Product Service

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Report On

FCC Testing of the
Cobham Tactical Communications NETNode IP Mesh Radio Phase 5
In accordance with FCC 47 CFR Part 90 and FCC 47 CFR Part 2

COMMERCIAL-IN-CONFIDENCE

FCC ID: XRFNETNODE-5R

Document 75932706 Report 02 Issue 2 February 2016

Product Service

TÜV SÜD Product Service, Octagon House, Concorde Way, Segensworth North,
Fareham, Hampshire, United Kingdom, PO15 5RL
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REPORT ON

FCC Testing of the
Cobham Tactical Communications NETNode IP Mesh Radio Phase 5
In accordance with FCC 47 CFR Part 90 and FCC 47 CFR Part 2

Document 75932706 Report 02 Issue 2

February 2016

PREPARED FOR

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PREPARED BY

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Senior Administrator, Project Support

APPROVED BY

Nic Forsyth
Authorised Signatory

DATED 05 February 2016

This report has been up-issued to Issue 2 to include a statement in section 1.6

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 90 and FCC 47 CFR Part 2. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

G Lawler M Russell M Toubella

UKAS TESTING 0141

Product Service

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Product Service

SECTION 1

REPORT SUMMARY

FCC Testing of the
Cobham Tactical Communications NETNode IP Mesh Radio Phase 5
In accordance with FCC 47 CFR Part 90 and FCC 47 CFR Part 2

1.1 INTRODUCTION

The information contained in this report is intended to show the verification of FCC Testing of the Cobham Tactical Communications NETNode IP Mesh Radio Phase 5 to the requirements of FCC 47 CFR Part 90 and FCC 47 CFR Part 2.

Objective	To perform FCC Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Cobham Tactical Communications
Model Number(s)	Mesh Phase 5
Serial Number(s)	033812
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 90 (2014) FCC 47 CFR Part 2 (2014)
Incoming Release Date	Application Form 16 December 2015
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	PO-038839-1 17 November 2015
Start of Test	8 December 2015
Finish of Test	15 December 2015
Name of Engineer(s)	G Lawler M Russell M Toubella
Related Document(s)	ANSI C63.4: 2009

Note: This report shows compliance to the limits of the specification over the frequency range 2000 MHz to 2500 MHz.

However, the authorised frequency band is 2450 MHz to 2483.5 MHz and the product will be limited to transmit in this band. This report shows compliance over and including the 2450 MHz to 2483.5 MHz frequency band.

Product Service

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 90 and FCC 47 CFR Part 2 is shown below.

Section	Specification Clause		Test Description	Result	Comments/Base Standard
	Part 90	Part 2			
Transmit - 16-QAM 2/3 - 2.5 MHz Bandwidth - PoE at 50 V					
2.3	-	2.1049	Occupied Bandwidth	Pass	
Transmit - 16-QAM 2/3 - 3.0 MHz Bandwidth - PoE at 50 V - PoE at 50 V					
2.3	-	2.1049	Occupied Bandwidth	Pass	
Transmit - 16-QAM 2/3 - 3.5 MHz Bandwidth - PoE at 50 V - PoE at 50 V					
2.3	-	2.1049	Occupied Bandwidth	Pass	
Transmit - 16-QAM 2/3 - 5.0 MHz Bandwidth - PoE at 50 V - PoE at 50 V					
2.3	-	2.1049	Occupied Bandwidth	Pass	
Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V - PoE at 50 V					
2.1	90.205	2.1046	Maximum Conducted Output Power	Pass	
2.2	90.207	2.1047	Type of Emissions	Pass	
2.3	-	2.1049	Occupied Bandwidth	Pass	
2.4	90.210	2.1051	Spurious Emissions at Antenna Terminals	Pass	
2.5	90.210	2.1051	Emission Mask	Pass	
2.6	90.213	2.1055	Frequency Stability	Pass	
2.7	-	2.1047 (d)	Modulation Characteristics	Pass	

Product Service

Section	Specification Clause		Test Description	Result	Comments/Base Standard
	Part 90	Part 2			
Transmit - 16-QAM 2/3 - 7.0 MHz Bandwidth - PoE at 50 V - PoE at 50 V					
2.3	-	2.1049	Occupied Bandwidth	Pass	
Transmit - 16-QAM 2/3 - 8.0 MHz Bandwidth - PoE at 50 V - PoE at 50 V					
2.3	-	2.1049	Occupied Bandwidth	Pass	
Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - 12 V DC					
2.6	90.213	2.1055	Frequency Stability	Pass	
Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - 48 V DC					
2.6	90.213	2.1055	Frequency Stability	Pass	

Product Service

1.3 APPLICATION FORM

EQUIPMENT DESCRIPTION	
Model Name/Number	NETNode IP Mesh Radio Phase 5
Part Number	NETNode2x2W-5R-200250
Hardware Version	1.0
Software Version	v0.1l
FCC ID (if applicable)	XRFNETNODE-5R
Industry Canada ID (if applicable)	N/A
Technical Description (Please provide a brief description of the intended use of the equipment)	Cobham NETNode IP mesh radios can be combined in a fluid self forming, self healing mesh containing up to sixteen radios. The entire mesh can operate in a selectable bandwidth of between 2.5 and 10MHz, providing greater than 25Mb/s of IP data.The highly f

POWER SOURCE

☐ AC mains — State voltage

AC supply frequency (Hz)

VAC

Max Current

Hz

☐ Single phase ☐ Three phase

And / Or (DC_1)

☒ External DC supply

Nominal voltage	12 V	Max Current	5	A
Extreme upper voltage	18 V			
Extreme lower voltage	12 V			

And / Or (DC_2)

☒ External DC supply

Nominal voltage	48 V	Max Current	1.25	A
Extreme upper voltage	50 V			
Extreme lower voltage	20 V			

And / Or (DC_3)

☒ External DC supply

Nominal voltage	48 V	Max Current	1.25	A
Extreme upper voltage	55 V			
Extreme lower voltage	42 V			

Battery

☐ Nickel Cadmium ☐ Lead acid (Vehicle regulated)

☐ Alkaline ☐ Leclanche

☐ Lithium ☐ Other Details :

Volts nominal.

End point voltage as quoted by equipment manufacturer V

Product Service

FREQUENCY INFORMATION					
Frequency Range	2000 to2500	MHz			
Channel Spacing (where applicable)	125KHz				
Receiver Frequency Range (if different)	2000 to2500	MHz			
Channel Spacing (if different)	125KHz				
Test Frequencies*	Bottom	2000	MHz	Channel Number (if applicable)	N/A
	Middle	2250	MHz	Channel Number (if applicable)	N/A
	Top	2500	MHz	Channel Number (if applicable)	N/A
Intermediate Frequencies		N/A MHz			
Highest Internally Generated Frequency :		2500 MHz			

POWER CHARACTERISTICS				
Maximum TX power	2	W		
Minimum TX power	0.002	W (if variable)		
Is transmitter intended for :				
Continuous duty			☐ Yes	☒ No
Intermittent duty			☒ Yes	☐ No
If intermittent state DUTY CYCLE				
Transmitter ON	(variable depending on data throughput) seconds			
Transmitter OFF	(variable depending on data throughput) seconds			

ANTENNA CHARACTERISTICS					
☒	Antenna connector		State impedance	50	Ohm
☐	Temporary antenna connector		State impedance		Ohm
☐	Integral antenna	Type	State impedance		dBi
☐	External antenna	Type	State impedance		dBi

MODULATION CHARACTERISTICS			
☒	Amplitude	☐	Frequency
☒	Phase	☐	Other (please provide details):
Can the transmitter operate un-modulated?			☐ Yes ☒ No

CLASS OF EMISSION USED	
ITU designation or Class of Emission:	
1	6M00D1W
(if applicable) 2	
(if applicable) 3	
If more than three classes of emission, list separately:	

BATTERY POWER SUPPLY	
Model name/number	Identification/Part number
Manufacturer	Country of Origin

Product Service

ANCILLARIES (If applicable)	
Model name/number	Identification/Part number
Manufacturer	Country of Origin

EXTREME CONDITIONS_DC1					
Extreme test voltages (Max)	18	V	Extreme test voltages (Mix)		V
Nominal DC Voltage	12	V	DC Maximum Current	5	A
Maximum temperature	50	°C	Minimum temperature	-10	°C
EXTREME CONDITIONS_DC2					
Extreme test voltages (Max)	50	V	Extreme test voltages (Mix)		V
Nominal DC Voltage	48	V	DC Maximum Current	1.25	A
Maximum temperature	50	°C	Minimum temperature	-10	°C
EXTREME CONDITIONS_DC3					
Extreme test voltages (Max)	55	V	Extreme test voltages (Mix)		V
Nominal DC Voltage	48	V	DC Maximum Current	1.25	A
Maximum temperature	50	°C	Minimum temperature	-10	°C

I hereby declare that I am entitled to sign on behalf of the applicant and that the information supplied is correct and complete.

Name:

Position held: ENGINEERING PROJECT MANAGER

Date: 16/12/2015.

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was a Cobham Tactical Communications NETNode IP Mesh Radio Phase 5. A full technical description can be found in the manufacturer's documentation.

1.5 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure.

The EUT was powered from a 110 V AC supply.

FCC Measurement Facility Registration Number
90987 Octagon House, Fareham Test Laboratory

1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standard were made during testing.

1.7 MODIFICATION RECORD

Modification 0 - No modifications were made to the test sample during testing.

Product Service

SECTION 2

TEST DETAILS

FCC Testing of the
Cobham Tactical Communications NETNode IP Mesh Radio Phase 5
In accordance with FCC 47 CFR Part 90 and FCC 47 CFR Part 2

2.1 MAXIMUM CONDUCTED OUTPUT POWER

2.1.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.205
FCC 47 CFR Part 2, Clause 2.1046

2.1.2 Equipment Under Test and Modification State

Mesh Phase 5 S/N: 033812 - Modification State 0

2.1.3 Date of Test

9 December 2015

2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Test Procedure

The test was applied in accordance with the test method requirements of KDB 971168 D01 v02 r02, clause 5.2.1.

Measurements were performed on each individual antenna port and then summed as described in KDB 662911 D01 v02 r01 clause E.2 (b).

2.1.6 Environmental Conditions

Ambient Temperature	24.2°C
Relative Humidity	32.6%

Product Service

2.1.7 Test Results

110 V AC Supply

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, Maximum Conducted Output Power Results

2000 MHz		2250 MHz		2500 MHz	
dBm	W	dBm	W	dBm	W
36.63	4.60	36.22	4.18	36.33	4.30

FCC 47 CFR Part 90, Limit Clause 90.205

Frequency (MHz)	Limit
< 25	1000 W
25 to 50	300 W
72 to 76	300 W
150 to 174	Refer to 90.205 (d) of the specification
217 to 220	Refer to 90.259 of the specification
220 to 222	Refer to 90.729 of the specification
421 to 430	Refer to 90.279 of the specification
450 to 470	Refer to 90.205 (h) of the specification
470 to 512	Refer to 90.307 and 90.309 of the specification
758 to 775 and 788 to 805	Refer to 90.541 and 90.542 of the specification
806 to 824, 851 to 869, 869 to 901 and 935 to 940	Refer to 90.635 of the specification
902 to 927.25	LMS systems operating pursuant to subpart M of the specification : 30 W
927.25 to 928	LMS equipment: 300 W
929 to 930	Refer to 90.494 of the specification
1427 to 1429.5 and 1429.5 to 1432	Refer to 90.259 of the specification
2450 to 2483.5	5 W
4940 to 4990	Refer to 90.1215 of the specification
5850 to 5925	Refer to subpart M of the specification
All other frequency bands	On a case by case basis

The output power shall not exceed by more than 20 percent either the output power shown in the Radio Equipment List [available in accordance with § 90.203(a)(1)] for transmitters included in this list or when not so listed, the manufacturer's rated output power for the particular transmitter specifically listed on the authorization

2.2 TYPE OF EMISSIONS

2.2.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.207
FCC 47 CFR Part 2, Clause 2.1047

2.2.2 Equipment Under Test and Modification State

Mesh Phase 5 S/N: 033812 - Modification State 0

2.2.3 Date of Test

8 December 2015

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Test Procedure

The manufacturer has declared the class of emission as D1W. The EUT uses 16QAM, QPSK and BSPK modulation schemes with nominal bandwidths of 2.5 MHz, 3 MHz, 3.5 MHz, 5 MHz, 6 MHz, 7 MHz and 8 MHz. A plot of the fundamental configured to 16 QAM 2/3 with 6 MHz bandwidth has been included for illustrative purposes.

2.2.6 Environmental Conditions

Ambient Temperature	24.2°C
Relative Humidity	38.4%

Product Service

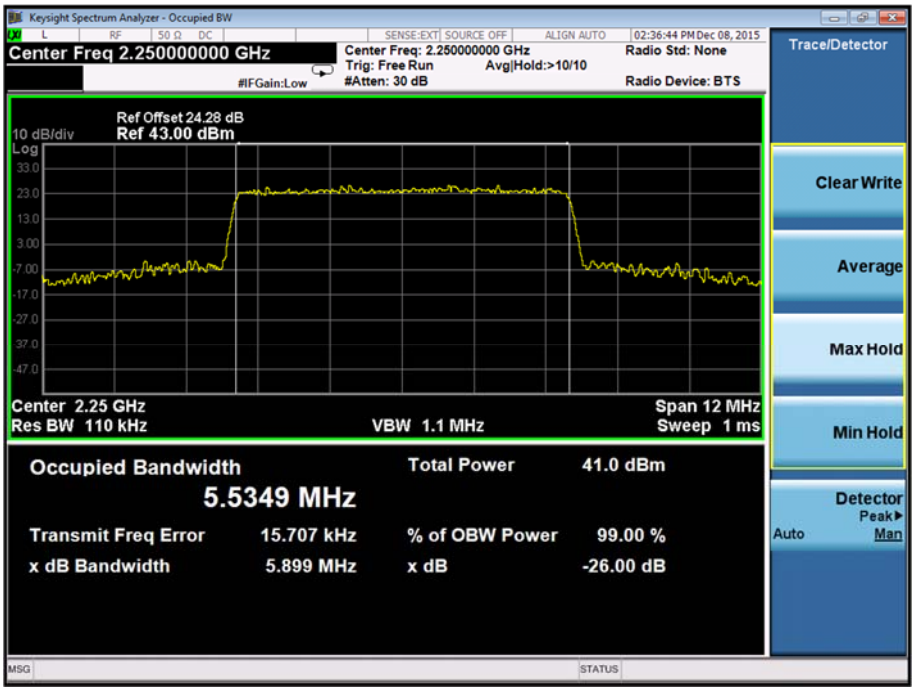
2.2.7 Test Results

110 V AC Supply

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, Type of Emissions Result

The class of the emission has been declared as D1W.

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, Type of Emissions Plot



FCC 47 CFR Part 90, Limit Clause 90.207

The class of emission declared is authorised for use within the scope of specification.

2.3 OCCUPIED BANDWIDTH

2.3.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049

2.3.2 Equipment Under Test and Modification State

Mesh Phase 5 S/N: 033812 - Modification State 0

2.3.3 Date of Test

8 December 2015

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Test Procedure

The test was performed in accordance with KDB 971168 D01 v02 r02, clause 4.2.

2.3.6 Environmental Conditions

Ambient Temperature	23.3 - 25.0°C
Relative Humidity	32.2 - 39.8%

Product Service

2.3.7 Test Results

Transmit - 16-QAM 2/3 - 2.5 MHz Bandwidth - PoE at 50 V

110 V AC Supply

Transmit - 16-QAM 2/3 - 2.5 MHz Bandwidth - PoE at 50 V, Occupied Bandwidth Results

2000 MHz	2250 MHz	2500 MHz
kHz	kHz	kHz
2330.4	2325.7	2341.1

Transmit - 16-QAM 2/3 - 2.5 MHz Bandwidth - PoE at 50 V, 2000 MHz, Occupied Bandwidth Plot

Transmit - 16-QAM 2/3 - 2.5 MHz Bandwidth - PoE at 50 V, 2250 MHz, Occupied Bandwidth Plot

Transmit - 16-QAM 2/3 - 2.5 MHz Bandwidth - PoE at 50 V, 2500 MHz, Occupied Bandwidth Plot

FCC 47 CFR Part 2, Limit Clause

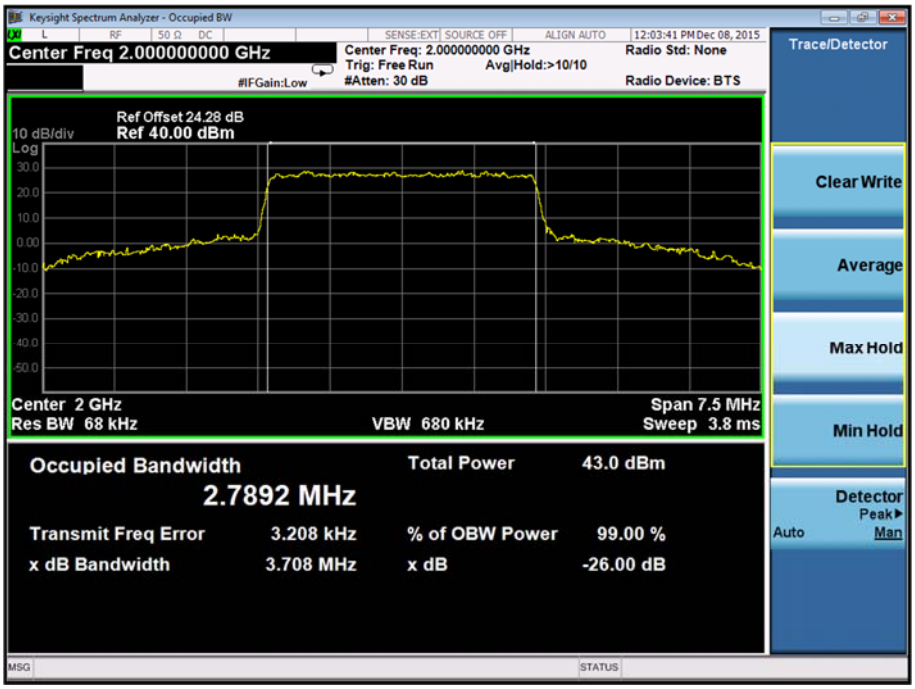
None Specified.

110 V AC Supply

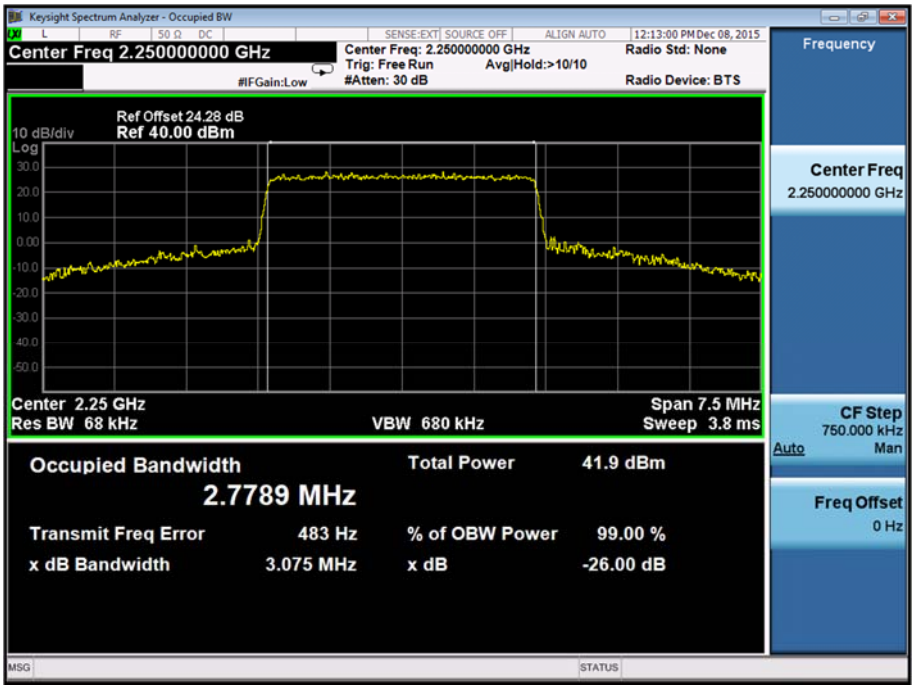
Transmit - 16-QAM 2/3 - 3.0 MHz Bandwidth - PoE at 50 V, Occupied Bandwidth Results

2000 MHz	2250 MHz	2500 MHz
kHz	kHz	kHz
2789.2	2778.9	2796.0

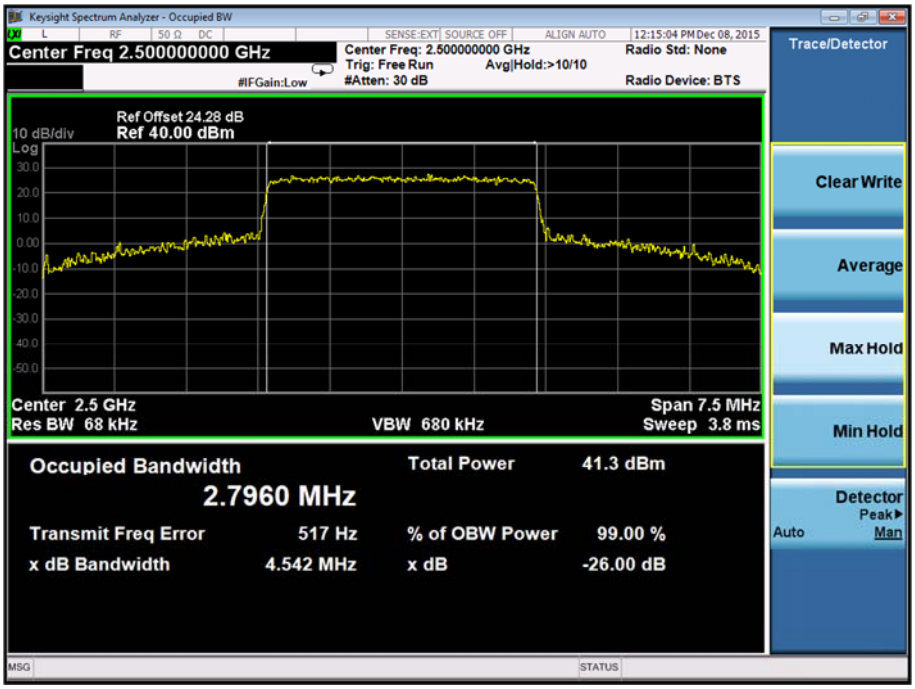
Transmit - 16-QAM 2/3 - 3.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, Occupied Bandwidth Plot



Transmit - 16-QAM 2/3 - 3.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, Occupied Bandwidth Plot



Transmit - 16-QAM 2/3 - 3.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, Occupied Bandwidth Plot



FCC 47 CFR Part 2, Limit Clause

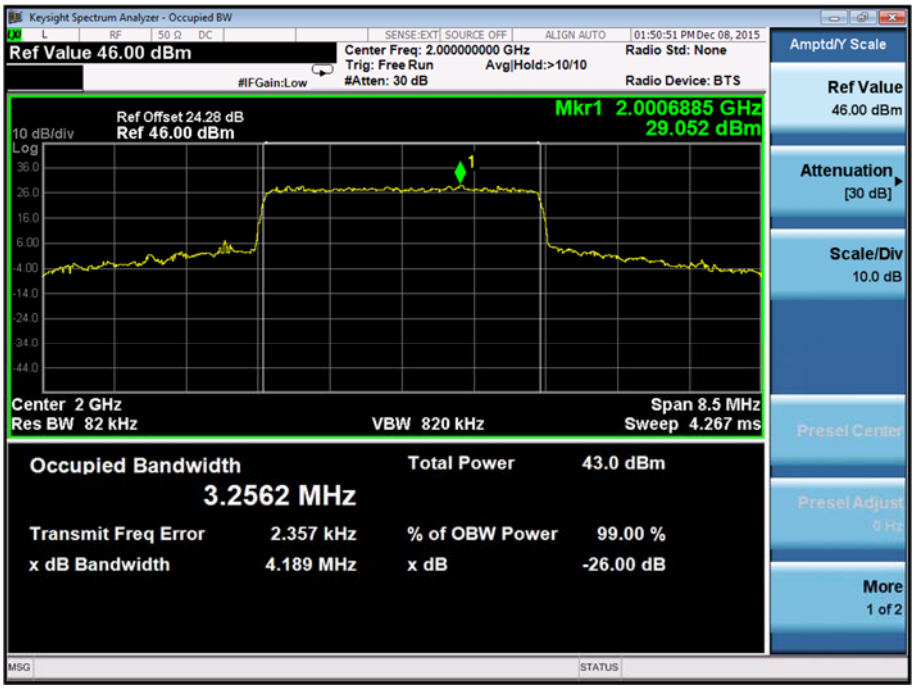
None Specified.

110 V AC Supply

Transmit - 16-QAM 2/3 - 3.5 MHz Bandwidth - PoE at 50 V, Occupied Bandwidth Results

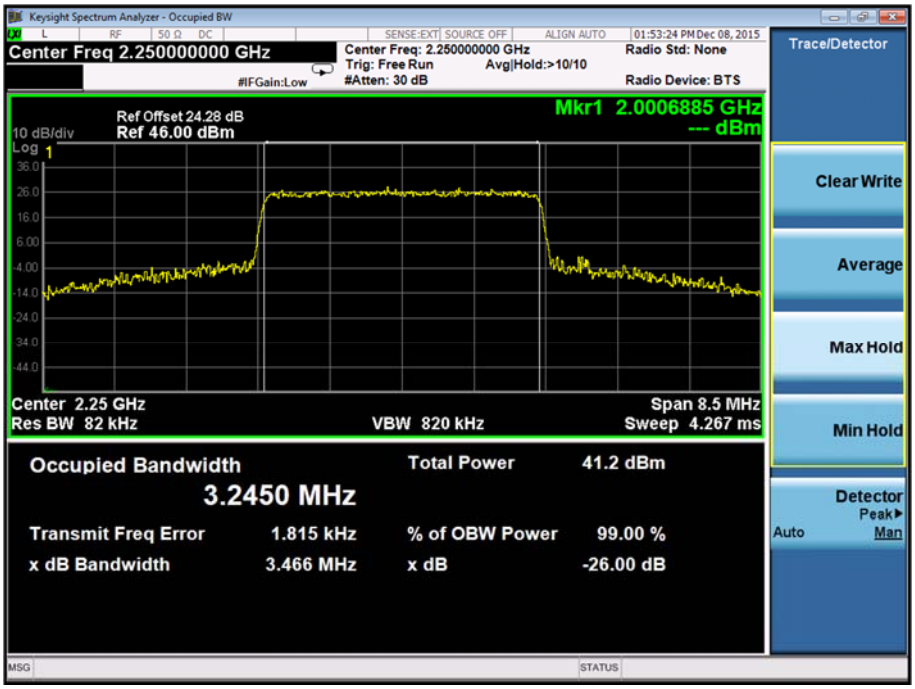
2000 MHz	2250 MHz	2500 MHz
kHz	kHz	kHz
3256.2	3245.0	3263.6

Transmit - 16-QAM 2/3 - 3.5 MHz Bandwidth - PoE at 50 V, 2000 MHz, Occupied Bandwidth Plot

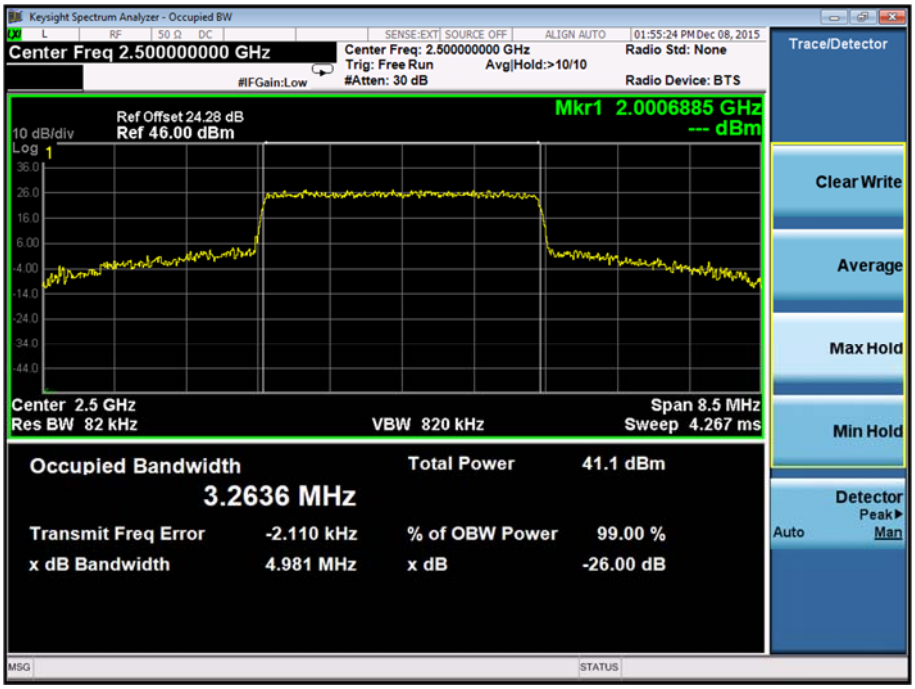


Product Service

Transmit - 16-QAM 2/3 - 3.5 MHz Bandwidth - PoE at 50 V, 2250 MHz, Occupied Bandwidth Plot



Transmit - 16-QAM 2/3 - 3.5 MHz Bandwidth - PoE at 50 V, 2500 MHz, Occupied Bandwidth Plot



FCC 47 CFR Part 2, Limit Clause

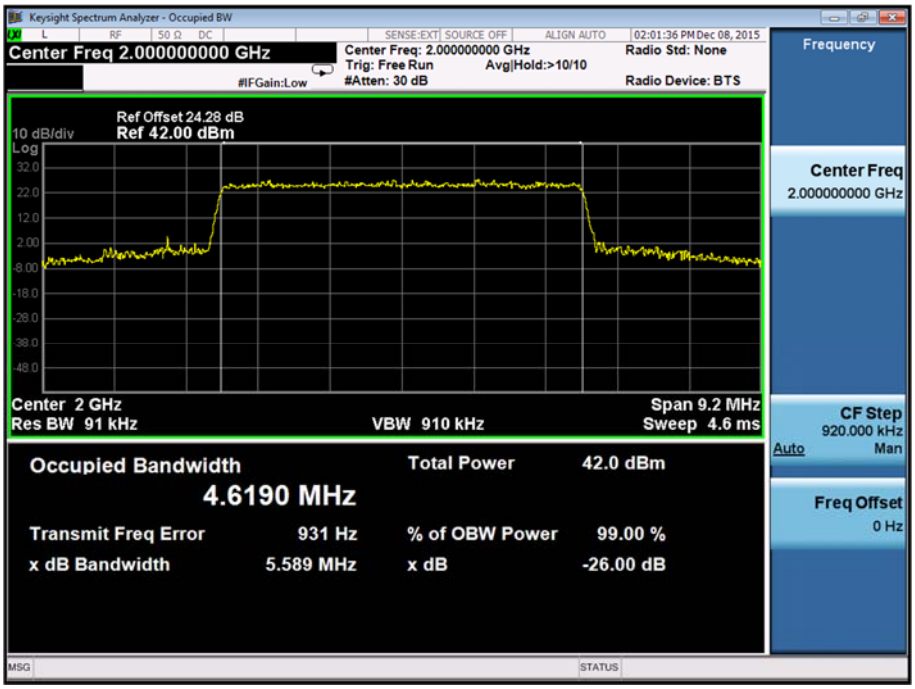
None Specified.

110 V AC Supply

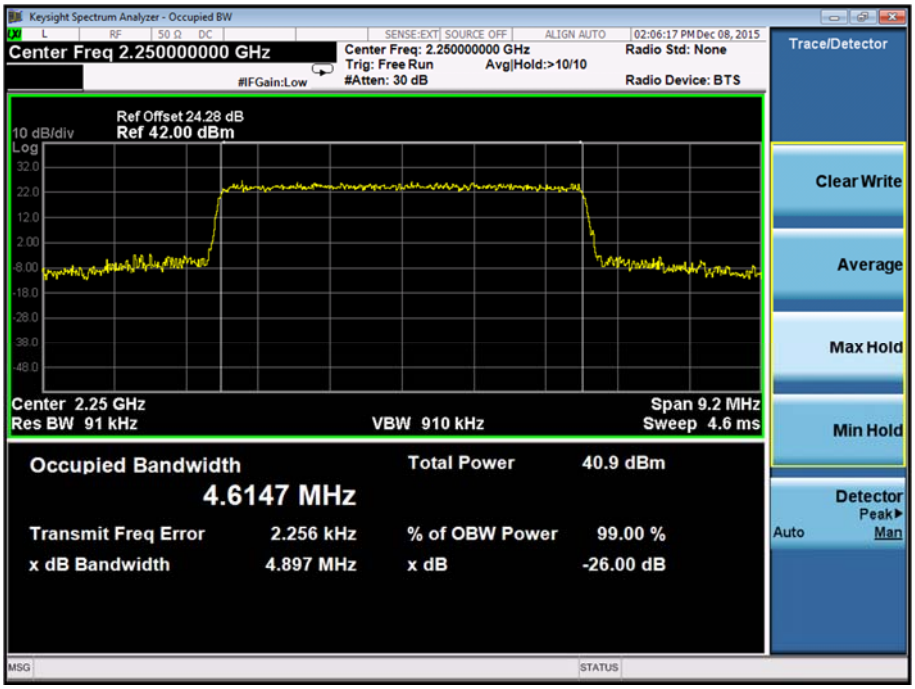
Transmit - 16-QAM 2/3 - 5.0 MHz Bandwidth - PoE at 50 V, Occupied Bandwidth Results

2000 MHz	2250 MHz	2500 MHz
kHz	kHz	kHz
4619.0	4614.7	4629.5

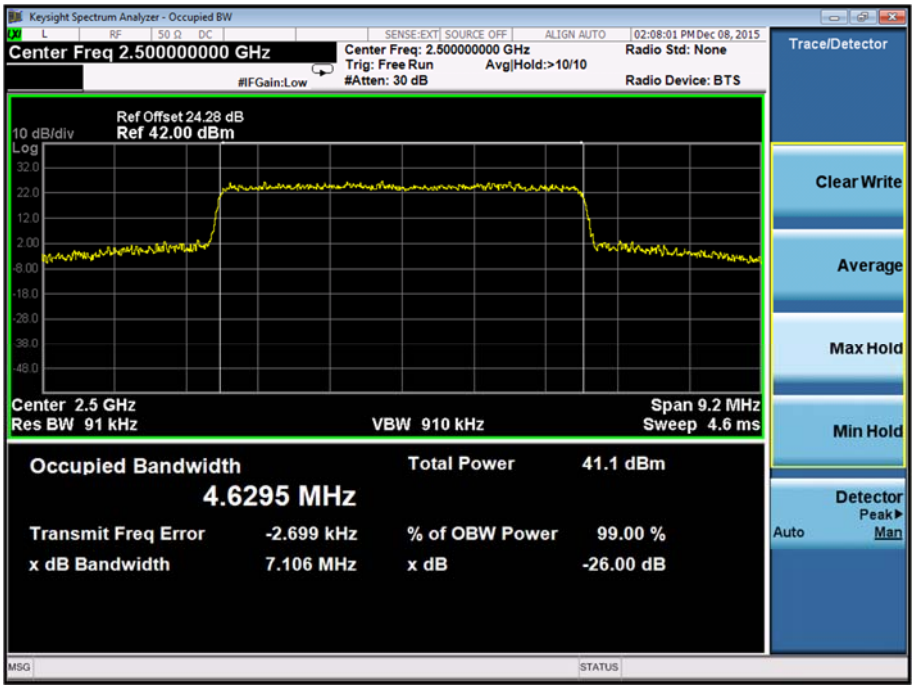
Transmit - 16-QAM 2/3 - 5.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, Occupied Bandwidth Plot



Transmit - 16-QAM 2/3 - 5.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, Occupied Bandwidth Plot



Transmit - 16-QAM 2/3 - 5.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, Occupied Bandwidth Plot



FCC 47 CFR Part 2, Limit Clause

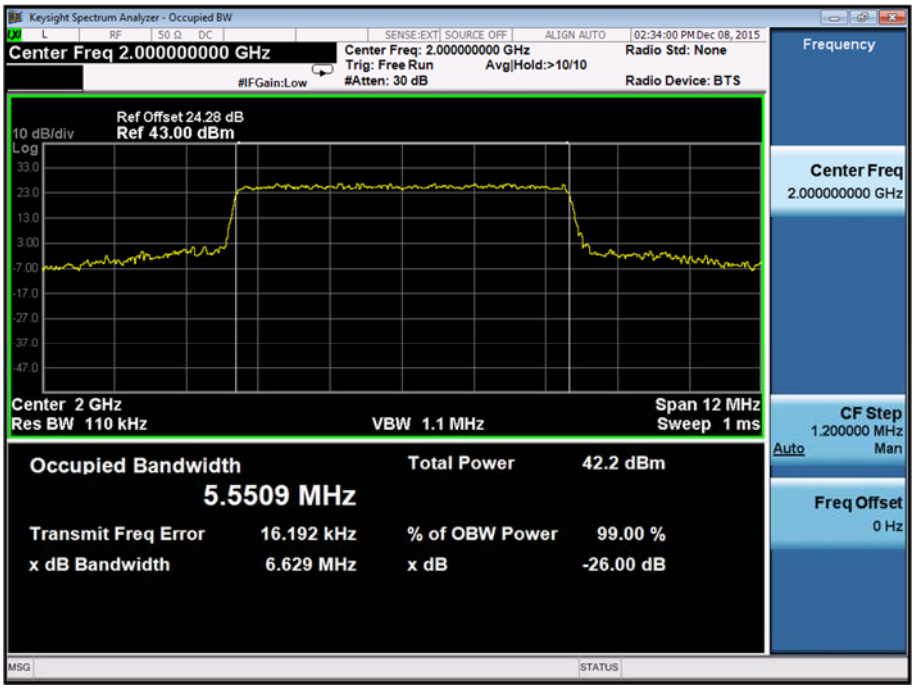
None Specified.

110 V AC Supply

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, Occupied Bandwidth Results

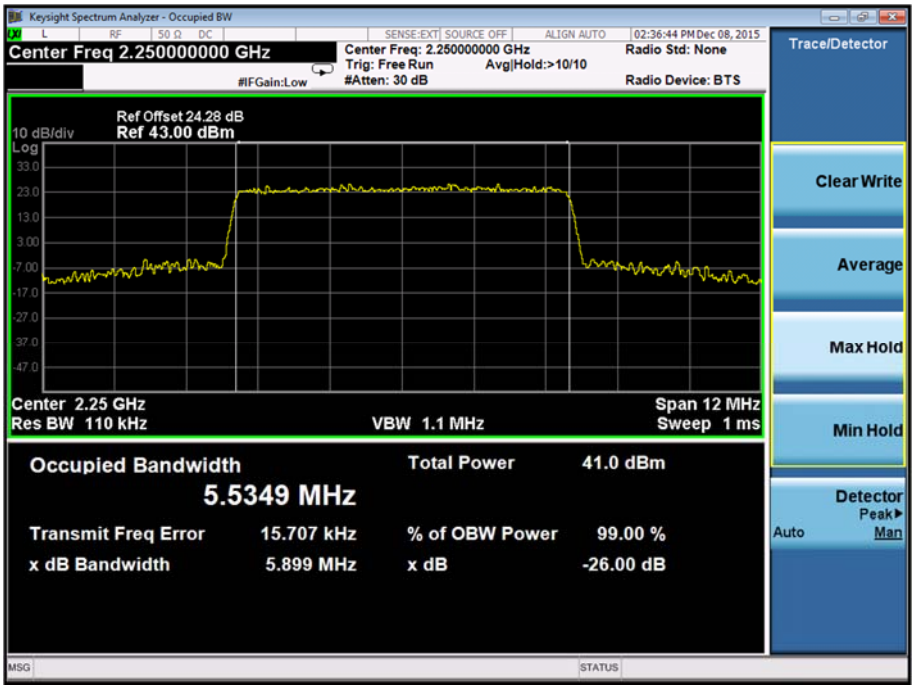
2000 MHz	2250 MHz	2500 MHz
kHz	kHz	kHz
5550.9	5534.9	5562.0

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, Occupied Bandwidth Plot

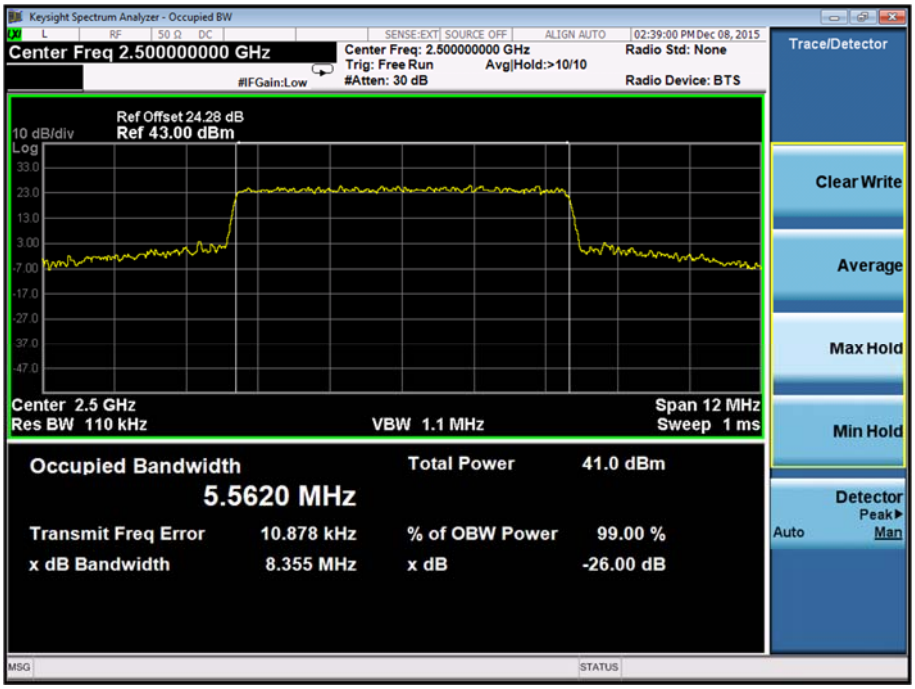


Product Service

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, Occupied Bandwidth Plot



Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, Occupied Bandwidth Plot



FCC 47 CFR Part 2, Limit Clause

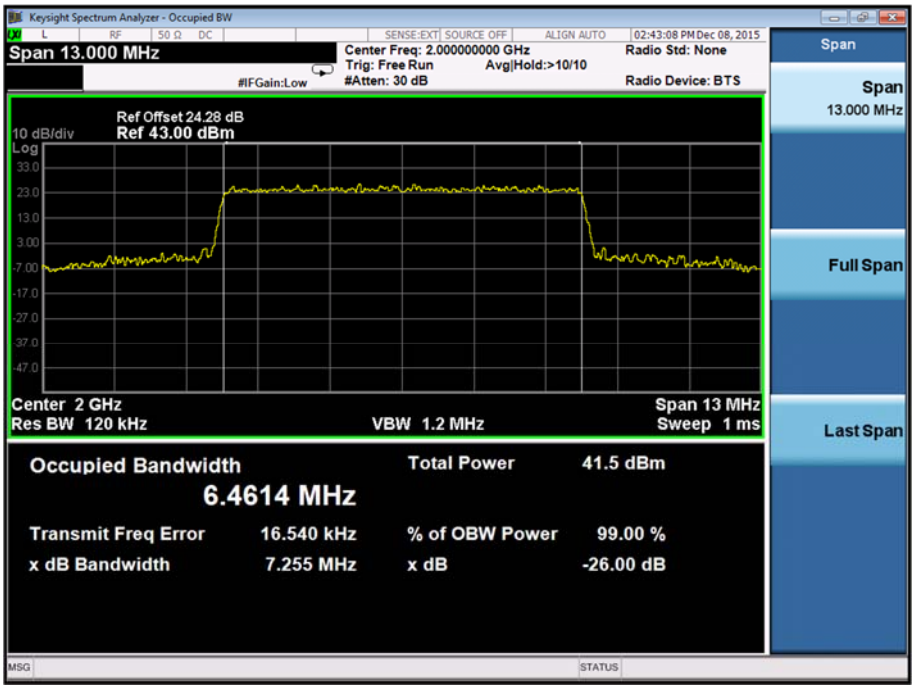
None Specified.

110 V AC Supply

Transmit - 16-QAM 2/3 - 7.0 MHz Bandwidth - PoE at 50 V, Occupied Bandwidth Results

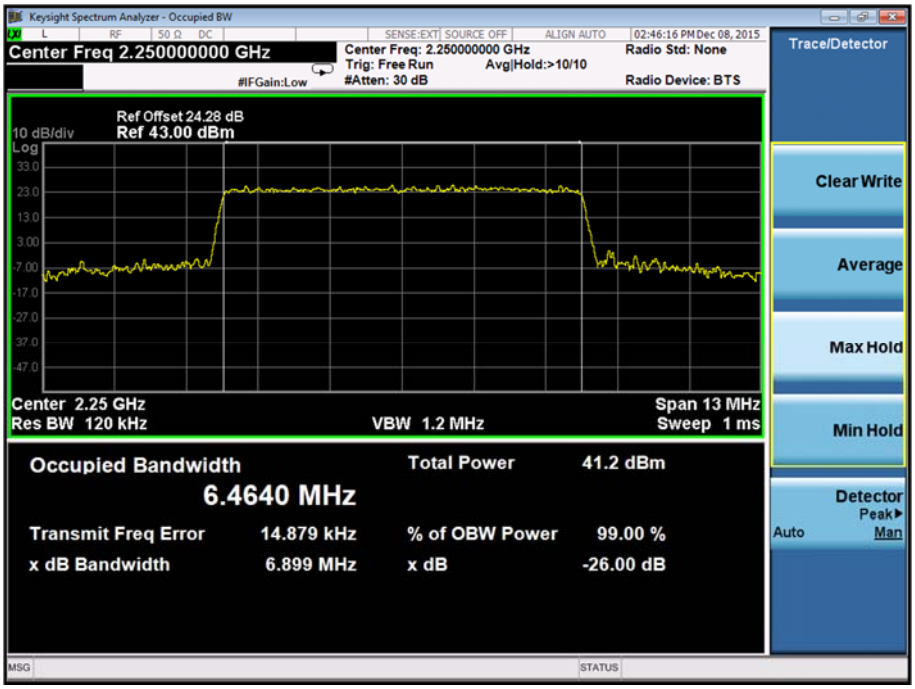
2000 MHz	2250 MHz	2500 MHz
kHz	kHz	kHz
6461.4	6464.0	6491.8

Transmit - 16-QAM 2/3 - 7.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, Occupied Bandwidth Plot

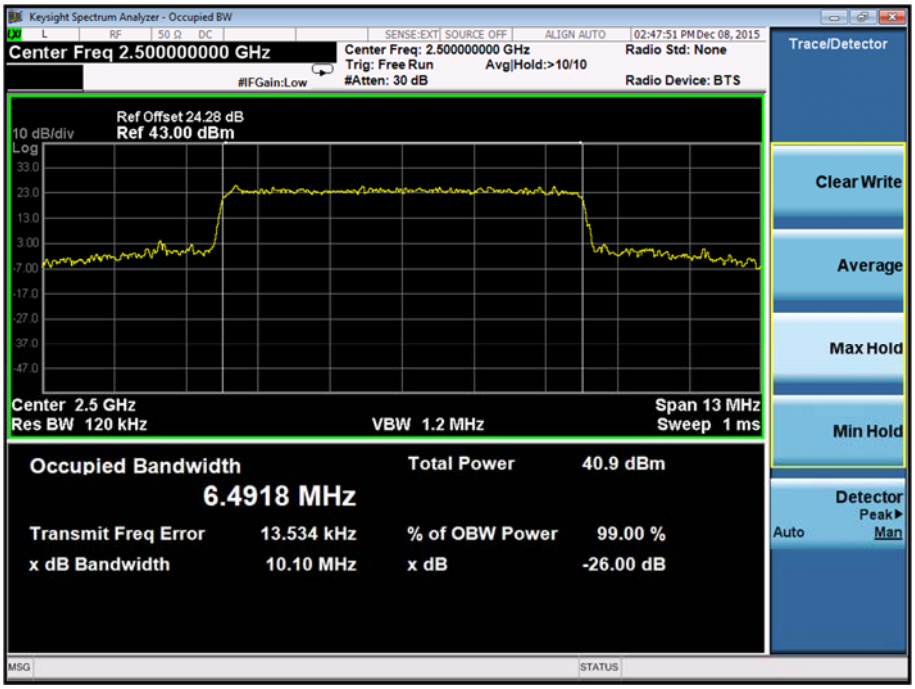


Product Service

Transmit - 16-QAM 2/3 - 7.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, Occupied Bandwidth Plot



Transmit - 16-QAM 2/3 - 7.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, Occupied Bandwidth Plot



FCC 47 CFR Part 2, Limit Clause

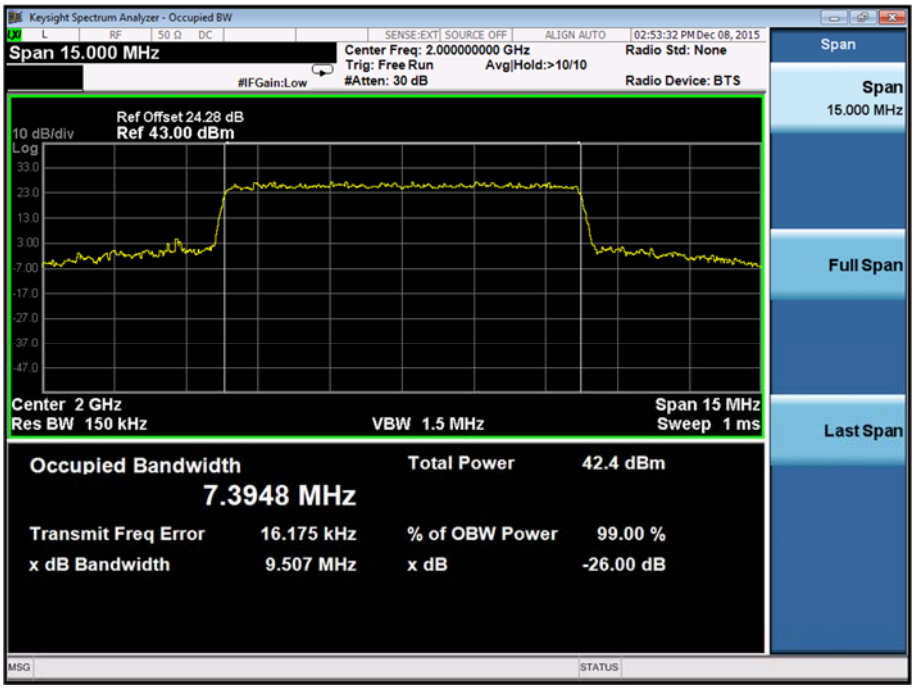
None Specified.

110 V AC Supply

Transmit - 16-QAM 2/3 - 8.0 MHz Bandwidth - PoE at 50 V, Occupied Bandwidth Results

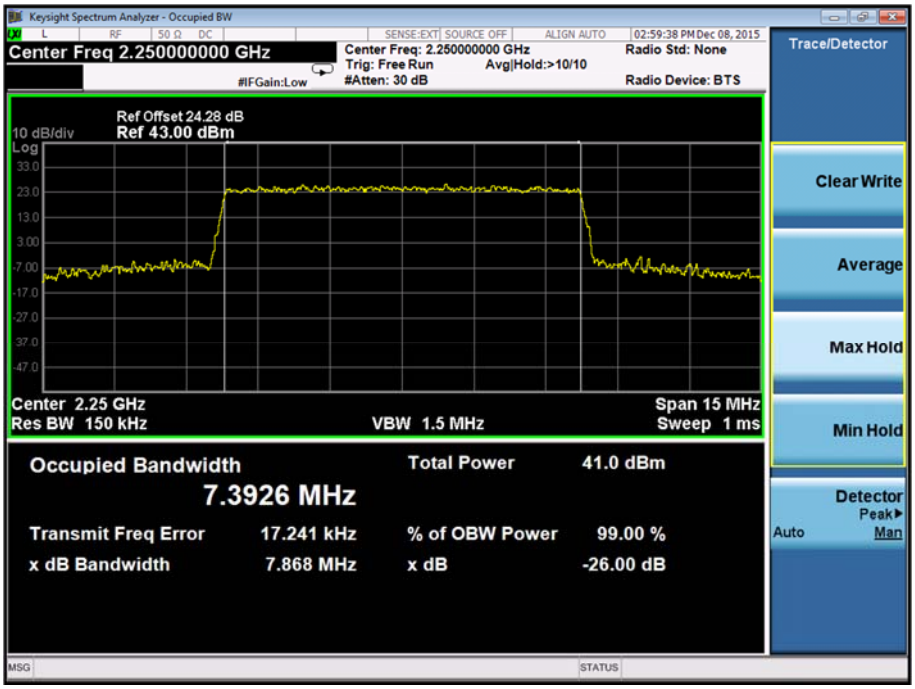
2000 MHz	2250 MHz	2500 MHz
kHz	kHz	kHz
7394.8	7392.6	7416.6

Transmit - 16-QAM 2/3 - 8.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, Occupied Bandwidth Plot

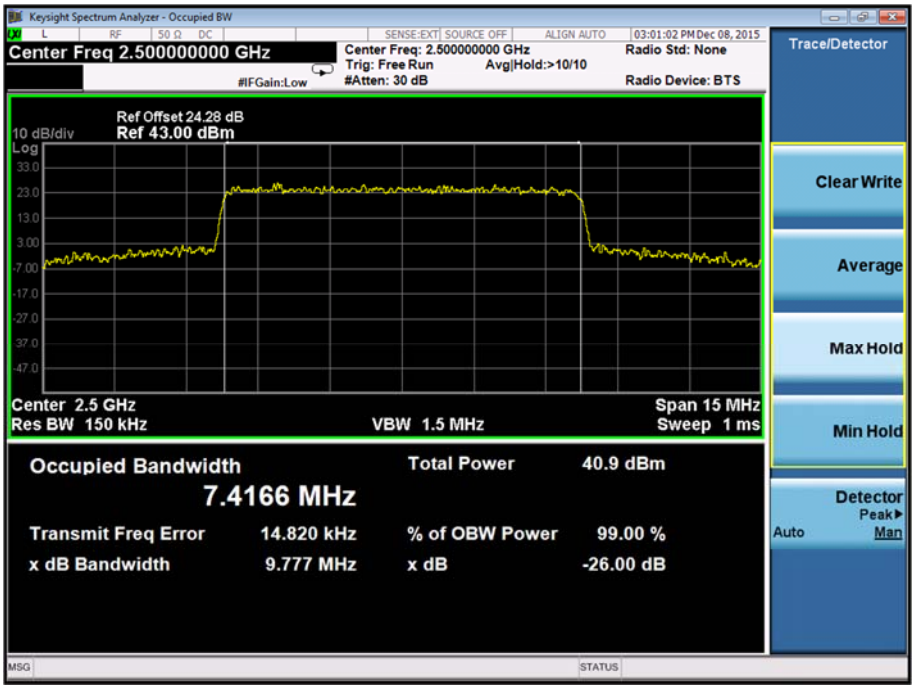


Product Service

Transmit - 16-QAM 2/3 - 8.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, Occupied Bandwidth Plot



Transmit - 16-QAM 2/3 - 8.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, Occupied Bandwidth Plot



FCC 47 CFR Part 2, Limit Clause

None Specified.

2.4 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

2.4.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.210
FCC 47 CFR Part 2, Clause 2.1051

2.4.2 Equipment Under Test and Modification State

Mesh Phase 5 S/N: 033812 - Modification State 0

2.4.3 Date of Test

9 December 2015

2.4.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.5 Test Procedure

This test was performed in accordance with the test method requirements of KDB 971168 D01 v02r 02, clause 6.

Remarks

Measurements were only performed on a single port as the manufacturer declared they are electrically identical. For spectra less than 30 MHz, a reduced RBW was used, however the limit was also reduced by 10 Log (100/Actual RBW used in kHz). An RMS detector with max hold has been used to obtain a worst case average result.

2.4.6 Environmental Conditions

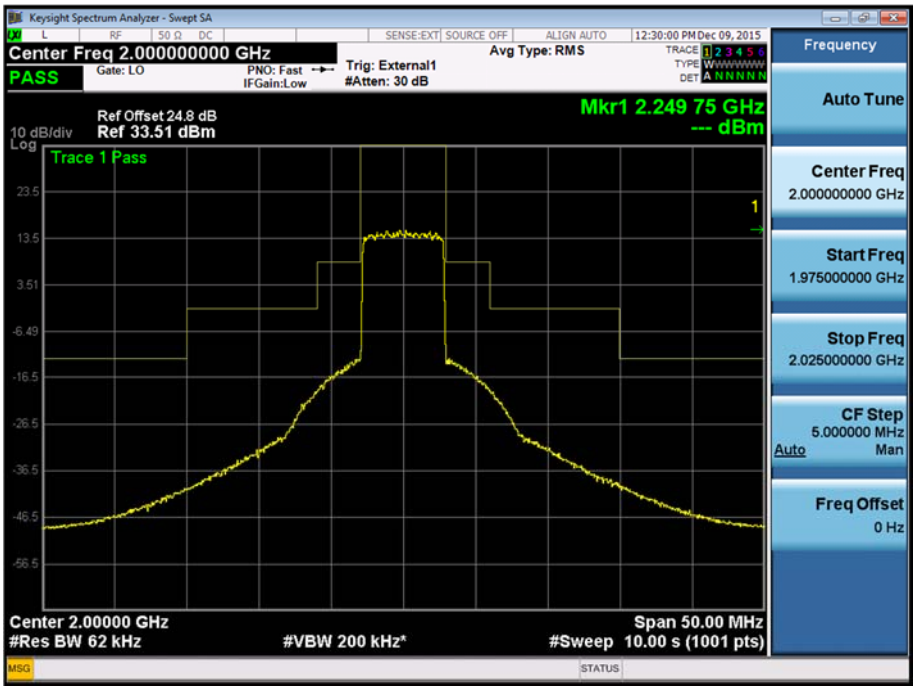
Ambient Temperature	24.2 - 24.6°C
Relative Humidity	32.7%

Product Service

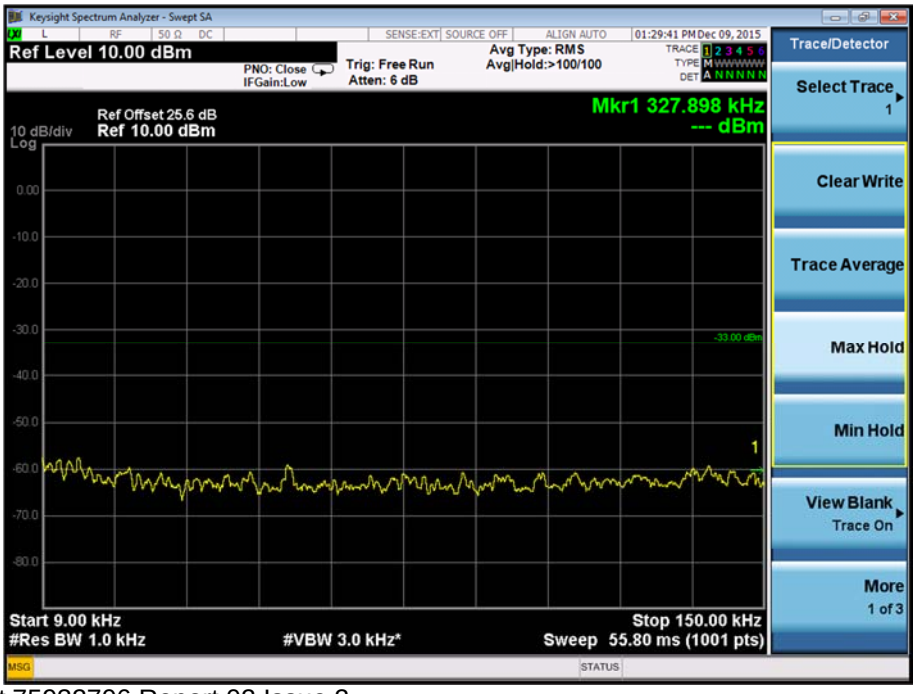
2.4.7 Test Results

110 V AC

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, Emission Mask, Spuious at Antenna Terminals Plot

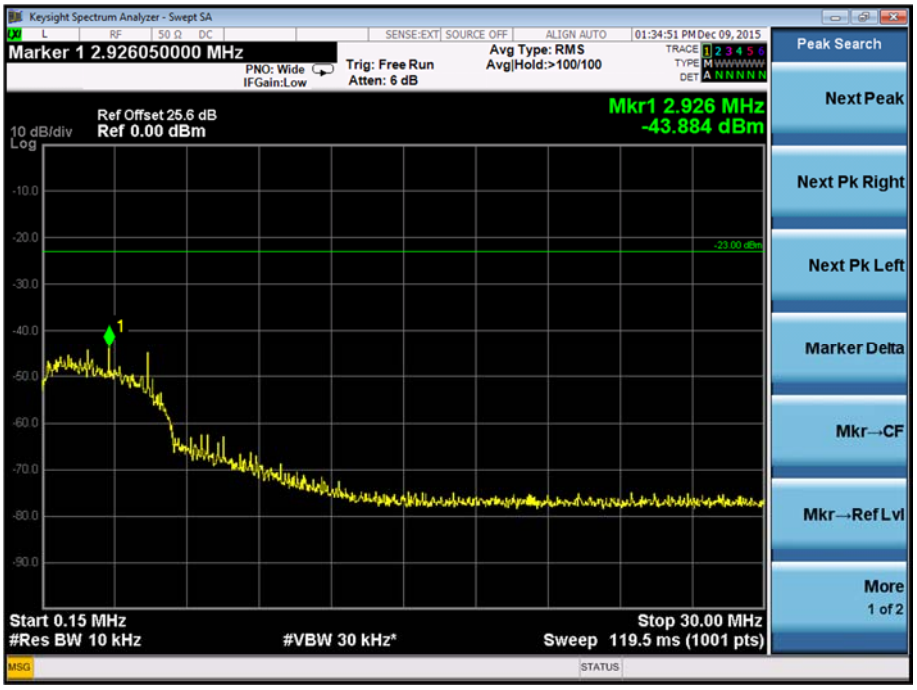


Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, 9 kHz to 150 MHz, Spuious at Antenna Terminals Plot

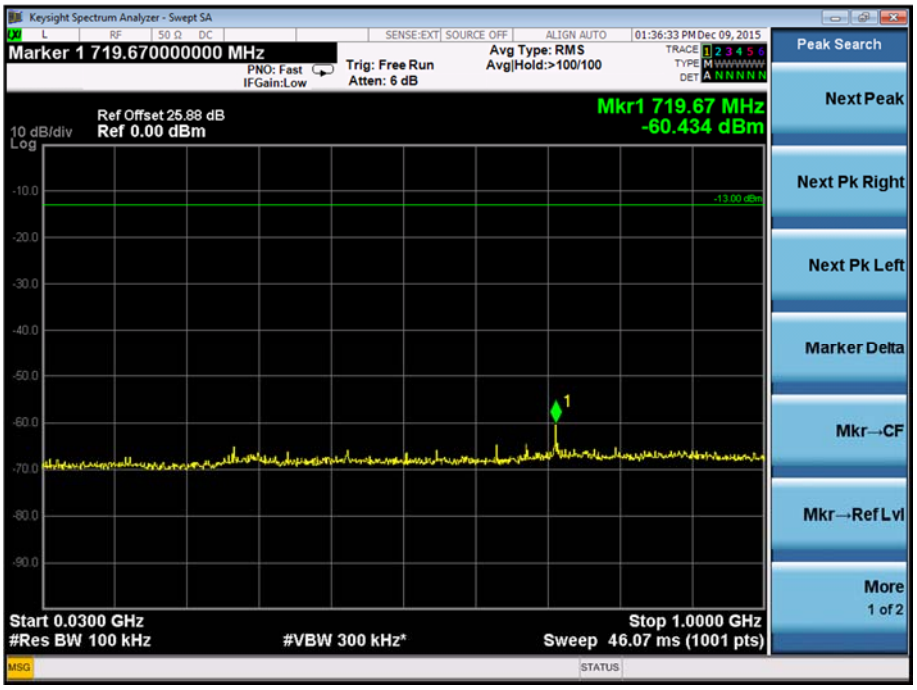


Product Service

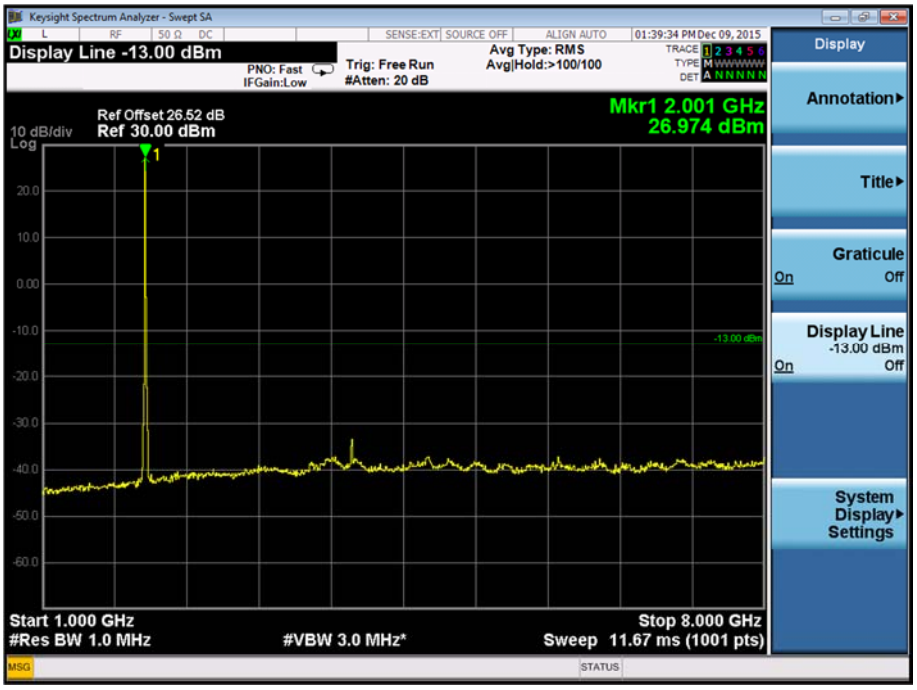
Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, 150 kHz to 30 MHz, Spuious at Antenna Terminals Plot



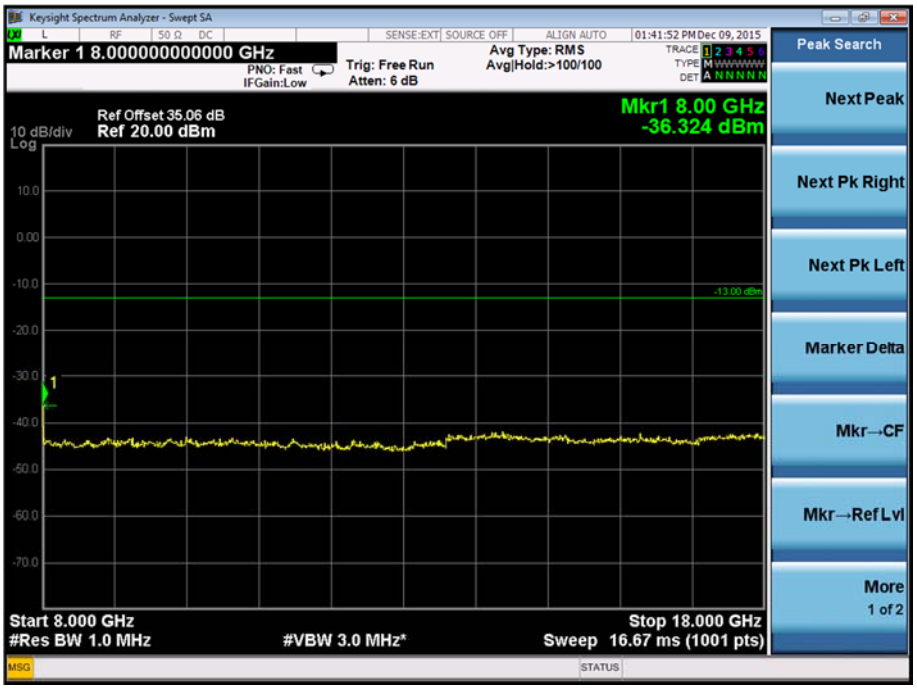
Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, 30 MHz to 1 GHz, Spuious at Antenna Terminals Plot



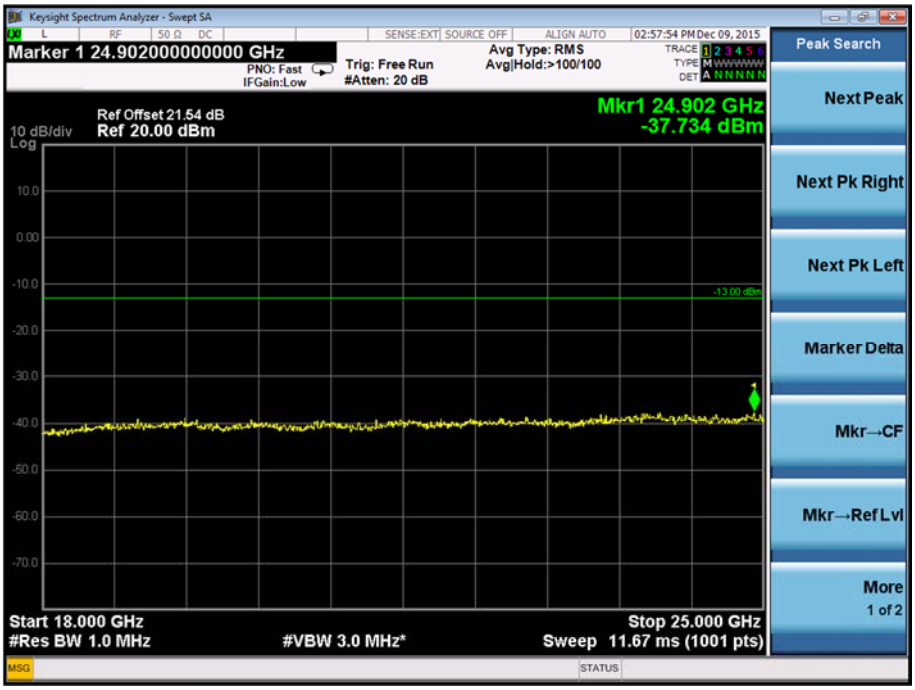
Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, 1 GHz to 8 GHz, Spuious at Antenna Terminals Plot



Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, 8 GHz to 18 GHz, Spuious at Antenna Terminals Plot

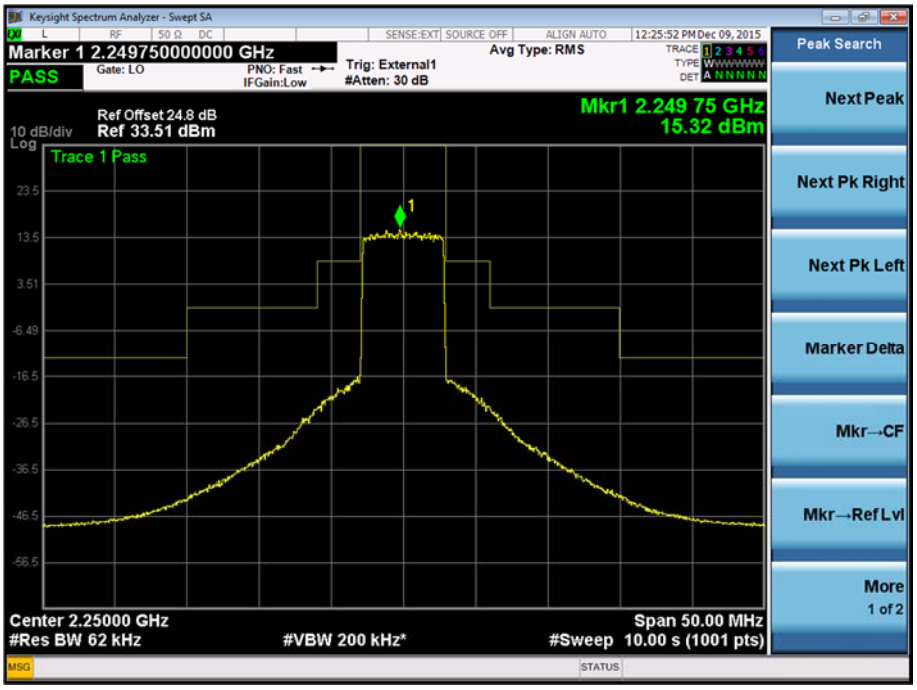


Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, 18 GHz to 25 GHz, Spuious at Antenna Terminals Plot

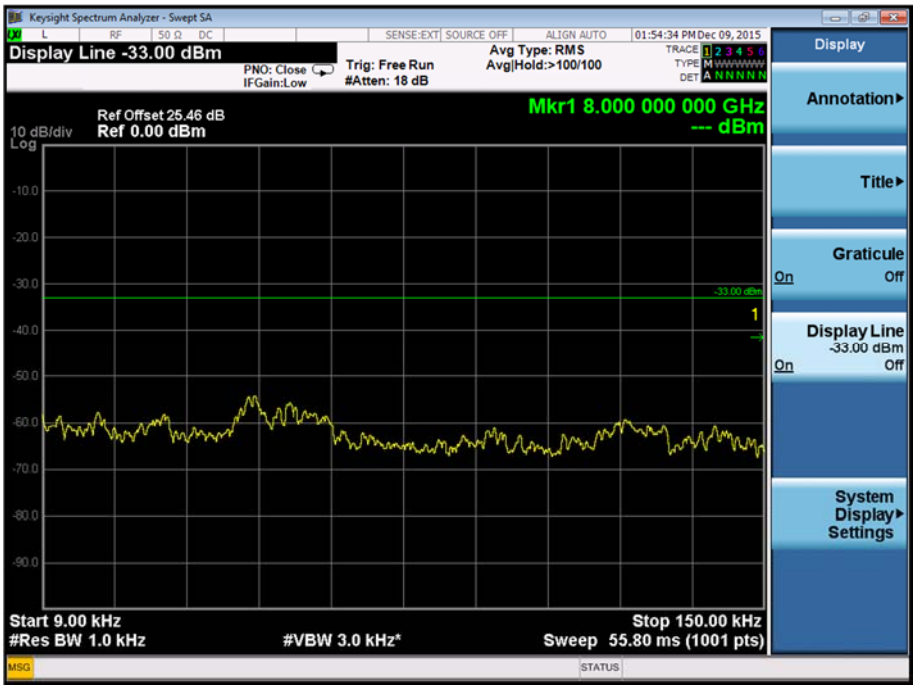


Product Service

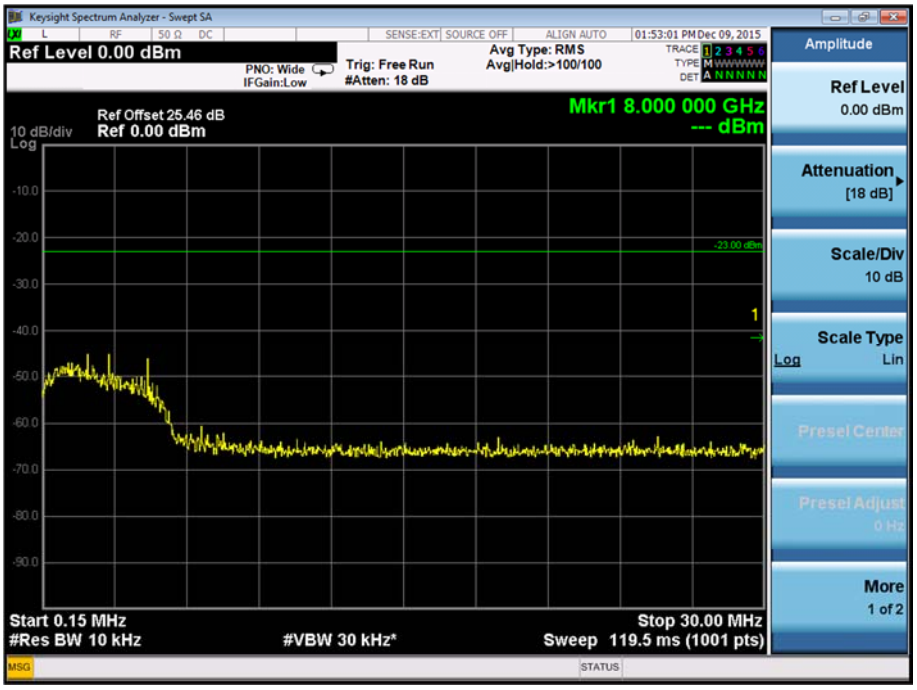
Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, Emission Mask, Spuious at Antenna Terminals Plot



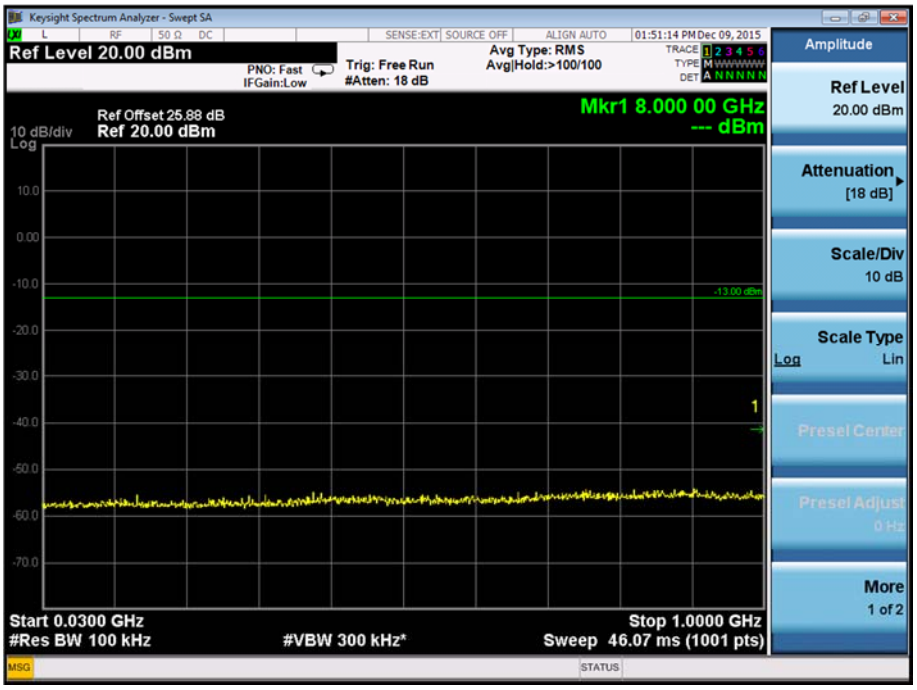
Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, 9 kHz to 150 kHz, Spuious at Antenna Terminals Plot



Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, 150 kHz to 30 MHz, Spuious at Antenna Terminals Plot

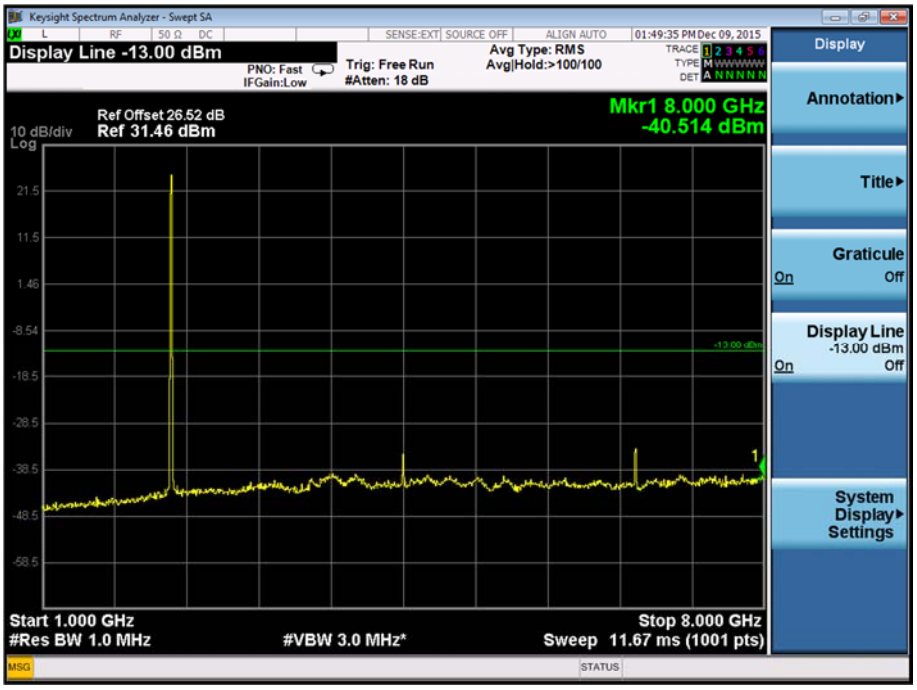


Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, 30 MHz to 1 GHz, Spuious at Antenna Terminals Plot

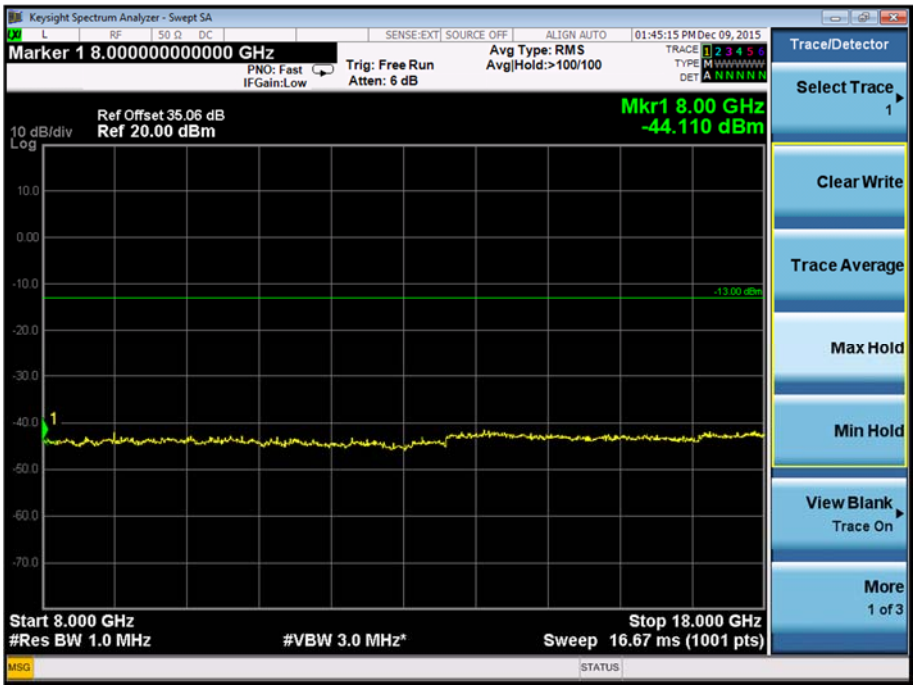


Product Service

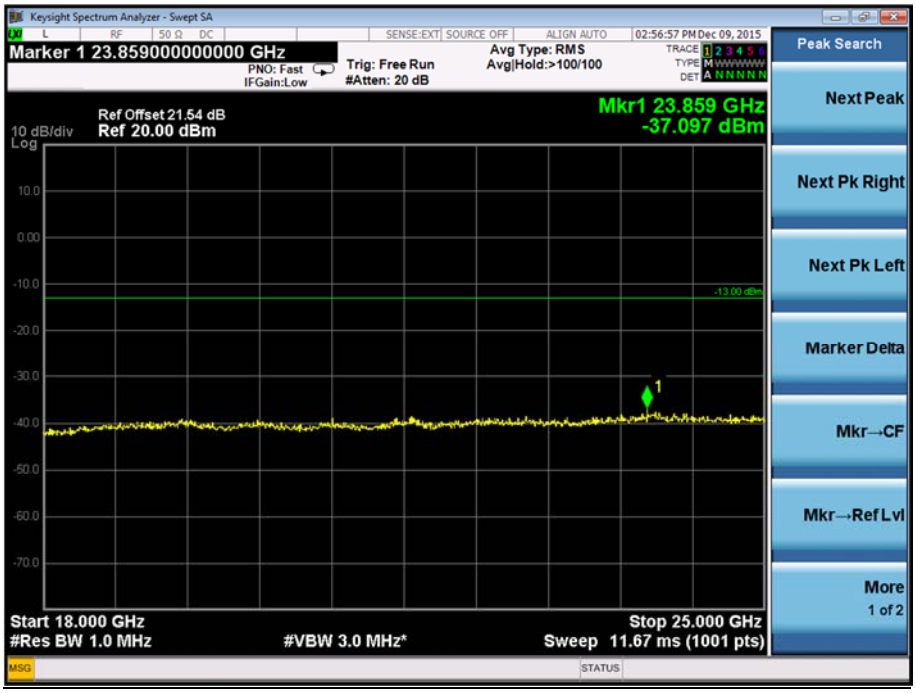
Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, 1 GHz to 8 GHz, Spuious at Antenna Terminals Plot



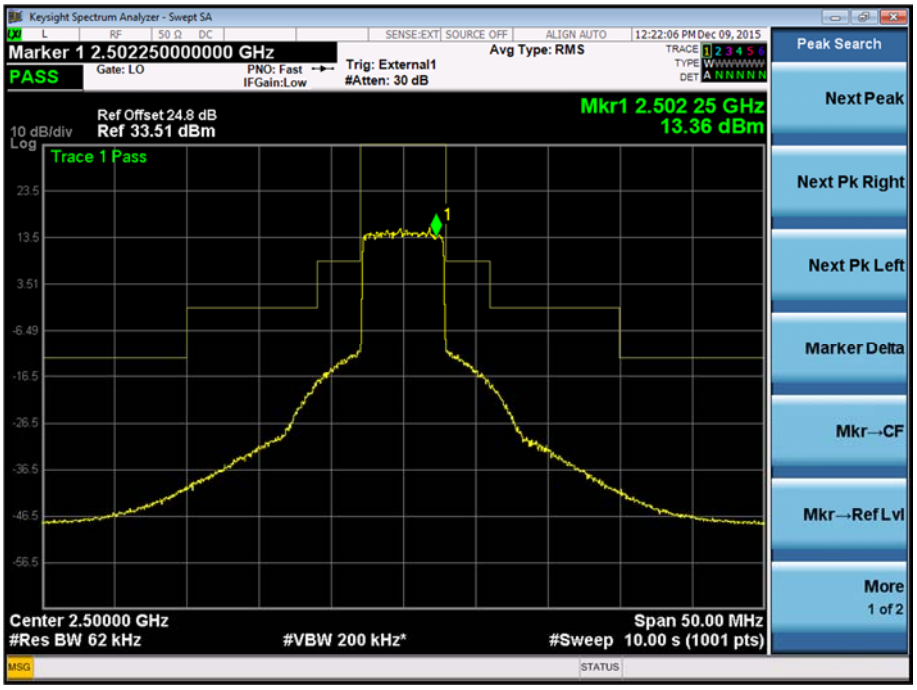
Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, 8 GHz to 18 GHz, Spuious at Antenna Terminals Plot



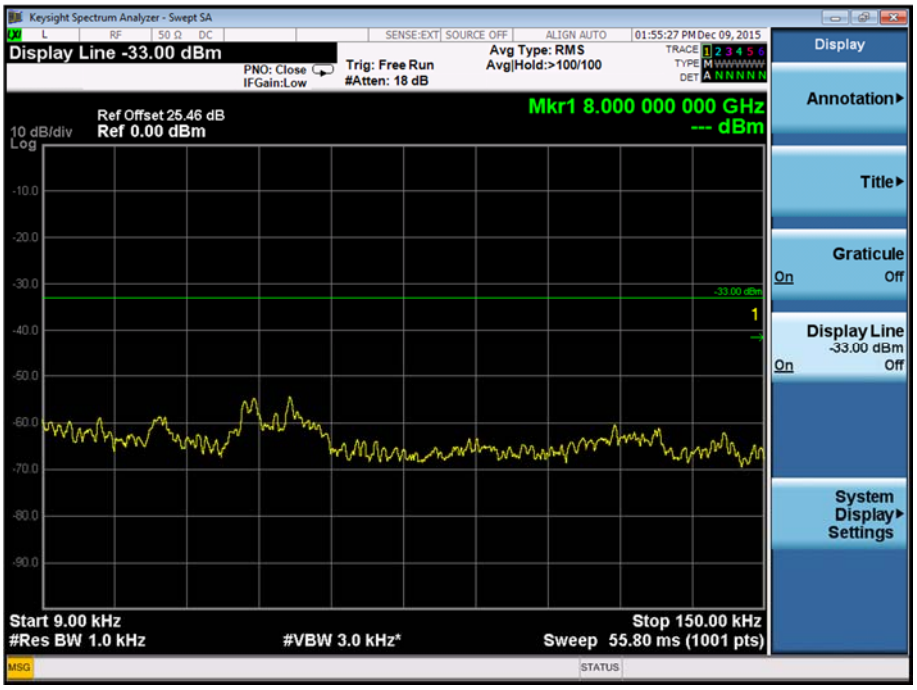
Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, 18 GHz to 25 GHz, Spuious at Antenna Terminals Plot



Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, Emission Mask, Spuious at Antenna Terminals Plot

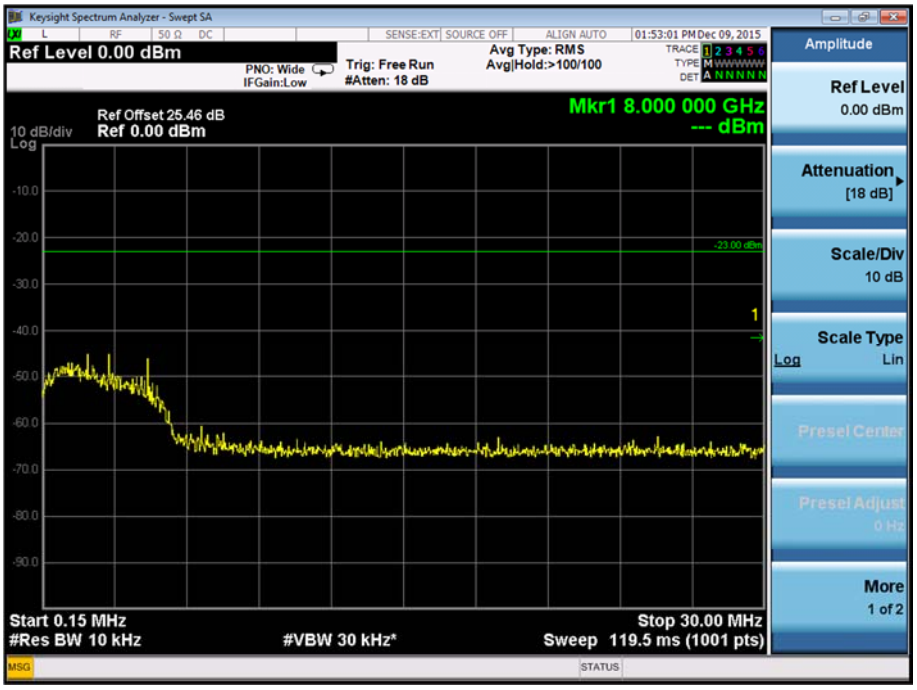


Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, 9 kHz to 150 kHz, Spuious at Antenna Terminals Plot

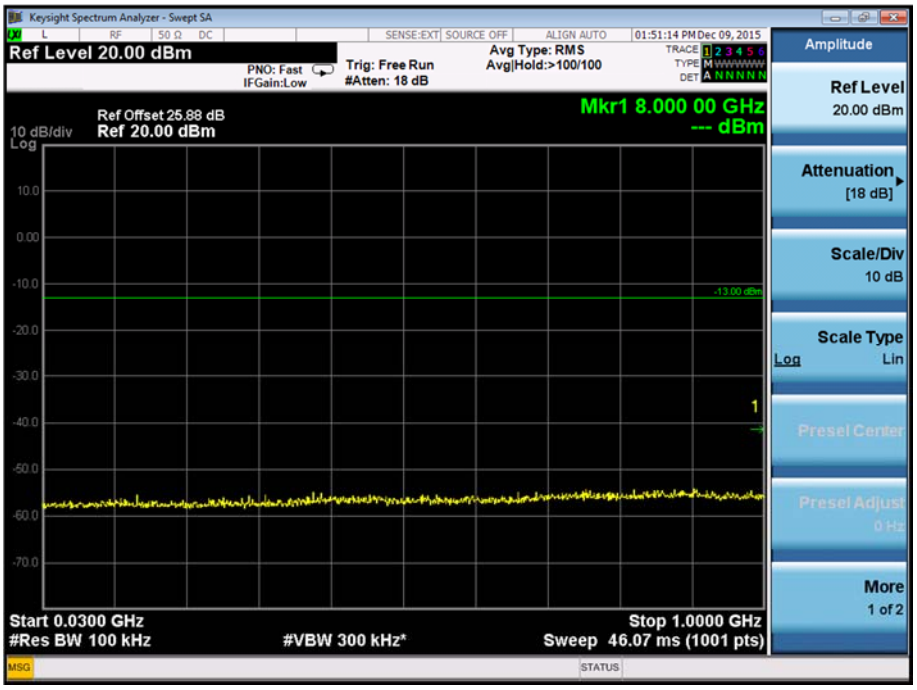


Product Service

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, 150 kHz to 30 MHz, Spuious at Antenna Terminals Plot

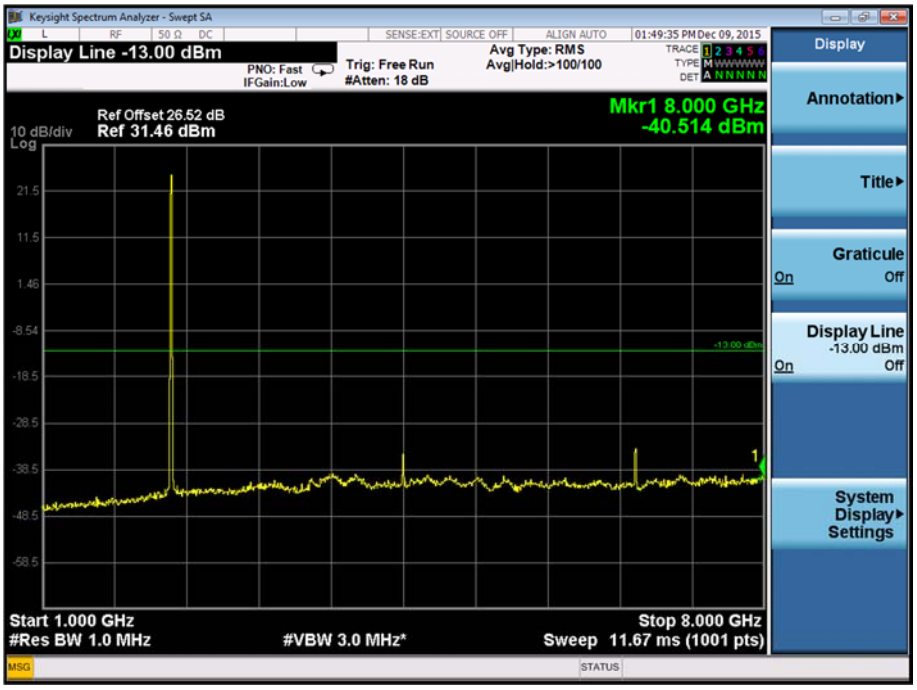


Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, 30 MHz to 1 GHz, Spuious at Antenna Terminals Plot

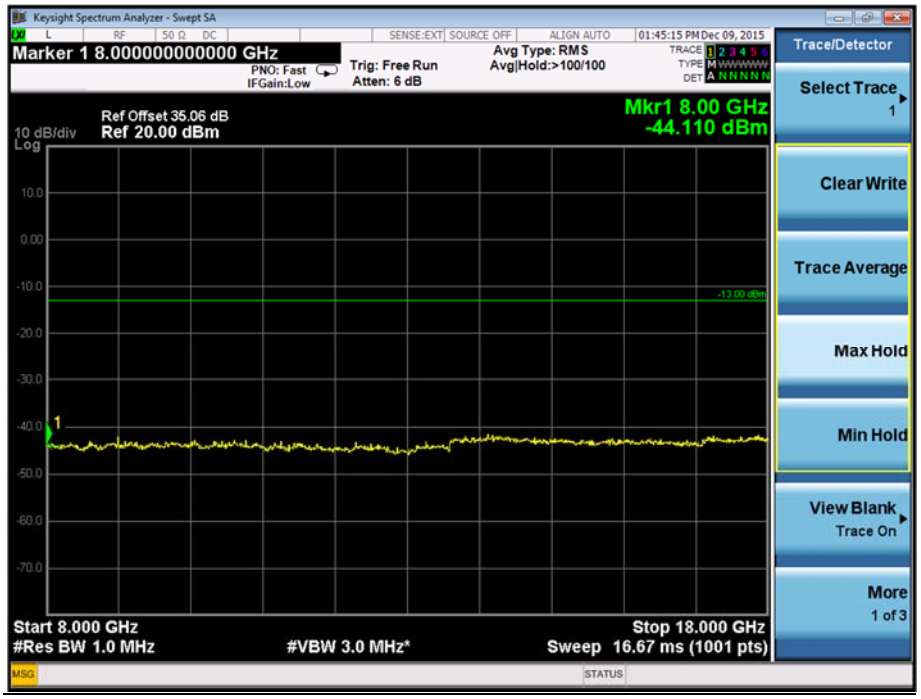


Product Service

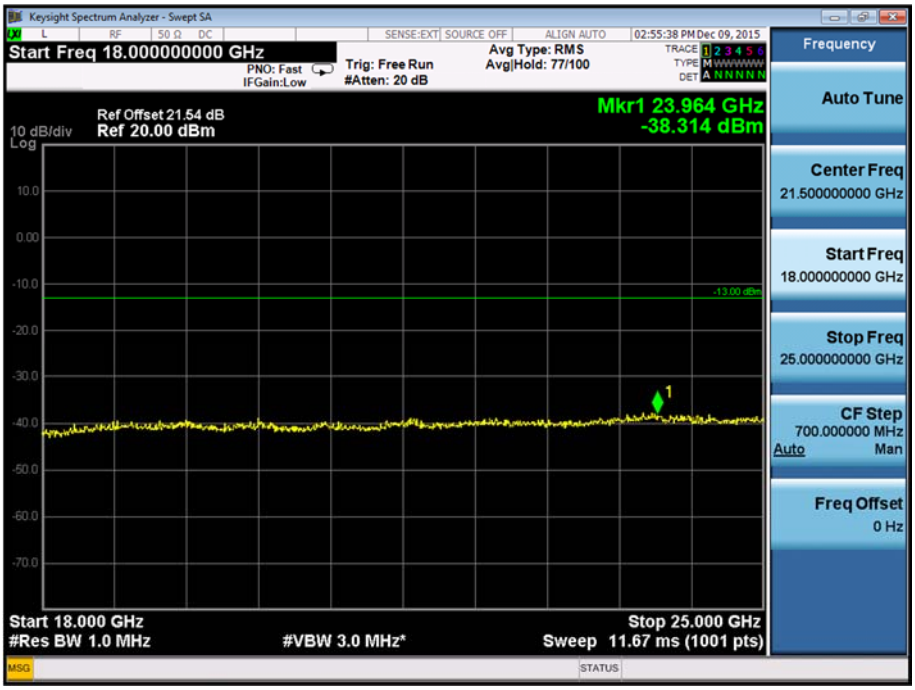
Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, 1 GHz to 8 GHz, Spuious at Antenna Terminals Plot



Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, 8 GHz to 18 GHz, Spuious at Antenna Terminals Plot



Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, 8 GHz to 18 GHz, Spuious at Antenna Terminals Plot



FCC 47 CFR Part 90, Limit Clause 90.210(c)

(c) Emission Mask C. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:
(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (fd/5) dB;
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (fd 2/11) dB or 50 dB, whichever is the lesser attenuation;
(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

2.5 EMISSION MASK

2.5.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.210
FCC 47 CFR Part 2, Clause 2.1051

2.5.2 Equipment Under Test and Modification State

Mesh Phase 5 S/N: 033812 - Modification State 0

2.5.3 Date of Test

15 December 2015

2.5.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.5 Test Procedure

The test was applied in accordance with the test method requirements KDB 971168 Clause 7 and ANSI C63.4 Clause 8.

For emissions greater than 50 kHz removed from the edge of the authorized bandwidth, measurements were performed radiated as follows:

Radiated; A preliminary profile of the Spurious Radiated Emissions was obtained up to the 10th harmonic by operating the EUT on a remotely controlled turntable within a semi-anechoic chamber. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation.

Using the information from the preliminary profiling of the EUT, the list of emissions was then confirmed or updated under Alternative Open Site conditions. Emission levels were maximised by adjusting the antenna height, antenna polarisation and turntable azimuth.

The EUT was set to transmit on maximum power with each channel tested separately.

For any emissions found the EUT was then removed from the chamber and replaced with a substitution antenna. Using a signal generator the level was adjusted to achieve the same value on the measuring instrument as previously recorded with the EUT. The final result was determined by a calculation using the signal generator level, antenna gain and cable loss.

The measurements were performed at a 3m distance unless otherwise stated.

2.5.6 Environmental Conditions

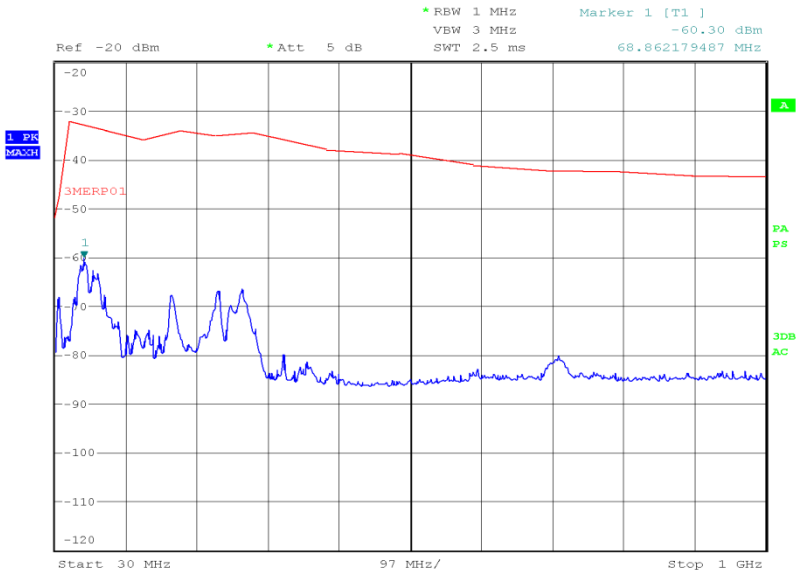
Ambient Temperature	20.5°C
Relative Humidity	47.0%

Product Service

2.5.7 Test Results

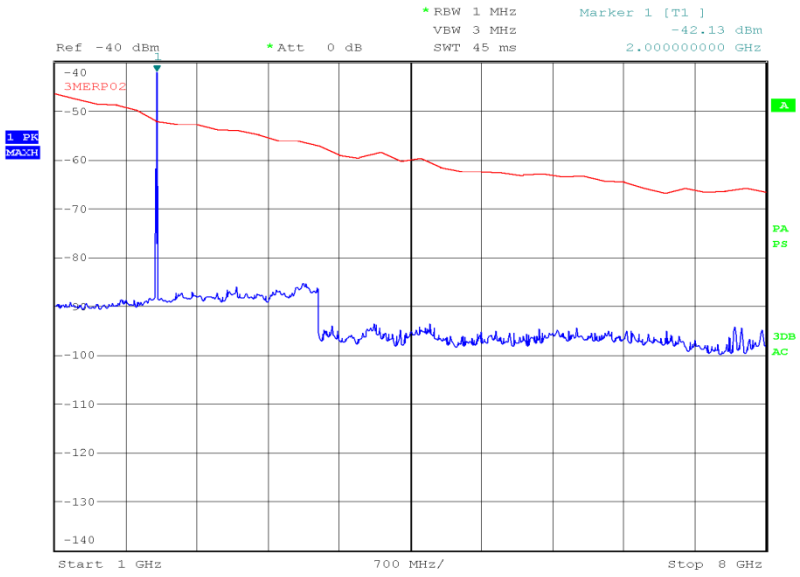
110 V AC

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, 30 MHz to 1 GHz, Spurious Radiated Emissions Plot



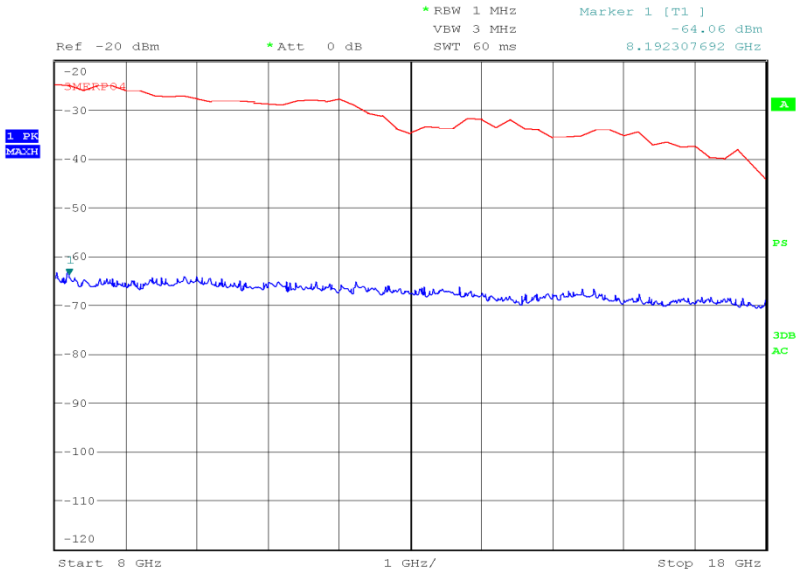
Date: 15.DEC.2015 17:29:45

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, 1 GHz to 8 GHz, Spurious Radiated Emissions Plot



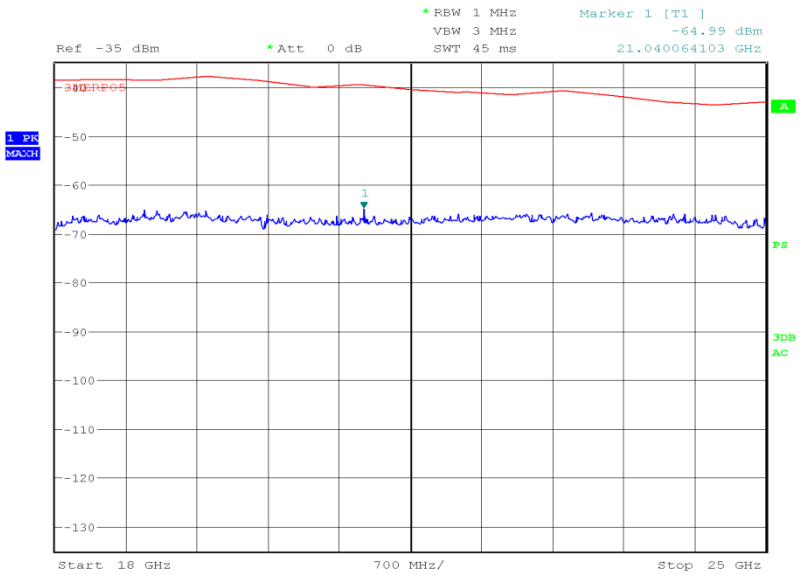
Date: 15.DEC.2015 18:12:44

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, 8 GHz to 18 GHz, Spurious Radiated Emissions Plot



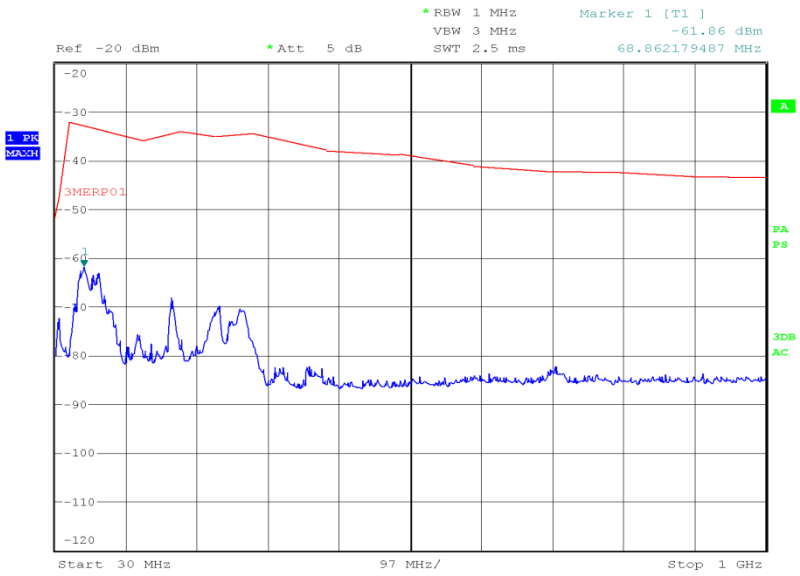
Date: 15.DEC.2015 18:29:21

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2000 MHz, 18 GHz to 25 GHz, Spurious Radiated Emissions Plot



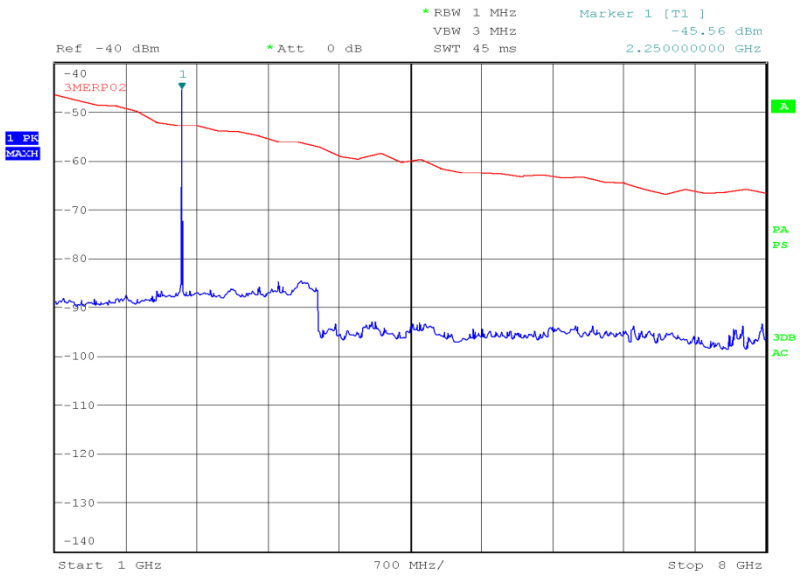
Date: 15.DEC.2015 22:57:54

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, 30 MHz to 1 GHz, Spurious Radiated Emissions Plot



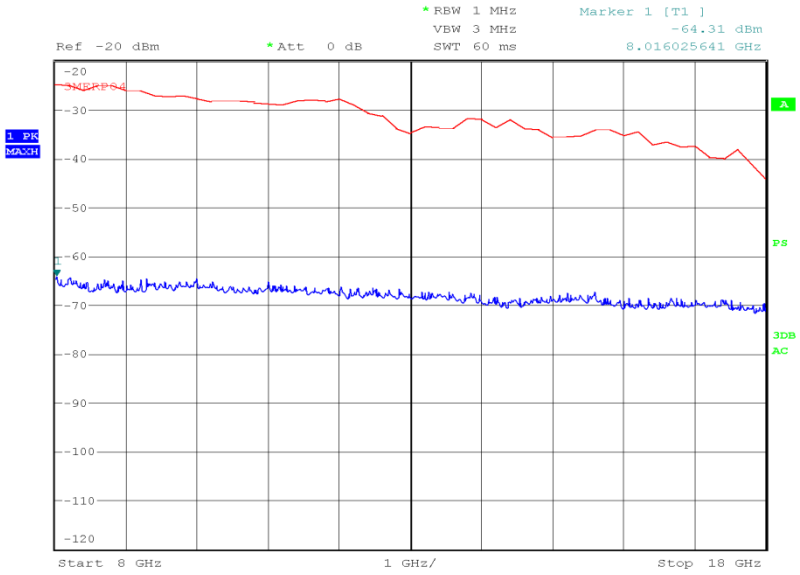
Date: 15.DEC.2015 17:24:14

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, 1 GHz to 8 GHz, Spurious Radiated Emissions Plot



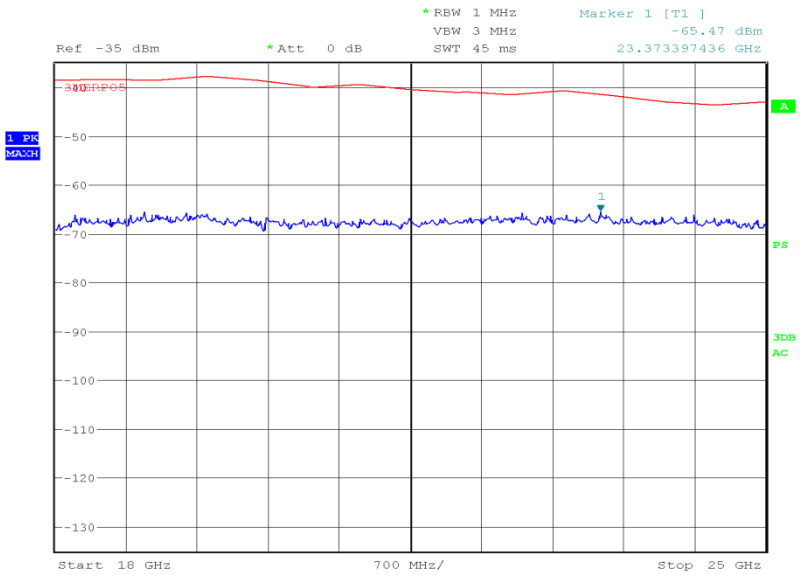
Date: 15.DEC.2015 18:00:58

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, 8 GHz to 18 GHz, Spurious Radiated Emissions Plot



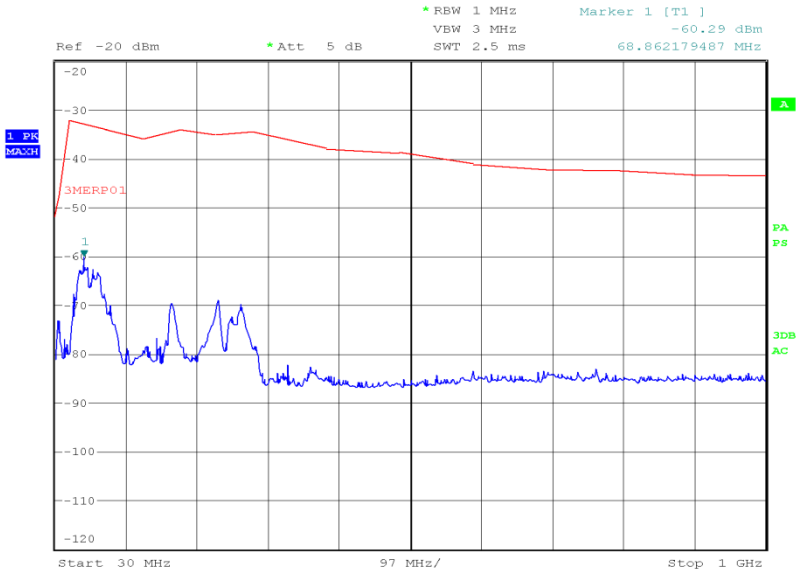
Date: 15.DEC.2015 18:42:52

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, 18 GHz to 25 GHz, Spurious Radiated Emissions Plot



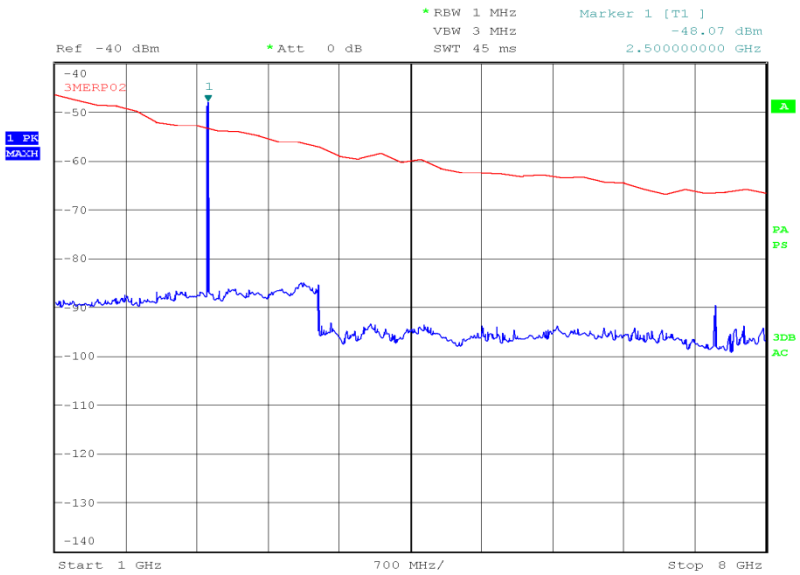
Date: 15.DEC.2015 23:03:45

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, 30 MHz to 1 GHz, Spurious Radiated Emissions Plot



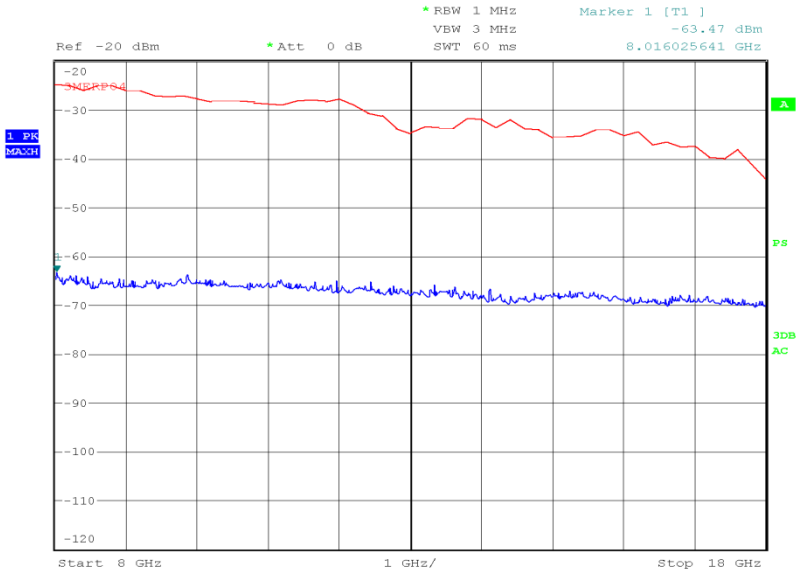
Date: 15.DEC.2015 17:32:36

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, 1 GHz to 8 GHz, Spurious Radiated Emissions Plot



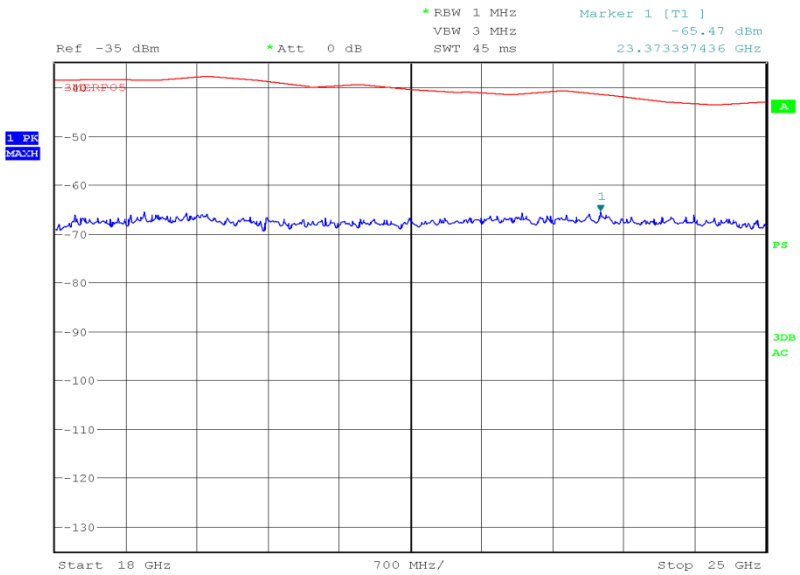
Date: 15.DEC.2015 17:52:04

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, 8 GHz to 18 GHz, Spurious Radiated Emissions Plot



Date: 15.DEC.2015 18:50:42

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2500 MHz, 18 GHz to 25 GHz, Spurious Radiated Emissions Plot



Date: 15.DEC.2015 23:03:45

Product Service

FCC 47 CFR Part 90, Limit Clause 90.210(c)

(c) Emission Mask C. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:
(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (fd/5) dB;
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (fd 2/11) dB or 50 dB, whichever is the lesser attenuation;
(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

2.6 FREQUENCY STABILITY

2.6.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.213
FCC 47 CFR Part 2, Clause 2.1055

2.6.2 Equipment Under Test and Modification State

Mesh Phase 5 S/N: 033812 - Modification State 0

2.6.3 Date of Test

10 December 2015 & 11 December 2015

2.6.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.5 Test Procedure

Measurements were performed in accordance with FCC 47 CFR Part 2, clause 2.1055.

Remarks

The EUT was not capable of transmitting an unmodulated carrier therefore the 10 dB bandwidth points were measured and the centre frequency calculated.

2.6.6 Environmental Conditions

Ambient Temperature	22.7 - 23.4°C
Relative Humidity	35.4 - 47.0%

Product Service

2.6.7 Test Results

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - 12 V DC, 2250 MHz, Transmit, 16-QAM, Frequency Tolerance Under Voltage Variations Results

Voltage	Fundamental Frequency Deviation (ppm)
12 V DC	-0.18
10.2 V DC	0.18
13.8 V DC	0.36

Remarks

The customer declared that the unit has a low voltage cut out that activates at approximately 9.5 V DC. FCC Part 2, clause 2.1055 states that the voltage shall be measured at the input to the cable supplied with the equipment. The voltage drop from the cables supplied was sufficient enough to activate this cut off when the voltage was set at 10.2 V DC. The measurement result recorded was with a supply voltage measured as 11.3 V DC.

FCC 47 CFR Part 90, Limit Clause 90.213

The frequency error shall not exceed 2.5 ppm

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - 48 V DC, 2250 MHz, Transmit, 16-QAM, Frequency Tolerance Under Voltage Variations Results

Voltage	Fundamental Frequency Deviation (ppm)
48 V DC	0.89
40.8 V DC	-0.71
55.2 V DC	-0.71

FCC 47 CFR Part 90, Limit Clause 90.213

The frequency error shall not exceed 2.5 ppm

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, Transmit, 16-QAM, Frequency Tolerance Under Temperature Variations Results

Temperature Interval	Fundamental Frequency Deviation (ppm)
-30 ºC	-0.36
-20 ºC	-0.53
-10 ºC	-0.53
0 ºC	-0.36
+10 ºC	-0.36
+20 ºC	-0.18
+30 ºC	-0.18
+40 ºC	0.18
+50 ºC	-0.89

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, 2250 MHz, Transmit, 16-QAM, Frequency Tolerance Under Voltage Variations Results

Voltage	Fundamental Frequency Deviation (ppm)
110 V AC	-0.18
93.5 V AC	-1.07
126.5 V AC	-0.53

FCC 47 CFR Part 90, Limit Clause

None specified

2.7 MODULATION CHARACTERISTICS

2.7.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1047 (d)

2.7.2 Equipment Under Test and Modification State

Mesh Phase 5 S/N: 033812 - Modification State 0

2.7.3 Date of Test

9 December 2015

2.7.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.7.5 Test Procedure

The test was performed in accordance with KDB 971168 D01 v02 r02, clause 3.

2.7.6 Environmental Conditions

Ambient Temperature	.0°C
Relative Humidity	.0%

Product Service

2.7.7 Test Results

110 V AC Supply

Transmit - 16-QAM 2/3 - 6.0 MHz Bandwidth - PoE at 50 V, Modulation Characteristics, Customer Description

The modualtion schemes used in the device are 16-QAM 2/3, 16-QAM 1/2, QPSK 2/3, QPSK 1/2 and BPSK 2/3. The different modulation schemes are used by the radio to provide an optimal balance of robustness and data capacity as the quality of the link changes. The most robust modes will sustain the link the longest as the path loss increases through range or environment (e.g. urban NLOS) whilst reducing the data capacity. Where the link can sustain it higher order modulation is used to maximise the data throughput of the system.

FCC 47 CFR Part 2, Limit Clause 2.1047 (d)

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.

Product Service

SECTION 3

TEST EQUIPMENT USED

Product Service

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1 – Maximum Conducted Output Power					
Attenuator 10dB/25W	Weinschel	46-10-43	400	12	18-Jun-2016
Attenuator 10dB/10W)	Trilithic	HFP-50N	454	12	19-Aug-2016
Attenuator (10dB, 10W)	Texscan	HFP-50N	468	12	22-Jun-2016
Attenuator (10dB)	Weinschel	47-10-34	481	12	1-Apr-2016
Broadband Resistive Power Divider	Weinschel	1506A	601	12	24-Mar-2016
Crystal Detector	Hewlett Packard	8470B	1320	12	5-Jun-2016
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	1-Apr-2016
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	12-Dec-2015
Attenuator (20dB, 150W)	Narda	769-20	3367	12	29-May-2016
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
DC - 12.4 GHz 10 dB Attenuator 1 W	Suhner	6810.17.A	3964	12	23-Oct-2016
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
DC to TTL Converter	TUV SUD Product Service	N/A	4377	-	TU
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4504	12	26-Feb-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4505	12	26-Feb-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4506	12	26-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016
Section 2.2 - Type of Emissions					
Attenuator 10dB/10W)	Trilithic	HFP-50N	454	12	19-Aug-2016
Attenuator (10dB, 10W)	Texscan	HFP-50N	468	12	22-Jun-2016
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	1-Apr-2016
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	12-Dec-2015
Attenuator (20dB, 150W)	Narda	769-20	3367	12	29-May-2016
DC - 12.4 GHz 10 dB Attenuator 1 W	Suhner	6810.17.A	3964	12	23-Oct-2016
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4056	-	O/P Mon
Hygropalm Temperature and Humidity Meter	Rotronic	HP21	4410	12	15-Apr-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4504	12	26-Feb-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4505	12	26-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016

Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.3 - Occupied Bandwidth					
Attenuator 10dB/10W)	Trilithic	HFP-50N	454	12	19-Aug-2016
Attenuator (10dB, 10W)	Texscan	HFP-50N	468	12	22-Jun-2016
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	1-Apr-2016
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	12-Dec-2015
Attenuator (20dB, 150W)	Narda	769-20	3367	12	29-May-2016
DC - 12.4 GHz 10 dB Attenuator 1 W	Suhner	6810.17.A	3964	12	23-Oct-2016
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4056	-	O/P Mon
Hygropalm Temperature and Humidity Meter	Rotronic	HP21	4410	12	15-Apr-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4504	12	26-Feb-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4505	12	26-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016
Section 2.4- Spurious Emissions at Antenna Terminals					
Attenuator 10dB/25W	Weinschel	46-10-43	400	12	18-Jun-2016
Attenuator 10dB/10W)	Trilithic	HFP-50N	454	12	19-Aug-2016
Attenuator (10dB, 10W)	Texscan	HFP-50N	468	12	22-Jun-2016
Attenuator (10dB)	Weinschel	47-10-34	481	12	1-Apr-2016
Broadband Resistive Power Divider	Weinschel	1506A	601	12	24-Mar-2016
Splitter	Weinschel	1593	1292	12	11-May-2016
Crystal Detector	Hewlett Packard	8470B	1320	12	5-Jun-2016
Attenuator (9dB, 1W, SMA dc - 18GHz)	Midwest Microwave	444	2775	-	O/P Mon
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	1-Apr-2016
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	12-Dec-2015
Power Divider	Weinschel	1506A	3345	12	2-Jun-2016
Attenuator (20dB, 150W)	Narda	769-20	3367	12	29-May-2016
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
DC - 12.4 GHz 10 dB Attenuator 1 W	Suhner	6810.17.A	3964	12	23-Oct-2016
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
DC to TTL Converter	TUV SUD Product Service	N/A	4377	-	TU
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4504	12	26-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.5 - Emission Mask					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	29-Apr-2016
Antenna (Double Ridge Guide)	Q-Par Angus Ltd	QSH 180K	1511	24	27-Nov-2016
Pre-Amplifier	Phase One	PS04-0086	1533	12	30-Jul-2016
Pre-Amplifier	Phase One	PSO4-0087	1534	12	23-Dec-2015
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Filter (Hi Pass)	Lorch	9HP7-7000-SR	2833	12	5-Feb-2016
Antenna (Bilog)	Chase	CBL6143	2904	24	11-Jun-2017
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	2-Nov-2016
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Multimeter	Fluke	177	3833	12	16-Jun-2016
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Hygropalm Temperature and Humidity Meter	Rotronic	HP21	4410	12	15-Apr-2016
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	-	TU
Cable (Rx, SMAm-SMAm 0.5m)	Scott Cables	SLSLL18-SMSM-00.50M	4528	6	19-Feb-2016
Section 2.6 - Frequency Stability					
Digital Temperature Indicator + T/C	Fluke	51	412	12	19-Feb-2016
Attenuator 10dB/10W)	Trilithic	HFP-50N	454	12	19-Aug-2016
Attenuator (10dB, 10W)	Texscan	HFP-50N	468	12	22-Jun-2016
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	13-Feb-2016
Mains Voltage Monitor	TUV SUD Product Service	MVM1	1378	12	3-Sep-2016
Programmable Power Supply	California Inst	2001RP	1898	-	TU
Multimeter	Iso-tech	IDM101	2422	12	22-Jan-2016
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	1-Apr-2016
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	12-Dec-2015
Power Divider	Weinschel	1506A	3345	12	2-Jun-2016
Attenuator (20dB, 150W)	Narda	769-20	3367	12	29-May-2016
DC - 12.4 GHz 10 dB Attenuator 1 W	Suhner	6810.17.A	3964	12	23-Oct-2016
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	13-Feb-2016
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016

TU – Traceability Unscheduled
O/P MON – Output Monitored with Calibrated Equipment

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	MU
Spurious Emissions at Antenna Terminals	± 3.454 dB
Maximum Conducted Output Power	± 0.70 dB
Type of Emissions	N/A
Occupied Bandwidth	± 16.74 kHz
Emission Mask	± 3.08 dB
Frequency Stability	± 46.70 Hz
Modulation Characteristics	-

Product Service

SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).