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## Report On

FCC Testing of the Sharp SHL25 Dual-band CDMA (BC0, BC6) & Quad-band GSM (GSM850/GSM900/DCS1800/PCS1900) & Dual-band UMTS (FDD I, FDD V) & Quad-band LTE (B1, B3, B17, B18) & AXGP (TDD 41) multi mode cellular phone with Bluetooth, ANT+, WLAN, SRD (NFC, FeliCa) and GPS in accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 22 (GSM 850)

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FCC ID: APYHRO00206

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COMMERCIAL-IN-CONFIDENCE

**REPORT ON**

FCC Testing of the Sharp SHL25 Dual-band CDMA (BC0, BC6) & Quad-band GSM (GSM850/GSM900/DCS1800/PCS1900) & Dual-band UMTS (FDD I, FDD V) & Quad-band LTE (B1, B3, B17, B18) & AXGP (TDD 41) multi mode cellular phone with Bluetooth, ANT+, WLAN, SRD (NFC, FeliCa) and GPS in accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 22 (GSM 850)

Document 75925936 Report 16 Issue 1

May 2014

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Authorised Signatory

**DATED**

14 May 2014

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**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 22. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

S Milliken

M Russell



J Tuckwell

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## **SECTION 1**

### **REPORT SUMMARY**

FCC Testing of the  
Sharp SHL25 Dual-band CDMA (BC0, BC6) & Quad-band GSM  
(GSM850/GSM900/DCS1800/PCS1900) & Dual-band UMTS (FDD I, FDD V) & Quad-band LTE  
(B1, B3, B17, B18) & AXGP (TDD 41) multi mode cellular phone with Bluetooth, ANT+, WLAN,  
SRD (NFC, FeliCa) and GPS  
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 22 (GSM 850)



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## 1.1 INTRODUCTION

The information contained in this report is intended to show the verification of FCC Testing of the Sharp SHL25 Dual-band CDMA (BC0, BC6) & Quad-band GSM (GSM850/GSM900/DCS1800/PCS1900) & Dual-band UMTS (FDD I, FDD V) & Quad-band LTE (B1, B3, B17, B18) & AXGP (TDD 41) multi mode cellular phone with Bluetooth, ANT+, WLAN, SRD (NFC, FeliCa) and GPS to the requirements of FCC CFR 47 Part 2 and FCC CFR 47 Part 22.

Objective	To perform FCC Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Sharp Corporation
Model Number(s)	SHL25
Serial Number(s)	IMEI 004401115170785 IMEI 004401115170207 IMEI 004401115170652
Number of Samples Tested	3
Test Specification/Issue/Date	FCC CFR 47 Part 2 (2013) FCC CFR 47 Part 22 (2013)
Disposal	Held Pending Disposal
Reference Number	Not Applicable
Date	Not Applicable
Order Number	10070
Date	10 March 2014
Start of Test	3 April 2014
Finish of Test	16 April 2014
Name of Engineer(s)	S Milliken M Russell J Tuckwell
Related Document(s)	ANSI C63.4: 2009



## 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 22 is shown below.

Section	Spec Clause		Test Description	Result	Comments/Base Standard
	Pt 2	Pt 22			
GSM 850					
2.1	2.1051	22.905	Spurious Emissions at Band Edge	Pass	
2.2	*	22.913 (a)	Effective Radiated Power	Pass	
2.3	2.1046	22.913 (a)	Maximum Peak Output Power - Conducted	Pass	
2.4	-	22.917	Emission Limitations for Cellular Equipment	Pass	
2.5	2.1051	22.917 (a)	Conducted Spurious Emissions	Pass	
2.6	2.1049 (h)	22.917 (b)	Occupied Bandwidth	Pass	
2.7	2.1047 (d)	-	Modulation Characteristics	-	Customer Declaration
2.8	2.1055	22.355	Frequency Stability	Pass	



Product Service

### **1.3 PRODUCT TECHNICAL DESCRIPTION**

Please refer to the SHL25 Model Description Form.

### **1.4 PRODUCT INFORMATION**

#### **1.4.1 Technical Description**

The Equipment Under Test (EUT) was a Sharp SHL25 Dual-band CDMA (BC0, BC6) & Quad-band GSM (GSM850/GSM900/DCS1800/PCS1900) & Dual-band UMTS (FDD I, FDD V) & Quad-band LTE (B1, B3, B17, B18) & AXGP (TDD 41) multi mode cellular phone with Bluetooth, ANT+, 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.



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## **SECTION 2**

### **TEST DETAILS**

FCC Testing of the  
Sharp SHL25 Dual-band CDMA (BC0, BC6) & Quad-band GSM  
(GSM850/GSM900/DCS1800/PCS1900) & Dual-band UMTS (FDD I, FDD V) & Quad-band LTE  
(B1, B3, B17, B18) & AXGP (TDD 41) multi mode cellular phone with Bluetooth, ANT+, WLAN,  
SRD (NFC, FeliCa) and GPS  
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 22 (GSM 850)





## **2.1 SPURIOUS EMISSIONS AT BAND EDGE**

### **2.1.1 Specification Reference**

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

### **2.1.2 Equipment Under Test and Modification State**

SHL25 S/N: IMEI 004401115170785 - Modification State 0

### **2.1.3 Date of Test**

10 April 2014

### **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 applied in accordance with the requirements of FCC CFR 47 Part 22.905 in conjunction with the test methods described in document 971168 D01 Power Meas License Digital Systems v02r01.

The EUT was configured in a GSM circuit switched voice call using GMSK modulation at maximum output power using a communications test set. The EUT was connected to a spectrum analyser via a cable, combiner and attenuator. The path loss was entered as a reference level offset. A spectrum analyser was used to perform the measurements with resolution and video bandwidths settings of 3 kHz and 10 kHz respectively, using an RMS detector and max hold trace. A sufficient number of sweeps were allowed for the trace to stabilise before measuring the greatest emission within 1 MHz adjacent to the authorised bandwidth edge. This test sequence was repeated to measure the emissions adjacent to the bottom and top edges of the authorised bandwidth.

### **2.1.6 Environmental Conditions**

Ambient Temperature	23.6°C
Relative Humidity	26.3%



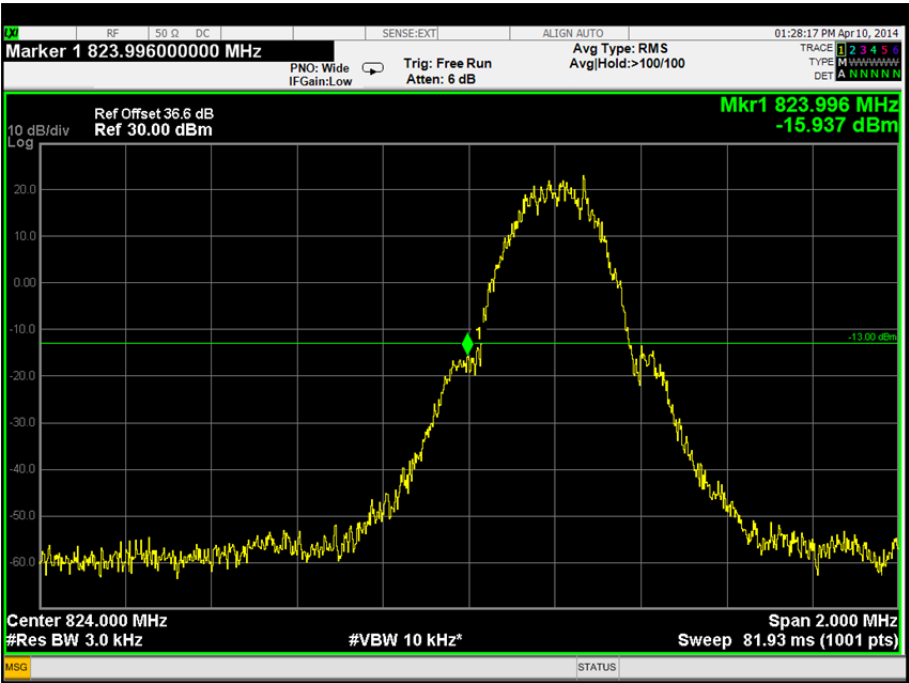
Product Service

2.1.7 Test Results

4.0 V DC Supply

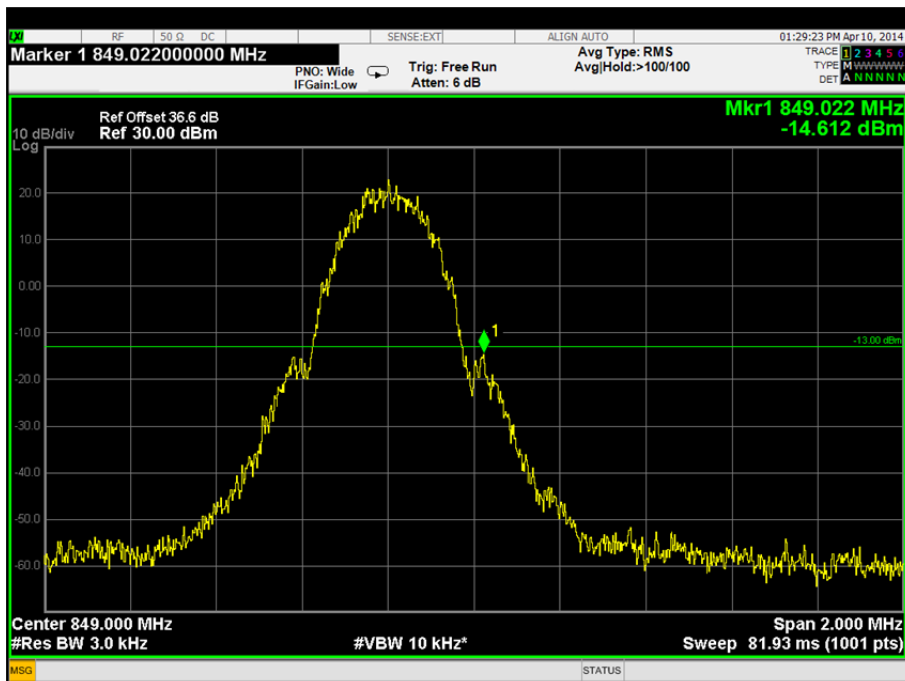
Frequency Block (MHz)	Mode	Lower Block Edge Test Channels/Frequencies	Upper Block Edge Test Channels/Frequencies
A :(824.0 – 835.0)	GSM	Channel : 128 Frequency : 824.2 MHz	N/A
B :(846.5 – 849.0)	GSM	N/A	Channel : 251 Frequency : 848.8MHz

Frequency Block A





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Frequency Block BLimit Clause

-13 dBm at block edge.



## **2.2 EFFECTIVE RADIATED POWER**

### **2.2.1 Specification Reference**

FCC CFR 47 Part 22, Clause 22.913 (a)

### **2.2.2 Equipment Under Test and Modification State**

SHL25 S/N: IMEI 004401115170207 - Modification State 0

### **2.2.3 Date of Test**

8 April 2014

### **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**

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.

### **2.2.6 Environmental Conditions**

Ambient Temperature	20.7°C
Relative Humidity	37.0%

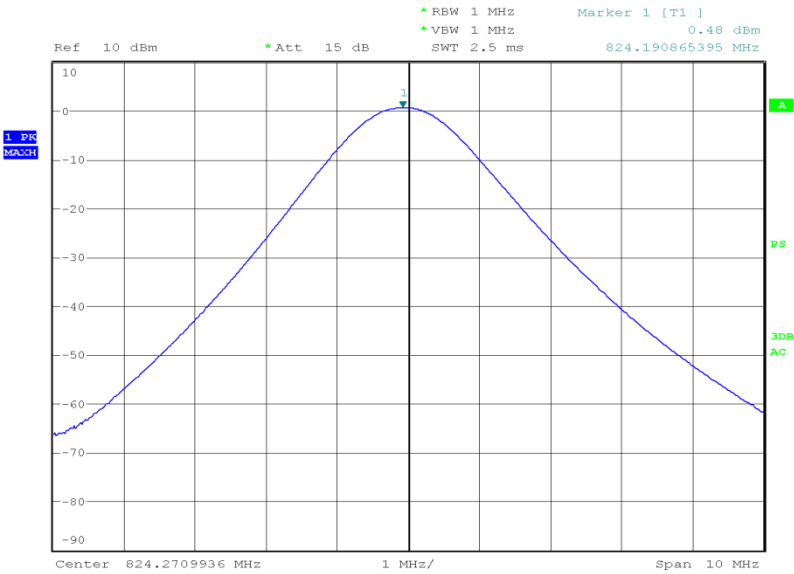


Product Service

2.2.7 Test Results

824.20 MHz

Result (dBm)	Result (W)
27.47	0.558



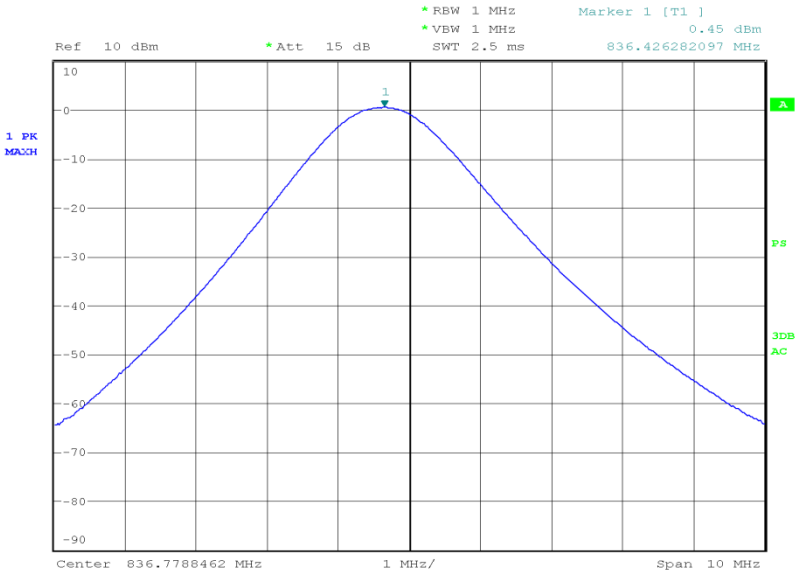
Date: 8.APR.2014 11:52:06



Product Service

836.40 MHz

Result (dBm)	Result (W)
27.74	0.594



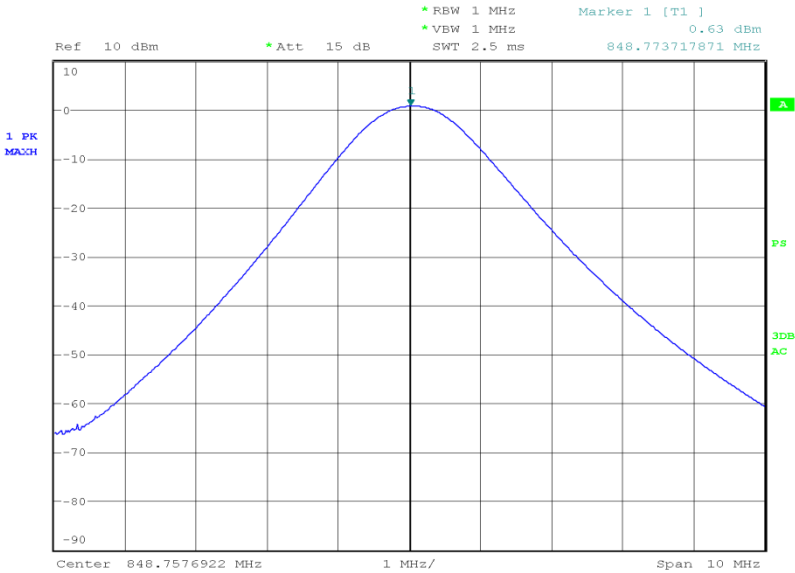
Date: 8.APR.2014 12:04:45



Product Service

848.80 MHz

Result (dBm)	Result (W)
28.09	0.644



Date: 8.APR.2014 12:19:19

Limit Clause

Mobile – 7 W or 38.45 dBm



Product Service

## **2.3 MAXIMUM PEAK OUTPUT POWER - CONDUCTED**

### **2.3.1 Specification Reference**

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

### **2.3.2 Equipment Under Test and Modification State**

SHL25 S/N: IMEI 004401115170652 - Modification State 0

### **2.3.3 Date of Test**

3 April 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**

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 22.913 (a), FCC CFR 47 Part 2.1046 and KDB 971168.

The EUT was configured in a GSM circuit switched voice call using GMSK modulation at maximum output power on bottom, middle or top channel using a communications test set. The EUT was connected to a wideband peak power meter via a cable, combiner and attenuator. The path loss was entered as an offset on the power meter and the peak result was recorded.

### **2.3.6 Environmental Conditions**

Ambient Temperature	25.6°C
Relative Humidity	37.0%





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**2.3.7 Test Results**

4.0 V DC Supply

824.20 MHz

Mode	Result (dBm)	Result (W)
GSM	33.06	2.02

836.40 MHz

Mode	Result (dBm)	Result (W)
GSM	32.73	1.87

848.80 MHz

Mode	Result (dBm)	Result (W)
GSM	32.91	1.95

Limit Clause

Mobile – 7 W or 38.45 dBm



## **2.4 EMISSION LIMITATIONS FOR CELLULAR EQUIPMENT**

### **2.4.1 Specification Reference**

FCC CFR 47 Part 22, Clause 22.917

### **2.4.2 Equipment Under Test and Modification State**

SHL25 S/N: IMEI 004401115170207 - Modification State 0

### **2.4.3 Date of Test**

11 April 2014

### **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**

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 maximum power with modulation. The EUT was tested on bottom, middle and top channels at maximum power.

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

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

### **2.4.6 Environmental Conditions**

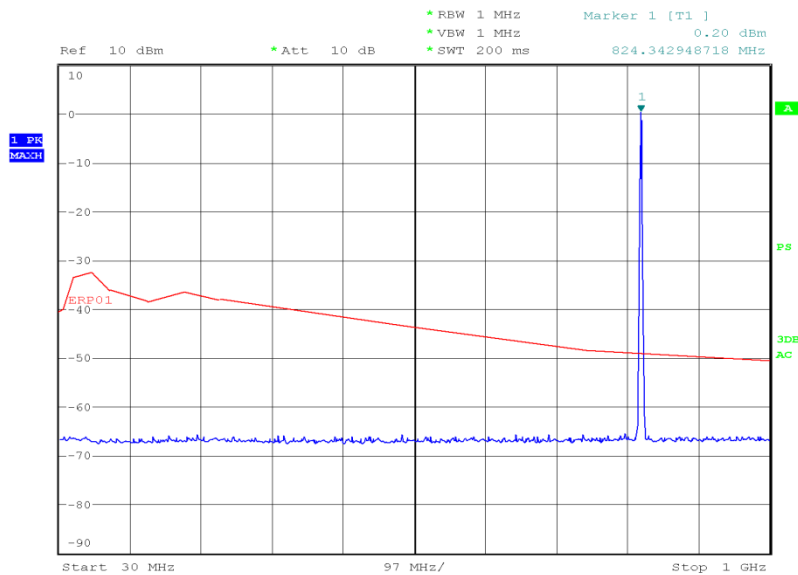
Ambient Temperature	21.6°C
Relative Humidity	32.0%



## 2.4.7 Test Results

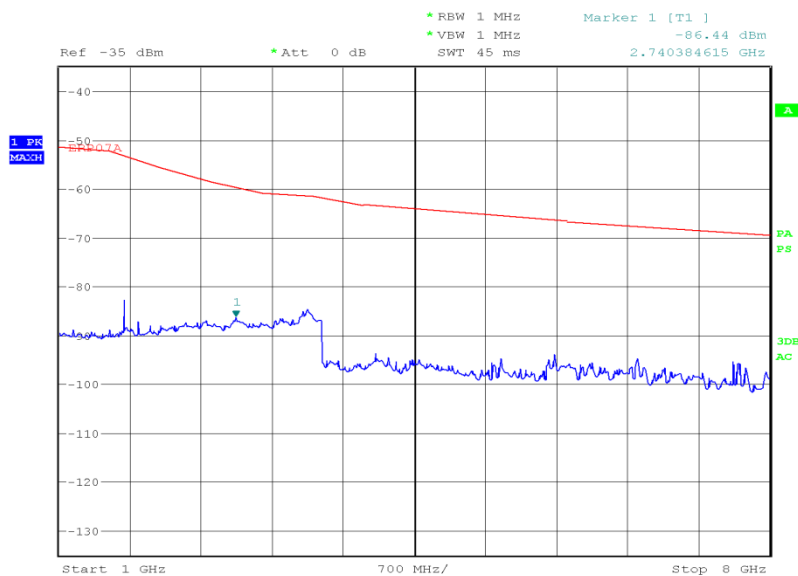
824.20 MHz

30 MHz to 1 GHz



Date: 8.APR.2014 15:36:42

1 GHz to 8 GHz

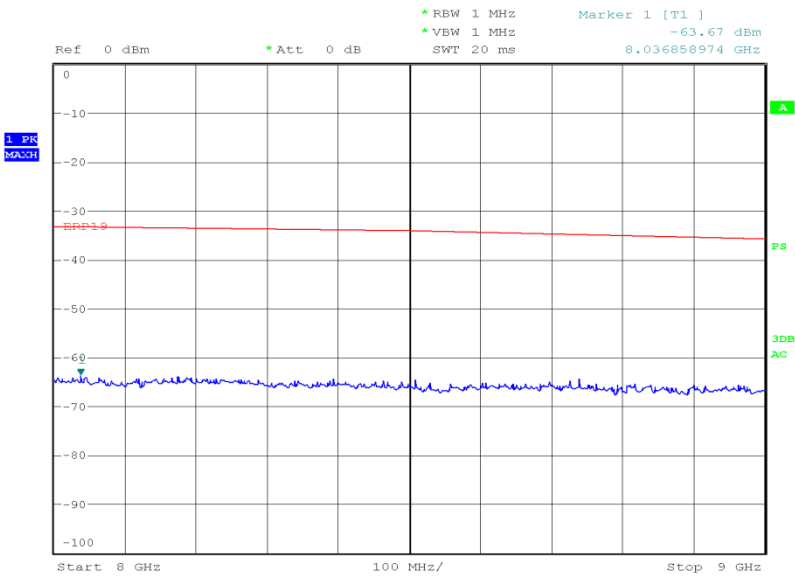


Date: 9.APR.2014 15:51:39



Product Service

8 GHz to 9 GHz



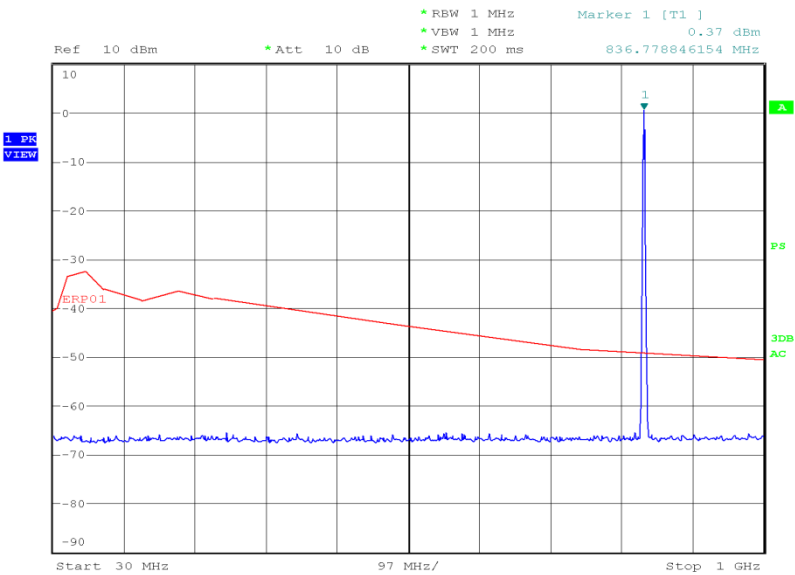
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Product Service

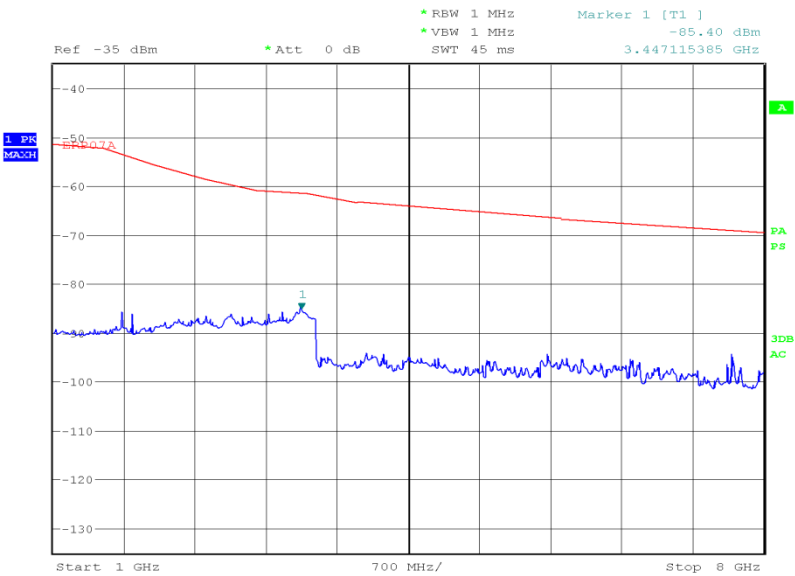
836.40 MHz

30 MHz to 1 GHz



Date: 8.APR.2014 15:45:02

1 GHz to 8 GHz

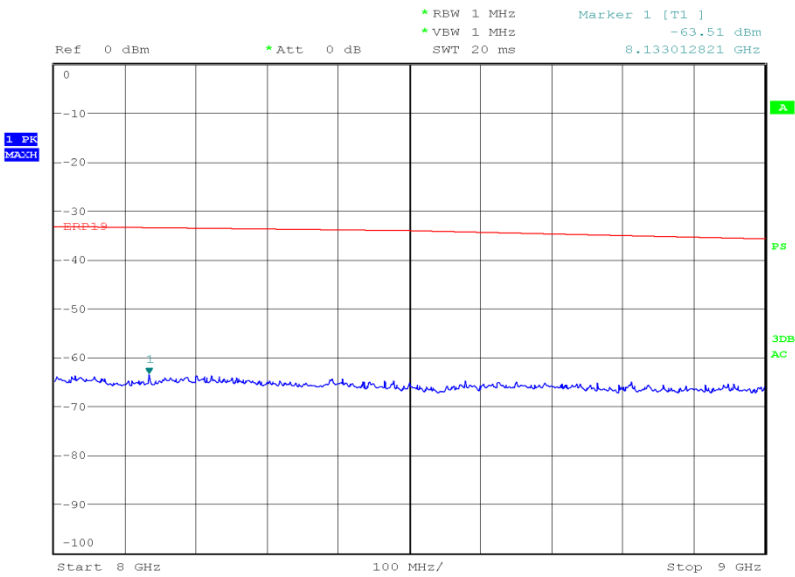


Date: 9.APR.2014 15:22:17



Product Service

8 GHz to 9 GHz



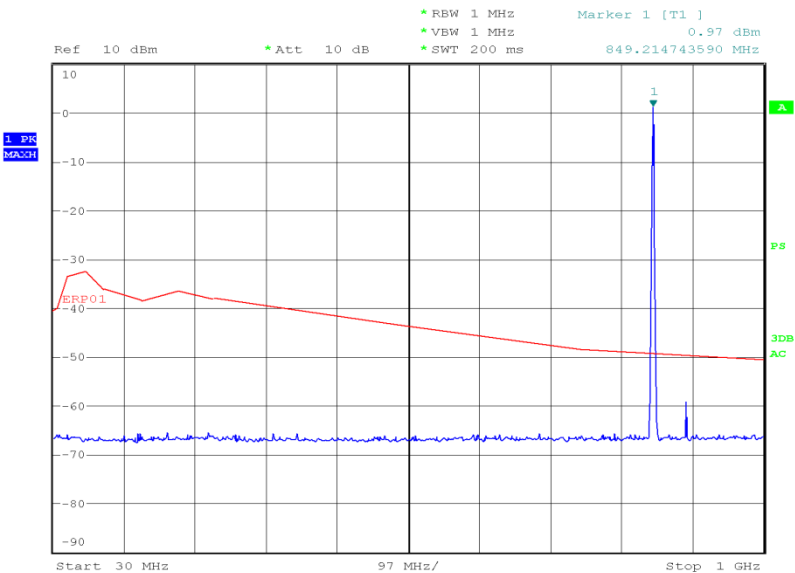
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Product Service

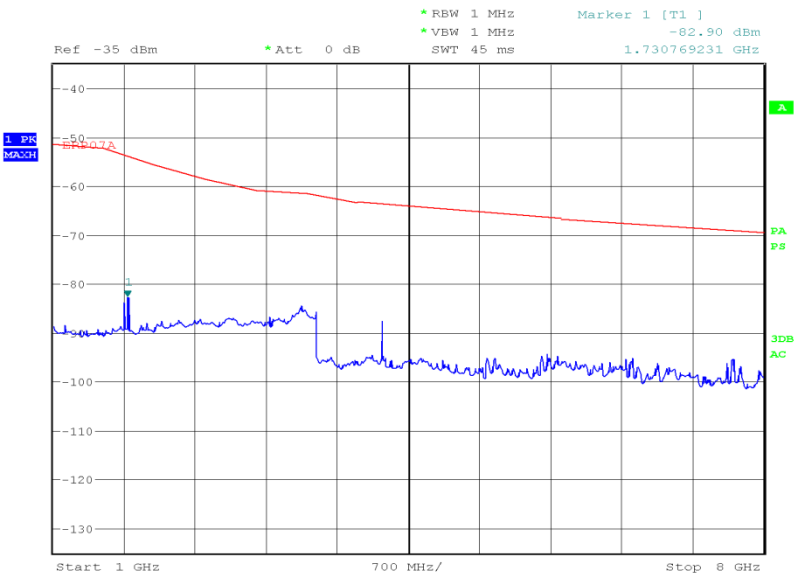
848.80 MHz

30 MHz to 1 GHz



Date: 8.APR.2014 15:55:46

1 GHz to 8 GHz

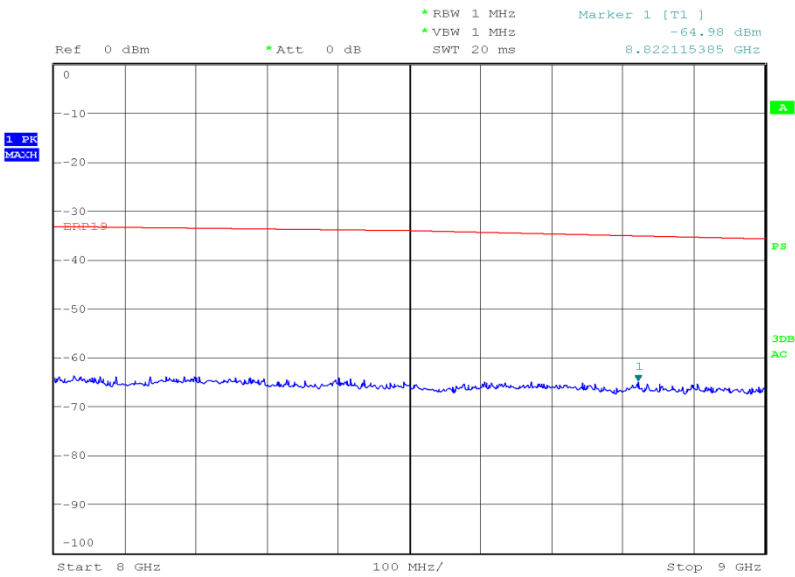


Date: 9.APR.2014 15:34:24



Product Service

8 GHz to 9 GHz



Date: 11.APR.2014 15:38:35

Limit Clause

43+10log(P) or -13 dBm





Product Service

## **2.5 CONDUCTED SPURIOUS EMISSIONS**

### **2.5.1 Specification Reference**

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

### **2.5.2 Equipment Under Test and Modification State**

SHL25 S/N: IMEI 004401115170785 - Modification State 0

### **2.5.3 Date of Test**

10 April 2014

### **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 applied in accordance with the requirements of FCC CFR 47 Part 22.917 in conjunction with the test methods described in document 971168 D01 Power Meas License Digital Systems v02r01.

The EUT was configured in a GSM circuit switched voice call using GMSK modulation at maximum output power using a communications test set. The EUT was connected to a spectrum analyser via a cable, combiner and an attenuator. When measuring emissions frequencies greater than 1.5 GHz, a 1.5 GHz High Pass Filter was utilised. The path loss was entered as a reference level offset. A spectrum analyser was used to perform the measurements with resolution and video bandwidths settings of 1 MHz and 3 MHz respectively, using a peak detector and max hold trace. A sufficient number of sweeps were allowed for the trace to stabilise before measuring the greatest emission with a peak marker. This test sequence was repeated to measure the greatest peak emissions when operating the EUT on the bottom, middle and top operating channel within the authorised band.

### **2.5.6 Environmental Conditions**

Ambient Temperature	24.5°C
Relative Humidity	26.0%

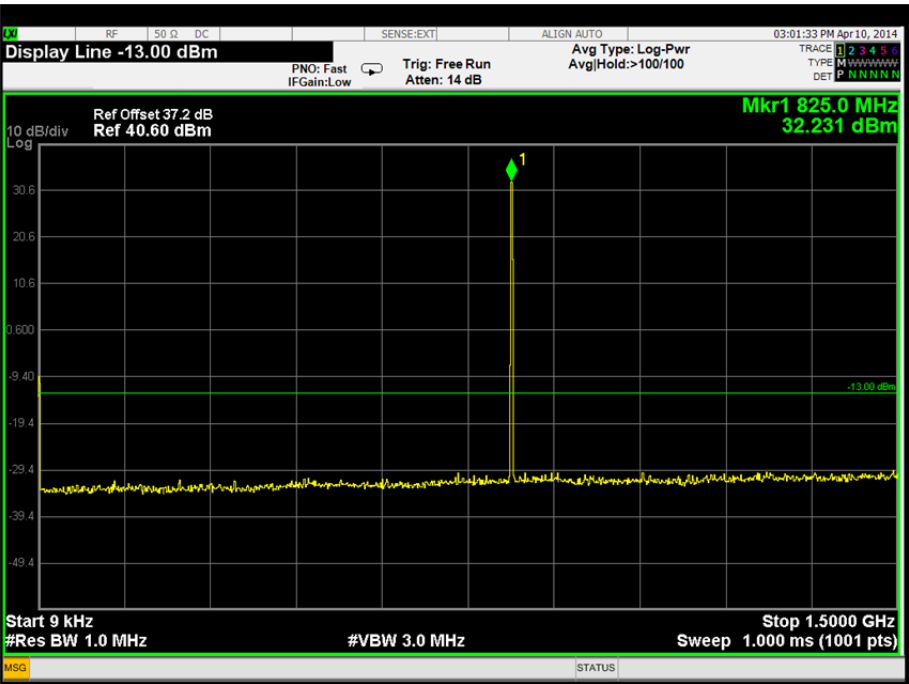


Product Service

2.5.7 Test Results

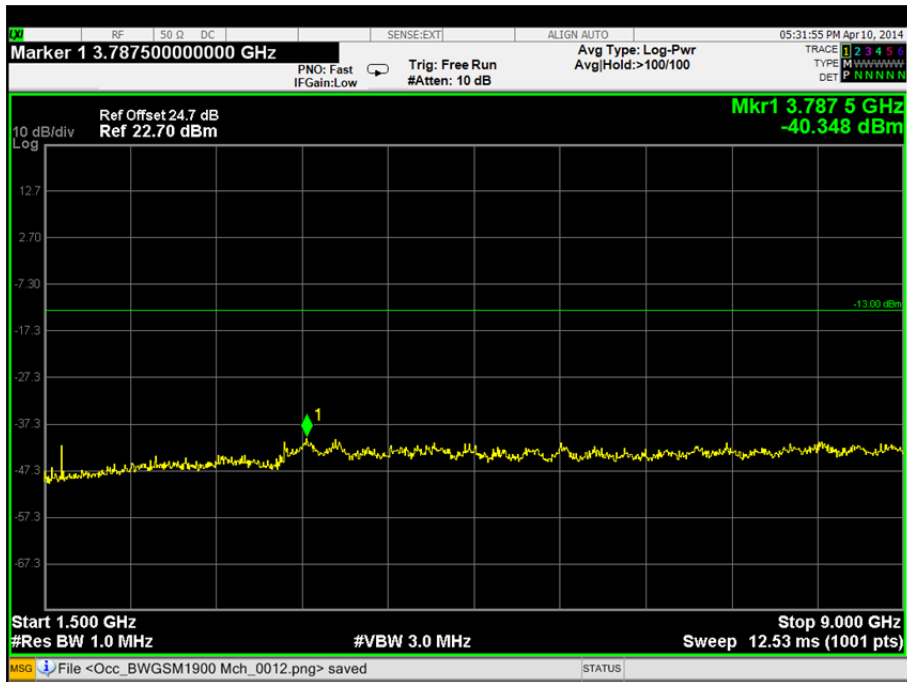
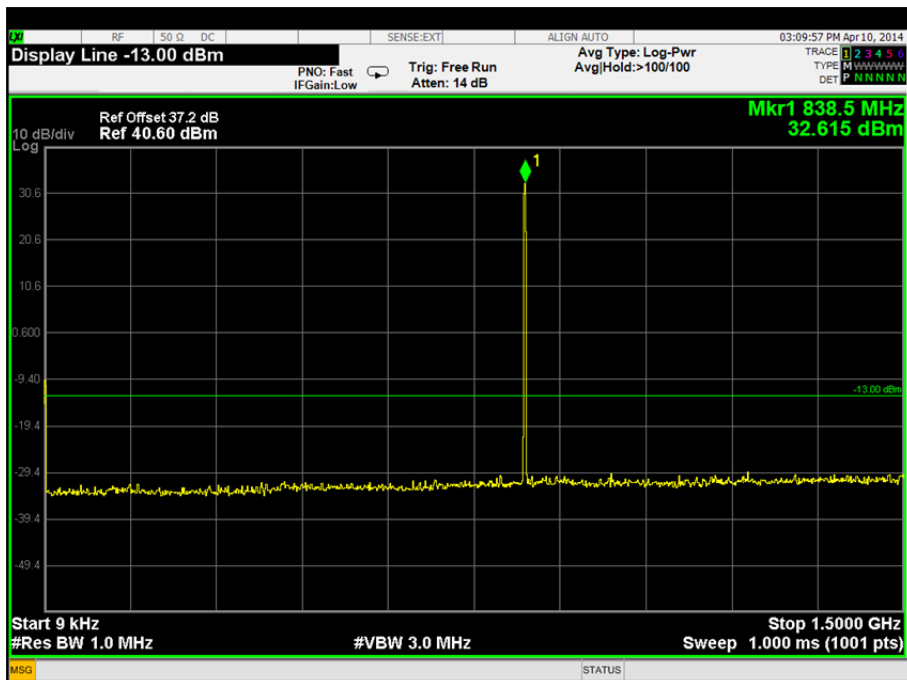
824.20 MHz

9 kHz to 1.5 GHz





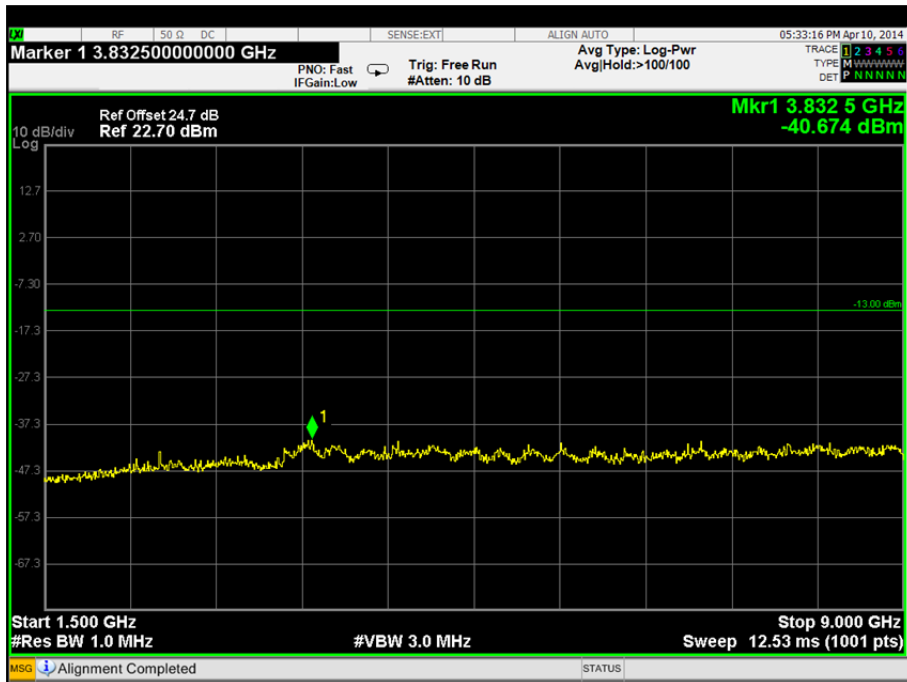
Product Service

1.5 GHz to 9 GHz836.40 MHz9 kHz to 1.5 GHz



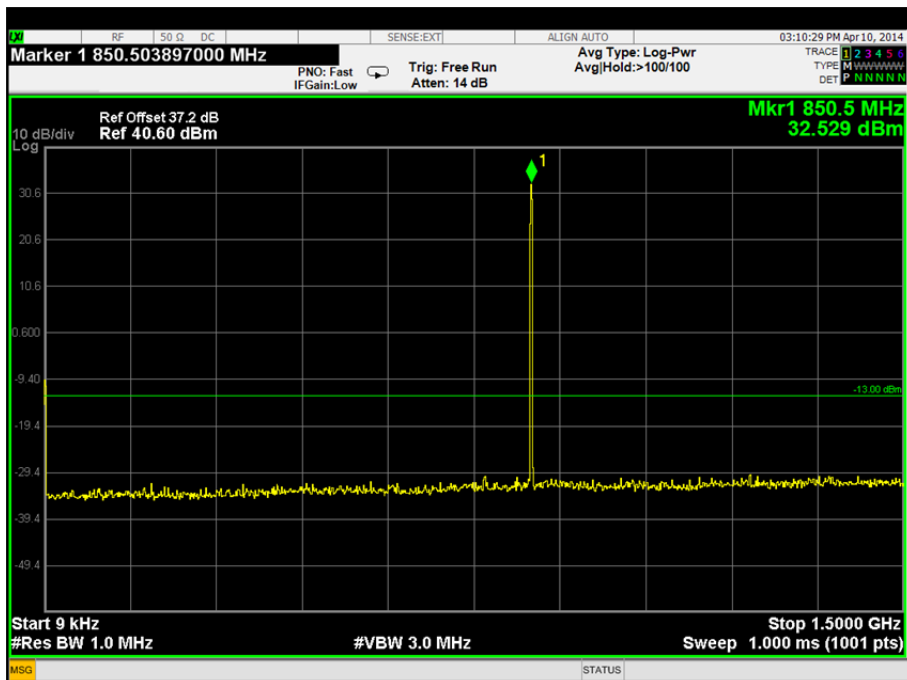
Product Service

1.5 GHz to 9 GHz



848.80 MHz

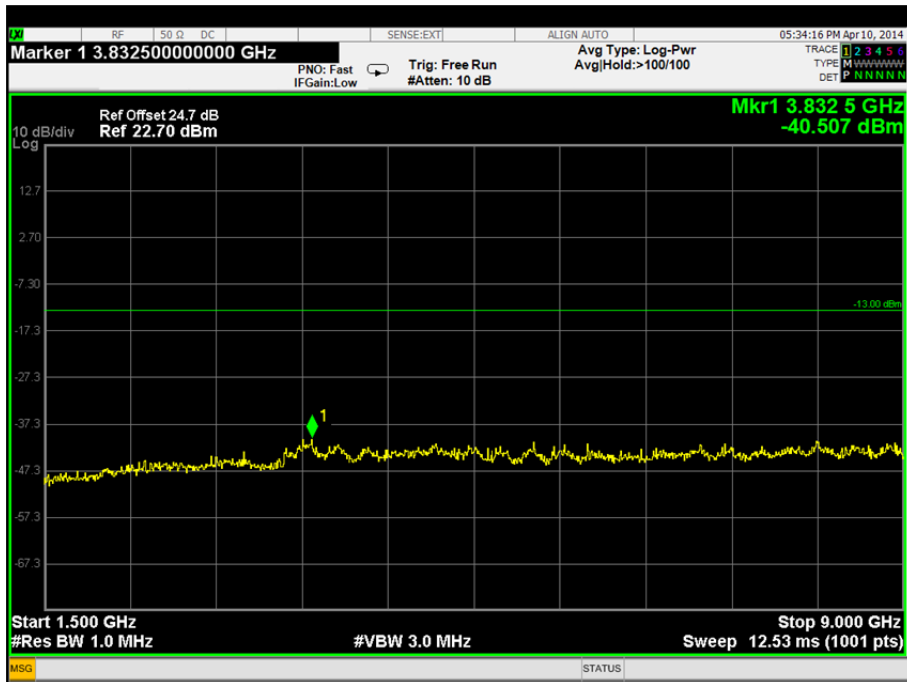
9 kHz to 1.5 GHz





Product Service

1.5 GHz to 9 GHz



Limit Clause

$43 + 10\log(P)$  or -13 dBm



Product Service

## **2.6 OCCUPIED BANDWIDTH**

### **2.6.1 Specification Reference**

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

### **2.6.2 Equipment Under Test and Modification State**

SHL25 S/N: IMEI 004401115170652 - Modification State 0

### **2.6.3 Date of Test**

4 April 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**

The test was applied in accordance with the requirements of FCC CFR 47 Part 22.917 (b) in conjunction with the test methods described in document 971168 D01 Power Meas License Digital Systems v02r01.

The EUT was configured in a GSM circuit switched voice call using GMSK modulation at maximum output power using a communications test set. The EUT was connected to a spectrum analyser via a cable, combiner and attenuator. The path loss was entered as a reference level offset. A spectrum analyser was used to perform the measurements with resolution and video bandwidth settings of 3 kHz and 10 kHz respectively, using a peak detector and max hold trace. A sufficient number of sweeps were allowed for the trace to stabilise and using an occupied bandwidth measurement function of the spectrum analyser; the 26 dB bandwidth was recorded. This test sequence was repeated to measure the 26 dB bandwidths of the bottom, middle and top operating channel within the authorised band.

### **2.6.6 Environmental Conditions**

Ambient Temperature	23.7°C
Relative Humidity	35.2%



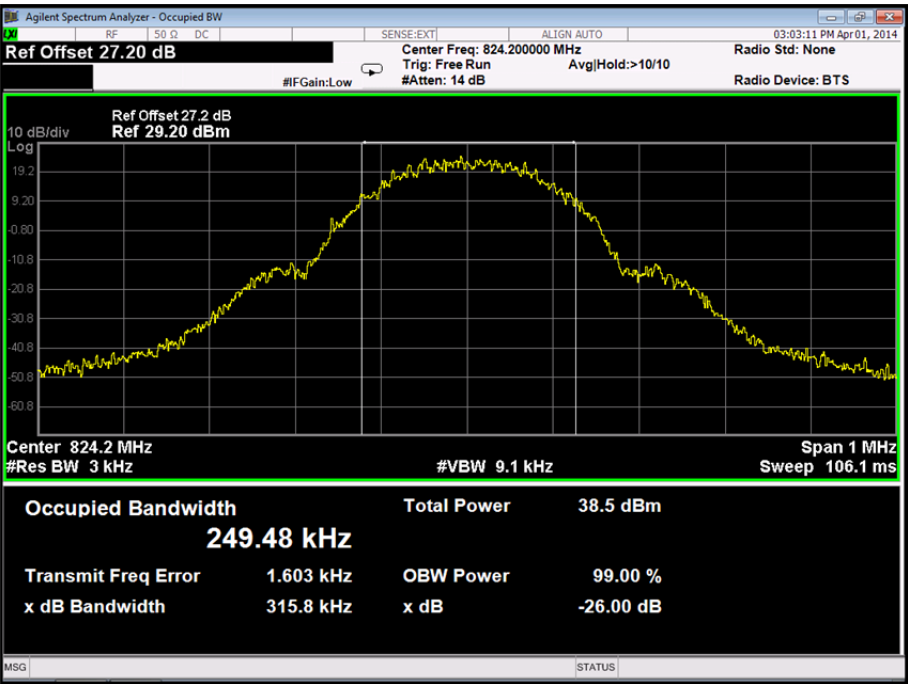
Product Service

2.6.7 Test Results

4.0 V DC Supply

824.20 MHz

Mode	Occupied Bandwidth (kHz)
GSM	315.8

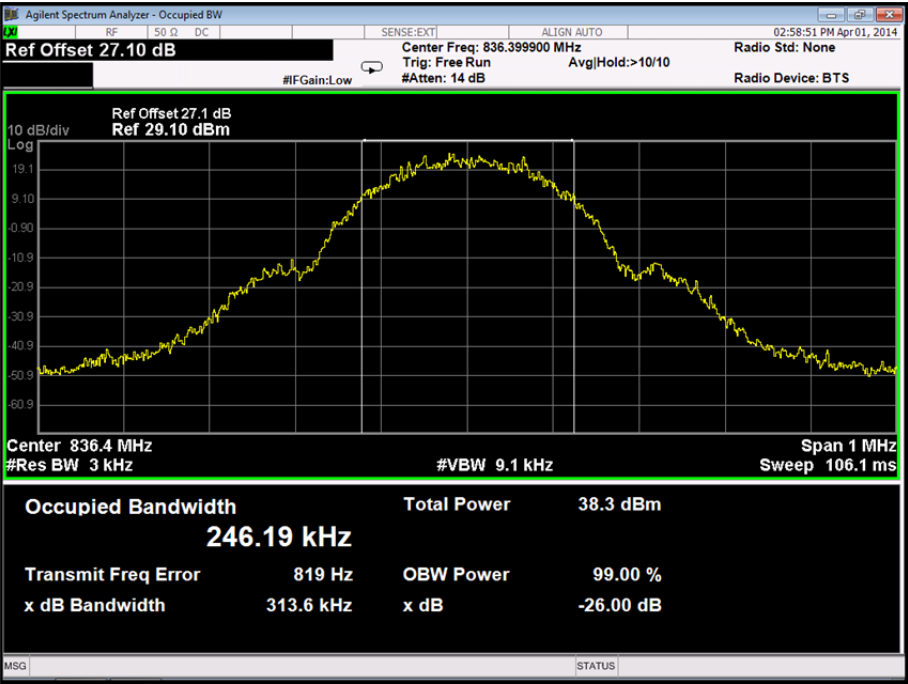




Product Service

836.40 MHz

Mode	Occupied Bandwidth (kHz)
GSM	313.6



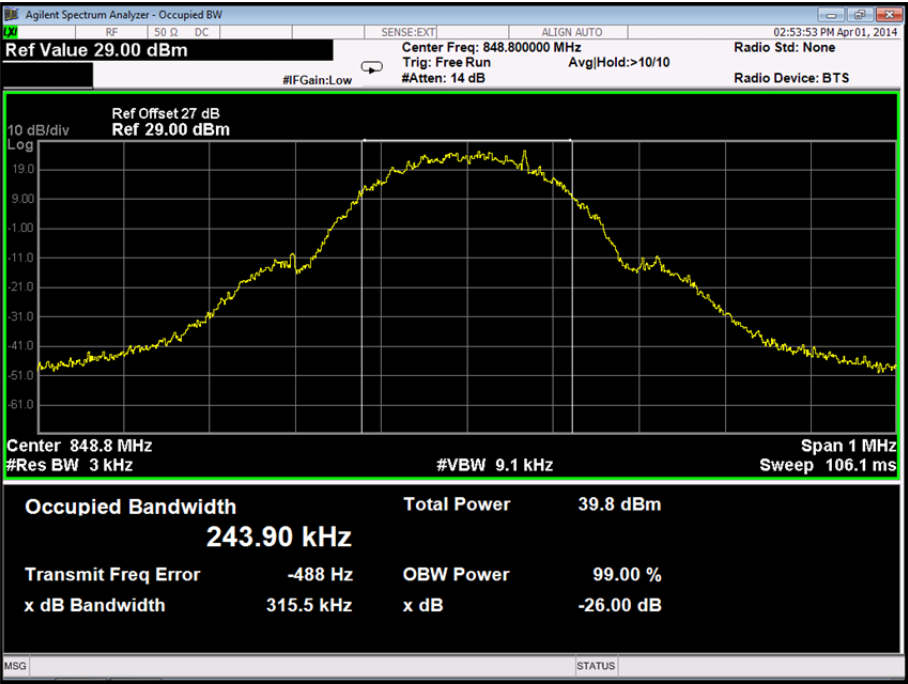




Product Service

848.80 MHz

Mode	Occupied Bandwidth (kHz)
GSM	315.5



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.



## **2.7 MODULATION CHARACTERISTICS**

### **2.7.1 Specification Reference**

FCC CFR 47 Part 2, Clause 2.1047 (d)

### **2.7.2 Equipment Under Test**

SHL25

### **2.7.3 Test Results**

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

$\text{bit rate} / \text{Channel bandwidth} = 270.83333 \text{ kbit/s} / 200 \text{ kHz} = 1.354 \text{ bit/s/Hz.}$

The bandwidth product  $BT = \text{Bandwidth} \times \text{bit duration} = 81.25 \text{ kHz} \times 3.6923 \text{ micros} = 0.3$

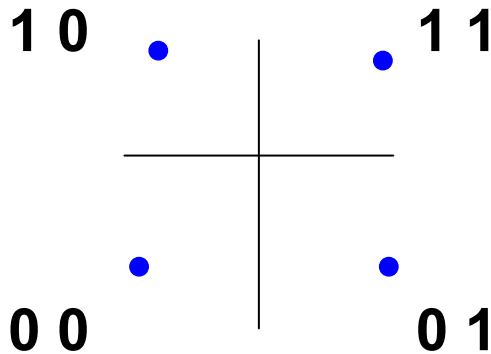
### **GMSK OVERVIEW**

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	0 1
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  $180^\circ$  ( $\pi$  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  $\pm 90^\circ$

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 =  $90^\circ$  or  $\pi/2$ , 0 =  $-90^\circ$  or  $-\pi/2$  phase shift)

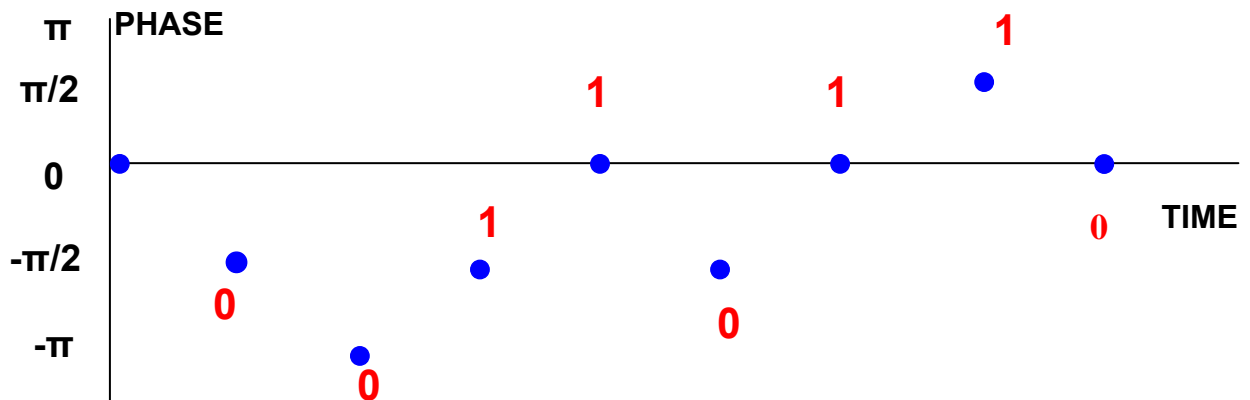
I Stream	0		1		0		1	
	$-\pi/2$		$-\pi/2$		$-\pi/2$		$\pi/2$	
Q stream		0		1		1		0
		$-\pi/2$		$\pi/2$		$\pi/2$		$-\pi/2$



3. Combine (add) the two PSK signals:

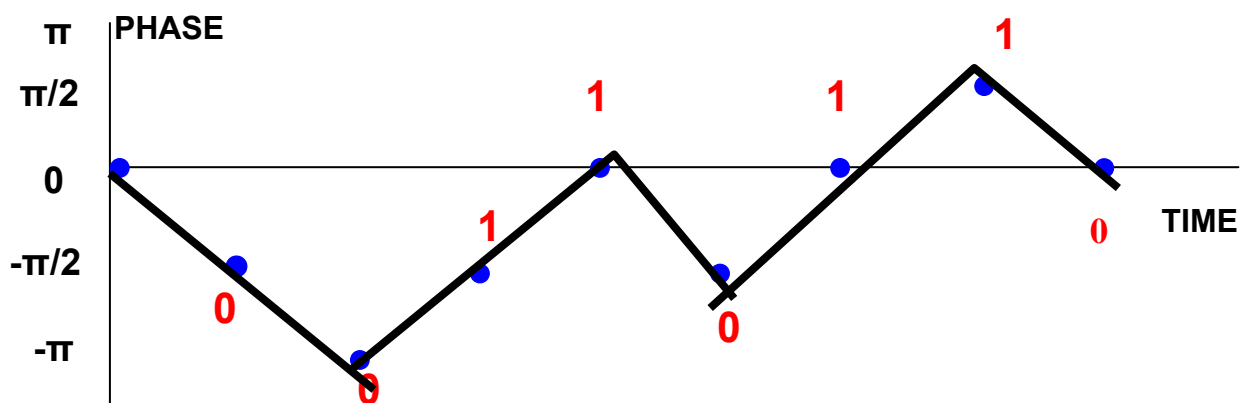
Combined Phase	$-\pi/2$	$-\pi$	$-\pi/2$	0	$-\pi/2$	0	$\pi/2$	0
----------------	----------	--------	----------	---	----------	---	---------	---

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



It would be preferable to have "gradual" changes in phase 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 filtered 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

## **2.8 FREQUENCY STABILITY**

### **2.8.1 Specification Reference**

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

### **2.8.2 Equipment Under Test and Modification State**

SHL25 S/N: IMEI 004401115170785 - Modification State 0

### **2.8.3 Date of Test**

16 April 2014

### **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 test was applied in accordance with the test method requirements of FCC CFR 47 Part 22.315 and FCC CFR 47 Part 2.1055.

The EUT was configured in a GSM circuit switched voice call using GMSK modulation at maximum output power on the middle channel using a communications test set. The communications test set was connected to an external 10 MHz rubidium frequency standard to increase accuracy of the measurement. The Tx measurement function of the communications tester was then used and the maximum frequency error was then recorded.

Measurements were repeated over the temperature range of +50°C to -30°C in 10°C steps and at +20°C the voltage was varied to the maximum and minimum end point voltages as declared by the manufacturer.

### **2.8.6 Environmental Conditions**

Ambient Temperature	22.0°C
Relative Humidity	29.4%



### 2.8.7 Test Results

Temperature Interval (°C)	Mode	Modulation	Deviation (ppm)
-30	GSM	GMSK	0.024
-20	GSM	GMSK	0.022
-10	GSM	GMSK	0.024
0	GSM	GMSK	0.021
+10	GSM	GMSK	0.023
+20	GSM	GMSK	0.022
+30	GSM	GMSK	0.022
+40	GSM	GMSK	0.024
+50	GSM	GMSK	0.030

### Limit Clause

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	-	-

Under Voltage Variations836.40 MHz

DC Voltage (V)	Mode	Modulation	Deviation (ppm)
4.0 V DC	GSM	GMSK	0.023
3.7 V DC	GSM	GMSK	0.026
4.0 V DC	GSM	GMSK	0.023

Limit Clause

Frequency Range (MHz)	Base, Fixed (ppm)	Mobile $\leq$ 3 watts (ppm)	Mobile $\leq$ 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	n/a	n/a
929 to 960	1.5	n/a	n/a
2110 to 2220	10	n/a	n/a



Product Service

### **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
<b>Section 2.1 - Spurious Emissions at Band Edge</b>					
Attenuator (10dB)	Weinschel	47-10-34	481	12	28-Mar-2015
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	22-Jul-2014
Hygrometer	Rotronic	I-1000	2891	12	8-Jul-2014
Radio Communications Test Set	Rohde & Schwarz	CMU 200	3035	12	25-Oct-2014
Multimeter	Fluke	79 Series II	3057	12	24-Sep-2014
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	12-Dec-2014
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	13-Sep-2014
Combiner/Splitter	Weinschel	1506A	3878	12	21-Mar-2015
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	18-Sep-2014
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	22-Jul-2014
PXA Signal Analyser	Agilent Technologies	N9030A PXA	4409	12	27-Feb-2015
<b>Section 2.2 - Effective Radiated Power</b>					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	3-May-2014
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	8-Nov-2014
Communications Tester	Rohde & Schwarz	CMU 200	442	12	8-Nov-2014
Filter (High Pass)	Lorch	SHP7-7000-SR	566	12	24-Feb-2015
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	1002	12	18-Sep-2014
Pre-Amplifier	Phase One	PSO4-0087	1534	12	30-Sep-2014
Screened Room (5)	Rainford	Rainford	1545	24	10-Jan-2015
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
GSM Test Set	Rohde & Schwarz	CMU 200	2809	12	18-Jun-2014
Antenna (Bilog)	Chase	CBL6143	2904	24	10-Jun-2015
Antenna (Log Periodic)	Schaffner	UPA6108	3108	12	15-May-2014
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Oct-2014
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	-	TU
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	4143	12	22-Jul-2014
Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	S/N: 114640	12	02-Dec-2014
<b>Section 2.3 - Maximum Peak Output Power - Conducted</b>					
Multimeter	White Gold	WG022	190	12	28-Oct-2014
Communications Tester	Rohde & Schwarz	CMU 200	442	12	8-Nov-2014
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	30-Oct-2014
Power Divider	Weinschel	1506A	604	12	23-May-2014
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	16-Jul-2014
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	13-Sep-2014
P-Series Power Meter	Agilent Technologies	N1911A	3981	12	18-Sep-2014
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3983	12	18-Sep-2014
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	18-Sep-2014



Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
<b>Section 2.4 - Emission Limitations for Cellular Equipment</b>					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	3-May-2014
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	1002	12	18-Sep-2014
Pre-Amplifier	Phase One	PS04-0086	1533	12	19-Dec-2014
Screened Room (5)	Rainford	Rainford	1545	24	10-Jan-2015
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna (Bilog)	Chase	CBL6143	2904	24	10-Jun-2015
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Oct-2014
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Tilt Antenna Mast	maturio GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	maturio GmbH	NCD	3917	-	TU
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	4143	12	22-Jul-2014
Suspended Substrate Highpass Filter	Advance Power Components	11SH10-3000/X18000-O/O	4412	12	21-Mar-2015
<b>Section 2.5 - Conducted Spurious Emissions</b>					
Attenuator (10dB)	Weinschel	47-10-34	481	12	28-Mar-2015
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	22-Jul-2014
Hygrometer	Rotronic	I-1000	2891	12	8-Jul-2014
Radio Communications Test Set	Rohde & Schwarz	CMU 200	3035	12	25-Oct-2014
Multimeter	Fluke	79 Series II	3057	12	24-Sep-2014
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	12-Dec-2014
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	13-Sep-2014
Combiner/Splitter	Weinschel	1506A	3878	12	21-Mar-2015
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	18-Sep-2014
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	22-Jul-2014
PXA Signal Analyser	Agilent Technologies	N9030A PXA	4409	12	27-Feb-2015
<b>Section 2.6 - Occupied Bandwidth</b>					
Multimeter	White Gold	WG022	190	12	28-Oct-2014
Communications Tester	Rohde & Schwarz	CMU 200	442	12	8-Nov-2014
Attenuator (10dB)	Weinschel	47-10-34	481	12	28-Mar-2015
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	30-Oct-2014
Power Divider	Weinschel	1506A	604	12	23-May-2014
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	22-Jul-2014
Power Supply Unit	Farnell	TSV-70	2043	-	O/P Mon
Hygrometer	Rotronic	I-1000	2891	12	8-Jul-2014
Radio Communications Test Set	Rohde & Schwarz	CMU 200	3035	12	25-Oct-2014
Multimeter	Fluke	79 Series II	3057	12	24-Sep-2014
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	12-Dec-2014
Hygrometer	Rotronic	I-1000	3220	12	16-Jul-2014
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	13-Sep-2014
Combiner/Splitter	Weinschel	1506A	3878	12	21-Mar-2015
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	18-Sep-2014
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	22-Jul-2014
PXA Signal Analyser	Agilent Technologies	N9030A PXA	4409	12	27-Feb-2015



Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
<b>Section 2.8 - Frequency Stability</b>					
Multimeter	White Gold	WG022	190	12	28-Oct-2014
Digital Temperature Indicator + T/C	Fluke	51	412	12	12-Feb-2015
Power Supply Unit	Hewlett Packard	6253A	441	-	O/P Mon
Temperature Chamber	Montford	2F3	467	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	22-Jul-2014
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	28-Mar-2015
DC - 12.4 GHz 10 dB Attenuator	Suhner	6810.17.A	3965	12	17-Oct-2014
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	4143	12	22-Jul-2014
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	4144	12	17-Jul-2014
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	22-Jul-2014

TU – Traceability Unscheduled

O/P MON – Output Monitored with Calibrated Equipment



### 3.2 MEASUREMENT UNCERTAINTY

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

Test Discipline	MU
Modulation Characteristics	-
Frequency Stability	$\pm 46.70$ Hz
Maximum Peak Output Power - Conducted	$\pm 0.70$ dB
Conducted Spurious Emissions	$\pm 3.454$ dB
Emission Limitations for Cellular Equipment	30MHz to 1GHz: $\pm 5.1$ dB 1GHz to 40GHz: $\pm 6.3$ dB
Spurious Emissions at Band Edge	30MHz to 1GHz: $\pm 5.1$ dB 1GHz to 40GHz: $\pm 6.3$ dB
Occupied Bandwidth	$\pm 16.74$ kHz
Effective Radiated Power	30MHz to 1GHz: $\pm 5.1$ dB 1GHz to 40GHz: $\pm 6.3$ dB



Product Service

## **SECTION 4**

### **ACCREDITATION, DISCLAIMERS AND COPYRIGHT**



Product Service

#### 4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



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