

EXHIBIT 14

RADIATED SPURIOUS EMISSIONS MEASUREMENTS

Measurements of radiated spurious emissions were performed in accordance with the requirements and conditions of § 24.238 and § 2.1053; requirements, procedures and results are described in this exhibit.

Requirements

Broadband PCS equipment operating under the authority of Part 24, Subpart E, must comply with the emissions limits given in § 24.238(a): "On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least $43 + 10 \log (P)$ dB."

Section 2.1053(a) of the FCC Rules specifies that measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified. Furthermore, § 2.1057 requires that measurements be made from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency (approximately 20 GHz for PCS 1900 terminals).

Per § 2.1053(a), the allowable field strength of radiated spurious emissions is found by referencing the relative radiated power of each emissions to the rated RF output power of the Core Engine, assuming that each is radiated from a halfwave dipole antenna. At a distance R from an ideal dipole antenna excited by a 1 W (30.0 dBm) signal, the electric field strength is (see, for example, Antennas, John D. Kraus, 2nd Edition, pg. 49):

$$E = \frac{1}{R} \times \sqrt{30 \times P_T \times G}$$

Where:

- E = Field Strength in Volts/meter
- R = Measurement distance in meters
- P_T = Transmitter Rated Power in Watts (30 dBm nominal = 1 W)
- G = Gain of an Ideal Dipole (1.64x or 2.15 dBi)

Therefore, at a distance of 3 m from the transmitter / dipole:

$$E = \frac{1}{3} \times \sqrt{30 \times 1.0 \times 1.64}$$
$$E = 2.34 \frac{V}{m} \text{ or } 127.34 \text{ dB}\mu\frac{V}{m}$$

As required by § 24.238(a), spurious emissions must be attenuated by at least $43+10\log(P)$ dB; for a rated RF output power of 1 W, the required attenuation is thus 43 dB. Therefore, at 3 meters from the device, the radiated spurious emissions field strength limit is:

$$E = 127.34 - 43.0 \text{ dB}\mu\frac{V}{m}$$

$$E = 84.4 \text{ dB}\mu\frac{V}{m}$$

Note that, for any rated transmitter output power P, the absolute level of spurious emissions is found to be -13 dBm (the same absolute power level requirement for conducted spurious emissions). At a distance of 3 meters, a power of -13 dBm into an ideal dipole produces an equivalent field strength of 84.4 dBμV/m, giving the same result using the field strength equation previously presented.

Additionally, because Part 24 applies only to PCS transmissions, only transmitter and transmitter-related spurious emissions are subject to the limits given in § 24.238. Radiated spurious emissions from receivers which operate above 960 MHz are not regulated, per § 15.101(b). All other emissions, including those originating from digital control, processing, and other circuitry, and power supplies, and whether radiated or conducted onto the AC powerline, are regulated as unintentional emissions by Part 15 of the FCC rules. In accordance with the guidance given in § 15.101, this category of emissions is subject to the verification process.

Measurement Procedure and Results Summary

Measurements of radiated spurious emissions were performed at and by Criterion Technology of Rollinsville, CO. Criterion Technology is accredited through the national Voluntary Laboratory Accreditation Program (NVLAP) and a description of its open air test site (OATS) has been filed with the FCC. Measurement procedures and results are described in the test report prepared by Criterion Technology, which is on file.

For all radiated and AC powerline conducted emissions measurements, the Core Engine was mounted to a carrier board as Figures E14.1 and E14.2. This carrier board provided a conditioned interface for the DC power and RS-232 signals to the Core Engine. Measurements of unintentional (non transmitter related) emissions, both radiated and AC powerline conducted, were performed to ensure that these emissions from the Core Engine are well below the Class B limits. When incorporated into an OEM product, unintentional emissions from the Core Engine will thus not contribute excessively to the emission from the combined product; Class B performance will also enable the Core Engine to be incorporated into any type of end product.

Similarly, measurements of transmitter-related (above 1 GHz) emissions II demonstrated that the Core Engine complies with the radiated spurious limits given in § 24.238 without any allowance for additional shielding from the host product.

Measurements performed by Criterion Technologies were in accordance with the procedures given in ANSI C63.4-1992, "*Method of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz*" over the frequency range of 30 MHz to 20 GHz. For measurements below 1 GHz, emissions were measured per standard practice. Above 1 GHz, peak (versus average) measurements were made.

The Criterion Test Report indicates that the Core Engine meets the transmitter radiated emissions requirements and limit given in §§ 24.238 and 2.1053. Furthermore, all other emissions, both radiated and conducted, and from all sources excluding the Core Engine transmitter (i.e., receiver, digital, etc.) comply with FCC Part 15, Class B limits.

Representative values for the field strength of transmitter spurious radiated emissions are presented in Tables E14.1 and E14.2, for measurements below and above 1 GHz, respectively. For these measurements, the transmitter was tuned to a mid-band PCS 1900 channel at 1880.0 MHz (channel 661). Similar results were measured with the transmitter tuned to the low (channel 512, 1850.2 MHz) and high (channel 810, 1909.8 MHz) PCS 1900 channels in the licensed PCS spectrum.



Figure E14.1. Radiated Emissions set-up at Criterion Technologies.



Figure E14.2. Radiated Emissions set-up at Criterion Technologies.

Table E14.1. Representative radiated spurious emissions results below 1GHz

Frequency (MHz)	Field Strength at 10 m (dB μ V/m)	Limit at 10 m (dB μ V/m)	Margin (dB)
32.1571	20.40	29.54	9.14
39.0079	20.13	29.54	9.41
48.0053	22.49	29.54	7.51
48.7489	20.60	29.54	8.94
50.7949	20.69	29.54	8.85
52.0000	20.60	29.54	8.94
56.3060	21.21	29.54	8.33
60.0011	18.96	29.54	10.58
65.0000	20.95	29.54	8.59
78.0000	20.83	29.54	8.71
82.5517	20.21	29.54	9.33
84.4998	20.39	29.54	9.15
90.9595	22.29	33.06	10.77
104.0000	20.72	33.06	12.34
112.6323	16.93	33.06	16.13
117.0000	21.11	33.06	11.95
130.0000	20.34	33.06	12.72
137.2939	20.83	33.06	12.23
143.0000	14.77	33.06	18.29
156.0000	21.62	33.06	11.44
169.0000	17.45	33.06	15.61
175.5009	19.17	33.06	13.89
188.4979	18.22	33.06	14.84
195.0000	12.94	33.06	20.12
208.0000	20.70	33.06	12.36
221.0000	16.59	33.06	18.97
224.2504	18.90	33.06	16.66
233.2482	12.62	33.06	22.94
234.0000	24.01	33.06	11.55
247.0000	24.01	33.06	13.91
269.7525	21.80	33.06	13.76
273.0000	17.01	33.06	18.55
276.2469	22.64	33.06	12.92
279.4952	20.58	33.06	14.98
286.0000	22.52	33.06	13.04
299.0000	23.86	33.06	11.70
308.7507	26.11	33.06	9.45
312.0000	26.73	33.06	8.83
325.0000	24.64	33.06	10.92
338.0000	20.41	33.06	15.15
351.0000	19.78	33.06	15.78
364.0000	19.85	33.06	15.71

Table E14.2. Representative radiated spurious emissions results above 1 GHz

Frequency (MHz)	Field Strength at 3 m (dB μ V/m)	Limit at 3 m (dB μ V/m)	Margin (dB)
1452.0000	56.15	84.4	28.25
1600.0000	55.87	84.4	28.53
1879.9470	99.85	84.4	NA - FUNDAMENTAL
2904.0000	44.98*	84.4	39.42
3200.0000	46.09	84.4	38.31
3760.0000	62.79	84.4	21.61
4356.0000	54.17	84.4	30.23
4800.0000	52.32	84.4	32.08
5640.0000	60.51	84.4	23.89
5808.0000	54.11*	84.4	30.29
6400.0000	54.96*	84.4	29.44
7260.0000	56.72*	84.4	27.68
7520.0000	65.33	84.4	19.07
8000.0000	56.35	84.4	28.05
9400.0000	68.8	84.4	15.6
11280.0000	65.08*	84.4	19.32
13160.0000	72.23*	84.4	12.17
15040.0000	76.97*	84.4	7.43
	* = at noise floor		