Step (13) Determine the FCC limit on power for spurious emissions on the frequency of each measured emission as follows:

The rules require that spurious emissions be attenuated at least 30 decibels below the transmit power level. Therefore, the maximum received power limit for a spurious emission can be calculated from the formula:

$dBm_{spur} = dBm_{meas} + AF_{121.5} - AF_{spurfreq} - 30$

where:

dBm_{meas} = measured receiver reading (Section 2.1511(c), step 5).

$AF_{121.5}$ = tuned dipole antenna factor at 121.5 MHz.

$AF_{spurfreq}$ = tuned dipole antenna factor at spurious freq.

Step (14) Record in dB below the fundamental emissions the level of all spurious and harmonic emissions within 10 dB of the FCC limits.

§ 2.1513 Measurements of modulation characteristics.

(a) *Set-up*. Test of modulation characteristics are to be performed in an RF shielded room.

Step (1) Place the EPIRB directly on a metal ground plane, such as the shielded room floor.

Step (2) Place a suitable receiving antenna at a convenient distance from the EPIRB and connect it to the input of the spectrum analyzer or receiver to observe the radiated signal from the EPIRB.

Step (3) Set the spectrum analyzer or receiver controls as follows:

I.F. bandwidth: 300 kHz minimum
Video filter: OFF or as wide as possible
Amplitude scale: Linear
Frequency: 121.5 MHz
Scan width: 0 Hz

Step (4) Connect the detected output of the spectrum analyzer or receiver to the input of the storage oscilloscope.

Step (5) Set the oscilloscope controls as necessary to allow the demodulated waveform to be viewed. The input signal is to be DC coupled.

(b) *Measurement of Audio Frequencies*.

Step (1) Activate the EPIRB.

Step (2) Trigger the oscilloscope and store at least one complete cycle of the audio waveform.

Step (3) Measure the period (T) of the waveform. The period is the time difference between the half voltage points at the beginning and end of one complete cycle of the waveform. See Figure 2.

Step (4) Calculate the frequency (F), where:

$F=1/T$.

Step (5) Repeat Steps 2 through 4 until the highest and lowest audio frequencies are found.

NOTE: The lowest and highest frequencies may occur several cycles before or after the transition from low to high frequency.)

Step (6) Determine the audio frequency range (F_{range}), where:

$F_{range}=F_{high} - F_{low}$

Step (7) Record instrument settings and the lowest and highest audio frequencies. Record the audio frequency range in Hertz.

Step (8) Repeat Steps 1–7, above, for 243 MHz.

(c) *Modulation factor*.

Step (1) Activate the EPIRB.

Step (2) Trigger the oscilloscope and store at least one complete cycle of the audio waveform. The input signal is to be DC coupled or erroneous results will be obtained.

Step (3) Measure the maximum voltage (V_{max}), and the minimum voltage (V_{min}) for the cycle. The modulation factor (M) is calculated from the following formula:

$$M = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$$

See Figure 2.

Step (4) Repeat Steps 2 and 3 until the lowest modulation factor is found.

Step (5) Record instrument settings and the lowest modulation factor, expressed as a ratio between 0 and 1.

Step (6) Repeat the above measurements for 243 MHz.

(d) *Modulation duty cycle*.

Step (1) Activate the EPIRB.

Step (2) Trigger the oscilloscope and store at least one complete cycle of the audio waveform.

Step (3) Measure the period (T) of the waveform. The period is the time difference between the half voltage points at the beginning and end of one cycle of the waveform. See Figure 2.

Step (4) Measure the pulse width (t_p) of the waveform. The pulse width is the time difference between the half voltage points on the rising and falling portions of the waveform. See Figure 2.

Step (5) Calculate the duty cycle (D) as follows:

$$D = \frac{t_p}{T}$$

Step (6) Repeat Steps 2 through 5 a sufficient number of times to determine the highest and lowest duty cycles.

Step (7) Record instrument settings and the highest and lowest duty cycles in percent.

Step (8) Repeat Steps 1–7 for 243 MHz.

(e) *Sweep repetition rate.*

Step (1) Connect a speaker to the detected output of the spectrum analyzer or receiver so the audio frequencies are audible. Alternatively, an FM radio tuned to 108 MHz placed in the vicinity of the EPIRB may be used.

Step (2) Activate the EPIRB.

Step (3) Time the number of audio sweeps (N) for a one minute interval.

Step (4) Calculate the audio sweep rate (R) using R=N/60.

Step (5) Record instrument settings and the sweep repetition rate in Hertz.

§ 2.1515 Spectral measurements.

(a) *Set-up.* Spectral measurements are to be performed in a shielded room.

Step (1) Place the EPIRB directly on a metal ground plane, such as the shielded room floor. The EPIRB should be powered by its own internal battery with its standard antenna attached and deployed.

Step (2) Place a suitable receiving antenna at a convenient distance from the EPIRB and connect it to the input of the spectrum analyzer to observe the radiated signal from the EPIRB. A signal generator and frequency counter capable of operating at 121.5 and 243 MHz are also required for these tests.

(b) *Occupied bandwidth test.*

Step (1) Activate the EPIRB and observe the fundamental frequency on a spectrum analyzer. Adjust location of receiving antenna and spectrum analyzer controls to obtain a suitable signal level (i.e., a level which will not overload the spectrum analyzer, but is far enough above the noise floor to allow determination of whether or not the sidebands are attenuated by at least the amount required in the rules).

Step (2) Set spectrum analyzer controls as follows:

I.F. bandwidth: 10 kHz
Video filter: OFF or as wide as possible
Scan time: 100 ms./div.
Amplitude scale: 10 dB/div.
Scan width: 20 Hz/div.
Center frequency: 121.5 MHz

Step (3) Record the signal level in dbm.

Step (4) Calculate the mean power reference level by adding 10 $\log_{10}$ (D), where D is the modulation duty cycle determined in section 2.1513(d) of this part, to the recorded signal level.

Step (5) Set spectrum analyzer controls as follows:

I.F. bandwidth: 100 Hz
Video filter: OFF or as wide as possible
Scan time: 10 sec./div.
Amplitude scale: 10 dB/div.
Scan width: 20 kHz/div.

Step (6) Check the modulation sidebands for compliance with the required attenuation below the mean power reference level specified in § 80.211 of the rules.

Step (7) Record how the test was performed, instrument settings and the occupied bandwidth in kHz and the 3 dB bandwidth of the carrier in Hz. (See § 2.1517 of this part).

Step (8) Repeat Steps 1 through 7 for the signal at 243 MHz.

(c) *Signal enhancement test.* The setup specified in § 2.1515(a) is to be used in this method of measuring signal enhancement. Other methods may be used if shown to give results equivalent to or more accurate than this method.

Step (1) Activate the EPIRB and locate the carrier frequency at 121.5 MHz on the spectrum analyzer. Adjust location of receiving antenna and spectrum analyzer controls to obtain a suitable signal level (i.e., a level which will not overload the analyzer, but is far enough above the noise floor to allow sidebands at least 40 dB below the carrier to be viewed).

Step (2) Set the spectrum analyzer controls as follows:

I.F. bandwidth: 10 kHz
Video filter: OFF or as wide as possible
Scan time: 100 ms./div.
Amplitude scale: 5 dB/div.
Scan width: 10 kHz/div.
Center frequency: 121.5 MHz

Step (3) Record the amplitude in dBm.

Step (4) Calculate the total power output by adding 10 log(D), where D is the modulation duty cycle determined in § 2.1513(d) of this part, to the recorded signal level.

Step (5) Set the spectrum analyzer controls as follows:

I.F. bandwidth: 60 Hz or less
Video filter: OFF or as wide as possible
Scan time: 10 sec./div.
Amplitude scale: 5 dB/div.
Scan width: 20 Hz/div.
Center frequency: 121.5 MHz

Step (6) Measure and record the carrier power dBm as displayed on the spectrum analyzer.

Step (7) Calculate the ratio of carrier power to total power from Steps 4 and 6 using the following formula:

$$\frac{\text{carrier power}}{\text{total power}} = \log_{10}^{-1} \left[\frac{dB_c - dB_T}{10} \right]$$

dB_C = carrier power in step 6
dB_T = total power in step 4