Measurement of RF Interference from a Cascade Networks Model Cyclone Transciever ISM Band (2400 to 2483.5MHz) using the Cyclone Model 2400-360.15 Omni Antenna

For : Cascade Networks, Inc.
Longview WA

P.O. No. : 34938
Date Received : December 20, 2004
Date Tested : December 20 and 21, 2004
Test Personnel : Richard E. King
Specification : FCC "Code of Federal Regulations" Title 47 Part 15.247, Subpart C

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TABLE OF CONTENTS

Measurement of RF Emissions from a Cascade Networks Cyclone Transciever

1.0 INTRODUCTION:

1.1 Description of Test Item - This document presents the results of tests performed to determine if the Cascade Networks Cyclone Transceiver (ISM Band) would meet the FCC requirements when using a Cyclone model 2400-360.15 omni antenna. The test item is a Motorola Canopy transceiver modified by Cascade Networks and designed to transmit in the 2400MHz to 2483.5MHz band. Cascade Networks modifies the Canopy transceiver to adapt it for their use with the above antenna. The tests were performed for Cascade Networks Inc, of Longview, Washington.

1.2 Purpose - The test series was performed to determine if the test item when used with the above antenna continues to meet the radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2003. The addition of the above antenna will require a Class II permissive change to the original grant.

1.3 Deviations, Additions and Exclusions - There were no deviations, additions to, or exclusions from the test specification during this test series.

1.4 Applicable Documents - The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart C, dated 1 October 2003
- 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"

1.5 Subcontractor Identification - This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code: 100278-0.

1.6 Laboratory Conditions The temperature at the time of the test was 23ºC and the relative humidity was 11%.

2.0 TEST ITEM SETUP AND OPERATION:

The test item is a Cascade Networks Cyclone Transciever with an external antenna. A block diagram of the test item setup is shown as Figure 1.

2.1 Power Input - The test item was powered with 24VDC from a Motorola model SADB-1129 transformer via the 45 feet of CAT 5 Ethernet cable.

2.2 Grounding - The test item was grounded via the 45 feet of CAT 5 Ethernet cable to the transformer.

2.3 Peripheral Equipment - The test item was submitted with a Panasonic ToughBook laptop that was used to power and communicate with the test item via one 45 foot long CAT 5 Ethernet cable.

2.4 Interconnect Cables - The test item was connected to the laptop via a 45 foot long CAT 5 Ethernet cable.

2.5 Operational Mode - For all tests the test item was placed on an 80cm high non-conductive stand. The test item and all peripheral equipment were energized.

For all tests, the test item was controlled and powered by the laptop computer. Through the computer the test item was set to transmit continuously in a continuous wave mode. The tests were performed with the test item transmitting at 2400MHz, 2440MHz and 2483.5MHz.

3.0 TEST EQUIPMENT:

3.1 Test Equipment List - A list of the test equipment used can be found on Table I. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

3.2 Calibration Traceability Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.0 REQUIREMENTS, PROCEDURES AND RESULTS:

4.1 Powerline Conducted Emissions

4.1.1 Requirements – Since conducted emissions will be provided by Cascade Networks, no conducted emission measurements were taken.

4.2 Antenna Conducted Emissions Measurements:

4.2.1 Requirements – Per section 15.247(c), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by at least 20 dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated emissions measurement. Attenuation below the general limits specified in §15.209(a) is not required. In

addition, radiated emissions which fall on the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a) (see§ 15.205(c)).

4.2.2 Procedures – The transmitter was connected to a spectrum analyzer through two 20dB attenuators. The resolution bandwidth was set to 100kHz with a video bandwidth of 1MHz. The maximum meter reading was recorded for the harmonics starting with the 2nd harmonic up to the 10th harmonic. The peak emissions in a 100kHz bandwidth was measured for the low, middle and high channels.

4.2.3 Results: The antenna conducted emissions for the low, middle and high channel are shown on data page 12. As can be seen by the data the test item did meet the emissions limits of 15.247(c).

4.3 Radiated Measurements

4.3.1 Requirements - Per section 15.247(c), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by at least 20 dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated emissions measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall on the restricted bands, as defined in §15.205(a), must comply with the radiated emission limits specified in §15.209(a) (see§ 15.205(c)).

Paragraph 15.209(a) has the following radiated emission limits:

Frequency MHz	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30.0-88.0	100	3
88.0-216.0	150	3
216.0-960.0	200	3
Above 960	500	3

4.3.2 Procedures - Radiated measurements were manually performed in a 32ft. x 20ft. x 14ft. high shielded enclosure. The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals

from entering the enclosure on these leads.

The radiated emission tests were performed on all harmonics which fall in restricted bands.

To ensure that maximum emission levels were measured, the following steps were taken:

1) Measurements were made using an average detector and a standard gain horn antenna.
2) To ensure that maximum or worst case, emission levels were measured, the following steps were taken:
   (a) The test item was rotated so that all of its sides were exposed to the receiving antenna.
   (b) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
   (c) The measuring antenna was raised and lowered for each antenna polarization to maximize the readings.

Photographs of the test item setup with antenna are presented as Figures 2.

4.3.3 Results - The radiated emission levels are presented on data pages 13 through 15. As can be seen by the data the test item did meet the emissions limits of 15.247(c).

5.0 CONCLUSIONS:

It was determined that the Cascade Networks Cyclone Transciever tested with the Cyclone model 2400-360.15 omni antenna, did fully meet the selected emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15.247, Subpart C, Section 15.205 et seq. for Intentional Radiators, when tested per ANSI C63.4-2003. Addition of this antenna qualifies as a class II permissive change to the original grant of certification.

6.0 CERTIFICATION:

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the test item at the test date as operated by Cascade Networks, Inc. personnel. Any electrical or mechanical modification made to the test item subsequent to the specified test date will serve to invalidate the data and void this certification.

7.0 ENDORSEMENT DISCLAIMER:

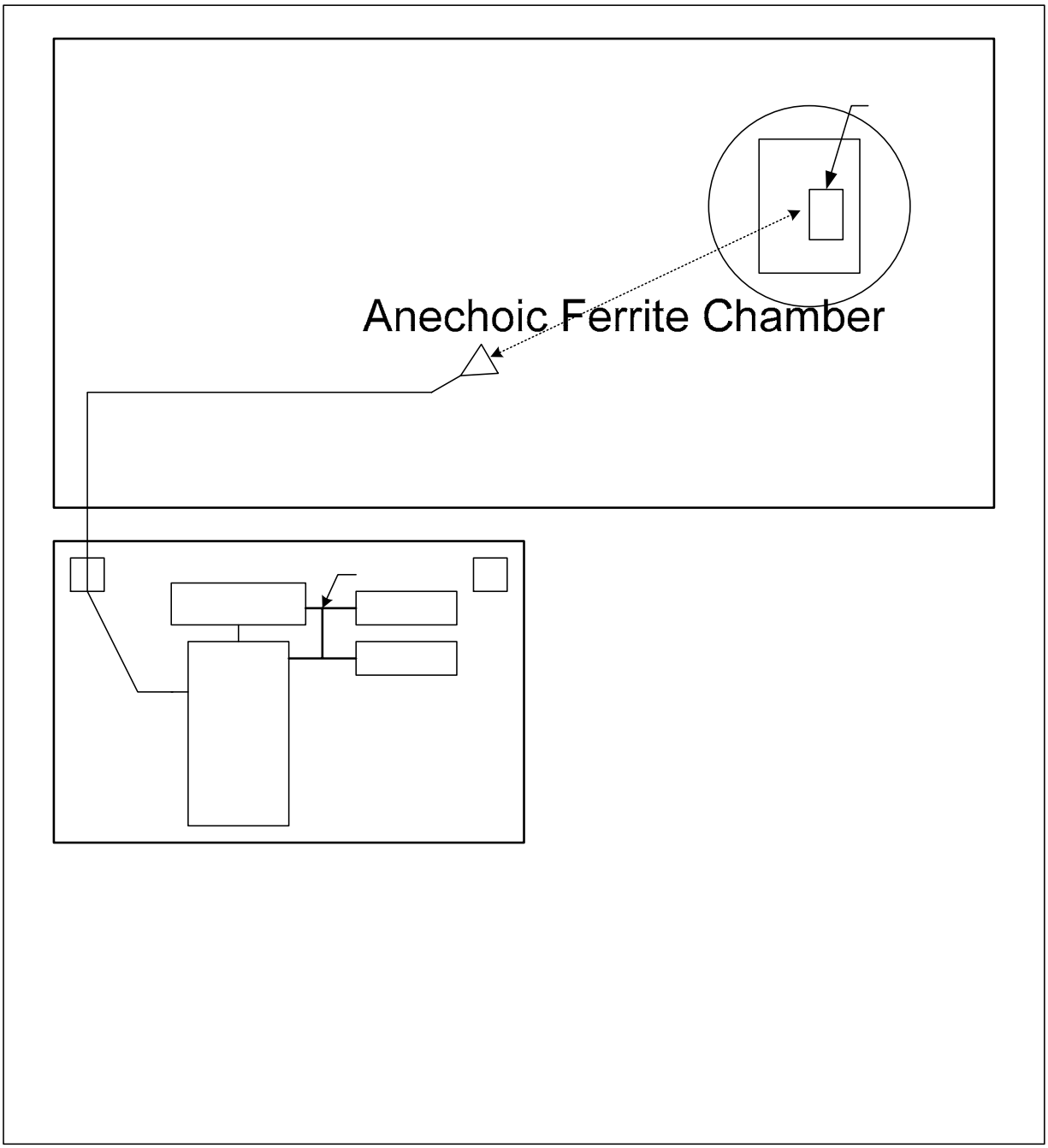
This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.

TABLE I: TEST EQUIPMENT LIST

ELITE ELECTRONIC ENG. INC. Page: 1

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Cal Inv	Due Date
Equipment Type: ACCESSORIES, MISCELLANEOUS								
XOB1	ADAPTER	HEWLETT PACKARD	K281C	10422	18-26.5GHZ		NOTE 1	
XOB2	ADAPTER	HEWLETT PACKARD	K281C,012	09407	18-26.5GHZ		NOTE 1	
Equipment Type: AMPLIFIERS								
APH0	POWER AMPLIFIER	HEWLETT PACKARD	11975A	2304A00322	2-8GHZ		NOTE 1	
Equipment Type: ANTENNAS								
NHA0	STANDARD GAIN HORN ANTENNA	NARDA	640	---	8.2-12.4GHZ		NOTE 1	
NHE0	STANDARD GAIN HORN ANTENNA	NARDA	639	---	12.4-18GHZ		NOTE 1	
NHE1	STANDARD GAIN HORN ANT. -	NARDA	639	---	12.4-18GHZ		NOTE 1	
NHG0	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ		NOTE 1	
NHG1	STANDARD GAIN HORN ANTENNA	NARDA	638	---	18-26.5GHZ		NOTE 1	
NHH0	STANDARD GAIN HORN ANTENNA	NARDA	V637	---	26.5-40GHZ		NOTE 1	
NHH1	STANDARD GAIN HORN ANTENNA	NARDA	V637	---	26.5-40GHZ		NOTE 1	
NWI0	RIDGED WAVE GUIDE	AEL	H1498	153	2-18GHZ	09/05/04	12	09/05/05
Equipment Type: CONTROLLERS								
CMA0	MULTI-DEVICE CONTROLLER	EMCO	2090	9701-1213	---		N/A	
Equipment Type: RECEIVERS								
RAE1	SPECTRUM ANALYZER (DCC-CEM	HEWLETT PACKARD	85660A	2209A01336	100HZ-22GHZ	02/14/04	12	02/14/05
RAI0	FREQUENCY MIXER	HEWLETT PACKARD	11970A	2332A00292	26-40GHZ	06/02/03	N/A	
RBA1	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB26	100146	20HZ-26.5GHZ	03/29/04	12	03/29/05
Equipment Type: SIGNAL GENERATORS								
GBX1	SYNTHESIZED SWEEPER	HEWLETT PACKARD	83630A	3420A00857	10MHZ-26.5GHZ		NOTE 1	
GSB0	SWEEP OSCILLATOR	HEWLETT PACKARD	8350B	2309A02104	0.01-40GHZ	06/11/04	12	06/11/05
GSBC	TUNING HEAD	HEWLETT PACKARD	83572B	2429A00203	26.5-40GHZ	06/03/04	12	06/03/05

Cal. Interval: Listed in Months I/O: Initial Only N/A: Not Applicable
Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.



Hpib cbl

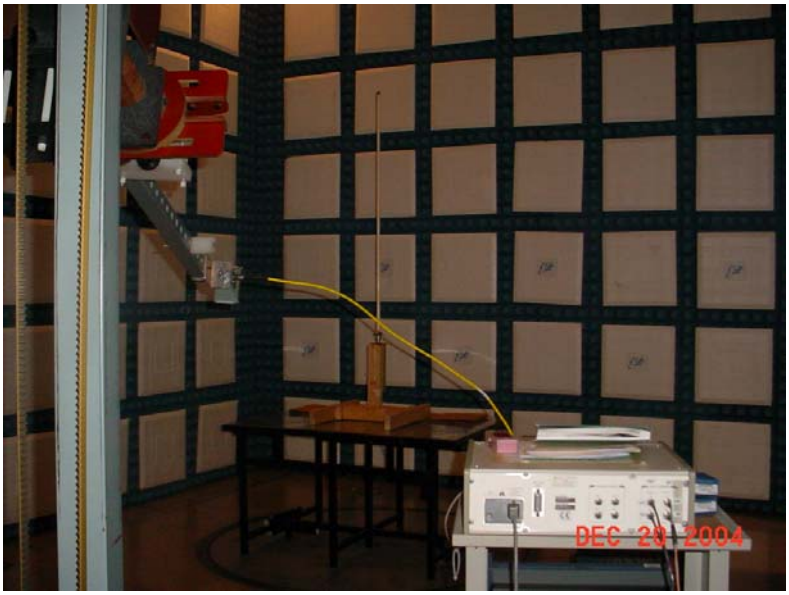
Turn Table & Mast Controller

Computer

Printer

Figure 2

Vertical



Horizontal

Test Setup For Measurement of radiated emissions Cyclone model 2400-360.15 omni antenna

MANUFACTURER : Cascade Networks
MODEL : Cyclone Transceiver
S/N : None given
SPECIFICATION : FCC-15.247 Antenna Conducted Emissions
DATE : December 20, 2004
NOTES : Low & Middle Channel

LOW Channel

FREQ MHz	MTR RDG dBm	Amb.	BW	Attenuation	TOTAL dBm	15.247 LIMIT 20dBc
2400.0	-16.7		100kHz/1M	40.0	23.3	
4800.0	-84.6		100kHz/1M	40.0	-44.6	3.3
7200.0	-86.9	*	100kHz/1M	40.0	-46.9	3.3
9600.0	-86.8	*	100kHz/1M	40.0	-46.8	3.3
12000.0	-85.5	*	100kHz/1M	40.0	-45.5	3.3
14400.0	-86.5	*	100kHz/1M	40.0	-46.5	3.3
16800.0	-85.6	*	100kHz/1M	40.0	-45.6	3.3
19200.0	-85.4	*	100kHz/1M	40.0	-45.4	3.3
21600.0	-84.7	*	100kHz/1M	40.0	-44.7	3.3
24000.0	-85.1	*	100kHz/1M	40.0	-45.1	3.3

MID Channel

FREQ MHz	MTR RDG dBm	Amb.	BW	Attenuation	TOTAL dBm	15.247 LIMIT 20dBc
2440.0	-16.8		100kHz/1M	40.0	23.2	
4880.0	-84.4		100kHz/1M	40.0	-44.4	3.2
7320.0	-86.6	*	100kHz/1M	40.0	-46.6	3.2
9760.0	-87.1	*	100kHz/1M	40.0	-47.1	3.2
12200.0	-85.8	*	100kHz/1M	40.0	-45.8	3.2
14640.0	-85.3	*	100kHz/1M	40.0	-45.3	3.2
17080.0	-86.3	*	100kHz/1M	40.0	-46.3	3.2
19520.0	-85.5	*	100kHz/1M	40.0	-45.5	3.2
21960.0	-85.5	*	100kHz/1M	40.0	-45.5	3.2
24400.0	-86.2	*	100kHz/1M	40.0	-46.2	3.2

Checked BY : Richard E. King

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MANUFACTURER : Cascade Networks
MODEL : Cyclone Transceiver
S/N : None given
SPECIFICATION : FCC-15.247 Antenna Conducted Emissions
DATE : December 20, 2004
NOTES : High Channel

HIGH Channel

FREQ MHz	MTR RDG dBm	Amb.	BW	Attenuation	TOTAL dBm	15.247 LIMIT 20dBc
2482.5	-20.7		100kHz/1M	40.0	19.30	
4965.0	-84.9		100kHz/1M	40.0	-44.90	-0.7
7447.5	-86.9	*	100kHz/1M	40.0	-46.90	-0.7
9930.0	-86.1	*	100kHz/1M	40.0	-46.10	-0.7
12412.5	-85.4	*	100kHz/1M	40.0	-45.40	-0.7
14895.0	-85.1	*	100kHz/1M	40.0	-45.10	-0.7
17377.5	-85.6	*	100kHz/1M	40.0	-45.60	-0.7
19860.0	-85.3	*	100kHz/1M	40.0	-45.30	-0.7
22342.5	-86.1	*	100kHz/1M	40.0	-46.10	-0.7
24825.0	-85.5	*	100kHz/1M	40.0	-45.50	-0.7

Checked BY : Richard E. King

Richard E. King

MANUFACTURER : Cascade Networks
MODEL : Cyclone Transceiver
ANTENNA : Cyclone model 2400-360.15 omni
S/N : None given
SPECIFICATION : FCC-15C Radiated Emissions
DATE : December 20, 2004
NOTES : Low Channel

FREQ	ANT	MTR RDG	Amb		Dist. Corr.	ANT	CABLE	Pre.	TOTAL	15.209 LIMIT
MHz	POL	dBuV	.	BW	Fac	FAC	LOSS	AMP.	dBuV/m	dBuV/m
4800.0	H	12.8	*	1M/10		34.2	0.5	0.0	47.5	54.0
4800.0	V	12.8	*	1M/10		34.2	0.5	0.0	47.5	54.0
12000.0	H	13.2	*	1M/10	-9.5	41.3	1.0	0.0	46.0	54.0
12000.0	V	13.2	*	1M/10	-9.5	41.3	1.0	0.0	46.0	54.0
19200.0	H	15.2	*	1M/10	-9.5	42.6	0.0	0.0	48.3	54.0
19200.0	V	15.1	*	1M/10	-9.5	42.6	0.0	0.0	48.2	54.0
24000.0	H	15.9	*	1M/10	-9.5	42.6	0.0	0.0	49.0	54.0
24000.0	V	15.9	*	1M/10	-9.5	42.6	0.0	0.0	49.0	54.0

Checked BY : Richard E. King

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MANUFACTURER : Cascade Networks
MODEL : Cyclone Transceiver
ANTENNA : Cyclone model 2400-360.15 omni
S/N : None given
SPECIFICATION : FCC-15C Radiated Emissions
DATE : December 20, 2004
NOTES : Mid Channel

FREQ	ANT	MTR RDG	Amb		Dist. Corr.	ANT	CABLE	Pre.	TOTAL	15.209 LIMIT
MHz	POL	dBuV	.	BW	Fac	FAC	LOSS	AMP.	dBuV/m	dBuV/m
4880.0	H	12.9	*	1M/10		34.2	0.5	0.0	47.6	54.0
4880.0	V	12.9	*	1M/10		34.2	0.5	0.0	47.6	54.0
7320.0	H	13.9	*	1M/10		38.8	0.8	0.0	53.5	54.0
7320.0	V	13.9	*	1M/10		38.8	0.8	0.0	53.5	54.0
12200.0	H	15.6	*	1M/10	-9.5	41.3	1.0	0.0	48.4	54.0
12200.0	V	15.6	*	1M/10	-9.5	41.3	1.0	0.0	48.4	54.0
19520.0	H	16.5	*	1M/10	-9.5	42.6	0.0	0.0	49.6	54.0
19520.0	V	17.2	*	1M/10	-9.5	42.6	0.0	0.0	50.3	54.0

Checked BY : Richard E. King

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MANUFACTURER : Cascade Networks
MODEL : Cyclone Transceiver
ANTENNA : Cyclone model 2400-360.15 omni
S/N : None given
SPECIFICATION : FCC-15C Radiated Emissions
DATE : December 20, 2004
NOTES : High Channel

FREQ	ANT	MTR RDG	Amb		Dist. Corr.	ANT	CABLE	Pre.	TOTAL	15.209 LIMIT
MHz	POL	dBuV	.	BW	Fac	FAC	LOSS	AMP.	dBuV/m	dBuV/m
4965.0	H	12.9	*	1M/10		34.2	0.5	0.0	47.6	54.0
4965.0	V	12.9	*	1M/10		34.2	0.5	0.0	47.6	54.0
7447.5	H	13.3	*	1M/10		38.8	0.8	0.0	52.9	54.0
7447.5	V	13.3	*	1M/10		38.8	0.8	0.0	52.9	54.0
12412.5	H	15.2	*	1M/10	-9.5	41.3	1.0	0.0	48.0	54.0
12412.5	V	15.1	*	1M/10	-9.5	41.3	1.0	0.0	47.9	54.0
19860.0	H	15.3	*	1M/10	-9.5	42.6	0.0	0.0	48.4	54.0
19860.0	V	15.5	*	1M/10	-9.5	42.6	0.0	0.0	48.6	54.0
22342.5	H	15.7	*	1M/10	-9.5	41.5	0.0	0.0	47.7	54.0
22342.5	V	15.6	*	1M/10	-9.5	41.5	0.0	0.0	47.6	54.0

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