



Product Service

---

**Choose certainty.  
Add value.**

## Report On

FCC Testing of the Sharp SHL23 Dual-band CDMA (BC0, BC6) & Quad-band GSM (GSM850/GSM900/DCS1800/PCS1900) & Dual-band UMTS (FDDI, FDDV) & Quad-band LTE (B1, B3, B11, B18) multi mode cellular phone with Bluetooth, WLAN, SRD (NFC,FeliCa) and GPS  
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 22 (GSM 850)

COMMERCIAL-IN-CONFIDENCE  
FCC ID: APYHRO00196

Document 75923862 Report 11 Issue 2

November 2013



Product Service

TÜV SÜD Product Service, Octagon House, Concorde Way, Segensworth North,  
Fareham, Hampshire, United Kingdom, PO15 5RL  
Tel: +44 (0) 1489 558100. Website: [www.tuv-sud.co.uk](http://www.tuv-sud.co.uk)

COMMERCIAL-IN-CONFIDENCE

**REPORT ON**

FCC Testing of the  
Sharp SHL23 Dual-band CDMA (BC0, BC6) & Quad-band GSM  
(GSM850/GSM900/DCS1800/PCS1900) & Dual-band UMTS (FDDI,  
FDDV) & Quad-band LTE (B1, B3, B11, B18) multi mode cellular  
phone with Bluetooth, WLAN, SRD (NFC,FeliCa) and GPS  
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 22  
(GSM 850)

Document 75923862 Report 11 Issue 2

November 2013

**PREPARED FOR**

Sharp Communication Compliance Ltd  
Azure House  
Bagshot Road  
Bracknell  
Berkshire  
RG12 7QY

**PREPARED BY**

  
\_\_\_\_\_  
**Natalie Bennett**  
Senior Administrator, Test Solutions

**APPROVED BY**

  
\_\_\_\_\_  
**Mark Jenkins**  
Authorised Signatory

**DATED**

04 November 2013

**This report has been up-issued to Issue 2 to amend the model description.**

**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);

  
\_\_\_\_\_  
T Guy

  
\_\_\_\_\_  
S Milliken



  
\_\_\_\_\_  
M Russell

Document 75923862 Report 11 Issue 2

Page 1 of 45

COMMERCIAL-IN-CONFIDENCE



## CONTENTS

Section	Page No
<b>1</b>	<b>REPORT SUMMARY ..... 3</b>
1.1	Introduction ..... 4
1.2	Brief Summary of Results ..... 5
1.3	Product Technical Description ..... 6
1.4	Product Information ..... 6
1.5	Test Conditions ..... 6
1.6	Deviations from the Standard ..... 6
1.7	Modification Record ..... 6
<b>2</b>	<b>TEST DETAILS ..... 7</b>
2.1	Spurious Emissions at Band Edge ..... 8
2.2	Effective Radiated Power ..... 11
2.3	Maximum Peak Output Power - Conducted ..... 15
2.4	Emission Limitations for Cellular Equipment ..... 17
2.5	Conducted Spurious Emissions ..... 24
2.6	Occupied Bandwidth ..... 29
2.7	Modulation Characteristics ..... 33
2.8	Frequency Stability ..... 36
<b>3</b>	<b>TEST EQUIPMENT USED ..... 39</b>
3.1	Test Equipment Used ..... 40
3.2	Measurement Uncertainty ..... 43
<b>4</b>	<b>ACCREDITATION, DISCLAIMERS AND COPYRIGHT ..... 44</b>
4.1	Accreditation, Disclaimers and Copyright ..... 45



Product Service

## **SECTION 1**

### **REPORT SUMMARY**

FCC Testing of the  
Sharp SHL23 Dual-band CDMA (BC0, BC6) & Quad-band GSM  
(GSM850/GSM900/DCS1800/PCS1900) & Dual-band UMTS (FDDI, FDDV) & Quad-band LTE  
(B1, B3, B11, B18) multi mode cellular phone with  
Bluetooth, WLAN, SRD (NFC,FeliCa) and GPS  
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 22 (GSM 850)



Product Service

## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of the FCC Testing of the Sharp SHL23 Dual-band CDMA (BC0, BC6) & Quad-band GSM (GSM850/GSM900/DCS1800/PCS1900) & Dual-band UMTS (FDDI, FDDV) & Quad-band LTE (B1, B3, B11, B18) multi mode cellular phone with Bluetooth, 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)	SHL23
Serial Number(s)	IMEI 004401114892967 IMEI 004401114893031
Number of Samples Tested	2
Test Specification/Issue/Date	FCC CFR 47 Part 2 (2012) FCC CFR 47 Part 22 (2012)
Disposal	Held Pending Disposal
Reference Number	Not Applicable
Date	Not Applicable
Order Number	9860
Date	25 September 2013
Start of Test	30 September 2013
Finish of Test	17 October 2013
Name of Engineer(s)	T Guy S Milliken M Russell
Related Document(s)	ANSI C63.4: 2009



Product Service

**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 SHL23 Model Description Form.

### **1.4 PRODUCT INFORMATION**

#### **1.4.1 Technical Description**

The Equipment Under Test (EUT) was a Sharp SHL23 Dual-band CDMA (BC0, BC6) & Quad-band GSM (GSM850/GSM900/DCS1800/PCS1900) & Dual-band UMTS (FDDI, FDDV) & Quad-band LTE (B1, B3, B11, B18) multi mode cellular 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 Accreditation  
90987 Octagon House, Fareham Test Laboratory

### **1.6 DEVIATIONS FROM THE STANDARD**

No deviations from the applicable test standard were made during testing

### **1.7 MODIFICATION RECORD**

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



Product Service

## **SECTION 2**

### **TEST DETAILS**

FCC Testing of the  
Sharp SHL23 Dual-band CDMA (BC0, BC6) & Quad-band GSM  
(GSM850/GSM900/DCS1800/PCS1900) & Dual-band UMTS (FDDI, FDDV) & Quad-band LTE  
(B1, B3, B11, B18) multi mode cellular phone with  
Bluetooth, WLAN, SRD (NFC,FeliCa) and GPS  
In accordance with FCC CFR 47 Part 2 and FCC CFR 47 Part 22 (GSM 850)



Product Service

## 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

SHL23 S/N: IMEI 004401114892967 - Modification State 0

### 2.1.3 Date of Test

16 October 2013

### 2.1.4 Test Equipment Used

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

### 2.1.5 Test Procedure

In accordance with 22.917(b), any emissions outside of the block edges shall be attenuated by at least  $43 + 10 \log (P)$ . The measurements are shown to  $\pm 1$  MHz from the block edges. The plots shown under the Spurious Emissions sections covers the required range of 9 kHz to 9 GHz.

Band Edge measurements were performed using and RBW of at least 1% of the occupied bandwidth. Using an RMS detector, measurements were made only during the transmit on time by using a gated trigger.

The reference power and path losses of all channels used for testing in each frequency block were measured. Having entered the reference level offset, a limit line was displayed, showing the  $-13 \text{ dBm} (43 + 10 \log (P))$ , limit. The EUT was operated at maximum power with GMSK modulation.

### 2.1.6 Environmental Conditions

Ambient Temperature	22.8°C
Relative Humidity	37.2%

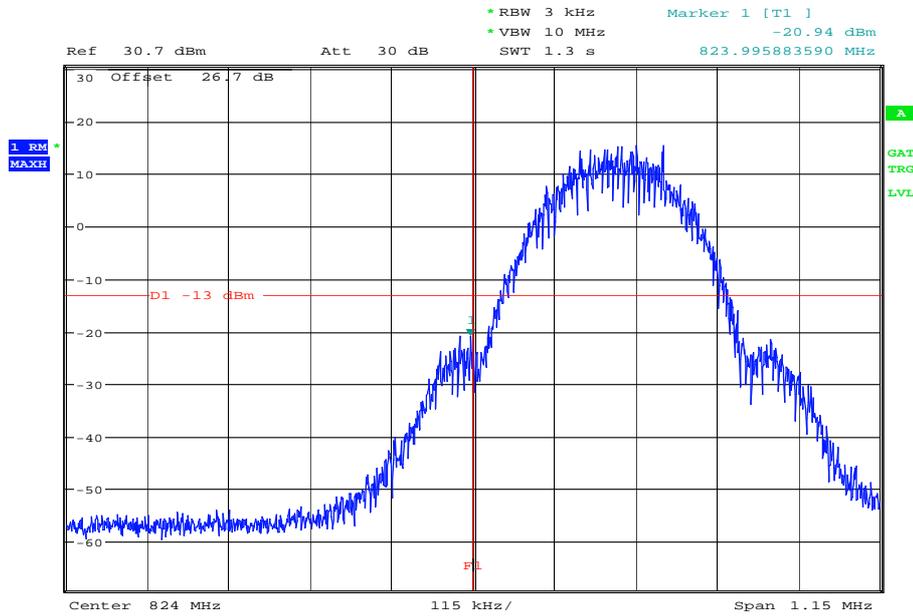


2.1.7 Test Results

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 : 848.4MHz

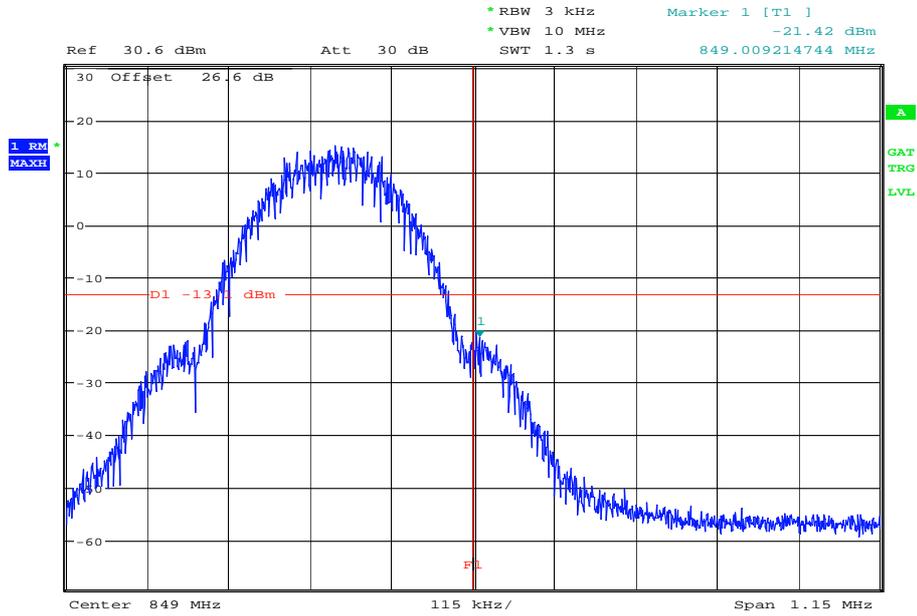
Frequency Block A



Date: 16.OCT.2013 09:25:52



Frequency Block B



Date: 16.OCT.2013 09:33:54

Limit Clause

-13 dBm at block edge.



Product Service

## **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**

SHL23 S/N: IMEI 004401114893031 - Modification State 0

### **2.2.3 Date of Test**

9 October 2013 & 11 October 2013

### **2.2.4 Test Equipment Used**

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

### **2.2.5 Test Procedure**

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**

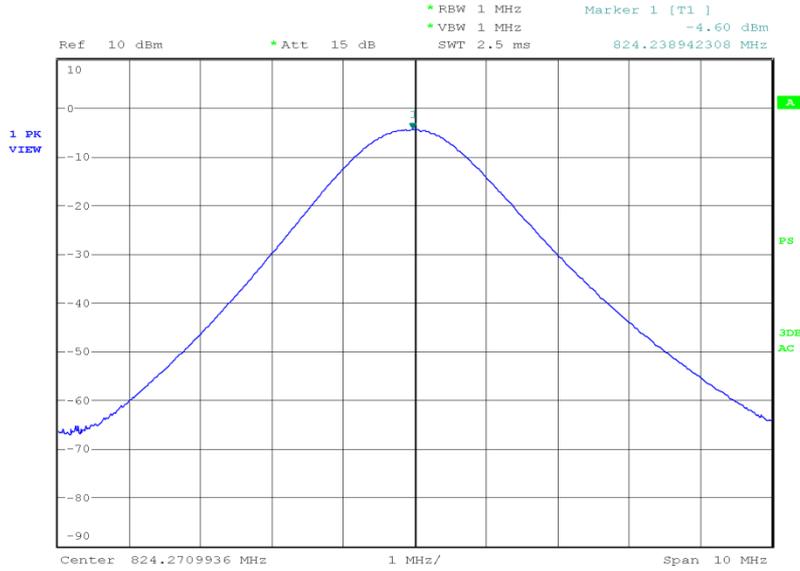
Ambient Temperature	19.2 - 20.0°C
Relative Humidity	32.0 - 39.0%



### 2.2.7 Test Results

#### 824.20 MHz

Result (dBm)	Result (W)
28.12	0.648

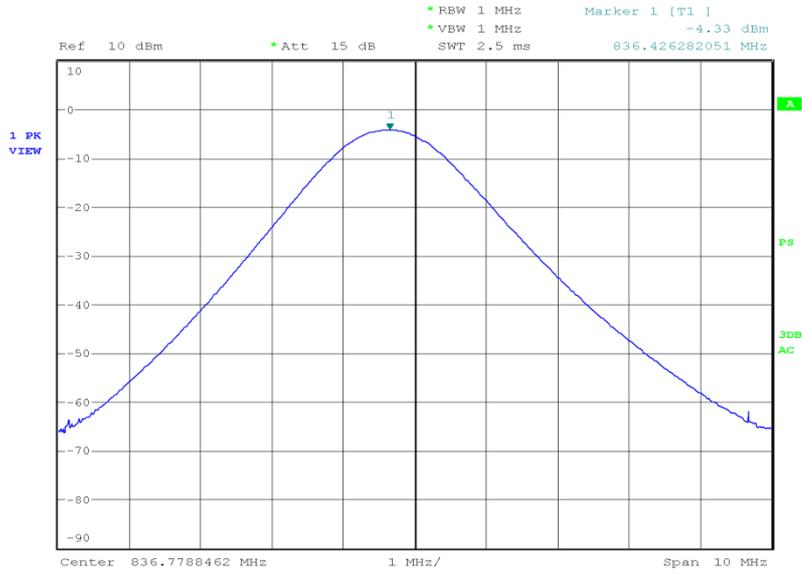


Date: 9.OCT.2013 22:35:35



836.40 MHz

Result (dBm)	Result (W)
28.16	0.654



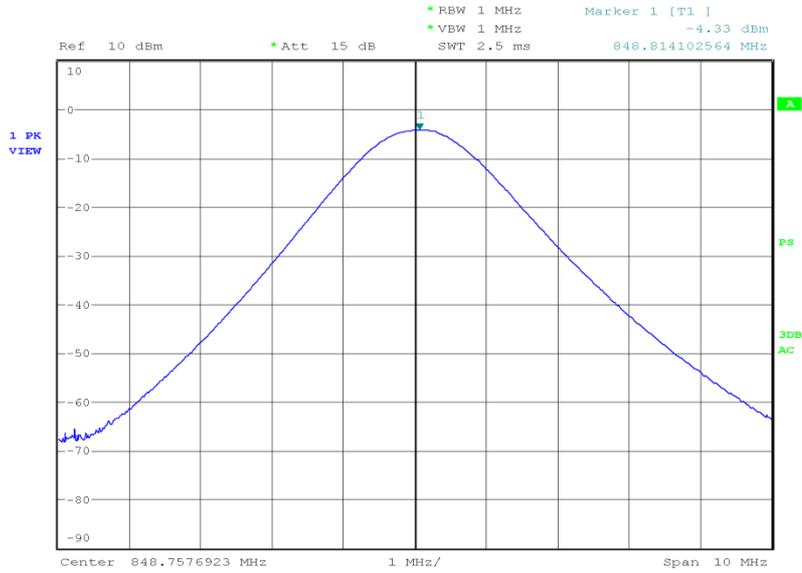
Date: 9.OCT.2013 22:27:12



Product Service

848.80 MHz

Result (dBm)	Result (W)
27.65	0.582



Date: 9.OCT.2013 23:31:48

Limit Clause

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

SHL23 S/N: IMEI 004401114892967 - Modification State 0

### **2.3.3 Date of Test**

30 September 2013

### **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**

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

The EUT was operating in GSM 850 mode supporting GMSK modulation and was tested in this mode of operation.

### **2.3.6 Environmental Conditions**

Ambient Temperature	22.3°C
Relative Humidity	54.2%



Product Service

**2.3.7 Test Results**

4.0 V DC Supply

824.20 MHz

Mode	Result (dBm)	Result (W)
GSM	32.64	1.837

836.40 MHz

Mode	Result (dBm)	Result (W)
GSM	32.39	1.734

848.80 MHz

Mode	Result (dBm)	Result (W)
GSM	32.36	1.722

Limit Clause

Mobile – 7 W or 38.45 dBm

Base Stations – 500 W or 57 dBm



Product Service

## **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**

SHL23 S/N: IMEI 004401114893031 - Modification State 0

### **2.4.3 Date of Test**

10 October 2013

### **2.4.4 Test Equipment Used**

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

### **2.4.5 Test Procedure**

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**

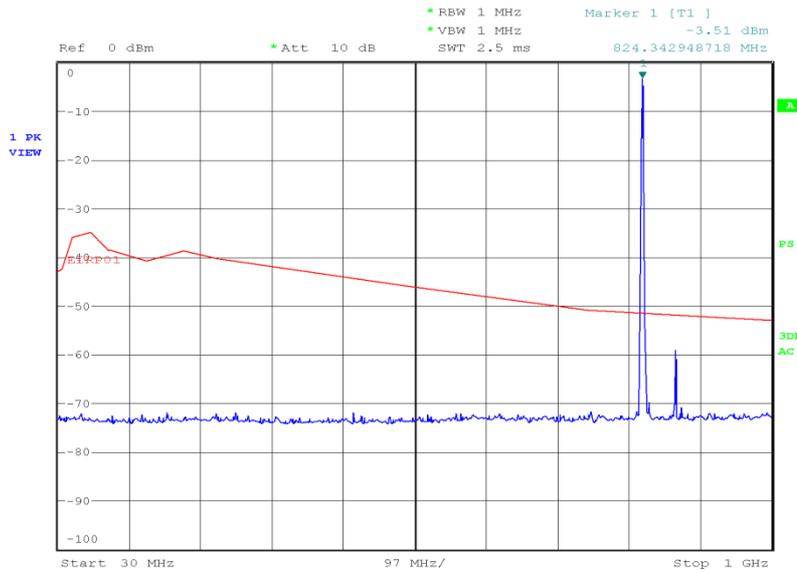
Ambient Temperature	20.5°C
Relative Humidity	40.0%



### 2.4.7 Test Results

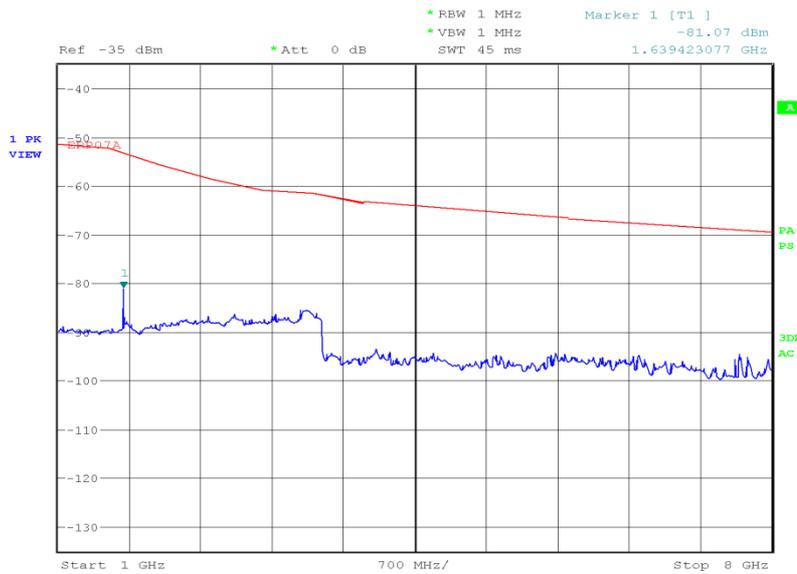
#### 824.20 MHz

#### 30 MHz to 1 GHz



Date: 10.OCT.2013 02:47:10

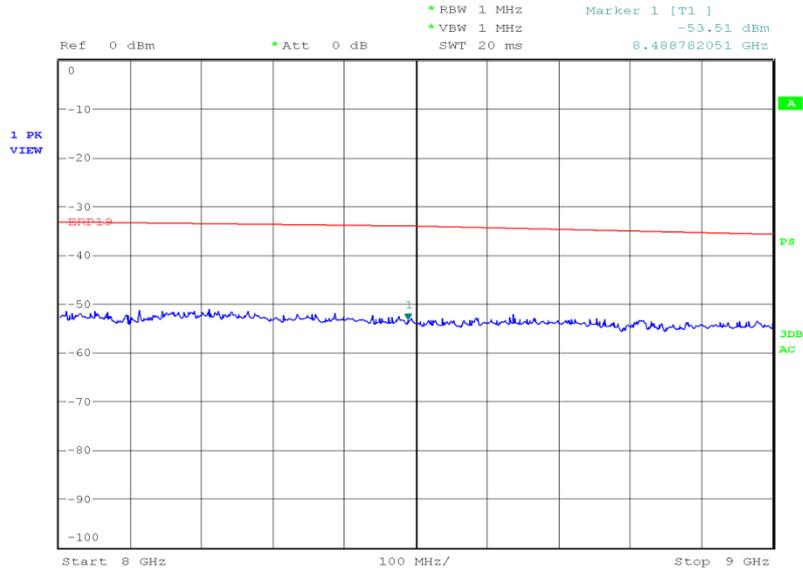
#### 1 GHz to 8 GHz



Date: 10.OCT.2013 00:15:10



8 GHz to 9 GHz

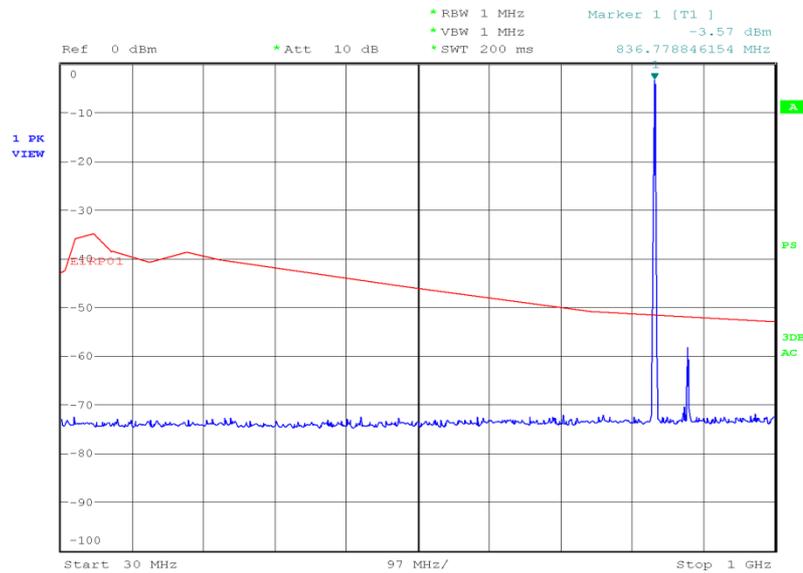


Date: 10.OCT.2013 03:29:47



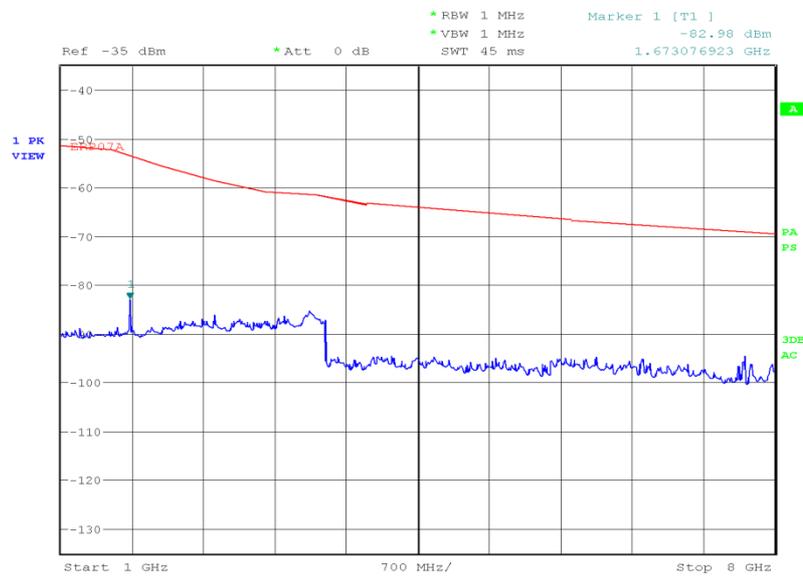
836.40 MHz

30 MHz to 1 GHz



Date: 10.OCT.2013 02:34:36

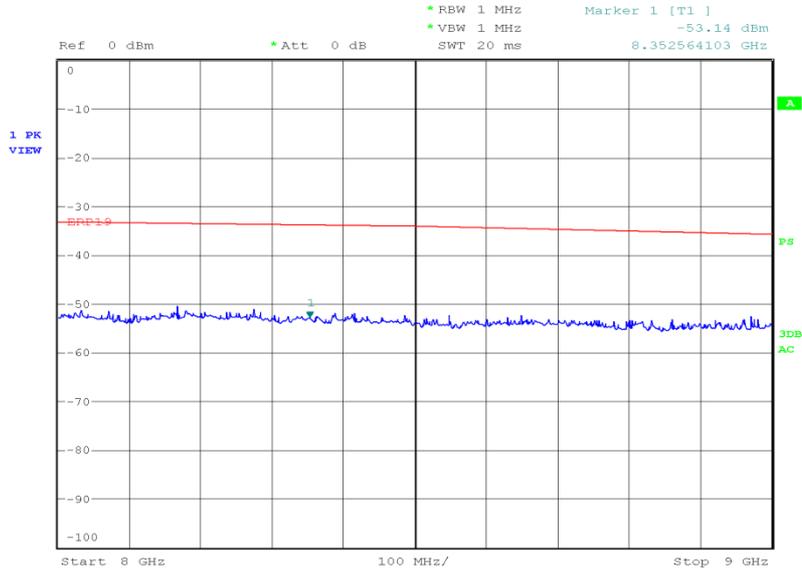
1 GHz to 8 GHz



Date: 10.OCT.2013 00:02:46



8 GHz to 9 GHz

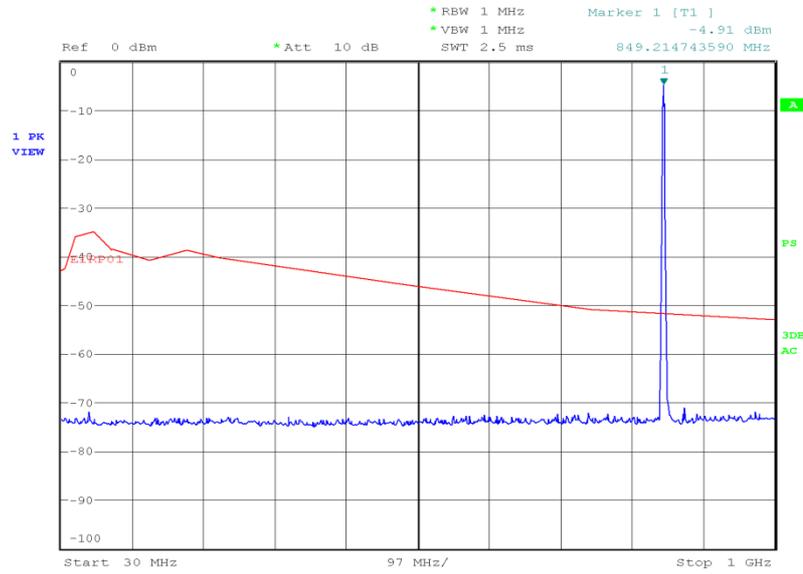


Date: 10.OCT.2013 03:26:22



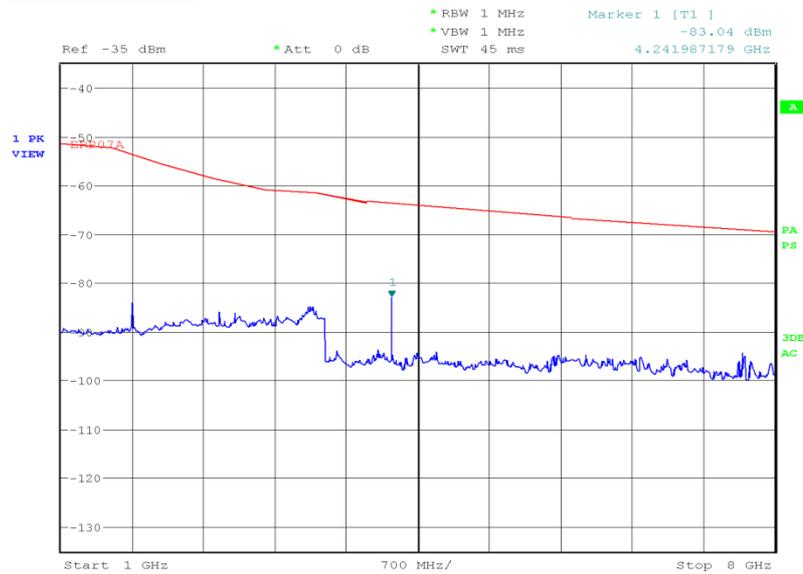
848.80 MHz

30 MHz to 1 GHz



Date: 10.OCT.2013 02:55:27

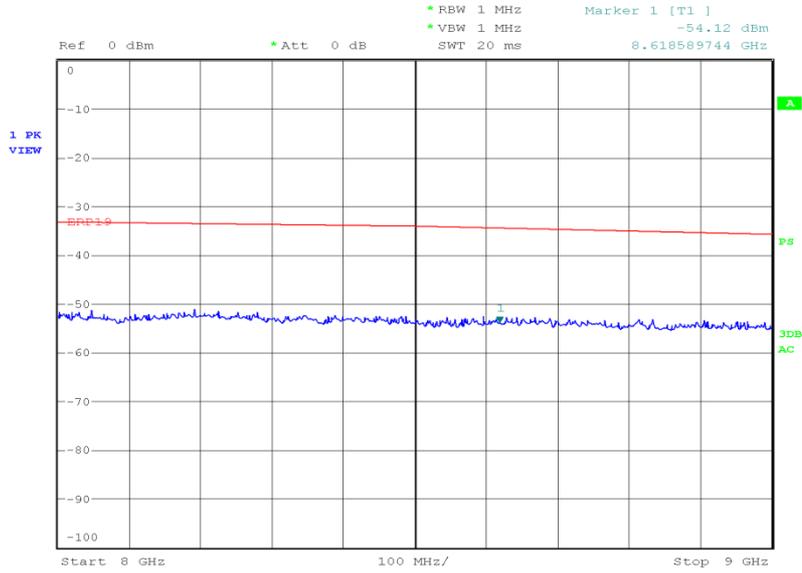
1 GHz to 8 GHz



Date: 10.OCT.2013 00:18:44



8 GHz to 9 GHz



Date: 10.OCT.2013 03:33:34

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

SHL23 S/N: IMEI 004401114892967 - Modification State 0

### 2.5.3 Date of Test

16 October 2013

### 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

In accordance with Part 2.1051, the spurious emissions from the antenna terminal were measured. The transmitter output power was attenuated using a combination of filters and attenuators and the frequency spectrum investigated from 9 kHz to the 10th harmonic. The EUT was set to transmit on full power with modulation. The EUT was tested on Bottom, Middle and Top channels for maximum power. The resolution and video bandwidths were set to 1 MHz and 3 MHz thus meeting the requirements of Part 22.917(b). The spectrum analyser detector was set to max hold.

From 9 kHz to 4 GHz, an attenuator was used. For measuring the range 1.5 GHz to 9 GHz an attenuator and high pass filter were used. This was to reduce saturation effects in the spectrum analyser.

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

### 2.5.6 Environmental Conditions

Ambient Temperature	22.8°C
Relative Humidity	37.2%

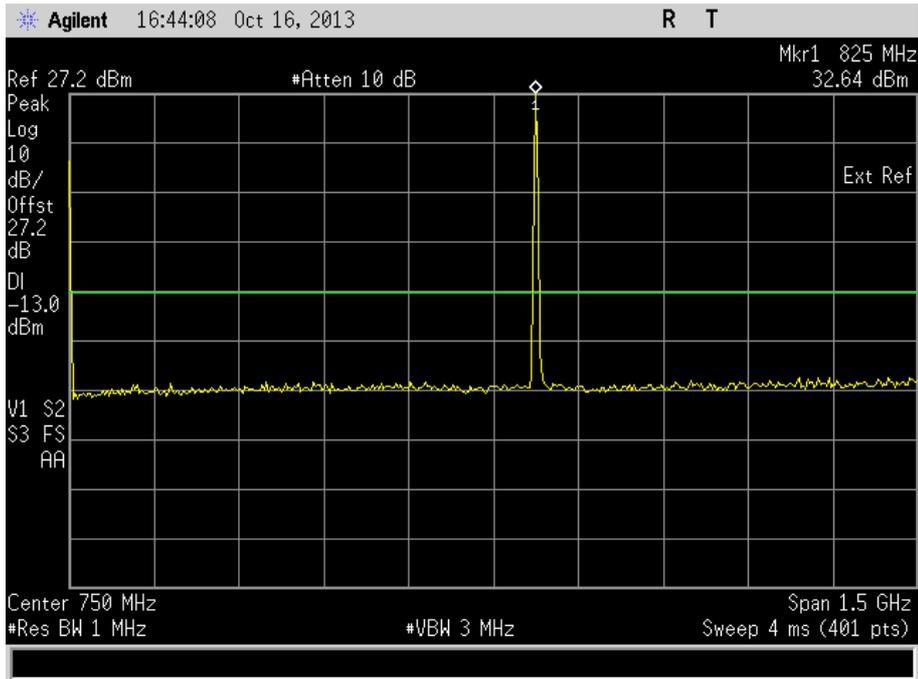


Product Service

2.5.7 Test Results

824.20 MHz

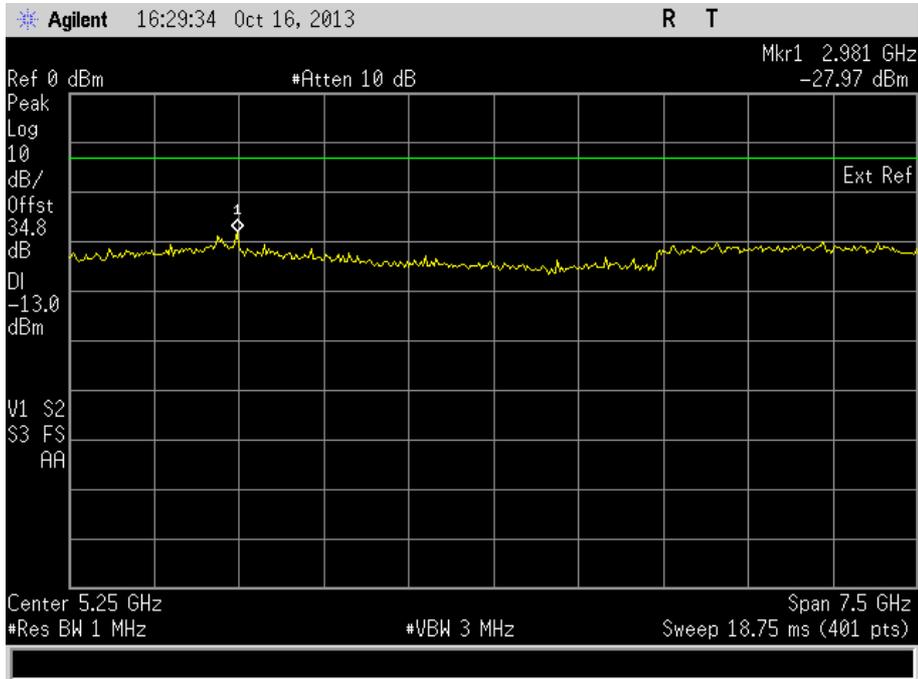
9 kHz to 1.5 GHz





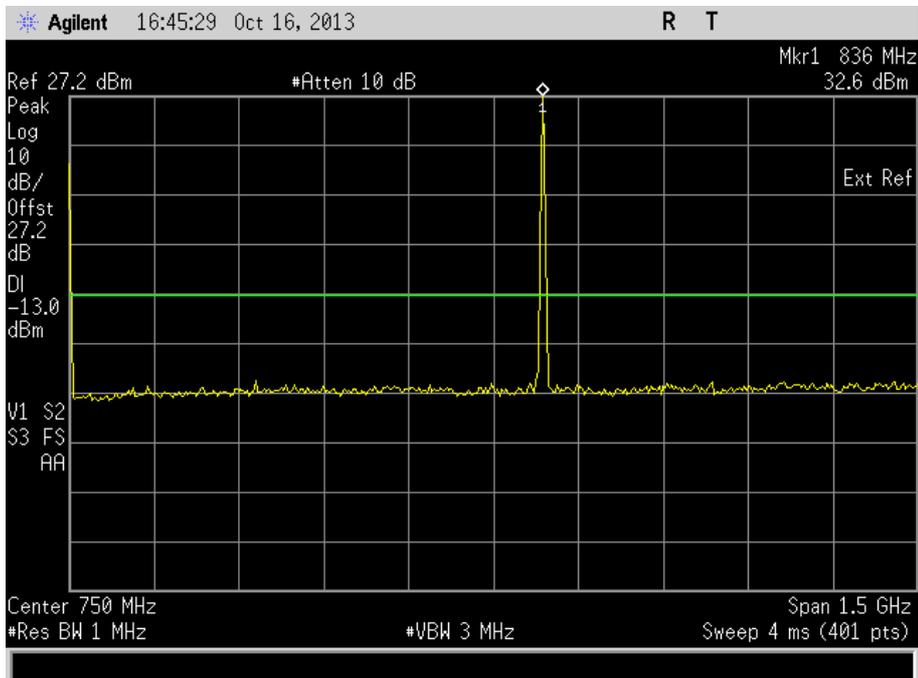
Product Service

1.5 GHz to 9 GHz



836.40 MHz

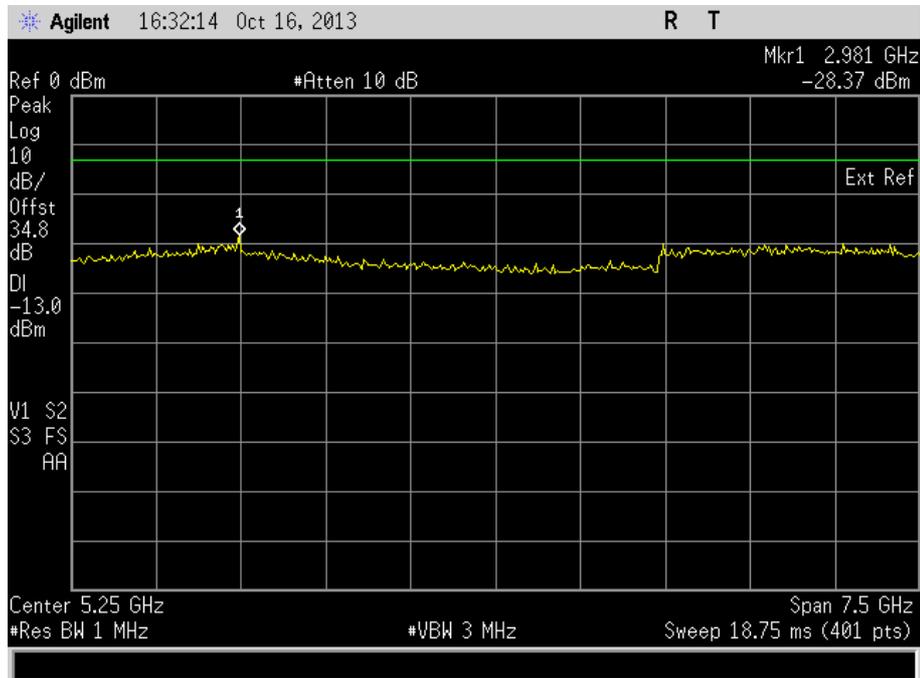
9 kHz to 1.5 GHz





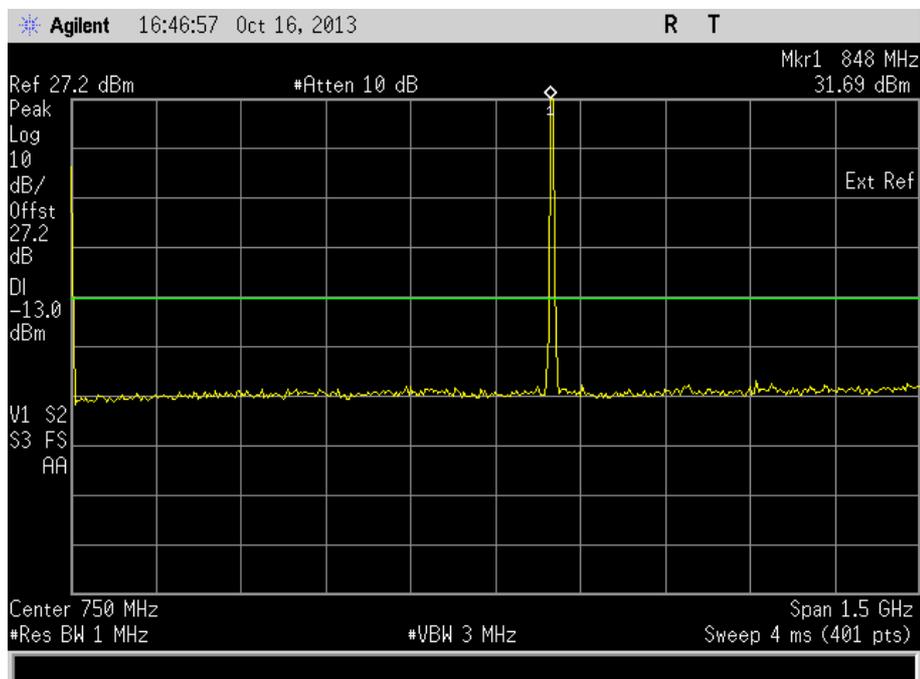
Product Service

1.5 GHz to 9 GHz



848.80 MHz

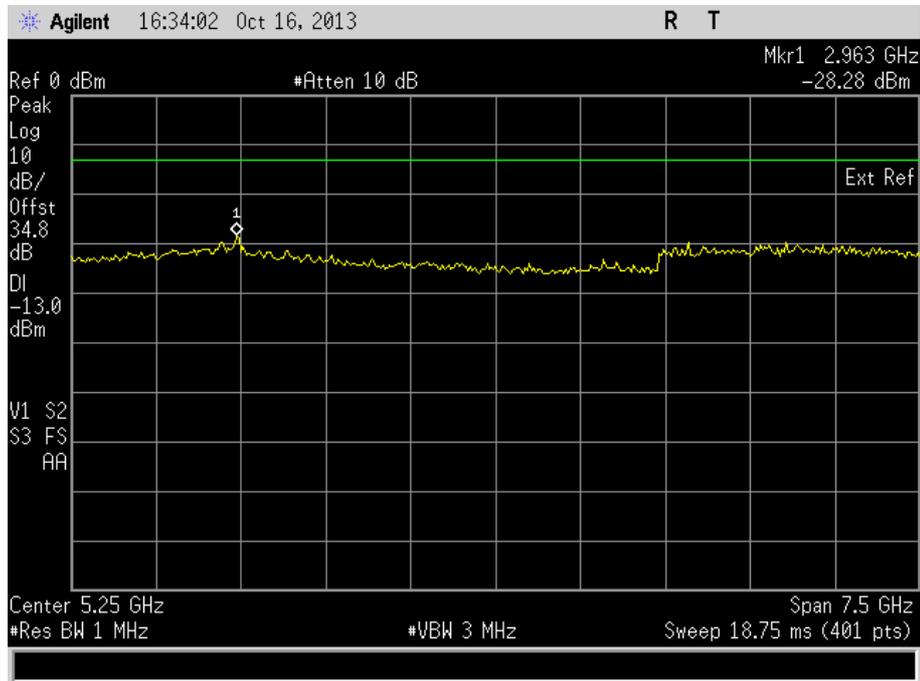
9 kHz to 1.5 GHz





Product Service

1.5 GHz to 9 GHz



Limit Clause

43+10log(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

SHL23 S/N: IMEI 004401114892967 - Modification State 0

### 2.6.3 Date of Test

16 October 2013

### 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 EUT was transmitting at maximum power, with modulation. Using a resolution bandwidth of 10 kHz and a video bandwidth of 100 kHz, the -26 dBc points were established and the emission bandwidth determined.

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

### 2.6.6 Environmental Conditions

Ambient Temperature	22.8°C
Relative Humidity	37.2%



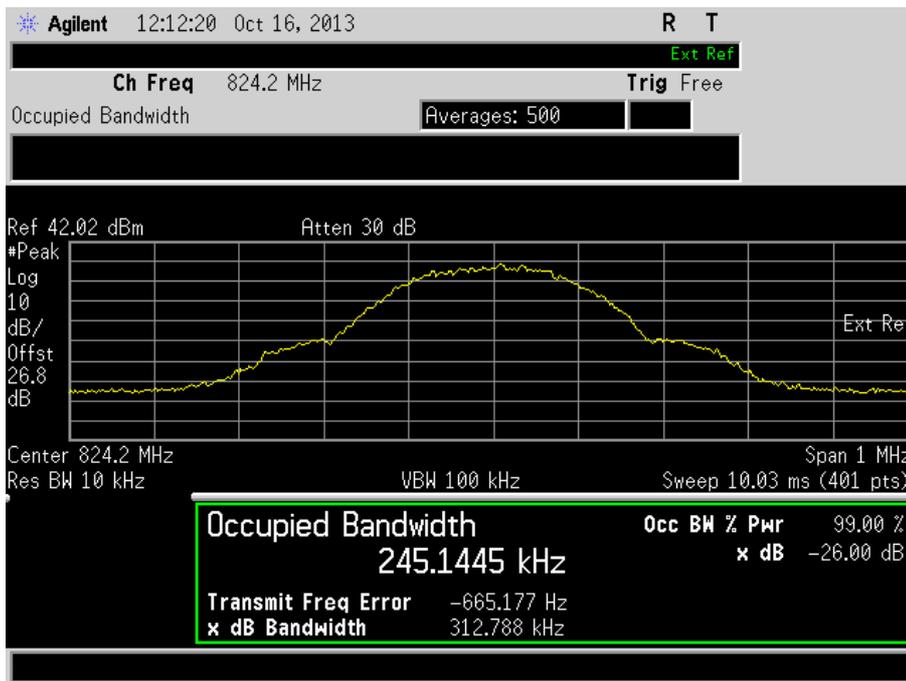
Product Service

2.6.7 Test Results

4.0 V DC Supply

824.20 MHz

Mode	Occupied Bandwidth (kHz)	26 dB Bandwidth (kHz)
GSM	245.145	312.788

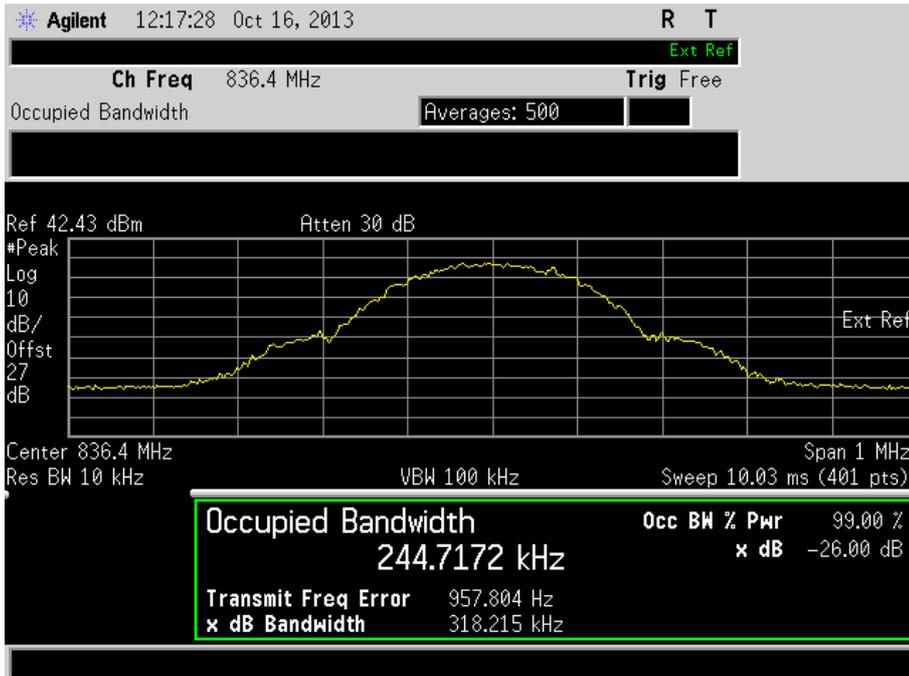




Product Service

836.40 MHz

Mode	Occupied Bandwidth (kHz)	26 dB Bandwidth (kHz)
GSM	244.717	318.215

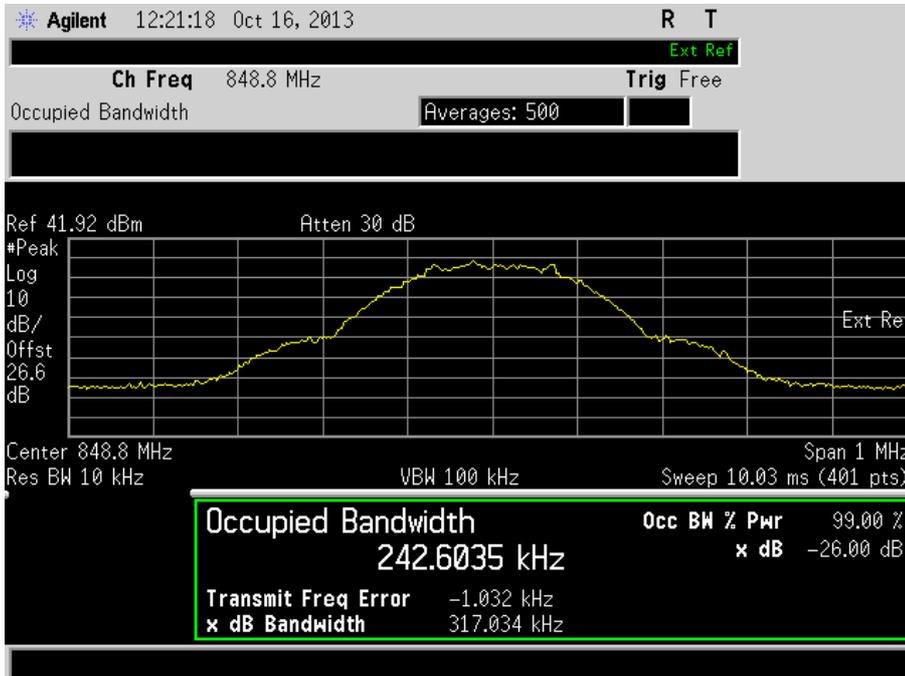




Product Service

848.80 MHz

Mode	Occupied Bandwidth (kHz)	26 dB Bandwidth (kHz)
GSM	242.604	317.034



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

SHL23

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

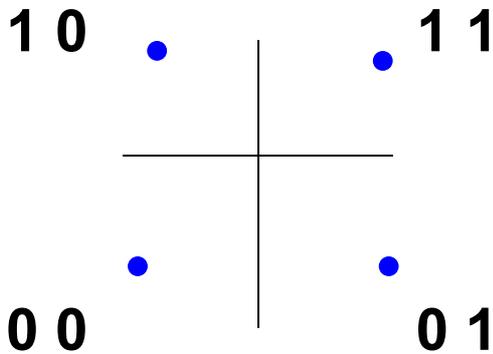
### **GMSK OVERVIEW**

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° ( $\pi$  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° or  $\pi/2$ , 0 = -90° or  $-\pi/2$  phase shift)

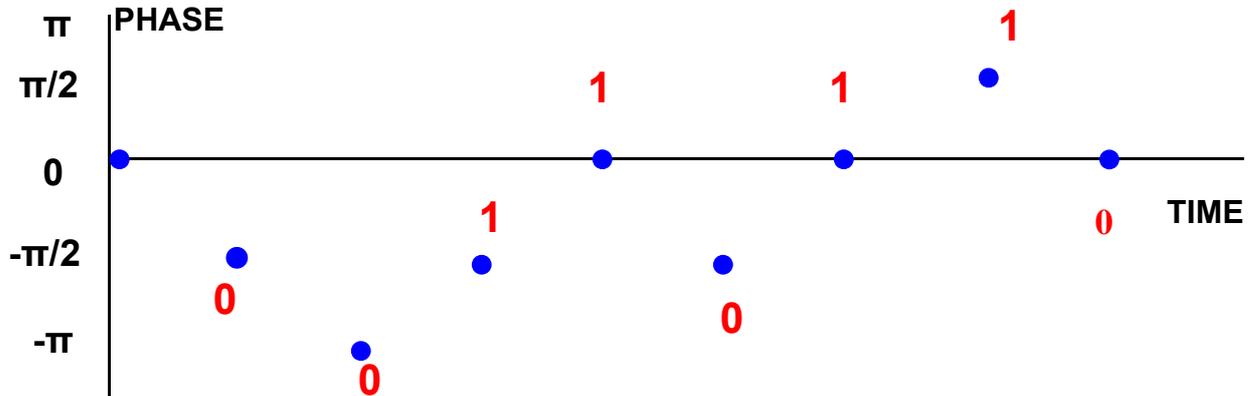
I Stream	0		1		0		1	
	$-\pi/2$		$-\pi/2$		$-\pi/2$		$\pi/2$	
Q stream		0		1		1		0
		$-\pi/2$		$\pi/2$		$\pi/2$		$-\pi/2$



3. Combine (add) the two PSK signals:

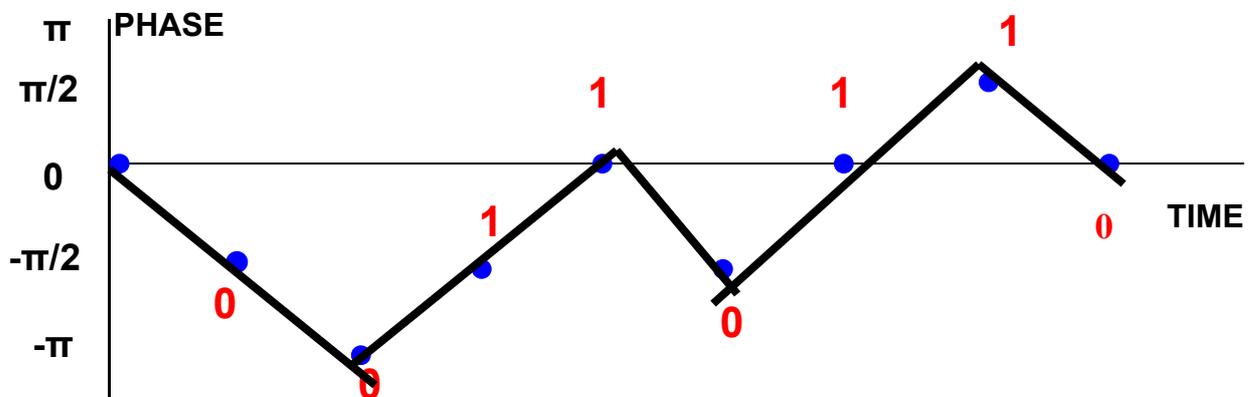
Combined Phase	$-\pi/2$	$-\pi$	$-\pi/2$	0	$-\pi/2$	0	$\pi/2$	0
----------------	----------	--------	----------	---	----------	---	---------	---

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**

SHL23 S/N: IMEI 004401114892967 - Modification State 0

### **2.8.3 Date of Test**

17 October 2013

### **2.8.4 Test Equipment Used**

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

### **2.8.5 Test Procedure**

The EUT was set to transmit on maximum power with modulation. A communications test set, was used to measure the frequency error. The maximum result was taken over 200 bursts. The temperature was adjusted between -30°C and +50°C in 10° steps as per 2.1055 and the frequency error was measured at each temperature.

### **2.8.6 Environmental Conditions**

Ambient Temperature	21.7°C
Relative Humidity	51.8%



Product Service

**2.8.7 Test Results**

Temperature Interval (°C)	Mode	Modulation	Deviation (ppm)
-30	GSM	GMSK	-0.049
-20	GSM	GMSK	0.039
-10	GSM	GMSK	-0.023
0	GSM	GMSK	-0.022
+10	GSM	GMSK	-0.019
+20	GSM	GMSK	-0.027
+30	GSM	GMSK	-0.013
+40	GSM	GMSK	-0.014
+50	GSM	GMSK	-0.024

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	-	-



Product Service

Under Voltage Variations

836.40 MHz

DC Voltage (V)	Mode	Modulation	Deviation (ppm)
4.0 V DC	GSM	GMSK	-0.027
3.7 V DC	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	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>					
Multimeter	White Gold	WG022	190	12	30-Oct-2013
Communications Tester	Rohde & Schwarz	CMU 200	442	12	1-Nov-2013
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	13-Aug-2014
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	24-Jan-2014
Power Supply	Hewlett Packard	6104A	1948	-	TU
Hygrometer	Rotronic	I-1000	3220	12	16-Jul-2014
Attenuator (20dB/100W)	Weinschel	48-20-43	4138	9	8-Nov-2013
<b>Section 2.2 – Effective Radiated Power</b>					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	3-Apr-2014
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
GSM Test Set	Rohde & Schwarz	CMU 200	2809	12	18-Jun-2014
Antenna (Log Periodic)	Schaffner	UPA6108	3108	12	5-Apr-2014
Antenna (DRG Horn)	ETS-LINDGREN	3115	3125	12	17-Jul-2014
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	3171	12	10-Sep-2014
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	11-Oct-2013
Tilt Antenna Mast	matur GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	matur GmbH	NCD	3917	-	TU
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	4144	12	17-Jul-2014
<b>Section 2.3 - Maximum Peak Output Power - Conducted</b>					
Power Divider	Weinschel	1506A	604	12	23-May-2014
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	24-Jan-2014
GSM Test Set	Rohde & Schwarz	CMU 200	2809	12	18-Jun-2014
Power Supply	Farnell	LT30-2	2903	-	TU
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
True RMS Multimeter	Fluke	179	4007	12	19-Mar-2014
Attenuator (20dB/100W)	Weinschel	48-20-43	4138	9	8-Nov-2013
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	4144	12	17-Jul-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 Broadband PCS Equipment</b>					
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	3-Apr-2014
Antenna (Bilog)	Schaffner	CBL6143	287	24	18-Jan-2014
Dual Power Supply Unit	Thurlby	PL320	288	-	TU
Antenna (Double Ridge Guide)	Q-Par Angus Ltd	QSH 180K	1511	24	7-Nov-2014
Pre-Amplifier	Phase One	PSO4-0087	1534	12	30-Sep-2014
Screened Room (5)	Rainford	Rainford	1545	36	25-Dec-2013
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Filter (Hi Pass)	Lorch	9HP7-7000-SR	2833	12	1-Feb-2014
Antenna (Bilog)	Chase	CBL6143	2904	24	10-Jun-2015
Antenna (Log Periodic)	Schaffner	UPA6108	3108	12	5-Apr-2014
Antenna (DRG Horn)	ETS-LINDGREN	3115	3125	12	17-Jul-2014
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	3171	12	10-Sep-2014
Amplifier (1 - 8GHz)	Phase One	PS06-0060	3175	12	9-Aug-2014
Amplifier (8 - 18GHz)	Phase One	PS06-0061	3176	12	9-Aug-2014
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	11-Oct-2013
Test Receiver	Rohde & Schwarz	ESIB	2941	12	23-Oct-2013
3 GHz High Pass Filter	K&L Microwave	11SH10-3000/X18000-O/O	3552	12	1-Feb-2014
Tilt Antenna Mast	maturo GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	maturo GmbH	NCD	3917	-	TU
P-Series Power Meter	Agilent Technologies	N1911A	3980	12	18-Sep-2014
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3982	12	18-Sep-2014
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	4144	12	17-Jul-2014
<b>Section 2.5 - Conducted Spurious Emissions</b>					
Multimeter	White Gold	WG022	190	12	30-Oct-2013
Communications Tester	Rohde & Schwarz	CMU 200	442	12	1-Nov-2013
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	13-Aug-2014
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	24-Jan-2014
Power Supply	Hewlett Packard	6104A	1948	-	TU
High Pass Filter (4GHz)	RLC Electronics	F-100-4000-5-R	2773	12	1-Feb-2014
Filter	Daden Anthony Ass	MH-1500-7SS	2778	12	1-Feb-2014
Hygrometer	Rotronic	I-1000	3220	12	16-Jul-2014
Attenuator (20dB/100W)	Weinschel	48-20-43	4138	9	8-Nov-2013
<b>Section 2.6 - Occupied Bandwidth</b>					
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Multimeter	White Gold	WG022	190	12	30-Oct-2013
RF Coupler	TUV SUD Product Service	TUV	415	-	TU
Communications Tester	Rohde & Schwarz	CMU 200	442	12	1-Nov-2013
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	13-Aug-2014
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	24-Jan-2014
Power Supply	Hewlett Packard	6104A	1948	-	TU
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	30-Nov-2013
High Pass Filter (4GHz)	RLC Electronics	F-100-4000-5-R	2773	12	1-Feb-2014
Filter	Daden Anthony Ass	MH-1500-7SS	2778	12	1-Feb-2014
Hygrometer	Rotronic	I-1000	3220	12	16-Jul-2014
True RMS Multimeter	Fluke	179	4007	12	19-Mar-2014
Attenuator (20dB/100W)	Weinschel	48-20-43	4138	9	8-Nov-2013



Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
<b>Section 2.8 - Frequency Stability</b>					
Power Supply Unit	Farnell	LT-30-2	41	-	O/P Mon
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Communications Tester	Rohde & Schwarz	CMU 200	442	12	1-Nov-2013
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	18-Oct-2013
Multimeter	Fluke	79 Series III	611	12	16-Aug-2014
GPS Frequency Standard	Rapco	GPS-804/3	1312	6	24-Jan-2014
Power Supply	Hewlett Packard	6104A	1948	-	TU
Hygrometer	Rotronic	I-1000	3220	12	16-Jul-2014
Power Divider	Weinschel	1506A	3345	12	23-May-2014
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	4-Jul-2014
P-Series Power Meter	Agilent Technologies	N1911A	3980	12	18-Sep-2014
50 MHz-18 GHz Wideband Power Sensor	Agilent Technologies	N1921A	3982	12	18-Sep-2014
True RMS Multimeter	Fluke	179	4007	12	19-Mar-2014
Attenuator (20dB/100W)	Weinschel	48-20-43	4138	9	8-Nov-2013

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



Product Service

## **SECTION 4**

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



Product Service

#### 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).

This report must not be reproduced, except in its entirety, without the written permission of TÜV SÜD Product Service

© 2013 TÜV SÜD Product Service