TEST REPORT

Test Report No. : UL-RPT-RP11241886JD07AB V5.0

Manufacturer	:	Apple Inc.
Model No.	:	A1779
FCC ID	:	BCG-E3086A
Technology	:	LTE Band 26
Test Standard(s)	:	FCC Part 90 Subpart S

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2. The results in this report apply only to the sample tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 5.0 supersedes all previous versions.

Date of Issue: 03 August 2016

Checked by:

Sarah Williams
Engineer, Radio Laboratory

Company Signatory:

Steven White
Service Lead, Radio Laboratory
UL VS LTD

This laboratory is accredited by UKAS. The tests reported herein have been performed in accordance with its terms of accreditation.

UL VS LTD

Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23 8BG, UK
Telephone: +44 (0)1256 312000
Facsimile: +44 (0)1256 312001

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1. Customer Information

Company Name:	Apple Inc.
Address:	1 Infinite Loop Cupertino, CA 95014 U.S.A.

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR90
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 90 Subpart S - Regulations Governing Licensing and Use of Frequencies in the 806-824, 851-869, 896-901 and 935-940 MHz Bands
Site Registration:	209735
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	12 May 2016 to 19 July 2016

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 90.635(b) / 2.1046	Transmitter Carrier Output Power and Effective Radiated Power (ERP)	Complied
Part 90.209(b)(7) / 2.1049	Transmitter Occupied Bandwidth	Complied
Part 90.691 / 2.1053	Transmitter Radiated Emissions	Complied
Part 90.691 / 2.1053	Transmitter Radiated Band Edge Emissions	Complied
Part 90.213 / 2.1055	Transmitter Frequency Stability (Temperature and Voltage Variation)	Complied

2.3. Methods and Procedures

Reference:	ANSI/TIA-603-D-2010
Title:	Land Mobile FM or PM Communications Equipment Measurements and Performance Standards
Reference:	FCC KDB 971168 D01 v02r02, October 17 2014
Title:	Measurement Guidance for Certification of Licensed Digital Transmitters

2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample Serial Number:	C7CRG011H6DH
Test Sample IMEI:	358640070087480 *(Radiated LAT Sample #1)*
Hardware Version:	REV1.0
Software Version:	iOS: 14A241z BB FW: 0.16.04
FCC ID:	BCG-E3086A

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample Serial Number:	C7CRG018H6DH
Test Sample IMEI:	358640070087482 *(Radiated LAT Sample #2)*
Hardware Version:	REV1.0
Software Version:	iOS: 14A241z BB FW: 0.16.04
FCC ID:	BCG-E3086A

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample Serial Number:	C7CRF01JH7X9
Test Sample IMEI:	358640070022890 *(Radiated UAT Sample #1)*
Hardware Version:	REV1.0
Software Version:	iOS: 14A241z BB FW: 0.16.04
FCC ID:	BCG-E3086A

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample Serial Number:	C7CRF01NH7X9
Test Sample IMEI:	358640070022893 *(Radiated UAT Sample #2)*
Hardware Version:	REV1.0
Software Version:	iOS: 14A241z BB FW: 0.16.04
FCC ID:	BCG-E3086A

Identification of Equipment Under Test (continued)

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample Serial Number:	C7CRR02THCPX
Test Sample IMEI:	358640070064218 *(Conducted Sample #1)*
Hardware Version Number:	REV1.0
Software Version Number:	iOS: 14A241z BB FW: 0.16.04
FCC ID:	BCG-E3086A

Brand Name:	Apple
Model Name or Number:	A1779
Test Sample Serial Number:	C7CRG02QH6DH *(Conducted Sample #2)*
Hardware Version Number:	REV1.0
Software Version Number:	iOS: 14A241z BB FW: 0.16.04
FCC ID:	BCG-E3086A

3.2. Description of EUT

The Equipment Under Test was a mobile phone with GSM/GPRS/EGPRS/UMTS/LTE/TD-SCDMA and CDMA technologies. It also supports IEEE 802.11a/b/g/n/ac, Bluetooth®, GPS and NFC. The rechargeable battery is not user accessible.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Tested Technology:	LTE		
Type of Equipment	Transceiver		
Channel Bandwidth:	1.4, 3, 5 & 10 MHz		
Modulation Type:	QPSK & 16QAM		
Duty Cycle:	100 %		
Antenna Type:	Integral		
Antenna Gain (LAT):	-7.27 dBd		
Antenna Gain (UAT):	-5.43 dBd		
Power Supply Requirement(s):	Nominal	3.8 VDC	
	Minimum	3.5 VDC	
	Maximum	4.4 VDC	
Transmit Frequency Range:	814 MHz to 824 MHz		
Channels Tested:	**Channel Bandwidth (MHz)**	**N_{ul}**	**Frequency of Uplink (MHz)**
Bottom Channel	1.4	26697	814.7
	3	26705	815.5
	5	26715	816.5
Middle Channel	All	26740	819.0
Top Channel	1.4	26783	823.3
	3	26775	822.5
	5	26765	821.5

Note:

Based on the information contained in *Interim Guidance for Equipment Authorization of Devices with Channel Bandwidths Combined Across Two Contiguous Service Rule Allocations OET/Lab/EACB, June 6, 2013,* all supported emissions were tested on 824.0 MHz as the boundary frequency between FCC Rule Part 90-S and Rule Part 22-H. As Rule Part 22-H has the more onerous limits, the boundary emissions have been tested against this, and so are not included in this report.

3.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Laptop PC
Brand Name:	Dell
Model Name or Number:	Latitude E5410
Serial Number:	UL Asset No. 00763

Description:	USB diagnostic cable
Brand Name:	Not stated
Model Name or Number:	Kong
Serial Number:	202D5E

Description:	Personal Hands Free (PHF)
Brand Name:	Apple
Model Name or Number:	Apple Ear Plugs
Serial Number:	Not stated

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):

- Transmit Mode - The EUT was set to transmit with maximum output power using the required channel bandwidth. QPSK and 16QAM modulations were both tested, with Resource Block allocation as detailed in section 4.3.

4.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

- The EUT was placed into a non-ui mode by using the teraterm application on a UL laptop PC. Instructions were provided by the customer to enable the baseband and radio *(Cellular_RSE_setup_V3.0.doc)*. This enabled the EUT to connect via a radiated link with the Rohde & Schwarz CMW 500 system simulator operating in transceiver mode. The CMW 500 was used to configure the EUT operating mode.
- The device contains two cellular antennas which do not transmit simultaneously.
    - LAT – Lower Antenna (Primary)
    - UAT – Upper Antenna (Secondary)

  Both antennas have been tested to demonstrate compliance.
- For the LAT conducted measurements, the RF conducted port was connected with an external RF cable, supplied by the customer.
- For the UAT conducted cellular measurements, the RF conducted port was exposed and extended with a short RF cable supplied by the customer.
- Conducted measurements at temperature and voltage extremes were performed using a conducted sample supplied by the customer. Short DC flying leads were connected internally to the device in place of the battery, and exited through a hole in the casing. These leads were then extended to a DC power supply for testing purposes.
- The EUT was placed in three orthogonal orientations X, Y and Z to determine the worst case orientation for radiated spurious emissions. The worst case orientation for the LAT was X and for the UAT was Z.
- Transmitter radiated spurious emissions tests were performed with the EUT set to transmit with a 10 MHz channel bandwidth with QPSK modulation applied and 1 resource block with 0 offset. This was found to be the worst case modulation scheme with regards to emissions after preliminary investigations and therefore it was deemed to be the worst case.
- The worst-case radiated emission among all accessories, is determined by the manufacturer to be with the headset connected. The compliance lab performed final testing only with the headset attached.
- Transmitter radiated spurious emissions tests were performed with the PHF connected to the EUT.

4.3. Resource Block Allocation

Channel Bandwidth (MHz)	Maximum No. of Resource Blocks	Resource Block / Offset Number					
		Sub Test 1		Sub Test 2		Sub Test 3	
		RB	Offset	RB	Offset	RB	Offset
1.4	6	1	0	1	5	6	0
3	15	1	0	1	14	15	0
5	25	1	0	1	24	25	0
10	50	1	0	1	49	50	0

Transmitter Occupied Bandwidth was carried out using sub test 3, for both QPSK and 16QAM modulation schemes.

Transmitter radiated spurious emissions tests were performed with the EUT set to transmit with a 10 MHz channel bandwidth with QPSK modulation applied and 1 resource block with 0 offset. This was found to be the worst case modulation scheme with regards to emissions after preliminary investigations and therefore it was deemed to be the worst case.

Transmitter Radiated Band Edge Emissions was tested with sub tests 1, 2 and 3 on all supported channel bandwidths using QPSK and 16-QAM modulations.

Transmitter Frequency Stability test was carried out with sub test 3, with a channel bandwidth of 1.4 MHz only.

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to *Section 6* for Measurement Uncertainty details.

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2. Test Results

5.2.1. Transmitter Carrier Output Power and Effective Radiated Power (ERP) - LAT

Test Summary:

Test Engineer:	Keith Tucker	**Test Date:**	19 July 2016
Test Sample IMEI:	358640070064218		

FCC Reference:	Parts 90.635(b) / 2.1046
Test Method Used:	KDB 971168 Section 2.2 footnote 1, Section 5.6 & Notes below

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	46

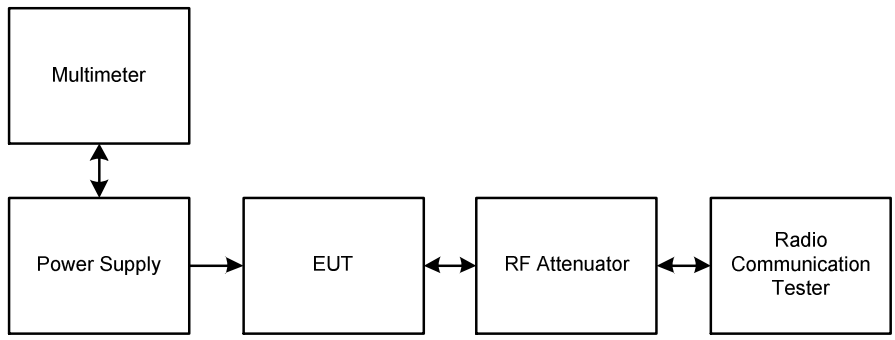
Note(s):

1. The customer stated that the EUT has a maximum antenna gain of -5.12 dBi. As the limit is ERP, the gain in dBi has been converted to dBd. The dBd gain figure has been calculated as:

   -5.12 dBi – 2.15 dB = -7.27 dBd

2. Conducted average power was measured using a calibrated Rohde and Schwarz CMW 500 Wideband Radio Communication Tester.
3. The RF port of the EUT was connected to the Communication Tester via an RF cable and suitable attenuation. An RF level offset was entered on the Communication Tester to compensate for the loss of the attenuator and RF cable.

Test setup:



Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 1.4 MHz Channel Bandwidth / Bottom Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
814.7	6	0	23.22	-7.27	15.95	50.00	34.05	Complied
814.7	3	3	23.23	-7.27	15.96	50.00	34.04	Complied
814.7	3	0	23.26	-7.27	15.99	50.00	34.01	Complied
814.7	3	1	23.30	-7.27	16.03	50.00	33.97	Complied
814.7	1	5	23.17	-7.27	15.90	50.00	34.10	Complied
814.7	1	0	23.18	-7.27	15.91	50.00	34.09	Complied
814.7	1	3	23.23	-7.27	15.96	50.00	34.04	Complied

Results: 1.4 MHz Channel Bandwidth / Bottom Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
814.7	6	0	22.18	-7.27	14.91	50.00	35.09	Complied
814.7	3	3	23.24	-7.27	15.97	50.00	34.03	Complied
814.7	3	0	23.22	-7.27	15.95	50.00	34.05	Complied
814.7	3	1	23.25	-7.27	15.98	50.00	34.02	Complied
814.7	1	5	23.29	-7.27	16.02	50.00	33.98	Complied
814.7	1	0	23.27	-7.27	16.00	50.00	34.00	Complied
814.7	1	3	23.36	-7.27	16.09	50.00	33.91	Complied

Results: 1.4 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	6	0	23.16	-7.27	15.89	50.00	34.11	Complied
819.0	3	3	23.15	-7.27	15.88	50.00	34.12	Complied
819.0	3	0	23.16	-7.27	15.89	50.00	34.11	Complied
819.0	3	1	23.18	-7.27	15.91	50.00	34.09	Complied
819.0	1	5	23.08	-7.27	15.81	50.00	34.19	Complied
819.0	1	0	23.09	-7.27	15.82	50.00	34.18	Complied
819.0	1	3	23.13	-7.27	15.86	50.00	34.14	Complied

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 1.4 MHz Channel Bandwidth / Middle Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	6	0	22.03	-7.27	14.76	50.00	35.24	Complied
819.0	3	3	23.22	-7.27	15.95	50.00	34.05	Complied
819.0	3	0	23.24	-7.27	15.97	50.00	34.03	Complied
819.0	3	1	23.26	-7.27	15.99	50.00	34.01	Complied
819.0	1	5	23.18	-7.27	15.91	50.00	34.09	Complied
819.0	1	0	23.16	-7.27	15.89	50.00	34.11	Complied
819.0	1	3	23.21	-7.27	15.94	50.00	34.06	Complied

Results: 1.4 MHz Channel Bandwidth / Top Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
823.3	6	0	23.07	-7.27	15.80	50.00	34.20	Complied
823.3	3	3	23.06	-7.27	15.79	50.00	34.21	Complied
823.3	3	0	23.05	-7.27	15.78	50.00	34.22	Complied
823.3	3	1	23.09	-7.27	15.82	50.00	34.18	Complied
823.3	1	5	23.02	-7.27	15.75	50.00	34.25	Complied
823.3	1	0	23.05	-7.27	15.78	50.00	34.22	Complied
823.3	1	3	23.07	-7.27	15.80	50.00	34.20	Complied

Results: 1.4 MHz Channel Bandwidth / Top Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
823.3	6	0	22.01	-7.27	14.74	50.00	35.26	Complied
823.3	3	3	23.23	-7.27	15.96	50.00	34.04	Complied
823.3	3	0	23.21	-7.27	15.94	50.00	34.06	Complied
823.3	3	1	23.25	-7.27	15.98	50.00	34.02	Complied
823.3	1	5	22.99	-7.27	15.72	50.00	34.28	Complied
823.3	1	0	22.98	-7.27	15.71	50.00	34.29	Complied
823.3	1	3	23.04	-7.27	15.77	50.00	34.23	Complied

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 3 MHz Channel Bandwidth / Bottom Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
815.5	15	0	23.24	-7.27	15.97	50.00	34.03	Complied
815.5	8	7	23.19	-7.27	15.92	50.00	34.08	Complied
815.5	8	0	23.21	-7.27	15.94	50.00	34.06	Complied
815.5	8	4	23.24	-7.27	15.97	50.00	34.03	Complied
815.5	1	14	23.20	-7.27	15.93	50.00	34.07	Complied
815.5	1	0	23.23	-7.27	15.96	50.00	34.04	Complied
815.5	1	7	23.27	-7.27	16.00	50.00	34.00	Complied

Results: 3 MHz Channel Bandwidth / Bottom Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
815.5	15	0	22.22	-7.27	14.95	50.00	35.05	Complied
815.5	8	7	22.14	-7.27	14.87	50.00	35.13	Complied
815.5	8	0	22.19	-7.27	14.92	50.00	35.08	Complied
815.5	8	4	22.19	-7.27	14.92	50.00	35.08	Complied
815.5	1	14	23.33	-7.27	16.06	50.00	33.94	Complied
815.5	1	0	23.34	-7.27	16.07	50.00	33.93	Complied
815.5	1	7	23.45	-7.27	16.18	50.00	33.82	Complied

Results: 3 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	15	0	23.22	-7.27	15.95	50.00	34.05	Complied
819.0	8	7	23.15	-7.27	15.88	50.00	34.12	Complied
819.0	8	0	23.17	-7.27	15.90	50.00	34.10	Complied
819.0	8	4	23.18	-7.27	15.91	50.00	34.09	Complied
819.0	1	14	23.17	-7.27	15.90	50.00	34.10	Complied
819.0	1	0	23.20	-7.27	15.93	50.00	34.07	Complied
819.0	1	7	23.23	-7.27	15.96	50.00	34.04	Complied

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 3 MHz Channel Bandwidth / Middle Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	15	0	22.15	-7.27	14.88	50.00	35.12	Complied
819.0	8	7	22.18	-7.27	14.91	50.00	35.09	Complied
819.0	8	0	22.20	-7.27	14.93	50.00	35.07	Complied
819.0	8	4	22.21	-7.27	14.94	50.00	35.06	Complied
819.0	1	14	23.18	-7.27	15.91	50.00	34.09	Complied
819.0	1	0	23.24	-7.27	15.97	50.00	34.03	Complied
819.0	1	7	23.22	-7.27	15.95	50.00	34.05	Complied

Results: 3 MHz Channel Bandwidth / Top Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
822.5	15	0	23.11	-7.27	15.84	50.00	34.16	Complied
822.5	8	7	23.08	-7.27	15.81	50.00	34.19	Complied
822.5	8	0	23.17	-7.27	15.90	50.00	34.10	Complied
822.5	8	4	23.09	-7.27	15.82	50.00	34.18	Complied
822.5	1	14	23.03	-7.27	15.76	50.00	34.24	Complied
822.5	1	0	23.08	-7.27	15.81	50.00	34.19	Complied
822.5	1	7	23.08	-7.27	15.81	50.00	34.19	Complied

Results: 3 MHz Channel Bandwidth / Top Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
822.5	15	0	22.06	-7.27	14.79	50.00	35.21	Complied
822.5	8	7	22.20	-7.27	14.93	50.00	35.07	Complied
822.5	8	0	22.34	-7.27	15.07	50.00	34.93	Complied
822.5	8	4	22.25	-7.27	14.98	50.00	35.02	Complied
822.5	1	14	23.51	-7.27	16.24	50.00	33.76	Complied
822.5	1	0	23.59	-7.27	16.32	50.00	33.68	Complied
822.5	1	7	23.60	-7.27	16.33	50.00	33.67	Complied

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 5 MHz Channel Bandwidth / Bottom Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
816.5	25	0	23.30	-7.27	16.03	50.00	33.97	Complied
816.5	12	13	23.24	-7.27	15.97	50.00	34.03	Complied
816.5	12	0	23.28	-7.27	16.01	50.00	33.99	Complied
816.5	12	7	23.24	-7.27	15.97	50.00	34.03	Complied
816.5	1	24	23.23	-7.27	15.96	50.00	34.04	Complied
816.5	1	0	23.26	-7.27	15.99	50.00	34.01	Complied
816.5	1	12	23.20	-7.27	15.93	50.00	34.07	Complied

Results: 5 MHz Channel Bandwidth / Bottom Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
816.5	25	0	22.15	-7.27	14.88	50.00	35.12	Complied
816.5	12	13	22.23	-7.27	14.96	50.00	35.04	Complied
816.5	12	0	22.25	-7.27	14.98	50.00	35.02	Complied
816.5	12	7	22.27	-7.27	15.00	50.00	35.00	Complied
816.5	1	24	23.54	-7.27	16.27	50.00	33.73	Complied
816.5	1	0	23.57	-7.27	16.30	50.00	33.70	Complied
816.5	1	12	23.53	-7.27	16.26	50.00	33.74	Complied

Results: 5 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	25	0	23.24	-7.27	15.97	50.00	34.03	Complied
819.0	12	13	23.20	-7.27	15.93	50.00	34.07	Complied
819.0	12	0	23.23	-7.27	15.96	50.00	34.04	Complied
819.0	12	7	23.22	-7.27	15.95	50.00	34.05	Complied
819.0	1	24	23.24	-7.27	15.97	50.00	34.03	Complied
819.0	1	0	23.28	-7.27	16.01	50.00	33.99	Complied
819.0	1	12	23.21	-7.27	15.94	50.00	34.06	Complied

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 5 MHz Channel Bandwidth / Middle Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	25	0	22.24	-7.27	14.97	50.00	35.03	Complied
819.0	12	13	22.14	-7.27	14.87	50.00	35.13	Complied
819.0	12	0	22.13	-7.27	14.86	50.00	35.14	Complied
819.0	12	7	22.16	-7.27	14.89	50.00	35.11	Complied
819.0	1	24	23.21	-7.27	15.94	50.00	34.06	Complied
819.0	1	0	23.31	-7.27	16.04	50.00	33.96	Complied
819.0	1	12	23.20	-7.27	15.93	50.00	34.07	Complied

Results: 5 MHz Channel Bandwidth / Top Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
821.5	25	0	23.19	-7.27	15.92	50.00	34.08	Complied
821.5	12	13	23.10	-7.27	15.83	50.00	34.17	Complied
821.5	12	0	23.21	-7.27	15.94	50.00	34.06	Complied
821.5	12	7	23.19	-7.27	15.92	50.00	34.08	Complied
821.5	1	24	23.17	-7.27	15.90	50.00	34.10	Complied
821.5	1	0	23.28	-7.27	16.01	50.00	33.99	Complied
821.5	1	12	23.22	-7.27	15.95	50.00	34.05	Complied

Results: 5 MHz Channel Bandwidth / Top Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
821.5	25	0	22.14	-7.27	14.87	50.00	35.13	Complied
821.5	12	13	22.07	-7.27	14.80	50.00	35.20	Complied
821.5	12	0	22.17	-7.27	14.90	50.00	35.10	Complied
821.5	12	7	22.17	-7.27	14.90	50.00	35.10	Complied
821.5	1	24	22.99	-7.27	15.72	50.00	34.28	Complied
821.5	1	0	23.08	-7.27	15.81	50.00	34.19	Complied
821.5	1	12	23.03	-7.27	15.76	50.00	34.24	Complied

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 10 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	50	0	23.32	-7.27	16.05	50.00	33.95	Complied
819.0	25	24	23.15	-7.27	15.88	50.00	34.12	Complied
819.0	25	0	23.31	-7.27	16.04	50.00	33.96	Complied
819.0	25	12	23.29	-7.27	16.02	50.00	33.98	Complied
819.0	1	49	23.06	-7.27	15.79	50.00	34.21	Complied
819.0	1	0	23.23	-7.27	15.96	50.00	34.04	Complied
819.0	1	24	23.21	-7.27	15.94	50.00	34.06	Complied

Results: 10 MHz Channel Bandwidth / Middle Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	50	0	22.26	-7.27	14.99	50.00	35.01	Complied
819.0	25	24	22.21	-7.27	14.94	50.00	35.06	Complied
819.0	25	0	22.30	-7.27	15.03	50.00	34.97	Complied
819.0	25	12	22.31	-7.27	15.04	50.00	34.96	Complied
819.0	1	49	23.18	-7.27	15.91	50.00	34.09	Complied
819.0	1	0	23.36	-7.27	16.09	50.00	33.91	Complied
819.0	1	24	23.33	-7.27	16.06	50.00	33.94	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	Testo	608-H1	45041825	02 Apr 2017	12
M1869	Wideband Radio Comms Tester	Rohde & Schwarz	CMW500	145923	05 Apr 2017	12
A2845	Attenuator	Radiall	R411.806.121	24325927	Calibrated before use	-
A2844	Attenuator	Radiall	R411.803.121	23404066	Calibrated before use	-
S0562	Power Supply	Thurlby Thandar	PL330QMD	054895	Calibrated before use	-
M1269	Multimeter	Fluke	179	90250210	13 May 2017	12
G0628	Signal Generator	Rohde & Schwarz	SMBV100A	261847	25 Jan 2017	12
M1835	Signal Analyser	Rohde & Schwarz	FSV30	103050	26 Feb 2017	12

5.2.2. Transmitter Carrier Output Power and Effective Radiated Power (ERP) - UAT

Test Summary:

Test Engineer:	Keith Tucker	**Test Date:**	19 July 2016
Test Sample IMEI:	358640070064218		

FCC Reference:	Parts 90.635(b) / 2.1046
Test Method Used:	KDB 971168 Section 2.2 footnote 1, Section 5.6 & Notes below

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	46

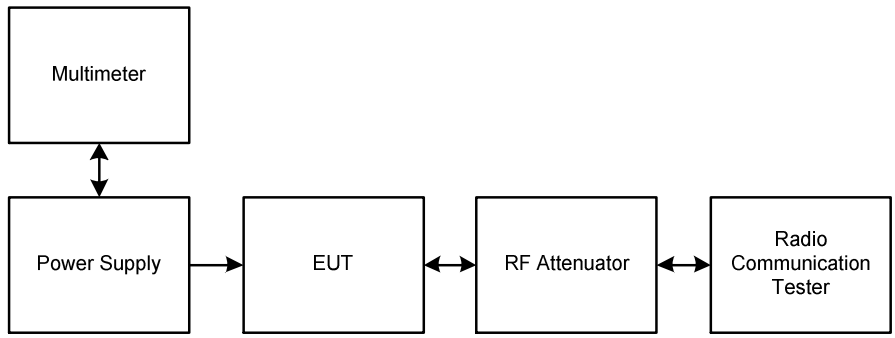
Note(s):

1. The customer stated that the EUT has a maximum antenna gain of -3.28 dBi. As the limit is ERP, the gain in dBi has been converted to dBd. The dBd gain figure has been calculated as:

   -3.28 dBi – 2.15 dB = -5.43 dBd

2. Conducted average power was measured using a calibrated Rohde and Schwarz CMW 500 Wideband Radio Communication Tester.
3. The RF port of the EUT was connected to the Communication Tester via an RF cable and suitable attenuation. An RF level offset was entered on the Communication Tester to compensate for the loss of the attenuator and RF cable.

Test setup:



Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 1.4 MHz Channel Bandwidth / Bottom Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
814.7	6	0	20.32	-5.43	14.89	50.00	35.11	Complied
814.7	3	3	21.29	-5.43	15.86	50.00	34.14	Complied
814.7	3	0	21.29	-5.43	15.86	50.00	34.14	Complied
814.7	3	1	21.35	-5.43	15.92	50.00	34.08	Complied
814.7	1	5	21.22	-5.43	15.79	50.00	34.21	Complied
814.7	1	0	21.23	-5.43	15.80	50.00	34.20	Complied
814.7	1	3	21.29	-5.43	15.86	50.00	34.14	Complied

Results: 1.4 MHz Channel Bandwidth / Bottom Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
814.7	6	0	19.23	-5.43	13.80	50.00	36.20	Complied
814.7	3	3	20.27	-5.43	14.84	50.00	35.16	Complied
814.7	3	0	20.24	-5.43	14.81	50.00	35.19	Complied
814.7	3	1	20.29	-5.43	14.86	50.00	35.14	Complied
814.7	1	5	20.33	-5.43	14.90	50.00	35.10	Complied
814.7	1	0	20.31	-5.43	14.88	50.00	35.12	Complied
814.7	1	3	20.41	-5.43	14.98	50.00	35.02	Complied

Results: 1.4 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	6	0	20.28	-5.43	14.85	50.00	35.15	Complied
819.0	3	3	21.22	-5.43	15.79	50.00	34.21	Complied
819.0	3	0	21.20	-5.43	15.77	50.00	34.23	Complied
819.0	3	1	21.24	-5.43	15.81	50.00	34.19	Complied
819.0	1	5	21.15	-5.43	15.72	50.00	34.28	Complied
819.0	1	0	21.16	-5.43	15.73	50.00	34.27	Complied
819.0	1	3	21.19	-5.43	15.76	50.00	34.24	Complied

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 1.4 MHz Channel Bandwidth / Middle Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	6	0	19.08	-5.43	13.65	50.00	36.35	Complied
819.0	3	3	20.26	-5.43	14.83	50.00	35.17	Complied
819.0	3	0	20.31	-5.43	14.88	50.00	35.12	Complied
819.0	3	1	20.29	-5.43	14.86	50.00	35.14	Complied
819.0	1	5	20.20	-5.43	14.77	50.00	35.23	Complied
819.0	1	0	20.18	-5.43	14.75	50.00	35.25	Complied
819.0	1	3	20.24	-5.43	14.81	50.00	35.19	Complied

Results: 1.4 MHz Channel Bandwidth / Top Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
823.3	6	0	20.23	-5.43	14.80	50.00	35.20	Complied
823.3	3	3	21.16	-5.43	15.73	50.00	34.27	Complied
823.3	3	0	21.15	-5.43	15.72	50.00	34.28	Complied
823.3	3	1	21.19	-5.43	15.76	50.00	34.24	Complied
823.3	1	5	21.13	-5.43	15.70	50.00	34.30	Complied
823.3	1	0	21.16	-5.43	15.73	50.00	34.27	Complied
823.3	1	3	21.18	-5.43	15.75	50.00	34.25	Complied

Results: 1.4 MHz Channel Bandwidth / Top Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
823.3	6	0	19.08	-5.43	13.65	50.00	36.35	Complied
823.3	3	3	20.33	-5.43	14.90	50.00	35.10	Complied
823.3	3	0	20.30	-5.43	14.87	50.00	35.13	Complied
823.3	3	1	20.32	-5.43	14.89	50.00	35.11	Complied
823.3	1	5	20.09	-5.43	14.66	50.00	35.34	Complied
823.3	1	0	20.08	-5.43	14.65	50.00	35.35	Complied
823.3	1	3	20.13	-5.43	14.70	50.00	35.30	Complied

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 3 MHz Channel Bandwidth / Bottom Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
815.5	15	0	20.43	-5.43	15.00	50.00	35.00	Complied
815.5	8	7	20.28	-5.43	14.85	50.00	35.15	Complied
815.5	8	0	20.29	-5.43	14.86	50.00	35.14	Complied
815.5	8	4	20.32	-5.43	14.89	50.00	35.11	Complied
815.5	1	14	21.30	-5.43	15.87	50.00	34.13	Complied
815.5	1	0	21.34	-5.43	15.91	50.00	34.09	Complied
815.5	1	7	21.39	-5.43	15.96	50.00	34.04	Complied

Results: 3 MHz Channel Bandwidth / Bottom Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
815.5	15	0	19.31	-5.43	13.88	50.00	36.12	Complied
815.5	8	7	19.22	-5.43	13.79	50.00	36.21	Complied
815.5	8	0	19.26	-5.43	13.83	50.00	36.17	Complied
815.5	8	4	19.27	-5.43	13.84	50.00	36.16	Complied
815.5	1	14	20.39	-5.43	14.96	50.00	35.04	Complied
815.5	1	0	20.41	-5.43	14.98	50.00	35.02	Complied
815.5	1	7	20.49	-5.43	15.06	50.00	34.94	Complied

Results: 3 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	15	0	20.35	-5.43	14.92	50.00	35.08	Complied
819.0	8	7	20.23	-5.43	14.80	50.00	35.20	Complied
819.0	8	0	20.23	-5.43	14.80	50.00	35.20	Complied
819.0	8	4	20.23	-5.43	14.80	50.00	35.20	Complied
819.0	1	14	21.21	-5.43	15.78	50.00	34.22	Complied
819.0	1	0	21.26	-5.43	15.83	50.00	34.17	Complied
819.0	1	7	21.30	-5.43	15.87	50.00	34.13	Complied

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 3 MHz Channel Bandwidth / Middle Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	15	0	19.22	-5.43	13.79	50.00	36.21	Complied
819.0	8	7	19.26	-5.43	13.83	50.00	36.17	Complied
819.0	8	0	19.38	-5.43	13.95	50.00	36.05	Complied
819.0	8	4	19.41	-5.43	13.98	50.00	36.02	Complied
819.0	1	14	20.32	-5.43	14.89	50.00	35.11	Complied
819.0	1	0	20.38	-5.43	14.95	50.00	35.05	Complied
819.0	1	7	20.30	-5.43	14.87	50.00	35.13	Complied

Results: 3 MHz Channel Bandwidth / Top Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
822.5	15	0	20.25	-5.43	14.82	50.00	35.18	Complied
822.5	8	7	20.24	-5.43	14.81	50.00	35.19	Complied
822.5	8	0	20.16	-5.43	14.73	50.00	35.27	Complied
822.5	8	4	20.21	-5.43	14.78	50.00	35.22	Complied
822.5	1	14	21.24	-5.43	15.81	50.00	34.19	Complied
822.5	1	0	21.12	-5.43	15.69	50.00	34.31	Complied
822.5	1	7	21.20	-5.43	15.77	50.00	34.23	Complied

Results: 3 MHz Channel Bandwidth / Top Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
822.5	15	0	19.13	-5.43	13.70	50.00	36.30	Complied
822.5	8	7	19.37	-5.43	13.94	50.00	36.06	Complied
822.5	8	0	19.41	-5.43	13.98	50.00	36.02	Complied
822.5	8	4	19.42	-5.43	13.99	50.00	36.01	Complied
822.5	1	14	20.71	-5.43	15.28	50.00	34.72	Complied
822.5	1	0	20.71	-5.43	15.28	50.00	34.72	Complied
822.5	1	7	20.76	-5.43	15.33	50.00	34.67	Complied

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 5 MHz Channel Bandwidth / Bottom Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
816.5	25	0	20.21	-5.43	14.78	50.00	35.22	Complied
816.5	12	13	20.17	-5.43	14.74	50.00	35.26	Complied
816.5	12	0	20.12	-5.43	14.69	50.00	35.31	Complied
816.5	12	7	20.10	-5.43	14.67	50.00	35.33	Complied
816.5	1	24	21.07	-5.43	15.64	50.00	34.36	Complied
816.5	1	0	21.08	-5.43	15.65	50.00	34.35	Complied
816.5	1	12	21.05	-5.43	15.62	50.00	34.38	Complied

Results: 5 MHz Channel Bandwidth / Bottom Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
816.5	25	0	18.99	-5.43	13.56	50.00	36.44	Complied
816.5	12	13	19.07	-5.43	13.64	50.00	36.36	Complied
816.5	12	0	19.14	-5.43	13.71	50.00	36.29	Complied
816.5	12	7	19.20	-5.43	13.77	50.00	36.23	Complied
816.5	1	24	20.47	-5.43	15.04	50.00	34.96	Complied
816.5	1	0	20.40	-5.43	14.97	50.00	35.03	Complied
816.5	1	12	20.34	-5.43	14.91	50.00	35.09	Complied

Results: 5 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	25	0	20.26	-5.43	14.83	50.00	35.17	Complied
819.0	12	13	20.22	-5.43	14.79	50.00	35.21	Complied
819.0	12	0	20.31	-5.43	14.88	50.00	35.12	Complied
819.0	12	7	20.22	-5.43	14.79	50.00	35.21	Complied
819.0	1	24	21.19	-5.43	15.76	50.00	34.24	Complied
819.0	1	0	21.27	-5.43	15.84	50.00	34.16	Complied
819.0	1	12	21.22	-5.43	15.79	50.00	34.21	Complied

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 5 MHz Channel Bandwidth / Middle Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	25	0	19.24	-5.43	13.81	50.00	36.19	Complied
819.0	12	13	19.22	-5.43	13.79	50.00	36.21	Complied
819.0	12	0	19.24	-5.43	13.81	50.00	36.19	Complied
819.0	12	7	19.26	-5.43	13.83	50.00	36.17	Complied
819.0	1	24	20.29	-5.43	14.86	50.00	35.14	Complied
819.0	1	0	20.41	-5.43	14.98	50.00	35.02	Complied
819.0	1	12	20.27	-5.43	14.84	50.00	35.16	Complied

Results: 5 MHz Channel Bandwidth / Top Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
821.5	25	0	20.27	-5.43	14.84	50.00	35.16	Complied
821.5	12	13	20.21	-5.43	14.78	50.00	35.22	Complied
821.5	12	0	20.34	-5.43	14.91	50.00	35.09	Complied
821.5	12	7	20.30	-5.43	14.87	50.00	35.13	Complied
821.5	1	24	21.32	-5.43	15.89	50.00	34.11	Complied
821.5	1	0	21.36	-5.43	15.93	50.00	34.07	Complied
821.5	1	12	21.24	-5.43	15.81	50.00	34.19	Complied

Results: 5 MHz Channel Bandwidth / Top Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
821.5	25	0	19.19	-5.43	13.76	50.00	36.24	Complied
821.5	12	13	19.26	-5.43	13.83	50.00	36.17	Complied
821.5	12	0	19.34	-5.43	13.91	50.00	36.09	Complied
821.5	12	7	19.27	-5.43	13.84	50.00	36.16	Complied
821.5	1	24	20.22	-5.43	14.79	50.00	35.21	Complied
821.5	1	0	20.28	-5.43	14.85	50.00	35.15	Complied
821.5	1	12	20.16	-5.43	14.73	50.00	35.27	Complied

Transmitter Carrier Output Power and Effective Radiated Power (ERP) (continued)

Results: 10 MHz Channel Bandwidth / Middle Channel / QPSK

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	50	0	20.40	-5.43	14.97	50.00	35.03	Complied
819.0	25	24	20.24	-5.43	14.81	50.00	35.19	Complied
819.0	25	0	20.40	-5.43	14.97	50.00	35.03	Complied
819.0	25	12	20.40	-5.43	14.97	50.00	35.03	Complied
819.0	1	49	21.14	-5.43	15.71	50.00	34.29	Complied
819.0	1	0	21.21	-5.43	15.78	50.00	34.22	Complied
819.0	1	24	21.23	-5.43	15.80	50.00	34.20	Complied

Results: 10 MHz Channel Bandwidth / Middle Channel / 16QAM

Frequency (MHz)	Resource Block(s)	Resource Block Offset	Conducted RF Power (dBm)	Antenna Gain (dBd)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
819.0	50	0	19.28	-5.43	13.85	50.00	36.15	Complied
819.0	25	24	19.27	-5.43	13.84	50.00	36.16	Complied
819.0	25	0	19.40	-5.43	13.97	50.00	36.03	Complied
819.0	25	12	19.41	-5.43	13.98	50.00	36.02	Complied
819.0	1	49	20.30	-5.43	14.87	50.00	35.13	Complied
819.0	1	0	20.43	-5.43	15.00	50.00	35.00	Complied
819.0	1	24	20.44	-5.43	15.01	50.00	34.99	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	Testo	608-H1	45041825	02 Apr 2017	12
M1869	Wideband Radio Comms Tester	Rohde & Schwarz	CMW500	145923	05 Apr 2017	12
A2845	Attenuator	Radiall	R411.806.121	24325927	Calibrated before use	-
A2844	Attenuator	Radiall	R411.803.121	23404066	Calibrated before use	-
S0562	Power Supply	Thurlby Thandar	PL330QMD	054895	Calibrated before use	-
M1269	Multimeter	Fluke	179	90250210	13 May 2017	12
G0628	Signal Generator	Rohde & Schwarz	SMBV100A	261847	25 Jan 2017	12
M1835	Signal Analyser	Rohde & Schwarz	FSV30	103050	26 Feb 2017	12

5.2.3. Transmitter Occupied Bandwidth

Test Summary:

Test Engineer:	Keith Tucker	**Test Date:**	22 June 2016
Test Sample IMEI:	358640070064218		

FCC Reference:	Parts 90.209(b)(7) / 2.1049
Test Method Used:	KDB 971168 Section 4.2

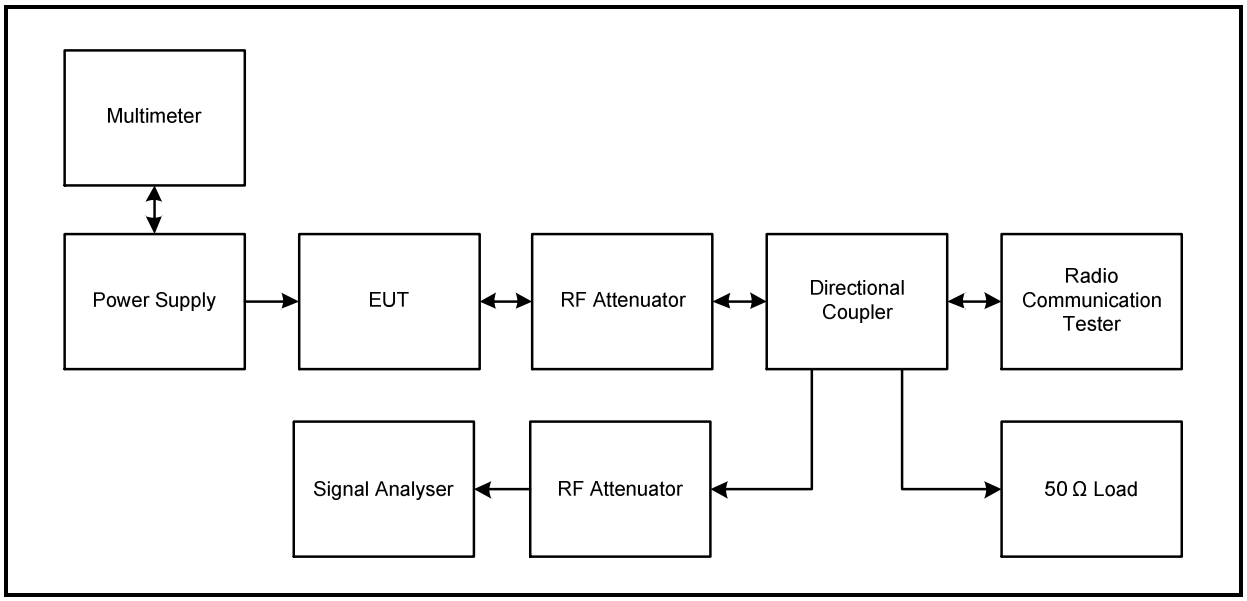
Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	56

Note(s):

1. Occupied bandwidth (99% bandwidth) was measured using a signal analyser occupied bandwidth function.
2. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks settings as detailed in section 4.3 of this report.
3. The RF port of the EUT was connected to the signal analyser via RF cables, directional coupler and suitable attenuation.

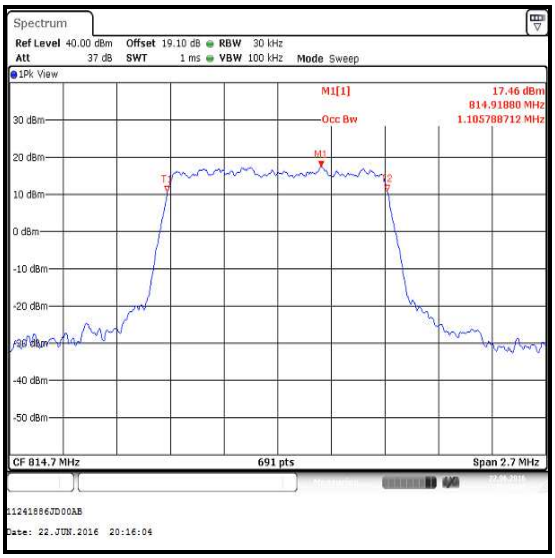
Test setup:



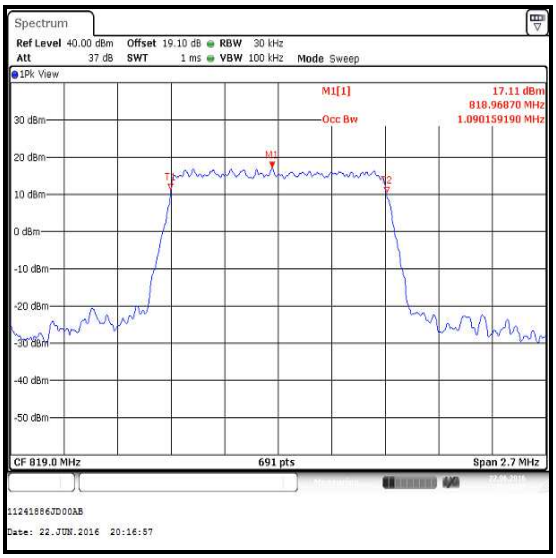
Transmitter Occupied Bandwidth (continued)

Results: 1.4 MHz Channel Bandwidth / QPSK

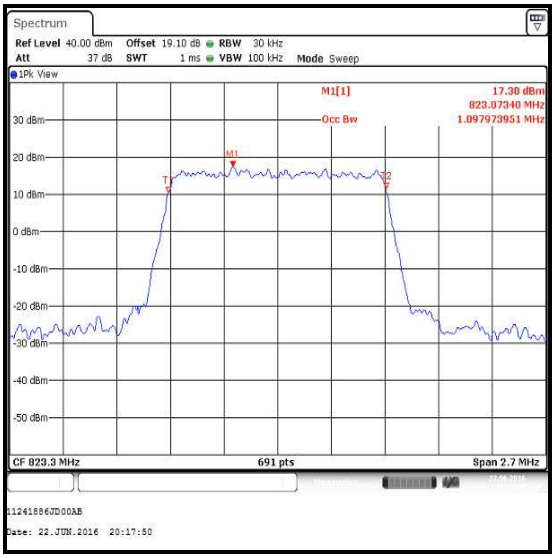
Channel	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	6	0	30	100	1.106
Middle	6	0	30	100	1.090
Top	6	0	30	100	1.098



Bottom Channel / QPSK



Middle Channel / QPSK

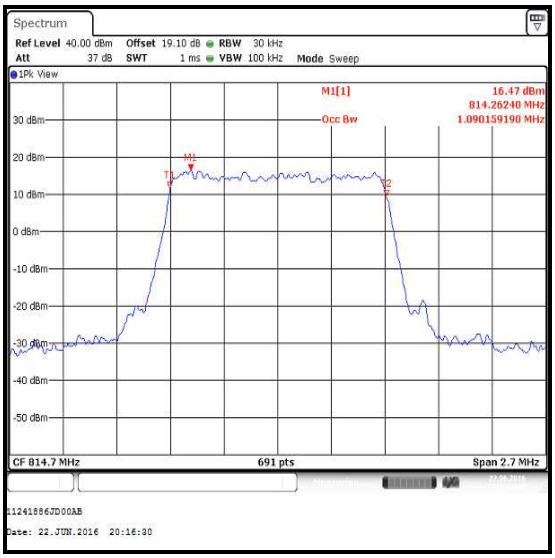


Top Channel / QPSK

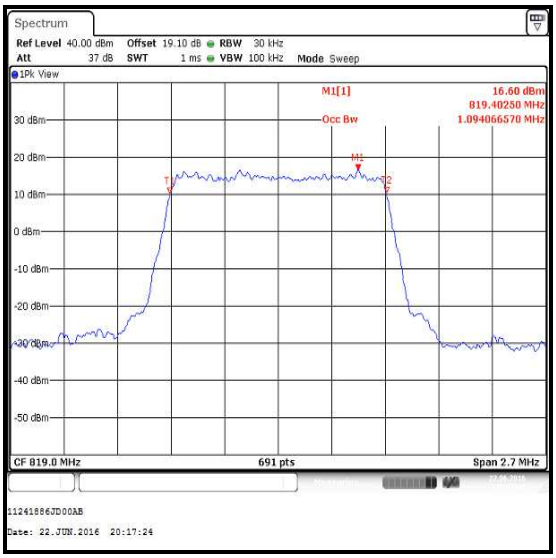
Transmitter Occupied Bandwidth (continued)

Results: 1.4 MHz Channel Bandwidth / 16QAM

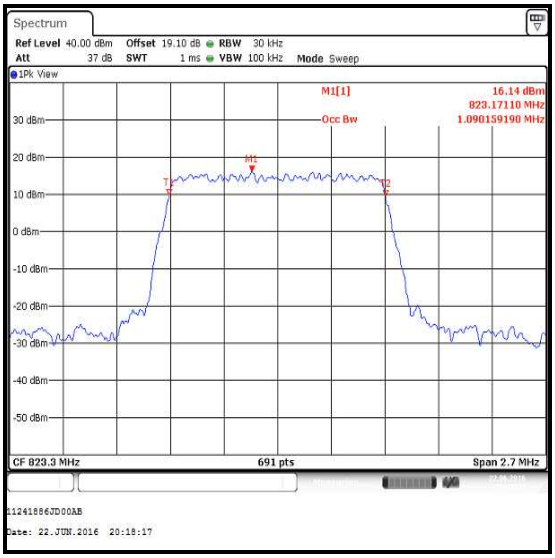
Channel	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	6	0	30	100	1.090
Middle	6	0	30	100	1.094
Top	6	0	30	100	1.090



Bottom Channel / 16QAM



Middle Channel / 16QAM

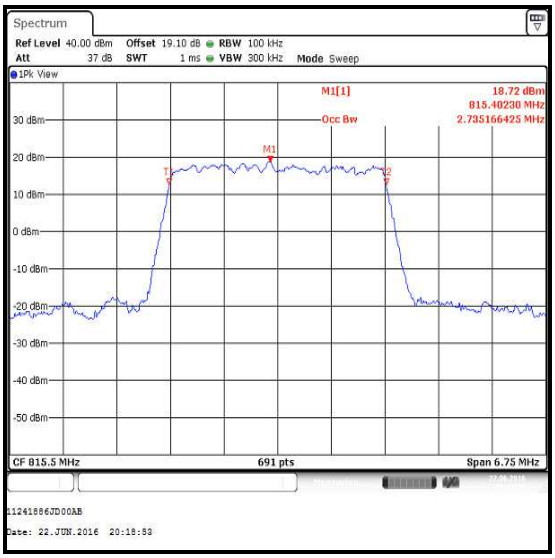


Top Channel / 16QAM

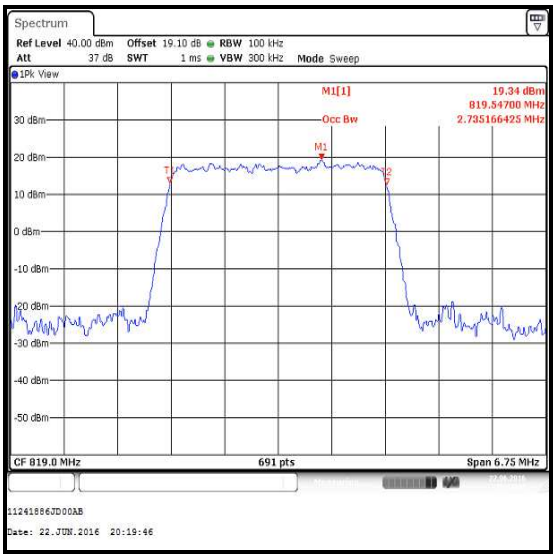
Transmitter Occupied Bandwidth (continued)

Results: 3 MHz Channel Bandwidth / QPSK

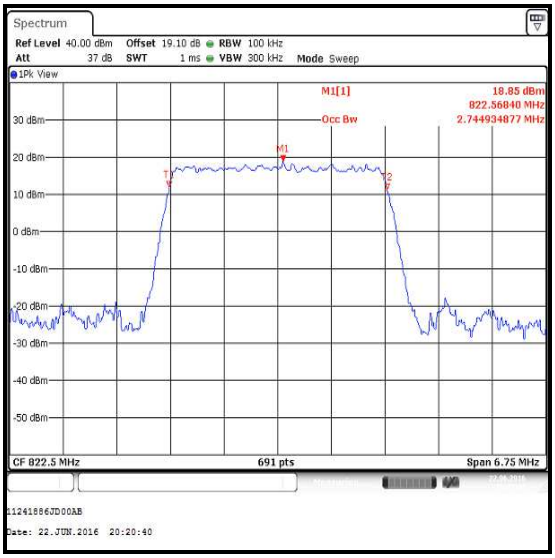
Channel	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	15	0	100	300	2.735
Middle	15	0	100	300	2.735
Top	15	0	100	300	2.745



Bottom Channel / QPSK



Middle Channel / QPSK

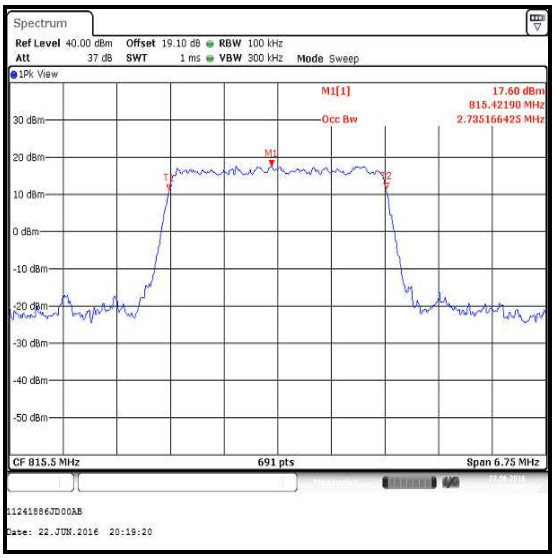


Top Channel / QPSK

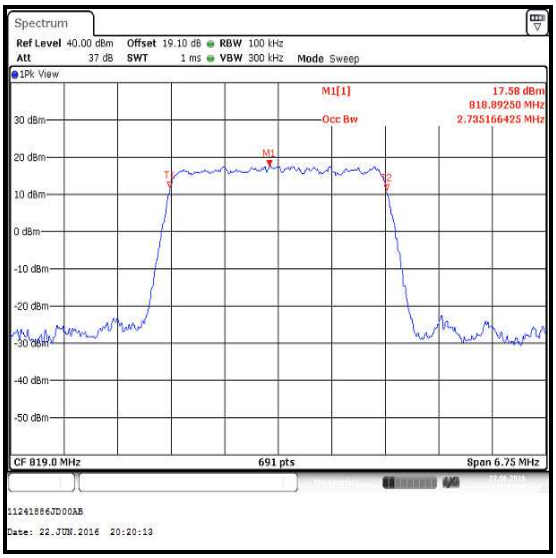
Transmitter Occupied Bandwidth (continued)

Results: 3 MHz Channel Bandwidth / 16QAM

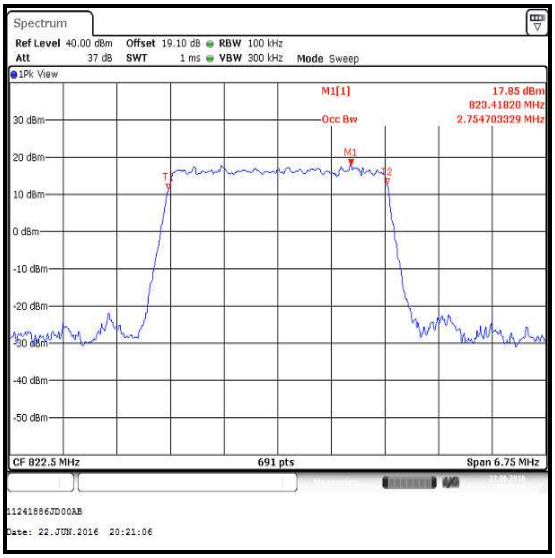
Channel	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	15	0	100	300	2.735
Middle	15	0	100	300	2.735
Top	15	0	100	300	2.755



Bottom Channel / 16QAM



Middle Channel / 16QAM

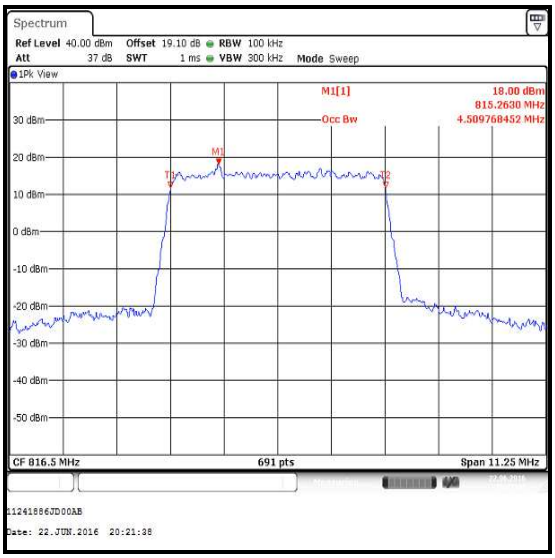


Top Channel / 16QAM

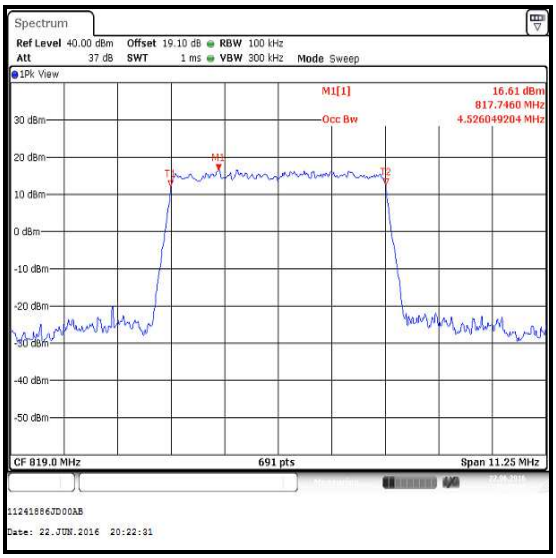
Transmitter Occupied Bandwidth (continued)

Results: 5 MHz Channel Bandwidth / QPSK

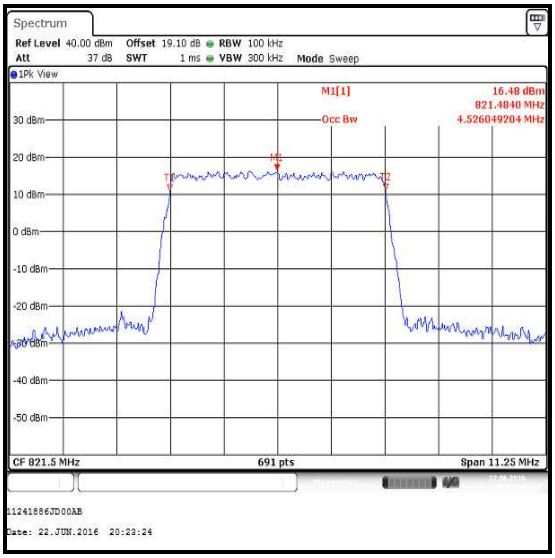
Channel	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	25	0	100	300	4.510
Middle	25	0	100	300	4.526
Top	25	0	100	300	4.526



Bottom Channel / QPSK



Middle Channel / QPSK

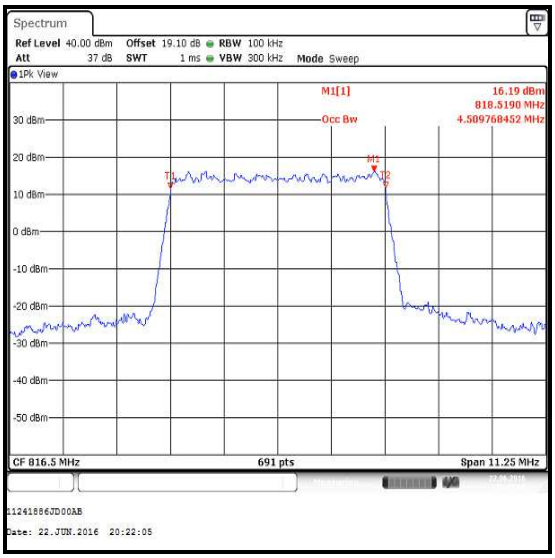


Top Channel / QPSK

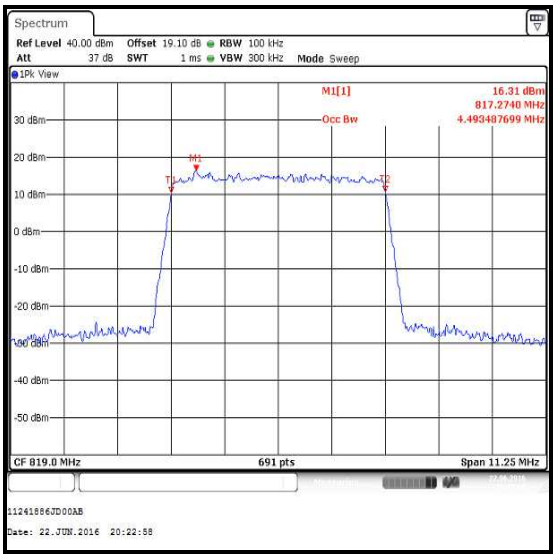
Transmitter Occupied Bandwidth (continued)

Results: 5 MHz Channel Bandwidth / 16QAM

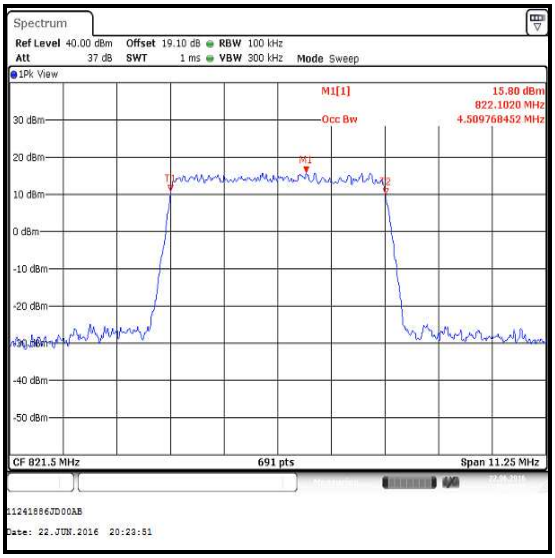
Channel	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
Bottom	25	0	100	300	4.510
Middle	25	0	100	300	4.493
Top	25	0	100	300	4.510



Bottom Channel / 16QAM



Middle Channel / 16QAM

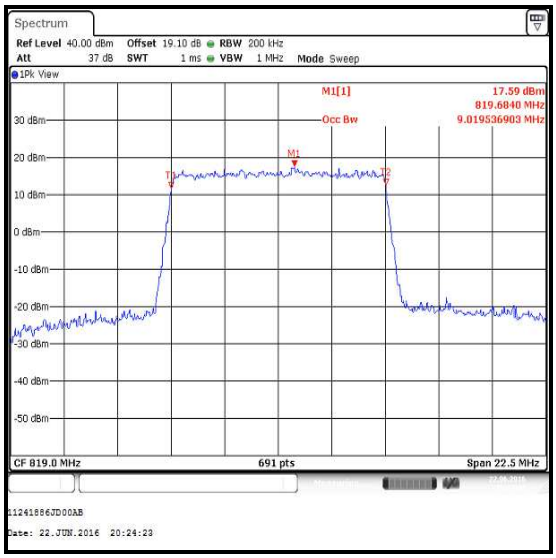


Top Channel / 16QAM

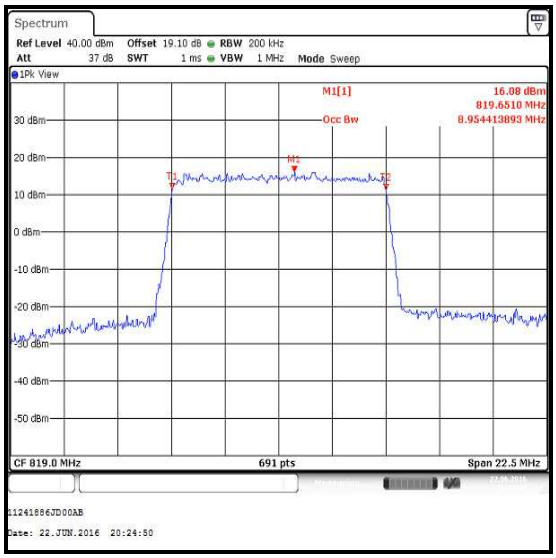
Transmitter Occupied Bandwidth (continued)

Results: 10 MHz Channel Bandwidth / Middle Channel

Modulation	Resource Block(s)	Resource Block Offset	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)
QPSK	50	0	200	1000	9.020
16QAM	50	0	200	1000	8.954



Middle Channel / QPSK



Middle Channel / 16QAM

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2002	Thermohygrometer	Testo	608-H1	45041825	02 Apr 2017	12
M1869	Wideband Radio Comms Tester	Rohde & Schwarz	CMW500	145923	05 Apr 2017	12
M1873	Signal Analyser	Rohde & Schwarz	FSV30	103074	27 Jun 2017	12
A2845	Attenuator	Radiall	R411.806.121	24325927	Calibrated before use	-
A2844	Attenuator	Radiall	R411.803.121	23404066	Calibrated before use	-
A2500	Directional Coupler	AtlanTecRF	CDC-003060-10	13122501 835	Calibrated before use	-
S0562	Power Supply	Thurlby Thandar	PL330QMD	054895	Calibrated before use	-
M1269	Multimeter	Fluke	179	90250210	13 May 2017	12

5.2.4. Transmitter Radiated Emissions – LAT

Test Summary:

Test Engineers:	David Doyle & Andrew Edwards	**Test Dates:**	02 June 2016 & 03 June 2016
Test Sample IMEI:	358640070087482		

FCC Reference:	Parts 90.691 / 2.1053
Test Method Used:	KDB 971168 Section 6.1 referencing FCC Part 2.1053
Frequency Range:	30 MHz to 9 GHz
Configuration:	10 MHz, QPSK, 1RB, 0 Offset

Environmental Conditions:

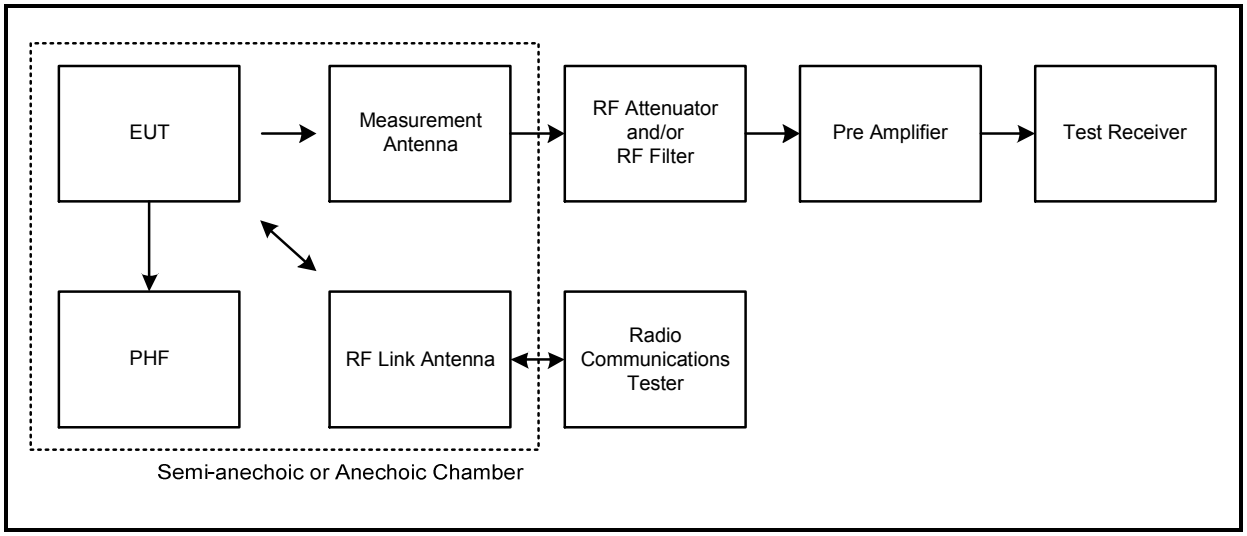
Temperature (°C):	23 to 24
Relative Humidity (%):	39 to 42

Note(s):

1. The EUT was set to transmit with a 10 MHz channel bandwidth with QPSK modulation applied and 1 resource block with 0 offset, as this was found to be the worst case modulation scheme with regards to emissions after preliminary investigations and was therefore deemed to be the worst case.
2. The emission seen on the 30 MHz to 1 GHz plot at approximately 819 MHz is the EUT carrier.
3. No spurious emissions were detected above the measurement system noise floor therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
4. Middle channel results are recorded in this report and are representative of bottom and top channel results which are held on the UL IT server and available for inspection on request.
5. Pre-scan measurements below 1 GHz are performed on separate plots with different transducer factors for vertical and horizontal polarisation. The pre-scan plot for 30 MHz to 1 GHz in this test report is for vertical only. All other plots are stored on the company server and are available if required.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
7. Pre-scans above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
8. Radiated spurious emission testing between 150 kHz and 30 MHz was performed for support of the NFC test report. No spurious emissions were observed above the noise floor of the measurement system.

Transmitter Radiated Emissions – LAT (continued)

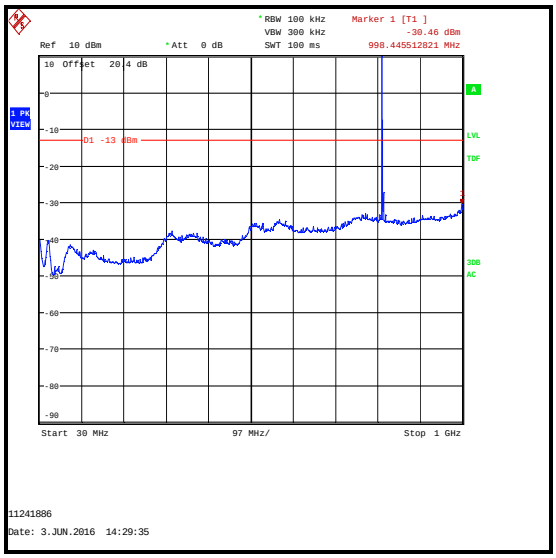
Test setup for radiated measurements:

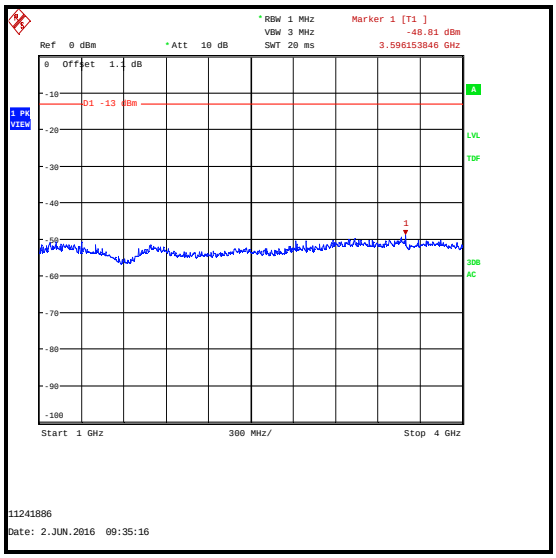


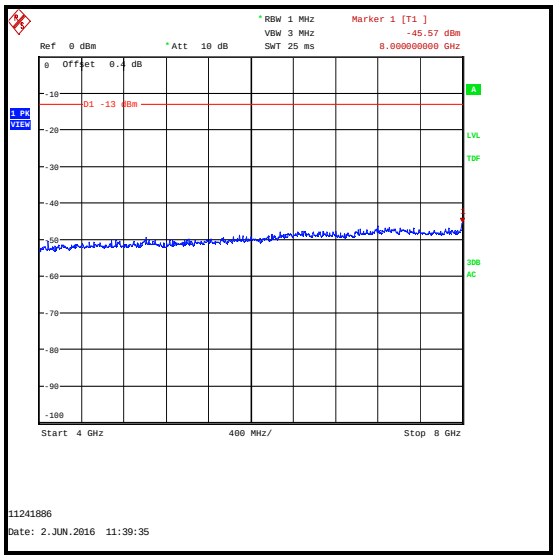
Results: Middle Channel

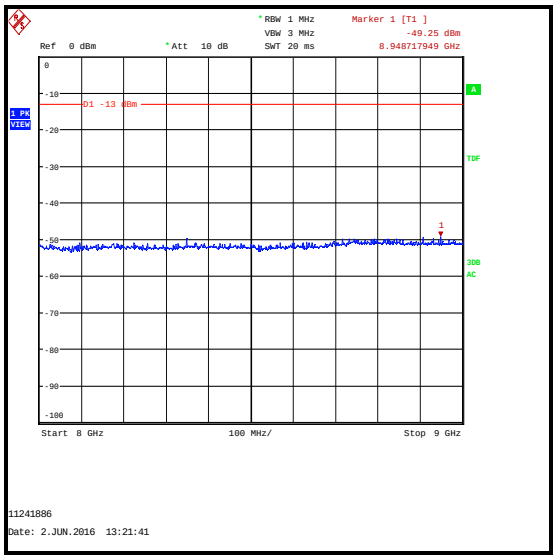
Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
998.446	-30.5	-13.0	17.5	Complied

Transmitter Radiated Emissions – LAT (continued)









Transmitter Radiated Emissions – LAT (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Apr 2017	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	17 May 2017	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	21 Mar 2017	12
A2888	Antenna	Schwarzbeck	VULB 9163	9163-941	07 Apr 2017	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	07 Apr 2017	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	06 May 2017	12
A2863	Pre-Amplifier	Agilent	8449B	3008A02100	07 Jan 2017	12
A2891	Pre-Amplifier	Schwarzbeck	BBV 9718	9718-306	07 Apr 2017	12
A2918	Attenuator	AtlanTecRF	AN18W5-20	832828#1	19 May 2017	12
A2908	High Pass Filter	Wainwright	WHJE5-920-1000-4000-60EE	3	23 May 2017	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	19 May 2017	12

5.2.5. Transmitter Radiated Emissions – UAT

Test Summary:

Test Engineers:	David Doyle & Andrew Edwards	**Test Dates:**	02 June 2016 & 03 June 2016
Test Sample IMEI:	358640070022893		

FCC Reference:	Parts 90.691 / 2.1053
Test Method Used:	KDB 971168 Section 6.1 referencing FCC Part 2.1053
Frequency Range:	30 MHz to 9 GHz
Configuration:	10 MHz, QPSK, 1RB, 0 Offset

Environmental Conditions:

Temperature (°C):	23 to 24
Relative Humidity (%):	39 to 42

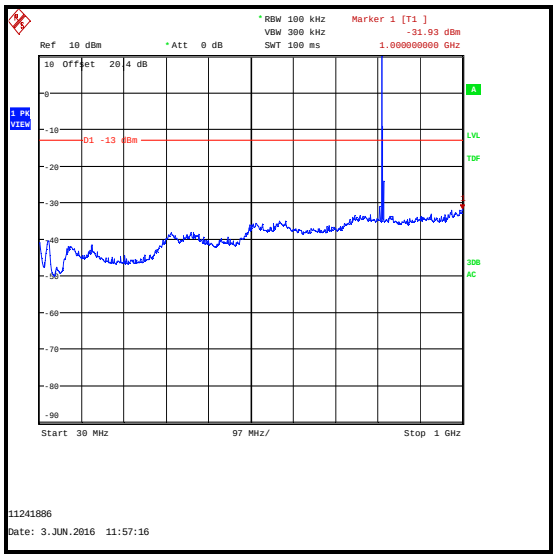
Note(s):

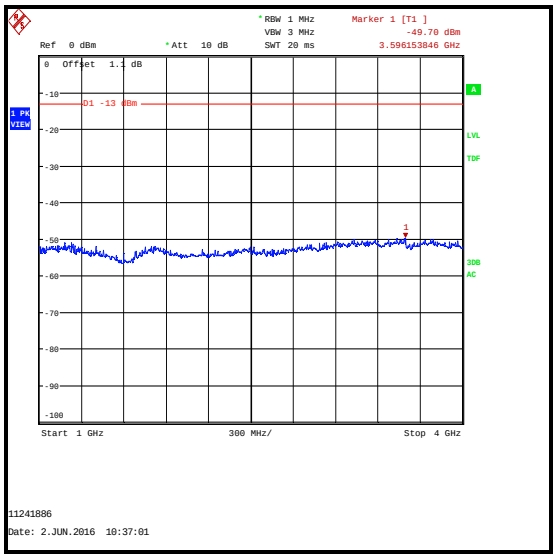
1. The EUT was set to transmit with a 10 MHz channel bandwidth with QPSK modulation applied and 1 resource block with 0 offset, as this was found to be the worst case modulation scheme with regards to emissions after preliminary investigations and was therefore deemed to be the worst case.
2. The emission seen on the 30 MHz to 1 GHz plot at approximately 819 MHz is the EUT carrier.
3. No spurious emissions were detected above the measurement system noise floor therefore the highest peak noise floor reading of the measuring receiver was recorded in the table below.
4. Middle channel results are recorded in this report and are representative of bottom and top channel results which are held on the UL IT server and available for inspection on request.
5. Pre-scan measurements below 1 GHz are performed on separate plots with different transducer factors for vertical and horizontal polarisation. The pre-scan plot for 30 MHz to 1 GHz in this test report is for vertical only. All other plots are stored on the company server and are available if required.
6. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
7. Pre-scans above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
8. Radiated spurious emission testing between 150 kHz and 30 MHz was performed for support of the NFC test report. No spurious emissions were observed above the noise floor of the measurement system.

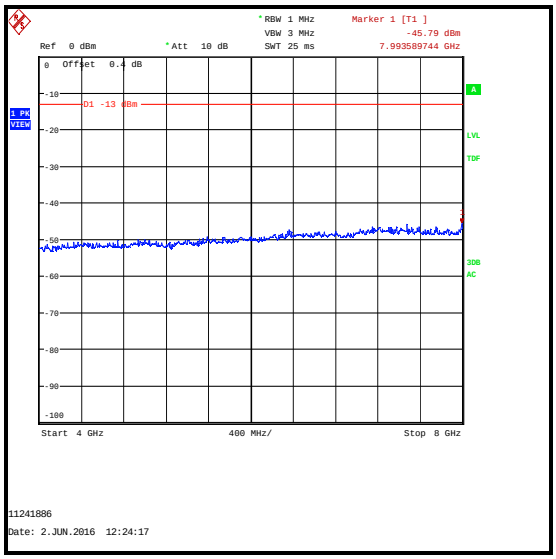
Results: Middle Channel

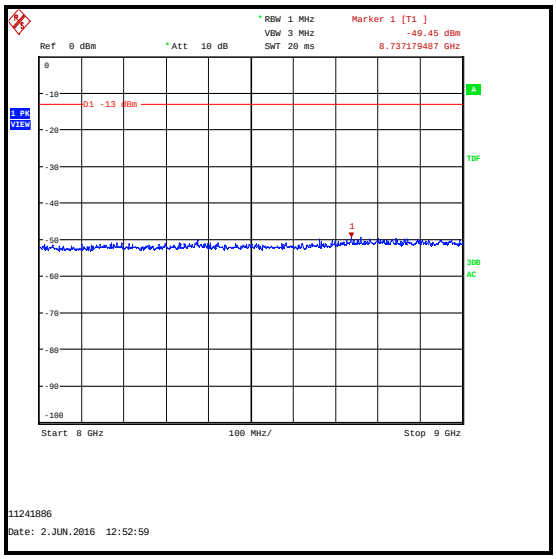
Frequency (MHz)	Peak Level (dBm)	Limit (dBm)	Margin (dB)	Result
1000.000	-31.9	-13.0	18.9	Complied

Transmitter Radiated Emissions – UAT (continued)









Transmitter Radiated Emissions – UAT (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Apr 2017	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	17 May 2017	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	21 Mar 2017	12
A2888	Antenna	Schwarzbeck	VULB 9163	9163-941	07 Apr 2017	12
A2889	Antenna	Schwarzbeck	BBHA 9120 B	BBHA 9120 B 653	07 Apr 2017	12
A2890	Antenna	Schwarzbeck	HWRD 750	014	06 May 2017	12
A2863	Pre-Amplifier	Agilent	8449B	3008A02100	07 Jan 2017	12
A2891	Pre-Amplifier	Schwarzbeck	BBV 9718	9718-306	07 Apr 2017	12
A2918	Attenuator	AtlanTecRF	AN18W5-20	832828#1	19 May 2017	12
A2908	High Pass Filter	Wainwright	WHJE5-920-1000-4000-60EE	3	23 May 2017	12
A2914	High Pass Filter	AtlanTecRF	AFH-03000	2155	19 May 2017	12

5.2.6. Transmitter Radiated Emissions at Band Edges - LAT

Test Summary:

Test Engineers:	David Doyle & Nick Steele	**Test Dates:**	22 June 2016 & 24 June 2016
Test Sample IMEI:	358640070087480		

FCC Reference:	Parts 90.691 / 2.1053
Test Method Used:	KDB 971168 Section 6.1 referencing FCC Part 2.1053

Environmental Conditions:

Temperature (°C):	24 to 26
Relative Humidity (%):	38 to 44

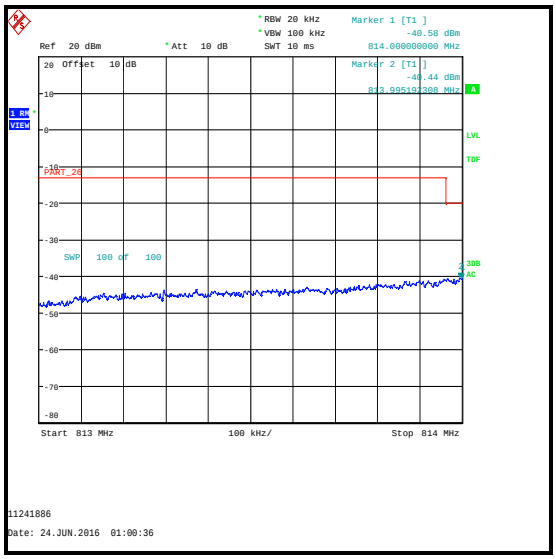
Note(s):

1. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks settings as detailed in section 4.3 of this report.
2. Measurements were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. The measurement antenna was placed at a fixed height of 1.5 metres above the test chamber floor in line with the EUT.
3. 1.4 MHz Channel bandwidth: In the first 37.5 kHz immediately outside and adjacent to the operating band, the test receiver resolution bandwidth was set to 20 kHz (>1% of the widest 26 dB emission bandwidth) and video bandwidth 100 kHz (as close to > three times the resolution bandwidth as the test receiver allowed).
4. 3 MHz Channel bandwidth: In the first 37.5 kHz immediately outside and adjacent to the operating band, the test receiver resolution bandwidth was set to 30 kHz (1% of the widest 26 dB emission bandwidth) and video bandwidth 100 kHz (as close to > three times the resolution bandwidth as the test receiver allowed).
5. 5 MHz Channel bandwidth: In the first 37.5 kHz immediately outside and adjacent to the operating band, the test receiver resolution bandwidth was set to 50 kHz (1% of the widest 26 dB emission bandwidth) and video bandwidth 200 kHz (as close to > three times the resolution bandwidth as the test receiver allowed).
6. 10 MHz Channel bandwidth: In the first 37.5 kHz immediately outside and adjacent to the operating band, the test receiver resolution bandwidth was set to 100 kHz (>1% of the widest 26 dB emission bandwidth) and video bandwidth 300 kHz (three times the resolution bandwidth).
7. Sweep time was set to auto and an RMS detector with trace averaging of at least 100 sweeps was used.

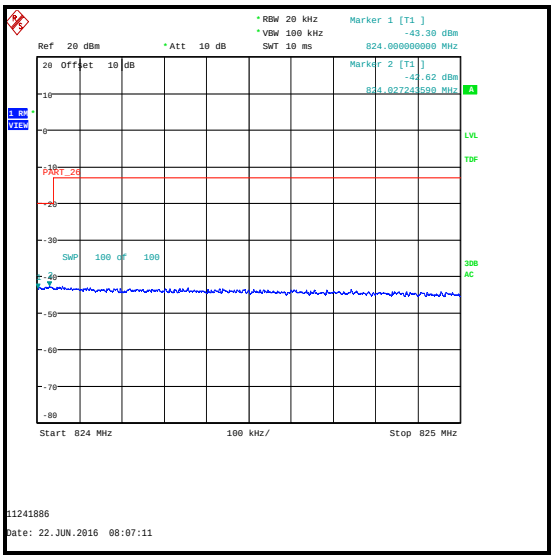
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 1.4 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
813.995	6	0	-40.4	-20.0	20.4	Complied
814	6	0	-40.6	-20.0	20.6	Complied
824	6	0	-43.3	-20.0	23.3	Complied
824.027	6	0	-42.6	-20.0	22.6	Complied



QPSK / Lower Band Edge

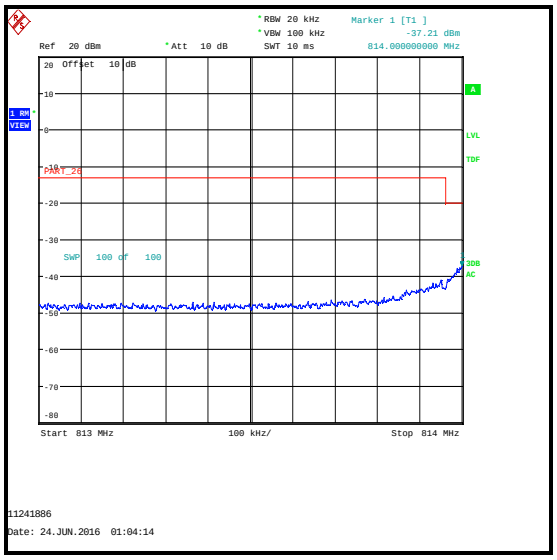


QPSK / Upper Band Edge

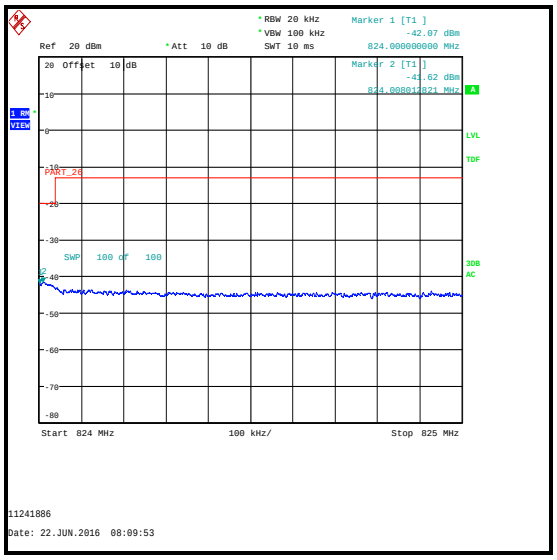
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 1.4 MHz Channel Bandwidth / QPSK

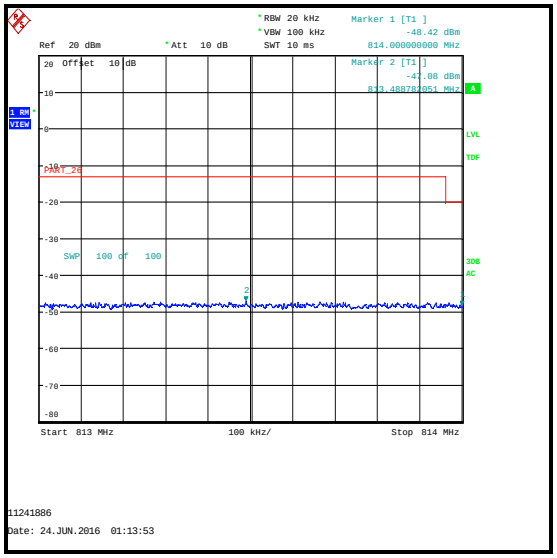
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-37.2	-20.0	17.2	Complied
824	1	5	-42.1	-20.0	22.1	Complied
814	1	5	-48.4	-20.0	28.4	Complied
824	1	0	-44.8	-20.0	28.8	Complied



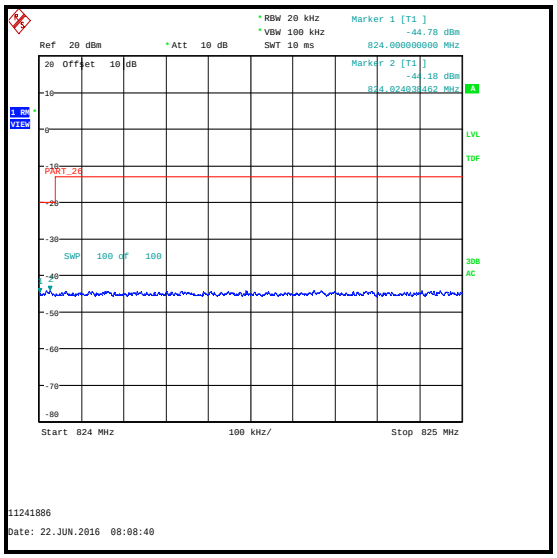
QPSK / 1 RB 0 offset / Lower Band Edge



QPSK / 1 RB 5 offset / Upper Band Edge



QPSK / 1 RB 5 offset / Lower Band Edge

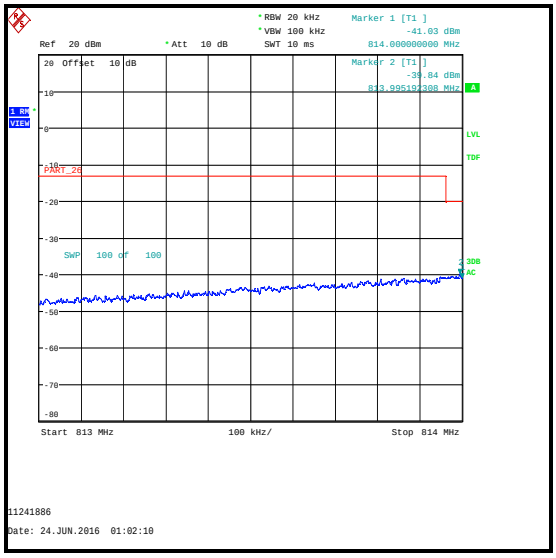


QPSK / 1 RB 0 offset / Upper Band Edge

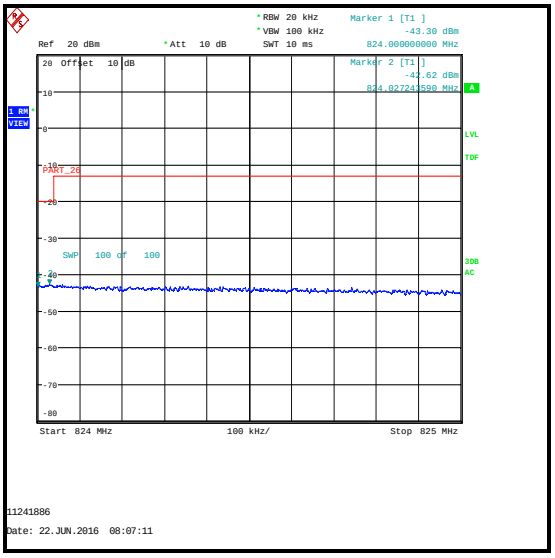
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 1.4 MHz Channel Bandwidth / 16QAM

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
813.995	6	0	-39.8	-20.0	19.8	Complied
814	6	0	-41.0	-20.0	21.0	Complied
824	6	0	-43.3	-20.0	23.3	Complied
824.027	6	0	-42.6	-20.0	22.6	Complied



16QAM / Lower Band Edge

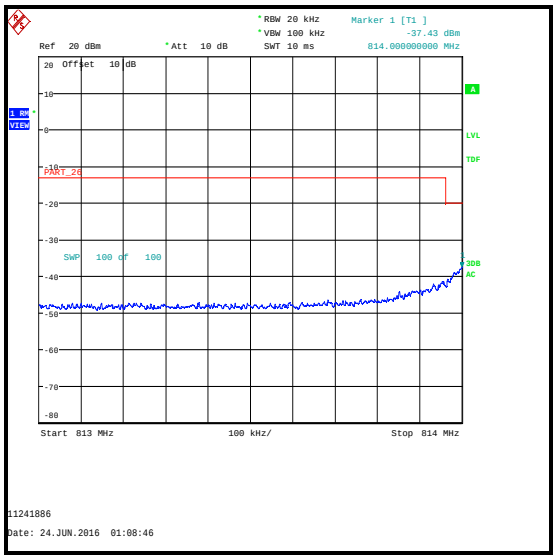


16QAM / Upper Band Edge

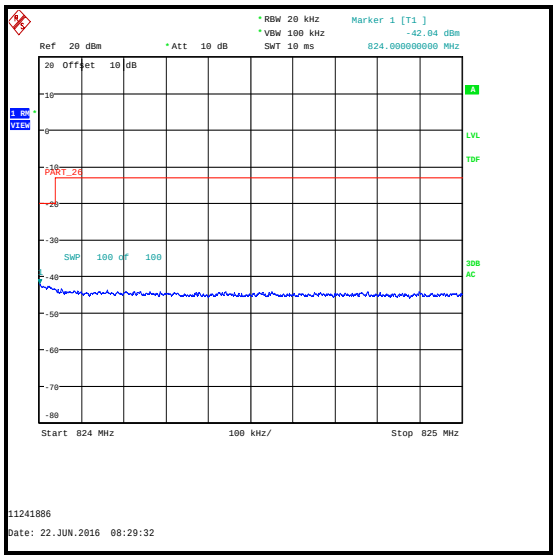
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 1.4 MHz Channel Bandwidth / 16QAM

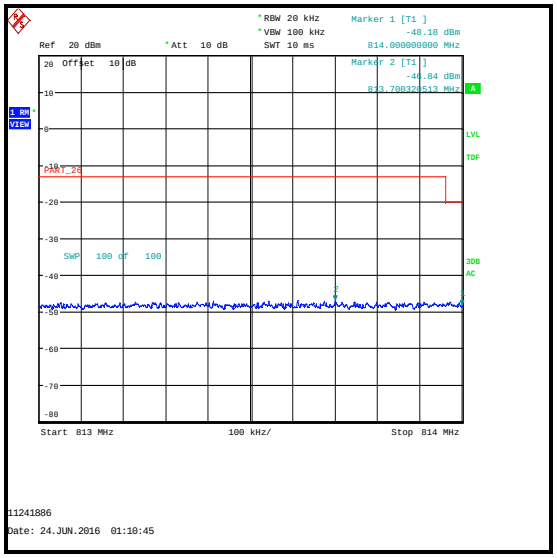
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-37.4	-20.0	17.4	Complied
824	1	5	-42.0	-20.0	22.0	Complied
814	1	5	-48.2	-20.0	28.2	Complied
824	1	0	-44.6	-20.0	24.6	Complied



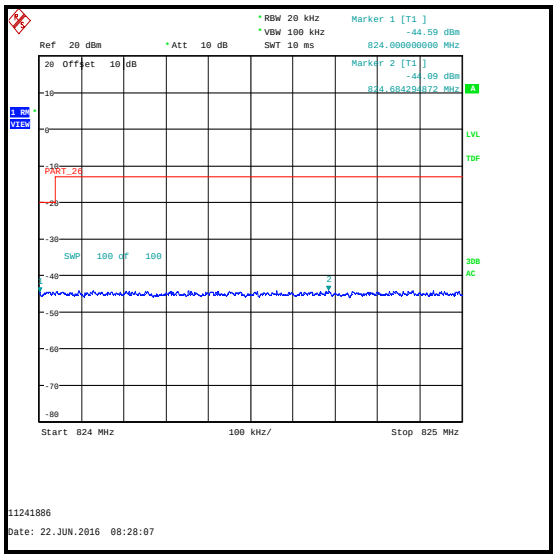
16QAM / 1 RB 0 offset / Lower Band Edge



16QAM / 1 RB 5 offset / Upper Band Edge



16QAM / 1 RB 5 offset / Lower Band Edge

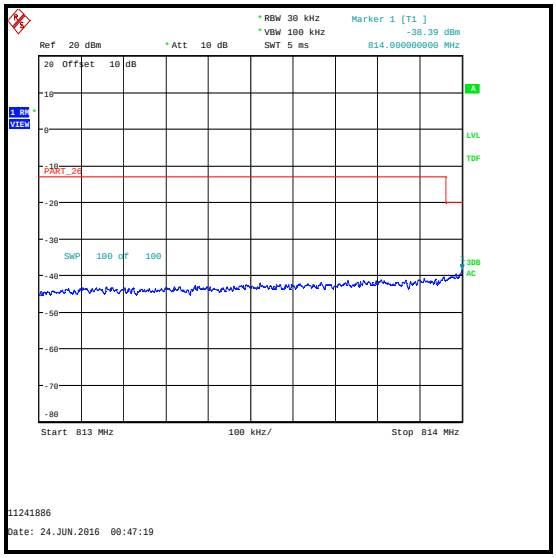


16QAM / 1 RB 0 offset / Upper Band Edge

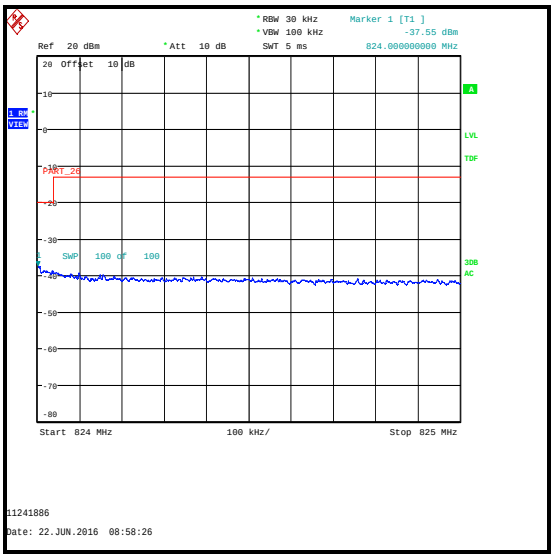
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 3 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	15	0	-38.4	-20.0	18.4	Complied
824	15	0	-37.6	-20.0	17.6	Complied



QPSK / Lower Band Edge

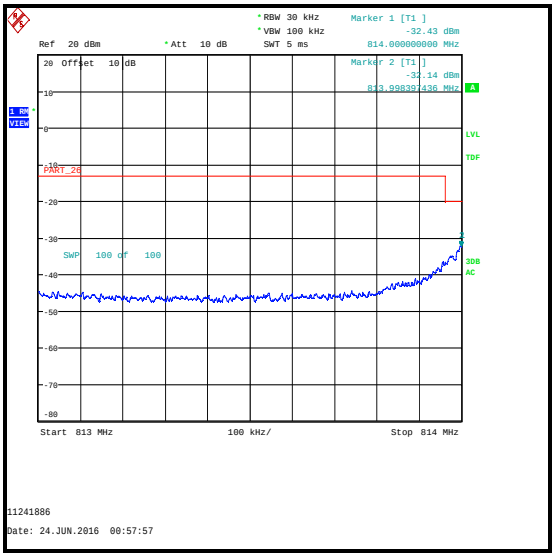


QPSK / Upper Band Edge

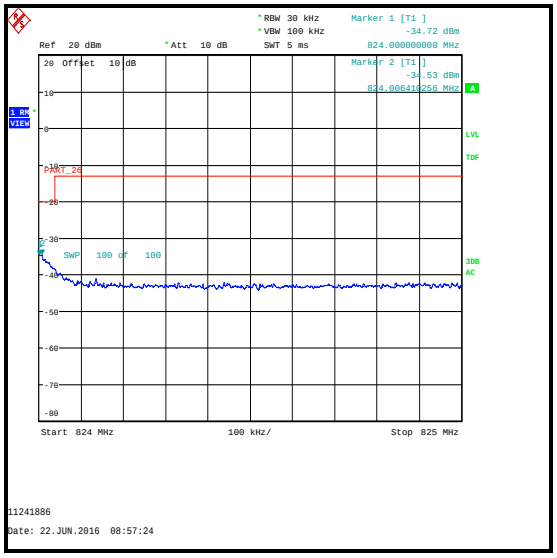
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 3 MHz Channel Bandwidth / QPSK

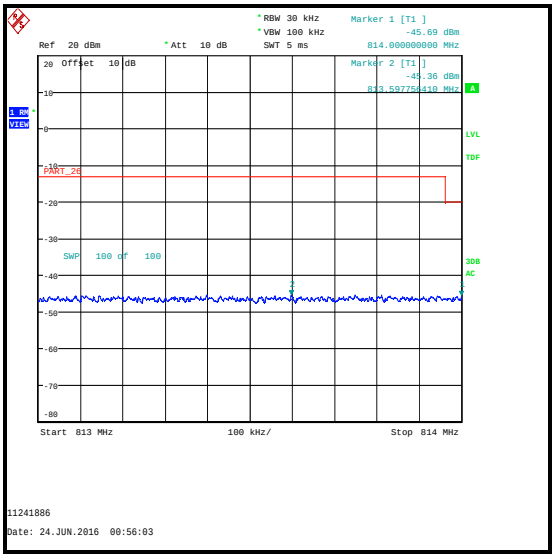
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-32.4	-20.0	12.4	Complied
824	1	14	-34.7	-20.0	14.7	Complied
814	1	14	-45.7	-20.0	25.7	Complied
824	1	0	-43.6	-20.0	23.6	Complied



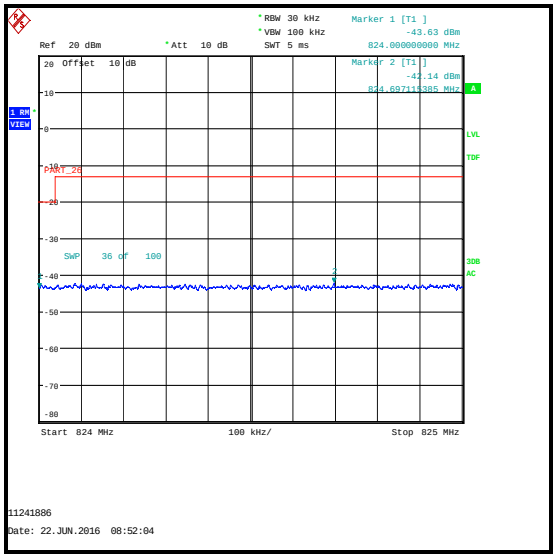
QPSK / 1 RB 0 offset / Lower Band Edge



QPSK / 1 RB 14 offset / Upper Band Edge



QPSK / 1 RB 14 offset / Lower Band Edge

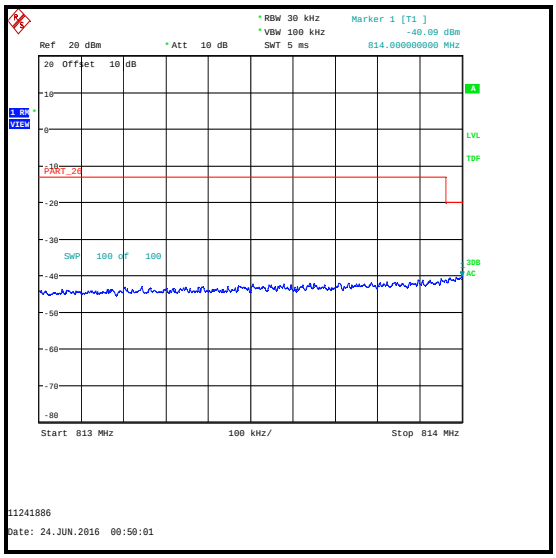


QPSK / 1 RB 0 offset / Upper Band Edge

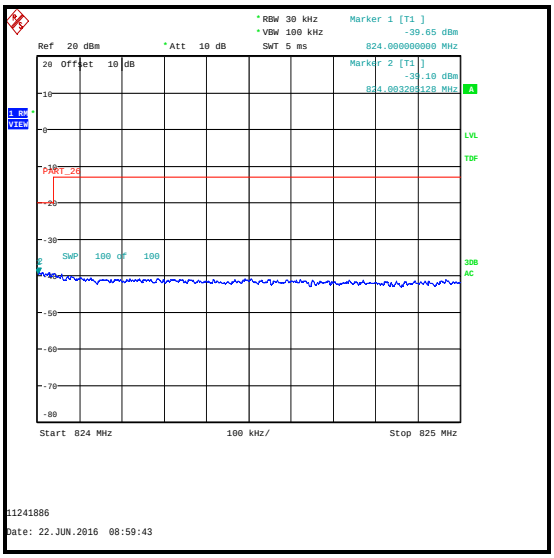
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 3 MHz Channel Bandwidth / 16QAM

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	15	0	-40.1	-20.0	20.1	Complied
824	15	0	-39.7	-20.0	19.7	Complied
824.003	15	0	-39.1	-20.0	19.1	Complied



16QAM / Lower Band Edge

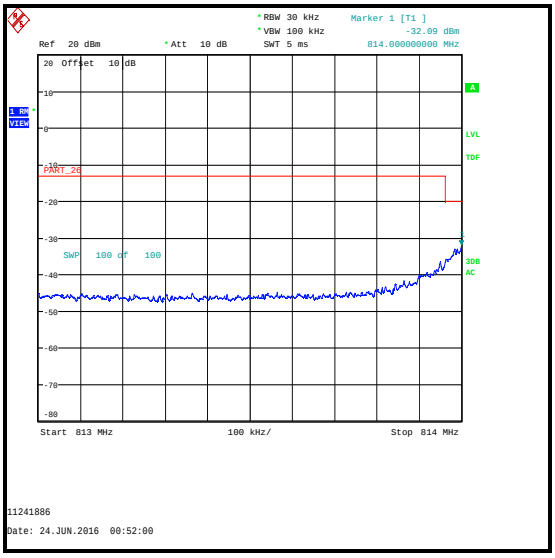


16QAM / Upper Band Edge

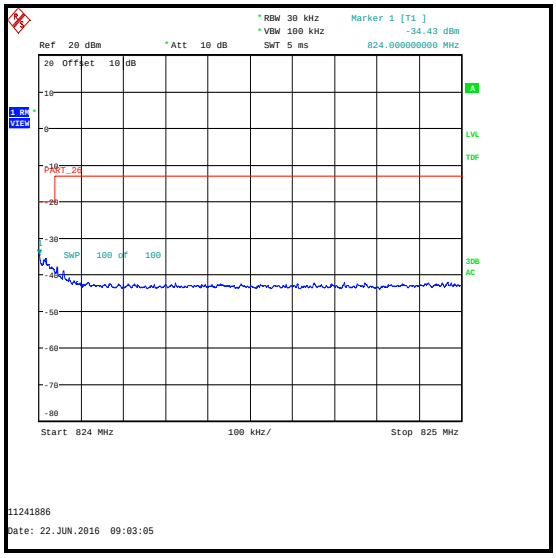
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 3 MHz Channel Bandwidth / 16QAM

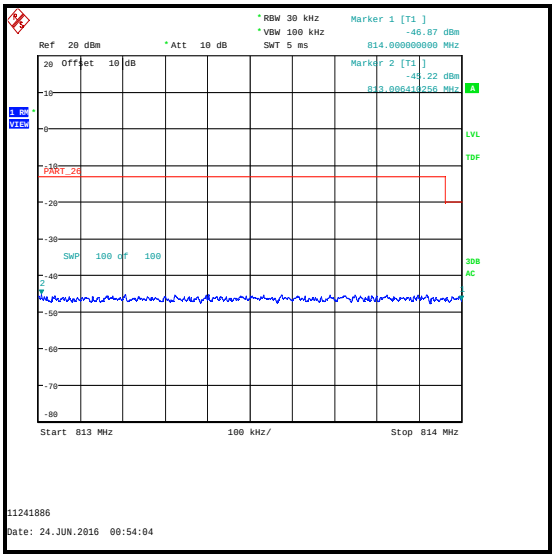
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-32.1	-20.0	12.1	Complied
824	1	14	-34.4	-20.0	14.4	Complied
814	1	14	-46.9	-20.0	26.9	Complied
824	1	0	-43.1	-20.0	23.1	Complied



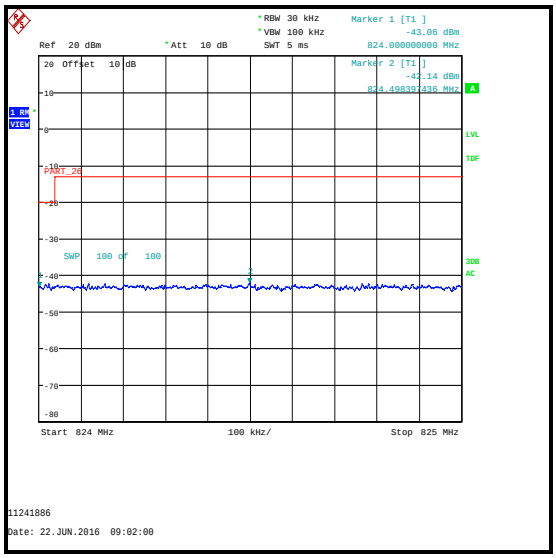
16QAM / 1 RB 0 offset / Lower Band Edge



16QAM / 1 RB 14 offset / Upper Band Edge



16QAM / 1 RB 14 offset / Lower Band Edge

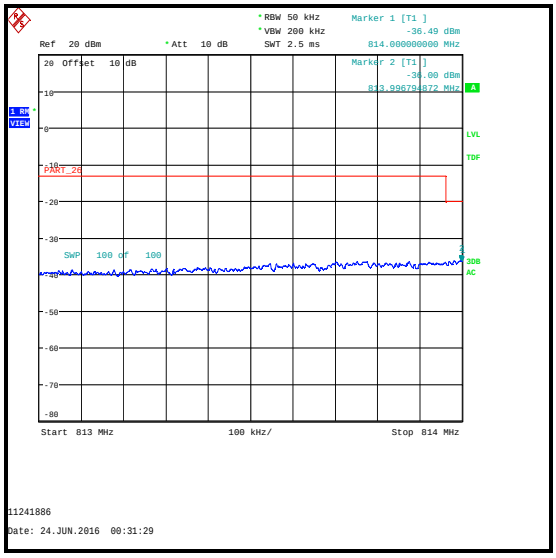


16QAM / 1 RB 0 offset / Upper Band Edge

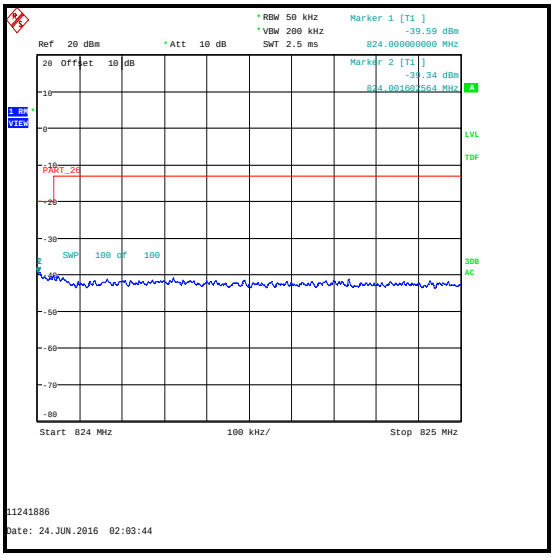
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 5 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
813.997	25	0	-36.0	-20.0	16.0	Complied
814	25	0	-36.5	-20.0	16.5	Complied
824	25	0	-39.6	-20.0	19.6	Complied
824.002	25	0	-39.3	-20.0	19.3	Complied



QPSK / Lower Band Edge

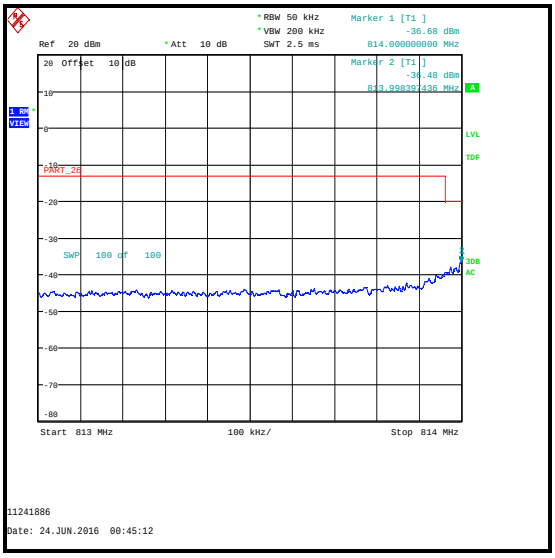


QPSK / Upper Band Edge

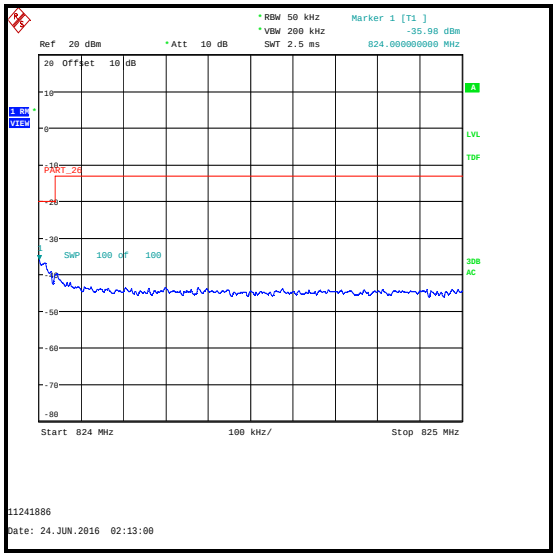
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 5 MHz Channel Bandwidth / QPSK

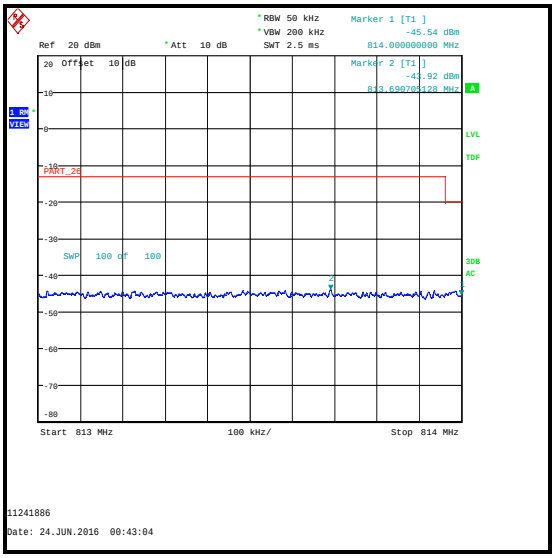
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-36.7	-20.0	16.7	Complied
824	1	24	-36.0	-20.0	16.0	Complied
814	1	24	-45.5	-20.0	25.5	Complied
824	1	0	-45.0	-20.0	25.0	Complied



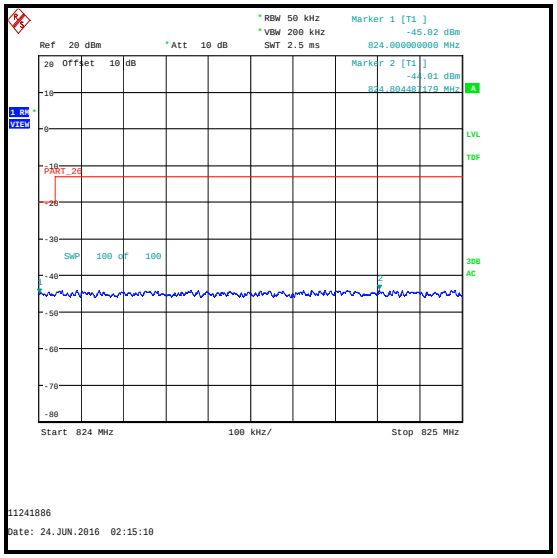
QPSK / 1 RB 0 offset / Lower Band Edge



QPSK / 1 RB 24 offset / Upper Band Edge



QPSK / 1 RB 24 offset / Lower Band Edge

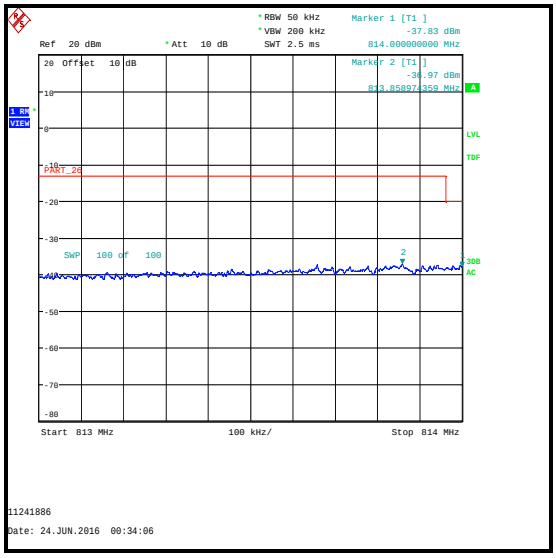


QPSK / 1 RB 0 offset / Upper Band Edge

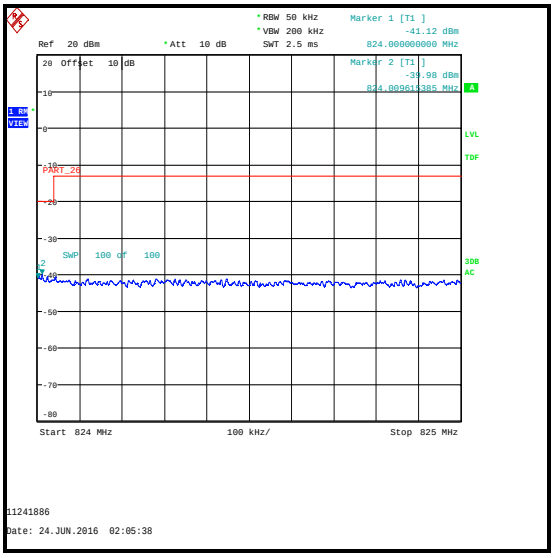
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 5 MHz Channel Bandwidth / 16QAM

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
813.859	25	0	-37.0	-20.0	17.0	Complied
814	25	0	-37.8	-13.0	24.8	Complied
824	25	0	-41.1	-20.0	21.1	Complied
824.010	25	0	-40.0	-20.0	20.0	Complied



16QAM / Lower Band Edge

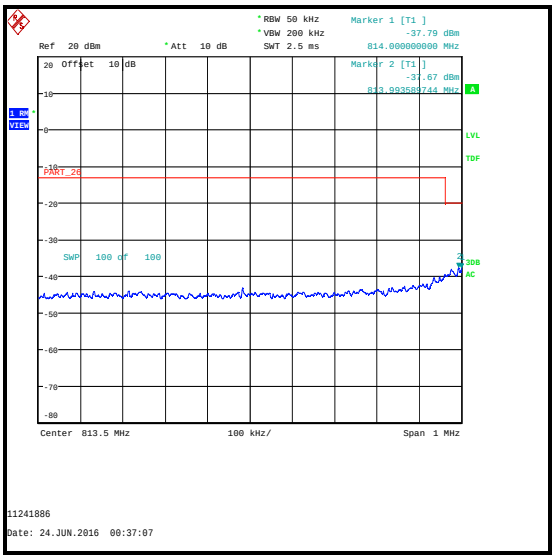


16QAM / Upper Band Edge

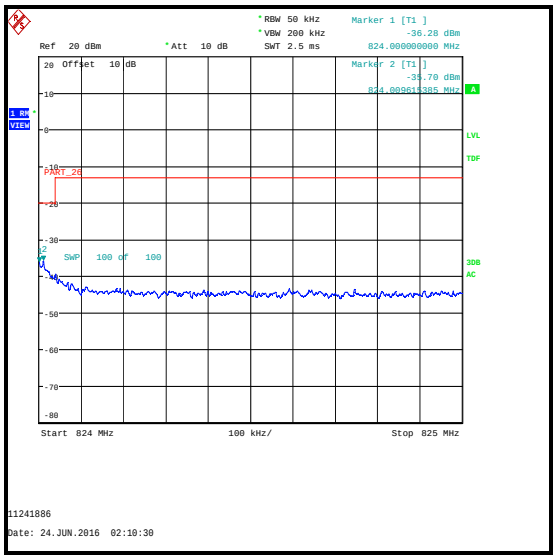
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 5 MHz Channel Bandwidth / 16QAM

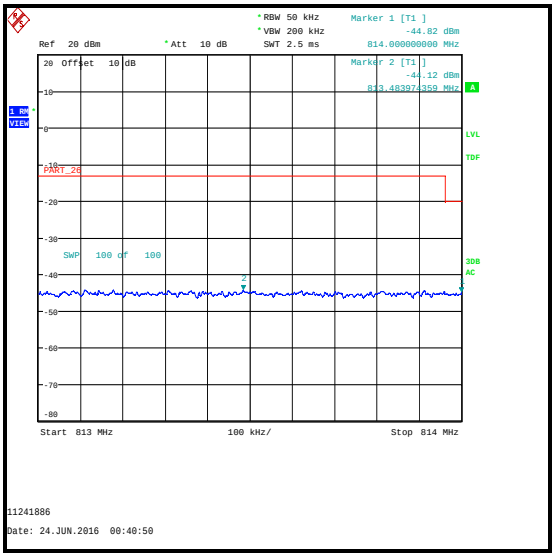
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-37.8	-20.0	17.8	Complied
824	1	24	-36.3	-20.0	16.3	Complied
814	1	24	-44.8	-20.0	24.8	Complied
824	1	0	-44.7	-20.0	24.7	Complied



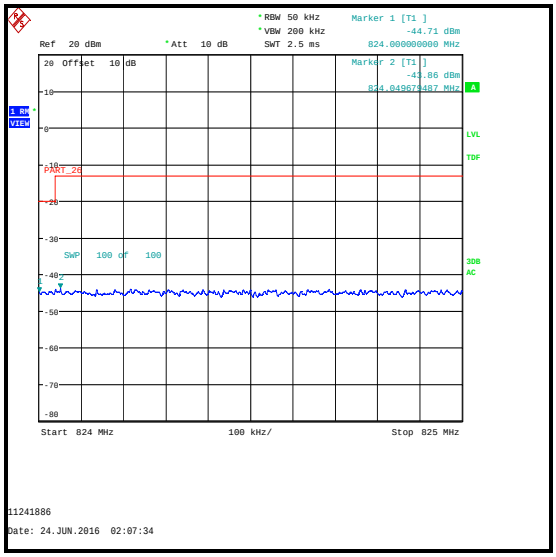
16QAM / 1 RB 0 offset / Lower Band Edge



16QAM / 1 RB 24 offset / Upper Band Edge



16QAM / 1 RB 24 offset / Lower Band Edge

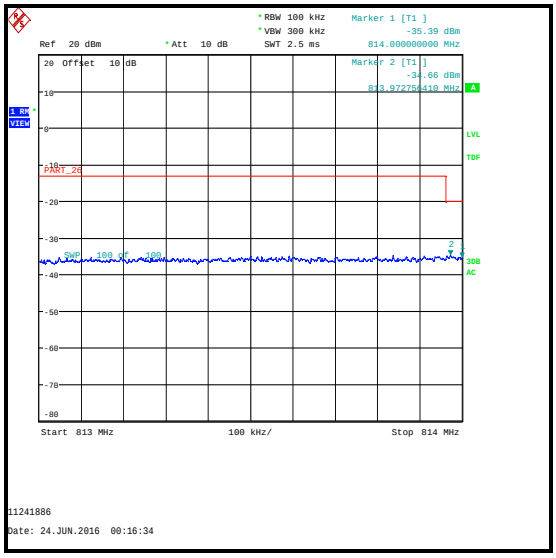


16QAM / 1 RB 0 offset / Upper Band Edge

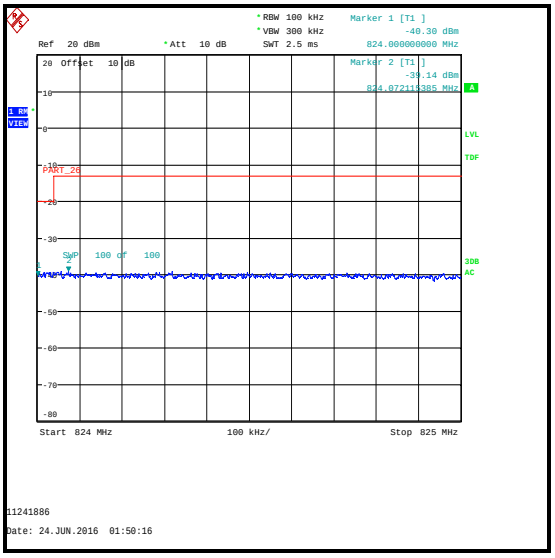
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 10 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
813.973	50	0	-34.7	-20.0	14.7	Complied
814	50	0	-35.4	-20.0	15.4	Complied
824	50	0	-40.3	-20.0	20.3	Complied
824.072	50	0	-39.1	-13.0	26.1	Complied



QPSK / Lower Band Edge

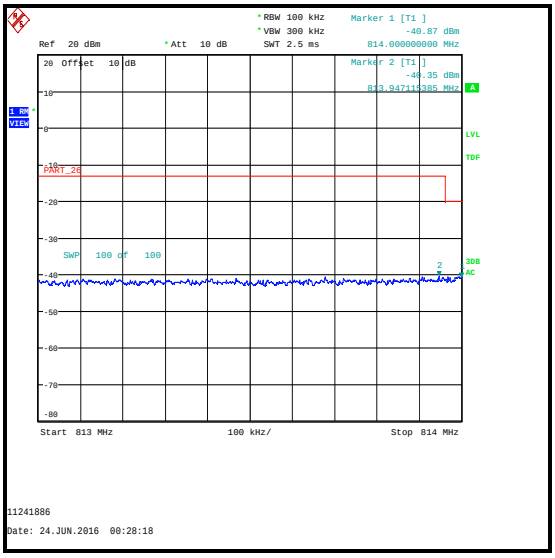


QPSK / Upper Band Edge

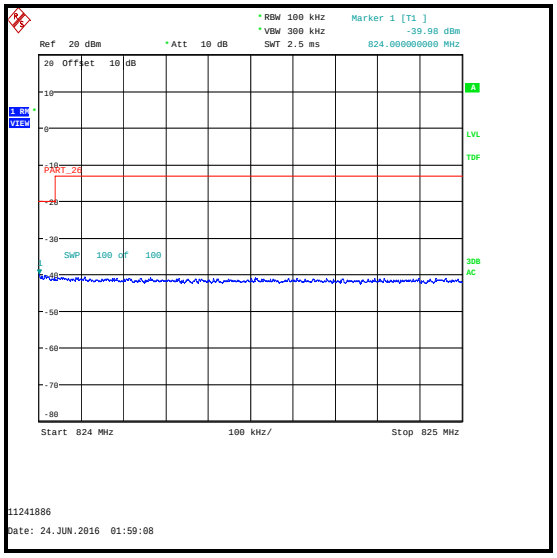
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 10 MHz Channel Bandwidth / QPSK

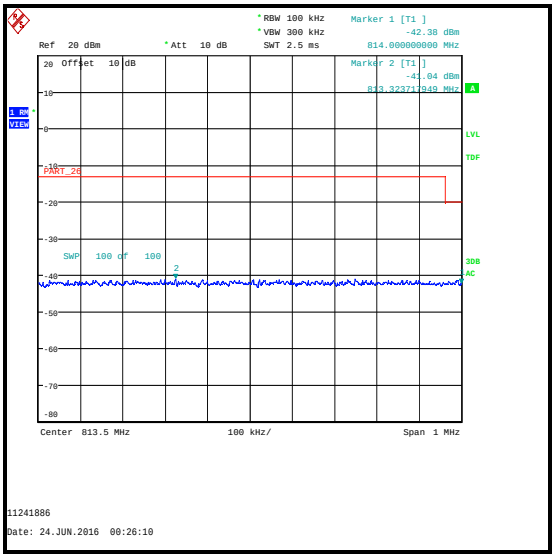
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-40.9	-20.0	20.9	Complied
824	1	49	-40.0	-20.0	20.0	Complied
814	1	49	-42.4	-20.0	22.4	Complied
824	1	0	-42.1	-20.0	22.1	Complied



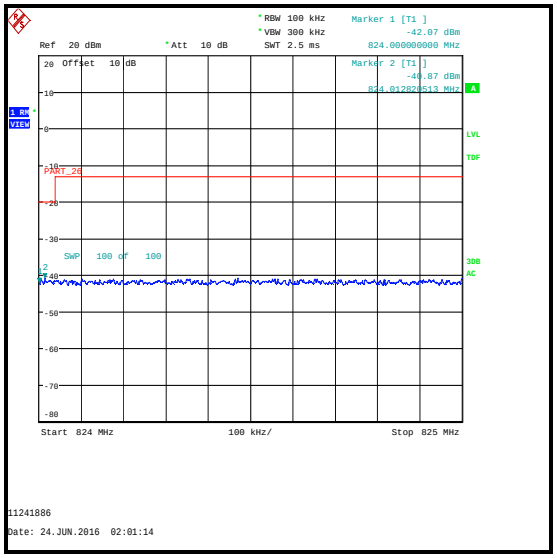
QPSK / 1 RB 0 offset / Lower Band Edge



QPSK / 1 RB 49 offset / Upper Band Edge



QPSK / 1 RB 49 offset / Lower Band Edge

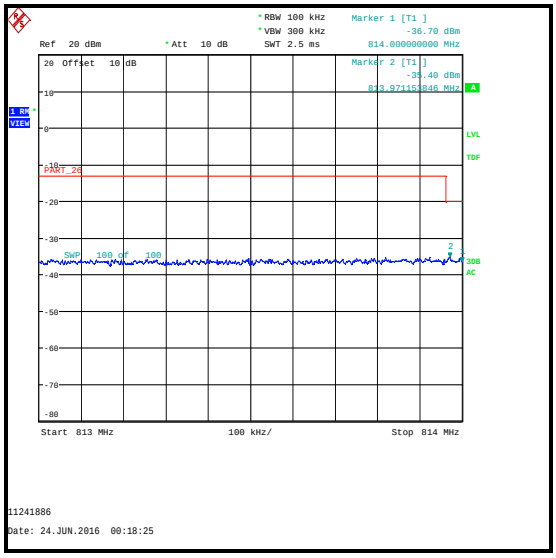


QPSK / 1 RB 0 offset / Upper Band Edge

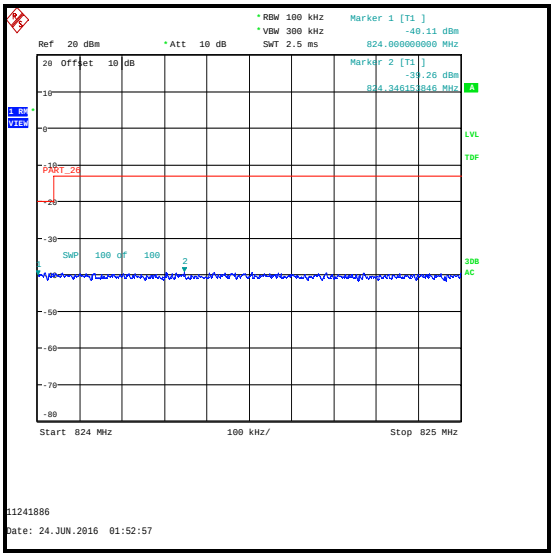
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 10 MHz Channel Bandwidth / 16QAM

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
813.971	50	0	-35.4	-20.0	15.4	Complied
814	50	0	-36.7	-20.0	16.7	Complied
824	50	0	-40.1	-20.0	20.1	Complied
824.346	50	0	-39.3	-13.0	26.3	Complied



16QAM / Lower Band Edge

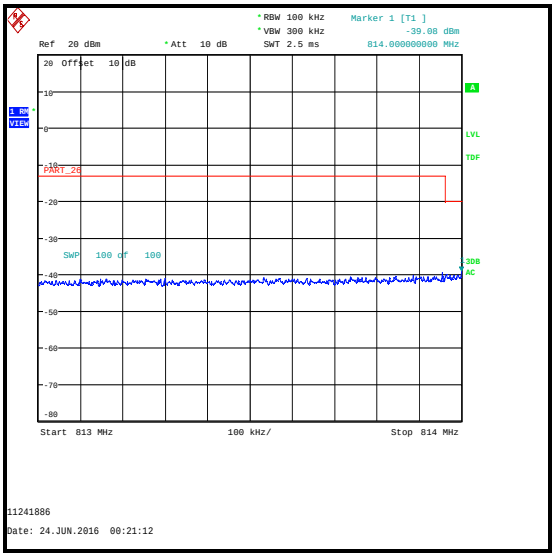


16QAM / Upper Band Edge

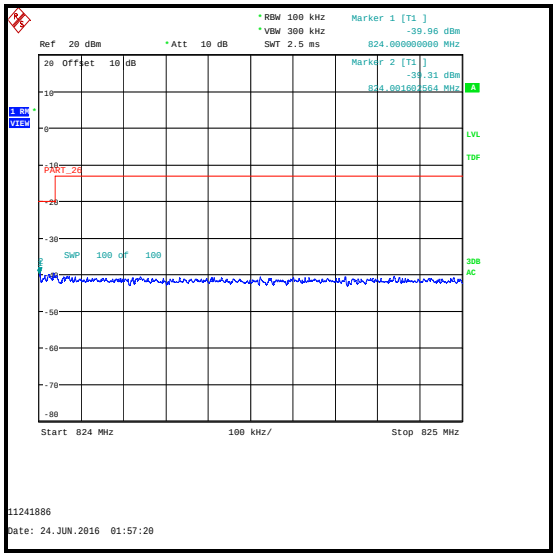
Transmitter Radiated Emissions at Band Edges (continued) - LAT

Results: 10 MHz Channel Bandwidth / 16QAM

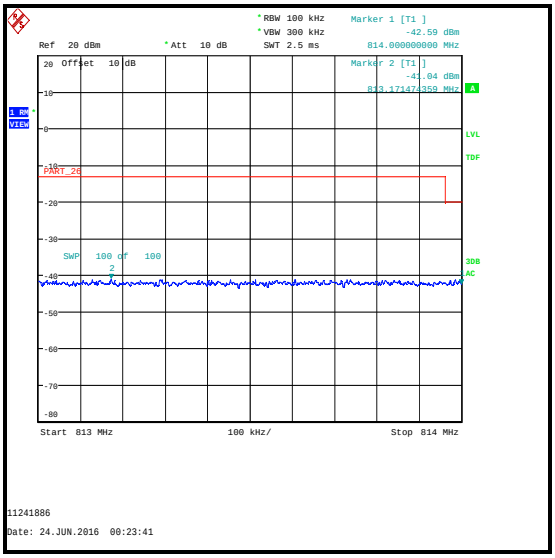
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-39.1	-20.0	19.1	Complied
824	1	49	-40.0	-20.0	20.0	Complied
814	1	49	-42.6	-20.0	22.6	Complied
824	1	0	-41.7	-20.0	21.7	Complied



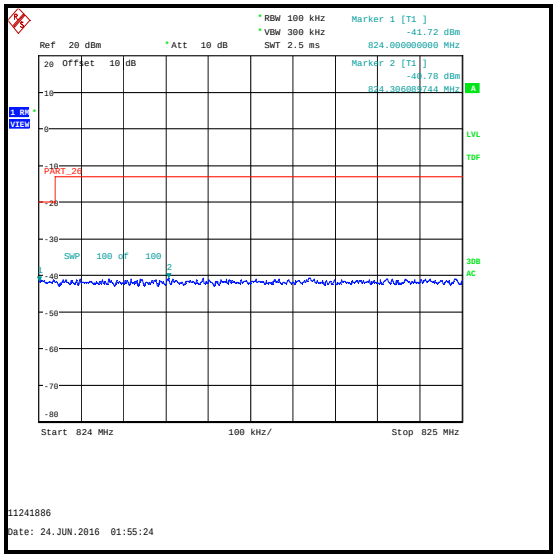
16QAM / 1 RB 0 offset / Lower Band Edge



16QAM / 1 RB 49 offset / Upper Band Edge



16QAM / 1 RB 49 offset / Lower Band Edge



16QAM / 1 RB 0 offset / Upper Band Edge

Transmitter Radiated Emissions at Band Edges (continued) - LAT

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Apr 2017	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	17 May 2017	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	21 Mar 2017	12
A2888	Antenna	Schwarzbeck	VULB 9163	9163-941	07 Apr 2017	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#1	19 May 2017	12

5.2.7. Transmitter Radiated Emissions at Band Edges - UAT

Test Summary:

Test Engineers:	Nick Steele & David Doyle	**Test Dates:**	22 June 2016 to 24 June 2016
Test Sample IMEI:	358640070022890		

FCC Reference:	Parts 90.691 / 2.1053
Test Method Used:	KDB 971168 Section 6.1 referencing FCC Part 2.1053

Environmental Conditions:

Temperature (°C):	24 to 26
Relative Humidity (%):	38 to 44

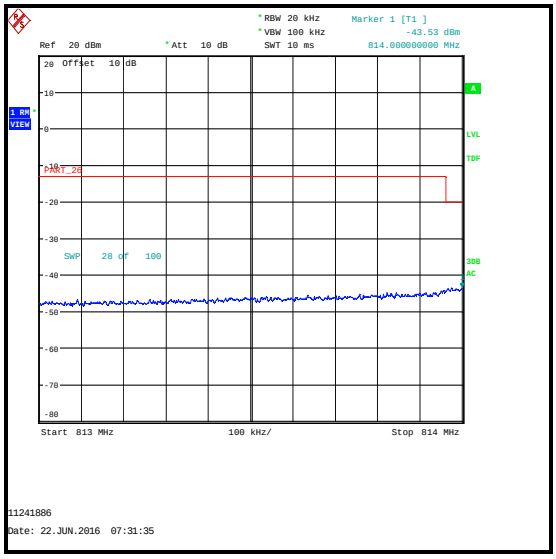
Note(s):

1. Measurements were performed with the EUT transmitting with QPSK and 16QAM modulation schemes, with resource blocks settings as detailed in section 4.3 of this report.
2. Measurements were performed in a fully anechoic chamber (Asset Number K0017) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. The measurement antenna was placed at a fixed height of 1.5 metres above the test chamber floor in line with the EUT.
3. 1.4 MHz Channel bandwidth: In the first 37.5 kHz immediately outside and adjacent to the operating band, the test receiver resolution bandwidth was set to 20 kHz (>1% of the widest 26 dB emission bandwidth) and video bandwidth 100 kHz (as close to > three times the resolution bandwidth as the test receiver allowed).
4. 3 MHz Channel bandwidth: In the first 37.5 kHz immediately outside and adjacent to the operating band, the test receiver resolution bandwidth was set to 30 kHz (1% of the widest 26 dB emission bandwidth) and video bandwidth 100 kHz (as close to > three times the resolution bandwidth as the test receiver allowed).
5. 5 MHz Channel bandwidth: In the first 37.5 kHz immediately outside and adjacent to the operating band, the test receiver resolution bandwidth was set to 50 kHz (1% of the widest 26 dB emission bandwidth) and video bandwidth 200 kHz (as close to > three times the resolution bandwidth as the test receiver allowed).
6. 10 MHz Channel bandwidth: In the first 37.5 kHz immediately outside and adjacent to the operating band, the test receiver resolution bandwidth was set to 100 kHz (>1% of the widest 26 dB emission bandwidth) and video bandwidth 300 kHz (three times the resolution bandwidth).
7. Sweep time was set to auto and an RMS detector with trace averaging of at least 100 sweeps was used.

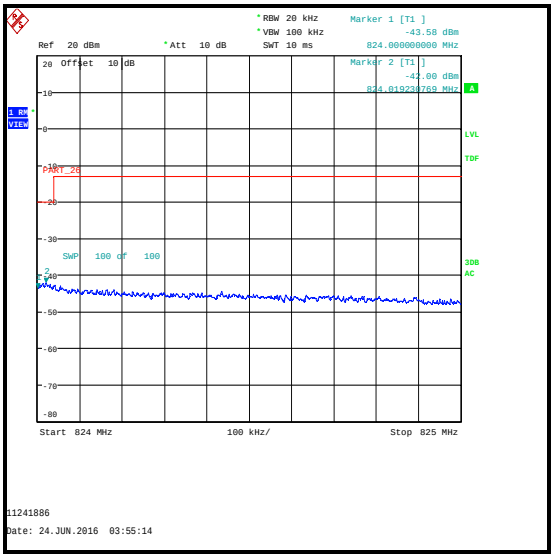
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 1.4 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	6	0	-43.5	-20.0	23.5	Complied
824	6	0	-43.6	-20.0	23.6	Complied
824.019	6	0	-42.0	-20.0	22.0	Complied



QPSK / Lower Band Edge

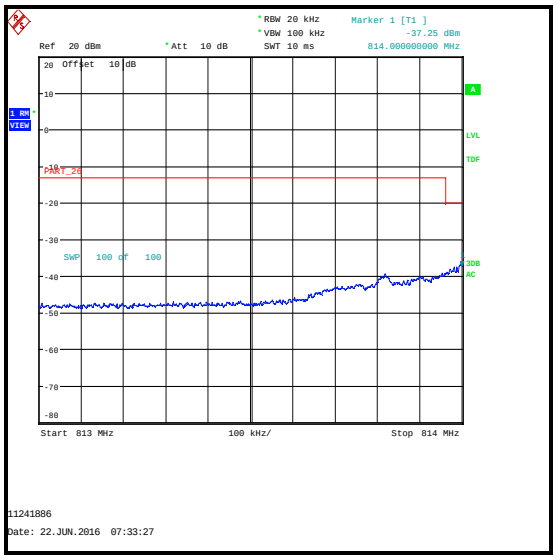


QPSK / Upper Band Edge

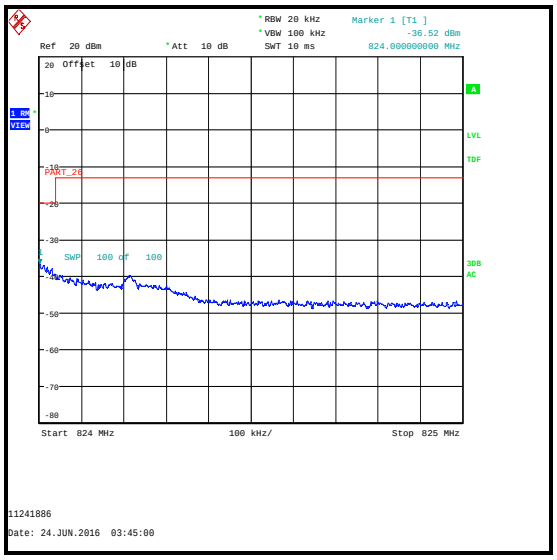
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 1.4 MHz Channel Bandwidth / QPSK

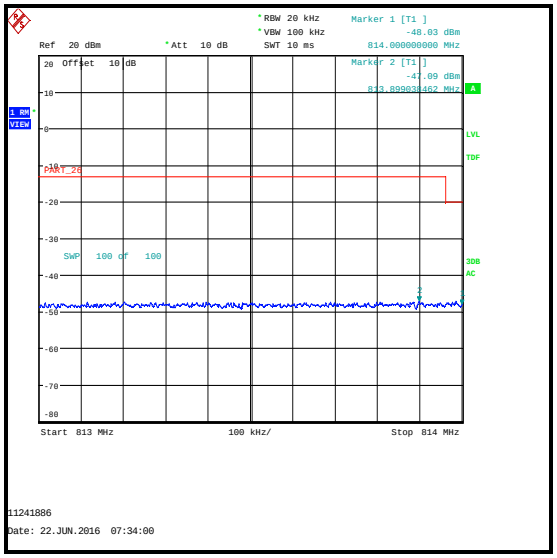
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-37.3	-20.0	17.3	Complied
824	1	5	-36.5	-20.0	16.5	Complied
814	1	5	-48.0	-20.0	28.0	Complied
824	1	0	-46.6	-20.0	26.6	Complied



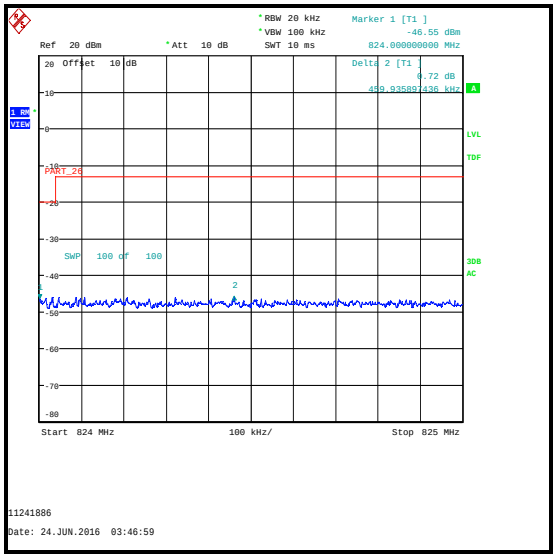
QPSK / 1 RB 0 offset / Lower Band Edge



QPSK / 1 RB 5 offset / Upper Band Edge



QPSK / 1 RB 5 offset / Lower Band Edge

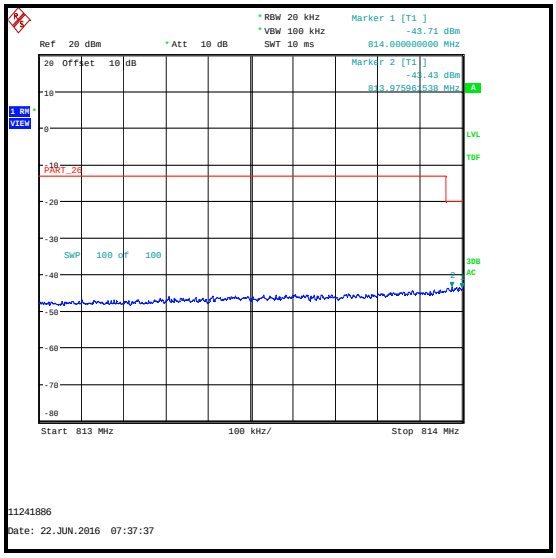


QPSK / 1 RB 0 offset / Upper Band Edge

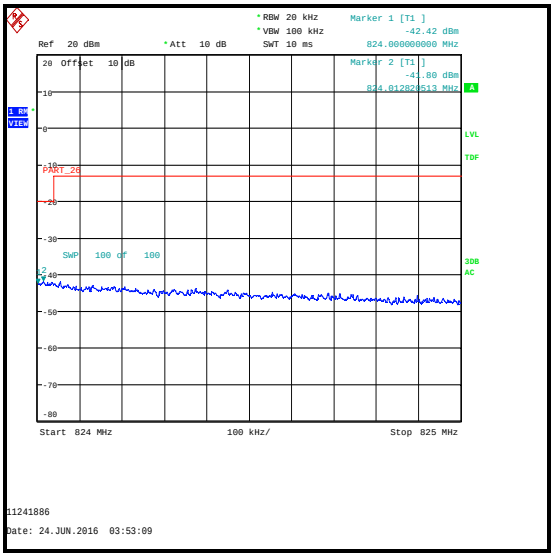
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 1.4 MHz Channel Bandwidth / 16QAM

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
813.976	6	0	-43.4	-20.0	23.4	Complied
814	6	0	-43.7	-20.0	23.7	Complied
824	6	0	-42.4	-20.0	22.4	Complied
824.013	6	0	-41.8	-20.0	21.8	Complied



16QAM / Lower Band Edge

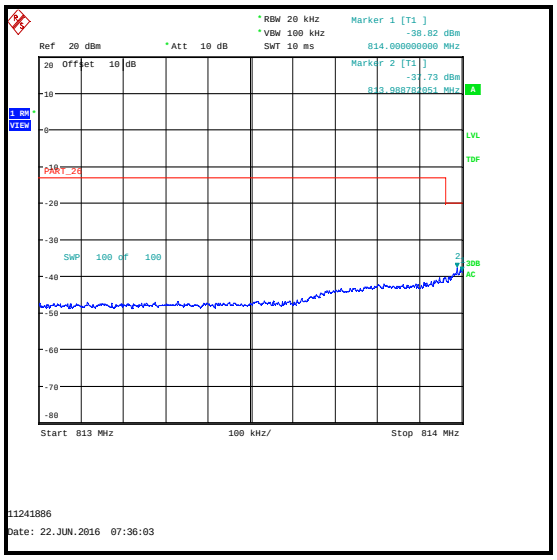


16QAM / Upper Band Edge

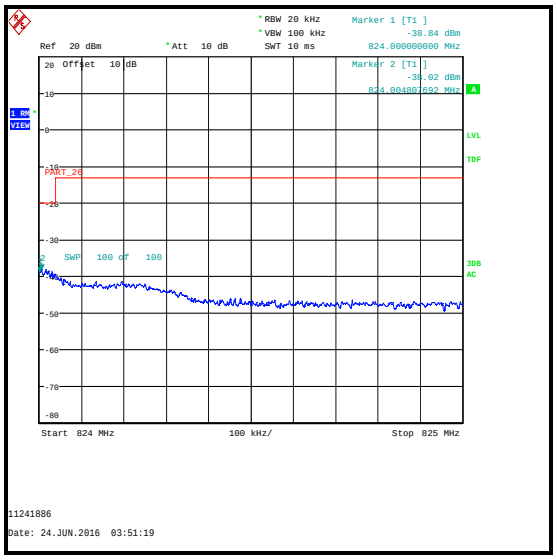
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 1.4 MHz Channel Bandwidth / 16QAM

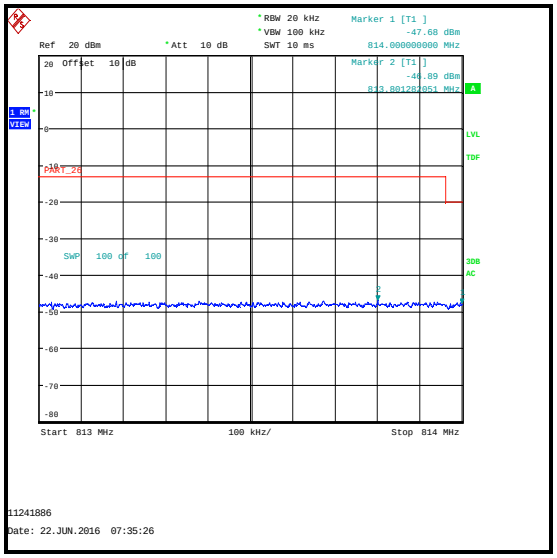
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-38.8	-20.0	18.8	Complied
824	1	5	-38.8	-20.0	18.8	Complied
814	1	5	-47.7	-20.0	27.7	Complied
824	1	0	-47.8	-20.0	27.8	Complied



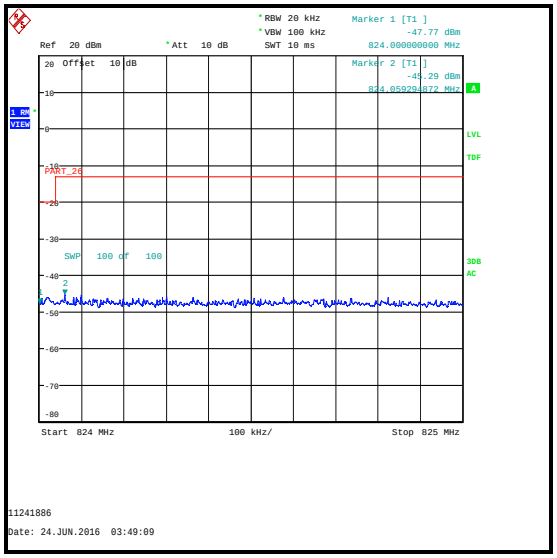
16QAM / 1 RB 0 offset / Lower Band Edge



16QAM / 1 RB 5 offset / Upper Band Edge



16QAM / 1 RB 5 offset / Lower Band Edge

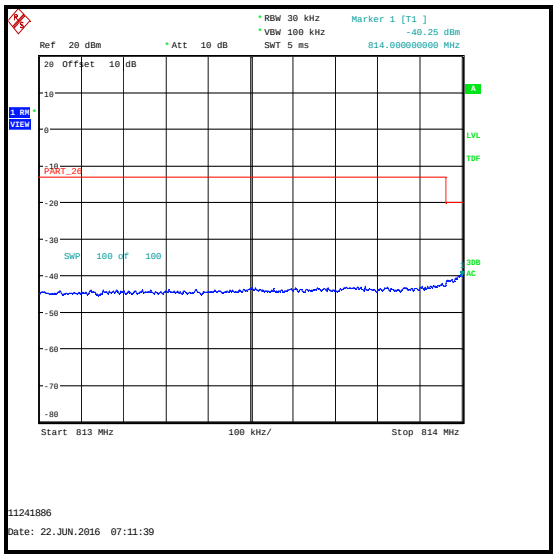


16QAM / 1 RB 0 offset / Upper Band Edge

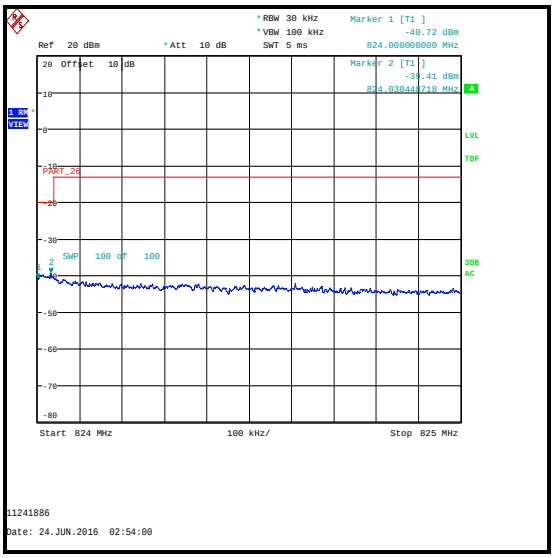
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 3 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	15	0	-40.3	-20.0	20.3	Complied
824	15	0	-40.7	-20.0	20.7	Complied
824.030	15	0	-39.4	-20.0	19.4	Complied



QPSK / Lower Band Edge

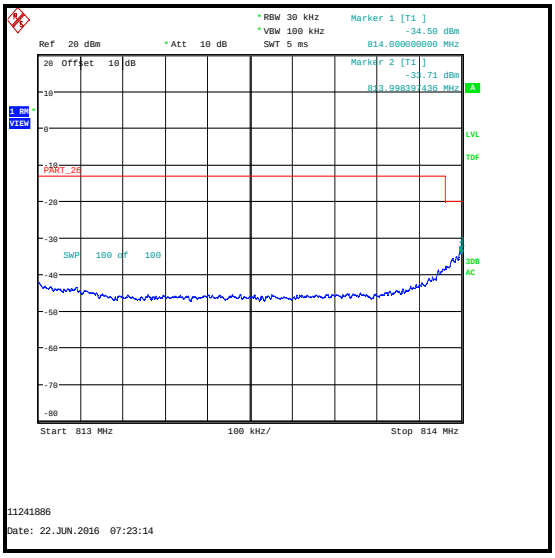


QPSK / Upper Band Edge

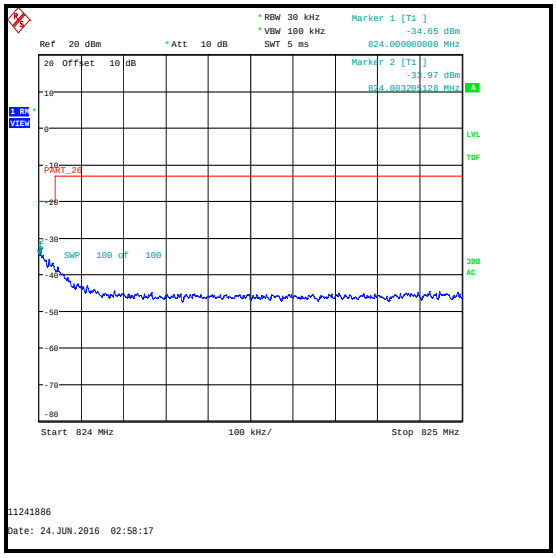
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 3 MHz Channel Bandwidth / QPSK

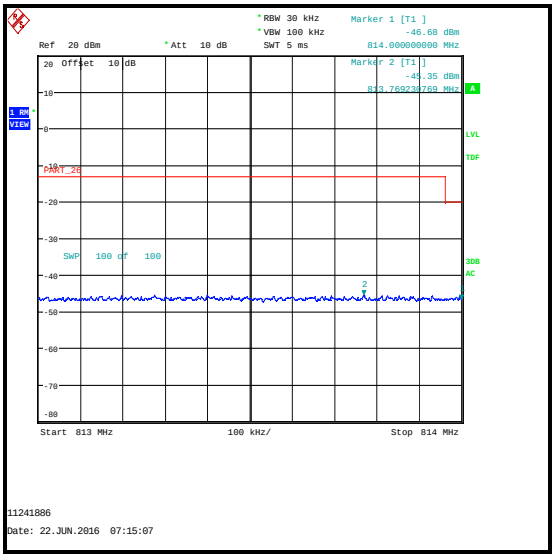
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-34.5	-20.0	14.5	Complied
824	1	14	-34.7	-20.0	14.7	Complied
814	1	14	-46.7	-20.0	26.7	Complied
824	1	0	-46.1	-20.0	26.1	Complied



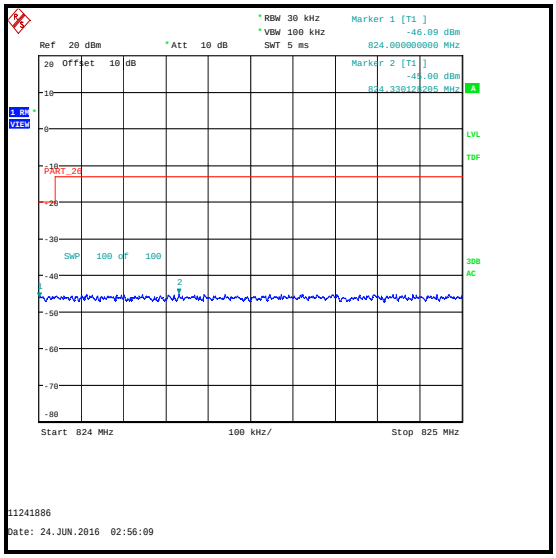
QPSK / 1 RB 0 offset / Lower Band Edge



QPSK / 1 RB 14 offset / Upper Band Edge



QPSK / 1 RB 14 offset / Lower Band Edge

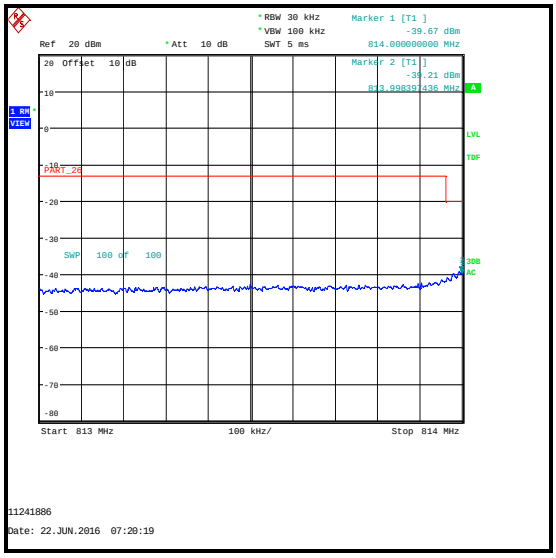


QPSK / 1 RB 0 offset / Upper Band Edge

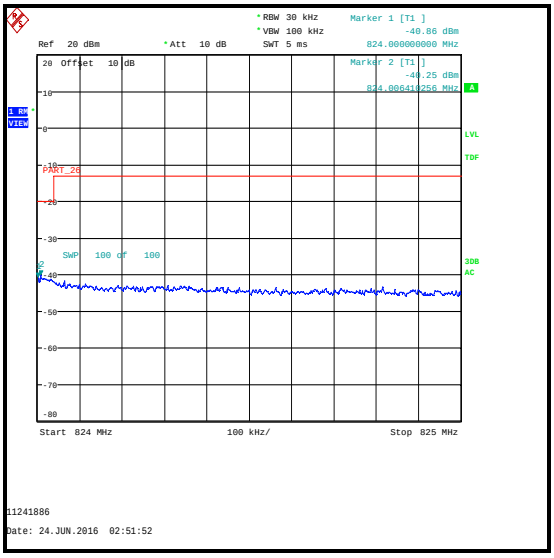
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 3 MHz Channel Bandwidth / 16QAM

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
813.998	15	0	-39.2	-20.0	19.2	Complied
814	15	0	-39.7	-20.0	19.7	Complied
824	15	0	-40.9	-20.0	20.9	Complied
824.006	15	0	-40.3	-20.0	20.3	Complied



16QAM / Lower Band Edge

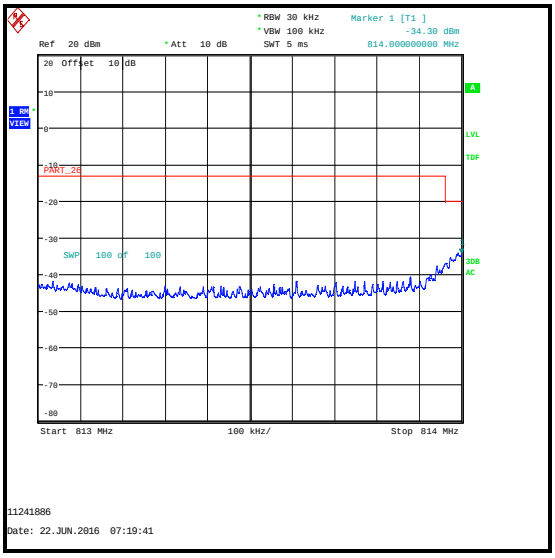


16QAM / Upper Band Edge

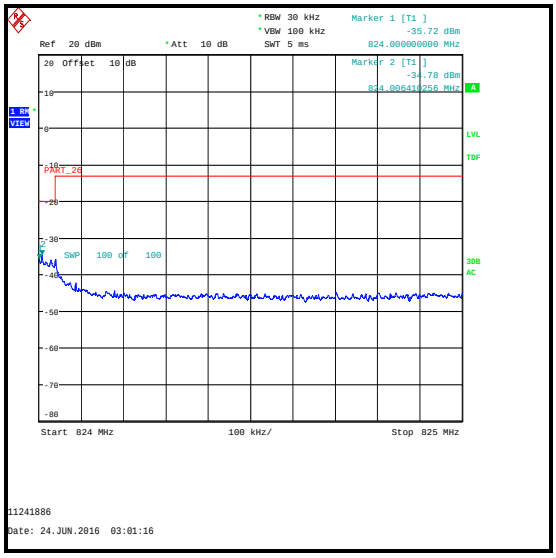
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 3 MHz Channel Bandwidth / 16QAM

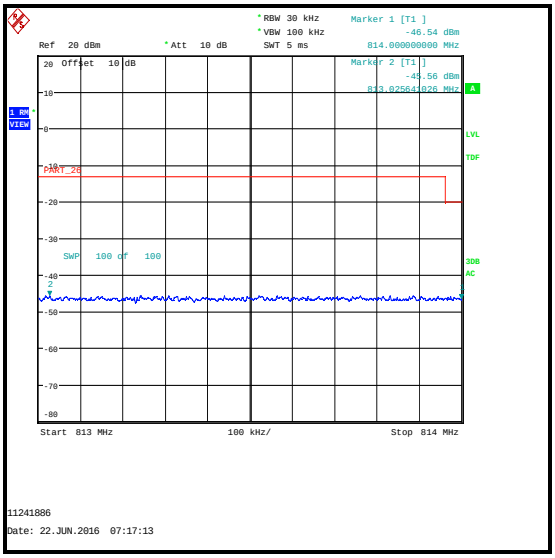
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-34.3	-20.0	14.3	Complied
824	1	14	-35.7	-20.0	15.7	Complied
814	1	14	-46.5	-20.0	26.5	Complied
824	1	0	-45.8	-20.0	25.8	Complied



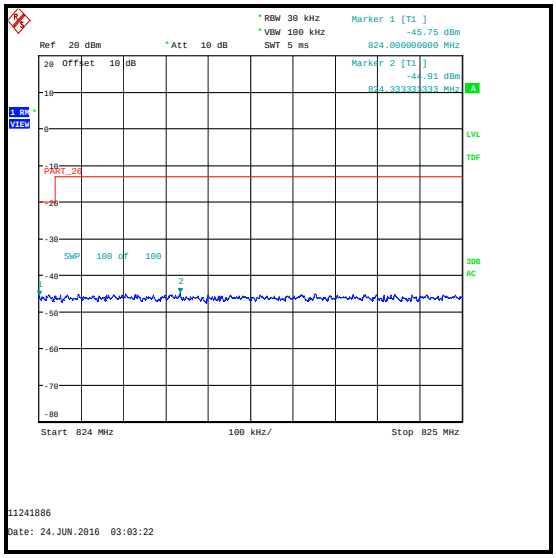
16QAM / 1 RB 0 offset / Lower Band Edge



16QAM / 1 RB 14 offset / Upper Band Edge



16QAM / 1 RB 14 offset / Lower Band Edge

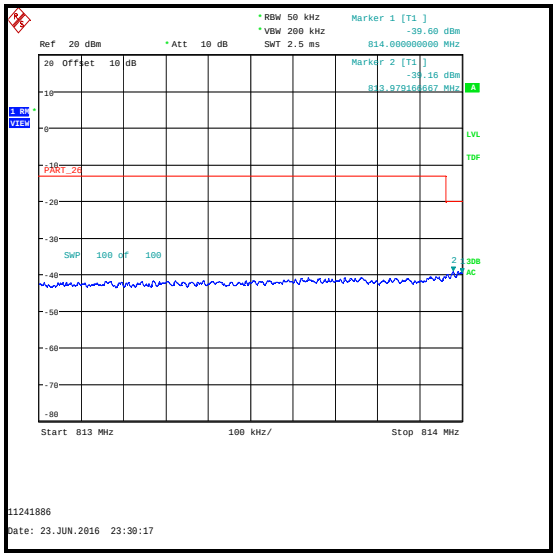


16QAM / 1 RB 0 offset / Upper Band Edge

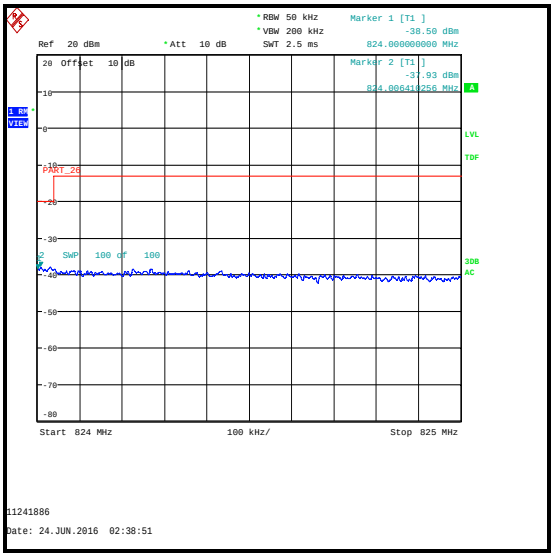
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 5 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
813.979	25	0	-39.2	-20.0	19.2	Complied
814	25	0	-39.6	-20.0	19.6	Complied
824	25	0	-38.5	-20.0	18.5	Complied
824.006	25	0	-37.9	-20.0	17.9	Complied



QPSK / Lower Band Edge

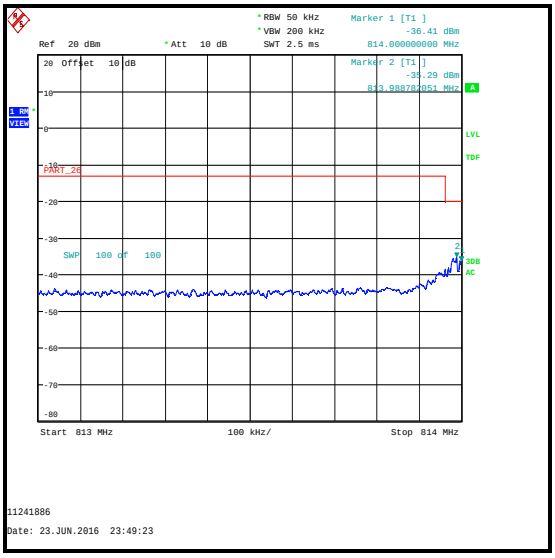


QPSK / Upper Band Edge

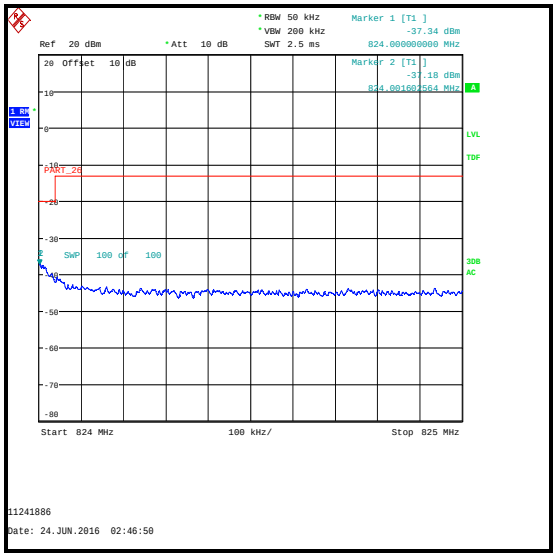
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 5 MHz Channel Bandwidth / QPSK

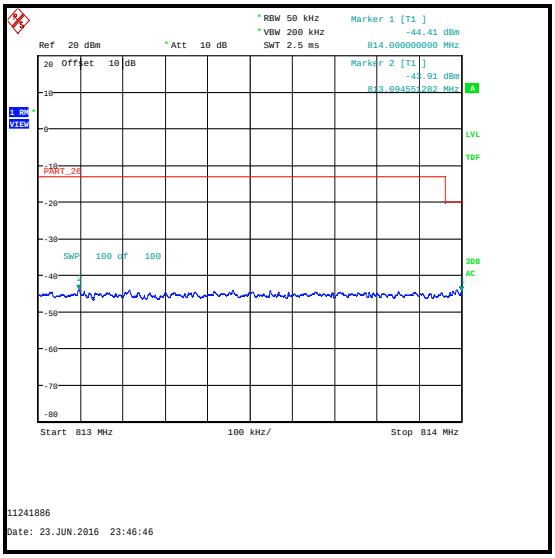
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-36.4	-20.0	16.4	Complied
824	1	24	-37.3	-20.0	17.3	Complied
814	1	24	-44.4	-20.0	24.4	Complied
824	1	0	-44.6	-20.0	24.6	Complied



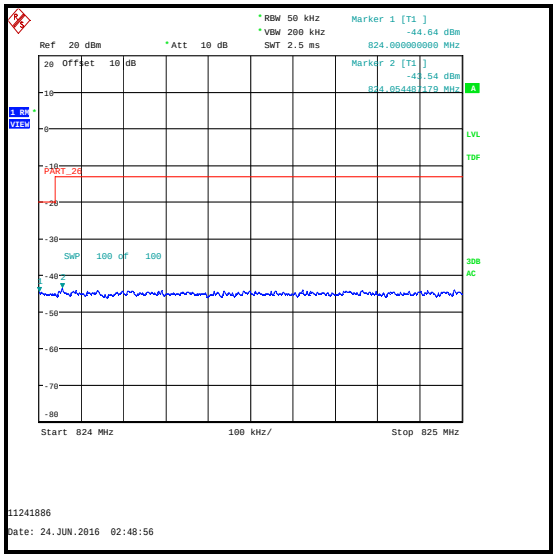
QPSK / 1 RB 0 offset / Lower Band Edge



QPSK / 1 RB 24 offset / Upper Band Edge



QPSK / 1 RB 24 offset / Lower Band Edge

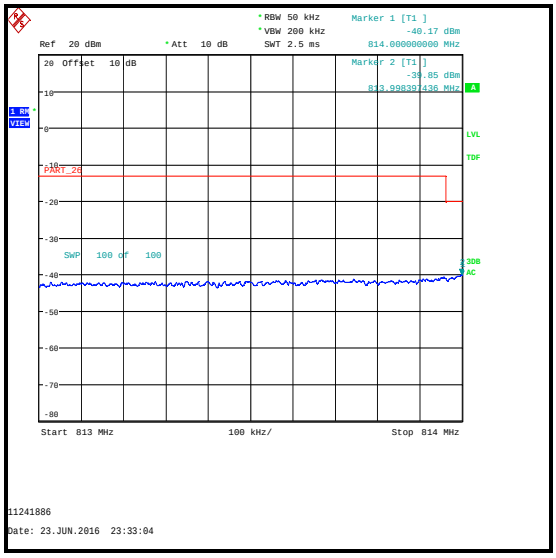


QPSK / 1 RB 0 offset / Upper Band Edge

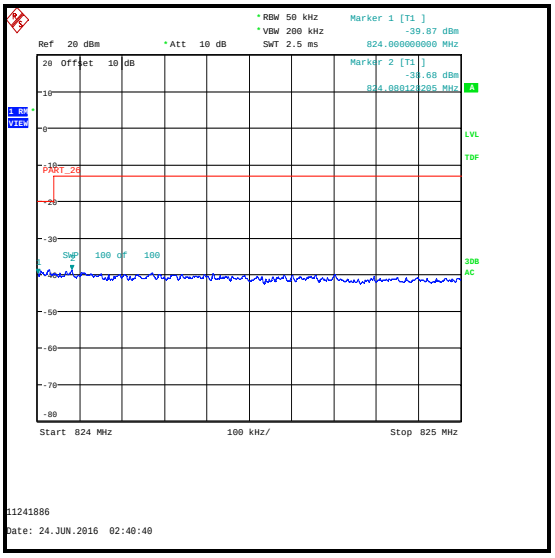
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 5 MHz Channel Bandwidth / 16QAM

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
813.998	25	0	-39.9	-20.0	19.9	Complied
814	25	0	-40.2	-20.0	20.2	Complied
824	25	0	-39.9	-20.0	19.9	Complied
824.080	25	0	-36.7	-13.0	23.7	Complied



16QAM / Lower Band Edge

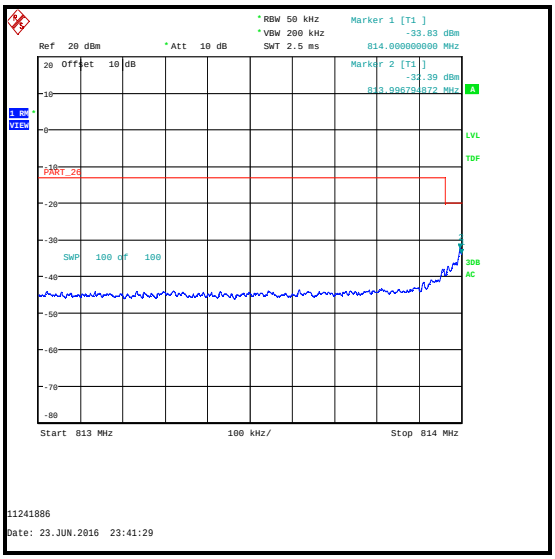


16QAM / Upper Band Edge

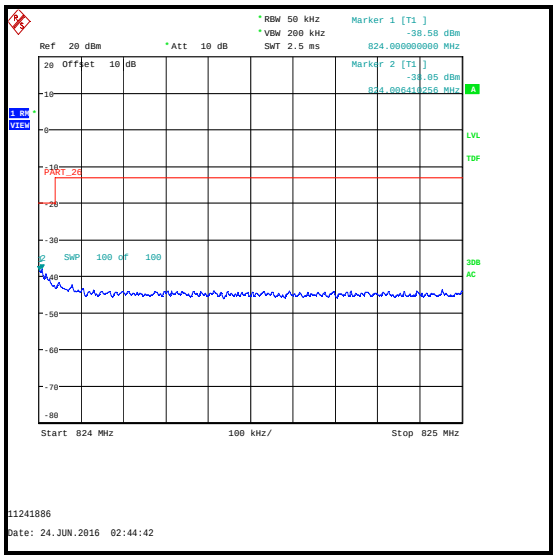
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 5 MHz Channel Bandwidth / 16QAM

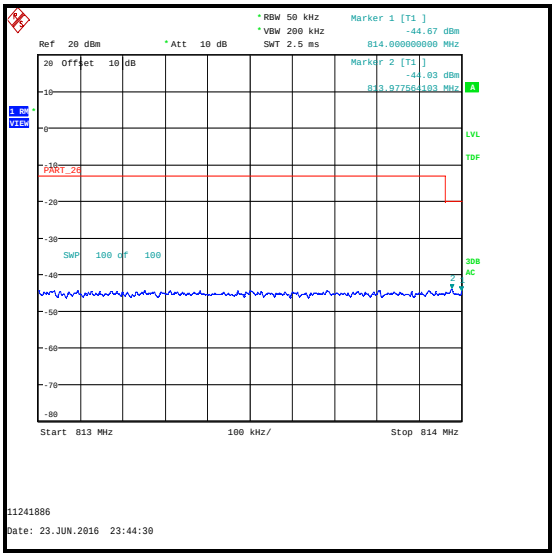
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-33.8	-20.0	13.8	Complied
824	1	24	-38.6	-20.0	18.6	Complied
814	1	24	-44.7	-20.0	24.7	Complied
824	1	0	-44.8	-20.0	24.8	Complied



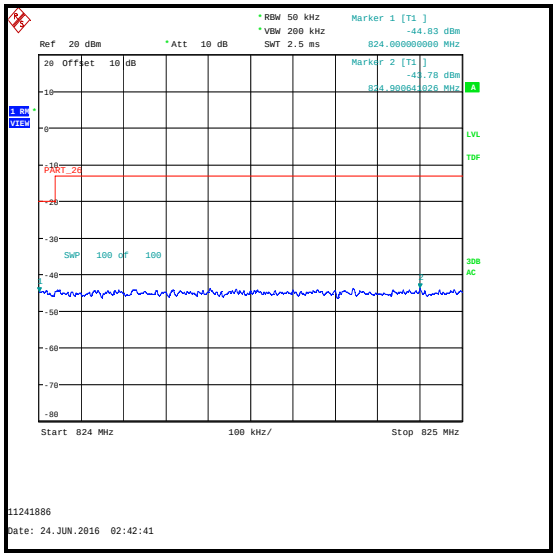
16QAM / 1 RB 0 offset / Lower Band Edge



16QAM / 1 RB 24 offset / Upper Band Edge



16QAM / 1 RB 24 offset / Lower Band Edge

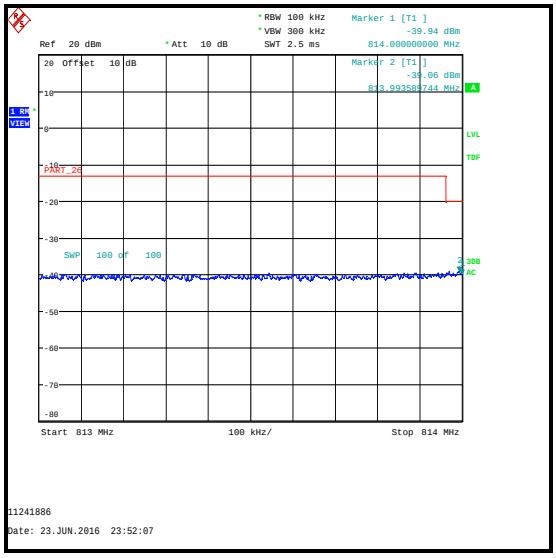


16QAM / 1 RB 0 offset / Upper Band Edge

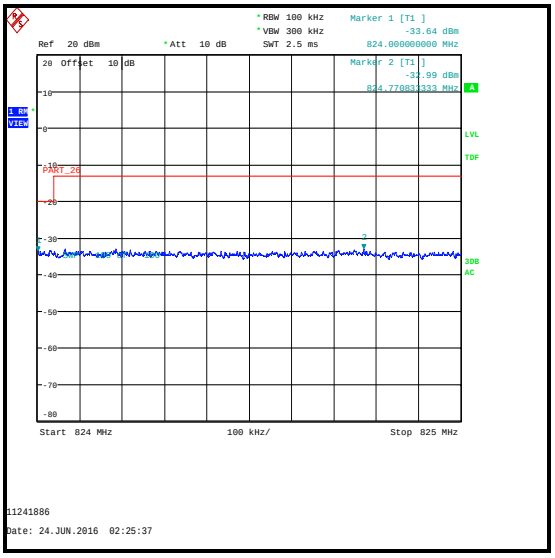
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 10 MHz Channel Bandwidth / QPSK

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
813.994	50	0	-39.1	-20.0	19.1	Complied
814	50	0	-39.9	-20.0	19.9	Complied
824	50	0	-33.6	-20.0	13.6	Complied
824.771	50	0	-33.0	-13.0	20.0	Complied



QPSK / Lower Band Edge

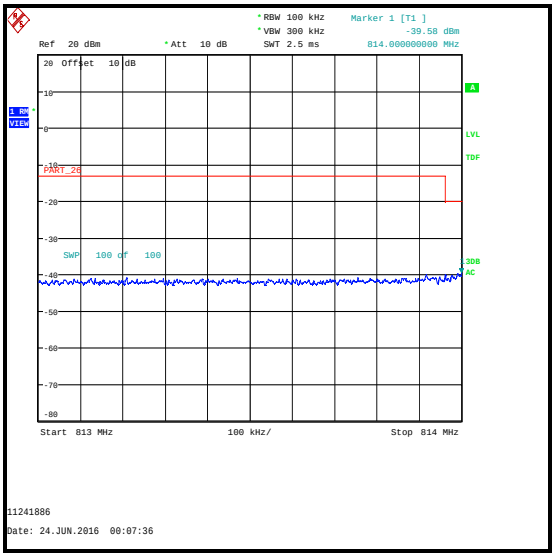


QPSK / Upper Band Edge

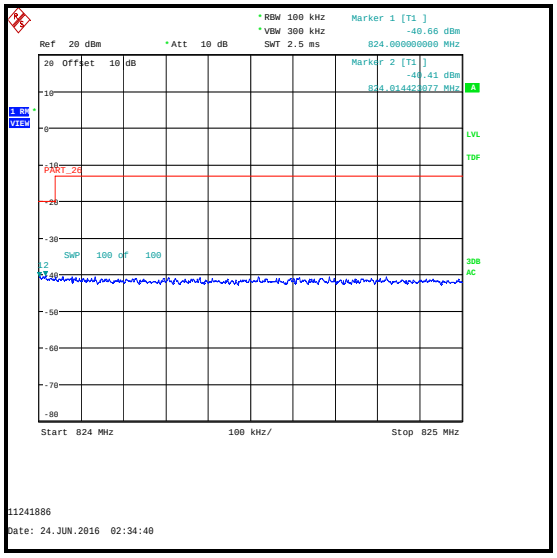
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 10 MHz Channel Bandwidth / QPSK

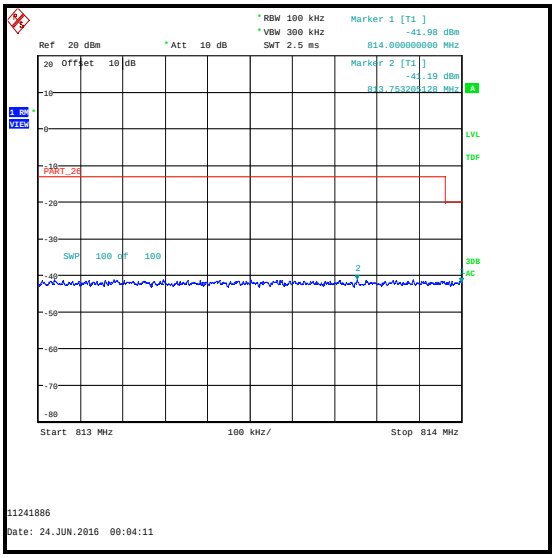
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-39.6	-20.0	19.6	Complied
824	1	49	-40.7	-20.0	20.7	Complied
814	1	49	-42.0	-20.0	22.0	Complied
824	1	0	-41.2	-20.0	21.2	Complied



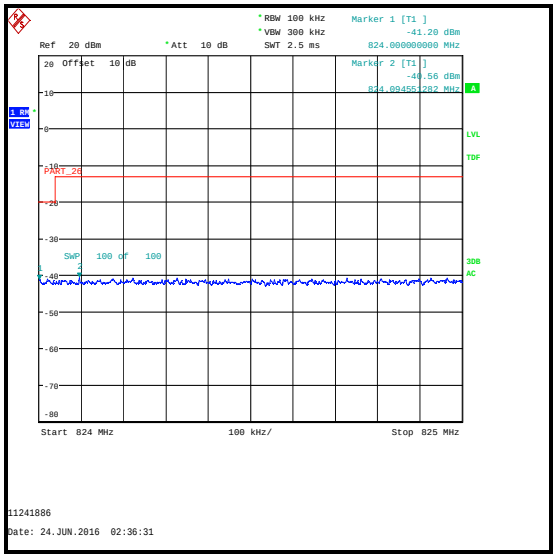
QPSK / 1 RB 0 offset / Lower Band Edge



QPSK / 1 RB 49 offset / Upper Band Edge



QPSK / 1 RB 49 offset / Lower Band Edge

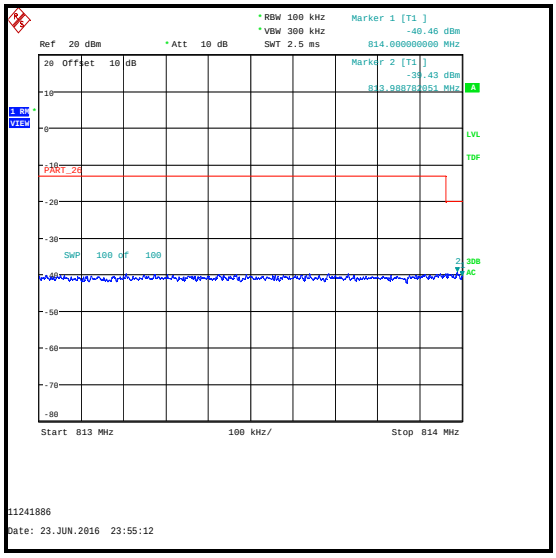


QPSK / 1 RB 0 offset / Upper Band Edge

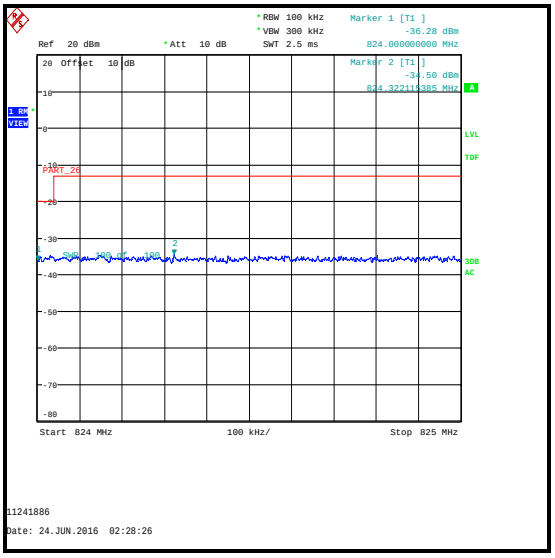
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 10 MHz Channel Bandwidth / 16QAM

Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
813.989	50	0	-39.4	-20.0	19.4	Complied
814	50	0	-40.5	-20.0	20.5	Complied
824	50	0	-36.3	-20.0	16.3	Complied
824.322	50	0	-34.5	-13.0	21.5	Complied



16QAM / Lower Band Edge

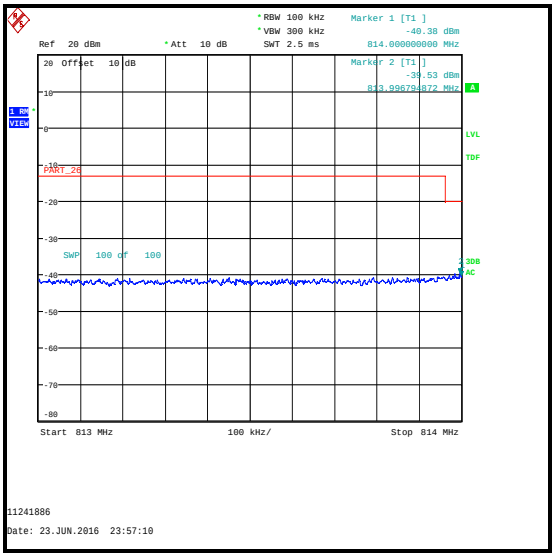


16QAM / Upper Band Edge

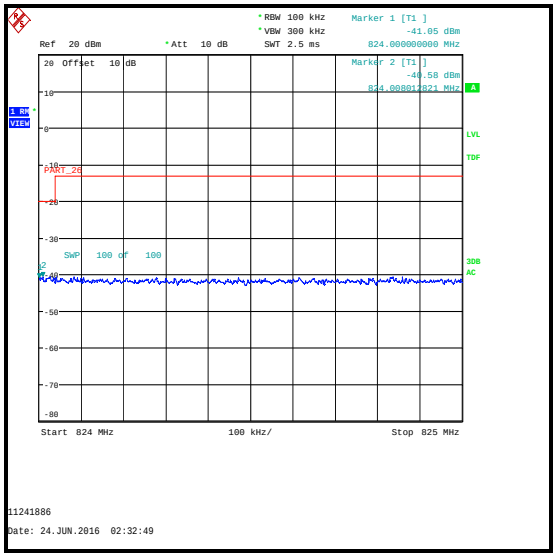
Transmitter Radiated Emissions at Band Edges (continued) - UAT

Results: 10 MHz Channel Bandwidth / 16QAM

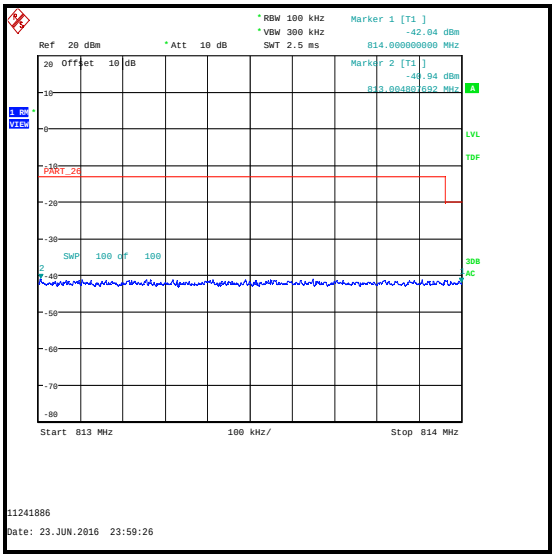
Frequency (MHz)	Resource Blocks	Resource Block Offset	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
814	1	0	-40.4	-20.0	20.4	Complied
824	1	49	-41.1	-20.0	21.1	Complied
814	1	49	-42.0	-20.0	22.0	Complied
824	1	0	-41.9	-20.0	21.9	Complied



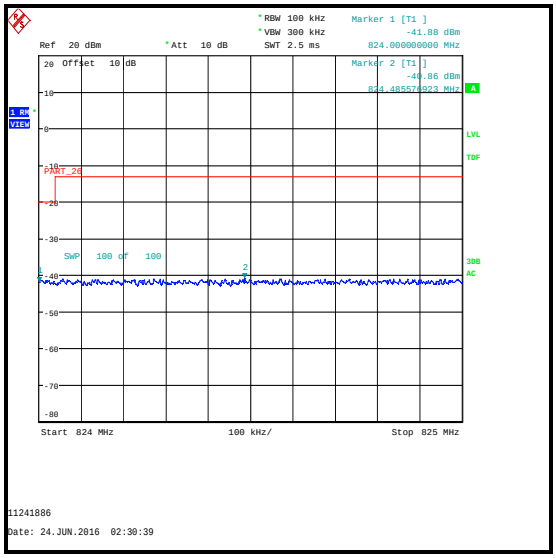
16QAM / 1 RB 0 offset / Lower Band Edge



16QAM / 1 RB 49 offset / Upper Band Edge



16QAM / 1 RB 49 offset / Lower Band Edge



16QAM / 1 RB 0 offset / Upper Band Edge

Transmitter Radiated Emissions at Band Edges (continued) - UAT

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2003	Thermohygrometer	Testo	608-H1	45046641	22 Apr 2017	12
K0017	3m RSE Chamber	Rainford EMC	N/A	N/A	17 May 2017	12
M1995	Test Receiver	Rohde & Schwarz	ESU40	100428	21 Mar 2017	12
A2888	Antenna	Schwarzbeck	VULB 9163	9163-941	07 Apr 2017	12
A2916	Attenuator	AtlanTecRF	AN18W5-10	832827#1	19 May 2017	12

5.2.8. Transmitter Frequency Stability (Temperature Variation)

Test Summary:

Test Engineer:	Stefan Ho	**Test Date:**	12 May 2016
Test Sample Serial Number:	C7CRG02QH6DH		

FCC Reference:	Parts 90.213 / 2.1055
Test Method Used:	KDB 971168 Section 9.0 referencing ANSI TIA-603-D-2010 Section 2.2.2 and FCC Part 2.1055

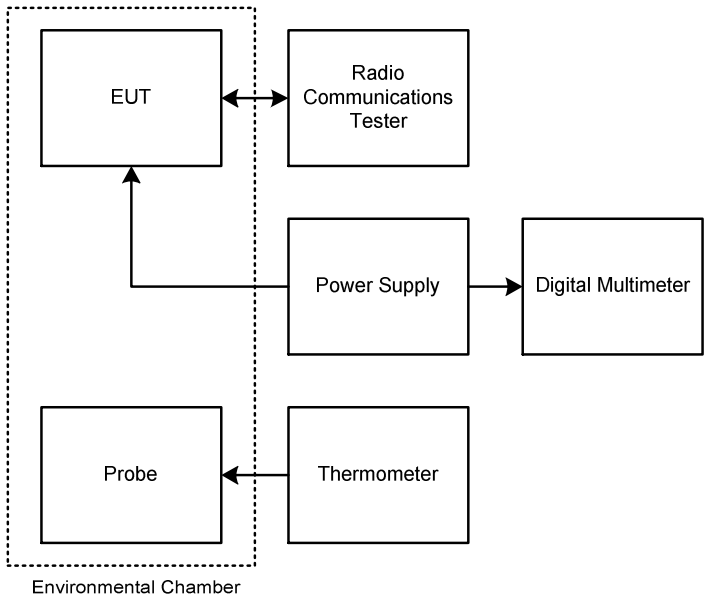
Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	43

Note(s):

1. Flying leads were connected internally to the EUT in place of the battery. These leads extended and connected to a bench power supply at the nominal voltage of 3.8 V.
2. Frequency error was measured using a calibrated Rohde and Schwarz CMW 500 Universal Radio Communications Tester in accordance with current Rohde and Schwarz application notes. The EUT was connected by suitable RF cables to the CMW 500. A bi-directional communications link was established between the EUT and CMW 500. The frequency meter value was recorded.
3. Temperature was monitored throughout the test with a calibrated digital thermometer.

Test setup:



Transmitter Frequency Stability (Temperature Variation) (continued)

Results: Middle Channel (819.0 MHz)

Temperature (ºC)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	818.999995	5	0.0061	2.5	2.4939	Complied
-20	818.999995	5	0.0061	2.5	2.4939	Complied
-10	818.999995	5	0.0061	2.5	2.4939	Complied
0	818.999996	4	0.0049	2.5	2.4951	Complied
10	818.999996	4	0.0049	2.5	2.4951	Complied
20	818.999996	4	0.0049	2.5	2.4951	Complied
30	818.999994	6	0.0073	2.5	2.4927	Complied
40	818.999995	5	0.0061	2.5	2.4939	Complied
50	818.999996	4	0.0049	2.5	2.4951	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	02 Apr 2017	12
M1869	Wideband Radio Comms Tester	Rohde & Schwarz	CMW 500	145923	05 Apr 2017	12
M1674	Environmental Chamber	Espec Corporation	SU-241	90213139	Calibrated before use	-
M1642	Thermometer	Fluke	52II	18890119	25 Apr 2017	12
S0576	DC power supply	TTI	PL330QMD	066701	Calibrated before use	-
M122	Multimeter	Fluke	77	64910017	21 Apr 2017	12

5.2.9. Transmitter Frequency Stability (Voltage Variation)

Test Summary:

Test Engineer:	Stefan Ho	**Test Date:**	12 May 2016
Test Sample Serial Number:	C7CRG02QH6DH		

FCC Reference:	Parts 90.213 / 2.1055
Test Method Used:	KDB 971168 Section 9.0 referencing ANSI TIA-603-D-2010 Section 2.2.2 and FCC Part 2.1055

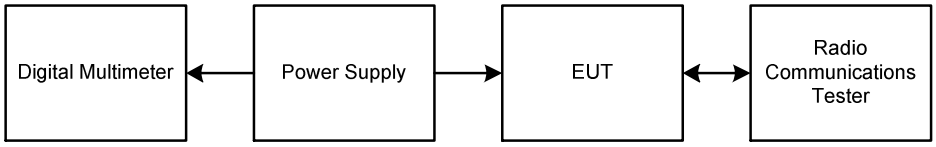
Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	43

Note(s):

1. Flying leads were connected internally to the EUT in place of the battery. These leads were extended and connected to a bench power supply.
2. Frequency error was measured using a calibrated Rohde & Schwarz CMW 500 Universal Radio Communications Tester in accordance with current Rohde & Schwarz application notes. The EUT was connected by suitable RF cables to the CMW 500. A bi-directional communications link was established between the EUT and CMW 500. The frequency meter value was recorded.
3. Voltage was monitored throughout the test with a calibrated digital voltmeter.

Test setup:



Transmitter Frequency Stability (Voltage Variation) (continued)

Results: Middle Channel (819.0 MHz)

Supply Voltage (V)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
3.4	818.999994	6	0.0073	2.5	2.4927	Complied
4.2	818.999996	4	0.0049	2.5	2.4951	Complied

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1659	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	02 Apr 2017	12
M1869	Wideband Radio Comms Tester	Rohde & Schwarz	CMW 500	145923	05 Apr 2017	12
S0576	DC power supply	TTI	PL330QMD	066701	Calibrated before use	-
M122	Multimeter	Fluke	77	64910017	21 Apr 2017	12

6. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Conducted Carrier Output Power	814 MHz to 824 MHz	95%	±1.36 dB
Occupied Bandwidth	814 MHz to 824 MHz	95%	±3.92 %
Radiated Emissions	30 MHz to 1 GHz	95%	±5.65 dB
Radiated Emissions	1 GHz to 9 GHz	95%	±2.94 dB
Frequency Stability	814 MHz to 824 MHz	95%	±23 Hz

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

7. Report Revision History

Version Number	Revision Details		
	Page No(s)	**Clause**	**Details**
1.0	-	-	Initial Version
2.0	-	-	Updates as requested by the TCB
3.0	-	-	Updates as requested by the TCB
4.0	-	-	Updates as requested by the TCB
5.0	-	-	Updates as requested by the TCB

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