MOTOROLA

**PERSONAL COMMUNICATIONS SECTOR**

# PRODUCT SAFETY AND COMPLIANCE EMC LABORATORY

# EMC TEST REPORT

**Test Report Number** – 15615-1

**Report Date** – February 4, 2005

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 Mark Sidlow Name: Mark Sidlow

Title: Senior Electrical Engineer Date : February 4, 2005



A2LA Certificate Number: 1846-01

A2LA ACCREDITED

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# Test Report Details

| | |
|---|---|
| Tests Performed By: | Motorola Personal Communications Sector<br>Product Safety and Compliance Group<br>600 North US Hwy 45<br>Libertyville, IL 60048<br>PH (847) 523-6167 Fax (847) 523-4538<br>Motorola PCS FRN: 0004321311<br>FCC Registration Number: 316588<br>Industry Canada Number: IC3908 |
| Tests Requested By: | Motorola Inc.<br>Personal Communications Sector<br>600 North US Hwy 45<br>Libertyville, IL 60048 |
| Product Type: | Cellular Phone |
| Signaling Capability: | GSM 850, 1900 |
| Model Number: | C155 |
| Version: | SJUG0654DA |
| Serial Numbers: | 010404-00-000346-9, 010404-00-000376-6 |
| Testing Complete Date: | February 3*, 2005* |

# 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:

__X__ Part 15 Subpart B – Unintentional Radiators
__X__ Part 22 Subpart H - Public Mobile Services
__X__ 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) | Pass |
| 3 | Modulation Characteristics | NA |
| 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) | 2.7 |
| 3 | Modulation Characteristics | NA |
| 4 | Occupied Bandwidth | See Plots |
| 5 | Spurious Emissions at Antenna Terminal | 22.4 dB |
| 6 | Field Strength of Spurious Emissions | 2.8 dB |
| 7 | Frequency Stability | 54 Hz |
| 8 | Field Strength of Spurious Emissions from Unintentional Radiators | Below noise floor |

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 22º 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 | Equipment Type | Model No. | Serial Number | Cal. Due Date |
|---|---|---|---|---|
| Rohde & Schwarz | Receiver | ESI26 | 838786/010 | 5/17/2005 |
| Hewlett-Packard | EMC Analyzer | 8593EM | 3536A00118 | 10/2/2005 |
| Hewlett-Packard | EMC Analyzer | 7405 | US39440191 | 11/13/2005 |
| Miteq | Preamplifier 0.1-26.5GHz | NSP2650-NF-S | 966350 | 1/8/2006 |
| ETS | DRG Horn Antenna | 3115 | 6222 | 10/4/2005 |
| A.H. Systems Inc. | DRG Horn Antenna | SAS-2--/571 | 265 | 5/5/2005 |
| ETS | Log-Periodic Antenna | 3148 | 1188 | 3/5/2005 |
| ETS | Biconical Antenna | 3110B | 3370 | 11/14/2005 |
| Attenuator | Weinschel | AS-6 | 6675 | 10/14/2005 |
| Attenuator | Weinschel | AS-6 | 6677 | 11/4/2005 |
| 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 | 1/18/2006 |
| Giga-Tronics | Power Meter | 8651A | 8650561 | 4/8/2005 |
| 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) |
|---|---|
| 824.2 | 32.18 |
| 836.6 | 32.83 |
| 848.8 | 32.82 |

**GSM 1900**

| Frequency (MHz) | Power (dBm) |
|---|---|
| 1850.20 | 29.62 |
| 1880.00 | 29.61 |
| 1909.80 | 29.63 |

# 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 IHDT56EX2 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:

| | |
|---|---|
| 824.2 Mhz | 30.69 dBm |
| 836.6 Mhz | 32.13 dBm |
| 848.8 Mhz | 32.04 dBm, |

GSM 1900:

| | |
|---|---|
| 1850.2 MHz: | 31.87 dBm |
| 1880.0 MHz: | 32.99 dBm |
| 1909.8 MHz: | 32.73 dBm |

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

max EIRP in GSM 850 mode is 32.13 dBm **(max ERP is 30.03 dBm)**
**max EIRP in GSM 1900 mode is 32.99 dBm** (max ERP is 30.89 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. 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 | 300 | Auto | 1001 | Max Hold | Peak | 30 |
| OCBW | 3 | Auto | 1001 | Max Hold | Peak | 30 |
| Lower Band Edge | 1 | Auto | 2004 | Max Hold | Peak | 30 |
| Upper Band Edge | 1 | Auto | 2004 | Max Hold | Peak | 30 |

## Measurement Results

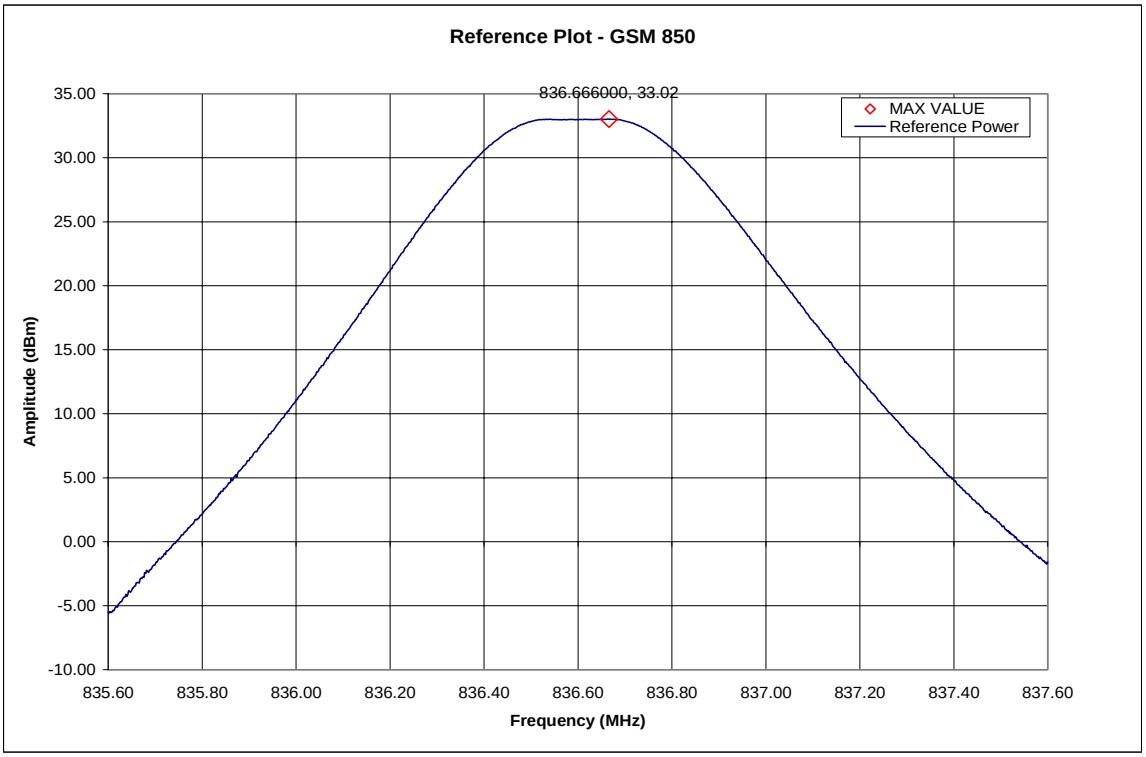
## Measurement Summary

| Band | Value Measured | Value | Units |
|---|---|---|---|
| Cell | Reference Power | 32.02 | MHz |
| Cell | OCBW | 0.00 | KHz |
| Cell | Lower Band Edge Emissions | -16.42 | dBm |
| Cell | Upper Band Edge Emissions | -15.97 | dBm |
| PCS | Reference Power | 29.93 | dBm |
| PCS | OCBW | 260.40 | kHz |
| PCS | Lower Band Edge Emissions | -19.38 | dBm |
| PCS | Upper Band Edge Emissions | -19.58 | dBm |

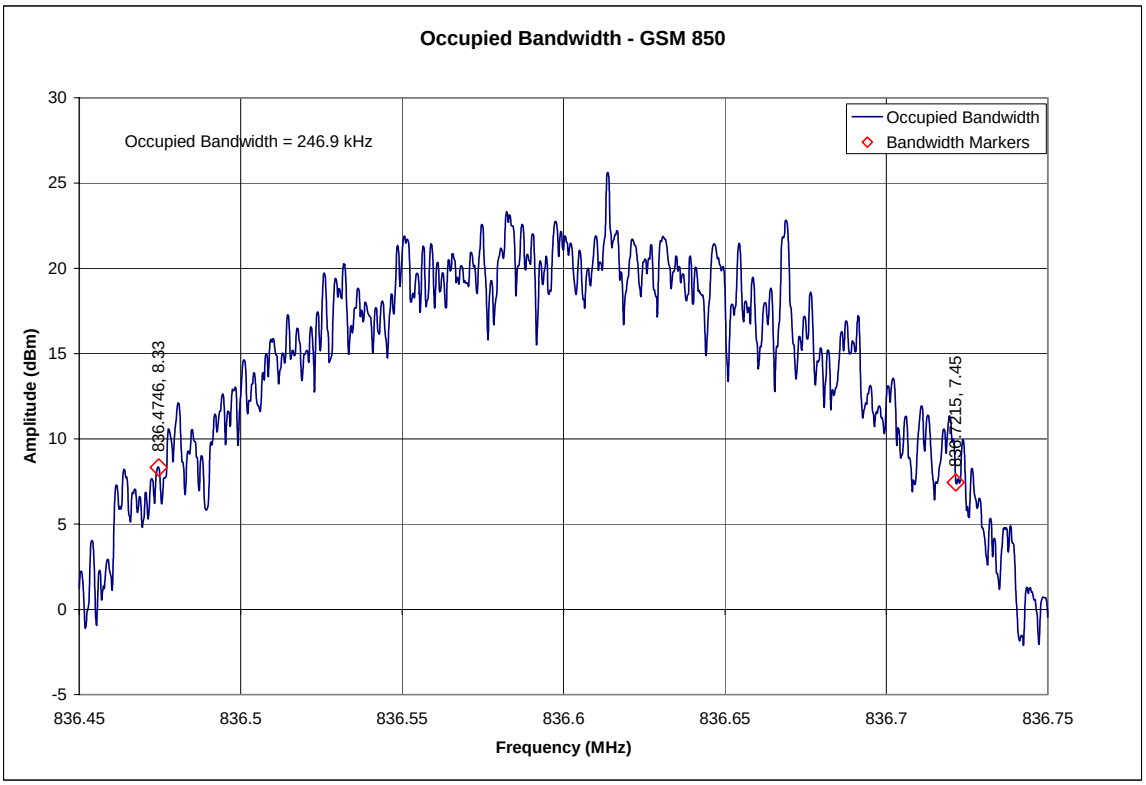
Attached

## Measurement Results – GSM 850

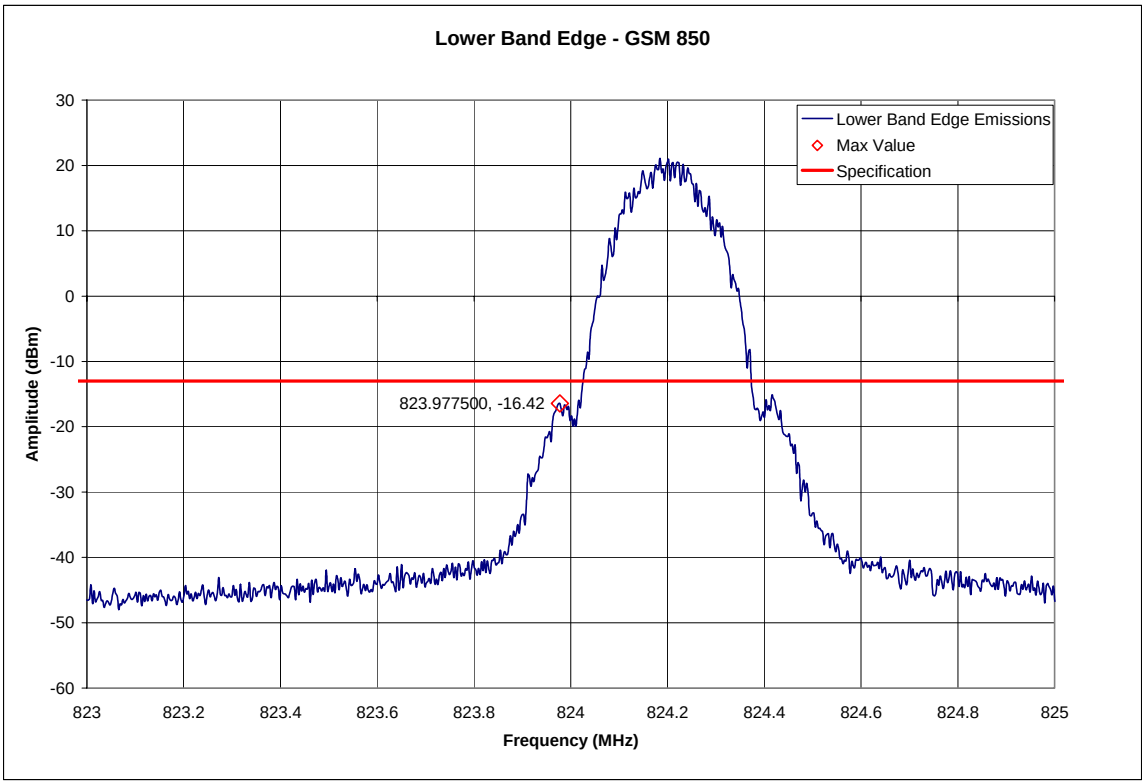
GSM 850 Reference Level



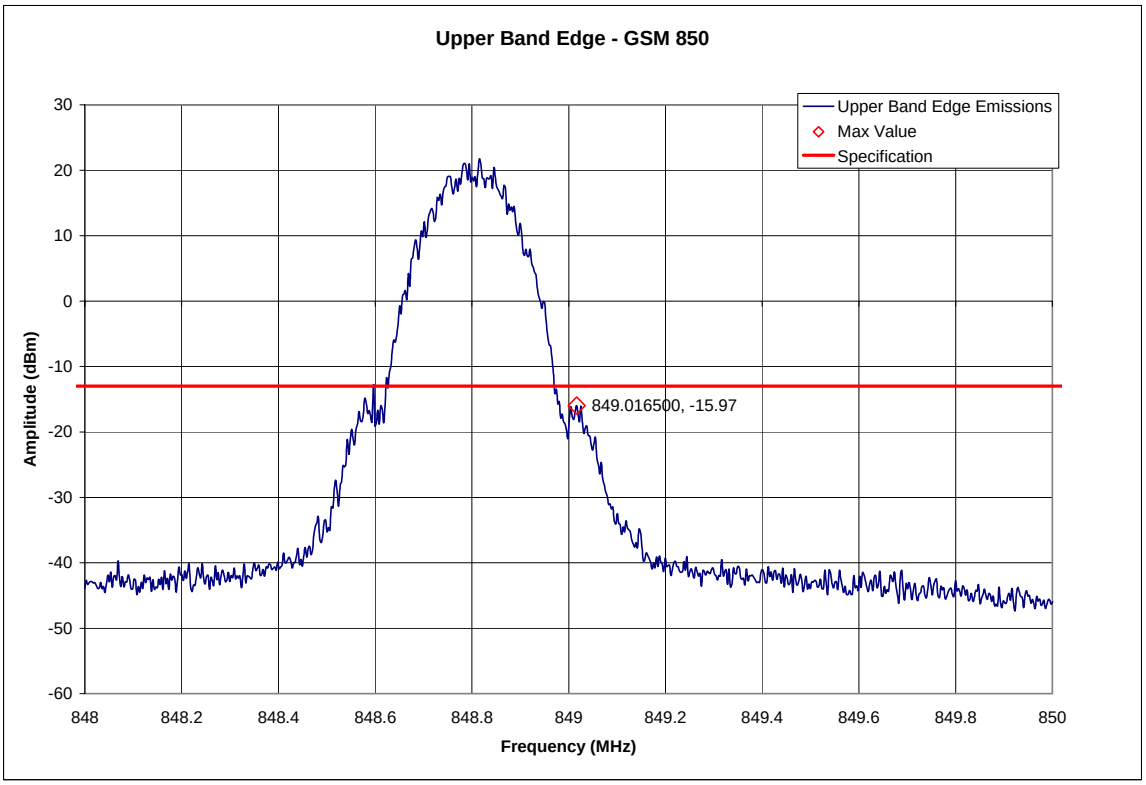

GSM 850 Occupied Bandwidth



GSM 850 Ch128 Lower Band Edge

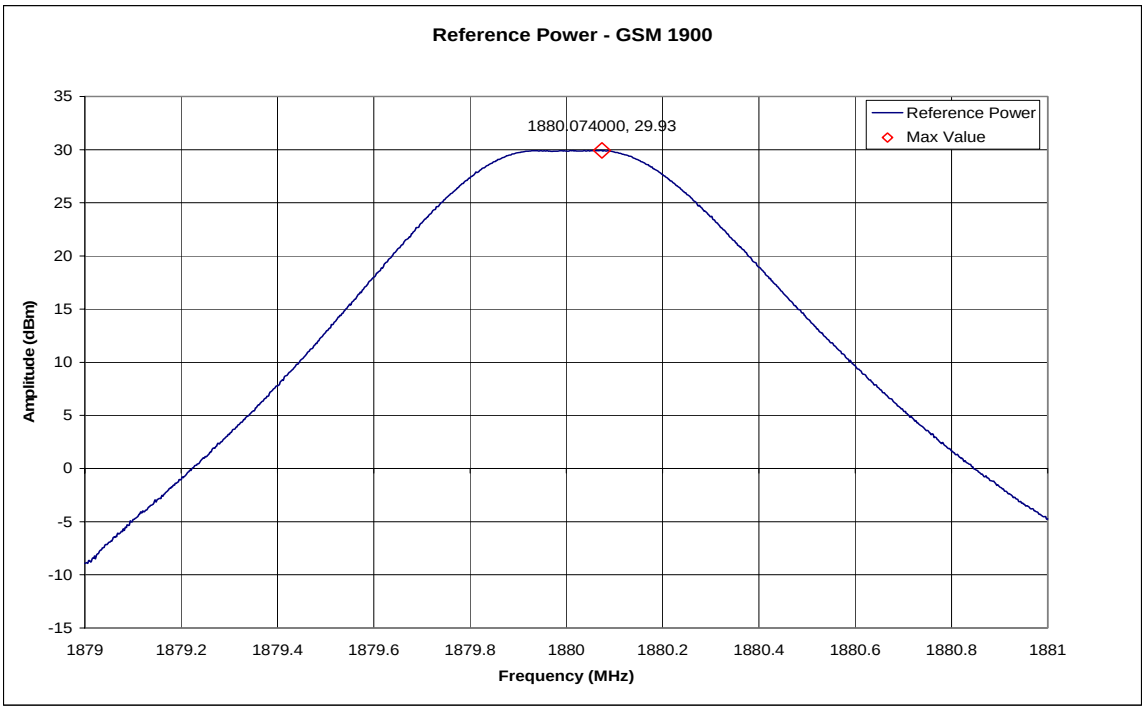



GSM 850 Ch251 Upper Band Edge

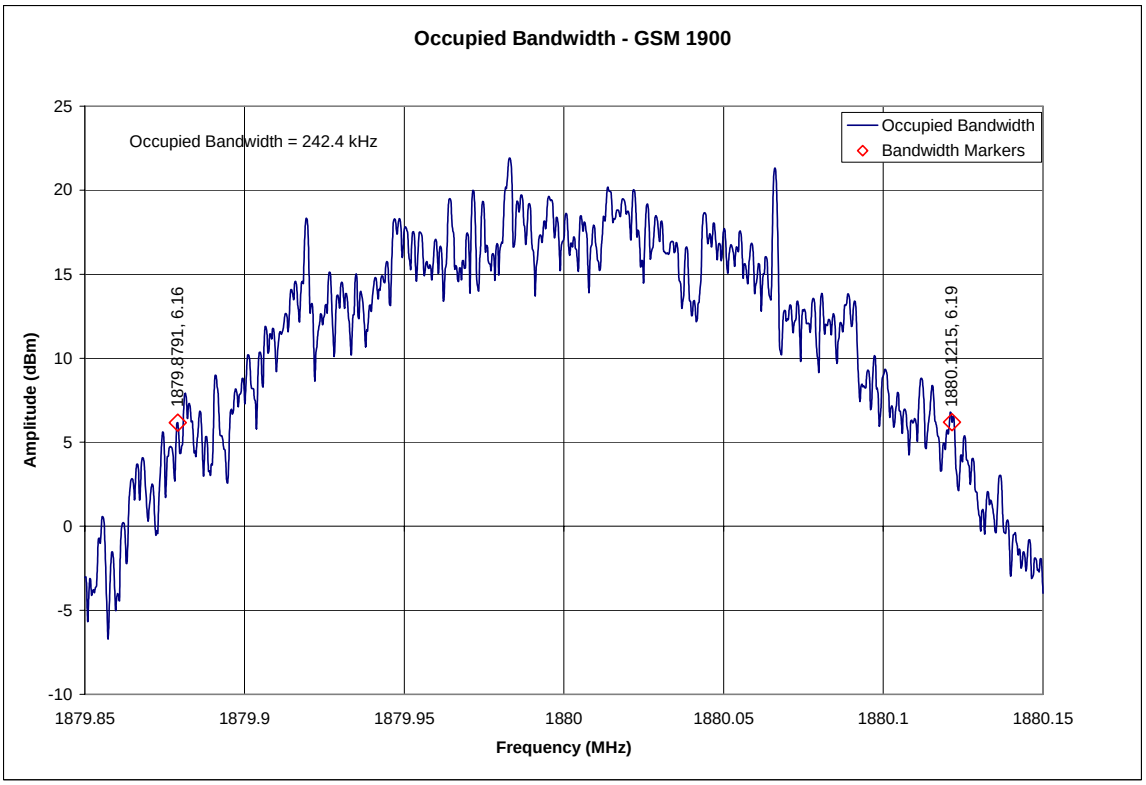


## Measurement Results – GSM 1900

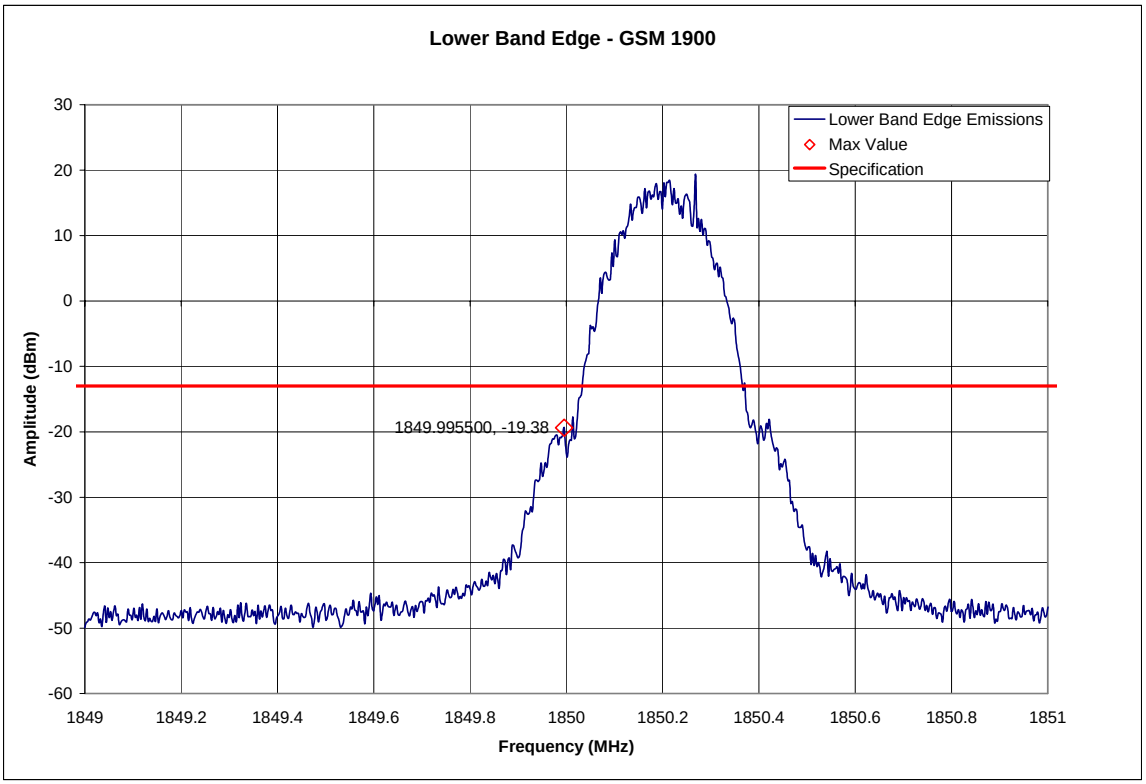
GSM/PCS 1900 Reference Level



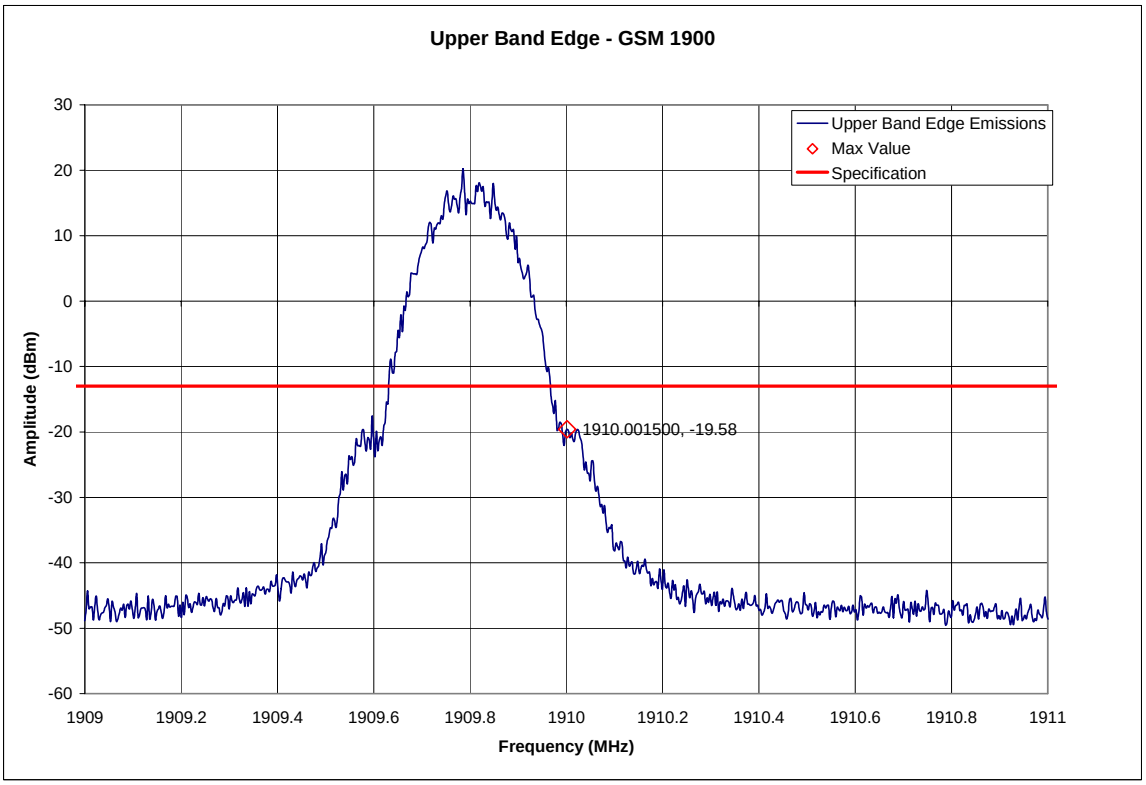

GSM/PCS 1900 Occupied Bandwidth



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 |

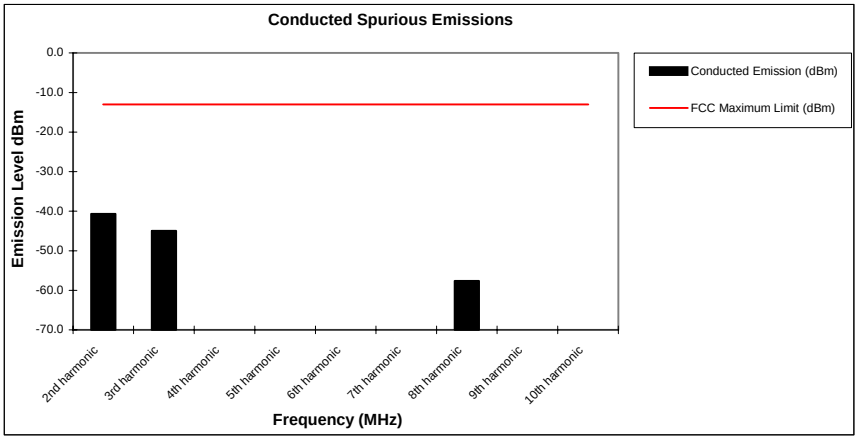
## Measurement Results

Attached

# Measurement Results
# Modulation: GSM 850

### Conducted Spurious and Harmonic Emissions

| Harmonic of Fundamental | FCC Maximum Limit (dBm) | Conducted Emission (dBm) |
|---|---|---|
| 2nd harmonic | -13 | -40.7 |
| 3rd harmonic | -13 | -44.9 |
| 4th harmonic | -13 | * |
| 5th harmonic | -13 | * |
| 6th harmonic | -13 | * |
| 7th harmonic | -13 | * |
| 8th harmonic | -13 | -57.6 |
| 9th harmonic | -13 | * |
| 10th harmonic | -13 | * |

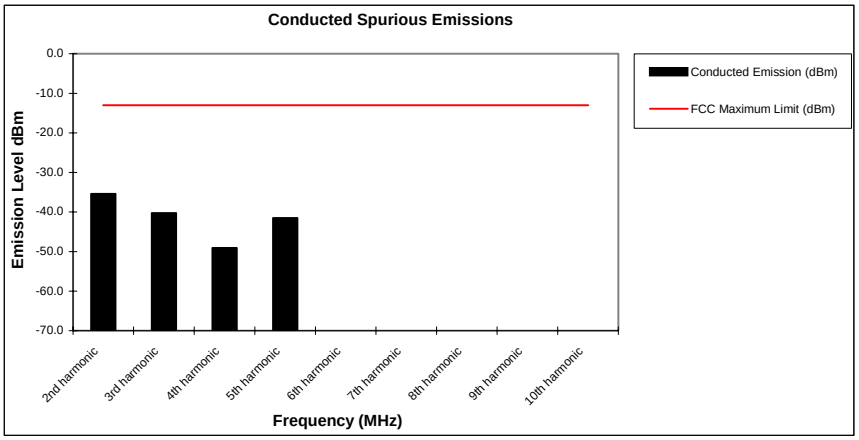



Notes:
1. * Indicates the spurious emission could not be detected due to noise limitations or ambients.
2. Each emission reported reflects the highest absolute level at the specific harmonic for the low, mid, and high channels at maximum power.
3. The Spectrum was investigated from 9 kHz to the tenth 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 | -35.4 |
| 3rd harmonic | -13 | -40.2 |
| 4th harmonic | -13 | -49.1 |
| 5th harmonic | -13 | -41.5 |
| 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 |

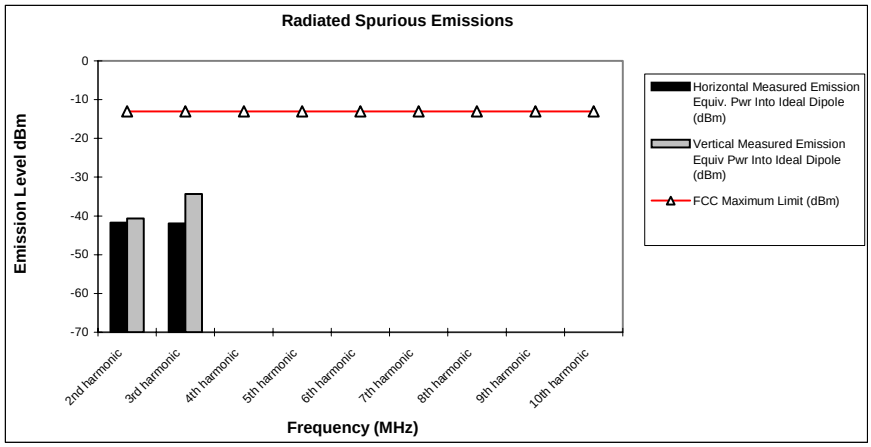
## Measurement Results

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 | -41.8 | -40.7 |
| 3rd harmonic | -13 | -42.0 | -34.4 |
| 4th harmonic | -13 | * | * |
| 5th harmonic | -13 | * | * |
| 6th harmonic | -13 | * | * |
| 7th harmonic | -13 | * | * |
| 8th harmonic | -13 | * | * |
| 9th harmonic | -13 | * | * |
| 10th harmonic | -13 | * | * |

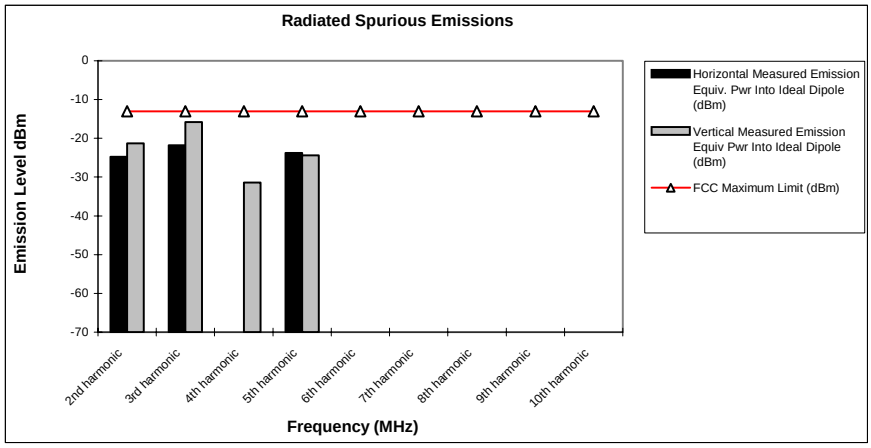



Notes:
1. * Indicates the spurious emission could not be detected due to noise limitations or ambients.
2. Each emission reported reflects the highest absolute level at the specific harmonic for the low, mid, and high channels at maximum power.
3. The Spectrum was investigated from 30 MHz to the tenth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

# 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 | -24.8 | -21.3 |
| 3rd harmonic | -13 | -21.8 | -15.8 |
| 4th harmonic | -13 | * | -31.4 |
| 5th harmonic | -13 | -23.8 | -24.4 |
| 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 -30º C to +60º C and at intervals of 10º 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

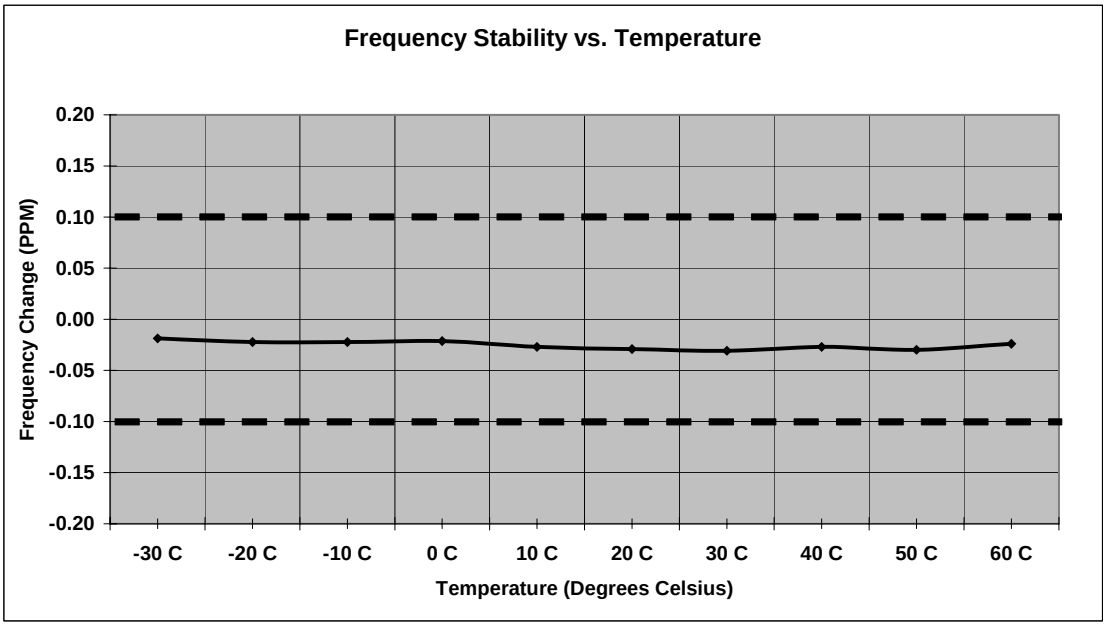
Attached

## Measurement Results
## Modulation: GSM850

# Frequency Stability

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

| Temperature | Frequency Error | Frequency Error | Voltage | Voltage |
|---|---|---|---|---|
| C | HZ | (PPM) | (%) | (VDC) |
| | | | | |
| -30 C | **-35.00** | **-0.019** | 100% | 3.80 |
| -20 C | **-42.00** | **-0.022** | 100% | 3.80 |
| -10 C | **-42.00** | **-0.022** | 100% | 3.80 |
| 0 C | **-40.00** | **-0.021** | 100% | 3.80 |
| 10 C | **-51.00** | **-0.027** | 100% | 3.80 |
| 20 C | **-55.00** | **-0.029** | 100% | 3.80 |
| 30 C | **-58.00** | **-0.031** | 100% | 3.80 |
| 40 C | **-51.00** | **-0.027** | 100% | 3.80 |
| 50 C | **-56.00** | **-0.030** | 100% | 3.80 |
| 60 C | **-45.00** | **-0.024** | 100% | 3.80 |
| | | | | |
| 20 C | **-63.00** | **-0.034** | Battery Endpoint | 3.53 |




Technician: RICK MOTA
Date: 1/20/2005
Product Name: C155
Submission #: 15615-1
S/N: 01040-00-000346-9

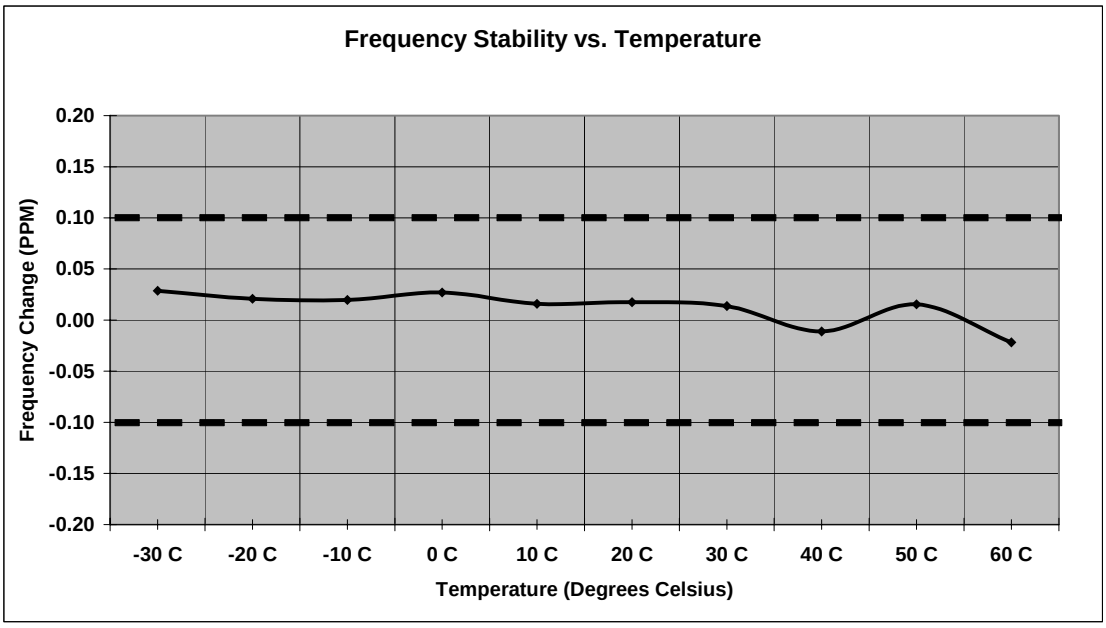
(Uncontrolled When Printed) Form Control Number: FCD-0192, Rev. 3

## 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 | **54.00** | **0.029** | 100% | 3.80 |
| -20 C | **39.00** | **0.021** | 100% | 3.80 |
| -10 C | **37.00** | **0.020** | 100% | 3.80 |
| 0 C | **51.00** | **0.027** | 100% | 3.80 |
| 10 C | **30.00** | **0.016** | 100% | 3.80 |
| 20 C | **33.00** | **0.018** | 100% | 3.80 |
| 30 C | **26.00** | **0.014** | 100% | 3.80 |
| 40 C | **-21.00** | **-0.011** | 100% | 3.80 |
| 50 C | **29.00** | **0.015** | 100% | 3.80 |
| 60 C | **-41.00** | **-0.022** | 100% | 3.80 |
| | | | | |
| 20 C | **52.00** | **0.028** | Battery Endpoint | 3.53 |




Technician: RICK MOTA
Date: 1/20/2005
Product Name: C155
Submission #: 15615-1
S/N: 01040-00-000346-9

(Uncontrolled When Printed) Form Control Number: FCD-0192, Rev. 3

# 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)

The receiver settings were as follows:

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

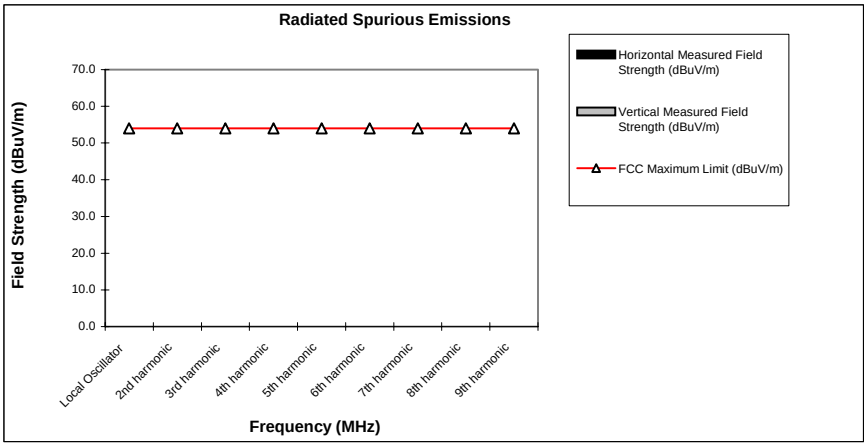
## Measurement Results

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 | * | * |
| 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 | * | * |

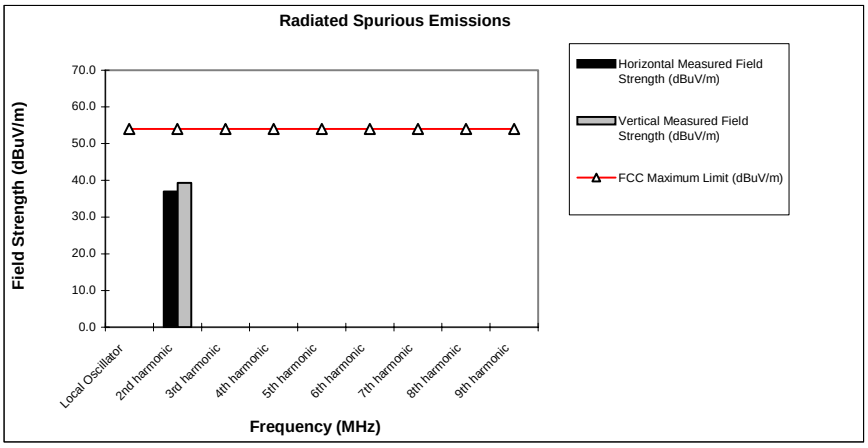



Notes:
1. * Indicates the spurious emission could not be detected due to noise limitations or ambients.
2. Each emission reported reflects the highest absolute level at the specific frequency for the low, mid, and high channels.

# Measurement Results
# Modulation: GSM 1900

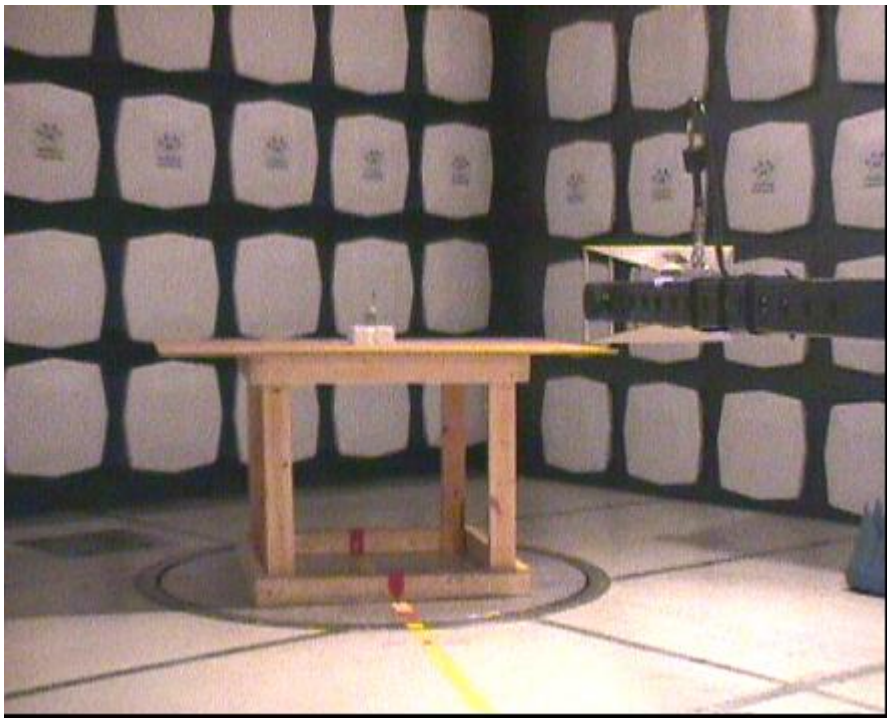
## Receiver Radiated Spurious Emissions

| 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 | 36.9 | 39.3 |
| 3rd harmonic | 54 | * | * |
| 4th harmonic | 54 | * | * |
| 5th harmonic | 54 | * | * |
| 6th harmonic | 54 | * | * |
| 7th harmonic | 54 | * | * |
| 8th harmonic | 54 | * | * |
| 9th harmonic | 54 | * | * |
| 10th harmonic | 54 | * | * |

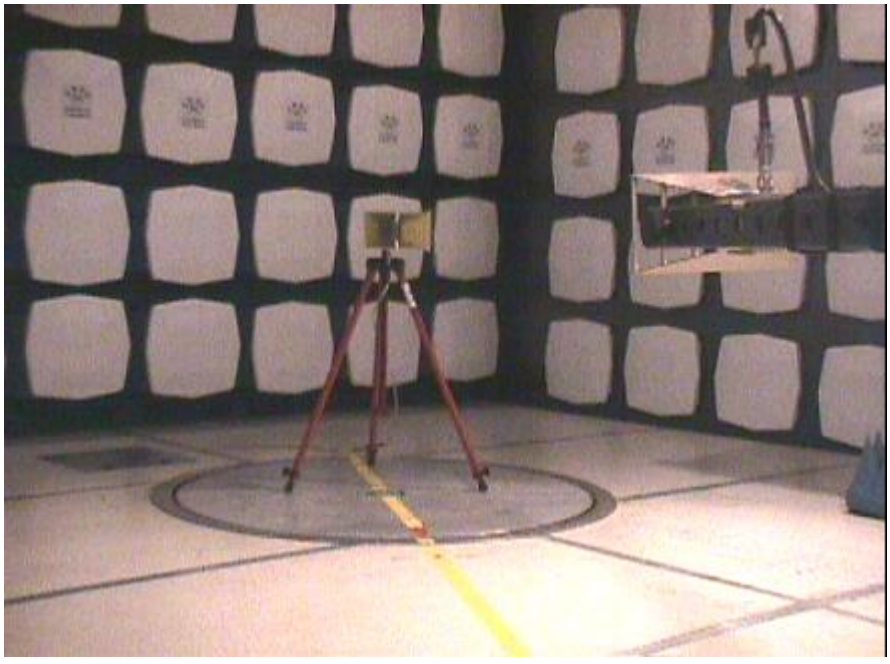



Notes:
1. * Indicates the spurious emission could not be detected due to noise limitations or ambients.
2. Each emission reported reflects the highest absolute level at the specific frequency for the low, mid, and high channels.

## Appendix A – Radiated Emissions Test Setup Photos



A.1 Radiated Emissions Measurement



A.2 Substitution Measurement

**End of Test Report**