

FCC PART 90  
REPORT OF MEASUREMENTS

DEVICE: 450 MHz – 470 MHz 1 CHANNEL  
TRANSMITTER

MODEL: TM60/1.9

MANUFACTURER: ANGEL IGLESIAS S.A.

ADDRESS: POL. IND. 27 n°30 (MARTUTENE)  
20014 SAN SEBASTIAN  
SPAIN

WORK ORDER: 2465HR

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## 1. General

### 1.1 Document History

REVISION	DATE	COMMENTS
-	15 July 2001	Initial Release, Harry H. Hodes

Note: Acme Testing Co. hereby makes the following statements so as to conform with Chapter 10 (Test Reports) Requirement of ANSI C63.4:1992 "Methods and Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz":

- The units described in this report were received at Acme Testing Co.'s facilities on 13 April 2001. Testing was performed on the units described in this report on 17 April 2001.
- The Test Results reported herein apply only to the Units actually tested, and to substantially identical Units.
- This test report must not be used to claim product endorsement by A2LA or any agency of the U.S. Government, or any other foreign government.

This document is the property of Acme Testing, Co., and shall not be reproduced, except in full, without prior written approval of Acme Testing Co. However, all ownership rights are hereby returned unconditionally to Angel Iglesias S.A. and approval is hereby granted to Angel Iglesias S.A. and its employees and agents to reproduce all or part of this report for any legitimate business purpose without further reference to Acme Testing Co.

### 1.2 Purpose

The purpose of this report is to show compliance of the 450 MHz – 470 MHz 1 Channel 3.25 Milliwatt Transmitter, Model TM60/1.9 to the Title 47 CFR: Part 90.201. This report references the applicable electromagnetic requirements.

THE DATA CONTAINED IN THIS REPORT WAS COLLECTED AND COMPILED BY:

---

ANDREW K. PACE  
EMC ENGINEER

### 1.3 Manufacturer

Company Name: Angel Iglesias S.A.  
Contact: Luis Rodriguez  
Street Address: Pol. Ind. 27 n°30 (Martutene)  
20014 San Sebastian  
Spain  
Telephone: +34 943 448800  
Fax: +34 943 448816  
E-mail: Rodriquez.l@ikusi.es  
Web: www.ikusi.es

### 1.4 Test location

Laboratory: Test Site #1  
Street Address: 2002 Valley Highway  
Mailing Address: PO Box 3  
City/State/Zip: Acme WA 98220-0003  
Telephone: 888 226-3837  
Fax: 360 595-2722  
E-mail: acmetest@acmetesting.com  
Web: www.acmetesting.com

### 1.5 Accreditations and Listings

Acme Testing Co.'s test facilities are accredited by A2LA for a specific scope of accreditation which includes the tests detailed herein, under Certificate Numbers: 0829-01 (Acme, WA). Acme Testing Co.'s test facilities that are used to perform radiated and conducted emissions are currently registered with the Federal Communications Commission under registration number: 90420 (Acme, WA). In addition, Acme Testing Co.'s test facilities are also registered with the Industry Canada under registration number: IC3251 (Acme, WA).

## 2. Test Results Summary

Summary of Test Results  
450 MHz – 470 MHz 1 Channel Transmitter, Model TM60/1.9

Paragraph No.	Test Criteria	Status
<b>90.205 (g)</b>	<b>RF Power Output</b>	<b>Pass*</b>
<b>90.212</b>	<b>Modulation Limiting</b>	<b>Pass*</b>
<b>90.209</b>	<b>Occupied Bandwidth</b>	<b>Pass*</b>
<b>2.991</b>	<b>Spurious Emission at Antenna Terminals</b>	<b>Pass</b>
<b>90.210</b>	<b>Field Strength of Spurious Radiation</b>	<b>Pass*</b>
<b>90.213</b>	<b>Frequency Stability</b>	<b>Pass*</b>
<b>90.214</b>	<b>Transient Frequency Behavior</b>	<b>Pass*</b>

\* Exempt per 90.217, see section 4 for details.

The signed original of this report, supplied to the client, represents the only “official” copy. Retention of any additional copies (electronic or non-electronic media) is at Acme Testing Co.’s discretion to meet internal requirements only. The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units, and meet the requirements of the specifications referenced herein.

Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) is factored into the “Correction Factor” documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.

The measurements contained in this report were made in accordance with the referenced standards and all applicable Public Notices received prior to the date of testing delete. Acme Testing Co. assumes responsibility only for the accuracy and completeness of this data as it pertains to the sample tested.

REVIEWED AND APPROVED BY:

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Harry H. Hodes  
President/CEO  
Principal EMC Engineer

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Date of Issuance

### 3. Description of Equipment and Peripherals

#### 3.1 Equipment Under Test (EUT)

Device: 450 MHz – 470 MHz 1 Channel Transmitter  
Model Number: TM60/1.9  
Number of Channels: 1  
Frequency: 450.875 MHz  
Modulation: FM  
Serial Number: 0101596  
FCC ID: NORTM60  
Power: 7.2 Volt Ni-Cd Battery  
Grounding: None

#### **4. Exemption from technical standards**

Paragraph No: 90.217

Except as noted herein, transmitters used at stations licensed below 800 MHz on any frequency listed in subparts B and C of this part or licensed on a business category channel above 800 MHz which have an output power not exceeding 120 milliwatts are exempt from the technical requirements set out in this subpart, but must instead comply with the following:

- a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emissions appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.
- b) For equipment designed to operate with a 12.5 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.
- c) For equipment designed to operate with a 6.25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 12.5 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.
- d) Transmitters may be operated in the continuous carrier transmit mode.

## 5. Test Set Up Photographs



## 6. RF Power Output

Paragraph No: 90.205 (g)

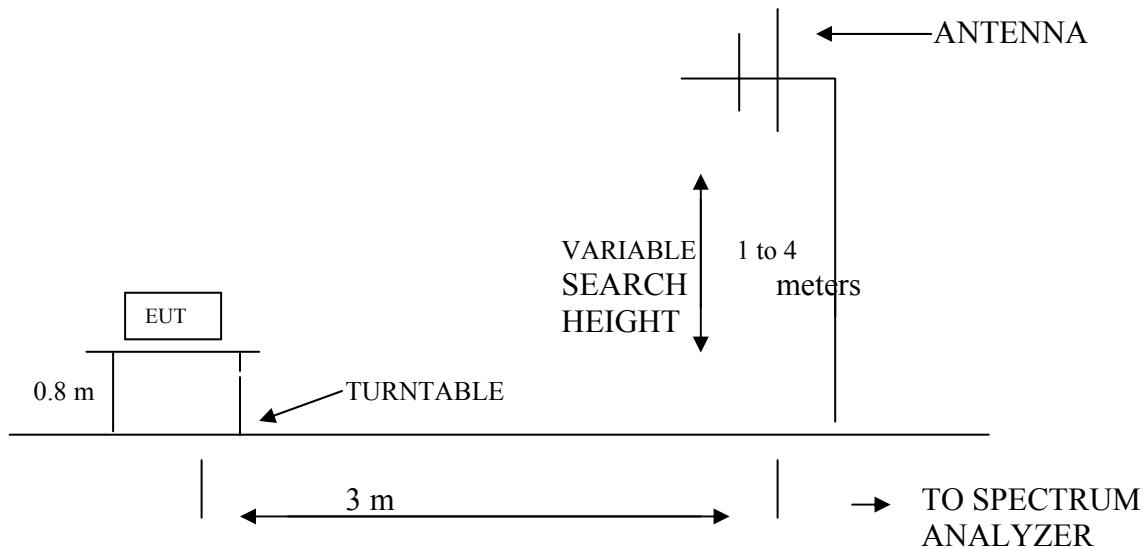
### 6.1 Test Procedure

Since the EUT is equipped with an integral antenna, power output is measured using effective radiated power (ERP) relative to a half-wave dipole antenna. ERP is measured using the substitution antenna method. The method of measurement in TIA/EIA-603 2.2.12 for measuring radiated spurs is adapted for making fundamental ERP measurements.

### 6.2 Test Equipment

- ⇒ Spectrum Analyzer (blue): Hewlett-Packard 8566B, Serial Number 2410A00168, Calibrated: 04 April 2001, Calibration due Date: 04 April 2002
- ⇒ RF Preselector (blue): Hewlett-Packard 85685A, Serial Number 2648A-00519, Calibrated: 04 April 2001, Calibration due Date: 04 April 2002
- ⇒ Quasi Peak Adapter (blue): Hewlett-Packard 85650A, Serial Number 2043A00327, Calibrated: 04 April 2001, Calibration due Date: 04 April 2002
- ⇒ Open Area Test Site: Acme Testing Co., Test Site Number 1, Calibrated: 1 December 2000, Calibration due Date: 1 December 2001
- ⇒ Broadband Biconical Antenna (blue) (20 MHz to 200 MHz): EMCO 3110, Serial Number 1180, Calibrated: 19 June 2000, Calibration due Date: 19 June 2001
- ⇒ Broadband Log Periodic Antenna (blue) (200 MHz to 1000 MHz): EMCO 3146, Serial Number 2852, Calibrated: 19 June 2000, Calibration due Date: 19 June 2001
- ⇒ EUT Turntable Position Controller: Rothenbuhler Engineering, Custom, No Calibration Required
- ⇒ Antenna Mast: Compliance Design, model M100/200, No Calibration Required
- ⇒ Roberts Dipole Antenna Set (30 MHz to 1000 MHz): Compliance Design A 100
- ⇒ Frequency Counter 20 Hz to 24 GHz: Systron Donner 6045B, Serial Number 26010-0, Calibrated: 20 March 2001, Calibration due Date: 20 March 2002

### 6.3 Test Set-up Block Diagram



### 6.4 Minimum Standard

Paragraph No. 90.205 (g) contains limits for transmitter of this type. However, this EUT complies with paragraph 90.217, which replaces all of the technical limits set out in part 90 with one power output limit of 120 miliwatts.

### 6.5 Test Results

The measured effective radiated power (ERP) relative to a half-wave dipole antenna is 0.10 milliwatts.

## 7. Modulation Limiting

Paragraph No: 90.212

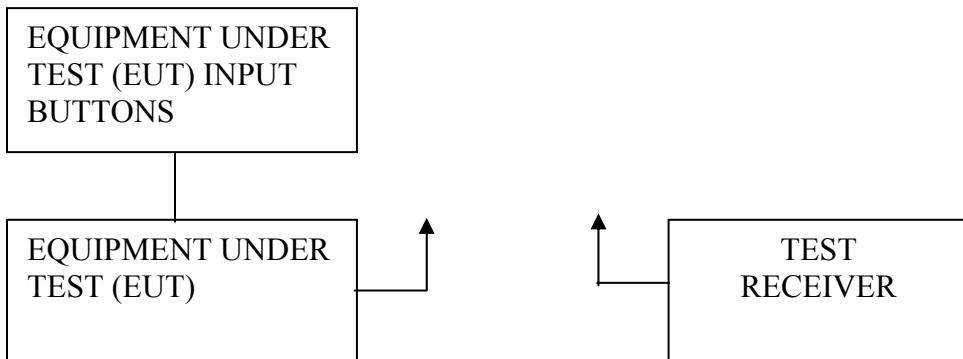
### 7.1 Test Procedure

The equipment under test (EUT) has no input jacks or ports. The only way to modulate the output is to press one of the control buttons on the EUT. All control buttons were pressed and the highest deviation on the test receiver was recorded. Therefore an air-interface measurement was made.

### 7.2 Test Equipment

- ⇒ Measuring Receiver: Hewlett-Packard 8902A, Serial Number 3216A03958, Calibrated: 20 December 2000, Calibration due Date: 20 December 2001
- ⇒ Sensor Module: Hewlett-Packard 11722A, Serial Number 3111A04739, Calibrated: 19 March 2001, Calibration due Date: 19 March 2002
- ⇒ Broadband Log Periodic Antenna (red) (200 MHz to 1000 MHz): EMCO 3146, Serial Number 9712-4994, 05 February 2001, Calibration due Date: 05 February 2002

### 7.3 Test Set-up Block Diagram



### 7.4 Minimum Standard

Paragraph 90.212 contains modulation limits for transmitters of this type. However, this EUT complies with paragraphs 90.217, which replaces all of the technical limits set out in part 90 with one power output limit of 120 miliwatts.

### 7.5 Test Results

The maximum deviation is 3.16 kHz.

## 8. Occupied Bandwidth

Paragraph No: 90.209

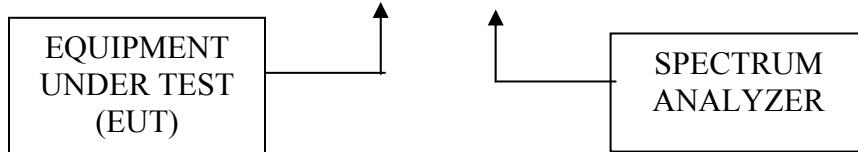
### 8.1 Test Procedures

Since the EUT employs an integral antenna, an air-interface measurement was made. A program was then used to calculate the 99% power bandwidth.

### 8.2 Test Equipment

- ⇒ Spectrum Analyzer: Hewlett-Packard 8566B, Serial Number 2747A-05662, Calibrated: 4 September 1997, Calibration due Date: 4 September 1998
- ⇒ RF Preselector: Hewlett-Packard 85685, Serial Number 2510A-00106, Calibrated: 4 September 1997, Calibration due Date: 4 September 1998
- ⇒ Broadband Log Periodic Antenna (red) (200 MHz to 1000 MHz): EMCO 3146, Serial Number 9712-4994, 05 February 2001, Calibration due Date: 05 February 2002

### 8.3 Test Set-up Block Diagram

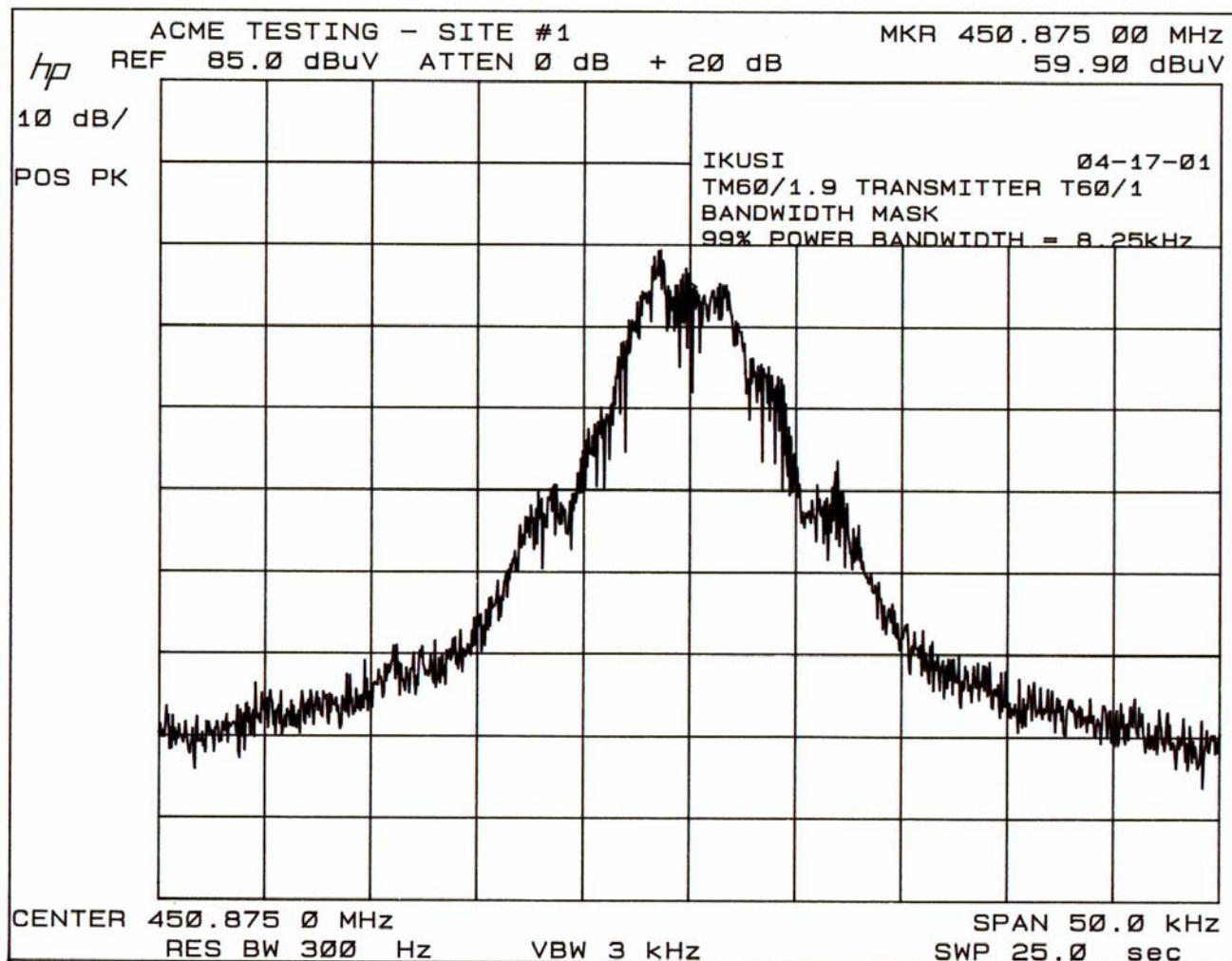


### 8.4 Minimum Standard

Paragraph 90.269 contains bandwidth limits for transmitters of this type. However, this EUT complies with paragraphs 90.217, which replaces all of the technical limits set out in part 90 with one power output limit of 120 miliwatts.

### 8.5 Test Results

\* See plot on the next page.



## 9. Spurious Emission At Antenna Terminals

Paragraph No: 2.1051

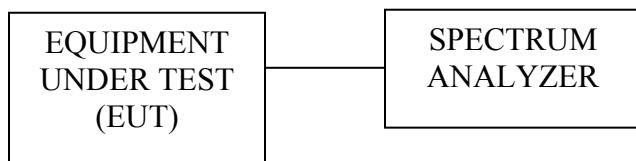
### 9.1 Test Procedures

The method of measurement is TIA/EIA-603 2.2.13.

### 9.2 Test Equipment

- ⇒ Spectrum Analyzer (blue): Hewlett-Packard 8566B, Serial Number 2410A00168, Calibrated: 04 April 2001, Calibration due Date: 04 April 2002
- ⇒ RF Preselector (blue): Hewlett-Packard 85685A, Serial Number 2648A-00519, Calibrated: 04 April 2001, Calibration due Date: 04 April 2002

### 9.3 Test Set-up Block Diagram



### 9.4 Minimum Standard

The EUT has an integral antenna, therefore no conducted spurious emissions testing was performed. All spurious emissions testing was performed radiated.

### 9.5 Test Results

None.

## 10. Field Strength of Spurious Radiation

Paragraph No: 90.210

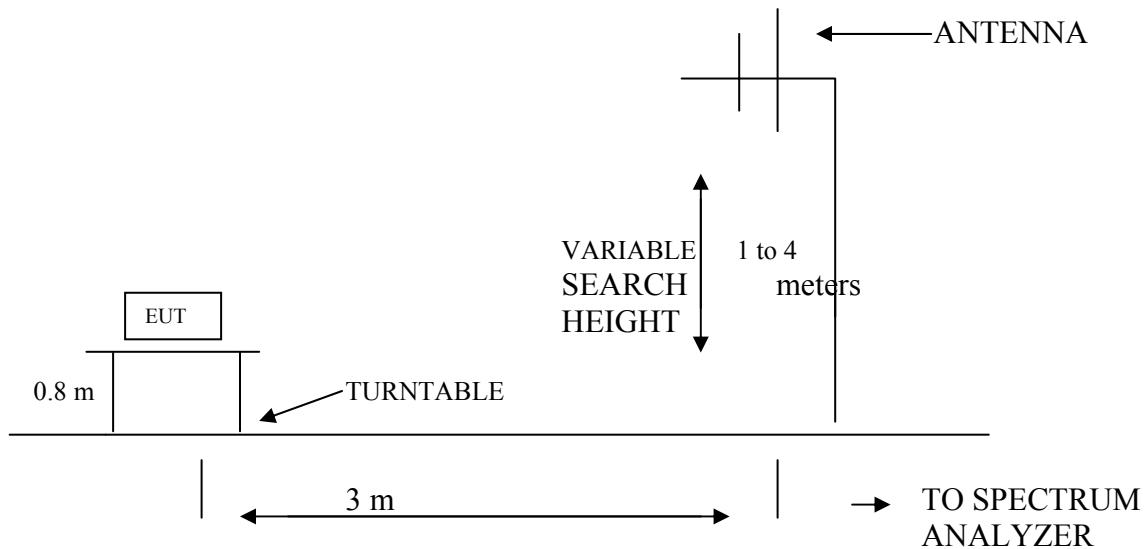
### 10.1 Test Procedures

The method of measurement is TIA/EIA-603 2.2.12.

### 10.2 Test Equipment

- ⇒ Spectrum Analyzer (blue): Hewlett-Packard 8566B, Serial Number 2410A00168, Calibrated: 04 April 2001, Calibration due Date: 04 April 2002
- ⇒ RF Preselector (blue): Hewlett-Packard 85685A, Serial Number 2648A-00519, Calibrated: 04 April 2001, Calibration due Date: 04 April 2002
- ⇒ Quasi Peak Adapter (blue): Hewlett-Packard 85650A, Serial Number 2043A00327, Calibrated: 04 April 2001, Calibration due Date: 04 April 2002
- ⇒ Open Area Test Site: Acme Testing Co., Test Site Number 1, Calibrated: 1 December 2000, Calibration due Date: 1 December 2001
- ⇒ Broadband Biconical Antenna (blue) (20 MHz to 200 MHz): EMCO 3110, Serial Number 1180, Calibrated: 19 June 2000, Calibration due Date: 19 June 2001
- ⇒ Broadband Log Periodic Antenna (blue) (200 MHz to 1000 MHz): EMCO 3146, Serial Number 2852, Calibrated: 19 June 2000, Calibration due Date: 19 June 2001
- ⇒ EUT Turntable Position Controller: Rothenbuhler Engineering, Custom, No Calibration Required
- ⇒ Antenna Mast: Compliance Design, model M100/200, No Calibration Required
- ⇒ Roberts Dipole Antenna Set (30 MHz to 1000 MHz): Compliance Design A 100
- ⇒ Frequency Counter 20 Hz to 24 GHz: Systron Donner 6045B, Serial Number 26010-0, Calibrated: 20 March 2001, Calibration due Date: 20 March 2002

### 10.3 Test Set-up Block Diagram



### 10.4 Minimum Standard

Paragraph 90.210 contains radiation limits for transmitters of this type. However, this EUT complies with paragraphs 90.217, which replaces all of the technical limits set out in part 90 with one power output limit of 120 miliwatts.

### 10.5 Test Results

Frequency (MHz)	Field Strength (dBuV/m)	Effective Radiated Power (dBm)	Attenuation (dBc)	Polarity
450.875	65	-10.1	0	H
250.6734	7.7	-76	65.9	V
256.2030	8.2	-75	64.9	V
261.7326	7.8	-74.5	64.4	V
267.2621	5.7	-74	63.9	V
272.7917	3	-69	58.9	V
250.6734	11.2	-77.5	67.4	H
256.2030	14.8	-73.3	63.2	H
261.7326	14.7	-73.3	63.2	H
267.2621	14.9	-73.6	63.5	H
272.7917	14.1	-74.6	64.5	H

## 11. Frequency Stability

Paragraph No: 90.213

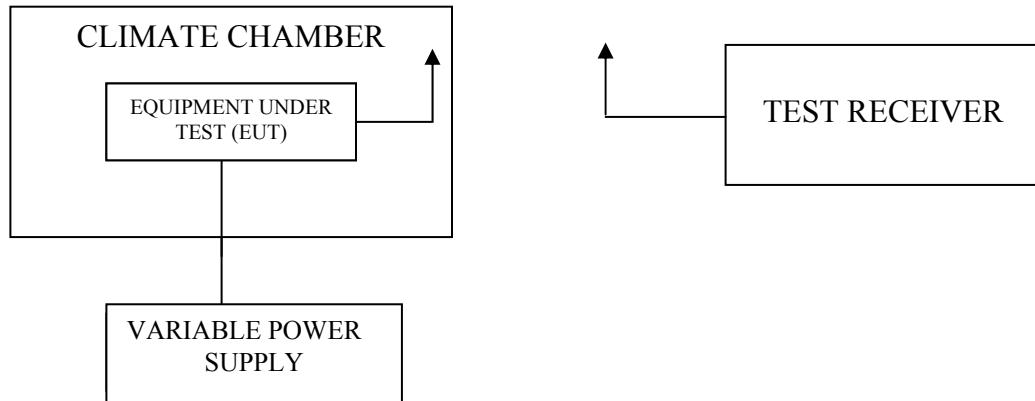
### 11.1 Test Procedures

Since the EUT incorporates an integral antenna, an air-interface measurement was made. The metal door of the temperature chamber was replaced with a non-conductive one to allow a radiated measurement.

### 11.2 Test Equipment

- ⇒ Measuring Receiver: Hewlett-Packard 8902A, Serial Number 3216A03958, Calibrated: 20 December 2000, Calibration due Date: 20 December 2001
- ⇒ Broadband Log Periodic Antenna (red) (200 MHz to 1000 MHz): EMCO 3146, Serial Number 9712-4994, 05 February 2001, Calibration due Date: 05 February 2002
- ⇒ Temperature Chamber: Tenny TJR, Serial Number 25275-14

### 11.3 Test Set-up Block Diagram



### 11.4 Minimum Standard

Paragraph 90.213 contains stability limits for transmitters of this type. However, this EUT complies with paragraphs 90.217, which replaces all of the technical limits set out in part 90 with one power output limit of 120 miliwatts.

## 11.5 Test Results

The maximum frequency drift is 2403 hertz.

The nominal test frequency is 450,875,000 hertz.

### Frequency Drift versus Temperature

Temperature (Degrees Celsius)	Frequency (Hertz)	Frequency Drift (Hertz)
-30	450,876,560	1560
-20	450,877,403	2403
-10	450,876,355	1355
0	450,875,760	760
10	450,875,481	481
20	450,875,229	229
30	450,875,227	227
40	450,875,354	354
50	450,876,244	1244

## 12. Transient Frequency Behavior

Paragraph No: 90.214

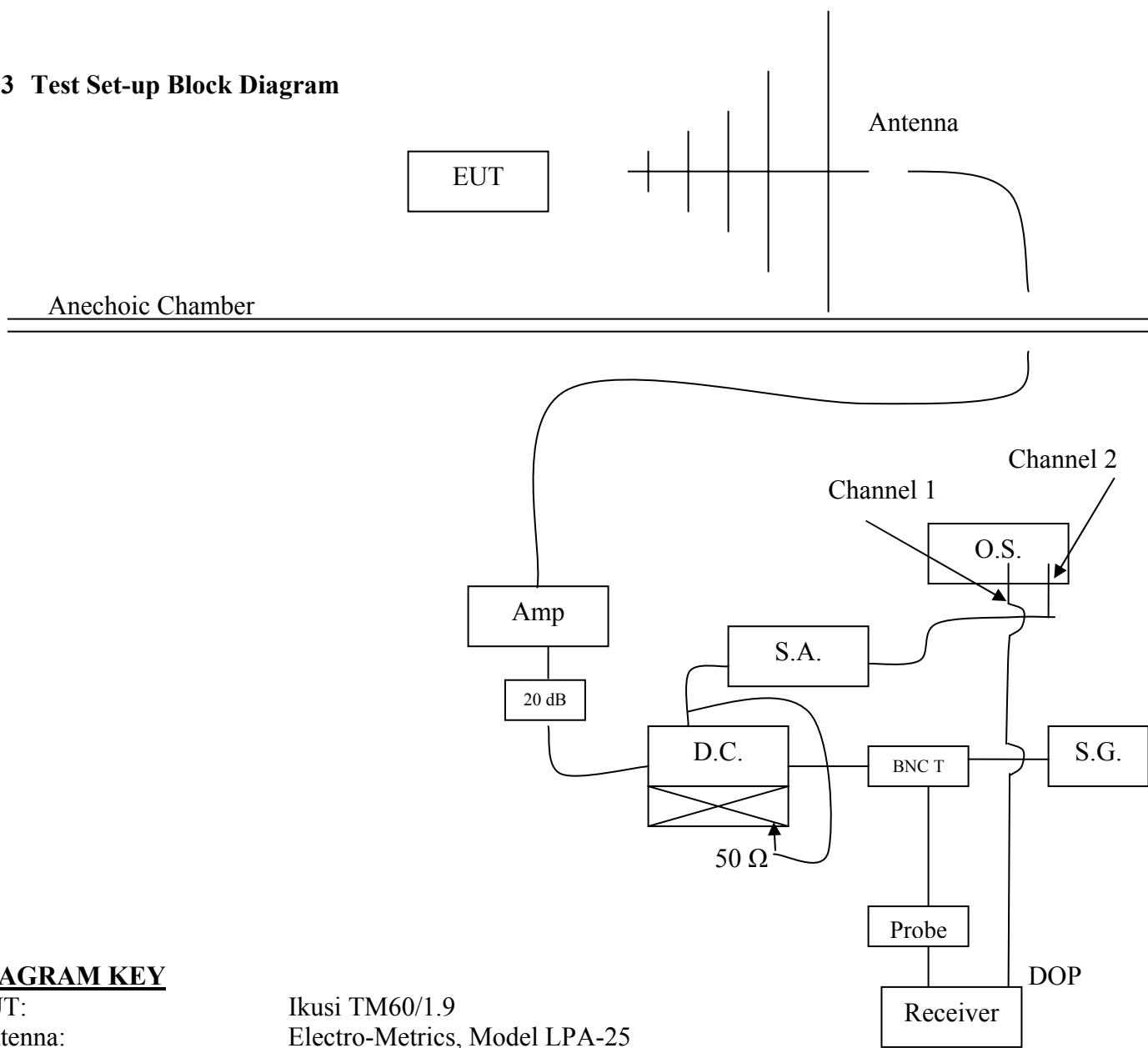
### 12.1 Test Procedures

The method of measurement was TIA/EIA-603 2.219. Since the EUT incorporates an integral antenna, an air-interface measurement was made.

### 12.2 Test Equipment

- ⇒ Measuring Receiver: Hewlett-Packard 8902A, Serial Number 3216A03958, Calibrated: 20 December 2000, Calibration due Date: 20 December 2001
- ⇒ Log Periodic Antenna: Electro-Metrics LPA-25, Serial Number 1063, Calibrated: 14 September 2000, Calibration due Date: 14 September 2001
- ⇒ Dual Amplifier (0.1 MHz to 1300 MHz): Hewlett-Packard 8447D, Serial Number 2443A04391, Calibrated: 18 April 2001, Calibration due Date: 18 April 2001
- ⇒ Dual Directional Coupler: Hewlett-Packard 778D, Serial Number 2511A-02573, Calibrated: 16 June 2001, Calibration due Date: 16 June 2002
- ⇒ Sensor Module: Hewlett-Packard 11722A, Serial Number 3111A04739, Calibrated: 19 March 2001, Calibration due Date: 19 March 2002
- ⇒ Spectrum Analyzer (yellow): Hewlett-Packard 8566B, Serial Number 2403A06519, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001
- ⇒ RF Preselector (yellow): Hewlett-Packard 85685A, Serial Number 2648A00392, Calibrated: 20 November 2000, Calibration due Date: 20 November 2001
- ⇒ Signal Generator: Gigatronics 6060B, Serial Number 5110180, Calibrated: 20 March 2001, Calibration due Date: 20 March 2002
- ⇒ 400 MHz Digitizing Storage Oscilloscope: Tektronics TDS 460A/XL, Serial Number B070841, Calibrated: 30 April 2001, Calibration due Date: 30 April 2002

## 12.3 Test Set-up Block Diagram

**DIAGRAM KEY**

EUT:	Ikusi TM60/1.9
Antenna:	Electro-Metrics, Model LPA-25
Amplifier (Amp):	Hewlett-Packard, Model 8477D
20 dB:	Pasternak
D.C.:	Hewlett Packard, Model 778D
Spectrum Analyzer (S.A.):	Hewlett-Packard 8566B (stack)
Oscilloscope (O.S.):	Tektronix, Model TDS 460A
Signal Generator (S.G.):	Giga-Tronics, Model 6060B
Probe:	Hewlett-Packard, Model 11722A
Receiver:	Hewlett Packard, Model 8902A

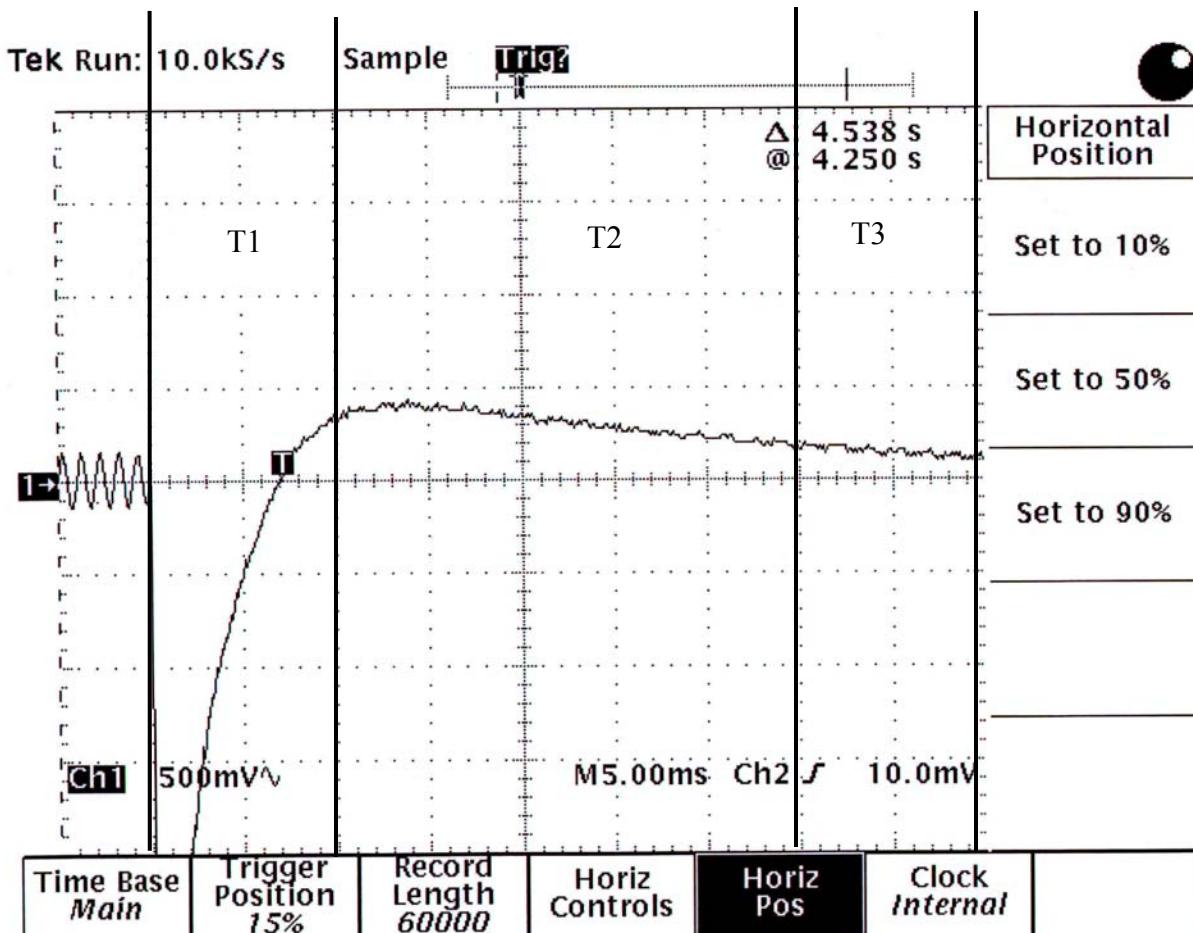
## 12.4 Minimum Standard

Paragraph 90.213 contains transient limits for transmitters of this type. However, this EUT complies with paragraphs 90.217, which replaces all of the technical limits set out in part 90 with one power output limit of 120 miliwatts.

## 12.5 Test Results

Time Intervals	Time	Measured Frequency Difference (kHz)
T1	10 milliseconds	No Limit
T2	25 milliseconds	50 kHz
T3	10 milliseconds	No Limit

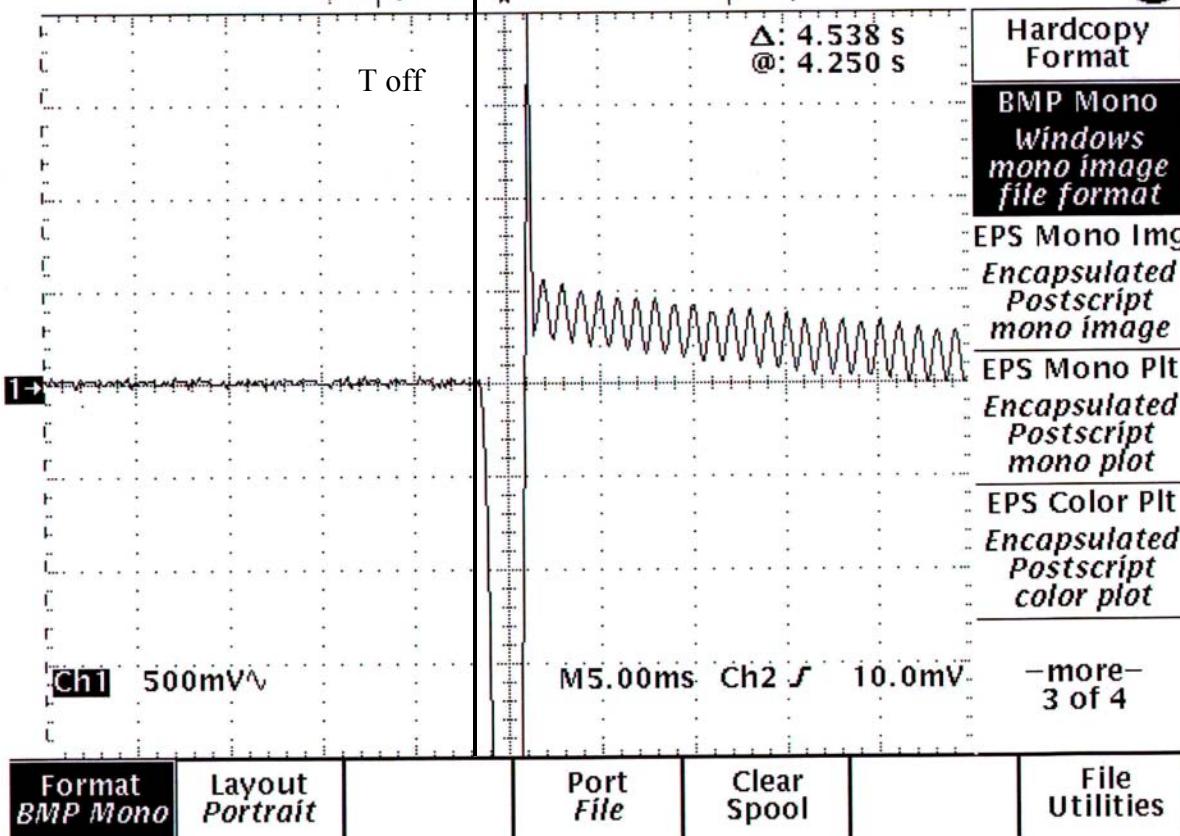
Note: See plot on next page.



Tek Run: 10.0kS/s

Sample

Trig?



### **13. Miscellaneous Comments and Notes**

1. None.

## 14. Informative Information



American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC GUIDE 25-1990 (EN45001)

ACME TESTING  
2002 Valley Highway  
Acme, WA 98220-0003  
Steve Fitzgerald Phone: 360 595 2785

ELECTRICAL (EMC)

Valid to: November 30, 2001

Certificate Number: 0829-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following Electromagnetic Compatibility (EMC) tests:

Radiated & Conducted Emissions  
Immunity  
Voltage sags  
Harmonics  
Flicker

On the following materials and products:

Electrical and electronic equipment for information technology; industrial, scientific, and medical applications; residential service; receivers; and licensed and unlicensed transmitters.

Using the following standards:

U.S. Code of Federal Regulations (CFR) 47, FCC Method Parts 15 (using ANSI C63.4-1992), 18 & 90

CISPR: 11; 13; 14 (excluding click measurements); 22 (including Amendments 1 and 2)

CNS: 13439; 13438

EN: 50081-1; 50081-2; 50082-1; 50082-2; 55011; 55013; 55014-1 (excluding click measurements); 55014-2; 55022; 55103-1; 55103-2; 60601-1-2; 60945 (sections 9 & 10 only); 61000-4-2; 61000-4-3; 61000-4-4; 61000-4-5 (single phase only, excluding 10/700 surge testing); 61000-4-6; 61000-4-8; 61000-4-11; 61000-3-2; 61000-3-3

AS/NZS: 3548, 2064.1/2, 4251.1, 4252.1

IEC: 801-2; 801-3; 801-4; 801-5, 1000-4-2; 1000-4-3; 1000-4-4; 1000-4-5; 1000-4-6

ENV: 50140; 50204

ICES-003 Issue 2 Revision 1

RSS-210 Issue 2

Belcore GR-1089-CORE (Sections 2 through 3.2.4)

5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8370 • Phone: 301 644 3248 • Fax: 301 662 2974



Laboratory Division  
7435 Oakland Mills Road  
Columbia, MD. 21046

November 22, 1999

Registration Number: 90420

Acme Testing Company  
P.O. Box 3  
2002 Valley Highway  
Acme, WA 98220-0003

Attention: Paul Slavens

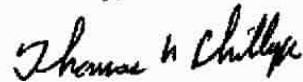
Re: Measurement facility located at Acme, Sites 1 & 2  
3, 10 & 30 meter sites  
Date of Listing: November 22, 1999

Gentlemen:

Your submission of the description of the subject measurement facility has been reviewed and found to be in compliance with the requirements of Section 2.948 of the FCC Rules. The description has, therefore, been placed on file and the name of your organization added to the Commission's list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that this filing must be updated for any changes made to the facility, and at least every three years from the date of listing the data on file must be certified as current.

If requested, the above mentioned facility has been added to our list of those who perform these measurement services for the public on a fee basis. An up-to-date list of such public test facilities is available on the Internet on the FCC Website at [WWW.FCC.GOV](http://WWW.FCC.GOV), E-Filing, OET Equipment Authorization Electronic Filing.

Sincerely,



Thomas W Phillips  
Electronics Engineer