



Test Report No. 8812331751

Applicant: StePac L.A. Ltd.

Equipment Under Test:

Control Unit transceiver

Model: Xsense-HUB

FCC ID: XCCXSENSE-HUB

***From The Standards Institution
Of Israel
Industry Division
Electronics & Telematics Laboratory
EMC Section***

**Test Report No.: 8812331751****Page 1 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB**

Applicant:	StePac L.A. Ltd.
Address:	Tefen Industrial Park, Building 12, PO Box 73, Tefen 24959, Israel
Sample for test selected by:	The customer
The date of tests:	18/11 – 21/12 2008

Description of Equipment Under Test (EUT):	Control Unit transceiver.
Model:	Xsense-HUB
Software version of radio unit	5.8
Hardware version of radio unit	Rev. C
Serial Number:	0330
Manufactured by:	CartaSense

Reference Documents:

- ❖ CFR 47 FCC: Rules and Regulations; Part 15. "Radio frequency devices";
 - Subpart B: "Unintentional radiators" (2007)
 - Section 15.109 "Radiated emission limit"
 - Subpart C: "Intentional radiators" (2007),
 - Section 15.205. "Restricted bands of operations"
 - Section 15.207. "Conducted limits".
 - Section 15.209. "Radiated emission limits, general requirements".
 - "Radiated Emission Limits, Additional Provisions";
 - Section 15.240. "Operation in the band 433.5 – 434.5 MHz".

This Test Report contains 25 pages and may be used only in full.	This Test Report applies only to the specimen tested and may not be applied to other specimens of the same product.
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**Test Report No.:** 8812331751**Page 2 of 25 pages****Title:** Test on Control Unit transceiver **FCC ID:** XCCXSENSE-HUB **Model:** Xsense-HUB

Table of Contents

1. EUT Description and operation	3
1.1. General description:	3
2. Test summary	4
2.1. Potential emission sources:	7
2.2. EUT setup and operation:	7
3. Measurements, examinations and derived results	7
3.1. Location of the Test Site:	7
3.2. Test condition:	7
3.3. Initial visual check and functional test:	7
3.4. Radiated emission test.	8
3.5. Test of field strength emission from intentional radiator.	9
3.6. Test of automatically limiting operation.	16
3.7. Test of conducted emission at main terminal.	18
3.8. Test of field strength emission in receive mode	20
4. Appendix 1. Test equipment used	21
5. Appendix 2: Antenna Factor and Cable Loss	22



Test Report No.: 8812331751

Page 3 of 25 pages

Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB

1. EUT Description and operation

1.1. General description:

* Note: the customer supplied all information in clause below.

The hub function is to communicate with wireless tags. When tags come in range of the hub they connect to the hub by wireless communication and transfer information to the hub. The hub selects one of 4 operation frequencies, upon channel availability. Channel is changed if the hub detects interference. Channel frequencies are:

Channel 0 – 433.74 MHz
Channel 1 – 433.90 MHz
Channel 2 – 434.05 MHz
Channel 3 – 434.20 MHz

Declare maximum EIRP power:	-10 dBm@ 434 MHz
Type of modulation:	FSK
Antenna type:	External flat antenna. Mfr Byoondoor mod.BY-433-5

The EUT power source: 100 – 230VAC power supply.

The EUT's block diagram is shown in Figures 1

The EUT external and internal views are presented in Photos #1.

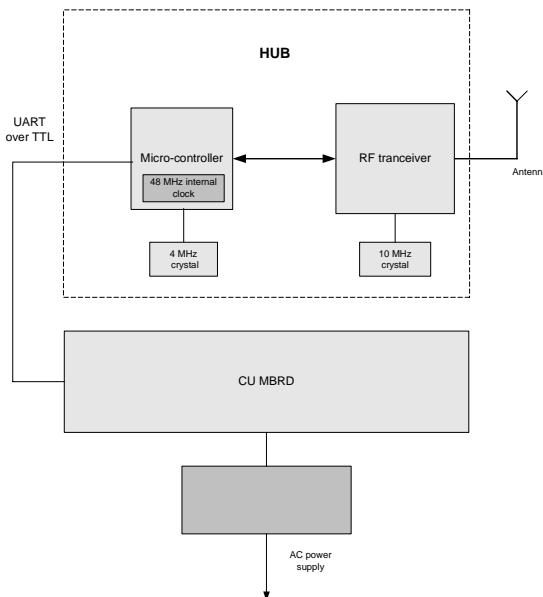


Figure 1. Transceiver block diagram.

**Test Report No.: 8812331751****Page 4 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB**

2. Test summary

Parameter	FCC Part 15 Reference paragraph	Comply/not comply with the requirements
Radiated emission test in receive mode	Subpart B Section 15.109(a)	Comply
Test of field strength emission from intentional radiators	“Radiated Emission Limits, Additional Provisions”; Section 15.240.	Comply
Radiated emission from intentional radiators in restricted bands	Subpart C Section 15.205	Comply
Conducted emission test	Subpart C Section 15.207	Comply

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Position: Head of EMC Branch

Telematics
Laboratory

January 2009

Name: Michael Feldman
Position: Test Technician



Test Report No.: 8812331751

Page 5 of 25 pages

Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB

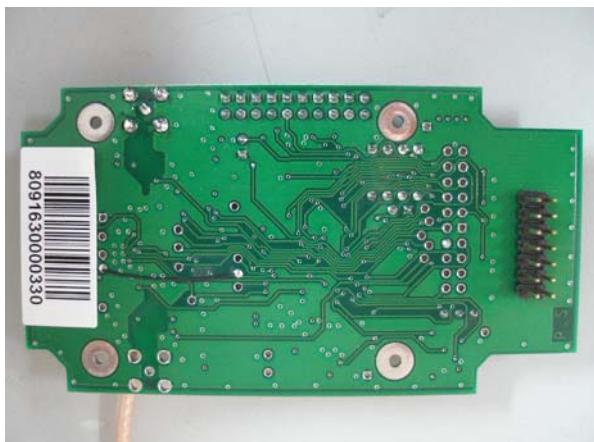


Photo 1. EUT's external and internal view



Test Report No.: 8812331751

Page 6 of 25 pages

Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB



Photo 2. Spurious emissions test setup.



**Photo 3. Spurious emissions test setup.
Typically installation of external antenna on metal surface.**

**Test Report No.: 8812331751****Page 7 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB**

2.1. Potential emission sources:

The potential emission sources are detailed in Table 1.

Table 1. Potential emission sources

Frequency	Location
32.768 kHz crystal	Microcontroller oscillator
4.0 MHz crystal	Microcontroller oscillator
10.0 MHz crystal	RF transceiver crystal oscillator
48.0 MHz	Internal microcontroller clock
434 MHz RF signal	PCB

2.2. EUT setup and operation:

Respective tests were performed in Transmission (Tx) and Receiving (Rx) modes. Radiated emission test was performed:

In band - at middle carrier frequency -434.05 MHz.

Band – edge measurements at lowest carrier frequency – 433.74 MHz and at highest carrier frequency - 434.2 MHz.

Measurements of transmitter were performed in continue transmission mode.

3. Measurements, examinations and derived results

3.1. Location of the Test Site:

Preliminary radiated test was conducted at the EMC laboratory of the Standards Institution of Israel in Tel-Aviv. Final tests were conducted in an Open Area Test Site located at Kibbutz Native Halamed Hai in Emek HaEla, Israel.

3.2. Test condition:

Temperature: 21 °C. Humidity: 59 %. Atmospheric pressure: 1011 mbar.

3.3. Initial visual check and functional test:

Initial visual check and brief built- in- test of the EUT was performed before testing.

- No external damages were found.

- The test on the EUT passed successfully.

**Test Report No.: 8812331751****Page 8 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB**

3.4. Radiated emission test.

3.4.1. General:

Per FCC Part 15 Subpart C Sections 15.209, 15.240.

- * Initial scans were made using a peak detector but still using the appropriate ANSI IF bandwidth.
- * A tolerance limit was set 10 dB below the specification limit. Levels above the tolerance limit were retested using the Peak, QP and Average detectors.

3.4.2. Preliminary radiated emission tests:

Preliminary investigation from 9 kHz up to ten harmonic of carrier frequency was performed. Test was conducted in a semi-anechoic chamber at distance 3 meters. The EUT was setup in its typical configuration and operated in its various modes. For each mode of operation the frequency spectrum was monitored. EUT configuration, cable configuration and mode of operation, which produced the maximum level of emission, were documented. A list of frequencies to be tested was prepared.

3.4.3. Final measurements:

The final radiated emission measurements were performed at the Open Area Test Site at the same (3 m) test distance. The EUT was operated as described above. The EUT was installed on a turn - table. Biconilog and Double Ridged Guide antennas were used. The measurements were performed at each frequency that founded previously at which the signal level was 10 dB below the limit or less. The levels were maximized by rotating turntable through 360°, changing antenna height and changing antenna-to-EUT polarization from vertical to horizontal. The worse case result was noted in tables.

3.4.4. Radiated emission test results:

All emissions, measured from the EUT at the 9kHz-30MHz frequency range were to 20 dB at least below limit.

Final result measurements in transmit mode above 30MHz are presented in tables and plots ##1 - 14 in section 3.5.5.

**Test Report No.:** 8812331751**Page 9 of 25 pages****Title:** Test on Control Unit transceiver **FCC ID:** XCCXSENSE-HUB **Model:** Xsense-HUB

3.5. Test of field strength emission from intentional radiator.

3.5.1. General:

Per FCC Part 15 Subpart C clause 15.240 (b)

3.5.2. Requirements:

The field strength emissions from intentional radiators operated according to section 15.240 (b) requirements shall comply with the limit based on the average value.

Table 2. Section 15.240 limit.

Fundamental Frequency MHz	Calculated Peak Field Strength limit of Fundamental dB (μ V/m)	Calculated Average Field Strength limit of Fundamental dB (μ V/m)
434.05	94.8	80.8

Note: The field strength of emissions radiated on any frequency outside of the specified band shall not exceed the general emission limit in § 15.209.

3.5.3. Test procedure:

The test was conducted according to clause 15.240.

3.5.4. Test summary:

The tested unit meets the standard requirement.



Test Report No.: 8812331751

Page 10 of 25 pages

Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB

3.5.5.

Test results:

Table 3. Radiated emission result at carrier frequency.

Carrier frequency MHz	Antenna pol.	Peak Ampl. dB (μ V/m)	Peak Limit dB (μ V/m)	Margin dB	Avg Ampl.* dB (μ V/m)	Specified Avg@3m limit, dB (μ V/m)	Margin dB
434.05	Vertical	88.6	94.8	6.2	78.4	80.8	2.4

*Average amplitude result was calculated from measured Peak value – Average factor.

Average factor calculation see at bottom of the page.

For recorded fundamental frequency result see plot #1.

Noted spurious emission results present in table below.

Table 4. Spurious emission result in up to 1GHz band.

Freq. MHz	Antenna pol.	QP Ampl dB (μ V/m)	Specified 15.209 limit, dB (μ V/m)	Margin dB	Reference Plot	Note
433.5	Vertical	33.8*	46.0	12.2	Plot # 5, 7, 8	Marker-Delta method
434.5	Vertical	37.3	46.0	8.7	Plot #10	-

*Measurement result was calculated according to DA 00-705 marker-delta method.

Delta result 45.2 dB was subtracted from carrier peak result.

Table 5. Spurious emission above 1.0 GHz band.

Freq. MHz	Antenna pol.	Peak Ampl dB (μ V/m)	Specified Peak Ampl limit, dB (μ V/m)	Margin dB	Avg Ampl** dB (μ V/m)	Specified @3m limit, dB (μ V/m)	Margin dB	Ref. Plot
1302.1	Horizontal	51.5	74.0*	22.5	41.3	54.0*	12.7	Plot #7
1736.1	Horizontal	43.9	74.0	30.1	33.7	54.0	20.3	Plot #8

*Limit 15.205 restricted bands.

**Average amplitude result was calculated from measured Peak value – Average factor.

Average factor = 20 Log Tx on/100msec = 20 Log [30.75ms/100] = -10.2 dB

Duration of transmission through 100 msec period is 10.25 ms x 3 pulse = 30.75 msec.

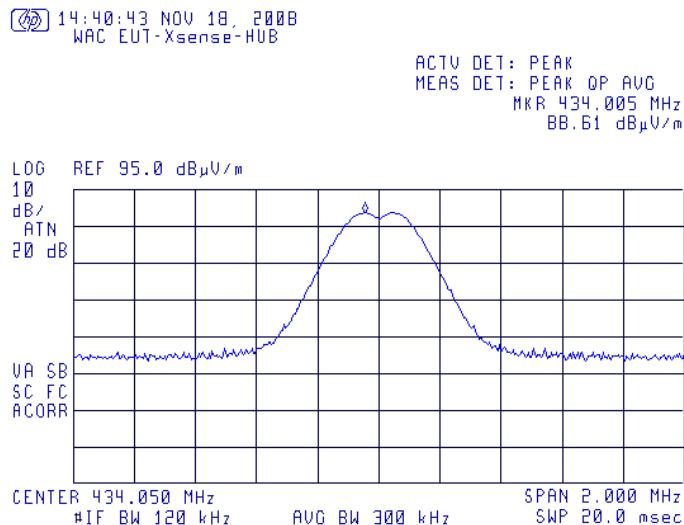
Average factor calculations based on result from plot # 15 (b).



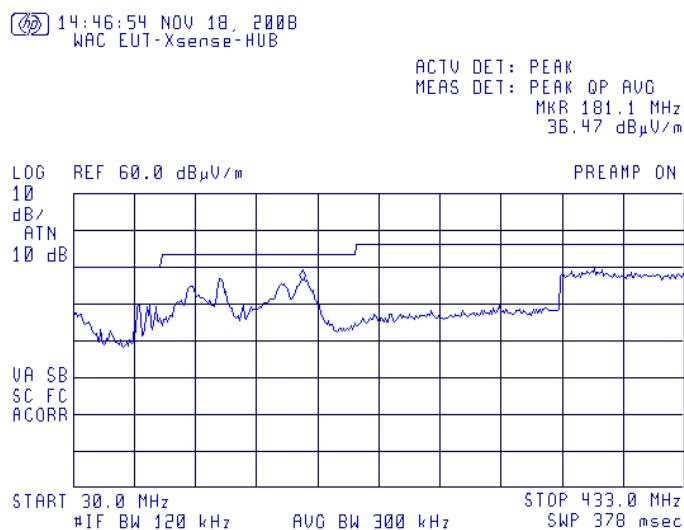
Test Report No.: 8812331751

Page 11 of 25 pages

Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB



Plot # 1. Field strength of fundamental frequency 434.05 MHz.



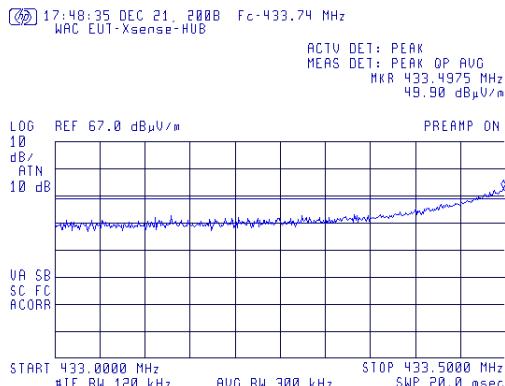
Plot # 2. Spurious emissions scan 30 MHz – 433 MHz. Test distance =3m.



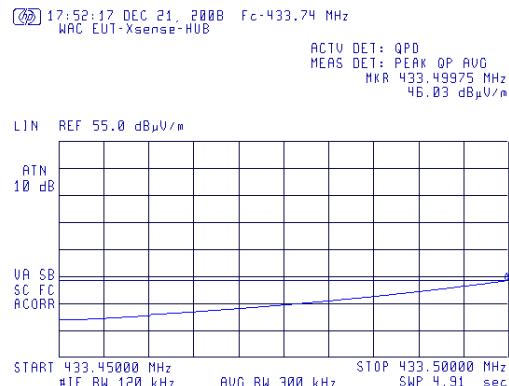
Test Report No.: 8812331751

Page 12 of 25 pages

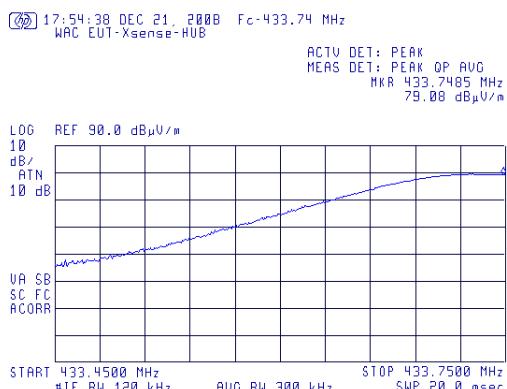
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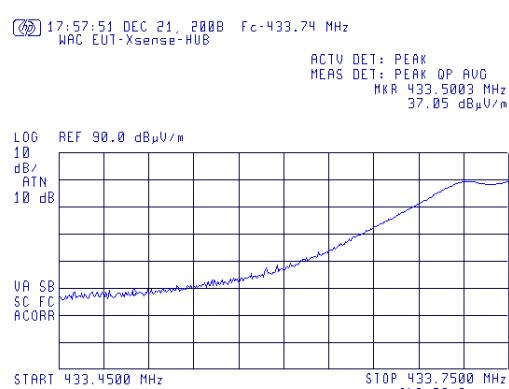
Plot # 3



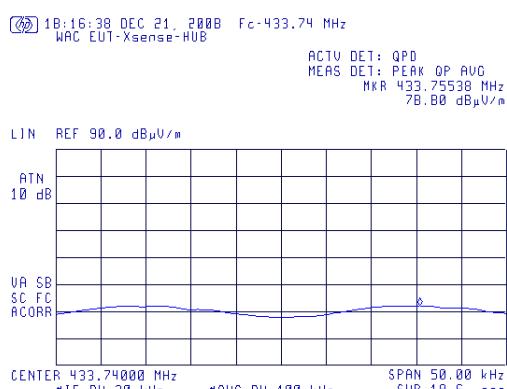
Plot # 4



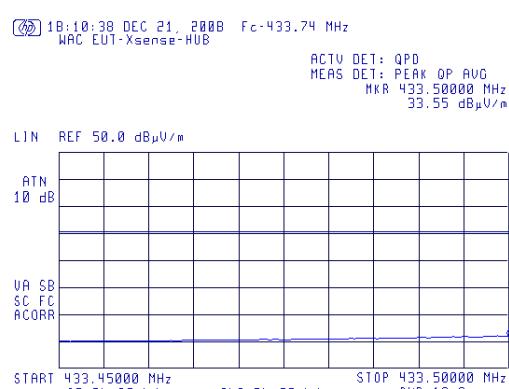
Plot # 5



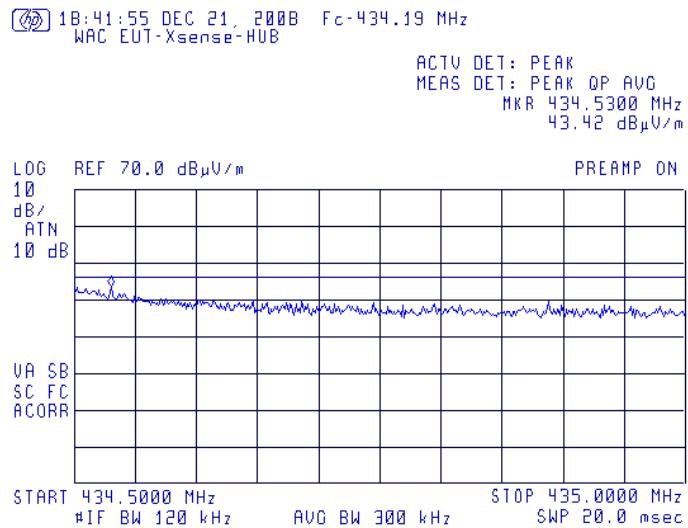
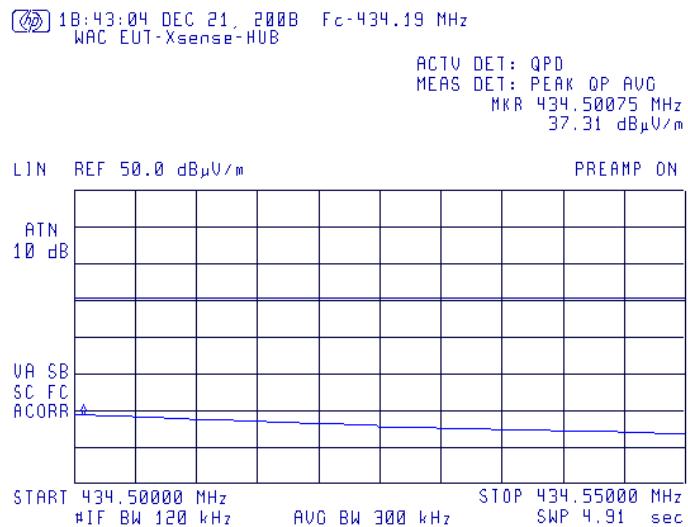
Plot # 6

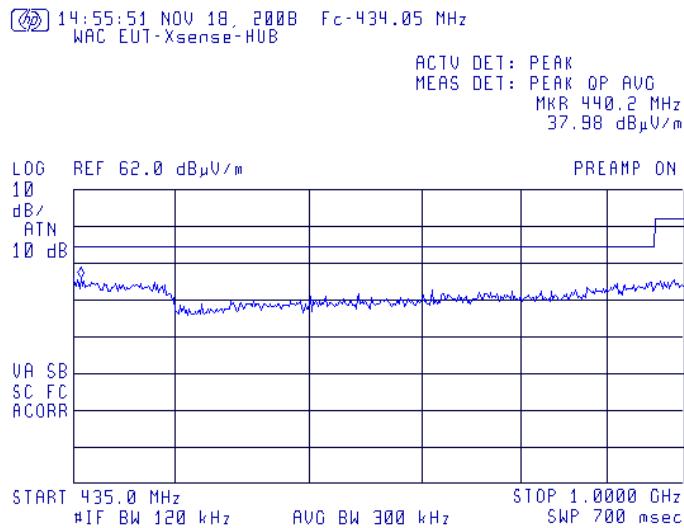
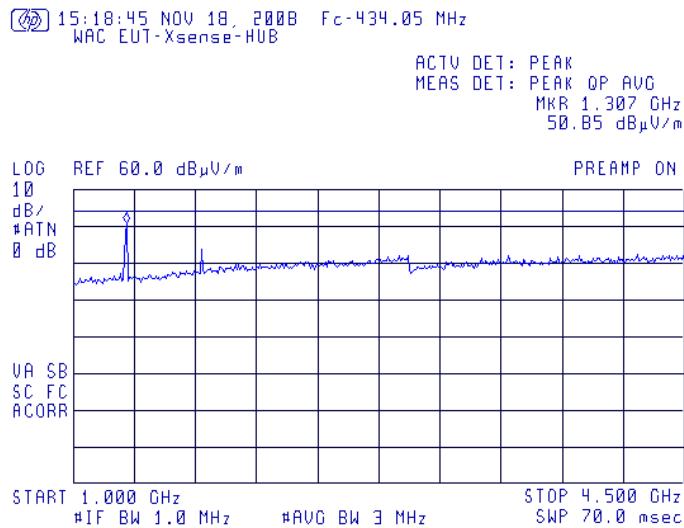


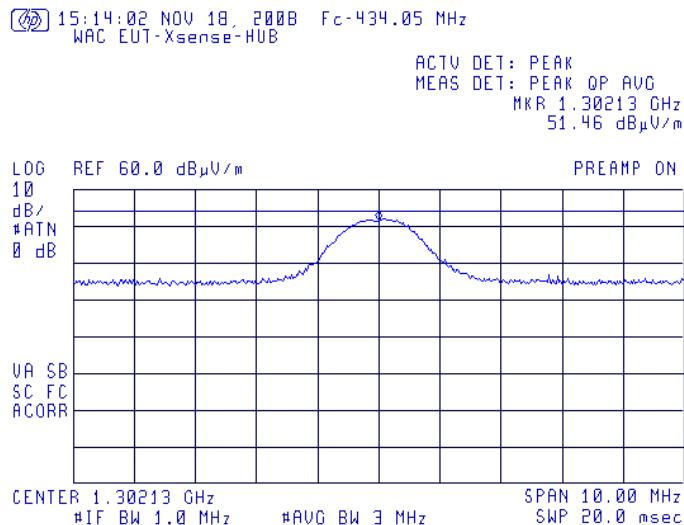
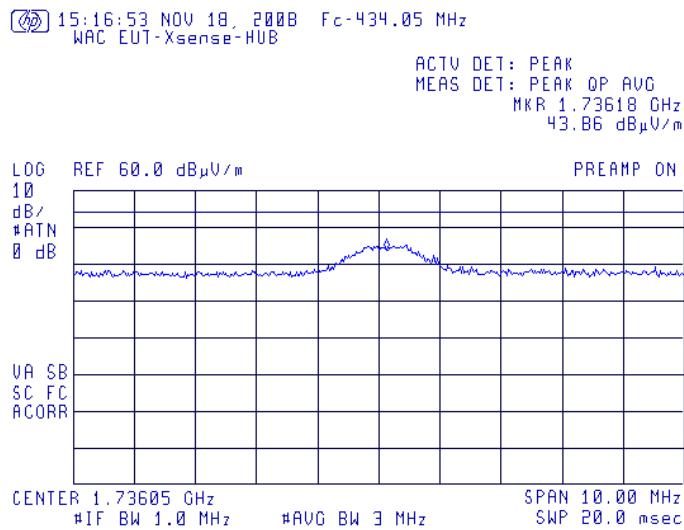
Plot # 7



Plot # 8

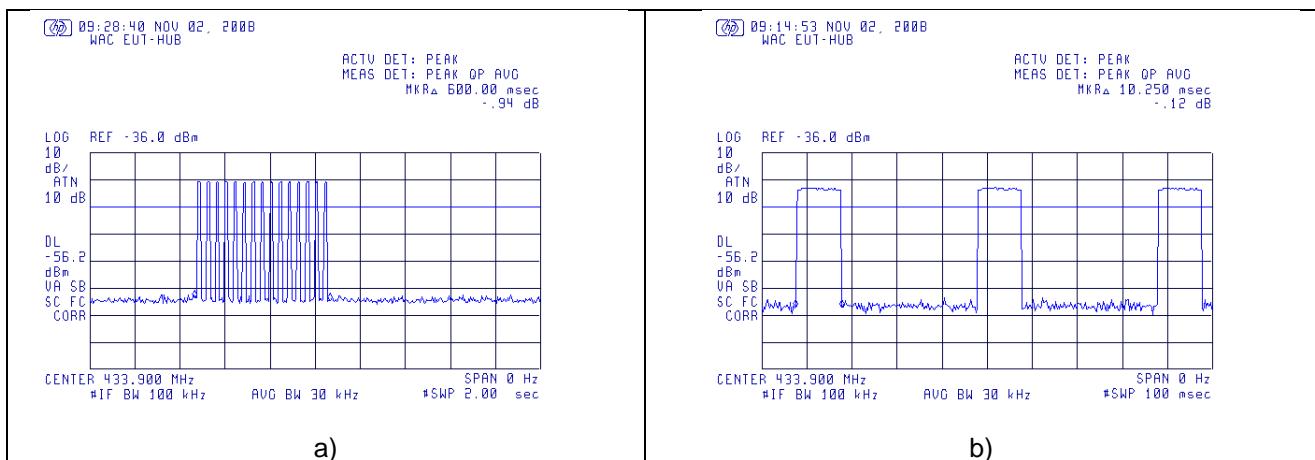
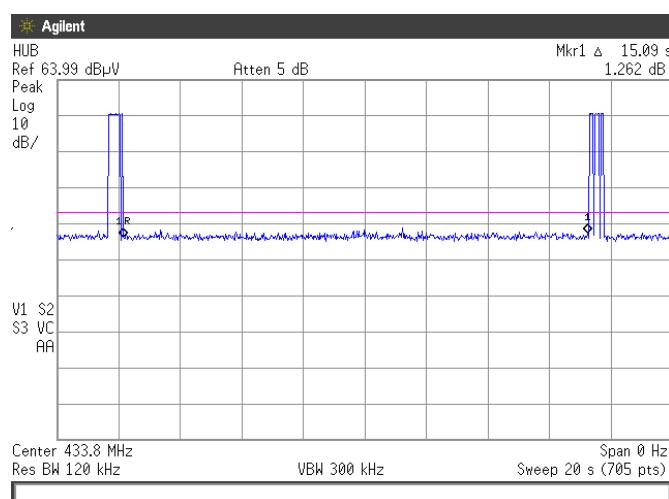
**Test Report No.: 8812331751****Page 13 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB****Plot # 9. Emission scan at 434 .5 MHz – 435 MHz frequency range. Fcarrier - 434.2 MHz****Plot # 10. Emission scan at 434 .5 MHz – 435 MHz frequency range.
Fcarrier - 434.2 MHz. QP detector..**

**Test Report No.: 8812331751****Page 14 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB****Plot # 11. Spurious emissions scan at 435 MHz – 1000 MHz frequency range.****Plot # 12. Spurious emissions scan at 1 GHz – 4.5 GHz frequency range.**

**Test Report No.: 8812331751****Page 15 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB****Plot # 13. The carrier frequency third harmonic. Detector peak.****Plot # 14. The carrier frequency 4 th harmonic. Detector peak.**

**Test Report No.: 8812331751****Page 16 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB****3.6. Test of automatically limiting operation.****3.6.1. General**

Per FCC Part 15 Subpart C clause 15.240 (b)

**Plot # 15. Duration of transmission- Tx on.****Plot # 16. Test of the silent period between transmissions.****3.6.2. Test summary:**

Duration of each transmission is 0.6 sec and silent period between transmissions is more than 10 second.

Transmitter meets the standard requirement.

**Test Report No.: 8812331751****Page 17 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB**

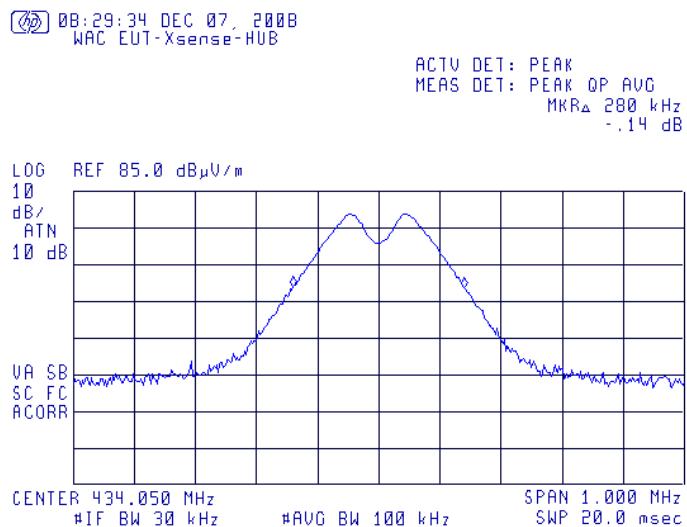
3.7. *Test of occupied bandwidth per 15.215(c)*

3.7.1. Requirements:

Intentional radiator must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band.

3.7.2. Test results:

Test result is presented in plot # 17 below.



Plot # 17. Occupied bandwidth test result

3.7.3. Test summary:

20 dB occupied bandwidth is 280 kHz.

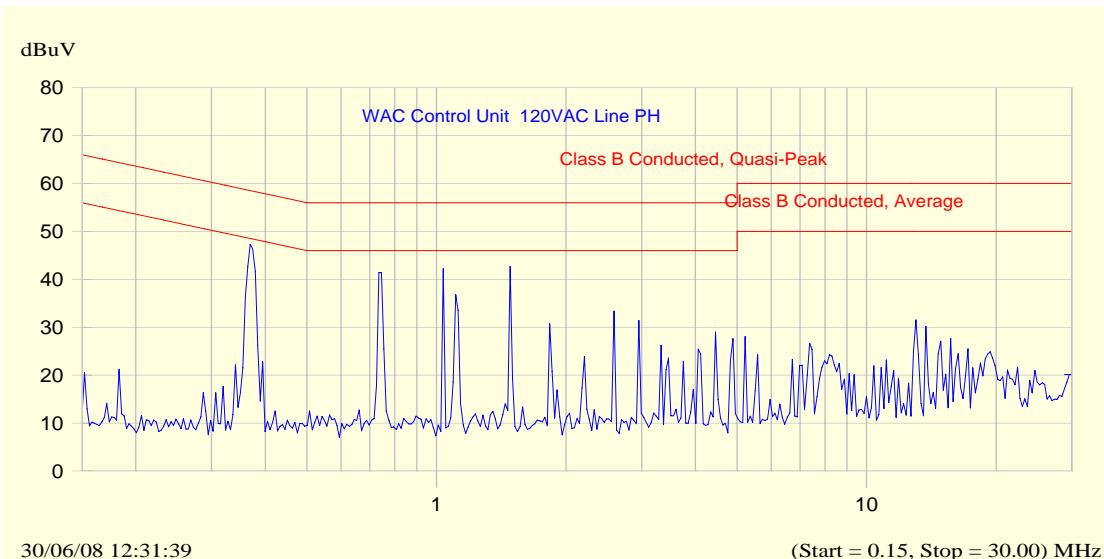
The tested unit meets the standard requirement.

**Test Report No.: 8812331751****Page 18 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB****3.8. Test of conducted emission at main terminal.****3.8.1. General**

Per FCC Part 15 Subpart C clause 15.207 (a)

3.8.2. Test procedure:

The test was conducted according to clause 15.207.

**Table 6. Test result. Line Phase.**

Frequency MHz	QP Ampl. dBuV	QP Limit dB	QP-QP Limit dB	Avg Ampl. dBuV	Average Limit dB	Avg-Avg Limit dB
0.373	47.0	58.4	-11.4	44.5	48.4	-3.9
0.743	44.7	56.0	-11.3	40.4	46.0	-5.6
1.118	43.5	56.0	-12.5	35.9	46.0	-10.1
1.496	40.9	56.0	-15.1	26.7	46.0	-19.3
2.598	36.5	56.0	-19.5	24.4	46.0	-21.6
2.970	31.3	56.0	-24.7	22.9	46.0	-23.1



Test Report No.: 8812331751

Page 19 of 25 pages

Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB

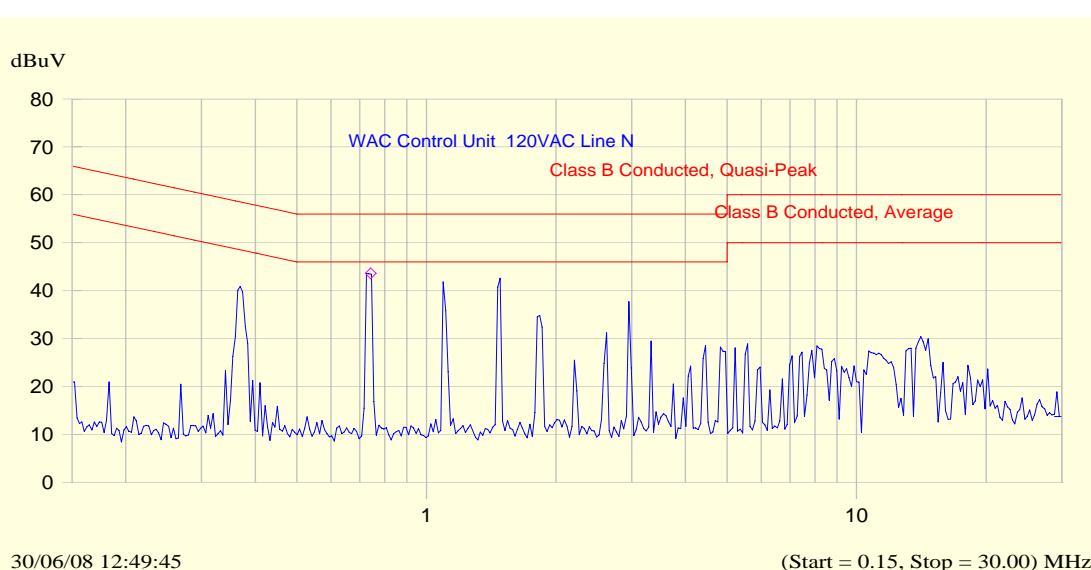


Table 7. Test result. Line Neutral.

Frequency MHz	QP Ampl. dBuV	QP Limit dB	QP-QP Limit dB	Avg Ampl. dBuV	Average Limit dB	Avg-Avg Limit dB
0.372	44.1	58.4	-14.4	40.7	48.4	-7.8
0.742	42.7	56.0	-13.3	34.8	46.0	-11.2
1.119	42.2	56.0	-13.8	34.7	46.0	-11.3
1.496	41.2	56.0	-14.8	29.6	46.0	-16.4
2.613	36.0	56.0	-20.0	23.6	46.0	-22.4
2.988	31.4	56.0	-24.6	21.8	46.0	-24.2

3.8.3.

Test summary:

The tested unit meets the standard requirement.

**Test Report No.: 8812331751****Page 20 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB**

3.9. Test of field strength emission in receive mode

3.9.1. General

Per FCC Part 15 Subpart B clause 15.109 (a)

3.9.2. Test procedure:

The test was conducted according to clause 15.109.

Table 8. Radiated emission test results

Frequency (MHz)	Antenna Polariz. V/H	Antenna Height (m)	Turn-table Angle (°)	Emission Level @ 3 m (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)	Results
117.0	V	1.00	51	36.8	43.5	6.7	Complies
118.0	V	1.00	355	37.1	43.5	6.4	Complies
132.4	V	1.00	80	31.3	43.5	12.2	Complies
137.7	V	1.00	90	32.7	43.5	10.8	Complies
184.0	V	1.00	179	37.3	43.5	6.2	Complies
186.0	V	1.00	308	37.5	43.5	6.0	Complies

Note: Emission level = E Reading (dB μ V) + Cable loss (dB) + Antenna Factor (dB/m)
For Cable Loss and Antenna Factor refer to Appendix 2.

3.9.3. Test summary:

The tested unit meets the standard requirement.

**Test Report No.: 8812331751****Page 21 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB**

4. Appendix 1. Test equipment used

All measurements equipment is on SII calibration schedule with a recalibration interval not exceeding one year.

Instrument	MFR	Model	Serial No.	Due calibration date
EMI Receiver 9 kHz – 6.5 GHz	HP	8546A+85460A	SII 4068	April 2009
Antenna Loop 0.009 - 30 MHz	EMCO	6502	SII 4874	Mar 09
Biconilog Antenna 30 – 2000 MHz	Teseq GmbH	CBL 6112D	S/N 23181	Sept 2009
EMI Analyser 9 kHz - 26.5 GHz	HP	E7405A	SII 4944	Nov 2009
Antenna Double Ridged Guide, 1-18 GHz	EMCO	3115	SII4873	Sept 2009
LISN 9 kHz – 30 MHz	FCC	LISN 250-32-4-16	SII5023	Oct 2009
Transient limiter 0.009-200 MHz	HP	11947A	3107105	Oct 2009
Oscilloscope	HP	54610B	US37340682	May 2009
RF cable, 3m	Sucoflex	104PE	21328/4PE	Oct 2009
Antenna Mast	R&S	HCM	100002	N/A
Metallic turntable	R&S	HCT12	100001	N/A
Positioning controller	R&S	HCC	100002	N/A



Test Report No.: 8812331751

Page 22 of 25 pages

Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB

5. Appendix 2: Antenna Factor and Cable Loss

Cable Loss (10m cable + Mast)

Point	Frequency (MHz)	Cable Loss (dB)	Point	Frequency (MHz)	Cable Loss (dB)
1	30	0.53	21	1000	3.68
2	50	0.75	22	1100	3.82
3	100	1.08	23	1200	4.07
4	150	1.39	24	1300	4.24
5	200	1.61	25	1400	4.43
6	250	1.752	26	1500	4.6
7	300	2.00	27	1600	4.7
8	350	2.15	28	1700	4.85
9	400	2.26	29	1800	4.98
10	450	2.383	30	1900	5.19
11	500	2.52	31	2000	5.34
12	550	2.606	32	2100	5.51
13	600	2.75	33	2200	5.69
14	650	2.856	34	2300	5.89
15	700	3.06	35	2400	6.07
16	750	3.20	36	2500	6.22
17	800	3.27	37	2600	6.28
18	850	3.38	38	2700	6.41
19	900	3.46	39	2800	6.53
20	950	3.55	40	2900	6.84

Antenna Factor for Active Loop Antenna, Model 6502

Frequency (MHz)	Magnetic Antenna Factor (dBS/m)	Electric Antenna Factor (dB)
0.009	-31.9	19.6
0.010	-32.8	18.7
0.020	-36.9	14.6
0.050	-39.1	12.4
0.075	-39.5	12.1
0.100	-39.5	12.0
0.150	-39.6	11.9
0.250	-39.8	11.8
0.500	-39.9	11.7
0.750	-40.0	11.6
1.000	-39.9	11.7
2.000	-40.2	11.3
3.000	-40.5	11.0
4.000	-40.5	11.0
5.000	-40.7	10.9
10.000	-41.4	10.1
15.000	-41.7	9.9
20.000	-42.1	9.5
25.000	-43.0	8.5
30.000	-44.1	7.5

**Test Report No.: 8812331751****Page 23 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB****Antenna Factor****For Bilog Antenna, Model Number: CBL 6112D, S/N: 23181**

No.	f / MHz)	AF / dB/m						
1	30	17.90	170	9.40	530	17.70	1040	22.20
2	32	16.70	175	9.00	540	18.25	1060	22.50
3	34	15.55	180	8.50	550	18.60	1080	22.50
4	36	14.35	185	8.45	560	14.45	1100	22.40
5	38	13.30	190	8.60	570	18.40	1120	22.60
6	40	12.20	195	8.85	580	18.50	1140	22.45
7	42	11.05	200	8.95	590	18.60	1160	22.50
8	44	9.95	205	8.80	600	18.60	1180	22.40
9	46	8.90	210	8.50	610	18.80	1200	22.80
10	48	8.05	215	8.20	620	18.99	1220	22.95
11	50	7.30	220	8.50	630	19.05	1240	23.10
12	52	6.80	225	9.00	640	19.23	1260	23.40
13	54	6.45	230	9.65	650	19.10	1280	23.35
14	56	6.00	235	10.30	660	19.13	1300	23.62
15	58	5.70	240	11.00	670	19.04	1320	23.64
16	60	5.45	245	11.60	680	19.00	1340	23.86
17	62	5.30	250	12.00	690	19.17	1360	23.95
18	64	5.20	255	12.45	700	19.28	1380	23.90
19	66	5.30	260	12.85	710	19.25	1400	24.45
20	68	5.30	265	12.50	720	19.45	1420	24.74
21	70	5.35	270	12.45	730	19.75	1440	24.93
22	72	5.50	275	12.40	740	19.95	1460	25.03
23	74	5.80	280	12.55	750	20.07	1480	25.45
24	76	6.00	285	12.65	760	19.85	1500	25.30
25	78	6.60	290	12.75	770	19.80	1520	25.25
26	80	6.70	295	12.95	780	19.85	1540	25.36
27	82	7.15	300	13.00	790	19.95	1560	25.58
28	84	7.60	310	13.35	800	20.05	1580	25.50
29	86	8.10	320	13.75	810	20.10	1600	25.65
30	88	8.50	330	13.85	820	20.35	1620	25.60
31	90	8.90	340	14.10	830	20.40	1640	25.70
32	92	9.20	350	14.50	840	20.35	1660	25.83
33	94	9.75	360	14.70	850	20.46	1680	25.97
34	96	9.95	370	14.90	860	20.39	1700	26.10
35	98	10.20	380	15.10	870	20.29	1720	26.25
36	100	10.50	390	15.45	880	20.24	1740	26.04
37	105	11.25	400	16.00	890	20.35	1760	26.14
38	110	11.70	410	16.40	900	20.55	1780	26.20
39	115	11.70	420	16.70	910	20.45	1800	26.40
40	120	11.80	430	16.35	920	20.60	1820	26.64
41	125	11.80	440	16.30	930	20.60	1840	26.86
42	130	11.70	450	16.30	940	20.66	1860	27.12
43	135	11.35	460	16.70	950	20.88	1880	27.00
44	140	10.95	470	17.05	960	21.11	1900	27.25
45	145	10.35	480	17.20	970	20.93	1920	27.36
46	150	10.05	490	17.30	980	21.03	1940	27.68
47	155	9.70	500	17.40	990	21.05	1960	27.10
48	160	9.70	510	17.50	1000	21.10	1980	27.06
49	165	9.45	520	17.60	1020	21.40	2000	27.25

**Test Report No.: 8812331751****Page 24 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB**

Antenna Factor
Double Ridged Guide Antenna mfr EMCO model 3115 1m calibration

Point	Frequency (MHz)	Antenna Factor (dB/m)
1	1000	23.9
2	2000	28.3
3	3000	31.0
4	4000	33.1
5	4500	32.5
6	5000	32.4
7	6000	53.7
8	6500	35.6
9	7000	36.4
10	7500	36.9
11	8000	37.0
12	8500	38.0
13	9000	38.6
14	9500	38.4
15	10000	38.4
16	10500	38.4
17	11000	38.9
18	11500	39.6
19	12000	39.4
20	12500	39.2
21	13000	40.3
22	13500	41.0
23	14000	41.2
24	14500	41.3
25	15000	40.0
26	15500	38.0
27	16000	38.1
28	16500	40.3
29	17000	42.2
30	17500	44.6
31	18000	46.2

Cable Loss
Type: Sucoflex 104PE; Ser.No.21328/4PE; 3 m length

Point	Frequency (GHz)	Cable Loss (dB)
0	0.0-1.8	1.67
1	1.8 – 3.6	2.39
2	3.6 – 5.4	3.04
3	5.4-7.2	3.58
4	7.2-9.0	4.06
5	9.0-10.8	4.49
6	10.8-12.6	4.91
7	12.6-14.4	5.31
8	14.4-16.2	5.66
9	16.2-18.00	6.01

**Test Report No.: 8812331751****Page 25 of 25 pages****Title: Test on Control Unit transceiver FCC ID: XCCXSENSE-HUB Model: Xsense-HUB**

DA 00-705

Released March 30, 2000

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.

Questions pertaining to this document may be directed to Gregory Czumak, phone: (301) 362-3052, e-mail: GCZUMAK@FCC.GOV