

ENGINEERING TEST REPORT



PHMUL
Model No.: PHMUL08

FCC ID: NSNPHMUL08

Applicant:
G4S Justice Services Canada, Inc
#103 6592 176 St
Surrey, BC
CANADA, V3S 4G5

In Accordance With

FEDERAL COMMUNICATIONS COMMISSION (FCC)
Part 15, Subpart C, Section 15.231
Momentarily Operation at 433.92 MHz

UltraTech's File No.: G4S-003BF15C231

This Test report is Issued under the Authority of
Tri M. Luu, Professional Engineer,
Vice President of Engineering
UltraTech Group of Labs

Date: November 17, 2008



Report Prepared by: JaeWook Choi

Tested by: Hung Trinh, RFI Technician

Issued Date: November 17, 2008

Test Dates: September 26 & 28, 2008 /
November 14, 2008

- The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

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2005-82 & 83

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.231
Title:	Telecommunication - Code of Federal Regulations, CFR 47, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Section 15.231- Momentarily Operation at 433.92 MHz.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	Residential

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-15	2008	Code of Federal Regulations – Telecommunications
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
CISPR 16-1-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-2-1	2004	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-1: Conducted disturbance measurement

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	G4S Justice Services Canada, Inc
Address:	#103 6592 176 St Surrey, BC CANADA, V3S 4G5
Contact Person:	Mr. Harv Hundal Phone #: +1 604 576 8658 x238 Fax #: +1 604 576 0436 Email Address: harp.hundal@ca-g4s.com

MANUFACTURER	
Name:	G4S Justice Services Canada, Inc
Address:	#103 6592 176 St Surrey, BC CANADA, V3S 4G5
Contact Person:	Mr. Harv Hundal Phone #: +1 604 576 8658 x238 Fax #: +1 604 576 0436 Email Address: harp.hundal@ca-g4s.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Product Name:	PHMUL
Model Name or Number:	PHMUL08
Serial Number:	309727
Type of Equipment:	Periodic Transmitter
Power Input Source:	AC Power Adapter (DC 9V, 2.75A)
Primary User Functions of EUT:	Enables electronic curfew monitoring of participant

ULTRATECH GROUP OF LABS

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File #: G4S-003BF15C231
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- Accreditation: FCC & NVLAP (USA), ACA (Australia), VCCI (Japan), ITI (UK), ACC-LAB (Canada, Europe/APEC/Canada MRA)
- All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitters	
Exposure Category:	Mobile
Intended Operating Environment:	Residential

Xemics Transceiver A	
RF Output Power Rating:	77.19 dB μ V/m Avg E-field @ 3 meters
Operating Frequency Range:	433.92 MHz
Duty Cycle:	11.8%
20 dB Bandwidth:	175.6 kHz
Modulation Type:	F1D
Antenna Connector Type:	Integral
Antenna Description:	LINX 433-SP2 Splat antenna (grounded line planar antenna)

Xemics Transceiver B	
RF Output Power Rating:	76.53 dB μ V/m Avg E-field @ 3 meters
Operating Frequency Range:	433.92 MHz
Duty Cycle:	11.8%
20 dB Bandwidth:	175.6 kHz
Modulation Type:	F1D
Antenna Connector Type:	Integral
Antenna Description:	LINX 433-SP2 Splat antenna (grounded line planar antenna)

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	AC Power Jack	1	Power Jack	N/A
2	Line In	1	RJ11	Non-shielded
3	Phone In	1	RJ11	Non-shielded

2.5. ANCILLARY EQUIPMENT

None

2.6. GENERAL TEST SETUP

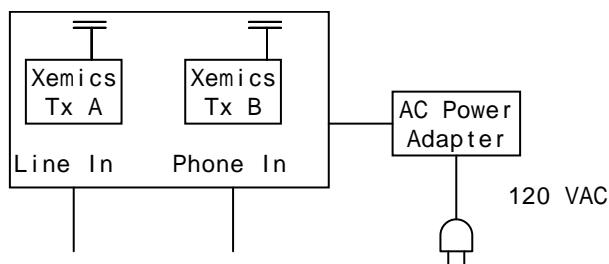


EXHIBIT 3. EUT OPERATION CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The EUT was set to transmit in burst mode continuously by means of special setting for testing purpose only.
Special Test Software:	None
Special Hardware Used:	None
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment.

Transmitter Test Signal	
Frequency	433.92 MHz

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

Powerline Conducted Emissions were performed in Ultratech's shielded room, 16'(L) by 12'(W) by 12'(H).

Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049A-3). Calibration site expiry date for IC is May 17, 2009.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSIONS TEST RESULTS

FCC Sections	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirement (Permanently attached antenna used with this device)	Yes
15.231(a)	Provisions of FCC 15.231	Yes
15.231(b)	Transmitter Radiated Emissions - Fundamental, Harmonic and Spurious	Yes
15.231(c)	20 dB Bandwidth	Yes
15.107(a)	Power Line Conducted Emissions Measurements (Transmit & Receive)	Yes
15.109(a)	Radiated Emissions for Receiver and Digital device	Yes
15.111(a)	Receiver Antenna Power Conducted Emissions Non-Integral Antenna Port	N/A (Integral Antenna)
1.1307 & 2.1091	RF Exposure Evaluation	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4.

5.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to EXHIBIT 6. for Measurement Uncertainties.

5.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C64.3, FCC 15.209 and CISPR 16-1.

5.4. METHOD OF MEASUREMENTS

The measurements were performed in accordance with Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4.

5.5. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

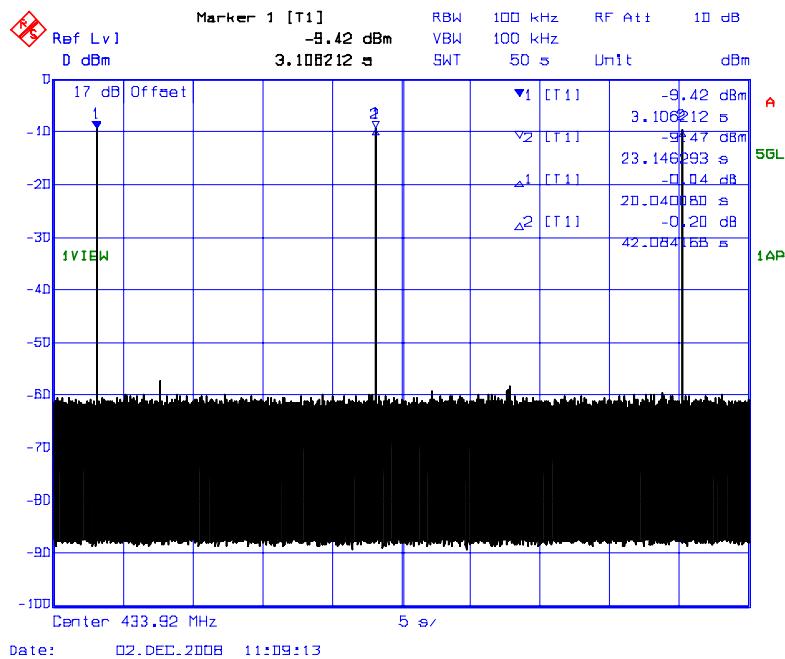
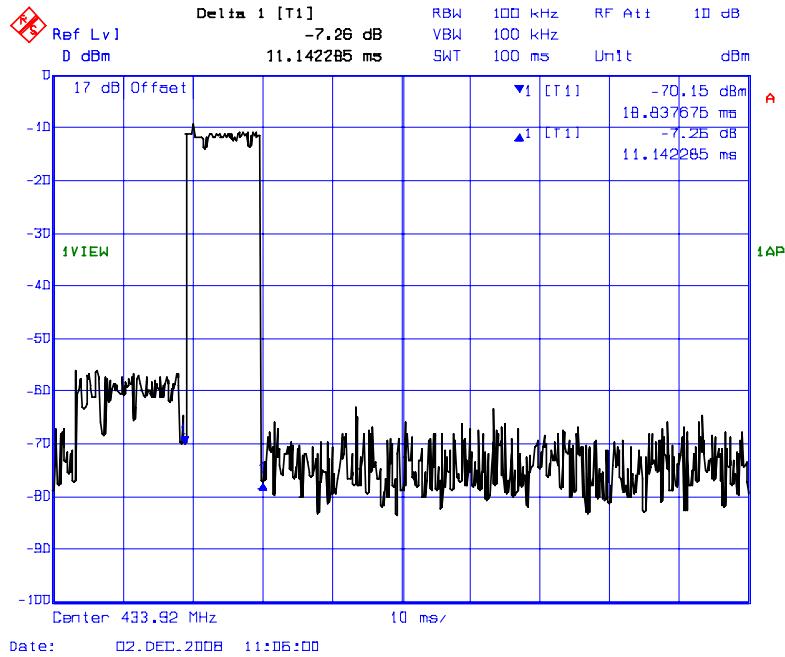
The essential function of the EUT is for monitoring curfew compliance by low-risk offenders via RF link.

5.6. PERIODIC OPERATION PROVISIONS [§15.231(a)]

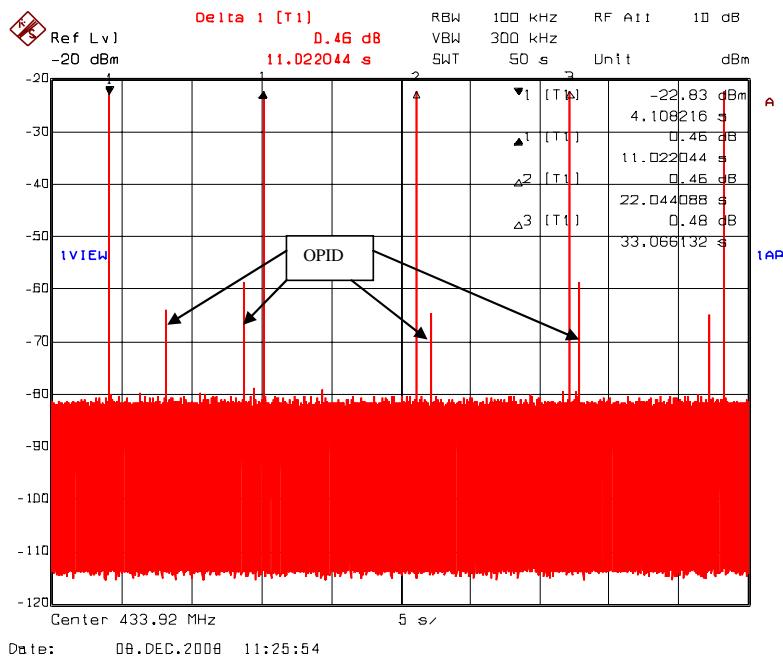
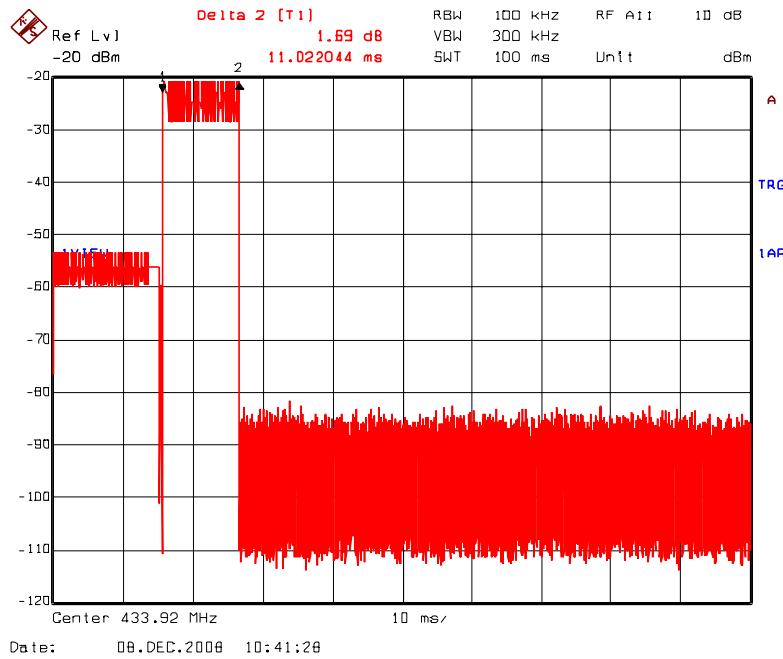
5.6.1. Engineering Analysis

FCC PROVISIONS	ANALYSIS ON COMPLIANCE
§15.231(a): The intentional radiator restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal.	Electronic offender monitoring system
§15.231(a)(1): A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.	N/A
§15.231(a)(2): A transmitter activated automatically shall cease transmission within 5 seconds after activation.	No more than 11.8 ms transmission. See operational description.
§15.231(a)(3): Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions do not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed 2 seconds per hour.	Qualifies as security or safety application and complies. 1,888 msec in monitoring mode – 11.8 msec transmission for every 22.5 sec and maximum 160 transmissions per an hour 1,994 msec in range test mode – 11.8 msec transmission for every 11.0 sec and maximum 169 transmissions per an hour See operational description.
§15.231(a)(4): Internal Radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.	Qualify as security or safety application.
§15.231(a)(5): Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmission are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.	N/A

<Monitoring Mode>



<Range Test Mode>



5.7. TRANSMITTER RADIATED EMISSIONS @ 3 METERS – FUNDAMENTAL, HARMONIC & SPURIOUS EMISSIONS [§15.231(b), 15.209 & 15.205]

5.7.1. Limits

The RF radiated emissions measured at 3 Meters distance shall not exceed the field strength below:

Fundamental Frequency (MHz)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emission (microvolts/meter)
260 - 470	¹ 3,750 to 12,500	¹ 375 to 1,250

¹ Linear interpolation.

Field Strength of Fundamental Limit @ 433.92 MHz = 80.83 dB μ V/m

Field Strength of Spurious Limit (outside restricted bands) = 60.83 dB μ V/m

Emissions within the restricted bands specified in §15.205(a) shall not exceed the general radiated emission limits specified in §15.209(a).

47 CFR 15.205(a) - Restricted Frequency Bands

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	2655–2900	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			

47 CFR 15.209(a) - Field Strength Limits within Restricted Frequency Bands

Frequency (MHz)	Field Strength Limits (microvolts/m)	Distance (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

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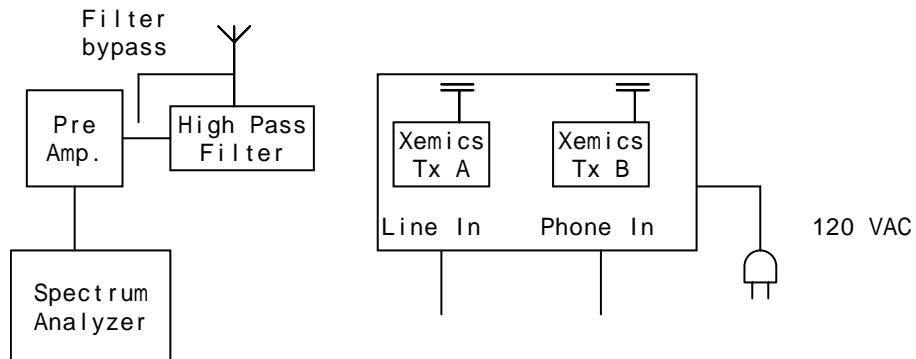
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- Accreditation: FCC & NVLAP (USA), ACA (Australia), VCCI (Japan), ITI (UK), ACC-LAB (Canada, Europe/APEC/Canada MRA)
- All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

5.7.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004 and ANSI C63.4.

5.7.3. Test Arrangement



5.7.4. Test Data

Remarks: Because the EUT employs pulsed operation, the unit was modified for continuous operation and the readings were corrected by subtraction the peak-average correction factor derived from the appropriate duty cycle calculation. See §15.35 (c).

- $T_{x_{on}} = 11.8 \text{ ms}$
- Duty cycle = $T_{x_{on}} / 100 = 0.118$
- **Peak-to-Average Factor** = $20 \cdot \log(0.118) = -18.56 \text{ dB}$

5.7.4.1. Xemics Transceiver A

Frequency (MHz)	Peak E-Field @3m (dB μ V/m)	Average E-Field @3m (dB μ V/m)	Antenna Plane (V/H)	§15.231(b) Limits @ 3m (dB μ V/m)	§15.209 (a) Limits @ 3m (dB μ V/m)	Margin (dB)
433.92	95.44	76.88	V	80.83	--	-3.95
433.92	95.75	77.19	H	80.83	--	-3.64

No signal found.

- The emissions were scanned from 30 MHz to 5 GHz at 3 meters distance and all spurious and harmonic emissions were recorded. The Average value of the measured emissions were compared with the limits as per Sec 15.231(b)(2).
- The transmitter was placed in three different orthogonal positions for searching maximum field strength level.
- The peak-average correction factor was obtained from the duty cycle calculation. See the Remarks above for details.

5.7.4.2. Xemics Transceiver B

Frequency (MHz)	Peak E-Field @3m (dB μ V/m)	Average E-Field @3m (dB μ V/m)	Antenna Plane (V/H)	§15.231(b) Limits @ 3m (dB μ V/m)	§15.209 (a) Limits @ 3m (dB μ V/m)	Margin (dB)
433.92	94.58	76.02	V	80.83	--	-4.81
433.92	95.09	76.53	H	80.83	--	-4.30

No signal found.

- The emissions were scanned from 30 MHz to 5 GHz at 3 meters distance and all spurious and harmonic emissions were recorded. The Average value of the measured emissions were compared with the limits as per Sec 15.231(b)(2).
- The transmitter was placed in three different orthogonal positions for searching maximum field strength level.
- The peak-average correction factor was obtained from the duty cycle calculation. See the Remarks above for details.

5.8. EMISSION BANDWIDTH [§15.231(c)]

5.8.1. Limits

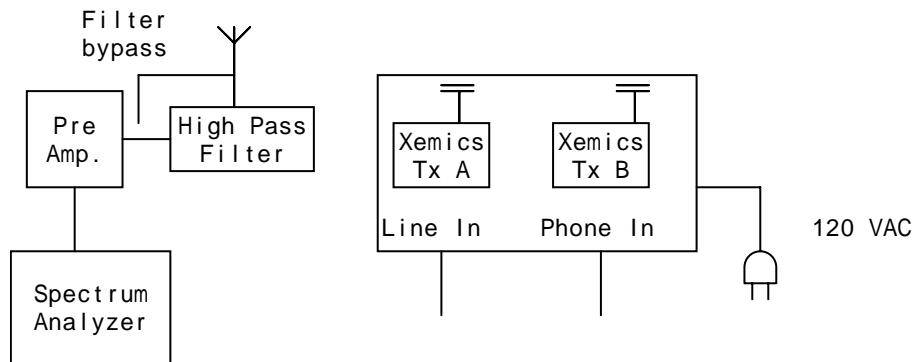
The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

5.8.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004, §15.231(c) & ANSI C63.4.

The transmitter output was loosely coupled to the spectrum analyzer through a receiving antenna and the bandwidth of the fundamental frequency was measured with the spectrum analyzer with the resolution bandwidth of the spectrum analyzer set per ANSI C63.4.

5.8.3. Test Arrangement

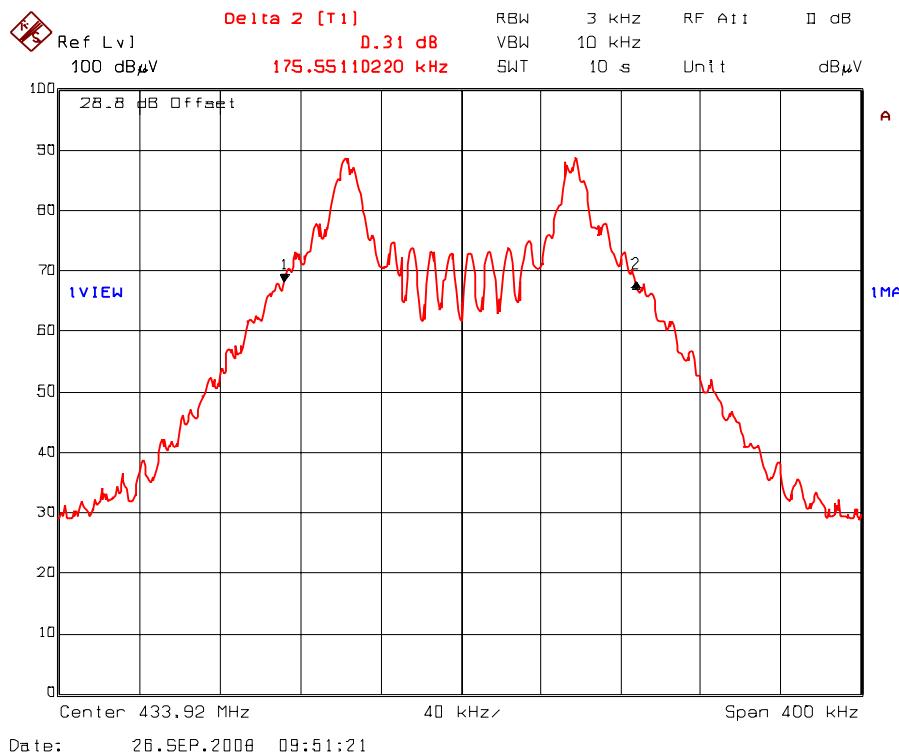


5.8.4. Test Data

Transmitter	Frequency (MHz)	20 dB Bandwidth (kHz)	Maximum Limit (kHz)	Pass/Fail
Xemics Tx A	433.92	175.551	1085	Pass
Xemics Tx B	433.92	175.551	1085	Pass

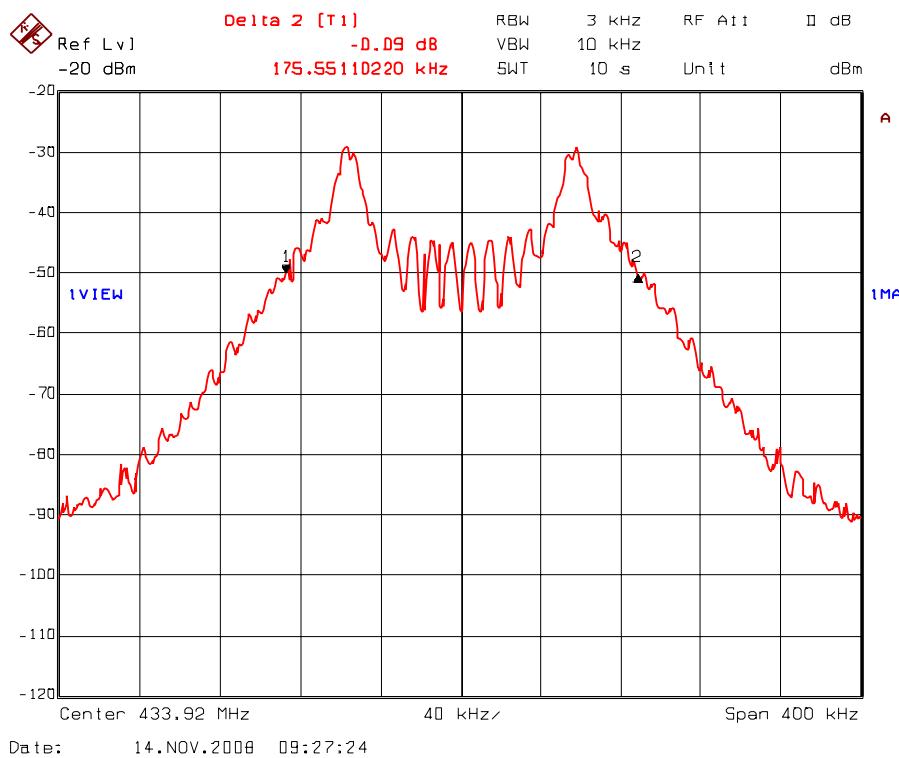
5.8.4.1. Xemics Transceiver A

Plot 1. 20 dB Bandwidth
Test Frequency: 433.92 MHz



5.8.4.2. Xemics Transceiver B

Plot 2. 20 dB Bandwidth
Test Frequency: 433.92 MHz



5.9. POWER LINE CONDUCTED EMISSION [47 CFR §15.107(a)]

5.9.1. Limit(s)

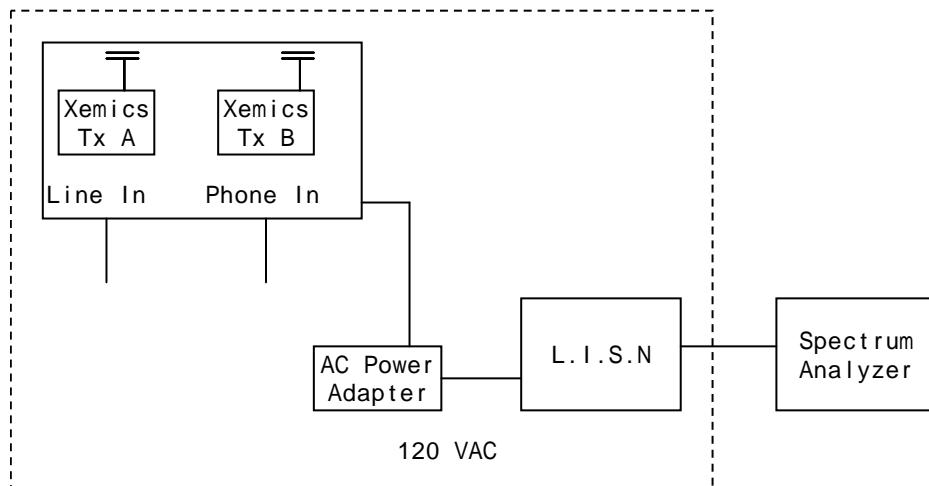
The equipment shall meet the limits of the following table:

CLASS B LIMITS		
Test Frequency Range (MHz)	Quasi-Peak (dB μ V)	Average (dB μ V)
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

5.9.2. Method of Measurements

Refer to Ultratech Test Procedures ULTR-P001-2004 & ANSI C63.4 for method of measurements.

5.9.3. Test Arrangement



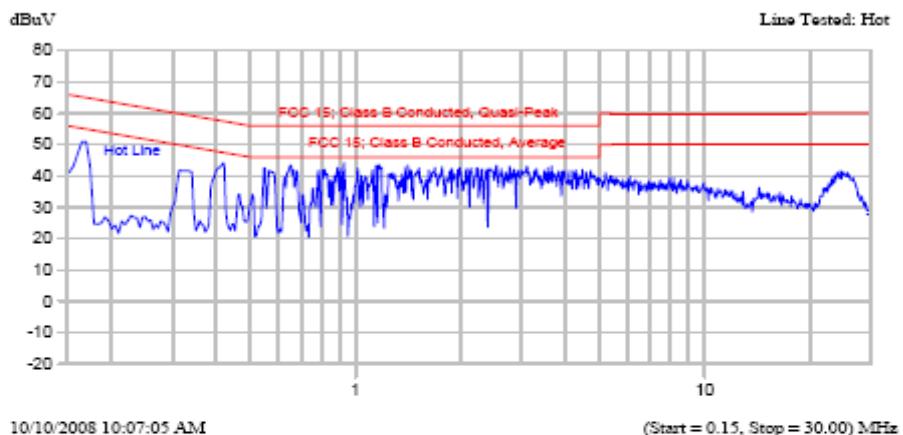
5.9.3.1. Test data

Plot 3. Power Line Conducted Emissions

Line Voltage: 120 VAC

Line Tested: Hot Line

Current Graph

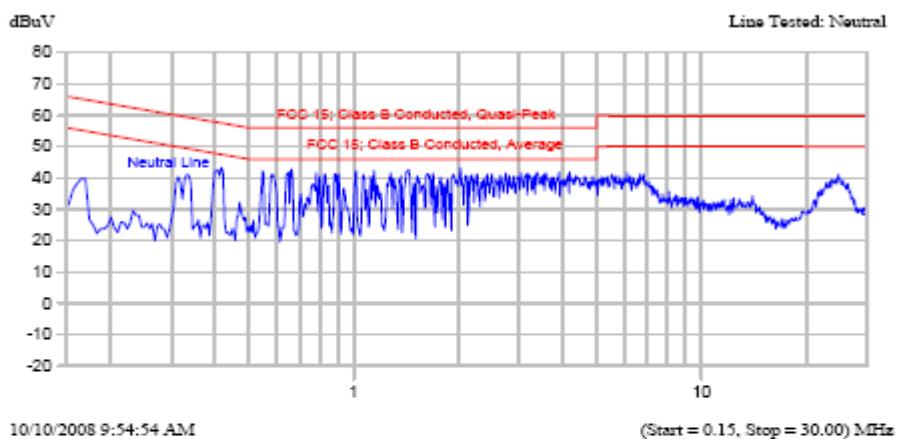


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta dB	QP-QP Limit dB	Avg dBuV	Delta dB	Avg-Avg Limit dB	Trace Name
0.152	50.3	46.9	-19.0	28.1	28.1	-27.8	27.8	Hot Line
0.309	43.0	40.7	-20.7	27.3	27.3	-24.1	24.1	Hot Line
0.423	45.0	43.4	-14.7	29.6	29.6	-18.5	18.5	Hot Line
0.558	43.9	41.5	-14.5	29.0	29.0	-17.0	17.0	Hot Line
0.664	44.4	42.5	-13.5	28.7	28.7	-17.3	17.3	Hot Line
0.928	44.6	42.9	-13.1	28.2	28.2	-17.8	17.8	Hot Line
1.156	43.7	41.4	-14.6	25.0	25.0	-21.0	21.0	Hot Line
1.177	43.8	41.8	-14.2	26.9	26.9	-19.1	19.1	Hot Line
2.531	43.5	39.8	-16.2	25.3	25.3	-20.7	20.7	Hot Line

Plot 4. Power Line Conducted Emissions
Line Voltage: 120 VAC
Line Tested: Neutral Line

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.327	42.1	40.6	-20.3	31.0	-19.8	Neutral Line
0.421	44.3	42.8	-15.4	30.4	-17.8	Neutral Line
0.559	43.6	41.1	-14.9	29.1	-16.9	Neutral Line
0.661	43.9	42.0	-14.0	27.9	-18.1	Neutral Line
0.671	44.6	42.7	-13.3	28.7	-17.3	Neutral Line
0.773	42.9	40.8	-15.2	22.6	-23.4	Neutral Line
0.924	44.3	42.2	-13.8	27.8	-18.2	Neutral Line
1.022	42.7	40.2	-15.8	23.9	-22.1	Neutral Line
1.413	43.2	40.4	-15.6	25.2	-20.8	Neutral Line
2.019	43.5	40.3	-15.7	25.9	-20.1	Neutral Line

5.10. SPURIOUS RADIATED EMISSIONS FROM RECEIVER [15.109(A)]

5.10.1. Limits

The equipment shall meet the limits of the following table:

Test Frequency Range (MHz)	Limits @3m (dB μ V/m)	EMI Detector Used	Measuring Bandwidth (kHz)
30 – 88	40.0	Quasi-Peak	RBW = 120 kHz, VBW \geq 120 kHz
88 – 216	43.5	Quasi-Peak	RBW = 120 kHz, VBW \geq 120 kHz
216 – 960	46.0	Quasi-Peak	RBW = 120 kHz, VBW \geq 120 kHz
Above 960	54.0	Average	RBW = 1 MHz, VBW \geq 1MHz

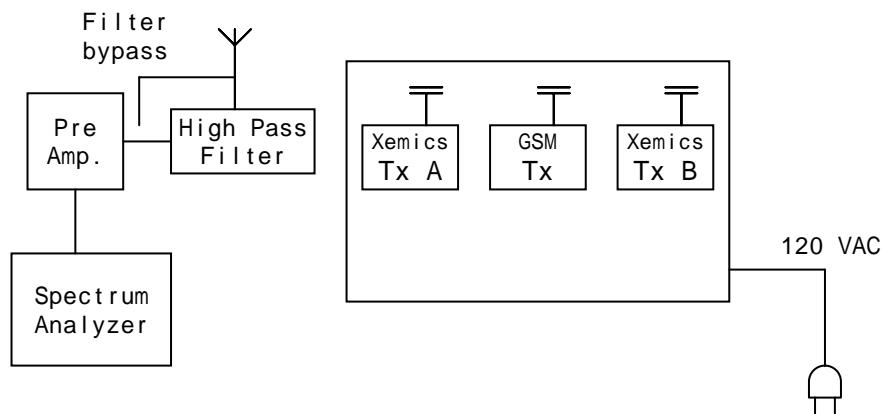
5.10.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004, RSS-210, Issue 7 and ANSI C63.4.

The EUT shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown in the following table:

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30
1.705 - 108	1000
108 – 500	2000
500 -1000	5000
Above 1000	5 th harmonic of the highest frequency or 40 GHz, whichever is lower

5.10.3. Test Arrangement



5.10.4. Test Data

5.10.4.1. Xemics Transceiver A

The emissions were scanned from 30 MHz to 2.5 GHz at 3 meters distance. All emissions less than 20 dB below the limits were recorded.

FREQUENCY (MHz)	RF LEVEL@3m (dBuV/m)	DETECTOR USED (PEAK/QP)	ANTENNA PLANE (H/V)	LIMIT (dBuV/m)	MARGIN (dB)	PASS/ FAIL
No signal found.						

5.10.4.2. Xemics Transceiver B

The emissions were scanned from 30 MHz to 2.5 GHz at 3 meters distance. All emissions less than 20 dB below the limits were recorded.

FREQUENCY (MHz)	RF LEVEL@3m (dBuV/m)	DETECTOR USED (PEAK/QP)	ANTENNA PLANE (H/V)	LIMIT (dBuV/m)	MARGIN (dB)	PASS/ FAIL
No signal found.						

5.11. SPURIOUS EMISSIONS FROM CLASS B UNINTENTIONAL RADIATORS (DIGITAL DEVICE) [15.109(A)]

5.11.1. Limits

The equipment shall meet the limits of the following table:

Test Frequency Range (MHz)	Limits @3m (dB μ V/m)	EMI Detector Used	Measuring Bandwidth (kHz)
30 – 88	40.0	Quasi-Peak	RBW = 120 kHz, VBW \geq 120 kHz
88 – 216	43.5	Quasi-Peak	RBW = 120 kHz, VBW \geq 120 kHz
216 – 960	46.0	Quasi-Peak	RBW = 120 kHz, VBW \geq 120 kHz
Above 960	54.0	Average	RBW = 1 MHz, VBW \geq 1MHz

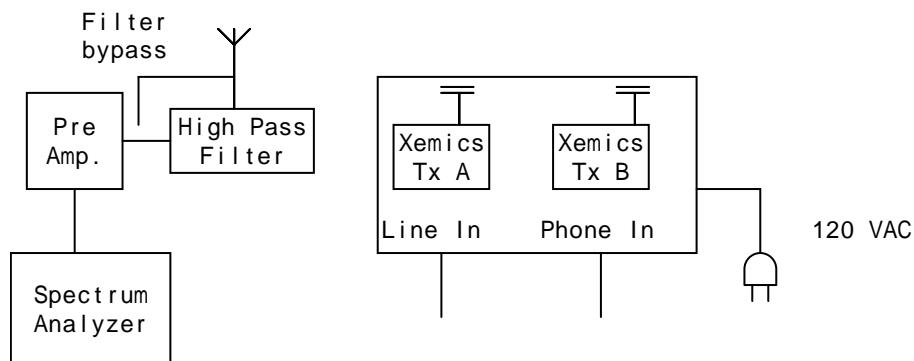
5.11.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004, RSS-210, Issue 7 and ANSI C63.4.

The EUT shall be investigated from the lowest radio frequency signal generated or used in the device, without going below the lowest frequency for which a radiated emission limit is specified, up to the frequency shown in the following table:

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30
1.705 - 108	1000
108 – 500	2000
500 -1000	5000
Above 1000	5 th harmonic of the highest frequency or 40 GHz, whichever is lower

5.11.3. Test Arrangement



5.11.4. Test Data

The emissions were scanned from 30 MHz to 2.5 GHz at 3 meters distance. All emissions less than 20 dB below the limits were recorded.

FREQUENCY (MHz)	RF LEVEL@3m (dBuV/m)	DETECTOR USED (PEAK/QP)	ANTENNA PLANE (H/V)	LIMIT (dBuV/m)	MARGIN (dB)	PASS/ FAIL
30.0	34.51	PEAK	V	40.0	-5.49	PASS
30.0	24.96	PEAK	H	40.0	-15.04	PASS
30.0	32.87	QP	V	40.0	-7.13	PASS
38.9	26.72	PEAK	V	40.0	-13.28	PASS
38.9	17.12	PEAK	H	40.0	-22.88	PASS
73.4	28.70	PEAK	V	40.0	-11.30	PASS
95.9	24.94	PEAK	V	43.5	-18.56	PASS

5.12. RF Exposure Evaluation [1.1307 & 2.1091]

Transmitter and modules certified for mobile or portable exposure conditions and categorically excluded by Sec. 2.1091(c) can be incorporated in mobile host devices without further testing or certification when:

- i) The closest separation among all simultaneous transmitting antennas is ≥ 20 cm; or
- ii) The antenna separation distance and MPE compliance boundary requirements that enable all simultaneous transmitting antennas incorporated within the host to comply with MPE limits are specified in the application filing of at least one of the certified transmitters incorporated in the host device. In addition, when transmitters certified for portable use are incorporated in a mobile host device the antenna(s) must be ≥ 5 cm from all other simultaneous transmitting antennas. All antennas must be at least 20 cm from users and nearby persons.

5.12.1. RF exposure estimation

Transmitter	ERP	RFx routine evaluation
Xemics Transceiver A at 433.92 MHz	-20.19 dBm ERP (77.19 dBuV/m _{@3m}) < 1.5 W ERP	Categorically excluded
Xemics Transceiver B at 433.92 MHz	-20.85 dBm ERP (76.53 dBuV/m _{@3m}) < 1.5 W ERP	Categorically excluded

- Xemics Transceiver A and Xemics Transceiver B never transmit simultaneously.

EXHIBIT 6. Test Equipments List

Test Instruments	Manufacturer	Model No.	Serial No.	Operating Range
24'(L) x 16'(W) x 8'(H) RF Shielded Chamber	Braden Shielding
Attenuator	Weinschel	46-20-34	BM1347	DC – 18 GHz
Attenuator	Weinschel	46-30-34	BM5354	DC – 18 GHz
BiConiLog Antenna	Emco	3142	10005	0.03 – 2 GHz
BiConiLog Antenna	ETS-Lindgren	3142B	1575	26 MHz – 2 GHz
EMC Analyzer	Hewlett Packard	8593EM	...	9kHz – 22 GHz
High Pass Filter	Mini-Circuits	SHP-800	10427	Cut off 710 MHz
High Pass Filter	Mini-Circuits	SHP-600	19949	Cut off 560 MHz
Horn Antenna	Emco	3155	9701-5061	1 – 18 GHz
Horn Antenna	Emco	3155	9911-5955	1 – 18 GHz
L.I.S.N.	EMCO	3825/2	89071531	9 kHz – 200 MHz 50 Ohms / 50 mH
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz
RF Amplifier	Com-Power	PA-103		1 MHz – 1 GHz
Spectrum Analyzer	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz
Spectrum Analyzer / EMI Receiver	Hewlett Packard	8546A	3650A00371	9 kHz – 6.5 GHz Built-in amplifier 30dB
Transient Limiter	Hewlett Packard	11947A	310701998	9 kHz – 200 MHz 10 dB attenuation

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994).

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	± 1.5	± 1.5
LISN coupling specification	Rectangular	± 1.5	± 1.5
Cable and Input Transient Limiter calibration	Normal (k=2)	± 0.3	± 0.5
Mismatch: Receiver VRC $\Gamma_1 = 0.03$ LISN VRC $\Gamma_R = 0.8(9 \text{ kHz}) 0.2 (30 \text{ MHz})$ Uncertainty limits $20\text{Log}(1+\Gamma_1\Gamma_R)$	U-Shaped	± 0.2	± 0.3
System repeatability	Std. deviation	± 0.2	± 0.05
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	± 1.25	± 1.30
Expanded uncertainty U	Normal (k=2)	± 2.50	± 2.60

Sample Calculation for Measurement Accuracy in 150 kHz to 30 MHz Band:

$$u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)} = \pm \sqrt{(1.5^2 + 1.5^2)/3 + (0.5/2)^2 + (0.05/2)^2 + 0.35^2} = \pm 1.30 \text{ dB}$$

$$U = 2u_c(y) = \pm 2.6 \text{ dB}$$

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (+ dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	<u>+1.0</u>	<u>+1.0</u>
Cable Loss Calibration	Normal (k=2)	<u>+0.3</u>	<u>+0.5</u>
EMI Receiver specification	Rectangular	<u>+1.5</u>	<u>+1.5</u>
Antenna Directivity	Rectangular	<u>+0.5</u>	<u>+0.5</u>
Antenna factor variation with height	Rectangular	<u>+2.0</u>	<u>+0.5</u>
Antenna phase center variation	Rectangular	0.0	<u>+0.2</u>
Antenna factor frequency interpolation	Rectangular	<u>+0.25</u>	<u>+0.25</u>
Measurement distance variation	Rectangular	<u>+0.6</u>	<u>+0.4</u>
Site imperfections	Rectangular	<u>+2.0</u>	<u>+2.0</u>
Mismatch: Receiver VRC $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67(Bi)$ 0.3 (Lp) Uncertainty limits $20\log(1+\Gamma_1\Gamma_R)$	U-Shaped	+1.1 -1.25	<u>+0.5</u>
System repeatability	Std. Deviation	<u>+0.5</u>	<u>+0.5</u>
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k=2 is used:

$$U = 2u_c(y) = 2x(+2.19) = +4.38 \text{ dB} \quad \text{And} \quad U = 2u_c(y) = 2x(-2.21) = -4.42 \text{ dB}$$