***This report file has been split in two pieces in order to accommodate the large file size. For pages 1 through 11, please see the file with description Part 1 of 2.***

# 4 TEST DATA AND RESULTS (continued)

## 4.3 Channel Bandwidth Measurement

### 4.3.1 Procedure

The EUT was put into a continuous transmit mode. The analyzer was set to a 2 MHz span around the selected channel with 30 kHz resolution bandwidth and 30 kHz video bandwidth. The analyzer was put into max hold mode and the peak value measured. A threshold line was put 20 dB below the peak. Two markers were set at the intersection of the signal and the 20 dB line. The frequency difference between the markers was recorded as the 20 dB bandwidth. No external attenuator was used. Cable losses were automatically compensated by the analyzer. The same procedure was repeated for three different channels (low, medium and high) to cover the transmit range.

### 4.3.2 Results

The widest 20 dB bandwidth measured was 997 kHz at 2.402 GHz. The other two channels shown on the following plots had bandwidths of 982 kHz (2.440 GHz) and 957 kHz (2.480 GHz). All bandwidths were below the required 1 MHz limit.

**Note:**
All conducted measurements were repeated with radio supply voltage modified to 90% and 110% of the nominal 110V. Since the module power is regulated on-board, no differences due to the voltage variation were observed.

## 4.4 Conducted Out-of-band Emissions

### 4.4.1 Procedure

The EUT was put into continuous transmit mode. The analyzer was set to 300 kHz RBW (1 MHz for ranges 2,3,4) and 300 kHz VBW (1MHz for rangeS 2,3,4). Then four scans were performed in max hold mode with 30 MHz - 1 GHz, 1 GHz - 3 GHz, 3 GHz - 10 GHz and 10 GHz - 24 GHz ranges. Also the 50 MHz region around the fundamental was investigated. Found peaks are listed in the results section. No external attenuator was used. Cable losses were automatically compensated by the analyzer. The measurements were repeated for channels at 2.402, 2.440 and 2.480 GHz

# 4 TEST DATA AND RESULTS (continued)

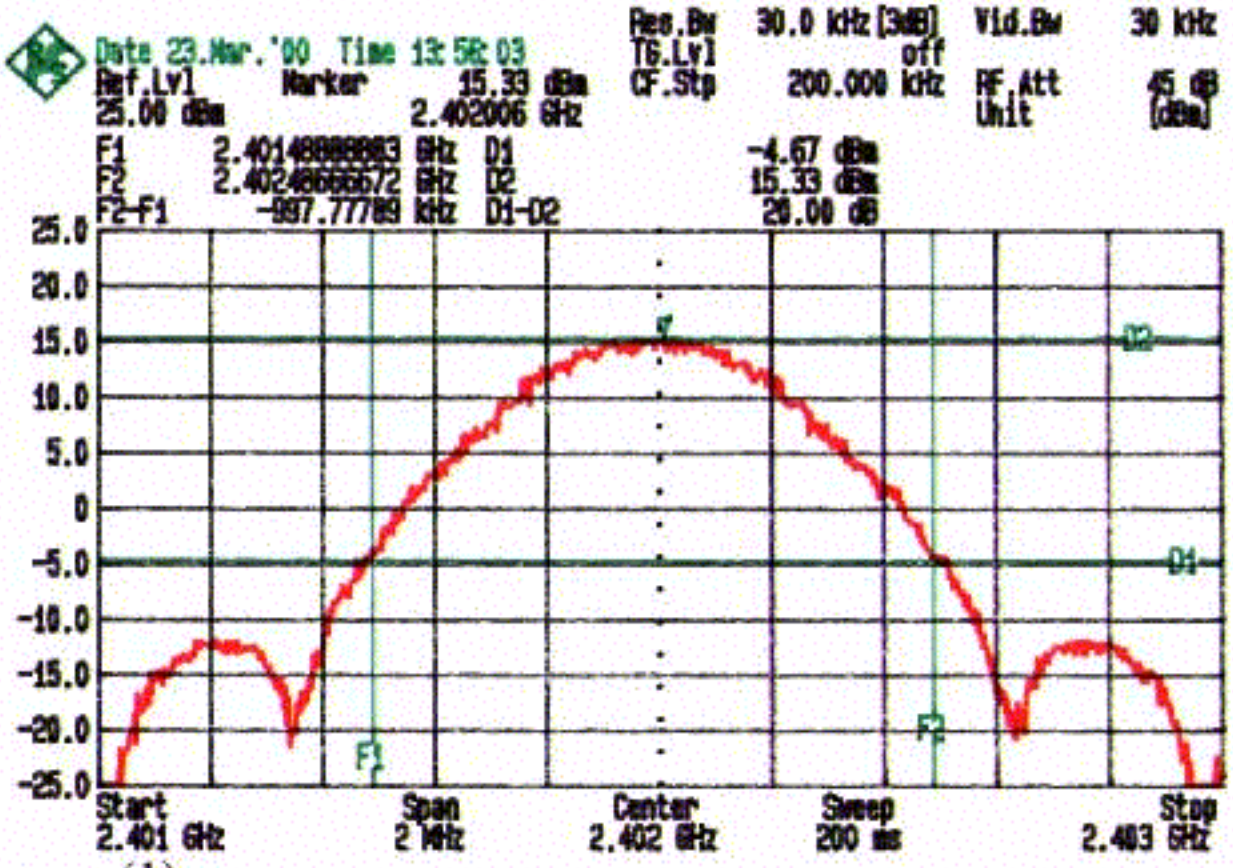
## 4.4 Conducted Out-of-band Emissions

### 4.4.2 Results

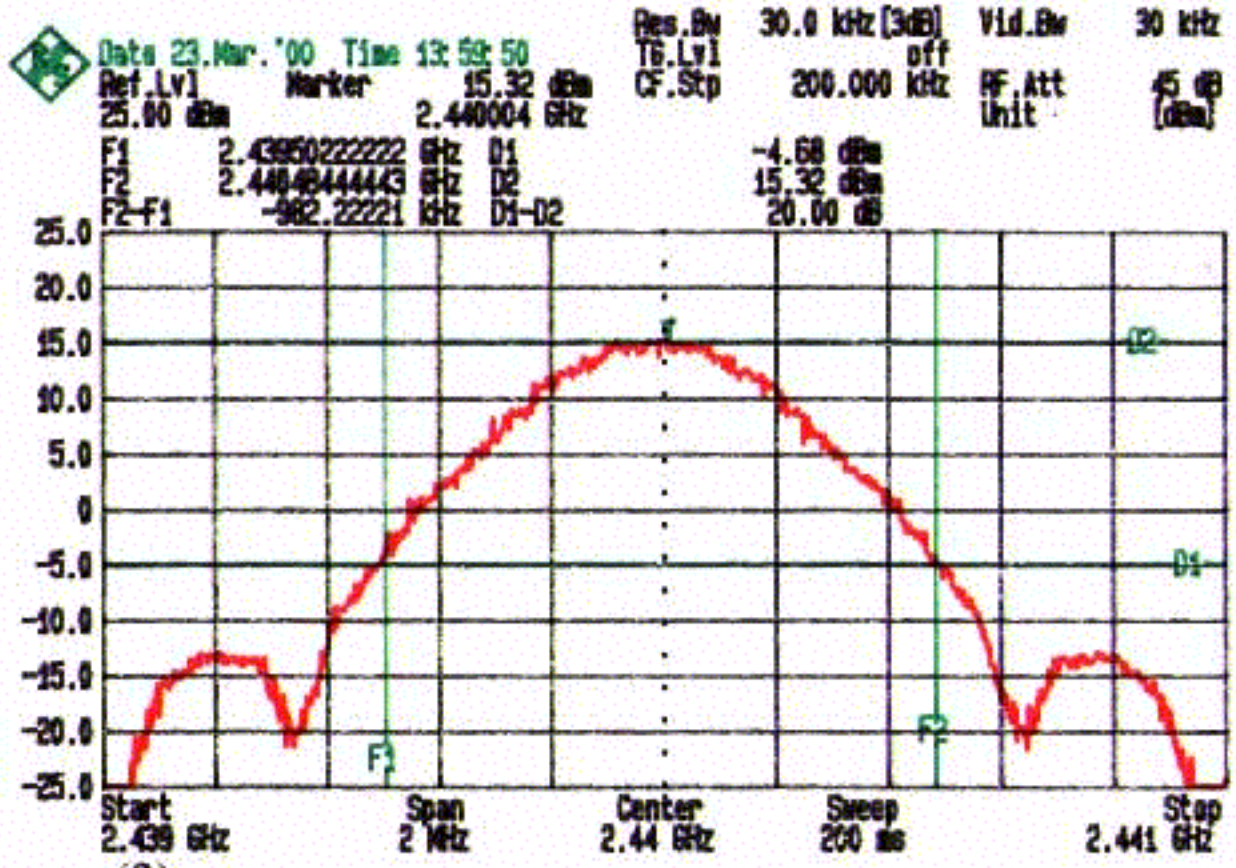
Plots in following pages show the harmonic and spurious out-of-band emissions of the EUT measured at the antenna connector. All found peaks and their margins are listed in the following tables The EUT was found compliant with the requirements for conducted out-of-band emissions.

| Frequency (GHz) | Emission Type | Level (dBm) | QP/Avg. Level (dBm) | Limit (dBm) (*) | Margin (dB) |
|---|---|---|---|---|---|
| ***Transmit on channel 1*** | | | | | |
| 4.804 | harmonic | -55.60 | -58.34 | 0 | 58.34 |
| 7.206 | harmonic | -42.13 | -46.37 | 0 | 46.37 |
| 9.608 | harmonic | -53.84 | -56.27 | 0 | 56.27 |
| 12.010 | harmonic | -62.07 | -66.31 | 0 | 66.31 |
| ***Transmit on channel 39*** | | | | | |
| 4.880 | harmonic | -40.87 | -45.21 | 0 | 45.21 |
| 7.320 | harmonic | -49.56 | -52.86 | 0 | 52.86 |
| 9.760 | harmonic | -57.42 | -60.73 | 0 | 60.73 |
| 12.200 | harmonic | -44.64 | -48.22 | 0 | 48.22 |
| 16.640 | harmonic | -48.92 | -51.32 | 0 | 51.32 |
| 17.080 | harmonic | -61.15 | -65.10 | 0 | 65.1 |
| 19.520 | harmonic | -54.32 | -58.08 | 0 | 58.08 |
| 21.960 | harmonic | -63.18 | -66.92 | 0 | 66.92 |
| ***Transmit on channel 79*** | | | | | |
| 4.960 | harmonic | -38.79 | -44.06 | 0 | 44.06 |
| 7.440 | harmonic | -57.86 | -62.24 | 0 | 62.24 |
| 12.400 | harmonic | -67.45 | -71.43 | 0 | 71.43 |
| 14.880 | harmonic | -68.62 | -72.03 | 0 | 72.03 |
| 17.360 | harmonic | -60.12 | -63.78 | 0 | 63.78 |

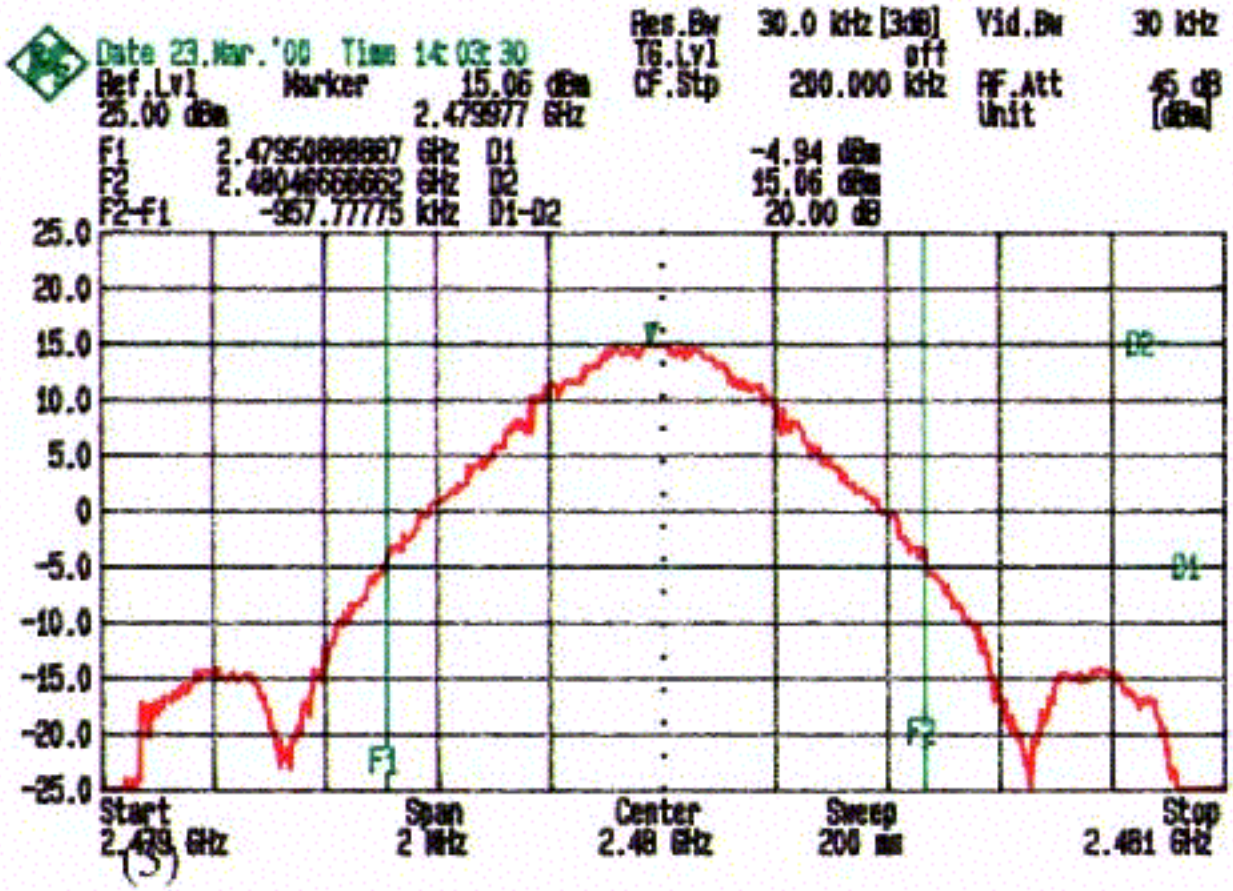
(*) Limit for harmonics is 20 dB below the lowest fundamental signal (~20 dBm). For all other emission the limit is given in Part 15 paragraph 209.




(1)



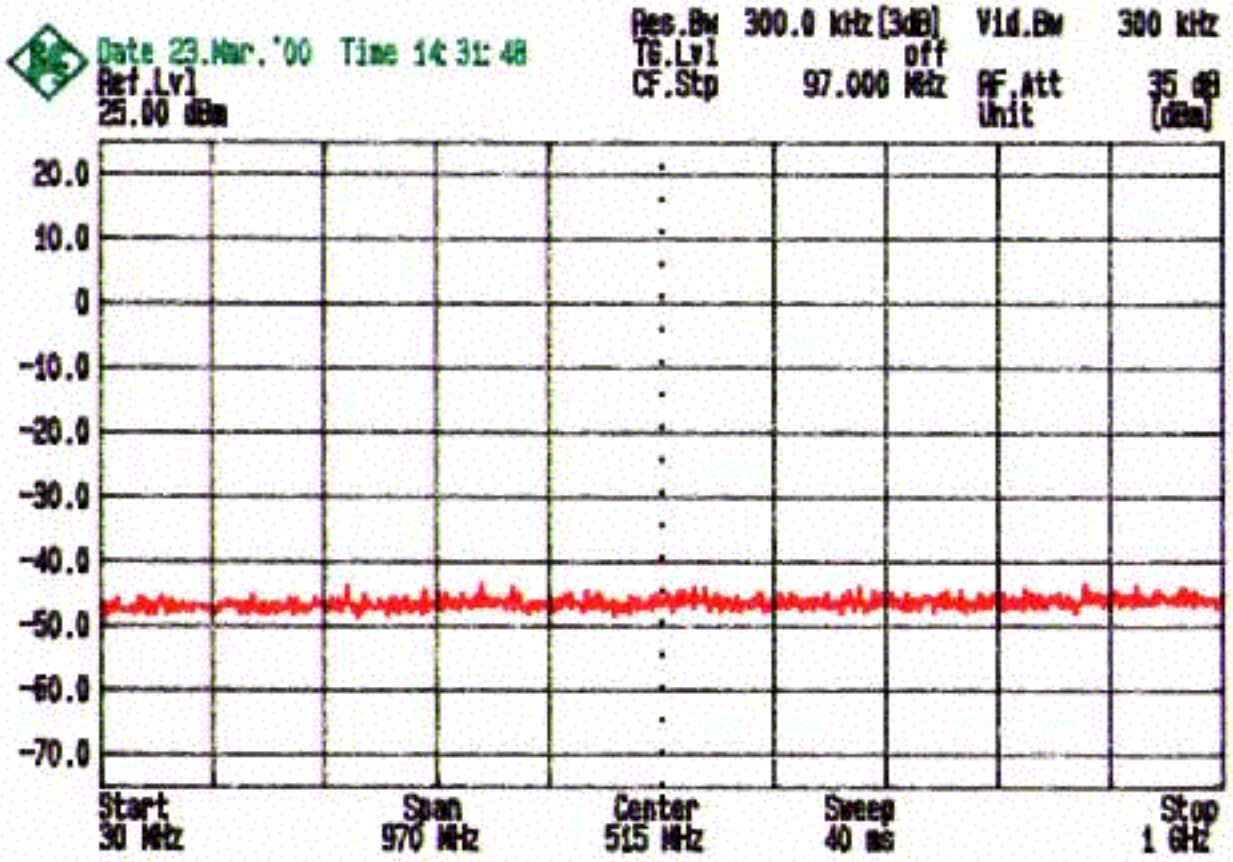

(2)

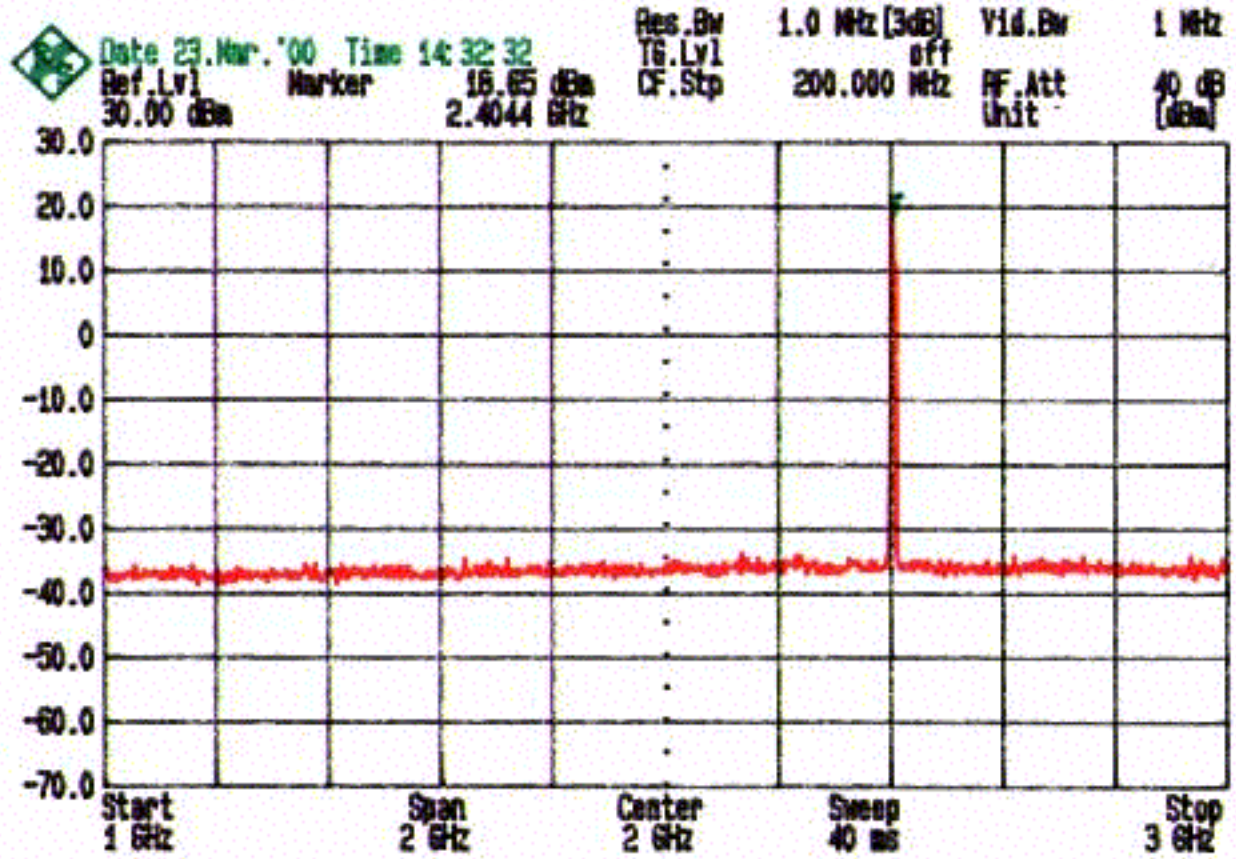


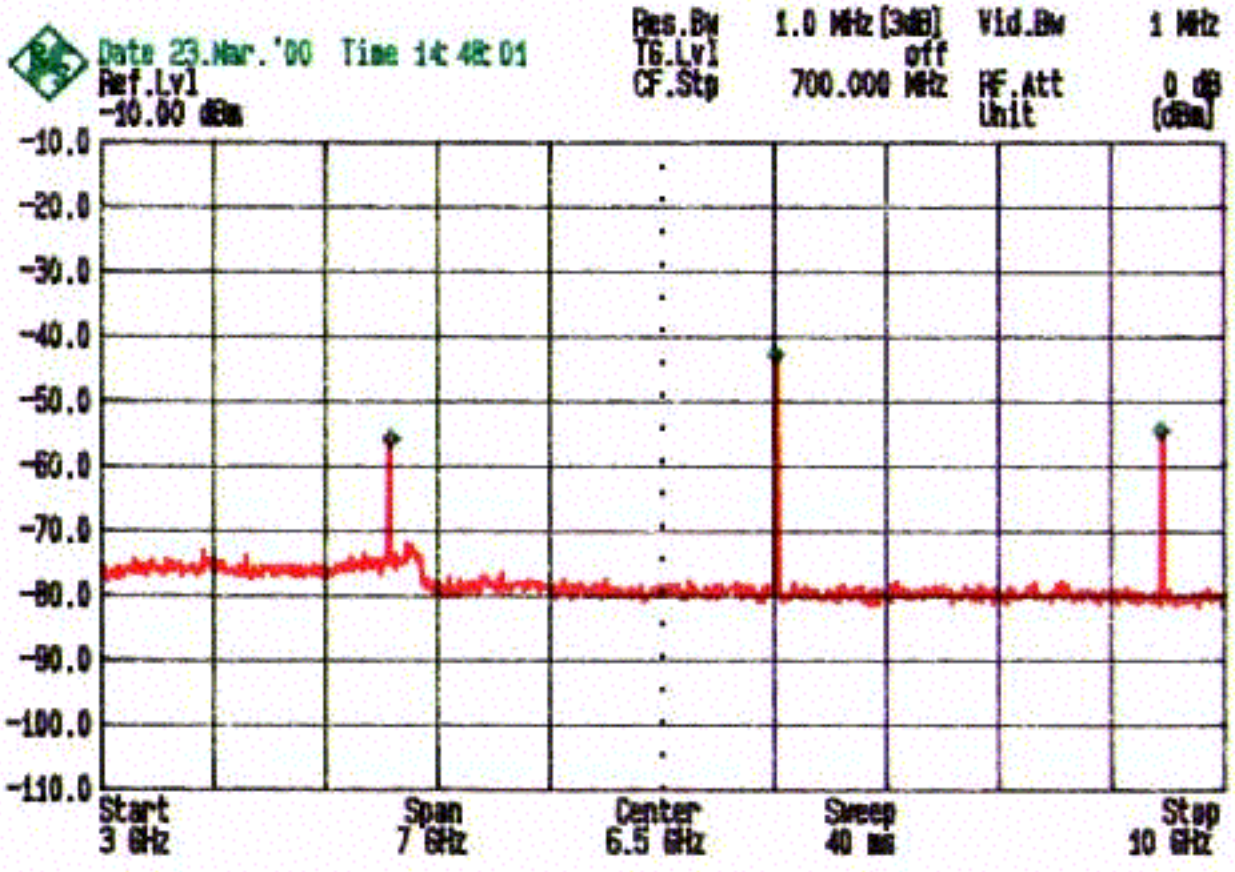

(3)

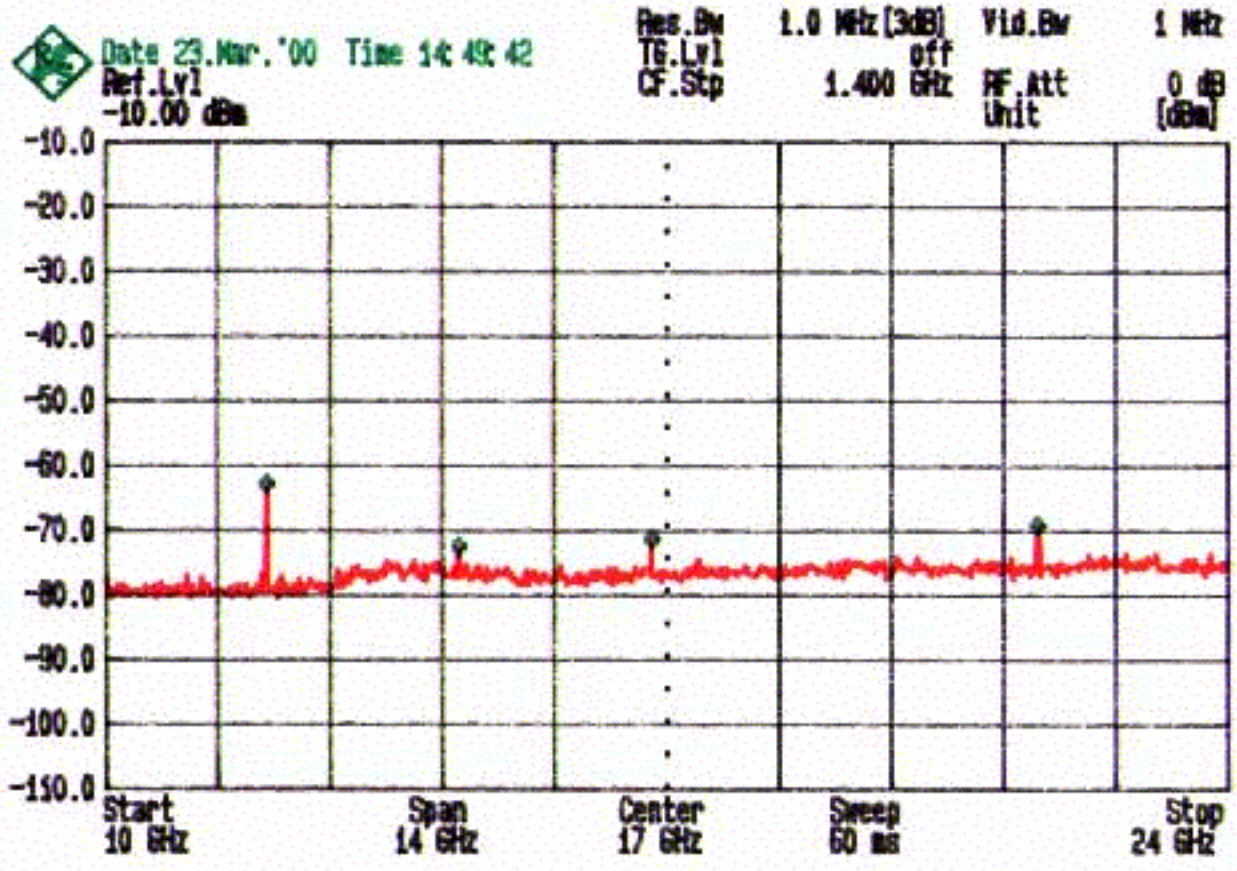
**20 dB Bandwidth Measurement**

1) Low Channel
2) Mid Channel
3) High Channel

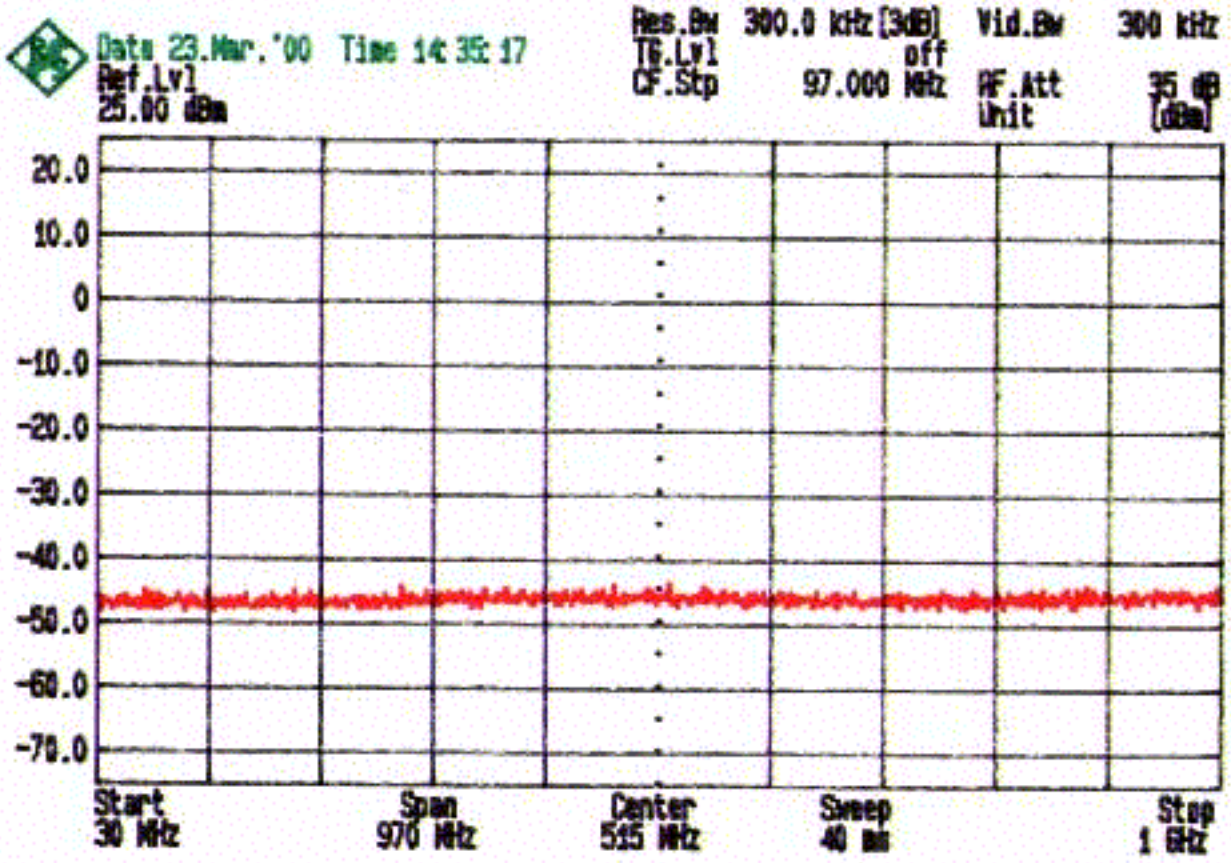


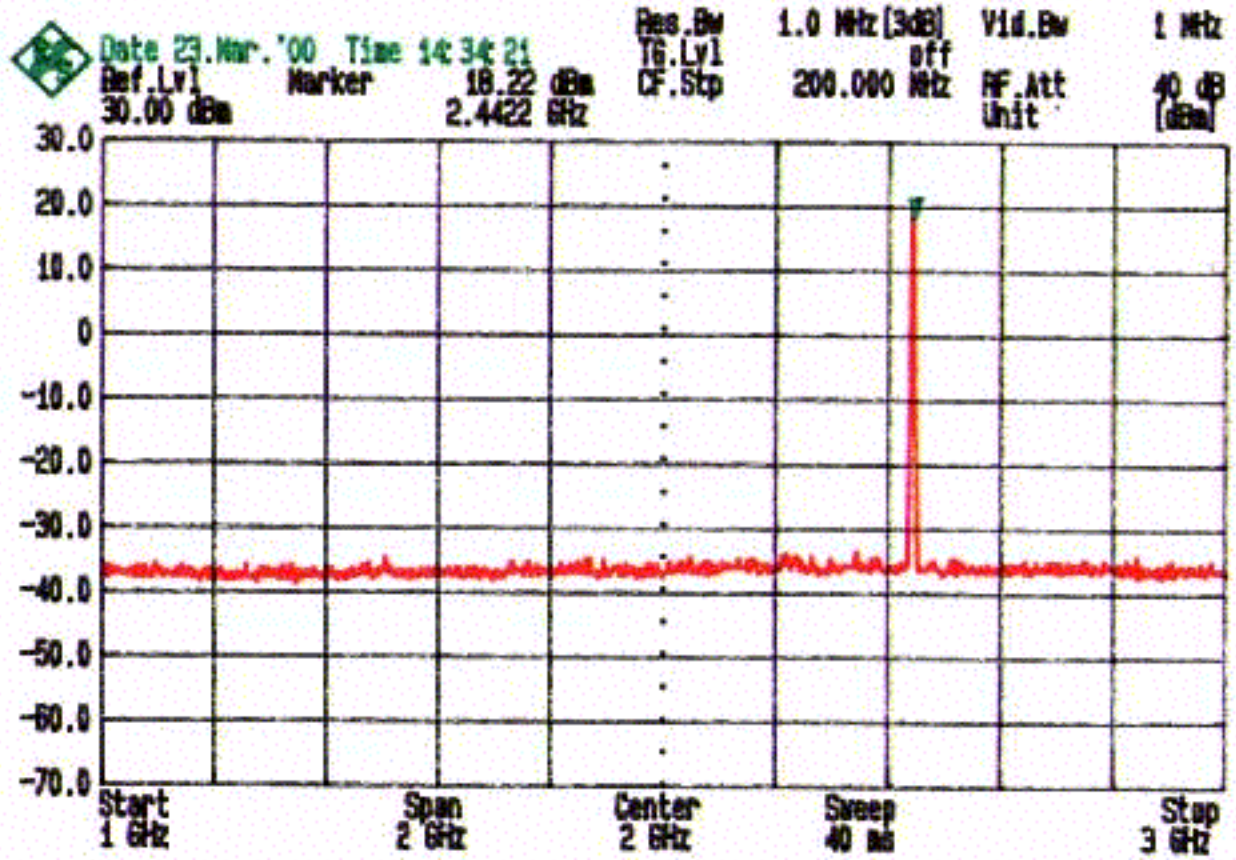



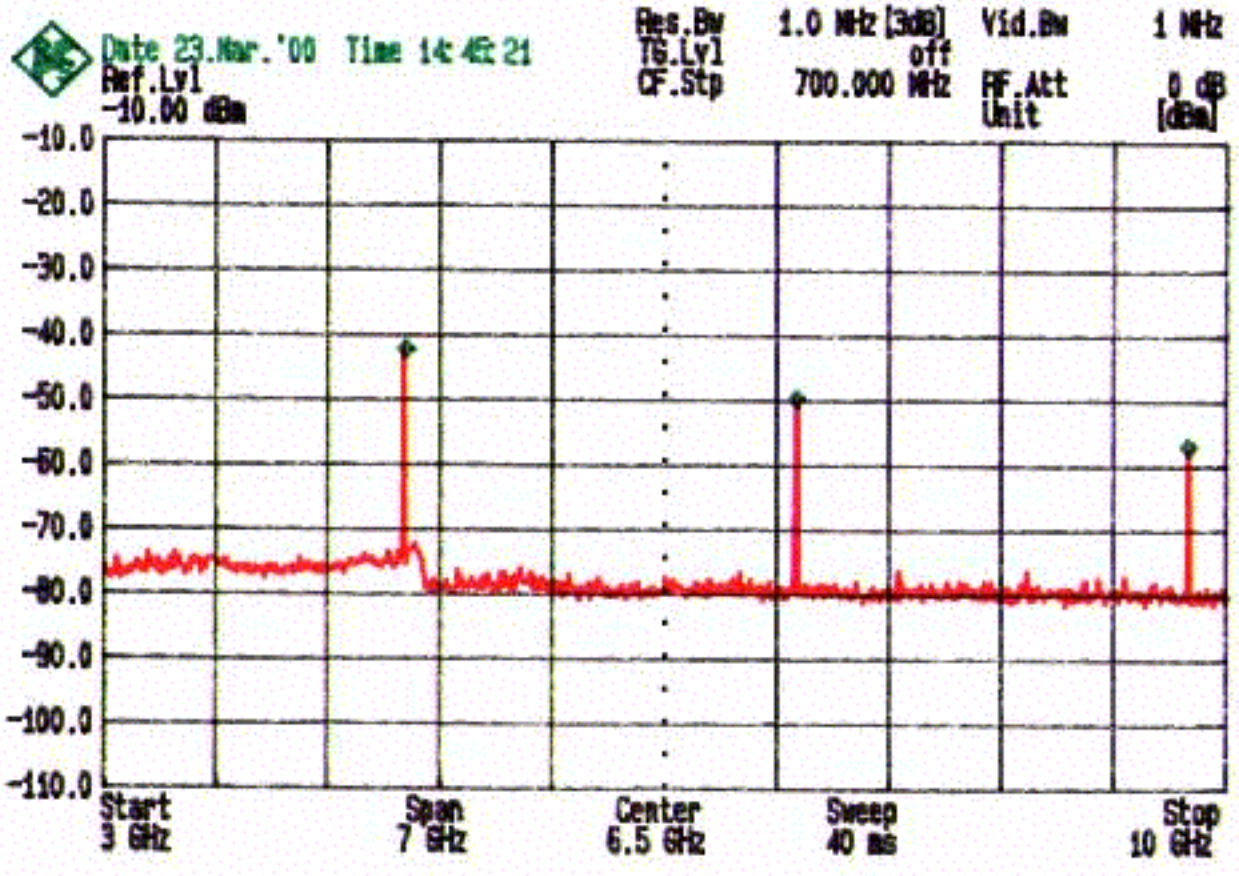



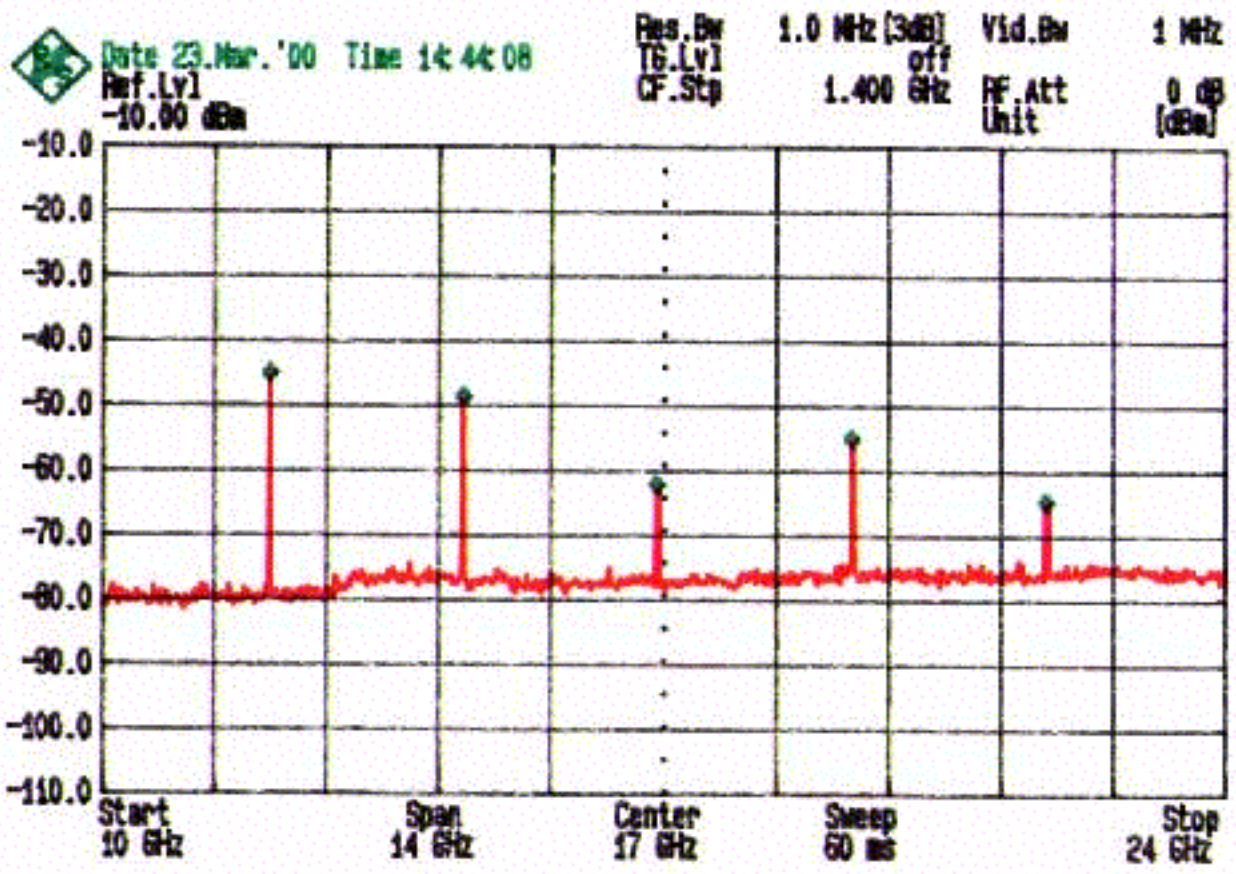




**Conducted Spurious Emissions Plots (Low Channel)**

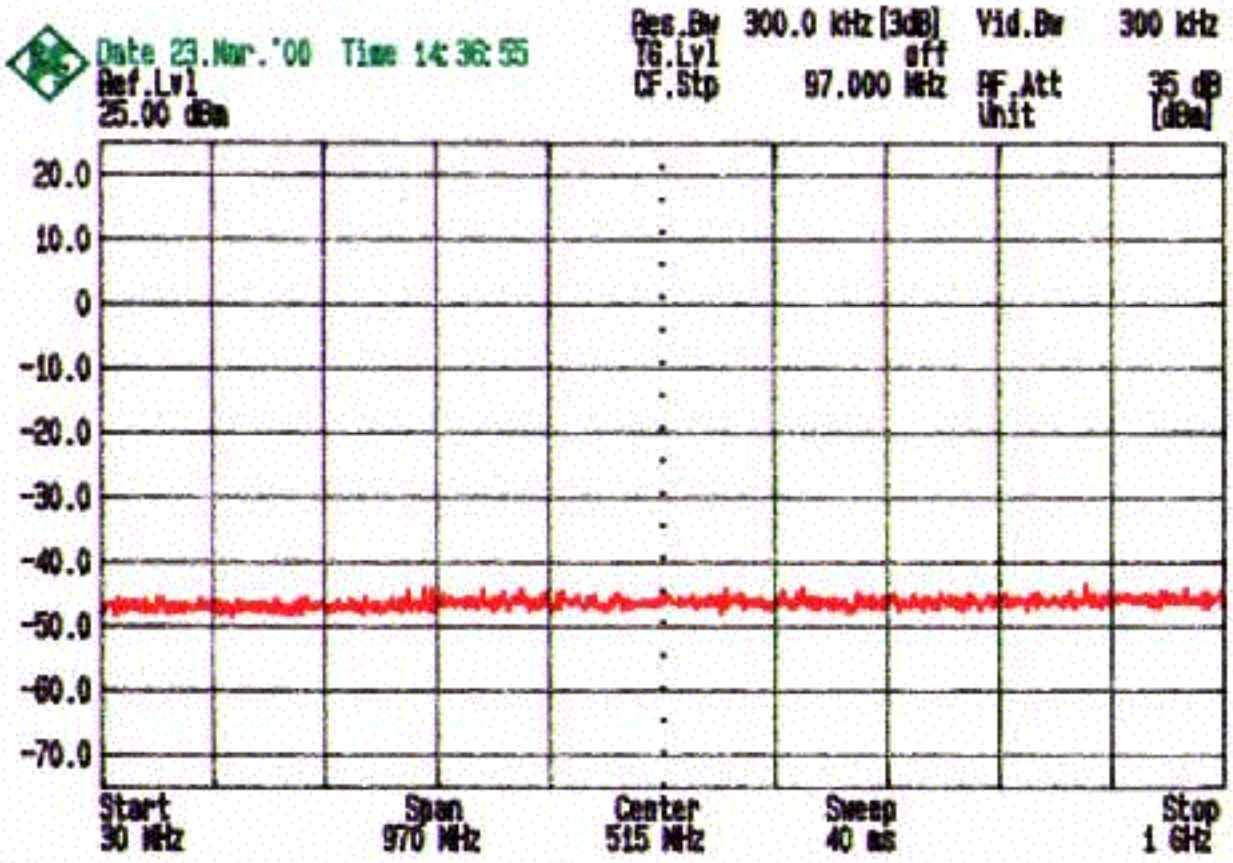


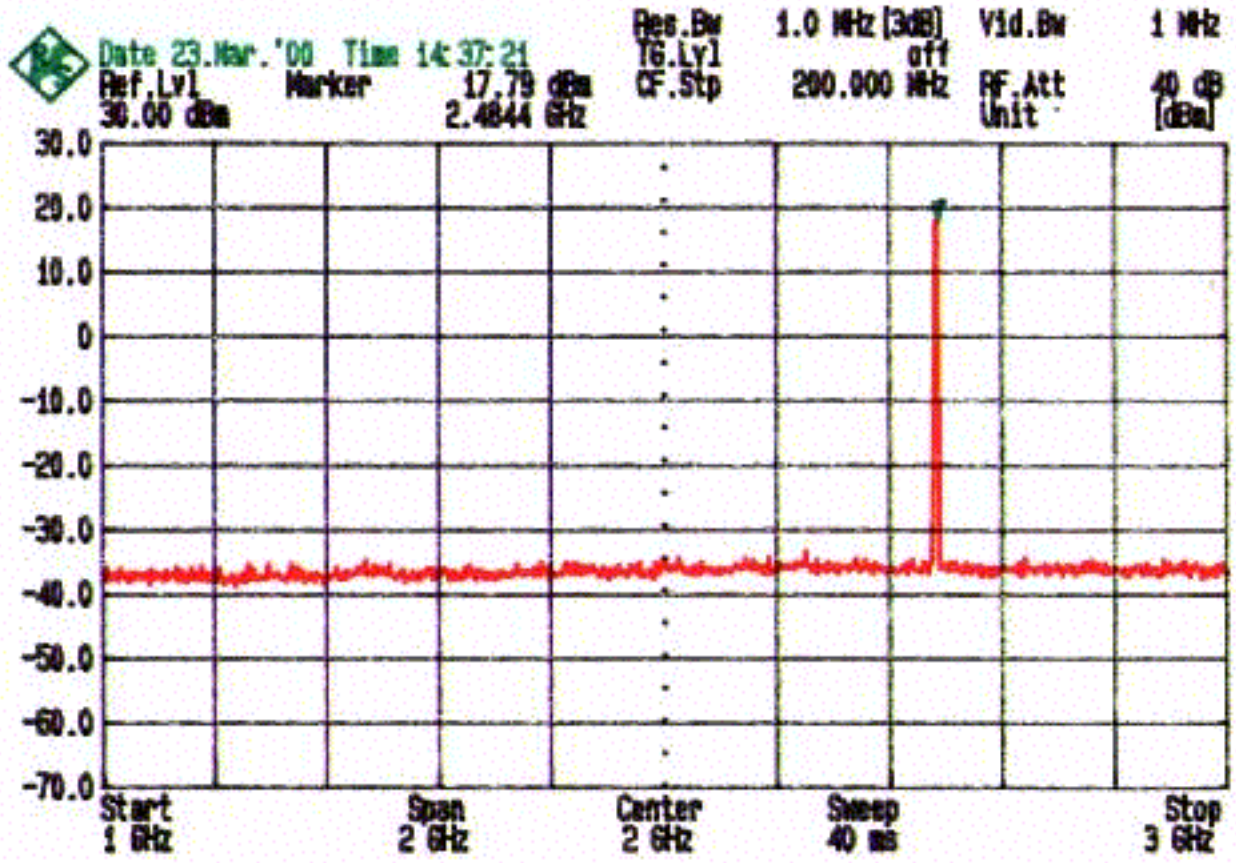



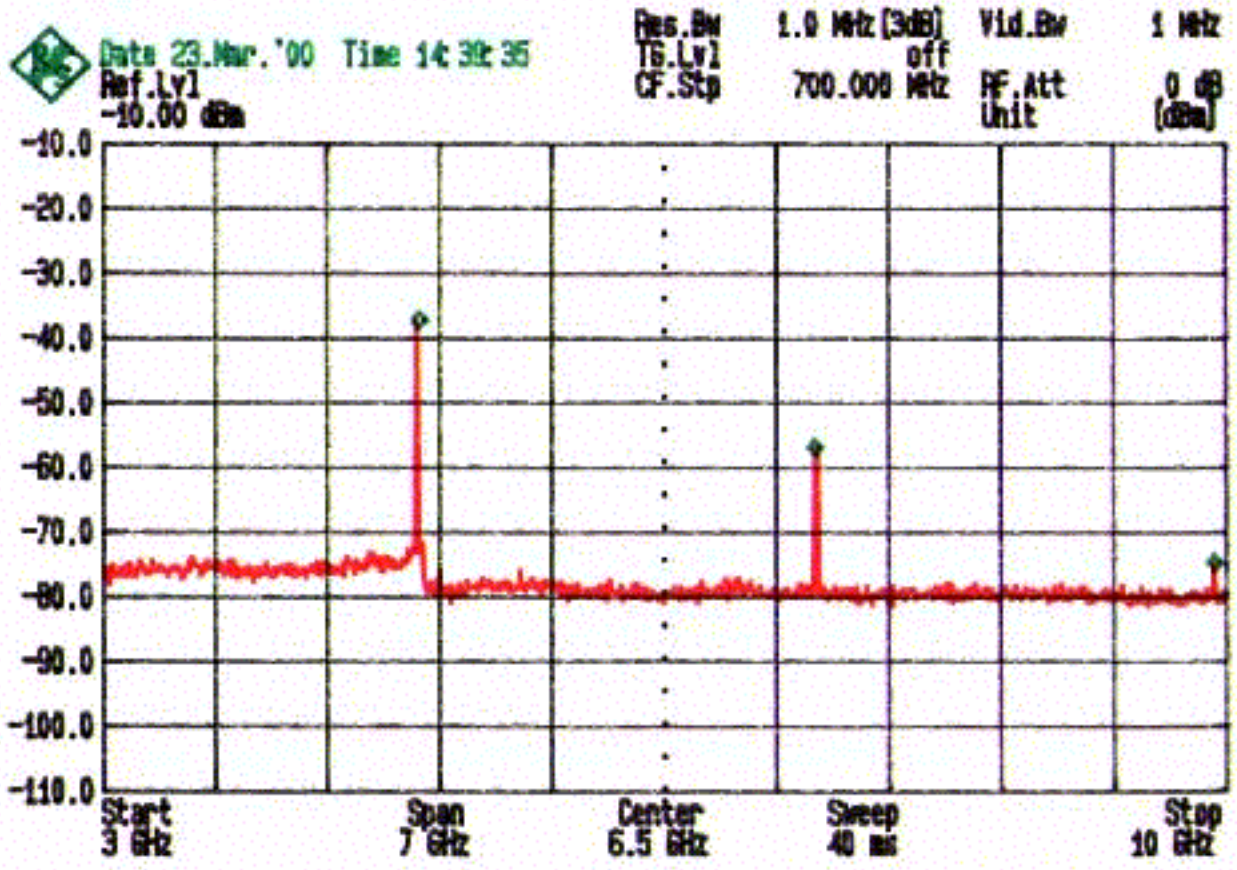



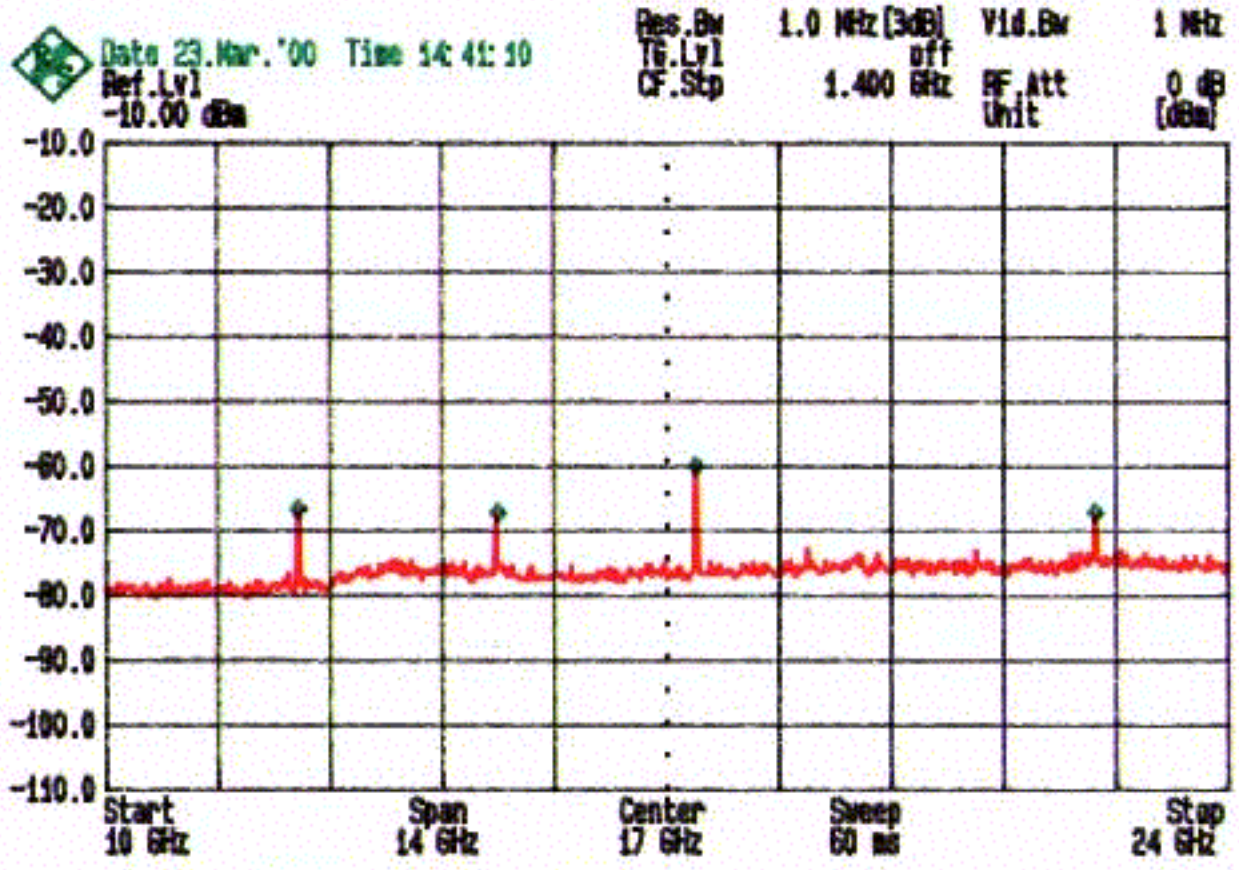




**Conducted Spurious Emissions Plots (Mid Channel)**




**Conducted Spurious Emissions Plots (High Channel)**

## 4.5 RADIATED SPURIOUS EMISSIONS

### 4.5.1.1 30 MHz - 1 GHz Band Procedure

First with the transmitter turned off, the EUT was powered up and a pre-scan was performed at 3m by rotating the EUT 360° and changing the antenna height between 1 m and 4 m. All suspicious peaks were noted. Then with the quasi-peak detector at 120 kHz RBW all suspicious peaks were scanned in the maximized EUT direction and antenna height. Same measurements were made for both polarizations of the antenna. The analyzer/receiver was programmed to compansate for all loss and gain factors (such as cables, antennas, preamplifiers etc.). The peak and quasi-peak readings were recorded. The limit used was FCC Part 15 class B radiated emissions limit. Then the same measurements were repeated with the transmitter in a constant transmit mode. This time only suspicious peaks in restricted bands (Part 15.205) were investigated. The measurements were performed three times for each type of the antennas (dipole, patch and omnidirectional).

### 4.5.1.2 30 MHz - 1 GHz Band Results

All emissions measured were below the limit. The table on following pages shows the measured values above 20 dB margin, system loss/gain factors for those emissions and the position of the EUT and the measurement antenna.

### 4.5.2.1 1 GHz - 24 GHz Band Procedure

With the transmitter in continuous transmit mode, a pre-scan of the EUT was performed at 1m by rotating the EUT 360° and changing the antenna height between 1m and 4m. All suspicious peaks were noted. Then with the average-peak detector at 1 MHz RBW all suspicious peaks were scanned in the maximized EUT direction and antenna height. Same measurements were made for both polarizations of the antenna. The analyzer/receiver was programmed to compansate for all loss and gain factors (such as cables, antennas, preamplifiers etc.). A 10 dB correction factor was added to the readings for the reduction of measurements distance. The peak and average readings were recorded. The limits used were the limits specified in paragraphs 205 (restricted bands), 209 (spurious emissions), 247 (c) (harmonic emissions) of Part 15. The measurements were performed three times for the highest gain of each type of the antennas (dipole, patch and omnidirectional).

### 4.5.2.2 1 GHz - 24 GHz Band Results

The tables on following pages show the measured values, system loss/gain factors for those emissions and the position of the EUT and the antenna.
Since no emissions were found above 12.5 GHz, the band between 18 GHz and 24 GHz was not scanned.

| Frequency (MHz) | Reading Peak (dBuV/m) | Reading QP (dBuV/m) | Antenna Factor (dB) | System Loss (dB) | Limit (dBuV/m) | Azimuth Angle (°) | Antenna Height (m) | Polariz. | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| **Dipole Antenna Measurements** | | | | | | | | | |
| 130.30 | 47.24 | 36.09 | 12.42 | 11.90 | 40.00 | 325.00 | 1m | V | **3.91** |
| 136.50 | 43.58 | 34.62 | 12.38 | 11.74 | 40.00 | 20.00 | 1m | V | **5.38** |
| 145.80 | 44.63 | 35.99 | 12.06 | 11.49 | 40.00 | 5.00 | 1.5m | V | **4.01** |
| 147.70 | 37.64 | 32.65 | 11.93 | 11.43 | 40.00 | 345.00 | 1m | V | **7.35** |
| 149.70 | 35.79 | 35.23 | 11.81 | 11.38 | 40.00 | 315.00 | 1m | V | **4.77** |
| 173.55 | 33.57 | 28.05 | 10.19 | 10.70 | 40.00 | 70.00 | 1m | V | **11.95** |
| 214.55 | 36.50 | 34.78 | 10.47 | 11.76 | 40.00 | 320.00 | 1.5m | V | **5.22** |
| 120.90 | 41.83 | 34.61 | 12.32 | 12.16 | 40.00 | 135.00 | 1m | H | **5.39** |
| 135.80 | 45.10 | 35.76 | 12.39 | 11.77 | 40.00 | 150.00 | 1.5m | H | **4.24** |
| 146.20 | 39.70 | 32.05 | 11.99 | 11.46 | 40.00 | 5.00 | 1.5m | H | **7.95** |
| 157.10 | 43.83 | 36.05 | 11.35 | 11.11 | 40.00 | 35.00 | 1.5m | H | **3.95** |
| 171.09 | 39.65 | 36.40 | 10.34 | 10.74 | 40.00 | 305.00 | 1m | H | **3.60** |
| 213.91 | 38.55 | 35.34 | 10.41 | 11.64 | 40.00 | 335.00 | 1m | H | **4.66** |
| **Patch Antenna Measurements** | | | | | | | | | |
| 130.30 | 47.85 | 36.23 | 12.42 | 11.90 | 40.00 | 325.00 | 1m | V | **3.77** |
| 136.50 | 43.62 | 34.21 | 12.38 | 11.74 | 40.00 | 20.00 | 1m | V | **5.79** |
| 145.80 | 44.71 | 35.43 | 12.06 | 11.49 | 40.00 | 5.00 | 1.5m | V | **4.57** |
| 147.70 | 37.89 | 32.76 | 11.93 | 11.43 | 40.00 | 345.00 | 1m | V | **7.24** |
| 149.70 | 36.21 | 35.84 | 11.81 | 11.38 | 40.00 | 315.00 | 1m | V | **4.16** |
| 173.55 | 33.84 | 29.02 | 10.19 | 10.70 | 40.00 | 70.00 | 1m | V | **10.98** |
| 214.55 | 36.12 | 34.33 | 10.47 | 11.76 | 40.00 | 320.00 | 1.5m | V | **5.67** |
| 120.90 | 41.74 | 33.98 | 12.32 | 12.16 | 40.00 | 135.00 | 1m | H | **6.02** |
| 135.80 | 45.23 | 35.61 | 12.39 | 11.77 | 40.00 | 150.00 | 1.5m | H | **4.39** |
| 146.20 | 39.86 | 32.46 | 11.99 | 11.46 | 40.00 | 5.00 | 1.5m | H | **7.54** |
| 157.10 | 43.51 | 35.48 | 11.35 | 11.11 | 40.00 | 35.00 | 1.5m | H | **4.52** |
| 171.09 | 39.22 | 35.94 | 10.34 | 10.74 | 40.00 | 305.00 | 1m | H | **4.06** |
| 213.91 | 38.92 | 34.51 | 10.41 | 11.64 | 40.00 | 335.00 | 1m | H | **5.49** |
| **Omni-directional Antenna Measurements** | | | | | | | | | |
| 130.30 | 47.02 | 35.64 | 12.42 | 11.90 | 40.00 | 325.00 | 1m | V | **4.36** |
| 136.50 | 43.16 | 34.23 | 12.38 | 11.74 | 40.00 | 20.00 | 1m | V | **5.77** |
| 145.80 | 44.28 | 35.51 | 12.06 | 11.49 | 40.00 | 5.00 | 1.5m | V | **4.49** |
| 147.70 | 37.48 | 32.50 | 11.93 | 11.43 | 40.00 | 345.00 | 1m | V | **7.50** |
| 149.70 | 35.11 | 34.91 | 11.81 | 11.38 | 40.00 | 315.00 | 1m | V | **5.09** |
| 173.55 | 33.08 | 27.83 | 10.19 | 10.70 | 40.00 | 70.00 | 1m | V | **12.17** |
| 214.55 | 36.69 | 35.03 | 10.47 | 11.76 | 40.00 | 320.00 | 1.5m | V | **4.97** |
| 120.90 | 41.27 | 34.17 | 12.32 | 12.16 | 40.00 | 135.00 | 1m | H | **5.83** |
| 135.80 | 44.98 | 35.24 | 12.39 | 11.77 | 40.00 | 150.00 | 1.5m | H | **4.76** |
| 146.20 | 39.43 | 31.67 | 11.99 | 11.46 | 40.00 | 5.00 | 1.5m | H | **8.33** |
| 157.10 | 43.26 | 35.41 | 11.35 | 11.11 | 40.00 | 35.00 | 1.5m | H | **4.59** |
| 171.09 | 39.17 | 36.12 | 10.34 | 10.74 | 40.00 | 305.00 | 1m | H | **3.88** |
| 213.91 | 39.04 | 35.61 | 10.41 | 11.64 | 40.00 | 335.00 | 1m | H | **4.39** |

## Radiated Emissions Results (below 1 GHz)

| Frequency MHz | Ant. Factors dB | Sys. Gain dB | Peak value (*) dBµV/m | AVG value (*) dBµV/m | FCC Limit dBµV/m | Ant. Height m | Antenna Polarization | Azimuth deg. | Margin dB |
|---|---|---|---|---|---|---|---|---|---|
| Dipole Antenna | | | | | | | | | |
| 4804 | 32.8 | -1.2 | 43.8 | 39.6 | 54 | 1 | V | 30 | **14.40** |
| 4880 | 33.1 | -1.2 | 42.7 | 37.9 | 54 | 1 | V | 30 | **16.10** |
| 4960 | 33.2 | -1.2 | 45.1 | 39.8 | 54 | 1 | V | 30 | **14.20** |
| 7206 | 36.3 | -1.4 | 48.3 | 43.4 | 54 | 1 | V | 30 | **10.60** |
| 7320 | 36.5 | -1.4 | 47.8 | 44 | 54 | 1 | V | 30 | **10.00** |
| 7440 | 36.8 | -1.4 | 47.2 | 42.9 | 54 | 1 | V | 30 | **11.10** |
| Patch Antenna | | | | | | | | | |
| 4804 | 32.8 | -1.2 | 46.7 | 41.8 | 54 | 1 | H | 90 | **12.20** |
| 4880 | 33.1 | -1.2 | 45.8 | 41.2 | 54 | 1 | H | 90 | **12.80** |
| 4960 | 33.2 | -1.2 | 46.2 | 41.3 | 54 | 1 | H | 90 | **12.70** |
| 7206 | 36.3 | -1.4 | 49.3 | 45.4 | 54 | 1 | H | 90 | **8.60** |
| 7320 | 36.5 | -1.4 | 48.2 | 44.7 | 54 | 1 | H | 90 | **9.30** |
| 7440 | 36.8 | -1.4 | 48.7 | 44.9 | 54 | 1 | H | 90 | **9.10** |
| Omni-Directional Antenna | | | | | | | | | |
| 4804 | 32.8 | -1.2 | 47.3 | 43.7 | 54 | 1 | V | 0 | **10.30** |
| 4880 | 33.1 | -1.2 | 46.8 | 43.1 | 54 | 1 | V | 0 | **10.90** |
| 4960 | 33.2 | -1.2 | 46.9 | 42.7 | 54 | 1 | V | 0 | **11.30** |
| 7206 | 36.3 | -1.4 | 48.1 | 43.8 | 54 | 1 | V | 30 | **10.20** |
| 7320 | 36.5 | -1.4 | 47.5 | 43.1 | 54 | 1 | V | 30 | **10.90** |
| 7440 | 36.8 | -1.4 | 48.6 | 44.5 | 54 | 1 | V | 30 | **9.50** |

(*) Measurement is made at 1m distance; therefore, a 10 dB correction factor added.
RBW = 1 MHz VBW = 1 MHz

## Radiated Emissions Results (above 1 GHz)

# 4.6 POWERLINE CONDUCTED EMISSIONS

## 4.6.1 Powerline Conducted Emissions Procedure

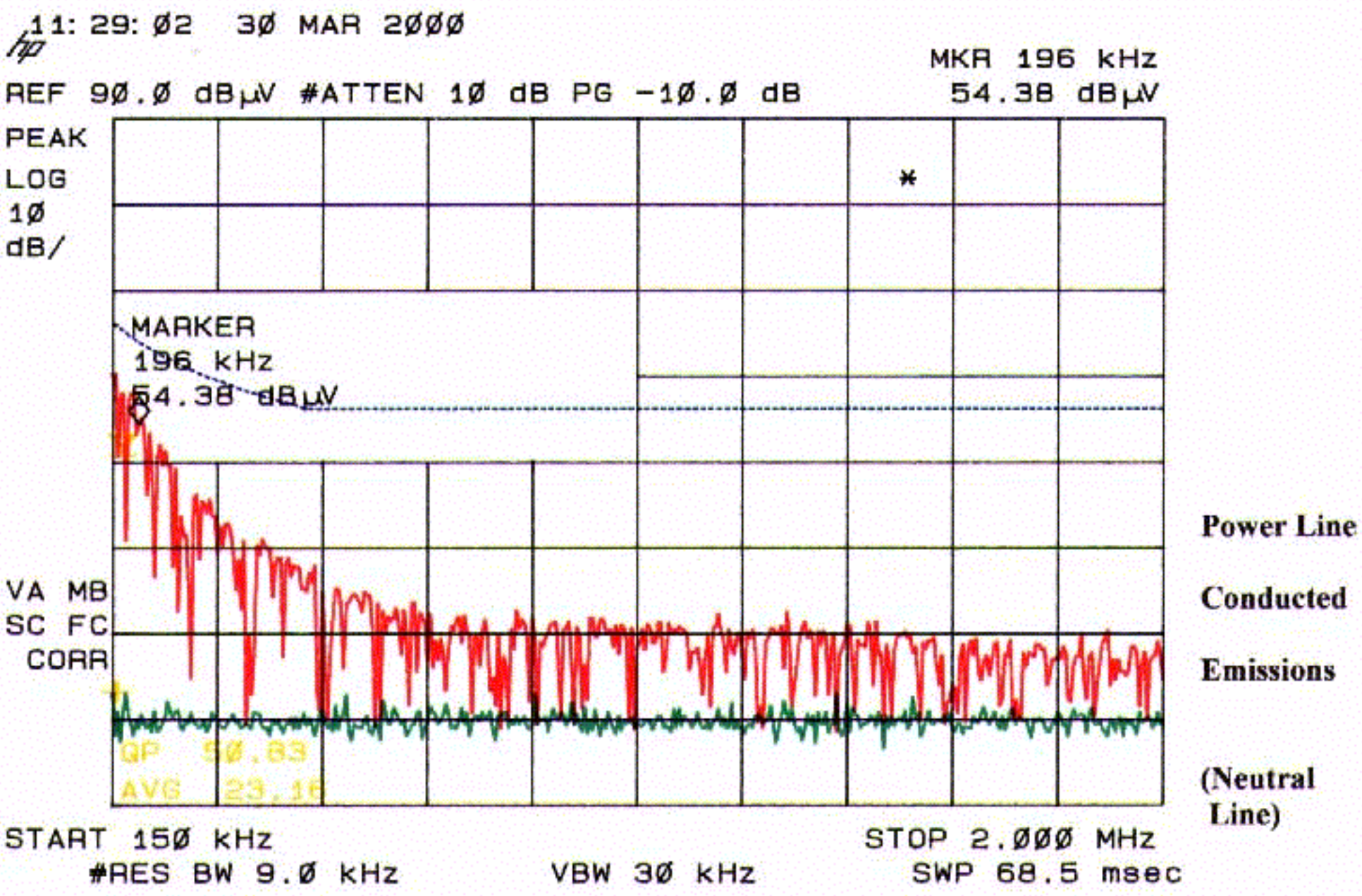
With the EUT set up on the non-conductive table in front of the vertical ground plane, emissions injected by the EUT into the hot and neutral sides of the powerlines were measured through a LISN. At suspicious peaks QP and average readings were performed and compared to the relevant limits (CISPR 22 Class A)

## 4.6.2 Powerline Conducted Emissions Results

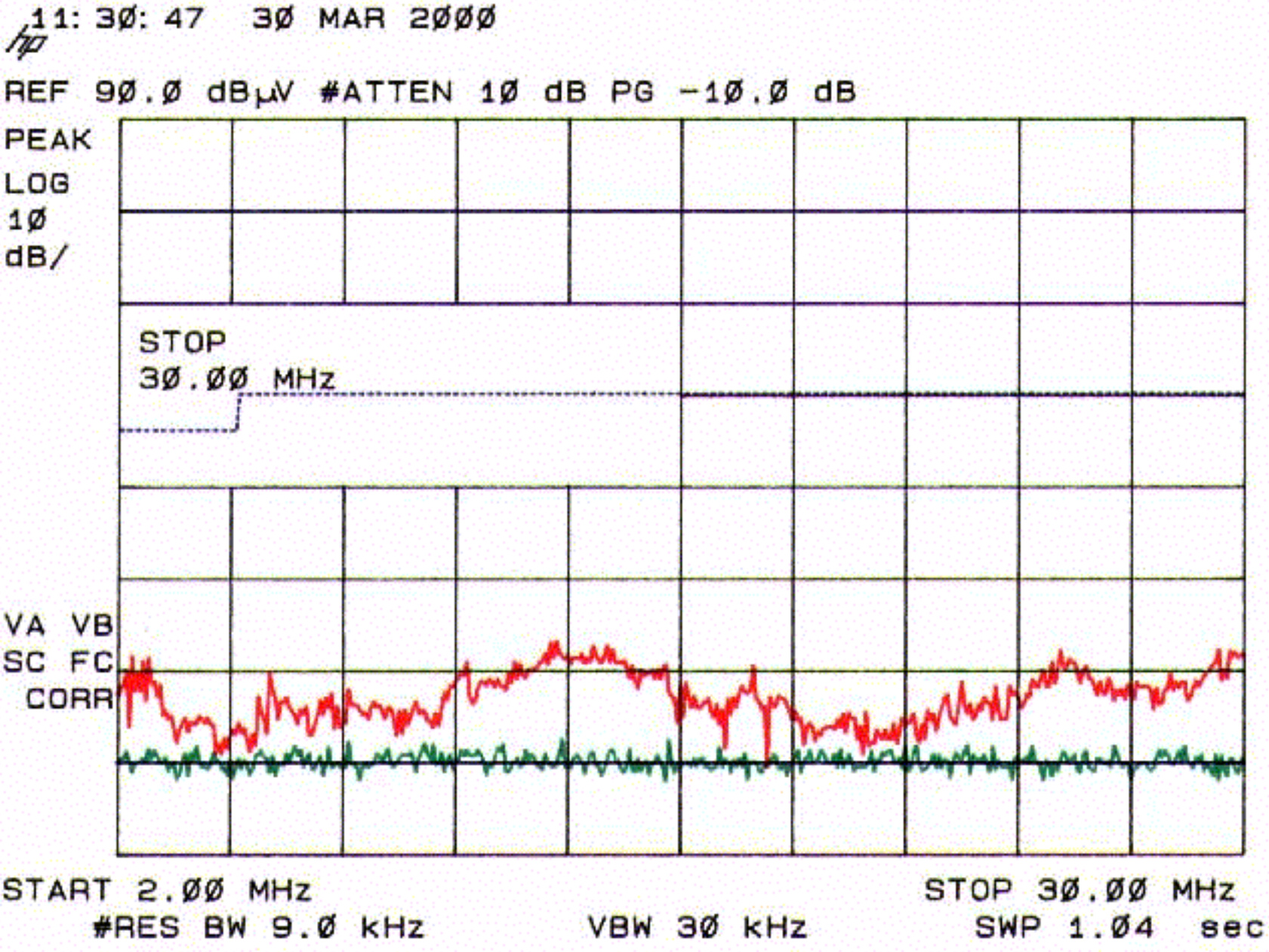
The table below shows a list of the readings and their comparison to the limit lines. All emissions measured, were well below the limits line. The plots on the following pages show the conducted emissions in both lines.

| **Line** | **Frequency (MHz)** | **Peak Level (dBmV)** | **QP –Level (dBmV)** | **Avg. Level (dBmV)** | **Limit** (*) **(dBmV)** | **Margin (dB)** |
|---|---|---|---|---|---|---|
| Neutral | .155 | 57.27 | 52.43 | 28.34 | 66 | 37.66 |
| Neutral | .196 | 54.38 | 50.83 | 23.16 | 65 | 41.84 |
| Neutral | 2.9 | 32.83 | 30.15 | 23.44 | 56 | 32.56 |
| Neutral | 13.1 | 33.07 | 29.81 | 24.13 | 60 | 35.87 |
| Hot | .155 | 54.82 | 51.16 | 35.18 | 66 | 30.82 |
| Hot | .209 | 53.27 | 52.31 | 34.23 | 64 | 29.77 |
| Hot | 2.7 | 34.79 | 32.15 | 28.14 | 56 | 27.86 |
| Hot | 6.7 | 31.85 | 30.08 | 23.17 | 60 | 36.83 |
| Hot | 14.9 | 31.67 | 28.92 | 23.65 | 60 | 36.35 |
| Hot | 29.8 | 30.97 | 28.41 | 24.11 | 60 | 35.89 |

(*) Limits for average measurement




**Power Line Conducted Emissions (Neutral Line)**



11: 23: 25  3Ø MAR 2ØØØ

MKR 2Ø9 kHz
53.27 dBµV

REF 9Ø.Ø dBµV #ATTEN 1Ø dB PG -1Ø.Ø dB

PEAK
LOG
1Ø
dB/

MARKER
2Ø9 kHz
53.27 dBµV

VA MB
SC FC
CORR

QP 52.31
AVG 34.23

START 15Ø kHz
#RES BW 9.Ø kHz
VBW 3Ø kHz
STOP 3.5ØØ MHz
SWP 124 msec

**Power Line Conducted Emissions (Hot Line)**

11: 24: 58  3Ø MAR 2ØØØ

REF 9Ø.Ø dBµV #ATTEN 1Ø dB PG -1Ø.Ø dB

PEAK
LOG
1Ø
dB/

STOP
3Ø.ØØ MHz

VA VB
SC FC
CORR

START 3.5Ø MHz
#RES BW 9.Ø kHz
VBW 3Ø kHz
STOP 3Ø.ØØ MHz
SWP 981 msec