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# Report On

FCC Testing of the Sharp SHF32 Quad-band GSM  
(850/900/1800/1900) & Dual-band UMTS (FDDI, FDDV) & Dual-band  
LTE (B1, B26) multi mode cellular phone with Bluetooth, WLAN,  
SRD(FeliCa) and GPS

In accordance with FCC 47 CFR Part 22 and FCC 47 CFR Part 2  
(GSM 850)

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FCC ID: APYHRO00224

Document 75930192 Report 05 Issue 1

June 2015



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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)

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**REPORT ON**

FCC Testing of the  
Sharp SHF32 Quad-band GSM (850/900/1800/1900) & Dual-band  
UMTS (FDDI, FDDV) & Dual-band LTE (B1, B26) multi mode cellular  
phone with Bluetooth, WLAN, SRD(FeliCa) and GPS  
In accordance with FCC 47 CFR Part 22 and FCC 47 CFR Part 2  
(GSM 850)

Document 75930192 Report 05 Issue 1

June 2015

**PREPARED FOR**

Sharp Communication Compliance Ltd  
Inspired  
Easthampstead Road  
Bracknell  
Berkshire  
RG12 1NS

**PREPARED BY**

**Natalie Bennett**  
Senior Administrator, Project Support

**APPROVED BY**

**Simon Bennett**  
Authorised Signatory

**DATED**

25 June 2015

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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 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);

M Choudhury

M Russell



G Lawler

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## **SECTION 1**

### **REPORT SUMMARY**

FCC Testing of the  
Sharp SHF32 Quad-band GSM (850/900/1800/1900) & Dual-band UMTS (FDDI, FDDV) &  
Dual-band LTE (B1, B26) multi mode cellular phone with Bluetooth, WLAN, SRD(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 SHF32 Quad-band GSM (850/900/1800/1900) & Dual-band UMTS (FDDI, FDDV) & Dual-band LTE (B1, B26) multi mode cellular phone with Bluetooth, WLAN, SRD(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                                                                                                                                   |
| Model Number(s)               | SHF32                                                                                                                                               |
| Serial Number(s)              | IMEI 004401115362432<br>IMEI 004401115362374                                                                                                        |
| Number of Samples Tested      | 2                                                                                                                                                   |
| Test Specification/Issue/Date | FCC 47 CFR Part 22 (2014)<br>FCC 47 CFR Part 2 (2014)                                                                                               |
| Disposal                      | Held Pending Disposal                                                                                                                               |
| Reference Number              | Not Applicable                                                                                                                                      |
| Date                          | Not Applicable                                                                                                                                      |
| Order Number                  | 10534                                                                                                                                               |
| Date                          | 17 April 2015                                                                                                                                       |
| Start of Test                 | 24 May 2015                                                                                                                                         |
| Finish of Test                | 9 June 2015                                                                                                                                         |
| Name of Engineer(s)           | M Choudhury<br>M Russell<br>G Lawler                                                                                                                |
| Related Document(s)           | ANSI C63.4 (2009)<br>ANSI TIA-603-C (2004)                                                                                                          |



## 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.

| Section | Specification Clause |            | Test Description                            | Result | Comments/Base Standard |
|---------|----------------------|------------|---------------------------------------------|--------|------------------------|
|         | Part 22              | Part 2     |                                             |        |                        |
| GSM 850 |                      |            |                                             |        |                        |
| 2.1     | 22.355               | 2.1055     | Frequency Tolerance                         | Pass   |                        |
| 2.2     | 22.905               | 2.1051     | Spurious Emissions at Band Edge             | Pass   |                        |
| 2.3     | 22.913 (a)           | 2.1046     | Maximum Conducted Output Power              | Pass   |                        |
| 2.4     | 22.917               | -          | Emission Limitations for Cellular Equipment | Pass   |                        |
| 2.5     | 22.917 (b)           | 2.1049 (h) | 26 dB Bandwidth                             | Pass   |                        |
| 2.6     | -                    | 2.1047 (d) | Modulation Characteristics                  | -      | Customer Declaration   |



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### **1.3 PRODUCT TECHNICAL DESCRIPTION**

Please refer to the SHF32 Model Description Form.

### **1.4 PRODUCT INFORMATION**

#### **1.4.1 Technical Description**

The Equipment Under Test (EUT) was a Sharp SHF32 Quad-band GSM (850/900/1800/1900) & Dual-band UMTS (FDDI, FDDV) & Dual-band LTE (B1, B26) multi mode cellular phone with Bluetooth, WLAN, SRD(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 SHF32 Quad-band GSM (850/900/1800/1900) & Dual-band UMTS (FDDI, FDDV) &  
Dual-band LTE (B1, B26) multi mode cellular phone with Bluetooth, WLAN, SRD(FeliCa) and  
GPS

In accordance with FCC 47 CFR Part 22 and FCC 47 CFR Part 2 (GSM 850)





Product Service

## **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**

SHF32 S/N: IMEI 004401115362432 - Modification State 0

### **2.1.3 Date of Test**

8 June 2015 & 9 June 2015

### **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

The frequency measurement function on a CMU 200 was used to measure the frequency error.  
The CMU 200 was configured in Circuit Switched mode to an uplink frequency of 836.40 MHz.

### **2.1.6 Environmental Conditions**

|                     |               |
|---------------------|---------------|
| Ambient Temperature | 21.4 - 24.9°C |
| Relative Humidity   | 30.9 - 33.6%  |



### 2.1.7 Test Results

#### 4.0 V DC Supply

#### GSM 850, 836.40 MHz, Circuit-Switched Voice, GMSK, Frequency Tolerance Under Temperature Variations Results

| Temperature | Fundamental Frequency Deviation (ppm) |
|-------------|---------------------------------------|
| -30 °C      | 0.023                                 |
| -20 °C      | 0.023                                 |
| -10 °C      | 0.020                                 |
| 0 °C        | 0.020                                 |
| +10 °C      | 0.022                                 |
| +20 °C      | 0.027                                 |
| +30 °C      | 0.023                                 |
| +40 °C      | 0.020                                 |
| +50 °C      | 0.024                                 |

#### GSM 850, 836.40 MHz, Circuit-Switched Voice, GMSK, Frequency Tolerance Under Voltage Variations Results

| Voltage  | Fundamental Frequency Deviation (ppm) |
|----------|---------------------------------------|
| 4.0 V DC | 0.023                                 |
| 3.7 V DC | 0.022                                 |

#### 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                | -                      | -                      |



Product Service

## **2.2 SPURIOUS EMISSIONS AT BAND EDGE**

### **2.2.1 Specification Reference**

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

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

SHF32 S/N: IMEI 004401115362432 - Modification State 0

### **2.2.3 Date of Test**

29 May 2015

### **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**

This test was performed in accordance with KDB 971168 D01 v02r02, clause 6.

#### Remarks

An RMS detector and trace averaging were used to perform the measurement.

### **2.2.6 Environmental Conditions**

|                     |        |
|---------------------|--------|
| Ambient Temperature | 24.2°C |
| Relative Humidity   | 34.5%  |



Product Service

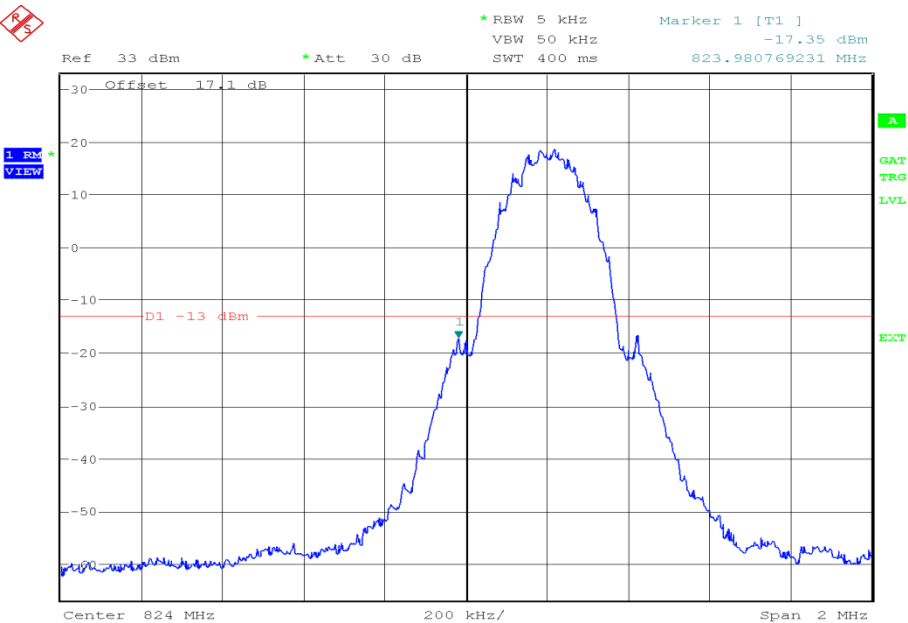
2.2.7 Test Results

4.0 V DC Supply

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

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

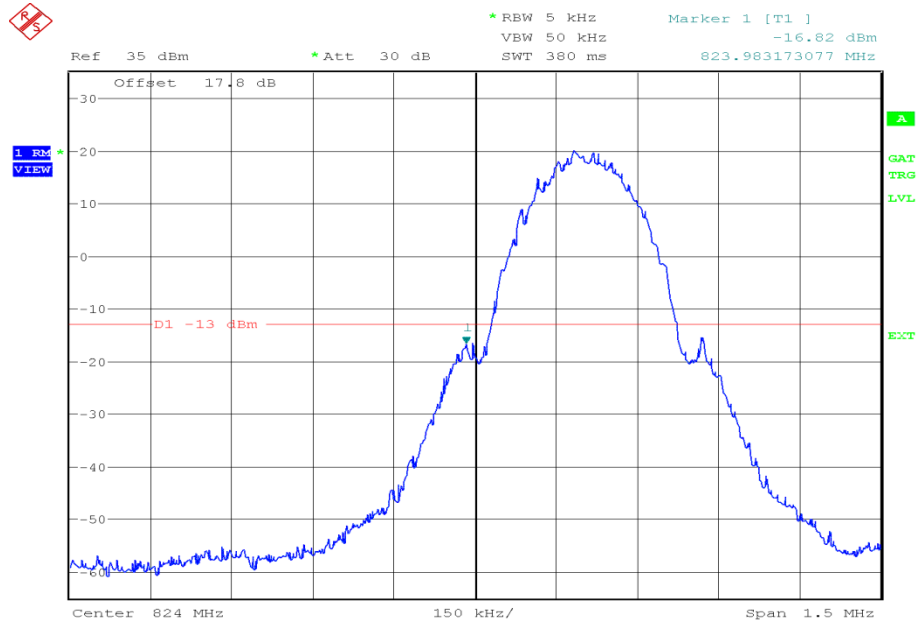
GSM 850, Circuit-Switched Voice, GMSK, Frequency Block A, Spurious Emissions at Band Edge Plot



Date: 29.MAY.2015 09:32:10



Product Service

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

Date: 29.MAY.2015 09:24:27

FCC 47 CFR Part 22, Limit Clause 22.905 and 22.917

-13 dBm at block edge.



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## 2.3 MAXIMUM CONDUCTED OUTPUT POWER

### 2.3.1 Specification Reference

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

### 2.3.2 Equipment Under Test and Modification State

SHF32 S/N: IMEI 004401115362432 - Modification State 0

### 2.3.3 Date of Test

28 May 2015

### 2.3.4 Test Equipment Used

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

### 2.3.5 Test Procedure

This test was performed in accordance with KDB 971168 D01 v02r02, clause 5.2.3.

#### Remarks

Results have been expressed in terms of ERP as per KDB 412172 D01 v01.

### 2.3.6 Environmental Conditions

Ambient Temperature 25.3°C  
Relative Humidity 32.3 - 32.5%

### 2.3.7 Test Results

4.0 V DC Supply

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

| Frequency  | Conducted Power (dBm) | Antenna Gain | ERP (dBm) | EIRP (W) |
|------------|-----------------------|--------------|-----------|----------|
| 824.20 MHz | 31.91                 | 2.0 dBi      | 31.76     | 1.500    |
| 836.40 MHz | 31.89                 | 2.0 dBi      | 31.74     | 1.493    |
| 848.80 MHz | 32.16                 | 2.0 dBi      | 32.01     | 1.589    |

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

Mobile Transmitters: 7 W or 38.45 dBm



Product Service

## **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**

SHF32 S/N: IMEI 004401115362374 - Modification State 0

### **2.4.3 Date of Test**

24 May 2015

### **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 KDB 971168 D01 v02r02, Clause 5.8 and 7 and ANSI TIA-603-C, Clause 2.2.12. The EUT was configured as defined in ANSI C63.4.

### **2.4.6 Environmental Conditions**

|                     |        |
|---------------------|--------|
| Ambient Temperature | 21.4°C |
| Relative Humidity   | 42.0%  |



Product Service

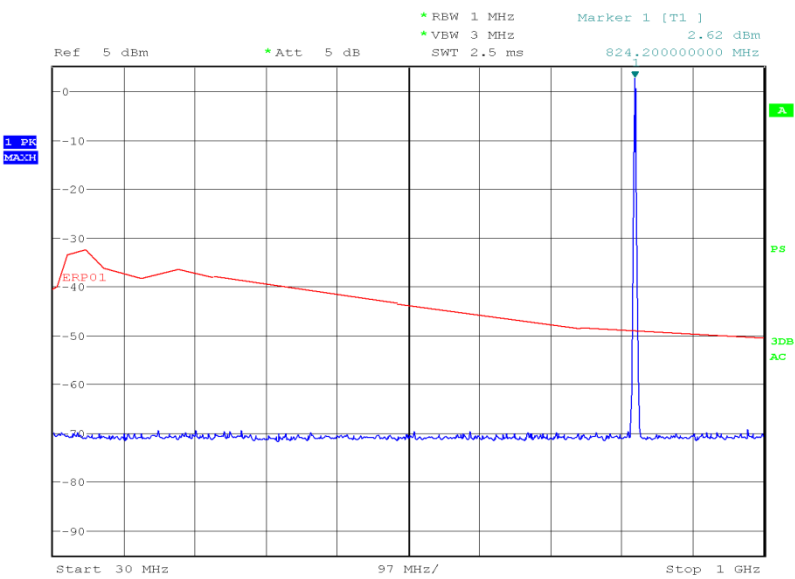
2.4.7 Test Results

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 Cellular Equipment Plot

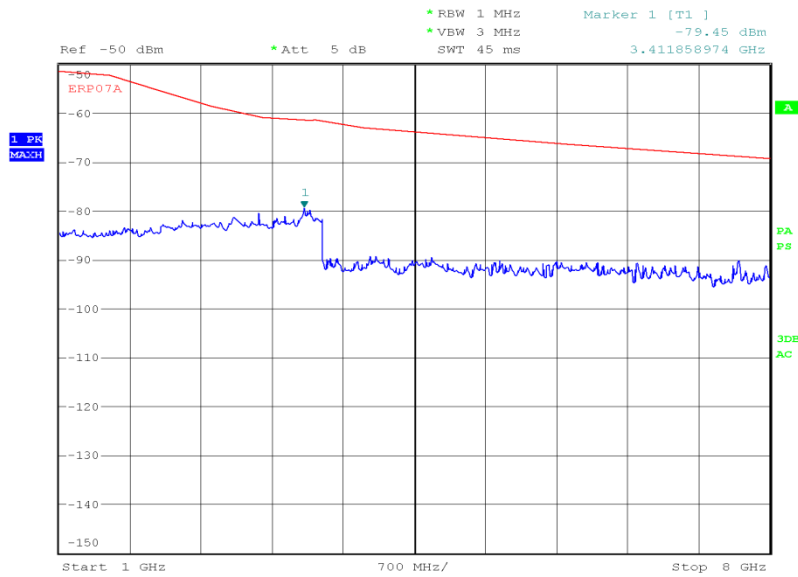


Date: 24.MAY.2015 20:22:14

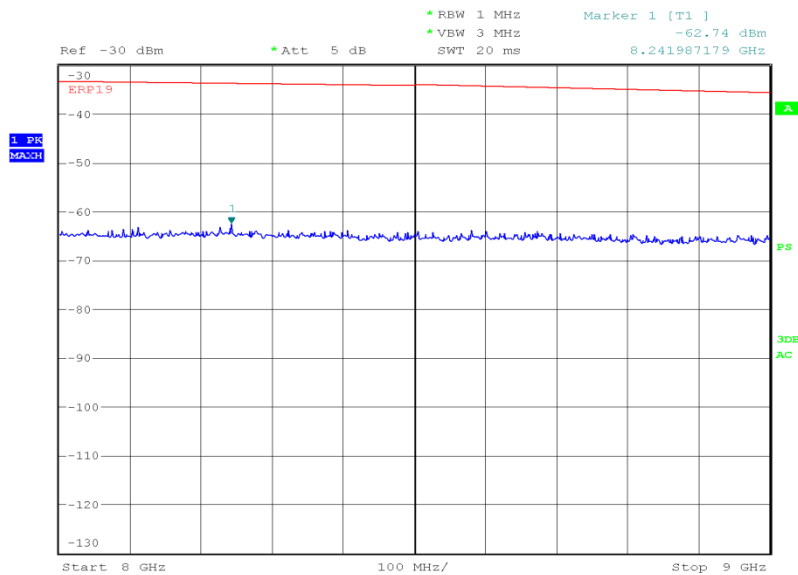




Product Service

GSM 850, 824.20 MHz, 1 GHz to 8 GHz, Emission Limitations for Cellular Equipment Plot

Date: 24.MAY.2015 22:51:59

GSM 850, 824.20 MHz, 8 GHz to 9 GHz, Emission Limitations for Cellular Equipment Plot

Date: 24.MAY.2015 21:34:14



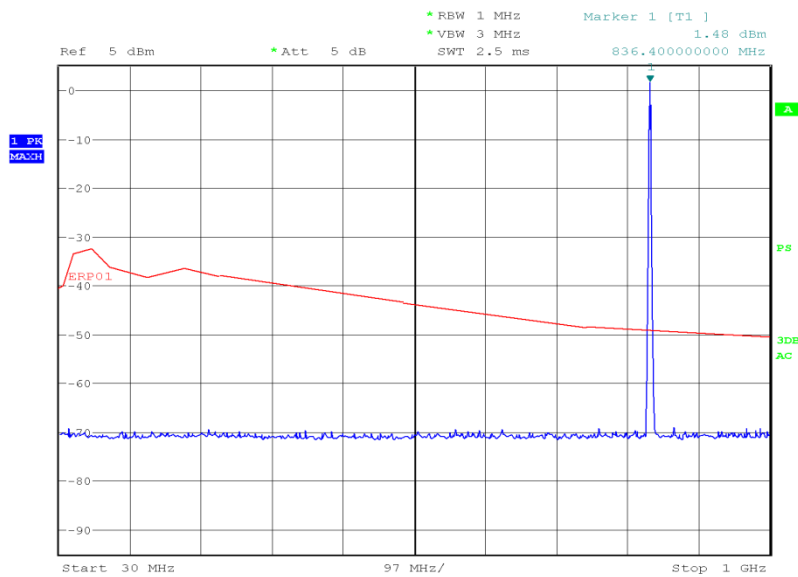
Product Service

### 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 Cellular Equipment Plot

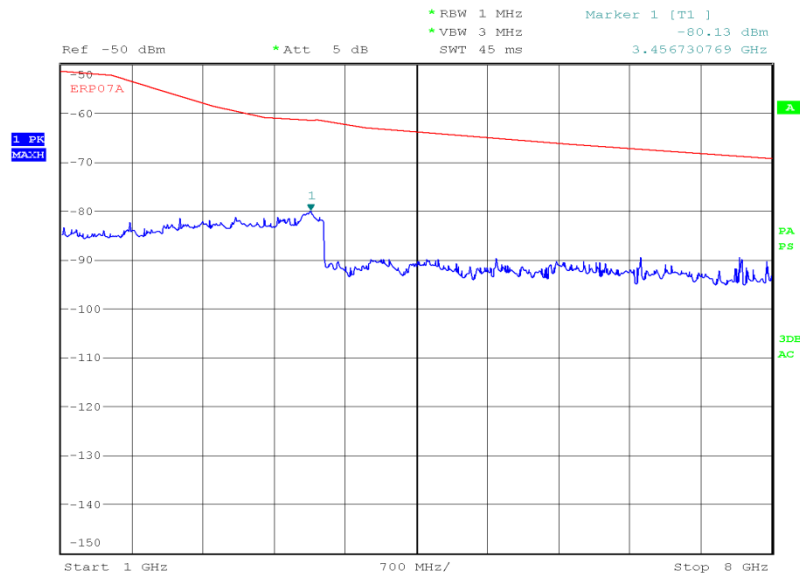


Date: 24.MAY.2015 20:13:59



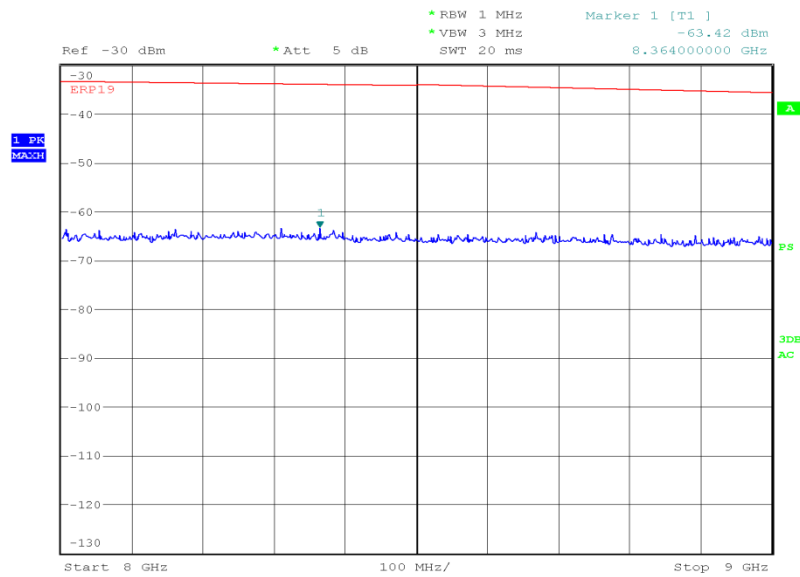
Product Service

GSM 850, 836.40 MHz, 1 GHz to 8 GHz, Emission Limitations for Cellular Equipment Plot



Date: 24.MAY.2015 22:56:24

GSM 850, 836.40 MHz, 8 GHz to 9 GHz, Emission Limitations for Cellular Equipment Plot



Date: 24.MAY.2015 21:40:08



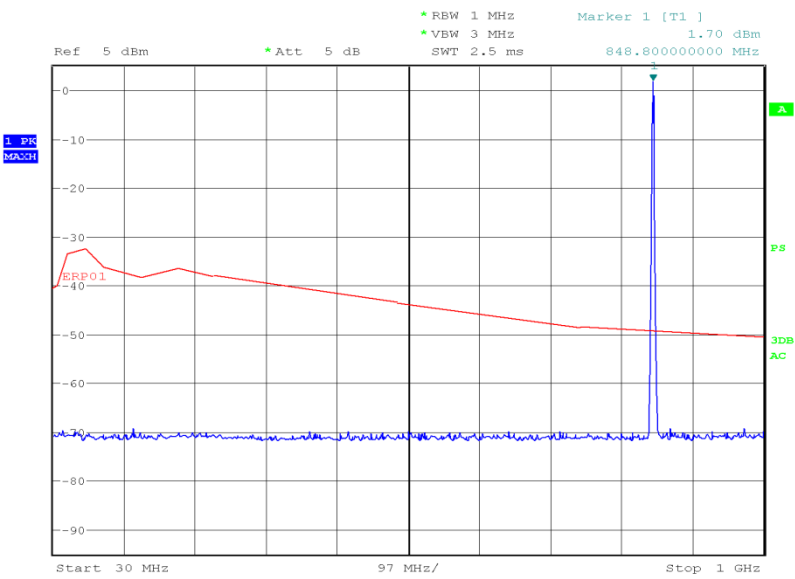
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GSM 850, 848.80 MHz, Emission Limitations for Cellular Equipment Results

| 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 Cellular Equipment Plot

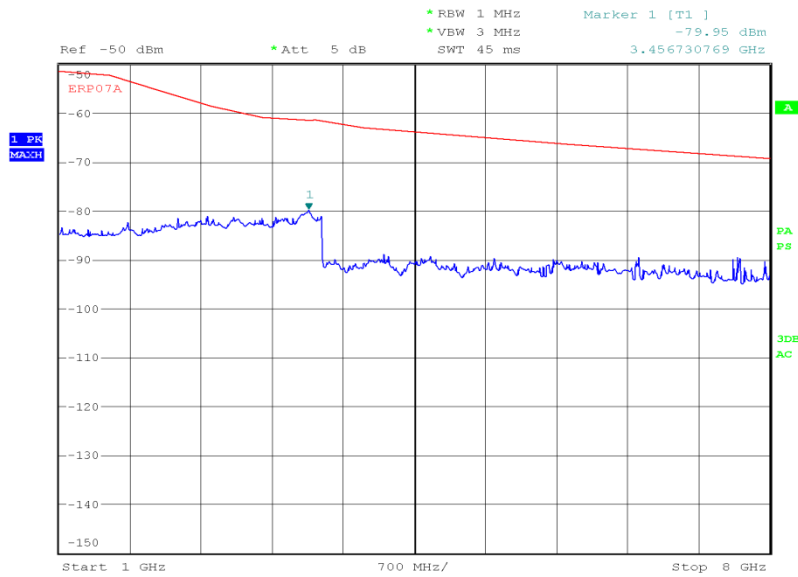


Date: 24.MAY.2015 20:23:54



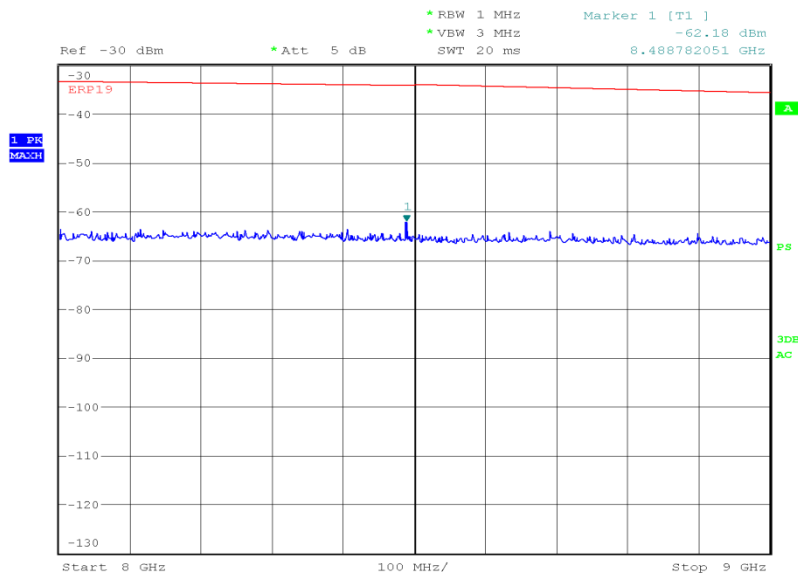
Product Service

### GSM 850, 848.80 MHz, 1 GHz to 8 GHz, Emission Limitations for Cellular Equipment Plot



Date: 24.MAY.2015 22:59:13

### GSM 850, 848.80 MHz, 8 GHz to 9 GHz, Emission Limitations for Cellular Equipment Plot



Date: 24.MAY.2015 21:42:09

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

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



Product Service

**2.5 26 dB BANDWIDTH****2.5.1 Specification Reference**

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

**2.5.2 Equipment Under Test and Modification State**

SHF32 S/N: IMEI 004401115362432 - Modification State 0

**2.5.3 Date of Test**

29 May 2015

**2.5.4 Test Equipment Used**

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

**2.5.5 Test Procedure**

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

**2.5.6 Environmental Conditions**

|                     |        |
|---------------------|--------|
| Ambient Temperature | 24.2°C |
| Relative Humidity   | 36.8%  |



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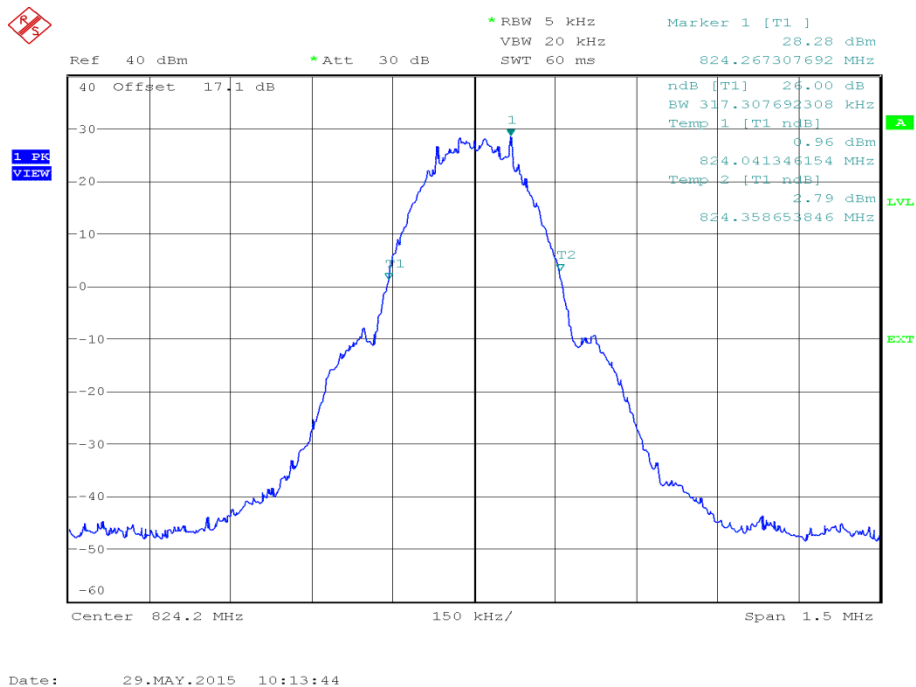
## 2.5.7 Test Results

4.0 V DC Supply

### GSM 850, GMSK, 26 dB Bandwidth Results

|            |            |            |
|------------|------------|------------|
| 824.20 MHz | 836.40 MHz | 848.80 MHz |
| kHz        | kHz        | kHz        |
| 317.308    | 317.308    | 317.308    |

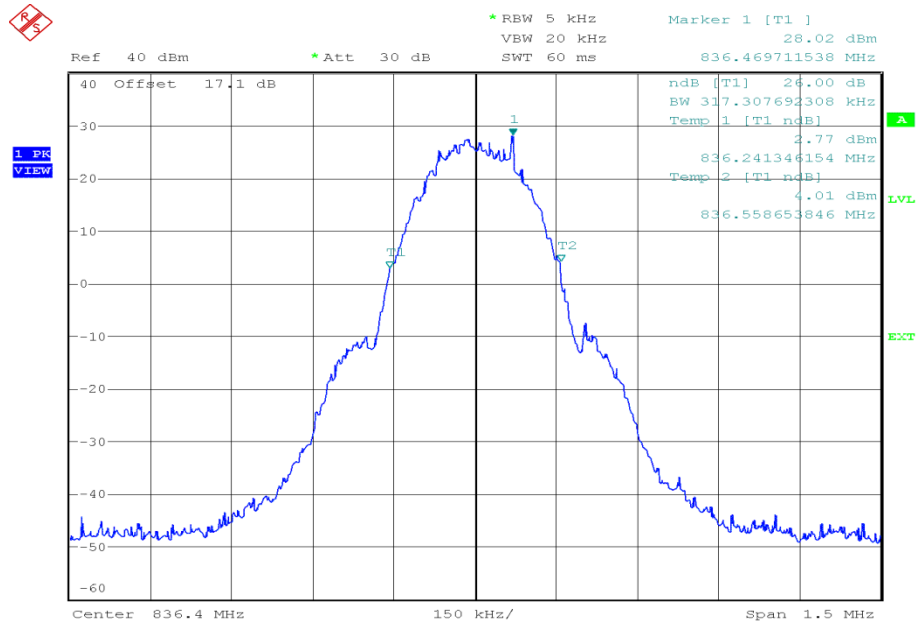
### GSM 850, 824.20 MHz, GMSK, 26 dB Bandwidth Plot





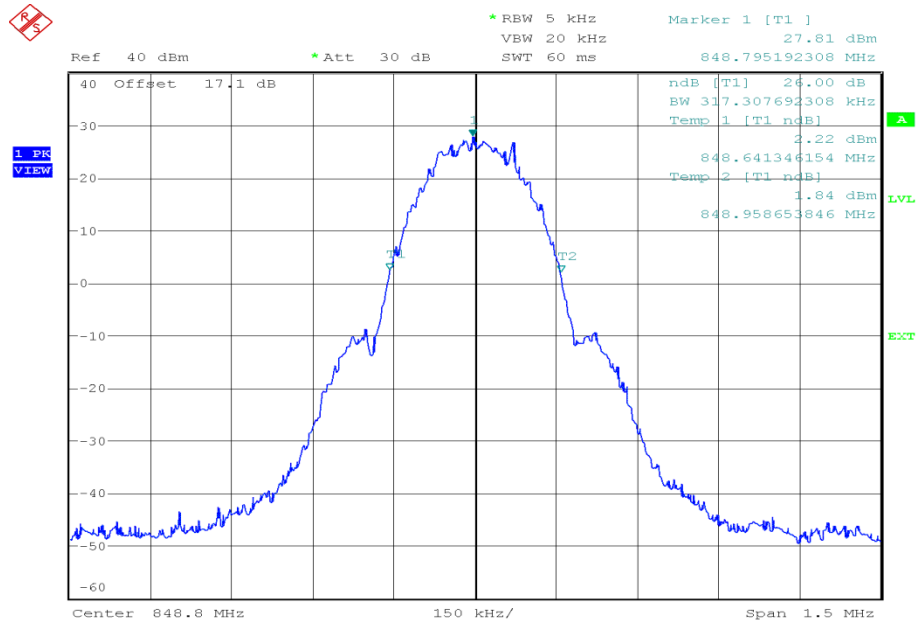
Product Service

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



Date: 29.MAY.2015 10:18:43

### GSM 850, 848.80 MHz, GMSK, 26 dB Bandwidth Plot



Date: 29.MAY.2015 10:22:34

### FCC 47 CFR Part 22, Limit Clause

None specified.





## **2.6 MODULATION CHARACTERISTICS**

### **2.6.1 Specification Reference**

FCC 47 CFR Part 22 and FCC 47 CFR Part 2, Clause 2.1047 (d)

### **2.6.2 Equipment Under Test**

SHF32

### **2.6.3 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

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

The bandwidth product BT = Bandwidth x bit duration = 81.25 kHz x 3.6923 micros = 0.3

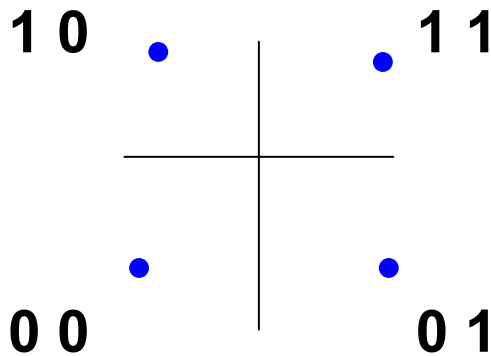
#### **GMSK OVERVIEW**

The modulation scheme used for the EUT is GMSK.

A brief overview of how GMSK works is shown below.

#### **GMSK (Gaussian Minimum Shift Keying)**

The fundamental principal behind GMSK is Phase shift keying. This splits a data stream into a series of 2-digit phase shifts, using the following phase shifts to represent data pairs.



Therefore for the BIT sequence 0 0 1 1 1 0 0 1 The corresponding phase shift will be used

|              |      |     |      |      |
|--------------|------|-----|------|------|
| BIT SEQUENCE | 0 0  | 1 1 | 1 0  | 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)

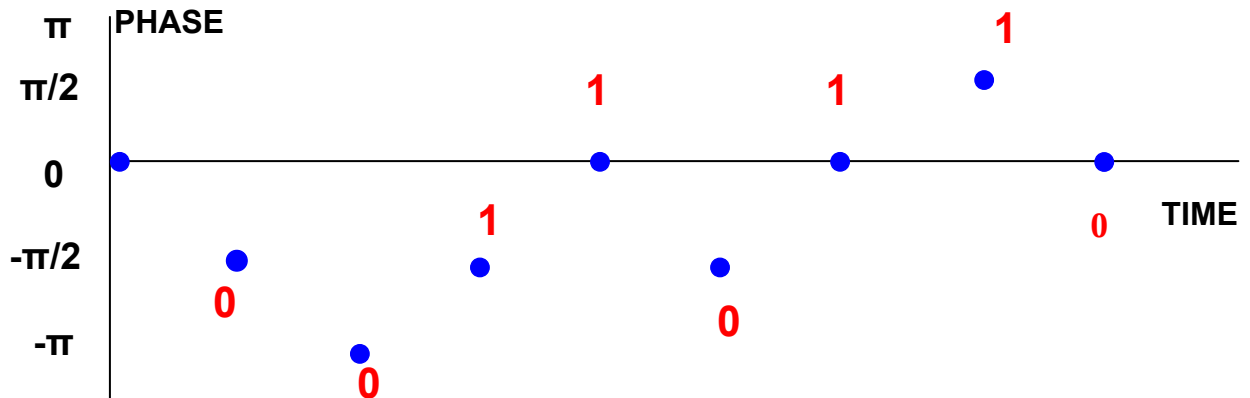
|          |          |          |          |         |          |         |         |          |
|----------|----------|----------|----------|---------|----------|---------|---------|----------|
| I Stream | 0        |          | 1        |         | 0        |         | 1       |          |
|     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



3. Combine (add) the two PSK signals:

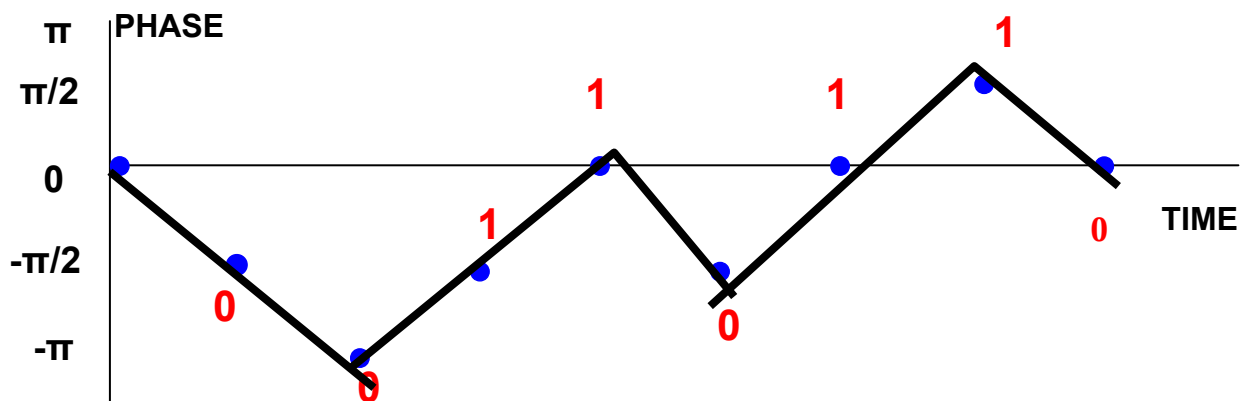
|                |          |        |          |   |          |   |         |   |
|----------------|----------|--------|----------|---|----------|---|---------|---|
| Combined Phase | $-\pi/2$ | $-\pi$ | $-\pi/2$ | 0 | $-\pi/2$ | 0 | $\pi/2$ | 0 |
|----------------|----------|--------|----------|---|----------|---|---------|---|

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



It would be preferable to have "gradual" changes in 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.



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 - Frequency Tolerance</b>             |                      |                            |        |                             |                 |
| Radio Communications Test Set                        | Rohde & Schwarz      | CMU 200                    | 39     | 12                          | 15-Dec-2015     |
| Climatic Chamber                                     | Votsch               | VT4002                     | 161    | -                           | O/P Mon         |
| Power Supply Unit                                    | Hewlett Packard      | 6253A                      | 441    | -                           | O/P Mon         |
| Power Supply Unit                                    | Farnell              | H60-25                     | 1092   | -                           | O/P Mon         |
| Rubidium Standard                                    | Rohde & Schwarz      | XSRM                       | 1316   | 6                           | 28-Jul-2015     |
| Multimeter                                           | Iso-tech             | IDM101                     | 2419   | 12                          | 7-Oct-2015      |
| Digital Thermometer                                  | Digitron             | T208                       | 2831   | 12                          | 31-Jul-2015     |
| Radio Communications Test Set                        | Rohde & Schwarz      | CMU 200                    | 3035   | 12                          | 6-Nov-2015      |
| Attenuator (30dB/50W)                                | Aeroflex / Weinschel | 47-30-34                   | 3164   | 12                          | 12-Dec-2015     |
| Thermocouple Thermometer                             | Fluke                | 51                         | 3173   | 12                          | 4-Dec-2015      |
| Hygrometer                                           | Rotronic             | I-1000                     | 3220   | 12                          | 24-Jul-2015     |
| Attenuator (10dB, 20W)                               | Lucas Weinschel      | 1                          | 3225   | 12                          | 12-Dec-2015     |
| MasterCard Reference Terminal                        | Sagem Monetel        | EFT 30                     | 3745   | -                           | TU              |
| DC - 12.4 GHz 10 dB Attenuator 1 W                   | Suhner               | 6810.17.A                  | 3964   | 12                          | 22-Oct-2015     |
| DC - 12.4 GHz 10 dB Attenuator                       | Suhner               | 6810.17.A                  | 3965   | 12                          | 22-Oct-2015     |
| True RMS Multimeter                                  | Fluke                | 179                        | 4007   | 12                          | 31-Jul-2015     |
| Wideband Radio Communication Tester                  | Rohde & Schwarz      | CMW 500                    | 4144   | 12                          | 7-Nov-2015      |
| Frequency Standard                                   | Spectracom           | Secure Sync 1200-0408-0601 | 4393   | 6                           | 28-Jul-2015     |
| 2 metre SMA Cable                                    | IW Microwave         | 3PS-1806LC-788-3PS         | 4525   | 12                          | 29-Jan-2016     |
| <b>Section 2.2 - Spurious Emissions at Band Edge</b> |                      |                            |        |                             |                 |
| Radio Communications Test Set                        | Rohde & Schwarz      | CMU 200                    | 39     | 12                          | 15-Dec-2015     |
| Power Supply Unit                                    | Hewlett Packard      | 6253A                      | 441    | -                           | O/P Mon         |
| Attenuator (10dB)                                    | Weinschel            | 47-10-34                   | 481    | 12                          | 1-Apr-2016      |
| Power Splitter                                       | Weinschel            | 1506A                      | 606    | 12                          | 24-Mar-2016     |
| Power Supply Unit                                    | Farnell              | H60-25                     | 1092   | -                           | O/P Mon         |
| Rubidium Standard                                    | Rohde & Schwarz      | XSRM                       | 1316   | 6                           | 28-Jul-2015     |
| Spectrum Analyser                                    | Rohde & Schwarz      | FSU26                      | 2747   | 12                          | 20-Jan-2016     |
| Hygrometer                                           | Rotronic             | I-1000                     | 2891   | 12                          | 16-Jul-2015     |
| Attenuator (10dB, 50W)                               | Aeroflex / Weinschel | 47-10-34                   | 3166   | 12                          | 16-Sep-2015     |
| Hygrometer                                           | Rotronic             | I-1000                     | 3220   | 12                          | 24-Jul-2015     |
| Attenuator (10dB, 20W)                               | Lucas Weinschel      | 1                          | 3225   | 12                          | 12-Dec-2015     |
| Signal Analyser                                      | Rohde & Schwarz      | FSQ 26                     | 3545   | 12                          | 6-Aug-2015      |
| Network Analyser                                     | Rohde & Schwarz      | ZVA 40                     | 3548   | 12                          | 3-Sep-2015      |
| Combiner/Splitter                                    | Weinschel            | 1506A                      | 3877   | 12                          | 24-Mar-2016     |
| DC - 12.4 GHz 10 dB Attenuator 1 W                   | Suhner               | 6810.17.A                  | 3964   | 12                          | 22-Oct-2015     |
| True RMS Multimeter                                  | Fluke                | 179                        | 4007   | 12                          | 31-Jul-2015     |
| Wideband Radio Communication Tester                  | Rohde & Schwarz      | CMW 500                    | 4144   | 12                          | 7-Nov-2015      |
| Calibration Unit                                     | Rohde & Schwarz      | ZV-Z54                     | 4368   | 12                          | 24-Sep-2015     |
| Frequency Standard                                   | Spectracom           | Secure Sync 1200-0408-0601 | 4393   | 6                           | 28-Jul-2015     |
| Wideband Radio Test Set                              | Rohde & Schwarz      | CMW500                     | 4546   | 12                          | 23-Jan-2016     |



| Instrument                                                       | Manufacturer             | Type No.                   | TE No. | Calibration Period (months) | Calibration Due |
|------------------------------------------------------------------|--------------------------|----------------------------|--------|-----------------------------|-----------------|
| <b>Section 2.3 – Maximum Conducted Output Power</b>              |                          |                            |        |                             |                 |
| Radio Communications Test Set                                    | Rohde & Schwarz          | CMU 200                    | 39     | 12                          | 15-Dec-2015     |
| Power Supply Unit                                                | Hewlett Packard          | 6253A                      | 441    | -                           | O/P Mon         |
| 20dB/2W Attenuator                                               | Narda                    | 4772-20                    | 462    | -                           | TU              |
| Attenuator (10dB)                                                | Weinschel                | 47-10-34                   | 481    | 12                          | 1-Apr-2016      |
| Power Supply Unit                                                | Farnell                  | H60-25                     | 1092   | -                           | O/P Mon         |
| Rubidium Standard                                                | Rohde & Schwarz          | XSRM                       | 1316   | 6                           | 28-Jul-2015     |
| Multimeter                                                       | Iso-tech                 | IDM101                     | 2419   | 12                          | 7-Oct-2015      |
| Spectrum Analyser                                                | Rohde & Schwarz          | FSU26                      | 2747   | 12                          | 20-Jan-2016     |
| Hygrometer                                                       | Rotronic                 | I-1000                     | 2891   | 12                          | 16-Jul-2015     |
| Attenuator (10dB, 50W)                                           | Aeroflex / Weinschel     | 47-10-34                   | 3166   | 12                          | 16-Sep-2015     |
| Hygrometer                                                       | Rotronic                 | I-1000                     | 3220   | 12                          | 24-Jul-2015     |
| Attenuator (10dB, 20W)                                           | Lucas Weinschel          | 1                          | 3225   | 12                          | 12-Dec-2015     |
| Signal Analyser                                                  | Rohde & Schwarz          | FSQ 26                     | 3545   | 12                          | 6-Aug-2015      |
| Network Analyser                                                 | Rohde & Schwarz          | ZVA 40                     | 3548   | 12                          | 3-Sep-2015      |
| Combiner/Splitter                                                | Weinschel                | 1506A                      | 3877   | 12                          | 24-Mar-2016     |
| DC - 12.4 GHz 10 dB Attenuator 1 W                               | Suhner                   | 6810.17.A                  | 3964   | 12                          | 22-Oct-2015     |
| P-Series Power Meter                                             | Agilent Technologies     | N1911A                     | 3980   | 12                          | 22-Sep-2015     |
| P-Series Power Meter                                             | Agilent Technologies     | N1911A                     | 3981   | 12                          | 22-Sep-2015     |
| 50 MHz-18 GHz Wideband Power Sensor                              | Agilent Technologies     | N1921A                     | 3982   | 12                          | 22-Sep-2015     |
| 50 MHz-18 GHz Wideband Power Sensor                              | Agilent Technologies     | N1921A                     | 3983   | 12                          | 22-Sep-2015     |
| True RMS Multimeter                                              | Fluke                    | 179                        | 4007   | 12                          | 31-Jul-2015     |
| Wideband Radio Communication Tester                              | Rohde & Schwarz          | CMW 500                    | 4144   | 12                          | 7-Nov-2015      |
| Calibration Unit                                                 | Rohde & Schwarz          | ZV-Z54                     | 4368   | 12                          | 24-Sep-2015     |
| Frequency Standard                                               | Spectracom               | Secure Sync 1200-0408-0601 | 4393   | 6                           | 28-Jul-2015     |
| 2 metre N-Type Cable                                             | IW Microwave             | NPS-1806LC-788-NPS         | 4503   | 12                          | 20-May-2016     |
| Wideband Radio Test Set                                          | Rohde & Schwarz          | CMW500                     | 4546   | 12                          | 23-Jan-2016     |
| <b>Section 2.4 - Emission Limitations for Cellular Equipment</b> |                          |                            |        |                             |                 |
| Antenna (Double Ridge Guide, 1GHz-18GHz)                         | EMCO                     | 3115                       | 234    | 12                          | 29-Apr-2016     |
| Dual Power Supply Unit                                           | Thurlby                  | PL320                      | 288    | -                           | TU              |
| Pre-Amplifier                                                    | Phase One                | PS04-0086                  | 1533   | 12                          | 23-Dec-2015     |
| Screened Room (5)                                                | Rainford                 | Rainford                   | 1545   | 24                          | 26-Jun-2015     |
| Turntable Controller                                             | Inn-Co GmbH              | CO 1000                    | 1606   | -                           | TU              |
| Filter (Hi Pass)                                                 | Lorch                    | 9HP7-7000-SR               | 2833   | 12                          | 5-Feb-2016      |
| Antenna (Bilog)                                                  | Chase                    | CBL6143                    | 2904   | 24                          | 10-Jun-2015     |
| Radio Communications Test Set                                    | Rohde & Schwarz          | CMU 200                    | 3035   | 12                          | 6-Nov-2015      |
| EMI Test Receiver                                                | Rohde & Schwarz          | ESU40                      | 3506   | 12                          | 27-Oct-2015     |
| 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              |
| Hygropalm Temperature and Humidity Meter                         | Rotronic                 | HP21                       | 4410   | 12                          | 15-Apr-2016     |
| Suspended Substrate Highpass Filter                              | Advance Power Components | 11SH10-3000/X18000-O/O     | 4411   | 12                          | 24-Mar-2016     |
| 2m K-Type Cable (Rx)                                             | Scott Cables             | KPS-1501-2000-KPS          | 4527   | 6                           | 29-Jul-2015     |
| 0.5m SMA Cable (Rx)                                              | Scott Cables             | SLSLL18-SMSM-00.50M        | 4528   | 6                           | 29-Jul-2015     |
| Wideband Radio Test Set                                          | Rohde & Schwarz          | CMW500                     | 4546   | 12                          | 23-Jan-2016     |



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| Instrument                           | Manufacturer         | Type No.                   | TE No. | Calibration Period (months) | Calibration Due |
|--------------------------------------|----------------------|----------------------------|--------|-----------------------------|-----------------|
| <b>Section 2.5 - 26 dB Bandwidth</b> |                      |                            |        |                             |                 |
| Radio Communications Test Set        | Rohde & Schwarz      | CMU 200                    | 39     | 12                          | 15-Dec-2015     |
| Power Supply Unit                    | Hewlett Packard      | 6253A                      | 441    | -                           | O/P Mon         |
| Attenuator (10dB)                    | Weinschel            | 47-10-34                   | 481    | 12                          | 1-Apr-2016      |
| Power Splitter                       | Weinschel            | 1506A                      | 606    | 12                          | 24-Mar-2016     |
| Power Supply Unit                    | Farnell              | H60-25                     | 1092   | -                           | O/P Mon         |
| Rubidium Standard                    | Rohde & Schwarz      | XSRM                       | 1316   | 6                           | 28-Jul-2015     |
| Spectrum Analyser                    | Rohde & Schwarz      | FSU26                      | 2747   | 12                          | 20-Jan-2016     |
| Hygrometer                           | Rotronic             | I-1000                     | 2891   | 12                          | 16-Jul-2015     |
| Attenuator (10dB, 50W)               | Aeroflex / Weinschel | 47-10-34                   | 3166   | 12                          | 16-Sep-2015     |
| Hygrometer                           | Rotronic             | I-1000                     | 3220   | 12                          | 24-Jul-2015     |
| Attenuator (10dB, 20W)               | Lucas Weinschel      | 1                          | 3225   | 12                          | 12-Dec-2015     |
| Signal Analyser                      | Rohde & Schwarz      | FSQ 26                     | 3545   | 12                          | 6-Aug-2015      |
| Combiner/Splitter                    | Weinschel            | 1506A                      | 3877   | 12                          | 24-Mar-2016     |
| DC - 12.4 GHz 10 dB Attenuator 1 W   | Suhner               | 6810.17.A                  | 3964   | 12                          | 22-Oct-2015     |
| True RMS Multimeter                  | Fluke                | 179                        | 4007   | 12                          | 31-Jul-2015     |
| Wideband Radio Communication Tester  | Rohde & Schwarz      | CMW 500                    | 4144   | 12                          | 7-Nov-2015      |
| Frequency Standard                   | Spectracom           | Secure Sync 1200-0408-0601 | 4393   | 6                           | 28-Jul-2015     |
| Wideband Radio Test Set              | Rohde & Schwarz      | CMW500                     | 4546   | 12                          | 23-Jan-2016     |

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 Tolerance                         | $\pm 46.75$ Hz                                                 |
| Maximum Conducted Output Power              | $\pm 0.70$ dB                                                  |
| Emission Limitations for Cellular Equipment | 30 MHz to 1 GHz: $\pm 5.1$ dB<br>1 GHz to 40 GHz: $\pm 6.3$ dB |
| Spurious Emissions at Band Edge             | $\pm 0.70$ dB                                                  |
| 26 dB Bandwidth                             | $\pm 13.64$ kHz                                                |





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.

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