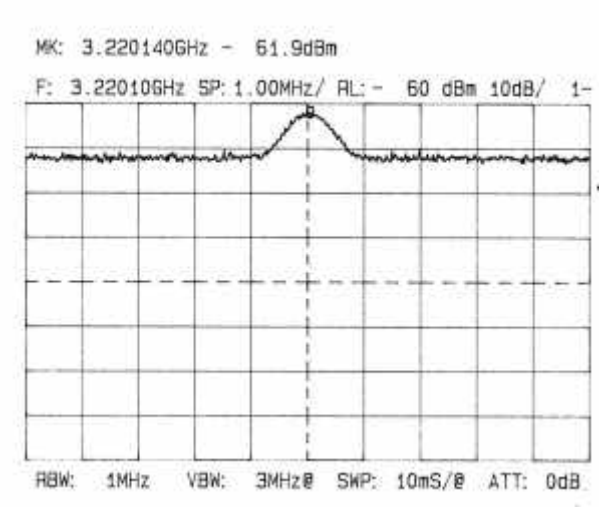
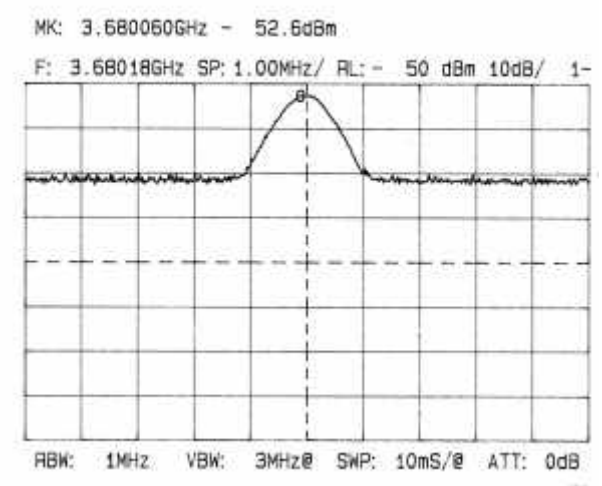
Plot 4.3.24
Conducted spurious emissions
Frequency 460.030
7th harmonic



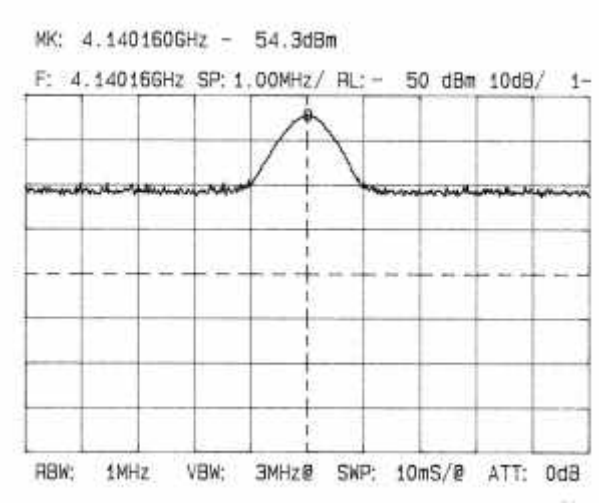
Ext. attenuation 25.5 dB.
Ps = – 61.9 +25.5 = – 36.4 dBm
Att (vs Pc) = 43.16 – (– 36.4) = 79.56 dBc
Lim = 50 + 10 log P = 63.16 dBc

Plot 4.3.25
Conducted spurious emissions
Frequency 460.030
8th harmonic



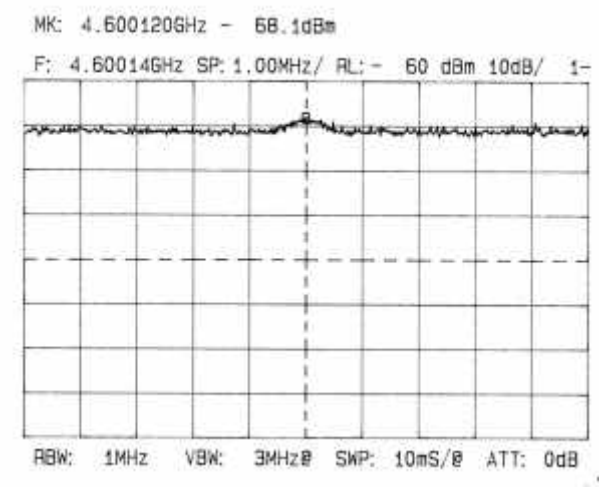
Ext. attenuation 23.1 dB.
Ps = – 52.6 +23.1 = – 29.5 dBm
Att (vs Pc) = 43.16 – (– 29.5) = 72.66 dBc
Lim = 50 + 10 log P = 63.16 dBc

Plot 4.3.26
Conducted spurious emissions
Frequency 460.030
9th harmonic



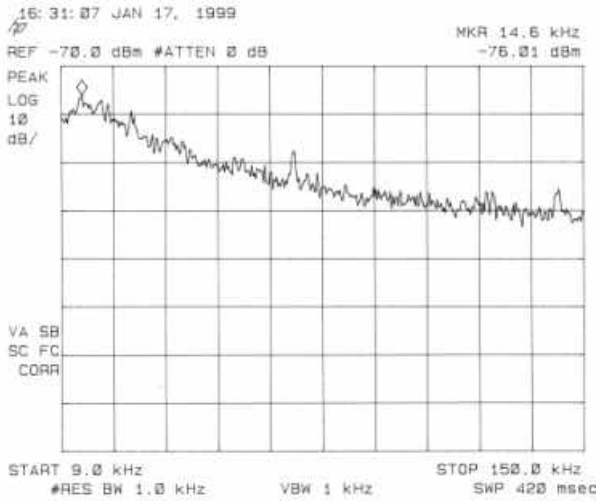
Ext. attenuation 25.9 dB.
Ps = – 54.3 +25.9 = – 28.4 dBm
Att (vs Pc) = 43.16 – (– 28.4) = 71.56 dBc
Lim = 50 + 10 log P = 63.16 dBc

Plot 4.3.27
Conducted spurious emissions
Frequency 460.030
10th harmonic



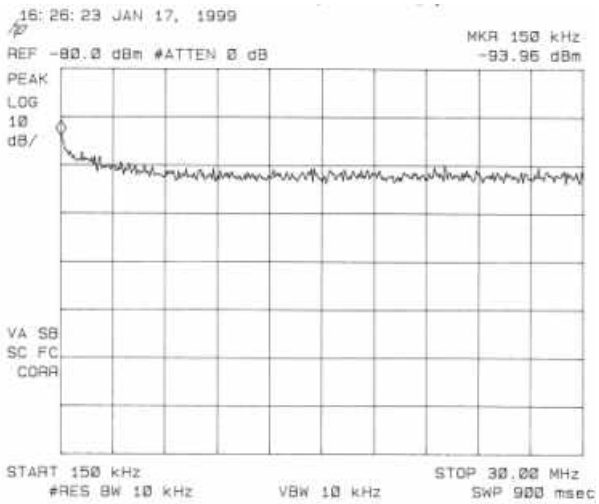
Ext. attenuation 27.3 dB.
Ps = – 68.1 +27.3 = – 40.8 dBm
Att (vs Pc) = 43.16 – (– 40.8) = 83.96 dBc
Lim = 50 + 10 log P = 63.16 dBc

Plot 4.3.28
Conducted spurious emissions
Frequency 460.030
9 kHz – 150 kHz



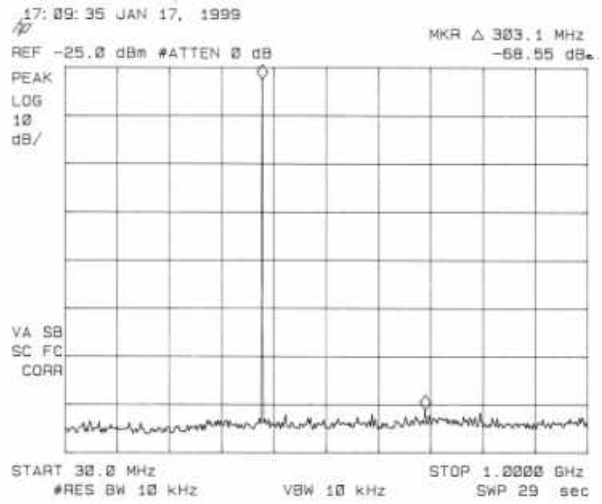
Ext. attenuation 40 dB.
Ps = – 76.01 +40 + 10 log (10kHz/1kHz) = – 26.01 dBm
Att (vs Pc) = 43.16 – (– 26.01) = 69.17 dBc
Lim = 50 + 10 log P = 63.16 dBc

Plot 4.3.29
Conducted spurious emissions
Frequency 460.030
150 kHz – 30 MHz



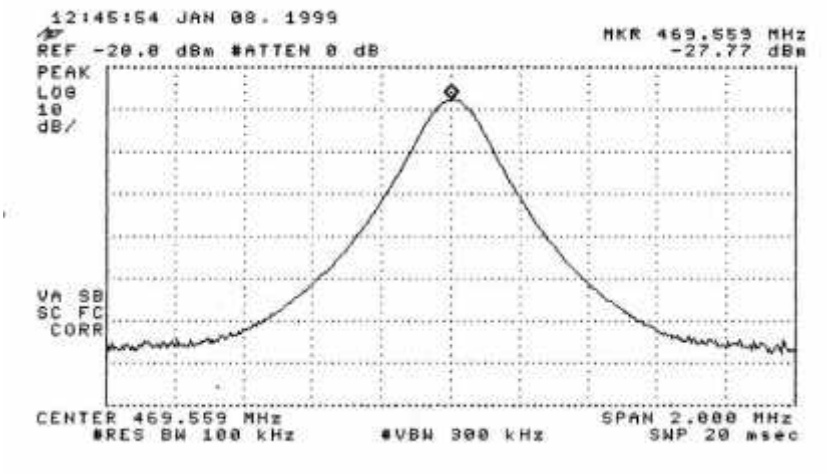
Ext. attenuation 40 dB.
Ps = – 93.96 +40 + = – 53.46 dBm
Att (vs Pc) = 43.16 – (– 53.46) = 96.62 dBc
Lim = 50 + 10 log P = 63.16 dBc

Plot 4.3.30
Conducted spurious emissions
Frequency 460.030
30 MHz – 1000 MHz



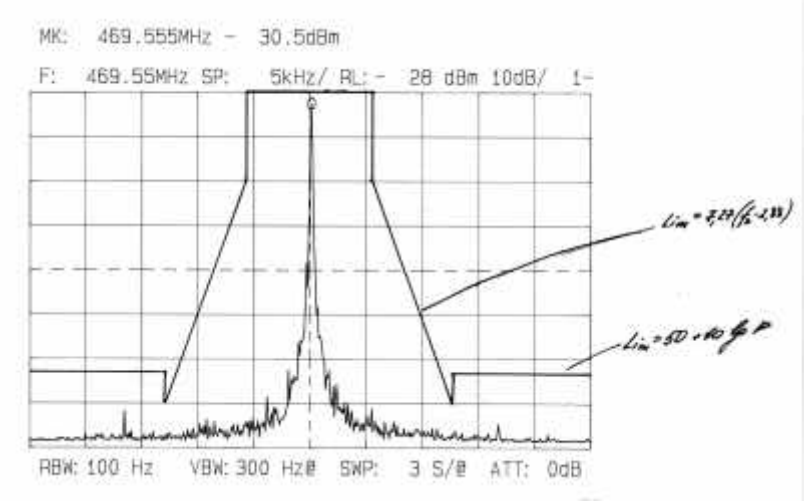
Ext. attenuation 70 dB.
Att (vs Pc) = 68.55 dBc
Lim = 50 + 10 log P = 63.16 dBc

Plot 4.3.31
Frequency 469.559
Carrier

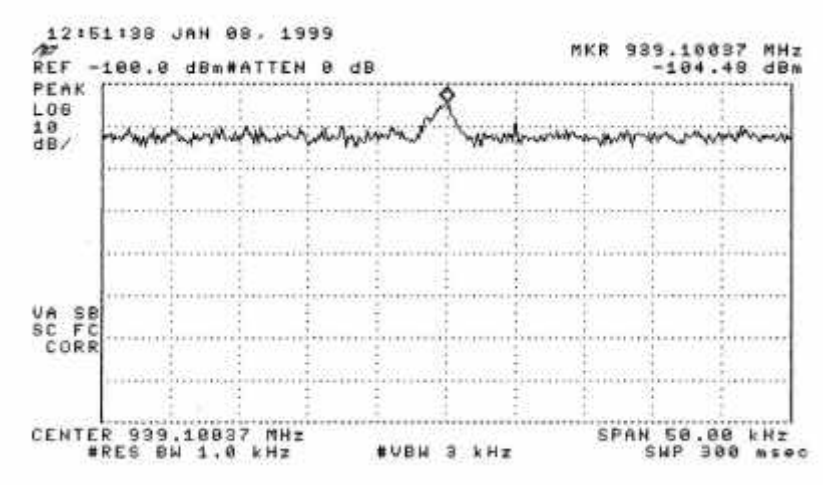


Ext. attenuation 70 dB.
P = – 27.77 +70 = 42.43 dBm

Plot 4.3.32
Frequency 469.559
Emission mask

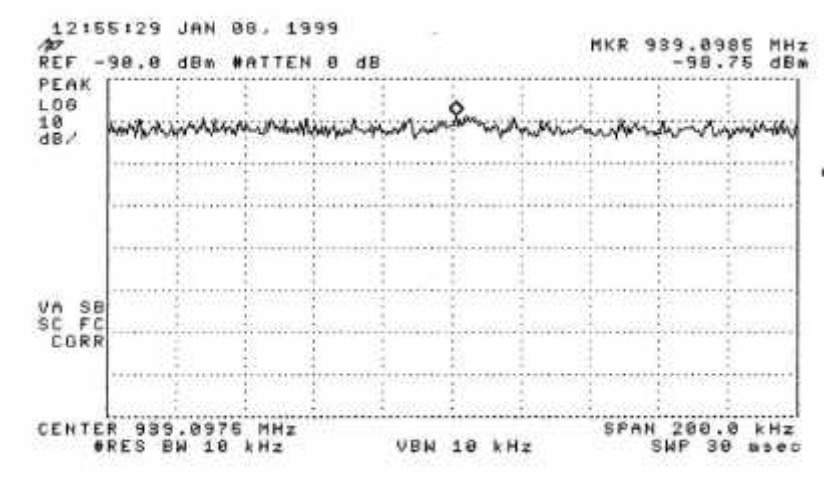


Plot 4.3.33
Conducted spurious emissions
Frequency 469.559
2nd harmonic



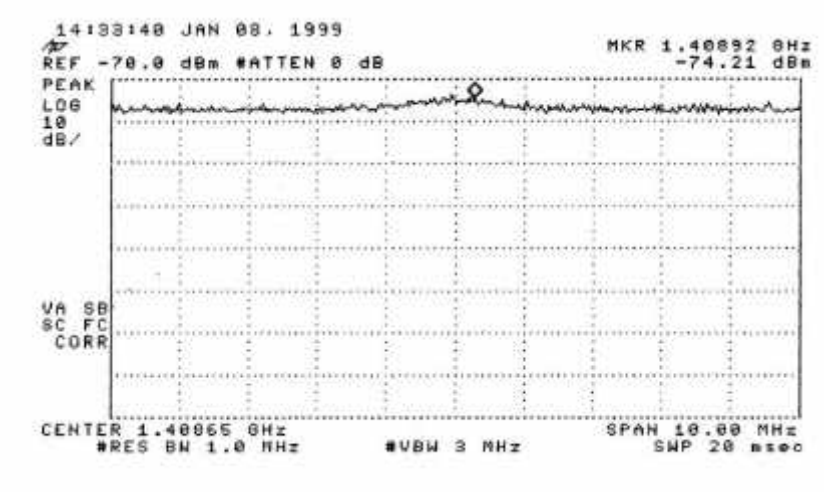
Ext. attenuation 70 dB.
Att (vs Pc) = 104.48 – 27.77 = 76.71 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.34
Conducted spurious emissions
Frequency 469.559
2nd harmonic



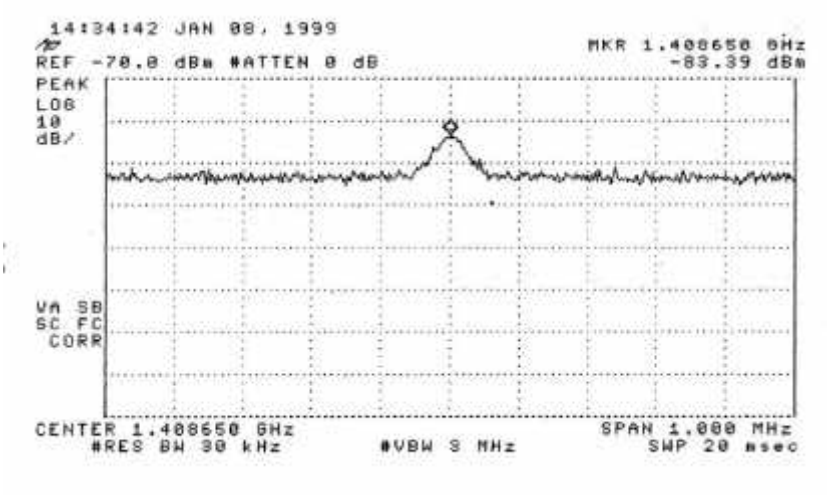
Ext. attenuation 70 dB.
Att (vs Pc) = 98.75 – 27.77 = 70.98 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.35
Conducted spurious emissions
Frequency 469.559
3d harmonic



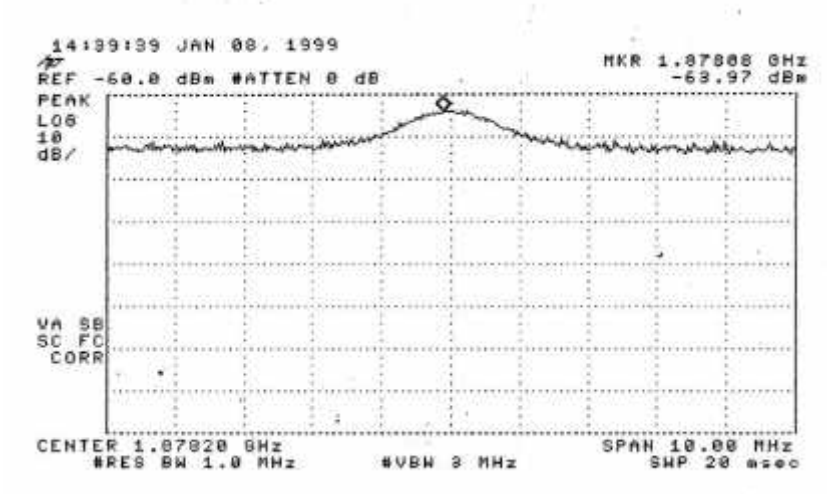
Ext. attenuation 46.25 dB.
P = – 74.21 + 46.25 = – 27.96 dBm
Att (vs Pc) = 42.23 – (– 27.96) = 70.19 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.36
Conducted spurious emissions
Frequency 469.559
3d harmonic



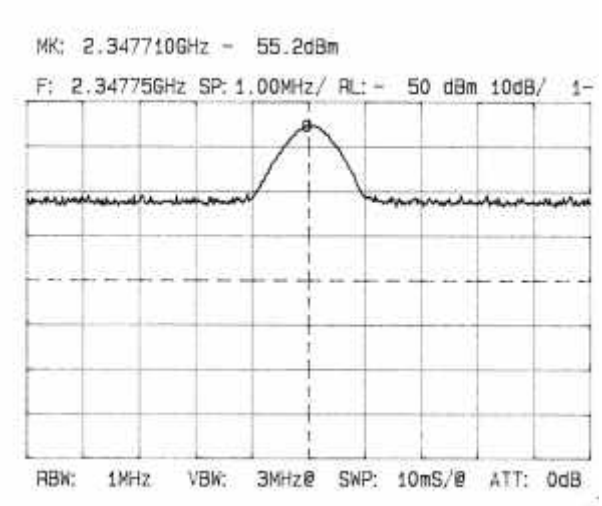
Ext. attenuation 46.25 dB.
P = – 83.39 + 46.25 = – 37.14 dBm
Att (vs Pc) = 42.23 – (– 37.14) = 79.37 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.37
Conducted spurious emissions
Frequency 469.559
4th harmonic



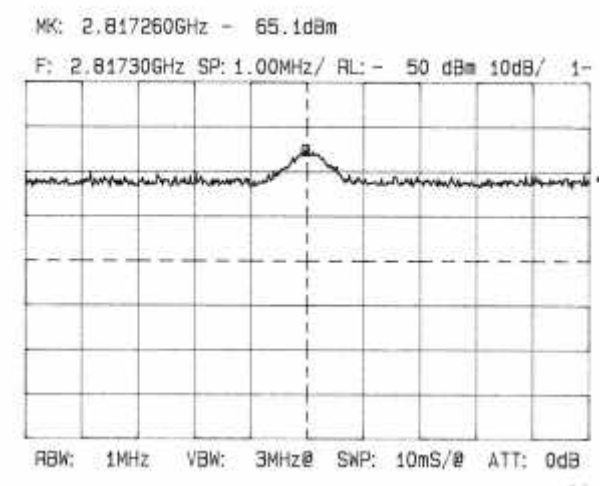
Ext. attenuation 24.63 dB.
P = – 63.97 + 24.63 = – 39.34 dBm
Att (vs Pc) = 42.23 – (– 39.34) = 81.57 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.38
Conducted spurious emissions
Frequency 469.559
5th harmonic



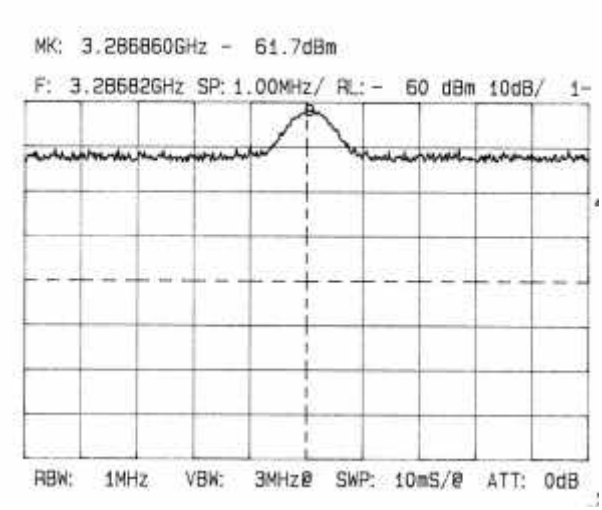
Ext. attenuation 28.2 dB.
P = – 55.2 + 28.2 = – 27.0 dBm
Att (vs Pc) = 42.23 – (– 27.0) = 69.23 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.39
Conducted spurious emissions
Frequency 469.559
6th harmonic



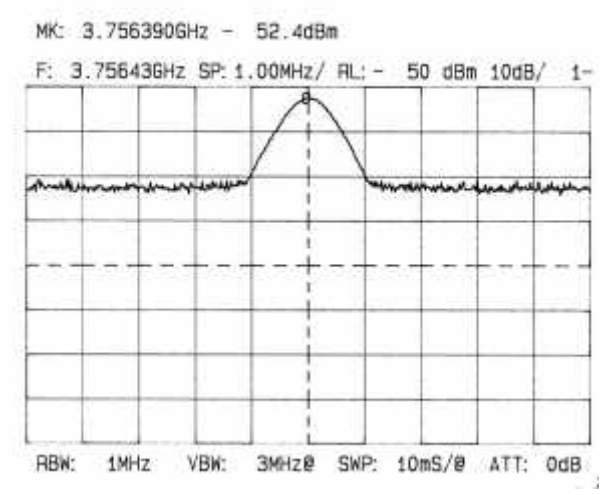
Ext. attenuation 28.1 dB.
P = – 65.1 + 28.1 = – 37 dBm
Att (vs Pc) = 42.23 – (– 37) = 79.23 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.40
Conducted spurious emissions
Frequency 469.559
7th harmonic



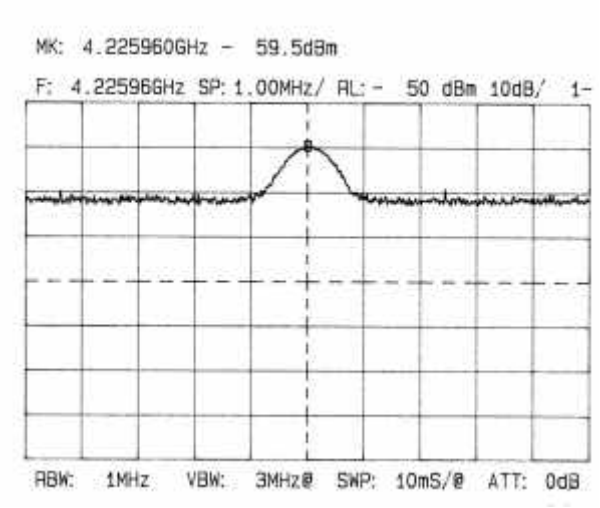
Ext. attenuation 25.5 dB.
P = – 61.7 + 25.5 = – 36.2 dBm
Att (vs Pc) = 42.23 – (– 36.2) = 78.43 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.41
Conducted spurious emissions
Frequency 469.559
8th harmonic



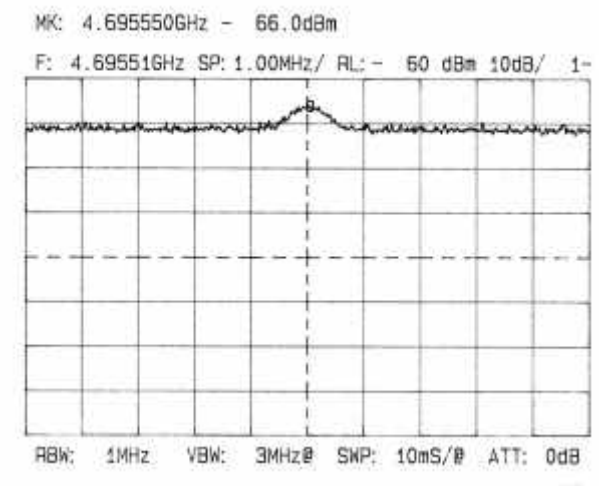
Ext. attenuation 23.1 dB.
P = – 52.4 + 23.1 = – 29.3 dBm
Att (vs Pc) = 42.23 – (– 29.3) = 71.53 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.42
Conducted spurious emissions
Frequency 469.559
9th harmonic



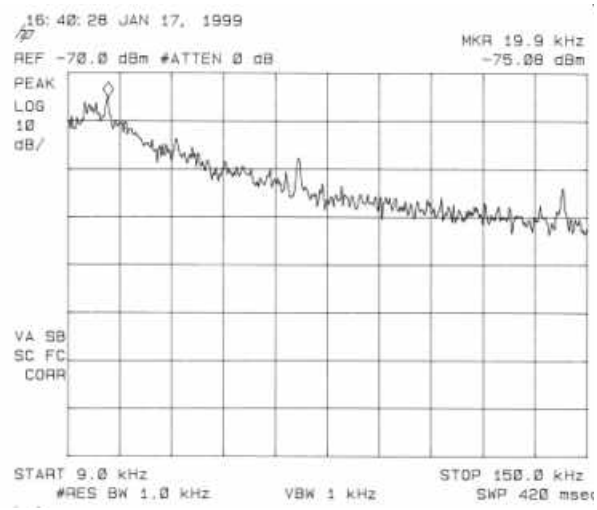
Ext. attenuation 25.9 dB.
P = – 59.5 + 25.9 = – 33.6 dBm
Att (vs Pc) = 42.23 – (– 33.6) = 75.83 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.43
Conducted spurious emissions
Frequency 469.559
10th harmonic



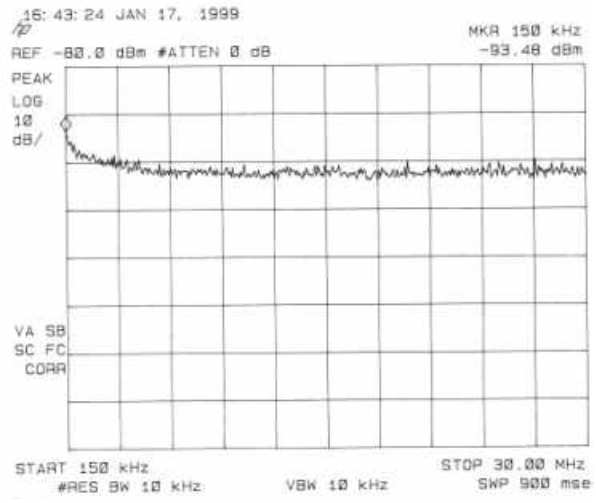
Ext. attenuation 27.3 dB.
P = – 66.0 + 27.3 = – 38.7 dBm
Att (vs Pc) = 42.23 – (– 38.7) = 80.93 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.44
Conducted spurious emissions
Frequency 469.559
9 kHz – 150 kHz



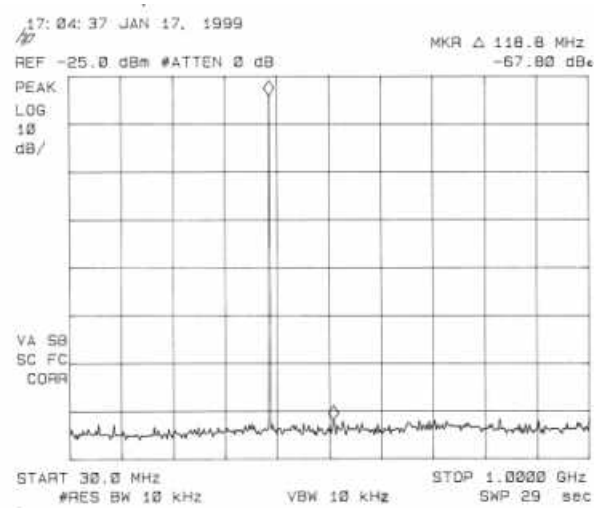
Ext. attenuation 40 dB.
Ps = – 75.08 + 40 + 10 log (10kHz/1kHz) = – 25.08 dBm
Att (vs Pc) = 42.23 – (– 25.08) = 67.31 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.45
Conducted spurious emissions
Frequency 469.559
150 kHz – 30 MHz



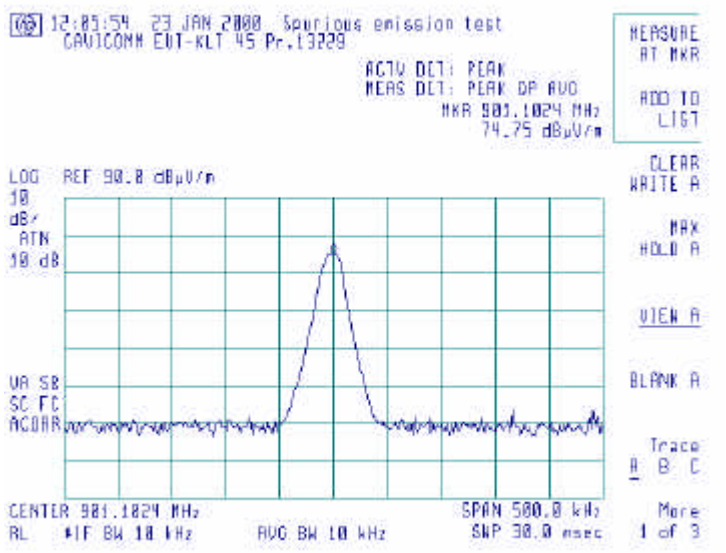
Ext. attenuation 40 dB.
Ps = – 93.48 + 40 = – 53.48 dBm
Att (vs Pc) = 42.23 – (– 53.48) = 95.71 dBc
Lim = 50 + 10 log P = 62.23 dBc

Plot 4.3.46
Conducted spurious emissions
Frequency 469.559
30 MHz – 1000 MHz

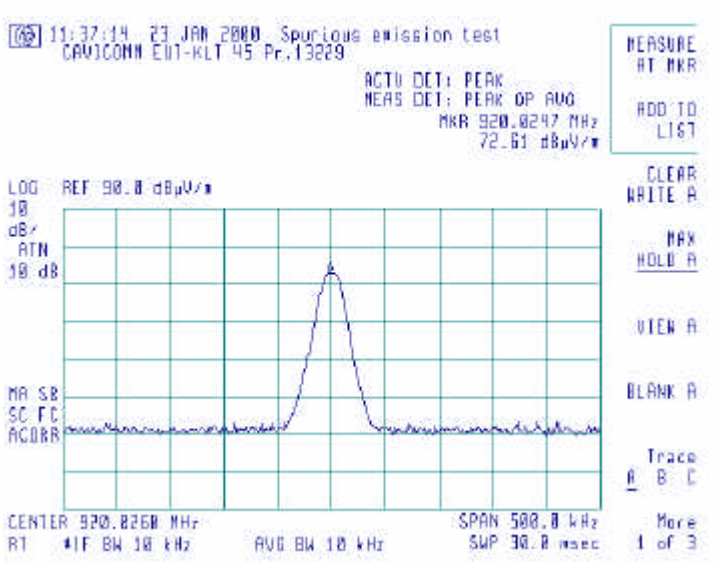


Ext. attenuation 70 dB.
Att (vs Pc) = 67.80 dBc
Lim = 50 + 10 log P = 62.23 dBc

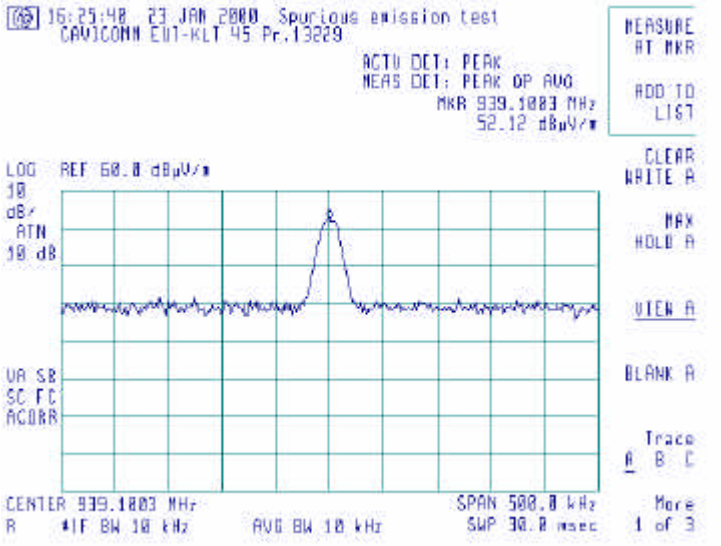
Plot 4.3.47
Radiated spurious emissions
Frequency 450.550
2nd harmonic



Plot 4.3.48
Radiated spurious emissions
Frequency 460.013
2nd harmonic



Plot 4.3.49
Radiated spurious emissions
Frequency 469.559
2nd harmonic



Plot 4.3.50
Radiated spurious emissions
30 MHz – 1000 MHz

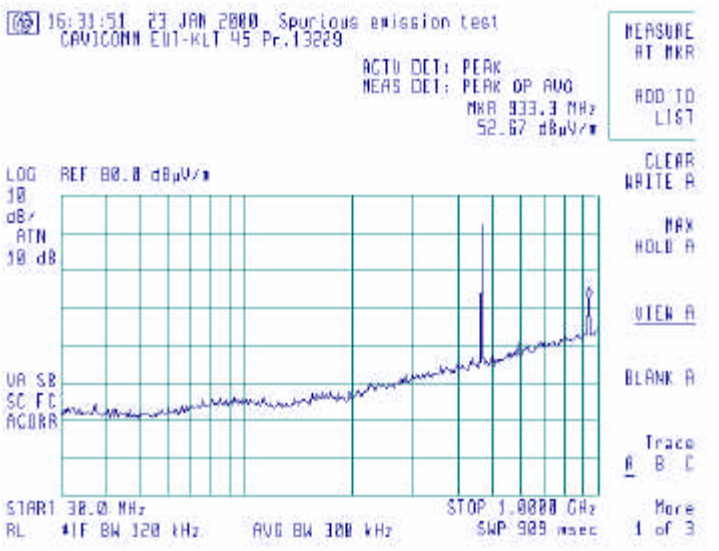
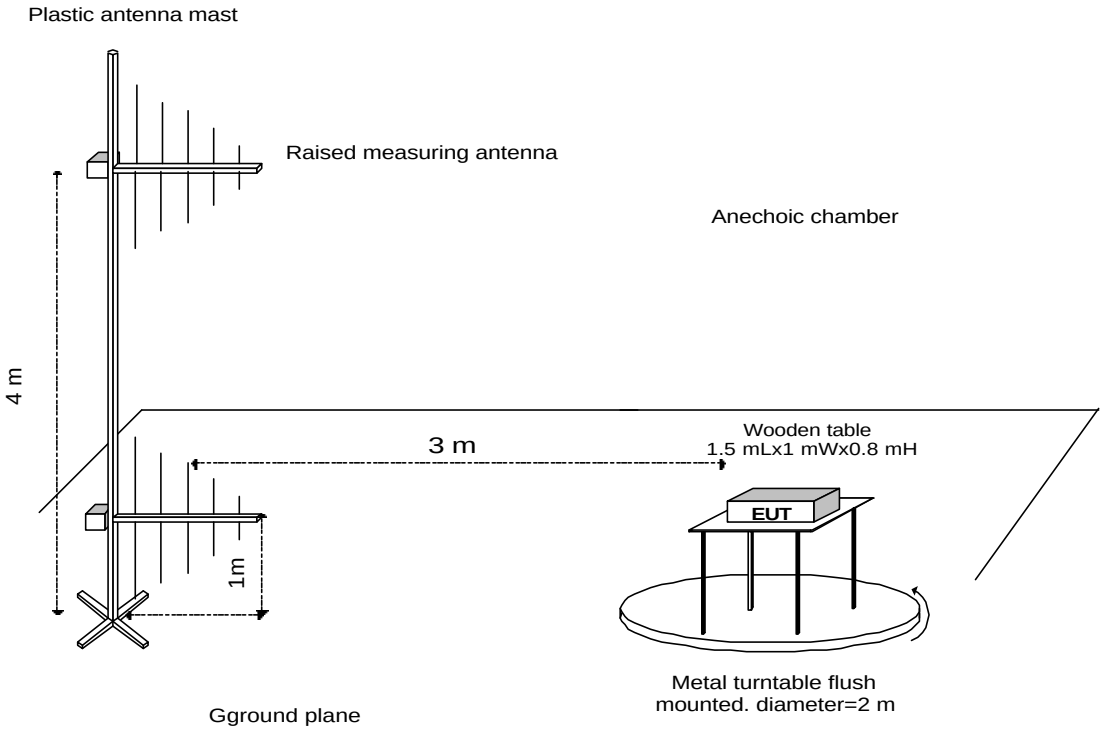
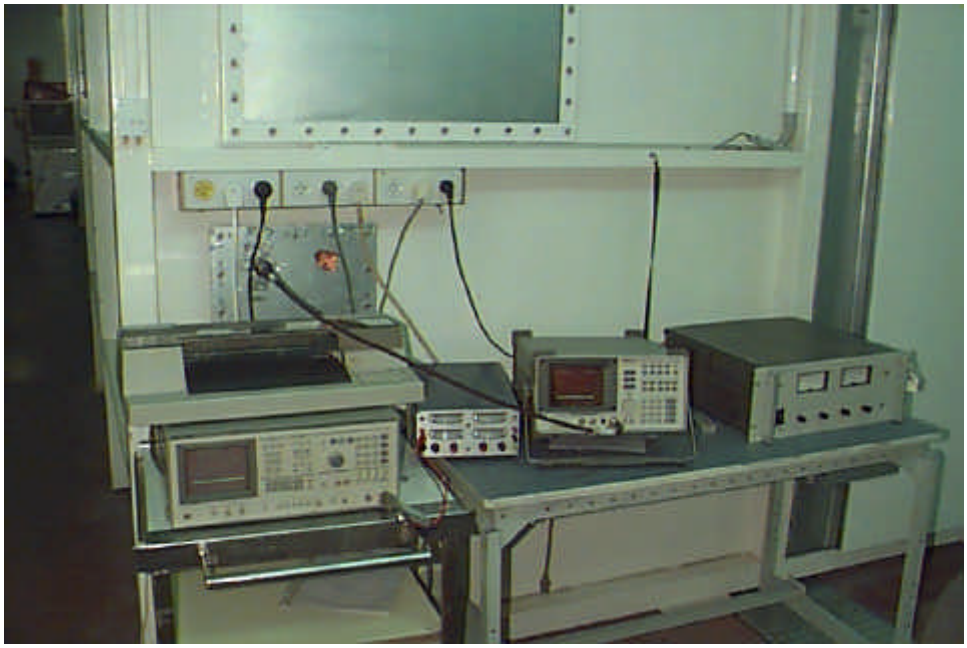


Figure 4.3.2
Radiated emission (disturbance) test setup for table-top equipment



Photograph 4.3.1
Conducted spurious emissions test setup



4.4 Frequency stability measurements according to FCC part 90 paragraph 213

4.4.1 General

According to paragraph 90.213, the minimum frequency stability limit (in parts per million) is 2.5 ppm for mobile equipment in frequency range 421 – 512 MHz.

For frequency 450 550 000 Hz the specified limit is 1126 Hz.
For frequency 460 013 000 Hz the specified limit is 1150 Hz.
For frequency 469 550 000 Hz the specified limit is 1173 Hz.

4.4.2 Test procedure

The frequency stability was investigated for various temperatures in the range from –30°C to +50°C at intervals of 10°C through the range.

Test results are recorded in Table 4.4.1 and shown in Plots 4.4.1 to 4.4.27.

At 20°C the test was repeated with 85% and 115% voltage supplied.

While maintaining 20°C inside the environmental chamber, the EUT (F = 469.550 MHz) was turned on and the operating frequencies were recorded at startup and two minutes after the EUT was energized.

Test results are recorded in Table 4.4.2 and shown in Plots 4.4.28 to 4.4.33.

The EUT was found to comply with requirements of paragraphs 90.213 .

Reference numbers of test equipment used

HL 0026	HL 0493	HL 0559	HL 0590	HL 0887	HL 0888

Full description is in Appendix A.

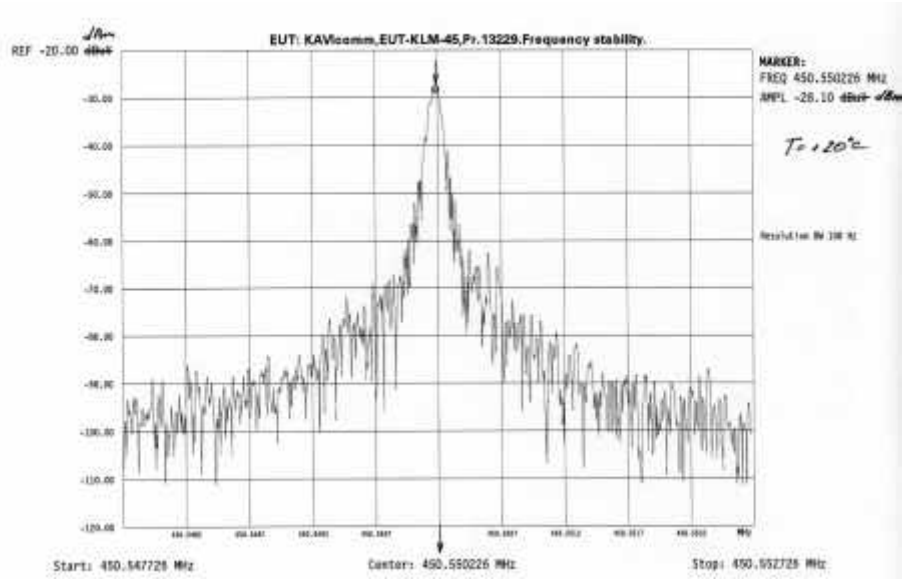
Table 4.4.1
Frequency stability test results

Temperature, °C	Displacement, Hz			Pass/ Fail
	Reference F = 450.550226 MHz, Limit ±1126 Hz	Reference F = 460.012591 MHz, Limit ±1150 Hz	Reference F = 469.550198 MHz, Limit ±1173 Hz	
-30	+ 400	+ 408	+ 242	Pass
-20	+ 229	+ 386	+ 248	Pass
-10	+ 228	+ 338	+ 173	Pass
0	+ 253	+ 268	+ 161	Pass
10	+ 108	+ 202	+ 30	Pass
20	450.550226	460.012591	469.550198	Ref
30	- 175	- 254	- 770	Pass
40	- 254	- 226	- 855	Pass
50	- 586	- 451	- 731	Pass

Table 4.4.2
Frequency stability test results

Supplied voltage, V	Time after switch on, min	Frequency, Hz	Displacement, Hz	Limit, Hz	Pass/ Fail
13.2	0	469550184	+ 184	1173	Pass
13.2	2	469550029	+ 29	1173	Pass
10.8	0	469550032	+ 32	1173	Pass
10.8	2	469549984	- 16	1173	Pass
15.6	0	469549948	- 52	1173	Pass
15.6	2	469549981	- 19	1173	Pass

Plot 4.4.1
Frequency stability test results
F = 450.550226
Temperature + 20°



Plot 4.4.2
Frequency stability test results
F = 450.550226
Temperature – 30°