

Test report no. : 91316/13

Item tested : LivingColors – Luminaire

Type of equipment: Low Power Transceiver

Client : Silicon & Software Systems Polska Sp. z O. O.

FCC Part 15.249

Low Power Transceiver
2400 – 2483.5 MHz Band

RSS210 Issue 7 & RSS Gen Issue 2

Low-Power Licence-exempt Radiocommunications devices
2400 – 2483.5 MHz Band

28 March 2008

Authorized by :

Frode Sveinsen
Technical Verificator

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1 GENERAL INFORMATION

1.1 Testhouse Info

Name : Nemko Comlab
Address : Gåsevikveien 8, Box 96
N-2027 Kjeller, NORWAY
Telephone : +47 64 84 57 00
Fax : +47 64 84 57 05
E-mail: post@comlab.no
FCC test firm registration # : 994405
Industry Canada OATS registration # : 4443

1.2 Client Information

Name : Silicon & Software Systems Polska Sp.Z O.O.
Address : ul. Nyska 83/85, 50-505 Wroclaw, Poland
Telephone : +48 71 3348177

Contact:

Name : Sebastian Roslan
Telephone : +48 71 3348177
E-mail : Sebastian.roslan@s3group.com

1.3 Manufacturer (if other than client)

Name : Philips Lighting
Address : BU Consumer Lamps, Mathildelaan 1, 5611 BD, Eindhoven , The Netherlands
Telephone : +31 40 2755531
Fax : -

Contact:

Name : Bao Trinh
Telephone : +31 40 2755531
E-mail : bao.trinh@philips.com

2 Test Information

2.1 Test Item

Name :	Luminaire
Model/version :	LivingColors Luminaire
Serial number :	TX: S/N 339 , RX: S/N 356
Hardware identity and/or version:	2.4
Software identity and/or version :	Not stated
Operating frequency:	2433 MHz
Transmitter data rate:	250kbit/s
Tuneable Bands :	None
Emissions Designator :	/
Number of Channels :	1
Operating Modes :	Transceiver
Channel spacing:	None
Channel bandwidth:	200kHz (TX) , 540kHz (RX)
Type of Modulation :	MSK
User Frequency Adjustment :	None
Rated Output Power :	-4dBm (0.4 mW)
Type of Power Supply :	AC mains 120V /60Hz
Antenna gain:	/
Antenna Connector :	Integral
Antenna Diversity Supported :	None

¹ The tested equipment has integrated antenna only

Theory of Operation

The Luminaire is a transceiver. It is a single channel AC operated unit.

Description of Test Item

The required frequencies, modulation and modes are selected by preprogrammed software on the EUT.

The measurements were done with the EUT powered by 120 V AC. It was checked that power variations between 85% and 115% did not have any influence on the measurements. And measurements were performed only at normal conditions.

All radiated measurements were performed on three axes.

2.2 Test Environment

2.2.1 Normal test condition

Temperature: 20 - 22 °C
Relative humidity: 30 - 40 %
Normal test voltage: AC/DC converter, 120V 60Hz

The values are the limit registered during the test period.

2.3 Test Period

Item received date: 2007-09-03
Test period : 2007-09-05 to 2007-09-07

3 TEST REPORT SUMMARY

3.1 General

Manufacturer: Philips Lighting

Model No.: Luminaire

Serial No.: /

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC CFR 47 Part 15.249 and Industry Canada RSS-210 Issue 7.

Radiated tests were conducted in accordance with ANSI C63.4-2003. The radiated tests were made in a semi-anechoic chamber at measuring distances of 3 and 10 metres.

☒ New Submission

☒ Production Unit

☐ Class II Permissive Change

☐ Pre-production Unit

DXT Equipment Code

☐ Family Listing

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".



TEST REPORT #: 91316/13

TESTED BY: 
G.Suwanthakumar, Test engineer

DATE: 28.03.2008

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3.2 Test Summary

Name of test	FCC Part 15 reference	RSS210 Issue 7 / RSS Gen Issue 2	Result
Supply Voltage Variations	15.31(e)	4.5	Complies ²
Transmitter frequency stability	15.31(m)	7.2.4	Complies
Antenna Requirement	15.203	7.1.4	Integral ¹
Power-Line Conducted Emission	15.207(C)	7.2.2	Complies
6 dB bandwidth	15.215(c)	-	Complies
Peak Power Output	15.249(a)(c)	A2.9	Complies
Band edge Emissions	15.249(d)	A.2.9	Complies
Spurious Emissions (Radiated)	15.249 (e)	A2.9 & 4.3	Complies
Spurious Emissions (Antenna Conducted)	15.249	7.2.3.1	N/A ¹
Receiver Spurious Emissions (Radiated)	N/A	6	Complies

¹ The EUT has only integral antenna.

² Power supply varied according to the standard

RSS Gen issue 2 covers section 6 & 7

RSS 210 issue 7 covers section A2.9

3.3 Description of modification for Modification Filing

Not applicable.

3.4 Comments

The EUT is delivered with pre-programmed 1 channel to operate in TX or RX mode.

The LC7 has integral antenna only.

3.5 Family List Rational

Not Applicable.

4 TEST RESULTS

4.1 Power-Line Conducted Emissions

Para. No.: 15.207 (a)

Test Performed By: G.Suwanthakumar

Date of Test: 06.09.2007

Measurement procedure: ANSI C63.4-2003 using 50 μ H/50 ohms LISN.

Test Results: **Complies**

Measured both in standby mode and operating mode.

Highest measured value (L1 and N):

Frequency	Detector	Measured value	Limit	Margin
MHz	QP/AV	dB μ V	dB μ V	dB
0.154	QP	44	65,8	> 20
0.154	AV	19	55,8	> 20
1.5	QP	29	56	> 20
1.5	AV	12	46	> 20
12	QP	24	60	> 20
12	AV	7	50	> 20

See the attached graphs for peak scan. The measured peak values are also within the requirements.

4.2 Transmitter Frequency Stability

Para. No.: /

Test Performed By: G.Suwanthakumar

Date of Test: 05.09.07

Measurement Data:

Temperature	Channel nr.	Given Frequency (MHz)	Measured value (MHz)	Deviation (Hz)
20 ° C	-	2433	2433	0

Comment:

For information only:

There are no requirements to frequency tolerance for low power devices in the 2400 – 2483.5 MHz band according to 15.249 or RSS 210

4.3 6 dB bandwidth

Para. No.: 15.215(c)

Test Performed By: G.Suwanthakumar

Date of Test: 05.09.2007

Test Results: Complies

Measurement Data:

	2433 MHz
Measured 6 dB bandwidth (kHz)	360.72

See the attached graphs

4.4 Peak Power Output

Para. No.: 15.249 (a)

Test Performed By: G.Suhandhakumar

Date of Test: 05.09.2007

Test Results: Complies

Measurement Data:

Maximum field strength: 76.63dB μ V/m

RF channel	2433 MHz
Measured maximum field strength – Vertical polarization	71.40 dB μ V/m
Measured maximum field strength – Horizontal polarization	76.63 dB μ V/m

The used instrument settings are : RBW/VBW: 1MHz , Peak detector.

See attached graph

Detachable antenna?

☐ Yes ☒ No

If detachable, is the antenna connector non-standard?

☐ Yes ☐ No

The tested equipments have integral antennas only.

Requirements:

The maximum peak output power shall be $\leq$ 94dB μ V/m

4.5 Band Edge Emissions

Para. No.: 15.249 (d)

Test Performed By: G.Suhanthakumar	Date of Test: 05.09.2007
------------------------------------	--------------------------

Test Results: Complies

Measurement Data:

RF channel	2433
Measured maximum dBc	> 50

The operating frequency is well away from 2400 MHz (lower band edge) & well within 2483.5 MHz (upper band edge). And transmission level is low.

Requirements:

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.

4.6 Spurious Emissions (Radiated)

Para. No.: 15.249 (e)

Test Performed By: G.Suhandhakumar

Date of Test: 05.09.2007

Test Results: Complies

Measurement Data:

Radiated emission 9 kHz - 25 GHz, see attached table

Highest value: Peak 48 dB μ V/m, average 29 dB μ V/m, 4.8 GHz

The worst case is obtained at vertical polarization .Measured Peak values are lower than 48 dB μ V/m

In RX mode no spurious emission detected in the frequency range 9kHz – 25 GHz.

Duty Cycle Correction Factor Calculation:

RF duty cycle Correction Factor: Calculation according to RF burst Para 15.35 (c):

Measured duty cycle: on time 0.84 ms , ON+OFF time: 7.2 (see attached graphs)

$$-20 \cdot \log (0.8/7.2) = 19 \text{ dB}$$

Maximum duty cycle according to Para 15.35 (b): **20 dB**

This value is used for calculating the Peak limit for spurious emissions and for calculating the Spurious Emissions value with Average Detector when measuring with Peak Detector above 1 GHz.

Radiated spurious emissions are performed from 9kHz to 25 GHz .

Example of frequency graph of radiated emission is also attached.

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor".

No components above 4.8 GHz were detected

Radiated Emission 1 – 25 GHz, Peak , Luminaire

Measured with Peak Detector

The maximum emission is obtained at vertical polarization (worst case).

Frequency	RF channel	Dist. corr. factor	Field strength, Peak, 3 metres	DC Corr. Factor	Limit	Margin
GHz		dB	dB μ V/m	dB	dB μ V/m	dB
4.8	2433	0	48	-	74	26
Above 2 nd	2433	0	None detected	-	74	-

Radiated emission 1- 25 GHz, Average , Luminaire

Measured with Peak Detector

Frequency	RF channel	Dist. corr. factor	Field strength, Peak, 3 metres	DC Corr. Factor	Limit	Margin
GHz		dB	dB μ V/m	dB	dB μ V/m	dB
4.8	2433	0	48	19	54	25
Above 2 nd	2433	0	None detected	19	54	-

Radiated Emission 30 – 1000 MHz, Luminaire

Measured with Q-Peak Detector

The maximum emission is obtained at vertical polarization (worst case).

Frequency	Operational condition	Field strength	Measuring distance	Limit FCC15.209	Margin
MHz		dB μ V/m	metres	dB μ V/m	dB
43,5	TX on/VP	25	3	40.0	15
63,5	TX on/VP	20	3	40	20
80	TX on/VP	20	3	40	20
106,5	TX on/VP	17	3	43,5	23
123,1	TX on/VP	17	3	43.5	26,5
156	TX on/VP	23	3	43,5	20,5
312	TX on/VP	26	3	46	20
364	TX on/VP	24	3	46	22
416	TX on/VP	29	3	46	17
468	TX on/VP	24	3	46	22

4.7 Receiver Spurious Emissions (Radiated)

Para. No.: 6

Test Performed By: G.Suwanthakumar

Date of Test: 05.09.2007

Test Results: Complies

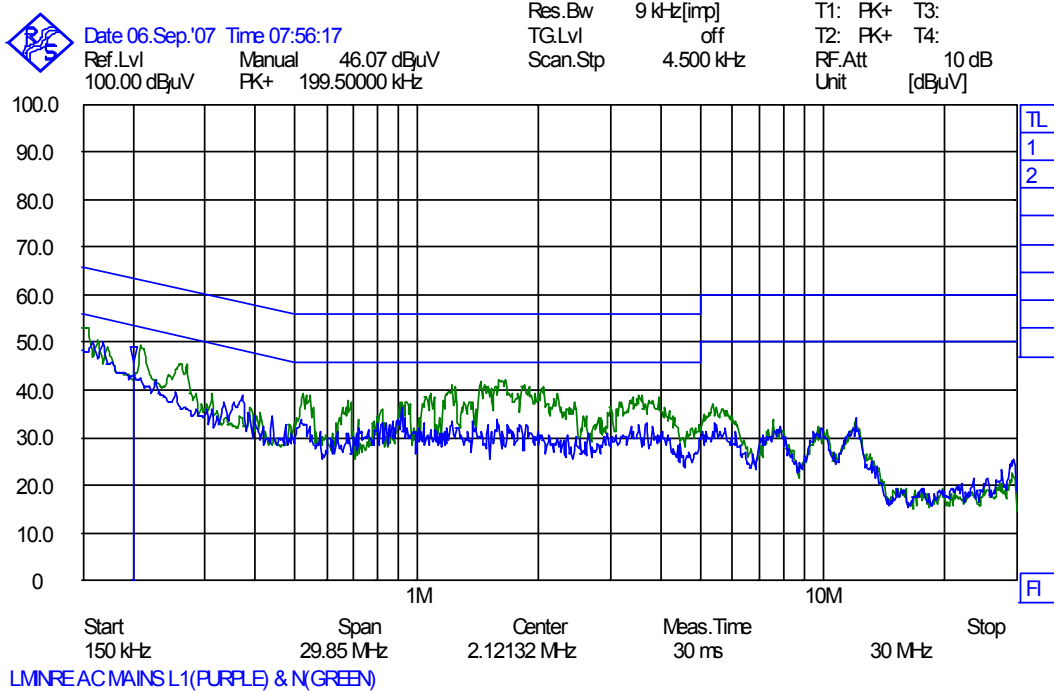
Measurement Data:

Radiated emission 9 kHz - 25 GHz, see attached table

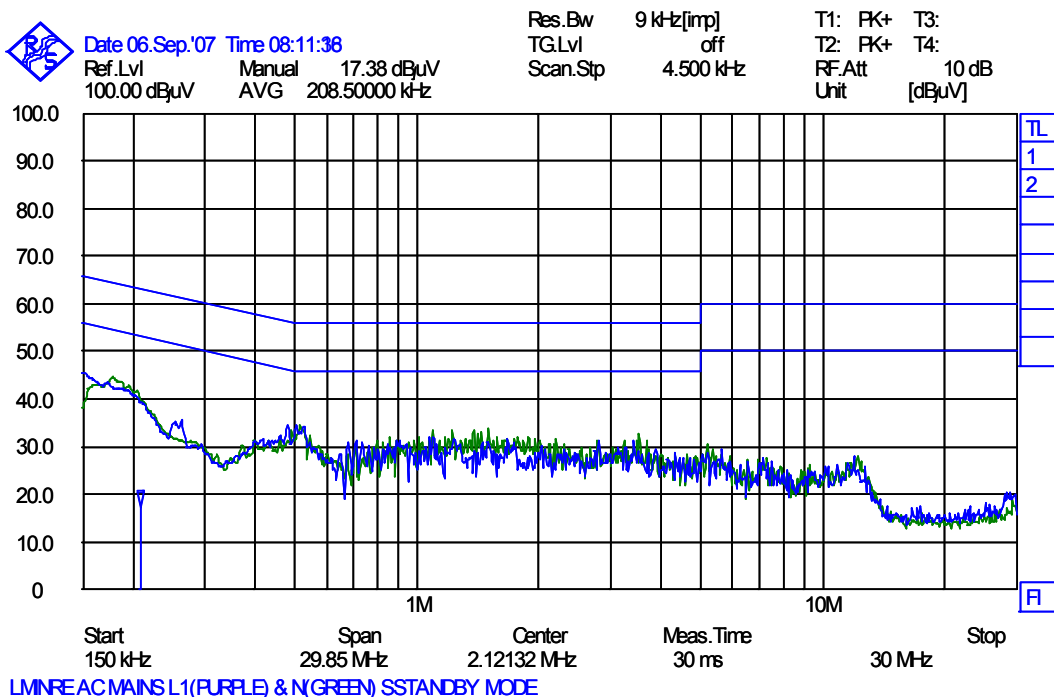
In RX mode no spurious emission detected in the frequency range 9kHz – 25 GHz. Except at 4.8 GHz. The measured value with peak dectector is 49.92 dBuV/m. The calculated average vaule is 30.8 dBuV/m

This value is used for calculating the Peak limit for spurious emissions and for calculating the Spurious Emissions value with Average Detector when measuring with Peak Detector above 1 GHz.

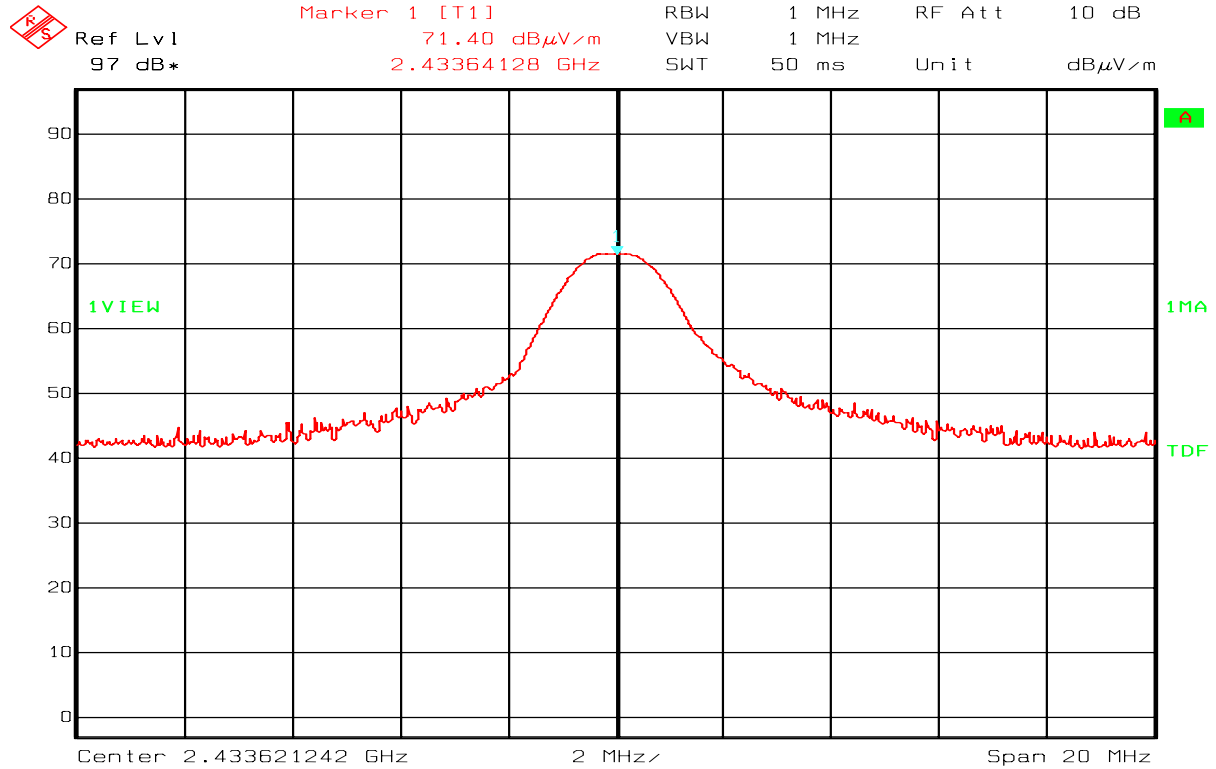
Example of frequency graph of radiated emission is also attached.



Conducted emission – In active mode

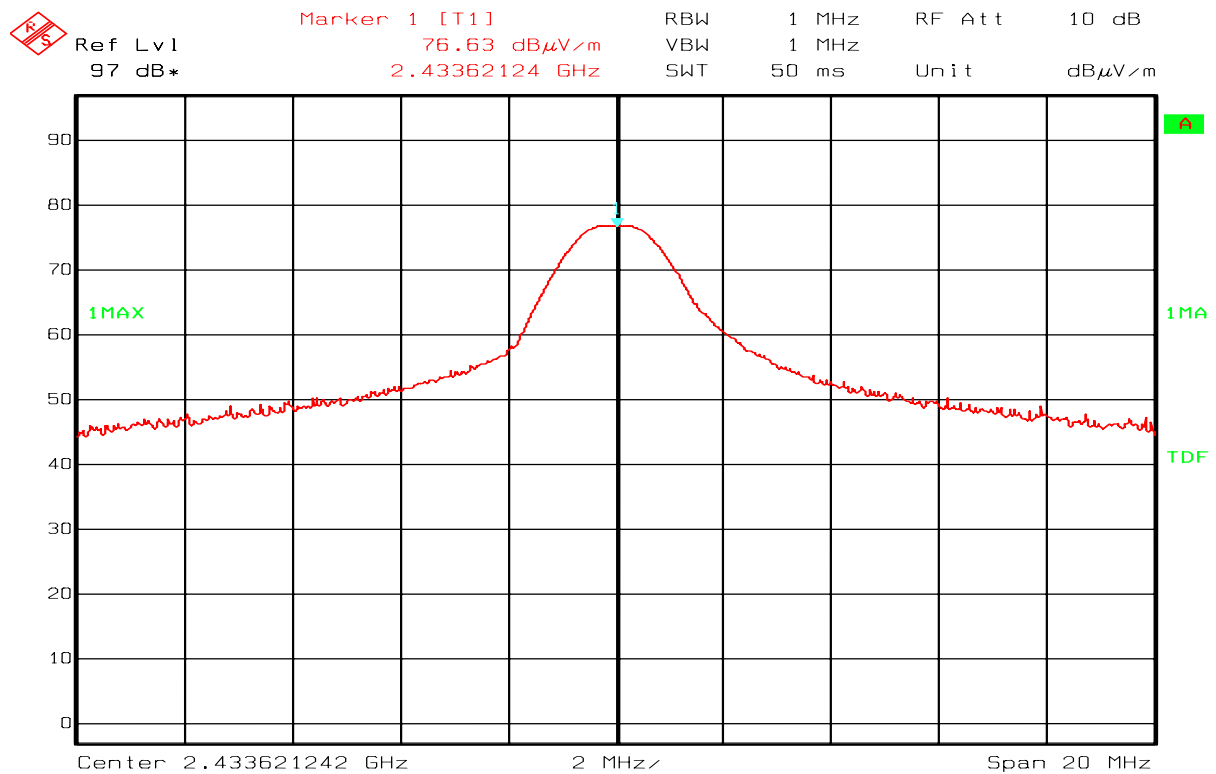


Conducted emission – In standby mode



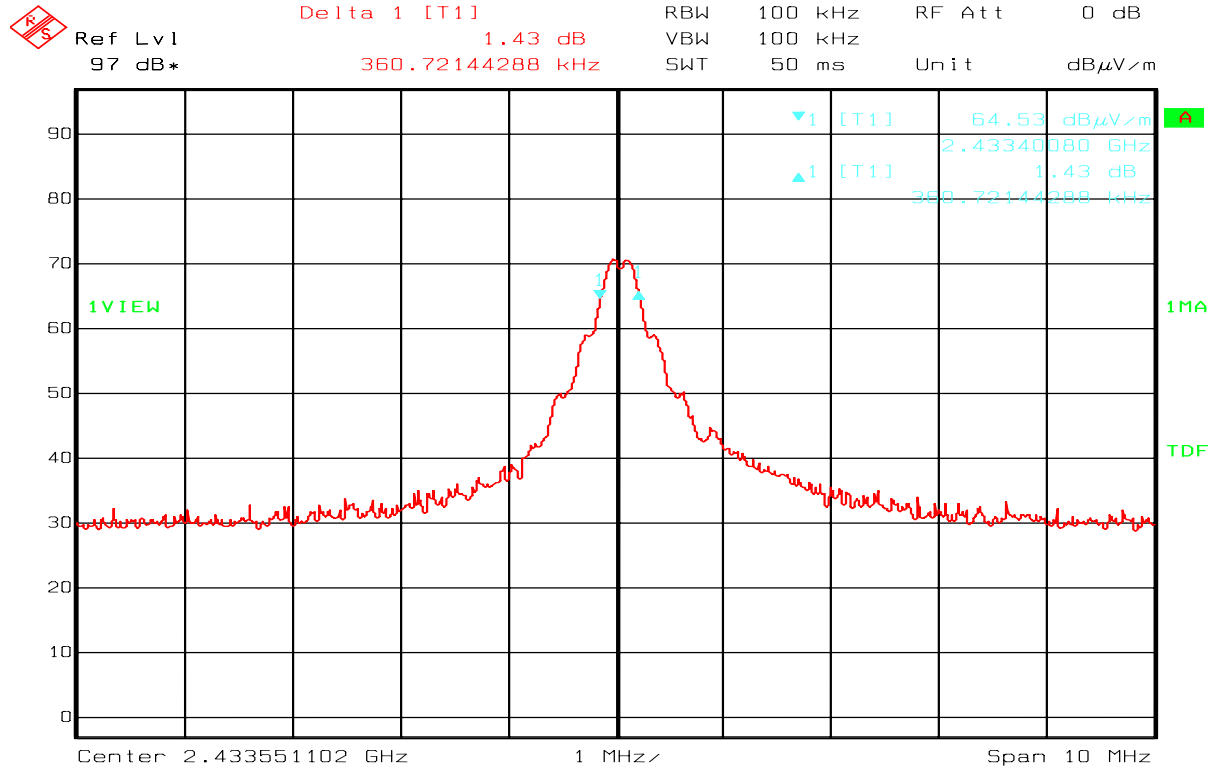
Date: 5.SEP.2007 8:01:35

Luminaire- Maximum field strength – 71.40 dB μ V/m - Vertical polarization

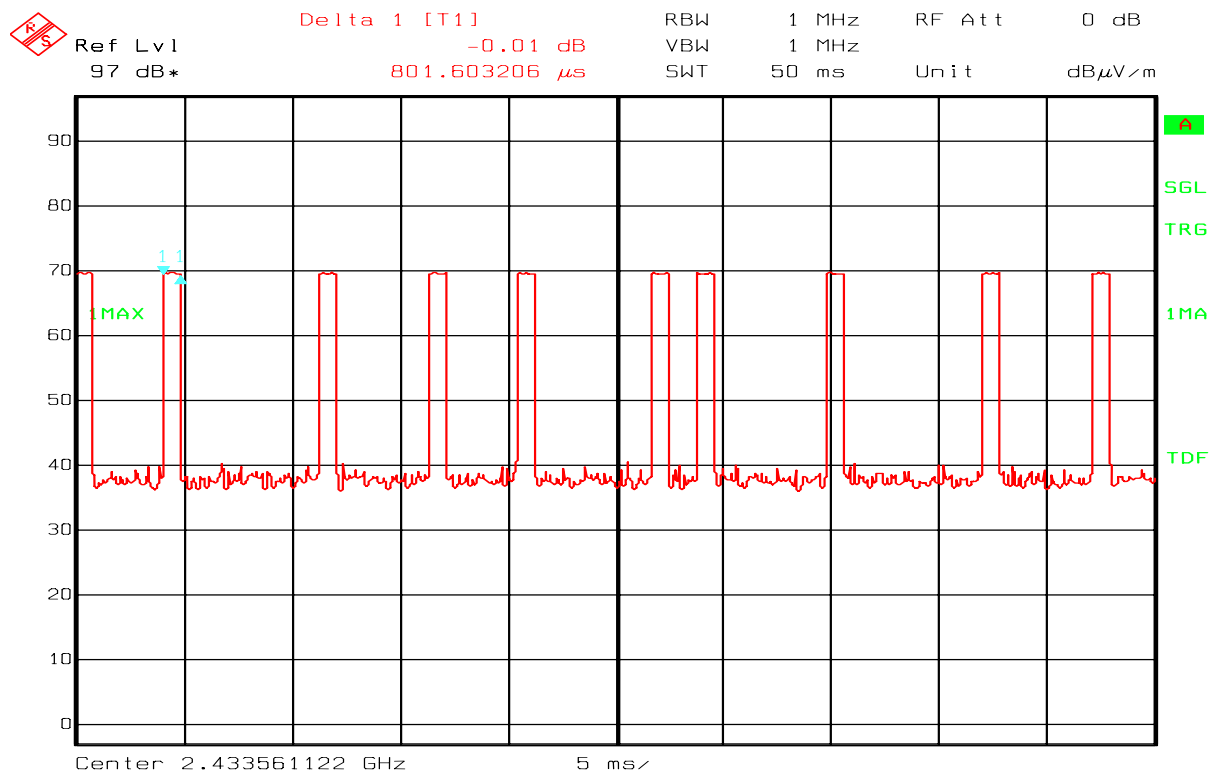


Date: 5.SEP.2007 7:56:37

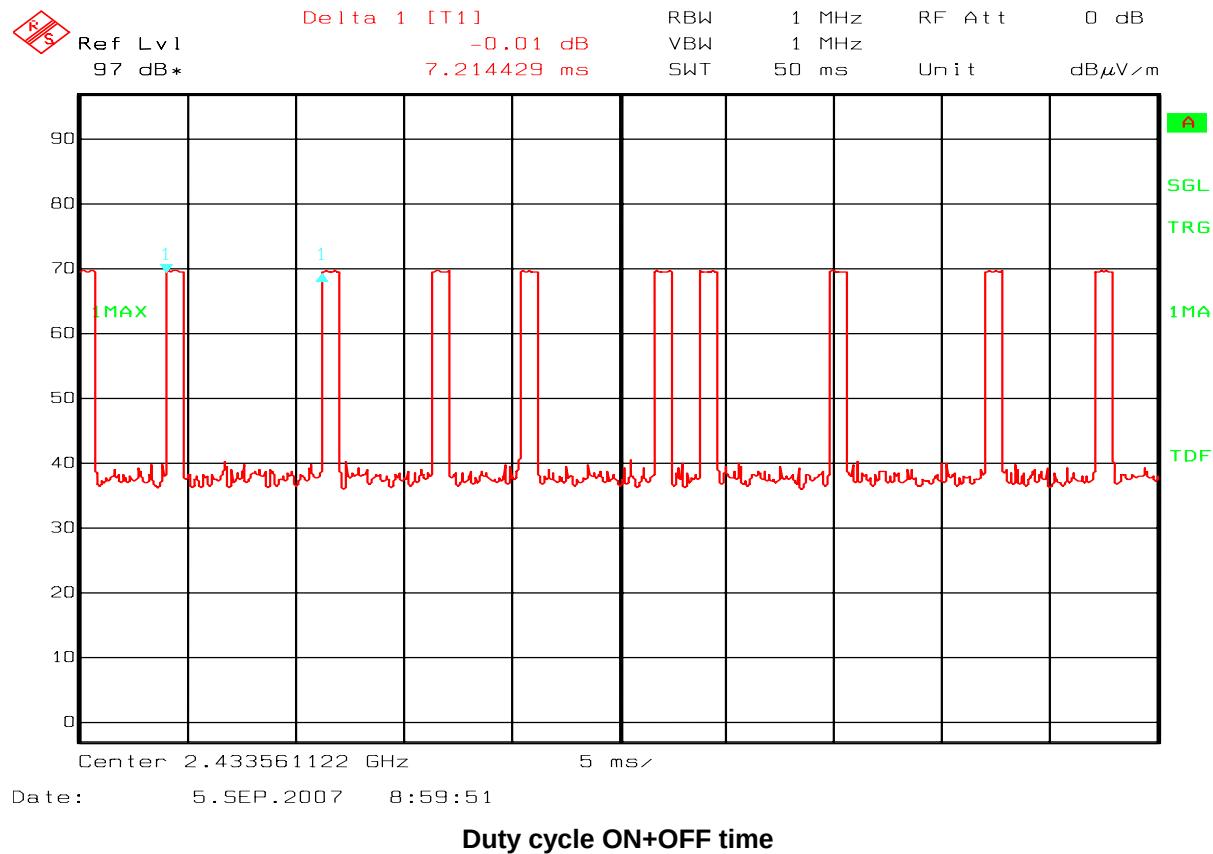
Luminaire- Maximum field strength – 76.63 dB μ V/m - Horizontal polarization



6 dB bandwidth



Duty cycle ON time

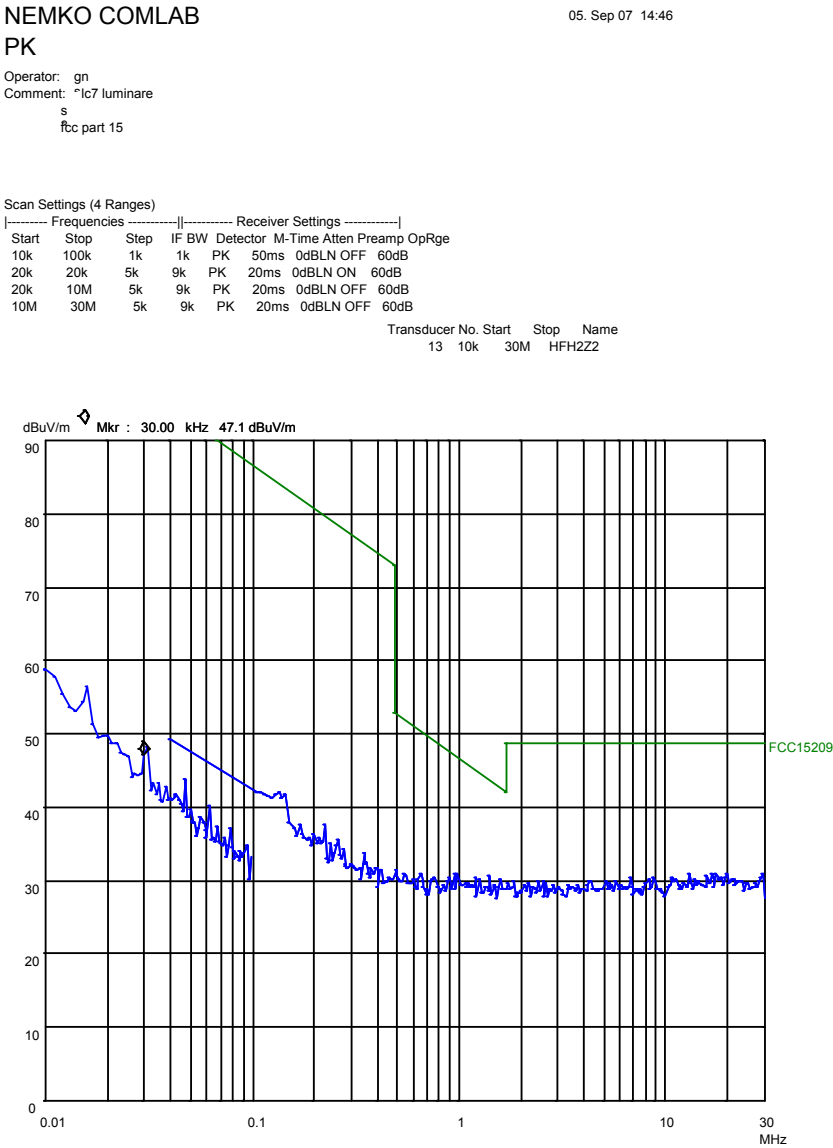


Radiated emission 10 kHz-30 MHz.

Measuring distance 10 m, measured with Peak detector.

No component detected, see attached graph.

Limit is converted to 10 m using 40 dB/decade according to 15.31 (f) (2).



Luminaire - 10 kHz – 30MHz –radiated emission - (TX/RX mode)

Measuring distance 3 m .
No component detected, see attached graphs.

Nemko Comlab

05. Sep 07 11:59

pk

EUT: LC7(luminaire)
Manuf: S3
Op Cond: 3m hp
Operator: gns
Test Spec: FCC part 15
Comment: TX mode

Scan Settings (1 Range)

Frequencies

Receiver Settings

Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30M	200M	50k	120k	PK	50ms	AUTO	LN ON	60dB

Transducer No.

Start

Stop

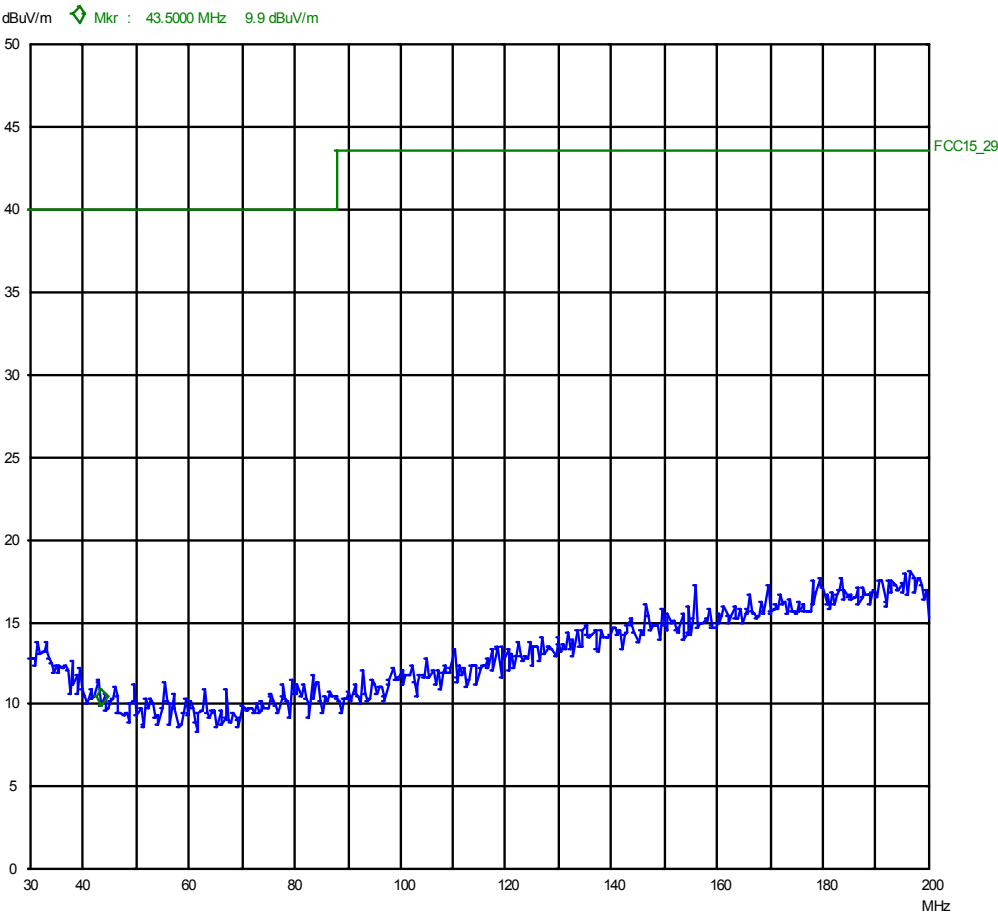
Name

20

30M

200M

HK116



TX/RX mode: Luminaire - Radiated emission 30 –200MHz, Horizontal polarization

Nemko Comlab

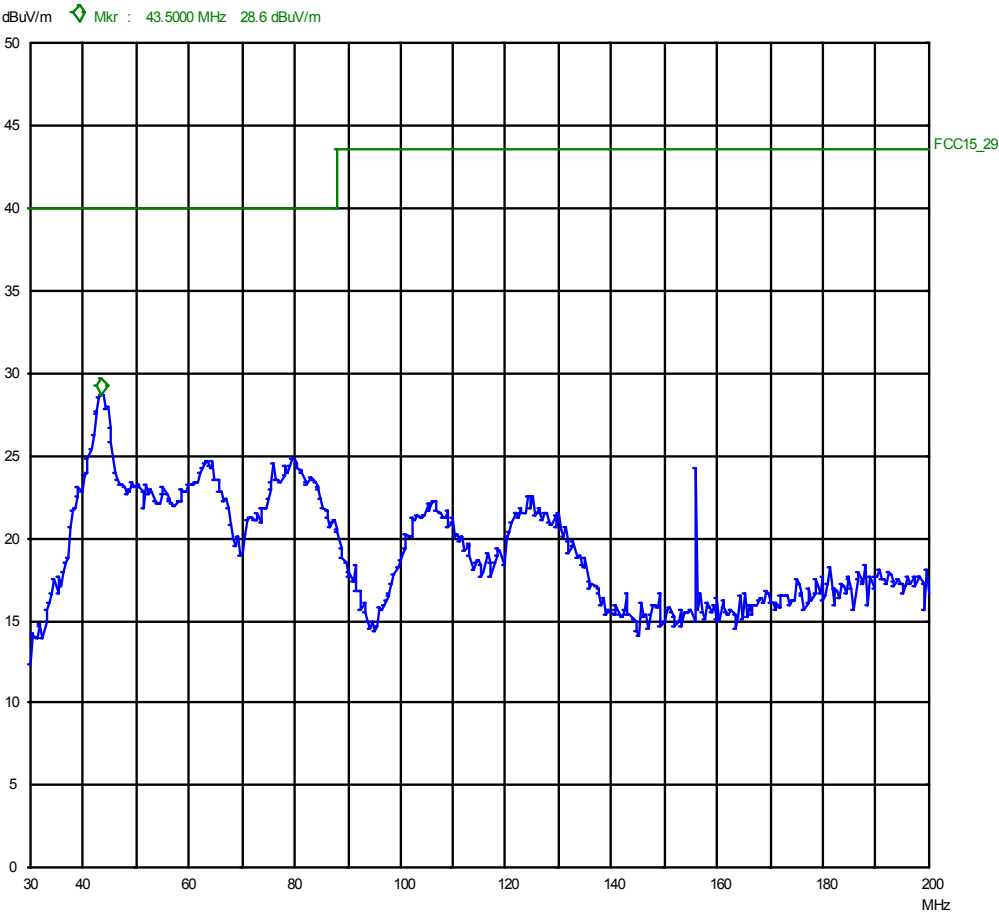
05. Sep 07 11:50

pk

EUT: LC7(luminare)
Manuf: S3
Op Cond: 3m vpP
Operator: gns
Test Spec: FCC part 15
Comment: TX mode

Scan Settings (1 Range)

Frequencies					Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
30M	200M	50k	120k	PK	50ms	AUTO	LN ON	60dB	
		Transducer No.	Start	Stop	Name				
		20	30M	200M	HK116				



TX mode: Luminaire- Radiated emission 30 –200MHz, Vertical polarization

Nemko Comlab

05. Sep 07 12:08

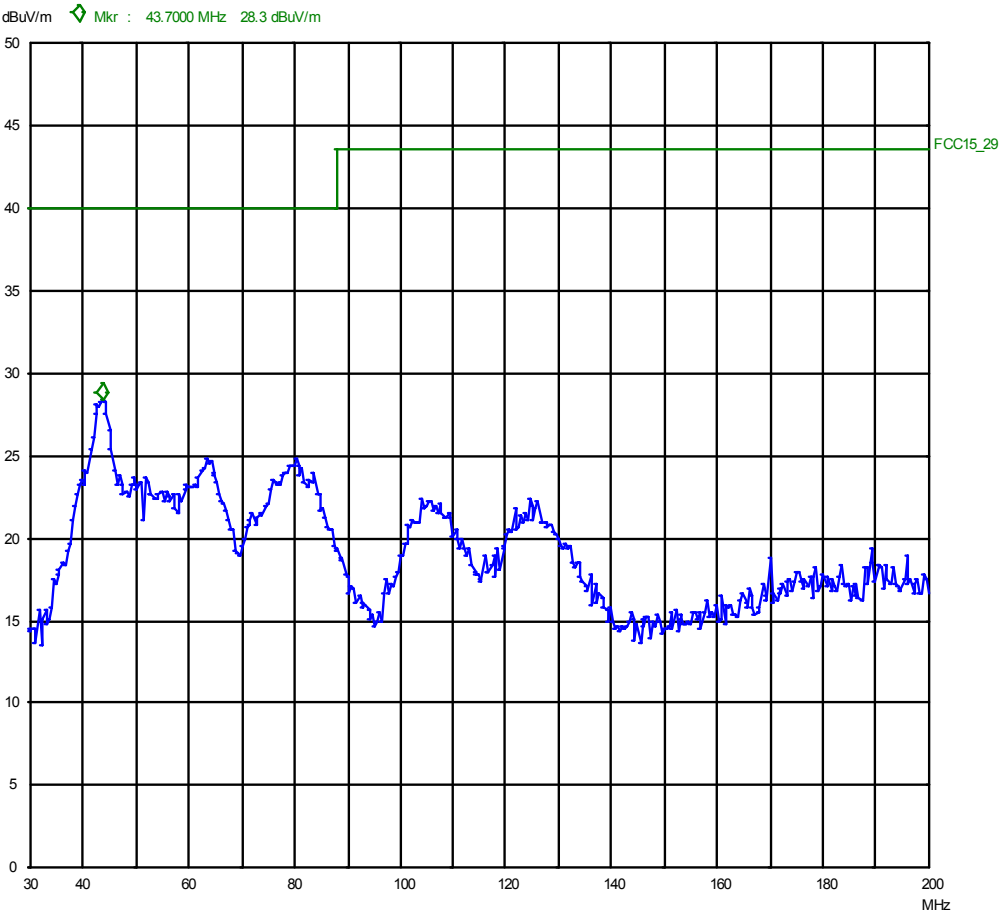
pk

EUT: LC7(luminare)
Manuf: S3
Op Cond: 3m vp
Operator: gns
Test Spec: FCC part 15
Comment: rx mode

Scan Settings (1 Range)

Frequencies				Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp OpRge
30M	200M	50k	120k	PK	50ms	AUTO	LN ON 60dB

Transducer No.	Start	Stop	Name
20	30M	200M	HK116



RX mode: Luminaire- Radiated emission 30 –200MHz, Vertical polarization

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05. Sep 07 13:11

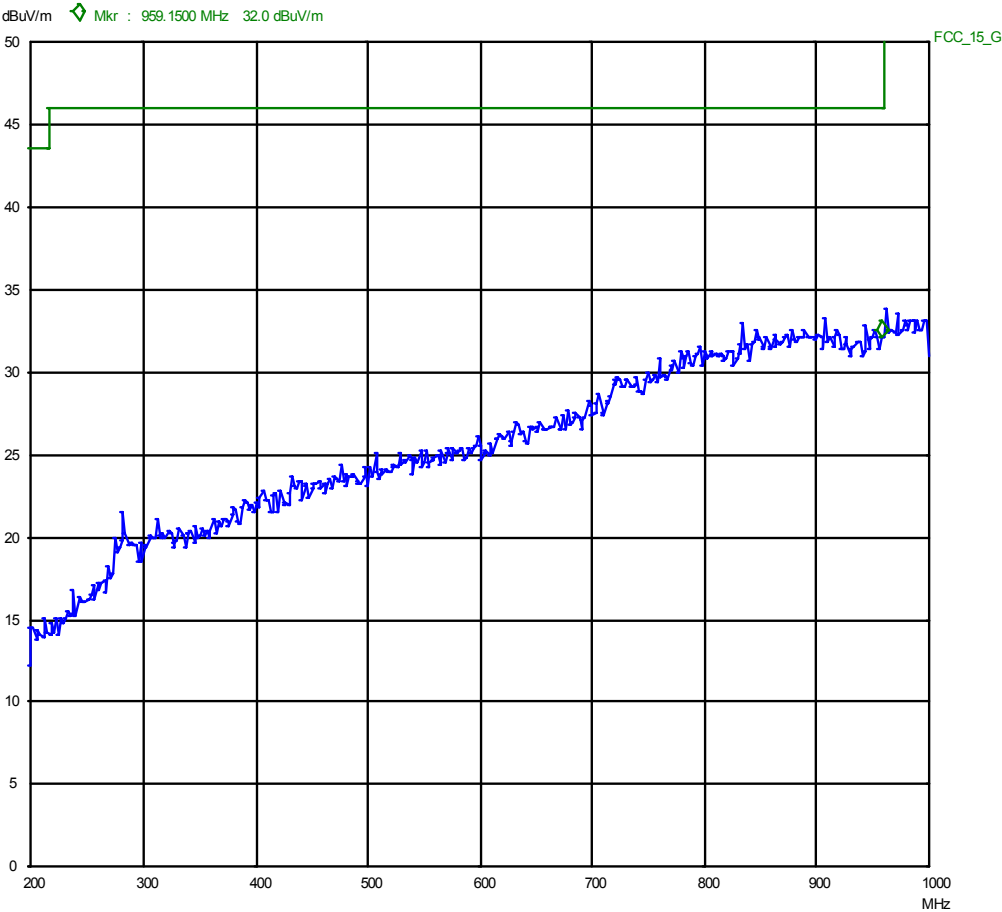
pk

EUT: LC7(luminare)
Manuf: S3
Op Cond: 3m hp
Operator: gns
Test Spec: FCC part 15
Comment: TX mode

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
200M	1000M	50k	120k	PK	50ms	AUTO	LN ON	60dB

Transducer No.	Start	Stop	Name
21	200M	1000M	HL223



TX/RX mode: Luminaire - Radiated emission 200 –1000 MHz, Horizontal polarization

Nemko Comlab
pk

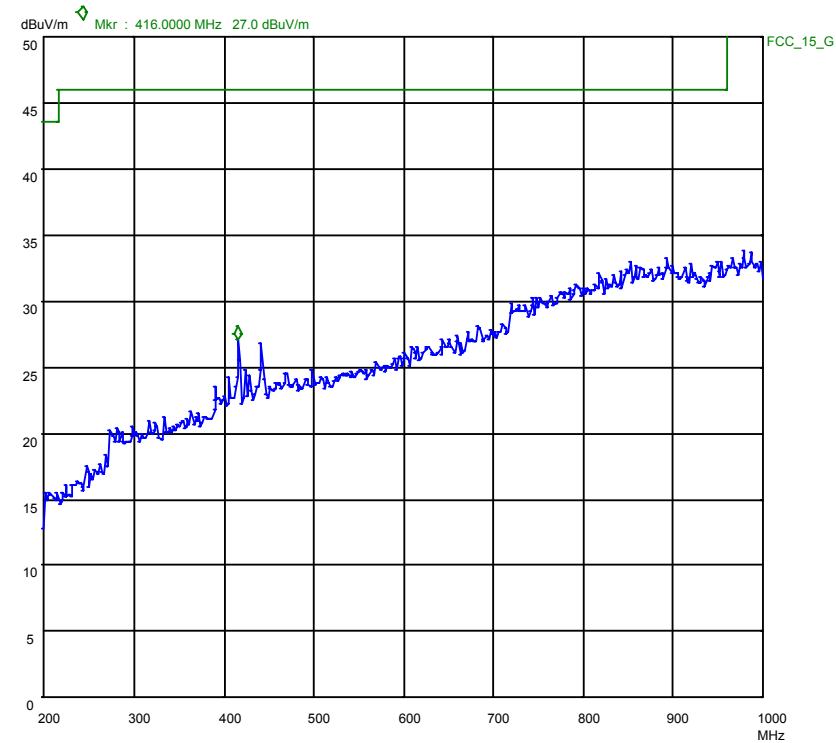
05. Sep 07 13:44

EUT: LC7(luminare)
Manuf: S3
Op Cond: 3m vp
Operator: gn
Test Spec: FCC part 15
Comment: rx mode

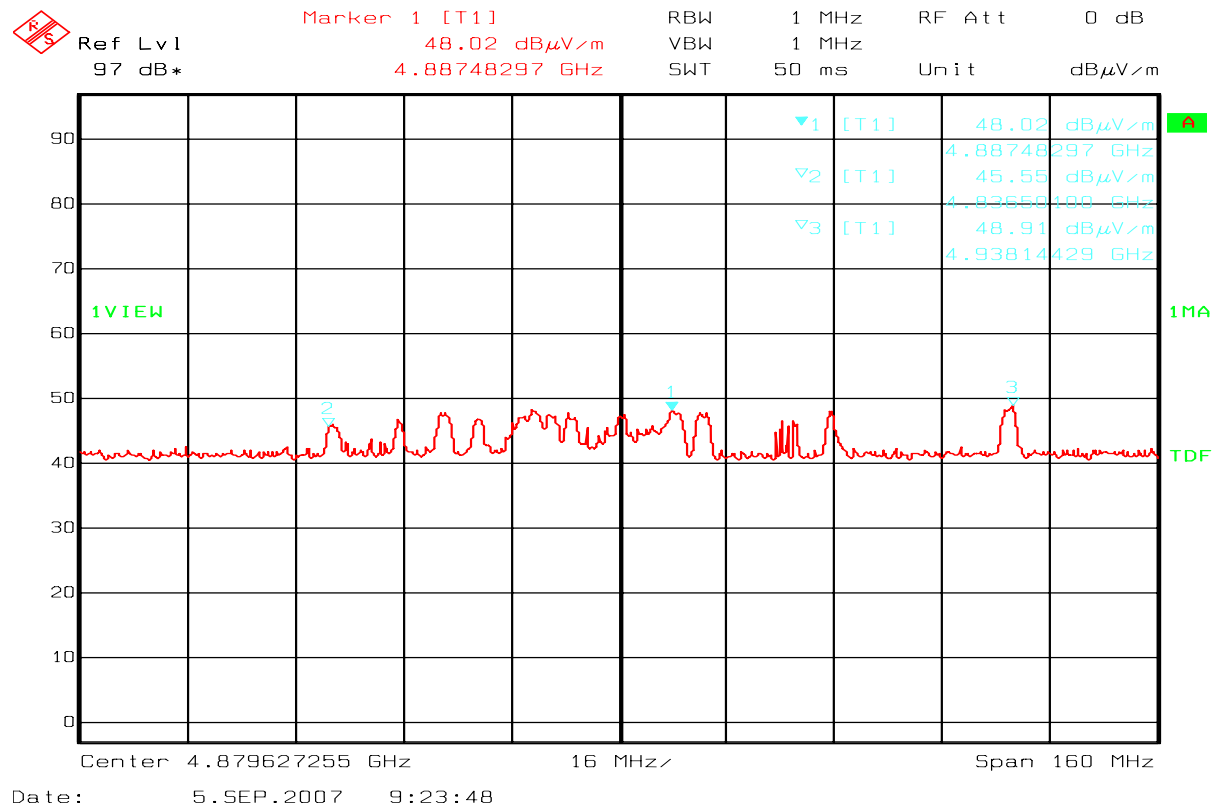
Scan Settings (1 Range)

----- Frequencies -----||----- Receiver Settings -----|
Start Stop Step IF BW Detector M-Time Atten Preamp OpRge
200M 1000M 50k 120k PK 50ms AUTO LN ON 60dB

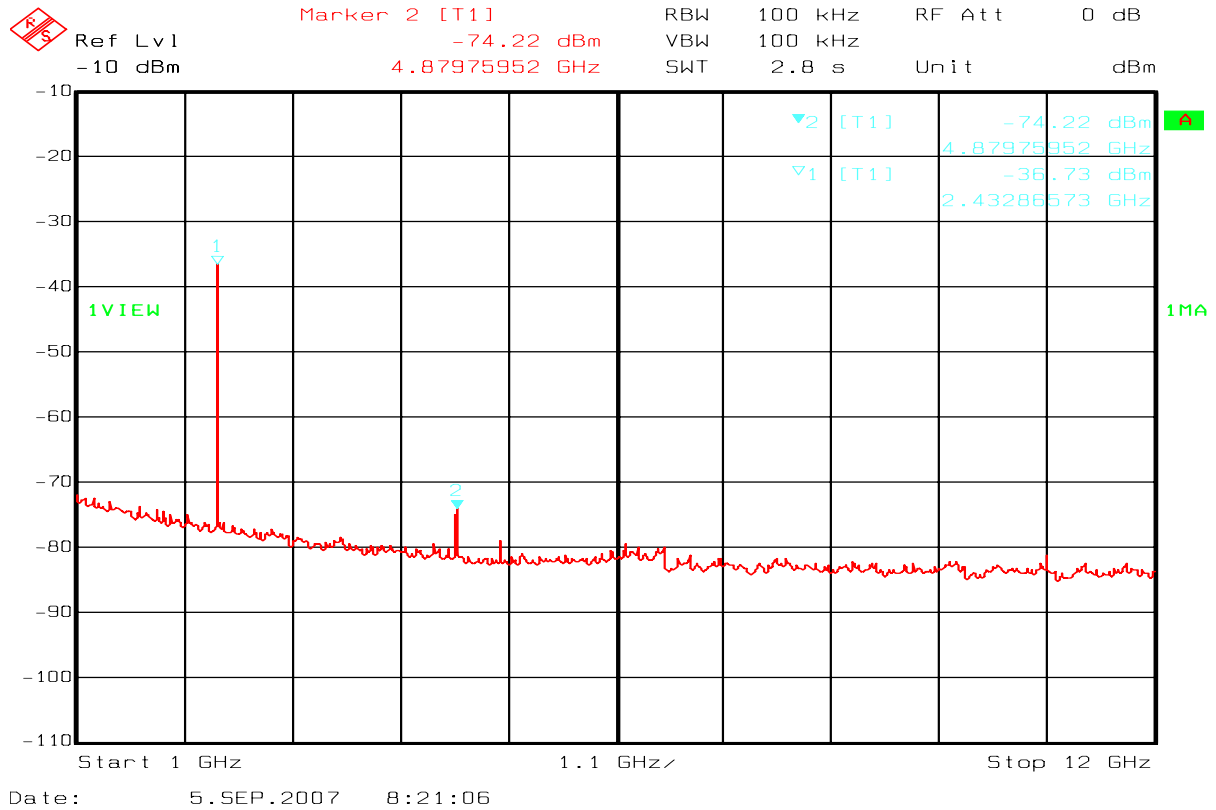
Transducer No. Start Stop Name
21 200M 1000M HL223



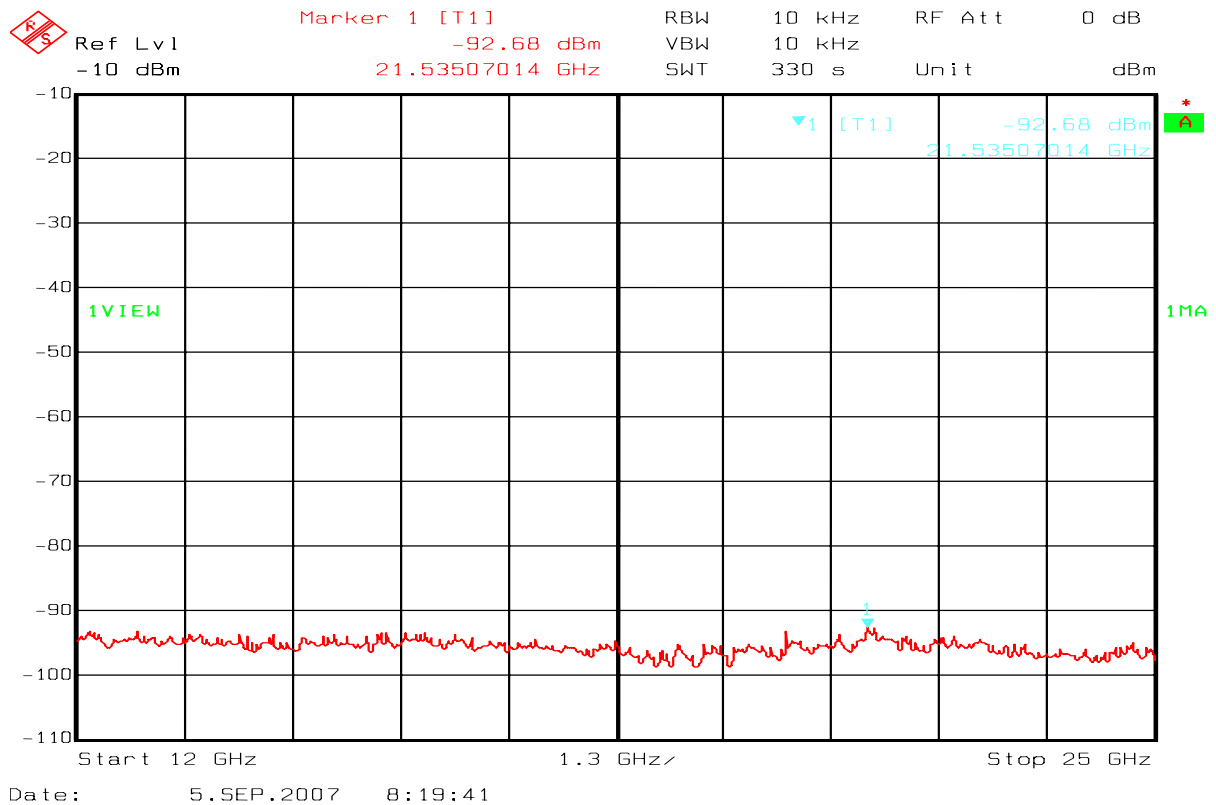
TX/RX mode: Luminaire - Radiated emission 200 –1000 MHz, Vertical polarization



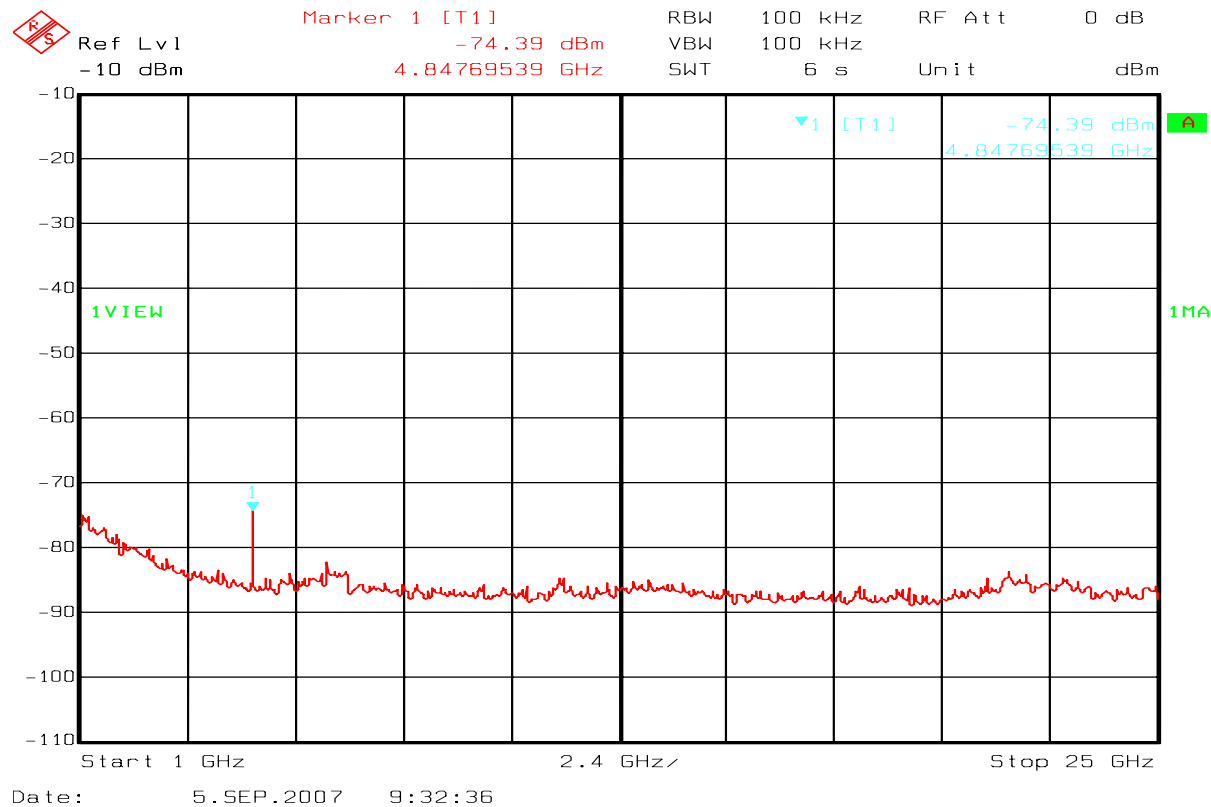
2nd harmonic – Vertical Polarization



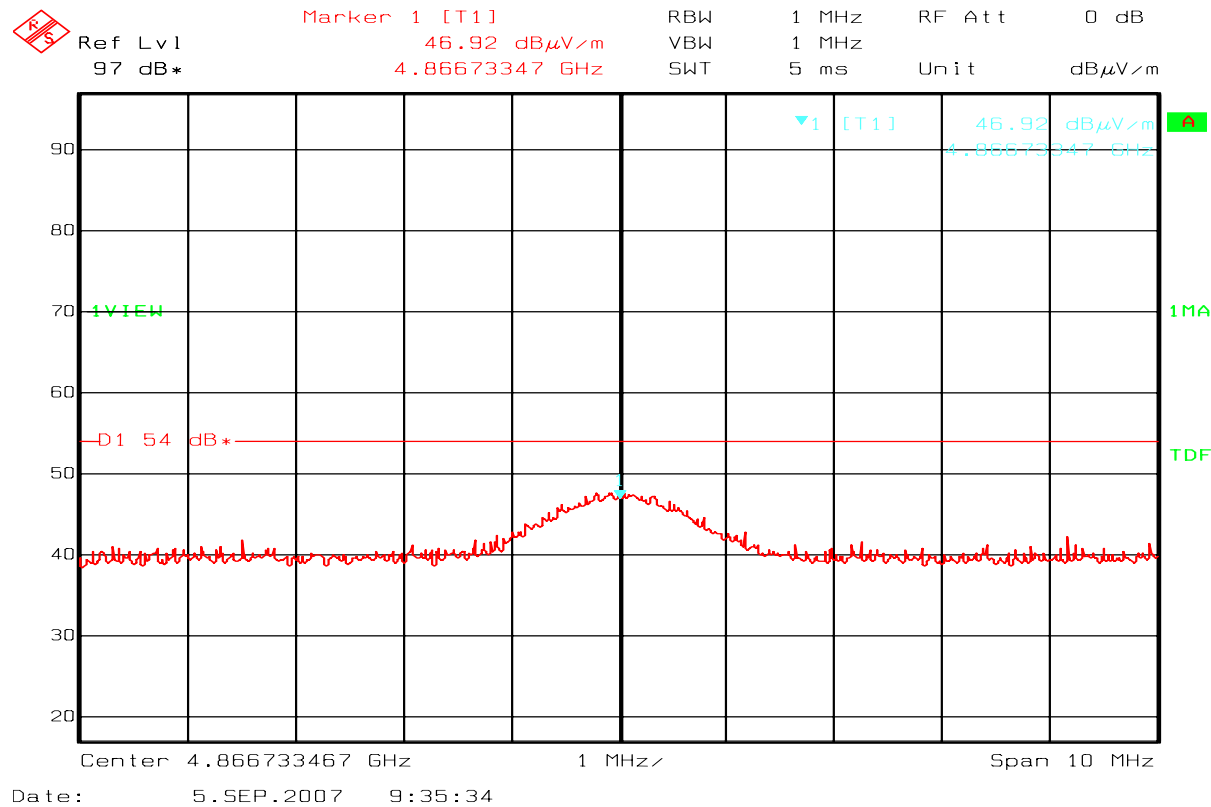
TX mode: Spurious scan 1 - 12 GHz (peak detector)



TX mode: Spurious scan 12 - 25 GHz (peak detector)



RX mode: Spurious scan 1 - 25 GHz (peak detector)



RX mode: 2nd Harmonic (peak detector)

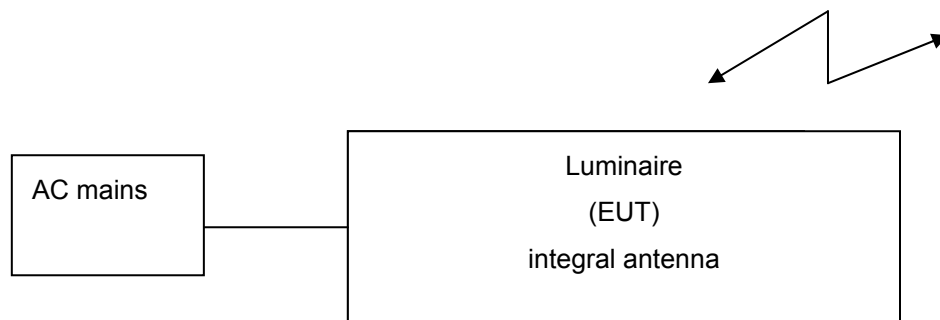
5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

No.	Instrument/ancillary	Type of instrument/ancillary	Manufacturer	Ref. no.
1	FSEK30	Spectrum Analyzer	Rohde & Schwarz	LR 1337
2	ESN	EMI Reciever	Rohde & Schwarz	LR 1237
3	3115	Antenna horn	EMCO	LR 1330
4	643	Antenna horn	Narda	LR 093
5	642	Antenna horn	Narda	LR 220
6	PM7320X	Antenna horn	Siverts lab	LR 103
7	DBF-520-20	Antenna horn	Systron Donner	LR 101
8	638	Antenna horn	Narda	LR 098
9	5VF1000/2000	BP filter	Trilithic	LR 1174
10	5VF2000/4000	BP filter	Texscan	LR 42
11	ESH3-Z3	LISN	Rohde & Schwarz	LR 1076
12	8449B	Amplifier	Hewlett Packard	LR 1322
13	-	Shielded room	ETS	LR 1410
14	HFH2-Z2	Antenna loop	Rohde and Schwarz	LR 285
15	10855A	Amplifier	Hewlett Packard	LR 1445
16	HL223	Antenna log.per	Rohde & Schwarz	LR 1261
17	HK116	Antenna biconic	Rohde & Schwarz	LR 1260
18	ESVS 30	Test Receiver	Rohde & Schwarz	LR 1101
19	R3271	Spectrum Analyser	Advantest	LR 1123

6 BLOCK DIAGRAM

6.1 System set up



Luminaire

6.2 Test Site Radiated Emission

