

February 18, 2005

Mr. C.K. Li
Mr. Patrick Bowen
Mr. John Turner
Kyocera Wireless Corporation
10300 Campus Point Drive
San Diego, CA 92121

Ref: Substitution Method Transmitter testing

Dear Sirs,

This letter is intended to clarify the methodology Nemko USA typically uses when testing Kyocera Handset products to FCC Part 22 & 24.

- 1) Methodology Used: TIA/EIA-603 (see attached excerpt)
- 2) The Substitution Method is used for fundamental power levels and spurious emissions when RF emission signals are measured within 20 dB of the limit.
- 3) Formula Used to calculate the values:
 - a) Measured value + antenna factor + cable loss - preamplifier = Max Level
 - b) Margin = Max level - Limit
 - c) Signal Generator power level - cable loss + antenna gain = ERP Part 22 or EIRP Part 24
 - d) Substituted Margin = ERP (or EIRP) - Limit

Note: gain for dipole = 0; antenna factor is not the same as antenna gain

Note: The signal generator power level is the power required when transmitting into the substituting antenna to duplicate the Measured Value. Substituted margin is reported in 731 forms pertaining to certification grants and Class II Permissive Changes when a direct conducted power reading cannot be performed.

We hope this explanation helps clarify the approach Nemko uses when testing your products. Please contact me with further questions.

Sincerely,

Chip Fleury

Chip Fleury
Technical Customer Service Manager

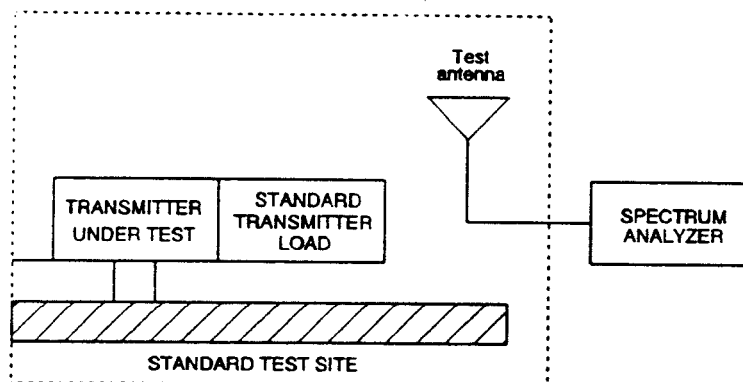
- 2) Video Bandwidth ≥ 3000 Hz.
 - 3) Sweep Speed ≤ 2000 Hz/second.
 - 4) Detector Mode = Positive Peak.
 - 5) Span that will allow proper viewing of the test bandwidth (see section 1.3.4.4).
- c) Set the center frequency of the spectrum analyzer to the assigned transmitter frequency. Key the transmitter, and set the level of the unmodulated carrier to a full scale reference line. This is the 0 dB reference for the measurement.
- d) Modulate the transmitter with a 2500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50% of rated system deviation. The input level shall be established at the frequency of maximum response of the audio modulating circuit. Transmitters employing digital modulation techniques that bypass the limiter and the audio low-pass filter shall be modulated as specified by the manufacturer.
- e) Record the resulting spectrum analyzer presentation of the emission level with an on-line recording device or in a photograph. It is recommended that the emission limit be drawn on the plotted graph or photograph.

2.2.12 Radiated Spurious Emissions

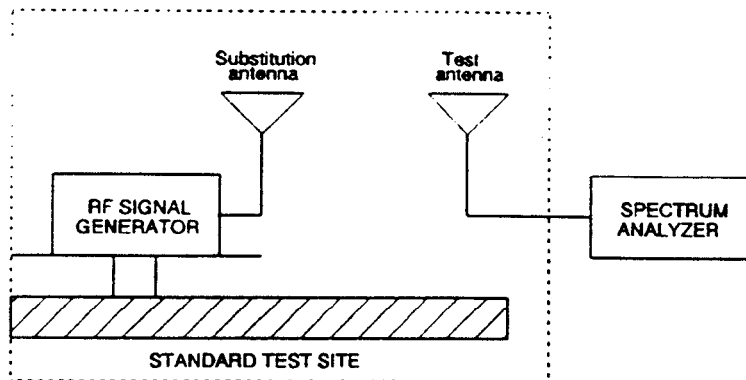
2.2.12.1 Definition

Radiated spurious emissions are emissions from the equipment when transmitting into a non-radiating load on a frequency or frequencies which are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communications desired.

2.2.12.2 Method of Measurement



- a) Connect the equipment as illustrated.
- b) Adjust the spectrum analyzer for the following settings:
 - 1) Resolution Bandwidth ≤ 3 kHz.
 - 2) Video Bandwidth ≥ 10 kHz.
 - 3) Sweep Speed ≤ 2000 Hz/second.
 - 4) Detector Mode = Positive Peak.
- c) Place the transmitter to be tested on the turntable in the standard test site. The transmitter is transmitting into a non-radiating load which is placed on the turntable. The RF cable to this load should be of minimum length.
- d) For each spurious measurement the test antenna should be adjusted to the correct length for the frequency involved. This length may be determined from a calibration ruler supplied with the equipment. Measurements shall be made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier, except for the region close to the carrier equal to \pm the test bandwidth (see section 1.3.4.4).
- e) For each spurious frequency, raise and lower the test antenna from 1 m to 4 m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Then the turntable should be rotated 360° to determine the maximum reading. Repeat this procedure to obtain the highest possible reading. Record this maximum reading.
- f) Repeat step e) for each spurious frequency with the test antenna polarized vertically.



- g) Reconnect the equipment as illustrated.

- h) Keep the spectrum analyzer adjusted as in step b).
- i) Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At the lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground.
- j) Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both ends horizontally polarized and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output.
- k) Repeat step j) with both antennas vertically polarized for each spurious frequency.
- l) Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps j) and k) by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna.
- m) The levels record in step l) are the absolute levels of radiated spurious emissions in dBm. The radiated spurious emissions in dB can be calculated by the following:

Radiated spurious emissions (dB) =

$$10 \log_{10} \left(\frac{\text{TX power in watts}}{0.001} \right) - \text{the levels in step l)}$$

NOTE: It is permissible to use other antennas provided they can be referenced to a dipole.