



**Nemko Test Report:** 9372RUS3

**Applicant:** Andrew Corporation  
108 Rand Park Drive  
Garner, NC 27529  
USA

**Equipment Under Test:** TFAH-US5B  
(E.U.T.)

**In Accordance With:** **CFR 47 Part 90, Subpart I**  
Private Land Mobile Repeater

**Tested By:** Nemko USA Inc.  
802 N. Kealy  
Lewisville, TX 75057-3136

**TESTED BY:**   
David Light, Senior Wireless Engineer

**DATE:** 09 January, 2008

**APPROVED BY:**   
Jon Fink

**DATE:** 11 January, 2008

## **Table of Contents**

|                                     |                                                |           |
|-------------------------------------|------------------------------------------------|-----------|
| <b>SECTION 1.</b>                   | <b>SUMMARY OF TEST RESULTS</b>                 | <b>3</b>  |
| <b>SECTION 2.</b>                   | <b>GENERAL EQUIPMENT SPECIFICATION</b>         | <b>5</b>  |
| <b>SECTION 3.</b>                   | <b>RF POWER OUTPUT</b>                         | <b>7</b>  |
| <b>SECTION 4.</b>                   | <b>OCCUPIED BANDWIDTH</b>                      | <b>8</b>  |
| <b>SECTION 5.</b>                   | <b>SPURIOUS EMISSIONS AT ANTENNA TERMINALS</b> | <b>17</b> |
| <b>SECTION 6.</b>                   | <b>FIELD STRENGTH OF SPURIOUS EMISSIONS</b>    | <b>30</b> |
| <b>SECTION 7.</b>                   | <b>TEST EQUIPMENT LIST</b>                     | <b>31</b> |
| <b>ANNEX A - TEST METHODOLOGIES</b> |                                                | <b>32</b> |
| <b>ANNEX B - TEST DIAGRAMS</b>      |                                                | <b>38</b> |

## Section 1. Summary of Test Results

Manufacturer Andrew Corporation

Model No.: TFAH-US5B

Serial No.: 074405615

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 CFR Part 90, Subpart I.



New Submission



Production Unit



Class II Permissive Change



Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.

See "Summary of Test Data".



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**Summary Of Test Data**

| NAME OF TEST                            | PARA. NO. | SPEC.        | RESULT   |
|-----------------------------------------|-----------|--------------|----------|
| RF Power Output                         | 90.205    |              | Complies |
| Occupied Bandwidth                      | 90.210    | Input/Output | Complies |
| Spurious Emissions at Antenna Terminals | 90.210    | Plots        | Complies |
| Field Strength of Spurious Emissions    | 90.210    |              | Complies |
| Frequency Stability                     | 90.213    |              | NA       |

**Footnotes For N/A's:**

- (1) Since the E.U.T. does not contain modulation circuitry modulation testing was not performed.
- (2) Frequency stability was not tested since the rf input signal frequency is not translated by the EUT.
- (3) Since the E.U.T. is not a keyed carrier system, Transient Frequency Behavior was not performed.

**Section 2. General Equipment Specification****Transmitter****Supply Voltage Input:**

120 Vac

**Frequency Range:**

851 to 869 MHz

935 to 941 MHz

**Type(s) of Modulation:**F3E  
(Voice)  
☒F1D  
☒F2D  
☒GXW  
(iDEN)  
☒Other  
☐**Output Impedance:**

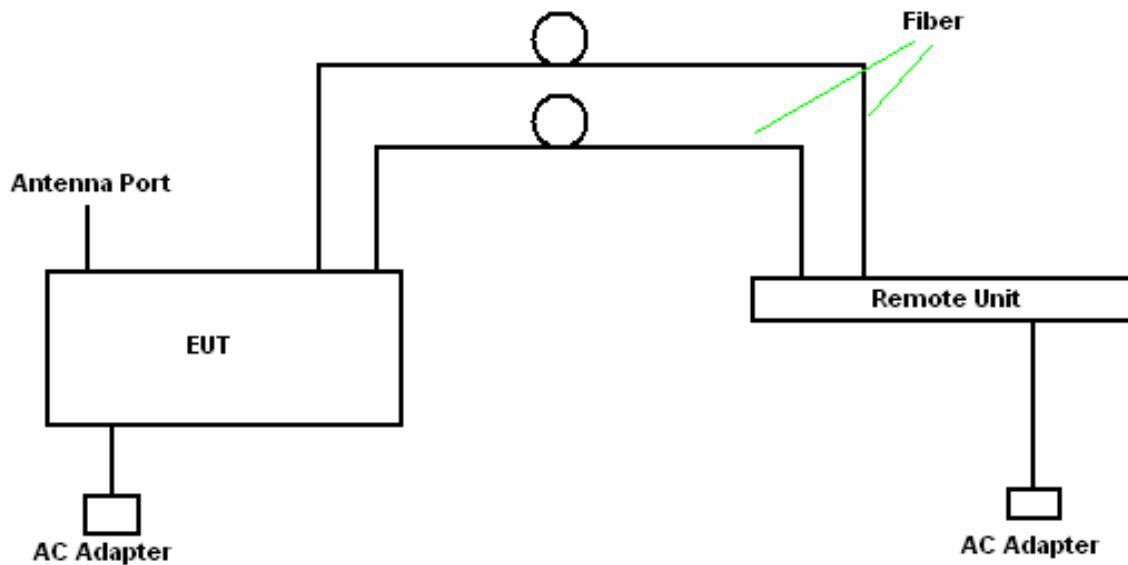
50 ohms

**RF Power Output (rated):** $\frac{1.25}{31}$ W (max)  
dBm (max)**Frequency Translation:**F1-F1  
☐F1-F2  
☐N/A  
☒**Band Selection:**Software  
☐Duplexer  
Change  
☐Fullband  
Coverage  
☒

### **Description of EUT**

The TFAH-US5B is a five band high power remote unit designed to distribute LMR800, Cellular850, LMR900, AWS1700, and Extended PCS1900 band signals along the same fiber.

### **System Diagram**



**Section 3. RF Power Output**

|                               |                       |
|-------------------------------|-----------------------|
| NAME OF TEST: RF Power Output | PARA. NO.: 2.985      |
| TESTED BY: David Light        | DATE: 08 January 2008 |

**Test Results:** Complies.**Measurement Data:**

| Direction And Band | Modulation | Output per Channel (dBm) | Composite Power (dBm) | Composite Power (W) |
|--------------------|------------|--------------------------|-----------------------|---------------------|
| Downlink 800       | Analog     | 28*                      | 31                    | 1.25                |
| Downlink 900       | Analog     | 28*                      | 31                    | 1.25                |
| Downlink 800       | iDEN       | 25*                      | 28                    | 0.63                |
| Downlink 900       | iDEN       | 25*                      | 28                    | 0.63                |

\* Based on two carriers

RBW: 10 MHz

VBW: 10 MHz

**Equipment Used:** 1036-1082-1471-1472**Measurement Uncertainty:** +/- 1.7 dB**Temperature:** 22 °C**Relative Humidity:** 35 %

#### Section 4. Occupied Bandwidth

|                                  |                       |
|----------------------------------|-----------------------|
| NAME OF TEST: Occupied Bandwidth | PARA. NO.: 2.989      |
| TESTED BY: David Light           | DATE: 08 January 2008 |

**Test Results:** Complies.

**Test Data:** See attached plot(s).

**Equipment Used:** 1036-1082-1471-1472

**Measurement Uncertainty:** 1X10<sup>-7</sup> ppm

**Temperature:** 22 °C

**Relative Humidity:** 35 %

EQUIPMENT: TFAH-US5B

# Test Data – Occupied Bandwidth

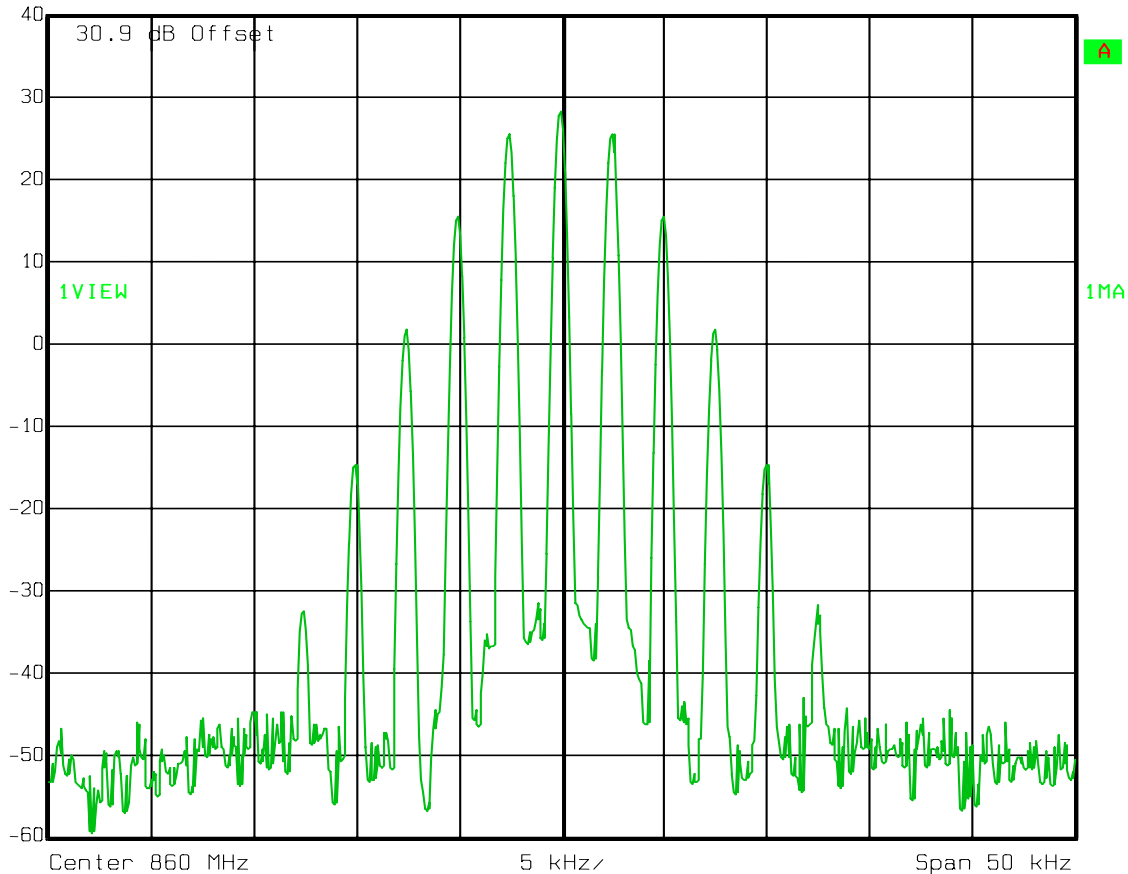
Analog – Output

2.5 kHz tone / 3 kHz peak deviation



Ref Lvl  
40 dBm

|     |        |        |         |
|-----|--------|--------|---------|
| RBW | 300 Hz | RF Att | 20 dB   |
| VBW | 300 Hz | Mixer  | -10 dBm |
| SWT | 2.8 s  | Unit   | dBm     |



Date: 08.JAN.2008 09:50:00

EQUIPMENT: TFAH-US5B

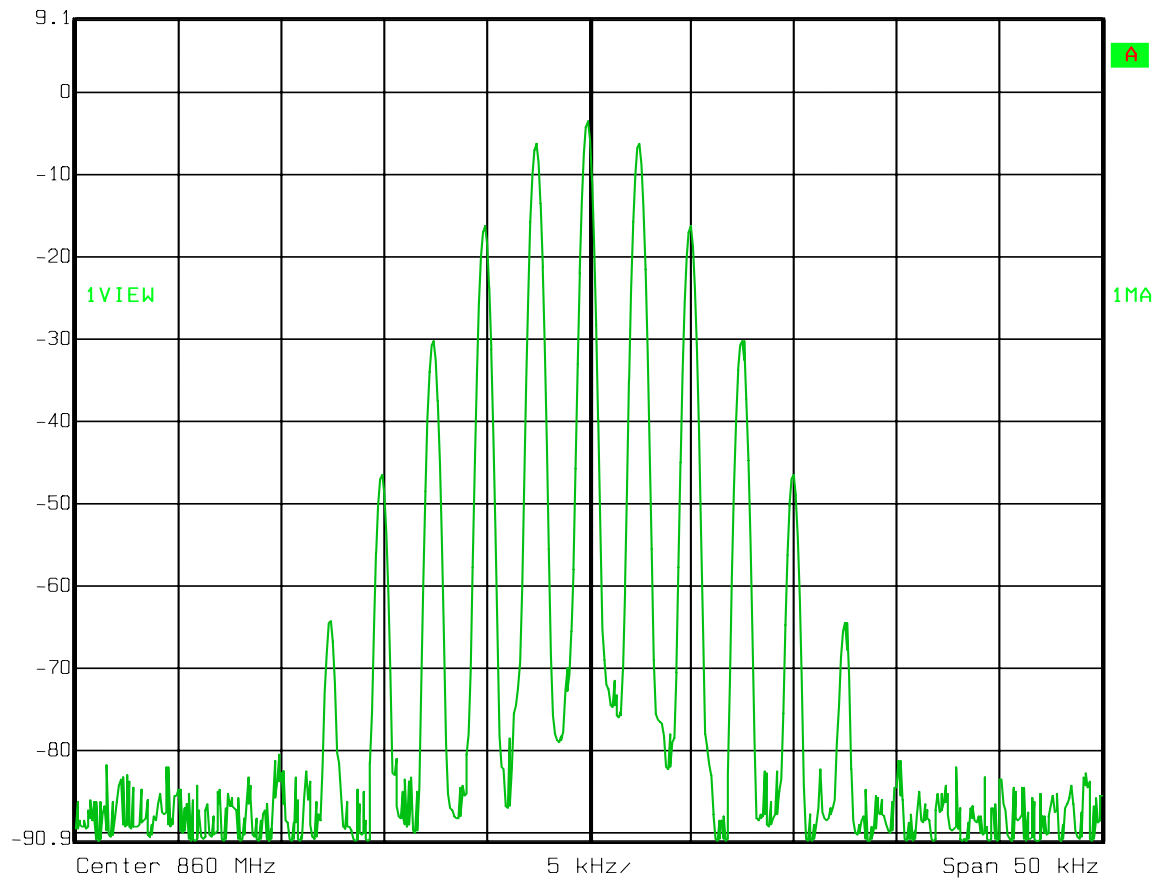
# Test Data – Occupied Bandwidth

Analog - Input



Ref Lvl  
9.1 dBm

|     |        |        |         |
|-----|--------|--------|---------|
| RBW | 300 Hz | RF Att | 20 dB   |
| VBW | 300 Hz | Mixer  | -10 dBm |
| SWT | 2.8 s  | Unit   | dBm     |



Date: 08.JAN.2008 09:51:07

EQUIPMENT: TFAH-US5B

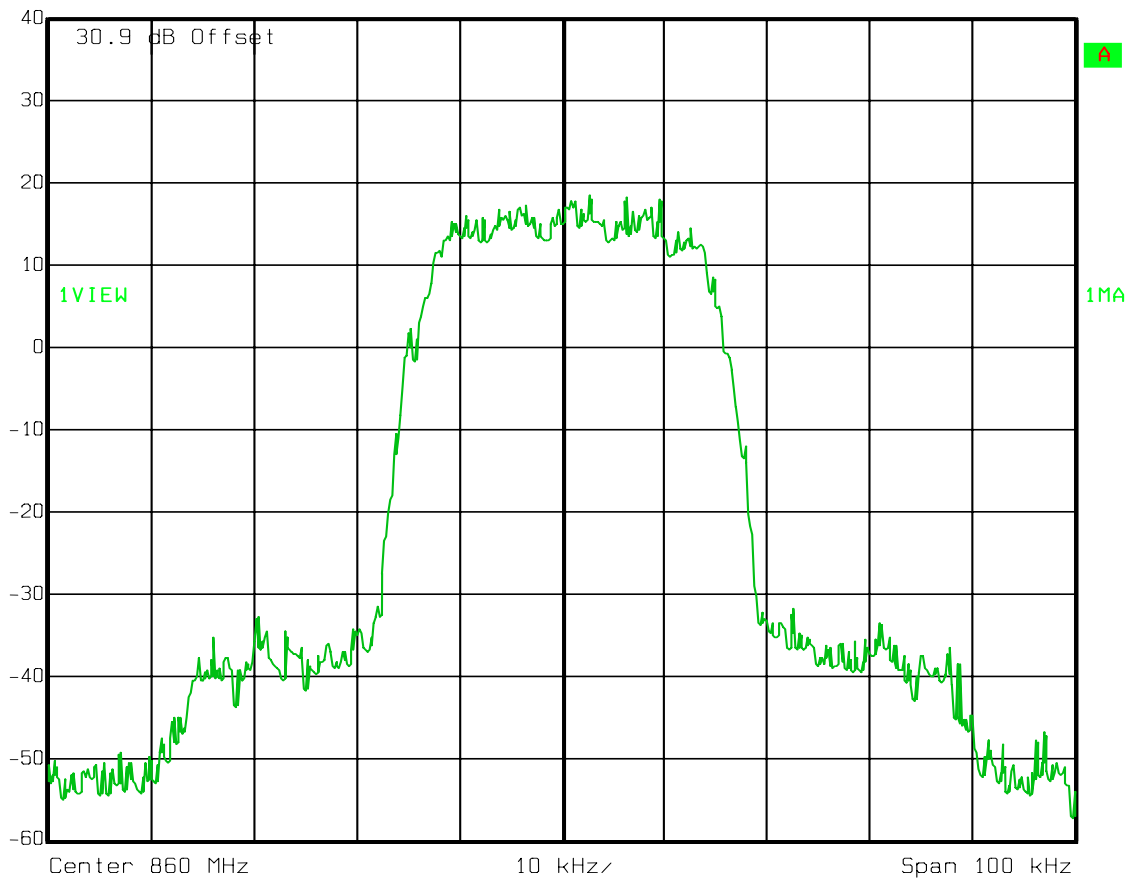
# Test Data – Occupied Bandwidth

iDEN - Output



Ref Lvl  
40 dBm

|     |        |        |         |
|-----|--------|--------|---------|
| RBW | 1 kHz  | RF Att | 20 dB   |
| VBW | 1 kHz  | Mixer  | -10 dBm |
| SWT | 250 ms | Unit   | dBm     |



Date: 08.JAN.2008 09:37:43

EQUIPMENT: TFAH-US5B

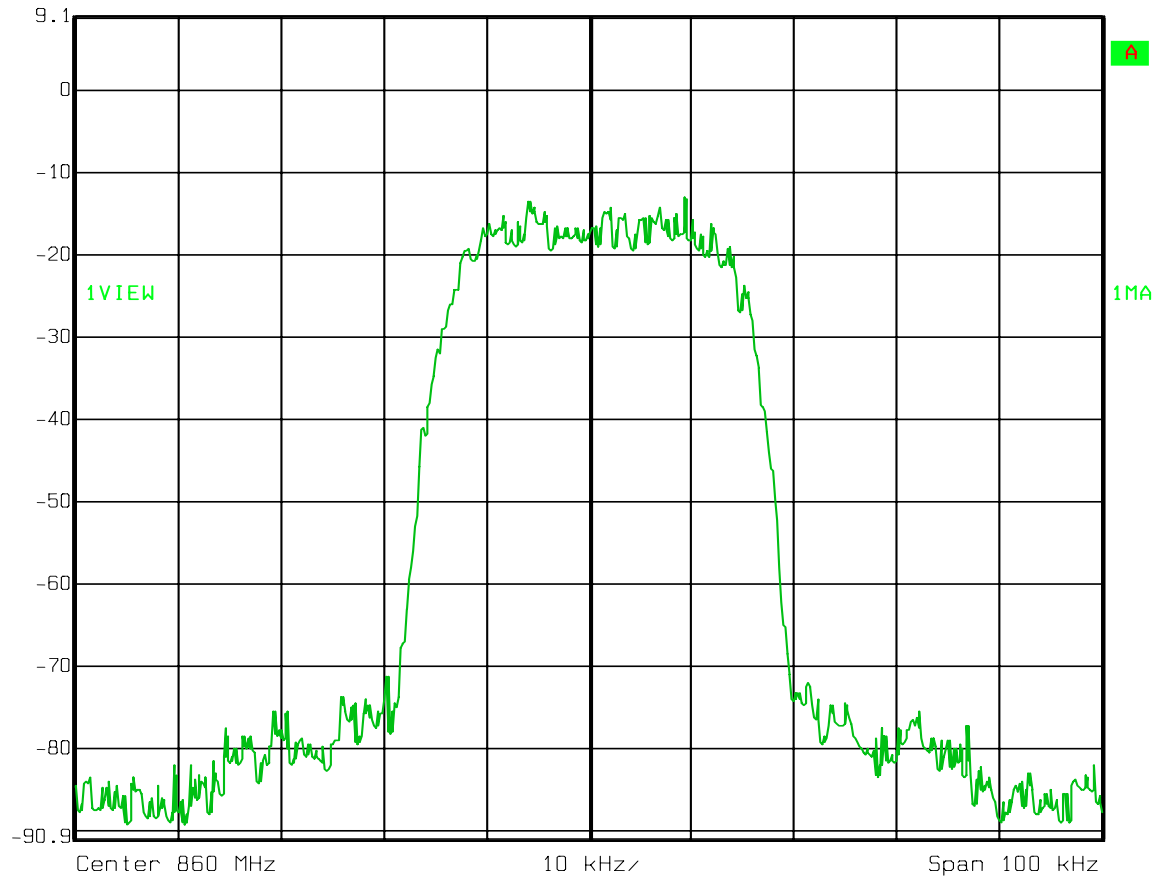
# Test Data – Occupied Bandwidth

iDEN - Input



Ref Lvl  
9.1 dBm

|     |        |        |         |
|-----|--------|--------|---------|
| RBW | 1 kHz  | RF Att | 20 dB   |
| VBW | 1 kHz  | Mixer  | -10 dBm |
| SWT | 250 ms | Unit   | dBm     |



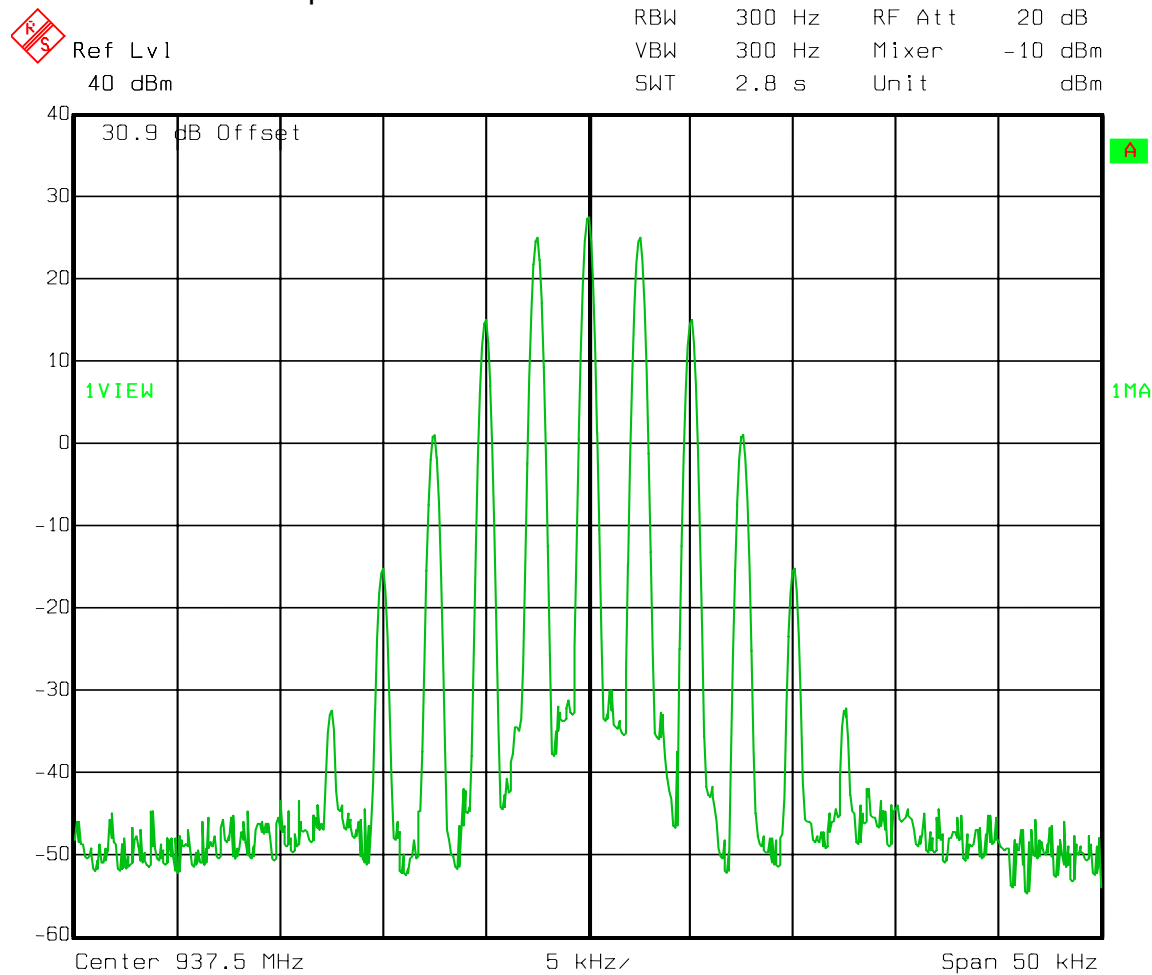
Date: 08.JAN.2008 09:38:47

EQUIPMENT: TFAH-US5B

### Test Data – Occupied Bandwidth

Analog - Output

2.5 kHz tone / 3 kHz peak deviation



Date: 08.JAN.2008 10:11:17

EQUIPMENT: TFAH-US5B

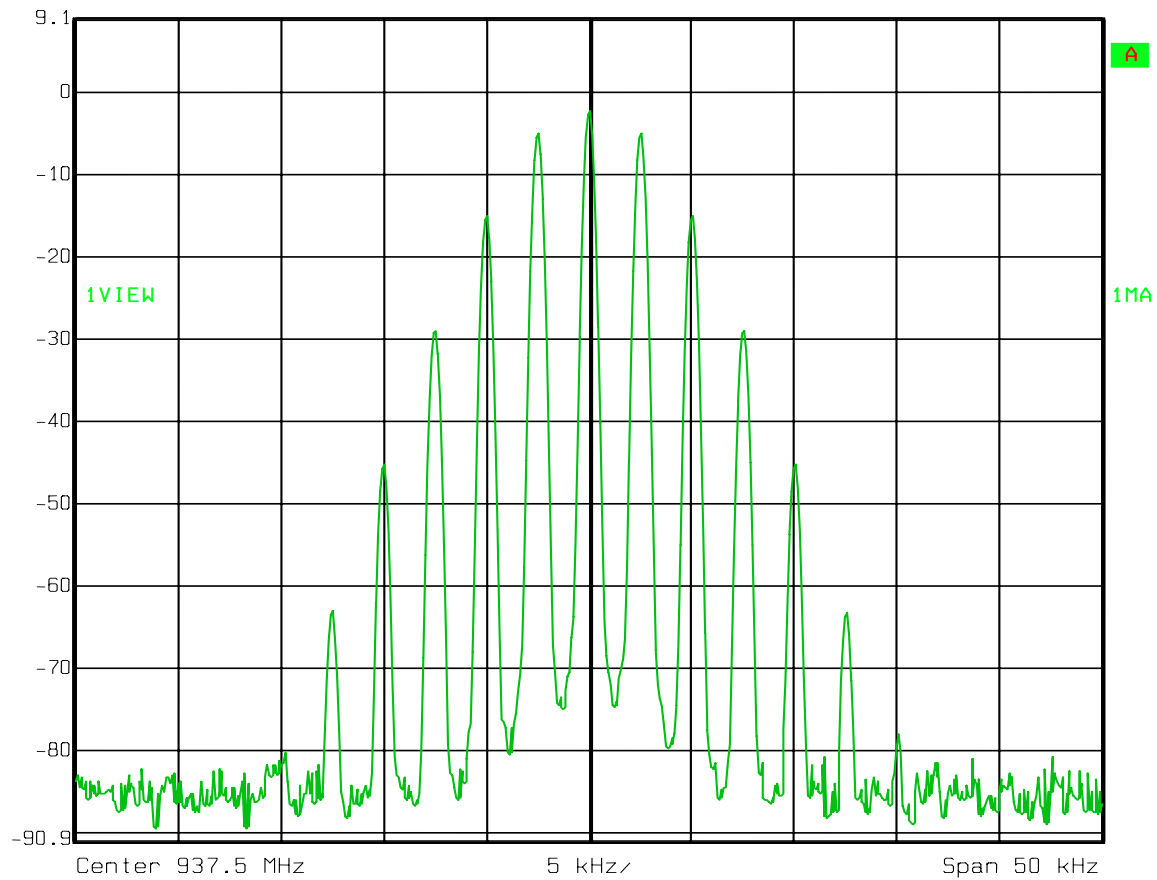
# Test Data – Occupied Bandwidth

Analog - Input



Ref Lvl  
9.1 dBm

|     |        |        |         |
|-----|--------|--------|---------|
| RBW | 300 Hz | RF Att | 20 dB   |
| VBW | 300 Hz | Mixer  | -10 dBm |
| SWT | 2.8 s  | Unit   | dBm     |



Date: 08.JAN.2008 10:12:14

EQUIPMENT: TFAH-US5B

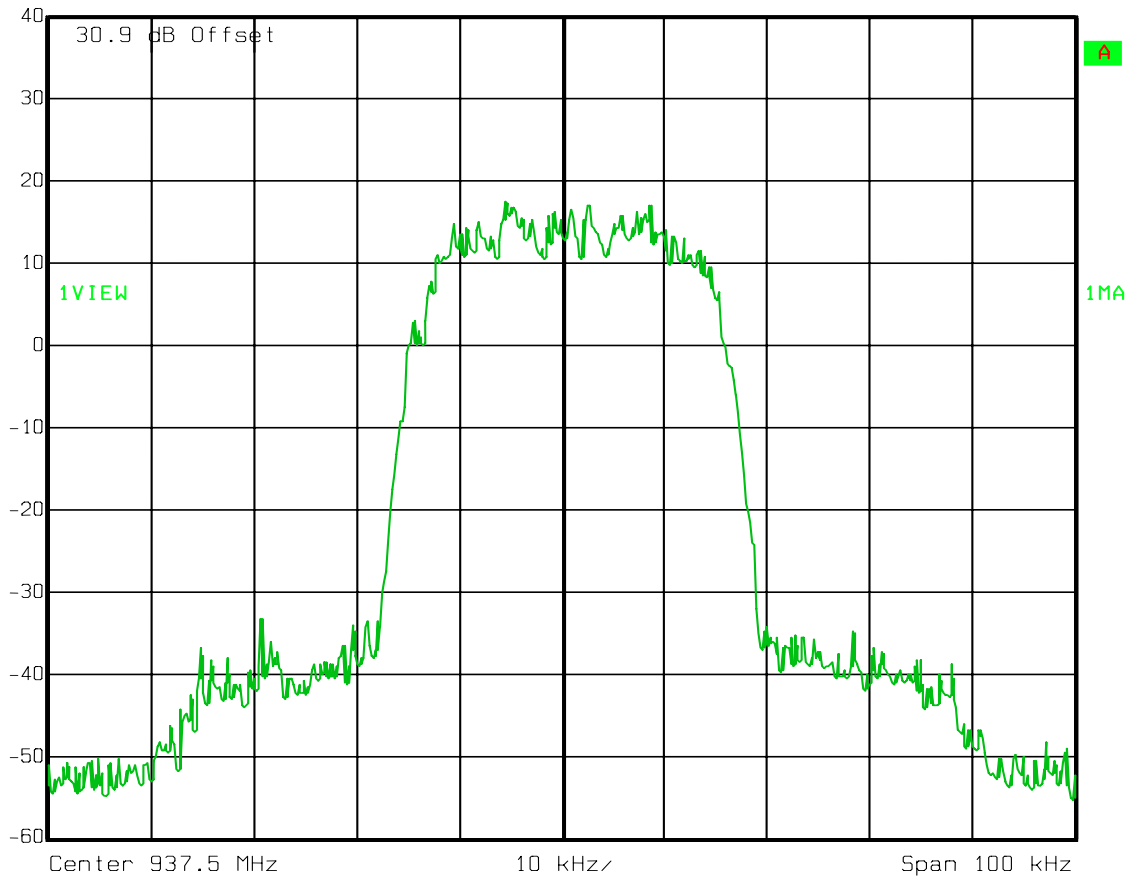
# Test Data – Occupied Bandwidth

iDEN - Output



Ref Lvl  
40 dBm

|     |        |        |         |
|-----|--------|--------|---------|
| RBW | 1 kHz  | RF Att | 20 dB   |
| VBW | 1 kHz  | Mixer  | -10 dBm |
| SWT | 250 ms | Unit   | dBm     |



Date: 08.JAN.2008 10:03:10

EQUIPMENT: TFAH-US5B

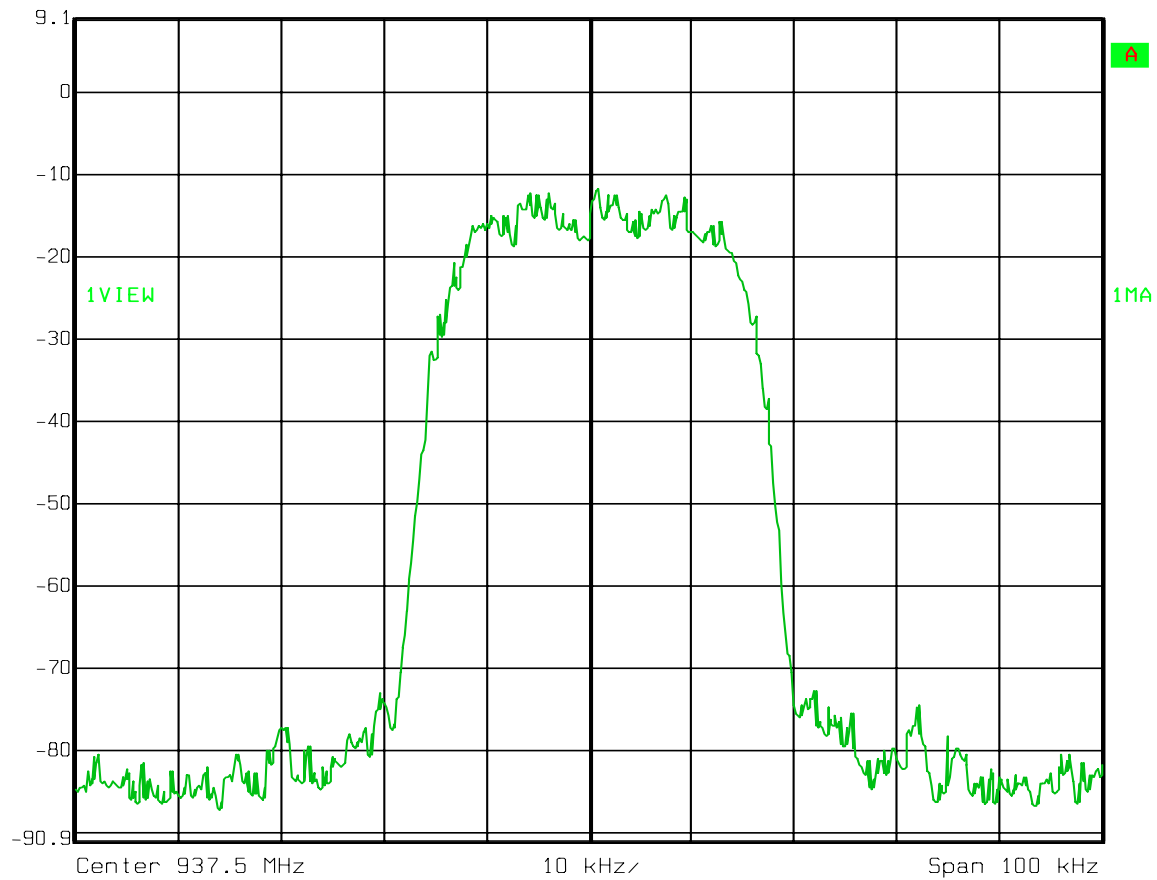
# Test Data – Occupied Bandwidth

iDEN - Input



Ref Lvl  
9.1 dBm

|     |        |        |         |
|-----|--------|--------|---------|
| RBW | 1 kHz  | RF Att | 20 dB   |
| VBW | 1 kHz  | Mixer  | -10 dBm |
| SWT | 250 ms | Unit   | dBm     |



Date: 08.JAN.2008 10:04:09

## Section 5. Spurious Emissions at Antenna Terminals

|                                                      |                       |
|------------------------------------------------------|-----------------------|
| NAME OF TEST: Spurious Emissions @ Antenna Terminals | PARA. NO.: 2.991      |
| TESTED BY: David Light                               | DATE: 08 January 2008 |

**Test Results:** Complies.

**Test Data:** See attached plot(s).

**Equipment Used:** 1036-1082-1471-1472

**Measurement Uncertainty:** +/- 1.7 dB

**Temperature:** 22 °C

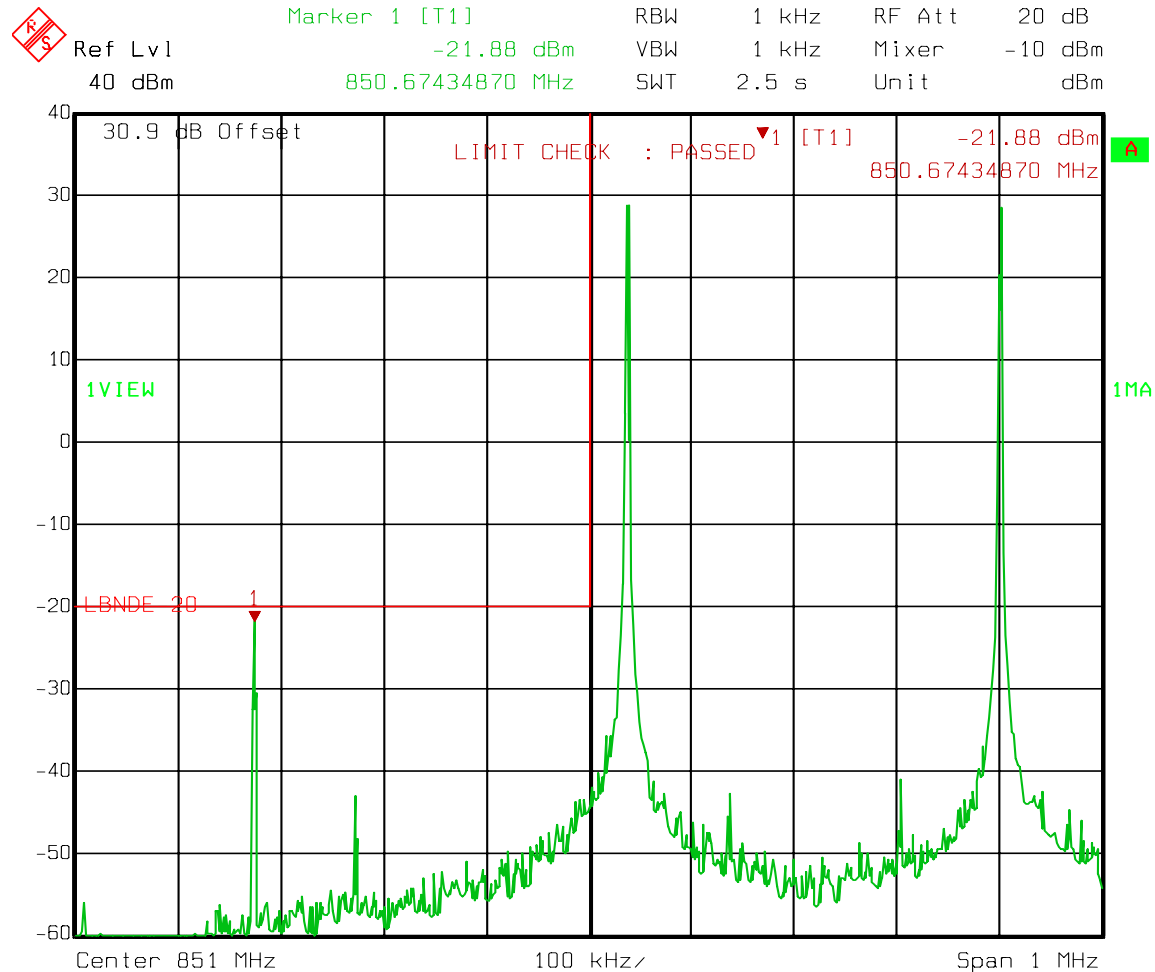
**Relative Humidity:** 35 %

## Test Data – Spurious Emissions at Antenna Terminals

## Lower Bandedge Intermodulation

## Analog

## Downlink 800 band



Date: 08.JAN.2008 09:55:07

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EQUIPMENT: TFAH-US5B

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**Test Data – Spurious Emissions at Antenna Terminals**

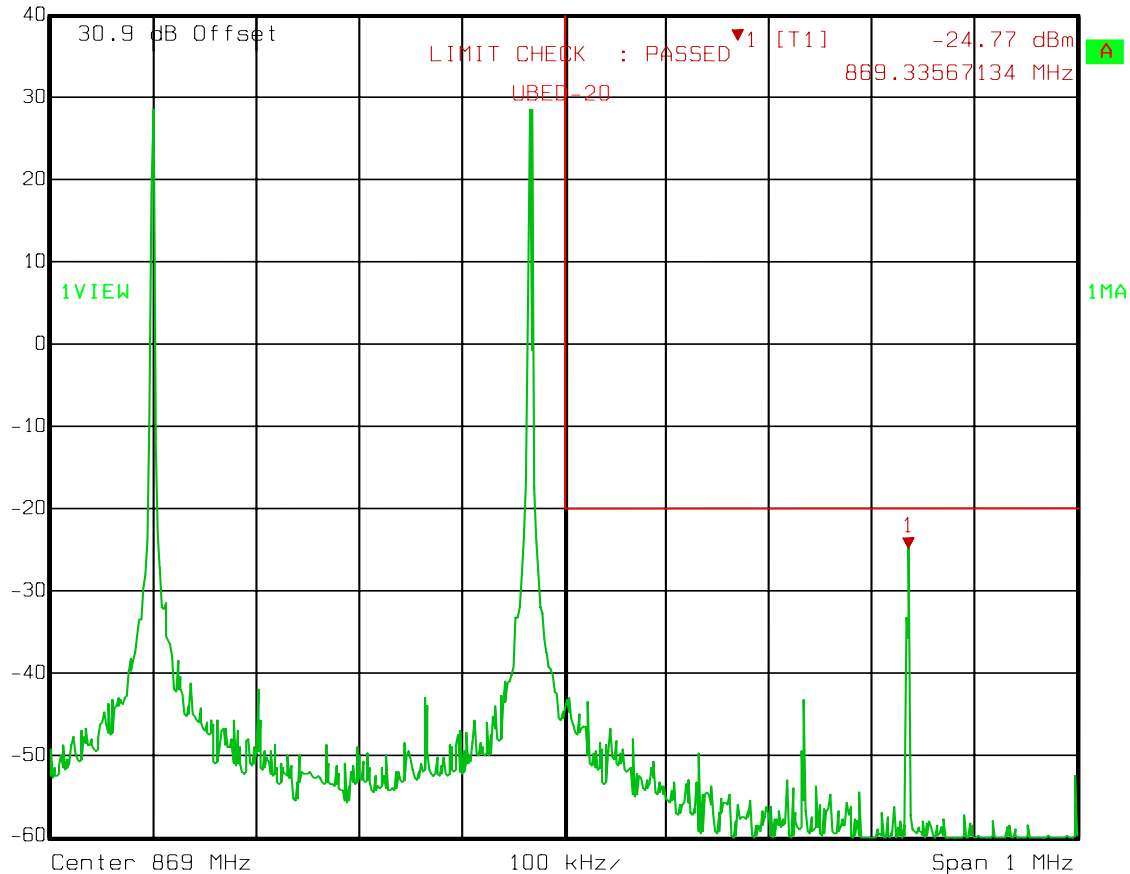
Upper Bandedge Intermodulation

Analog

Downlink 800 band



Marker 1 [T1] RBW 1 kHz RF Att 20 dB  
Ref Lvl -24.77 dBm VBW 1 kHz Mixer -10 dBm  
40 dBm 869.33567134 MHz SWT 2.5 s Unit dBm



Date: 08.JAN.2008 09:56:54

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EQUIPMENT: TFAH-US5B

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**Test Data – Spurious Emissions at Antenna Terminals**

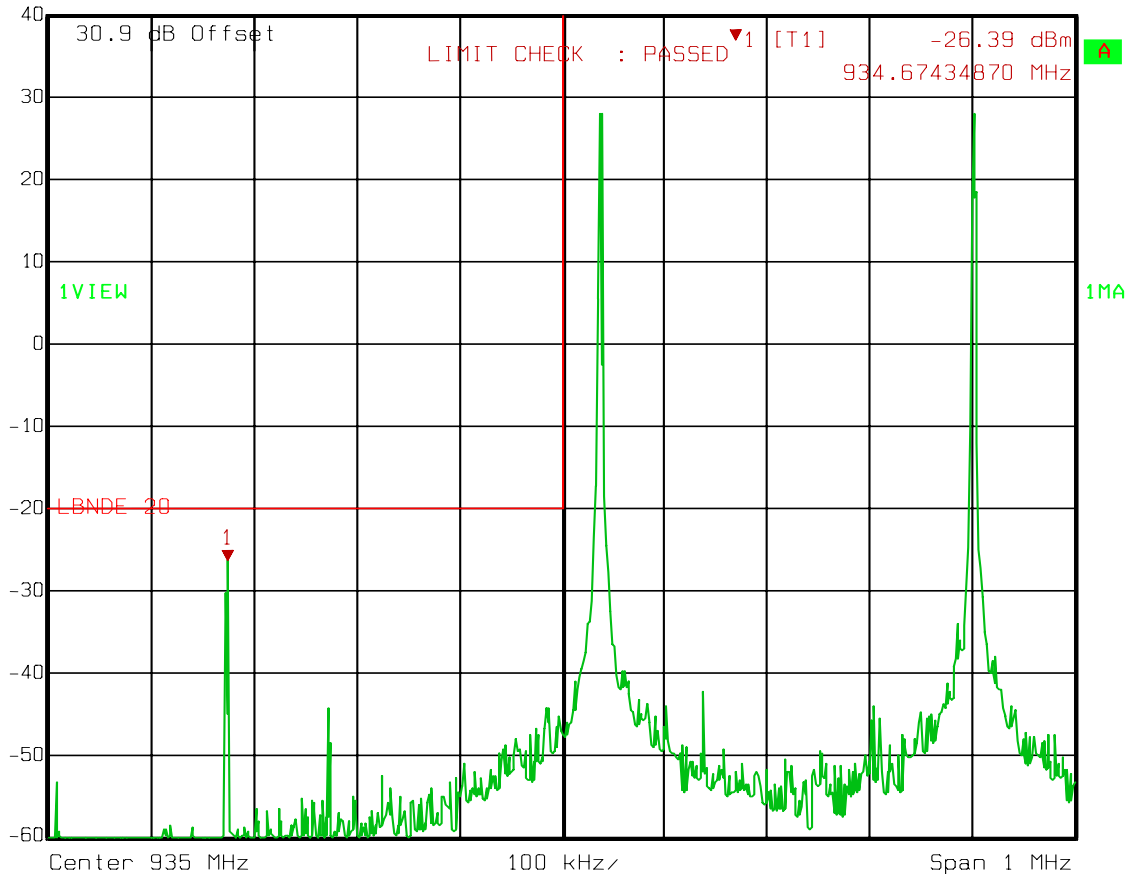
Lower Bandedge Intermodulation

Analog

Downlink – 900 band



Ref Lvl 40 dBm  
Marker 1 [T1] 934.67434870 MHz  
RBW 1 kHz  
VBW 1 kHz  
SWT 2.5 s  
RF Att 20 dB  
Mixer -10 dBm  
Unit dBm



Date: 08.JAN.2008 10:16:15

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EQUIPMENT: TFAH-US5B

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**Test Data – Spurious Emissions at Antenna Terminals**

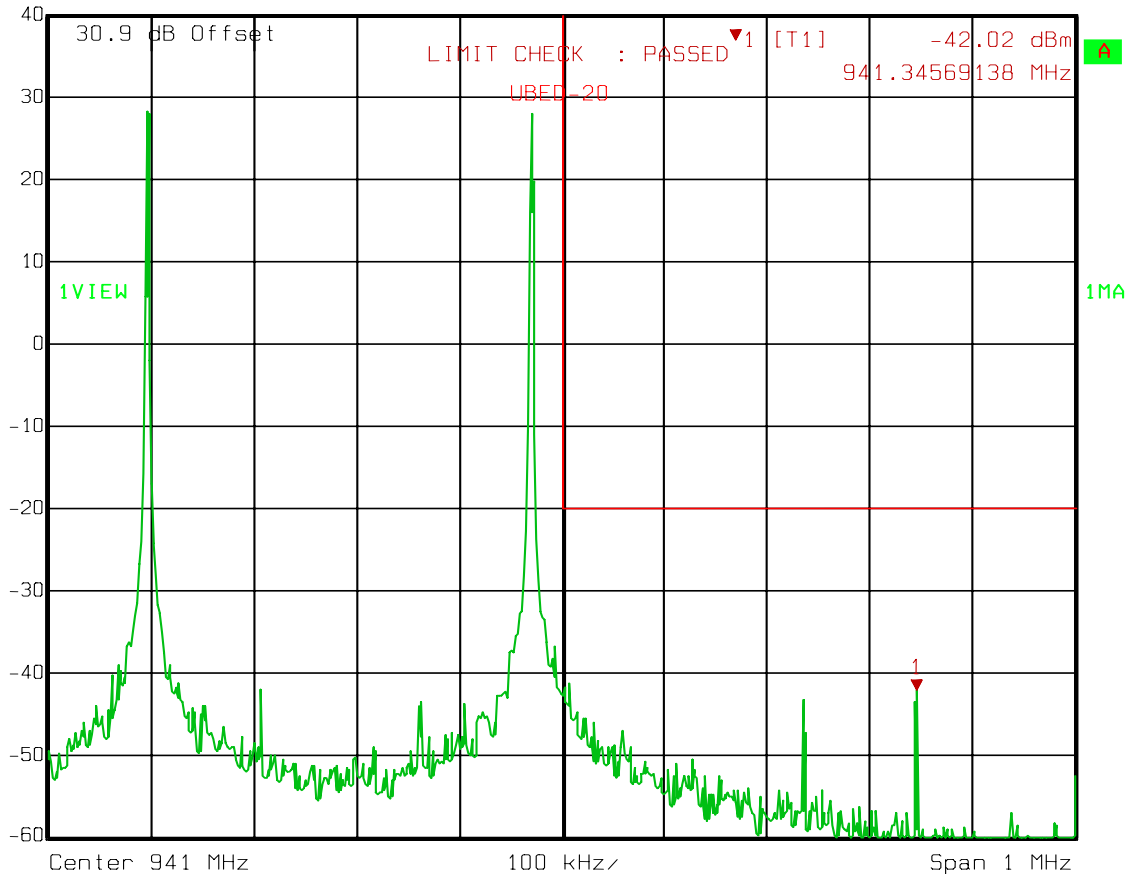
Upper Bandedge Intermodulation

Analog

Downlink – 900 band



|         |                  |     |       |        |         |
|---------|------------------|-----|-------|--------|---------|
| Ref Lvl | Marker 1 [T1]    | RBW | 1 kHz | RF Att | 20 dB   |
| 40 dBm  | -42.02 dBm       | VBW | 1 kHz | Mixer  | -10 dBm |
|         | 941.34569138 MHz | SWT | 2.5 s | Unit   | dBm     |

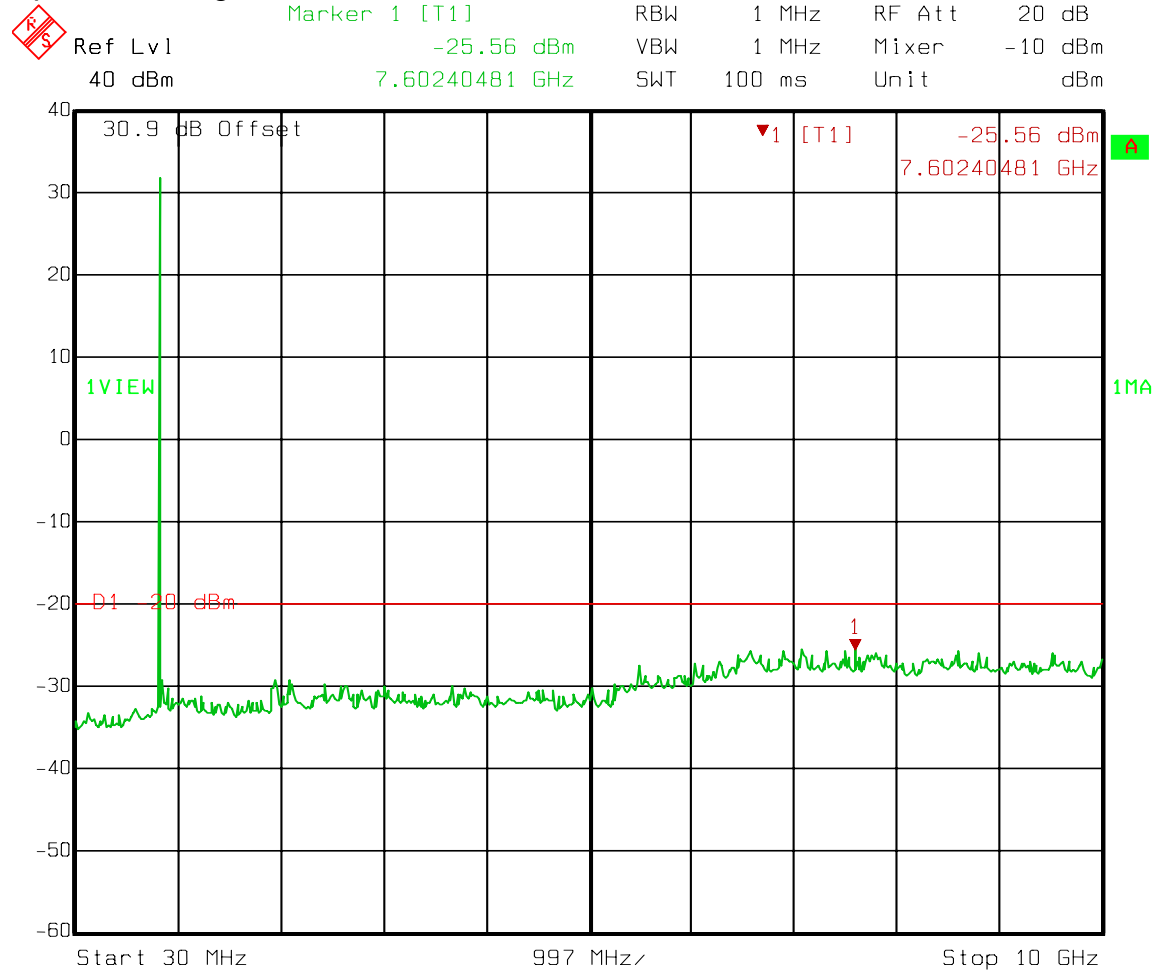


Date: 08.JAN.2008 10:17:20

EQUIPMENT: TFAH-US5B

# Test Data – Spurious Emissions at Antenna Terminals

## Spurs – Analog – Downlink – 800 band

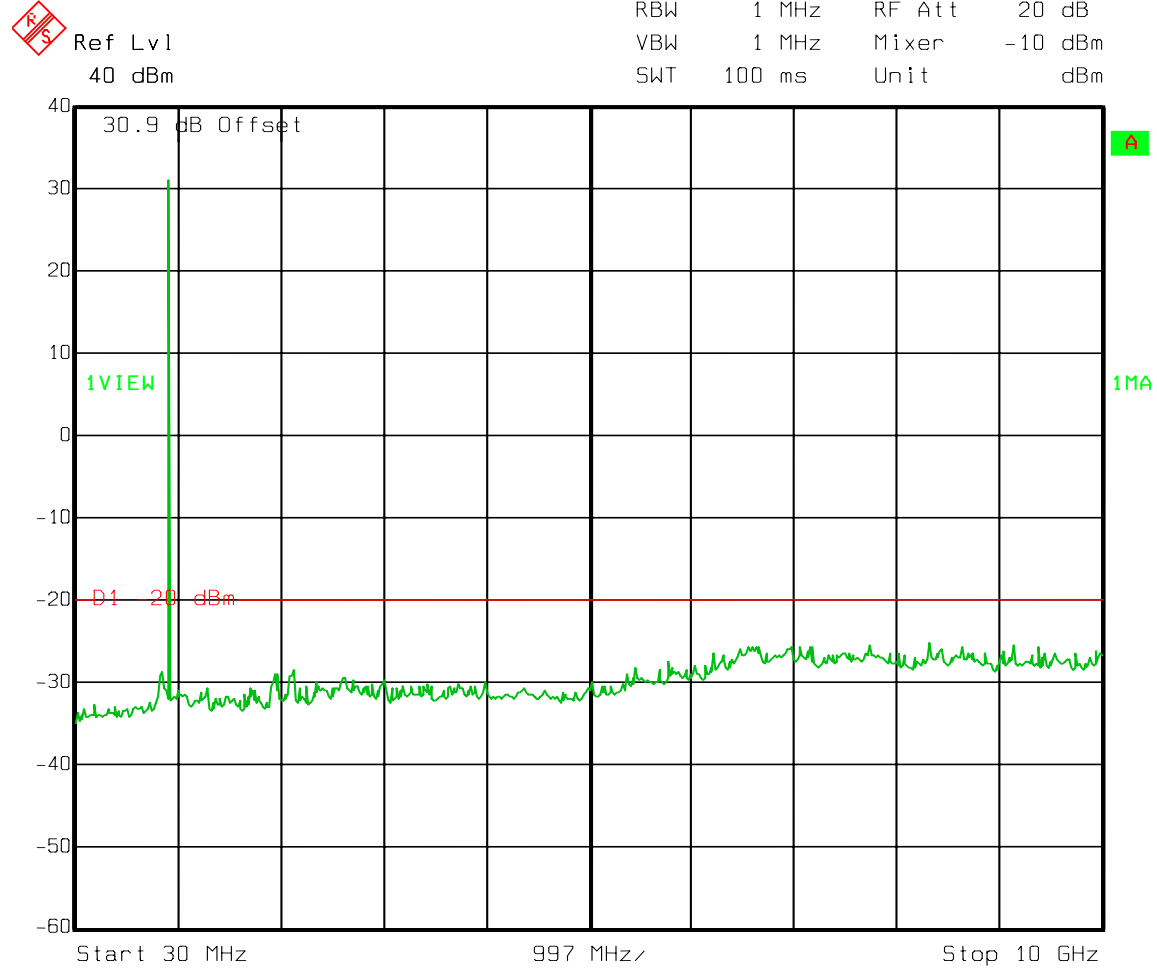


Date: 08.JAN.2008 09:52:23

EQUIPMENT: TFAH-US5B

# Test Data – Spurious Emissions at Antenna Terminals

Spurs – Analog – Downlink – 900 band



Date: 08.JAN.2008 10:13:23

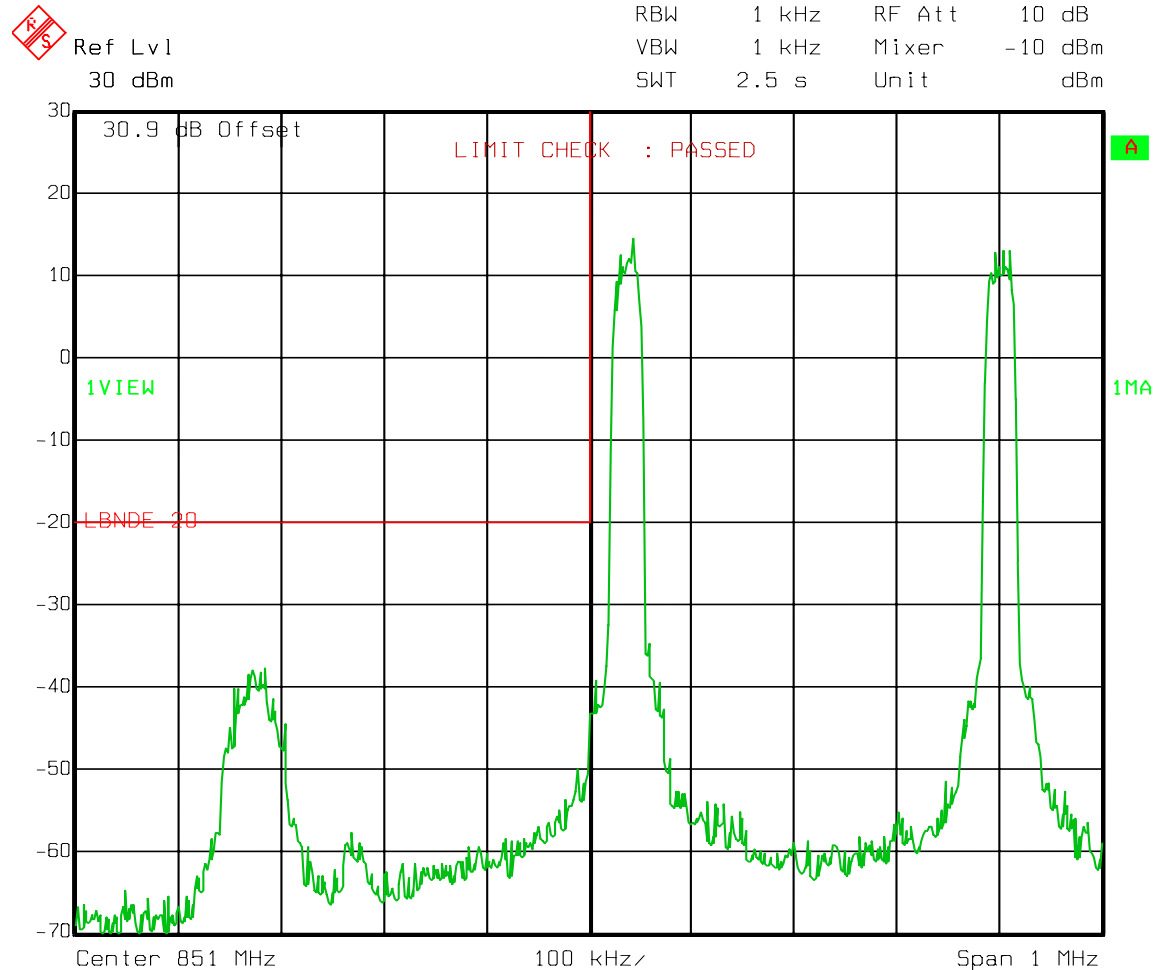
EQUIPMENT: TFAH-US5B

# Test Data – Spurious Emissions at Antenna Terminals

Lower Bandedge Intermodulation

iDEN

Downlink – 800 band



Date: 08.JAN.2008 09:44:02

EQUIPMENT: TFAH-US5B**Test Data – Spurious Emissions at Antenna Terminals**

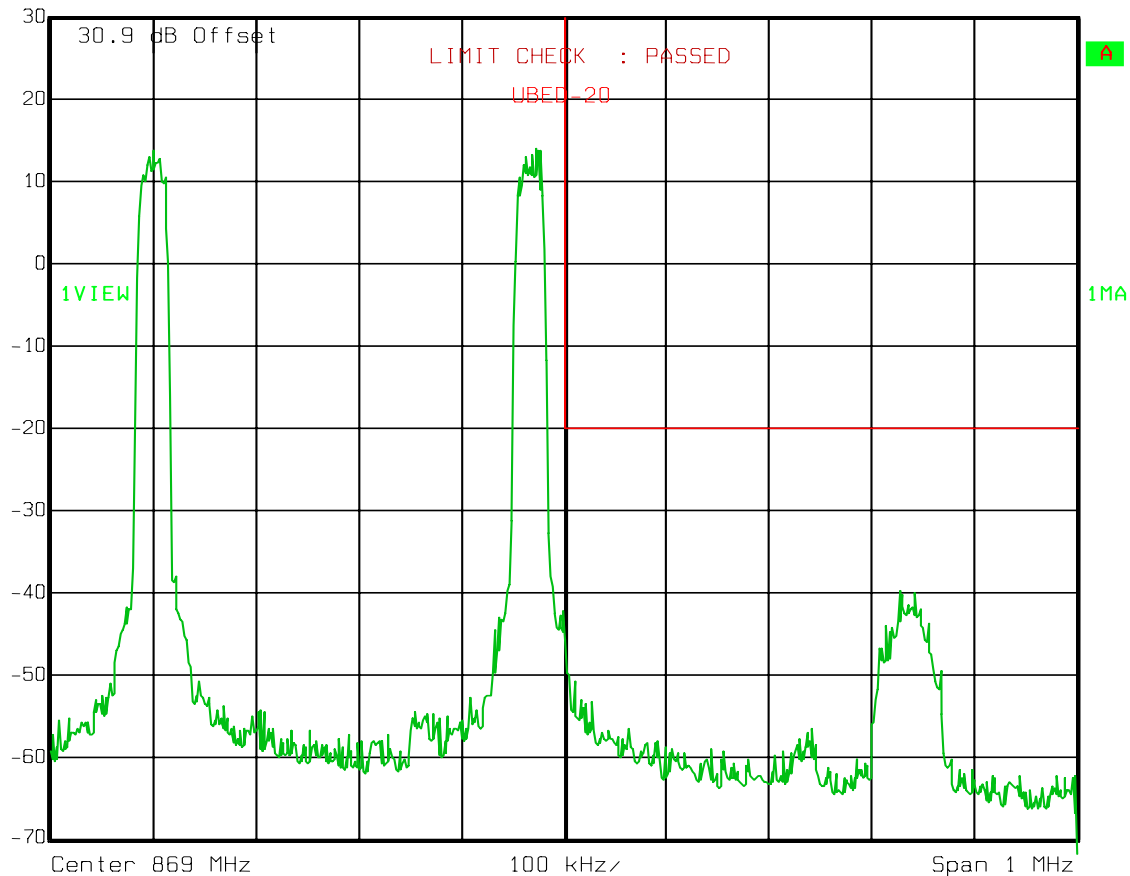
Upper Bandedge Intermodulation

iDEN

Downlink – 800 band

Ref Lvl  
30 dBm

|     |       |        |         |
|-----|-------|--------|---------|
| RBW | 1 kHz | RF Att | 10 dB   |
| VBW | 1 kHz | Mixer  | -10 dBm |
| SWT | 2.5 s | Unit   | dBm     |



Date: 08.JAN.2008 09:46:19

EQUIPMENT: TFAH-US5B

# Test Data – Spurious Emissions at Antenna Terminals

Lower Bandedge Intermodulation

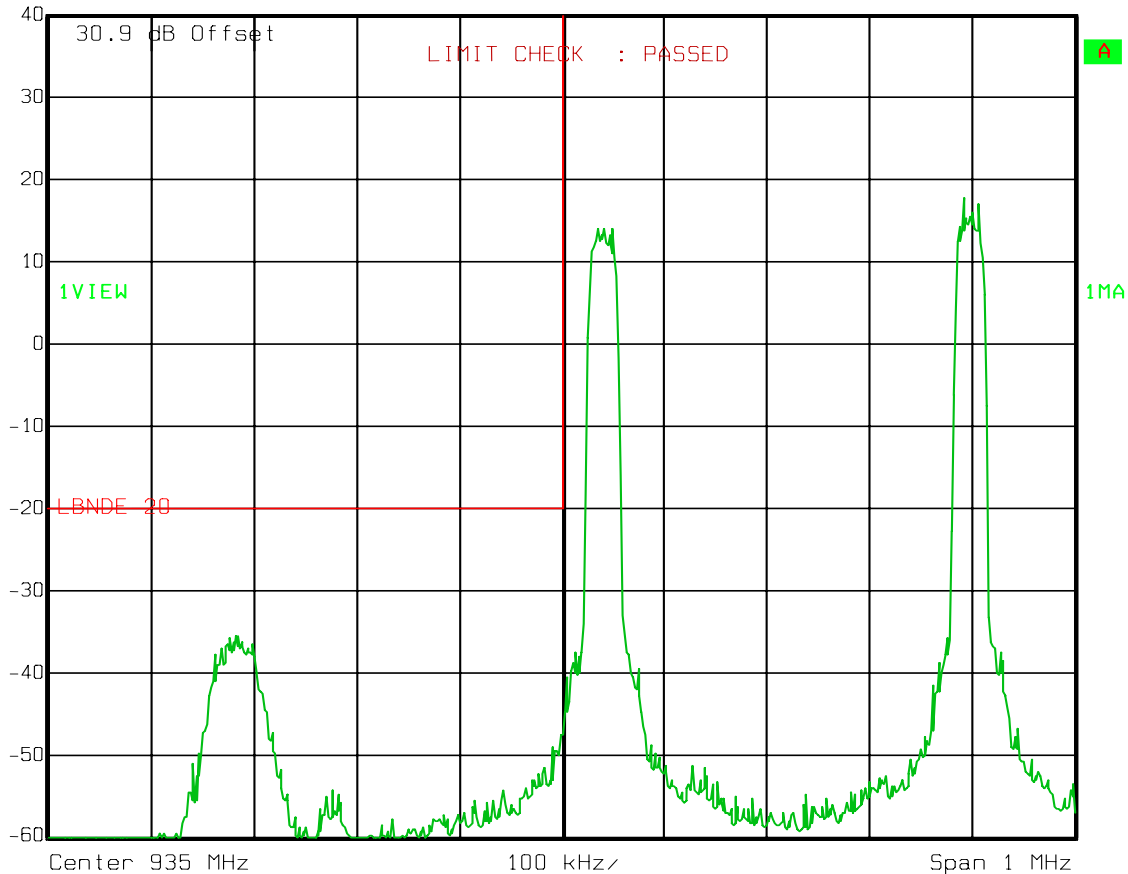
iDEN

Downlink – 900 band



Ref Lvl  
40 dBm

|     |       |        |         |
|-----|-------|--------|---------|
| RBW | 1 kHz | RF Att | 20 dB   |
| VBW | 1 kHz | Mixer  | -10 dBm |
| SWT | 2.5 s | Unit   | dBm     |



Date: 08.JAN.2008 10:07:46

EQUIPMENT: TFAH-US5B

# Test Data – Spurious Emissions at Antenna Terminals

Upper Bandedge Intermodulation

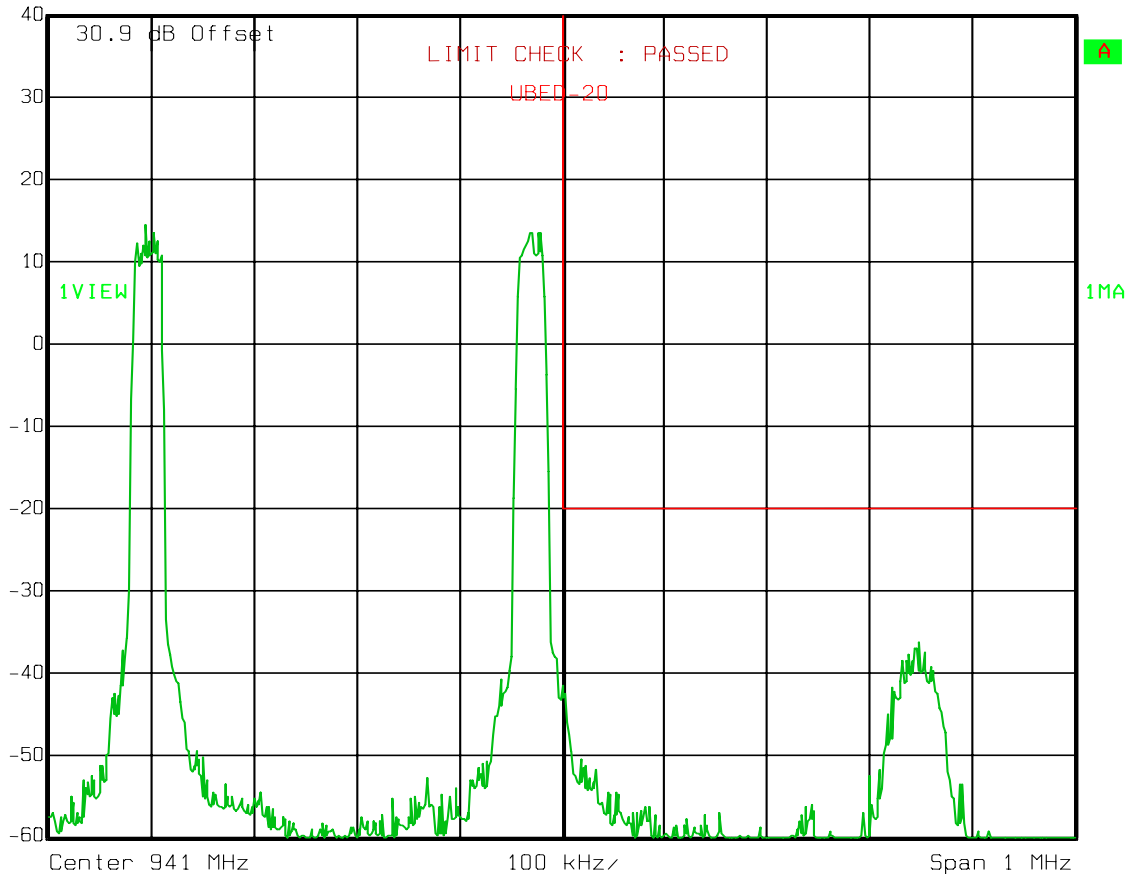
iDEN

Downlink – 900 band



Ref Lvl  
40 dBm

|     |       |        |         |
|-----|-------|--------|---------|
| RBW | 1 kHz | RF Att | 20 dB   |
| VBW | 1 kHz | Mixer  | -10 dBm |
| SWT | 2.5 s | Unit   | dBm     |

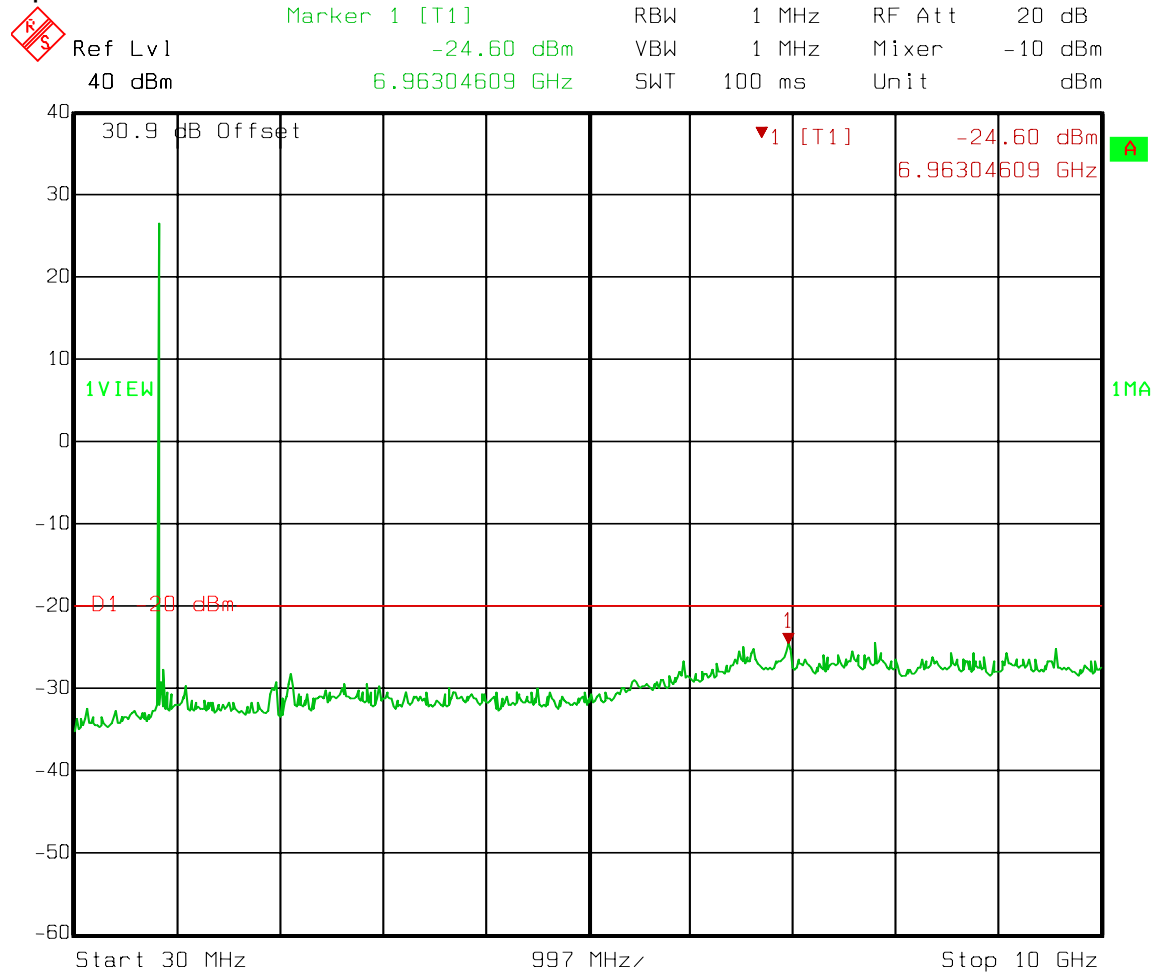


Date: 08.JAN.2008 10:09:21

EQUIPMENT: TFAH-US5B

# Test Data – Spurious Emissions at Antenna Terminals

## Spurs – iDEN – Downlink – 800 band

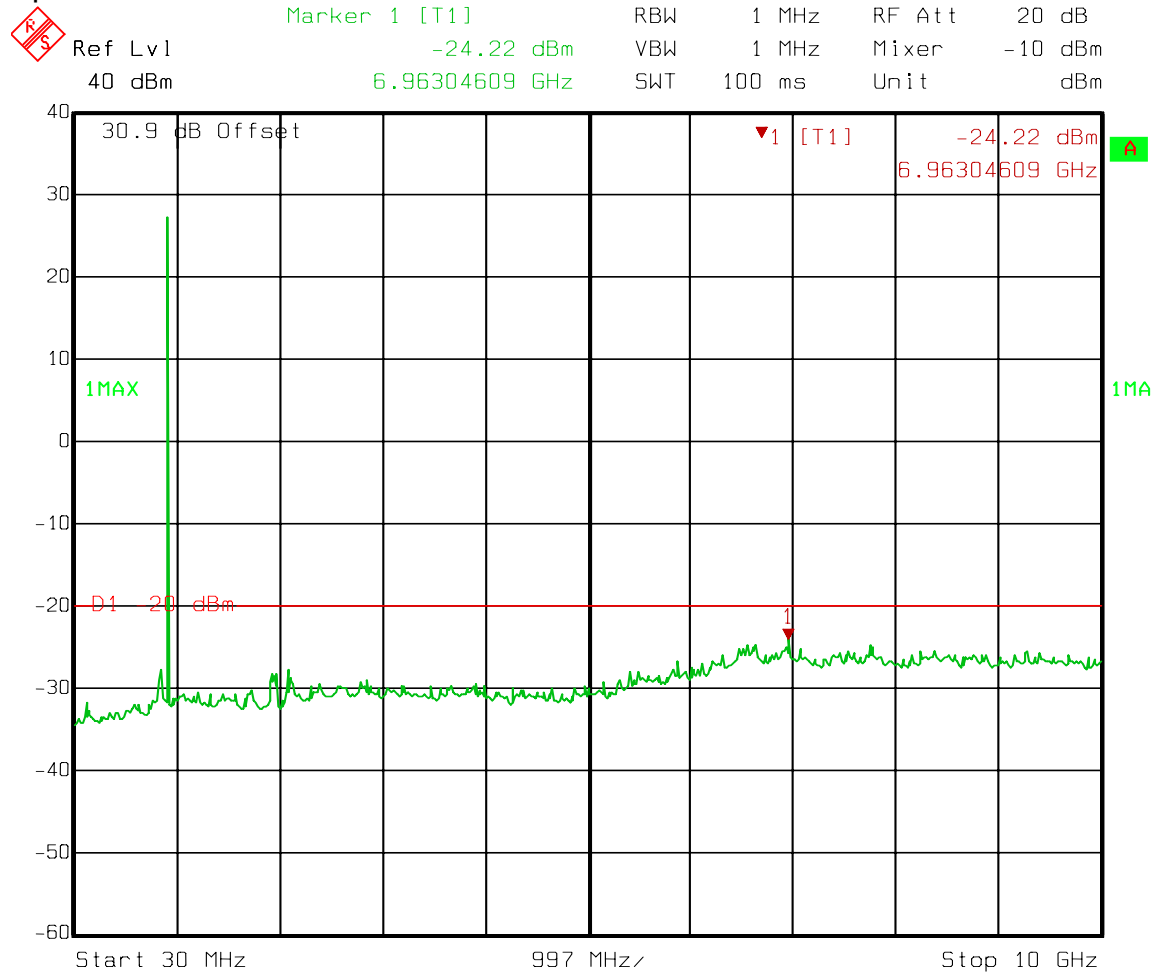


Date: 08.JAN.2008 09:40:16

EQUIPMENT: TFAH-US5B

# Test Data – Spurious Emissions at Antenna Terminals

Spurs – iDEN – Downlink – 900 band



Date: 08.JAN.2008 10:05:19

## **Section 6. Field Strength of Spurious Emissions**

|                                                    |                       |
|----------------------------------------------------|-----------------------|
| NAME OF TEST: Field Strength of Spurious Emissions | PARA. NO.: 2.993      |
| TESTED BY: David Light                             | DATE: 08 January 2008 |

**Test Results:** Complies.

**Test Data:** There were no emissions detected above the noise floor which was at least 20 dB below the specification limit.

**Equipment Used:** 1464-1484-1485-791-1016-759-760-993

**Measurement Uncertainty:** +/-1.7 dB

**Temperature:** 22 °C

**Relative Humidity:** 35 %

**Section 7. Test Equipment List**

| Nemko ID | Description                | Manufacturer<br>Model Number   | Serial Number | Calibration<br>Date | Calibration<br>Due |
|----------|----------------------------|--------------------------------|---------------|---------------------|--------------------|
| 1036     | SPECTRUM ANALYZER          | ROHDE & SCHWARZ<br>FSEK30      | 830844/006    | 05/26/06            | 05/26/08           |
| 1082     | CABLE 2m                   | Astrolab<br>32027-2-29094-72TC | N/A           | CBU                 | N/A                |
| 1471     | 10 db Attenuator DC 18 Ghz | MCL Inc.<br>BW-S10W2 10db-2WDC | NONE          | CBU                 | N/A                |
| 1472     | 20db Attenuator DC 18 Ghz  | Omni Spectra<br>20600-20db     | NONE          | CBU                 | N/A                |
| 1464     | Spectrum analyzer          | Hewlett Packard<br>8563E       | 3551A04428    | 01/24/07            | 01/24/09           |
| 1484     | Cable                      | Storm<br>PR90-010-072          | N/A           | 05/02/07            | 05/01/08           |
| 1485     | Cable                      | Storm<br>PR90-010-216          | N/A           | 05/02/07            | 05/01/08           |
| 791      | PREAMP, 25dB               | Nemko USA, Inc.<br>LNA25       | 398           | 05/01/07            | 04/30/08           |
| 1016     | Pre-Amp                    | HEWLETT PACKARD<br>8449A       | 2749A00159    | 05/01/07            | 04/30/08           |
| 759      | ANTENNA, LOG PERIODIC      | A.H. SYSTEMS<br>SAS-200/510    | 556           | 03/30/07            | 03/29/08           |
| 760      | Antenna biconical          | Electro Metrics<br>MFC-25      | 477           | 01/19/07            | 01/19/08           |
| 993      | Horn antenna               | A.H. Systems<br>SAS-200/571    | XXX           | 08/31/07            | 08/30/08           |

## **ANNEX A - TEST METHODOLOGIES**

**NAME OF TEST: RF Power Output****PARA. NO.: 2.985**

**Minimum Standard:** Para. No. 90.205(a). The maximum allowable station ERP is dependent upon the stations HAAT and required service area and will be authorized in accordance with Table 1 of 90.205(d).

**Method Of Measurement:**Detachable Antenna:

The peak power at antenna terminals is measured using a peak power meter or spectrum analyzer. Power output is measured with the maximum rated input level. If a spectrum analyzer is used the RBW is set to a value greater than the 20 dB bandwidth of the modulated rf waveform.

Integral Antenna:

The antenna substitution method is used to determine the equivalent radiated power at spurious frequencies. The spurious emissions are measured at a distance of 3 meters. The EUT is then replaced with a reference substitution antenna with a known gain referenced to an isotropic radiator. This antenna is fed with a signal at the spurious frequency. The level of the signal is adjusted to repeat the previously measured level. The resulting eirp is the signal level fed to the reference antenna corrected for gain referenced to an isotropic radiator.

NAME OF TEST: Spurious Emissions at Antenna  
Terminals

PARA. NO.: 2.991

Minimum Standard:

90.210, Table 1

Table 1

| Frequency Band (MHz) | Mask for equipment with Low Pass Filter | Mask for equipment without Low Pass Filter |
|----------------------|-----------------------------------------|--------------------------------------------|
| Below 25             | A or B                                  | A or C                                     |
| 25 - 50              | B                                       | C                                          |
| 72 - 76              | B                                       | C                                          |
| 150 - 174            | B, D or E                               | C, D or E                                  |
| 150 Paging only      | B                                       | C                                          |
| 220 - 222            | F                                       | F                                          |
| 421 - 512            | B, D or E                               | C, D or E                                  |
| 450 paging only      | B                                       | H                                          |
| 806 - 821/ 851 - 866 | B                                       | G                                          |
| 821 - 824/ 866 - 869 | B                                       | H                                          |
| 896 - 901/ 935 - 940 | I                                       | J                                          |
| 902 - 928            | K                                       | K                                          |
| 929 - 930            | B                                       | G                                          |
| Above 940            | B                                       | C                                          |
| All other bands      | B                                       | C                                          |

| MASK        | Spurious Limit |
|-------------|----------------|
| A,B,C,G,H,I | -13dBm         |
| D,J         | -20dBm         |
| E,F,K       | -25dBm         |

Test Method:

RBW: 1% of emission bandwidth in the 0 - 1 GHz range.  
1 MHz at frequencies above 1 GHz.  
VBW $\geq$ RBW

The spectrum is searched up to 10 times the fundamental frequency.

|                                         |                         |
|-----------------------------------------|-------------------------|
| <b>NAME OF TEST: Occupied Bandwidth</b> | <b>PARA. NO.: 2.989</b> |
|-----------------------------------------|-------------------------|

**Minimum Standard:** Not defined. Input/Output

**Method Of Measurement:**

Analog

Spectrum analyzer settings:

RBW=VBW=300 Hz

Span: 100 kHz

Sweep: Auto

iDEN

RBW=VBW= 300 Hz

Span: 100 kHz

Sweep: Auto

**NAME OF TEST: Field Strength of Spurious****PARA. NO.: 2.993****Minimum Standard:** Para. No. 90.210, see table 1 for applicable mask.**Method Of Measurement:** TIA/EIA-603

The antenna substitution method is used to determine the equivalent radiated power at spurious frequencies. The spurious emissions are measured at a distance of 3 meters. The EUT is then replaced with a reference substitution antenna with a known gain referenced to an isotropic radiator. This antenna is fed with a signal at the spurious frequency. The level of the signal is adjusted to repeat the previously measured level. The resulting eirp is the signal level fed to the reference antenna corrected for gain referenced to an isotropic radiator.

| <b>MASK</b> | <b>Spurious Limit</b> |
|-------------|-----------------------|
| A,B,C,G,H,I | -13dBm                |
| D,J         | -20dBm                |
| E,F,K       | -25dBm                |

**NAME OF TEST: Frequency Stability****PARA. NO.: 2.995**

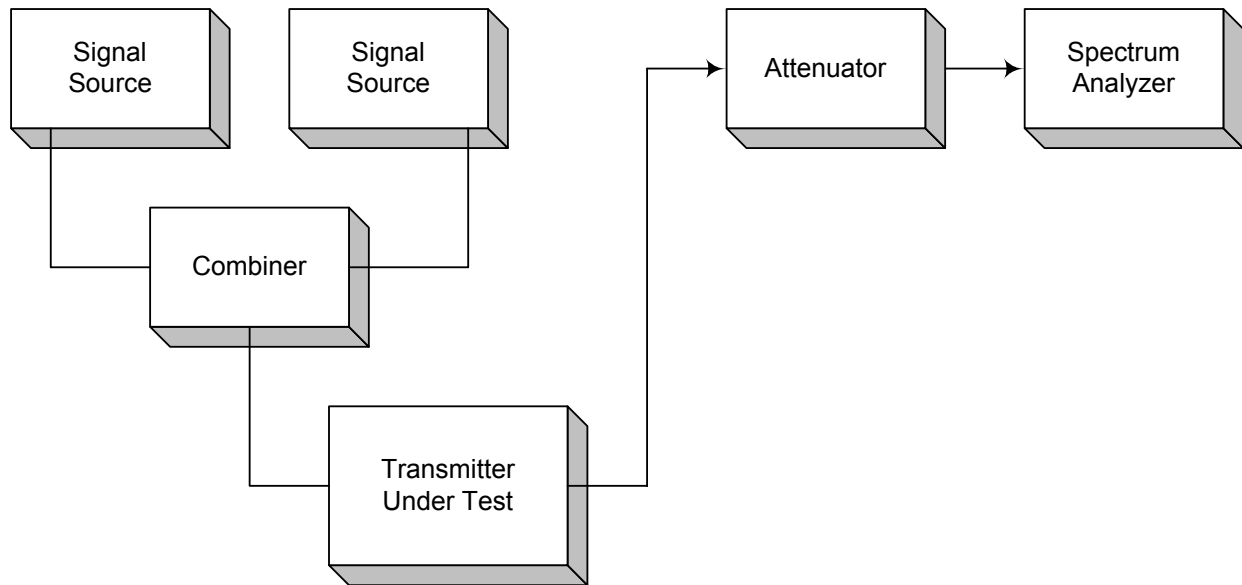
**Minimum Standard:** Para. No. 990.213. The transmitter carrier frequency shall remain within the assigned frequency below in ppm.

**Table 2**

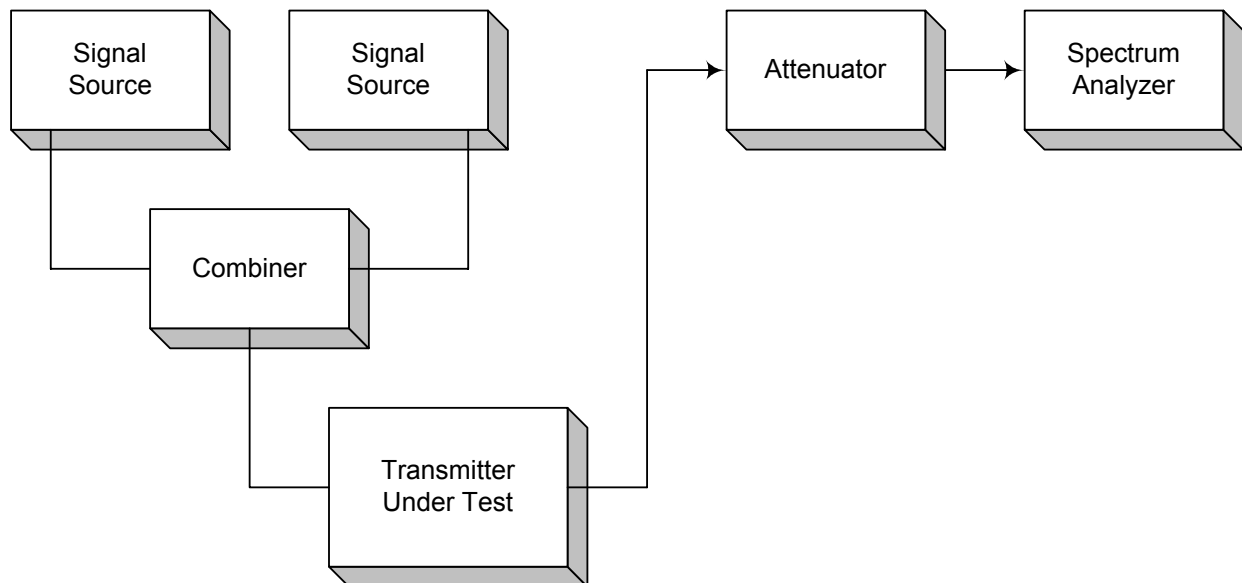
| Frequency Band<br>(MHz) | Fixed And Base<br>Stations | Mobile Stations   |                   |
|-------------------------|----------------------------|-------------------|-------------------|
|                         |                            | > 2 Watts o/p pwr | < 2 Watts o/p pwr |
| Below 25                | 100                        | 100               | 200               |
| 25 - 50                 | 20                         | 20                | 50                |
| 72 - 76                 | 5                          | -                 | 50                |
| 150 - 174               | 5                          | 5                 | 5                 |
| 220 - 222               | 0.1                        | 1.5               | 1.5               |
| 421 - 512               | 2.5                        | 5                 | 5                 |
| 806 - 821               | 1.5                        | 2.5               | 2.5               |
| 821 - 824               | 1.0                        | 1.5               | 15                |
| 851 - 866               | 1.5                        | 2.5               | 2.5               |
| 866 - 869               | 1.0                        | 1.5               | 1.5               |
| 869 - 901               | 0.1                        | 1.5               | 1.5               |
| 902 - 928               | 2.5                        | 2.5               | 2.5               |
| 929 - 930               | 1.5                        | -                 | -                 |
| 935 - 940               | 0.1                        | 1.5               | 1.5               |
| 1427 - 1435             | 300                        | 300               | 300               |
| Above 2450              | -                          | -                 | -                 |

## **ANNEX B - TEST DIAGRAMS**

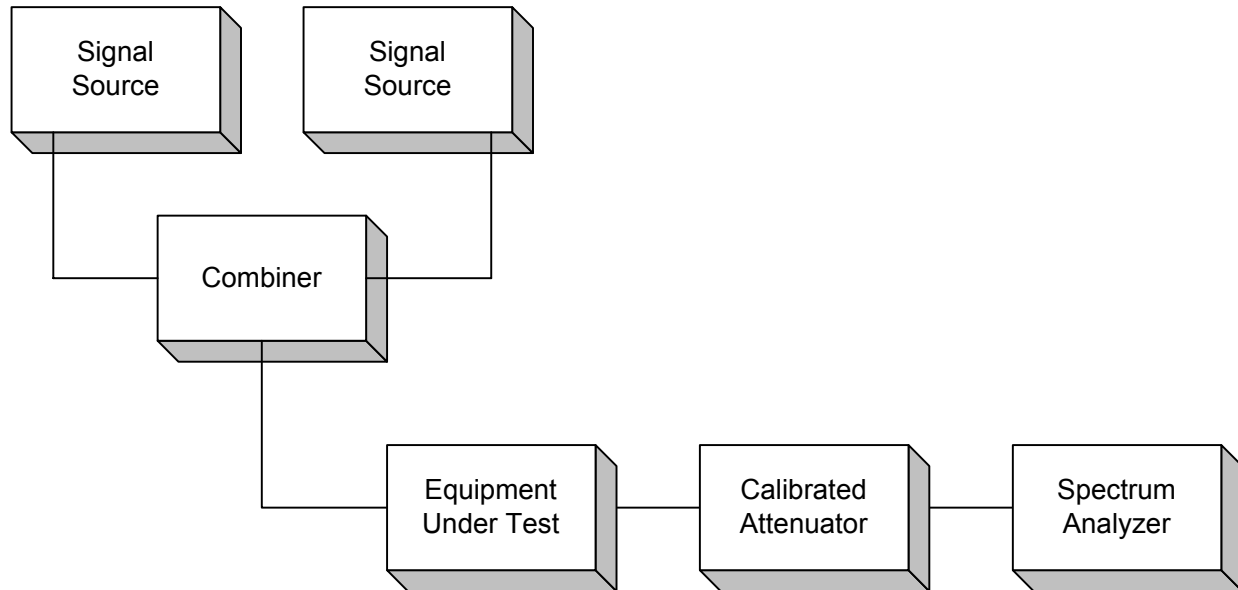
**Para. No. 2.985 - R.F. Power Output**



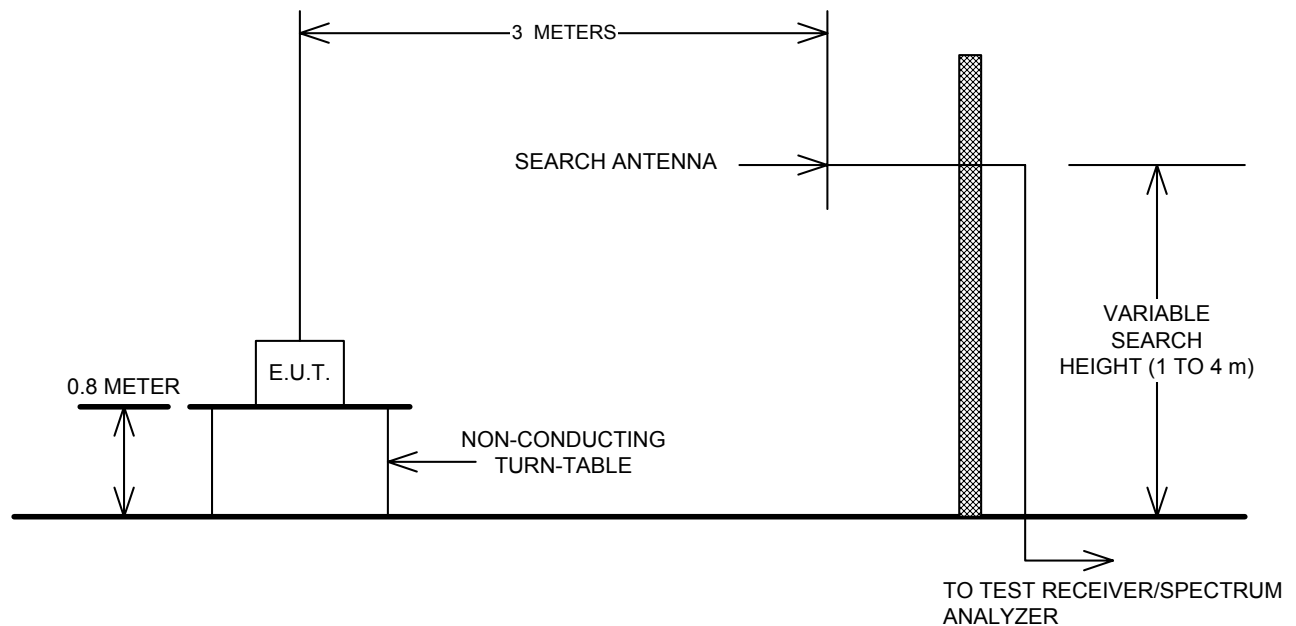
**Para. No. 2.989 - Occupied Bandwidth**



**Para. No. 2.991 - Spurious Emissions at Antenna Terminals**



**Para. No. 2.993 - Field Strength of Spurious Radiation**



Para. No. 2.995 - Frequency Stability

