1250 Peterson Dr., Wheeling, IL 60090

Company: Tecnova
Model Tested: ZR1
Report Number: 12340

FCC Rules and Regulations / Intentional Radiators

Operational in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz, Bands

Part 15, Subpart C, Section 15.247

THE FOLLOWING **"MEETS"** THE ABOVE TEST SPECIFICATION

Formal Name:	ZigRay
Kind of Equipment:	Wireless 802.15.4 transceiver
Test Configuration:	Plugged into other products by a 20pin header (Tested at 120 vac, 60 Hz)
Model Number(s):	ZR1
Model(s) Tested:	ZR1
Serial Number(s):	X100, X101
Date of Tests:	June 30, 2006 and July 3, & 5, 2006
Test Conducted For:	Tecnova 1486 St. Paul Avenue Gurnee, Illinois 60031

NOTICE: "This report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government". Please see the "Additional Description of Equipment Under Test" page listed inside of this report. This report must not be reproduced (except in full), without the approval of D.L.S. Electronic Systems.

1250 Peterson Dr., Wheeling, IL 60090

Company: Tecnova
Model Tested: ZR1
Report Number: 12340

SIGNATURE PAGE

Report By:

Arnom C. Rowe
Test Engineer
EMC-001375-NE

Reviewed By:

William Stumpf
OATS Manager

Approved By:

Brian Mattson
General Manager

Company Official:

Tecnova

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United States Department of Commerce
National Institute of Standards and Technology

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NVLAP LAB CODE: 100276-0

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

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ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

2005-10-01 through 2006-09-30
Effective dates

For the National Institute of Standards and Technology

NVLAP-01C (REV. 2005-05-19)

1.0 SUMMARY OF TEST REPORT

It was found that the ZigRay, Model Number(s) ZR1, **''meets''** the radio interference conducted and radiated emission requirements of the FCC "Rules and Regulations", Part 15, Subpart C, Section 15.247 for operational in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz, Bands.

This test report relates only to the items tested and contains the following number of pages.

Text: 70

2.0 INTRODUCTION

On June 30, 2006 and July 3, & 5, 2006, a series of radio frequency interference measurements was performed on ZigRay, Model Number(s) ZR1, Serial Number: X100, X101. The tests were performed according to the procedures of the FCC as stated in the "Methods of Measurement of Radio-Noise Emissions for Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" found in the American National Standards Institute, ANSI C63.4-2003. Tests were performed by personnel of D.L.S. Electronic Systems, Inc. who are responsible to Donald L. Sweeney, Senior EMC Engineer.

3.0 OBJECT

The purpose of this series of tests was to determine if the test sample could meet the radio frequency interference emission requirements of the FCC "Rules and Regulations", Part 15, Subpart C, Sections 15.205, 15.209 & 15.247 for Intentional Radiators operating in the Bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

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.

4.0 TEST SET-UP

All emission tests were performed at D.L.S. Electronic Systems, Inc. and set up according to the American National Standards Institute, ANSI C63.4-2003, Section 8, (Figures 11a and 11b).

All radiated emissions tests were performed with the test item placed on a 80 cm high rotating non-conductive table, located in the test room. Equipment normally operated on the floor was placed on a metal covered turntable which is flush with the surrounding conducting ground plane. The ground plane has an electrical isolation layer over its surface approximately 7 mm thick. The EUT is separated from the turntable ground plane by a non-conductive layer. The equipment under test was set up according to ANSI C63.4-2003, Sections 6 and 8.

5.0 TEST EQUIPMENT (Bandwidths and Detector Function)

All preliminary data below 1000 MHz was automatically plotted using the HP Spectrum Analyzer or ESI 26/40 Fixed Tuned Receiver. The data was taken using Peak, Quasi-Peak or the Average Detector Functions as required. This information was then used to determine the frequencies of maximum emissions. Above 1000 MHz, final data was taken using the Average Detector.

Below 1000 MHz, final data was taken using the HP Spectrum Analyzer and/or ESI 26/40 Fixed Tuned Receiver. These plots were made using the Peak or Quasi-Peak Detector functions, with manual measurements performed on the questionable frequencies using the Quasi-Peak or the Average Detector Function of the Analyzer or ESI 26/40 Fixed Tuned Receiver as required. Above 1000 MHz, final data was taken using the Average Detector on the Spectrum Analyzer.

The bandwidths shown below are specified by ANSI C63.4-2003, Section 4.2.

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

A list of the equipment used can be found in Table 1. All primary equipment was calibrated against known reference standards with a verified traceable path to NIST.

6.0 AMBIENT MEASUREMENTS

For emissions measurements, broadband antennas and an EMI Test Receiver with a panoramic spectrum display are used. First the frequency range is scanned and displayed on the test receiver display. Next the scanned frequency range is divided into smaller ranges, and then it is manually tuned through to determine the emissions from the EUT. A headset or loudspeaker is connected to the test receiver's AM/FM demodulated output as an aid in detecting ambient signals and finding frequencies of significant emission from the EUT. If there is any doubt as to the source of the emission, it is further investigated by rotating the EUT, or by disconnecting the power from the EUT.

The EUT is set up in its typical configuration and operated in its various modes. For tabletop systems, cables are manipulated within the range of likely configurations. For floor-standing equipment, the cables are located in the same manner as the user would install them and no further manipulation is made. If the manner of cable installation is not known, or if it changes with each installation, cables or wires for floor-standing equipment shall be manipulated to the extent possible to produce the maximum level of emissions. For each mode of operation, the frequency spectrum is monitored. Variations in antenna height, antenna polarization, EUT azimuth, and cable or wire placement (each variable within bounds specified elsewhere) are explored to produce the emissions that have the highest amplitude relative to the limit. These methods are performed to the specifications in MP-5 or ANSI C63.4-2003, as appropriate.

7.0 DESCRIPTION OF TEST SAMPLE: (See also Paragraph 8.0)

7.1 Description:

This device is a wireless transceiver operating in the ISM band from 2400Mhz to 2483.5Mhz. The device uses the 802.15.4 protocol and is intended to be used as a module. The device will be used in a variety of products and will connect to these various hosts through a 20pin connector. This device is intended to be used as a wireless data path for small amounts of data.

7.2 PHYSICAL DIMENSIONS OF EQUIPMENT UNDER TEST

Length: 2.0" x Width: 1.125" x Height: 0.22"

7.3 LINE FILTER USED:

NA

7.4 INTERNAL CLOCK FREQUENCIES:

Switching Power Supply Frequencies:

NA

Clock Frequencies:

16 MHz

7.5 DESCRIPTION OF ALL CIRCUIT BOARDS:

1. Blank PC board PN: 09-0278-00001 Rev. E
2. PCB assembly PN: 10-0378-00001 Rev. E

8.0 ADDITIONAL DESCRIPTION OF TEST SAMPLE:
(See also Paragraph 7.0)

1: There were no additional descriptions noted at the time of test.

I certify that the above, as described in paragraph 7.0, describes the equipment tested and will be manufactured as stated.

By: _____ _____
Signature Title

For: _____ _____
Company Date

9.0 PHOTO INFORMATION AND TEST SET-UP

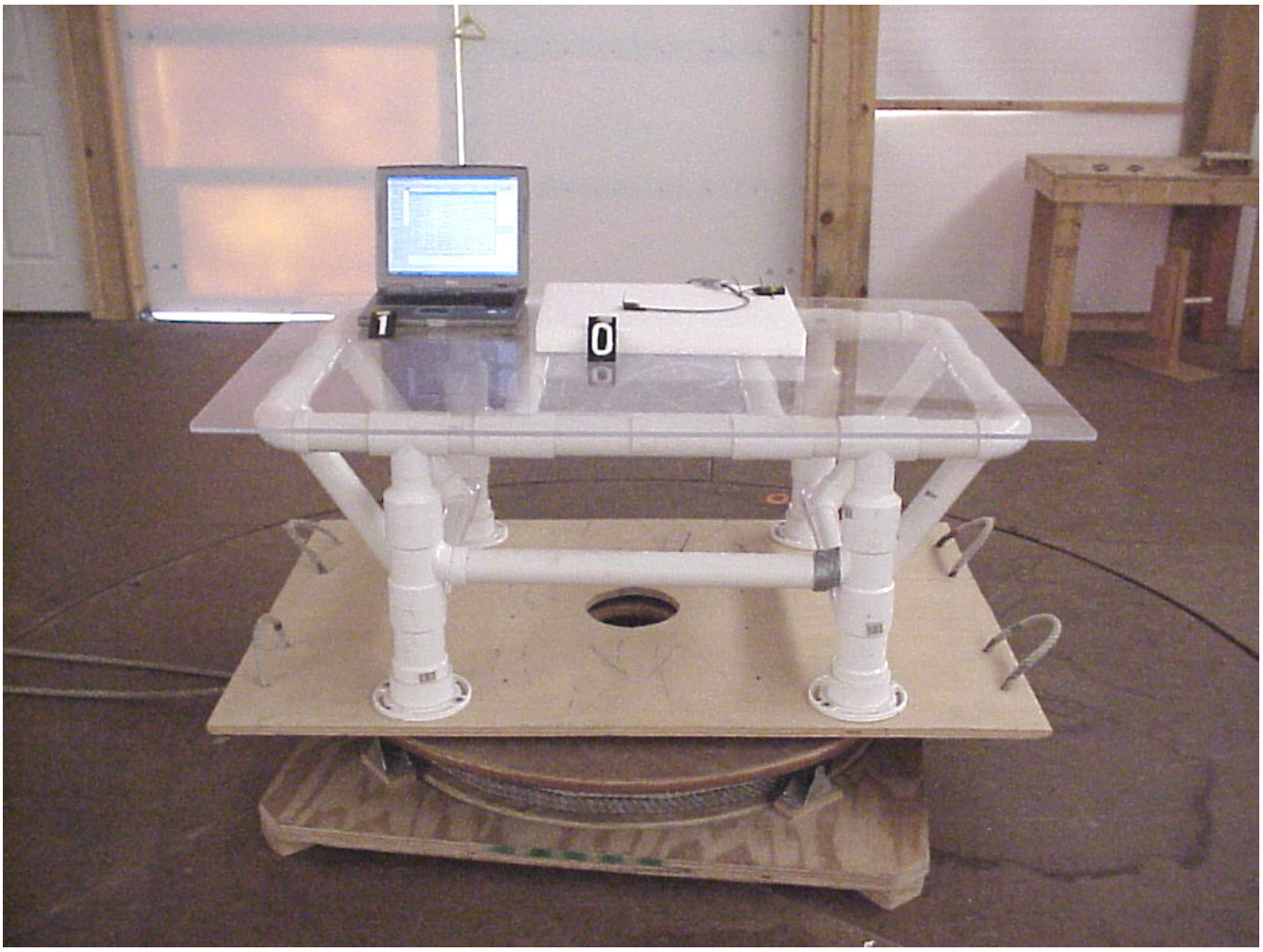
Item 0 ZigRay
Model Number: ZR1 Serial Number: X100, X101

Item 1 Dell Laptop Computer

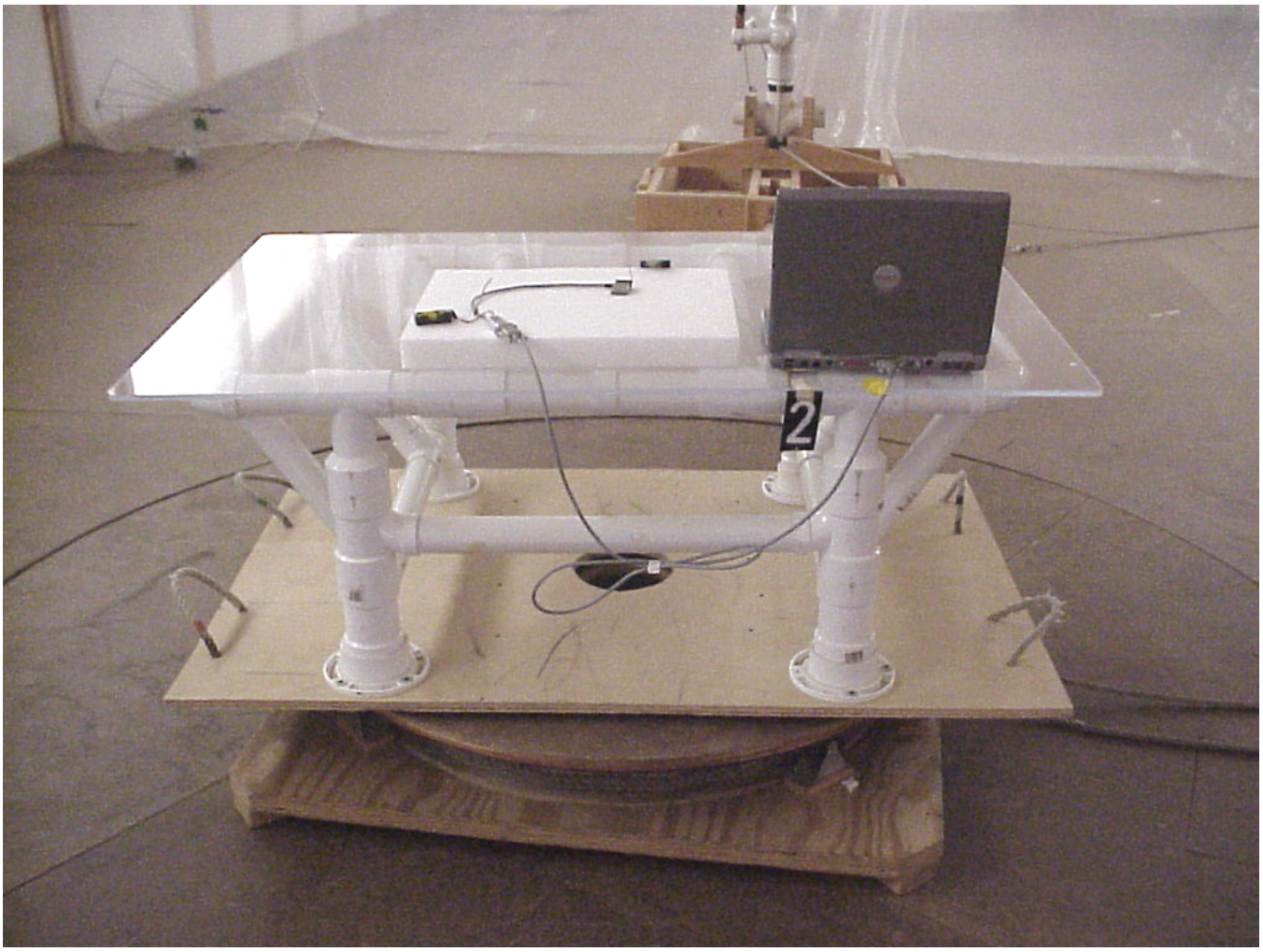
Model Number: PP17L Serial Number: JTGTJ91

Item 2 Shielded Serial Cable with Metal Shells. 2m

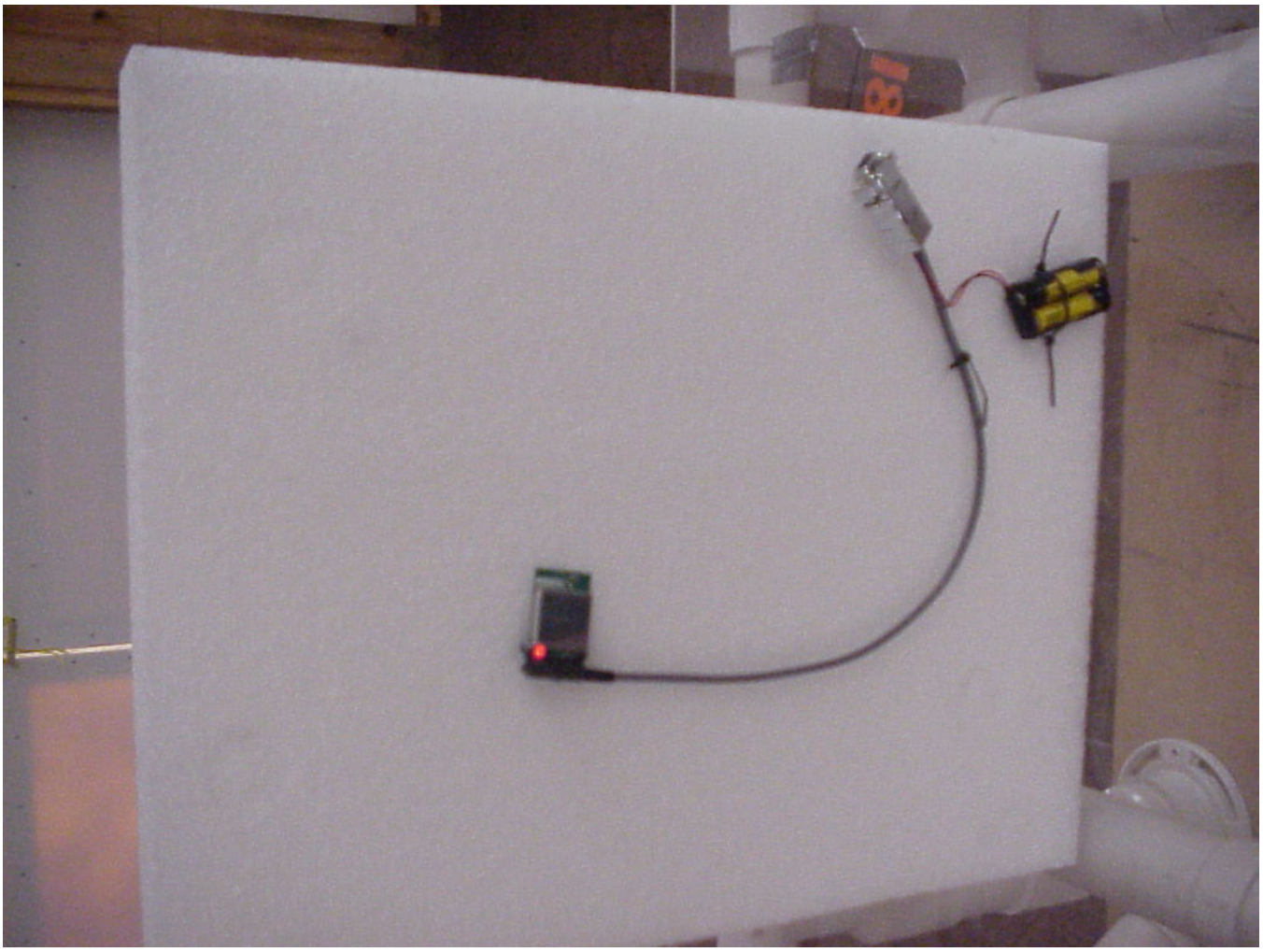
10.0 RADIATED PHOTOS TAKEN DURING TESTING



10.0 RADIATED PHOTOS TAKEN DURING TESTING

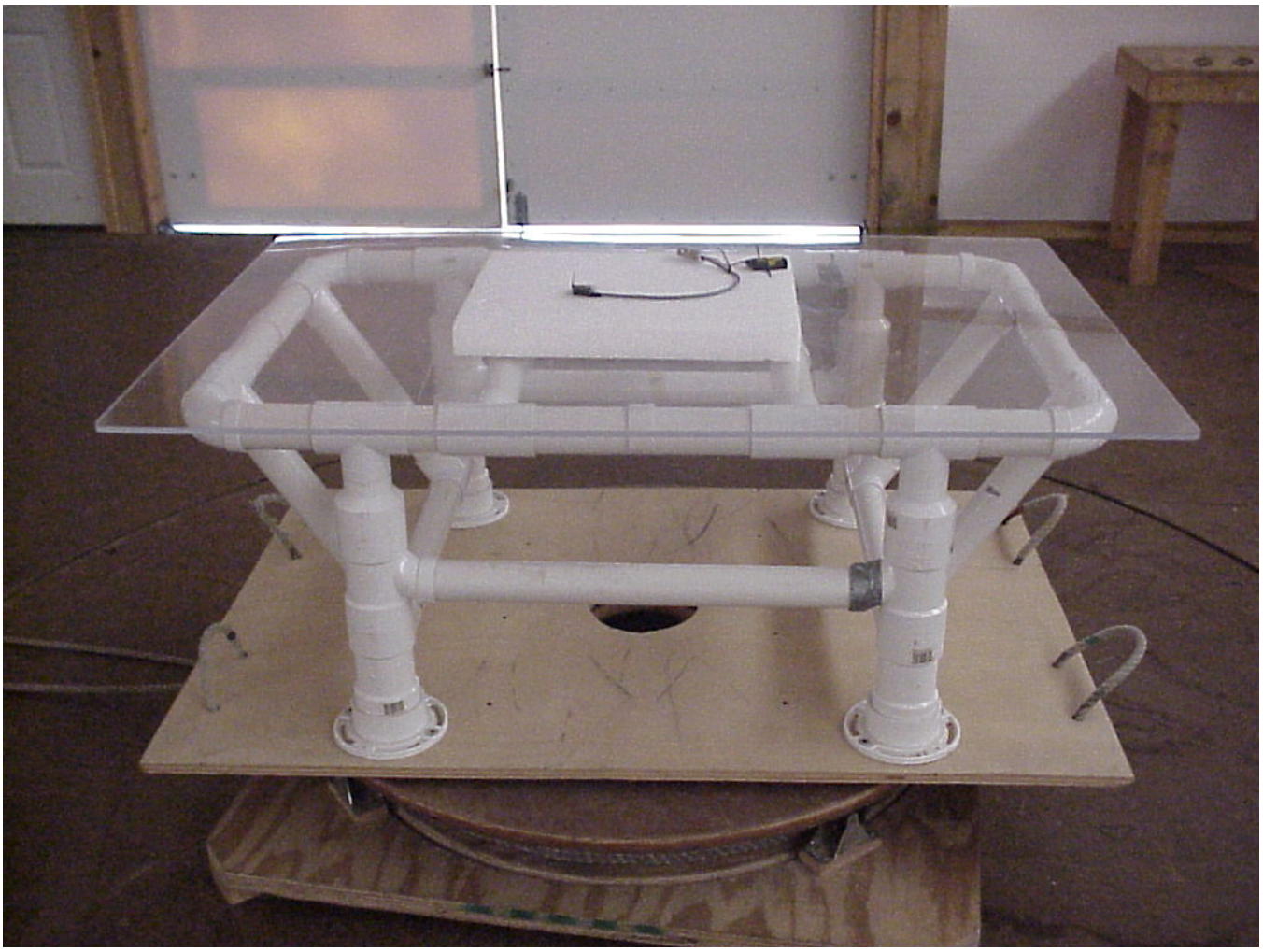


10.0 RADIATED PHOTOS TAKEN DURING TESTING



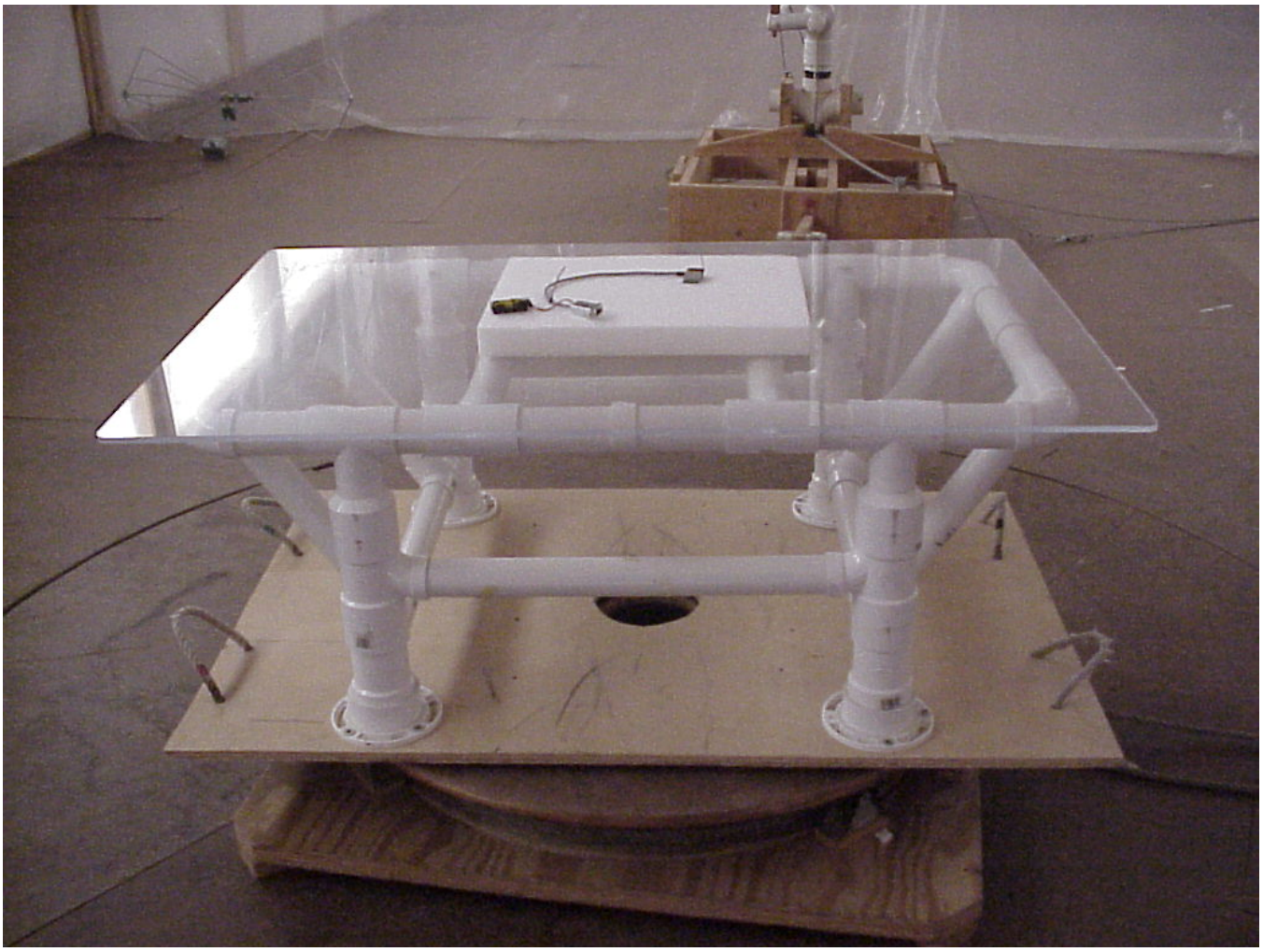
CLOSE UP OF THE EUT

10.0 RADIATED PHOTOS TAKEN DURING TESTING



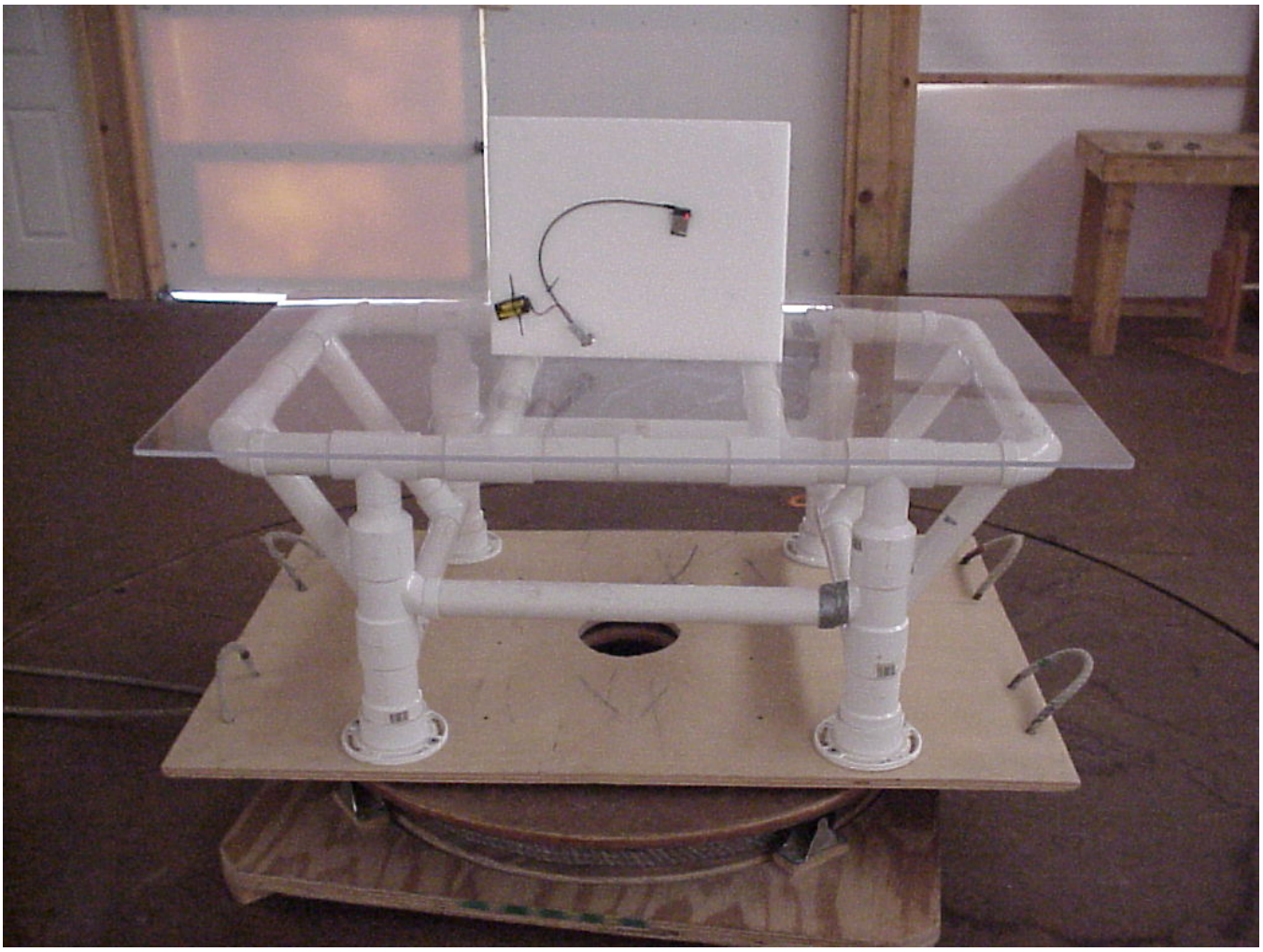
"X" AXIS (FRONT)

10.0 RADIATED PHOTOS TAKEN DURING TESTING



"X" AXIS (REAR)

10.0 RADIATED PHOTOS TAKEN DURING TESTING



"Y" AXIS

10.0 RADIATED PHOTOS TAKEN DURING TESTING

"Z" AXIS

10.0 CONDUCTED PHOTOS TAKEN DURING TESTING

10.0 CONDUCTED PHOTOS TAKEN DURING TESTING

11.0 RESULTS OF TESTS

The radio interference emission charts results can be seen on the pages at the end of this report. Data sheets indicating the test measurements taken during testing can also be found at the end of this report. Points on the emission charts shown with a yellow mark are background frequencies that were verified during testing.

12.0 CONCLUSION

It was found that the ZigRay, Model Number(s) ZR1 **''meets''** the radio interference conducted and radiated emission requirements of the FCC "Rules and Regulations", Part 15, Subpart C, Section 15.247 for operational in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz, Bands.

TABLE 1 – EQUIPMENT LIST

Test Equipment	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Due Dates
Receiver	Rohde & Schwarz	ESI 26	837491/010	20 Hz – 26 GHz	11/06
Receiver	Rohde & Schwarz	ESI 40	837808/006	20 Hz – 40 GHz	12/06
Receiver	Rohde & Schwarz	ESI 40	837808/005	20 Hz – 40 GHz	12/06
Antenna	EMCO	3104C	00054891	20 MHz – 200 MHz	2/07
Antenna	Electrometrics	LPA-25	1114	200 MHz – 1 GHz	3/07
Antenna	EMCO	3104C	00054892	20 MHz – 200 MHz	3/07
Antenna	Electrometrics	3146	1205	200 MHz – 1 GHz	3/07
Antenna	EMCO	3104C	97014785	20 MHz – 200 MHz	2/07
Antenna	EMCO	3146	97024895	200 MHz – 1 GHz	3/07
Antenna	EMCO	3115	2479	1 GHz – 18 GHz	8/06
Antenna	EMCO	3115	99035731	1 GHz – 18 GHz	4/07
Antenna	Rohde & Schwarz	HUF-Z1	829381001	20 MHz – 1 GHz	2/07
Antenna	Rohde & Schwarz	HUF-Z1	829381005	20 MHz – 1 GHz	8/06

All primary equipment is calibrated against known reference standards with a verified traceable path to NIST.

TABLE 1 – EQUIPMENT LIST

Test Equipment	Manufacturer	Model Number	Serial Number	Frequency Range	Cal Due Dates
LISN	Solar	8012-50-R-24-BNC	8305116	10 MHz – 30 MHz	8/06
LISN	Solar	8012-50-R-24-BNC	814548	10 MHz – 30 MHz	8/06
LISN	Solar	9252-50-R-24-BNC	961019	10 MHz – 30 MHz	12/06
LISN	Solar	9252-50-R-24-BNC	971612	10 MHz – 30 MHz	10/06
LISN	Solar	9252-50-R-24-BNC	92710620	10 MHz – 30 MHz	7/06

All primary equipment is calibrated against known reference standards with a verified traceable path to NIST.

APPENDIX A

TEST PROCEDURE

Part 15, Subpart C, Section 15.247 (a-h)

OPERATION WITHIN THE BAND 2400-2483.5 MHz,

APPENDIX A

1.0 CONDUCTED EMISSION MEASUREMENTS

If applicable, the conducted emissions were measured over the frequency range from 150 kHz to 30 MHz in accordance with the power line measurements as specified in the American National Standards Institute, ANSI C63.4-2003, Section 12. Since the device is operated from the public utility lines, the 115 Vac 60 Hz power leads, high and low sides, were to be measured by connecting the measuring equipment to the appropriate meter terminal of the LISN. All signals were then recorded. The allowed levels for Intentional Radiators cannot exceed 250 uV (47.96 dBuV) at any frequency between 150 kHz and 30 MHz, as stated in Section 15.207a.

All conducted emissions measurements were made at a test room temperature of **73°F** at **56%** relative humidity.

APPENDIX A

DATA AND GRAPH(S) TAKEN DURING TESTING

PART 15.207

FCC Part 15.247 Class B

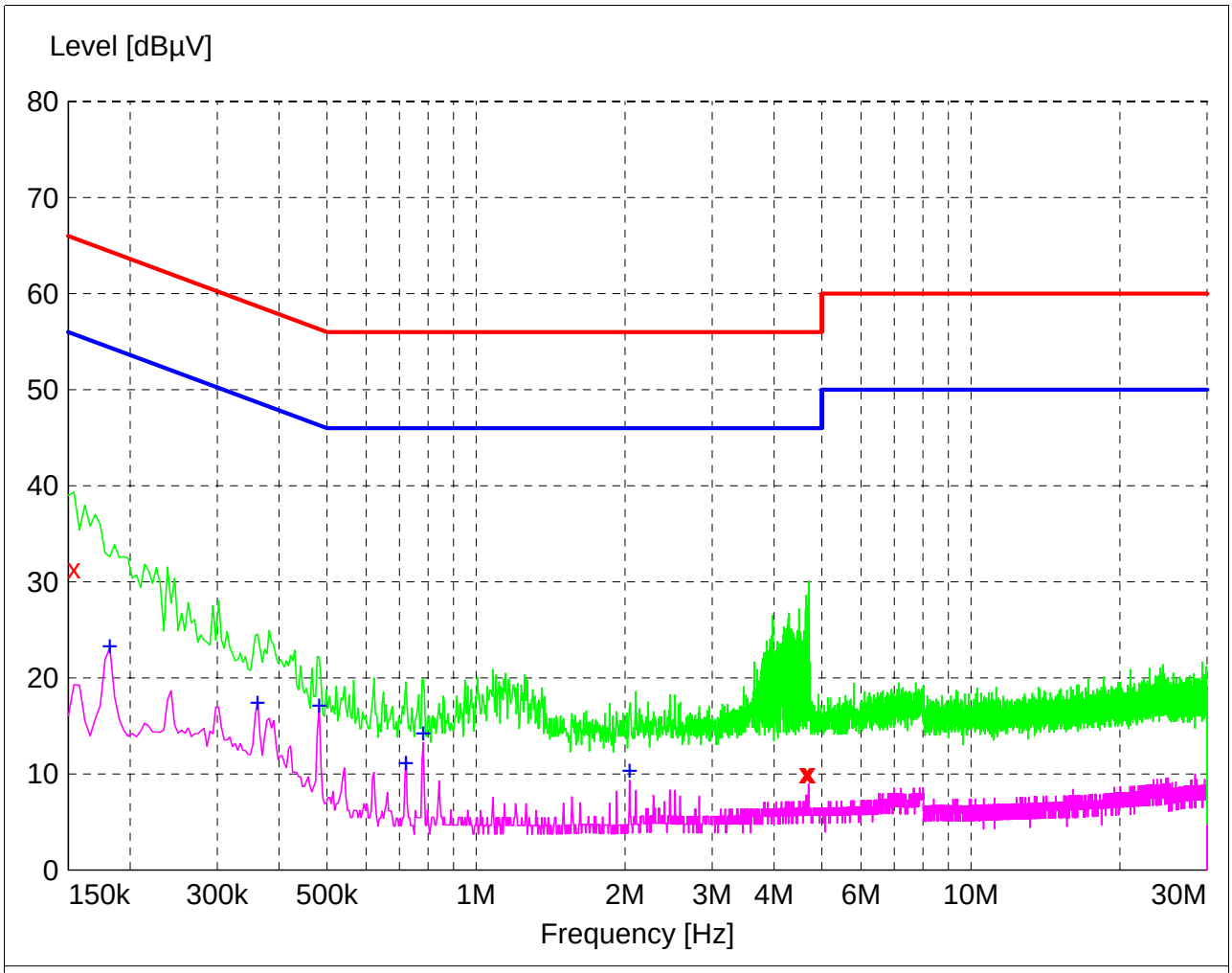
Voltage Mains Test

EUT:	Zigray
Manufacturer:	Tecnova
Operating Condition:	73 deg. F, 56% R.H.
Test Site:	DLS O.F. Site 1 (Screenroom)
Operator:	Jason Lauer
Test Specification:	3 VDC Power - Line 1 (DC Ground)
Comment:	Transmit Frequency = 2.405 GHz
	Date: 07-05-2006

SCAN TABLE: "Line Cond Scrn RmFin"

Short Description: Line Conducted Emissions

Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	4.0 kHz	QuasiPeak CISPR AV	5.0 s	9 kHz	LISN DLS#128



x x MES zigfcTx1l1_fin
+ + MES zigfcTx1l1_fin2
MES zigfcTx1l1_pre
MES zigfcTx1l1_pre2
LIM FCC ClassB V QP New Voltage Amplitude QP Limit
LIM FCC ClassB V AV New Voltage Amplitude AVG Limit

MEASUREMENT RESULT: "zigfcTx1l1_fin"

7/5/2006 10:37AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.154000	31.40	11.4	66	34.4	QP	---	---
4.634000	10.00	10.4	56	46.0	QP	---	---
4.646000	10.00	10.4	56	46.0	QP	---	---
4.666000	10.00	10.4	56	46.0	QP	---	---
4.698000	10.00	10.4	56	46.0	QP	---	---
4.710000	10.00	10.4	56	46.0	QP	---	---

MEASUREMENT RESULT: "zigfcTx1l1_fin2"

7/5/2006 10:37AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.182000	23.30	11.0	54	31.1	CAV	---	---
0.362000	17.40	10.3	49	31.3	CAV	---	---
0.482000	17.10	10.2	46	29.2	CAV	---	---
0.722000	11.10	10.2	46	34.9	CAV	---	---
0.782000	14.20	10.2	46	31.8	CAV	---	---
2.042000	10.30	10.3	46	35.7	CAV	---	---

FCC Part 15.247 Class B

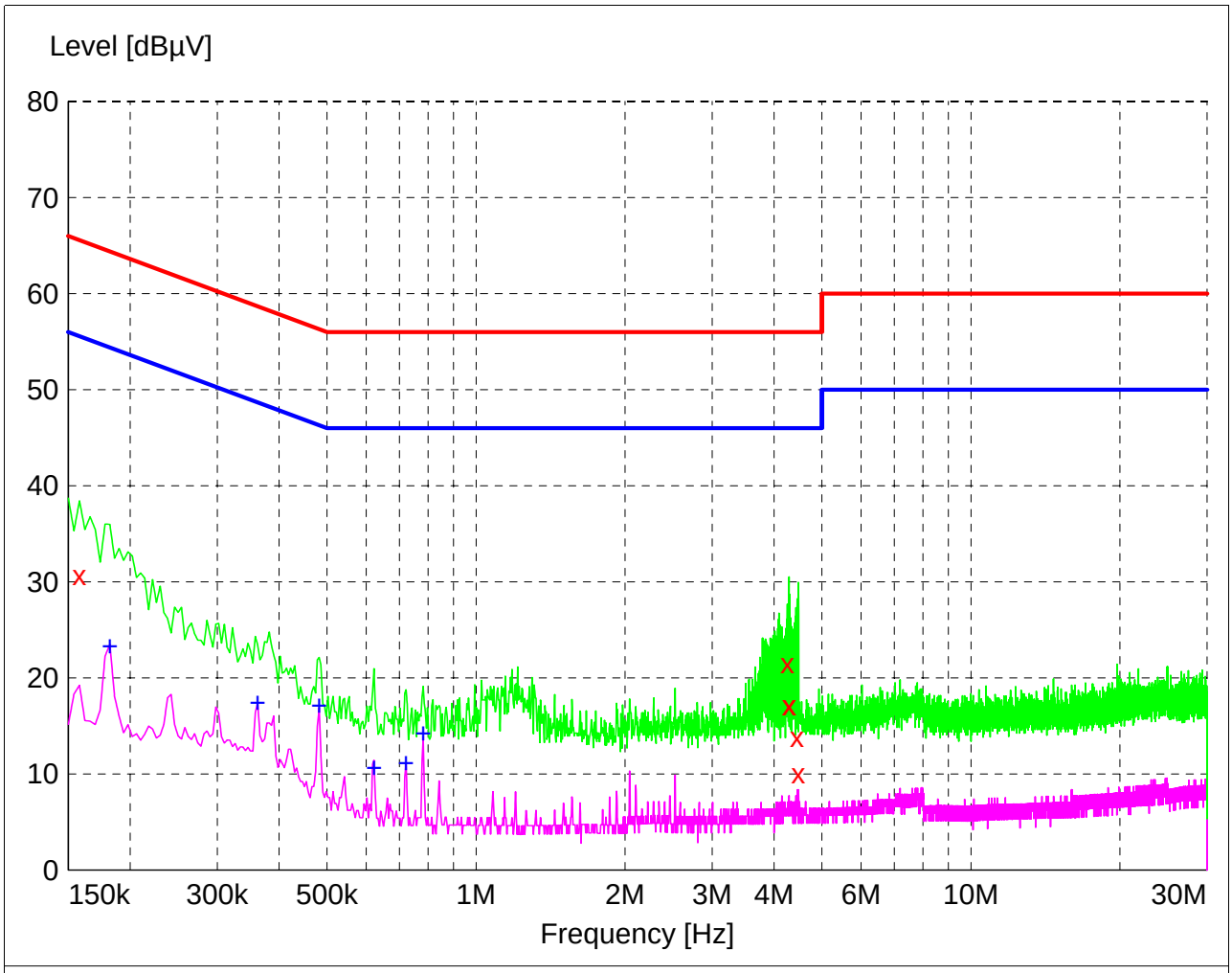
Voltage Mains Test

EUT:	Zigray
Manufacturer:	Tecnova
Operating Condition:	73 deg. F, 56% R.H.
Test Site:	DLS O.F. Site 1 (Screenroom)
Operator:	Jason Lauer
Test Specification:	3 VDC Power - Line 2 (DC Positive)
Comment:	Transmit Frequency = 2.405 GHz
	Date: 07-05-2006

SCAN TABLE: "Line Cond Scrn RmFin"

Short Description: Line Conducted Emissions

Start Frequency	Stop Frequency	Step Width	Detector	Meas. Time	IF Bandw.	Transducer
150.0 kHz	30.0 MHz	4.0 kHz	QuasiPeak CISPR AV	5.0 s	9 kHz	LISN DLS#128



MEASUREMENT RESULT: "zigfcTx1l2_fin"

7/5/2006 10:42AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.158000	30.70	11.4	66	34.9	QP	---	---
4.258000	21.50	10.4	56	34.5	QP	---	---
4.290000	17.10	10.4	56	38.9	QP	---	---
4.298000	17.10	10.4	56	38.9	QP	---	---
4.454000	13.80	10.4	56	42.2	QP	---	---
4.482000	10.00	10.4	56	46.0	QP	---	---

MEASUREMENT RESULT: "zigfcTx1l2_fin2"

7/5/2006 10:42AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.182000	23.30	11.0	54	31.1	CAV	---	---
0.362000	17.40	10.3	49	31.3	CAV	---	---
0.482000	17.10	10.2	46	29.2	CAV	---	---
0.622000	10.60	10.1	46	35.4	CAV	---	---
0.722000	11.10	10.2	46	34.9	CAV	---	---
0.782000	14.20	10.2	46	31.8	CAV	---	---

APPENDIX A

2.0 SPURIOUS EMISSIONS AT ANTENNA TERMINALS – PART 15.247(c)

Spurious conducted emissions were measured at the antenna terminals. Plots were made showing the amplitude of each harmonic emission with the equipment operated. As shown by the radiated charts there was no reason to believe that there were any spurious emissions other than the harmonics that were than individually investigated when doing the conducted test at the antenna terminals. Measurements were made up to the 10th harmonic of the fundamental.

The allowed emissions for transmitters operating in the 2400 MHz - 2485 MHz bands for ZigRay equipment are found under Part 15, Section 15.247(c). This paragraph states that in any 100 kHz bandwidth outside the frequency band which the spread spectrum intentional radiator is operating, the radio frequency power produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

NOTE: See the following pages for the data ad graphs of the actual measurements made:

APPENDIX A

CONDUCTED EMISSION DATA AND GRAPH(S)

TAKEN FOR

SPURIOUS EMISSION MEASUREMENTS MADE

AT THE ANTENNA TERMINALS

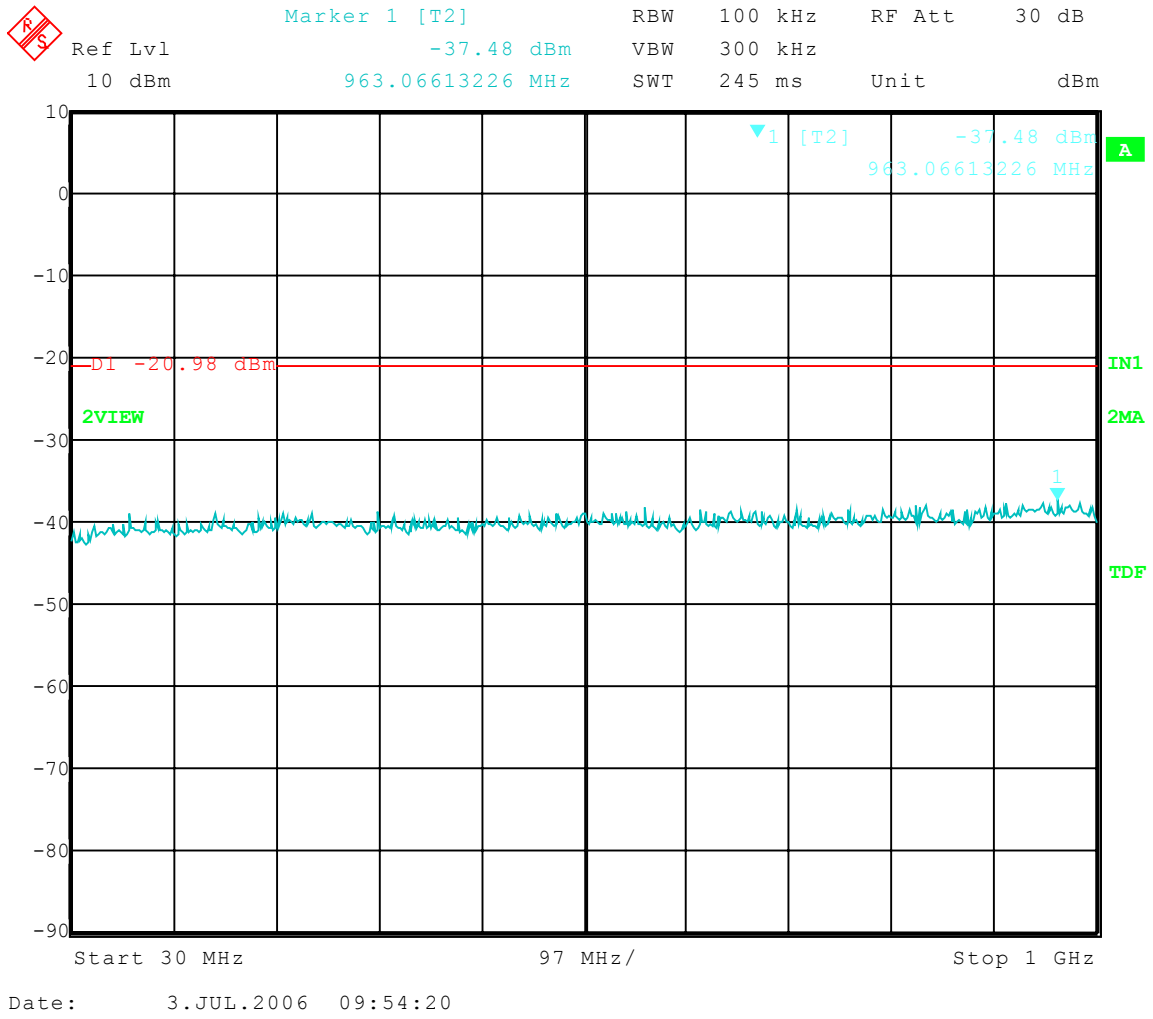
PART 15.247(c)

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Spurious Emissions - Conducted
Operator: Jason Lauer
Comment: High Channel Transmit = 2.480 GHz
Frequency Range: 30 to 1000 MHz
Limit = -20.98 dBm

All Spurious Emissions at Least 20 dB below Peak Level of In Band Frequency



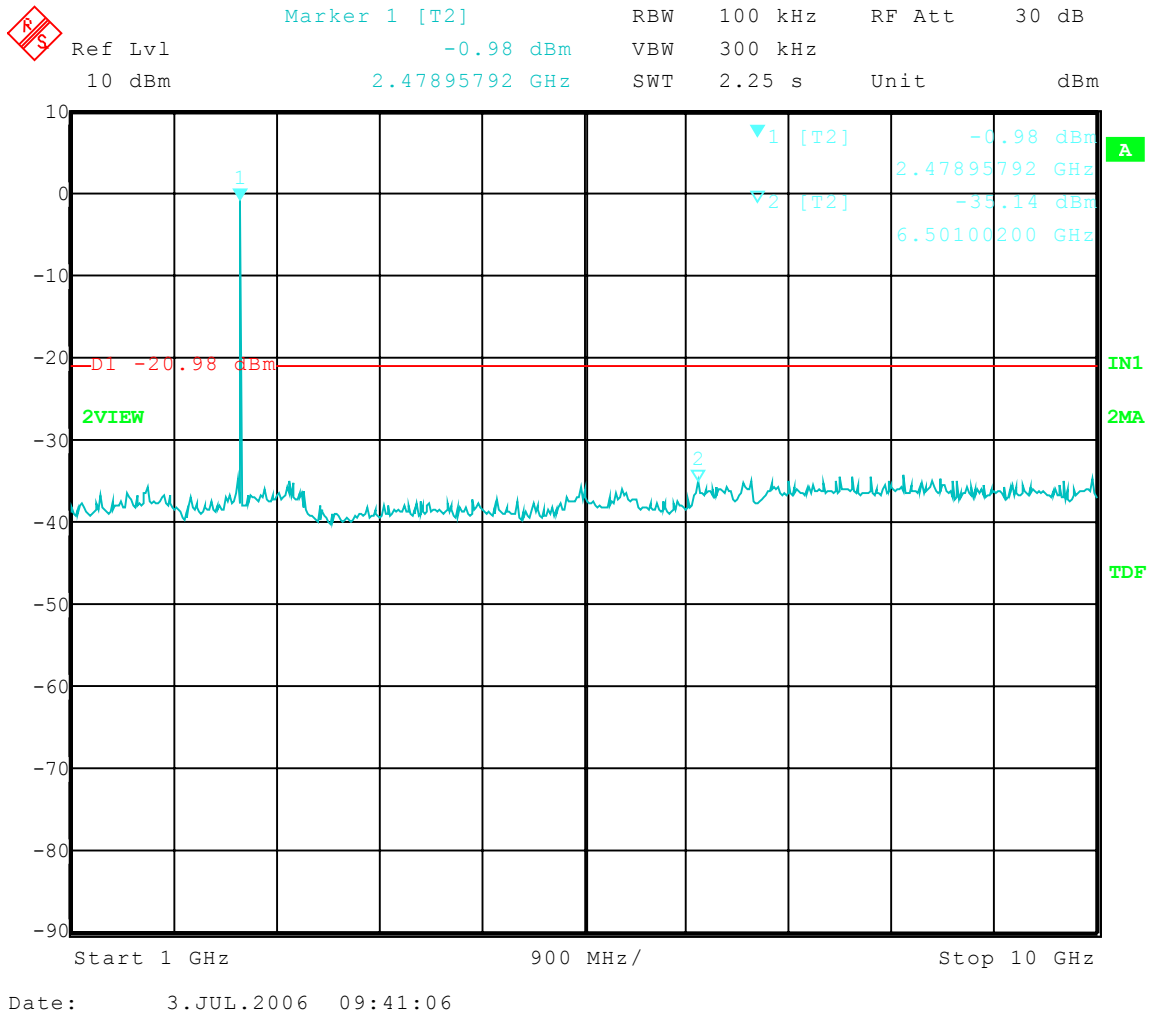
Date: 3.JUL.2006 09:54:20

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Spurious Emissions - Conducted
Operator: Jason Lauer
Comment: High Channel Transmit = 2.480 GHz
Frequency Range: 1 to 10 GHz
Limit = -20.98 dBm

All Spurious Emissions at Least 20 dB below Peak Level of In Band Frequency

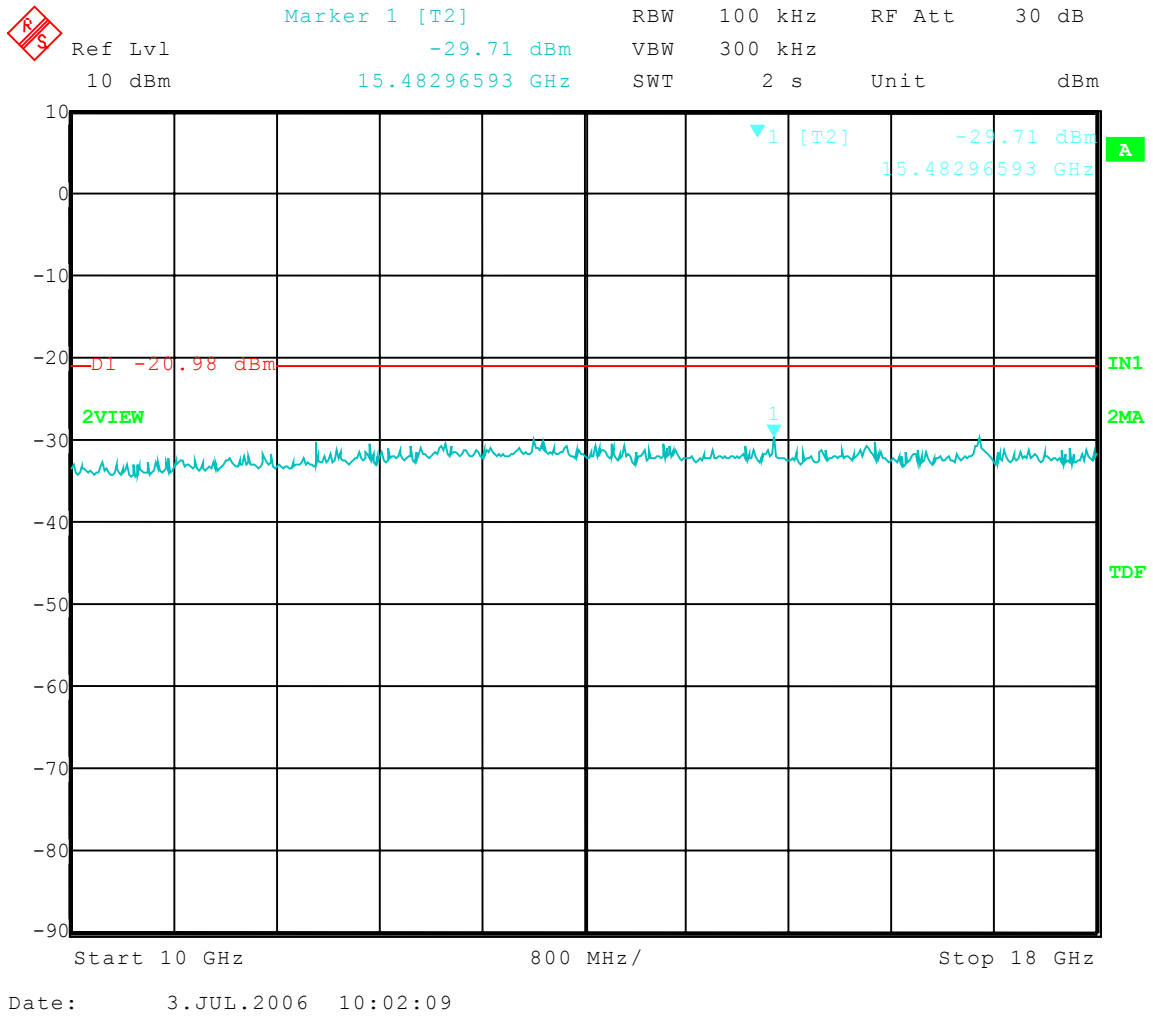


1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Spurious Emissions - Conducted
Operator: Jason Lauer
Comment: High Channel Transmit = 2.480 GHz
Frequency Range: 10 to 18 GHz
Limit = -20.98 dBm

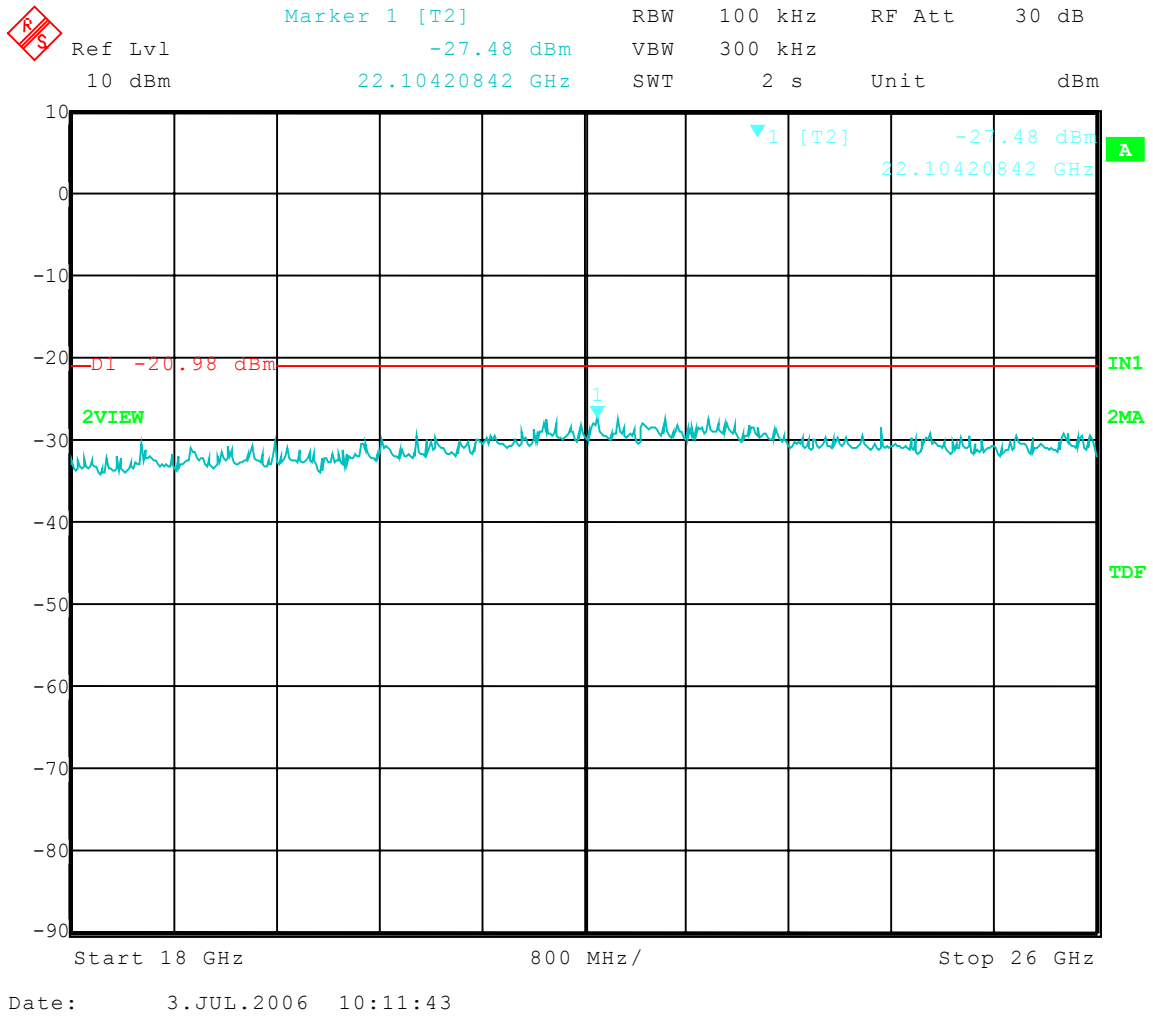
All Spurious Emissions at Least 20 dB below Peak Level of In Band Frequency



APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Spurious Emissions - Conducted
Operator: Jason Lauer
Comment: High Channel Transmit = 2.480 GHz
Frequency Range: 18 to 26 GHz
Limit = -20.98 dBm

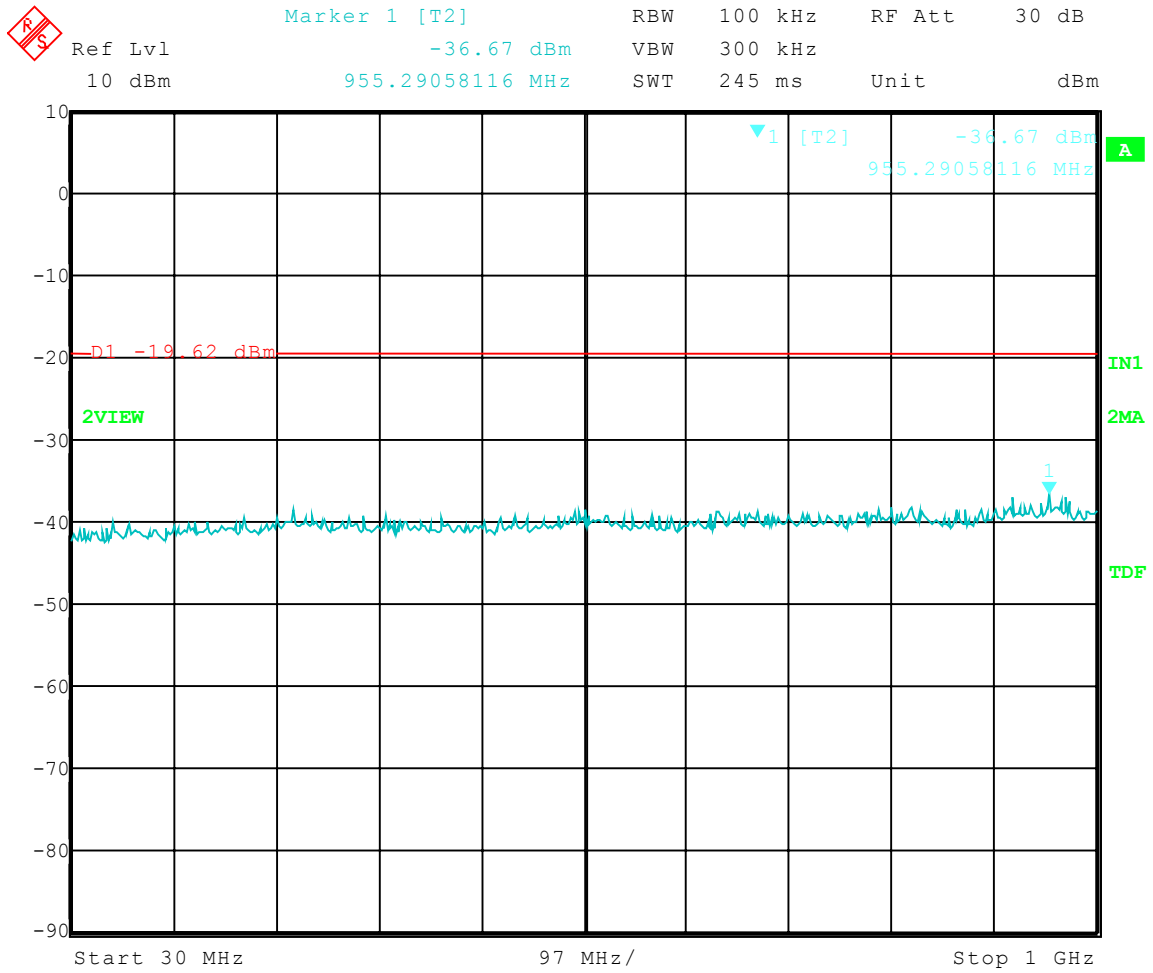
All Spurious Emissions at Least 20 dB below Peak Level of In Band Frequency



APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Spurious Emissions - Conducted
Operator: Jason Lauer
Comment: Middle Channel Transmit = 2.440 GHz
Frequency Range: 30 to 1000 MHz
Limit = -19.62 dBm

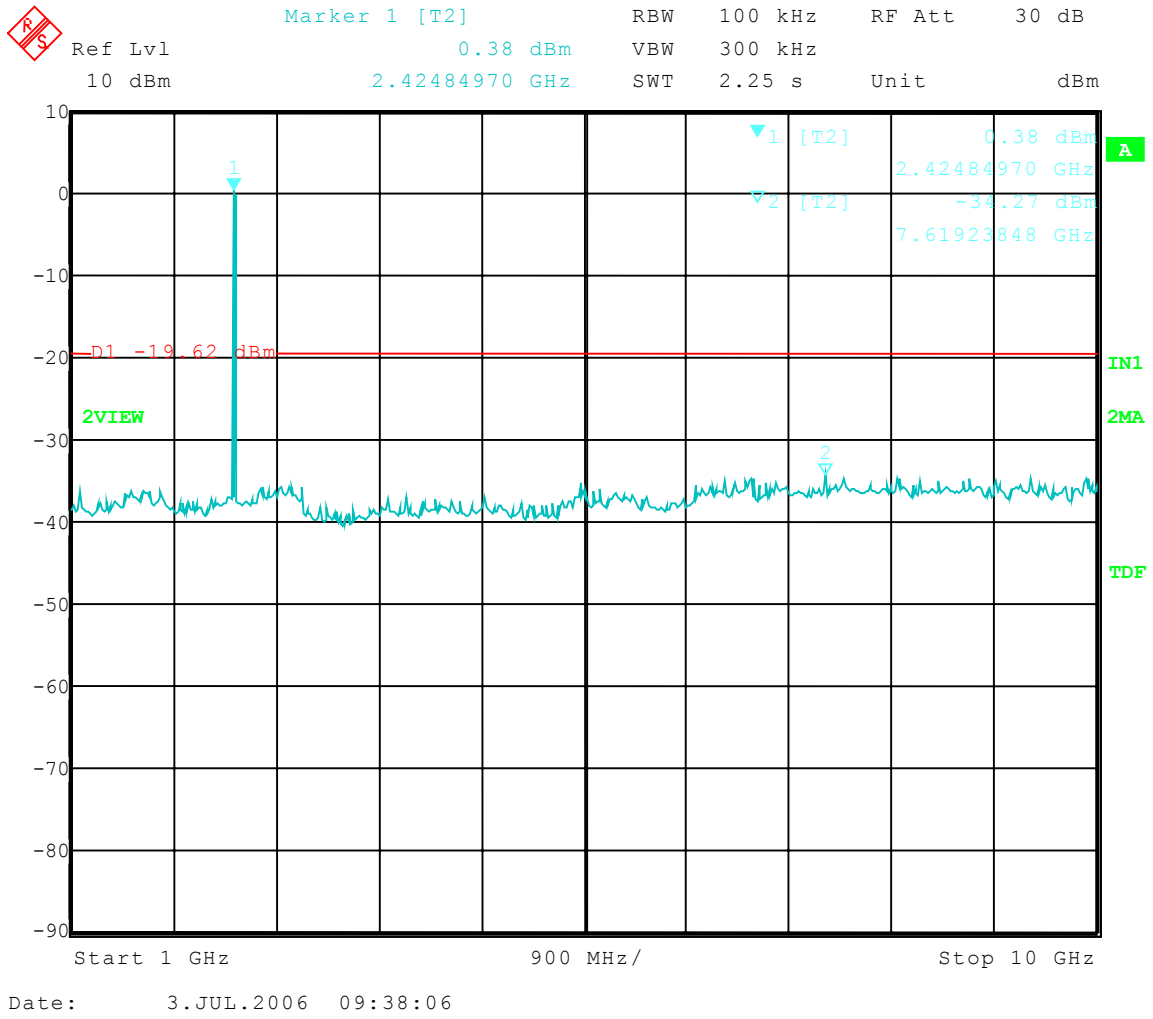
All Spurious Emissions at Least 20 dB below Peak Level of In Band Frequency



APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Spurious Emissions - Conducted
Operator: Jason Lauer
Comment: Middle Channel Transmit = 2.440 GHz
Frequency Range: 1 to 10 GHz
Limit = -19.62 dBm

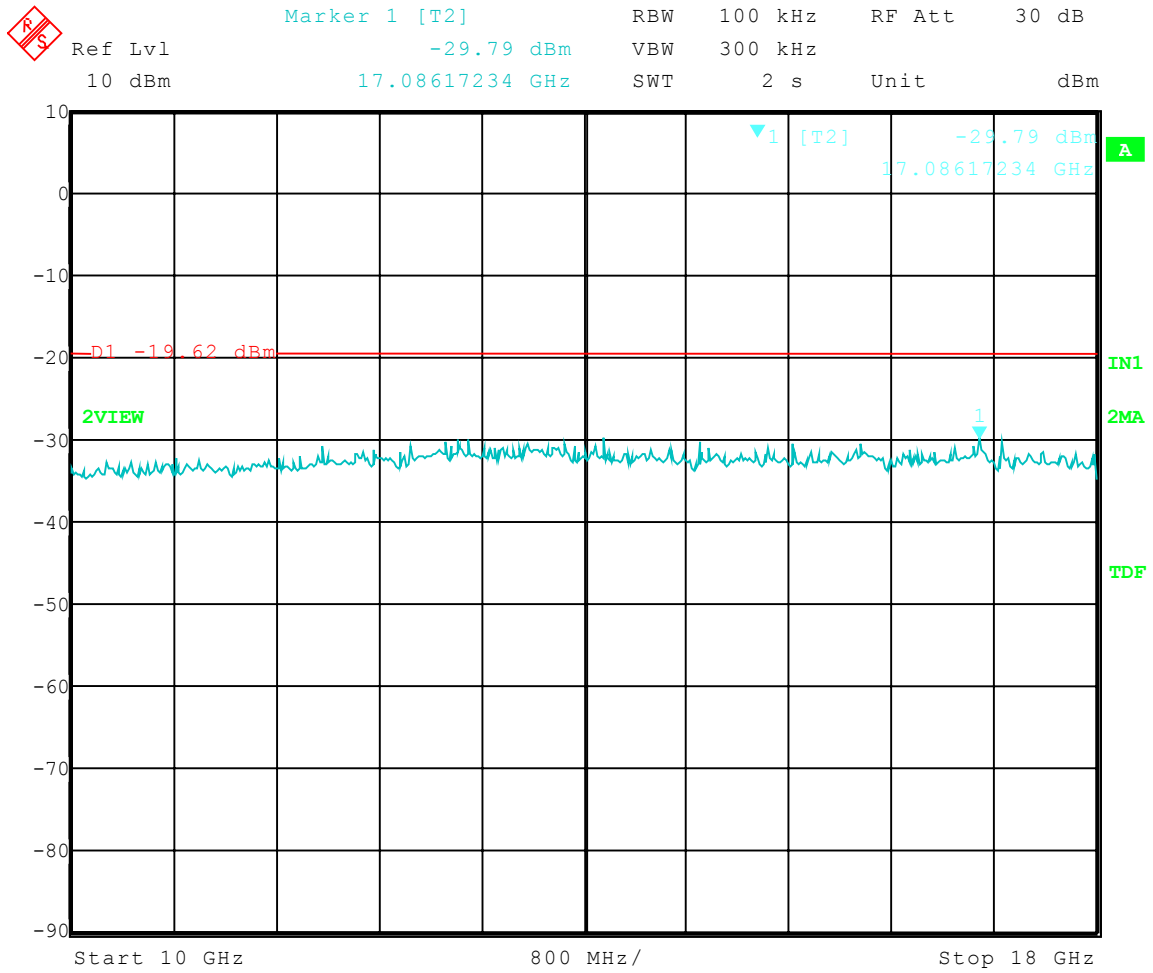
All Spurious Emissions at Least 20 dB below Peak Level of In Band Frequency



APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Spurious Emissions - Conducted
Operator: Jason Lauer
Comment: Middle Channel Transmit = 2.440 GHz
Frequency Range: 10 to 18 GHz
Limit = -19.62 dBm

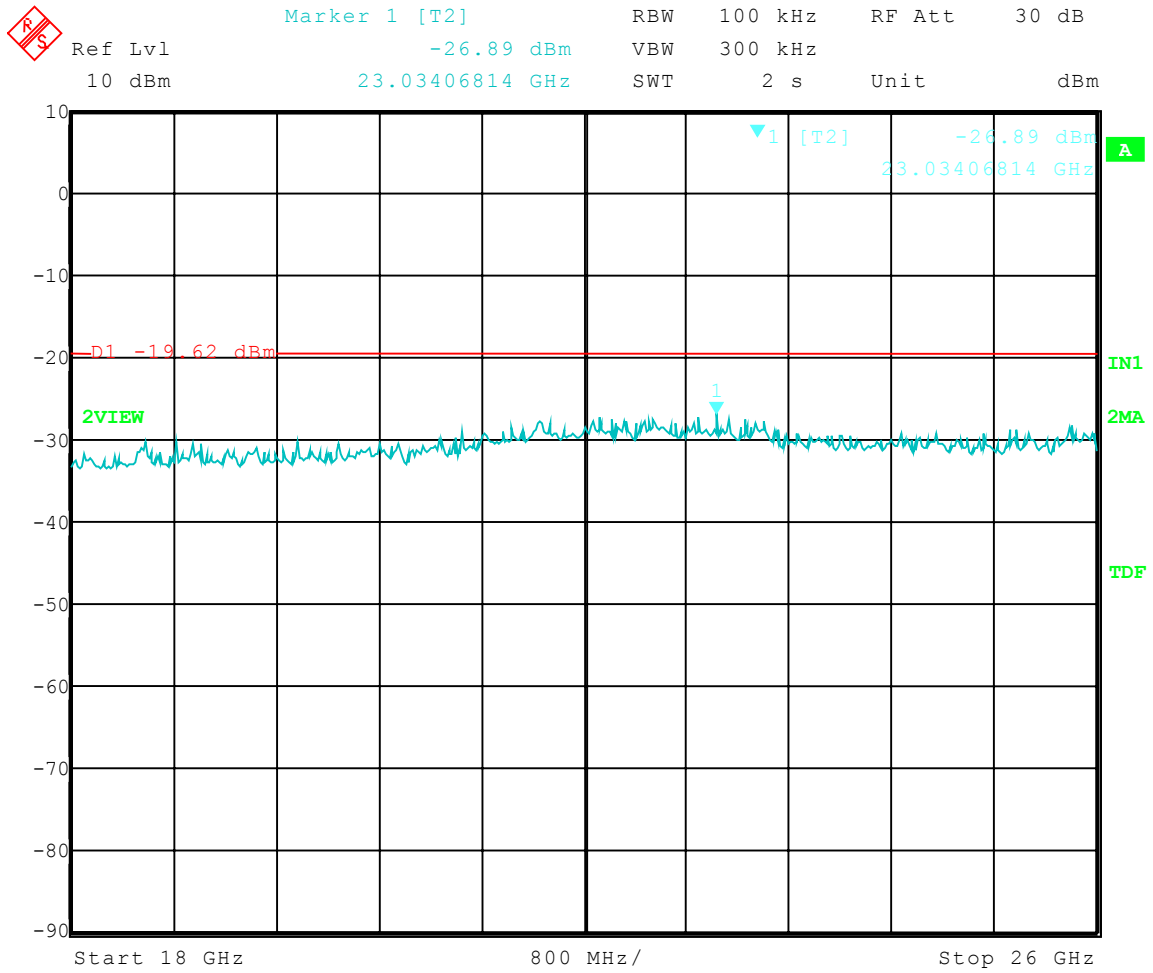
All Spurious Emissions at Least 20 dB below Peak Level of In Band Frequency



APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Spurious Emissions - Conducted
Operator: Jason Lauer
Comment: Middle Channel Transmit = 2.440 GHz
Frequency Range: 18 to 26 GHz
Limit = -19.62 dBm

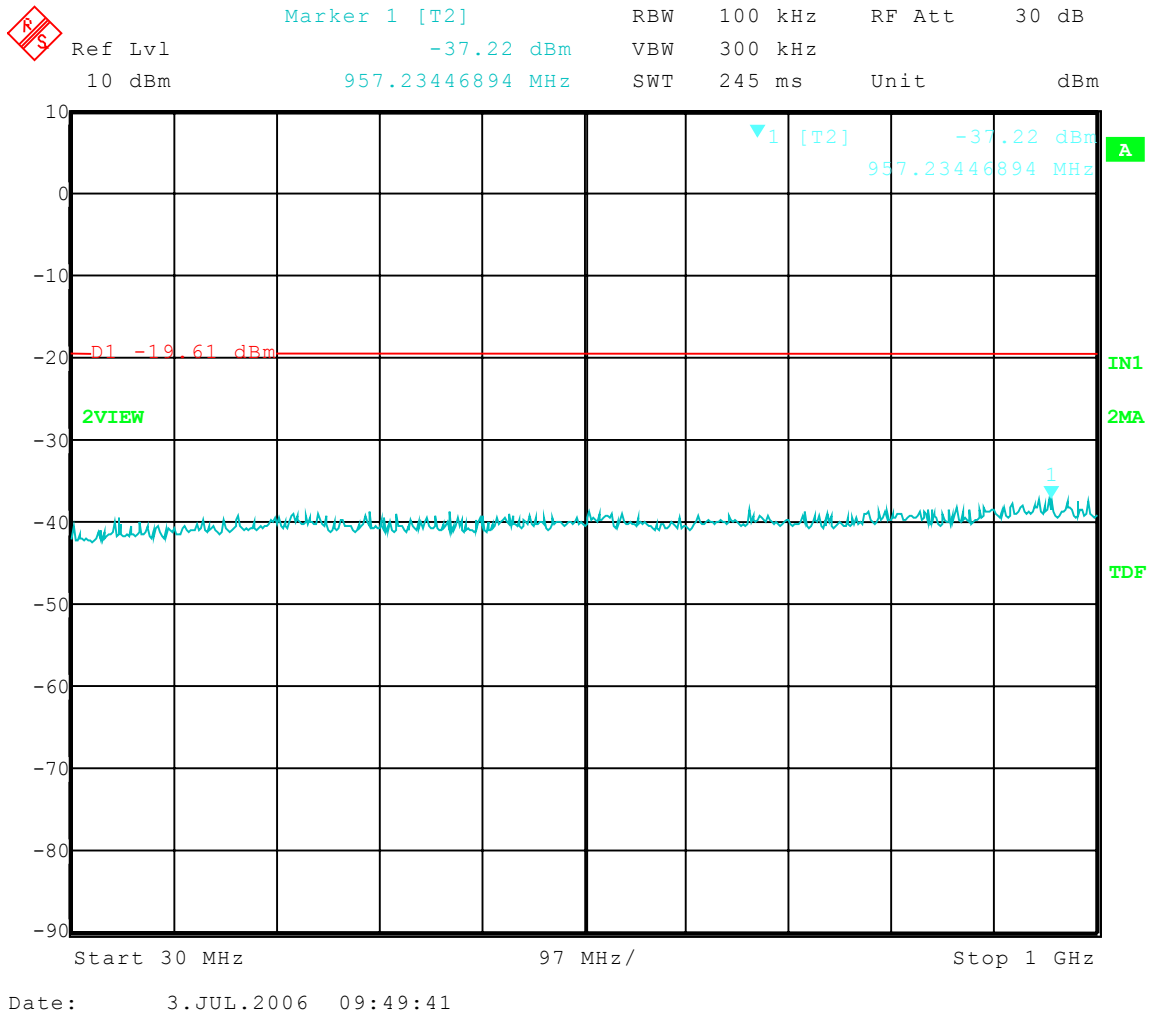
All Spurious Emissions at Least 20 dB below Peak Level of In Band Frequency



APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Spurious Emissions - Conducted
Operator: Jason Lauer
Comment: Low Channel Transmit = 2.405 GHz
Frequency Range: 30 to 1000 MHz
Limit = -19.61 dBm

All Spurious Emissions at Least 20 dB below Peak Level of In Band Frequency



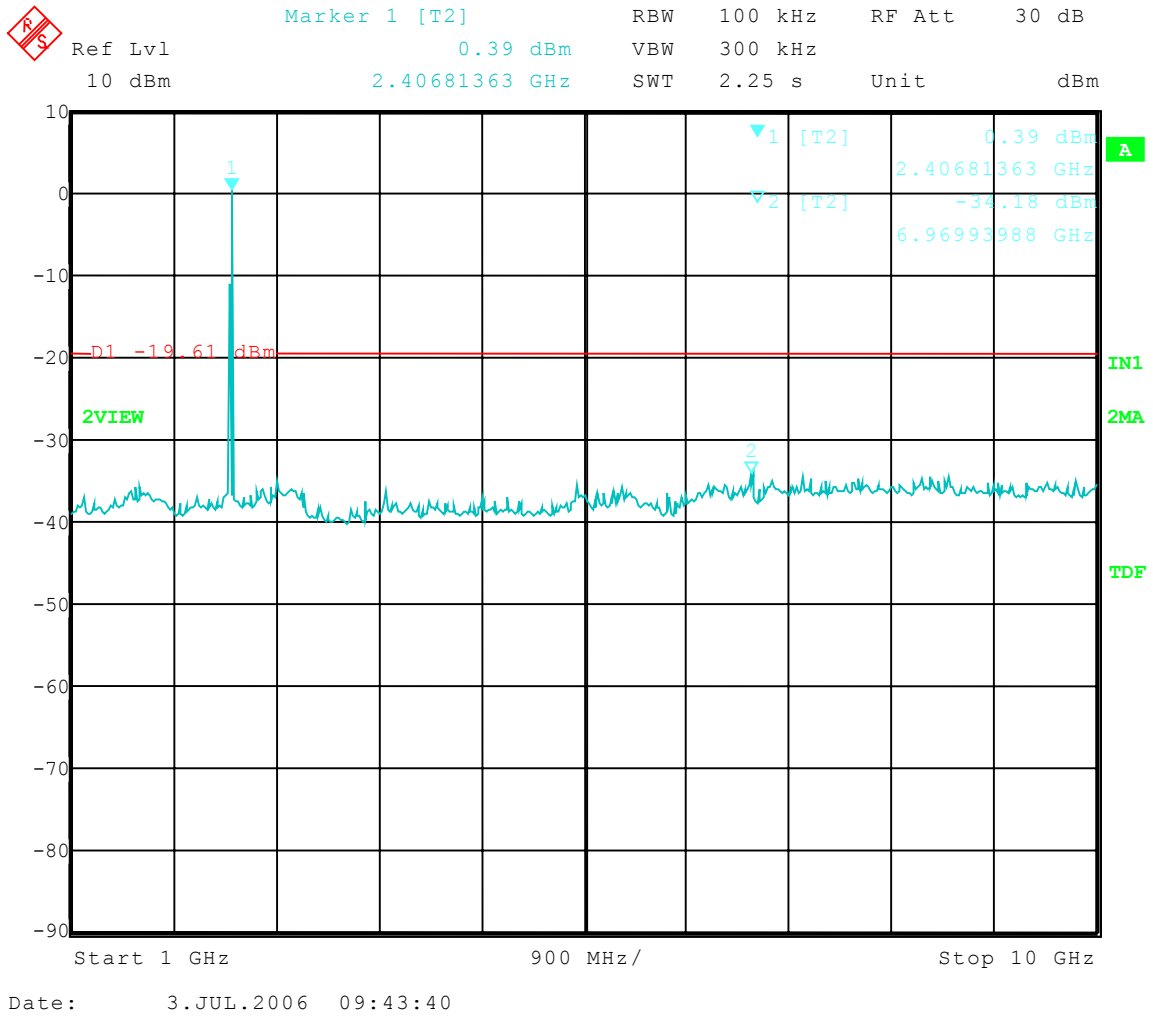
1250 Peterson Dr., Wheeling, IL 60090

Company: Tecnova
Model Tested: ZR1
Report Number: 12340

APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Spurious Emissions - Conducted
Operator: Jason Lauer
Comment: Low Channel Transmit = 2.405 GHz
Frequency Range: 1 to 10 GHz
Limit = -19.61 dBm

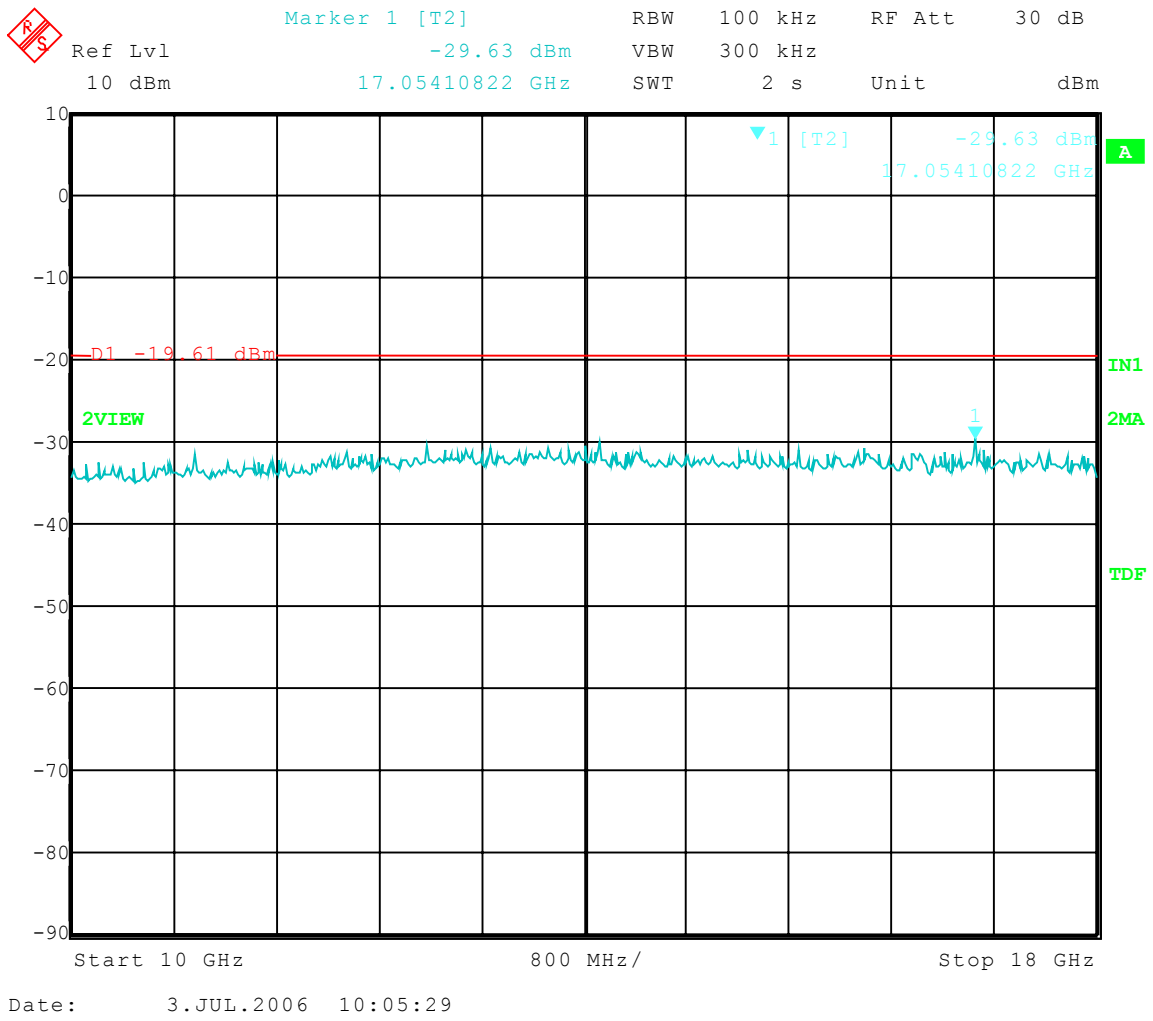
All Spurious Emissions at Least 20 dB below Peak Level of In Band Frequency



APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Spurious Emissions - Conducted
Operator: Jason Lauer
Comment: Low Channel Transmit = 2.405 GHz
Frequency Range: 10 to 18 GHz
Limit = -19.61 dBm

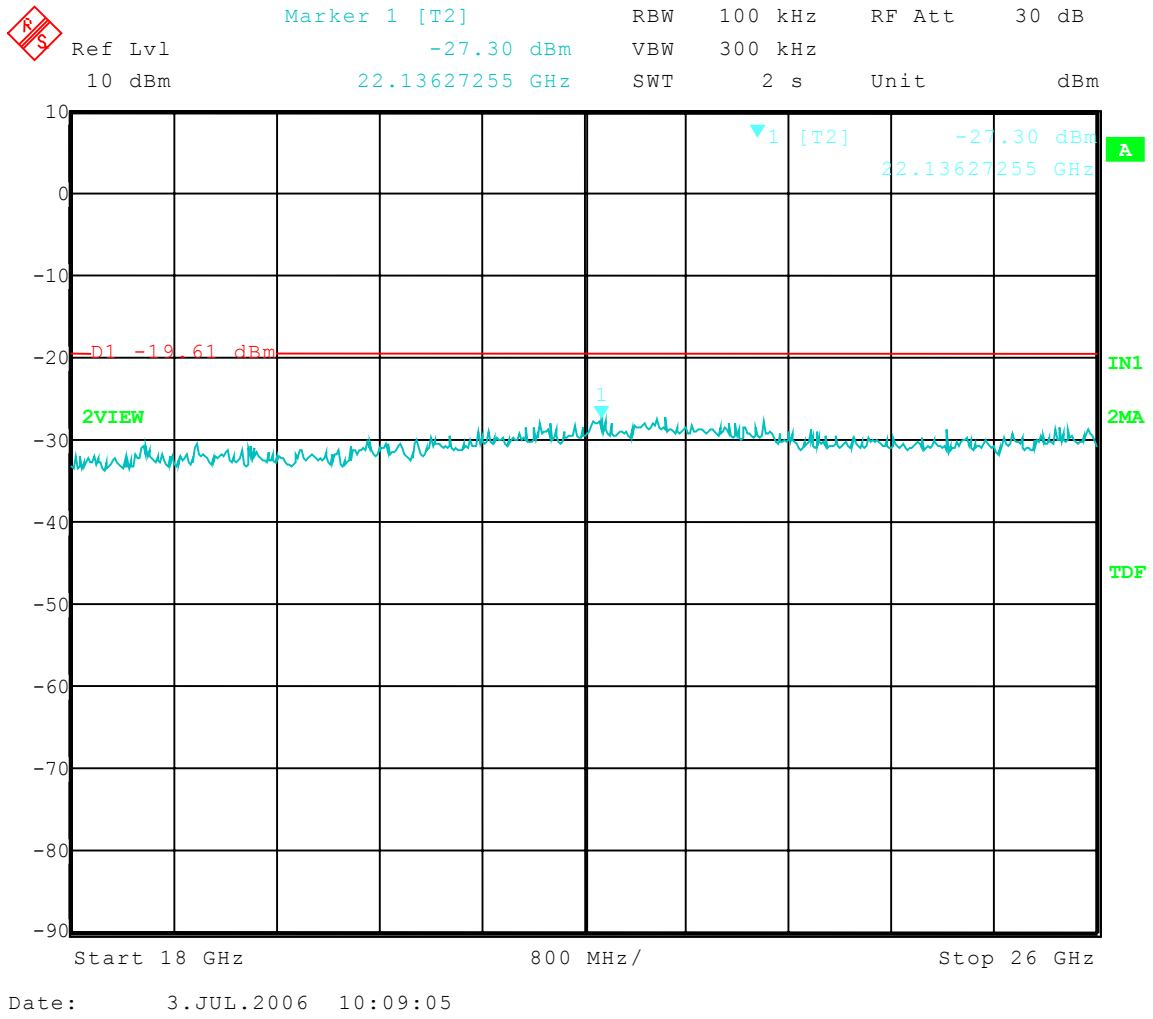
All Spurious Emissions at Least 20 dB below Peak Level of In Band Frequency



APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Spurious Emissions - Conducted
Operator: Jason Lauer
Comment: Low Channel Transmit = 2.405 GHz
Frequency Range: 18 to 26 GHz
Limit = -19.61 dBm

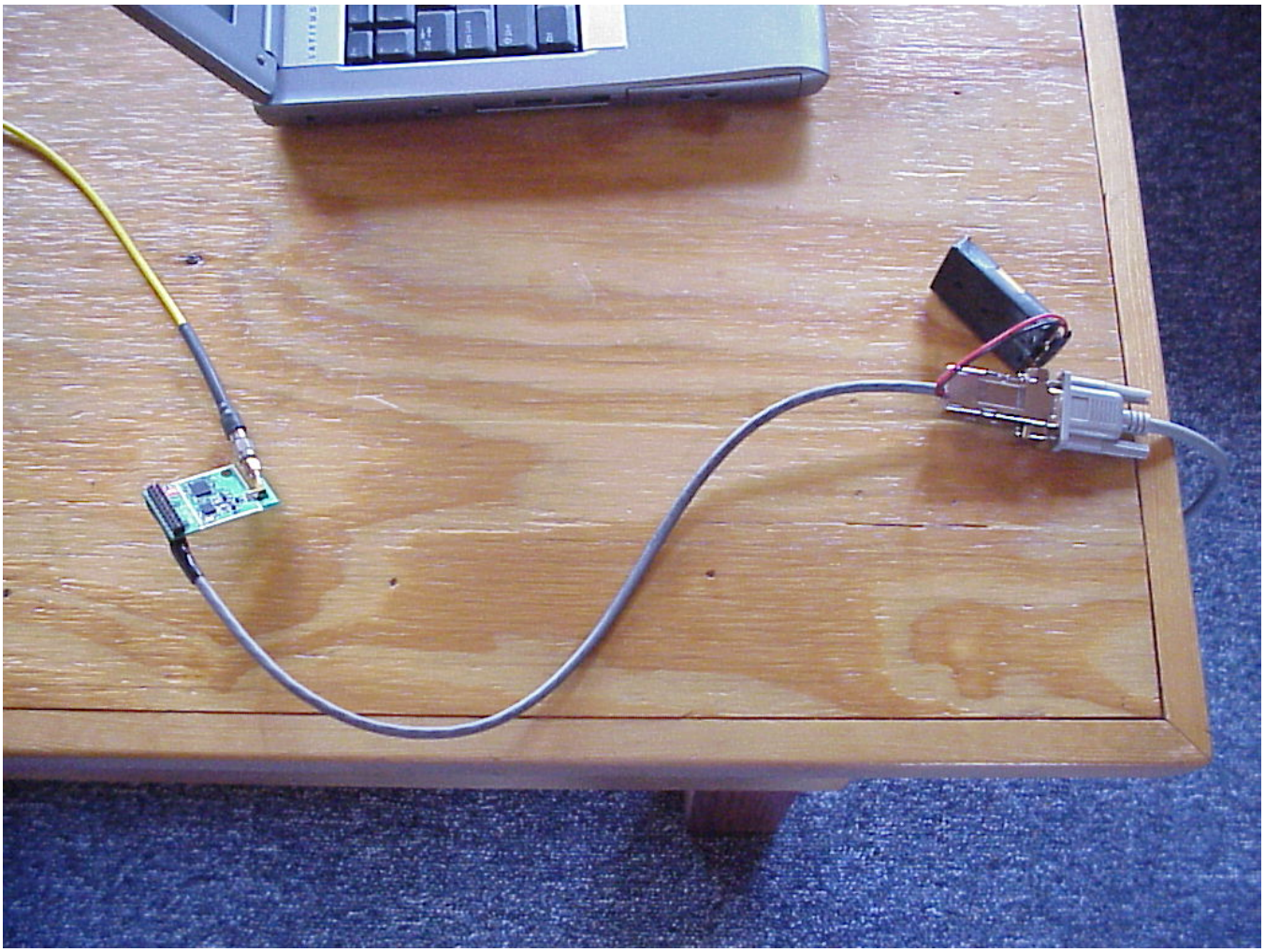
All Spurious Emissions at Least 20 dB below Peak Level of In Band Frequency



Date: 3.JUL.2006 10:09:05

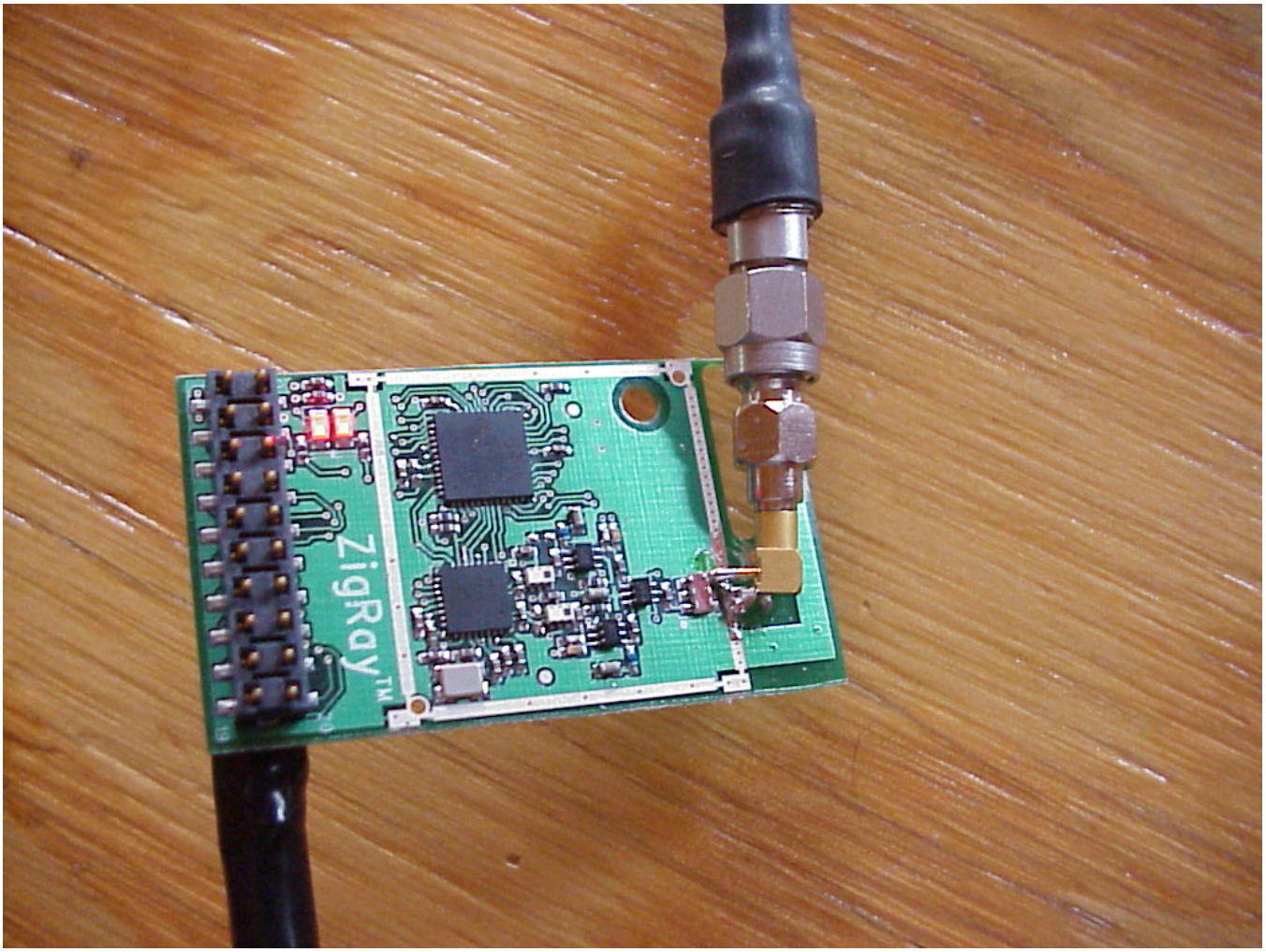
APPENDIX A

3.0 CONDUCTED EMISSIONS (ANTENNA TERMINAL) PHOTOS TAKEN DURING TESTING



APPENDIX A

3.0 CONDUCTED EMISSIONS (ANTENNA TERMINAL) PHOTOS TAKEN DURING TESTING



APPENDIX A

4.0 RESTRICTED BANDS

As stated in Section 15.205a, the fundamental emission from the ZigRay shall not fall within any of the bands listed below:

Frequency in MHz	Frequency in MHz	Frequency in MHz	Frequency in GHz
.0900 to .1100	162.0125 to 167.17	2310.0 to 2390	9.30 to 9.50
.4900 to .5100	167.7200 to 173.20	2483.5 to 2500	10.60 to 12.70
2.1735 to 2.1905	240.000 to 285.00	2655.0 to 2900	13.25 to 13.40
8.362 to 8.3660	322.200 to 335.40	3260.0 to 3267	14.47 to 14.50
13.36 to 13.410	399.900 to 410.00	3332.0 to 3339	15.35 to 16.20
25.50 to 25.670	608.000 to 614.00	3345.8 to 3358	17.70 to 21.40
37.50 to 38.250	960.000 to 1240.00	3600.0 to 4400	22.01 to 23.13
73.00 to 75.500	1300.000 to 1427.00	4500.0 to 5250	23.60 to 24.00
108.00 to 121.94	1435.000 to 1626.50	5350.0 to 5450	31.20 to 31.80
123.00 to 138.00	1660.000 to 1710.00	7250.0 to 7750	36.43 to 36.50
149.90 to 150.00	1718.800 to 1722.20	8025.0 to 8500	ABOVE 38.60
156.70 to 156.90	2200.000 to 2300.00	9000.0 to 9200	

NOTE:

The noise floor within the Restricted Bands for the EMC Receiver and HP Spectrum Analyzer will typically lay 20 dB below the limit.

5.0 BAND EDGE AND RESTRICT BAND COMPLIANCE

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the attenuation below the general limits specified in 15.209 is not required.

The field strength of any **radiated emissions** which fall within the restricted bands shall not exceed the general radiated emissions limits as stated Section 15.209.

NOTE: See the following page(s) for the graph(s) made showing compliance for Band Edge and Restrict Band:

APPENDIX A

DATA AND GRAPH(S) TAKEN SHOWING

THE BAND EDGE AND

RESTRICT BAND COMPLIANCE

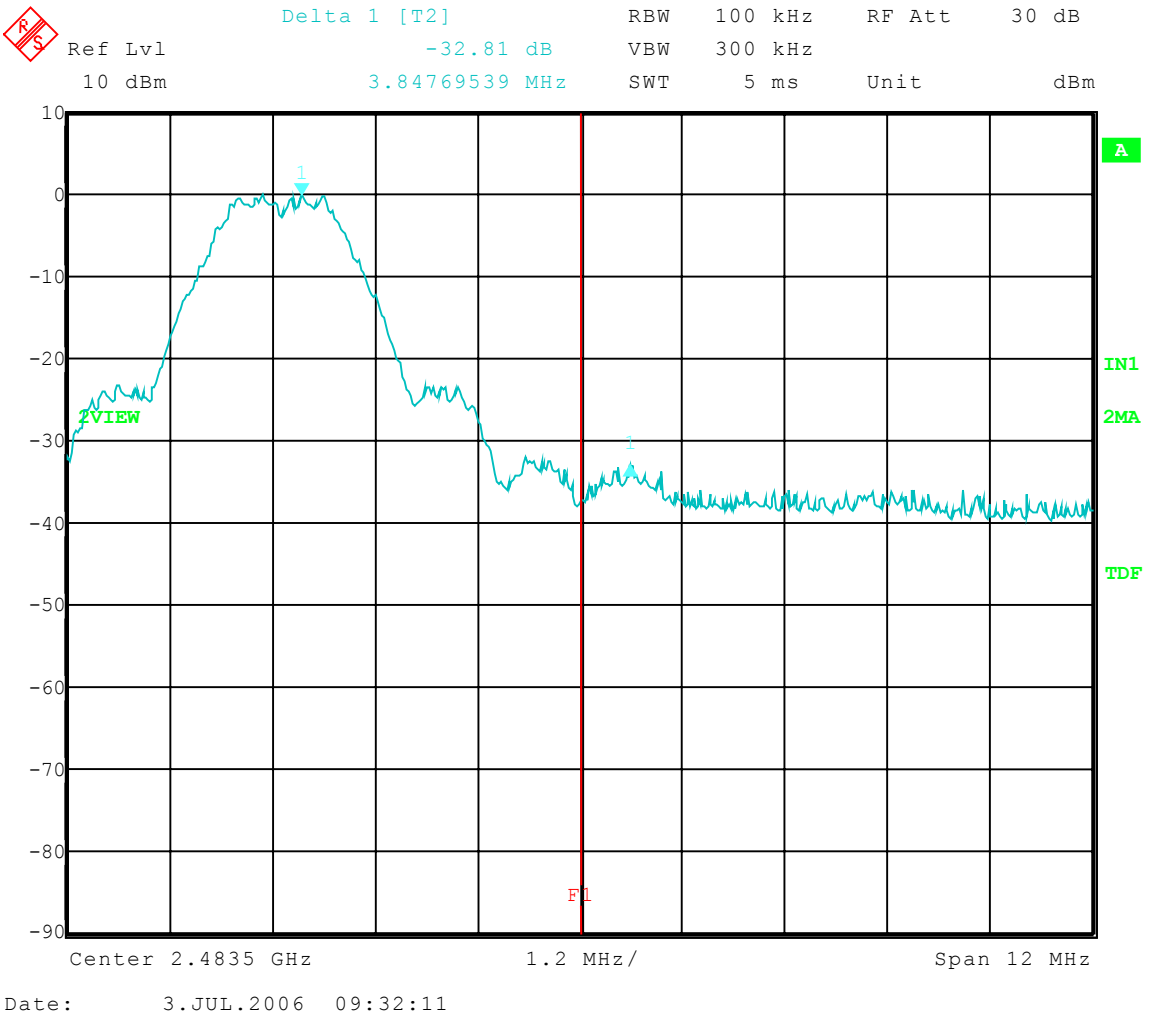
PART 15.247(c)

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Test Date: 07-03-2006
Company: Tecnova
EUT: Zigray
Test: Low Band-Edge Compliance - Conducted
Operator: Jason Lauer
Comment: High Channel: Frequency – 2.480 GHz

Band-Edge Frequency = 2.4835 GHz
Band-Edge > 20 dB Below Peak In-Band Emission



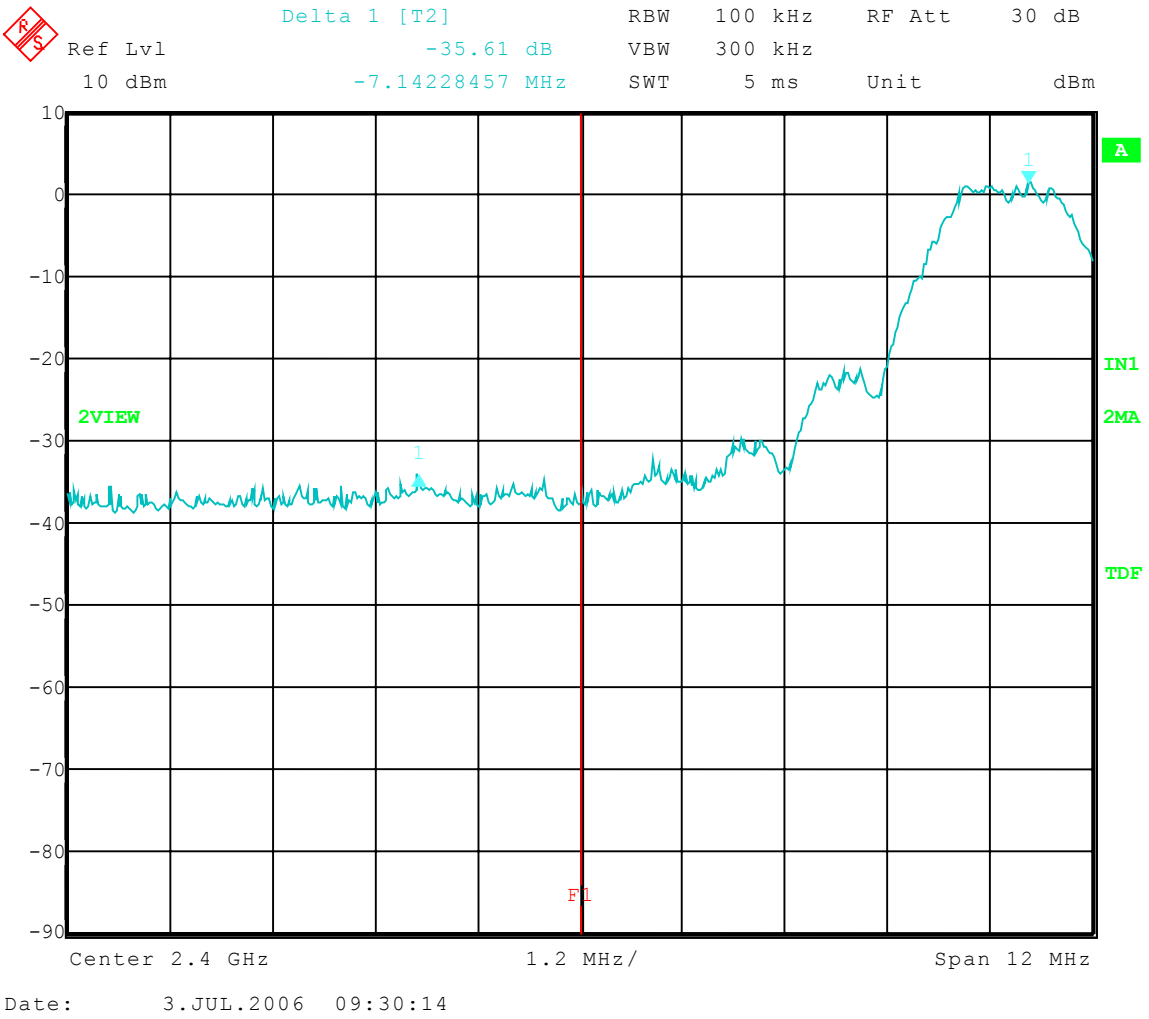
1250 Peterson Dr., Wheeling, IL 60090

Company: Tecnova
Model Tested: ZR1
Report Number: 12340

APPENDIX A

Test Date: 070-3-2006
Company: Tecnova
EUT: Zigray
Test: Low Band-Edge Compliance - Conducted
Operator: Jason Lauer
Comment: Low Channel: Frequency – 2.405 GHz

Band-Edge Frequency = 2.4 GHz
Band-Edge > 20 dB Below Peak In-Band Emission



1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

Radiated Spurious Emissions in Restricted Bands (30 MHz to 25 GHz)

Tested at a 3 Meter Distance (30 MHz - 10 GHz)
Tested at a 1 Meter Distance (10 GHz - 25 GHz)

EUT: Zigray
Manufacturer: Tecnova
Operating Condition: 71 deg F; 53% R.H.
Test Site: Site 3
Operator: Jason Lauer
Test Specification: FCC Part 15.247(d) and FCC Part 15.205
Comment: Continuous Transmit
Date: 06/30/2006

Notes: **(1)** Peak measurements taken with RBW = 1 MHz, VBW = 3 MHz, Sweep: Auto
(2) Average measurements taken with RBW = 1 MHz, VBW = 10 Hz, Sweep: Auto
(3) All other restricted band emissions at least 20 dB under the limit.

Channel 16: 2.480 GHz

Frequency (GHz)	Measurement Detector	Ant. Pol.	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)	Comment
4.96	Peak	Vert	61.64	33.62	-34.0	61.3	N/A	61.3	74	12.7	Res. Band
4.96	Average	Vert	53.20	33.62	-34.0	52.8	6.1	46.7	54	7.3	Res. Band
4.96	Peak	Horz	62.36	33.62	-34.0	62.0	N/A	62.0	74	12	Res. Band
4.96	Average	Horz	54.10	33.62	-34.0	53.7	6.1	47.6	54	6.4	Res. Band
7.44	Peak	Vert	59.04	36.63	-30.4	65.3	N/A	65.3	74	8.7	Res. Band
7.44	Average	Vert	48.77	36.63	-30.4	55.0	6.1	48.9	54	5.1	Res. Band
7.44	Peak	Horz	60.46	36.63	-30.4	66.7	N/A	66.7	74	7.3	Res. Band
7.44	Average	Horz	50.20	36.63	-30.4	56.4	6.1	50.3	54	3.7	Res. Band
12.40	Peak	Vert	53.10	38.78	-30.1	61.8	N/A	61.8	83.5	21.7	Res. Band
12.40	Average	Vert	42.10	38.78	-30.1	50.8	6.1	44.7	63.5	18.8	Res. Band
12.40	Peak	Horz	51.82	38.78	-30.1	60.5	N/A	60.5	83.5	23.0	Res. Band
12.40	Average	Horz	40.35	38.78	-30.1	49.0	6.1	42.9	63.5	20.6	Res. Band

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APPENDIX A

Radiated Spurious Emissions in Restricted Bands (30 MHz to 25 GHz)

Tested at a 3 Meter Distance (30 MHz - 10 GHz)
Tested at a 1 Meter Distance (10 GHz - 25 GHz)

EUT: Zigray
Manufacturer: Tecnova
Operating Condition: 71 deg F; 53% R.H.
Test Site: Site 3
Operator: Jason Lauer
Test Specification: FCC Part 15.247(d) and FCC Part 15.205
Comment: Continuous Transmit
Date: 06/30/2006

Notes: **(1)** Peak measurements taken with RBW = 1 MHz, VBW = 3 MHz, Sweep: Auto
(2) Average measurements taken with RBW = 1 MHz, VBW = 10 Hz, Sweep: Auto
(3) All other restricted band emissions at least 20 dB under the limit.

Channel 8: 2.440 GHz

Frequency (GHz)	Measurement Detector	Ant. Pol.	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)	Comment
4.88	Peak	Vert		33.46	-34.1	64.69	N/A	64.7	74	9.3	Res. Band
4.88	Average	Vert		33.46	-34.1	56.28	6.1	50.2	54	3.8	Res. Band
4.88	Peak	Horz		33.46	-34.1	66.43	N/A	66.4	74	7.6	Res. Band
4.88	Average	Horz		33.46	-34.1	58.11	6.1	52.0	54	2.0	Res. Band
7.32	Peak	Vert		36.30	-30.6	64.07	N/A	64.0	74	10.0	Res. Band
7.32	Average	Vert		36.30	-30.6	52.88	6.1	46.8	54	7.2	Res. Band
7.32	Peak	Horz		36.30	-30.6	65.05	N/A	65.0	74	9.0	Res. Band
7.32	Average	Horz		36.30	-30.6	54.07	6.1	47.9	54	6.1	Res. Band
12.20	Peak	Vert		38.94	-29.6	65.11	N/A	65.1	83.5	18.4	Res. Band
12.20	Average	Vert		38.94	-29.6	53.90	6.1	47.8	63.5	15.7	Res. Band
12.20	Peak	Horz		38.94	-29.6	65.74	N/A	65.7	83.5	17.8	Res. Band
12.20	Average	Horz		38.94	-29.6	54.34	6.1	48.2	63.5	15.3	Res. Band

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APPENDIX A

Radiated Spurious Emissions in Restricted Bands (30 MHz to 25 GHz)

Tested at a 3 Meter Distance (30 MHz - 10 GHz)
Tested at a 1 Meter Distance (10 GHz - 25 GHz)

EUT: Zigray
Manufacturer: Tecnova
Operating Condition: 71 deg F; 53% R.H.
Test Site: Site 3
Operator: Jason Lauer
Test Specification: FCC Part 15.247(d) and FCC Part 15.205
Comment: Continuous Transmit
Date: 06/30/2006

Notes: **(1)** Peak measurements taken with RBW = 1 MHz, VBW = 3 MHz, Sweep: Auto
(2) Average measurements taken with RBW = 1 MHz, VBW = 10 Hz, Sweep: Auto
(3) All other restricted band emissions at least 20 dB under the limit.

Channel 1: 2.405 GHz

Frequency (GHz)	Measurement Detector	Ant. Pol.	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)	Comment
4.81	Peak	Vert	64.07	33.32	-34.4	63.0	N/A	63.0	74	11.0	Res. Band
4.81	Average	Vert	55.89	33.32	-34.4	54.8	6.1	48.7	54	5.3	Res. Band
4.81	Peak	Horz	66.16	33.32	-34.4	65.1	N/A	65.1	74	8.9	Res. Band
4.81	Average	Horz	58.19	33.32	-34.4	57.1	6.1	51.0	54	3.0	Res. Band
12.025	Peak	Vert	58.92	39.08	-29.6	68.4	N/A	68.4	83.5	15.1	Res. Band
12.025	Average	Vert	48.03	39.08	-29.6	57.5	6.1	51.4	63.5	12.1	Res. Band
12.025	Peak	Horz	58.93	39.08	-29.6	68.4	N/A	68.4	83.5	15.1	Res. Band
12.025	Average	Horz	48.02	39.08	-29.6	57.5	6.1	51.4	63.5	12.1	Res. Band

APPENDIX A

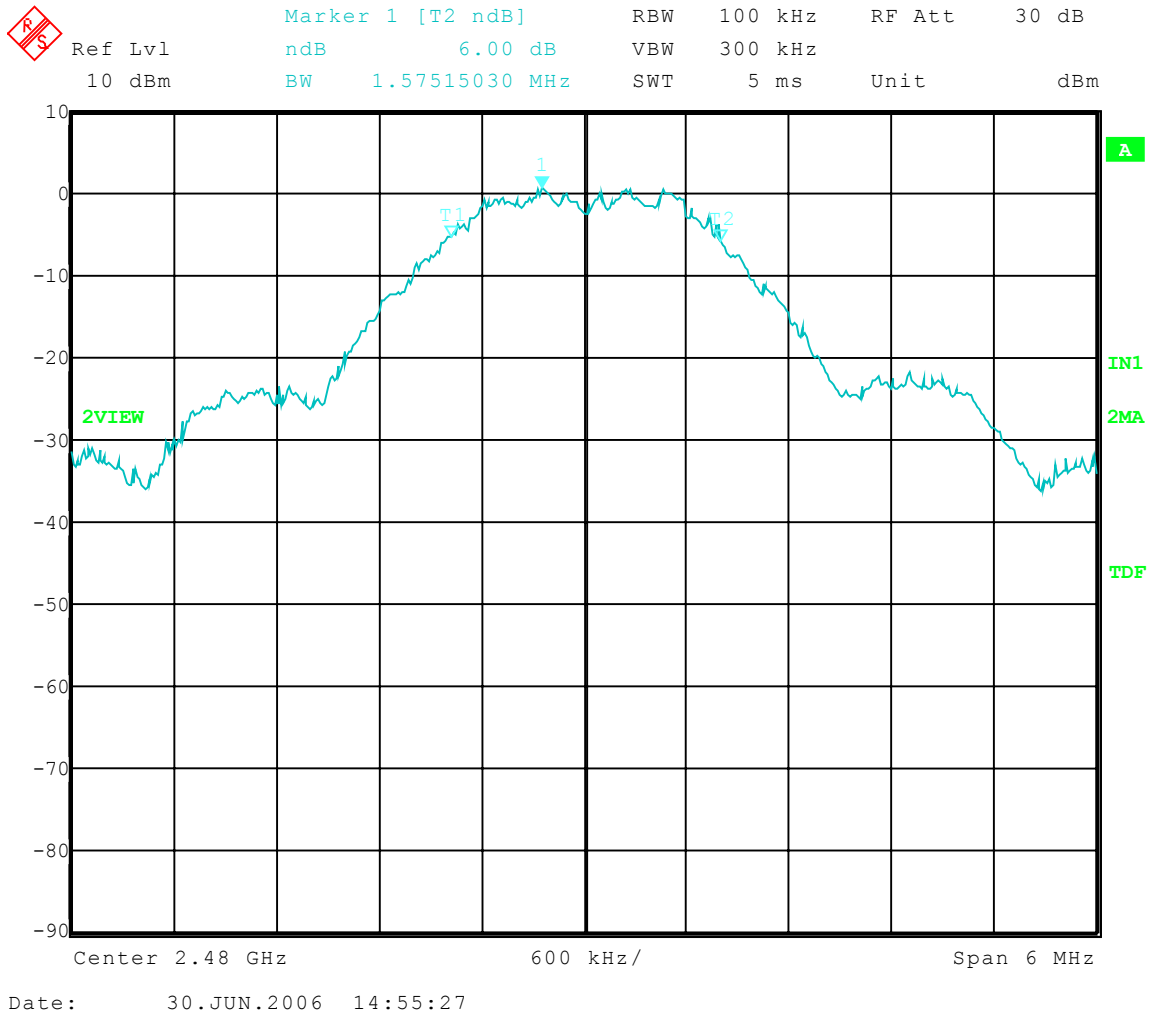
6 dB BANDWIDTH GRAPHS

PART 15.247

APPENDIX A

Test Date: 06-30-2006
Company: Tecnova
EUT: Zigray
Test: 6 dB Bandwidth - Conducted
Operator: Jason Lauer
Comment: High Channel: Frequency – 2.480 GHz

6 dB Bandwidth = 1.575 MHz



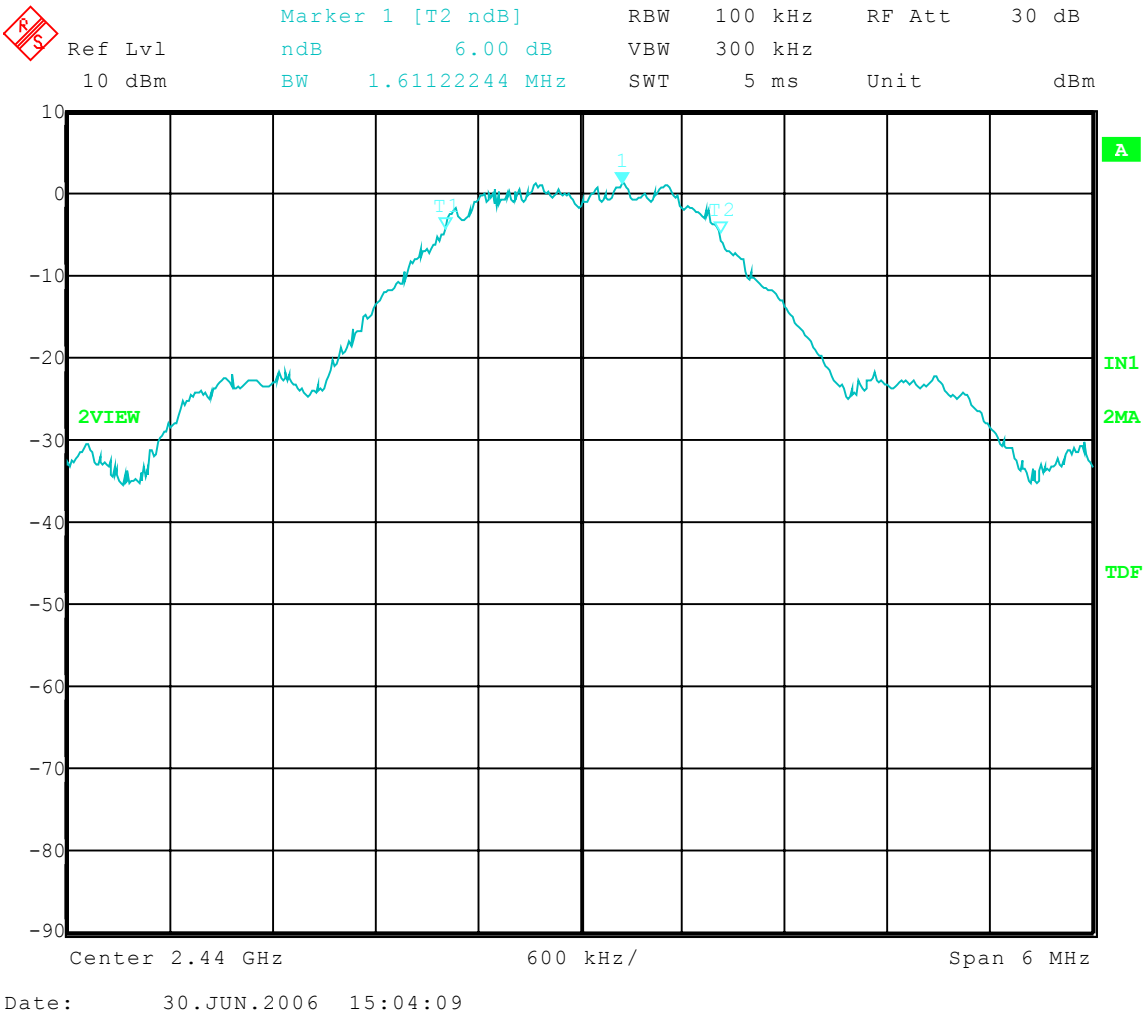
1250 Peterson Dr., Wheeling, IL 60090

Company: Tecnova
Model Tested: ZR1
Report Number: 12340

APPENDIX A

Test Date: 06-30-2006
Company: Tecnova
EUT: Zigray
Test: 6 dB Bandwidth - Conducted
Operator: Jason Lauer
Comment: Middle Channel: Frequency – 2.440 GHz

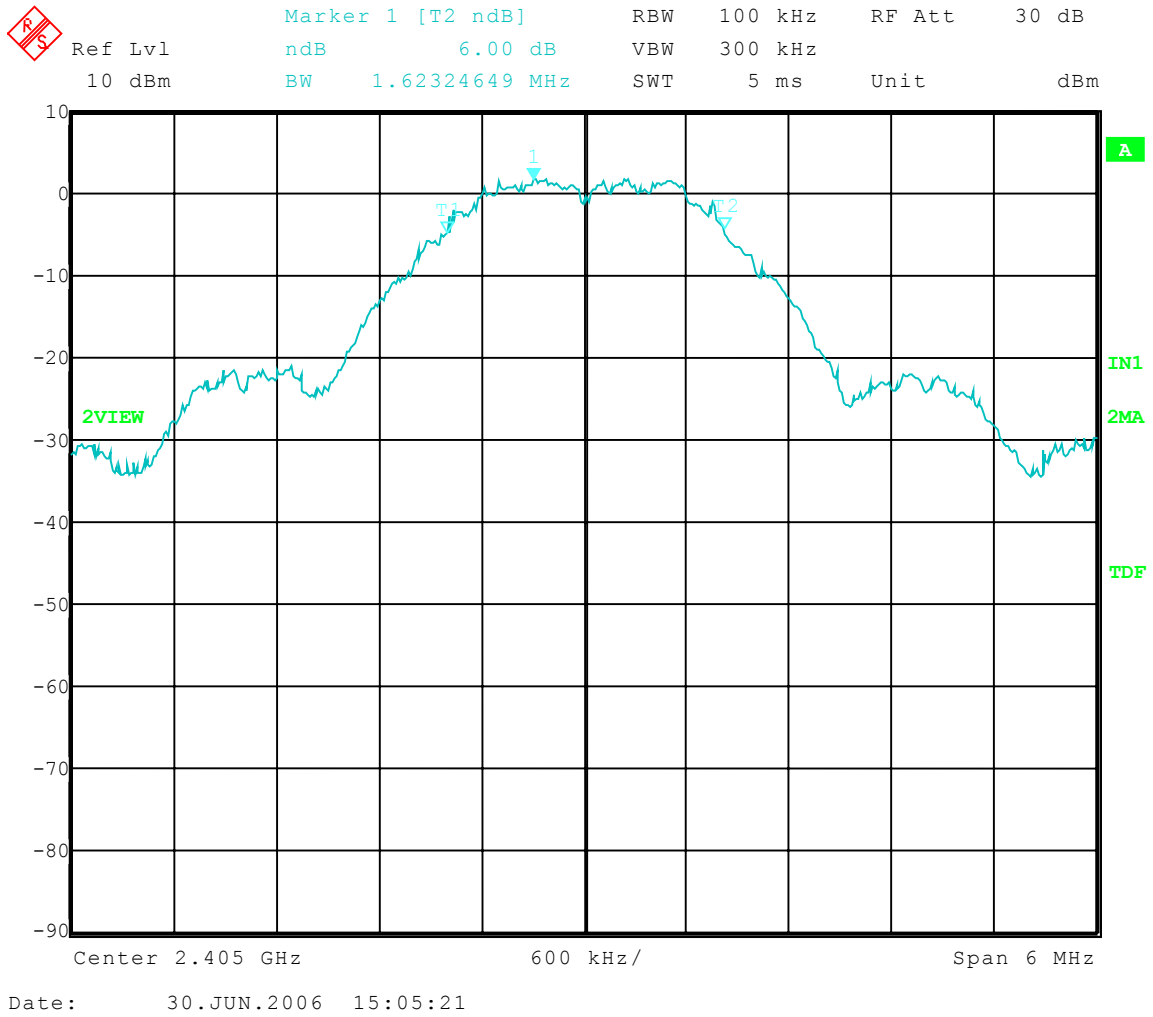
6 dB Bandwidth = 1.611 MHz



APPENDIX A

Test Date: 06-30-2006
Company: Tecnova
EUT: Zigray
Test: 6 dB Bandwidth - Conducted
Operator: Jason Lauer
Comment: Low Channel: Frequency – 2.405 GHz

6 dB Bandwidth = 1.623 MHz



APPENDIX A

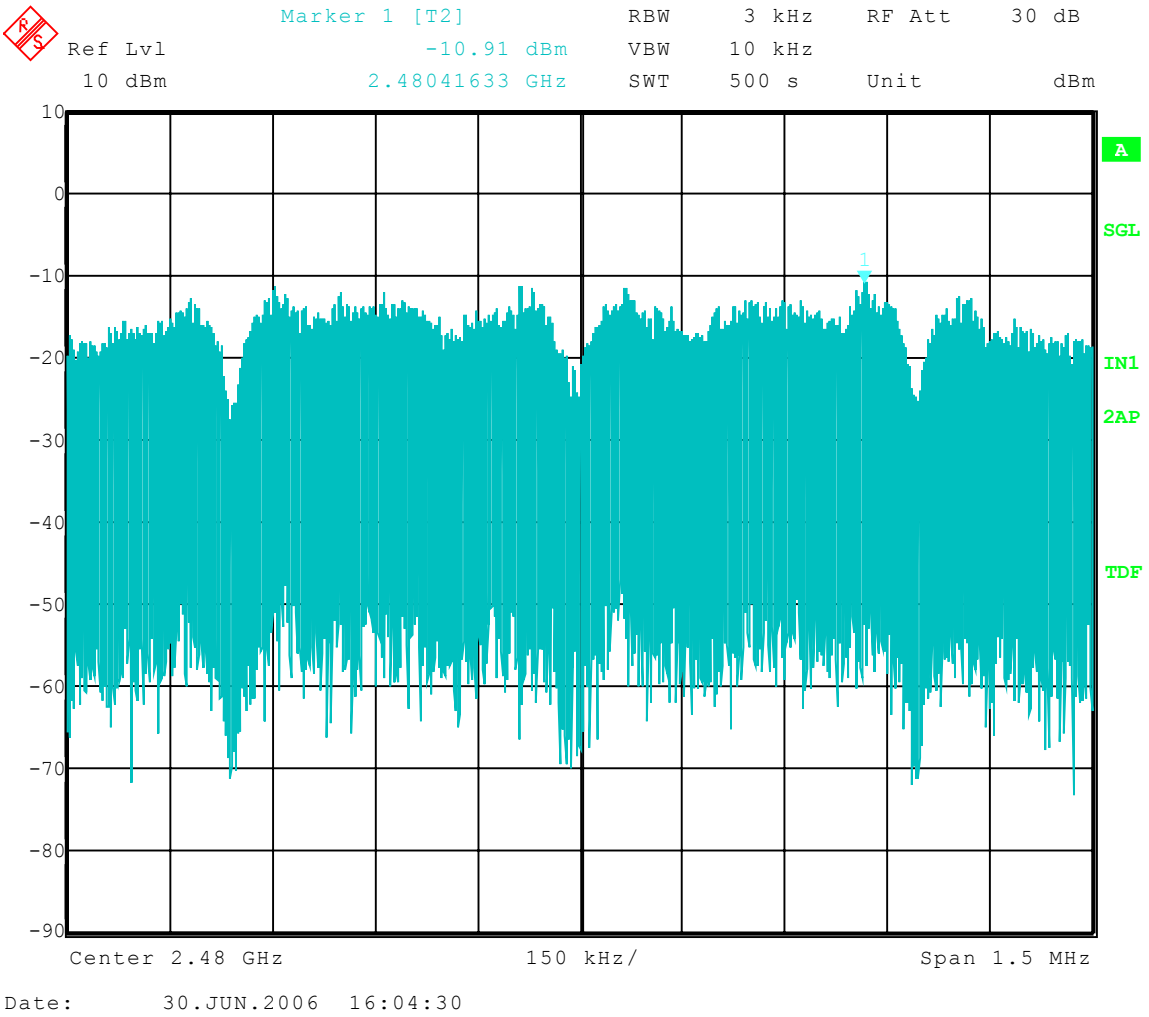
PEAK POWER SPECTRAL DENSITY GRAPH(S)

PART 15.247

APPENDIX A

Test Date: 06-30-2006
Company: Tecnova
EUT: Zigray
Test: Peak Power Spectral Density - Conducted
Operator: Jason Lauer
Comment: High Channel: Frequency – 2.480 GHz

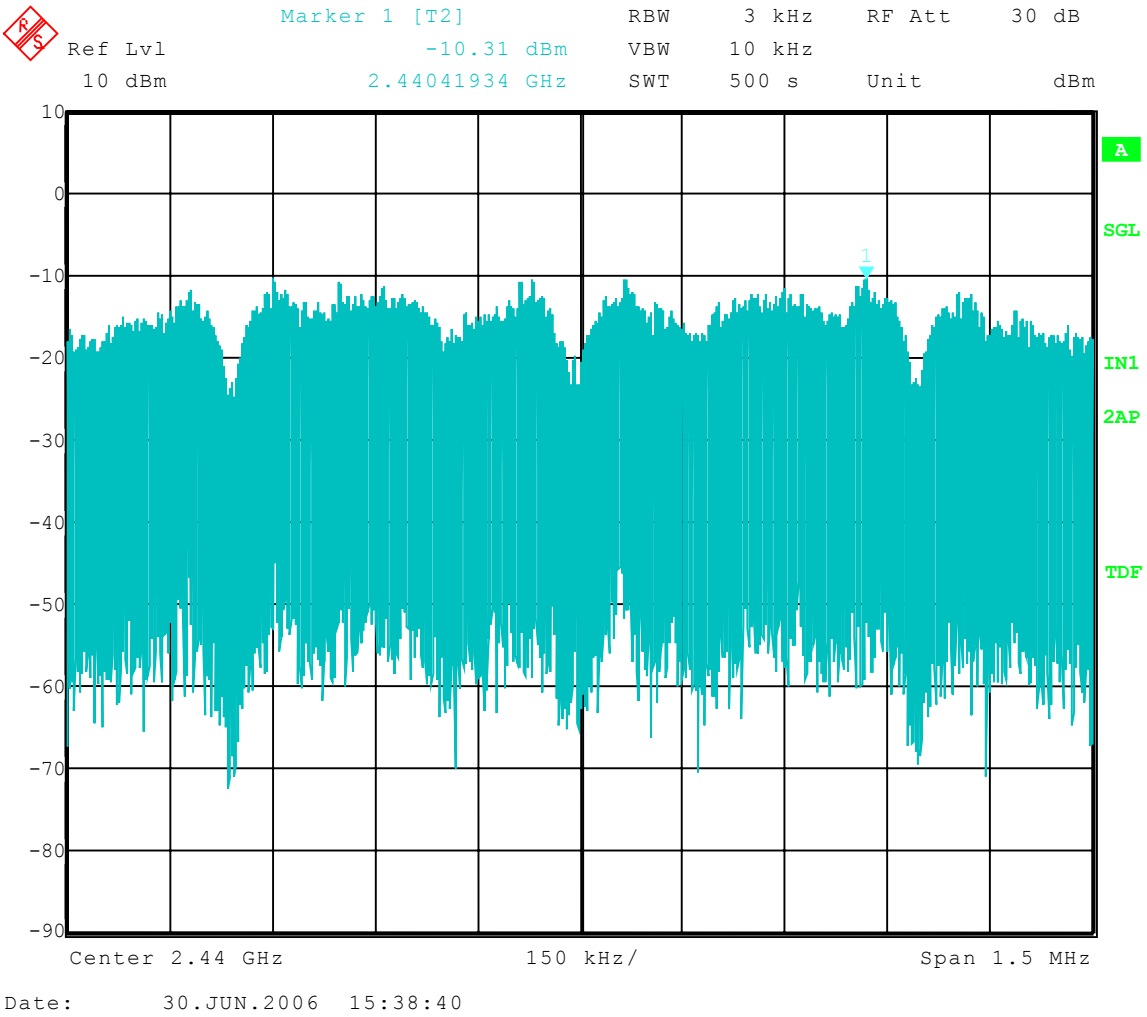
3 kHz Bandwidth = -10.91 dBm



APPENDIX A

Test Date: 06-30-2006
Company: Tecnova
EUT: Zigray
Test: Peak Power Spectral Density - Conducted
Operator: Jason Lauer
Comment: Middle Channel: Frequency – 2.440 GHz

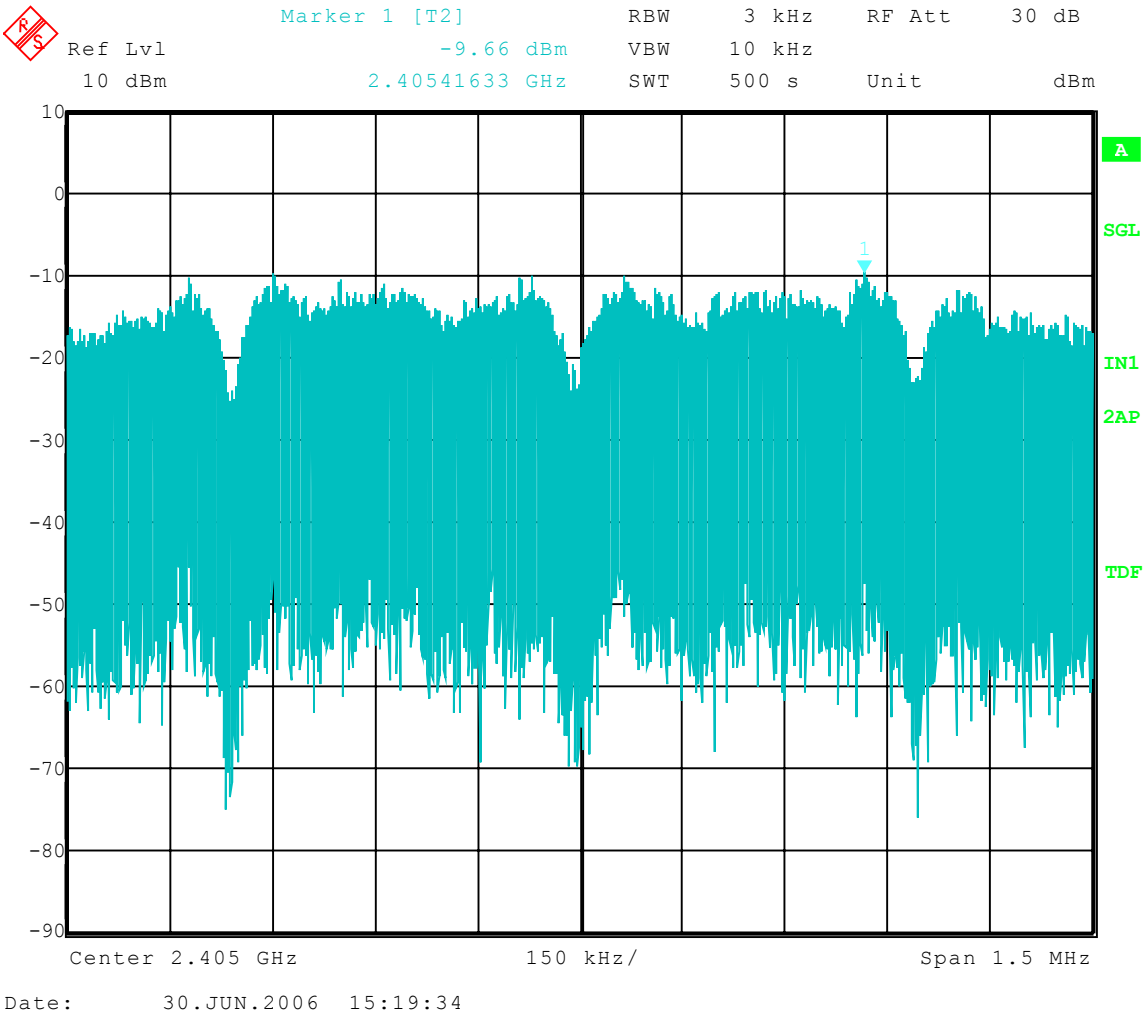
3 kHz Bandwidth = -3.61 dBm



APPENDIX A

Test Date: 06-30-2006
Company: Tecnova
EUT: Zigray
Test: Peak Power Spectral Density - Conducted
Operator: Jason Lauer
Comment: Low Channel: Frequency – 2.405 GHz

3 kHz Bandwidth = -9.66 dBm



APPENDIX A

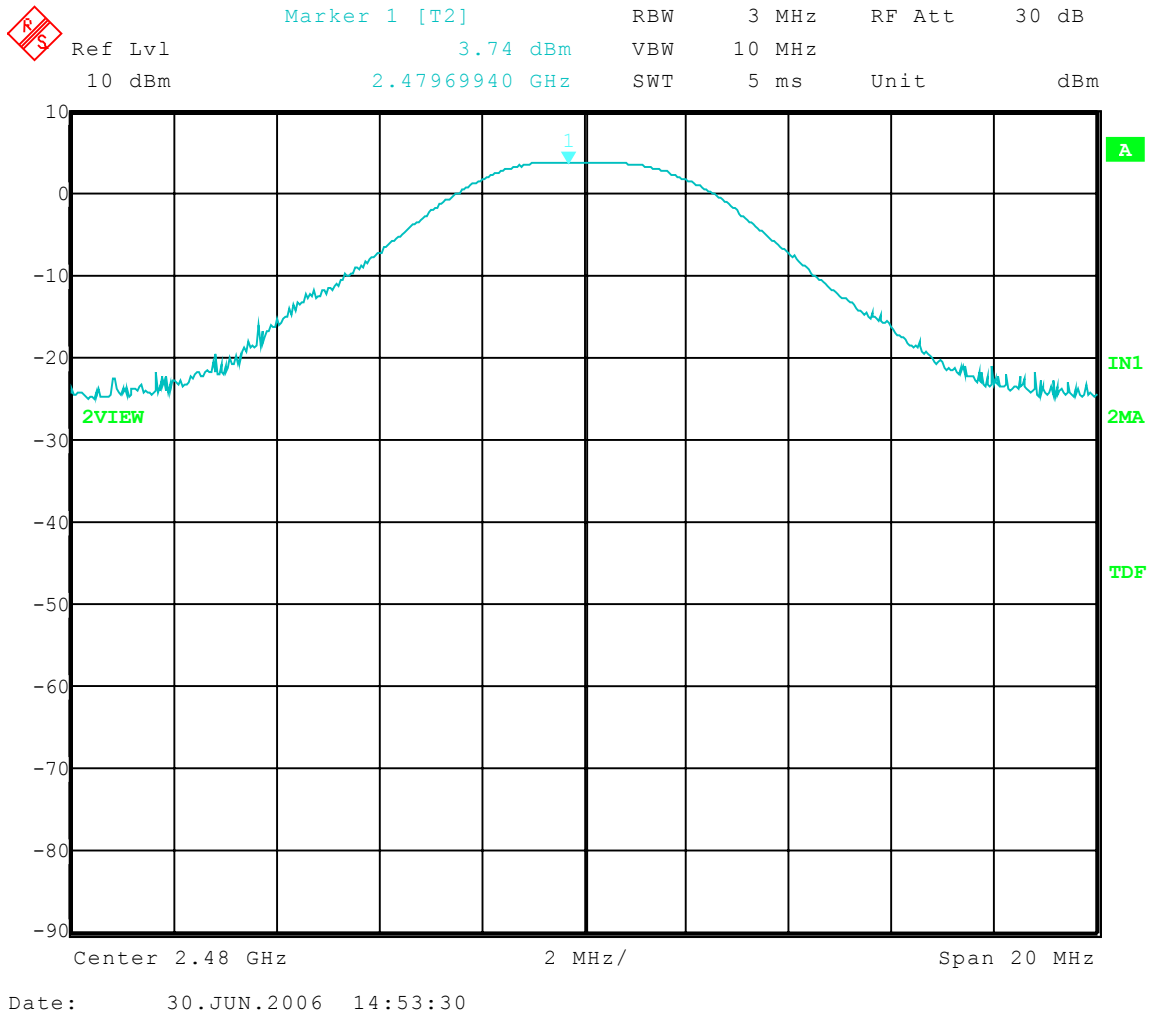
CONDUCTED PEAK OUTPUT POWER GRAPHS

PART 15.247

APPENDIX A

Test Date: 06-30-2006
Company: Tecnova
EUT: Zigray
Test: Peak Power Output - Conducted
Operator: Jason Lauer
Comment: High Channel: Frequency – 2.480 GHz

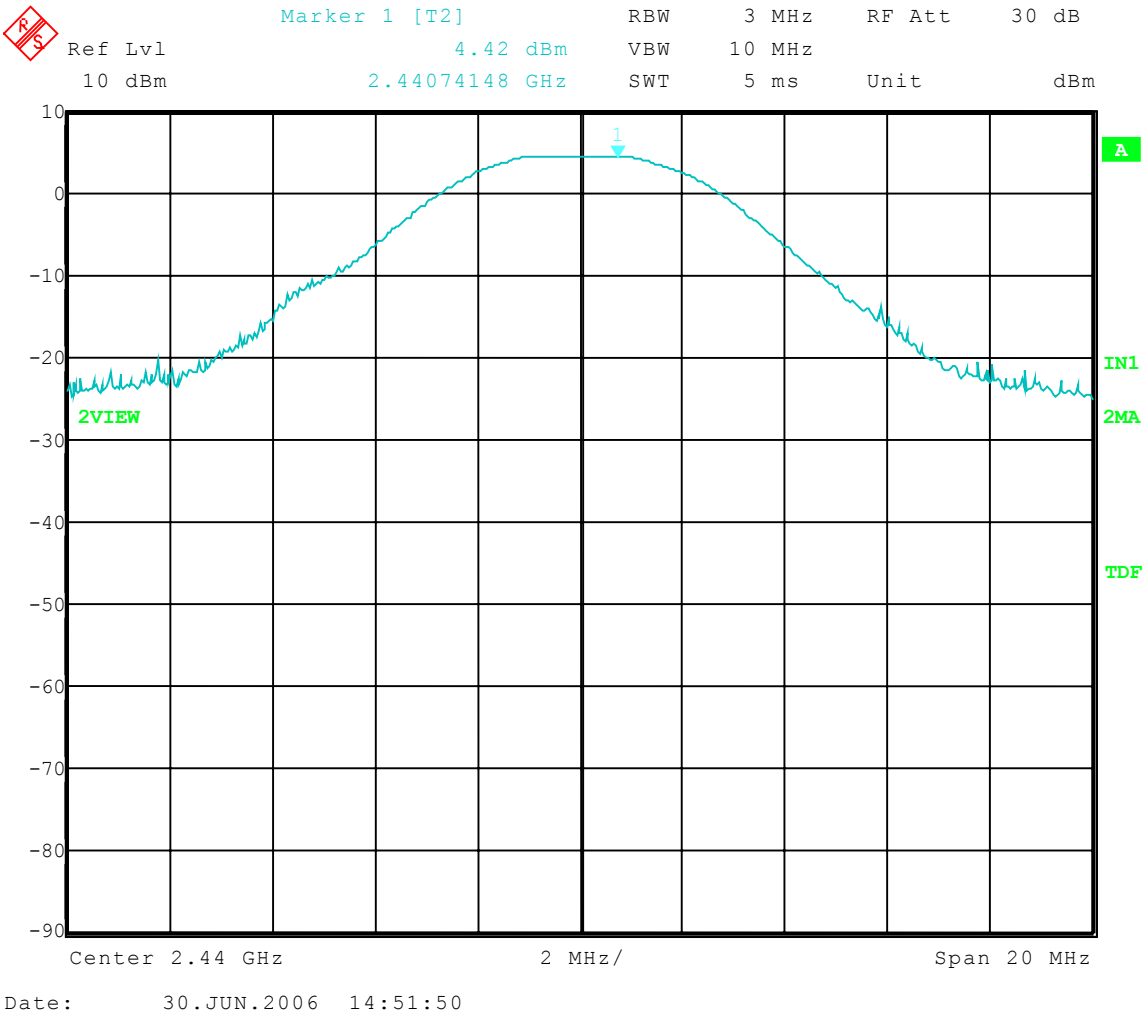
Peak Output Power = 3.74 dBm = 2.37 mW



APPENDIX A

Test Date: 06-30-2006
Company: Tecnova
EUT: Zigray
Test: Peak Power Output - Conducted
Operator: Jason Lauer
Comment: Middle Channel: Frequency – 2.440 GHz

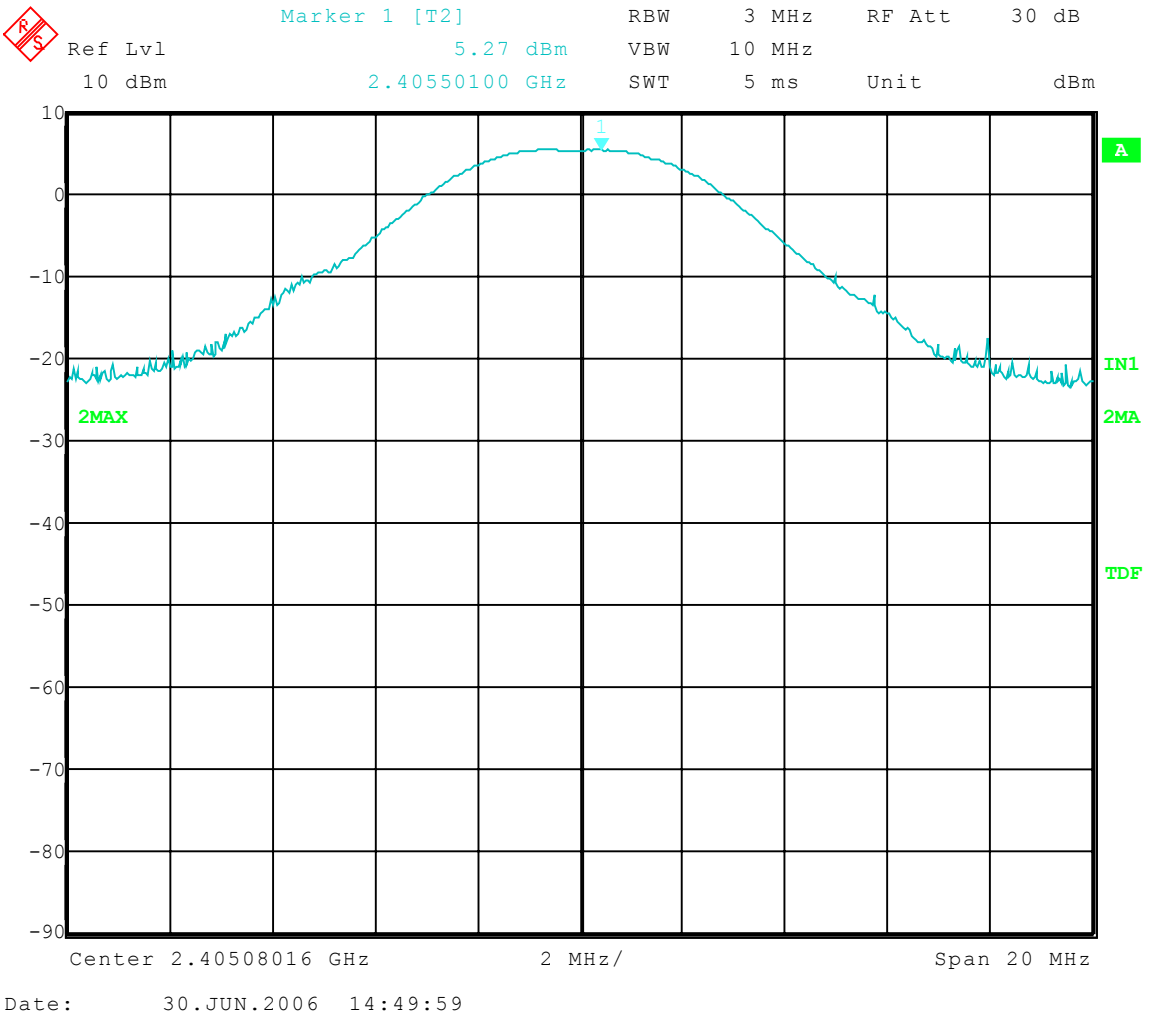
Peak Output Power = 4.42 dBm = 2.77 mW



APPENDIX A

Test Date: 06-30-2006
Company: Tecnova
EUT: Zigray
Test: Peak Power Output - Conducted
Operator: Jason Lauer
Comment: Low Channel: Frequency – 2.405 GHz

Peak Output Power = 5.27 dBm = 3.36 mW



APPENDIX A

EIRP FOR MPE EVALUATION GRAPHS

APPENDIX A

DLS Electronic Systems, Inc.

Company: Tecnova

Operator: Jason Lauer

Date of test: 06-30-2006

Temperature: 72 deg. F

Humidity: 57% R.H.

EIRP - Substitution Method

Model: **Zigray**

Channel: 1**6**

Frequency and Polarization (MHz)	Max. Field Strength of EUT @ 3 meters (dBuV/m)	Output of Signal Generator when field strength equals that of EUT (dBm)	Correction factor for cable between Signal Gen. and subst. antenna (dB)	Gain of subst. antenna (dBi)	Strength of emission [EIRP] (dBm)	Limit (dBm)	Margin (dB)	Strength of emission [EIRP] (mW)
2480 vertical	105.87	1.94	2.80	9.68	8.82	30.00	21.18	7.62
2480 horizontal	105.82	0.49	2.80	9.68	7.37	30.00	22.63	5.46

EIRP = Signal generator output - cable loss + antenna gain

$ERP_{(ref.\ to\ ½\lambda\ dipole)}$ = Signal generator output - cable loss + antenna gain - 2.15

(Ref. ITU-R SM.329-8 Annex 1[1])

1250 Peterson Dr., Wheeling, IL 60090

APPENDIX A

DLS Electronic Systems, Inc.

Company: Tecnova

Operator: Jason Lauer

Date of test: 06-30-2006

Temperature: 72 deg. F

Humidity: 57% R.H.

EIRP - Substitution Method

Model: **Zigray**

Channel: **8**

Frequency and Polarization (MHz)	Max. Field Strength of EUT @ 3 meters (dBuV/m)	Output of Signal Generator when field strength equals that of EUT (dBm)	Correction factor for cable between Signal Gen. and subst. antenna (dB)	Gain of subst. antenna (dBi)	Strength of emission [EIRP] (dBm)	Limit (dBm)	Margin (dB)	Strength of emission [EIRP] (mW)
2440 vertical	106.27	2.18	2.79	9.63	9.02	30.00	20.98	7.98
2440 horizontal	106.26	0.31	2.79	9.63	7.15	30.00	22.85	5.19

EIRP = Signal generator output - cable loss + antenna gain

$ERP_{(ref.\ to\ ½\lambda\ dipole)}$ = Signal generator output - cable loss + antenna gain - 2.15

(Ref. ITU-R SM.329-8 Annex 1[1])

APPENDIX A

DLS Electronic Systems, Inc.

Company: Tecnova

Operator: Jason Lauer

Date of test: 06-30-2006

Temperature: 72 deg. F

Humidity: 57% R.H.

EIRP - Substitution Method

Model: **Zigray**

Channel: **1**

Frequency and Polarization (MHz)	Max. Field Strength of EUT @ 3 meters (dBuV/m)	Output of Signal Generator when field strength equals that of EUT (dBm)	Correction factor for cable between Signal Gen. and subst. antenna (dB)	Gain of subst. antenna (dBi)	Strength of emission [EIRP] (dBm)	Limit (dBm)	Margin (dB)	Strength of emission [EIRP] (mW)
2405 vertical	106.39	2.39	2.78	9.59	9.20	30.00	20.80	8.32
2405 horizontal	106.13	0.06	2.78	9.59	6.87	30.00	23.13	4.86

EIRP = Signal generator output - cable loss + antenna gain

$ERP_{(ref.\ to\ ½\lambda\ dipole)}$ = Signal generator output - cable loss + antenna gain - 2.15

(Ref. ITU-R SM.329-8 Annex 1[1])