Report On

FCC Testing of the
Sharp CDMA SHX11 Tri-Band CDMA (BC0, BC3 and BC6) and Tri-Band GSM (900 MHz, 1800 MHz and 1900 MHz) Dual Mode Cellular Phone with Bluetooth, WLAN, FeliCa and GPS

COMMERCIAL-IN-CONFIDENCE

FCC ID: APYHRO00151

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REPORT ON

FCC Testing of the
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Document 75913577 Report 09 Issue 1

June 2011

PREPARED FOR

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M Jenkins
Authorised Signatory

DATED 21 June 2011

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC CFR 47: Part 24. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

B Airs R Henley A Guy

Product Service

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Product Service

SECTION 1

REPORT SUMMARY

FCC Testing of the
Sharp CDMA SHX11 Tri-Band CDMA (BC0, BC3 and BC6) and Tri-Band GSM (900 MHz, 1800 MHz and 1900 MHz) Dual Mode Cellular Phone with Bluetooth, WLAN, FeliCa and GPS

Product Service

1.1 INTRODUCTION

The information contained in this report is intended to show verification of Sharp CDMA SHX11 Tri-Band CDMA (BC0, BC3 and BC6) and Tri-Band GSM (900 MHz, 1800 MHz and 1900 MHz) Dual Mode Cellular Phone with Bluetooth, WLAN, FeliCa and GPS to the requirements of FCC CFR 47 Part 2 and 24.

Objective	To perform FCC Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Sharp Corporation
Model Number(s)	CDMA SHX11
Serial Number(s)	IMEI: 004401113358168
Software Version	C3251
Hardware Version	PP1
Number of Samples Tested	One
Test Specification/Issue/Date	FCC CFR 47 Part 2: 2010 FCC CFR 47 Part 24: 2010
Incoming Release Date	Application Form 14 June 2011
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	8492 14 April 2011
Start of Test	19 May 2011
Finish of Test	20 June 2011
Name of Engineer(s)	A Guy R Henley B Airs
Related Document(s)	ANSI C63.4: 2003

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1.2 BRIEF SUMMARY OF RESULTS

A brief summary of results for each configuration, in accordance with FCC CFR 47 Part 2 and 24 is shown below.

Configuration 1:							
Section	Spec Clause		Test Description	Mode	Mod State	Result	Base Standard
	Part 2	Part 24					
2.1	2.1055	24.135(a)	Frequency Stability Under Temperature Variations	1850.2 MHz	-	N/A	
				1880.0 MHz	0	Pass	
				1909.8 MHz	-	N/A	
2.2	2.1055	24.135(a)	Frequency Stability Under Voltage Variations	1850.2 MHz	-	N/A	
				1880.0 MHz	0	Pass	
				1909.8 MHz	-	N/A	
2.3	2.1051	24.229	Spurious Emissions at Band Edge	1850.2 MHz	0	Pass	
				1880.0 MHz	-	N/A	
				1909.8 MHz	0	Pass	
2.4	2.1046	24.232	Maximum Peak Output Power – Conducted	1850.2 MHz	0	Pass	
				1880.0 MHz	0	Pass	
				1909.8 MHz	0	Pass	
2.5	-	24.232(c)	Effective Isotropic Radiated Power	1850.2 MHz	0	Pass	
				1880.0 MHz	0	Pass	
				1909.8 MHz	0	Pass	
2.6	2.1051	24.238	Emissions for Broadband PCS Equipment	1850.2 MHz	0	Pass	
				1880.0 MHz	0	Pass	
				1909.8 MHz	0	Pass	
2.7	2.1051	24.238(a)	Conducted Spurious Emissions	1850.2 MHz	0	Pass	
				1880.0 MHz	0	Pass	
				1909.8 MHz	0	Pass	
2.8	2.1049	24.238(b)	Occupied Bandwidth	1850.2 MHz	0	Pass	
				1880.0 MHz	0	Pass	
				1909.8 MHz	0	Pass	
2.9	2.1047(d)	-	Modulation Characteristics	1850.2 MHz	0	Pass	
				1880.0 MHz	0	Pass	
				1909.8 MHz	0	Pass	

N/A – Not Applicable

Product Service

1.3 APPLICATION FORM

APPLICANT'S DETAILS		
COMPANY NAME :	Sharp Telecommunications of Europe Ltd	
ADDRESS :	Azure House, Bagshot Road Bracknell, Berkshire RG12 7QY	
NAME FOR CONTACT PURPOSES :	Ken Newman	
TELEPHONE NO: 01344 301 883	FAX NO:	01344 300 293
	E-MAIL:	ken.newman@sharp.eu

EQUIPMENT INFORMATION

Equipment designator:

Model name/number CDMA CDMA SHX11 Identification number APYHRO00151

Supply Voltage:

[ ]	AC mains	State AC voltage …… V	and AC frequency …… Hz
[ ]	DC (external)	State DC voltage …… V	and DC current …… A
[X]	DC (internal)	State DC voltage 3.7 V	and Battery type Li-ion

Frequency characteristics:

Frequency range 1850.2.2 MHz to 1909.8 MHz Channel spacing (if channelized)

Designated test frequencies:
Bottom: 1850.2.2 MHz Middle: 1880 MHz Top: 1909.8 MHz

Power characteristics:

Maximum transmitter power 32 dBm Minimum transmitter power …… W (if variable)

[X] Continuous transmission
[ ] Intermittent transmission State duty cycle ……
If intermittent, can transmitter be set to continuous transmit test mode? Y/N

Antenna characteristics:

[X]	Antenna connector	State impedance 50 ohm
[ ]	Temporary antenna connector	State impedance …… ohm
[ ]	Integral antenna	State gain …… dBi

Modulation characteristics:

[ ]	Amplitude	[ ]	Other
[ ]	Frequency	Details: ……	
[X]	Phase		

Can the transmitter operate un-modulated? N
ITU Class of emission: ……

Extreme conditions:

Maximum temperature +60 ºC Minimum temperature -20 ºC
Maximum supply voltage 4.0 V Minimum supply voltage 3.7 V

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

Signature : T. Taki
Name : Tetsuya Taki
Position held : Manager
Date : 14 June 2011

Product Service

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was an Sharp CDMA SHX11 Tri-Band CDMA (BC0, BC3 and BC6) and Tri-Band GSM (900 MHz, 1800 MHz and 1900 MHz) Dual Mode Cellular Phone with Bluetooth, WLAN, FeliCa and GPS. A full technical description can be found in the manufacturer's documentation.

1.4.2 Test Configuration

Configuration 1:

The EUT was configured in accordance with FCC CFR 47 Part 2 and 24.

1.4.3 Modes of Operation

Modes of operation of each EUT during testing were as follows:

Mode 1 – 1850.2 MHz

Mode 2 – 1880.0 MHz

Mode 3 – 1909.8 MHz

Information on the specific test modes utilised are detailed in the test procedure for each individual test.

1.5 TEST CONDITIONS

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

The EUT was powered from either a 3.7 V DC Supply.

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.7 MODIFICATION RECORD

No modifications were made to the EUT during testing.

Product Service

SECTION 2

TEST DETAILS

FCC Testing of the
Sharp CDMA SHX11 Tri-Band CDMA (BC0, BC3 and BC6) and Tri-Band GSM (900 MHz, 1800 MHz and 1900 MHz) Dual Mode Cellular Phone with Bluetooth, WLAN, FeliCa and GPS

Product Service

2.1 FREQUENCY STABILITY UNDER TEMPERATURE VARIATIONS

2.1.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1055
FCC CFR 47 Part 24, Clause 24.135(a)

2.1.2 Equipment Under Test

CDMA SHX11, S/N: IMEI: 004401113358168

2.1.3 Date of Test and Modification State

16 June 2011 - Modification State 0

2.1.4 Test Equipment Used

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

2.1.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 24.

The EUT was set to transmit on maximum power with GMSK modulation scheme. A digital communications analyer (CMU 200), was used to measure the frequency error. The maximum result was taken over 200 bursts. The temperature was adjusted between -30°C and +50°C in 10° steps as per 2.1055.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 2

2.1.6 Environmental Conditions

	16 June 2011
Ambient Temperature	20.5°C
Relative Humidity	48.4%

Product Service

2.1.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 2 and 24 for Frequency Stability Under Temperature Variations.

The test results are shown below.

Configuration 1 - Mode 2

4.0 V DC Supply

Temperature Interval (ºC)	Test Frequency (MHz)	Mode	Deviation (Hz)	Limit (kHz)
-30	1880.0	GMSK	+31	±1ppm or ±2.091
-20	1880.0	GMSK	+30	±1ppm or ±2.091
-10	1880.0	GMSK	+30	±1ppm or ±2.091
0	1880.0	GMSK	+29	±1ppm or ±2.091
+10	1880.0	GMSK	+31	±1ppm or ±2.091
+20	1880.0	GMSK	+30	±1ppm or ±2.091
+30	1880.0	GMSK	+30	±1ppm or ±2.091
+40	1880.0	GMSK	+29	±1ppm or ±2.091
+50	1880.0	GMSK	+30	±1ppm or ±2.091

Limit Clause

The frequency stability of the transmitter shall be maintained within ± 0.0001 % ± 1 ppm of the center frequency

2.2 FREQUENCY STABILITY UNDER VOLTAGE VARIATIONS

2.2.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1055
FCC CFR 47 Part 24, Clause 24.135(a)

2.2.2 Equipment Under Test

CDMA SHX11, S/N: IMEI: 004401113358168

2.2.3 Date of Test and Modification State

20 June 2011 - Modification State 0

2.2.4 Test Equipment Used

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

2.2.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 24.

The EUT was set to transmit on maximum power on GMSK modulation. A digital communications anlayser (CMU 200), was used to measure the frequency error. The maximum result was taken over 200 bursts.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 2

2.2.6 Environmental Conditions

	20 June 2011
Ambient Temperature	21.7°C
Relative Humidity	56.8%

Product Service

2.2.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 2 and 24 for Frequency Stability Under Voltage Variations.

The test results are shown below.

Configuration 1 - Mode 2

DC Voltage (V)	Test Frequency (MHz)	Mode	Deviation (Hz)	Deviation Limit (kHz)
4.0	1880.0	GMSK	6.0	±1ppm or ±1.960
3.7	1880.0	GMSK	8.0	±1ppm or ±1.960

Limit Clause

The frequency stability of the transmitter shall be maintained within ± 0.000 % of ± 1 ppm of the center frequency.

2.3 SPURIOUS EMISSIONS AT BAND EDGE

2.3.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1051
FCC CFR 47 Part 24, Clause 24.229

2.3.2 Equipment Under Test

CDMA SHX11, S/N: IMEI: 004401113358168

2.3.3 Date of Test and Modification State

19 May 2011 - Modification State 0

2.3.4 Test Equipment Used

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

2.3.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 24.

In accordance with 24.238, any emissions outside of the block edges shall be attenuated by at least 43 + 10 log (P). The measurements are shown to ±1 MHz from the block edges. The plots shown under the Spurious Emissions sections covers the required range of 9 kHz to 20 GHz.

The reference power and path losses of all channels used for testing in each frequency block were measured. Having entered the reference level offset , a limit line was displayed, showing the -13 dBm (43 + 10 log (P)), limit.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 3

2.3.6 Environmental Conditions

	19 May 2011
Ambient Temperature	27.2°C
Relative Humidity	25.7%

Product Service

2.3.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 2 and 24 for Spurious Emissions at Band Edge.

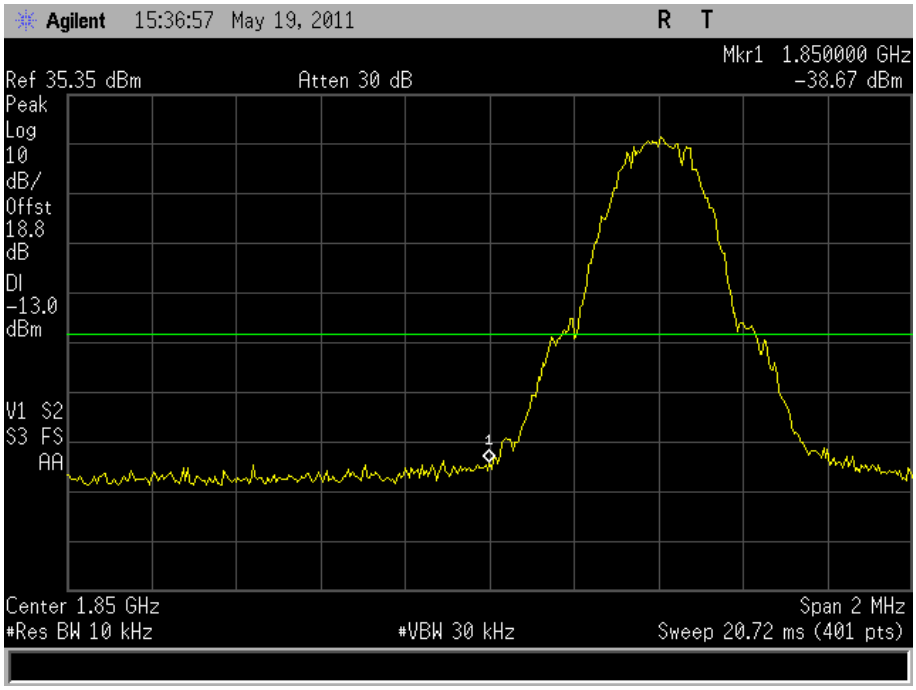
The test results are shown below.

Configuration 1 – Modes 1 and 3

4.0 V DC Supply

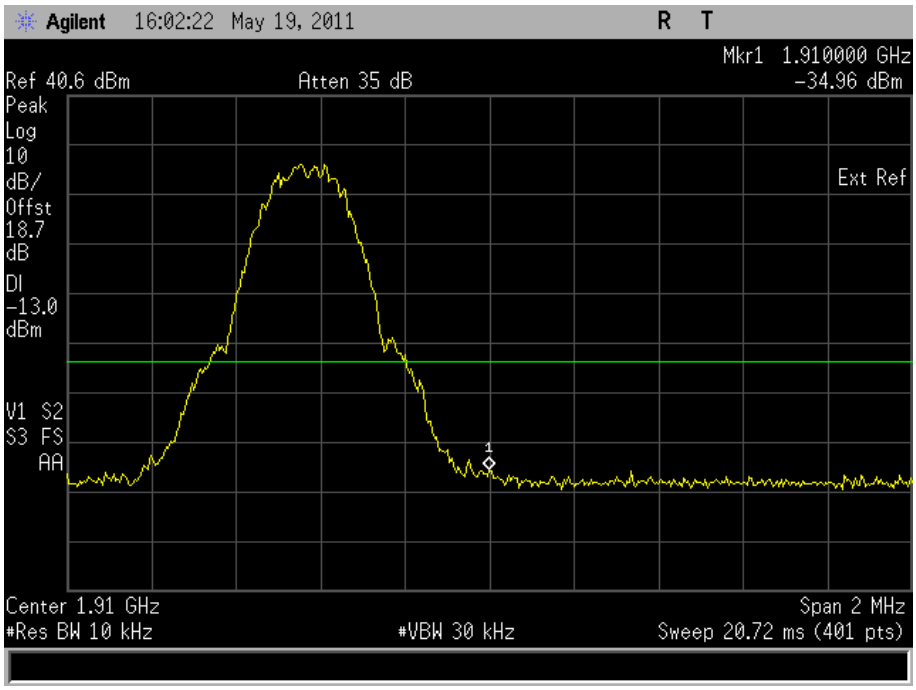
Frequency Block (MHz)	Mode	Lower Block Edge Test Channels/Frequencies	Upper Block Edge Test Channels/Frequencies
A :(1850.0 – 1865.0)	GMSK	Channel : 513 Frequency : 1850.4 MHz	N/A
B :(1895.0 – 1910.0)	GMSK	N/A	Channel : 809 Frequency : 1909.6 MHz

Frequency Block A



Product Service

Frequency Block B



Limit Clause

-13 dBm at block edge.

2.4 MAXIMUM PEAK OUTPUT POWER - CONDUCTED

2.4.1 Specification Reference

FCC CFR 47 Part 24, Clause 2.1046
FCC CFR 47 Part 24, Clause 24.232

2.4.2 Equipment Under Test

CDMA SHX11, S/N: IMEI: 004401113358168

2.4.3 Date of Test and Modification State

19 May 2011 - Modification State 0

2.4.4 Test Equipment Used

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

2.4.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 24.

Using a spectrum analyser and attenuator(s), the output power of the EUT was measured at the antenna terminals.

The EUT supports GSM, GPRS and EDGE. The EUT was tested in GMSK mode of operation.

The spectrum analyser RBW and VBW were set to 1 MHz and the path loss measured and entered as a reference offset level.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2
- Mode 3

2.4.6 Environmental Conditions

	19 May 2011
Ambient Temperature	27.2°C
Relative Humidity	25.7%

Product Service

2.4.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 2 and 24 for Maximum Peak Output Power - Conducted.

The test results are shown below.

Configuration 1 - Modes 1, 2 and 3

4.0 V DC Supply

Frequency (MHz)	Mode	Result (dBm)	Result (W)
1850.2	GMSK	30.21	1.050
1880.0	GMSK	29.86	0.968
1909.8	GMSK	30.41	1.099

Limit Clause

Mobile – 7 W
Base Stations – 500 W

Product Service

2.5 EFFECTIVE ISOTROPIC RADIATED POWER

2.5.1 Specification Reference

FCC CFR 47 Part 24, Clause 24.232(c)

2.5.2 Equipment Under Test

CDMA SHX11, S/N: IMEI: 004401113358168

2.5.3 Date of Test and Modification State

17 June 2011 - Modification State 0

2.5.4 Test Equipment Used

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

2.5.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 24.

Measurements of the fundamental from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The fundamental frequency was maximised by adjusting the antenna height, antenna polarisation and turntable azimuth. A peak detector was used with the trace set to max hold. The maximum result was recorded.

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

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

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2
- Mode 3

2.5.6 Environmental Conditions

	17 June 2011
Ambient Temperature	19.5°C
Relative Humidity	42.0%

Product Service

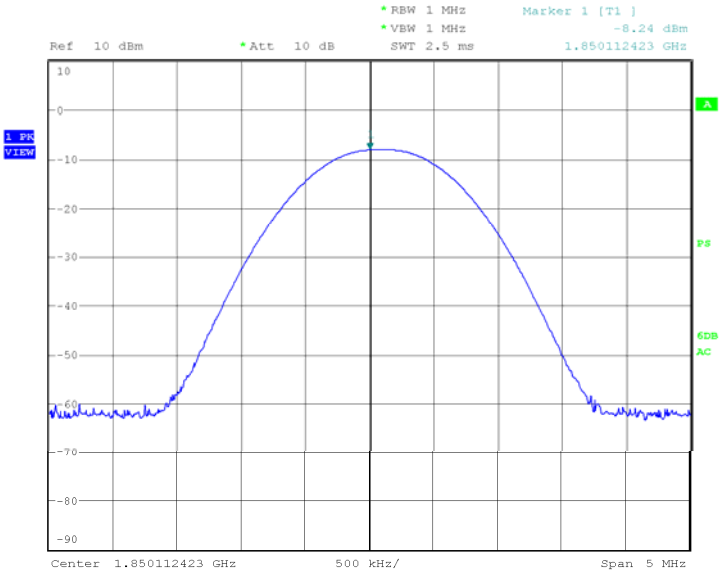
2.5.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 24 for Effective Isotropic Radiated Power.

The test results are shown below.

Configuration 1 - Mode 1

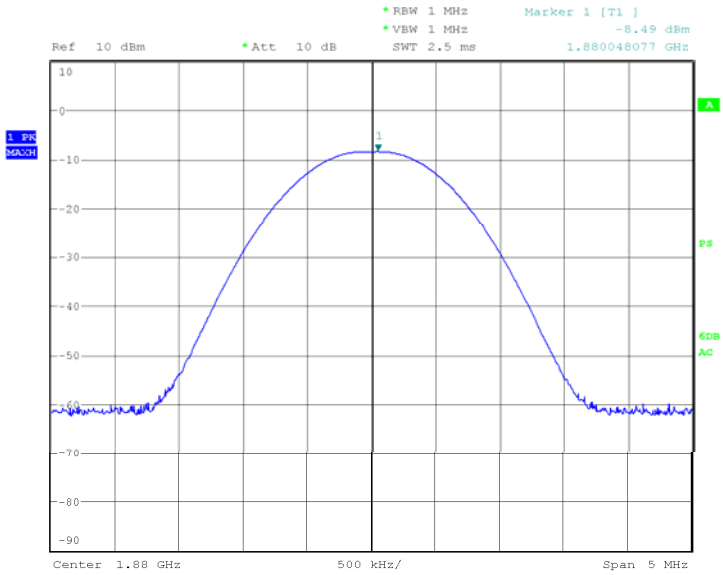
Frequency (MHz)	Result (dBm)	Limit (dBm)	Result (W)	Limit (W)
1850.2	32.5	38.45	1.78	7.0



Product Service

Configuration 1 - Mode 2

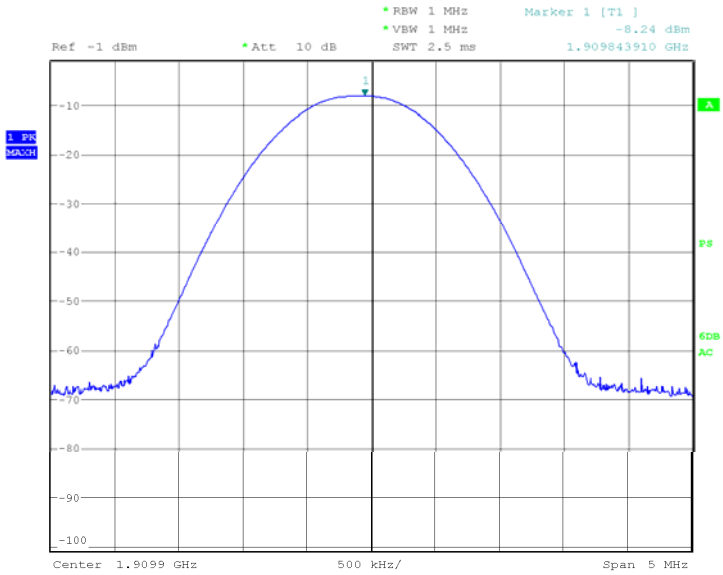
Frequency (MHz)	Result (dBm)	Limit (dBm)	Result (W)	Limit (W)
1880.0	32.8	38.45	1.91	7.0



Product Service

Configuration 1 - Mode 3

Frequency (MHz)	Result (dBm)	Limit (dBm)	Result (W)	Limit (W)
1909.8	32.5	38.45	1.78	7.0



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Limit Clause

Mobile – 7 W, Base Stations – 500 W

Product Service

2.6 EMISSION FOR BROADBAND PCS EQUIPMENT

2.6.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1051
FCC CFR 47 Part 24, Clause 24.238

2.6.2 Equipment Under Test

CDMA SHX11, S/N: IMEI: 004401113358168

2.6.3 Date of Test and Modification State

17 and 19 June 2011 - Modification State 0

2.6.4 Test Equipment Used

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

2.6.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 24.

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

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

The EUT was set to transmit on full power on GMSK modulation. The EUT was tested on bottom, middle and top channels at maximum power.

For any emissions found the EUT was then removed from the chamber and replaced with a substitution antenna. Using a signal generator the level was adjusted to achieve the same value on the measuring instrument as previously recorded with the EUT. The final result was determined by a calculation using the signal generator level, antenna gain and cable loss. The measurements were performed at a 3m distance unless otherwise stated.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2
- Mode 3

Product Service

2.6.6 Environmental Conditions

	17 June 2011	19 June 2011
Ambient Temperature	19.5°C	20.7°C
Relative Humidity	42.0%	46.0%

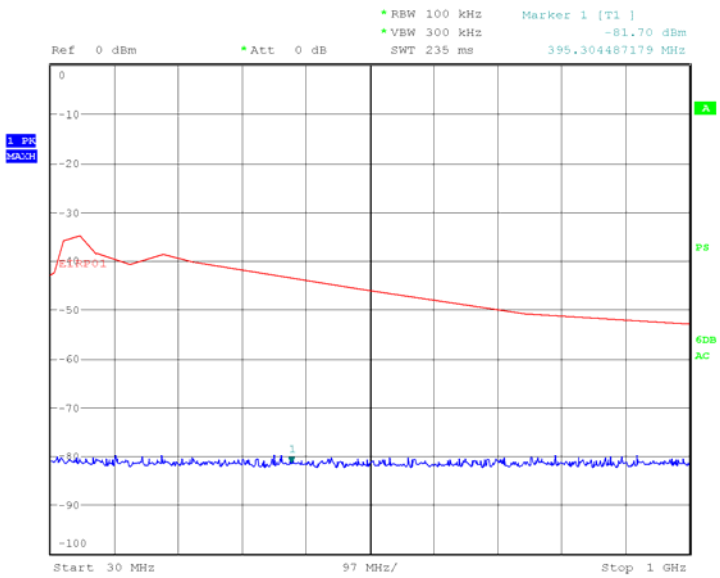
2.6.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 2 and 24 for Emission for Broadband PCS Equipment.

The test results are shown below.

Configuration 1 - Mode 1

30MHz to 1GHz



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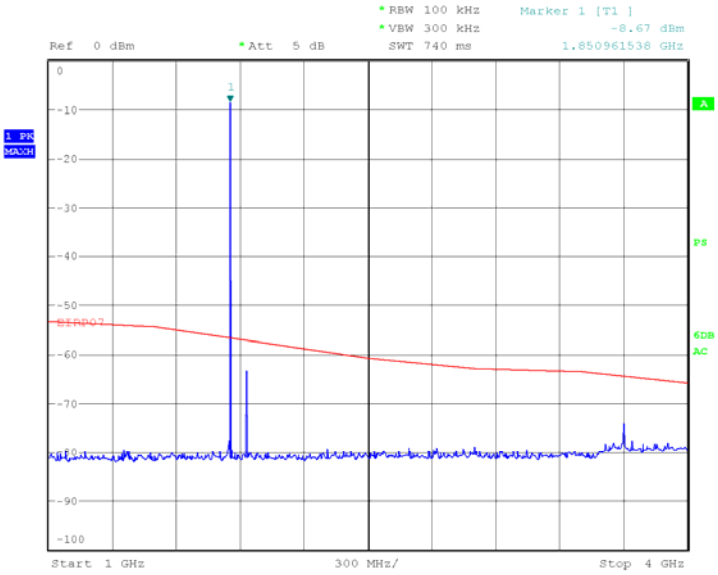
Product Service

1GHz to 4GHz



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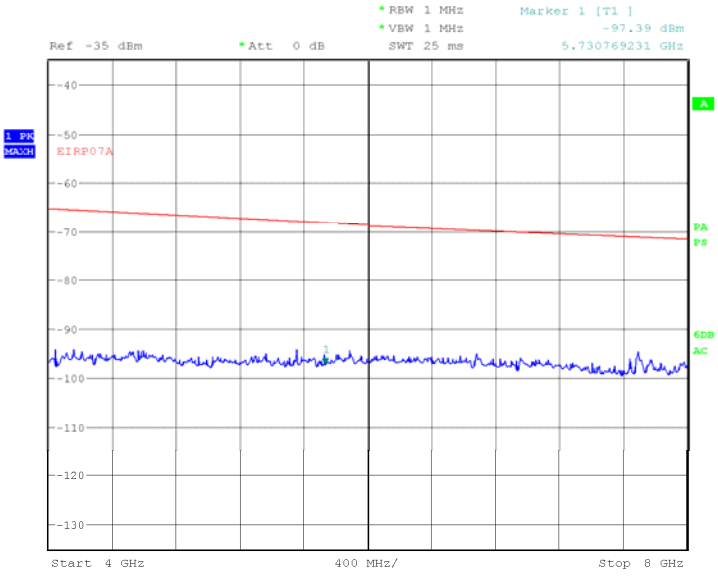
4GHz to 8GHz



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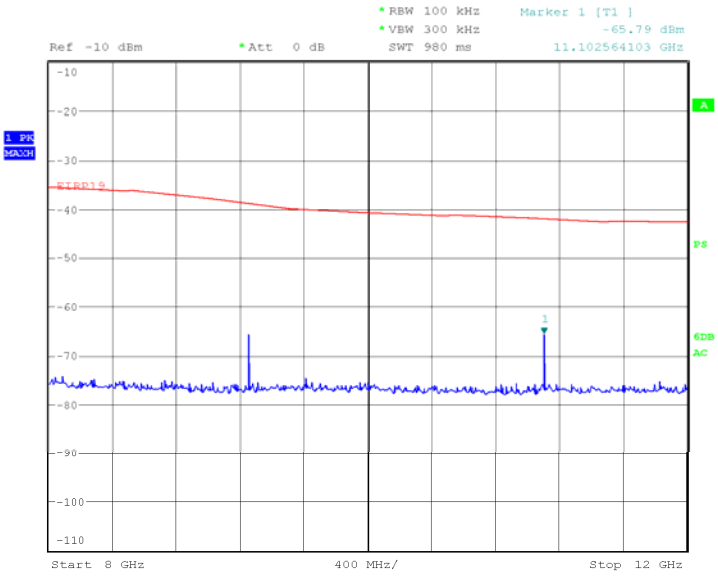
Product Service

8GHz to 12GHz



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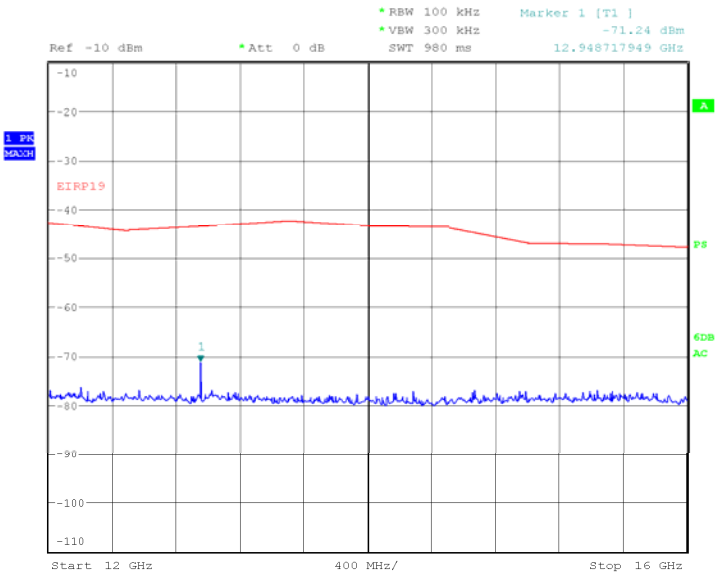
12GHz to 16GHz



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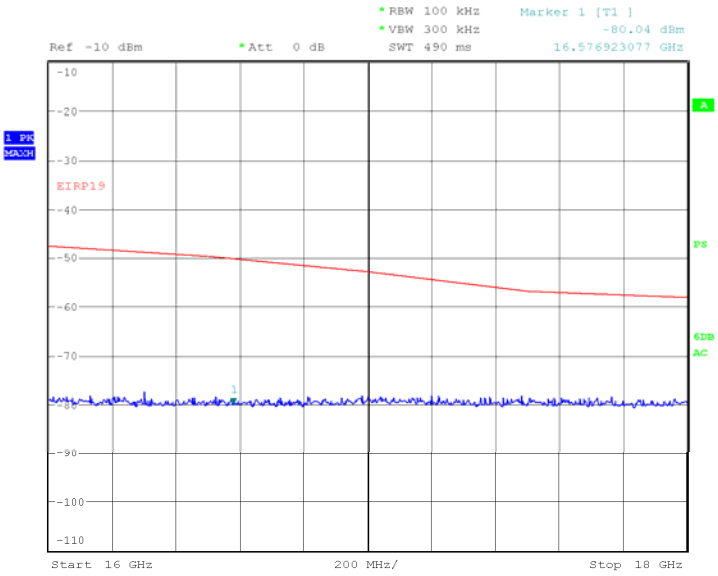
Product Service

16GHz to 18GHz



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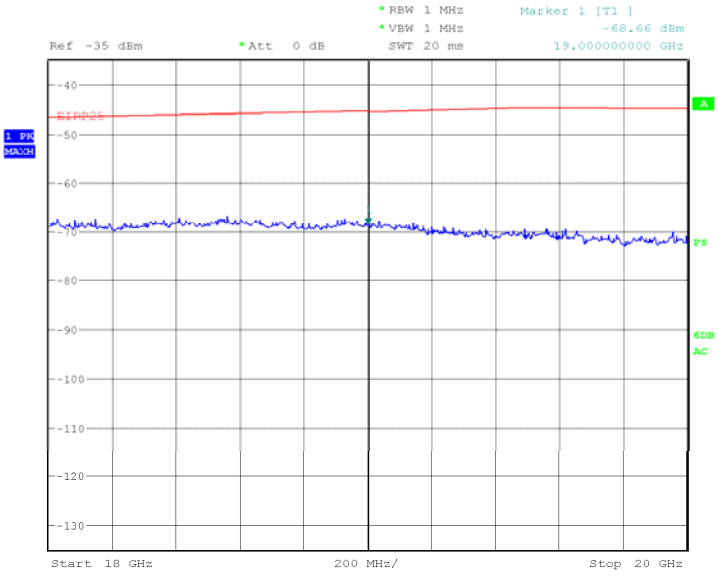
18GHz to 20GHz



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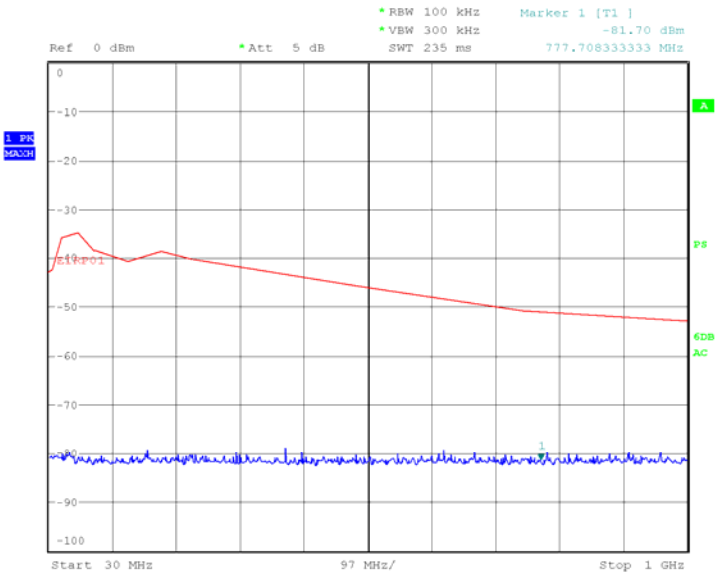
Product Service

Configuration 1 - Mode 2

30MHz to 1GHz



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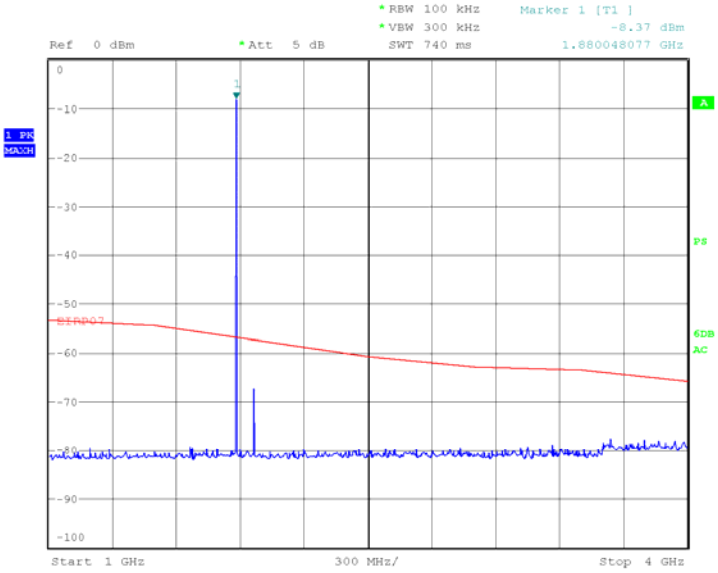
1GHz to 4GHz



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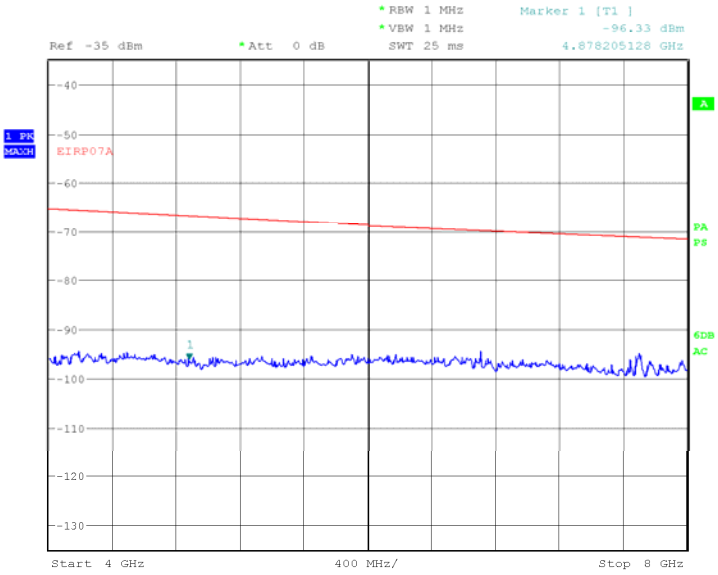
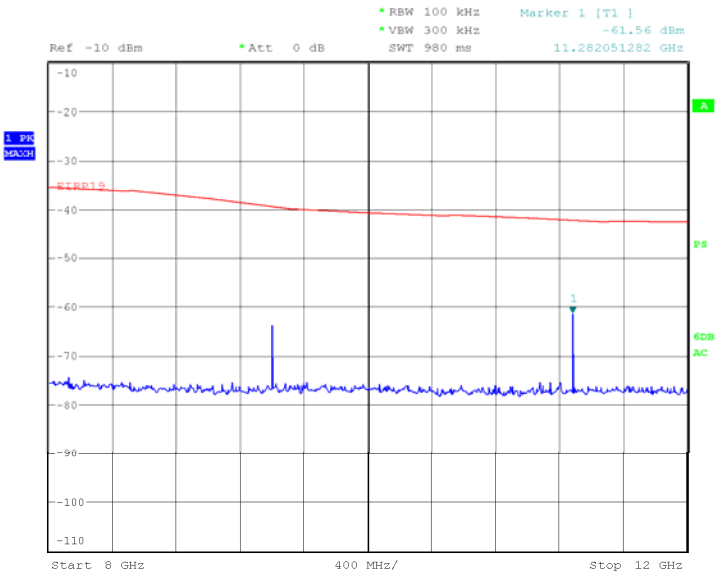
4GHz to 8GHz



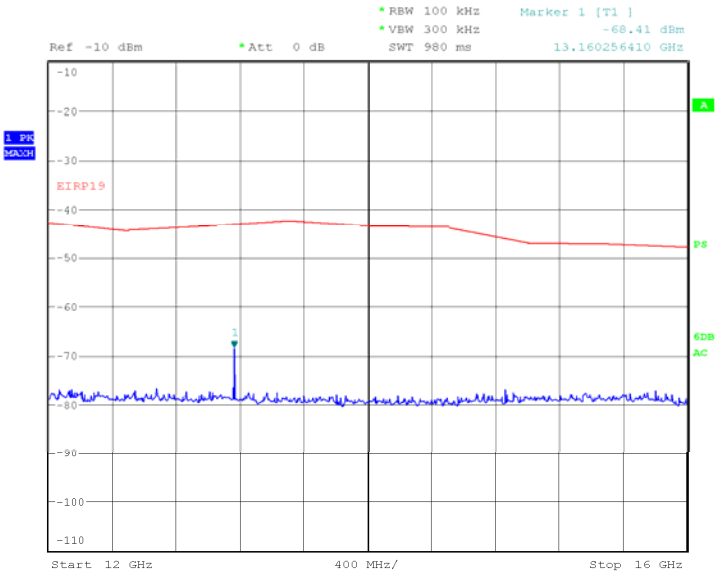
Date: 18.JUN.2011 01:35:19

8GHz to 12GHz



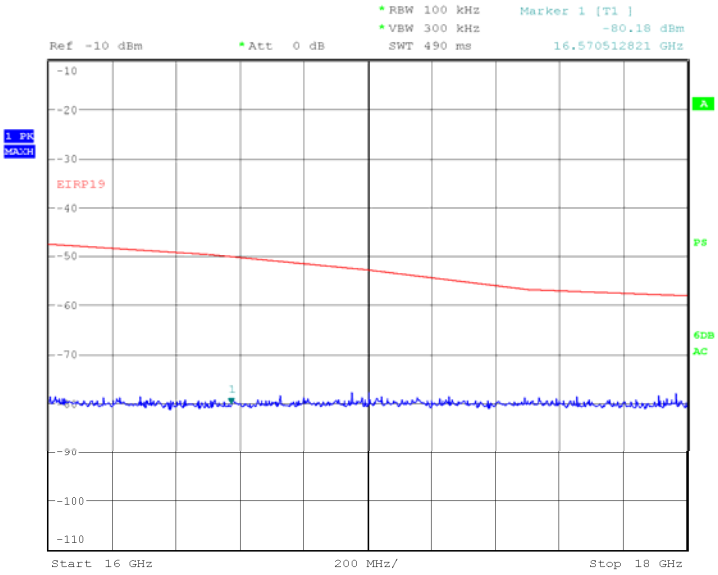
Date: 18.JUN.2011 03:22:14

12GHz to 16GHz



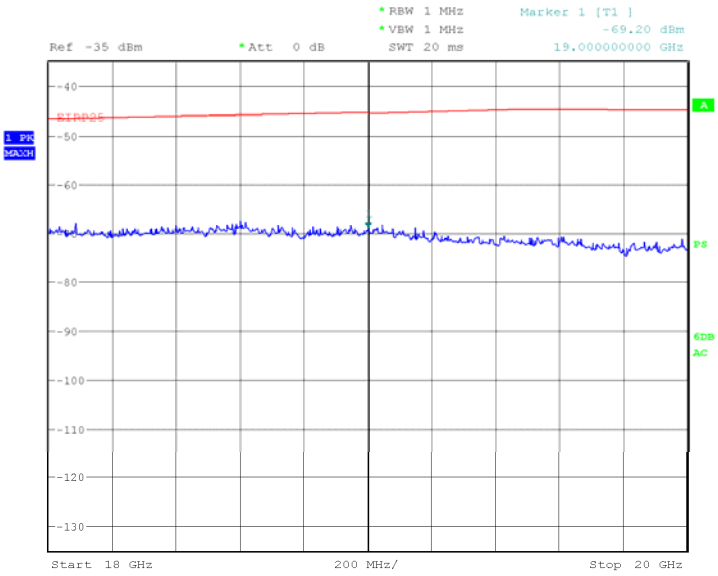
Date: 18.JUN.2011 03:25:47

16GHz to 18GHz



Date: 18.JUN.2011 03:28:07

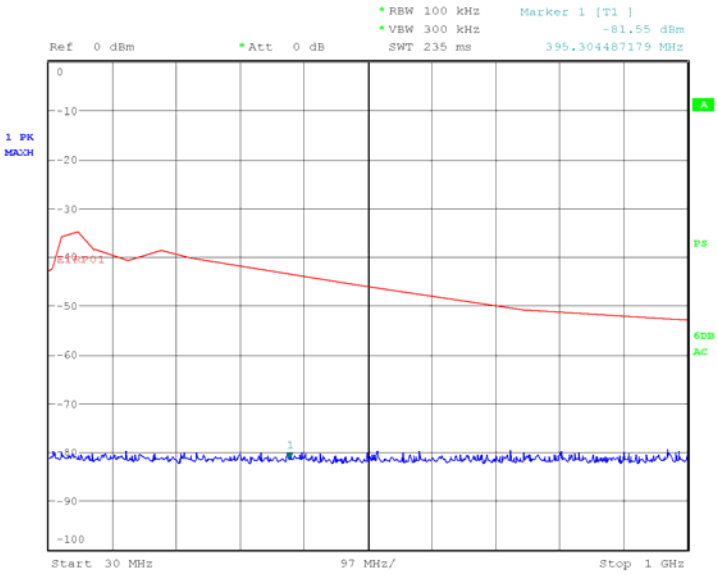
18GHz to 20GHz



Date: 19.JUN.2011 11:50:12

Configuration 1 - Mode 3

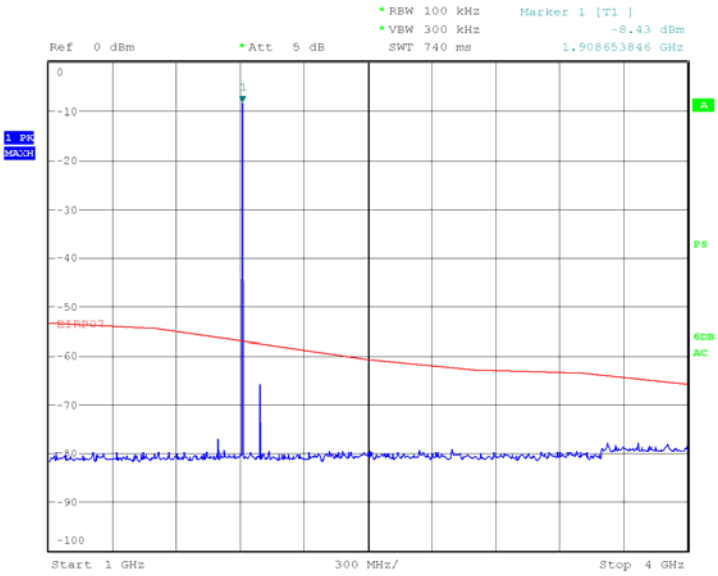
30MHz to 1GHz



Date: 17.JUN.2011 23:13:12

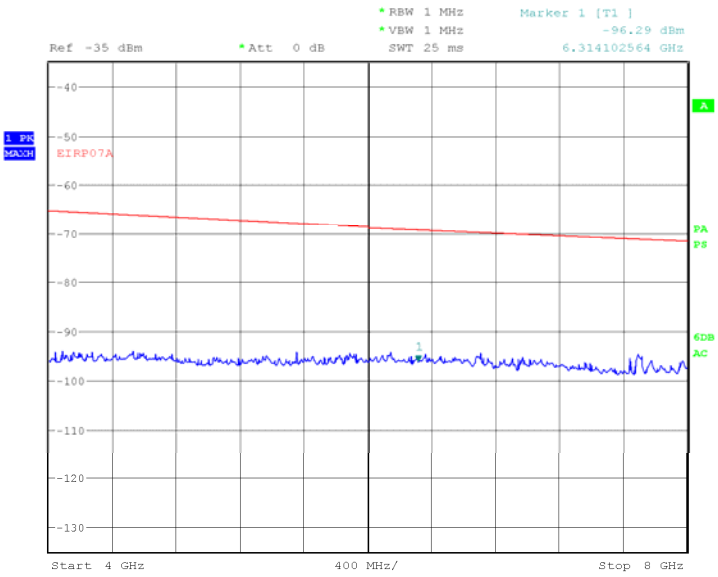
Product Service

1GHz to 4GHz



Date: 18.JUN.2011 01:13:10

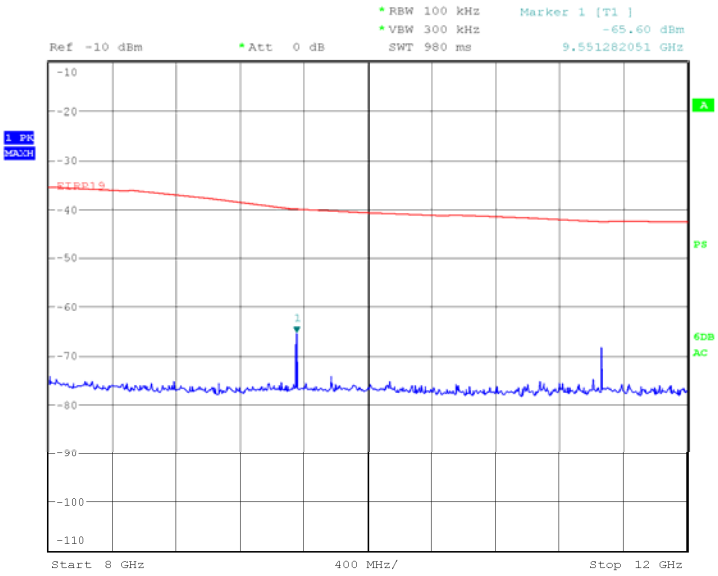
4GHz to 8GHz



Date: 18.JUN.2011 01:43:56

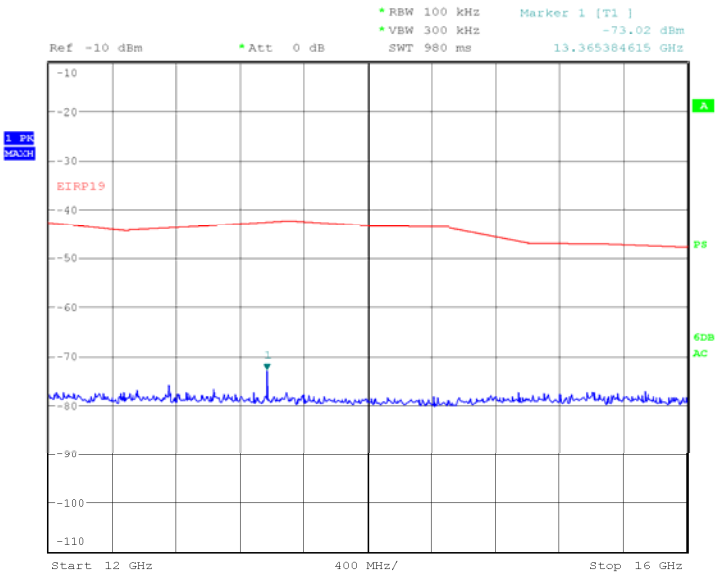
Product Service

8GHz to 12GHz



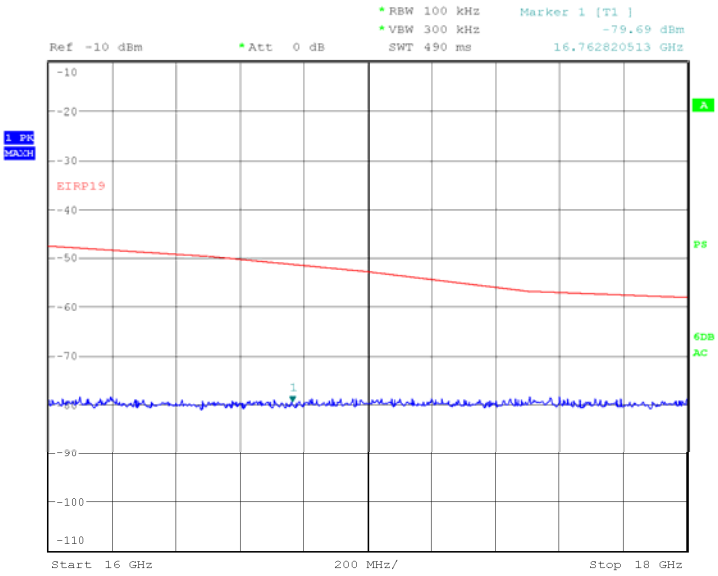
Date: 18.JUN.2011 03:37:25

12GHz to 16GHz



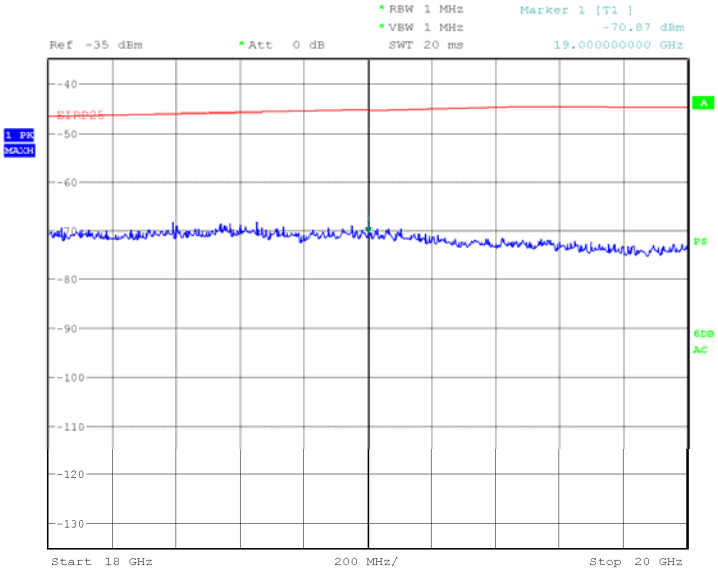
Date: 18.JUN.2011 03:34:48

16GHz to 18GHz



Date: 18.JUN.2011 03:32:44

18GHz to 20GHz



Date: 19.JUN.2011 11:52:03

Limit Clause

43+10log(P) or -13 dBm

Product Service

2.7 CONDUCTED SPURIOUS EMISSIONS

2.7.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1051
FCC CFR 47 Part 24, Clause 24.238(a)

2.7.2 Equipment Under Test

CDMA SHX11, S/N: IMEI: 004401113358168

2.7.3 Date of Test and Modification State

20 May 2011 - Modification State 0

2.7.4 Test Equipment Used

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

2.7.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 24.

In accordance with Part 2.1051, the spurious emissions from the antenna terminal were measured. The transmitter output power was attenuated using a combination of filters and attenuators and the frequency spectrum investigated from 9 kHz to 20 GHz. The EUT was set to transmit on full power with GMSK modulation. The EUT was tested on Bottom, Middle and Top channels for maximum power. The resolution and video bandwidths were set to 1 MHz and 3 MHz thus meeting the requirements of Part 24.238(a). The spectrum analyser detector was set to max hold.

From 9 kHz to 4 GHz, an attenuator was used. For measuring the range 4 GHz to 20 GHz an attenuator and high pass filter were used. This was to reduce saturation effects in the spectrum analyser.

The maximum path loss across the measurement band were used as reference level offsets to ensure worst case.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2
- Mode 3

Product Service

2.7.6 Environmental Conditions

	20 May 2011
Ambient Temperature	27.2°C
Relative Humidity	25.7%

2.7.7 Test Results

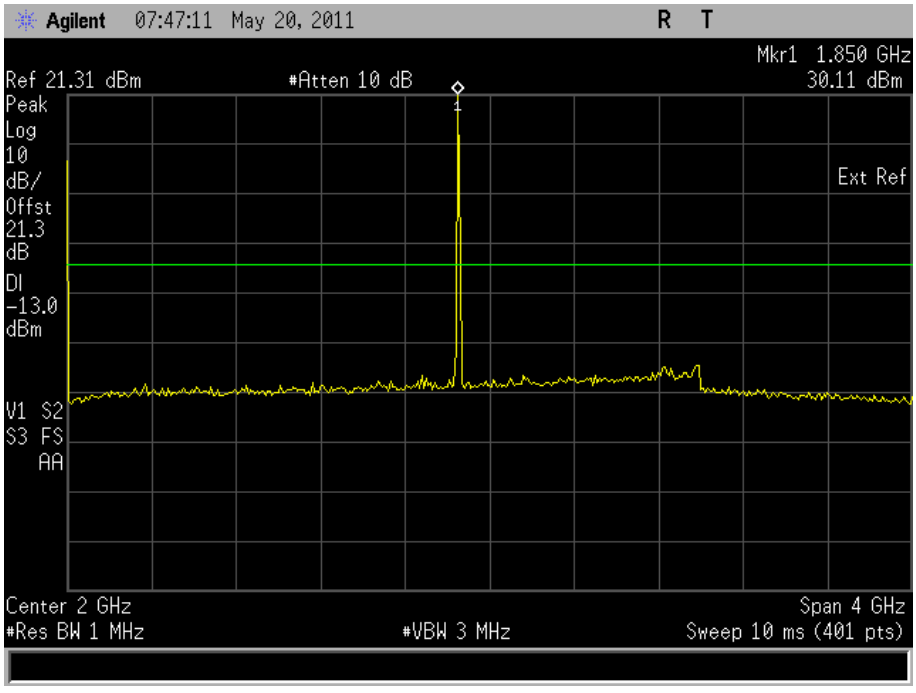
For the period of test the EUT met the requirements of FCC CFR 47 Part 2 and 24 for Conducted Spurious Emissions.

The test results are shown below.

4.0 V DC Supply

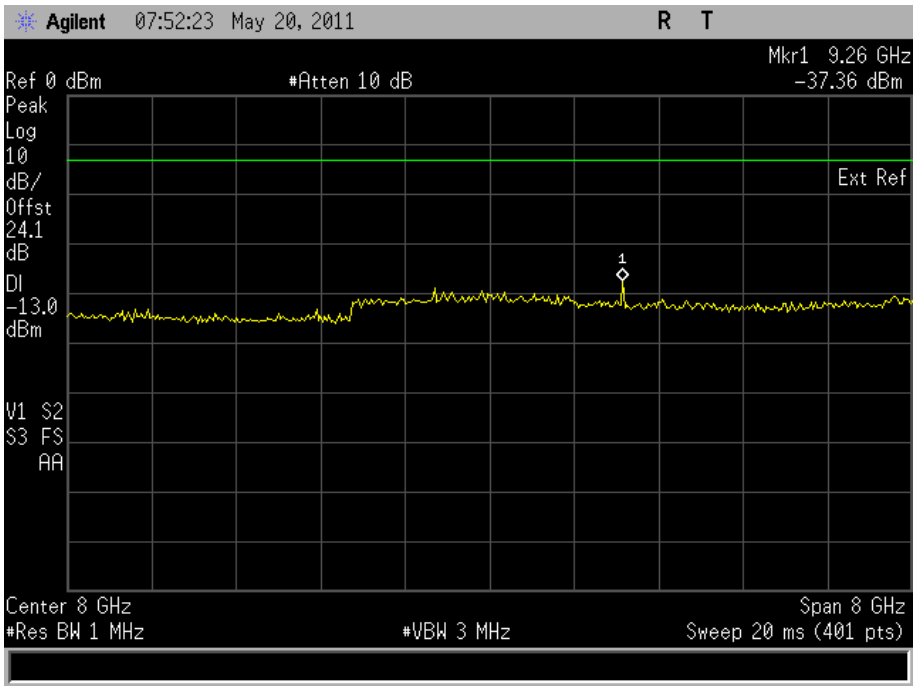
Configuration 1 – Mode 1

9 kHz to 4 GHz

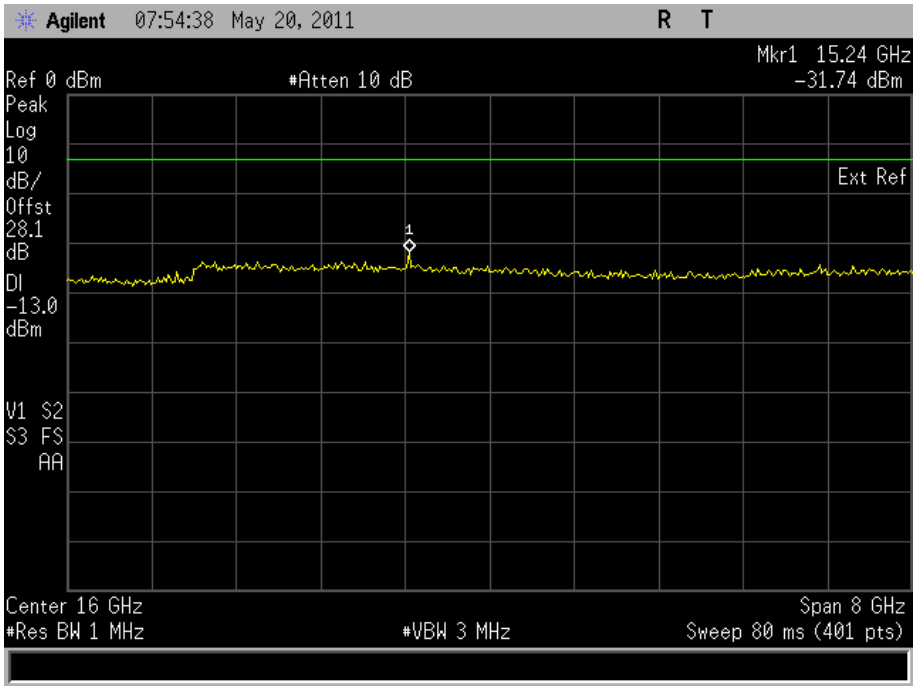


Product Service

4 GHz to 12 GHz



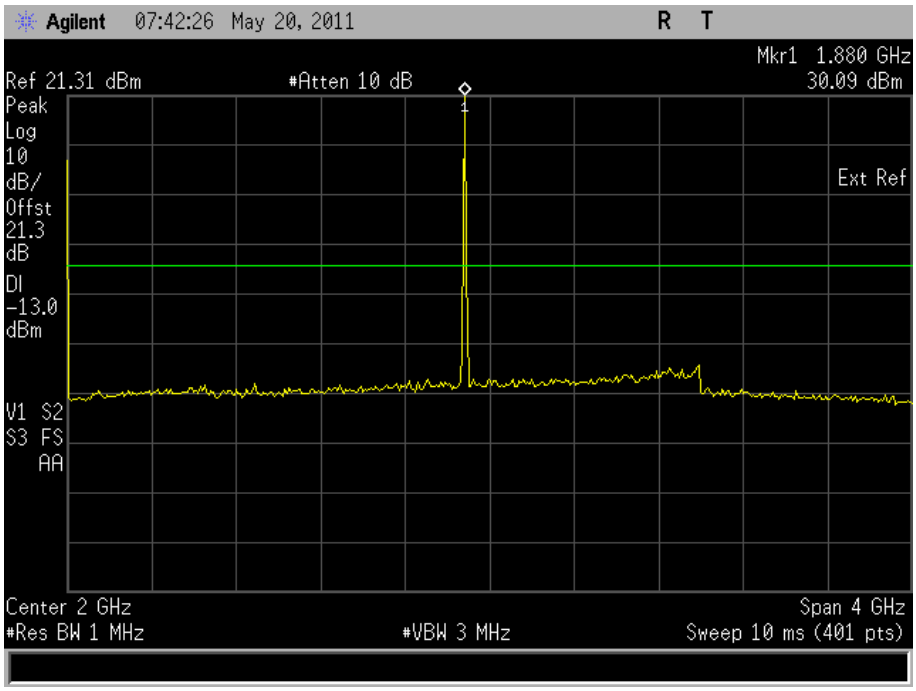
12 GHz to 20 GHz



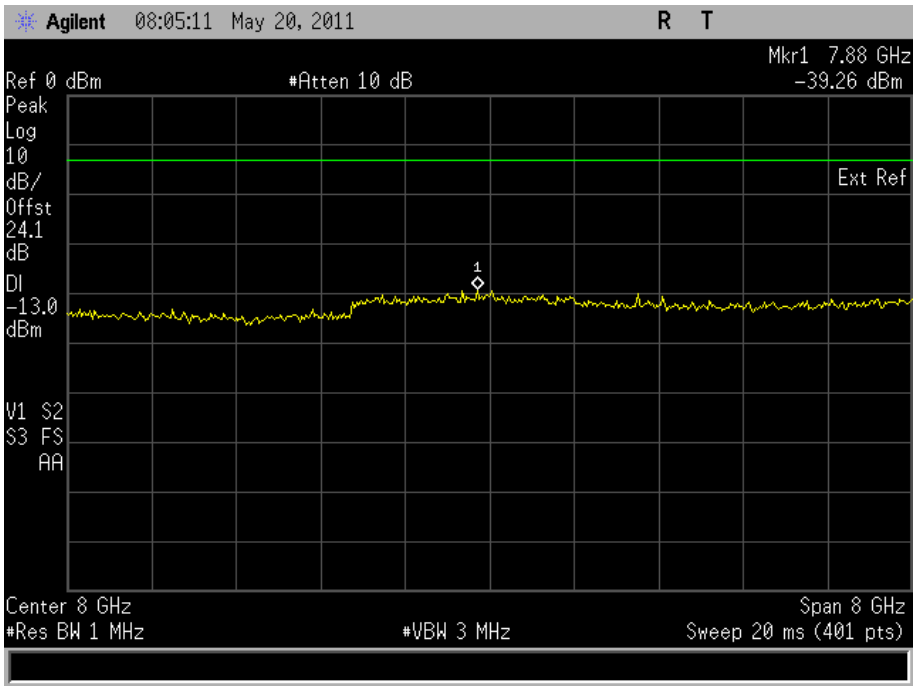
Product Service

Configuration 1 - Mode 2

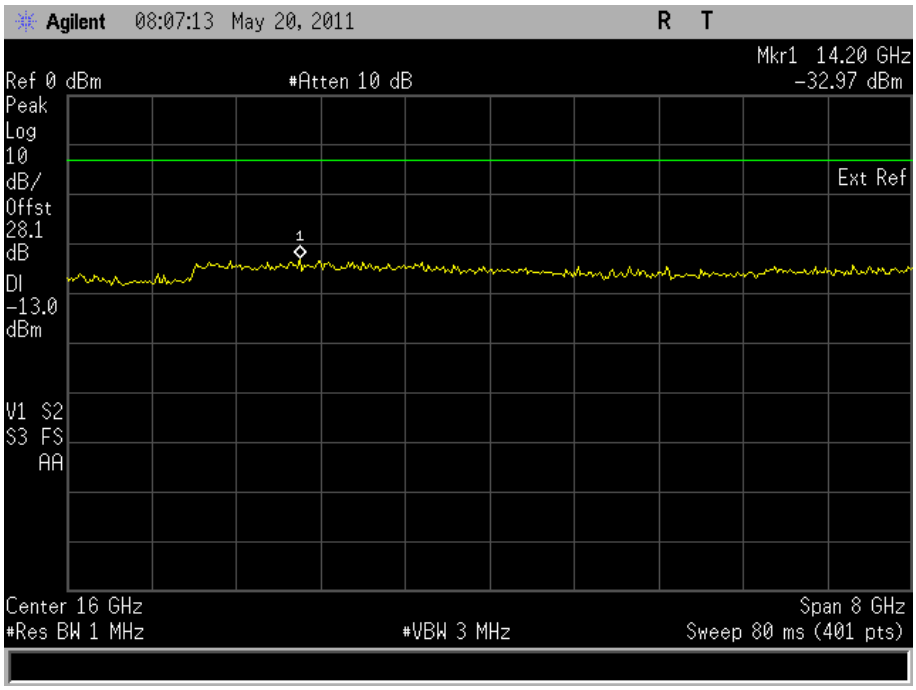
9 kHz to 4 GHz



4 GHz to 12 GHz

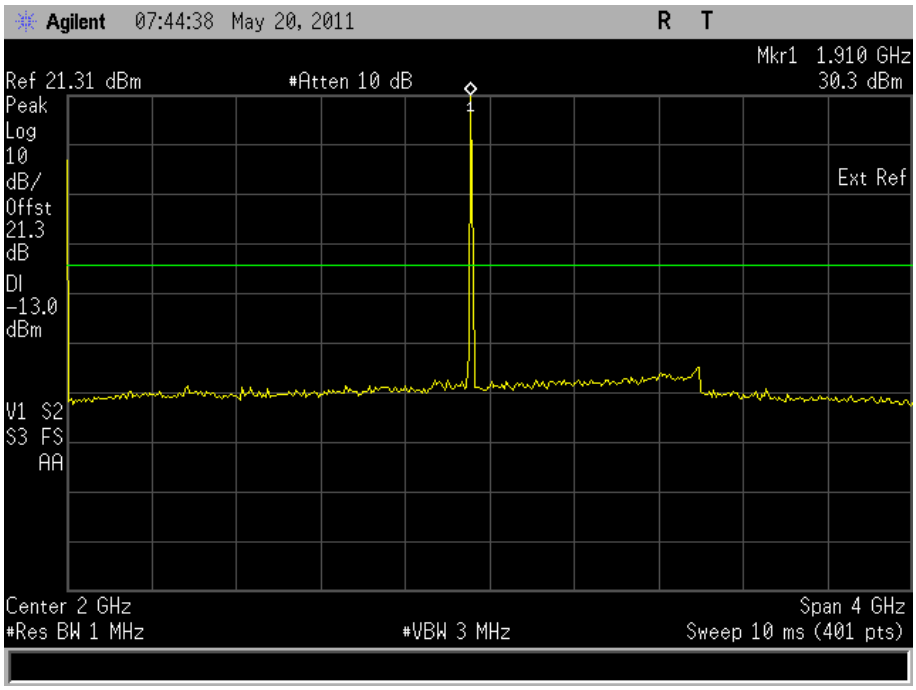


12 GHz to 20 GHz



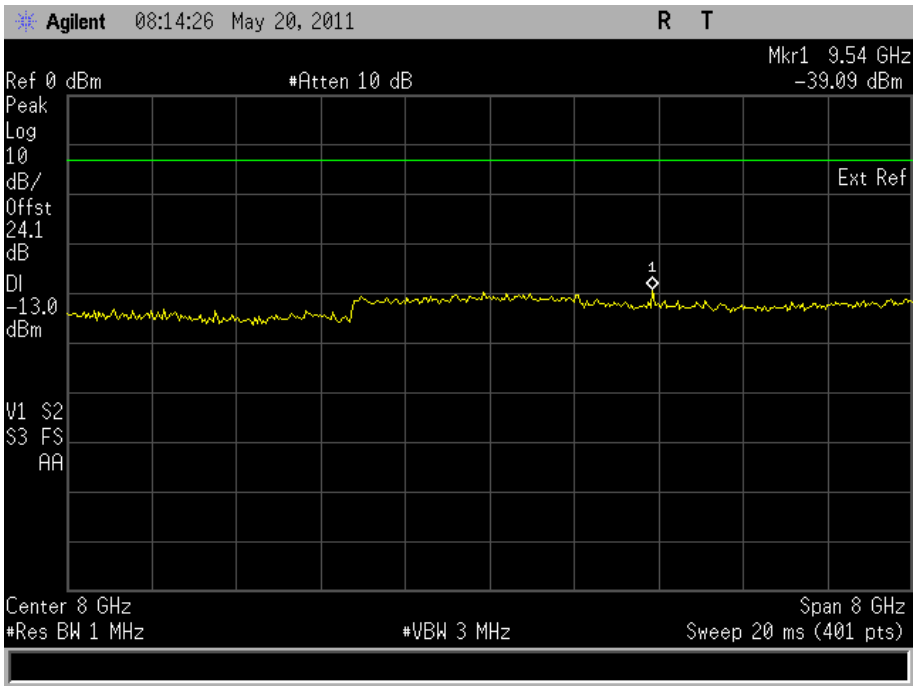
Configuration 1 - Mode 3

9 kHz to 4 GHz

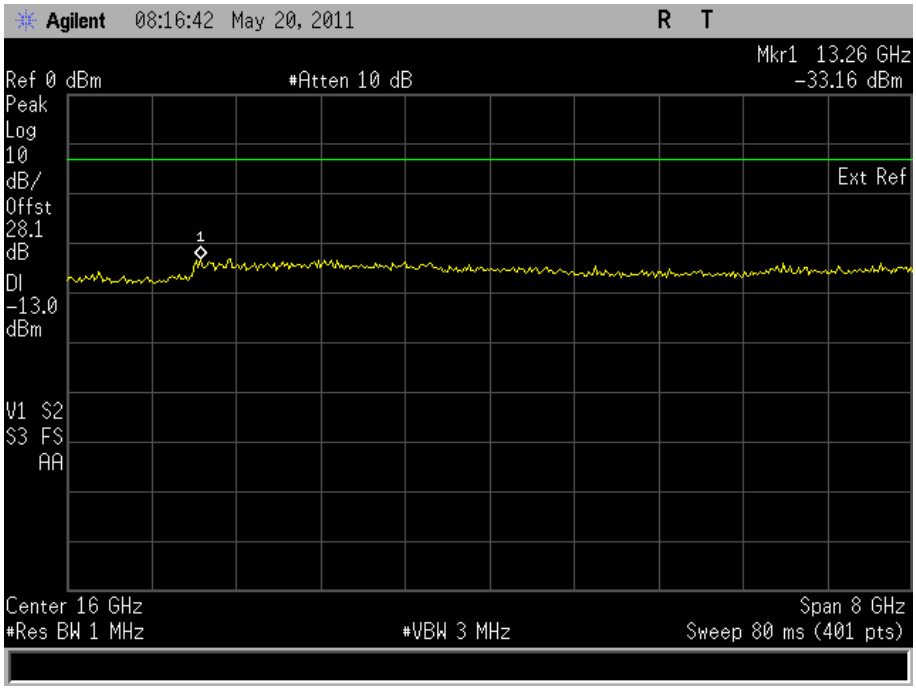


Product Service

4 GHz to 12 GHz



12 GHz to 20 GHz



Limit Clause

43+10log(P) or -13 dBm

Product Service

2.8 OCCUPIED BANDWIDTH

2.8.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1049
FCC CFR 47 Part 24, Clause 24.238(a)

2.8.2 Equipment Under Test

CDMA SHX11, S/N: IMEI: 004401113358168

2.8.3 Date of Test and Modification State

19 May 2011 - Modification State 0

2.8.4 Test Equipment Used

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

2.8.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2 and 24.

The EUT was transmitting at maximum power, with GMSK modulation. Using a resolution bandwidth of 10 kHz and a video bandwidth of 30 kHz, the -26 dBc points were established and the emission bandwidth determined.

The plot of the following pages shows the resultant display from the Spectrum Analyser.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2
- Mode 3

2.8.6 Environmental Conditions

	19 May 2011
Ambient Temperature	27.2°C
Relative Humidity	25.7%

Product Service

2.8.7 Test Results

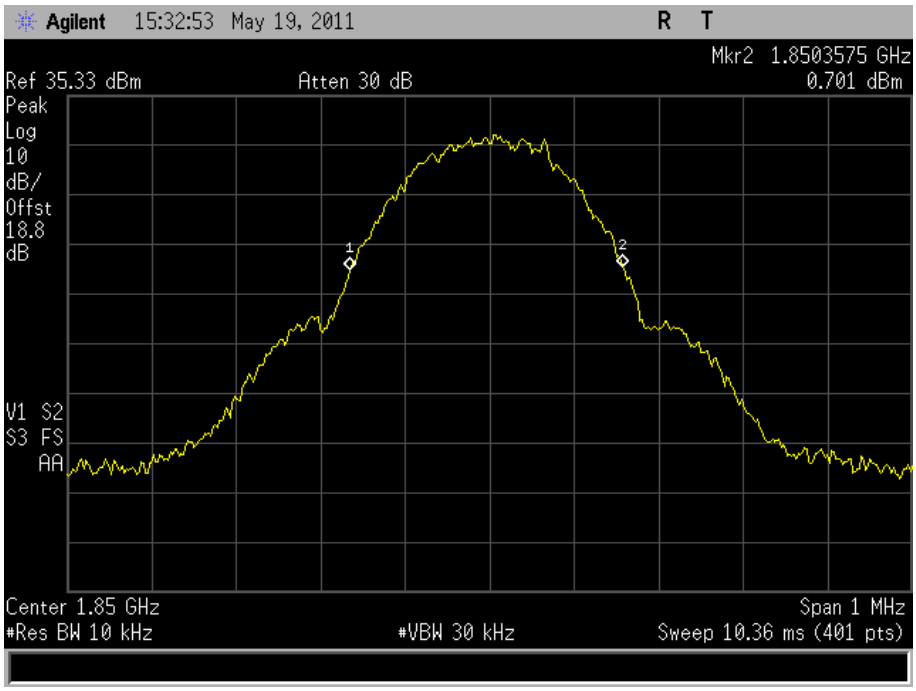
For the period of test the EUT met the requirements of FCC CFR 47 Part 2 and 24 for Occupied Bandwidth.

The test results are shown below.

4.0 V DC Supply

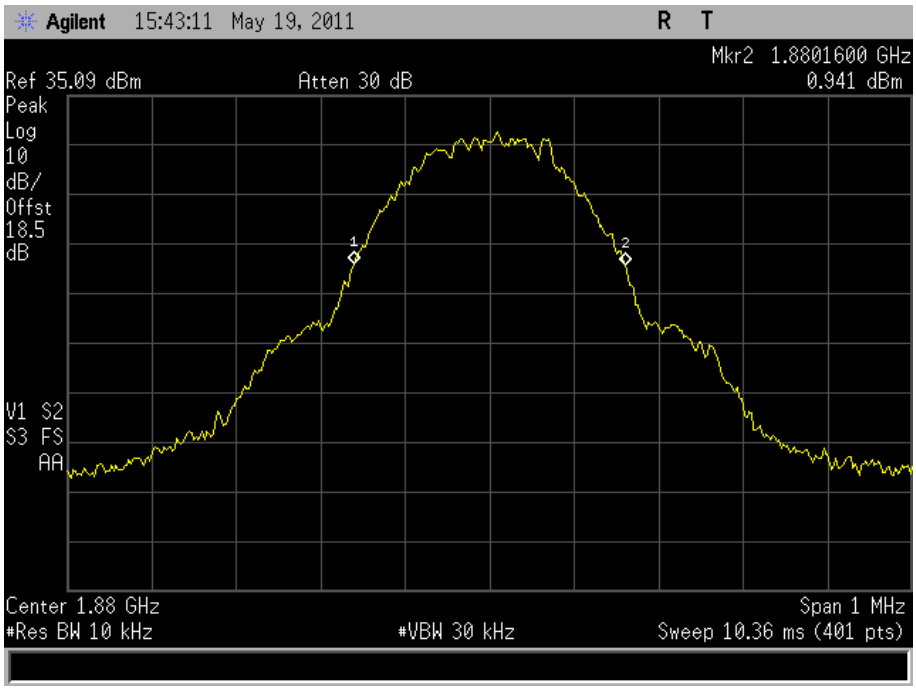
Frequency (MHz)	Mode	Occupied Bandwidth (kHz)
1850.2	GMSK	322.5
1880.0	GMSK	320.0
1909.8	GMSK	320.0

Configuration 1 – Mode 1

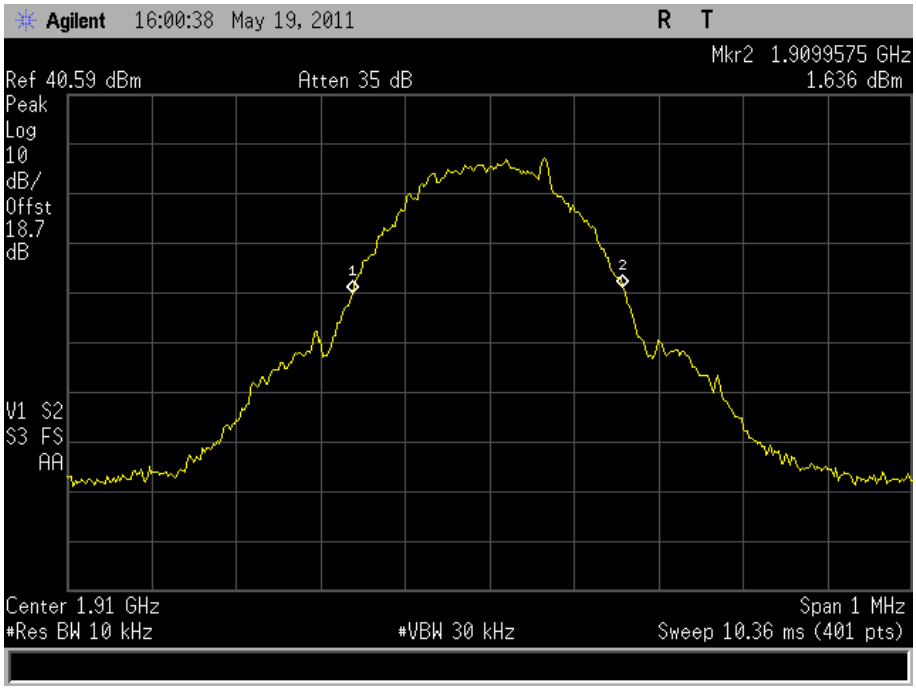


Product Service

Configuration 1 - Mode 2



Configuration 1 - Mode 3



Limit Clause

The occupied bandwidth, that is the frequency bandwidth such that, below is lower and above is upper frequency limits, the mean powers radiated are each equal to 0.5% of the total mean power radiated by a given emission.

Product Service

2.9 MODULATION CHARACTERISTICS

2.9.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1047(d)

2.9.2 Equipment Under Test

CDMA SHX11, S/N: IMEI: 004401113358168

2.9.3 Date of Test and Modification State

19 May 2011 - Modification State 0

2.9.4 Test Equipment Used

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

2.9.5 Test Method and Operating Modes

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 2.

Description Of Modulation Technique

The modulation scheme used in GSM is called Gaussian Minimum Shift Keying (GMSK). GMSK facilitates the use of narrow bandwidth and allows for both coherent and non coherent detection capabilities. It is a scheme in which the transitions from One to Zero or Zero to One do not occur quickly, but over a period of time. If pulses are transmitted quickly harmonics are transmitted. The power spectrum for a square wave is rich in harmonics, and the power within the side lobes is wasted, and can be a cause of potential interference.

A method to reduce the harmonics is to round off the edges of the pulses thus lowering the spectral components of the signal. In GSM this is done by using a Gaussian pre-filter which typically has a bandwidth of 81.25kHz. The output from the Gaussian filter then phase modulates the carrier. As there are no dramatic phase transitions of the carrier this gives a constant envelope and low spectral component output from the transmitter.

The spectral efficiency is calculated by

bit rate / Channel bandwidth = 270.83333 kbit/s / 200 kHz = 1.354 bit/s/Hz.

The bandwidth product BT = Bandwidth x bit duration = 81.25 kHz x 3.6923 micros = 0.3

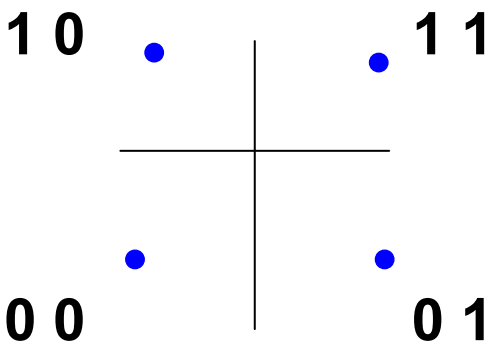
GMSK OVERVIEW

The modulation scheme used for the EUT is GMSK.

A brief overview of how GMSK works is shown below.

GMSK (Gaussian Minimum Shift Keying)

The fundamental principal behind GMSK is Phase shift keying. This splits a data stream into a series of 2-digit phase shifts, using the following phase shifts to represent data pairs.



Therefore for the BIT sequence 0 0 1 1 1 0 0 1 The corresponding phase shift will be used

BIT SEQUENCE	0 0	1 1	1 0	01
PHASE	225º	45º	135º	315º

This is called QPSK (Quadratic Phase Shift Keying)

However

There is a problem with QPSK: transition from e.g. 00 to 11 gives phase shift of 180° (π radians). This has the effect of inverting the carrier waveform and this can lead to detection errors at the receiver.

Solution: restrict phase changes to ± 90°

1. Split bitstream into 2 streams e.g.

	0 0		1 1		0 1		1 0	
I Stream	0		1		0		1	
Q stream		0		1		1		0

2. Modulate each stream with PSK (1 = 90° or π/2, 0 = -90° or - π/2 phase shift)

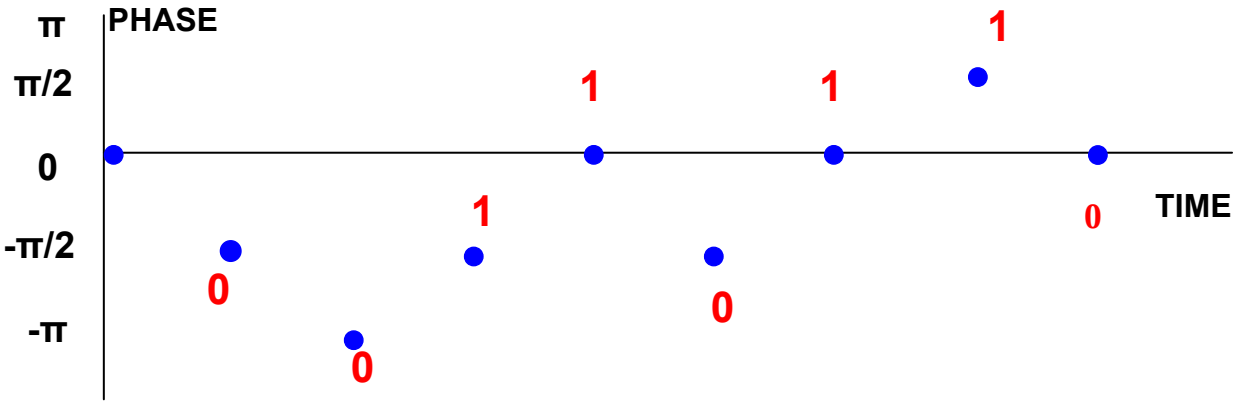
I Stream	0		1		0		1	
	-π/2		-π/2		-π/2		π/2	
Q stream		0		1		1		0
		-π/2		π/2		π/2		-π/2

Product Service

3. Combine (add) the two PSK signals:

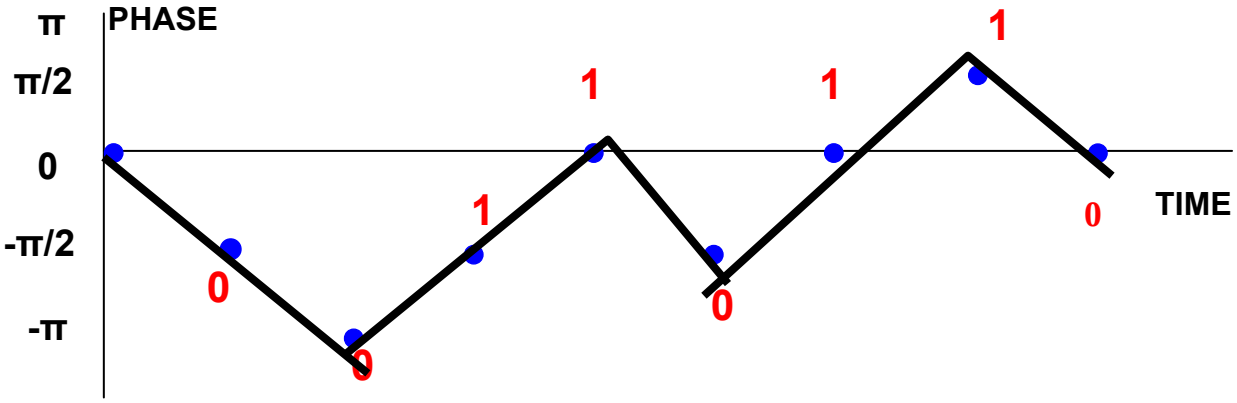
Combined Phase	-π/2	-π	-π/2	0	-π/2	0	π/2	0

Result: offset - QPSK, phase change is restricted to ± π/2 radians:



It would be preferable to have "gradual" changes in place between each pair of bits (Continuous-phase modulation). Replacing each “rectangular” shaped pulse (for 1 or 0) with a sinusoidal pulse can do this:

Result: Minimum Shift Keying (MSK):



Gaussian Minimum Shift Keying

MSK has high sidebands relative to the main lobes in the frequency domain - this can lead to interference with adjacent signals.

If the rectangular pulses corresponding to the bitstream are filtering using a Gaussian-shaped impulse response filter, we get Gaussian MSK (GMSK) - this has low sidelobes compared to MSK.

The test was performed with the EUT in the following configurations and modes of operation:

Configuration 1 - Mode 1
- Mode 2
- Mode 3

Product Service

2.9.6 Environmental Conditions

	19 May 2011
Ambient Temperature	27.2°C
Relative Humidity	25.7%

Product Service

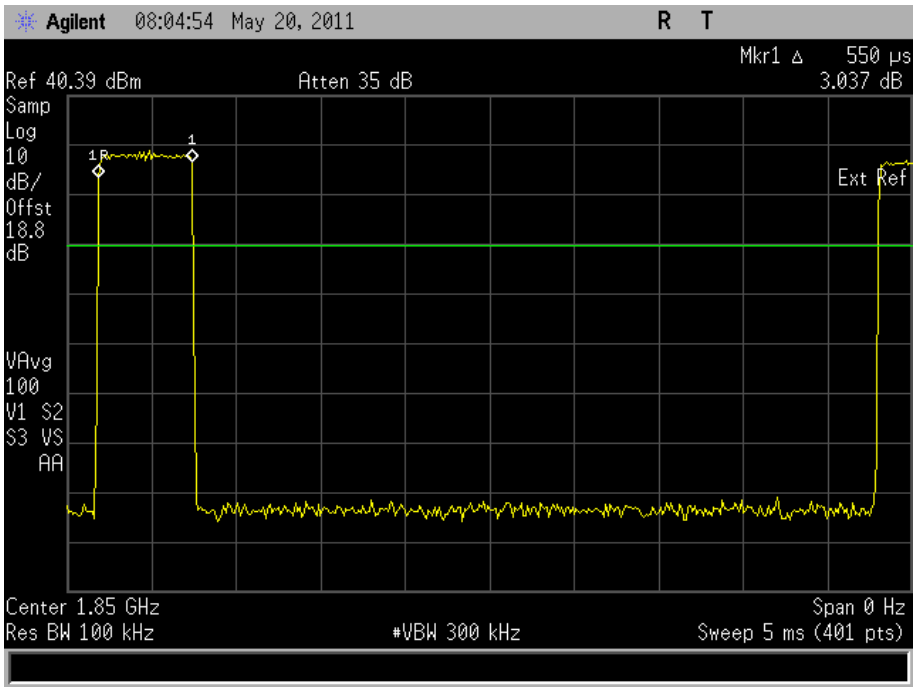
2.9.7 Test Results

For the period of test the EUT met the requirements of FCC CFR 47 Part 2 for Modulation Characteristics.

The test results are shown below.

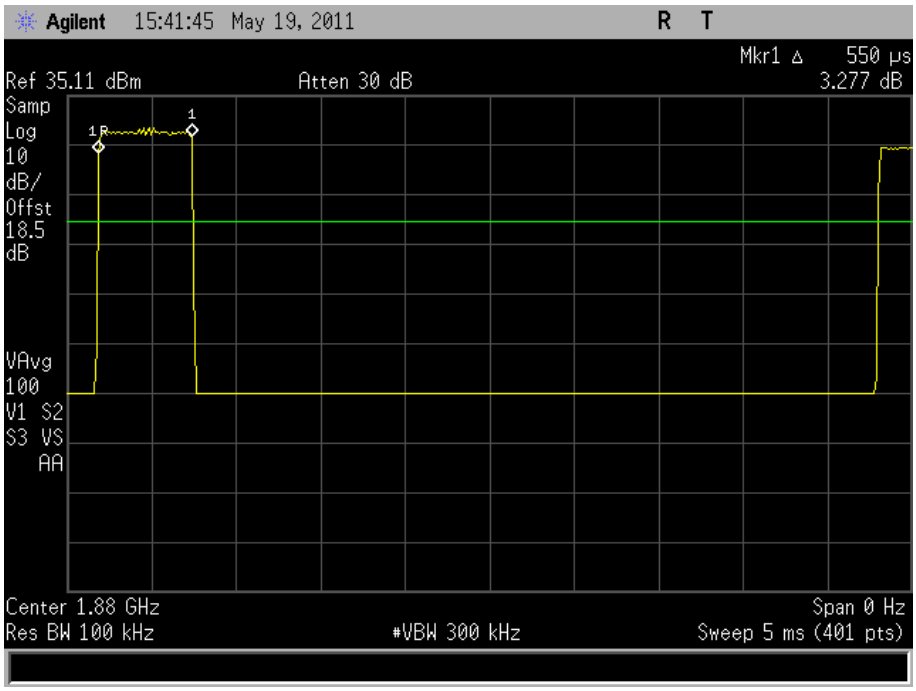
4.0 V DC Supply

Configuration 1 – Mode 1

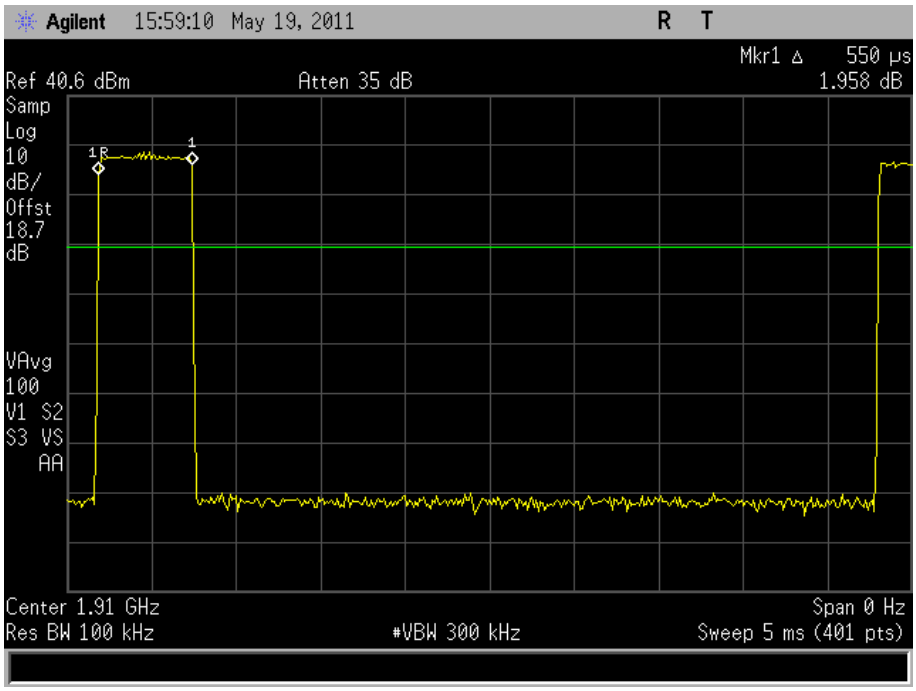


Product Service

Configuration 1 – Mode 2



Configuration 1 – Mode 3



Product Service

SECTION 3

TEST EQUIPMENT USED

Product Service

3.1 TEST EQUIPMENT USED

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

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1 - Frequency Stability under Temperature Variations					
Radiocommunications Tester	Rohde & Schwarz	CMU 200	39	12	18-Nov-2011
Multimeter	White Gold	WG022	190	12	26-Oct-2011
Temperature Chamber	Montford	2F3	467	-	O/P Mon
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	12	23-Jun-2011
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Thermocouple Thermometer	Fluke	51	3173	12	12-Jul-2011
Hygrometer	Rotronic	I-1000	3220	12	3-May-2012
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3700	12	11-Jan-2012
Combiner/Splitter	Weinschel	1506A	3880	12	22-Feb-2012
Section 2.2 - Frequency Stability under Voltage Variations					
Multimeter	White Gold	WG022	190	12	26-Oct-2011
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	12	23-Jun-2011
Spectrum Analyser	Hewlett Packard	E4407B	1154	12	17-Jun-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	11-Sep-2011
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	3-May-2012
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	8-Feb-2012
Combiner/Splitter	Weinschel	1506A	3880	12	22-Feb-2012
Section 2.3 – Spurious Emissions at Band Edge					
Radiocommunications Tester	Rohde & Schwarz	CMU 200	39	12	18-Nov-2011
Multimeter	White Gold	WG022	190	12	26-Oct-2011
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	12	23-Jun-2011
Attenuator (10dB)	Weinschel	47-10-34	481	12	24-Mar-2012
Spectrum Analyser	Hewlett Packard	E4407B	1154	12	17-Jun-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	11-Sep-2011
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Multimeter	Iso-tech	IDM101	2424	12	3-Sep-2011
Filter	Daden Anthony Ass	MH-1500-7SS	2778	12	22-Dec-2011
Attenuator (3dB)	Suhner	6803.17.B	3026	12	24-Mar-2012
Hygrometer	Rotronic	I-1000	3220	12	3-May-2012
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	8-Feb-2012
'3.5mm' - '3.5mm' RF Cable (1m)	Rhophase	3PS-1803-1000-3PS	3697	12	28-Jan-2012
Combiner/Splitter	Weinschel	1506A	3879	12	22-Feb-2012
Combiner/Splitter	Weinschel	1506A	3880	12	22-Feb-2012

Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.4 - Maximum Peak Output Power					
Antenna (Double Ridge Guide)	EMCO	3115	34	12	17-Jul-2011
Spectrum Analyser	Rohde & Schwarz	FSEM	37	12	18-Apr-2012
Radiocommunications Tester	Rohde & Schwarz	CMU 200	39	12	18-Nov-2011
Power Meter	Hewlett Packard	436A	94	12	11-Oct-2011
Peak Power Analyser	Hewlett Packard	8990A	107	12	11-Feb-2012
Multimeter	White Gold	WG022	190	12	26-Oct-2011
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	12-Nov-2011
Power Sensor	Hewlett Packard	8484A	420	12	6-Sep-2011
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	12	23-Jun-2011
Attenuator (10dB)	Weinschel	47-10-34	481	12	24-Mar-2012
Spectrum Analyser	Hewlett Packard	E4407B	1154	12	17-Jun-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	11-Sep-2011
Spectrum Analyser	Agilent	E7405A	1410	12	29-Mar-2012
Attenuator	Hewlett Packard	11708A	1507	12	17-Dec-2011
Screened Room (5)	Rainford	Rainford	1545	24	3-Feb-2014
Screened Room (8)	Rainford	Rainford	1548	-	TU
Turntable/Mast Controller	EMCO	2090	1609	-	TU
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Multimeter	Iso-tech	IDM101	2424	12	3-Sep-2011
Programmable Power Supply	Iso-tech	IPS 2010	2437	-	O/P Mon
Hygromer	Rotronic	A1	2677	12	20-Jan-2012
Power Sensor	Hewlett Packard	84812A	2743	-	TU
Filter	Daden Anthony Ass	MH-1500-7SS	2778	12	22-Dec-2011
Hygrometer	Rotronic	I-1000	2882	12	10-Jul-2011
Attenuator (3dB)	Suhner	6803.17.B	3026	12	24-Mar-2012
Antenna (DRG Horn)	ETS-LINDGREN	3115	3125	12	27-Apr-2012
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	3171	12	12-Aug-2011
Hygrometer	Rotronic	I-1000	3220	12	3-May-2012
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011
Signal Generator: 10MHz to 20GHz	Rohde & Schwarz	SMR20	3475	12	20-Dec-2011
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	9-Sep-2011
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	8-Feb-2012
'3.5mm' - '3.5mm' RF Cable (1m)	Rhophase	3PS-1803-1000-3PS	3697	12	28-Jan-2012
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	12	10-Aug-2011
Combiner/Splitter	Weinschel	1506A	3879	12	22-Feb-2012
Combiner/Splitter	Weinschel	1506A	3880	12	22-Feb-2012
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Section 2.5 and 2.6 – Effective Isotropic Radiated Power and Emission for Broadband PCS Equipment					
Standard Gain Horn Antenna	Flann	1624-20	30	12	18-Feb-2012
Antenna (Double Ridge Guide)	EMCO	3115	34	12	17-Jul-2011
Spectrum Analyser	Rohde & Schwarz	FSEM	37	12	18-Apr-2012
Screened Room (8)	Rainford	Rainford	1548	-	TU
Programmable Power Supply	Iso-tech	IPS 2010	2435	-	O/P Mon
Hygrometer	Rotronic	I-1000	2882	12	10-Jul-2011
Antenna (Biconnical)	Schaffner	VBA6106A	3107	12	23-Aug-2011
Antenna (Log Periodic)	Schaffner	UPA6108	3109	12	30-Mar-2012
Amplifier (1 - 8GHz)	Phase One	PS06-0060	3175	12	2-Jul-2011
Amplifier (8 - 18GHz)	Phase One	PS06-0061	3176	12	2-Jul-2011
3 GHz High Pass Filter	K&L Microwave	11SH10-3000/X18000-O/O	3552	12	14-Apr-2012
Low Noise Pre Amplifier	Mini-Circuits	ZHL-1042J	3602	12	6-Dec-2011

Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.7 - Conducted Spurious Emissions					
Radiocommunications Tester	Rohde & Schwarz	CMU 200	39	12	18-Nov-2011
Multimeter	White Gold	WG022	190	12	26-Oct-2011
Termination 50ohm/50W	Bird	8085	389	12	3-Sep-2011
Multimeter	Iso-tech	IDM-101	466	12	2-Mar-2012
Attenuator (10dB, 10W)	Weinschel	23-10-34	470	12	23-Jun-2011
Attenuator (10dB)	Weinschel	47-10-34	481	12	24-Mar-2012
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	22-Sep-2011
Spectrum Analyser	Hewlett Packard	E4407B	1154	12	17-Jun-2011
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	11-Sep-2011
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Multimeter	Iso-tech	IDM101	2424	12	3-Sep-2011
Programmable Power Supply	Iso-tech	IPS 2010	2437	-	O/P Mon
High Pass Filter (4GHz)	RLC Electronics	F-100-4000-5-R	2773	12	6-Sep-2011
Filter	Daden Anthony Ass	MH-1500-7SS	2778	12	22-Dec-2011
Attenuator (3dB)	Suhner	6803.17.B	3026	12	24-Mar-2012
Hygrometer	Rotronic	I-1000	3220	12	3-May-2012
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	23-Feb-2012
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	8-Feb-2012
'3.5mm' - '3.5mm' RF Cable (1m)	Rhophase	3PS-1803-1000-3PS	3697	12	28-Jan-2012
Combiner/Splitter	Weinschel	1506A	3879	12	22-Feb-2012
Combiner/Splitter	Weinschel	1506A	3880	12	22-Feb-2012
Section 2.8 – Occupied Bandwidth					
Radiocommunications Tester	Rohde & Schwarz	CMU 200	39	12	18-Nov-2011
Attenuator (10dB)	Weinschel	47-10-34	481	12	24-Mar-2012
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	11-Sep-2011
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Multimeter	Iso-tech	IDM101	2424	12	3-Sep-2011
Attenuator (3dB)	Suhner	6803.17.B	3026	12	24-Mar-2012
Hygrometer	Rotronic	I-1000	3220	12	3-May-2012
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011
Combiner/Splitter	Weinschel	1506A	3879	12	22-Feb-2012
Section 2.9 - Modulation Characteristics					
Radiocommunications Tester	Rohde & Schwarz	CMU 200	39	12	18-Nov-2011
Attenuator (10dB)	Weinschel	47-10-34	481	12	24-Mar-2012
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	11-Sep-2011
Multimeter	Iso-tech	IDM101	2424	12	3-Sep-2011
Attenuator (3dB)	Suhner	6803.17.B	3026	12	24-Mar-2012
Hygrometer	Rotronic	I-1000	3220	12	3-May-2012
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	12	2-Jun-2011
'3.5mm' - '3.5mm' RF Cable (1m)	Rhophase	3PS-1803-1000-3PS	3697	12	28-Jan-2012
Combiner/Splitter	Weinschel	1506A	3879	12	22-Feb-2012

TU – Traceability Unscheduled
O/P Mon – Output monitored using calibrated equipment.

Product Service

3.2 MEASUREMENT UNCERTAINTY

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

Test Discipline	Frequency / Parameter	MU
Radiated Emissions, Bilog Antenna, AOATS	30MHz to 1GHz Amplitude	5.1dB*
Radiated Emissions, Horn Antenna, AOATS	1GHz to 40GHz Amplitude	6.3dB*
Conducted Emissions, LISN	150kHz to 30MHz Amplitude	3.2dB*
Conducted Emissions, ISN	150kHz to 30MHz Amplitude	2.1dB
Substitution Antenna, Radiated Field	30MHz to 18GHz Amplitude	2.6dB
Discontinuous Interference	150kHz to 30MHz Amplitude	3.0dB*
Interference Power	30MHz to 300MHz Amplitude	3.0dB*
Radiated E-Field Susceptibility	10MHz to 6GHz Test Amplitude	2.0dB†
Conducted Susceptibility RF	50kHz to 1000MHz Amplitude EM Clamp Method of Test CDN Method of Test BCI Clamp Method of Test Direct Injection Method of Test	 3.1dB• 1.2dB• 1.1dB• 1.2dB•
Conducted Susceptibility LF	DC to 150kHz	1.0%†
Power Frequency Magnetic Field	50Hz/60Hz Amplitude	0.45%
Magnetic Emissions	9kHz to 30MHz Amplitude	3.4dB*
Magnetic Field/Flux iaw EN 50366	10Hz to 400kHz	2.64%
Harmonics and Flicker	The test was applied using proprietary equipment that meets the requirements of EN 61000-3-2 and EN 61000-3-3	—
Mains Voltage Variations and Interrupts	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-11	—
Fast Transient Burst	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-4	—
Electrostatic Discharge	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-2	—
Surge	The test was applied using proprietary equipment that meets the requirements of EN 61000-4-5	—
Vehicle Transients	The test was applied using proprietary equipment that meets the requirements of ISO 7637-1 and 2	—
Compass Safe Distance	Azimuth Accuracy	0.10°
Channel Occupancy/Separation	19.1kHz	N/A
Maximum Output Power	Not Applicable	±0.5dB
Number of Channels	Not Applicable	N/A
20dB Bandwidth	19.1kHz	±0.5dB

Worst case error for both Time and Frequency measurement 12 parts in 10^6.

* In accordance with CISPR 16-4-2
† In accordance with UKAS Lab 34
• In accordance with EN61000-4-6

Product Service

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

Product Service

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

UKAS TESTING 0141

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

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

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