

TRaC Wireless Test Report : TTR-002403WUS1

Applicant : Quail Ltd

Apparatus : Q-DT8 (QD Drive Thru Headset)

Specification(s) : CFR47 Part 15D

Purpose of Test : Certification

FCCID : UDDQDT8

Authorised by



: Radio Product Manager

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Section 1:

Introduction

1.1 General

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on samples submitted to the Laboratory.

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TRaC Telecoms & Radio.**

1.2 Tests Requested By

This testing in this report was requested by :

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1.3 Manufacturer

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1.4 Apparatus Assessed

The following apparatus was assessed between 21st December 2010 – 31st March 2011:

Q-DT8 (QD Drive Thru Headset)

1.5 System Description

The system is made up of two parts, a fixed part and a portable part. The portable part is a cordless headset device. The portable part is capable of operating on a maximum of 60 channels (time spectrum windows). The fixed part is a wall mounted base station transmitter.

The system operates in the 1920MHz -1930MHz band. The system use 5 different frequency channels 1.728MHz apart using MC/TDMA/TDD (Multi Carrier / Time Division Multiple Access / Time Division Duplex) using GFSK modulation.

The system employs a 10ms frame, divided into 24 equal timeslots, numbered 0-23. The Base station always transmits in the first half of the frame, and the Portable always transmits on the duplex mate in the second half of the frame.

The Portable is the initiating device. A physical bearer is composed of a transmit single-slot and a receive single-slot for narrowband communications. The two halves of a given bearer are always exactly half a frame (5ms, 12 single slots) apart.

During the testing frequency administration was utilised to allow operation on only certain channels during the tests. The frequency administration was performed using a software interface. A portable part and a fixed part with a temporary antenna connector were supplied to allow conducted measurements where applicable.

1.6 Test Result Summary

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

The statements relating to compliance with the standards below apply ONLY as qualified in the notes and deviations stated in sections 1.6 to 1.7 of this test report.

Full details of test results are contained within Appendix A. The table overleaf summarises the results of the assessment.

Abbreviations used in the overleaf table:

CFR	: Code of Federal Regulations	ANSI	: American National Standards Institution
RSS	: Radio Standards Specification	PLCE	: Power Line Conducted Emissions

TEST/EXAMINATION	Part 15	Result
Coordination with Fixed Microwave Service	15.307 (b)	No Note 1
Cross reference to Subpart B	15.309 (b)	-
Labelling Requirements	15.311 15.19 (a)(3)	-
Measurement Procedures	15.313	-
Antenna Requirement	15.317 15.203	Pass
Modulation Techniques	15.319 (b)	Pass
Conducted AC Powerline	15.315 15.207	Pass
Emission Bandwidth	15.323 (a)	Pass
Peak Transmit Power	15.319 (c)	Pass
Power Spectral Density	15.319 (d)	Pass
Antenna Gain	15.319 (e)	Pass
Automatic Discontinuation of Transmission	15.319 (f)	Pass
Radio Frequency Radiation Exposure	15.319 (i)	Pass
Monitoring Thresholds	15.323 (c)(2) 15.323 (c)(9)	Pass
Monitoring of Intended Transmit Window and Maximum Reaction Time	15.323 (c)(1)	Pass
Monitoring Bandwidth	15.323 (c)(7)	Pass
Access Criteria Functional Test	15.323 (c)(6)	No Note 2
Duration of Transmission	15.323 (c)(3)	Pass
Connection Acknowledgement	15.323 (c)(4)	Pass
Lower threshold Selected Channel, Power Accuracy, Segment Occupancy	15.323 (c)(5)	Pass
Monitoring Antenna	15.323 (c)(8)	Pass
Duplex Connections	15.323 (c)(10)	Pass
Alternative Monitoring Interval for Co-located Devices	15.323 (c)(11)	Pass
Fair Access to Spectrum Related to (c)(10) & (c)(11)	15.323 (c)(12)	Pass
Emission Inside and Outside the Sub-band	15.323 (d)	Pass
Frame Period	15.323 (e)	Pass
Frequency Stability	15.323 (f)	Pass

Note:

1. Requirement removed April 4th 2005 see public notice DX 05-1005.
2. The portable part has a removable battery that is charged separately.
3. The portable part connects indirectly via the fixed part report for results
4. The EUT does not transmit control and signalling information.
5. Not utilized by this EUT as devices will not be co-located within 1m of each other.

1.7 Notes Relating To The Assessment

With regard to this assessment, the following points should be noted:

The results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 1.7 of this test report (Deviations from Test Standards).

For emissions testing, throughout this test report, "Pass" indicates that the results for the sample as tested were below the specified limit (refer also to Section 2, Measurement Uncertainty).

Where relevant, the apparatus was only assessed using the monitoring methods and susceptibility criteria defined in this report.

All testing with the exception of testing at the Open Area Test Site was performed under the following environmental conditions:

Temperature	: 17 to 23 °C
Humidity	: 45 to 75 %
Barometric Pressure	: 86 to 106 kPa

All dates used in this report are in the format dd/mm/yy.

This assessment has been performed in accordance with the requirements of ISO/IEC 17025.

1.7 Deviations from Test Standards

The maximum duration of transmission (15.323 (c)(3)) is a declaration by the manufacturer rather than a measured value. The system incorporates a mechanism that disables the headset after 2 minuets of inactivity (movement). Due to this facility to save battery life constant movement of the headset would have been required. As this is not practical the manufacture has stated the maximum transmission duration

Section 2:**Measurement Uncertainty****2.1 Measurement Uncertainty Values****Radio Testing – General Uncertainty Schedule**

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

Uncertainty in test result (Equipment - TRLUH120) = **2.18dB**
Uncertainty in test result (Equipment – TRL05) = **1.08dB**
Uncertainty in test result (Equipment – TRL479) = **2.48dB**

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

Uncertainty in test result (Equipment - TRLUH120) = **119ppm**
Uncertainty in test result (Equipment – TRL05) = **0.113ppm**
Uncertainty in test result (Equipment – TRL479) = **0.265ppm**

[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**, Uncertainty in test result (30MHz – 1GHz) = **4.6dB**, Uncertainty in test result (1GHz-18GHz) = **4.7dB**

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

Uncertainty in test result (Equipment TRL479) Up to 8.1GHz = **3.31dB**
Uncertainty in test result (Equipment TRL479) 8.1GHz – 15.3GHz = **4.43dB**
Uncertainty in test result (Equipment TRL479) 15.3GHz – 21GHz = **5.34dB**
Uncertainty in test result (Equipment TRLUH120) Up to 26GHz = **3.14dB**

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

Uncertainty in overall test level = **2.1dB**, Uncertainty in time measurement = **0.59%**, Uncertainty in Amplitude measurement = **0.82%**

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

Uncertainty in test result = **2.59% (frequency)**
Uncertainty in test result = **1.32dB (amplitude)**

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3:

Modifications

3.1 Modifications Performed During Assessment

No Modifications were made during the assessment.

Appendix A: Formal Emission Test Results

Abbreviations used in the tables in this appendix:

Spec	: Specification	ALSR	: Absorber Lined Screened Room
Mod	: Modification	OATS	: Open Area Test Site
		ATS	: Alternative Test Site
EUT	: Equipment Under Test		
SE	: Support Equipment	Ref	: Reference
		Freq	: Frequency
L	: Live Power Line		
N	: Neutral Power Line	MD	: Measurement Distance
E	: Earth Power Line	SD	: Spec Distance
Pk	: Peak Detector	Pol	: Polarisation
QP	: Quasi-Peak Detector	H	: Horizontal Polarisation
Av	: Average Detector	V	: Vertical Polarisation
CDN	: Coupling & decoupling network		

A1 Cross Reference to Subpart B

CFR 47 Part 15.309(b)

The unit contains digital circuitry, which is not directly related to the radio transmitter. See emissions outside the sub-band for results.

A2 Labelling Information

CFR 47 Part 15.311 & 15.19(a)(3)

This information is contained in a separate document. See attached exhibit.

A3 Antenna Requirements

CFR 47 Part 15.317 & 15.203

The unit employs an integral antenna arrangement.

A4 Modulation Techniques

CFR 47 Part 15.139(b)

The Quail Ltd Q-DT8 is an isochronous device operating in the 1920 MHz – 1930 MHz frequency band.

The Quail Ltd Q-DT8 modulation technique is based on DECT technology as described in European standards EN 300 175-2 and EN 300 175-3.

The Quail Ltd Q-DT8 modulation techniques are MC/TDMA/TDD (Multi Carrier / Time Division Multiple Access / Time Division Duplex) using GFSK modulation.

A5 Radio Frequency Radiation Exposure

CFR 47 Part 15.319(i)

This information is contained in a separate document

A6 Transmitter Emission Bandwidth

Test Details:	
Regulation	CFR 47 Part 15.323(a)
Measurement standard	ANSI C63.17 sub-clause 6.1.3
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

Test Details: $f_l = 1921.536$ MHz				
ΔP (dBc)	f_l (MHz)	f_h (MHz)	Δf (MHz)	Limit
-26	1920.805231	1922.281192	1.476	50kHz > Δf > 2.5MHz
-12	1920.954269	1922.141769	1.188	N/A
-6	1921.141769	1921.776385	0.635	N/A

Test Details: $f_c = 1924.992$ MHz				
ΔP (dBc)	f_l (MHz)	f_h (MHz)	Δf (MHz)	Limit
-26	1924.251615	1925.737192	1.486	50kHz > Δf > 2.5MHz
-12	1924.410269	1925.297769	0.888	N/A
-6	1924.597769	1925.237192	0.639	N/A

Test Details: $f_h = 1928.448$ MHz				
ΔP (dBc)	f_l (MHz)	f_h (MHz)	Δf (MHz)	Limit
-26	1927.717231	1929.198000	1.481	50kHz > Δf > 2.5MHz
-12	1927.866269	1929.048962	1.183	N/A
-6	1928.058577	1928.688385	0.630	N/A

A7 Peak Transmit Power

Test Details:	
Regulation	CFR 47 Part 15.319(c)
Measurement standard	ANSI C63.17 sub-clause 6.1.2
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

Frequency (MHz)	Peak Transmit Power (dBm)	Limit (dBm)
1921.536	20.19	20.86
1924.992	20.04	20.86
1928.448	20.14	20.86

Note: 1. Permanent antenna was replaced with temporary antenna connector to enable conducted measurement.
 2. Antenna gain < 3dBi and so correction of the limit is not required.
 3. See Annex E for Peak Transmit Power Plots.

Limit

The limit for Peak Transmit Power (PTP) is calculated using the following formula:

$$PTP = 5 \log_{10} EBW - 10 \text{ dBm}$$

This limit must be corrected to take into account any gain of the antenna greater than 3dBi.
 Where: EBW is the transmitter emission bandwidth in Hz as determined in the previous test.

$$PTP = 5 \log_{10} EBW - 10 \text{ dBm}$$

$$EBW = 1.485577 \text{ MHz}$$

$$PTP = 20.86 \text{ dBm}$$

A8 Power Spectral Density

Test Details:	
Regulation	CFR 47 Part 15.319(d)
Measurement standard	ANSI C63.17 sub-clause 6.1.2
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

Frequency (MHz)	Power Spectral Density (mW/3kHz)	Limit (mW/3kHz)
1921.536	0.12	3
1924.992	0.13	3
1928.448	0.12	3

Note:

1. Permanent antenna was replaced with temporary antenna connector to enable conducted measurement.
2. Antenna gain < 3dBi and so correction of the limit is not required.
3. See Annex E for Peak Transmit Power Plots.

Limit

The power spectral density shall not exceed 3mW in any 3 kHz bandwidth as measured with a spectrum analyser having a resolution bandwidth of 3 kHz.

A9 Antenna Gain**CFR 47 Part 15.319(e)**

Any directional gain of the antenna exceeding 3dBi has an effect on the limit applied to the measurements taken for the peak transmit power test. If the directional gain of the antenna is less than 3dBi it is not required to be taken into account.

Maximum Antenna Gain	Exceeds 3dBi by
Monopole, 2dBi	N/A

Note: Antenna Gain Declared by Manufacturer

A10 Automatic Discontinuation of Transmissions

Test Details:	
Regulation	CFR 47 Part 15.319(f)
Measurement standard	ANSI C63.17 sub-clause 6.1.2
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

Automatic discontinuation of transmission means break off of transmissions that are not control and signalling information.

The Q-DT8 is a Portable part and as such does not transmit control and signalling information the counter part device is a fixed part device and does transmit control and signalling information.

Part	Transmits Control and Signalling Information	Equipment Under Test
Fixed Part	X	
Portable Part		X

Results

The following tests were performed after a connection had been established with the counter part device

Number	Test	Reaction of EUT	Pass / Fail
1	Remove Battery From Headset	C	Pass
2	Remove power From Companion Device	A	Pass

A – Connection breakdown, Cease of all transmissions.

B – Connection breakdown, EUT transmits control and signalling information.

C – Connection breakdown, Counterpart transmits control and signalling information.

A11 Monitoring Thresholds

Test Details:	
Regulation	CFR 47 Part 15.323(c)(2)
Measurement standard - Calculation	ANSI C63.17 sub-clause 7.2.1
Calculations	As laid out in ANSI C63.17 sub-clauses 4.3.3 and 4.3.4
Measurement standard	ANSI C63.17 sub-clause 7.3
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

Calculation of monitoring threshold limits for isochronous devices:

$$\text{Lower threshold: } T_L = -174 + 10\log_{10}B + M_U + P_{MAX} - P_{EUT} \text{ (dBm)}$$

$$\text{Upper threshold: } T_U = -174 + 10\log_{10}B + M_U + P_{MAX} - P_{EUT} \text{ (dBm)}$$

Where:

B	= Emission bandwidth (Hz)
M _U	= dBs the threshold may exceed thermal noise (30 for T _L & 50 for T _U)
P _{MAX}	= Output Power Limit (dBm)
P _{EUT}	= Transmitted power (dBm)

Monitor Threshold	B (MHz)	M _U (dB)	P _{MAX} (dBm)	P _{EUT} (dBm)	Threshold (dBm)
T _L	1.485577	30.00	20.86	20.19	-81.61
T _U	1.485577	50.00	20.86	20.19	-61.61

Note: 1. Threshold levels rounded up/down to nearest whole number

The threshold level was determined following the procedure as laid out in ANSI C63.17 sub-clause 7.3.2 (a) Frequency administration was used to allow operation on the carrier closest to the centre of the band.

Limits

The EUT must not transmit until the interference level is less than or equal to:

$$\text{Measured Threshold Level} \leq T_U + U_M$$

Where:

T _U	= Calculated Upper threshold level
T _L	= Calculated Lower threshold level
U _M	= Margin of uncertainty in threshold measurements (6dB)

Results

Monitor threshold	Measured Threshold Level	Limit	Pass/Fail
Lower Threshold (dBm)	N/A	N/A	N/A
Upper threshold (dBm)	-73.61	-55.61	Pass

Note: 1. T_U is applicable as the EUT implements more than 40 channels.

A11 Monitoring of Intended Transmit Window & Maximum Reaction Time

Test Details:	
Regulation	CFR 47 Part 15.323(c)(1)
Measurement standard	ANSI C63.17 sub-clause 7.5
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

The EUT was frequency administered to only one operating. The interference generator was fed pulses from the function generator to produce a pulsed carrier of the specified time length and the output of the interference generator was set to the required level. The pulse generator and companion device were synchronized so the position of the pulses corresponded to the time-slot pattern in the frame of the EUT. The test is performed with the unit frequency administered to operate only on middle frequency (1924.992MHz).

For each of the required tests the pulse width and interference level are as below:

Test c)

With the interference generator output set at the relevant calculated threshold level plus measurement uncertainty (U_M) and the width of the pulse interference exceeds the largest of $50\mu s$ and $50\sqrt{1.25/B}\mu s$ verify that the EUT does not establish a connection.

Test d)

With the interference generator output set at 6dB above the relevant calculated threshold level plus measurement uncertainty (U_M) and the width of the pulse interference exceeds the largest of $35\mu s$ and $35\sqrt{1.25/B}\mu s$ verify that the EUT does not establish a connection.

Where B = Emission bandwidth of the EUT in MHz

Results

Single Slot Configuration

Test Equation (μs)	Pulse Width (μs)	Interferer Level (dBm)	Connection Made	Pass/Fail
$50\sqrt{1.25/B}$	50	$T_U + U_m$	No	Pass
$35\sqrt{1.25/B}$	35	$T_U + U_m + 6$	No	Pass

Notes: 1. T_U is the calculated upper threshold.
2. U_m is Margin of uncertainty in threshold measurements (6dB).

A12 Monitoring Bandwidth & Antenna

Monitoring Bandwidth – CFR 47 Part 15.323(c)(7)

The monitoring bandwidth test was carried out in accordance with ANSI C63.17 sub-clause 7.4.

ANSI C63.17 sub-clause 7.4 states that if the monitoring is made through the radio receiver used by the EUT for communication the intended bandwidth requirements for the monitoring system are met.

As declared by the manufacturer the EUT uses the radio receiver used for communication for monitoring therefore the intended bandwidth requirements for the monitoring system are met of ANSI C63.17 sub-clause 7.4 are met.

Monitoring Antenna – CFR 47 Part 15.323(c)(8)

As declared by the manufacturer the antenna of the EUT used for transmitting is the same antenna that is used for monitoring.

A13 Power Accuracy

CFR 47 Part 15.323(c)(5)

The power measurement resolution for the previous comparison must be accurate to within 6dB.

The monitoring threshold test covered in Part 15.323 (c)(2) automatically proves that this requirement is met.

A14 Segment Occupancy

CFR 47 Part 15.323(c)(5)

The manufacturer declares that no device or group of co-operating devices located within 1 meter of each other shall, during any frame period, occupy more than 6 MHz of aggregate bandwidth, or alternatively, more than one third of the time and spectrum windows defined by the system.

A15 Duration Of Transmission

Test Details:	
Regulation	CFR 47 Part 15.323(c)(3)
Measurement standard	ANSI C63.17 sub-clause 8.2.2
EUT sample number	NA
Modification state	NA
SE in test environment	NA
SE isolated from EUT	NA
EUT set up	NA

The test was to verify that with the companion device off the EUT does not transmit on the same time/spectrum window for more than the limit.

Result

Repetition of Access Criteria	Maximum Transmission Time	Maximum Transmission Time Limit	Pass/Fail
Period	7.55 Hours	<8 Hours	Pass

Note: 1. The portable part is the initiating device that repeats the access criteria
 2. Maximum transmission time is a declaration (see section 1.7)

A16 Connection Acknowledgement

Test Details:	
Regulation	CFR 47 Part 15.323(c)(4)
Measurement standard	ANSI C63.17 sub-clause 8.2.1
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

The test was to verify that after a connection is broken the EUT terminates its transmission on the current communication channel within 30 seconds or less.

Result

Test	Time Taken (seconds)	Limit (seconds)	Pass/Fail
Transmission on communications channel no acknowledgement received (note 2)	0.508	1	Pass
Established communication channel termination, acknowledgements to EUT blocked during communication (note 2)	4.917	30	Pass
Established communication channel termination, acknowledgements to Companion device blocked during communication (note 1)	5.016	30	Pass

Note: 1. The companion device transmits a beacon signal when acknowledgements are blocked.
 2. The EUT does not transmit a control channel.
 3. See Appendix B for Acknowledgement plots.

A17 Least Interfered Channel (LIC) Procedure

Test Details:	
Regulation	CFR 47 Part 15.323(c)(5)
Measurement standard	ANSI C63.17 sub-clause 7.3.3
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

The EUT utilizes more than 40 channels; therefore the least interfered channel testing is applicable.

The EUT was frequency administered to operating on two frequencies only, f1 and f2.

$$\begin{aligned} f1 &= 1924.992 \text{ MHz} \\ f2 &= 1926.720 \text{ MHz} \end{aligned}$$

Test b)

Interference on f1 was set at $T_L + U_M + 7\text{dB}$ and at $T_L + U_M$ on f2. Initiate communication. The EUT should transmit on f2. Repeat 5 times. If the EUT transmits on f1 the test is failed.

Test c)

Interference on f1 was set at $T_L + U_M$ and at $T_L + U_M + 7\text{dB}$ on f2. Initiate communication. The EUT should transmit on f1. Repeat 5 times. If the EUT transmits on f2 the test is failed.

Test d)

Interference on f1 was set at $T_L + U_M + 1\text{dB}$ and at $T_L + U_M - 6\text{dB}$ on f2. Initiate communication. The EUT should transmit on f2. Repeat 5 times. If the EUT transmits on f1 the test is failed.

Test e)

Interference on f1 was set at $T_L + U_M - 6\text{dB}$ and at $T_L + U_M + 7\text{dB}$ on f2. Initiate communication. The EUT should transmit on f1. Repeat 5 times. If the EUT transmits on f2 the test is failed.

Result

Test	Transmit on f1	Transmit on f2	Wanted Transmit Channel	Pass/Fail
b	No	Yes	f2	Pass
c	Yes	No	f1	Pass
d	No	Yes	f2	Pass
e	Yes	No	f1	Pass

Note: 1. All tests were repeated 5 times.

A18 Selected Channel Confirmation

Test Details:	
Regulation	CFR 47 Part 15.323(c)(1) & (c)(5)
Measurement standard	ANSI C63.17 sub-clause 7.3.4
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

The test is to ensure the EUT monitors the time/spectrum window immediately prior to transmission.

The EUT was frequency administered to operating on two frequencies only, f1 and f2.

$$\begin{aligned} f1 &= 1924.992 \text{ MHz} \\ f2 &= 1923.264 \text{ MHz} \end{aligned}$$

Test a)

Interference is applied on f1 at a level of $T_U + U_M$. Verify a connection is established on f2.

Any connection is terminated.

Test b)

Interference is applied on f2 at a level of $T_U + U_M$ and immediately removed from f1 and the EUT is immediately caused to attempt transmission. In this case the EUT should transmit on f1

The test is applied in both single and long slot configurations.

Result

Test	Transmit on f1	Transmit on f2	Wanted Transmit Channel	Pass/Fail
a	No	Yes	f2	Pass
b	Yes	No	f1	Pass

Note: 1. Results in the above table are applicable for both single and long slot configurations.

A19 Duplex Connections

Test Details:	
Regulation	CFR 47 Part 15.323(c)(10)
Measurement standard	ANSI C63.17 sub-clause 8.3.2
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

Before all tests are carried out any connection is terminated.

Test b)

The system is restricted to operation on one frequency (1924.992 MHz) using administration. Verify that a connection between the EUT and its companion device can be made.

Test c) & d)

Apply interference at a level $T_L + U_M$ to all transmit time slots except one which has interference at least 10dB below T_L . Apply interference at a level $T_L + U_M + 10$ dB to all receive time slots except one which has interference at least 10dB below T_L . The interference free receive timeslot should not be the duplex mate of the interference free transmit timeslot. The EUT should establish a connection on the interference free receive slot and its duplex mate.

Test e) & f)

Apply interference at a level $T_L + U_M$ to all receive time slots except one which has interference at least 10dB below T_L . Apply interference at a level $T_L + U_M + 10$ dB to all transmit time slots except one which has interference at least 10dB below T_L . The interference free transmit timeslot should not be the duplex mate of the interference free receive timeslot. The EUT should establish a connection on the interference free transmit slot and its duplex mate.

Test g)

Apply interference at a level $T_U + U_M$ to all receive and transmit time slots except one which has interference at least 10dB below T_L . The interference free transmit and receive time slots shall not constitute a duplex pair. The EUT should not transmit or establish a connection.

Result

Test	Connection Made	Time Slot Selected	Required Time Slot	Pass/Fail
b	Yes	N/A	Any	Pass
c & d	Yes	Interference Free Receive Slot and Duplex Mate	Interference Free Receive Slot and Duplex Mate	Pass
e & f	Yes	Interference Free Transmit Slot and Duplex Mate	Interference Free Transmit Slot and Duplex Mate	Pass
g	No	None	None	Pass

Note: 1. The Q-DT8 is the initiating device,
2. The Q-DTB is the responding device

A20 Alternative Monitoring Interval For Co-Located Devices

Test Details:	
Regulation	CFR 47 Part 15.323(c)(11)
Measurement standard	ANSI C63.17 sub-clause 8.4.
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

For the purposes of this testing the EUT is the initiating device and the companion is the responding device

Test b)

The system is restricted to operation on one frequency (1924.992 MHz) using administration. Verify that a connection between the EUT and its companion device can be made.

Test c)

Apply interference at a level $T_L + U_M$ to all transmit time/spectrum windows on the enabled carrier. The interferer must use the same physical layer as the EUT transmissions, but with a system identifier different from that used by the EUT and companion device. Apply no interference to the receive time/spectrum windows on the enabled carriers.

Test d)

Cause the EUT to attempt to establish a connection. If a connection is established, the test is failed.

Result

Test	Connection Made	Pass/Fail
b	Yes	Pass
d	No	Pass

Note: 1. The Q-DT8 is the initiating device,
2. The Q-DTB is the responding device

A21 Fair Access To Spectrum

CFR 47 Part 15.323(c)(12)

The provisions of (10) & (11) shall not be used to extend the range of spectrum occupied over space or time for the purposes of denying fair access to the spectrum to other devices.

The manufacturer declares that this device does not work in a mode, which denies fair access to the spectrum to others.

(10) Relates to part 15.323(c)(10) and 4.3.4(b)(10)

(11) Relates to part 15.323(c)(11) and 4.3.4(b)(11)

A22 Emissions Inside and Outside the Sub-Band - Conducted

Test Details: Lowest Operating Frequency	
Regulation	CFR 47 Part 15.323(d)
Measurement standard	ANSI C63.17 sub-clause 6.1.6.
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

Out-of-Band Emissions from UPCS bandedge	FREQ. (MHz)	MEAS. Rx. (dBm)	CABLE & ATTEN. LOSS (dB)	EMISSION LEVEL (dBm)	LIMIT (dBm)
> - 2.5MHz					
- 1.25 MHz – 2.5 MHz					
- 1.25 MHz					
+ 1.25 MHz					
+ 1.25 MHz – 2.5 MHz					
> + 2.5MHz	3843.000	-64.30	21.9	-42.4	-39.5
	5763.000	-78.32	21.5	-56.8	-39.5
	7684.000	-82.19	21.8	-60.4	-39.5
	9605.000	-81.57	21.9	-59.6	-39.5
Limits	Out-of-Band Emissions From UPCS bandedge			Attenuation (dB) required below Reference power of 112mW	
	± 1.25MHz			30	
	±1.25 MHz – 2.5 MHz			50	
	> ±2.5MHz			60	
	In band Emissions from centre of emission bandwidth			Attenuation (dB) required below permitted peak power for the EUT	
	1B – 2B			30	
	2B – 3B			50	
	3B – UPCS band edge			60	

Test Details: Highest Operating Frequency	
Regulation	CFR 47 Part 15.323(d)
Measurement standard	ANSI C63.17 sub-clause 6.1.6.
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

Out-of-Band Emissions from UPCS bandedge	FREQ. (MHz)	MEAS. Rx. (dBm)	CABLE & ATTEN. LOSS (dB)	EMISSION LEVEL (dBm)	LIMIT (dBm)
> - 2.5MHz					
- 1.25 MHz – 2.5 MHz					
- 1.25 MHz					
+ 1.25 MHz					
+ 1.25 MHz – 2.5 MHz					
> + 2.5MHz	3858.000	-64.33	22.1	-42.2	-39.5
	5784.000	-77.66	21.8	-55.8	-39.5
	7712.000	-81.50	21.5	-60.0	-39.5
	9641.000	-81.69	22.5	-59.2	-39.5
Limits	Out-of-Band Emissions From UPCS bandedge			Attenuation (dB) required below Reference power of 112mW	
	± 1.25MHz			30	
	±1.25 MHz – 2.5 MHz			50	
	> ±2.5MHz			60	
	In band Emissions from centre of emission bandwidth			Attenuation (dB) required below permitted peak power for the EUT	
	1B – 2B			30	
	2B – 3B			50	
	3B – UPCS band edge			60	

Notes:

- 1 EUT fitted with temporary antenna connector.
- 2 New / Fully Charged batteries used for battery powered products.
- 3 See Appendix B for out of band emissions compliance plots, offsets <2.5 MHz
- 4 See Appendix B for in band emissions compliance plots.
- 5 Resolution bandwidth approximately 1% of emissions bandwidth.
- 6 Video bandwidth 3 x Resolution bandwidth.
- 7 Receiver detector = Peak detector, Max Hold Enabled.
- 8 Emissions greater than 20 dB below the limit are not necessarily recorded.

Test Method:

- 1 The EUT was connected to a spectrum analyser via suitable attenuation or filter.
- 2 The Spectrum analyser was tuned to upper and lower offsets in turn.
- 3 Any emissions found were measured with the required analyser settings.

A23 Frame Repetition Stability

Test Details:	
Regulation	CFR 47 Part 15.323(e)
Measurement standard	ANSI C63.17 sub-clause 6.2.2 & 6.2.3
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

Frame Repetition Stability

This is the mean value of the frame repetition rate recorded over 1000 samples. For devices that divide access in time the repetition rate shall not exceed 10ppm.

Result

Frame Repetition Stability (ppm)	Limit (ppm)	Pass/Fail
0	10ppm	Pass

Frame Period and Jitter

Jitter is the difference in time between the rising edges of consecutive pulses.

Result

Maximum Jitter (μs)	3xSD Jitter (μs)	Frame period (ms)	Limit (μs)		Pass/Fail
			Frame Period (ms)	Jitter (μs)	
0.02	0.06	10.00006	2 or 10/X	12.5	Pass

A24 Frequency Stability

Test Details:	
Regulation	CFR 47 Part 15.323(f)
Measurement standard	ANSI C63.17 sub-clause 6.2.1
EUT sample number	S14
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C

This testing is carried out with the following conditions over 5000 samples.

Results

Temperature (°C)	Voltage (Vdc)	Fc (MHz)	offset (kHz)	offset (ppm)	Limit (ppm)
+20	Vnom	1924.992	-12	6.23	±10ppm
-20	Vnom	1924.992	-3	1.56	±10ppm
+55	Vnom	1924.992	1	0.52	±10ppm

Note:

1. The EUT is battery powered therefore voltage variations are not required.
2. Frequency variation at Tnom relative to EUT operating Frequency.
3. Frequency variation at Temperature extremes relative to frequency at Tnom.

A25 Unintentional Radiated Emissions

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test applies to all spurious emissions on directly related to the transmitter. The maximum permitted field strength is listed in Section 15.109. The EUT was set to operate in a transmit standby / receive mode.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : 3m alternative test site : X

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details:	
Regulation	CFR 47 Part 15.323(d)
Measurement standard	ANSI C63.17 sub-clause 6.1.6.
Frequency range	30MHz – 20GHz
EUT sample number	S16
Modification state	0
SE in test environment	None
SE isolated from EUT	S21
EUT set up	Refer to Appendix C
Photographs (Appendix F)	1 & 2

The worst case radiated emission measurements for spurious emissions are listed below:

Ref No.	FREQ. (MHz)	MEAS Rx (dB μ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB μ V/m)	EXTRAP FACT (dB)	FIELD ST'GH (μ V/m)	LIMIT (μ V/m)
1.	3851.644	43.69	1.3	32.5	32.4	45.09	-9.54	59.89	500

Notes:

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1 For emissions below 30MHz the cable losses are assumed to be negligible.
- 2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
- 3 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.
- 4 For Frequencies below 1 GHz, RBW = 120 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak	RBW=VBW= 1MHz
Average	RBW=VBW= 1MHz

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 15:2008 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits 47 CFR Part 15: Clause 15.209 for all emissions:

Frequency of emission (MHz)	Field strength μ V/m	Measurement Distance m	Field strength $\text{dB}\mu\text{V/m}$
0.009-0.490	2400/F(kHz)	300	67.6/F (kHz)
0.490-1.705	24000/F(kHz)	30	87.6/F (kHz)
1.705-30	30	30	29.5
30-88	100	3	40.0
88-216	150	3	43.5
216-960	200	3	46.0
Above 960	500	3	54.0

(a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

$$\text{Extrapolation (dB)} = 20 \log_{10} \left(\frac{\text{measurement distance}}{\text{specification distance}} \right)$$

(b) The levels may have been rounded for display purposes.

(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels		✓		
Effect of Position of EUT cables & samples on emission levels			✓	
(i) Parameter defined by standard and / or single possible, refer to Appendix D (ii) Parameter defined by client and / or single possible, refer to Appendix D (iii) Parameter had a negligible effect on emission levels, refer to Appendix D (iv) Worst case determined by initial measurement, refer to Appendix D				

Appendix B:

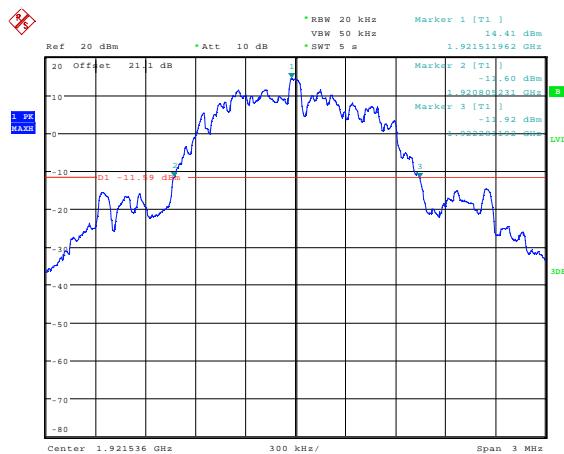
Supporting Graphical Data

This appendix contains graphical data obtained during testing.

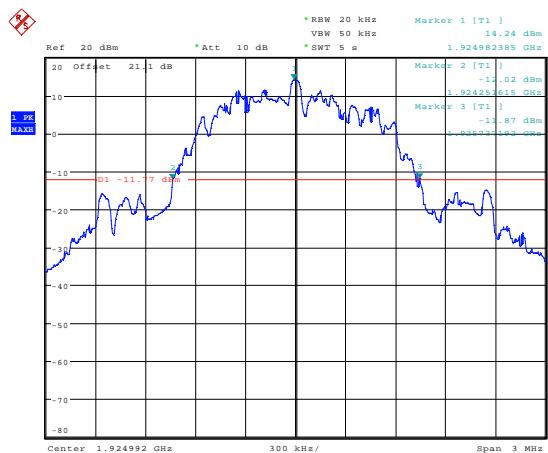
Notes:

- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.
- (d) Appendix C details the numbering system used to identify the sample and its modification state.
- (e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

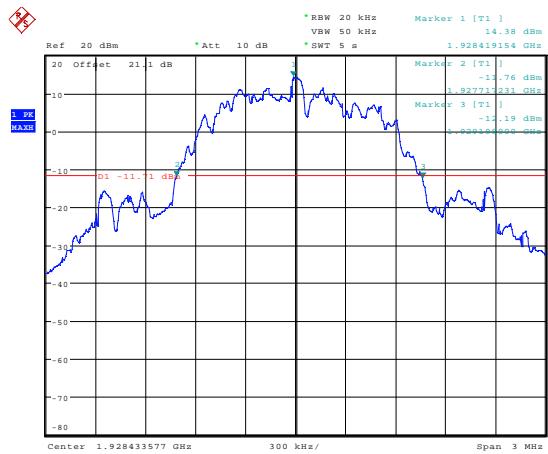
Emission Bandwidth



Date: 23.DEC.2010 14:13:23

 f_I 

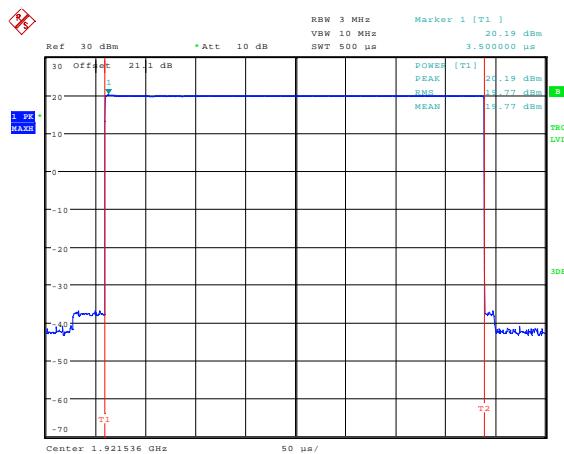
Date: 23.DEC.2010 13:57:15

 f_c 

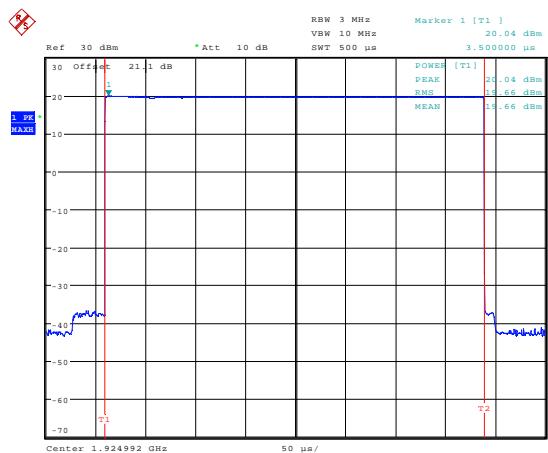
Date: 23.DEC.2010 13:35:59

 f_h

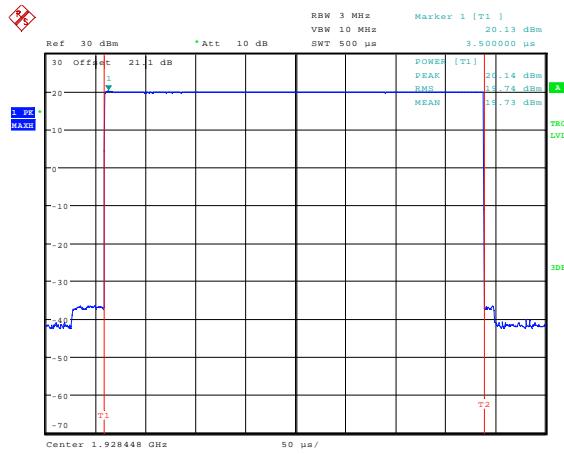
Peak Transmit Power



Date: 23.DEC.2010 14:08:21

 f_I 

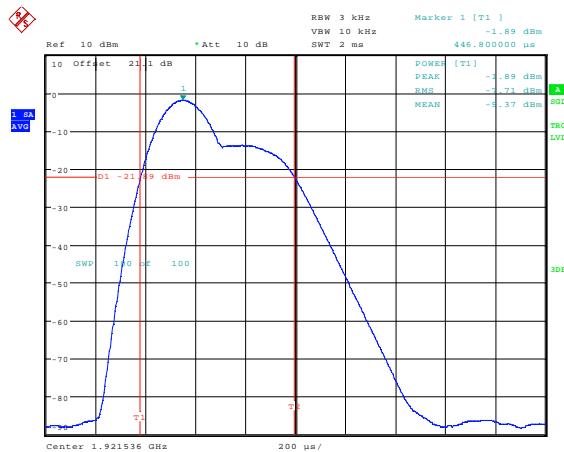
Date: 23.DEC.2010 14:03:55

 f_c 

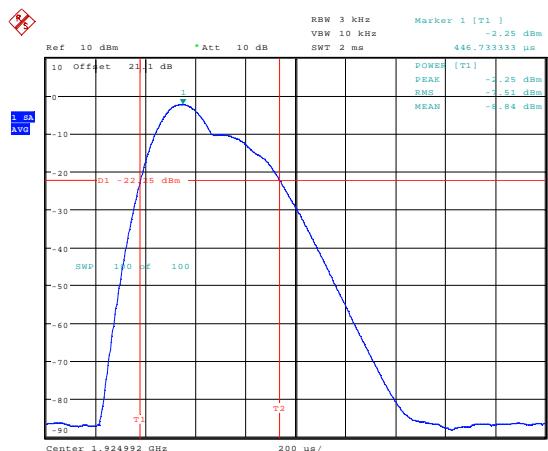
Date: 23.DEC.2010 13:22:52

 f_h

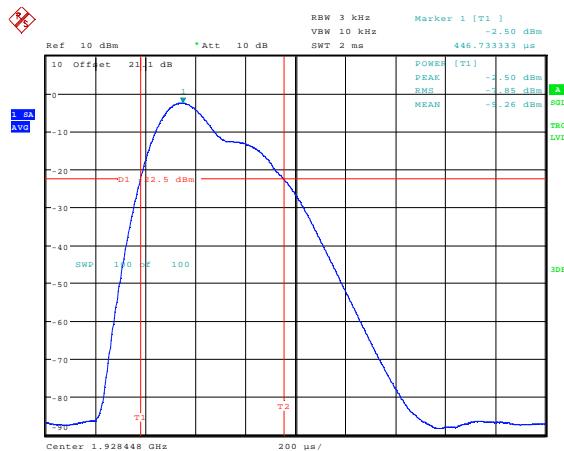
Power Spectral Density



Date: 23.DEC.2010 14:10:43

 f_I 

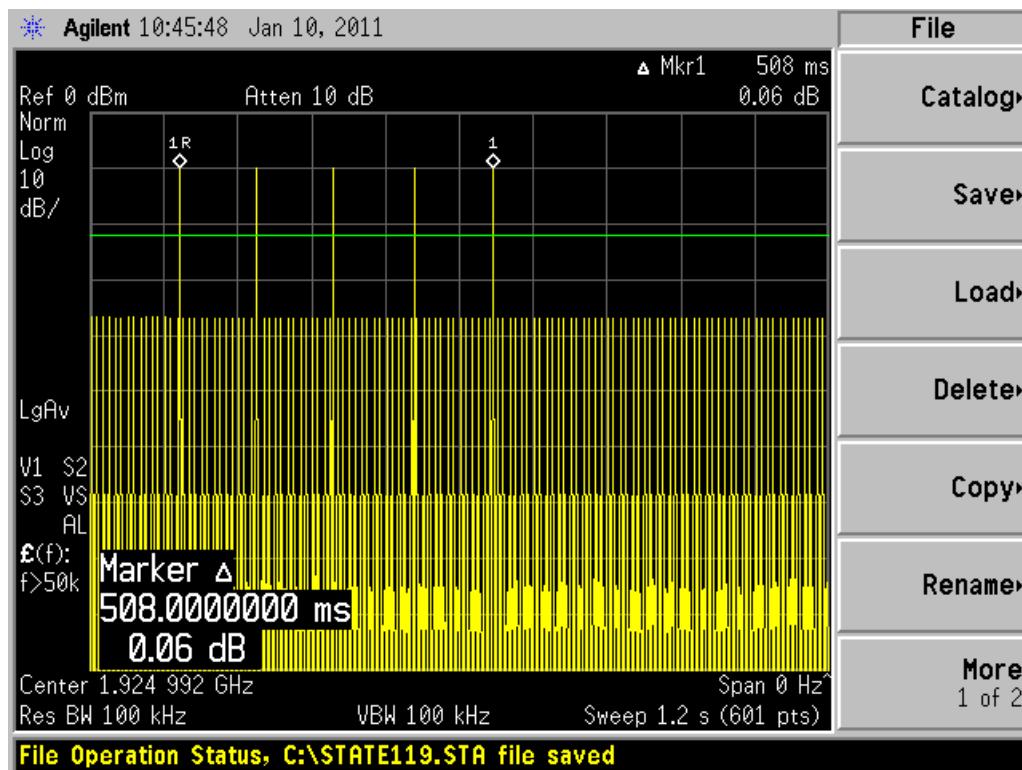
Date: 23.DEC.2010 14:01:42

 f_c 

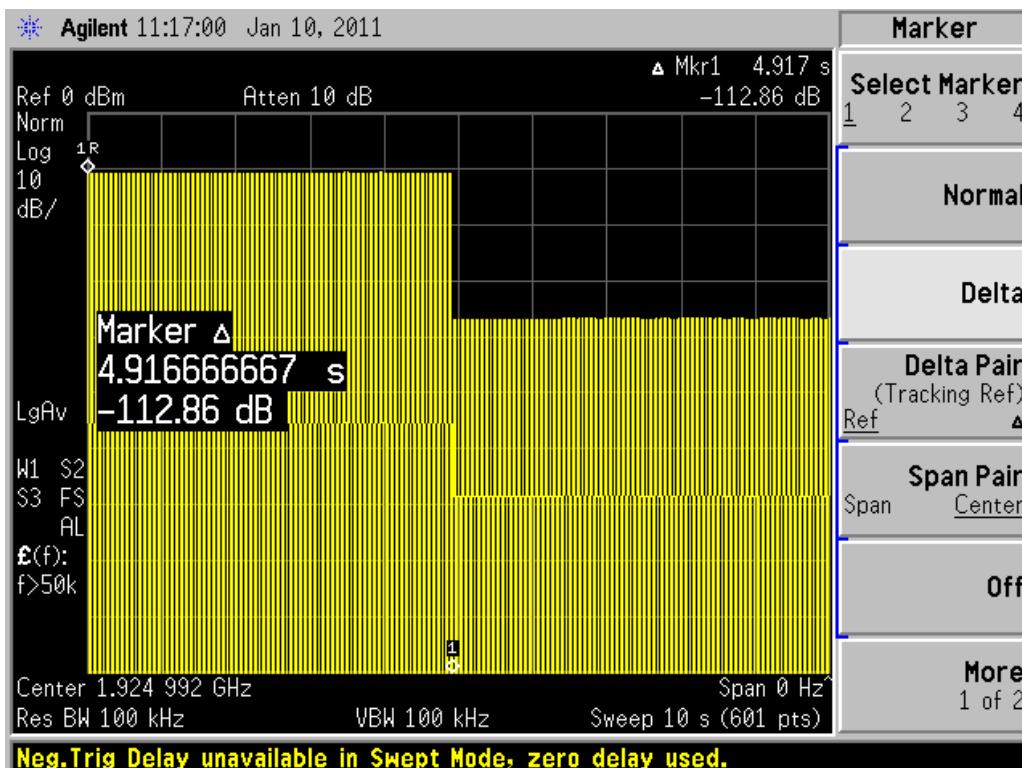
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 f_h

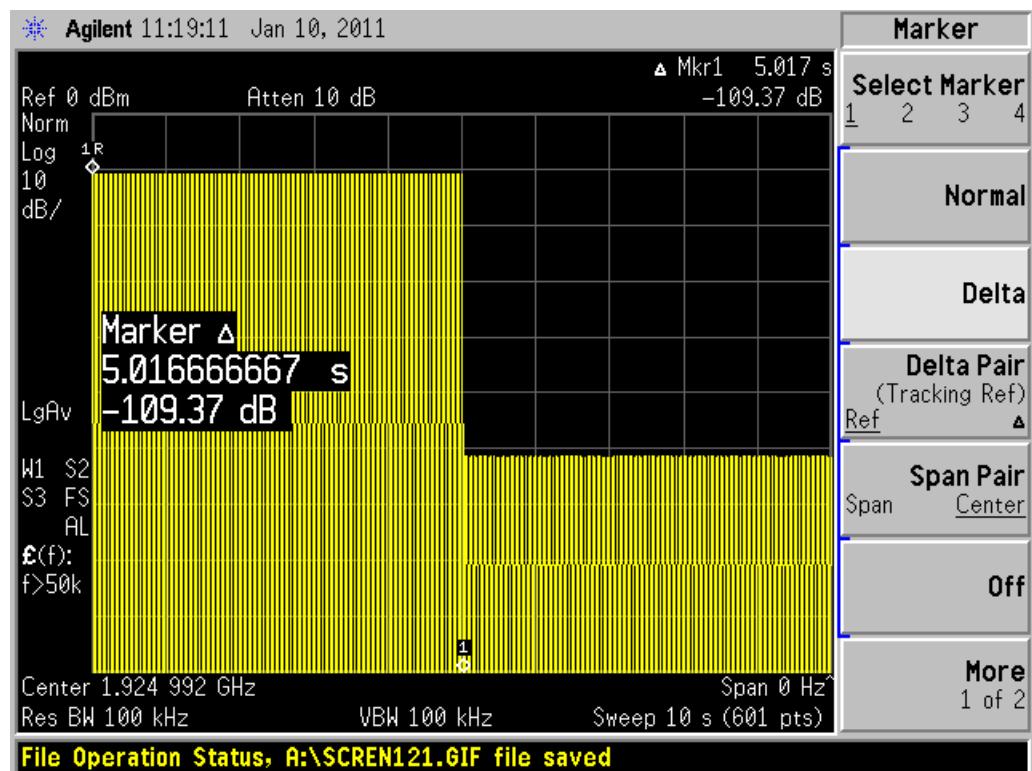
Acknowledgements



Transmissions on Communications Channel - Initial Acknowledgement Not Received

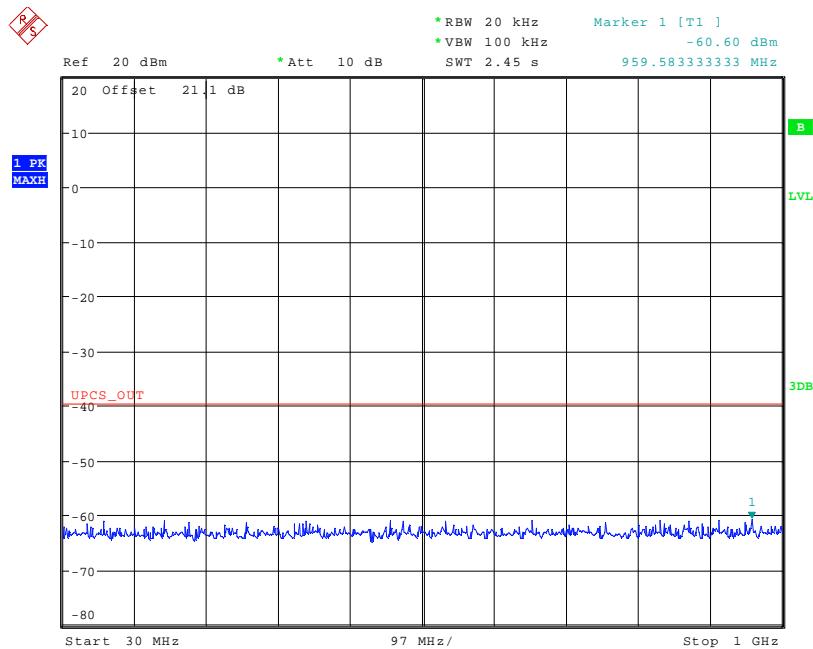


Cease Of Transmissions on Communications Channel – Acknowledgement To EUT Blocked



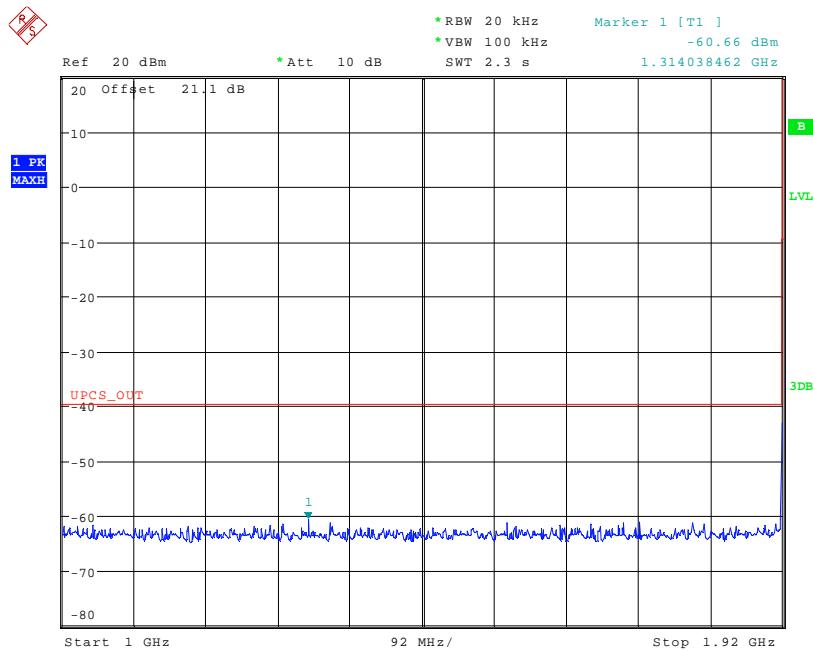
Cease Of Transmissions on Communications Channel – Acknowledgement To Companion Blocked

Conducted Emissions outside the Sub-Band RF carrier set to the lowest carrier defined by the EUT



Date: 23.DEC.2010 15:06:31

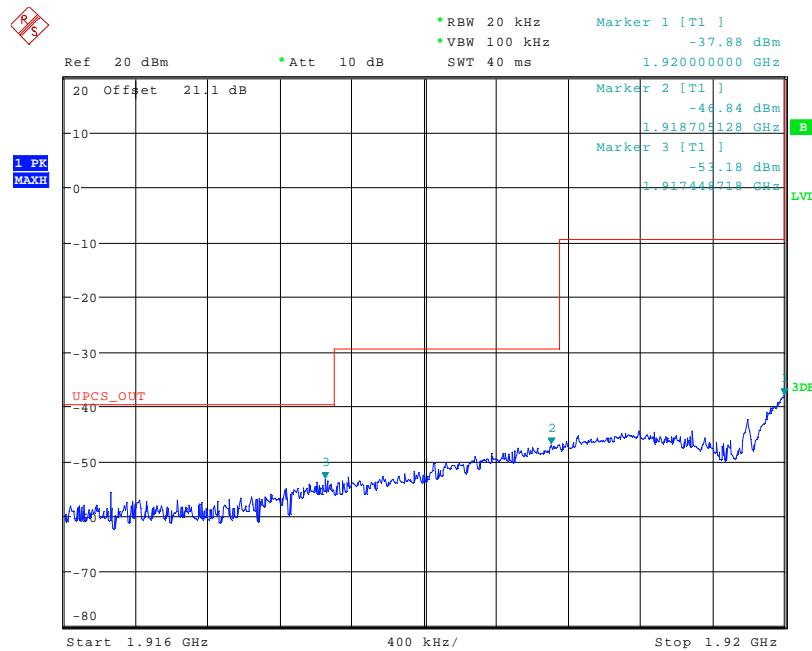
30MHz – 1GHz



Date: 23.DEC.2010 15:07:14

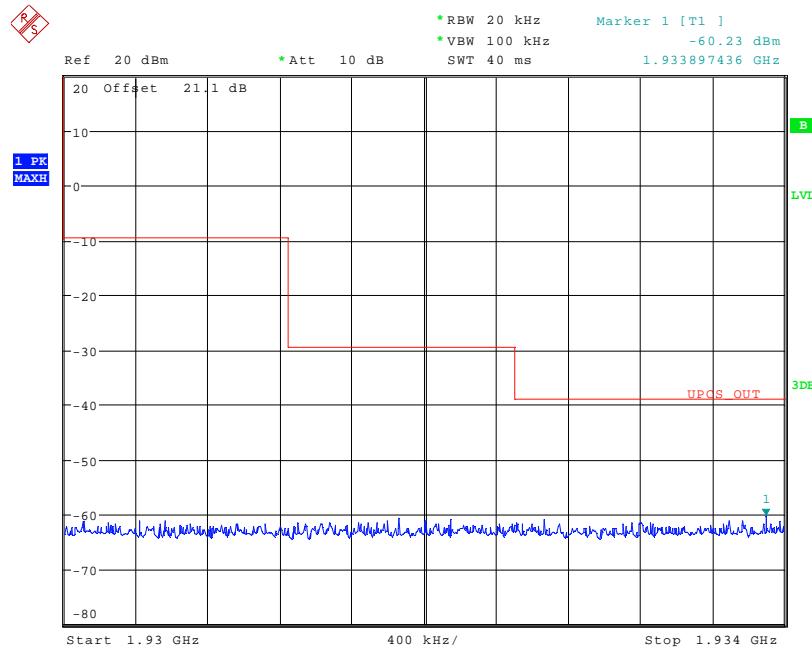
1GHz – Lower Bandedge

Conducted Emissions outside the Sub-Band RF carrier set to the lowest carrier defined by the EUT



Date: 23.DEC.2010 15:08:35

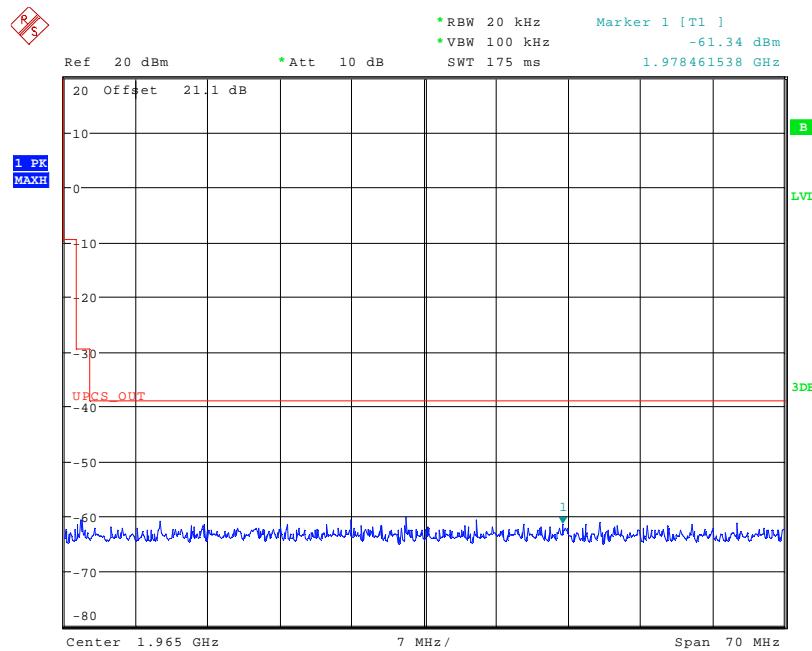
Lower Bandedge - > 2.5MHz



Date: 23.DEC.2010 15:09:01

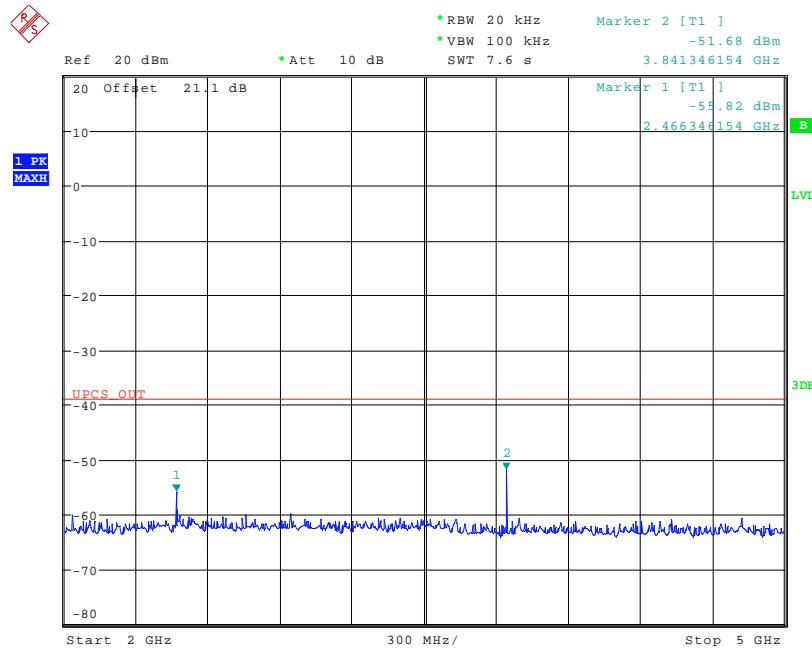
Upper Bandedge - > 2.5MHz

Conducted Emissions outside the Sub-Band RF carrier set to the lowest carrier defined by the EUT



Date: 23.DEC.2010 15:10:53

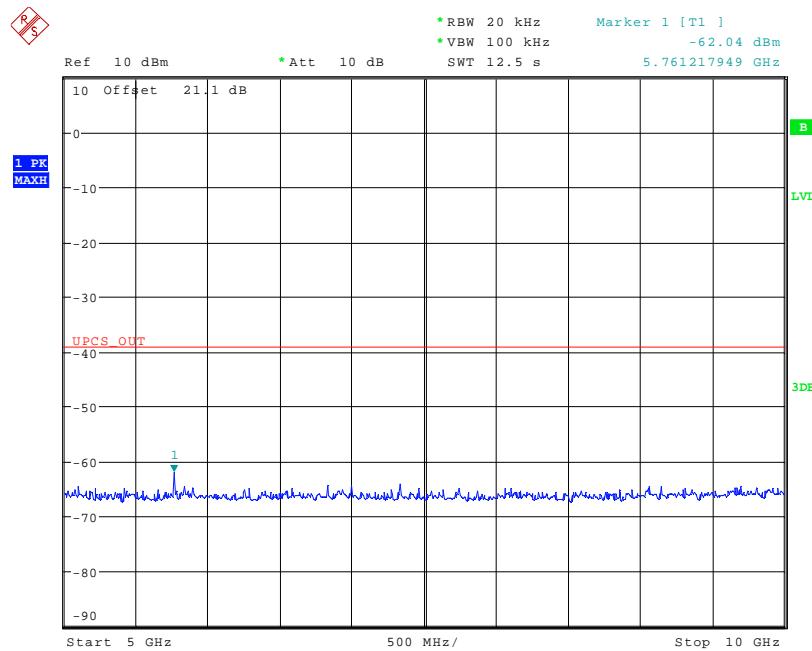
Upper Bandedge – 2GHz



Date: 23.DEC.2010 15:11:48

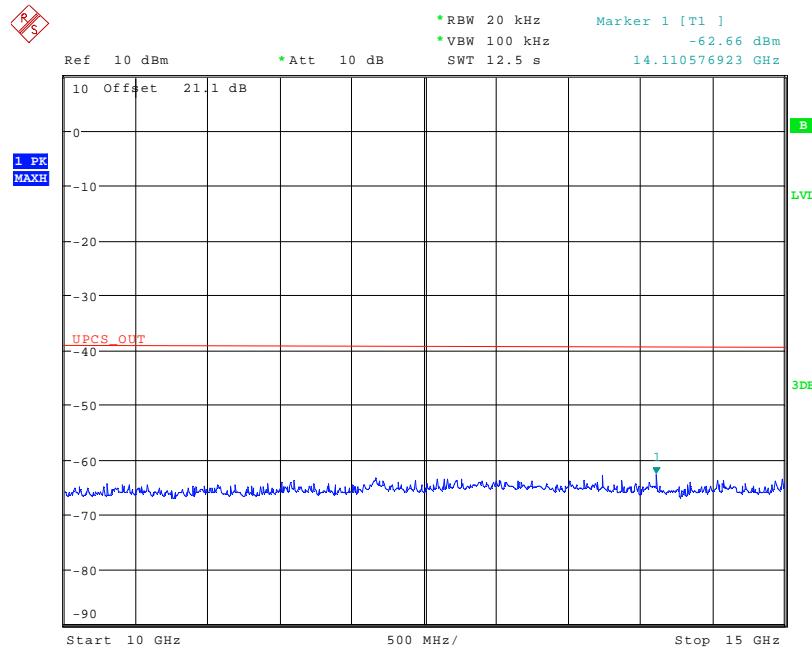
2 GHz – 5GHz

Conducted Emissions outside the Sub-Band RF carrier set to the lowest carrier defined by the EUT



Date: 23.DEC.2010 15:18:03

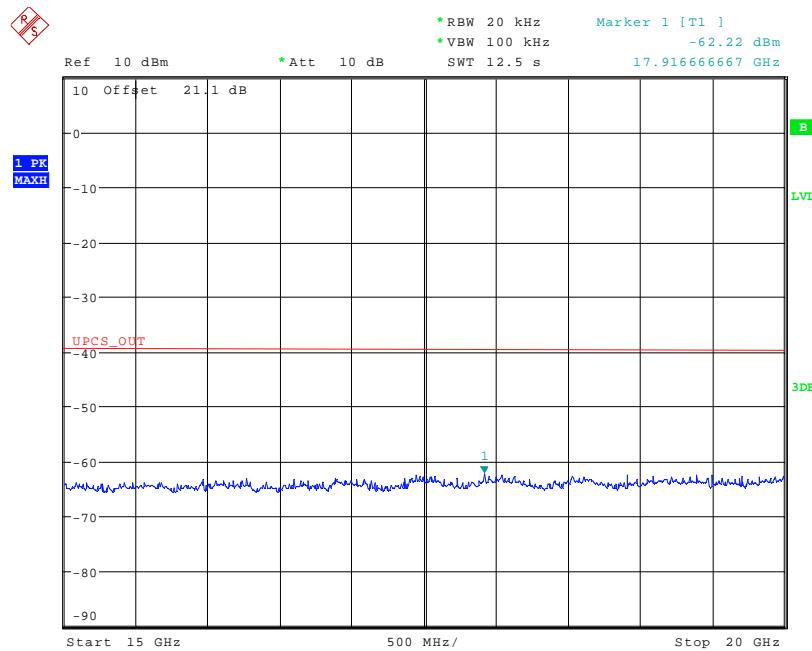
5 GHz – 10 GHz



Date: 23.DEC.2010 15:22:29

10 GHz – 15 GHz

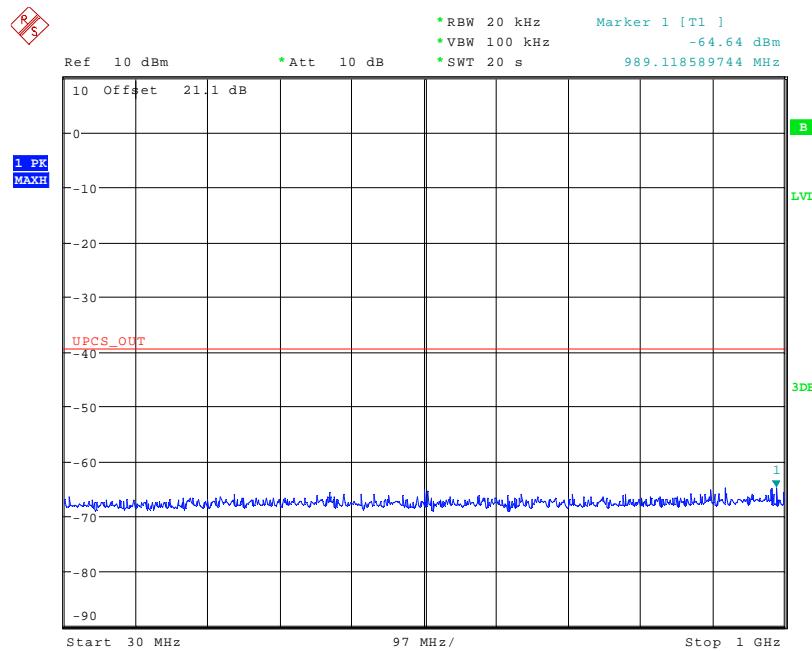
Conducted Emissions outside the Sub-Band RF carrier set to the lowest carrier defined by the EUT



Date: 23.DEC.2010 15:38:54

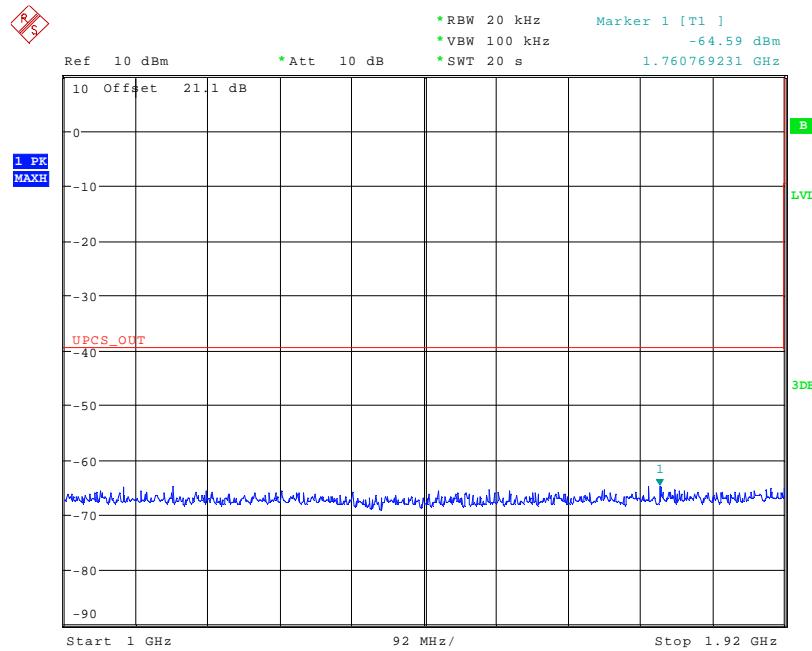
15 GHz – 20 GHz

Conducted Emissions outside the Sub-Band RF carrier set to the highest carrier defined by the EUT



Date: 23.DEC.2010 15:44:52

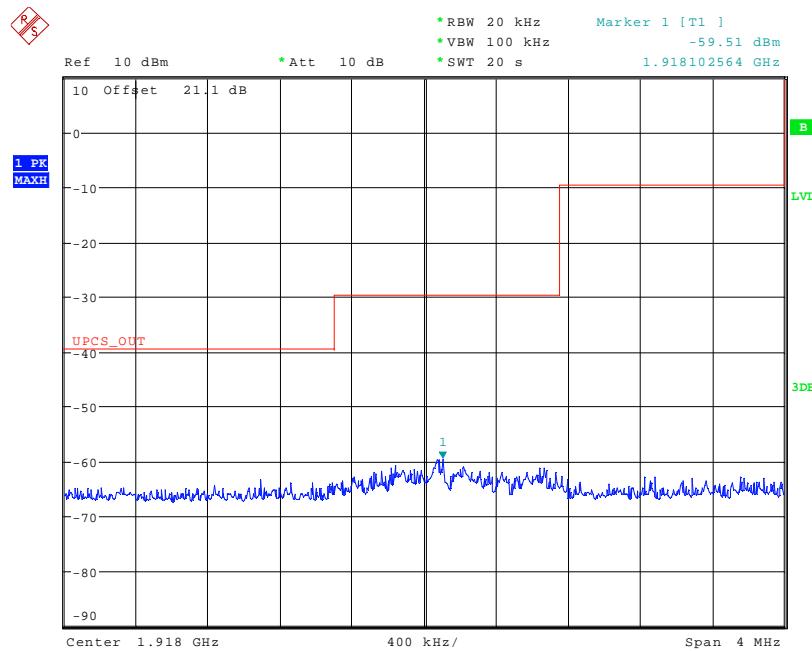
30MHz – 1GHz



Date: 23.DEC.2010 15:43:51

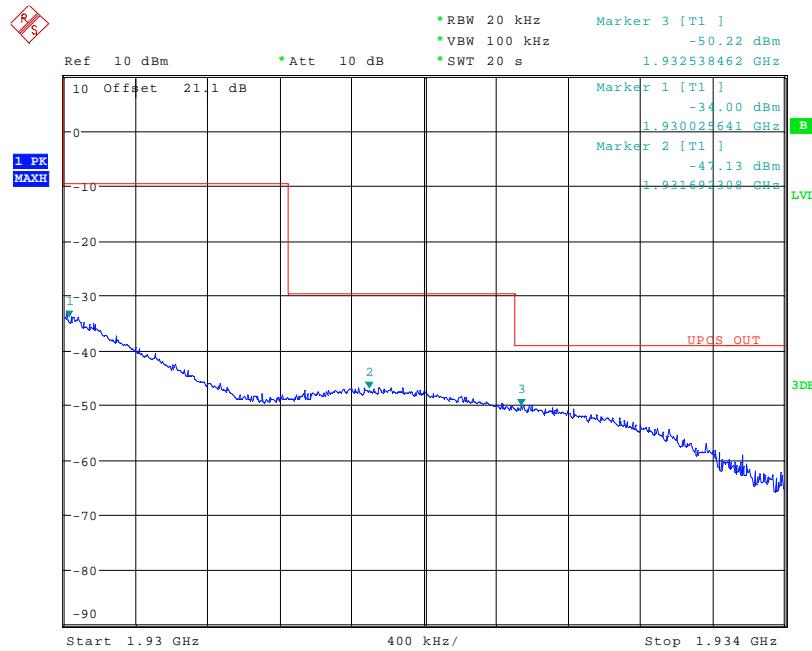
1GHz – Lower Bandedge

Conducted Emissions outside the Sub-Band RF carrier set to the highest carrier defined by the EUT



Date: 23.DEC.2010 15:43:18

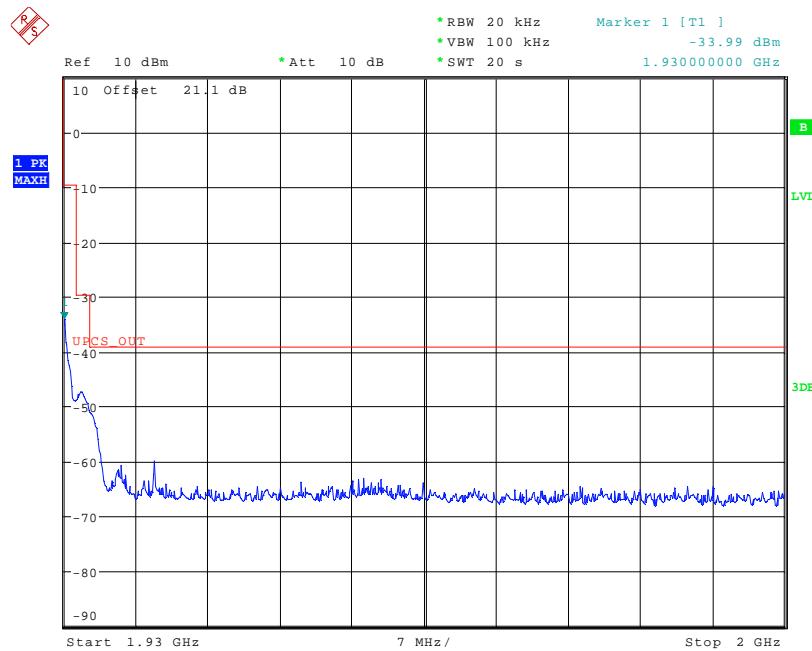
Lower Bandedge - > 2.5MHz



Date: 23.DEC.2010 15:42:33

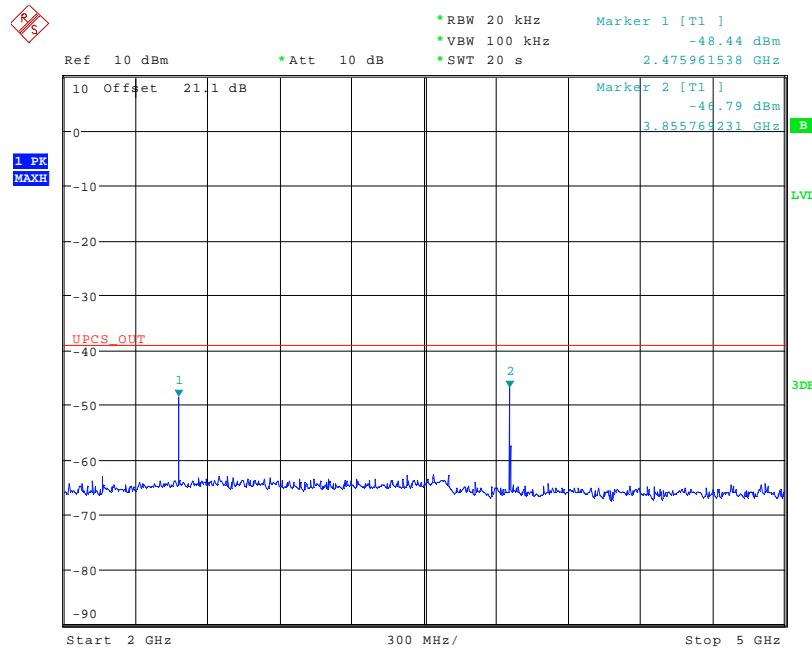
Upper Bandedge - > 2.5MHz

Conducted Emissions outside the Sub-Band RF carrier set to the highest carrier defined by the EUT



Date: 23.DEC.2010 15:41:44

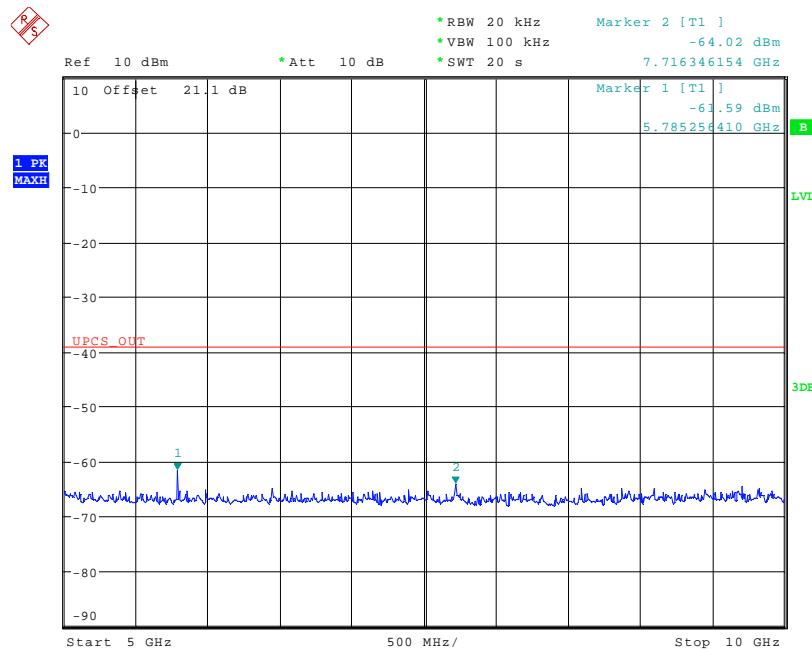
Upper Bandedge – 2GHz



Date: 23.DEC.2010 15:49:29

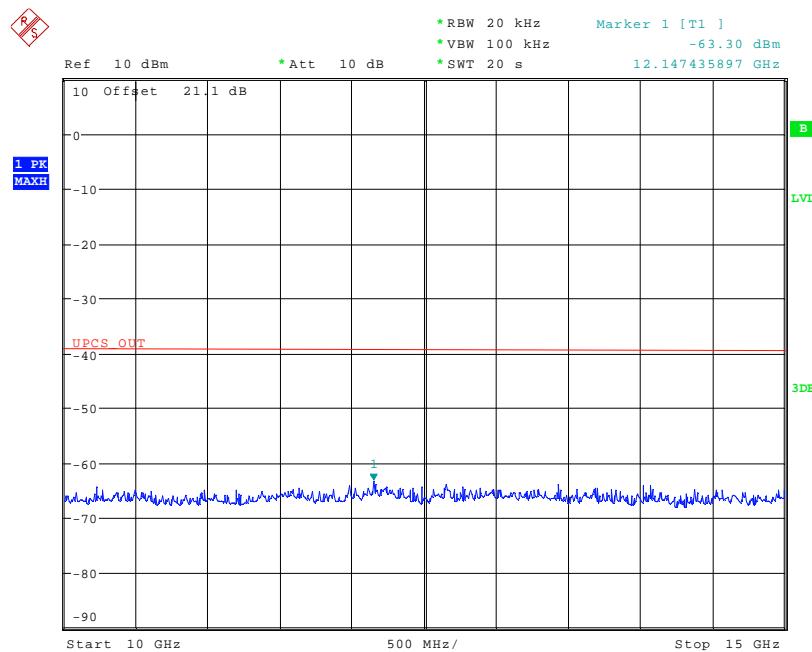
2 GHz – 5GHz

Conducted Emissions outside the Sub-Band RF carrier set to the highest carrier defined by the EUT



Date: 23.DEC.2010 15:50:59

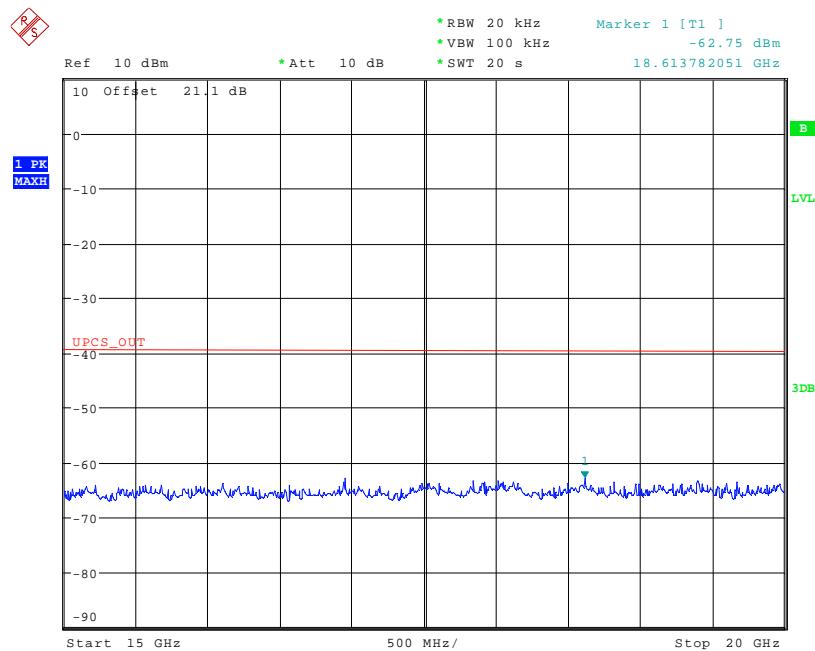
5 GHz – 10 GHz



Date: 23.DEC.2010 15:51:38

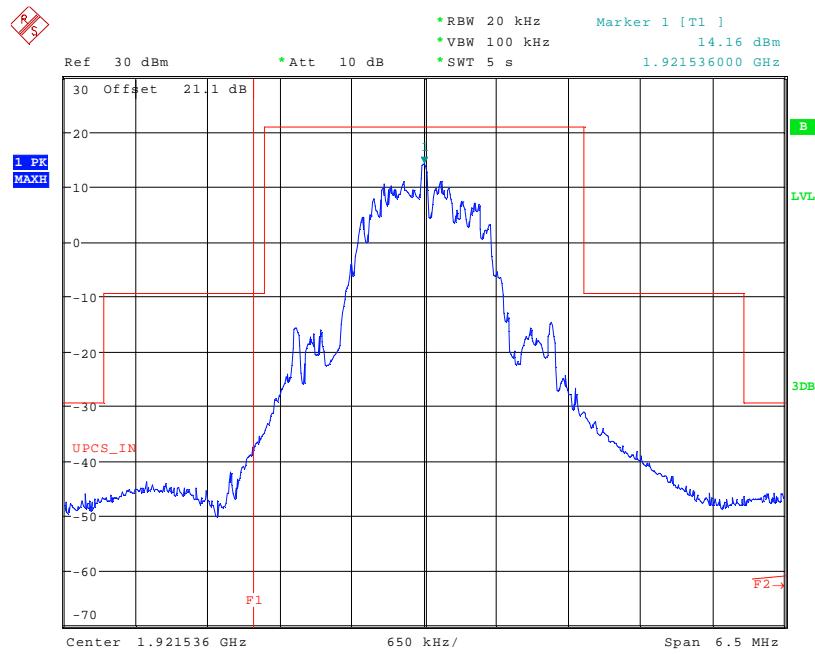
10 GHz – 15 GHz

Conducted Emissions outside the Sub-Band RF carrier set to the highest carrier defined by the EUT



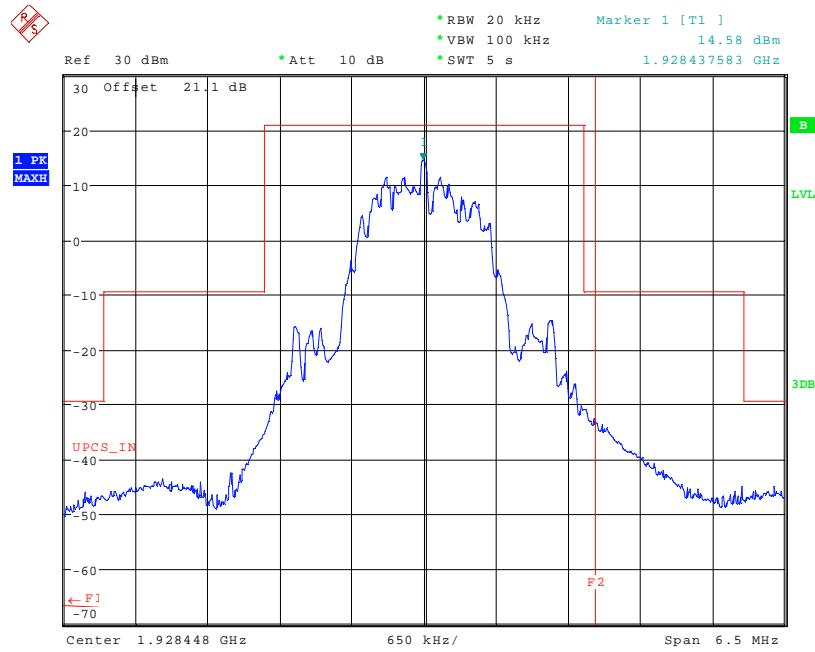
Date: 23.DEC.2010 15:52:39

15 GHz – 20 GHz



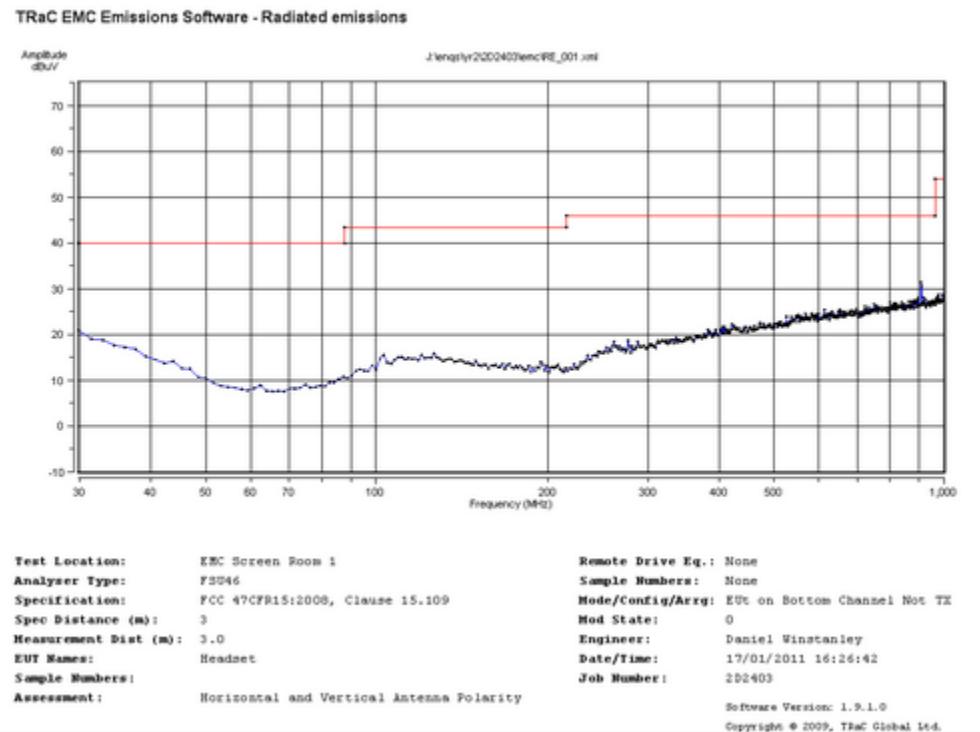
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Emissions inside the Sub-Band RF carrier set to the highest carrier defined by the EUT

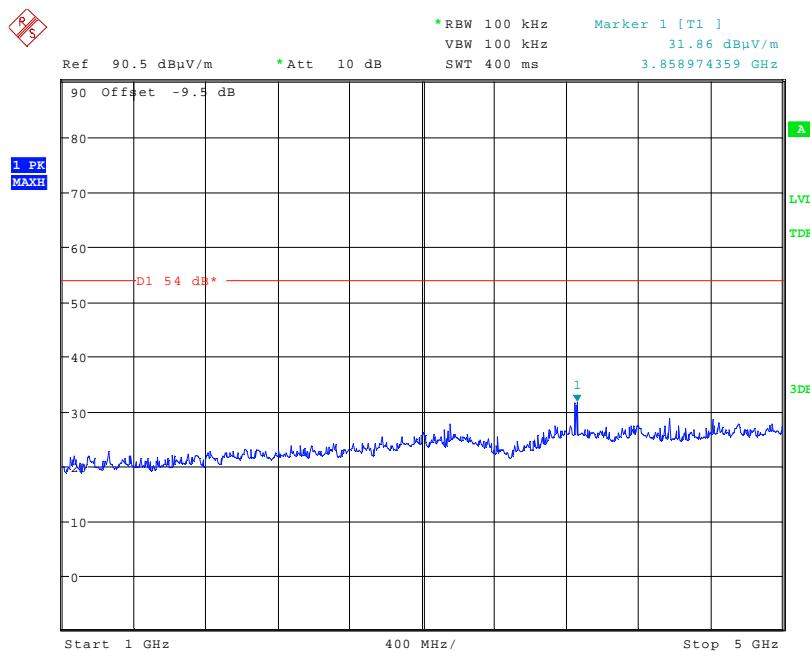


Date: 23.DEC.2010 14:46:50

Emissions inside the Sub-Band RF carrier set to the highest carrier defined by the EUT

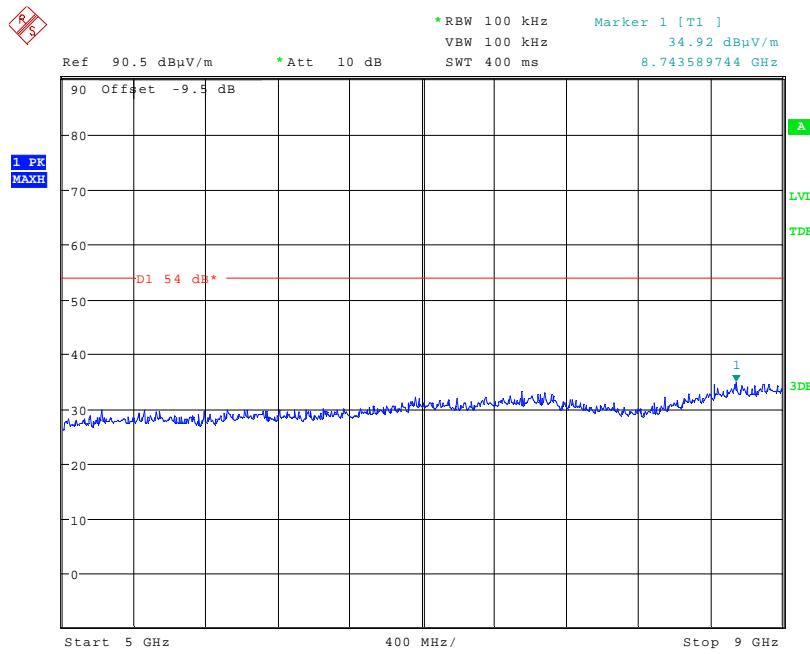


Unintentional Radiated spurious emissions 30 MHz to 1 GHz



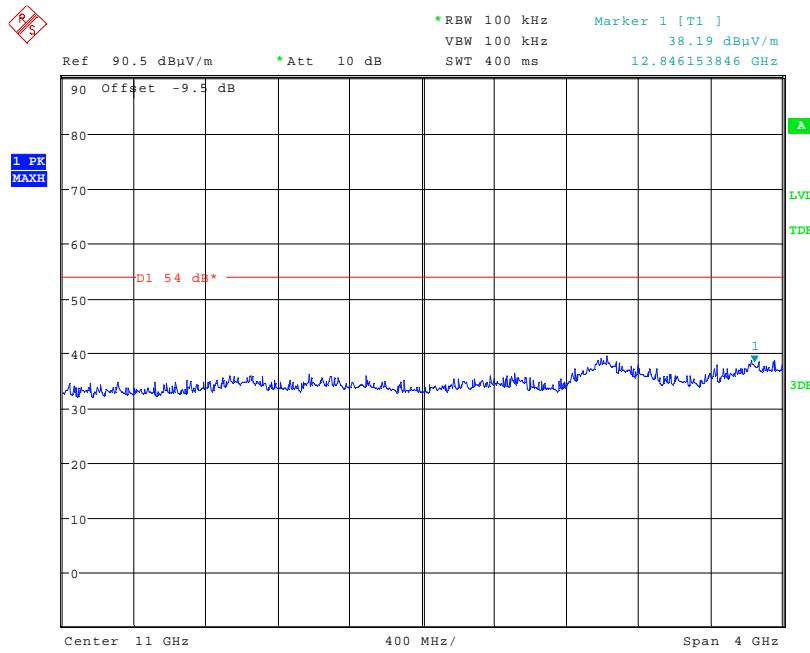
Date: 18.JAN.2011 10:08:26

Unintentional Radiated spurious emissions 1 GHz to 5 GHz



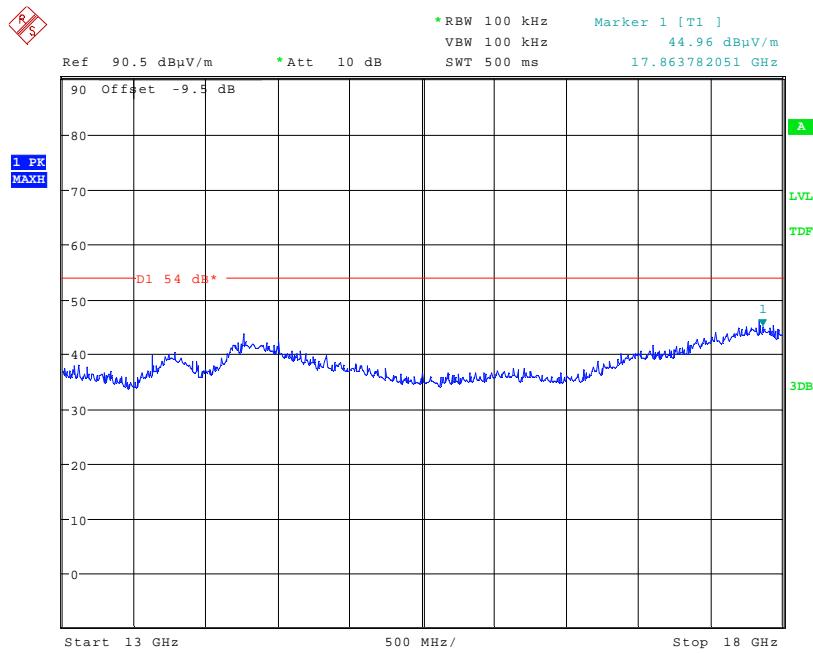
Date: 18.JAN.2011 10:09:25

Unintentional Radiated spurious emissions 5 GHz to 9 GHz



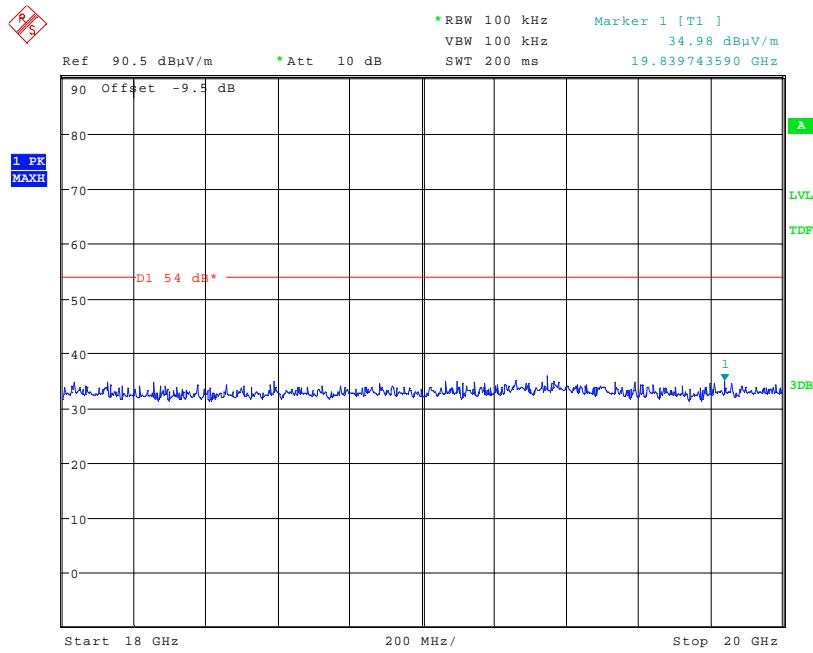
Date: 18.JAN.2011 10:09:49

Unintentional Radiated spurious emissions 9 GHz to 13 GHz



Date: 18.JAN.2011 10:10:13

Unintentional Radiated spurious emissions 13 GHz to 18GHz



Date: 18.JAN.2011 10:57:55

Unintentional Radiated spurious emissions 18 GHz to 20 GHz

Appendix C: Additional Test and Sample Details

This appendix contains details of:

1. The samples submitted for testing.
2. Details of EUT operating mode(s)
3. Details of EUT configuration(s) (see below).
4. EUT arrangement (see below).

Throughout testing, the following numbering system is used to identify the sample and its modification state:

Sample No: Sxx Mod w

where:

xx	= sample number	eg. S01
w	= modification number	eg. Mod 2

The following terminology is used throughout the test report:

Support Equipment (SE) is any additional equipment required to exercise the EUT in the applicable operating mode. Where relevant SE is divided into two categories:

SE in test environment: The SE is positioned in the test environment and is not isolated from the EUT (e.g. on the table top during REFE testing).

SE isolated from the EUT: The SE is isolated via filtering from the EUT. (e.g. equipment placed externally to the ALSR during REFE testing).

EUT configuration refers to the internal set-up of the EUT. It may include for example:

- Positioning of cards in a chassis.
- Setting of any internal switches.
- Circuit board jumper settings.
- Alternative internal power supplies.

Where no change in EUT configuration is **possible**, the configuration is described as “single possible configuration”.

EUT arrangement refers to the termination of EUT ports / connection of support equipment, and where relevant, the relative positioning of samples (EUT and SE) in the test environment.

For further details of the test procedures and general test set ups used during testing please refer to the related document "EMC Test Methods - An Overview", which can be supplied by TRaC Telecoms & Radio upon request.

C1) Test samples

The following samples of the apparatus were submitted by the client for testing :

Sample No.	Description	Identification
S14	Headset – Temporary Antenna Connector	None
S16	Headset – Radiated Sample	None

The following samples of apparatus were submitted by the client as host, support or drive equipment (auxiliary equipment):

Sample No.	Description	Identification
S21	Drive Thru Base – Companion Device	none

The following samples of apparatus were supplied by TRaC Telecoms & Radio as support or drive equipment (auxiliary equipment):

Identification	Description

C2) EUT Operating Mode During Testing.

During testing, the EUT was exercised as described in the following tables :

Test	Description of Operating Mode
RF Parameter Testing	EUT transmitting in normal communications with companion device Frequency administered to operate on a single frequency as required

Test	Description of Operating Mode
RF Etiquette Testing	EUT normal communications with companion device. Frequency administered to operate single/multiple frequencies and selected time slots as required.

Test	Description of Operating Mode:
Receiver (ERP) spurious emissions	EUT active but non-transmitting.

C3) EUT Configuration Information.

The EUT was submitted for testing in one single possible configuration.

C4) List of EUT Ports

The tables below describe the termination of EUT ports:

Sample : S14
Tests : Conducted

Port	Description of Cable Attached	Cable length	Equipment Connected
Temporary Antenna	Coaxial Cable	10cm	Measurement System

Sample : S16
Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
None			

* Only connected during setup.

C5 Details of Equipment Used

TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRLUH281	FSU46	Spectrum Analyser	Rhode & Schwarz	10/02/2011
TRL138	3115	1-18GHz Horn Antenna	EMCO	10/09/2009
TRL139	3115	1-18GHz Horn Antenna	EMCO	17/08/2009
TRL572	8499B	1 – 26.5 GHz Pre Amplifier	Agilent	24/11/2010
UH004	ESHS10	Receiver	Rhode & Schwarz	14/12/2010
TRLUH191	CBL611/A	BiLog Periodic Antenna	York	08/11/2010
TRLUH93		BiLog Periodic Antenna	Chase	03/06/2009
TRLUH377	ESU26	EMI Receiver	Rhode & Schwarz	11/06/2010
TRL11	TCC 125-815P	Temperature Chamber	Shartree	Use TRL426
TRL426	52 Series II	Temperature indicator	Fluke	04/03/2011
TRL176	2042	Signal Generator	Marconi	08/07/2010
TRLUH221	271	Function Generator	Wavetek	Use UH122
TRLUH122	TDS520B	Oscilloscope	Tektronix	Info Only
TRLUH303	11667A	Splitter/Combiner	HP	Cal in use
TRLUH305	11667A	Splitter/Combiner	HP	Cal in use
TRLUH307	8472A	Crystal Detector	HP	Info only
RFG433	CMD60	Modulation Analyser	Rhode & Schwarz	11/12/2008
REF844	E4438C	Signal Generator	Agilent	19/02/2010
N/A	SH4141	High Pass Filter	BCS Filters	04/12/2009

Appendix D:

Additional Information

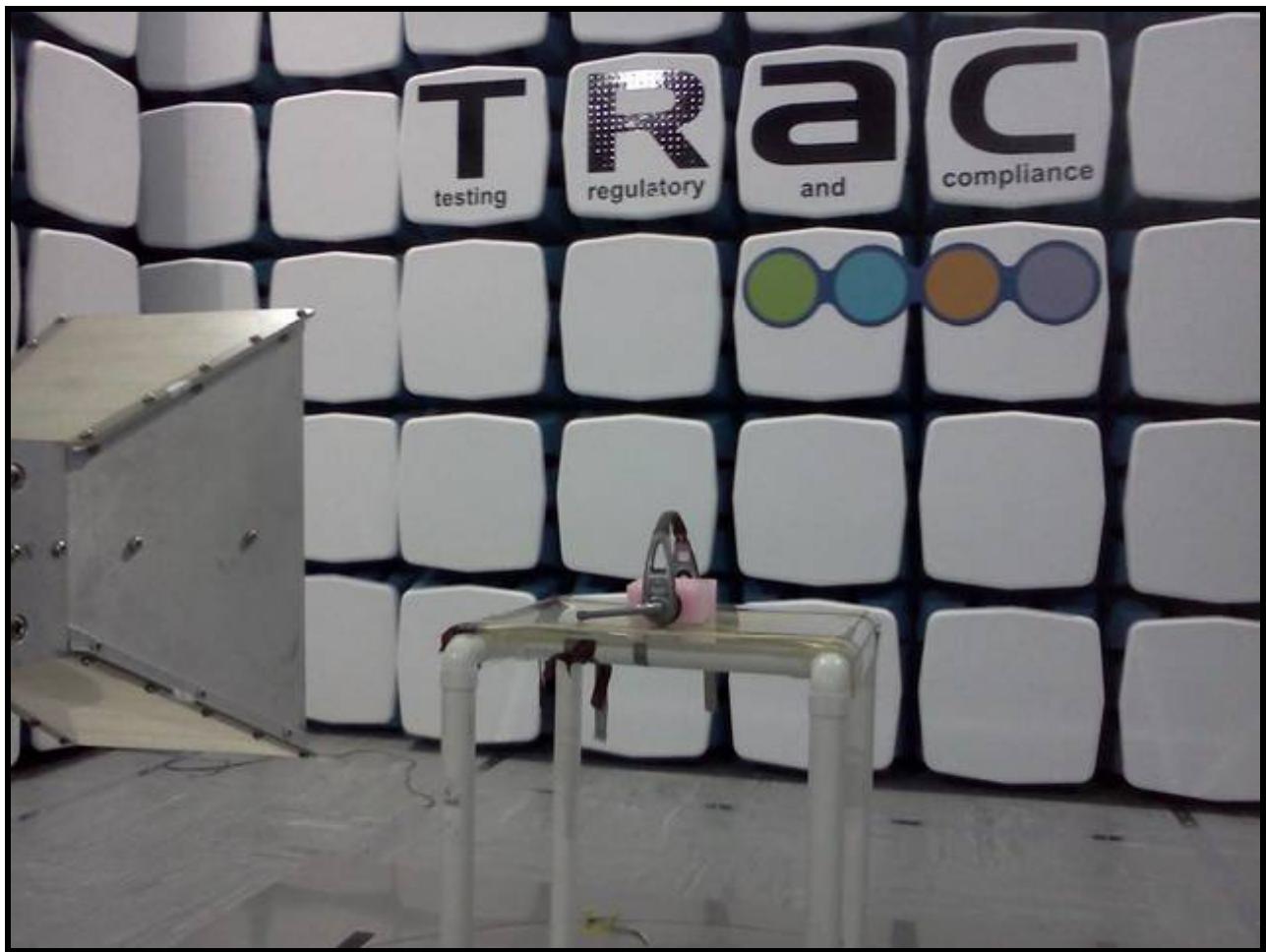
No additional information is included within this test report.

Appendix E:

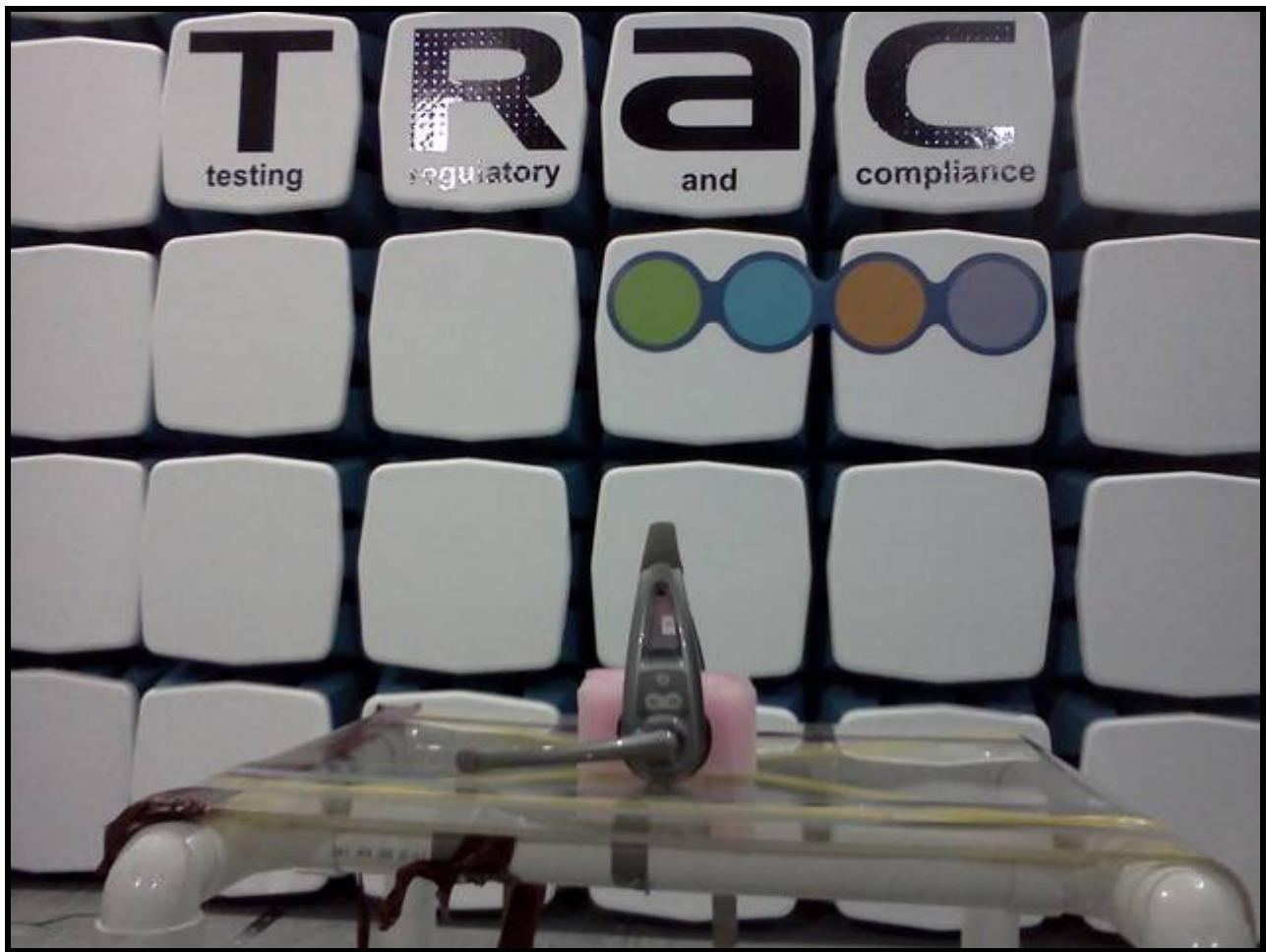
Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: Q-DT8 front view.
2. Radiated electric field emissions arrangement: Q-DT8 close up.
3. Photo of the Q-DT8 Top Overview
4. Photo of the Q-DT8 Side Overview



Photograph 1



Photograph 2



Photograph 3



Photograph 4

