L.S. Compliance, Inc.
W66 N220 Commerce Court
Cedarburg, WI 53012
262-375-4400

COMPLIANCE TESTING OF:

Quartex Synchronization Transmitter
Model FM-72

PREPARED FOR:

Quartex, Division of Primex, Inc.
965 Wells Street
Lake Geneva, WI 53147

TEST REPORT NUMBER:

301190 T

DATE(S) OF TESTING:

October 19th and 30th, 2001

Table of Contents

1. L. S. Compliance In Review

L. S. Compliance, Inc. is located in Cedarburg, Wisconsin – United States.

We may be contacted by:

Mail: **L. S. Compliance, Inc.**
W66 N220 Commerce Court
Cedarburg, Wisconsin 53012

Phone: **262-375-4400**
Fax: **262-375-4248**
E-mail: eng@lsr.com

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

A2LA – American Association for Laboratory Accreditation
Accreditation based on ISO/IEC 17025 : 1999
with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: 1255.01

U. S. Conformity Assessment Body (CAB) Validation
Validated by the European Commission as a U. S. Conformity Assessment Body operating under the U. S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union EMC Directive 89/336/EEC, Article 10.2.
Date of Validation: January 16, 2001

Federal Communications Commission (FCC) – USA
Listing of 3 Meter Semi-Anechoic Chamber based on 47CFR 2.948
FCC Registration Number: 90756

Listing of 3 and 10 meter OATS based on 47CFR 2.948
FCC Registration Number: 90757

Industry Canada
On-file, 3 Meter Semi-Anechoic Chamber based on 47CRF 2.948
File Number: IC 3088

On-file 3 and 10 Meter OATS based on RSS-210
File Number: IC 3088-A

2. A2LA Certificate of Accreditation

THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

L.S. COMPLIANCE, INC.
Cedarburg, WI

for technical competence in the field of

Electrical (EMC) Testing

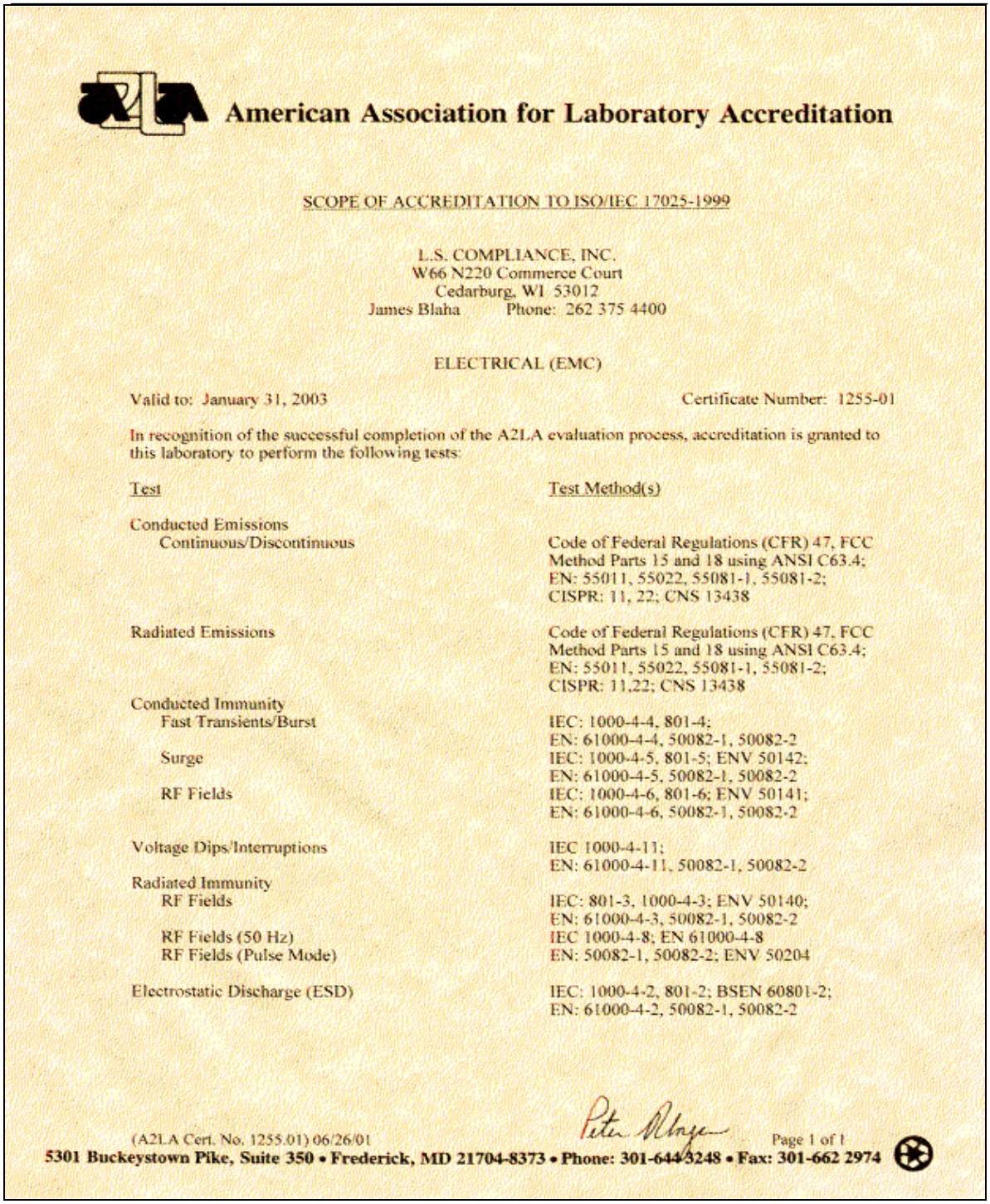
The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified field of testing. Testing and calibration laboratories that comply with this International Standard also operate in accordance with ISO 9001 or ISO 9002.

Presented this 26th day of June, 2001.

President
For the Accreditation Council
Certificate Number 1255.01
Valid to January 31, 2003

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical (EMC) Scope of Accreditation

3. A2LA Scope of Accreditation



American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025-1999

L.S. COMPLIANCE, INC.
W66 N220 Commerce Court
Cedarburg, WI 53012
James Blaha Phone: 262 375 4400

ELECTRICAL (EMC)

Valid to: January 31, 2003 Certificate Number: 1255-01

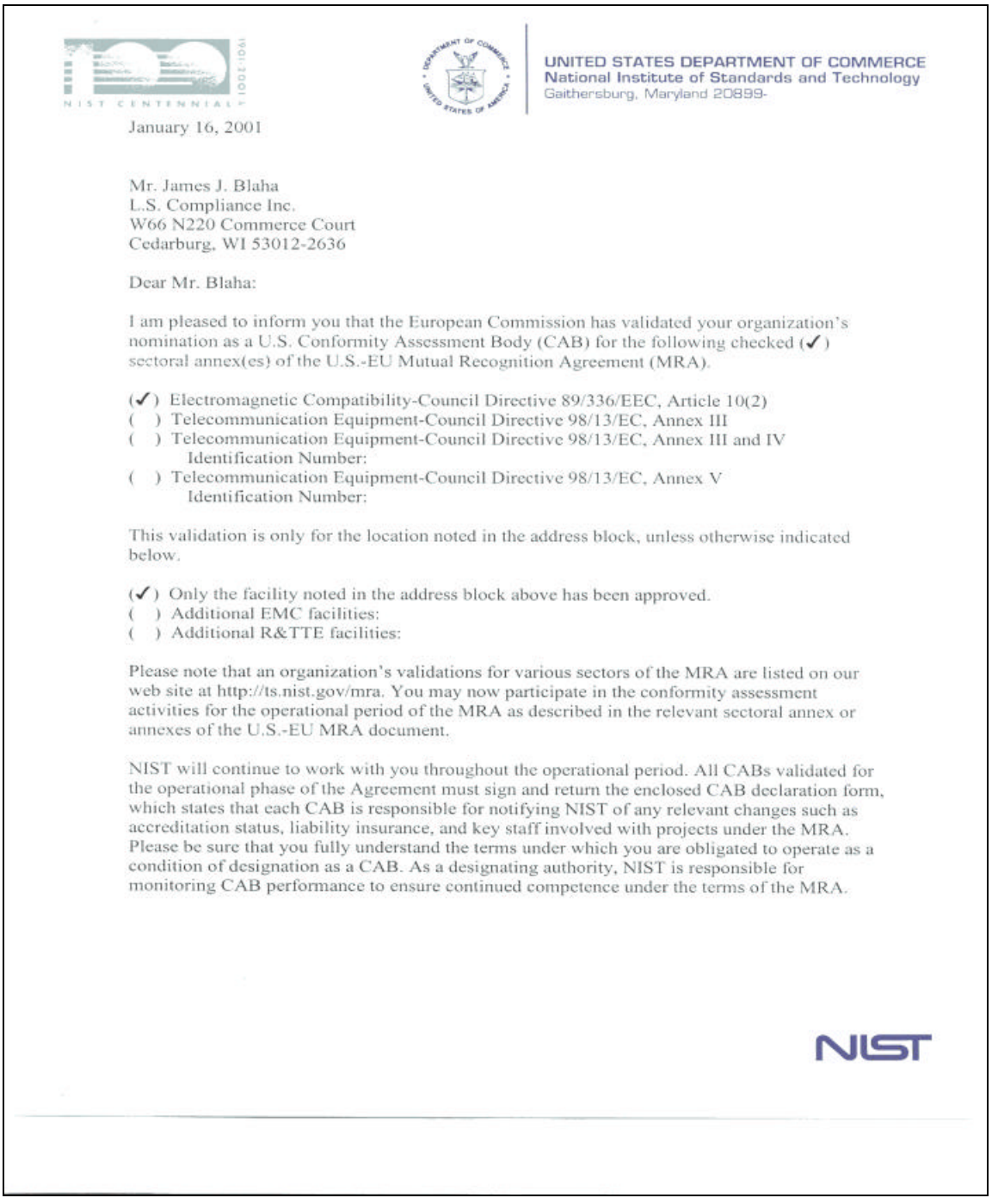
In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests:

Test	Test Method(s)
Conducted Emissions Continuous/Discontinuous	Code of Federal Regulations (CFR) 47, FCC Method Parts 15 and 18 using ANSI C63.4; EN: 55011, 55022, 55081-1, 55081-2; CISPR: 11, 22; CNS 13438
Radiated Emissions	Code of Federal Regulations (CFR) 47, FCC Method Parts 15 and 18 using ANSI C63.4; EN: 55011, 55022, 55081-1, 55081-2; CISPR: 11,22; CNS 13438
Conducted Immunity Fast Transients/Burst	IEC: 1000-4-4, 801-4; EN: 61000-4-4, 50082-1, 50082-2
Surge	IEC: 1000-4-5, 801-5; ENV 50142; EN: 61000-4-5, 50082-1, 50082-2
RF Fields	IEC: 1000-4-6, 801-6; ENV 50141; EN: 61000-4-6, 50082-1, 50082-2
Voltage Dips/Interruptions	IEC 1000-4-11; EN: 61000-4-11, 50082-1, 50082-2
Radiated Immunity RF Fields	IEC: 801-3, 1000-4-3; ENV 50140; EN: 61000-4-3, 50082-1, 50082-2
RF Fields (50 Hz)	IEC 1000-4-8; EN 61000-4-8
RF Fields (Pulse Mode)	EN: 50082-1, 50082-2; ENV 50204
Electrostatic Discharge (ESD)	IEC: 1000-4-2, 801-2; BSEN 60801-2; EN: 61000-4-2, 50082-1, 50082-2

(A2LA Cert. No. 1255.01) 06/26/01 Page 1 of 1

5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8373 • Phone: 301-644-3248 • Fax: 301-662 2974

4. Validation Letter – U.S. Competent Body for EMC Directive 89/336/EEC



UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

January 16, 2001

Mr. James J. Blaha
L.S. Compliance Inc.
W66 N220 Commerce Court
Cedarburg, WI 53012-2636

Dear Mr. Blaha:

I am pleased to inform you that the European Commission has validated your organization's nomination as a U.S. Conformity Assessment Body (CAB) for the following checked (✓) sectoral annex(es) of the U.S.-EU Mutual Recognition Agreement (MRA).

(✓) Electromagnetic Compatibility-Council Directive 89/336/EEC, Article 10(2)
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex III
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex III and IV
Identification Number:
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex V
Identification Number:

This validation is only for the location noted in the address block, unless otherwise indicated below.

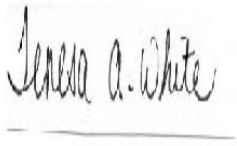
(✓) Only the facility noted in the address block above has been approved.
( ) Additional EMC facilities:
( ) Additional R&TTE facilities:

Please note that an organization's validations for various sectors of the MRA are listed on our web site at http://ts.nist.gov/mra. You may now participate in the conformity assessment activities for the operational period of the MRA as described in the relevant sectoral annex or annexes of the U.S.-EU MRA document.

NIST will continue to work with you throughout the operational period. All CABs validated for the operational phase of the Agreement must sign and return the enclosed CAB declaration form, which states that each CAB is responsible for notifying NIST of any relevant changes such as accreditation status, liability insurance, and key staff involved with projects under the MRA. Please be sure that you fully understand the terms under which you are obligated to operate as a condition of designation as a CAB. As a designating authority, NIST is responsible for monitoring CAB performance to ensure continued competence under the terms of the MRA.

NIST

5. Signature Page



Prepared By: **November 9, 2001**

Teresa A. White, Document Coordinator **Date**

Tested By: **November 9, 2001**

Kenneth L. Boston, EMC Lab Manager **Date**

Tested By: **November 9, 2001**

Thomas T. Lee, EMC Engineer **Date**
NARTE Test Lab Engineer, ALT-0064-E

Approved By: **November 9, 2001**

Kenneth L. Boston, EMC Lab Manager **Date**
PE#31926 Licensed Professional Engineer
Registered in the State of Wisconsin, United States

6. Product and General Information

Manufacturer:	Quartex, Division of Primex, Inc.
Model No.:	FM-72
Serial No.:	Pre-production
Description:	Data Transmitter
Frequency Range:	72.0 – 73.0 MHz

7. Product Description

The FM-72 is a data transmitter, which sends telemetry to various co-located paging receivers, which are located in wall clocks, for the purpose of time synchronization. It is provided for by 47 CFR, Part 90.238 as a telemetry device.

8. Test Requirements

The following FCC requirements are met: 47 CFR, 2.1053, 90.257(b)(2), 90.210.

9. Summary of Test Report

DECLARATION OF CONFORMITY

The Equipment Under Test (EUT) was found to **MEET** the requirements as described within the specification of Title 47 CFR FCC, Part 90, Subpart J, and Part 2.1053 Radiated Spurious Emissions for a low-power non-broadcast transmitter.

10. Introduction

On October 19, 2001 a series of Radiated Emission tests were performed on the EUT. These tests were performed using the procedures outlined in ANSI C63.4-2001 for unintentional radiators, and in accordance with the limits set forth in FCC Part 90 for a non-voice and other specialized operation transmitters. These tests were performed by Kenneth Boston, EMC Lab Manager and Thomas T. Lee, EMC Engineer/NARTE Test Lab Engineer of L.S. Compliance.

11. Purpose

All Radiated Emission tests upon the EUT were performed to measure the emissions in the frequency bands described in title 47 CFR, FCC Part 90, including 90.210 (general technical parts) to determine whether these emissions are below the limits expressed within the standards. AC line Conducted Emissions were also measured and compared to the CFR, Part 15.207 limits, as additional technical data. These tests were performed in accordance with the procedure described in the American National Standard for methods of measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2001). Another document used as a reference for the EMI Receiver specification was the Comite International Special Des Perturbations Radioelelectriques (CISPR) Number 16-1, 1993.

12. Radiated Emissions Test

Test Setup

The test setup was assembled in accordance with ANSI C63.4-2001. The Quartex FM-72 was placed on an 80cm high non-conductive table centered on a flush mounted 2-meter diameter turntable inside the 3 Meter Semi-Anechoic, FCC listed Chamber located at L. S. Compliance, Inc., Cedarburg, Wisconsin. The EUT was operated in normal mode, using AC power as provided by a wall transformer. The transmitter was set to operate continuously, on one channel (72.24 MHz), and a suitable artificial antenna load was connected to the antenna port for the duration of the radiated emissions tests. Signal levels that were seen to be close to the regulatory limits were verified using a substitution method, with a tuned Dipole. The applicable limits are provided at a 3 meter distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a list of the test equipment.

Test Procedure

Spurious radiation measurements were performed on the EUT in the 3 Meter Semi-Anechoic, FCC listed Chamber, located at L. S. Compliance, Inc. in Cedarburg, Wisconsin. The frequency range from 30 MHz to 1000 MHz was scanned, and levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on the non-conductive wooden table in the 3 Meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the test object. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. The maximum radiated emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities.

Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. Included in this list are calibration information and equipment descriptions. All equipment is calibrated and used according to the operations manual supplied by the manufacturer. All calibrations of the antennas used were performed at an N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and a HP 8546A EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the HP 8546A EMI Receiver database. As a result, the data taken from the HP 8546A EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The HP 8546A EMI Receiver was operated with a bandwidth of 120 kHz for measurements below 1 GHz. Both the Peak and Quasi-Peak Detector functions were utilized.

Test Results

The EUT was found to MEET the Radiated Emissions requirements of Title 47 CFR, FCC Part 90.257(b)(2) for an unintentional radiator (Canada RSS-210). The frequencies with significant signals were recorded and plotted as shown in the Data Charts and Graphs.

Notes:

Calculation of Radiated Emissions Limits

FIELD STRENGTH OF SPURIOUS/HARMONIC FREQUENCIES

In accordance with Section 90.210 (2.1053)
All out of band spurious emissions must be below the mean power of the carrier by at least:

$$43 + 10 \log(\text{carrier power})$$

which for a 1.0 watt rating on the test sample is:

$$43 + 10 \log(1))$$
$$43 = 43 \text{ dBc}$$

-43 dBc from 30 dBm = -13. dBm

FIELD STRENGTH OF PART 90 LIMIT: AT R = 3 METERS DSTANCE

FROM THE STANDARD REFERENCE FORMULA FOR POWER TRANSMITTED VERSUS ELECTRIC FIELD:

$$Pt = (R^{**}) \times |E|^{**} / 30$$

Then to convert to dB:

$$Pt = 20\log|E| + 20\log(R) - 10\log(30)$$

Insert additional terms to convert watts to milli-watts (in dB) and volts to micro-volts (in dBμV):

$$Pt = 20\log|E\mu v| - 20\log(1{,}000{,}000) + 10\log(1000) + 20\log(3) - 10\log(30)$$

$$Pt = 20\log|E\mu v| - 120 + 30 + 9.54 - 14.77$$

$$Pt = 20\log|E\mu v| - 95.23$$

OR; $20\log|E\mu v| = Pt \text{ (in dBm)} + 95.23$

$|E|$ (in dBμV) = -13 dBm + 95.23 = 82.23 dBμV/m , at 3 meters

Summary of Results and Conclusions

Based on the procedures outlined in this report, and the test results included in Appendices A and B, it can be determined that the EUT does MEET the emission requirements of Title 47 CFR, FCC Part 15, Subpart B (Industry Canada RSS-210) for an unintentional radiator.

The enclosed test results pertain to the samples of the test item listed, and only for the tests performed per the data sheets. Any subsequent modification or changes to the test items could invalidate the data contained herein, and could therefore invalidate the findings of this report.

Measurement of Electromagnetic Radiated Emissions
upon a 3 Meter I. C. Listed Site

Frequency Range inspected: 30 MHz - 1,000 MHz

Date of Test: October 19, 2001

Location of Test: L. S. Compliance, Inc.
W66 N220 Commerce Court
Cedarburg, WI 53012

Manufacturer: Quartex, Div. Of Primex, Inc.

Model No.: FM-72

Serial No.: Pre-Production

Configuration: Continuous TX on 72.24 MHz

Specifications: 90.257(b)(2), 2.1053

Detector(s) Used: Peak

Distance: 3 Meters

Equipment: HP 8546A EMI Receiver; EMCO 3115 Double-Ridged Waveguide Antenna; EMCO 3146A Log Periodic Antenna; EMCO 3110 Biconical Antenna

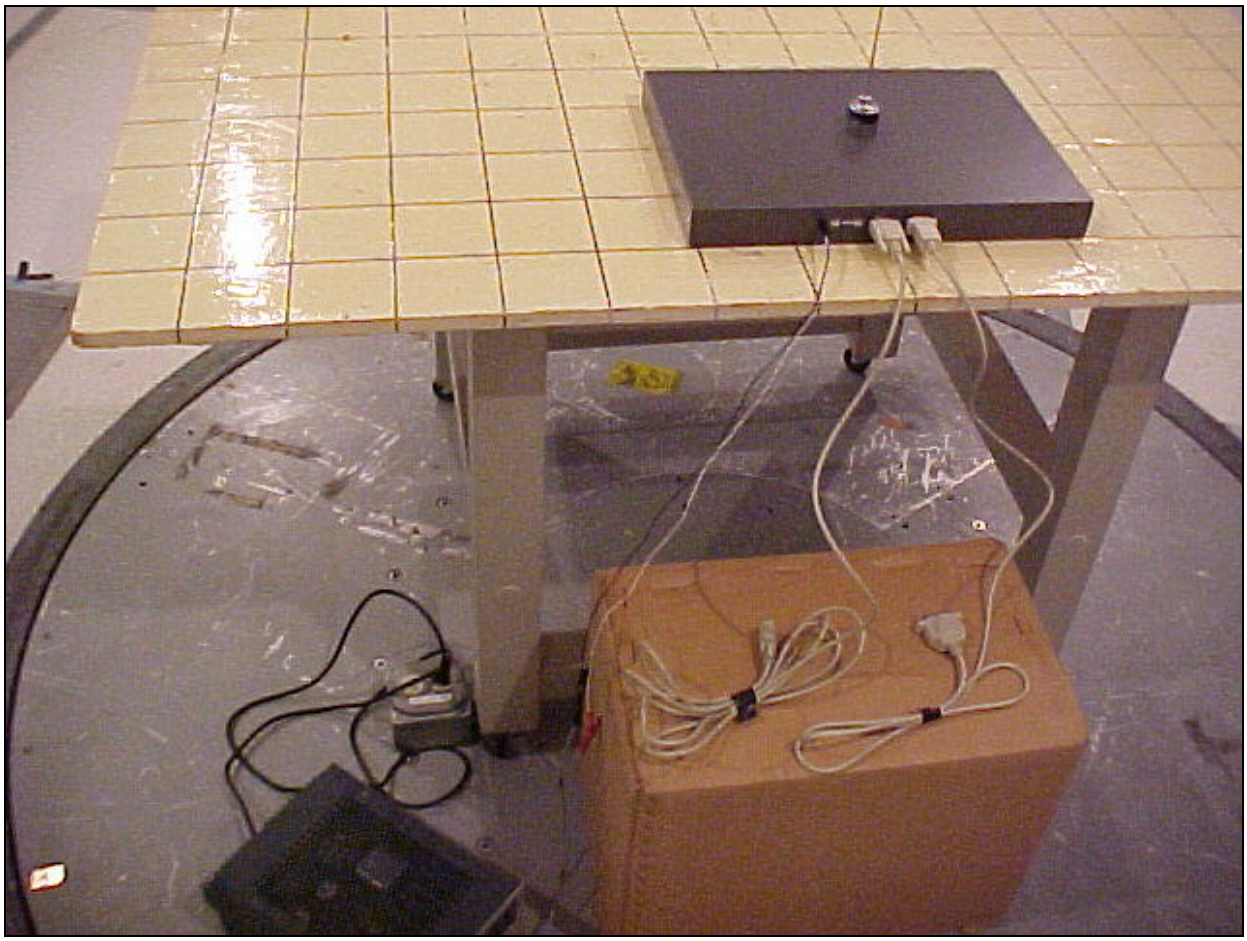
The following table depicts the level of significant emissions found:

Frequency (MHz)	Antenna Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dBmV/m)	(dBmV/m)	Margin (dB)
90.1	V	--	1.0	180°	30.0	82.2	52.2
180.2	V	--	1.0	180°	25.0	82.2	57.2
723.0	V	--	1.0	180°	29.0	82.2	53.2

Notes: Emissions seen with antenna port terminated with a 50 ohm terminating load. All other signals seen were even further below the Part 90 limit of –13 dBµ except the fundamental, which is covered in the Appendix.

Photos Taken During Radiated Emissions Testing

Test Setup for Radiated Emissions Testing in the 3 Meter Chamber

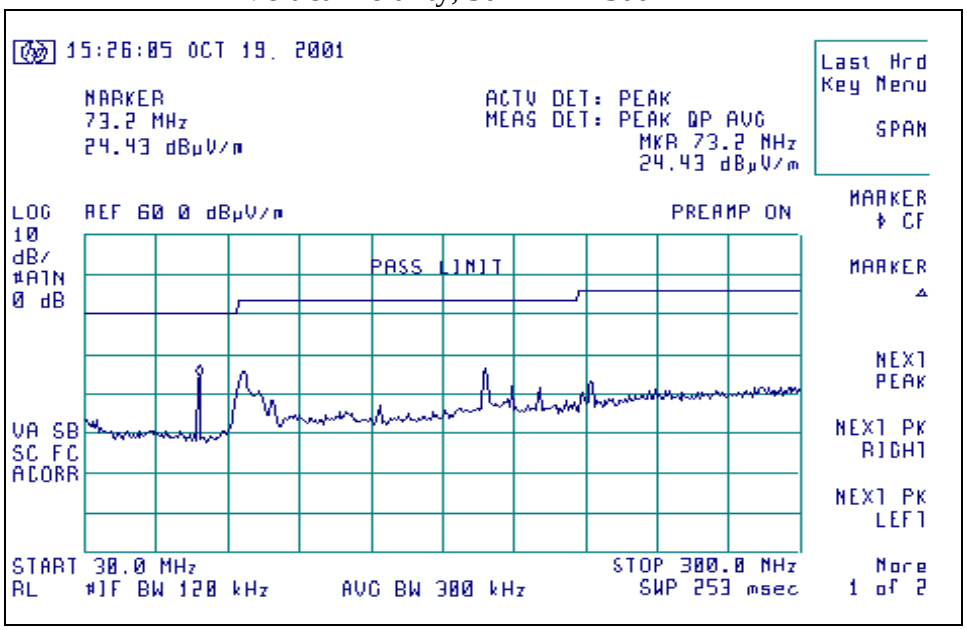


View of the EUT during the Radiated Emissions Testing.
Antenna in place, but port internally terminated with a 50 Ohm load.

Graphs made during Radiated Emissions Testing

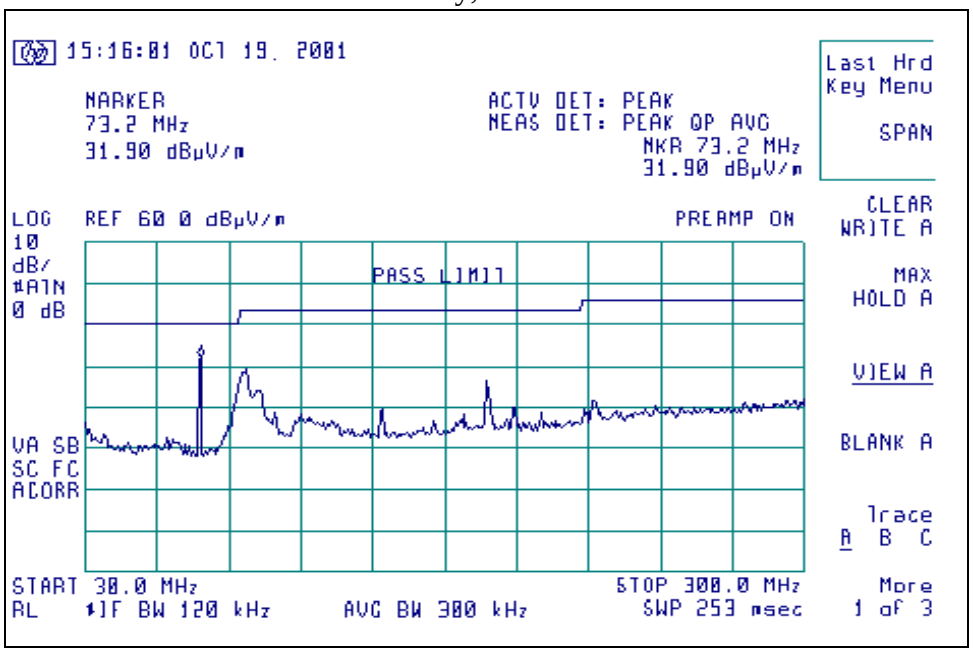
Signature Scan of Radiated Emissions

Vertical Polarity, 30 MHz – 300 MHz



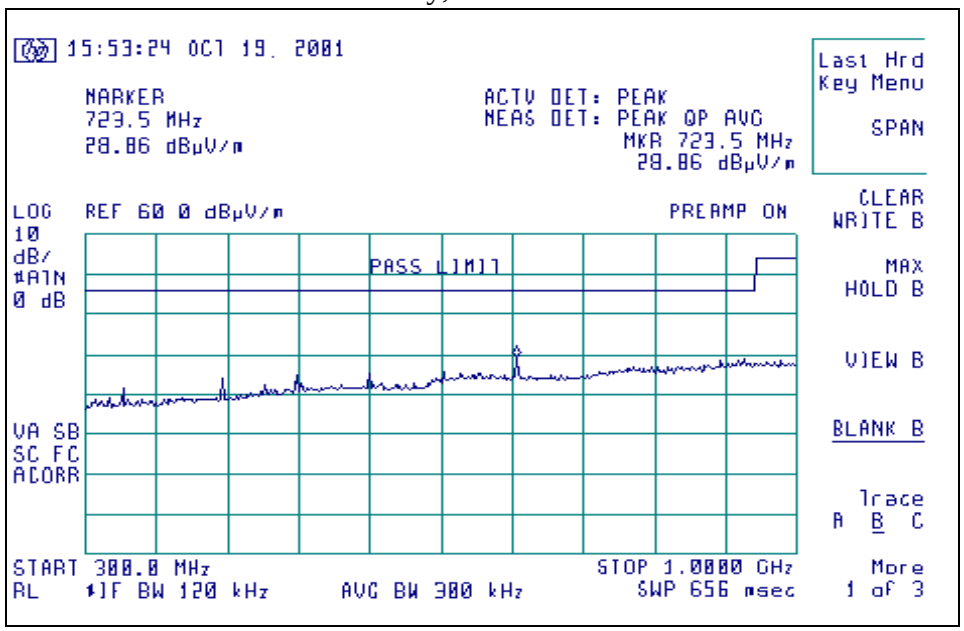
Signature Scan of Radiated Emissions

Horizontal Polarity, 30 MHz – 300 MHz



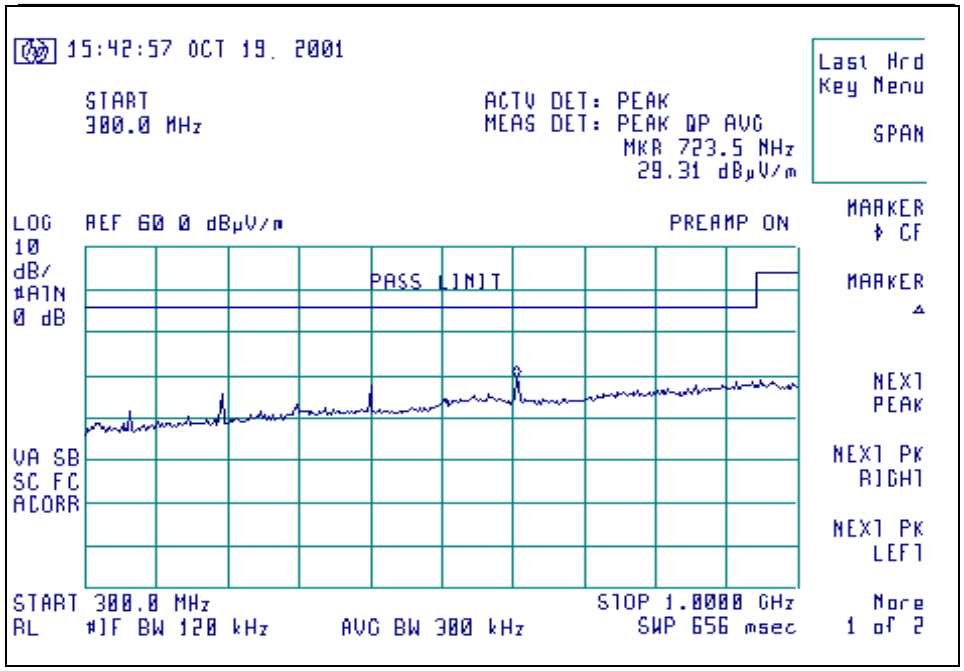
Signature Scan of Radiated Emissions

Vertical Polarity, 30 MHz – 1000 MHz



Signature Scan of Radiated Emissions

Horizontal Polarity, 300 MHz – 1000 MHz



13. Conducted Emissions Test (AC Line)

Test Setup

The Conducted Emissions test was performed within the 3 Meter Semi-Anechoic, FCC listed Chamber, or FCC listed Shielded Room, located at L.S. Compliance, Inc. in Cedarburg, Wisconsin. The test area and setup are in accordance with ANSI C63.4-2001 and with Title 47 CFR, FCC Part 15, Subpart B (Industry Canada RSS-210). The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT's power supply was plugged into a 50Ω (ohm), 50/250 µH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was fed into the 3 Meter Semi-Anechoic Chamber via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup in the 3 Meter Semi-Anechoic Chamber and connected to the LISN, the RF Sampling Port of the LISN was cabled to a 10 dB Attenuator-Limiter, and then to the HP 8546A EMI Receiver. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

Test Procedure

The appropriate frequency range and bandwidths were entered into the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1 (1993), Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30MHz. Final readings were then taken and recorded.

Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operations manual supplied by the manufacturer. Calibrations of the LISN and Limiter are traceable to N.I.S.T. All cables are calibrated and checked periodically for malfunction. The emissions are measured on the HP 8546A EMI Receiver, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

Test Results

The EUT was found to MEET the Conducted Emissions requirements of FCC Part 15, Conducted Emissions. See the Data Charts and Graphs for more details of the test results.

Notes:

This test is not required of a Part 90 device, and was performed only as an additional step to insure a higher performance level in the environments for which this product is intended.

Measurement of Electromagnetic Conducted Emission in the Shielded Room

Frequency Range inspected: 450 KHz to 30 MHz

Date of Test: October 30, 2001

Location of Test: L. S. Compliance, Inc.
W66 N220 Commerce Court
Cedarburg, WI 53012

Manufacturer: Quartex, Div. Of Primex, Inc.

Model No.: FM-72

Serial No.: Pre-Production

Configuration: Continuous TX on 72.24 MHz

Specifications: 15.207 used, not required

Detector(s) Used: Quasi-Peak

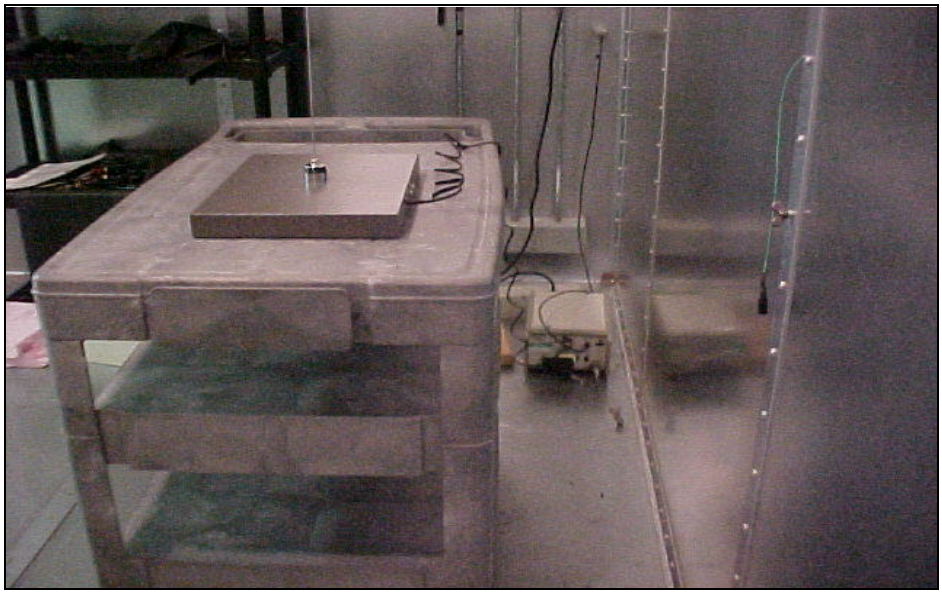
Distance: N/A

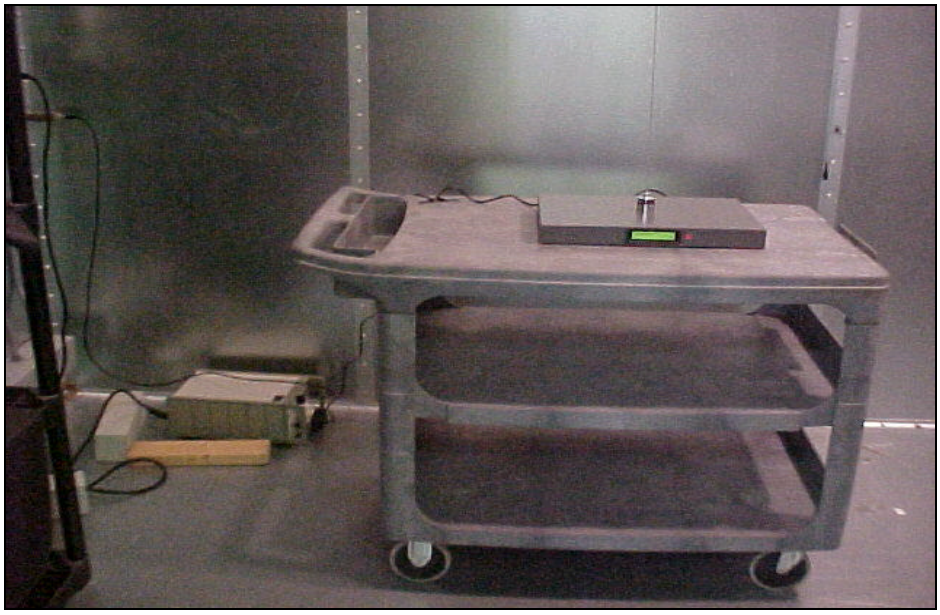
Equipment: HP 8546A EMI Receiver; EMCO 3816nm L.I.S.N.

Frequency (MHz)	**Line**	**EMI Reading (dBmV/m)**	**Limit (dBmV/m)**	**Margin (dB)**
.597	L2	44.8	48.0	3.2
.897	L2	43.6	48.0	4.4
1.040	L2	43.8	48.0	4.2
.597	L1	47.3	48.0	0.7
.898	L1	46.2	48.0	1.8
1.370	L1	45.5	48.0	2.5

Photos Taken During Conducted Emissions Testing

Test Setup for Conducted Emissions Testing

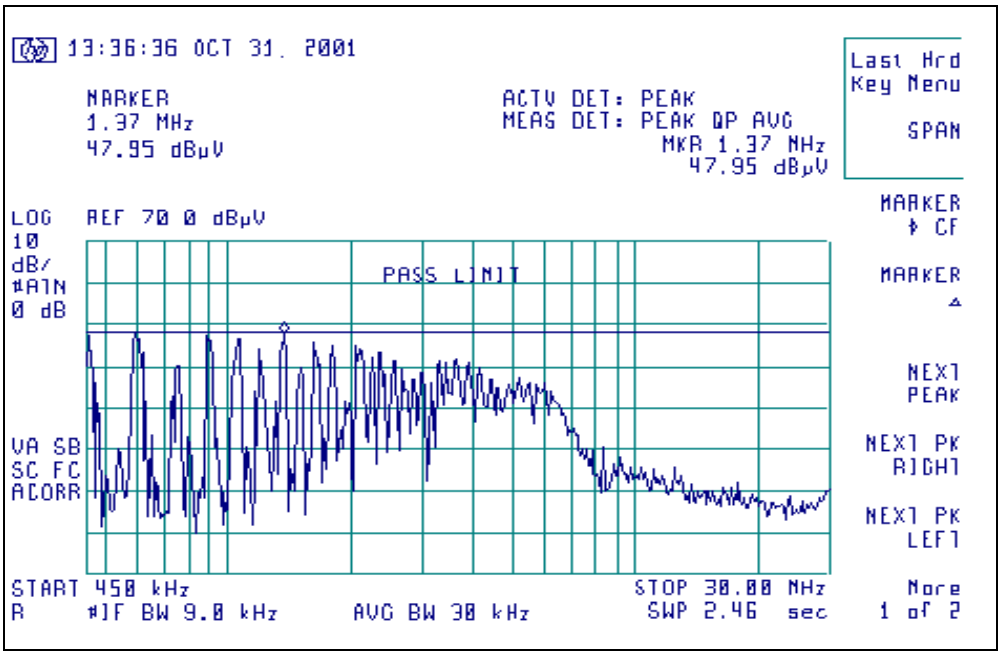




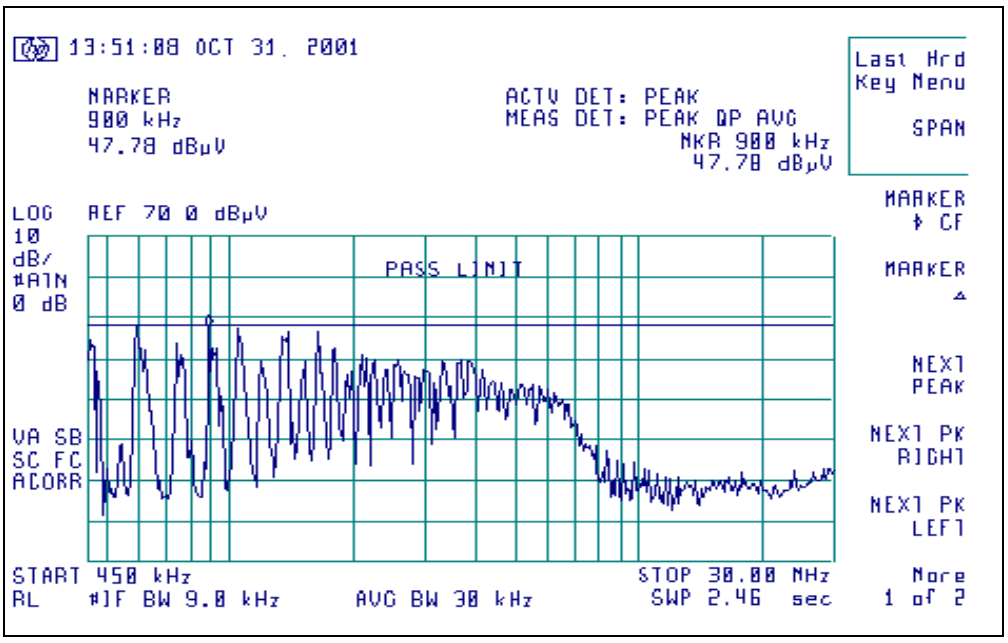
Views of the EUT during the Conducted Emissions Testing.

Graphs made during Conducted Emissions Testing

Signature Scan of Conducted Emissions, Line 1



Signature Scan of Conducted Emissions, Line 2



14. Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Calibration Information	
					Date	Due Date
AA960004	EMCO	93146	9512-4276	Log-Periodic Antenna	02-28-01	02-28-02
AA960005	EMCO	3110B	9601-2280	Biconical Antenna	09-24-01	09-24-02
EE960004	EMCO	2090	9607-1164	Mast/Ttable Controller	N/A	N/A
EE960013	HP	8546A	3617A00320	Receiver RF Section	11-01-00	11-01-01
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	11-01-00	11-01-01
N/A	LSC	Cable	0011	3 meter ½" Heliax Cable	12-07-00	12-07-01
N/A	LSC	Cable	0038	1 meter RG 214 Cable	12-07-00	12-07-01
N/A	LSC	Cable	0050	10 meter RG 214 Cable	12-07-00	12-07-01
N/A	LSC	Attenuator		10 db Attenuator		

Note 1* - Equipment calibrated within a traceable system.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uc Value in Appropriate Units
Radiated Emissions	3 Meter Chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3 Meter Chamber, Log Periodic Antenna	4.80 dB
Radiated Emissions	10 Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10 Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB

APPENDIX A

Part 90 Type Acceptance, Conducted Measurements