




## Measurement of RF Interference from a Model No. 28132536 Volvo P3 BlueTooth Radio Transmitter

For : Delphi Electronics and Safety  
: 601 Joaquin Cavaros Road  
: Los Indios, TX

P.O. No. : 450611199  
Date Received : May 27, 2008  
Date Tested : May 27 through May 29, 2008  
Test Personnel : Daniel Crowder  
Specifications : FCC Part 15, Subpart C, Section 15.247 for Frequency  
Hopping Spread Spectrum Intentional Radiators within the  
2400-2483.5MHz band.  
: Industry Canada RSS-210

Test Report By :   
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Approved By :   
Raymond J. Klouda  
Registered Professional Engineer of  
Illinois - 44894



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**REVISION HISTORY**

Revision	Date	Description
—	06/03/2008	Initial release

## Measurement of RF Emissions from a Delphi Electronics and Safety Volvo P3 BlueTooth Radio, Part No. 28132536

### 1 INTRODUCTION

#### 1.1 Scope of Tests

This document represents the results of the series of radio interference measurements performed on a Volvo P3 BlueTooth Radio, Part No. 28132536, (hereinafter referred to as the test item). No serial number was assigned to the test item. The test item is a BlueTooth hybrid frequency hopping spread spectrum transmitter. The transmitter was designed to transmit in 2400-2483.5 MHz, band using an internal antenna. The test item was manufactured and submitted for testing by Delphi Electronics and Safety located in Los Indios, TX.

#### 1.2 Purpose

The test series was performed to determine if the test item meets the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247 for Intentional Radiators and Industry Canada's RSS-210 for Low-power License-exempt radio communication devices. Testing was performed in accordance with ANSI C63.4-2003.

#### 1.3 Deviations, Additions and Exclusions

There were no deviations, additions to, or exclusions from the test specification during this test series

#### 1.4 EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois.

#### 1.5 Laboratory Conditions

The temperature at the time of the test was 22°C and the relative humidity was 32%.

### 2 APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart C, dated 1 October 2007
- ANSI C63.4-2003, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"
- Industry Canada RSS-210, Issue 7, June 2007, "Spectrum Management and Telecommunications Radio Standards Specification, Low-power License-exempt radio communication devices (All Frequency Bands): Category I Equipment"
- Industry Canada RSS-GEN, Issue 2, June 2007, "Spectrum Management and Telecommunications Radio Standards Specification, General Requirements and Information for the Certification of radio communication equipment"

### 3 TEST ITEM SET-UP AND OPERATION

#### 3.1 General Description

The test item is a Volvo P3 BlueTooth Radio hybrid frequency hopping spread spectrum transmitter, Part No. 28132536. A block diagram of the test item set-up is shown as Figure 1.



3.1.1 Power Input

The test item obtained 13.5VDC from an external power supply simulating the typical power input from an automotive battery.

3.1.2 Peripheral Equipment

No peripheral equipment was required to operate the test item.

3.1.3 Interconnect Cables

The following interconnect cables were submitted with the test item:

Item	Description
Cable harness	1.0 meter long wiring harness from the test item to the power source and equivalent loads.

3.1.4 Grounding

The test item was grounded through the return lead of the power supply simulating typical input power in an automobile.

3.2 Operational Mode

For all tests, the test item was placed on an 80cm high non-conductive stand. The test item was energized. The test item could be programmed to operate in each of the following modes: transmit at 2402.0 MHz, 2441.0 MHz and 2480.0 MHz, frequency hopping enabled and inquiry.

3.3 Test Item Modifications

No modifications were required for compliance.

## 4 TEST FACILITY AND TEST INSTRUMENTATION

4.1 Shielded Enclosure

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. With the exception of the floor, the reflective surfaces of the shielded chamber are lined with ferrite tiles on the walls and ceiling. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2003 for site attenuation.

4.2 Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Section 9. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

Radiated emissions were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths specified by the FCC and with the quasi-peak detector function. The receiver bandwidth was 120 kHz for the 30 MHz to 1000 MHz radiated emissions data and 1MHz for radiated emissions data above 1GHz.

4.3 Calibration Traceability

Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.4 Measurement Uncertainty

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system. The measurement uncertainty for these tests is presented below:



Conducted Emission Measurements		
Combined Standard Uncertainty	1.07	-1.07
Expanded Uncertainty (95% confidence)	2.1	-2.1

Radiated Emission Measurements		
Combined Standard Uncertainty	2.26	-2.18
Expanded Uncertainty (95% confidence)	4.5	-4.4

## 5 TEST PROCEDURES

### 5.1 Powerline Conducted Emissions

#### 5.1.1 Requirements

Since the test item is typically powered with 13.5VDC from an automotive battery, no conducted emissions tests are required.

### 5.2 Radiated Measurements

#### 5.2.1 Requirements

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is 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, based on either an RF conducted or a radiated emissions measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a).

Paragraph 15.209(a) has the following radiated emission limits:

Frequency MHz	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30.0-88.0	100	3
88.0-216.0	150	3
216.0-960.0	200	3
Above 960	500	3

#### 5.2.2 Procedures

Radiated measurements were performed in a 32ft. x 20ft. x 14ft. high semi anechoic chamber. The radiated emissions were investigated over the frequency range of 30 MHz to 25.0 GHz.

- 1) For all harmonics not in the restricted bands, the following procedure was used:
  - a) The field strength of the fundamental was measured using a double ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the test item. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.

- b) The field strengths of all of the harmonics not in the restricted band were then measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the test item. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
  - c) To ensure that maximum or worst case emission levels were measured, the following steps were taken when measuring the fundamental emissions and the spurious emissions:
    - i) The test item was rotated so that all of its sides were exposed to the receiving antenna.
    - ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
    - iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.
    - iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer. The measuring antenna was not raised or lowered to ensure maximized readings, instead the test item was rotated through all axis to ensure the maximum readings were recorded for the test item.
  - d) All harmonics not in the restricted bands must be at least 20 dB below level measured at the fundamental. However, attenuation below the general limits specified in §15.209(a) is not required.
- 2) For all emissions in the restricted bands, the following procedure was used:
- a) The field strengths of all emissions below 1 GHz were measured using a bi-log antenna. The bi-log antenna was positioned at a 3 meter distance from the test item. A peak detector with a resolution bandwidth of 100 kHz was used on the spectrum analyzer.
  - b) The field strengths of all emissions above 1 GHz were measured using a double-ridged waveguide antenna. The waveguide antenna was positioned at a 3 meter distance from the test item. A peak detector with a resolution bandwidth of 1 MHz was used on the spectrum analyzer.
  - c) To ensure that maximum or worst case emission levels were measured, the following steps were taken when taking all measurements:
    - i) The test item was rotated so that all of its sides were exposed to the receiving antenna.
    - ii) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
    - iii) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.
    - iv) In instances where it was necessary to use a shortened cable between the measuring antenna and the spectrum analyzer. The measuring antenna was not raised or lowered to ensure maximized readings, instead the test item was rotated through all axis to ensure the maximum readings were recorded for the test item.
  - d) For all radiated emissions measurements below 1 GHz, if the peak reading is below the limits listed in 15.209(a), no further measurements are required. If however, the peak readings exceed the limits listed in 15.209(a), then the emissions are remeasured using a quasi-peak detector.
  - e) For all radiated emissions measurements above 1 GHz, the peak readings must comply with the 15.35(b) limits. 15.35(b) states that when average radiated emissions measurements are specified, there also is a limit on the peak level of the radiated emissions. The limit on the peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. Therefore, all peak readings above 1 GHz must be no greater than 20 dB above the limits specified in 15.209(a).

### 5.2.3 Results

The preliminary radiated emissions plots are presented on pages 17 through 25. Factors for the antennas and



cables were added to the data before it was plotted. This data is only presented for a reference, and is not used as official data. Final radiated emissions data are presented on data pages 26 through 31. As can be seen from the data, all emissions measured from the test item were within the specification limits. Photographs of the test configuration for radiated emission are shown as Figures 2.

### 5.3 20 dB Bandwidth

#### 5.3.1 Requirements

Per section 15.247(a)(1), frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate within an output power no greater than 125 mW.

#### 5.3.2 Procedures

The test item was set up inside the chamber. With the hopping function disabled, the test item was allowed to transmit continuously. The frequency hopping channel was set separately to low, middle, and high hopping channels. The resolution bandwidth (RBW) was set to > to 1% of the 20 dB BW.

The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined. The analyzer's display was plotted using a 'screen dump' utility.

#### 5.3.3 Results

The plots on pages 32 through 34 show that the maximum 20 dB bandwidth was 883.8 kHz. The 99% bandwidth measurement was 893 kHz.

### 5.4 Carrier Frequency Separation

#### 5.4.1 Requirements

Per section 15.247(a)(1), alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate within an output power no greater than 125 mW.

#### 5.4.2 Procedures

The test item was set up inside the chamber. With the hopping function enabled, the test item was allowed to transmit continuously.

The resolution bandwidth (RBW) was set to > to 1% of the span. The peak detector and 'Max-Hold' function were engaged. The span was set wide enough to capture the peaks of at least two adjacent channels. When the trace had stabilized after multiple scans, the marker-delta function was used to determine the separation between the peaks of the adjacent channels. The analyzer's display was plotted using a 'screen dump' utility.

#### 5.4.3 Results

Page 35 shows the carrier frequency separation. As can be seen from this plot, the carrier frequency separation is 1.0 MHz which is greater than the 20 dB bandwidth of the hopping channel (883.8kHz).

### 5.5 Number of Hopping Frequencies

#### 5.5.1 Requirements

Per section 15.247(a)(1)(iii), frequency hopping systems operating in the 2400-2483.5 MHz band shall use at least 15 hopping channels.

### 5.5.2 Procedures

The test item was set up inside the chamber. With the hopping function enabled, the test item was allowed to transmit continuously.

The resolution bandwidth (RBW) was set to > to 1% of the span. The peak detector and 'Max-Hold' function were engaged. The span was set wide enough to capture the entire frequency band of operation.

The test item's signal was allowed to stabilize after multiple scans. The number of hopping frequencies was counted. The analyzer's display was plotted using a 'screen dump' utility.

### 5.5.3 Results

Page 36 shows the number of hopping frequencies. As can be seen from this plot, the number of hopping frequencies is 79 which is greater than the minimum number of required hopping frequencies for systems operating in the 2400-2483.5 MHz band.

## 5.6 Time of Occupancy

### 5.6.1 Requirements

Per section 15.247(a)(1)(iii), for frequency hopping systems operating in the 2400-2483.5 MHz band, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

### 5.6.2 Procedures

The test item was set up inside the chamber. With the hopping function enabled, the test item was allowed to transmit continuously.

The resolution bandwidth (RBW) was set to 1 MHz. The peak detector and 'Max-Hold' function were engaged. With the span set to 0 Hz, the sweep time was adjusted to capture a single event in order to measure the dwell time per hop. The analyzer's display was plotted using a 'screen dump' utility. Then, the sweep time was expanded to greater than 0.4 seconds multiplied by the number of hopping channels employed (.4 seconds \* 79 hops = 31.6 seconds).

### 5.6.3 Results

Pages 37 through 40 show the plots for the time of occupancy (dwell time). As can be seen from the plots, the time of occupancy can be determined by 380.8 uS multiplied by 330 hops within a 31.6 second sweep. This calculated value is equal to 0.126 seconds which is less than the 0.4 seconds maximum allowed.

## 5.7 Peak Output Power

### 5.7.1 Requirements

Per section 15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band and employing at least 75 non-overlapping hopping channels, the maximum peak output conducted power shall not be greater than 1 W (30 dBm). Per section 15.247(b)(4), this limit is based on the use of antennas with directional gains that do not exceed 6dBi. Since the limit allows for a 6 dBi antenna gain, the maximum EIRP can be increased by 6 dB to 4 Watt (36 dBm).

### 5.7.2 Procedures

The test item was placed on the non-conductive stand and set to transmit. A double ridged waveguide antenna was placed at a test distance of 3 meters from the test item. The test item was maximized for worst case emissions (or maximum output power) at the measuring antenna. The maximum meter reading was recorded. The peak power output was measured for the 2402.0 MHz, 2441.0 MHz and 2480.0 MHz hopping frequencies.

The equivalent power was determined from the field intensity levels measured at 3 meters using the substitution

method. To determine the emission power, a second double ridged waveguide antenna was then set in place of the test item and connected to a calibrated signal generator. The output of the signal generator was adjusted to match the received level at the spectrum analyzer. The signal level was recorded. The reading was then corrected to compensate for cable loss and antenna gain, as required. The peak power output was calculated for 2402.0 MHz, 2441.0 MHz and 2480.0 MHz hopping frequencies.

### 5.7.3 Results

The results are presented on page 41. The maximum EIRP measured from the transmitter was -3.1 dBm or 0.5 mW which is below the 4 Watt (36 dBm) limit.

## 5.8 Band edge Compliance

### 5.8.1 Requirements

Per section 15.247(d), the emissions at the band edges must be at least 20 dB below the highest level measured within the band but attenuation below the general limits listed in 15.209(a) is not required. In addition, the radiated emissions which fall in the restricted band beginning at 2483.5 MHz must meet the general limits of 15.209(a).

### 5.8.2 Procedures

- 1) The test item was placed in the test chamber.
- 2) The test item was set to transmit continuously at the channel closest to the low band-edge (hopping function disabled).
- 3) The meter reading was recorded.
- 4) To determine the band edge compliance, the following spectrum analyzer settings were used:
  - a) Center frequency = low band-edge frequency.
  - b) Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
  - c) Resolution bandwidth (RBW) = 100 kHz (at least 1% of the span).
  - d) The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
  - e) The marker was set on the peak of the in-band emissions. A display line was placed 20 dB down from the peak of the in-band emissions. All emissions which fall outside of the authorized band of operation must be below the 20 dB down display line. (All emissions to the left of the center frequency (band edge) must be below the display line.)
  - f) The analyzer's display was plotted using a 'screen dump' utility.
- 5) Step 5) was repeated with the frequency hopping function enabled.
- 6) The test item was set to transmit continuously at the channel closest to the high band-edge (hopping function disabled).
- 7) The test item was maximized for worst case emissions at the measuring antenna. A peak reading was taken with a resolution bandwidth of 1 MHz and a video bandwidth of 1 MHz or greater. An average reading was then taken with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz. The maximum peak and average meter readings were recorded.
- 8) To determine the band edge compliance, the following spectrum analyzer settings were used:
  - a) Center frequency = high band-edge frequency.
  - b) Span = Wide enough to capture the peak level of the emission operating on the channel closest



to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.

- c) Resolution bandwidth (RBW) = 100 kHz (at least 1% of the span).
  - d) The 'Max-Hold' function was engaged. The analyzer was allowed to scan until the envelope of the transmitter bandwidth was defined.
  - e) The marker was set on the peak of the in-band emissions. This level corresponds to the maximized peak reading previously taken. The "marker-delta" method described in Public Notice DA 00-705 was then used to determine band edge compliance. The delta between the marker and the general limit (54 dBuV/m) was calculated by subtracting the general limit (54 dBuV/m) from the maximum reading taken with a 1 MHz bandwidth. This delta represents how far below the marker the emissions outside of the authorized band of operation must be. A display line was placed at this level. All emissions which fall outside of the authorized band of operation must be below the display line. (All emissions to the right of the center frequency (band-edge) must be below the display line.)
  - f) The analyzer's display was plotted using a 'screen dump' utility.
- 9) The previous step was repeated with the frequency hopping function enabled.

### 5.8.3 Results

Pages 42 through 45 show the radiated band-edge compliance results. As can be seen from these plots, the emissions at the low end band edge are within the 20 dB down limits. The emissions at the high end band edge are within the general limits using the delta marker method.

## 5.9 Power Spectral Density

### 5.9.1 Requirements

Per section 15.247(d), the peak power spectral density from the intentional radiator shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### 5.9.2 Procedures

The output of the test item was connected to the power meter through a 20 dB pad. The test item was put into inquiry mode. The resolution bandwidth (RBW) was initially set to 3MHz to set the reference level. Knowing the peak level, the result of this plot was used to determine the 8dBm limit. The resolution bandwidth (RBW) was set to 3kHz, the sweep time was set to the span divided by 3kHz (1 MHz/3kHz = 333 seconds). The peak detector and 'Max-Hold' function was engaged. The analyzer's display was plotted using a 'screen dump' utility.

### 5.9.3 Results

Data page 46 shows the power spectral density results. As can be seen from this plot, the peak power density is less than 8dBm in a 3kHz band during any time interval of continuous transmission.

## 6 CONCLUSIONS

It was determined that the Delphi Electronics and Safety Volvo P3 BlueTooth Radio, Part No. 28132536 hybrid frequency hopping spread spectrum transmitter, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections 15.207 and 15.247 for Intentional Radiators Operating within the 2400-2483.5 MHz band, and Industry Canada's RSS-210 for Low-power License-exempt radio communication devices when tested per ANSI C63.4-2003.

## 7 CERTIFICATION

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under



conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the test item at the test date. Any electrical or mechanical modification made to the test item subsequent to the specified test date will serve to invalidate the data and void this certification.

## 8 ENDORSEMENT DISCLAIMER

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.



## 9 EQUIPMENT LIST

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
APW1	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-30-20G20R6G-3R0	PL2927/0646	20GHZ-26.5GHZ	12/18/2007	12/18/2008
APW3	PREAMPLIFIER	PLANAR ELECTRONICS	PE2-35-120-5R0-10-12	PL2924	1GHZ-20GHZ	11/30/2007	11/30/2008
CDS2	COMPUTER	GATEWAY	MFATXPNT NMZ 500L	0028483108	1.8GHZ	N/A	
CMA0	MULTI-DEVICE CONTROLLER	EMCO	2090	9701-1213	---	N/A	
MDA1	MULTIMETER (D. CROWDER)	FLUKE CORPORATION	26	72030992	I;VDC;VAC;R	2/13/2008	2/13/2009
NTA1	BILOG ANTENNA	CHASE EMC LTD.	BILOG CBL6112	2054	0.03-2GHZ	6/5/2007	6/5/2008
NWF0	RIDGED WAVE GUIDE	EMCO	3105	2035	1-12.4GHZ	10/13/2007	10/13/2008
NWI0	RIDGED WAVE GUIDE	AEL	H1498	153	2-18GHZ	10/13/2007	10/13/2008
NWN0	DOUBLE RIDGED GUIDE ANTENNA	ETS-LINDGREN	3116	00026778	18 TO 40 GHZ	10/4/2007	10/4/2008
RBB0	EMI TEST RECEIVER 20HZ TO 40 GHZ.	ROHDE & SCHWARZ	ESIB40	100250	20 HZ TO 40GHZ	11/5/2007	11/5/2008
SEK1	DC POWER SUPPLY	LABORNETZGERAT	L3205	94081004	0-32VDC;0-5A	NOTE 1	
XPR0	HIGH PASS FILTER	K&L MICROWAVE	11SH10-4800/X20000	001	4.8-20GHZ	7/23/2007	7/23/2008

I/O: Initial Only; N/A: Not Applicable; Note 1 - For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

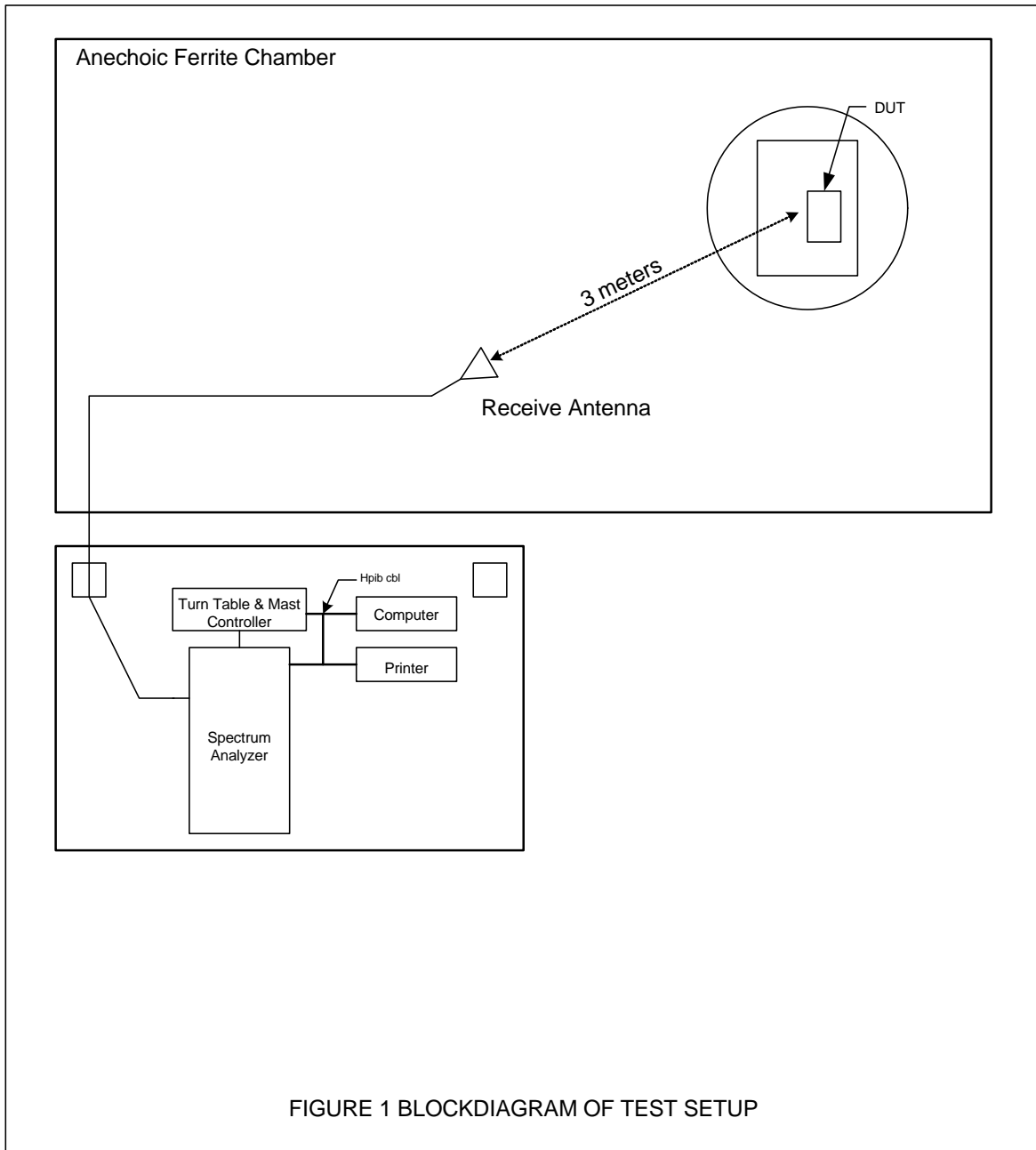


Figure 2

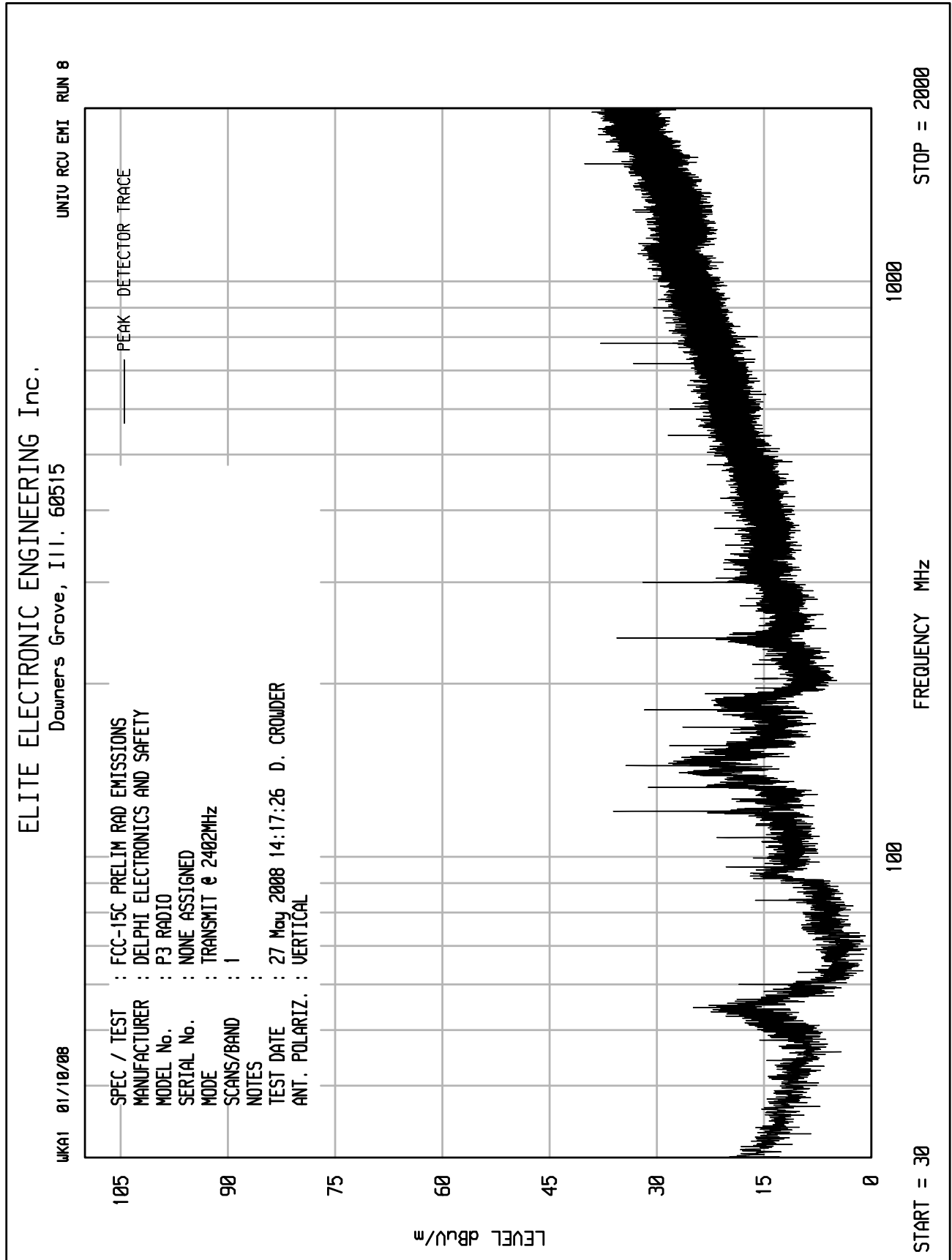


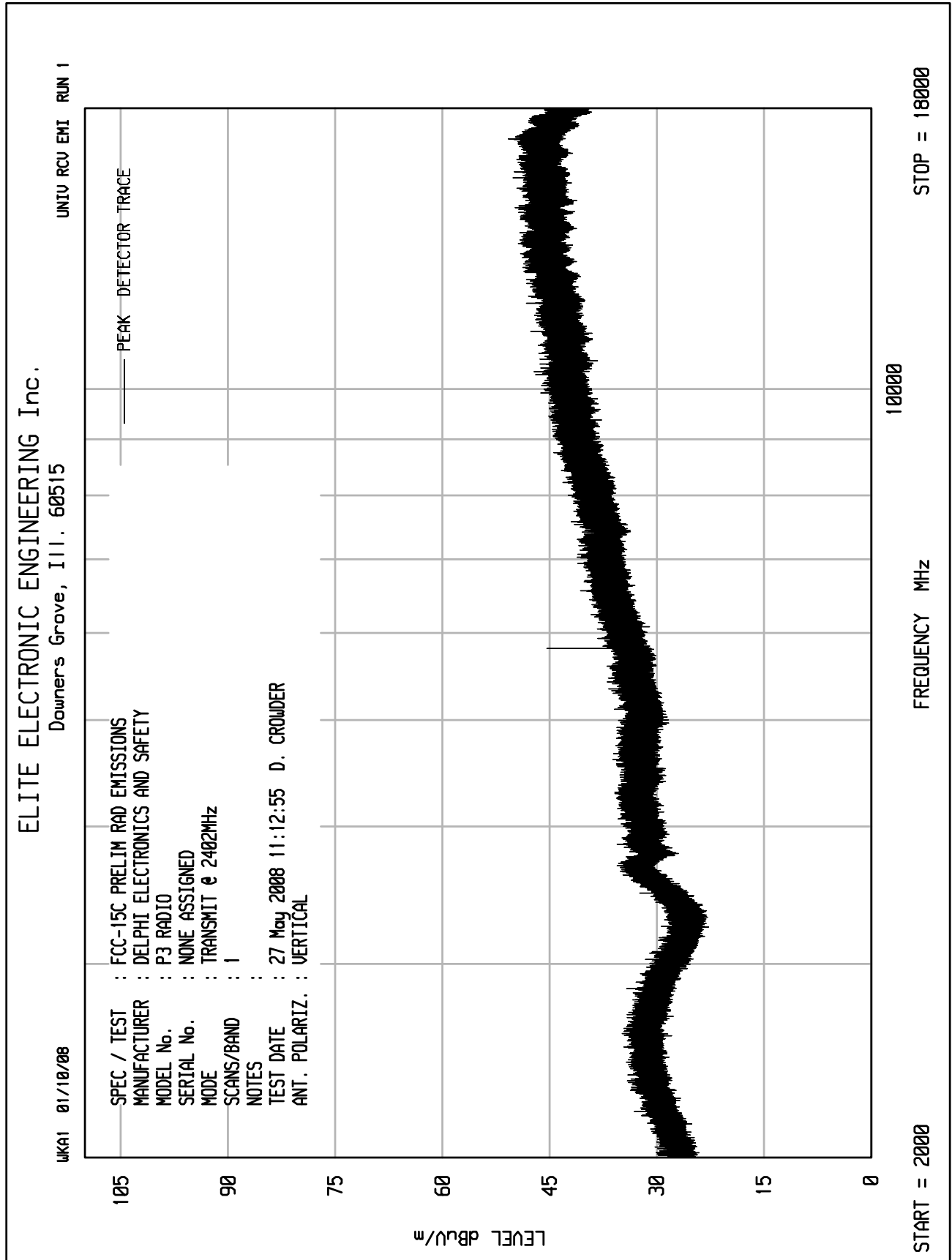
Test Set-up for Radiated Emissions – Horizontal Polarization



Test Set-up for Radiated Emissions – Vertical Polarization







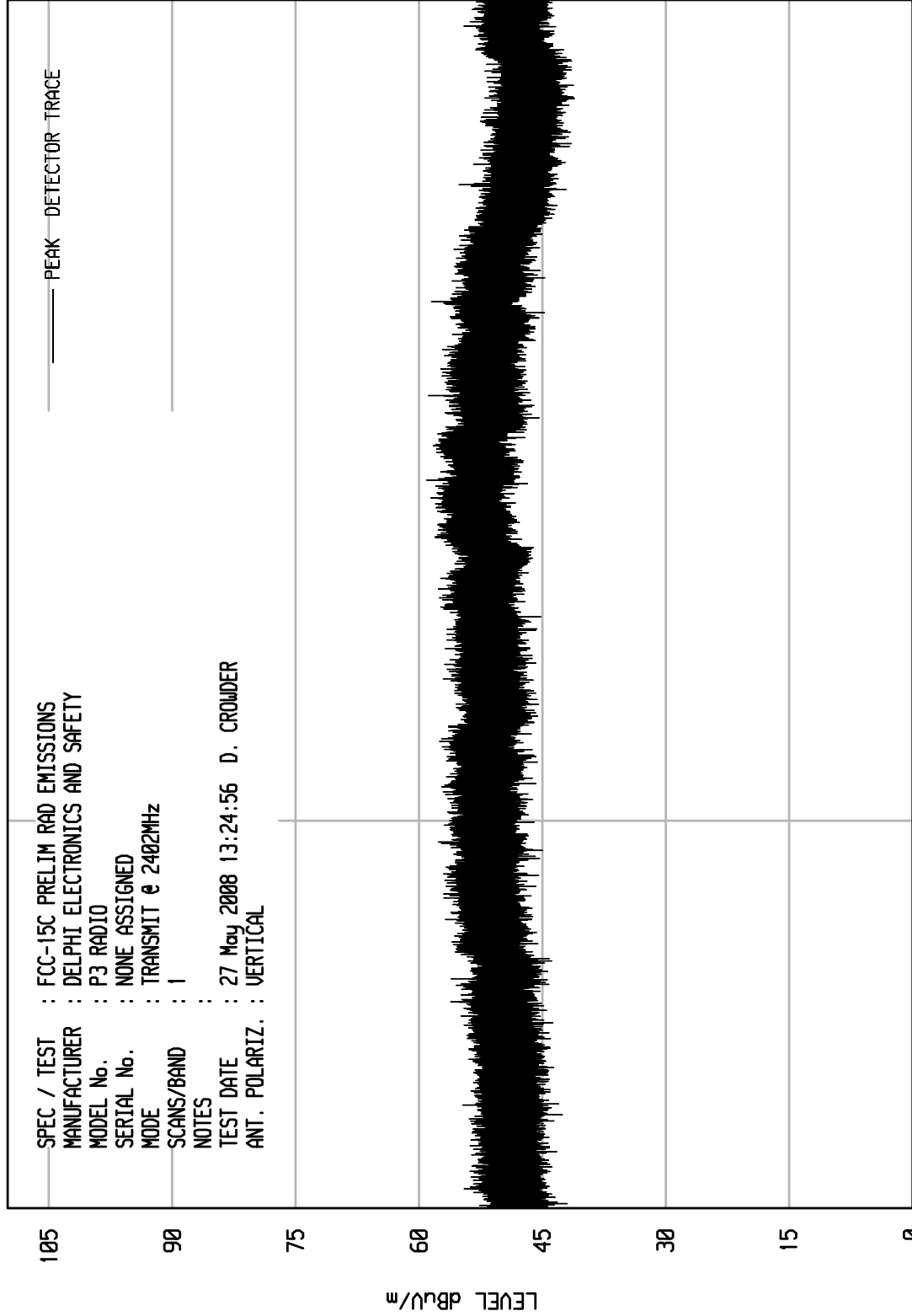


ELITE ELECTRONIC ENGINEERING Inc.

Downers Grove, Ill. 60515

UNIV RCU EMI RUN 7

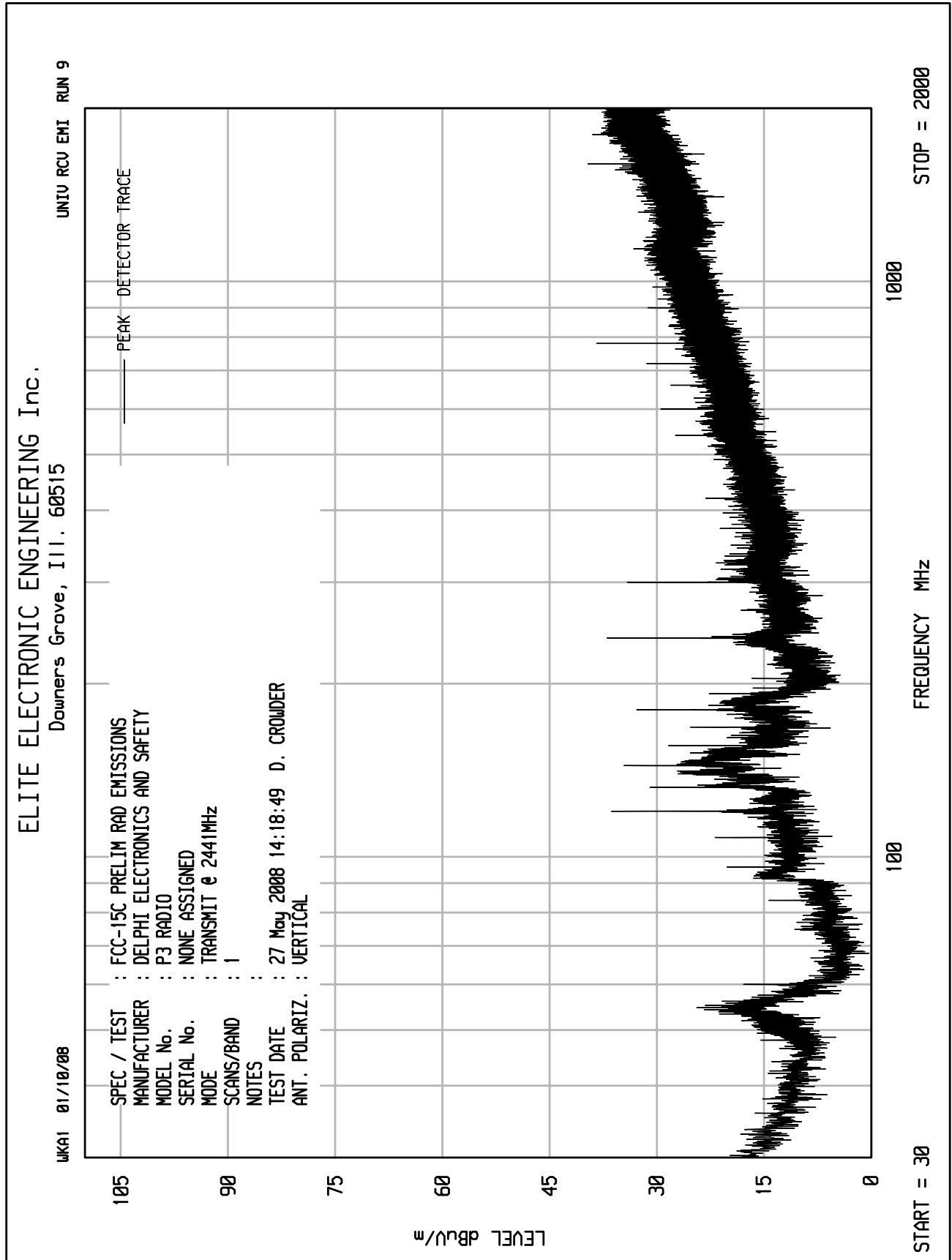
UKA1 01/10/08



STOP = 25000

FREQUENCY MHz

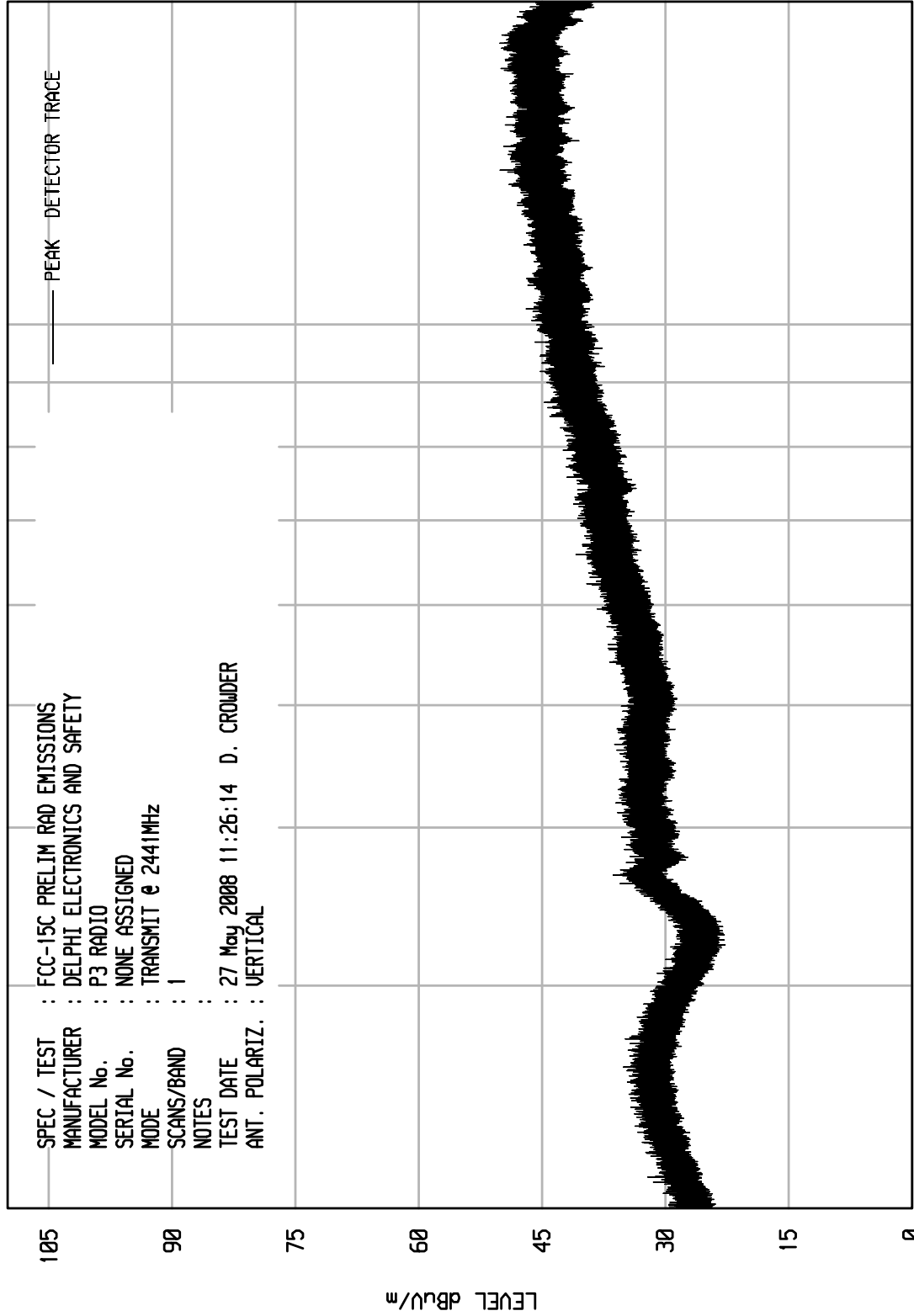
START = 18000



ELITE ELECTRONIC ENGINEERING Inc.  
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UNIV RCU EMI RUN 2

UKA1 01/10/08



STOP = 18000

FREQUENCY MHz

START = 2000



ELITE ELECTRONIC ENGINEERING Inc.

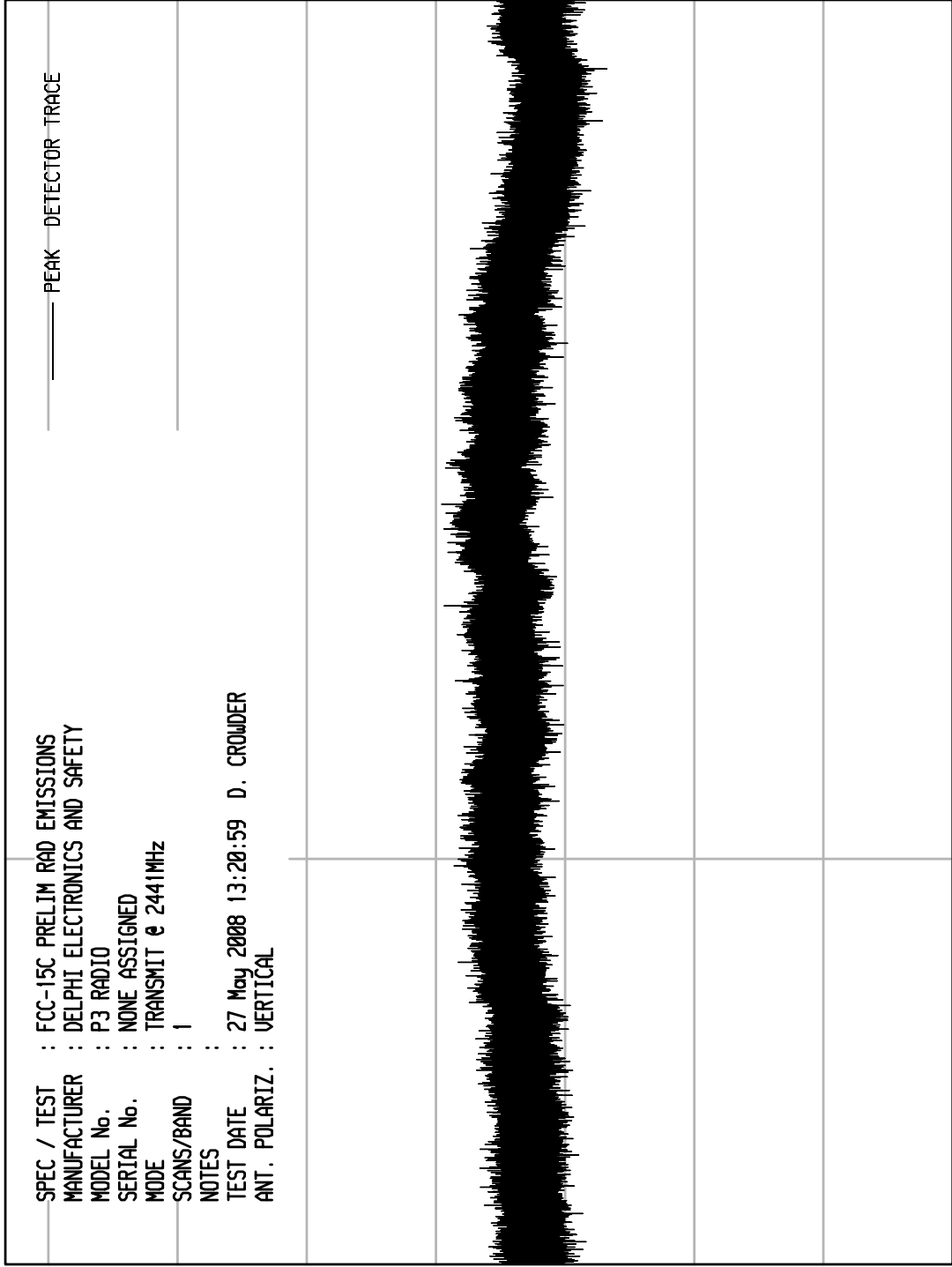
Downers Grove, Ill. 60515

UNIV RCU EMI RUN 6

UKA1 01/10/08

SPEC / TEST : FCC-15C PRELIM RAD EMISSIONS  
 MANUFACTURER : DELPHI ELECTRONICS AND SAFETY  
 MODEL No. : P3 RADIO  
 SERIAL No. : NONE ASSIGNED  
 MODE : TRANSMIT @ 2441MHz  
 SCANS/BAND : 1  
 NOTES :  
 TEST DATE : 27 May 2008 13:20:59 D. CROWDER  
 ANT. POLARIZ. : VERTICAL

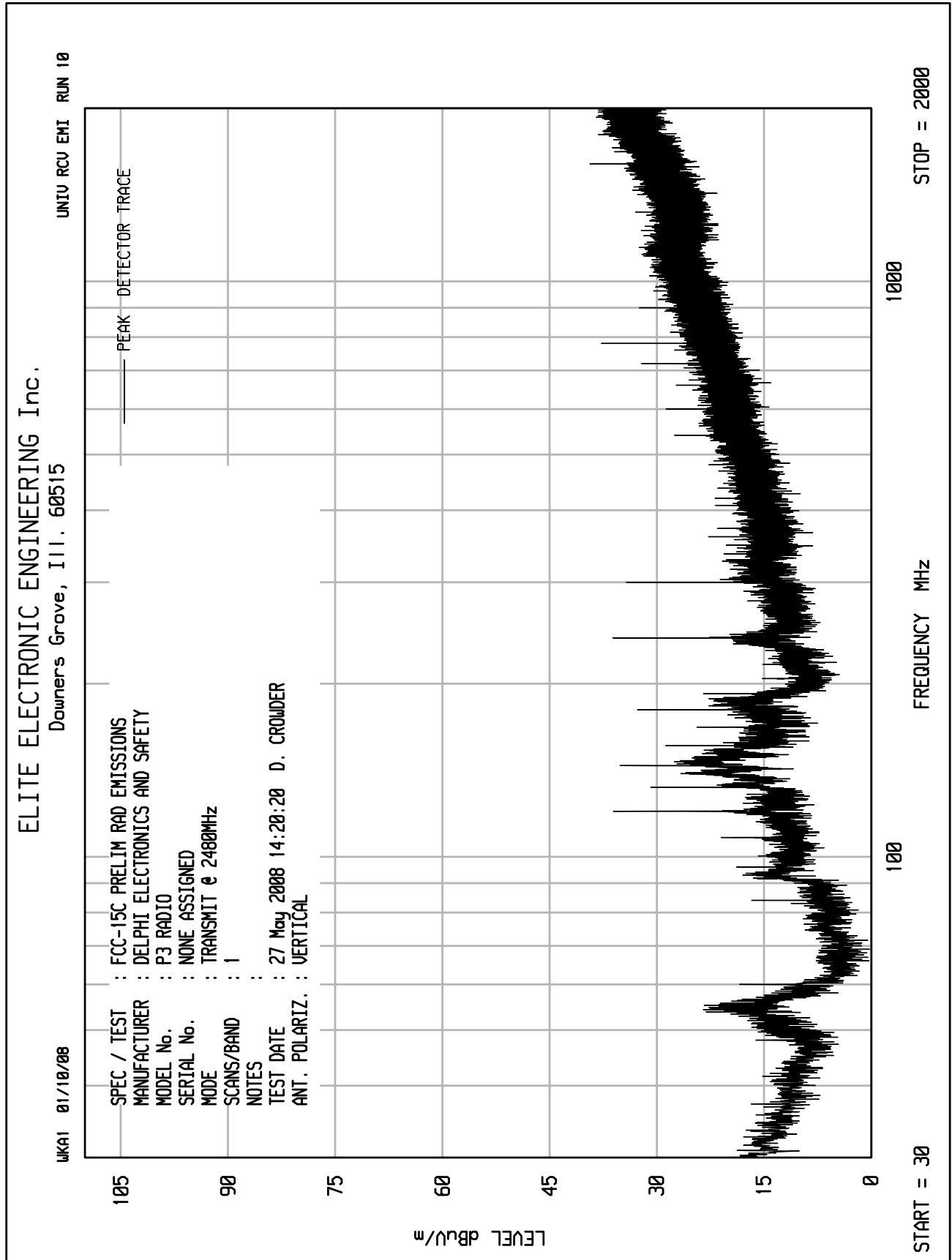
— PEAK DETECTOR TRACE



START = 18000

FREQUENCY MHz

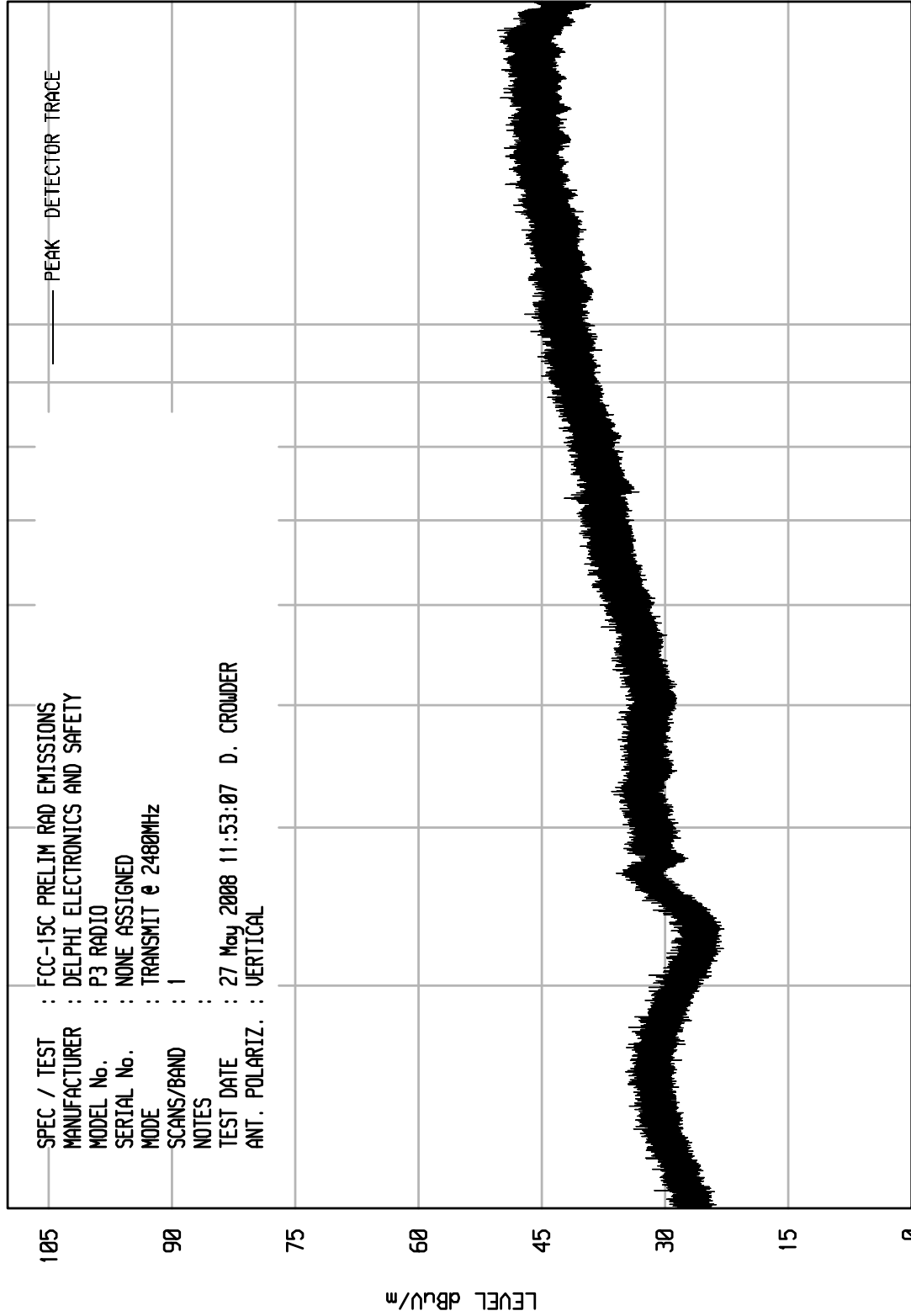
STOP = 25000



ELITE ELECTRONIC ENGINEERING Inc.  
Downers Grove, Ill. 60515

UNIU RCU EMI RUN 3

UKA1 01/10/08



STOP = 18000

FREQUENCY MHz

START = 2000



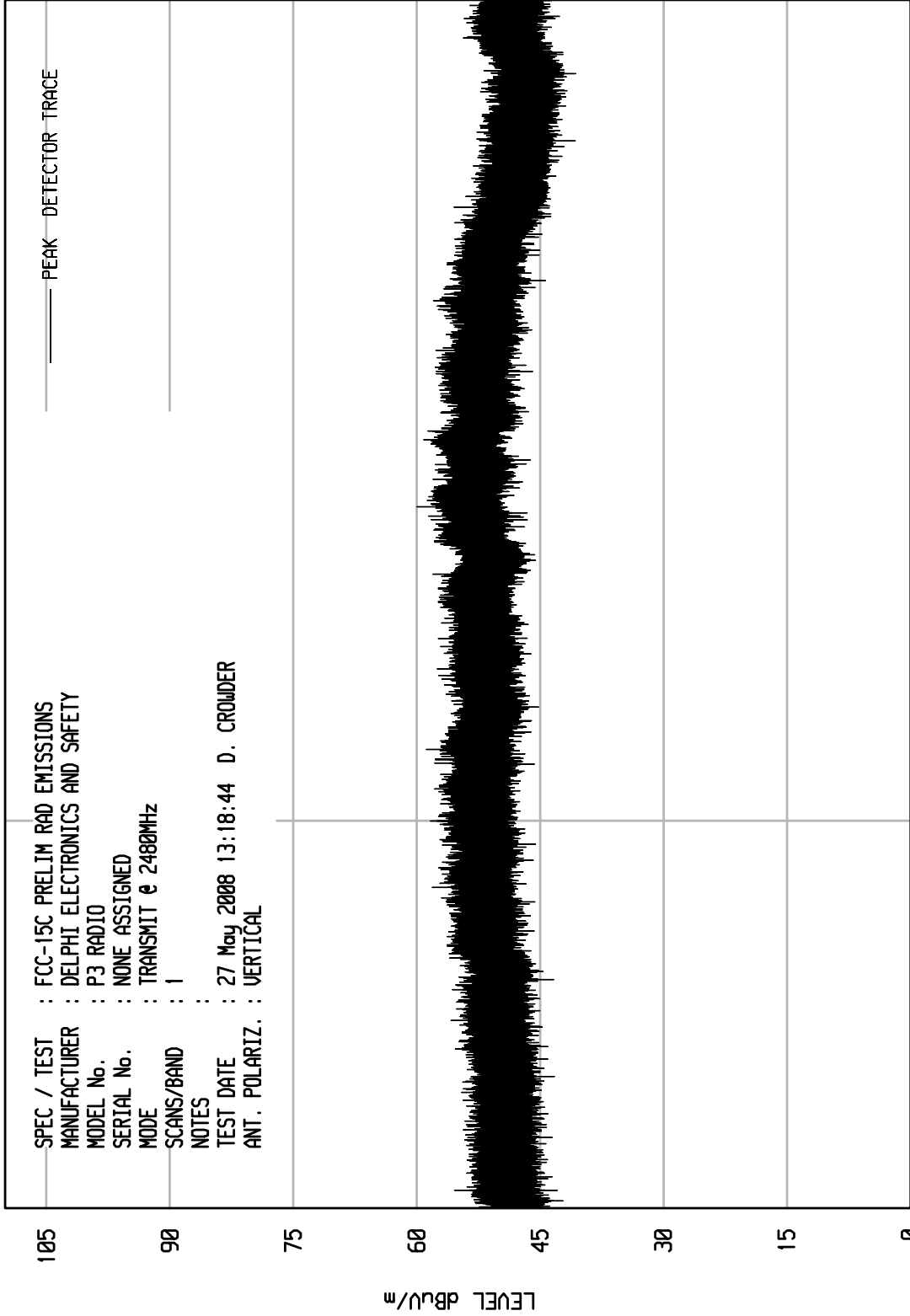


ELITE ELECTRONIC ENGINEERING Inc.

Downers Grove, Ill. 60515

UKA1 01/10/08

UNIV RCU EMI RUN 5



START = 18000

FREQUENCY MHz

STOP = 25000



Data Page

Manufacturer : Delphi Electronics and Safety  
 Model No. : 28132536  
 Serial No. : None Assigned  
 Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions  
 Date : May 28, 2008  
 Mode : Transmit @ 2402.0MHz  
 Test Distance : 3 meters  
 Notes : Gray rows indicate restricted bands which must meet the general limits  
       : Peak measurements

Frequency MHz	Antenna Polarity	Meter Reading dBuV	Ambient	Cable Loss dB	Antenna Factor dB	Pre Amp Gain dB	Total dBuV/m	Total uV/m	Limit uV/m
2402.00	H	52.2		3.5	31.4	0.0	87.0	22423.2	
2402.00	V	55.9		3.5	31.4	0.0	90.7	34331.9	
4804.00	H	44.9	*	4.9	34.6	-40.1	44.3	164.7	5000.0
4804.00	V	42.1	*	4.9	34.6	-40.1	41.5	119.3	5000.0
7206.00	H	44.1	*	6.6	38.1	-39.8	49.1	283.5	3433.2
7206.00	V	45.3	*	6.6	38.1	-39.8	50.3	325.5	3433.2
9608.00	H	44.3	*	7.5	39.7	-38.8	52.7	430.8	3433.2
9608.00	V	43.4	*	7.5	39.7	-38.8	51.8	388.4	3433.2
12010.00	H	46.1	*	8.5	41.4	-39.6	56.4	657.7	5000.0
12010.00	V	45.7	*	8.5	41.4	-39.6	56.0	628.1	5000.0
14412.00	H	44.7	*	9.7	43.7	-39.9	58.3	818.0	3433.2
14412.00	V	45.0	*	9.7	43.7	-39.9	58.6	846.8	3433.2
16814.00	H	44.6	*	10.4	44.6	-38.8	60.9	1103.8	3433.2
16814.00	V	44.3	*	10.4	44.6	-38.8	60.6	1066.3	3433.2
19216.00	H	35.1	*	2.2	45.6	-40.2	42.7	136.1	5000.0
19216.00	V	34.8	*	2.2	45.6	-40.2	42.4	131.5	5000.0
21618.00	H	35.1	*	2.2	46.2	-26.2	57.4	740.1	3433.2
21618.00	V	35.3	*	2.2	46.2	-26.2	57.6	757.3	3433.2
24020.00	H	31.7	*	2.2	45.8	-27.4	52.3	412.9	3433.2
24020.00	V	31.9	*	2.2	45.8	-27.4	52.5	422.5	3433.2

Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain



Data Page

Manufacturer : Delphi Electronics and Safety  
Model No. : 28132536  
Serial No. : None Assigned  
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions  
Date : May 28, 2008  
Mode : Transmit @ 2402.0MHz  
Test Distance : 3 meters  
Notes : Average measurements in Restricted Bands

Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain

Frequency MHz	Antenna Polarity	Meter Reading dBuV	Ambient	Cable Loss dB	Antenna Factor dB	Pre Amp Gain dB	Total dBuV/m	Total uV/m	Limit uV/m
4804.00	H	37.1	*	4.9	34.6	-40.1	36.5	67.1	500.0
4804.00	V	38.0	*	4.9	34.6	-40.1	37.4	74.5	500.0
12010.00	H	31.3	*	8.5	41.4	-39.6	41.5	119.1	500.0
12010.00	V	31.2	*	8.5	41.4	-39.6	41.5	118.7	500.0
19216.00	H	20.1	*	2.2	45.6	-40.2	27.6	24.1	500.0
19216.00	V	20.0	*	2.2	45.6	-40.2	27.6	24.0	500.0



Data Page

Manufacturer : Delphi Electronics and Safety  
 Model No. : 28132536  
 Serial No. : None Assigned  
 Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions  
 Date : May 28, 2008  
 Mode : Transmit @ 2441.0 MHz  
 Test Distance : 3 meters  
 Notes : Gray rows indicate restricted bands which must meet the general limits  
       : Peak measurements

Frequency MHz	Antenna Polarity	Meter Reading dBuV	Ambient	Cable Loss dB	Antenna Factor dB	Pre Amp Gain dB	Total dBuV/m	Total uV/m	Limit uV/m
2441.00	H	50.4		3.5	31.4	0.0	85.3	18364.7	
2441.00	V	56.4		3.5	31.4	0.0	91.3	36642.4	
4882.00	H	44.5	*	5.0	34.6	-40.1	44.0	158.1	5000.0
4882.00	V	46.8	*	5.0	34.6	-40.1	46.2	203.9	5000.0
7323.00	H	46.2	*	6.7	38.2	-39.7	51.3	366.6	5000.0
7323.00	V	46.5	*	6.7	38.2	-39.7	51.6	378.1	5000.0
9764.00	H	46.7	*	7.5	39.8	-38.7	55.3	584.7	3664.2
9764.00	V	47.6	*	7.5	39.8	-38.7	56.2	647.1	3664.2
12205.00	H	44.9	*	8.7	41.4	-39.4	55.6	599.4	5000.0
12205.00	V	46.9	*	8.7	41.4	-39.4	57.5	752.9	5000.0
14646.00	H	45.4	*	9.8	44.1	-40.1	59.3	920.8	3664.2
14646.00	V	45.1	*	9.8	44.1	-40.1	59.0	892.6	3664.2
17087.00	H	45.0	*	10.5	44.4	-38.7	61.3	1159.8	3664.2
17087.00	V	46.2	*	10.5	44.4	-38.7	62.5	1334.8	3664.2
19528.00	H	35.1	*	2.2	45.8	-40.2	42.9	139.5	5000.0
19528.00	V	35.0	*	2.2	45.8	-40.2	42.9	139.3	5000.0
21969.00	H	36.5	*	2.2	46.4	-26.9	58.1	804.0	3664.2
21969.00	V	36.5	*	2.2	46.4	-26.9	58.1	804.0	3664.2
24410.00	H	33.8	*	2.2	46.2	-27.5	54.7	543.2	3664.2
24410.00	V	33.7	*	2.2	46.2	-27.5	54.6	538.8	3664.2

Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain



Data Page

Manufacturer : Delphi Electronics and Safety  
Model No. : 28132536  
Serial No. : None Assigned  
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions  
Date : May 28, 2008  
Mode : Transmit @ 2441.0 MHz  
Test Distance : 3 meters  
Notes : Average measurements in restricted bands

Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain

Frequency MHz	Antenna Polarity	Meter Reading dBuV	Ambient	Cable Loss dB	Antenna Factor dB	Pre Amp Gain dB	Total dBuV/m	Total uV/m	Limit uV/m
4882.00	H	36.8	*	5.0	34.6	-40.1	36.3	65.2	500.0
4882.00	V	37.8	*	5.0	34.5	-40.1	37.1	71.5	500.0
7323.00	H	35.5	*	6.7	38.2	-39.7	40.6	106.9	500.0
7323.00	V	36.2	*	6.7	38.2	-39.7	41.3	115.9	500.0
12205.00	H	31.8	*	8.7	41.4	-39.4	42.5	133.0	500.0
12205.00	V	31.7	*	8.7	41.4	-39.4	42.4	131.4	500.0
19528.00	H	20.1	*	2.2	45.8	-40.2	27.9	24.8	500.0
19528.00	V	20.0	*	2.2	45.8	-40.2	27.8	24.7	500.0



Data Page

Manufacturer : Delphi Electronics and Safety  
 Model No. : 28132536  
 Serial No. : None Assigned  
 Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions  
 Date : May 28, 2008  
 Mode : Transmit @ 2480.0 MHz  
 Test Distance : 3 meters  
 Notes : Gray rows indicate restricted bands which must meet the general limits  
       : Peak measurements

Frequency MHz	Antenna Polarity	Meter Reading dBuV	Ambient	Cable Loss dB	Antenna Factor dB	Pre Amp Gain dB	Total dBuV/m	Total uV/m	Limit uV/m
2480.00	H	51.3		3.5	31.4	0.0	86.2	20522.0	
2480.00	V	56.0		3.5	31.4	0.0	90.9	35254.9	
4960.00	H	45.0	*	5.0	34.6	-40.2	44.4	166.9	5000.0
4960.00	V	44.8	*	5.0	34.6	-40.2	44.2	163.1	5000.0
7440.00	H	44.2	*	6.7	38.2	-39.7	49.4	295.5	5000.0
7440.00	V	44.7	*	6.7	38.2	-39.7	49.9	314.1	5000.0
9920.00	H	45.3	*	7.5	40.0	-38.6	54.1	508.0	3525.5
9920.00	V	45.5	*	7.5	40.0	-38.6	54.4	522.3	3525.5
12400.00	H	45.4	*	8.9	41.4	-39.3	56.5	669.2	5000.0
12400.00	V	44.3	*	8.9	41.4	-39.3	55.4	591.0	5000.0
14880.00	H	43.6	*	9.9	44.5	-40.3	57.8	774.1	3525.5
14880.00	V	41.6	*	9.9	44.5	-40.3	55.7	612.8	3525.5
17360.00	H	42.4	*	10.7	44.3	-39.0	58.4	833.6	3525.5
17360.00	V	42.0	*	10.7	44.3	-39.0	58.0	794.2	3525.5
19840.00	H	35.1	*	2.2	45.9	-40.2	43.0	141.8	5000.0
19840.00	V	35.0	*	2.2	45.9	-40.2	43.0	141.7	5000.0
22320.00	H	36.5	*	2.2	46.5	-27.1	58.1	798.9	5000.0
22320.00	V	36.5	*	2.2	46.5	-27.1	58.1	798.9	5000.0
24800.00	H	33.7	*	2.2	46.5	-27.2	55.2	578.2	3525.5
24800.00	V	33.7	*	2.2	46.5	-27.2	55.2	576.2	3525.5

Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain



Data Page

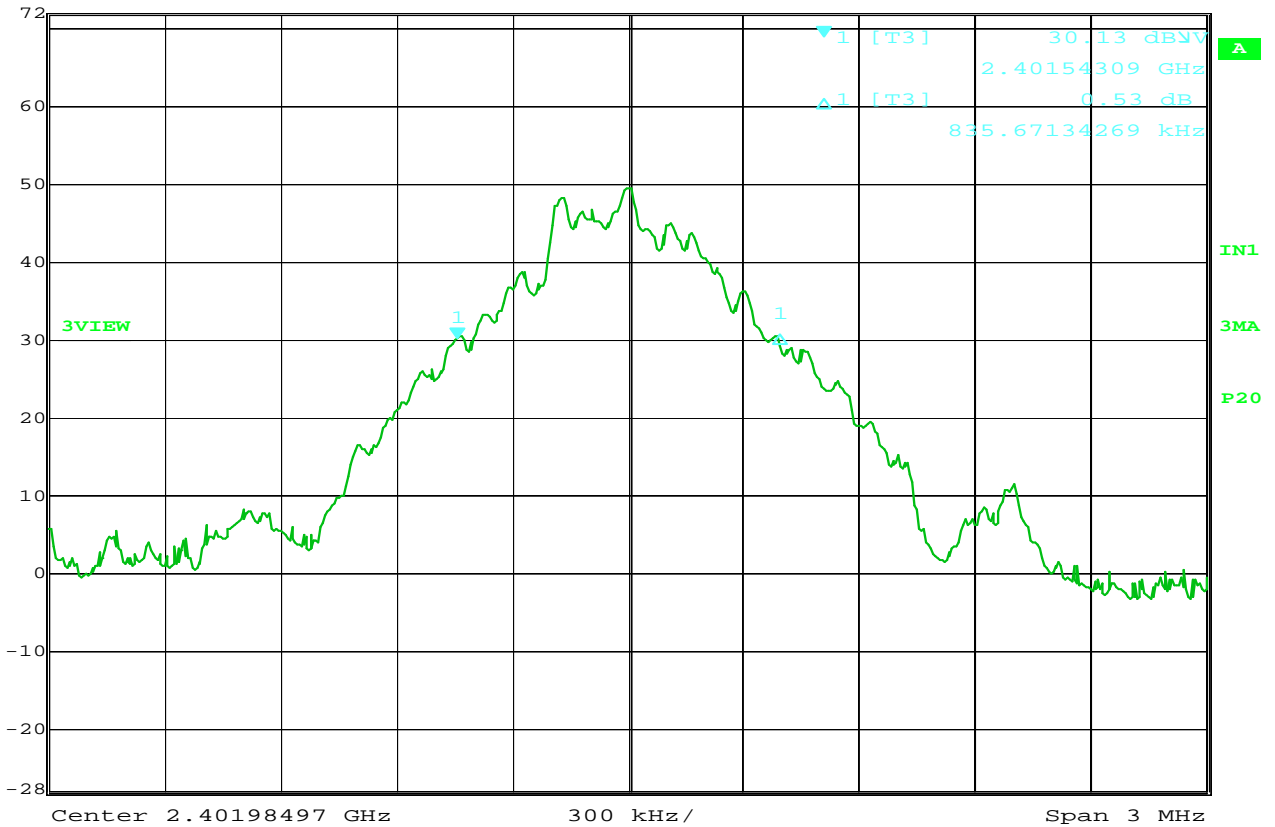
Manufacturer : Delphi Electronics and Safety  
Model No. : 28132536  
Serial No. : None Assigned  
Test Specification : FCC Part 15, Subpart C, Section 15.247, Radiated Emissions  
Date : May 28, 2008  
Mode : Transmit @ 2480.0 MHz  
Test Distance : 3 meters  
Notes : Average measurements in restricted bands

Total = Meter Reading + Cable Loss + Antenna Factor + Preamp Gain

Frequency MHz	Antenna Polarity	Meter Reading dBuV	Ambient	Cable Loss dB	Antenna Factor dB	Pre Amp Gain dB	Total dBuV/m	Total uV/m	Limit uV/m
4960.00	H	36.2	*	5.0	34.6	-40.2	35.6	60.6	500.0
4960.00	V	36.7	*	5.0	34.6	-40.2	36.2	64.4	500.0
7440.00	H	30.7	*	6.7	38.2	-39.7	35.9	62.3	500.0
7440.00	V	30.6	*	6.7	38.2	-39.7	35.8	62.0	500.0
12400.00	H	32.0	*	8.9	41.4	-39.3	43.1	142.1	500.0
12400.00	V	29.3	*	8.9	41.4	-39.3	40.4	104.6	500.0
19840.00	H	20.1	*	2.2	45.9	-40.2	28.0	25.2	500.0
19840.00	V	20.1	*	2.2	45.9	-40.2	28.1	25.4	500.0
22320.00	H	22.1	*	2.2	46.5	-27.1	43.7	152.9	500.0
22320.00	V	22.8	*	2.2	46.5	-27.1	44.4	166.0	500.0



Marker 1 [T3] RBW 30 kHz RF Att 0 dB  
 Ref Lvl 30.13 dBmV VBW 30 kHz  
 72 dBmV 2.40154309 GHz SWT 8.5 ms Unit dBmV



Date: 28.MAY.2008 19:46:30

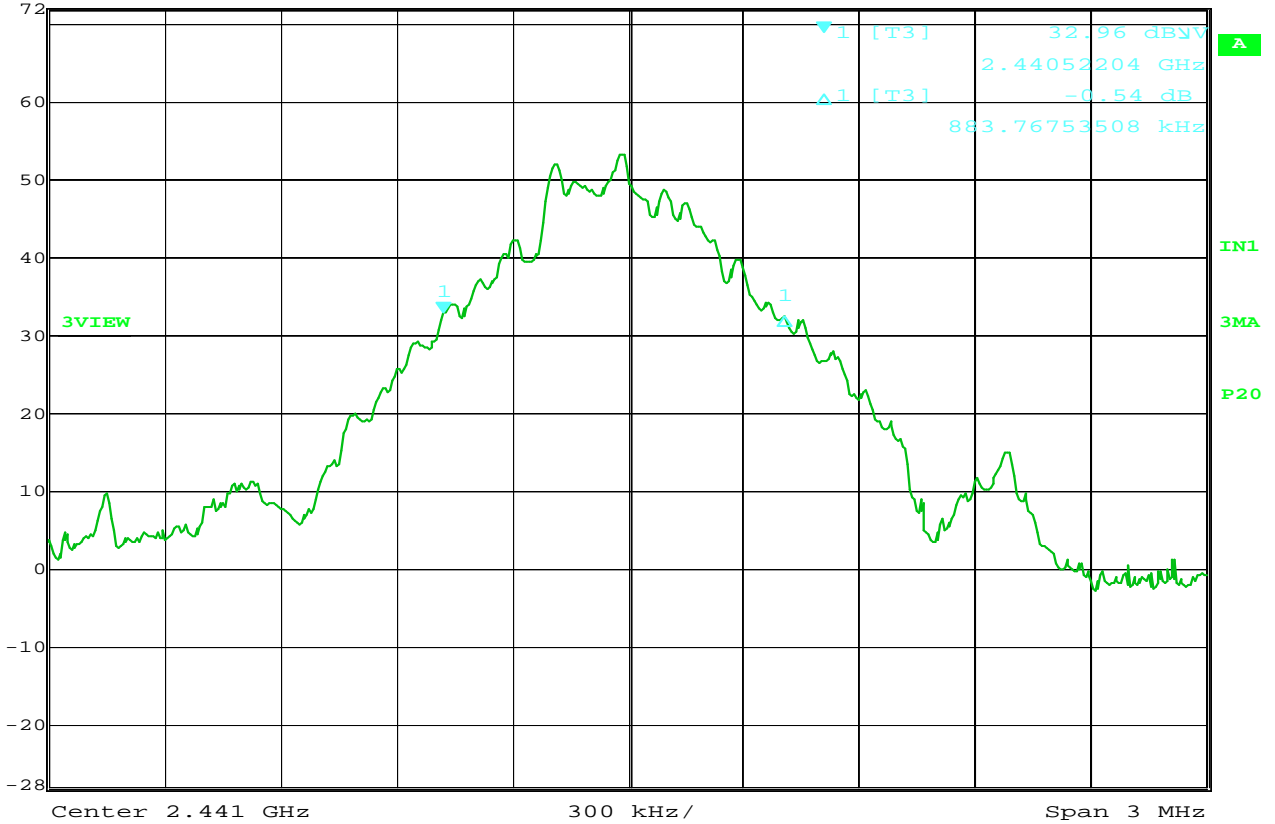
FCC 15.247 20 dB Bandwidth Measurement

MANUFACTURER : Delphi Electronics and Safety  
 TEST ITEM : Volvo P3 BlueTooth Radio  
 MODEL NUMBER : 28132536  
 TEST MODE : Transmit @ 2402.0 MHz  
 NOTES : 20dB bandwidth is 835.7kHz





Ref Lvl 72 dBV  
 Marker 1 [T3] 32.96 dBV  
 2.44052204 GHz  
 RBW 30 kHz RF Att 0 dB  
 VBW 30 kHz  
 SWT 8.5 ms Unit dBV



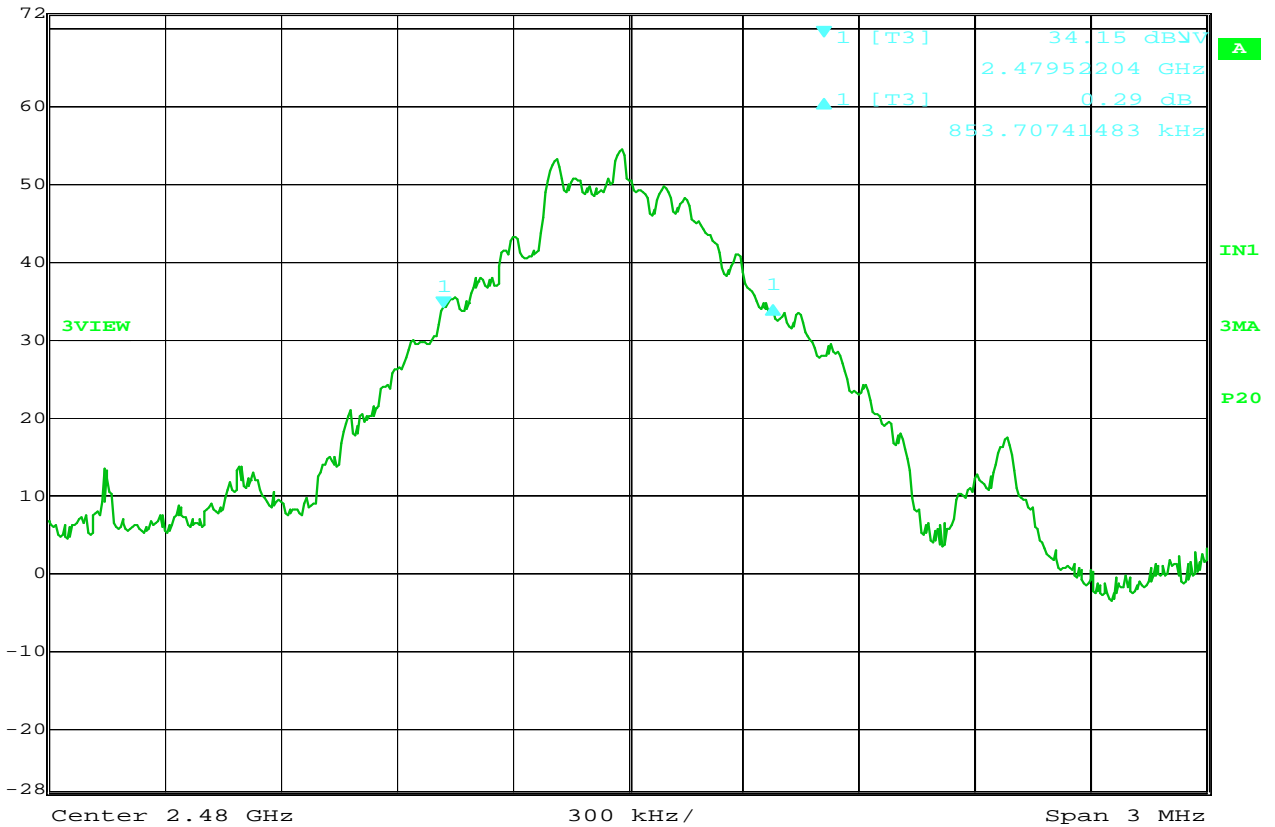
Date: 28.MAY.2008 20:50:55

FCC 15.247 20 dB Bandwidth Measurement

MANUFACTURER : Delphi Electronics and Safety  
 TEST ITEM : Volvo P3 BlueTooth Radio  
 MODEL NUMBER : 28132536  
 TEST MODE : Transmit @ 2441.0 MHz  
 NOTES : 20dB bandwidth is 883.8kHz



Delta 1 [T3] RBW 30 kHz RF Att 0 dB  
 Ref Lvl 0.29 dB VBW 30 kHz  
 72 dBmV 853.70741483 kHz SWT 8.5 ms Unit dBmV



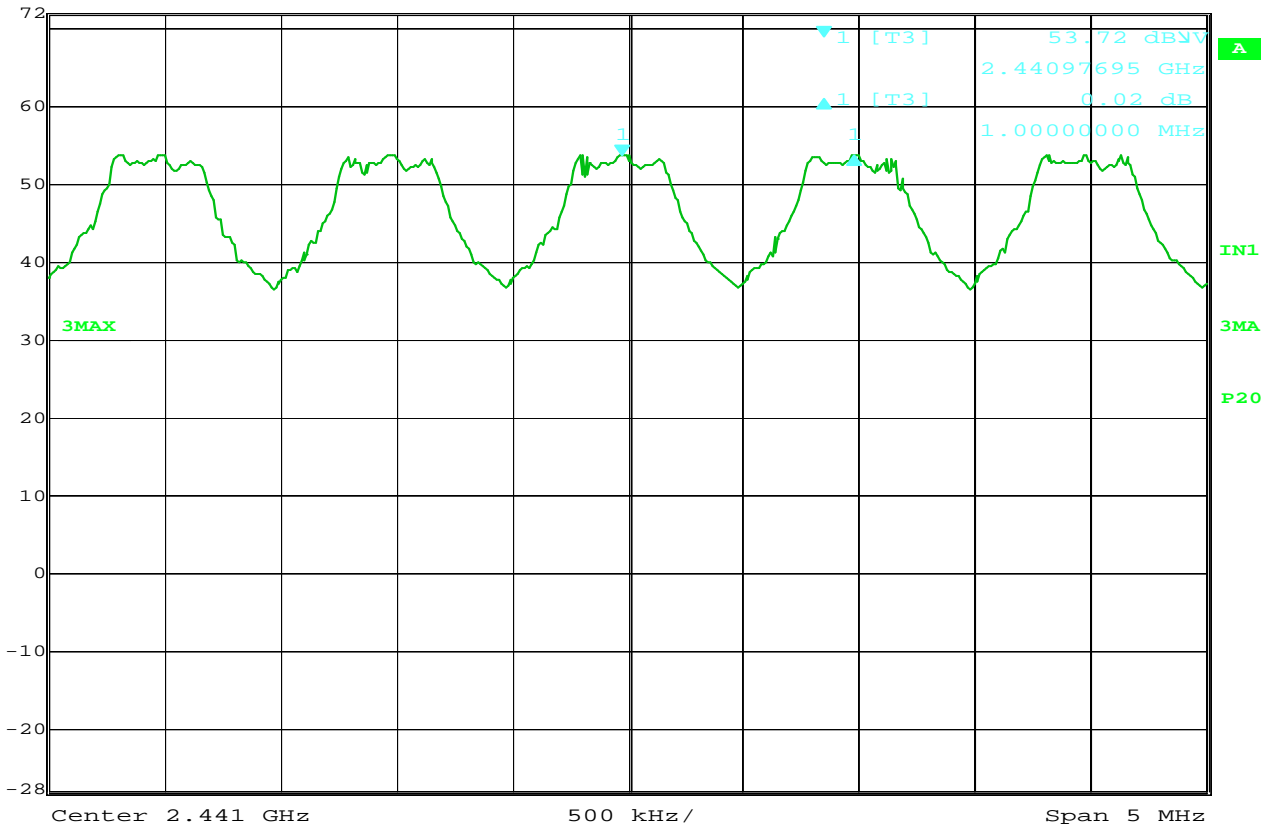
Date: 28.MAY.2008 20:54:05

FCC 15.247 20 dB Bandwidth Measurement

MANUFACTURER : Delphi Electronics and Safety  
 TEST ITEM : Volvo P3 BlueTooth Radio  
 MODEL NUMBER : 28132536  
 TEST MODE : Transmit @ 2480.0 MHz  
 NOTES : 20dB bandwidth is 853.7kHz



Delta 1 [T3] RBW 100 kHz RF Att 0 dB  
 Ref Lvl 0.02 dB VBW 100 kHz  
 72 dBmV 1.00000000 MHz SWT 5 ms Unit dBmV



Date: 28.MAY.2008 21:05:18

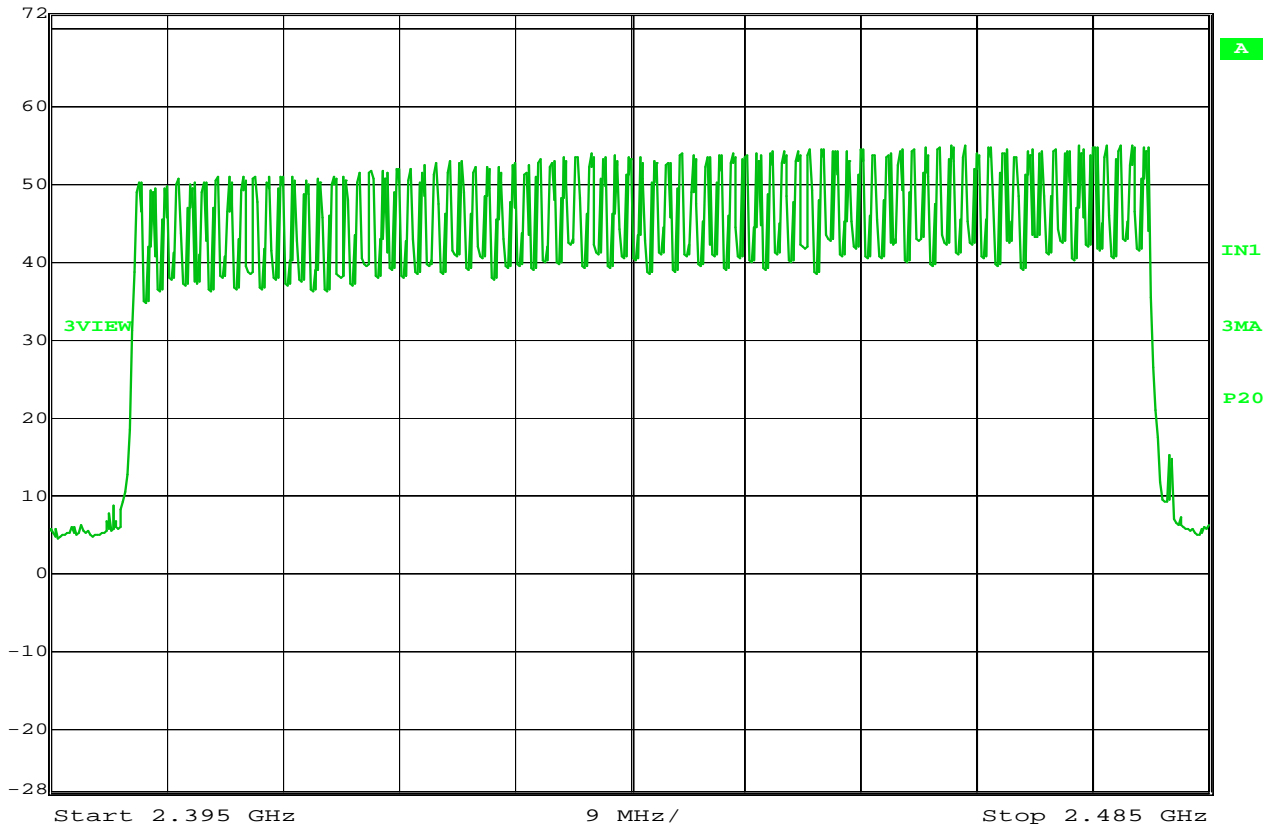
FCC 15.247 Carrier Frequency Separation

MANUFACTURER : Delphi Electronics and Safety  
 TEST ITEM : Volvo P3 BlueTooth Radio  
 MODEL NUMBER : 28132536  
 TEST MODE : Frequency Hopping Enabled  
 NOTES : Carrier Frequency Separation is 1.0MHz



Ref Lvl  
72 dBV

RBW 100 kHz RF Att 0 dB  
VBW 100 kHz  
SWT 22.5 ms Unit dBV



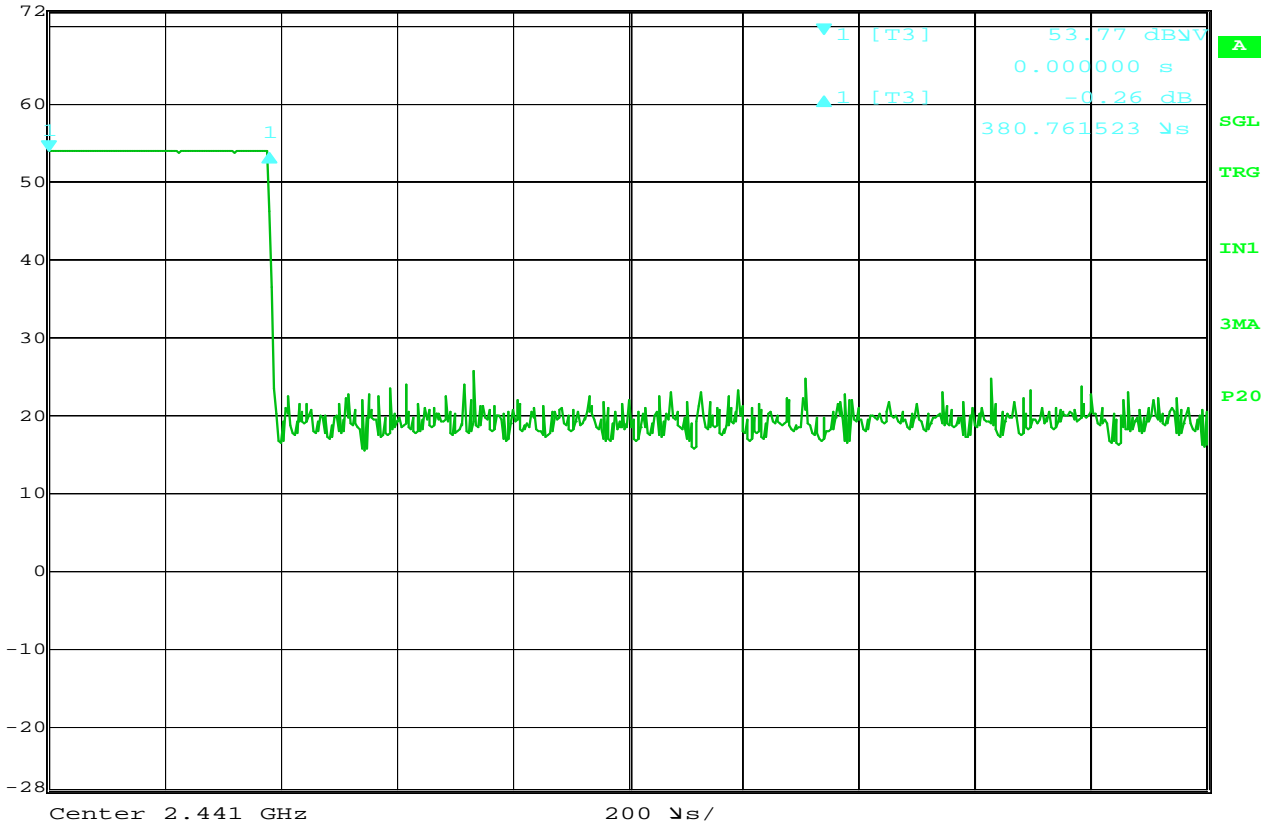
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### FCC 15.247 Number of Hopping Frequencies

MANUFACTURER : Delphi Electronics and Safety  
TEST ITEM : Volvo P3 BlueTooth Radio  
MODEL NUMBER : 28132536  
TEST MODE : Frequency Hopping Enabled  
NOTES : Number of hopping channels is 79



Ref Lvl	Delta 1 [T3]	RBW	10 MHz	RF Att	0 dB
72 dBV	-0.26 dB	VBW	10 MHz		
	380.761523 $\mu$ s	SWT	2 ms	Unit	dBV



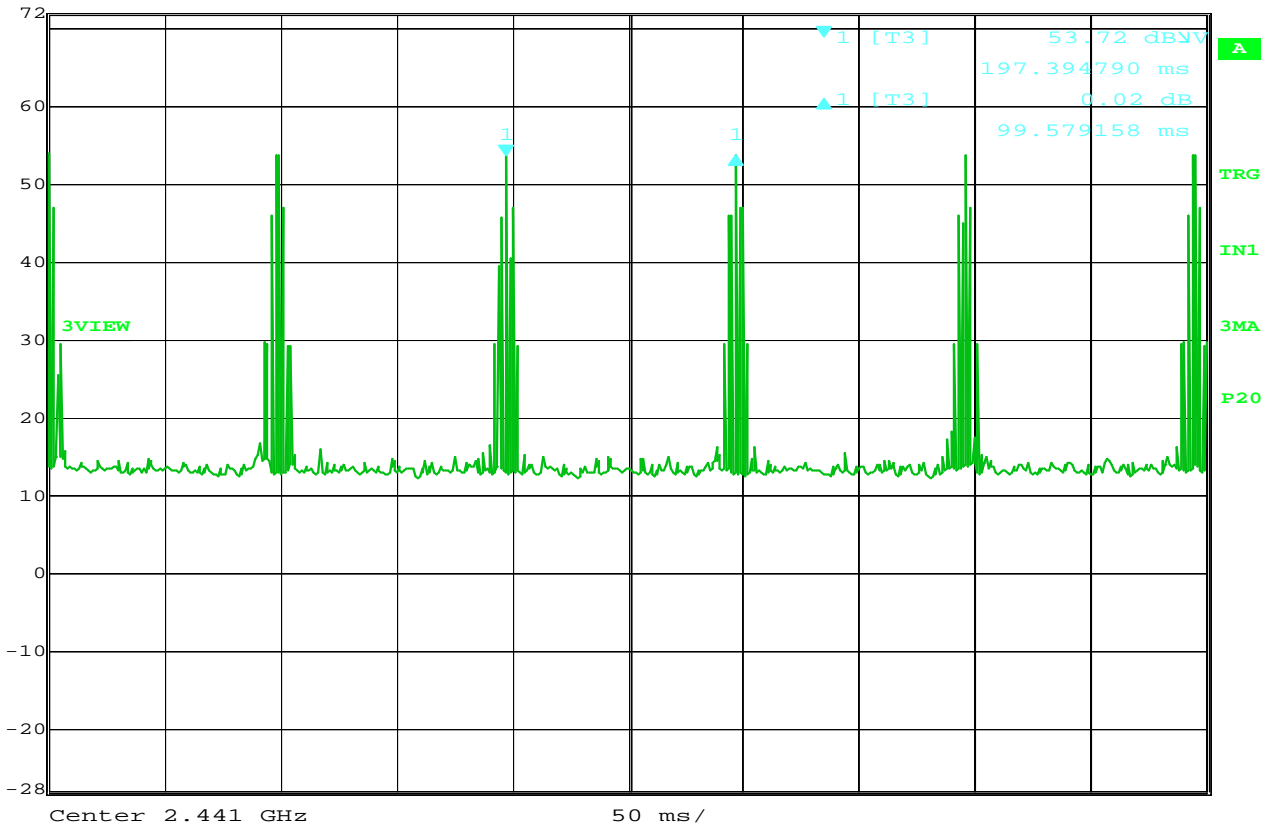
Date: 28.MAY.2008 21:44:32

FCC 15.247 Dwell Time

MANUFACTURER : Delphi Electronics and Safety  
TEST ITEM : Volvo P3 BlueTooth Radio  
MODEL NUMBER : 28132536  
TEST MODE : Frequency Hopping Enabled  
NOTES : 380.8  $\mu$ s On time



	Delta 1 [T3]	RBW	1 MHz	RF Att	0 dB
Ref Lvl	0.02 dB	VBW	1 MHz		
72 dBmV	99.579158 ms	SWT	500 ms	Unit	dBmV



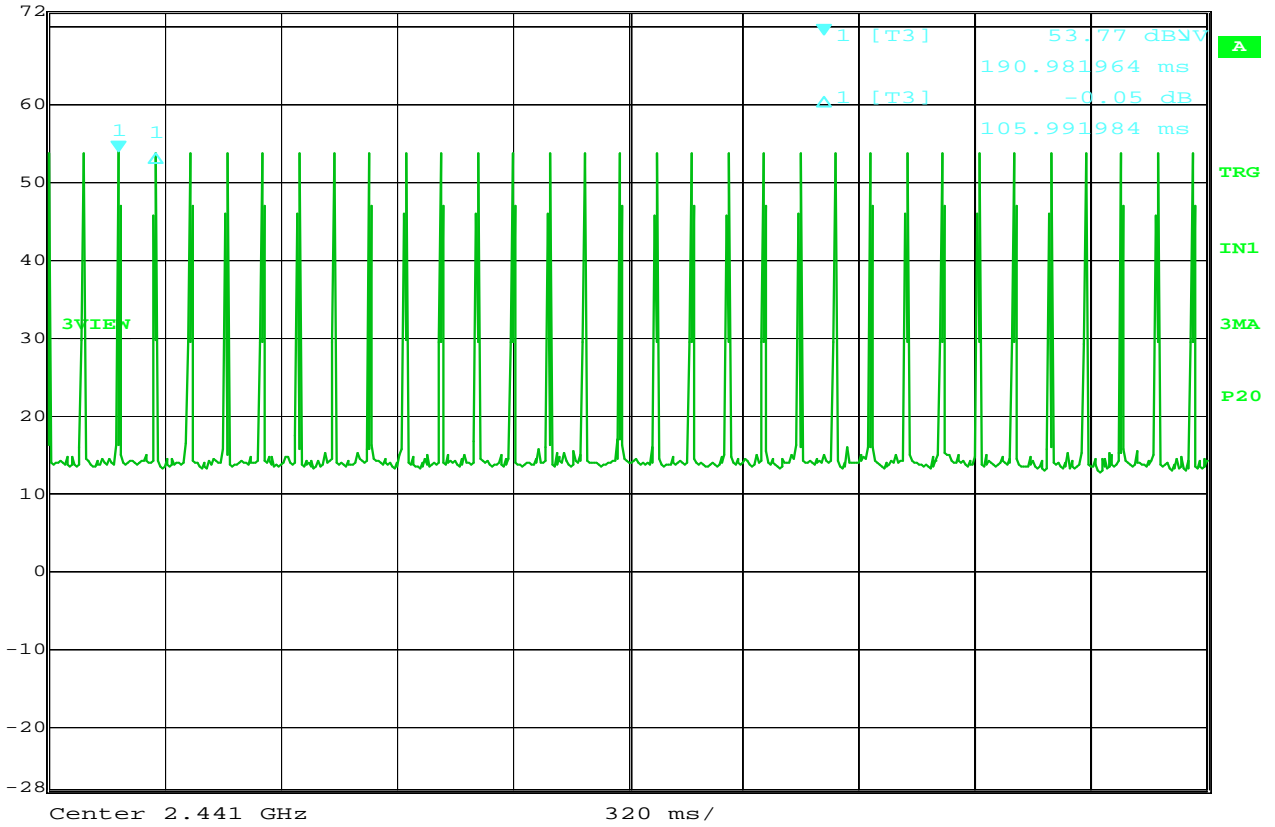
Date: 28.MAY.2008 21:47:50

FCC 15.247 Dwell Time

MANUFACTURER	: Delphi Electronics and Safety
TEST ITEM	: Volvo P3 BlueTooth Radio
MODEL NUMBER	: 28132536
TEST MODE	: Frequency Hopping Enabled
NOTES	: 99.6 mS between pulses



Marker 1 [T3] RBW 1 MHz RF Att 0 dB  
 Ref Lvl 53.77 dB $\mu$ V VBW 1 MHz  
 72 dB $\mu$ V 190.981964 ms SWT 3.2 s Unit dB $\mu$ V



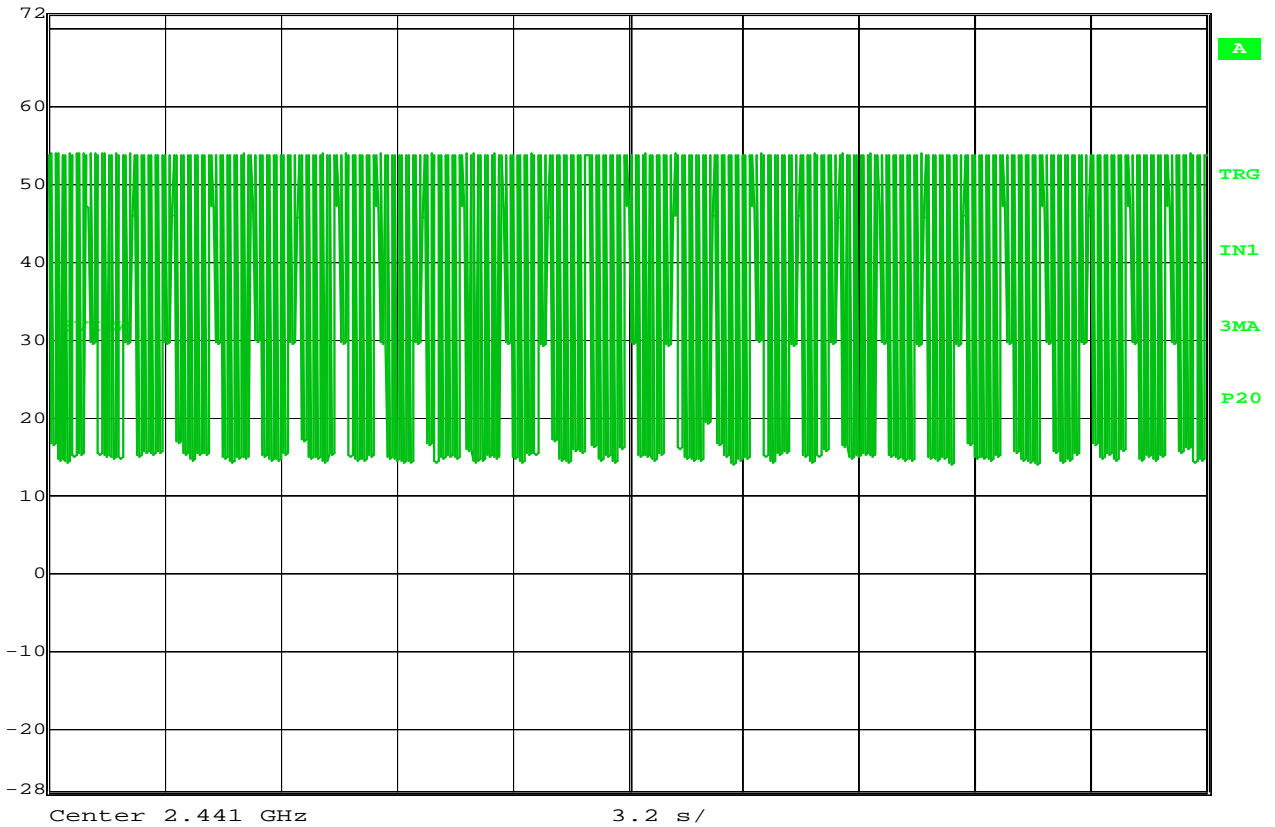
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FCC 15.247 Dwell Time

MANUFACTURER : Delphi Electronics and Safety  
 TEST ITEM : Volvo P3 BlueTooth Radio  
 MODEL NUMBER : 28132536  
 TEST MODE : Frequency Hopping Enabled  
 NOTES : 33 pulses in 3.16 seconds



Ref Lvl 72 dBV  
RBW 1 MHz RF Att 0 dB  
VBW 1 MHz  
SWT 32 s Unit dBV



Date: 28.MAY.2008 21:55:06

FCC 15.247 Dwell Time

MANUFACTURER : Delphi Electronics and Safety  
TEST ITEM : Volvo P3 BlueTooth Radio  
MODEL NUMBER : 28132536  
TEST MODE : Frequency Hopping Enabled  
NOTES : 330 pulses in 31.6 S  
: 330 pulses \* 380.8uS = 125.7mS





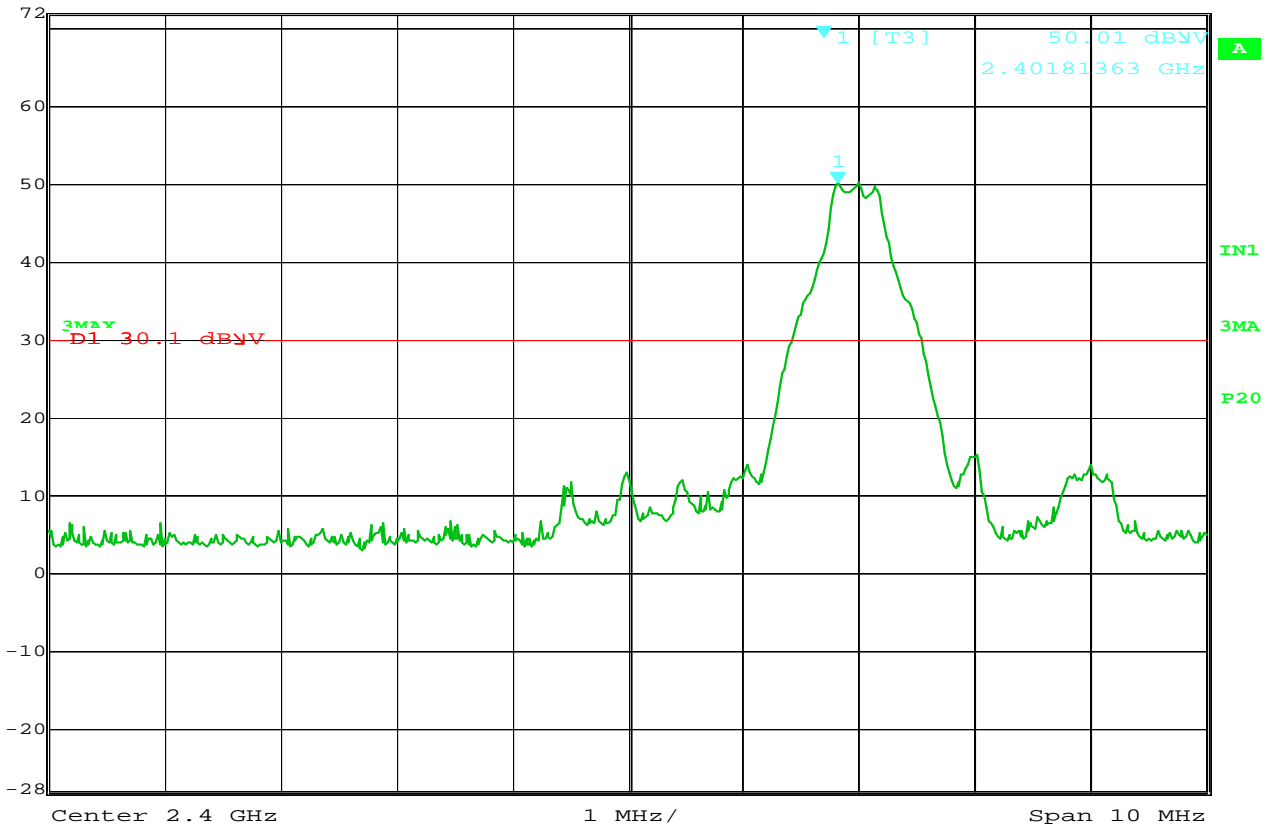
Manufacturer : Delphi Electronics and Safety  
Model No. : 28132536  
Serial No. : None Assigned  
Test Specification : FCC Part 15, Subpart C, 15.247, Peak Output Power  
: Radiated Measurement  
Date : March 28, 2008  
Notes : Test Distance is 3 meters

Frequency MHz	Antenna Polarity	Meter Reading dBuV	Matched Signal Generator Reading dBm	Antenna Gain dB	Cable Loss dB	EIRP dBm	Limit dBm
2402	H	52.2	-7.4	4.2	2.8	-6.0	36
2402	V	55.9	-5.0	4.2	2.8	-3.6	36
2441	H	50.4	-9.5	4.4	2.8	-7.9	36
2441	V	56.4	-4.7	4.4	2.8	-3.1	36
2480	H	51.3	-8.4	4.5	2.8	-6.7	36
2480	V	56.0	-5.0	4.5	2.8	-3.3	36

$EIRP = \text{Sig. Gen. Reading} + \text{Antenna Gain} - \text{Cable Loss}$



Marker 1 [T3] RBW 100 kHz RF Att 0 dB  
 Ref Lvl 72 dBV 50.01 dBV VBW 100 kHz  
 2.40181363 GHz SWT 5 ms Unit dBV



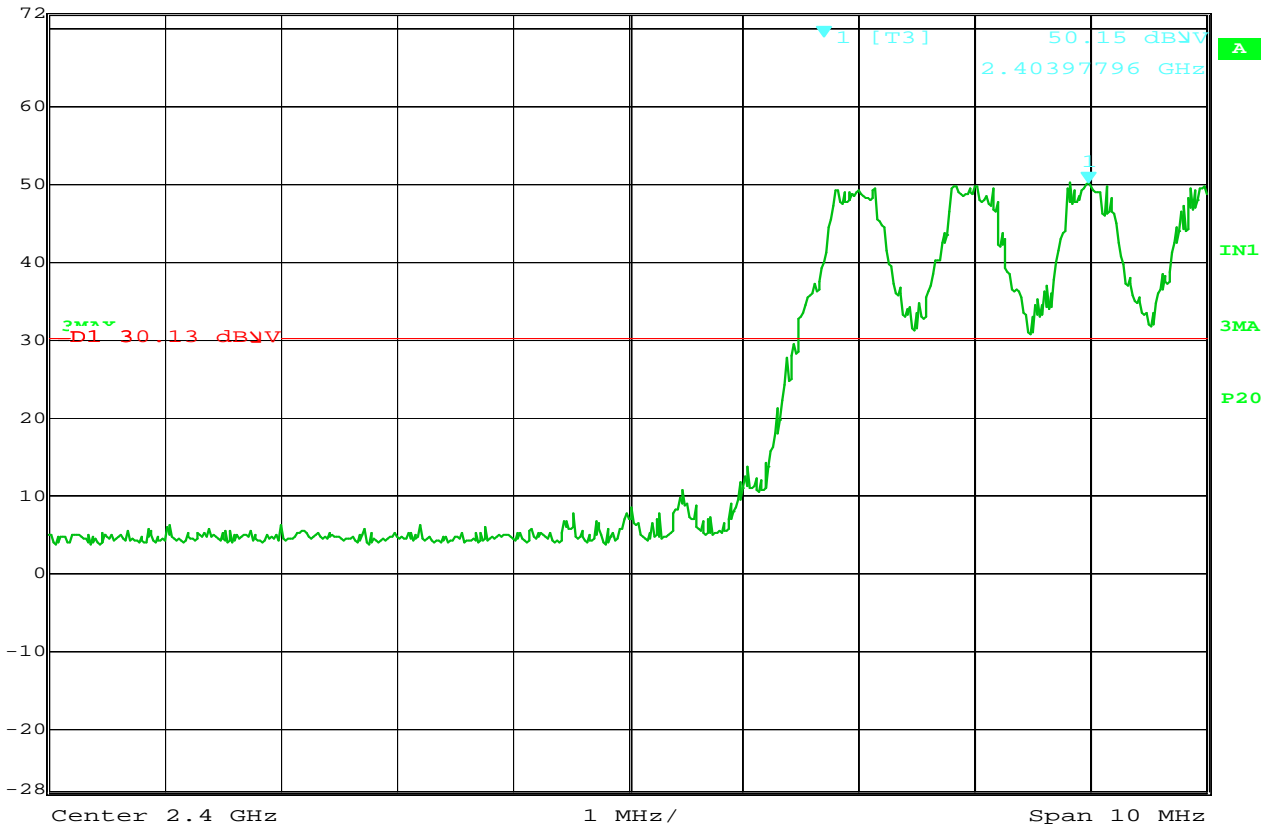
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FCC 15.247 Band edge Compliance

MANUFACTURER : Delphi Electronics and Safety  
 TEST ITEM : Volvo P3 BlueTooth Radio  
 MODEL NUMBER : 28132536  
 TEST MODE : Transmit @ 2402.0 MHz  
 NOTES : 20 dBc



Marker 1 [T3] RBW 100 kHz RF Att 0 dB  
 Ref Lvl 72 dBV 50.15 dBV VBW 100 kHz  
 2.40397796 GHz SWT 5 ms Unit dBV



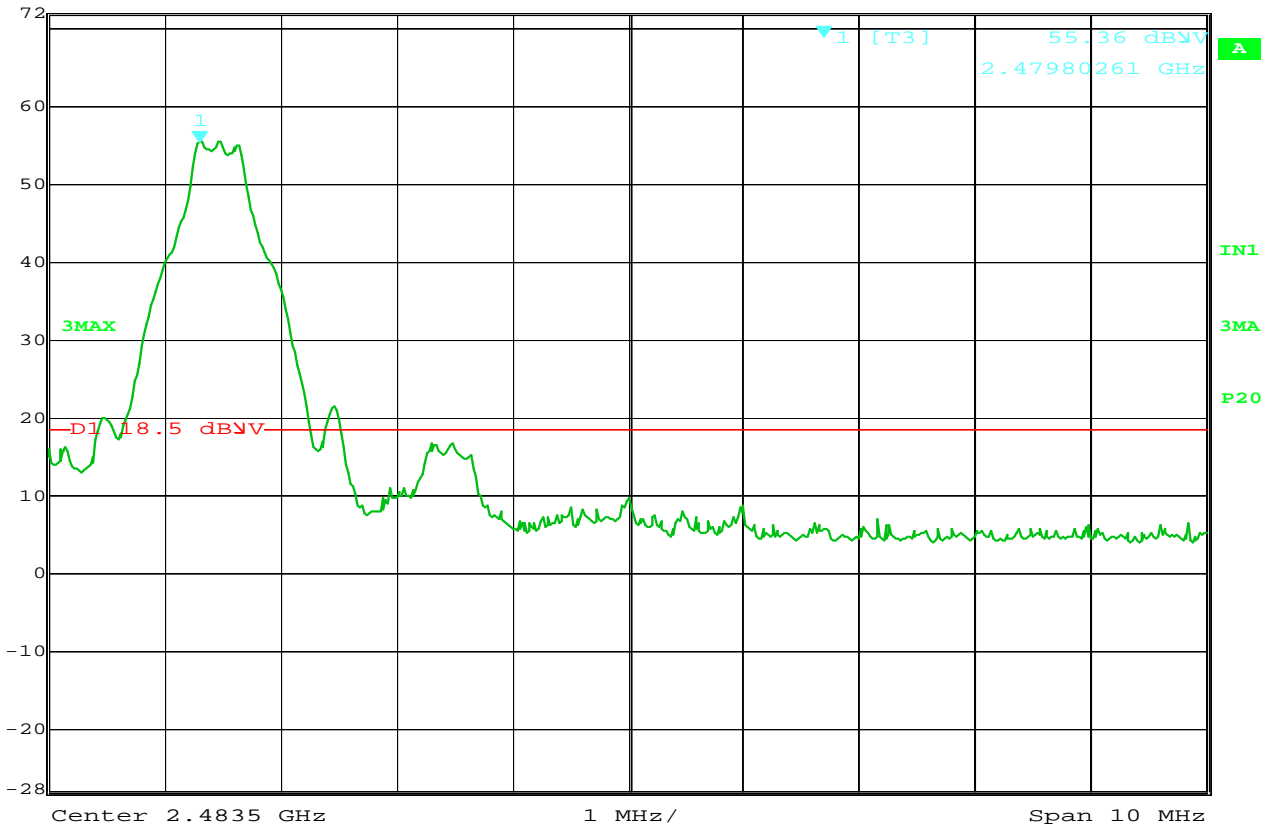
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FCC 15.247 Band edge Compliance

MANUFACTURER : Delphi Electronics and Safety  
 TEST ITEM : Volvo P3 BlueTooth Radio  
 MODEL NUMBER : 28132536  
 TEST MODE : Frequency Hopping Enabled  
 NOTES : 20 dBc



Marker 1 [T3]      RBW 100 kHz      RF Att 0 dB  
 Ref Lvl 72 dBuV      55.36 dBuV      VBW 100 kHz  
 2.47980261 GHz      SWT 5 ms      Unit dBuV



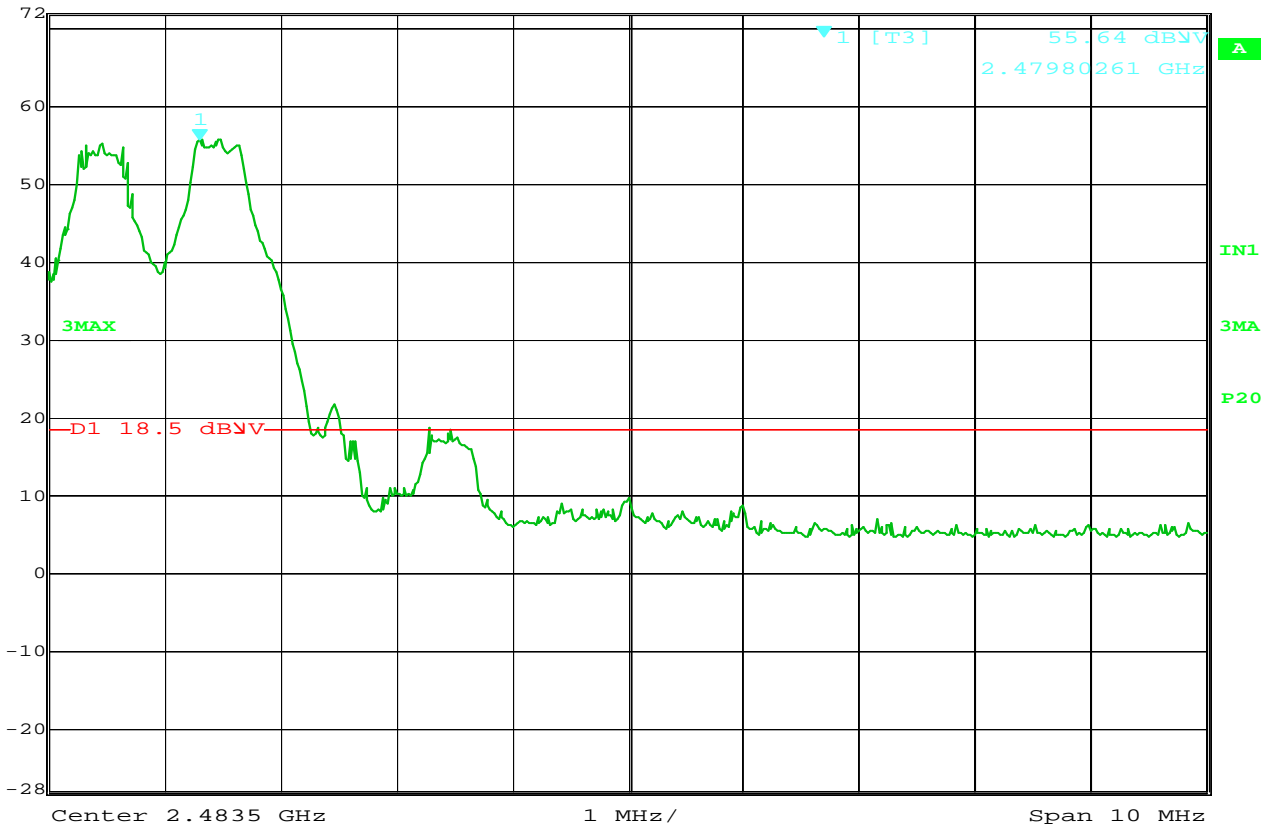
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### FCC 15.247 Band edge Compliance

MANUFACTURER : Delphi Electronics and Safety  
 TEST ITEM : Volvo P3 BlueTooth Radio  
 MODEL NUMBER : 28132536  
 TEST MODE : Transmit @ 2480.0 MHz  
 NOTES : Delta Marker Method  
           : 90.9dBuV/m – 54 dBuV = 36.9 dBc  
           : 55.4dBuV – 36.9 dBc = 18.5 dBuV



Marker 1 [T3]      RBW 100 kHz      RF Att 0 dB  
 Ref Lvl 72 dBV      55.64 dBV      VBW 100 kHz  
 2.47980261 GHz      SWT 5 ms      Unit dBV



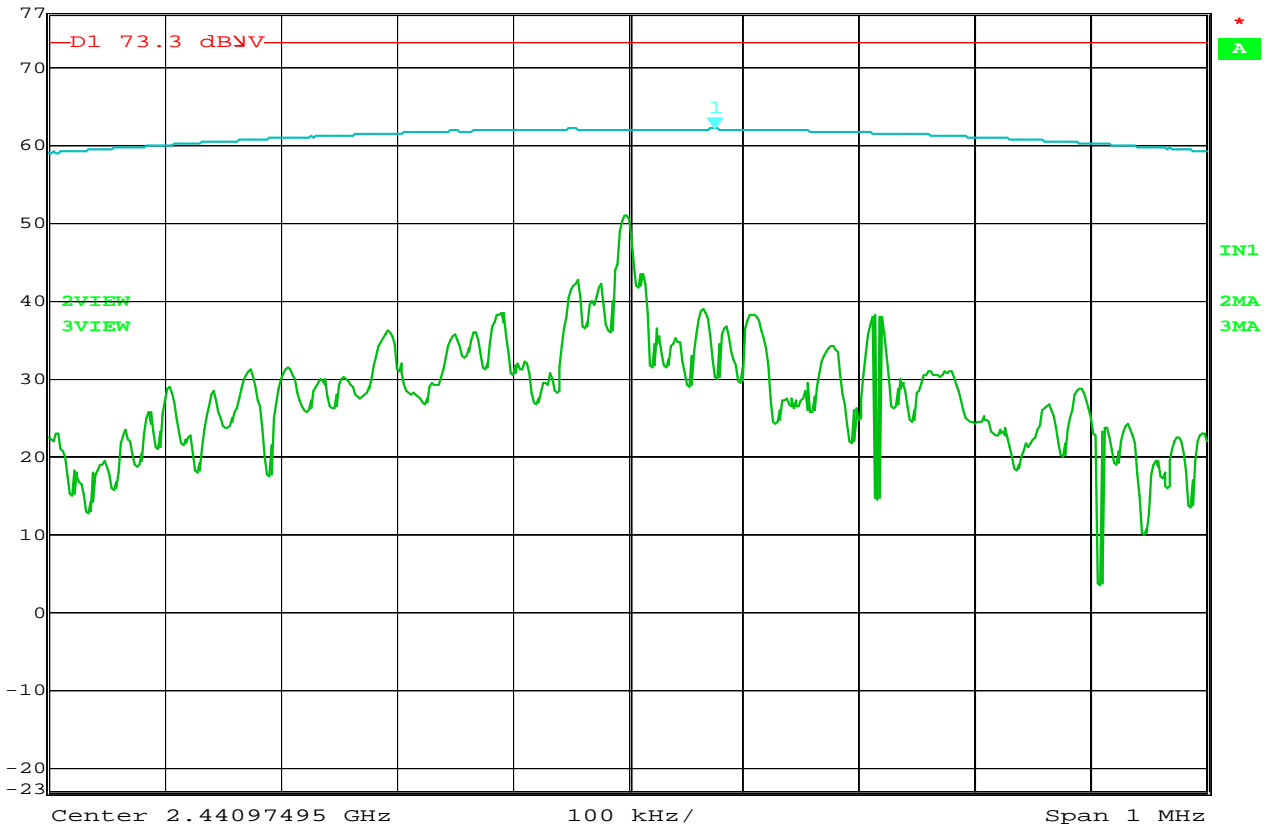
Date: 28.MAY.2008 17:35:18

### FCC 15.247 Band edge Compliance

MANUFACTURER : Delphi Electronics and Safety  
 TEST ITEM : Volvo P3 BlueTooth Radio  
 MODEL NUMBER : 28132536  
 TEST MODE : Frequency Hopping Enabled  
 NOTES : Delta Marker Method  
           : 90.9dBuV/m – 54 dBuV = 36.9 dBc  
           : 55.4dBuV – 36.9 dBc = 18.5 dBuV



Marker 1 [T2] RBW 3 kHz RF Att 0 dB  
 Ref Lvl 62.18 dBuV VBW 30 kHz  
 77 dBuV 2.44105010 GHz SWT 340 s Unit dBuV



Date: 29.MAY.2008 16:08:00

FCC 15.247 Power Spectral Density

MANUFACTURER : Delphi Electronics and Safety  
 TEST ITEM : Volvo P3 BlueTooth Radio  
 MODEL NUMBER : 28132536  
 TEST MODE : Inquiry  
 NOTES : 91.3dBuV/m = -3.1 dBm matched in 100kHz RBW.  
 : Blue trace = 62.2 dBuV at peak equivalent to -3.1 dBm.  
 : Display line (Red trace) is equal to + 8dBm; (8 - (-3.1) = 11.1 dB difference;  
 : 62.2 dBuV + 11.1 dB = 73.3 dBuV  
 : Green trace = power spectral density in 3kHz RBW with 340 second sweep time.