Electromagnetic Compatibility Test Report

Tests Performed on a Motorola AIEG

315 MHz Transmitter, Part Number 22692190

Formerly P/N 90584373

Radiometrics Document RP-4943

ACCREDITED
Certification # 1495.01

Product Detail:
FCC ID: LHJ009
Equipment type: Momentarily Operated Transmitter

Test Standards:
US CFR Title 47, Chapter I, FCC Part 15 Subpart C
FCC Part 15 CFR Title 47: 2001
Industry Canada RSS-210, Issue 5 as required for Category I Equipment

This report concerns: **Class II Permissive Change**
FCC Part 15.231

Tests Performed For:	*Test Facility:*
Motorola AIEG 4000 Commercial Av. Northbrook, IL 60062-1840	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446 Phone: (815) 293-0772 e-mail: info@radiomet.com

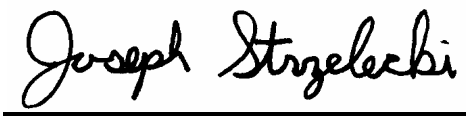
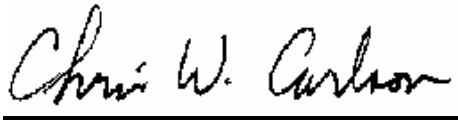
Test Date(s): (Month-Day-Year)
12/21/2002

Document RP-4943 Revisions:

Rev.	Issue Date	Affected Pages	Revised By	Authorized Signature for Revision
0	01/28/2003			

Table of Contents

1 ADMINISTRATIVE DATA

Equipment Under Test: A Motorola AIEG, 315 MHz Transmitter Model: 22692190 Serial Number: SEP54 This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year) 12/18/2002	*Test Date(s): (Month-Day-Year)* 12/21/2002
Test Report Written By: Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Test Witnessed By:* The tests were not witnessed by Motorola AIEG
Radiometrics' Personnel Responsible for Test:  Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Test Report Approved By*  Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a 315 MHz Transmitter, Model 22692190, manufactured by Motorola AIEG. The detailed test results are presented in a separate section. The following is a summary of the test results.

This report is in regards to a Class II permissive change. The only change in the product is one transistor (Q10A) has changed part numbers. The old transistor part number is MMBR5179LT1 and the new transistor part number is MMBTH10LT1. The reason for the change is that the original transistor is being discontinued.

Emissions Tests Results

Environmental Phenomena	Frequency Range	Basic Standard	Test Result	Notes
RF Radiated Emissions	30-3200 MHz	RSS-210 & FCC Part 15	Pass	Fundamental emission slightly lower; Harmonics higher than original
Occupied Bandwidth Test	Fundamental Freq.	RSS-210 & FCC Part 15	Pass	Did not change from Original grant

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a 315 MHz Transmitter, Part Number 22692190, manufactured by Motorola AIEG. The EUT was in good working condition during the tests, with no known defects.

The EUT consists of four momentary push button switches, an RF oscillator (315 MHz 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 that is sent to the RF oscillator at a 2 kHz 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.

3.1.1 FCC Section 15.203 Antenna Requirements

The EUT has a permanent antenna internal to its case. The antenna is a trace on the circuit board.

3.2 Related Submittals

Motorola AIEG is not submitting any other products simultaneously for equipment authorization related to the EUT. The associated receiver has not changed since the original submittal.

4 TESTED SYSTEM DETAILS

The identification for the EUT is as follows.

Model Number Serial Number	Manufacturer & Description	Cable Descriptions
M/N: 22692190 (EUT) S/N: SEP54	Motorola AIEG 315 MHz Transmitter	No cables can be connected to the product.

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. The EUT was tested as a stand-alone device. Power was supplied with a new battery.

4.2 Special Accessories

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

4.3 Equipment Modifications

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

5 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Test Specifications

Document	Date	Title
FCC CFR Title 47	2001	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
ANSI C63.4-1992	1992	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IC RSS-210 Issue 5	2001	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands)
IC RSS-212 Issue 1	1998	Test Methods For Radio Equipment

6 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics has been accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 1999 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the "basic standards" listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la.org).

The following is a list of sites used during testing:

Chamber A: Is an anechoic chamber that measures 24' L X 12' W X 12' H. The walls and ceiling are fully lined with ferrite absorber tiles. The floor has a 10' x 10' section of ferrite absorber tiles in the located in the center. Panashield of Rowayton, Connecticut manufactured the chamber. The enclosure is NAMAS certified.

Open Area Test Site (OATS): Is located on 8625 Helmar Road in Newark, Illinois, USA and measures 56' L X 24' W X 17' H. The entire open field test site has a metal ground screen. The FCC has accepted these sites as test site number 31040/SIT 1300F2. The FCC test site Registration Number is 90897. Details of the site characteristics are on file with the Industry Canada as file number IC3124.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

7 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8 TEST PROCEDURES

The test procedures used are in accordance with the Industry Canada RSS-212 and 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.

8.1 Radiated RF Emissions Measurement Procedures

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 bandwidth used from 450 kHz to 30 MHz is 9 or 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. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists.

From 30 to 1000 MHz an Anritsu Spectrum analyzer and a MITEQ AM-1431 amplifier with a 10 dB attenuator connected to the input. The out of band emissions and the ambient emissions were below the level of input overload (80 dBuV).

For tests from 1 to 3200 GHz, an HP8566A spectrum analyzer was used with a Celeritek uWave amplifier. The fundamental emission, out of band emissions and the ambient emissions were below the level of input overload (72 dBuV).

Final radiated emissions measurements were performed in the open area test site at a test distance of 3 meters. Measurements were performed using the peak or quasi-peak detector function. The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground. 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. All other tests are performed at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The was device was rotated through three orthogonal axis as per 13.1.4.1 of ANSI C63.4 during the prescans and during final radiated tests.

The entire frequency range from 30 to 3200 MHz was slowly scanned with particular attention paid to those frequency ranges which appeared high in the preliminary emission scan. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. Radiated emission measurements are performed with linearly polarized broadband antennas.

8.1.1 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	CF = Cable Attenuation Factor	AF = Antenna Factor
RA = Receiver Amplitude	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

9 PEAK TO AVERAGE CALCULATIONS

As required by FCC section 15.35 and RSS-210 section 6.5, the Peak to Average correction factor was calculated with the data supplied by the EUT designer. 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

The calculations have not changed since the original submittal

10 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification. The results relate only to the EUT listed herein. Any modifications made to the EUT subsequent to the indicated test date will invalidate the data and void this certification.

11 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-05	RMC/Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	11/29/02
AMP-12	MITEQ	Pre-amplifier	AM-1431	530935	0.01-1000MHz	12 Mo.	12/28/01
ANT-03	Tensor	Biconical Antenna	4104	2231	20-200MHz	24 Mo.	08/07/01
ANT-06	EMCO	Log-Periodic Ant.	3146	1248	200-1000MHz	24 mo	08/07/01
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	09/30/02
ATT-02	KDI	Attenuator	A710N	RMC1	DC-10GHz	12 Mo.	12/31/01
REC-01	Hewlett Packard	Spectrum Analyzer	8566A	2106A02115, 2209A01349	30Hz-22GHz	12 Mo.	06/07/02
REC-03	Anritsu	Spectrum Analyzer	MS2601B	MT94589	0.01-2200MHz	12 Mo.	10/11/02

Note: All calibrated equipment is subject to periodic checks.

12 TEST SETUP DOCUMENTATION

Figure 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

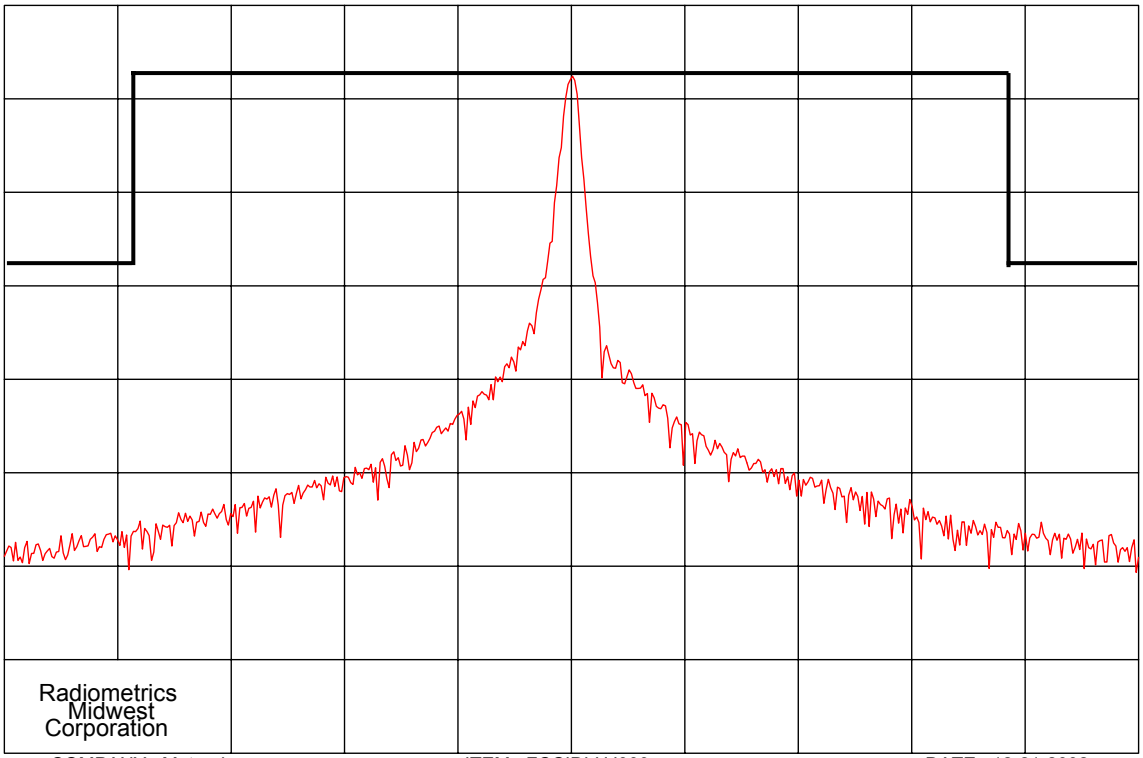
Notes:
- Not to Scale

13 OCCUPIED BANDWIDTH DATA

The occupied bandwidth of the RF output was measured using a 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 2. Occupied Bandwidth Plot



The Occupied bandwidth did not change from the original submittal.

14 DETAILED TEST RESULTS

14.1 Radiated Emissions Test Results

Manufacturer	Motorola AIEG	Specification	FCC Part 15 Subpart C & RSS-210
Part Number	22692190	Test Date	12/21/02
Serial Number	SEP54	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; BC = Biconical (ANT-3); LP = Log-Periodic (ANT-6); HN = Horn (ANT-13) P = peak; Q = QP		

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	79.4	15.5	27.3	6.2	11.1	62.7	75.6	12.9	V/LP
630.2	55.6	20.1	27.7	8.6	11.1	45.5	55.6	10.1	V/LP
945.3	48	24.1	27.2	9.8	11.1	43.6	55.6	12.0	V/LP
1260.3	61.5	26.0	29.2	2.1	11.1	49.3	55.6	6.3	V/HN
1575.5	62.8	27.2	29.2	2.3	11.1	52.0	54.0	2.0	V/HN
1890.5	50.9	28.6	28.8	2.5	11.1	42.1	55.6	13.5	V/HN
2205.5	48.8	29.7	29.8	2.6	11.1	40.2	54.0	13.8	V/HN
2520.7	50.5	30.6	28.7	2.9	11.1	44.2	55.6	11.4	V/HN
2835.7	54.1	31.2	28.6	3.0	11.1	48.6	54.0	5.4	V/HN
3150.7	47.4	32.0	28.5	3.1	11.1	42.9	55.6	12.7	V/HN
315.1	86.6	15.5	27.3	6.2	11.1	69.9	75.6	5.7	H/LP
630.2	53.3	20.1	27.7	8.6	11.1	43.2	55.6	12.4	H/LP
945.3	42.2	24.1	27.2	9.8	11.1	37.8	55.6	17.8	H/LP
1260.4	63.7	26.0	29.2	2.1	11.1	51.5	55.6	4.1	H/HN
1575.3	61.9	27.2	29.2	2.3	11.1	51.1	54.0	2.9	H/HN
1890.5	47.6	28.6	28.8	2.5	11.1	38.8	55.6	16.8	H/HN
2205.5	50.7	29.7	28.7	2.6	11.1	43.2	54.0	10.8	H/HN
2520.5	54.8	30.6	28.7	2.9	11.1	48.5	55.6	7.1	H/HN
2835.7	53	31.2	28.6	3.0	11.1	47.5	54.0	6.5	H/HN
3150.7	51.8	32.0	28.5	3.1	11.1	47.3	55.6	8.3	H/HN

* Peak Reading

Judgment: Passed by 2.0 dB
Test Personnel: Joseph Strzelecki