



TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: StarMax 3160 Subscriber Station

To: FCC Part 90 Subpart Z: October 2008

Test Report Serial No:
RFI/RPT1/RP75476JD03A

This Test Report Is Issued Under The Authority Of Brian Watson, Operations Director:	
	
Checked By:	Nigel Davison
Signature:	
Date of Issue:	08 January 2010

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1. Customer Information














Company Name:	Harris Stratex Networks
Address:	4 Bell Drive Hamilton International Technology Park Blantyre, Lanarkshire Scotland G72 0FB

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR90
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications) 2008: Part 90 Subpart Z – Wireless Broadband Services In The 3650-3700 MHz Band- Private Land Mobile Radio Services
Site Registration:	FCC: 209735
Location of Testing:	RFI Global Services Ltd, Wade Road, Basingstoke, Hampshire, RG24 8AH, England
Test Dates:	21 August 2009 to 24 December 2009

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Port Type	Result
FCC Part 15.107	Idle Mode AC Conducted Emissions	AC Mains	
FCC Part 15.109	Idle Mode Radiated Spurious Emissions	Enclosure	
FCC Part 15.207	Transmitter AC Conducted Emissions	AC Mains	
FCC Part 90.205 / 2.1046 / 90.1321	Transmitter Carrier Output Power (EIRP)	Antenna	
FCC Part 90.1321 / 2.1046	Transmitter Peak Power Spectral Density (Conducted)	Antenna	
FCC Part 90.209 / 2.1049	Transmitter Occupied Bandwidth (Bandwidth Limitations)	Antenna	
FCC Part 90.1323 / 2.1051	Transmitter Conducted Emissions	Antenna	
FCC Part 90.1323 / 2.1051	Transmitter Band Edge Conducted Emissions	Antenna	
FCC Part 90.1323 / 2.1053	Transmitter Radiated Emissions	Antenna	
FCC Part 90.1323 / 2.1053	Transmitter Band Edge Radiated Emissions	Antenna	
FCC Part 90.213 / 2.1055	Transmitter Frequency Stability (Temperature & Voltage Variation)	Antenna	
Key to Results  = Complied  = Did not comply			

2.3. Methods and Procedures

Reference:	ANSI TIA-603-C-2004
Title:	Land Mobile Communications Equipment, Measurements and performance Standards
Reference:	ANSI C63.4 (2003)
Title:	American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

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)

Description:	WiMAX 802.16e Subscriber Station
Brand Name:	Harris Stratex
Model Name or Number:	StarMax 3160-37-14-05
Serial Number:	TSS40420900004
Hardware Version Number:	Rev-B
Software Version Number:	Kernel: 4.1.1.13 Application: 4.1.1.13 BootLoader: 4.1.1.11
FCC ID Number:	VPX-3160-37A

Description:	Power over Ethernet power injector
Brand Name:	PowerDsine
Model Name or Number:	3001
Serial Number:	R08126050010732901
Hardware Version Number:	Not marked or stated
Software Version Number:	Not marked or stated
FCC ID Number:	N/A

3.2. Description of EUT

The Equipment Under Test (EUT) was a radio Subscriber Station operating in the 3.6 GHz band. The equipment operates according to WiMax IEEE 802.16e -2005. The Subscriber Station comprises of a radio transceiver and digital control unit mounted in a weatherproof metal casing with an integrated, cross polarised, high gain antenna. Power to the Subscriber Station is supplied from a Power over Ethernet power injector via Ethernet cable. The Power over Ethernet power injector is in turn, powered from a 120 VAC 60 Hz supply.

3.3. Modifications Incorporated in the EUT

The following modifications were applied to the EUT during testing:

Date	Description of Modification	Tests Affected
08-12-2009	Disconnection of integrated antenna. In order to operate the EUT with the integrated antenna disconnected during emissions testing, the EUT rear casing was modified in order to pass an RF cable from the EUT radio printed circuit board to the Base Station. The RF cable was connected to the main port on the EUT radio board. The other end of this cable was connected to the measurement system.	Radiated emissions
14-12-2009	Reduction of power on 5 MHz channel widths from the default setting of 25 dBm to a new setting of 22 dBm. The new setting has to be entered using a test command every time the EUT is power cycled. The 10 MHz channel is unchanged.	Conducted output power, radiated output power, band edge and power spectral density in a 1 MHz bandwidth.
21-12-2009	EUT Part No. changed by Client from 3160-37-12-05 (as indicated on the EUT label) to 3160-37-14-05.	None

3.4. Additional Information Related to Testing

Tested Technology:	WiMAX 802.16e-2005	
Category of Equipment:	Transceiver	
Type of Equipment	Subscriber Station	
Intended Operating Environment:	Residential, Commercial and Industrial	
Highest Internally Generated Clock or Oscillator Frequency:	3.7 GHz	
Modulation Type:	QPSK, 16QAM, 64QAM	
Duty Cycle	60/40 (with the BS transmitting 60%)	
Channel Spacing:	5 MHz, 10 MHz	
Antenna Connection Type:	Internal. R/A MCX plug	
Antenna Type:	Directional	
Antenna Gain:	14 dBi	
Power Supply Requirement:	Nominal	120 VAC
	Minimum	102 VAC
	Maximum	138 VAC
Tested Temperature Range:	Minimum	-30°C
	Maximum	+50°C
Transmit and Receive Frequency Range:	3.650 – 3.675 GHz	
Transmit and Receive Channels Tested 5 MHz Channel:	Channel ID	Channel Frequency (MHz)
	Bottom	3652.5
	Middle	3662.5
	Top	3672.5
Transmit and Receive Channels Tested 10 MHz Channel:	Channel ID	Channel Frequency (MHz)
	Bottom	3655.0
	Middle	3662.0
	Top	3670.0

3.5. Port Identification

Port	Description	Type	Applicable
1	Data / power	Ethernet	Y
2	Internal RF	R/A MCX socket	Y

3.6. Support Equipment

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

Description:	Base Station
Brand Name:	Harris Stratex
Model Name or Number:	8200-36-02-01
Serial Number:	X00000277X0929X
Cable Length and Type:	N/A
Connected to Port:	RF

Description:	IP Packet Generator PC for Subscriber Unit
Brand Name:	Dell
Model Name or Number:	OPTIPLEX GX620
Serial Number:	PC460NT
Cable Length and Type:	CAT5 Ethernet Cable >3 metres
Connected to Port:	Subscriber Unit

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

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

- Idle mode, powered on but not in communication with the support base station.
- Transmit mode – In communication with the support Base Station, operating at maximum output power with a modulated carrier operating with maximum packet transfer rate supported by the modulation type under test.

4.2. Configuration and Peripherals

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

- Radiated Testing
 - Idle Mode – The EUT was connected to a Power over Ethernet power supply. The internal main and diversity RF ports were connected to the integrated antenna.
 - Transmit Mode – The EUT was connected to a Power over Ethernet power supply. The Power over Ethernet power supply was connected to the support PC by an Ethernet cable. The EUT was connected to the support Base Station with suitable RF attenuators and cables.
- Conducted Testing
 - AC Conducted - The EUT was connected to a Power over Ethernet power supply. The internal main and diversity RF ports were connected to the integrated antenna. The EUT was connected to the support Base Station and measurement equipment by suitable RF attenuators, cables and couplers.
 - Transmit and Idle Mode – The EUT was connected to a Power over Ethernet power supply. The Power over Ethernet power supply was connected to the support PC by an Ethernet cable. The EUT was connected to the support Base Station and measurement equipment by suitable RF attenuators, cables and couplers.
- A client/server session was established between the PCs connected to the EUT and Base Station. UDP packets were sent from a PC connected to the EUT to the PC connected to the BS at the maximum packet rate supported by the modulation scheme under test.

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. Measurement Uncertainty* for details.

5.2. Test Results

5.2.1. Idle Mode AC Conducted Spurious Emissions

Test Summary:

FCC Part:	15.107
Test Method Used:	ANSI C63.4 Section 7 and relevant annexes

Environmental Conditions:

Temperature Range (°C):	19
Relative Humidity Range (%):	33

Note(s):

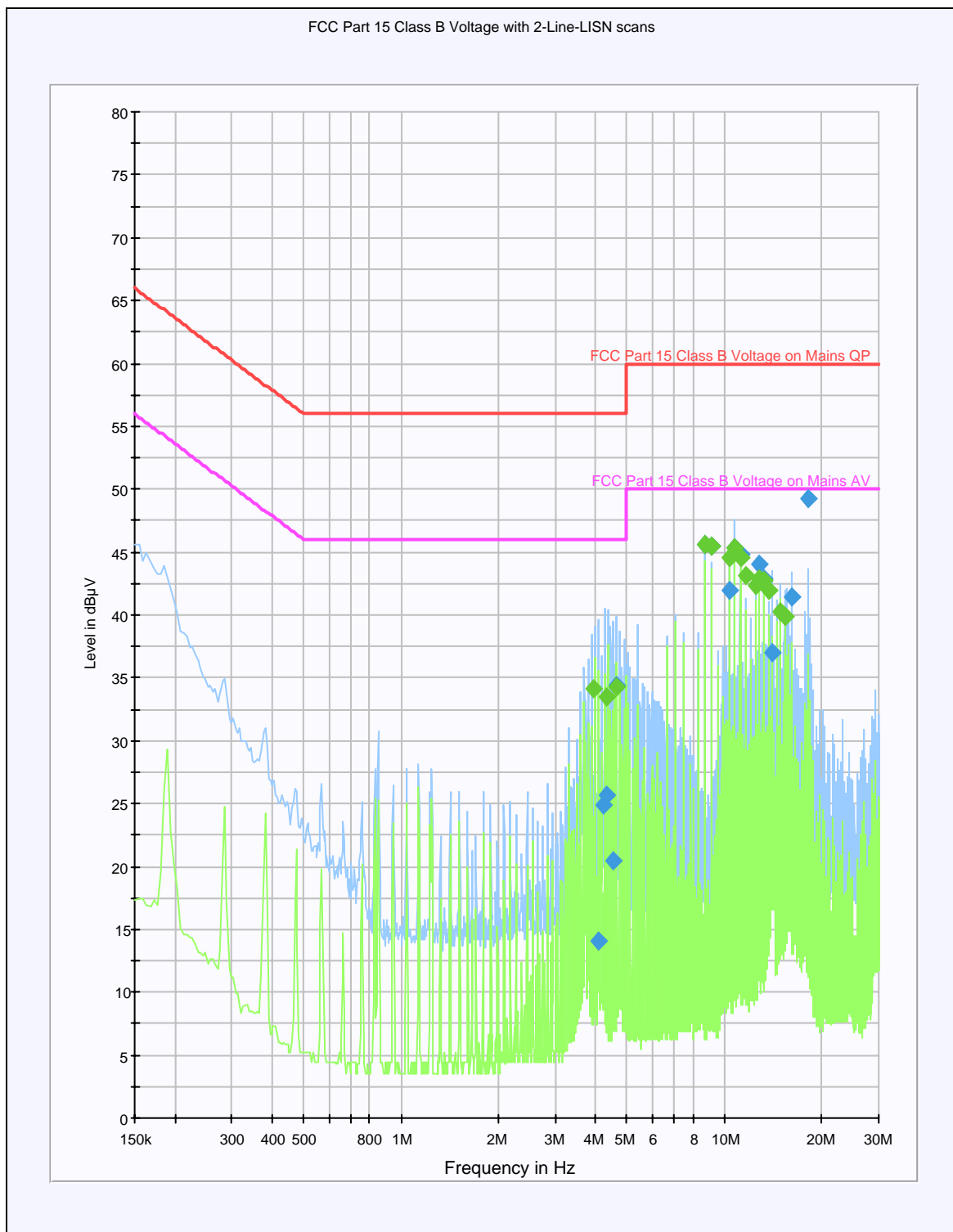
1. Power to the EUT was provided from a Power over Ethernet power injector with 120 VAC 60 Hz input. The 120 VAC 60 Hz input voltage to the Power over Ethernet power was provided through a LISN.
2. The EUT was connected to the Power over Ethernet power injector through an Ethernet cable 1.5 metre in length.
3. The EUT RF port was connected to a Base Station through suitable RF cables and attenuators. A communication link between EUT and Base Station was established. The EUT transmitter was turned off and the test performed.

Idle Mode AC Conducted Spurious Emissions (continued)**Results: Quasi Peak Detector Measurements**

Frequency (MHz)	Line	Quasi Peak Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
4.060500	Live 1	14.1	56.0	41.9	Complied
4.245000	Live 1	24.9	56.0	31.1	Complied
4.339500	Live 1	25.7	56.0	30.3	Complied
4.528500	Live 1	20.4	56.0	35.6	Complied
4.618500	Live 1	34.4	56.0	21.6	Complied
8.709000	Neutral	45.7	60.0	14.3	Complied
9.123000	Neutral	45.5	60.0	14.5	Complied
10.365000	Neutral	42.0	60.0	18.0	Complied
10.779000	Neutral	45.3	60.0	14.7	Complied
11.193000	Neutral	44.8	60.0	15.2	Complied
12.853500	Neutral	44.1	60.0	15.9	Complied
13.267500	Live 1	42.9	60.0	17.1	Complied
14.095500	Live 1	37.0	60.0	23.0	Complied
16.170000	Live 1	41.5	60.0	18.5	Complied
18.244500	Live 1	49.2	60.0	10.8	Complied

Results: Average Detector Measurements

Frequency (MHz)	Line	Average Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
3.957000	Live 1	34.2	46.0	11.8	Complied
4.335000	Live 1	33.5	46.0	12.5	Complied
4.614000	Live 1	34.3	46.0	11.7	Complied
8.709000	Neutral	45.6	50.0	4.4	Complied
9.123000	Neutral	45.5	50.0	4.5	Complied
10.365000	Neutral	44.5	50.0	5.5	Complied
10.779000	Neutral	45.4	50.0	4.6	Complied
11.197500	Neutral	44.5	50.0	5.5	Complied
11.611500	Neutral	43.1	50.0	6.9	Complied
12.439500	Live 1	42.3	50.0	7.7	Complied
12.853500	Live 1	42.9	50.0	7.1	Complied
13.267500	Live 1	42.7	50.0	7.3	Complied
13.681500	Live 1	42.0	50.0	8.0	Complied
14.928000	Live 1	40.3	50.0	9.7	Complied
15.342000	Live 1	39.9	50.0	10.1	Complied

Idle Mode AC Conducted Spurious Emissions (continued)

Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

5.2.2. Idle Mode Radiated Spurious Emissions**Test Summary:**

FCC Part:	15.109
Test Method:	ANSI C63.4 Section 7 and relevant annexes
Frequency Range:	30 MHz to 1 GHz

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	32

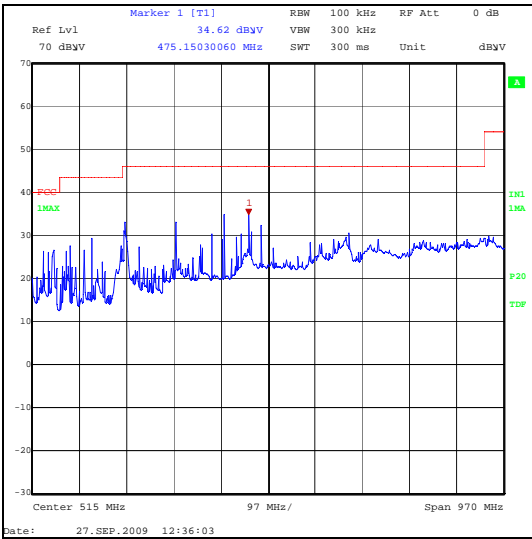
Results:

Frequency (MHz)	Antenna Polarity	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
220.501	Vertical	32.8	46.0	13.2	Complied
325.471	Vertical	32.9	46.0	13.1	Complied
475.153	Vertical	34.6	46.0	11.4	Complied

Note(s):

1. The measurement antenna was rotated through the horizontal and vertical planes. The highest levels were recorded in the above table.

Idle Mode Radiated Spurious Emissions (continued)



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.

Idle Mode Radiated Spurious Emissions (continued)**Test Summary:**

FCC Part:	FCC 15.109
Test Method:	ANSI C63.4 Section 7 and relevant annexes
Frequency Range:	1 GHz to 20 GHz

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	32

Results: Highest Peak Level

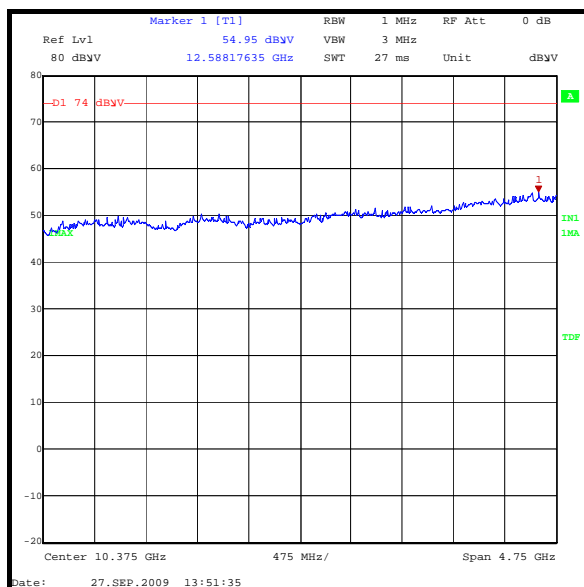
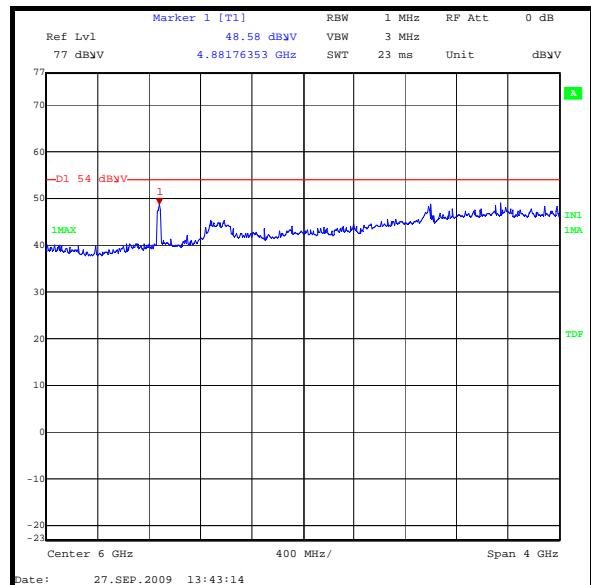
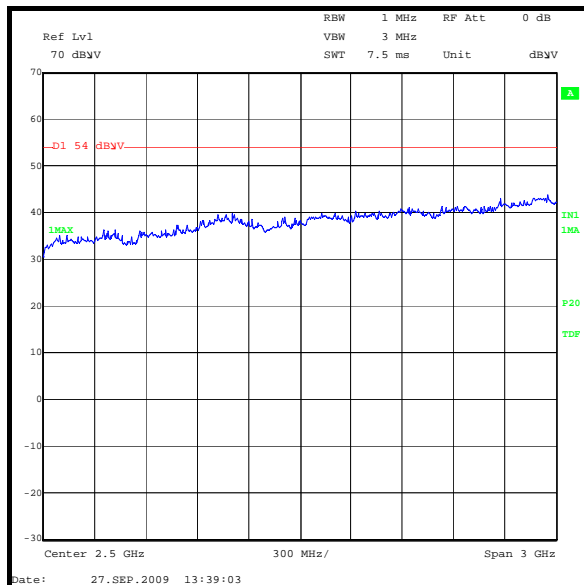
Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Peak Level (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)	Result
4.873371	Vertical	46.5	-1.8	48.3	74.0	25.7	Complied

Results: Highest Average Level

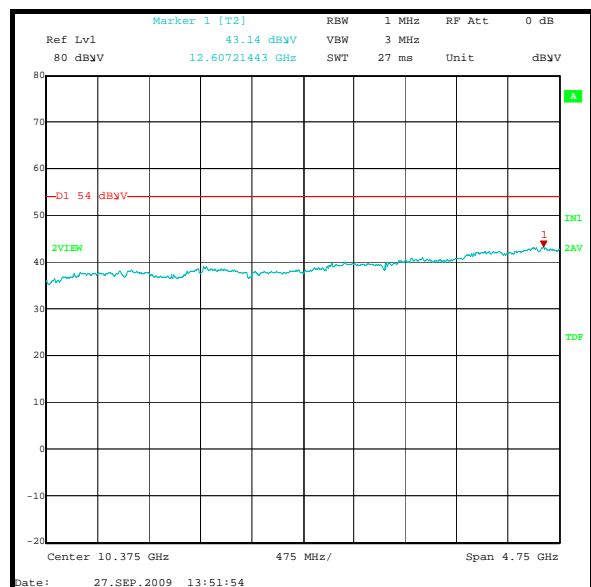
Frequency (GHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Peak Level (dBμV/m)	Average Limit (dBμV/m)	Margin (dB)	Result
4.873371	Vertical	46.5	-1.8	48.3	54.0	5.7	Complied

Note(s):

1. Pre-scans were performed using a peak detector against the average limits. Where the noise floor was close to the average limits, the tests were also repeated using a peak detector against peak limits.
2. The measurement antenna was rotated through the horizontal and vertical planes. The highest levels were recorded in the above table.
3. No other emissions were observed.

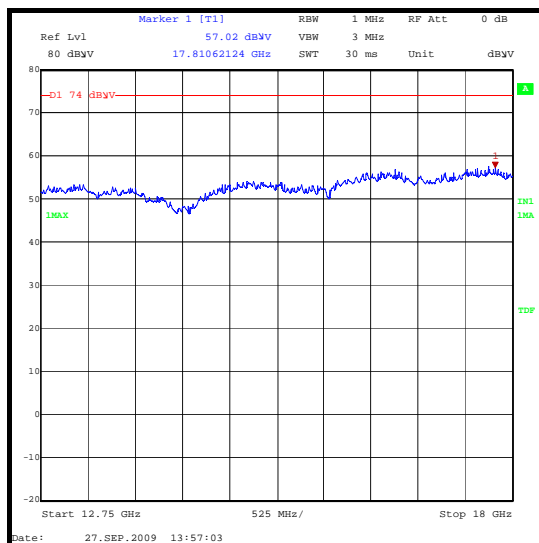
Idle Mode Radiated Spurious Emissions (continued)

Peak detector

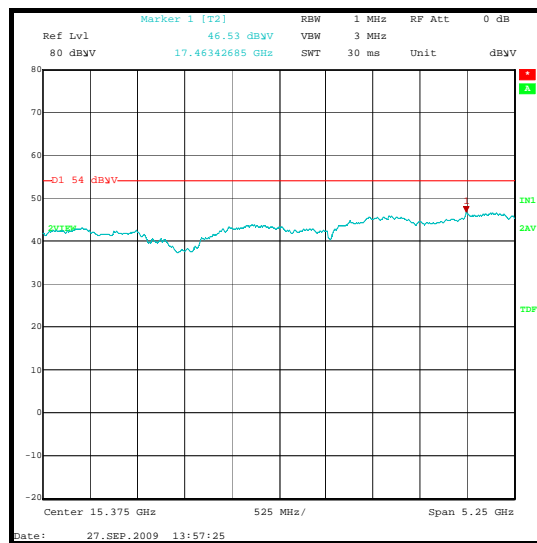


Average detector

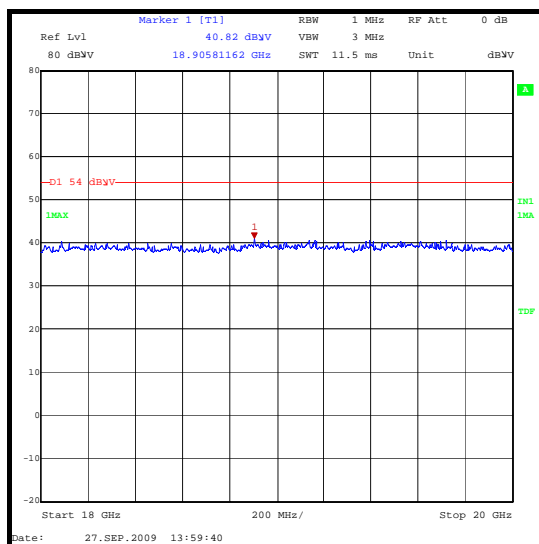
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Idle Mode Radiated Spurious Emissions (continued)

Peak detector



Average detector



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

5.2.3. Transmitter AC Conducted Spurious Emissions**Test Summary:**

FCC Part:	15.207
Test Method Used:	As detailed in ANSI C63.4 Section 7 and relevant annexes

Environmental Conditions:

Temperature Range (°C):	19
Relative Humidity Range (%):	33

Note(s):

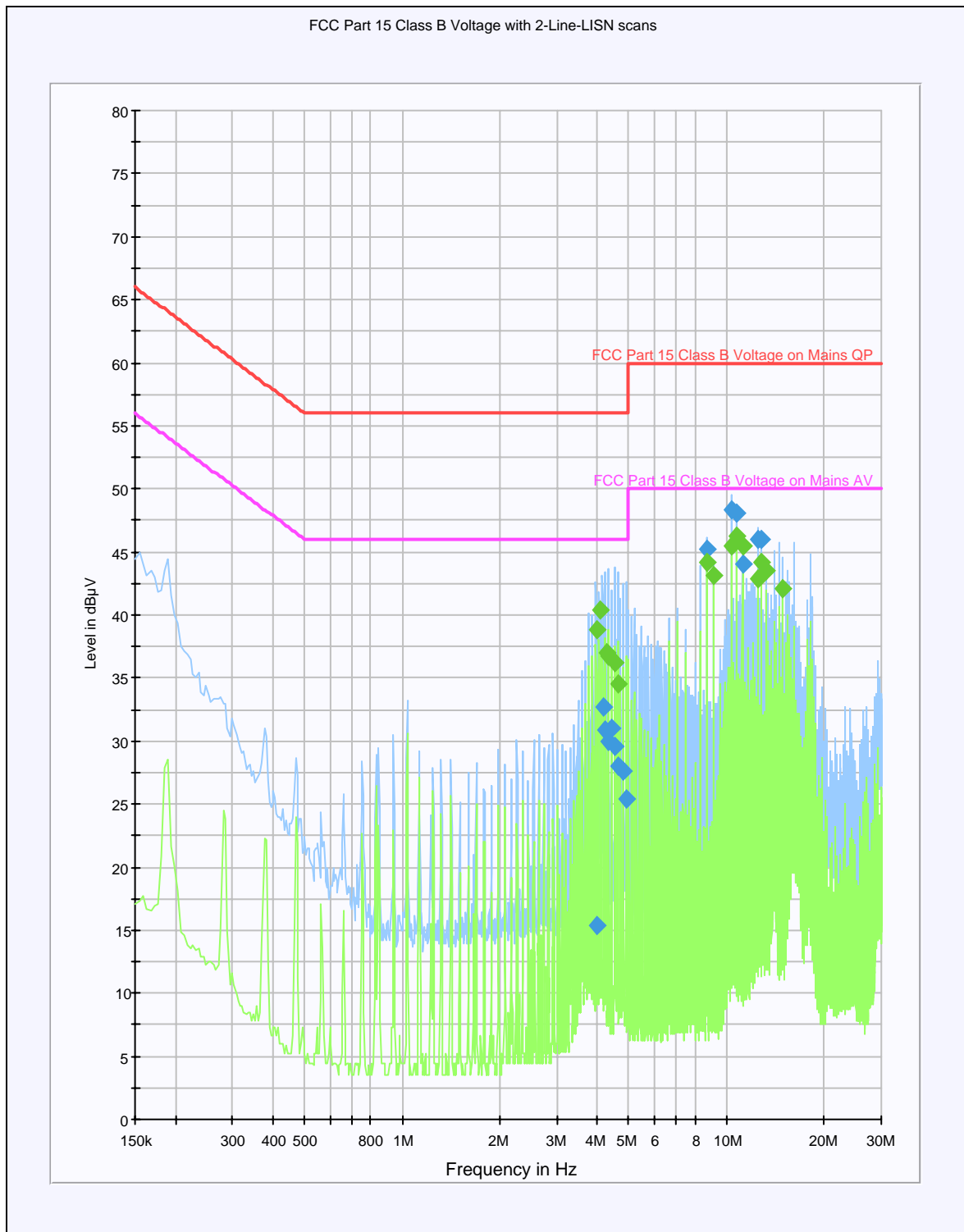
1. Power to the EUT was provided from a Power over Ethernet power injector with 120 VAC 60 Hz input. The 120 VAC 60 Hz input voltage to the Power over Ethernet power was provided through a LISN.
2. The EUT was connected to the Power over Ethernet power injector through an Ethernet cable 1.5 metres in length.
3. The EUT RF port was connected to a Base Station through suitable RF cables and attenuators. A communication link between EUT and Base Station was established. Data packets were sent on the uplink. The EUT was configured to transmit at maximum power using QPSK 1/2 modulation on the top channel using a 5 MHz channel width during the test.

Transmitter AC Conducted Spurious Emissions (continued)**Results: Quasi Peak Detector Measurements**

Frequency (MHz)	Line	Quasi Peak Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
3.979500	Live 1	15.4	56.0	40.6	Complied
4.150500	Neutral	32.7	56.0	23.3	Complied
4.245000	Neutral	30.9	56.0	25.1	Complied
4.339500	Neutral	30.0	56.0	26.0	Complied
4.434000	Neutral	31.0	56.0	25.0	Complied
4.528500	Neutral	29.6	56.0	26.4	Complied
4.623000	Neutral	28.0	56.0	28.0	Complied
4.812000	Neutral	27.6	56.0	28.4	Complied
4.906500	Neutral	25.4	56.0	30.6	Complied
8.704500	Live 1	45.2	60.0	14.8	Complied
10.365000	Live 1	48.3	60.0	11.7	Complied
10.779000	Live 1	48.0	60.0	12.0	Complied
11.193000	Live 1	44.1	60.0	15.9	Complied
12.439500	Live 1	45.9	60.0	14.1	Complied
12.853500	Live 1	46.0	60.0	14.0	Complied

Results: Average Detector Measurements

Frequency (MHz)	Line	Average Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
3.966000	Live 1	38.8	46.0	7.2	Complied
4.060500	Neutral	40.5	46.0	5.5	Complied
4.249500	Neutral	37.0	46.0	9.0	Complied
4.344000	Neutral	36.8	46.0	9.2	Complied
4.533000	Neutral	36.2	46.0	9.8	Complied
4.627500	Neutral	34.5	46.0	11.5	Complied
8.709000	Live 1	44.2	50.0	5.8	Complied
9.123000	Live 1	43.1	50.0	6.9	Complied
10.365000	Live 1	45.5	50.0	4.5	Complied
10.779000	Live 1	46.3	50.0	3.7	Complied
11.193000	Live 1	45.5	50.0	4.5	Complied
12.439500	Live 1	42.9	50.0	7.1	Complied
12.853500	Live 1	44.1	50.0	5.9	Complied
13.267500	Live 1	43.6	50.0	6.4	Complied
14.928000	Live 1	42.0	50.0	8.0	Complied

Idle Mode AC Conducted Spurious Emissions (continued)

Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

5.2.4. Transmitter Carrier Output Power (EIRP)**Test Summary:**

FCC Part:	2.1046, 90.205(r) and 90.1321(a)
Test Method:	ANSI TIA-603-C Section 2.2

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	33

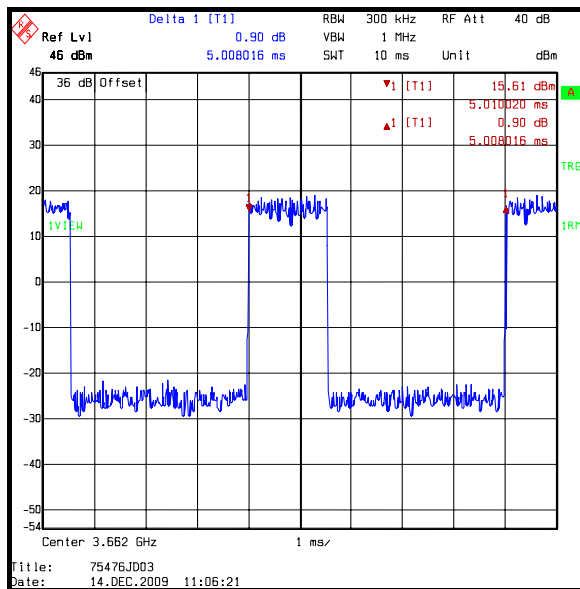
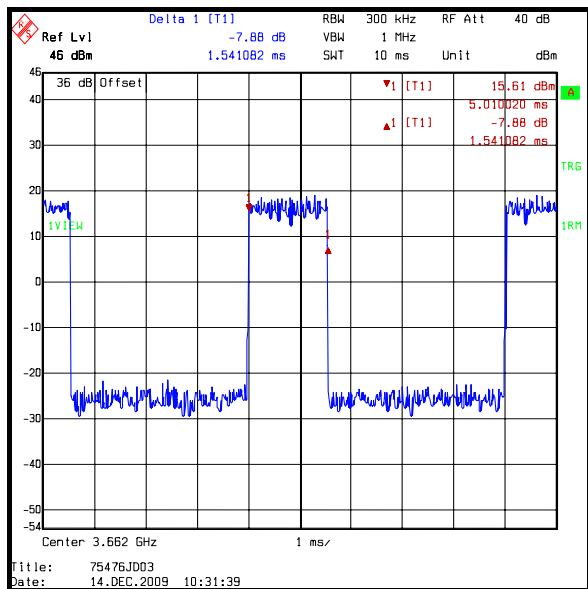
Note(s):

1. The Client's stated maximum conducted output power is 22 dBm for 5 MHz channels and 25 dBm for 10 MHz channels. The default maximum output is 25 dBm for both channel widths. The power was reduced to 22 dBm on the 5 MHz channel by use of a test command through the EUT serial port as requested by the Client. The power output on the 10 MHz channel remained at 25 dBm.
2. Power measurements were made using a calibrated Agilent N1912A power meter and N1921A wideband power sensor. WiMax configuration was selected on the power meter. The power meter was configured to perform a gated measurement across the complete EUT transmit burst. The meter was configured to measure the average power across the burst.
3. The Effective Isotropic Radiated Power (EIRP) was calculated by adding the Client's stated antenna gain to the measured conducted RF output power.
4. All modulation types were tested.
5. The declared antenna gain of 14 dBi was added to the conducted output power. The antenna is integral, therefore no cable losses were considered in the calculation.

Transmitter Carrier Output Power (EIRP) (continued)

TX Duty Cycle

The EUT transmits with a duty cycle of less than 100%.



TX On period = 1.5 ms

TX Off period = 3.5 ms

Duty cycle = 30%

Transmitter Carrier Output Power (EIRP) (continued)**Results: Centre Channel - 5 MHz**

Modulation / Coding Scheme	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm / 5 MHz)	Margin (dB)	Result
QPSK-1/2	22.1	14.0	36.1	37.0	0.9	Complied
QPSK-3/4	21.4	14.0	35.4	37.0	1.6	Complied
16QAM-1/2	21.4	14.0	35.4	37.0	1.6	Complied
16QAM-3/4	21.4	14.0	35.4	37.0	1.6	Complied
64QAM-2/3	21.6	14.0	35.6	37.0	1.4	Complied
64QAM-3/4	21.4	14.0	35.4	37.0	1.6	Complied
64QAM-5/6	21.3	14.0	35.3	37.0	1.7	Complied

Results: Centre Channel - 10 MHz

Modulation / Coding Scheme	Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm / 10 MHz)	Margin (dB)	Result
QPSK-1/2	25.4	14.0	39.4	40.0	0.6	Complied
QPSK-3/4	25.4	14.0	39.4	40.0	0.6	Complied
16QAM-1/2	25.4	14.0	39.4	40.0	0.6	Complied
16QAM-3/4	25.4	14.0	39.4	40.0	0.6	Complied
64QAM-2/3	25.5	14.0	39.5	40.0	0.5	Complied
64QAM-3/4	25.0	14.0	39.0	40.0	1.0	Complied
64QAM-5/6	25.3	14.0	39.3	40.0	0.7	Complied

5.2.5. Transmitter Peak Power Spectral Density (Conducted)**Test Summary:**

FCC Part:	FCC 90.1321(a)/2.1046
Test Method:	ANSI TIA-603-C Section 2.2

Environmental Conditions:

Temperature (°C):	18
Relative Humidity (%):	28

Note(s):

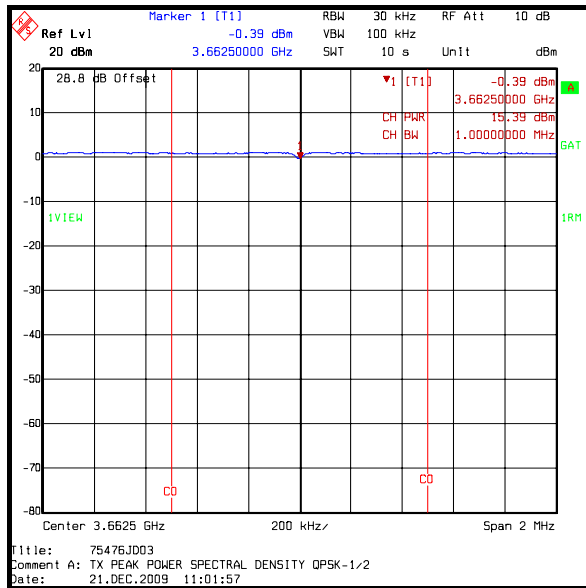
1. The highest mean level of the carrier emission found in a 1 MHz measurement bandwidth was measured using the channel power function of a spectrum analyser. In order to only measure the period when the EUT transmitter is on, the spectrum analyser was connected to a power meter and the gated output of the power meter was used to trigger the external gate input of the spectrum analyser. The spectrum analyser was left to sweep across the screen several times in order to maximise the reading.
2. In accordance with the Client's requirements following Response to Inquiry to FCC (Tracking Number 976660), the antenna gain used is that which will be the lowest used with the EUT.
3. The EUT was configured to transmit at the maximum output power on each modulation / coding scheme.
4. The declared antenna gain of 14 dBi was added to the conducted output power. The antenna is integral, therefore no cable losses were considered in the calculation.

Transmitter Peak Power Spectral Density (continued)**Results: Centre Channel - 5 MHz**

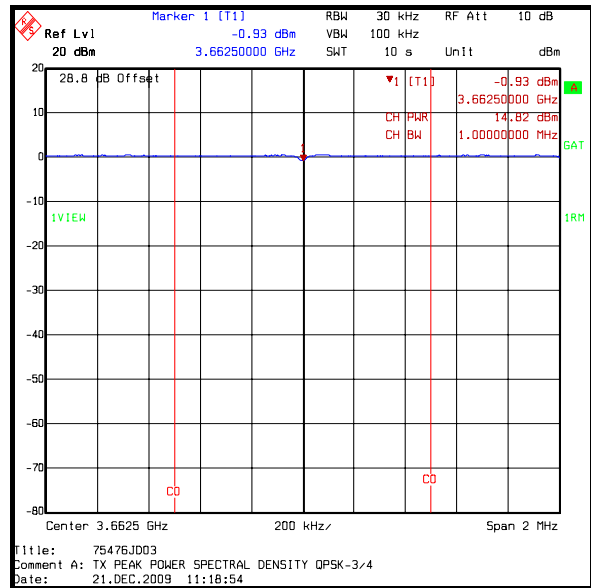
Modulation / Coding Scheme	Conducted Power (dBm)	Antenna Gain (dBi)	Power Spectral Density (dBm)	Limit (dBm)	Margin (dB)	Result
QPSK-1/2	15.4	14.0	29.4	30.0	0.6	Complied
QPSK-3/4	14.8	14.0	28.8	30.0	1.2	Complied
16QAM-1/2	14.9	14.0	28.9	30.0	1.1	Complied
16QAM-3/4	14.8	14.0	28.8	30.0	1.2	Complied
64QAM-2/3	15.3	14.0	29.3	30.0	0.7	Complied
64QAM-3/4	14.6	14.0	28.6	30.0	1.4	Complied
64QAM-5/6	14.4	14.0	28.4	30.0	1.6	Complied

Results: Centre Channel - 10 MHz

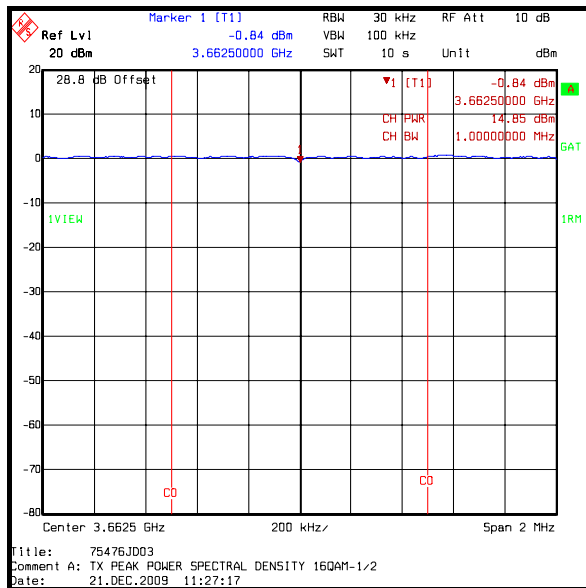
Modulation / Coding Scheme	Conducted Power (dBm)	Antenna Gain (dBi)	Power Spectral Density (dBm)	Limit (dBm)	Margin (dB)	Result
QPSK-1/2	15.7	14.0	29.7	30.0	0.3	Complied
QPSK-3/4	15.7	14.0	29.7	30.0	0.3	Complied
16QAM-1/2	15.7	14.0	29.7	30.0	0.3	Complied
16QAM-3/4	15.7	14.0	29.7	30.0	0.3	Complied
64QAM-2/3	15.7	14.0	29.7	30.0	0.3	Complied
64QAM-3/4	15.0	14.0	29.0	30.0	1.0	Complied
64QAM-5/6	15.5	14.0	29.5	30.0	0.5	Complied

Transmitter Peak Power Spectral Density – 5 MHz (continued)

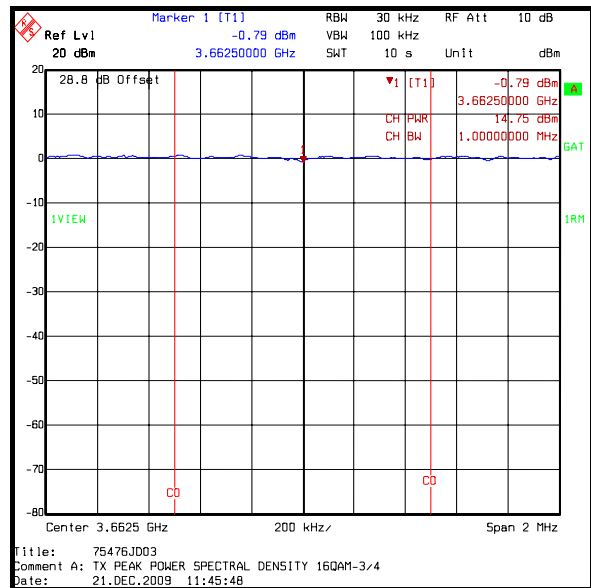
QPSK-1/2



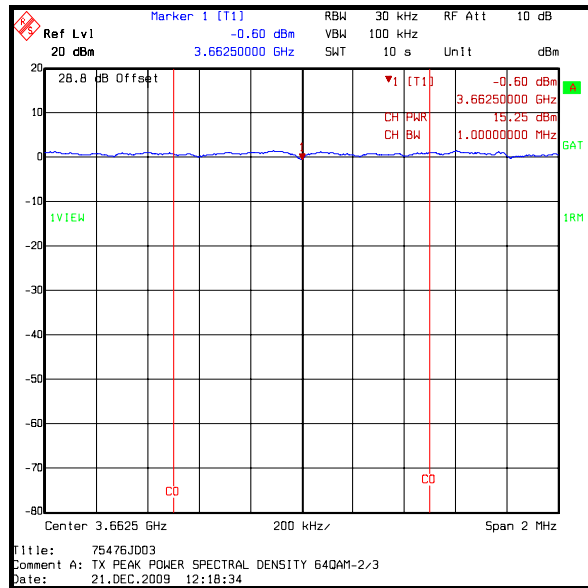
QPSK-3/4



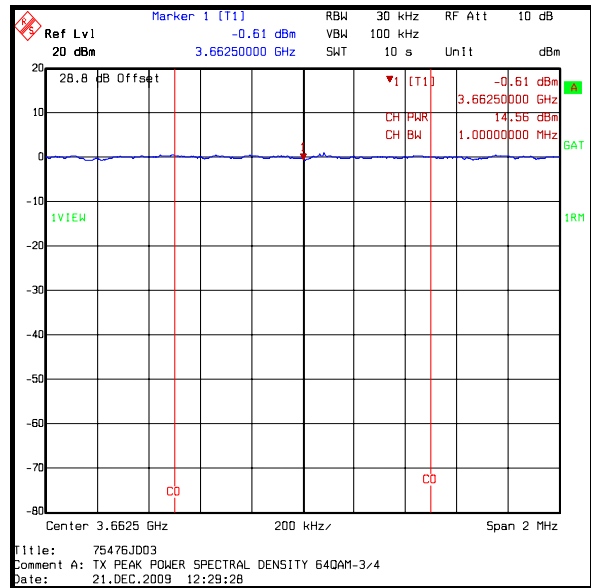
16QAM-1/2



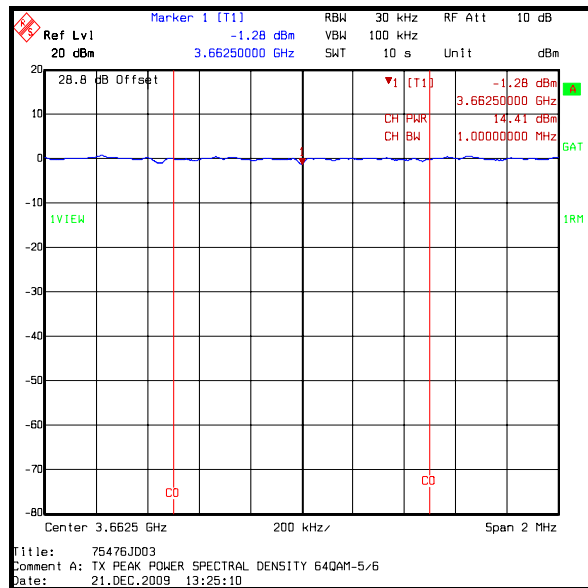
16QAM-3/4

Transmitter Peak Power Spectral Density – 5 MHz (continued)

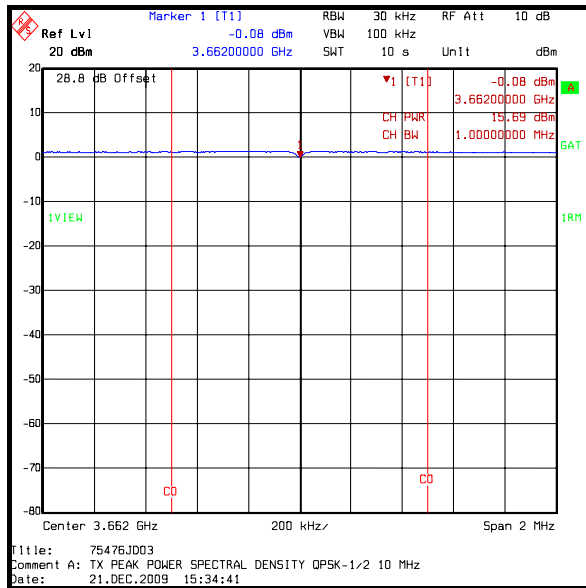
64QAM-2/3



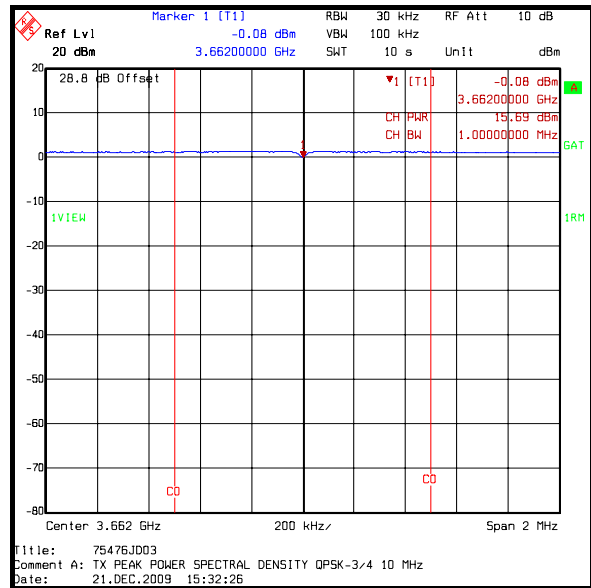
64QAM-3/4



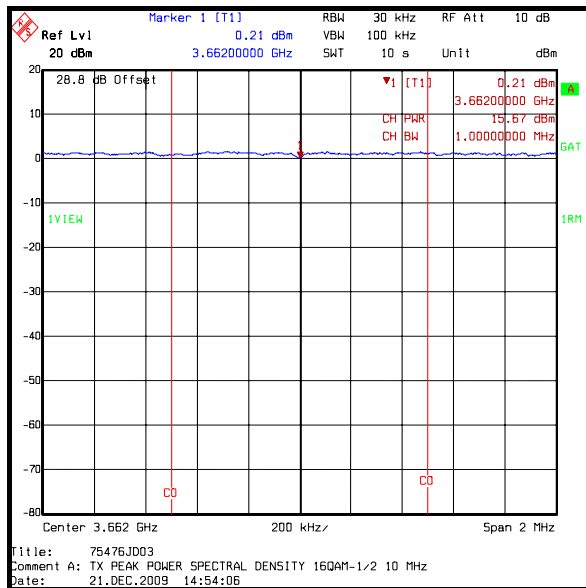
64QAM-5/6

Transmitter Peak Power Spectral Density – 10 MHz (continued)

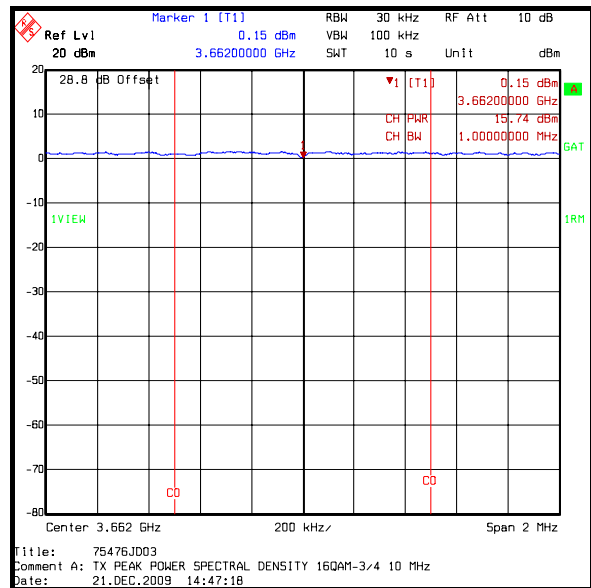
QPSK-1/2



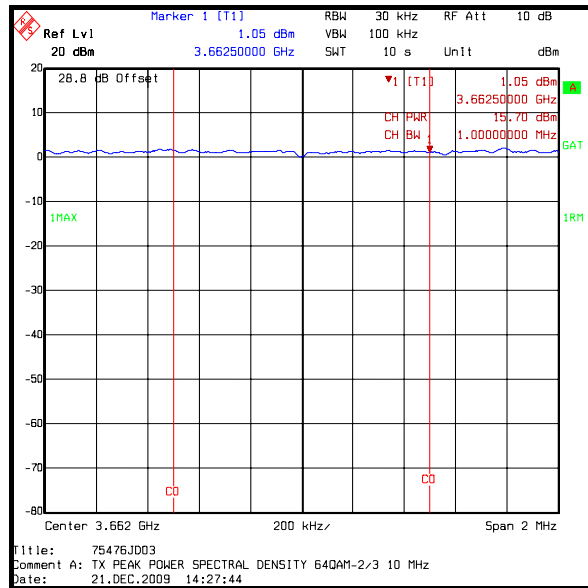
QPSK-3/4



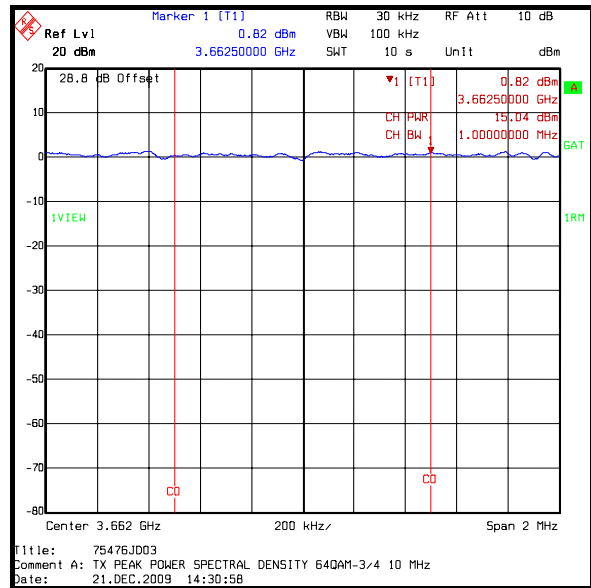
16QAM-1/2



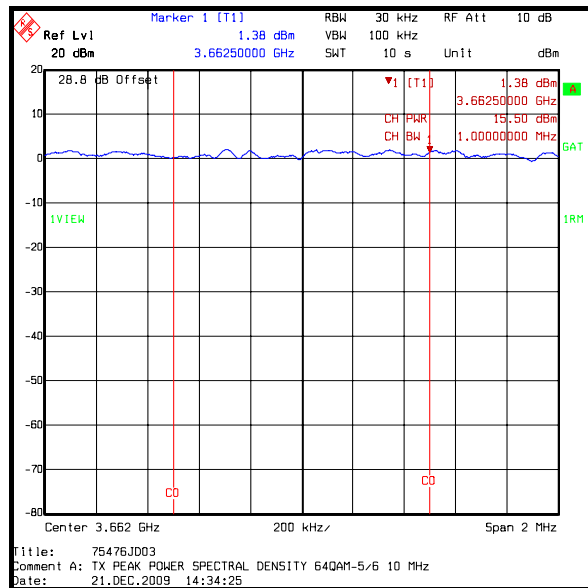
16QAM-3/4

Transmitter Peak Power Spectral Density – 10 MHz (continued)

64QAM-2/3



64QAM-3/4



64QAM-5/6

5.2.6. Transmitter Occupied Bandwidth (Bandwidth Limitations)**Test Summary:**

FCC Part:	Part 90.209 and 2.1049
Test Method:	ANSI C63.4 Section 13.1.7

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	44 to 51

Note(s):

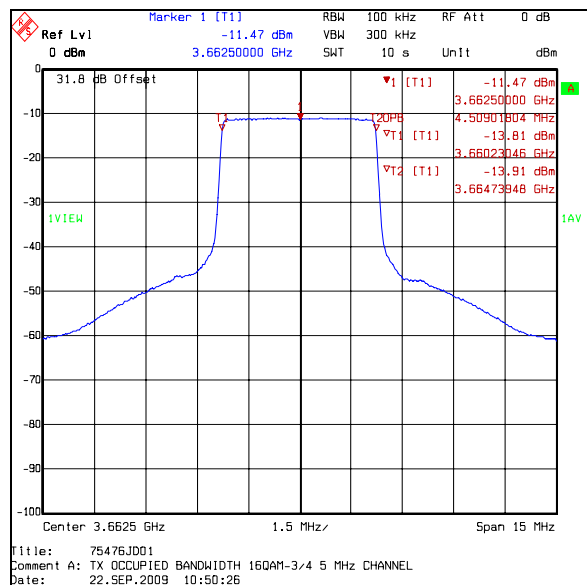
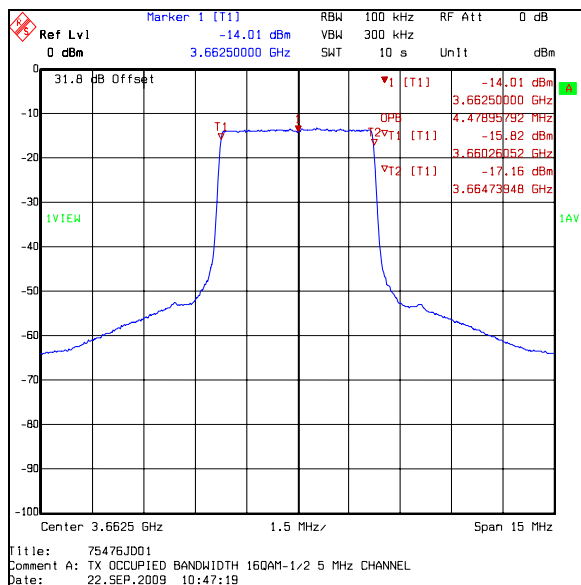
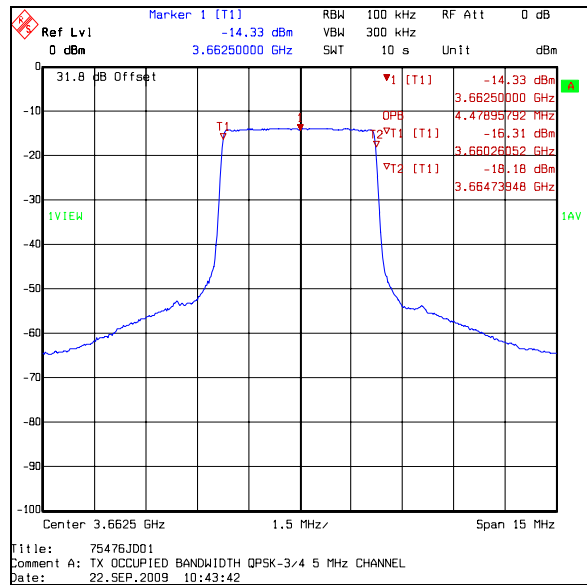
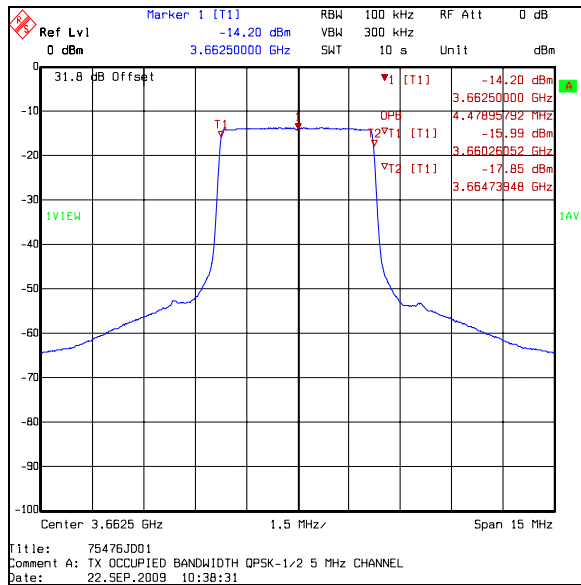
1. Occupied bandwidth measurements were performed using the occupied bandwidth function of a spectrum analyser. Measurement bandwidths were set automatically by the spectrum analyser.
2. The EUT was transmitting at maximum power at the maximum data rate supported by the modulation type under test.

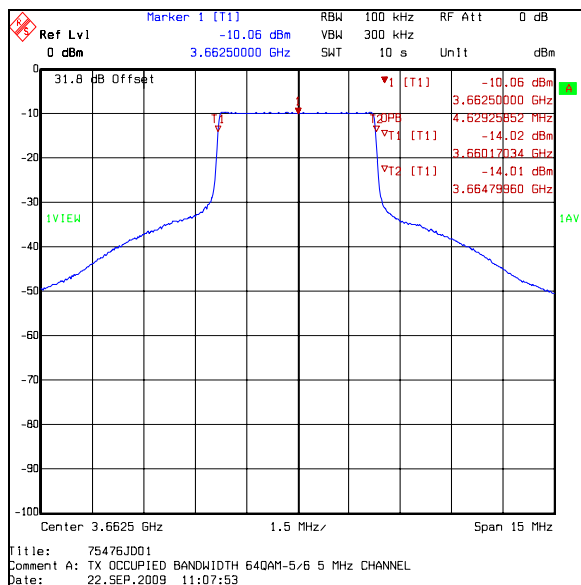
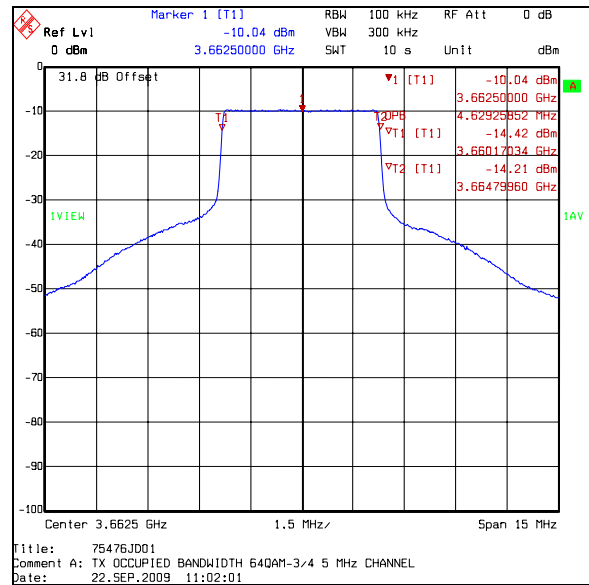
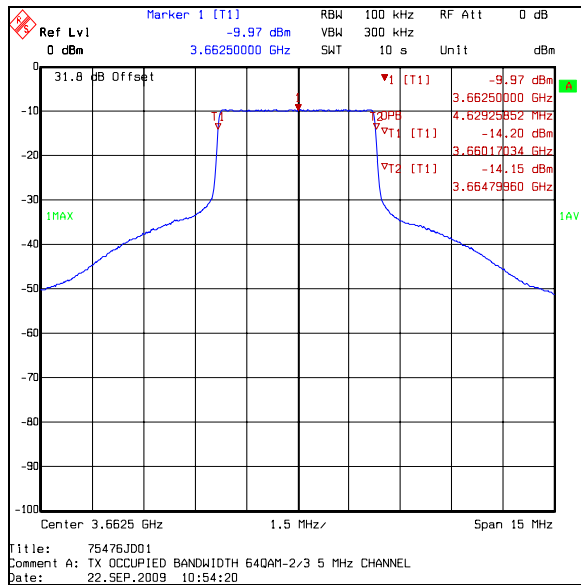
Transmitter Occupied Bandwidth (continued)**Results: Centre Channel - 5 MHz**

Modulation / Coding Scheme	Frequency (MHz)	RBW (kHz)	VBW (kHz)	Occupied Bandwidth (kHz)
QPSK-1/2	3662.5	100	300	4478.958
QPSK-3/4	3662.5	100	300	4478.958
16QAM-1/2	3662.5	100	300	4478.958
16QAM-3/4	3662.5	100	300	4509.018
64QAM-2/3	3662.5	100	300	4629.259
64QAM-3/4	3662.5	100	300	4629.259
64QAM-5/6	3662.5	100	300	4629.259

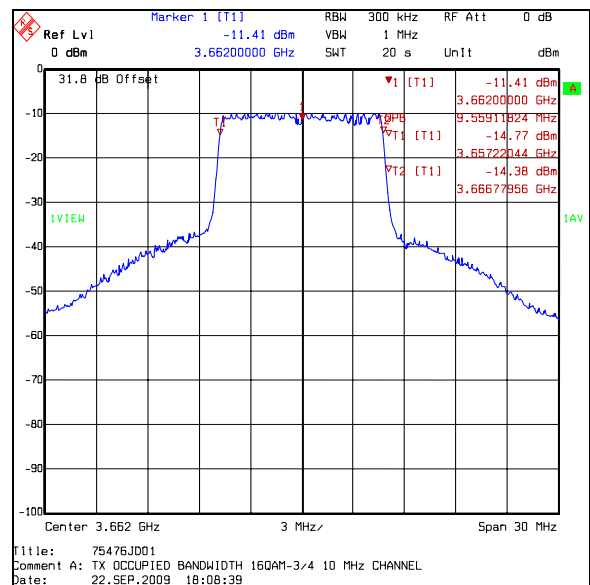
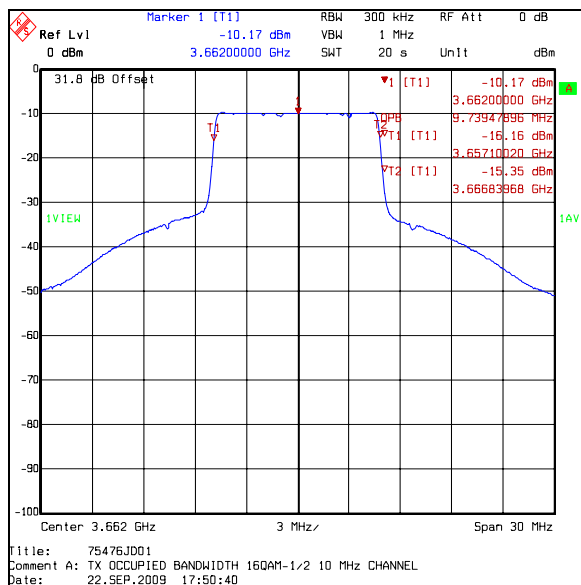
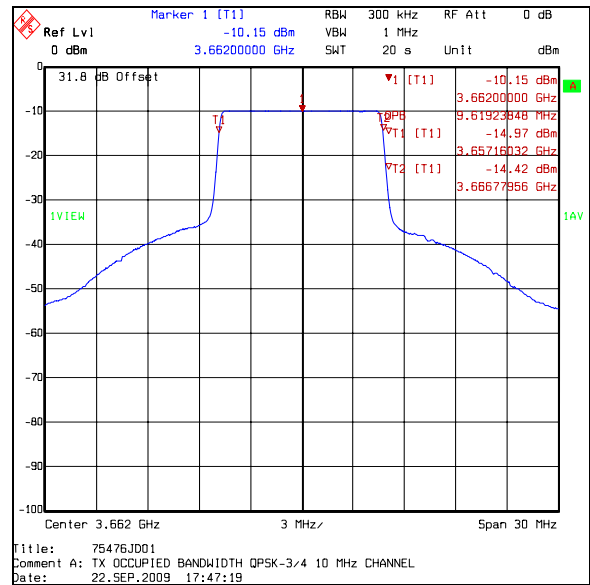
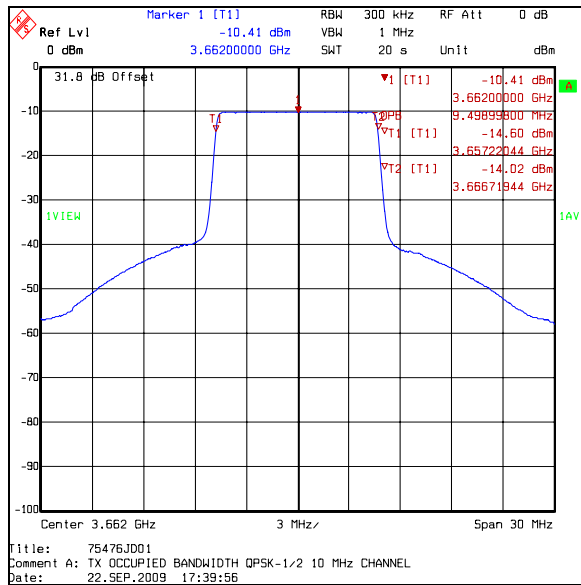
Results: Centre Channel - 10 MHz

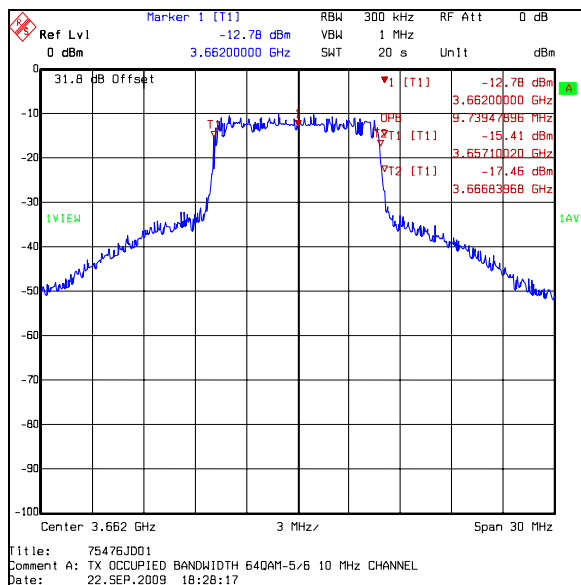
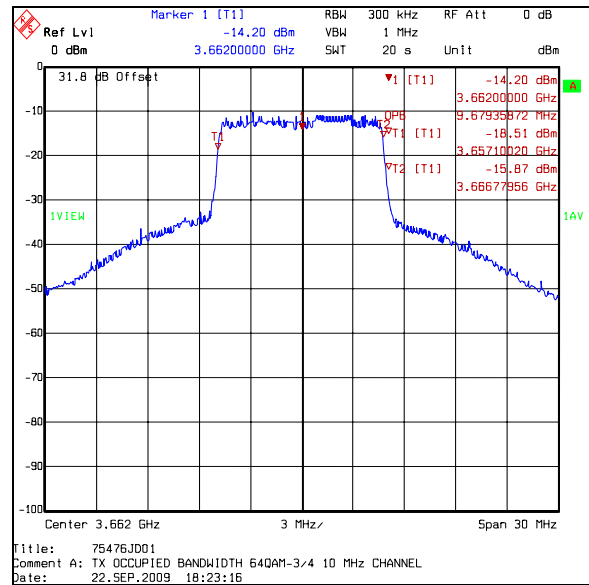
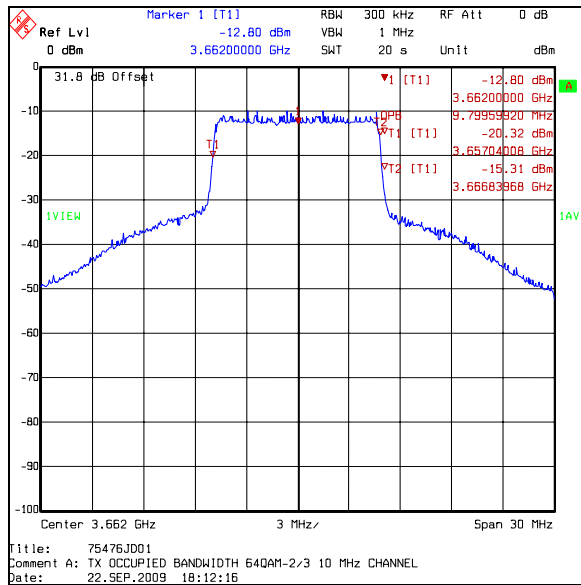
Modulation / Coding Scheme	Frequency (MHz)	RBW (kHz)	VBW (kHz)	Occupied Bandwidth (kHz)
QPSK-1/2	3662.0	300	1000	9498.998
QPSK-3/4	3662.0	300	1000	9619.238
16QAM-1/2	3662.0	300	1000	9739.479
16QAM-3/4	3662.0	300	1000	9599.118
64QAM-2/3	3662.0	300	1000	9799.599
64QAM-3/4	3662.0	300	1000	9679.359
64QAM-5/6	3662.0	300	1000	9739.479

Transmitter Occupied Bandwidth – 5 MHz (continued)

Transmitter Occupied Bandwidth – 5 MHz (continued)

Transmitter Occupied Bandwidth – 10 MHz (continued)



Transmitter Occupied Bandwidth – 10 MHz (continued)

5.2.7. Transmitter Conducted Emissions**Test Summary:**

FCC Part:	Part 90.1323 and Part 2.1051
Test Method:	ANSI TIA-603-C-2004 Section 2.2.13

Environmental Conditions:

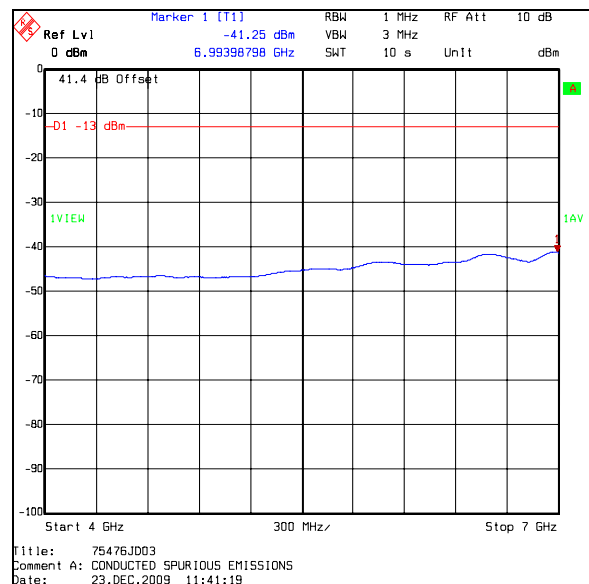
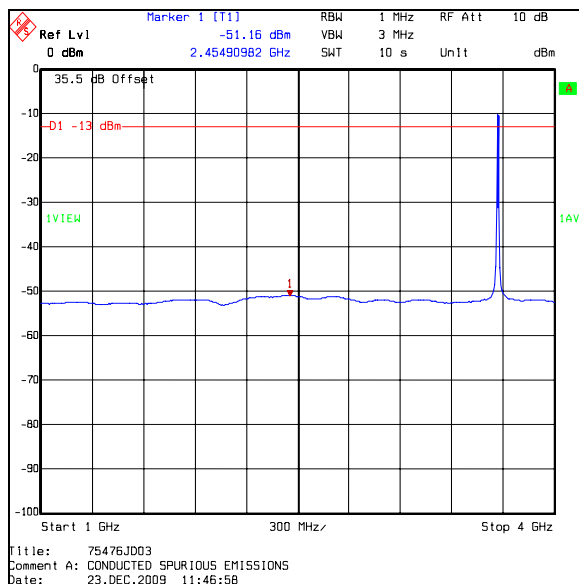
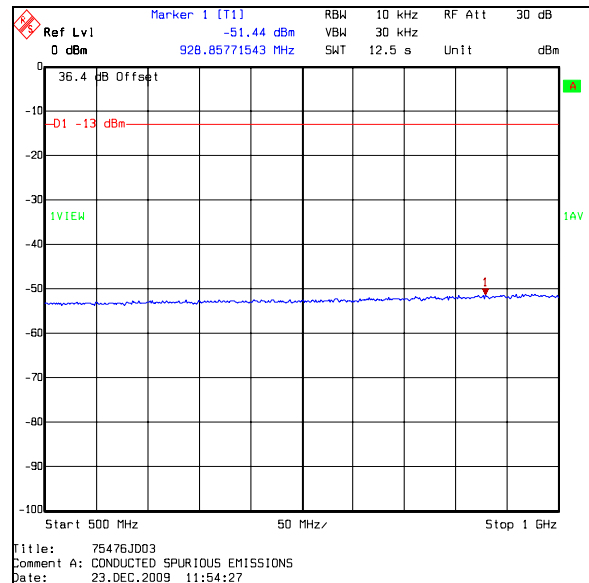
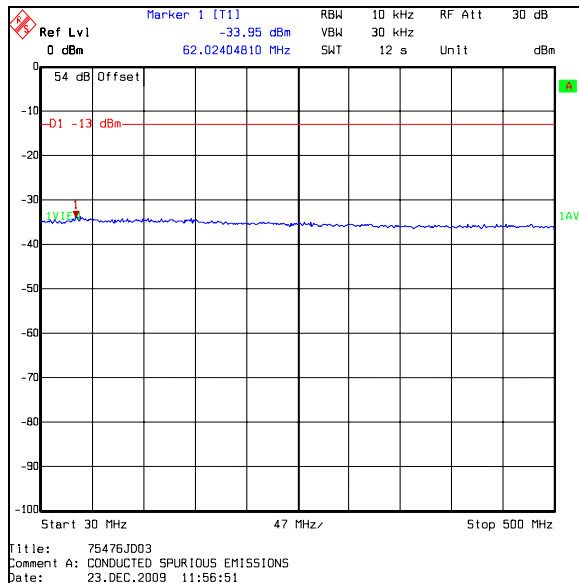
Temperature (°C):	20
Relative Humidity (%):	26

Note(s):

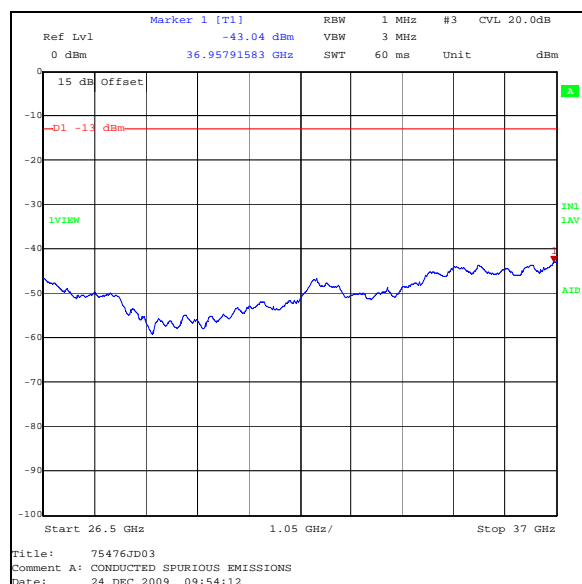
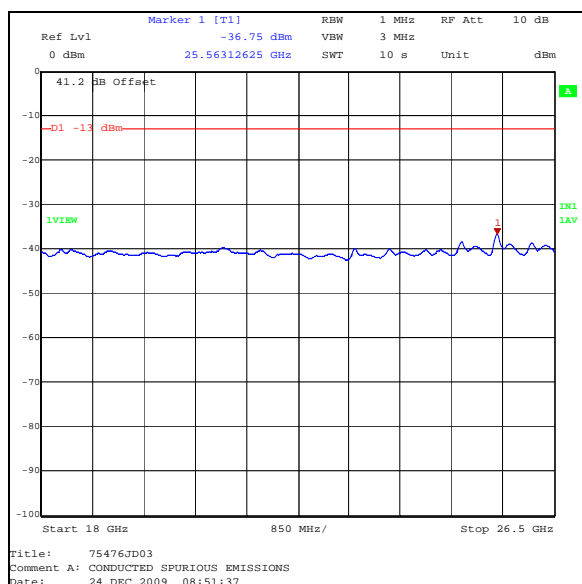
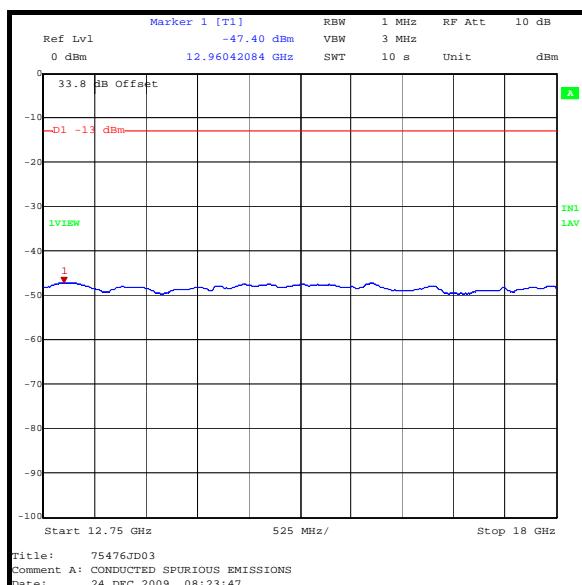
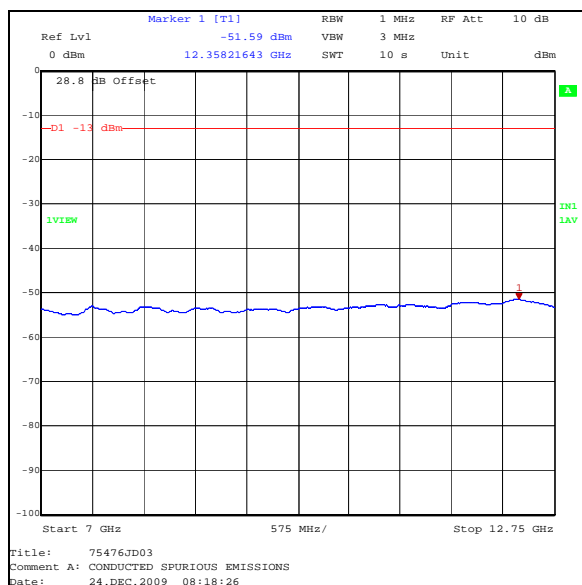
1. The integrated high gain antenna was removed from the EUT casing and disconnected from the main RF port on the radio PCB within the EUT. The internal RF cable from the main RF port was routed through an access hole in the casing. The integrated high gain antenna was re-fitted to the EUT casing. The RF cable from the main RF port was connected to a Base Station using suitable RF cables and attenuators. A link was established between the EUT and support base station. The EUT was then configured to transmit at maximum power on the upper 10 MHz channel using QPSK modulation. A 10 MHz channel was selected as this was previously measured and has the highest output power.
2. The RF diversity port on the EUT was connected to the integrated high gain antenna during the tests.
3. The carrier is shown on the 1 GHz to 4 GHz plot at approximately 3670 MHz.
4. No emissions were observed above the noise floor of the measurement system. The highest noise floor level was recorded.

Results:

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
62.024	-34.0	-13.0	21.0	Complied

Transmitter Conducted Emissions (continued)

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Conducted Emissions (continued)

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

5.2.8. Transmitter Band Edge Conducted Emissions**Test Summary:**

FCC Part:	FCC Part 90.1323 and Part 2.1051
Test Method:	ANSI TIA-603-C Section 2.2.13 and FCC Part 90.1323

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	29

Note(s):

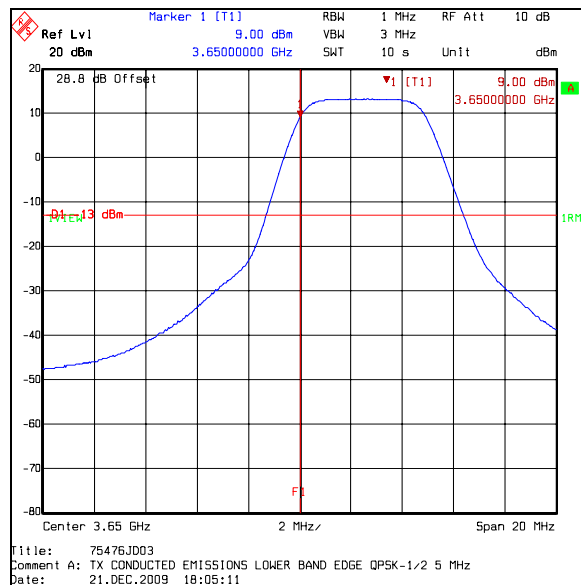
1. Power and occupied bandwidth tests were previously performed on all modulation types and coding schemes. The results show minimal differences between all configurations, therefore conducted band edge measurements were performed using only QPSK 1/2 modulation on the 5 MHz and 10 MHz channels.
2. Pre-scans at the band edges were performed in a 1 MHz measurement bandwidth. As the bottom channel is adjacent to the lower band edge, final measurements were also performed in a 1MHz strip below and adjacent to, the lower band edge using the channel power function of a spectrum analyser. Measurement bandwidths were set automatically by the spectrum analyser. Lower band edge pre-scan and final measurement plots were recorded.
3. Measurements were performed using an RMS detector.
4. The EUT was configured to transmit at the maximum output power on each modulation / coding scheme.

Transmitter Band Edge Conducted Emissions (continued)**Results: 5 MHz / Lower Band Edge**

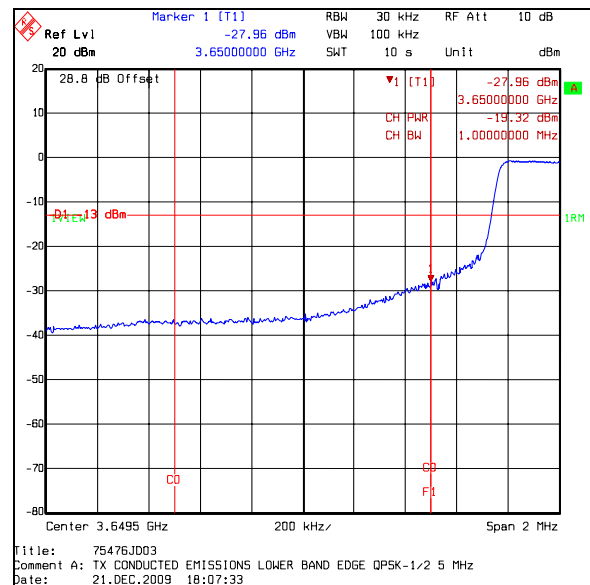
Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3650.0	-19.3	-13.0	6.3	Complied

Results: 10 MHz/ Lower Band Edge

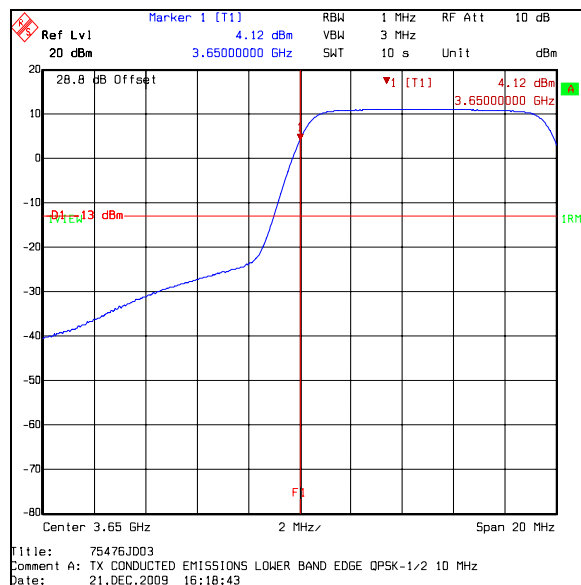
Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3650.0	-21.7	-13.0	8.7	Complied

Transmitter Band Edge Conducted Emissions (continued)

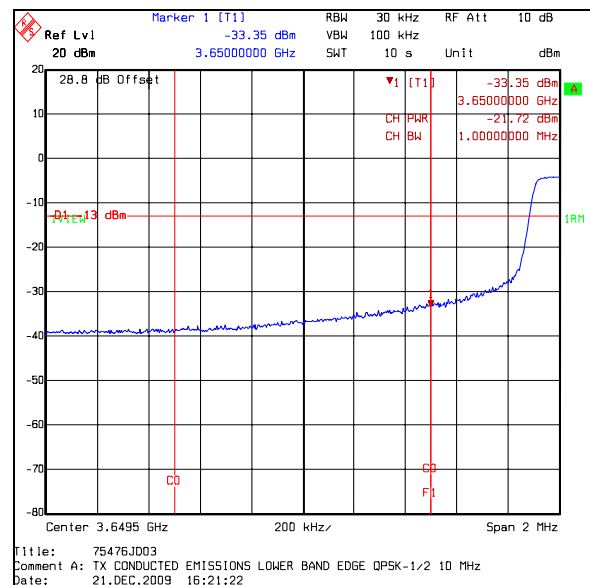
Bottom Channel / Lower band edge / 5 MHz channel



Bottom Channel / Lower band edge / 5 MHz channel



Bottom Channel / Lower band edge / 10 MHz channel



Bottom Channel / Lower band edge / 10 MHz channel

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

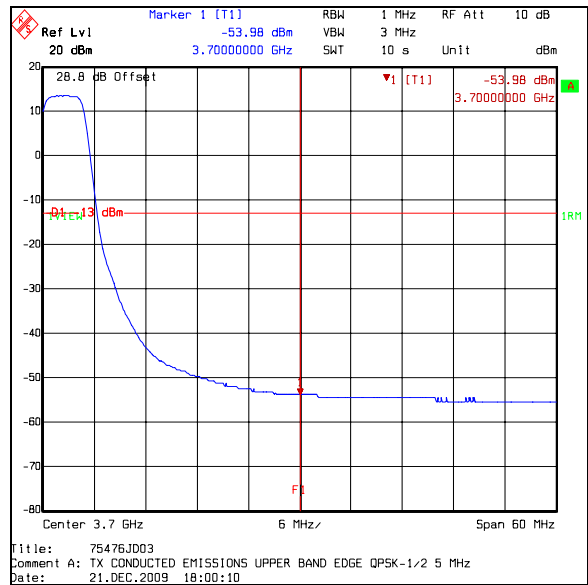
Transmitter Band Edge Conducted Emissions (continued)**Results: 5 MHz / Upper Band Edge**

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3700.0	-54.0	-13.0	41.0	Complied

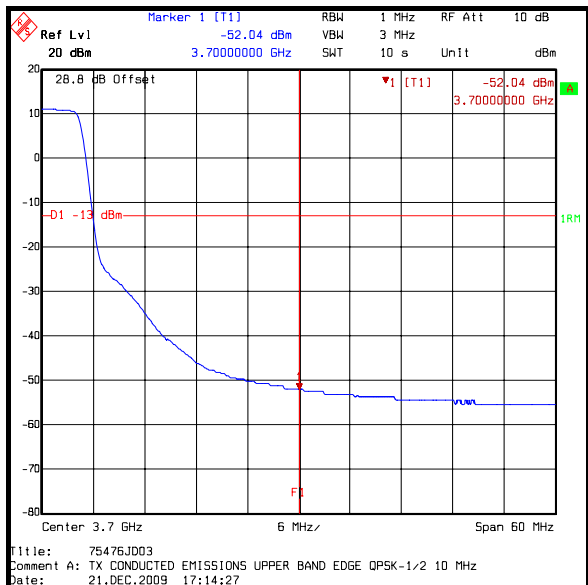
Results: 10 MHz/ Upper Band Edge

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3700.0	-52.0	-13.0	39.0	Complied

Transmitter Band Edge Conducted Emissions (continued)



Top Channel / Upper band edge / 5 MHz channel



Top Channel / Upper band edge / 10 MHz channel

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

5.2.9. Transmitter Radiated Emissions (Out of Band)**Test Summary:**

FCC Part:	90.1323 and 2.1053
Test Method:	ANSI TIA-603-C 2004 Section 2.2.12 and ANSI C63.4 Section 8

Environmental Conditions:

Temperature (°C):	20 to 21
Relative Humidity (%):	22

Note(s):

1. The integrated high gain antenna was removed from the EUT casing and disconnected from the RF ports on the radio PCB within the EUT. The internal RF cable from the main RF port was routed through an access hole in the casing in accordance with the Client's instructions. The integrated high gain antenna was re-fitted to the EUT casing. The RF cable from the EUT main RF port was connected to a Base Station outside the test chamber using suitable RF cables and attenuators. A link was established between the EUT and support base station. The EUT was then configured to transmit at maximum power on the upper 10 MHz channel using QPSK modulation. A 10 MHz channel was selected as this was previously measured and was confirmed as having the highest output power.
2. The cable connected to the EUT RX diversity port was terminated into a 50 Ohm load inside the EUT. This was taped to the inner part of the casing to avoid short circuiting to the EUT printed circuit boards.
3. An earth strap was fitted between the earthing point on the EUT casing and the structure of the anechoic chamber during the testing.
4. Measurements were made with a peak detector.
5. Pre-scans were performed on the top channel. Final measurements were performed on the bottom, centre and top channels.
6. The carrier is shown on the 1 GHz to 4 GHz plot at approximately 3670 MHz.
7. Final measurements were made using appropriate RF attenuators and filters where required.
8. The measurement antenna was rotated through the vertical and horizontal planes and the highest level recorded.

Transmitter Radiated Emissions (continued)**Results: Bottom Channel**

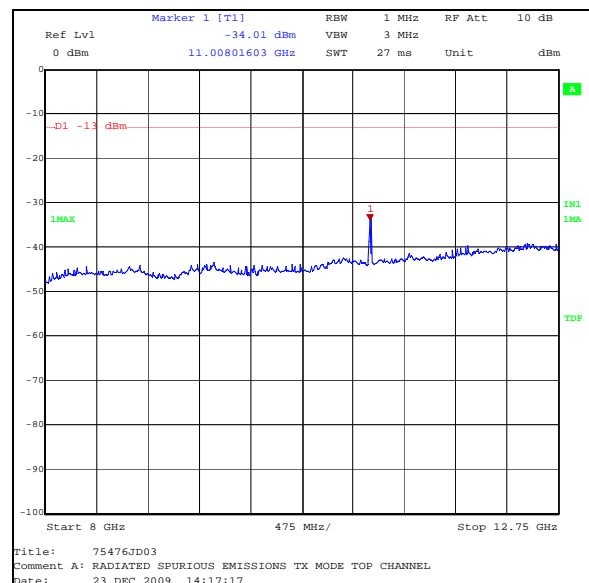
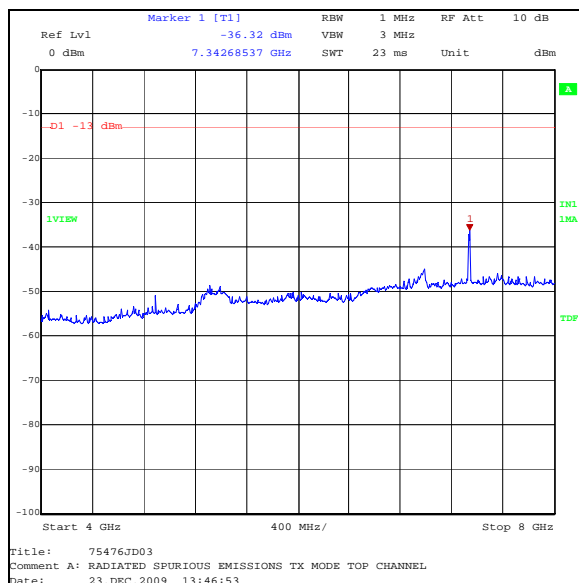
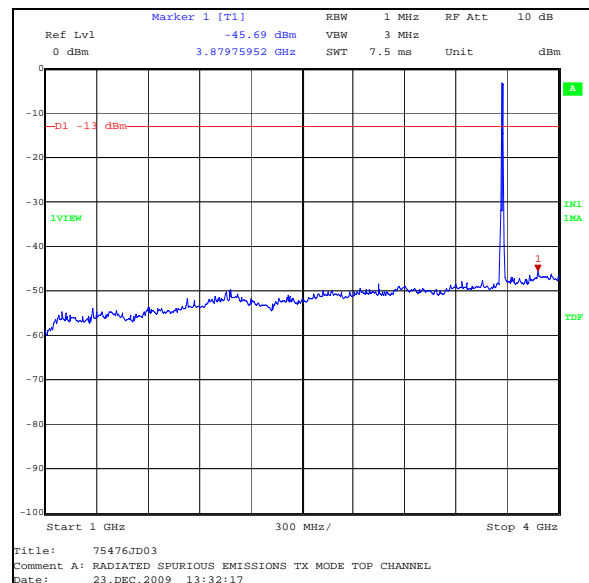
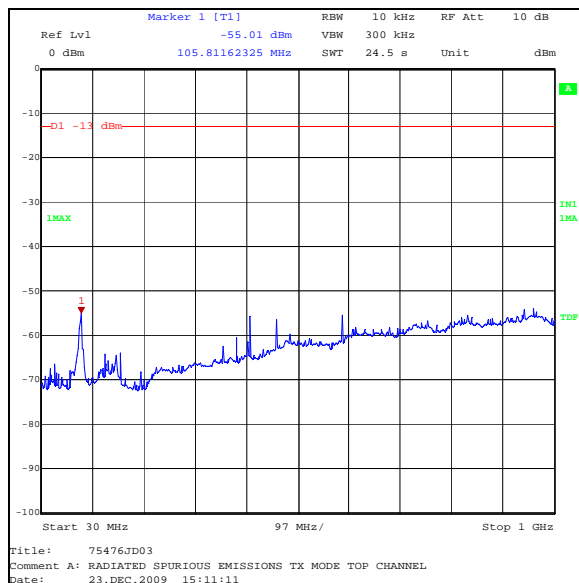
Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
7310.511	-29.3	-13.0	16.3	Complied
10963.960	-28.7	-13.0	15.7	Complied

Results: Centre Channel

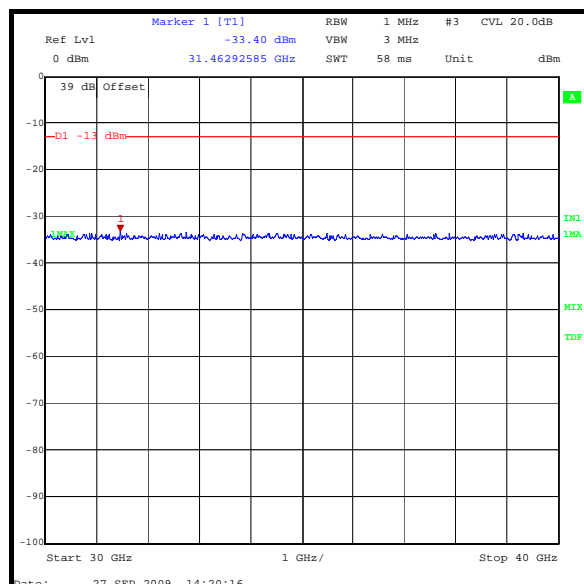
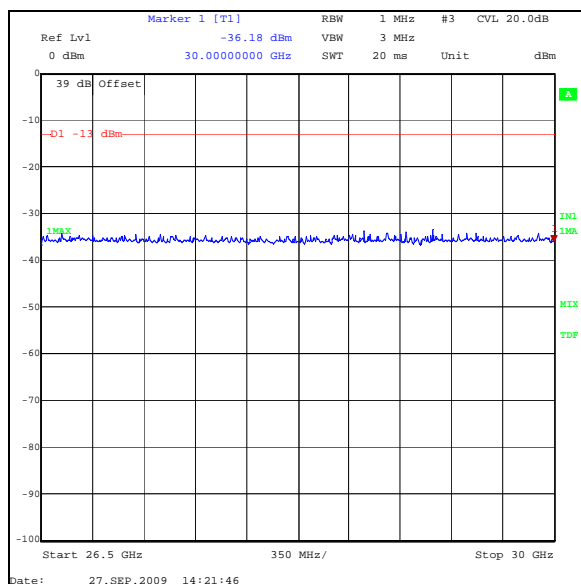
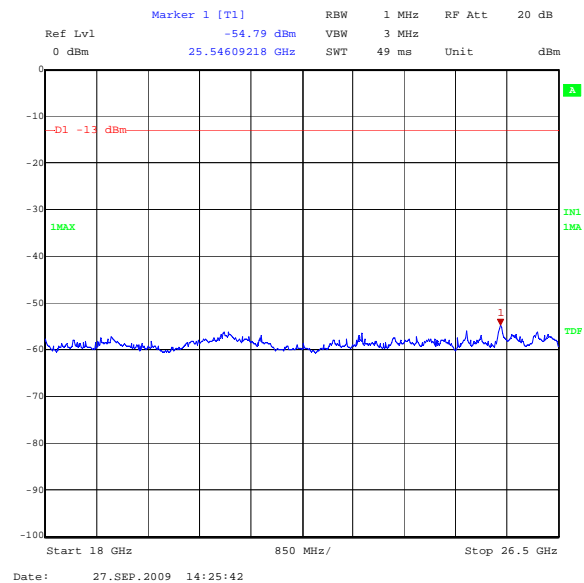
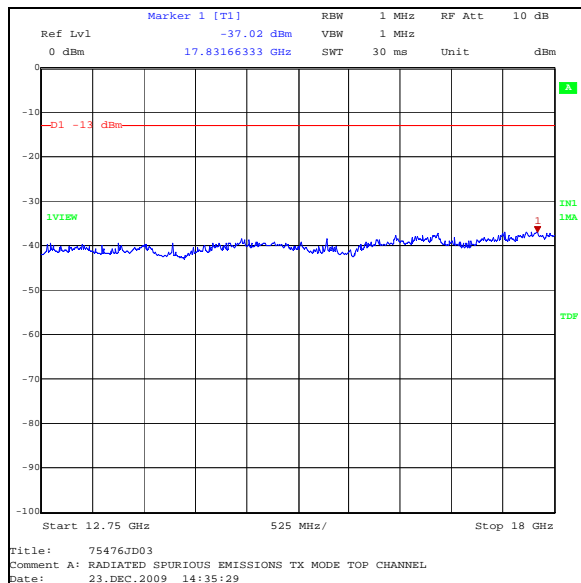
Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
7324.098	-29.4	-13.0	16.4	Complied
10985.856	-28.4	-13.0	15.4	Complied

Results: Top Channel

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
7339.649	-29.3	-13.0	16.3	Complied
11009.503	-31.6	-13.0	18.6	Complied

Transmitter Radiated Emissions (Out of Band) (continued)

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Radiated Emissions (Out of Band) (continued)

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

5.2.10. Transmitter Band Edge Radiated Emissions**Test Summary:**

FCC Part:	90.1323 and 2.1053
Test Method:	ANSI TIA-603-C 2004 Section 2.2.12 and ANSI C63.4 Section 8

Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	21

Note(s):

1. Measurement setup was as described in the transmitter radiated spurious emissions section of this report.
2. Measurements were made with a peak detector.
3. Pre-scans at the band edges were performed in a 1 MHz measurement bandwidth. As the bottom channel is adjacent to the lower band edge, final measurements were performed in a 1MHz strip below and adjacent to, the lower band edge using the channel power function of a spectrum analyser. Measurement bandwidths were set automatically by the spectrum analyser. Lower band edge pre-scan and final measurement plots were recorded.
4. The measurement antenna was rotated through the vertical and horizontal planes and the highest level recorded.

Transmitter Band Edge Radiated Emissions (continued)**Results: 5 MHz / QPSK 1/2 / Lower Band Edge**

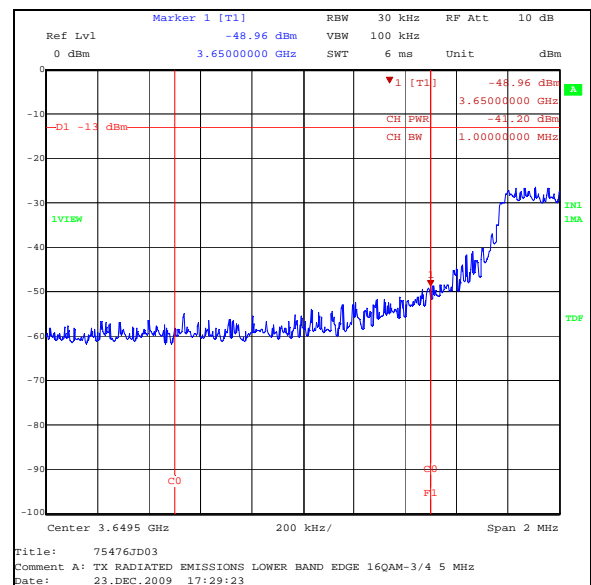
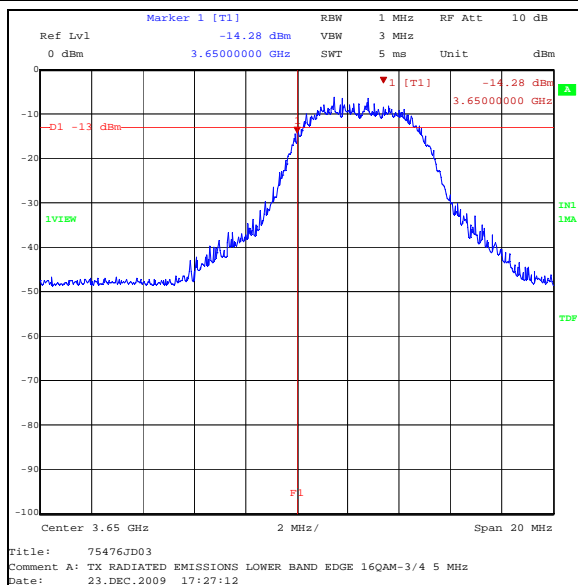
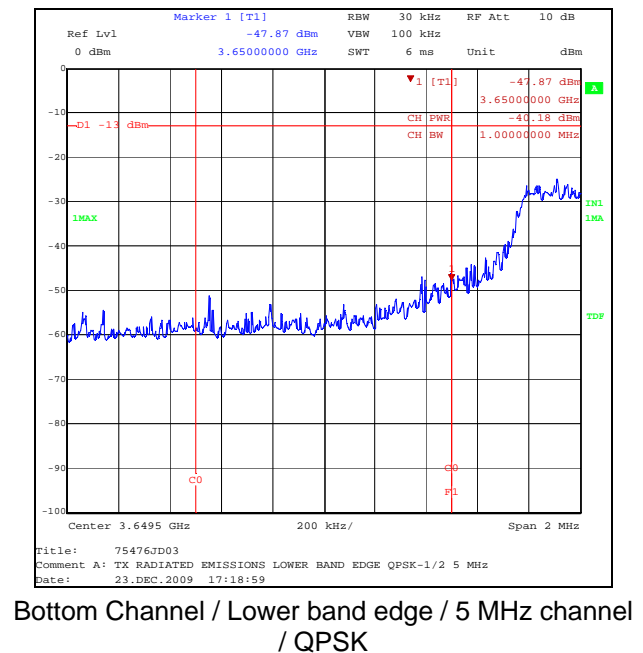
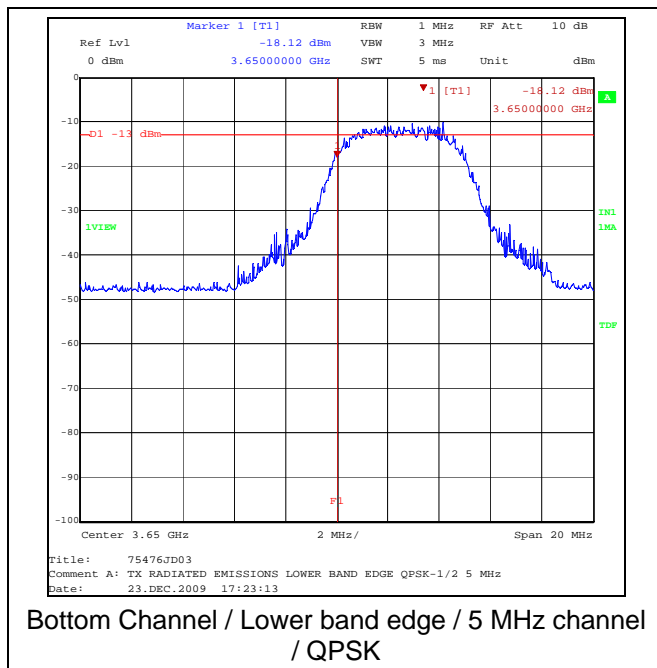
Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3650.0	-40.2	-13.0	27.2	Complied

Results: 5 MHz / 16QAM 3/4 / Lower Band Edge

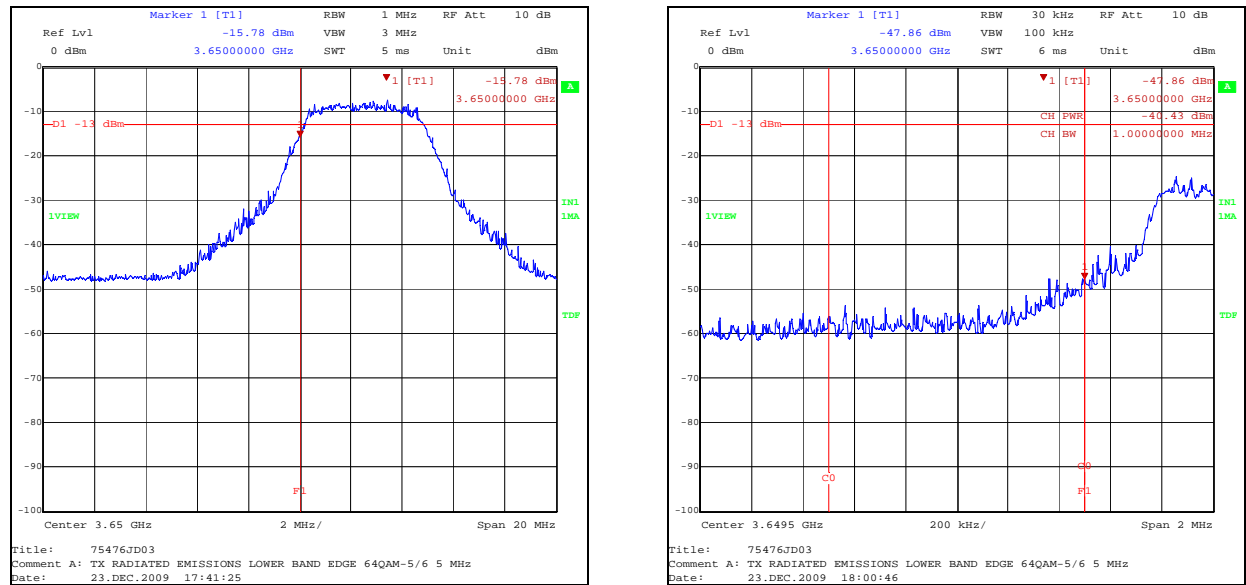
Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3650.0	-41.2	-13.0	28.2	Complied

Results: 5 MHz / 64QAM 5/6 / Lower Band Edge

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3650.0	-40.4	-13.0	27.4	Complied

Transmitter Band Edge Radiated Emissions (continued)

Transmitter Band Edge Radiated Emissions (continued)



Bottom Channel / Lower band edge / 5 MHz channel / 64QAM

Bottom Channel / Lower band edge / 5 MHz channel / 64QAM

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Band Edge Radiated Emissions (continued)**Results: 10 MHz / QPSK 1/2 / Lower Band Edge**

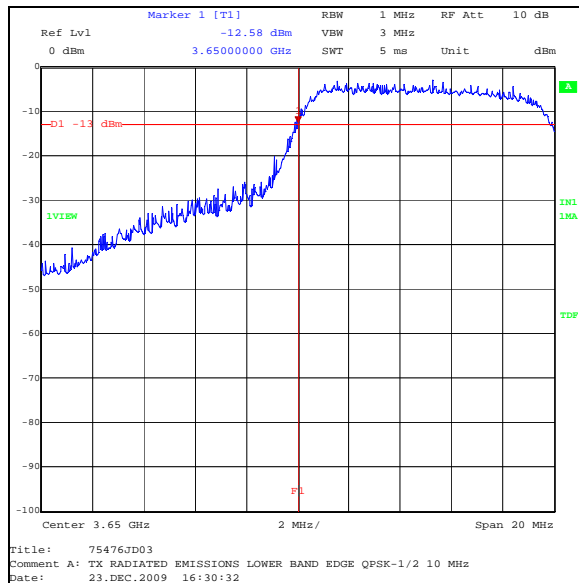
Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3650.0	-36.4	-13.0	23.4	Complied

Results: 10 MHz / 16QAM 3/4 / Lower Band Edge

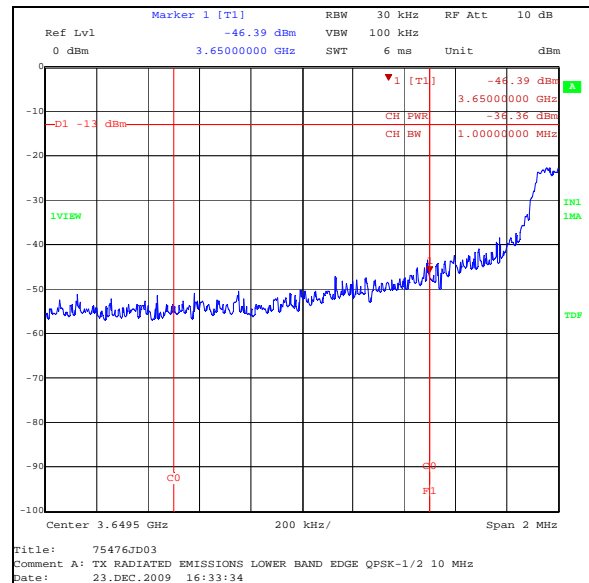
Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3650.0	-37.2	-13.0	24.2	Complied

Results: 10 MHz / 64QAM 5/6 / Lower Band Edge

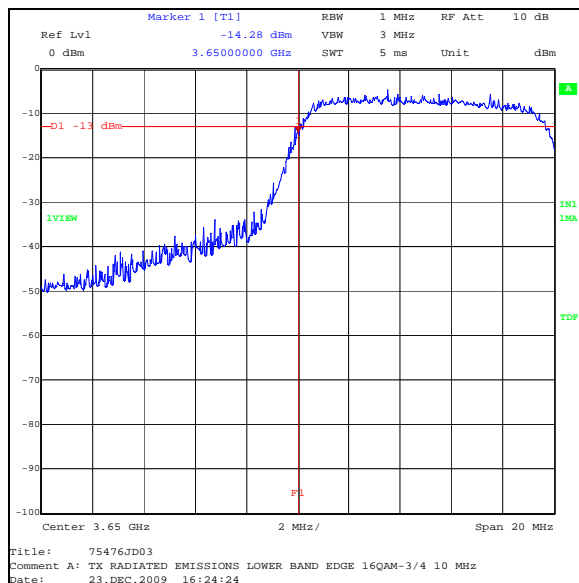
Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3650.0	-35.4	-13.0	22.4	Complied

Transmitter Band Edge Radiated Emissions (continued)

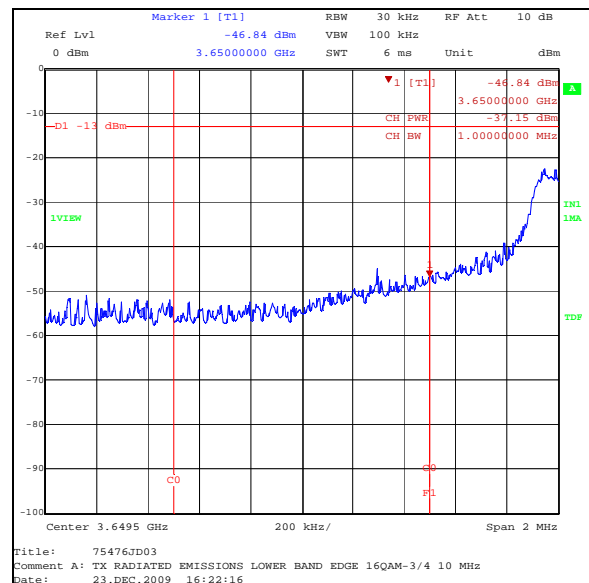
Bottom Channel / Lower band edge / 10 MHz
channel / QPSK



Bottom Channel / Lower band edge / 10 MHz
channel / QPSK

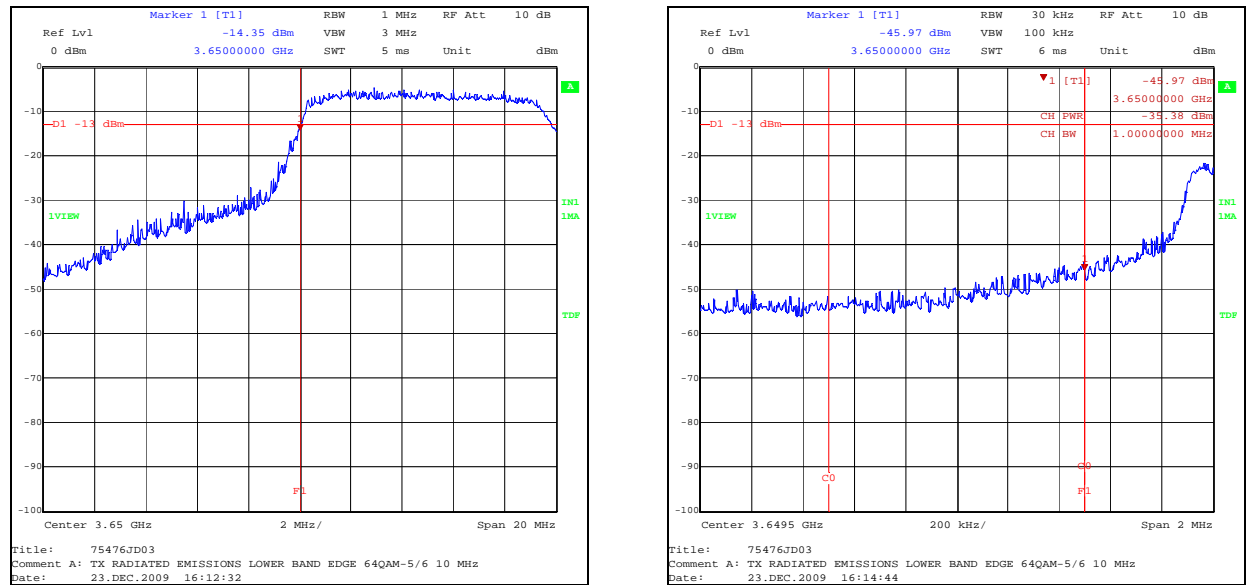


Bottom Channel / Lower band edge / 10 MHz
channel / 16QAM



Bottom Channel / Lower band edge / 10 MHz
channel / 16QAM

Transmitter Band Edge Radiated Emissions (continued)



Bottom Channel / Lower band edge / 10 MHz
channel / 64QAM

Bottom Channel / Lower band edge / 10 MHz
channel / 64QAM

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Band Edge Radiated Emissions (continued)**Results: 5 MHz / QPSK 1/2 / Upper Band Edge**

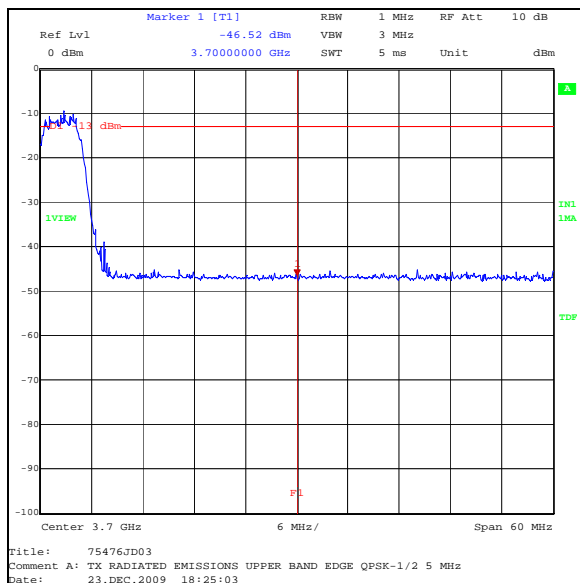
Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3700.0	-46.5	-13.0	33.5	Complied

Results: 5 MHz / 16QAM 3/4 / Upper Band Edge

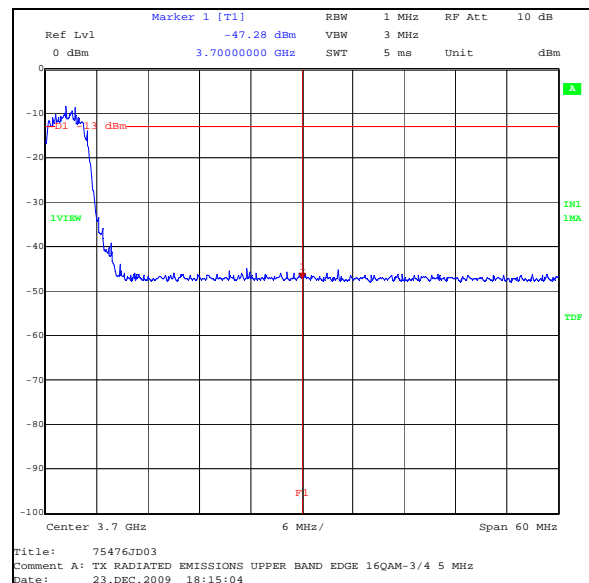
Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3700.0	-47.3	-13.0	34.3	Complied

Results: 5 MHz / 64QAM 5/6 / Upper Band Edge

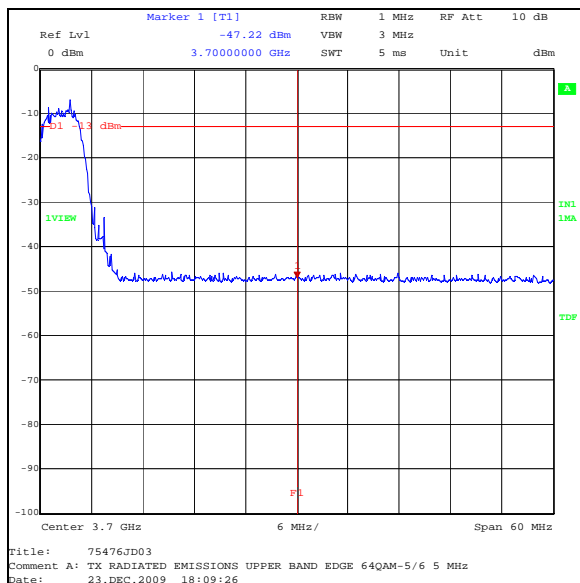
Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3700.0	-47.2	-13.0	34.2	Complied

Transmitter Band Edge Radiated Emissions (continued)

Top Channel / Upper band edge / 5 MHz channel /
QPSK



Top Channel / Upper band edge / 5 MHz channel /
16QAM



Top Channel / Upper band edge / 5 MHz channel /
64QAM

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter Band Edge Radiated Emissions (continued)**Results: 10 MHz / QPSK 1/2 / Upper Band Edge**

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3700.0	-47.2	-13.0	34.2	Complied

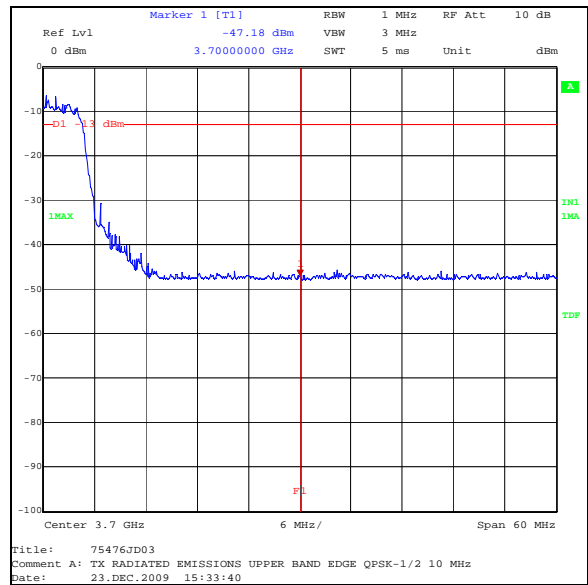
Results: 10 MHz / 16QAM 3/4 / Upper Band Edge

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3700.0	-48.6	-13.0	35.6	Complied

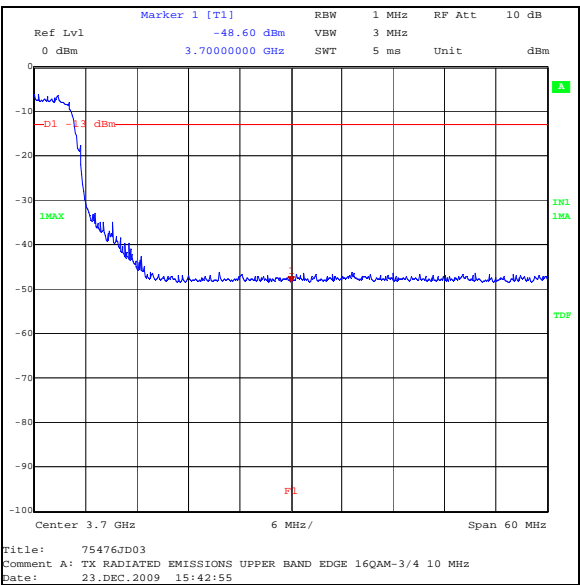
Results: 10 MHz / 64QAM 5/6 / Upper Band Edge

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3700.0	-47.5	-13.0	34.5	Complied

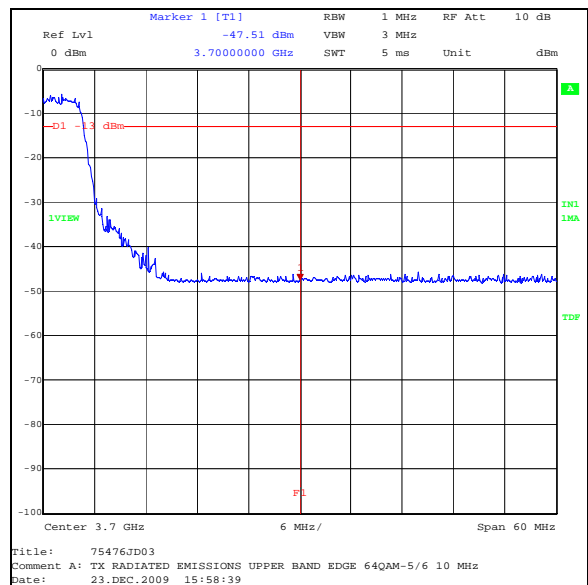
Transmitter Band Edge Radiated Emissions (continued)



Top Channel / Upper band edge / 10 MHz channel / QPSK



Top Channel / Upper band edge / 10 MHz channel / 16QAM



Top Channel / Upper band edge / 10 MHz channel / 64QAM

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

5.2.11. Transmitter Frequency Stability (Temperature Variation)

FCC Part:	90.213\10\ and 2.1055(a)(1)
Test Method:	ANSI TIA-603C-2004 Section 2.2

Environmental Conditions:

Ambient Temperature (°C):	24
Ambient Relative Humidity (%):	35

Results:

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Lower Band Edge (MHz)	Margin (MHz)	Result
-30	3654.979384	20616	3650	4.979384	Complied
-20	3654.985995	14005	3650	4.985995	Complied
-10	3654.991389	8611	3650	4.991389	Complied
0	3654.991093	8907	3650	4.991093	Complied
10	3654.992466	7534	3650	4.992466	Complied
20	3654.992521	7479	3650	4.992521	Complied
30	3654.977423	22577	3650	4.977423	Complied
40	3654.975505	24495	3650	4.975505	Complied
50	3654.978474	21526	3650	4.978474	Complied

Note(s):

1. Tests were performed on the bottom channel as this is closest to the band edges.
2. Minimum frequency stability is to be specified in the station authorisation.

5.2.12. Transmitter Frequency Stability (Voltage Variation)**Test Summary:**

FCC Part:	90.213\10\ and 2.1055(d)
Test Method:	ANSI TIA-603C-2004 Section 2.2

Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	42

Results:

Supply Voltage (VAC)	Measured Frequency (MHz)	Frequency Error (Hz)	Lower Band Edge (MHz)	Margin (MHz)	Result
102	3654.992458	7542	3650	4.992458	Complied
120	3654.992521	7479	3650	4.992521	Complied
138	3654.993547	6453	3650	4.993547	Complied

Note(s):

1. Tests were performed on the bottom channel as this is closest to the band edges.
2. The PoE power supply input voltage was varied. Tests were performed at nominal voltage and nominal voltage $\pm 15\%$.
3. Minimum frequency stability is to be specified in the station authorisation.

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
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±4.05 dB
Conducted Emissions	30 MHz to 37 GHz	95%	±2.62 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	±4.65 dB
Radiated Spurious Emissions	1 GHz to 37 GHz	95%	±2.94 dB
Carrier Output Power (EIRP)	3652.5 MHz to 3672.5 MHz	95%	±0.27 dB
Occupied Bandwidth	3652.5 MHz to 3672.5 MHz	95%	±2.63 dB
Frequency Stability	3652.5 MHz to 3672.5 MHz	95%	±0.92 ppm

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.

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A1065	Attenuator	Hewlett Packard	8494B	3308A38165	Calibrated before use	-
A1096	Directional Coupler	MIDISCO	MDC6223 W20	None	Calibration not required	-
A1100	Directional Coupler	Hewlett Packard	HP87300C	3239A01058	Calibrated before use	-
A1363	6 dB attenuator	Atlantic	AA40-06	1	Calibrated before use	-
A1391	Attenuator	HUBER + SUHNER AG	757987	6810.17.B	Calibrated before use	-
A1393	Attenuator	HUBER + SUHNER AG	757456	6820.17.B	Calibrated before use	-
A1418	Attenuator	HP	N/A	CSC21296	Calibrated before use	-
A1424	20 dB pad	Atlantic	AA40-20	N/A	Calibrated before use	-
A1428	Directional Coupler	Narda	3292-1	02439	Calibrated before use	-
A1534	Pre Amplifier	Hewlett Packard	8449B OPT H02	3008A00405	Calibrated before use	-
A1785	Low Noise Amplifier	Farran Technology	FLNA-28-30	FTL 6483	Calibrated before use	-
A1818	Antenna	EMCO	3115	00075692	27 Nov 2009	12
A1830	Pulse Limiter	Rhode & Schwarz	ESH3-Z2	100668	05 Jan 2009	12
A1975	High Pass Filter	AtlanTecRF	AFH-03000	090424010	Calibrated before use	-
A1980	Atlan TecRF High Pass Filter	Atlan TecRF	N/A	09110900303	Calibrated before use	-
A203	Antenna	Flann Microwave Ltd	22240-20	343	Calibrated before use	-
A255	Antenna	Flann Microwave	16240-20	519	Calibrated before use	-
A366	Isolator	MRI	FRR-400	169	Calibration not required	-
A465	Attenuator	Hewlett Packard	HP 8496B	3131P324	Calibrated before use	-
A649	Single Phase LISN	Rohde & Schwarz	ESH3-Z5	825562/008	19 Mar 2009	12
C1028	Coaxial Cable	Rosenberger	FA210B-1-010M-30X30	FA00C 7588	04 May 2009	12

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
C1083	Cable	Rosenberger	001	2799	Calibrated before use	-
C1111	Cable	Semflex Inc.	X116BFSX 10080	0337	Calibrated before use	-
C1125	Cable	Rosenberger	FA147a102 000202	1704 34842-02	Calibrated before use	-
C1150	36 Tensolite RF Cable	Atlantic	Qflex 5236	N/A	Calibrated before use	-
C1163	Cable	Rosenberger Micro-Coax	FA210A101 0007070	43187-1	Calibrated before use	-
C1262	Cable	Rosenberger	FA210A007 5008080	49356-2	03 Apr 2009	12
E0513	Environmental Chamber	TAS	LT600 Series 3	23900506	Calibration not required	-
G085	Continuous Wave Generator	Hewlett Packard	83650L	3614A00104	27 Oct 2008	24
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	01 Sep 2009	12
K0005	Site Reference 4429	RFI Global Services Ltd	N/A	N/A	Calibration not required	-
K0008	Site Reference 4422	RFI Global Services Ltd	N/A	N/A	Calibration not required	-
L0998	Agilent N1912A Power Meter	Agilent	N1912A	MY45100213	28 Oct 2009	12
L0998	Agilent N1912A Wideband Power Sensor	Agilent	N1921A	MY45240313	28 Oct 2009	12
M1124	Spectrum Analyser	Rohde & Schwarz	ESIB26	100046K	09 Mar 2009	12
M1242	Spectrum Analyser	Rohde & Schwarz, Inc.	FSEM30	845986/022	09 Dec 2008	14
M1249	Thermometer	Fluke	52II	88800049	01 Jul 2009	12
M1251	Digital Multimeter	Fluke	175	89170179	23 Jun 2009	12
M1263	Test Receiver	Rohde & Schwarz	ESIB7	100265	22 Apr 2009	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	21 Oct 2009	12
M1390	Harmonic Mixer	Farran Technology	WHMP 28	FTL1677B	Calibrated before use	-
M166	Thermometer/ Barometer/ Hygrometer	EuroCom	None	None	30 Apr 2009	12

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
M208	Thermometer/ Hygrometer	RS Comp Ltd	RS212-124	M208-RS212-124	30 Apr 2009	12

NB In accordance with UKAS requirements all the measurement equipment is on a calibration schedule.