Electromagnetic Compatibility
Test Report

Prepared in accordance with

EN 55022:2006+A1:2007

On

DC/DC Converter
LTM4606

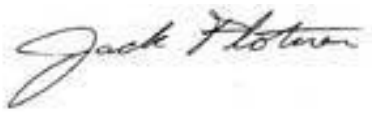
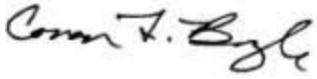
For

Linear Technology Corporation
1630 McCarthy Blvd.
Milpitas, CA 95035
U.S.A.

Prepared by:

TUV Rheinland of North America, Inc.
2305 Mission College Blvd., Suite 105
Santa Clara, CA 95054
U.S.A.

Auftraggeber: *Client:*	Linear Technology Corporation 1630 McCarthy Blvd. Milpitas, CA 95035	Eddie Beville Main (408) 432-1900 Ext. 3007 Fax (408) 434-0507 ebeville@linear.com	
Bezeichnung: *Identification:*	DC DC Converter	**Serien-Nr.:** *Serial No.*	None
Gegenstand der Prüfung: *Test item:*	LTM4606	**Prüfdatum:** *Date tested:*	December 6th 2010
Prüfort: *Testing location:*	TUV Rheinland of North America 2305 Mission College Blvd., Suite 105 Santa Clara, CA 95054 U.S.A.	Tel: (925) 249-9123 Fax: (925) 249-9124	
Prüfgrundlage: *Test specification:*	Emissions: EN 55022:2006+A1:2007		
Prüfergebnis: *Test Result:*	**Der vorstehend beschriebene Prüfgegenstand wurde geprüft und entspricht oben genannter Prüfgrundlage. The above product was found to be Compliant to the above test standard(s)**		

geprüft / *tested by:* Jack Plotner	**kontrolliert** / *reviewed by:* Conan Boyle
 12/23/2010 **Datum** *Date* **Name** *Name* **Unterschrift** *Signature*	 12/28/2010 **Datum** *Date* **Name** *Name* **Unterschrift** *Signature*

Sonstiges : *Other Aspects:*	**None**

Abkürzungen: OK, Pass, Compliant, Complies = entspricht Prüfgrundlage Fail, Not Compliant, Does not Comply = entspricht nicht Prüfgrundlage N/A = nicht anwendbar	Abbreviations: OK, Pass, Compliant, Complies = passed Fail, Not Compliant, Does Not Comply = failed N/A = not applicable

FC	NVLAP NVLAP LAB CODE 100411-0	Industry Canada Industrie Canada	VCCI
US5251		**2932D-1**	**1097**

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1 General Information

1.1 Scope

This report is intended to document the status of conformance with the requirements of EN 55022:2006+A1:2007 based on the results of testing performed on December 6th, 2010 on the DC DC Converter, Model No. LTM4606, manufactured by This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT (Equipment Under Test) in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

1.3 *Summary of Test Results*

Applicant	Linear Technology Corporation 1630 McCarthy Blvd. Milpitas, CA 95035	**Tel**	(408) 432-1900	**Contact**	Eddie Beville
		Fax	(408) 434-0507	**e-mail**	ebeville@linear.com

Description	DC/DC Converter	**Model Number**	LTM4606
Serial Number	None	**Test Voltage/Freq.**	4.5 - 28 Vdc
Test Date Completed:	December 6th, 2010	**Test Engineer**	Jack Plotner

Standards	Description	Severity Level or Limit	Criteria	Test Result
EN 55022:2006+A1:2007 Product Family Standard Emissions	Information Technology Equipment – Radio Disturbance	See called out basic standards below	See Below	Complies
EN 55022:2006+A1:2007	Radiated Emissions	Class B, 30 - 1000 MHz	Limit	Complies

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 NIST / NVLAP

TUV Rheinland of North America is accredited by the National Voluntary Laboratory Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Standard 17025:2005 (Lab Code: 100411-0). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.2 Acceptance by Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Lane, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / NVLAP accreditation will be accepted by each member country.

2.2 Test Facilities

All of the test facilities are located at 1279 Quarry Lane, Pleasanton, California 94566, USA. (2305 Mission College, Santa Clara, 95054, USA location is Pleasanton Annex)

Emission Test Facility

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2003, at test distances of 3 and 10 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by NVLAP (Lab Code 100411-0).

Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7m x 3.7m x 3.175mm thick aluminum floor connected to PE ground. For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6m x 0.8m x 0.8m high non-conductive table with a 3.175mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470 kΩ resistors. The Vertical Coupling Plane consists of an aluminum plate 50cm x 50cm x 3.175mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470 kΩ resistors. For each of the other tests, the HCP is removed.

RF Field Immunity testing is performed in a 10m semi-anechoic chamber with absorber added to floor.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.9m x 3.7m x 3.175mm thick aluminum ground plane which is connected to one end of the anechoic chamber.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or co-variances of these other quantities weighted according to how the measurement result varies with changes in these quantities. The term standard uncertainty is the result of a measurement expressed as a standard deviation.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand. The fraction may be viewed as the coverage probability or level of confidence of the interval.

Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

Table 1: Summary of Uncertainties - Emissions

	U_{lab}	U_{cispr}
Radiated Disturbance @ 10m		
30 MHz – 1,000 MHz	3.2 dB	5.2 dB

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

2.5 Measurement Equipment Used

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy	Test
EMI Receiver (Receiver Section)	HP	85462A	3807A00445	01/20/2010	01/20/2011	RE
EMI Receiver (RF Filter Section)	HP	85460A	3704A00407	01/20/2010	01/20/2011	RE
9 kHz – 1 GHz Ant. Preamplifier	Sonoma	310N	185516	1/20/2010	1/20/2011	RE
Bilog Antenna Emissions	EMCO	3142	9701-1117	07/14/2010	07/14/2011	RE

Note: CE = Conducted Emissions, CI= Conducted Immunity, DP=Disturbance Power, EFT=Electrical Fast Transients, ESD = Electrostatic Discharge, FLI=Flicker, HAR=Harmonics, MF=Magnetic Field Immunity, RE=Radiated Emissions, RI=Radiated Immunity, SI=Surge Immunity, VDSI=Voltage Dips and Short Interruptions

3 Product Information

3.1 Product Description

See Section 6.4.

3.2 Equipment Modifications and Test Setup

None.

3.3 Test Plan

The EUT product information, test configuration, mode of operation, test types, test procedures, test levels, pass/failure criteria, in this report were carried out per the product test plan located in Appendix A of this report

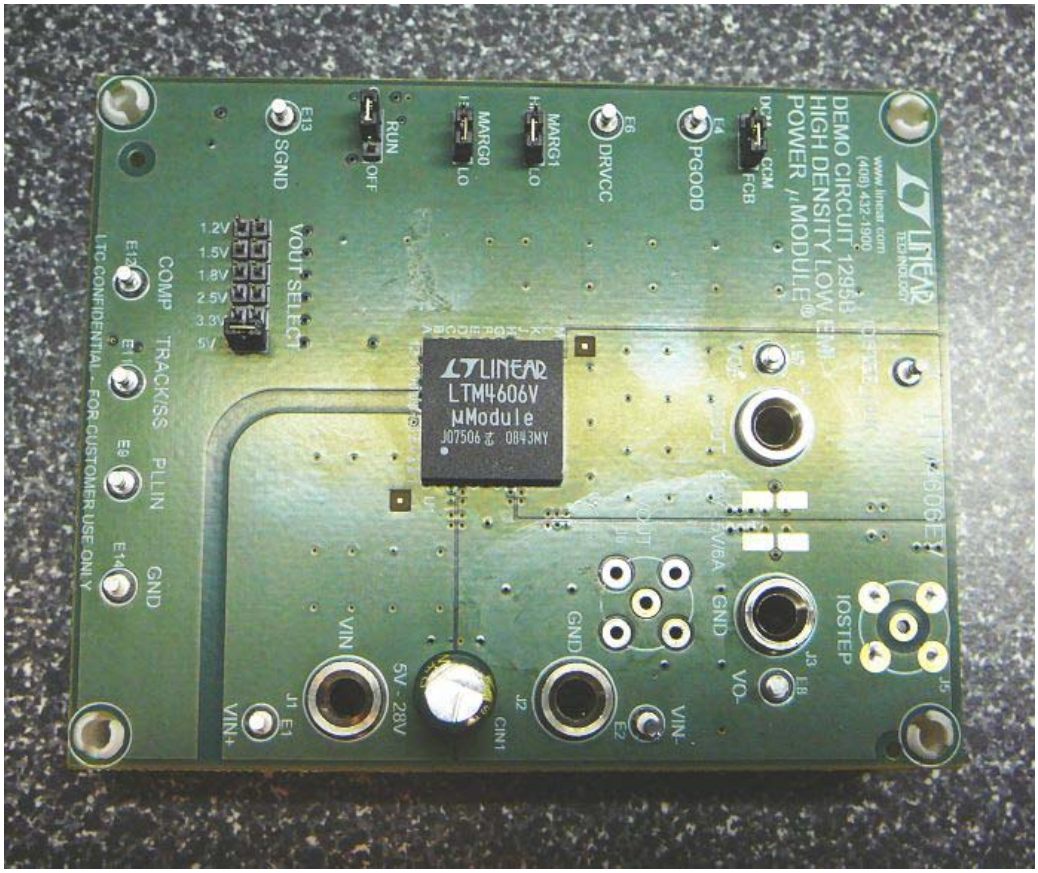


Figure 1 – Photo of EUT with Fixture – Front

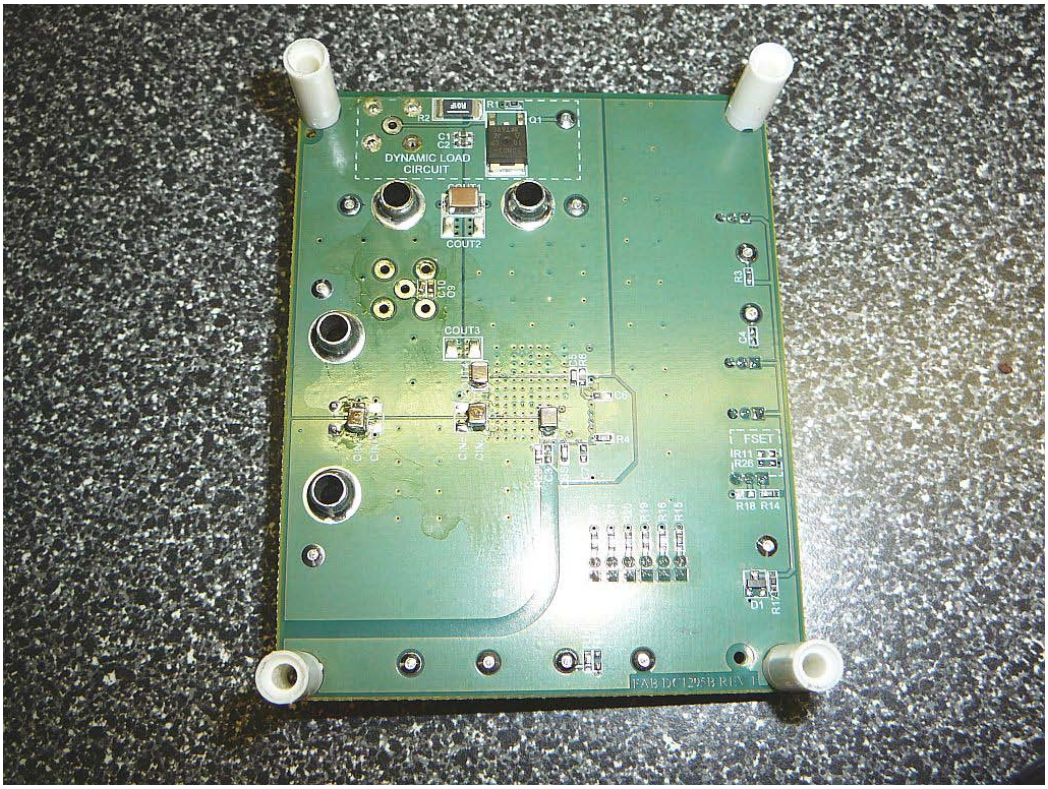


Figure 2 – Photo of EUT with Fixture – Back

4 Emissions

4.1 Radiated Emissions

This test measures the electromagnetic levels of spurious signals generated by the EUT that radiated from the EUT and may affect the performance of other nearby electronic equipment.

4.1.1 Overview of Test

Results	**Complies** (as tested per this report)	**Date**	December 6th, 2010
Standard	EN 55022:2006+A1:2007		
Product Model	LTM4606	**Serial#**	None
Configuration	See test plan for details.		
Test Set-up	Tested in 10m chamber, placed on turn-table, see test plan for details.		
EUT Powered By	5 - 28 Vdc		
Frequency Range	30 – 1000 MHz @ 10m		
Perf. Criteria	Class B (Below Limit)	**Perf. Verification**	Readings Under Limit
Mod. to EUT	None	**Test Performed By**	Jack Plotner

4.1.2 Test Procedure

Radiated emissions tests were performed using the procedures of ANSI C63.4 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration.

The frequency range from 30 – 1000 MHz was investigated for radiated emissions on all configurations.

4.1.3 Deviations

There were no deviations from the test methodology listed in the test plan for the radiated emission test.

4.1.4 Final Test

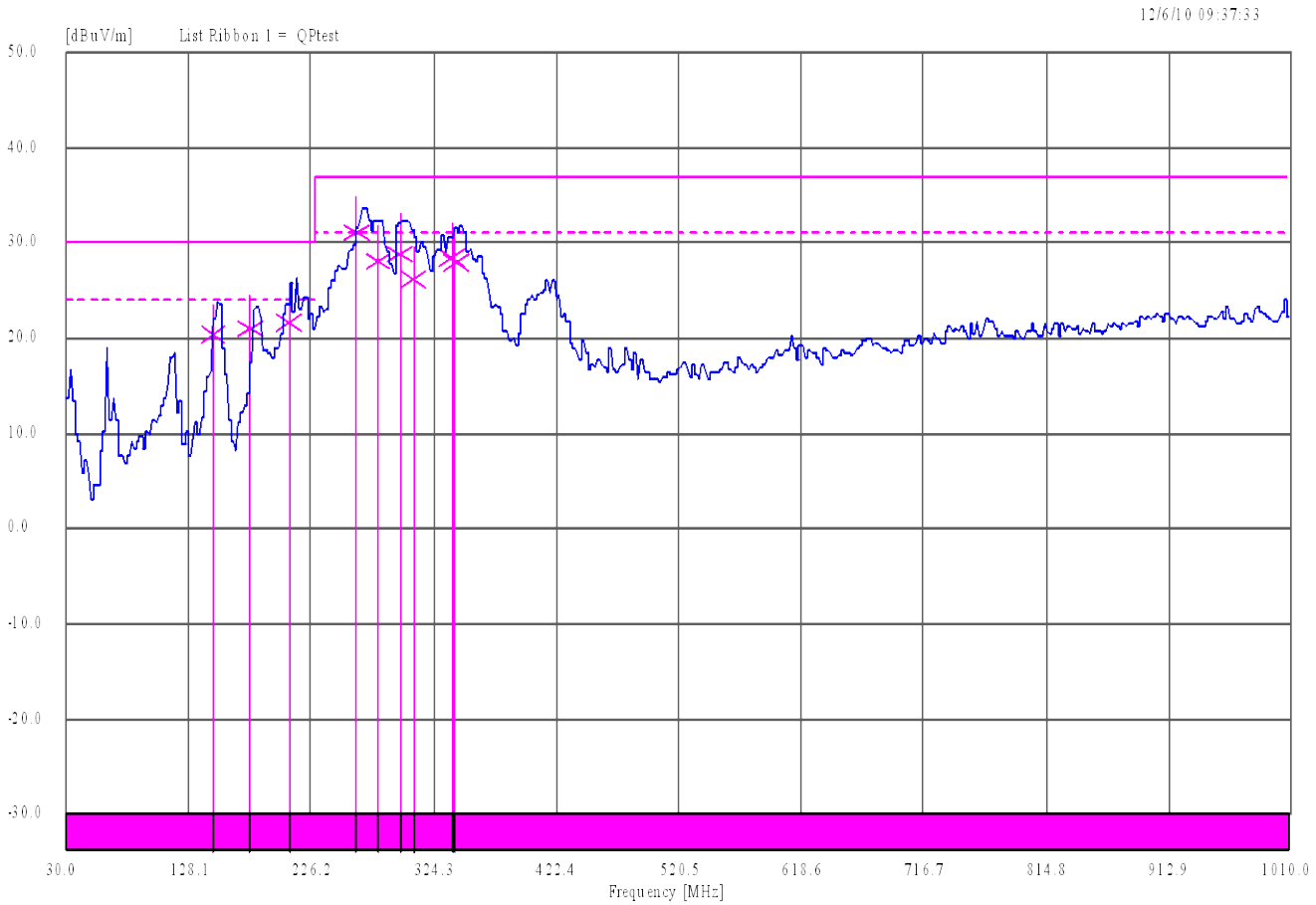
All final radiated emissions measurements were below (in compliance) the limits.

4.1.5 Final Graphs

NOTES: 28 Vdc Input / 5 Vdc Output @ 5 Amps

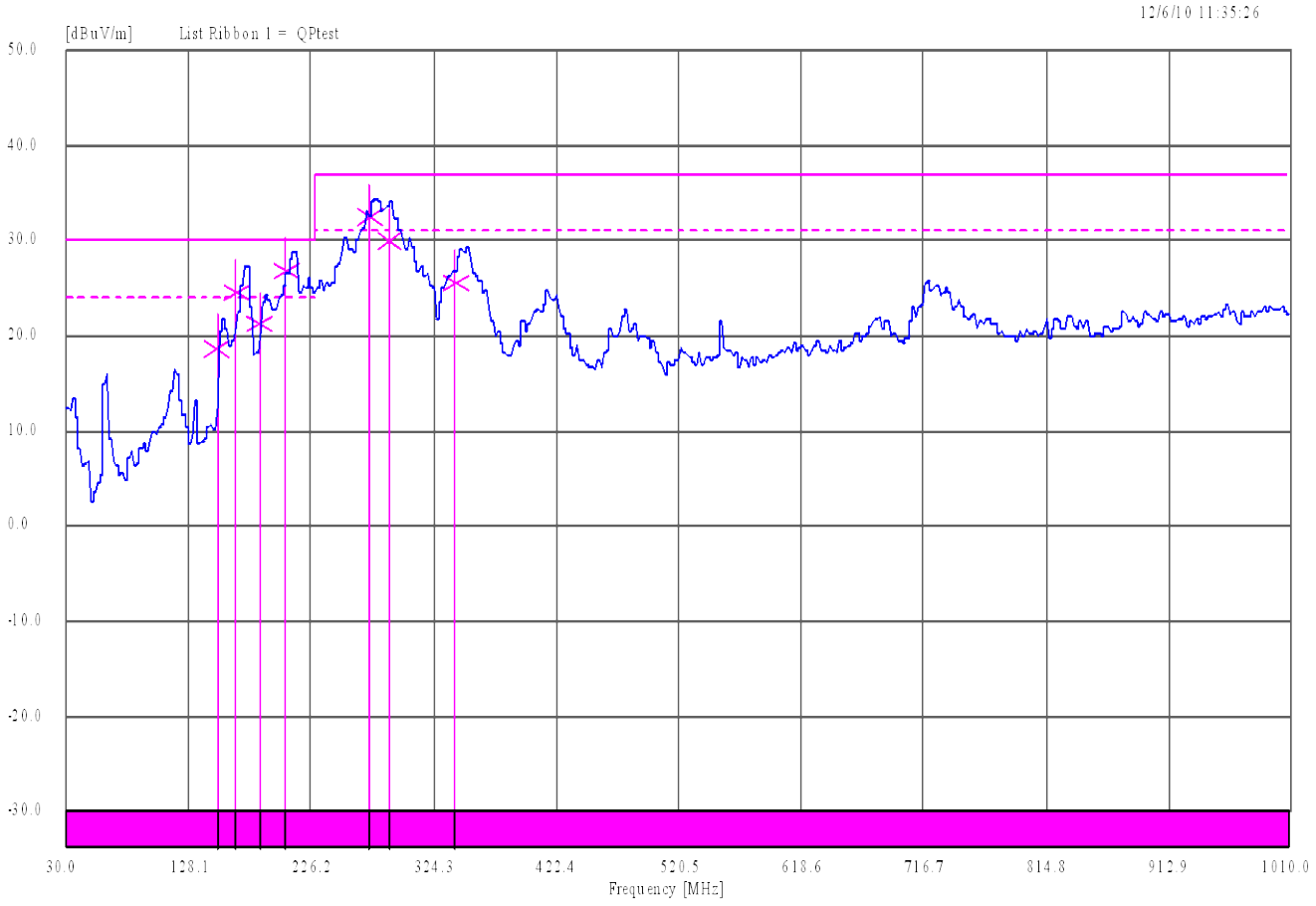
Radiated Emissions 30 – 1000 MHz

Vertical / Horizontal



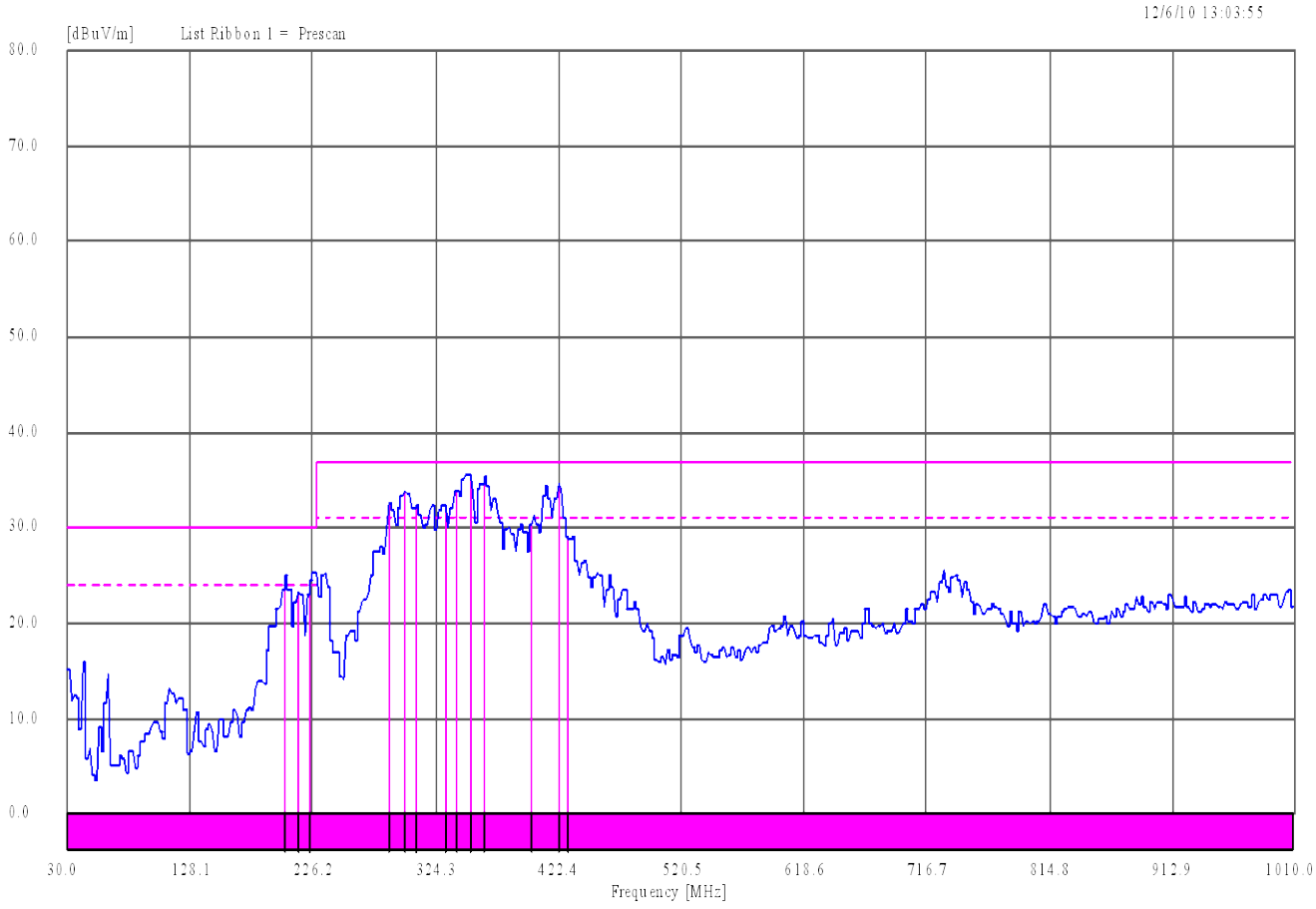
NOTES: 12 Vdc Input / 5 Vdc Output @ 6 Amps

Radiated Emissions 30 – 1000 MHz
Vertical / Horizontal



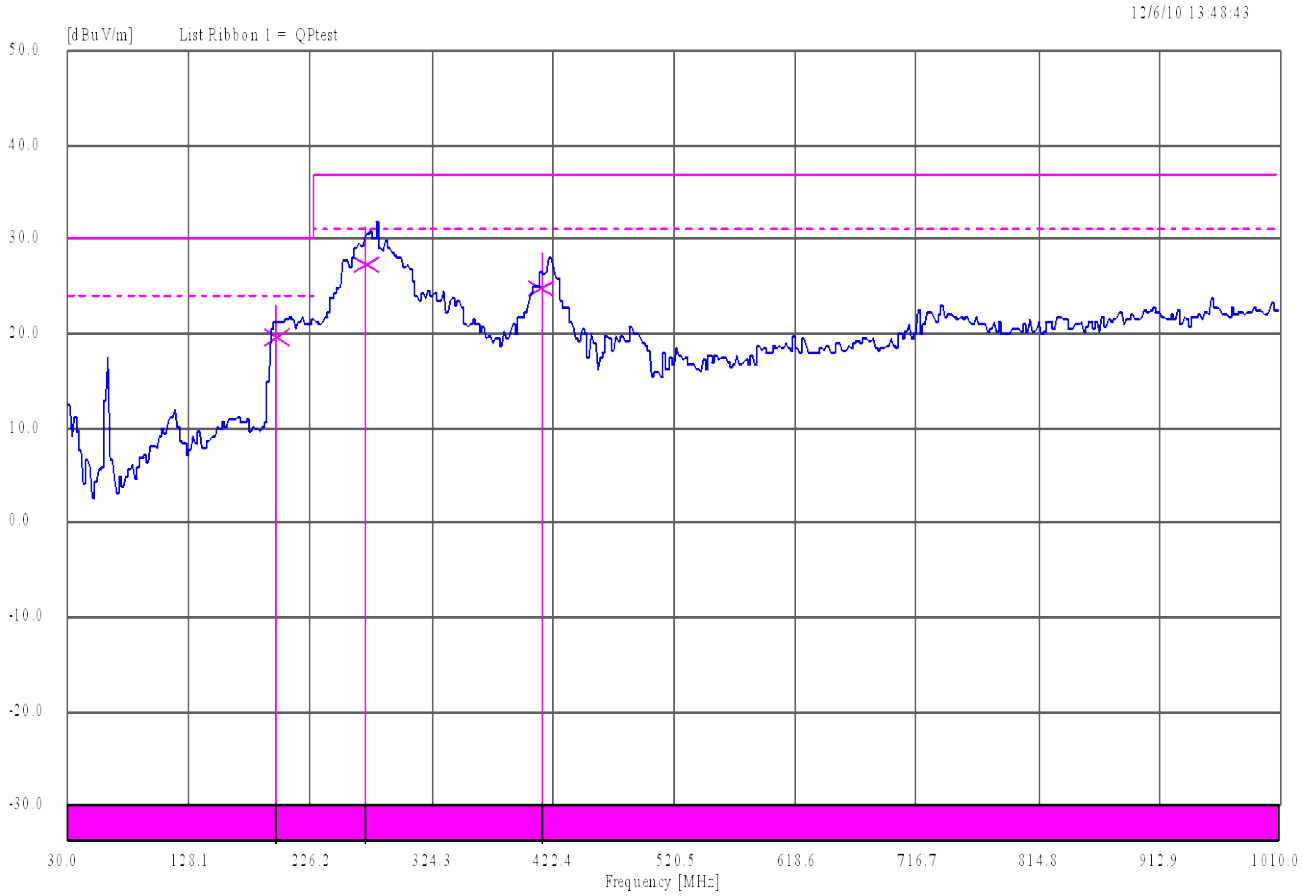
NOTES: 28 Vdc Input / 2.5 Vdc Output @ 6 Amps

Radiated Emissions 30 – 1000 MHz
Vertical / Horizontal



NOTES: 12 Vdc Input / 2.5 Vdc Output @ 6 Amps

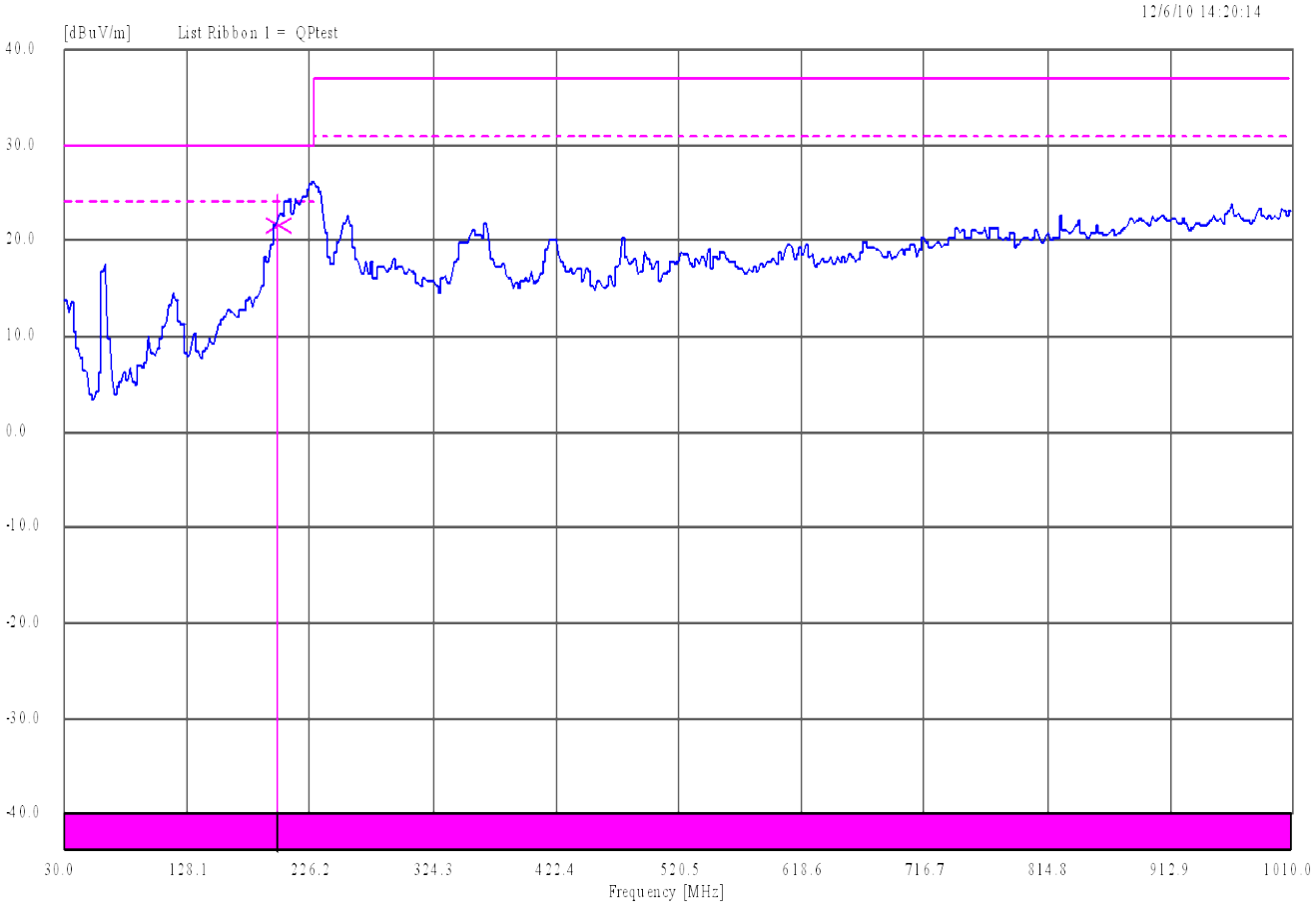
Radiated Emissions 30 – 1000 MHz
Vertical / Horizontal



NOTES: 5 Vdc Input / 2.5 Vdc Output @ 6 Amps

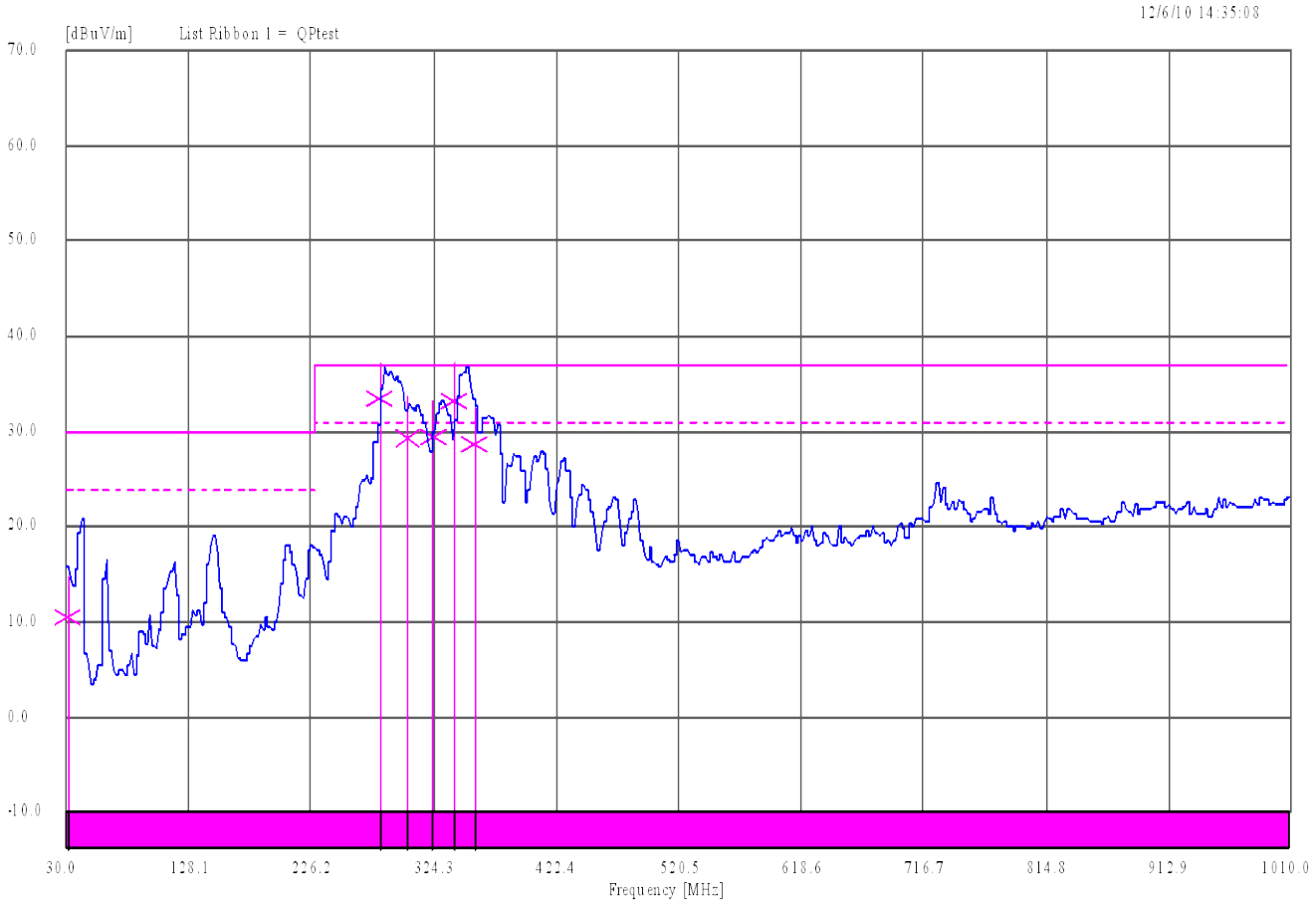
Radiated Emissions 30 – 1000 MHz

Vertical / Horizontal



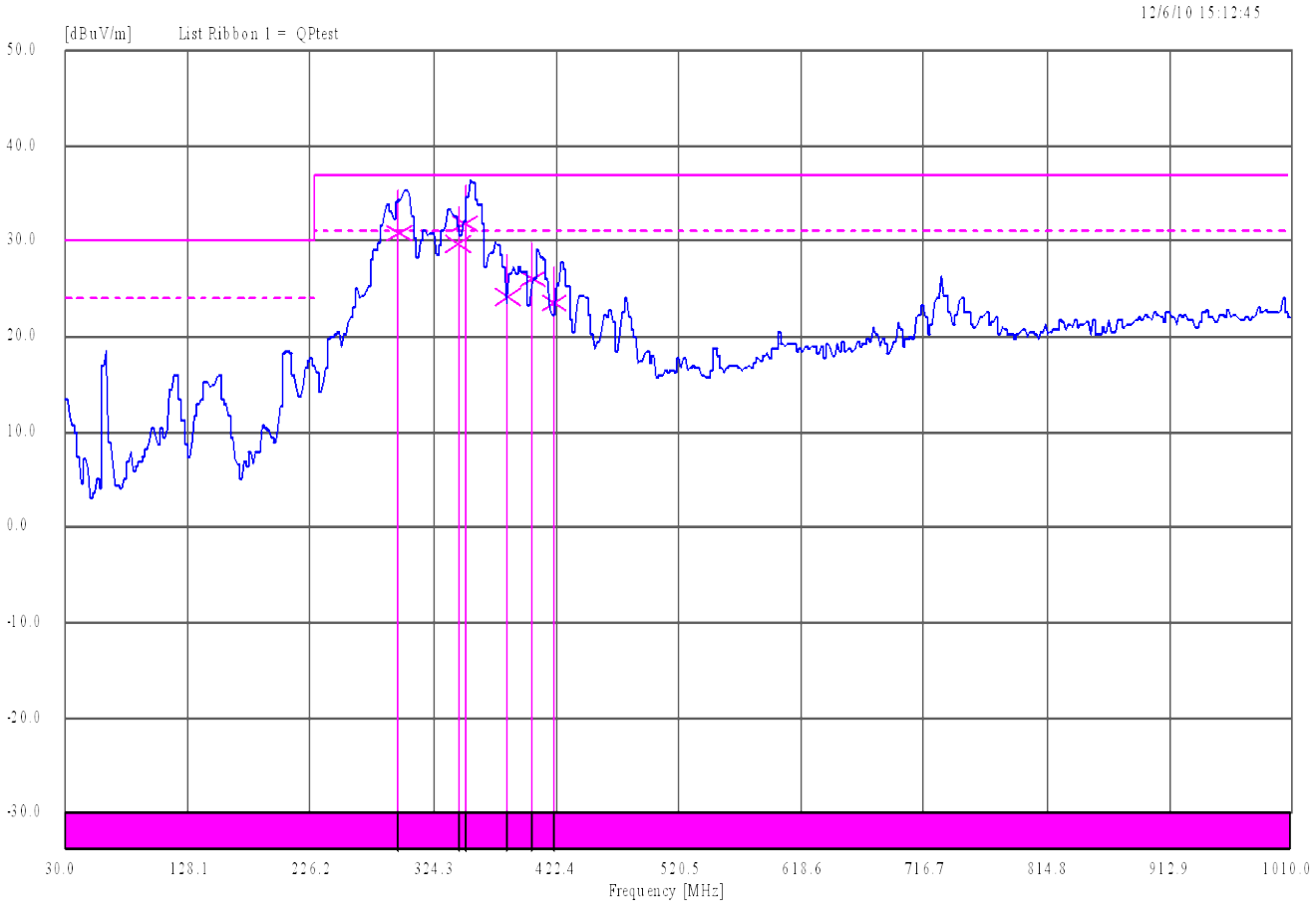
NOTES: 28 Vdc Input / 1.2 Vdc Output @ 6 Amps

Radiated Emissions 30 – 1000 MHz
Vertical / Horizontal



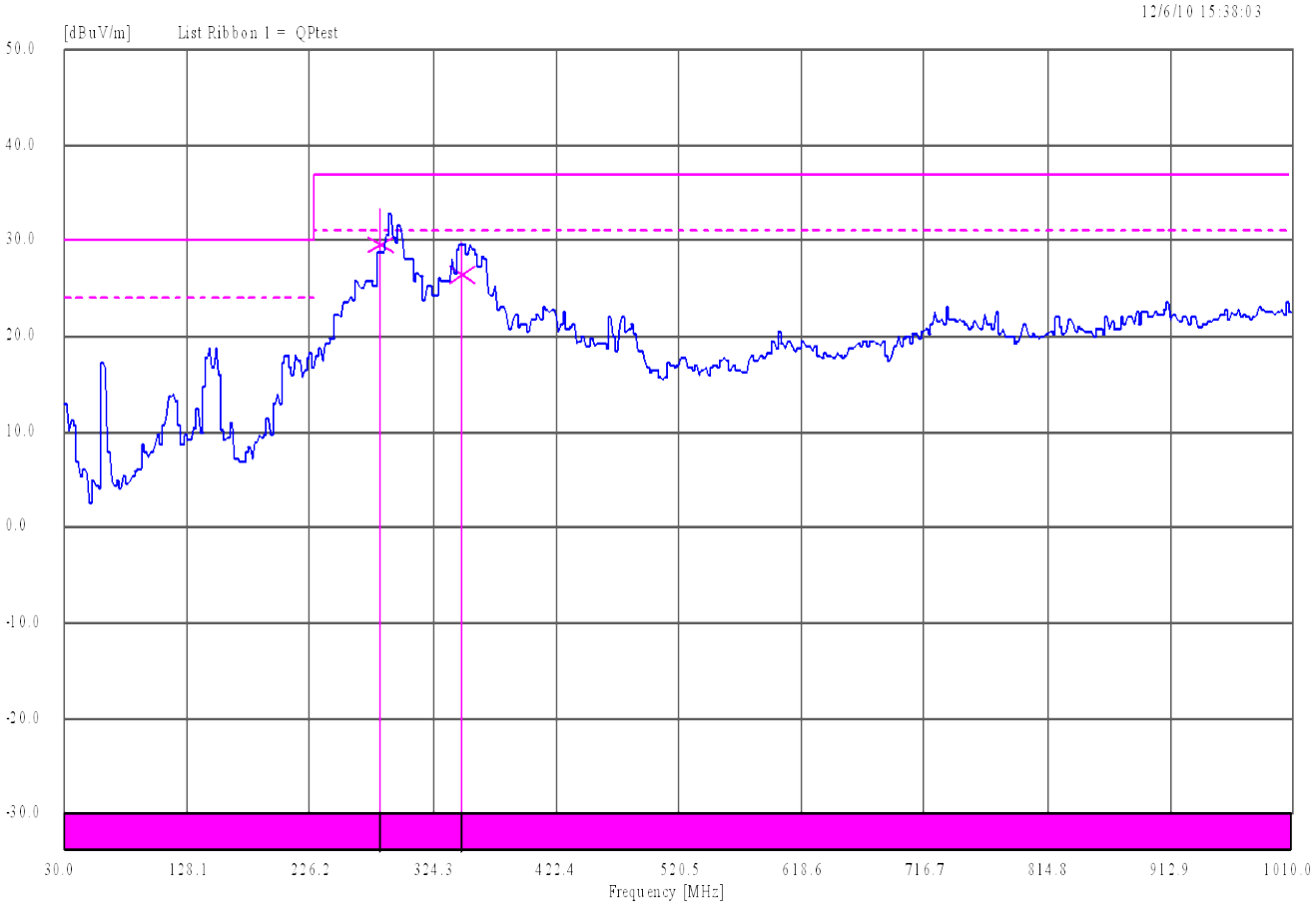
NOTES: 24 Vdc Input / 1.2 Vdc Output @ 6 Amps

Radiated Emissions 1000 – 6000 MHz
Vertical / Horizontal



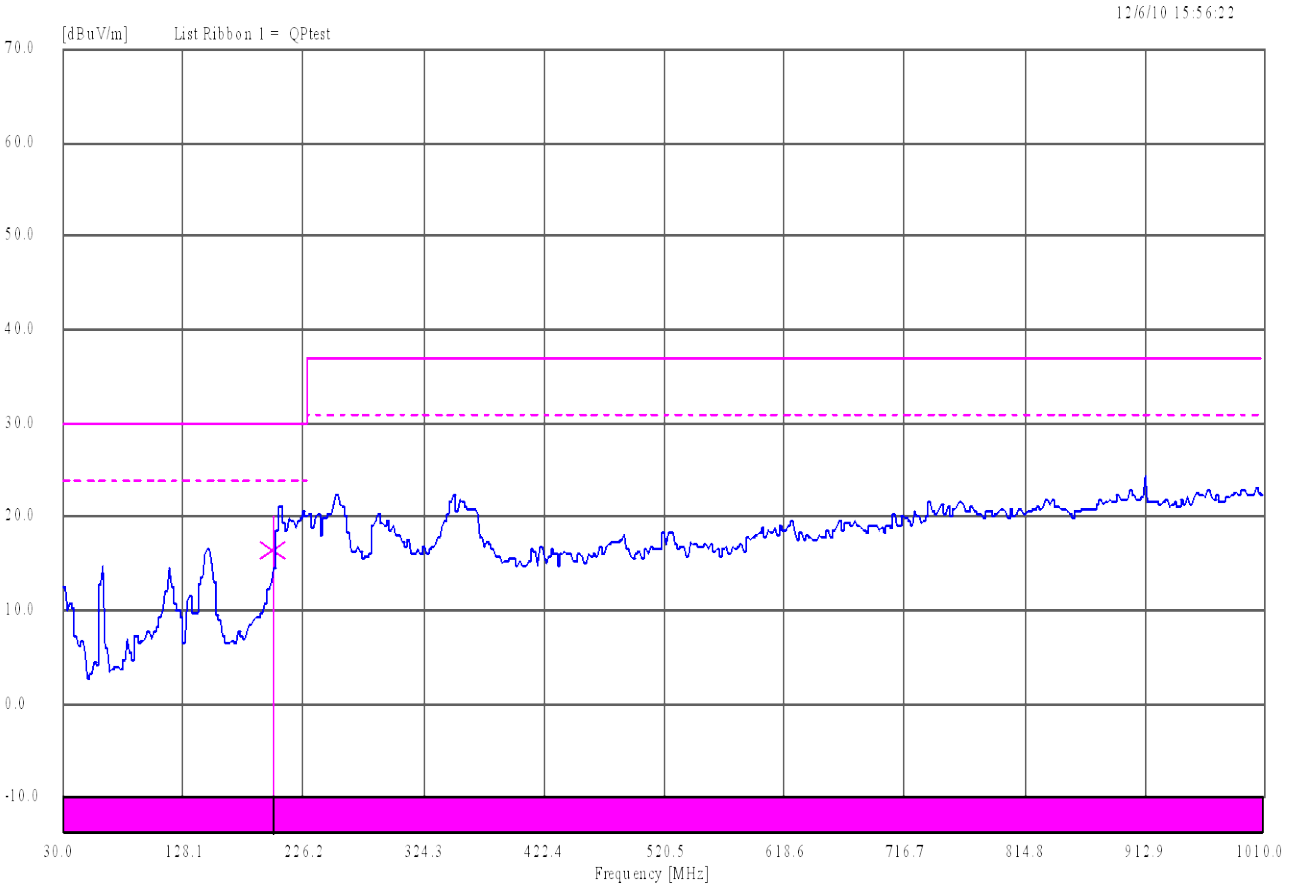
NOTES: 12 Vdc Input / 1.2 Vdc Output @ 6 Amps

Radiated Emissions 1000 – 6000 MHz
Vertical / Horizontal



NOTES: 5 Vdc Input / 1.2 Vdc Output @ 6 Amps

Radiated Emissions 1000 – 6000 MHz
Vertical / Horizontal



4.1.6 Radiated Emissions Scan Tabulated Data

28 Vdc Input / 5 Vdc Output @ 5 Amps

Frequency	Peak	QP	QP Lmt	QP Margin	Angle	Hgt	Pol	Total Correction Factor
MHz	dBuV/m	dBuV/m	dBuV/m	dB	deg	cm		
147.743273	23.51	20.36	30.00	-9.64	211	106	Vert	-12.96
176.798321	24.61	20.98	30.00	-9.02	177	322	Horz	-11.37
208.324446	25.43	21.66	30.00	-8.34	64	102	Vert	-10.35
262.231747	34.77	31.16	37.00	-5.84	304	397	Horz	-8.03
280.116415	31.93	28.07	37.00	-8.93	117	106	Vert	-7.44
297.094874	33.07	28.83	37.00	-8.17	130	105	Vert	-8.04
308.033536	29.71	26.22	37.00	-10.78	131	232	Vert	-6.78
339.041928	32.03	28.48	37.00	-8.52	188	198	Horz	-5.66
342.127680	31.27	27.92	37.00	-9.08	175	190	Horz	-5.19

12 Vdc Input / 5 Vdc Output @ 6 Amps

Frequency	Peak	QP	QP Lmt	QP Margin	Angle	Hgt	Pol	Total Correction Factor
MHz	dBuV/m	dBuV/m	dBuV/m	dB	deg	cm		
150.429734	22.22	18.59	30.00	-11.41	118	397	Horz	-12.57
165.946920	28.02	24.61	30.00	-5.39	216	126	Vert	-12.13
185.214889	24.64	21.28	30.00	-8.72	177	331	Horz	-11.05
206.452449	30.29	26.83	30.00	-3.17	79	100	Vert	-10.37
272.696718	35.82	32.49	37.00	-4.51	94	105	Vert	-7.48
288.445872	33.40	29.95	37.00	-7.05	99	103	Vert	-8.17
341.619996	29.11	25.48	37.00	-11.52	150	210	Horz	-5.28

28 Vdc Input / 2.5 Vdc Output @ 6 Amps

Frequency	Peak	QP	QP Lmt	QP Margin	Angle	Hgt	Pol	Total Correction Factor
MHz	dBuV/m	dBuV/m	dBuV/m	dB	deg	cm		
218.775279	25.73	21.89	30.00	-8.11	69	165	Vert	-10.00
229.078557	24.50	20.62	30.00	-9.38	94	197	Vert	-9.19
282.200884	33.06	29.39	37.00	-7.61	134	359	Horz	-7.69
293.227690	34.42	30.40	37.00	-6.60	150	278	Horz	-8.24
341.508027	35.34	31.37	37.00	-5.63	154	261	Horz	-5.31
344.532075	36.99	32.98	37.00	-4.02	156	300	Horz	-4.73
353.171822	36.58	32.81	37.00	-4.19	156	264	Horz	-4.38

12 Vdc Input / 2.5 Vdc Output @ 6 Amps

Frequency	Peak	QP	QP Lmt	QP Margin	Angle	Hgt	Pol	Total Correction Factor
MHz	dBuV/m	dBuV/m	dBuV/m	dB	deg	cm		
198.714993	23.16	19.61	30.00	-10.39	37	397	Horz	-10.76
271.269744	31.23	27.34	37.00	-9.66	131	356	Horz	-7.54
412.968819	28.56	24.79	37.00	-12.21	326	203	Horz	-3.67

5 Vdc Input / 2.5 Vdc Output @ 6 Amps

Frequency	Peak	QP	QP Lmt	QP Margin	Angle	Hgt	Pol	Total Correction Factor
MHz	dBuV/m	dBuV/m	dBuV/m	dB	deg	cm		
200.759949	24.96	21.54	30.00	-8.46	15	397	Horz	-10.70

28 Vdc Input / 1.2 Vdc Output @ 6 Amps

Frequency	Peak	QP	QP Lmt	QP Margin	Angle	Hgt	Pol	Total Correction Factor
MHz	dBuV/m	dBuV/m	dBuV/m	dB	deg	cm		
31.419797	14.93	10.52*	30.00	-19.48	67	242	Vert	-5.13
281.030330	37.19	33.51	37.00	-3.49	160	304	Horz	-7.55
303.325556	33.61	29.27	37.00	-7.73	174	321	Horz	-7.19
324.175364	33.31	29.49	37.00	-7.51	339	251	Horz	-6.19
340.854901	37.28	33.23	37.00	-3.77	154	204	Horz	-5.42
357.493804	32.56	28.69	37.00	-8.31	351	248	Horz	-4.11

24 Vdc Input / 1.2 Vdc Output @ 6 Amps

Frequency	Peak	QP	QP Lmt	QP Margin	Angle	Hgt	Pol	Total Correction Factor
MHz	dBuV/m	dBuV/m	dBuV/m	dB	deg	cm		
296.285842	35.29	30.91	37.00	-6.09	146	301	Horz	-8.11
344.216868	33.70	29.74	37.00	-7.26	154	268	Horz	-4.79
349.227943	35.77	31.87	37.00	-5.13	163	308	Horz	-4.57
383.690838	28.65	24.19	37.00	-12.81	144	262	Horz	-3.46
403.206075	29.76	26.09	37.00	-10.91	327	235	Horz	-3.78
421.273850	27.22	23.48	37.00	-13.52	323	225	Horz	-3.41

12 Vdc Input / 1.2 Vdc Output @ 6 Amps

Frequency	Peak	QP	QP Lmt	QP Margin	Angle	Hgt	Pol	Total Correction Factor
MHz	dBuV/m	dBuV/m	dBuV/m	dB	deg	cm		
282.115078	33.27	29.60	37.00	-7.40	150	346	Horz	-7.68
347.629774	29.93	26.45	37.00	-10.55	163	256	Horz	-4.60

5 Vdc Input / 1.2 Vdc Output @ 6 Amps

Frequency	Peak	QP	QP Lmt	QP Margin	Angle	Hgt	Pol	Total Correction Factor
MHz	dBuV/m	dBuV/m	dBuV/m	dB	deg	cm		
201.211867	20.04	16.44	30.00	-13.56	188	397	Horz	-10.67

4.1.7 Photos

Figure 3 – Radiated Emissions Test Setup – Front

Figure 4 – Radiated Emissions 30 - 1000 MHz Test Setup – Back

Appendix A

5 Test Plan

This test report is intended to follow this test plan outlined here in unless other wise stated in this here report. The following test plan will give details on product information, standards to be used, test set ups and refer to TUV test procedures. The test procedures will give the steps to be taken when performing the stated test. The product information below came via client, product manual, product itself and or the internet.

5.1 General Information

Client	Linear Technology Corporation.
Address	1630 McCarthy Blvd.
Address	Milpitas, CA 95035
Contact Person	Eddie Beville
Telephone	(408) 432-1900 Extension 3007
Fax	(408) 434-0507
e-mail	ebeville@linear.com

5.2 Model(s) Name

LTM4606

5.3 Type of Product

DC DC Converter

5.4 Equipment Under Test (EUT) Description

The LTM4606 is an ultra low noise, high voltage, 6 A switching mode DC/DC power supply. The onboard input filter and noise cancellation circuits achieve low noise operation, thus effectively reducing the electromagnetic interference (EMI).

5.5 Modifications

None

5.6 Product Environment

☒	**Residential**	☐	**Hospital**
☒	**Light Industrial**	☐	**Small Clinic**
☒	**Industrial**	☐	**Doctor's office**
☐	**Other**		

*Check all that apply

5.7 Countries

☐	**USA**
☐	**Taiwan**
☐	**Japan**
☒	**Europe**

*Check all that apply

5.8 Applicable Documents

Standards	Description
EN 55022:2006+A1:2007	Radiated Emissions

5.9 EUT Electrical Powered Information

5.9.1 Electrical Power Type

☐	**AC**	☒	**DC**	☐	**Batteries**	☐	**Host -**

5.9.2 Electrical Power Information

Name	**Type**	**Voltage**		**Frequency**	**Current**	**Notes**
		min	**max**			
DC Input	DC	4.5	28.0	800 kHz	Load Dependent	
DC Output	DC	0.6	5	800 kHz	6 A Max	
Notes	None					

5.9.3 EUT Modes of Operation

One.

5.10 EUT Clock/Oscillator Frequencies

☒	**Less than 108 MHz**	**FCC – scan up to 1 GHz**
☐	**Less than 500 MHz**	**FCC – scan up to 2 GHz**
☐	**Less than 1000 MHz**	**FCC – scan up to 5 GHz**
☐	**Greater then 1000 MHz**	**FCC – scan up to 5th Harmonic or 40 GHz**

5.11 Electrical Support Equipment

Type	Manufacture	Model	Connected To
Power Supply	Lambda	LP532-FM	EUT input
Load Resistors	N/A	N/A	EUT Output

5.12 EUT Equipment/Cabling Information

EUT Port	Connected To	Location	Cable Type		
			Length	Shielded	Bead
VIN	Power Supply	Inside Chamber	1 meter	No	No
VOUT	Resistive Load	Inside Chamber	0.2 meters	No	No

5.13 EUT Test Program

None

5.14 Monitoring of EUT during Testing

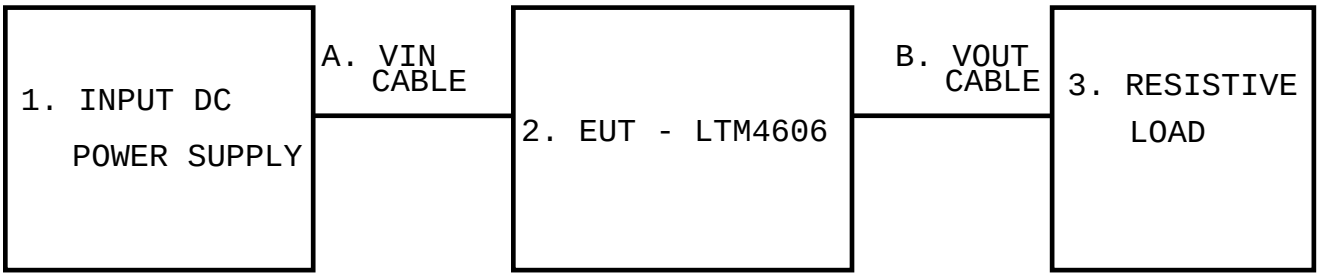
For Emissions testing the EUT output voltage is checked during the test.

5.15 EUT Configuration

5.15.1 Description

Configuration	Description
One	Installed on 24 Vdc Out demo circuit board.
Notes	All configurations tested with a resistive load.

5.15.2 Block Diagram



5.16 Emissions

5.16.1 Radiated Emissions

5.16.1.1 Final Radiated Emissions Test Set-up

Standard	EN 55022:2006 +A1:2007			**TUV Test Procedure**	QP093006
Limit	Class B	**Emissions Verification**			Emissions Under Limit
Frequency Range	30 – 1000 MHz	**Ant Dist**	10m	**Det**	QP 30 – 1000 MHz,
Scan #1	Configuration 1 (30 – 1000 MHz)				
Configuration	See Section 5.16				

END OF REPORT