3.6 Average time of occupancy definition according to § 15.247

3.6.1 General

This parameter was checked to prove that the average time of occupancy on any frequency is not greater than 0.4 seconds within any 30 second period.

3.6.2 Calculation

The average occupancy time was calculated from the following equation:

Number of channels = 79
Dwell time = 20 msec
Transmitter "on" time = 2.12 msec
Transmitter returns to each channel frequency during 30 sec
30 sec / 79 x 20 msec = 167 times

Average occupancy time = transmitter "on" time on each channel x 167 times =
2.12 msec x167 = 0.353 sec, which is less than the required 0.4 sec.

3.7 Radiated emissions test according to § 15.205, 15.209(a), 15.247(c)

3.7.1 General

This test was performed to measure radiated emissions except carriers generated by the transmitter.

3.7.2 Test set-up

The radiated emission measurements were performed at 3 meters test distance in the anechoic chamber with biconilog antenna from 30 MHz to 2 GHz and at the open field test site with the double ridged guide antenna from 2 GHz to 24 GHz as shown in Photographs 3.7.1 to 3.7.14. The EUT was installed on the 0.8 m high wooden table which was on the top of the metal turntable flush mounted with the ground plane. To find the maximum radiation measuring antenna height was changed from 1 to 4 m, the turntable was rotated 360° and the antennas polarization was changed from vertical to horizontal.

3.7.3 Test results

The test was performed for transmitter operating with modulation at 3 carrier (channels) frequencies 2.402, 2.441 and 2.480 GHz with the 16 dBi integral antenna and with the 6 dBi, 16 dBi, 16.5 dBi, 17dBi gain external antennas.
The average (duty cycle correction) factor was obtained from the par. 3.3 of this test report.
The test results are brought in Tables 3.7.1 to 3.7.6.
Emissions found in 30 - 1000 MHz range were due to the incorporated digital device and are brought in section 3.8 of this test report.

Reference numbers of test equipment used

HL 0025	HL 0038	HL 0041	HL 0121	HL 0275	HL 0287	HL 0465
HL 0521	HL 0547	HL 0589	HL 0604	HL 0812	HL 0813	HL 0815
HL 0816	HL 1175	HL 1200				

Full description is given in Appendix A.

Table 3.7.1 Radiated emissions measurement test results with modulated carrier and integral antenna

EUT: **SU-A-xD1V-2.4 series**
DATE: June 2, 1999
Relative Humidity: 52%
Ambient Temperature: 24°C

MEASUREMENTS PERFORMED AT 3 METRE DISTANCE

Freq. GHz	Ant. pol.	Measured result dB (μV)	Det. type	VBW MHz	Antenna factor dB (1/m)	Cable loss dB	Amplifier gain dB	Average factor dB	Radiated emission dB (μV/m)	Limit dB(μV/m)	Margin dB	Pass/ Fail
2.386	V	62.2	Peak	3	NA	NA	NA	-19.5	42.7	54	11.3	Pass
2.395	V	45.65	AVR	3	NA	NA	NA	NA	45.65	54	8.35	Pass
7.206	H	50	Peak	1	35.7	3.3	35	-19.5	34.5	54	19.5	Pass
7.323	H	44	Peak	1	35.8	3.5	35	-19.5	28.9	54	25.1	Pass
7.440	H	45	Peak	1	35.9	3.9	35	-19.5	30.3	54	23.7	Pass

Notes to table:

Measurements were performed with double ridged guide antenna.
Resolution bandwidth = 1 MHz
Radiated emission dB(μV/m) = measured result dB(μV) + antenna factor dB(1/m) +cable loss (dB) – amplifier gain (dB) + average factor (dB). During the measurements the received emissions were amplified
Average factor = -19.5 dB (see section 3.3.1).

Table abbreviations:

Ant. pol. – antenna polarization (V-vertical, H-horizontal)
Det. type – detector type (avr – average)
VBW - videobandwidth
Margin = dB below (negative if above) specification limit.

Table 3.7.2 Radiated emissions measurement test results with modulated carrier and integral antenna

EUT: **SU-A-xD-2.4 series**
DATE: May 6, 1999
Relative Humidity: 47%
Ambient Temperature: 23°C

MEASUREMENTS PERFORMED AT 3 METRE DISTANCE

Frequency GHz	Measured result dB (μV)	Antenna factor dB (1/m)	Cable loss amplifier gain dB	Radiated emission dB (μV/m)	Limit dB(μV/m)	Margin dB	Pass/ Fail
3.924	37.6	33.4	8.53	42.97	54	11.03	Pass
4.002	37.1	33.7	10.93	40.37	54	13.63	Pass
4.080	40.4	33.5	17.53	36.87	54	17.13	Pass
4.804	40.5	33.6	16.56	38.04	54	15.96	Pass
4.882	40.7	33.8	17.36	37.64	54	16.36	Pass
4.960	45.1	34.4	15.33	44.67	54	9.33	Pass
7.323	54.1	35.8	28.7	41.7	54	12.3	Pass
7.440	65.4	35.8	29.93	51.77	54	2.23	Pass
12.400	52.5	39.5	30.5	52.0	54	12.0	Pass

Notes to table:

Test results listed in the table were obtained throughout the measurements with double ridged guide antenna in vertical polarization and peak detector.
Resolution bandwidth = 1 MHz, videobandwidth = 3 MHz
Radiated emission dB(μV/m) = measured result dB(μV) + antenna factor dB(1/m) +cable loss (dB) – amplifier gain (dB) + average factor (dB). During the measurements the received emissions were amplified
Average factor = -19.5 dB (see section 3.3.1).

Table abbreviations:

Ant. pol. – antenna polarization (V-vertical, H-horizontal)
Det. type – detector type (avr – average)
Margin = dB below (negative if above) specification limit.

Table 3.7.3 Radiated emissions measurement test results with modulated carrier and with 6dBi external antenna

EUT: **AU-O-2.4 series**
DATE: May 6, 1999
Relative Humidity: 47%
Ambient Temperature: 23°C

MEASUREMENTS PERFORMED AT 3 METRE DISTANCE

Frequency GHz	Measured result dB (μV)	Antenna factor dB (1/m)	Cable loss amplifier gain dB	Radiated emission dB (μV/m)	Limit dB(μV/m)	Margin dB	Pass/ Fail
3.9240	39.0	33.4	8.53	44.27	54	9.73	Pass
4.002	39.3	33.7	10.93	42.57	54	11.43	Pass
4.080	46.7	33.5	17.53	43.17	54	10.83	Pass
4.8041	44.2	33.6	16.56	41.74	54	12.26	Pass
4.882	48.2	33.8	17.36	45.14	54	8.86	Pass
4.9602	44.0	34.4	15.33	43.57	54	10.43	Pass
7.323	62.2	35.8	28.7	49.8	54	4.2	Pass
7.4394	61.0	35.8	29.93	47.37	54	6.63	Pass

Notes to table:

Test results listed in the table were obtained throughout the measurements with double ridged guide antenna in vertical polarization and peak detector.
Resolution bandwidth = 1 MHz, videobandwidth = 3 MHz
Radiated emission dB(μV/m) = measured result dB(μV) + antenna factor dB(1/m) +cable loss (dB) – amplifier gain (dB) + average factor (dB). During the measurements the received emissions were amplified
Average factor = -19.5 dB (see section 3.3.1).

Table abbreviations:

Ant. pol. – antenna polarization (V-vertical, H-horizontal)
Det. type – detector type (avr – average)
Margin = dB below (negative if above) specification limit.

Table 3.7.4 Radiated emissions measurement test results with modulated carrier and with 16dBi external antenna

EUT: **AU-O-2.4 series**
DATE: May 6, 1999
Relative Humidity: 47%
Ambient Temperature: 23°C

MEASUREMENTS PERFORMED AT 3 METRE DISTANCE

Frequency GHz	Measured result dB (μV)	Antenna factor dB (1/m)	Cable loss amplifier gain dB	Radiated emission dB (μV/m)	Limit dB(μV/m)	Margin dB	Pass/ Fail
3.9239	40.2	33.4	8.53	45.57	54	8.43	Pass
4.0019	38.8	33.7	10.93	42.07	54	11.93	Pass
4.0801	43.6	33.5	17.53	40.07	54	13.93	Pass
4.8039	48.5	33.6	16.56	46.04	54	7.96	Pass
4.882	54.5	33.8	17.36	51.44	54	2.56	Pass
4.9599	46.2	34.4	15.33	45.77	54	8.23	Pass
7.323	58.1	35.8	28.7	45.7	54	8.3	Pass
7.4396	60.3	35.8	29.93	46.67	54	7.33	Pass

Notes to table:

Test results listed in the table were obtained throughout the measurements with double ridged guide antenna in vertical polarization and peak detector.
Resolution bandwidth = 1 MHz, videobandwidth = 3 MHz
Radiated emission dB(μV/m) = measured result dB(μV) + antenna factor dB(1/m) +cable loss (dB) – amplifier gain (dB) + average factor (dB). During the measurements the received emissions were amplified
Average factor = -19.5 dB (see section 3.3.1).

Table abbreviations:

Ant. pol. – antenna polarization (V-vertical, H-horizontal)
Det. type – detector type (avr – average)
Margin = dB below (negative if above) specification limit.

Table 3.7.5 Radiated emissions measurement test results with modulated carrier and with 16.5 dBi external antenna

EUT: **AU-O-2.4 series**
DATE: May 6, 1999
Relative Humidity: 47%
Ambient Temperature: 23°C

MEASUREMENTS PERFORMED AT 3 METRE DISTANCE

Frequency GHz	Measured result dB (µV)	Antenna factor dB (1/m)	Cable loss amplifier gain dB	Radiated emission dB (µV/m)	Limit dB(µV/m)	Margin dB	Pass/ Fail
3.9239	39.2	33.4	8.53	44.57	54	9.43	Pass
4.002	39.0	33.7	10.93	42.27	54	11.73	Pass
4.080	42.8	33.5	17.53	39.27	54	14.73	Pass
4.804	45.8	33.6	16.56	43.34	54	10.66	Pass
4.882	51.7	33.8	17.36	48.64	54	5.36	Pass
4.9598	46.9	34.4	15.33	46.47	54	7.53	Pass
7.3233	64.5	35.8	28.7	52.1	54	1.9	Pass
7.4399	63.1	35.8	29.93	49.47	54	4.53	Pass

Notes to table:

Test results listed in the table were obtained throughout the measurements with double ridged guide antenna in vertical polarization and peak detector.
Resolution bandwidth = 1 MHz, videobandwidth = 3 MHz
Radiated emission dB(µV/m) = measured result dB(µV) + antenna factor dB(1/m) +cable loss (dB) – amplifier gain (dB) + average factor (dB). During the measurements the received emissions were amplified
Average factor = -19.5 dB (see section 3.3.1).

Table abbreviations:

Ant. pol. – antenna polarization (V-vertical, H-horizontal)
Det. type – detector type (avr – average)
Margin = dB below (negative if above) specification limit.

Table 3.7.6 Radiated emissions measurement test results with modulated carrier and with 17 dBi external antenna

EUT: **AU-O-2.4 series**
DATE: May 6, 1999
Relative Humidity: 47%
Ambient Temperature: 23°C

MEASUREMENTS PERFORMED AT 3 METRE DISTANCE

Frequency GHz	Measured result dB (μV)	Antenna factor dB (1/m)	Cable loss amplifier gain dB	Radiated emission dB (μV/m)	Limit dB(μV/m)	Margin dB	Pass/ Fail
3.9239	39.5	33.4	8.53	44.87	54	9.13	Pass
4.0019	38.4	33.7	10.93	41.67	54	12.33	Pass
4.080	44.2	33.5	17.53	40.67	54	13.33	Pass
4.804	40.6	33.6	16.56	38.14	54	15.86	Pass
4.882	46.9	33.8	17.36	43.84	54	10.16	Pass
4.960	40.4	34.4	15.33	39.97	54	14.03	Pass
7.3234	64.0	35.8	28.7	51.6	54	2.4	Pass
7.4396	61.6	35.8	29.93	47.97	54	6.03	Pass

Notes to table:

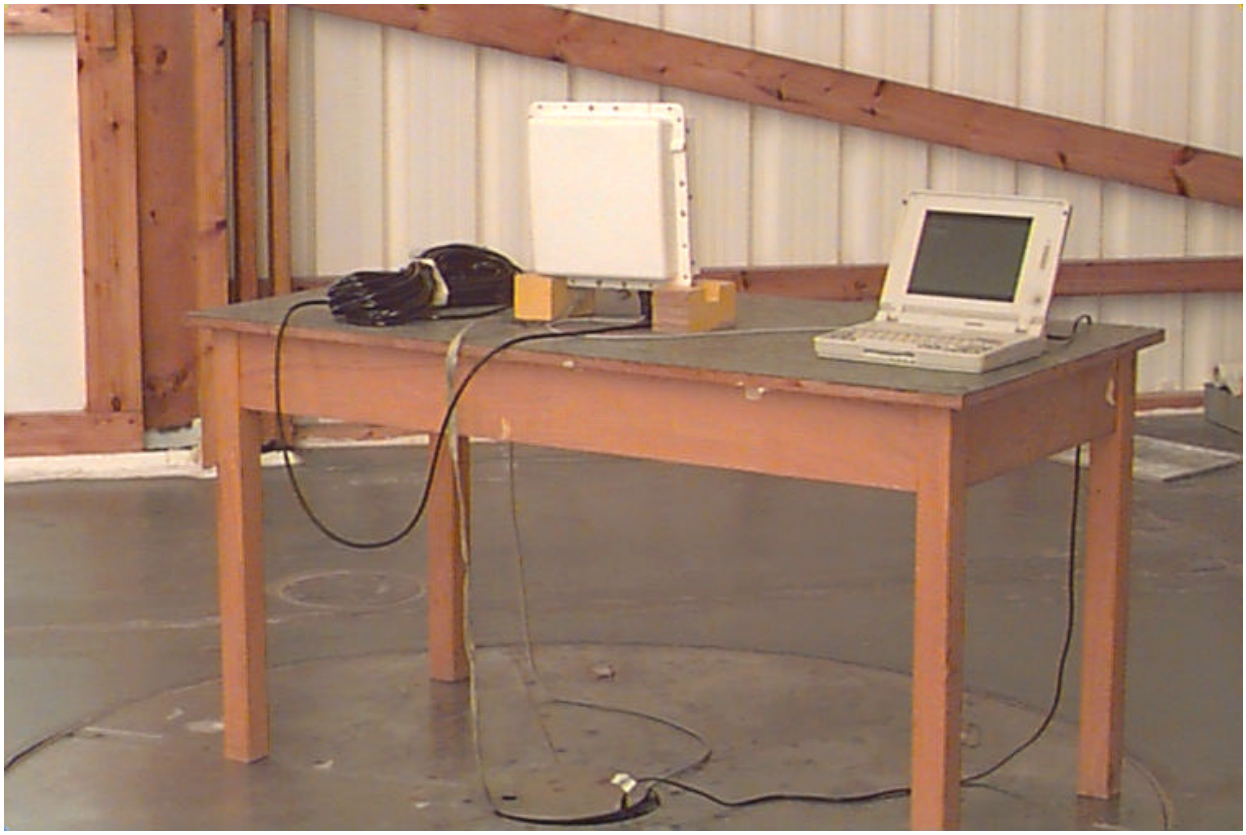
Test results listed in the table were obtained throughout the measurements with double ridged guide antenna in horizontal polarization and peak detector.
Resolution bandwidth = 1 MHz, videobandwidth = 3 MHz
Radiated emission dB(μV/m) = measured result dB(μV) + antenna factor dB(1/m) +cable loss (dB) – amplifier gain (dB) + average factor (dB). During the measurements the received emissions were amplified
Average factor = -19.5 dB (see section 3.3.1).

Table abbreviations:

Ant. pol. – antenna polarization (V-vertical, H-horizontal)
Det. type – detector type (avr – average)
Margin = dB below (negative if above) specification limit.

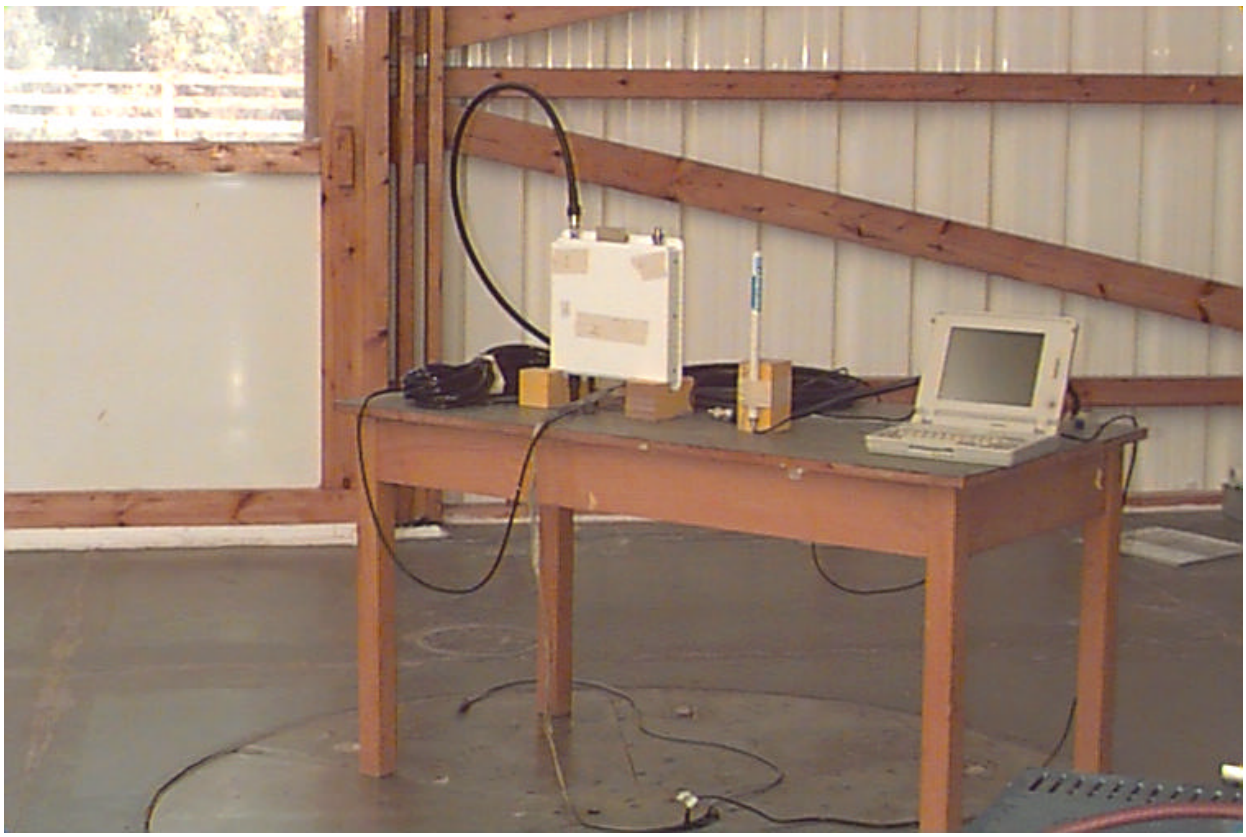
Photograph No. 3.7.1
Radiated emission measurement test setup for EUT with integral antenna

Photograph No. 3.7.2
Radiated emission measurement test setup for EUT with integral antenna

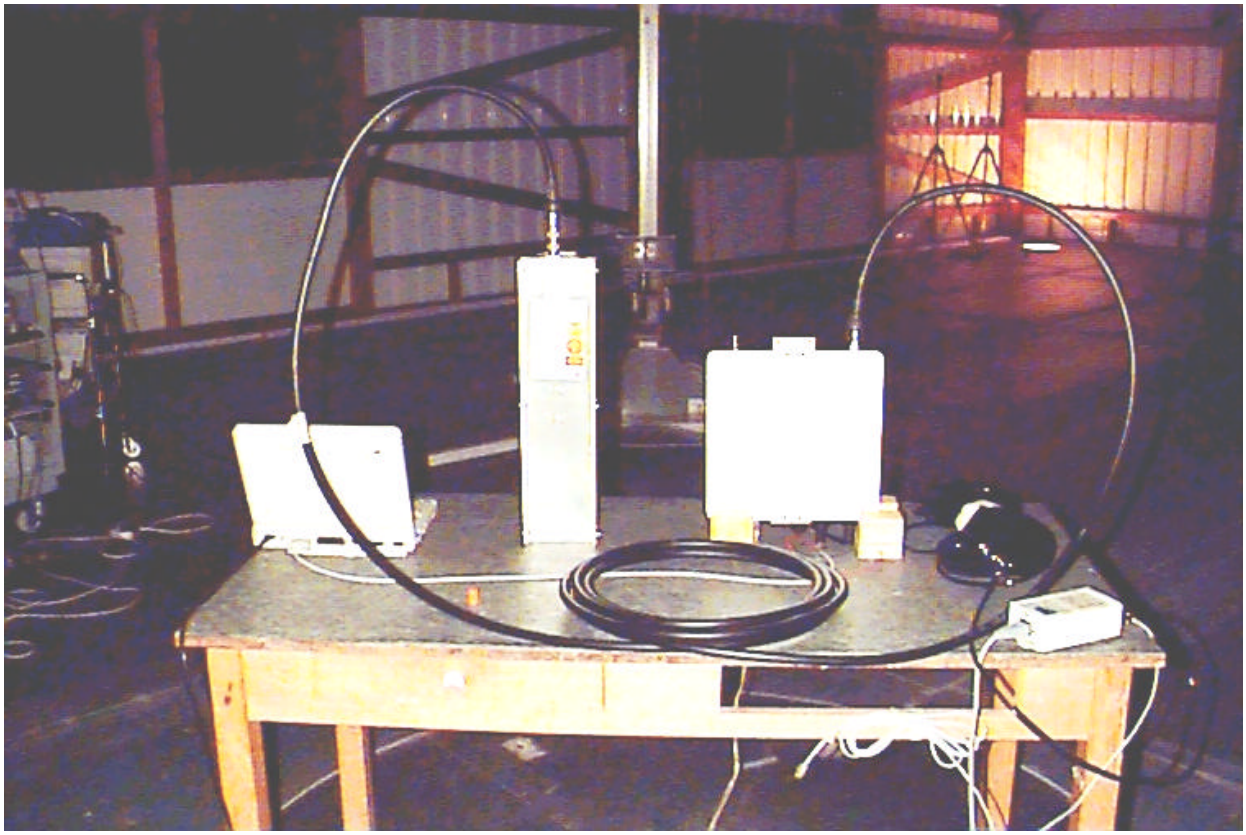


Photograph No. 3.7.3
Radiated emission measurement test setup for EUT with 6 dBi external antenna

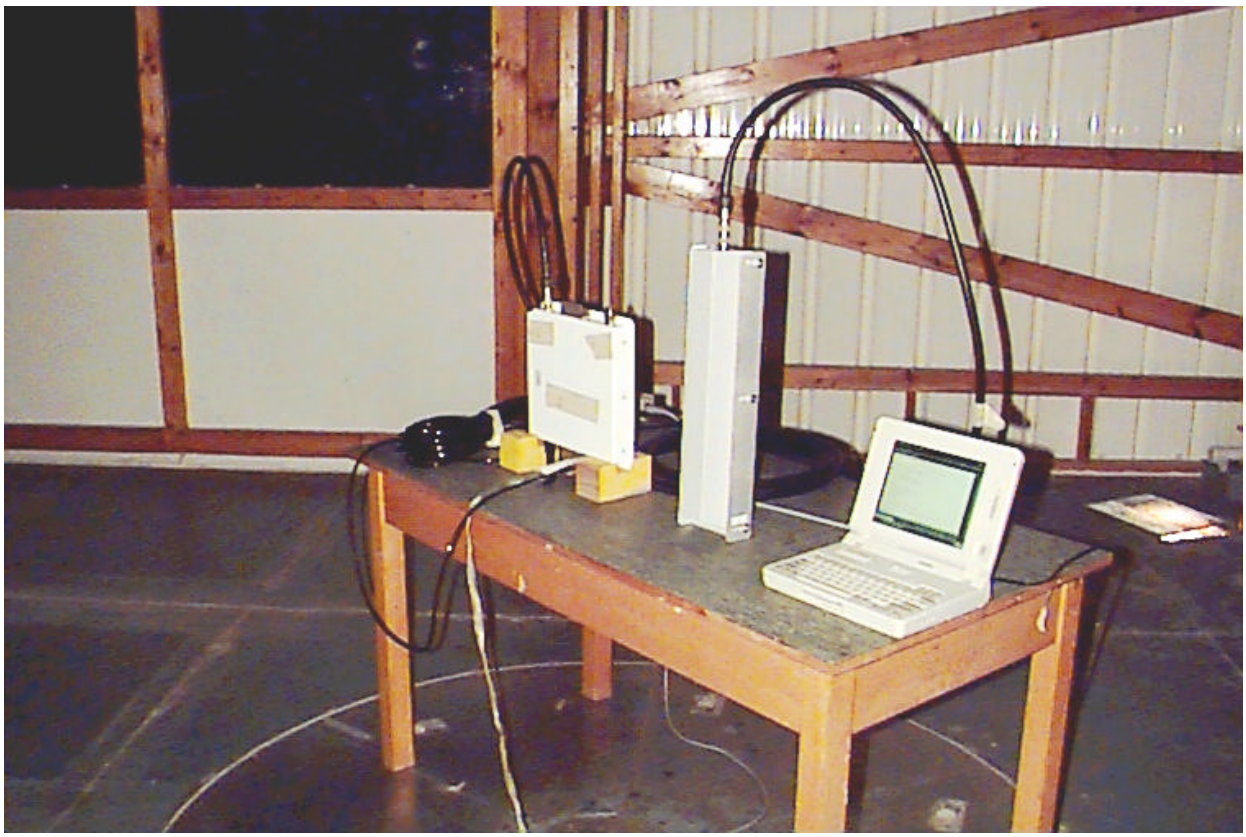
Photograph No. 3.7.4
Radiated emission measurement test setup for EUT with 6 dBi external antenna



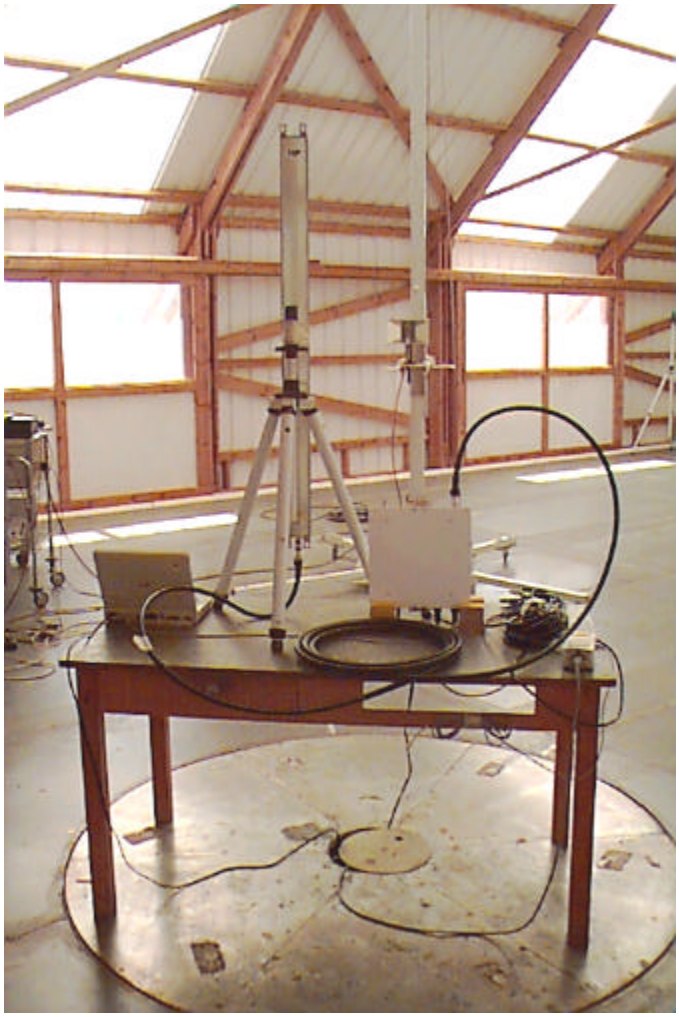
Photograph No. 3.7.5
Radiated emission measurement test setup for EUT with 16 dBi external antenna



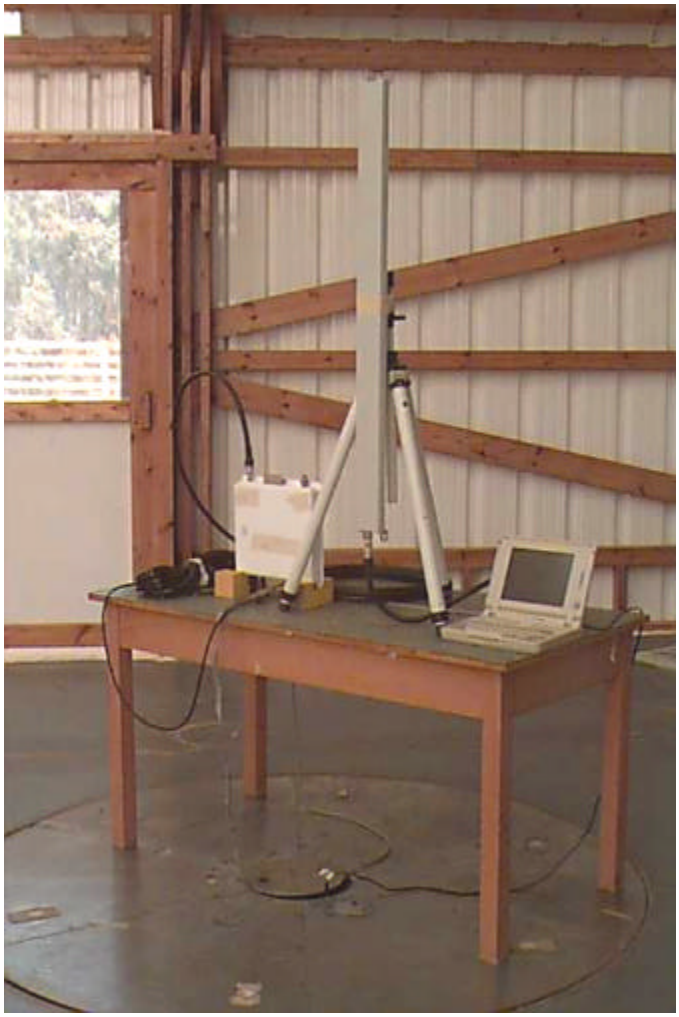
Photograph No. 3.7.6
Radiated emission measurement test setup for EUT with 16 dBi external antenna



Photograph No. 3.7.7
Radiated emission measurement test setup for EUT with 16.5 dBi external antenna



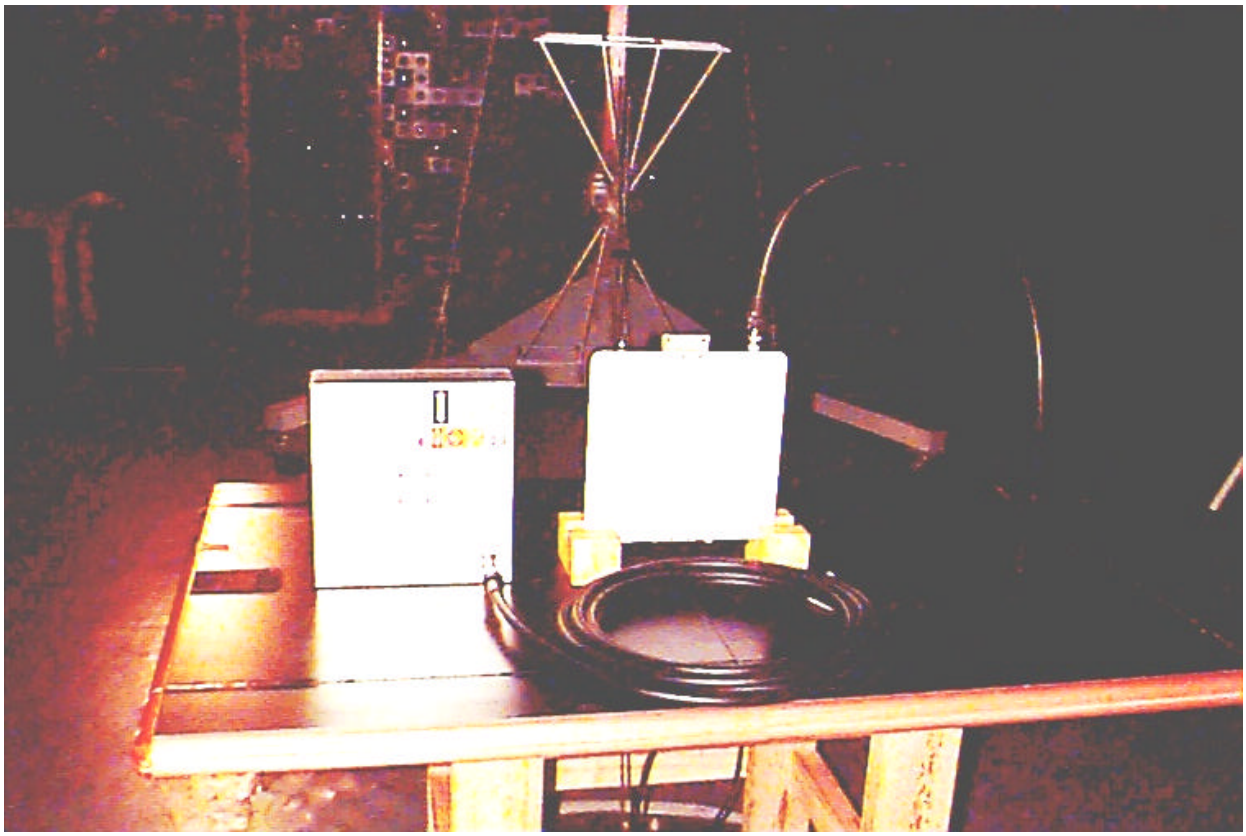
Photograph No. 3.7.8
Radiated emission measurement test setup for EUT with 16.5 dBi external antenna



Photograph No. 3.7.9
Radiated emission measurement test setup for EUT with 17 dBi external antenna

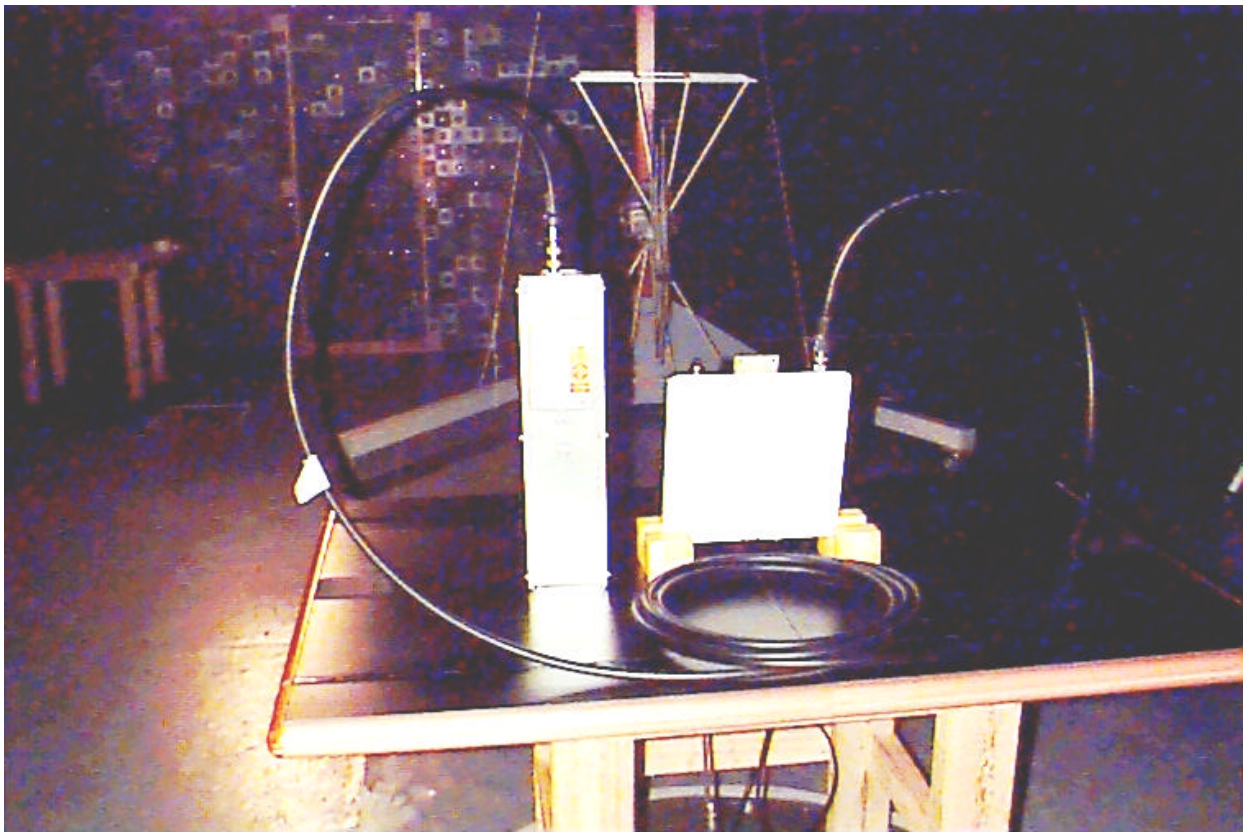
Photograph No. 3.7.10
Radiated emission measurement test setup for EUT with 17 dBi external antenna

Photograph No. 3.7.11
Radiated emission measurement test setup for EUT with 17 dBi external antenna

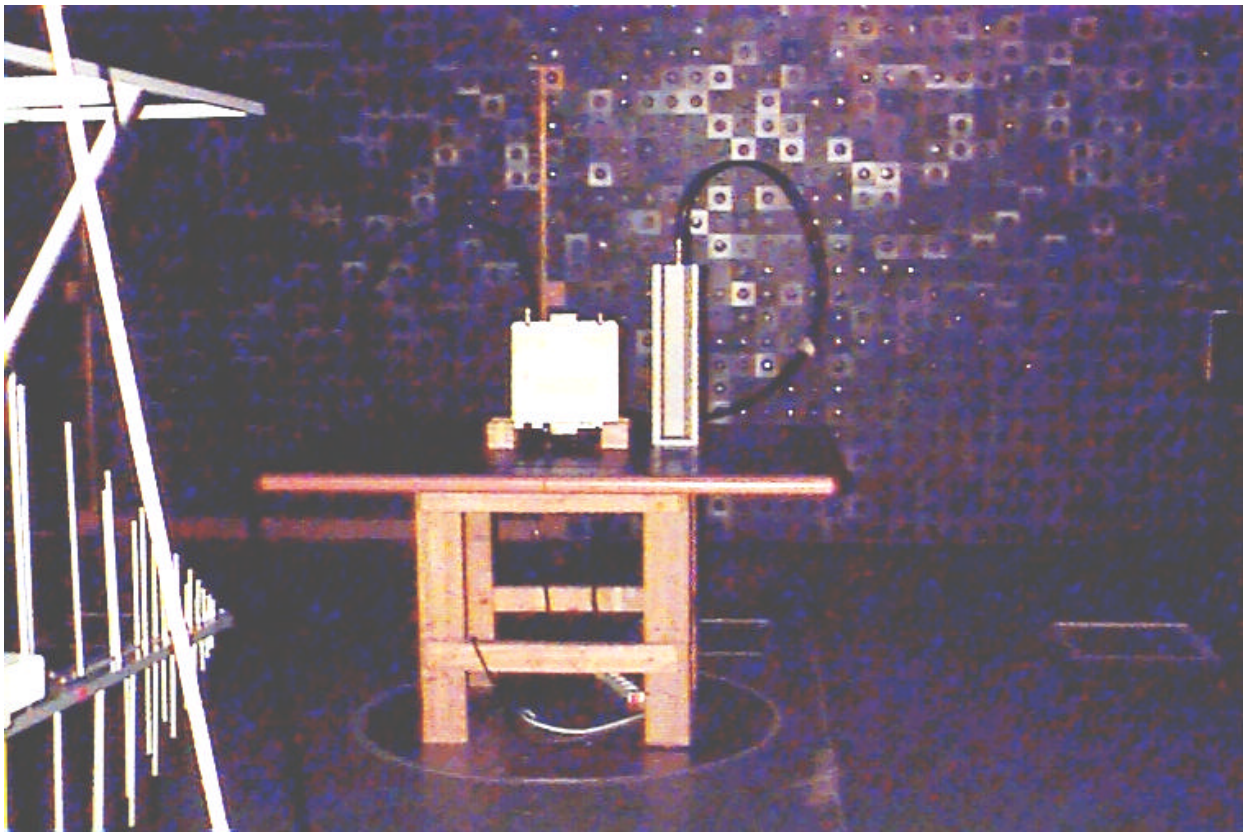


Photograph No. 3.7.12
Radiated emission measurement test setup for EUT with 17 dBi external antenna

Photograph No. 3.7.13
Radiated emission measurement test setup for EUT with 16 dBi external antenna



Photograph No. 3.7.14
Radiated emission measurement test setup for EUT with 16 dBi external antenna



3.8 Unintentional class B digital device radiated emissions test according to §15.109

3.8.1 General

This test was performed to measure radiated emissions from the incorporated digital device of the EUT and also to verify the EUT full compliance with §15.109.

3.8.2 Test set-up

The radiated emissions measurements of the EUT outdoor unit with incorporated digital device and receiver were performed in the anechoic chamber at 3 meters measuring distance with biconilog and double ridged guide antennas. The measurements were done from 30 MHz to 5th harmonic (12.5 GHz). The radiated emissions measurements of the EUT indoor unit were performed from 30 MHz to 1 GHz.
The EUT was placed on the wooden table as shown in Figure 3.8.1 and Photographs 3.8.1 to 3.8.3 (indoor unit), Photographs 3.7.11 to 3.7.14 (outdoor unit).
To find maximum radiation the turntable was rotated 360^{o}, the cables position was varied, the measuring antenna height changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal. In frequency range from 30 to 1000 MHz the EMI receiver settings were: RBW=120 kHz, quasi-peak detector.

The receiver radiated emission measurements from 1 GHz up to 12.5 GHz were performed with the spectrum analyzer settings: RBW=1 MHz, VBW=1 MHz or VBW=3 MHz, peak detector was used. The spectrum analyzer settings are shown in the plots.

The results of measurements were recorded into Tables 3.8.1 to 3.8.6.

Reference numbers of test equipment used

HL 0041	HL 0121	HL 0275	HL 0465	HL 0521	HL 0589	HL 0593
HL 0594	HL 0604	HL 0815	HL 0816	HL 1175		

Full description is given in Appendix A.

Table 3.8.1 Radiated emission measurements test results for SU-A/O-xD1V-2.4 outdoor unit frequency range 30 MHz – 12.5 GHz

DATE: June 1, 1999
RELATIVE HUMIDITY: 49%
AMBIENT TEMPERATURE: 22°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency MHz	Ant. Pol.	Antenna Height m	TT Pos. °	Radiated Emissions dB (µV/m)	Specified Limit dB (µV/m)	Margin dB	Pass/ Fail
75.022	V	1	12	34.87	40.0	5.13	Pass
200.005	V	1	353	34.72	43.5	8.78	Pass
340.012	H	1.1	1	40.57	46.0	5.43	Pass
648.005	H	1.3	358	39.08	46.0	6.92	Pass

Notes to table calculations:

Measurements were performed with biconilog antenna and quasi-peak detector
Resolution bandwidth = 120 kHz
Ant. Pol. = Antenna polarization (V-vertical, H-horizontal)
TT Pos. = turntable position in degrees, (EUT front panel = 0^o)
Margin = dB below (negative if above) specification limit.

Table 3.8.2 Radiated emission measurements test results for SU-A/O-xD1V-2.4 indoor unit frequency range 30 MHz – 1 GHz

DATE: May 4, 1999
RELATIVE HUMIDITY: 49%
AMBIENT TEMPERATURE: 22°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency MHz	Radiated Emissions dB (µV/m)	Spec. Limit dB (µV/m)	Spec. Margin dB	Pass/ Fail
32.461	31.80	40.0	8.20	Pass
40.985	31.19	40.0	8.81	Pass
108.900	31.85	43.5	11.65	Pass
465.335	39.15	46.0	6.85	Pass
930.679	36.72	46.0	9.28	Pass

Notes to table calculations:

Measurements were performed with biconilog antenna and quasi-peak detector
Resolution bandwidth = 120 kHz
Spec. Margin = Specification margins = dB below (negative if above) specification limit.

Table 3.8.3 Radiated emission measurements test results for SU-A-xD-2.4 outdoor unit frequency range 30 MHz – 12.5 GHz

DATE: May 16, 1999
RELATIVE HUMIDITY: 47%
AMBIENT TEMPERATURE: 23°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency MHz	Radiated emissions dB (µV/m)	Specified Limit dB (µV/m)	Margin dB	Pass/ Fail
71.467	33.75	40	6.25	Pass
71.543	35.36	40	4.64	Pass
71.769	34.38	40	5.62	Pass
76.360	32.10	40	7.90	Pass
674.962	30.02	46	15.98	Pass

Notes to table calculations:
Measurements were performed with biconilog antenna and quasi-peak detector
Resolution bandwidth = 120 kHz

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency MHz	Detector type	Measured result dB (µV/m)	Average factor dB	Radiated Emissions dB (µV/m)	Specified Limit dB (µV/m)	Margin dB	Pass/ Fail
1961.98	peak	62.08	-19.5	42.58	54	11.42	Pass
2000.95	peak	60.93	-19.5	41.43	54	12.57	Pass
2039.93	peak	61.01	-19.5	41.51	54	12.49	Pass
2712.0	average	47.04	NA	47.04	54	6.96	Pass

Notes to table calculations:

Measurements were performed with double ridged guide antenna in vertical polarization
Resolution bandwidth = 1MHz, video bandwidth = 3 MHz
Average factor = -19.5 dB (see section 3.3.1).
Margin = dB below (negative if above) specification limit.

Table 3.8.4 Radiated emission measurements test results for SU-A-xD-2.4 indoor unit frequency range 30 MHz – 1 GHz

DATE: May 4, 1999
RELATIVE HUMIDITY: 49%
AMBIENT TEMPERATURE: 22°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency MHz	Radiated Emissions dB (μV/m)	Specified Limit dB (μV/m)	Margin dB	Pass/ Fail
35.468	29.12	40.0	10.88	Pass
108.452	37.22	43.5	6.28	Pass
332.379	37.15	46.0	8.85	Pass

Notes to table calculations:

Measurements were performed with biconilog antenna and quasi-peak detector
Resolution bandwidth = 120 kHz
Margin = dB below (negative if above) specification limit.

Table 3.8.5 Radiated emission measurements test results for AU-O-2.4 outdoor unit frequency range 30 MHz – 12.5 GHz

DATE: May 5, 1999
RELATIVE HUMIDITY: 49%
AMBIENT TEMPERATURE: 22°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency MHz	Antenna Height m	TT Pos. °	Radiated Emissions dB (µV/m)	Specified Limit dB (µV/m)	Margin dB	Pass/ Fail
81.661	1	-1.9	32.07	40.0	7.93	Pass
200.008	1	274	33.52	43.5	9.98	Pass
350.000	1.32	348	35.05	46.0	10.95	Pass
399.997	1.32	348	36.15	46.0	9.85	Pass
428.278	1.28	360	34.00	46.0	12.00	Pass
903.986	1.04	47	38.37	46.0	7.63	Pass

Notes to table calculations:

Measurements were performed with biconilog antenna in vertical polarization and quasi-peak detector, resolution bandwidth = 120 kHz
TT Pos. = turntable position in degrees, (EUT front panel = 0^o)
Margin = dB below (negative if above) specification limit.

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency MHz	Detector type	Measured result dB (µV/m)	Average factor dB	Radiated Emissions dB (µV/m)	Specified Limit dB (µV/m)	Margin dB	Pass/ Fail
1961.96	peak	64.58	-19.5	45.08	54	8.92	Pass
2000.96	peak	66.35	-19.5	46.85	54	7.15	Pass
2039.96	peak	66.06	-19.5	46.56	54	7.44	Pass
1756.00	average	38.7	NA	38.7	54	15.3	Pass
2640.00	average	40.0	NA	40.0	54	14.0	Pass

Notes to table calculations:

Measurements were performed with double ridged guide antenna in vertical polarization
Resolution bandwidth = 1MHz, video bandwidth = 1 MHz
Average factor = -19.5 dB (see section 3.3.1).
Margin = dB below (negative if above) specification limit.