



# EMC Test Report

**Project Number: 3071804****Report Number: 3071804EMC01****Revision Level: 0****Client: Airo Wireless, Inc.****Equipment Under Test: Intrinsically Safe Cellular Phone****Model: I-SAFE™28****FCC Rule Parts: Part 2, Part 22(H), Part 24(E)****Industry Canada: RSS-132, Issue 3: 2013, RSS-133 Issue 6: 2013,****Report issued on: 17 Dec 2013****Test Result: Compliant**

Tested by:

  
\_\_\_\_\_  
Jeremy O. Pickens, Senior EMC Engineer

Reviewed by:

  
\_\_\_\_\_  
David Schramm, EMC Manager**Remarks:**

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or Testing done by SGS International Electrical Approvals in connection with distribution or use of the product described in this report must be approved by SGS international Electrical Approvals in writing.

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## 1 Summary of Test Results

Reference Sections	Test Description	Test Limit	Test Condition	Test Result
<b>Transmit Mode Testing</b>				
2.1046	Conducted Output Power	N/A	Conducted	Reported
24.232(d) RSS-132 5.4 RSS-133 6.4	Peak-to-Average Ratio	<13 dB		Pass
2.1049 22.917(a) 24.238(a)	Occupied Bandwidth	N/A		Reported
2.1051 22.917(a) 24.238(a)	Band Edge / Conducted Spurious Emissions	$< 43 + 10\log_{10}(P_{\text{Watts}})$ at band edge and for all out of band emissions		Pass
22.913(a)(2)	Effective Radiated Power	< 7 Watts max ERP	Radiated	Pass
RSS-132 5.4	Effective Radiated Power	< 11.5 Watts max ERP		Pass
24.232(c) RSS-133 6.4	Effective Isotropic Radiated Power	< 2 Watts max EIRP		Pass
2.1053 22.917(a) 24.238(a) RSS-132 5.5 RSS-133 6.5	Radiated Spurious Emissions	$< 43 + 10\log_{10}(P_{\text{Watts}})$ at band edge and for all out of band emissions		Pass
2.1055 22.917(a) 24.238(a) RSS-132 5.3 RSS-132 6.3	Frequency Stability	<2.5 ppm		Pass

### 1.1 Modifications Required to Compliance

None

## 2 General Information

### 2.1 Client Information

Name: Airo Wireless, Inc..  
Address: 6001 36th Avenue W  
City, State, Zip, Country: Everett, WA 988203, USA

### 2.2 Test Laboratory

Name: SGS North America, Inc.  
Address: 620 Old Peachtree Road NW, Suite 100  
City, State, Zip, Country: Suwanee, GA 30024, USA

### 2.3 General Information of EUT

Type of Product: Intrinsically Safe Cellular Phone  
Model Number: I-SAFE™ 28  
FCC ID: QDL-ISAFE28  
IMEI Number: 013451000002022  
RIL Version: 2.2.9.0  
Rated Voltage: 3.7 Vdc, battery  
Test Voltage: Fully charged 3.7 Vdc, battery  
Tx Frequency Range: 824.2 – 846.6 MHz (GSM)  
826.4 – 846.6 MHz (WCDMA Band V)  
1850.2 – 1909.8 MHz (GSM)  
1852.4 – 1907.6 MHz (WCDMA Band II)  
Maximum RF Output Power: 1.941 W (32.9 dBm) ERP (GSM850)  
0.076 W (18.8 dBm) ERP (Band V, WCDMA)  
0.397 W (26.0 dBm) EIRP (GSM1900)  
0.158 W (22.0 dBm) EIRP (Band II, WCDMA)

Sample Received Date: 06 June 2013  
Dates of testing: 22 July - 06 September 2013

### 2.4 Operating Modes and Conditions

The EUT was exercised by connecting a CMW communications tester to the device. The CMW was used to control signaling and modes during testing.

### 3 US Cellular Band

#### 3.1 RF Output Power

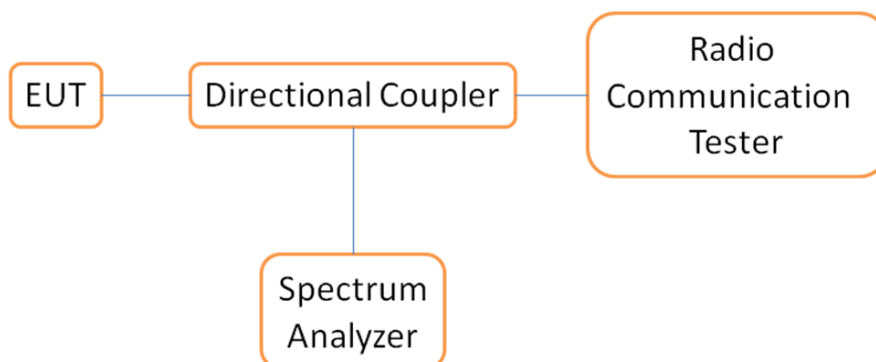
##### 3.1.1 Test Result

Test Description	Basic Standards	Test Result
RF Output Power	FCC Part 2.1046	Reported

##### 3.1.2 Test Method

A radio link was established between EUT and Radio Communication Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester. The output power was measured by a spectrum analyzer with the use of a directional coupler.

For testing WCDMA and GSM signaling modes, the center channel was used.



### 3.1.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### Environmental Conditions

Temperature: 21.7 °C

Relative Humidity: 46.9 %

Atmospheric Pressure: 101.9 kPa

### 3.1.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jun-2014
UNIVERSAL RADIO COMMUNICATIONS TESTER	CMU 200	ROHDE & SCHWARZ	S/N: 100432	25-Sep-2013
POWER SPLITTER	ZFRSC-183-S+	MINI-CIRCUITS	EA01	CNR
SIGNAL GENERATOR	HMC-2240	HITTITE	B079813	CNR

Note: The calibration period equipment is 1 year.

### 3.1.5 Test Data

Mode	Band	Measured Power, dBm
UMTS	Band V	23.2
GSM (frame average)	GSM850	22.3
GSM (burst average)	GSM850	31.3
GSM-GPRS	GSM850	28.6
GSM-Edge	GSM850	28.4

## 3.2 Occupied Bandwidth

### 3.2.1 Test Result

Test Description	Basic Standards	Test Result
Occupied Bandwidth	FCC Part 2.1049	Reported

### 3.2.2 Test Method

The occupied bandwidth is the frequency bandwidth such that below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power by a given emission. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sample detector shall be used since a peak detector may produce a wider than actual bandwidth.

A radio link was established between EUT and Radio Communications Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester. The occupied bandwidth is measured using spectrum analyzer's occupied bandwidth measurement. RBW is set to 3 kHz on spectrum analyzer.

The bandwidth of 99% power can be read on spectrum analyzer.

### 3.2.3 Test Site

SGS EMC Laboratory, Suwanee, GA

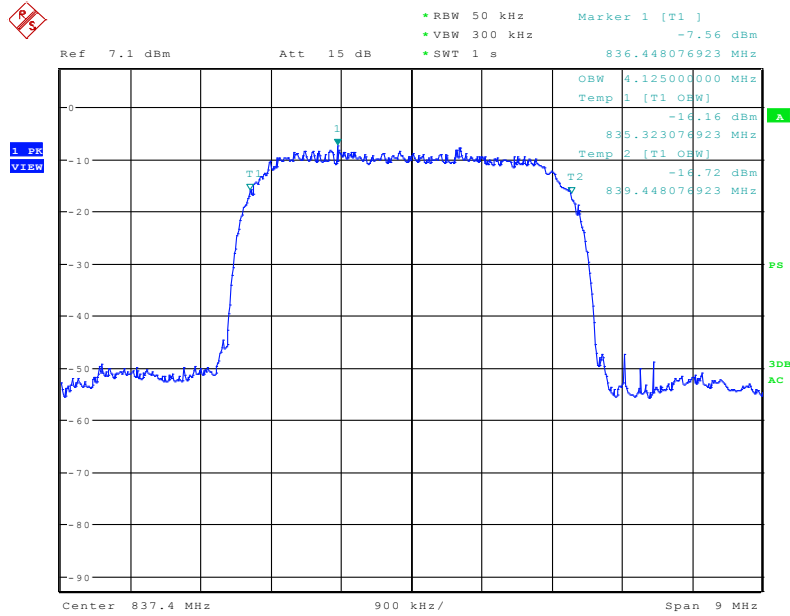
### 3.2.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jun-2014
UNIVERSAL RADIO COMMUNICATIONS TESTER	CMU 200	ROHDE & SCHWARZ	S/N: 100432	25-Sep-2013
POWER SPLITTER	ZFRSC-183-S+	MINI-CIRCUITS	EA01	CNR
SIGNAL GENERATOR	HMC-2240	HITTITE	B079813	CNR

Note: The calibration period equipment is 1 year.

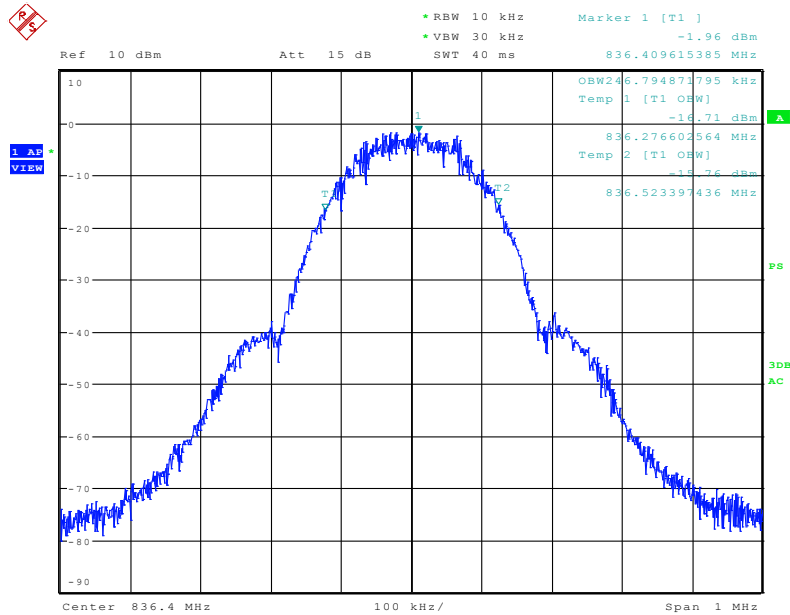
### 3.2.5 Test Data

#### WCDMA – Band V



Date: 23.JUL.2013 20:28:13

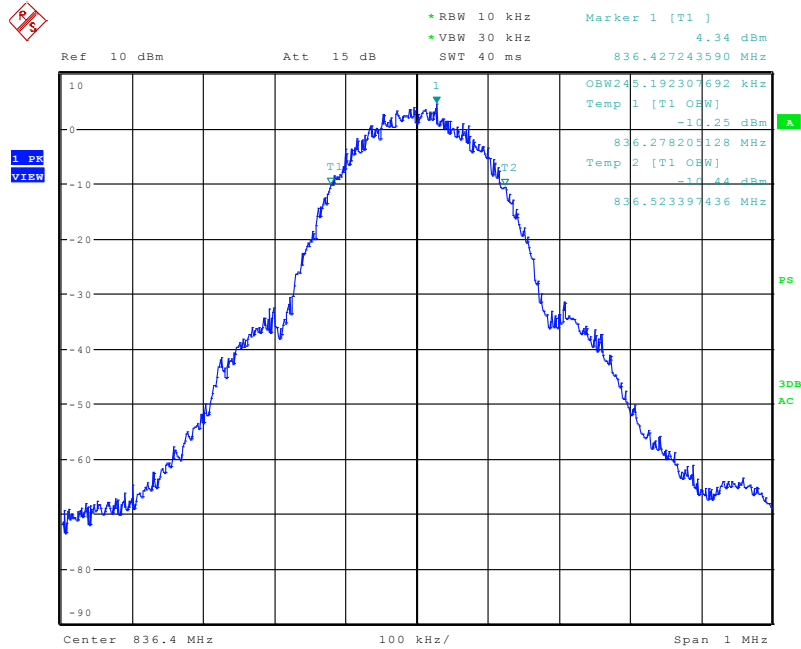
#### GSM850 – Voice



Date: 23.JUL.2013 16:35:03

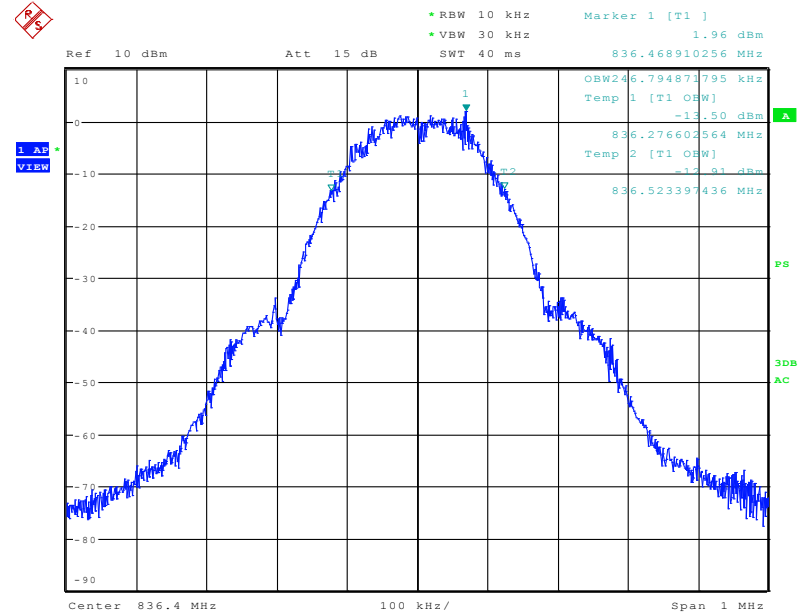


## GSM850 – GPRS



Date: 23.JUL.2013 21:35:53

## GSM850 – EGPRS



Date: 23.JUL.2013 19:16:40

### 3.3 Band Edge and Conducted Spurious Emissions

#### 3.3.1 Test Result

Test Description	Basic Standards	Test Result
Conducted spurious emissions and Band Edge	2.1051 22.917(a)	Pass

#### 3.3.2 Test Method

The levels of the carrier and the various conducted spurious and harmonics frequencies are measured by means of a calibrated spectrum analyzer. The emissions spectrum emanating from the EUT transmit antenna port is scanned from the lowest frequency generated in the equipment up to a frequency including its 10<sup>th</sup> harmonic. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB. Compliance is based on the use of a spectrum analyzer employing a resolution bandwidth of 1 MHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of a least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emissions bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

#### 3.3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### 3.3.4 Test Equipment

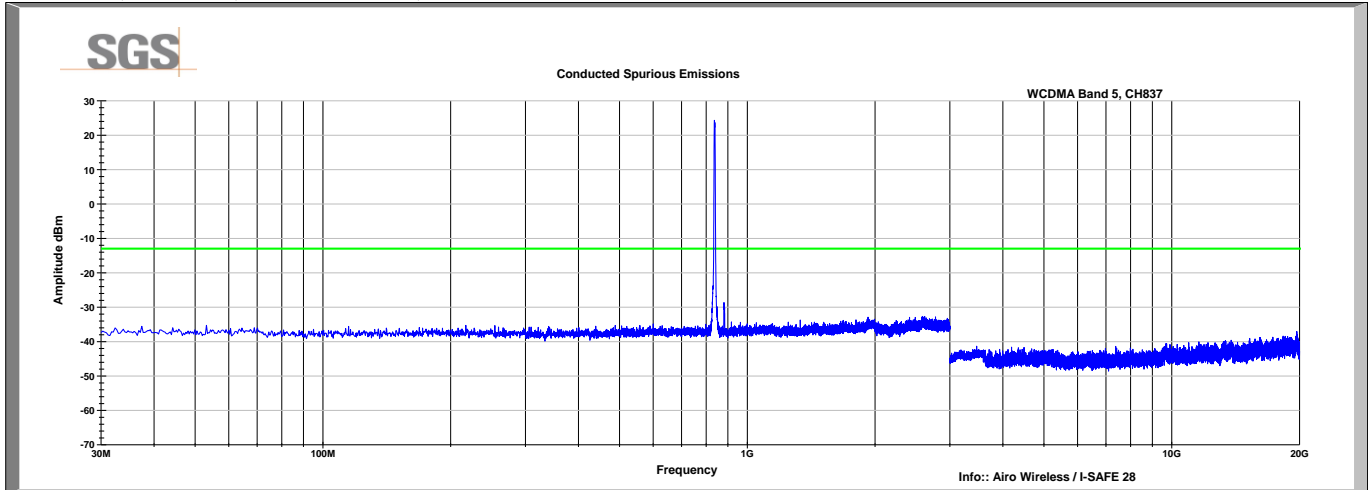
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jun-2014
UNIVERSAL RADIO COMMUNICATIONS TESTER	CMU 200	ROHDE & SCHWARZ	S/N: 100432	25-Sep-2013
POWER SPLITTER	ZFRSC-183-S+	MINI-CIRCUITS	EA01	CNR
SIGNAL GENERATOR	HMC-2240	HITTITE	B079813	CNR
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	24-Sep-2013

Note: The calibration period equipment is 1 year.

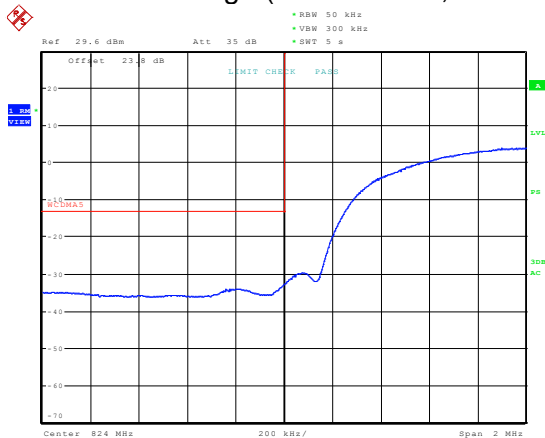
### 3.3.5 Test Data

Test Date: 23 July 2013 and 29 July 2013

WCDMA, Band V, Channel 837, 837.5 MHz

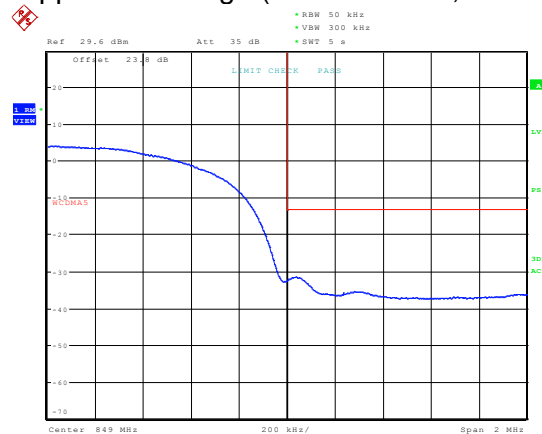


#### Lower Band Edge (Channel 782, 826.5 MHz)



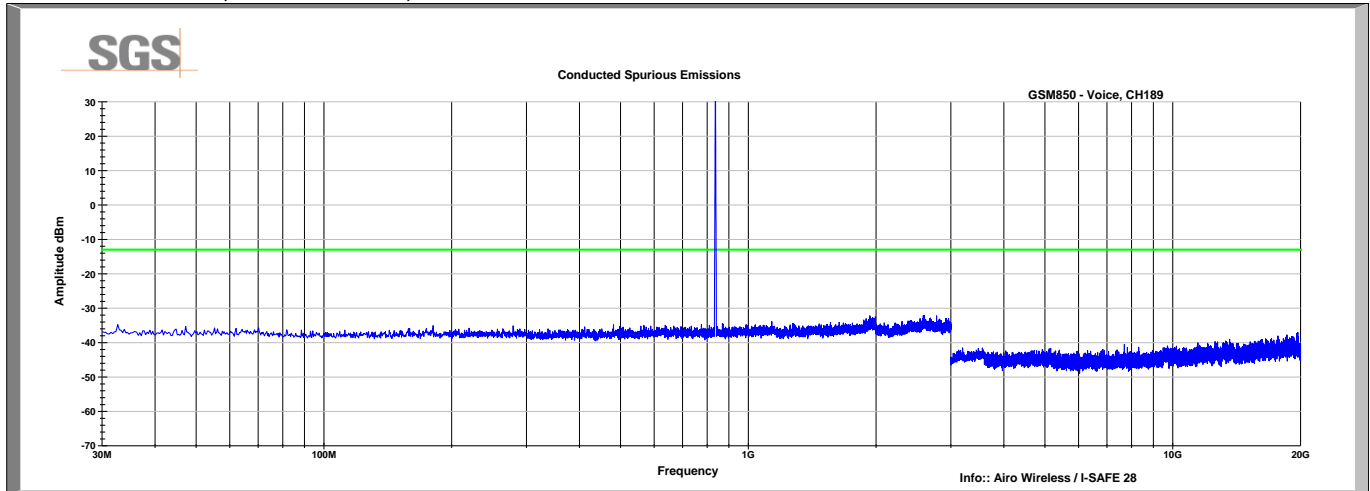
Date: 23.JUL.2013 22:51:22

#### Upper Band Edge (Channel 4233, 846.6 MHz)

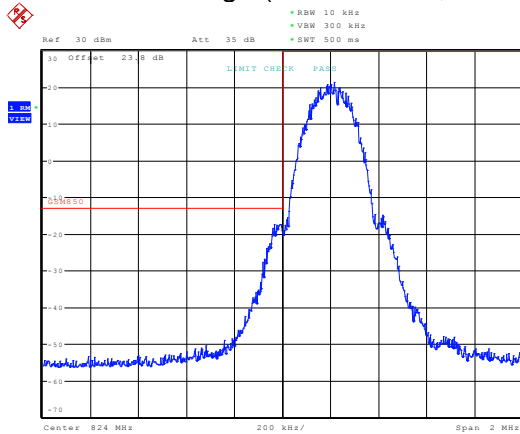


Date: 23.JUL.2013 22:50:42

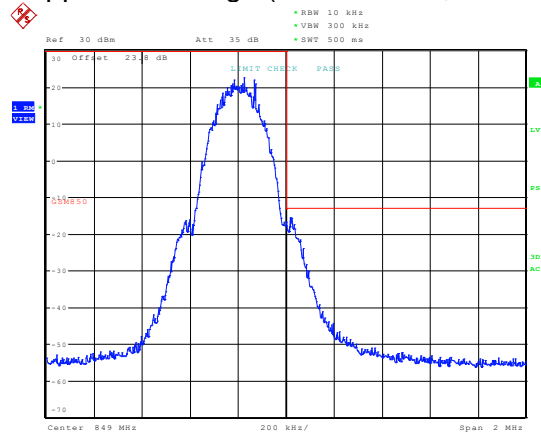
Test Date: 23 July 2013 and 29 July 2013  
GSM850 - Voice, Channel 189, 836.4 MHz



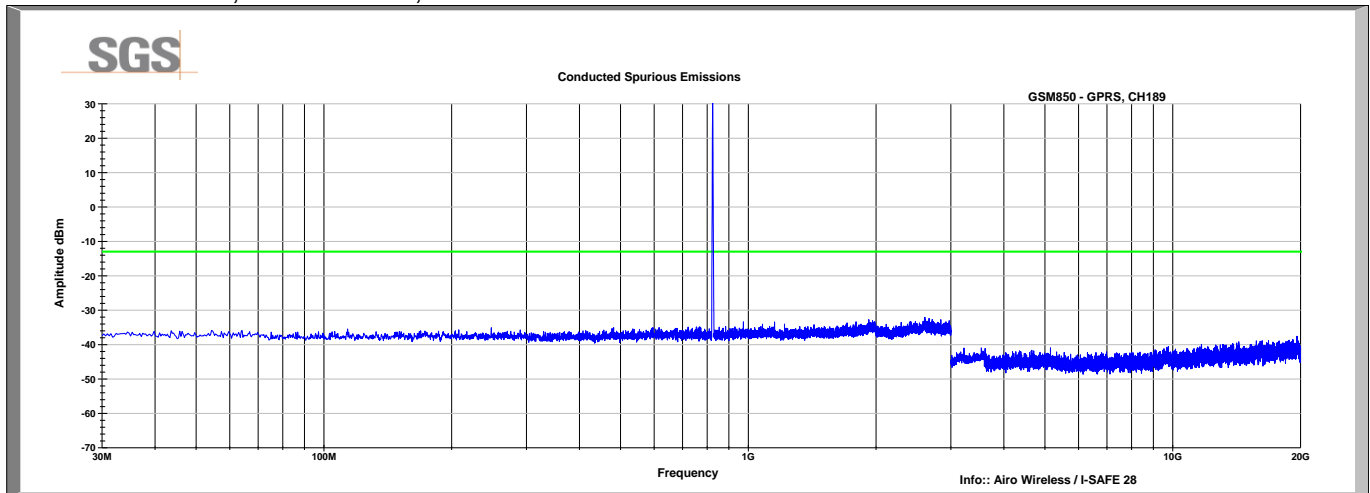
Lower Band Edge (Channel 128, 824.2 MHz)



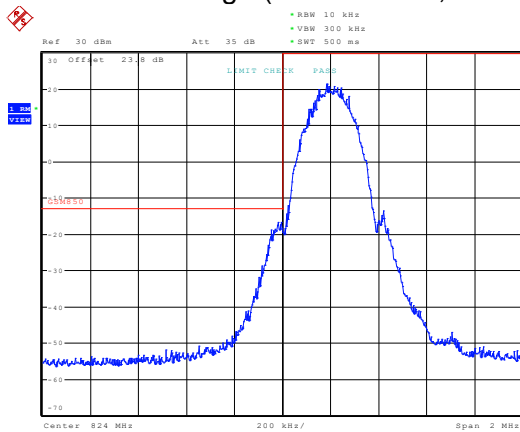
Upper Band Edge (Channel 251, 848.8 MHz)



Test Date: 23 July 2013 and 29 July 2013  
GSM850 - GPRS, Channel 189, 836.4 MHz

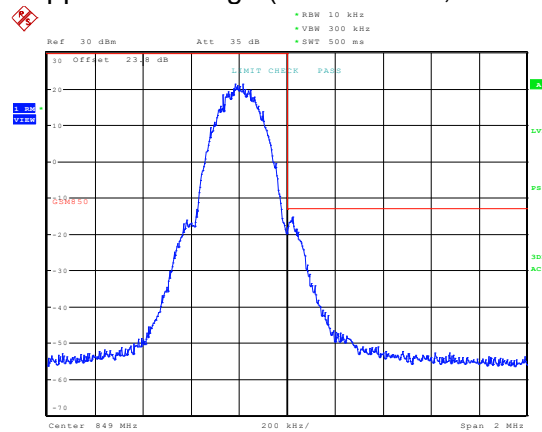


Lower Band Edge (Channel 128, 824.2 MHz)



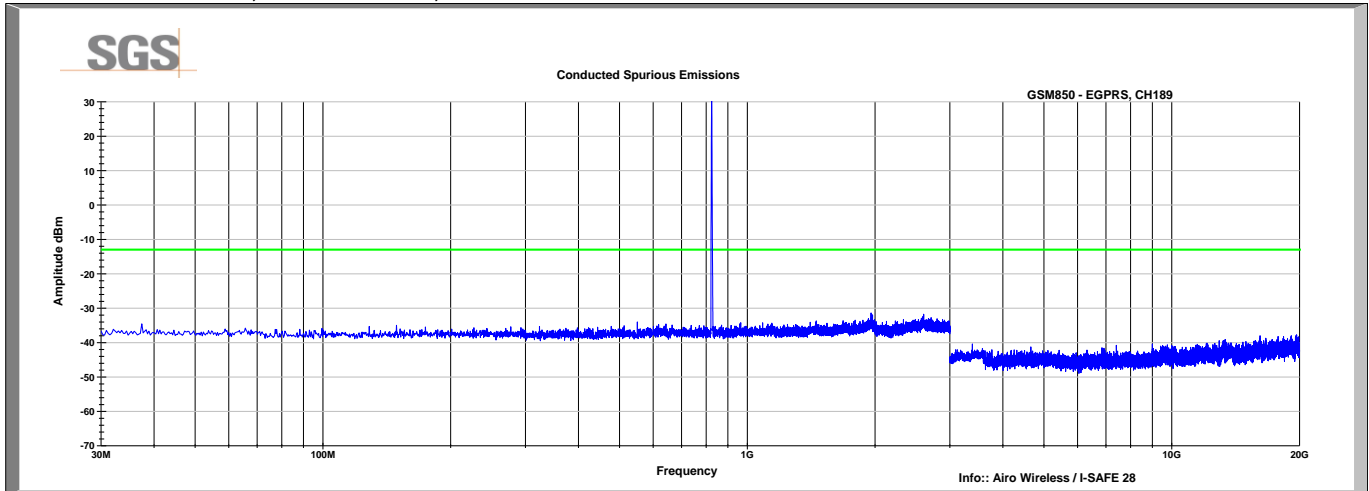
Date: 23.JUL.2013 21:52:34

Upper Band Edge (Channel 251, 848.8 MHz)

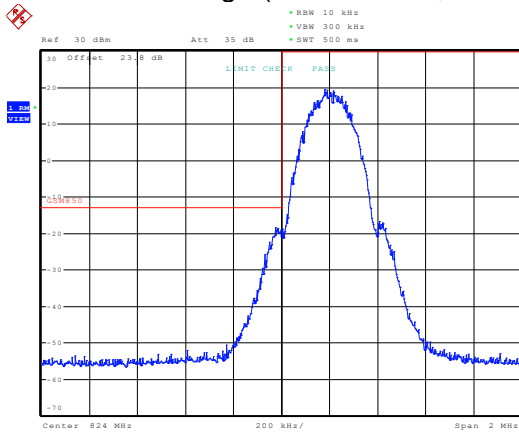


Date: 23.JUL.2013 21:53:53

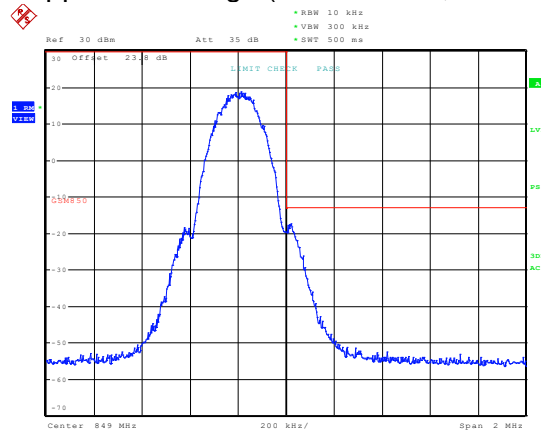
Test Date: 23 July 2013 and 29 July 2013  
GSM850 - EGPRS, Channel 189, 836.4 MHz



Lower Band Edge (Channel 128, 824.2 MHz)



Upper Band Edge (Channel 251, 848.8 MHz)



### 3.4 Effective Radiated Power

#### 3.4.1 Test Result

Test Description	Basic Standards	Test Result
Effective Radiated Power	FCC Part 22.913	Pass

#### 3.4.2 Test Method

The measurements above 1 GHz are carried out in a fully anechoic chamber. Below 1 GHz, the measurements are carried out in semi-anechoic chamber. The EUT was placed on a 0.8 meter high non-conductive table at a 3 meters test distance from the test receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT. The height of receiving antenna is varied from 1 to 4 m to find the maximum power value. A radio link was established between EUT and Radio Communications Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester. A RMS detector is used and RBW is set to 3MHz. Then the antenna height and turn table rotation is adjusted till the maximum power value is founded on spectrum analyzer.

The EUT was positioned through each of its three orthogonal axes and the highest level was reported.

A dipole antenna (below 1 GHz) or double-ridged waveguide antenna (above 1 GHz) was substituted in place of the EUT. The substitution antenna was driven by a signal generator. The receive antenna was varied to find the maximum response to the spectrum analyzer. Then the level of signal generator was adjusted to achieve the same power value on the spectrum analyzer or receiver as the maximum value measured from the EUT.

The ERP/EIRP of the EUT was calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.

#### 3.4.3 Test Site

10m Semi-anechoic chamber, SGS EMC Laboratory, Suwanee, GA

### 3.4.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079690	12-Sep-2013
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	10-Jun-2014
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079699	25-Mar-2014
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	24-Sep-2013
RF CABLE - 7000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079712	20-Sep-2013
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079711	20-Sep-2013
RF CABLE	SF106	HUBER&SUHNER	B085888	22-Oct-2013
CMW500 WIDEBAND RADIO COMMUNICATIONS TESTER	CMW500	ROHDE & SCHWARZ	B085757	29-Oct-2013
DIPOLE BALUN 4	3121D-DB4	ETS-LINDGREN	B085753	16-Mar-2015
SIGNAL GENERATOR	HMC-T2240	HITTITE	B001212	CNR

Note: The calibration period equipment is 1 year.

### 3.4.5 Test Data

Freq (MHz)	Pol	Mode	SigGen Out (dBm)	Cable Loss (dB)	Net to Sub Ant (dBm)	Reading (dBuV)	Antenna Gain (dBi)	EUT Level (dBuV)	ERP (dBm)	ERP (Watts)
836.5	H	GSM	1.2	1.2	0	76.12	0	108.9	32.8	1.897
836.5	H	GSM EDGE	1.2	1.2	0	76.12	0	108.9	32.8	1.897
836.5	H	GSM GPRS	1.2	1.2	0	76.12	0	109	32.9	1.941
836.5	H	WCDMA	1.2	1.2	0	76.12	0	94.9	18.8	0.076
836.5	H	WCDMA - HSUPA	1.2	1.2	0	76.12	0	93.4	17.3	0.053



### 3.5 Radiated Spurious Emissions

#### 3.5.1 Test Result

Test Description	Basic Standards	Test Result
Radiated Spurious Emissions	FCC Part 2.1053 FCC Part 22.917(a)	Pass

#### 3.5.2 Test Method

The levels of the carrier and the various conducted spurious and harmonics frequencies are measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10<sup>th</sup> harmonic. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB. Compliance is based on the use of a spectrum analyzer employing a resolution bandwidth of 1 MHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of a least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emissions bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

The EUT was manipulated through each of its three orthogonal axes with the measurement oriented in both vertical and horizontal polarizations.

A radio link was established between EUT and Radio Communications Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester.

The measurement was conducted at the middle channels, 384 in RC3/SO55.

### 3.5.3 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
RF CABLE - 7000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079716	20-Sep-2013
BIPOLE ANTENNA	CBL 6143A	TESEQ	B085931	15-Oct-2013
COAXIAL CABLE	1134	GORE	B094785	16-May-2014
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079824	12-Dec-2013
DESKTOP AMPLIFIER 1- 18 GHZ	NSP1800-25-HG	MITEQ	B085930	30-Oct-2013
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079699	25-Mar-2014
FILTER	BRC50720	MICRO-TRONICS	S/N: 002	NCR
FILTER	BRC50719	MICRO-TRONICS	S/N: 003	NCR
FILTER	BRC50718	MICRO-TRONICS	S/N: 001	NCR
FILTER	HPM50110	MICRO-TRONICS	S/N: 073	NCR
FILTER	HPM50108	MICRO-TRONICS	S/N: 054	NCR
FILTER	HPM50111	MICRO-TRONICS	S/N: 074	NCR
RF CABLE	SF106	HUBER&SUHNER	B085892	23-Oct-2013
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079711	20-Sep-2013
WIDEBAND RADIO COMMUNICATION TESTER	CMW 500	ROHDE & SCHWARZ	S/N: 111428	29-Oct-2013

Note: The calibration period equipment is 1 year.

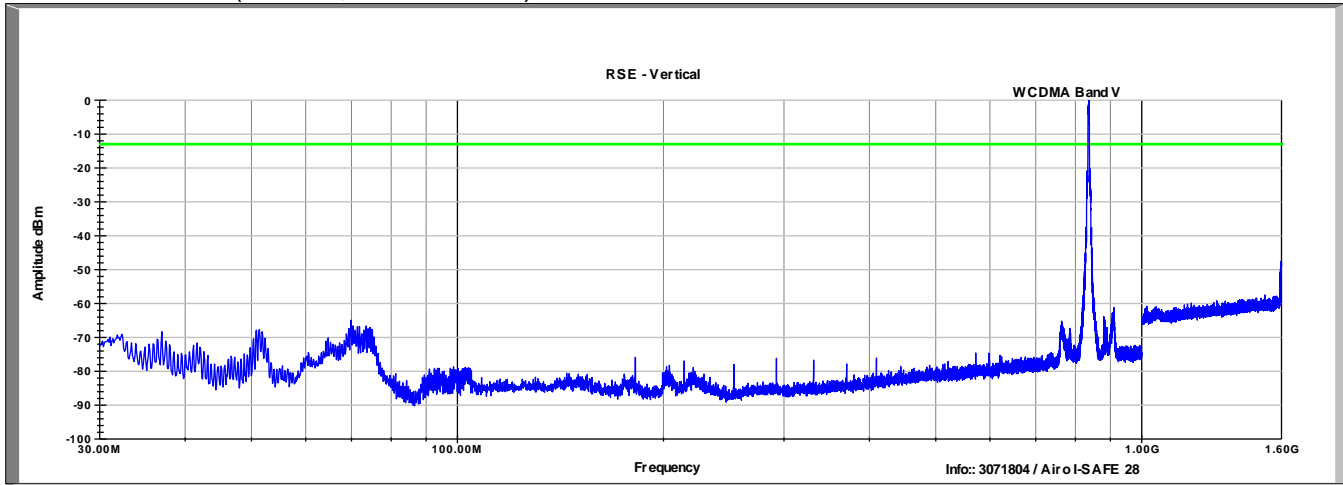
### 3.5.4 Test Data

Test Date: 31 Jul 2013

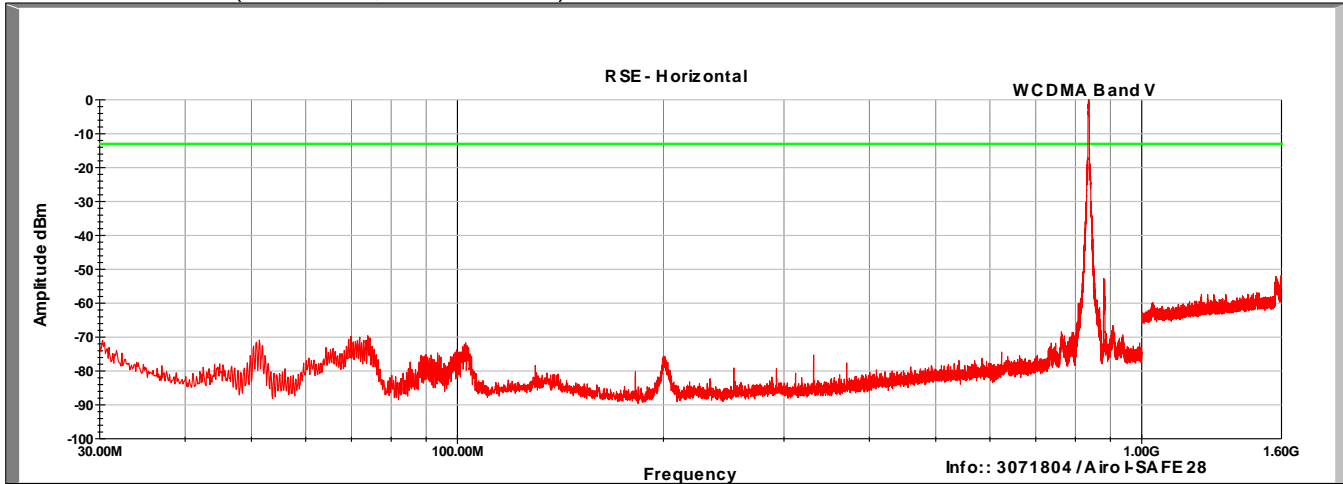
There were no spurious emissions within 20 dB of the limit.

### 3.5.5 Plots

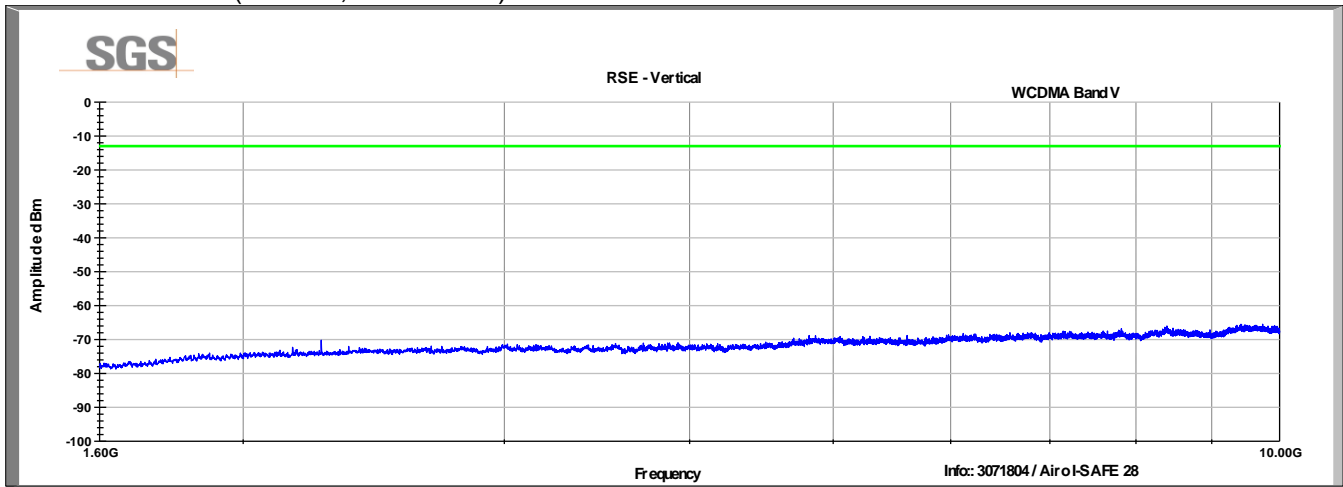
WCDMA Band V (Vertical, 30-1600MHz)



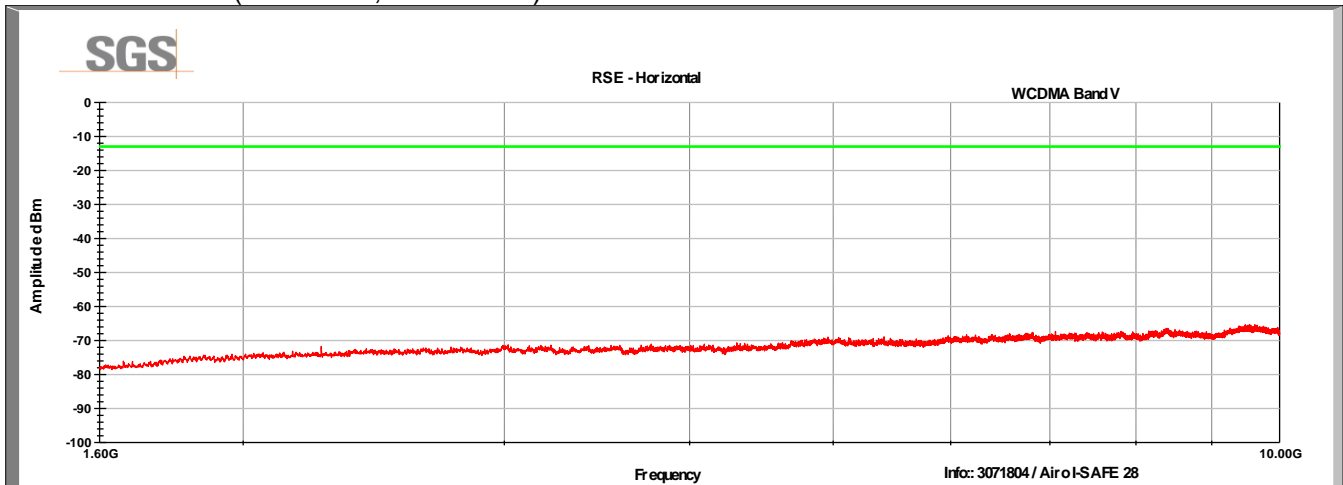
WCDMA Band V (Horizontal, 30-1600MHz)



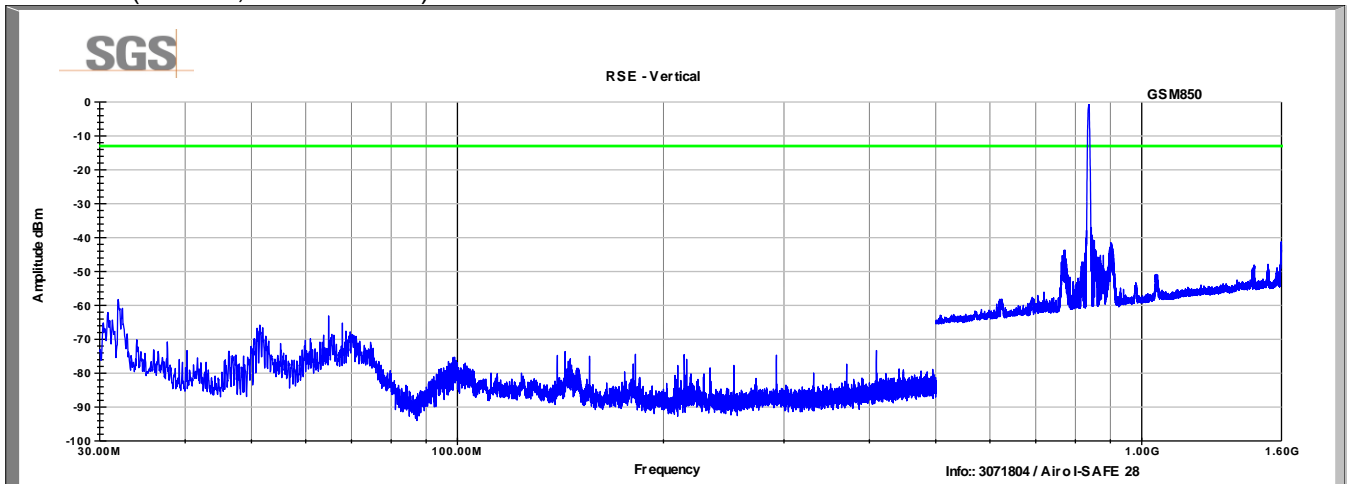
### WCDMA Band V (Vertical, 1.6-10GHz)



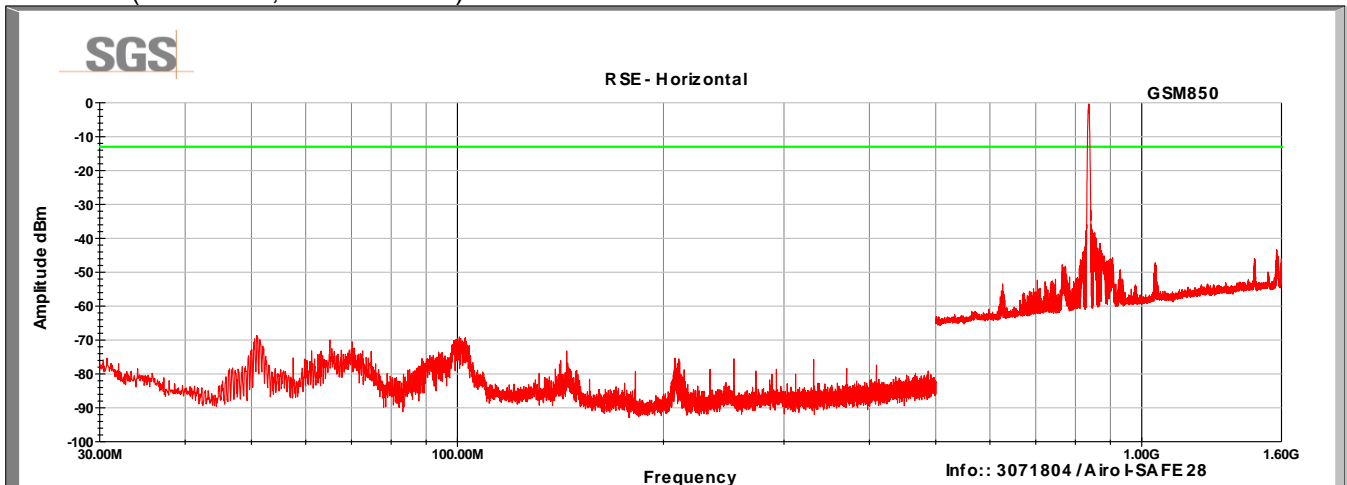
### WCDMA Band V (Horizontal, 1.6-10GHz)



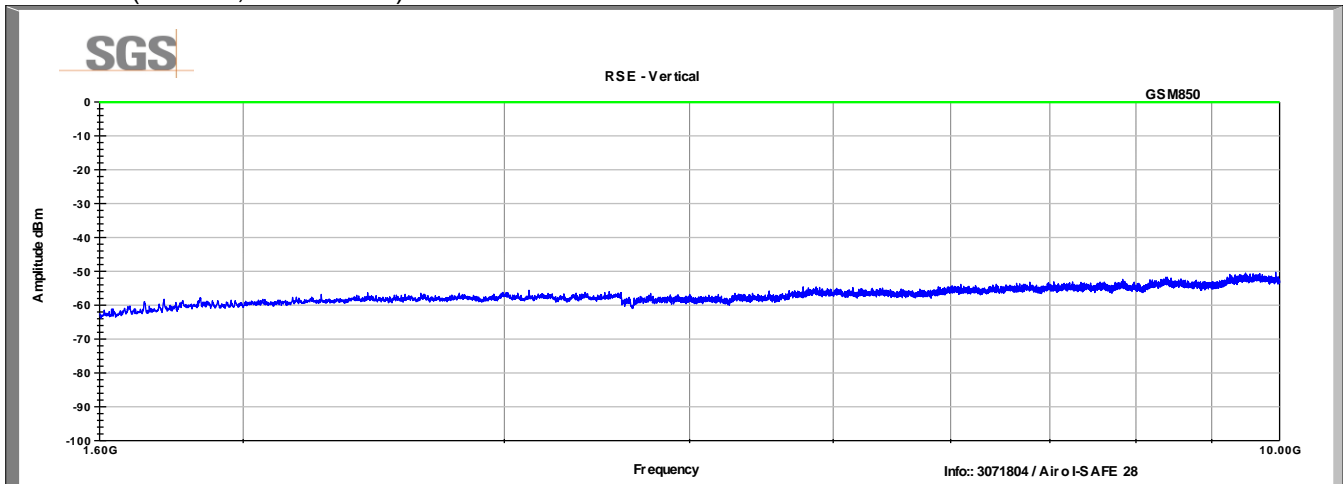
### GSM850 (Vertical, 30-1600MHz)



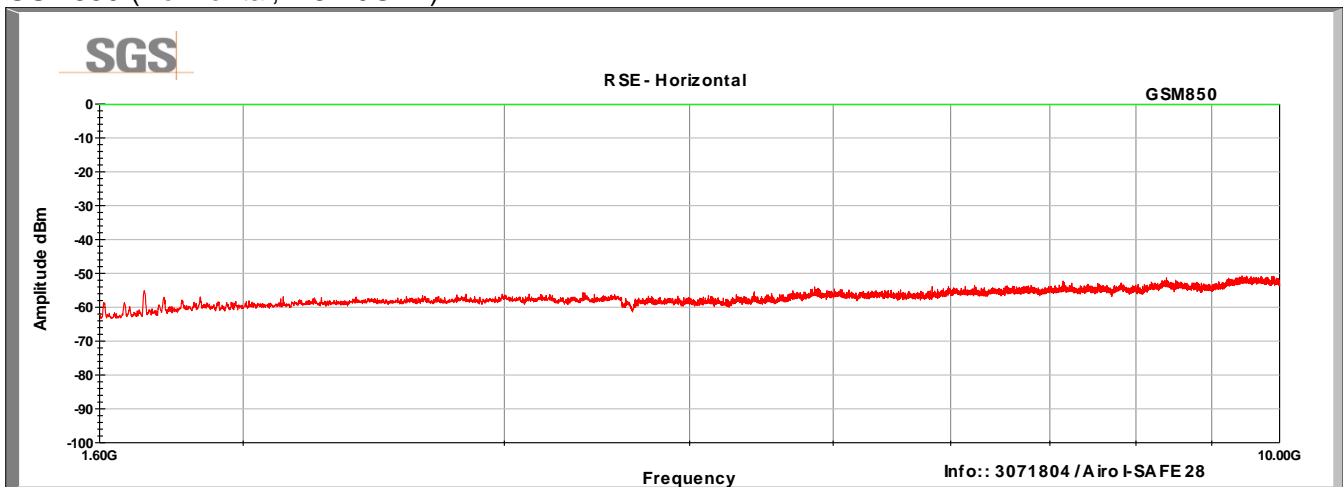
### GSM850 (Horizontal, 30-1600MHz)



### GSM850 (Vertical, 1.6-10GHz)



### GSM850 (Horizontal, 1.6-10GHz)



### 3.6 Frequency Stability

#### 3.6.1 Test Result

Test Description	Basic Standards	Test Result
Frequency Stability	2.1055 22.917(a)	Pass

#### 3.6.2 Test Method

The EUT was placed inside the Environmental Chamber and was left inside chamber to stabilize to set temperature for minimum of thirty minutes before any measurements were made. The EUT was tested at GSM850 channel 384 and WCDMA Band V channel 4182.

#### 3.6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.1 °C

Relative Humidity: 40.5 %

Atmospheric Pressure: 98.6 kPa

#### 3.6.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
CMW500 WIDEBAND RADIO COMMUNICATIONS TESTER	CMW500	ROHDE & SCHWARZ	B085757	29-Oct-2013
ENVIRONMENTAL CHAMBER	SM-16-8200	THERMOTRON	B079727	8-Aug-2014
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079822	12-Dec-2013
MINI-MAX ENVIRONMENTAL CHAMBER	SM-16C	THERMOTRON	L21	NCR

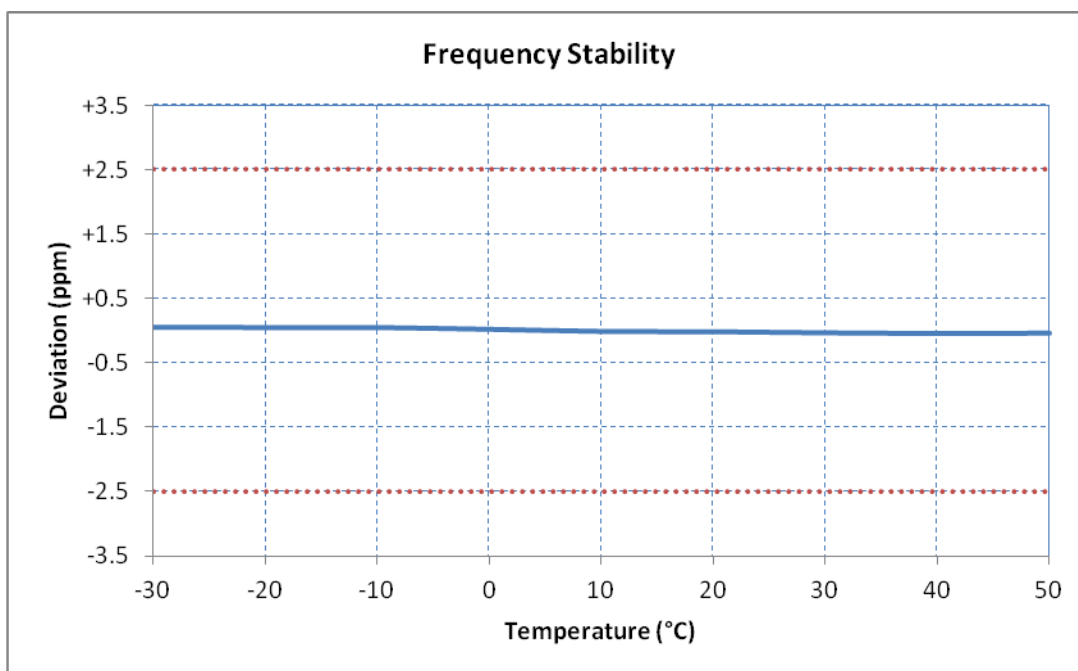
Note: The calibration period equipment is 1 year.

### 3.6.5 Test Data

Test Date: 06 Sept 2013

GSM850, Channel 384 (836.4MHz)

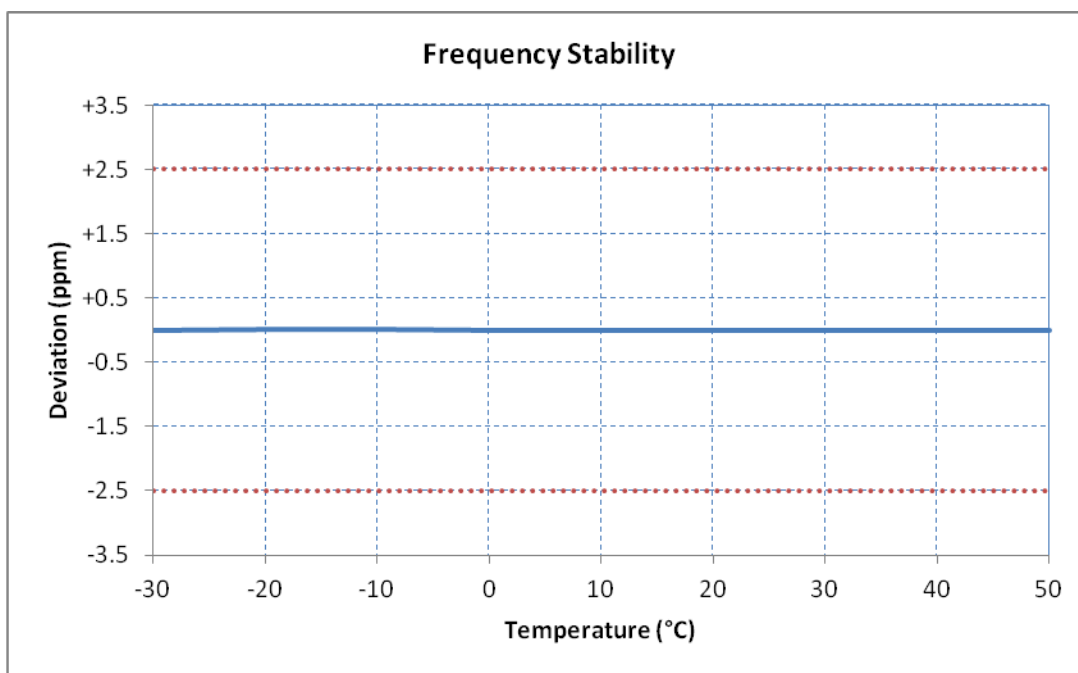
Voltage %	Power V <sub>DC</sub>	Temp °C	Frequency Hz	Max Freq Dev Hz	Freq Dev ppm	Deviation %
100%	3.700	+20 (Ref)	836,399,983	-16.63	-0.02	-0.000002
100%	3.700	-30	836,400,039	+38.87	+0.05	+0.000005
100%	3.700	-20	836,400,035	+34.90	+0.04	+0.000004
100%	3.700	-10	836,400,034	+34.45	+0.04	+0.000004
100%	3.700	0	836,400,013	+13.27	+0.02	+0.000002
100%	3.700	+10	836,399,988	-12.14	-0.01	-0.000001
100%	3.700	+20	836,399,984	-15.63	-0.02	-0.000002
100%	3.700	+30	836,399,971	-29.06	-0.03	-0.000003
100%	3.700	+40	836,399,962	-37.71	-0.05	-0.000005
100%	3.700	+50	836,399,967	-33.13	-0.04	-0.000004
115%	4.225	+20	836,399,988	-11.66	-0.01	-0.000001
Battery End	3.350	+20	836,399,976	-23.63	-0.03	-0.000003





## WCDMA Band V, Channel 4182 (836.4MHz)

Voltage %	Power V <sub>DC</sub>	Temp °C	Frequency Hz	Max Freq Dev Hz	Freq Dev ppm	Deviation %
100%	3.700	+20 (Ref)	836,399,991	-9.01	-0.01	-0.000001
100%	3.700	-30	836,399,990	-10.08	-0.01	-0.000001
100%	3.700	-20	836,400,009	+9.42	+0.01	+0.000001
100%	3.700	-10	836,400,010	+9.62	+0.01	+0.000001
100%	3.700	0	836,399,991	-9.16	-0.01	-0.000001
100%	3.700	+10	836,399,988	-11.78	-0.01	-0.000001
100%	3.700	+20	836,399,990	-10.27	-0.01	-0.000001
100%	3.700	+30	836,399,990	-10.12	-0.01	-0.000001
100%	3.700	+40	836,399,990	-9.90	-0.01	-0.000001
100%	3.700	+50	836,399,991	-9.18	-0.01	-0.000001
115%	4.225	+20	836,399,990	-9.96	-0.01	-0.000001
Battery End	3.350	+20	836,399,993	-6.62	-0.01	-0.000001



## 4 US PCS Band

### 4.1 RF Output Power

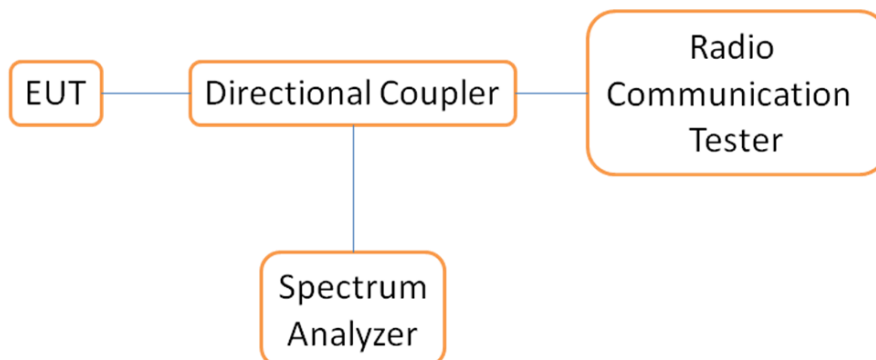
#### 4.1.1 Test Result

Test Description	Basic Standards	Test Result
RF Output Power	FCC Part 2.1046	Reported

#### 4.1.2 Test Method

A radio link was established between EUT and Radio Communication Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester. The output power was measured by a spectrum analyzer with the use of a directional coupler.

For CDMA Band II and GSM 1900, the measurement was conducted at the center channel: 1880MHz. The CDMA measurement was taken using the CCDF function of the spectrum analyzer. The GSM1900 signal was measured using the method described in clause 5.1.1 of KDB document 971168 D01 Power Meas License Digital Systems v02r01.



### 4.1.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### Environmental Conditions

Temperature: 25.6 °C

Relative Humidity: 55.2 %

Atmospheric Pressure: 97.6 kPa

### 4.1.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jun-2014
CMW500 WIDEBAND	CMW500	ROHDE & SCHWARZ	B085757	29-Oct-2013
POWER SPLITTER	ZFRSC-183-S+	MINI-CIRCUITS	EA01	CNR
SIGNAL GENERATOR	HMC-2240	HITTITE	B079813	CNR

Note: The calibration period equipment is 1 year.

#### 4.1.5 Test Data

Mode	Band	Measured Power, dBm
UMTS	Band II	22.3
GSM (frame average)	GSM1900	20.3
GSM (burst average)	GSM1900	29.3
GSM-GPRS	GSM1900	25.3
GSM-Edge	GSM1900	25.3

## 4.2 Peak to Average Ratio

### 4.2.1 Test Result

Test Description	Basic Standards	Test Result
Peak to Average Ratio	FCC Part 24.232(d)	Pass

### 4.2.2 Test Method

KDB document 971168 D01 Power Meas License Digital Systems v02r01 was used to determine peak-to-average ratio. For the WCDMA measurement, Clause 5.7.1 was used which defined the measurement method using the CCDF function of the spectrum analyzer. Clause 5.7.2 was used to measure the pulsed GSM signal.

### 4.2.3 Test Site

SGS EMC Laboratory, Suwanee, GA

### 4.2.4 Test Equipment

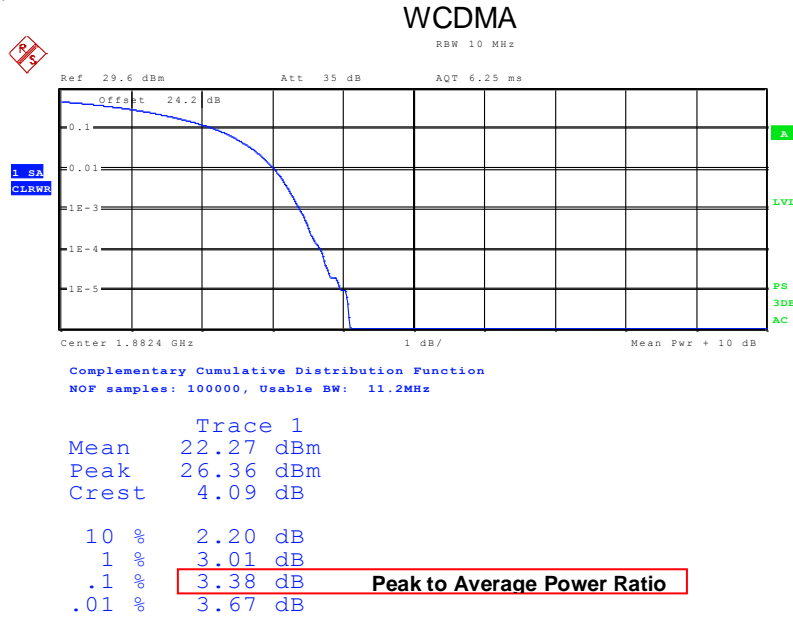
Test Date: 23 July 2013

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EPM SERIES POWER	E4419B	AGILENT / HP	B079628	13-Aug-2013
POWER SENSOR	84814A	AGILENT	B086132	13-Aug-2013
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jun-2014

Note: The calibration period equipment is 1 year.

## 4.2.5 Test Data

Test Date: 30 July 2013



Date: 23.JUL.2013 16:13:28

### GSM1900

$$\text{PAPR (dB)} = P_{\text{Pk}} \text{ (dBm)} - P_{\text{Avg}} \text{ (dBm)}$$

Peak Power ( $P_{\text{Pk}}$ ) = 29.99dBm

Average Power ( $P_{\text{Avg}}$ ) = 20.5dBm (Measured with Power Meter) + 8.99dB (Duty Cycle Correction)

$$\text{PAPR (dB)} = 29.99 - (20.5 + 8.99) = 0.5\text{dB}$$

### 4.3 Occupied Bandwidth

#### 4.3.1 Test Result

Test Description	Basic Standards	Test Result
Occupied Bandwidth	FCC Part 2.1049 FCC Part 24.238(a)	Reported

#### 4.3.2 Test Method

The occupied bandwidth is the frequency bandwidth such that below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power by a given emission. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sample detector shall be used since a peak detector may produce a wider than actual bandwidth.

A radio link was established between EUT and Radio Communications Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester. The occupied bandwidth is measured using spectrum analyzer's occupied bandwidth measurement. RBW is set to 3 kHz on spectrum analyzer.

The bandwidth of 99% power can be read on spectrum analyzer.

The measurement was conducted at three channels: 25, 600 and 1175 (low, middle and high channels) in RETAP 12288K test mode.

#### 4.3.3 Test Site

SGS EMC Laboratory, Suwanee, GA

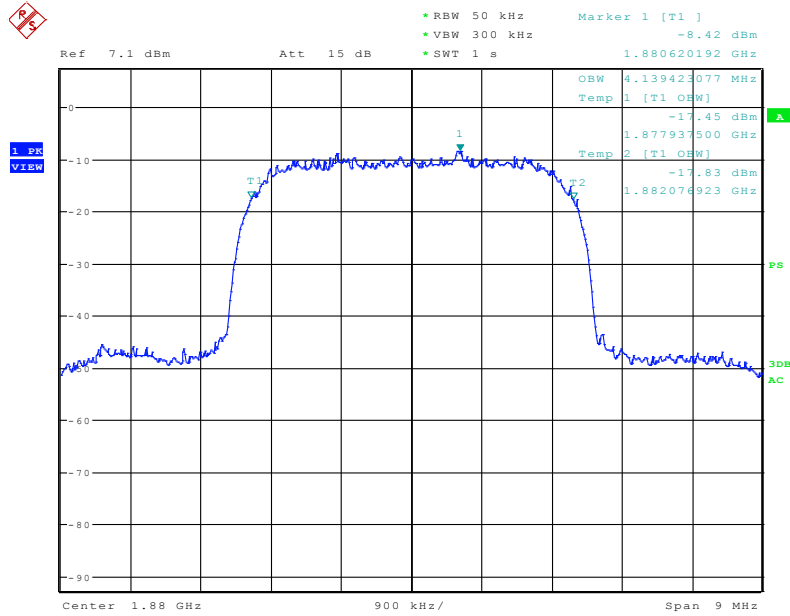
#### 4.3.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jun-2014
UNIVERSAL RADIO COMMUNICATIONS TESTER	CMU 200	ROHDE & SCHWARZ	S/N: 100432	25-Sep-2013
POWER SPLITTER	ZFRSC-183-S+	MINI-CIRCUITS	EA01	CNR
SIGNAL GENERATOR	HMC-2240	HITTITE	B079813	CNR

Note: The calibration period equipment is 1 year.

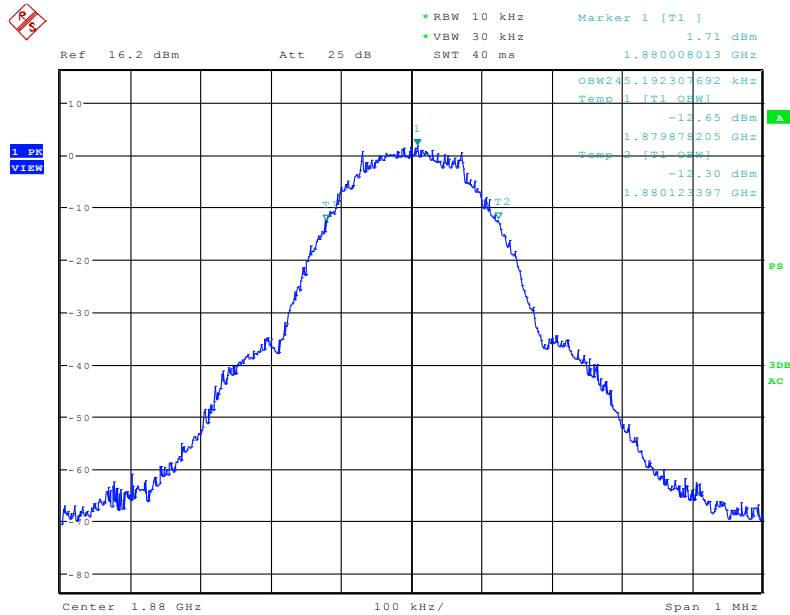
## 4.3.5 Test Data

### WCDMA – Band II



Date: 23.JUL.2013 20:31:27

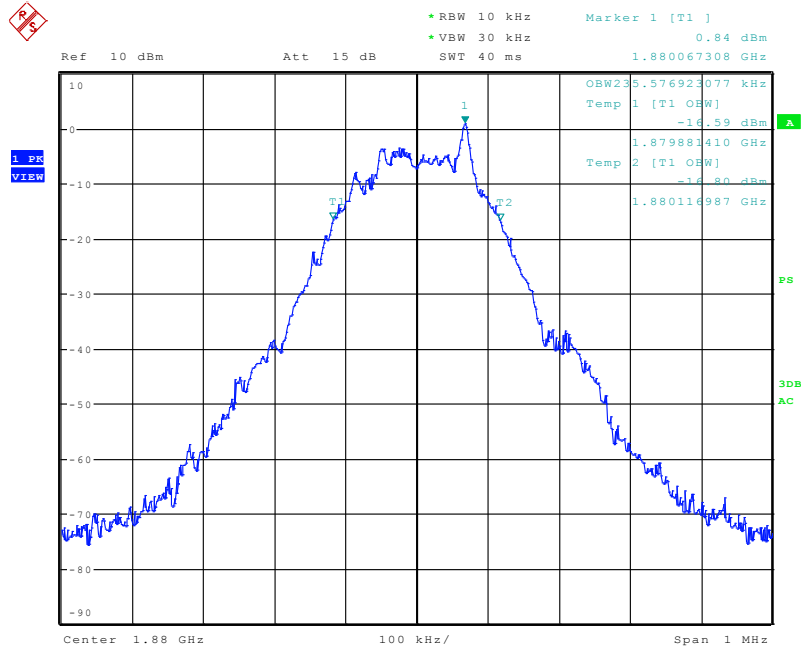
### GSM1900 – Voice



Date: 23.JUL.2013 20:46:52

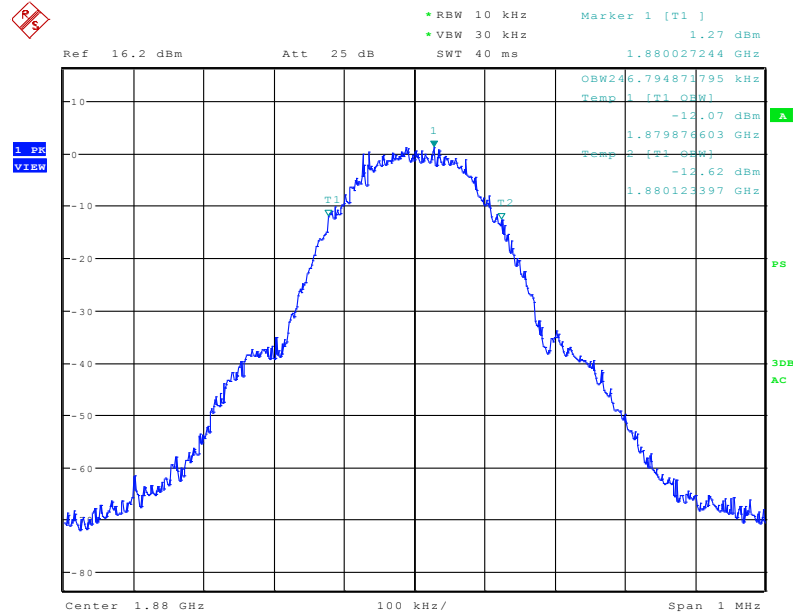


## GSM1900 – GPRS



Date: 23.JUL.2013 21:31:26

## GSM1900 – EGPRS



Date: 23.JUL.2013 20:58:29

## 4.4 Band Edge and Conducted Spurious Emissions

### 4.4.1 Test Result

Test Description	Basic Standards	Test Result
Conducted spurious emissions and Band Edge	2.1051 24.238(a)	Pass

### 4.4.2 Test Method

The levels of the carrier and the various conducted spurious and harmonics frequencies are measured by means of a calibrated spectrum analyzer. The emissions spectrum emanating from the EUT transmit antenna port is scanned from the lowest frequency generated in the equipment up to a frequency including its 10<sup>th</sup> harmonic. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB. Compliance is based on the use of a spectrum analyzer employing a resolution bandwidth of 1 MHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of a least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emissions bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

### 4.4.3 Test Site

SGS EMC Laboratory, Suwanee, GA

### 4.4.4 Test Equipment

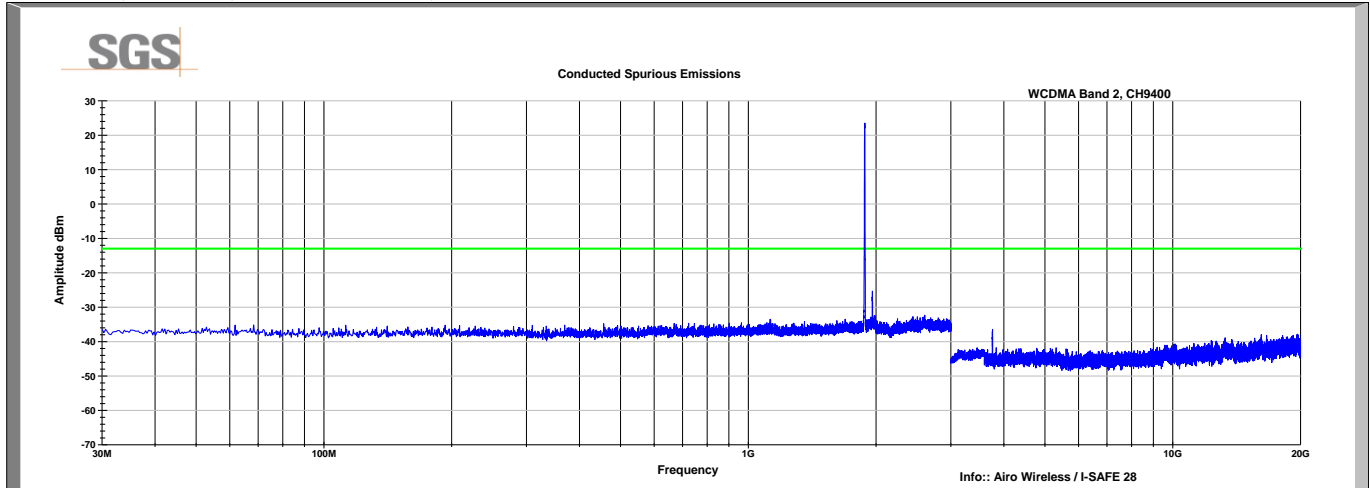
Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU8	ROHDE & SCHWARZ	B085759	21-Jun-2014
UNIVERSAL RADIO COMMUNICATIONS TESTER	CMU 200	ROHDE & SCHWARZ	S/N: 100432	25-Sep-2013
POWER SPLITTER	ZFRSC-183-S+	MINI-CIRCUITS	EA01	CNR
SIGNAL GENERATOR	HMC-2240	HITTITE	B079813	CNR
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	24-Sep-2013

Note: The calibration period equipment is 1 year.

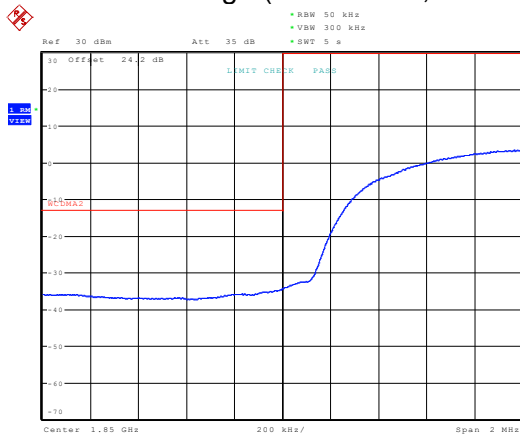
## 4.4.5 Test Data

Test Date: 23 July 2013 and 29 July 2013

WCDMA, Band II, Channel 9400, 1880 MHz

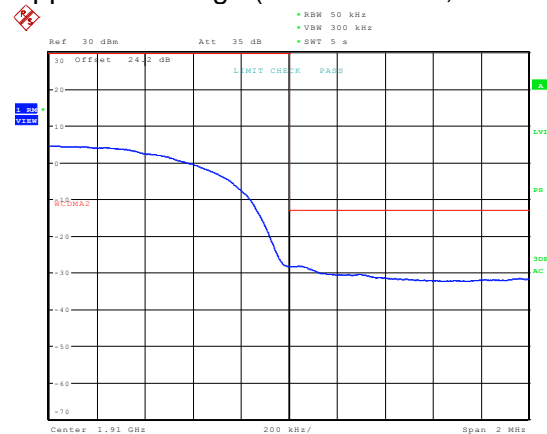


Lower Band Edge (Channel 12, 1852.5 MHz)



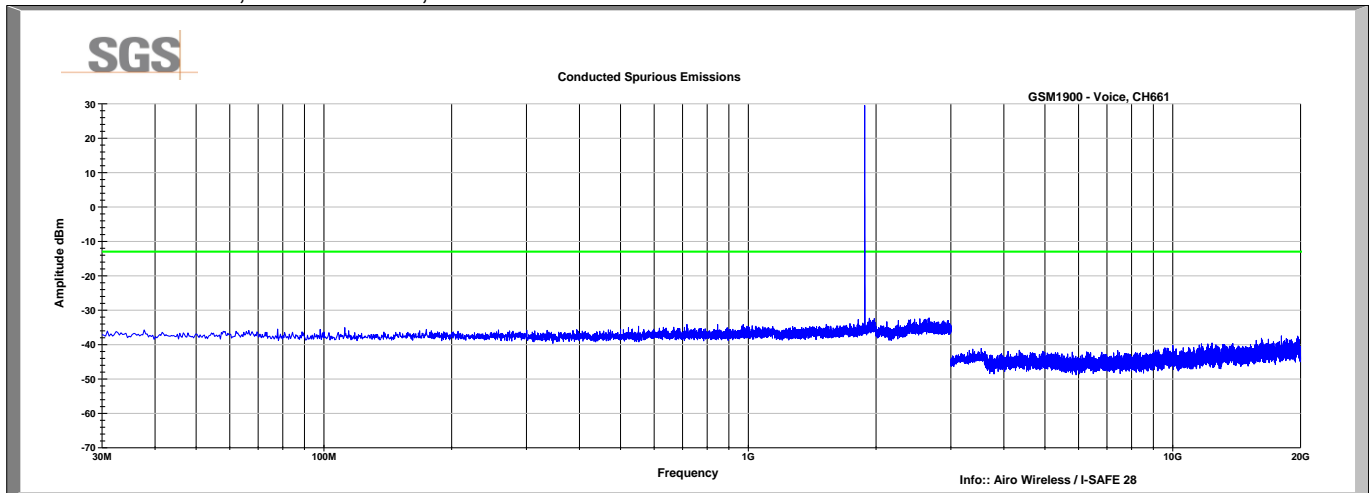
Date: 23.JUL.2013 22:26:14

Upper Band Edge (Channel 9538, 1907.6 MHz)

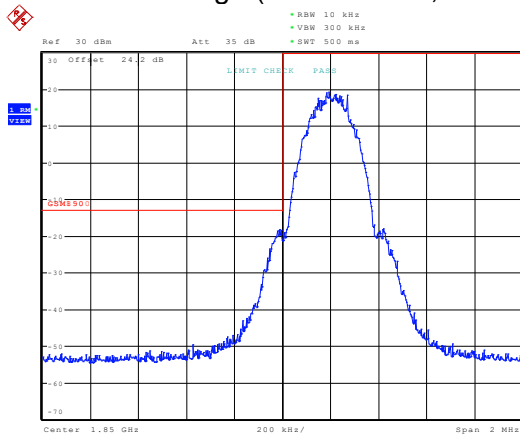


Date: 23.JUL.2013 22:42:45

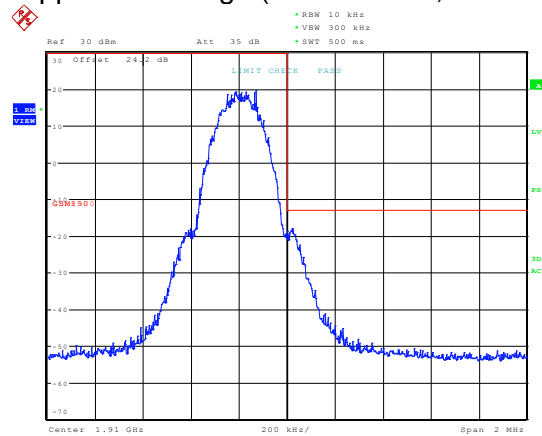
Test Date: 23 July 2013 and 29 July 2013  
GSM1900 - Voice, Channel 661, 1880 MHz



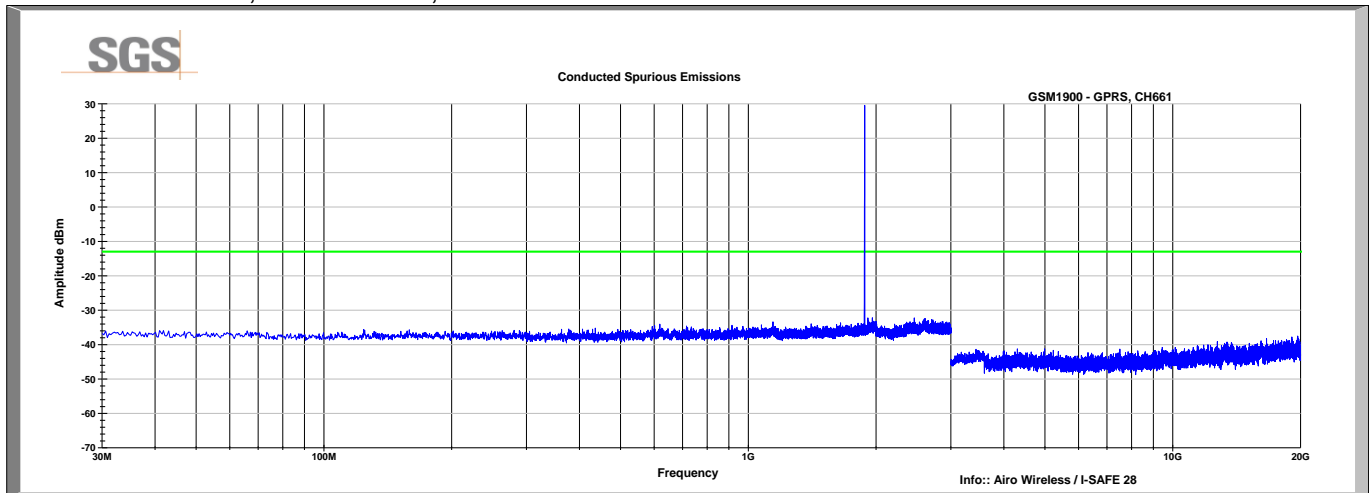
Lower Band Edge (Channel 512, 1850.2 MHz)



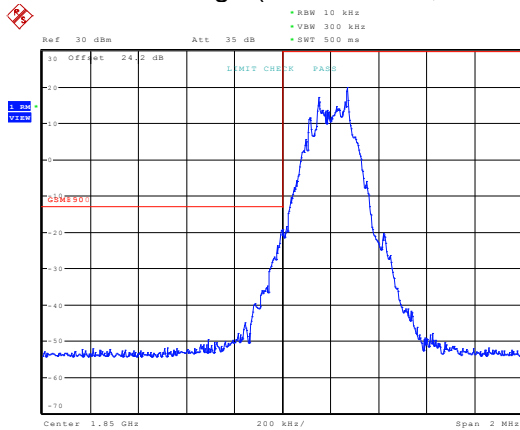
Upper Band Edge (Channel 810, 1909.8 MHz)



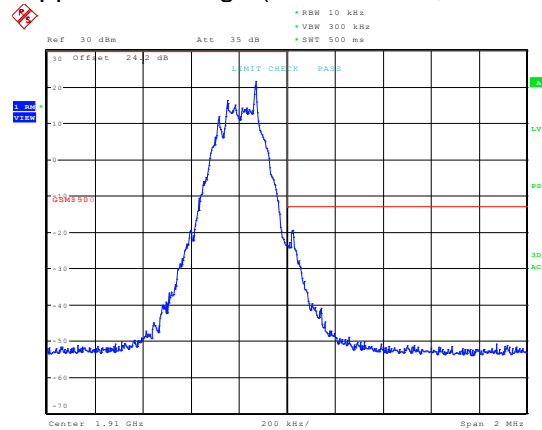
Test Date: 23 July 2013 and 29 July 2013  
GSM1900 - GPRS, Channel 661, 1880 MHz



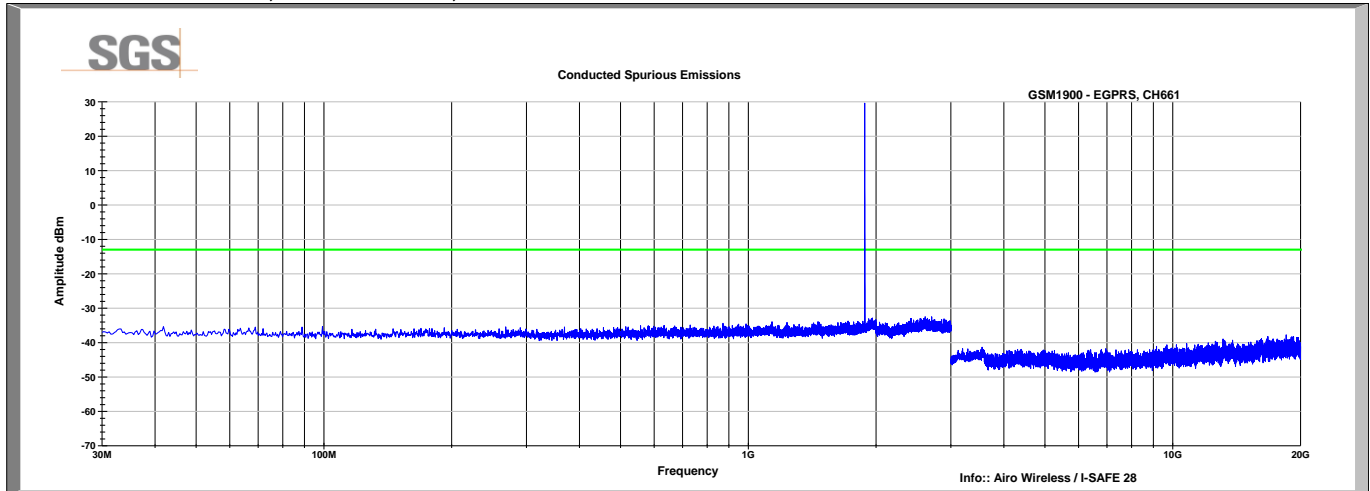
Lower Band Edge (Channel 512, 1850.2 MHz)



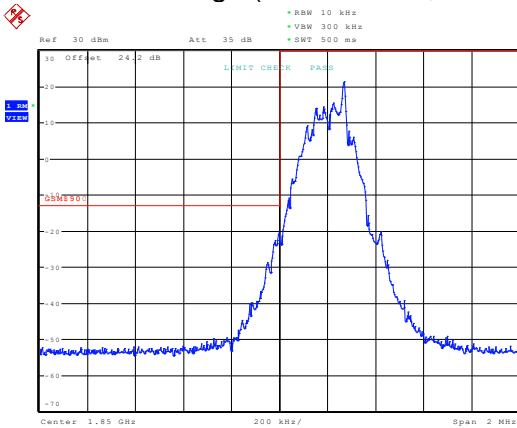
Upper Band Edge (Channel 810, 1909.8 MHz)



Test Date: 23 July 2013 and 29 July 2013  
GSM1900 - EGPRS, Channel 661, 1880 MHz

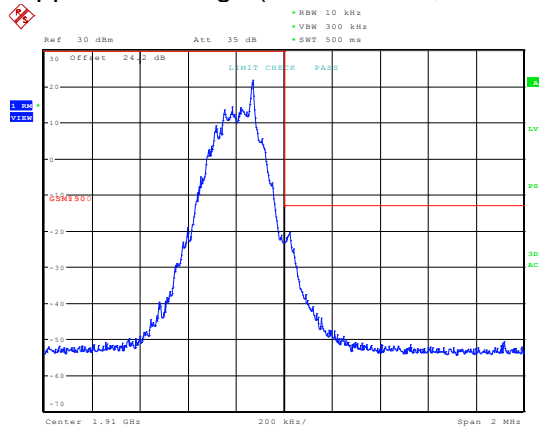


Lower Band Edge (Channel 512, 1850.2 MHz)



Date: 23.JUL.2013 22:14:52

Upper Band Edge (Channel 810, 1909.8 MHz)



Date: 23.JUL.2013 22:13:45

## 4.5 Effective Isotropic Radiated Power

### 4.5.1 Test Result

Test Description	Basic Standards	Test Result
Effective Radiated Power	FCC Part 24.232(c)	Pass

### 4.5.2 Test Method

The measurements above 1 GHz are carried out in a fully anechoic chamber. Below 1 GHz, the measurements are carried out in semi-anechoic chamber. The EUT was placed on a 0.8 meter high non-conductive table at a 3 meters test distance from the test receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT. The height of receiving antenna is varied from 1 to 4 m to find the maximum power value. A radio link was established between EUT and Radio Communications Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester. A RMS detector is used and RBW is set to 3MHz. Then the antenna height and turn table rotation is adjusted till the maximum power value is founded on spectrum analyzer.

The EUT was positioned through each of its three orthogonal axes and the highest level was reported.

A dipole antenna (below 1 GHz) or double-ridged waveguide antenna (above 1 GHz) was substituted in place of the EUT. The substitution antenna will be driven by a signal generator. The receive antenna is varied to find the maximum response to the spectrum analyzer. Then the level of signal generator will be adjusted to achieve the same power value on the spectrum analyzer or receiver.

The ERP/EIRP of the EUT can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.

### 4.5.3 Test Site

10m Semi-anechoic chamber, SGS EMC Laboratory, Suwanee, GA

#### 4.5.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079690	12-Sep-2013
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	10-Jun-2014
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079699	25-Mar-2014
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	24-Sep-2013
RF CABLE - 7000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079712	20-Sep-2013
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079711	20-Sep-2013
RF CABLE	SF106	HUBER&SUHNER	B085888	22-Oct-2013
CMW500 WIDEBAND RADIO COMMUNICATIONS TESTER	CMW500	ROHDE & SCHWARZ	B085757	29-Oct-2013
DIPOLE BALUN 4	3121D-DB4	ETS-LINDGREN	B085753	16-Mar-2015
SIGNAL GENERATOR	HMC-T2240	HITTITE	B001212	CNR

Note: The calibration period equipment is 1 year.

#### 4.5.5 Test Data

Freq (MHz)	Pol	Mode	SigGen Out (dBm)	Cable Loss (dB)	Net to Sub Ant (dBm)	Reading (dBuV)	Antenna Gain (dBi)	EUT Level (dBuV)	ERP / EIRP (dBm)
1880	H	GSM	1.7	1.7	0	66	4.687	87.3	26.0
1880	H	GSM-EDGE	1.7	1.7	0	66	4.687	87.1	25.8
1880	H	GSM-GPRS	1.7	1.7	0	66	4.687	87.1	25.8
1880	V	WCDMA	1.7	1.7	0	68	4.687	84.4	21.1
1880	H	WCDMA - HSUPA	1.7	1.7	0	66	4.687	80.3	19.0



## 4.6 Radiated Spurious Emissions

### 4.6.1 Test Result

Test Description	Basic Standards	Test Result
Radiated Spurious Emissions	FCC Part 2.1053 FCC Part 22.917(a)	Pass

### 4.6.2 Test Method

The levels are measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10<sup>th</sup> harmonic. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB. Compliance is based on the use of a spectrum analyzer employing a resolution bandwidth of 1 MHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of a least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emissions bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

The EUT was manipulated through each of its three orthogonal axes with the measurement oriented in both vertical and horizontal polarizations.

A PCS band notch filter or a high pass filter was used to protect the preamplifier from overload condition.

A radio link was established between EUT and Radio Communications Tester. The output power of the EUT was set to maximum value by using the maximum power setting on the Radio Communications Tester.

The measurement was conducted at the middle channel.

### 4.6.3 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
ANTENNA, BILOG	JB6	SUNOL	B079690	12-Sep-2013
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	10-Jun-2014
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079699	25-Mar-2014
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	24-Sep-2013
RF CABLE - 7000MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079712	20-Sep-2013
RF CABLE - 7500MM (10KHZ - 18GHZ)	SF106	HUBER&SUHNER	B079711	20-Sep-2013
RF CABLE	SF106	HUBER&SUHNER	B085888	22-Oct-2013
CMW500 WIDEBAND RADIO COMMUNICATIONS TESTER	CMW500	ROHDE & SCHWARZ	B085757	29-Oct-2013
DIPOLE BALUN 4	3121D-DB4	ETS-LINDGREN	B085753	16-Mar-2015
SIGNAL GENERATOR	HMC-T2240	HITTITE	B001212	CNR

Note: The calibration period equipment is 1 year.

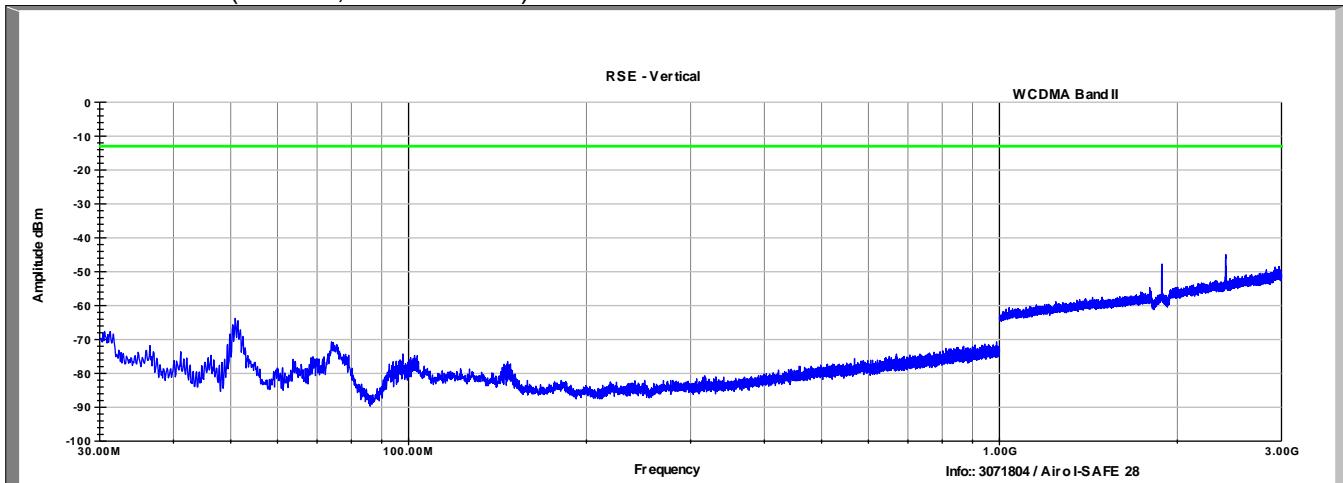
#### 4.6.4 Test Data

Test Date: 6 Aug 2012

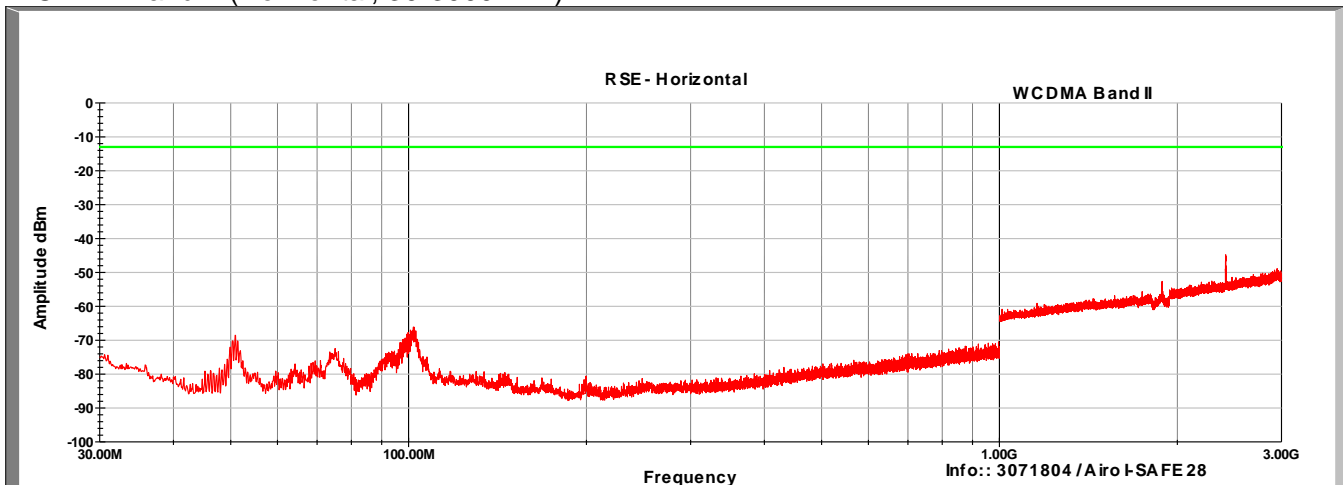
There were no other emissions within 20 dB of the limit.

#### 4.6.5 Test Plots

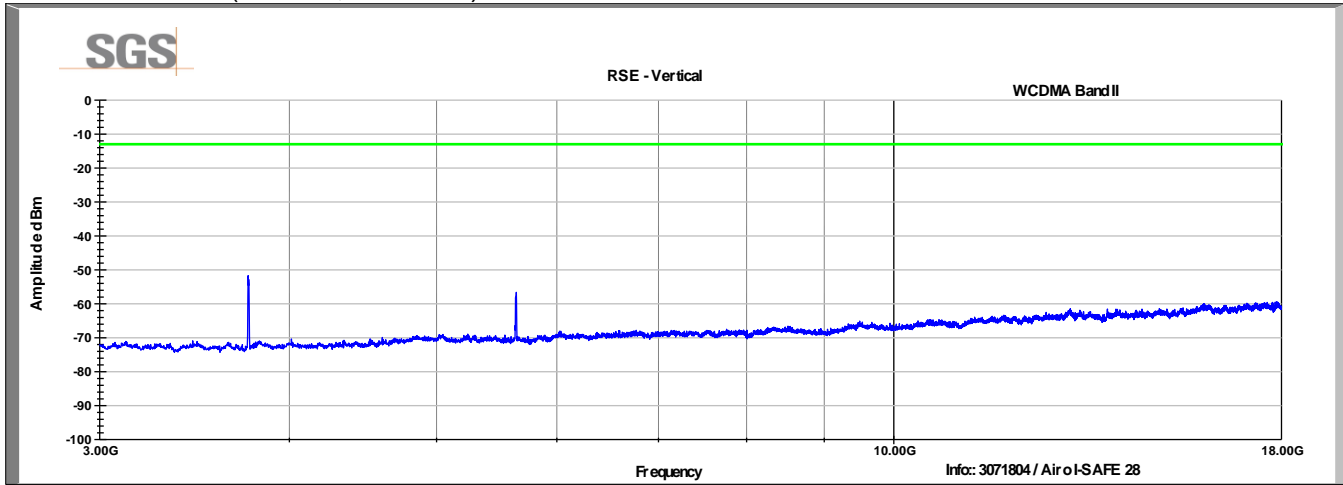
WCDMA Band II (Vertical, 30-3000MHz)



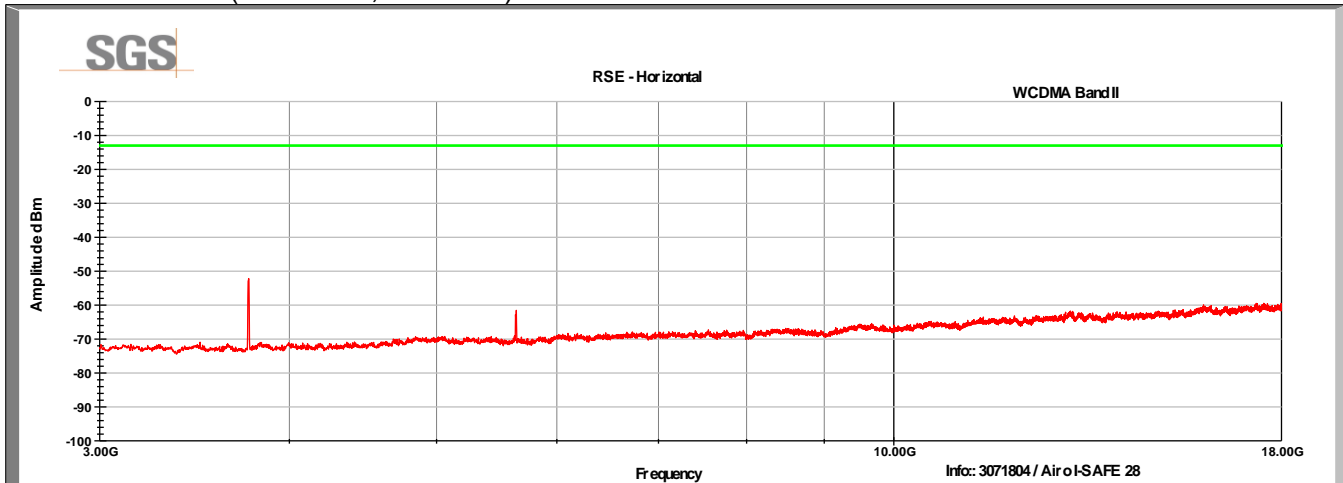
WCDMA Band II (Horizontal, 30-3000MHz)



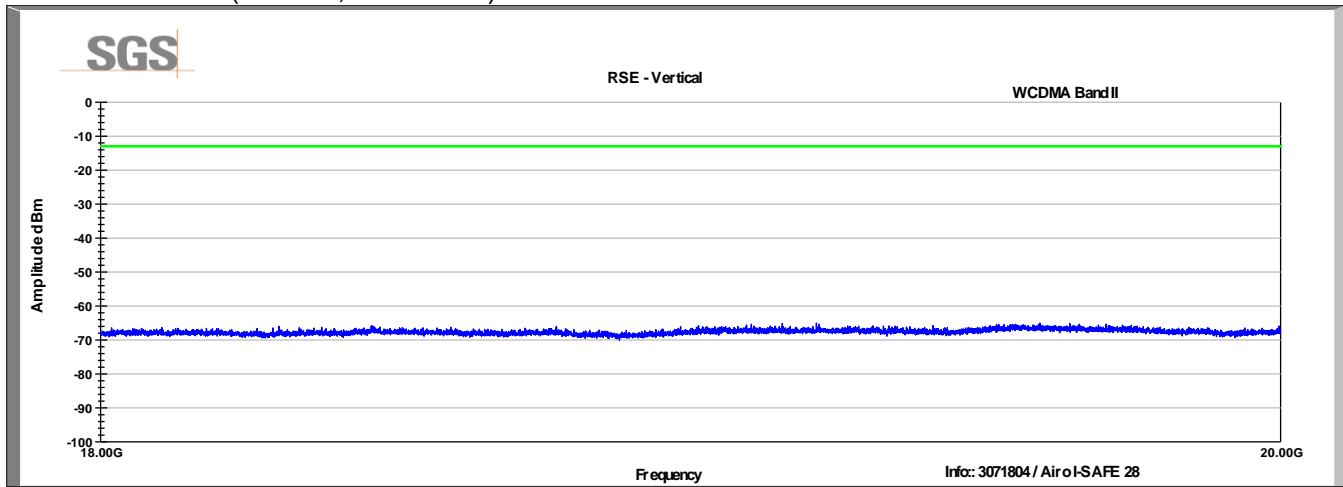
## WCDMA Band II (Vertical, 3-18GHz)



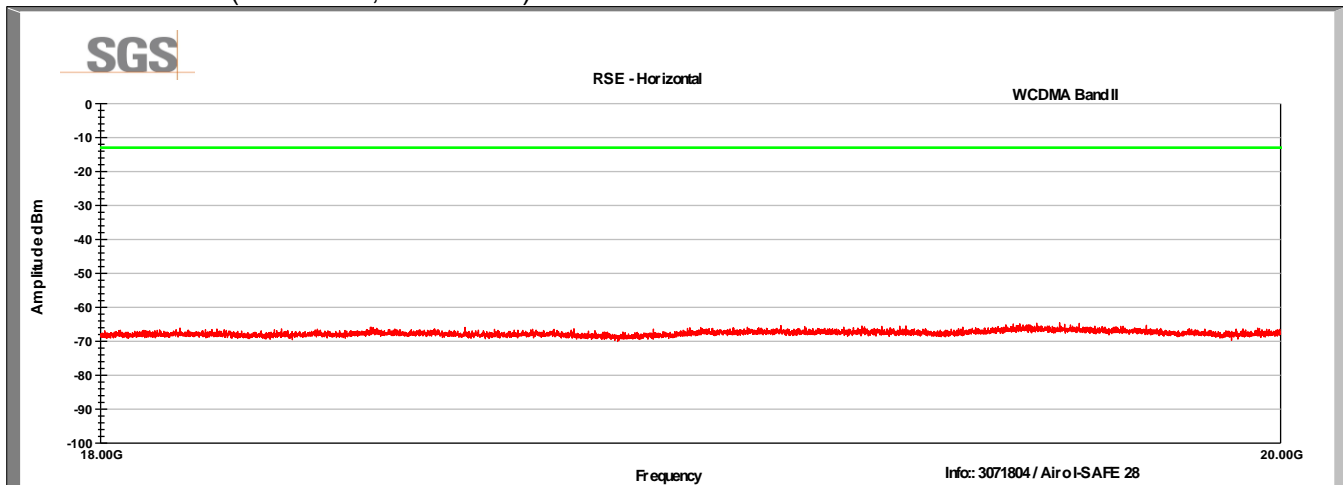
## WCDMA Band II (Horizontal, 3-18GHz)



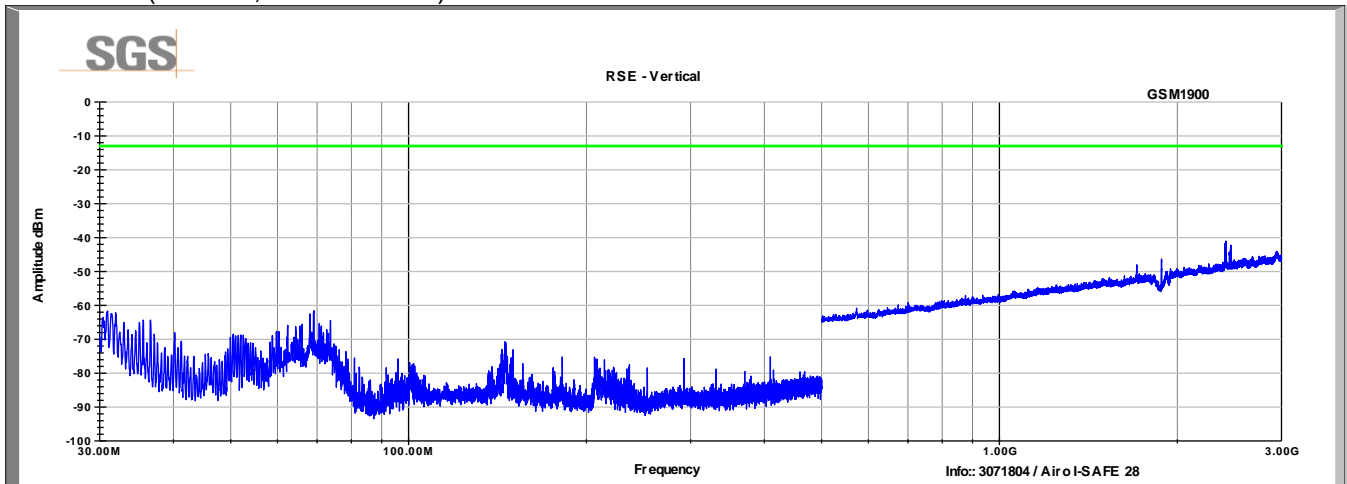
### WCDMA Band II (Vertical, 18-20GHz)



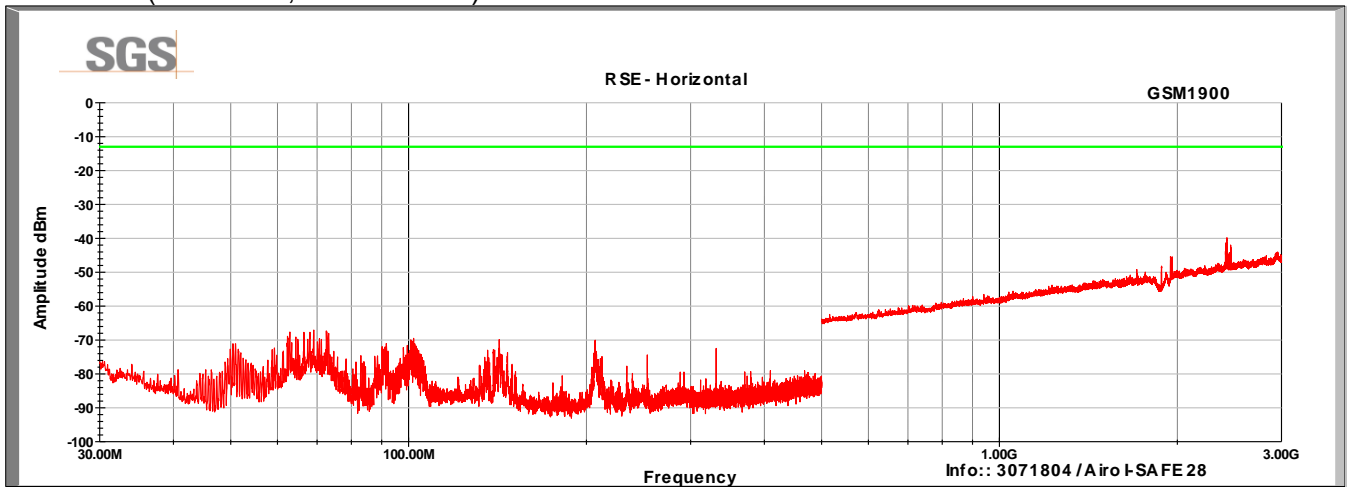
### WCDMA Band II (Horizontal, 18-20GHz)



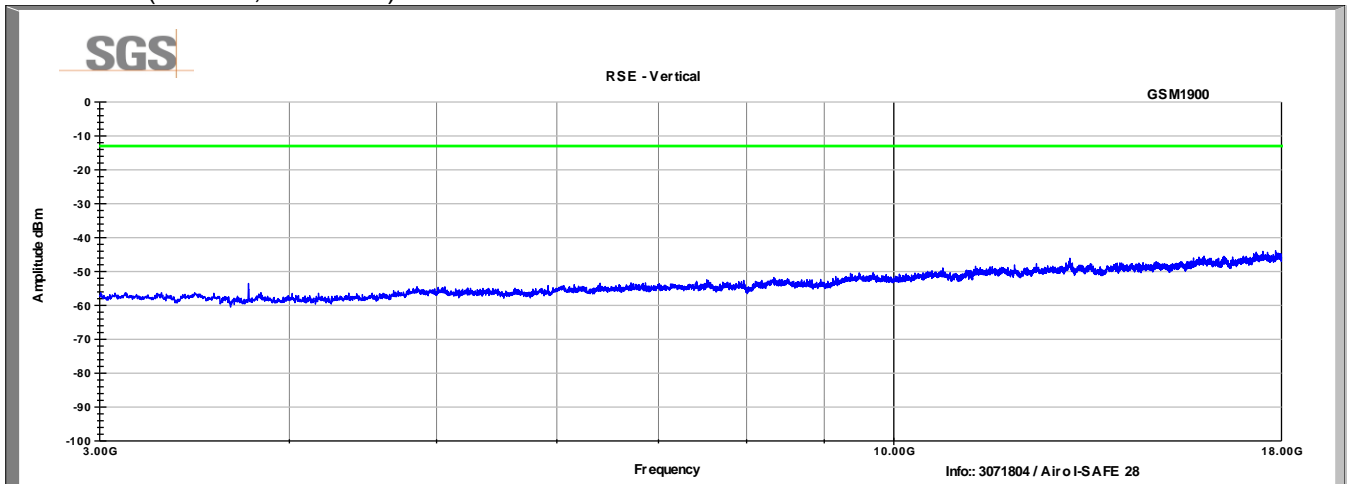
### GSM1900 (Vertical, 30-3000MHz)



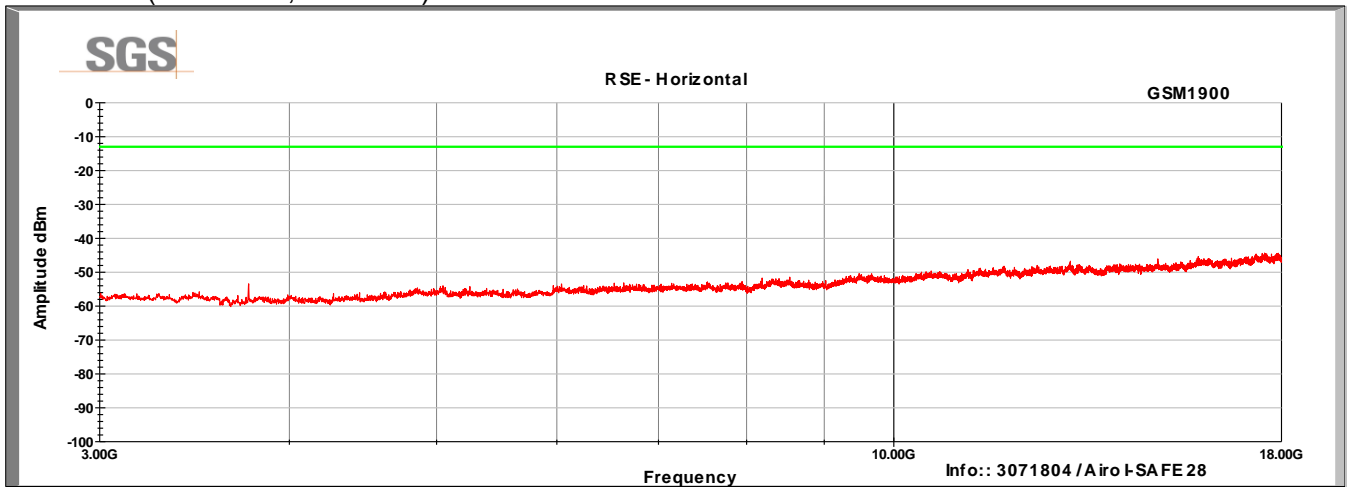
### GSM1900 (Horizontal, 30-3000MHz)



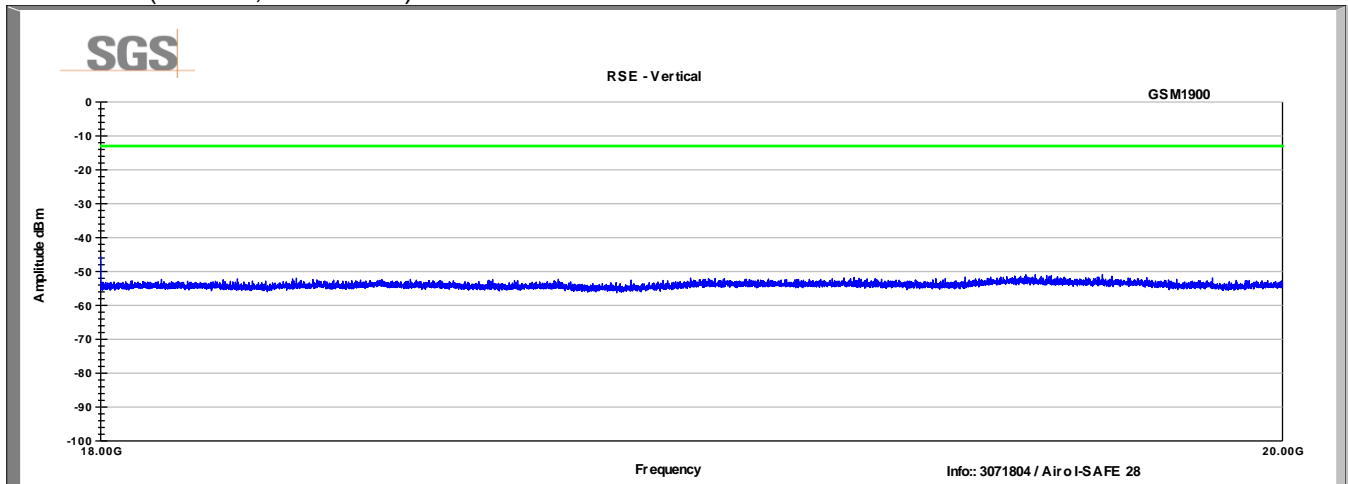
## GSM1900 (Vertical, 3-18GHz)



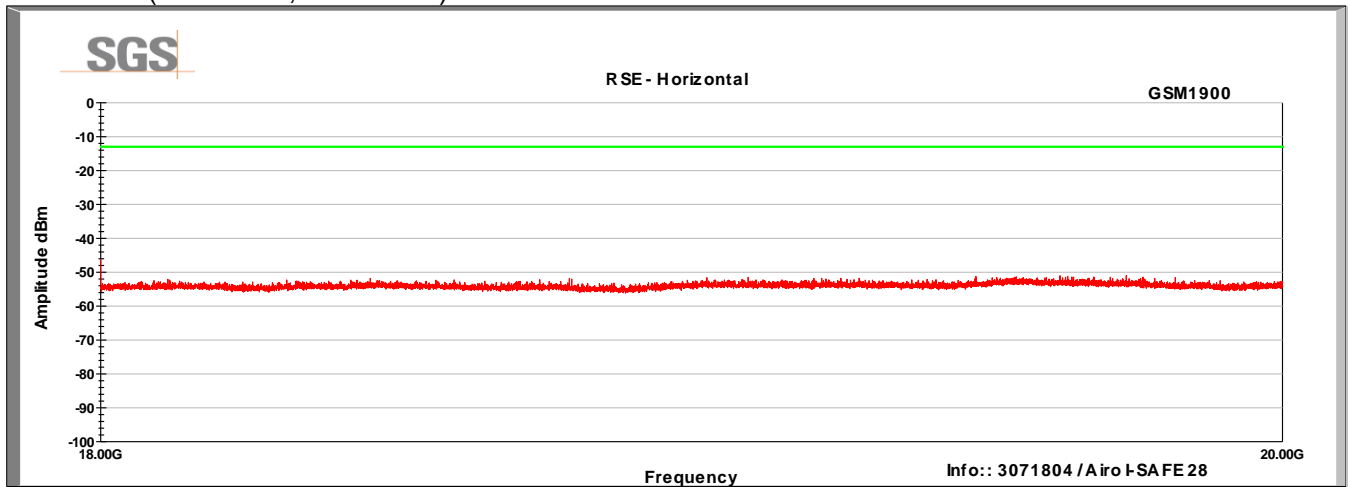
## GSM1900 (Horizontal, 3-18GHz)



### GSM1900 (Vertical, 18-20GHz)



### GSM1900 (Horizontal, 18-20GHz)





## 4.7 Frequency Stability

### 4.7.1 Test Result

Test Description	Basic Standards	Test Result
Frequency Stability	2.1055 24.238(a)	Pass

### 4.7.2 Test Method

The EUT was placed inside the Environmental Chamber and was left inside chamber to stabilize to set temperature for minimum of thirty minutes before any measurements were made. The EUT was tested at GSM1900 channel 661 and WCDMA Band II channel 9400.

### 4.7.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.1 °C

Relative Humidity: 40.5 %

Atmospheric Pressure: 98.6 kPa

### 4.7.4 Test Equipment

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
CMW500 WIDEBAND RADIO COMMUNICATIONS TESTER	CMW500	ROHDE & SCHWARZ	B085757	29-Oct-2013
ENVIRONMENTAL CHAMBER	SM-16-8200	THERMOTRON	B079727	8-Aug-2014
COAXIAL CABLE	SUCOFLEX 102	HUBER&SUHNER	B079822	12-Dec-2013
MINI-MAX ENVIRONMENTAL CHAMBER	SM-16C	THERMOTRON	L21	NCR

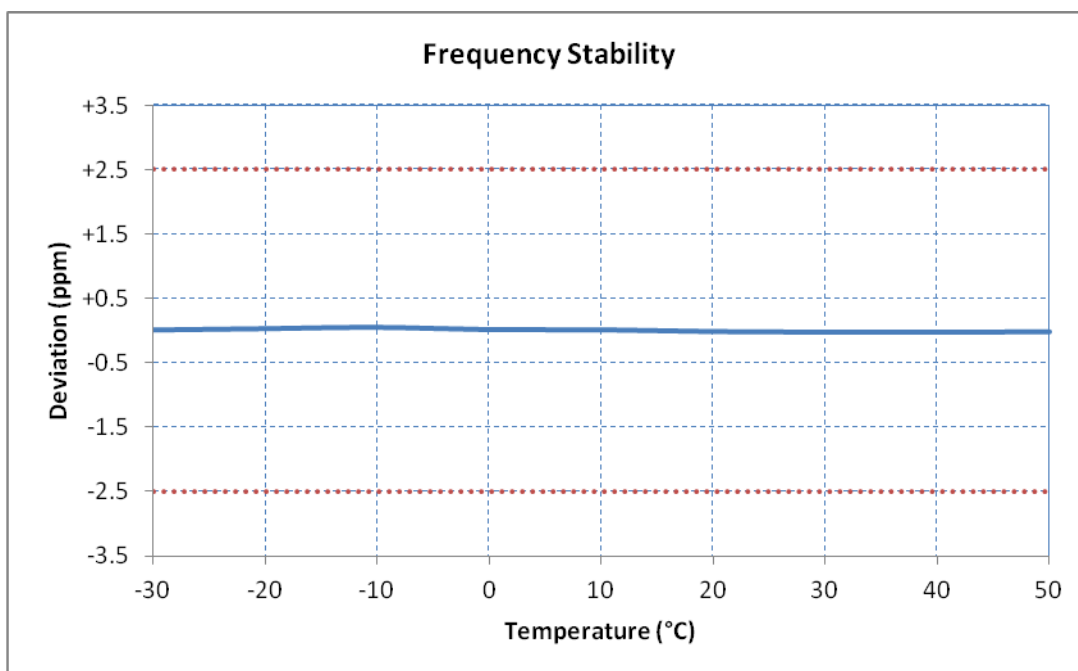
Note: The calibration period equipment is 1 year.

## 4.7.5 Test Data

Test Date: 06 Sept 2013

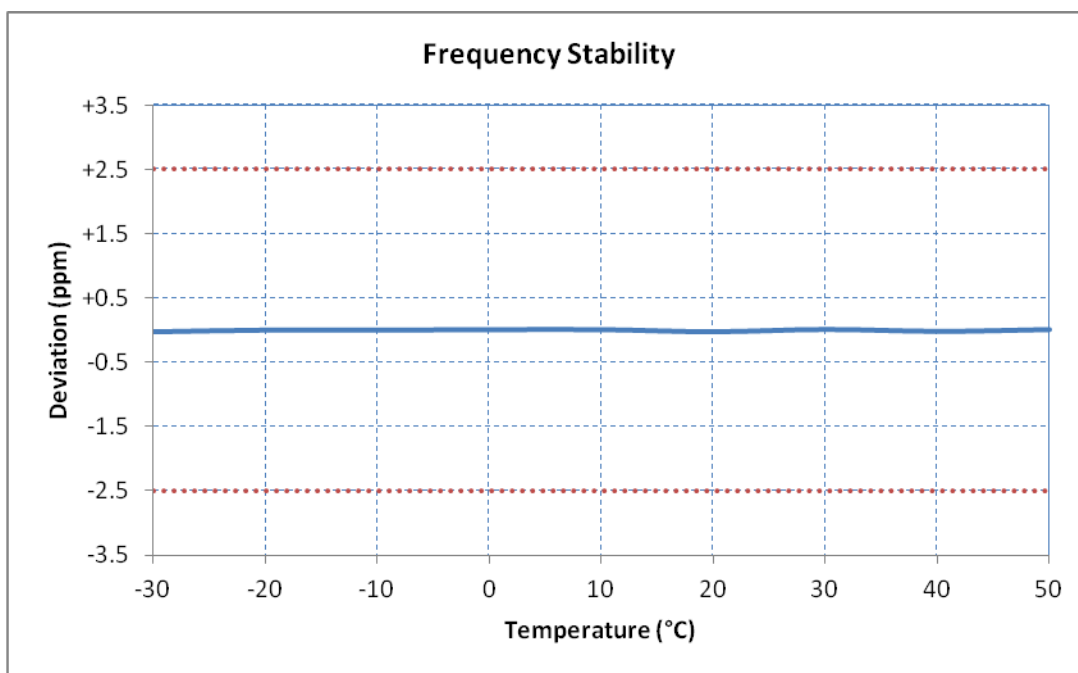
GSM1900, Channel 661 (1880MHz)

Voltage %	Power V <sub>DC</sub>	Temp °C	Frequency Hz	Max Freq Dev Hz	Freq Dev ppm	Deviation %
100%	3.700	+20 (Ref)	1,879,999,981	-19.44	-0.01	-0.000001
100%	3.700	-30	1,880,000,027	+27.22	+0.01	+0.000001
100%	3.700	-20	1,880,000,062	+61.76	+0.03	+0.000003
100%	3.700	-10	1,880,000,097	+97.08	+0.05	+0.000005
100%	3.700	0	1,880,000,036	+35.74	+0.02	+0.000002
100%	3.700	+10	1,880,000,032	+32.09	+0.02	+0.000002
100%	3.700	+20	1,879,999,985	-15.17	-0.01	-0.000001
100%	3.700	+30	1,879,999,968	-32.12	-0.02	-0.000002
100%	3.700	+40	1,879,999,969	-30.96	-0.02	-0.000002
100%	3.700	+50	1,879,999,979	-20.95	-0.01	-0.000001
115%	4.225	+20	1,879,999,963	-37.39	-0.02	-0.000002
Battery End	3.350	+20	1,879,999,953	-46.72	-0.02	-0.000002



## WCDMA Band II, Channel 9400 (836.4MHz)

Voltage %	Power V <sub>DC</sub>	Temp °C	Frequency Hz	Max Freq Dev Hz	Freq Dev ppm	Deviation %
100%	3.700	+20 (Ref)	1,879,999,959	-40.86	-0.02	-0.000002
100%	3.700	-30	1,879,999,960	-40.28	-0.02	-0.000002
100%	3.700	-20	1,880,000,013	+13.41	+0.01	+0.000001
100%	3.700	-10	1,880,000,014	+13.60	+0.01	+0.000001
100%	3.700	0	1,880,000,025	+25.06	+0.01	+0.000001
100%	3.700	+10	1,880,000,028	+27.89	+0.01	+0.000001
100%	3.700	+20	1,879,999,964	-35.96	-0.02	-0.000002
100%	3.700	+30	1,880,000,033	+32.63	+0.02	+0.000002
100%	3.700	+40	1,879,999,975	-25.42	-0.01	-0.000001
100%	3.700	+50	1,880,000,030	+30.49	+0.02	+0.000002
115%	4.225	+20	1,879,999,972	-27.57	-0.01	-0.000001
Battery End	3.350	+20	1,879,999,971	-28.81	-0.02	-0.000002



## 5 Revision History

Revision Level	Description of changes	Revision Date
0	Initial release	10 Sept 2013
1	Added IC section references to Section 1 Summary Corrected frequency range indications in Section 2.3 Added missing WCDMA EIRP data in Section 4.5.5	17 Dec 2013