi)	EIRP PSD (dBm/100 MHz)	Conducted PSD (dBm/100MHz)	Limit (dBm/100MHz)	Margin (dB)
BPSK	V	197	0	-19.29	40.8	19	33.25	14.25	75	-41.75
QPSK	V	197	0	-19.29	40.8	19	33.25	14.25	75	-41.75
16QAM	V	197	0	-19.29	40.8	19	33.25	14.25	75	-41.75
64QAM	V	197	0	-19.3	40.8	19	33.24	14.24	75	-41.76
256QAM	V	197	0	-19.3	40.8	19	33.24	14.24	75	-41.76

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case per Hypercore. Raback unit has 3 Hypercores (40 degree sub-sectors) and each Hypercore with two polarization (H and V).
Note: Each Hypercore cannot transmit at the same frequency simultaneously, so the testing result shown as the worst case.

Test Plots



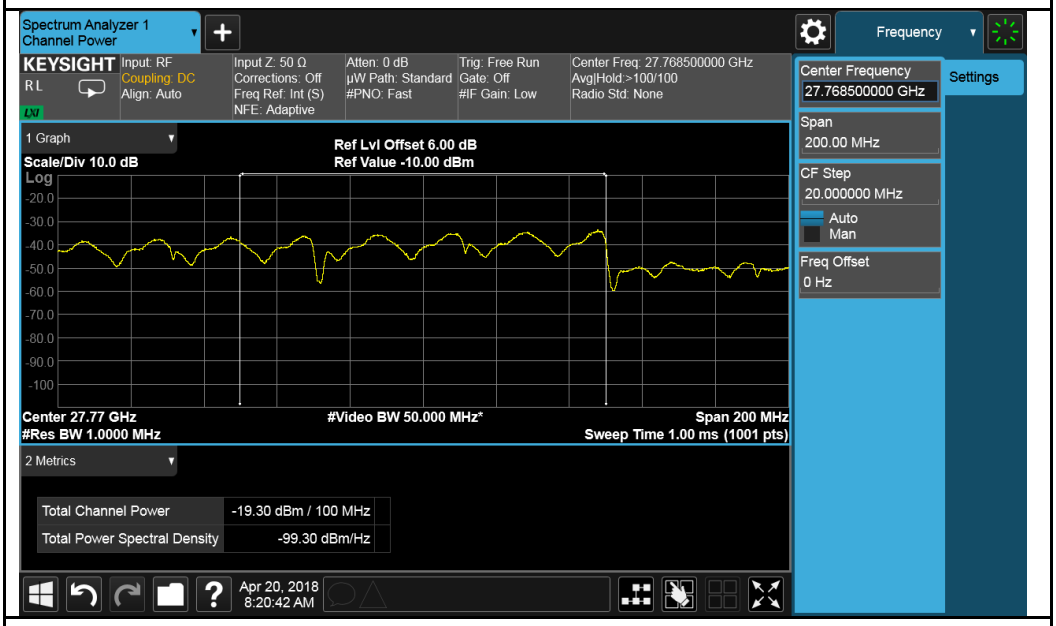
BPSK



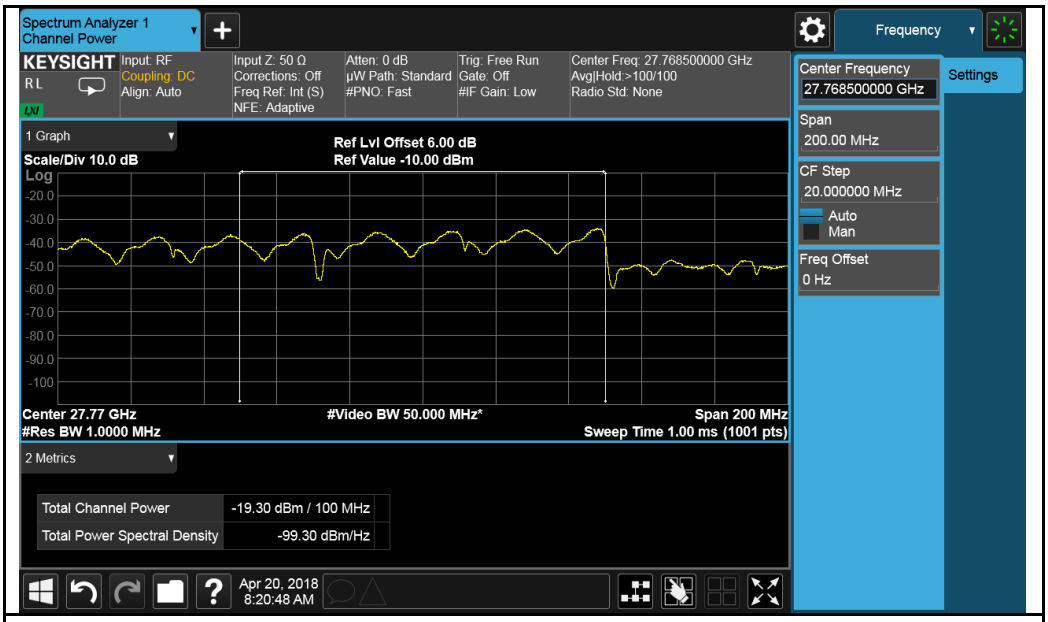
QPSK


Spectrum Analyzer 1
Channel Power
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 0 dB
µW Path: Standard
#PNO: Fast
Trig: Free Run
Gate: Off
#IF Gain: Low
Center Freq: 27.768500000 GHz
Avg|Hold:>100/100
Radio Std: None
Frequency
Center Frequency
27.768500000 GHz
Settings
Span
200.00 MHz
CF Step
20.000000 MHz
Auto
Man
Freq Offset
0 Hz
1 Graph
Ref Lvl Offset 6.00 dB
Scale/Div 10.0 dB
Ref Value -10.00 dBm
Log
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100
Center 27.77 GHz
#Res BW 1.0000 MHz
#Video BW 50.000 MHz*
Span 200 MHz
Sweep Time 1.00 ms (1001 pts)
2 Metrics
Total Channel Power
-19.29 dBm / 100 MHz
Total Power Spectral Density
-99.29 dBm/Hz
Apr 20, 2018
8:20:36 AM

16QAM


Spectrum Analyzer 1
Channel Power
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 0 dB
µW Path: Standard
#PNO: Fast
Trig: Free Run
Gate: Off
#IF Gain: Low
Center Freq: 27.768500000 GHz
Avg|Hold:>100/100
Radio Std: None
Frequency
Center Frequency
27.768500000 GHz
Settings
Span
200.00 MHz
CF Step
20.000000 MHz
Auto
Man
Freq Offset
0 Hz
1 Graph
Ref Lvl Offset 6.00 dB
Scale/Div 10.0 dB
Ref Value -10.00 dBm
Log
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100
Center 27.77 GHz
#Res BW 1.0000 MHz
#Video BW 50.000 MHz*
Span 200 MHz
Sweep Time 1.00 ms (1001 pts)
2 Metrics
Total Channel Power
-19.30 dBm / 100 MHz
Total Power Spectral Density
-99.30 dBm/Hz
Apr 20, 2018
8:20:42 AM

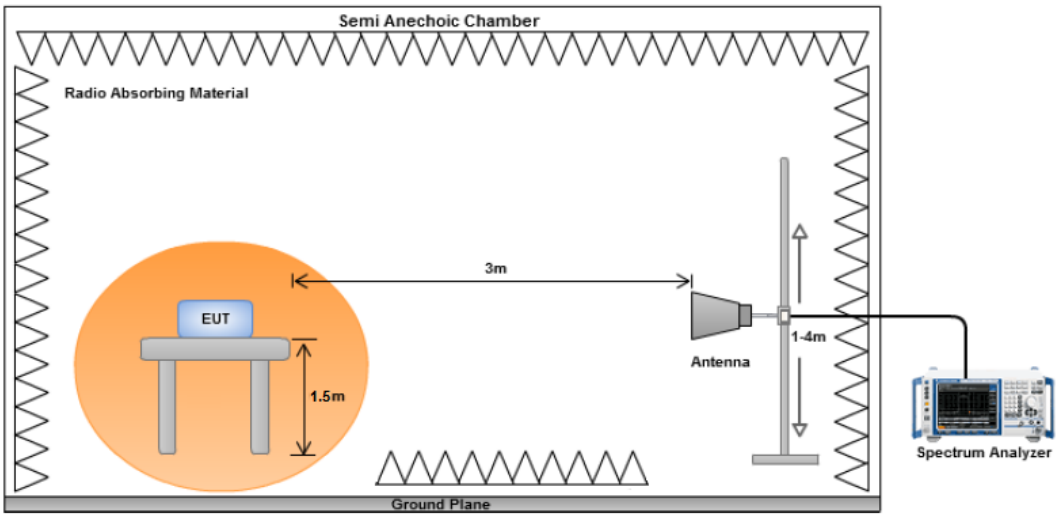
64QAM


Spectrum Analyzer 1
Channel Power
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 0 dB
µW Path: Standard
#PNO: Fast
Trig: Free Run
Gate: Off
#IF Gain: Low
Center Freq: 27.768500000 GHz
Avg|Hold:>100/100
Radio Std: None
Frequency
Center Frequency
27.768500000 GHz
Settings
Span
200.00 MHz
CF Step
20.000000 MHz
Auto
Man
Freq Offset
0 Hz
1 Graph
Ref Lvl Offset 6.00 dB
Scale/Div 10.0 dB
Ref Value -10.00 dBm
Log
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100
Center 27.77 GHz
#Res BW 1.0000 MHz
#Video BW 50.000 MHz*
Span 200 MHz
Sweep Time 1.00 ms (1001 pts)
2 Metrics
Total Channel Power
-19.30 dBm / 100 MHz
Total Power Spectral Density
-99.30 dBm/Hz
Apr 20, 2018
8:20:48 AM

256QAM

10.4 RF Conducted Output Power

Requirement(s):

Spec		Applicable
30.405	**Frequency band (MHz)** / **Fixed (dBW)** 27,500-28,350[1] / + 55 38,600-40,000 / + 55 [1]For Point-to-multipoint user stations authorized in these bands, the EIRP shall not exceed 55 dBw or 42 dBw/MHz.	☒
Test Setup		
Test Procedure	ANSI C63.26-2015 Section 5.2.4.4..1 ANSI C63.26-2015 Section 6.4 - Radiated power measurements are performed using the signal analyzer's "channel power" measurement capability for signals with continuous operation. - RBW = 1-5% of the expected OBW - VBW >= 3 * RBW - Span = 2 * to 3 * the OBW - Detector = RMS - Trigger is set to "free run" - Trace mode = trace averaging (RMS) over 100 sweeps - Allow trace to fully stabilize.	
Test Date	04/17/2018-04/20/2018	Environmental condition: Temperature 22ºC; Relative Humidity 46%; Atmospheric Pressure 1020mbar
Remark	The average EIRP reported below is calculated per formula specifiec in d) of ANSI C63.26-2015 Section 5.2.7 EIRP (dBm) = E (dBuV/m) + 20log(D) -104.8, where D is the measurement distance (in the far field region) in m. For this section, all EIRP density measurments were performed at a distance of 3m, so the effective correction is: EIRP (dBm) = E (dBuV/m) – 95.26dB = Analyzer Level (dBm) + AFCL (dB/m) + 107dB -95.26dB = Analyzer Level (dBm) + AFCL (dB/m) + 11.74dB Conducted Average PSD (dBm) = Average EIRP Density (dBm) – Antenna Gain (dBi) Per ANSI C63.26-2015 Section 6.4, individual EIRPs are also summed before compared to the limit. The angle of the horn antenna was rotated to maximize and find the worst case emissions. Worst case EIRP is reported below. +55 dBW = 85 dBm.	
Result	☒ Pass ☐ Fail	

Test Data ☒ Yes ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

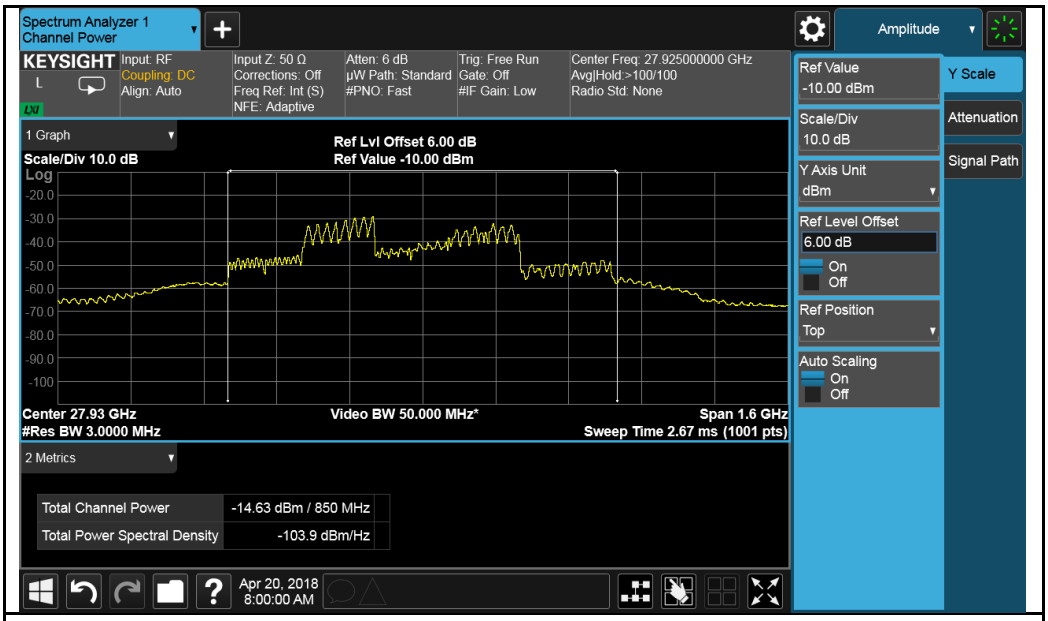
Test was done by Cipher at 10m chamber.

Conducted Power results

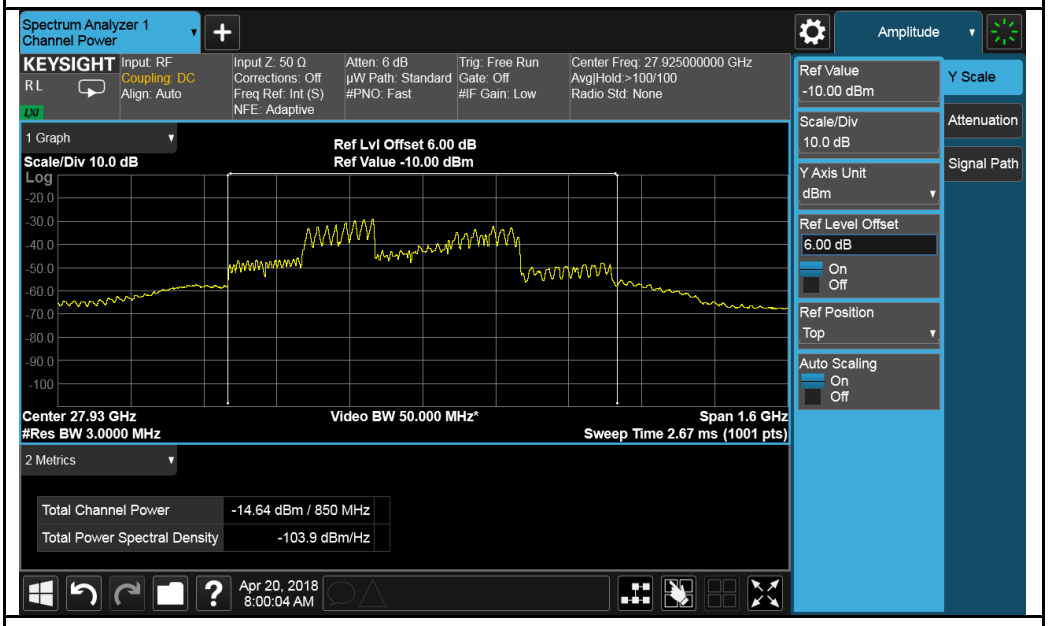
Modulation	Horn Polarity	Horn Height (cm)	Turntable Azimuth (degrees)	Analyzer Level (dBm)	AFCL (dB/m)	EUT Antenna Gain (dBi)	EIRP (dBm)	Conducted Power (dBm)	EIRP Limit (dBm)	Margin (dB)
BPSK	V	197	0	-14.63	40.8	19	37.91	18.91	85	-47.09
QPSK	V	197	0	-14.64	40.8	19	37.9	18.9	85	-47.1
16QAM	V	197	0	-14.64	40.8	19	37.9	18.9	85	-47.1
64QAM	V	197	0	-14.65	40.8	19	37.89	18.89	85	-47.11
256QAM	V	197	0	-14.65	40.8	19	37.89	18.89	85	-47.11

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case per Hypercore. Raback unit has 3 Hypercores (40 degree sub-sectors) and each Hypercore with two polarization (H and V).
Note: Each Hypercore cannot transmit at the same frequency simultaneously, so the testing result shown as the worst case.

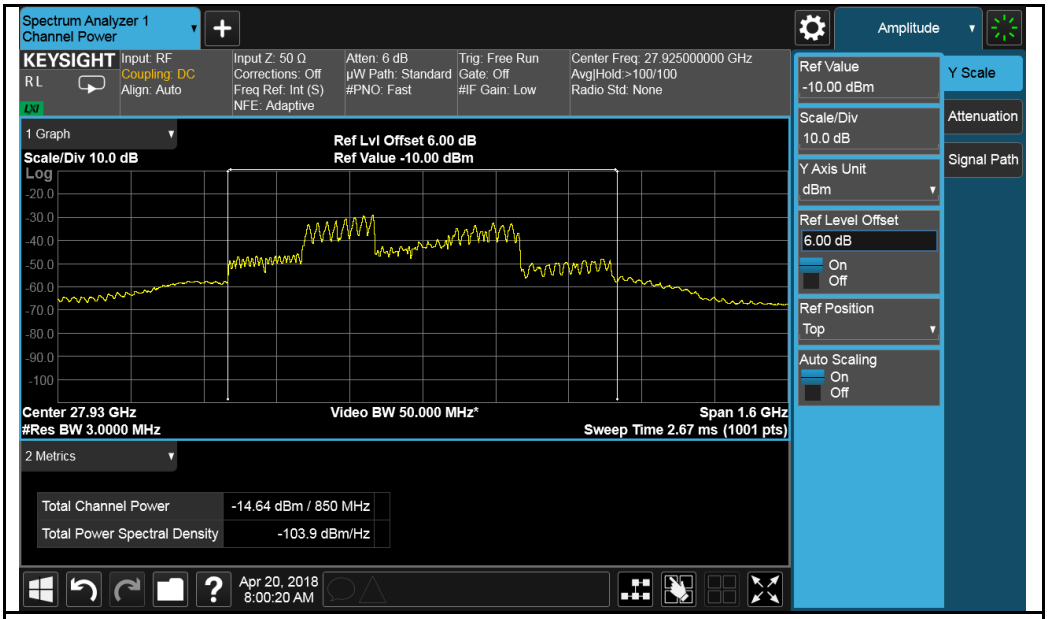
Test Plots



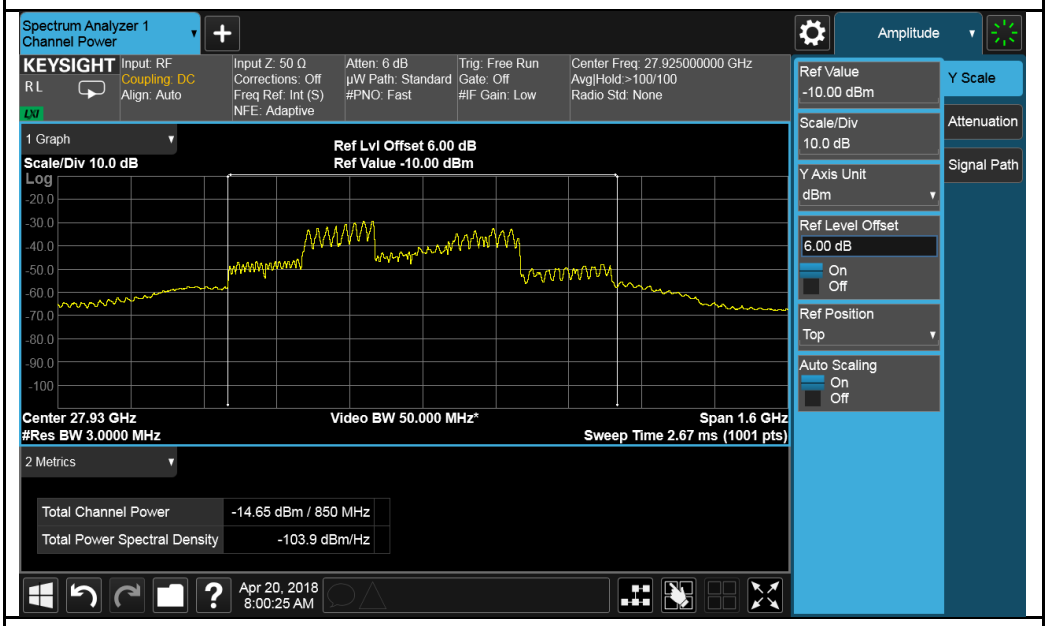
BPSK



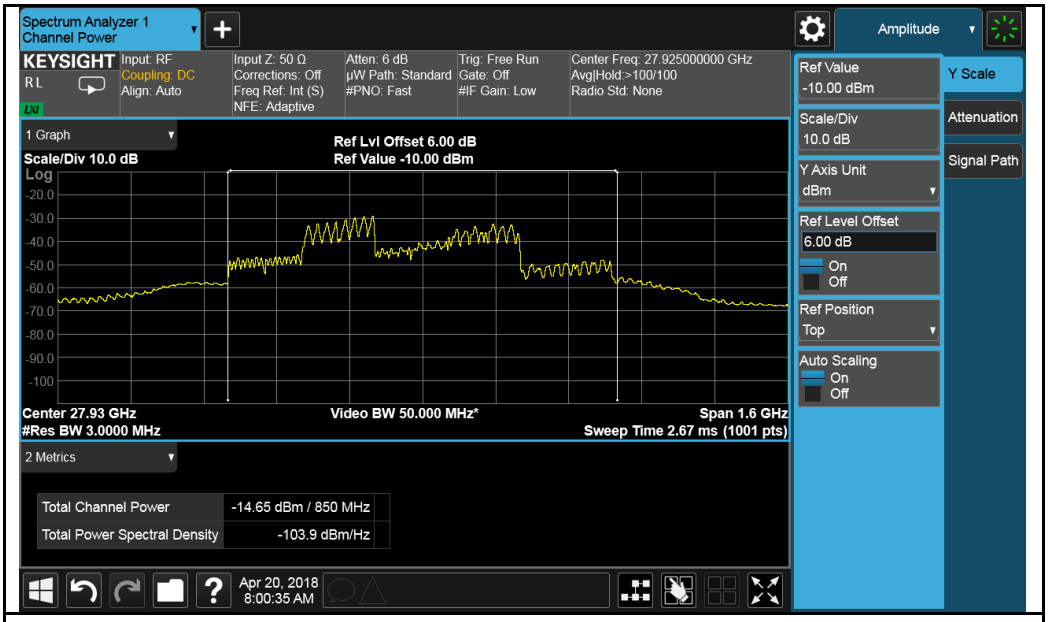
QPSK


Spectrum Analyzer 1
Channel Power
Amplitude
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 6 dB
µW Path: Standard
#PNO: Fast
Trig: Free Run
Gate: Off
#IF Gain: Low
Center Freq: 27.925000000 GHz
Avg|Hold:>100/100
Radio Std: None
1 Graph
Ref Lvl Offset 6.00 dB
Scale/Div 10.0 dB
Ref Value -10.00 dBm
Log
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100
Center 27.93 GHz
#Res BW 3.0000 MHz
Video BW 50.000 MHz*
Span 1.6 GHz
Sweep Time 2.67 ms (1001 pts)
2 Metrics
Total Channel Power
-14.64 dBm / 850 MHz
Total Power Spectral Density
-103.9 dBm/Hz
Apr 20, 2018
8:00:20 AM
Ref Value
-10.00 dBm
Scale/Div
10.0 dB
Y Axis Unit
dBm
Ref Level Offset
6.00 dB
On
Off
Ref Position
Top
Auto Scaling
On
Off
Y Scale
Attenuation
Signal Path

16QAM


Spectrum Analyzer 1
Channel Power
Amplitude
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 6 dB
µW Path: Standard
#PNO: Fast
Trig: Free Run
Gate: Off
#IF Gain: Low
Center Freq: 27.925000000 GHz
Avg|Hold:>100/100
Radio Std: None
1 Graph
Ref Lvl Offset 6.00 dB
Scale/Div 10.0 dB
Ref Value -10.00 dBm
Log
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100
Center 27.93 GHz
#Res BW 3.0000 MHz
Video BW 50.000 MHz*
Span 1.6 GHz
Sweep Time 2.67 ms (1001 pts)
2 Metrics
Total Channel Power
-14.65 dBm / 850 MHz
Total Power Spectral Density
-103.9 dBm/Hz
Apr 20, 2018
8:00:25 AM
Ref Value
-10.00 dBm
Scale/Div
10.0 dB
Y Axis Unit
dBm
Ref Level Offset
6.00 dB
On
Off
Ref Position
Top
Auto Scaling
On
Off
Y Scale
Attenuation
Signal Path

64QAM


Spectrum Analyzer 1
Channel Power
Amplitude
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
Atten: 6 dB
µW Path: Standard
#PNO: Fast
Trig: Free Run
Gate: Off
#IF Gain: Low
Center Freq: 27.925000000 GHz
Avg|Hold:>100/100
Radio Std: None
1 Graph
Ref Lvl Offset 6.00 dB
Ref Value -10.00 dBm
Scale/Div 10.0 dB
Log
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100
Center 27.93 GHz
#Res BW 3.0000 MHz
Video BW 50.000 MHz*
Span 1.6 GHz
Sweep Time 2.67 ms (1001 pts)
2 Metrics
Total Channel Power
-14.65 dBm / 850 MHz
Total Power Spectral Density
-103.9 dBm/Hz
Apr 20, 2018
8:00:35 AM
Ref Value
-10.00 dBm
Scale/Div
10.0 dB
Y Axis Unit
dBm
Ref Level Offset
6.00 dB
On
Off
Ref Position
Top
Auto Scaling
On
Off
Y Scale
Attenuation
Signal Path

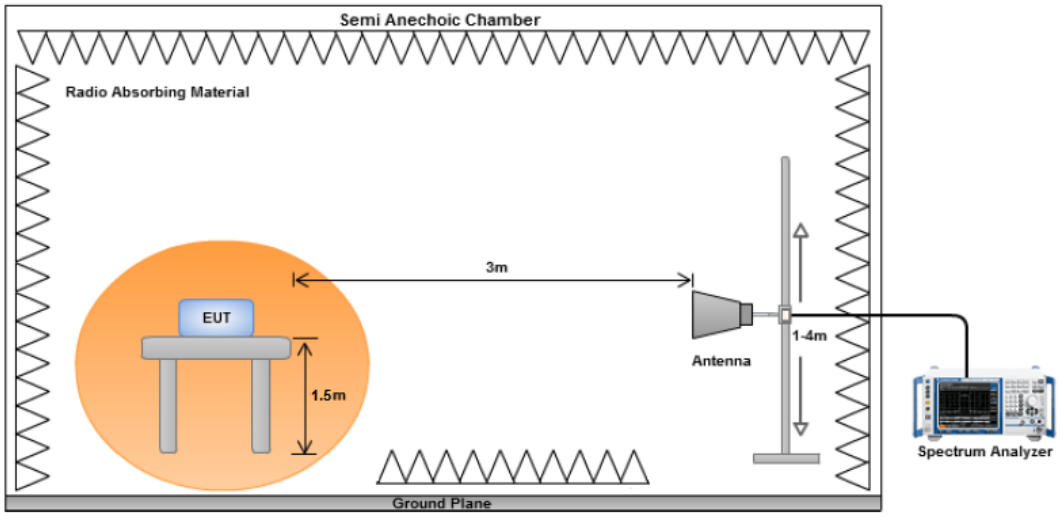
256QAM

10.5 Band Edge Emissions

Requirement(s):

Spec		Applicable
2.1051 30.203	All out of band emissions are measured in a radiated setup while the EUT is operating at its maximum duty cycle, at maxmum power, and at the appropriate frequencies. All modulations were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section. The minimum permissible attenuation level of any spurious emission is -13dBm/1MHz. However, in the bands immediately outside and adjacent to the licensee's frequency block, having a band width 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.	☒

Test Setup



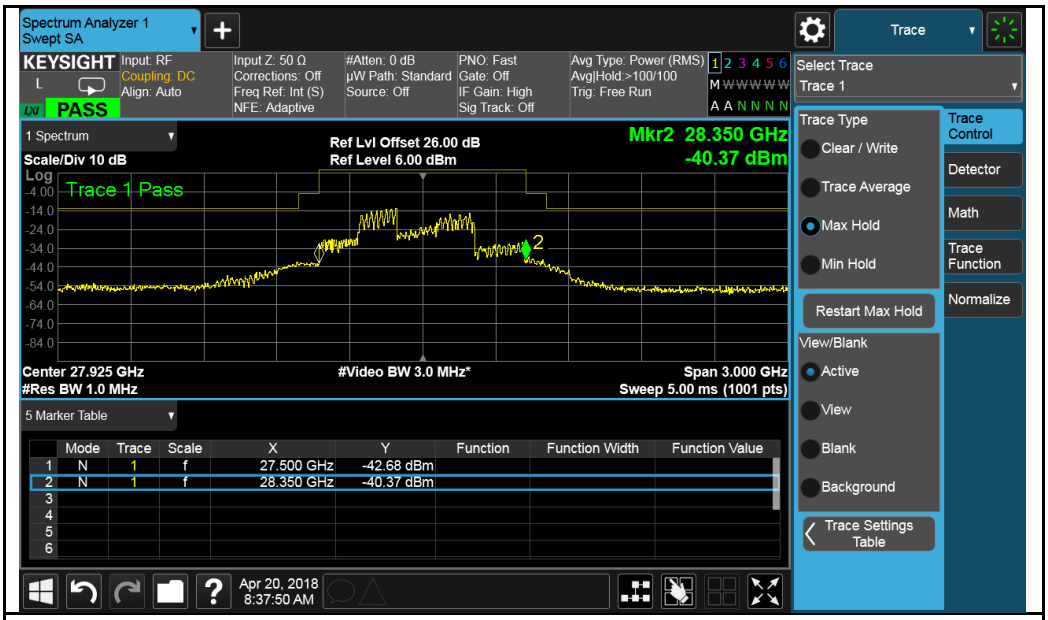
Test Procedure	ANSI C63.26-2015 Section 5.7.3 ANSI C63.26-2015 Section 6.4 - Start and stop frequency were set such that both upper and lower band edges are measured. - Span was set large enough so as to capture all out of band emissions near the band edge. - RBW = 1MHz - VBW >= 3 * RBW - Detector = RMS - Trigger is set to "free run" - Trace mode = trace averaging - Allow trace to fully stabilize.			
Test Date	04/17/2018-04/20/2018	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	22ºC 46% 1020mbar
Remark	The EUT was tested while positioned upright and mounted on a mast 1.5m height. The worst case emissions are reported with the EUT in this fixed position and with the modulations and active component carriers shown in the tables below. All measurements in this section was performed in the radiated setup in the far field. All appropriate Antenna Factor and Cable Loss have been applied in the spectrum analyzer for each measurement. Additionally, the conducted vand edge emissions were measured by subtractiog the EUT's antenna gain from the measured EIRP in the spectrum analyzer.			
Result	☒ Pass ☐ Fail			

Test Data ☐ Yes ☒ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Cipher at 10m chamber.

Test Plots

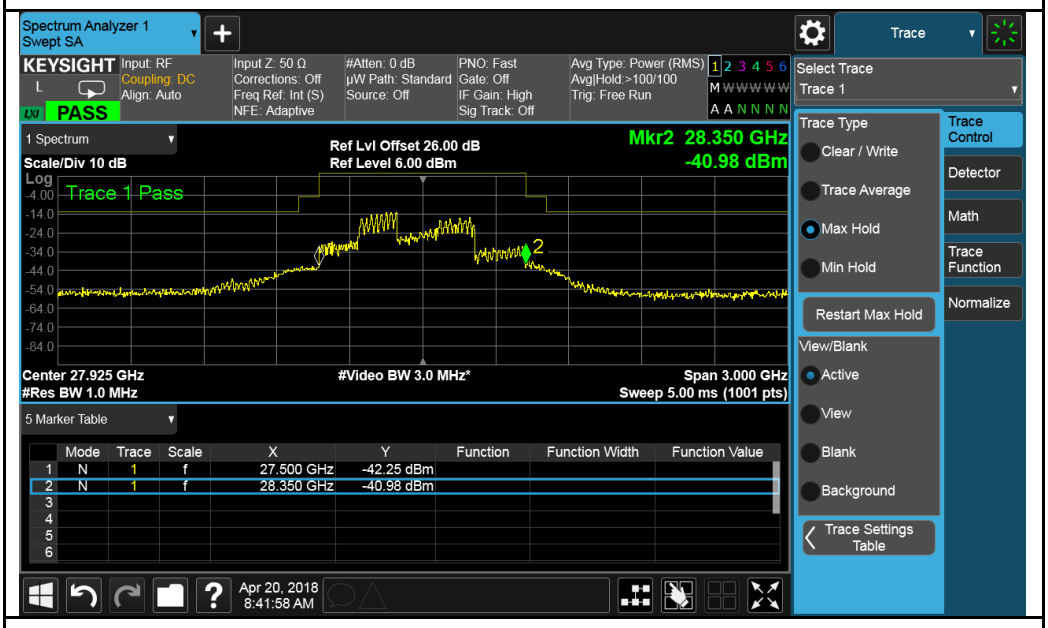


BPSK

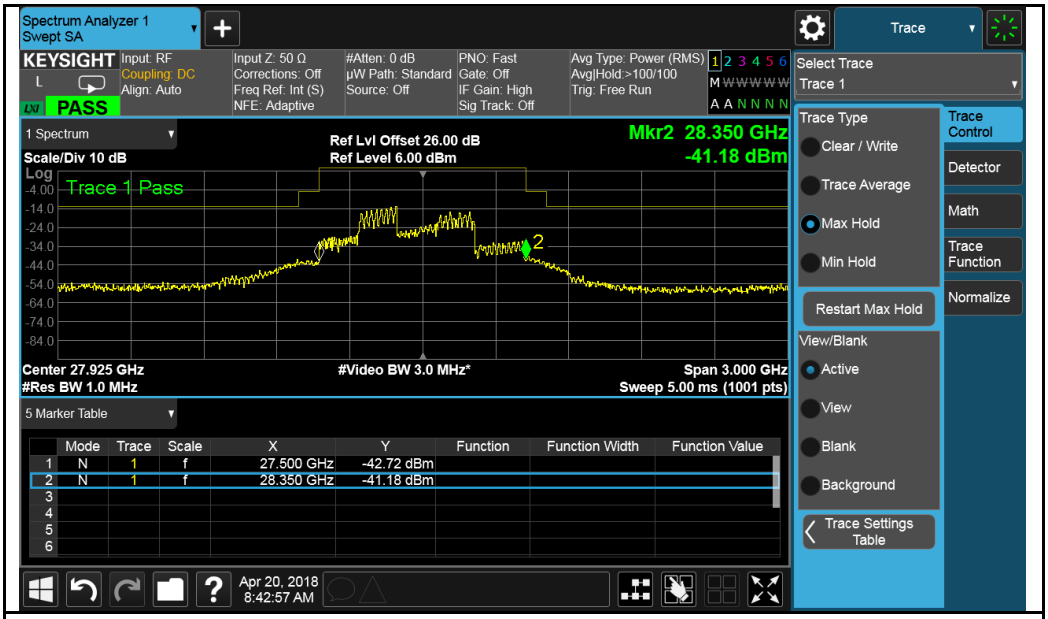
QPSK


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
#Atten: 0 dB
µW Path: Standard
Source: Off
PNO: Fast
Gate: Off
IF Gain: High
Sig Track: Off
Avg Type: Power (RMS)
Avg|Hold:>100/100
Trig: Free Run
PASS
1 Spectrum
Ref Lvl Offset 26.00 dB
Ref Level 6.00 dBm
Mkr2 28.350 GHz
-41.53 dBm
Scale/Div 10 dB
Log
Trace 1 Pass
Center 27.925 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz*
Span 3.000 GHz
Sweep 5.00 ms (1001 pts)
5 Marker Table
Mode Trace Scale X Y Function Function Width Function Value
1 N 1 f 27.500 GHz -42.24 dBm
2 N 1 f 28.350 GHz -41.53 dBm
Trace
Select Trace
Trace 1
Trace Type
Clear / Write
Trace Average
Max Hold
Min Hold
Restart Max Hold
View/Blank
Active
View
Blank
Background
Trace Settings Table
Trace Control
Detector
Math
Trace Function
Normalize
Apr 20, 2018
8:40:47 AM

16QAM


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
#Atten: 0 dB
µW Path: Standard
Source: Off
PNO: Fast
Gate: Off
IF Gain: High
Sig Track: Off
Avg Type: Power (RMS)
Avg|Hold:>100/100
Trig: Free Run
PASS
1 Spectrum
Ref Lvl Offset 26.00 dB
Ref Level 6.00 dBm
Mkr2 28.350 GHz
-40.98 dBm
Scale/Div 10 dB
Log
Trace 1 Pass
Center 27.925 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz*
Span 3.000 GHz
Sweep 5.00 ms (1001 pts)
5 Marker Table
Mode Trace Scale X Y Function Function Width Function Value
1 N 1 f 27.500 GHz -42.25 dBm
2 N 1 f 28.350 GHz -40.98 dBm
Trace
Select Trace
Trace 1
Trace Type
Clear / Write
Trace Average
Max Hold
Min Hold
Restart Max Hold
View/Blank
Active
View
Blank
Background
Trace Settings Table
Trace Control
Detector
Math
Trace Function
Normalize
Apr 20, 2018
8:41:58 AM

64QAM


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
PASS
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
#Atten: 0 dB
µW Path: Standard
Source: Off
PNO: Fast
Gate: Off
IF Gain: High
Sig Track: Off
Avg Type: Power (RMS)
Avg|Hold:>100/100
Trig: Free Run
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 26.00 dB
Ref Level 6.00 dBm
Mkr2 28.350 GHz
-41.18 dBm
Trace 1 Pass
Center 27.925 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz*
Span 3.000 GHz
Sweep 5.00 ms (1001 pts)
5 Marker Table
Mode Trace Scale X Y Function Function Width Function Value
1 N 1 f 27.500 GHz -42.72 dBm
2 N 1 f 28.350 GHz -41.18 dBm
Trace
Select Trace
Trace 1
Trace Type
Clear / Write
Trace Average
Max Hold
Min Hold
Restart Max Hold
View/Blank
Active
View
Blank
Background
Trace Settings Table
Trace Control
Detector
Math
Trace Function
Normalize
Apr 20, 2018
8:42:57 AM

256QAM

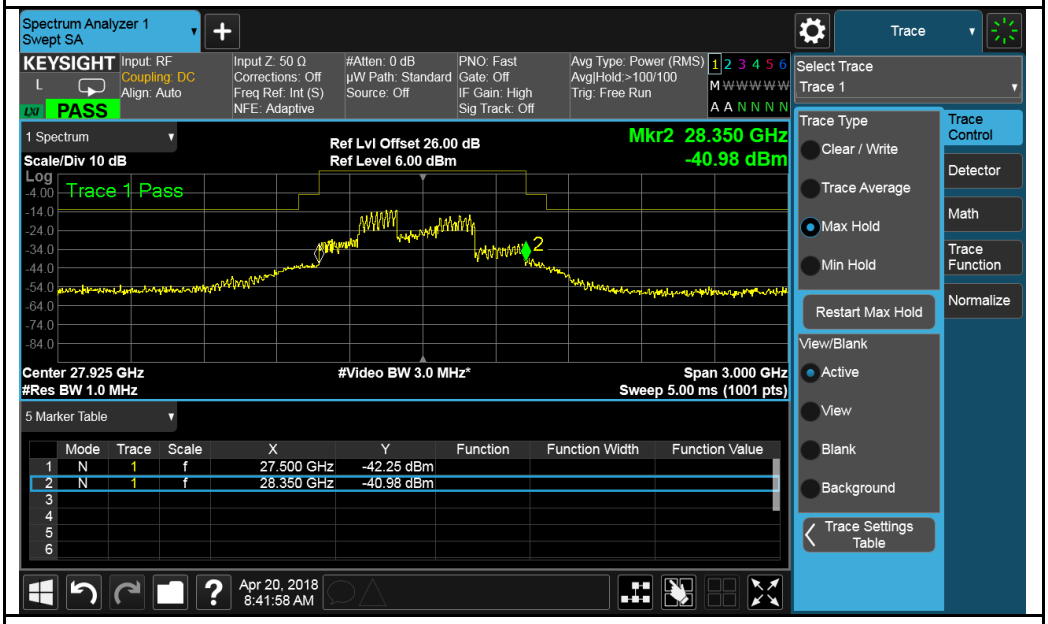
Left Side Edge

Right Side Edge

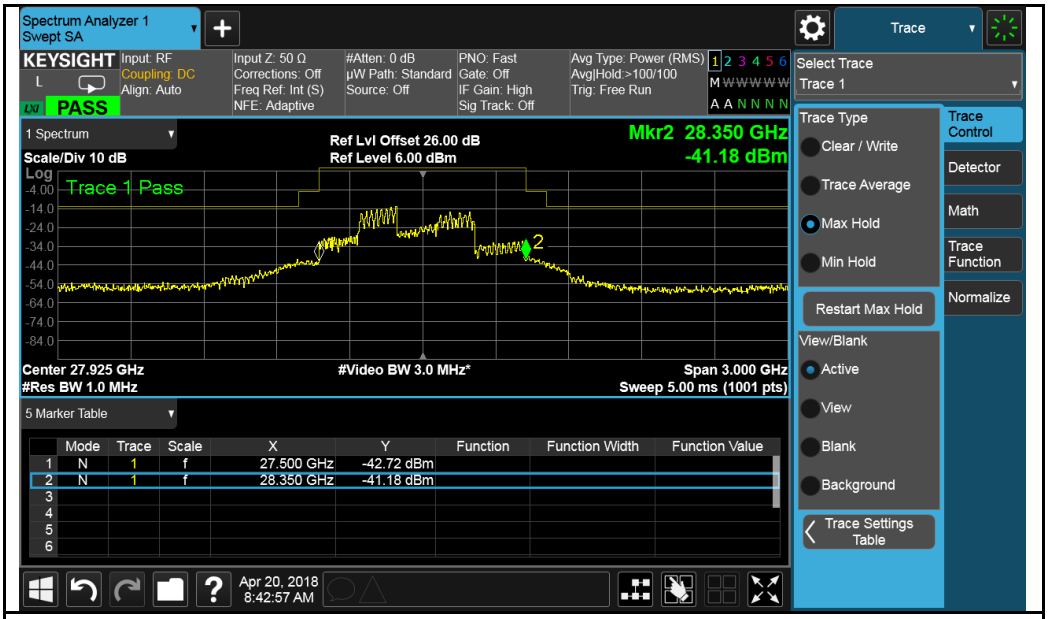
Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case per Hypercore. Raback unit has 3 Hypercores (40 degree sub-sectors) and each Hypercore with two polarization (H and V).
Left side edge and right side edge above show only the worst modulation BPSK.


Spectrum Analyzer 1
Swept SA
KEYSIGHT
PASS
Trace
Select Trace
Trace 1
Trace Type
Clear / Write
Trace Average
Max Hold
Min Hold
Restart Max Hold
View/Blank
Active
View
Blank
Background
Trace Settings Table
Trace Control
Detector
Math
Trace Function
Normalize
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 26.00 dB
Ref Level 6.00 dBm
Mkr2 28.350 GHz
-41.53 dBm
Trace 1 Pass
Center 27.925 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz*
Span 3.000 GHz
Sweep 5.00 ms (1001 pts)
5 Marker Table
Mode Trace Scale X Y Function Function Width Function Value
1 N 1 f 27.500 GHz -42.24 dBm
2 N 1 f 28.350 GHz -41.53 dBm
Apr 20, 2018
8:40:47 AM

16QAM


Spectrum Analyzer 1
Swept SA
KEYSIGHT
PASS
Trace
Select Trace
Trace 1
Trace Type
Clear / Write
Trace Average
Max Hold
Min Hold
Restart Max Hold
View/Blank
Active
View
Blank
Background
Trace Settings Table
Trace Control
Detector
Math
Trace Function
Normalize
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 26.00 dB
Ref Level 6.00 dBm
Mkr2 28.350 GHz
-40.98 dBm
Trace 1 Pass
Center 27.925 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz*
Span 3.000 GHz
Sweep 5.00 ms (1001 pts)
5 Marker Table
Mode Trace Scale X Y Function Function Width Function Value
1 N 1 f 27.500 GHz -42.25 dBm
2 N 1 f 28.350 GHz -40.98 dBm
Apr 20, 2018
8:41:58 AM

64QAM

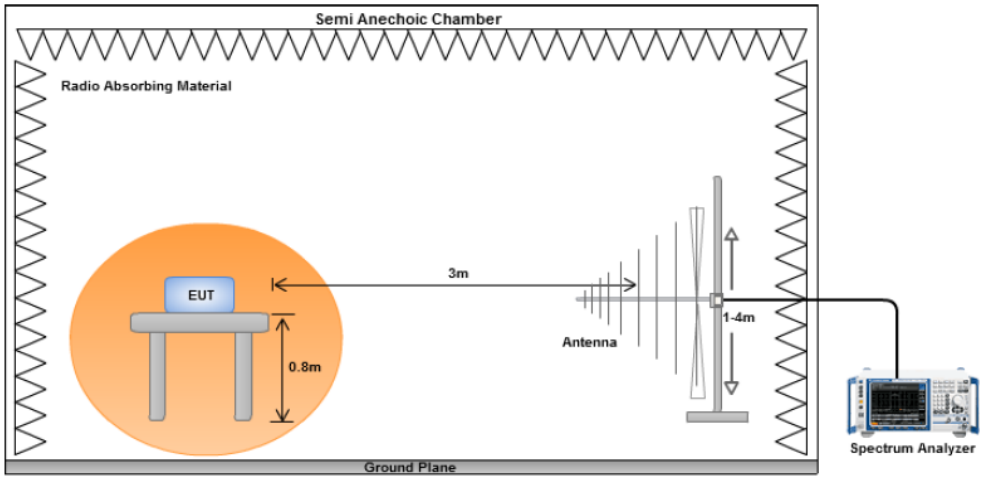
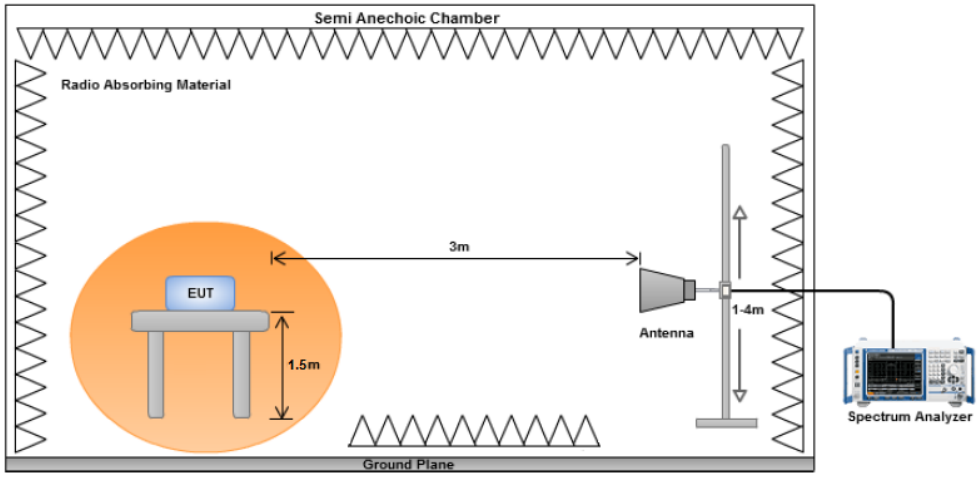


256QAM

Note: Each Hypercore cannot transmit at the same frequency simultaneously, so the testing result shown as the worst case.

10.6 Radiated Spurious and Harmonic Emissions

Requirement(s):

Spec		Applicable
2.1051 30.230	Out of band emissions were scanned from 30MHz to 100GHz in a radiated test setup with the EUT operating at maximum duty cycle and power. Spurious emission plots were obtained for Low, Mid and High operating channels.All modulations were investigated to determine worst case condition. The conductive power or total radiate power of any emissions outside a licensee's frequency block shall be -13dBm/1HMz.	☒
Below 1G Test Setup		
Above 1G Test Setup		
Procedure	1. The EUT was switched on and allowed to warm up to its normal operating condition. 2. The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner: a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen. b. The EUT was then rotated to the direction that gave the maximum emission. c. Finally, the antenna height was adjusted to the height that gave the maximum emission. 3. An average measurement was then made for that frequency point. 4. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.	
Remark	The EUT was tested while positioned upright and mounted on a mast 1.5m height. The worst case emissions are reported with the EUT in this fixed position and with the modulations and active component carriers shown in the tables below. Emissions below 18GHz were measured at a 3 meter test distance, while emissions above 18GHz were	

	measured at the appropriate far field distance. All appropriate Antenna Factor and Cable Loss have been applied in the spectrum analyzer for each measurement. All the emissions list the worst case.
Result	☒ Pass ☐ Fail

Test Data ☒ Yes (See below) ☐ N/A
Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Cipher at 10m chamber.

Radiated Emission Test Results (Below 1GHz)

Test specification	below 1GHz			
Environmental Conditions:	Temp (°C):	23	Result	Pass
	Humidity (%)	46		
	Atmospheric (mbar):	1018		
Mains Power:	120VAC, 60Hz			
Tested by:	Cipher			
Test Date:	04/17/2018-04/20/2018			
Remarks:	BPSK			

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
52	-31.69	240	168	V	52	-30.89	0	0.58	-31.47	-13	-18.47
52	-29.28	169	179	H	52	-28.48	0	0.58	-29.06	-13	-16.06
120	-39.54	267	171	V	120	-32.74	0	0.58	-33.32	-13	-20.32
120	-41.75	156	158	H	120	-34.95	0	0.58	-35.53	-13	-22.53
240	-35.26	271	172	V	240	-28.46	0	0.58	-29.04	-13	-16.04
240	-35.72	152	163	H	240	-28.92	0	0.58	-29.5	-13	-16.5

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case per Hypercore. Raback unit has 3 Hypercores (40 degree sub-sectors) and each Hypercore with two polarization (H and V).
Note: Each Hypercore cannot transmit at the same frequency simultaneously, so the testing result shown as the worst case.

Radiated Emission Test Results (Above 1GHz)
1G-40G

BPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
6909	-61.96	181	159	V	6909	-45.66	10.16	3.08	-38.58	-13	-25.58
6909	-57.71	271	157	H	6909	-41.41	10.16	3.08	-34.33	-13	-21.33
11386	-62.51	215	155	V	11386	-56.91	11.54	4.9	-50.27	-13	-37.27
11386	-65.1	271	170	H	11386	-59.5	11.54	4.9	-52.86	-13	-39.86

QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
6981	-57.65	268	156	V	6981	-41.35	10.16	3.08	-34.27	-13	-21.27
6981	-62.24	217	154	H	6981	-45.94	10.16	3.08	-38.86	-13	-25.86
11268	-64.7	270	171	V	11268	-59.1	11.54	4.9	-52.46	-13	-39.46
11268	-65.51	148	161	H	11268	-59.91	11.54	4.9	-53.27	-13	-40.27

16QAM

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
6951	-62.17	181	159	V	6951	-45.87	10.16	3.08	-38.79	-13	-25.79
6951	-58.22	273	156	H	6951	-41.92	10.16	3.08	-34.84	-13	-21.84
11411	-62.72	217	154	V	11411	-57.12	11.54	4.9	-50.48	-13	-37.48
11411	-64.93	270	173	H	11411	-59.33	11.54	4.9	-52.69	-13	-39.69

64QAM

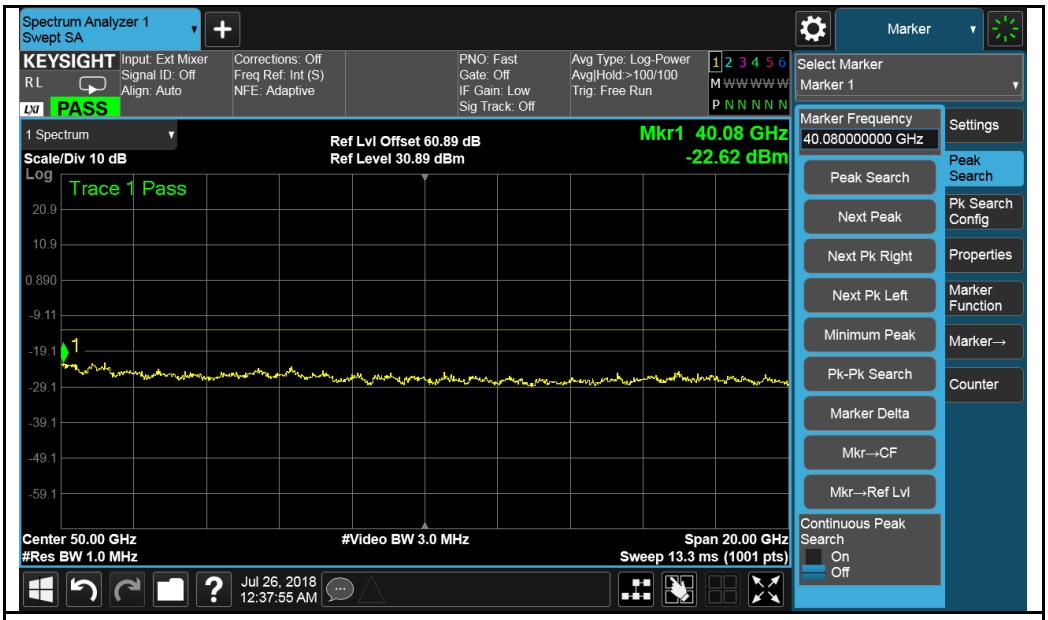
Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
6933	-58.24	271	160	V	6933	-41.94	10.16	3.08	-34.86	-13	-21.86
6933	-62.85	215	157	H	6933	-46.55	10.16	3.08	-39.47	-13	-26.47
11456	-65.03	270	170	V	11456	-59.43	11.54	4.9	-52.79	-13	-39.79
11456	-65.77	148	163	H	11456	-60.17	11.54	4.9	-53.53	-13	-40.53

256QAM

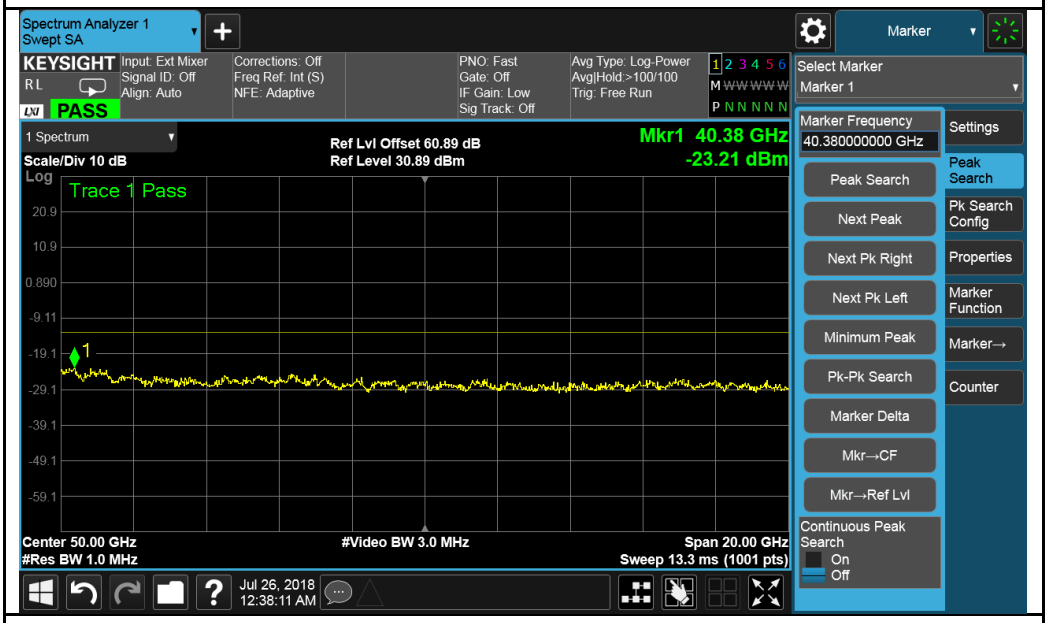
Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
6911	-59.99	146	172	V	6911	-43.69	10.16	3.08	-36.61	-13	-23.61
6911	-62.29	183	160	H	6911	-45.99	10.16	3.08	-38.91	-13	-25.91
12001	-58.38	271	157	V	12001	-52.78	11.54	4.9	-46.14	-13	-33.14
12001	-62.09	219	155	H	12001	-56.49	11.54	4.9	-49.85	-13	-36.85

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case per Hypercore. Raback unit has 3 Hypercores (40 degree sub-sectors) and each Hypercore with two polarization (H and V).
Note: Each Hypercore cannot transmit at the same frequency simultaneously, so the testing result shown as the worst case.

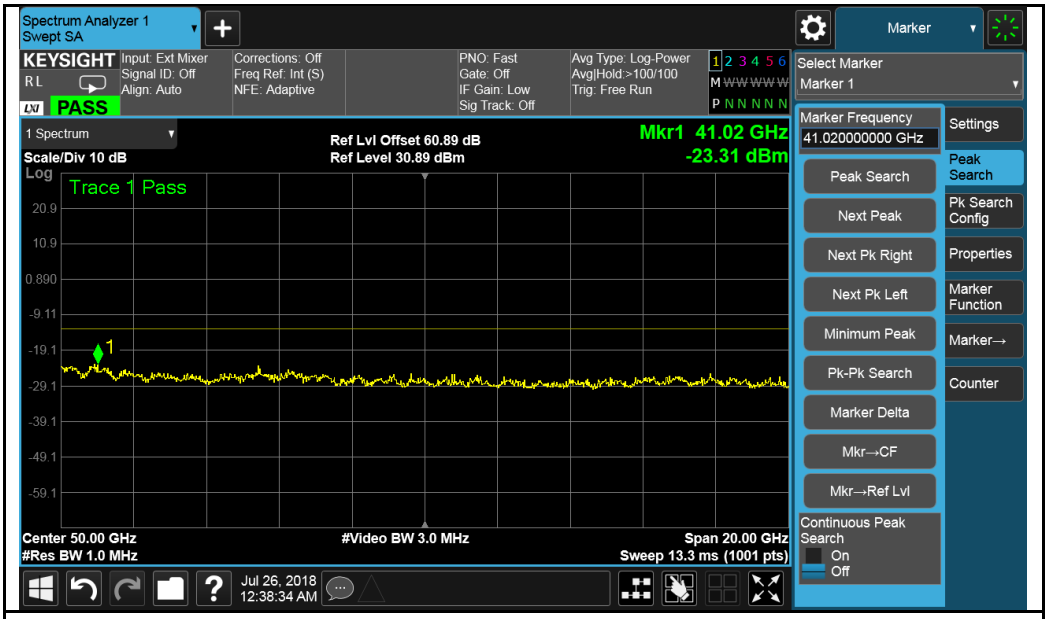
Test Plots
40G – 60G



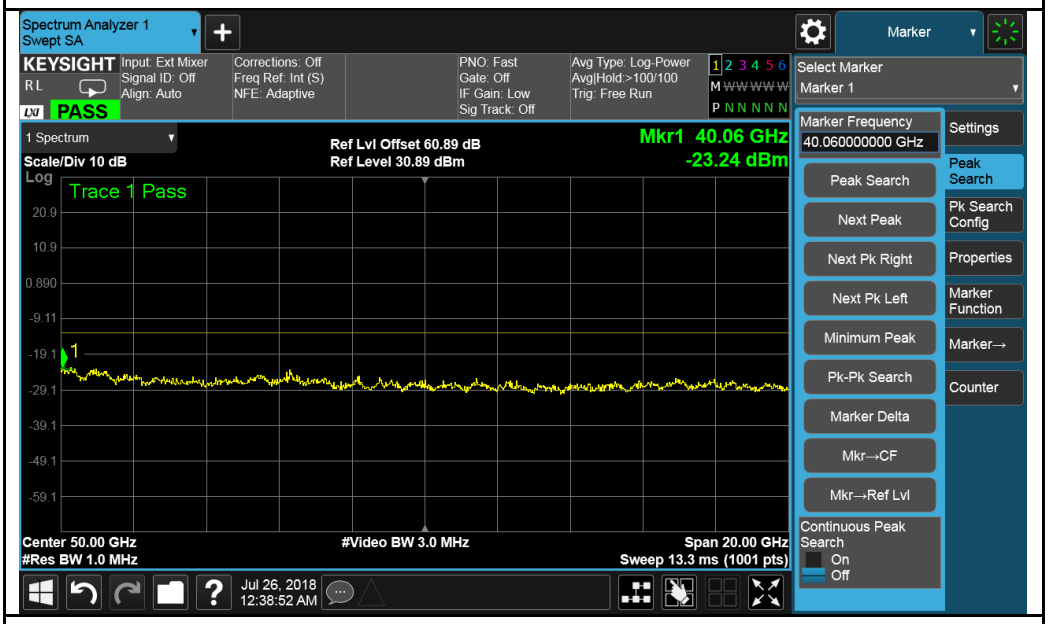
BPSK



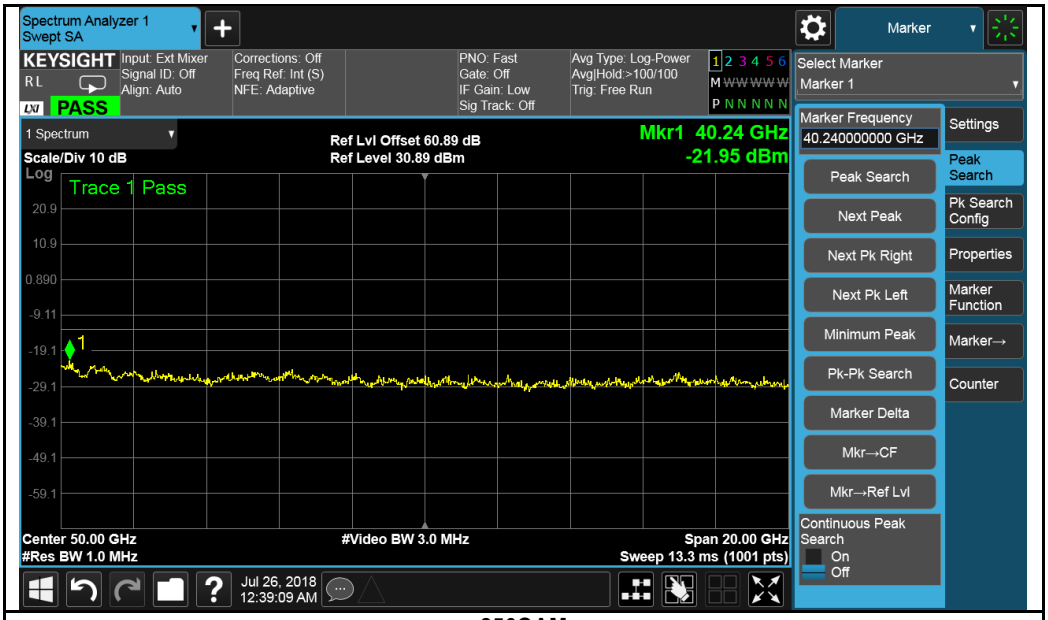
QPSK


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: Ext Mixer
Signal ID: Off
Align: Auto
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
PASS
1 Spectrum
Ref Lvl Offset 60.89 dB
Ref Level 30.89 dBm
Mkr1 41.02 GHz
-23.31 dBm
Scale/Div 10 dB
Log
Trace 1 Pass
Center 50.00 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Span 20.00 GHz
Sweep 13.3 ms (1001 pts)
Jul 26, 2018
12:38:34 AM
Marker
Select Marker
Marker 1
Marker Frequency
41.020000000 GHz
Settings
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Pk Search Config
Properties
Marker Function
Marker→
Counter

16QAM

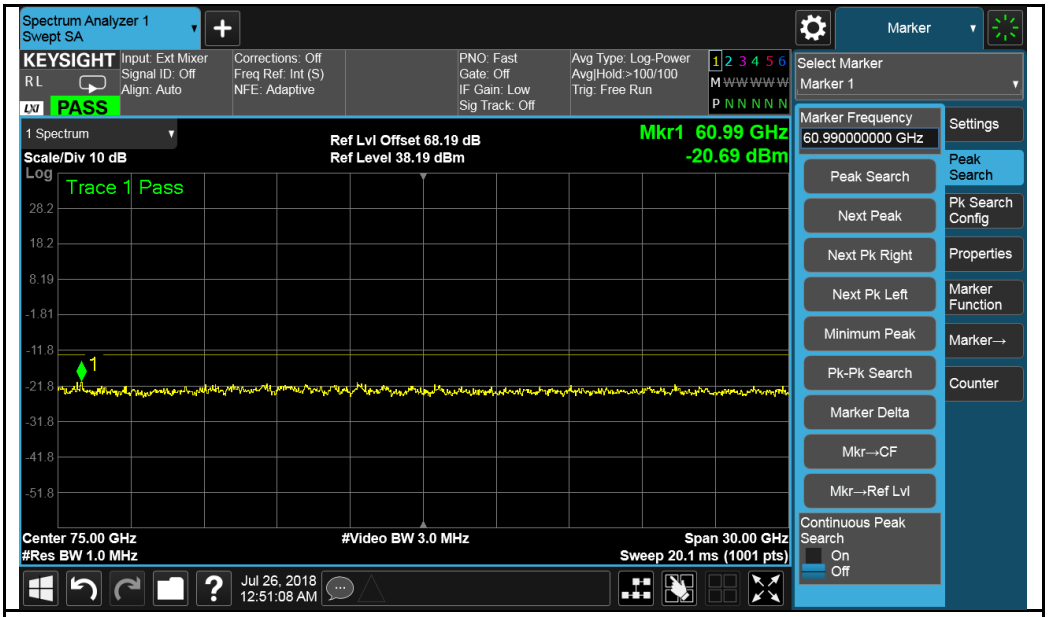

Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: Ext Mixer
Signal ID: Off
Align: Auto
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
PASS
1 Spectrum
Ref Lvl Offset 60.89 dB
Ref Level 30.89 dBm
Mkr1 40.06 GHz
-23.24 dBm
Scale/Div 10 dB
Log
Trace 1 Pass
Center 50.00 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Span 20.00 GHz
Sweep 13.3 ms (1001 pts)
Jul 26, 2018
12:38:52 AM
Marker
Select Marker
Marker 1
Marker Frequency
40.060000000 GHz
Settings
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Pk Search Config
Properties
Marker Function
Marker→
Counter

64QAM

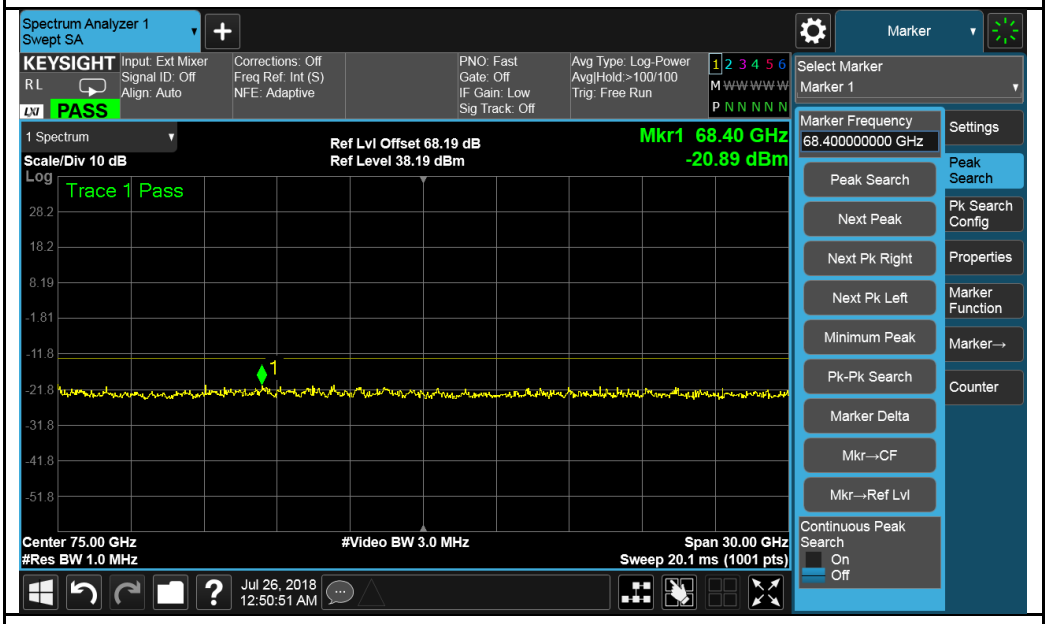

Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: Ext Mixer
Signal ID: Off
Align: Auto
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
PASS
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 60.89 dB
Ref Level 30.89 dBm
Mkr1 40.24 GHz
-21.95 dBm
Log
Trace 1 Pass
20.9
10.9
0.890
-9.11
-19.1
-29.1
-39.1
-49.1
-59.1
Center 50.00 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Span 20.00 GHz
Sweep 13.3 ms (1001 pts)
Jul 26, 2018
12:39:09 AM
Marker
Select Marker
Marker 1
Marker Frequency
40.240000000 GHz
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Settings
Peak Search
Pk Search Config
Properties
Marker Function
Marker→
Counter

256QAM

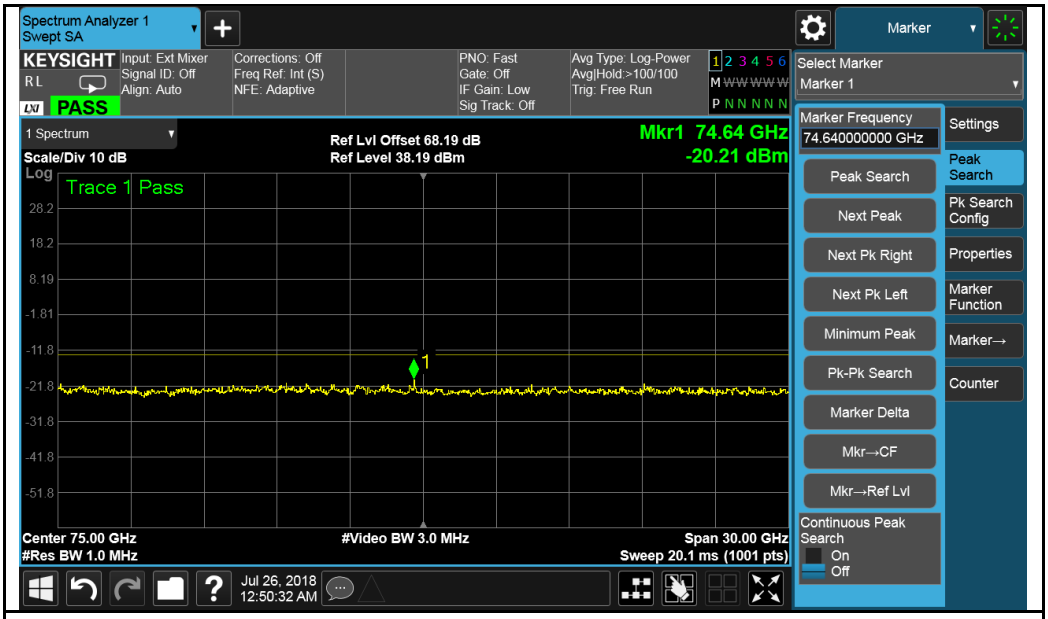
60G – 90G



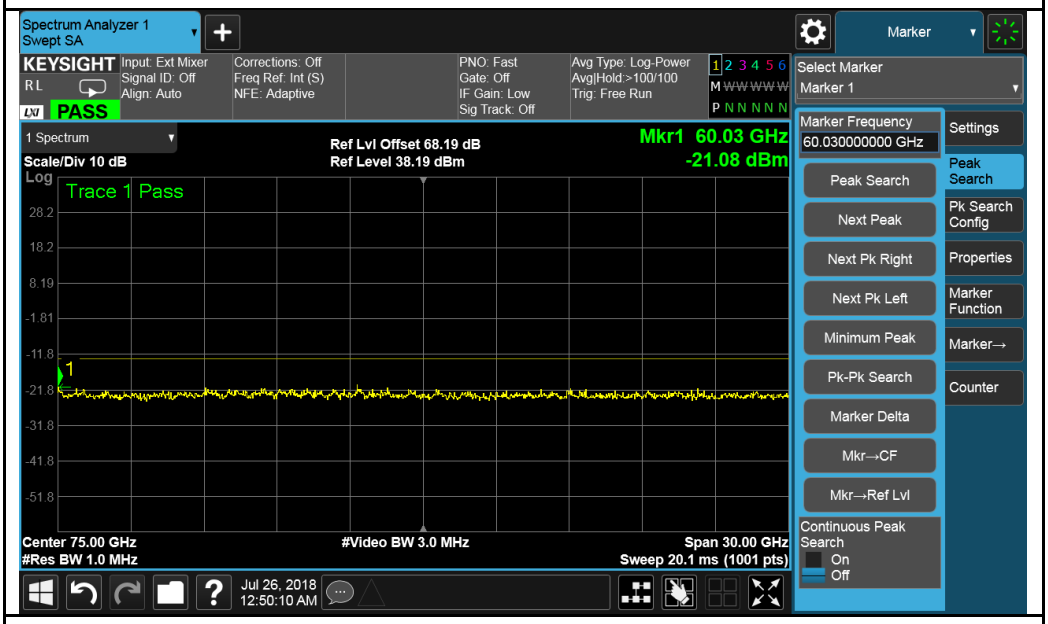
BPSK



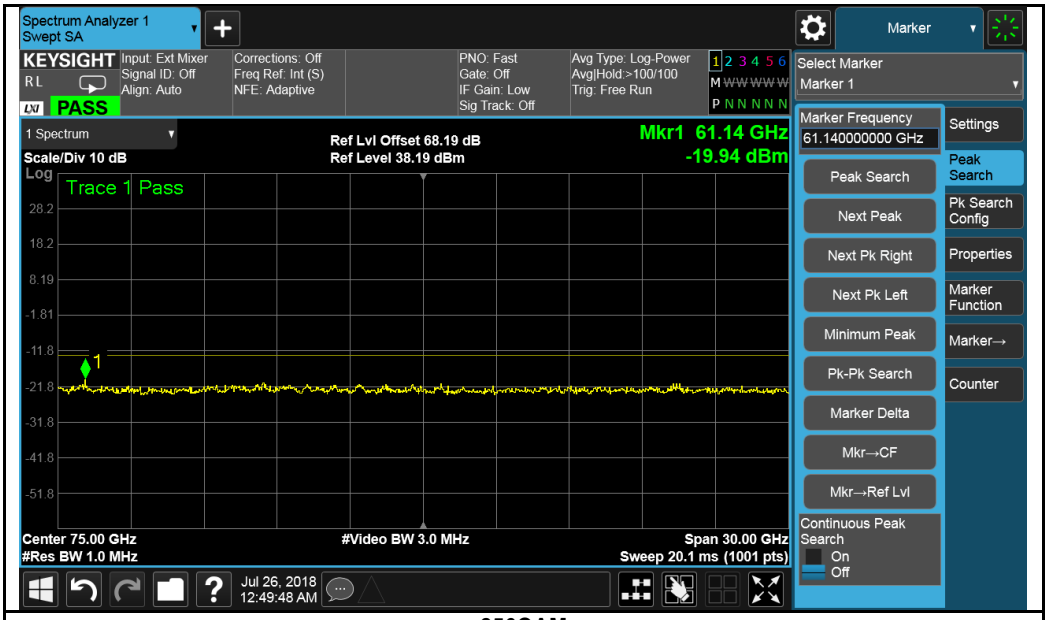
QPSK


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: Ext Mixer
Signal ID: Off
Align: Auto
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
PASS
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 68.19 dB
Ref Level 38.19 dBm
Mkr1 74.64 GHz
-20.21 dBm
Trace 1 Pass
Center 75.00 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Span 30.00 GHz
Sweep 20.1 ms (1001 pts)
Jul 26, 2018
12:50:32 AM
Marker
Select Marker
Marker 1
Marker Frequency
74.640000000 GHz
Settings
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Pk Search Config
Properties
Marker Function
Marker→
Counter

16QAM

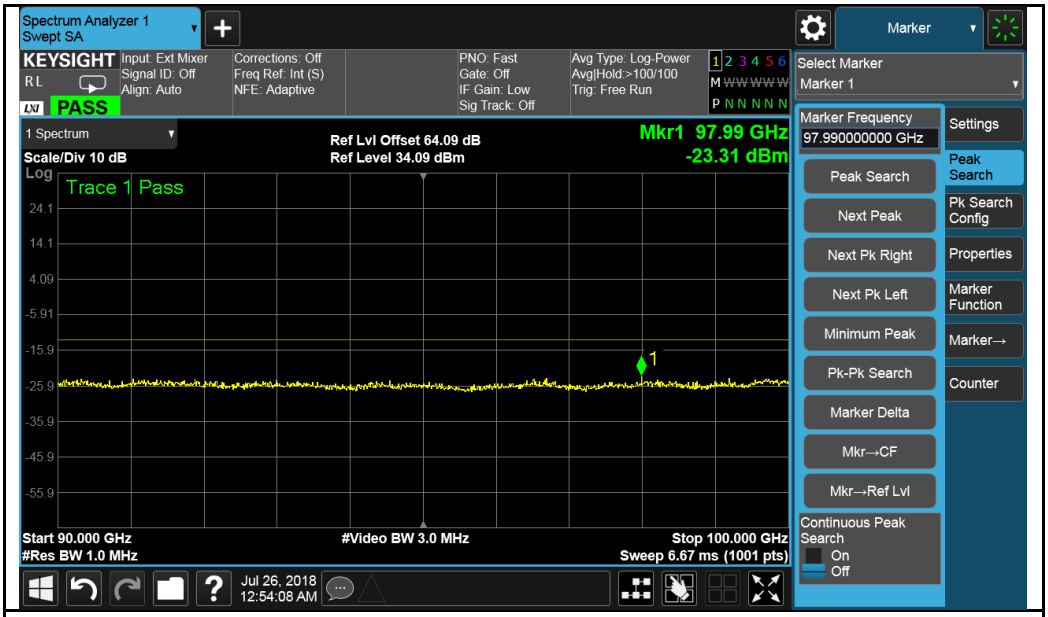

Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: Ext Mixer
Signal ID: Off
Align: Auto
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
PASS
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 68.19 dB
Ref Level 38.19 dBm
Mkr1 60.03 GHz
-21.08 dBm
Trace 1 Pass
Center 75.00 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Span 30.00 GHz
Sweep 20.1 ms (1001 pts)
Jul 26, 2018
12:50:10 AM
Marker
Select Marker
Marker 1
Marker Frequency
60.030000000 GHz
Settings
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Pk Search Config
Properties
Marker Function
Marker→
Counter

64QAM

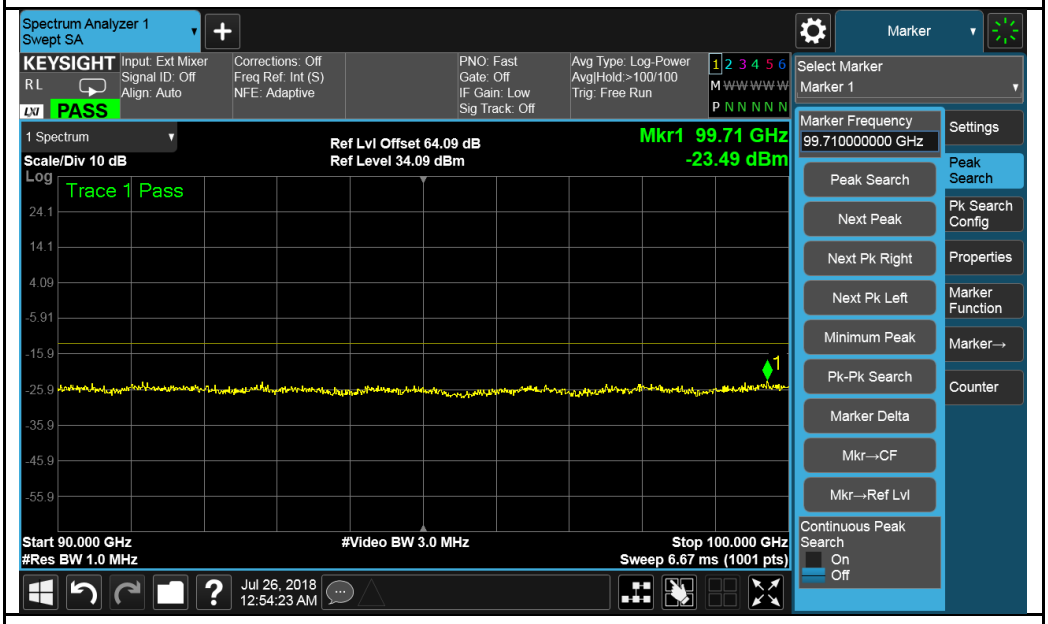

Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: Ext Mixer
Signal ID: Off
Align: Auto
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
PASS
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 68.19 dB
Ref Level 38.19 dBm
Mkr1 61.14 GHz
-19.94 dBm
Log
Trace 1 Pass
28.2
18.2
8.19
-1.81
-11.8
-21.8
-31.8
-41.8
-51.8
Center 75.00 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Span 30.00 GHz
Sweep 20.1 ms (1001 pts)
Jul 26, 2018
12:49:48 AM
Marker
Select Marker
Marker 1
Marker Frequency
61.140000000 GHz
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Settings
Peak Search
Pk Search Config
Properties
Marker Function
Marker→
Counter

256QAM

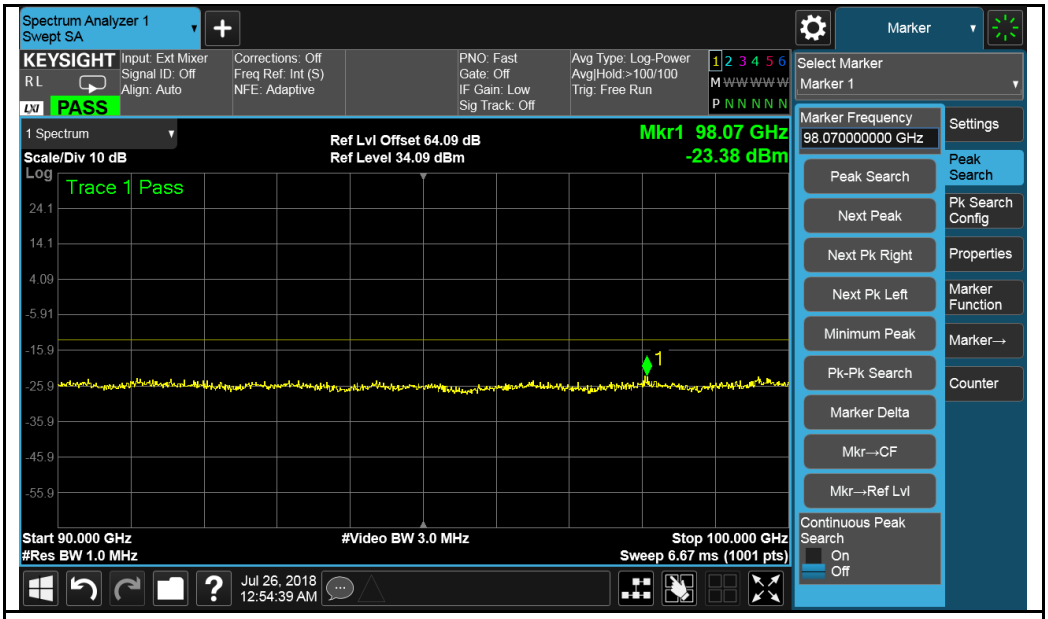
90G – 100G



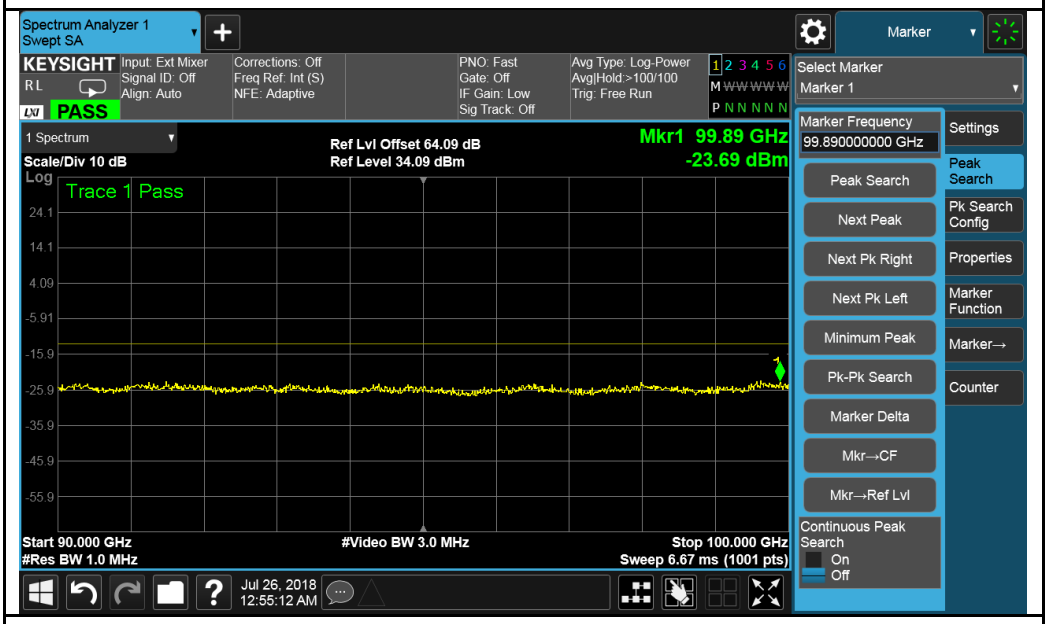
BPSK



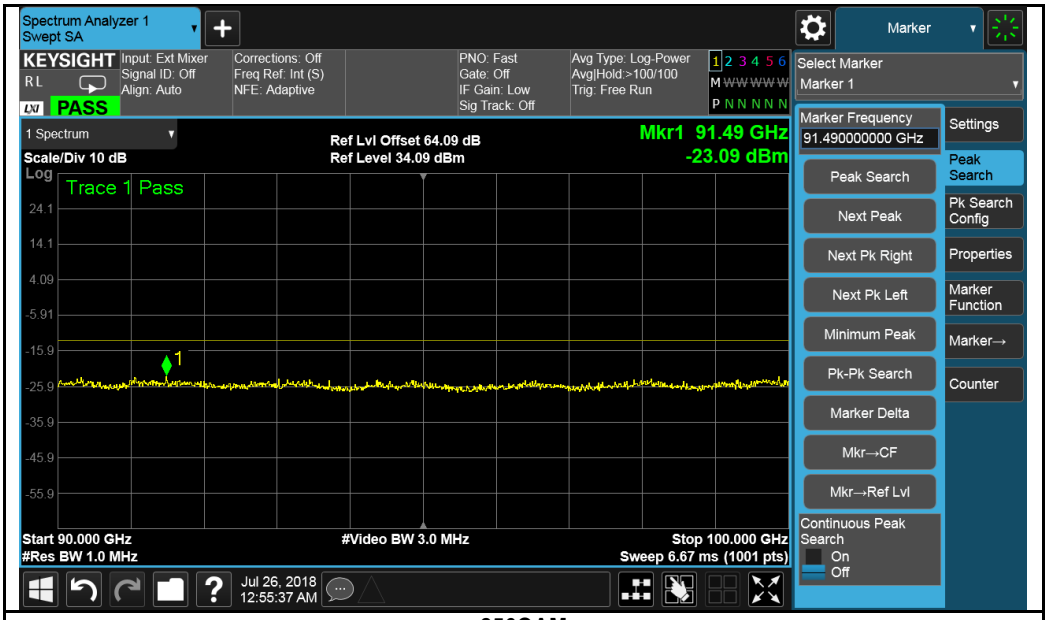
QPSK


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: Ext Mixer
Signal ID: Off
Align: Auto
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
PASS
1 Spectrum
Ref Lvl Offset 64.09 dB
Ref Level 34.09 dBm
Mkr1 98.07 GHz
-23.38 dBm
Scale/Div 10 dB
Log
Trace 1 Pass
24.1
14.1
4.09
-5.91
-15.9
-25.9
-35.9
-45.9
-55.9
Start 90.000 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Stop 100.000 GHz
Sweep 6.67 ms (1001 pts)
Jul 26, 2018
12:54:39 AM
Marker
Select Marker
Marker 1
Marker Frequency
98.070000000 GHz
Settings
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Pk Search Config
Properties
Marker Function
Marker→
Counter

16QAM


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: Ext Mixer
Signal ID: Off
Align: Auto
Corrections: Off
Freq Ref: Int (S)
NFE: Adaptive
PNO: Fast
Gate: Off
IF Gain: Low
Sig Track: Off
Avg Type: Log-Power
Avg|Hold:>100/100
Trig: Free Run
PASS
1 Spectrum
Ref Lvl Offset 64.09 dB
Ref Level 34.09 dBm
Mkr1 99.89 GHz
-23.69 dBm
Scale/Div 10 dB
Log
Trace 1 Pass
24.1
14.1
4.09
-5.91
-15.9
-25.9
-35.9
-45.9
-55.9
Start 90.000 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz
Stop 100.000 GHz
Sweep 6.67 ms (1001 pts)
Jul 26, 2018
12:55:12 AM
Marker
Select Marker
Marker 1
Marker Frequency
99.890000000 GHz
Settings
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Minimum Peak
Pk-Pk Search
Marker Delta
Mkr→CF
Mkr→Ref Lvl
Continuous Peak Search
On
Off
Pk Search Config
Properties
Marker Function
Marker→
Counter

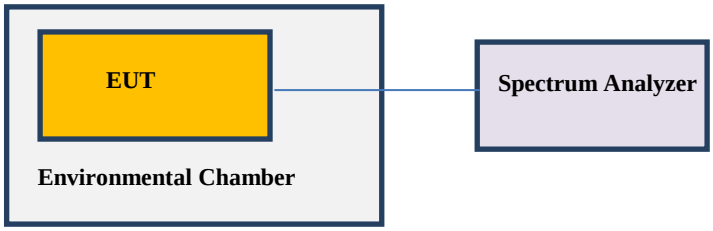
64QAM



256QAM

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case per Hypercore. Raback unit has 3 Hypercores (40 degree sub-sectors) and each Hypercore with two polarization (H and V).
Note: Mixers loss, cable loss, distance factor has been calculated, put in the offset.
Note: Each Hypercore cannot transmit at the same frequency simultaneously, so the testing result shown as the worst case.

10.7 Frequency Stability

Spec				Applicable
2.1055	Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015. The Frequency stability of the transmitter is measured by: a. Temperature: The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber. b. Primary Supply Voltage: The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.			☒
Test Setup				
Procedure	ANSI C63.26-2015 Section 5.6 1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference). 2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter. 3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.			
Test Date	04/17/2018-04/20/2018	Environmental condition	Temperature 25 °C Relative Humidity 31.5 % Atmospheric Pressure 1019 mbar	
Remark	The EUTwas measured using horn antenna connected to a spectrum analyzer. The EUT was placed inside an environmental chamber.			
Result	☒ Pass ☐ Fail			

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☐ Yes (See below) ☒ N/A

Test was done by Cipher at RF test site.

Test Results:

Type	Condition	Voltage	Nominal Frequency (Hz)	Measured Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
Center frequency	Norm Temp	Vnorm	27930000000	27930001284	1284	0.0000046
	Norm Temp	Vmax	27930000000	27930001284	1284	0.0000046
	Norm Temp	Vmin	27930000000	27930001284	1284	0.0000046
	Low Temp	Vnorm	27930000000	27930000779	779	0.0000028
	Low Temp	Vmax	27930000000	27930000779	779	0.0000028
	Low Temp	Vmin	27930000000	27930001623	1623	0.0000058
	High Temp	Vnorm	27930000000	27930001455	1455	0.0000052
	High Temp	Vmax	27930000000	27930001455	1455	0.0000052
	High Temp	Vmin	27930000000	27930000769	769	0.0000027

Note: Based on the results of the frequency stability test at the center channel the frequency deviation results measured are very small. AS such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deciation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Cycle	Cal Due	In use
Radiated Emissions						
Keysight EXA 44GHz Spectrum Analyzer	N9010A	MY51440112	11/02/2017	1 Year	11/02/2018	☑
Pre-Amplifier	SAS-474	579	05/04/2017	1 Year	05/04/2018	☑
Preamplifier (100KHz-7GHz)	LPA-6-30	11170602	02/09/2018	1 Year	02/09/2019	☑
Bi-Log antenna (30MHz~2GHz)	JB1	A030702	01/13/2018	1 Year	01/13/2019	☑
Horn Antenna (1-26.5GHz)	3115	10SL0059	08/11/2017	1 Year	08/11/2018	☑
Horn Antenna (18-40GHz)	SAS-574	579	05/04/2017	1 Year	05/04/2018	☑
Horn Antenna (40 – 60GHz)	M19HWA	170811-1	08/11/2017	1 Year	08/11/2018	☑
Horn Antenna (60 – 90GHz)	M12HWA	170811-1	08/11/2017	1 Year	08/11/2018	☑
Horn Antenna (90 – 140GHz)	M08HWA	170811-1	08/11/2017	1 Year	08/11/2018	☑
Tuned Dipole Antenna 30 - 1000 MHz (4pcs set)	AD-100	40133	03/08/2018	1 Year	03/8/2019	☑
Highpass filter	WR-12	51346340	03/21/2018	1 Year	04/21/2019	☑
Test Equity Environment Chamber	1007H	61201	10/21/2017	1 Year	10/21/2018	☑

Annex B. SIEMIC Accreditation

Accreditations	Document	Scope / Remark
ISO 17025 (A2LA)		Please see the documents for the detailed scope
ISO Guide 65 (A2LA)		Please see the documents for the detailed scope
TCB Designation		A1, A2, A3, A4, B1, B2, B3, B4, C
FCC DoC Accreditation		FCC Declaration of Conformity Accreditation
FCC Site Registration		3 meter site
FCC Site Registration		10 meter site
IC Site Registration		3 meter site
IC Site Registration		10 meter site
EU NB		**Radio & Telecommunications Terminal Equipment:** EN45001 – EN ISO/IEC 17025
		Electromagnetic Compatibility: EN45001 – EN ISO/IEC 17025
Singapore iDA CB(Certification Body)		Phase I, Phase II
Vietnam MIC CAB Accreditation		Please see the document for the detailed scope
Hong Kong OFCA		**(Phase II)** OFCA Foreign Certification Body for Radio and Telecom
		(Phase I) Conformity Assessment Body for Radio and Telecom
Industry Canada CAB		**Radio:** Scope A – All Radio Standard Specification in Category I
		Telecom: CS-03 Part I, II, V, VI, VII, VIII

Japan Recognized Certification Body Designation		**Radio**: A1. Terminal equipment for purpose of calling **Telecom**: B1. Specified radio equipment specified in Article 38-2, Paragraph 1, Item 1 of the Radio Law
Korea CAB Accreditation		**EMI:** KCC Notice 2008-39, RRL Notice 2008-3: CA Procedures for EMI KN22: Test Method for EMI **EMS:** KCC Notice 2008-38, RRL Notice 2008-4: CA Procedures for EMS KN24, KN61000-4-2, -4-3, -4-4, -4-5, -4-6, -4-8, -4-11: Test Method for EMS
		Radio: RRL Notice 2008-26, RRL Notice 2008-2, RRL Notice 2008-10, RRL Notice 2007-49, RRL Notice 2007-20, RRL Notice 2007-21, RRL Notice 2007-80, RRL Notice 2004-68
		Telecom: President Notice 20664, RRL Notice 2007-30, RRL Notice 2008-7 with attachments 1, 3, 5, 6; President Notice 20664, RRL Notice 2008-7 with attachment 4
Taiwan NCC CAB Recognition		LP0002, PSTN01, ADSL01, ID0002, IS6100, CNS14336, PLMN07, PLMN01, PLMN08
Taiwan BSMI CAB Recognition		CNS 13438
Japan VCCI		R-3083: Radiation 3 meter site C-3421: Main Ports Conducted Interference Measurement T-1597: Telecommunication Ports Conducted Interference Measurement
Australia CAB Recognition		**EMC:** AS/NZS CISPR 11, AS/NZS CISPR 14.1, AS/NZS CISPR22, AS/NZS 61000.6.3, AS/NZS 61000.6.4
		Radio communications: AS/NZS 4281, AS/NZS 4268, AS/NZS 4280.1, AS/NZS 4280.2, AS/NZS 4295, AS/NZS 4582, AS/NZS 4583, AS/NZS 4769.1, AS/NZS 4769.2, AS/NZS 4770, AS/NZS 4771
		Telecommunications: AS/ACIF S002:05, AS/ACIF S003:06, AS/ACIF S004:06 AS/ACIF S006:01, AS/ACIF S016:01, AS/ACIF S031:01, AS/ACIF S038:01, AS/ACIF S040:01, AS/ACIF S041:05, AS/ACIF S043.2:06, AS/ACIF S60950.1
Australia NATA Recognition		AS/ACIF S002, AS/ACIF S003, AS/ACIF S004, AS/ACIF S006, AS/ACIF S016,AS/ACIF S031, AS/ACIF S038, AS/ACIF S040, AS/ACIF S041, AS/ACIF S043.2