FCC PART 15 SUB-PART B & C
EMI TEST REPORT

on

Commercial & Industrial (C & I)
Meter

[FCC ID: OWS-925]

Models:

C & I Meter

applicant

Innovatec Communications, LLC
13000 West Silver Spring Dr.
P.O. Box 910
Butler, Wisconsin 53007-0910 USA

evaluated and prepared by

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EN45001 Accredited Compliance Laboratory (RES-GmbH)

Registration number: TTI-P-G 159/98-00 (RES-GmbH)

TEST RESULT SUMMARY
FCC PART 15 SUB-PART B & C

General Information

Product Name *FCC ID:* *Models:*	C & I METER OWS-925 C & I Meter	
Manufacturer's Name: *Manufacturer's Address* *Contact:*	Innovatec Communications, LLC 13000 West Silver Spring Dr. P.O. Box 910 Butler, Wisconsin 53007-0910 USA • Tel: (262) 783-0200 • Fax: (262) 783-0205 Mr. Kevin Prudlow	
Laboratory	International Technology Company (ITC) 9959 Calaveras Road, PO Box 543 Sunol, CA 94586-0543 • Tel: (925) 862-2944 • Fax: (925) 862-9013 Email: itcemc@aol.com • Web Site: www.itcemc.com	
Test Number *Test Report Number* *Test Date* *Project Technician*	20000410-5 0004RS110-5/F April 7 - 10, 2000 Bruce Gordon	
Test Results	☑ Pass	☐ Fail
Total Number of Pages	Pages	***Date of Issue:*** Thursday May 4, 2000

According to testing performed at International Technology Company (ITC); the above-mentioned unit is in compliance with the emissions requirements defined in FCC Part 15 B and C. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics. Any modifications necessary for compliance made during testing on the above mentioned date(s) must be implemented in all production units for compliance to be maintained.

International Technology Company (ITC) as an independent testing laboratory, declares that the equipment tested as specified above conforms to the emissions requirements of FCC Part 15 B & C.

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International Technology Company is:

Accepted by the Federal Communications Commission (FCC) for FCC Methods, CISPR Methods and AUSTEL Technical Standards (Ref: NVLAP Lab Code 200172-0)

Validated by the Chinese Taipei Bureau of Standards, Metrology, and Inspection (BSMI) under APEC MRA as a Conformity Assessment Body (CAB) under Appendix B, Phase 1 Procedures. BSMI # SL2-IN-E-024R

Approved by the Industry Canada for Telecom Testing

Certified by International Technology Company (ITC)GmbH for EMC Testing according to the European EMC Directive 89/336/EEC per EN45001

Certified by Reg. TP for EMC Testing according to the European EMC Directive 89/336/EEC per EN45001 for RES GmbH (DAR-Registration number: TTI-P-G 159/98-00)

Certified by the Voluntary Control Council for Interference by Information Technology Equipment (VCCI) for EMC testing, in accordance with the Regulations for Voluntary Control Measures, Article 8, Registration Numbers- Site 1: C-714 & R-696 and Site 2: C-715 & R-697

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- MTTF Calculations
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- SEMI S2 Reviews, 1993
- USB Specification Evaluations/Testing
- SAE Specification Evaluations/Testing
- EIA/TIA Specifications i.e. 571-A and 631
- MIL-STD i.e. 461,462,1541/EMC, 883/ESD

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FCC 15 /SubPart C	UL 2601/Medical	EN 55103-1/ 55103-2
FCC 24	UL 1459 /Telecom	EN 60601-1-2
FCC 68 (Analog and Digital)	UL 1411 /Audio, Radio, TV	EN 55011 /55013 /55014
FCC 90	UL 813 /Commercial Audio	EN 55015 /55020 /55022
FCC 95	UL 1604 /Hazard. Location	EN 60555-2 /60555-3
	UL 508 /Energy Mgmt. Equip.	EN 61000-3-2 /61000-3-3
		EN 61000-4-2 /61000-4-3
		EN 61000-4-4 /61000-4-5
		EN 61000-4-6 /61000-4-8 /61000-4-11

Canada: EMI, Safety, Telecom	**Asia - Australia/ International**	
RSS 210 & RSS 221	CISPR 11, 13, 14, 15, 16, 20, 22	
Industry Canada /IC CS-03	VCCI Class 1 & 2 /Japan	
All c-UL Standards for Canada	AS/NZ 3548: C-Tick Mark, EMC	EU: Safety/Machinery (EN)
All CSA Standards, including:	CNS 13438 - 1996/Taiwan	EN 60950 /61010-1
CSA No. 950/ ITE	ITU Standards	EN 60204 /60065
CSA No. 601-1/Medical	IEC /ETSI Standards	EN 60601-1-1
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PART 1
GENERAL

1.1 Test Methodology

The electromagnetic interference tests, which this report describes, were performed by an independent electromagnetic compatibility consultant, International Technology Company, in accordance with the FCC test procedure ANSI C63.4-1992.

1.1.1 Test Facility

The open area test site, the conducted measurement facility, and the test equipment used to collect the emissions data is located in Sunol, California, and is fully described in site attenuation report. The approved site attenuation description is on file at the Federal Communications Commission.

1.1.2 Accuracy of Test Data

The test results contained in this report accurately represent Powerline Conducted Emissions, Open Field Radiated Emissions, Occupied Bandwidth, Frequency Stability, RF Power Output, Spurious and Harmonic tests generated by the sample equipment under test.

Equipment Tested	C & I Meter
FCC ID	OWS-925
Date of Test	April 7 - 10, 2000

Tests Performed:

1. Powerline Conducted Emissions in a shielded room utilizing two LISN's in accordance with the FCC test procedure 47 CFR §15.207. Part 2 of this report contains details.

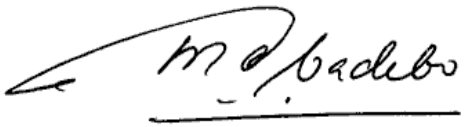
2. Radiated Emissions in a 3-meter open area site in accordance with the FCC test procedure 47 CFR §15.209 and §15.31(m). Part 3 of this report contains details.

3. The conducted maximum power and the 6dB Bandwidth were performed in accordance with the FCC test procedure 47 CFR §15.247(2). Part 4 of this report contains details.

4. Harmonics and Spurious Emissions Test in accordance with the FCC test procedure 47 CFR §2.1053 and §15.247(c). Part 5 of this report contains details.

5. The conducted Peak Power Spectral Density and the Processing Gain were measured in accordance with procedures described in 47 CFR §15.247 (d) and §15.247 (e) respectively . Part 6 of this report contains details.

The results show that the sample equipment tested as described in this report is in compliance with the FCC Rules Part 15, SubPart B: Powerline Conducted Emissions, Open Field Radiated Emissions. Occupied Bandwidth, Harmonics and Spurious Emissions, Maximum Peak Output Power tests requirement limits of, SubPart C.



Michael Gbadebo, PE
Chief Engineer/Principal Consultant

1.2 Summary

1.2.1 Description of Equipment Under Test (EUT)

See Appendix D for more information

Model Name(s): C & I Meter

Applicant: Innovatec Communications, LLC
Address: 13000 West Silver Spring Dr.
P.O. Box 910
Butler, Wisconsin 53007-0910 USA
- Tel: (262) 783-0200
- Fax: (262) 783-0205

Client Contact: Mr. Kevin Prudlow

Test Technician: Bruce Gordon

Test Number: 20000410-5
File Number: 0004RS110-5/F

1.2.2 Support Equipment included in the Tests:

The C & I was tested as a stand-alone device

PART 2
POWERLINE CONDUCTED EMISSIONS
Per FCC PART 15 SUBPART B, CLASS B

2.1 Configuration and Procedure

2.1.1 EUT Configuration

Pre-scan measurements are first performed by collecting data with a spectrum analyzer. Significant peaks are marked and then quasi-peaked. Measurement range investigated was from 450KHz to 30MHz. The C & I was set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was a receiver with bandwidth parameters as stipulated in ANSI C63.4-1992. The C & I was set up on a wooden non-conductive tabletop, 80 cm above the ground reference plane, in a shielded room. Excess cord of the equipment was looped, on top of LISN to form a 30-cm by 40-cm bundle. Grounding was through the power cord and voltage was 220Vac.

2.1.2 Test Procedure

The system was set up as described above, with the EUT was running in a continuous transmission mode with modulation turned on. The LAN (NCI) transmitter was transmitting continuously with modulation turned on while the modem card inside the EUT was connected to a telephone line simulator. The C & I was operated in a worst-case condition of orientation. The power line conducted EMI tests were run on all phases of the current carrying conductors of the power cords of the EUT. The highest line conducted emissions were also analyzed in detail by operating the spectrum analyzer in fixed tuned mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables were moved around to maximize the emissions, and the position of the peripheral devices were interchanged to check for any changes in emissions.

2.2 Powerline Conducted Emissions Per FCC Part 15 SubPart B, Class B

2.1.3 Data Table Legend and Field Strength Calculation

'Margin' indicates the degree of compliance with the applicable limit. For example, a margin of -8 dB means that the emission is 8 dB below the limit (in compliance). A margin of +4 dB means that the emission is 4 dB over the limit (out of compliance). The margin is calculated as follows: Margin = Corrected Amplitude - Limit; where Corrected Amplitude = Amplitude + Cable Loss - Distance Factor, the amplitude measured in a quasi peak mode.

2.1.4 Spectrum Analyzer Configuration (during swept frequency scans)

Start Frequency..... 450 KHz
Stop Frequency..... 30MHz
Sweep Speed ..... Manual
Resolution Bandwidth..... 10KHz
Video Bandwidth..... 10KHz
Quasi Peak Adapter Bandwidth..... 9KHz
Quasi Peak Adapter Mode..... Normal

2.2 Powerline Conducted Emissions Per FCC Part 15 SubPart B, Class B

2.2.1 Administrative Details

Date(s) of Test: April 7 - 10, 2000
Temperature/Humidity: 24.0°C / 63%
Test Technician(s): Bruce Gordon

2.2.2 Test Results

The table below shows a summary of the highest conducted emissions on all current carrying conductors of the EUT power cord compared to the FCC Class B limit.

INDICATED FREQ MHz	MPL dBuV	CABLE LOSS dB	CORR AMPL dBuV	COND -	GND -	FCC 15 LIMIT dBuV	CLASS A MARGIN dB	FCC 15 LIMIT dBuV	CLASS B MARGIN dB
.561	38.7	1.0	39.7	Neut	con	60.0	-20.3	48.0	-8.2
.621	37.8	1.0	38.8	Hot	con	60.0	-21.2	48.0	-9.2
5.317	42.7	1.0	43.7	Neut	con	69.5	-25.8	48.0	-4.2
5.337	44.3	1.0	45.3	Hot	con	69.5	-24.2	48.0	-2.7
11.161	44.7	1.0	45.7	Neut	con	69.5	-23.9	48.0	-2.3
11.432	43.1	1.0	44.1	Hot	con	69.5	-25.4	48.0	-3.8

Power line Conducted Emissions [C & I Meter]

INDICATED FREQ MHz	MPL dBuV	CABLE LOSS dB	CORR AMPL dBuV	COND -	GND -	FCC 15 LIMIT dBuV	CLASS A MARGIN dB	FCC 15 LIMIT dBuV	CLASS B MARGIN dB
.617	39.1	1.0	40.1	Hot	con	60.0	-19.9	48.0	-7.9
.618	38.9	1.0	39.9	Neut	con	60.0	-20.1	48.0	-8.1
11.603	43.9	1.0	44.9	Hot	con	69.5	-24.7	48.0	-3.1
11.722	43.5	1.0	44.5	Neut	con	69.5	-25.0	48.0	-3.4
15.057	33.1	1.0	34.1	Neut	con	69.5	-35.4	48.0	-13.8
20.970	37.4	1.0	38.4	Hot	con	69.5	-31.1	48.0	-9.6
25.500	40.6	1.0	40.6	Neut	con	69.5	-27.9	48.0	-6.4

Power line Conducted Emissions [C & I Meter]

No emissions of significant levels were observed between 450 KHz and the lowest frequencies shown in the above data. No emissions of significant levels were observed between the highest frequencies shown in the above data and 30 MHz.

Conclusion: The C & I meet the requirements of the test reference for Powerline Conducted Emissions.

PART 3
OPEN FIELD RADIATED EMISSIONS
Per FCC PART 15 SUBPART B, CLASS B

3.1 Configuration and Procedure

3.1.1 EUT Configuration

Pre-scan measurements are first performed by collecting data with a spectrum analyzer. Significant peaks are marked and then quasi-peaked. Measurement range investigated was from 30 MHz to 1 GHz. The EUT was set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was a receiver with bandwidth parameters as stipulated in ANSI C63.4-1992. The C & I set up on a wooden non-conductive tabletop, 80 cm above the ground reference plane, in an open field. The dimension of the table was 1.5m x 1.0m. Excess cord was folded back to form a 30-cm by 40-cm bundle, which was hanging in the middle distance above the ground plane. Frequency measurement was taken from 30MHz to 10^{th} harmonic.

3.1.2 Test Procedure

The EUT was set up as described above, acquiring Remote Meter Interface continuously and transmitting data via LAN and telephone line networks. The C & I was rotated 360 degrees azimuth and the search antenna height varied 1to 4 m in order to maximize the emissions from the EUT. The highest emissions were also analyzed in detail by operating the spectrum analyzer in fixed tuned mode to determine the precise amplitude of the emissions. While doing so, interconnecting cables were moved around to maximize the emissions.

3.1.3 Data Table Legend and Field Strength Calculation

'Margin' indicates the degree of compliance with the applicable limit. For example, a margin of -8 dB means that the emissions are 8 dB below the limit (in compliance); +a margin of +4 dB means that the emission is 4 dB over the limit (out of compliance). The margin calculated as follows:
Margin = Corrected Amplitude - Limit, where Corrected Amplitude = Amplitude + Antenna Correction Factor + Cable Loss - Distance Factor, measured in quasi peak mode.

3.1.4 Spectrum Analyzer Configuration (during swept frequency scans)

Start Frequency 30MHz
Stop Frequency.....1000MHz
Sweep Speed .....Manual
Measurements below 1GHz
RES Bandwidth..... 100 KHz
Video Bandwidth..... 100 KHz
Quasi Peak Adapter Mode..... Normal
Quasi peak Adapter Bandwidth..... 120 KHz
Measurements above 1GHz (unless stated otherwise)
Analyzer Mode .....Video Filter
RES Bandwidth..... 1MHz
Video Bandwidth..... 1MHz
Freq. Span..... 3MHz
Offset..... 0dB
Quasi Peak Adapter Mode..... Disabled

3.2 Open Field Radiated Emissions Per FCC Part 15 SubPart B, Class B

3.2.1 Administrative Details

Date(s) of Test: April 7 - 10, 2000
Distance: 10M Field
Temperature/Humidity: 19.8$^{0^{\circ}}$C / 64%
ATM Pressure: 1010 Mbar
Test Technician(s): Bruce Gordon
Antenna Used: Biconical Antenna, model # 3104, S/N 3459 and Log Periodic Antenna, model # 3146, S/N 2075 (calibrated June 25, 1999, next calibration due date is June 25, 2000)

3.2.2 Test Results

The table below shows a summary of the highest amplitudes of the radiated emissions from the equipment under test at various antenna heights, antenna polarization, and EUT orientations.

INDICATED		CORRECTION		FACT	CORR	TURNTAB		ANT	FCC CLASS A		FCC CLASS B	
FREQ	AMPL	ANT	CAB	DIST	AMPL	ANG	HT	POL	LIMIT	MARGIN	LIMIT	MARGIN
MHz	dBuV/m	dB	dB	dB	dbuV/m	DEG	m	-	dBuV/m	dB	dBuV/m	dB
123.18	16.5	13.8	3.9	0.0	34.2	180	1.0	VB	54.0	-19.7	43.5	-9.3
129.91	16.4	13.1	4.0	0.0	33.5	90	2.0	HB	54.0	-20.5	43.5	-10.0
168.00	14.7	14.9	4.5	0.0	34.1	180	1.0	VB	54.0	-19.8	43.5	-9.4
168.07	14.0	14.9	4.5	0.0	33.5	90	2.0	HB	54.0	-20.5	43.5	-10.1
189.84	18.7	16.9	4.6	0.0	40.2	90	2.0	HB	54.0	-13.8	43.5	-3.3
194.82	19.3	17.4	4.7	0.0	41.4	90	2.0	HB	54.0	-12.6	43.5	-2.1
198.74	12.6	14.9	4.7	0.0	32.2	180	1.0	VB	54.0	-21.8	43.5	-11.4
199.79	24.1	14.1	4.7	0.0	42.9	90	2.0	HB	54.0	-11.0	43.5	-.6
204.80	22.7	13.6	4.7	0.0	41.0	90	1.0	HL	54.0	-13.0	43.5	-2.5
209.80	19.6	13.3	4.7	0.0	37.6	90	1.0	HL	54.0	-16.4	43.5	-6.0
216.04	16.0	12.8	4.8	0.0	33.6	180	1.0	VL	56.9	-23.3	46.0	-12.4
254.75	13.5	13.4	5.2	0.0	32.1	90	1.0	HL	56.9	-24.8	46.0	-13.9
259.73	20.3	13.6	5.2	0.0	39.1	180	1.0	HL	56.9	-17.8	46.0	-6.9
259.74	14.0	13.6	5.2	0.0	32.8	90	1.0	HL	56.9	-24.1	46.0	-13.2

3.2 Open Field Radiated Emissions Per FCC Part 15 SubPart B, Class B…..

Test Results…..

The table below shows a summary of the highest amplitudes of the radiated emissions from the equipment under test at various antenna heights, antenna polarization, and EUT orientations.

INDICATED FREQ	AMPL	CORRECTION ANT	CAB	FACT DIST	CORR AMPL	TURNTAB ANG	HT	ANT POL	FCC CLASS A LIMIT	MARGIN	FCC CLASS B LIMIT	MARGIN
MHz	dBuV/m	dB	dB	dB	dbuV/m	DEG	m	-	dBuV/m	dB	dBuV/m	dB
319.90	17.5	15.3	5.3	0.0	38.1	180	1.0	HL	56.9	-18.8	46.0	-7.9
324.70	12.0	15.4	5.4	0.0	32.8	180	1.0	HL	56.9	-24.1	46.0	-13.2
329.66	20.0	15.5	5.4	0.0	40.9	180	1.0	VL	56.9	-16.0	46.0	-5.1
329.68	12.4	15.5	5.4	0.0	33.3	180	1.0	VL	56.9	-23.6	46.0	-12.7
329.90	15.6	15.5	5.4	0.0	36.5	180	1.0	HL	56.9	-20.4	46.0	-9.5
340.30	13.0	15.5	5.6	0.0	34.1	180	1.0	HL	56.9	-22.8	46.0	-11.9
350.20	12.8	15.6	5.7	0.0	34.1	180	1.0	HL	56.9	-22.8	46.0	-11.9
359.61	11.7	15.8	5.7	0.0	33.2	180	1.0	VL	56.9	-23.7	46.0	-12.8
364.69	6.5	15.9	5.7	0.0	28.1	180	1.0	VL	56.9	-28.8	46.0	-17.9
369.69	13.2	15.9	5.8	0.0	34.9	180	1.0	VL	56.9	-22.0	46.0	-11.1
407.82	19.0	16.8	6.1	0.0	41.9	180	1.0	VL	56.9	-15.0	46.0	-4.1
409.61	7.2	16.9	6.1	0.0	30.2	180	1.0	HL	56.9	-26.7	46.0	-15.8
424.32	12.9	17.9	6.1	0.0	36.9	180	1.0	VL	56.9	-20.0	46.0	-9.1
429.60	6.3	17.9	6.1	0.0	30.3	180	1.0	HL	56.9	-26.6	46.0	-15.7
782.53	6.9	22.2	7.7	0.0	36.8	180	1.0	VL	56.9	-20.1	46.0	-9.2
792.46	13.6	22.3	7.8	0.0	43.7	180	1.0	VL	56.9	-13.2	46.0	-2.3
938.50	5.2	24.0	8.3	0.0	37.5	0	1.0	HL	56.9	-19.4	46.0	-8.5
938.52	13.1	24.0	8.3	0.0	45.4	180	1.0	VL	56.9	-11.5	46.0	-.6

Table 3.2.2 Open Field Radiated Emissions for C & I Meter

No emissions of significant levels were observed between 30 MHz and the lowest frequencies shown in the above data. No emissions of significant levels were observed between the highest frequency shown in the above data and 1000MHz.

Conclusion: The C & I meet the requirements of the test reference for Open Field Radiated Emissions.

PART 4
BANDWIDTH MEASUREMENTS
Per FCC PART 15 SECTION 47 CFR §15.247(2)

4.1 Configuration and Procedure

4.1.1 EUT Configuration

The C & I was set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was an Hewlett Packard 8566B Spectrum Analyzer with detector and bandwidth parameters as stipulated in C63.4-1992.

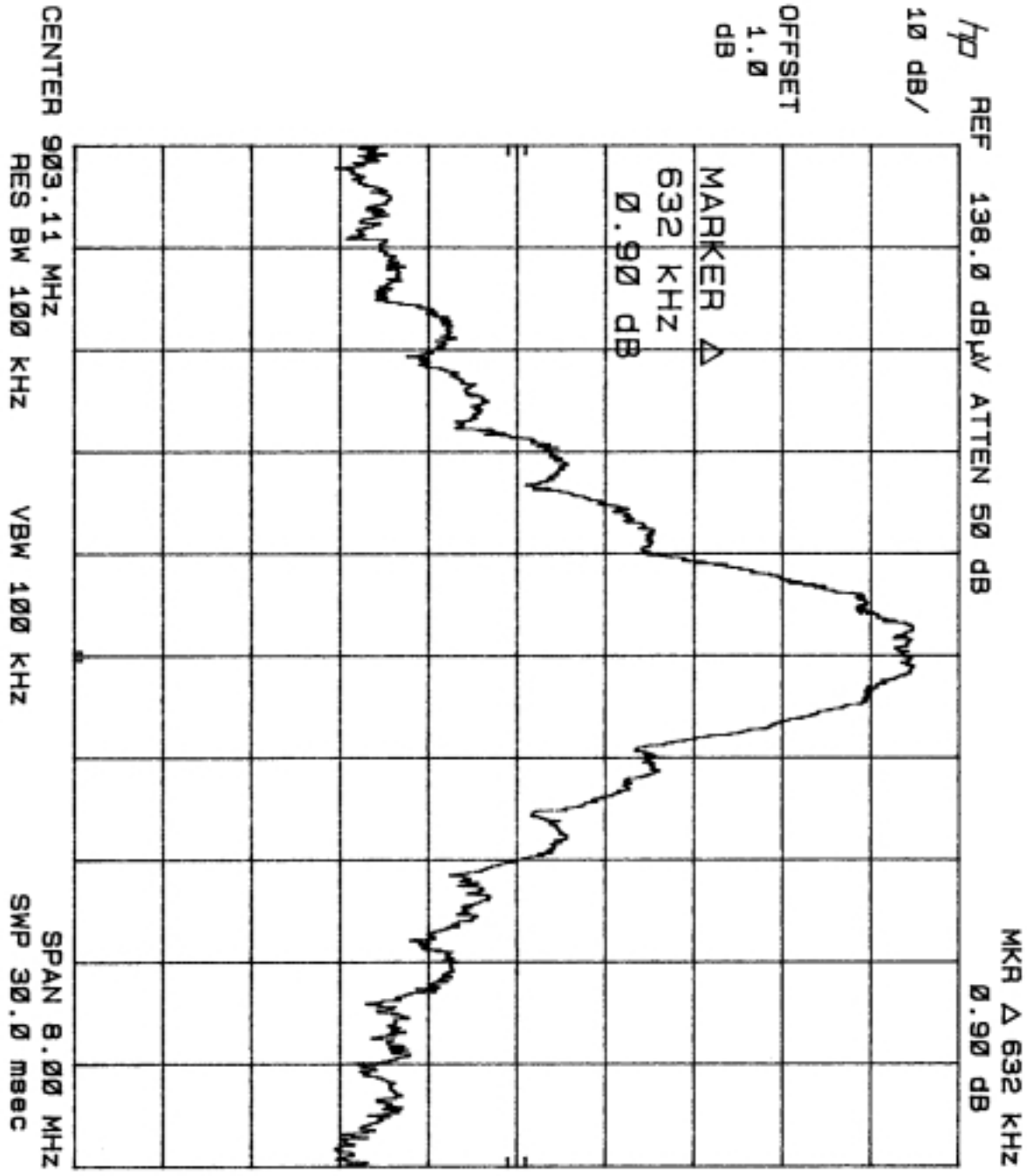
4.1.2 Test Procedure

The C & I was placed on the test table. The EUT was configured for maximum response and was set up as described above to transmit continuously. Signal was monitored with a HP 8566B Spectrum Analyzer, using the EMCO Double-Ridged Waveguide Horn Antenna, model #3115.

4.2.1 Bandwidth Test

Per FCC Part 15 Section 47 CFR §15.247(2)

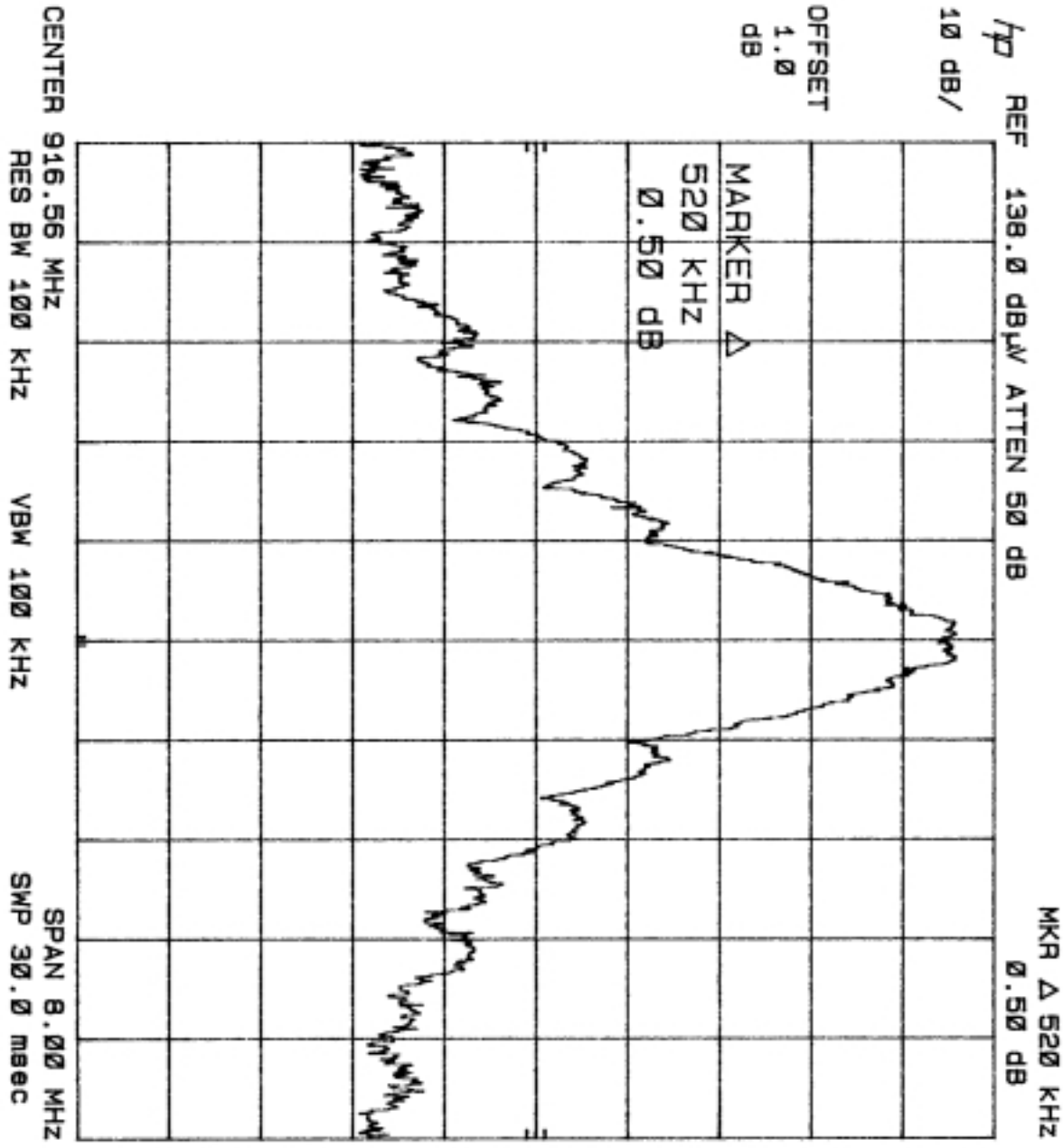
Conducted 6dB Bandwidth Plot –Conductive (Low Channel Frequency), LAN (NCI)



4.2.2 Bandwidth Test

Per FCC Part 15 Section 47 CFR §15.247(2)

Conductive 6dB Bandwidth Plot –Conductive (Medium Channel Frequency) , LAN (NCI)



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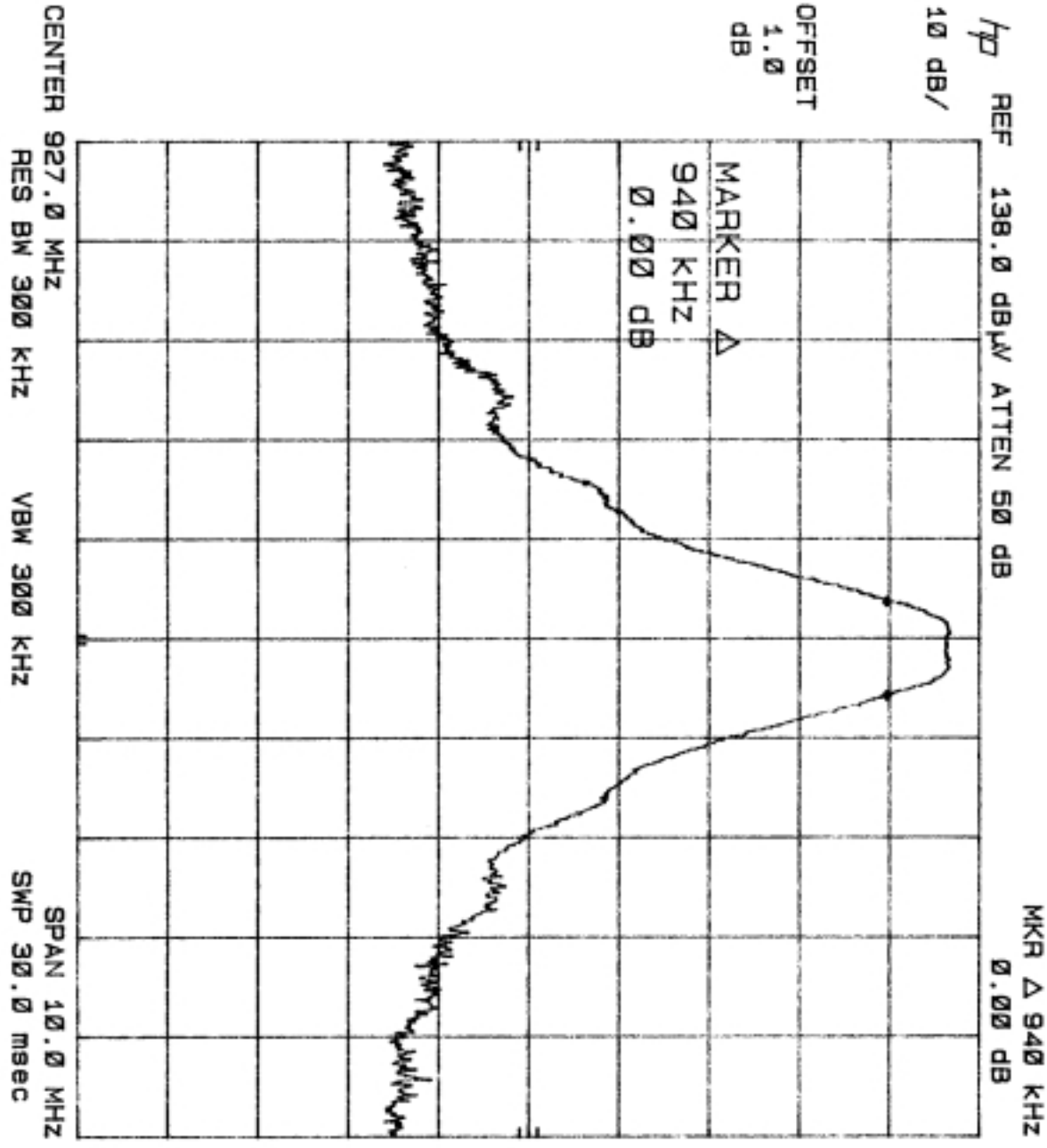
Web: www.itcemc.com

4.2.3 Bandwidth Test

Per FCC Part 15 Section 47 CFR §15.247(2)

Conductive 6dB Bandwidth Plot –Conductive (High Channel Frequency), LAN (NCI)



PART 5
FUNDAMENTAL HARMONIC & SPURIOUS EMISSIONS
Per FCC PART 2 SECTION 47 CFR §2.1053 &
PART 15 SECTION 47 CFR §15.249(a)

5.1. Configuration and Procedure

5.1.1 EUT Configuration

The C & I was set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was Hewlett Packard 8566B and 8569A Spectrum Analyzers with detector and bandwidth parameters as stipulated in C63.4-1992. At frequencies above 1GHz, average measurements, if necessary, were made using the video filter method and quasi peak detector and preselector functions were disabled.

5.1.2 Test Procedure

The C & I was placed on the test table. The EUT was configured for maximum response and was set up as described above and configured to transmit continuously. Signal strength was monitored at HP 8566B and 8569A Spectrum Analyzers, below and above the center frequencies using an appropriate receiving antenna. Maximum emissions were obtained by varying the height of the antennas and then orienting the turntable in 360-degree turns with the analyzer in the manual mode. Unless stated otherwise, the antenna to EUT distance was 3 meters. Any multiple entries cover the two orientations of the C & Is and cover all three axes due to rotation of the test table and EUT and are the maximum signals resulting from rotation and height search at each frequency. The measurements are quasi-peak measurements below 1 GHz and average measurements above 1 GHz

5.1.3 Spectrum Analyzer Configuration (During Swept Frequency Scans)

Start Frequency ..... 30 MHz
Stop Frequency..... 1,000MHz
Sweep Speed ..... Manual
RES & Video Bandwidth 100KHz
Quasi Peak Adapter Mode..... Normal
Quasi peak Adapter Bandwidth..... 120 KHz
Measurements above 1GHz (unless stated otherwise)
Start Frequency ..... 1 GHz
Stop Frequency..... 24.835 GHz
Sweep Speed ..... Manual
Analyzer Mode ..... Video Filter
RES Bandwidth..... 1MHz
Video Bandwidth..... 1MHz

5.2 Fundamental Harmonic & Spurious Emissions of the LAN (NCI) module
Per Part 15 Section 47 CFR §15.247 (c)

5.2.1 Administrative Details

Date(s) of Test: April 7 - 10, 2000
Emission Limits: Class C
Test Technician(s): Bruce Gordon

5.2.2 Test Results

The table below shows a summary of the highest amplitudes of the radiated emissions from the equipment under test at various antenna heights, antenna polarizations, and EUT orientations.

Table #1: Harmonics and Spurious Emissions at Low Frequency
Channel 0 [903MHz] of the C & I Meter with LAN (NCI) transmitting at 1-m distance.

FREQ	AMPL	ANT	CAB	Amplifier	Distance	Ant Ht	POL	Total	LIMIT	MARGIN
Mhz	dBuV	Loss(dB)	Loss(dB)	Gain(dB)	3m (dB)	m	Ant	dBuV/m	dBuV/m	dB
139.6	39.8	12.6	4.1	-35.5	-10.5	1.1	VB	10.5	96.9	-86.4
265.9	45.9	13.8	5.2	-35.5	-10.5	1.15	VL	18.9	96.9	-78
330.2	58.4	15.4	5.4	-35.5	-10.5	1.1	VL	33.2	96.9	-63.7
* 903.2	136.3	25.5	1.1	-35.5	-10.5	1.2	VH	116.9		
**1806.00	68.9	27.2	2	-35.5	-10.5	1.2	VH	52.1	96.9	-44.8
*** 2712	59.1	29.4	3.5	-35.5	-10.5	1.1	VH	46	96.9	-50.9
3618	53.3	32.5	5.7	-35.5	-10.5	1.2	VH	45.5	96.9	-51.4
4524	43.6	33.5	8.9	-35.5	-10.5	1.1	VH	40	96.9	-56.9
5430	21.6	35.3	12.4	-35.5	-10.5	1.2	VH	23.3	96.9	-73.6

* Fundamental
** 2nd Harmonics
*** 3rd Harmonics

5.2 Fundamental Harmonic & Spurious Emissions of the LAN (NCI) module

Per FCC Part 2 Section 47 CFR §2.1053 & Part 15 Section 47 CFR §15.247(c)…

Table #2: Harmonics and Spurious Emissions at Middle Frequency Channel 9 [916MHz] of the C& I Meter with LAN (NCI) transmitting at 1-m distance.

FREQ	AMPL	ANT	CAB	Amplifier	Distance	Ant Ht	POL	Total	LIMIT	MARGIN
Mhz	dBuV	Loss(dB)	Loss(dB)	Gain(dB)	3m (dB)	m	Ant	dBuV/m	dBuV/m	dB
133.6	45.7	12.9	4	-35.5	-10.5	1.1	VB	16.6	98.6	-82
139.2	41.9	12.6	4.1	-35.5	-10.5	1.15	VB	12.6	98.6	-86
264.47	53.7	13.8	5.2	-35.5	-10.5	1.1	VL	26.7	98.6	-71.9
264.6	51.2	13.8	5.2	-35.5	-10.5	1.2	HL	24.2	98.6	-74.4
323.06	61.6	15.4	5.4	-35.5	-10.5	1.2	VL	36.4	98.6	-62.2
* 915.7	137.9	25.5	1.2	-35.5	-10.5	1.1	VH	118.6		
** 1831.4	59.8	27.4	2.1	-35.5	-10.5	1.2	VH	43.3	98.6	-55.3
*** 2747.1	65.2	29.5	3.6	-35.5	-10.5	1.1	VH	52.3	98.6	-46.3
3662.8	51.7	32.5	6	-35.5	-10.5	1.2	VH	44.2	98.6	-54.4
4578.5	42.4	33.5	9.4	-35.5	-10.5	1.3	VH	39.3	98.6	-59.3
5494.2	31.3	35.3	13	-35.5	-10.5	1.1	VH	33.6	98.6	-65

* Fundamental
** 2nd Harmonics
*** 3rd Harmonics

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5.2 Fundamental Harmonic & Spurious Emissions of the LAN (NCI) module

Per FCC Part 2 Section 47 CFR §2.1053 & Part 15 Section 47 CFR §15.247(c).

Table #3: Harmonics and Spurious Emissions at high Frequency Channel 16 [927MHz] of the C& I Meter with LAN (NCI) transmitting at 1-m distance.

FREQ	AMPL	ANT	CAB	Amplifier	Distance	Ant Ht	POL	Total	LIMIT	MARGIN
Mhz	dBuV	Loss(dB)	Loss(dB)	Gain(dB)	3m (dB)	m	Ant	dBuV/m	dBuV/m	dB
133.68	47.3	12.9	4	-35.5	-10.5	1.1	VB	18.2	98.2	-80
139.31	44.6	12.6	4.1	-35.5	-10.5	1.2	VB	15.3	98.2	-82.9
264.42	56.7	13.8	5.2	-35.5	-10.5	1.2	VL	29.7	98.2	-68.5
264.55	55.9	13.8	5.2	-35.5	-10.5	1.2	HL	28.9	98.2	-69.3
323.19	63.2	15.4	5.4	-35.5	-10.5	1.2	VL	38	98.2	-60.2
* 927.5	137.5	25.5	1.2	-35.5	-10.5	1.1	VH	118.2		
** 1855	61.8	27.4	2.2	-35.5	-10.5	1.2	VH	45.4	98.2	-52.8
** 2782.5	63.7	29.5	3.8	-35.5	-10.5	1.1	VH	51	98.2	-47.2
3710	55.2	33	6.2	-35.5	-10.5	1.2	VH	48.4	98.2	-49.8
4637.5	41.9	33.8	9.6	-35.5	-10.5	1.1	VH	39.3	98.2	-58.9
5565	36.8	35.3	13.4	-35.5	-10.5	1.2	VH	39.5	98.2	-58.7

* Fundamental
** 2nd Harmonics
*** 3rd Harmonics

No emissions of significant levels were observed in any 100 Khz bandwidth and the peak emissions that ere measured were at least 20 dB below the output measured in 100 Khz bandwidth.
No emissions of significant levels were observed between the highest frequency shown in the above data and up to 10th harmonics.

Conclusion: The C & I Meters meet the requirements of the test reference for Harmonics and Spurious Emissions.

PART 6
MAXIMUM PEAK OUTPUT POWER
Per FCC PART 15 SECTION 47 CFR §15.247 (b)

6.1. Configuration and Procedure

6.1.1 EUT Configuration

The C & I meter was set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was an Hewlett Packard 8569A Spectrum Analyzer with detector and bandwidth parameters as stipulated in C63.4-1992.

6.1.2 Test Procedure

The C & I was placed on the test table. The EUT was configured for maximum response and was set up as described above and configured to transmit continuously. Signal was monitored with a HP 8566B Spectrum Analyzer, using the EMCO Double-Ridged Waveguide Horn Antenna, model 3115. Unless stated otherwise, the antenna to EUT distance was 1 meter. The RF power output = Measured value + antenna correction + cable correction –Amplifier Gain (if provided)

6.2.1 Maximum Peak Output Power

Per FCC Part 15 Section 47 CFR §15.247(b)

Maximum Conductive Peak Output Power Plot of LAN (NCI), Low channel Frequency

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.2.2 Maximum Peak Output Power

Per FCC Part 15 Section 47 CFR §15.247(b)

Maximum Conductive Peak Output Power Plot of LAN (NCI), Medium Channel

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6.2.3 Maximum Peak Output Power
Per FCC Part 15 Section 47 CFR §15.247(b)

Maximum Conductive Peak Output Power Plot of LAN (NCI), High Channel Frequency

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6.3.1 Conductive Peak Power Spectral Density Per FCC Part 15 Section 47 CFR §15.247(d)

Maximum Conductive Peak Power Density Plot f LAN (NCI), Low Frequency

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6.3.2 Conductive Peak Power Spectral Density Per FCC Part 15 Section 47 CFR §15.247(d)

Maximum Conductive Peak Power Density Plot of LAN (NCI), Medium Frequency

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6.3.3 Conductive Peak Power Spectral Density Per FCC Part 15 Section 47 CFR §15.247(d)

Maximum Conductive Peak Power Density Plot Of LAN (NCI), High Frequency

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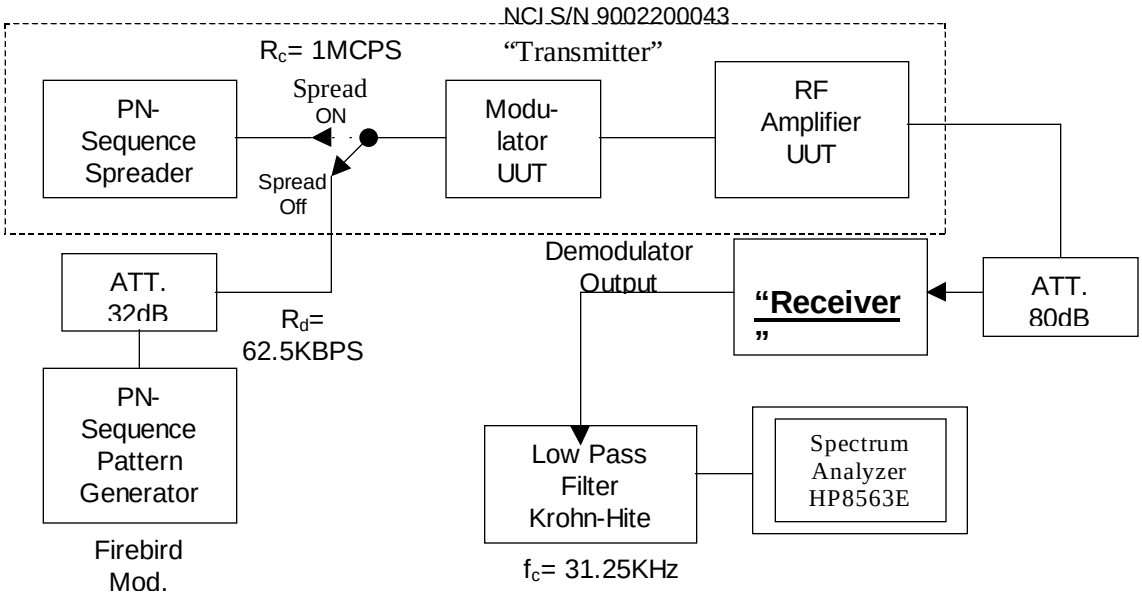
6.4 Processing Gain Measurement
Per FCC Part 15 Section 47 CFR §15.247(e) (1)

"Processing Gain Measurement"
Reference: FCC Requirements Part 15, Paragraph 15.247, (e), (1)

Test block diagram:



Test Parameters:

1) Data rate R_d= 62.5KBPS
   Symbol rate R_s= 31.25KSPS
2) Chip Rate R_c= 1MCPS
3) Processing gain G_p= 10*Log(R_c/R_d)= 12dB
4) Receiver low pass filter cut-off frequency
   f_c= symbol rate= 31.25KHz
5) Low pass filter characteristic: Maximally flat, 48dB/Octave

Test method (para. 15.247 (e) (1)):

1) The data sequence is generated by the PN-Sequence pattern generator at 62.5KHz . This generator emulates the original data generated internally by the ASIC chip in the UUT. The test pattern used is a maximal sequence of length 2047 (R-11).
2) The processing gain is the difference between the unspread S/N to the spread S/N at the output of the low pass filter, expressed in "dB".
3) Since the noise power at the output of the low pass filter does not change when the signal is unspread or spread, the processing gain is measured by comparing the power spectrum of the unspread and spread signals.

DSSS Processing Gain Calculation of LAN (NCI) Module per FCC 15.247 (e)

- The Transmit module generates the spread spectrum binary sequence for output to the RF modulator (directly modulated VCO.

- The Transmitter logic encodes two consecutive bits of data into one of four possible 32- bit (chip) PN sequences. Consequently, an improvement in the signal to noise ratio is achieved since each pair of the data bit is now represented by 32 chips. The improvement, or processing gain in decibel is calculated as:

1. data rate: 62.5KBs
2. chip rate: 62.5KBs x 16B/B = 1MB/s
3. modulated transmission BW: 1.0MHz (6dB BW, measured)

- $G_p = BW_{transmission}$ / data rate
- $G_p = [10 \log(16)]dB$
- $G_p = 12dB$

Processing Gain = 12 dB

The Transmitted PN sequence is further randomized by modulus-2 addition with a fixed 2047-bit PN sequence. This operation smoothes (spectral Whitens) the output spectrum by eliminating discrete spectral components

APPENDIX A
MEASUREMENT PROCEDURES

Conducted Emissions

The measurements are performed in a 21' x 14' x 9' shielded room. A wooden bench 80 cm in height is located at the center of the shielded room; desktop EUT are placed on top of this bench. The rear of the EUT and bench are placed 40 cm from the shielded room wall. All items on the table (or test-table) are placed at least 10 cm apart. Excess EUT power cord is folded back and forth to form a 30 cm by 40 cm long bundle, hanging approximately in the middle between the ground plane and table. The EUT power cord is plugged into a LISN 80 cm away, while all other devices are plugged into a second LISN, also 80 cm away from the closest part of the EUT.

The highest emissions are also analyzed in detail by operating the spectrum analyzer in fixed tuned mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables are moved around to maximize the emissions, and the position of the peripheral devices are interchanged to check for any changes in emissions.

Radiated Emissions

The EUT is set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992.

The EUT and support equipment is set up on the turntable of an open field site. Desktop EUT are set up on a wooden stand (test table), 80 cm above the ground plane. All items on the table are placed at least 10 cm apart. Interconnecting cables which hang closer than 40 cm to the ground plane are folded back and forth to form a 30 cm by 40 cm long bundle, hanging approximately between the ground plane and table.

The highest emissions are also analyzed, in detail, by operating the spectrum analyzer in fixed tuned quasi-peak mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables are moved around and at the highest amplitudes observed, the EUT is rotated in the horizontal plane while changing the antenna polarization in the vertical plane to maximize the reading. Once the maximum reading is obtained, the antenna elevation and polarization will be varied between specified limits to maximize the readings. The position of the peripheral devices is interchanged to check for any changes in emissions.

APPENDIX B
DESCRIPTION OF OPEN FIELD TEST SITE

The open field test site is located on a 5.5-acre parcel, in the agriculturally zoned section of the city of Sunol, California. It is situated adjacent to Highway 680 on the West Side, and adjacent to Calaveras Road in the Southeast. Distance of the site to each of these roads is a minimum of 200 feet. The north end of the site is surrounded by hills measuring up to 150 ft. high. The distance of the site to the hills is approximately 200 ft.

Supporting structures used to support device being measured and test instrumentation include the following:

a. Test Platform measuring 50 ft by 100 ft. The platform is located on top of a very large ground screen, to enhance a homogeneous reflective surface.

b. Test Site building measures approx. 5000 Sq. ft. This building houses the test laboratory, the shielded room, for performing Line Conducted test, test personnel and other support staff. The test building is an all-wooden building, constructed using 2 by 4-inch studs. It also contains all necessary electrical wiring and utilities.

The International Technology Company (ITC) RFI test site described above has been approved for conducting contract RFI measurement work for client companies following the procedures stated in FCC/OET ANSI C63.4-1992, EN 55011, EN 55022 Vfg. 243/1991 and VDE-0877. The site attenuation characteristics are routinely measured and recorded every three months.

Test site approved by VDE, File # F-R HF-MK.
Test site approved by FCC, Registration # 31010/SIT/ ITC.
Test site approved by VCCI, Membership # 242.
Test site approved by the Industry Canada, Registration # DEB 5072-7, DEB 90-3008.

APPENDIX C
TEST EQUIPMENT

Some or all of the following test equipment is currently used to measure the conducted and/or radiated emissions from the equipment under test:

Test Equipment	*Model*	*Serial Number*
Spectrum Analyzer	Hewlett Packard 8590A	2752 A02715
Spectrum Monitor	Rhode & Schwarz EZM	881 334/025
Test Receiver (9 KHz - 30 MHz)	Rhode & Schwarz ESH3	RES 0753
Test Receiver (20-1300 MHz)	Rhode & Schwarz ESVP	RES 0749
Spectrum Analyzer	Hewlett-Packard 8566B	2618A02909
Spectrum Analyzer	Hewlett-Packard 8567A	2602A00239
Spectrum Analyzer Display (Site 1)	Hewlett-Packard 8590A	2542A11954
Spectrum Analyzer Display (Site 2)	Hewlett-Packard 85662A	2542A12593
Quasi Peak Adapter (Site 1)	Hewlett-Packard 85650	2521A00871
Quasi Peak Adapter (Site 2)	Hewlett-Packard 85650A	2521A00737
Preselector (Site 1)	Hewlett-Packard 85685A	2620A00265
Preselector (Site 2)	Hewlett-Packard 85685A	2648A00462
Preamp	Hewlett-Packard 8447D	2648A04855
Preamp	Hewlett-Packard 8449B	3008A00101
Computer	Hewlett-Packard 9000/300	RES 449
Absorbing Clamp	MDS21	891 092/025
Antenna Cable (OPTK45)	RG8/u	-
Antenna System	EMCO 3230	-
Biconical Antenna (Site 1)	EMCO 3104	3549
Biconical Antenna (Site 2)	EMCO 3104C	9111-4463
Log Periodic Antenna (Site 1) (200-1000 MHz)	EMCO 3146	2075
Log Periodic Antenna (Site 2) (200-1000 MHz)	EMCO 3146	9510-4202
Adj. Element Dipole Antenna (28 MHz-1 GHz)	EMCO 3120	2632
Horn Antenna	Eaton 96001	2632
LISN (25 Amp)	EMCO 38825/2	xxx0-2008
LISN (100 Amp)	Solar 8610-50-TS-100N	
LISN	EMCO 3825/2R	1188/1001

Test Equipment...

Test Equipment	*Model*	*Serial Number*
Remote Controlled 8 ft Rotating Table	RES RT1	
Remote Controlled 25 ft Rotating Table	RES RT2	
Remote Controlled 4 ft Rotating Table	RES RT3, RT4, RT5	
Remote Controlled 4 m Antenna Mast	RES AM1	
Remote Controlled 6 m Antenna Mast	RES AM2, RES AM3	
3 Phase 220 VAC/50 Hz Generator	-	DB7130B40
Oscilloscope (300 MHz)	Tektronix 2465	
Digital Scope	Hitachi VC-6075	
Power Analyzer	Valhalla Scientific/2101	RES 574
Digital Thermometer	Omega 440	
DC Power Supply	Kepco JQE 150-1.5m	H177085

The spectrum analyzers are self-calibrated before every test and are calibrated to NIST standards annually. All of the other EMI equipment is calibrated on a monthly basis using the spectrum analyzers as standards. Calibration dates of equipment are June 25, 1999. Next calibration is due on June 25, 2000.

APPENDIX D
EUT TECHNICAL DESCRIPTION / SPECIFICATION

C & I Meter Specification

Power Supply [*Electrical]*

- 90 – 265 VAC input voltage range
- 50 or 60 Hz
- 100% operational with 100 mS of service interruption
- +5 VDC ± 5% @ 3.5 A output, continuous
- +3.6 VDC @ 300 mA output, continuous
- Maximum ripple of ± 100 mV
- Load Regulation of ± 5 %
- Isolation designed to applicable portions of the ANSI C-12 standard
- Appropriate protection against lightning strikes, short circuits and line surges should be placed on the front end of the power supply

Power Supply [Mechanical]

- Power Indication LED and 2 data LEDs on the Ampro parallel port
- An SPI UART and RS232 level shifter for interface with the NCI
- A coin cell battery for the Real Time Clock backup (refer to section 2.6 for battery specification)
- A manual processor reset, push button switch
- PC/104 power interface; 1-64 and 1-40 pin dual row 0.100” centers female sockets
- 2-10 pin 0.100” centers dual row female sockets for the Ampro COM1 and COM2 RS232 serial ports
- 1-10 pin 0.100” centers dual row female socket for the Ampro utility port
- 1-26 pin 0.100” centers dual row female socket for the Ampro parallel port
- 4 mounting holes for the PC/104 card
- 2-22 pin 2 mm centers dual row female shrouded connector for Pager and for NCI board
- 4 mounting holes for the Pager
- 4 mounting holes for the NCI board
- A copper area underneath the NCI for shielding
- A 5 pin straight, keyed Molex type 0.156” centers header, with pins 2 and 4 removed, for power connection.
- A 3 pin straight, keyed Molex type 0.156” centers header, with pin 2 removed, for Telco connection
- A 2 pin straight, keyed Molex type 0.156” centers header for the modem connection

Power Supply [*Environmental]*

- -40 - +85 o C working temperature range
- Up to 95 % humidity (non-condensing)
- 10 years mean time before failure

C & I Meter Specification…..

Control Module [Electrical]

- Ampro Core Module / 3SXi
- +5 VDC powered through PC/104 Interface
- 500 mA consumption

Control Module [Mechanical]

- PC/104 form factor and interface
- Two serial (RS232) ports with a 10 pin dual row straight 0.100" centers headers placed on the bottom of the board
- One parallel interface port with a 26 pin dual row straight 0.100" centers headers placed on the bottom of the board
- One utility port with a 10 pin dual row straight 0.100" centers headers placed on the bottom of the board
- Do not populate J6 Floppy interface header
- Do not populate J8 IDE interface header
- Do not populate J7 power header

Control Module [Environmental]

- -40 - +85 o C working temperature range

NCI Module[Electrical]

- 500 mA @ +5 VDC and 150 mA @ +3.6 VDC power supply
- RF Specification (Refer to NCI specification document)
- Appropriate protection against lightning strikes and Electro Static Discharge (ESD) should be placed between the NCI and the corresponding antenna

NCI Module[Mechanical]]

- 1-22 pin 2 mm centers dual row male shrouded connector, placed on the bottom of the board for power, serial (RS232) and other I/O connections

NCI Module[Environmental]

- -40 - +85 o C working temperature range

Pager [Environmental]

-40 - +85 o C working temperature range

RTC Backup Battery

The following requirements are based on backing up the Real Time Clock only. The requirements do not take into account backing up of the SRAM.

- 3.6 V Lithium coin cell
- 165 mAh minimum capacity
- Board mount
- -40 - +85 o C working temperature range
- 10 year battery life

Specification…..

Enclosure

- NEMA 4X steel type
- Powder coated (white preferred for final product)
- 8"x 6"x 3.5" in dimension
- Dedicated grounding stud
- Removable lid with a weather proof gasket
- 3 outside connector holes; 1 for the power connector, 1 for the LAN antenna connector and 1 for the WAN antenna connector or the Telco connector.

LAN Antenna

- 902 – 928 MHz
- 3 dBi Gain
- N type connector
- Pivot base with set screws
- 50 Ohms
- Water resistant

Housing Connectors

- N type, antenna outside mount connector with a 3 feet RG316/U cable and a straight SMA on the other end of the cable
- 4 pin Power Conxall metal type female connector with 4-18 AWG, **XX** inches wires, and a 5 pin Molex type keyed female 0.156" centers connector on the other end of the cable
- 3 pin Telco Conxall metal type female connector with 3-18 AWG, **XX** inches wires, and a 3 pin Molex type keyed female 0.156" centers connector on the other end of the cable

External Cables

- 4 pin Power Conxall metal type male over-molded connector with 4-18 AWG shielded and sleeved, **XX** feet wires, and a 3 prong light pole power connector on the other end of the cable
- 3 pin Telco Conxall metal type male over-molded with 3-18 AWG shielded and sleeved, **XX** feet wires, without any termination on the other end of the cable.

NCI (LAN) RF Module Specifications
Per FCC 2.1033 (b)(4)

- Frequency Range 903-927 Mhz
- Spectrum Technique Direct Sequence Spread Spectrum
- Modulation Scheme Minimum Shift Key (MSK)
- Bit Rate 62.5 kb/sec (12Mhz/192)
- Chipping Rate 1Mc/sec (62.5kb/sec x 16 chips/bit)
- Channel Capacity 17 (From 0-16)
- Channel Spacing 1.5 Mhz
- Power supply 3.6Vdc/500 mA (Constant Tx)
- Power Consumption 3.6Vdc/90 mA (Constant Rx)
- PLL VCO 1.4 V max
- Null to Null Bandwidth 1.5 Mhz
- 6 dB Bandwidth > 600 Khz
- First Side-lobe Level 25dBc
- Output Power 30dBm
- Receive Sensitivity -90 dBm
- Frequency Tolerance ± 20ppm
- Total Frequency Drift ± 45ppm
- List of Channel Frequency:

List of Channel Frequency

CHANNEL	Freq.(Mhz)
0	903.0
1	904.5
2	906.0
3	907.5
4	909.0
5	910.5
6	912.0
7	913.5
8	915.0
9	916.5
10	918.0
11	919.5
12	xxx.0
13	922.5
14	924.0
15	925.5
16	927.0

DSSS Processing Gain Calculation of LAN (NCI) Module per FCC 15.247 (4)(d)

- The Transmit module generates the spread spectrum binary sequence for output to the RF modulator (directly modulated VCO.

- The Transmitter logic encodes two consecutive bits of data into one of four possible 32- bit (chip) PN sequences. Consequently, an improvement in the signal to noise ratio is achieved since each pair of the data bit is now represented by 32 chips. The improvement, or processing gain in decibel is calculated as:

  Processing Gain = 10 log (32chips/2 bits)
  Processing Gain = 12 dB

- The Transmitted PN sequence is further randomized by modulus-2 addition with a fixed 2047-bit PN sequence. This operation smoothes (spectral Whitens) the output spectrum by eliminating discrete spectral components.

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APPENDIX E
MODIFICATION LETTER

To whom it may concern:

This is to certify that **No Modifications** were necessary for:

C & I, models: Pager/Gateway and Telco/Gateway

To comply with:

1. Powerline Conducted Emissions in a shielded room utilizing two LISN's in accordance with the FCC test procedure 47 CFR §15.207.

2. Radiated Emissions in a 3-meter open area site in accordance with the FCC test procedure 47 CFR §15.209 and §15.31(m).

3. Occupied Bandwidth Test in accordance with the FCC test procedure 47 CFR §15.247.

4. Harmonics and Spurious Emissions Test in accordance with the FCC test procedure 47 CFR §2.1053 and §15.247(c).

5. Maximum Peak Output Power Test Requirement in accordance with 47 CFR §15.247(b).

The results show that the sample equipment tested as described in this report is in compliance with the FCC Rules Part 15, SubPart B: Powerline Conducted Emissions, en Field Radiated Emissions. Occupied Bandwidth, Harmonics and Spurious Emissions and Maximum Peak Output Power test requirement limits of, SubPart C.

For further information, please contact the manufacturer at

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