WIRELESS AND SENSING PRODUCTS

AN1200.04

Application Note:

FCC Regulations for ISM Band Devices: 902 - 928 MHz

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2 Introduction

The purpose of this technical note is to assist the engineer in understanding the requirements, including test methodology, of the Federal Communications Commission (FCC) towards operating of non-licensed devices operating in the 902 - 928 MHz ISM band.

It is intended that this report is read in conjunction with the following documents:

- Part 15 of Title 47 of the Code of Federal Regulations
- FCC Office of Engineering and Technology; "Understanding the FCC Regulations for Low-Power, Non-Licensed Transmitters (OET Bulletin 63); February 1996
- FCC Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems (DA 00-705); March 30, 2000
- FCC Office of Engineering and Technology; "Measurement of Digital Transmission Systems Operating under Section 15.247"; March 23, 2005

3 An Overview of FCC Regulations

Low-power, non-licensed devices operating in the 902 - 928 MHz ISM band are everywhere, from simple toys, wireless security systems, wireless telemetry, through to wireless automatic meter reading.

In the United States, the FCC is the body responsible for implementing rules to limit the potential for interference to licensed operations by low-power, non-licensed transmitters. These rules are documented in Part 15 of Title 47 of the Code of Federal Regulations ("FCC Part 15"), and it is recommended that the engineer refers to an up to date version of this regulation.

3.1 FCC Part 15

Operation to FCC Part 15 is subject to two conditions. Firstly, the device may not cause harmful interference, and secondly the device must accept any interference received, including interference that may cause undesired operation. Hence, there is no guaranteed quality of service when operating a Part 15 device.

For operation in the 902 - 928 MHz band, a low-power, non-licensed device will generally fall within the remit of the following subparts of the regulation:

- Part 15.247: Frequency Hopping and Digitally Modulated Intentional Radiators
- Part 15.249: General Non-Licensed Intentional Radiators

Note that other subparts of FCC Part 15 can be applied to devices operating in the 900 MHz band and these are briefly discussed later in this document.

3.2 Part 15.247

Devices that operate to FCC Part 15.247 are limited to frequency hopping and digitally modulated schemes. The two processes are illustrated below in Figure 1.

3.2.1 Frequency Hopping Spread Spectrum Requirements

Frequency hopping schemes are often referred to as frequency hopping spread spectrum (FHSS) To be considered as a compliant for a frequency hopping system the device or system must meet the following requirements:

1. The channel carrier frequencies must be separated by a minimum of 25 kHz, or the 20 dB bandwidth of the hopping channel, whichever is the greater.
2. The channel hopping frequencies which are selected at the system, hopping rate must be pseudo-random in nature. On average, each channel hopping frequency must be used equally.
3. The receiver bandwidth should match that of the transmitter and will hop in synchronization.

4. If the 20 dB bandwidth is less than 250 kHz, the system shall use at least 50 channels. The average dwell time on a particular channel shall not exceed 400 mS within a 20 second period. If the 20 dB bandwidth is 250 kHz or greater, then the system shall use at least 25 channels. The average dwell time shall not exceed 400 mS within a 10 second period.
5. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
6. For systems employing at least 50 channels, the maximum peak conducted output power output is +30 dBm (1 W). For systems employing less than 50 channels but at least 25 channels, the maximum output power is +24 dBm (0.25 W).
7. If the antenna used has a directional gain in excess of 6 dBi then the conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
8. In any 100 kHz bandwidth outside the frequency band of operation the power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.
9. Radiated harmonic and spurious emissions which fall within the restricted bands, as defined in FCC Part 15.205 must comply with the radiated emission limits specified in FCC Part 15.209. Please refer to Sections 4.1.7 and 4.2.3 for further details.

From the above it can be seen that in the process of frequency hopping the signal appears to occupy a very wide bandwidth, although the instantaneous signal bandwidth can is either narrowband or wideband (providing that the 20 dB signal bandwidth does not exceed 500 kHz).

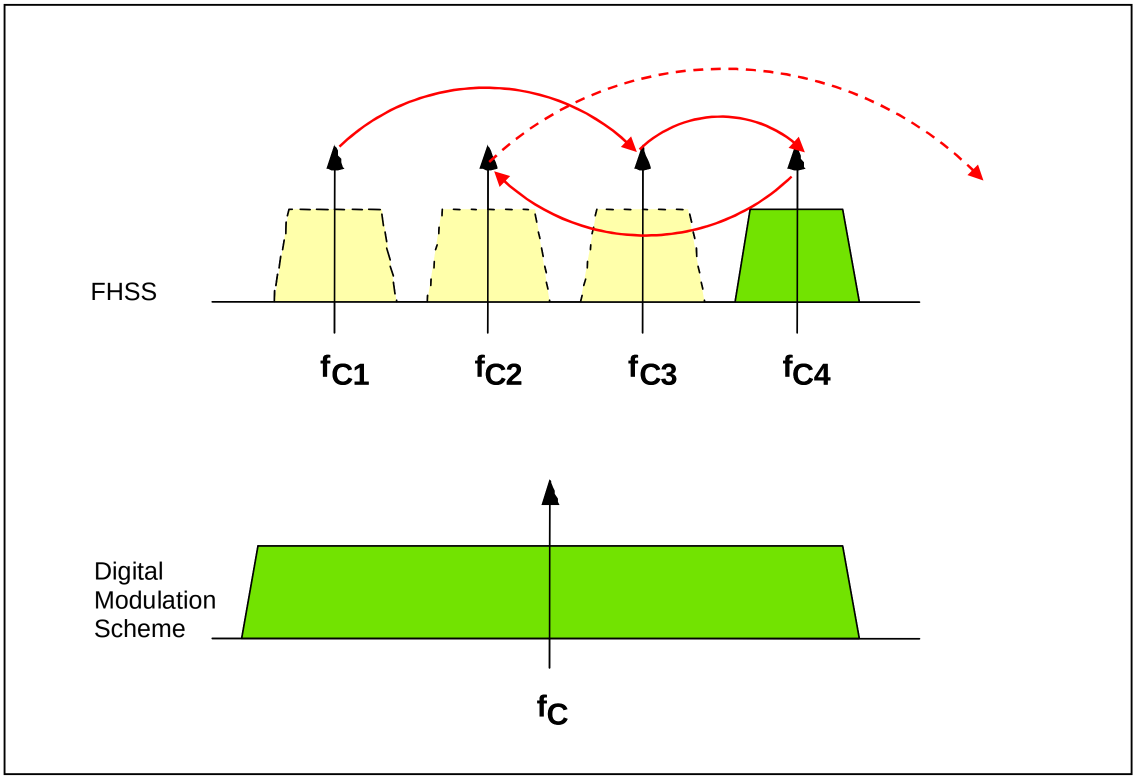

Figure 1: FHSS and Digital Modulation Scheme Spectrums

3.2.2 Digital Modulation Scheme Requirements

The FCC, under the definition of digital modulation schemes, allows a device to comply with these regulations without necessarily implementing Direct Sequence Spread Spectrum (DSSS), provided that the following requirements are met:

1. The minimum 6 dB bandwidth of the signal shall be at least 500 kHz.

2. The maximum permitted peak conducted output power is +30 dBm (1 W). However, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.
3. If the antenna used has a directional gain in excess of 6 dBi then the conducted output power described shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
4. In any 100 kHz bandwidth outside the frequency band of operation the power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.
5. Radiated harmonic and spurious emissions which fall within the restricted bands, as defined in FCC Part 15.205 must comply with the radiated emission limits specified in FCC Part 15.209. Please refer to Sections 4.1.7 and 4.2.3 for further details.

Direct sequence spread spectrum applies to the direct multiplication of the binary data at the transmitter by a pseudo-random bit sequence to generate a transmitted data stream defined in terms of a kilochips/second data rate. At the receiver, the reverse process is applied to recover the original binary data stream.

The effect of this process is to generate a transmitted modulation spectrum that approaches that of “random” (or white) noise. Since the power spectral density of random noise is less than that of a coherent signal at the same power level, this allows for a higher transmit power level to be maintained whilst still complying with FCC regulations.

From the above it can be seen that compliance with digital modulation schemes implies wideband modulation.

3.3 Part 15.249

As opposed to Part 15.247 or the other subparts of FCC Part 15 that apply to operation in the 902 - 928 MHz the provisions of FCC Part 15.249 do not enforce restrictions on either the modulation scheme or the end application.

The requirements for compliance with FCC Part 15.249 are listed below:

1. The maximum permitted field strength is 50mV/m or 93.98 dBμV/m. Since the field strength limits are specified at a distance of 3m from the radiating source, this equates to a conducted power of approximately -1 dBm[1] when measured at the antenna port.
2. The maximum permitted field strength of harmonic components is 500μV/m or 53.98μV/m. Again field strength limits are specified at a distance of 3m; this equates to a conducted power level of approximately -41 dBm when measured at the antenna port.
3. Radiated emissions other than harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.
4. Subpart 15.31 duty cycle correction applies to pulse modulated transmitters and where an average limit for carrier or spurious field strength is specified.

3.4 Part 15.243

Operation is restricted to the 890 - 940 MHz band for devices to use radio frequency energy to measure the characteristics of a material. Use of this frequency band to this subpart precludes voice communication or other data transmission.

3.5 Part 15.245

Operation is restricted to the 902 - 928 MHz band and is limited to devices operating as field disturbance sensors, excluding perimeter protection systems.

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[1] $P(dBm) = 20\log\left[E(\mu V/m) * d(m)\right] - 104.77$

where: E = field strength; d = distance

4 Device Measurements

4.1 Part 15.247 Measurements for Frequency Hopping Systems

Unless specified, the spectrum analyzer detector should be set to peak; the video bandwidth (VBW) should be equal or greater than the resolution bandwidth (RBW) of the instrument, and the display set to peak hold.

4.1.1 20 dB Channel Bandwidth

Center the spectrum analyzer about a modulated carrier with data present. Set the frequency span to approximately twice or three times the 20 dB. Measure the 20 dB channel bandwidth using either the spectrum analyzer's delta-marker or reference line function, as illustrated below in Figure 2. Note that the RBW should be at least 1% of the measured 20 dB bandwidth. The effect on the measured channel bandwidth as a function of the spectrum analyzer RBW is highlighted. With the RBW set to 3 kHz (approximately 1% of the measured 20 dB bandwidth under these test conditions); the measured bandwidth is 34.5 kHz. With the RBW set to 10 kHz, the measured bandwidth is 57 kHz.

A FCC accredited test lab will be able to advise on the correct measurement configuration.

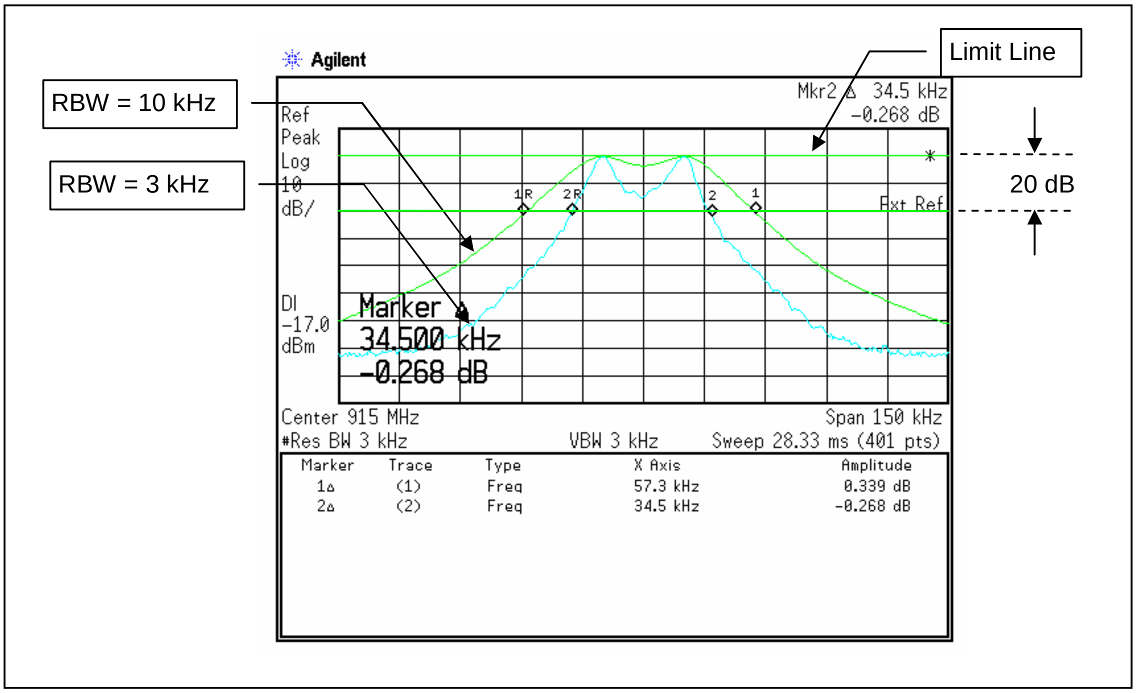

Figure 2: Measurement of 20 dB Bandwidth

4.1.2 Carrier Frequency Separation

The device under test should have frequency hopping enabled. The frequency span of the spectrum analyzer should be wide enough to capture the peaks of two adjacent channels. Figure 3 below illustrates the measurement of carrier frequency separation. Since the FCC refer to the carrier frequency separation, this parameter can be measured on either an un-modulated carrier or the modulated signal (in the case of 2-level FSK the mid point between the peal-to-peak frequency deviation of the modulated carrier should be used as the reference). The frequency span should be set wide enough to capture the peaks of two adjacent hopping channels and the resolution bandwidth set to at least 1% of the span.

With reference to the observations of Section 4.1.1, the channel separation, at 100 kHz, complies with FCC requirements. If numerous data rates and frequency deviation settings are applied for different modes of operation, a separate measurement must be made for each mode.

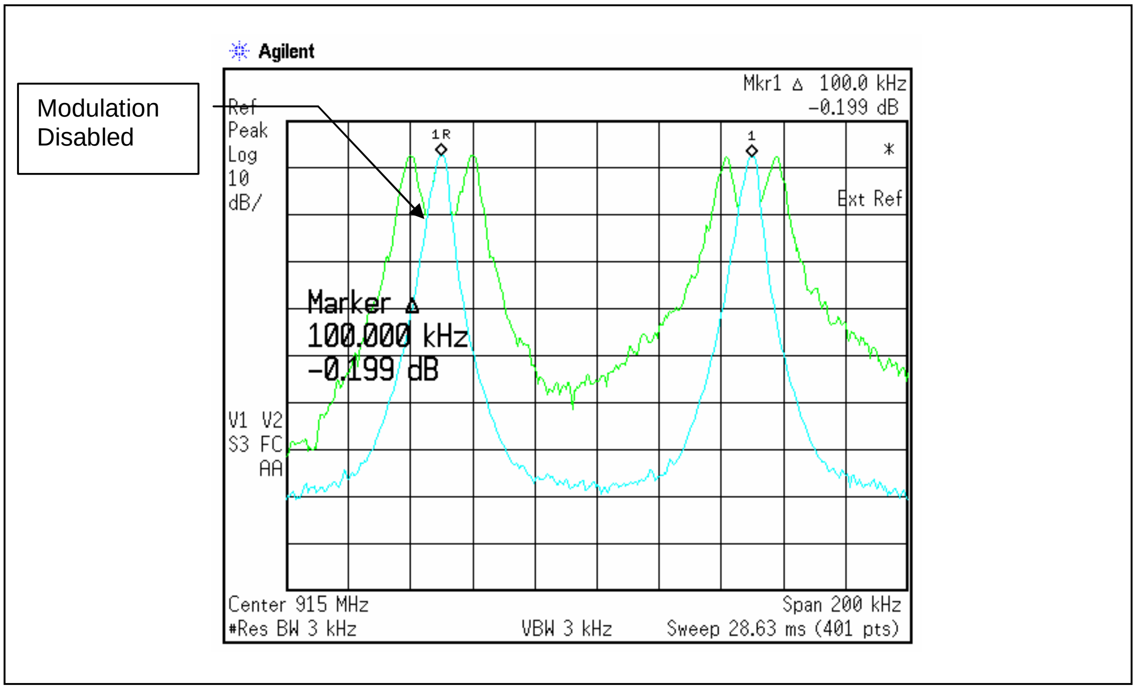

Figure 3: Measurement of Carrier Frequency Separation

4.1.3 Number of Hopping Channels

Set the span of the frequency synthesizer to cover the entire 902 - 928 MHz band, if necessary the span may be broken up into sections to enable each discrete hopping carrier frequency to be displayed. The RBW should be at least 1% of the total span.

4.1.4 Dwell Time

With frequency hopping enabled, set the spectrum analyzer to zero span mode centered on a hopping channel. Adjust the sweep time to capture the entire on-channel dwell period and set the RBW to 1 MHz. An example of a dwell time measurement is illustrated in Figure 4.

4.1.5 Peak Output Power

To measure the peak output power, center the spectrum analyzer on a hopping channel and set the span to approximately 5 times the 20 dB bandwidth measured in Section 4.1.1 and the RBW to greater than the 20 dB bandwidth. Take into account the cable loss associated with the measurement.

4.1.6 Band Edge Conducted Emissions

To perform these measurements, select the channels closest to the frequency band edges at 902 MHz and 928 MHz. Set the span to be wide enough to observe the peak level of the emission on the channel closest to the band edge as well as any modulation products that fall outside the authorized band of operation. The RBW should be greater than 1% of the span and at least 100 kHz (since the requirements of the FCC are for measurement within a 100 kHz bandwidth). Ensure that any emissions that fall outside the 902 - 928 MHz band are at least 20 dB below the peak amplitude of the wanted transmission.

Repeat the above procedure, but this time with frequency hopping enabled, to ensure that any switching transients caused by the hopping function also comply with the specified limits.

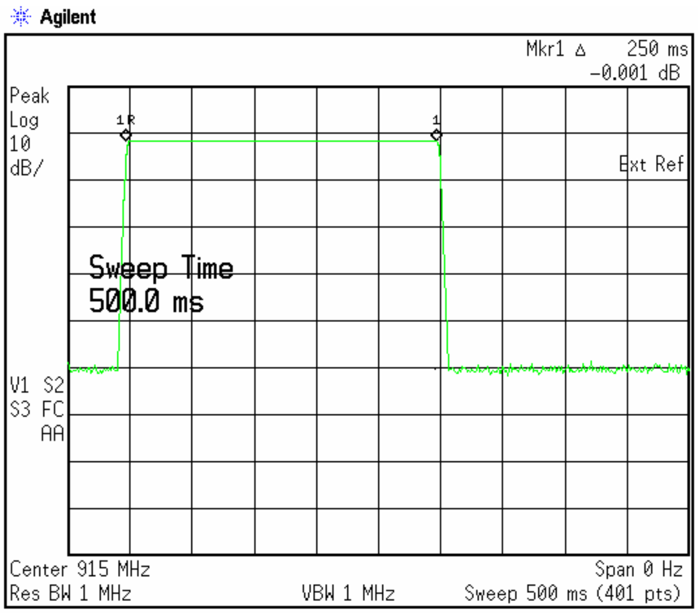

Figure 4: Measurement of Hopping Channel Dwell Time

An example of a band edge emissions measurement is indicated below in Figure 5. Note that although there is evidence of switching transients below the band edge of 902 MHz, and the skirt of the transmitter is clearly visible, that these are below the 20 dB limit of the specification.

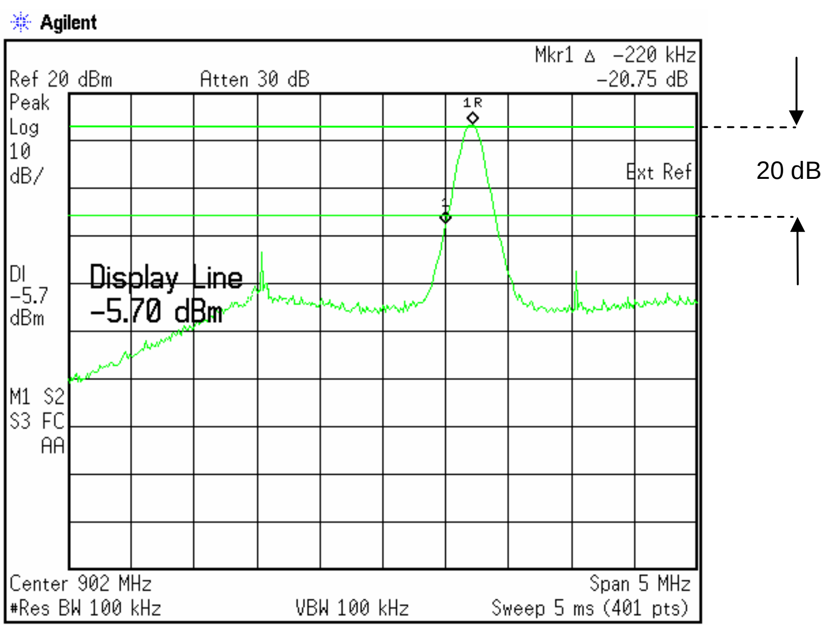

Figure 5: Transient Band Edge Conducted Emissions Measurement

4.1.7 Spurious RF Conducted Emissions

Whilst FCC require that RF spurious emissions falling within restricted frequency bands as defined in subpart 15.205 must comply with the limits defined in subpart15.209 are measured in open-field test conditions, FCC Part 15.247 requires that all harmonics and spurs must be at least 20 dB below the highest emission level within the authorized frequency band, when measured with a 100 kHz RBW.

Typically several measurements will be required to cover the entire band of interest. The RBW should be set to 100 kHz. VBW should be greater than RBW.

Spurious emissions should be measured from the lowest frequency generated by the device, in-band emissions as well as spurious and harmonic emissions up to the 10^{th} harmonic of the channel frequency. Note that the lowest frequency emission generated by the device can include reference oscillator, clock signals and any low frequency emissions from the microcontroller.

4.2 Part 15.247 Measurements for Digital Modulation Schemes

4.2.1 Signal Bandwidth

The signal bandwidth, with modulation enabled, is measured using a spectrum analyzer of frequency span wide enough to capture the entire modulation envelope and RBW of 100 kHz, as illustrated below in Figure 6.

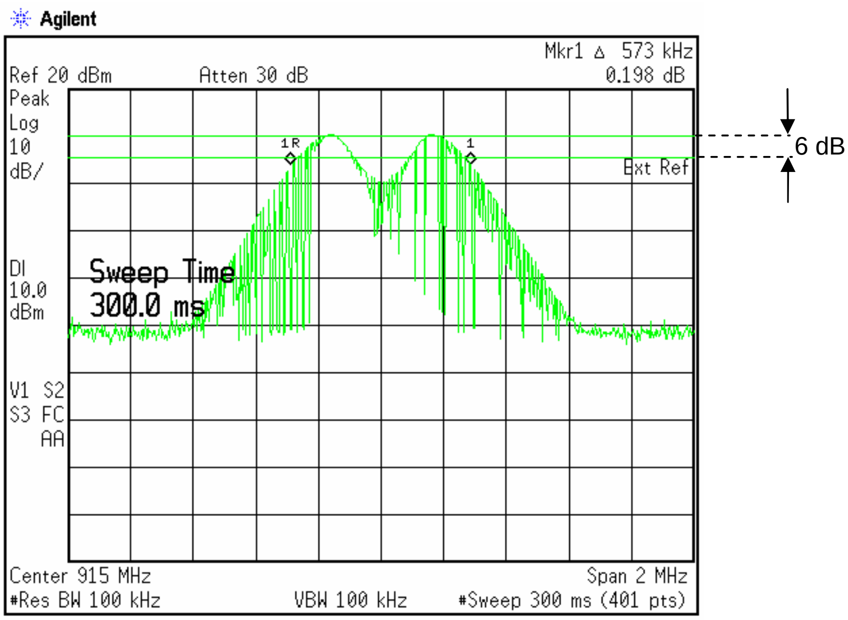

Figure 6: Measurement of Signal Bandwidth

4.2.2 Output Power

There are two methods recommended by the FCC for measuring the output power of a digitally transmitted signal under section 15.247. The first method is a peak power measurement, similar to that described in Section 4.1.5. The frequency span of the spectrum analyzer should be wide enough to capture the entire modulated signal and the RBW set greater than the 6 dB signal measured in 4.2.1, above.

The second method assumes a pulse transmission, where the transmitter is transmitting at maximum output power for a time period, T.

If the sweep time of the spectrum analyzer is $\leq$ T, then spectral trace averaging and summing the power across the band can be employed. This procedure should only be employed if it results in averaging over intervals where the transmitter is operating at maximum output power.

The procedure is listed below:

1. Set the frequency span of the spectrum analyzer to be wide enough to cover the entire modulated signal.
2. Set RBW to 1 MHz and VBW to at least 3 MHz.
3. If the frequency span/number of points of the display ("bin width") is < 0.5 RBW then use the spectrum analyzer's sample detector. Otherwise select peak detector mode of operation.
4. Select video triggering and ensure that the trigger level only triggers on transmitted pulses at the maximum power level. The transmitter must be set to operate at maximum power over the entire sweep of every sweep. However, if the device transmits continuously, with no off intervals or reduced power intervals, the trigger may be set to "free run".
5. Average over 100 traces.
6. Compute power by integrating the spectrum across the 26 dB signal bandwidth. The integration function can be performed by summing power levels in each 1 MHz band (the RBW) in linear power terms. The 1 MHz band power levels to be summed can be obtained by averaging, in linear power terms, power levels in each frequency bin across the 1 MHz. Alternatively, if the spectrum analyzer has a band power measurement function, this can be employed by setting the band limits equal to the band edges of the modulated signal.

If the sweep time > T, then the measurement procedure will depend upon the bandwidth of the signal.

If the signal bandwidth $\leq$ the RBW setting, use the spectrum analyzer is zero span mode and average the traces. This procedure should only be employed if it results in averaging over intervals where the transmitter is operating at maximum output power.

1. Set the frequency span of the spectrum analyzer to zero span mode, with the center frequency set to the midpoint between the -26 dB points of the signal.
2. Set RBW at least equal to the signal bandwidth and VBW at least 3 times RBW. If this is not possible use the highest available VBW, although this must be at least equal to RBW.
3. Select the spectrum analyzer sample detector mode.
4. Set the spectrum analyzer sweep time equal to the pulse transmission duration.
5. Select video triggering and ensure that the trigger level only triggers on transmitted pulses at the maximum power level.
6. Average over 100 sweeps and determine the peak from the resulting trace average.

If the signal bandwidth is > than the maximum RBW setting of the spectrum analyzer, use video averaging with the spectrum analyzer set to maximum hold mode and sum the power across the band.

1. Set the frequency span of the spectrum analyzer to be wide enough to cover the entire modulated signal and set the sweep trigger to "free run".
2. Set RBW to 1 MHz and the VBW equal or greater than 1/T (where T = pulse transmission time).
3. Select the sample detector mode if the bin width (i.e. the frequency span/number of points displayed is less than 0.5 RBW. Otherwise select peak detector mode.
4. Set the trace to max hold and allow to run for 60 seconds.
5. Calculate the power by integrating the spectrum across the 26 dB signal bandwidth or apply a bandwidth correction factor of 10*log(BW/1 MHz) to the spectral peak of the emission. The integration function can be performed by summing power levels in each 1 MHz band (the RBW) in linear power terms. The 1 MHz band power levels to be summed can be obtained by averaging, in linear power terms, power levels in each frequency bin across the 1 MHz. Alternatively, if the spectrum analyzer has a band power measurement function, this can be employed by setting the band limits equal to the band edges of the modulated signal.

However, note that the power spectral density limits, defined in Section 4.2.4 must not be exceeded.

4.2.3 Spurious RF Conducted Emissions

Whilst FCC require that RF spurious emissions falling within restricted frequency bands as defined in subpart 15.205 must comply with the limits defined in subpart15.209 are measured in open-field test conditions, FCC Part 15.247 requires that all harmonics and spurs must be at least 20 dB below the highest emission level within the authorized frequency band, when measured with a 100 kHz RBW. In addition, if the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as described above, the required attenuation shall be 30.

Typically several measurements will be required to cover the entire band of interest. The RBW should be set to 100 kHz. VBW should be greater than RBW.

Spurious emissions should be measured from the lowest frequency generated by the device, in-band emissions as well as spurious and harmonic emissions up to the 10^{th} harmonic of the channel frequency. Note that the lowest frequency emission generated by the device can include reference oscillator, clock signals and any low frequency emissions from the microcontroller.

4.2.4 Power Spectral Density

The method of measuring the power spectral density should be similar to that used top measure the conducted output power. If the peak output power was measured, then the corresponding peak power spectral density, if the average output power was measured, then the average power spectral density should be measured.

The recommended procedure for measuring peak spectral density is outlined below:

1. Center the spectrum analyzer on to the emission peak(s) within the signal passband. Set the RBW to 3 kHz and VBW to greater than the RBW. The sweep time should be set to the frequency span/3kHz (i.e. for a 1.5 MHz span, the sweep time should be 500 seconds). The peak measured signal level should not exceed + 8 dBm.
2. Take into account the following and correct the measured results as defined below.
3. If the measured spectral line spacing is greater than 3 kHz then no correction factor is required.
4. If the measured spectral line spacing is equal or less than 3 kHz, reduce the RBW until the individual spectral lines are resolved. The measured results must be normalized to 3 kHz by summing the power of all the individual spectral lines within a 3kHz band (in linear power units) to determine compliance.
5. If the spectrum line spacing cannot be resolved on the available spectrum analyzer, the noise density function on most modern conventional spectrum analyzers will directly measure the noise power density normalized to a 1 Hz noise power bandwidth. Add 35 dB for correction to 3 kHz.

An example of the measuring the peak power spectral density measured is shown in Figure 7. Since the spectral line spacing is greater than 3 kHz and hence no correction factor is required. As outlined in Section 3.2.2, there is now no longer a requirement for the addition of processing gain in the signal path, which was typically achieved by the implementation of a encoding/decoding algorithm or “chip spreading” However, since the effect of this process reduces the power spectral density it is possible to transmit at a higher carrier power level whilst still complying with FCC regulations.

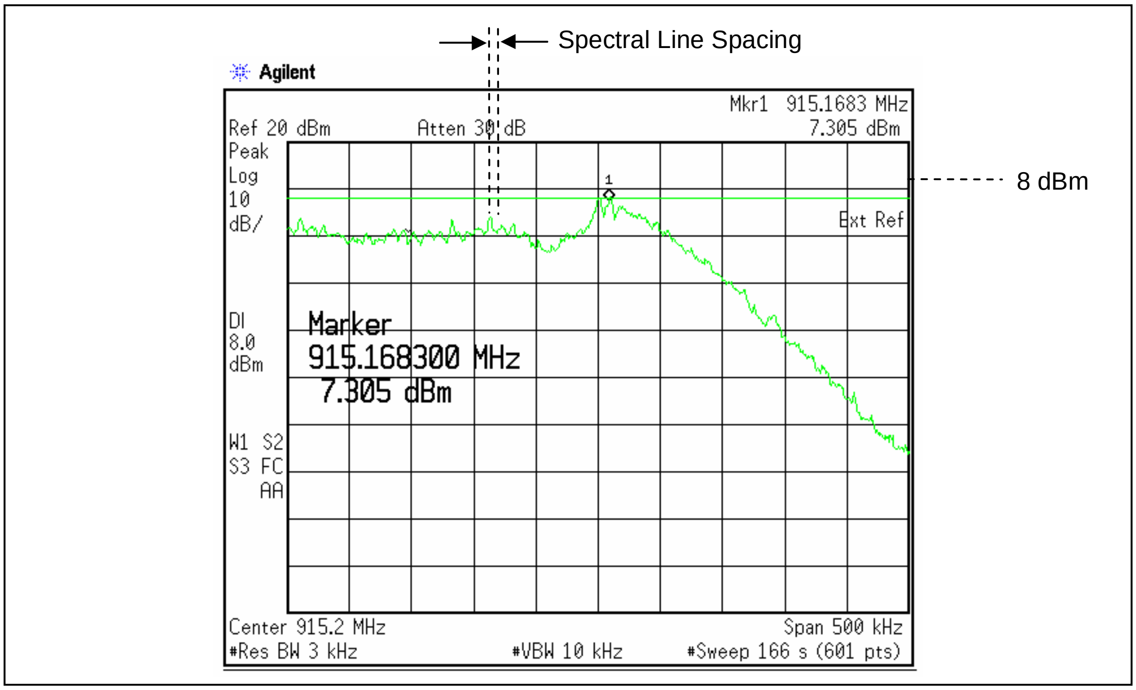

Figure 7: Measurement of Peak Spectrum Density

To measure the average power spectral density:

1. Center the spectrum analyzer on to the emission peak(s) within the signal passband. Set the RBW to 3 kHz and VBW to greater than 9 kHz. The sweep time should be set to automatic.
2. The spectrum analyzer's peak detector mode should be used. A sample detector may be employed providing that; (i) the bin width (i.e. frequency span/number of points in the spectrum display) is less than 0.5 RBW; (ii) the transmission pulse or sequence of pulses remains at maximum transmit power throughout each of the 100 sweeps of averaging and that the interval between pulses is not included in any of the sweeps (e.g., 100 sweeps should occur during one transmission, or each sweep gated to occur during a transmission). If this condition cannot be met then a peak detector set to max hold must be used.
3. Select video triggering and ensure that the trigger level only triggers on transmitted pulses at the maximum power level. The transmitter must operate at maximum power for the entire sweep of every sweep. If the device transmits continuously, with no off intervals or reduced power intervals, the trigger may be set to "free run".
4. Average over 100 sweeps and determine the peak from the resulting trace average. Ensure that in averaging mode that the spectrum analyzer does not default to sample detector mode.

4.3 Part 15.209 Measurements

Devices operating under the provisions of subpart 15.249 are restricted to field strength emissions of the fundamental transmission of 50mV/m and harmonic emissions of 500µV/m when measured at a distance of 3m. Whilst this equates to approximately -1 dBm and -41 dBm, respectively when measured conducted into a 50Ω load, it is necessary that these measurements be performed at a 3 m OATS (Open-Air Test Site) range.

Part 15.247 devices that generate spurious or harmonic emissions that fall within the restricted frequency bands listed in subpart 15.205 are subject to the spurious emission levels of subpart 15.209, as tabulated below. In addition, if the transmission is of a pulsed nature it is recommended that the device is modified so that the device transmits in continuous mode and then corrected by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation as described in subparts 15.35(b) and (c).

MHz	*MHz*	*MHz*	*GHz*
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	Above 38.6
13.36 - 13.41			

Table 1: Restricted Frequency Bands

Within these frequency bands only spurious and harmonic emissions are permitted. Harmonics of wanted transmissions in the 902 - 928 MHz are highlighted in red. Emissions falling within these restricted bands are subject to the radiated emissions limits outlined below.

Frequency (MHz)	*Field Strength (μV/m)*	*Measurement Distance (m)*	*Conducted (dBm)*
0.009 - 0.490	2400/f (kHz)	300	$12.4 - 20*\log(f)_{kHz}$
0.490 - 1.705	24000/f (kHz)	30	$12.4 - 20*\log(f)_{kHz}$
1.705 - 30.0	30	30	-46
30 - 88	100	3	-56
88 - 216	150	3	-52
216 - 960	200	3	-49
> 960	500	3	-41

Table 2: Emitted Field Strength Limits

4.3.1 Open-Air Test Site Requirements

A simplified example of an open air test site is illustrated below in Figure 8. The FCC recommends that the guidelines of the ANSI/IEEE C63.4-2003 standard (“Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”) be followed.

The radiated emissions of the device under test should be measured with the test antenna horizontally and vertically polarized. The height of the test antenna should be adjusted to maximize the received emissions from the DUT, whilst the DUT is place in three orthogonal planes (if appropriate).

Measurements are performed over the frequency range from 9 kHz up to the 10th harmonic (typically 9.3 GHz). Identification of peak emissions can be performed with the RBW of the spectrum analyzer set to 100 kHz for frequencies below 1 GHz and 1 MHz for frequencies above 1 GHz. The VBW can be set to the same value as RBW. Once identified, the peak emission of a spurious transmission can be measured with the VBW set to 10 Hz. This level should take into account the antenna factor and any losses or gains in the test set up. Typically a notch filter, center frequency set to the frequency of the wanted transmission is employed to prevent the measurement equipment from becoming overloaded.

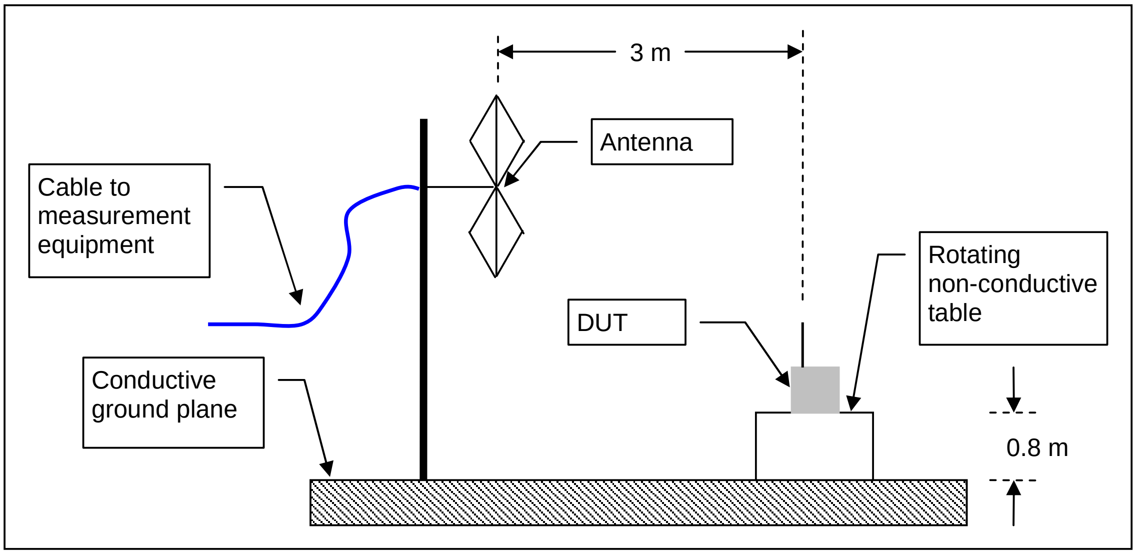

Figure 8: 3 Meter Test Site

Generally, radiated emissions measurements are performed by an FCC accredited laboratory as part of the submission to the FCC. A list of accredited laboratories can be obtained from the FCC.

4.3.2 Duty Cycle Correction Factor

For frequency hopping or pulsed systems where the dwell time per channel or transmitter on-time is less than 100 mS, the field strength can be determined by averaging over one complete pulse train, including blanking intervals.

The correction factor can be calculated by using the following formula:

$$C_F(dB) = 20\log\left(\frac{dwell\ time}{100mS}\right)$$

As an alternative, if the dwell time or pulse duration exceeds 100 mS, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

5 Conclusions

It should be noted that this technical note is intended to provide an awareness and understanding of the FCC requirements for un-licensed intentional radiators operating in the 902 - 928 MHz band. It provides an outline of the main regulatory requirements of Subparts 15.247 and 15.249, together with the test methodology employed to ensure that the device complies with the current regulations. This document highlights that by employing spread spectrum techniques or pulsed transmissions it is possible to transmit at higher emission levels.

It is recommended that final product testing be performed at an FCC accredited test laboratory for final product certification.

6 Further Information

The latest published version of Part 15 of Title 47 of the Code of Federal Regulations can be obtained from the National Archives and Records Administration Code of Federal Regulations website at the following link: http://www.access.gpo.gov/nara/cfr/cfr-table-search.html#page1

FCC Office of Engineering and Technology; "Understanding the FCC Regulations for Low-Power, Non-Licensed Transmitters (OET Bulletin 63); February 1996:
http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet63/oet63rev.pdf

FCC Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems (DA 00-705); March 30, 2000:
http://www.fcc.gov/Bureaus/Engineering_Technology/Public_Notices/2000/da000705.txt

FCC Office of Engineering and Technology; "Measurement of Digital Transmission Systems Operating under Section 15.247"; March 23, 2005:
http://gullfoss2.fcc.gov/prod/oet/forms/blobs/IDBretrieve.cgi?attachment_id=20422

The Federal Communications Commission website can be found at: http://www.fcc.gov/

The Office of Engineering and Technology of the FCC home page: http://www.fcc.gov/oet/

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