DNB ENGINEERING, INC.

CERTIFICATION
FOR
INTENTIONAL RADIATOR

per
Part 15 Subpart C
(CFR 47, 15,203, 15.207, 15.209 & 15.249)

EUT: 2.4 GHz TRANSMITTER

PREPARED FOR APPLICANT:
VECCOM
3 TZE Chiang 1 Road
Chingli Industrial Park
Tao Yuan Hsien, Taiwan, ROC

REPORT # 96023-1
Test Date: Sept. 30 – Oct. 2, 1998

Prepared By:
DNB ENGINEERING, INC.
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Revision Letter	Number of Pages	Page No. of Rev.	Description	Date
A			Document Release	

TRANSMITTAL SUMMARY

Unit tested:	2.4 GHz TRANSMITTER
Model #:	2G4 TX Module
FCC ID:	LB32G4-TX-MOD
Specifications:	ANSI C63.4 (1992) and CFR 47 FCC part 15 Subpart C
Purpose of Report:	This report was prepared to document the status of the 2.4 GHz TRANSMITTER with requirements of the standards listed above.
Requirements not applicable to EUT	Part 15.37 - Not applicable Emergency Broadcast System - Not applicable Spread Spectrum Exhibit - Not applicable Scanning Receiver - Not applicable
Test Summary	The EUT's compliance status according to the tests performed is as follows.

REQUIREMENTS	STATUS
FCC part 15 Subpart C	
per 15.203, 15.207, 15.209 & 15.249	COMPLIANT

CERTIFICATION OF TEST DATA - per 2.911(d)

This report, containing emissions test data and evaluations, has been prepared by an independent electromagnetic compatibility laboratory, DNB ENGINEERING, in accordance with the applicable specifications and instructions required per the Introduction. DNB Engineering has been evaluated to do these tests by the American Association for Laboratory Accreditation, A2LA.

The data evaluation and equipment configuration presented herein are a true and accurate representation of the measurements of the test emissions characteristics as of the dates and at the times of the test under the conditions herein specified.

Equipment Tested:	2.4 GHz TRANSMITTER
Model #:	2G4 TX Module
FCC ID#:	LB32G4-TX-MOD
Dates of Test:	Sept. 30 – Oct. 2, 1998

Test Performed: _____ _____

Gaylord Alexander Buchanan — Date
Test Technician

Test Report Reviewed: _____ _____

Rick Linford — Date
Facility Manager
Regulatory Engineer

TABLE OF CONTENTS

1. **INTRODUCTION** **6**

1.1 ADMINISTRATIVE DATA PER 2.1033(A) AND 2.911(C) 6
1.1.1 REQUEST FOR CERTIFICATION Per 2.1033(b)1: *6*
1.2 RELATED SUBMITTALS/GRANTS 6
1.3 PURPOSE OF TESTS 6

2. TEST DESCRIPTION **7**

2.1 TEST CONFIGURATION *7*
2.2 EQUIPMENT DESCRIPTION 7
2.2.1 Mode of Operation *7*
2.3 ANTENNA REQUIREMENT - PER 15.203 7
2.4 SCHEMATICS ..... **Error! Bookmark not defined.**
2.4.1 Circuit Description - per 2.1033(b)4 ..... *8*
2.5 PHOTOGRAPH OF EUT - PER 2.1033(B)(7) 9

3. EMISSIONS FCC PART 15 ..... **10**

3.1 RADIATED EMISSIONS TEST SETUP AND PROCEDURE - PER 2.1033(B)(6) PER 2.947(A) 10
3.1.1 Spurious Radiation Test Site Per 2.1033(b)6 ..... *10*
3.1.2 Example Of Typical Calculation Per 2.1033(b)6 ..... *12*
3.1.3 Diagram of Test Setup - per 2.1033(b)5 ..... *13*
3.1.4 Field Strength of Intentional Radiator Inside of Band *14*
3.1.5 Emissions Radiated Outside of Band *15*
3.1.6 Occupied Bandwidth *16*
3.1.7 Photograph of Radiated Test Setup - per 2.1033(b)(7) *17*
3.2 CONDUCTED EMISSIONS TEST SETUP AND PROCEDURE - PER 2.1033(B)(6) PER 2.947(A) 18
3.2.1 Diagram of Test Setup - per 2.1033(b)5 ..... *19*
3.2.2 Conducted Compliance Data - table #2 ..... *20*
3.2.3 Photographs of Conducted Test Setup - per 2.1033(b)(7) *21*

4. LABELING REQUIREMENTS - PER 2.1033(B)(7) **22**

4.1 ADDITIONAL LABEL REQUIRED 22
4.2 PHOTOGRAPH OF LABEL 22

5. SCHEMATIC DIAGRAMS **23**

6. OWNERS MANUAL **24**

7. APPENDIX SECTION **25**

7.1 APPENDIX A: TEST DATA 26
7.2 APPENDIX B: UNCERTAINTY TOLERANCE 27
7.3 APPENDIX C: TEST SITE CERTIFICATION, CHALK CREEK EMI SITE - PER 2.948(A) 29
7.4 APPENDIX D: EMC INSTRUMENTATION 31
7.5 APPENDIX E: INFORMATION SUPPLIED TO APPLICANT 33

1. INTRODUCTION

1.1 Administrative Data Per 2.1033(a) and 2.911(c)

1.1.1 REQUEST FOR CERTIFICATION Per 2.1033(b)1:

Applicant: ***VECCOM***
3 TZE Chiang 1 Road
Chingli Industrial Park
Tao Yuan Hsien, Taiwan, ROC

Contact: Steven Chang

Dates of Test: Sept. 30 – Oct. 2, 1998

Equipment Under Test (EUT): 2.4 GHz TRANSMITTER
FCC ID: LB32G4-TX-MOD

1.2 Related Submittals/Grants

None

1.3 Purpose of Tests

The purpose of this series of tests was to demonstrate the Electromagnetic Compatibility (EMC) characteristics of the EUT. The following tests were performed:

REQUIREMENTS	STATUS
FCC part 15 Subpart C	
per 15.203, 15.207, 15.209 & 15.249	COMPLIANT

2. TEST DESCRIPTION

2.1 Test Configuration

Config-uration	Unit Name - Processor, Monitor, Printer, Cable, etc. (indent for features of a unit)	Style/Model/ Part No.	Serial Number	Obj. of test	120V	220V	Comments/ FCC ID#
A	2.4 GHz TRANSMITTER	2G4 TX Module		■			12 Vdc
	AC to DC Adapter, Avshare	M/N SPC41-120500			■		120 Vac to 12 Vdc
	1000 Hz audio source	HP 652A			■		
	Audio Cables	RCA Jack					Right and Left
	Video Source	Panasonic					
	Video Cable	RG58					CCTV

■ - *Specific device(s) for which this test is being conducted.*

2.2 Equipment Description

Wireless audio video sharing device. Allows a user to view video and hear audio on television or audio on a stereo that is located remotely from a VCR, CD without using wires.

2.2.1 Mode of Operation

Input a 1 kHz tone into Audio Channels and CCTV video into video input.

2.3 Antenna Requirement - per 15.203

Antenna is soldered on both ends; it is not interchangeable.

2.3.1 Circuit Description - per 2.1033(b)4

Send video input signal through video pre-emphasis circuits and amplifier circuits along with audio input signal left and right channels, then pass through audio pre-emphasis circuit which is being separately modulated into 6.0 MHz and 6.5 MHz. Next, combine audio with video signals and modulate into 2.4 GHz, then through amplifier transmitter in which the CPU controls 4 LED select channels s/w and uses I2CHUS to control P22(SDA5055) for oscillation, 2.4 GHz carrier frequency.

2.3.2 Photograph of EUT - per 2.1033(b)(7)

2.4 GHz TRANSMITTER

Photo # 1. Complete assembly - Top View
Photo # 2. Complete assembly - Bottom View
Photo # 3. RF Module - Bottom View
Photo # 4. RF Module Internal - Side 1 View
Photo # 5. RF Module Internal - Side 2 View

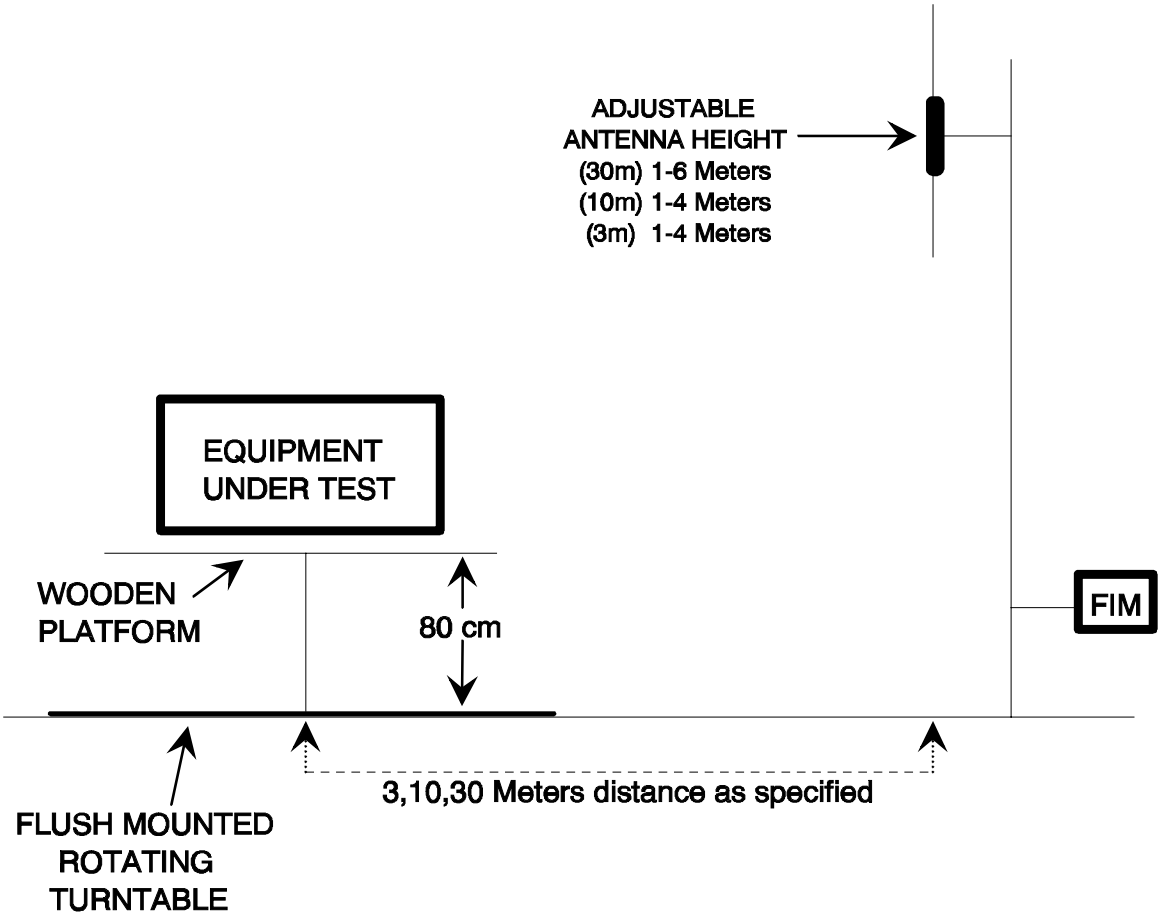
3. EMISSIONS FCC PART 15

per FCC part 15 Subpart C

3.1 Radiated Emissions Test Setup and Procedure - Per 2.1033(b)(6) Per 2.947(a)

The EUT was placed on a wooden table 1 meter wide and 1.5 meters long which rests on a flush mounted, steel-top turntable on the open area test site as shown in Section 3.1.1.1. The top of the table is 80 cm above the ground plane. The turntable can be rotated 360 degrees. Measuring antenna is set at the prescribed distance. Measurements are made with broad band antennas that have been correlated with tuned dipole antennas. The mast is 4.5 meters high and is self-supporting. The height of the antenna can be varied from 1 to 4 meters. Positioning of the antenna is controlled remotely.

3.1.1 Test Site Per 2.1033(b)6



Radiated Test Setup and Procedure - cont'd

The EUT is put into the operational test mode as stated in Section 2.2.1 is then started.

The spectrum analyzer is setup to store the peak emission over the band of the antenna. Peak EUT and ambient emissions are stored while the turntable is rotated 360^0. Peak spectrum analyzer trace is then plotted with the addition of antenna and cable correction factors. The limit is plotted on the same graph. A receiver with CISPR Quasi Peak capabilities is then used on the frequencies identified as the highest with respect to the plotted limit. Ambients are noted on the graph along with EUT emissions. The highest EUT frequencies, with respect to the limit, are maximized.

To maximize emissions levels, the turntable is rotated and the antenna is raised and lowered to determine the point of maximum emanations. The cables are then manipulated at that point to maximize emissions. Measurements are made with the antennas in each horizontal and vertical polarization separately. The data obtained from these tests is corrected with the proper cable, preamplifier and antenna factors. The results are then transcribed onto tables that show the maximum emission levels. The highest emissions are listed in a Radiated Emissions Summary table.

If no emissions can be found, the lowest harmonics of the EUT clocks within the bands of the standard are tuned into with the receiver. If no emissions are found, the noise floor will be entered into the table and noted. A minimum of six frequencies will be logged. Summary results will reflect only actual emissions from the EUT.

Radiated Test Setup and Procedure - cont'd

The field intensity measurements are made using standard techniques with a spectrum analyzer or EMI receiver as the calibrated Field Intensity Meter (FIM). Preamplifiers and filters are used when required.

When using the Hewlett Packard Model 8568B Spectrum Analyzer as the FIM, the Analyzer is calibrated to read signal level in dBm. Where:

0 dBm (50 ohms) = 107 dBuV (50 ohms)

The signal level (dBuV) = indicated signal level (dBm) + 107 dB. To obtain the signal level in dBuV/m it is necessary to add the antenna factor in dB.

3.1.2 Example Of Typical Calculation Per 2.1033(b)6

Measurement Distance = 3 Meter

Rohde and Schwarz reading @ 60 MHz		*49.0 dBuV*
Antenna Factor	*+7.5 dBuV*	
Cable Loss	*+2.0 dBuV*	
Preamplifier	*-25.5 dBuV*	
	-16.0 dBuV	*-16.0 dBuV*
Field Strength dBuV/m at 3 Meter =		*33.0 dBuV*

The Following FCC limits for acceptance were used:

Limit 902 to 928 MHz (At the Carrier Frequency):
50,000 μV/M = 20 log (50,000) dBμV/M = 94.0 dBμV/M @ 3 Meters

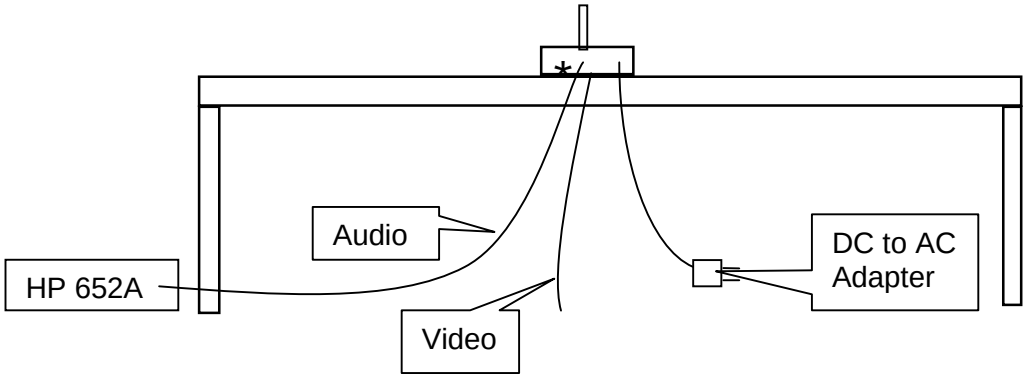
Limit 88 to 216 MHz (Not at the Carrier Frequency):
150 μV/M = 20 log (150) dBμV/M = 43.5 dBμV/M @ 3 Meters

Limit 30 to 88 MHz:
100 μV/M = 20 log (100) dBμV/M = 40.0 dBμV/M @ 3 Meters

Limit >960 Mhz:

500μV/M = 20 log (500) dBμV/M = 54.0 dBμV/M @ 3 Meters

3.1.3 Diagram of Test Setup - per 2.1033(b)5



* - OBJECT OF TEST

3.1.4 *Field Strength of Intentional Radiator Inside of Band*

Measurements of radiated and conducted emission data were taken at all tune to frequencies.

The EUT was compliant with CFR 47, 15.249(a) field strength of intentional radiator.

Radiated Emissions Inside the Band Summary Test Data

per FCC part 15, Subpart C (15.249 (a) at 3 meters

COMPANY *EUT: 2.4 GHz TRANSMITTER*

Transmitter Field Strength

Frequency MHz	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Delta (dB)
2415.66	89.3	94.0	**-4.7**
2433.98	90.6	94.0	**-3.4**
2452.94	89.9	94.0	**-4.1**
2466.74	90.5	94.0	**-3.5**

- *Reference Appendix A for all data taken.*

3.1.5 Emissions Radiated Outside of Authorized Band and Harmonics of Intentional Radiator

The EUT was compliant with CFR 47, 15.249(c) radiated emissions requirements.

per FCC part 15, Subpart C (15.249 (c) at 3 meters

Table 3.1.5(1)

COMPANY EUT: 2.4 GHz TRANSMITTER

Freq. (MHz)	Meas'd (dBuV)	Amp Factors (dB)	Cable Factors (dB)	Antenna Factors (dB)	Total Factors (dB)	Corrected signal (dBuV/m)	Limit (dBuV/m)	Delta (dB)
4934.00	43.1	29.2	5.8	33.8	10.4	**53.5**	54.0	**-0.5**
4833.50	42.6	29.2	5.8	33.4	10.0	**52.6**	54.0	**-1.4**
4868.40	40.7	29.2	5.8	33.5	10.1	**50.8**	54.0	**-3.2**
7251.60	29.2	28.8	7.7	37.1	15.9	**45.1**	54.0	**-8.9**
7402.20	28.2	28.8	8.0	37.2	16.4	**44.6**	54.0	**-9.4**
7302.60	26.3	28.8	7.8	37.1	16.1	**42.4**	54.0	**-11.6**

- *Six highest frequencies relative to the Limit.*
- *Reference Appendix A for all data taken.*
- *Data was taken on the 2nd and 3rd harmonics of the low, mid and high tuned to frequencies. No emissions were detected of 4th and higher harmonics so only the middle tuned to frequency was used.*
- *The EUT was investigated form 30 MHz to 18,000 MHz.*

3.1.6 Compliance with Limits at Band Edge

The spectrum analyzer was adjusted as follows:

Low end of band.

Frequency: 2400 MHz
Input Attenuation: 10 dB
Span: 5 MHz/div
Vertical Scale: 10 dB/div
Resolution Bandwidth: 1MHz
Reference Level: 94 dBuV
Detector: Peak

High end of band.

Frequency: 2483.5 MHz
Input Attenuation: 10 dB
Span: 5 MHz/div
Vertical Scale: 10 dB/div
Resolution Bandwidth: 1MHz
Reference Level: 94 dBuV
Detector: Peak

Refer to the following plots.

3.1.7 Photograph of Radiated Test Setup - per 2.1033(b)(7)

2.4 GHz TRANSMITTER

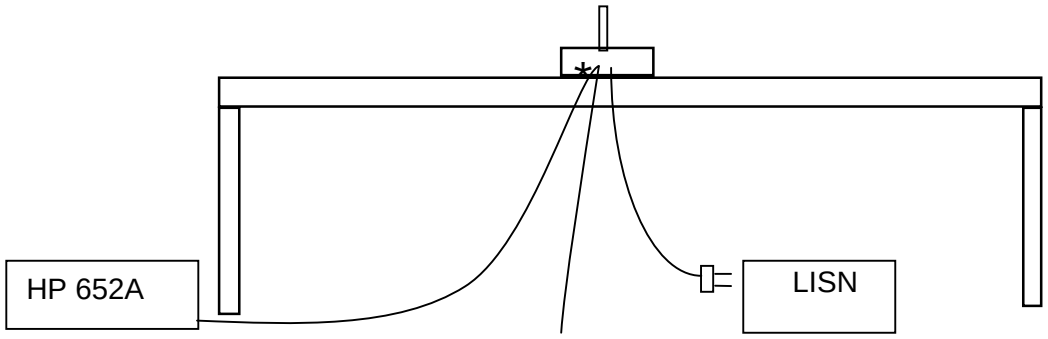
Photo # 6. - Radiated

3.2 Conducted Emissions Test Setup and Procedure - Per 2.1033(b)(6) Per 2.947(a)

The EUT was in the Mode of Operation as stated in Section 2.2.1 and set up in the open area test site as shown in Section 3.2.1. The conducted tests are performed by inserting a 50 ohm, 50 uH LISN in series with the power line of the EUT. The tests are either performed on each unit individually or on several units at a time for each test configuration.

The spectrum analyzer is setup to store the peak emissions over the range stated in the applicable standard. Cables are then adjusted to maximize emissions. The peak spectrum analyzer trace and limits are plotted onto graph paper. A receiver (with CISPR quasi peak and average capability) is used to identify the highest frequencies with respect to the limit. Ambients are noted on the graph along with emissions from the EUT. EUT emissions with more than 10 dB margin may only have peak spectrum analyzer measurements taken. The highest levels are listed in the Conducted Emissions Summary Test Data.

3.2.1 Diagram of Test Setup - per 2.1033(b)5



* - OBJECT OF TEST

3.2.2 Conducted Compliance Data - table #2

The EUT was compliant with FCC part 15 class B conducted emissions requirements.

Conducted Emission Summary Test Data
per FCC part 15, class B

Configuration A			COMPANY			2.4 GHz TRANSMITTER				
Equipment on LISN	Freq. MHz	Meas'd (dBuV)	LISN Factors	Cable Factors	Total Factors	**Total (dBuV)**	Limit (dBuV)	**Delta**	Detec. Mode	Line
EUT	**0.450**	35.20	0.10	0.20	0.30	**35.50**	48.0	**-12.5**	QP	Phase 1
EUT	**0.700**	32.00	0.10	0.30	0.40	**32.40**	48.0	**-15.6**	QP	Phase 1
EUT	**0.517**	29.90	0.10	0.20	0.30	**30.20**	48.0	**-17.8**	QP	Neutral
EUT	**0.600**	28.40	0.10	0.20	0.30	**28.70**	48.0	**-19.3**	QP	Phase 1
EUT	**3.000**	4.50	0.20	0.50	0.70	**5.20**	48.0	**-42.8**	QP	Phase 1
EUT	**2.579**	2.60	0.20	0.40	0.60	**3.20**	48.0	**-44.8**	QP	Neutral

- *Reference Appendix A for all test data.*
- *Six highest frequencies relative to the Limit.*
- *P1 = Phase 1, P2 = Phase 2, P3 = Phase 3, N = Neutral*

3.2.3 Photographs of Conducted Test Setup - per 2.1033(b)(7)

2.4 GHz TRANSMITTER

Photo # 7 - Conducted

4. LABELING REQUIREMENTS - PER 2.1033(B)(7)

Label will be constructed of 0.02 inch plastic attached as shown on the equipment with permanent adhesive.

All information on the label will be etched or screened. All methods will exceed the expected lifetime of the equipment.

The label will be large enough to allow all information to be readily legible.

4.1 Additional Label Required

This device complies with Part 15 of the FCC Rules. Operation is subject to the following tow conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

Shown above is a copy of the label with the Part 15.19 Compliance Statement, Location of required information is checked "below".

☐ *The label will be placed in a conspicuous location on the device.*

☐ *The device is too small for a compliance label. Therefore the label will be placed in a prominent location in the Instruction Manual or other information supplied to the user.*

☐ *The device is too small for a compliance label. The label will be placed on the container in which the device will be marketed.*

4.2 Photograph of Label

PAGE # 26 . Placement of label on device
PAGE # 27 . Contents of label

5. SCHEMATIC DIAGRAMS

6. OWNERS MANUAL

7. APPENDIX SECTION

7.1 APPENDIX A: TEST DATA

7.2 APPENDIX B: UNCERTAINTY TOLERANCE

UNCERTAINTY TOLERANCE

DNB Engineering's Utah Facility is within acceptable uncertainty tolerances per ANSI C63.4 (1992) sections 5.4.6.1 and 5.4.6.2 as well as CISPR 16-1(1993) Annex M, section M.2.

ANSI C63.4 (1992)

5.4.6.1 Site Attenuation. A measurement site shall be considered acceptable for radiated electromagnetic field measurements if the horizontal and vertical NSA derived from measurements, i.e., the "measured NSA," are within ±4 dB of the theoretical NSA (5.4.6.3) for an ideal site.

5.4.6.1 NSA Tolerance. The ±4 dB tolerance in 5.4.6.1 includes instrumentation calibration errors, measurement technique errors, and errors due to site anomalies. These errors are analyzed in ANSI C63.6-1988 [3], wherein it is shown that the performance of a well-built site contributes only 1 dB of the total allowable tolerance.

CISPR 16-1 (1993)

M.2 Error analysis

. . . The total estimated errors are the basis for the ±4 dB site acceptability criterion consisting of approximately 3 dB measurement uncertainty and an additional allowable 1 dB for site imperfections.

7.3 APPENDIX C: TEST SITE CERTIFICATION, CHALK CREEK EMI SITE - per 2.948(a)

SITE CHARACTERISTICS, CHALK CREEK EMI TEST SITE

General:

The DNB Engineering test facility is located in Chalk Creek Canyon near Coalville, Utah. Site characteristics were measured according to the procedures outlined in ANSI C63.4 (1992) "Characteristics of Open Field Test Site". The results of these characterizations indicate that the Chalk Creek site is an outstanding facility to perform accurate and repeatable EMI tests.

This facility has been FCC approved to perform class B certification testing since January, 1986. In October of 1996, according to the FCC requirement to re-apply every three years, the facility was recertified. Certification was granted for the 3, 10, and 30 meter positions for both ranges. Facility approval was granted by the FCC Oct. 15, 1996 under file number 31040/PRV 1300F2.

In July of 1997, **The American Association for Laboratory Accreditation**, **A2LA**, granted accreditation to this facility. Standards for which accreditation was granted: RF Emissions: ANSI C63.4 - 1992, FCC Part 15 subpart B and C, FCC Part 18 CISPR 11, CISPR 13, CISPR 14, CISPR 22, EN 55011, EN 55013, EN 55014, EN 55022, EN 60601-1-2, EN 50081-1, EN 50081-2, IEC 601-1-2; RF Immunity: EN 50082-1, EN 50082-2, Radiated Susceptibility: EN 61000-4-3, ENV 50140, ENV 50204, IEC 1000-4-3, IEC 801-3, ESD: EN 61000-4-2, IEC 1000-4-2, IEC 801-2, EFT: EN 61000-4-4, IEC 1000-4-4, IEC 801-4, Surge: EN 61000-4-5, ENV 50142, IEC 1000-4-5, IEC 801-5, Injected RF Immunity: EN 61000-4-6, ENV 50141, IEC 1000-4-6, IEC 801-6

In September,1994 the National Certified Testing/Competent/ Notified Body for Norway and Scandinavian Countries (NEMKO) approved this test facility. DNB now offers the testing required for the CE Mark. **NEMKO EMC Laboratory Authorization No.: ELA 131** Standards for which accreditation was granted: RF Emission: EN 55011, EN 55022, EN 50081-1, EN 50081-2; RF Immunity: EN 50082-1, EN 50082-2

In September, 1994, the New Zealand Ministry of Commerce certified that DNB ENGINEERING, INC. EMC facilities meet their laboratory approval criteria for EMC testing and placed DNB ENGINEERING on their list of Ministry-Approved laboratories.

In August, 1995, VCCI certified that the Chalk Creek facility was acceptable to perform EMI test according to VCCI requirements. The certificate number is 715.

Ambient Emissions

Ambient emission measurements were made to determine the level of the ambient emanations at the DNB test facility. The results indicate that all ambient signals are below the FCC, and VCCI radiated emission limits or that each can easily be identified as an ambient signal.

7.4 APPENDIX D: EMC INSTRUMENTATION AND MEASUREMENT EQUIPMENT

All test equipment is calibrated by a certified metrology facility using standards traceable to NIST.

Each instrument is calibrated annually or more frequently if required.

Test Equipment for Emissions

Description	Manufacturer	Model	Serial	CalDue
Antenna Mast, site 2 (30m)	AH Systems	AMSC-6	2159-4C	
Plotter	HP	7475A	2517A20261	
Printer	HP	2671G	2520A31080	
PRE Amp (30m)	HP	8447D	2727A06182	3/4/99
PRE Amp (3,10m)	HP	8447D	2727A06180	6/17/99
CISPR Adapter site 2	HP	85650A	2043A00277	9/25/99
Computer desk top site 1	HP	9826A	2439A09175	
Spectrum Analyzer site 2	HP	8568B	1721A00113	9/23/99
Receiver site 2	R&S	ESH3	872842/045	5/13/99
Receiver site 2	R&S	ESVP	882402/005	1/27/99
Spectrum Monitor site 2	R&S site 1	EZM(3)	880 087/038	
Log Periodic Antenna site 2	SCH	UHAL09107	91071004(L10)	7/24/99
Biconical Antenna site 2	SCH	BBA9106	11	7/20/99
LISN	SCH	NSLK 8126	142	10/24/98
LISN	SCH	NNLA 8120	301	10/24/98
Bicon Antenna	AH SYS	SAS-200/543	183	7/20/99
Log Periodic Antenna	AH SYS	SAS-200/512	322	7/24/99
Horn Antenna, Double Rdg Gd	AH SYS	SAS-200/571	222	4/3/99
Horn Antenna	AR	AT4000	10801	
Antenna Mast, site 1(30m outside)	DNB	2159-2	AMS6	
Antenna Mast, site 1(10m inside)	EMCO 1	1050*	1236a	
Antenna Mast, site 1(3m inside)	EMCO1	1050*	1236b	
Printer	HP	2671G	2520A31883	
Computer desk top	HP	9826A	231A05633	
PRE Amp (3m)	HP	8447D	2727A06191	6/18/99
PRE Amp (30m) site 1	HP	8447D	2727A06181	6/17/99
CISPR Adapter site 1 (ref. only)	HP	85650A	2043A00124	10/24/98
Plotter	HP	7475A	2325A64445	
Spectrum Analyzer site 1	HP	8566B	2421A00516	10/24/98
RF/Preselector site 1 (ref. only)	HP	85685A	2724A00659	10/24/98
PRE Amp. (10m)	HP	8447D	2727A06184	6/17/99
Amplifier	Mini-Circuits	ZHL-1042J	N111496-6	
Amplifier (2-20 GHz, 22dB gain)	MITEQ	AFS6-02002000-18O-MP	428738	6/17/99
Receiver site 1	R&S	ESH3	882399/025	6/19/99
Spectrum Monitor site 1	R&S	EZM(3)	880 487/037	
Receiver site 1	R&S	ESVP	879807/048	6/19/99
LISN	SCH	NNLK 8121	218	10/23/98
Biconical Antenna site 1	SCH	BBA1906	13	10/24/98
Log Periodic Antenna	SCH	UJALP9107	2C	7/24/99
LISN	SCH	NNLK 8121	156	10/23/98
Antenna Mast site 1 port. (10m outside)	Unisys	U-258	CC-300-5023	

7.5 APPENDIX E: INFORMATION SUPPLIED TO APPLICANT

INFORMATION PERTAINING TO EQUIPMENT MANUFACTURED AFTER COMPLIANCE TESTING

It is prudent that manufacturers have an established Quality Assurance program to spot check their products on a periodic basis, either based upon time or quantities produced. Obviously, a change in the engineering design should be sufficient justification for a re-test.

The Quality assurance test need not be formal Verification or Certification such as required during the initial production of the product. However, it should be sufficient in scope to assure that the EMI characteristics of the product have not changed to the degree that the product exceeds the FCC limits. If a new model of a product is produced, it must undergo full Verification or Certification testing and, in case of Certification, be filed with the FCC.

It is expected that the FCC will place greater emphasis and resources in spot checking commercially available products. If a product is found not to be compliant with the Limits specified in Part 15, Subpart B. the manufacturer will be subject to the appropriate penalties imposed by the Commission. The initial Certification or Verification is sufficient to justify initial production. The additional quality assurance testing performed is the manufacturer's responsibility to assure continued compliance.