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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 22 and FCC 47 CFR Part 2 (GSM 850)

COMMERCIAL-IN-CONFIDENCE

FCC ID: APYHRO00243

Document 75935599 Report 14 Issue 1

September 2016



Product Service

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COMMERCIAL-IN-CONFIDENCE

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 22 and FCC 47 CFR Part 2 (GSM 850)

Document 75935599 Report 14 Issue 1

September 2016

PREPARED FOR

PREPARED BY

APPROVED BY

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Natalie Bennett Senior Administrator, Project Support

Simon Bennett Authorised Signatory

DATED

22 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 22 and FCC 47 CFR Part 2. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);



G Lawle

D Rallev

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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 22 and FCC 47 CFR Part 2 (GSM 850)



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 22 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 004401115905347
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 22 (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	7 September 2016
Name of Engineer(s)	D Ralley M Russell G Lawler
Related Document(s)	ANSI C63.4 (2014) ANSI TIA-603-C (2004)

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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 22 and FCC 47 CFR Part 2 is shown below.

Oration	Specificati	on Clause	Test Description		O among a sta /D a a a Ottan d and	
Section	Part 22	Part 2	Test Description	Result	Comments/Base Standard	
GSM 850	GSM 850					
2.1	22.355	2.1055	Frequency Tolerance	Pass		
2.2	22.905 and 22.917	2.1051	Spurious Emissions at Band Edge	Pass		
2.3	22.913 (a)(2)	2.1046	Maximum Conducted Output Power	Pass		
2.4	22.917	-	Emission Limitations for Cellular Equipment	Pass		
2.5	22.917 (a)	2.1051	Spurious Emissions at Antenna Terminals	Pass		
2.6	22.917 (b)	2.1049 (h)	26 dB Bandwidth	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 22 and FCC 47 CFR Part 2 (GSM 850)



2.1 FREQUENCY TOLERANCE

2.1.1 Specification Reference

FCC 47 CFR Part 22, Clause 22.355 FCC 47 CFR Part 2, Clause 2.1055

2.1.2 Equipment Under Test and Modification State

S/N: IMEI 004401115905156 - Modification State 0

2.1.3 Date of Test

26 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

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 836.4 MHz and the frequency reference was set to an external 10MHz rubidium frequency standard.

2.1.6 Environmental Conditions

Ambient Temperature	23.7°C
Relative Humidity	45.9%



2.1.7 Test Results

4.0 V DC Supply

<u>GSM 850, 836.40 MHz, Circuit-Switched, GMSK, Frequency Tolerance Under Temperature</u> <u>Variations Results</u>

Temperature	Fundamental Frequency Deviation (ppm)
-30 °C	-0.02272
-20 °C	-0.02272
-10 °C	-0.02391
0°C	-0.01913
+10 °C	-0.01913
+20 °C	-0.02272
+30 °C	0.02272
+40 °C	0.01435
+50 °C	0.01674

FCC 47 CFR Part 22, Limit Clause 22.355

Frequency Range (MHz)	Base, Fixed (ppm)	Mobile ≤ 3 watts (ppm)	Mobile ≤ 3 watts (ppm)
25 to 50	20	20	50
50 to 450	5	5	50
450 to 512	2.5	5	5
821 to 896	1.5	2.5	2.5
928 to 929	5.0	-	-
929 to 960	1.5	-	-
2110 to 2220	10	-	-



2.2 SPURIOUS EMISSIONS AT BAND EDGE

2.2.1 Specification Reference

FCC 47 CFR Part 22, Clause 22.905 and 22.917 FCC 47 CFR Part 2, Clause 2.1051

2.2.2 Equipment Under Test and Modification State

S/N: IMEI 004401115905156 - Modification State 0

2.2.3 Date of Test

7 September 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 KDB 971168 D01 v02r02, Clause 6.

Remarks

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

An external trigger was derived from the CMU 200.

An RMS detector was used in conjunction with a gated external trigger to ensure measurements were made during a transmission burst with an RBW which was at least 1% of the measured 26dB Bandwidth.

Sweep time was calculated such that, the minimum dwell time per measurement point was greater than 1 ms.

2.2.6 Environmental Conditions

Ambient Temperature	23.4°C
Relative Humidity	56.3%



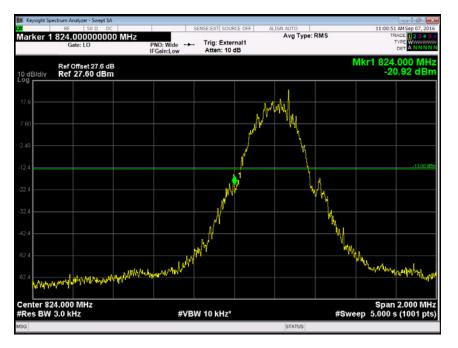
2.2.7 Test Results

4.0 V DC Supply

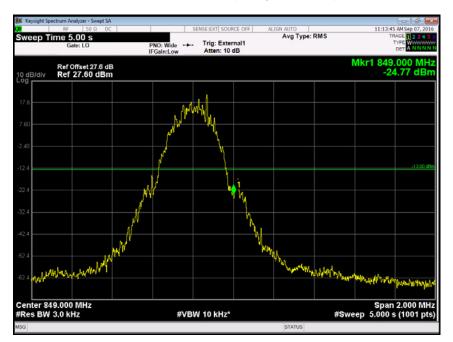
GSM 850, Circuit-Switched, GMSK, Spurious Emissions at Band Edge Results

Block Edge	Frequency Block (MHz)		
Block Edge	A :824.0 MHz – 835.0 MHz	B :846.5 MHz – 849.0 MHz	
Lower	Channel: 128 824.2 MHz	-	
Upper	-	Channel: 251 848.8 MHz	

GSM 850, Circuit-Switched, GMSK, Frequency Block A, Spurious Emissions at Band Edge Plot







GSM 850, Circuit-Switched, GMSK, Frequency Block B, Spurious Emissions at Band Edge Plot

FCC 47 CFR Part 22, Limit Clause 22.905 and 22.917

-13 dBm at block edge.



2.3 MAXIMUM CONDUCTED OUTPUT POWER

2.3.1 Specification Reference

FCC 47 CFR Part 22, Clause 22.913 (a)(2) FCC 47 CFR Part 2, Clause 2.1046

2.3.2 Equipment Under Test and Modification State

S/N: IMEI 004401115905156 - Modification State 0

2.3.3 Date of Test

10 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

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

Remarks

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

ERP (dBm) = Pout (dBm) + Antenna Gain (dBi) - 2.15 dB

2.3.6 Environmental Conditions

Ambient Temperature22.3°CRelative Humidity61.7%



2.3.7 Test Results

4.0 V DC Supply

GSM 850, Circuit-Switched, Maximum Conducted Output Power Results

Frequency	Conducted Power (dBm)	Antenna Gain	ERP (dBm)	ERP (W)
824.20 MHz	32.28	2.0 dBi	32.13	1.63
836.40 MHz	32.46	2.0 dBi	32.31	1.70
848.80 MHz	32.41	2.0 dBi	32.26	1.68

FCC 47 CFR Part 22, Limit Clause 22.913 (a)(2)

Mobile Transmitters: 7 W or 38.45 dBm



2.4 EMISSION LIMITATIONS FOR CELLULAR EQUIPMENT

2.4.1 Specification Reference

FCC 47 CFR Part 22, Clause 22.917

2.4.2 Equipment Under Test and Modification State

S/N: IMEI 004401115905347 - Modification State 0

2.4.3 Date of Test

29 August 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 test was performed in accordance with ANSI C63.26, clause 5.5.

2.4.6 Environmental Conditions

Ambient Temperature21.5°CRelative Humidity61.0%



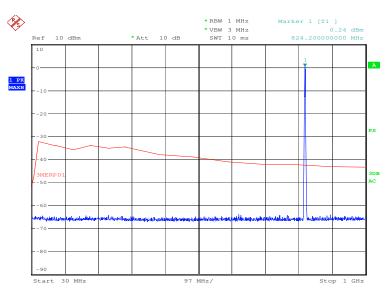
2.4.7 Test Results

GSM 850, 824.20 MHz, Emission Limitations for Cellular Equipment Results

Frequency (MHz)	Emission Results (dBm)
*	

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

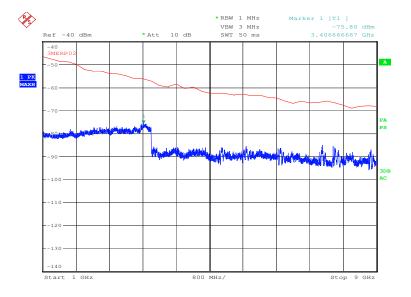
GSM 850, 824.20 MHz, 30 MHz to 1 GHz, Emission Limitations for Celluar Equipment Plot



Date: 29.AUG.2016 10:58:24



GSM 850, 824.20 MHz, 1 GHz to 9 GHz, Emission Limitations for Celluar Equipment Plot



Date: 29.AUG.2016 08:38:24

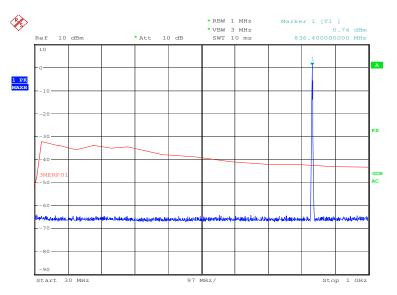


GSM 850, 836.40 MHz, Emission Limitations for Cellular Equipment Results

Frequency (MHz)	Emission Results (dBm)
*	

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

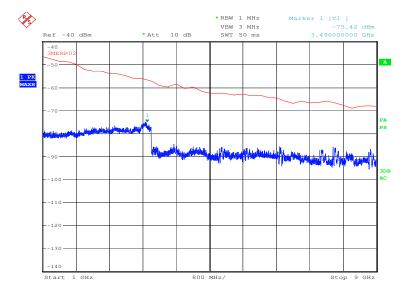
GSM 850, 836.40 MHz, 30 MHz to 1 GHz, Emission Limitations for Celluar Equipment Plot



Date: 29.AUG.2016 11:00:10



GSM 850, 836.40 MHz, 1 GHz to 9 GHz, Emission Limitations for Celluar Equipment Plot



Date: 29.AUG.2016 08:30:00

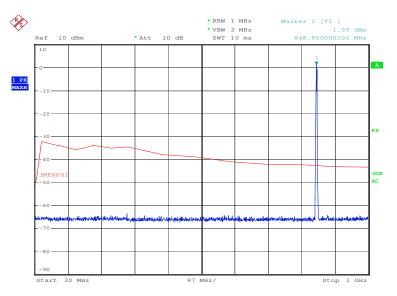


GSM 850, 848.80 MHz, Emission Limitations for Cellular Equipment Results

Frequency (MHz)	Emission Results (dBm)
*	

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

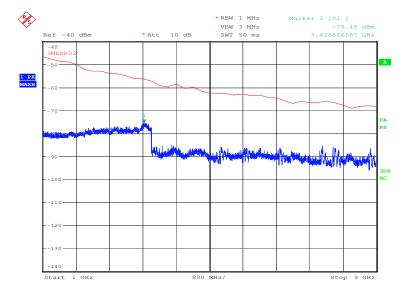
GSM 850, 848.80 MHz, 30 MHz to 1 GHz, Emission Limitations for Celluar Equipment Plot



Date: 29.AUG.2016 11:01:58



GSM 850, 848.80 MHz, 1 GHz to 9 GHz, Emission Limitations for Celluar Equipment Plot



Date: 29.AUG.2016 08:45:51

FCC 47 CFR Part 22, Limit Clause 22.917 (a)

43+10log(P) or -13 dBm



2.5 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

2.5.1 Specification Reference

FCC 47 CFR Part 22, Clause 22.917 (a) FCC 47 CFR Part 2, Clause 2.1051

2.5.2 Equipment Under Test and Modification State

S/N: IMEI 004401115905156 - Modification State 0

2.5.3 Date of Test

7 September 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

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 100 kHz as defined in 22.917(b). Measurements were made with a Peak detector and the trace set to Max Hold.

2.5.6 Environmental Conditions

Ambient Temperature	24.0°C
Relative Humidity	68.4%



2.5.7 Test Results

4.0 V DC Supply

GSM 850, 824.20 MHz, Spurious Emissions at Antenna Terminals Results

Frequency (MHz)	Emission Results (dBm)
*	

*No emissions were detected within 20 dB of the limit.

GSM 850, 824.20 MHz, 9 kHz to 1.5 GHz, Spurious Emissions at Antenna Terminals Plot

Keysight Spr	ectrum Analyzer - Swept SA							
_	RF S0 Q DC		SENSE:EXT SOUR	CE OFF	ALIGN AUTO			PM Sep 07, 201
arker 1	824.404053600 M Gate: LO	PNO: Fast -	Trig: Exter Atten: 20 d		Avg Type: Avg Hold:	Log-Pwr 150/150	11	
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	00 GHz					Stop 9.000 GF

GSM 850, 824.20 MHz, 1.5 GHz to 9 GHz, Spurious Emissions at Antenna Terminals Plot



GSM 850, 836.40 MHz, Spurious Emissions at Antenna Terminals Results

Frequency (MHz)	Emission Results (dBm)
*	

*No emissions were detected within 20 dB of the limit.

GSM 850, 836.40 MHz, 9 kHz to 1.5 GHz, Spurious Emissions at Antenna Terminals Plot

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Mar		59 Ω DC .59148047 jate: LO	5 MHz	NO: Fast	SENSE:EXT SOUR Trig: Exter Atten: 20 c	nal1	ALIGN AUTO Avg Typ Avg Hold	e: Log-Pwr I: 150/150	TF	IPM Sep 07, 2016 ACE 2 3 4 5 6 TYPE MWWWWWWW DET PNNNNN
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27.6						• 1				
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-22.4										
-32.4										
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	t 0.0 MHz s BW 100 I	kHz		#VB	W 300 kHz			Sweet	Stop 1 5 16.00 ms	1.5000 GHz (40001 pts)
MSG							STATUS			



	RF 50 Ω DC .033125000000 (Gate: LO	GHz	SENSE:EXT SOUR	CE OFF AL	IGN AUTO		12:18:58	PM Sep 07, 201
		PNO: Fast	Trig: Extern Atten: 6 dE		Avg Type: I Avg Hold: 1	.og-Pwr 00/100	1	ACE 2 3 4 5 TYPE MWWW DET PNNNN
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art 1.500							Stop	9.000 GH
Res BW 1	00 KHZ	#VB	W 300 kHz			sweep	77.33 ms	40001 pt

GSM 850, 836.40 MHz, 1.5 GHz to 9 GHz, Spurious Emissions at Antenna Terminals Plot



GSM 850, 848.80 MHz, Spurious Emissions at Antenna Terminals Results

Frequency (MHz)	Emission Results (dBm)
*	

*No emissions were detected within 20 dB of the limit.

GSM 850, 848.80 MHz, 9 kHz to 1.5 GHz, Spurious Emissions at Antenna Terminals Plot

🚺 Key	sight Spect	rum Analyzer - Swept							- 6 -
Mari	ker 1 8	RF 50 Ω 48.9664062 Gate: LO	PNO: Fast	SENSE:EXT SOUR Trig: Exter Atten: 20 d	nal1		Type: Log-Pwr Iold: 200/200		3 AM Sep 07, 2016 RACE 2 3 4 5 6 TYPE MWWWWWW DET P NNNNN
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	t 0.0 M	Hz 00 kHz		W 300 kHz			Swee	Stop ⁻ p 16.00 ms	1.5000 GHz (40001 pts)
MSG		00 MHZ	<i></i>			STAT		p 10.00 ms	(recer pro)



Keysight Spe	ctrum Analyzer - Swept Si								
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larker 1	1.6978125000 Gate: LO		PNO: Fast ++ FGain:Low	. Trig: Exter Atten: 6 d		Avg Type: Avg Hold: 2	Log-Pwr 200/200		ACE 2 3 4 5 TYPE MWWWW DET PNNN
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3.6									
8.5									
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tart 1.50 Res BW			#)(D	W 300 kHz			Swaan	Stop	9.000 GH
10-51 211	100 KHZ		#VB	W JUU KHZ			Sweep	77.33 ms	40001 Dt

GSM 850, 848.80 MHz, 1.5 GHz to 9 GHz, Spurious Emissions at Antenna Terminals Plot

FCC 47 CFR Part 22, Limit Clause 22.917 (a)

43+10log(P) or -13 dBm



2.6 26 dB BANDWIDTH

2.6.1 Specification Reference

FCC 47 CFR Part 22, Clause 22.917 (b) FCC 47 CFR Part 2, Clause 2.1049 (h)

2.6.2 Equipment Under Test and Modification State

S/N: IMEI 004401115905156 - Modification State 0

2.6.3 Date of Test

26 August 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 4.1.

2.6.6 Environmental Conditions

Ambient Temperature21.4 - 23.6°CRelative Humidity48.5 - 48.8%



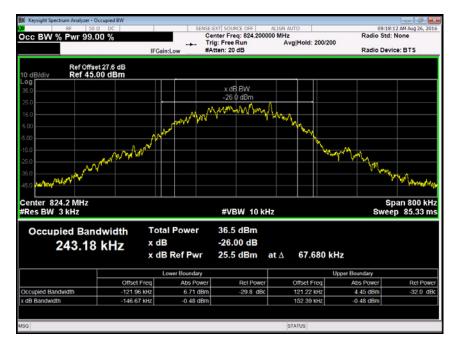
2.6.7 Test Results

4.0 V DC Supply

GSM 850, GMSK, 26 dB Bandwidth Results

824.20 MHz	836.40 MHz	848.80 MHz
kHz	kHz	kHz
299.06	298.16	299.32

GSM 850, 824.20 MHz, GMSK, 26 dB Bandwidth Plot



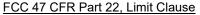


Keysight Spectrum Analyzer - Oc	Sector Contraction Contraction					
enter Freq 836.400	0000 MHz	Ce	EXT SOURCE OFF nter Freq: 836.4000 g: Free Run tten: 20 dB	ALIGN AUTO 00 MHz Avg[Hold: 200/	Radio Std	
Ref Offset dB/div Ref 45.0						
5.0			x dB BW -26.0 dBm			
5.0		amount	monthen	Mm.		
	ſ	ndur		" wy		
	of the second second				man Mary	What
enter 836.4 MHz Res BW 3 kHz			#VBW 10 kH	-iz		pan 800 kH ep 85.33 m
Occupied Band 240.51	kHz ×	otal Power dB dB Ref Pwr	36.5 dBm -26.00 dB 25.6 dBm	at 🛆 67.360	kHz	
					Upper Boundary	
		Lower Boundary				
-	Offset Freq	Lower Boundary Abs Power	Rel Power	Offset Freq	Abs Power	Rel Pow
	-121.30 kHz	Abs Power 8.61 dBm	Rel Power -27.9 dBc	119.22 kHz	7.22 dBm	Rel Pow -29.3 dE
cupied Bandwidth JB Bandwidth		Abs Power				

GSM 850, 836.40 MHz, GMSK, 26 dB Bandwidth Plot







None specified.



2.7 MODULATION CHARACTERISTICS

2.7.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1047 (d)

2.7.2 Test Results

GSM 850, Modulation Characteristics, Customer Description

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

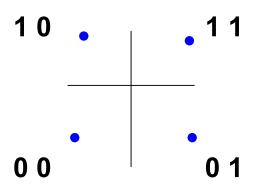
The modulation scheme used for the EUT is GMSK.

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	CE	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)

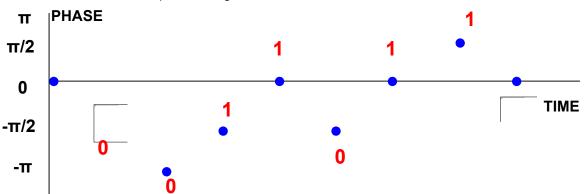
I Stream	0		1		0		1	
	-π/2		-π/2		-π/2		π/2	
Q stream		0		1		1		0
		-π/2		π/2		π/2		-π/2



3. Combine (add) the two PSK signals:

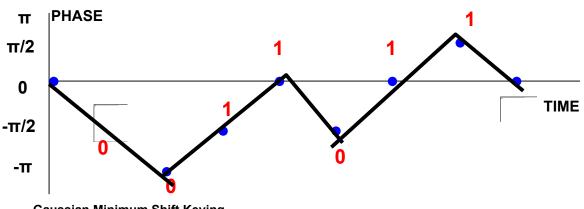
Combined Phase	-π/2	-π	-π/2	0	-π/2	0	π/2	0

Result: offset - QPSK, phase change is restricted to $\pm \pi/2$ 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.

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	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1 - Frequency Toler	ance				
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
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
Hygrometer	Rotronic	I-1000	3220	12	23-Aug-2017
Power Divider	Weinschel	1506A	3345	12	7-Jun-2017
Frequency Standard	Spectracom	Secure Sync 1200- 0408-0601	4393	6	5-Mar-2017
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
1 metre K-Type Cable	Florida Labs	KMS-180SP-39.4- KMS	4519	12	16-Feb-2017
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	8-Oct-2016
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	TU
Section 2.2 - Spurious Emissi	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
Power Divider	Weinschel	1506A	3345	12	7-Jun-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
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	8-Oct-2016
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	TU

COMMERCIAL-IN-CONFIDENCE



Product Service

Section 2.3 - Maximum Conducted Output Power Radio Communications Test Rohde & Schwarz CMU 200 442 12 18-Jan-2017 Set 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 Rohonic L1000 3220 12 19-Aug-2017 Herkork Analyser Rohonic Schwarz ZVA 40 3987 12 2-Sep-2016 Communications/Splitter Weinschel Schwarz ZVA 40 3982 12 2-Sep-2016 Power Sensor Aglient Technologies N1921A 3982 12 2-Sep-2016 Calibration Unit Rohde & Schwarz ZV-Z54 4368 12 3-Sep-2016 Guideand Radio Test Set Rohde & Schwarz CMU 200 442 12 18-Jan-2017 Section 2.4 - Ensistion Limitations for Cellular Equipment Rohde & Schwarz <td< th=""><th>Instrument</th><th>Manufacturer</th><th>Туре No.</th><th>TE No.</th><th>Calibration Period (months)</th><th>Calibration Due</th></td<>	Instrument	Manufacturer	Туре No.	TE No.	Calibration Period (months)	Calibration Due
Set Fuke 75 Mk3 455 12 10-Sep-2016 20dB/2W Attenuator Narda 4772-20 462 - TU Rubidum Standard Rohde & Schwarz XSRM 1316 6 3-Sep-2016 Hygrometer Rohde & Schwarz ZVA 40 3548 12 2-Sep-2016 Combiner/Splitter Weinschel 1506A 3648 12 2-Sep-2016 Ontz-16 Griz Wideband Aglient Technologies N1911A 3980 12 2-Sep-2016 Calibration Unit Rohde & Schwarz ZV-Z54 4368 12 7-Sep-2016 Frequency Standard Spectracom Secure Sync 1200- 4933 6 3-Sep-2016 Videband Radio Test Set Rohde & Schwarz CMW200 4546 12 3-Feb-2017 Screened Room (5) Rainford Rainford 1545 36 2-Obce-2017 Turntable Controller Inn-Co GmbH CO 1000 1606 1 1-Uun-2017 Screened Room (5) Rainford Rainford	Section 2.3 - Maximum Condu	cted Output Power				
20dB/2W Attenuator Narda 4772-20 462 . TU Rubidum Standard Rohde & Schwarz XSRM 1316 6 3-5ep-2016 Hygrometer Rotronic L-1000 3220 12 19-Aug-2017 Combiner/Splitter Weinschel 1506A 3578 12 7-Jun-2017 P-Seres Power Meter Aglient Technologies N1911A 3980 12 25-Sep-2016 Calibration Unit Rohde & Schwarz ZV-Z54 4368 12 7-Sep-2016 Frequency Standard Spectracom Secure Sync 1200- 4393 6 3-Sep-2016 Videband Radio Test Set Rohde & Schwarz CMU 200- 4735 - TU Schonz 2.4 Rohde & Schwarz CMU 200- 4735 - TU Schonz 2.4 Rohde & Schwarz CMU 200- 4742 12 18-Jan-2017 Standom 2.5 Rohde & Schwarz CMU 200 442 12 18-Jan-2017 Standom 3.5 Ratinford Rahford 1545		Rohde & Schwarz	CMU 200	442	12	18-Jan-2017
Rubidum Standard Rohde & Schwarz XSRM 1316 6 3-Sep-2016 Hygrometer Rohde & Schwarz ZVA 40 3548 12 12-9-92-2016 Combiner/Splitter Weinschel 1506A 3878 12 7-Jun-2017 P-Series Power Meter Aglient Technologies N1911A 3980 12 25-Sep-2016 Calibration Unit Rohde & Schwarz ZV-Z54 4368 12 7-Sep-2016 Frequency Standard Spectracom Secure Sync 1200 4333 6 3-Sep-2016 Videband Radio Test Set Rohde & Schwarz CMW500 4546 12 3-Feb-2017 2 channel PSU Rohde & Schwarz CMW200 4546 12 3-Feb-2017 2 channel Rom (5) Rainford Rainford 1545 36 20-Dec-2017 2 metana (Biog) Chase CBL/JAR (200) 442 12 19-Jan-2017 2 Mit Standard Rohde & Schwarz CSUA 3506 12 2-No-2016 3 Frequency Standard Rainford </td <td></td> <td>Fluke</td> <td></td> <td></td> <td>12</td> <td>10-Sep-2016</td>		Fluke			12	10-Sep-2016
Hygrometer Rotronic I-1000 3220 12 19-Aug-2016 Network Analyser Rohde & Schwarz ZVA 40 3548 12 2-Sep-2016 Ombiner/Splitter Weinschel 1506A 3878 12 Z-Sep-2016 OS MHz-18 GHz Wideband Agilent Technologies N1911A 3982 12 Z5-Sep-2016 Calibration Unit Rohde & Schwarz ZV-Z54 4368 12 7-Sep-2016 Calibration Unit Rohde & Schwarz CMW500 4546 12 3-Feb-2017 Videband Radio Test Set Rohde & Schwarz CMW500 4546 12 3-Feb-2017 Section 2.4 - Emission Limitations for Cellular Equipment Radio Communications Test Rahde & Schwarz CMU200 442 12 18-Jan-2017 Sereened Room (5) Rainford Rainford 1645 36 20-Dec-2017 Turntable Controller Inn-Co GmbH C0 1000 1606 - TU Antenna (Bilog) Chase CBL6143 2904 24 11-Jun-2017	20dB/2W Attenuator			462		
Instruct 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 Solutiz-18 Grtz Wideband Agilent Technologies N1921A 3982 12 25-Sep-2016 Calibration Unit Rohde & Schwarz ZV-Z54 4368 12 7-Sep-2016 Wideband Radio Test Set Rohde & Schwarz CMW500 4546 12 3-Feb-2017 Section 2.4 Emission Limitations for Collar Egupment CMU 200 442 12 18-Jan-2017 Set Turntable Controller Inn-Co GmbH CO 1000 1666 - TU Antenna (Biog) Chale & Schwarz CMU 200 442 12 1-Nu-2017 Bm R Cable (N Type) Rhohde & Schwarz ESU40 3506 12 2-Nov-2016 Turntable Controller Inn-Co GmbH CO 1000 1606 - TU Digital	Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	
Combner/Splitter Weinschel 1506A 3878 12 7-Jun-2017 P-Series Dwer Meter Aglient Technologies N1911A 3980 12 25-Sep-2016 Galibration Unit Rohde & Schwarz ZV-Z54 4388 12 7-Sep-2016 Galibration Unit Rohde & Schwarz ZV-Z54 4388 12 7-Sep-2016 Videband Radio Test Set Rohde & Schwarz CMW500 4546 12 3-Sep-2016 Videband Radio Test Set Rohde & Schwarz CMW500 4546 12 3-Feb-2017 Section 2.4 - Emission Limitations for Cellular Equipment Radio Communications Test Rohde & Schwarz CMU 200 442 12 18-Jan-2017 Sectened Room (5) Rainford Rainford 1545 36 20-Dec-2017 Turntable Controller Inn-Co GmH CO 1000 1606 - TU Antenna (Bilog) Rohde & Schwarz ESU40 3506 12 2-Nov-2016 Sm RF Cable (N Type) Rohpase NPS-3203-9000- 3791 -	,0	Rotronic		3220		
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50 MHz-18 GHz Wideband Power Sensor Aglient Technologies N1921A 3982 12 25-Sep-2016 Calibration Unit Rohde & Schwarz ZV-Z54 4368 12 7-Sep-2016 Wideband Radio Test Set Rohde & Schwarz ZWW500 4546 12 3-Feb-2017 Videband Radio Test Set Rohde & Schwarz CMW500 4546 12 3-Feb-2017 Zchannel PSU Rohde & Schwarz LMW200 4735 - TU Sectore 2.4 - Emission Limitations for Cellular Equipment Rohde & Schwarz CMU 200 442 12 18-Jan-2017 Settened Room (5) Rainford Rainford Rainford 1545 36 20-Dec-2017 Turntable Controller Im-Co GmbH CO 1000 1606 - TU Antenna (Bilog) Chase CBL6143 2904 24 11-Jun-2017 Mast Controller maturo Gmbh TAM 4.0-P 3916 - TU Mast Controller maturo Gmbh NCD 3917 - TU <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td></t<>						
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Udeband Radio Test Set Rohde & Schwarz CMW500 4546 12 3-Feb-2017 2 Channel PSU Rohde & Schwarz HMP2020 4735 - TU Section 2.4 - Emission Limitations for Cellular Equipment Radio Communications Test Rohde & Schwarz CMU 200 442 12 18-Jan-2017 Sectened Room (5) Rainford Rainford 1545 36 20-Dec-2017 Turntable Controller Inn-Co GmbH CO 1000 1606 - TU Antenna (Blog) 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- 3791 - TU Mats Controller maturo Gmbh TAM 4.0-P 3916 - TU Digital thermo Hygrometer Radio Spares 1260 4420 12 23-Aug-2017 Cable (Yellow, Rx, Km-Km Scott Cables KPS-1501-2000- 4527 - TU	Calibration Unit	Rohde & Schwarz		4368	12	7-Sep-2016
Wideband Radio Test Set Rohde & Schwarz CMW500 4546 12 3-Feb-2017 2 Channel PSU Rohde & Schwarz HMP2020 4735 - TU Section 2.4 - Emission Limitations for Cellular Equipment Rohde & Schwarz CMU 200 442 12 18-Jan-2017 Screened Room (5) Rainford Rainford 1545 36 20-Dec-2017 Turntable Controller Inn-Co GmbH CO 1000 1606 - TU Antenna (Biog) 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-3203-9000- NPS TU Mast Controller TU Mast Controller maturo Gmbh NCD 3917 - TU Mast Controller maturo Gmbh NCD 3917 - TU Section 2.5 - Spurious Emissions at Antenna Terminals KPS-1501-2000- 4527 - TU Section 2.5 - Spurious Emiss	Frequency Standard	Spectracom		4393	6	3-Sep-2016
2 Channel PSU Rohde & Schwarz HMP2020 4735 - TU Section 2.4 - Emission Limitations for Cellular Equipment Radio Communications Test Rohde & Schwarz CMU 200 442 12 18-Jan-2017 Set Screened Room (5) Rainford Rainford 1545 36 20-Dec-2017 Turntable Controller Inn-Co GmbH CO 1000 1606 - TU Antenna (Bliog) 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- 3791 - TU Mast Controller maturo Gmbh NAM 4.0-P 3916 - TU Digital ithermor Hygrometer Radio Spares 1260 4300 12 23-Aug-2017 Cable (Yellow, Rx, Km-Km Socti Cables KPS-1501-2000- 4527 - TU Duble Ridged Waveguide ETS-Lindgren 3117 4722 12 29-Dec-2016	Wideband Radio Test Set	Rohde & Schwarz		4546	12	3-Feb-2017
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Turntable Controller Inn-Co GmbH CO 1000 1606 - TU Antenna (Blog) Chase CBL6143 294 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 11 Antenna Mast maturo Gmbh TAM 4.0-P 3916 - TU Digital thermo Hygrometer Radio Spares 1260 4300 12 23-Aug-2017 Cable (Yellow, RX, Km-Km Scott Cables KPS-1501-2000- KPS 4527 - TU 2m) cstt Cables KPS-1501-2000- KPS 4527 - TU 2m) cstot Cables KPS-1501-2000- KPS 4527 - TU 2motherna Mattimeter Rohde & Schwarz CMU 200 442 12 18-Jan-2017 Setton 2.5 - Spurious Emissions at Antenna Terminals - TU - TU Multimeter Fluke 75 Mk3 455 <td< td=""><td></td><td>Rainford</td><td>Rainford</td><td>1545</td><td>36</td><td>20-Dec-2017</td></td<>		Rainford	Rainford	1545	36	20-Dec-2017
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EMI Test Receiver Rohde & Schwarz ESU40 3506 12 2-Nov-2016 9m RF Cable (N Type) Rhophase NPS-2303-9000- NPS 3791 - TU Mast Controller maturo Gmbh TAM 4.0-P 3916 - TU Mast Controller maturo Gmbh NCD 3917 - TU Objital thermo Hygrometer Radio Spares 1260 4300 12 23-Aug-2017 Cable (Yellow, Rx, Km-Km Scott Cables KPS-1501-2000- KPS 4527 - TU Double Ridged Waveguide ETS-Lindgren 3117 4722 12 29-Dec-2016 Horn Antenna ETS-Lindgren 3117 4722 12 18-Jan-2017 Set Rohde & Schwarz CMU 200 442 12 10-Sep-2016 OdB/ZW Attenuator Narda 4772-20 462 - TU Multimeter Fluke 75 Mk3 455 12 10-Sep-2016 OdB/ZW Attenuator Narda 4772-20 462 - <td></td> <td></td> <td></td> <td></td> <td></td> <td>-</td>						-
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COMMERCIAL-IN-CONFIDENCE



Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.6 - 26 dB Bandwidt	h				
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	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
Hygrometer	Rotronic	I-1000	3220	12	23-Aug-2017
Power Divider	Weinschel	1506A	3345	12	7-Jun-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
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
1 metre K-Type Cable	Florida Labs	KMS-180SP-39.4- KMS	4519	12	16-Feb-2017
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	8-Oct-2016
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	TU

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

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3.2 MEASUREMENT UNCERTAINTY

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

Test Discipline	MU
Frequency Tolerance	± 46.70 Hz
Modulation Characteristics	-
Maximum Conducted Output Power	± 0.70 dB
Spurious Emissions at Antenna Terminals	± 3.454 dB
Emission Limitations for Cellular Equipment	30 MHz to 1 GHz: ± 5.1 dB 1 GHz to 40 GHz: ± 6.3 dB
26 dB Bandwidth	± 16.74 kHz
Spurious Emissions at Band Edge	30 MHz to 1 GHz: ± 5.1 dB 1 GHz to 40 GHz: ± 6.3 dB



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).

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