



**MOTOROLA**

**PERSONAL COMMUNICATIONS SECTOR**

**PRODUCT SAFETY AND COMPLIANCE  
EMC LABORATORY**

**EMC TEST REPORT**

**Test Report Number** – 14583/14670-1

**Report Date** – August 31, 2004

The test results contained herein relate only to the model(s) identified. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics.

As the responsible EMC Engineer, I hereby declare that the equipment tested as specified in this report conforms to the requirements indicated.

A handwritten signature in blue ink that reads "Michael E. Hill".

Signature

Name: Michael E. Hill

Title: Senior Electrical Engineer

Date: 9/1/2004

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**Test Report Details**

Tests Performed By: Motorola Personal Communications Sector  
Product Safety and Compliance Group  
600 North US Hwy 45  
Libertyville, IL 60048  
PH (847) 523-6167 Fax (847) 523-4538  
Motorola PCS FRN: 0004321311  
FCC Registration Number: 316588  
Industry Canada Number: IC3908

Tests Requested By: Motorola Inc.  
Personal Communications Sector  
600 North US Hwy 45  
Libertyville, IL 60048

Product Type: Cellular Phone

Signaling Capability: GSM 850, 1900, Bluetooth, WLAN  
Model Number: MPX

Version: SGUG0156AA

Serial Numbers: 004400007088451, 004400007088022,  
004400007088485, 004400007088477,  
004400007088816,004400007088840,  
004400007546334

Testing Complete Date: August 23, 2004

**Applicable Standards**

All tests and measurements indicated in this document were performed in accordance with the Code of Federal Regulations Title 47 Part 2, Sub-part J as well as the following parts:

- Part 15 Subpart B – Unintentional Radiators
- Part 22 Subpart H - Public Mobile Services
- Part 24 - Personal Communications Services
- Part 90 - Private Land Mobile Radio Service

Applicable Standards: TIA EIA 137-A, TIA EIA 98-C, ANSI 63.4 2001, RSS-118 (AMPS), RSS-128 (TDMA), RSS-129 (CDMA), RSS-133 (PCS)

**Summary of Testing**

Test #	Test Name	Pass/Fail
1	RF Power Output	NA
2	ERP (Effective Radiated Power)	NA
3	Modulation Characteristics	Pass
4	Occupied Bandwidth	Pass
5	Spurious Emissions at Antenna Terminal	Pass
6	Field Strength of Spurious Emissions	Pass
7	Frequency Stability	Pass
8	Field Strength of Spurious Emissions from Unintentional Radiators	Pass

Test #	Test Name	Margin with respect to the Limit
1	RF Power Output	NA
2	ERP (Effective Radiated Power)	NA
3	Modulation Characteristics	NA
4	Occupied Bandwidth	See Plots
5	Spurious Emissions at Antenna Terminal	41.2 dB
6	Field Strength of Spurious Emissions	0.7 dB
7	Frequency Stability	100.00 Hz
8	Field Strength of Spurious Emissions from Unintentional Radiators	13.2 dB

The margin with respect to the limit is the minimum margin for all modes and bands. ( ) indicates the margin at which the product exceeds the limit.

**General and Special Conditions**

The EUT was tested using a fully charged battery when applicable. Where a battery could not be used due to the need for a controlled variation of input voltage, an external power supply was utilized.

All testing was done in an indoor controlled environment with an average temperature of 22° C and relative humidity of 50%.

**Equipment and Cable Configurations**

The EUT was tested in a stand-alone configuration that is representative of typical use.

**Measuring Equipment and Calibration Information**

<b>Manufacturer</b>	<b>Equipment Type</b>	<b>Model No.</b>	<b>Serial No.</b>	<b>Cal. Due Date</b>
Rohde & Schwarz	Receiver	ESI26	838786/010	5/17/2005
Hewlett-Packard	EMC Analyzer	8593EM	3536A00118	10/2/2004
Hewlett-Packard	EMC Analyzer	7405	US39440191	11/13/2004
Miteq	Preamplifier 0.1-26.5GHz	NSP2650-NF-S	966350	1/8/2005
ETS	DRG Horn Antenna	3115	6222	<b>9/29/2004</b>
A.H. Systems Inc.	DRG Horn Antenna	SAS-2--/571	365	12/17/2004
ETS	Log-Periodic Antenna	3148	1188	3/5/2005
ETS	Biconical Antenna	3110B	3370	11/14/2004
Attenuator	Weinschel	AS-6	6675	10/14/2004
Attenuator	Weinschel	AS-6	6677	11/4/2004
Rohde & Schwarz	Mobile Test Set	CMD 80	DE29008	N/A
Hewlett-Packard	Signal Generator	83623B	3844A01195	6/20/2005
Thermotron	Environmental Chamber	S-4	31580	1/5/2005
Hewlett-Packard	Pre-Amplifier	8347A	3307A02001	11/4/2004
Agilent	Power Meter	EE4418B	GB40206388	12/5/2004
Agilent	Power Sensor	E4412B	US38486321	11/23/2004
Hewlett-Packard	Pre-Amplifier	8447F	2805A03419	5/19/2005

All equipment is on a one-year calibration cycle.

**Measurement Procedures and Data**

**RF POWER OUTPUT**

**Measurement Procedure**

The RF output port of the equipment under test is directly coupled to the input of a HPE4406A Vector Signal Analyzer through a 10dB passive attenuator, adaptor (if needed), and specialized RF connector. The peak power output is measured for all channels.

CFR47 Part 2.1046

**Measurement Results**

**GSM 850**

Frequency (MHz)	Power (dBm)
824.20	33.67
836.60	33.87
848.80	33.65

**GSM 1900**

Frequency (MHz)	Power (dBm)
1850.20	29.72
1880.00	29.43
1909.80	29.80

## RADIATED (ERP)

### Measurement Procedure

The phone was tested in a 16' anechoic chamber with a 2-axis position system that permits taking complete spherical scans of the EUT's radiation patterns. For all tests, the phone was supported in a free space type environment, vertically oriented in the chamber. Tests were done for GSM 850 three frequencies (824.2, 836.6 and 848.8 MHz) and GSM 1900 three frequencies (1850.2, 1880.00, and 1909.80 MHz) with antenna stubby.

GSM measurements were made with the phone placed in a call using the HP8922M mobile station test set. The phone was weakly coupled to the test set and configured to transmit in full data rate mode. Radiated power was measured at each 15 degree step. The radiated power was measured using a Gigatronics 8542C power meter in "Burst Avg" mode. From these measurements, the software calculates the angle at which maximum radiated power occurs for each case, and the radiated power at this angle was extracted from the data. The max radiated power results for the GKRMPX001 follows, as EIRP in dBm. To get ERP (effective radiated power referenced to a half-wave dipole), subtract 2.1 dB from these numbers.

### Measurement Results

\* Data not supplied by EMC Lab

#### **GSM 850**

824.22 MHz: 33.22 dBm

836.66 MHz: 33.47 dBm

848.88 MHz: 32.95 dBm

#### **GSM 1900**

1850.2 MHz: 32.12 dBm

1880.0 MHz: 31.95 dBm

1909.8 MHz: 31.67 dBm

For all measurements, calibration was performed via gain substitution with a half-wave dipole.

Max EIRP in GSM 850 is 33.47 dBm (**max ERP is 31.37dBm**).

**Max EIRP in GSM 1900 is 32.12 dBm** (max ERP is 30.02 dBm).

## OCCUPIED BANDWIDTH

CFR47 Part 2.1049, 24.238

### Measurement Procedure

The RF output port of the equipment under test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. The amplitude of the spectrum analyzer is corrected for the attenuator and any other applicable losses. The analyzer is set for Peak Detector and each trace is set for Max Hold. A fully charged battery was used for the supply voltage.

The middle channel within the designated frequency block was measured. For digital modulation, the lower and upper band edge plots are displayed.

The plotted data shown for the band edge measurements is representative of data taken with a true 3 kHz resolution bandwidth filter. The raw data was taken using a 1 kHz resolution bandwidth and was integrated to produce a response representative of data taken using a true 3 kHz resolution bandwidth filter.

The occupied bandwidth was measured by integrating over 1001 points to determine the bandwidth occupied by 99 % of the transmitted power.

### Instrument Settings

Plot	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Sweep Points (#)	Trace Mode	Detector	Samples (≥ #)
Reference Plot - GSM 1900	300	Auto	1001	Max Hold	Peak	30
OCBW - GSM 1900	3	Auto	1001	Max Hold	Peak	30
Lower Band Edge - GSM 1900	1	Auto	2004	Max Hold	Peak	30
Upper Band Edge - GSM 1900	1	Auto	2004	Max Hold	Peak	30

### Measurement Results



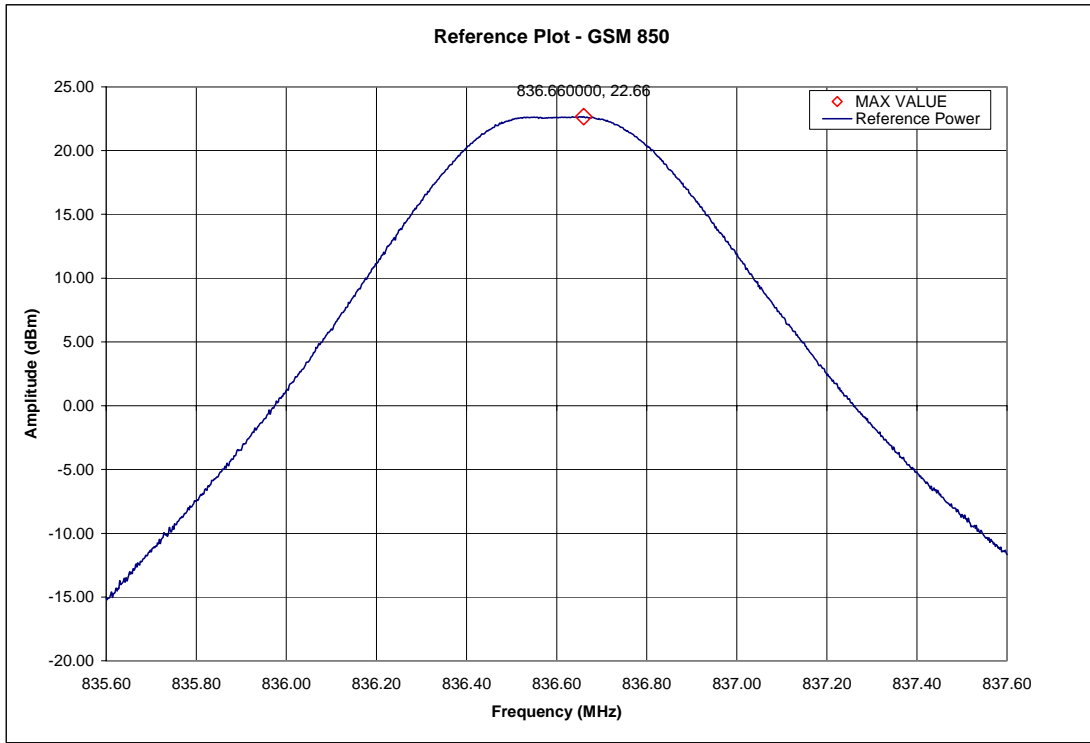
**Measurement Summary**

<b>Band</b>	<b>Value Measured</b>	<b>Value</b>	<b>Units</b>	<b>Frequency (MHz)</b>
Cellular	Reference Power	22.66	MHz	836.660000
Cellular	OCBW	237.00	kHz	
Cellular	Lower Band Edge Emissions	-26.09	dBm	823.998500
Cellular	Upper Band Edge Emissions	-25.10	dBm	849.016500
PCS	Reference Power	30.02	MHz	1879.938000
PCS	OCBW	235.50	kHz	
PCS	Lower Band Edge Emissions	-19.54	dBm	1849.995500
PCS	Upper Band Edge Emissions	-19.52	dBm	1910.004500

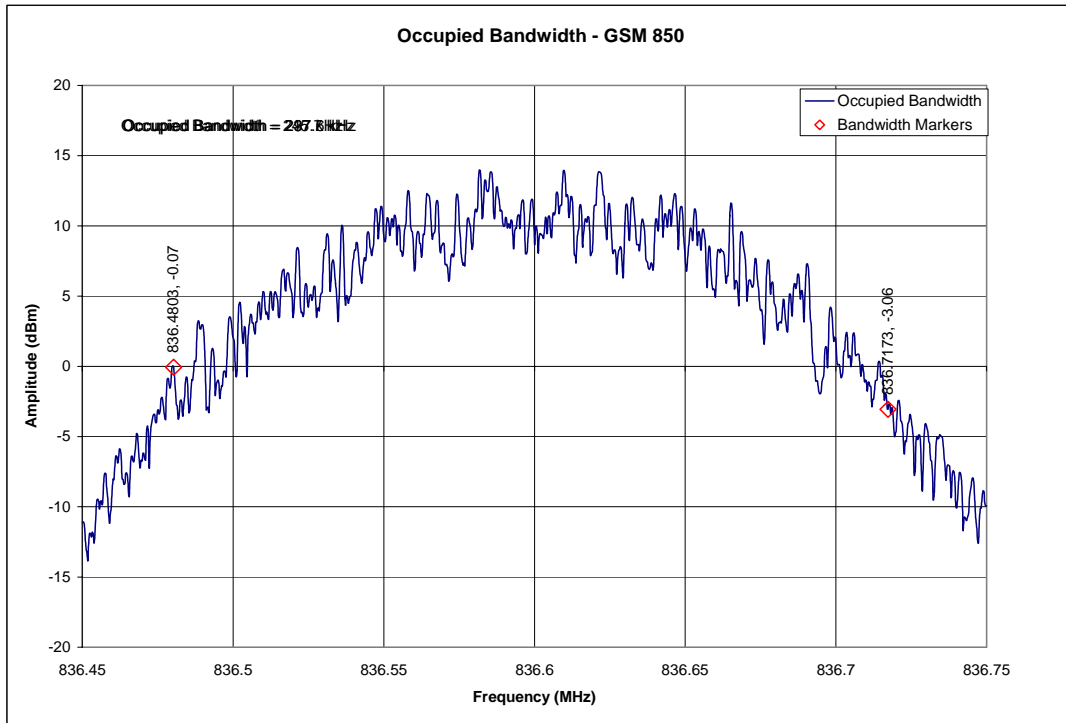
Attached

### Measurement Results – GSM 850

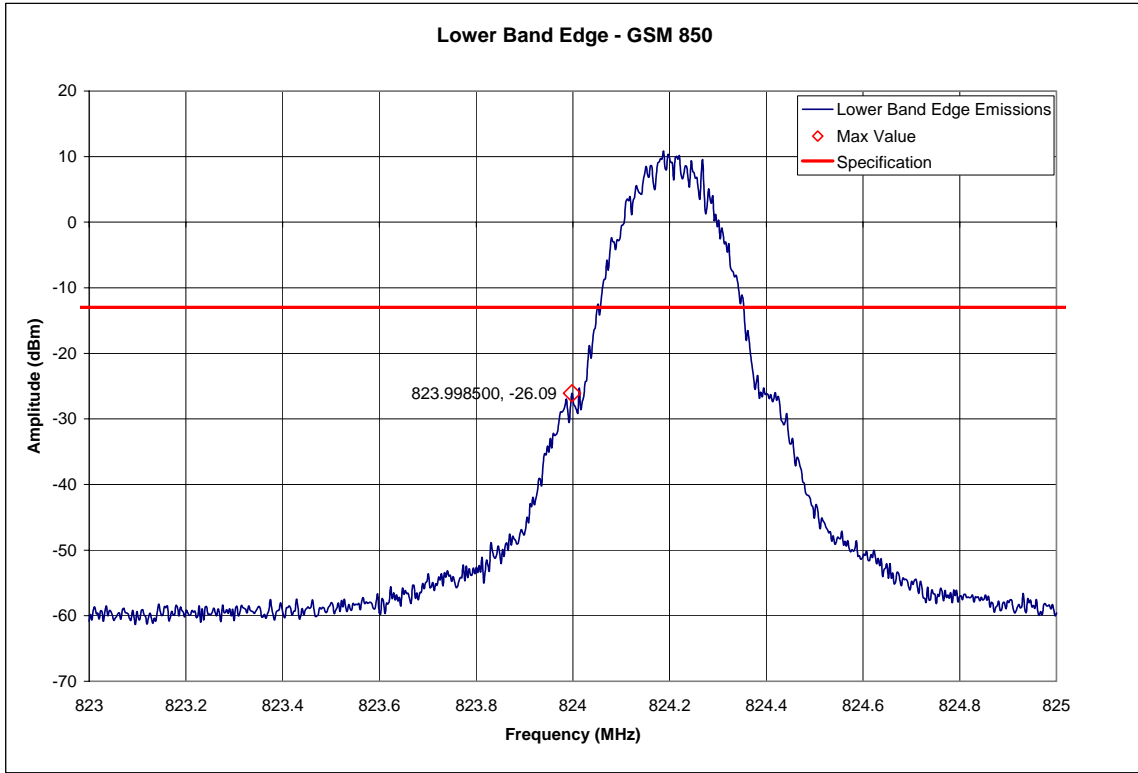
#### GSM/PCS 850 Reference Level



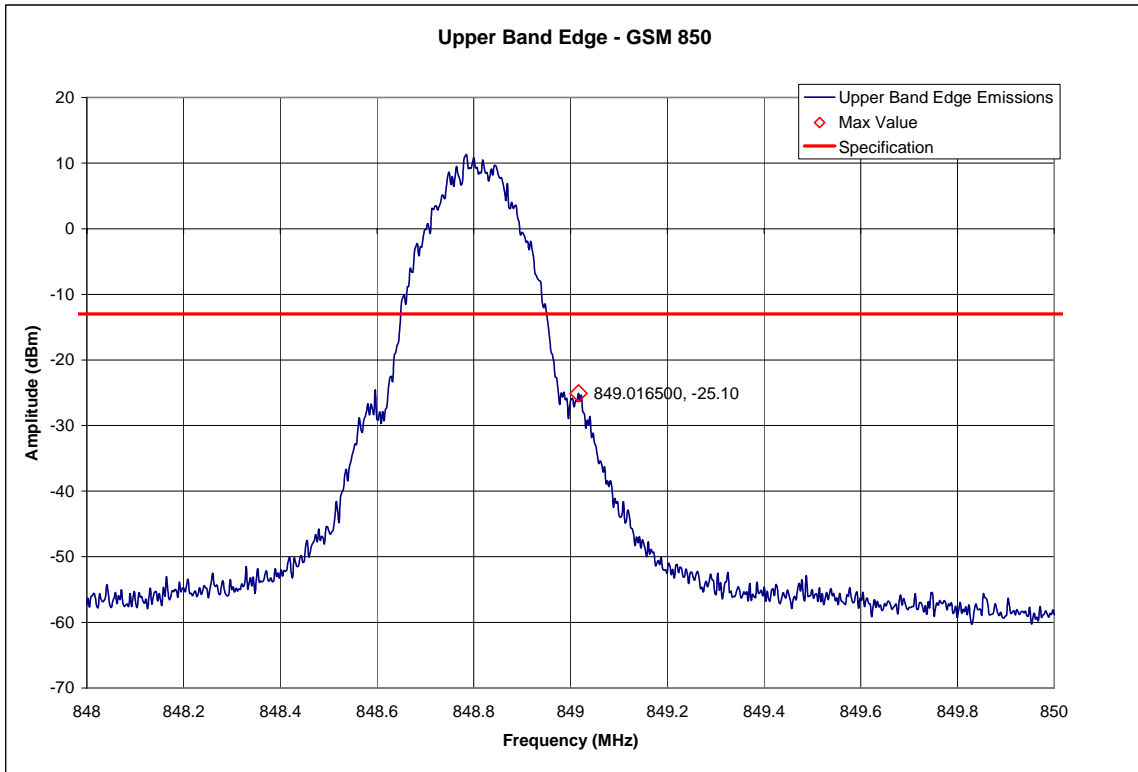
#### GSM/Cellular 850 Occupied Bandwidth



GSM/Cellular 850 Ch128 Lower Band Edge

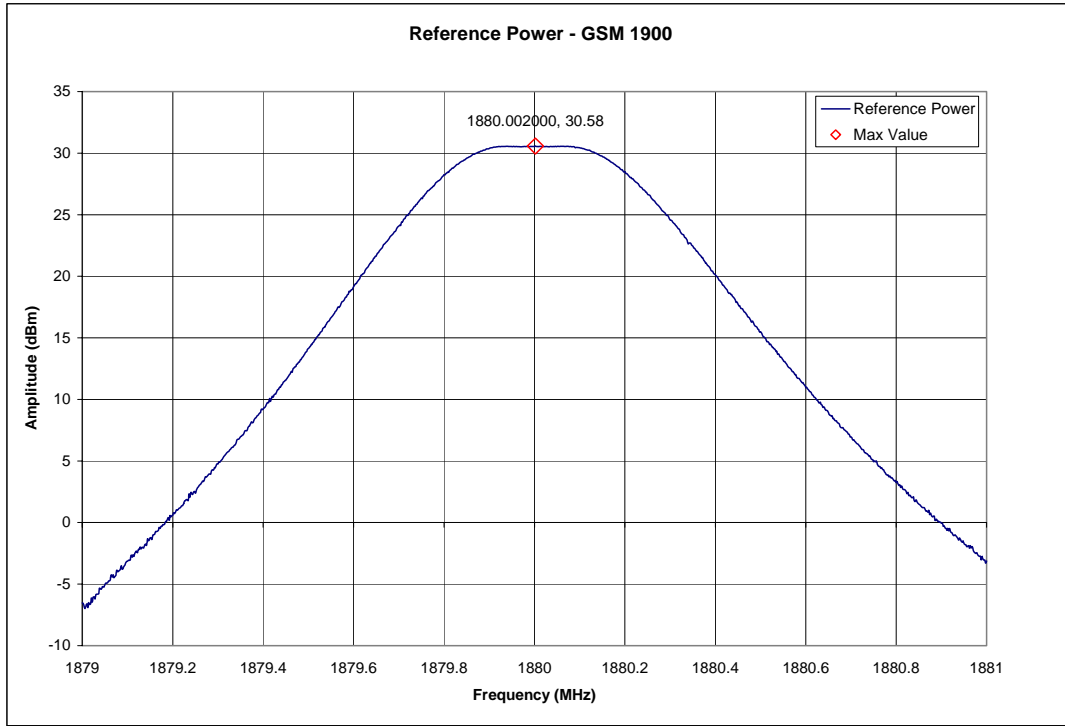


GSM/Cellular 1900 Ch251 Upper Band Edge

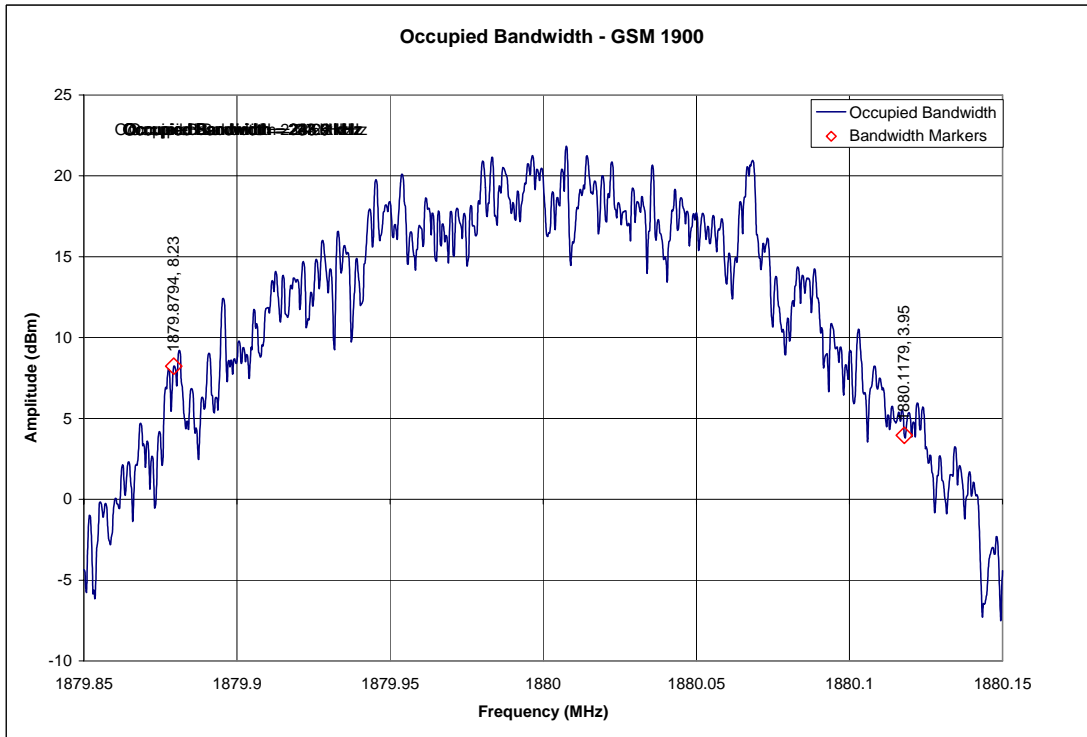


### Measurement Results – GSM 1900

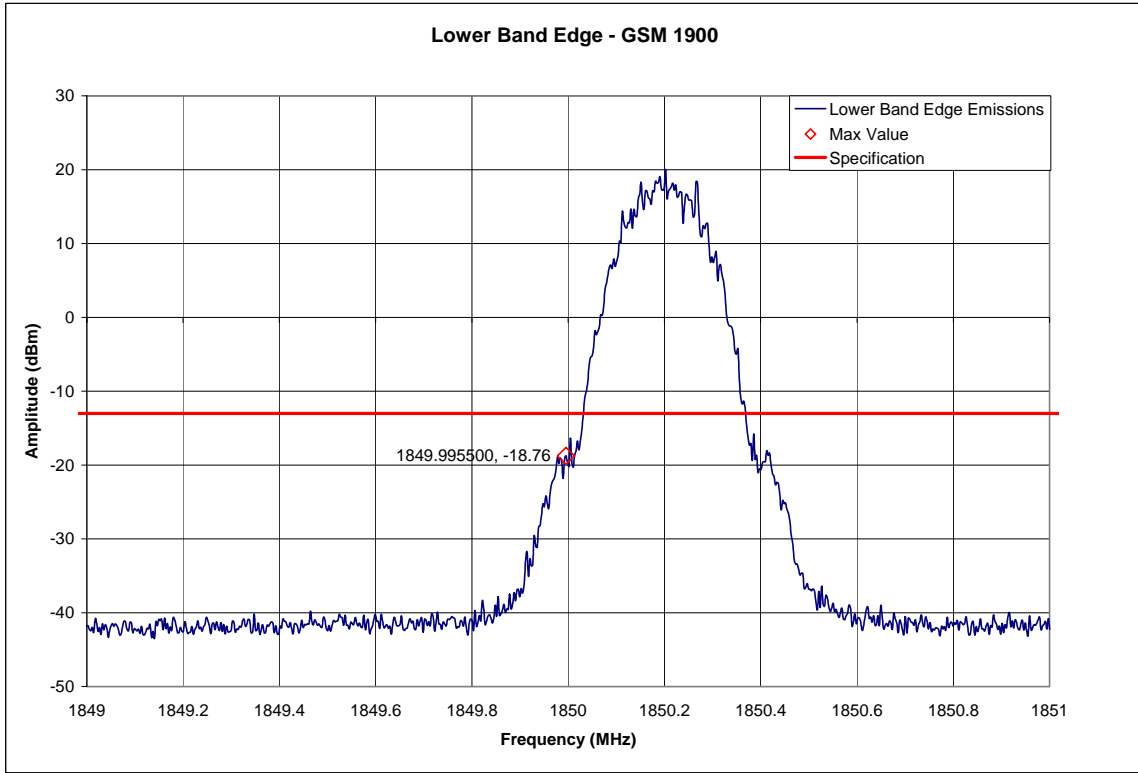
#### GSM/PCS 1900 Reference Level



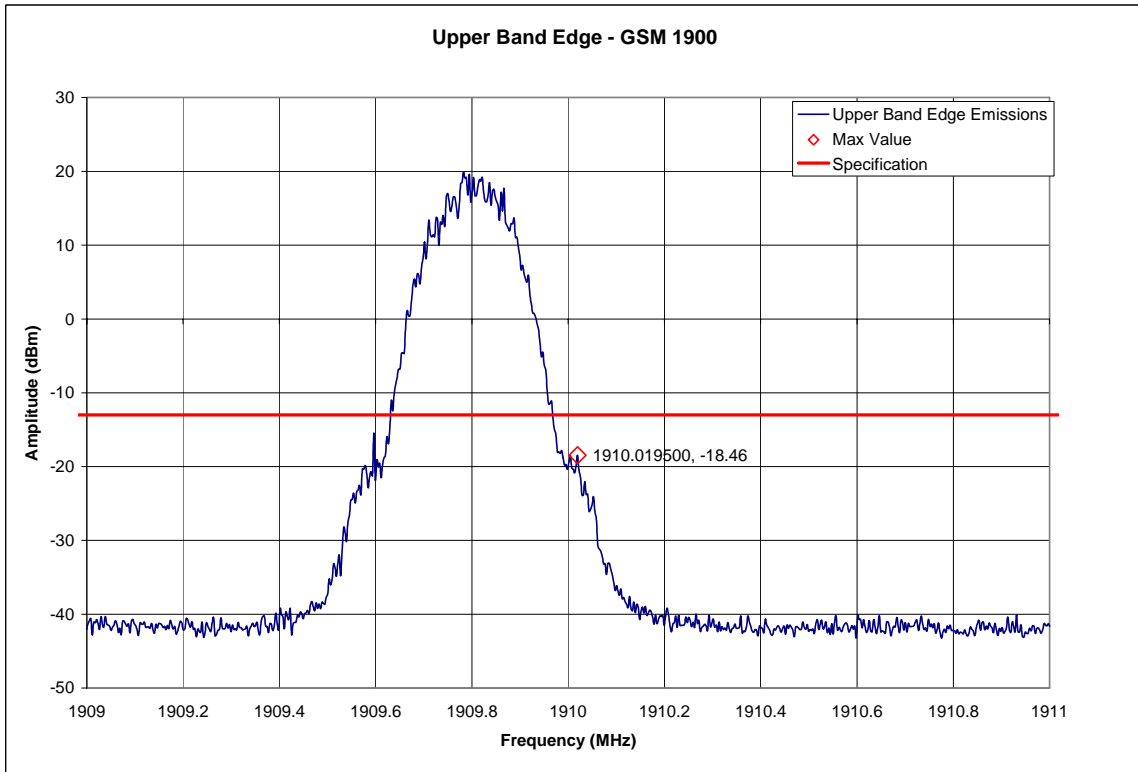
#### GSM/PCS 1900 Occupied Bandwidth



### GSM/PCS 1900 Ch512 Lower Band Edge



### GSM/PCS 1900 Ch810 Upper Band Edge



## **SPURIOUS EMISSIONS AT ANTENNA TERMINALS**

CFR47 Part 2.1051, 24.238

### **Measurement Procedure**

The RF output port of the Equipment Under Test is directly coupled to the input of the EMC analyzer through a specialized RF connector and a 10dB passive attenuator. A fully charged battery was used for the supply voltage.

The spectrum was investigated from the lowest frequency signal generated, without going below 9 kHz, up to at least the tenth harmonic of the fundamental or 40 GHz, whichever is lower.

Measurements were made at the middle channel within the frequency band and within the base station frequency range (869-894 MHz) for cellular.

The spectrum analyzer settings were as follows:

Units	dBm
Divisions	10 dB
Resolution Bandwidth	1 MHz
Video Bandwidth (AVG)	Auto
Sweep Time	Auto

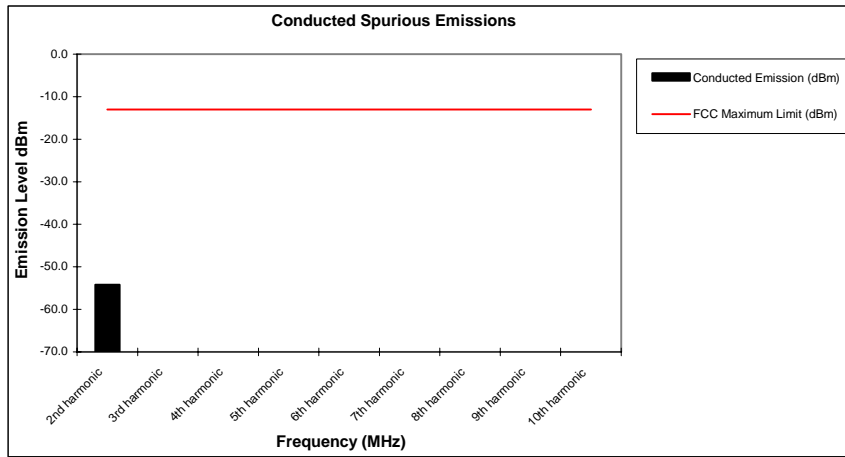
### **Measurement Results**

Attached

**Measurement Results**  
**Modulation: GSM 850**

**Conducted Spurious and Harmonic Emissions**

Harmonic of Fundamental	FCC Maximum Limit (dBm)	Conducted Emission (dBm)
2nd harmonic	-13	-54.2
3rd harmonic	-13	*
4th harmonic	-13	*
5th harmonic	-13	*
6th harmonic	-13	*
7th harmonic	-13	*
8th harmonic	-13	*
9th harmonic	-13	*
10th harmonic	-13	*



Notes:

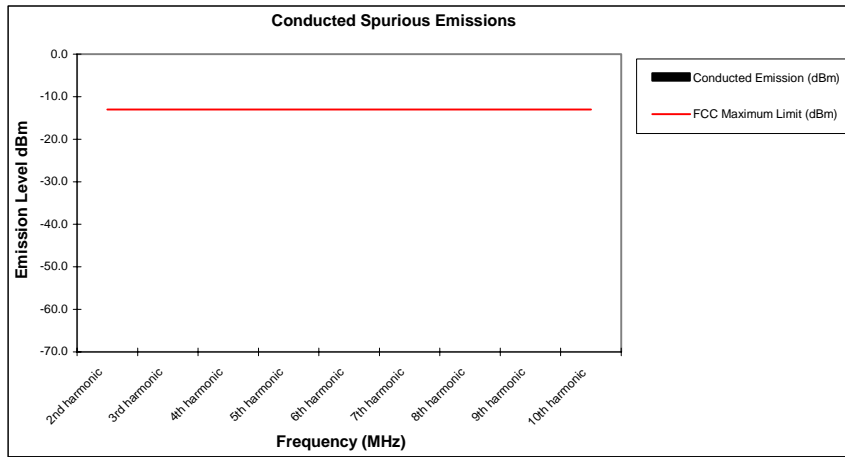
1. \* Indicates the spurious emission could not be detected due to noise limitations or ambients.
2. Each emission reported reflects the highest absolute level at the specific harmonic for the low, mid, and high channels at maximum power.
3. The Spectrum was investigated from 9 kHz to the tenth harmonic of the fundamental.

**Measurement Results**

**Modulation: GSM 1900**

**Conducted Spurious and Harmonic Emissions**

Harmonic of Fundamental	FCC Maximum Limit (dBm)	Conducted Emission (dBm)
2nd harmonic	-13	*
3rd harmonic	-13	*
4th harmonic	-13	*
5th harmonic	-13	*
6th harmonic	-13	*
7th harmonic	-13	*
8th harmonic	-13	*
9th harmonic	-13	*
10th harmonic	-13	*



Notes:

1. \* Indicates the spurious emission could not be detected due to noise limitations or ambients.
2. Each emission reported reflects the highest absolute level at the specific harmonic for the low, mid, and high channels at maximum power.
3. The Spectrum was investigated from 9 kHz to the tenth harmonic of the fundamental.



**FIELD STRENGTH OF SPURIOUS EMISSIONS**

CFR47 Part 2.1053, 22.917, 24.238

**Measurement Procedure**

The equipment under test is placed inside the semi-anechoic chamber on a wooden table at the turntable center. For each spurious frequency, the antenna mast is raised and lowered from 1 to 4 meters and the turntable is rotated 360 degrees to obtain a maximum reading on the spectrum analyzer. This is repeated for both horizontal and vertical polarizations of the receive antenna.

The equipment under test is then replaced with a substitution antenna fed by a signal generator. With the signal generator tuned to a particular spurious frequency, the antenna mast is raised and lowered from 1 to 4 meters to obtain a maximum reading at the spectrum analyzer. The output of the signal generator is then adjusted until a reading identical to that obtained with the actual transmitter is achieved.

The power in dBm of each spurious emission is calculated by correcting the signal generator level for cable loss and gain of the substitution antenna referenced to a dipole. A fully charged battery was used for the supply voltage.

The settings of the receiver were as follows:

Units	dBm
Divisions	5 dB
Resolution Bandwidth	1 MHz
Video Bandwidth (AVG)	Auto
Sweep Time	Auto

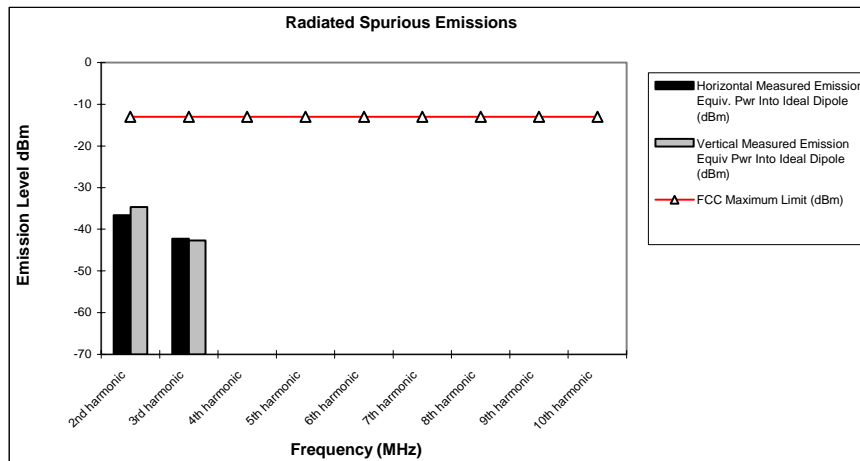
**Measurement Results**

Attached

**Measurement Results**  
**Modulation: GSM 850**

**Radiated Spurious and Harmonic Emissions**

Frequency (MHz)	FCC Maximum Limit (dBm)	Horizontal Measured Emission Equiv. Pwr Into Ideal Dipole (dBm)	Vertical Measured Emission Equiv Pwr Into Ideal Dipole (dBm)
2nd harmonic	-13	-36.6	-34.7
3rd harmonic	-13	-42.3	-42.7
4th harmonic	-13	*	*
5th harmonic	-13	*	*
6th harmonic	-13	*	*
7th harmonic	-13	*	*
8th harmonic	-13	*	*
9th harmonic	-13	*	*
10th harmonic	-13	*	*



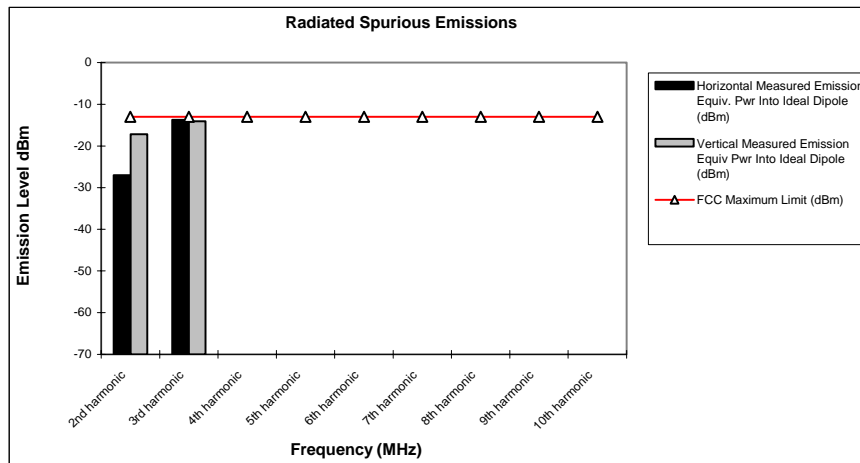
Notes:

- \* Indicates the spurious emission could not be detected due to noise limitations or ambients.
- Each emission reported reflects the highest absolute level at the specific harmonic for the low, mid, and high channels at maximum power.
- The Spectrum was investigated from 30 MHz to the tenth harmonic of the fundamental.

**Measurement Results**  
**Modulation: GSM 1900**

**Radiated Spurious and Harmonic Emissions**

Frequency (MHz)	FCC Maximum Limit (dBm)	Horizontal Measured Emission Equiv. Pwr Into Ideal Dipole (dBm)	Vertical Measured Emission Equiv Pwr Into Ideal Dipole (dBm)
2nd harmonic	-13	-27.0	-17.2
3rd harmonic	-13	-13.7	-14.1
4th harmonic	-13	*	*
5th harmonic	-13	*	*
6th harmonic	-13	*	*
7th harmonic	-13	*	*
8th harmonic	-13	*	*
9th harmonic	-13	*	*
10th harmonic	-13	*	*



Notes:

1. \* Indicates the spurious emission could not be detected due to noise limitations or ambients.
2. Each emission reported reflects the highest absolute level at the specific harmonic for the low, mid, and high channels at maximum power.
3. The Spectrum was investigated from 30 MHz to the tenth harmonic of the fundamental.

## FREQUENCY STABILITY

CFR47 Part 2.1055, 24.235

### **Measurement Procedure**

The equipment under test is placed in an environmental chamber. The antenna port of the Equipment Under Test is directly coupled to the input of the measurement equipment through a specialized RF connector. A power supply is attached as the primary voltage supply.

Frequency measurements are made at the extremes of the temperature range -30° C to +60° C and at intervals of 10° C with the primary supply voltage set to the nominal battery operating voltage. A period of time sufficient to stabilize all components of the equipment is allowed at each frequency measurement. The maximum variation of frequency is measured.

At room temperature, the primary supply voltage is reduced to the battery operating endpoint of the equipment under test. The maximum variation of frequency is measured. A battery eliminator was used for the input supply voltage.

### **Measurement Results**

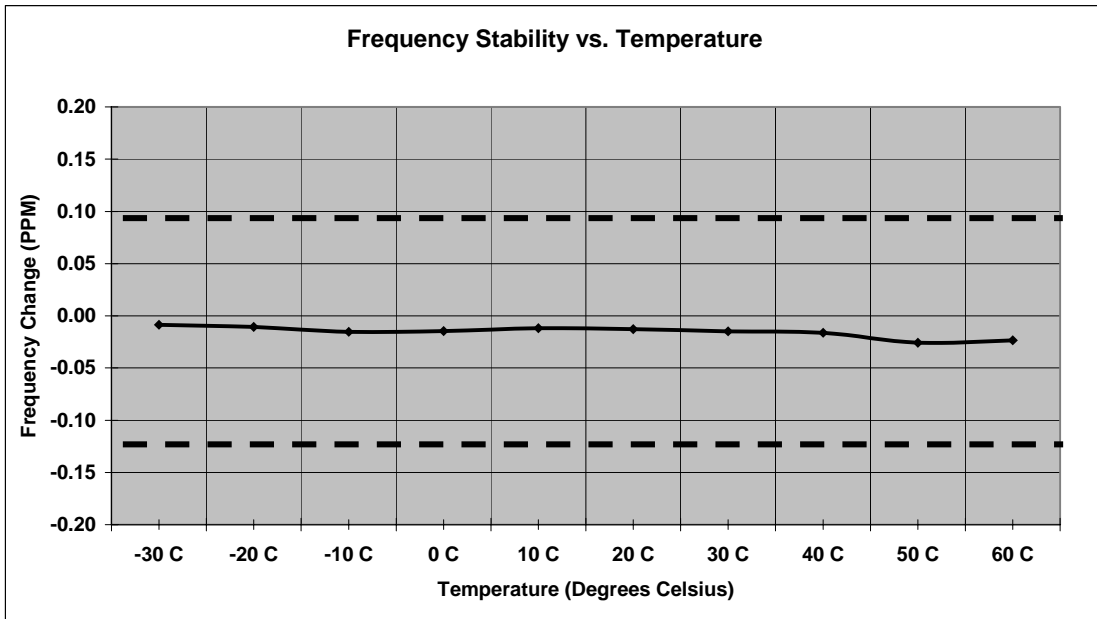
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**Measurement Results**  
**Modulation: GSM 850**

**Frequency Stability**

**Mode:** GSM 850      **Operating Frequency:** 836.6 MHz  
**Channel:** 190      **Deviation Limit (PPM):** 0.1 ppm

Temperature C	Frequency Error HZ	Frequency Error (PPM)	Voltage (%)	Voltage (VDC)
-30 C	-16.18	-0.009	100%	3.70
-20 C	-19.94	-0.011	100%	3.70
-10 C	-28.73	-0.015	100%	3.70
0 C	-27.66	-0.015	100%	3.70
10 C	-22.12	-0.012	100%	3.70
20 C	-23.95	-0.013	100%	3.70
30 C	-27.82	-0.015	100%	3.70
40 C	-30.69	-0.016	100%	3.70
50 C	-48.55	-0.026	100%	3.70
60 C	-44.08	-0.023	100%	3.70
20 C	-41.74	-0.022	Battery Endpoint	3.20

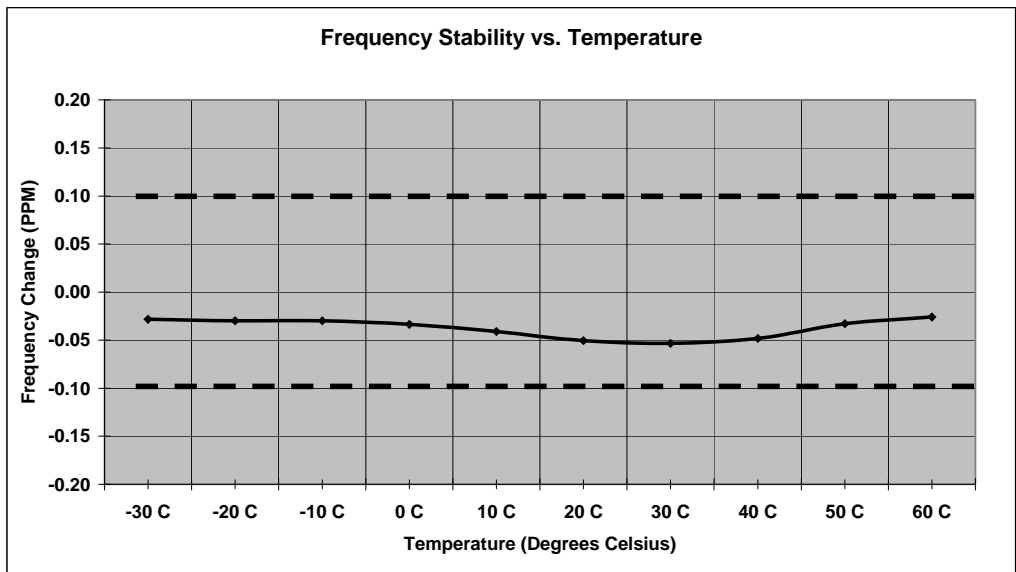


**Measurement Results**  
**Modulation: GSM1900**

**Frequency Stability**

Mode: GSM 1900      Operating Frequency: 1880.0 MHz  
 Channel: 661      Deviation Limit (PPM): 0.1 ppm

Temperature C	Frequency Error HZ	Frequency Error (PPM)	Voltage (%)	Voltage (VDC)
-30 C	-53.00	-0.028	100%	3.60
-20 C	-56.00	-0.030	100%	3.60
-10 C	-56.00	-0.030	100%	3.60
0 C	-63.00	-0.034	100%	3.60
10 C	-77.00	-0.041	100%	3.60
20 C	-95.00	-0.051	100%	3.60
30 C	-100.00	-0.053	100%	3.60
40 C	-90.50	-0.048	100%	3.60
50 C	-62.00	-0.033	100%	3.60
60 C	-49.00	-0.026	100%	3.60
20 C	-89.00	-0.047	Battery Endpoint	3.35



## **FIELD STRENGTH OF EMISSIONS FROM UNINTENTIONAL RADIATORS**

CFR47 Part 15.109

### **Measurement Procedure**

The equipment under test is placed inside the semi-anechoic chamber on a wooden table at the turntable center. For each radiated emission, the antenna mast is raised and lowered from 1 to 4 meters and the turntable is rotated 360 degrees to obtain a maximum peak reading on the spectrum analyzer. The radiated emissions are then measured using an EMI receiver employing a CISPR quasi-peak detector function below 1000 MHz and an average detector function above 1000 MHz. This is repeated for both horizontal and vertical polarizations of the receive antenna. A fully charged battery was used for the supply voltage.

The field strength of each radiated emission is calculated by correcting the EMI receiver level for cable loss, amplifier gain, and antenna correction factors.

$$\text{Field Strength (dBuV/m)} = \text{EMI Receiver Level (dBuV)} + \text{Cable Loss (dB)} - \text{Amplifier Gain (dB)} + \text{Antenna Correction Factor (1/m)}$$

The receiver settings were as follows:

Units	dBuV
Resolution Bandwidth	30 kHz
Video Bandwidth (AVG)	Auto
Sweep Time	auto
Attenuation	10 dB

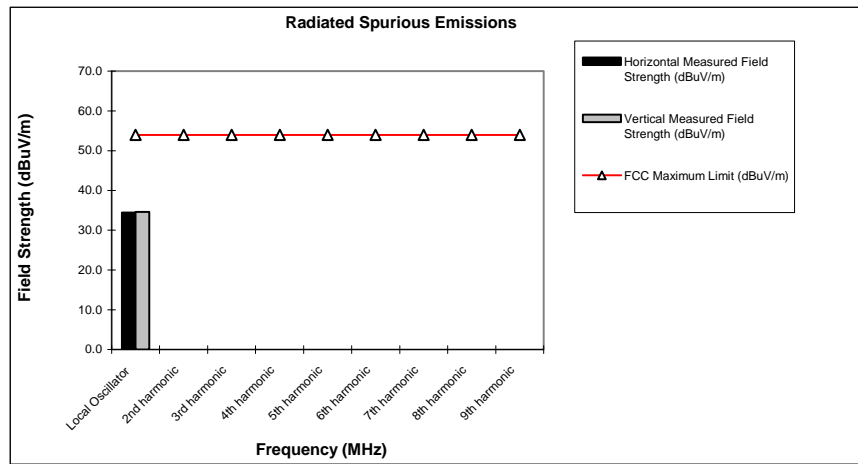
### **Measurement Results**

Attached

**Measurement Results**  
**Modulation: GSM 850**

**Receiver Radiated Spurious Emissions**

Frequency (MHz)	FCC Maximum Limit (dBuV/m)	Horizontal Measured Field Strength (dBuV/m)	Vertical Measured Field Strength (dBuV/m)
Local Oscillator	54	34.4	34.6
2nd harmonic	54	*	*
3rd harmonic	54	*	*
4th harmonic	54	*	*
5th harmonic	54	*	*
6th harmonic	54	*	*
7th harmonic	54	*	*
8th harmonic	54	*	*
9th harmonic	54	*	*
10th harmonic	54	*	*



Notes:

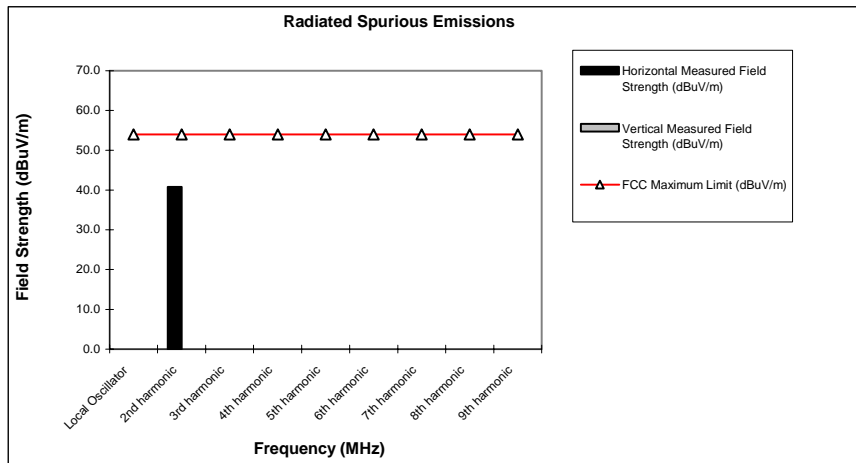
- \* Indicates the spurious emission could not be detected due to noise limitations or ambients.
- Each emission reported reflects the highest absolute level at the specific frequency for the low, mid, and high channels.



**Measurement Results**  
**Modulation: GSM 1900**

**Receiver Radiated Spurious Emissions**

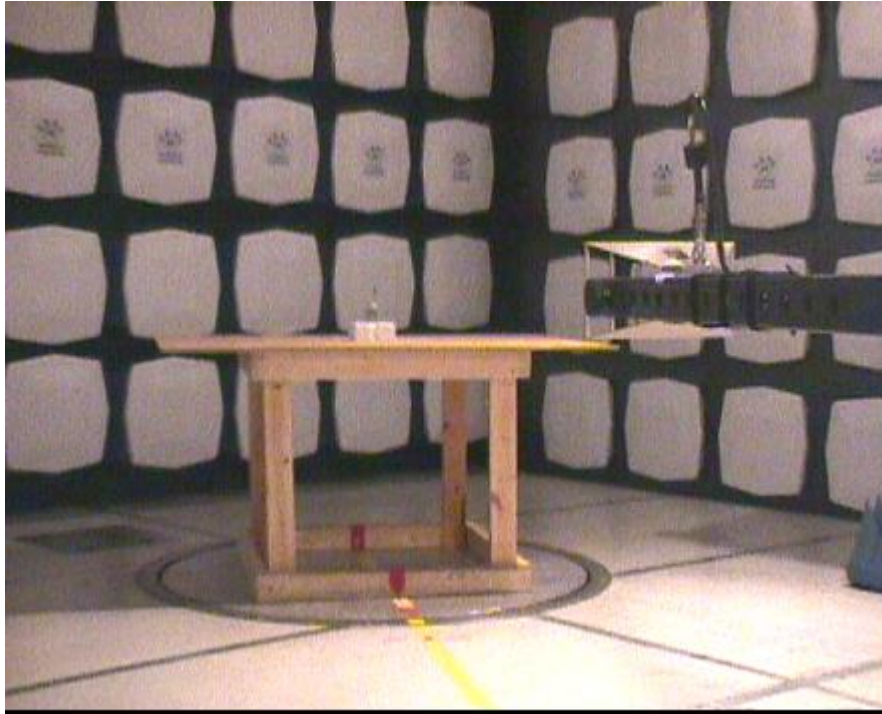
Frequency (MHz)	FCC Maximum Limit (dBuV/m)	Horizontal Measured Field Strength (dBuV/m)	Vertical Measured Field Strength (dBuV/m)
Local Oscillator	54	*	*
2nd harmonic	54	40.8	*
3rd harmonic	54	*	*
4th harmonic	54	*	*
5th harmonic	54	*	*
6th harmonic	54	*	*
7th harmonic	54	*	*
8th harmonic	54	*	*
9th harmonic	54	*	*
10th harmonic	54	*	*



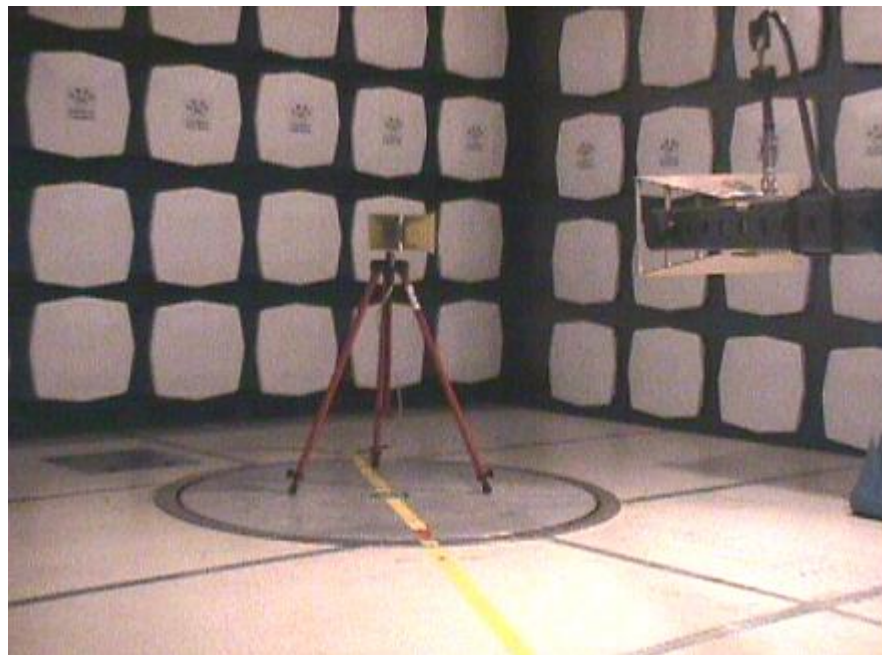
Notes:

- \* Indicates the spurious emission could not be detected due to noise limitations or ambients.
- Each emission reported reflects the highest absolute level at the specific frequency for the low, mid, and high channels.

**Appendix A – Radiated Emissions Test Setup Photos**



A.1 Radiated Emissions Measurement



A.2 Substitution Measurement

**End of Test Report**