



MOTOROLA

PERSONAL COMMUNICATIONS SECTOR

**PRODUCT SAFETY AND COMPLIANCE
EMC LABORATORY**

EMC TEST REPORT

Test Report Number – 7057-1

Report Date – July 22, 2002

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.

Signature

A handwritten signature in blue ink, appearing to read 'Kirby Munroe'.

Name: Kirby Munroe

Title: Compliance Engineer

Date : 7/22/2002

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Table of Contents

<u>Description</u>	<u>Page</u>
Test Report Details	3
Applicable Standards	3
Summary of Testing	4
General and Special Conditions	4
Equipment and Cable Configurations	4
Measuring Equipment and Calibration Information	5
Measurement Procedures and Data	
RF Power Output	6
Radiated Power (ERP)	7
Occupied Bandwidth	8
GSM 850 Mid Band Plot	9
GSM 850 Lower Band Edge	9
GSM 850 Upper Band Edge	10
GSM 1900 Mid Band Plot	11
GSM 1900 Lower Band Edge	11
GSM 1900 Upper Band Edge	12
Spurious Emissions at Antenna Terminals	13
GSM 850 Cellular Base Station Frequency Range Plot	14
Field Strength of Spurious Emissions	15
GSM 850 Tabular and Graphical Data	16
GSM 1900 Tabular and Graphical Data	17
Frequency Stability	18
GSM 850 Tabular and Graphical Data	19
GSM 1900 Tabular and Graphical Data	20
Field Strength of Spurious Emissions From Unintentional Radiators	21
GSM 850 Tabular and Graphical Data	22
GSM 1900 Tabular and Graphical Data	23
Appendix A - Radiated Emissions Test Setup Photos	
Figure A.1 – Radiated Emissions Measurement	24
Figure A.2 – Substitution Measurement	24

Test Report Details

Tests Performed By: Motorola Personal Communications Sector
Product Safety and Compliance Group
1500 Gateway Boulevard
Boynton Beach, FL 33426
PH (561) 739-2179 Fax (561) 739-2131
FCC Registration Number: 100000
Industry Canada Number: IC3908

Tests Requested By: Motorola Inc.
Personal Communications Sector
1500 Gateway Boulevard
Boynton Beach, FL 33426

Product Type: Cellular Phone

Signaling Capability: GSM 850, GSM 1900

Model Number: SUG2491AA

Serial Numbers: T720025, T720032, T720058

Received Date: 6/20/2002

Testing Start Date: 6/24/2002

Testing Complete Date: 7/18/2002

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: ANSI 63.4 2000, RSS-133

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	NA
5	Spurious Emissions at Antenna Terminal	>20 dB
6	Field Strength of Spurious Emissions	26.1 dB
7	Frequency Stability	57.7 Hz
8	Field Strength of Spurious Emissions from Unintentional Radiators	10.8 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

Manufacturer	Item	Item Version/	Serial	CALIBRATION
Name	Name	Model #	Number	DUE DATE
	Description			
Rohde & Schwarz	EMI Test Receiver	ESI26	838386/010	2/26/2003
Hewlett Packard	EMC Analyzer	E7405	US3944019	10/11/2002
Hewlett Packard	RF Amplifier	8347A	3307A02001	12/20/2002
Hewlett Packard	Pre-Amplifier	8449B	300BA00535	7/30/2002
ETS	DRG Horn Antenna	3115	6222	9/23/2002
A.H. Systems Inc.	DRG Horn Antenna	SAS-200/571	265	8/21/2002
A.H. Systems Inc.	DRG Horn Antenna	SAS-200/571	365	11/14/2002
ETS	Log-Periodic Antenna	3148	1188	12/6/2002
ETS	Log-Periodic Antenna	3148	1189	1/2/2003
ETS	Biconical Antenna	3110B	3369	12/15/2002
ETS	Biconical Antenna	3110B	3370	10/16/2002
Compliance Design	Biconical Antenna	B100	385	7/31/2002
Compliance Design	Biconical Antenna	B200	312	9/15/2002
Compliance Design	Biconical Antenna	B300	321	7/30/2002
Attenuator	Weinschel	AS-6	6675	10/10/2002
Attenuator	Weinschel	AS-6	6677	11/10/2002
Rohde & Schwarz	Mobile Test Set	CMD 80	DE29008	10/18/2002
Hewlett Packard	Signal Generator	83623B	3844A01195	1/16/2003
Thermotron	Environmental Chamber	S-4	31580	12/20/2002

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 8651A Gigatronix power meter with a 80701A power sensor through a specialized RF connector. The power output is measured for all channels.

CFR Part 2.1046

Measurement Results

* Data supplied by SAR Lab

GSM 850

Frequency (MHz)	Power (dBm)
824.2	29.44
836.4	29.52
848.8	29.52

GSM 1900

Frequency (MHz)	Power (dBm)
1850.2	29.74
1880.0	29.68
1909.8	29.77

RADIATED POWER (ERP)

Measurement Procedure

The phone was tested in Harvard Chamber 1, which is a 16' cubical anechoic chamber with a 2-axis positioner system that permits taking complete spherical scans of the AUT'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, 836.4, and 848.8) and GSM 1900 three frequencies (1850.2, 1880.0 and 1909.8 MHz) with antenna stubby.

GSM measurements were made with the phone placed into test mode. The phone was configured to transmit in full data rate mode. Radiated power was measured at every 15 degree step using a Gigatronics 8542C power meter in "Burst Avg" mode. The radiated power results follows, as EIRP in dBm. To get ERP (effective radiated power referenced to a half-wave dipole), subtract 2.1 dB from these numbers.

GSM 850:

824.2 MHz	29.07 dBm
836.4 MHz	29.45 dBm
848.8 MHz	29.71 dBm.

GSM 1900:

1850.2 MHz:	30.91 dBm
1880.0 MHz:	31.62 dBm
1909.8 MHz:	31.37 dBm

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

GSM 850 mode: Max EIRP is 29.71 dBm (**max ERP is 27.61 dBm**)

PCS 1900 mode: **Max EIRP is 31.62 dBm** (max ERP is 29.52 dBm)

OCCUPIED BANDWIDTH

CFR Part 2.1049, 22.917, 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. A fully charged battery was used for the supply voltage.

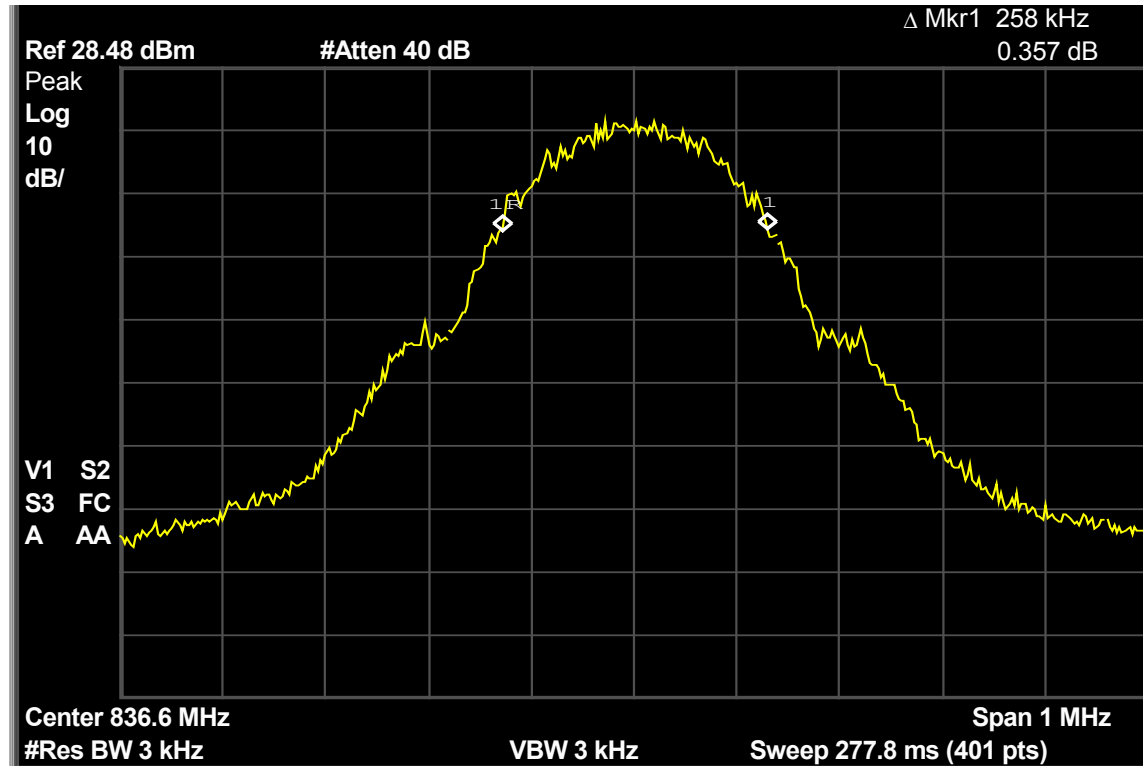
The middle channel within the designated frequency block was measured. For digital modulation, the lower and upper band edge plots are displayed.

Measurement Results

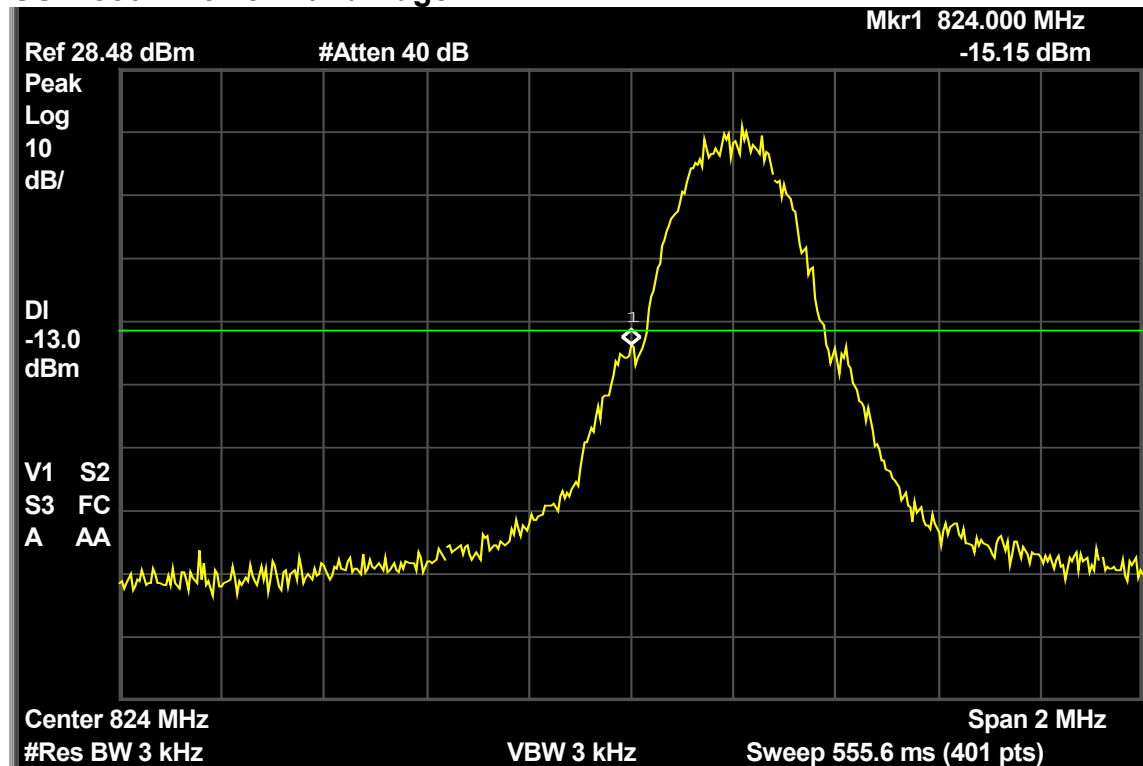
Attached

Measurement Results – GSM 850

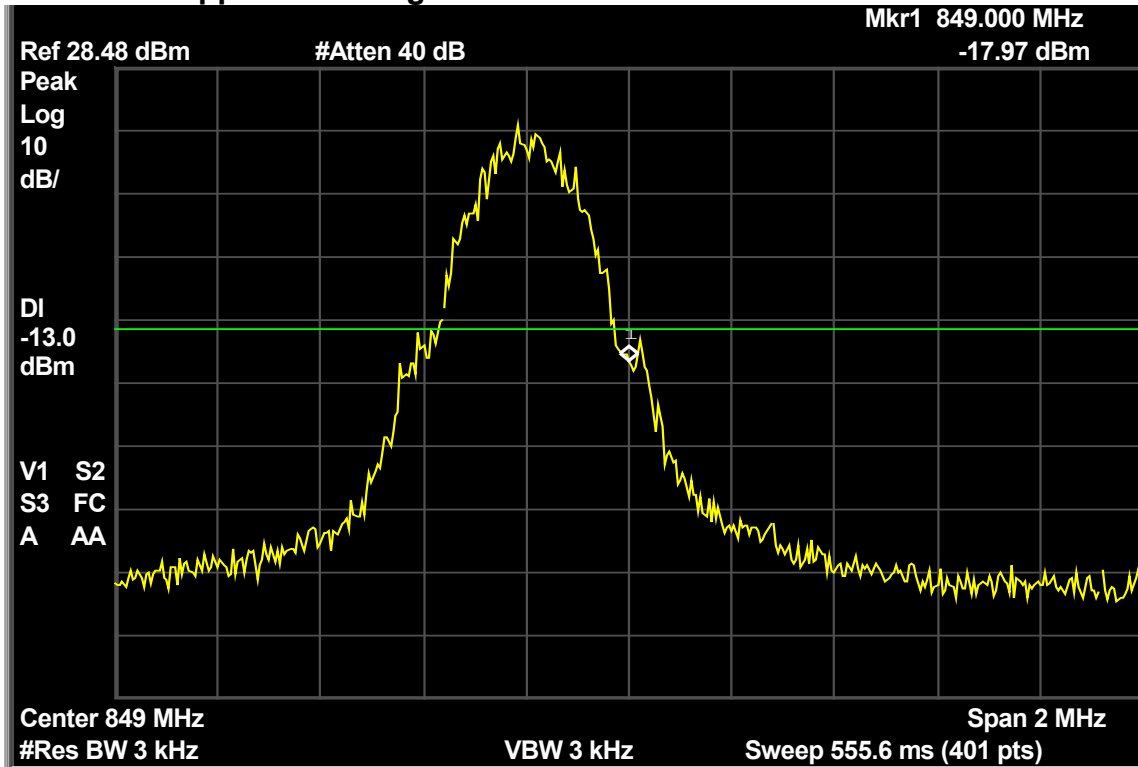
GSM 850



GSM 850 – Lower Band Edge

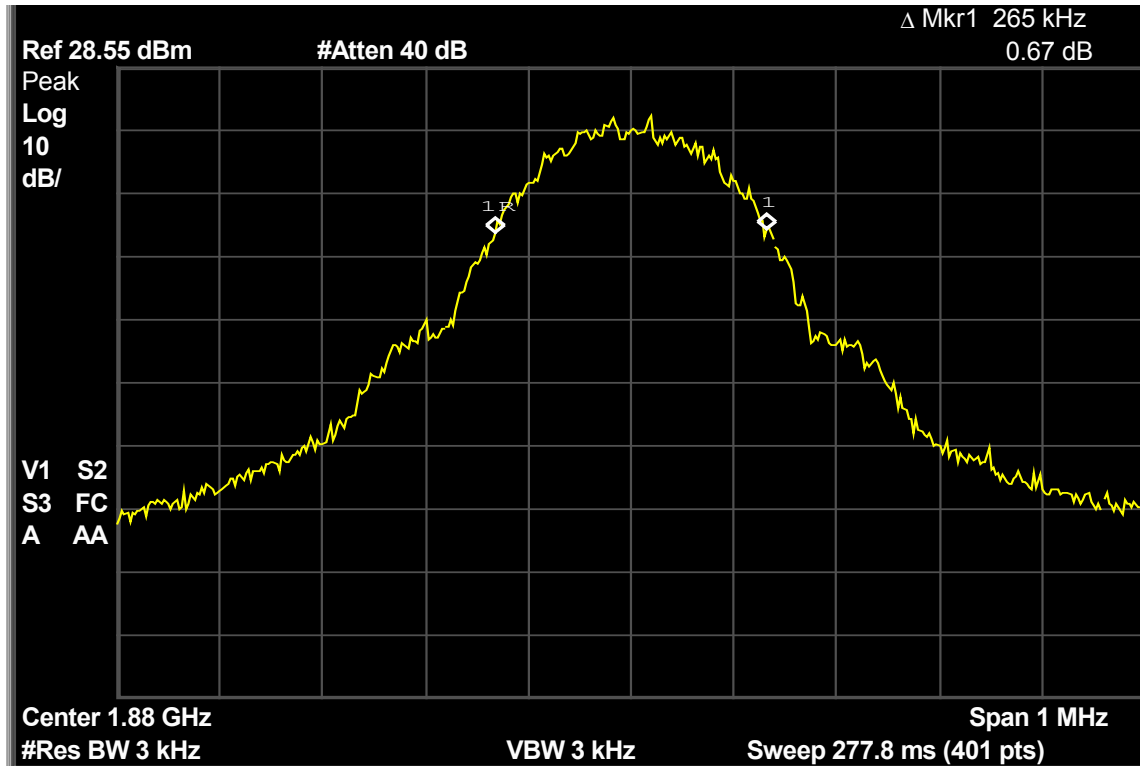


GSM 850 – Upper Band Edge

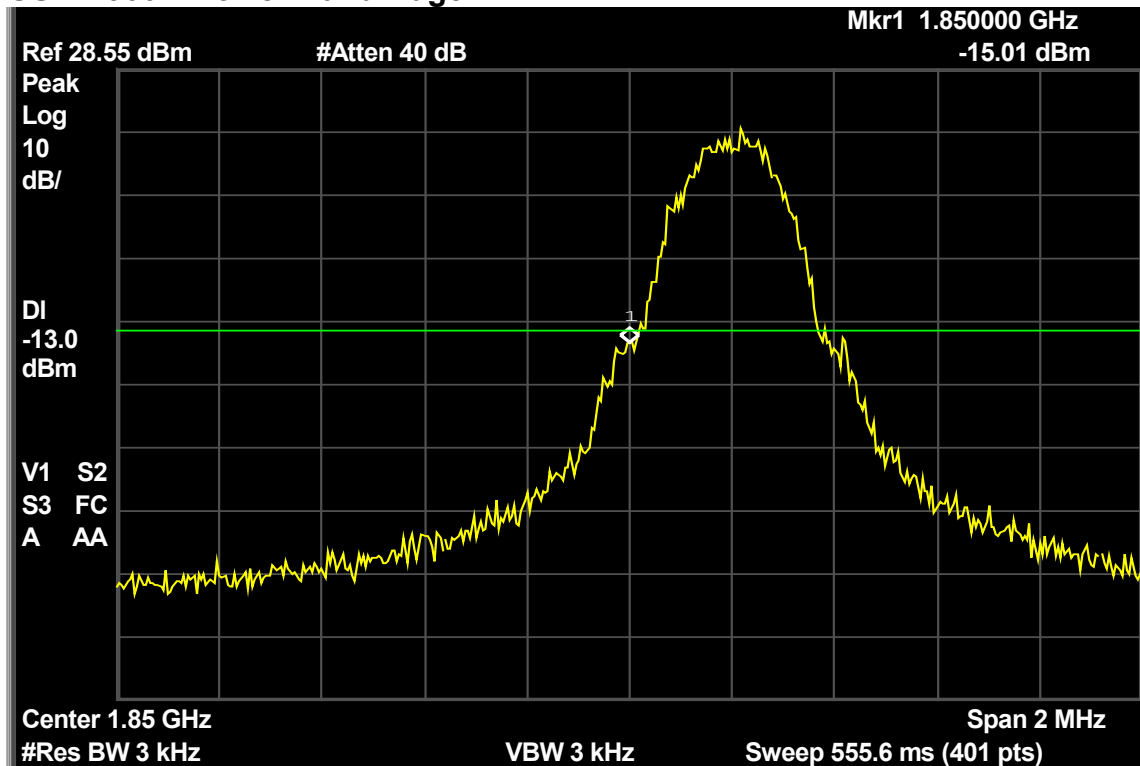


Measurement Results – GSM 1900

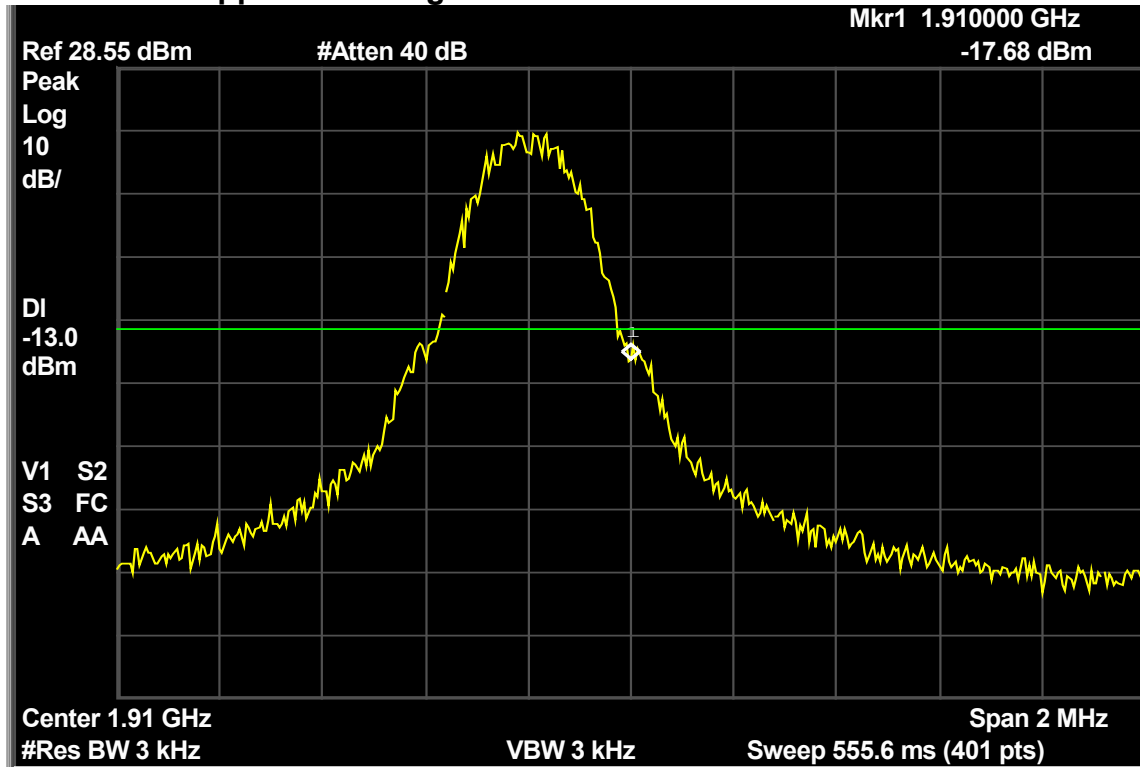
GSM 1900



GSM 1900 – Lower Band Edge



GSM 1900 – Upper Band Edge



SPURIOUS EMISSIONS AT ANTENNA TERMINALS

CFR Part 2.1051, 22.917, 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.

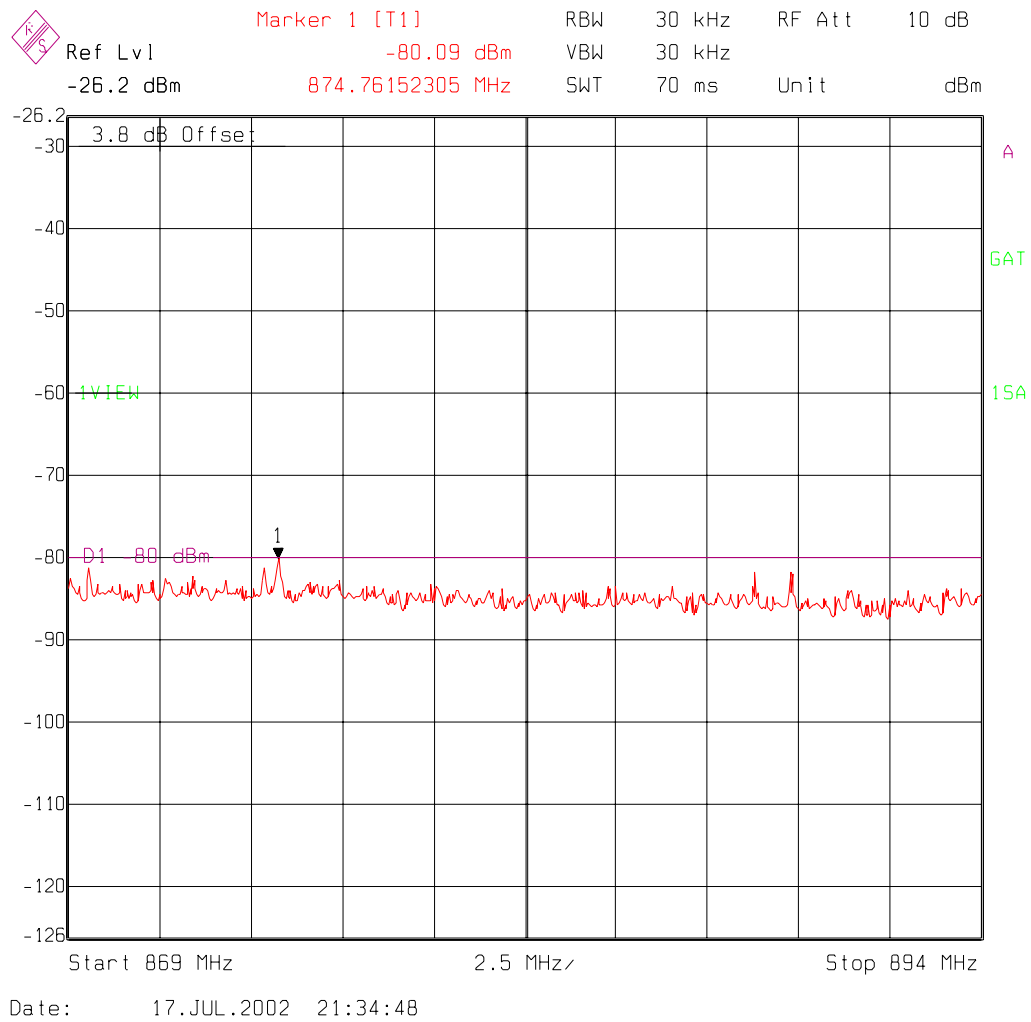
The spectrum was investigated from the lowest frequency signal generated, without going below 9 kHz, up to at least the tenth harmonic of the fundamental or 40 GHz, whichever is lower.

Measurements were made at the middle channel within the frequency band and within the base station frequency range (869-894 MHz). The base station frequency range plot represents worst-case the emissions, which corresponds to the EUT transmitting on channel 251.

Measurement Results

The magnitude of all spurious emissions were attenuated at least 20 dB below the permissible value and therefore not specified. The base station frequency range (869-894 MHz) emissions plot is attached.

GSM 850 – Cellular Base Station Frequency Range



FIELD STRENGTH OF SPURIOUS EMISSIONS

CFR 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.

Photographs of the radiated test set-up including substitution are enclosed in Appendix A.

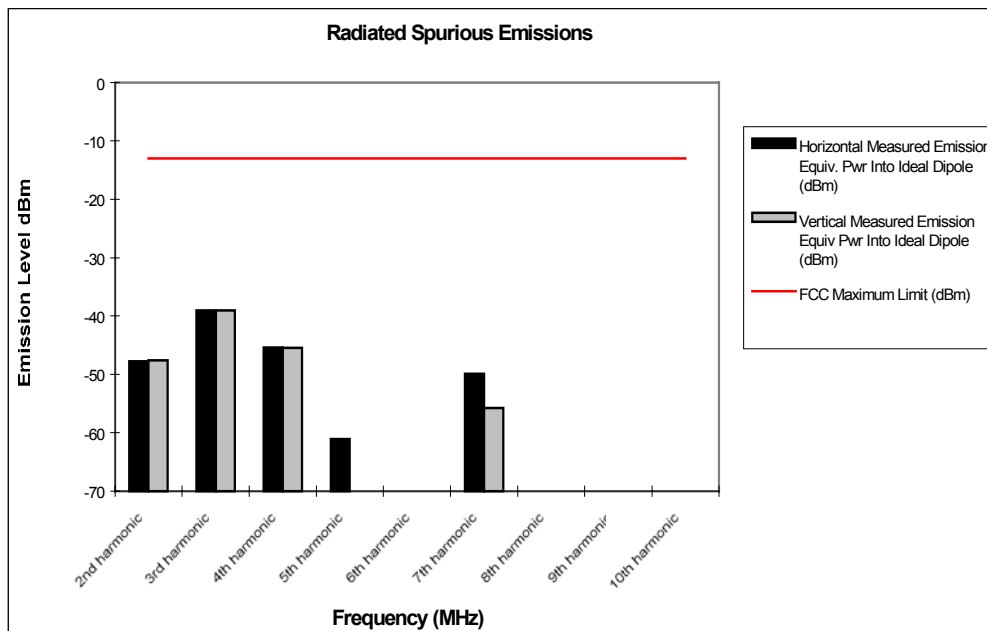
Measurement Results

Attached

Measurement Results

Modulation: GSM 850

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	-47.8	-47.6
3rd harmonic	-13	-39.1	-39.1
4th harmonic	-13	-45.4	-45.5
5th harmonic	-13	-61.1	*
6th harmonic	-13	*	*
7th harmonic	-13	-49.9	-55.7
8th harmonic	-13	*	*
9th harmonic	-13	*	*
10th harmonic	-13	*	*



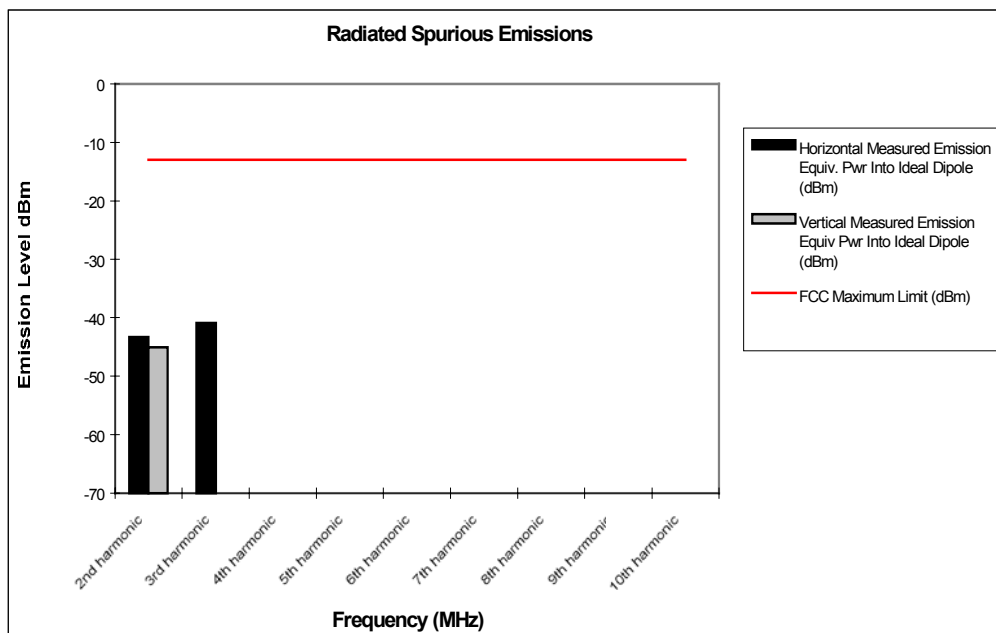
Notes:

- * 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

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	-43.3	-45.0
3rd harmonic	-13	-40.9	*
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.

FREQUENCY STABILITY

CFR Part 2.1055, 22.355, 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.

Measurement Results

Attached

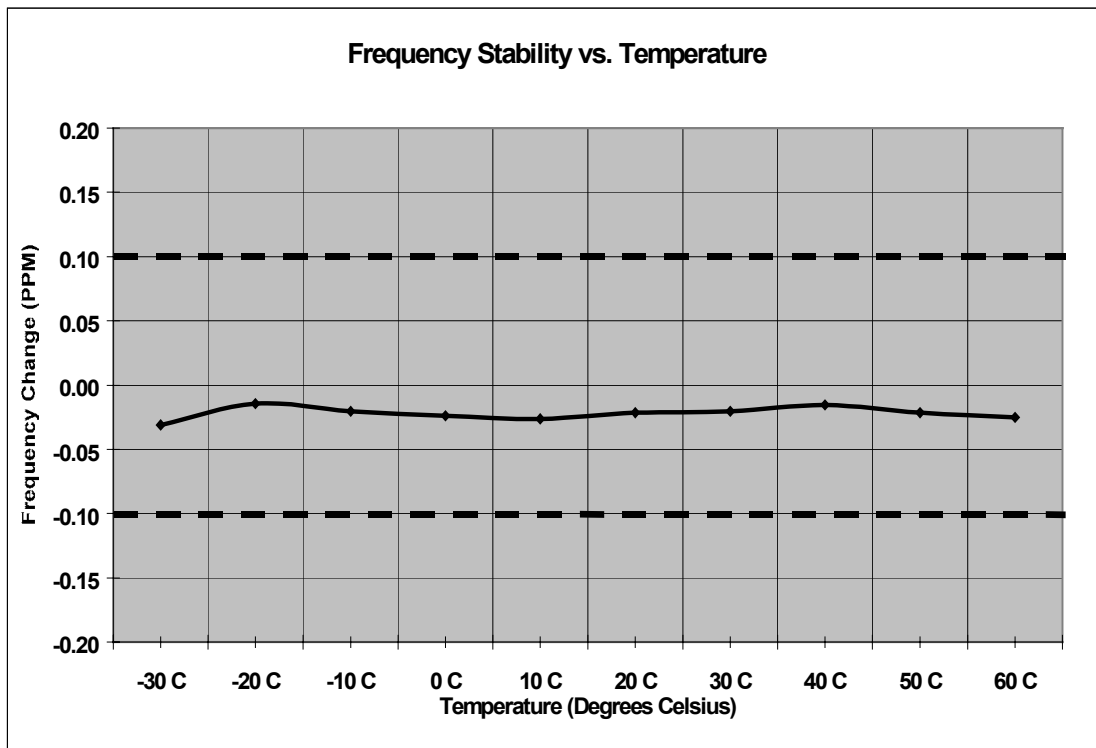
Measurement Results

Modulation: GSM 850

Frequency Stability

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

Temperature C	Frequency Error HZ	Frequency Error (PPM)	Voltage (%)	Voltage (VDC)
-30 C	-26.00	-0.031	100%	3.60
-20 C	-12.00	-0.014	100%	3.60
-10 C	-17.00	-0.020	100%	3.60
0 C	-20.00	-0.024	100%	3.60
10 C	-22.00	-0.026	100%	3.60
20 C	-18.00	-0.022	100%	3.60
30 C	-17.00	-0.020	100%	3.60
40 C	-13.00	-0.016	100%	3.60
50 C	-18.00	-0.022	100%	3.60
60 C	-21.00	-0.025	100%	3.60
20 C	-19.00	-0.023	Battery Endpoint	3.10



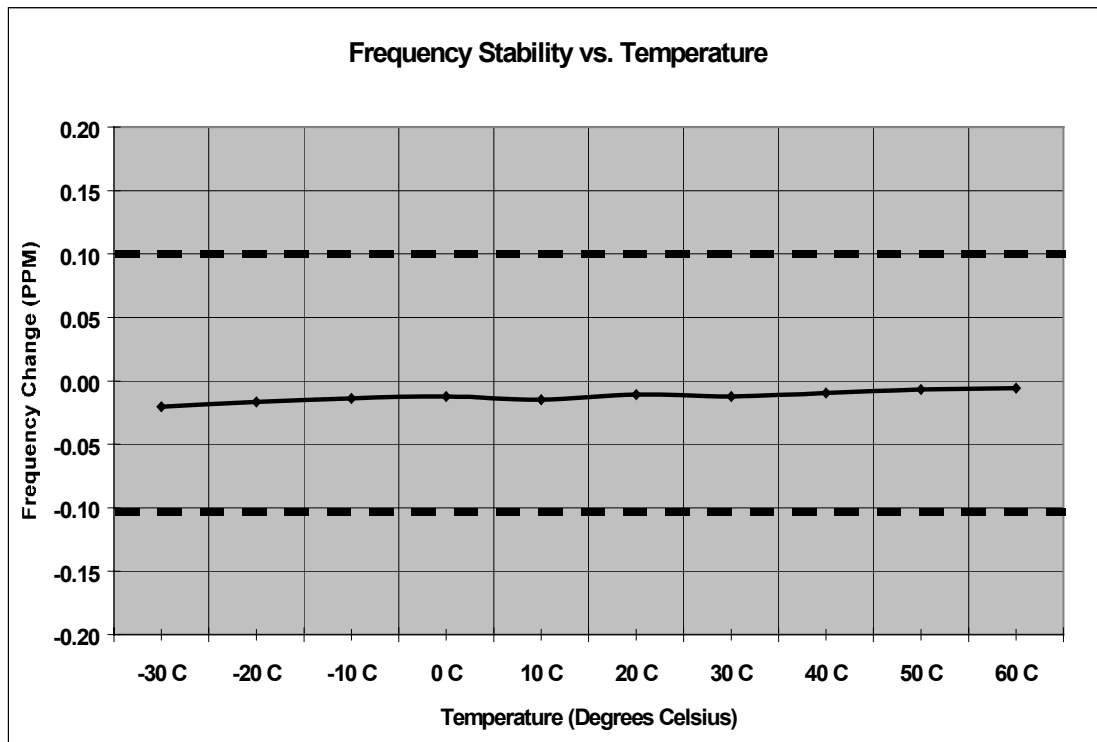
Measurement Results

Modulation: GSM 1900

Frequency Stability

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

Temperature C	Frequency Error HZ	Frequency Error (PPM)	Voltage (%)	Voltage (VDC)
-30 C	-38.00	-0.020	100%	3.60
-20 C	-31.00	-0.016	100%	3.60
-10 C	-26.00	-0.014	100%	3.60
0 C	-23.00	-0.012	100%	3.60
10 C	-28.00	-0.015	100%	3.60
20 C	-20.00	-0.011	100%	3.60
30 C	-23.00	-0.012	100%	3.60
40 C	-18.00	-0.010	100%	3.60
50 C	-13.00	-0.007	100%	3.60
60 C	-11.00	-0.006	100%	3.60
20 C	-23.00	-0.012	Battery Endpoint	3.10



FIELD STRENGTH OF EMISSIONS FROM UNINTENTIONAL RADIATORS

CFR 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.

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

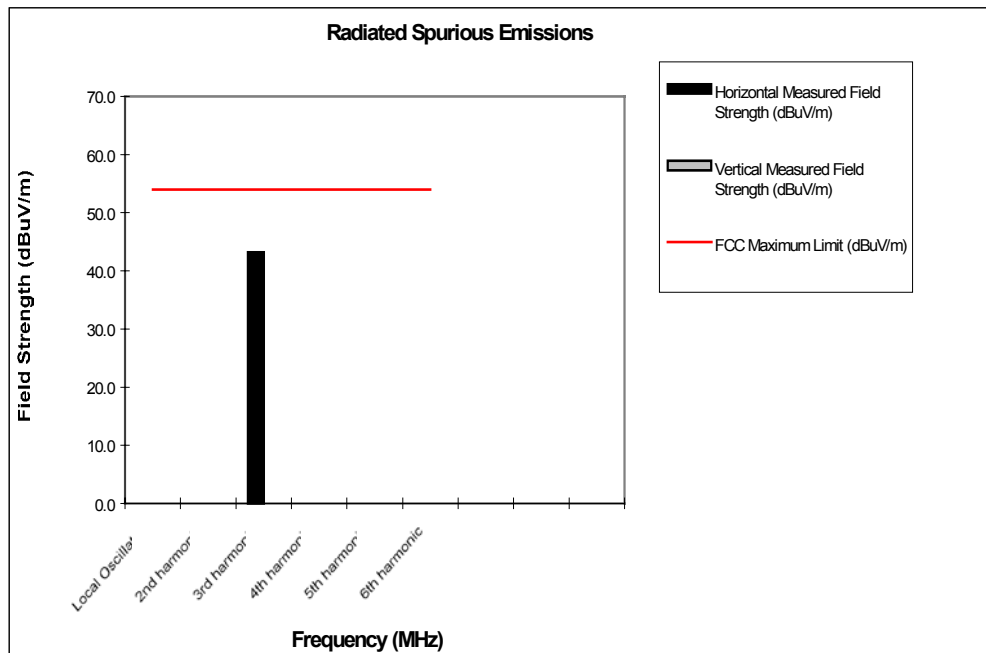
Measurement Results

Attached

Measurement Results

Modulation: GSM 850

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	*	*
3rd harmonic	54	43.2	*
4th harmonic	54	*	*
5th harmonic	54	*	*
6th harmonic	54	*	*



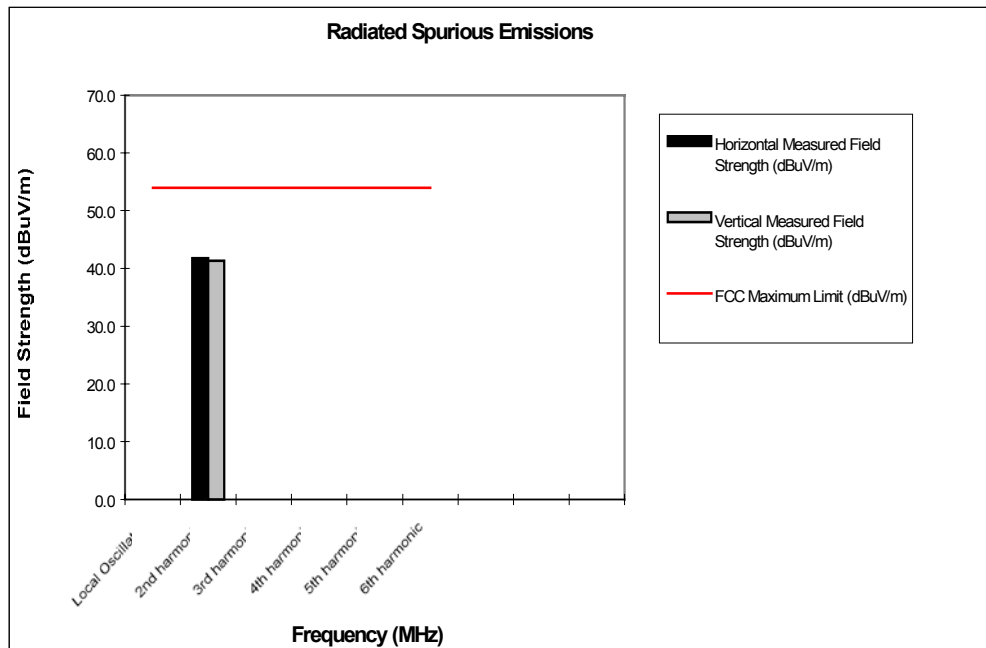
Notes:

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 frequency for the low, mid, and high channels.

Measurement Results

Modulation: GSM 1900

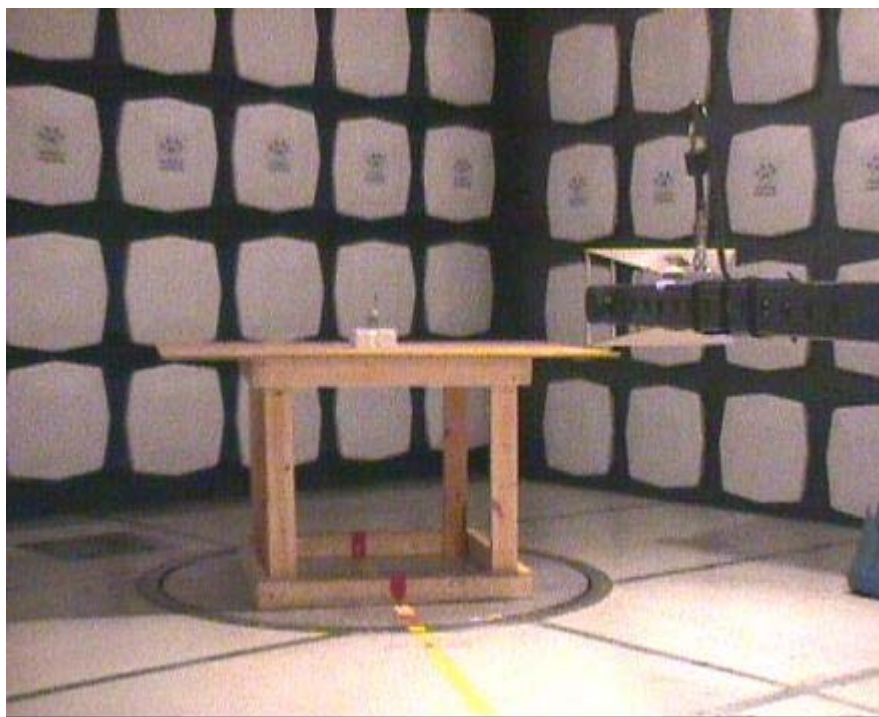
Frequency (MHz)	FCC Maximum Limit (dBuV/m)	Horizontal Measured Field Strength (dBuV/m)	Vertical Measured Field Strength (dBuV/m)
Local Oscillator	54	*	*
2nd harmonic	54	41.7	41.3
3rd harmonic	54	*	*
4th harmonic	54	*	*
5th harmonic	54	*	*
6th harmonic	54	*	*



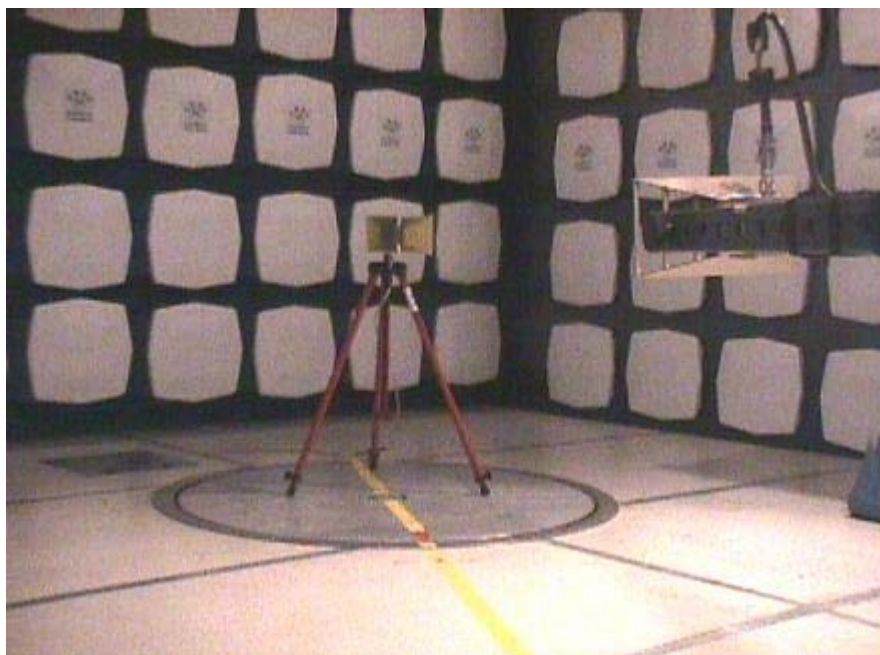
Notes:

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 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