# MEASUREMENT/TECHNICAL REPORT

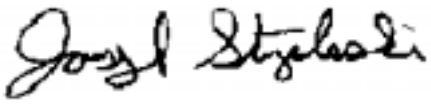
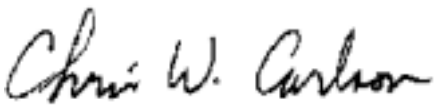
## Motorola AIEG Model 90584373

## FCC ID: LHJ009

## APPLICATION FOR CERTIFICATION

## RF Emission Measurements Performed For Determination of Compliance with the US Code of Federal Regulations Title 47, Chapter I, FCC Part 15 Subpart B As Required for Certification for Unintentional Radiators

Radiometrics Midwest Corporation Test Document RP-3880A
Issue Date: September 18, 1998
This report concerns: Original grant
Equipment type: Periodic Transmitter
Transition Rules per 15.37 are not requested.

| *Tests Performed For* | *Test Facility* |
|---|---|
| **Motorola AIEG**<br>4000 Commercial Av.<br>Northbrook, IL 60062-1840 | **Radiometrics Midwest Corporation**<br>12 East Devonwood<br>Romeoville, IL 60446<br>Phone: (815) 293-0772<br>FAX: (815) 293-0820<br>radiomet@ix.netcom.com |
| *Test Report Written By* | *Test Report Approved By* |
|  |  |
| Joseph Strzelecki<br>Senior EMC Engineer<br>NARTE EMC-000877-NE | Chris W. Carlson<br>Director of Engineering<br>NARTE EMC-000921-NE |

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## 1.0 General Information

### 1.1 Product Description

The Model 90584373 (referred to as the EUT in this report) is a 315 MHz Transmitter. The EUT is manufactured by Motorola AIEG.

The EUT consists of four momentary push button switches, an RF oscillator (315Mhz SAW based), a single 3V lithium coin cell battery, and a custom IC.

In normal use nothing occurs until one of the four buttons is pressed. The custom IC determines which button was activated, then constructs the correct digital message which is sent to the RF oscillator at a 2Khz rate. The RF oscillator is a simple ON-OFF Keyed stage. Once the transmission is complete the custom IC goes into a standby mode and remains inactive until the next button is pressed.

### 1.2 Related Submittals

Motorola AIEG has previously submitted the associated receiver pursuant to the Notification equipment authorization as FCC ID: LHJ008.

### 1.3 Tested System Details

The identification for the EUT is as follows.

| Model Number<br>Serial Number | FCC ID | Manufacturer &<br>Description | Cable<br>Descriptions |
|---|---|---|---|
| M/N: 90584373<br>(EUT) | LHJ009 | Motorola AIEG<br>315 MHz Transmitter | No cables can be<br>connected to the EUT |

### 1.4 Test Methodology

The test procedures used are in accordance with the ANSI document C63.4-1992, (July 17, 1992) "Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

### 1.5 Test Facility

The open area test site used to collect the radiated data is located on 8625 Helmar Road in Newark, Illinois. The open field test site has a metal ground screen. Details of the site characteristics are on file with the FCC. Conducted emission measurements and preliminary radiated emission scans were performed in shielded enclosure “B” at Radiometrics' Romeoville, Illinois EMI test lab. These sites have been fully described in a report and accepted by the FCC in a letter dated October 1, 1996 (31040/SIT 1300F2).

### 1.6 Test Equipment

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. Below 1 GHz, when a radiated emission is detected approaching the specification limit, the measurement of the emission is repeated using a tuned dipole antenna with a Roberts Balun.

The radiated emission measurements were performed with a spectrum analyzer. The bandwidths of the spectrum analyzers are adjusted to the correct bandwidths as specified by the FCC Rules. The bandwidth used from 450 kHz to 30 MHz is 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz a 1 MHz bandwidth is used. In order to increase the sensitivity of the spectrum analyzer, a preamplifier was used. The preamplifiers used had sufficient dynamic range that ensured that an overload condition was not present during the tests.

## 2.0 System Test Configuration

### 2.1 Test System and Justification

The system was configured for testing in a typical fashion (as a customer would normally use it).

### 2.2 EUT Test Configuration

The EUT was tested as a stand alone device. The button was taped down for continuous operation for testing

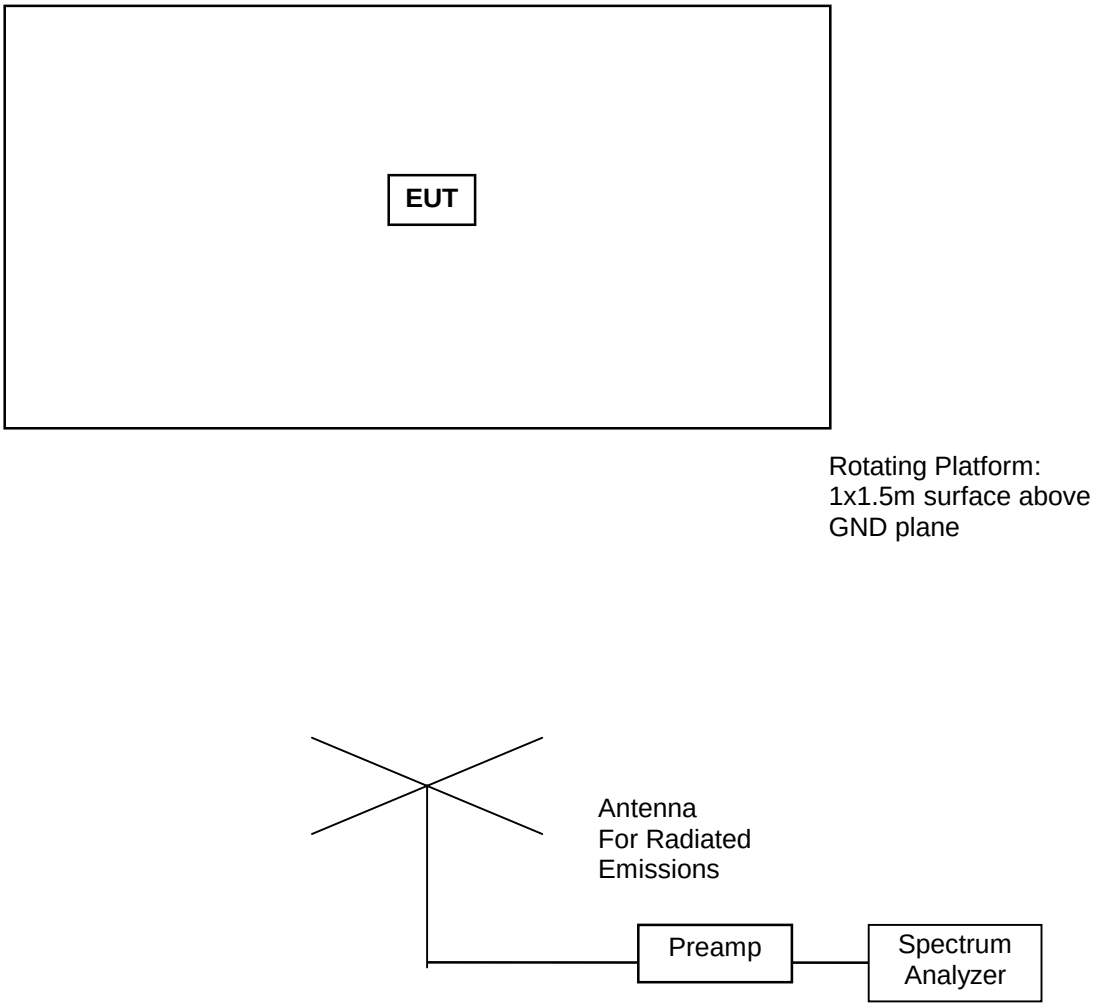
### 2.3 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

### 2.4 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

## Figure 2.1 Configuration of Tested System




**Radiated Emissions:**
- LISN's not used
- AC outlet with low-pass filter at the base of the turntable
- No vertical conductive wall
- Antenna height varied from 1 to 4 meters
- Distance from antenna to tested system is 3 meters

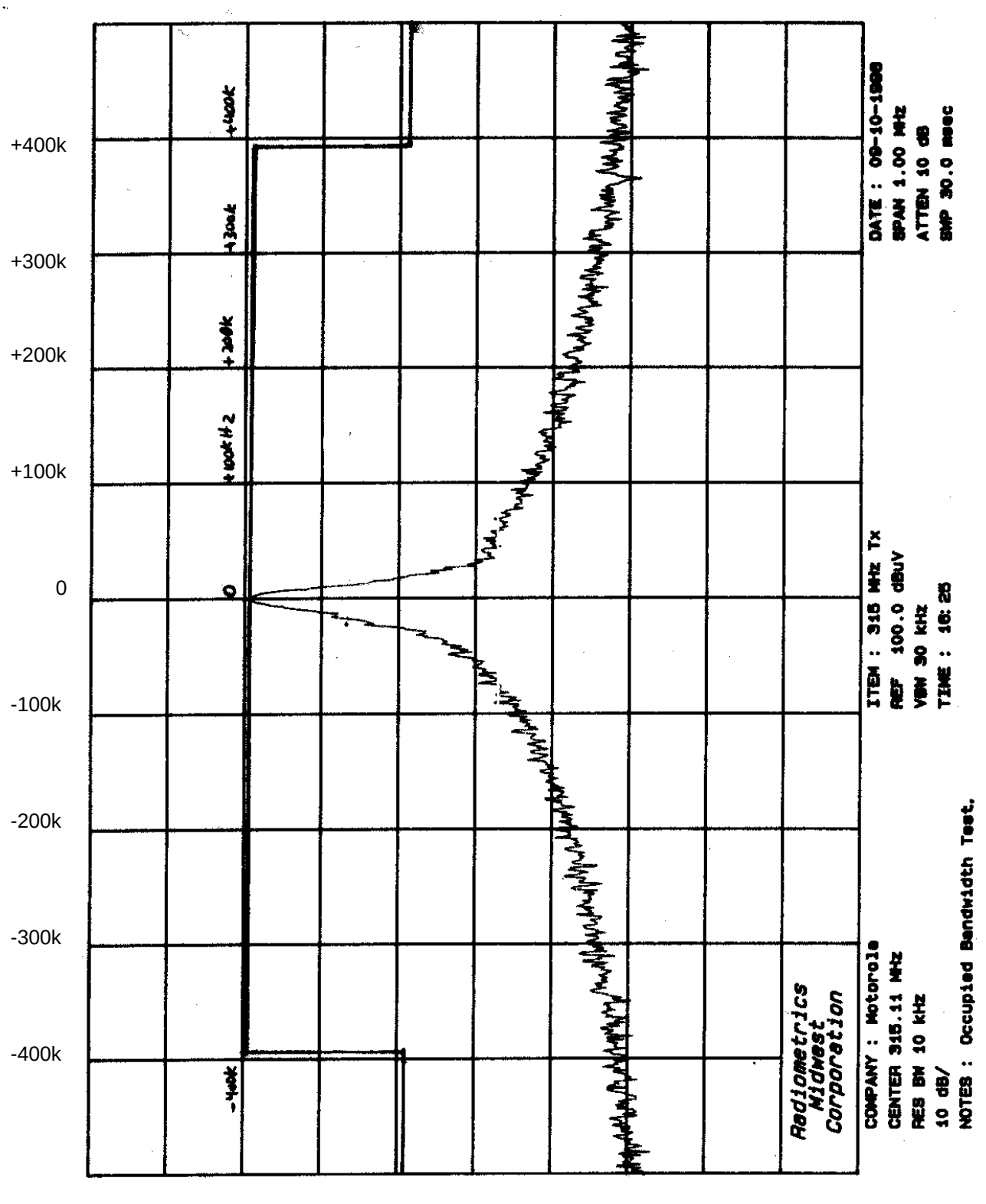
- Not to Scale

## 3.0 Occupied Bandwidth Data

The occupied bandwidth of the RF output was measured using an HP8566A spectrum analyzer. The bandwidth was measured using the peak detector function and a narrow resolution bandwidth.

A broadband antenna was used to receive the modulated signal. The spectrum analyzer was set to the "MAX HOLD" mode to record the worst case of the modulation. The spectrum analyzer display was digitized and plotted. A limit was drawn on the plots based on the level of the modulated carrier. The plots of the occupied bandwidth for the EUT are supplied on the following page.

**Figure 3.1 Occupied Bandwidth Plot**



## 4.0 Radiated Emissions Data

The following table lists the highest measured emission frequencies, and measured levels and the limit. A sample calculation is given in paragraph 4.1.

Model : 90584373
Test Date : September 12, 1998
Notes : Pol = Antenna Polarization; V = Vertical; H = Horizontal
: BC = Biconical; LP = Log Periodic; DP = Dipole; HN = Horn
Test Distance : 3 Meters
Notes : Low-loss coax cable was used above 1000 MHz.

| Freq MHz | Analyzer Reading* dBuV | Antenna Factor dB | Amp Gain dB | Cable Loss dB | Peak to Ave dB | Field Strength of Signal dBuV/m | Limit Field Strength dBuV/m | Margin Under Limit dB | Ant Type/Pol |
|---|---|---|---|---|---|---|---|---|---|
| 315.1 | 83.6 | 14.3 | 27.1 | 4.5 | 11.1 | 64.2 | 75.6 | 11.4 | V/LP |
| 630.2 | 54.4 | 19 | 27.0 | 7.3 | 11.1 | 42.6 | 55.6 | 13.0 | V/LP |
| 945.3 | 48.6 | 22.8 | 26.8 | 9.5 | 11.1 | 43.0 | 55.6 | 12.6 | V/LP |
| 1260.4 | 54.5 | 25.4 | 29.8 | 1.8 | 11.1 | 40.8 | 55.6 | 14.8 | V/HN |
| 1575.5 | 54.4 | 26.3 | 29.7 | 2 | 11.1 | 41.9 | 54 | 12.1 | V/HN |
| 1890.6 | 49.2 | 28 | 29.5 | 2.2 | 11.1 | 38.8 | 55.6 | 16.8 | V/HN |
| 2205.7 | 52.6 | 29.1 | 29.8 | 2.3 | 11.1 | 43.1 | 54 | 10.9 | V/HN |
| 2520.8 | 53.3 | 29.9 | 29.3 | 2.5 | 11.1 | 45.3 | 55.6 | 10.3 | V/HN |
| 2835.9 | 54.1 | 30.6 | 29.4 | 2.6 | 11.1 | 46.8 | 54 | 7.2 | V/HN |
| 3151.0 | 52.9 | 31.5 | 29.6 | 2.7 | 11.1 | 46.4 | 55.6 | 9.2 | V/HN |
| 315.1 | 90.2 | 14.3 | 27.1 | 4.5 | 11.1 | 70.8 | 75.6 | 4.8 | H/LP |
| 630.2 | 47.8 | 19 | 27.0 | 7.3 | 11.1 | 36.0 | 55.6 | 19.6 | H/LP |
| 945.3 | 47.6 | 22.8 | 26.8 | 9.5 | 11.1 | 42.0 | 55.6 | 13.6 | H/LP |
| 1260.4 | 54.5 | 25.4 | 29.8 | 1.8 | 11.1 | 40.8 | 55.6 | 14.8 | H/HN |
| 1575.5 | 54.4 | 26.3 | 29.7 | 2 | 11.1 | 41.9 | 54 | 12.1 | H/HN |
| 1890.6 | 49.2 | 28 | 29.5 | 2.2 | 11.1 | 38.8 | 55.6 | 16.8 | H/HN |
| 2205.7 | 52.6 | 29.1 | 29.8 | 2.3 | 11.1 | 43.1 | 54 | 10.9 | H/HN |
| 2520.8 | 53.3 | 29.9 | 29.3 | 2.5 | 11.1 | 45.3 | 55.6 | 10.3 | H/HN |
| 2835.9 | 54.1 | 30.6 | 29.4 | 2.6 | 11.1 | 46.8 | 54 | 7.2 | H/HN |
| 3151.0 | 52.9 | 31.5 | 29.6 | 2.7 | 11.1 | 46.4 | 55.6 | 9.2 | H/HN |

*Peak Reading

Judgment: Passed by 4.8 dB
Test Personnel: Joseph Strzelecki
Senior EMC Engineer

### 4.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain

Assume a receiver reading of 49.5 dBuV is obtained. The Antenna Factor of 8.1 and a Cable Factor of 1.7 is added. The Amplifier Gain of 23.3 dB is subtracted, giving a field strength of 36 dBuV/m. The 36 dBuV/m can be mathematically converted to its corresponding level in uV/m.

FS = 49.5 + 8.1 + 1.7 - 23.3 = 36.0 dBuV/m
Level in uV/m = Common Antilogarithm [(36 dBuV/m)/20] = 63.1 uV/m

### 4.2 Peak to Average Calculations

As required by section 15.35, the Peak to Average correction factor was calculated with the data supplied by the EUT manufacturer.

The following is an analysis to determine the maximum on time over any sampling of 100 mSec.

| | Total time | RF On Time |
|---|---|---|
| Wake up pulse | 7 mSec | 4 mSec |
| Data stream | 48 mSec (96 bits at 250usec on and 250 uSec off) | 24 mSec |
| No activity | 45 mSec | 0 mSec |
| SUM TOTAL | 100 mSec | 28 mSec |

**Figure 4.1 Duty Cycle Plot**