

Electromagnetic Compatibility Test Report

Prepared in accordance with

FCC Part 15C, RSS-210 Issue 8 and ANSI C63.10

On

FAMILY of HANDHELD INFRARED IMAGING CAMERA

Models:

Ti100, Ti105, Ti110, Ti125, TiR105, TiR110, TiR125

Model Ti25 was the model submitted for testing. See section 3 of this report

Fluke Electronics Corp.

6920 Seaway Blvd. Everett, WA 98203, USA

PO Box 9090 Everett, WA 98206, USA

Prepared by:

TUV Rheinland of North America, Inc.

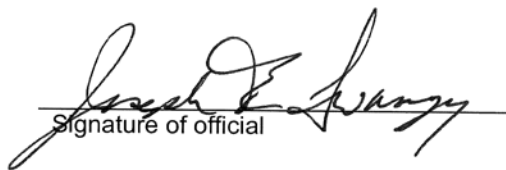
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Manufacturer's statement - attestation

The manufacturer; Fluke Corporation, as the responsible party for the equipment tested, hereby affirms:

- a) That he has reviewed and concurs that the test shown in this report are reflective of the operational characteristics of the device for which certification is sought;
- b) That the device in this test report will be representative of production units;
- c) That all changes (in hardware and software/firmware) to the subject device will be reviewed.
- d) That any changes impacting the attributes, functionality or operational characteristics documented in this report will be communicated to the body responsible for approving (certifying) the subject equipment.

Joseph Swanzy
Printed name of official


Signature of official

6920 Seaway Blvd.
Everett, WA 98203
Address

30 September 2011
Date





425-446-5626
Telephone number

swanzy@fluke.com
Email address of official

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Report No.:
31053468.001

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Client:	Fluke Electronics Corp. 6920 Seaway Blvd. Everett, WA 98203, USA PO Box 9090 Everett, WA 98206, USA	Joe Swanzy 425-347-6100 joe.swanzy@fluke.com
Identification:	HANDHELD INFRARED IMAGING CAMERA	Serial No.: RmIS-11019015
Test item:	FLUKE Ti125	Date tested: 21 October 2011
Testing location:	TUV Rheinland of North America 762 Park Avenue Youngsville, NC 27596-9470 U.S.A.	Tel: (919) 554-3668 Fax: (919) 554-3542
Test specification:	Emissions: FCC Part 15, Subpart C, RSS-210 Issue 8: FCC Parts 15.207(a) and RSS-GEN 7.2.4, FCC Part 15.31(e) FCC Parts 15.249(d), 15.209, 15.215(c) and RSS-210 A2.9, RSS-GEN 7.2.1 FCC Part 15.249 and RSS-210 Annex 2.9, FCC Parts 15.249(a), 15.249(c), RSS-210 A2.9(a), FCC Part 15.109(a) and RSS-210 2.2 and 2.3, FCC Part 15.107(a) and RSS-210 2.2 and 2.3 FCC Part 2.1093 and RSS-102, Issue 4,	
Test Result	The above product was found to be Compliant to the above test standard(s)	
tested by: Mark Ryan	reviewed by: Robert Richards	
 29 September 2011 Signature	 18 July 2013 Signature	
Other Aspects:	None	
Abbreviations:	OK, Pass, Compliant, Complies = passed Fail, Not Compliant, Does Not Comply = failed N/A = not applicable	
 90552 and 100881	 NVLAP Lab Code (200094-0)	Industry Canada IC-2932H

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1 General Information

1.1 Scope

This report is intended to document the status of conformance with the requirements of the FCC Part 15C, RSS-210 Issue 8 and ANSI C63.10 based on the results of testing performed on 21 October 2011 on the HANDHELD INFRARED IMAGING CAMERA, Model No. FLUKE Ti125, manufactured by Fluke Electronics Corp. 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 Revision History

Revision	Date	Description of Revision
--	21 Oct 2012	Initial Release
A&B	2 Nov 2011	Updated descriptions only
C	31 May 2013	Add Revision History section, and expand family description

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1.4 Summary of Test Results

Applicant	Fluke Electronics Corp. 6920 Seaway Blvd. Everett, WA 98203, USA PO Box 9090 Everett, WA 98206, USA	Tel	425-347-6100	Contact	Joe Swanzy
		Fax	425-446-6490	e-mail	joe.swanzy@fluke.com
Description	HANDHELD INFRARED IMAGING CAMERA	FLUKE Ti125	FLUKE Ti125		
Serial Number	RmIS-11019015	Test Voltage/Freq.	7.4 VDC Re-chargeable battery		
Test Date Completed:	21 October 2011	Test Engineer	Mark Ryan		
Standards	Description	Severity Level or Limit	Worst-case Values	Test Result	
FCC Part 15, Subpart C Standard	Radio Frequency Devices- Subpart C: Intentional Radiators	See called out parts below	See Below	Complies	
RSS-210 Issue 8 Standard	Low-Power Licence-exempt Radiocommunication Devices Category I Equipment	See called out parts below	See Below	Complies	
FCC Part 15.249 and RSS-210 Annex 2.9	Operation within the band 2400 to 2483.5 MHz	See called out parts below	See Below	Complies	
FCC Parts 15.249(a), 15.249(c), RSS-210 A2.9(a)	Radiated Output Power for Fundamental and Harmonic Frequencies	Fund: Shall not exceed 50mV/m at 3m Harmonics: Shall not exceed 500µV/m (0.5 mV/m) at 3m, (unrestricted bands)	33.67 mV/m 166 µV/m -	Complies	
FCC Parts 15.249(d), 15.209, 15.215(c) and RSS-210 A2.9, RSS-GEN 7.2.1	Out-of-Band Spurious Emissions (EUT in Transmit Mode)	Below the applicable limits	44.45 dBµV	Complies	
FCC Parts 15.207(a) and RSS-GEN 7.2.4	Conducted Emissions on AC Mains	150kHz - 30MHz	29.92 dBµV	Complies	
FCC Part 15.31(e)	Frequency Stability	Output at 0.85% and 1.15% of Nominal Voltage	400Hz Δ	Complies	
RSS-210 A1.1.3	Occupied Bandwidth	99% BW ≤ 0.5% of center freq.	2.64 MHz	Complies	
FCC Part 15.109(a) and RSS-210 2.2 and 2.3	Receive Mode - Radiated Emissions	Below limit of the restricted bands listed in RSS-GEN section 6	45.89 dBµV	Complies	
FCC Part 15.107(a) and RSS-210 2.2 and 2.3	Receive Mode - Conducted Emissions on AC Mains	Below limit of the restricted bands listed in RSS-GEN section 6	49.63 dBµV	Complies	
FCC Part 2.1093 and RSS-102, Issue 4	RF Exposure	SAR or MPE Requirements	3.16 mW	Complies	

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2 Laboratory Information

2.1 *Accreditations and Endorsements*

2.1.1 US Federal Communications Commission

TUV Rheinland of North America located at 762 Park Avenue, Youngsville, NC 27596-9470 is accredited by the commission for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No 90552 and 100881). The laboratory scope of accreditation includes: Title 47 CFR Part 15, and 18. The accreditation is updated every 3 years.

2.1.2 NIST / NVLAP

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: 200094-0). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Industry Canada

Registration No.: IC-2932H The OATS has been accepted by Industry Canada to perform testing to 3 and to 10m, based on the test procedures described in ANSI C63.10-2009.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland at the 762 Park Ave. Youngsville, N.C 27596 address has been assessed and approved in accordance with the Regulations for Voluntary Control Measures. (Registration No. R-1174, R-1679, C-1790 and C-1791).

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2.1.5 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:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{RAW} - \text{AMP} + \text{CBL} + \text{ACF}$$

Where: RAW = Measured level before correction (dB μ V)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

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

Sample radiated emissions calculation @ 30 MHz

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

$$25 \text{ dB}\mu\text{V/m} + 17.5 \text{ dB} - 20 \text{ dB} + 1.0 \text{ dB} = 23.5 \text{ dB}\mu\text{V/m}$$

2.2 Measurement Uncertainty Emissions

	U_{lab}	U_{cispr}
Radiated Disturbance @ 10m		
30 MHz – 1,000 MHz	3.3 dB	5.2 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.18 dB	3.6 dB
Disturbance Power		
30 MHz – 300 MHz	3.88 dB	4.5 dB

2.3 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.

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2.4 Measurement Equipment Used

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
Radiated Emissions (5 Meter Chamber and Bench top)					
Amplifier, preamp	Agilent Technologies	8449B	3008A01480	01-Feb-11	01-Feb-12
Antenna Horn 1-18GHz	EMCO	3115	2236	13-Dec-10	13-Dec-12
Antenna Horn 1-18GHz	EMCO	3115	5770	18-Aug-10	18-Aug-12
Ant. BiconiLog	Chase	CBL6140A	1108	24-Aug-11	24-Aug-12
Receiver, EMI	Rohde & Schwarz	ESIB40	100043	01-Aug-11	01-Aug-12
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	06-Dec-10	06-Dec-11
Cable, Coax	MicroCaox	MKR300C-0-0-1200-500500	002	16-Dec-10	16-Dec-11
Cable, Coax	Andrew	FSJ1-50A	003	16-Dec-10	16-Dec-11
Cable, Coax	Andrew	FSJ1-50A	030	16-Dec-10	16-Dec-11
Cable, Coax	Andrew	FSJ1-50A	045	16-Dec-10	16-Dec-11
High Pass Filter	Micro-tronics	BRM50702	049	20-Jan-11	20-Jan-12
Conducted Emissions (AC/DC and Signal I/O)					
LISN 15-18 (NSLK 8126)	Schwarzbeck Mess-Electronik	NSLK 8126	003885	21-Jan-11	21-Jan-12
Transient Limiter	Schaffner	CFL-9206	1649	01-Aug-11	01-Aug-12
Receiver, EMI	Rohde & Schwarz	ESH 3	860905/005	15-Dec-10	15-Dec-11
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	06-Dec-10	06-Dec-11
Cable, Coax	Pasternack	RG-223	051	16-Dec-10	16-Dec-11
General Laboratory Equipment					
Generator, Noise	York University	CNE III	Ser/98/66	CNR II	CNR II
Meter, Multi	Fluke	179	90580752	06-Dec-10	06-Dec-11
Power Supply, AC	California Instruments	3001ix	53354	07-Dec-10	07-Dec-11
Meter, Temp/Humid/Barom	Davis Instruments	7400	PB00205A13	1-Jan-11	1-Jan-12

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3 Product Information

3.1 Product Description

The Fluke Ti125 family models, Ti100, Ti105, Ti110, Ti125, TiR105, TiR110, and TiR125, are identical electrically (the Ti100 is an exception) but have minor mechanical differences. As an example, the Ti100 model has fixed focus no camera (the electrical exception); Ti105 and TiR105 have a camera with fixed focus; and the Ti110, Ti125, TiR110, and TiR125 have camera with a manual focus system. These mechanical focus differences are not associated with any electrical circuitry or shielding. The CC2530F256 radio transceiver circuitry is identical across all models.

Model Comparison:

Model	Main PCB, including radio components	Software	Visible Camera/Torch	Lens Focus Type	Temperature Range
Ti100	Nearly Identical - shared parts, layout, shielding	Model-specific. Radio software is identical	No	Fixed	-20°C to +250°C
Ti105	Identical - shared parts, layout, shielding	Model-specific. Radio software is identical	Yes	Fixed	-20°C to +250°C
TiR105	Identical - shared parts, layout, shielding	Model-specific. Radio software is identical	Yes	Fixed	-20°C to +150°C
Ti110	Identical - shared parts, layout, shielding	Model-specific. Radio software is identical	Yes	Manual	-20°C to +250°C
Ti125	Identical - shared parts, layout, shielding	Model-specific. Radio software is identical	Yes	Manual	-20°C to +350°C
TiR110	Identical - shared parts, layout, shielding	Model-specific. Radio software is identical	Yes	Manual	-20°C to +150°C
TiR125	Identical - shared parts, layout, shielding	Model-specific. Radio software is identical	Yes	Manual	-20°C to +150°C

The Fluke Ti110, Ti125, TiR110, and TiR125 use the IR-OptiFlex(tm) focus system. IR-OptiFlex keeps the Imager in focus at distances more than two feet. It also allows the flexibility of one-touch manual focus to fine tune the image in close-up situations. The Fluke Ti100 uses a focus-free system with a large depth of field that keeps the image in good focus at distances more than two feet. The model Ti125 was selected as the representative test sample for this test report.

3.2 Equipment Modifications

No modifications were needed to bring product into compliance.

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4 Radiated Emissions in Transmit mode

4.1 Radiated emissions - FCC Parts 15.249, RSS-210 A2.9(a)

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following limits:

Fundamental Frequency: 2400 to 2483.5 MHz – 50 mV/m (94 dB μ V/m) at 3m.

Harmonic Frequencies – 500 μ V/m (54 dB μ V/m) at 3m.

4.1.1 Over View of Test

Results	Complies (as tested per this report)			Date	19-26 September 2011		
Standard	FCC Parts 15.205, 15.209, 15.215(c), 15.249(a), 15.249(c), 15.249(d) RSS-210 A2.9, and RSS-GEN 7.2.1						
Product Model	FLUKE Ti125		Serial#	RmIS-11019015			
Test Set-up	Tested in a 5m Semi Anechoic chamber, placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane on a turn-table.						
EUT Powered By	7.4 VDC Re-chargeable battery	Temp	76 °F	Humidity	36%	Pressure	1007 mbar
Perf. Criteria	(Below Limit)		Perf. Verification		Readings Under Limit		
Mod. to EUT	None		Test Performed By		Mark Ryan		

4.1.2 Test Procedure

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.10:2009, RSS-GEN Issue 2. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

4.1.3 Deviations

Since all emissions outside the band are within the limits of FCC Part 15.209 and RSS-GEN 7.2.1, the emissions shown below are also compliant with FCC Parts 15.205, 15.209, 15.215(c), 15.249(d), RSS-210 A8.5, and RSS-GEN 7.2.1.

4.1.4 Final Test

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

The worst –case emissions are shown below. All other emissions are on file at TUV Rheinland.

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4.1.4.1 Worst Case Emissions inside the Frequency Band

Radiated Emissions of Fundamental Highest Emission Investigation										
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
2440.00	H	1	30	45.72	0.00	5.77	28.69	80.18	94.00	-13.82
2440.00	V	1	170	49.80	0.00	5.77	28.69	84.26	94.00	-9.74
2440.00	H	2.3	166	47.82	0.00	5.77	28.69	82.28	94.00	-11.72
2440.00	V	1	129	45.25	0.00	5.77	28.69	79.71	94.00	-14.29
2440.00	V	1.3	250	48.18	0.00	5.77	28.69	82.64	94.00	-11.38
2440.00	H	1.3	233	0.00	0.00	5.77	28.69	74.46	94.00	-19.54

Notes: The Average detector was used for the values shown above.

The EUT was set to transmit in un-modulated (CW) mode.

The Resolution and Video Bandwidth of the spectrum analyzer was set to 3 MHz.

Channels 0, 7 and 15 were investigated in three orientations, the list above shows the highest emissions from each orientation.

The emissions shown in **RED** are Orientation 1.

The emissions shown in **GREEN** are Orientation 2.

The emissions shown in **BLUE** are Orientation 3.

(Refer to Test Setup Photos.)

The **highlighted** emission produced the highest average emission output at 84.26 dB μ V/m at 3m.

84.26 dB μ V/m = 16.330 mV/m which is 33.67 mV/m below the 50 mV/m limit (at 3m).

The corrected Peak value was 90.05 dB μ V/m is less than of the Average limit + 20 dB (114.0 dB μ V/m).

4.1.4.2 High Midium and Low channel Emissions inside the Frequency Band
Radiated Emissions – Orientation 1

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
2405.00	H	1	216	55.01	0.00	5.71	28.57	89.29	114.00	
2405.00	V	1	216	48.71	0.00	5.71	28.57	82.99	94.00	
2405.00	H	1	300	52.96	0.00	5.71	28.57	87.24	114.00	
2405.00	H	1	300	46.55	0.00	5.71	28.57	80.83	94.00	
2440.00	V	1	170	55.59	0.00	5.77	28.69	90.05	114.00	
2440.00	V	1	170	49.80	0.00	5.77	28.69	84.26	94.00	
2440.00	H	1	30	51.50	0.00	5.77	28.69	85.96	114.00	
2440.00	H	1	30	45.72	0.00	5.77	28.69	80.18	94.00	
2485.00	V	1	172	53.08	0.00	5.84	28.84	87.76	114.00	
2485.00	V	1	172	46.10	0.00	5.84	28.84	80.78	94.00	
2485.00	H	1	293	50.46	0.00	5.84	28.84	85.14	114.00	
2485.00	H	1	293	43.85	0.00	5.84	28.84	78.53	94.00	

Notes: EUT is standing up
 Emissions shown in **Green** are Peak Emissions.
 Emissions shown in **Red** are Average Emissions.

ORIENTATION 1 PRODUCES THE HIGHEST EMISSIONS OUTPUT

4.1.4.3 Highest calculated EIRP Output power using the conducted method:

Frequency (GHz)	Channel Number	Conducted Power (dBm)	Max Antenna Gain (dBi)	Calculated isotropic power out (dBm)	Equivalent power (mW)
2.405	0	2.00	3	5.00	3.16
2.440	7	1.49	3	4.49	2.81
2.480	15	1.10	3	4.10	2.57

Note: the **highlighted** measurement is the Worst-Case measurement.

Note: highest Power was 2.0 dBm (Channel 0, measured directly from an apparatus that has been modified with an SMA connector) see page 43 of this report. The highest published gain of the Antenna used is +3 dBi. Therefore, the maximum radiated isotropic power output of the transmitter is 2.0 dBm + 3 dBi = 5 dBm which is equivalent to $10^{(5/10)} = \underline{\underline{3.16 \text{ mW}}}$.

The test data and plots for the other channels are on file at TUV Rheinland.

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4.2 Band Edge requirements - FCC Part 15.249(d), RSS-210 2.2

4.2.1 Test Over View

Results	Complies (as tested per this report)				Date	20 September 2011	
Standard	FCC Part 15.249(d), RSS 210 2.2						
Product Model	FLUKE Ti125			Serial#	RmIS-11019015		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	7.4 VDC Re-chargeable battery	Temp	76° F	Humidity	45%	Pressure	999 mbar
Perf. Criteria	(Below Limit)		Perf. Verification		Readings Under Limit		
Mod. to EUT	None		Test Performed By		Mark Ryan		

4.2.2 Test Procedure

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Sec. 15.209, whichever is the lesser attenuation.

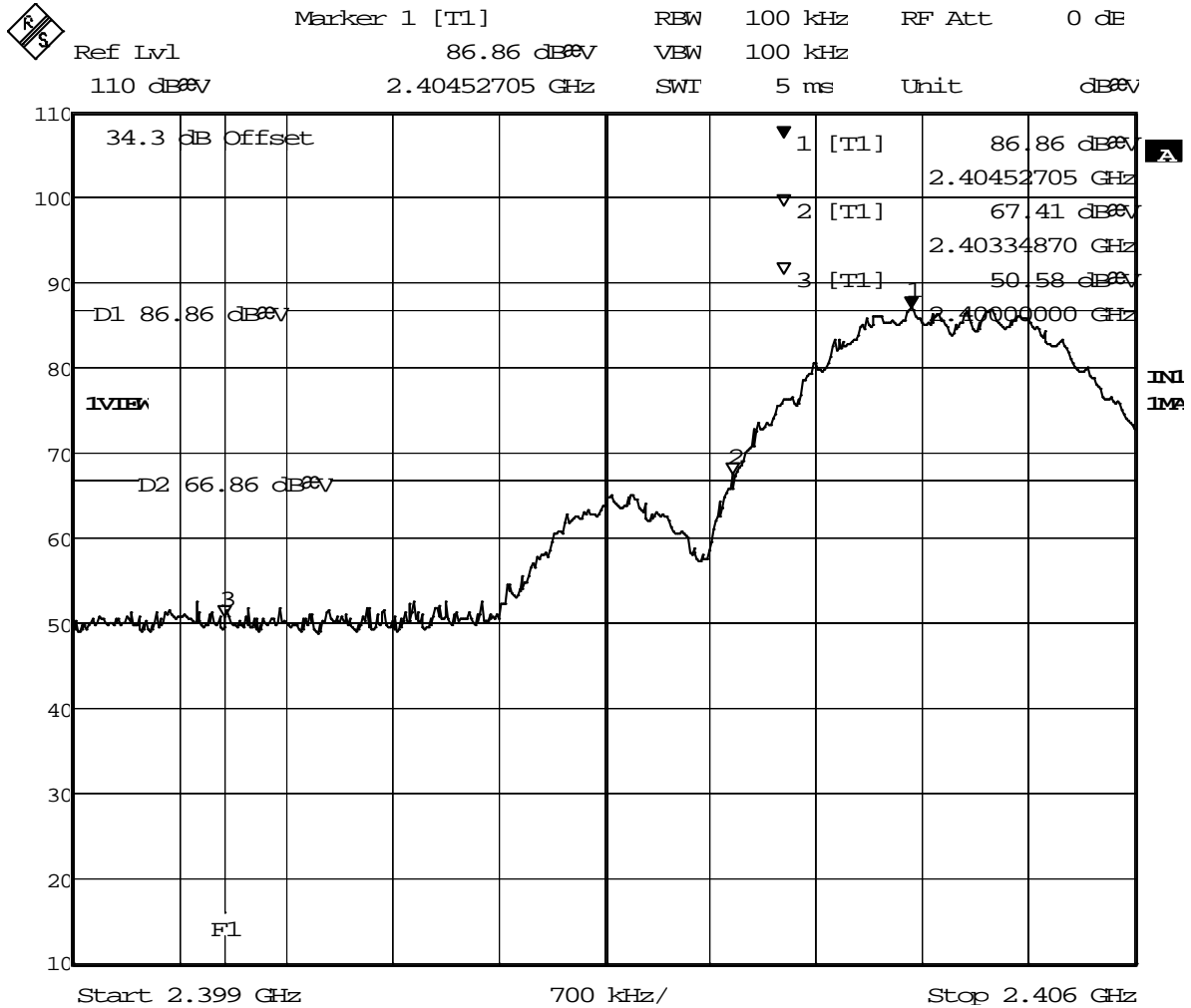
4.2.3 Deviations

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

4.2.4 Final Test

The EUT met the performance criteria requirement as specified in the standards.

The test results contained in this report refer exclusively to the product(s) presented for testing. No liability may be assumed for models or products not referred to herein. This test report may not be published or duplicated in part without permission of the testing body. This test report by itself does not constitute authorization for the use of any TUV Rheinland test mark. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.



Date: 20.SEP.2011 07:57:45

Notes: Measured using the Peak detector. Band Edge is at 2.4 GHz (Marker 3).

At the band edge of 2400.0 MHz: Peak = 50.58 dBμV/m which is 3.42 dB below the 54 dBμV/m Average limit.

The nearest restricted band (2390MHz) is 10 MHz below the band edge

At the lowest channel, the 20dB down point (Marker 2) is at 2403.35 MHz.

The band edge (F1 and Marker 3) is at 2400 MHz

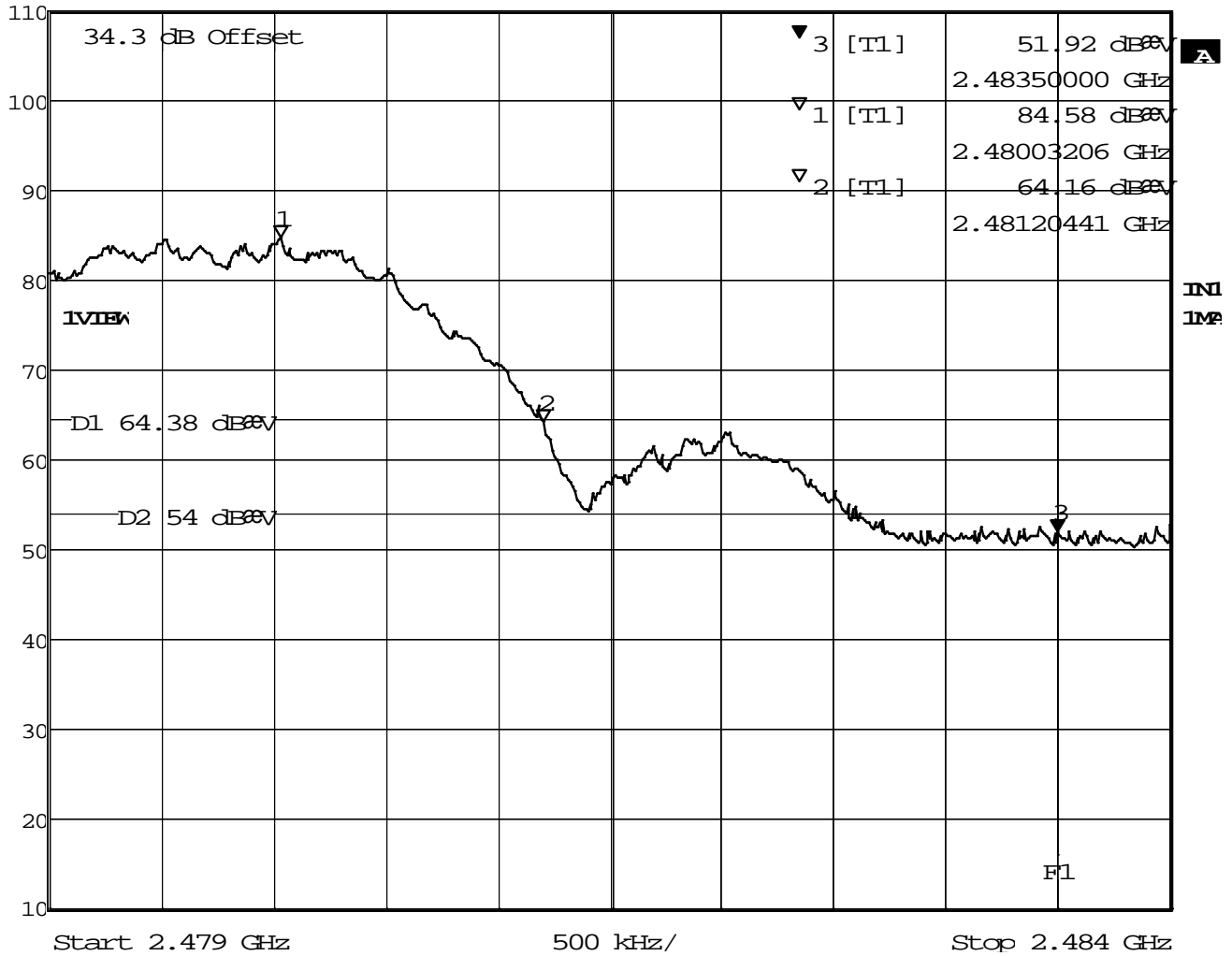
Figure 1: Lower Band Edge Measurement (Radiated Emission)

The EUT is compliant with the rules.

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Marker 3 [T1] REW 100 kHz RF Att 0 dB
 Ref Lvl 51.92 dBµV VBW 100 kHz
 110 dBµV 2.48350000 GHz SWF 5 ms Unit dBµV



Date: 20.SEP.2011 08:09:57

Note: Measured using the Peak detectors.

Band edge (F1) at 2483.5 MHz is also the start of a restricted band, so the rules of 15.205 apply.

The 20dB down point is 2.3 MHz away from the band edge.

At the band edge of 2483.5 MHz: Peak = 51.92 dBµV/m which is 2.08 dB below the 54 dBµV/m Average limit.

Figure 2: Upper Band Edge Measurement (Radiated Emission)

The EUT is compliant with the rules.

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4.1 Conducted Emissions on AC Mains – FCC 207(a) and RSS-GEN 7.2.4

This test measures the electromagnetic levels of spurious signals generated by the EUT on the AC power line that may affect the performance of other near by electronic equipment.

4.1.1 Over View of Test

Results	Complies (as tested per this report)				Date	26-27 September 2011	
Standard	FCC Parts 15.207(a) and RSS-GEN 7.2.4						
Product Model	FLUKE Ti125			Serial#	NA		
Test Set-up	Tested in shielded room. EUT placed on table, see test plans for details						
EUT Powered By	7.4 VDC Re-chargeable battery	Temp	73° F	Humidity	25%	Pressure	1011 mbar
Frequency Range	150 kHz – 30 MHz						
Perf. Criteria	(Below Limit)	Perf. Verification	Readings Under Limit for L1 & Neutral				
Mod. to EUT	None	Test Performed By	Mark Ryan				

4.1.2 Test Procedure

Conducted emissions tests were performed using the procedures of ANSI C64.4: 2009, 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 150kHz - 30MHz was investigated for conducted emissions.

Conducted Emissions measurements were performed in the shielded room using procedures specified in the test plan and standard.

4.1.3 Deviations

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

4.1.4 Final Test

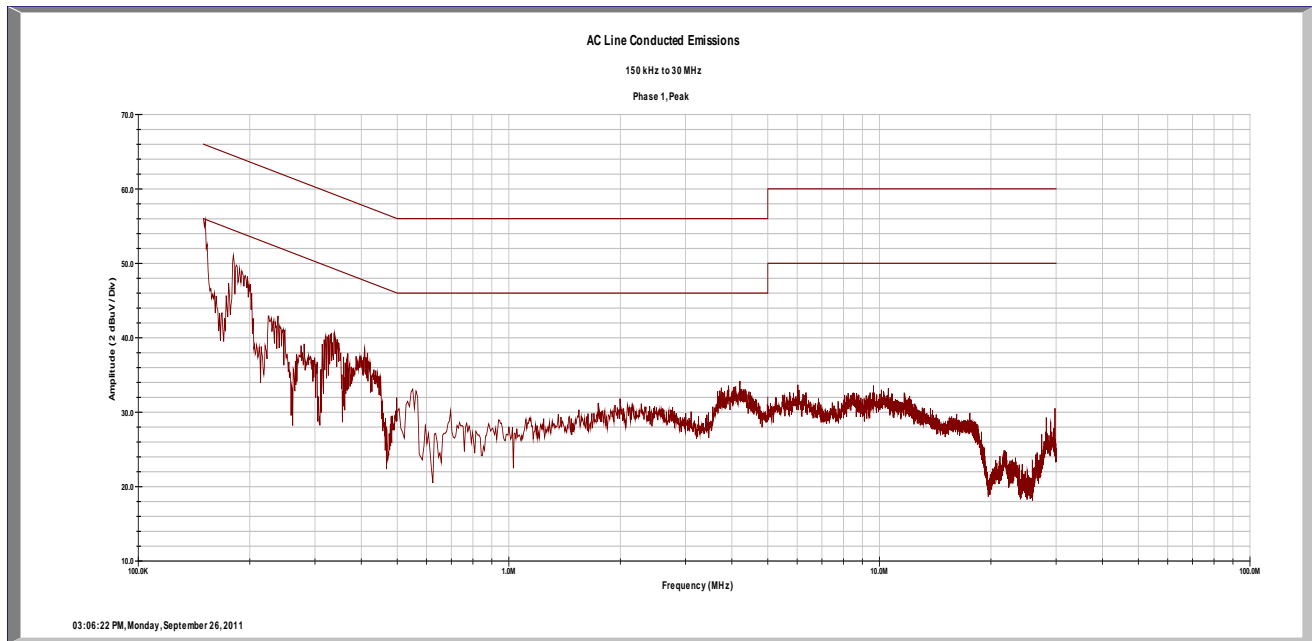
All final conducted emissions measurements were below (in compliance) the limits.

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4.1.5 Final Graphs and Tabulated Data

Conducted Emissions @ 120V/60Hz - Transmit mode on CH 0

Line 1



Freq (MHz)	ID (1,2,3,N)	Quasi FIM (dBuV)	Ave FIM (dBuV)	Cable Loss (dB)	TL/LISN (dB)	Limit QP (dBuV)	Limit AVE (dBuV)	Margin QP (dB)	Margin AVE (dB)
0.15	1	29.40	19.16	0.02	9.88	66.00	56.00	-26.69	-26.93
0.20	1	30.49	13.43	0.03	9.89	63.61	53.61	-23.20	-30.26
0.40	1	26.33	19.98	0.04	9.90	57.85	47.85	-21.58	-17.93
0.59	1	12.55	3.63	0.05	9.90	56.00	46.00	-33.50	-32.42
3.87	1	14.60	9.39	0.13	10.05	56.00	46.00	-31.22	-26.43
29.70	1	14.58	5.68	0.38	10.60	60.00	50.00	-34.45	-33.34

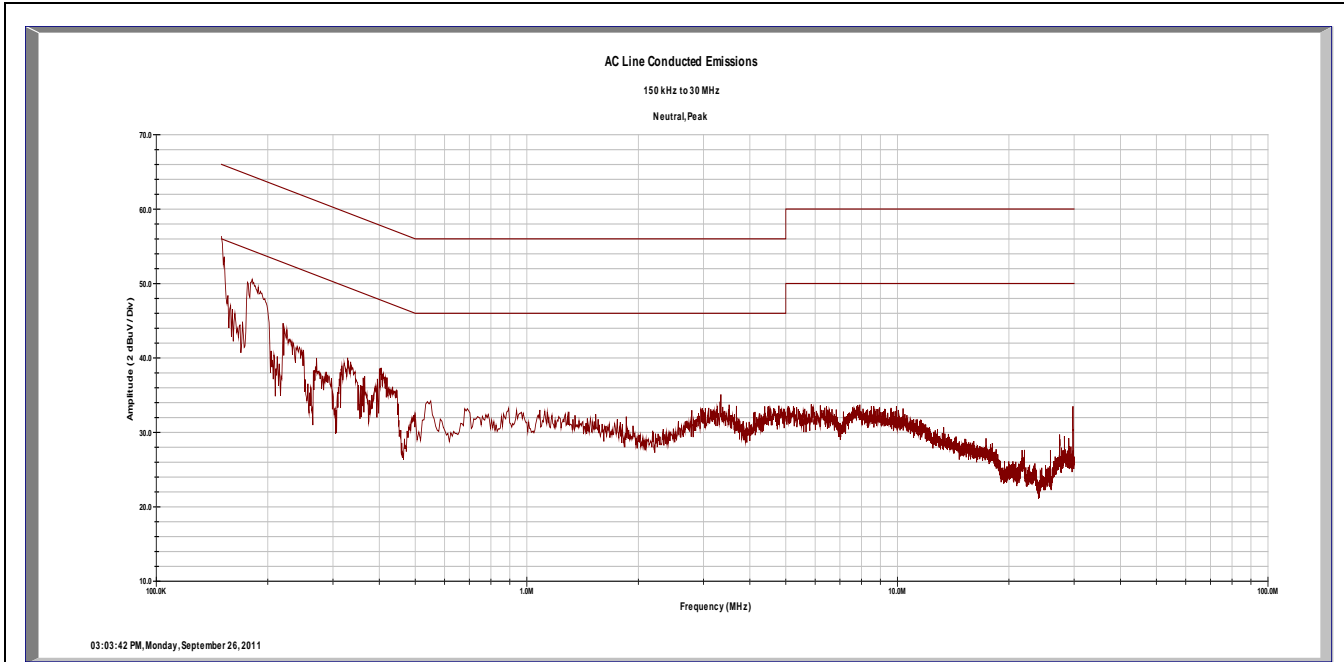
Quasi Spec Margin = Quasi FIM + Cable Loss + TL/LISN - QP Limit
Ave Spec Margin = Ave FIM + Cable Loss + TL/LISN CF - Ave Limit

Notes: Channels 0, 7 and 15 were investigated for conducted emissions on the AC Mains. These Transmit channels showed similar emissions, however Channel 0, shown above, was slightly worse.

The **highlighted** emission is the highest emission.

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Conducted Emissions @ 120V/60Hz - Transmit mode on CH 0
Neutral



Freq (MHz)	ID (1,2,3,N)	Quasi FIM (dBuV)	Ave FIM (dBuV)	Cable Loss (dB)	TL/LISN (dB)	Limit QP (dB)	Limit AVE (dB)	Margin QP (dB)	Margin AVE (dB)
0.15	N	29.33	17.18	0.02	9.87	66.00	56.00	-26.77	-28.92
0.20	N	23.78	17.18	0.03	9.87	63.61	53.61	-29.93	-26.53
0.40	N	19.76	8.63	0.04	9.88	57.85	47.85	-28.17	-29.30
0.57	N	15.53	7.05	0.05	9.89	56.00	46.00	-30.53	-29.01
3.87	N	15.59	8.64	0.13	10.05	56.00	46.00	-30.23	-27.18
29.71	N	15.28	7.60	0.38	10.33	60.00	50.00	-34.01	-31.70

Quasi Spec Margin = Quasi FIM + Cable Loss + TL/LISN - QP Limit
Ave Spec Margin = Ave FIM + Cable Loss + TL/LISN CF - Ave Limit

Notes: Channels 0, 7 and 15 were investigated for conducted emissions on the AC Mains. These Transmit channels showed similar emissions, however Channel 0, shown above, was slightly worse.

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4.2 99% Power Bandwidth – RSS-210 A1.1.3

For the purpose of Section A1.1, the 99% bandwidth shall be no wider than .25% of the center frequency for devices operating between 70-900MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

4.2.1 Test Overview

Results	Complies (as tested per this report)				Date	21 October 2011	
Standard	RSS-210 Section A1.1.3						
Product Model	FLUKE Ti125			Serial#	RmIS-11019015		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	7.4 VDC Re-chargeable battery	Temp	74° F	Humidity	38%	Pressure	1002 mbar
Perf. Criteria	(Below Limit)		Perf. Verification		Readings Under Limit		
Mod. to EUT	None		Test Performed By		Mark Ryan		

4.2.2 Test Procedure

Using the procedures of RSS-GEN section 4.6.1, the 1 kHz resolution bandwidth is 1% of the 1 MHz span. The Video bandwidth is 3 times that of the resolution bandwidth using the sample detector.

Per Annex A1.1.3 of RSS-210: The limit of the bandwidth would be 0.5% of 2.4 GHz or 12 MHz.

4.2.3 Deviations

There were no deviations from the test methodology listed in the test.

4.2.4 Final Results

The measured 99% bandwidth is 2.65 MHz, which is well below the 12 MHz limit.

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

The test results contained in this report refer exclusively to the product(s) presented for testing. No liability may be assumed for models or products not referred to herein. This test report may not be published or duplicated in part without permission of the testing body. This test report by itself does not constitute authorization for the use of any TUV Rheinland test mark. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

4.2.5 Final Data

Frequency (GHz)	Channel	99% Power Bandwidth (MHz)
2.405	0	2.63
2.440	7	2.65
2.480	15	2.63

Note: the highlighted measurement is the Worst-Case measurement.

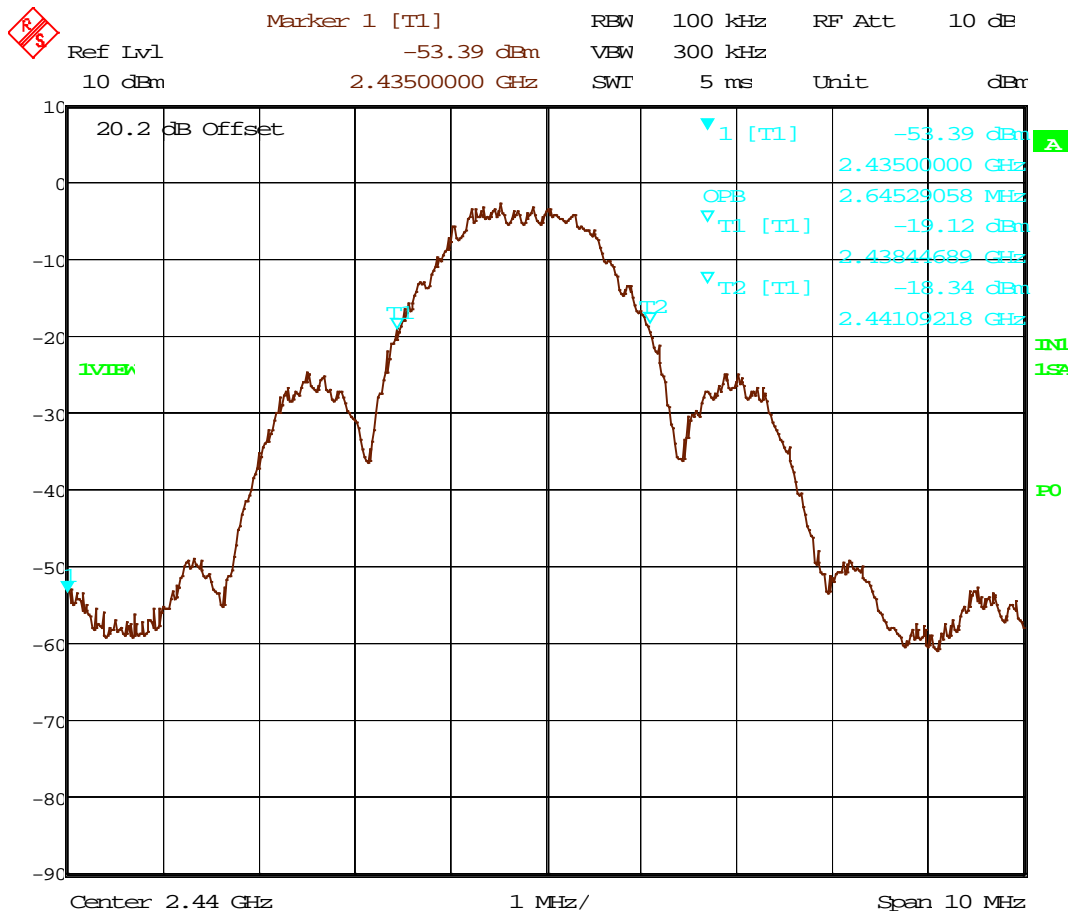


Figure 3 – 99% Power Bandwidth = 2.65 MHz

Note: A modified test sample with an SMA connector was provided to make this direct RF measurement. The Worst case plot shown, other channel plots are on file at TUV Rheinland.

The EUT is compliant to the requirements of RSS-210 A1.1.3

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4.3 Extreme Voltage Requirements - FCC Part 15.31(e)

FCC Part 15.31 states that for intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

4.3.1 Over View of Test

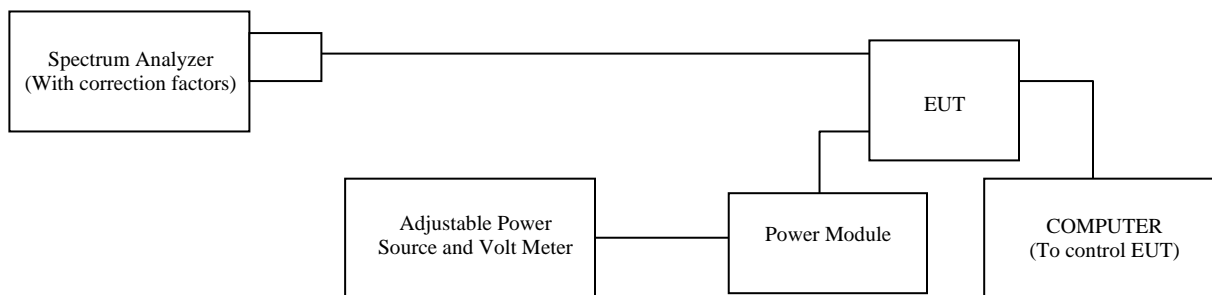
Results	Complies (as tested per this report)				Date	29 September 2011	
Standard	FCC Part 15.31(e)						
Product Model	FLUKE Ti125			Serial#	RmIS-11019015		
Test Set-up	Tested in shielded room. EUT placed on table, see test plans for details						
EUT Powered By	7.4 VDC Re-chargeable battery	Temp	76° F	Humidity	40%	Pressure	993 mbar
Mod. to EUT	None		Test Performed By		Mark Ryan		

4.3.2 Test Procedure

Since this module could be used in many different applications, including battery operation, the manufacturer selected that worst-case testing suite to be performed. The power source test was performed using the $\pm 15\%$ of rated voltage

Nominal Rated voltage: 120 VAC, the test will be performed at $\pm 15\%$ of rated voltage.

Test Setup:



Note: A modified test sample with an SMA connector was provided to make this direct RF measurement.

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4.3.3 Final Test

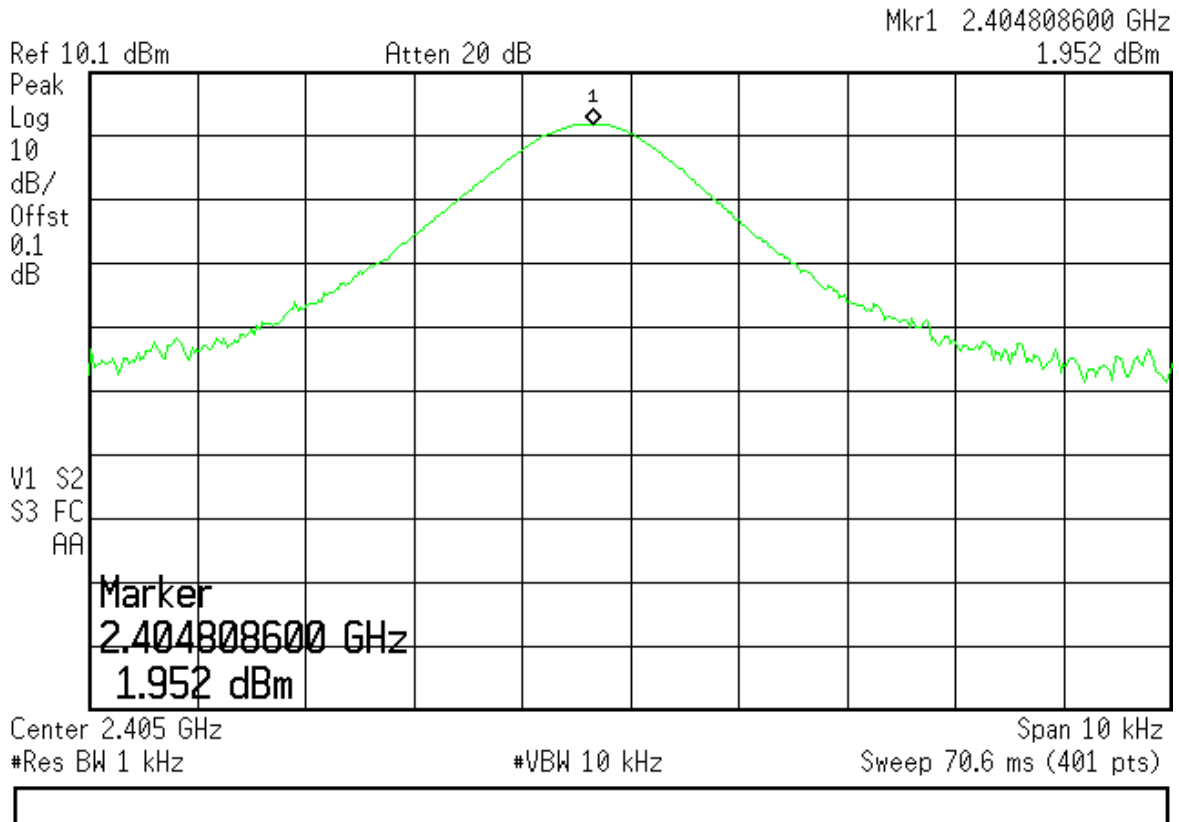
Reference at nominal temperature; +23° C

Volts	P(dBm)	Frequency in Hz	Δ to nominal Power (dB)	Δ to nominal Frequency (Hz)
120	2.000	2,404,808,825	0.00	0.00
102	2.001	2,404,809,225	0.001	400
138	1.952	2,404,808,600	-0.048	-225

Note: the highlighted measurement is the reference frequency and power

Nominal Rated Voltage (V_{Nom}): 120.0 Volts
 Nominal + 15%; Max Voltage (V_{max}): 138.0 Volts
 Nominal -15%; Minimum Voltage (V_{min}): 102.0 Volts

* Agilent 12:35:07 Sep 29, 2011



Worst Case power shift: 138 VAC from 2.00 dBm to 1.952 dBm.

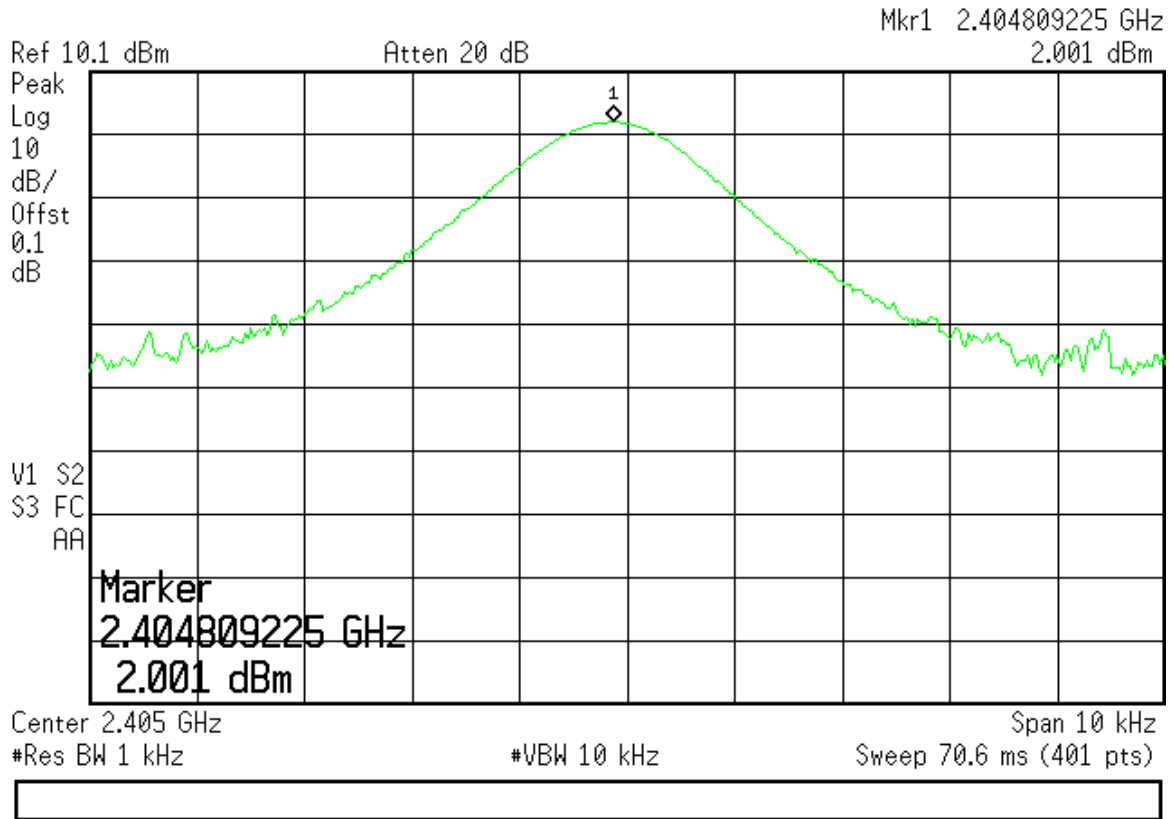
The test results contained in this report refer exclusively to the product(s) presented for testing. No liability may be assumed for models or products not referred to herein. This test report may not be published or duplicated in part without permission of the testing body. This test report by itself does not constitute authorization for the use of any TUV Rheinland test mark. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

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Agilent 12:32:58 Sep 29, 2011



Worst Case Frequency shift: 102 VAC from 2,404,808,825 Hz to 2,404,809,225 Hz.

As tested, the EUT was found to be compliant to the requirements of the test standard.

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5 Emissions in Receive Mode.

5.1 Radiated Emissions in Receive mode – FCC 15.109(a) and RSS-210

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.

5.1.1 Over View of Test

Results	Complies (as tested per this report)				Date	22 September 2011	
Standard	FCC Part 15.109(a) and RSS-210 2.2 and 2.3						
Product Model	FLUKE Ti125			Serial#	00500030		
Configuration	See test plan for details						
Test Set-up	Tested in a 5m Semi Anechoic chamber, placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane on a turn-table.						
EUT Powered By	7.4 VDC Re-chargeable battery	Temp	74° F	Humidity	45%	Pressure	999 mbar
Frequency Range	30 MHz to 13 GHz @ 3m						
Perf. Criteria	(Below Limit)		Perf. Verification	Readings Under Limit			
Mod. to EUT	None		Test Performed By	Mark Ryan			

5.1.2 Test Procedure

Radiated emissions tests were performed using the procedures of ANSI C63.4:2009 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 MHz to 13 GHz was investigated for radiated emissions.

Radiated emission testing was performed at a distance of 3 meters in a 5 meter semi-anechoic chamber.

5.1.3 Deviations

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

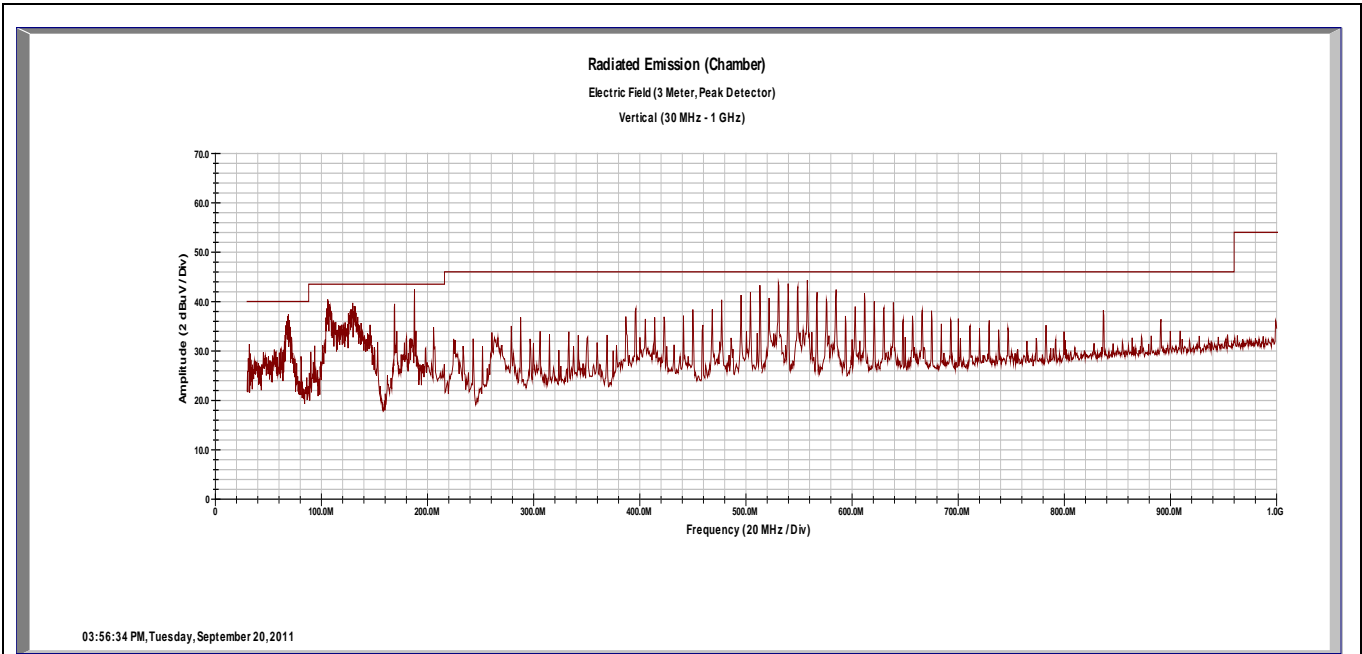
5.1.4 Final Test

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

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Radiated Emissions – Receive mode; Ch 7; 2440 MHz - 1 GHz

Vertical



03:56:34 PM, Tuesday, September 20, 2011

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y) = \pm 1.6\text{dB}$ Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence

Notes: 30MHz to 1GHz, Receive mode, Chanel 7, shown is worst case.

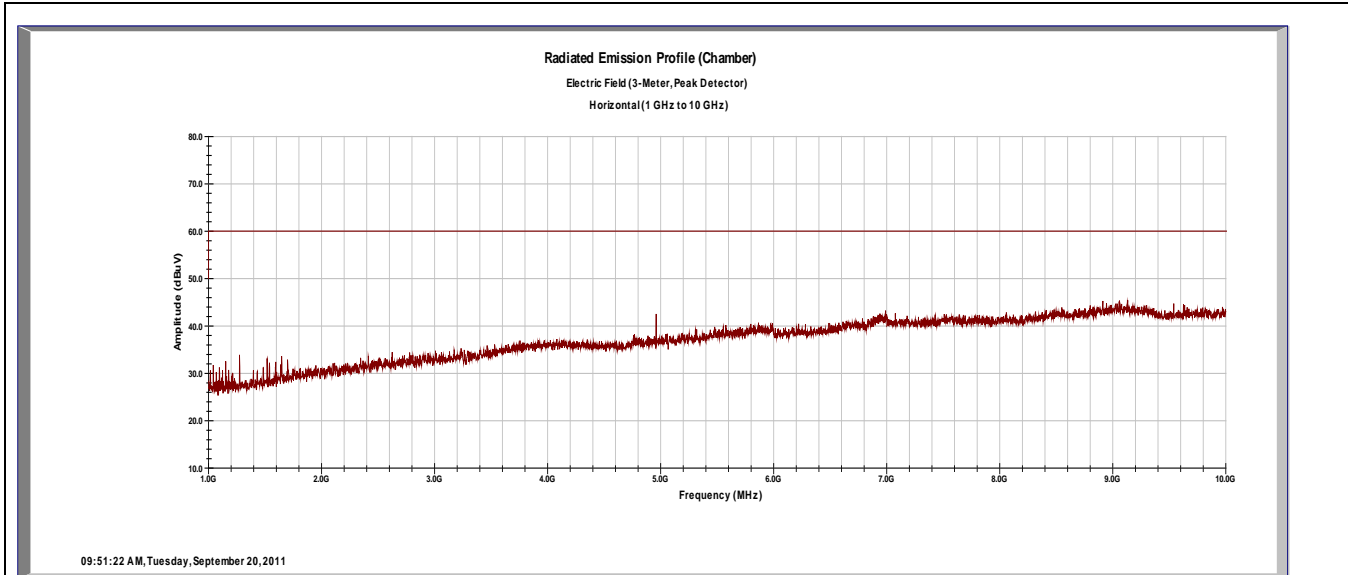
All emissions generated by the receiver is more than 20 dB below the limits.

The rest of the emissions shown in the plot are from the associated Class A digital device,

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Radiated Emissions – Receiver Mode – 1 to 10 GHz, Worst Case

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
Ch. 0:										
4809.60	H	1.3	35	42.03	34.48	11.51	33.08	52.14	74.00	-21.86
4809.60	H	1.3	35	35.78	34.48	11.51	33.08	45.89	54.00	-8.11
Ch. 7:										
4879.60	V	1	209	41.08	34.38	11.68	33.14	51.52	74.00	-22.48
4879.60	V	1	209	34.46	34.38	11.68	33.14	44.90	54.00	-9.10
Ch. 15:										
4959.50	V	1.0	58	42.46	34.31	11.63	33.27	53.05	74.00	-20.95
4959.50	V	1.0	58	33.23	34.31	11.63	33.27	43.82	54.00	-10.18

Notes: Channel 0 was worst case emissions in receiver mode.

The **highlighted** emission is the highest emission.

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5.2 Conducted Emissions in Receive mode – FCC 15.107(a) and RSS-210

This test measures the electromagnet levels of spurious signals generated by the EUT on the AC power line that may affect the performance of other near by electronic equipment.

5.2.1 Over View of Test

Results	Complies (as tested per this report)				Date	26-27 September 2011	
Standard	FCC Parts 15.207(a) and RSS-GEN 7.2.4						
Product Model	FLUKE Ti125			Serial#	RmIS-11019015		
Test Set-up	Tested in shielded room. EUT placed on table, see test plans for details						
EUT Powered By	7.4 VDC Re-chargeable battery	Temp	73° F	Humidity	25%	Pressure	1011 mbar
Frequency Range	150 kHz – 30 MHz						
Perf. Criteria	(Below Limit)	Perf. Verification	Readings Under Limit for L1 & Neutral				
Mod. to EUT	None		Test Performed By	Mark Ryan			

5.2.2 Test Procedure

Conducted emissions tests were performed using the procedures of ANSI C64.4: 2009, 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 150kHz - 30MHz was investigated for conducted emissions.

Conducted Emissions measurements were performed in the shielded room using procedures specified in the test plan and standard.

5.2.3 Deviations

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

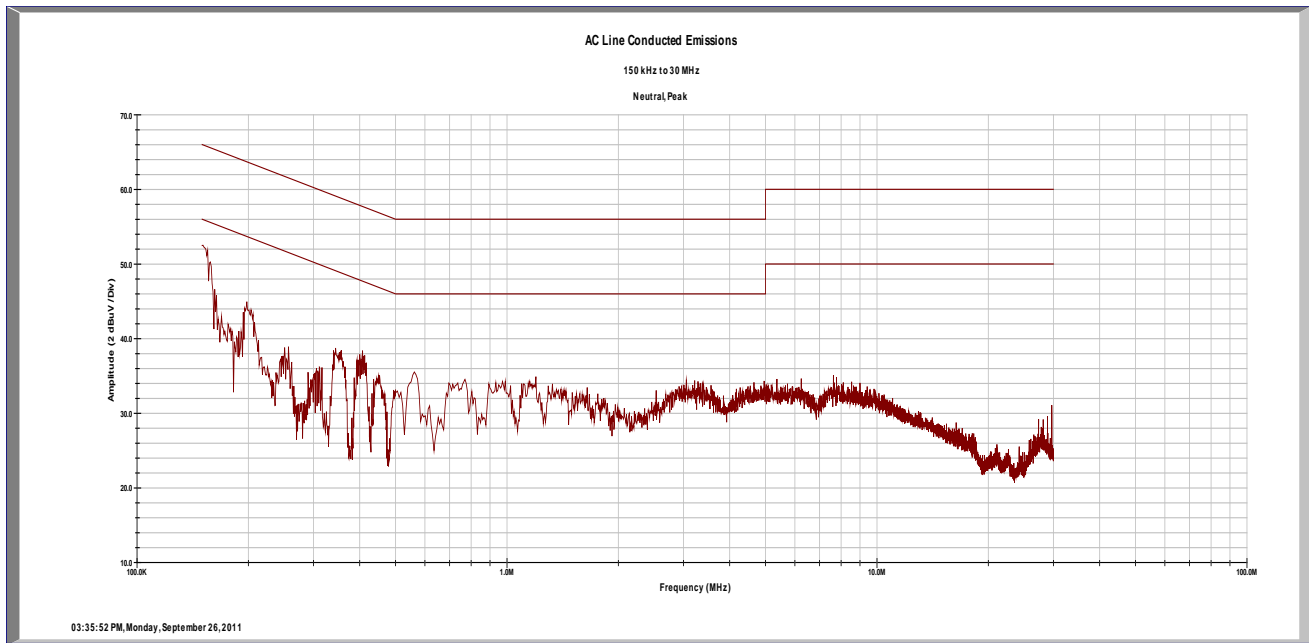
5.2.4 Final Test

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

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5.2.5 Final Graphs and Tabulated Data

Conducted Emissions @ 120V/60Hz – Receive Mode Ch 0
Neutral



Freq (MHz)	ID (1,2,3,N)	Quasi FIM (dBuV)	Ave FIM (dBuV)	Cable Loss (dB)	TL/LISN (dB)	Limit QP (dBuV)	Limit AVE (dBuV)	Margin QP (dB)	Margin AVE (dB)
0.15	N	39.74	26.29	0.02	9.87	66.00	56.00	-16.36	-19.81
0.20	N	30.69	17.10	0.03	9.87	63.61	53.61	-23.02	-26.61
0.40	N	24.12	13.10	0.04	9.88	57.85	47.85	-23.81	-24.83
0.55	N	22.81	15.79	0.04	9.89	56.00	46.00	-23.26	-20.28
3.12	N	19.46	12.47	0.11	10.02	56.00	46.00	-26.41	-23.40
3.88	N	16.71	9.92	0.13	10.05	56.00	46.00	-29.11	-25.90
29.64	N	8.87	2.96	0.38	10.32	60.00	50.00	-40.42	-36.33

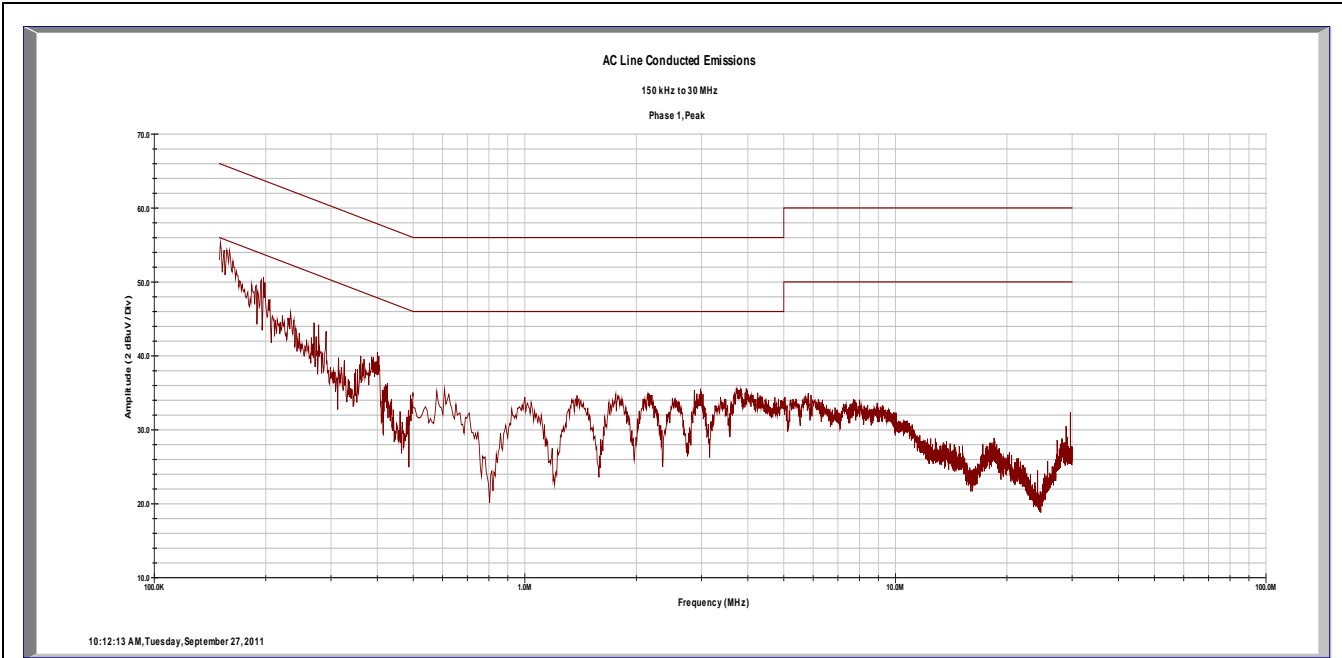
Quasi Spec Margin = Quasi FIM + Cable Loss + TL/LISN - QP Limit
 Ave Spec Margin = Ave FIM + Cable Loss + TL/LISN CF - Ave Limit

Notes: All Receive channels gave similar results.
 The **highlighted** emission is the highest emission.

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Conducted Emissions @ 230V/50Hz – Receive Mode Ch 0

Line 1



Freq (MHz)	ID (1,2,3,N)	Quasi FIM (dBuV)	Ave FIM (dBuV)	Cable Loss (dB)	TL/LISN (dB)	Limit QP (dBuV)	Limit AVE (dBuV)	Margin QP (dB)	Margin AVE (dB)
0.15	1	34.60	23.60	0.02	9.88	66.00	56.00	-21.49	-22.49
0.40	1	23.79	19.02	0.04	9.90	57.94	47.94	-24.21	-18.98
1.22	1	18.73	11.37	0.07	9.92	56.00	46.00	-27.28	-24.64
2.98	1	15.40	13.15	0.11	10.01	56.00	46.00	-30.48	-22.73
3.88	1	18.09	5.83	0.13	10.05	56.00	46.00	-27.73	-29.99
29.67	1	13.84	3.01	0.38	10.60	60.00	50.00	-35.19	-36.02

Quasi Spec Margin = Quasi FIM + Cable Loss + TL/LISN - QP Limit
Ave Spec Margin = Ave FIM + Cable Loss + TL/LISN CF - Ave Limit

Notes: All Receive channels gave similar results.

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6 RF Exposure

6.1 Exposure Requirements – FCC KDB # 447498 DO1 and RSS-102 Issue 4

FCC KDB # 447498 DO1 - Mobile and Portable Device RF Exposure and Procedures and Equipment Authorization Policies section 1) c) states that unless excluded by *specific FCC test procedures*, portable devices with output power $> 60/f_{\text{(GHz)}} \text{ mW}$ shall include SAR data for equipment approval.

RSS-102 section 2.5.1 states that a device is exempt from SAR evaluation if the frequency is “above 2.2 GHz and up to 3 GHz inclusively, and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use...”.

6.1.1 Test Procedure

If the antenna is located $> 20\text{cm}$ from the user, then an MPE calculation is acceptable.

If the antenna is located $< 20\text{cm}$ (portable / mobile / hand-held device) from the user, then SAR evaluation is required.

6.1.2 Evaluation

The EUT is a hand-held portable device where the antenna can be located less than 20cm from the user, therefore SAR evaluation is required.

6.1.2.1 Evaluation for FCC

FCC 447498 D01 Mobile Portable RF Exposure v04, Paragraph 2) section a) i) states:
“A device may be used in portable exposure conditions with no restrictions on host platforms when either the source-based time-averaged output power is $\leq 60/f_{\text{(GHz)}} \text{ mW}$ or all measured 1-g SAR are $< 0.4 \text{ W/kg}$.”

The minimum power that requires SAR is $60 / 2.4 \text{ GHz}$ or 25 mW.

The maximum power output plus maximum antenna gain of the EUT is:

$2\text{dBm} + 3\text{dBi (antenna)} = 5 \text{ dBm}$ which is equivalent to 3.16 mW.

The EUT is well below the 25mW power.

6.1.2.2 Evaluation for Industry Canada

The maximum power output plus maximum antenna gain of the EUT is:

$2\text{dBm} + 3\text{dBi (antenna)} = 5 \text{ dBm}$ which is equivalent to 3.16 mW.

The EUT is well below the 20mW power.

6.1.3 Conclusion

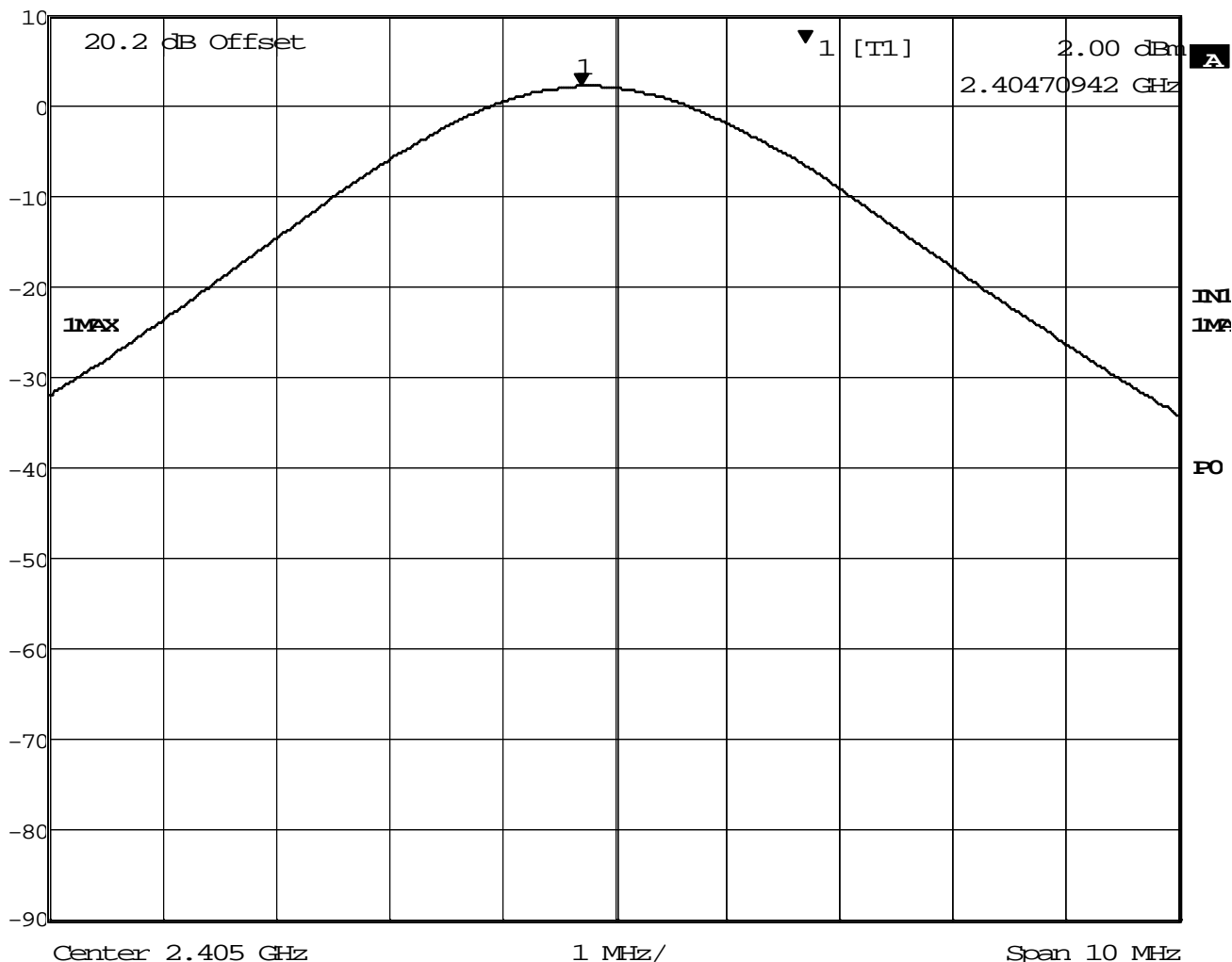
SAR data is not required for either FCC or Industry Canada.

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6.1.4 Direct Power Measurement.



Marker 1 [T1]	RBW	3 MHz	RF Att	10 dB
Ref Lvl	2.00 dBm	VBW	3 MHz	
10 dBm	2.40470942 GHz	SWT	5 ms	Unit dBm



Date: 15.SEP.2011 14:23:24

Figure 4 – 99% Power Bandwidth = 2.64 MHz

Note: A modified test sample with an SMA connector was provided to make this direct RF measurement.

The peak gain of the antenna is specified, by the manufacturer, to be +3dBi.

The Power was measured in CW Mode on Channels 0, 7 and 15.

The highest power output was produced at channel 0 (2405.0 MHz), shown above.

The test data and plots for the other channels are on file at TUV Rheinland.

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