



166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Code of Federal Regulations 47 Part 15 – Radio Frequency Devices

### Subpart C – Intentional Radiators

#### Section 15.231

Periodic operation in the band 40.66 - 40.70 MHz  
and above 70 MHz

THE FOLLOWING MEETS THE ABOVE TEST SPECIFICATION

Formal Name: AccuChrom-3 Remote Control

Kind of Equipment: Standalone battery operated handheld transmitter

Frequency Range: 433.92 MHz

Test Configuration: Battery operated transmitter tested for intentional radiated emissions in three orthogonal planes.

Model Number(s): GLED-RC

Model(s) Tested: GLED-RC

Serial Number(s): none (Test Sample)

Date of Tests: November 15-19, 2010

Test Conducted For: Gammex, Inc.  
7600 Discovery Drive  
Middleton, WI 53562-0327, USA

**NOTICE:** "This test report relates only to the items tested and must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government". Please see the "Description of Test Sample" page listed inside of this report.

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166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## SIGNATURE PAGE

Report By:

A handwritten signature in black ink that reads 'Adam D. Alger'.

Adam Alger  
Test Engineer

Reviewed By:

A handwritten signature in black ink that reads 'William Stumpf'.

William Stumpf  
OATS Manager

Approved By:

A handwritten signature in black ink that reads 'Brian J. Mattson'.

Brian Mattson  
General Manager



166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Table of Contents

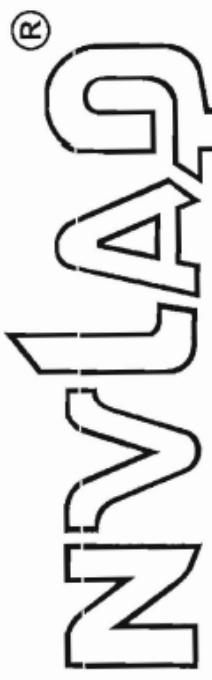
i.	Cover Page .....	1
ii.	Signature Page .....	2
iii.	Table of Contents.....	3
iv.	NVLAP Certificate of Accreditation .....	4
1.0	Summary of Test Report.....	5
2.0	Introduction.....	5
3.0	Test Facilities.....	5
4.0	Description of Test Sample.....	6
5.0	Test Equipment .....	7
6.0	Test Arrangements .....	7
7.0	Test Conditions .....	8
8.0	Modifications Made To EUT For Compliance .....	8
9.0	Additional Descriptions .....	8
10.0	Results.....	8
11.0	Conclusion .....	8
	Appendix A – Test Photos .....	9
	Appendix B – Measurement Data.....	13
1.0	Emission Bandwidth – 20 dB .....	13
2.0	Automatic Deactivation .....	15
3.0	Field Strength of Emissions – Fundamental and Spurious .....	17
4.0	Duty Cycle Correction .....	19



166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

United States Department of Commerce  
National Institute of Standards and Technology



## Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 100276-0

D.L.S. Electronic Systems, Inc.  
Wheeling, IL

is accredited by the National Voluntary Laboratory Accreditation Program for specific services,  
listed on the Scope of Accreditation, for:

### ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005.*

*This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO/ILAC-IAF Communiqué dated January 2009).*



2010-10-01 through 2011-09-30  
Effective dates

*July J. Bruce*  
For the National Institute of Standards and Technology

NVLAP-01C (REV. 2009-01-26)



166 South Carter, Genoa City, WI 53128

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Report Number: 16630  
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## 1.0 Summary of Test Report

It was determined that the Gammex, Inc. AccuChrom-3 Remote Control, Model GLED-RC, complies with the requirements of CFR 47 Part 15 Subpart C Section 15.231.

### Subpart C Section 15.231 Applicable Technical Requirements Tested:

Section	Description	Procedure	Note	Compliant?
15.231(c)	20 dB Emission Bandwidth	ANSI C63.4-2009 & ANSI C63.10-2009	1,2	Yes
15.231(a)(1)	Automatic Deactivation	ANSI C63.4-2009 & ANSI C63.10-2009	1,2	Yes
15.231(b)	Field Strength of Emissions - Fundamental and Spurious -	ANSI C63.4-2009 & ANSI C63.10-2009	1,2	Yes
15.35(c)	Duty Cycle Correction for Pulsed operation	ANSI C63.4-2009 & ANSI C63.10-2009	1,2	Yes

Note 1: Tested in 3 orthogonal planes.

Note 2: Radiated emission measurement.

## 2.0 Introduction

In November, 2010 the AccuChrom-3 Remote Control, Model GLED-RC, as provided from Gammex, Inc. was tested to the requirements of CFR 47 Part 15 Subpart C Section 15.231. To meet these requirements, the procedures contained within this report were performed by personnel of D.L.S Electronic Systems, Inc.

## 3.0 Test Facilities

D.L.S. Electronic Systems, Inc. is a full service EMC/Safety Testing Laboratory accredited to ISO 17025. NVLAP Certificate and Scope can be viewed at <http://www.dlsemc.com/certificate>. Our facilities are registered with the FCC, Industry Canada, and VCCI.

### Wisconsin Test Facility:

D.L.S. Electronic Systems, Inc.  
166 S. Carter Street  
Genoa City, Wisconsin 53128

### Wheeling Test Facility:

D.L.S. Electronic Systems, Inc.  
1250 Peterson Drive  
Wheeling, IL 60090



166 South Carter, Genoa City, WI 53128

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Report Number: 16630  
Project Number: 4058

## 4.0 Description of Test Sample

### Description:

The AccuChrom-3 Remote Control is the remote control for a patient positioning light source system that provides operator assistance in the positioning of patients for diagnostic imaging and radiation oncology. This system gives the operator the ability to change color and execute intensity changes employing a remote control device. The Optical Alignment Instrument provides a single line (saggital) or crossed lines (cross-hair) that indicate the location of the patient anatomy in relation to the iso-center of the imaging or treatment system.

### Type of Equipment / Frequency Range:

Handheld / 433.92 MHz

### Physical Dimensions of Equipment Under Test:

Length: 14.3 cm x Width: 6.4 cm x Height: 3.0 cm

### Power Source:

2 – 3.6 VDC Lithium-ion batteries.

### Internal Frequencies:

4 MHz

### Transmit / Receive Frequencies Used For Test Purpose:

433.92 MHz

### Type of Modulation(s) / Antenna Type:

OOK / Integral antenna

### Description of Circuit Board(s) / Part Number:

XMTR PCB Assembly	007634-00
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166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## 5.0 Test Equipment

A list of the equipment used can be found in the table below. All primary equipment was calibrated against known reference standards with a verified traceable path to NIST.

### D.L.S. Wisconsin – OATS 3

Description	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Dates	Cal Due Dates
Receiver	Rohde & Schwarz	ESI 40	837808/006	20 Hz – 40 GHz	4/10	4/11
Preamplifier	Rohde & Schwarz	TS-PR10	032001/005	9 kHz – 1 GHz	3/10	3/11
Antenna	EMCO	3104C	97014785	20 MHz – 200 MHz	9/10	9/12
Antenna	EMCO	3146	97024895	200 MHz – 1 GHz	9/10	9/12
Preamp	Miteq	AMF-6D-100200-50	313936	1GHz-10GHz	5/10	5/11
Horn Antenna	EMCO	3115	9502-4451	1-18GHz	4/09	4/11
Horn Antenna	EMCO	3115	9903-5731	1-18GHz	6/09	6/11
High Pass Filter	Mini-Circuits	NHP-900	15542	30 MHz – 7 GHz	8/10	8/11

## 6.0 Test Arrangements

### Radiated Emissions Measurement Arrangement:

All radiated emission measurements were performed at D.L.S. Electronic Systems, Inc. and set up according to ANSI C63.4-2009 and ANSI C63.10-2009, unless otherwise noted. Description of procedures and measurements can be found in Appendix B – Measurement Data. See Appendix A for additional photos of the test set up.

Unless otherwise noted, the bandwidth of the measuring receiver / analyzer used during testing is shown below.

Frequency Range	Bandwidth (-6 dB)
10 to 150 kHz	200 Hz
150 kHz to 30 MHz	9 kHz
30 MHz to 1 GHz	120 kHz
Above 1 GHz	1 MHz



166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## 7.0 Test Conditions

### **Test Conditions recorded during test:**

#### **Temperature and Humidity:**

70°F at 32% RH

#### **Battery Voltage:**

3.63 VDC

## 8.0 Modifications Made To EUT For Compliance

None noted at time of test.

## 9.0 Additional Descriptions

Two units were supplied for testing. One unit was configured to operate a continuous transmitting pulsed signal, and another unmodified unit. Unit tested in standby and transmitting modes. Only significant emissions were when unit was transmitting. Battery voltage was confirmed before and after each test.

## 10.0 Results

Measurements were performed in accordance with ANSI C63.4-2009 and ANSI C63.10-2009. Graphical and tabular data can be found in Appendix B at the end of this report.

## 11.0 Conclusion

The AccuChrom-3 Remote Control, Model GLED-RC, as provided from Gammex, Inc. tested in November, 2010 **meets** the requirements of CFR 47 Part 15 Subpart C Section 15.231.



166 South Carter, Genoa City, WI 53128

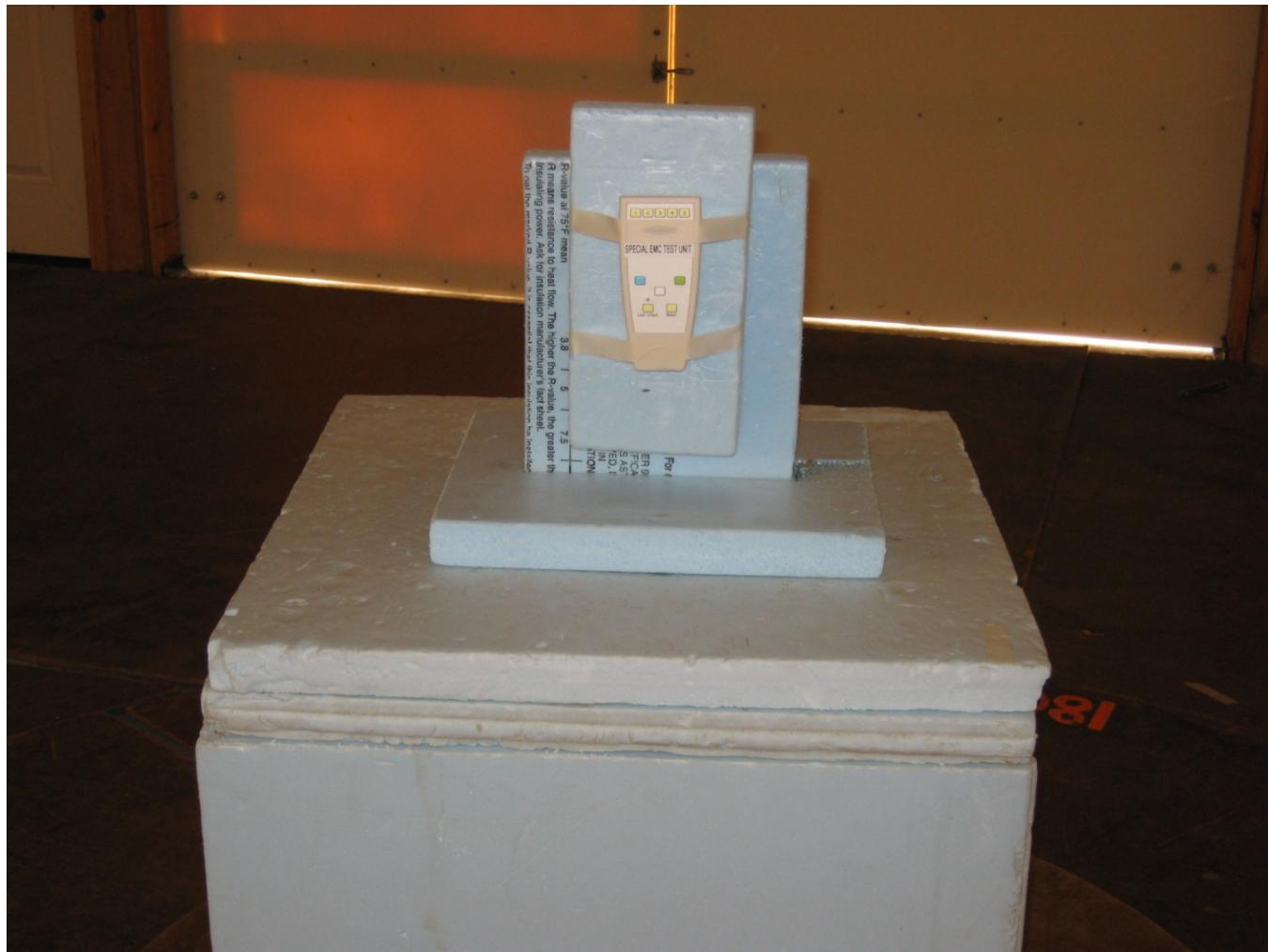
Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix A – Test Photos

### Photo Information and Test Setup:

Item: AccuChrom-3 Remote Control, Model GLED-RC

**Radiated Emissions – ‘Y’ Position**





166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix A

### Radiated Emissions – 'X' Position





166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix A

### Radiated Emissions – ‘Z’ Position



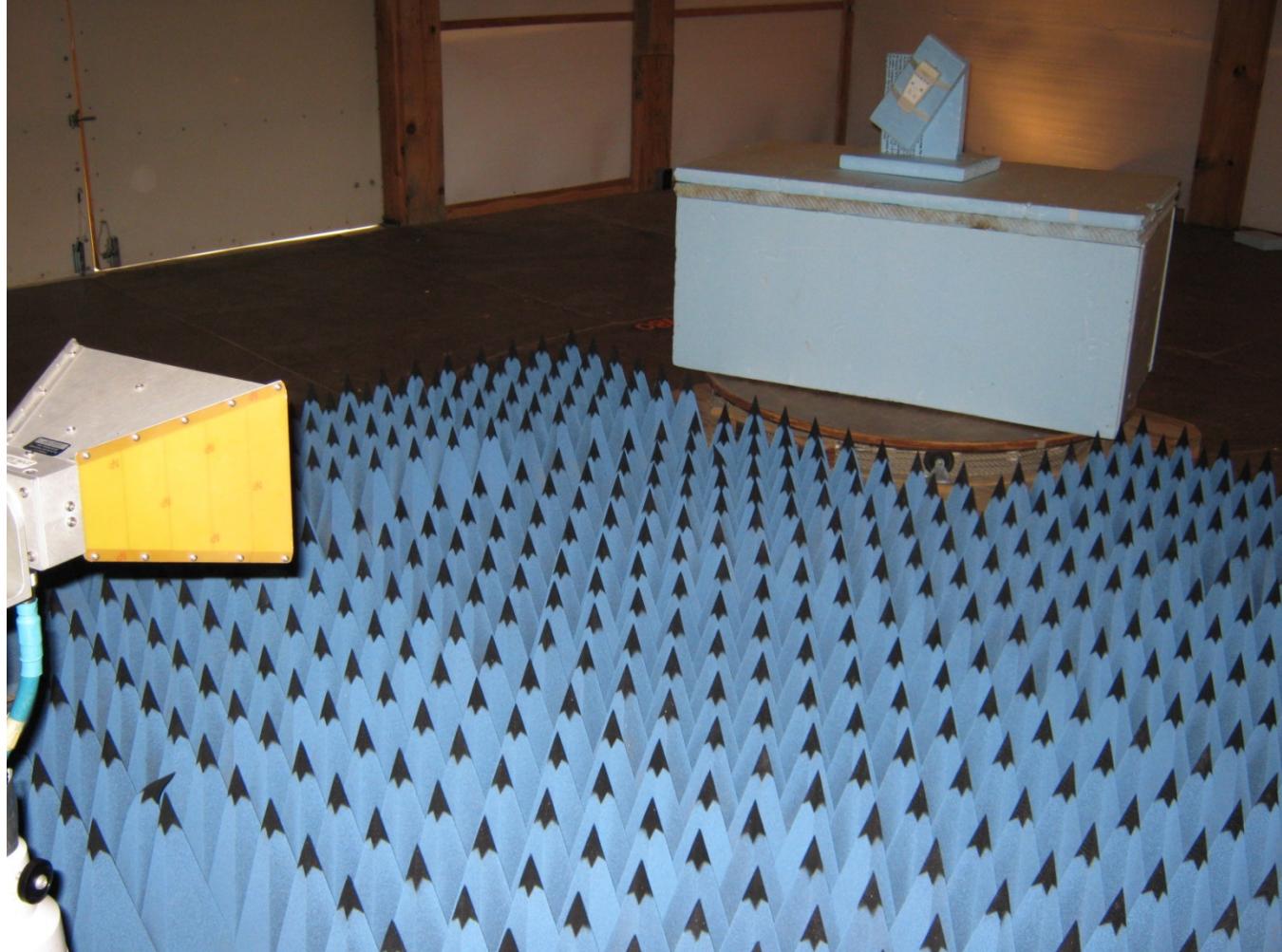


166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix A

### Radiated Emissions – Above 1000 MHz





166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix B – Measurement Data

### 1.0 Emission Bandwidth – 20 dB

#### Rule Part:

Section 15.231 (c)

#### Test Procedure:

ANSI C63.4-2009 and ANSI C63.10-2009

#### Limit:

Section 15.231 (c) :

$$433.92 \text{ MHz} \times 0.25\% = 1.0848 \text{ MHz}$$

#### Results:

Compliant  
20 dB bandwidth: **881.76 kHz**

#### Sample Equation(s):

None

#### Notes:

This was a radiated emissions measurement. The maximum field strength of the emission was determined and the bandwidth was measured from the points at 20 dB down from the modulated carrier.



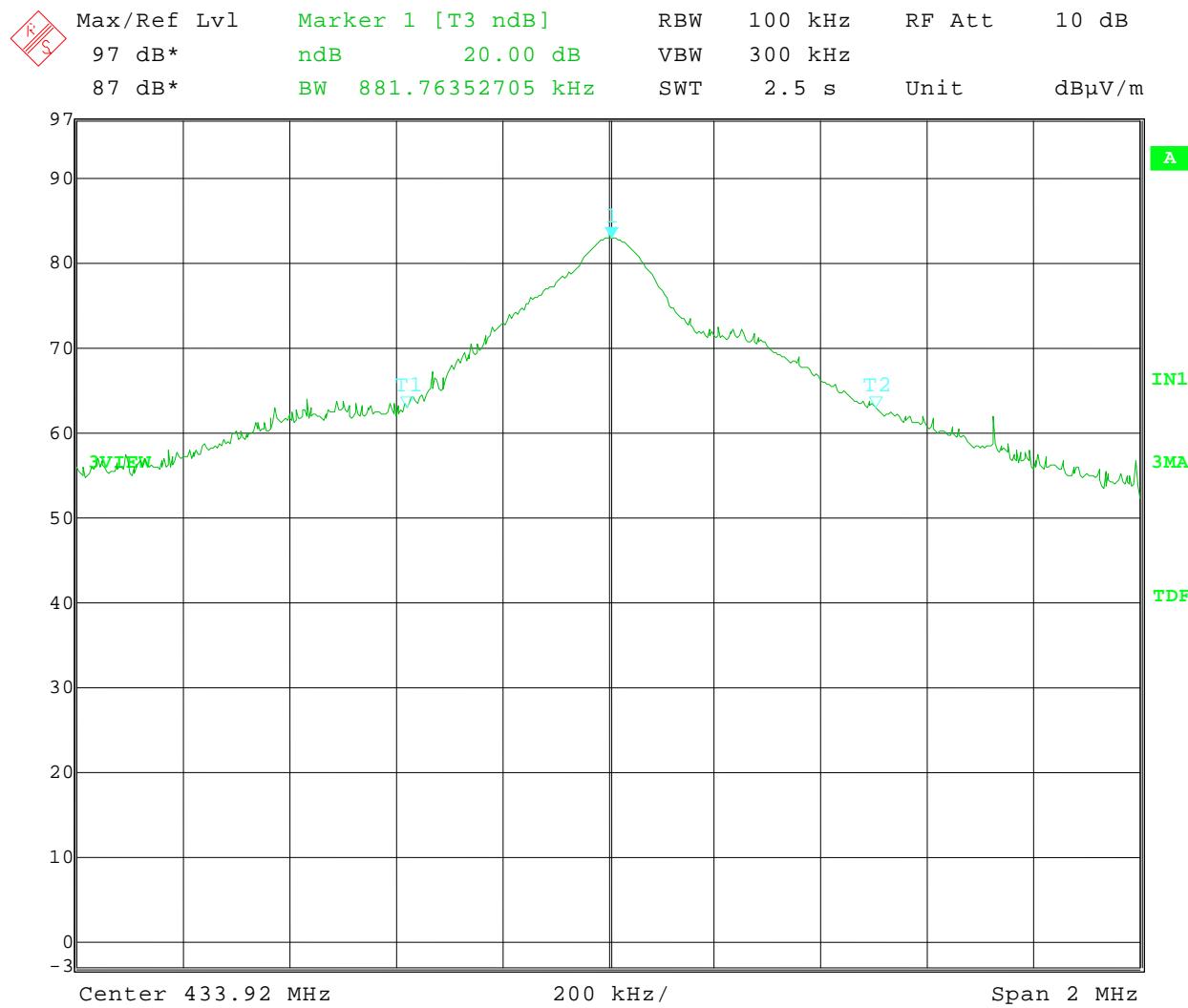
166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix B

Test Date: 11-15-2010  
Company: Gammex Inc.  
EUT: AccuChrom-3 Remote Control  
Test: 20 dB Bandwidth  
Operator: Adam A  
Comment: Transmit Frequency – 433.92 MHz

20 dB Bandwidth = 881.76 kHz



Date: 15.NOV.2010 10:38:16



166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix B

### 2.0 Automatic Deactivation

#### Rule Part:

15.231 (a) (1)

#### Test Procedure:

ANSI C63.4-2009 and ANSI C63.10-2009

#### Limit:

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

#### Results:

Compliant  
Time of deactivation: 2.96 seconds

#### Sample Equation(s):

None

#### Notes:

A key, held on the keypad of the EUT, was operating the transmitter. Once the key was released, the transmission ceased after 2.96 seconds.



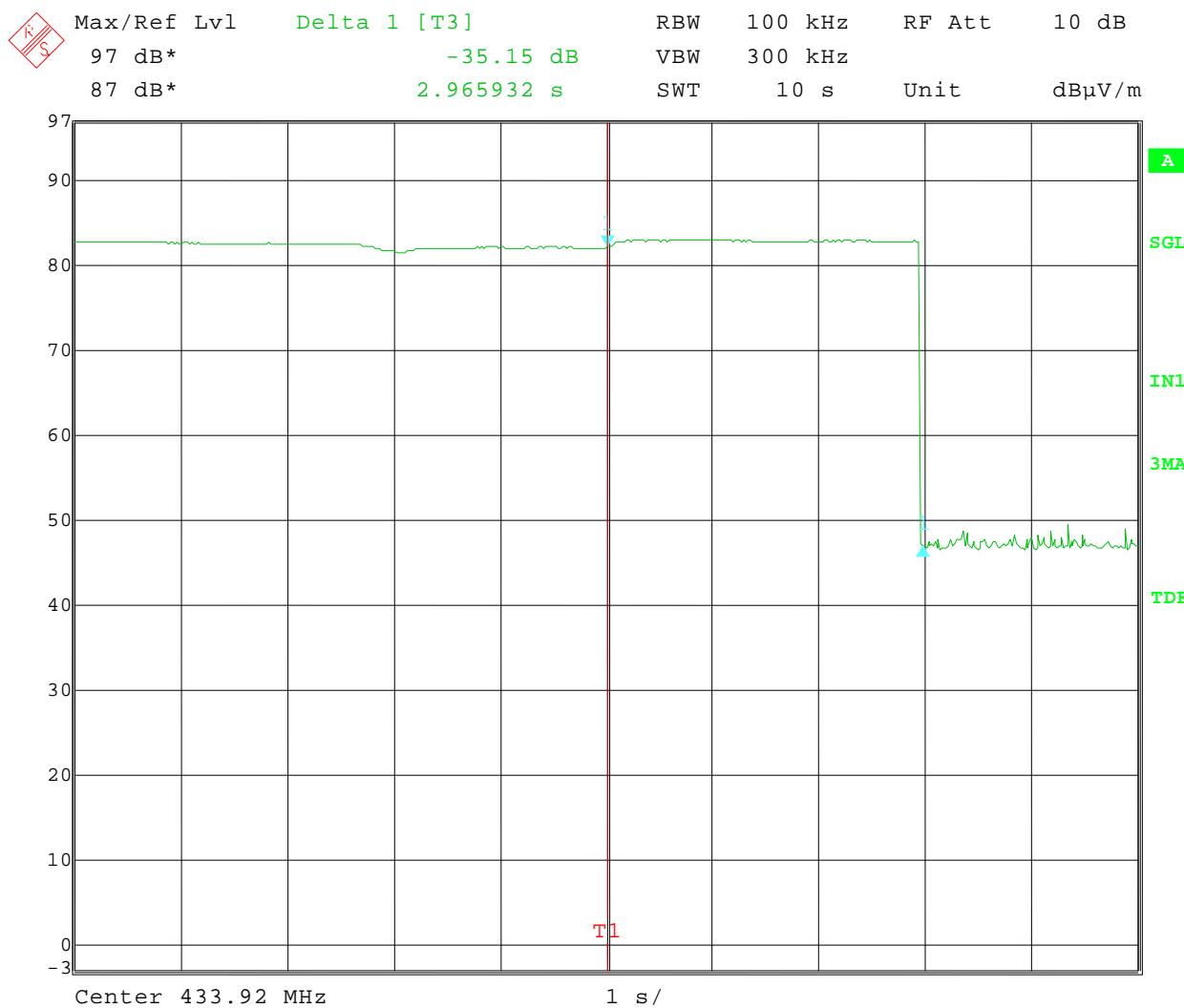
166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

Test Date: 11-15-2010  
Company: Gammex Inc.  
EUT: AccuChrom-3 Remote Control  
Test: Off time  
Operator: Adam A  
Comment: Transmit Frequency – 433.92 MHz

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.  
(Transmit button released at 5 second centerline and DUT continued to transmit for 2.96 seconds before deactivating.)

Off time = 2.96 seconds



Date: 15.NOV.2010 12:37:38



166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix B

### 3.0 Field Strength of Emissions – Fundamental and Spurious

#### Rule Part:

15.231 (b) including 15.205

#### Test Procedure:

ANSI C63.4-2009 and ANSI C63.10-2009

#### Limit:

Fundamental (F)  $\mu$ V/m at 3 meters: 41.6667(F) – 7083.3333

The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.

#### Results:

Compliant

#### Sample Equation(s):

$$41.6667(F) - 7083.3333 = 10996.68 \mu\text{V/m} \text{ at 3 meters}$$

$$20 * \log(10996.68) = 80.825 \text{ dB } \mu\text{V/m} \text{ at 3 meters}$$

Final Corrected = Total Level - Duty Cycle Correction

Margin = Limit - Final Corrected

Level = Total Level - System Loss - Antenna Factor

#### Notes:

The emissions were measured of the fundamental and spurious at a distance of three meters between the EUT and the measuring antenna. The EUT was rotated in 3 orthogonal planes and the highest emission was recorded. Since the unit was not able to transmit continuously, at an 100 % duty cycle, compliance is determined by comparing peak data, minus duty cycle correction, to the average limit.



166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
 Model Tested: GLED-RC  
 Report Number: 16630  
 Project Number: 4058

**Radiated Fundamental and Spurious Emissions – 30 MHz to 5 GHz**

Tested at a 3 Meter Distance 30MHz to 5GHz

**EUT:** AccuChrom-3 Remote Control  
**Manufacturer:** Gammex, Inc.  
**Operating Condition:** 70 deg F; 32% R.H.  
**Test Site:** DLS O.F. OATS 3  
**Operator:** Adam A  
**Test Specification:** FCC Part 15.231(b) / RSS-210 Issue 7 Annex 1 (table 4)  
**Comment:** Continuous transmit – 433.92 MHz  
**Date:** 11-15-2010

**Notes:** Since unit was not able to transmit continuously, compliance is determined by comparing Peak data, minus duty cycle correction, to the Average limits

**Legend:** H=Harmonic ; RB=Restricted Band ; F=Fundamental

Frequency (MHz)	Measurement Type	Antenna Polarization	Level (dBuV)	Antenna Factor (dB/m)	System Loss (dB)	Total Level (dBuV/m)	Duty Cycle Correction (dB)	Final Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	EUT Angle (deg)	Comment
433.920	Max Peak	Vert	62.68	15.92	4.50	83.10	0	83.10	100.825	17.7	1.3	105	F
	Average						6.22	76.88	80.825	3.9			F
	Max Peak	Horz	62.00	16.70	4.50	83.20	0	83.20	100.825	17.6	1.8	5	F
	Average						6.22	76.98	80.825	3.8			F
867.840	Max Peak	Vert	37.08	22.56	-18.50	41.14	0	41.14	80.825	39.7	1.0	220	H
	Average						6.22	34.92	60.825	25.9			H
	Max Peak	Horz	36.98	23.36	-18.50	41.84	0	41.84	80.825	39.0	1.4	170	H
	Average						6.22	35.62	60.825	25.2			H
1301.760	Max Peak	Vert	60.46	24.50	-38.10	46.86	0	46.86	74	27.1	1.0	180	H / RB
	Average						6.22	40.64	54	13.4			H / RB
	Max Peak	Horz	60.94	24.50	-38.10	47.34	0	47.34	74	26.7	1.2	210	H / RB
	Average						6.22	41.12	54	12.9			H / RB
1735.680	Max Peak	Vert	71.86	26.15	-38.20	59.81	0	59.81	80.825	21.0	1.0	170	H
	Average						6.22	53.59	60.825	7.2			H
	Max Peak	Horz	72.63	26.15	-38.20	60.58	0	60.58	80.825	20.2	1.5	205	H
	Average						6.22	54.36	60.825	6.5			H
2169.600	Max Peak	Vert	64.03	27.83	-37.80	54.06	0	54.06	80.825	26.8	1.0	180	H
	Average						6.22	47.84	60.825	13.0			H
	Max Peak	Horz	63.52	27.83	-37.80	53.55	0	53.55	80.825	27.3	1.0	180	H
	Average						6.22	47.33	60.825	13.5			H
2603.520	Max Peak	Vert	65.71	29.08	-37.20	57.59	0	57.59	80.825	23.2	1.1	165	H
	Average						6.22	51.37	60.825	9.5			H
	Max Peak	Horz	63.30	29.08	-37.20	55.18	0	55.18	80.825	25.6	1.3	340	H
	Average						6.22	48.96	60.825	11.9			H
3037.440	Max Peak	Vert	58.37	30.30	-37.30	51.37	0	51.37	80.825	29.5	1.0	155	H
	Average						6.22	45.15	60.825	15.7			H
	Max Peak	Horz	57.66	30.30	-37.30	50.66	0	50.66	80.825	30.2	1.2	175	H
	Average						6.22	44.44	60.825	16.4			H
3471.360	Max Peak	Vert	52.51	31.16	-37.10	46.57	0	46.57	80.825	34.3	1.0	170	H
	Average						6.22	40.35	60.825	20.5			H
	Max Peak	Horz	54.26	31.16	-37.10	48.32	0	48.32	80.825	32.5	1.4	170	H
	Average						6.22	42.10	60.825	18.7			H
3905.280	Max Peak	Vert	50.97	32.11	-36.90	46.18	0	46.18	74	27.8	1.0	200	H / RB
	Average						6.22	39.96	54	14.0			H / RB
	Max Peak	Horz	53.24	32.11	-36.90	48.45	0	48.45	74	25.6	1.4	120	H / RB
	Average						6.22	42.23	54	11.8			H / RB
4339.200	Max Peak	Vert	50.74	32.38	-36.00	47.12	0	47.12	74	26.9	1.0	90	H / RB
	Average						6.22	40.90	54	13.1			H / RB
	Max Peak	Horz	51.82	32.38	-36.00	48.20	0	48.20	74	25.8	1.4	150	H / RB
	Average						6.22	41.98	54	12.0			H / RB



166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix B

### 4.0 Duty Cycle Correction

#### Rule Part:

15.35 (c)

#### Test Procedure:

ANSI C63.4-2009 and ANSI C63.10-2009

#### Limit:

Informative

#### Results:

Informative

#### Sample Equation(s):

See data

#### Notes:

Since the unit was not able to transmit continuously, compliance is determined by comparing peak data, minus duty cycle correction, to the average limit.



166 South Carter, Genoa City, WI 53128

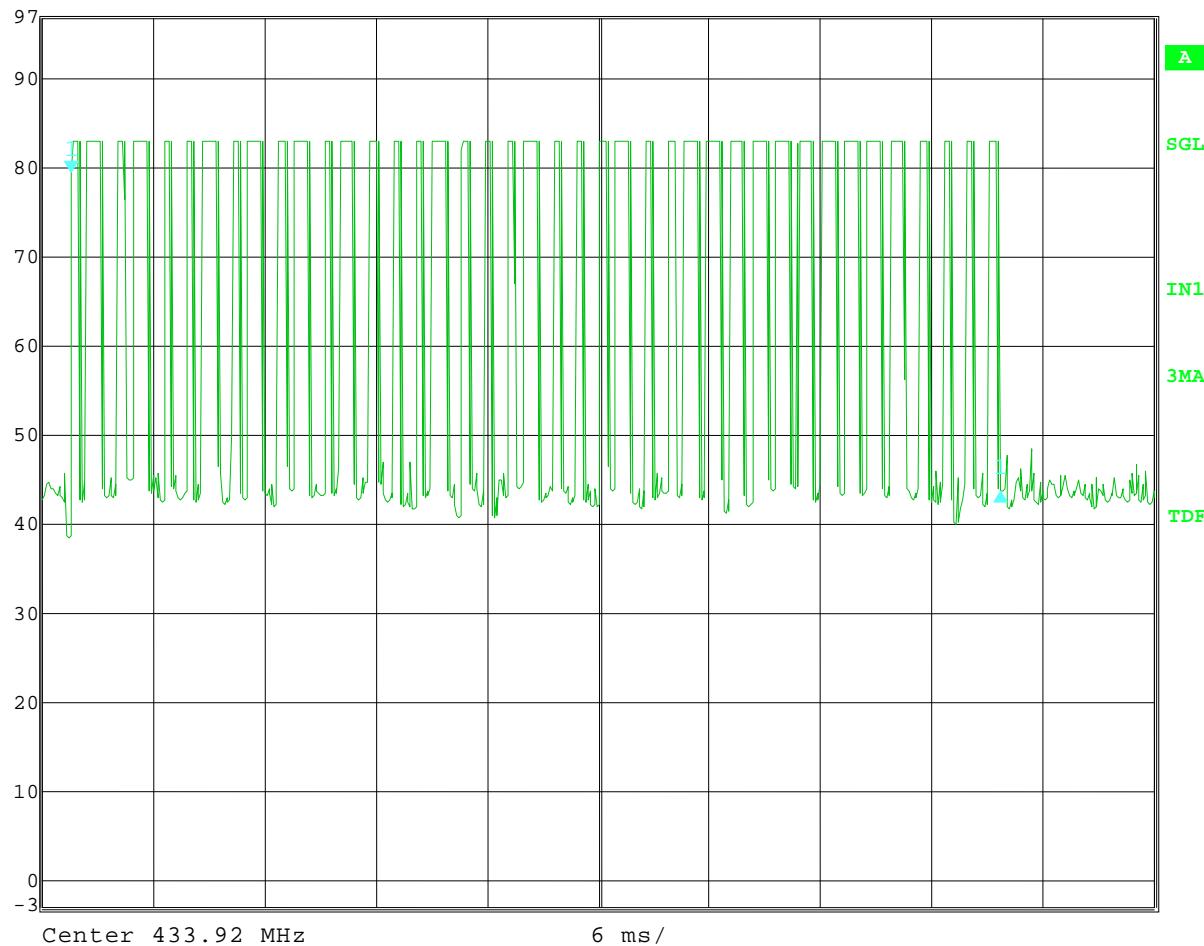
Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

Test Date: 11-15-10  
Company: Gammex Inc.  
EUT: AccuChrom-3 Remote Control  
Operator: Adam A  
Comment: Transmit Frequency – 433.92 MHz  
Comment: 39 wide pulses in 100 ms sweep  
30 narrow pulses in 100 ms sweep  
On time of one wide pulse = 881.76  $\mu$ s  
On time of one narrow pulse = 480.96  $\mu$ s  
Total on Time in 100 ms =  $39 * 881.76 \mu$ s +  $30 * 480.96 \mu$ s = 48.82 ms  
Total on Time in 100 ms =  $20 \log (48.82 / 100) = -6.23$

**Duty Cycle Correction Factor = 6.23 dB**

Length of Pulse Train: 50.19 ms

Max/Ref Lvl	Delta 1 [T3]	RBW	100 kHz	RF Att	10 dB
97 dB*	-35.82 dB	VBW	300 kHz		
87 dB*	50.190381 ms	SWT	60 ms	Unit	dB $\mu$ V/m



Date: 15.NOV.2010 11:05:19

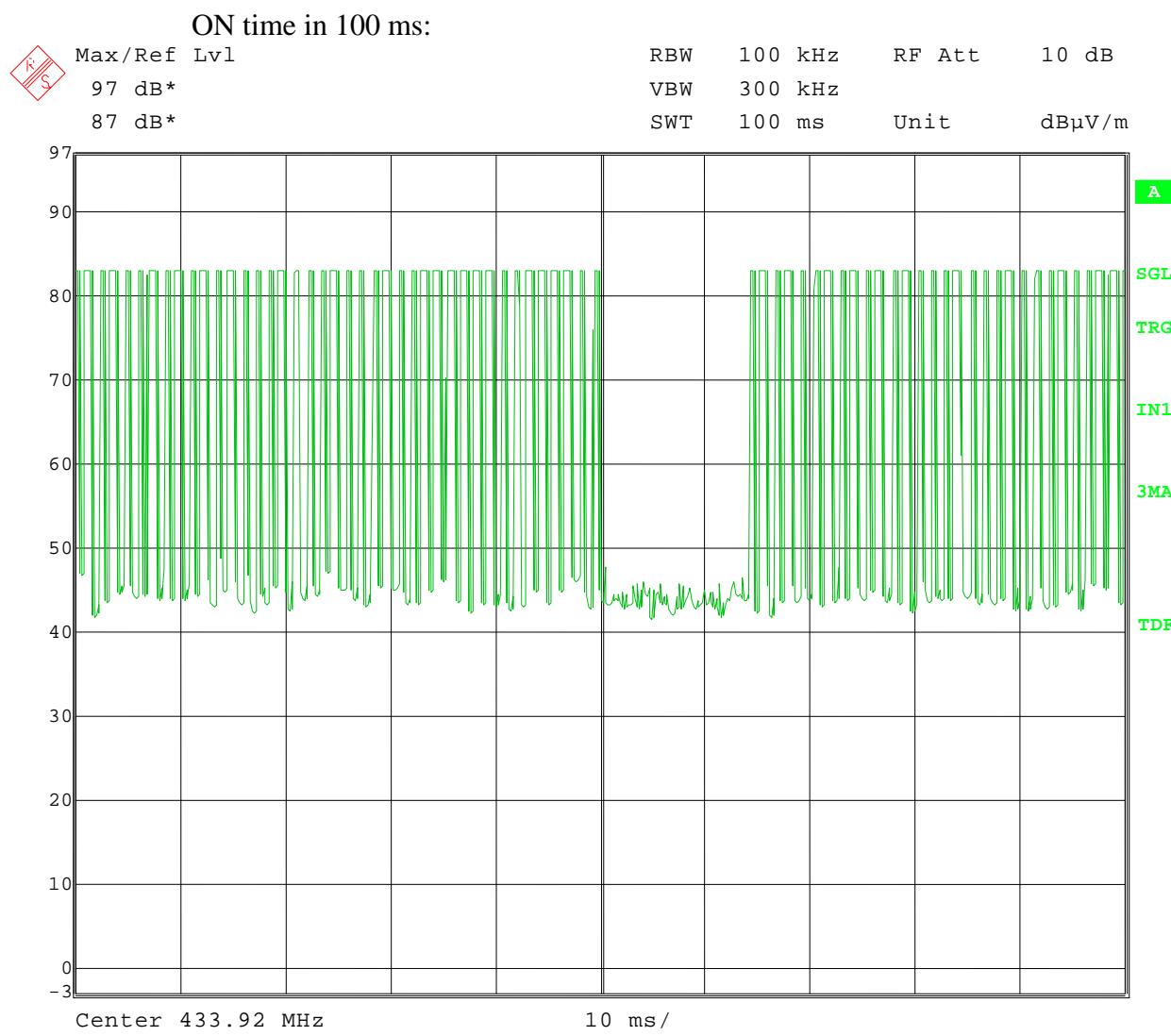


166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix B

Test Date: 11-15-10  
Company: Gammex Inc.  
EUT: AccuChrom-3 Remote Control  
Operator: Adam A  
Comment: Transmit Frequency – 433.92 MHz



Date: 15.NOV.2010 11:12:36



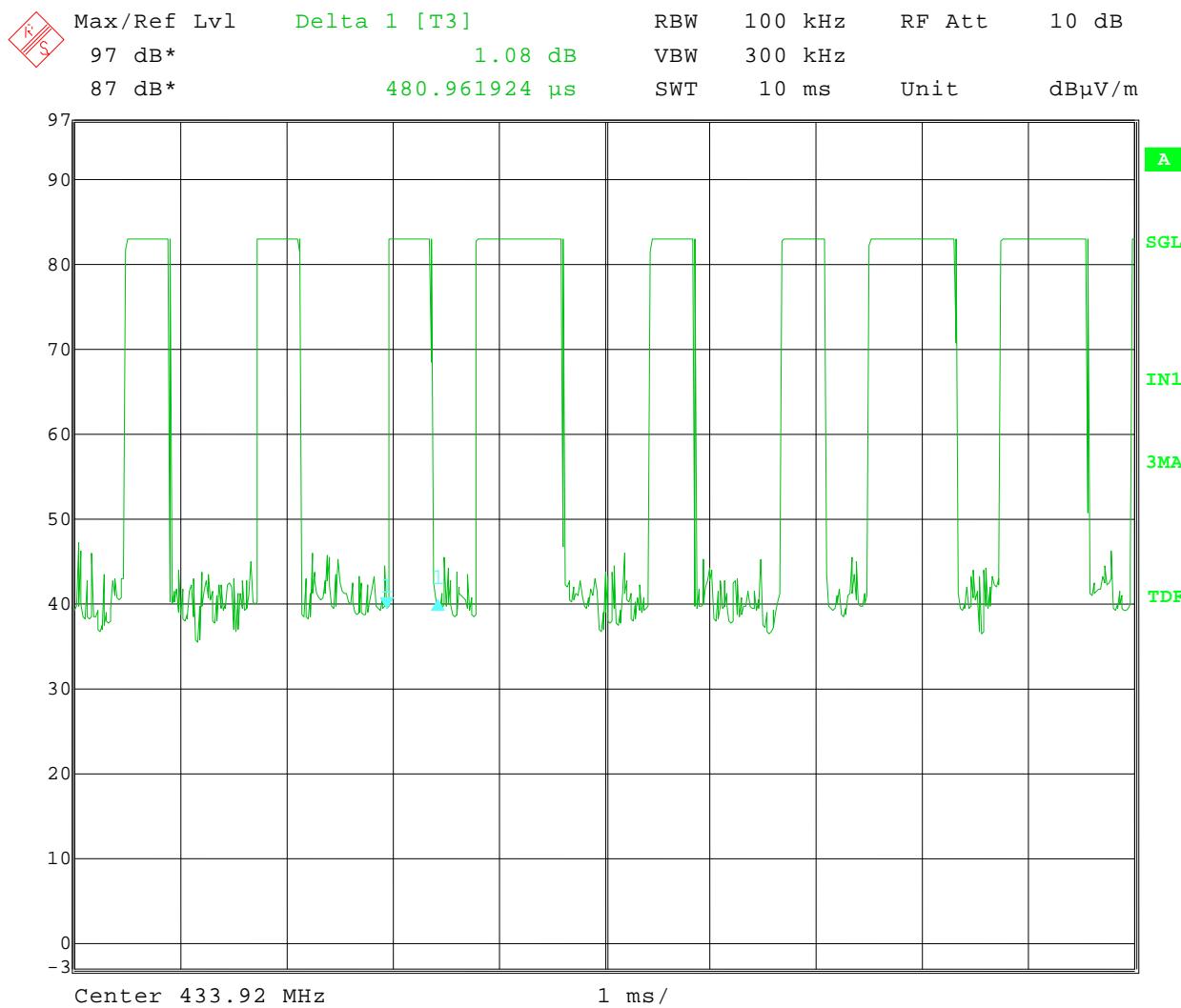
166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix B

Test Date: 11-15-10  
Company: Gammex Inc.  
EUT: AccuChrom-3 Remote Control  
Operator: Adam A  
Comment: Transmit Frequency – 433.92 MHz

ON time of narrow pulse:



Date: 15.NOV.2010 11:17:48



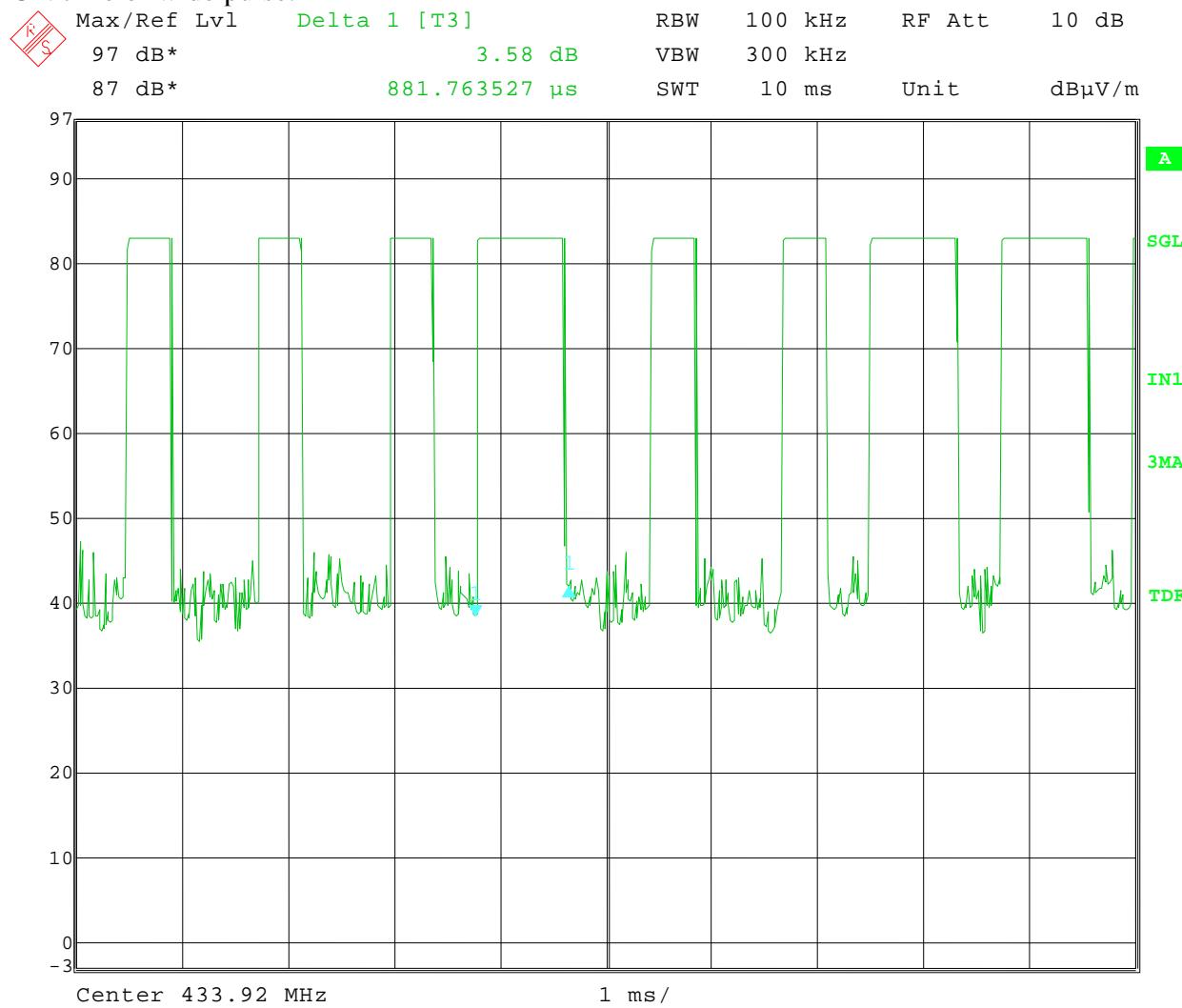
166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix B

Test Date: 11-15-10  
Company: Gammex Inc.  
EUT: AccuChrom-3 Remote Control  
Operator: Adam A  
Comment: Transmit Frequency – 433.92 MHz

ON time of wide pulse:



Date: 15.NOV.2010 11:18:48



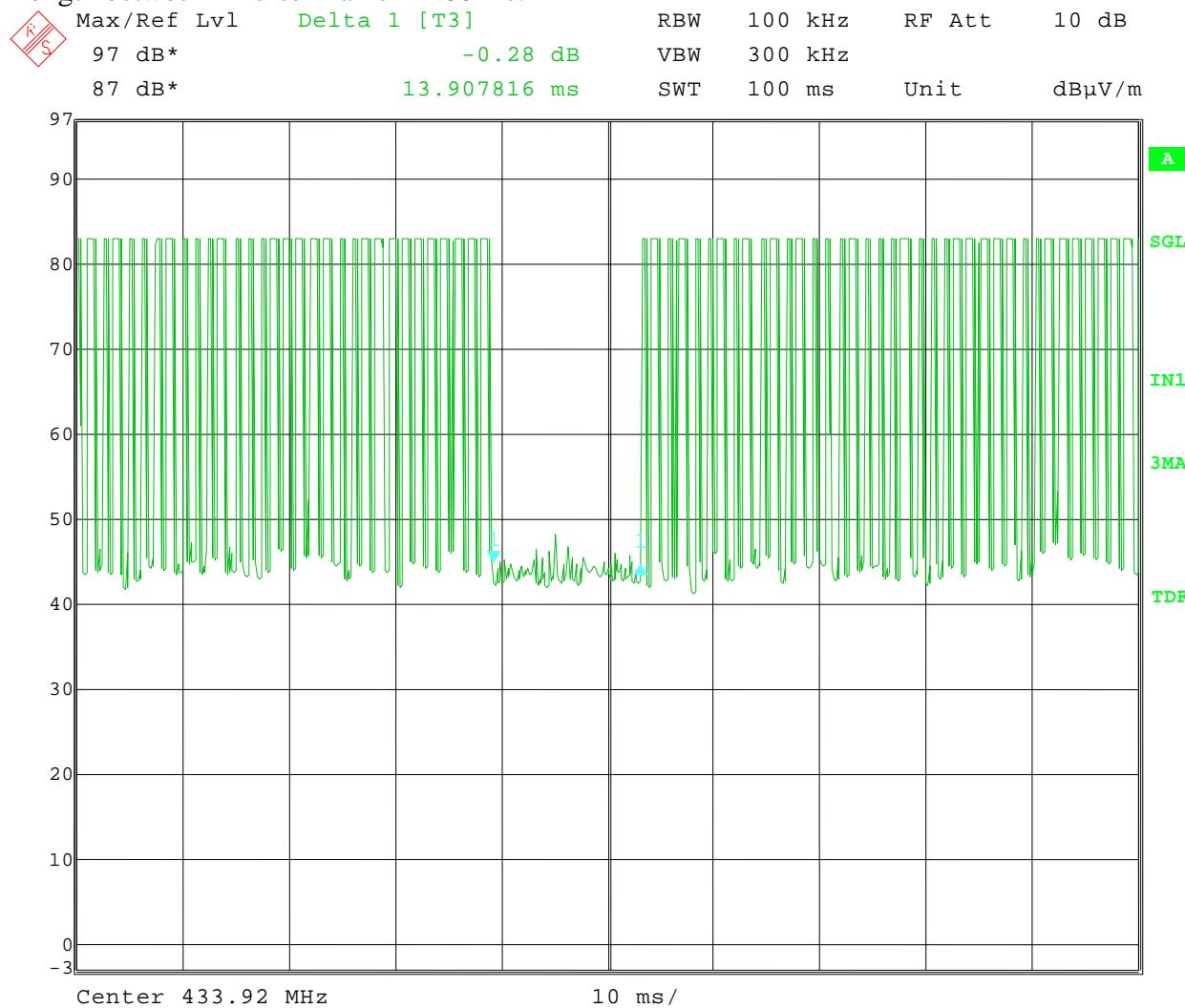
166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## Appendix B

Test Date: 11-15-10  
Company: Gammex Inc.  
EUT: AccuChrom-3 Remote Control  
Operator: Adam A  
Comment: Transmit Frequency – 433.92 MHz

Length between 2 Pulse Trains in 100 ms:



Date: 15.NOV.2010 11:21:47



166 South Carter, Genoa City, WI 53128

Company: Gammex, Inc.  
Model Tested: GLED-RC  
Report Number: 16630  
Project Number: 4058

## END OF REPORT

Revision #	Date	Comments	By
1.0	11-23-2010	Preliminary Release	AA
1.1	11-29-2010	Minor grammar corrections / clarifications	AA
1.2	11-30-2010	Minor grammar change and update to introduction	AA
1.3	12-06-2010	Added clarification to pg 17	AA