



**Applicant:** Daniels Electronics Ltd.  
43 Erie St  
Victoria, BC V8V 1P8

**Equipment Under Test:** VT-4E150 VHF Transmitter

**FCC ID:** H4JVT-4E150

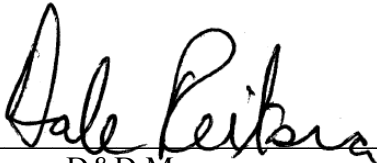
**In Accordance With:** FCC Part 22  
FCC Part 80  
FCC Part 90

**Tested By:** Daniels Electronics Ltd.  
43 Erie St  
Victoria, BC, V8V 1P8

And

Acme Testing Co.  
2002 Valley Highway  
Acme, WA, 98220-0003

**Authorized By:**

  
Dale Reitsma, D&D Manager

**Testing Verified By:**

  
John Shields, Communication Systems Designer

**Date:** 2 Aug 2006

**Total Number of Pages:** 28

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### **Appendix A: VT-4E150 VHF Transmitter** **– Measurements of Field Strength of Spurious Radiation**

# 1. Summary of Test Results

## General

**All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 22, 80, and 90.

This application is a new submission for approval of the **VT-4E150 VHF Transmitter**, operating in the 136 to 174 MHz frequency band of the Land Mobile Services. The equipment under test are pre-production units.

✓ New Submission  
Modification Filing  
Family Listing

Production Unit  
✓ Pre-Production Unit

## Summary of Test Data

| Name of Test                                              | Para No.                                           | Result   |
|-----------------------------------------------------------|----------------------------------------------------|----------|
| RF Power Output                                           | 47 CFR §2.1046                                     | Complies |
| Audio Frequency Response                                  | 47 CFR §2.1047 a)                                  | Complies |
| Audio Low-Pass Filter Response                            | 47 CFR §2.1047 a)                                  | Complies |
| Modulation Limiting                                       | 47 CFR §2.1047 b)                                  | Complies |
| Occupied Bandwidth (with Audio Low-Pass Filter Installed) | 47 CFR §2.1049 g), h)<br>47 CFR §90.210 d)         | Complies |
| Spurious Emissions at Antenna Terminals                   | 47 CFR §2.1051<br>47 CFR §90.210 d)                | Complies |
| Field Strength of Spurious Emissions                      | 47 CFR §2.1053<br>47 CFR §90.210 d)                | Complies |
| Frequency Stability                                       | 47 CFR §2.1055<br>47 CFR §90.213<br>47 CFR §90.539 | Complies |
| Transient Frequency Behaviour                             | 47 CFR §90.214                                     | Complies |

## Test Conditions:

The following conditions apply to all of the testing except when otherwise specified.

Temperature: 23°C  
Humidity: 30%

## 2. General Equipment Specifications

|                                              |                          |                                                                               |
|----------------------------------------------|--------------------------|-------------------------------------------------------------------------------|
| <b>Manufacturer:</b>                         | Daniels Electronics Ltd. |                                                                               |
| <b>Model Number:</b>                         | VT-4E150                 |                                                                               |
| <b>FCC ID:</b>                               | H4JVT-4E150              |                                                                               |
| <b>Starting Date of Testing:</b>             | June 8, 2006             |                                                                               |
| <b>Serial Numbers of EUTs:</b>               | R&D 10010                | Note: Used for the majority of the tests.                                     |
|                                              | R&D 10011                | Note: Used for Frequency Stability and Transient Frequency Behaviour Testing. |
|                                              | R&D 10001                | Note: Used for Field Strength of Spurious Emissions Testing                   |
| <b>Primary Power:</b>                        | 13.8V <sub>DC</sub>      |                                                                               |
| <b>Emission Designators (Analog)</b>         |                          |                                                                               |
| <b>12.5kHz Channel Spacing:</b>              | 11K0F3E                  |                                                                               |
| <b>25kHz Channel Spacing:</b>                | 16K0F3E                  |                                                                               |
| <b>Emission Designators (Digital):</b>       |                          |                                                                               |
| <b>Voice: 12.5kHz Channel Spacing:</b>       | 8K10F1E                  |                                                                               |
| <b>Data: 12.5kHz Channel Spacing:</b>        | 8K10F1D                  |                                                                               |
| <b>Data: Paging with external modulator:</b> | 9K2F1D                   |                                                                               |
| <b>Rated RF Power Output:</b>                | Variable: 0.5 to 8.0W    |                                                                               |
| <b>Channel Spacing:</b>                      | 12.5kHz & 25kHz          |                                                                               |
| <b>Frequency Range:</b>                      | 136 to 174MHz            |                                                                               |

### 3. RF Power Output

**Test Results:** Complies  
**Minimum Standard:** 47 CFR §2.1046  
 $\pm 1\text{dB}$  (defined by the manufacturer)  
**Test Procedure:** TIA-603-C Sect 2.2.1

Notes:

The center frequency is tested at the maximum and minimum output power; 8.0W (39.0dBm) and 0.5W (27.0dBm) respectively.

**EUT Model #:** VT-4E150  
**Serial Number:** R&D 10010

**Test Equipment:** Power Meter, Sensor, 50 ohm Load } Rohde & Schwarz CMS 54 (DE #1545)

**Measurement Data:**

Rated Power = 8.0W (39.0dBm)

| Frequency<br>(MHz) | Rated Power<br>(dBm) | Measured Power<br>(dBm) |
|--------------------|----------------------|-------------------------|
| 159                | 8.0W (39.0dBm)       | 7.98W (39.0dBm)         |

Rated Power = 0.5W (27.0dBm)

| Frequency<br>(MHz) | Rated Power<br>(dBm) | Measured Power<br>(dBm) |
|--------------------|----------------------|-------------------------|
| 159                | 0.5W (27.0dBm)       | 0.495W (26.9dBm)        |

## 4. Audio Frequency Response

**Test Results:** Complies  
**Minimum Standard:** 47 CFR §2.1047 a)  
**Test Procedure:** TIA-603-C Sect 2.2.6

Notes:

The center frequency is tested using a 12.5kHz and 25kHz channel spacing.

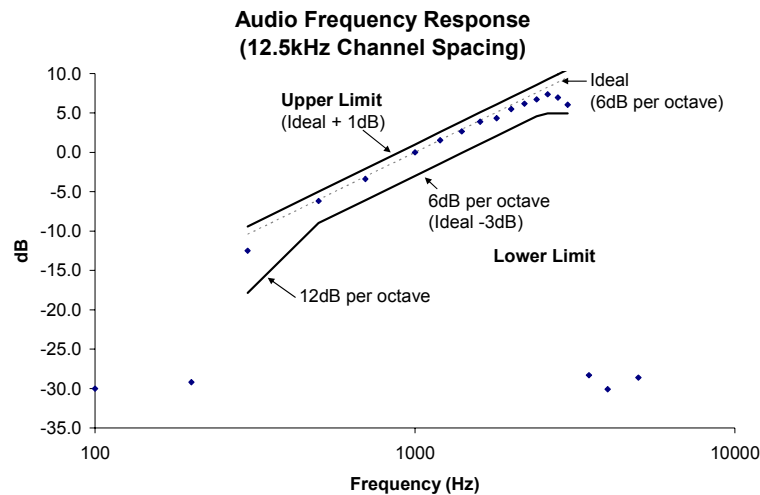
**EUT Model #:** VT-4E150  
**Serial Number:** R&D 10010

**Test Equipment:** Audio Generator, } Rohde & Schwarz CMS 54 (DE #1545)  
Test Receiver }  
Audio Level Meter Fluke 45 (DE #1720)

**Measurement Data:** See the graphs and tables below

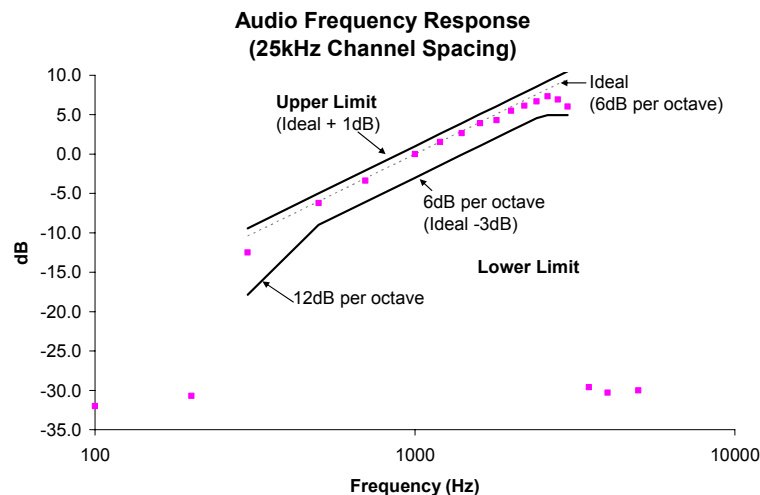
## 12.5kHz Channel Spacing (159MHz)

| Audio Freq (Hz) | 12.5kHz (dB) |
|-----------------|--------------|
| 100             | -30.0        |
| 200             | -29.2        |
| 300             | -12.5        |
| 500             | -6.2         |
| 700             | -3.4         |
| 1000            | 0.0          |
| 1200            | 1.5          |
| 1400            | 2.7          |
| 1600            | 3.9          |
| 1800            | 4.3          |
| 2000            | 5.5          |
| 2200            | 6.2          |
| 2400            | 6.7          |
| 2600            | 7.4          |
| 2800            | 7.0          |
| 3000            | 6.1          |
| 3500            | -28.3        |
| 4000            | -30.1        |
| 5000            | -28.6        |



## 25kHz Channel Spacing (159MHz)

| Audio Freq (Hz) | 25kHz (dB) |
|-----------------|------------|
| 100             | -32.0      |
| 200             | -30.7      |
| 300             | -12.5      |
| 500             | -6.2       |
| 700             | -3.4       |
| 1000            | 0.0        |
| 1200            | 1.5        |
| 1400            | 2.7        |
| 1600            | 3.9        |
| 1800            | 4.3        |
| 2000            | 5.5        |
| 2200            | 6.1        |
| 2400            | 6.7        |
| 2600            | 7.3        |
| 2800            | 6.9        |
| 3000            | 6.0        |
| 3500            | -29.6      |
| 4000            | -30.3      |
| 5000            | -30.0      |



## 5. Audio Low-Pass Filter Response

**Test Results:** Complies  
**Standard:** 47 CFR §2.1047 a)  
**Test Procedure:** TIA-603-C Sect 2.2.15

Notes:

The Audio Low-Pass Filter Response is not dependant on RF frequency. The response of the 12.5kHz and 25kHz channel spacing is measured.

**EUT Model #:** VT-4E150  
**Serial Number:** R&D 10010

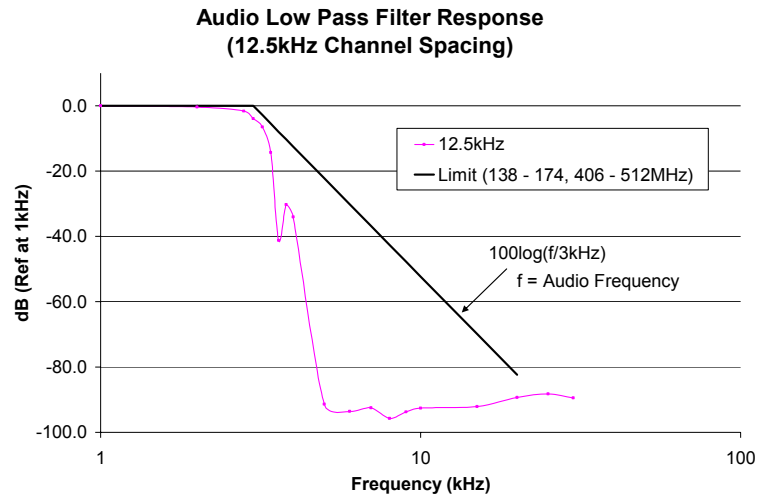
**Test Equipment:** Audio Generator Rohde & Schwarz CMS 54 (DE #1545)  
Audio Spectrum Analyzer IFR 2965A (DE #1396)

**Measurement Data:** See the graphs and tables below



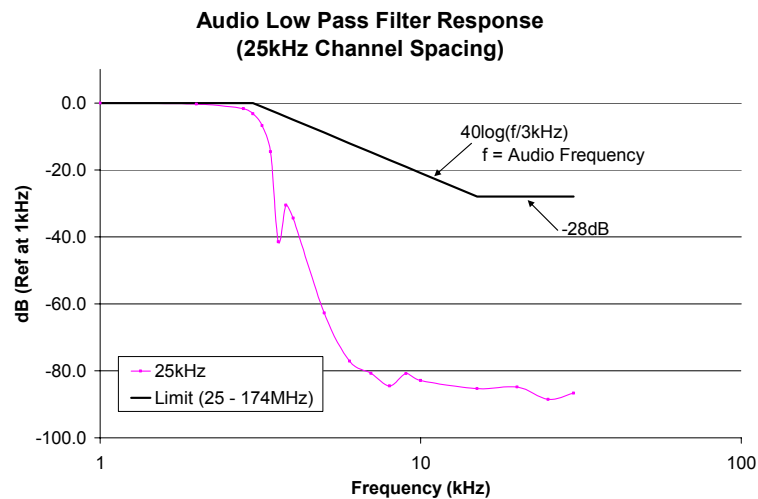
## 12.5kHz Channel Spacing

| Audio Freq (kHz) | 12.5kHz & 15kHz (dB rel. to 1kHz) |
|------------------|-----------------------------------|
| 1                | 0.0                               |
| 2                | -0.4                              |
| 2.8              | -1.6                              |
| 3                | -3.9                              |
| 3.2              | -6.5                              |
| 3.4              | -14.3                             |
| 3.6              | -41.3                             |
| 3.8              | -30.3                             |
| 4                | -34.1                             |
| 5                | -91.4                             |
| 6                | -93.6                             |
| 7                | -92.5                             |
| 8                | -95.7                             |
| 9                | -93.7                             |
| 10               | -92.6                             |
| 15               | -92.1                             |
| 20               | -89.3                             |
| 25               | -88.3                             |
| 30               | -89.4                             |



## 25kHz Channel Spacing

| Audio Freq (kHz) | 25kHz & 30kHz (dB rel. to 1kHz) |
|------------------|---------------------------------|
| 1                | 0.0                             |
| 2                | -0.4                            |
| 2.8              | -1.7                            |
| 3                | -3.2                            |
| 3.2              | -6.8                            |
| 3.4              | -14.6                           |
| 3.6              | -41.5                           |
| 3.8              | -30.5                           |
| 4                | -34.4                           |
| 5                | -62.8                           |
| 6                | -77.1                           |
| 7                | -80.7                           |
| 8                | -84.5                           |
| 9                | -80.8                           |
| 10               | -82.9                           |
| 15               | -85.3                           |
| 20               | -84.9                           |
| 25               | -88.5                           |
| 30               | -86.7                           |



## 6. Modulation Limiting

**Test Results:** Complies  
**Standard:** 47 CFR §2.1047 b)  
**Test Procedure:** 47 CFR §2.1047 b)

### Notes:

The modulation limiting is tested at the recommended audio frequencies of 300, 1000, 2500 and 3000Hz. The input level for each of these curves range from -20dBm to +15dBm. This input range allows the modulation limiting at the 1000Hz audio frequency to be more than 16dB greater than the input level necessary for 50% of the maximum modulation. The test receiver employs a 20kHz low pass audio filter.

The test procedure is specifically for analog; therefore the digital modulation inputs are not used.

The modulation limiting for 12.5kHz and 25kHz channel spacing are measured at the center frequency, with the maximum output power, 8W (39dBm).

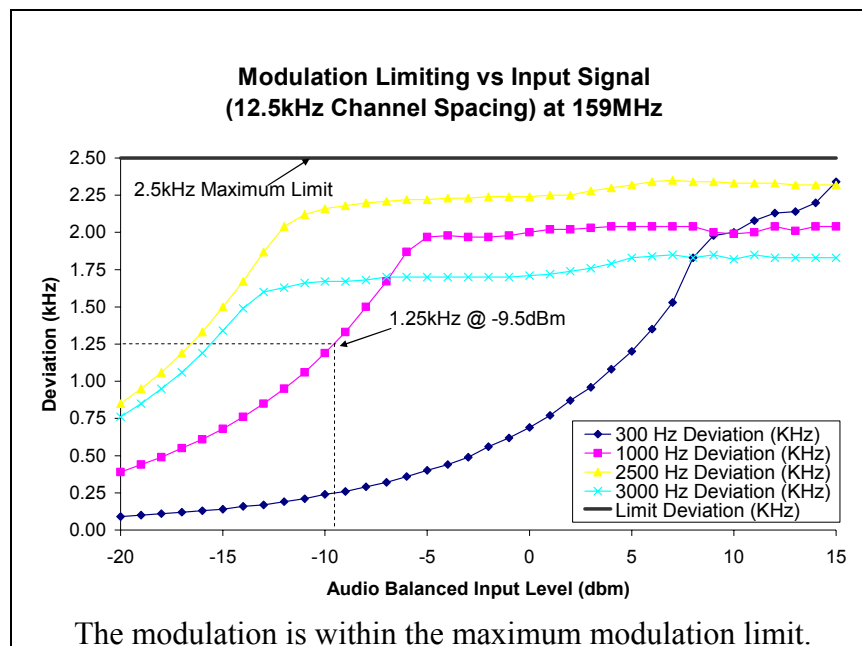
**EUT Model #:** VT-4E150  
**Serial Number:** R&D 10010

**Test Equipment:** Audio Generator }  
Test Receiver } Rohde & Schwarz CMS 54 (DE #1545)  
Audio Level Meter }

**Measurement Data:** See the graphs and tables below

## 12.5kHz Channel Spacing (159MHz), 8W (39dBm)

| Modulation versus Input Signal Test Results |           |           |           |           |
|---------------------------------------------|-----------|-----------|-----------|-----------|
| Audio Freq                                  | 300 Hz    | 1000 Hz   | 2500 Hz   | 3000 Hz   |
| Balance Input                               | Deviation | Deviation | Deviation | Deviation |
| (dBm)                                       | (KHz)     | (KHz)     | (KHz)     | (KHz)     |
| -20                                         | 0.09      | 0.39      | 0.85      | 0.76      |
| -19                                         | 0.10      | 0.44      | 0.95      | 0.85      |
| -18                                         | 0.11      | 0.49      | 1.06      | 0.95      |
| -17                                         | 0.12      | 0.55      | 1.19      | 1.06      |
| -16                                         | 0.13      | 0.61      | 1.33      | 1.19      |
| -15                                         | 0.14      | 0.68      | 1.50      | 1.34      |
| -14                                         | 0.16      | 0.76      | 1.67      | 1.49      |
| -13                                         | 0.17      | 0.85      | 1.87      | 1.60      |
| -12                                         | 0.19      | 0.95      | 2.04      | 1.63      |
| -11                                         | 0.21      | 1.06      | 2.12      | 1.66      |
| -10                                         | 0.24      | 1.19      | 2.16      | 1.67      |
| -9                                          | 0.26      | 1.33      | 2.18      | 1.67      |
| -8                                          | 0.29      | 1.50      | 2.20      | 1.68      |
| -7                                          | 0.32      | 1.67      | 2.21      | 1.70      |
| -6                                          | 0.36      | 1.87      | 2.22      | 1.70      |
| -5                                          | 0.40      | 1.97      | 2.22      | 1.70      |
| -4                                          | 0.44      | 1.98      | 2.23      | 1.70      |
| -3                                          | 0.49      | 1.97      | 2.23      | 1.70      |
| -2                                          | 0.56      | 1.97      | 2.24      | 1.70      |
| -1                                          | 0.62      | 1.98      | 2.24      | 1.70      |
| 0                                           | 0.69      | 2.00      | 2.24      | 1.71      |
| 1                                           | 0.77      | 2.02      | 2.25      | 1.72      |
| 2                                           | 0.87      | 2.02      | 2.25      | 1.74      |
| 3                                           | 0.96      | 2.03      | 2.28      | 1.76      |
| 4                                           | 1.08      | 2.04      | 2.30      | 1.79      |
| 5                                           | 1.20      | 2.04      | 2.32      | 1.83      |
| 6                                           | 1.35      | 2.04      | 2.34      | 1.84      |
| 7                                           | 1.53      | 2.04      | 2.35      | 1.85      |
| 8                                           | 1.83      | 2.04      | 2.34      | 1.83      |
| 9                                           | 1.98      | 2.00      | 2.34      | 1.85      |
| 10                                          | 2.00      | 1.99      | 2.33      | 1.82      |
| 11                                          | 2.08      | 2.00      | 2.33      | 1.85      |
| 12                                          | 2.13      | 2.04      | 2.33      | 1.83      |
| 13                                          | 2.14      | 2.01      | 2.32      | 1.83      |
| 14                                          | 2.20      | 2.04      | 2.32      | 1.83      |
| 15                                          | 2.34      | 2.04      | 2.32      | 1.83      |

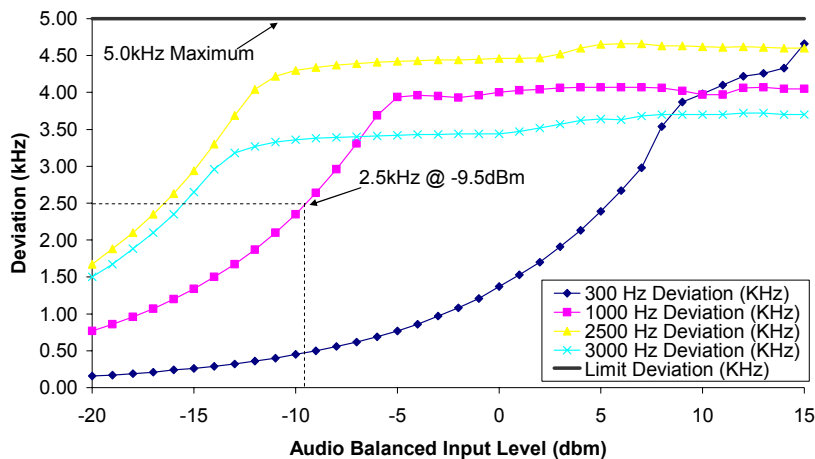


## 25kHz Channel Spacing (159MHz), 8W (39dBm)

Modulation versus Input Signal Test Results

| Audio Freq    | 300 Hz    | 1000 Hz   | 2500 Hz   | 3000 Hz   |
|---------------|-----------|-----------|-----------|-----------|
| Balance Input | Deviation | Deviation | Deviation | Deviation |
| (dBm)         | (KHz)     | (KHz)     | (KHz)     | (KHz)     |
| -20           | 0.16      | 0.77      | 1.67      | 1.50      |
| -19           | 0.17      | 0.86      | 1.88      | 1.67      |
| -18           | 0.19      | 0.96      | 2.10      | 1.88      |
| -17           | 0.21      | 1.07      | 2.35      | 2.10      |
| -16           | 0.24      | 1.20      | 2.63      | 2.35      |
| -15           | 0.26      | 1.34      | 2.94      | 2.65      |
| -14           | 0.29      | 1.50      | 3.30      | 2.96      |
| -13           | 0.32      | 1.67      | 3.69      | 3.18      |
| -12           | 0.36      | 1.87      | 4.04      | 3.27      |
| -11           | 0.40      | 2.10      | 4.22      | 3.33      |
| -10           | 0.45      | 2.35      | 4.30      | 3.36      |
| -9            | 0.50      | 2.64      | 4.34      | 3.38      |
| -8            | 0.56      | 2.96      | 4.37      | 3.39      |
| -7            | 0.62      | 3.31      | 4.39      | 3.40      |
| -6            | 0.69      | 3.69      | 4.41      | 3.41      |
| -5            | 0.77      | 3.94      | 4.42      | 3.42      |
| -4            | 0.86      | 3.96      | 4.43      | 3.43      |
| -3            | 0.97      | 3.95      | 4.44      | 3.43      |
| -2            | 1.08      | 3.93      | 4.44      | 3.44      |
| -1            | 1.21      | 3.96      | 4.45      | 3.44      |
| 0             | 1.37      | 4.00      | 4.46      | 3.44      |
| 1             | 1.53      | 4.03      | 4.46      | 3.47      |
| 2             | 1.70      | 4.04      | 4.47      | 3.52      |
| 3             | 1.91      | 4.06      | 4.52      | 3.57      |
| 4             | 2.13      | 4.07      | 4.60      | 3.62      |
| 5             | 2.39      | 4.07      | 4.65      | 3.64      |
| 6             | 2.67      | 4.07      | 4.66      | 3.63      |
| 7             | 2.98      | 4.07      | 4.66      | 3.68      |
| 8             | 3.54      | 4.06      | 4.63      | 3.70      |
| 9             | 3.87      | 4.02      | 4.63      | 3.70      |
| 10            | 3.98      | 3.97      | 4.62      | 3.70      |
| 11            | 4.10      | 3.97      | 4.61      | 3.70      |
| 12            | 4.22      | 4.06      | 4.62      | 3.72      |
| 13            | 4.26      | 4.07      | 4.61      | 3.72      |
| 14            | 4.33      | 4.05      | 4.60      | 3.70      |
| 15            | 4.66      | 4.05      | 4.60      | 3.70      |

Modulation Limiting vs Input Signal  
(25kHz Channel Spacing) at 159MHz



The modulation is within the maximum modulation limit.

## 7. Occupied Bandwidth (with audio low-pass filter installed)

**Test Results:** Complies  
**Standard:** 47 CFR §2.1049 g), h)  
47 CFR §90.210 d)  
47 CFR §90.210 d) 4)

**Test Procedure:** TIA-603-C Sect 2.2.11  
TIA-102.CAAA-B 2.2.5

### Notes:

The center frequency is tested under each of the modulation inputs 11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, and 9K2F1D. The center frequency will also be tested for the 99% Occupied BW under all modulation inputs listed above.

The band edges will be tested for their associated masks under modulation inputs 11K0F3E and, 8K10F1D or 8K10F1E only.

All of the Occupied Bandwidth tests are performed at the maximum output power, 8W (39dBm).

When transmitting in Digital mode, the signal characteristics of RF output are identical for both 8K10F1D and 8K10F1E modulation formats. Therefore, for purposes of brevity, test results for 8K10F1D modulation are included as representative of both modulation formats in this report.

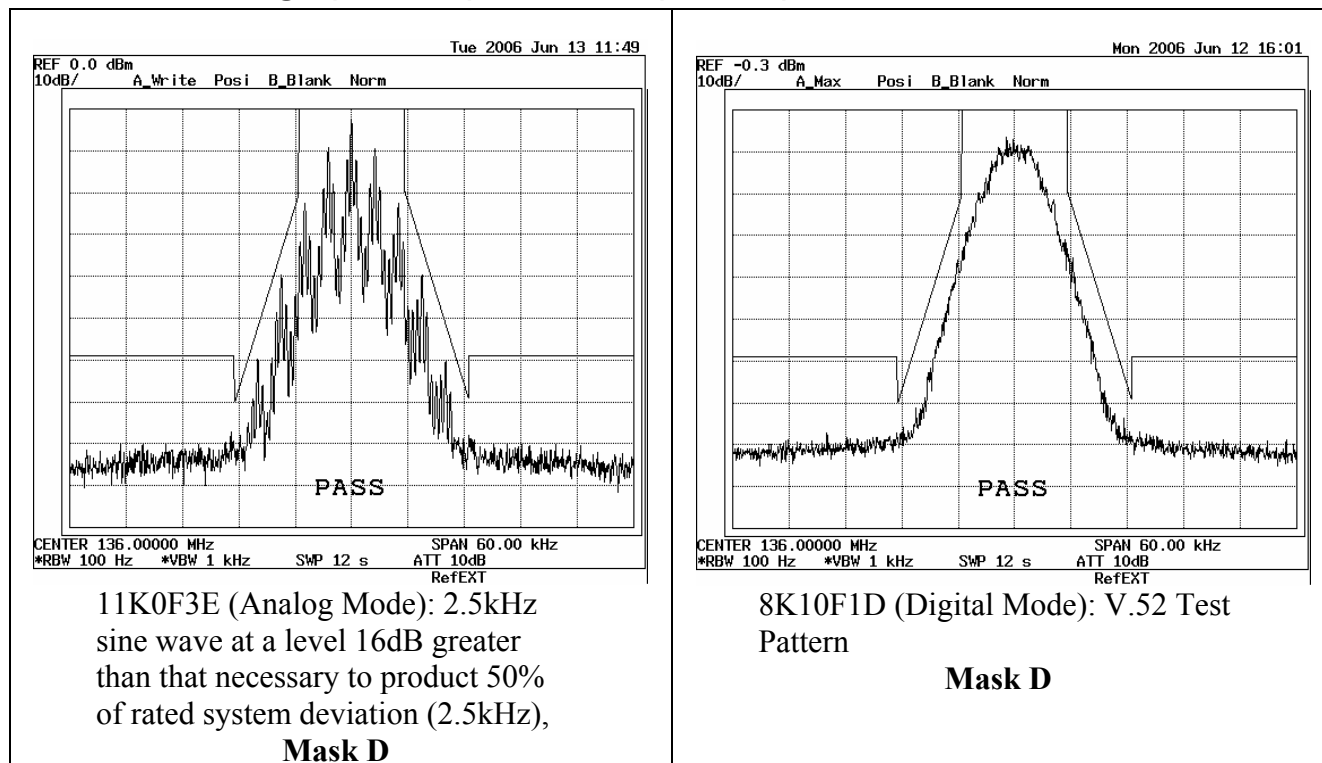
**EUT Model #:** VT-4E150  
**Serial Number:** R&D 10010

**Test Equipment:**

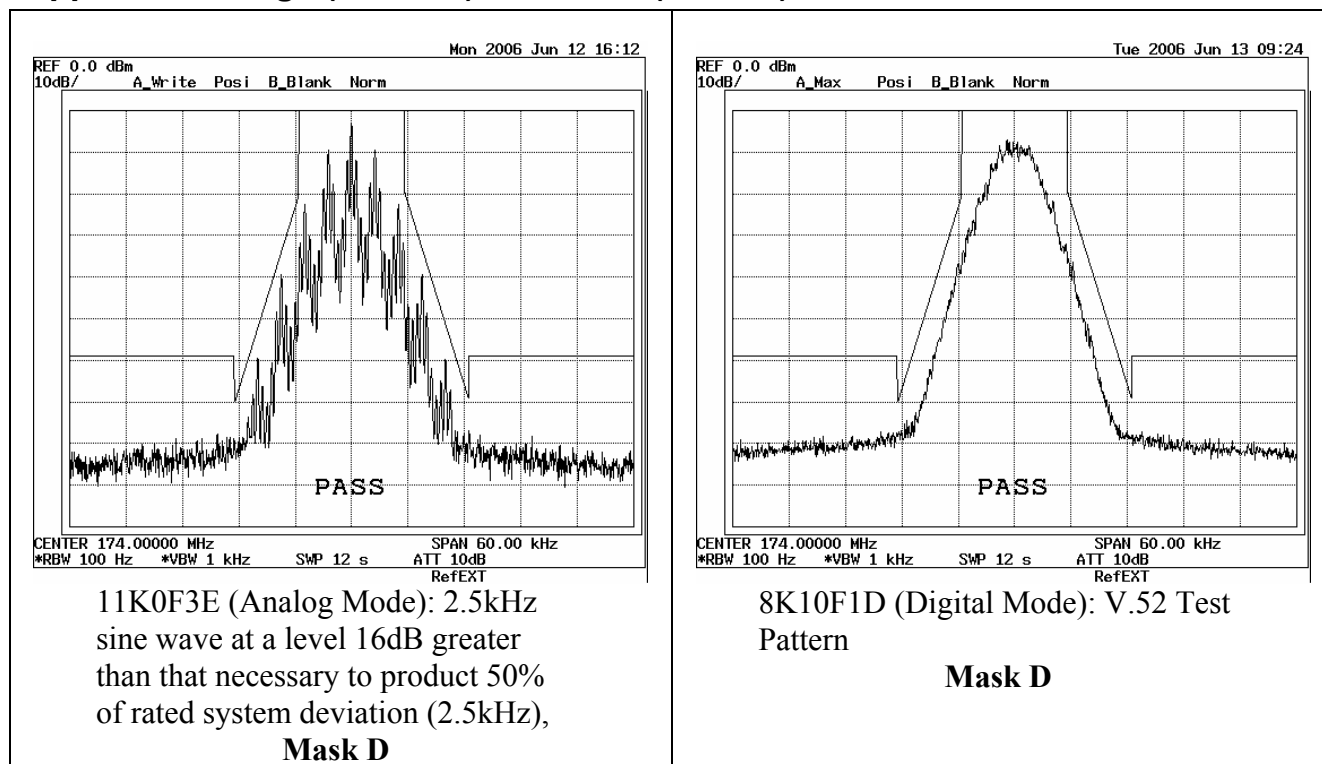
|                     |   |                            |
|---------------------|---|----------------------------|
| Audio Generator     | } | IFR 2975 (DE #1334)        |
| Power Meter         |   |                            |
| Power Sensor        |   |                            |
| Directional Coupler |   | HP 778D                    |
| Spectrum Analyzer   |   | Advantest R3132 (DE #1717) |
| 50ohm Loads         | } | General Lab Equipment      |
| Attenuators         |   |                            |

**Measurement Data:** See the following graphs:

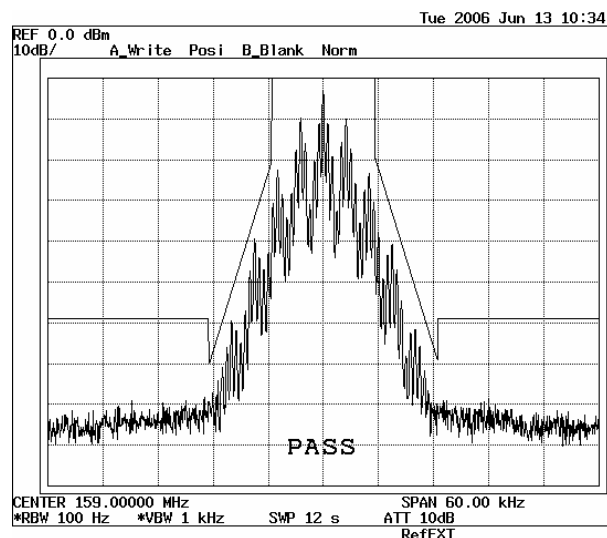
## Lower Band Edge (136MHz) OBW, 8W (39dBm)



## Upper Band Edge (174MHz) OBW, 8W (39dBm)

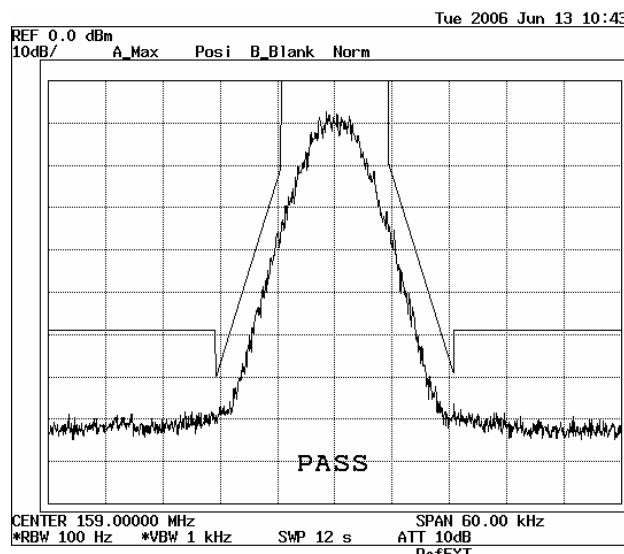


## Center Frequency (159MHz) OBW, 8W (39dBm)



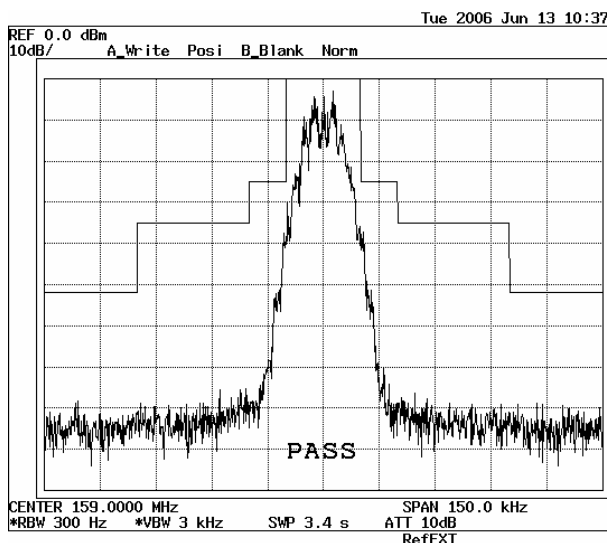
11K0F3E (Analog Mode): 2.5kHz  
sine wave at a level 16dB greater  
than that necessary to product 50%  
of rated system deviation (2.5kHz),

**Mask D**



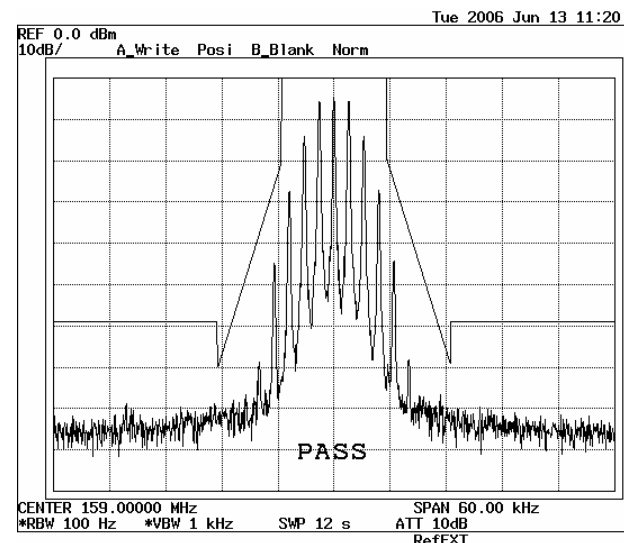
8K10F1D (Digital Mode): V.52 Test  
Pattern

**Mask D**



16K0F3E (Analog Mode): 2.5kHz  
sine wave at a level 16dB greater  
than that necessary to product 50%  
of rated system deviation (5.0kHz),

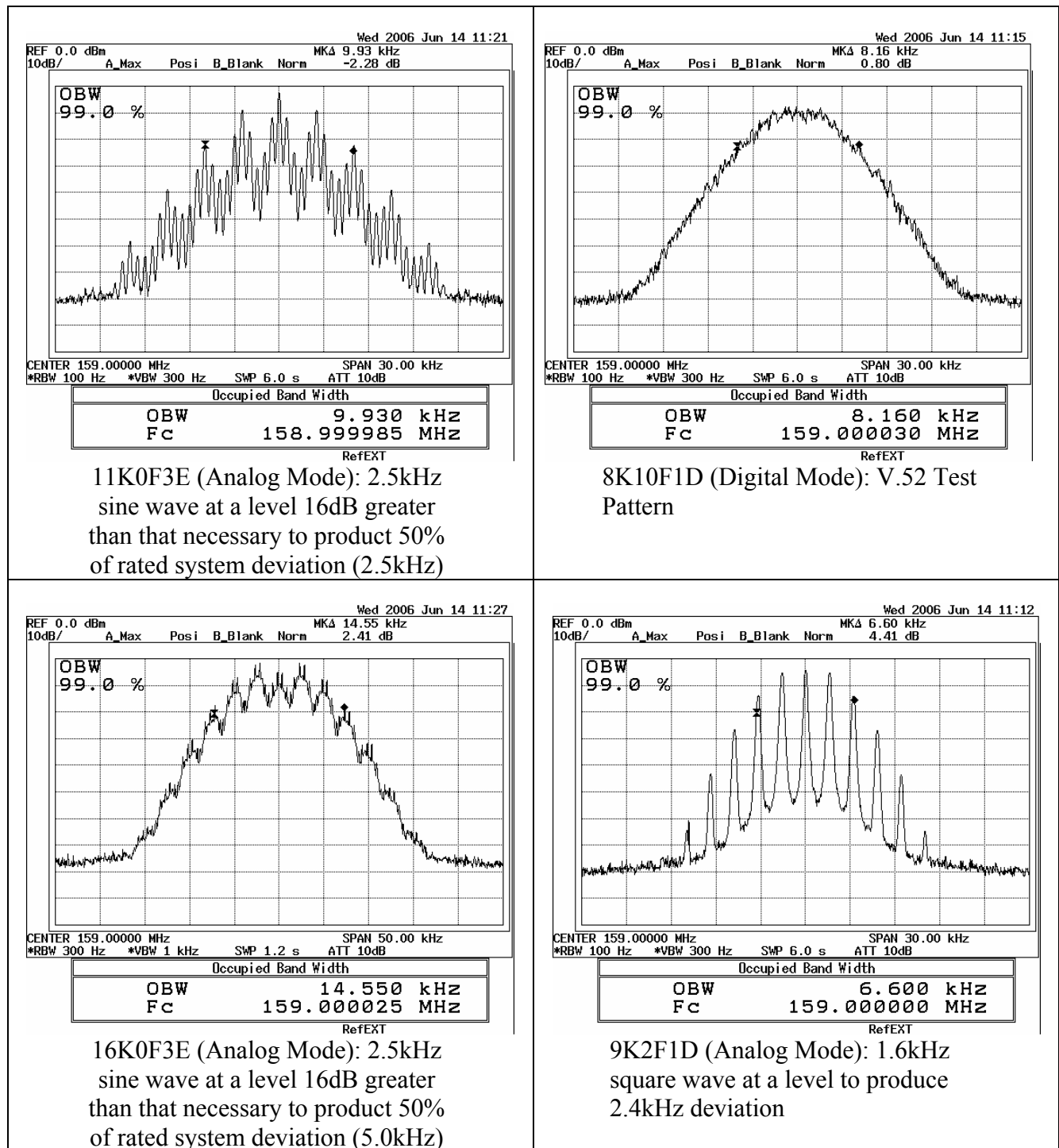
**Mask B**



9K2F1D (Analog Mode): 1.6kHz  
square wave at a level to produce  
2.4kHz deviation

**Mask D**

## Center Frequency (159MHz) 99% OBW, 8W (39dBm)





## 8. Spurious Emissions at Antenna Terminals

**Test Results:** Complies  
**Standard:** 47 CFR §2.1051  
47 CFR §90.210 d)

**Test Procedure:** TIA-603-C Sect 2.2.13

### Notes:

At the maximum rated output power, 8W (39dBm), a full sweep from 20MHz to 2GHz (or the 10<sup>th</sup> harmonic of the center frequency) is performed at the center frequency using each of the modulation inputs: 11K0F3E, 16K0F3E, 8K10F1D, 8K10F1E, and 9K2F1D.

At the lowest output power level 0.5W, a full sweep from 20MHz to 2GHz (or the 10<sup>th</sup> harmonic of the center frequency) is also performed at the center frequency using 11K0F3E and, 8K10F1D or 8K10F1E.

When transmitting in Digital mode, the signal characteristics of RF output are identical for both 8K10F1D and 8K10F1E modulation formats. Therefore, for purposes of brevity, test results for 8K10F1D modulation are included as representative of both modulation formats in this report.

The limit line that is shown on all the graphs is  $50 + 10 \log P$  or -20dBm. For the 25kHz channel spacing (16K0F3E) the limit line is the more relaxed limit of  $43 + 10 \log P$ . In this case the more stringent -20dBm limit line is still used for testing simplicity.

**EUT Model #:** VT-4E150  
**Serial Number:** R&D 10010

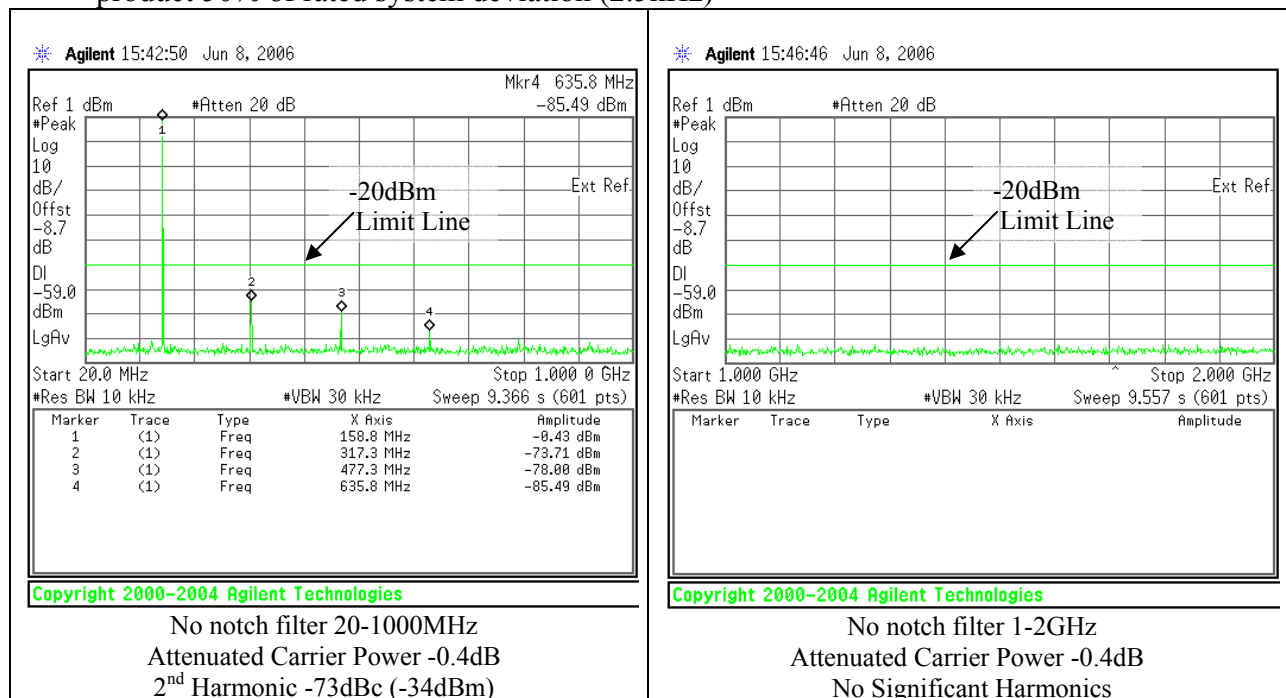
**Test Equipment:**

|                     |   |                           |
|---------------------|---|---------------------------|
| Audio Generator     | } | IFR 2975 (DE #1334)       |
| Power Meter         |   |                           |
| Power Sensor        |   |                           |
| Directional Coupler |   | HP 778D                   |
| Spectrum Analyzer   |   | Agilent E4440A (DE# 1414) |
| 50ohm Loads         | } | General Lab Equipment     |
| Attenuators         |   |                           |

**Measurement Data:** See following graphs:

## Center Frequency (159MHz) 11K0F3E Modulation Input, 8W (39dBm)

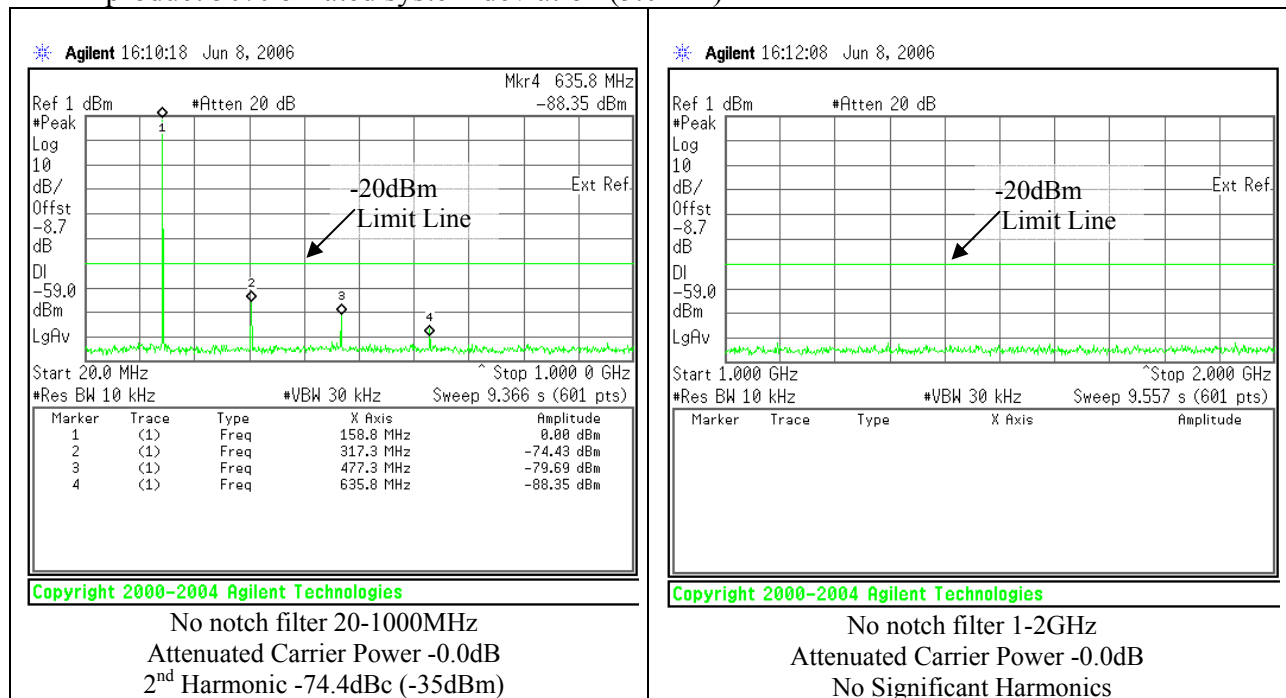
11K0F3E (Analog Mode): 2.5kHz sine wave at a level 16dB greater than that necessary to product 50% of rated system deviation (2.5kHz)



The worst case is the 2<sup>nd</sup> harmonic at -73dBc (-34dBm), which is 14dB below the limit.

## Center Frequency (159MHz) 16K0F3E Modulation Input, 8W (39dBm)

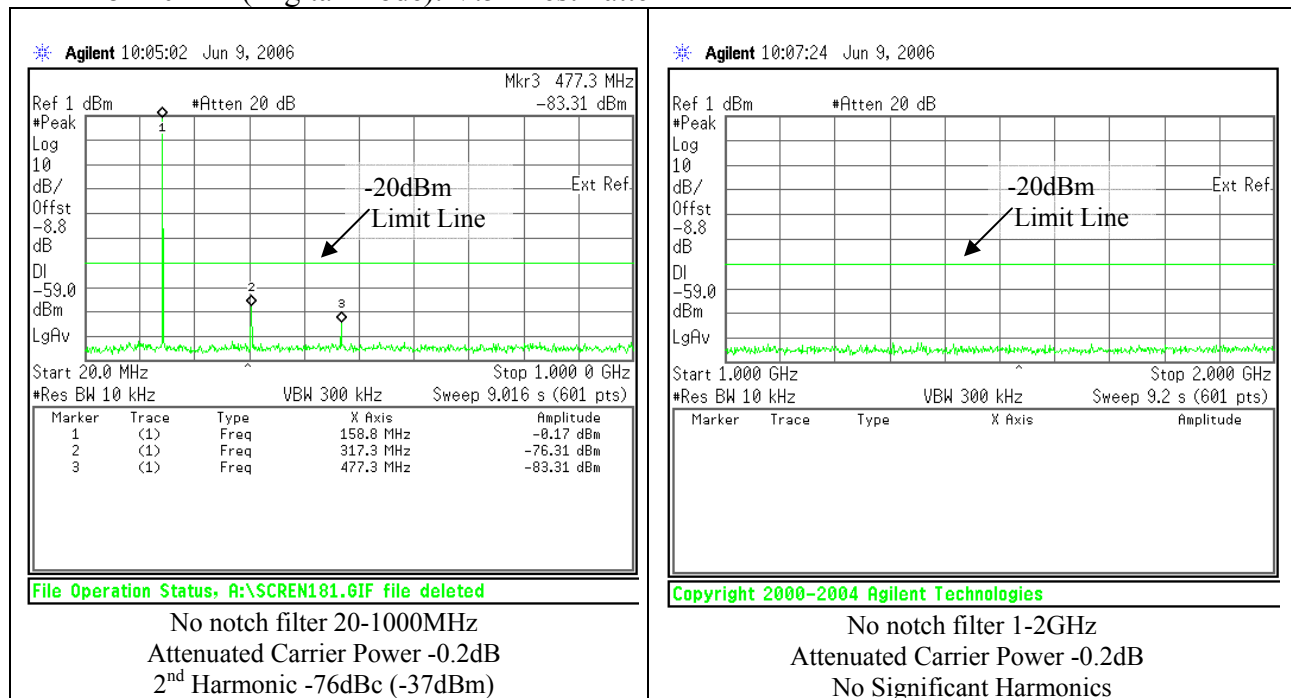
16K0F3E (Analog Mode): 2.5kHz sine wave at a level 16dB greater than that necessary to product 50% of rated system deviation (5.0kHz)



The worst case is the 2<sup>nd</sup> harmonic at -74dBc, which is 15dB below the limit.

## Center Frequency (159MHz) 8K10F1D Modulation Input, 8W (39dBm)

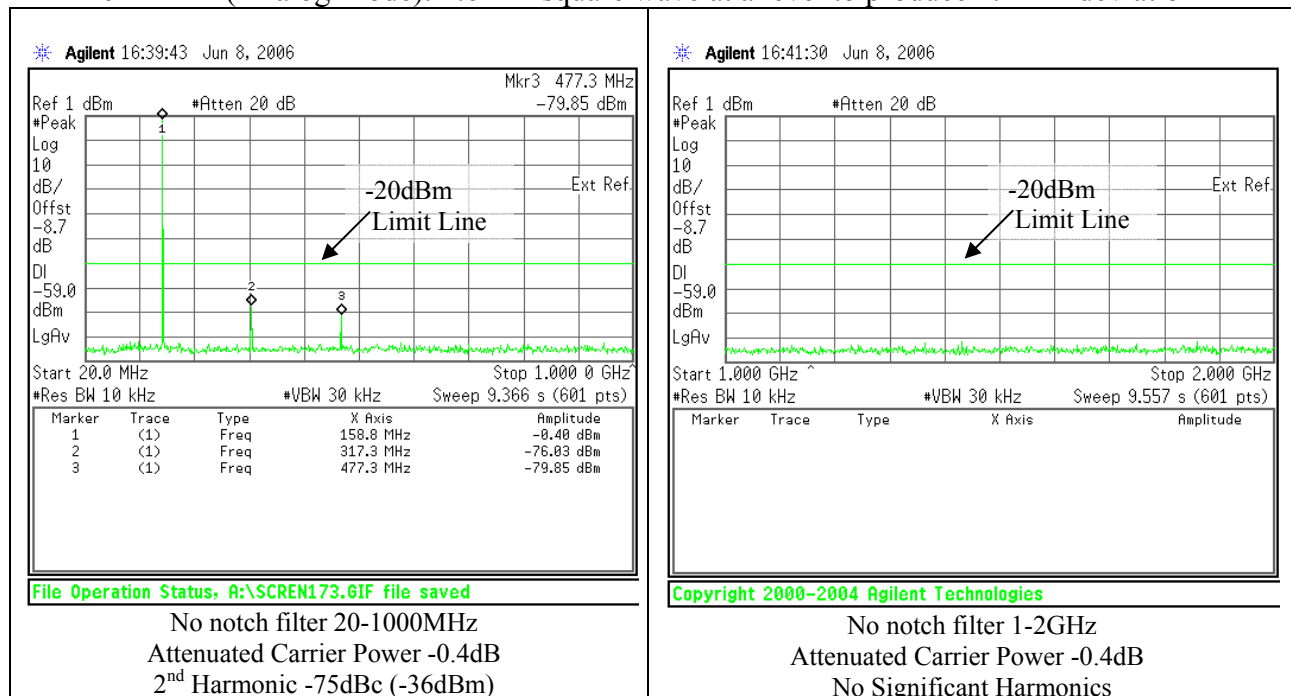
8K10F1D (Digital Mode): V.52 Test Pattern



The worst case is the 2<sup>nd</sup> harmonic at -76dBc, which is 17dB below the limit.

## Center Frequency (159MHz) 9K2F1D Modulation Input, 8W (39dBm)

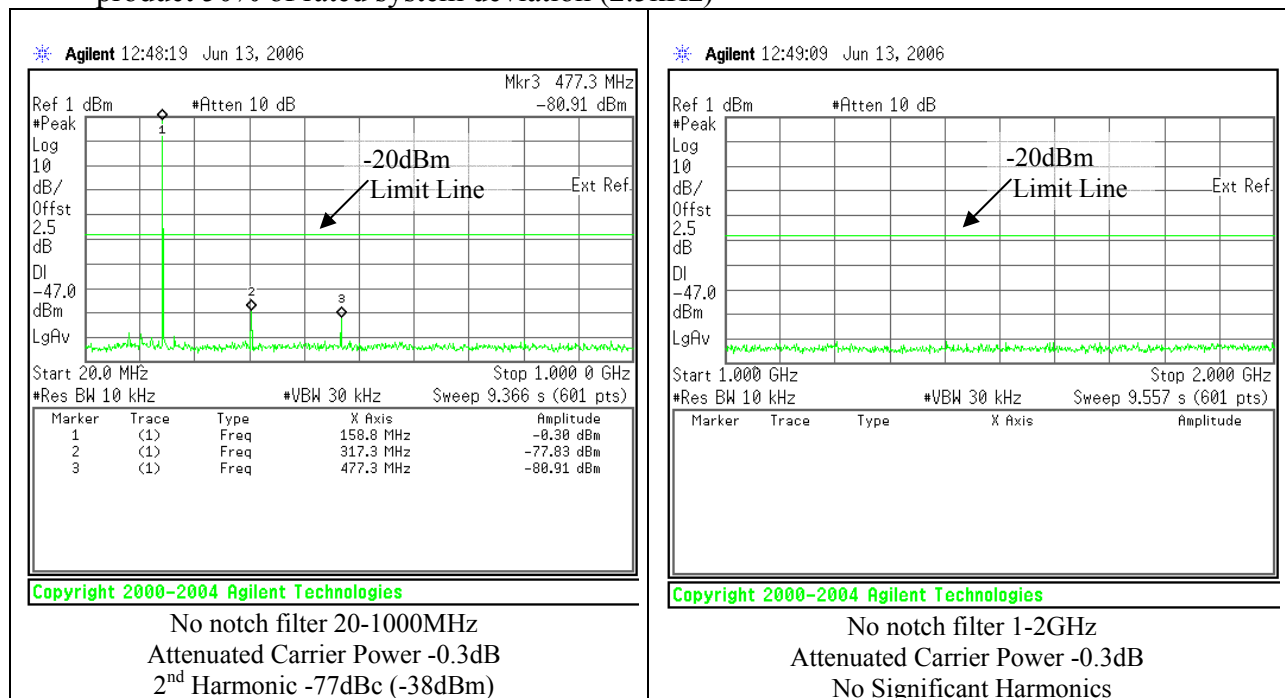
9K2F1D (Analog Mode): 1.6kHz square wave at a level to produce 2.4kHz deviation



The worst case is the 2<sup>nd</sup> harmonic at -75dBc, which is 16dB below the limit.

## Center Frequency (159MHz) 11K0F3E Modulation Input, 0.5W (27dBm)

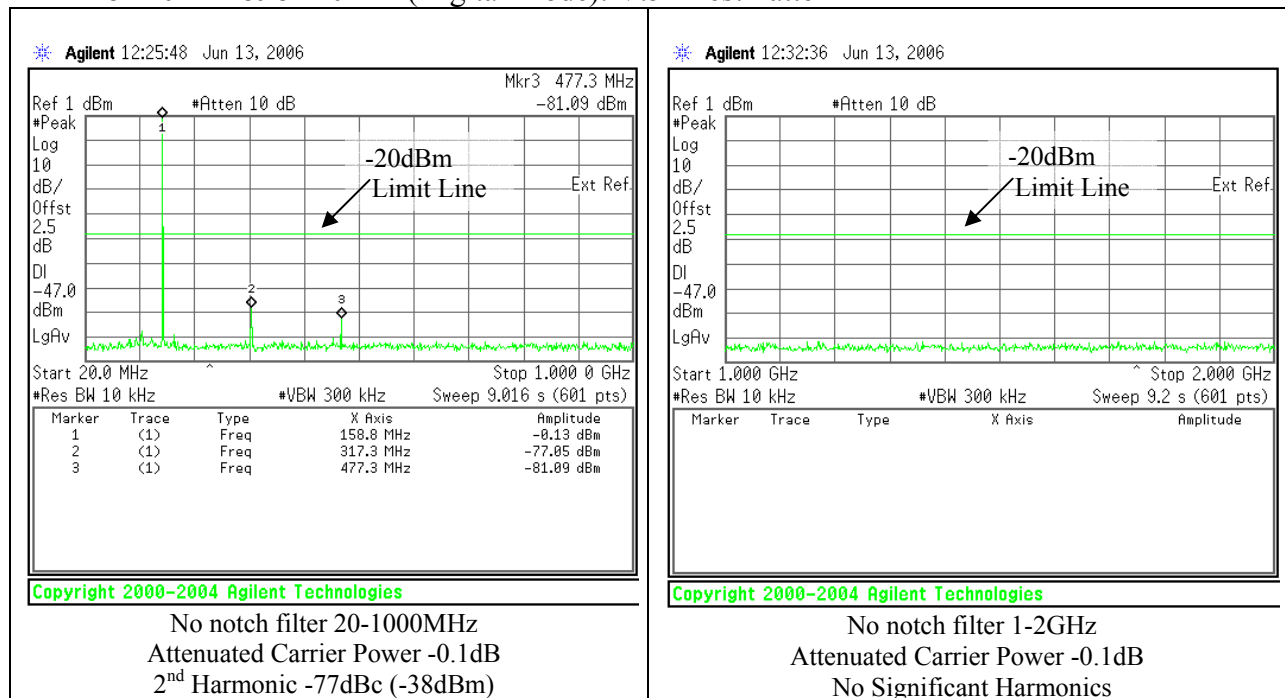
11K0F3E (Analog Mode): 2.5kHz sine wave at a level 16dB greater than that necessary to product 50% of rated system deviation (2.5kHz)



The worst case is the 2<sup>nd</sup> harmonic at -77dBc, which is 18dB below the limit.

## Center Frequency (159MHz) 8K10F1D Modulation Input, 0.5W (27dBm)

8K10F1D & 8K10F1E (Digital Mode): V.52 Test Pattern



The worst case is the 2<sup>nd</sup> harmonic at -77dBc, which is 18dB below the limit.

## 9. Field Strength of Spurious Emissions

### Test Results:

Complies

Note: Radiated Emissions at the center frequency were tested at an accredited measurement facility operated by Acme Testing Co. in Acme, Washington 98220-0003.

### Standard:

47 CFR §2.1053

47 CFR §90.201 d)

### Test Procedure:

TIA-603-C Sect 2.2.12

### EUT Model #:

VT-4E150

### Serial Number:

R&D 10001

### Test Results:

See attached **Appendix A: VT-4E150 UHF Transmitter – Measurements of Field Strength of Spurious Radiation** for full test results.

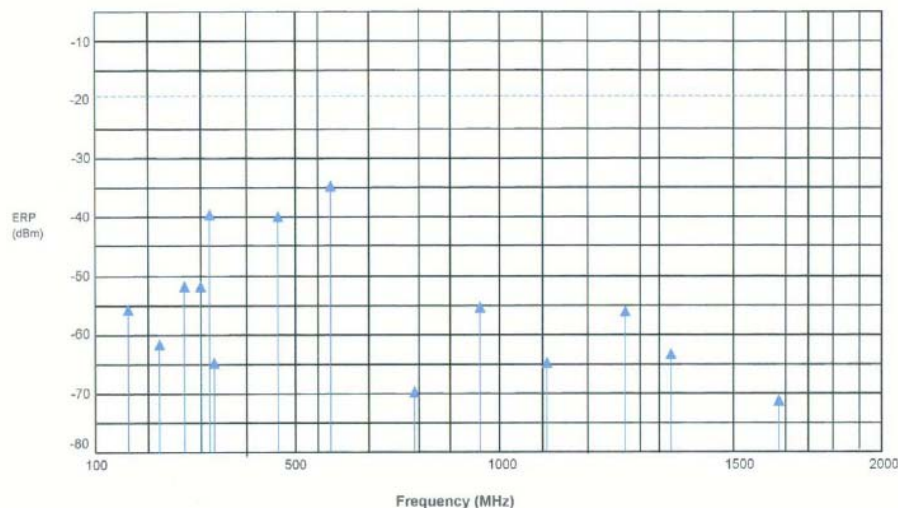
### Test Results Excerpt:

Daniels VT-4E150 @ 159 MHz  
Temp: 14 degrees C  
Humidity: 68 %  
Pressure: 984 mBar  
10/27/05, and 10/28/05

Limit -20 dBm

| Frequency | Polarization | Height | Azimuth | Signal Generator | Cable Loss | Antenna Gain | EIRP  | Margin |
|-----------|--------------|--------|---------|------------------|------------|--------------|-------|--------|
| 158.998   | H            | 1.50   | 273     | -40.6            | 16.5       | 2.1          | -55.0 | -35.0  |
| 227.998   | V            | 1.70   | 360     | -46.3            | 17.2       | 1.2          | -62.3 | -42.3  |
| 276.000   | H            | 3.40   | 70      | -34.8            | 17.9       | 1.4          | -51.3 | -31.3  |
| 300.000   | V            | 1.30   | 254     | -34.4            | 18.2       | 1.3          | -51.3 | -31.3  |
| 318.000   | V            | 1.30   | 254     | -21.4            | 18.4       | 1.4          | -38.4 | -18.4  |
| 347.999   | H            | 1.47   | 62      | -47.0            | 18.7       | 1.5          | -64.2 | -44.2  |
| 477.000   | H            | 1.75   | 270     | -18.8            | 20         | 1.2          | -37.6 | -17.6  |
| 635.998   | V            | 2.04   | 150     | -14.0            | 21.6       | 1.2          | -34.4 | -14.4  |
| 795.000   | V            | 1.20   | 307     | -45.0            | 22.9       | 0.6          | -67.3 | -47.3  |
| 954.000   | H            | 1.32   | 348     | -31.0            | 24.3       | 0.5          | -54.8 | -34.8  |
| 1113.000  | H            | 1.00   | 0       | -42.0            | 29.1       | 6.4          | -64.7 | -44.7  |
| 1272.997  | H            | 1.50   | 325     | -32.0            | 30.2       | 7.1          | -55.1 | -35.1  |
| 1431.001  | H            | 2.00   | 360     | -46.0            | 25.5       | 8.11         | -63.4 | -43.4  |
| 1589.996  | V            | 2.00   | 360     | -46.0            | 32.6       | 8.12         | -70.5 | -50.5  |

Radiated Spurious Emissions (ERP)  
Model VT-4E150  
TX Frequency = 159 MHz



## 10. Frequency Stability

**Test Results:** Complies  
**Standard:** 47 CFR §2.1055  
47 CFR §90.213  
47 CFR §90.539

**Test Procedure:** TIA-603-C Sect 2.2.2

### Notes:

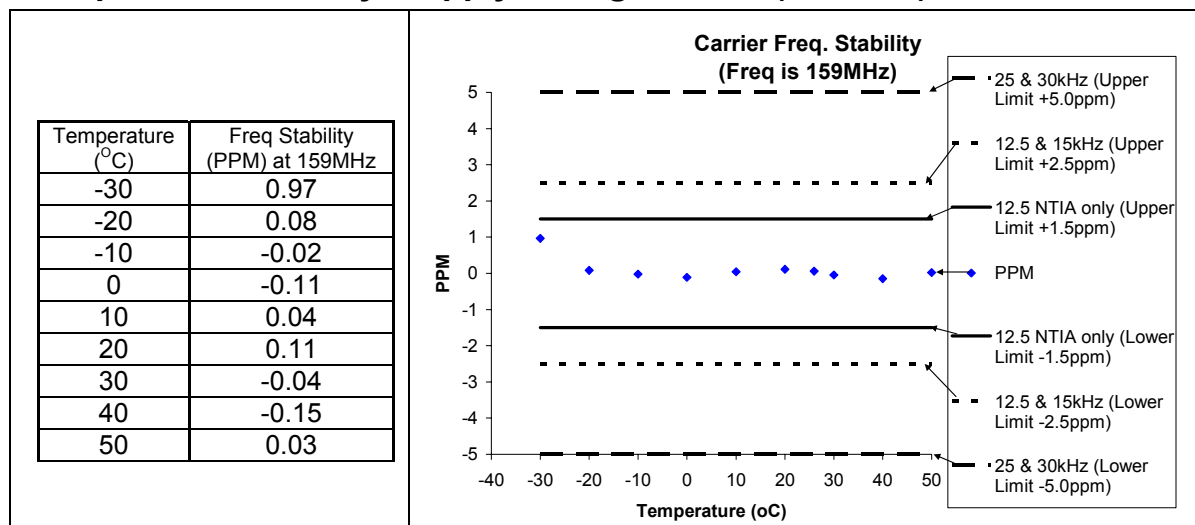
The center frequency is tested at each of the temperatures specified in the above test procedure. Once the chamber is within 1°C of the desired temperature, the environment chamber and the contents inside are given 20 minutes to acclimatize before the frequency is measured.

**EUT Model #:** VT-4E150  
**Serial Number:** R&D 10011

**Test Equipment:** Radio Test Set Marconi 2955B (DE# 0962)  
Temperature Chamber Thermotron 2800 (DE# 1341)  
Variable Power Supply { Daniels RTTJ-2 (DE# 2857)  
ICT2024-15A (DE# 2982)

**Measurement Data:** See the following table and graph:

### Temperature Stability, Supply Voltage is STV (13.8 V<sub>DC</sub>)



### Voltage Stability, Temperature at 20°C

| Supply Voltage (V <sub>DC</sub> ) | Freq Stability (PPM) at 159MHz |
|-----------------------------------|--------------------------------|
| 85%, 11.7V <sub>DC</sub>          | 0.10                           |
| 100%, 13.8V <sub>DC</sub>         | 0.10                           |
| 115%, 15.9V <sub>DC</sub>         | 0.10                           |

The limits for the Voltage Stability are the same as for Temperature Stability; the tightest limit, 12.5kHz NTIA only (±1.5ppm), is met.

## 11. Transient Frequency Response

**Test Results:** Complies  
**Standard:** 47 CFR §90.214

**Test Procedure:** TIA-603-C Sect 2.2.19

Notes:

The transient response is measured at the center frequency, 159MHz at the maximum output power, 8W (39dBm).

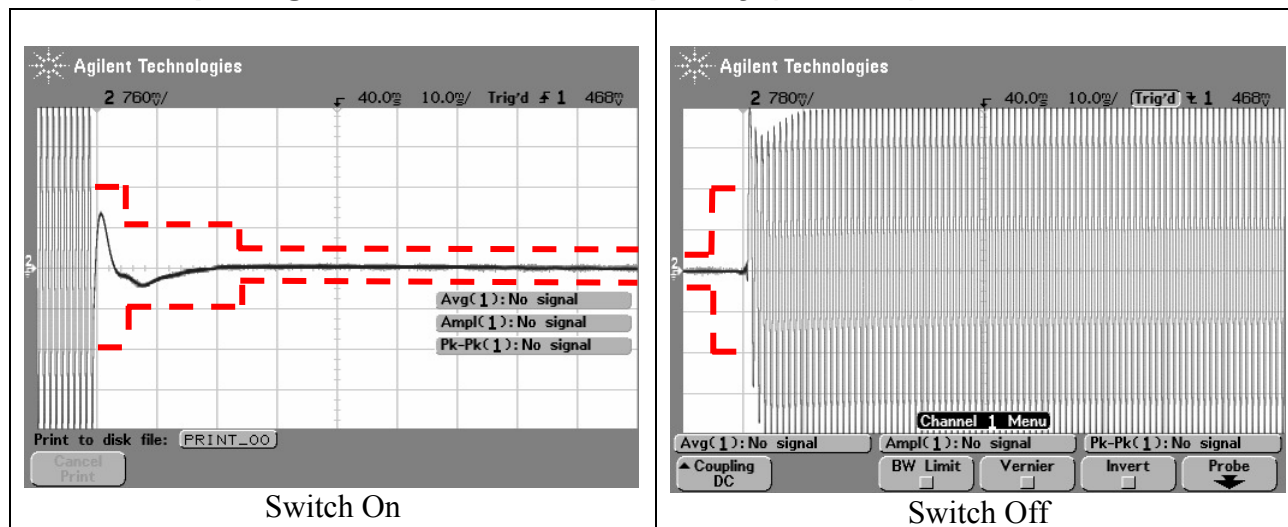
**EUT Model #:** VT-4E150  
**Serial Number:** R&D 10011

**Test Equipment:**

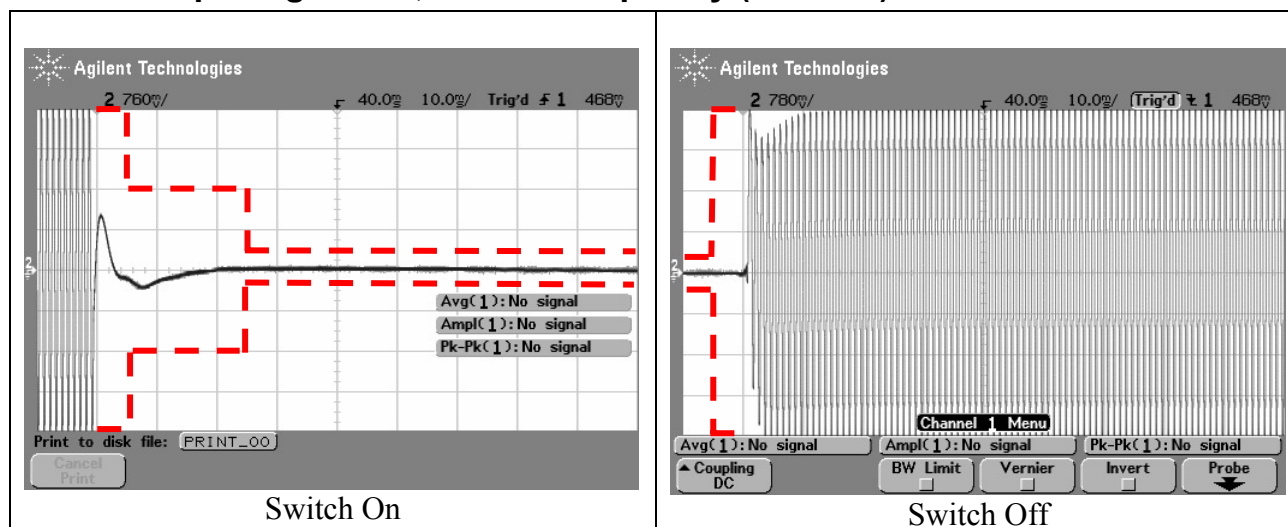
|                      |                                |
|----------------------|--------------------------------|
| RF Signal Generator  | IFR 2026B (DE# 1394)           |
| Storage Oscilloscope | Agilent 54622D (DE# 1190)      |
| Power Detector       | DE RF Power Detector           |
| Test Receiver        | DE Test Receiver 21.4MHz IF DC |
| Combiner             | Mini Circuits 15542            |
| 50 ohm load          | } General Lab Equipment        |
| Attenuators          |                                |

**Measurement Data:** See the following graphs:

## Channel Spacing 12.5kHz, Center Frequency (159MHz)



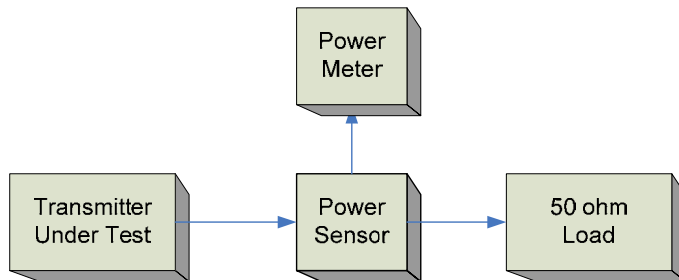
## Channel Spacing 25kHz, Center Frequency (159MHz)



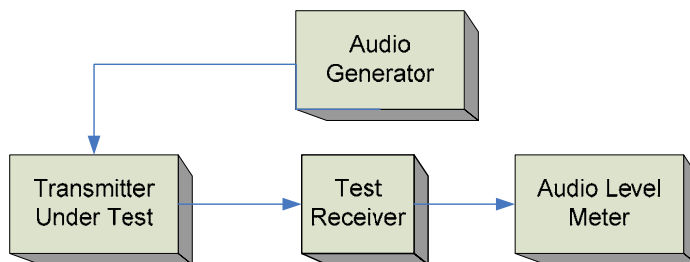


## 12. Block Diagrams

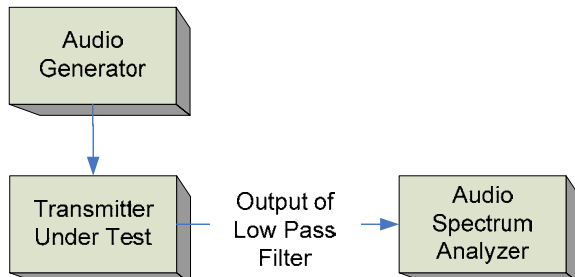
### RF Power Output



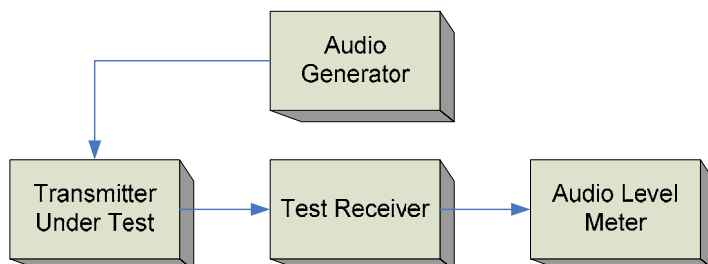
### Audio Frequency Response



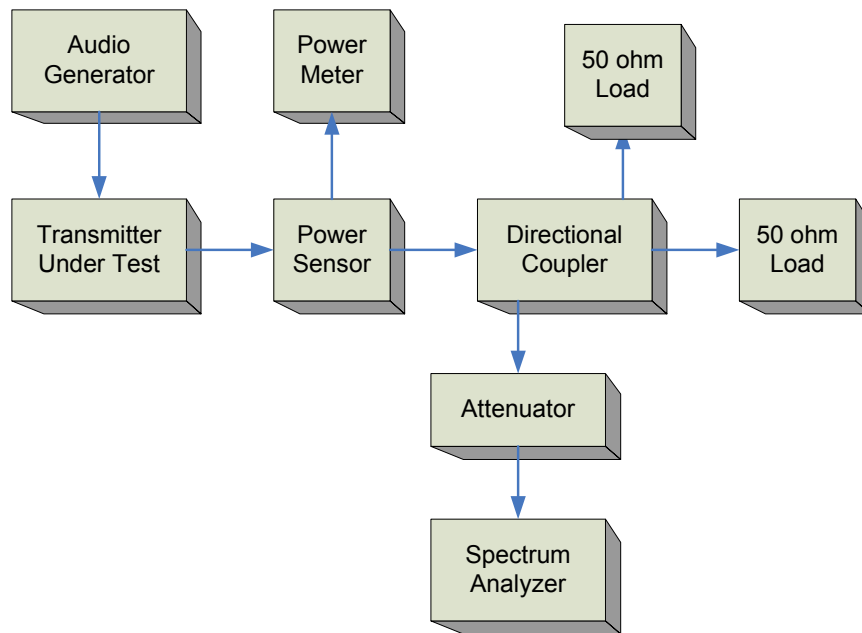
### Audio Low Pass Filter Response



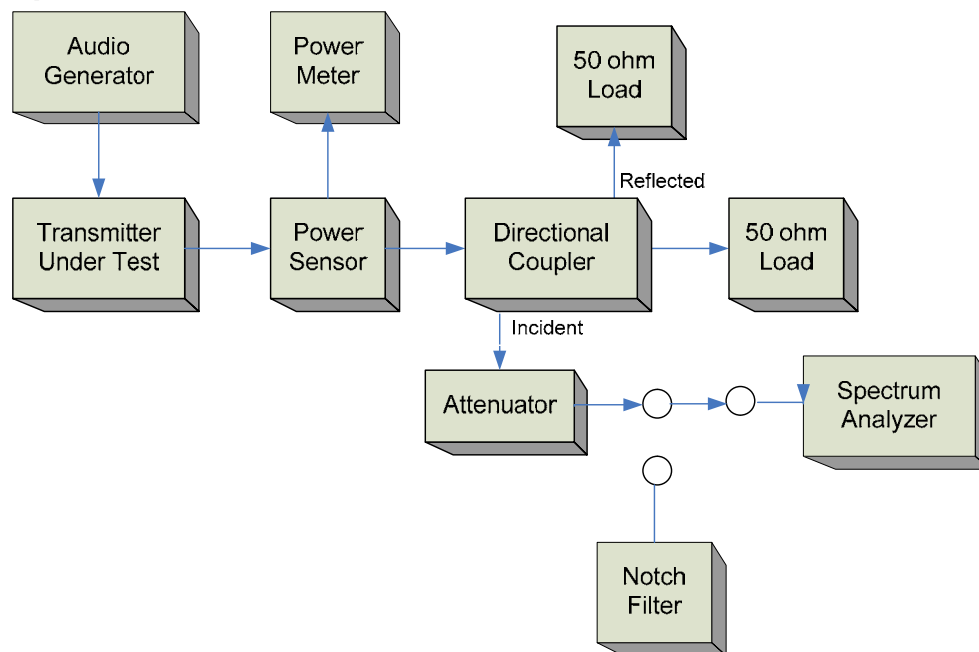
### Modulation Limiting



### Occupied Bandwidth (with audio low-pass filter installed)



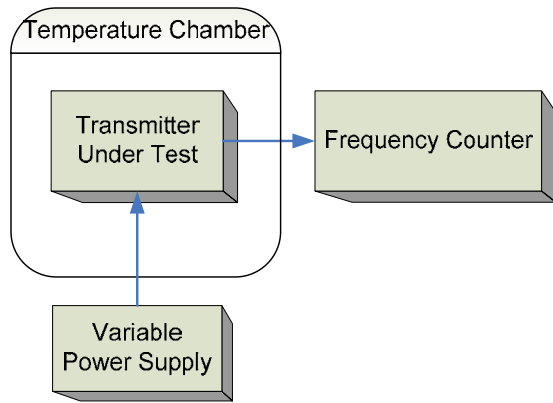
### Spurious Emissions at Antenna Terminals



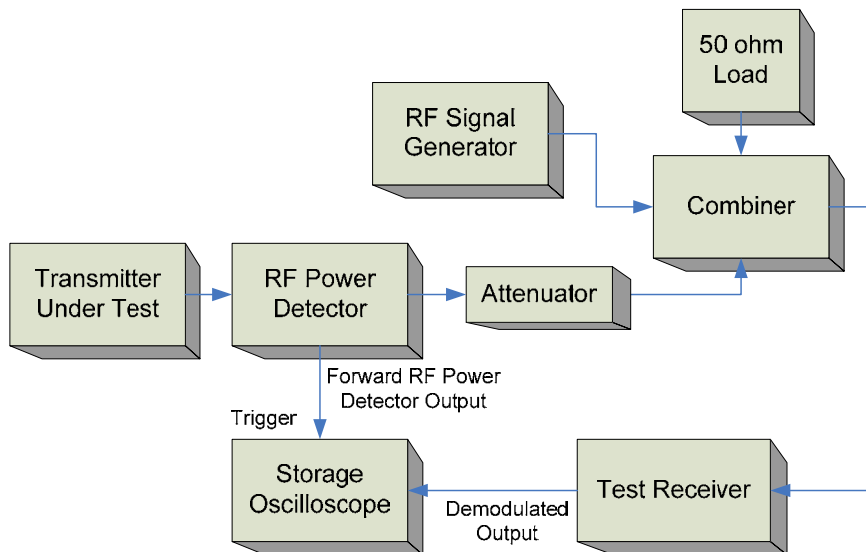
### Field Strength of Spurious Emissions

See Appendix A: VT-4E150 VHF Transmitter – Field Strength of Spurious Emissions

## Frequency Stability



## Transient Frequency Response



### 13. Test Equipment List

| Calibration Cycle | Equipment            | Manufacturer        | Model             | DE Serial | Last Calibration | Next Calibration |
|-------------------|----------------------|---------------------|-------------------|-----------|------------------|------------------|
| 1 Year            | Radio Test Set       | Rhode & Schwarz     | CMS 54            | 1545      | May 9, 2006      | May 9, 2007      |
| 1 Year            | Radio Test Set       | IFR                 | 2965A             | 1396      | Mar 22, 2006     | Mar 22, 2007     |
| 1 Year            | Radio Test Set       | Marconi             | 2955B             | 0962      | Feb 12, 2006     | Feb 12, 2007     |
| 1 Year            | Radio Test Set       | IFR                 | 2975              | 1334      | Aug 15, 2005     | Aug 15, 2006     |
| N/A               | Test Receiver        | Daniels Electronics | 21.4MHz IF DC     | N/A       | N/A              | N/A              |
| 1 Year            | Multi Meter          | Fluke               | 45                | 1720      | Feb 25, 2006     | Feb 25, 2007     |
| 1 Year            | Spectrum Analyzer    | Advantest           | R3132             | 1717      | May 4, 2006      | May 4, 2007      |
| 2 Years           | Spectrum Analyzer    | Agilent             | E4440A            | 1414      | April 14, 2005   | April 14, 2007   |
| 1 Year            | Temperature Chamber  | Thermotron          | 2800              | 1341      | Mar 19, 2006     | Mar 19, 2007     |
| 1 Year            | Voltage Regulator    | Daniels Electronics | RTTJ-2            | 2857      | Mar 8, 2006      | Mar 8, 2007      |
| 1 Year            | Power Supply         | Innovative Circuits | ICT2024-15A       | 2982      | May 29, 2006     | May 29, 2007     |
| 1 Year            | RF Signal Generator  | IFR                 | 2026B             | 1394      | Jul 13, 2005     | Jul 13, 2006     |
| 2 Years           | Storage Oscilloscope | Agilent             | 54622D            | 1190      | Jun 17, 2005     | Jun 17, 2006     |
| N/A               | Directional Coupler  | HP                  | 778D              | N/A       | N/A              | N/A              |
| N/A               | Combiner             | Mini Circuits       | 15542             | N/A       | N/A              | N/A              |
| N/A               | Power Detector       | Daniels Electronics | RF Power Detector | N/A       | N/A              | N/A              |