REGULATORY COMPLIANCE REPORT

TITLE: FCC & IC Test Report; passive re-Radiator accessory in a pit under a Metal Lid

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

REVISION HISTORY

A		initial release to CKC	06jan10	Engineering	
				Engineering	
				Engineering	

Summary

Test Data Summary

Passive re-Radiator Accessory

FCC 15.247 / IC RSS-210
Spread Spectrum Transmitter, 910 – 920 MHz

FCC ID: EO980Wi IC: 864D-80Wi

Device Model:
80W-i Water Endpoint

Model Numbers:
CFG-0900-001

Serial Numbers:
Accessory has no Serial Number
80Wi, ERW-0776-201, used w/antenna: 22917725

OATS Registration Number: FCC 90716, IC 5615

Rule	Description	Max. Reading	Pass/Fail
Part 15.247(d) / RSS-210 A8.5	Spurious Emissions – Radiated	-46.01dBc @ 1830 MHz	Pass
Parts 15.205 & 15.209 / RSS-210 2.2, 2.6 Tables 1 & 2	Restricted Bands / Spurious Emissions – Radiated	34.62dbuV/m @ 2745Mhz	Pass
RSS-210 Gen 7.2.3	Receiver Spurious Emissions	emissions below noise floor of 22.39uV/m	Pass

Rule versions: FCC Part 1), FCC Part 2), FCC Part 15, RSS-210 Issue 7 (June 2007), RSS-Gen Issue 2 (06-2007).
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
Roger Mulcahy	Test Technician
Jay Holcomb	Regulatory Manager
Steve Ivanca	Project Lead

15.247(d) / RSS-210 A8.5

Spurious Emissions

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. Attenuation below the general limits specified in Section 15.209 is not required.

Follow the procedure outlined in Annex A, and B of this document.

Equipment Used	Serial Number	Cal Date	Due Date
AH systems preamplifier model number PAM 0126	135	12/15/2008	12/15/2009
EMCO 6502 Loop (9kHz to 30Mhz)	9509-2970	10/15/2008	10/15/2010
Emco 3110B Biconical (30MHz-to 300MHz)	9807-3129	10/02/2009	10/02/2011
Emco 3146 Log Periodic (200Mhz to 1GHz)	9203-3358	10/12/2009	10/12/2010
EMCO 3115 wave guide (1GHz-18GHz)	9205-3878	03/17/2008	03/17/2010
Huber&Suhner Sucoflex 40ft cable	220297001	12/03/2007	12/03/2009
Agilent E7405A EMC spectrum analyzer	MY45113415	07/31/2009	07/31/2010
Lindgren DB-4 Dipole (400Mhz-1GHz)	78573	09/18/2008	09/18/2010

Date	Tested by	Temperature/humidity
10/17/2009 – 10/30/2009	Roger Mulcahy	59C / 16%

Frequency range investigated was 9 kHz to 9.2GHz. (part 15.33 (a)

Freq. MHz	Ant. Pos.	Level dBm	Level dBuV	Amplifier Gain dB	Ant. Factor dB	Cable Loss dB	**Corrected Level dBuV/m**	emissions dBc
910	Horizontal	-36.29	70.71	**0**	27.96	2.62	101.29	
910	Vertical	-38.19	68.81	**0**	27.96	2.62	99.39	
915	Horizontal	-35.93	71.07	**0**	28.04	2.63	101.74	
915	vertical	-35.68	71.32	**0**	28.04	2.63	101.99	
919.8	Horizontal	-37.47	69.53	**0**	28.12	2.63	100.28	
919.8	Vertical	-36.87	70.13	**0**	28.12	2.63	100.88	
1820	Vertical	-47.52	59.48	**35.43**	26.54	4.44	55.03	-46.96
1820	Horizontal	-50.66	56.34	**35.43**	26.54	4.44	51.89	-50.1
1830	Vertical	-46.61	60.39	**35.44**	26.58	4.45	55.98	-46.01
1830	Horizontal	-50.23	56.77	**35.44**	26.58	4.45	52.36	-49.63
1839.6	Vertical	-50.45	56.55	**35.44**	26.63	4.45	52.19	-49.8
1839.6	Horizontal	-50.09	56.91	**35.44**	26.63	4.45	52.55	-49.44

15.205, 15.209 / RSS-210 2.2, 2.6

Restricted Bands & Spurious Emissions

Only spurious emissions are permitted in any of the frequency bands listed below. The limits stated in 15.209 shall apply. Spurious emissions outside these bands shall also comply with the 15.209(a) limits.

Measure the field strength of all transmitter spurious emissions in the restricted bands listed below. Follow the procedure outlined in Annex A and B of this document.

MHz	MHz	MHz	GHz
0.090-0.110	13.36-13.41	399.9-410	5.35-5.46
0.495-0.505 (FCC)	16.42-16.423	608-614	7.25-7.75
2.1735-2.1905	16.69475-16.69525	960- 1427*	8.025-8.5
4.125-4.128	16.80425-16.80475	1435-1626.5	9.0-9.2
4.17725-4.17775	25.5-25.67	1645.5-1646.5	9.3-9.5
4.20725-4.20775	37.5-38.25	1660-1710	10.6-12.7
5.677-5.683 (IC)	73-74.6	1718.8-1722.2	13.25-13.4
6.215-6.218	74.8-75.2	2200-2300	14.47-14.5
6.26775-6.26825	108-121.94	2310-2390	15.35-16.2
6.31175-6.31225	123-138	2483.5-2500	17.7-21.4
8.291-8.294	149.9-150.05	2655-2900**	22.01-23.12
8.362-8.366	156.52475-156.52525	3260-3267	23.6-24.0
8.37625-8.38675	156.7-156.9	3332-3339	31.2-31.8
8.41425-8.41475	162.0125-167.17	3345.8-3358	36.43-36.5
12.29-12.293	167.72-173.2	3600-4400	Above 38.6
12.51975-12.52025	240-285	4.5-5.15	
12.57675-12.57725	322-335.4		

- for reference the FCC has relaxed some of the restricted bands and IC has not. In the FCC rules today: *960-1240 and *1300-1427MHz; **2690-2900MHz;

Equipment Used	Serial Number	Cal Date	Due Date
AH systems preamplifier model number PAM 0126	135	12/15/2008	12/15/2009
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Emco 3110B Biconical (30MHz-to 300MHz)	9807-3129	10/02/2009	10/02/2011
Emco 3146 Log Periodic (200Mhz to 1GHz)	9203-3358	10/12/2009	10/12/2010
EMCO 3115 wave guide (1GHz-18GHz)	9205-3878	03/17/2008	03/17/2010
Huber&Suhner Sucoflex 40ft cable	220297001	12/03/2007	12/03/2009
Agilent E7405A EMC spectrum analyzer	MY45113415	07/31/2009	07/31/2010

Date	Tested by	Temperature/humidity
10/17/2009 – 10/30/2009	Roger Mulcahy	60C / 16%

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.

$$20\log\left(\frac{5.925mS}{100mS}\right) = -24.55dB$$

Spurious Emission Limits

Frequency (MHz)	Field Strength (microvolts/meter)	in dBuV/m	Measurement Distance (meters)*	maximum Peak +20 over Avg limit dBuV/m
0.009-0.490 2400F	2440F (kHz)		300	
0.490-1.705 24000F	2400F (kHz)		30	
1.705-30.0	30	29.5	30	49.5
30-88	100	40	3	60
88-216	150	43.5	3	63.5
216-960	200	46	3	66
Above 960	500	54	3	74

FS (dBuV/) = 20 * log (FS(uV/m))

* Adjust 40dB/decade when measuring at different distances than specified.

For emissions measurements below 30MHz, rotate the loop antenna about its horizontal and vertical positions to maximize emissions.

Freq. MHz	Ant. Pos.	Level dBm	Level dBuV	Amplifier Gain dB	Ant. Factor dB	Cable Loss dB	Duty Cycle Correction dB	**Corrected Level dBuV/m**	Limit dBuV/m	Margin dB
2730	Vertical	-53.31	53.69	35.2	29.38	5.22	20	33.09	54	20.91
2730	Horizontal	-53.8	53.2	35.2	29.38	5.22	20	32.6	54	21.4
2745	Vertical	-52.92	54.08	35.2	29.43	5.24	20	33.55	54	20.45
2745	Horizontal	-51.85	55.15	35.2	29.43	5.24	20	34.62	54	19.38
2759.4	Vertical	-53.71	53.29	35.19	29.48	5.25	20	32.83	54	21.17
2759.4	Horizontal	-53.53	53.47	35.19	29.48	5.25	20	33.01	54	20.99

RSS-Gen 7.2.3 Receiver Spurious Emission Limits

7.2.3.2 Radiated Measurement

All spurious emissions shall comply with the limits of Table 1.

Receiver Spurious Emissions

The receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate. Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions. Radiated emission measurements are to be performed using a calibrated open-area test site. As an alternative, the conducted measurement method may be used when the antenna is detachable. In such a case, the receiver spurious signal may be measured at the antenna port. If the receiver is super-regenerative, stabilize it by coupling to it an un-modulated carrier on the receiver frequency (antenna conducted measurement) or by transmitting an un-modulated carrier on the receiver frequency from an antenna in the proximity of the receiver (radiated measurement). Taking care not to overload the receiver, vary the amplitude and frequency of the stabilizing signal to obtain the highest level of the spurious emissions from the receiver. For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tunable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

Receiver Spurious Emission Standard

The following receiver spurious emission limits shall be complied with:

(a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 1b. The resolution bandwidth of the spectrum analyzer shall be 100 kHz for spurious emission measurements below 1.0 GHz, and 1.0 MHz for measurements above 1.0 GHz.

Spurious Emission Limits for Receivers

Spurious Frequency (MHz)	dvuV/m	Field Strength (microvolt/m at 3 meters)
Noise floor @ 914.8MHz	27	22.39
30-88	40	100
88-216	43.5	150
216-960	46	200
Above 960	53.9	500

Equipment Used	Serial Number	Cal Date	Due
AH systems preamplifier model number PAM 0126	135	12/15/2008	12/15/2009
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Emco 3146 Log Periodic (200Mhz to 1GHz)	9203-3358	10/12/2009	10/12/2010
EMCO 3115 wave guide (1GHz-18GHz)	9205-3878	03/17/2008	03/17/2010
Huber&Suhner Sucoflex 40ft cable	220297001	12/03/2007	12/03/2009
Agilent E7405A EMC spectrum analyzer	MY45113415	07/31/2009	07/31/2010
AH systems preamplifier model number PAM 0126	135	12/15/2008	12/15/2009
Andrew Heliax length 10 Ft. dia.1/2 inch (pre scan for OATS testing)	FSJ4-50B	N/A	N/A

Date	Temp/Humidity °F / %	Tested by
11/30/2009	61/16	Roger Mulcahy

Frequency range investigated was 9 kHz to 9.2 GHz. Emissions from the Receiver were below the noise floor.

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

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 C63.4-1992 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 C63.4-1992 (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.

ANNEX B

Field Strength Measurement Procedure

This test measures the field strength of radiated emissions using a spectrum analyzer and a receiving antenna in accordance with ANSI C63.4-2003. During the test, the EUT is to be placed on a non-conducting support at 80 cm above the horizontal ground plane of the OATS. The horizontal distance between the antenna and the EUT is to be 3 meters. The bandwidths used shall be; 200 Hz from 9 kHz to 150 kHz, 9 kHz from 150 kHz to 30 MHz, 120 kHz from 30 MHz to 1000 MHz, and 1 MHz from 1 GHz to 40 GHz, with the detector set to peak hold.

1) The antenna correction factor, preamplifier gain (if the preamplifier is installed), and cable loss may be stored in tables in the EMC analyzer and the level at the analyzer is then the corrected level in dbuV/m. Otherwise it is calculated externally.
2) Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.
3) If appropriate, manipulate the system cables to produce the highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.
4) Rotate the EUT 360° to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat step 3). Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.
5) Move the antenna over its fully allowed range of travel to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to step 3) with the antenna fixed at this height. Otherwise, move the antenna to the height that repeats the highest amplitude observation and proceed.
6) Change the polarity of the antenna and repeat step 3), step 4), and step 5). Compare the resulting suspected highest amplitude signal with that found for the other polarity. Select and note the higher of the two signals.
7) The final maximized level displayed on the EMC analyzer is the field strength.