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Report On

FCC Testing of the Sharp Quad-band LTE (B1/B3/B17/B26), Dualband WCDMA (FDD I / V), Quad-band GSM (850/900/1800/1900) & WiMAX2+ (TDD41) multi mode Smart phone with Bluetooth, WLAN, SRD(NFC,FeliCa) and GPS in accordance with FCC 47 CFR Part 24 and FCC 47 CFR Part 2 (PCS 1900)

COMMERCIAL-IN-CONFIDENCE

FCC ID: APYHRO00243

Document 75935599 Report 15 Issue 1

September 2016



Product Service

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COMMERCIAL-IN-CONFIDENCE

REPORT ONFCC Testing of the Sharp Quad-band LTE (B1/ B3/ B17/ B26), Dual-
band WCDMA (FDD I / V) , Quad-band GSM (850/900/1800/1900) &
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SRD(NFC,FeliCa) and GPS in accordance with FCC 47 CFR Part 24
and FCC 47 CFR Part 2 (PCS 1900)

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September 2016

PREPARED FOR

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Natalie Bennett Senior Administrator, Project Support

an

Simon Bennett Authorised Signatory

DATED

23 September 2016

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

Test Engineer(s);

M Russell

P. Ralley D Ralley



Document 75935599 Report 15 Issue 1



CONTENTS

Section

Page No

1	REPORT SUMMARY	. 3
1.1 1.2 1.3 1.4 1.5 1.6 1.7	Introduction Brief Summary of Results Product Technical Description Product Information Test Conditions Deviations from the Standard Modification Record	.4 .5 .6 .6 .6
2	TEST DETAILS	.7
2.1 2.2 2.3 2.4 2.5 2.6 2.7	Spurious Emissions at Band Edge Maximum Conducted Output Power Frequency Stability Emission Limitations for Broadband PCS Equipment 26 dB Bandwidth Spurious Emissions at Antenna Terminals Modulation Characteristics	. 8 11 13 15 25 28 35
3	TEST EQUIPMENT USED	38
3.1 3.2	Test Equipment Used	39 42
4	ACCREDITATION, DISCLAIMERS AND COPYRIGHT	43
4.1	Accreditation, Disclaimers and Copyright	44



SECTION 1

REPORT SUMMARY

FCC Testing of the Sharp Quad-band LTE (B1/ B3/ B17/ B26), Dual-band WCDMA (FDD I / V) , Quad-band GSM (850/900/1800/1900) & WiMAX2+ (TDD41) multi mode Smart phone with Bluetooth, WLAN, SRD(NFC,FeliCa) and GPS In accordance with FCC 47 CFR Part 24 and FCC 47 CFR Part 2 (PCS 1900)



1.1 INTRODUCTION

The information contained in this report is intended to show the verification of FCC Testing of the Sharp Quad-band LTE (B1/ B3/ B17/ B26), Dual-band WCDMA (FDD I / V) , Quad-band GSM (850/900/1800/1900) & WiMAX2+ (TDD41) multi mode Smart phone with Bluetooth, WLAN, SRD(NFC,FeliCa) and GPS to the requirements of FCC 47 CFR Part 24 and FCC 47 CFR Part 2.

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
Serial Number(s)	IMEI 004401115905156 IMEI 004401115905321
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 24 (2015) FCC 47 CFR Part 2 (2015)
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	10879 18 July 2016
Start of Test	10 August 2016
Finish of Test	8 September 2016
Name of Engineer(s)	M Russell D Ralley G Lawler
Related Document(s)	ANSI C63.4 (2014) ANSI C63.26 (2015) ANSI TIA-603-C (2004) KDB 971168 D01 V02r02

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1.2 BRIEF SUMMARY OF RESULTS

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

Continu	Specificat	ion Clause	Test Description		Commente/Dess Standard
Section	Part 24	Part 2	Test Description	Result	Comments/Base Standard
PCS 1900					
2.1	24.229 and 24.238	2.1051	Spurious Emissions at Band Edge	Pass	
2.2	24.232	2.1046	Maximum Conducted Output Power	Pass	
2.3	24.235	2.1055	Frequency Stability	Pass	
2.4	24.238	2.1053	Emission Limitations for Broadband PCS Equipment	Pass	
2.5	24.238	2.1049 (h)	26 dB Bandwidth	Pass	
2.6	24.238 (a)	2.1051	Spurious Emissions at Antenna Terminals	Pass	
2.7	-	2.1047 (d)	Modulation Characteristics	-	Customer Declaration



1.3 PRODUCT TECHNICAL DESCRIPTION

Refer to Model Description APYHRO00243 Rev 4.0 document.

1.4 **PRODUCT INFORMATION**

1.4.1 Technical Description

The Equipment Under Test (EUT) was a Sharp Quad-band LTE (B1/B3/B17/B26), Dualband WCDMA (FDD I / V), Quad-band GSM (850/900/1800/1900) & WiMAX2+ (TDD41) multi mode Smart phone with Bluetooth, WLAN, SRD(NFC,FeliCa) and GPS. 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 4.0 V DC supply.

FCC Measurement Facility Registration Number 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 Sharp Quad-band LTE (B1/ B3/ B17/ B26), Dual-band WCDMA (FDD I / V) , Quad-band GSM (850/900/1800/1900) & WiMAX2+ (TDD41) multi mode Smart phone with Bluetooth, WLAN, SRD(NFC,FeliCa) and GPS In accordance with FCC 47 CFR Part 24 and FCC 47 CFR Part 2 (PCS 1900)



2.1 SPURIOUS EMISSIONS AT BAND EDGE

2.1.1 Specification Reference

FCC 47 CFR Part 24, Clause 24.229 and 24.238 FCC 47 CFR Part 2, Clause 2.1051

2.1.2 Equipment Under Test and Modification State

S/N: IMEI 004401115905156 - Modification State 0

2.1.3 Date of Test

10 August 2016

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 test was performed in accordance with KDB 971168 D01, clause 6.

2.1.6 Environmental Conditions

Ambient Temperature22.3°CRelative Humidity61.7%



2.1.7 Test Results

4.0 V DC Supply

PCS 1900, Circuit-Switched, GMSK, Spurious Emissions at Band Edge Results

Die ek Edre	Frequency Block (MHz)	
BIOCK Edge	A :1850 MHz – 1865 MHz	C :1895 MHz – 1910 MHz
Lower	Channel: 512 1850.2 MHz	-
Upper	-	Channel: 810 1909.8 MHz

PCS 1900, Circuit-Switched, GMSK, Frequency Block A, Spurious Emissions at Band Edge Plot





ectrum Analyzer - Swept SA Avg Type: RMS larker 1 1.910020000000 GHz + Trig: External1 Atten: 14 dB TYP PNO: Wide IFGain:Low te: LO Mkr1 1.910 020 GH -18.47 dB Ref Offset 27.02 dB Ref 30.00 dBm 0 dB/div m. 1 Span 2.000 MHz #Sweep 10.00 s (1001 pts) Center 1.910150 GHz #Res BW 5.1 kHz VBW 510 Hz* STATUS

PCS 1900, Circuit-Switched, GMSK, Frequency Block C, Spurious Emissions at Band Edge Plot

FCC 47 CFR Part 24, Limit Clause 24.229 (a)

Mobile Transmitters:

Block A: 1850 to 1865 MHz paired with 1930 to 1945 MHz Block B: 1870 to 1885 MHz paired with 1950 to 1965 MHz

FCC 47 CFR Part 24, Limit Clause 24.238 (a)

43 + 10 log (P) dB or -13 dBm.



2.2 MAXIMUM CONDUCTED OUTPUT POWER

2.2.1 Specification Reference

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

2.2.2 Equipment Under Test and Modification State

S/N: IMEI 004401115905156 - Modification State 0

2.2.3 Date of Test

10 August 2016

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

The test was performed in accordance with FCC KDB 971168 D01 v02r02, clause 5.1.2.

Remarks

The antenna gain was declared by the manufacturer as 2.0 dBi. The EIRP result was calculated using the formula below:

EIRP (dBm) = Pout (dBm) + Antenna Gain (dBi)

2.2.6 Environmental Conditions

Ambient Temperature	22.3°C
Relative Humidity	61.7%



2.2.7 Test Results

4.0 V DC Supply

PCS 1900, Circuit-Switched, Maximum Peak Conducted Output Power Results

Frequency	Conducted Power (dBm)	Antenna Gain	EIRP (dBm)	EIRP (W)
1850.2 MHz	29.92	2.0 dBi	31.92	1.56
1880.0 MHz	29.86	2.0 dBi	31.86	1.53
1909.8 MHz	29.72	2.0 dBi	31.72	1.49

FCC 47 CFR Part 24, Limit Clause 24.232 (c)

Mobile and portable stations: 2 Watts.



2.3 FREQUENCY STABILITY

2.3.1 Specification Reference

FCC 47 CFR Part 24, Clause 24.235 FCC 47 CFR Part 2, Clause 2.1055

2.3.2 Equipment Under Test and Modification State

S/N: IMEI 004401115905156 - Modification State 0

2.3.3 Date of Test

26 August 2016

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

This test was performed in accordance with FCC 47 CFR Part 2, clause 2.1055.

Remarks

A radio communications test set frequency measurement function was used to measure the frequency error. The radio communications test set was configured for an uplink frequency of 1880.0 MHz and the frequency reference was set to an external 10MHz rubidium frequency standard.

2.3.6 Environmental Conditions

Ambient Temperature	21.9°C
Relative Humidity	51.5%



2.3.7 Test Results

PCS 1900, 1880.0 MHz, Circuit-Switched,GMSK, Frequency Stability Under Temperature Variations Results

Temperature	Fundamental Measured Frequency (MHz)
-30 °C	1850.199954
-20 °C	1850.199958
-10 °C	1850.199958
0°0	1850.199961
+10 °C	1850.199964
+20 °C	1850.199966
+30 °C	1850.199980
+40 °C	1850.199970
+50 °C	1850.199966

PCS 1900, 1880.0 MHz, Circuit-Switched, GMSK, Frequency Stability Under Voltage Variations Results

Voltage	Fundamental Measured Frequency (MHz)
4.0 V DC	1850.199966
3.7 V DC	1850.199981

<u>Remark</u>

The measured frequency error over temperature and voltage extremes does not cause the fundamental emission to go outside the authorised frequency block.

FCC 47 CFR Part 24, Limit Clause 24.235

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorised frequency block.



2.4 EMISSION LIMITATIONS FOR BROADBAND PCS EQUIPMENT

2.4.1 Specification Reference

FCC 47 CFR Part 24, Clause 24.238 FCC 47 CFR Part 2, Clause 2.1053

2.4.2 Equipment Under Test and Modification State

S/N: IMEI 004401115905321 - Modification State 0

2.4.3 Date of Test

28 August 2016, 29 August 2016 & 4 September 2016

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

The testing was performed in accordance with ANSI C63.26, clause 5.5.

2.4.6 Environmental Conditions

Ambient Temperature20.3 - 21.5°CRelative Humidity61.0 - 65.0%



2.4.7 Test Results

PCS 1900, 1850.2 MHz, 30 MHz to 20 GHz, Emission Limitations for Broadband PCS Equipment Results

Frequency (MHz)	Emission Results (dBm)	
*		

*No emissions were detected within 10 dB of the limit.

PCS 1900, 1850.2 MHz, 30 MHz to 1 GHz, Emission Limitations for Broadband PCS Equipment Results



Date: 30.AUG.2016 16:37:38





PCS 1900, 1850.2 MHz, 1 GHz to 3 GHz, Emission Limitations for Broadband PCS Equipment Plot

Date: 29.AUG.2016 07:19:25





Date: 28.AUG.2016 18:42:45

Document 75935599 Report 15 Issue 1





PCS 1900, 1850.2 MHz, 8 GHz to 18 GHz, Emission Limitations for Broadband PCS Equipment Plot

Date: 28.AUG.2016 18:51:39





Date: 4.SEP.2016 08:12:27



PCS 1900, 1880.0 MHz, 30 MHz to 20 GHz, Emission Limitations for Broadband PCS Equipment Results

Frequency (MHz)	Emission Results (dBm)
*	

*No emissions were detected within 10 dB of the limit.

PCS 1900, 1880.0 MHz, 30 MHz to 1 GHz, Emission Limitations for Broadband PCS Equipment Results



Date: 30.AUG.2016 16:47:03





PCS 1900, 1880.0 MHz, 1 GHz to 3 GHz, Emission Limitations for Broadband PCS Equipment Plot

Date: 29.AUG.2016 07:15:24



PCS 1900, 1880.0 MHz, 3 GHz to 8 GHz, Emission Limitations for Broadband PCS Equipment Plot

Date: 28.AUG.2016 18:46:16

Document 75935599 Report 15 Issue 1





PCS 1900, 1880.0 MHz, 8 GHz to 18 GHz, Emission Limitations for Broadband PCS Equipment Plot

Date: 28.AUG.2016 18:57:53





Date: 4.SEP.2016 08:11:26



PCS 1900, 1909.8 MHz, 30 MHz to 20 GHz, Emission Limitations for Broadband PCS Equipment Results

Frequency (MHz)	Emission Results (dBm)
*	

*No emissions were detected within 10 dB of the limit.

PCS 1900, 1909.8 MHz, 30 MHz to 1 GHz, Emission Limitations for Broadband PCS Equipment Results



Date: 30.AUG.2016 16:48:59





PCS 1900, 1909.8 MHz, 1 GHz to 3 GHz, Emission Limitations for Broadband PCS Equipment Plot

Date: 29.AUG.2016 07:17:40



PCS 1900, 1909.8 MHz, 3 GHz to 8 GHz, Emission Limitations for Broadband PCS Equipment Plot

Date: 28.AUG.2016 18:48:46





PCS 1900, 1909.8 MHz, 8 GHz to 18 GHz, Emission Limitations for Broadband PCS Equipment Plot

Date: 28.AUG.2016 18:59:53





Date: 4.SEP.2016 08:10:19

FCC 47 CFR Part 24, Limit Clause 24.238 (a)

43 + 10 log (P) dB or -13 dBm.



2.5 26 dB BANDWIDTH

2.5.1 Specification Reference

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

2.5.2 Equipment Under Test and Modification State

S/N: IMEI 004401115905156 - Modification State 0

2.5.3 Date of Test

10 August 2016

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 Procedure

This test was performed in accordance with KDB 971168 D01 v02r02, clause 4.1.

2.5.6 Environmental Conditions

Ambient Temperature22.3°CRelative Humidity61.7%



2.5.7 Test Results

4.0 V DC Supply

PCS 1900, Circuit-Switched, 26 dB Bandwidth Results

1850.2 MHz	1880.0 MHz	1909.8 MHz
kHz	kHz	kHz
308.4	311.6	305.1



PCS 1900, 1850.2 MHz, Circuit-Switched, 26 dB Bandwidth Plot



Keysight Spectrum Analyzer - Occupied BW				- 6 - ×
Center Freq 1.880000000 G	GHz	Center Freq: 1.88000000	N AUTO/NO RF	04:49:03 PM Aug 09, 2016 Radio Std: None
	#IFGain:Low	Trig: Free Run #Atten: 24 dB	Avg Hold:>10/10	Radio Device: BTS
A JUJU Bot 40.00 dBm				Mkr1 1.8800672 GHz 26.226 dBm
Log			1	
30.0		manna		
20.0	and and		man and a start of the start of	
0.00	and a second		- my	
-10.0	not			~
-20.0				my -
30.0 mmanana				- Andrew - A
-40.0				
30.0				
Center 1.88 GHz #Res BW 5.1 kHz		#VBW 16 kHz		Span 800 kHz Sweep 29.33 ms
Occupied Bandwidth		Total Power	38.0 dBm	
24	3.30 kHz			
Transmit Freq Error	-369 Hz	% of OBW Powe	r 99.00 %	
x dB Bandwidth	311.6 kHz	x dB	-26.00 dB	
MSG			STATUS	

PCS 1900, 1880.0 MHz, Circuit-Switched, 26 dB Bandwidth Plot

PCS 1900, 1909.8 MHz, Circuit-Switched, 26 dB Bandwidth Plot





The emission bandwidth is defined as the width of the signal between two points, one below the carrier centre frequency and one above the carrier centre frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.



2.6 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

2.6.1 Specification Reference

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

2.6.2 Equipment Under Test and Modification State

S/N: IMEI 004401115905156 - Modification State 0

2.6.3 Date of Test

7 September 2016 & 8 September 2016

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

The test was performed in accordance with KDB 971168 D01 v02r02, Clause 6.

Remarks

The EUT was connected using a Rohde and Schwarz CMU 200. Measurements of the EUT were performed using a spectrum analyser.

Testing was carried out with an RBW of 1MHz as defined in 24.238(b). Measurements were made with a Peak detector and the trace set to Max Hold.

2.6.6 Environmental Conditions

Ambient Temperature	22.9°C
Relative Humidity	48.3 - 54.4%

Document 75935599 Report 15 Issue 1



2.6.7 Test Results

4.0 V DC Supply

PCS 1900, 1850.2 MHz, Spurious Emissions at Antenna Terminals Results

Frequency (MHz)	Emission Results (dBm)
*	

*No other emissions were detected within 10 dB of the limit.

PCS 1900, 1850.2 MHz, 9 kHz to 4 GHz, Spurious Emissions at Antenna Terminals Plot

🎉 Ke	sight Spectru	im Analyzer - Swept SA								
Mar	ker 1 1.	8504048366 Gate: L0	00 GHz	NO: Fast	Trig: Exter Atten: 20	rnal1 dB	Avg Type: Avg Hold:	Log-Pwr 50/50	02:15:14 TR	PM Sep 07, 2016 ACE 1 2 3 4 5 6 TYPE MWWWWWW DET P NNNNN
10 dE	B B/div F	tef Offset 27.6 dE tef 37.60 dBm	3					N	lkr1 1.85 29.	0 40 GHz 076 dBm
27.6					• ¹					
17.6										
7.60										
-2.40										
-12.4										-13.00 dBm
-22.4										من المطلوب ا
-32.4	والمارة ألغو وواله	und thin all a talk	al hora data data				a sa di salahinda Ngang tana sala	the second second second		
-42.4										
-52.4										
Star #Re	t 0 MHz s BW 1.0	0 MHz		#VB	W 3.0 MHz			Sweep	Stop 40.00 ms	4.000 GHz (40001 pts)
MSG							STATUS			



Keysight Spe	ectrum Analyzer - Swept SA						
LXI	RF 50 Ω DC	SENSE	:EXT SOURCE OFF	ALIGN AUTO	l on Dur	03:57:24	PM Sep 07, 2016
Marker 1	Gate: LO	PNO: Fast Ti IFGain:Low A	rig: External1 Atten: 6 dB	Avg Hold:	80/30		
10 dP/div	Ref Offset 39.49 dB					Mkr1 7.4	00 8 GHz 399 dBm
	Kei -10.00 uBili						-13.00 dBm
-20.0			1				
-30.0	. مقد بعد . الد دالم الكال أدبان .	and a state which and the	و المنظمة المثلية المراجع الم	and the states shall be	datani anina dita	All and the set of	a and a failed as the
Sec.	And the state of the state	Street, and the state	and the second second	a second second	Const printing and the	All and the state	Luche de las
-40.0							
-50.0							
-60.0							
-70.0							
-80.0							
-90.0							
-100							
Start 4.00 #Res BW	0 GHz 1.0 MHz	#VBW 3	.0 MHz		Sweep	Stop 1 80.00 ms	2.000 GHz (40001 pts)
MSG				STATUS	- Head		

PCS 1900, 1850.2 MHz, 4 GHz to 12 GHz, Spurious Emissions at Antenna Terminals Plot

PCS 1900, 1850.2 MHz, 12 GHz to 20 GHz, Spurious Emissions at Antenna Terminals Plot





PCS 1900, 1880.0 MHz, Spurious Emissions at Antenna Terminals Results

Frequency (MHz)	Emission Results (dBm)
*	

*No other emissions were detected within 10 dB of the limit.

PCS 1900, 1880.0 MHz, 9 kHz to 4 GHz, Spurious Emissions at Antenna Terminals Plot





PCS 1900, 1880.0 MHz, 4 GHz to 12 GHz, Spurious Emissions at Antenna Terminals Plot

Document 75935599 Report 15 Issue 1



Keysight S	Spectrum Analyzer - Swept SA				
Marker	1 19.366800000000 Gate: L0	GHz PNO: Fast IFGain:Low	Trig: External1 Atten: 6 dB	Avg Type: Log-Pwr Avg Hold: 30/30	03:49:11 PM Sep 07, 2016 TRACE 2 3 4 5 6 TYPE M
10 dB/div	Ref Offset 39.49 dB Ref -10.00 dBm				Mkr1 19.366 8 GHz -27.665 dBm
					13.00 084
-20.0					1
-30.0			na de parte de construir de l'angles de ser		
-40.0					
-50.0					
-60.0					
-70.0					
-80.0					
-90.0					
100					
Start 12. #Res BV	.000 GHz W 1.0 MHz	#VB\	W 3.0 MHz	Swee	Stop 20.000 GHz p 160.0 ms (40001 pts
MSG				STATUS	

PCS 1900, 1880.0 MHz, 12 GHz to 20 GHz, Spurious Emissions at Antenna Terminals Plot



PCS 1900, 1909.8 MHz, Spurious Emissions at Antenna Terminals Results

Frequency (MHz)	Emission Results (dBm)
*	

*No other emissions were detected within 10 dB of the limit.

PCS 1900, 1909.8 MHz, 9 kHz to 4 GHz, Spurious Emissions at Antenna Terminals Plot

🎉 Key	sight Spectru	m Analyzer - Swept SA								- 0 -
Mari	ker 1 1.	9098047029 Gate: LO	50 GHz	PNO: Fast ++-	Trig: Exter Atten: 20	nal1 1B	Avg Type: Avg Hold: 5	Log-Pwr i0/50	02:17:43 TR 1	ACE 1 2 3 4 5 6 YPE MWWWWWW DET P NNNNN
10 dE	B B/div R	ef Offset 27.6 dE ef 37.60 dBm	3						lkr1 1.90 28.	9 80 GHz 875 dBm
27.6					• ¹					
17.6										
7.60										
-2.40										-13.00 d 9m
-22.4										
-32.4					Niele Alexandre die	eren di bit		en all disk in relati		
-42.4	a beaut	and address of the second s	Carling a star of		a di kana di ka					
-52.4										
Star #Res	t 0 MHz s BW 1.0	MHz		#VB	W 3.0 MHz			Sweep	Stop 40.00 ms	4.000 GHz (40001 pts)
MSG							STATUS			



🚺 Keysight	t Spectrum Analyzer - Swept SA							- 6 -
L)XI	RF 50 Ω DC		SENSE:EXT SOURCE	OFF AL	IGN AUTO		03:53:41	1 PM Sep 07, 2016
Marker	1 4.049400000000 GH	z			Avg Type:	Log-Pwr	TI	RACE 1 2 3 4 5 6
	Gate: LO	PNO: Fast +	Trig: Externa	al1	Avg Hold:	30/30		TYPE MWWWWW
		IFGain:Low	Atten: 6 dB					DEI
	D (07						Mkr1 4.0	49 4 GHz
10 30 30	Ref Offset 39.49 dB						-28	415 dBm
Log	Rel -10.00 uBili							
								-13.00 dBm
-20.0								
<u></u> 1								
~								
-30.0	and public and the second states of the second states of the	a hit was have a state of the	المتعدر والعلال وأنا	and the second party and	The state of the state	بالإيمامي تقطح	and the state of the	a boyfil discript
	ALL AND DESCRIPTION OF A D	All provide and and the other	Standing and the second state	and the states of	the diamonda	ditte a late of a state	and a state of the second	Since Selling Side and
-40.0								
-50.0								
-60.0								
-70.0								
-70.0								
-80.0								
-90.0								
100								
-100								
Start 4.	000 GHz						Stop '	12.000 GHz
#Res B	W 1.0 MHz	#VE	3W 3.0 MHz			Sweep	80.00 ms	(40001 pts)
1100					CTATIC			
MSG					STATUS			

PCS 1900, 1909.8 MHz, 4 GHz to 12 GHz, Spurious Emissions at Antenna Terminals Plot

PCS 1900, 1909.8 MHz, 12 GHz to 20 GHz, Spurious Emissions at Antenna Terminals Plot





43 + 10 log (P) dB or -13 dBm.



2.7 MODULATION CHARACTERISTICS

2.7.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1047 (d)

2.7.2 Test Results

PCS 1900, Modulation Characteristics, Customer Description

Please insert appropiate template

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 SEQUEN	ICE	00	11	10	01
PHASE	225°	45°	135°	315°	

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		11		0 1		10	
I Stream	0		1		0		1	
Q stream		0		1		1		0

2. Modulate each stream with PSK (1 = 90° or $\pi/2$, 0 = -90° or $-\pi/2$ 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

-π/2

-π



0

0

-π/2

0

π/2

3. Combine (add) the two PSK signals:

-π/2

Combined Phase

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):



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.

FCC 47 CFR Part 2, Limit Clause 2.1047 (d)

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.



SECTION 3

TEST EQUIPMENT USED



3.1 TEST EQUIPMENT USED

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

Instrument	Manufacturer	Туре No.	TE No.	Calibration Period	Calibration Due			
				(months)				
Section 2.1 - Spurious Emissio	ons at Band Edge							
Radio Communications Test Set	Rohde & Schwarz	CMU 200	442	12	18-Jan-2017			
Multimeter	Fluke	75 Mk3	455	12	10-Sep-2016			
20dB/2W Attenuator	Narda	4772-20	462	-	TU			
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	30-Oct-2016			
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	5-Mar-2017			
Hygrometer	Rotronic	I-1000	3220	12	23-Aug-2017			
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016			
Combiner/Splitter	Weinschel	1506A	3878	12	7-Jun-2017			
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016			
Frequency Standard	Spectracom	Secure Sync 1200- 0408-0601	4393	6	5-Mar-2017			
Digital Multi-meter	Iso-tech	IDM93N	4435	12	25-Aug-2017			
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8- SMS	4518	12	16-Feb-2017			
1 metre K-Type Cable	Florida Labs	KMS-180SP-39.4- KMS	4519	12	16-Feb-2017			
Wideband Radio Test Set	Rohde & Schwarz	CMW500	4546	12	3-Feb-2017			
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016			
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	TU			
Section 2.2 - Maximum Conducted Output Power								
Radio Communications Test Set	Rohde & Schwarz	CMU 200	442	12	18-Jan-2017			
Multimeter	Fluke	75 Mk3	455	12	10-Sep-2016			
20dB/2W Attenuator	Narda	4772-20	462	-	TU			
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	3-Sep-2016			
Hygrometer	Rotronic	I-1000	3220	12	19-Aug-2016			
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016			
Combiner/Splitter	Weinschel	1506A	3878	12	7-Jun-2017			
P-Series Power Meter	Agilent Technologies	N1911A	3980	12	25-Sep-2016			
50 MHz-18 GHz Wideband	Agilent Technologies	N1921A	3982	12	25-Sep-2016			
Calibration Unit	Robde & Schwarz	7\/_754	4368	12	7-Sen-2016			
Frequency Standard	Spectracom	Secure Sync 1200- 0408-0601	4393	6	3-Sep-2016			
Wideband Radio Test Set	Rohde & Schwarz	CMW500	4546	12	3-Feb-2017			
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016			
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	TU			

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Product Service

Instrument	Manufacturer	Туре No.	TE No.	Calibration Period (months)	Calibration Due				
Section 2.3 - Frequency Stability									
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	30-Oct-2016				
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	3-Sep-2016				
Radio Communications Test Set	Rohde & Schwarz	CMU 200	2809	12	19-Jul-2017				
Climatic Chamber	TAS	Micro 225	2892	-	O/P Mon				
Thermocouple Thermometer	Fluke	51	3174	12	9-Dec-2016				
Power Divider	Weinschel	1506A	3345	12	7-Jun-2017				
Frequency Standard	Spectracom	Secure Sync 1200- 0408-0601	4393	6	3-Sep-2016				
Hygropalm Temperature and Humidity Meter	Rotronic	HP21	4410	12	27-Apr-2017				
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8- SMS	4518	12	16-Feb-2017				
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	8-Oct-2016				
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	TU				
Section 2.4 - Emission Limitat	Section 2.4 - Emission Limitations for Broadband PCS Equipment								
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	12-Feb-2018				
Radio Communications Test Set	Rohde & Schwarz	CMU 200	442	12	18-Jan-2017				
Pre-Amplifier	Phase One	PS04-0086	1533	12	29-Jul-2017				
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	23-Dec-2016				
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017				
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU				
Antenna (Bilog)	Chase	CBL6143	2904	24	11-Jun-2017				
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	2-Nov-2016				
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				
Digital thermo Hygrometer	Radio Spares	1260	4300	12	23-Aug-2017				
Suspended Substrate	Advance Power	11SH10-	4411	12	23-Mar-2017				
Highpass Filter	Components	3000/X18000-O/O							
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000- KPS	4527	-	TU				
Cable (Rx, SMAm-SMAm 0.5m)	Scott Cables	SLSLL18-SMSM- 00.50M	4528	6	3-Feb-2017				
Double Ridged Waveguide Horn Antenna	ETS-Lindgren	3117	4722	12	29-Dec-2016				

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Manufacturer



Calibration Due

				Period (months)	
Section 2.5 - 26 dB Bandwidth					
Radio Communications Test Set	Rohde & Schwarz	CMU 200	442	12	18-Jan-2017
Multimeter	Fluke	75 Mk3	455	12	10-Sep-2016
20dB/2W Attenuator	Narda	4772-20	462	-	TU
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	3-Sep-2016
Hygrometer	Rotronic	I-1000	3220	12	23-Aug-2017
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	2-Sep-2016
Combiner/Splitter	Weinschel	1506A	3878	12	7-Jun-2017
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	7-Sep-2016
Frequency Standard	Spectracom	Secure Sync 1200- 0408-0601	4393	6	3-Sep-2016
PXA Signal Analyser	Agilent Technologies	N9030A PXA	4409	12	8-Mar-2017
Wideband Radio Test Set	Rohde & Schwarz	CMW500	4546	12	3-Feb-2017
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	8-Oct-2016
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	TU
Section 2.6 - Spurious Emission	ons at Antenna Terminal	S			
Radio Communications Test Set	Rohde & Schwarz	CMU 200	442	12	18-Jan-2017
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	30-Oct-2016
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	5-Mar-2017
Filter	Daden Anthony Ass	MH-1500-7SS	2778	12	5-Feb-2017
Hygrometer	Rotronic	I-1000	3220	12	23-Aug-2017
Power Divider	Weinschel	1506A	3345	12	7-Jun-2017
High Pass Filter (3GHz)	RLC Electronics	F-100-3000-5-R	3349	12	1-Jun-2017
Signal Generator: 10MHz to 20GHz	Rohde & Schwarz	SMR20	3475	12	26-Feb-2017
Frequency Standard	Spectracom	Secure Sync 1200- 0408-0601	4393	6	5-Mar-2017
Digital Multi-meter	Iso-tech	IDM93N	4435	12	25-Aug-2017
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8- SMS	4518	12	16-Feb-2017

KMS-180SP-39.4-

KMS

N9030A

HMP2020

4519

4654

4735

12

12

-

Type No.

TE No.

Calibration

TU - Traceability Unscheduled

1 metre K-Type Cable

PXA Signal Analyser

2 Channel PSU

Instrument

O/P MON - Output Monitored with Calibrated Equipment

Florida Labs

Rohde & Schwarz

Keysight Technologies 16-Feb-2017

8-Oct-2016

TU



3.2 MEASUREMENT UNCERTAINTY

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

Test Discipline	MU	
Maximum Conducted Output Power	± 0.70 dB	
26 dB Bandwidth	To be determined from TMS	
Spurious Emissions at Antenna Terminals	± 3.454 dB	
Modulation Characteristics	-	
Spurious Emissions at Band Edge	To be determined from TMS	
Emission Limitations for Broadband PCS Equipment	30 MHz to 1 GHz: ± 5.1 dB 1 GHz to 40 GHz: ± 6.3 dB	
Frequency Stability	To be determined from TMS	



SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



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

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