

# MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **Computational Systems, Incorporated**

MODEL: **RF Smart Sensor, 4100, 001 Eng. Proto**

FCC ID: **NL54100**

DATE: **January 15, 1998**

This report concerns (check one): Original grant X  
Class II change \_\_\_\_\_

Equipment Type: **DSS- Spread Spectrum Transceiver**

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes \_\_\_\_\_ No X

If yes, defer until: \_\_\_\_\_  
date

N.A. agrees to notify the Commission by N.A.  
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

United States Technologies, Inc.  
3505 Francis Circle  
Alpharetta, GA 30004

Phone Number: (770) 740-0717  
Fax Number: (770) 740-1508

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## **GENERAL INFORMATION**

### **1.1 Product Description**

The Equipment Under Test (EUT) is the Computational Systems, Incorporated Spread Spectrum Transceiver, Model RF Smart Sensor, 4100, 001 Eng. Proto.

## **1.2 Related Submittal(s)/Grant(s)**

The EUT will be used with part of a system to send/receive data. The transceiver presented in this report will be used with another transceiver which has been submitted and approved under FCC ID: NL52400.

The EUT is subject to the following authorizations:

- a) Certification as a transceiver
- b) Verification as a receiver and digital device

The information contained in this report is presented for the certification & verification authorization(s) for the EUT.

## **TEST AND MEASUREMENTS**

### **2.1 Configuration of Tested System**

The sample was tested per ANSI C63.4, Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (1992). Conducted and radiated emissions data were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions. Interconnecting cables were manipulated as necessary to maximize emissions. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are shown in Figure 2.

The sample used for testing was received by U.S. Technologies on December 17, 1998 in good condition.

Due to complexities involved with dismantling the unit to program channel selection, CSI provided separate preprogrammed units, four were for different transmit channels and one for receive mode of operation.

### **2.2 Test Facility**

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and submitted to the FCC, and accepted in their letter marked 31040/SIT. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number IC2982.

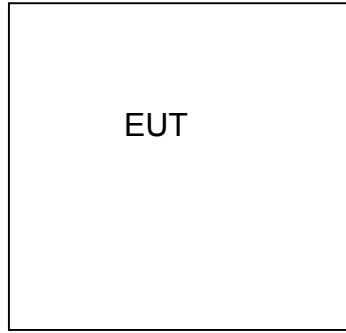
### **2.3 Test Equipment**

Table 2 describes test equipment used to evaluate this product.

### **2.4 Modifications**

No modifications were made by US Tech, to bring the EUT into compliance with FCC Part 15, Class B Limits for the transmitter portion of the EUT or the Class A Digital Device Requirements.

**FIGURE 1**  
**TEST CONFIGURATION**



**Test Date:** January 15, 1998  
**UST Project:** 98-672  
**Customer:** Computational Systems, Incorporated  
**Model:** RF Smart Sensor, 4100, 001 Eng. Proto

**FIGURE 2a**

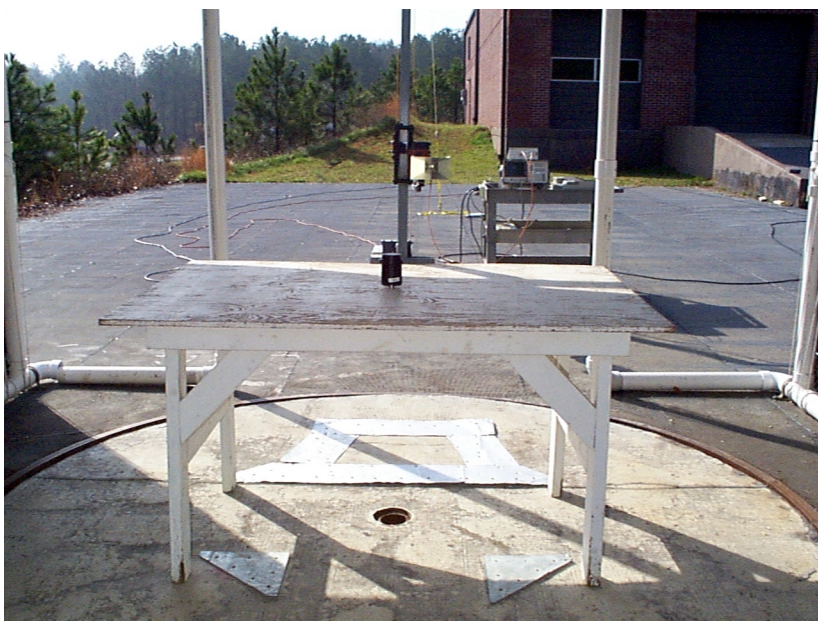
**Photograph(s) for Spurious Emissions (Front)**



**Test Date:** January 15, 1998  
**UST Project:** 98-672  
**Customer:** Computational Systems, Incorporated  
**Model:** RF Smart Sensor, 4100, 001 Eng. Proto

**FIGURE 2b**

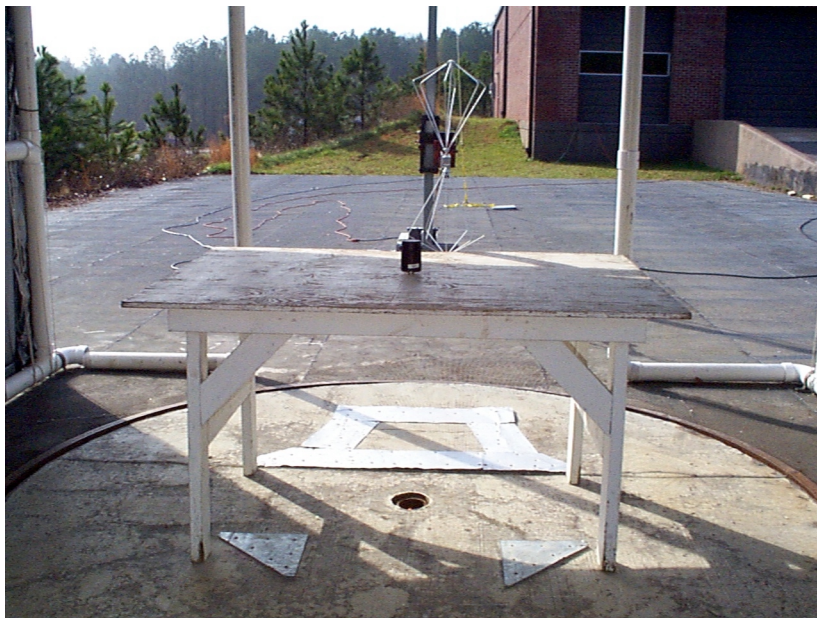
**Photograph(s) for Spurious Emissions (Back)**



**Test Date:** January 15, 1998  
**UST Project:** 98-672  
**Customer:** Computational Systems, Incorporated  
**Model:** RF Smart Sensor, 4100, 001 Eng. Proto

**FIGURE 2c**

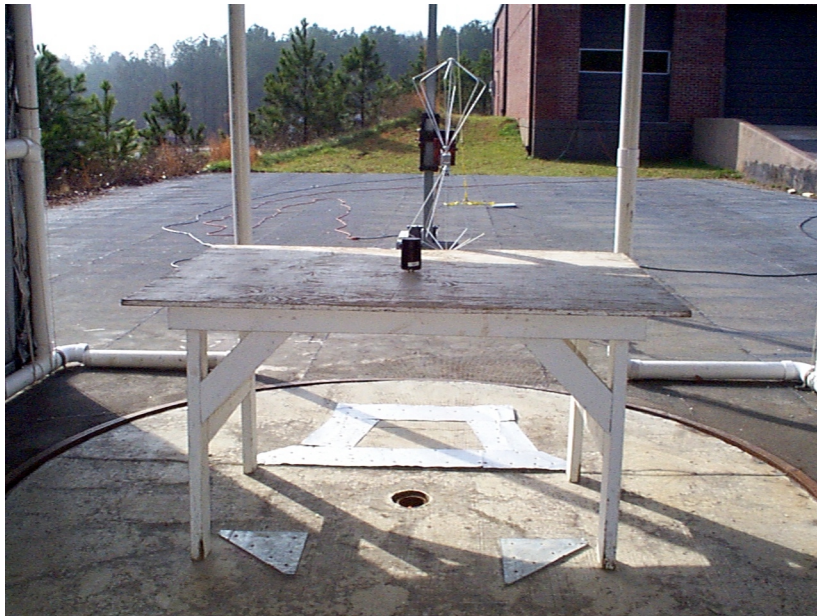
**Photograph(s) for Digital Device Emissions (Front)**



**Test Date:** January 15, 1998  
**UST Project:** 98-672  
**Customer:** Computational Systems, Incorporated  
**Model:** RF Smart Sensor, 4100, 001 Eng. Proto

**FIGURE 2d**

**Photograph(s) for Digital Device Emissions (Back)**



**TABLE 1****EUT and Peripherals**

| <b>PERIPHERAL<br/>MANUFACTURER</b>                                | <b>MODEL<br/>NUMBER</b> | <b>SERIAL<br/>NUMBER</b>                  | <b>FCC ID:</b>       | <b>CABLES<br/>P/D</b> |
|-------------------------------------------------------------------|-------------------------|-------------------------------------------|----------------------|-----------------------|
| Transmitter<br>Computational<br>Systems,<br>Incorporated<br>(EUT) | 4100                    | 14427, 14424,<br>14399, 14411, &<br>14396 | NL54100<br>(Pending) | None                  |

**TABLE 2**  
**TEST INSTRUMENTS**

| TYPE                 | MANUFACTURER    | MODEL    | SN.           |
|----------------------|-----------------|----------|---------------|
| SPECTRUM ANALYZER    | HEWLETT-PACKARD | 8593E    | 3205A00124    |
| SPECTRUM ANALYZER    | HEWLETT-PACKARD | 8558B    | 2332A09900    |
| S A DISPLAY          | HEWLETT-PACKARD | 853A     | 2404A02387    |
| COMB GENERATOR       | HEWLETT-PACKARD | 8406A    | 1632A01519    |
| RF PREAMP            | HEWLETT-PACKARD | 8447D    | 1937A03355    |
| RF PREAMP            | HEWLETT-PACKARD | 8449B    | 3008A00480    |
| HORN ANTENNA         | EMCO            | 3115     | 3723          |
| BICONICAL ANTENNA    | EMCO            | 3110     | 9307-1431     |
| LOG PERIODIC ANTENNA | EMCO            | 3146     | 9110-3600     |
| BILOG                | CHASE           | CBL6112A | 2238          |
| LISN                 | SOLAR ELE.      | 8012     | 865577        |
| LISN                 | SOLAR ELE.      | 8028     | 910494        |
| LISN                 | SOLAR ELE.      | 8028     | 910495        |
| THERMOMETER          | FLUKE           | 52       | 5215250       |
| MULTIMETER           | FLUKE           | 85       | 53710469      |
| FUNCTION GENERATOR   | TEKTRONIX       | CFG250   | CFG250TW15059 |
| PLOTTER              | HEWLETT-PACKARD | 7475A    | 2325A65394    |

## **2.6 Antenna Description (Paragraph 15.203)**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The Model Computational Systems, Incorporated RF Smart Sensor, 4100, 001 Eng. Proto incorporates an internal antenna only.

Manufacturer: Cushcraft Corporation  
48 Perimeter Road  
P.O. Box 4680  
Manchester, NH 03108

Type: Offset Patch

Model Number: Custom Made

Gain: 0 dBd

Connector: Hirose H.FL-R

**2.7 Peak power within the band 2400-2483.5 MHz per FCC Section 15.247(b)**

Peak power within the band 2400 – 2483.5 MHz has been measured with a spectrum analyzer by connecting the spectrum analyzer directly via a short cable to the antenna output terminals or across the antenna leads on the PCB as specified by the manufacturer. The results of the measurements are given in Table 3 and Figure 3a through Figure 3c. The spectrum analyzer did not have a RBW greater than the 6 dB bandwidth for the largest Fundamental Bandwidth, therefore this data was taken using the channel power function of the spectrum analyzer.

The EUT did not incorporate any antennas of directional gain greater than 6 dBi, therefore the output power has not been reduced as required by 15.247(b)(3).

**TABLE 3**  
**PEAK POWER OUTPUT**

**Test Date:** January 15, 1998  
**UST Project:** 98-672  
**Customer:** Computational Systems, Incorporated  
**Model:** RF Smart Sensor, 4100, 001 Eng. Proto

| Frequency of Fundamental (MHz) | Measurement (dBm)* | Measurement (Watt)* | FCC Limit (Watt) |
|--------------------------------|--------------------|---------------------|------------------|
| 2.42250                        | 18.17              | 0.0656              | 1.0              |
| 2.43250                        | 17.14              | 0.0518              | 1.0              |
| 2.45250                        | 17.07              | 0.0590              | 1.0              |

\* Measurement includes 1.25 cable loss

**Tester**  
**Signature:** \_\_\_\_\_ **Name:** Tim R. Johnson

Figure 3a.  
Peak Power per FCC Section 15.247(b) (Low)

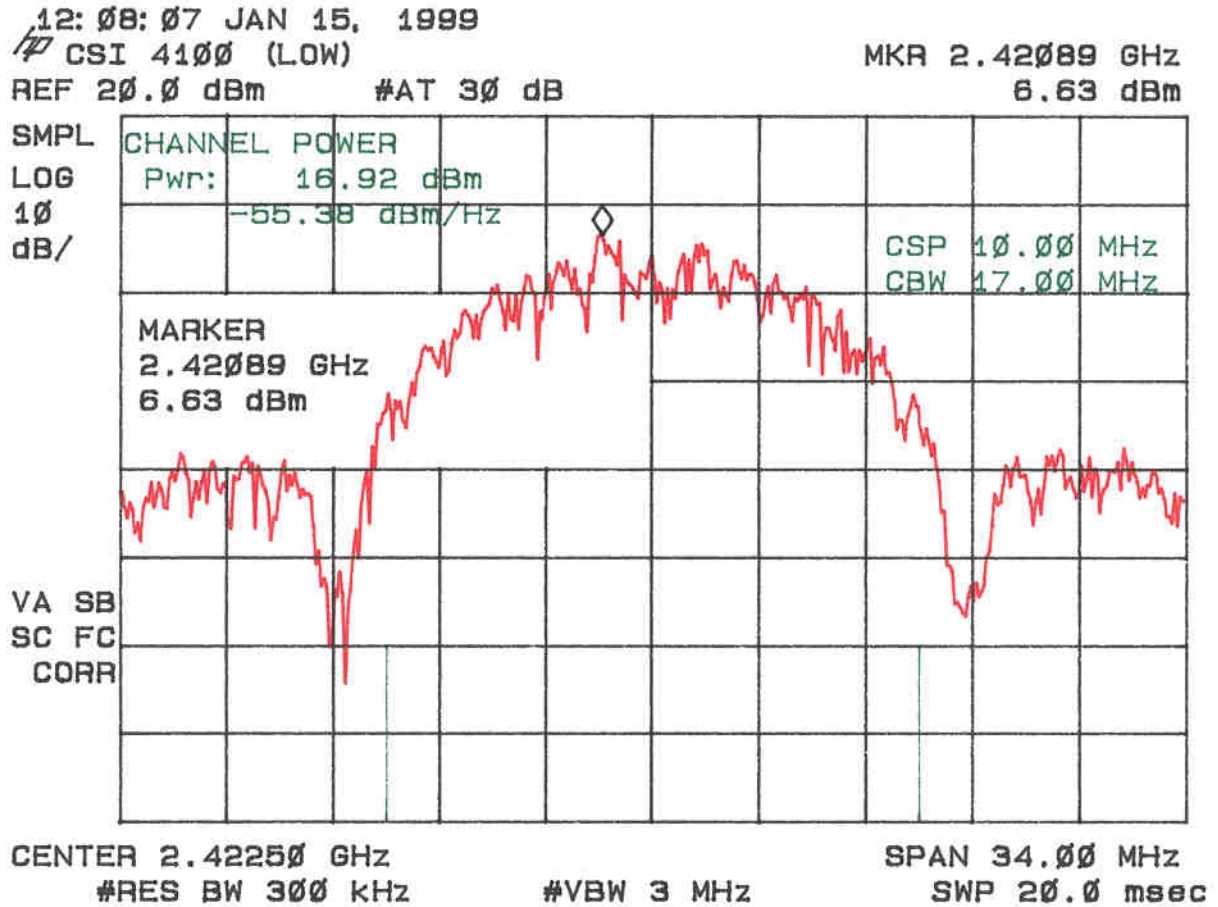


Figure 3b.  
Peak Power per FCC Section 15.247(b) (Mid)

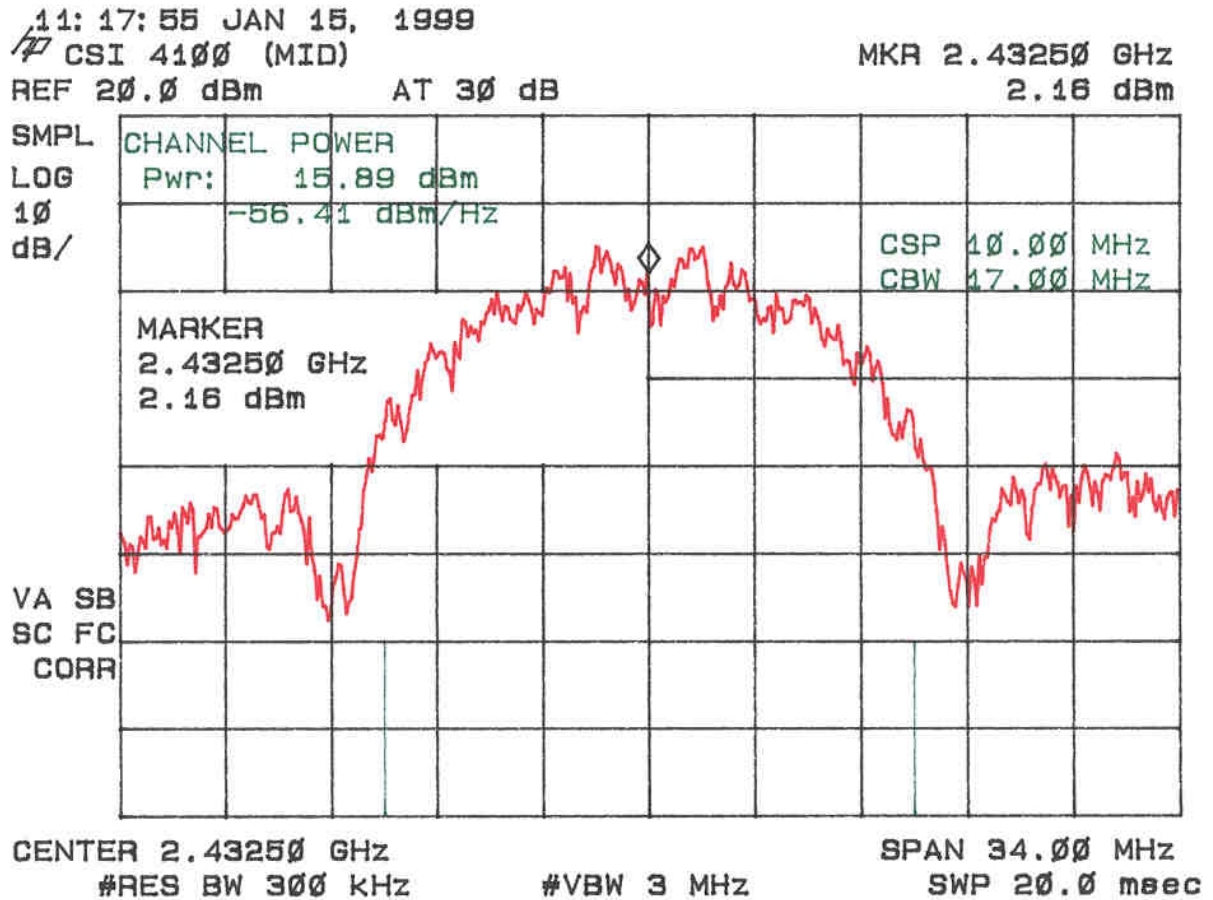
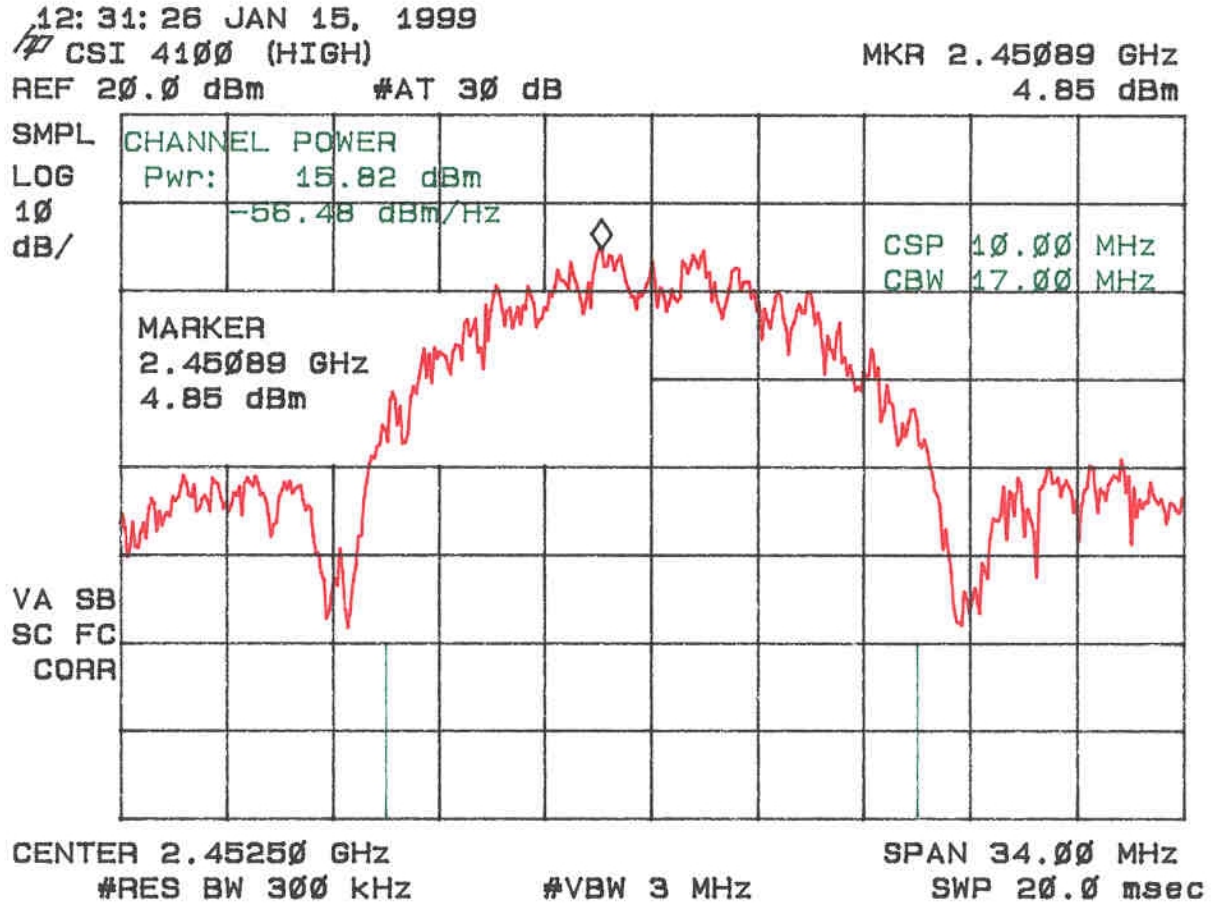


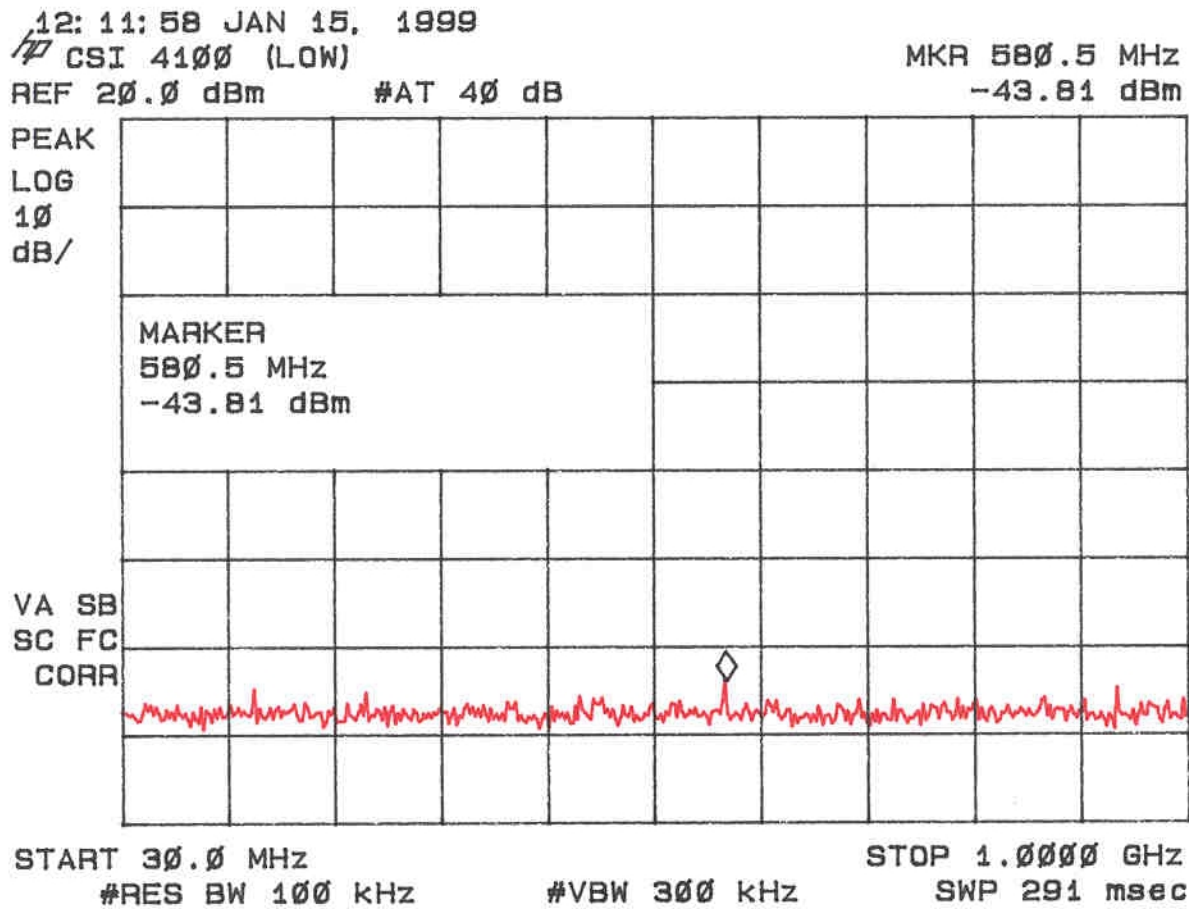
Figure 3c.  
Peak Power per FCC Section 15.247( b) (High)



## **2.8 Antenna Conducted Spurious Emission in the Frequency Range 30 - 25000 MHz (FCC Section 15.247(c))**

Spurious emissions in the frequency range 30 - 25000 have been measured with a spectrum analyzer by connecting the spectrum analyzer directly via a short cable to the antenna output terminals or across the antenna leads on the PCB as specified by the manufacturer. The spectrum analyzer was set for a 50  impedance with the RBW = 100 kHz & VBW > RBW. All spurious emissions were measured to be greater than 20 dB down from the fundamental. The results of conducted spurious emissions are given in Figure 4a through Figure 4l.

Figure 4a  
Conducted Spurious Emission 15.247(c) Low



**Figure 4b**  
**Conducted Spurious Emission 15.247(c) Low**

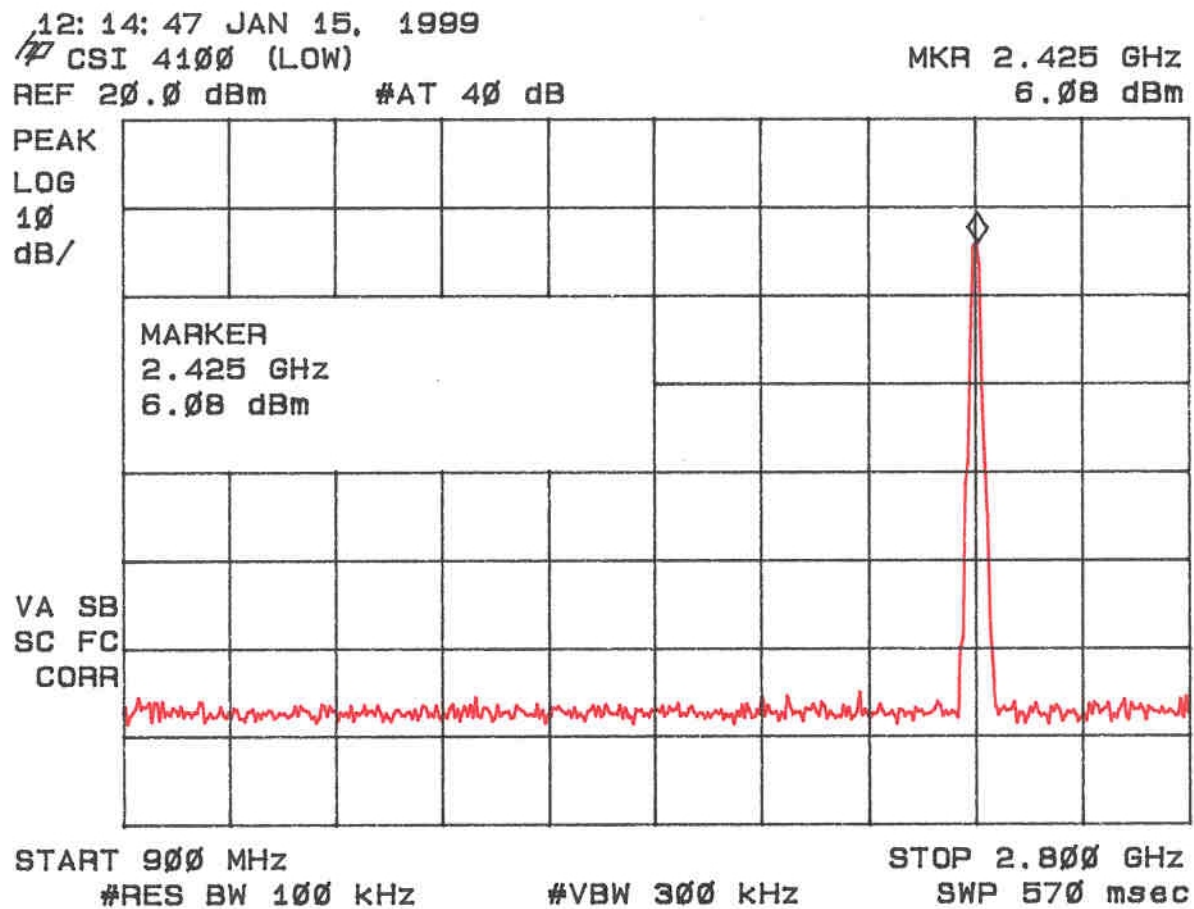


Figure 4c  
Conducted Spurious Emission 15.247(c) Low

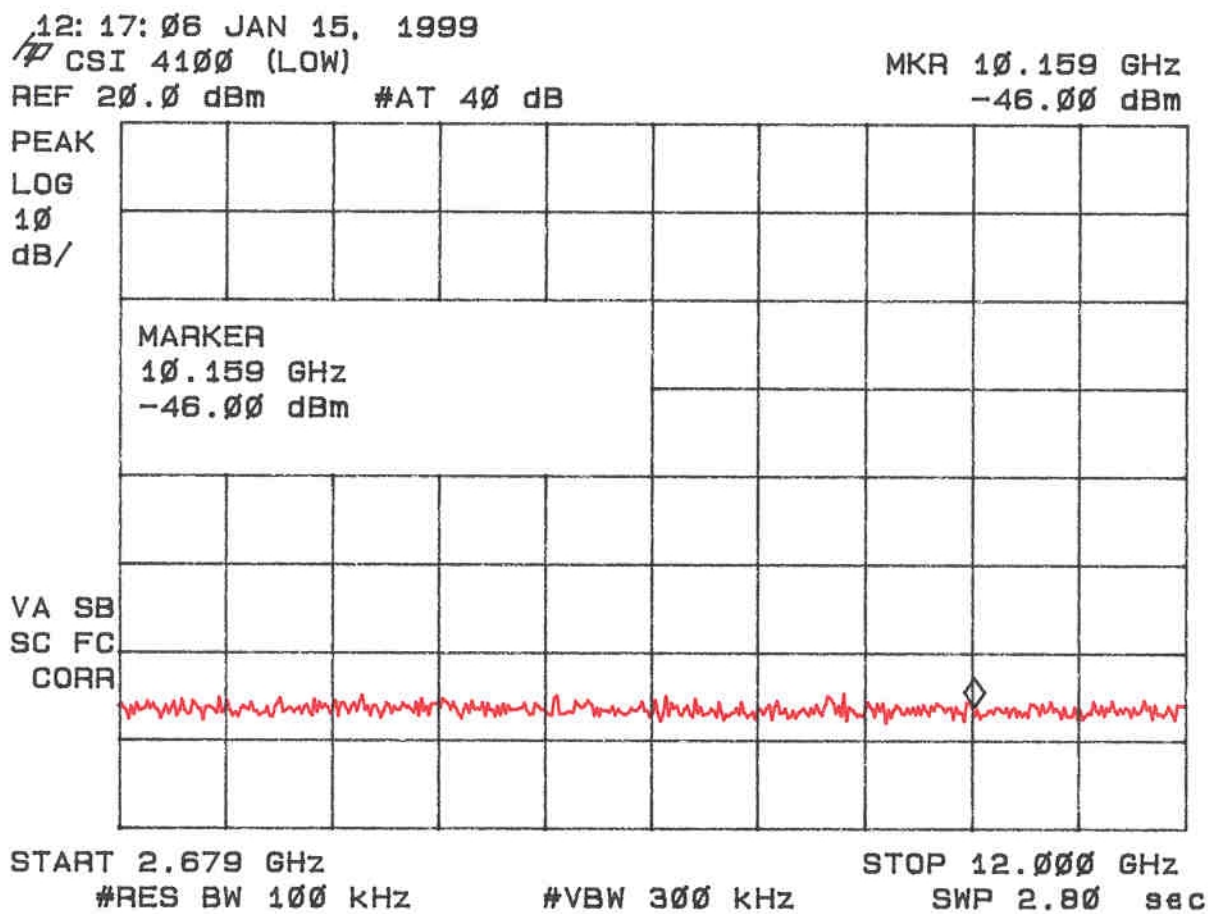
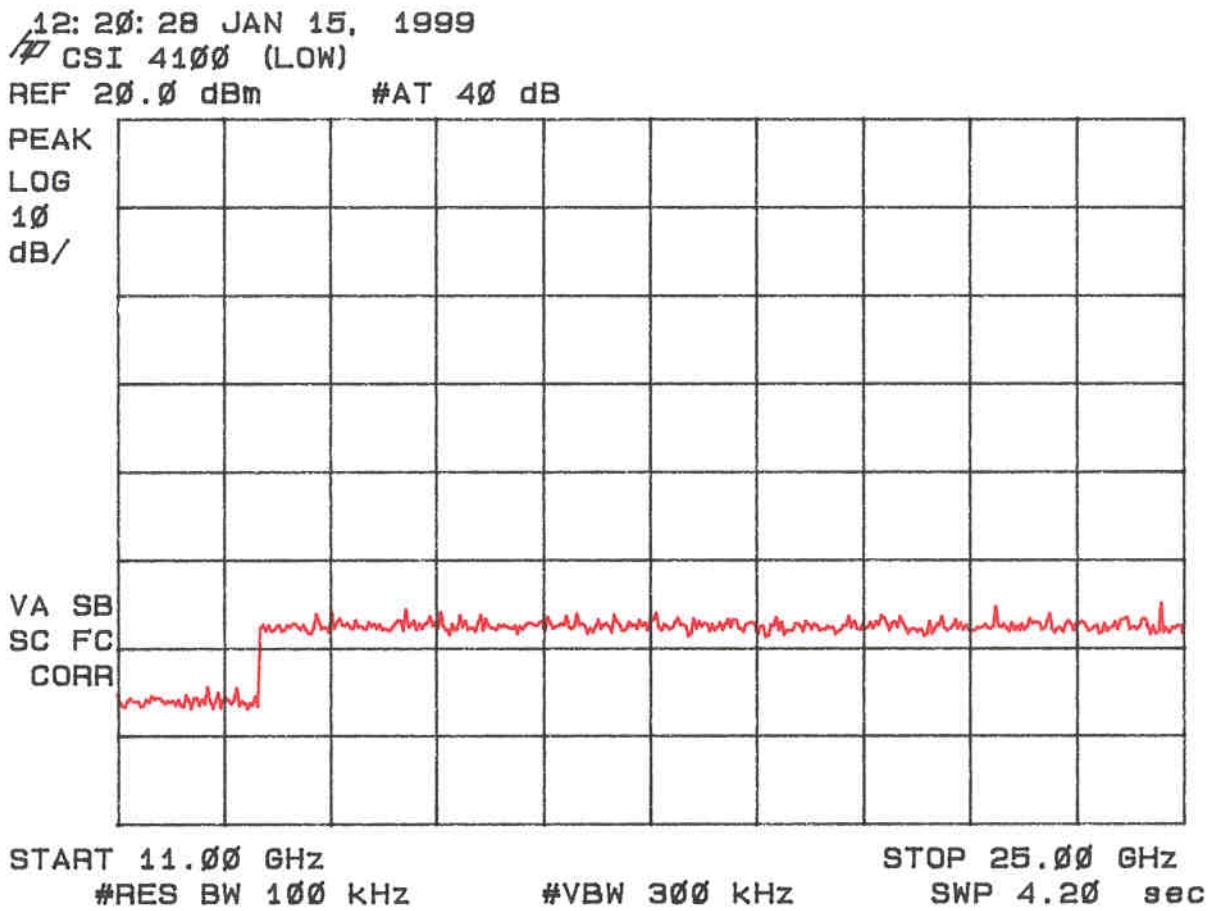


Figure 4d  
Conducted Spurious Emission 15.247(c) Low



**Figure 4e**  
**Conducted Spurious Emission 15.247(c) Mid**

11: 41: 45 JAN 15, 1999

CSI 4100 (MID)

REF 20.0 dBm

#AT 40 dB

MKR 580.5 MHz

-44.68 dBm

PEAK  
LOG  
10  
dB/MARKER  
580.5 MHz  
-44.68 dBmVA SB  
SC FC  
CORR

START 30.0 MHz

#RES BW 100 kHz

#VBW 300 kHz

STOP 1.0000 GHz

SWP 291 msec

**Figure 4f**  
**Conducted Spurious Emission 15.247(c) Mid**

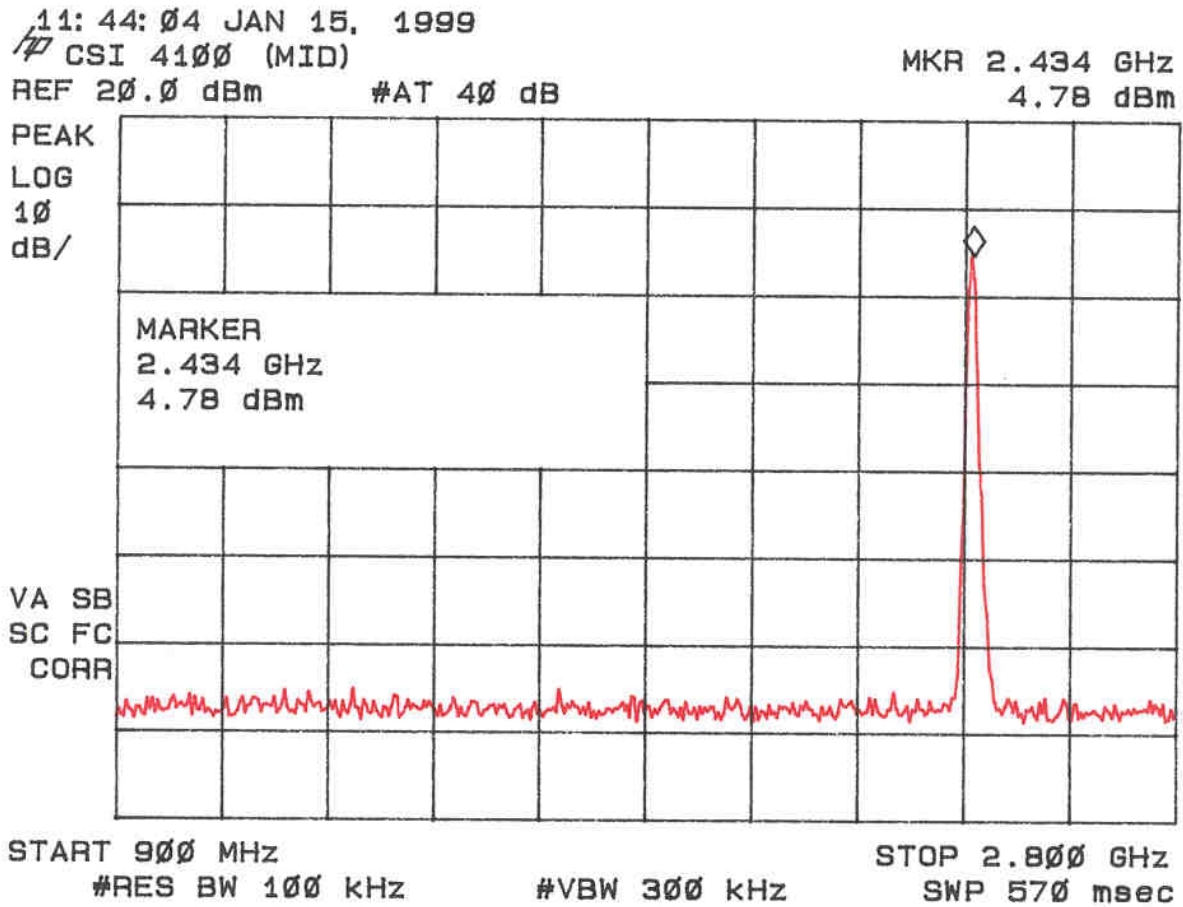


Figure 4g  
Conducted Spurious Emission 15.247(c) Mid

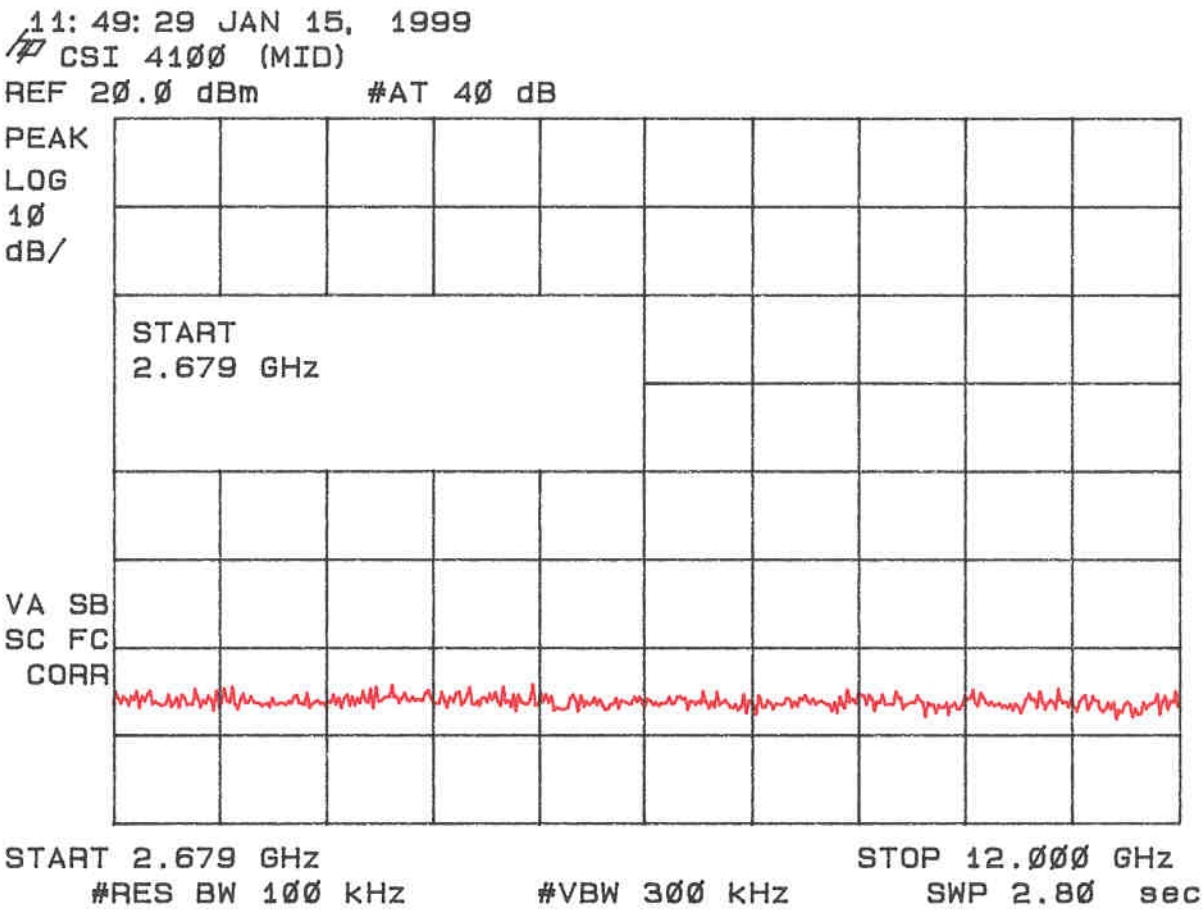


Figure 4h  
Conducted Spurious Emission 15.247(c) Mid

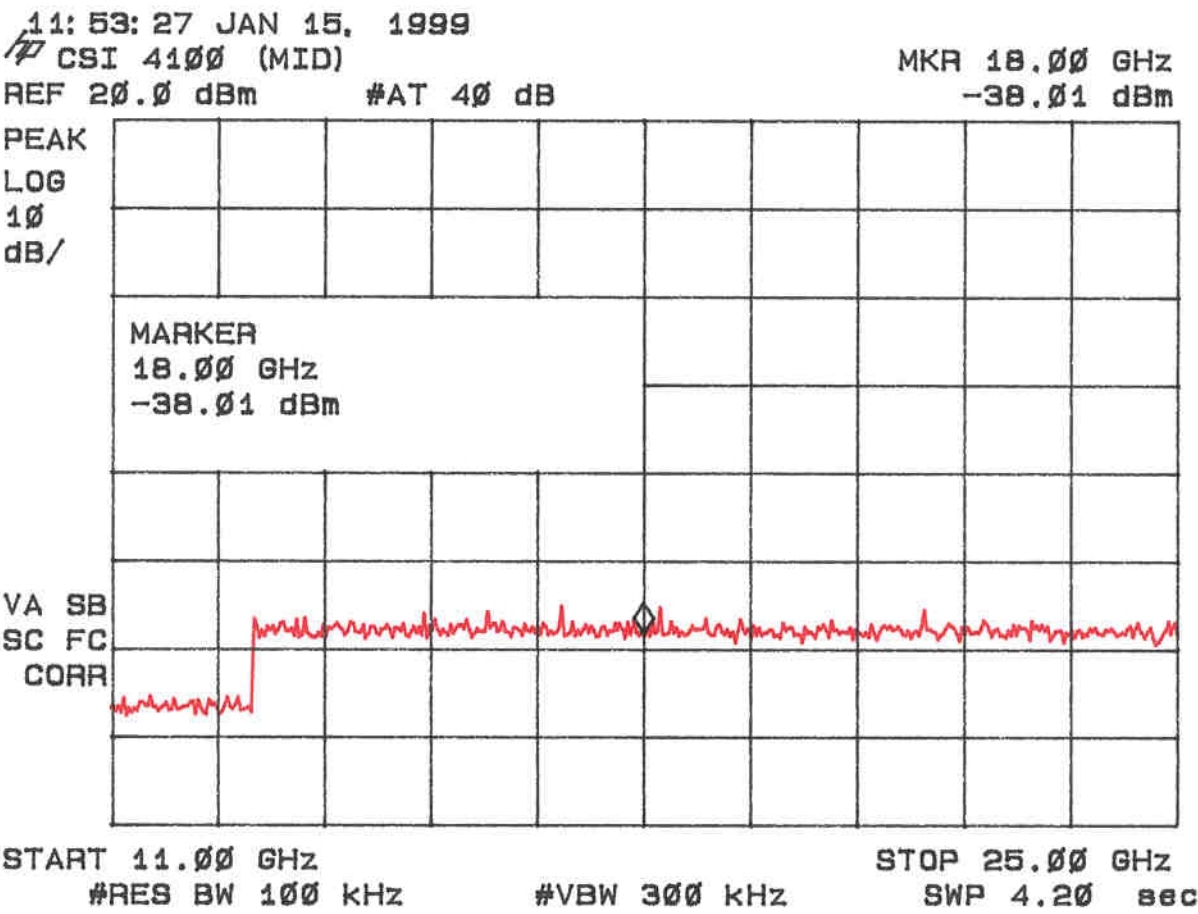
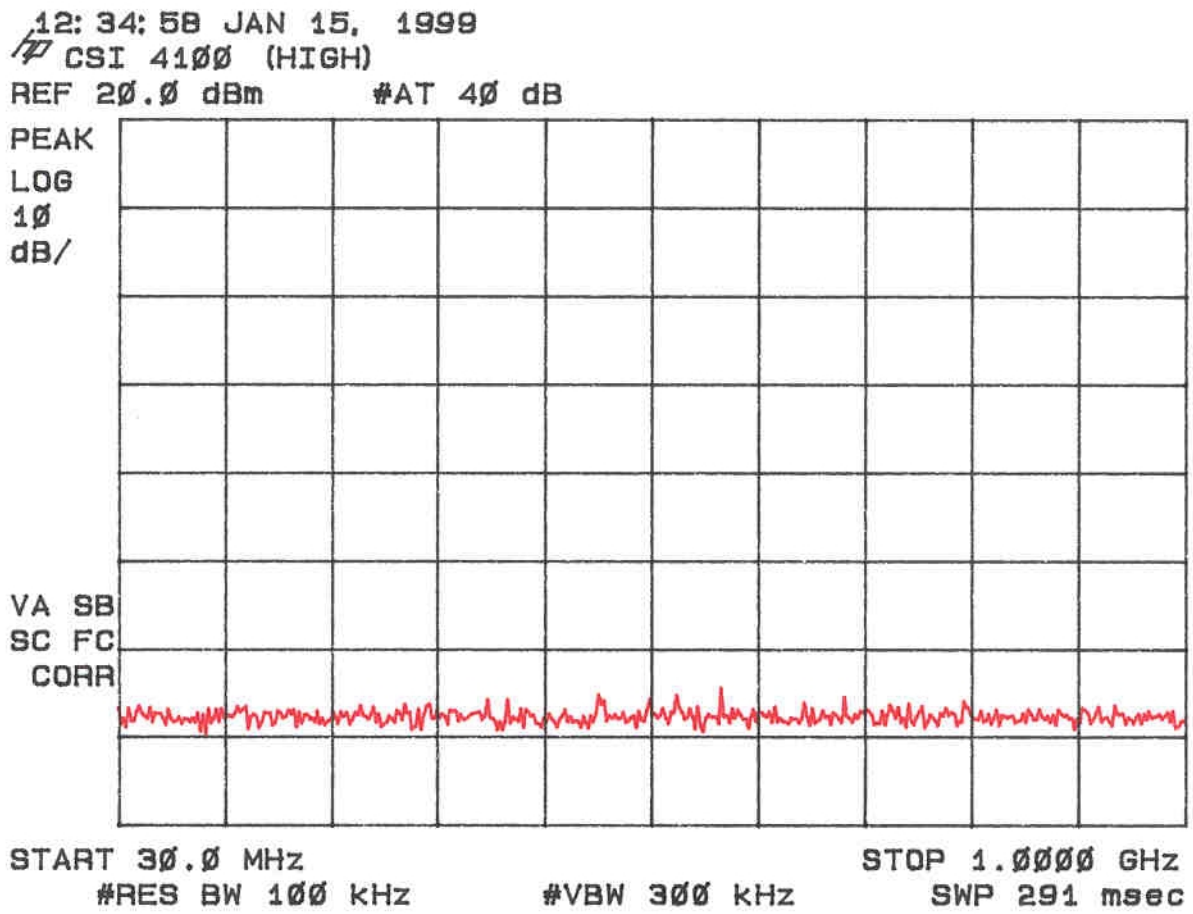


Figure 4i  
Conducted Spurious Emission 15.247(c) High



**Figure 4j**  
**Conducted Spurious Emission 15.247(c) High**

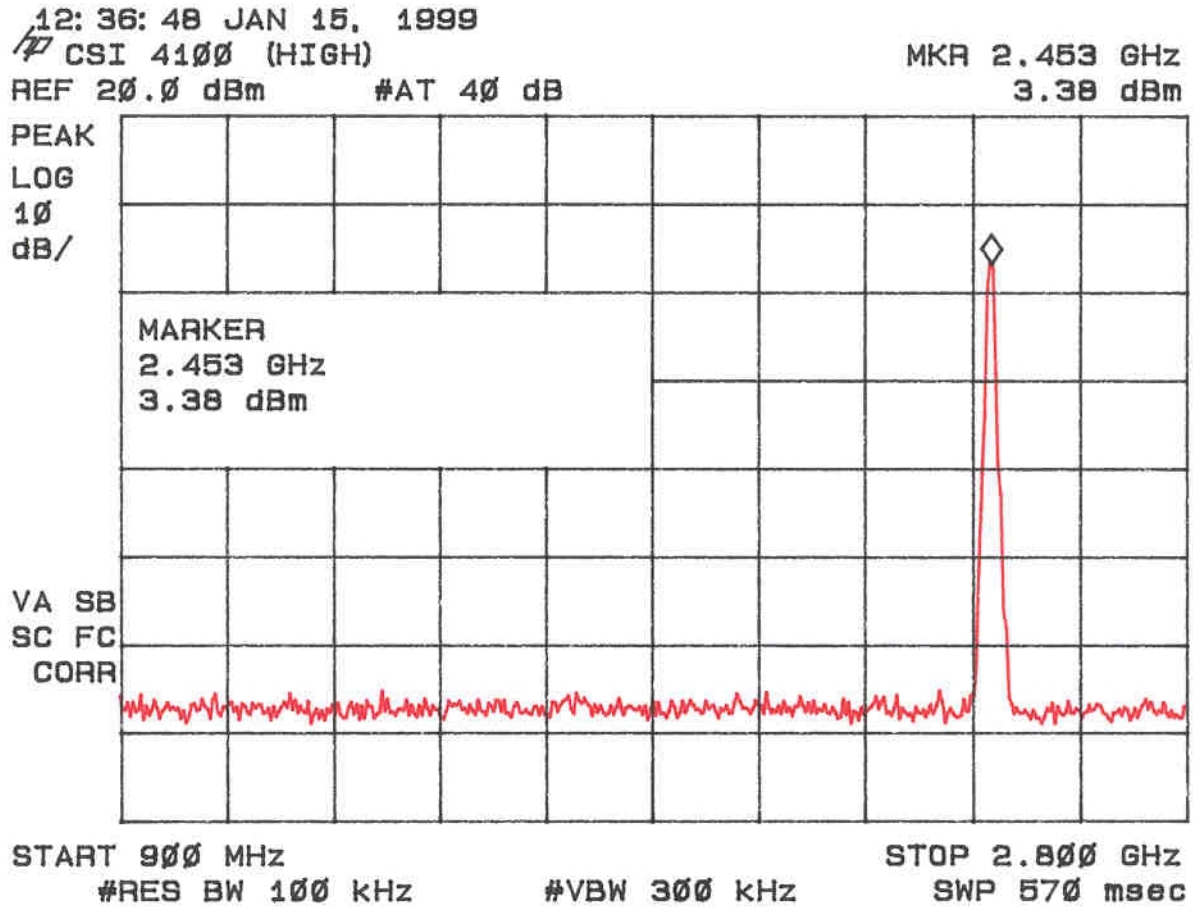


Figure 4k  
Conducted Spurious Emission 15.247(c) High

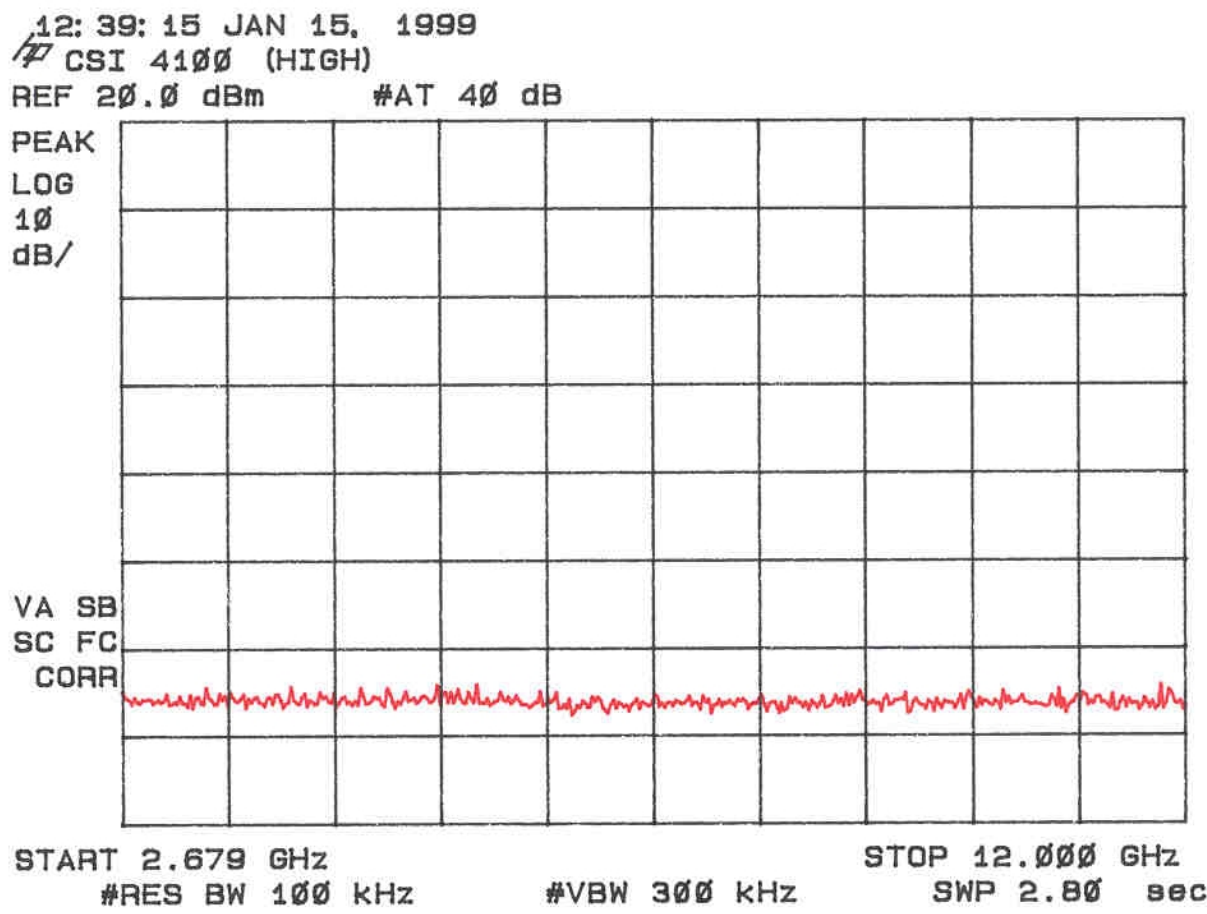


Figure 4I  
Conducted Spurious Emission 15.247(c) High

