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RF Test Report:

Altiostar Proxima LTE iRRH

FCC ID: NXP-44380400

SC_TR_153_C

Prepared for:

Altiostar Inc.
100 Ames Pond Drive
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MA 01876
USA

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1 Revision History

Revision	Originator	Date	Comment
A	C Blackham	13 Feb 2015	1st release
B	C Blackham	12 Mar 2015	Two typing errors corrected
C	C Blackham	16 Mar 2015	Extra test results added

2 Purpose

This document details the Altiostar Proxima P4 LTE iRRH (intelligent Remote Radio Head), model number iRU44380400-1, designed to transmit in the 2110-2155 MHz band.

3 Reference Documents

[Ref 1]	47CFR2	Title 47 Code of Federal Regulations Part 2: frequency allocations and radio treaty matters; general rules and regulations
[Ref 2]	47 CRF27	Title 47 Code of Federal Regulations Part 27: Miscellaneous Communications Services
[Ref 3]	TIA-603-C	Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards
[Ref 4]	KDB 662911 D01 v02r01	Federal Communications Commission Office of Engineering and Technology Laboratory Division; Emissions Testing of Transmitters with Multiple Outputs in the Same Band (e.g., MIMO, Smart Antenna, etc)
[Ref 5]	KDB971168 DO1 v02r02	Federal Communications Commission Office of Engineering and Technology Laboratory Division; Measurement guidance for certification of licensed digital transmitters.

4 Test Information

4.1 Client

Altiostar Inc.

100 Ames Pond Drive

Tewksbury

MA 01876

USA

4.2 Test personnel

Antenna port tests

Testing was performed by Charlie Blackham of Sulis Consultants Ltd at Altiostar UK offices on 6th February 2015 and 16th March 2016, and at Hursley EMC on 10th February 2015.

Radiated Spurious Emissions (section 12)

Testing was performed by Richard Pennell of Hursley EMC services Ltd, at their FCC Registered test facility, UK designation number UK0006, on 10th February 2015 under job 15R058.

4.3 Test sample

The results herein only refer to sample detailed in section 6

5 Product Description

The basestation supports operation with 10 and 20 MHz bandwidths, with OFDMA modulation at the following modulation rates:

- QPSK
- 16 QAM
- 64 QAM

The unit is fitted with four RF transceiver RF ports, Ant1, ANT2, ANT3 and Ant4. These are designed to support MIMO operation and are connected to:

Either four 2dBi omnidirectional antennas

Or a pair of external cross-polarised sectored antennas with maximum gain of 18dBi.

Transmit power was set to maximum permitted of 1.5 W (31.8dBm) per port.

Measurements were performed on the following channels within the band of operation:

10 MHz channels: 2150 MHz

20 MHz channels: 2145 MHz

The test waveform has a 100% duty cycle so no gating or allowance for duty cycle is required when taking measurements

6 Test Configuration

6.1 Test sample and Operating mode

The equipment under test (EUT) was:

Manufacturer	Name	Model Number	Serial Number
Altiostar	Proxima P4	iRU44380400-1	4014681

Table 1: Equipment under test

6.2 Support equipment

The support equipment was:

Description	Manufacturer	Name	Serial Number
Laptop	HP	250	Dvt-mobile altiostar

Table 2: Support Equipment

6.3 Equipment set-up

Equipment was configured as per figure 1:

- The Proxima system was configured used a web browser application that allowed the unit to be placed into a test mode and the required frequency, bandwidth and power to be set
- The insertion loss of the Attenuator and Co-ax cable were before testing and their combined path-loss was programmed into the analyser as a Transducer Factor.

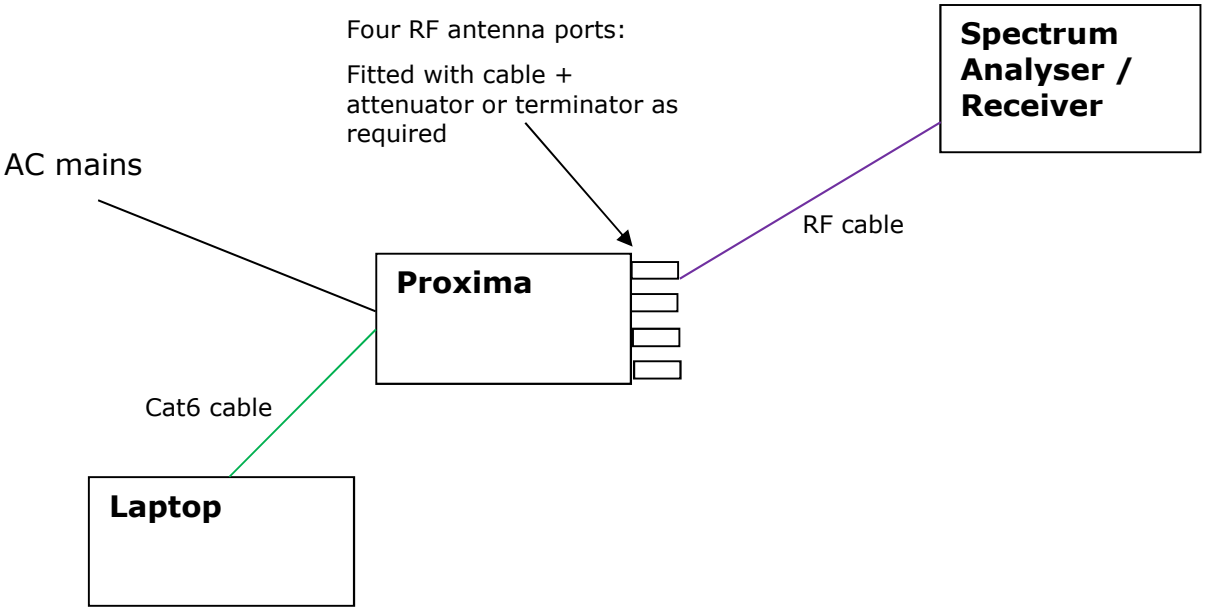


Figure 1: Configuration for test

7 Summary of Tests performed

Test	47 CFR Part	Limit	Result	Section
Transmit Power	27.50(d)(2) / 2.1046	1640 W EIRP	Pass	8
Spectral Power Density	27.50(d)(2) / 2.1046	1640 W EIRP/MHz	Pass	9
Occupied Bandwidth	2.1049	None	Pass	10
Conducted Spurious Emissions (out of band)	27.53(h) / 2.1051	-13 dBm	Pass	11
Radiated Spurious Emissions	27.53(h) / 2.1053	-13 dBm	Pass	12
Frequency Stability	27.54 / 2.10	None	See report SC_TR_154_A	

Table 3: Summary of tests performed

8 Transmit Power 47CFR90.1321

8.1 Requirement and test method

The Proxima device is designed to be installed without Geographic limits.

27.50 Power limits and duty cycle.

(d) (2) The power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:

(i) An equivalent isotropically radiated power (EIRP) of 1640 watts when transmitting with an emission bandwidth of 1 MHz or less;

(ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.

(d)(5) Equipment employed must be authorized in accordance with the provisions of §24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

(d)(6) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

Measurement made using KDB971168 DO1, section 5.2

The total power was summed in accordance with KDB662911D01 and the result compared against the limit. Specifically, the power was measured at Antenna port 1 and then 10log4 dB, or 6 dB, was added to show total power from all four ports.

8.2 Test results

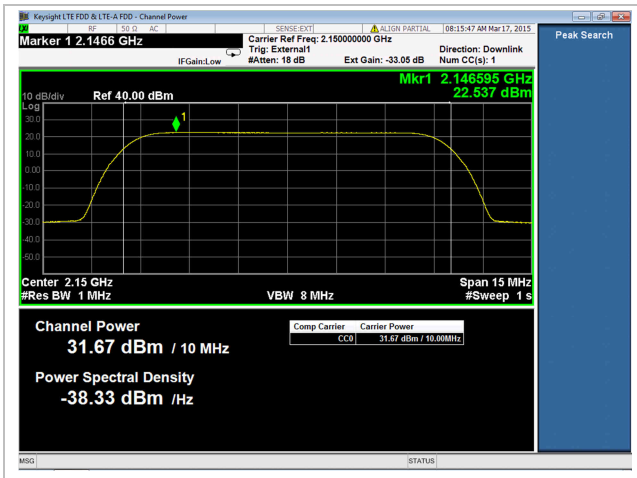
The table below shows worst case results for plots in figure 2.

Further plots of other modes are shown in figure 3.

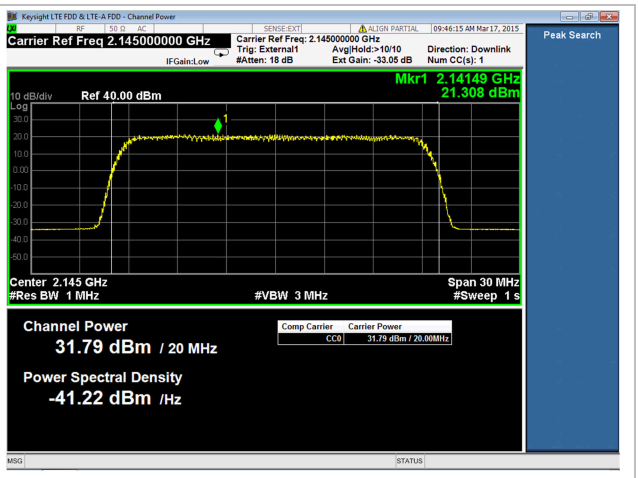
Channel Bandwidth	Port	TX power (dBm)	Summed TX power (dBm)	TX power EIRP (dBm)	TX power EIRP (W)	Limit EIRP (W)	Result	Modulation
10	Ant 1	31.67	37.67	55.66	370.7	1640.0	Pass	QPSK
20	Ant 1	31.79	37.79	55.79	379.3	1640.0	Pass	16QAM

Table 4: Transmit power

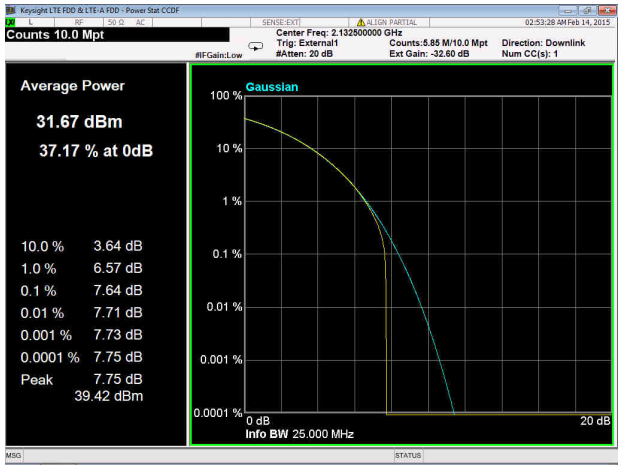
Peak to Average (PAR) ratio is controlled using crest factor reduction techniques and worst case is 7.75dBm, plot PAR in figure 2.



10 MHz channel, QPSK

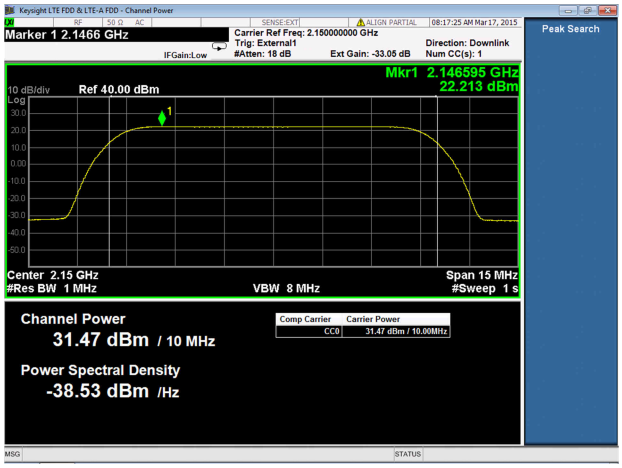


20 MHz channel, 16 QAM

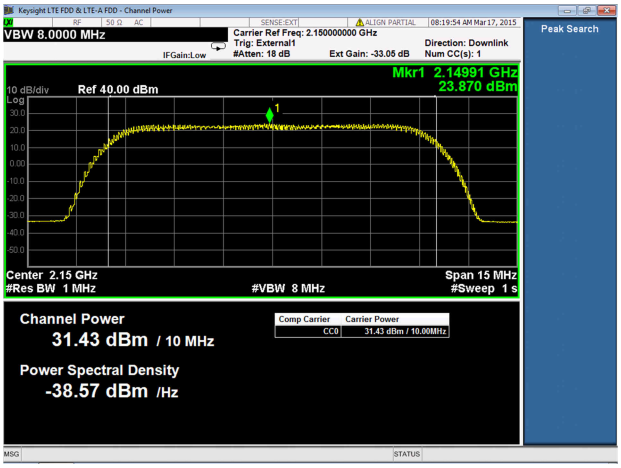


PAR

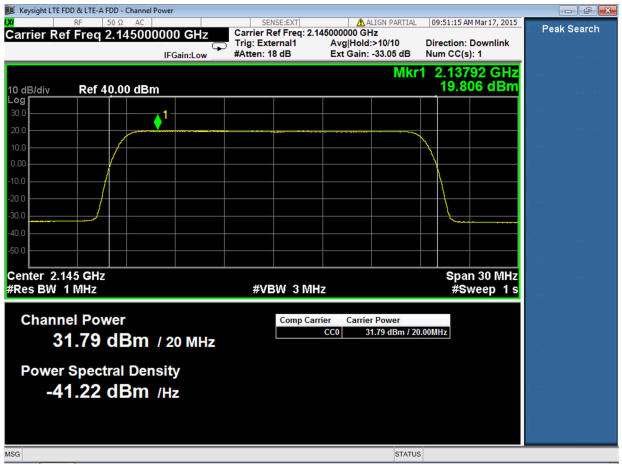
Figure 2: Transmit Power and PAR plots



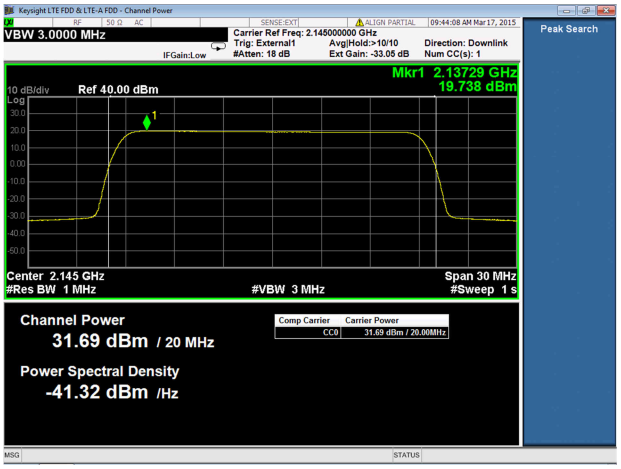
10 MHz Channel, 64 QAM



10 MHz Channel, 16 QAM



20 MHz Channel, 64 QAM



20 MHz Channel, QPSK

Figure 3: Additional Transmit Power plots

9 Spectral Power Density

9.1 Requirement and test method

As per section 8.1

Measured using 1 MHz RBW and peak search

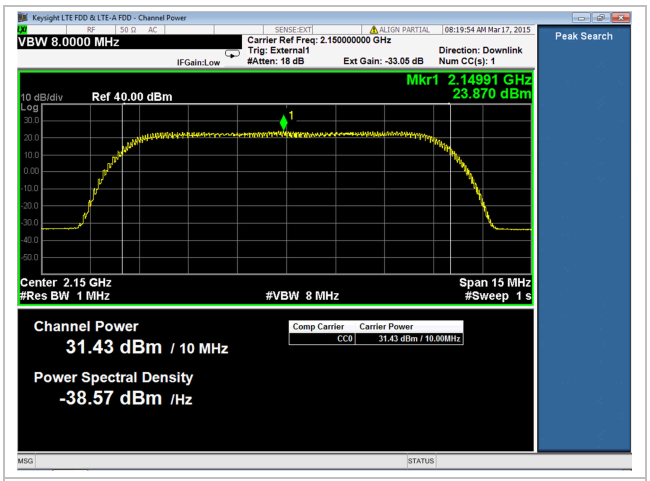
9.2 Test results

The table below shows worst case results for plots in figure 4.

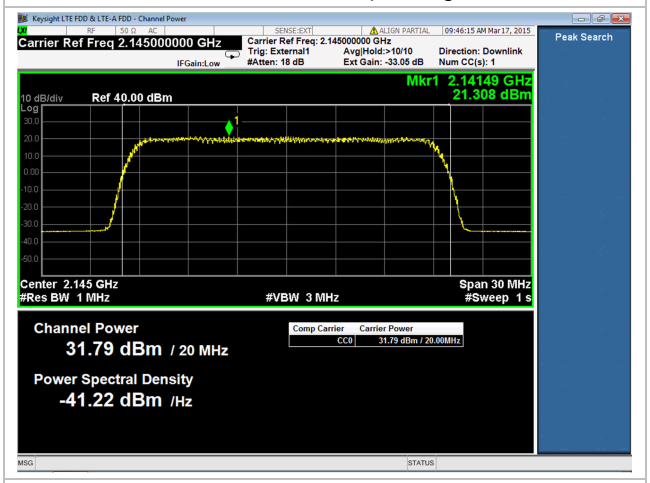
Further plots of other modes are shown in figure 5.

Channel Bandwidth	TX power (dBm)	Summed TX power (dBm)	TX power EIRP (dBm)	TX power EIRP (W)	Limit EIRP (W)	Result	Modulation
10	23.870	29.87	47.87	61.2	1640.0	Pass	16 QAM
20	21.308	27.31	45.31	33.9	1640.0	Pass	16 QAM

Table 5: Transmit power spectral density

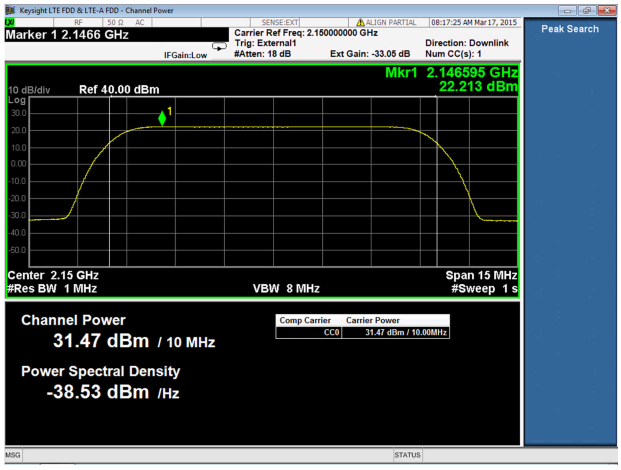


10 MHz channel, 16 QAM

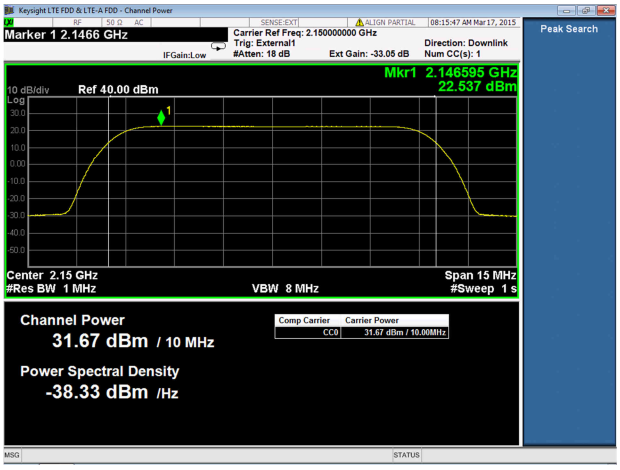


20 MHz channel, 16 QAM

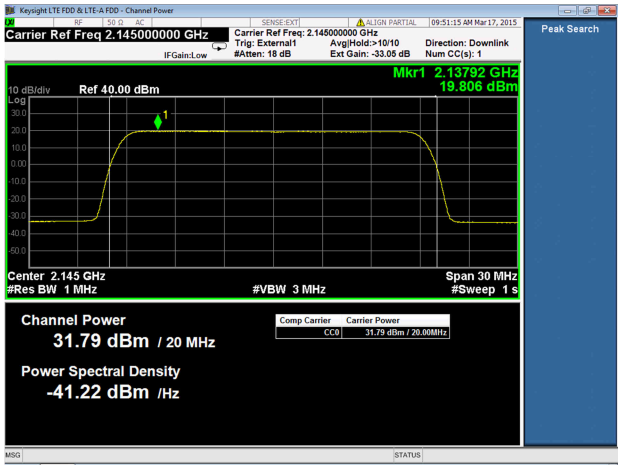
Figure 4: Transmit Power Spectral Density plots



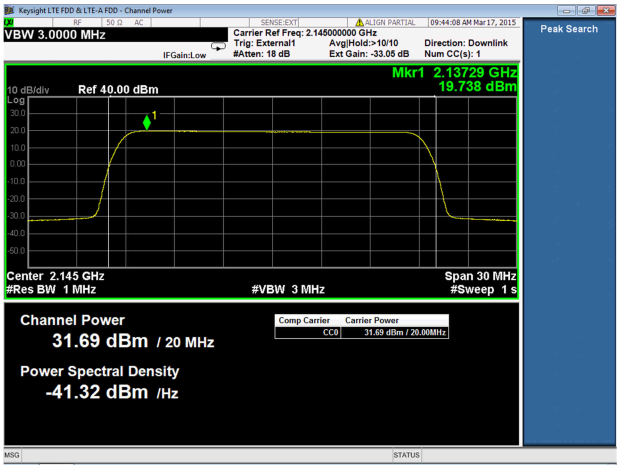
10 MHz Channel, 64 QAM



10 MHz Channel, QPSK



20 MHz Channel, 64 QAM



20 MHz Channel, QPSK

Figure 5: Additional PSD plots

10 Occupied Bandwidth

The occupied bandwidth was measured using the inbuilt function on the Signal Analyser set to measure the 99.5% (-26 dB) emission bandwidth. Measurement was made using RMS detector.

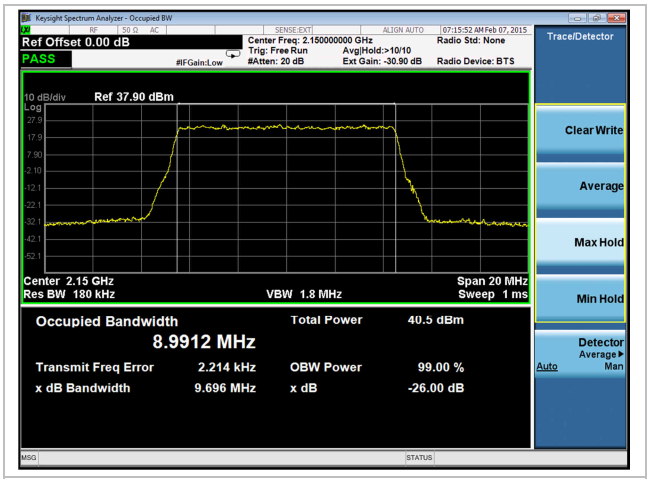
There is no pass/fail criterion so measurement results are reported without reference to a limit for measurements on antenna port 1.

The table below shows worst case results for plots in figure 6.

Further plots of other modes are shown in figure 7.

Channel Bandwidth	TX Freq (MHz)	Occupied Bandwidth (MHz)	Modulation
10	2150	8.991	QPSK
20	2145	17.964	QPSK

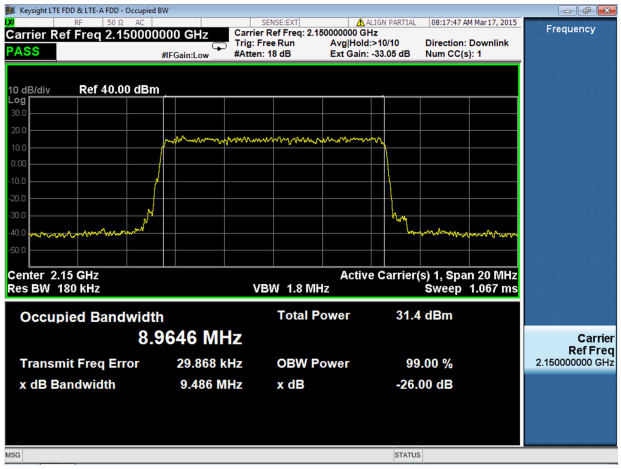
Table 6: Occupied Bandwidth test results



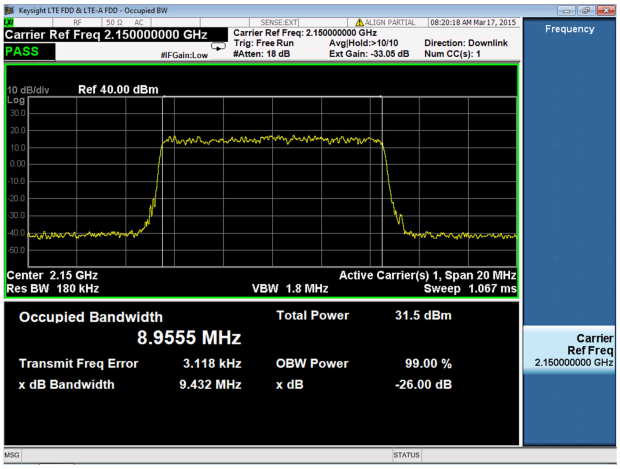
10 MHz channel, QPSK

20 MHz channel, QPSK

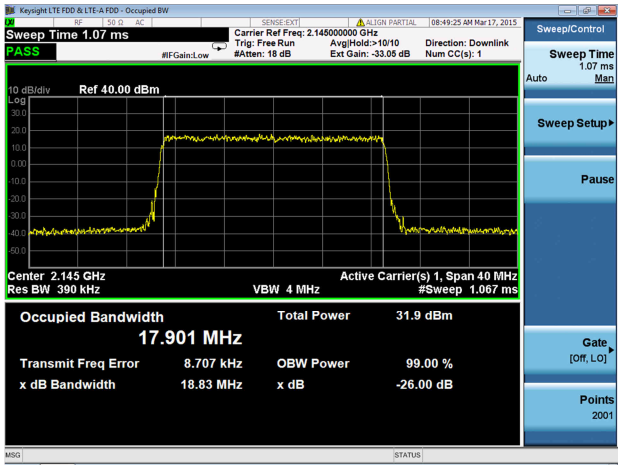
Figure 6: Occupied Bandwidth plots



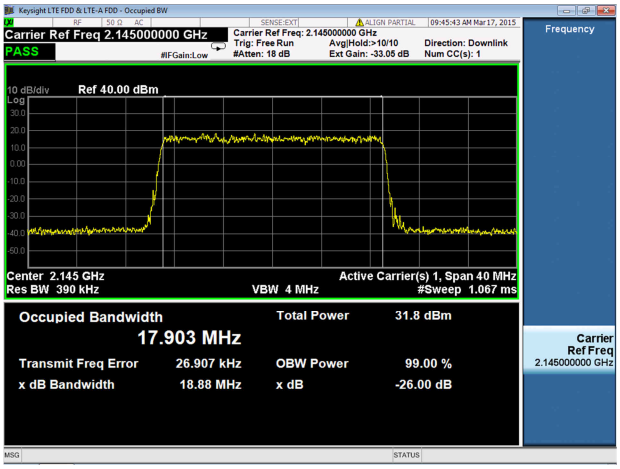
10 MHz Channel, 64 QAM



10 MHz Channel, 16 QAM



20 MHz Channel, 64 QAM



20 MHz Channel, 16 QAM

Figure 7: Additional PSD plots

11 Conducted Spurious Emissions inc. Band Edge

11.1 Requirement and test method

> 27.53(h) AWS emission limits—(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 log10 (P) dB.

The licensed band of operation was considered to be a single 10 MHz channel for 10 MHz operation and a single 20 MHz channel for 20 MHz operation.

Initial scan was performed on top channel.

Emissions exceeded the limit close to the fundamental transmission frequency and these were investigated using RMS detector and adjacent channel power measurement capability of the spectrum analyser as shown on plots Screen 11.

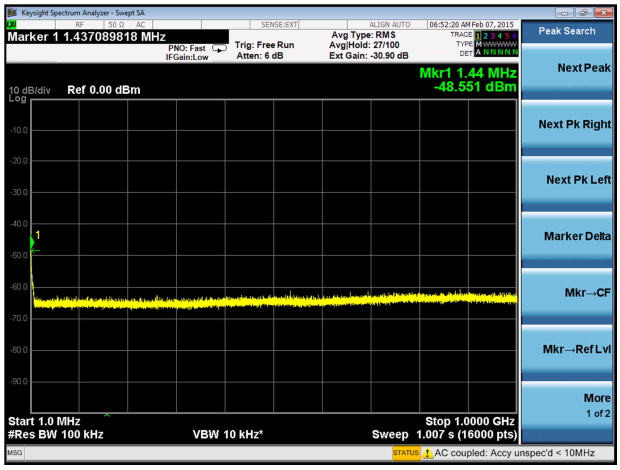
Determination of total spurious emission was done by adding 10 log (4), or 6.0 dB to the emission level measured on port Ant1 and this was compares with limit of -13dBm as per KDB 662911 section 3(a)(iii)

11.2 Results for 10 MHz channels

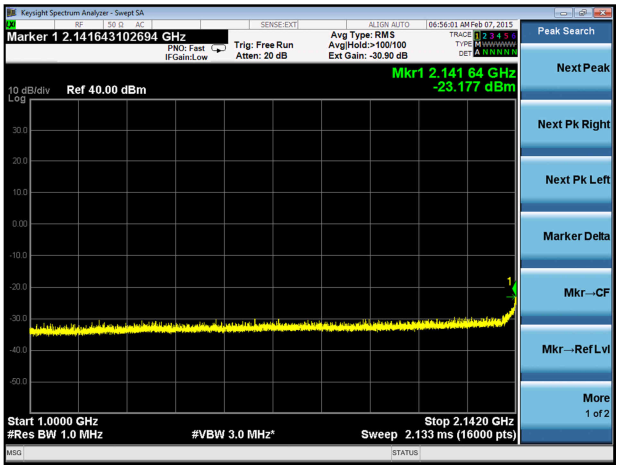
Test performed on antenna port 1 for QPSK modulation which had highest TX power and widest Occupied Bandwidth

Frequency Range	Maximum emission (Measured)	Maximum emission (calculated)	Limit (dBm)	Result	Plot
10-1000 MHz	-48.5	-42.5	-13.0	Pass	Screen 12
1000-2142 MHz	-23.177	-17.177	-13.0	Pass	Screen 13
2142-2145 MHz 2155-2158 MHz	-27.67	-21.67	-13.0	Pass	Screen 11
2158–3000 MHz	-25.08	-19.08	-13.0	Pass	Screen 14
3 – 10 GHz	-25.7	-21.7	-13.0	Pass	Screen 15
10-22 GHz	-54.17	-48.17	-13.0	Pass	15R058C1

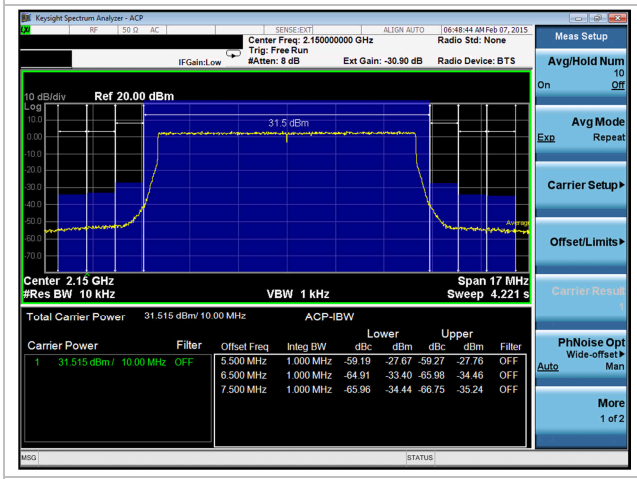
Table 7: Conducted spurious emissions, 10 MHz channel



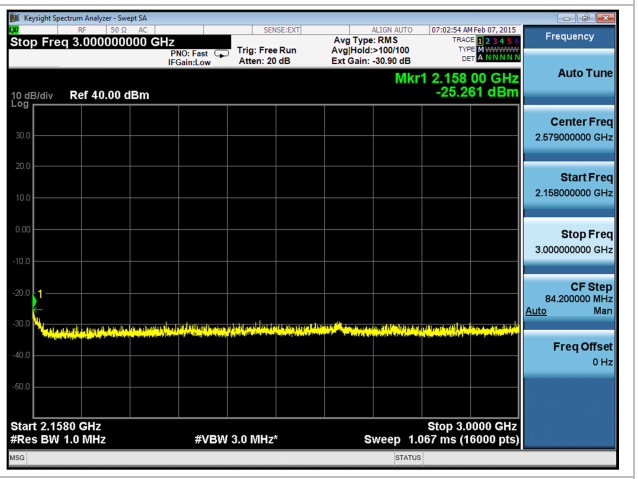
Screen 12



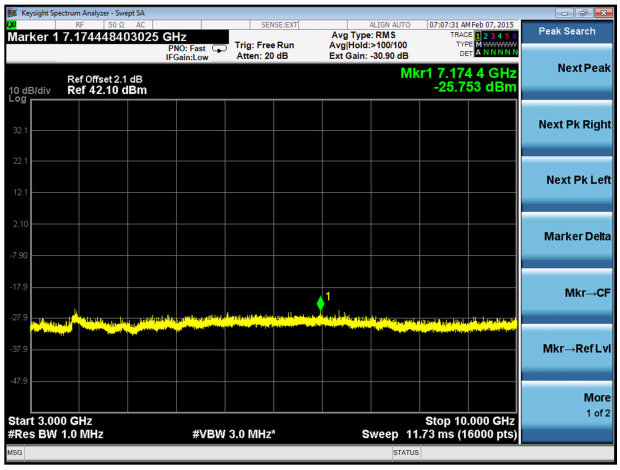
Screen 13



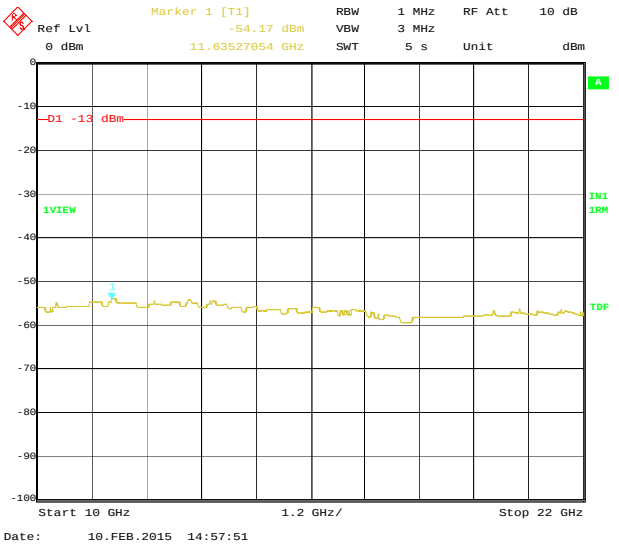
Screen 11



Screen 14



Screen 15[1]



15R058C1

Figure 8: Conducted Spurious Emissions plots, 10 MHz channels

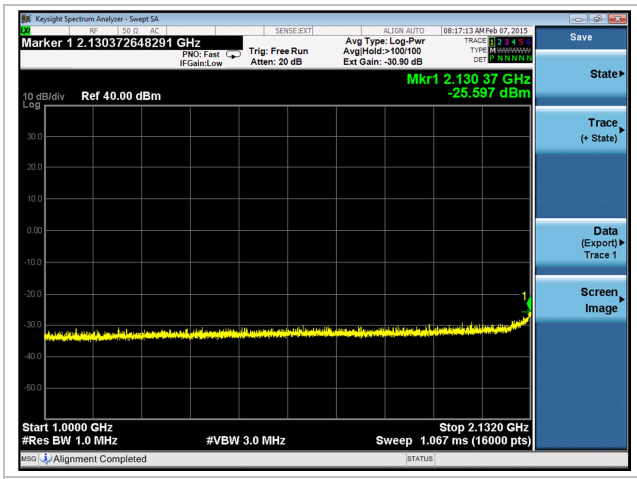
[1] Additional 2.1 dB offset for 3-10 GHz to account for extra cable loss in this band.

11.3 Results for 20 MHz channels

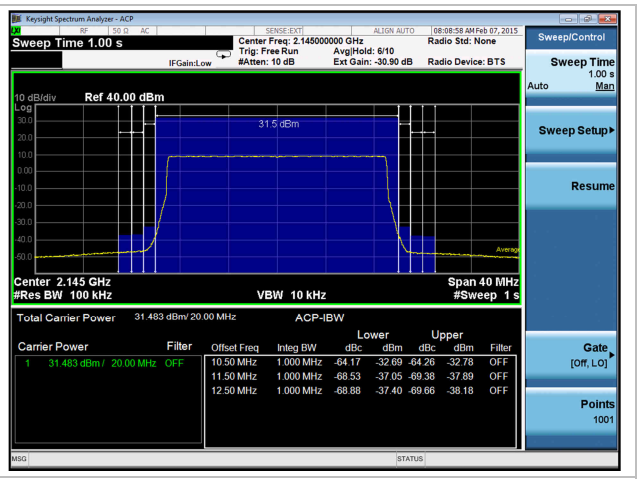
10 MHz channel emissions within 20 dB of the limit were also checked with 20 MHz channel operation and QPSK modulation, which had widest Occupied Bandwidth:

Frequency Range	Maximum emission (Measured)	Maximum emission (calculated)	Limit (dBm)	Result	Plot
1000-2132 MHz	-25.6	-19.6	-13.0	Pass	Screen 43
2132-2135 MHz 2155-2158 MHz	-32.69	-26.69	-13.0	Pass	Screen 41
2158–3000 MHz	-25.0	-19.0	-13.0	Pass	Screen 44
3 – 10 GHz	-24.4	-18.4	-13.0	Pass	Screen 45

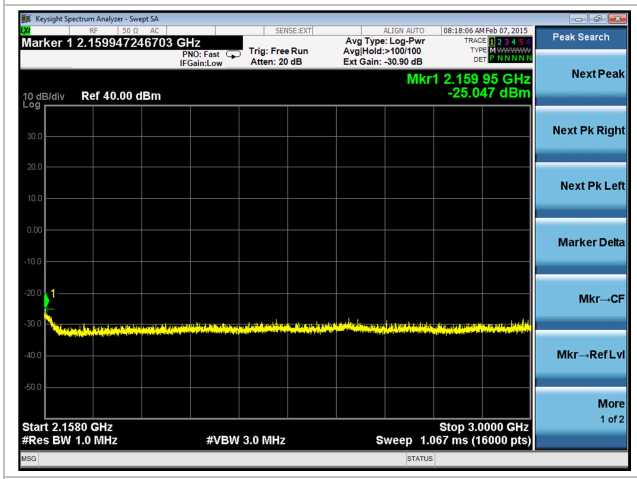
Table 8: Conducted spurious emissions, 20 MHz channel



Screen 43



Screen 41



Screen 44

Screen 45

Figure 9: Conducted Spurious Emissions plots, 20 MHz channels

12 Radiated Spurious Emissions

12.1 Requirement and test method

§ 90.1323 Emission limits.

> (a) The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth.

Attenuation of 43+10log(P) dBm equates to an absolute limit of -13dBm.

All measurements below 18 GHz were performed at 3m distance

Emissions above 18 GHz were measured at 1m and checked by sniffing over the whole device with device hand-held at approximately 30 cm.

Pre-scan measurements were performed with a spectrum analyser, using a peak detector with 100 kHz RBW for frequencies below 1 GHz and 1 MHz for frequencies above 1 GHz.

The cabinet radiation was performed while antenna ports were terminated with 50Ω load.

Initial pre-scan measurements were performed with limit determined by

E = EIRP – 20log D + 104.8

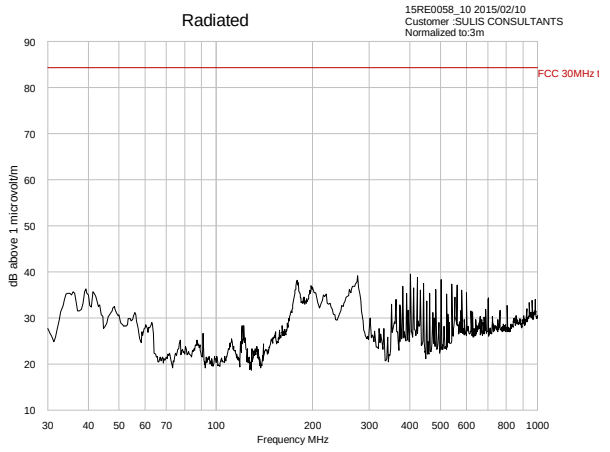
Where pre-scans showed emissions within 20dB of the limit, final measurement was made using substitution method.

12.2 Results

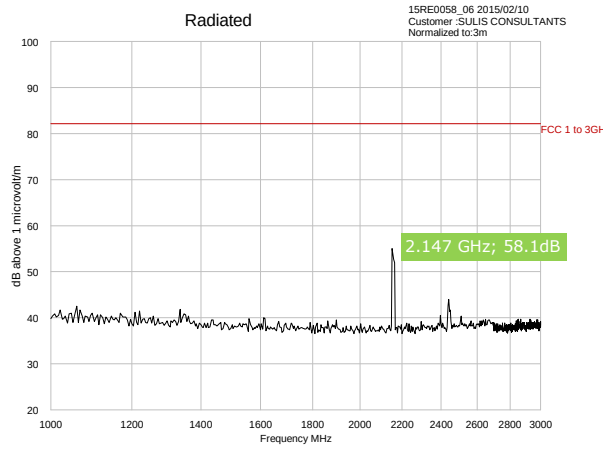
Initial pre-scans were performed using peak detector.

No emissions were found within 20dB of the limit.

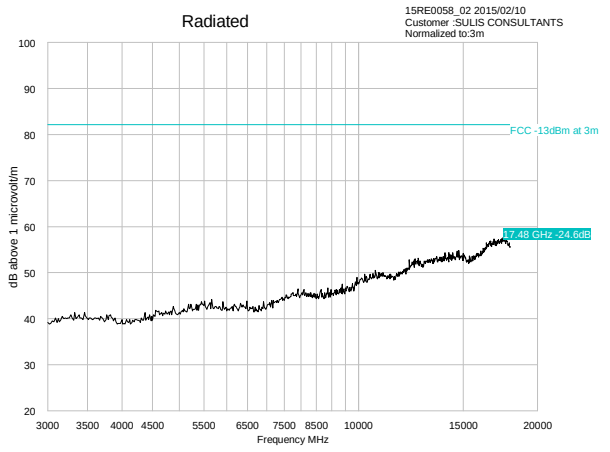
Worst case plots for 10 MHz channels are included below in figure 7 for information.



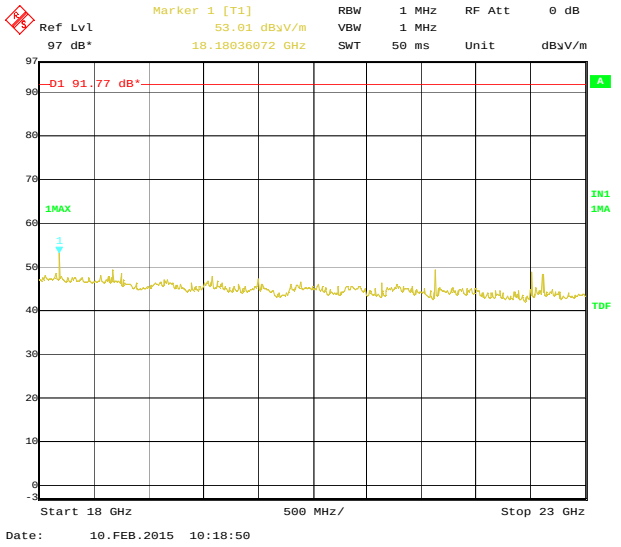
30 - 1000 MHz



1 – 3 GHz



10 - 18 GHz



18 – 23 GHz

Figure 10: RSE pre-scans, 10 MHz channel

13 Test equipment

Description	Manufacturer	Name	Serial Number	Calibration certificate
Testing at Altiostar				
PXA Signal Analyser	Agilent	N9030A	MY541702228	4105006-4886110-1
Network Analyser	HP	8719D	US38110410	Electroservices T385943C
Attenuator	Fairview Microwave	SA18N25WA-30	None	Calibrated before test using Network Analyser
RF cable	Times Microwave	SLU18-SMNM-01.75m	3716	
Testing at Hursley				
Noise source	York EMC	CGE03C	0606	N/A (relative measurement)
Attenuator	Fairview Microwave	SA18N25WA-30	None	Calibrated before test using noise source
RF CABLE	Ultiflex	SMA	HA210A0009M30309	
Pre-amp	HP	8449B	HEMC ID#250	Calibration data held by Hursley EMC Services Ltd under their UKAS accreditation, no. 1871.
Pre-amp	HP	8447D	HEMC ID#050	
Antenna	Chase	Bilog	HEMC ID#452	
Antenna	Schwarbeck	1-10 G Horn	HEMC ID#466	
Antenna	Q-Par Angus	2-18 G Horn	HEMC ID#071a	
Antenna	Q-Par Angus	18-40 G Horn	HEMC ID#399	
Receiver	R&S	ESCI7	HEMC ID#552	
Spec An	HP	8593EM	HEMC ID#040	
Receiver	R&S	ESIB40	HEMC ID#021	
cable	-	-	HEMC ID#434	

Table 9: Test Equipment