REGULATORY COMPLIANCE REPORT

TITLE: FCC & IC Conducted measurements Test Report for 15.247 & RSS-210 Frequency Hopping Device

FC300SR

AUTHOR: William Stoner

REV	CCO	DESCRIPTION OF CHANGE	DATE	APPROVALS	
001		INITIAL RELEASE		Engineering	
				Regulatory	

REVISION HISTORY

a		initial upload	18nov11	Engineering	
				Regulatory	
b1		after 1st TCB questions Corrected Typo in Summary. Added note to Occupied bandwidth screen captures.	18dec11	Engineering	Ray Stoner
				Regulatory	
c		Changes for reduced power	31dec11	Engineering	Ray Stoner
				Regulatory	

Test Data Summary

FCC 15.247 / IC RSS-210; Frequency Hopping Transmitter;
FC300 SR 908– 923.8 MHz for EUT
FCC ID:EO9FC300SR
IC:864A-FC300SR
IC Device Models (for IC):FC300
Serial Numbers – see below

Rule	Description	Spec Limit	Max. Reading	Pass/Fail
Part 15.247 (a)(1)	System Receivers	see below	Match this device	Pass
Part 15.31(e)	Variation of Input Voltage – Conducted	n/a	26.5 dBm	n/a
Part 15.247(a)(1)(i) / RSS-210 A8.1(c)	Number of Hopping Channels – conducted	=> 50	80	Pass
Part 15.247(a)(1)(i) / RSS 210 8.1 (a)	20dB Bandwidth – conducted	< 250kHz	139.3kHz	Pass
Part 15.247(a)(1) / RSS-210 A8.1(b)	Carrier Frequency Separation – conducted	> 20dB BW	200kHz	Pass
Part 15.247(a)(1)(i);(g); (h) / RSS-210 A8.1(c)	Time of Occupancy, Short Burst, Intelligence	< 400mS in 20sec	18.18	Pass
Part 15.247(b) (2) / RSS-210 A8.4(1)	Power Output – conducted	< 1.0W	0.4681W	Pass
15.247(d) / RSS-210 A8.5	Spurious Emissions - conducted	-20dBc	-22.87dBc	Pass

Rule versions: FCC Part 1; FCC Part 2; FCC Part 15, RSS-102 Issue 4 (03-2010); RSS-210 Issue 8 (12-2010); RSS-Gen Issue 3 (12-2010).
Reference docs: ANSI C63.4-2003; DA 00-705 (03-30-2000); OET65 (08-1997); OET65C (06-2001); IEEE C95.3-2002.

Cognizant Personnel	
Name	Title
William Stoner	Test Engineer
Name	Title
Jay Holcomb	Regulatory Manager
Name	Title
Drew Rosenberg	Project Lead

CONDITIONS DURING TESTING

No Modifications to the EUT were necessary during the testing.

NOTE: This report contains only conducted emission measurements. All radiated emissions measurements and AC Line conducted emission measurements are found in the radiated emission report.

FCC 15.31(m); Number of Channels
Freqency range of the transmitter is 908 MHz to 923.8 MHz. This is greater than 10 MHz, therefore this device was tested on three channels. The low channel was centered at 908 MHz, the mid-channel was centered at 916 MHz and the high channel at 923.8 MHz.

FCC 15.203; Antenna Connector Requirements for detachable antennas
The antenna is removable and has a unique Reverse Sex SMA connector; therefore the EUT complies with these FCC rules.

ANSI C63.4 - Temperature and Humidity During Testing
The temperature during testing was within +10º C and +40º C.
The Relative humidity was between 10% and 90%.
RSS-Gen 4.3: Tests shall be performed at ambient temperature

EQUIPMENT UNDER TEST (EUT) DESCRIPTION
Itron declares that the EUT tested was representative of a production unit.

EQUIPMENT UNDER TEST

EUT Module

Manuf:	Itron, Inc.
Model:	FC300SR
Serial Number(s)	FC30011242858
Power source	Fully charged battery running on AC battery charger

Plot Information
In the zero span measurements, the line in the display is the trigger level.

Peripheral Devices
The EUT was tested with the following peripheral devices:
15VDC Power Supply Battery Charger

Manuf:	GlobTek, Inc
Model:	GT-81081-6015-T3
Serial:	RoHS100187103/09

15.247(a)(1)

System receivers

… … …The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals

THIS DEVICE IS OPERATED IN SYSTEMS THAT THE READING DEVICES, HAVE INPUT BANDWIDTHS THAT MATCH THIS DEVICE AND THAT STAY IN SYNCRONIZATION.

15.31(e)

Variation of Supply Voltage

Vary the supply voltage from 85% to 115% of the nominal voltage. If the power level of the fundamental signal varies with supply voltage, record the voltage level at which the fundamental signal is at its highest and use that voltage level for all further testing.

Equipment Used	Serial Number	Cal Date	Due
Agilent 4440A	MY44022578	04/20/2011	04/20/2012
Fluke 75 Multimeter	84011050	3/23/2011	3/31/2012
Staco energy products Variac	NA	NA	NA
Date	Tested by		
12/29/2011	William Stoner		

Voltage	Level (dBm)
115V	26.5
97.75V	26.4
132.25V	26.4

15.247(a) (1) (i) / RSS-210 A8.1 (c)

Number of Hopping Channels, conducted

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

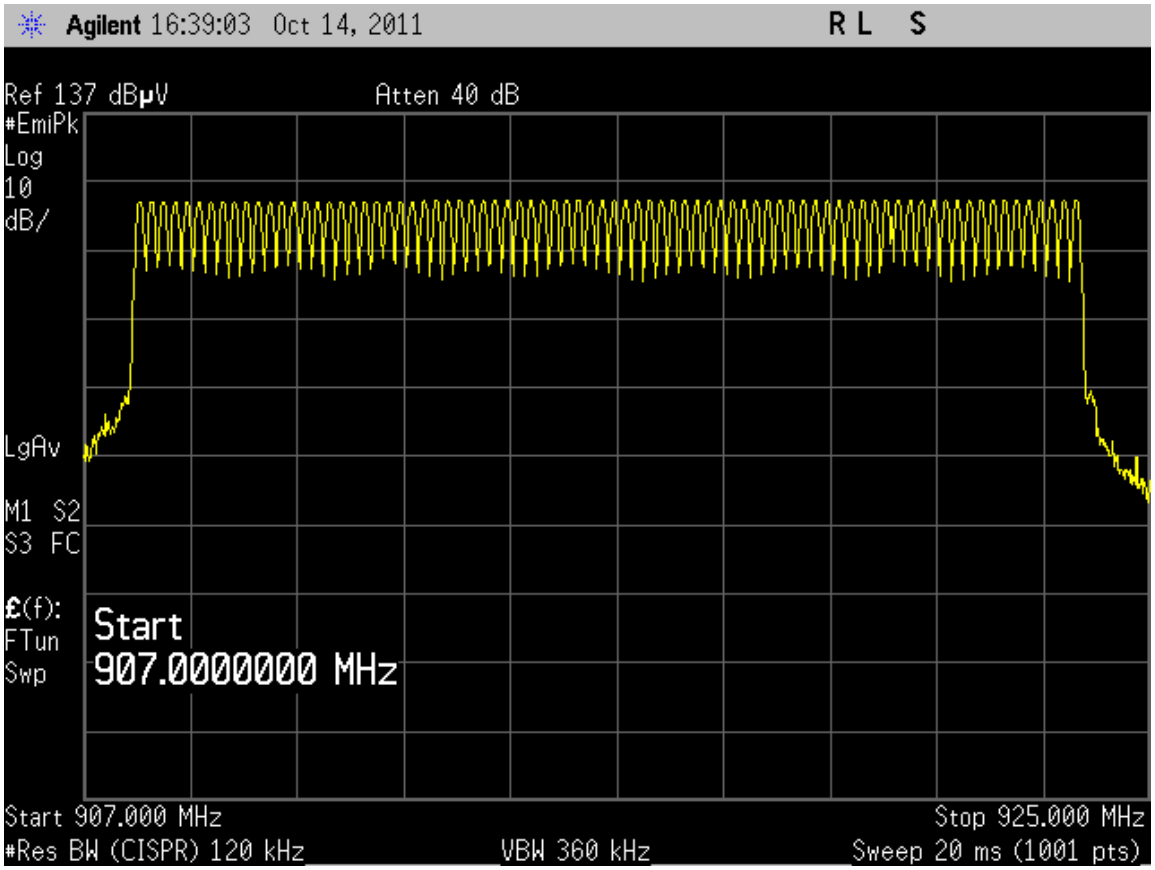
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation
RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = Peak
Trace = max hold

Allow the trace to stabilize. It may prove necessary to break the span up into sections, in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

Equipment Used	Serial Number	Cal Date	Due
Agilent 4440A	MY44022578	04/20/2011	04/20/2012
Date	Tested by		
10/14/2011	William Stoner		

There are 80 channels.



15.247(a) (1) (i) / RSS-210 A8.1 (a)

20 dB Bandwidth, Conducted

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies

Verify that the 20 dB bandwidth of the hopping channel is less than 250 kHz.

Use the following spectrum analyzer settings:

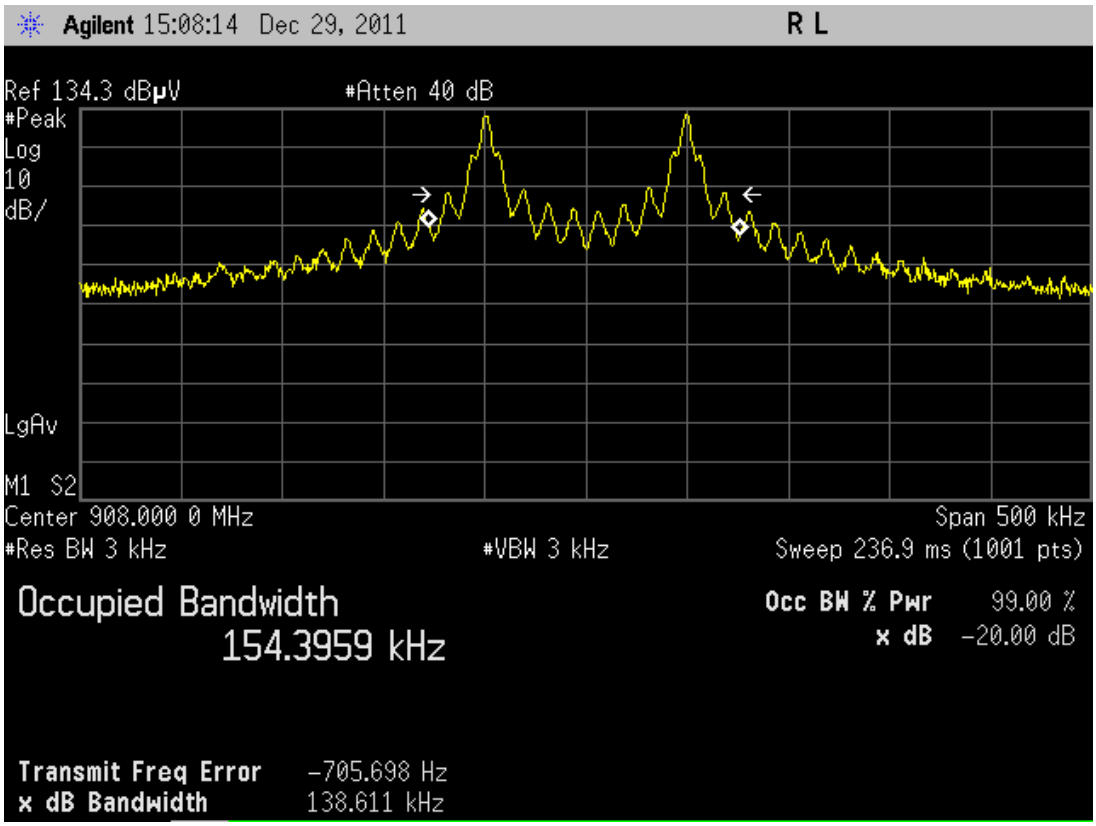
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel.
RBW ≥ 1% of the 20 dB bandwidth
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

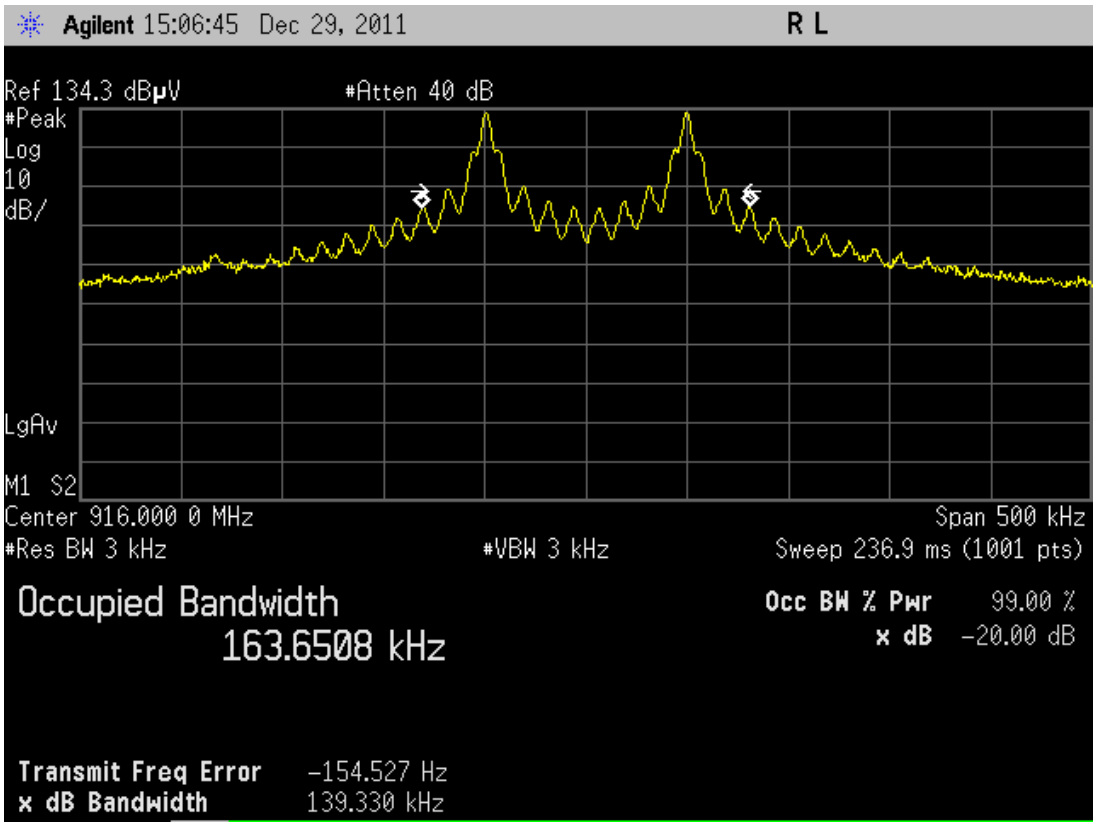
The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the mission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

Equipment Used	Serial Number	Cal Date	Due
Agilent 4440A	MY44022578	04/20/2011	04/20/2012
Date	Tested by		
12/29/2011	William Stoner		

Frequency, MHz	total BW, kHz
908.0	*138.6*
916.0	*139.3*
923.8	*139.2*

Note: In the screen captures below, the 20 dB bandwidth measurement is found on the line "x dB Bandwidth" and not the line below "Occupied Bandwidth".


Agilent 15:08:14 Dec 29, 2011
R L
Ref 134.3 dBµV
#Atten 40 dB
#Peak
Log
10
dB/
LgAv
M1 S2
Center 908.000 0 MHz
Span 500 kHz
#Res BW 3 kHz
#VBW 3 kHz
Sweep 236.9 ms (1001 pts)
Occupied Bandwidth
154.3959 kHz
Occ BW % Pwr 99.00 %
x dB -20.00 dB
Transmit Freq Error -705.698 Hz
x dB Bandwidth 138.611 kHz


Agilent 15:06:45 Dec 29, 2011
R L
Ref 134.3 dBµV
#Atten 40 dB
#Peak
Log
10
dB/
LgAv
M1 S2
Center 916.000 0 MHz
Span 500 kHz
#Res BW 3 kHz
#VBW 3 kHz
Sweep 236.9 ms (1001 pts)
Occupied Bandwidth
163.6508 kHz
Occ BW % Pwr 99.00 %
x dB -20.00 dB
Transmit Freq Error -154.527 Hz
x dB Bandwidth 139.330 kHz


Agilent 14:59:12 Dec 29, 2011
R L
Ref 134.3 dBµV
#Atten 40 dB
#Peak
Log
10
dB/
LgAv
M1 S2
Center 923.800 0 MHz
Span 500 kHz
#Res BW 3 kHz
#VBW 3 kHz
Sweep 236.9 ms (1001 pts)
Occupied Bandwidth
173.7663 kHz
Occ BW % Pwr 99.00 %
x dB -20.00 dB
Transmit Freq Error -3.545 kHz
x dB Bandwidth 139.155 kHz

15.247(a) (1) / RSS-210 A8.1 (b)

Carrier Frequency Separation, conducted

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

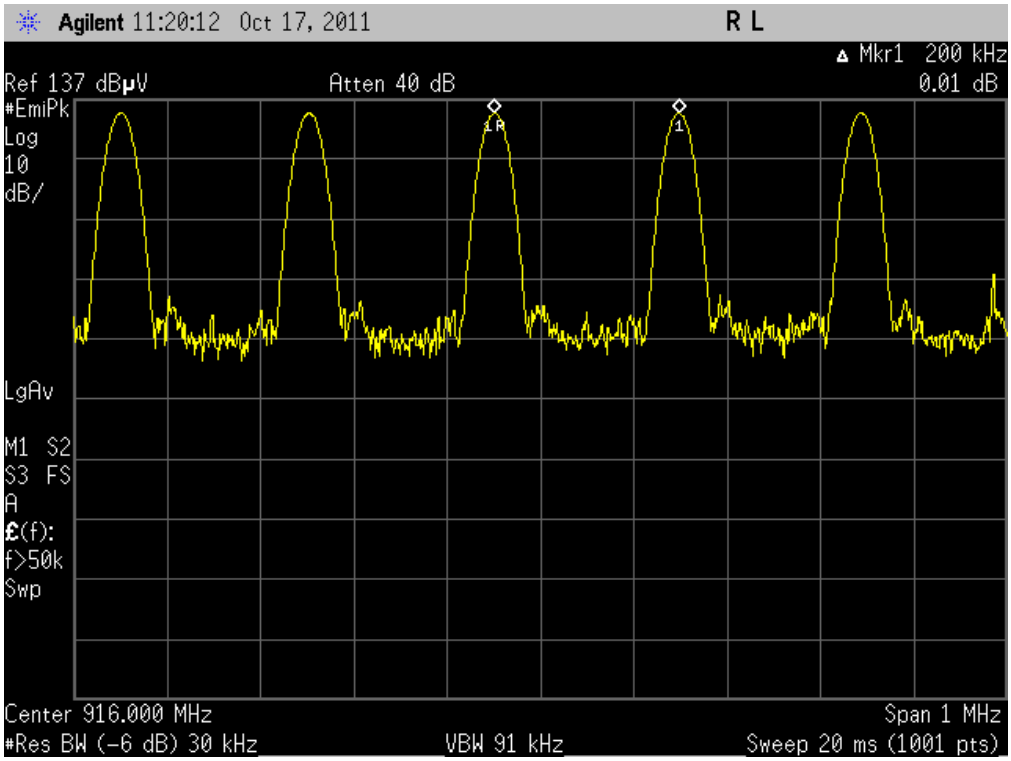
Verify that the channel separation is > the 20dB bandwidth of a single transmission.
The EUT must have its hopping function enabled. Use the following analyzer settings:

RBW ≥ 1% of the span
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Equipment Used	Serial Number	Cal Date	Due
Agilent 4440A	MY44022578	04/20/2011	04/20/2012
Date	Tested by		
10/17/2011	William Stoner		

Carrier separation is 200 kHz.



15.247(a) (1) (i); (g); (h) / RSS-210 A8.1 (c)

Time of Occupancy, conducted

The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter.

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period;

Short Bursts 15.247 (g)

… a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

Intelligence 15.247 (h)

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Verify that the transmitted signal does not occupy a single frequency for more than 400 mS in a 20 second period.

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

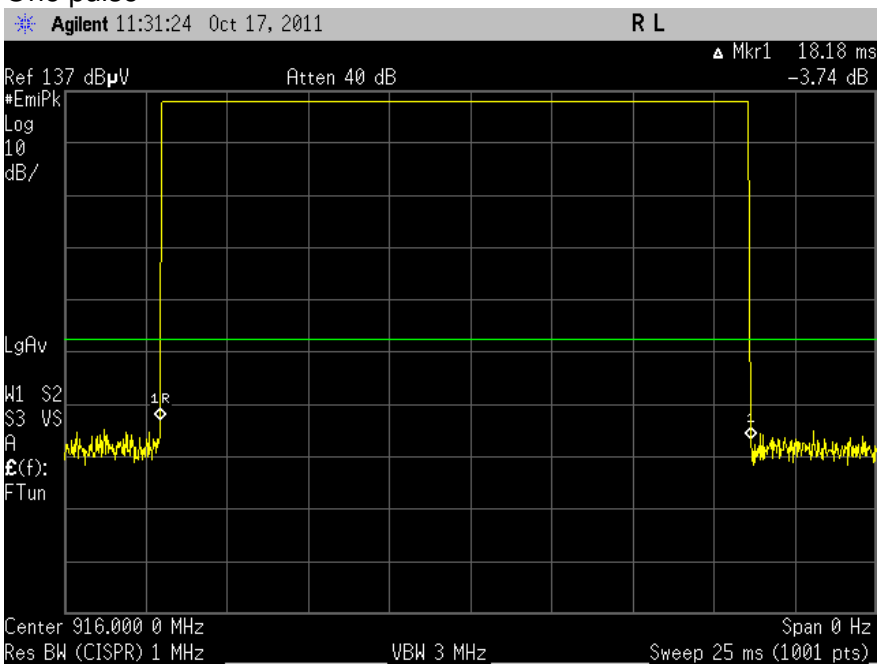
Span = zero span, centered on a hopping channel
RBW = 1 MHz
VBW ≥ RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. Submit this plot(s).

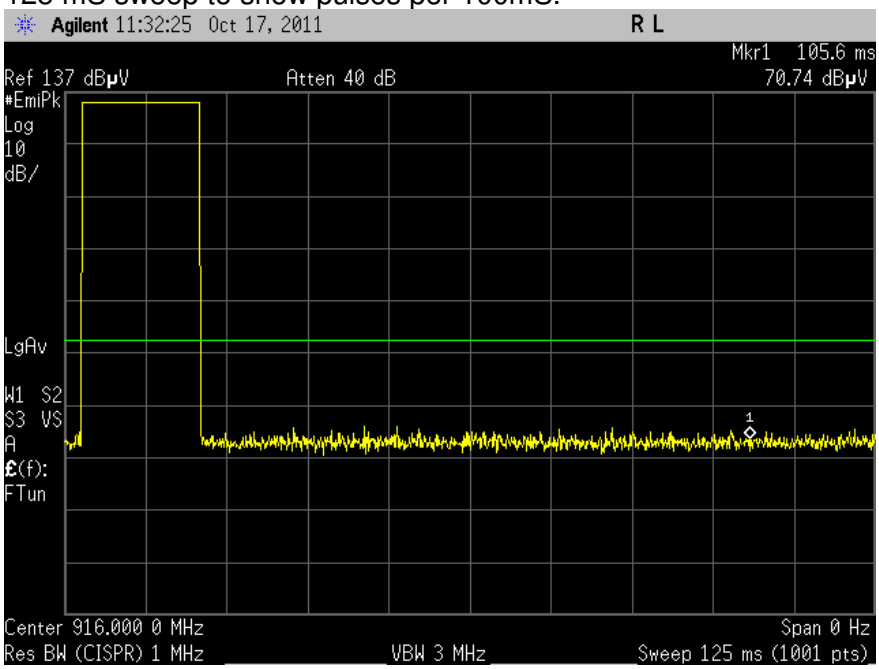
Each transmission is 18.18mS long. Each transmission takes place on one of 80 different channels (per 15.247 (a) (1) (i) and number of Hopping Channels test above) in a pseudo-random sequence which shows compliance to the Short Bursts requirements in 15.247 (g). All 80 channels are used equally on the average. The algorithm that determines the pseudo-random hop sequence does not allow the device to transmit on the same channel more than 6 times in a 20 second period. The maximum possible occupancy time on any one frequency is 109.08 mS within a 20 second period. In addition, there is no intelligence or capability in this system to monitor other usage in the spectrum or to provide coordination with any other transmitters.

Equipment Used	Serial Number	Cal Date	Due
Agilent 4440A	MY44022578	04/20/2011	04/20/2012
Date	Tested by		
10/17/2011	William Stoner		

One pulse



125 mS sweep to show pulses per 100mS.



NOTE: Green line is video triggering level.

Per FCC DA 00-705; a *Duty Cycle Correction Factor* (20log(dwell time/100mS)) can be applied to show compliance to the 15.209 limit. From above dwell time is defined here as: 18.18 mS

20 log (18.18ms / 100mS) = -14.8 dB

15.247(b) (2) / RSS-210 A8.4 (1)

Power Output - Conducted

The maximum peak conducted output power of the intentional radiator shall not exceed the following: For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels.

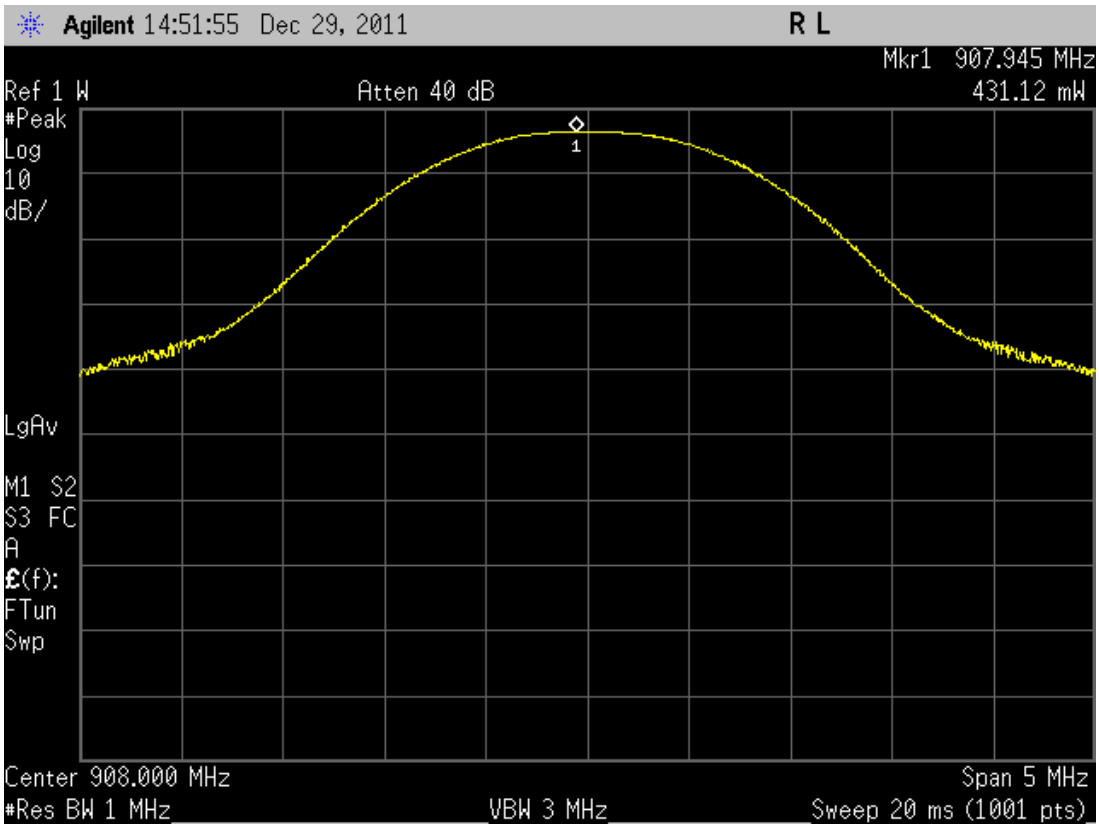
Use the following spectrum analyzer settings:

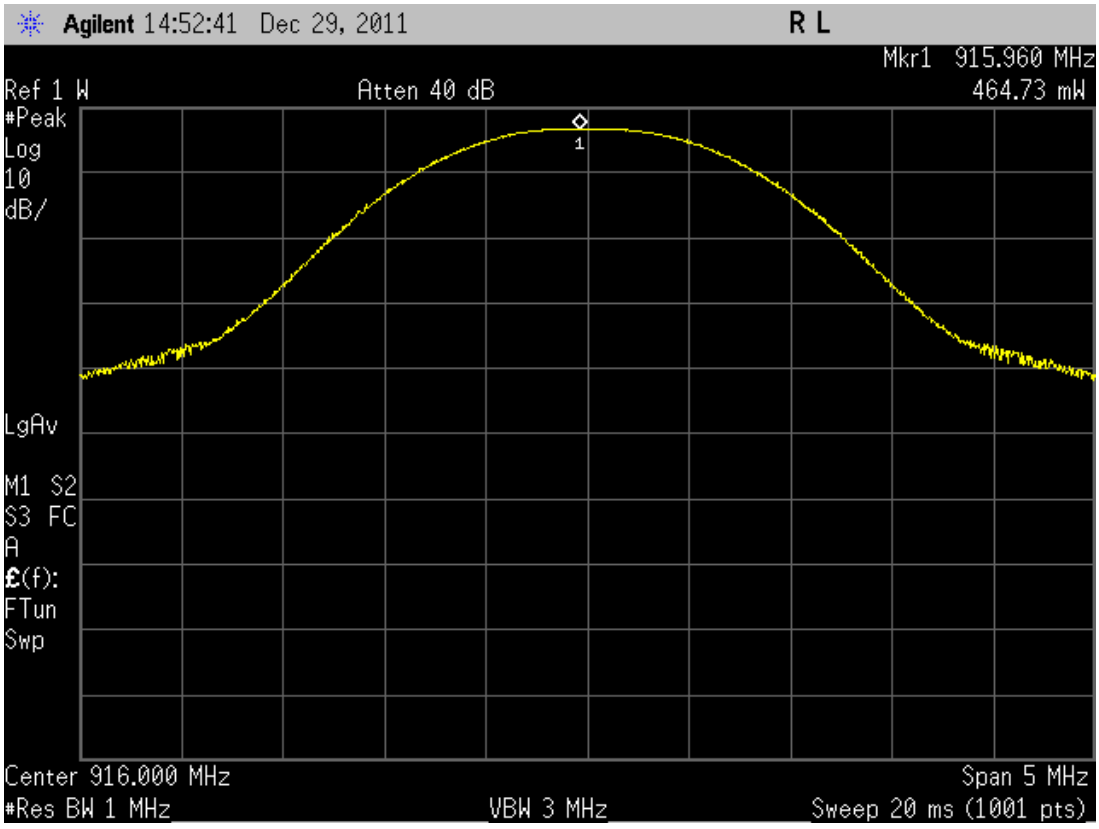
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel.
RBW > the 20 dB bandwidth of the emission being measured.
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

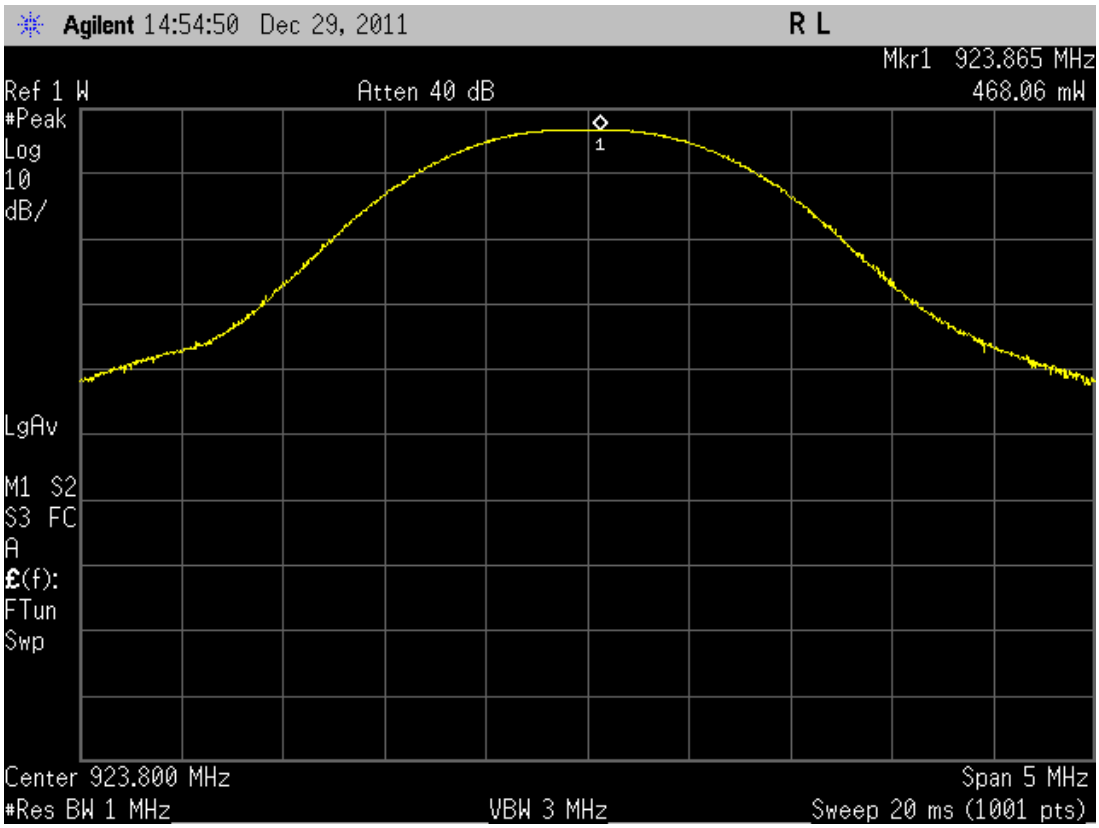
Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power. The limit is specified in one of the subparagraphs of this Section. Submit this plot. A peak responding power meter may be used instead of a spectrum analyzer.

Equipment Used	Serial Number	Cal Date	Due
Agilent 4440A	MY44022578	04/20/2011	04/20/2012
Date	Tested by		
12/29/2011	William Stoner		

Frequency, MHz	Power out, Watts
908	*0.4311*
916	*0.4647*
923.8	*0.4681*


Agilent 14:51:55 Dec 29, 2011
R L
Mkr1 907.945 MHz
431.12 mW
Ref 1 W
Atten 40 dB
#Peak
Log
10
dB/
LgAv
M1 S2
S3 FC
A
£(f):
FTun
Swp
Center 908.000 MHz
Span 5 MHz
#Res BW 1 MHz
VBW 3 MHz
Sweep 20 ms (1001 pts)


Agilent 14:52:41 Dec 29, 2011
R L
Mkr1 915.960 MHz
464.73 mW
Ref 1 W
Atten 40 dB
#Peak
Log
10
dB/
LgAv
M1 S2
S3 FC
A
£(f):
FTun
Swp
Center 916.000 MHz
Span 5 MHz
#Res BW 1 MHz
VBW 3 MHz
Sweep 20 ms (1001 pts)


Agilent 14:54:50 Dec 29, 2011
R L
Mkr1 923.865 MHz
468.06 mW
Ref 1 W
Atten 40 dB
#Peak
Log
10
dB/
LgAv
M1 S2
S3 FC
A
£(f):
FTun
Swp
Center 923.800 MHz
Span 5 MHz
#Res BW 1 MHz
VBW 3 MHz
Sweep 20 ms (1001 pts)

15.247(d) / RSS-210 A8.5

Spurious Emissions - Conducted

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)). (note: 15.247 (b)(3) is for digital modulation.

Equipment Used	Serial Number	Cal Date	Due
Agilent 4440A	MY44022578	04/20/2011	04/20/2012
Date	Tested by		
12/29/2011	William Stoner		

Frequency range investigated was 9 kHz to 9.28GHz. (part 15.33 (a))

Cable loss was added to the spectrum analyzer as a correction. The level in the table is the true corrected value.

1	2	3	4	5
		Carrier		
Freq	Level	level	Limit	Margin
MHz	dBm	dBm	-20dBc	dB
1816	-36.82	26.68	6.68	-43.5
1832	-33.11	26.68	6.68	-39.79
1848	31.54	26.68	6.68	24.86
2724	0.98	26.68	6.68	-5.7
2748	3.69	26.68	6.68	-2.99
2771.25	3.81	26.68	6.68	-2.87
3632	-39.89	26.68	6.68	-46.57
3664	-40.32	26.68	6.68	-47
3695.01	-39.21	26.68	6.68	-45.89
4540	-15.56	26.68	6.68	-22.24
4580	-16.33	26.68	6.68	-23.01
4618.75	-15.89	26.68	6.68	-22.57
5448	-37.78	26.68	6.68	-44.46
5496	-40.4	26.68	6.68	-47.08
5542.5	-38.64	26.68	6.68	-45.32
6356	-33.1	26.68	6.68	-39.78
6412	-32.99	26.68	6.68	-39.67
6466.25	-35.84	26.68	6.68	-42.52
7264	-45.8	26.68	6.68	-52.48
7328	-47.19	26.68	6.68	-53.87
7390	-45.27	26.68	6.68	-51.95
8172	-33.62	26.68	6.68	-40.3
8244	-32.83	26.68	6.68	-39.51
8313.75	-34.71	26.68	6.68	-41.39
9080	-54.31	26.68	6.68	-60.99
9160	-54.78	26.68	6.68	-61.46
9237.57	54.34	26.68	6.68	47.66

[4] = [3] - 20; [5] = [2] – [4];

ANNEX A

direct from FCC DA-00-705, March 30, 2000

(ANSI references updated however)

Spurious RF Conducted Emissions

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section. Submit these plots.

Spurious Radiated Emissions

This test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Follow the guidelines in ANSI C63.4-2003 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel

of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative "marker-delta" method, listed at the end of this document, may be employed.

Alternative Test Procedures

If antenna conducted tests cannot be performed on this device, radiated tests to show compliance with the peak output power limit specified in Section 15.247(b) (2) and the spurious RF conducted emission limit specified in Section 15.247(d) are acceptable. A pre-amp, and, in the latter case, a high pass filter, are required for the following measurements.

1) Calculate the transmitter's peak power using the following equation:

$$E = \frac{\sqrt{30PG}}{d}$$

Where: E is the measured maximum fundamental field strength in V/m, utilizing a RBW ≥ the 20 dB bandwidth of the emission, VBW > RBW, peak detector function. Follow the procedures in C63.4-2003 with respect to maximizing the emission.

G is the numeric gain of the transmitting antenna with reference to an isotropic radiator.

d is the distance in meters from which the field strength was measured.

P is the power in watts for which you are solving:

$$P = \frac{(E \times d)^2}{30G}$$

2) To demonstrate compliance with the spurious RF conducted emission requirement of Section 15.247(d), use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 100 kHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Measure the field strength of both the fundamental emission and all spurious emissions with these settings. Follow the procedures in C63.4-2003 with respect to maximizing the emissions. The measured field strength of all spurious emissions must be below the measured field strength of the fundamental emission by the amount specified in Section 15.247(d). Note that if the emission falls in a Restricted Band, as defined in Section 15.205, the procedure for measuring spurious radiated emissions, listed above, must be followed.

Marker-Delta Method

In making radiated band-edge measurements, there can be a problem obtaining meaningful data since a measurement instrument that is tuned to a band-edge frequency may also capture some in-band signals when using the resolution bandwidth (RBW) required by measurement procedure ANSI C63.4-2003 (hereafter C63.4). In an effort to compensate for this problem, we have developed the following technique for determining band-edge compliance.

STEP 1) Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function required by C63.4 and our Rules for the frequency being measured. For example, for a device operating in the 902-928 MHz band under Section 15.249, use a 120 kHz RBW with a CISPR QP detector (a peak detector with 100 kHz RBW may alternatively be used). For transmitters operating above 1 GHz, use a 1 MHz RBW, a 1 MHz VBW, and a peak detector (as required by Section 15.35). Repeat the measurement with an average detector (i.e., 1 MHz RBW with 10 Hz VBW). Note: For pulsed emissions, other factors must be included. Please contact the FCC Lab for details if the emission under investigation is pulsed. Also, please note that radiated measurements of the fundamental emission of a transmitter operating under 15.247 are not normally required, but they are necessary in connection with this procedure.

STEP 2) Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.

STEP 3) Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.

STEP 4) The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge. Radiated emissions that are removed by more than two “standard” bandwidths must be measured in the conventional manner.