EMISSIONS TEST REPORT

Report Number: 3123410BOX.001
Project Number: 3123410

Testing performed on the

Model: X2003-Y-13

To

FCC Part 15, Subpart G

For

Ambient Corporation

Test Performed by:	Test Authorized by:
Intertek – ETL SEMKO	Ambient Corporation
70 Codman Hill Road	79 Chapel Street
Boxborough, MA 01719	Newton, MA 02458

Prepared by: _____ Date: 07/26/2007
Vathana F. Ven

Reviewed by: _____ Date: 7-31-2007
Roland Gubisch

1.0 Job Description

1.1 Client Information

This EUT has been tested at the request of:

Company:	Ambient Corporation 79 Chapel Street Newton, MA 02458
Contact:	Aron Viner
Telephone:	(617) 614-6729
Fax:	(617) 332-7260
Email:	Aron.viner@ambient.corp.com

1.2 Equipment Under Test

Equipment Type:	X2 PLC NODE
Model Number(s):	X2003-Y-13
Serial number(s):	x20636-0007F8, x2062900058F8 and x20636-0006F8
Manufacturer:	Ambient Corporation
EUT receive date:	6/19/07
EUT received condition:	Engineering Prototype
Test start date:	6/19/07
Test end date:	6/22/06

1.3 Test Plan Reference: FCC Part 15, Subpart G

1.4 Test Configuration/Operating Voltage

The equipment under test (EUT) was configured with all 3 ports active and wireless module was installed. The EUT was operated at 115 Vac.

Special test conditions:

i) The EUT was tested at three overhead (mounting on the poles) which is typical installation. For overhead testing locations, the distance between poles was at least 300 meters.

ii) The EUT was tested in the following configuration and corresponding output power level:
- On the overhead medium voltage (MV) line with the MV overhead capacitive coupler, model: ARTECHE OVERCAP-S24.

The couplers are passive devices and they are part of the system, therefore, separate FCC certification is not required.

iii) The EUT was tested in two test modes with the MV overhead capacitive coupler.
- **Test mode 1** was from 2 to 30 MHz.
- **Test mode 2** was from 30 to 35 MHz.

Test mode 1 and **Test mode 2** represent the full band of operation.

iv) The output power level settings are corrected to be equal for 10, 20 and 30 MHz of operation.

v) During the test, the EUT was operated in head-end (HE) mode which was defined as the worst case scenario (1000 bursts/second).

vi) Prior to the field testing, the EUT was pre-scanned in the semi-anechoic chamber to identify the unwanted emissions from 30 MHz to 2 GHz.

vii) All overhead testing were performed at horizontal distance of 10 meters from the poles. Slant distances SL were calculated from the formula:

$$SL = [(\text{line height} - \text{antenna center height})^2 + (\text{horizontal distance})^2]^{1/2}$$

The corresponding distance correction factors CF were calculated according to:

$$CF = 40 \log_{10}(10m/SL) \text{ for frequencies below 30 MHz}$$

$$CF = 20 \log_{10}(10m/SL) \text{ for frequencies at and above 30 MHz}$$

The overhead measurements were performed at 11 testing points for **Test mode** 1.
All testing were performed with only one coupler connected at any given time.

viii) For **Test mode 1** from 2 to 30 MHz, the active loop antenna which was mounted at 1.2 meter above ground on the non-conductive tripod was used to measure the emissions. The emissions were maximized by rotating the antenna 360°.

ix) For **Test mode 2** from 30 to 35 MHz, the biconical and log periodical antenna were mounted on the mast. Five testing points were used. The emissions were maximized by raising and lowering the antenna from 1 to 4 meters in both polarizations.

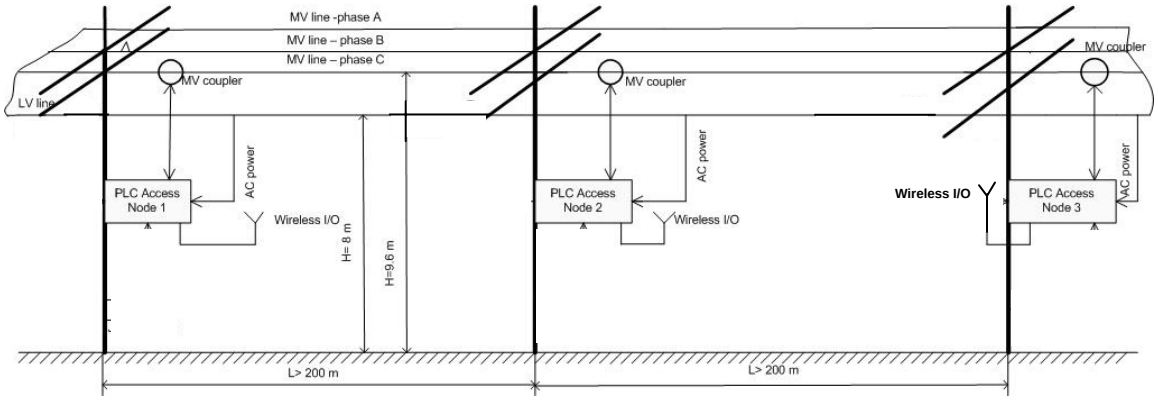
ix) All testing was performed up to 2 GHz.

x) During radiated emissions scan, a 50 kHz sweep was used.

xi) The X2 PLC NODE was tested with MV overhead capacitive coupler at Charlotte, NC.

1.4.1 Block Diagram

Block diagram: for testing X2 PLC NODE on the overhead lines



1.4.2. Cables:

Cable	Shielding	Connector	Length (m)	Qty.
Coaxial cable	Coax	Metal	>3	3
Power cable	None	Metal	>3	1
Ethernet cable	Foil	Metal	>3	1

1.4.3. Support Equipment:

None.

1.5 Mode(s) of Operation:

The EUT was tested in two test modes. **Test mode 1** was from 2 to 30 MHz and **Test mode 2** was from 30 to 35 MHz, the combination of which constituted the full band of operation. Power setting was defined by appropriated test mode and configuration.

1.5a EUT Cycle Time: Not applicable.

1.6 Floor Standing Equipment: Applicable:____ Not Applicable:_X_

2.0 Test Summary

TEST STANDARD	RESULTS	
Basic Standards from FCC Part 15 Subpart G		
SUB-TEST	**TEST PARAMETER**	**COMMENT**
Emissions	Emissions below specified limits	Pass

Notes:

REVISION SUMMARY – The following changes have been made to this Report:

Date	Project No.	Project Handler	Page(s)	Item	Description of Change

3.0 Sample Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF – AG - DF
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB
DF = Distance factor

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m
DF = 14 dB

Level in μV/m = [10(18 dBμV/m)/20] = 7.9 μV/m

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(48.1\ dB\mu V / 20)}$ = 254 μV/m

3.1 Measurement Uncertainty

Compliance of the product is based on the measured value. However, the measurement uncertainty is included for informational purposes. The estimation of measurement uncertainty for emissions at a test site (OATS, sheltered site or semi-anechoic chamber) is well-documented in CISPR 16-4-2. Performing *in-situ* testing introduces additional uncertainties relating to characteristics of the site that vary from place to place and may not be stable with time:

— ground reflectivity

— reflections from or absorption by adjacent buildings and foliage

— differing overhead power cable geometries

— field strength roll-off characteristics

— large antenna-to-EUT uncertainty

— absorption and re-radiation of ambient and EUT emissions by long overhead power cables

— ambient emissions including transmitters, HV discharge, industrial noise and auto ignitions

— moisture level, affecting line loss and wooden pole dielectric

— RF resistance variation of ground connection

— changes in primary distribution loads

— capacitor bank switching

— secondary load variations from street lighting and premises.

The table below adopts the measuring instrument uncertainties from CISPR 16-4-2 and introduces factors to account for the unique factors introduced by *in-situ* testing. Such factors can only be an estimate.

RF Radiated Emissions *in-situ* Uncertainty Estimate, 10 m distance

Contribution	Probability distribution	9 kHz-30 MHz magnetic loop ± dB	30-100 MHz bilog ± dB
RECEIVER			
amplitude specification (2)	rectangular	1.5	1.5
input mismatch uncertainty (2)	U-shaped	1.0	1.0
SHIELDED CABLES			
cable loss calibration (1)	normal	0.1	0.2
ANTENNA			
antenna factor calibration (2)	rectangular	1.0	1.0
antenna factor frequency interpolation (2)	rectangular	0.3	0.3
mismatch uncertainty (2)	U-shaped	1.0	1.0
measurement distance variation (2)	rectangular	1.0	1.0
SITE			
ground reflectivity variations (3)	normal	1.5	2.0
reflections from structures (3)	normal	2.0	2.0
radiating cable geometry variations (4)	normal	2.0	2.0
field rolloff variations (1)	normal	2.0	1.0
cable absorption and re-radiation (4)	normal	2.0	1.0
measurements near ambient emissions (4)	normal	2.0	2.0
moisture effects (4)	normal	1.0	1.5
RF resistance variations of ground (4)	normal	1.0	1.0
primary load distribution changes (4)	normal	0.5	0.5
secondary load variations (4)	normal	0.5	0.5
Combined standard uncertainty $u_c(y)$	normal	2.94	2.81
Expanded uncertainty U	normal (k = 2)	5.88	5.62

Footnote: Basis for estimate

1 Measured
2 Calculated from device calibration or specifications
3 Determined from mathematical modeling
4 Estimated from plausible limits of effect

3.2 Site Description

Test Site(s):

The X2 PLC NODE was tested in *situ* at the following locations:

- with MV overhead capacitive coupler at 13010, 13406 and 14220 Sledge Road, Charlotte, NC.

- The pre-scanned was performed in the Semi-anechoic Chambers in Boxborough, MA

Test Results: Pass

Test Standard: Basic Standards from **FCC Part 15 Subpart G**

Test: Radiated emissions

Performance Criterion: N/A

Test Environment:

Environmental Conditions During Testing:	Humidity (%):	36	Pressure (hPa):	994	Ambient (°C):	33
Pretest Verification Performed	Yes		Equipment under Test:		X2003-Y-13	

Maximum Test Disturbance Parameters: Readings below specified limits.

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	12/19/2007
2	ANTENNA, bicon	A.H. Systems	SAS-540	567	08/02/2007
3	Cable, BNC - BNC, 10m long	Alpha	RG-58C/U	CBL10MS3	01/04/2008
4	Loop Antenna	EMCO	6502/1	1037	07/27/2007
5	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 197	CBL028	12/04/2007
6	ANTENNA, log periodic	A.H. Systems	SAS-510-2	1071	08/02/2007

Software Utilized:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	2/07/05 Revision

Test Results:

Radiated Emissions: Overhead MV capacitive coupler

Company:	Ambient Corporation			Antenna & Cables:	LF	Bands: N, LF, HF, SHF	
Model #:	X2003-Y-13			LF Antenna:	Loop1 05-10-07 1m E.ant	Loop1 05-10-07 1m E.ant	
Serial #:	Prototype			N Antenna:	LOG3 10-21-07 V10.ant	LOG3 10-21-07 H10.ant	
Engineers:	Vathana Ven	Location:	In-situ	HF Antenna:	EMC04 V 1m 12-13-2007.txt	EMC04 H 1m 12-13-2007.txt	
Project #:	3123410	Date(s):	06/19/07 06/20/07	SHF Antenna:	NONE.	NONE.	
Standard:	FCC Part 15 Subpart G			LF Cable(s):	CBL10MS3 01-04-08.txt	NONE.	
Receiver:	R&S ESCI (ROS002)	Limit Distance (m):	10	N Cable(s):	CBL10MS3 01-04-08.txt	CBL028 12-04-2007.txt	
PreAmp:	NONE.	Test Distance (m):	10 and 11.2	HF Cable(s):	CBL028 12-04-2007.txt	NONE.	
Barometer:	SAF285	Temp/Humidity/Pressure:	36 deg. C 33% 994	SHF Cable(s):	NONE.	NONE.	

PreAmp Used? (Y or N): N Voltage/Frequency: 120 Vac/60 Hz Frequency Range: 2 MHz - 2 GHz

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC
13010 Sledge Road												
QP	N/A	22.941	34.2	8.6	1.1	0.0	17.9	26.0	29.5	-3.5	9/30 kHz	
QP	N/A	23.111	27.0	8.6	1.1	0.0	17.9	18.8	29.5	-10.7	9/30 kHz	
QP	N/A	24.196	30.5	8.5	1.1	0.0	17.9	22.2	29.5	-7.3	9/30 kHz	
QP	N/A	25.464	32.8	8.2	1.1	0.0	17.9	24.2	29.5	-5.3	9/30 kHz	
QP	N/A	26.604	36.4	7.9	1.1	0.0	17.9	27.5	29.5	-2.0	9/30 kHz	
QP	N/A	27.664	30.0	6.7	1.2	0.0	17.9	20.0	29.5	-9.5	9/30 kHz	
QP	H	30.324	12.0	12.7	1.6	0.0	0.0	26.3	39.1	-12.8	120/300 kHz	
QP	H	31.484	6.0	12.0	1.6	0.0	0.0	19.6	39.1	-19.5	120/300 kHz	
QP	H	33.504	10.0	12.0	1.6	0.0	0.0	23.6	39.1	-15.5	120/300 kHz	

Notes: