



MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*

914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313
33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587-3201 • PHONE (510) 489-6300 • FAX (510) 489-6372
3162 BELICK STREET • SANTA CLARA, CA 95054-2401 • PHONE (408) 748-3585 • FAX (510) 489-6372

August 07, 2009

Linear Technology Corporation
1630 McCarthy Blvd.
Milpitas, CA 95035

Dear David Ng,

Enclosed is the EMC test report for compliance testing of the Linear Technology Corporation, LTM8020 (200mA, 36V DC/DC μ Module), tested to the requirements of EN 55022: 2006 for a Class B Device.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
MET LABORATORIES, INC.

Kanesa Pogi
Documentation Department

Reference: (\Linear Technology Corporation\EMCS81657A-EURO)

Certificates and reports shall not be reproduced except in full, without the written permission of MET Laboratories, Inc. This letter of transmittal is not a part of the attached report.



MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*

914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313
33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587-3201 • PHONE (510) 489-6300 • FAX (510) 489-6372
3162 BELICK STREET • SANTA CLARA, CA 95054-2401 • PHONE (408) 748-3585 • FAX (510) 489-6372

**Electromagnetic Compatibility
Test Report**

for the

**Linear Technology Corporation
LTM8020 (200mA, 36V DC/DC μ Module)**

Tested under

**EN 55022: 2006
For a Class B Device**

MET Report: EMCS81657A-EURO

August 07, 2009

Prepared for:

**Linear Technology Corporation
1630 McCarthy Blvd.
Milpitas, CA 95035**

**Prepared by:
MET Laboratories, Inc.
33439 Western Avenue
Union City, California 94587**



Electromagnetic Compatibility Test Report

For the

Linear Technology Corporation
LTM8020 (200mA, 36V DC/DC μ Module)

Tested under

EN 55022: 2006
For a Class B Device

MET Report: EMCS81657A-EURO

Asad Bajwa, Manager
Electromagnetic Compatibility Lab

Kanesa Pogi
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the applicable limits. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of EN 55022: 2006 under normal use and maintenance.

Randy Hoopai
Electromagnetic Compatibility Lab



Linear Technology Corporation
LTM8020 (200mA, 36V DC/DC μ Module)

Electromagnetic Compatibility
EN 55022: 2006

Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	August 07, 2009	Initial Issue.



Table of Contents

1.0 Testing Summary	1
2.0 Equipment Configuration	2
2.1 Overview	2
2.2 Test Site	2
2.3 Description of Test Sample	2
2.4 Equipment Configuration	3
2.5 Support Equipment	3
2.6 Ports and Cabling Information	4
2.7 Mode of Operation	4
2.8 Method of Monitoring EUT Operation	4
2.9 Modifications	4
2.10 Disposition of EUT	4
3.0 Electromagnetic Compatibility Emission Criteria	5
3.1 Radiated Emission: Limits of Electromagnetic Radiation Disturbance	5
4.0 Test Equipment	11

List of Tables

Table 1. Executive Summary of EN 55022 Compliance Testing	1
Table 2. Equipment Configuration	3
Table 3. Support Equipment	3
Table 4. Ports and Cabling Information	4
Table 5. Electromagnetic Radiated Disturbance limits from Clause 6 of EN 55022	5
Table 6. Radiated Emission Test Results, Mode 1 – 36V _{in} , 1.25V _{out} , 200mA	7
Table 7. Radiated Emission Test Results, Mode 2 – 36V _{in} , 2.5V _{out} , 200mA	8
Table 8. Radiated Emission Test Results, Mode 3 – 36V _{in} , 5V _{out} , 200mA	9

List of Figures

Figure 1. Block Diagram of Test Configuration	3
---	---

List of Photographs

Photograph 1. Radiated Emission: Limits of Electromagnetic Radiation Disturbance, Test Setup	10
--	----



List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dB μ A	Decibels above one microamp
dB μ V	Decibels above one microvolt
dB μ A/m	Decibels above one microamp per meter
dB μ V/m	Decibels above one microvolt per meter
DC	Direct Current
E	Electric Field
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
CISPR	Comite International Special des Perturbations Radioelectriques (International Special Committee on Radio Interference)
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kilohertz
kPa	kilopascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
μ H	microhenry
μ F	microfarad
μ s	microseconds
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
V/m	Volts per meter
VCP	Vertical Coupling Plane



1.0 Testing Summary

The following tests specified by EN 55022 were performed with the following results.

Specification	Test Description	Compliance
EN 55022: 2006	Radiated Emissions - Class B	Compliant

Table 1. Executive Summary of EN 55022 Compliance Testing



2.0 Equipment Configuration

2.1 Overview

MET Laboratories, Inc. was contracted by Linear Technology Corporation to perform testing on the LTM8020 (200mA, 36V DC/DC μ Module), under Linear Technology Corporation purchase order number X14282T.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Linear Technology Corporation, LTM8020 (200mA, 36V DC/DC μ Module) with the requirements of EN 55022 limits and Methods of Radio Disturbance characteristic of Information Technology Equipment.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	LTM8020 (200mA, 36V DC/DC μ Module)
Model(s) Covered:	LTM8020
EUT Specifications:	Primary Power: 34 to 36V
	Equipment Emissions Class: B
Evaluated by:	Randy Hoopai
Date(s):	August 07, 2009

2.2 Test Site

All testing was performed at MET Laboratories, Inc., 3162 Belick St. Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

2.3 Description of Test Sample

The LTM8020, Equipment Under Test (EUT) is a 36Vin, 200mA step down switching power converter. It was mounted to the DC1194A demonstration board.

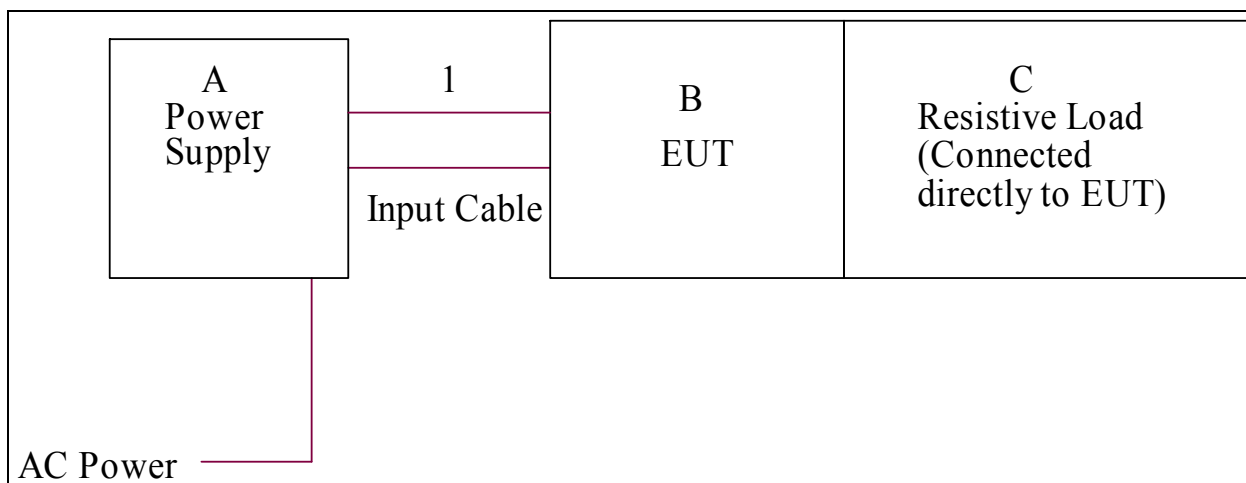


Figure 1. Block Diagram of Test Configuration

2.4 Equipment Configuration

The EUT was set up as outlined in Figure 1. All equipment incorporated as part of the EUT is included in the following list.

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Rev. #
B	N/A	200mA, 36V DC/DC μ Module	LTM8020	LTM8020EV	001	--

Table 2. Equipment Configuration

2.5 Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number	Customer Supplied Calibration Data
A	Power Supply	Power Designs	TPS343B	--
C	Resistive Load	N/A	N/A	--

Table 3. Support Equipment



2.6 Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty	Length as tested (m)	Max Length (m)	Shielded (Y/N)	Termination Box ID & Port Name
1	Input	2 conductor, 18 AWG (3 conductor for 1.25V _{out} configuration)	1	2	--	No	Vin

Table 4. Ports and Cabling Information

2.7 Mode of Operation

The EUT will be continuously power from 36Vin lab grade power supply. There will be three configurations tested:

1. 1.25V_{out} loaded to 200mA. An additional 5V bias is required when running this low of an output voltage.
2. 2.5V_{out} loaded to 200mA
3. 5V_{out} loaded to 200mA – this is maximum output power configuration

2.8 Method of Monitoring EUT Operation

1. The output voltage will be in regulation.
2. The output voltage will be significantly above or below its regulation point.

2.9 Modifications to the EUT

No modifications were made to the EUT.

2.10 Disposition of EUT

The test sample including all support equipment (if any), submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Linear Technology Corporation upon completion of testing.



3.0 Electromagnetic Compatibility Emission Criteria

3.1 Radiated Emission: Limits of Electromagnetic Radiation Disturbance

Test Method: EN 55022:1994 + A1:1995 + A2:1997
Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment.

Test Requirement(s): EN 55022, Section 6, Limits for Radiated Disturbances:

For radiated emission in the frequency range 30 MHz - 1 000 MHz, the EUT shall meet the Class B radiated emission limits shown in Table 5.

Frequency Band (MHz)	Class A Quasi-Peak limits 10 m measurement distance (dB μ V/m)	Class B Quasi-Peak limits 10 m measurement distance (dB μ V/m)
30 to 230	40	30
230 to 1000	47	37

Table 5. Electromagnetic Radiated Disturbance limits from Clause 6 of EN 55022

Test Procedure: The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber. The method of testing, test conditions, and test procedures of EN 55022 were used. An antenna was located 3 m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

Emissions measured at 3m were normalized using an inverse proportionality factor of 20dB per decade for comparison to the 10 m limit. The physical size of the EUT was taken into account as to avoid near-field effects, which could occur near 30 MHz. See Photograph 1 for a picture of the test setup.

Environmental Conditions for Radiated Emission	
Ambient Temperature:	22 °C
Relative Humidity:	48 %



Linear Technology Corporation
LTM8020 (200mA, 36V DC/DC μ Module)

Test Results: The EUT was compliant with the requirement(s) of this section.

Test Engineer(s): Randy Hoopai

Test Date(s): 07/16/09



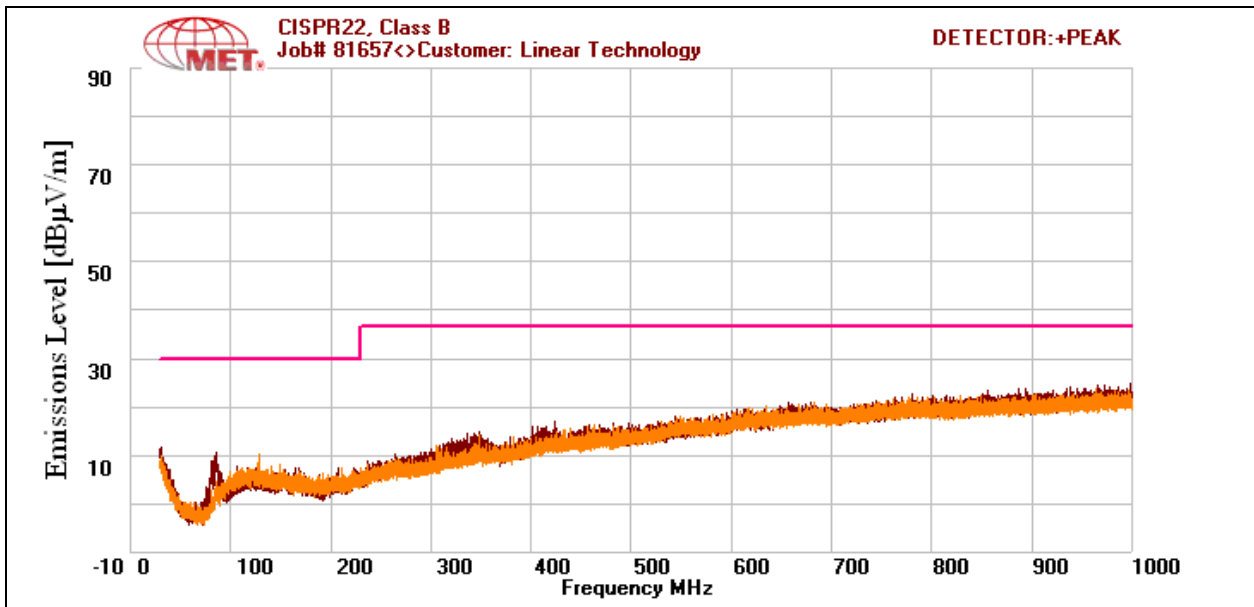
Linear Technology Corporation
LTM8020 (200mA, 36V DC/DC μ Module)

Radiated Emission: Limits of Electromagnetic Radiation Disturbance, Test Results

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
85.48	H	89	374	10.9	8.186	0	2.276	-10.46	10.902	30	-19.098
81.72	H	89	374	9.3	7.706	0	2.231	-10.46	8.777	30	-21.223
123.44	H	0	391	-2.3	12.769	0	2.752	-10.46	2.761	30	-27.239
343.32	H	98	100	4.7	14.866	0	4.737	-10.46	13.843	37	-23.157
407.76	H	103	100	2.3	16.976	0	5.172	-10.46	13.988	37	-23.012
128	V	360	100	2.6	13.18	0	2.82	-10.46	8.14	30	-21.86

Table 6. Radiated Emission Test Results, Mode 1 – 36Vin, 1.25Vout, 200mA

Note: The EUT was tested at 3 m. The data has been corrected for comparison with the 10 m limit using the formula: $20\log(3\text{ m}/10\text{ m})$ as expressed in the 'Distance Correction' column.





Linear Technology Corporation
LTM8020 (200mA, 36V DC/DC μ Module)

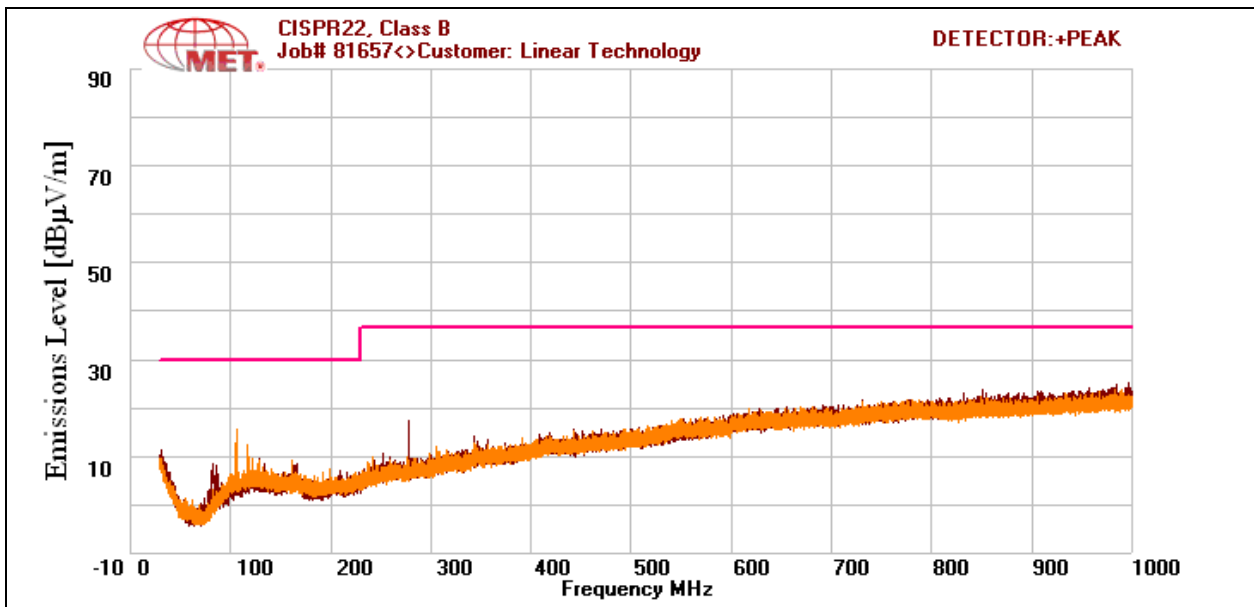
Radiated Emission: Limits of Electromagnetic Radiation Disturbance, Test Results

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV)	Limit (dBuV)	Margin (dB)
82.4	H	96	391	8.6	7.788	0	2.239	-10.46	8.167	30	-21.833
86.08	H	96	391	6.85	8.294	0	2.283	-10.46	6.967	30	-23.033
128	H	360	100	2.5	12.68	0	2.82	-10.46	7.54	30	-22.46
156.04	V	0	100	-2.2	11.417	0	3.17	-10.46	1.927	30	-28.073
162.36	H	91	156	2.4	10.606	0	3.209	-10.46	5.755	30	-24.245
234.64	H	0	391	-2.4	11.571	0	3.888	-10.46	2.599	37	-34.401

Table 7. Radiated Emission Test Results, Mode 2 – 36Vin, 2.5Vout, 200mA

Note(s): The EUT was tested at 3 m. The data has been corrected for comparison with the 10 m limit using the formula: $20\log(3\text{ m}/10\text{ m})$ as expressed in the 'Distance Correction' column.

In the plot below, peaks at 106, 119, and 278 MHz are not from EUT.





Linear Technology Corporation
LTM8020 (200mA, 36V DC/DC μ Module)

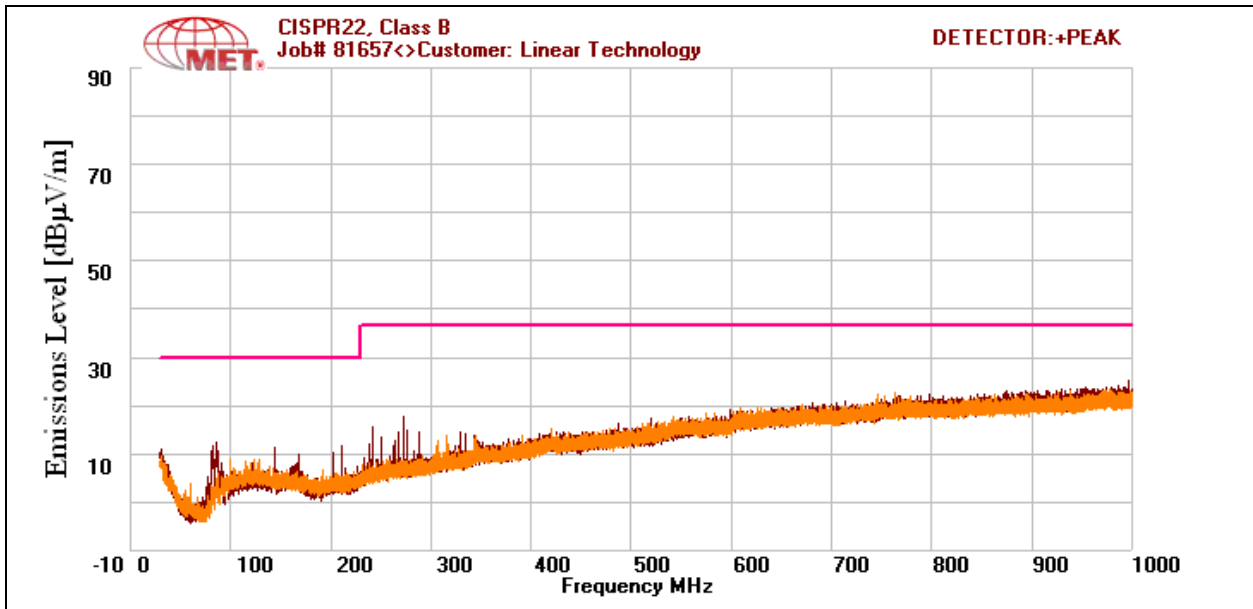
Radiated Emission: Limits of Electromagnetic Radiation Disturbance, Test Results

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dB μ V)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dB μ V)	Limit (dB μ V)	Margin (dB)
82.16	H	97	391	11.3	7.759	0	2.236	-10.46	10.835	30	-19.165
85.16	V	0	391	3	8.058	0	2.272	-10.46	2.87	30	-27.13
85.28	H	97	391	11.2	8.15	0	2.273	-10.46	11.163	30	-18.837
164.72	H	93	204	3.7	10.511	0	3.228	-10.46	6.979	30	-23.021
307.72	V	360	100	-0.8	13.709	0	4.436	-10.46	6.885	37	-30.115
343.4	H	110	100	3.8	14.868	0	4.737	-10.46	12.945	37	-24.055

Table 8. Radiated Emission Test Results, Mode 3 – 36Vin, 5Vout, 200mA

Note(s): The EUT was tested at 3 m. The data has been corrected for comparison with the 10 m limit using the formula: $20\log(3\text{ m}/10\text{ m})$ as expressed in the 'Distance Correction' column.

In the plot below, peak at 144 MHz, and peaks between 200 and 300 MHz are not from EUT.



Radiated Emission: Limits of Electromagnetic Radiation Disturbance, Test Setup



Photograph 1. Radiated Emission: Limits of Electromagnetic Radiation Disturbance, Test Setup



Linear Technology Corporation
LTM8020 (200mA, 36V DC/DC μ Module)

Electromagnetic Compatibility
Test Equipment
EN 55022: 2006

4.0 Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

Test Name: EN 55022 (CISPR 22):1998 Radiated Emissions Electric Field			Test Date(s): 07/16/09		
MET Asset #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2482	5 Meter Chamber	Panashield	641431	11/22/2008	11/22/2009
1S2501	EMI Test Receiver	Rhode & Schwarz	ESU40	4/27/2009	4/27/2010
1S2484	Bilog Antenna	Teseq	CBL6112D	1/27/2009	1/27/2011
1S2518	Thermo-Hygrometer	Fisher Scientific	11-661-7D	11/14/2007	11/13/2009