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 Ω impedance with the RBW = 100 kHz. 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
Antenna Conducted Spurious Emissions 15.247(c) Low

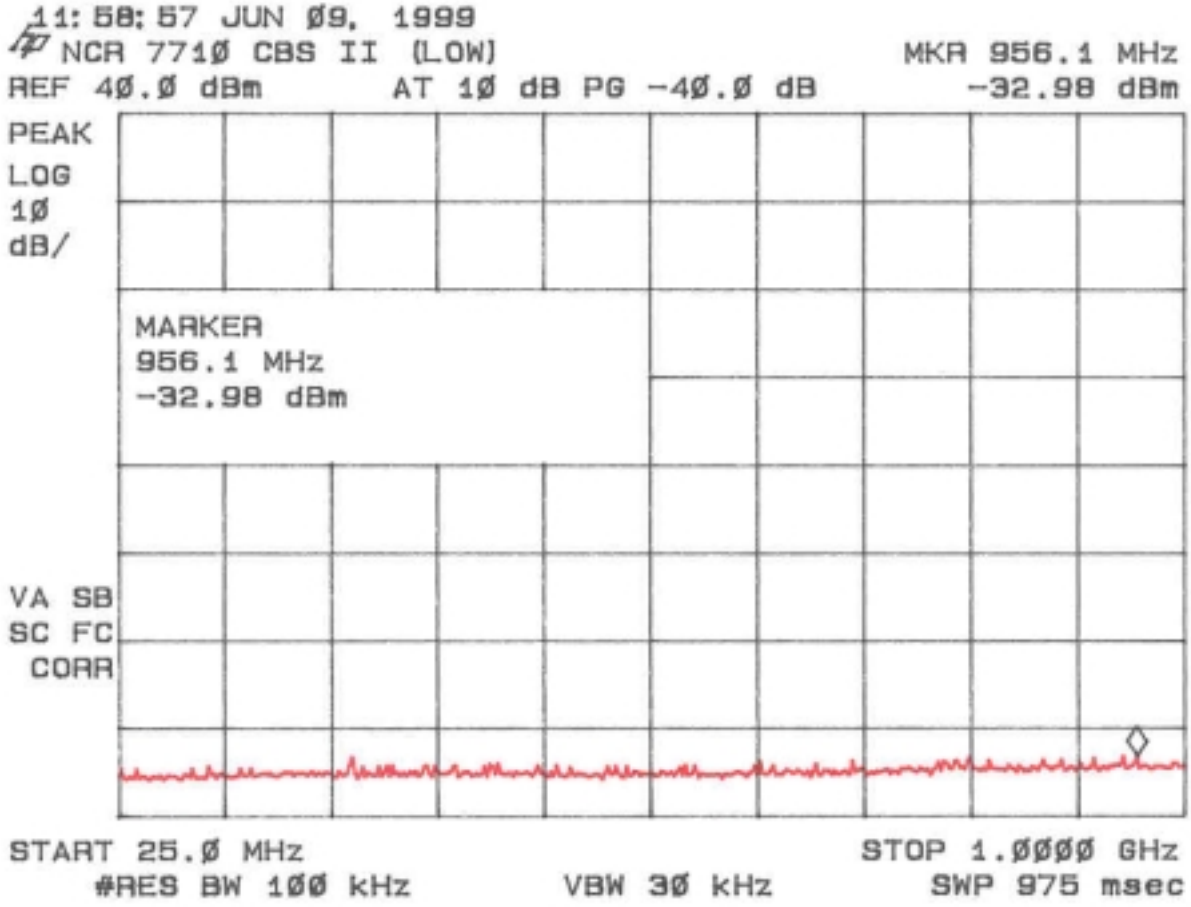


Figure 4b
Antenna Conducted Spurious Emissions 5.247(c) Low

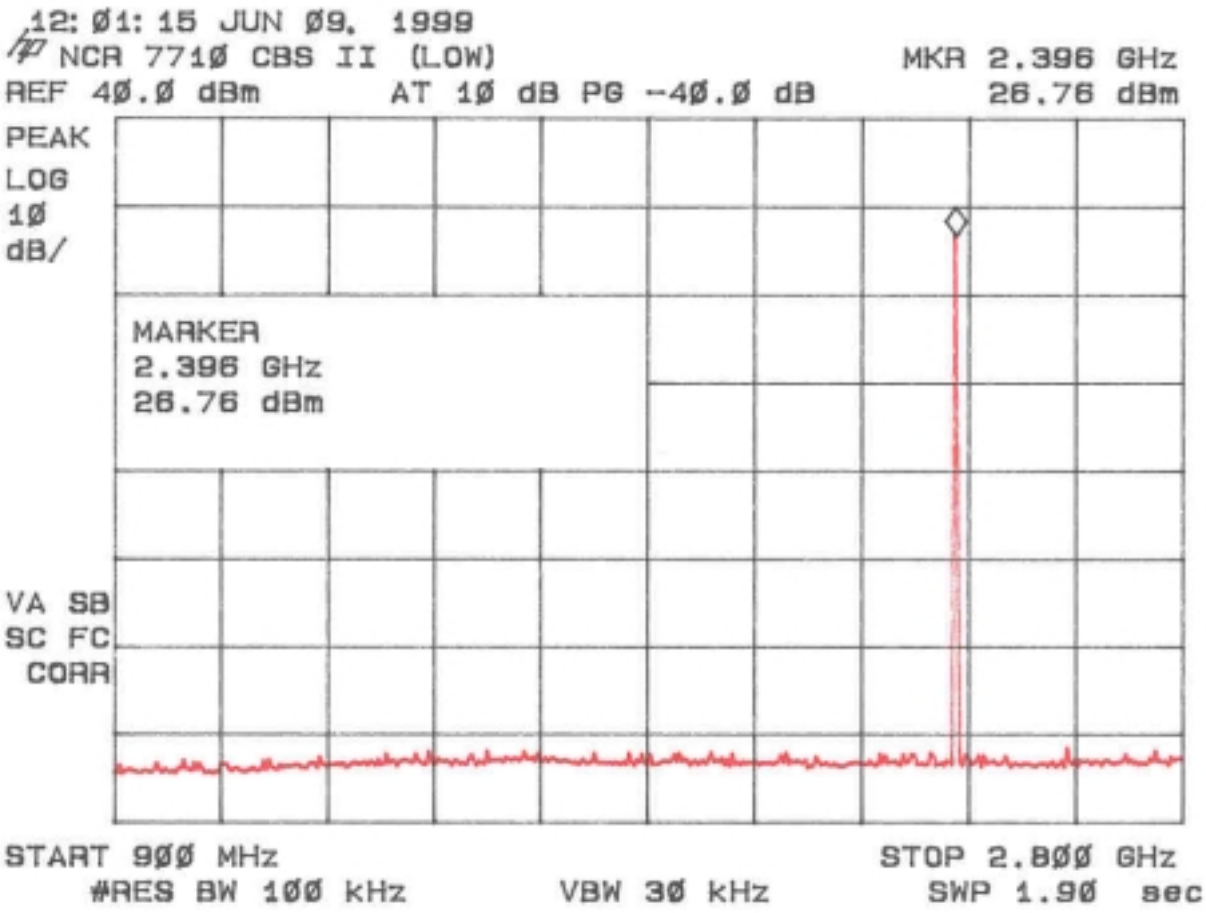


Figure 4c
Antenna Conducted Spurious Emissions 15.247(c) Low

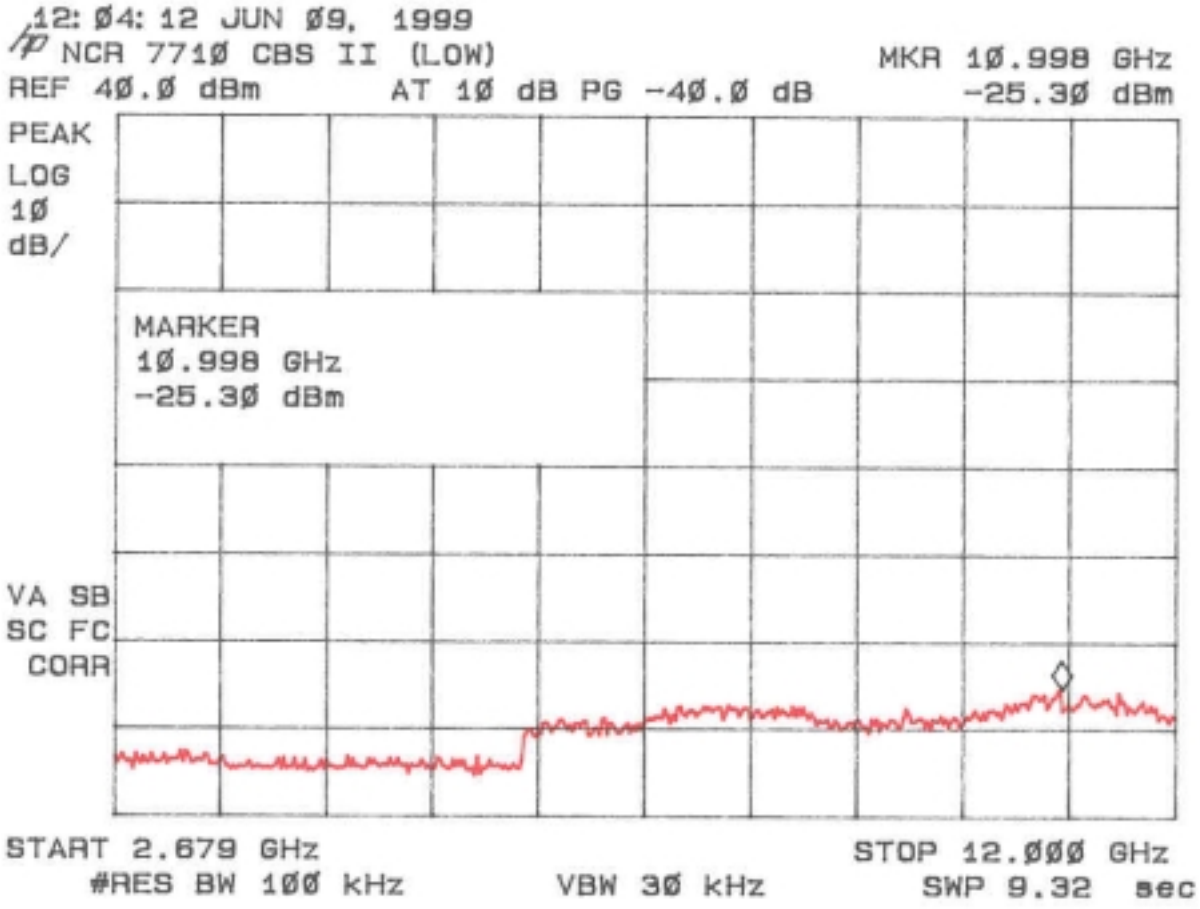


Figure 4d
Antenna Conducted Spurious Emissions 15.247(c) Low

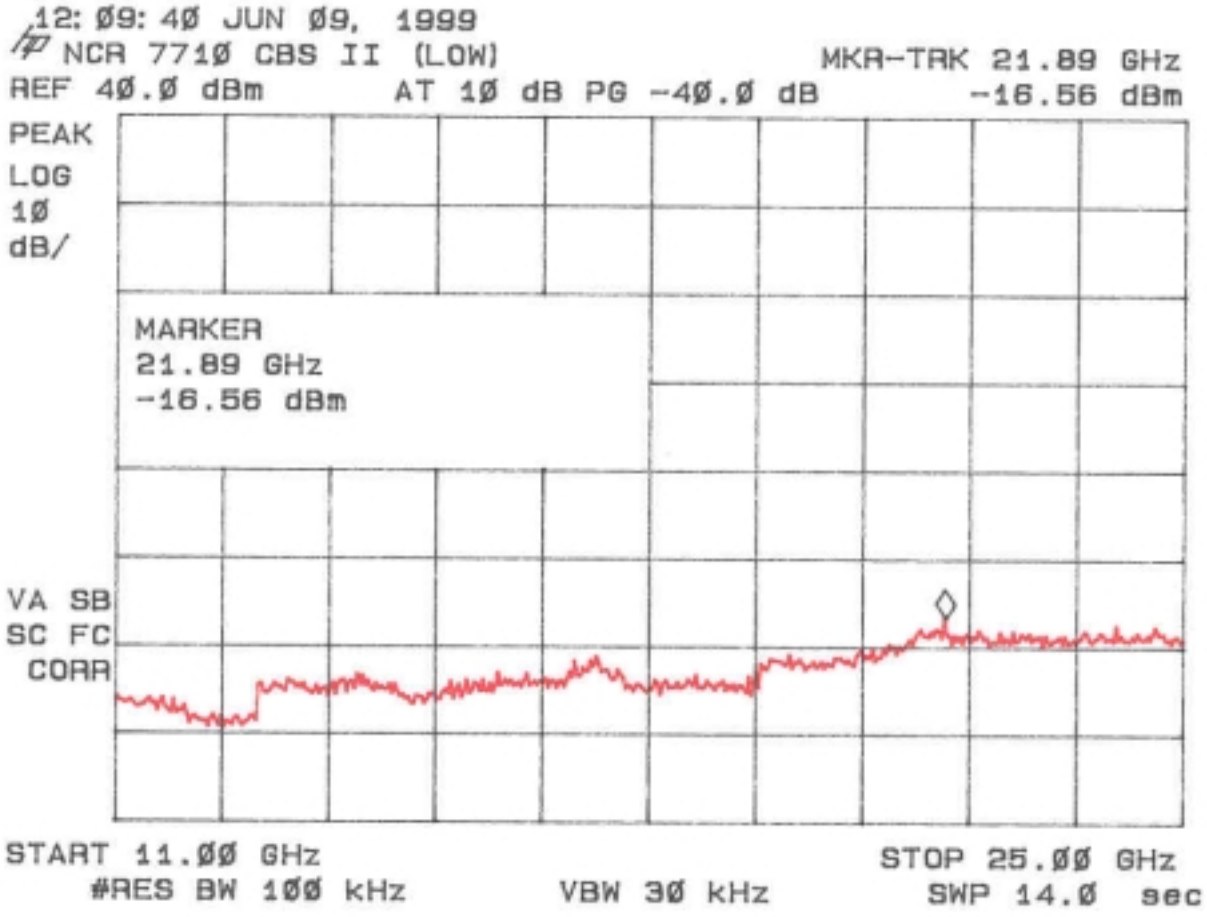


Figure 4e
Antenna Conducted Spurious Emissions 15.247(c) Mid

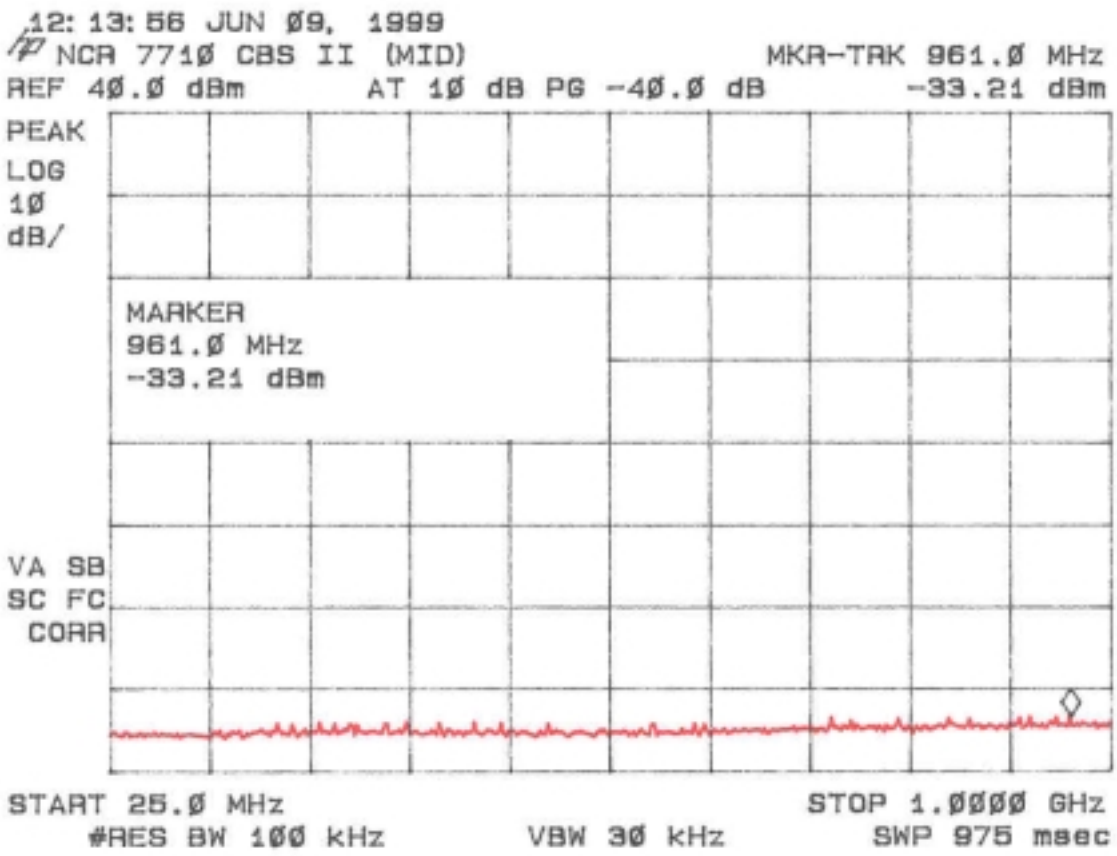


Figure 4f
Antenna Conducted Spurious Emissions 15.247(c) Mid

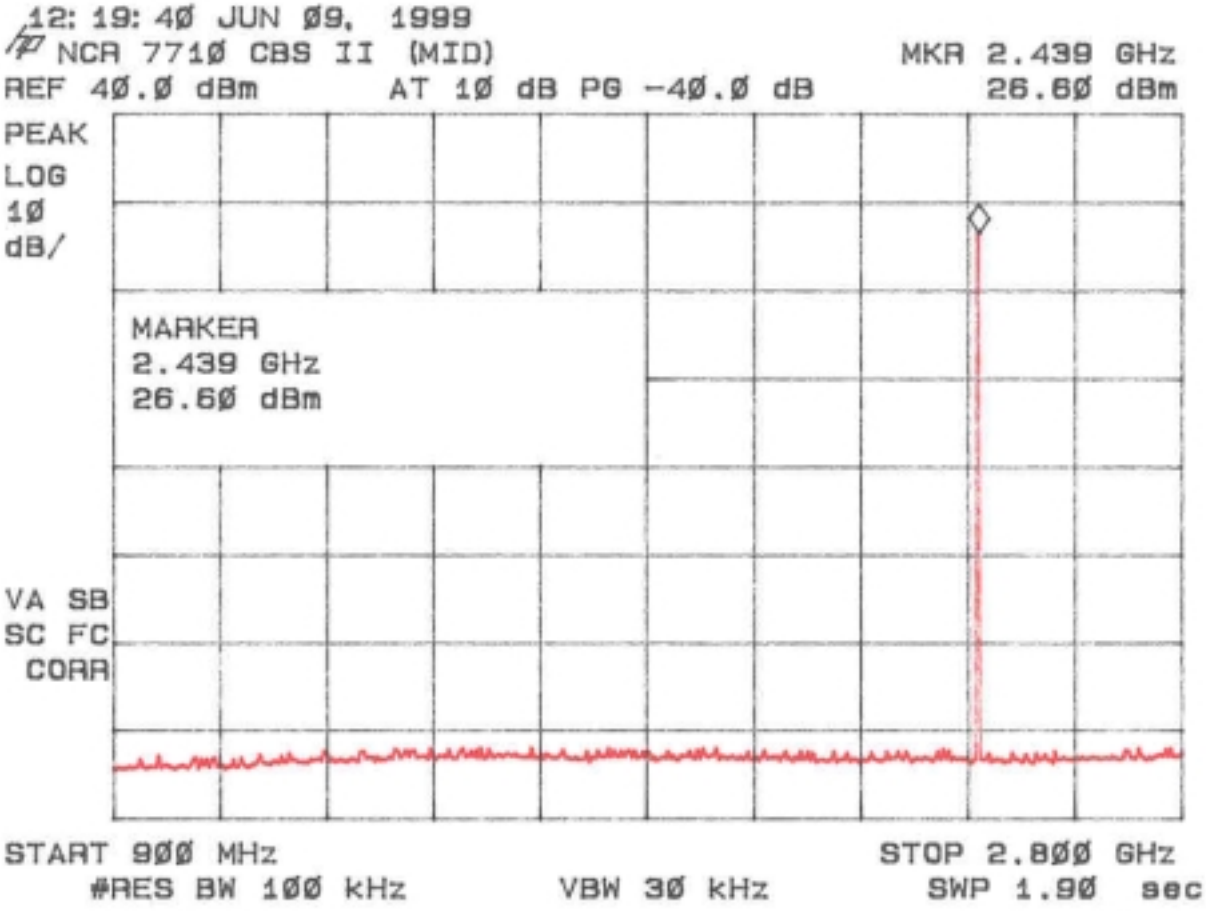


Figure 4g
Antenna Conducted Spurious Emissions 15.247(c) Mid

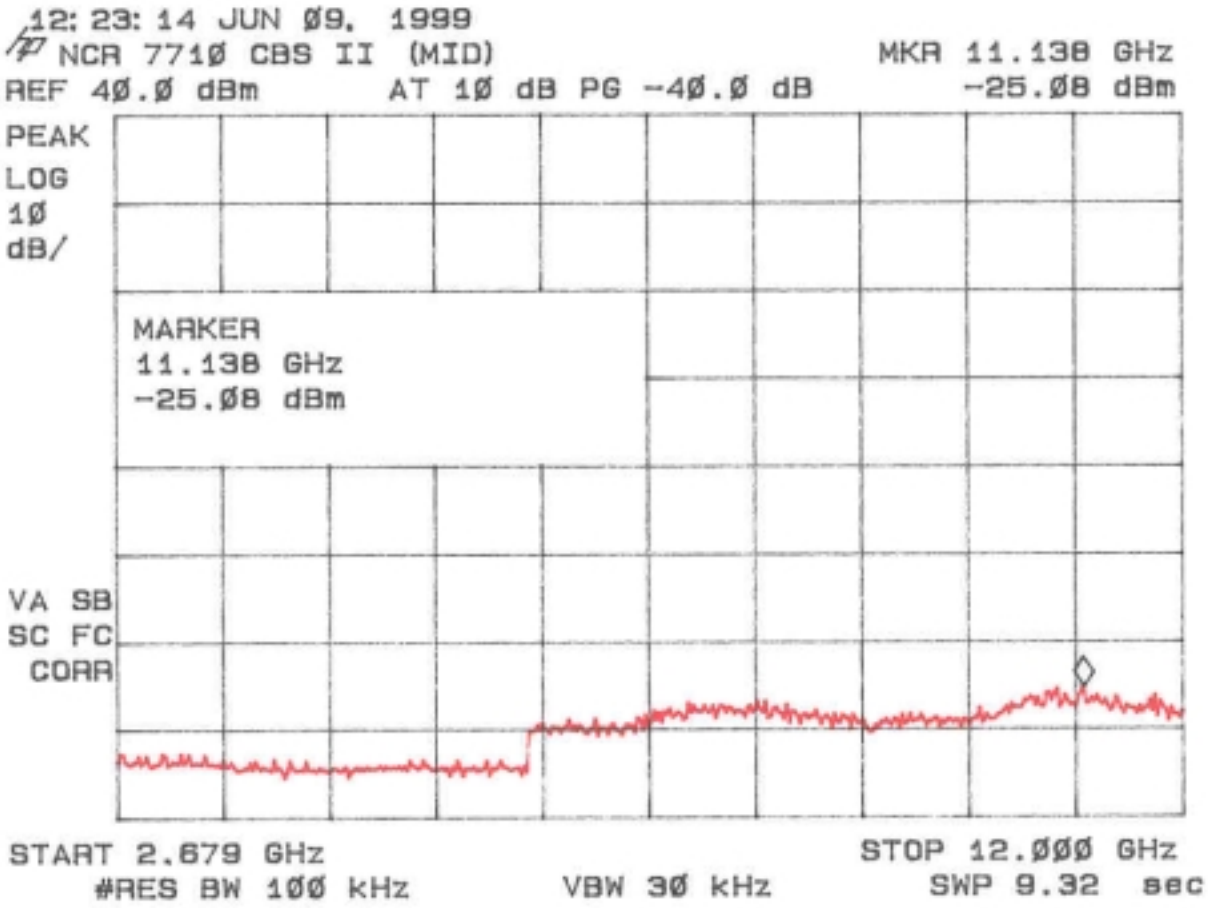


Figure 4h
Antenna Conducted Spurious Emissions 15.247(c) Mid

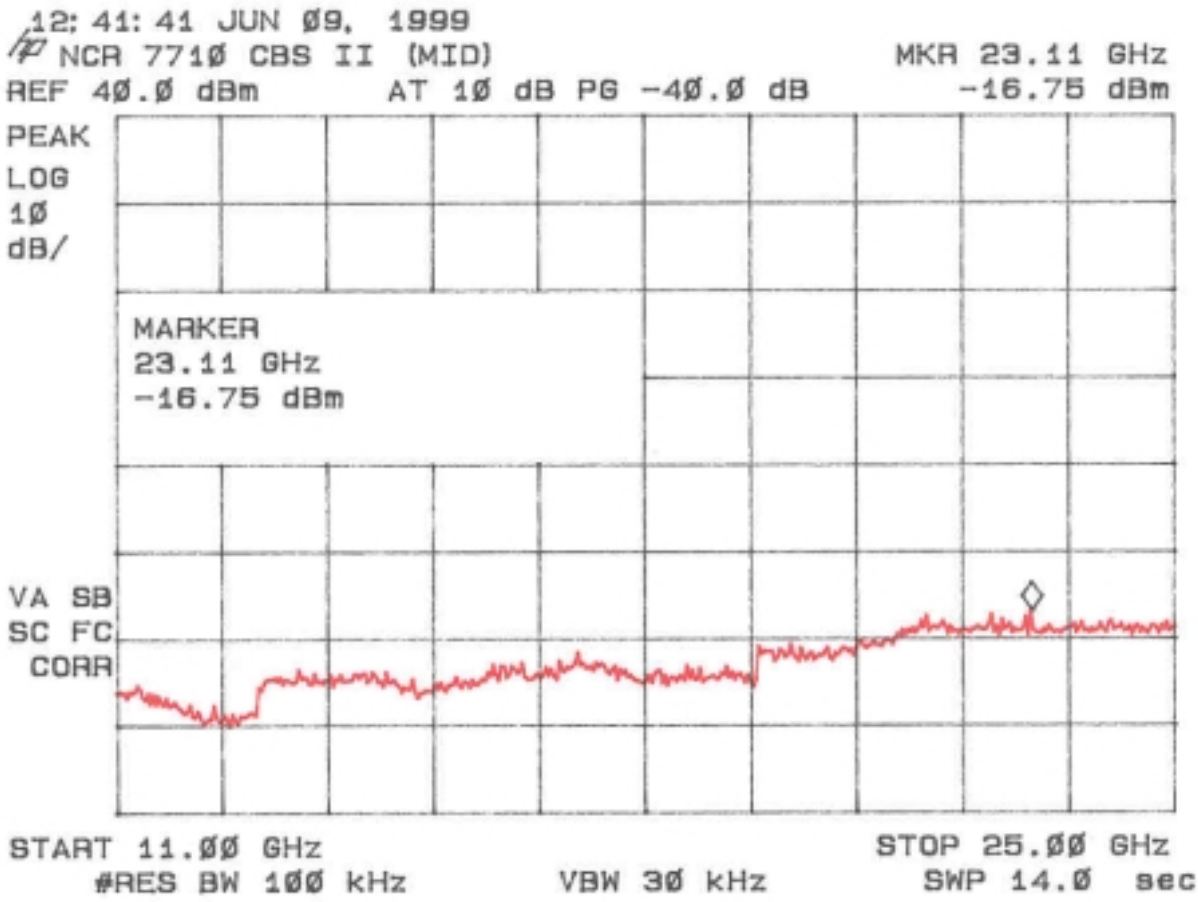


Figure 4i
Antenna Conducted Spurious Emissions 15.247(c) High

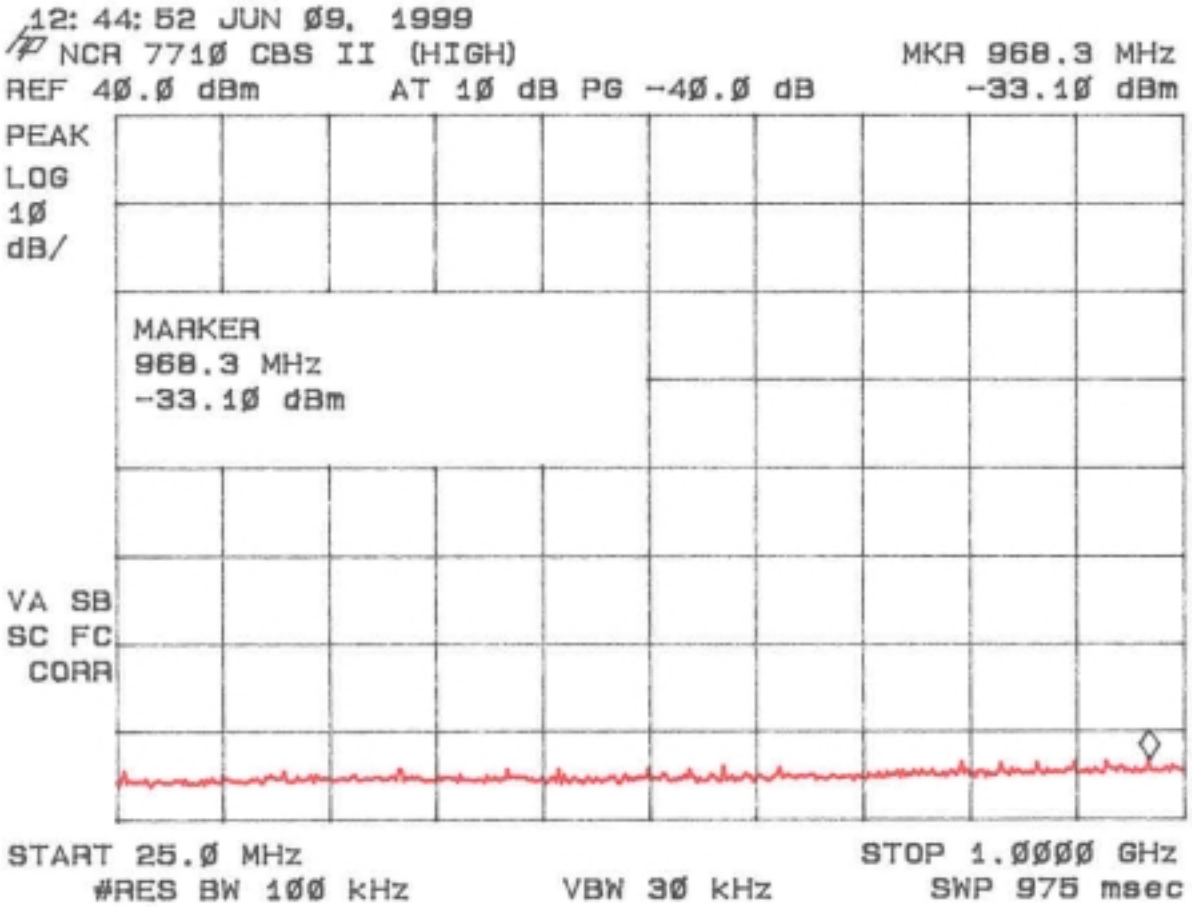


Figure 4j
Antenna Conducted Spurious Emissions 15.247(c) High

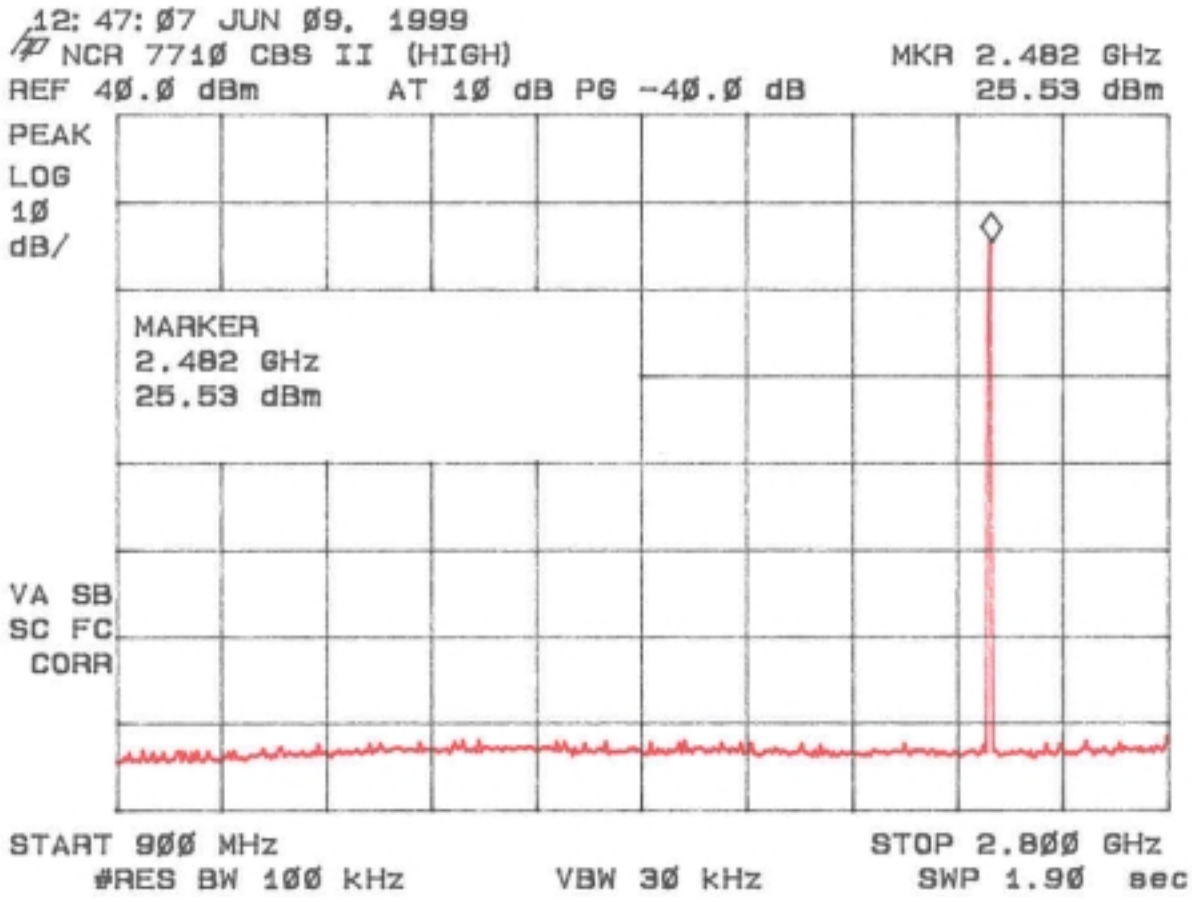


Figure 4k
Antenna Conducted Spurious Emissions 15.247(c) High

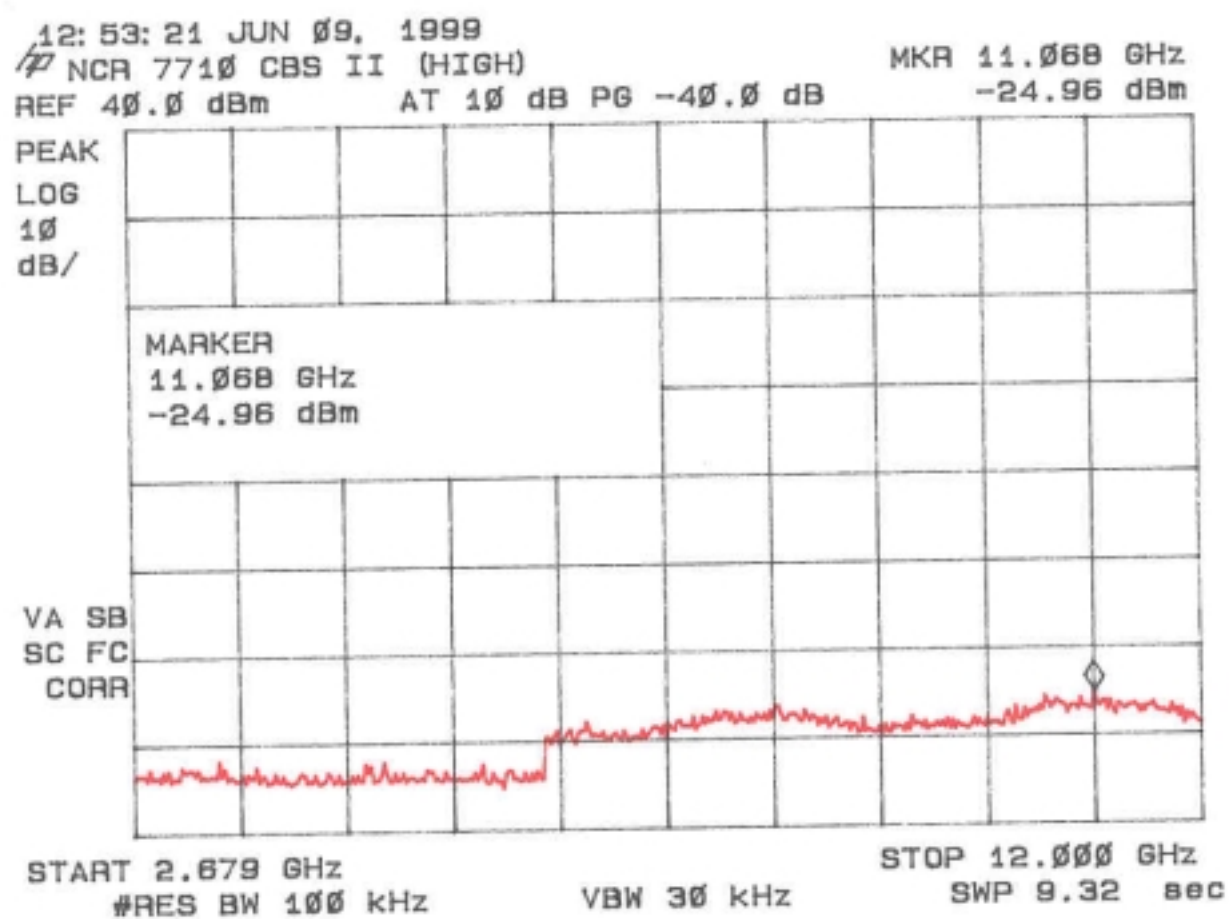
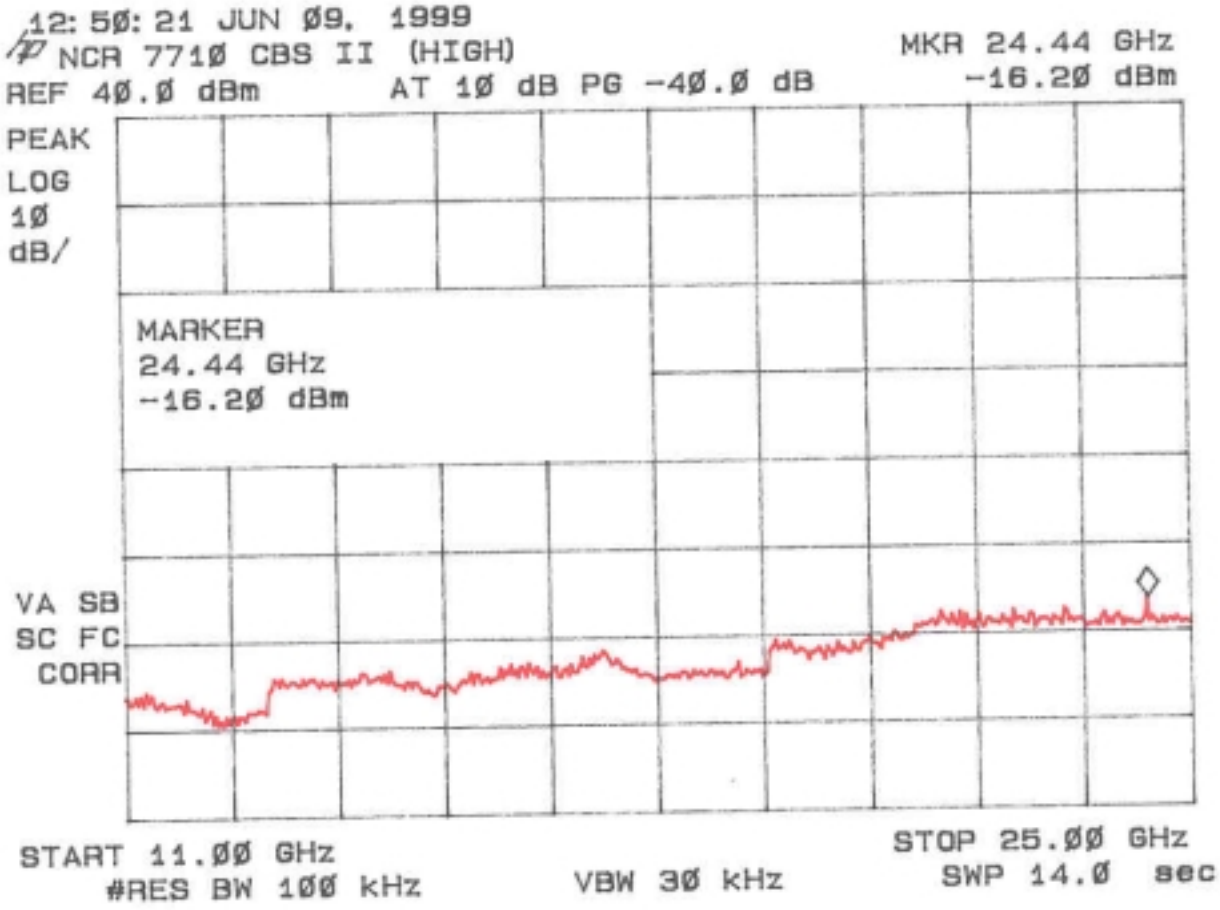


Figure 4l
Antenna Conducted Spurious Emissions 15.247(c) High



2.9 Peak Radiated Spurious Emission in the Frequency Range 30 -25000 MHz (FCC Section 15.247(c))

The EUT was hop-stopped and when possible placed into a continuous transmit mode of operation. A preliminary scan was performed on the EUT to determine frequencies that were caused by the transmitter portion of the product. Since the Digital Device portion of the unit was required to meet Class A limits, during the prescan the EUT had to be repeatedly cycled from transmit mode to idle mode in order to differentiate spurious signals from the transmitter. Significant emissions that fell within restricted bands were then measured on an OAT's site. Radiated measurements below 1 GHz were tested with a RBW = 120 kHz. Radiated measurements above 1 GHz were measured using a RBW = VBW = 1 MHz. The results of peak radiated spurious emissions falling within restricted bands are given in Table 4a (low), Table 4b, (mid), Table 4c (high) and Figure 5a-5b (low), Figure 5c-5d (mid) and Table 5e-5f (high).

Figure 5a
Peak Radiated Spurious Emission 15.247(c) Low

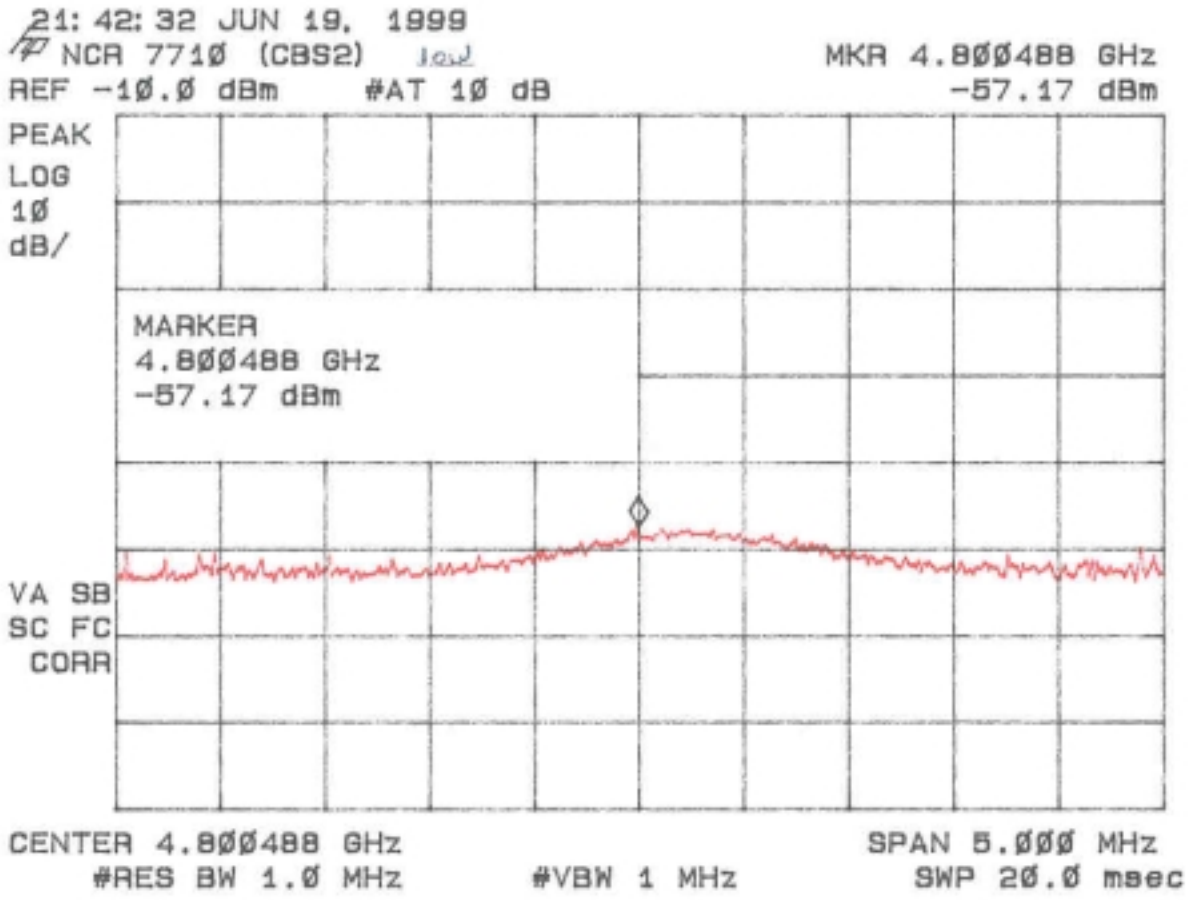


Figure 5b
Peak Radiated Spurious Emission 15.247(c) Low

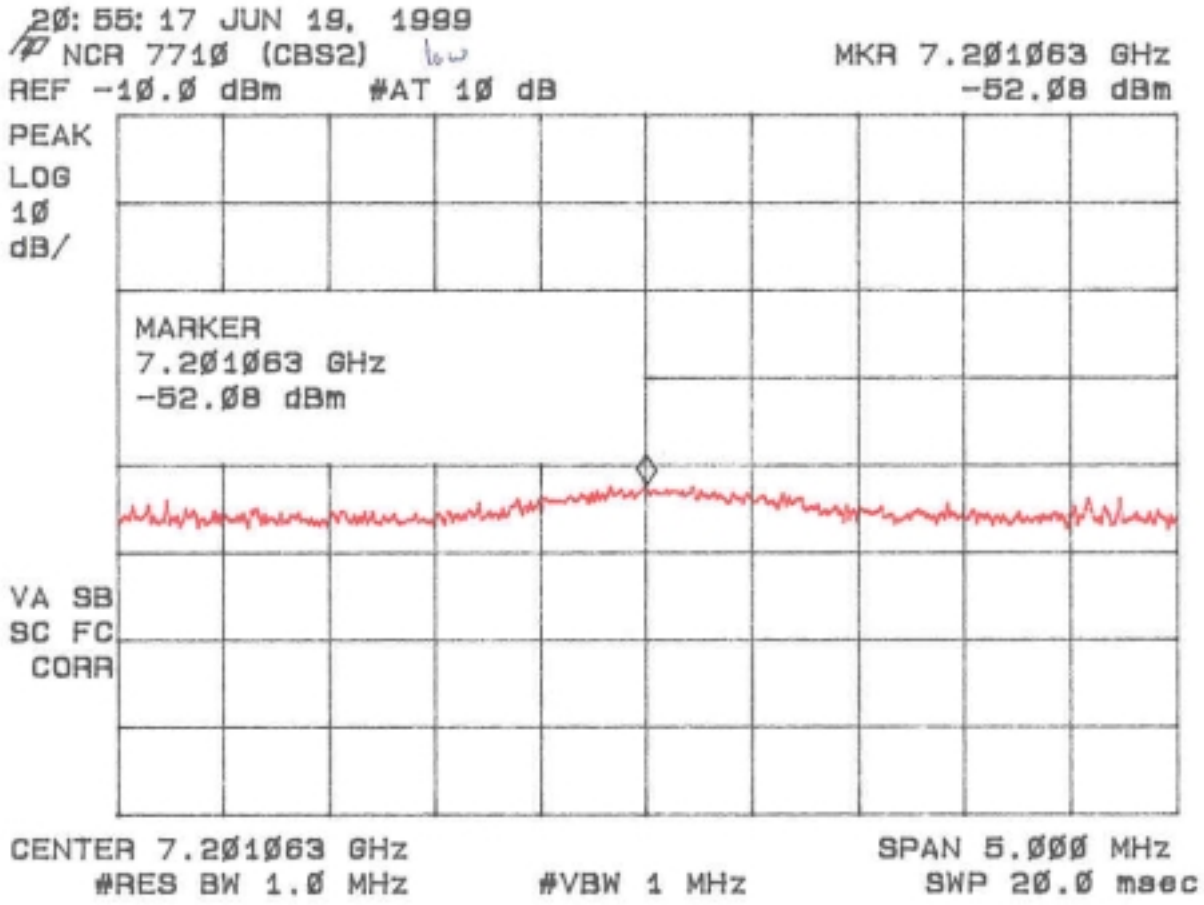


Figure 5c
Peak Radiated Spurious Emission 15.247(c) Mid

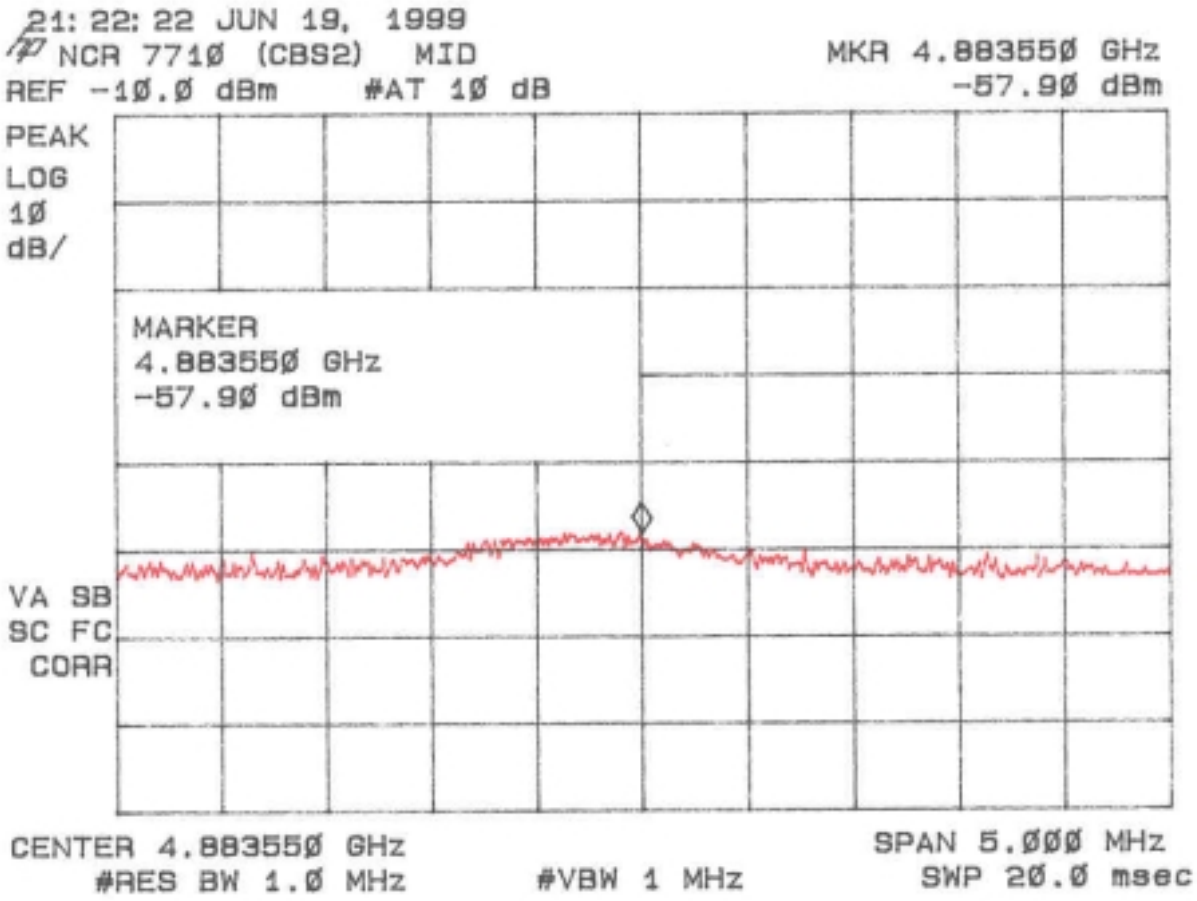


Figure 5d
Peak Radiated Spurious Emission 15.247(c) Mid

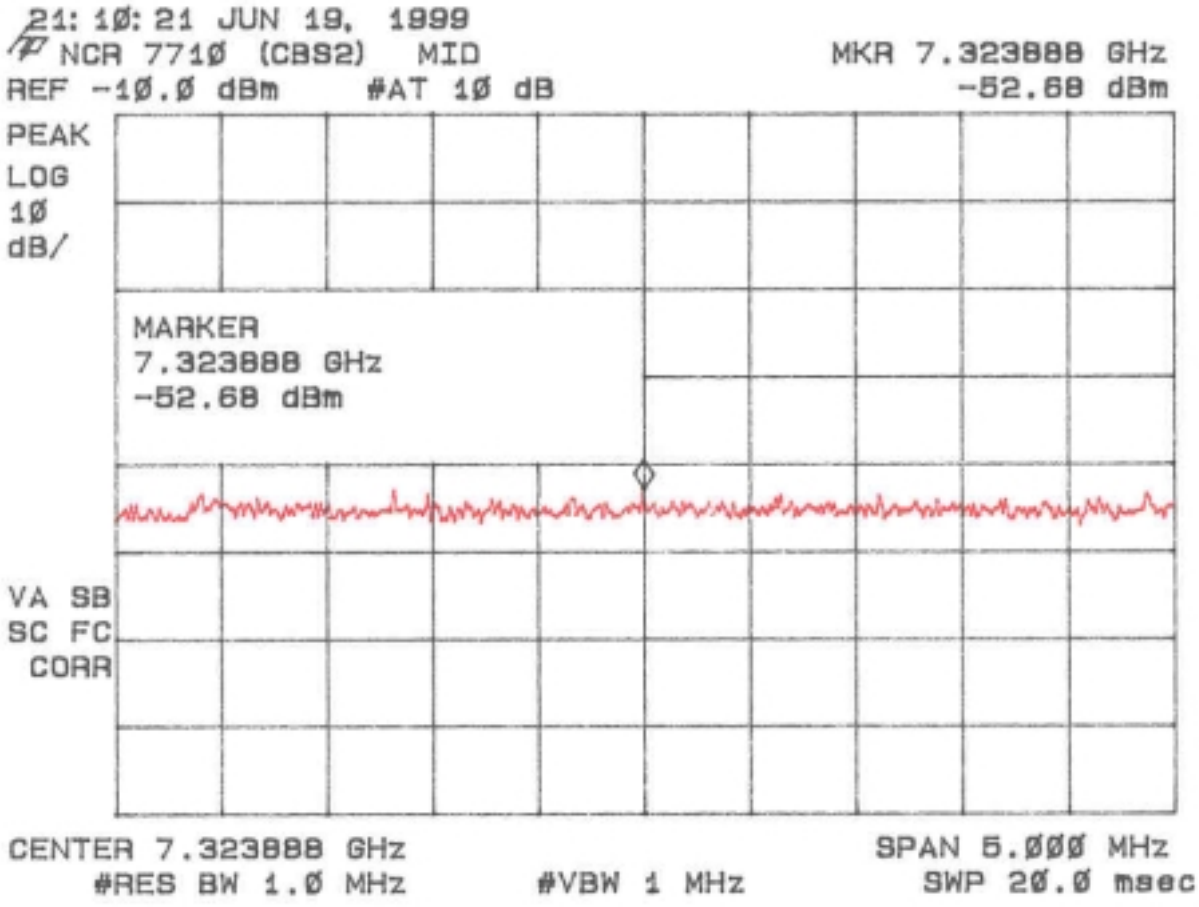


Figure 5e
Peak Radiated Spurious Emission 15.247(c) High

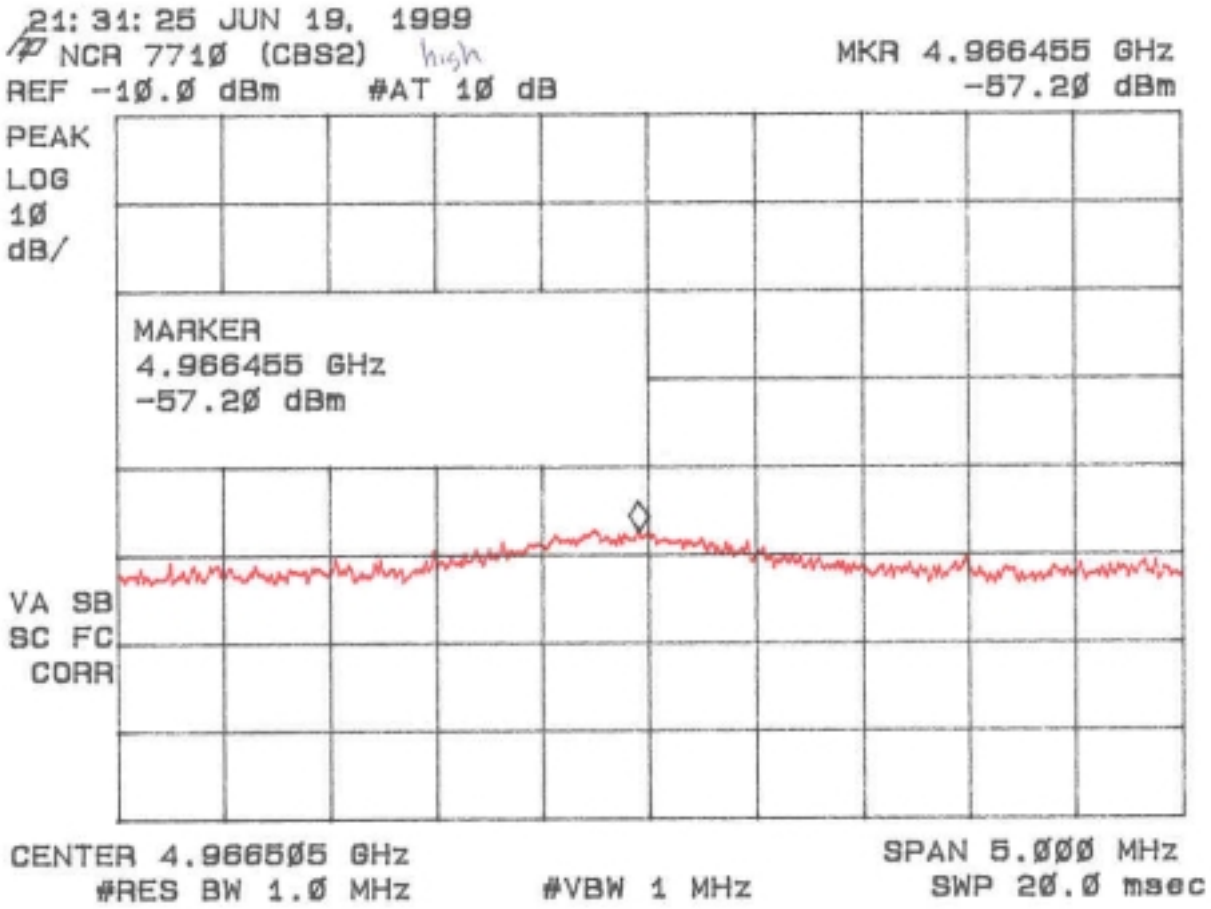
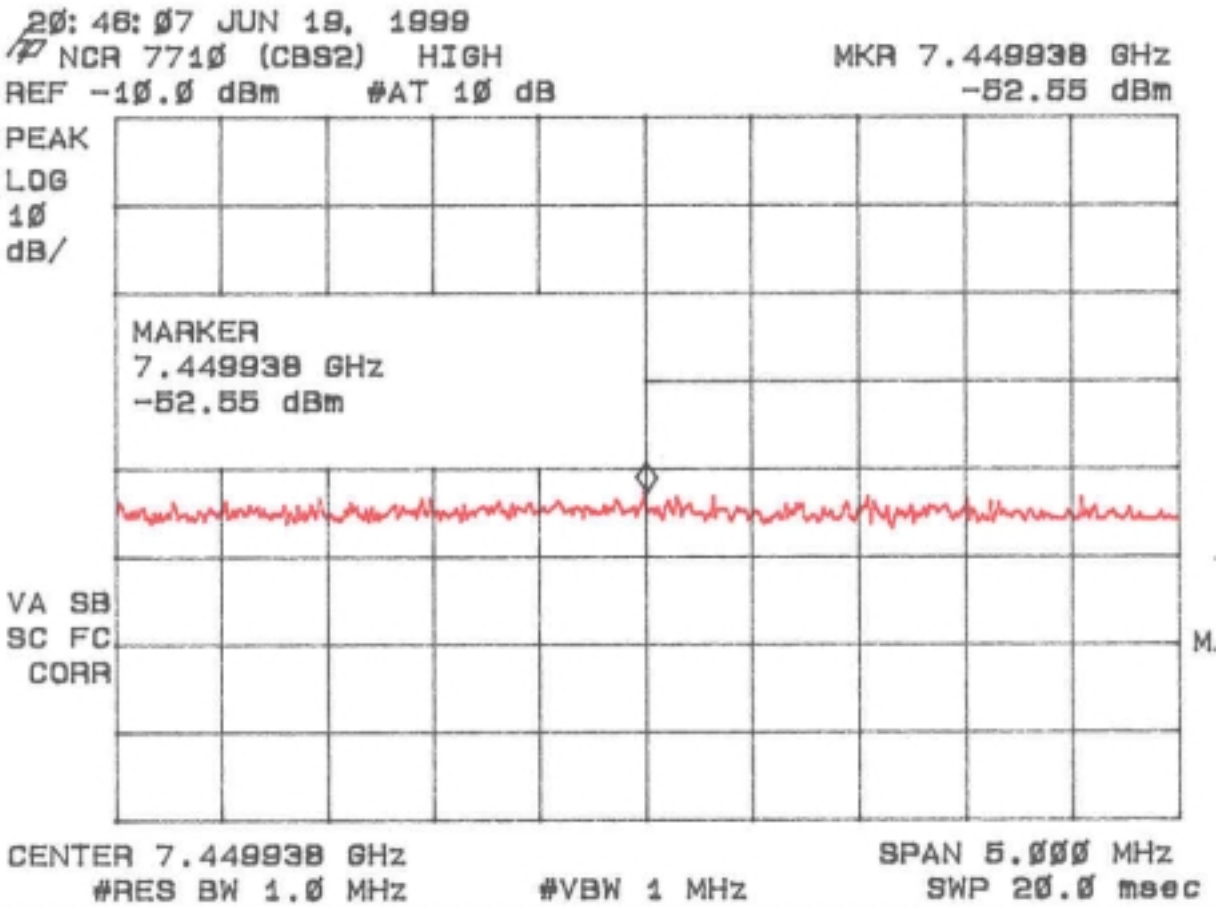


Figure 5f
Peak Radiated Spurious Emission 15.247(c) High



Test Date: June 3, 1999 and June 19, 1999
UST Project: 99-381
Customer: NCR Corporation
Model: 7710

TABLE 4a PEAK RADIATED SPURIOUS EMISSIONS (Low)

Freq. (GHz)	Test Data (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
0.117	-90.0	-	11.4	2.3	34.2	150
0.252	-84.0	-	12.8	3.5	92.3	200
0.335	-83.0	-	15.2	4.3	149.6	200
4.8005	-56.2*	34.3	34.6	7.9	891.2	5000
7.2011**	-60.6*	34.5	36.9	7.8	676.1	5000

*** = Data adjusted by + 1 dB for high pass filter**
**** = Due to system losses and that duty cycle corrections could not be applied (transmitter can operate > 100 ms on one channel) these measurements were made at 1 meter to achieve better dynamic range. The readings have been adjusted by 20 log (1/3) = -9.54 dB**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-56.2 - 34.3 + 34.6 + 7.9 + 107)/20) = 891.2
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Tim R. Johnson

Test Date: June 3, 1999 and June 19, 1999
UST Project: 99-381
Customer: NCR Corporation
Model: 7710

TABLE 4b PEAK RADIATED SPURIOUS EMISSIONS (Mid)

Freq. (GHz)	Test Data (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
0.117	-90.0	-	11.4	2.3	34.2	150
0.252	-83.0	-	12.8	3.5	103.5	200
0.335	-88.0	-	15.2	4.3	84.1	200
4.8836	-56.9*	34.3	34.7	8.1	851.1	5000
7.3239**	-61.2*	34.6	37.2	7.9	653.1	5000

*** = Data adjusted by + 1 dB for high pass filter**
**** = Due to system losses and that duty cycle corrections could not be applied (transmitter can operate > 100 ms on one channel) these measurements were made at 1 meter to achieve better dynamic range. The readings have been adjusted by 20 log (1/3) = -9.54 dB**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-56.9 - 34.3 + 34.7 + 8.1 + 107)/20) = 851.1
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Tim R. Johnson

Test Date: June 3, 1999 and June 19, 1999
UST Project: 99-381
Customer: NCR Corporation
Model: 7710

TABLE 4c PEAK RADIATED SPURIOUS EMISSIONS (High)

Freq. (GHz)	Test Data (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
0.117	-86.0	-	11.4	2.3	54.2	150
0.335	-83.0	-	15.2	4.3	149.6	200
4.9665	-56.2*	34.3	34.9	8.3	966.0	5000
7.4499**	-61.1*	34.6	37.5	7.9	683.9	5000

*** = Data adjusted by + 1 dB for high pass filter**
**** = Due to system losses and that duty cycle corrections could not be applied (transmitter can operate > 100 ms on one channel) these measurements were made at 1 meter to achieve better dynamic range. The readings have been adjusted by 20 log (1/3) = -9.54 dB**

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-56.2 - 34.3 + 34.7 + 8.3 + 107)/20) = 966.0
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Tim R. Johnson

2.10 Average Spurious Emission in the Frequency Range 30 - 25000 MHz (FCC Section 15.247(c))

The results of average radiated spurious emissions falling within restricted bands are given in Table 5a (low), Table 5b, (mid), Table 5c (high) and Figure 6a-6b (low), Figure 6c-6d (mid) and Table 6d-6e (high).

Figure 6a
Average Radiated Spurious Emission 15.247(c) Low

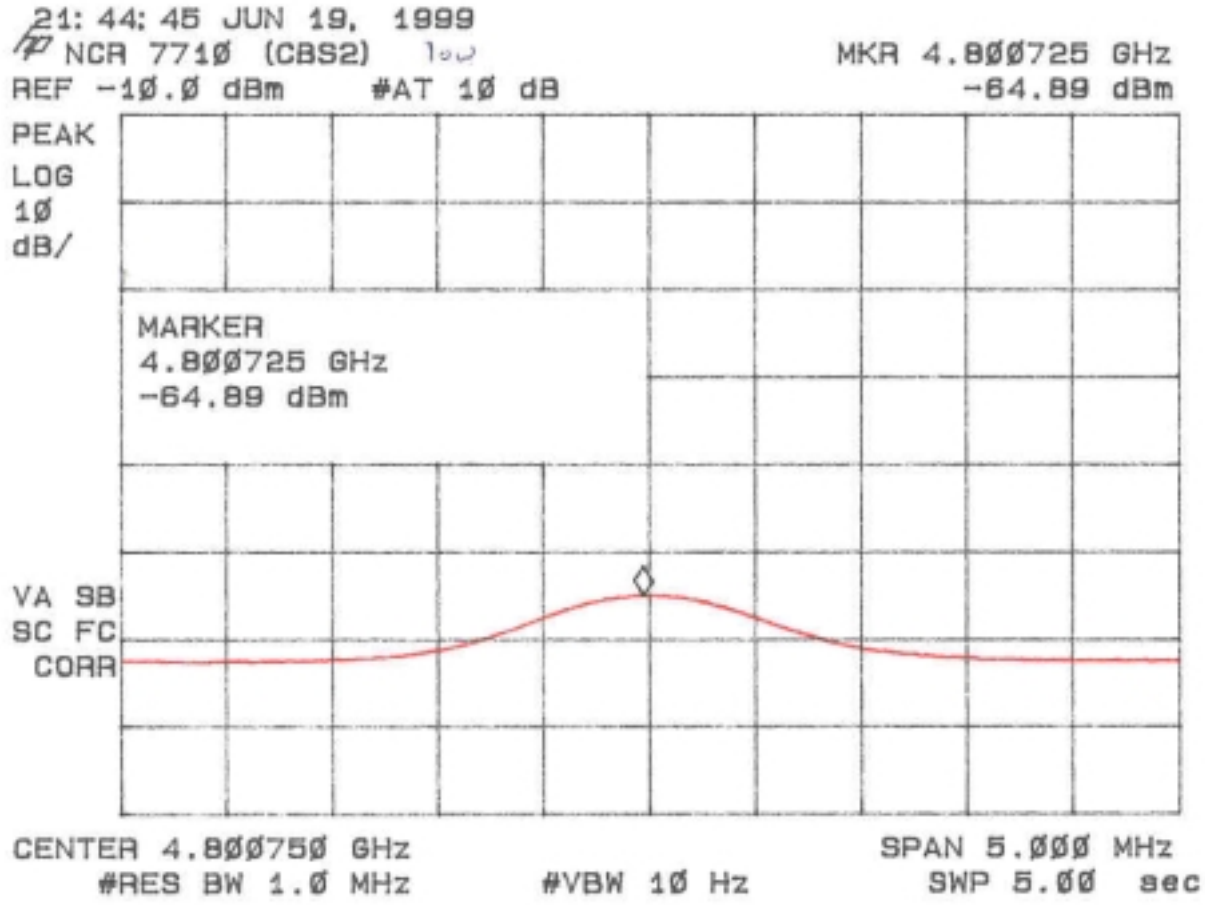


Figure 6b
Average Radiated Spurious Emission 15.247(c) Low

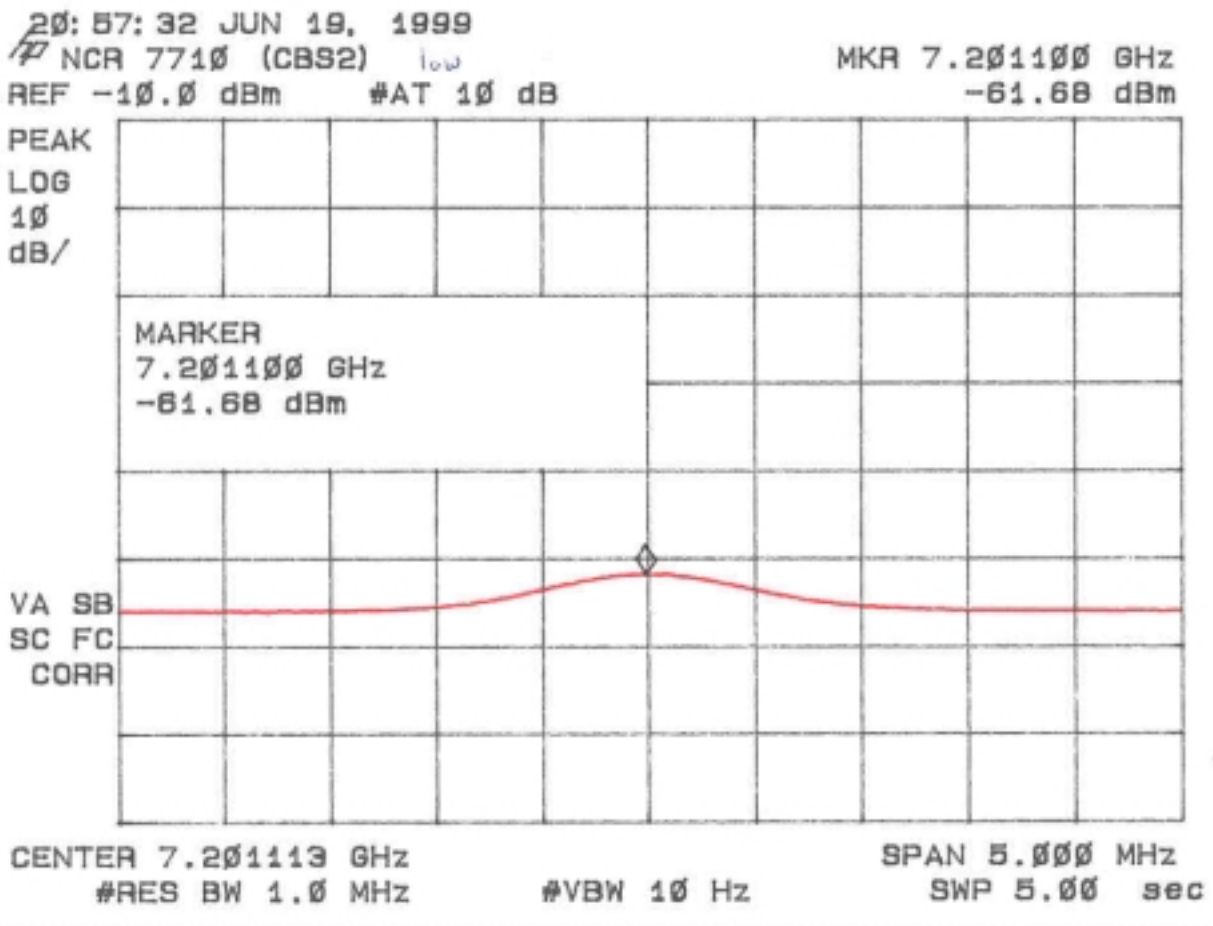


Figure 6c
Average Radiated Spurious Emission 15.247(c) Mid

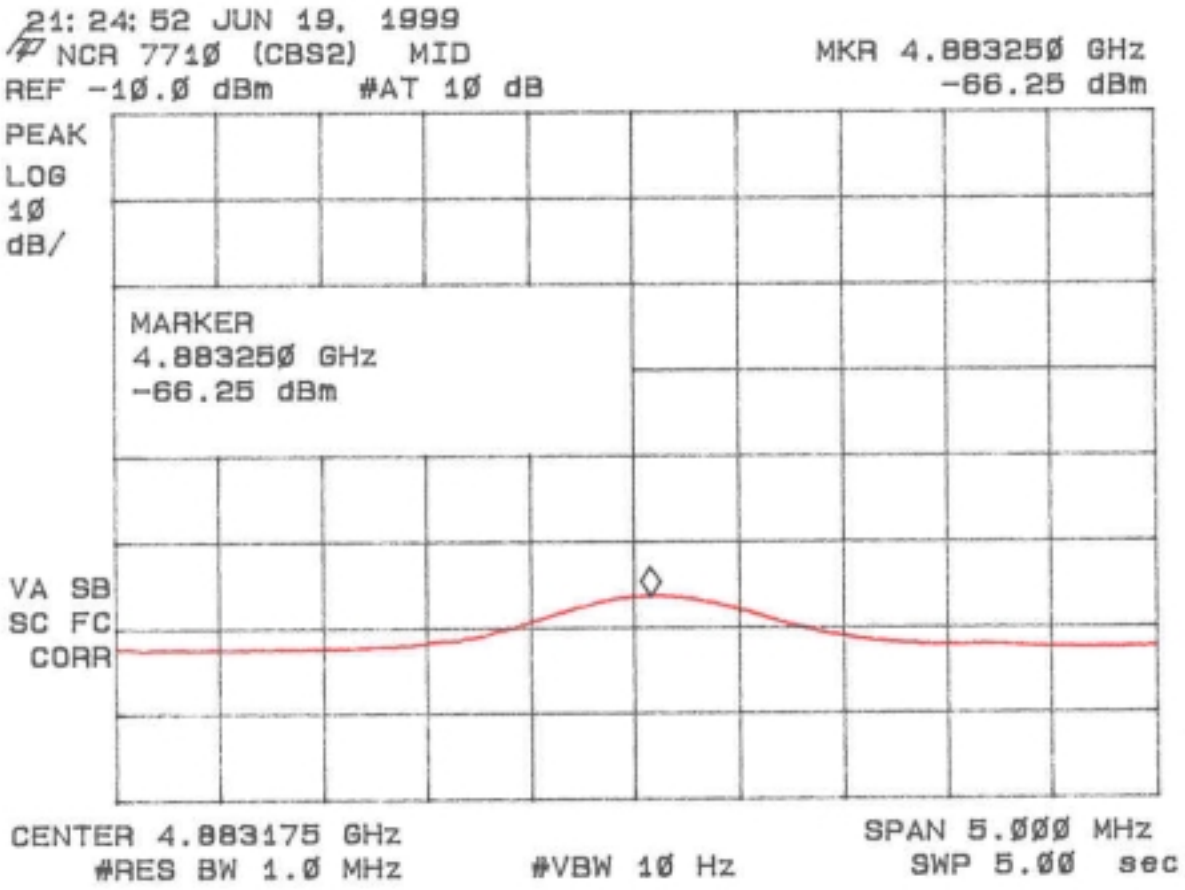


Figure 6d
Average Radiated Spurious Emission 15.247(c) Mid

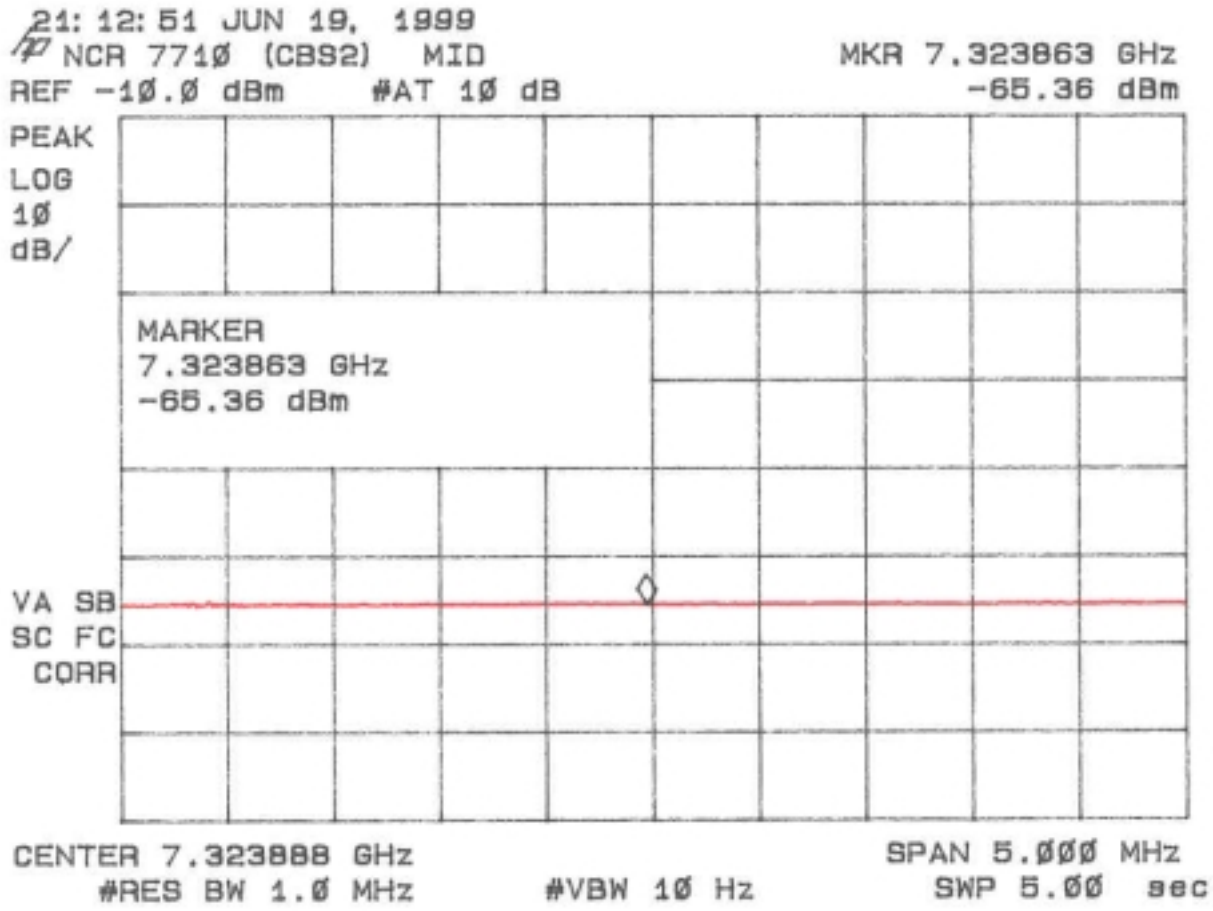


Figure 6e
Average Radiated Spurious Emission 15.247(c) High

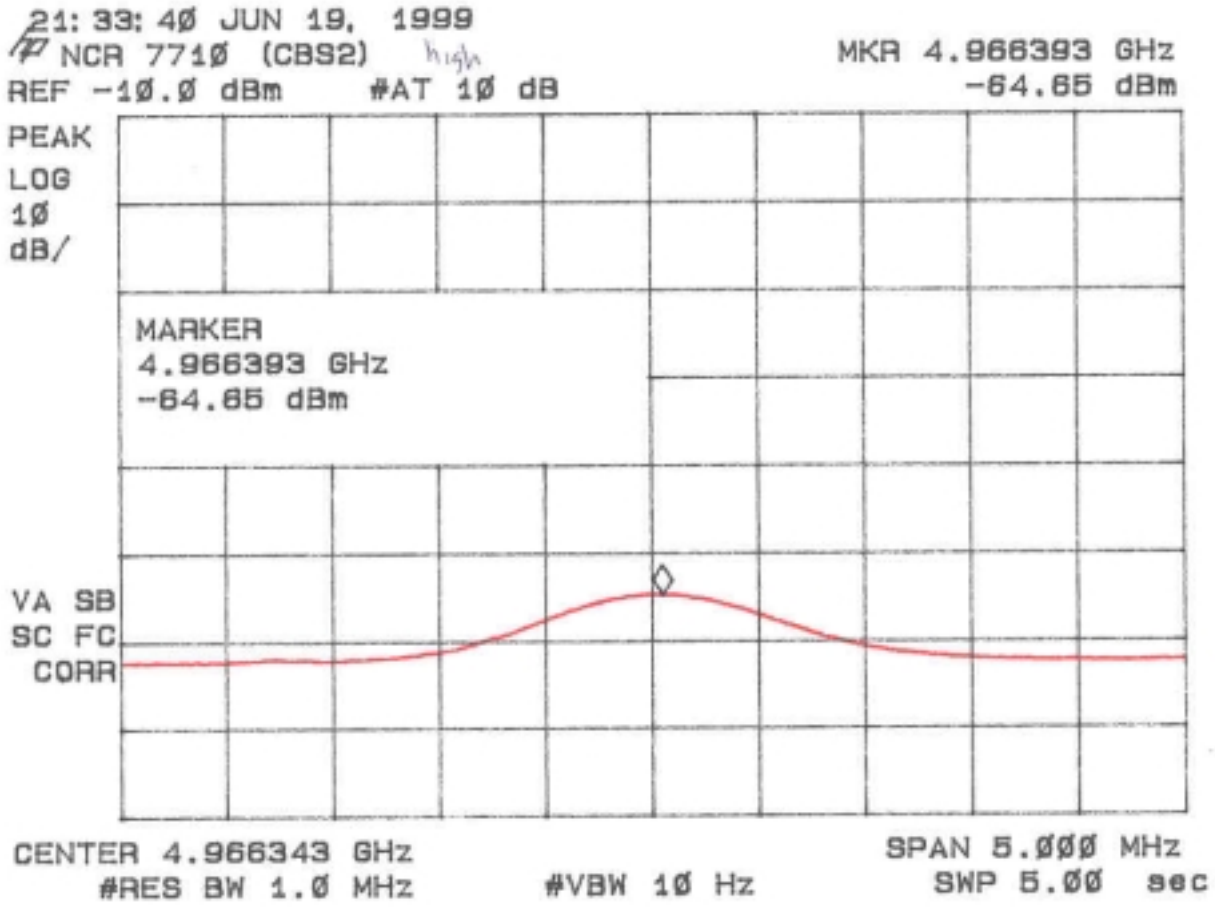


Figure 6f
Average Radiated Spurious Emission 15.247(c) High

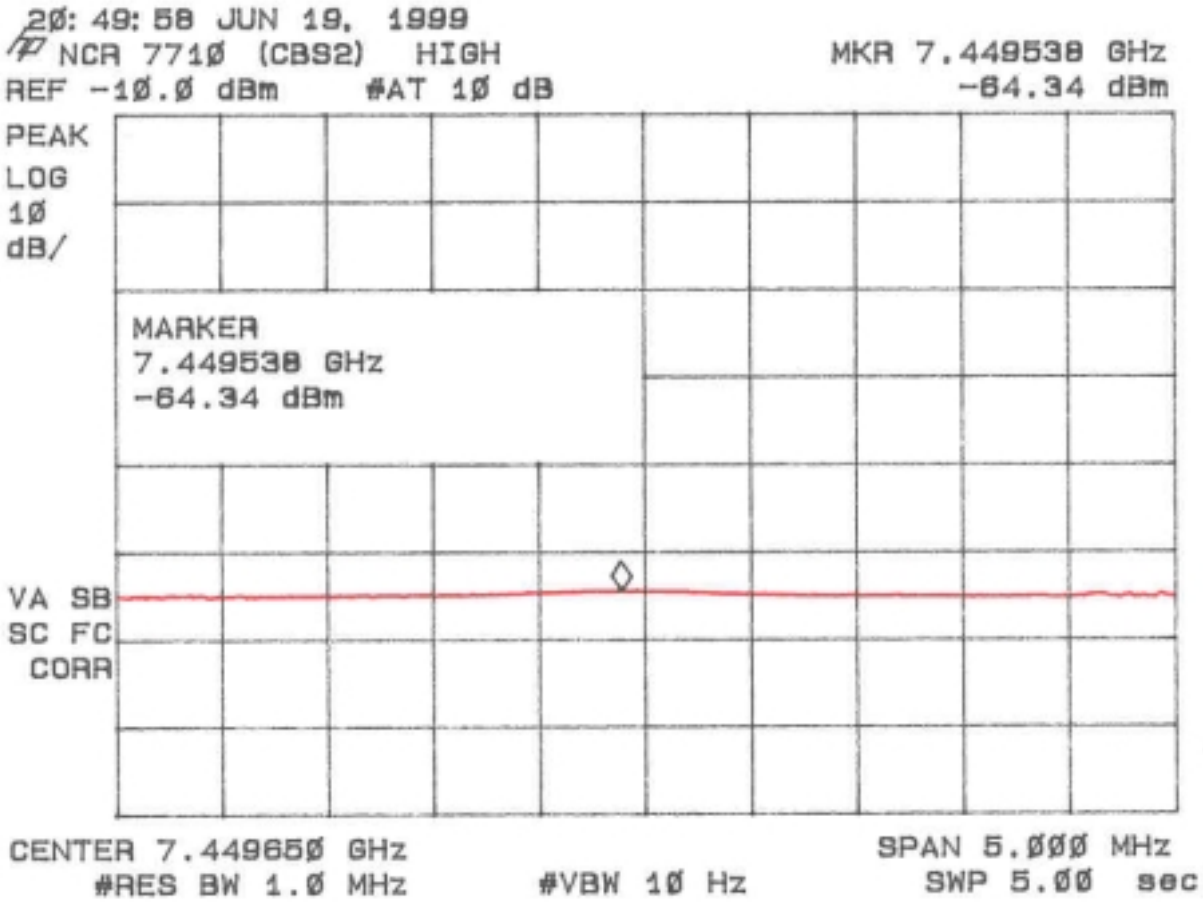


TABLE 5a AVERAGE RADIATED SPURIOUS EMISSIONS (Low)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.8005	-63.9*	34.3	34.6	7.9	367.3	500
7.2011**	-70.2*	34.5	36.9	7.8	222.8	500

TABLE 5b AVERAGE RADIATED SPURIOUS EMISSIONS (Mid)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.8836	-65.3*	34.3	34.7	8.1	323.6	500
7.3239**	-73.9*	34.6	37.2	7.9	151.4	500

TABLE 5c AVERAGE RADIATED SPURIOUS EMISSIONS (High)

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
4.9665	-63.7*	34.3	34.9	8.3	407.4	500
7.4499**	-72.8*	34.6	37.5	7.9	177.8	500

* = Data adjusted by + 1 dB for high pass filter

** = Due to system losses and that duty cycle corrections could not be applied (transmitter can operate > 100 ms on one channel) these measurements were made at 1 meter to achieve better dynamic range. The readings have been adjusted by 20 log (1/3) = -9.54 dB

SAMPLE CALCULATION:

RESULTS (uV/m @ 3m) =
Antilog ((-63.9 - 34.2 + 34.6 + 7.9 + 107)/20) = 367.3
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ Name: Tim R. Johnson

2.11 20 dB Bandwidth per FCC Section 15.247(a)(1)(ii) and Channel Separation per FCC Section 15.247(a)

The antenna port was connected to a spectrum analyzer that was set for a 50 Ω impedance with the RBW = approximately 1/100 of the manufacturers claimed RBW & VBW > RBW. The results of this test are given in Table 6 and Figure 7a through 7c. The channel separation is shown in Figure 7d.

TABLE 6
20 dB Bandwidth

Test Date: **June 26, 1999**
UST Project: **99-381**
Customer: **NCR Corporation**
Model: **7710**

Frequency (MHz)	MAXIMUM FCC LIMIT (MHz)
.0275	1.0
.0200	1.0
.0175	1.0

(Measured Channel Separation)

Frequency of Channel Separation (kHz)	MAXIMUM FCC LIMIT (kHz)
295	27.5

Note: The channel separation limit is 25 kHz or the 20 dB bandwidth, whichever is greater

Tester
Signature: _____ Name: Tim R. Johnson

Figure 7a.
20 dB Bandwidth per FCC Section 15.247(a)(1)(ii) (low)

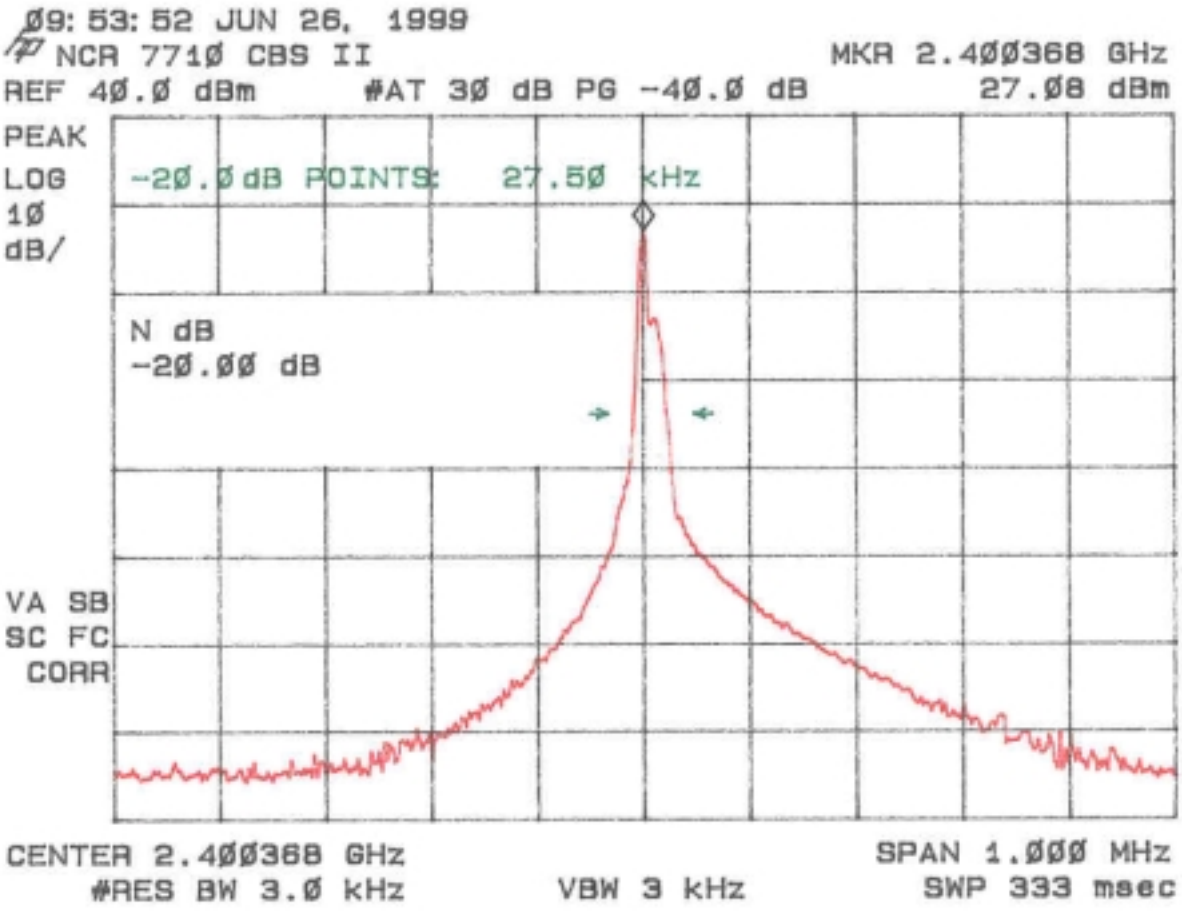


Figure 7b.
20 dB Bandwidth per FCC Section 15.247(a)(1)(ii) (Mid)

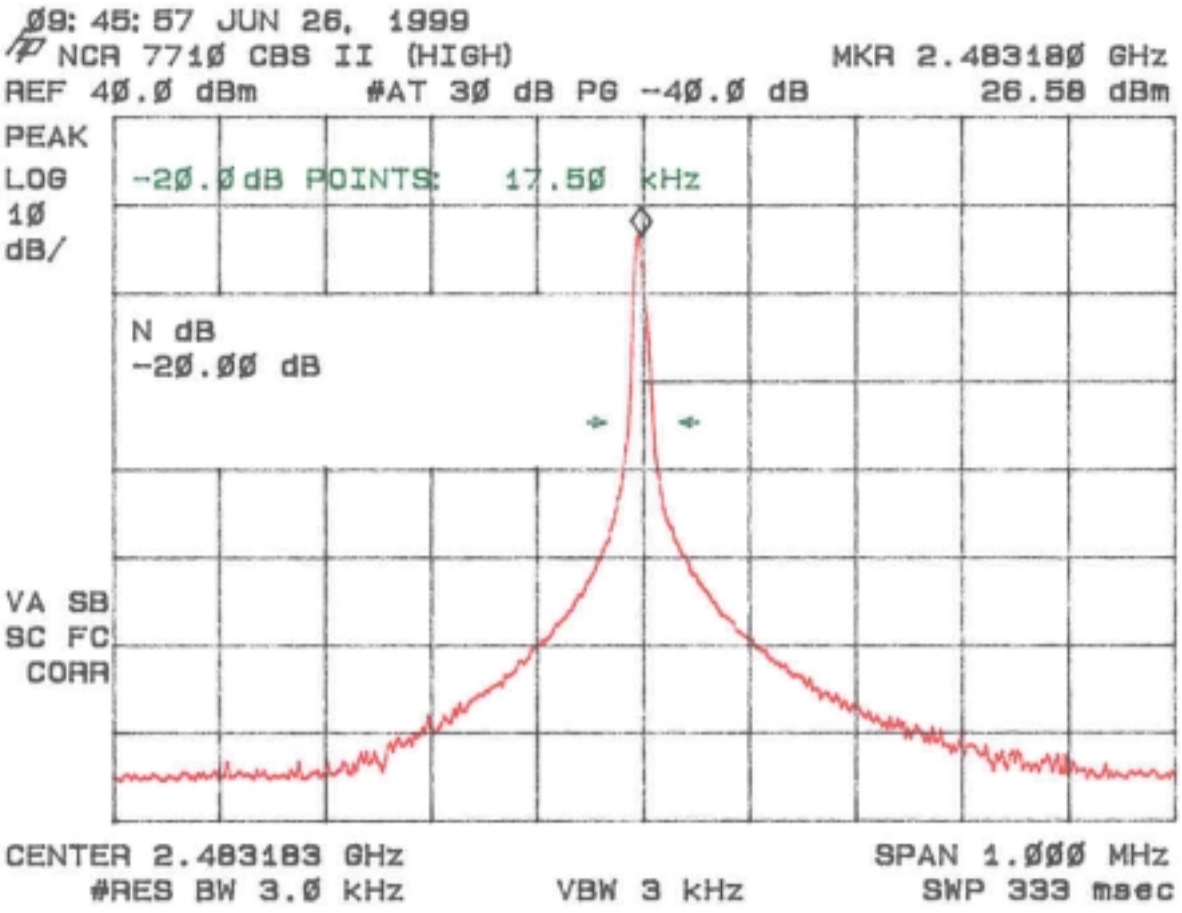


Figure 7c.
20 dB Bandwidth per FCC Section 15.247(a)(1)(ii) (High)

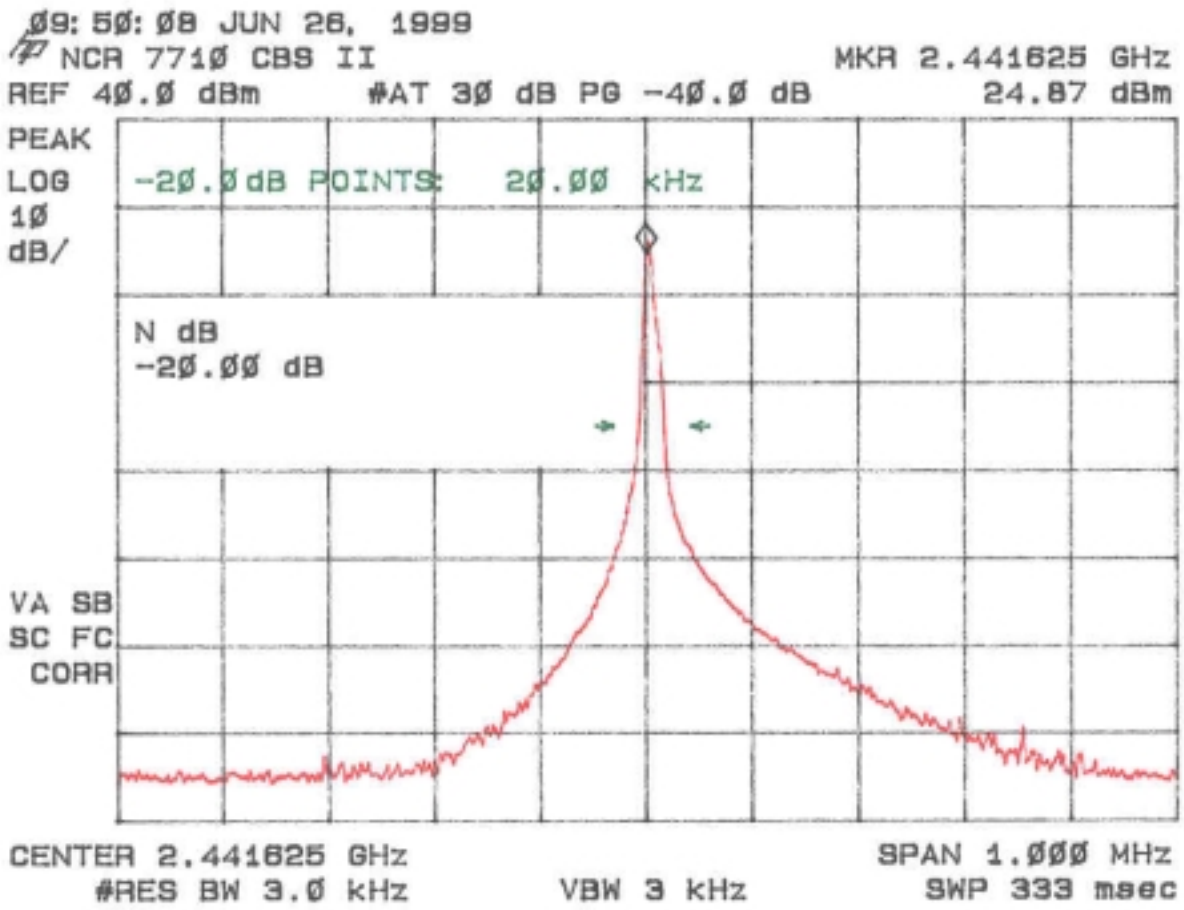
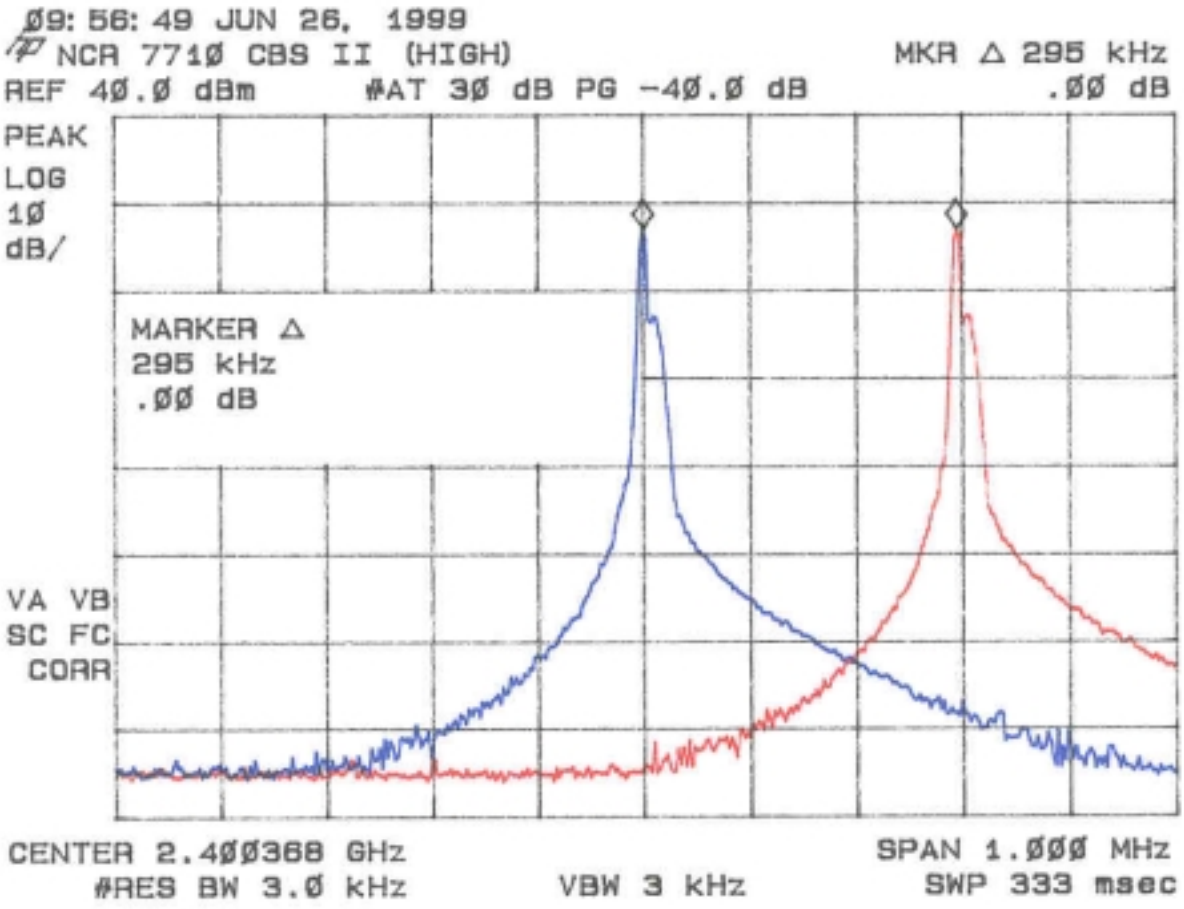


Figure 7d.
Channel Separation per FCC Section 15.247(a)



2.12 Number of Hopping Channels FCC Section 15.247(a)(1)(ii)

The transmitter was placed into a typical frequency hopping mode of operation. The 2400 – 2483.5 MHz band was centered on the screen and the RBW and VBW chosen such that the individual channels could be discerned. The trace capture time was a minimum of 5 minutes.

The results of this test are given in Table 7 and Figure 8.

TABLE 7
NUMBER OF HOPPING CHANNELS

Test Date: **June 26, 1999**
UST Project: **99-381**
Customer: **NCR Corporation**
Model: **7710**

Number of Hopping Frequencies Measured	FCC Limit (Minimum Number of Channels)
>76*	75

*NOTE: Due to the resolution bandwidth used and the bandwidth of each channel, the total number of frequencies was not accurately determined, but was verified to be greater than 76.

Tester
Signature: _____ **Name:** **Tim R. Johnson**

Figure 8a
Number of Hopping Channels FCC Section 15.247(a)(1)(ii)

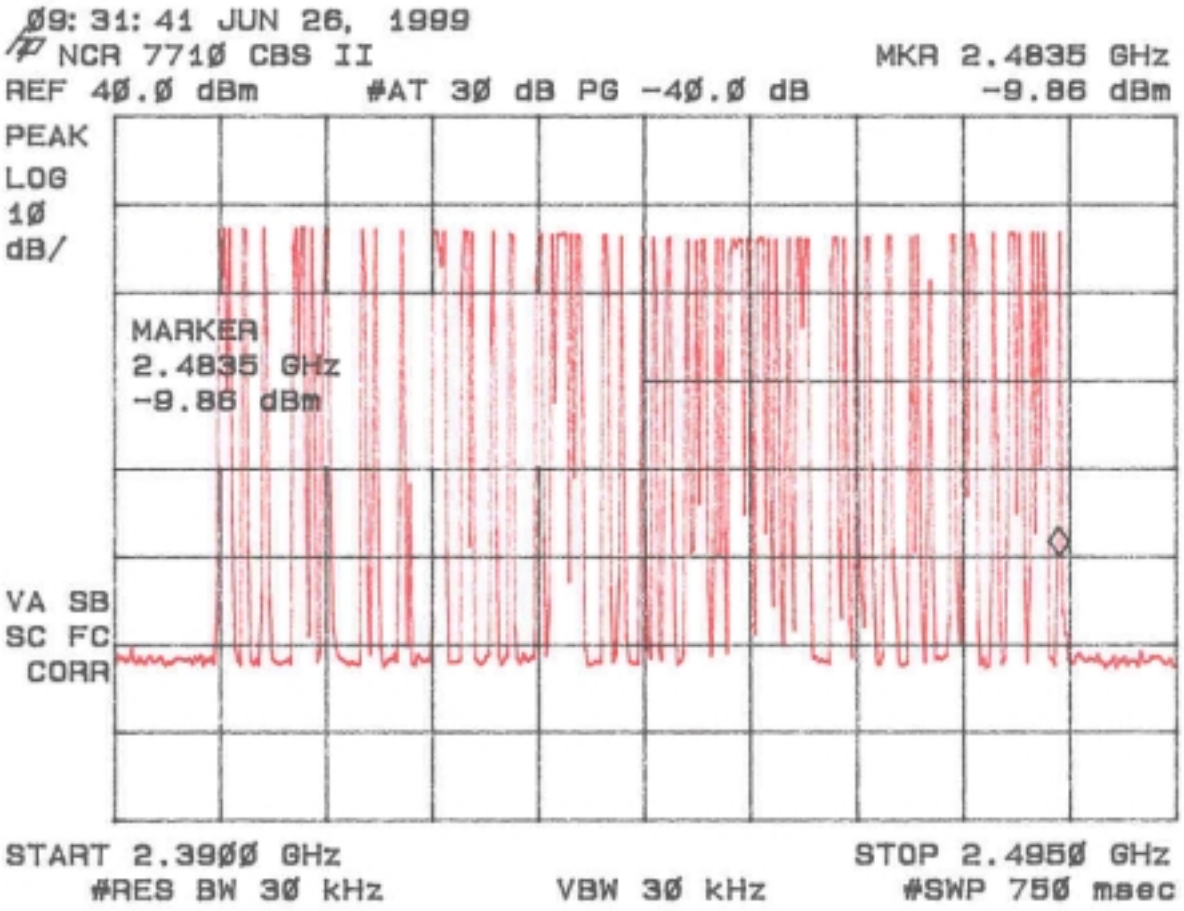
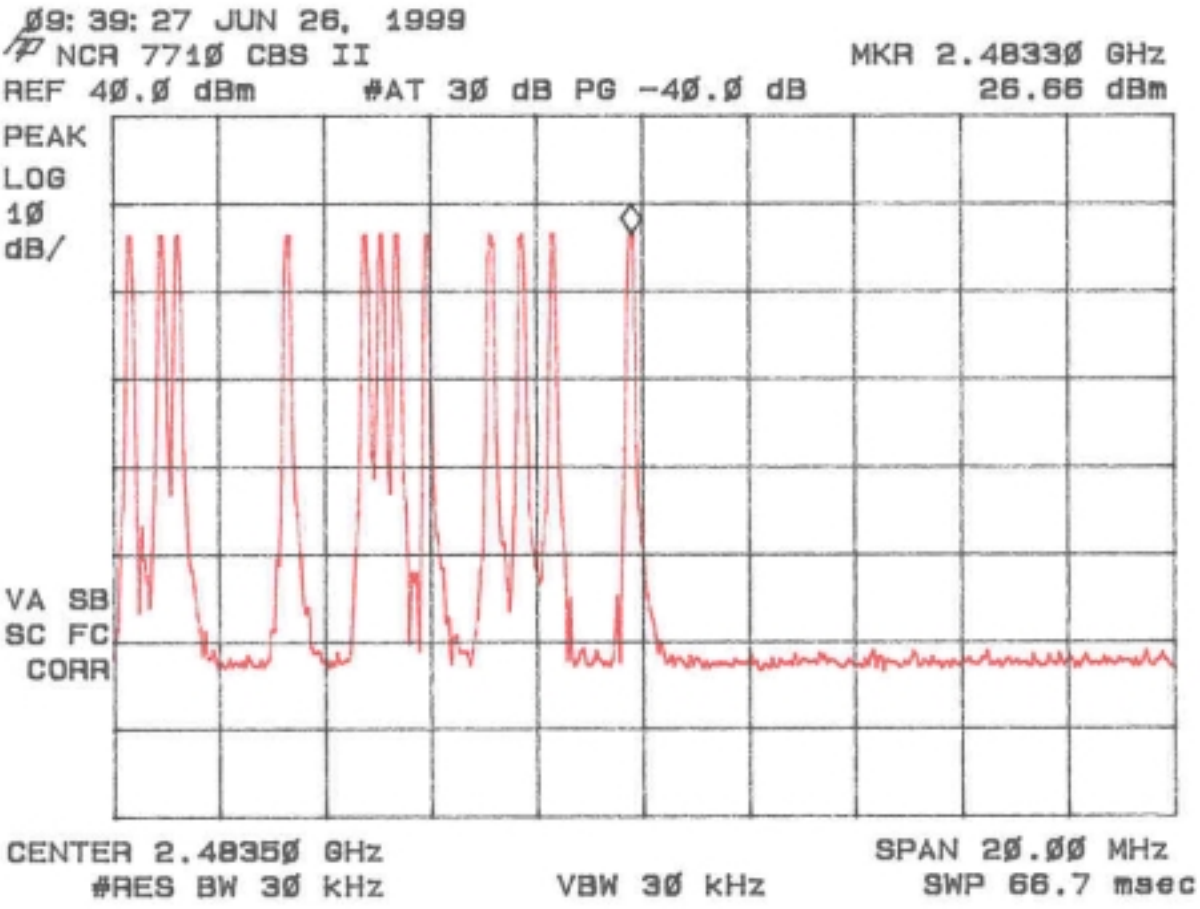


Figure 8b
Number of Hopping Channels FCC Section 15.247(a)(1)(ii)

(Showing Band-edge Characteristics)



2.13 Average Time of Occupancy per Channel FCC Section 15.247(a)(1)(ii)

The transmitter was placed into a typical frequency hopping mode of operation. Characteristics of the time of occupancy were measured for a typical low, mid, and high channel within the 2400 – 2483.5 MHz band.

The results of this test are given in Table 8 and Figures 9a-9f.

TABLE 8
AVERAGE TIME OF OCCUPANCY PER CHANNEL

Test Date: **June 9, 1999**
UST Project: **99-381**
Customer: **NCR Corporation**
Model: **7710**

Measured Average Time of Occupancy (seconds/per 30 seconds of time)	FCC Limit (seconds/per 30 seconds of time
0.390	0.4

Tester Signature: _____ **Name:** **Tim R. Johnson**

Figure 9a
Average Time of Occupancy per Channel FCC Section 15.247(a)(1)(ii) Low

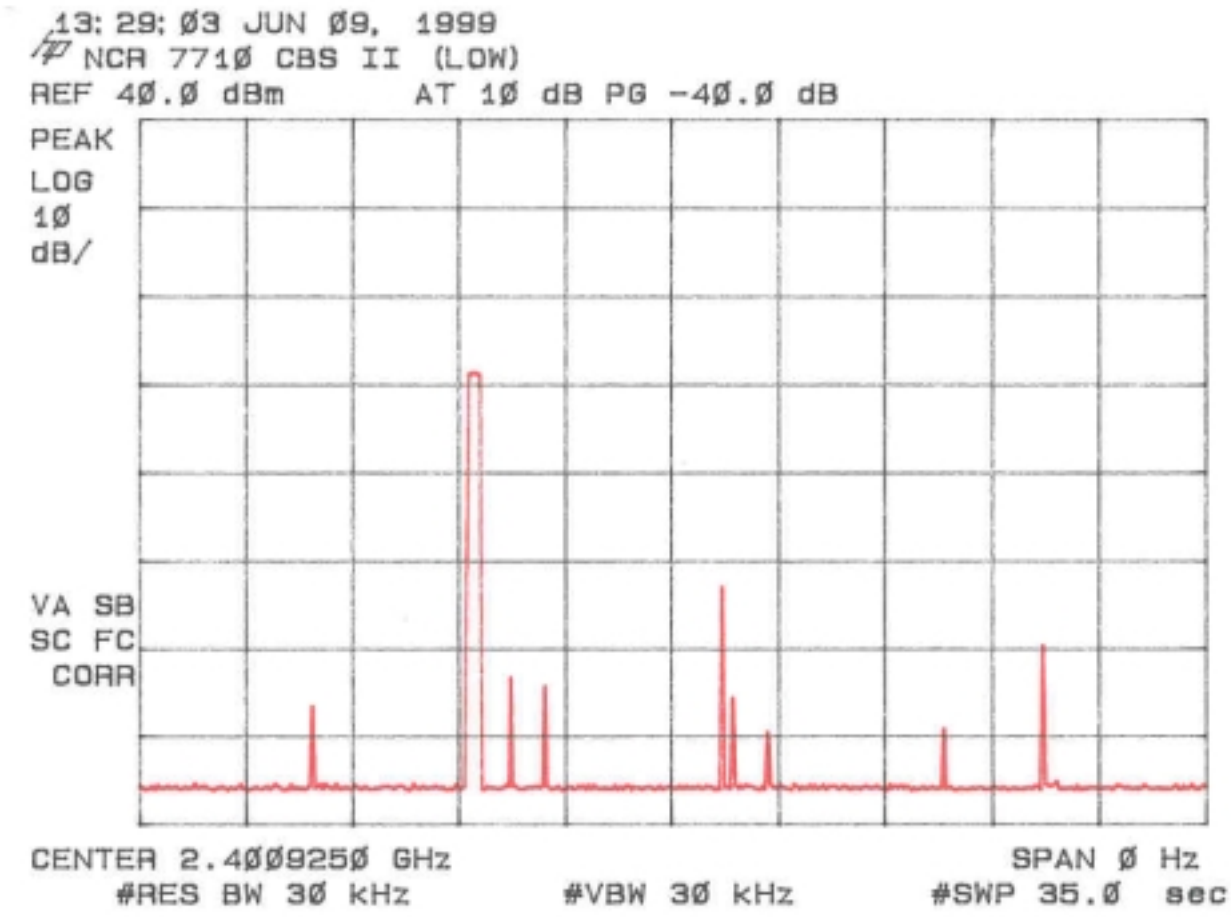


Figure 9b
Average Time of Occupancy per Channel FCC Section 15.247(a)(1)(ii) Low

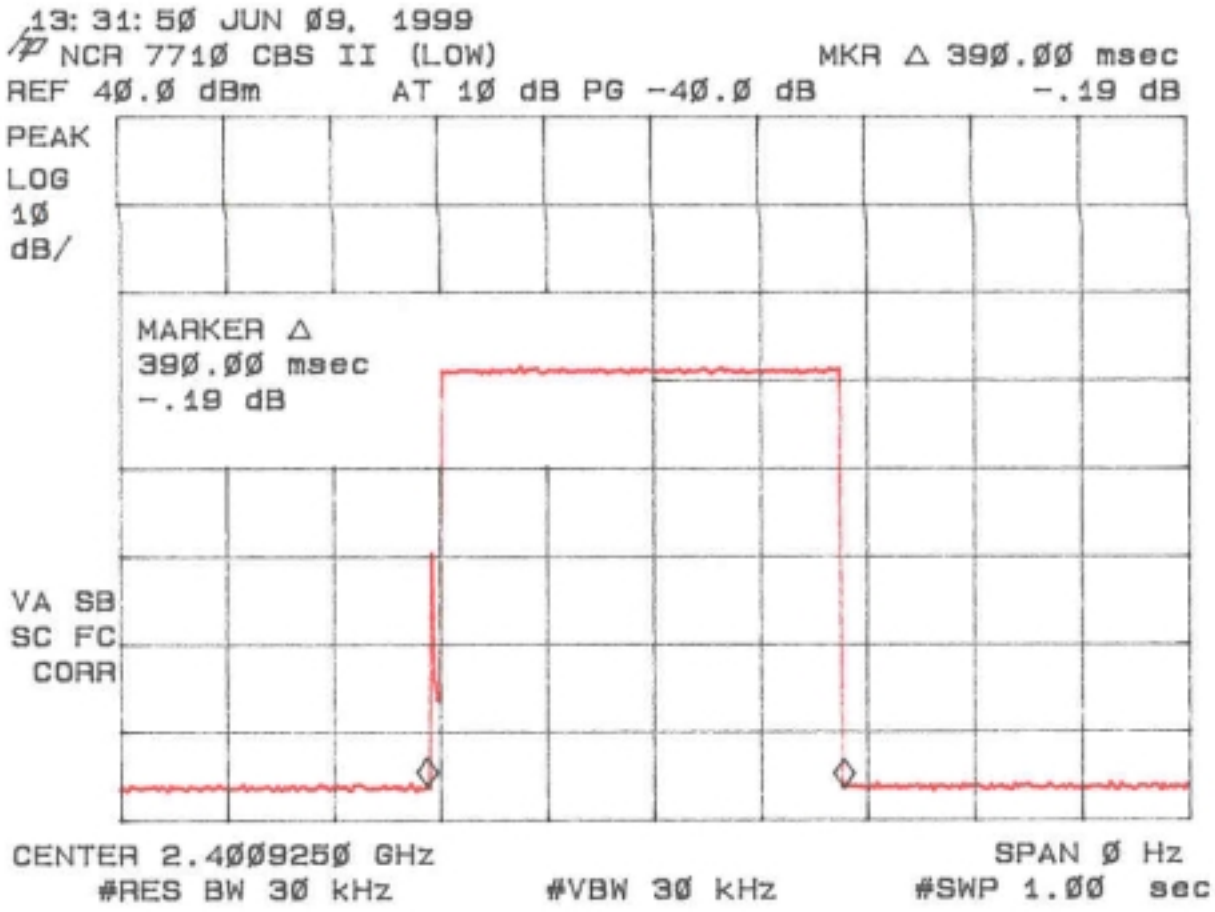


Figure 9c
Average Time of Occupancy per Channel FCC Section 15.247(a)(1)(ii) Mid

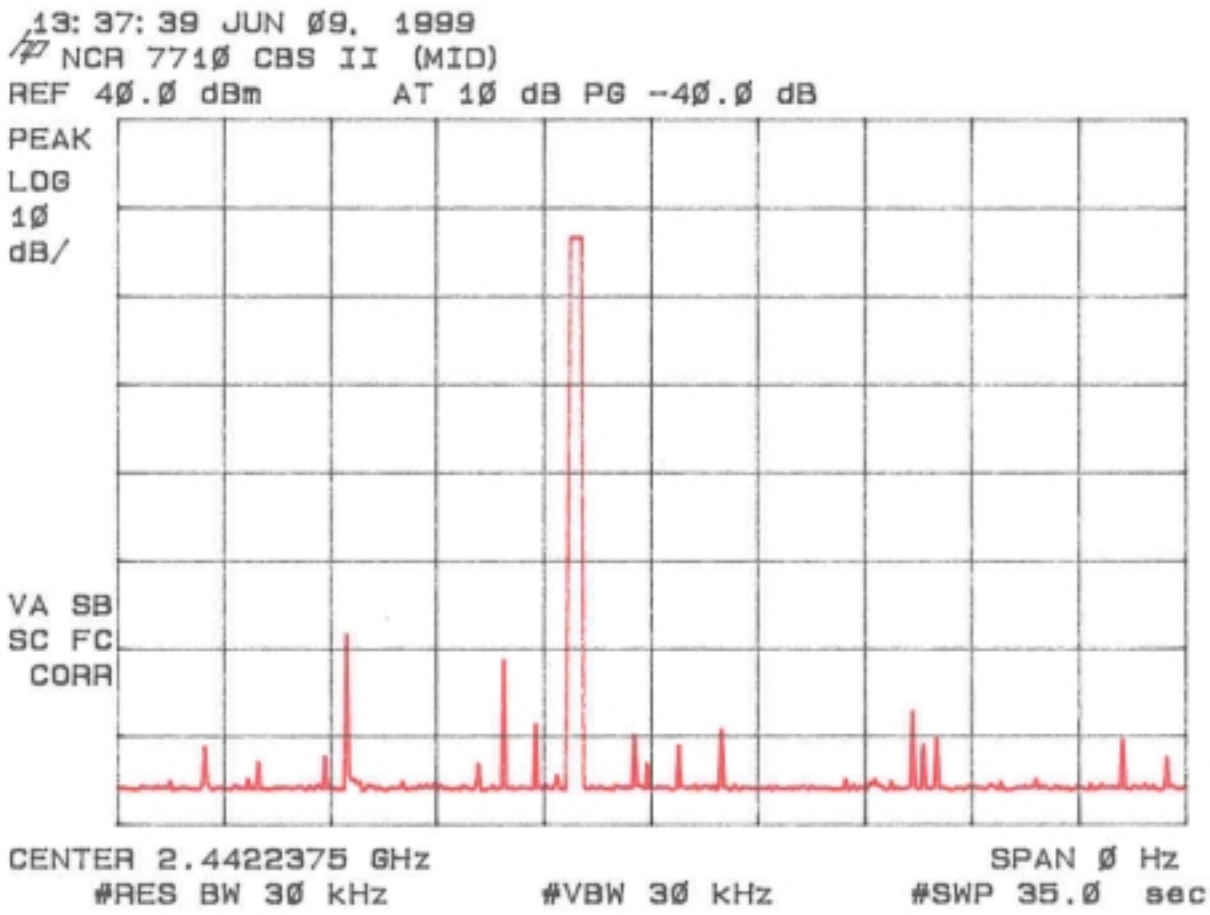


Figure 9d
Average Time of Occupancy per Channel FCC Section 15.247(a)(1)(ii) Mid

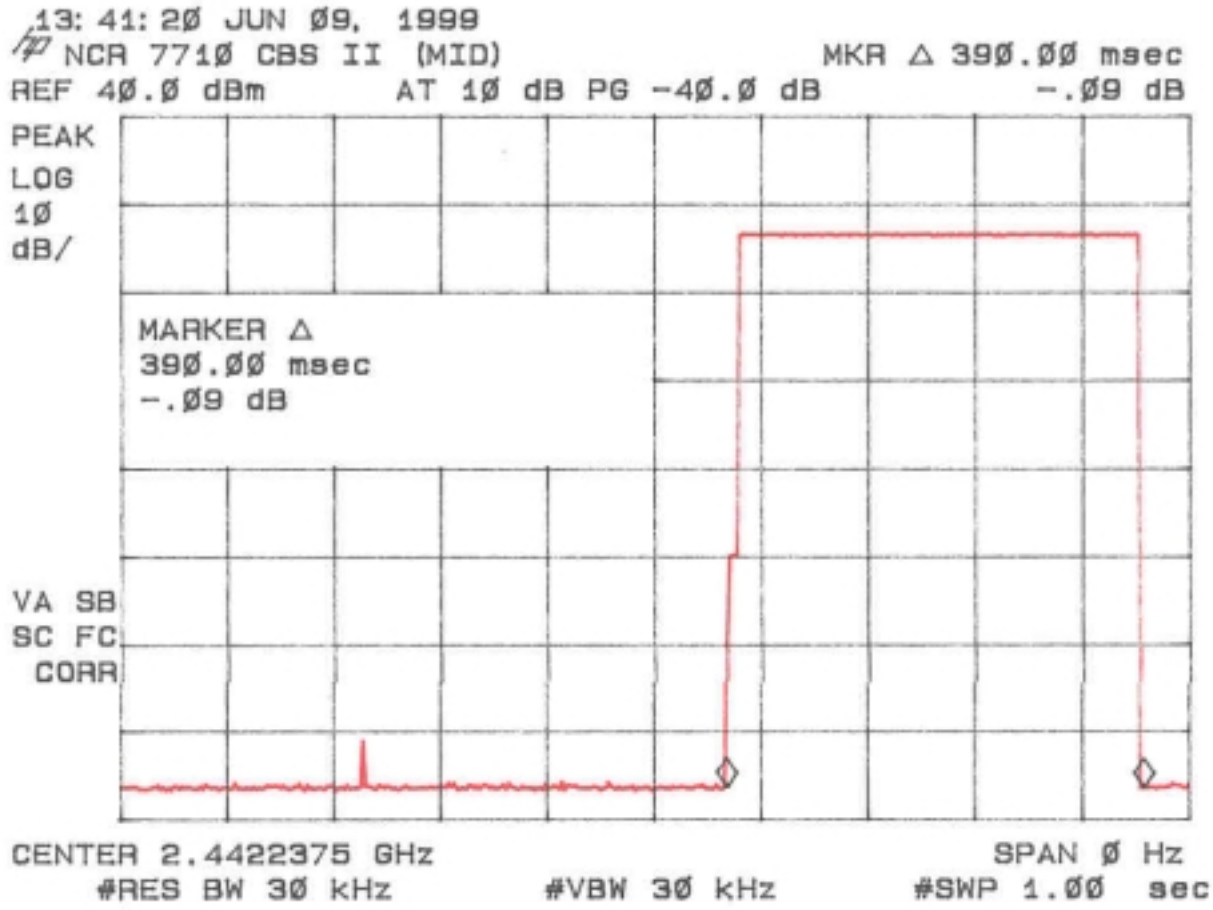


Figure 9e
Average Time of Occupancy per Channel FCC Section 15.247(a)(1)(ii) High

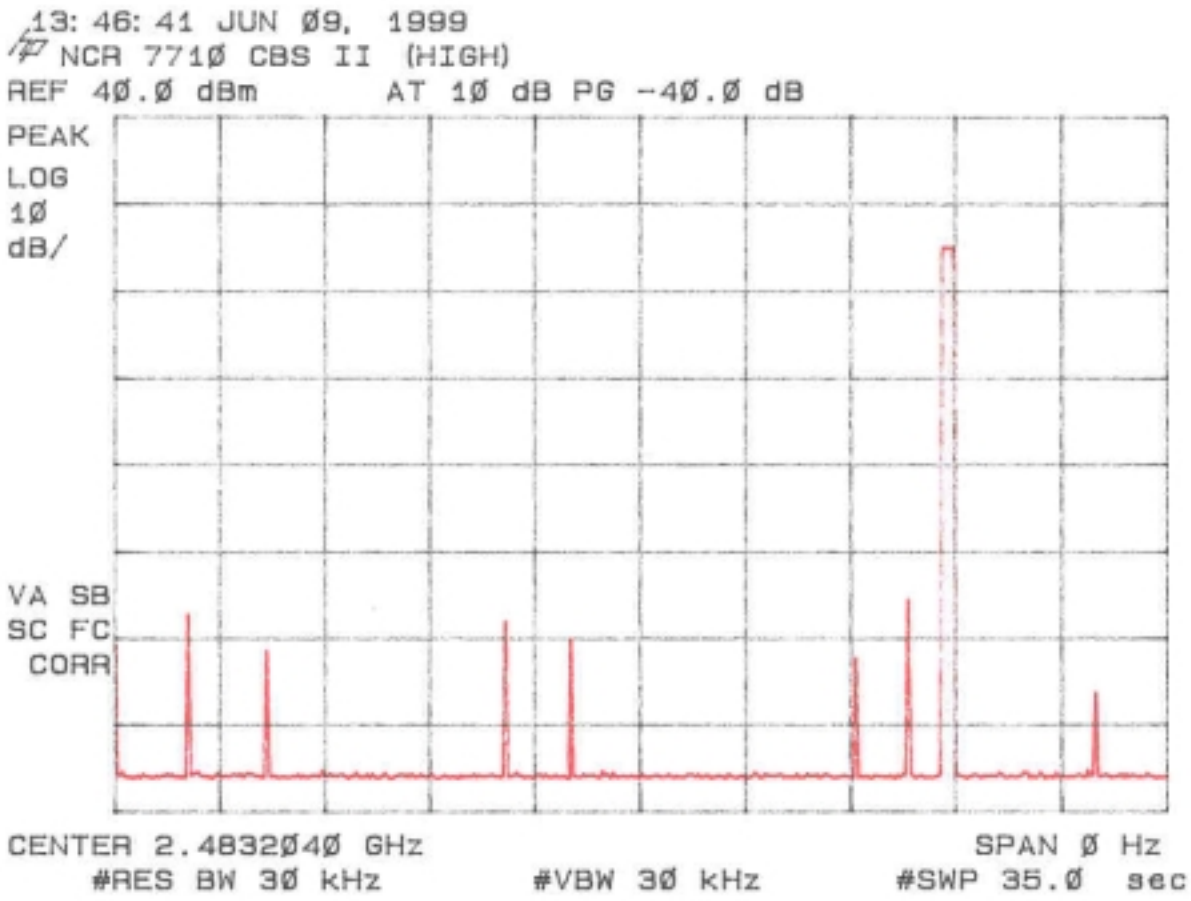
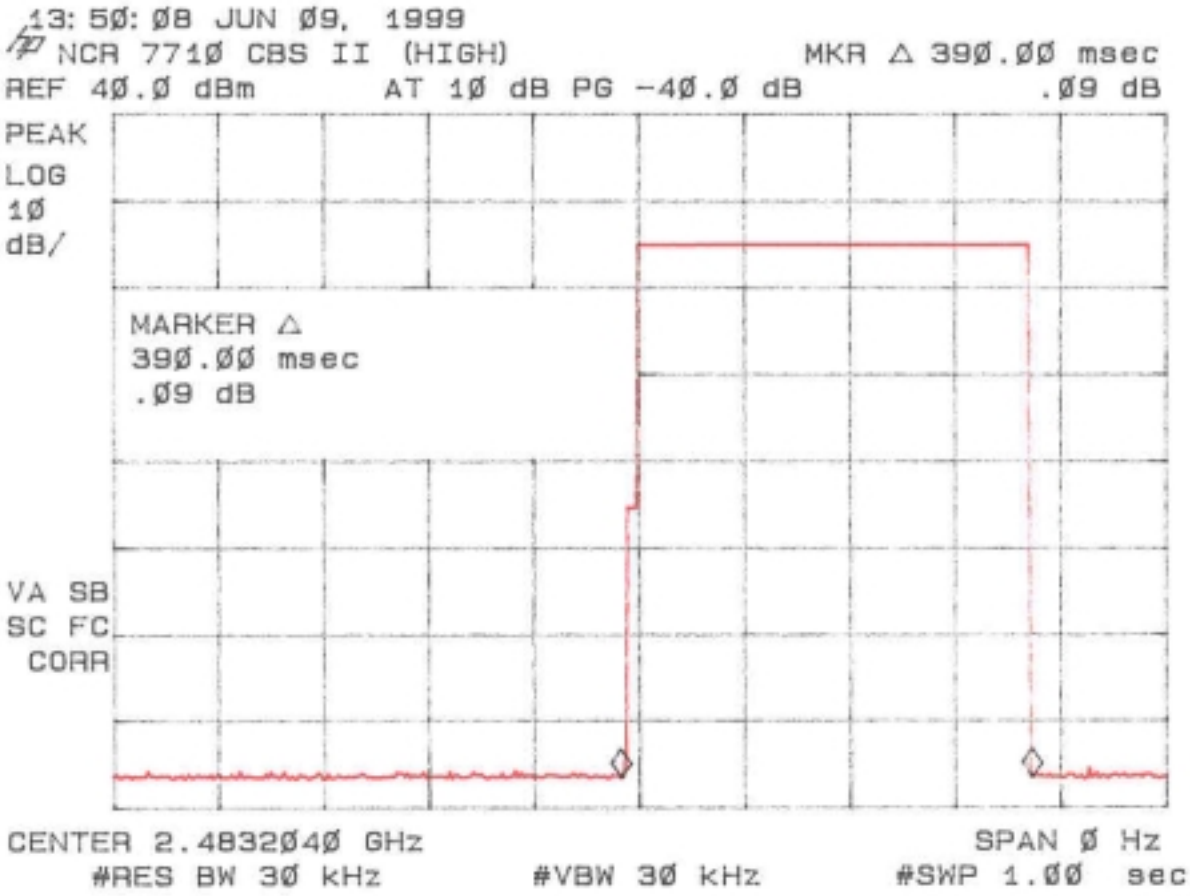


Figure 9f
Average Time of Occupancy per Channel FCC Section 15.247(a)(1)(ii) High



2.14 Power Line Conducted Emissions for Transmitter FCC Section 15.207

The conducted voltage measurements have been carried out in accordance with FCC Section 15.207, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmit. The results are given in Table 9.

TABLE 9. CONDUCTED EMISSIONS DATA (Transmit Mode)
CLASS B

Test Date: 5/18/99
UST Project: 99-381
Customer: NCR Corporation
Product: 7710

Worse Case Mode = Mid Channel (Others Similar)

FREQUENCY (MHz)	TEST DATA (dBm) PHASE	TEST DATA (dBm) NEUTRAL	RESULTS (uV) PHASE	RESULTS (uV) NEUTRAL	FCC LIMITS (uV)	MARGIN BELOW LIMIT (dB) PHASE	MARGIN BELOW LIMIT (dB) NEUTRAL
0.47	-73.0	-73.0	50.1	50.1	250	26.0	26.0
0.67	-74.0	-75.0	44.7	39.8	250	27.0	28.0
1.2	-75.0	-75.0	39.8	39.8	250	28.0	28.0
11.9	-70.0	-72.0	70.8	56.2	250	32.5	34.5
12.0	-74.0	-78.0	44.7	28.2	250	36.5	40.5
15.1	-74.0	-80.0	44.7	22.4	250	36.5	42.5

SAMPLE CALCULATIONS:

RESULTS uV =
Antilog ((-73.0 + 107)/20) = 50.1
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ **Name:** Tim R. Johnson

2.15 Radiated Emissions for Digital Device & Receiver (47 CFR 15.109a)

Radiated emissions were evaluated from 30 to 1000 MHz while the EUT was placed into a Receive mode of operation. Measurements were made with the analyzer's bandwidth set to 120. The results for less than 1 GHz are shown in Table 10.

TABLE 10. RADIATED EMISSIONS DATA
(Digital Device & Receiver)

CLASS A

Test Date: May 27, 1999
UST Project: 99-381
Customer: NCR Corporation
Product: 7710

Frequency (MHz)	Receiver Reading (dBm) @3m	Correction Factor (dB)	Corrected Reading (uV/m) @10 m	FCC Limit (uV/m) @10m
214.0	-82.0	14.9	29.6	150.0
227.0	-80.0	14.9	37.3	210.0
239.0	-83.0	15.5	28.4	210.0
335.0	-84.0	19.3	39.2	210.0
369.0	-84.0	19.7	41.1	210.0

*= Since the readings were so low @ 10m, the EUT was tested @ 3m to get good dynamic range on the readings.

SAMPLE CALCULATIONS:

RESULTS uV/m @ 10m = Antilog ((-82.0 + 14.9 – 10.46 + 107)/20) = 29.6
CONVERSION FROM dBm TO dBuV = 107 dB
CONVERSION FROM 3m to 10m = 20 log (3/10) = -10.46

Tester
Signature: _____ **Name:** Austin Thompson

2.16 Power Line Conducted Emissions for Digital Device and Receiver FCC Section 15.107

The conducted voltage measurements have been carried out in accordance with FCC Section 15.107, with a spectrum analyzer connected to a LISN and the EUT placed into an idle condition or a continuous mode of receive. The results are given in Table 11.

TABLE 11. CONDUCTED EMISSIONS DATA (DIGITAL DEVICE & RECEIVE MODE)
CLASS A

Test Date: 5/18/99
UST Project: 99-381
Customer: NCR Corporation
Product: 7710

Worse Case Mode = Low Channel (Others Similar)

FREQUENCY (MHz)	TEST DATA (dBm) PHASE	TEST DATA (dBm) NEUTRAL	RESULTS (uV) PHASE	RESULTS (uV) NEUTRAL	FCC LIMITS (uV)	MARGIN BELOW LIMIT (dB) PHASE	MARGIN BELOW LIMIT (dB) NEUTRAL
0.48	-73.0	-72.0	50.1	56.2	1000	26.0	25.0
0.54	-74.0	-75.0	44.7	39.8	1000	27.0	28.0
1.2	-74.0	-73.0	44.7	50.1	1000	27.0	26.0
11.8	-70.0	-70.0	70.8	70.8	3000	32.5	32.5
11.9	-72.0	-74.0	56.2	44.7	3000	34.5	36.5
15.1	-61.0	-63.0	199.5	158.5	3000	23.5	25.5

SAMPLE CALCULATIONS:

RESULTS uV =
Antilog ((-73.0 + 107)/20) = 50.1
CONVERSION FROM dBm TO dBuV = 107 dB

Tester
Signature: _____ **Name: Tim R. Johnson**