**EXHIBIT E: REPORT OF MEASUREMENTS [2.1033(B6)]**

# Test Report for FCC ID: NZLOBIHL3

# FCC Part 2.1031, Part 15 Subpart C(15.231)

**Report #0400714F**
**Issued 11/18/04**

## MODEL OBIHL3
## DIMMING MIRROR WITH HOMELINK® TRANSCEIVER,

Prepared for:

Mr. Colin Carpenter
Gentex Corporation
600 N. Centennial St.
Zeeland, MI 49464

Test Date(s): August 6,9,10, October 29, November 15, 2004

data recorded by

Ted Chaffee, NCE
Test Engineer, AHD

witnessed by

______________________________

This report prepared by:

Ted Chaffee, NCE
Technical Manager/Test Engineer, AHD

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## Statements Concerning this Report

**NVLAP Accreditation: NVLAP Lab Code 200129-0**
The scope of AHD accreditation is the test methods of:

| | |
|---|---|
| IEC/CISPR 22: | Limits and methods measurement of radio disturbance characteristics of information technology equipment. |
| FCC Method – 47 CFT Part 15: | Digital Devices. |
| AS/NZS 3548: | Electromagnetic Interference – Limits and Methods of Measurement of Information Technology Equipment. |
| IEC61000-4-2 and Amend.1: | ElectroStatic Discharge Immunity |
| IEC61000-4-5: | Surge Immunity |

**Test Data:**
This test report contains data included in the scope of NVLAP accreditation.

**Subcontracted Testing:**
This report does not contain data produced under subcontract.

**Test Traceability:**
The calibration of all measuring and test equipment and the measured data using this equipment are traceable to the National Institute for Standards and Technology (NIST).

**Limitations on results:**
The test results contained in this report relate only to the Item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require an evaluation to verify continued compliance.

**Limitations on copying:**
This report shall not be reproduced, except in full, without the written approval of AHD.

**Limitations of the report:**
This report shall not be used to claim product endorsement by NVLAP, FCC, or any agency of the US Government.

**Statement of Test Results Uncertainty:**
Following the guidelines of NAMAS publication NIS81 and NIST Technical Note 1297, the Measurement Uncertainty at a 95% confidence level is determined to be: ± 1.4 dB

## Manufacturer/Applicant [2.1033(b1)]

The manufacturer and applicant:

GENTEX CORPORATION
600 N. Centennial St.
Zeeland, Michigan 49464

## Measurement/Test Site Facility & Equipment

### Test Site [2.948, 2.1033(b6)]

The AHD test facility is centered on 9 acres of rural property near Sister Lakes, Michigan. The mailing address is 92723 M-152, Dowagiac, Michigan 49047. This test facility is NVLAP accredited (LabCode 200129-0). It has been fully described in a report filed with the FCC (No.90413) and Industry Canada (file:IC3161).

## Measurement Equipment Used

| Equipment Calibration | Model | S/N | Last Cal Date | Interval |
|---|---|---|---|---|
| HP EMI Receiver system | HP 8546A | | | |
| RF Filter Section | HP-85460A | 3448A00283 | 26-Aug-04 | 12 months |
| RF Receiver Section | HP-85462A | 3625A00342 | 26-Aug-04 | 12 months |
| EMCO BiconiLog Antenna | 3142 | 1077 | 24-Aug-04 | 12 months |
| Solar LISN | 8012-50-R-24-BNC | 962137 | 24-Aug-04 | 12 months |
| Solar LISN | 8012-50-R-24-BNC | 962138 | 24-Aug-04 | 12 months |
| (LCI) Double shielded 50ohm Coax | RG58/U | 920809 | 25-Oct-04 | 12 months |
| (3-M) Type 129FF Ultra Flex LowLoss | RG58/U | 9910-12 | 25-Oct-04 | 6 months |
| (3-M) LMR-400 Ultra Flex | LMR400 | 9812-11 | 25-Oct-04 | 6 months |
| (10-M) Amelco 50ohm Coax | RG213/U | 9903-10ab | 25-Oct-04 | 6 months |
| Double Ridged Horn | ONO91202-2 | A00329 | 01-Apr-04 | 36 months |

## Environment

The test was performed with the equipment under test, and measurement equipment inside the all-weather enclosure. Ambient temperature was 22deg.C., the relative humidity 40%.

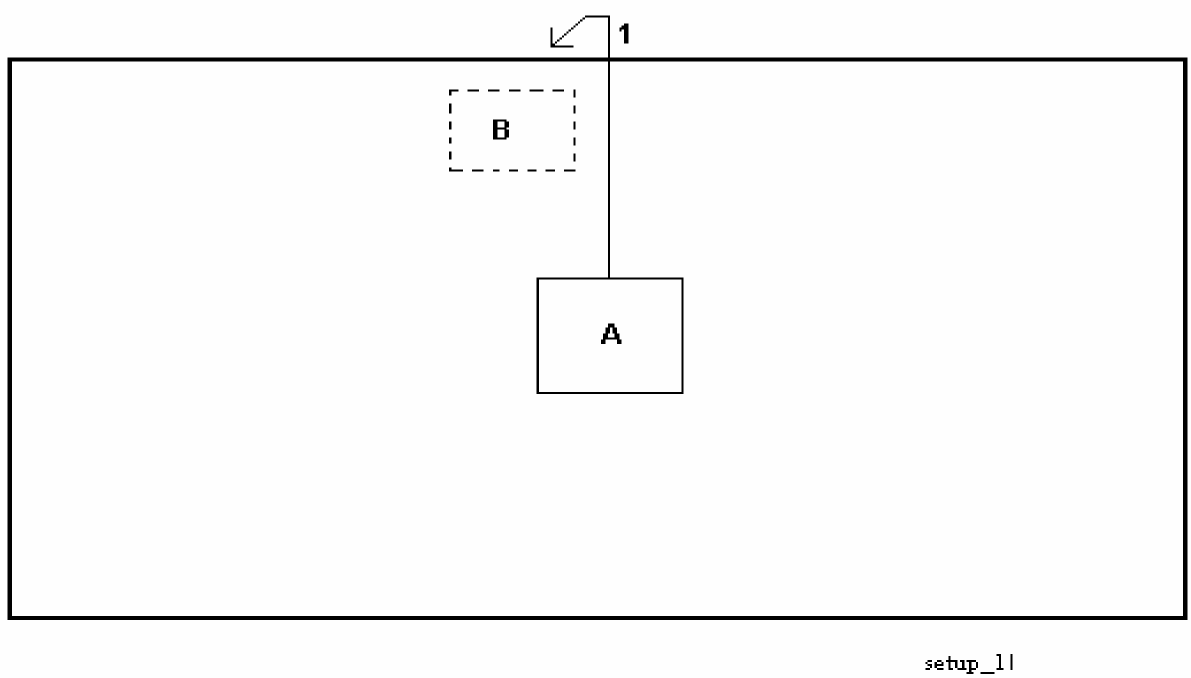
# Tested Configuration /Setup: [2.1033(b8)]

## Support Equipment & Cabling

| Setup Diagram Legend | Description | Model | Serial No. / Part No. | EMC Consideration |
|---|---|---|---|---|
| A | [EUT] Dimming mirror with Homelink® Garage Door Opener | [GENTEX] OBIHL3 | Pre-production | FCC ID: NZLOBIHL3 |
| B | 12V DC Power Supply | [Trygon] DL40-1 | 7968152 | Located on the turntable base below the EUT table. |
| 1 | Power Supply Cable Harness | -- | -- | 1.5 meters, Unshielded. |

## Setup Diagram

Note: Setup photographs are located in Attached Electronic File, Exhibit E.




BASIC EUT SETUP
(Legend designation is above)

**Description of Equipment Under Test**

The tested unit is a automotive mirror with five user interface buttons. Three of the buttons control the universal garage door opener transmitter. Two buttons select the mirror dimming function.

There are twp printed circuit boards.

1. RF transmitter. 2-layer PCB. 20MHz oscillator. Board #280-303-V3.
2. Main board. 2-layer PCB. 4MHz oscillator. Board #280-318-V3.

## Summary of Results:

1. This test series evaluated the Equipment Under Test to FCC Part 15, SubPart C.
2. The system tested is compliant to the requirement of CFR 47, FCC Part 15, SubPart C for periodic operation in the allowed frequency bands above 70MHz, ( Part 15.231 ).
3. The system tested is compliant to the requirement of CFR 47, FCC Part 15, SubPart B as a digital device.
4. The equipment under test was received on August 9, 2004 and this test series commenced on August 9, 2004.
5. The line conducted emission testing does not apply to this product. The device is powered from a 12 volt automobile source only.
6. The frequencies selected for final evaluation include 288MHz, 310MHz, and 418MHz. This is in accordance with 47 CFR 15.31(m). The 310MHz was selected as a mid-range frequency because it is the predominant frequency used in controlling garage doors. Past correspondence with the FCC regarding the selection of frequencies and test setup suggest this judgment as appropriate.
7. Occupied Bandwidth of the transmitted signal, at the 20dB point, nearest the limit occurred with the EUT transmitting at 288MHz with a pulse modulation of 30% duty cycle. The occupied bandwidth was measured to be 520KHz. This measurement is within the allowed 720KHz bandwidth. The greatest occupied bandwidth was recorded as 548KHz. This occurred while transmitting on 310MHz.
8. The preliminary scan for spurious emissions conducted in a shielded room indicated low level spurious signals.
9. The digital spurious emissions, indicated in the pre-scan, were measured at the 3meter open area test site. The observed emission nearest the limit occurred at 140MHz. The quasi-peak level was measured to be 14.0dBuV/m which is 29.5dB below the FCC Class B limit.

## Summary of Results continued:

10. The field strength level of the fundamental was measured for 288MHz, 310MHz, and 418MHz. The evaluation showed the emission nearest the limit occurred while operating at 310MHz with 500Hz pulsed modulation at a 50% duty cycle. The EUT was positioned on the 'side' and the receive antenna oriented in the horizontal polarization. This signal was measured to be 1.1dB below the limit of 75.3dBuV/m (5,833uV/m).
11. The evaluation of the field strength levels of the harmonics showed the emission nearest the limit occurred while operating at 418MHz with 500Hz pulsed modulation at 80% duty cycle. The EUT was positioned on the 'side'; and the receive antenna oriented in the vertical polarization. This signal, at 1672MHz, was measured to be 7.3dB below the limit of 54.0dBuV/m.
12. The average value of the coarse tune pulses over a 100mSec time, nearest the limit, occurred at 418MHz. The average measurement was determined to be 6702uV/m which is 3.8dB below the limit of 10,333uV/m..
13. The average value of the fine tune pulses over a 100mSec time, nearest the limit, occurred at 288MHz. The average measurement was determined to be 748uV/m which is 16.4dB below the limit of 4917uV/m. The highest average value occurred at 418MHz. The average measurement was determined to 1461uV/m which is 17.0dB below the limit of 10,333uV/m.

### Changes made to achieve compliance

1. NONE

### Variance from test plan

1. NONE

## Standards Applied to Test: [2.1033(b6)]

ANSI C63.4:2001
CFR47 FCC Part 2, Part 15, SubPart C, 15.231 Intentional Radiator; SubPart B, Digital Device
Public Notice DA 02-2850

## Test Methodology: [2.1033(b6)]

The pictures in this report, showing test setups, indicate the agreed upon configuration of testing for this product-type.

For the testing, the Universal Garage Door Opener Transmitter was installed in the automotive rearview mirror for which it has been designed. The system was placed at the center of the table 80cm above the ground plane pursuant to ANSI C63.4 for stand-alone equipment. Three orthogonal setup positions were used during the tests. The 12volt supply harness was routed to the edge of the long side of the table then down to the power supply located on the turntable base.

The line conducted emission testing was not performed on this product. In its final configuration the product is powered from an automobile 12 volt system only.

### Radiated

The system was placed upon a 1 x 1.5 meter non-metallic table 80cm above the open field site ground plane in the prescribed setup per ANSI C63.4.

The table sits upon a remote controlled turntable. The receiving antenna, located at the appropriate standards distance of 3 or 10 meters from the table center, is also remote controlled.

The principle settings of the EMI Receiver for radiated testing include:

| | | |
|---|---|---|
| IF Bandwidth: | 120KHz | for frequencies less than 1GHz. |
| | 1 MHz | for frequencies greater than 1GHz. |
| Detector Function: | Peak Mode | |
| | The Average levels were determined mathematically based upon the duty cycle of the pulsed modulation of the transmitted signal. | |

At frequencies up to 1000MHz a BiconiLog broadband antenna was used for measurements.

At frequencies above 1000MHz a double-ridge Horn broadband antenna was used for measurements.

During the evaluation the EUT was transmitting continuously.

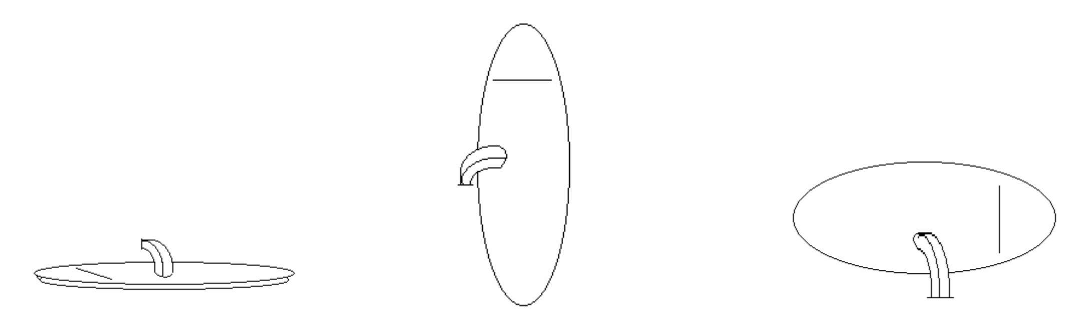
The turntable was rotated 360 degrees and the receiving antenna height varied from 1 to 4 meters to search out the highest emissions.

Preliminary tests were done at 288MHz, 310MHz, 340MHz, 365MHz, 390MHz, and 418MHz. The final measurements were made at a low band frequency (288MHz), a mid band frequency (310MHz), and a high band frequency (418MHz) pursuant to the requirements of 47CFR 15.31(m). At each frequency the EUT was placed in three orthogonal positions. At each position the 500Hz pulse modulation was adjusted to a 30%, 50%, and 80% duty cycle. At each duty cycle, measurements were taken with the receive antenna in vertical and horizontal positions.

The unit was evaluated up to the tenth harmonic of the fundamental as an intentional radiator, and up to 1000MHz as a digital device.

The orthogonal positions of EUT are:

Flat Side End



## FORMULAS AND SAMPLE CALCULATIONS:

THE HP8546A EMI Receiver has stored in memory the antenna and coax correction factors used in this test. The resultant Field Strength (FS) in dBuV/m presented by the HP8546A is the summation in decibels (dB) of the Received Level (RF), the Antenna Correction Factor (AF), and the Cable Loss Factor (CF).

Formula 1: FS(dBuV/m) = RF(dBuV) + AF(dB/m) +CF(dB)

The resultant Field Strength measurement is recorded using the peak hold detector of the HP8546A.

This recorded peak level is further corrected, by calculation, to an average level by a factor determined by the duty cycle of the pulsed modulation. The duty cycle factor is determined as outlined in Appendix I4 of the standard ANSI C63.4:1992.

Formula 2: Average Level(uV/m) = [ Peak Level(uV/m) ] x [ duty cycle factor ].

Formula 2a: Average Level(dBuV/m) = Peak Level)dBuV/m) + duty cycle factor(dB).

The duty cycle factor to apply is determined for the duty cycles of 30%, 50% and 80% as follows.

For 30% (0.30): duty cycle factor(dB) = 20*Log(0.3) = -10.46
For 50% (0.50): duty cycle factor(dB) = 20*Log(0.5) = -6.02
For 80% (0.80): duty cycle factor(dB) = 20*Log(0.8) = -1.94

As an example:

A measured peak level of 50% duty cycle pulse modulated signal is 500uV/m.
Calculated to dBuV/m is 20*Log(500) = 53.98dBuV/m Peak level.
Applying the duty cycle factor: Avg. Level(dBuV/m) = 53.98 - 6.02dB = 47.96dBuV/m.

Calculation of FCC limits Part 15.231

For the frequency range 260MHz - 470MHz, the limit is a linear interpolation between 3750uV/m and 12500uV/m where the limit at 260MHz is 3750uV/m and the limit at 470MHz is 12500uV/m.

A formula to calculate the limit is established with a ratio linearly equating the frequency range to the limit range.

$$( F_0 - F_L ) / ( F_H - F_L ) = ( L_0 - L_L ) / ( L_H - L_L )$$

where $F_0$ and $L_0$ represent the frequency in question and its limit
where $F_L$ and $L_L$ represent the lower frequency ( 260MHz ) and its limit ( 3750uV/m ).
Where $F_H$ and $L_H$ represent the higher frequency ( 470MHz ) and its limit ( 12500uV/m ).

The calculations for the frequencies included in the application are:

288MHz $( 288 - 260 ) / ( 470 - 260 ) = (L_0 - 3750 ) / ( 12500 - 3750 )$
$( 28 / 210 ) * ( 8750 ) = L_0 - 3750$
$L_0 = 1166.7 + 3750$
$L_0 = 4916.7$ uV/m is LIMIT at 288MHz

310MHz $( 310 - 260 ) / ( 470 - 260 ) = (L_0 - 3750 ) / ( 12500 - 3750 )$
$( 50 / 210 ) * ( 8750 ) = L_0 - 3750$
$L_0 = 2083.3 + 3750$
$L_0 = 5833.3$ uV/m is LIMIT at 310MHz

418MHz $( 418 - 260 ) / ( 470 - 260 ) = (L_0 - 3750 ) / ( 12500 - 3750 )$
$( 158 / 210 ) * ( 8750 ) = L_0 - 3750$
$L_0 = 6583.3 + 3750$
$L_0 = 10333.3$ uV/m is LIMIT at 418MHz

The limit in dB terms is calculated as the result of 20 times the log of the uV/m limit.

288MHz dB limit is 20 * LOG( 4916.7 uV/m) = 73.8 dBuV/m

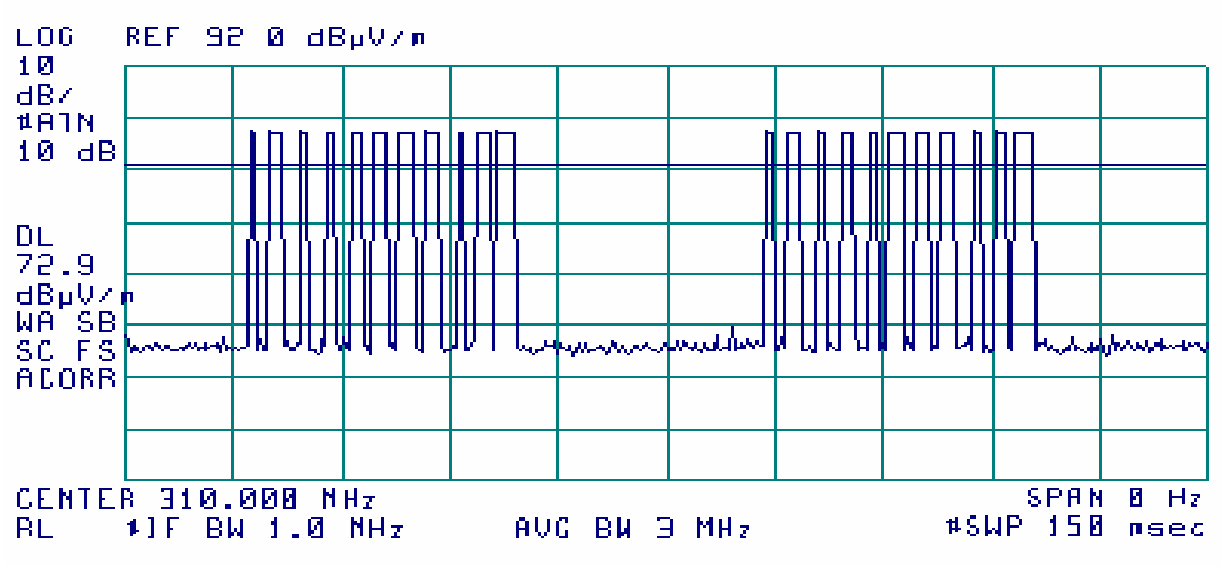
310MHz dB limit is 20 * LOG( 5833.3 uV/m) = 75.3 dBuV/m

418MHz dB limit is 20 * LOG( 10333.3 uV/m) = 80.3 dBuV/m

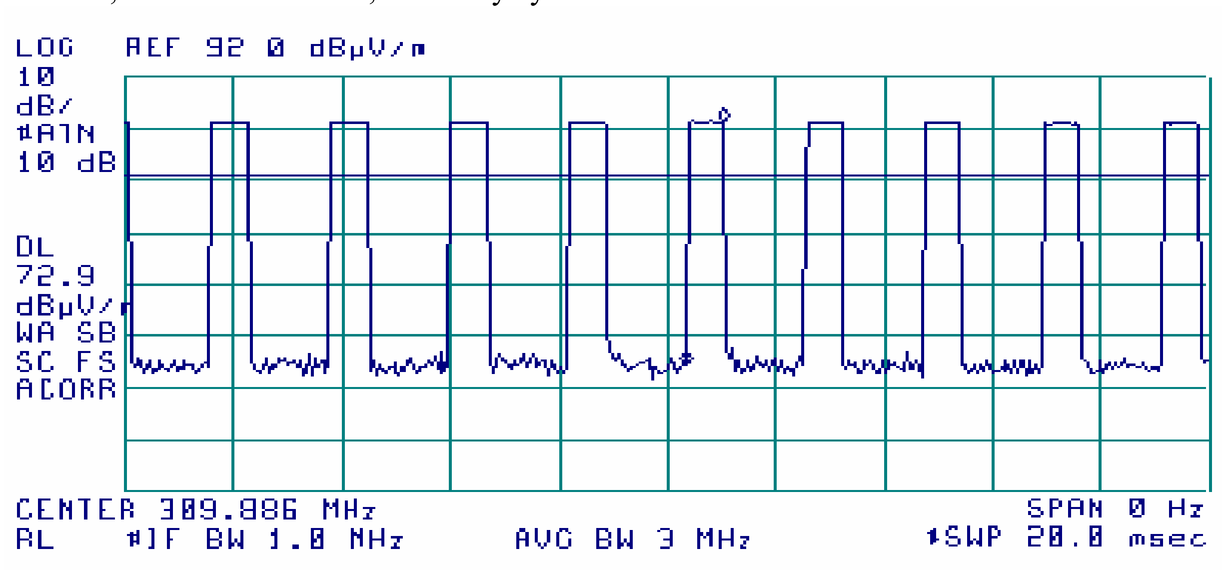
# Test Data [2.1033(b6)]

## Modulation Characteristics

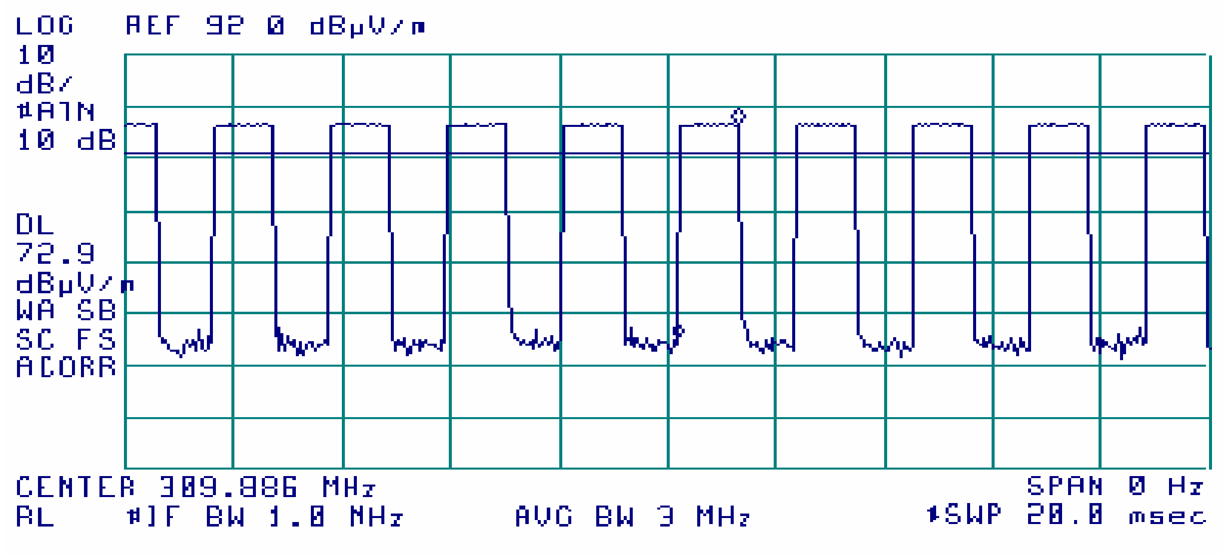
Typical encoding at 310MHz: Consisting of pulses of differing duty cycles.



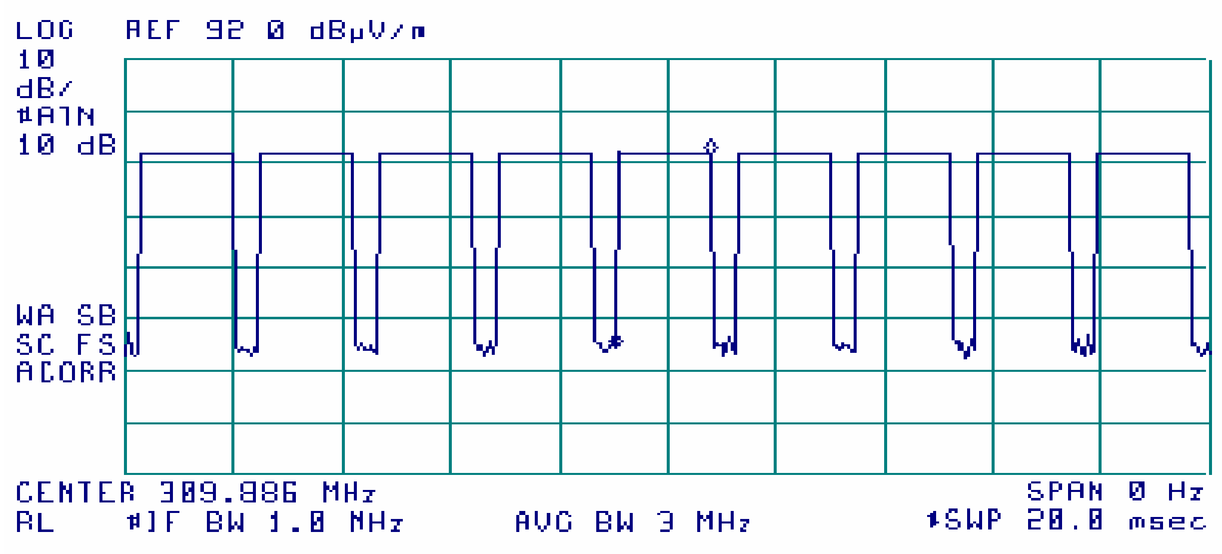

310MHz, 500Hz Modulation, 30% duty cycle



310MHz, 500Hz Modulation, 50% duty cycle



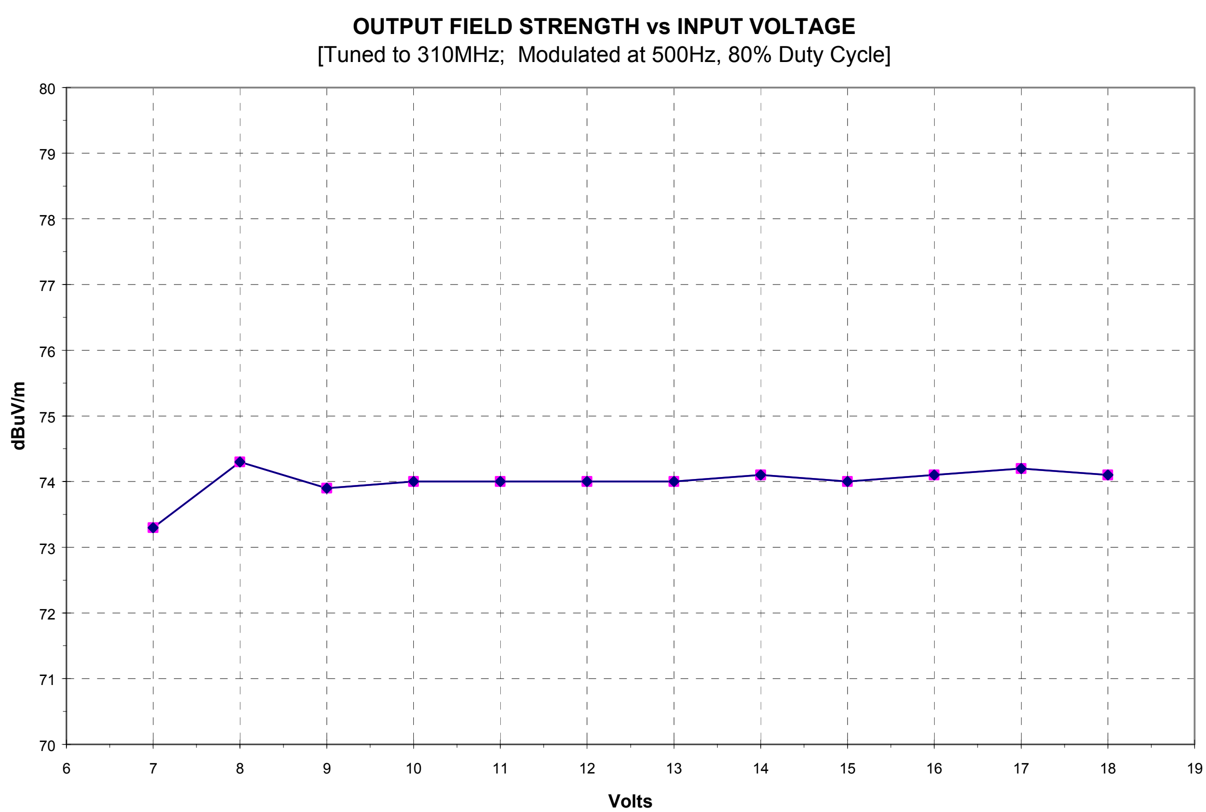

310MHz, 500Hz Modulation, 80% duty cycle



**Relative Emission Level vs. Supply Voltage [15.31(e)]**

The relative emission level as the supply voltage varied is presented in the charts below. The unit is powered by an automotive battery which is typically at 12VDC.

| TX OUTPUT vs Voltage LEVEL<br>310MHz, 80%duty cycle | |
|---|---|
| Volt In | TX OutPut<br>Pk dBuV/m |
| 6 | NoOp |
| 7 | 73.3 |
| 8 | 74.3 |
| 9 | 73.9 |
| 10 | 74 |
| 11 | 74 |
| 12 | 74 |
| 13 | 74 |
| 14 | 74.1 |
| 15 | 74 |
| 16 | 74.1 |
| 17 | 74.2 |
| 18 | 74.1 |



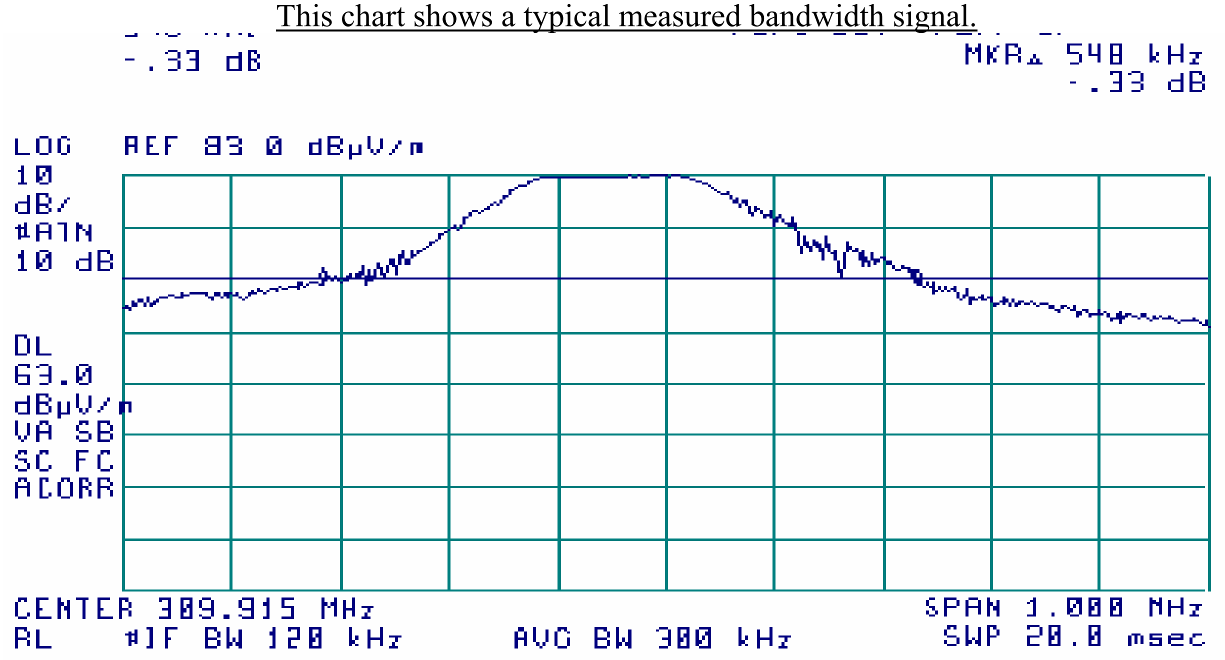
### Occupied Bandwidth [15.231(c)]

The maximum allowed 20dB bandwidth is determined pursuant to 15.231(c) and ANSI C63.4. The limit, pursuant to 15.231(c) is 0.25% of fundamental.
The resolution bandwidth of the measuring equipment is to be greater than 5% of the limit.
The minimum equipment resolution bandwidth required is calculated as >.05 * .0025 * 420MHz = 52.5KHz. An RBW of 120KHz is selected.

Formula 2: Allowed bandwidth = [ Fundamental ] x [ .0025 ]

| Fundamental (MHz) | Duty Cycle | Measured 20dB Bandwidth | LIMIT Fundamental * .0025 |
|---|---|---|---|
| 288 | 30% | 520KHz | 720 KHz |
| " | 50% | 485KHz | 720 KHz |
| " | 80% | 478KHz | 720 KHz |
| 310 | 30% | 548KHz | 775 KHz |
| " | 50% | 495KHz | 775 KHz |
| " | 80% | 488KHz | 775 KHz |
| 418 | 30% | 540KHz | 1045 KHz |
| " | 50% | 515KHz | 1045 KHz |
| " | 80% | 485KHz | 1045 KHz |

This chart shows a typical measured bandwidth signal.



## Restricted Bands: [15.205]

The following frequency bands are restricted. Only spurious emissions are permitted at levels limited by 15.209:

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090-0.110 | 16.42-16.423 | 399.9-410 | 4.5-5.25 |
| 0.490-0.510 | 16.69475-16.69525 | 608-614 | 5.35-5.46 |
| 2.1735-2.1905 | 16.80425-16.80475 | 960-1240 | 7.25-7.75 |
| 4.125-4.128 | 25.5-25.67 | 1300-1427 | 8.025-8.5 |
| 4.17725-4.17775 | 37.5-38.25 | 1435-1626.5 | 9.0-9.2 |
| 4.20725-4.20775 | 73-74.6 | 1645.5-1646.5 | 9.3-9.5 |
| 6.215-6.218 | 74.8-75.2 | 1660-1710 | 10.6-12.7 |
| 6.26775-6.26825 | 108-121.94 | 1718.8-1722.2 | 13.25-13.4 |
| 6.31175-6.31225 | 123-138 | 2200-2300 | 14.47-14.5 |
| 8.291-8.294 | 149.9-150.05 | 2310-2390 | 15.35-16.2 |
| 8.362-8.366 | 156.52475-156.52525 | 2483.5-2500 | 17.7-21.4 |
| 8.37625-8.38675 | 156.7-156.9 | 2655-2900 | 22.01-23.12 |
| 8.41425-8.41475 | 162.0125-167.17 | 3260-3267 | 23.6-24.0 |
| 12.29-12.293 | 167.72-173.2 | 3332-3339 | 31.2-31.8 |
| 12.51975-12.52025 | 240-285 | 3345.8-3358 | 36.43-36.5 |
| 12.57675-12.57725 | 322-335.4 | 3600-4400 | Above 38.6 |
| 13.36-13.41 | | | |

## LIMIT @ 3meter: [15.209(a)]

| | | |
|---|---|---|
| 30-88MHz | 100uV/m | 40dBuV/m |
| 88-216MHz | 150uV/m | 43.5dBuV/m |
| 216-960MHz | 200uV/m | 46dBuV/m |
| above 960MHz | 500uV/m | 54dBuV/m |

**Verification of no capability to tune within the Restricted Bands.**

The unit is designed capable of tuning from 288MHz to 420MHz except that the Homelink® firmware prevents the possibility of tuning to the restricted regions of 322-335.4MHz, 399.9-410MHz, and the region 304-307MHz.

An exercise which attempted to train the units into these restricted bands demonstrated how well the firmware functioned. The unit could not be trained any closer than 1MHz to the restricted bands of described in CFR47 15.205 and no closer than 500KHz outside the band 304-307MHz.

The spurious emissions observed in the restricted bands did not exceed the allowed limits.

**Radiated Field Strength Measurements: [15.231(b), 15.205]**

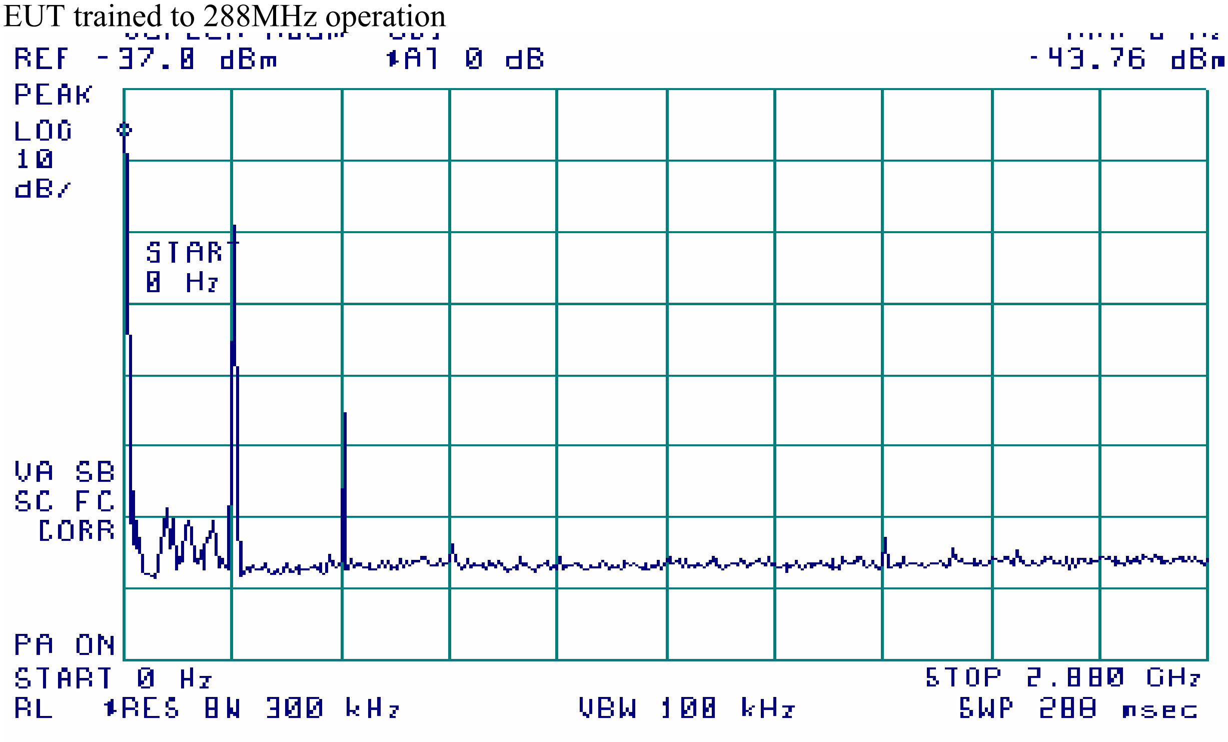
A scan of the OBIHL3 was made in a shielded room to study the emission profile of the EUT. These scans indicate there are low level spurious emissions from the unit other than the transmitter fundamental and its associated harmonics.

There were no emissions observed associated with the receiver section of the device.

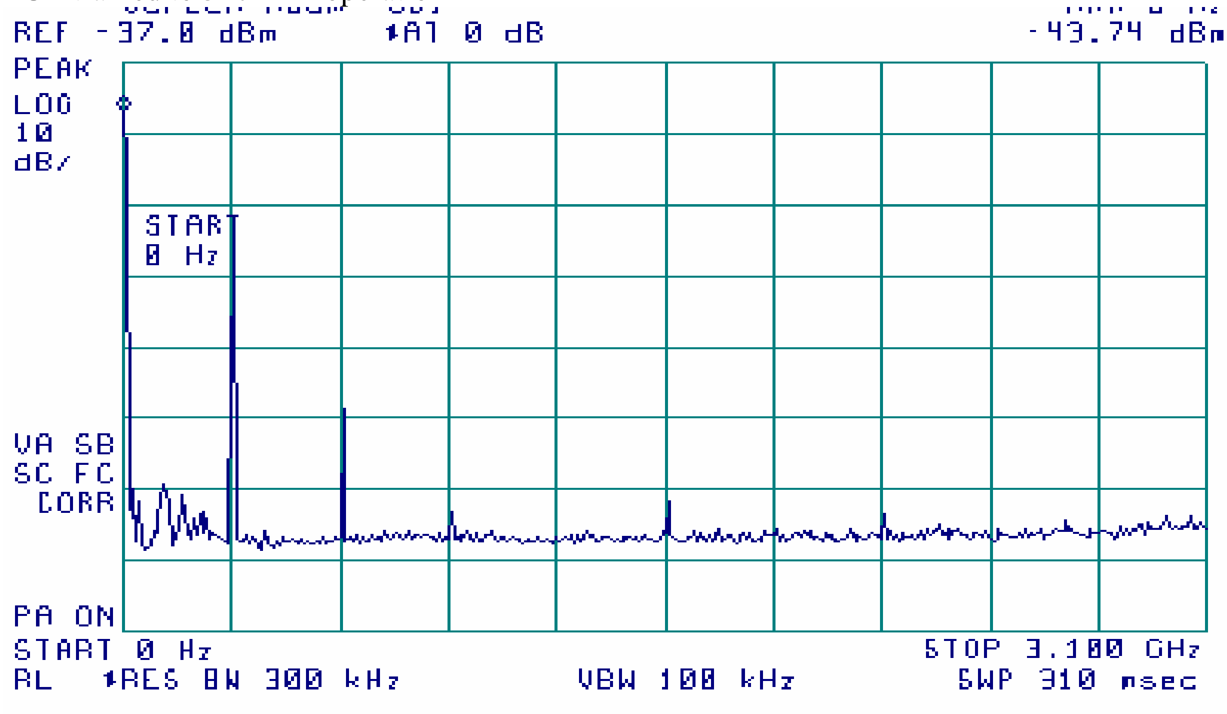
The suspect signals observed were then measured at the 3-meter open area test site.

The first series of the following charts show spectrum patterns of the EUT emissions. The levels indicated are not calibrated levels. Following the charts is a table of the measured levels at the 3-meter OATS.

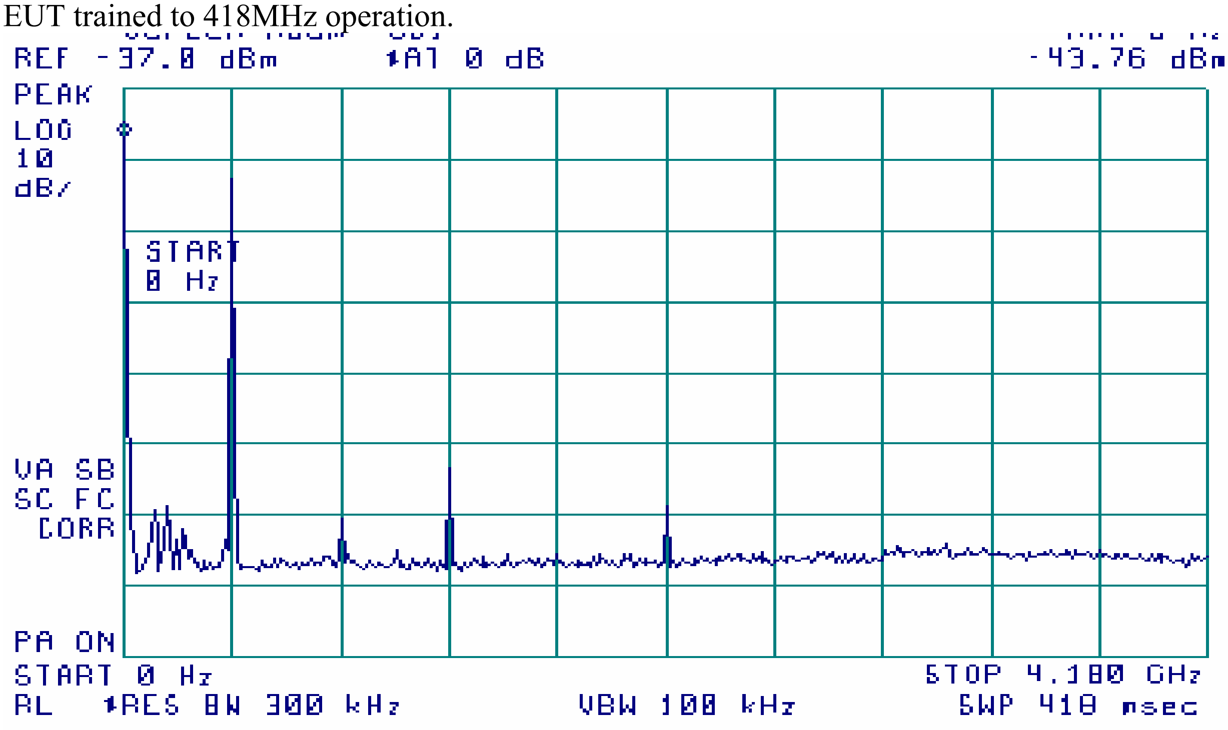
EUT trained to 288MHz operation



EUT trained to 310MHz operation

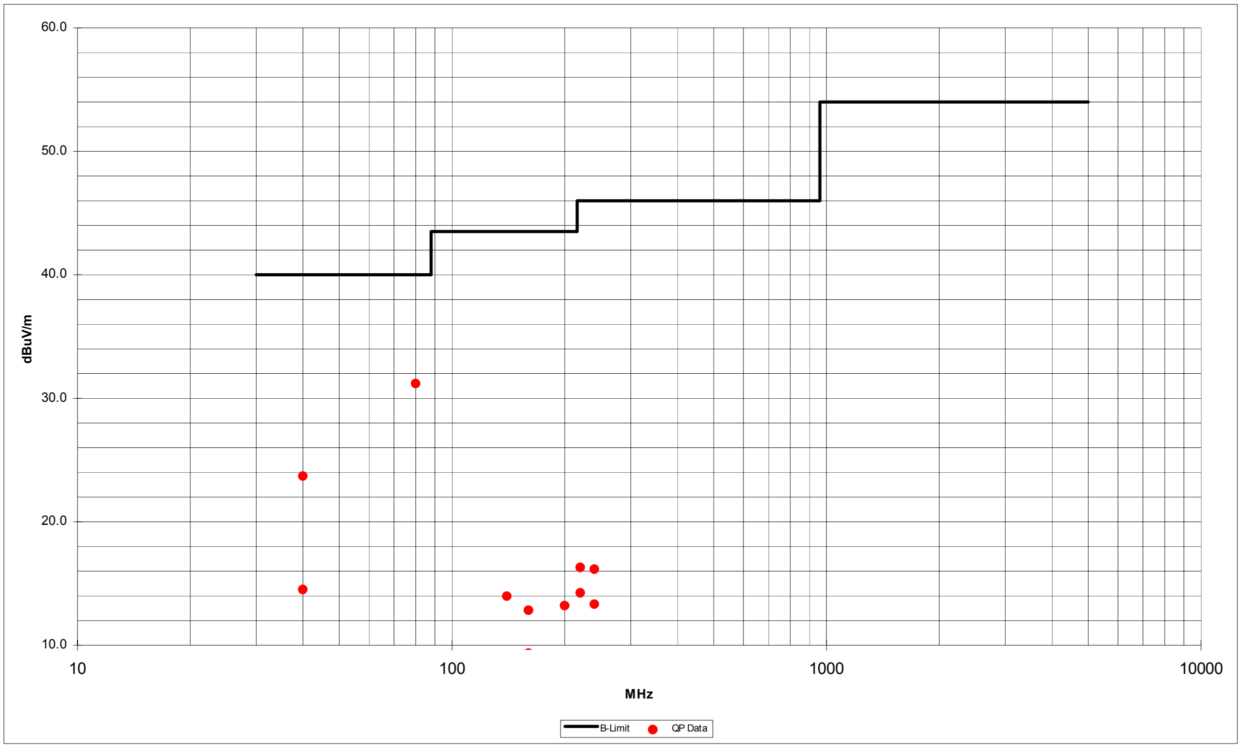



EUT trained to 418MHz operation.



## Radiated Field Strength Measurements

Graph of Quasi-Peak Measurements




Tabulated Quasi-Peak Measurements.

| Frequency<br>MHz | Polarity | Corrected Quasi Peak Measurement<br>dBuV/m | Included Cable+Antenna Factors<br>dB+dB/m | Turntable Azimuth<br>deg | Antenna Height<br>Mtr | FCC Class B Limit<br>dBuV/m | Margin<br>dB |
|---|---|---|---|---|---|---|---|
| 40.0** | V | 23.70 | 13.69 | 270 | 2.2 | 40.00 | 16.30 |
| 80.0** | H | 31.19 | 7.69 | 270 | 2.3 | 40.00 | 8.81 |
| 111.0** | H | 5.63 | 9.26 | 260 | 2.7 | 43.50 | 37.87 |
| 120.00 | H | 8.69 | 8.74 | 270 | 2.2 | 43.50 | 34.81 |
| 140.00 | V | 13.97 | 8.85 | 270 | 2.2 | 43.50 | 29.53 |
| 160.00 | V | 12.84 | 10.01 | 200 | 1.0 | 43.50 | 30.66 |
| 199.99 | V | 13.21 | 12.10 | 270 | 1.0 | 43.50 | 30.29 |
| 219.99 | H | 16.30 | 12.74 | 270 | 2.2 | 46.00 | 29.70 |
| 240.01 | H | 16.16 | 13.31 | 270 | 2.2 | 46.00 | 29.84 |

The frequencies for measurements were determined by the suspect list generated from the shielded room prescan.

**These suspect signal levels were measured to be at or below the background noise and ambient.

### Field Strength Measurements of Fundamental : [15.231(b)]

MEASUREMENT PROCEDURE:

1. The EUT was trained to one of the three test frequencies.
2. The EUT was trained to one of the three test duty cycles.
3. The EUT was setup to one of the three orthogonal positions.
4. Steps 1-3 were repeated to cover all positions, duty cycles, and frequencies.

DUT Tuned to transmit at 288MHz

| Freq.<br>MHz | DUT position | Ant. Pol. | Corrected Data Peak Detector<br>dBuV/m | Duty Cycle<br>% | Duty Cycle Factor<br>dB | Calculated Average Level<br>dBuV/m | FCC Limit<br>dBuV/m | Margin<br>dB | Cable +Ant. Factor<br>dB+dB/m |
|---|---|---|---|---|---|---|---|---|---|
| 288 | side | H | 81.7 | 30% | -10.46 | 71.2 | 73.8 | **2.6** | 14.7 |
| " | " | " | 78.1 | 50% | -6.02 | 72.1 | 73.8 | **1.7** | " |
| " | " | " | 73.6 | 80% | -1.94 | 71.7 | 73.8 | **2.1** | " |

DUT Tuned to transmit at 310MHz

| Freq.<br>MHz | DUT position | Ant. Pol. | Corrected Data Peak Detector<br>dBuV/m | Duty Cycle<br>% | Duty Cycle Factor<br>dB | Calculated Average Level<br>dBuV/m | FCC Limit<br>dBuV/m | Margin<br>dB | Cable +Ant. Factor<br>dB+dB/m |
|---|---|---|---|---|---|---|---|---|---|
| 310 | side | H | 83.7 | 30% | -10.46 | 73.2 | 75.3 | **2.1** | 15.1 |
| " | " | " | 80.2 | 50% | -6.02 | 74.2 | 75.3 | **1.1** | " |
| " | " | " | 74.4 | 80% | -1.94 | 72.5 | 75.3 | **2.8** | " |

DUT Tuned to transmit at 418MHz

| Freq.<br>MHz | DUT position | Ant. Pol. | Corrected Data Peak Detector<br>dBuV/m | Duty Cycle<br>% | Duty Cycle Factor<br>dB | Calculated Average Level<br>dBuV/m | FCC Limit<br>dBuV/m | Margin<br>dB | Cable +Ant. Factor<br>dB+dB/m |
|---|---|---|---|---|---|---|---|---|---|
| 418 | end | V | 88.1 | 30% | -10.46 | 77.6 | 80.3 | **2.7** | 18.3 |
| " | " | " | 84.6 | 50% | -6.02 | 78.6 | 80.3 | **1.7** | " |
| " | - | " | 79.0 | 80% | -1.94 | 77.1 | 80.3 | **3.2** | " |

### Field Strength Measurements of Harmonics: [15.231(b), 15.205]

DUT Tuned to transmit at 288MHz

| Freq. MHz | DUT position | Ant. Pol. | Corrected Data Peak Detector dBuV/m | Duty Cycle % | Duty Cycle Factor dB | Calculated Average Level dBuV/m | FCC Limit dBuV/m | Margin dB | Cable +Ant. Factor dB+dB/m |
|---|---|---|---|---|---|---|---|---|---|
| 576 | side | V | 55.3 | 30% | -10.46 | 44.8 | 53.8 | **9.0** | 21.4 |
| " | " | " | 51.5 | 50% | -6.02 | 45.5 | 53.8 | **8.3** | " |
| " | " | " | 39.8 | 80% | -1.94 | 37.9 | 53.8 | **15.9** | " |
| 864 | flat | H | 38.5 | 30% | -10.46 | 28.0 | 53.8 | **25.8** | 25.3 |
| " | end | V | 34.3 | 50% | -6.02 | 28.3 | 53.8 | **25.5** | " |
| " | - | " | 31 noise floor | 80% | -1.94 | <29.1 | 53.8 | **>24.7** | " |
| 1152 | flat | V | 39.3 | 30% | -10.46 | 28.8 | 54.0 | **25.2** | 28.7 |
| " | end | " | 39.3 | 50% | -6.02 | 33.3 | 54.0 | **20.7** | " |
| " | flat | " | 38.9 | 80% | -1.94 | 37.0 | 54.0 | **17.0** | " |
| 1440 | end | V | 42.9 | 30% | -10.46 | 32.4 | 54.0 | **21.6** | 29.4 |
| " | " | " | 42.0 | 50% | -6.02 | 36.0 | 54.0 | **18.0** | " |
| " | " | " | 41.0 | 80% | -1.94 | 39.1 | 54.0 | **14.9** | " |
| 1728 | - | V | 41 noise floor | 30% | -10.46 | <30.5 | 54.0 | **>23.5** | 30.3 |
| " | - | - | 41 noise floor | 50% | -6.02 | <35.0 | 54.0 | **>19.0** | " |
| " | - | - | 41 noise floor | 80% | -1.94 | <39.1 | 54.0 | **>14.9** | " |
| 2016 | side | V | 41 noise floor | 30% | -10.46 | <30.5 | 54.0 | **>23.5** | 31.2 |
| " | - | - | 41 noise floor | 50% | -6.02 | <35.0 | 54.0 | **>19.0** | " |
| " | - | - | 41 noise floor | 80% | -1.94 | <39.5 | 54.0 | **>14.9** | " |
| 2304 | side | V | 44 noise floor | 30% | -10.46 | <33.5 | 54.0 | **>20.5** | 32.3 |
| | - | " | 44 noise floor | 50% | -6.02 | <38.0 | 54.0 | **>16.0** | |
| " | - | " | 44 noise floor | 80% | -1.94 | <42.1 | 54.0 | **>11.9** | " |
| 2592 | - | V | 45 noise floor | 30% | -10.46 | <34.5 | 54.0 | **>19.5** | 33.1 |
| " | - | " | 45 noise floor | 50% | -6.02 | <39.0 | 54.0 | **>15.0** | " |
| " | - | " | 45 noise floor | 80% | -1.94 | <43.1 | 54.0 | **>10.9** | " |
| 2880 | - | V | 46 noise floor | 30% | -10.46 | <35.5 | 54.0 | **>18.5** | 33.3 |
| " | - | " | 46 noise floor | 50% | -6.02 | <40.0 | 54.0 | **>14.0** | " |
| " | - | " | 46 noise floor | 80% | -1.94 | <44.1 | 54.0 | **>9.9** | " |

DUT Tuned to transmit at 310MHz

| Freq. MHz | DUT position | Ant. Pol. | Corrected Data Peak Detector dBuV/m | Duty Cycle % | Duty Cycle Factor dB | Calculated Average Level dBuV/m | FCC Limit dBuV/m | Margin dB | Cable +Ant. Factor dB+dB/m |
|---|---|---|---|---|---|---|---|---|---|
| 620 | flat | H | 58.2 | 30% | -10.46 | 47.7 | 55.3 | **7.6** | 22.1 |
| " | end | H | 49.5 | 50% | -6.02 | 43.5 | 55.3 | **11.8** | " |
| " | " | " | 43.8 | 80% | -1.94 | 41.9 | 55.3 | **13.4** | " |
| 930 | side | H | 41 noise floor | 30% | -10.46 | <30.5 | 55.3 | **>24.8** | 25.8 |
| " | - | - | 41 noise floor | 50% | -6.02 | <35.0 | 55.3 | **>20.3** | " |
| " | - | - | 41 noise floor | 80% | -1.94 | <39.1 | 55.3 | **>16.2** | " |
| 1240 | flat | V | 41.2 | 30% | -10.46 | 30.7 | 54.0 | **23.3** | 29.0 |
| " | " | " | 39.8 | 50% | -6.02 | 33.8 | 54.0 | **20.2** | " |
| " | " | " | 39.6 | 80% | -1.94 | 37.7 | 54.0 | **16.3** | " |
| 1550 | side | H | 46.8 | 30% | -10.46 | 36.3 | 54.0 | **17.7** | 29.7 |
| " | " | " | 44.2 | 50% | -6.02 | 38.2 | 54.0 | **15.8** | " |
| " | " | " | 42.8 | 80% | -1.94 | 40.9 | 54.0 | **13.1** | " |
| 1860 | side | H | 43.0 | 30% | -10.46 | 32.5 | 55.3 | **22.8** | 30.7 |
| " | " | " | 41.7 | 50% | -6.02 | 35.7 | 55.3 | **19.6** | " |
| " | - | - | 40 noise floor | 80% | -1.94 | <38.1 | 55.3 | **>17.2** | " |
| 2170 | side | H | 46.4 | 30% | -10.46 | 35.9 | 55.3 | **19.4** | 31.8 |
| " | " | V | 45.8 | 50% | -6.02 | 39.8 | 55.3 | **15.5** | " |
| " | " | " | 44.3 | 80% | -1.94 | 42.4 | 55.3 | **12.9** | " |
| 2480 | - | V | 43 noise floor | 30% | -10.46 | <32.5 | 55.3 | **>22.8** | 32.9 |
| | - | | 43 noise floor | 50% | -6.02 | <37.0 | 55.3 | **>18.3** | |
| " | - | " | 43 noise floor | 80% | -1.94 | <41.1 | 55.3 | **>14.2** | " |
| 2790 | - | V | 44 noise floor | 30% | -10.46 | <33.5 | 54.0 | **>20.5** | 33.2 |
| " | - | " | 44 noise floor | 50% | -6.02 | <38.0 | 54.0 | **>16.0** | " |
| " | - | " | 44 noise floor | 80% | -1.94 | <42.1 | 54.0 | **>11.9** | " |
| 3100 | - | V | 45 noise floor | 30% | -10.46 | <34.5 | 54.0 | **>19.5** | 33.7 |
| " | - | " | 45 noise floor | 50% | -6.02 | <39.0 | 54.0 | **>15.0** | " |
| " | - | " | 45 noise floor | 80% | -1.94 | <43.1 | 54.0 | **>10.9** | " |

DUT Tuned to transmit at 418MHz

| Freq. MHz | DUT position | Ant. Pol. | Corrected Data Peak Detector dBuV/m | Duty Cycle % | Duty Cycle Factor dB | Calculated Average Level dBuV/m | FCC Limit dBuV/m | Margin dB | Cable +Ant. Factor dB+dB/m |
|---|---|---|---|---|---|---|---|---|---|
| 836 | flat | H | 52.2 | 30% | -10.46 | 41.7 | 60.3 | **18.6** | 25.0 |
| " | " | " | 45.0 | 50% | -6.02 | 39.0 | 60.3 | **21.3** | " |
| " | " | " | 39.8 | 80% | -1.94 | 37.9 | 60.3 | **22.4** | " |
| 1254 | side | V | 42.2 | 30% | -10.46 | 31.7 | 54.0 | **22.3** | 29.0 |
| " | " | " | 41.9 | 50% | -6.02 | 35.9 | 54.0 | **18.1** | " |
| " | " | " | 43.0 | 80% | -1.94 | 41.1 | 54.0 | **12.9** | " |
| 1672 | side | V | 51.1 | 30% | -10.46 | 40.6 | 54.0 | **13.4** | 30.1 |
| " | " | " | 50.2 | 50% | -6.02 | 44.2 | 54.0 | **9.8** | " |
| " | " | " | 48.6 | 80% | -1.94 | 46.7 | 54.0 | **7.3** | " |
| 2090 | side | H | 48.2 | 30% | -10.46 | 37.7 | 60.3 | **22.6** | 31.5 |
| " | " | " | 47.5 | 50% | -6.02 | 41.5 | 60.3 | **18.8** | " |
| " | " | " | 46.6 | 80% | -1.94 | 44.7 | 60.3 | **15.6** | " |
| 2508 | side | V | 47.1 | 30% | -10.46 | 36.6 | 60.3 | **23.7** | 33.0 |
| " | " | H | 47.5 | 50% | -6.02 | 41.5 | 60.3 | **18.8** | " |
| " | " | " | 46.9 | 80% | -1.94 | 45.0 | 60.3 | **15.3** | " |
| 2926 | - | V | 44 noise floor | 30% | -10.46 | <33.5 | 60.3 | **>26.8** | 33.3 |
| " | - | " | 44 noise floor | 50% | -6.02 | <38.0 | 60.3 | **>22.3** | " |
| " | - | " | 44 noise floor | 80% | -1.94 | <42.1 | 60.3 | **>18.2** | " |
| 3344 | - | V | 46 noise floor | 30% | -10.46 | <35.5 | 60.3 | **>24.8** | 34.4 |
| | - | | 46 noise floor | 50% | -6.02 | <40.0 | 60.3 | **>20.3** | |
| " | - | " | 46 noise floor | 80% | -1.94 | <44.1 | 60.3 | **>16.2** | " |
| 3762 | - | V | 47 noise floor | 30% | -10.46 | <36.5 | 54.0 | **>17.5** | 34.8 |
| " | - | " | 47 noise floor | 50% | -6.02 | <41.0 | 54.0 | **>13.0** | " |
| " | - | " | 47 noise floor | 80% | -1.94 | <45.1 | 54.0 | **>8.9** | " |
| 4180 | - | V | 47 noise floor | 30% | -10.46 | <36.5 | 54.0 | **>17.5** | 35.0 |
| " | - | " | 47 noise floor | 50% | -6.02 | <41.0 | 54.0 | **>13.0** | " |
| " | - | " | 47 noise floor | 80% | -1.94 | <45.1 | 54.0 | **>8.9** | " |

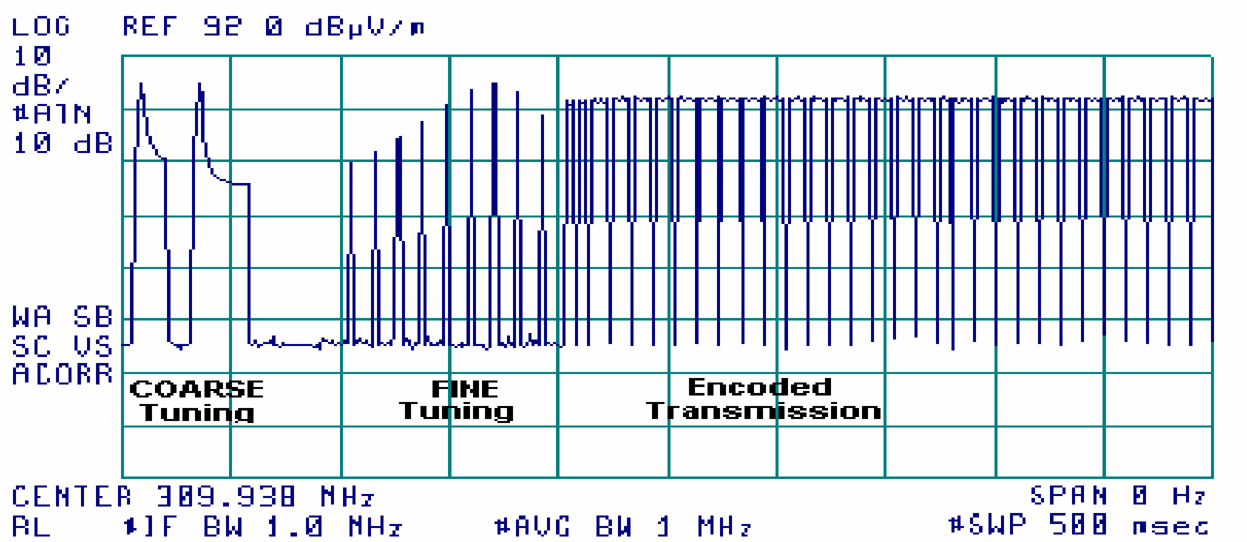
### Calculation of Field Strength of Tuning Pulses: [15.231(b)], 15.31(c)]

The tuning pulses are generated each time the OBIHL3 is activated.

The tuning pulse sequence is: During the first 100mSec of activation two pulses of a 'coarse' tune. During the second 100mSec of activation are nine pulses of a 'fine' tune. At approximately 200mSec after activation the encoded transmission begins.

The signal levels of the tuning pulses were maximized by maximizing the signal levels of the pulse modulated transmission. The antenna height and turntable azimuth for maximum emission levels were adjusted while measuring the field strength of the pulse modulated transmissions.

A typical tuning pulse sequence is presented in this figure below.




To determine the level of the tuning pulses for comparison to the limits, the following procedure was used.

MEASUREMENT PROCEDURE:

1. The EUT was trained to each of the three test frequencies at 30% duty cycle of the 500Hz modulating pulse. At 30% duty cycle the unit transmits at maximum output.
2. The HP8456A EMI Receiver was adjusted to a fundamental frequency and set at 0Hz span, with 1MHz IF Bandwidth.
3. The trigger level was adjusted to capture the pulses of interest.
4. The EUT was activated and a single trace recorded on the Receiver in order to capture the tuning pulses.
5. The captured trace was digitally stored. The stored data points (400 data points for a full screen trace) were then used in calculations to determine the levels of the pulses.

CALCULATION OF THE FIELD STRENGTH OF THE TUNING PULSES.[ 15.35(c) ]

Pursuant to 47 CFR 15.35(c), the field strength is determined by averaging over ONE complete pulse train up to 100mSec, including blanking intervals.

1. First was determined the number of data points captured which represented 100mSec span of time. There are 400 data points stored for one complete trace. The scan rate of the HP8546A receiver was set to capture the tuning pulses.

   Therefore: Number of data points per 100mSec
   = 100mSec * (400pts/scan) / (No. of mSec/scan).

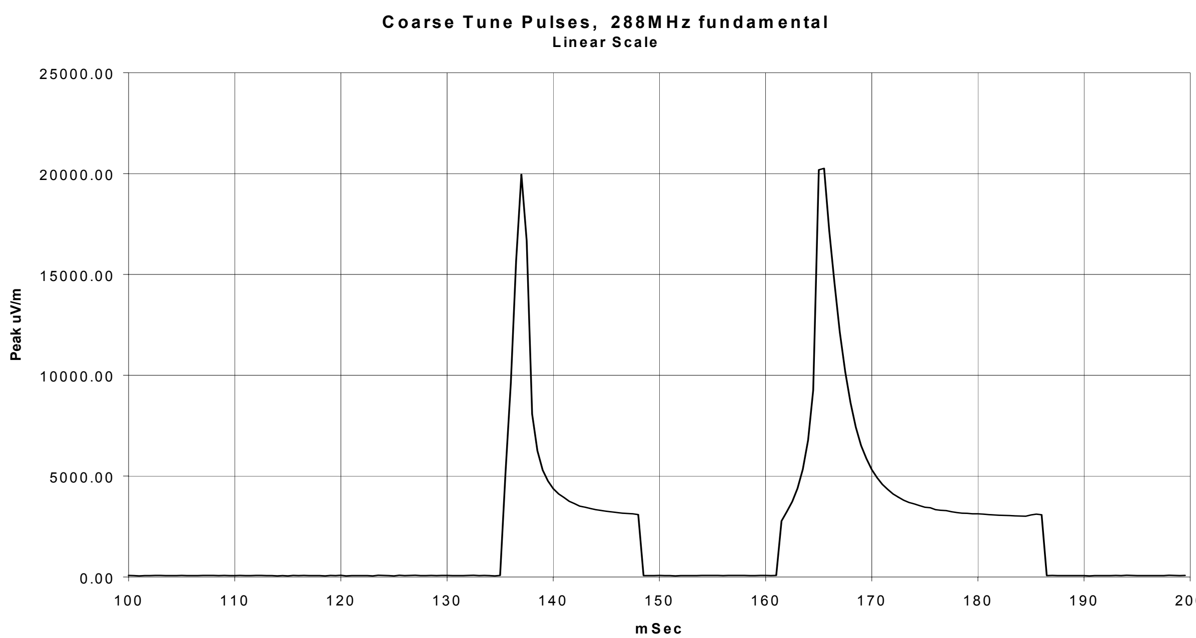
   Example: If the scan rate is set at 200mSec, then the number of data points per 100mSec is 100mSec * (400pts / 200mSec) = 200 pts.

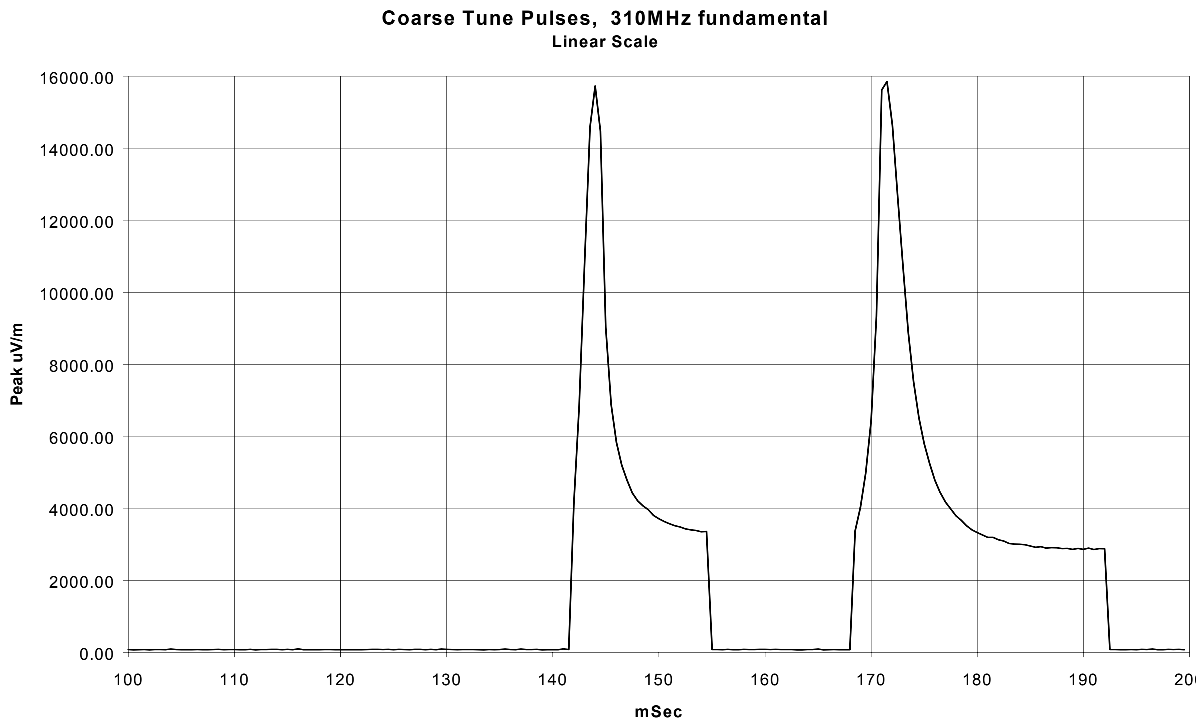
2. The AVERAGE field strength level (uV/m) within the 100mSec is then determined by dividing SUM of the levels (uV/m) of all data points by the number of data points.

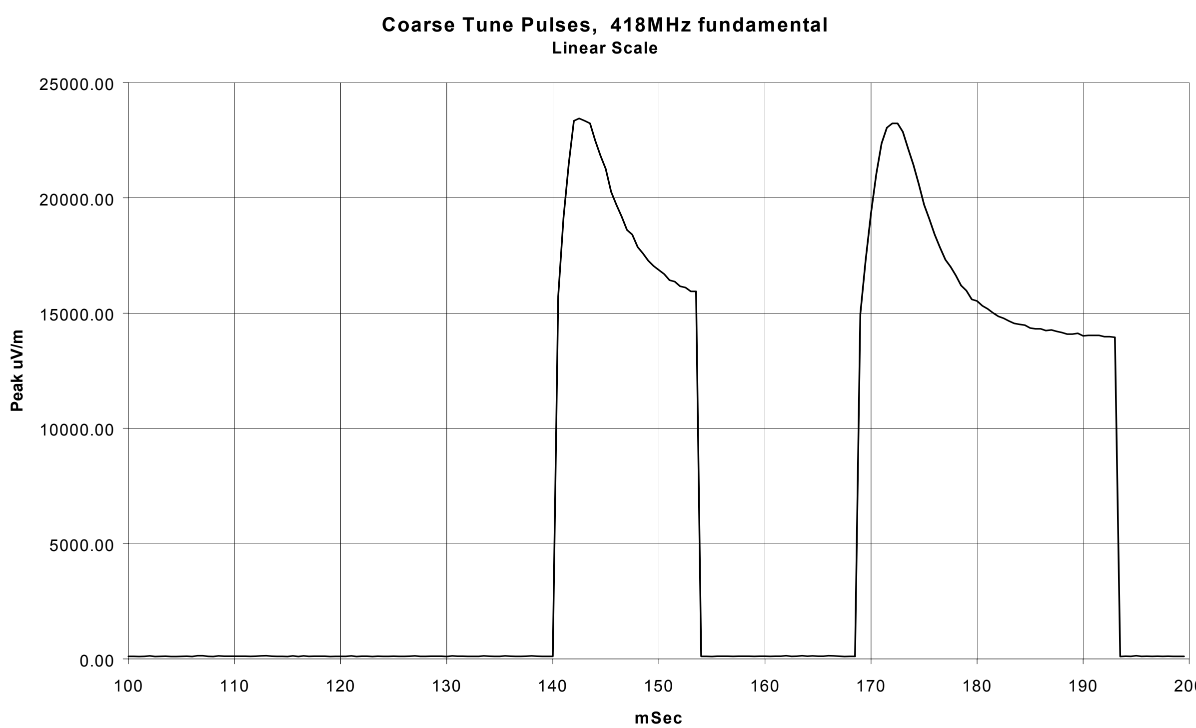
Formula 3: Average Field Intensity

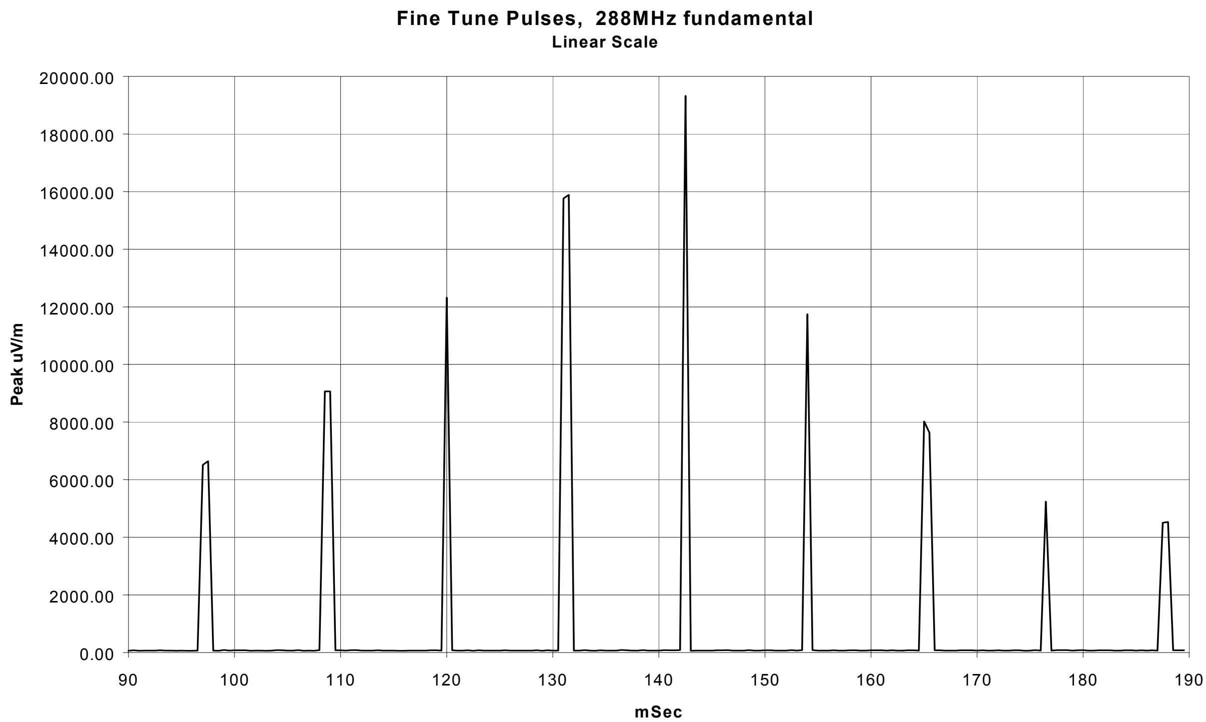
$$\text{Avg. F.I.} = \frac{\sum_{n=1}^{\text{no. of data pts}} (\text{Level}_n)\text{uV/m}}{(\text{number of data points})}$$

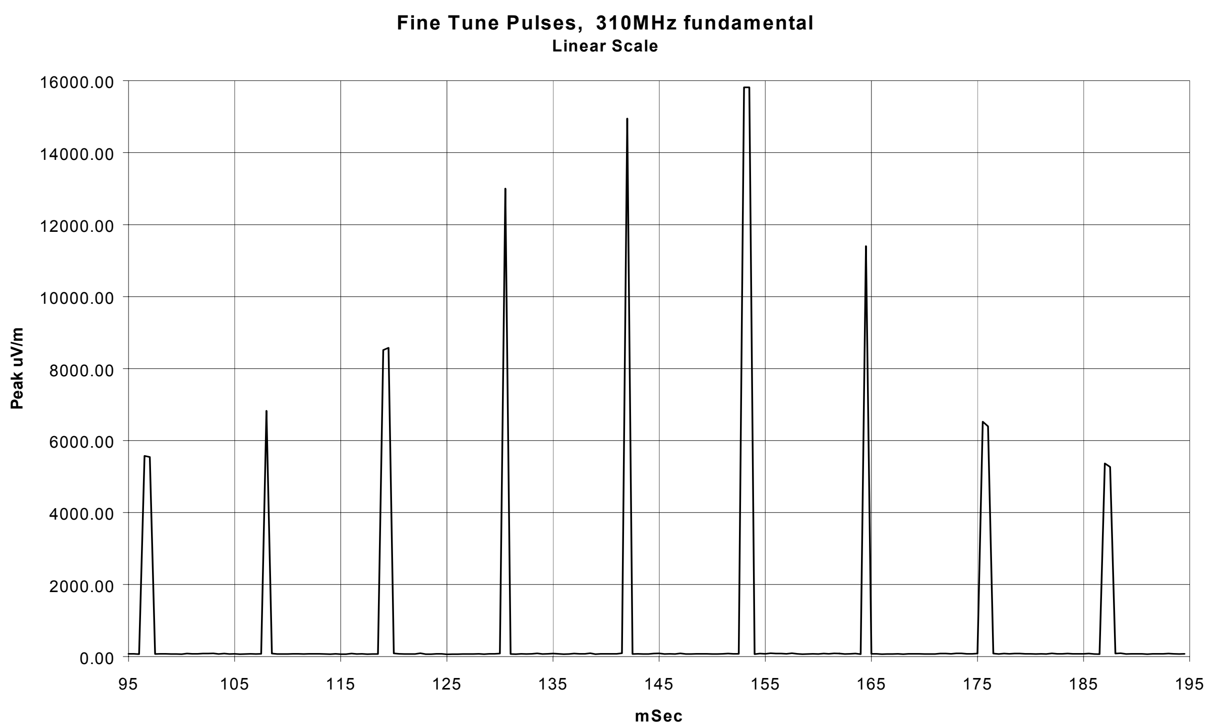
The charts that follow are the reproduction of the coarse tune pulse traces using number of data points representing 100mSec sweep time from the screen display of the HP8546A EMI receiver.

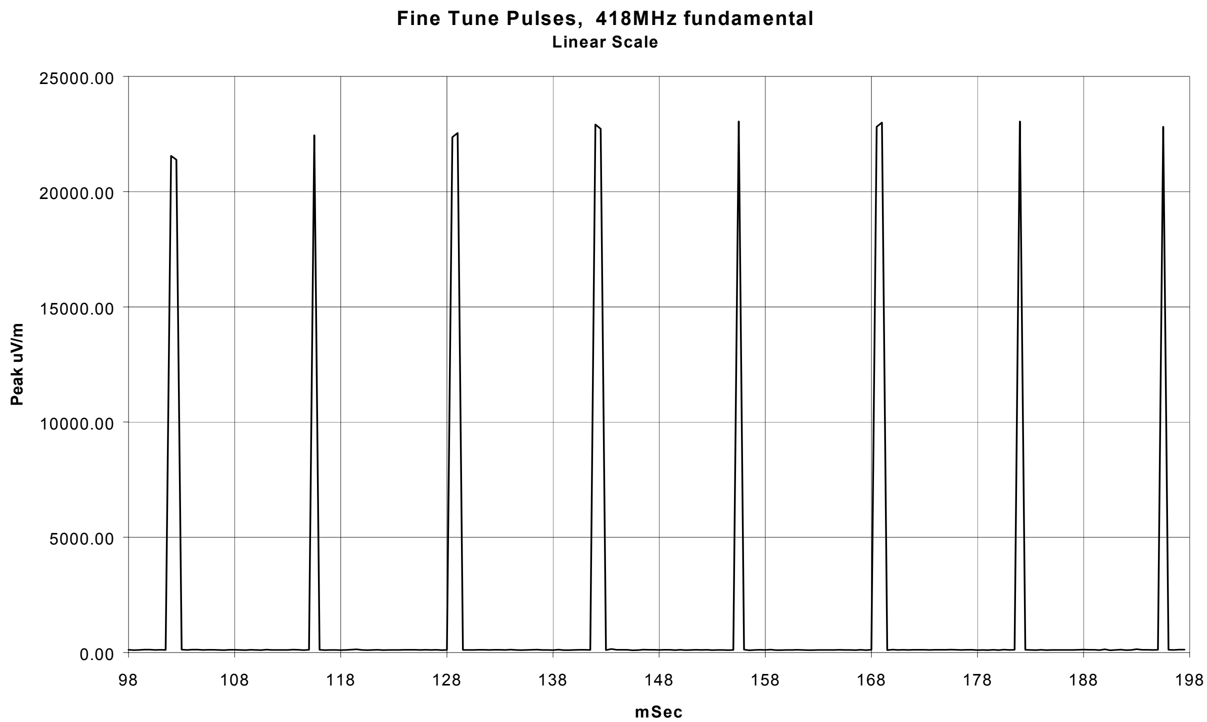



Coarse Tune Pulses, 310MHz fundamental
Linear Scale
Peak uV/m
16000.00
14000.00
12000.00
10000.00
8000.00
6000.00
4000.00
2000.00
0.00
100
110
120
130
140
150
160
170
180
190
200
mSec


Coarse Tune Pulses, 418MHz fundamental
Linear Scale
Peak uV/m
25000.00
20000.00
15000.00
10000.00
5000.00
0.00
100
110
120
130
140
150
160
170
180
190
200
mSec


Fine Tune Pulses, 288MHz fundamental
Linear Scale
Peak uV/m
20000.00
18000.00
16000.00
14000.00
12000.00
10000.00
8000.00
6000.00
4000.00
2000.00
0.00
90
100
110
120
130
140
150
160
170
180
190
mSec


Fine Tune Pulses, 310MHz fundamental
Linear Scale
Peak uV/m
16000.00
14000.00
12000.00
10000.00
8000.00
6000.00
4000.00
2000.00
0.00
95
105
115
125
135
145
155
165
175
185
195
mSec




The raw data used in calculating the average field intensity of the tuning pulses is available if required.

COARSE TUNE PULSES, Calculated average over 100mSec

| TX Freq. (MHz) | SUM of the levels of all data points in 100mSec span (uV/m) | Number of Data points in 100mSec span N | Average SUM/N (uV/m) | LIMIT (uV/m) | MARGIN (dB) |
|---|---|---|---|---|---|
| 288 | 432,542 | 200 | 2,163 | 4917 | **7.1** |
| 310 | 400,953 | 200 | 2,005 | 5833 | **9.3** |
| 418 | 1,340,379 | 200 | 6,702 | 10333 | **3.8** |

FINE TUNE PULSES, Calculated average over 100mSec

| TX Freq. (MHz) | SUM of the levels of all data points in 100mSec span (uV/m) | Number of Data points in 100mSec span N | Average SUM/N (uV/m) | LIMIT (uV/m) | MARGIN (dB) |
|---|---|---|---|---|---|
| 288 | 149,513 | 200 | 748 | 4917 | **16.4** |
| 310 | 143,641 | 200 | 718 | 5833 | **18.2** |
| 418 | 292,204 | 200 | 1,461 | 10333 | **17.0** |

The data used to calculate the average measurements is available upon request.