APREL Laboratories

# Assessment of Compliance

with respect to

FCC Rules & Regulations Parts 2.1046/22.913,

24.232 and 2.1053/22.917(e), 24.238

# Dual-Mode Dual-Band TDMA Phone
# Model EB-TX110A

**PANASONIC**

**Matsushita Mobile Communications**

**Development Corporation of U.S.A.**


51 Spectrum Way Nepean ON K2R 1E6
Tel: (613) 820-2730 Fax: (613) 820-4161
email: info@aprel.com

# Engineering Report

**Subject:** **Assessment of Compliance with Respect to FCC Rules & Regulations Parts 2.1046/22.913, 24.232 and 2.1053/22.917(e), 24.238**

**FCC ID:** **NWJ 10A001A**

**Product:** **Dual-Mode Dual-Band TDMA Phone AMPS, TDMA and PCS Modes**

**Model:** **EB-TX110A**

**Client:** **PANASONIC Matsushia Mobile Communications Development Corp. of U.S.A.**

Address: 1225 Northbrook Parkway, Suite 2-400
Suwanee, GA 30024
U.S.A.

Project #: MATB-EB-TX110A-3251

Prepared By: APREL Laboratories,
Regulatory Compliance Division

Approved by: _____ Date: June 30, 1999

**Jay Sarkar**
Director, Standards & Certification

Released by: _____ Date: June 30/99

**Dr. J.J. Wojcik, P.Eng.**

REGISTERED PROFESSIONAL ENGINEER
J. J. Wojcik
PROVINCE OF ONTARIO

51 Spectrum Way
Nepean, Ontario
K2R 1E6, Canada

Tel. (613) 820 2730
Fax (613) 820 4161
e-mail: info@aprel.com

FCC ID: NWJ 10A001A
Applicant: Matsushia Mobile Communications Development Corp. of U.S.A.
Equipment: **Dual-Mode Dual-Band TDMA Phone**
Model: **EB-TX110A**
Standard: FCC Rules and Regulations Parts 2.1046/22.913, 24.232 and 2.1053/22.917(e), 24.238

## ENGINEERING SUMMARY

This report contains the results of the engineering evaluation performed on an AMPS, 800 MHz TDMA and PCS **Dual-Mode Dual-Band TDMA Phone**. The tests were carried out in accordance with the FCC Rules and Regulations Parts 2.1046/22.913, 24.232 and 2.1053/22.917(e), 24.238.

Based on the test results, it is certified that the product meets the applicable requirements as set forth in the above specifications for Certification.

# Dual-Mode Dual-Band TDMA Phone
# AMPS, TDMA and PCS Modes
# EB-TX110A

## Summary of the Results

| Test Description | Page No. | Test Set-up Figure No. | Results Summary |
|---|---|---|---|
| RF Power Output of AMPS (ERP) Ref. FCC Parts: 2.1046 and 22.913 | 8 | 1 | **PASSED** |
| RF Power Output of 800 MHz TDMA (ERP), Ref. FCC Parts: 2.1046 and 22.913 | 8 | 1 | **PASSED** |
| RF Power Output of PCS (EIRP) Ref. FCC Parts: 2.1046 and 24.232 | 12 | 2 | **PASSED** |
| Field Strength of Spurious Radiation of AMPS, Ref. FCC Parts: 2.1053 and 22.917(e) | 17 | 3 | **PASSED** |
| Field Strength of Spurious Radiation of 800 MHz TDMA, Ref. FCC Parts: 2.1053 and 22.917(e) | 17 | 3 | **PASSED** |
| Field Strength of Spurious Radiation of PCS, Ref. FCC Parts: 2.1053 and 24.238 | 24 | 3 | **PASSED** |

# FCC SUBMISSION INFORMATION

| | |
|---|---|
| **FCC ID:** | **NWJ 10A001A** |
| Equipment: | **Dual-Mode Dual-Band TDMA Phone**<br>**AMPS, 800 MHz TDMA and PCS** |
| Model: | **EB-TX110A** |
| For: | Certification |
| Applicant: | PANASONIC<br>Matsushia Mobile Communications Development Corp. of U.S.A.<br>1225 Northbrook Parkway, Suite 2-400<br>Suwanee, GA 30024<br>U.S.A. |
| Manufacturer: | PANASONIC<br>Matsushia Mobile Communications Development Corp. of U.S.A.<br>1225 Northbrook Parkway, Suite 2-400<br>Suwanee, GA 30024<br>U.S.A. |
| Test Laboratory: | APREL Laboratories<br>51 Spectrum Way<br>Nepean, Ontario<br>Canada K2R 1E6 |

# MANUFACTURER'S DATA

| | |
|---|---|
| **Equipment Type:** | **Dual-Mode Dual-Band TDMA Phone**<br>**AMPS, 800 MHz TDMA and PCS** |
| **Model**: | **EB-TX110A** |
| **Reference:** | FCC Rules and Regulations Parts:<br>2.1046/22.913, 24.232 and 2.1053/22.917(e), 24.238 |
| **Manufacturer:** | PANASONIC<br>Matsushia Mobile<br>Communications Development Corp. of U.S.A. |
| **Power Source:** | 4.8 V, 800 mAh, Ni-Cd |
| **Development Stage of Unit:** | Production |

## GENERAL SPECIFICATIONS

| | | |
|---|---|---|
| 1. | Frequency Range: | 824.08  848.97 MHz,  1850.04  1909.95 MHz |
| 2. | Number of Channels: | 2830 |
| 3. | Standard Duty Cycle: | in TDMA is Full Rate 1/3; AMPS is CW. |
| 4. | Channel Spacing: | 25 KHz |
| 5. | Output Power: | 0.6W |
| 6. | Type of Modulation: | FM, $\pi/4$ DQPSK |
| 7. | Antenna Impedance | 50 Ω |

## CHANNELS TESTED

| | |
|---|---|
| Channel #384 | 836.52 MHz |
| Channel #799 | 848.97 MHz |
| Channel #991 | 824.04 MHz |

# INTRODUCTION

## General

This report describes the results of selected tests conducted on a **Dual-Mode Dual-Band TDMA Phone**, model **EB-TX110A** manufactured by PANASONIC, Matsushia Mobile Communications Development Corp. of U.S.A.

## Test Facility

The tests were performed for PANASONIC, Matsushia Mobile Communications Development Corp. of U.S.A by APREL Laboratories at APREL's EMI facility located in Nepean, Ontario, Canada. The laboratory operates an (3m and 10m) Open Area Test Site (OATS). The measurement facility is calibrated in accordance with ANSI C63.4-1992.

A description of the measurement facility in accordance with the radiated and AC line conducted test site criteria in ANSI C63.4-1992 is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations.

APREL's registration number is 31040/SIT (1300F2).

APREL is accredited by Standard Council of Canada, under NAPTO program (ISO Guide 25). APREL is also accredited by Industry Canada (formerly DOC) and recognised by the Federal Communications Commissions (FCC).

## Standard

The evaluation and analysis were conducted in accordance with FCC Rules and Regulations Parts: 2.1046/22.913, 24.232 and 2.1053/22.917(e), 24.238.

## Test Equipment

The test equipment used during the evaluation is listed in Appendix A. Calibration of all test equipment are performed at 12 month intervals. All equipment used is calibrated or verified in accordance with the intent of AQAP-6/MIL-STD-45662.

## Environmental Conditions

Measurements were conducted under normal laboratory conditions including open area test site.

- Temperature: 23 °C ± 2
- Relative Humidity: 30 - 50 %
- Air Pressure: 101 kPa ± 3

# TEST RESULTS

## RF POWER OUTPUT (ERP)

## AMPS AND TDMA(800MHZ) MODES

## DUAL-MODE DUAL-BAND TDMA PHONE

## EB-TX110A

**Test:** **RF Power Output as Radiated (ERP)**
**AMPS and TDMA(800MHz) Modes**

**Ref.:** **FCC Part 2 paragraph 2.985(a) and Part 22 paragraph 22.913(a)**

**Criteria:** The effective radiated power of the mobile transmitter must not exceed 7 Watts. The equipment must employ means to limit the power to the minimum necessary to maintain successful communications.

**Set-up:** See Figure No. 1.

**Environmental Conditions:** Temperature: 23 °C ± 2.
Air pressure:101 ± 3 kPa

**Equipment:** See Appendix A.

**Procedure**: RF Power Measurement by Radiated Method (ERP):

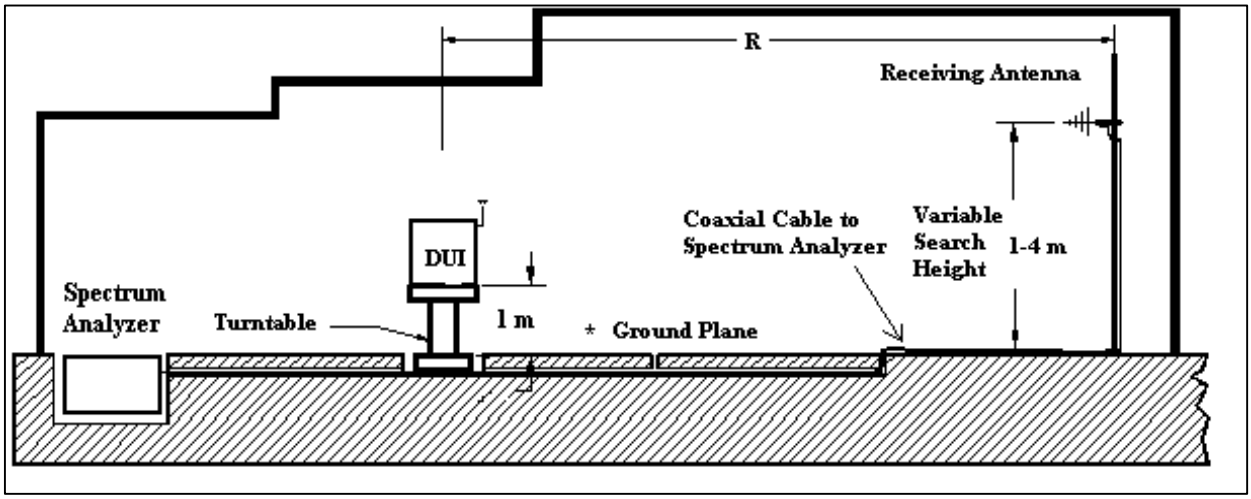
Test site: The radiated RF power measurements were taken at APREL Laboratory's open area test site (OATS) measurement facility. This open area test site is calibrated to ANSI C63.4 document and a description of the measurement facility is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations. (FCC File No.: 31040/SIT).

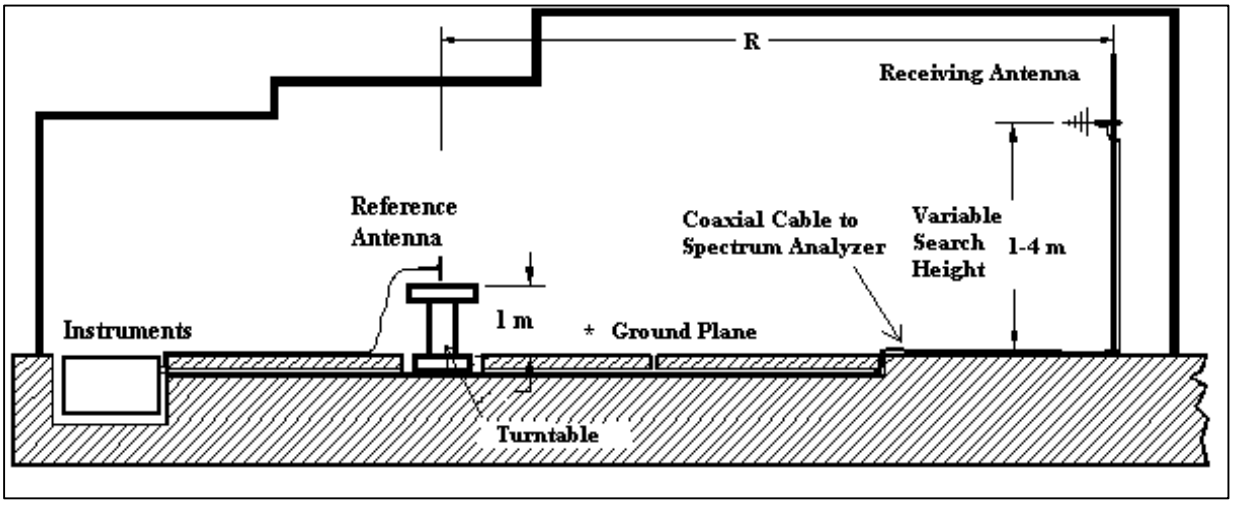
The test was set-up as illustrated in Fig. 1. The mobile was configured to operate at maximum power (power level 0) with carrier unmodulated. The equipment under test was placed on a turntable positioned 3 meters away from the calibrated receiving antenna, which in turn was connected to the spectrum analyzer.

For each transmitter frequency, the received signal was maximized by rotating the turntable and adjusting the height of the receiving antenna. To obtain the actual ERP, the mobile was replaced by a half-wave dipole antenna resonating at 800 MH vertically polarized, RF power amplifier and signal generator. The center of the dipole antenna was placed in the same location as the mobile. The signal generator level was adjusted until the reading on the spectrum analyzer was identical to that obtained when the mobile was on the turntable. The output of power amplifier was disconnected from the dipole and connected to an RF power meter. The effective radiated power was read directly from the power meter. The antenna factor and the cable loss between the power amplifier and antenna was taken into account during the measurement.

**Results:** **PASSED.** See Tables: 1 and 2.

**Set Up Figure 1**
**Effective Radiated Power (ERP)**




Note:
R=3 meter.
Instruments: Spectrum Analyzer, Signal Generator, RF Power Amplifier.
Receiving Antenna: Log-Periodic Antenna.
RF absorbing materials were used on the ground plane between transmitting and receiving antenna.
Reference Antenna is a half wave dipole (800 MHz).

**Dual-Mode Dual-Band TDMA Phone**

**TABLE 1**
**RF Power Output as Radiated (ERP)**
**AMPS Mode**

| Channel No. | Nominal Transmit Frequency | Manufacturer's Rated ERP (Power Level: 0) | Measured ERP (Power Level: 0) | Criteria ERP (Power Level: 0) |
|---|---|---|---|---|
| | (MHz) | (W) | (W) | (W) |
| 384 M | 836.52 | 0.6 | 0.30 | 7 |
| 799 H | 848.97 | 0.6 | 0.33 | 7 |
| 991 L | 824.04 | 0.6 | 0.29 | 7 |

**TABLE 2**
**RF Power Output as Radiated (ERP)**
**800 MHz TDMA Mode**

| Channel No. | Nominal Transmit Frequency | Manufacturer's Rated ERP (Power Level: 0) | Measured ERP (Power Level: 0) | Criteria ERP (Power Level: 0) |
|---|---|---|---|---|
| | (MHz) | (W) | (W) | (W) |
| 384 M | 836.52 | 0.6 | 0.52 | 7 |
| 799 H | 848.97 | 0.6 | 0.50 | 7 |
| 991 L | 824.04 | 0.6 | 0.50 | 7 |

**TEST RESULTS**

**RF POWER OUTPUT (EIRP)**

**PCS(1900MHZ) MODE**

**DUAL-MODE DUAL-BAND TDMA PHONE**

**EB-TX110A**

**Test:** **RF Power Output as Radiated (EIRP)**
**PCS Mode**

**Ref.:** **FCC Part 24, Subpart E, Paragraph 24.232 and 2.1046**

**Criteria:** Portable stations are limited to 2 Watts e.r.i.p peak power and the equipment must employ means to limit the power to the minimum necessary for successful communications.

Peak transmit power must be measured over any interval of continuous transmission using instruments calibrated in terms of an rms equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

**Set-up:** See Figure No. 2.

**Environmental Conditions:** Temperature: 23 °C ± 2.
Air pressure:101 ± 3 kPa

**Equipment:** See Appendix A.

**Procedure**: RF Power Measurement by Radiated Method (EIRP):

Test site: The radiated RF power measurements were taken at APREL Laboratory's open area test site (OATS) measurement facility. This open area test site is calibrated to ANSI C63.4 document and a description of the measurement facility is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations. (FCC File No.: 31040/SIT).

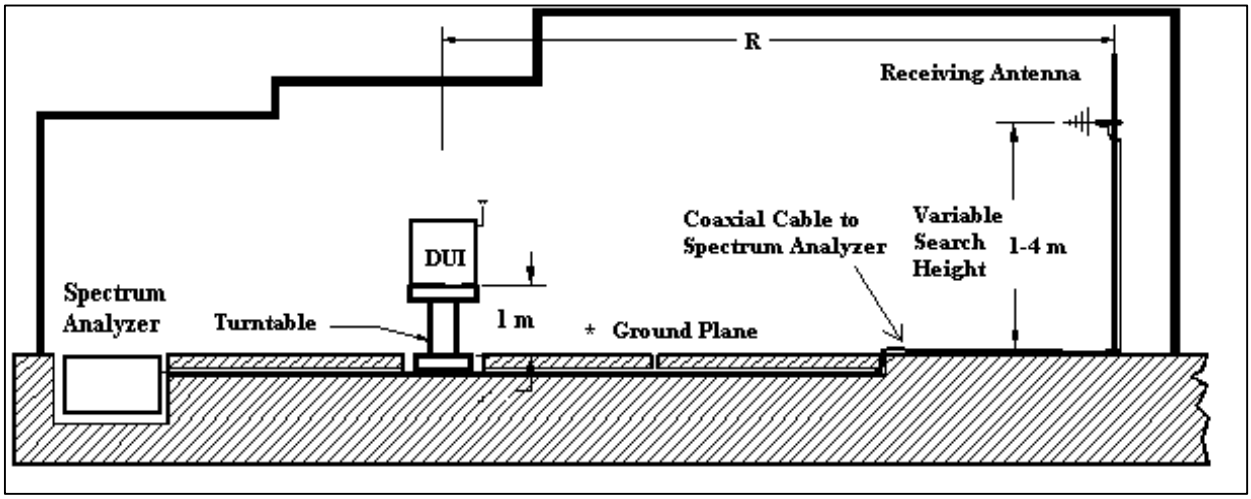
The test was set-up as illustrated in Fig. 1. The mobile was configured to operate at maximum power (power level 0) with carrier unmodulated. The equipment under test was placed on a turntable positioned 1.5 meters away from the calibrated receiving antenna, which in turn was connected to the spectrum analyzer.

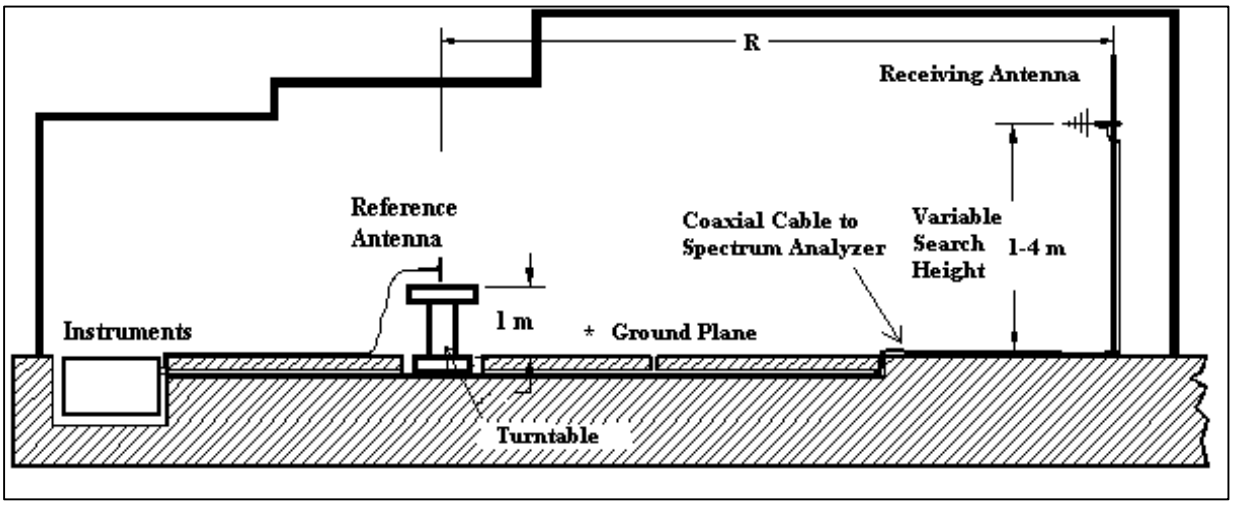
For each transmitter frequency, the received signal was maximized by rotating the turntable and adjusting the height of the receiving antenna. To obtain the actual ERP, the mobile was replaced by a half-wave dipole antenna resonating at 1900 MHz vertically polarized, RF power amplifier and signal generator. The center of the dipole antenna was placed in the same location as the mobile. The signal generator level was adjusted until the reading on the spectrum analyzer was identical to that obtained when the mobile was on the turntable.

The output of power amplifier was disconnected from the dipole and connected to an RF power meter. **The effective radiated power was read directly from the power meter and then converted to e.i.r.p. value, i.e, with respect to isotropic antenna. The antenna factor and the cable loss between the power amplifier and antenna was taken into account during the measurement.**

**Results:** **PASSED.** See Table 3.

**Set Up Figure 2**
**Equivalent Isotropically Radiated Power (e.i.r.p)**




Note:

R=1.5 meter.
Instruments: Spectrum Analyzer, Signal Generator, RF Power Amplifier.
Receiving Antenna: Double Ridged Horn Antenna.
RF absorbing materials were used on the ground plane between transmitting and receiving antenna.
Reference Antenna is a half wave dipole (1900 MHz).

**Dual-Mode Dual-Band TDMA Phone**

**TABLE 3**
**RF Power Output as Radiated (EIRP)**
**1900 MHz PCS Mode**

| Channel No. | Nominal Transmit Frequency | Manufacturer's Rated EIRP (Power Level: 0) | Measured EIRP (Power Level: 0) | Criteria EIRP (Power Level: 0) |
|---|---|---|---|---|
| | (MHz) | (W) | (W) | (W) |
| 2 L | 1850.04 | 0.6 | 0.78 | 2 |
| 998 M | 1879.92 | 0.6 | 0.65 | 2 |
| 1998 H | 1909.92 | 0.6 | 0.68 | 2 |

**TEST RESULTS**

**FIELD STRENGTH OF TRANSMITTER SPURIOUS RADIATION**

**AMPS AND TDMA(800MHZ) MODES**

**DUAL-MODE DUAL-BAND TDMA PHONE**

**EB-TX110A**

**Test:** **Field Strength of Transmitter Spurious Radiation**
**AMPS AND TDMA(800MHz) Modes**

**Ref.:** **FCC Parts: 2.1053 and 22.917(e)**

**Criteria:** On any frequency twice or more than twice the fundamental frequency of the mobile, the mean power of spurious emissions shall be attenuated below the power of the unmodulated carrier by at least 43 + 10 log (P) dB.

This was calculated to be 84.6 dBμV/m at 3 meters.

**Set-up:** See Figure No. 3.

**Environmental Conditions:** Temperature: 23 °C ± 2.
Air pressure: 101 ± 3 kPa

**Procedure**: The final measurements were taken at APREL Laboratory's open area test site (OATS) measurement facility. This open area test site is calibrated to ANSI C63.4 document and a description of the measurement facility is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations. (FCC File No.: 31040/SIT).

The mobile was configured to operate at maximum power with appropriate modulation. The mobile was keyed on channel 384 (836.52 MHz).

Prior to final measurements in the OATS, preliminary radiated spurious emissions were scanned in a shielded enclosure at a distance of 1 m using a broadband Discone antenna and horn antenna in order to determine the characteristic frequencies of the field strength of spurious emissions. Based on this information, measurements were performed in the OATS at these characteristic frequencies using calibrated antennas.

The transmitter output was fed to a HP 8920 A/D RF Communication Test Set and the output power was noted for reference. A 50 Ω dummy load was connected to the I/O Port at the bottom of the portable Handset. Any RF transmission was cut-off from the antenna by internal switch. All field strength measurements were made with spectrum analyzer and the appropriate calibrated antenna for the frequency range of 9 kHz up to 10$^{th}$ harmonics of the transmit frequency (See equipment list for the calibrated antenna used).

The equipment under test was placed on a turntable positioned 3 meters away from the calibrated receiving antenna, which in turn was connected to the spectrum analyzer. For each identified frequency, the received signal was maximized by the positioning of the turntable and the height of the antenna. The process was repeated for both horizontal and vertical polarization.

Information submitted includes the relative radiated power of each spurious emissions with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antenna.

Measurements given in the spurious emissions test result tables contain: analyzer reading, correction factor, and final reading. The final field strength level are derived from the analyzer measurement and the correction factor (antenna factor and cable loss) as shown in the following example:

Sample Calculation:

A. Spectrum analyzer reading (Direct measurement)

At 3346.08 MHz a spurious level of 27.2 dBµV @ 3 meters is measured.

B. Correction factor (antenna factor , cable loss and Amplifier Gain)

Cable loss: 12 dB
Antenna factor: 41 dB
Amplifier Gain: 20 dB
Total Correction Factor: 12 + 41 - 20 = 33 dB/m

C. Final Reading (Field Strength of spurious emission)

C=A+B
C= 27.2 dBµV + 33 dB
C= 60.2 dBµV/m @ 3 meters

D. The criteria level.

The field intensity which would be produced by the transmitter carrier operating into a half-wave dipole antenna (gain of 1.64), at a distance of 3 m was calculated using the following formula:

$$\text{Field Strength of carrier (dB}\mu\text{V/m)} = 10\log_{10}\left(\frac{PtG}{4\pi r^2}\right) + 146 \text{ dB}$$

Pt is transmitter power, 0.6 Watts
G is gain, 1.64
r is distance, 3 meters

Field Strength of carrier was calculated: 125.4 dBµV/m

D = Field Strength of carrier - (43 + (10 log P))
D = 125.4 dBµV/m - (43 + (10 log 0.6))
D = 84.6 dBµV/m @ 3 meters

Criteria (reference) level at 3 meters from 0.6 Watts into half-wave dipole antenna is 84.6 dBµV/m

E = Margin (spurious emission below the reference level)

E = D - C
E = 84.6 dBµV/m –60.2 dBµV/m
E = 24.4 dB

**Results:** **PASSED.** See Tables 4 & 5.

**Dual-Mode Dual-Band TDMA Phone**

**TABLE 4**
**Field Strength of Transmitter Spurious Radiation**
**AMPS mode**
Channel No.: 384
Transmitter Frequency: 836.52 MHz
Power Level: 0
Antenna Polarization: Horizontal

| Frequency (MHz) | Measured Level (dBµV) "A" | Correction Factor (dB/m) "B" | Field Strength (dBµV/m) "C" | Criteria Level (dBµV/m) "D" | Margin (dB) "E" |
|---|---|---|---|---|---|
| 1673.04 | 50.5 | 21.0 | 71.5 | 84.6 | 13.1 |
| 2509.56 | 37.1 | 27.0 | 64.1 | 84.6 | 20.5 |
| 3346.08 | 27.2 | 33.0 | 60.2 | 84.6 | 24.4 |

"C" = "A" + "B"
"E" = "D" - "C"

**TABLE 5**
**Field Strength of Transmitter Spurious Radiation**
**AMPS mode**
Channel No.: 384
Transmitter Frequency: 836.52 MHz
Power Level: 0
Antenna Polarization: Vertical

| Frequency (MHz) | Measured Level (dBµV) "A" | Correction Factor (dB/m) "B" | Field Strength (dBµV/m) "C" | Criteria Level (dBµV/m) "D" | Margin (dB) "E" |
|---|---|---|---|---|---|
| 1673.04 | 53.4 | 21.0 | 74.4 | 84.6 | 10.2 |
| 2509.56 | 39.8 | 27.0 | 66.8 | 84.6 | 17.8 |
| 3346.08 | 39.7 | 33.0 | 72.7 | 84.6 | 11.9 |

"C" = "A" + "B"
"E" = "D" - "C"

**TABLE 6**
**Field Strength of Transmitter Spurious Radiation**
**800 MHz TDMA Mode**
Channel No.: 384
Transmitter Frequency: 836.52 MHz
Power Level: 0
Antenna Polarization: Horizontal

| Frequency (MHz) | Measured Level (dBµV) "A" | Correction Factor (dB/m) "B" | Field Strength (dBµV/m) "C" | Criteria Level (dBµV/m) "D" | Margin (dB) "E" |
|---|---|---|---|---|---|
| 1673.04 | 50.5 | 21.0 | 71.5 | 84.6 | 13.1 |
| 2509.56 | 39.1 | 27.0 | 66.1 | 84.6 | 18.5 |
| 3346.08 | 45.3 | 33.0 | 78.3 | 84.6 | 6.3 |

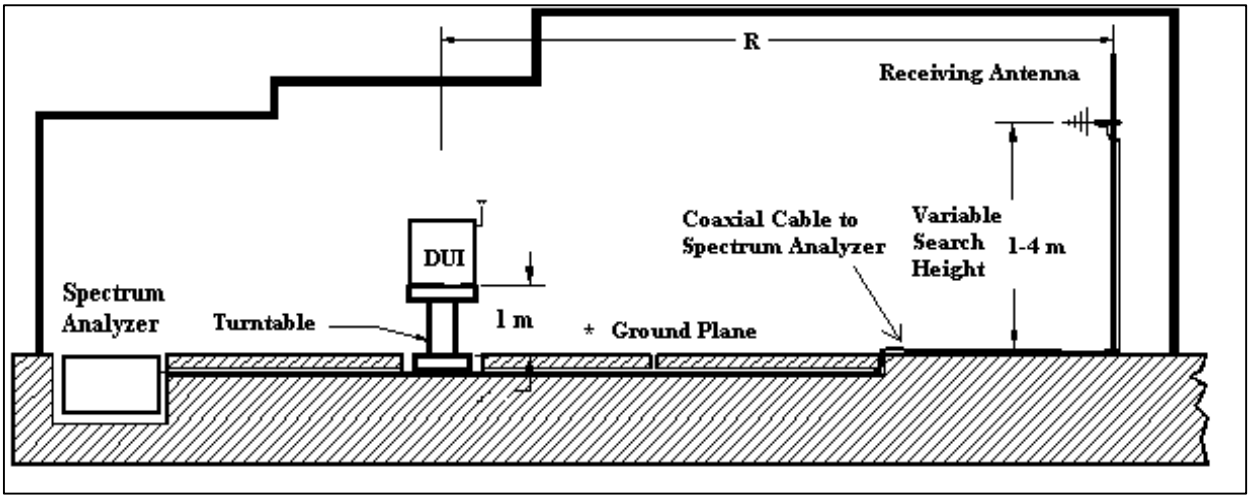
"C" = "A" + "B"
"E" = "D" - "C"

**TABLE 7**
**Field Strength of Transmitter Spurious Radiation**
**800 MHz TDMA Mode**
Channel No.: 384
Transmitter Frequency: 836.52 MHz
Power Level: 0
Antenna Polarization: Vertical

| Frequency (MHz) | Measured Level (dBµV) "A" | Correction Factor (Db/m) "B" | Field Strength (dBµV/m) "C" | Criteria Level (dBµV/m) "D" | Margin (dB) "E" |
|---|---|---|---|---|---|
| 1673.04 | 55.0 | 21.0 | 76.0 | 84.6 | 8.6 |
| 2509.56 | 41.6 | 27.0 | 68.6 | 84.6 | 16.0 |
| 3346.08 | 42.2 | 33.0 | 75.2 | 84.6 | 9.4 |

"C" = "A" + "B"
"E" = "D" - "C"

**Set Up Figure 3**
**Measurement of Field Strength of Transmitter Spurious Radiation**
**in open area site.**
**50 Ω termination connected to DUI**
**DUI antenna is not operational**




Note: R=3 meter.

**TEST RESULTS**

**FIELD STRENGTH OF TRANSMITTER SPURIOUS RADIATION**

**1900MHZ PCS MODE**

**DUAL-MODE DUAL-BAND TDMA PHONE**

**EB-TX110A**

**Test:** **Field Strength of Spurious Radiation**
**PCS Mode**

**Ref.:** **FCC Part 24, Subpart E, Paragraph 24.238 and Part 2.1053**

**Criteria:** 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..

This is calculated to be 84.6 dBµV

**Set-up:** See Set Up Figure No. 3.

**Environmental Conditions:** Temperature: 23 °C ± 2.
Air pressure: 101 ± 3 kPa

**Equipment:** See Appendix A.

**Procedure**:

1) The mobile was configured to operate at maximum power with pseudo random data modulation (inherent in the operation of the mobile vocoder and encryption algorithms when a call is established). The mobile was keyed on Channel 384.

2) The final measurements were taken at APREL Laboratory's 3m open area test site (OATS). This open area test site is calibrated to ANSI C63.4 document and is on file with the FCC (FCC File # 31040/SIT).

3) Prior to final measurements in the OATS, preliminary radiated spurious emissions were scanned in a shielded enclosure at a distance of 1 m using a broadband Discone and horn antenna in order to determine the characteristic frequencies of the field strength of spurious radiation. Based on this information, measurements were performed in the OATS at these characteristic frequencies using calibrated antennas.

4) The transmitter output was fed to a Rohde & Schwarz CMD55 Digital Radio communication tester and the output power was noted for reference. A 50 Ω dummy load was connected to the I/O port at the bottom of the portable handset. All field strength measurements were made with spectrum analyzer and the appropriate calibrated antenna for the frequency range of 1 MHz up to 10$^{th}$ harmonics of the transmit frequency (See equipment list for the calibrated antenna used).

5) The equipment under test was placed on a turntable positioned 3 meters away from the calibrated receiving antenna, which in turn was connected to the spectrum analyzer. For each identified frequency, the received signal was maximized by the positioning of the turntable and the height of the antenna. The process was repeated for both horizontal and vertical polarization.

6) Information submitted includes the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antenna.

7) Measurements given in the spurious emissions test result tables contain: analyzer reading, correction factor, and final reading. The final field strength level are derived from the analyzer measurement and the correction factor (antenna factor and cable loss) as shown in the following example:

8) Sample Calculation:

A. Spectrum analyzer reading (Direct measurement)

At 3761.84 MHz a spurious level of 28.0 dBµV @ 3 meters is measured.

B. Correction factor (antenna factor , cable loss and Amplifier Gain)

Cable loss: 13.5 dB
Antenna factor: 42 dB
Amplifier Gain: 20
Total Correction Factor: 13.5 + 42 - 20 = 35.5 dB/m

C. Final Reading (Field Strength of spurious emission)

C=A+B
C= 28.0 dBµV + 35.5 dB
C= 63.5 dBµV/m @ 3 meters

D. The criteria level.

The field intensity which would be produced by the transmitter carrier operating into a half-wave dipole antenna (gain of 1.64), at a distance of 3 m was calculated using the following formula:

Field Strength of carrier (dBμV/m) = $10\log_{10}\left(\frac{PtG}{4\pi r^2}\right)+146$ dB

Pt is transmitter power, 0.6 Watts
G is gain, 1.64
r is distance, 3 meters

Field Strength of carrier was calculated: 125.4 dBμV/m

D = Field Strength of carrier - (43 + (10 log P))
D = 125.4 dBμV/m - (43 + (10 log 1.0))
D = 84.6 dBμV/m @ 3 meters

Criteria (reference) level at 3 meters from 0.6 Watts into half-wave dipole antenna is 84.6 dBμV/m

E = Margin (spurious emission below the reference level)

E = D - C
E = 84.6 dBμV/m –63.5 dBμV/m
E = 21.1 dB

**Results:** **PASSED.** See Table 8 and 9.

**Dual-Mode Dual-Band TDMA Phone**

**TABLE 8**
**Field Strength of Transmitter Spurious Radiation**
**PCS Mode**
Channel No.: 998
Transmitter Frequency: 1880.92 MHz
Power Level: 0
Antenna Polarization: Horizontal

| Frequency (MHz) | Measured Level (dBµV) "A" | Correction Factor (dB/m) "B" | Field Strength (dBµV/m) "C" | Criteria Level (dBµV/m) "D" | Margin (dB) "E" |
|---|---|---|---|---|---|
| 3761.84 | 28.0 | 35.5 | 63.5 | 84.6 | 21.1 |

"C" = "A" + "B"
"E" = "D" - "C"
No other harmonics and spurious emission were detected.

**TABLE 9**
**Field Strength of Transmitter Spurious Radiation**
**PCS Mode**
Channel No.: 998
Transmitter Frequency: 1880.92 MHz
Power Level: 0
Antenna Polarization: Vertical

| Frequency (MHz) | Measured Level (dBµV) "A" | Correction Factor (dB/m) "B" | Field Strength (dBµV/m) "C" | Criteria Level (dBµV/m) "D" | Margin (dB) "E" |
|---|---|---|---|---|---|
| 3761.84 | 29.0 | 35.5 | 64.5 | 84.5 | 20.0 |

"C" = "A" + "B"
"E" = "D" - "C"
No other harmonics and spurious emission were detected.

# APPENDIX A

## List of Equipment

| Description | Manufacturer | Model # | Asset # | Cal. Due |
|---|---|---|---|---|
| Spectrum Analyzer | Anritsu | MS2601A | 100479 | Jun 15, 2000 |
| Spectrum Analyzer | Tektronix | 492 | 100949 | Aug 3, 1999 |
| Bi-conical Antenna | Eaton | 94455-1 | 100156 | Sep 13, 1999 |
| Log-Periodic Antenna | APREL Inc. | ALP1 | 100761 | May 2, 2000 |
| Double Ridged Guided Horn Antenna | APREL Inc. | A1 | 100400 | May 15, 2000 |
| 800 MHz Dipole | APREL Inc. | D-8355 | N/A | Jun 16, 2000 |
| 1900 MHz Dipole | APREL Inc. | D-1900S | N/A | Jun 16, 2000 |
| Turntable with Controller | EMCO | 1060-1.241 | 100506 | CNR |
| RF Communication Test Set | Hewlett-Packard | HP 8920 A/D | 301289 | Sep 13, 1999 |
| Signal Generator | Hewlett-Packard | HP 8662A | 100456 | Jun 28, 2000 |
| Signal Generator | Hewlett-Packard | HP 8340B | 100955 | Sep 4, 1999 |
| RF Power Amplifier | Amplifier Research | 25W1000M | 100735 | Oct 2, 1999 |
| RF Power Amplifier | Amplifier Research | 25W1000M | 100735 | Oct 2, 1999 |
| RF Power Amplifier | APREL Inc. | APR AMP 102 | 100995 | C.O.S |
| RF Power meter | Rohde & Schwarz | NRVS | 100851 | C.N.R |
| 20 dB Attenuator | Narda | 4779-20 | 301370 | Mar 14, 2000 |
| Shielded Room | Universal Shielding | 6/15/87 | 100554 | May 1, 2000 |
| OATS | APREL Inc. | 3m&10m | N/A | N/A |

CNR: Calibration Not Required.
COS: Calibration on Site.

# APPENDIX B

## Photographs


**Photo 1 Equipment under Test: EB-TX110A**

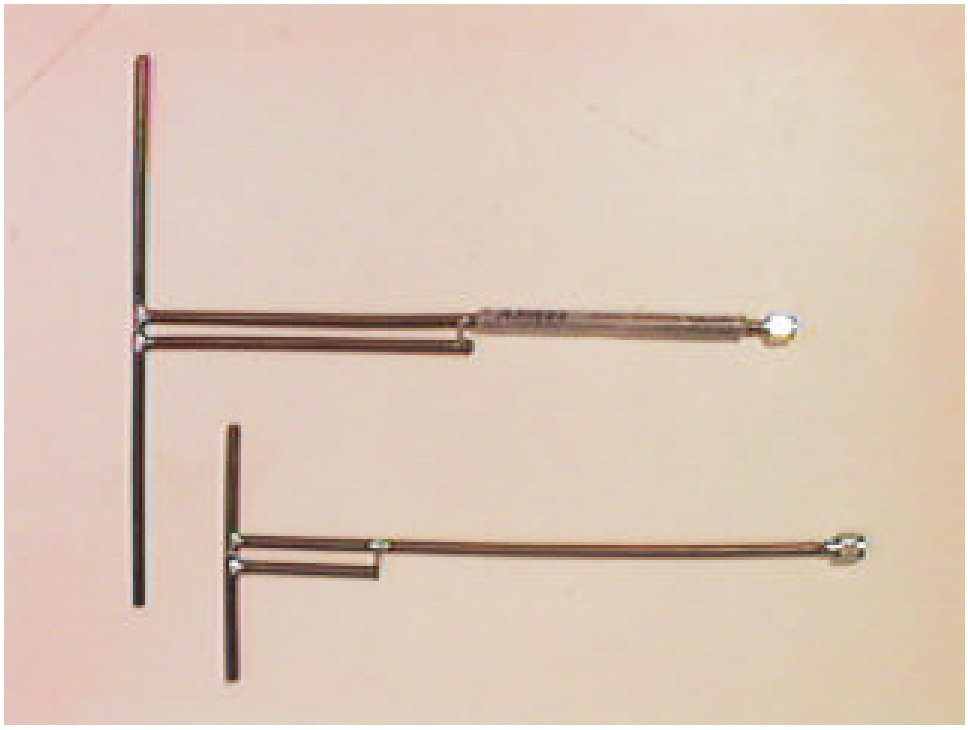


**Photo 2 Dipoles as Reference Antenna for 800 MHz and 1900 MHz**
**RF Power as Radiated Measurements**

**Photo 3 ERP Test Setup**

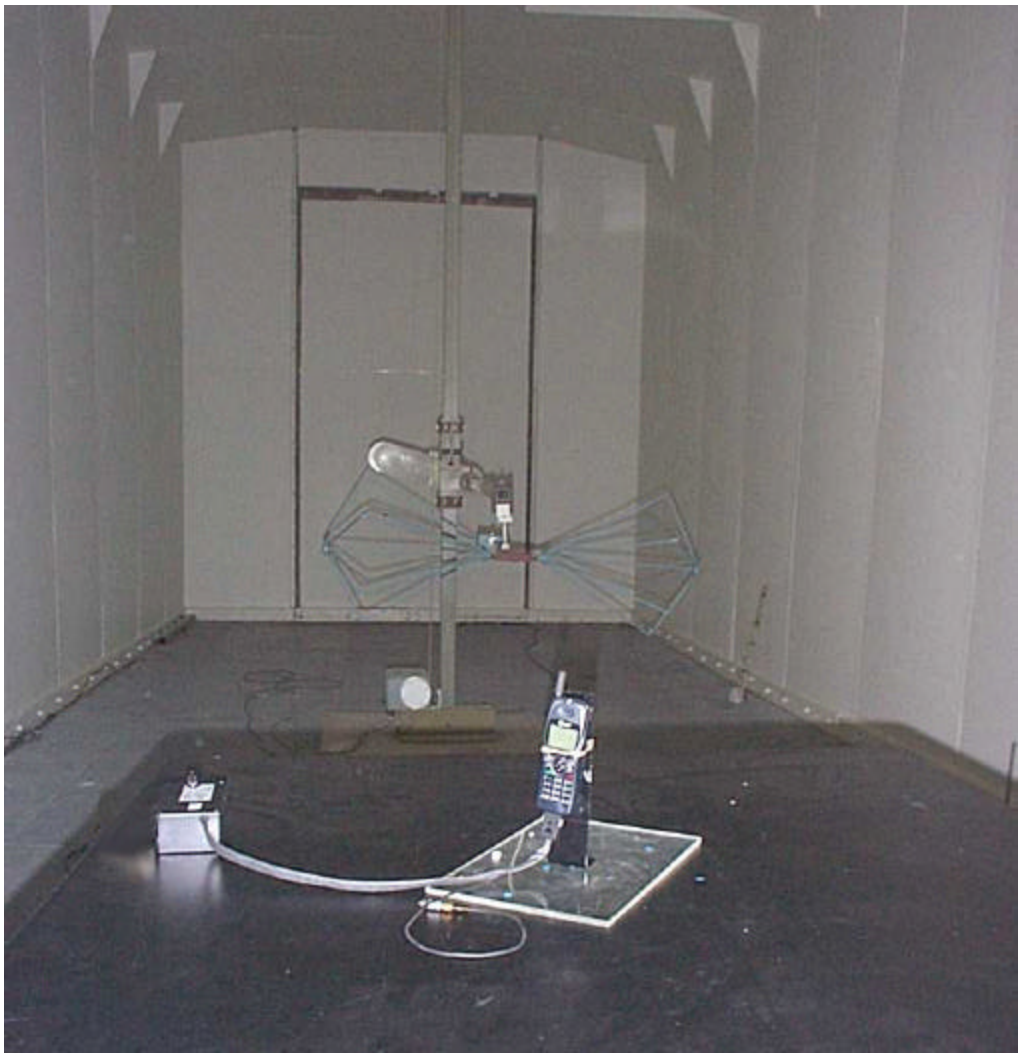


**Photo 4 Test Setup of Transmitter Spurious Radiation with 50 Ohms Load via I/O Port at the bottom of the phone. As such, the antenna was cut-off.**

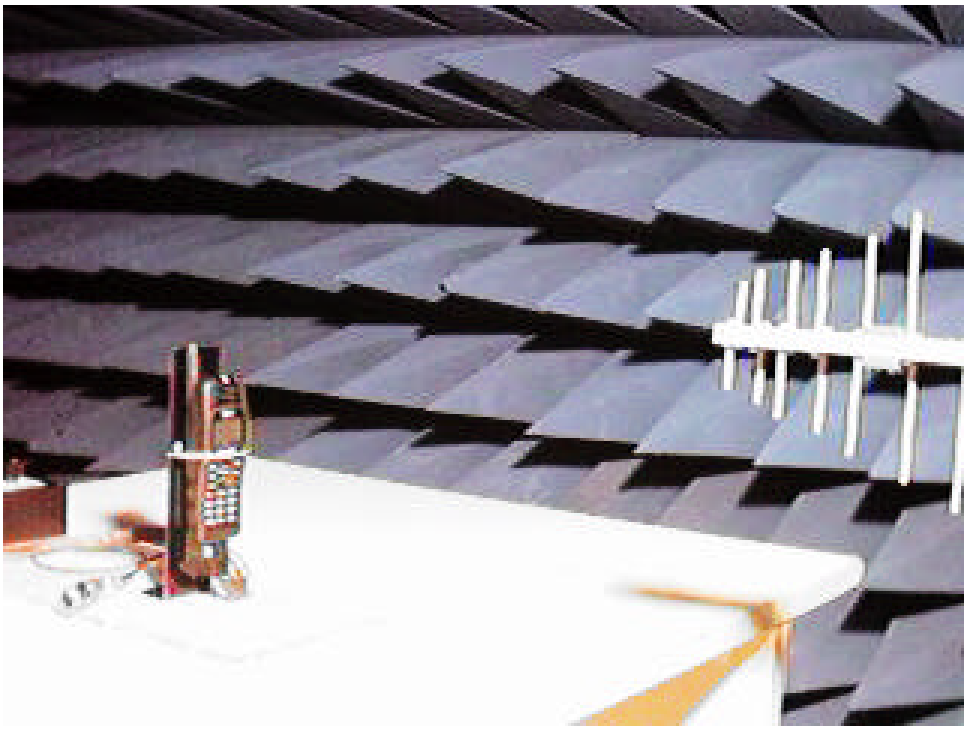


**Photo 5 Signature of Transmitter Spurious Radiation in Shielded Room**