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Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart E Specifications for Unlicensed National Information Infrastructure Devices on the BitRage Model: CR45-A-58 and CR45-A-58L

FCC ID:	PJK-CR45-A-58
GRANTEE:	BitRage 796 E. Pacific Dr., American Fork, UT 84003
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	March 19, 2001
FINAL TEST DATE:	March 14, 2001

AUTHORIZED SIGNATORY: _____

Mark R. Briggs
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SCOPE

An electromagnetic emissions test has been performed on the BitRage model CR45-A-58 and CR45-A-58L pursuant to Subpart E of Part 15 of FCC Rules for Unlicensed National Information Infrastructure Devices. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4-1992 as outlined in Elliott Laboratories test procedures.

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the BitRage model CR45-A-58 and CR45-A-58L and therefore apply only to the tested sample. The sample was selected and prepared by Chet Ferry of BitRage

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart E of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units which are subsequently manufactured.

STATEMENT OF COMPLIANCE

The tested sample of BitRage model CR45-A-58 and CR45-A-58L complied with the requirements of Subpart E of Part 15 of the FCC Rules for Unlicensed National Information Infrastructure Devices.

Maintenance of FCC compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

EMISSION TEST RESULTS

The following emissions tests were performed on the BitRage model CR45-A-58 and CR45-A-58L. The actual test results are contained in an exhibit of this report.

CONDUCTED INTERFERENCE VOLTAGE – AC POWER PORTS

The EUT was not tested with respect to the limits detailed in FCC Rules Part 15 Section 15.207, as the EUT is DC powered and is not intended to be powered from an AC-DC adapter.

OUTPUT POWER AND POWER SPECTRAL DENSITY - 15.407 (a)

Low Power Setting:
The EUT tested complied with the output power limits detailed in FCC Rules Part 15 Section 15.407 (a) (3). For a signal bandwidth of 82.04 MHz and a maximum antenna gain of 37 dBi for point-to-point applications the maximum permitted output power is 16 dBm (39.8mW). The actual power measured was 1.7 dBm (1.5 mW)

The EUT tested complied with the output power spectral density limits detailed in FCC Rules Part 15 Section 15.407 (a) (3). For a maximum antenna gain of 37 dBi the maximum permitted output power spectral density is 3 dBm/MHz. The actual power spectral density measured was –13.1 dBm/MHz.

High Power Setting:
The EUT tested complied with the output power limits detailed in FCC Rules Part 15 Section 15.407 (a) (3). For a signal bandwidth of 83 MHz and a maximum antenna gain of 31 dBi for point-to-point applications the maximum permitted output power is 22 dBm (158 mW). The actual power measured was 6.4 dBm (4.4 mW)

The EUT tested complied with the output power spectral density limits detailed in FCC Rules Part 15 Section 15.407 (a) (3). For a maximum antenna gain of 31 dBi the maximum permitted output power spectral density is 9 dBm/MHz. The actual power spectral density measured was -6 dBm/MHz.

PEAK EXCURSION RATIO - 15.407 (a) (6)

The ratio of the peak excursion of the modulation envelope to the peak transmit power did not exceed the 13dB limit detailed in 15.407 (a) (6). The actual ratio measured was 10.2 dB.

UNDESIRABLE EMISSIONS (SPURIOUS EMISSIONS) - 15.407 (b)

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.407 (b) (3). For spurious emissions falling outside of restricted bands the eirp limit detailed and 15.407 (b) (3) was used. For emissions falling within the restricted bands defined in 15.205 the field strength limit of 15.209 was used.

Spurious emissions were initially measured directly via the antenna port. For signals close the allocated UNII bands the eirp limit was applied by adding the in-band antenna gain to the signal level measured on the spectrum analyzer. The following measurement was extracted from the data recorded and represents the :highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

Antenna Port Conducted Emissions 30 MHz – 40 GHz: High Power Setting

Frequency MHz	Level dBm	eirp dBm	FCC 15.407 (b) Limit	Margin	Comments
5825.0	-56.9	-25.9	-17	-8.9	Assume antenna gain = 31dBi
5708.0	-59.3	-28.3	-27	-1.3	Assume antenna gain = 31dBi

Antenna Port Conducted Emissions 30 MHz – 40 GHz: Low Power Setting

Frequency MHz	Level dBm	eirp dBm	FCC 15.407 (b) Limit	Margin	Comments
5825.18	-60.5	-23.5	-17	-6.5	Assume antenna gain = 37dBi
5840.50	-67.0	-30.0	-27	-3.0	Assume antenna gain = 37dBi

For all other signals, radiated field strength measurements were made. The following measurement was extracted from the data recorded during the radiated electric field emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

Radiated Emissions 1 – 40 GHz

Frequency MHz	Level dBuV/m	Pol v/h	FCC 15.209/15.407 Limit	Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
23099.0	40.3	h	54.0	-13.7	Avg	173	1.7	Note 2

Note 2: Signal is in a restricted band

Note : Only the high power setting was tested whilst connected to a 6' dish antenna. Although this configuration will never be deployed it represented the worst case configuration of both high and low power radios with respect to radiated emissions.

AUTOMATIC DISCONTINUATION - 15.407 (c)

Refer to the Theory of Operations for details as to how the device meets the requirements of 15.407(c) regarding automatically discontinuing transmission in case of either absence of information to transmit or operational failure.

ANTENNA REQUIREMENTS

As the device is not intended to operate in the 15.15 – 15.25 GHz band an integral antenna as detailed in 15.407 (d) is not required. The antenna port is a standard, N-type connector, which is permitted as the system is intended for professional installation.

INTERFERENCE TO CO-CHANNEL MSS OPERATIONS – 15.407(e)

As the device is not intended to operate in the 15.15 – 15.25 GHz band the requirements of 15.407(e) do not apply.

RADIO FREQUENCY RADIATION EXPOSURE REQUIREMENTS – 15.407(f)

The exposure requirements are met through appropriate wording in the installation instructions and/or user's manual. An exhibit of this report addresses the rf exposure issues.

FREQUENCY STABILITY – 15.407(g)

The theory of operations details the frequency stability and how it ensures that the intentional signals are maintained within the band of operation under all conditions of normal operation as specified in the users manual.

MEASUREMENT UNCERTAINTIES

ISO Guide 25 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	30 to 1000	± 3.2

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The BitRage model CR45-A-58 and CR45-A-58L is a UNII radio which is designed to operate in fixed link, point-to-point applications in the 5.725-5.825 GHz bands using either a 6' dish antenna (37dBi gain) at the low power setting or a 3' dish antenna (gain = 31dBi) at the high power setting. The two units are the same except the 58L is configured to have a lower output power. The 58L is for use with dish antennas of 3' or 6' diameter. The 58 is for use with the 3' diameter antenna.

Normally, the EUT would be mounted to a pole during operation. During radiated emissions testing the EUT was mounted on a pole such that it was at a height of 1m above the ground. The EUT was connected to a 6' dish antenna and operated at the high power setting. This configuration, which would not be deployed in normal operation, resulted in a higher EIRP that either of the deployable configurations. By testing the system with the highest EIRP for radiated spurious emissions all lower EIRP configurations were covered by the one test.

The EUT is powered from a dual voltage dc supply. During testing a bench power supply was used. When installed the end-user is responsible for providing dc power from a distributed dc power network or other dc power source.

The sample was received on March 13, 2001 and tested on March 14, 2001. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number
BitRage CR45-A-58 and CR45-A-58L 5.8GHz UNII Transceiver	N/A
RadioWave SP6-5.2 6' Dish antenna (37dBi)	N/A

OTHER EUT DETAILS

The EUT operates at T3 data rates (44.736 Mb/s). One side of the link transmits in the 5.25 - 5.35 GHz band using a 2' diameter dish antenna with a gain of 28dBi. The other side of the link transmits in the 5.725 - 5.825 GHz band at two different power levels. The low power level can utilize dish antennas up to a maximum diameter of 6' (gain = 37dBi). The higher power level can utilize a dish of up to 3' in diameter (31dBi gain).

The system requires professional installation due to the logistics of antenna alignment and antenna mounting.

ENCLOSURE

The EUT enclosure is primarily constructed of fabricated sheet steel. It measures approximately 10 cm wide by 10 cm deep by 25 cm high.

MODIFICATIONS

The EUT did not require modifications during testing in order to comply with the emission specifications.

SUPPORT EQUIPMENT

The following equipment was used as local support equipment for emissions testing:

Manufacturer/Model/Description	Serial Number
Tenma 72-6615 DC Power supply	9912036

The following equipment was used as remote support equipment for emissions testing:

Manufacturer/Model/Description	Serial Number	FCC ID Number
Sunrise Telecom Sunset T3 BER tester	9027	DoC

EUT INTERFACE PORTS

The I/O cabling configuration during emissions testing was as follows:

		Cable(s)		
EUT Port	Connected To	Description	Shielded or Unshielded	Length(m)
DC Power	DC Power meter	Alpha 3223 SL005	Shielded	30
T3 Rx/Tx	BER Tester	75 ohm coaxial (x2)	Shielded	15
Antenna	6' Dish Antenna (note 1)	50 ohm coaxial (Belden 9913 or equivalent)	Shielded	1

Note 1: The antenna port was connected to the spectrum analyzer or power meter for measurements made directly on the antenna port.

EUT OPERATION

The EUT was configured to constantly transmit a pseudo-random data sequence generated by the BER tester at the output power detailed for each test.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on March 14, 2001 at the Elliott Laboratories Open Area Test Site #1 located at 684 West Maude Avenue, Sunnyvale, California. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4-1992. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

POWER METER

A power meter and thermister mount are used for all direct output power measurements from transmitters as they provide a broadband indication of the power output.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the entire 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

RADIATED EMISSIONS

Radiated emissions measurements are performed in two phases as well. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 MHz up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth which results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions which have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

Measurement bandwidths (video and resolution) are set in accordance with FCC procedures for the type of radio being tested.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions from the AC power port are given in units of microvolts, the limits for radiated electric field emissions are given in units of microvolts per meter at a specified test distance and the output power limits are given in temrs of Watts, milliwatts or dBm. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp) the following formula is used to determine the field strength limit in terms of microvolts per meter at a distance of 3m from the equipment under test:

$$E = \frac{1000000 \text{ v } 30\ P}{3} \quad \text{microvolts per meter}$$

where P is the eirp (Watts)

For reference, converting the voltage and electric field strength specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. Conversion of power specification limits from linear units (in milliwatts) to decibel form (in dBm) is accomplished by taking the base ten logarithm, then multiplying by 10.

OUTPUT POWER LIMITS, SECTION 15.407 (a)

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Output Power	Power Spectral Density
5150 - 5250	50mW (17 dBm)	4 dBm/MHz
5250 - 5350	250 mW (24 dBm)	11 dBm/MHz
5725 – 5825	1 Watts (30 dBm)	17 dBm/MHz

For system using antennas with gains exceeding 6dBi, the output power and power spectral density limits are reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5825 MHz band may use antennas with gains of up to 23dBi without this limitation. If the gain exceeds 23dBi then the output power limit of 1 Watt is reduced by 1dB for every dB the gain exceeds 23dBi.

SPURIOUS RADIATED EMISSIONS LIMITS, SECTION 15.209

The table below shows the limits for unwanted (spurious) emissions falling in the restricted bands detailed in Part 15.205.

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

SPURIOUS EMISSIONS SPECIFICATION LIMITS, SECTION 15.407 (b)

The table below shows the limits for unwanted (spurious) emissions outside of the allocated bands that do not fall in the restricted bands of 15.205.

Operating Frequency (MHz)	EIRP Limit (dBm)	Equivalent Field Strength At 3m (dBuV/m)
5150 - 5250	-27 dBm	68.3 dBuV/m
5250 - 5350	-27 dBm	68.3 dBuV/m
5725 – 5825	-27 dBm (note 1) -17 dBm (note 2)	68.3 dBuV/m 78.3 dBuV/m

Note 1: Applies to spurious signals separated by more than 10 MHz from the allocated band.
Note 2: Applies to spurious signals within 10 MHz of the allocated band.

AC POWER PORT CONDUCTED EMISSIONS LIMITS, SECTION 15.207

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - B = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

B = Broadband Correction Factor*

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

* Broadband Level - Per ANSI C63.4, 13 dB may be subtracted from the quasi-peak level if it is determined that the emission is broadband in nature. If the signal level in the average mode is six dB or more below the signal level in the peak mode, the emission is classified as broadband.

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

EXHIBIT 1: Test Equipment Calibration Data

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T42491 27 Pages

EXHIBIT 3: Radiated Emissions Test Configuration Photographs

Test Config Pics.pdf 2 Pages

EXHIBIT 4: Proposed FCC ID Label & Label Location

EXHIBIT 5: Detailed Photographs of BitRage Model CR45-A-58 and CR45-A-58LConstruction

External Photographs.pdf 1 page
Internal Photographs.pdf 11 Pages

EXHIBIT 6: Operator's Manual for BitRage Model CR45-A-58 and CR45-A-58L

User Manual.pdf 12 Pages
Installation Guide.pdf 12 Pages

EXHIBIT 7: Block Diagram of BitRage Model CR45-A-58 and CR45-A-58L

Block Diagram.pdf. 4 Pages

EXHIBIT 8: Schematic Diagrams for BitRage Model CR45-A-58 and CR45-A-58L

CR45 power Schematics.pdf	3 Pages
CR45A display Schematics.pdf	1 Page
CR45A_58 Schematics.pdf	3 Pages
CR45A_ba Schematics.pdf	6 Pages

EXHIBIT 9: Theory of Operation for BitRage Model CR45-A-58 and CR45-A-58L

Theory of Operations.pdf 3 Pages