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Report On

FCC Testing of the
The Boeing Company Black Smartphone
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 24 (GSM)

COMMERCIAL-IN-CONFIDENCE

FCC ID: H8V-BLK1

Document 75923267 Report 06 Issue 4 January 2014

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REPORT ON

FCC Testing of the
The Boeing Company Black Smartphone
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 24 (GSM)

Document 75923267 Report 06 Issue 4

January 2014

PREPARED FOR

The Boeing Company
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Springfield
VA 22153

PREPARED BY

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Senior Administrator (Technical)

APPROVED BY

Simon Bennett
Authorised Signatory

DATED 28 January 2014

This report has been up issued to Issue 4 to include additional test results for Frequency Stability.

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 2 and FCC CFR 47 Part 24. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

A Galpin G Lawler N Rousell T Guy

UKAS TESTING 0141

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CONTENTS

Product Service

SECTION 1

REPORT SUMMARY

FCC Testing of the
The Boeing Company Black Smartphone
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 24 (GSM)

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the FCC Testing of the The Boeing Company Black Smartphone to the requirements of FCC CFR 47 Part 2 and FCC CFR 47 Part 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	The Boeing Company
Model Number(s)	Black Smartphone
Serial Number(s)	XCV23200852 XCV23200791 XCV23200909
Number of Samples Tested	3
Test Specification/Issue/Date	FCC CFR 47 Part 2 (2012) FCC CFR 47 Part 24 (2012)
Incoming Release Date	Application Form 13 December 2013
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	48774 01 July 2013
Start of Test	21 July 2013
Finish of Test	23 January 2014
Name of Engineer(s)	A Galpin G Lawler N Rousell T Guy
Related Document(s)	ANSI C63.4: 2003

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1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 24 is shown below.

Section	Spec Clause		Test Description	Result	Comments/Base Standard
	Pt 2	Pt 24			
PCS 1900 - GMSK Modulation					
2.1	2.1055	24.135(a)	Frequency Stability	Pass	
2.2	2.1051	24.229	Spurious Emissions at Band Edge	Pass	
2.3	-	24.232(c)	Effective Isotropic Radiated Power	Pass	
2.4	2.1047(d)	-	Modulation Characteristics	-	Customer Declaration
2.5	2.1046	24.232	Maximum Peak Output Power - Conducted	Pass	
2.6	2.1051	24.238	Emission Limitations for Broadband PCS Equipment	Pass	
2.7	2.1051	24.238(a)	Conducted Spurious Emissions	Pass	
2.8	2.1049(h)	24.238(b)	Occupied Bandwidth	Pass	
PCS 1900 - 8PSK Modulation					
2.1	2.1055	24.135(a)	Frequency Stability	Pass	
2.2	2.1051	24.229	Spurious Emissions at Band Edge	Pass	
2.3	-	24.232(c)	Effective Isotropic Radiated Power	Pass	
2.4	2.1047(d)	-	Modulation Characteristics	-	Customer Declaration
2.5	2.1046	24.232	Maximum Peak Output Power - Conducted	Pass	
2.6	2.1051	24.238	Emission Limitations for Broadband PCS Equipment	Pass	
2.7	2.1051	24.238(a)	Conducted Spurious Emissions	Pass	
2.8	2.1049(h)	24.238(b)	Occupied Bandwidth	Pass	

1.3 APPLICATION FORM

APPLICANT'S DETAILS

COMPANY NAME :The Boeing Company
ADDRESS : 7700 Boston Blvd. Springfield, VA 22153

NAME FOR CONTACT PURPOSES : Brian Chapman

TELEPHONE NO: 703.270.6714FAX NO:
E-MAIL: brian.s.chapman@boeing.com

EQUIPMENT INFORMATION

Equipment designator:

Model name/number Identification number

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 ...3.8 V	and Battery type...Li-Ion.

Frequency characteristics:

Frequency range 1850.2MHz to 1909.8 MHz Channel spacing .....
(if channelized)

Designated test frequencies:
Bottom: 1850.2 MHz Middle: 1880.0MHz Top: 1909.8MHz

Power characteristics:

Maximum transmitter power 1.58W(32dBm) 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:

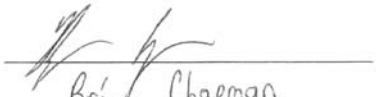
[ ]	Amplitude	[ ] Other
[ ]	Frequency	Details: .....
[X]	Phase	

Can the transmitter operate un-modulated? Y/N
ITU Class of emission: .....

Extreme conditions:

Maximum temperature	55 °C	Minimum temperature	-10 °C
Maximum supply voltage	4.0 V	Minimum supply voltage	3.8 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 : 
Name : Brian Chapman
Position held : Program Manager
Date : 12/13/13

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was a The Boeing Company Black Smartphone. A full technical description can be found in the manufacturer's documentation.

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.

The EUT was powered from a 3.8 V DC supply.

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standard were made during testing.

1.7 MODIFICATION RECORD

Modification 0 - No modifications were made to the test sample during testing.

SECTION 2

TEST DETAILS

FCC Testing of the
The Boeing Company Black Smartphone
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 24 (GSM)

2.1 FREQUENCY STABILITY

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 and Modification State

Black Smartphone S/N: XCV23200852 - Modification State 0

2.1.3 Date of Test

8 August 2013 & 27 August 2013

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 Procedure

The EUT was set to transmit on maximum power with GMSK and 8PSK modulation. A CMU200 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.

2.1.6 Environmental Conditions

Ambient Temperature	24.6 - 24.9°C
Relative Humidity	38.8 - 47.9%

2.1.7 Test Results

PCS 1900 - 8PSK Modulation

3.8 V DC Supply

Under Temperature Variations

1880.0 MHz

Temperature Interval (ºC)	Mode	Deviation (ppm)
-30	8-PSK	0.039362000
-20	8-PSK	0.035106000
-10	8-PSK	-0.017553192
0	8-PSK	0.017021277
+10	8-PSK	0.021276596
+20	8-PSK	0.020744681
+30	8-PSK	0.030851064
+40	8-PSK	0.029255319
+50	8-PSK	0.029787234

Limit Clause

The frequency stability of the transmitter shall be maintained within ± 0.0001 % (± 1 ppm).

Under Voltage Variations

1880.0 MHz

DC Voltage (V)	Mode	Deviation (ppm)
3.8	8-PSK	0.020744681
3.6	8-PSK	0.020212766
4.2	8-PSK	0.020744681

Limit Clause

The frequency stability of the transmitter shall be maintained within ± 0.0001 % (± 1 ppm).

PCS 1900 - GMSK Modulation

3.8 V DC Supply

Under Temperature Variations

1880.0 MHz

Temperature Interval (ºC)	Mode	Deviation (ppm)
-30	GMSK	0.0260
-20	GMSK	-0.0230
-10	GMSK	0.0058
0	GMSK	0.0005
+10	GMSK	0.0016
+20	GMSK	0.0011
+30	GMSK	0.0021
+40	GMSK	0.0032
+50	GMSK	0.0032

Limit Clause

The frequency stability of the transmitter shall be maintained within ± 0.0001 % (± 1 ppm).

Under Voltage Variations

1880.0 MHz

DC Voltage (V)	Mode	Deviation (ppm)
3.6	GMSK	0.0016
3.8	GMSK	-0.0160
4.2	GMSK	-0.0160

Limit Clause

The frequency stability of the transmitter shall be maintained within ± 0.0001 % (± 1 ppm).

2.2 SPURIOUS EMISSIONS AT BAND EDGE

2.2.1 Specification Reference

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

2.2.2 Equipment Under Test and Modification State

Black Smartphone S/N: XCV23200852 - Modification State 0

2.2.3 Date of Test

28 August 2013

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 Procedure

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.

Having entered the reference level offset , a limit line was displayed, showing the -13 dBm (43 + 10 log (P)), limit.

2.2.6 Environmental Conditions

Ambient Temperature	23.7°C
Relative Humidity	49.3%

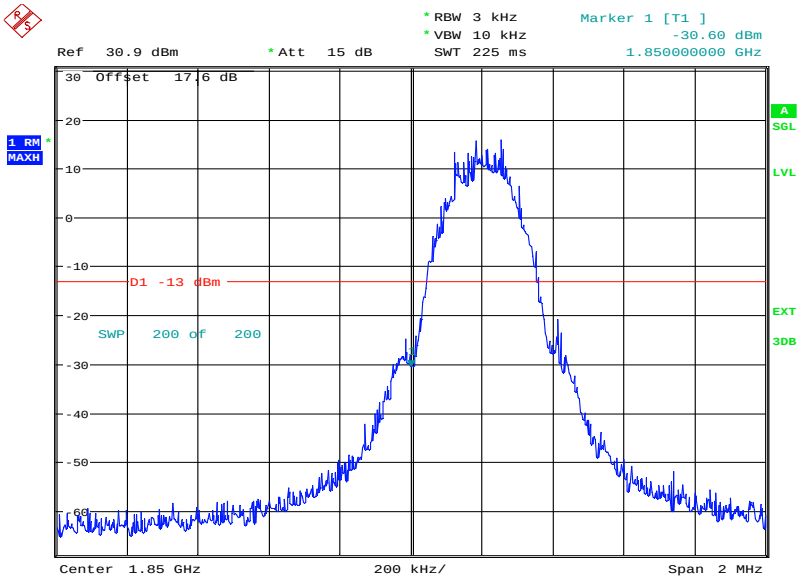
2.2.7 Test Results

PCS 1900 - 8PSK Modulation

3.8 V DC Supply

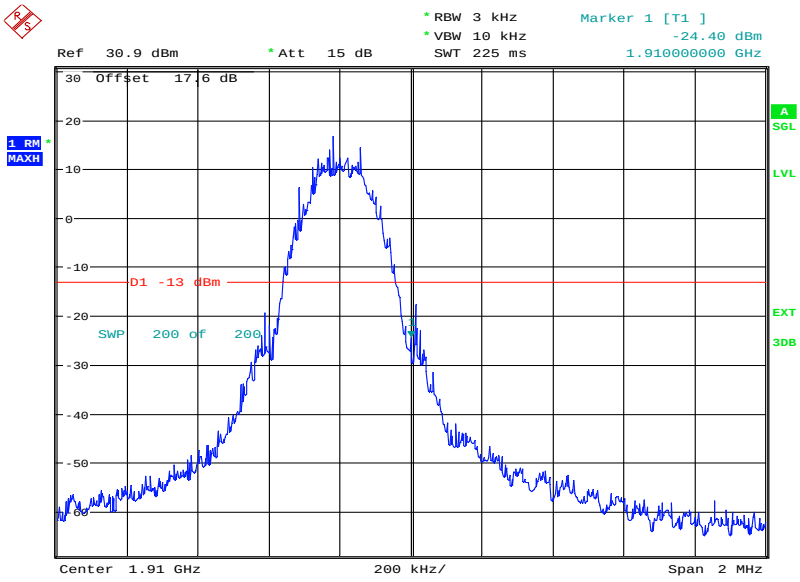
Frequency Block (MHz)	Mode	Lower Block Edge Test Channels/Frequencies	Upper Block Edge Test Channels/Frequencies
A :(1930.0 – 1945.0)	8-PSK	Channel : 512 Frequency : 1850.2 MHz	N/A
B :(1975.0 – 1990.0)	8-PSK	N/A	Channel : 810 Frequency : 1909.8 MHz

Frequency Block A



Date: 28.AUG.2013 10:01:40

Frequency Block B



Date: 28.AUG.2013 10:03:22

Limit Clause

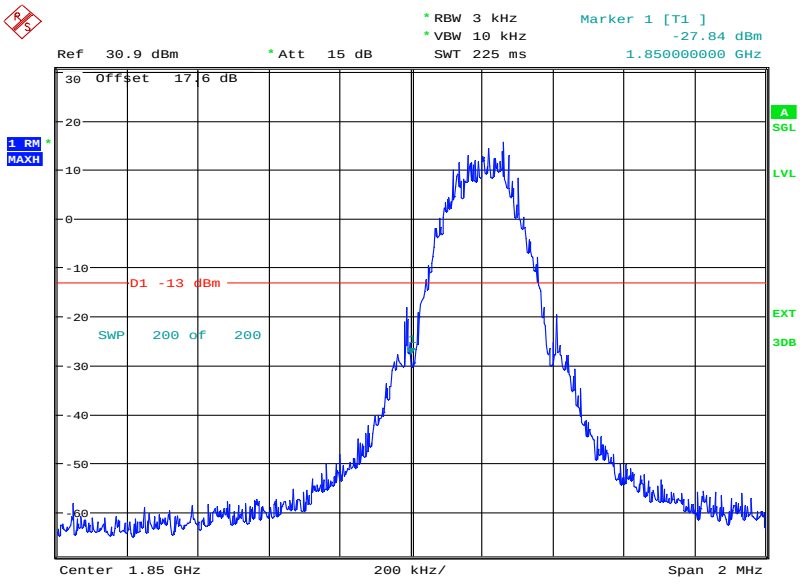
-13 dBm at block edge.

PCS 1900 - GMSK Modulation

3.8 V DC Supply

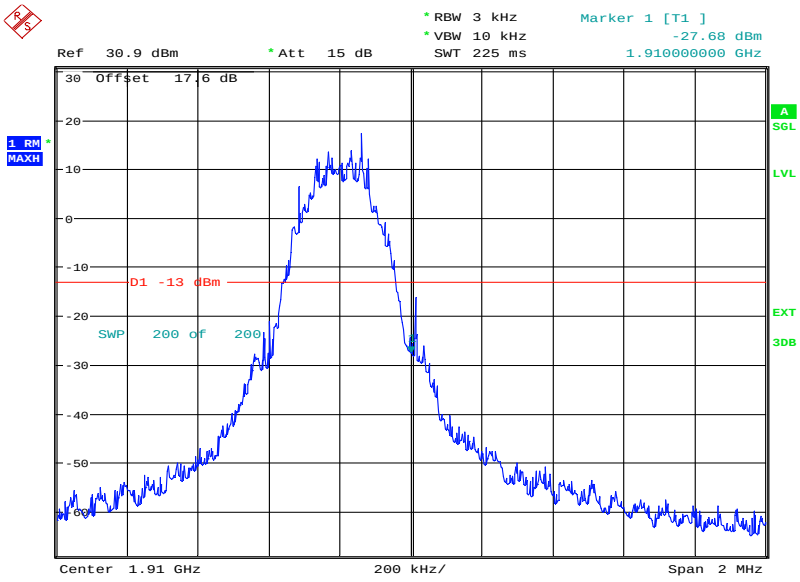
Frequency Block (MHz)	Mode	Lower Block Edge Test Channels/Frequencies	Upper Block Edge Test Channels/Frequencies
A :(1930.0 – 1945.0)	GMSK	Channel : 512 Frequency : 1850.2 MHz	N/A
B :(1975.0 – 1990.0)	GMSK	N/A	Channel : 810 Frequency : 1909.8 MHz

Frequency Block A



Date: 28.AUG.2013 10:07:14

Frequency Block B



Date: 28.AUG.2013 10:05:18

Limit Clause

-13 dBm at block edge.

2.3 EFFECTIVE ISOTROPIC RADIATED POWER

2.3.1 Specification Reference

FCC CFR 47 Part 24, Clause 24.232(c)

2.3.2 Equipment Under Test and Modification State

Black Smartphone S/N: XCV23200791 - Modification State 0

2.3.3 Date of Test

21 July 2013 & 22 January 2014

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 Procedure

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.

2.3.6 nvironmental Conditions

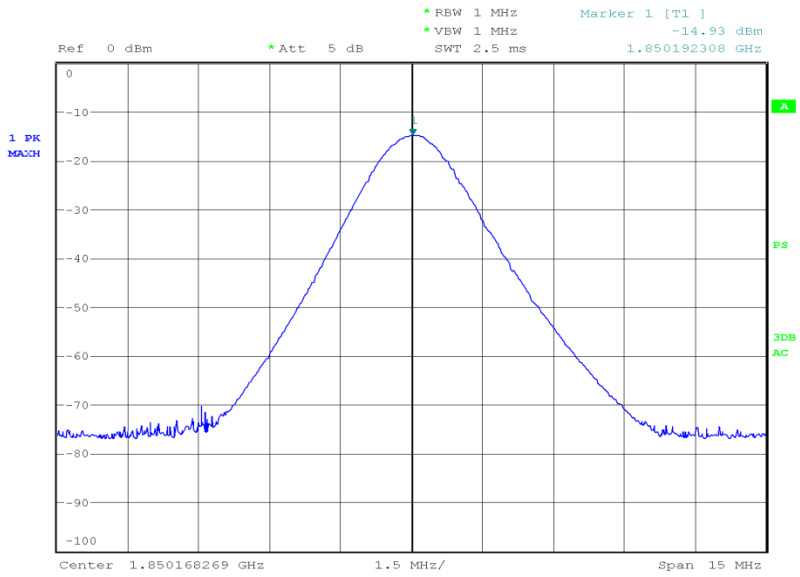
Ambient Temperature	18.9 - 23.4°C
Relative Humidity	28.0 - 39.0%

2.3.7 Test Results

PCS 1900 - 8PSK Modulation

1850.2 MHz

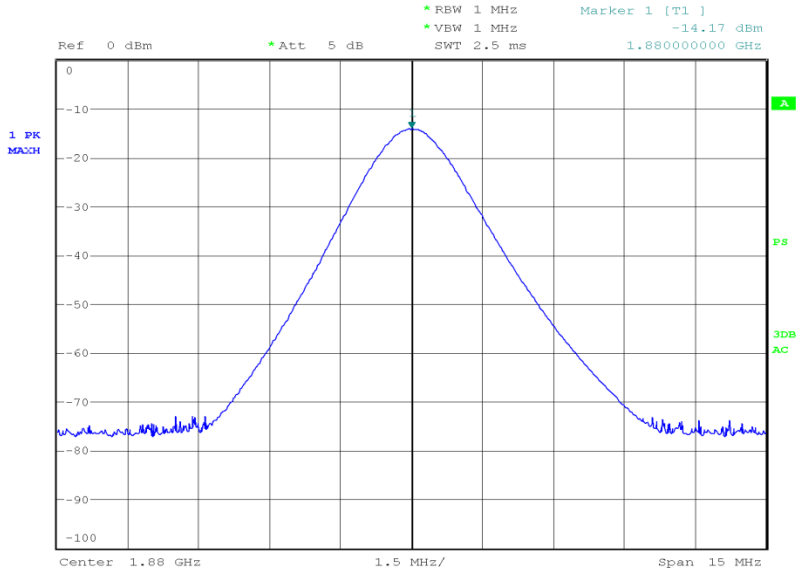
Result (dBm)	Result (W)
24.96	0.313



Date: 22.JAN.2014 20:33:39

1880.0 MHz

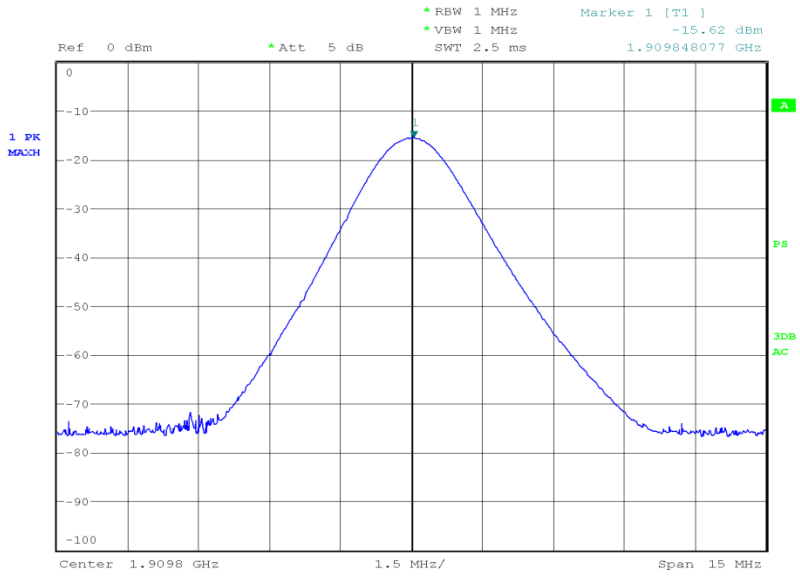
Result (dBm)	Result (W)
26.38	0.434



Date: 22.JAN.2014 20:36:39

1909.8 MHz

Result (dBm)	Result (W)
25.05	0.320



Date: 22.JAN.2014 20:42:49

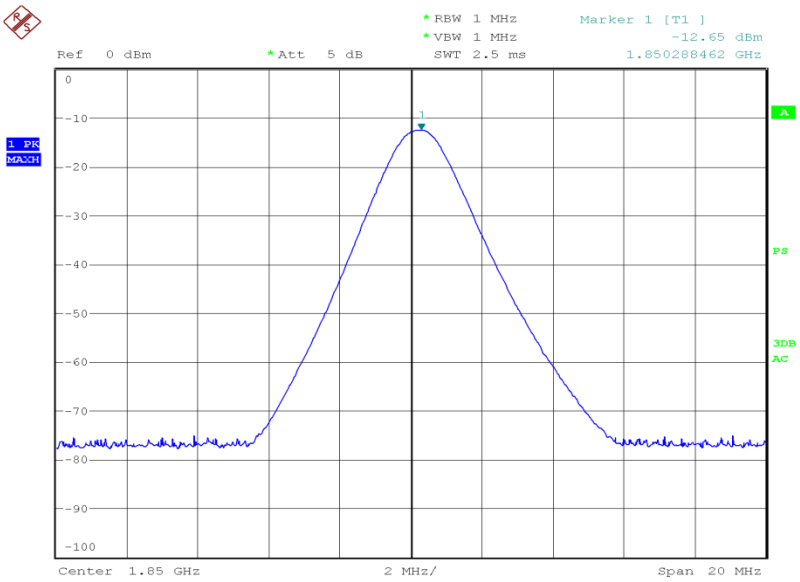
Limit Clause

Mobile – 7 W or 38.45 dBm
Base Stations – 500 W or 57 dBm

PCS 1900 - GMSK Modulation

1850.2 MHz

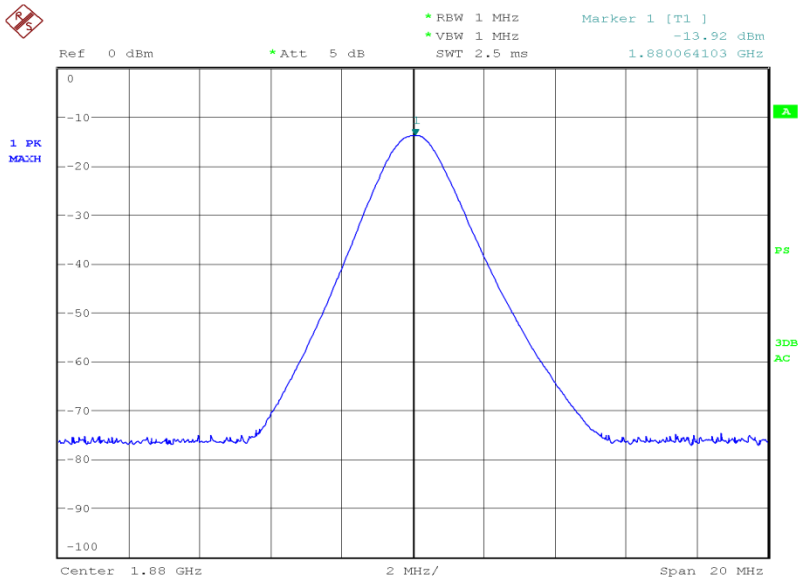
Result (dBm)	Result (W)
27.80	0.603



Date: 21.JUL.2013 09:12:20

1880.0 MHz

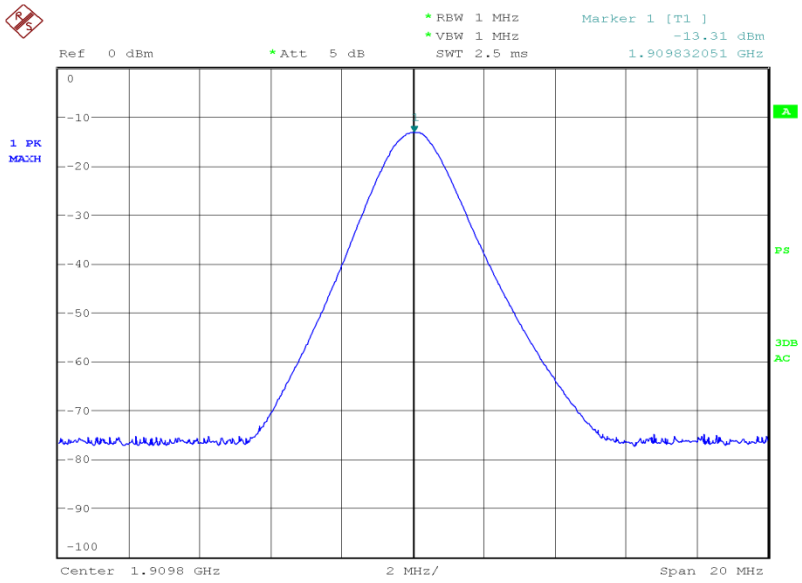
Result (dBm)	Result (W)
26.61	0.458



Date: 21.JUL.2013 09:30:26

1909.8 MHz

Result (dBm)	Result (W)
27.62	0.578



Limit Clause

Mobile – 2 W or 33 dBm

2.4 MAXIMUM PEAK OUTPUT POWER - CONDUCTED

2.4.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1046
FCC CFR 47 Part 24, Clause 24.232

2.4.2 Equipment Under Test and Modification State

Black Smartphone S/N: XCV23200852 - Modification State 0

2.4.3 Date of Test

21 and 22 August 2013

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 Procedure

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

The EUT supports GMSK and 8PSK modulation schemes and was tested in these modes 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.

2.4.6 Environmental Conditions

Ambient Temperature	22.9°C
Relative Humidity	55.1%

2.4.7 Test Results

PCS 1900 - 8PSK Modulation

3.8 V DC Supply

1850.2 MHz

Mode	Result (dBm)	Result (W)
8-PSK	28.01	0.632

1880.0 MHz

Mode	Result (dBm)	Result (W)
8-PSK	28.14	0.652

1909.8 MHz

Mode	Result (dBm)	Result (W)
8-PSK	27.97	0.627

Limit Clause

Mobile – 2 W or 33 dBm

PCS 1900 - GMSK Modulation

3.8 V DC Supply

1850.2 MHz

Mode	Result (dBm)	Result (W)
GMSK	28.11	0.647

1880.0 MHz

Mode	Result (dBm)	Result (W)
GMSK	28.21	0.662

1909.8 MHz

Mode	Result (dBm)	Result (W)
GMSK	28.04	0.637

Limit Clause

Mobile – 2 W or 33 dBm

2.5 MODULATION CHARACTERISTICS

2.5.1 Specification Reference

FCC CFR 47 Part 2, Clause 2.1047(d)

2.5.2 Equipment Under Test

Black Smartphone

2.5.3 Test Results

PCS 1900 - 8PSK Modulation and PCS 1900 - GMSK Modulation

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

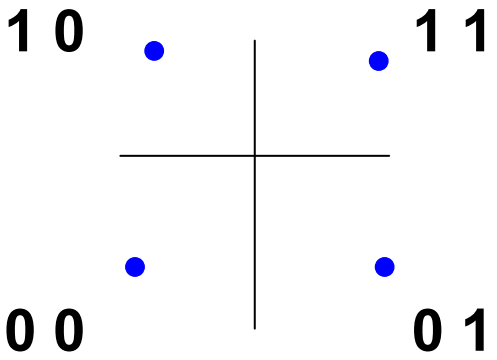
GMSK OVERVIEW

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)

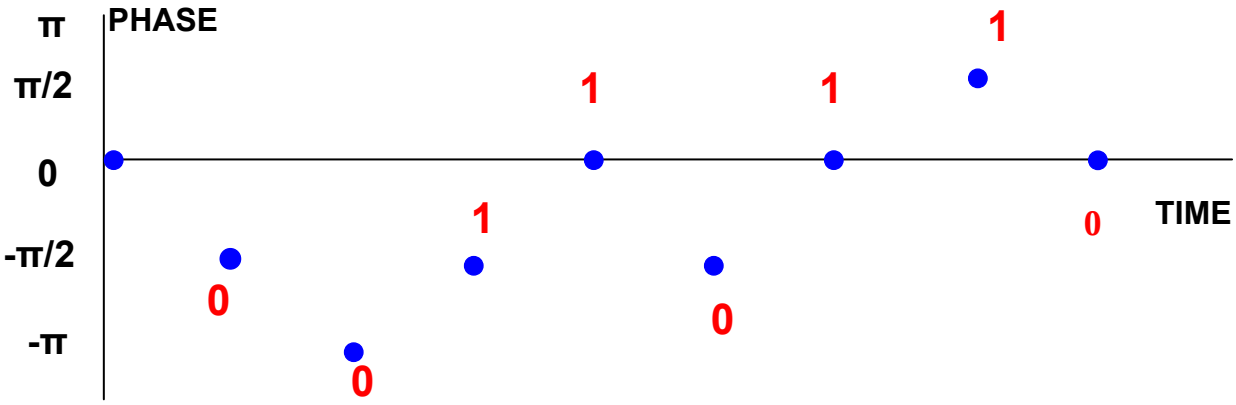
I Stream	0		1		0		1	
	-π/2		-π/2		-π/2		π/2	
Q stream		0		1		1		0
		-π/2		π/2		π/2		-π/2

Product Service

3. Combine (add) the two PSK signals:

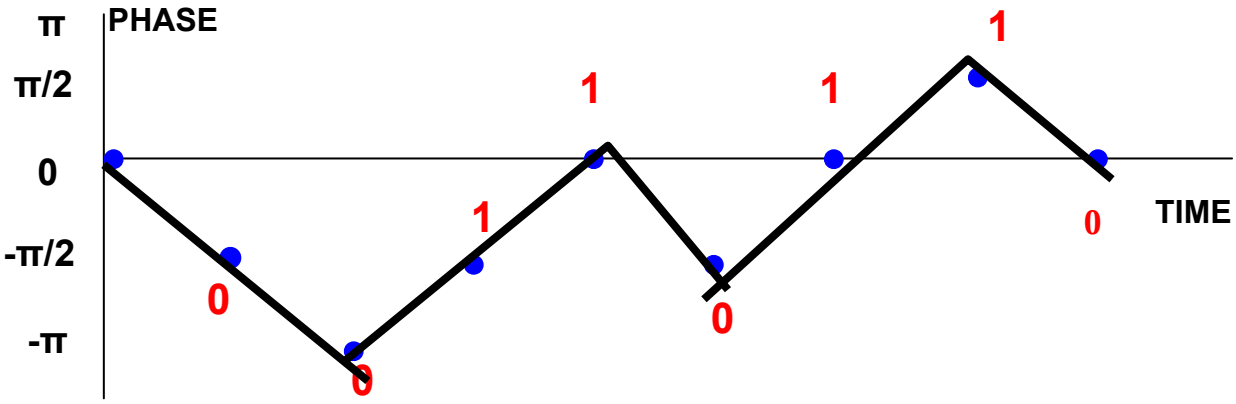
Combined Phase	-π/2	-π	-π/2	0	-π/2	0	π/2	0

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.

Limit Clause

A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

Product Service

2.6 EMISSION LIMITATIONS 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 and Modification State

Black Smartphone S/N: XCV23200791 - Modification State 0

2.6.3 Date of Test

21 July 2013, 22 July 2013, 7 August 2013, 22 January 2014 & 23 January 2014

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 Procedure

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 the worst case modulation scheme - GMSK. 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.

2.6.6 Environmental Conditions

Ambient Temperature	18.9 - 23.6°C
Relative Humidity	27.0 - 46.0%

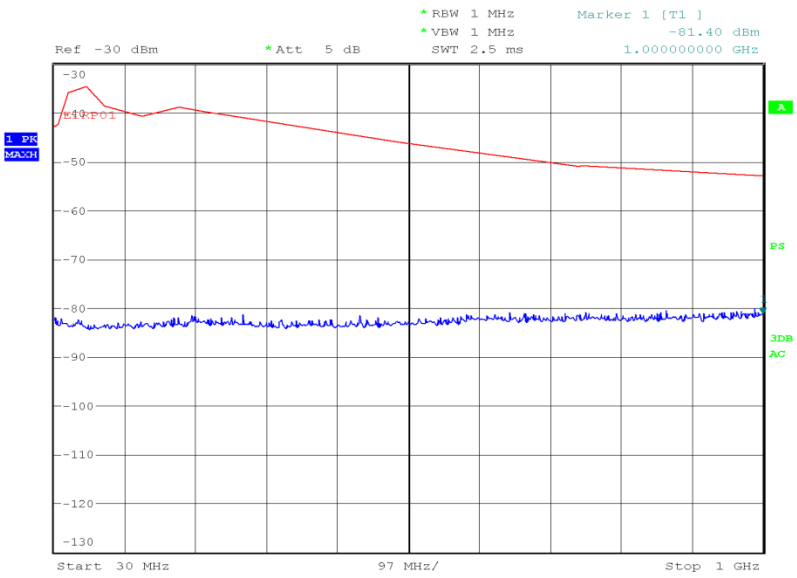
Product Service

2.6.7 Test Results

PCS 1900 - 8PSK Modulation

1850.2 MHz

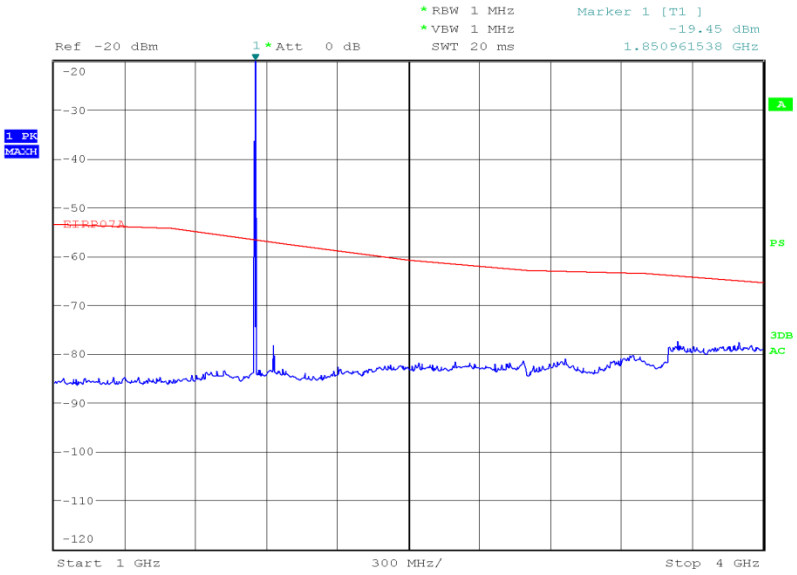
30 MHz to 1 GHz



Date: 22.JAN.2014 18:55:30

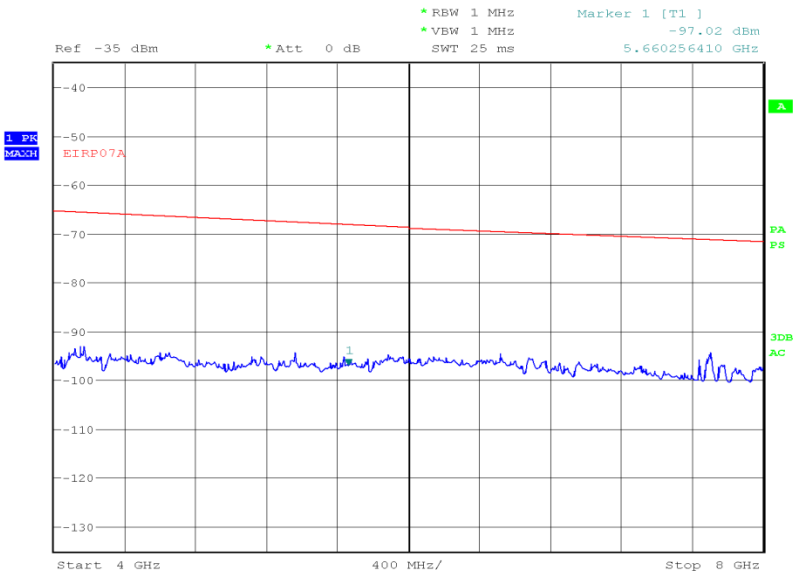
Product Service

1 GHz to 3 GHz



Date: 22.JAN.2014 22:02:48

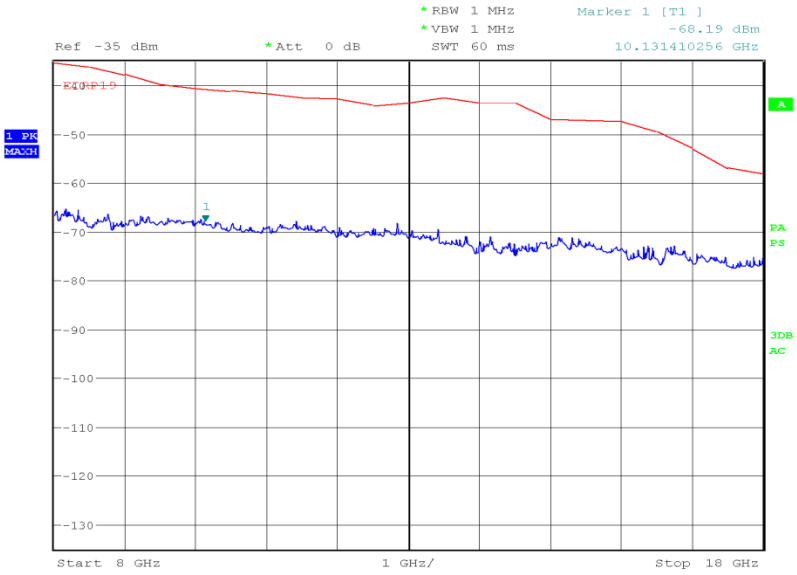
3 GHz to 8 GHz



Date: 22.JAN.2014 22:06:48

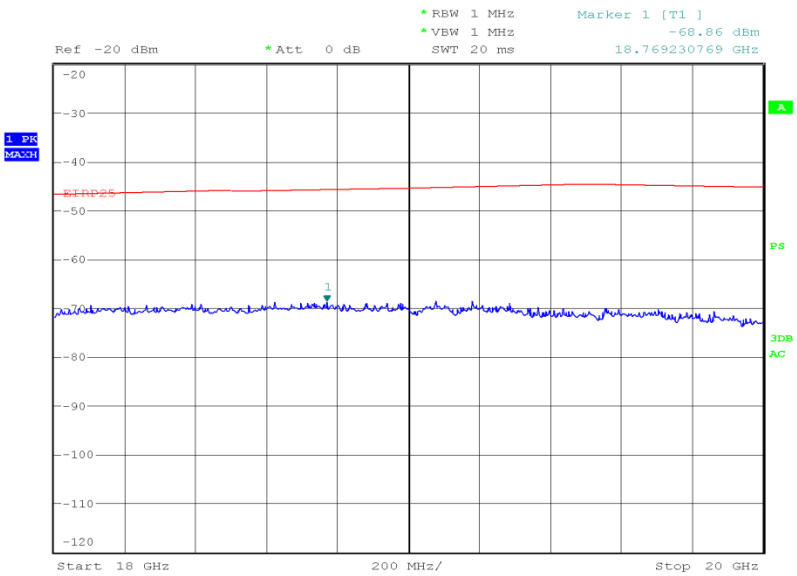
Product Service

8 GHz to 18 GHz



Date: 22.JAN.2014 22:29:52

18 GHz to 20 GHz

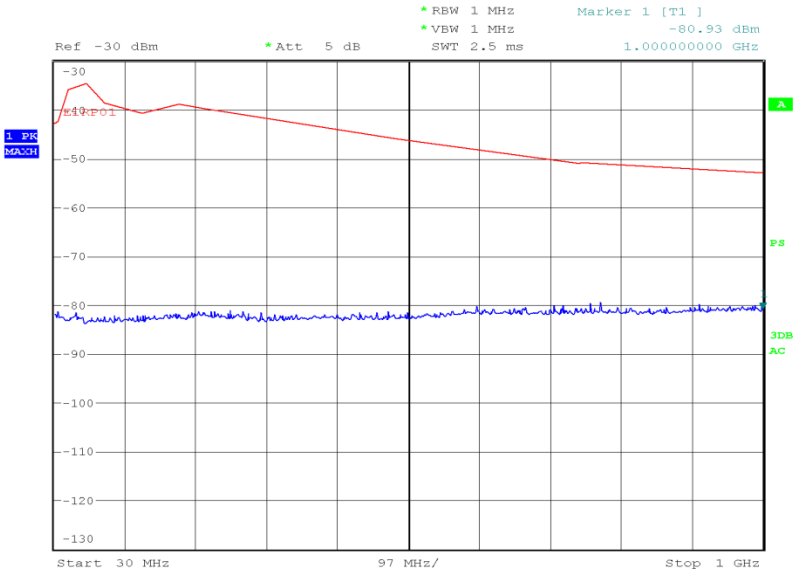


Date: 23.JAN.2014 01:02:38

Product Service

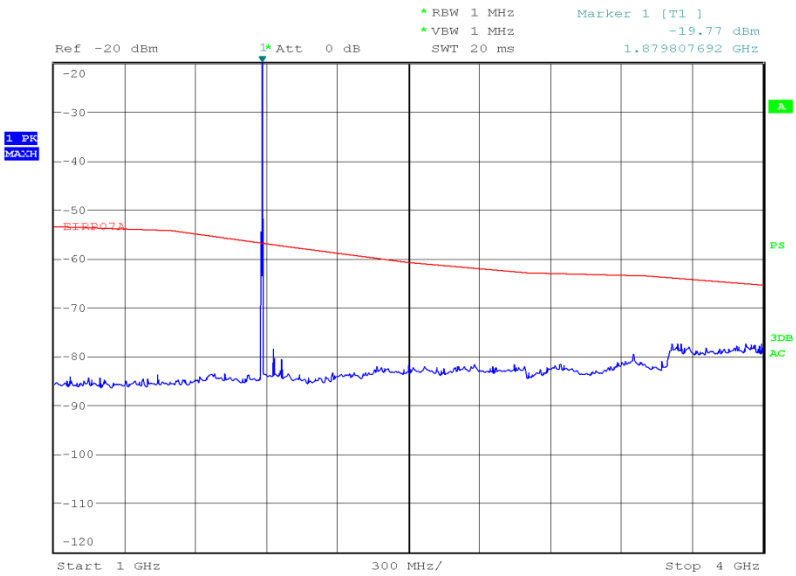
1880.0 MHz

30 MHz to 1 GHz



Date: 22.JAN.2014 18:57:15

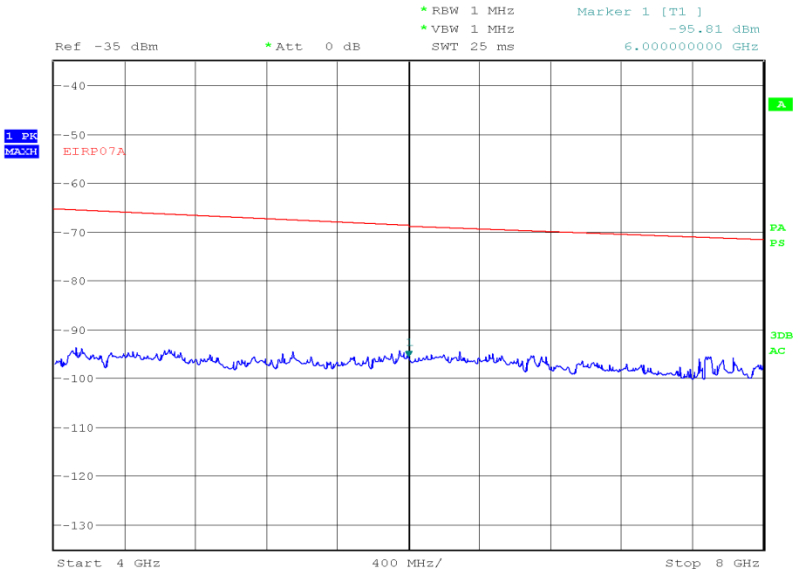
1 GHz to 3 GHz



Date: 22.JAN.2014 22:00:33

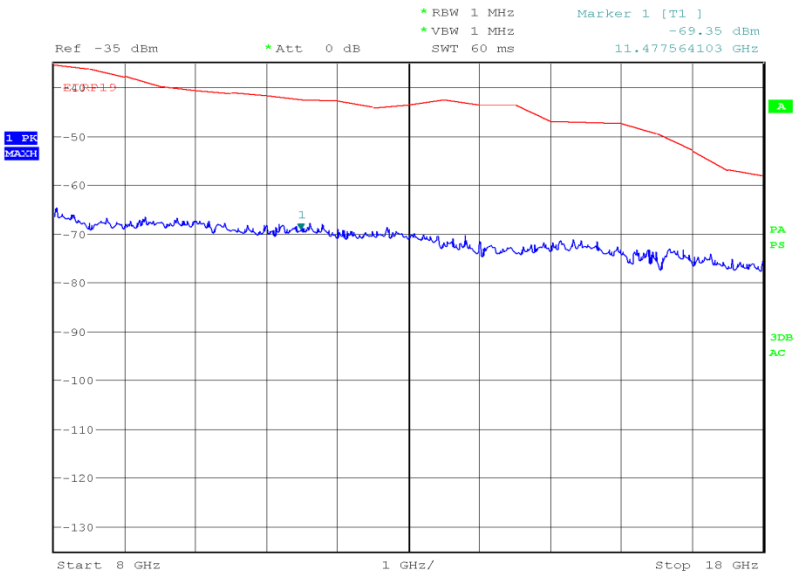
Product Service

3 GHz to 8 GHz



Date: 22.JAN.2014 22:08:55

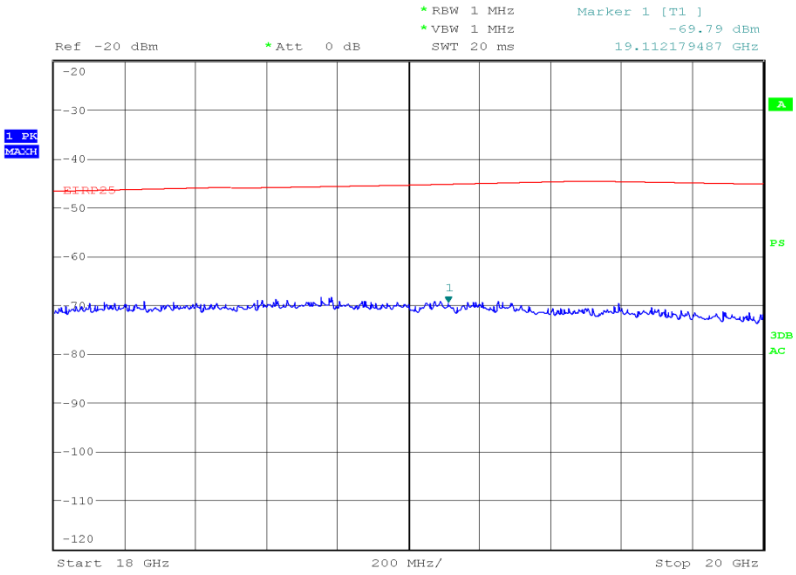
8 GHz to 18 GHz



Date: 22.JAN.2014 22:27:35

Product Service

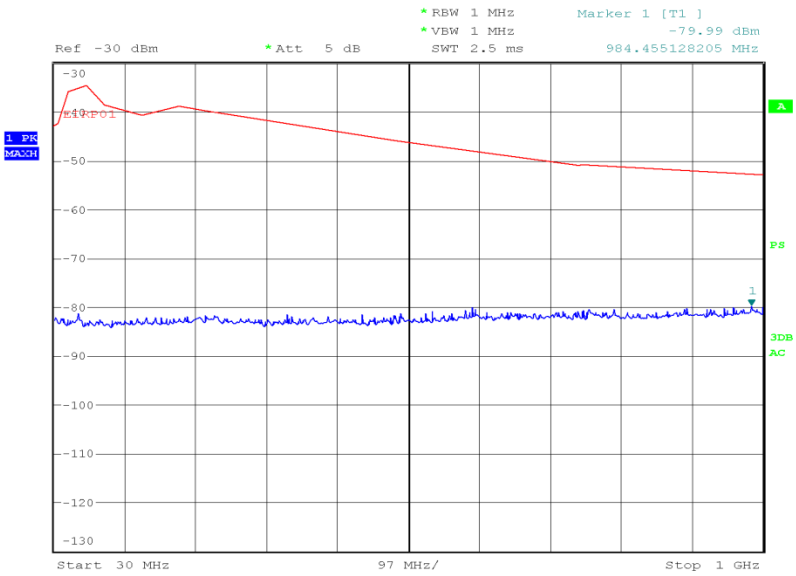
18 GHz to 20 GHz



Date: 23.JAN.2014 01:04:14

1909.8 MHz

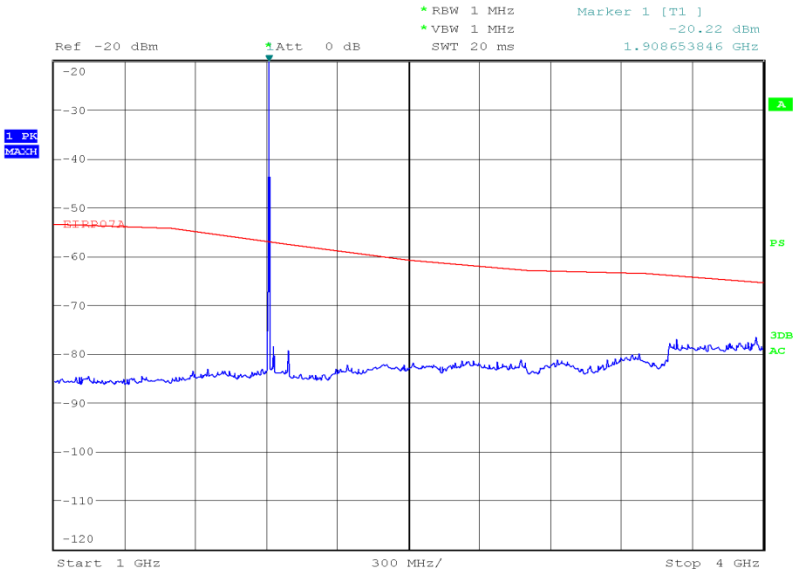
30 MHz to 1 GHz



Date: 22.JAN.2014 18:59:08

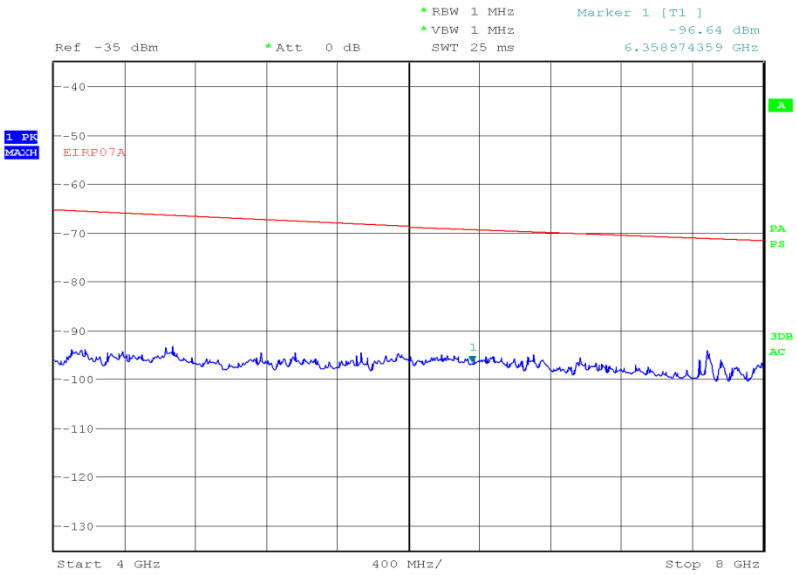
Product Service

1 GHz to 3 GHz



Date: 22.JAN.2014 21:52:44

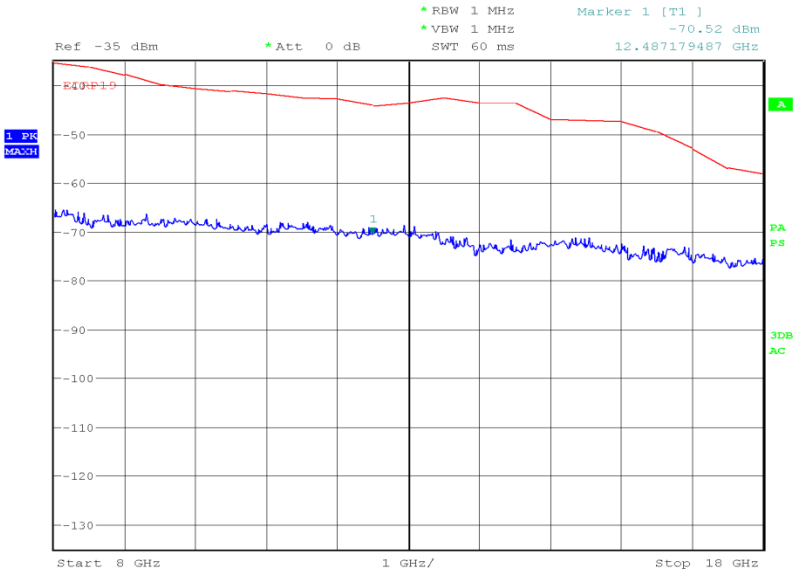
3 GHz to 8 GHz



Date: 22.JAN.2014 22:11:13

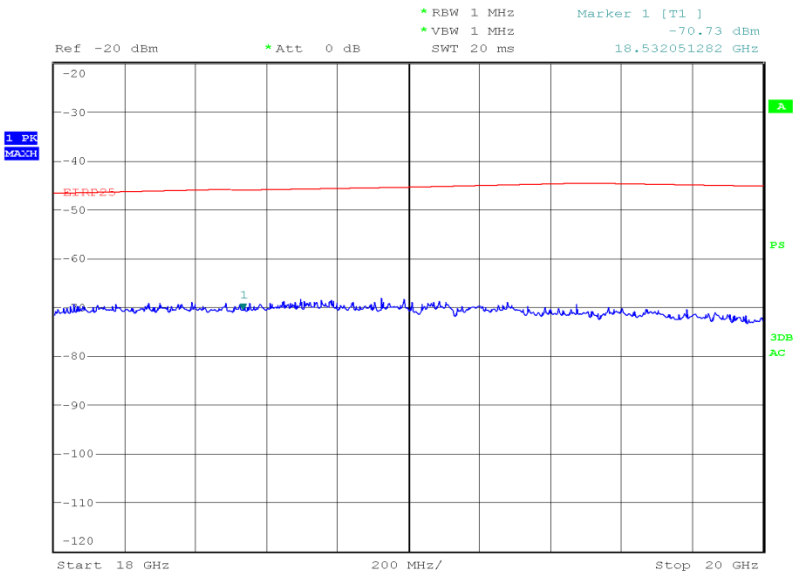
Product Service

8 GHz to 18 GHz



Date: 22.JAN.2014 22:25:25

18 GHz to 20 GHz



Date: 23.JAN.2014 01:06:58

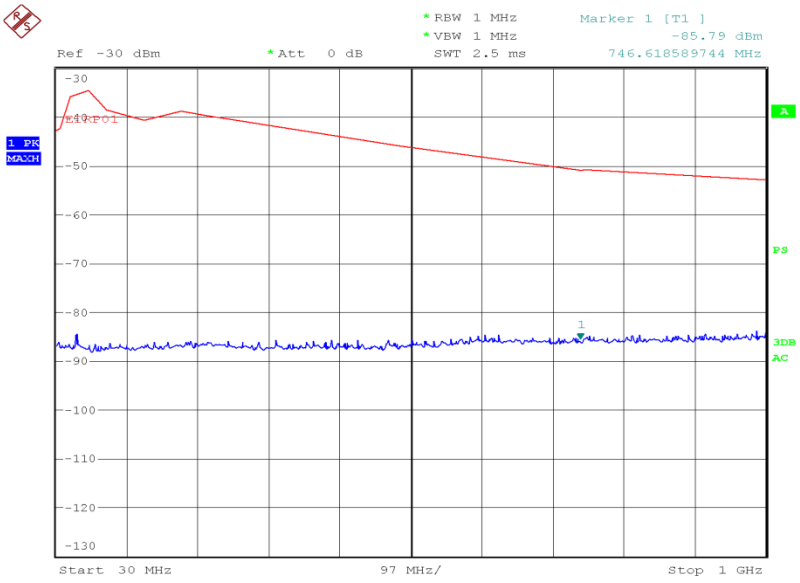
Limit Clause

43+10log(P) or -13 dBm

PCS 1900 - GMSK Modulation

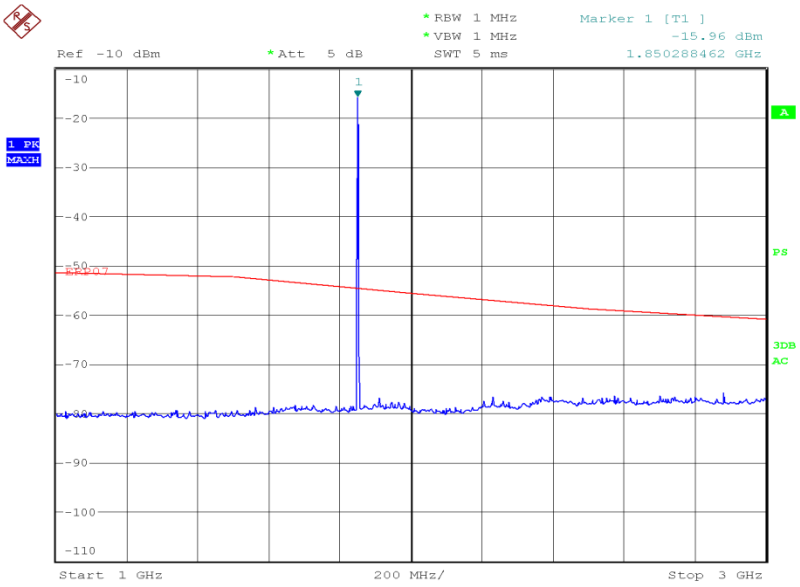
1850.2 MHz

30 MHz to 1 GHz



Date: 22.JUL.2013 20:48:59

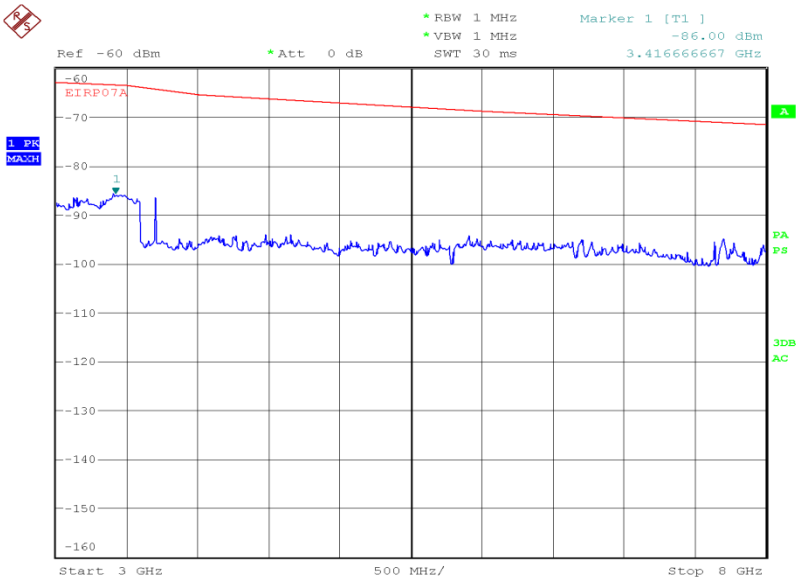
1 GHz to 3 GHz



Date: 21.JUL.2013 09:15:22

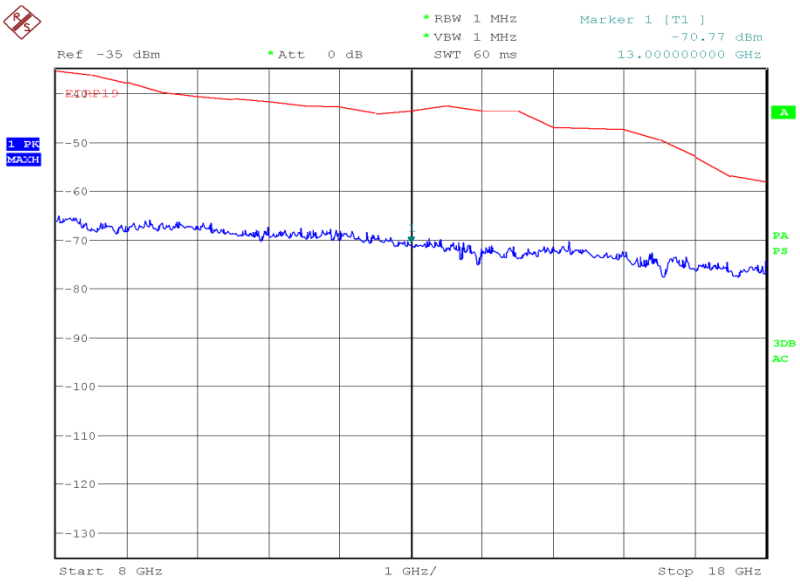
Product Service

3 GHz to 8 GHz



Date: 21.JUL.2013 13:47:57

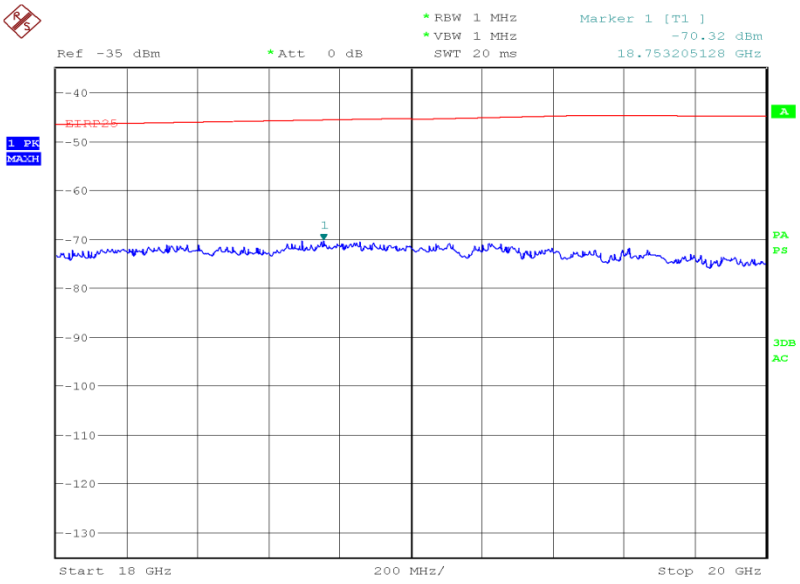
8 GHz to 18 GHz



Date: 21.JUL.2013 14:05:21

Product Service

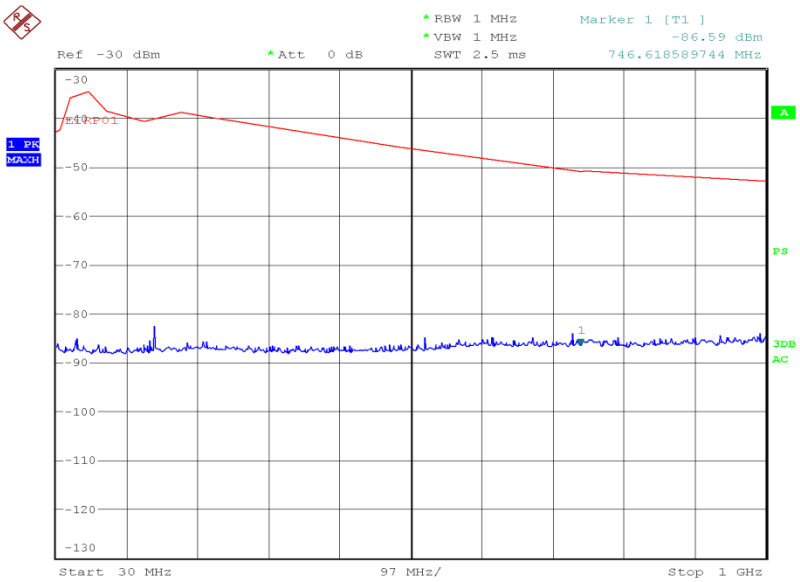
18 GHz to 20 GHz



Date: 7.AUG.2013 22:04:32

1880.0 MHz

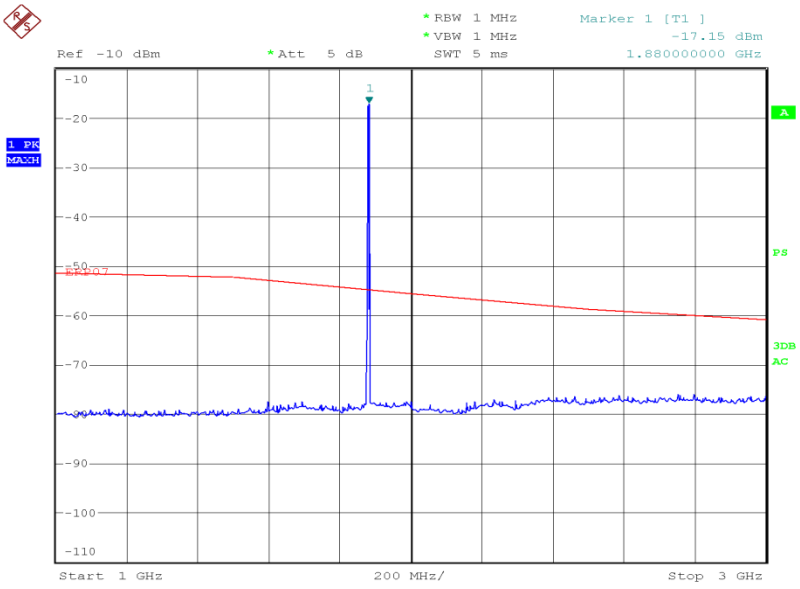
30 MHz to 1 GHz



Date: 22.JUL.2013 20:44:40

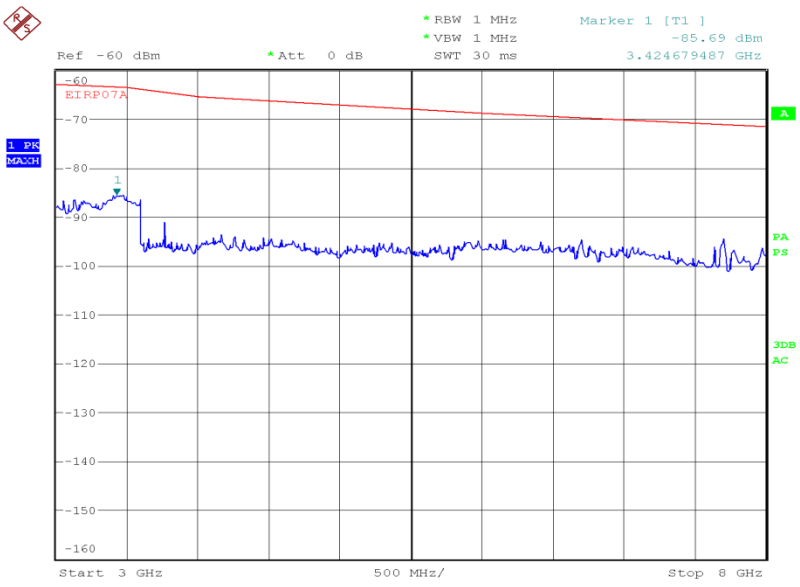
Product Service

1 GHz to 3 GHz



Date: 21.JUL.2013 09:21:16

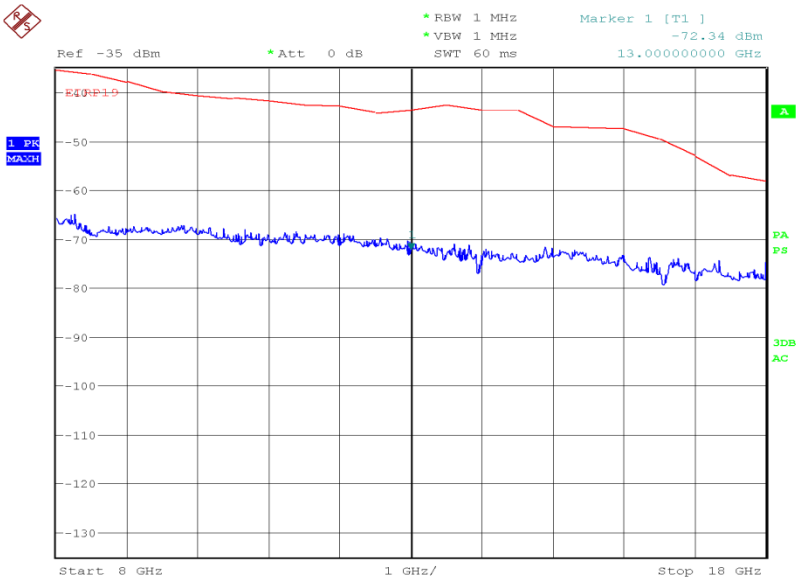
3 GHz to 8 GHz



Date: 21.JUL.2013 13:49:46

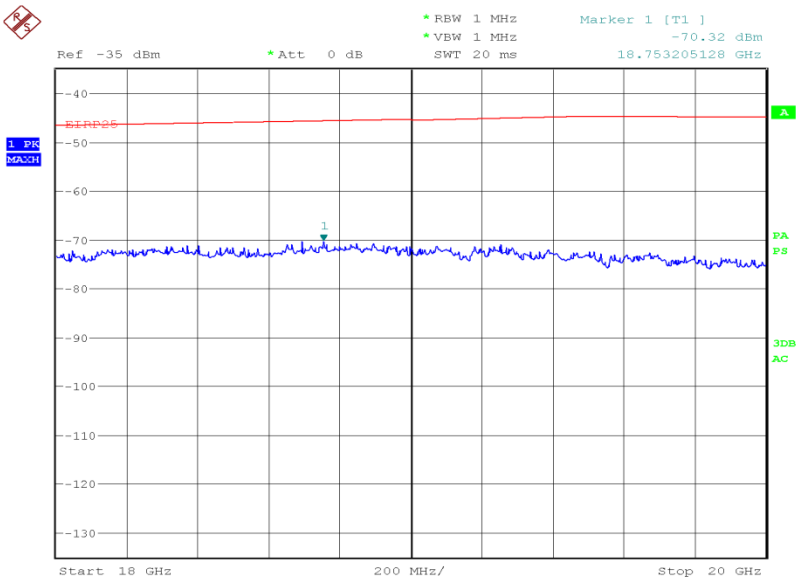
Product Service

8 GHz to 18 GHz



Date: 21.JUL.2013 14:11:00

18 GHz to 20 GHz

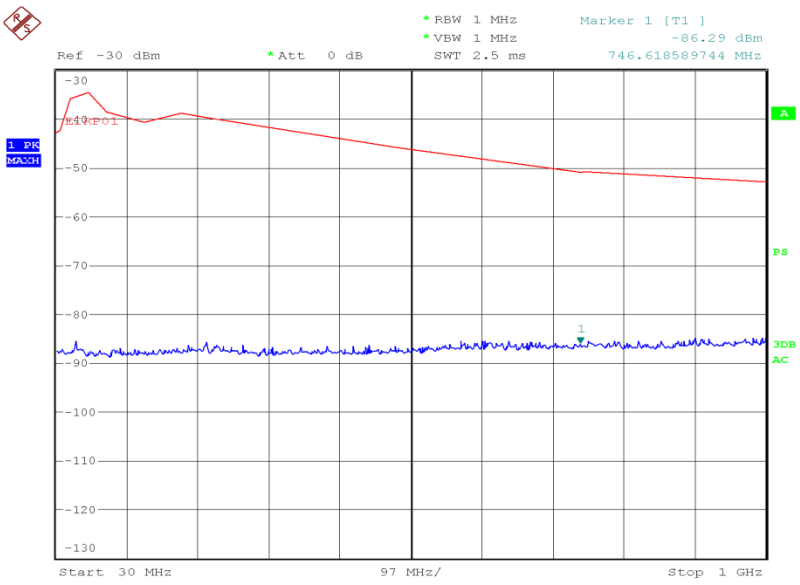


Date: 7.AUG.2013 22:03:32

Product Service

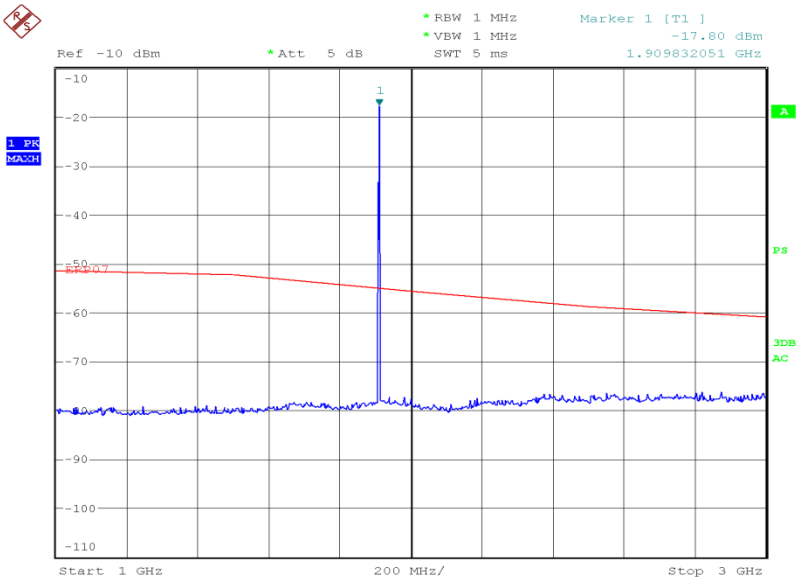
1909.8 MHz

30 MHz to 1 GHz



Date: 22.JUL.2013 20:42:34

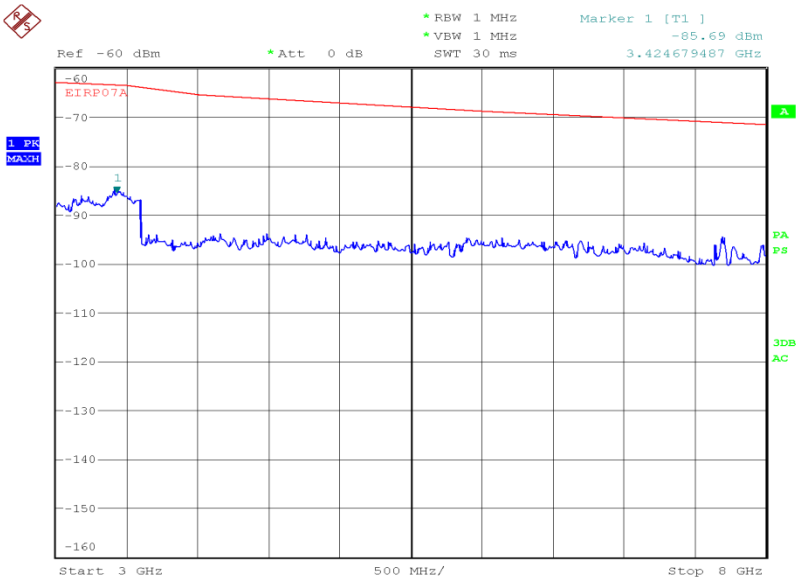
1 GHz to 3 GHz



Date: 21.JUL.2013 09:40:23

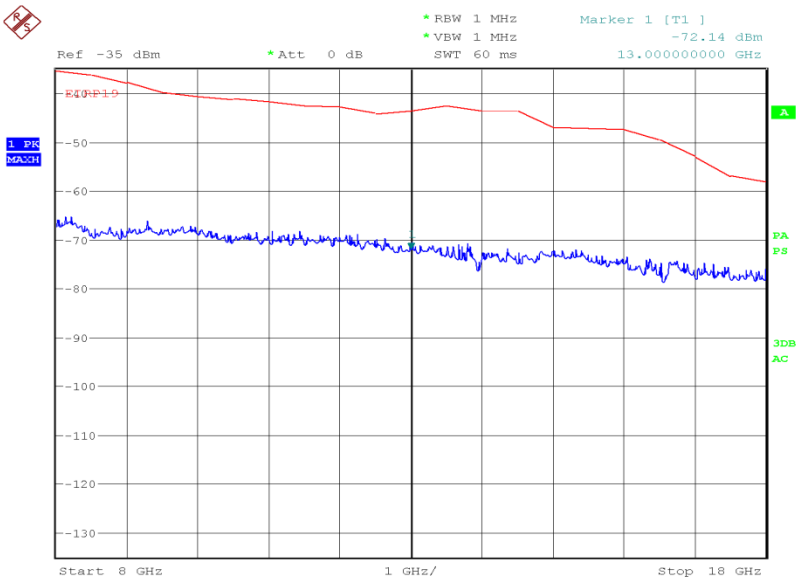
Product Service

3 GHz to 8 GHz



Date: 21.JUL.2013 13:52:33

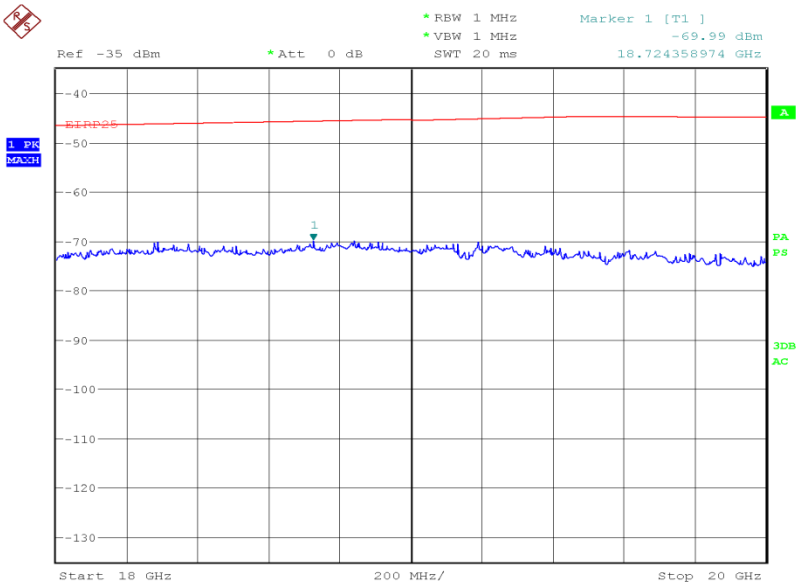
8 GHz to 18 GHz



Date: 21.JUL.2013 14:14:47

Product Service

18 GHz to 20 GHz



Date: 7.AUG.2013 22:02:33

Limit Clause

43+10log(P) or -13 dBm

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 and Modification State

Black Smartphone S/N: XCV23200852 - Modification State 0
Black Smartphone S/N: XCV23200909 - Modification State 0

2.7.3 Date of Test

22 August 2013

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 Procedure

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 GSMK and 8PSK modulations. 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 bands were used as reference level offsets to ensure worst case.

2.7.6 Environmental Conditions

Ambient Temperature	22.9°C
Relative Humidity	55.1%

Product Service

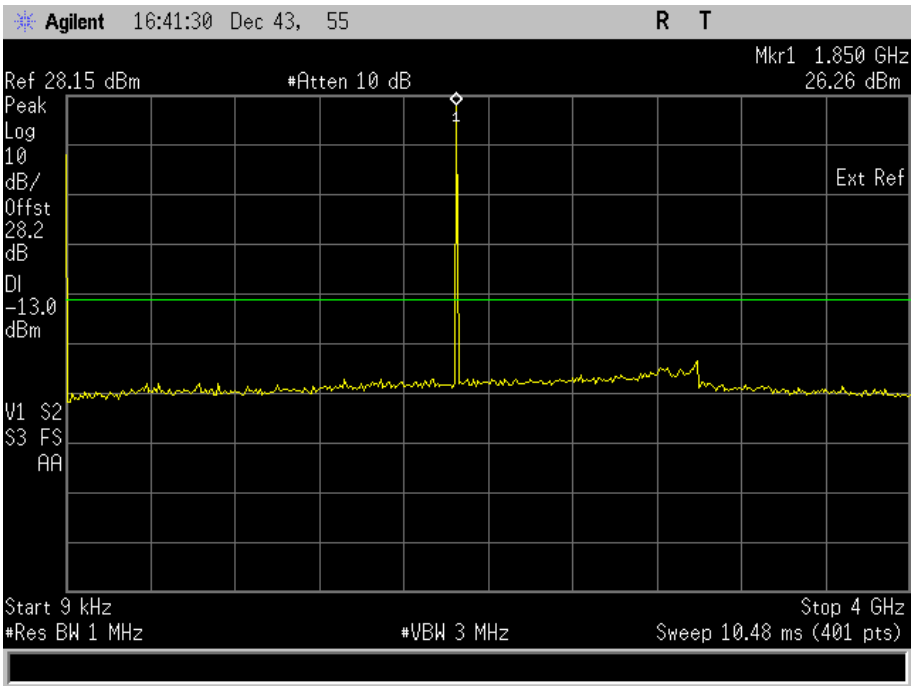
2.7.7 Test Results

PCS 1900 - 8PSK Modulation

3.8 V DC Supply

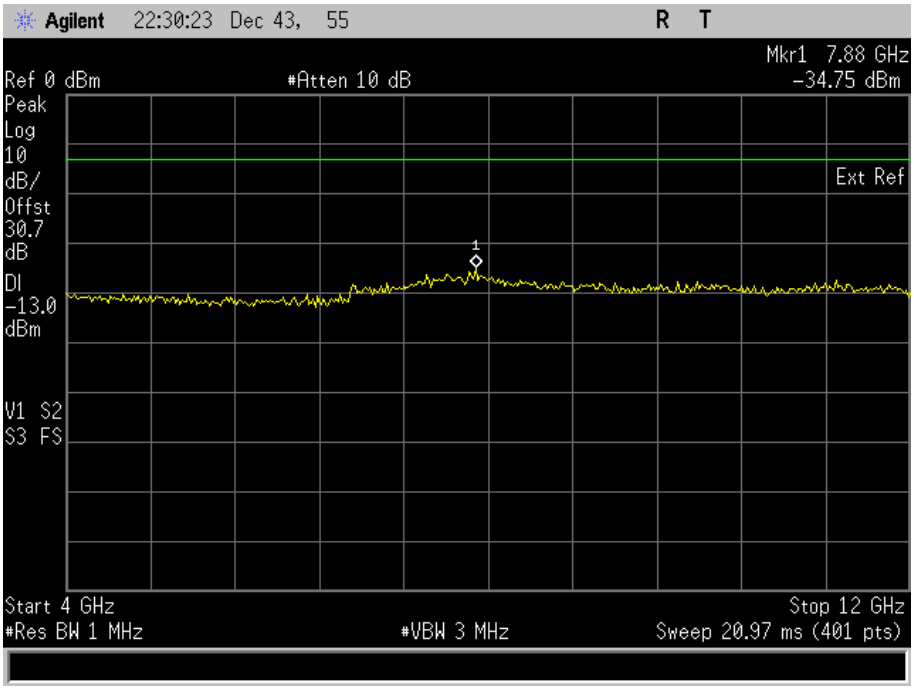
1850.2 MHz

9kHz to 4 GHz

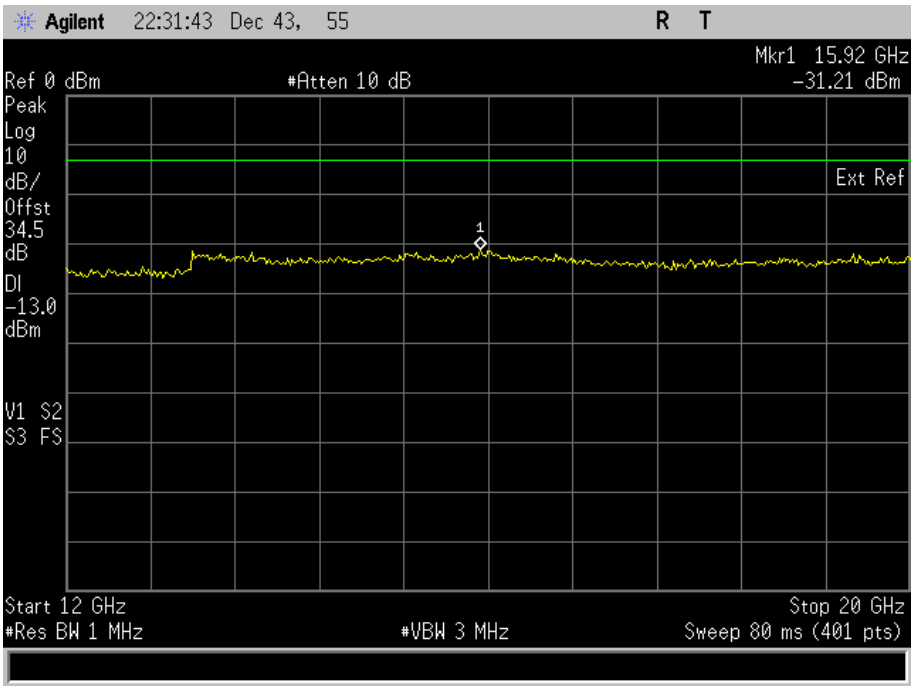


Product Service

4 GHz to 12 GHz



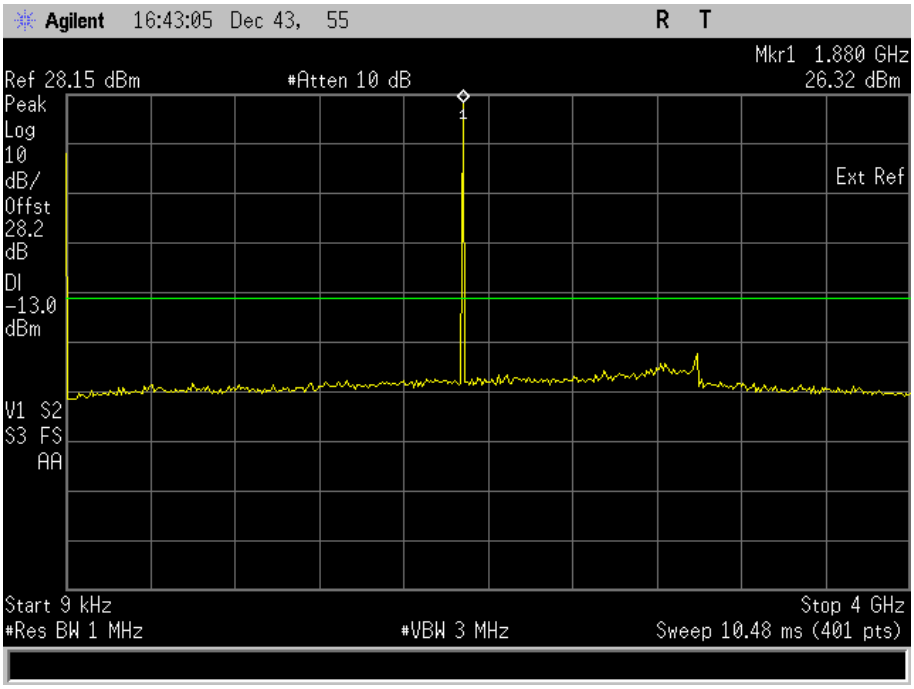
12 GHz to 20 GHz



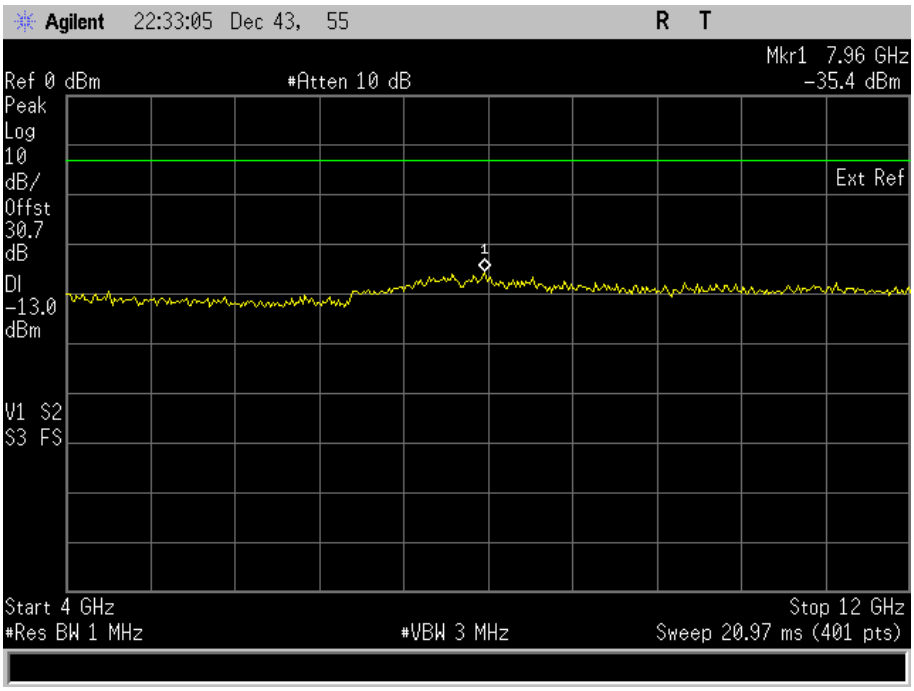
Product Service

1880.0 MHz

9kHz to 4 GHz

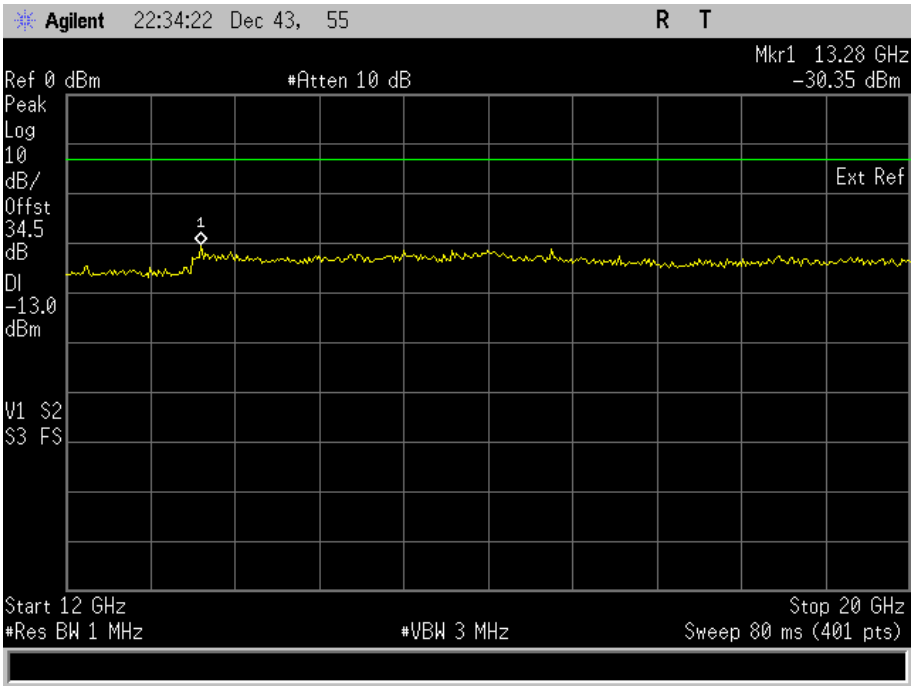


4 GHz to 12 GHz



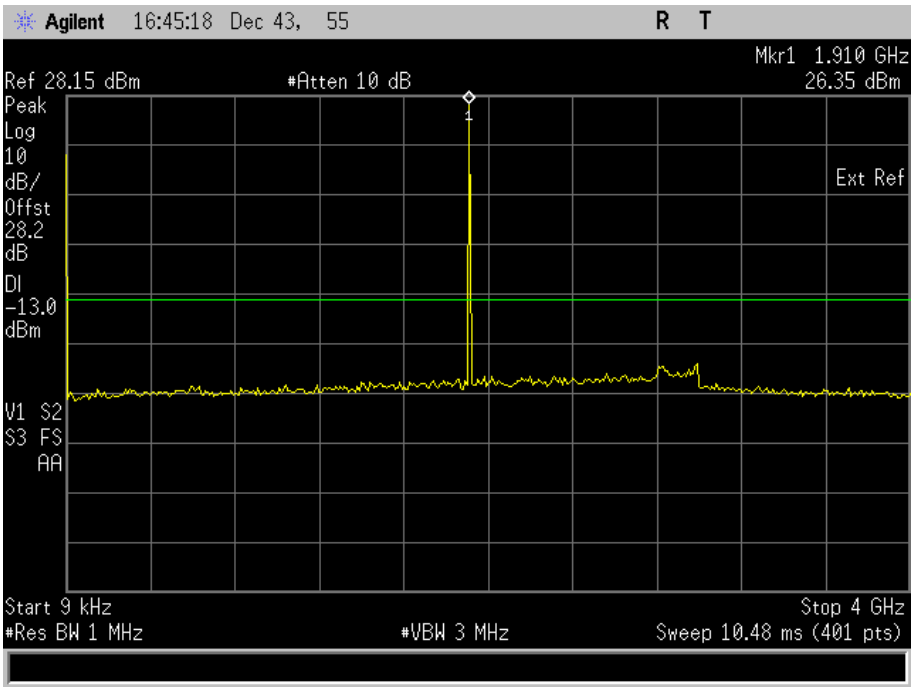
Product Service

12 GHz to 20 GHz



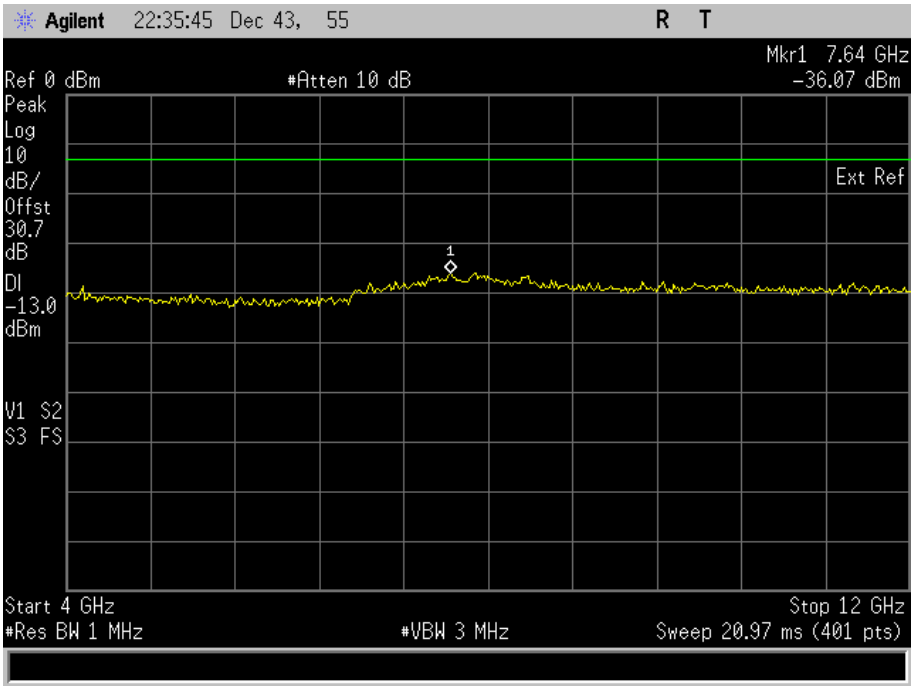
1909.8 MHz

9kHz to 4 GHz

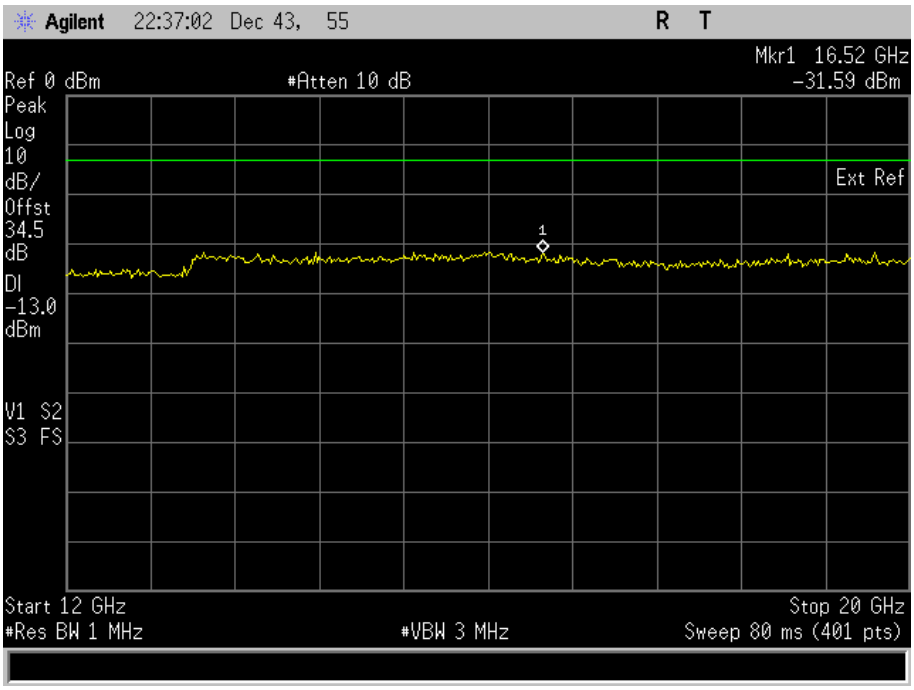


Product Service

4 GHz to 12 GHz



12 GHz to 20 GHz



Limit Clause

43+10log(P) or -13 dBm

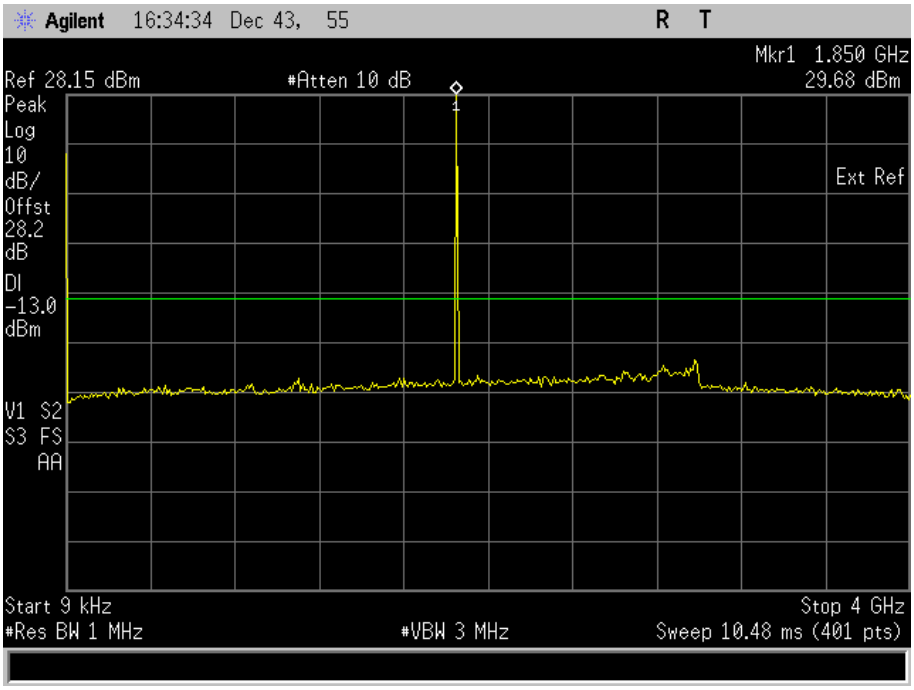
Product Service

PCS 1900 - GMSK Modulation

3.8 V DC Supply

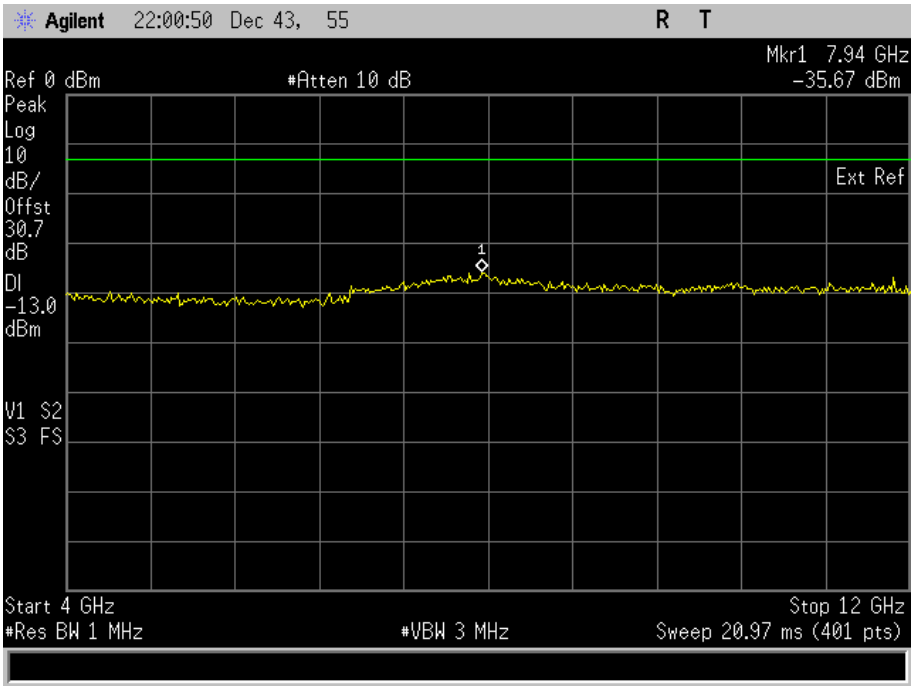
1850.2 MHz

9kHz to 4 GHz

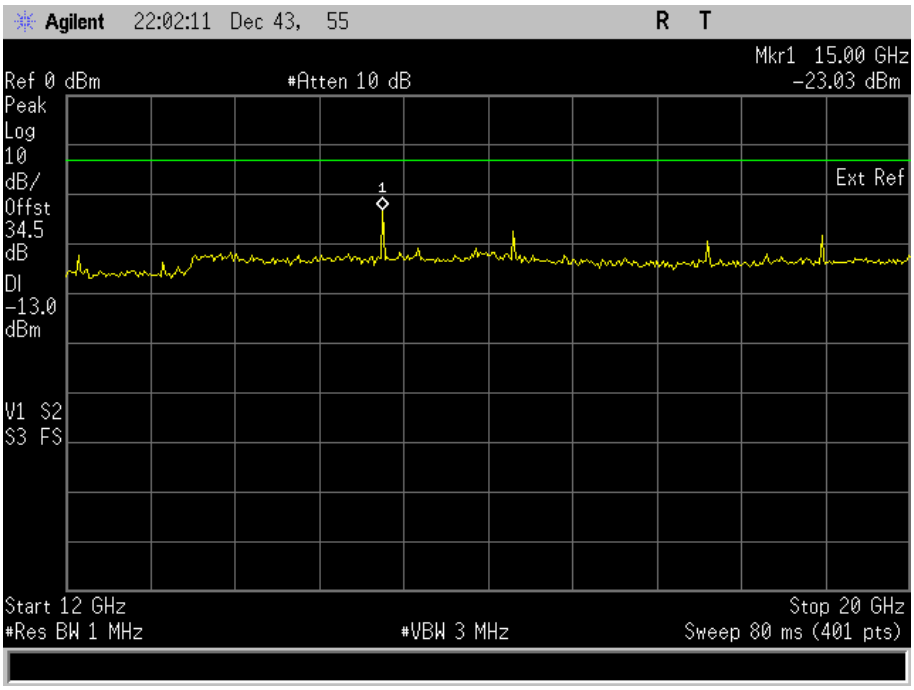


Product Service

4 GHz to 12 GHz



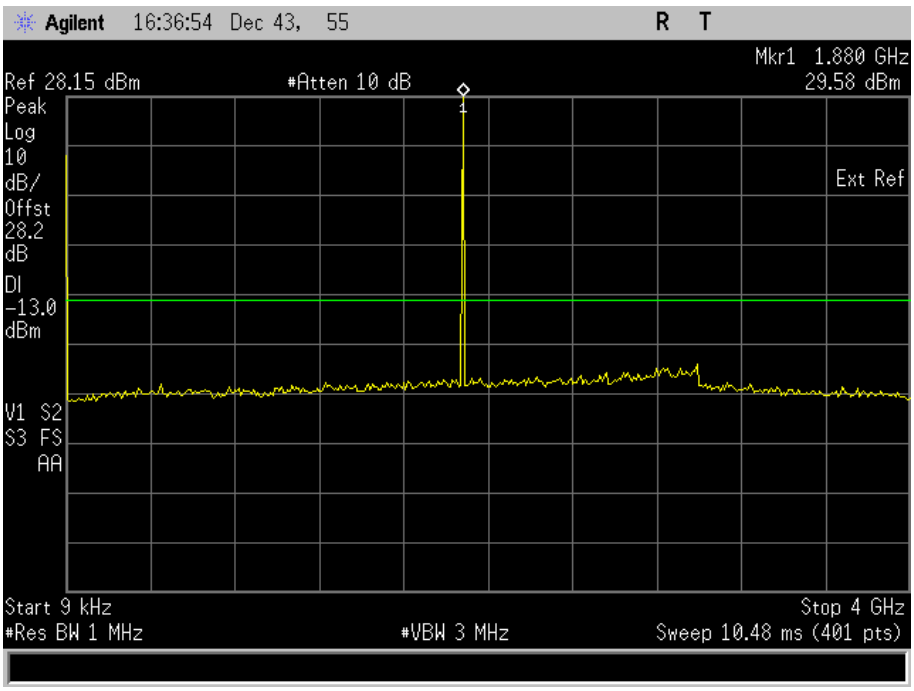
12 GHz to 20 GHz



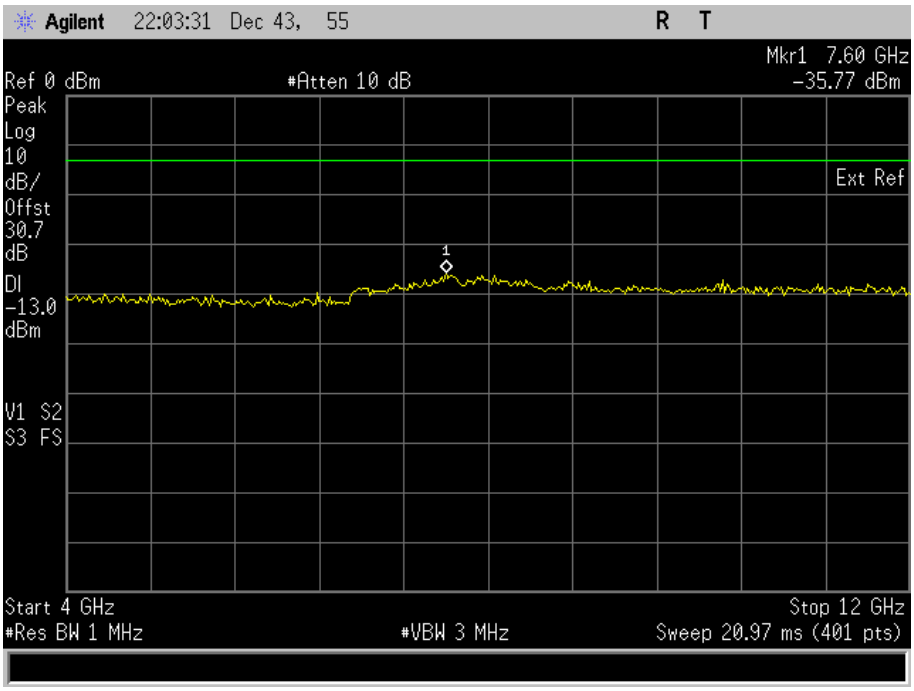
Product Service

1880.0 MHz

9kHz to 4 GHz

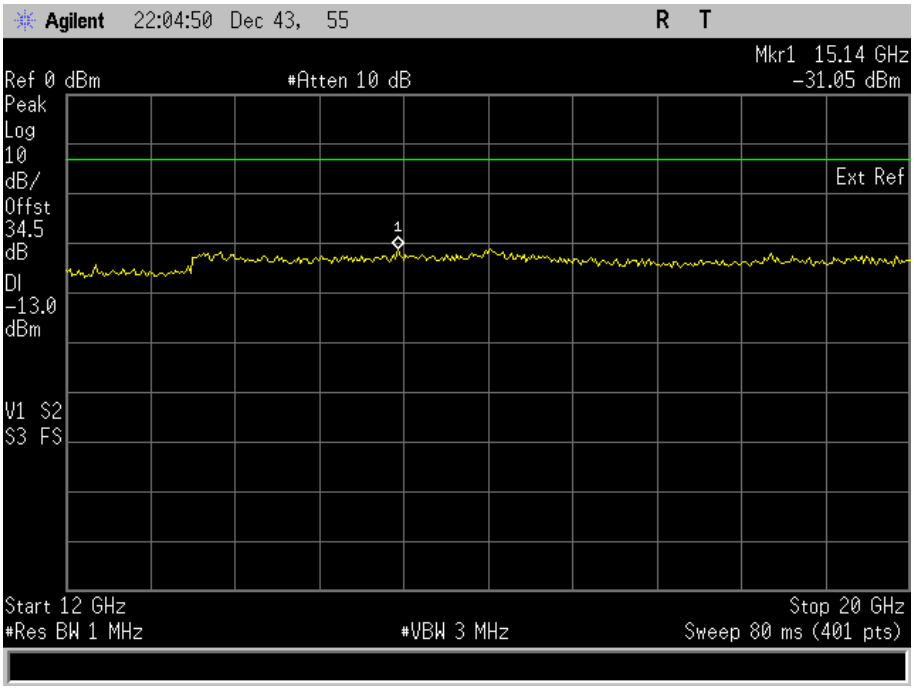


4 GHz to 12 GHz



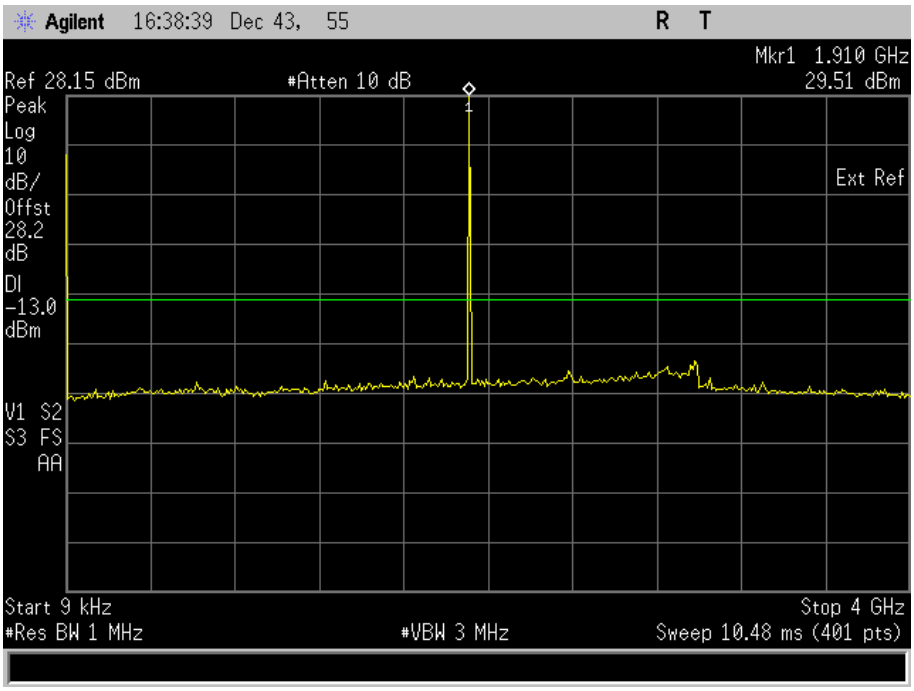
Product Service

12 GHz to 20 GHz



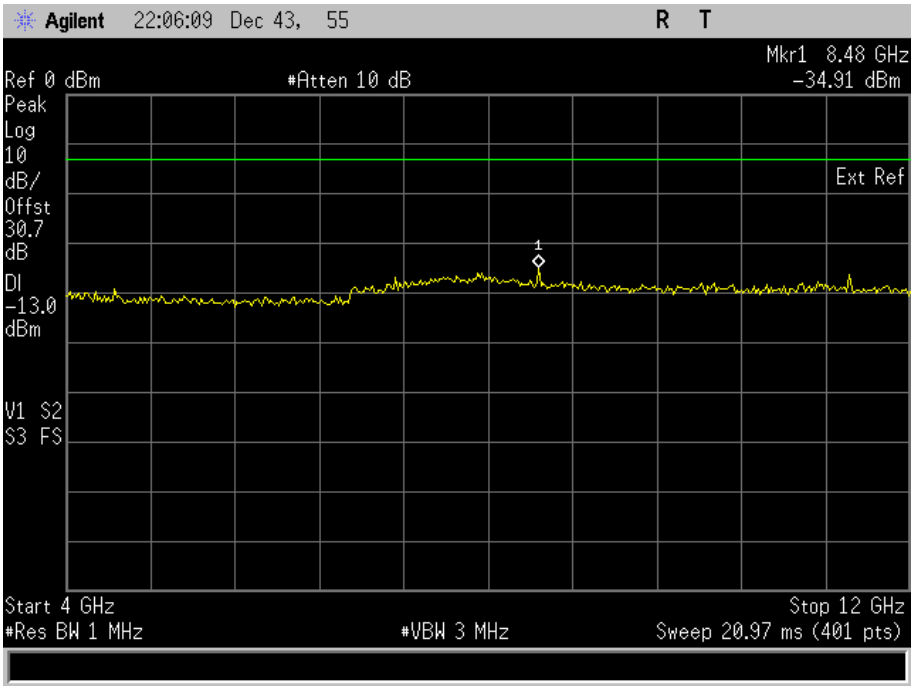
1909.8 MHz

9kHz to 4 GHz

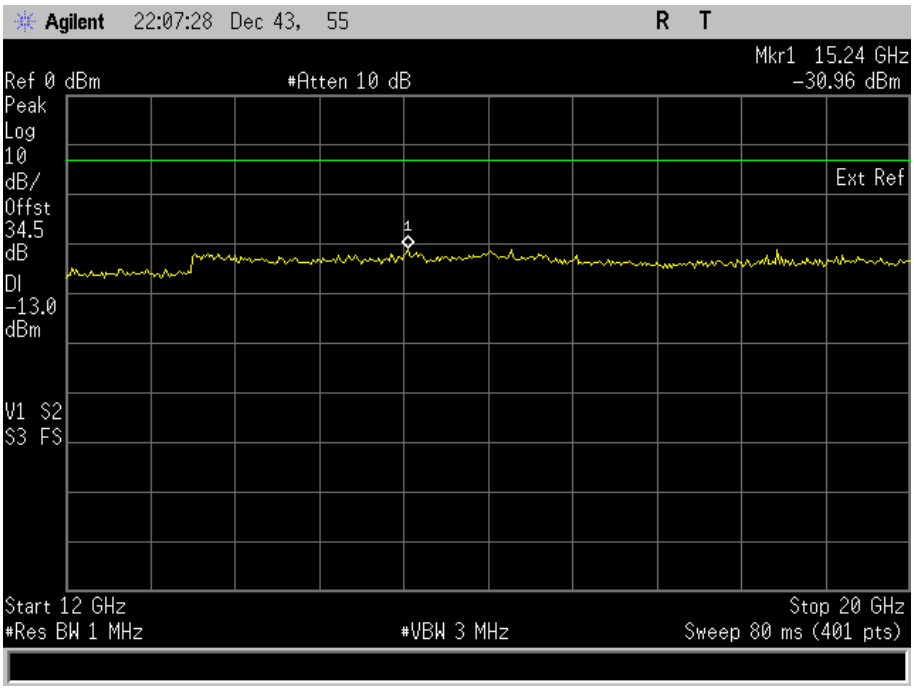


Product Service

4 GHz to 12 GHz



12 GHz to 20 GHz



Limit Clause

43+10log(P) or -13 dBm

2.8 OCCUPIED BANDWIDTH

2.8.1 Specification Reference

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

2.8.2 Equipment Under Test and Modification State

Black Smartphone S/N: XCV23200852 - Modification State 0

2.8.3 Date of Test

20 August 2013 & 22 August 2013

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 Procedure

The EUT was transmitting at maximum power, with GMSK and 8PSK modulations. 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.

2.8.6 Environmental Conditions

Ambient Temperature	22.9°C
Relative Humidity	55.1%

Product Service

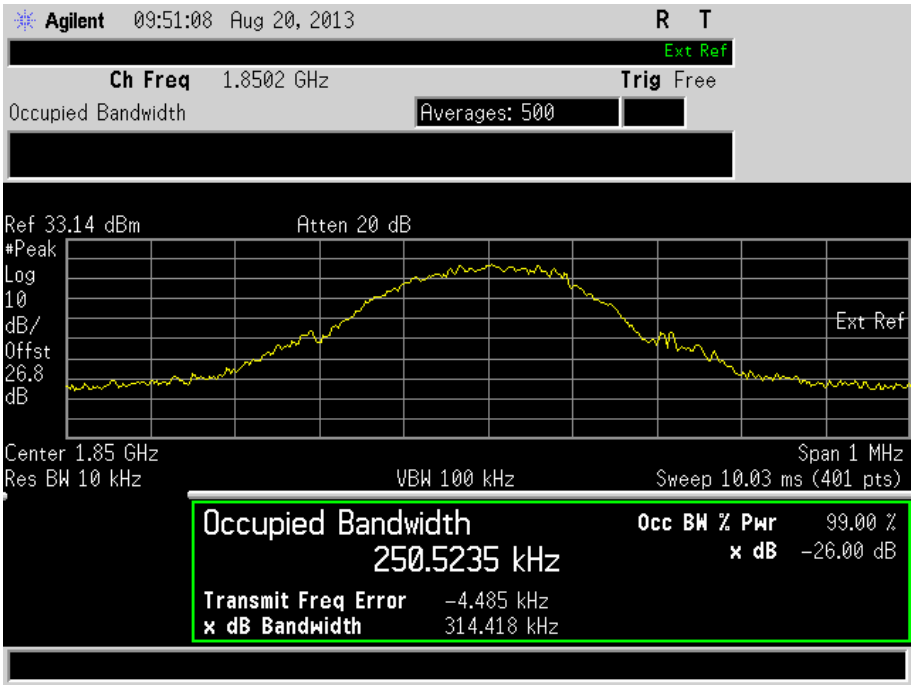
2.8.7 Test Results

PCS 1900 - 8PSK Modulation

3.8 V DC Supply

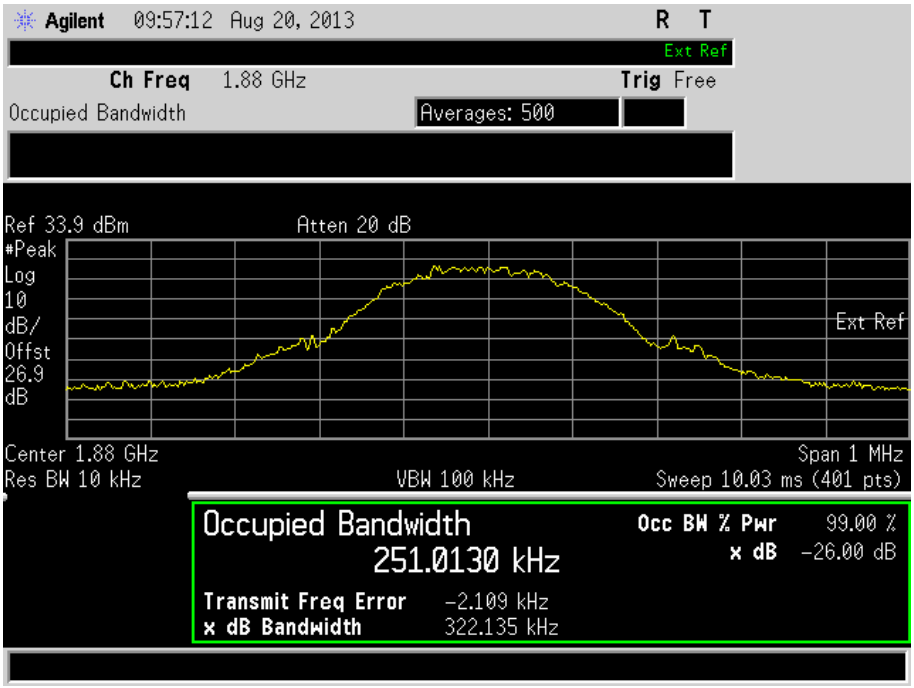
1850.2 MHz

Mode	Occupied Bandwidth (kHz)
8-PSK	250.5235



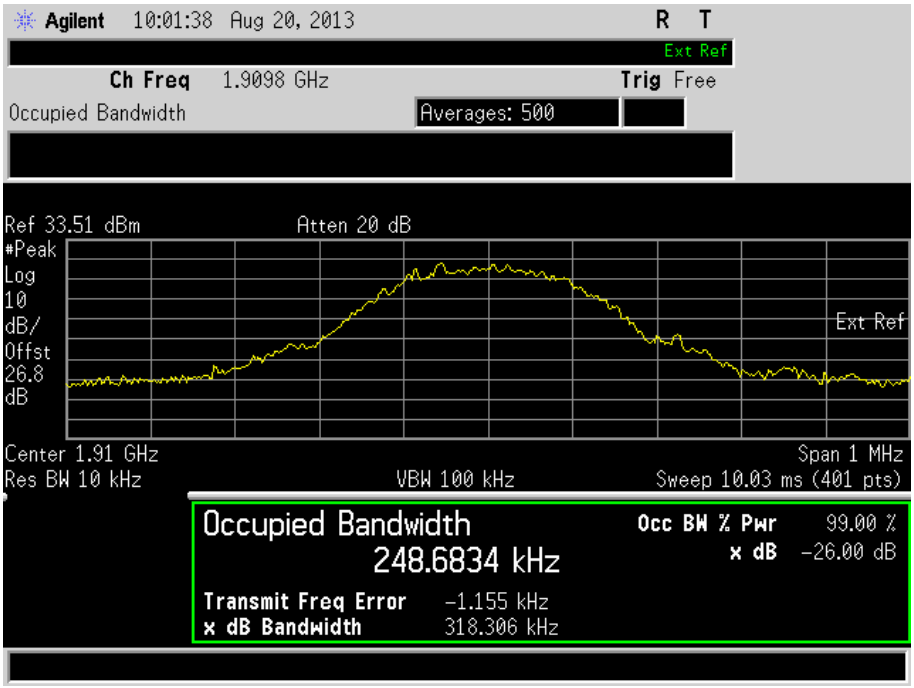
1880.0 MHz

Mode	Occupied Bandwidth (kHz)
8-PSK	251.013



1909.8 MHz

Mode	Occupied Bandwidth (kHz)
8-PSK	248.6834



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.

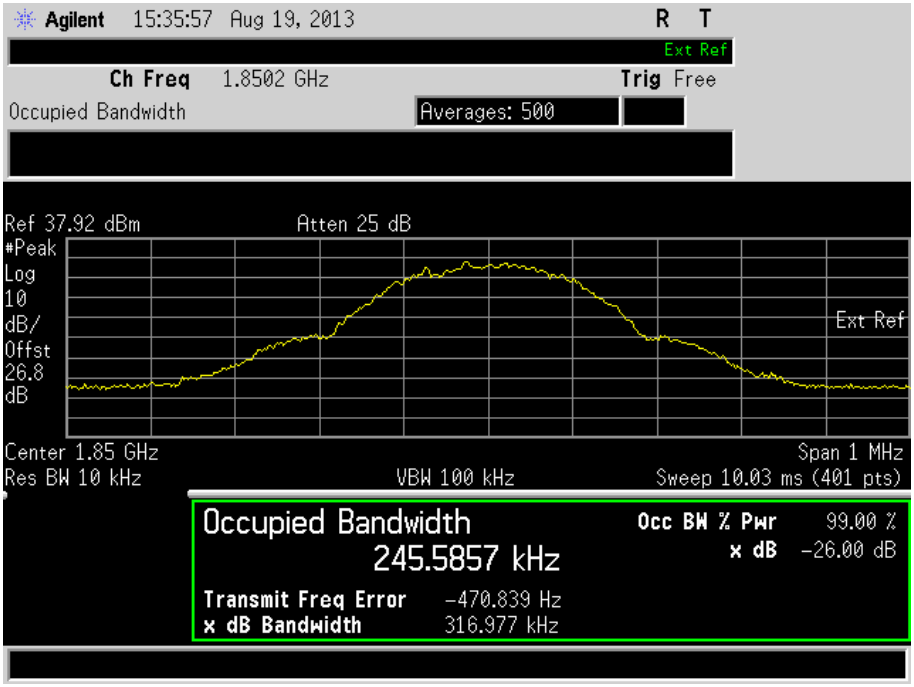
Product Service

PCS 1900 - GMSK Modulation

3.8 V DC Supply

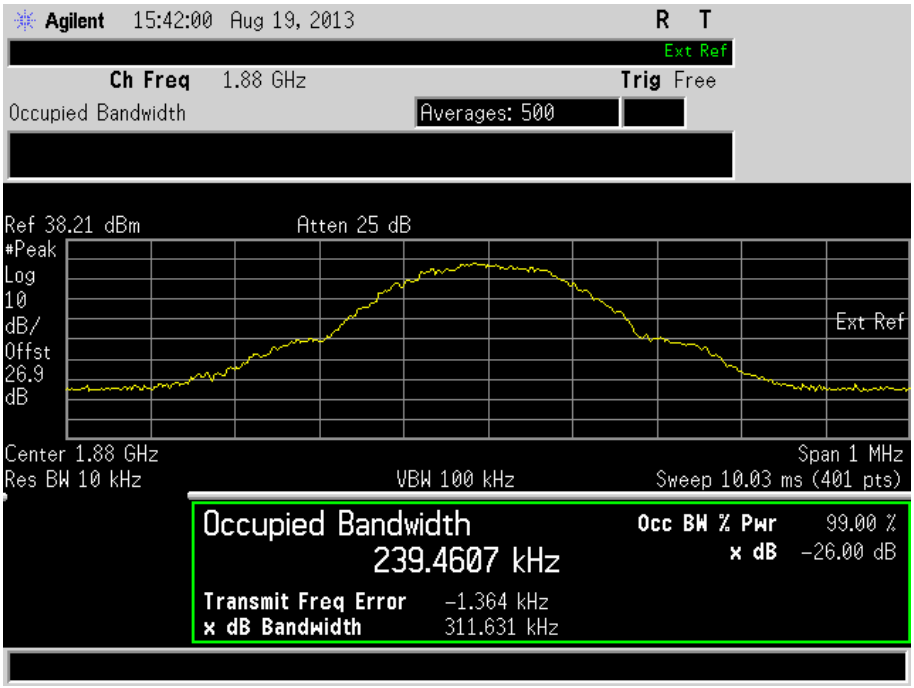
1850.2 MHz

Mode	Occupied Bandwidth (kHz)
GMSK	245.5857



1880.0 MHz

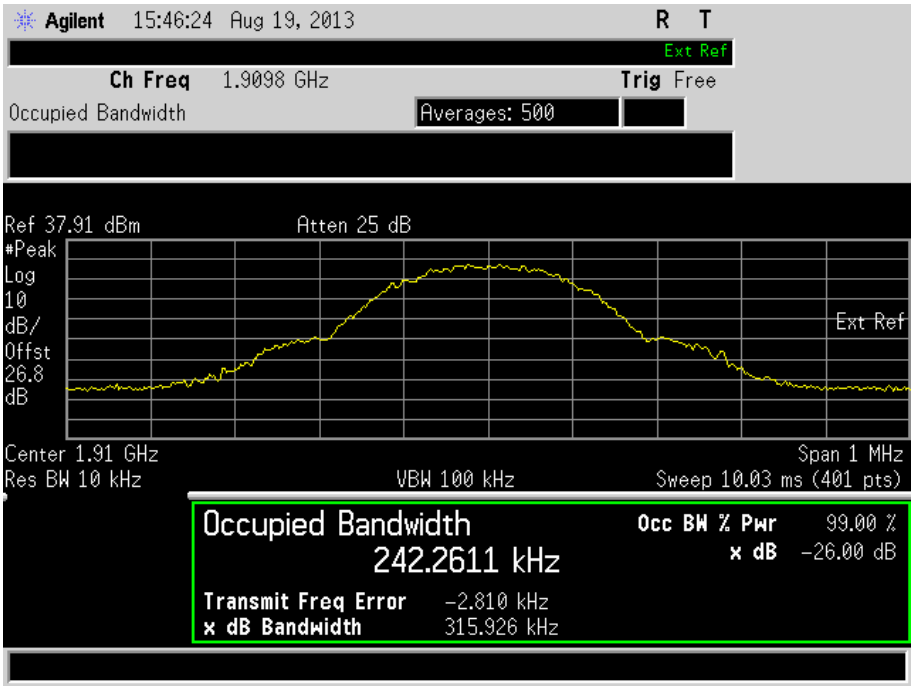
Mode	Occupied Bandwidth (kHz)
GMSK	239.4607



Product Service

1909.8 MHz

Mode	Occupied Bandwidth (kHz)
GMSK	242.2611



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

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					
Multimeter	White Gold	WG022	190	12	30-Oct-2013
Temperature Chamber	Montford	2F3	467	-	O/P Mon
Power Supply Unit	Farnell	D302T	609	-	O/P Mon
Radio Communications Test Set	Rohde & Schwarz	CMU 200	3035	12	6-Dec-2013
Thermocouple Thermometer	Fluke	51	3173	12	23-Aug-2013
Attenuator (10dB, 20W)	Lucas Weinschel	1	3225	12	11-Dec-2013
1 Metre N Type Cable	Rhophase	NPS-1601A-1000-NPS	4103	12	11-Jun-2014
Section 2.2 - Spurious Emissions at Band Edge					
Antenna (Bilog)	Schaffner	CBL6143	287	24	18-Jan-2014
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	18-Oct-2013
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	24-Jan-2014
Screened Room (5)	Rainford	Rainford	1545	36	25-Dec-2013
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Power Supply	Hewlett Packard	6104A	1948	-	TU
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	30-Nov-2013
High Pass Filter (4GHz)	RLC Electronics	F-100-4000-5-R	2773	12	1-Feb-2014
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	11-Oct-2013
'2.92mm' - '2.92mm' RF Cable (2m)	Rhophase	KPS-1503-2000-KPS	3694	12	25-Oct-2013
'2.92mm' - '2.92mm' RF Cable (2m)	Rhophase	KPS-1503-2000-KPS	3695	12	15-Oct-2013
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Dc-40GHz Power Splitter	Aeroflex / Weinschel	1534	3986	-	TU
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4099	12	26-Oct-2013
Section 2.3 - Effective Isotropic Radiated Power					
Antenna (Double Ridge Guide)	EMCO	3115	234	12	9-Nov-2013 03-Apr-2014
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	9-Nov-2013
Communications Tester	Rohde & Schwarz	CMU 200	442	12	1-Nov-2013
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	1002	12	7-Aug-2013 06-Sep-2013
Screened Room (5)	Rainford	Rainford	1545	36	25-Dec-2013
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna (Log Periodic)	Schaffner	UPA6108	3109	12	3-Apr-2014
Antenna (DRG Horn)	ETS-LINDGREN	3115	3125	12	17-Jul-2014
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	11-Oct-2013
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	4144	12	17-Jul-2014

Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.4- Maximum Peak Output Power - Conducted					
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	18-Oct-2013
Power Supply	Hewlett Packard	6104A	1948	-	TU
Radio Communications Test Set	Rohde & Schwarz	CMU 200	3035	12	6-Dec-2013
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	13-Jun-2014
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	31-Aug-2013
Combiner/Splitter	Weinschel	1506A	3877	12	19-Mar-2014
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4099	12	26-Oct-2013
Section 2.6 – Emission for Broadband PCS Equipment					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	3-Apr-2014
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	9-Nov-2013
Antenna (Bilog)	Schaffner	CBL6143	287	24	18-Jan-2014
Dual Power Supply Unit	Thurlby	PL320	288	-	TU
Communications Tester	Rohde & Schwarz	CMU 200	442	12	1-Nov-2013 08-Nov-2014
Antenna (Double Ridge Guide)	Q-Par Angus Ltd	QSH 180K	1511	24	7-Nov-2014
Pre-Amplifier	Phase One	PS04-0086	1533	12	27-Sep-2013 19-Dec-2014
Pre-Amplifier	Phase One	PSO4-0087	1534	12	30-Sep-2014
Screened Room (5)	Rainford	Rainford	1545	36	25-Dec-2013 25-Jan-2014
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
High Pass Filter (4GHz)	RLC Electronics	F-100-4000-5-R	2773	12	1-Feb-2014
Antenna (Bilog)	Chase	CBL6143	2904	24	10-Jun-2015
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Oct-2014
Amplifier (1 - 8GHz)	Phase One	PS06-0060	3175	-	O/P MON
Amplifier (8 - 18GHz)	Phase One	PS06-0061	3176	-	O/P MON
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	11-Oct-2013 22-Oct-2014
3 GHz High Pass Filter	K&L Microwave	11SH10-3000/X18000-O/O	3552	12	1-Feb-2014
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Section 2.7 - Conducted Spurious Emissions					
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	18-Oct-2013
Spectrum Analyser	Agilent Technologies	E7405A	1410	12	11-Sep-2013
Power Supply	Hewlett Packard	6104A	1948	-	TU
High Pass Filter (4GHz)	RLC Electronics	F-100-4000-5-R	2773	12	1-Feb-2014
Filter	Daden Anthony Ass	MH-1500-7SS	2778	-	O/P MON
Radio Communications Test Set	Rohde & Schwarz	CMU 200	3035	12	6-Dec-2013
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	13-Jun-2014
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	31-Aug-2013
Combiner/Splitter	Weinschel	1506A	3877	12	19-Mar-2014
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4099	12	26-Oct-2013
1 Metre K Type Cable	Rhophase	KPS-1501A-1000-KPS	4106	12	25-Oct-2013

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.8- Occupied Bandwidth					
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	18-Oct-2013
Power Supply	Hewlett Packard	6104A	1948	-	TU
Radio Communications Test Set	Rohde & Schwarz	CMU 200	3035	12	6-Dec-2013
ESA-E Series Spectrum Analyser	Agilent Technologies	E4402B	3348	12	13-Jun-2014
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	31-Aug-2013
Combiner/Splitter	Weinschel	1506A	3877	12	19-Mar-2014
1 Metre SMA Cable	Rhophase	3PS-1801A-1000-3PS	4099	12	26-Oct-2013

TU – Traceability Unscheduled
O/P MON – Output Monitored with Calibrated Equipment

Note: Some items of equipment are shown as having two calibration dates due to testing being carried out at two different times. The latter calibration dates refer to 8PSK test cases for ERP and Radiated Spurious Emission performed in January 2014

3.2 MEASUREMENT UNCERTAINTY

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

Test Discipline	MU
Modulation Characteristics	-
Maximum Peak Output Power - Conducted	± 0.70 dB
Emission for Broadband PCS Equipment	± 3.08 dB
Conducted Spurious Emissions	± 3.454 dB
Spurious Emissions at Band Edge	± 2.20 dB
Occupied Bandwidth	± 10.14 kHz
Effective Isotropic Radiated Power	± 3.08 dB
Frequency Stability	± 99.54 Hz

Product Service

SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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).