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Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart E (UNII Devices) and Industry Canada RSS 210 Issue 4 (LELEAN Devices) on the D-Link Corporation Model: DWL-A650 and DW-690

FCC ID:	KA22001120011-1
GRANTEE:	D-Link Corporation No.8, Li-shing Road VII Hsinchu, Taiwan
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	December 27, 2001
FINAL TEST DATE:	December 18 and December 19, 2001
AUTHORIZED SIGNATORY:	Mark Briggs Director of Engineering

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DECLARATIONS OF COMPLIANCE

Equipment Name and Model:
DWL-A650 and DW-690

Manufacturer:
D-Link Corporation
No.8, Li-shing Road VII
Hsinchu, Taiwan

Tested to applicable standards:
RSS-210, Issue 4, December 2000 (Low Power License-Exempt Radiocommunication Devices)
FCC Part 15 Subpart E (UNII Devices)

Measurement Facility Description Filed With Department of Industry:

Departmental Acknowledgement Number: IC2845**SV2** Dated August 12, 2001
Departmental Acknowledgement Number: IC2845**SV4** Dated July 19, 2001

I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above mentioned departmental standards (through the use of ANSI C63.4 as detailed in section 5.3 of RSS-210, Issue 4); and that the equipment performed in accordance with the data submitted in this report.

Signature	_____
Name	Mark Briggs
Title	Director of Engineering
Company	Elliott Laboratories Inc.
Address	684 W. Maude Ave Sunnyvale, CA 94086 USA
Date:	December 27, 2001

Maintenance of compliance with the above standards 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.).

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SCOPE

An electromagnetic emissions test has been performed on the D-Link Corporation model DWL-A650 and DW-690 pursuant to Subpart E of Part 15 of FCC Rules for Unlicensed National Information Infrastructure (UNII) devices and RSS-210 Issue 4 for licence-exempt local area network (LELAN) 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 D-Link Corporation model DWL-A650 and DW-690 and therefore apply only to the tested sample. The sample was selected and prepared by Shinglin Chung of D-Link Corporation.

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.

SUMMARY OF RESULTS

FCC Part 15 Section	RSS 210 Section	Description	Comments	Result
Operation in the 5.15 – 5.25 GHz Band				
15.407 (d)		As the device operates in the 5.15 – 5.25 GHz band the antenna must be integral to the device.	Antenna Gain = 4 dBi The antenna is integral to the device.	COMPLIES
15.407(e)		Indoor operation only	Refer to user's manual in Appendix 6	COMPLIES
15.407(a) (1)		26dB Bandwidth	55.8 – 77 MHz in Turbo Mode 28.2 - 41.8 MHz in 802.11a (Normal) Mode	N/A
	6.2.2 q1 (i)	20dB Bandwidth	33.8 – 49.3 MHz in Turbo Mode 17.7 - 26 MHz in 802.11a Mode	N/A
15.407(a) (1)	6.2.2 q1 (i)	Output Power	12.8 dBm in Turbo Mode 13.2 dBm in 802.11a Mode	COMPLIES
15.407(a) (1))	6.2.2 q1 (i)	Power Spectral Density	-2.47 dBm/MHz in Turbo Mode 1.2 dBm/MHz in 802.11a Mode	COMPLIES
15.407(b) (2)	6.2.2 q1 (ii)	Spurious Emissions above 1GHz	-.1dB @ 15630MHz in turbo mode -1.5dB @ 15540MHz in 802.11a Mode	COMPLIES
Operation in the 5.25 – 5.35 GHz Band. Note: The device is restricted to indoor use only, therefore the spectral density of spurious emissions in the 5.15 – 5.25 GHz band were limited to the power spectral limits for intentional signals detailed in FCC 15.407(a)(1) and RSS 210 6.2.2 q1 (i)				
		Maximum Antenna Gain /Integral Antenna	Antenna Gain = 4 dBi The antenna is integral to the device.	COMPLIES
15.407(a) (1)		26dB Bandwidth	55.8 – 77 MHz in Turbo Mode 28.2 - 41.8 MHz in 802.11a (Normal) Mode	N/A
	6.2.2 q1 (i)	20dB Bandwidth	33.8 – 49.3 MHz in Turbo Mode 17.7 - 26 MHz in 802.11a Mode	N/A
15.407(a) (2)	6.2.2 q1 (ii)	Output Power	14.5 dBm in turbo mode 12.7 dBm in 802.11a Mode	COMPLIES
15.407(a) (2))	6.2.2 q1 (ii)	Power Spectral Density	-3.03 dBm/MHz in turbo mode -0.1dBm/MHz in 802.11a Mode	COMPLIES
15.407(b) (2)	6.2.2 q1 (ii)	Spurious Emissions above 1GHz	-1.5dB @ 15750MHz in turbo mode -0.1dB @ 15780MHz in 802.11a Mode	COMPLIES
General requirements for all bands				
15.407(b) (5) / 15.209	6.2.2 q1 (ii)	Spurious Emissions below 1GHz	-15.5dB @ 100MHz	COMPLIES
	6.2.2 q(iv)(a)	Digital Modulation	Digital Modulation is used, refer to the "Theory of Operations" (Appendix 9) for a detailed explanation.	COMPLIES
	6.2.2 q(iv)(b)	Peak Spectral Density	3.0 dBm/MHz in turbo mode 6.1 dBm/MHz in 802.11a Mode	COMPLIES
15.407(a)(6)		Peak Excursion Ratio	Less than 13dB	COMPLIES
	6.2.2 q(iv)(c)	Channel Selection	The channels used represent the highest, lowest and center channels available.	N/A
15.407 (c)	6.2.2 q(iv)(d)	Automatic Discontinuation of Operation in the absence of information to transmit	Operation is discontinued in the absence of information to transmit, refer to the "Theory of Operations" in Appendix 9 for a detailed explanation.	COMPLIES
15.407 (g)	6.2.2 q(iv)(e)	Frequency Stability	Frequency stability is 20 ppm, refer to the "Theory of Operations" in Appendix 9 for a detailed analysis.	COMPLIES

FCC Part 15 Section	RSS 210 Section	Description	Comments	Result
	6.2.2 q(iv)(g)	User Manual information	All relevant statements have been included in the user's manuals. Refer to Appendix 6 for details	COMPLIES
15.407 (f)	6.2.2 q(iv)(g)	RF Exposure Requirements	Refer to MPE calculations in Appendix 11	COMPLIES
15.407(b) / 15.207	6.6	AC Conducted Emissions	-13.7dB @ 0.4701MHz	COMPLIES

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 D-Link Corporation model DWL-A650 and DW-690 is an 802.11a DWL-A650 and DW-690 device that is designed to operate in the 5.15-5.25 and 5.25-5.35GHz UNII/LELAN bands. Normally, the EUT would be installed into the PC Card slot of a laptop PC. The EUT was installed in a laptop and the whole system was treated as table-top equipment during testing to simulate the end user environment.

The EUT can support data rates of up to 54Mb/s in 802.11a mode using a nominal channel bandwidth of 20MHz. It has a higher data rate mode of 72Mb/s when operating in "Turbo Mode". This mode uses a nominal channel bandwidth of 40MHz.

The sample was received on December 18, 2001 and tested on December 18 and December 19, 2001. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number
D-Link Corporation DWL-A650, DW-690 802.11a DWL-A650 and DW-690	3
D-Link Corporation 802.11a DWL-A650 and DW-690	18

OTHER EUT DETAILS

The two cards used identical circuit boards. One card (s/n 18) was used for tests performed on the device operating in 802.11a mode and the other card (s/n 3) was used for tests performed in Turbo Mode. The two cards use different plastic housings (which extend beyond the metal DWL-A650 and DW-690 enclosure and outside the laptop) for the antennae.

The output power is set via software using PCDAC values. These values are used in a look-up table within the device to set the output power to a nominal level. The PCDAC values used for the tests results submitted for product certification are the ones that will be used in normal operation.

ENCLOSURE

The EUT enclosure is primarily fabricated from sheet metal to fit the form factor for PC cards.

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	FCC ID Number
ASUS M1300 Series Laptop	18NG008506	DoC
Dell PP01L Laptop	TW-0791UH-12800-0BD-1339	-
Hewlett Packard Printer	2714S40166	-
US Robotics Pilot PDA	-	-
Dell ADP-70EB Power Adaptor	TH-09364U-17971-0AU-0VWN	-

No remote support equipment was used during emissions testing.

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length (m)
PCI Card	Laptop	Wireless Card	N/A	N/A
Parallel	Printer	Parallel	Shielded	3
Serial	PDA	Serial	Shielded	3
AC	Adaptor	Two Wire	Unshielded	2

EUT OPERATION

The EUT was set to operate in a continuous transmit mode at a data rate of 6Mb/s for 802.11a mode and 12Mb/s for turbo mode. These data rates produce the highest spectral density for their respective modes.

The channels used for testing were selected as representing the highest and lowest available channels for each mode plus a channel from the middle of the frequency band.

During the radiated emissions below 1GHz and conducted emissions tests the laptop was transmitting data at 5.26GHz in normal mode and pcdac at 12. In addition to transmitting on the center channel the laptop was displaying an H pattern on its screen.

ANTENNA REQUIREMENTS

As the device is intended to operate in the 5.15 – 5.25 GHz band an integral antenna as detailed in 15.407 (d) and RSS-210 6.2.2(q1) (i) is required. The antenna for the device is an integral antenna that is not accessible to the end user.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on December 18 and December 19, 2001at the Elliott Laboratories Open Area Test Site #4 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 Federal Communications Commission. In accordance with Industry Canada rules detailed in RSS 210 Issue 4 and RSS-212, construction, calibration, and equipment data for the test sites have been filed with the Federal Communications 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

Either a spectrum analyzer or a power meter and thermister mount are used for all direct output power measurements from transmitters.

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 Appendix 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:

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

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.

FCC 15.407 (a) OUTPUT POWER LIMITS

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.

RS-210 6.2.2(q1) OUTPUT POWER LIMITS

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	200mW (23 dBm)	10 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

The table below shows the limits for unwanted (spurious) emissions falling in the restricted bands detailed in Part 15.205 and Industry Canada RSS-210 Table 2.

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

The table below shows the limits for unwanted (spurious) emissions outside of the restricted bands above 1GHz.

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 (note 1)	68.3 dBuV/m
5725 – 5825	-27 dBm (note 2)	68.3 dBuV/m
	-17 dBm (note 3)	78.3 dBuV/m

Note 1: If operation is restricted to indoor use only then emissions in the band 5.15 – 5.25 GHz must meet the power spectral density limits for the intentional signals detailed in RSS 210 and FCC Subpart E for devices operating in the 5.15 – 5.25 Ghz band.
Note 2: Applies to spurious signals separated by more than 10 MHz from the allocated band.
Note 3: Applies to spurious signals within 10 MHz of the allocated band.

AC POWER PORT CONDUCTED EMISSIONS LIMITS

The table below shows the limits for emissions on the AC power line as detailed in FCC Part 15.205 and Industry Canada RSS-210 section 6.6.

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

APPENDIX 1: Test Equipment Calibration Data

Conducted and Radiated Emissions, 20-Dec-01 12:03 AM
Engineer: Vishal

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
EMCO	Biconical Antenna, 30-300 MHz	3110B	1320	12	5/23/2001	5/23/2002
Elliott Laboratories	LISN 2 x (Solar 8028 LISN + 6512 Caps)	LISN-5, Support	379	12	8/10/2001	8/10/2002
Fischer Custom Comm.	LISN, Freq. 0.9 -30 MHz,16 Amp	FCC-LISN-50/250-16-2	1079	12	6/15/2001	6/15/2002
EMCO	Log Periodic Antenna, 0.2-1 GHz	3146	1294	12	3/27/2001	3/27/2002
Rohde& Schwarz	Pulse Limiter	ESH3 Z2	812	12	1/23/2001	1/23/2002
Rohde & Schwarz	Test Receiver, 0.009-30 MHz	ESH3	1316	12	5/9/2001	5/9/2002
Rohde & Schwarz	Test Receiver, 20-1300 MHz	ESVP	1317	12	5/9/2001	5/9/2002

Antenna Conducted Emissions, Radiated Spurious Emissions Above 1GHz
Engineer: Mark

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	786	12	2/7/2001	2/7/2002
Hewlett Packard	Microwave EMI test system (SA40, 30Hz - 40GHz)	84125C	1149	12	2/5/2001	2/5/2002
Hewlett Packard	Spectrum Analyzer 9KHz - 26GHz	8563E	284	12	2/22/2001	2/22/2002

APPENDIX 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T 45735 63 Pages

Elliott

EMC Test Data

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Emissions Spec:	FCC 15 B & E	Class:	B
Immunity Spec:	N/A	Environment:	N/A

EMC Test Data

For The

D-Link Corporation

Model

Cardbus

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Emissions Spec:	FCC 15 B & E	Class:	B
Immunity Spec:	N/A	Environment:	N/A

EUT INFORMATION

General Description

The EUT is an 802.11a CardBus device that is designed to operate in the 5.15-5.25 and 5.25-5.35GHz UNII/LELAN bands. Normally, the EUT would be installed into the PC Card slot of a laptop PC. The EUT was installed in a laptop and the whole system was treated as table-top equipment during testing to simulate the end user environment.

The EUT can support data rates of up to 54Mb/s in 802.11a mode using a nominal channel bandwidth of 20MHz. It has a higher data rate mode of 72Mb/s when operating in "Turbo Mode". This uses a nominal channel bandwidth of 40MHz.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
D-Link Corporation	DWL-A650, DW-690	802.11a CardBus	3	
D-Link Corporation		802.11a CardBus	18	

Other EUT Details

The two cards used identical circuit boards. One card (s/n 18) was used for tests performed on the device operating in 802.11a mode and the other card (s/n 3) was for tests performed in Turbo Mode. The two cards use different plastic housings (which extends beyond the metal CardBus enclosure and outside the laptop) for the antennae.

The output power is set via software using PCDAC values. These values are used in a look-up table within the device to set the output power to a nominal level. The PCDAC values used for the tests results submitted for product certification are the ones that will be used in normal operation.

EUT Enclosure

The EUT enclosure is primarily fabricated from sheet metal to fit the form factor for PC cards.

Modification History

Mod. #	Test	Date	Modification
1	-	-	None made during testing

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Emissions Spec:	FCC 15 B & E	Class:	B
Immunity Spec:	N/A	Environment:	N/A

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
ASUS	M1300 Series	Laptop	18NG008506	DoC
Dell	PP01L	Laptop	TW-0791UH-12800-0BD-1339	
Hewlett Packard		Printer	2714S40166	
US Robotics	Pilot	PDA		
Dell	ADP-70EB	Power Adaptor	TH-09364U-17971-0AU-0VWN	

The ASUS laptop was used as the host laptop for radiated spurious emissions measurements above 1GHz and all antenna conducted emissions. The Dell laptop was used for all digital device radiated emissions tests and the AC power conducted emissions test. The printer and palm pilot were not connected when the ASUS laptop was being used.

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
PCI Card	Laptop	Wireless Card	N/A	N/A
Parallel	Printer	Parallel	Shielded	3
Serial	PDA	Serial	Shielded	3
AC	Adaptor	Two Wire	Unshielded	2

EUT Operation During Emissions

The EUT was set to operate in a continuous transmit mode at a data rate of 6Mb/s for 802.11a mode and 12Mb/s for turbo mode. These data rates produce the highest spectral density for their repsective modes.

The channels used for testing were selected as representing the highest and lowest available channels for each mode plus a channel from the middle of the frequency band.

During the radiated emissions below 1GHz and conducted emissions tests the laptop was transmitting data at 5.26GHz in normal mode and pcdac at 12. In addition to transmitting on the center channel the laptop was displaying an H pattern on its screen.

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Radiated Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 12/19/2001
Test Engineer: Vishal
Test Location: SVOATS #2
Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing.

On the OATS, the measurement antenna was located 3 meters from the EUT for the measurement range 30 - 1000 MHz and 3m from the EUT for the frequency range 1 - 10 GHz.

Note, **preliminary** testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. **Maximized** testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Note, for testing above 1 GHz, the FCC specifies the limit as an average measurement. In addition, the FCC states that the peak reading of any emission above 1 GHz, can not exceed the average limit by more than 20 dB.

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, Preliminary Scan 30 - 1000 MHz	FCC B	Pass	-15.5dB @ 100MHz
2	RE, 30 - 1000MHz - Maximized Emissions	FCC B	Pass	-15.5dB @ 100MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Elliott

EMC Test Data

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Run #1: Preliminary Radiated Emissions, 30-1000 MHz

Frequency	Level	Pol	FCC B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
100.000	28.0	V	43.5	-15.5	QP	280	1.0	
210.000	28.0	H	43.5	-15.5	QP	160	1.5	
797.500	29.0	V	46.0	-17.0	QP	360	1.0	
300.000	29.0	H	46.0	-17.0	QP	140	1.4	
797.500	28.7	H	46.0	-17.3	QP	250	1.1	
53.600	22.0	V	40.0	-18.0	QP	300	1.1	
300.000	28.0	V	46.0	-18.0	QP	170	1.0	
695.500	27.7	V	46.0	-18.3	QP	120	1.2	
695.500	27.5	H	46.0	-18.5	QP	210	1.0	
424.300	26.0	V	46.0	-20.0	QP	180	1.0	
530.000	26.0	H	46.0	-20.0	QP	0	1.1	
400.000	25.2	V	46.0	-20.8	QP	180	1.2	
499.500	25.0	H	46.0	-21.0	QP	180	1.3	
400.000	25.0	H	46.0	-21.0	QP	200	1.0	
180.000	22.0	H	43.5	-21.5	QP	220	1.8	

Run #2: Maximized Readings From Run #1

Frequency	Level	Pol	FCC B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
100.000	28.0	V	43.5	-15.5	QP	280	1.0	
210.000	28.0	H	43.5	-15.5	QP	160	1.5	
797.500	29.0	V	46.0	-17.0	QP	360	1.0	
300.000	29.0	H	46.0	-17.0	QP	140	1.4	
797.500	28.7	H	46.0	-17.3	QP	250	1.1	
53.600	22.0	V	40.0	-18.0	QP	300	1.1	

Elliott

EMC Test Data

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Conducted Emissions - Power Ports

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 12/19/2001
Test Engineer: Vishal
Test Location: SVOATS #2

Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

For tabletop equipment, the EUT was located on a wooden table, 40 cm from a vertical coupling plane and 80cm from the LISN. A second LISN was used for all local support equipment.

Ambient Conditions:

Temperature: 10°C
Rel. Humidity: 89%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power 120V/60Hz	FCC B	Pass	-13.7dB @ .4701MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Run #1: AC Power Port Conducted Emissions, 0.45 - 30 MHz 120 V / 60 Hz

Frequency	Level	Power	FCC-B	FCC-B	Detector	Comments
MHz	dBuV	Lead	Limit	Margin	Function	
0.470	34.3	Line 1	48.0	-13.7	PK	
5.700	34.3	Line 1	48.0	-13.7	PK	
19.258	33.3	Line 1	48.0	-14.7	PK	
5.753	30.0	Neutral	48.0	-18.0	QP	
19.056	28.8	Neutral	48.0	-19.2	QP	
0.470	27.7	Neutral	48.0	-20.3	QP	

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

FCC Part 15 Subpart E Tests: Turbo Mode

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test:	12/18/2001 - 12/19/2001	Config. Used:	PC Card #18
Test Engineer:	Juan M. / Vishal / Mark	Config Change:	
Test Location:	SVOATS# 4	Host Unit Voltage	

General Test Configuration

The EUT was located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT unless stated otherwise.

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators and cables used.

Ambient Conditions:

Temperature: 10°C

Rel. Humidity: 89%

Summary of Results: Turbo Mode

Run #	Test Performed	Limit	Result	Comments
1	Output Power	15.407(a) (1), (2)	pass	12.8dBm / 14.5dBm
2	Power Spectral Density (PSD)	15.407(a) (1), (2)	pass	-2.47dBm/MHz / 3.03dBm/MHz
2	Power Spectral Density (PSD)	RSS 210	pass	6.1dBm/MHz
3	26dB Bandwidth	15.407	pass	55.8 - 77 MHz
3	20 dB Bandwidth	RSS 210	pass	33.8 - 49.3 MHz
4	Peak Excursion Envelope	15.407(a) (6)	Pass	Peak to average excursion < 13dB
5	Antenna Conducted - Out of Band Spurious	15.407(b)	pass	All emissions below the 27dBm/MHz limit
6	RE, 1000 - 40000 MHz - Spurious Emissions	15.407(b)(6)	Pass	-.1dB @ 15630MHz

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

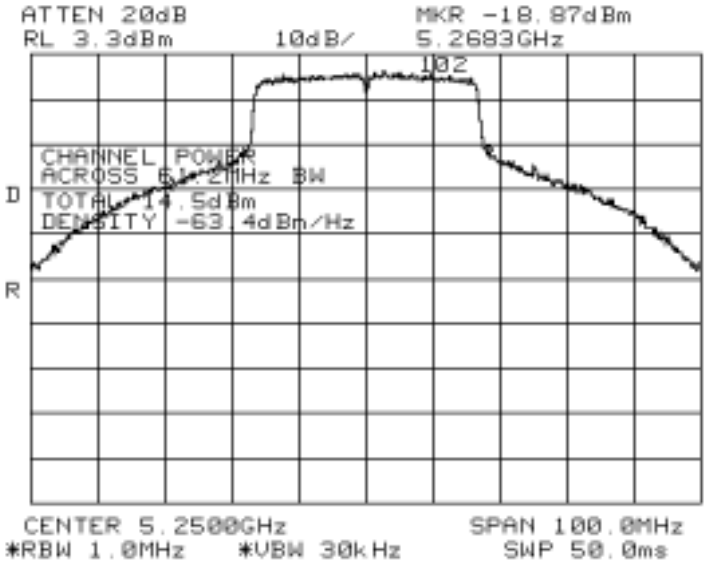
Run #1: Output Power

Antenna Gain: 4 dBi

Channel	Frequency (MHz)	PC_DAC	Output Power (dBm)	FCC Limit (dBm) (note 3)	Comments
Low	5210	11	12.1	17.0	Note 2
	5210	11	12.8	17.0	Note 1
Mid	5250	12	13.8	17.0	Note 2
	5250	12	14.5	17.0	Note 1 / (102)
High	5290	10	11.7	24.0	Note 2
	5290	10	12.6	24.0	Note 1

Note 1:	Measured using spectrum analyzer's power measurement function (RBW = 1MHz, VBW = 30kHz) which summed the power over the occupied bandwidth (26dB bandwidth).
Note 2:	Measured using a Power Meter with a thermal sensor
Note 3:	RSS 210 limit is 23dBm in the 5.15 to 5.25 GHz band, 6dB higher than the FCC limit. This limit is based on the emission bandwidth and operating frequency.

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B



Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Run #2: Power Spectral Density

Antenna Gain: 4 dBi

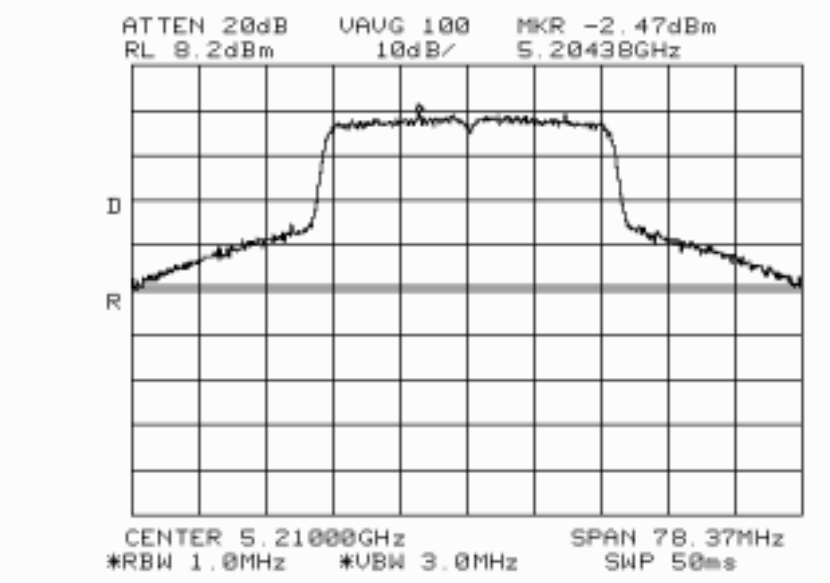
PCDAC	Frequency (MHz)	Power Spectral Density (dBm/MHz)	FCC Limit (dBm) note 2	Peak Power Spectral Density (dBm)	
11	5210	-2.47	4.0	5.87	Note 1
12	5250	-3.03	4.0	6.13	Note 1
10	5290	-3.03	11.0	5.5	Note 1

Note 1:	The above measurements were made using RBW = 1MHz, VBW = 3MHz, video averaging on. To demonstrate compliance with RSS 210, the peak PSD was also measured using RBW= VBW=1MHz, video averaging off during the peak excursion measurements (run #4). The peak PSD (meausred with RBW=VBW=1MHz) of **6.1dBm** did not exceed the maximum permitted average PSD of 10dBm (5.15 to 5.25 GHz band) or 11dBm (5.25-5.35GHz band) so no restriction is placed on the output power or average PSD with respect to RSS 210.
Note 2:	RSS 210 limit is 10dBm/MHz in the 5.15 to 5.25 GHz band, 6dB higher than the FCC limit.

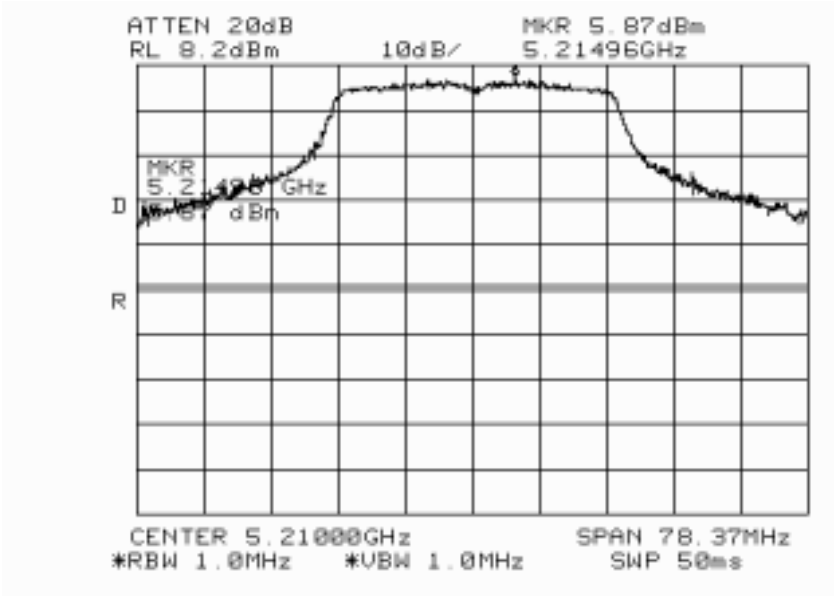
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Plots Showing Power Spectral Density (RBW = 1MHz, VBW = 3 MHz, video averaging ON)

FCC Power Density

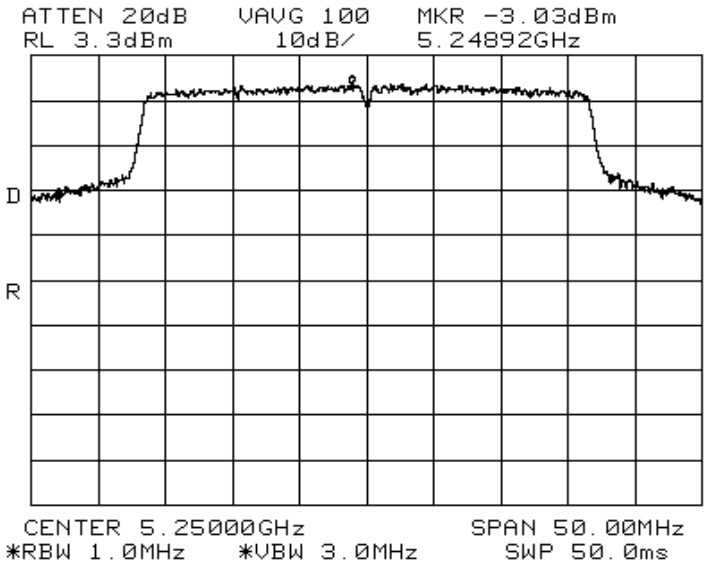


Canada Power Density

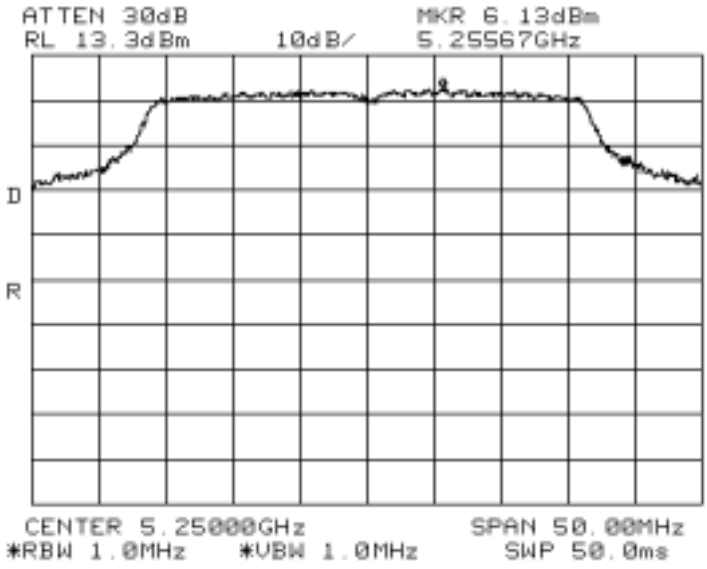


Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

FCC Power Density

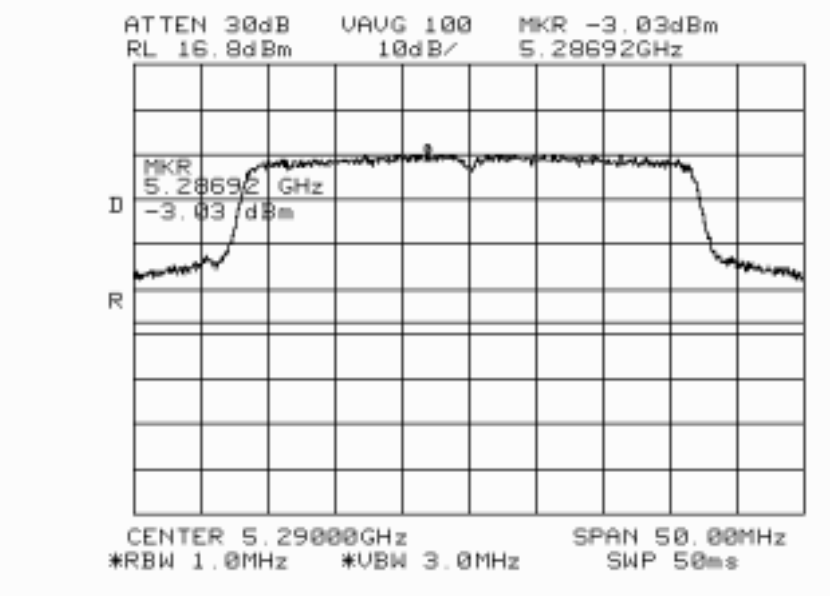


Canada Power Density

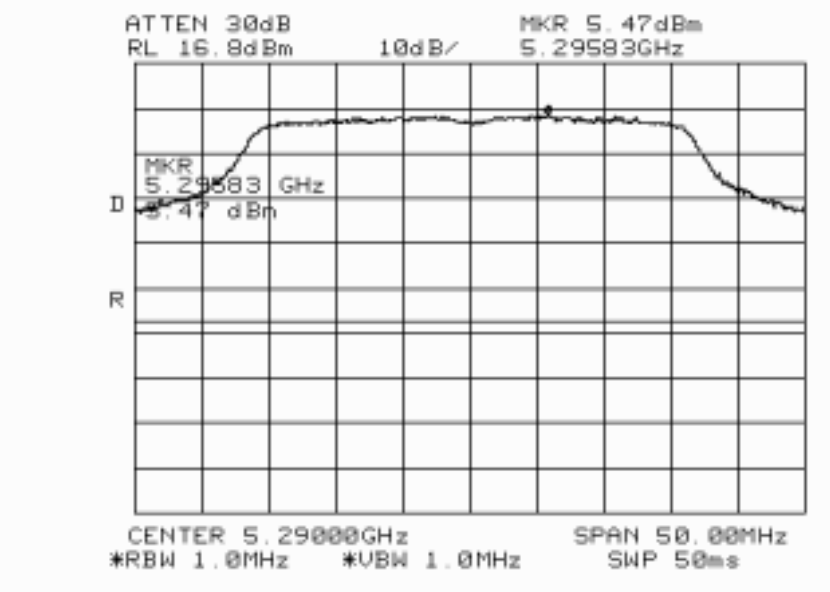


Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

FCC Power Density



Canada Power Density

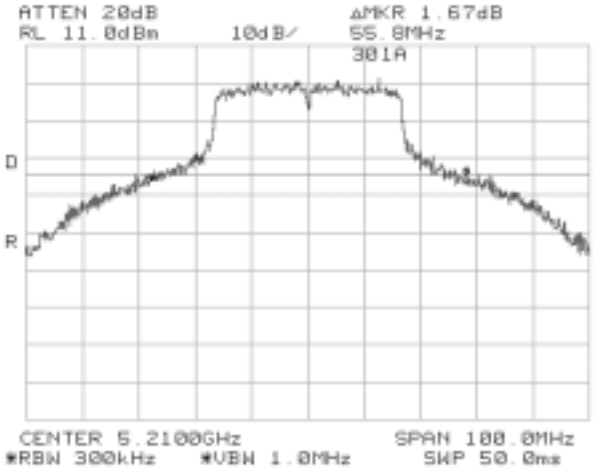


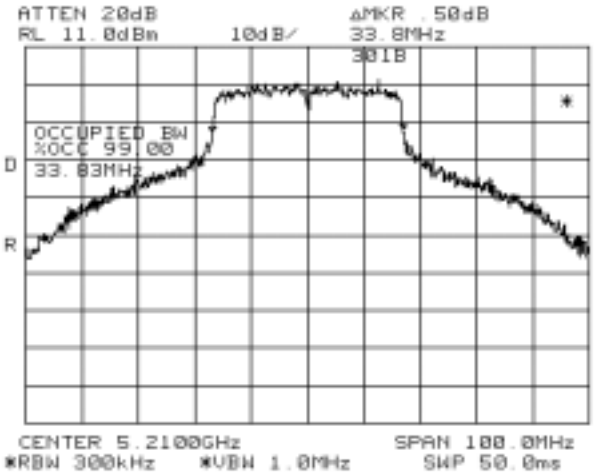
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Run #3: Signal Bandwidth

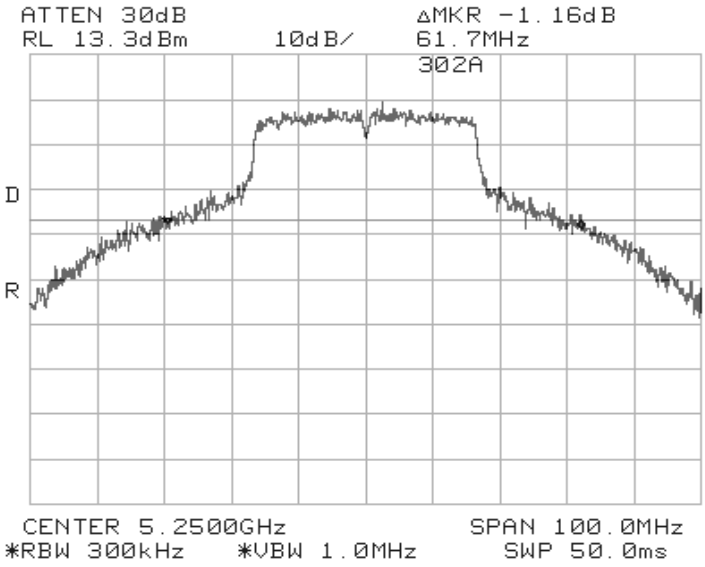
Channel	Frequency (MHz)	Resolution Bandwidth	26 dB Signal Bandwidth (MHz)	20 dB Signal Bandwidth (MHz)	Graph reference #
low	5210	300 kHz	55.80	33.83	301A and 301B
mid	5250	300 kHz	61.70	36.00	302A and 302B
high	5290	300 kHz	77.00	49.33	303A and 303B

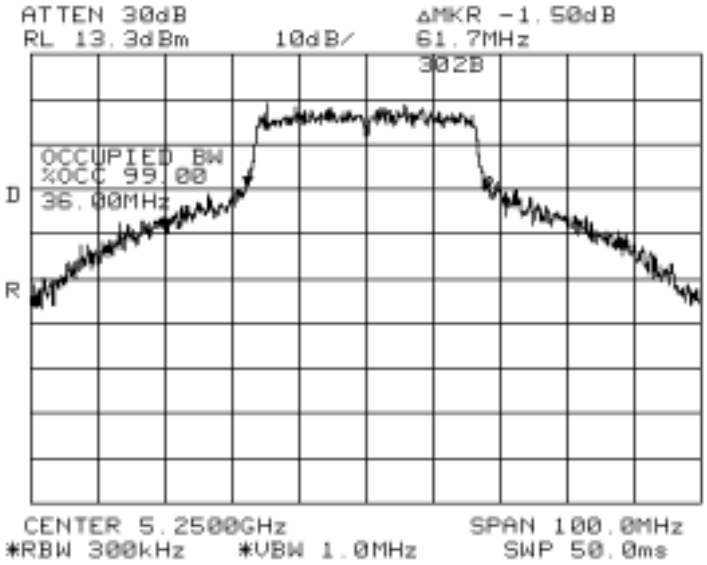
Plots Showing Signal Bandwidth



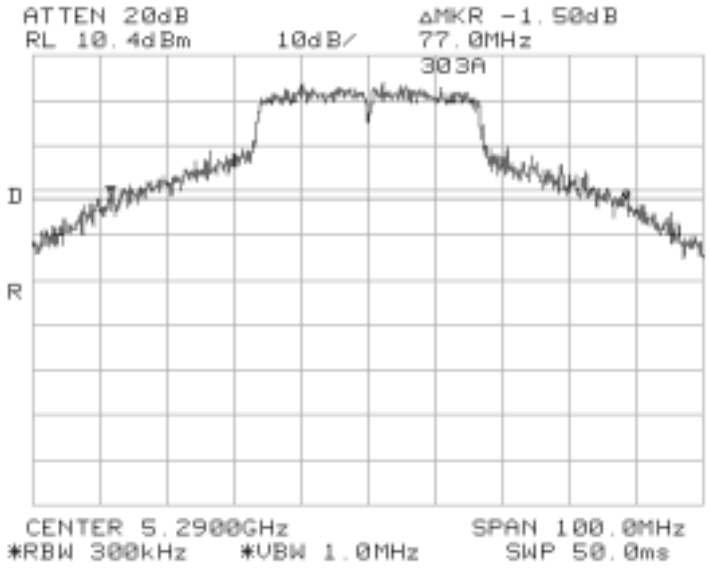


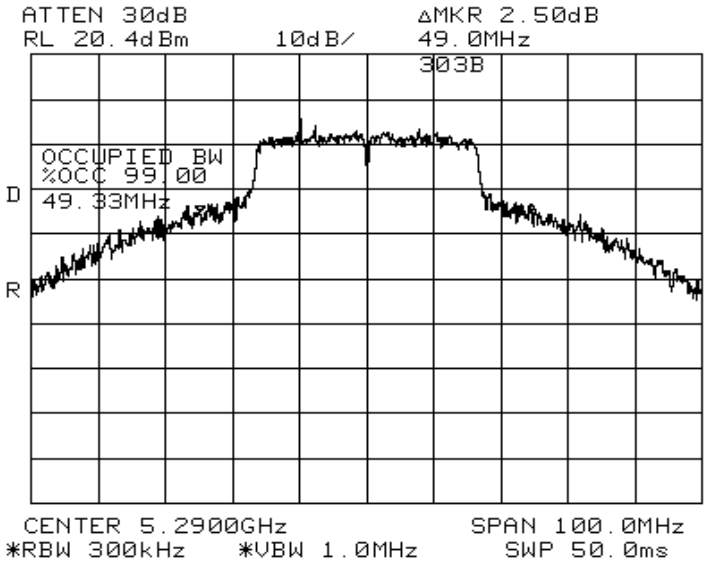
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B





Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B





Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

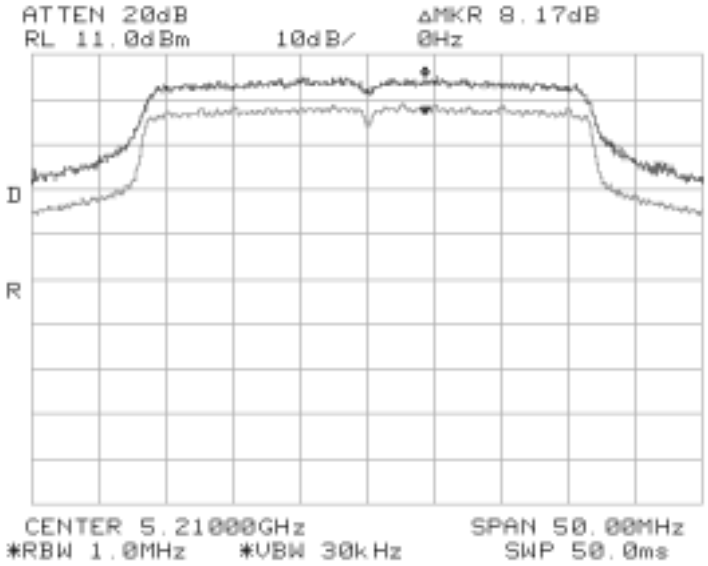
Run #4: Peak Excursion Measurement

Plots Showing Peak Excursion

Trace A: RBW = VBW = 1MHz

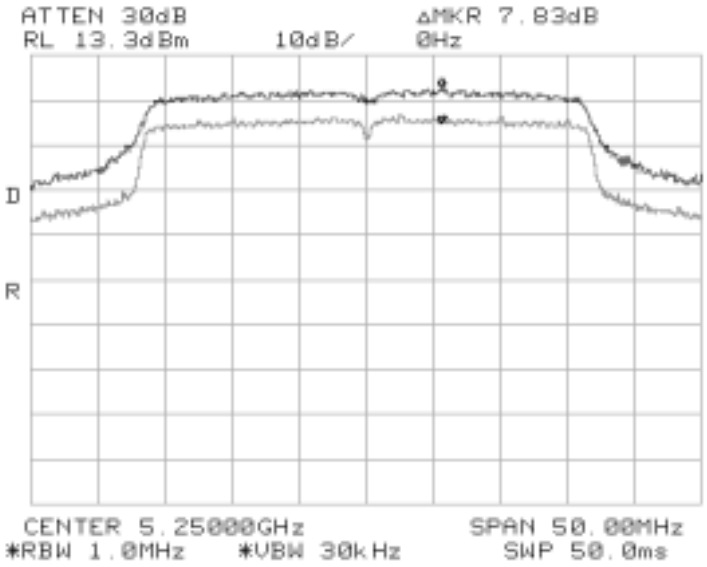
Trace B: RBW = 1 MHz, VBW = 30kHz

Low Channel; Peak Excursion = 8.17 dB



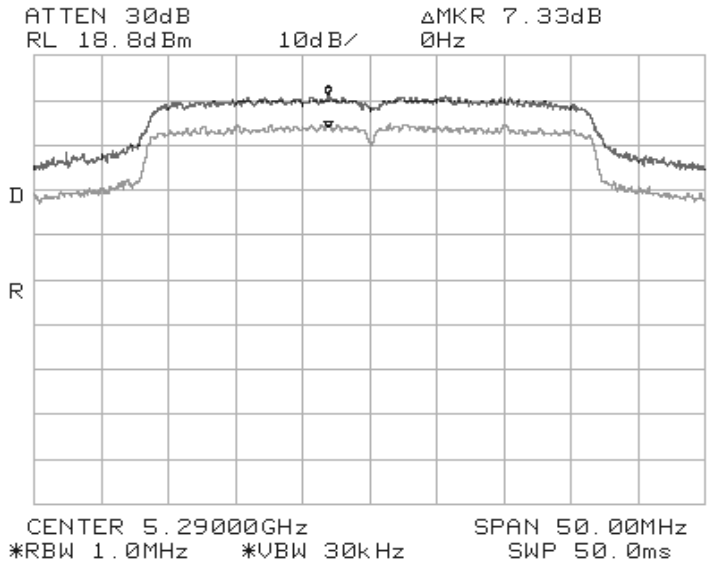
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Middle Channel; Peak Excursion =7.83 dB



Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

High Channel; Peak Excursion = 7.33 dB



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EMC Test Data

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Run #5: Out Of Band Spurious Emissions - Antenna Conducted

The antenna gain of the radios integral antenna is 3.9 dBi. The EIRP limit is -27dBm/MHz for all out of band signals that do not fall in restricted bands. A limit of -30.9 dBm was, therefore, used for signals not in restricted bands and close to the intentional band with the assumption that the antenna gain was equal to 3.9 within 100 MHz of the upper and lower band edges. For signals removed from the band edge by more than 100MHz, radiated measurements were made (refer to run #6) if the signal amplitude exceeded -37dBm.

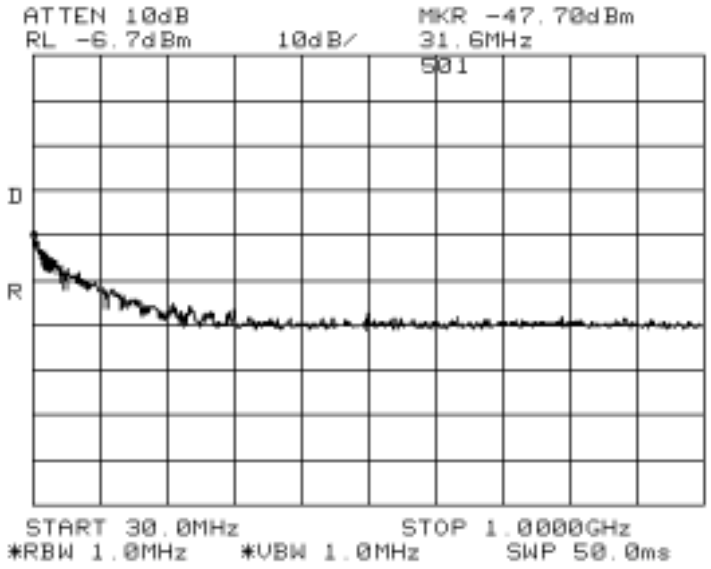
Channel	Frequency (MHz)	Frequency Range	Highest Spurious Signal	Graph reference #
low	5210	30 - 1000 MHz	Note 4	501
		1 to 5.15 GHz	3117 (Note 2), 4168 (Note 3)	502
		5.25 to 10 GHz	6248 (Note 3)	503
		10 GHz to 20 GHz	10420 (Note 3), 15650 (Note 1)	504
		20 GHz to 40 GHz	None	505
mid	5250	30 - 1000 MHz	Note 4	506
		1 to 5.25 GHz	3146 (Note 2), 4202 (Note 1)	507
		5.35 to 10 GHz	6296 (Note 3)	508
		10 GHz to 20 GHz	10500 (Note 3), 15770 (Note 1)	509
		20 GHz to 40 GHz	None	510
high	5290	30 - 1000 MHz	Note 4	511
		1 to 5.30 GHz	3179 (Note 2), 4232 (Note 1)	512
		5.34 to 10 GHz	6342 (Note 3)	513
		10 GHz to 20 GHz	10570 (Note 3), 15870 (Note 1)	514
		20 GHz to 40 GHz	None	515

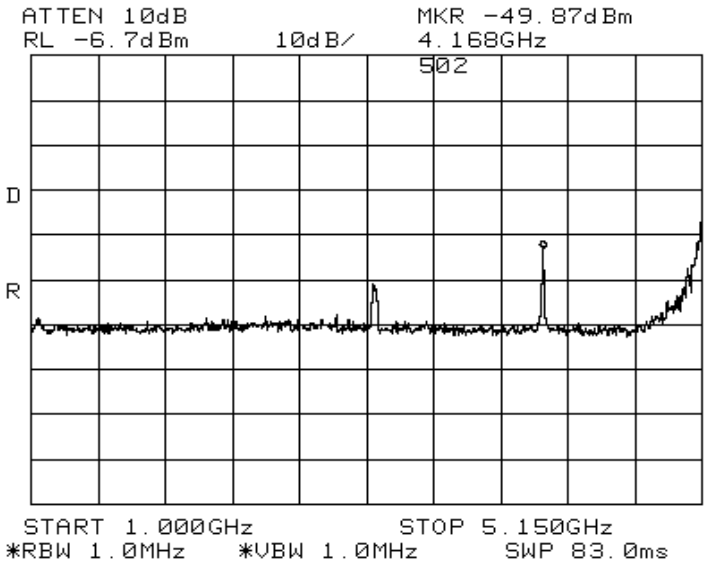
Note 1:	Signal is in a restricted band. Refer to run #6 for field strength measurements.
Note 2:	Signal is not in restricted band. Limit is -27dBm eirp. As the signal strength is significantly lower than -27dBm no field strength measurements required.
Note 3:	Signal is not in restricted band. Limit is -27dBm eirp. Although the signal strength is significantly lower than -27dBm field strength measurements were made (refer to run #6)
Note 4:	All spurious signals in this frequency band measured during digital device radiated emissions test.

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

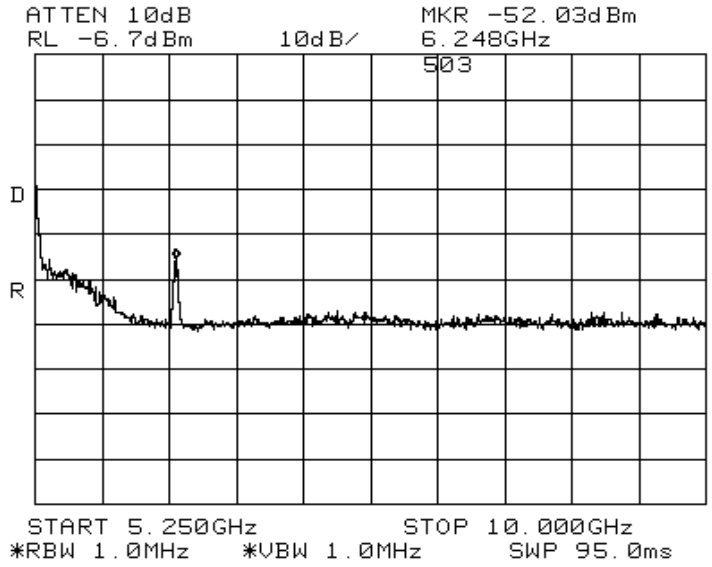
Plots Showing Out-Of-Band Emissions (RBW=VBW=1MHz)

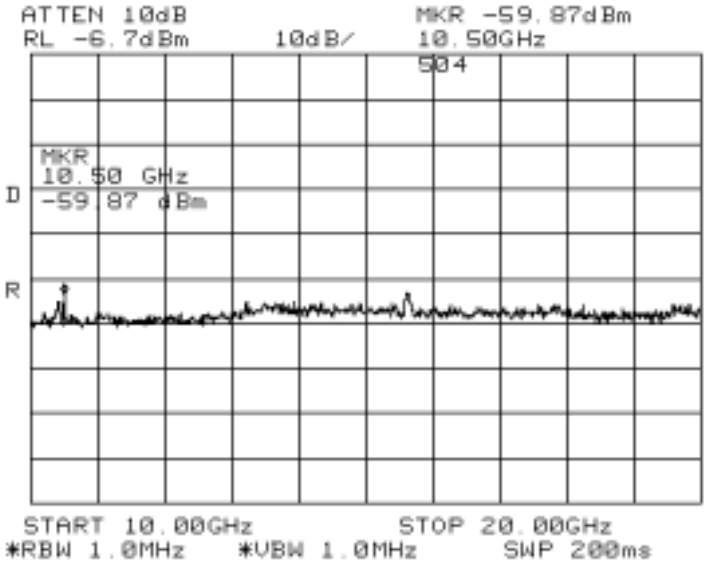
EUT operating at 5.21 GHz:



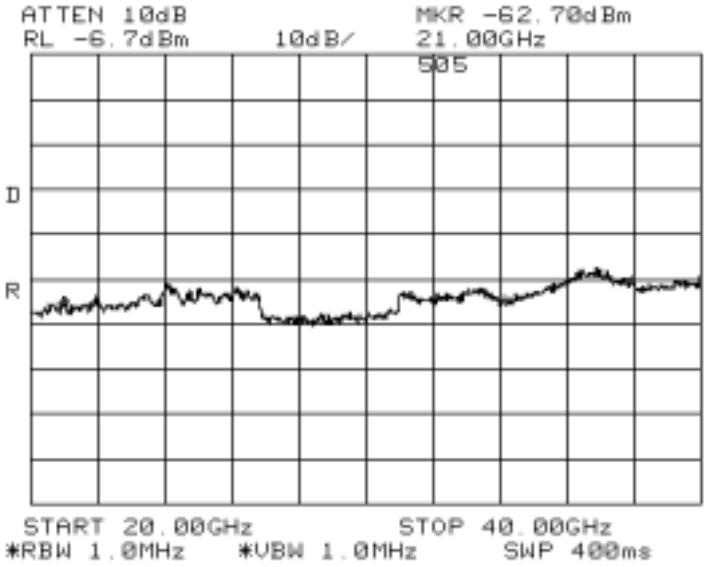


Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

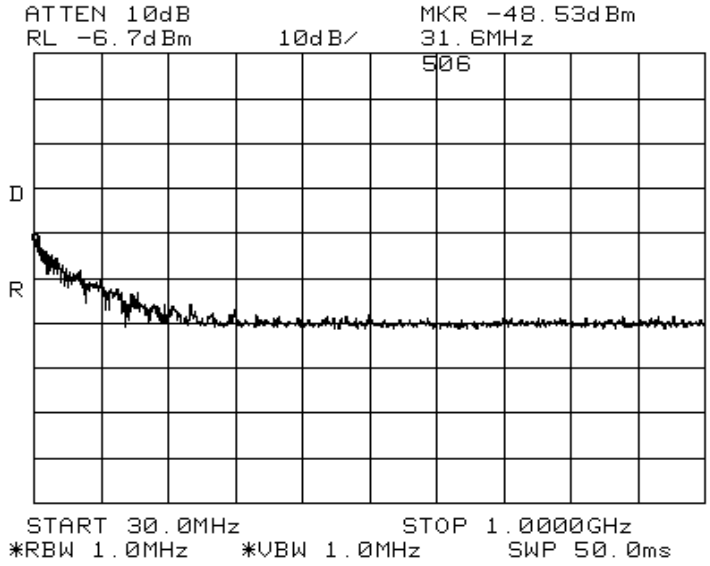




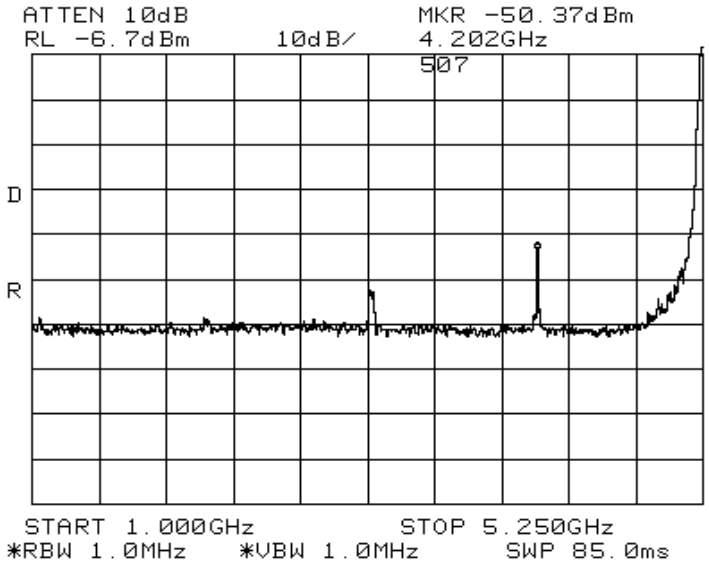
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

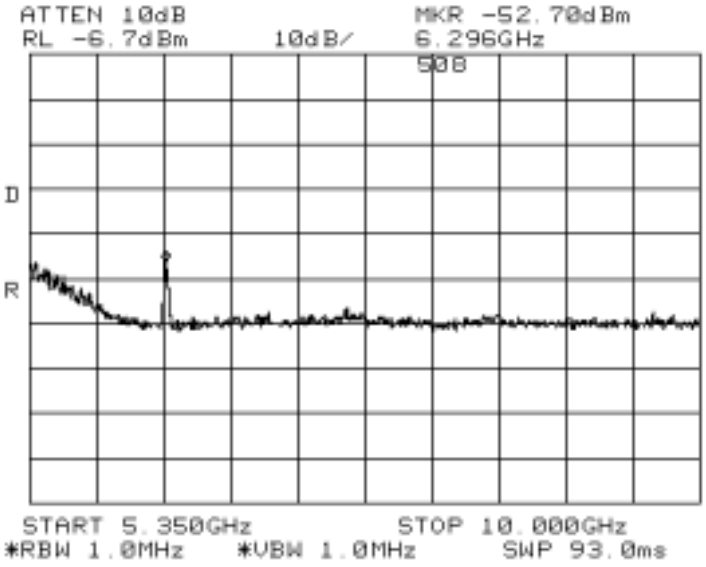


EUT operating at 5.25GHz:

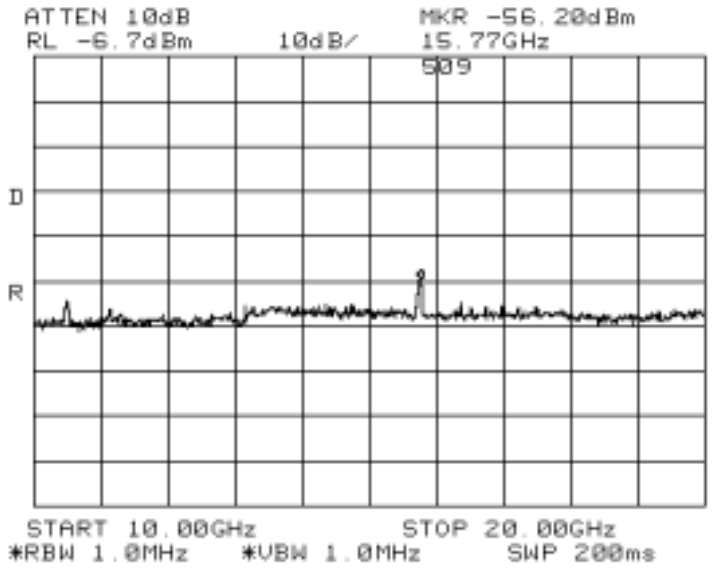


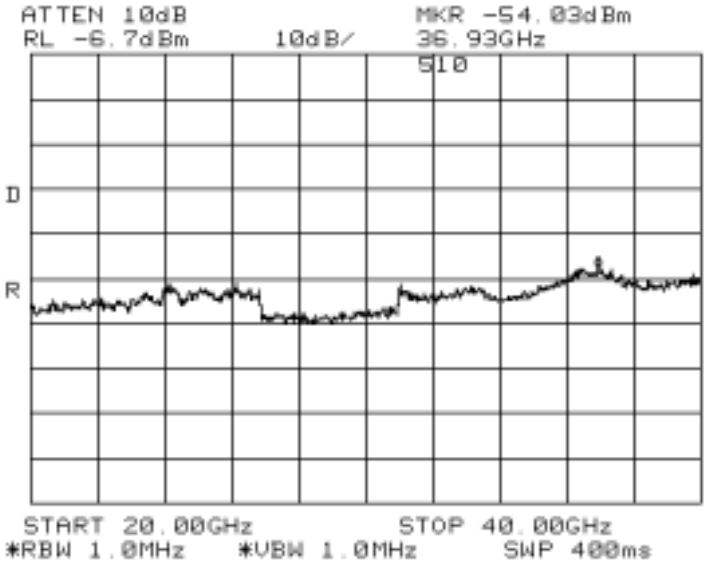
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B





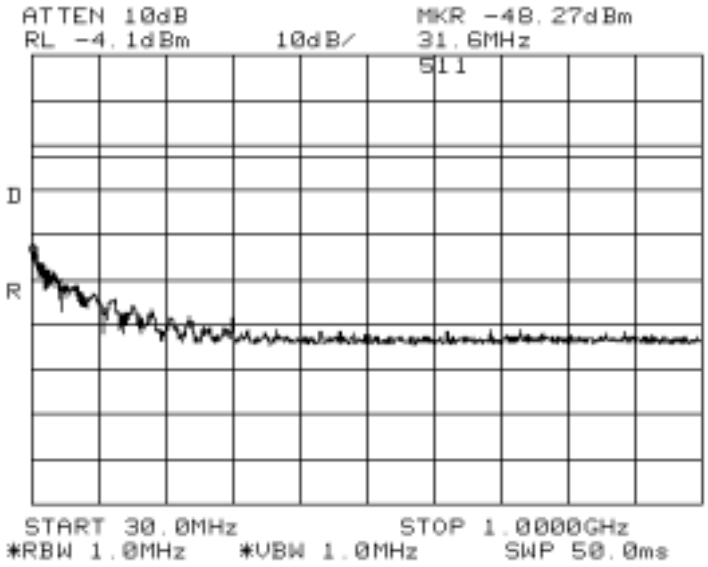
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

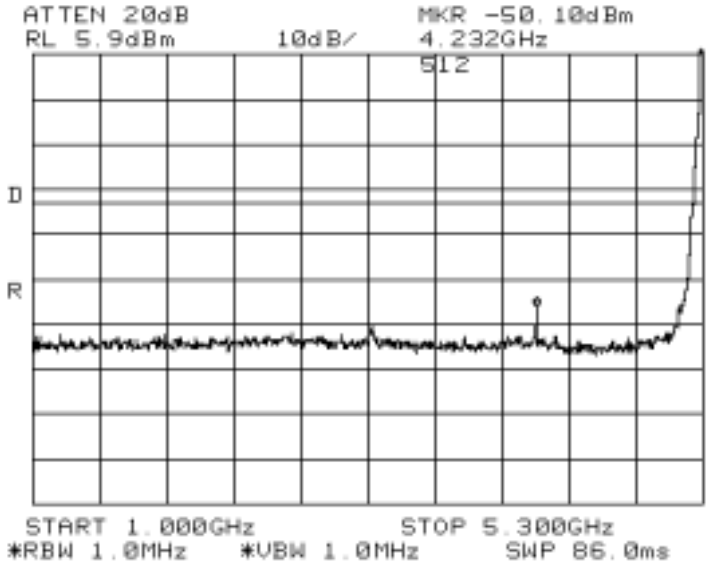




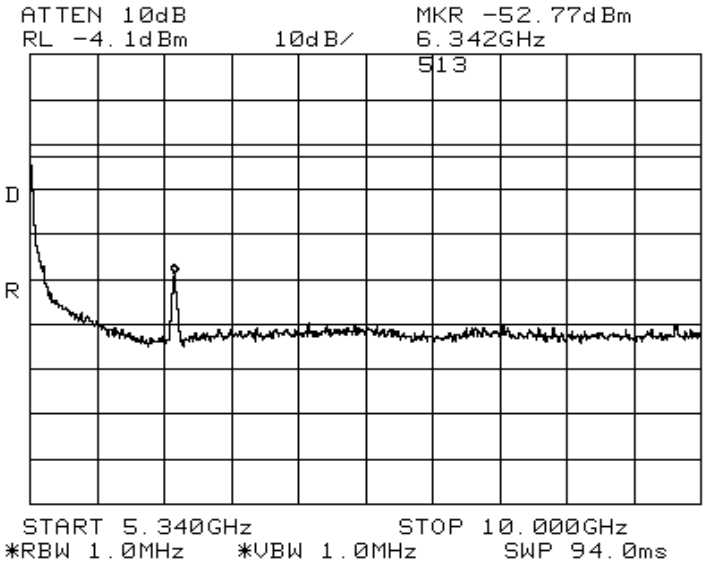
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

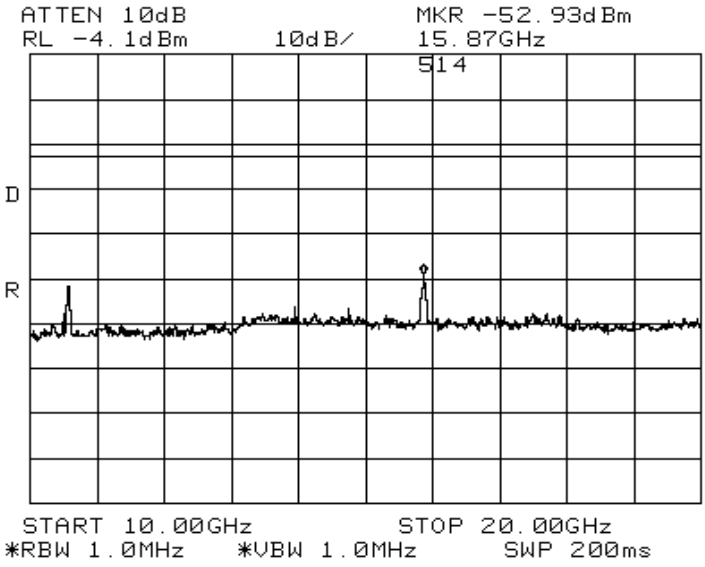
EUT operating at 5.29GHz:



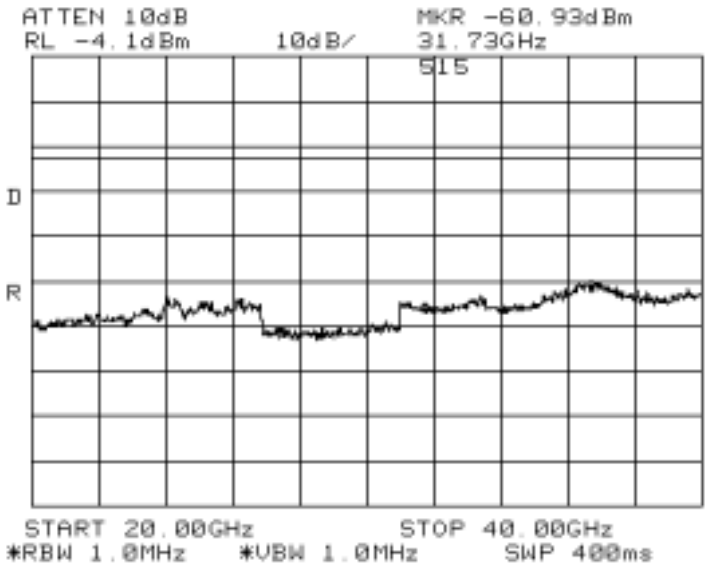


Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B





Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B



Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

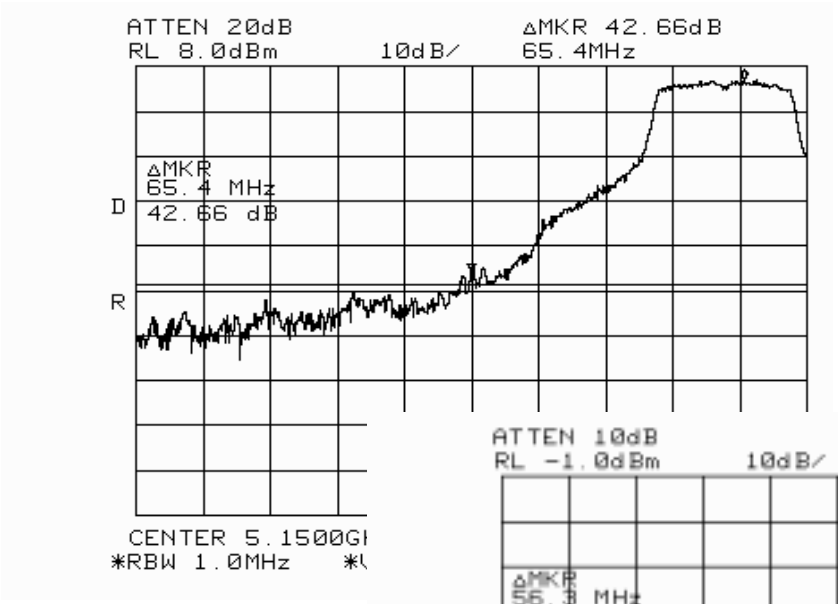
Band Edge Measurements:

For signals in the restricted bands immediately above and below the 5.15 to 5.35 GHz allocated band a measurement was made of the amplitude of the spurious emissions with respect to the intentional signals. The relative amplitude, in dBc, was then applied to the average and peak field strength of the intentional signal made on the OATS to calculate the field strength of the unintentional signals.

Plots Showing Out-Of-Band Emissions (Peak RBW=VBW=1MHz; Average RBW = 1MHz, VBW = 10Hz)

5.15 GHz band edge, EUT operating on the lowest channel (2.21GHz, PCDAC=11)

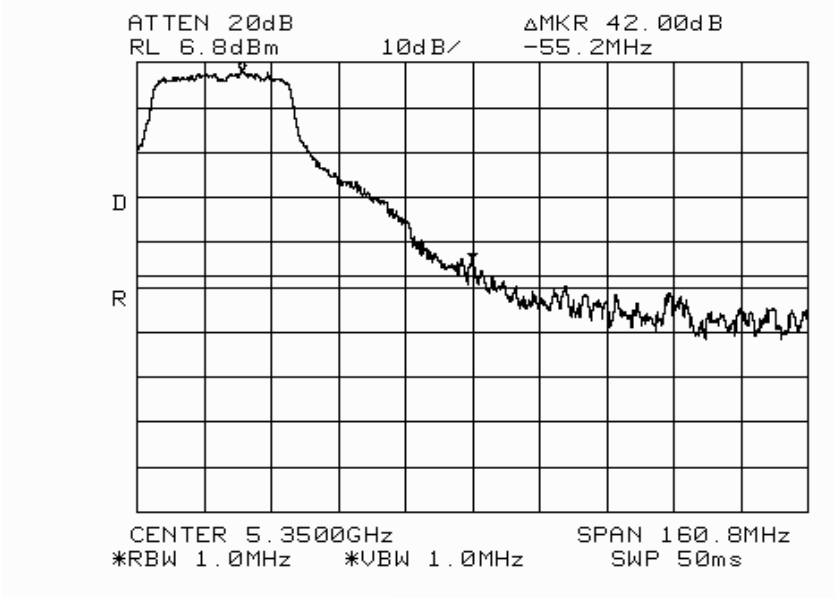
The highest signal within 60 MHz of the 5.15 GHz band was -42.7 dBc (Peak) / -52.5 dBc (Average)

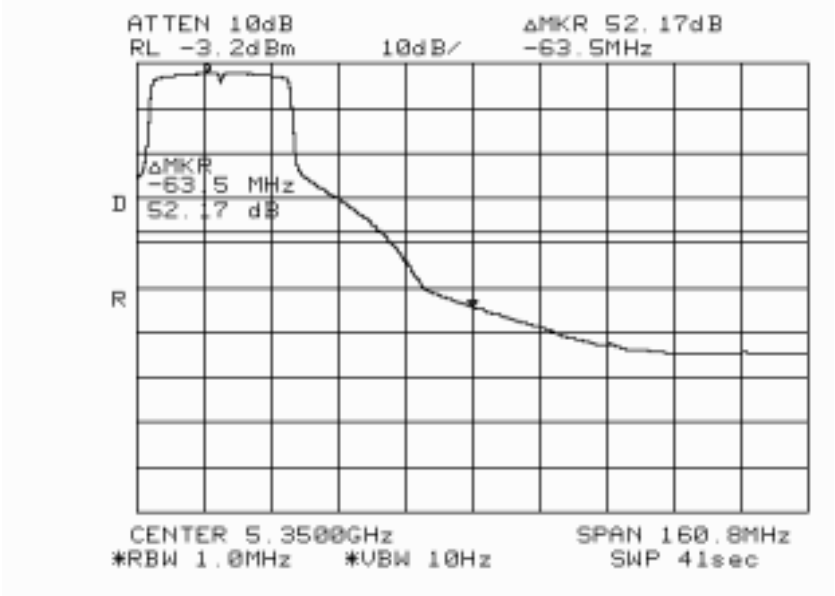


Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

5.35 GHz band edge EUT operating on highest channel (5.29 GHz) at PCDAC=10:

The highest signal in the 5.35 to 5.46 GHz band was -42.00 dBc (Peak) / -52.2dBc (Average)





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EMC Test Data

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Run #6a: Radiated Spurious Emissions, 1000 - 40000 MHz

Spurious emissions from 30 - 1000 MHz were measured while performing emissions measurements of the digital device.

Limit for emissions in restricted bands:	54dBuV/m (Average)	74dBuV/m (Peak)
Limit for emissions outside of restricted bands:	EIRP < -27dBm/MHz	(68dBuV/m)

Fundamental signal measurements (to calculate the band edge field strengths):

EUT On Lowest Channel Available (5.21 GHz), PCDAC=11

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5214.646	106.3	V	-	-	Pk			Peak reading, peak limit
5213.692	97.5	V	-	-	Avg			Average reading, average limit

EUT On Highest Channel Available (5.29GHz), PCDAC = 10

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5294.592	104.5	V	-	-	Pk	300	1.0	Peak reading, peak limit
5293.770	96.2	V	-	-	Avg	300	1.0	Average reading, average limit

Band Edge Field Strength Calculations using PCDAC=11 for low channel and PCDAC = 10 for high channel:

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5150.0	63.6	v	74.0	-10.4	Pk			Note 1
5150.0	45.0	v	54.0	-9.0	Avg			Note 1
5350.0	62.5	v	74.0	-11.5	Pk			Note 2
5350.0	44.0	v	54.0	-10.0	Avg			Note 2

Note 1:	EUT operating on the lowest channel available in the 5.15 - 5.25 MHz band. Signal level calculated using the relative measurements in run #5 (-42.7 dBc for peak and -52.5dBc for average) applied to the highest peak and average field strength measurements of the fundamental signal level.
Note 2:	EUT operating on highest channel available in the 5.25 - 5.35 MHz band. Signal level calculated using the relative measurements in run #5 (-42 dBc for peak and -52.2 dBc for average) applied to the highest peak and average field strength measurements of the fundamental signal level.

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Run #6b: Radiated Spurious Emissions, 1000 - 40000 MHz
EUT On Lowest Channel Available (5.21 GHz), PCDAC = 11

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
15630.0	53.9	h	54.0	-0.1	Avg	333	1.4	Note 2
15630.0	53.8	v	54.0	-0.2	Avg	333	1.3	Note 2
15630.0	66.1	h	74.0	-7.9	Pk	333	1.4	Note 2
20840.0	44.2	v	54.0	-9.8	Avg	286	1.3	Note 2
15630.0	63.8	v	74.0	-10.2	Pk	333	1.3	Note 2
10420.0	57.1	h	68.3	-11.2	Note 3	306	1.4	Note 4
10420.0	56.3	v	68.3	-12.0	Note 3	266	1.4	Note 4
4168.0	41.2	h	54.0	-12.8	Pk			Note 2,5, Peak reading, avg limit
4168.0	39.3	v	54.0	-14.7	Pk			Note 2,5, Peak reading, avg limit
20840.0	57.6	v	74.0	-16.4	Pk	286	1.4	Note 2
6252.0	44.1	v	68.3	-24.2	Note 3	335	1.6	Note 4
6252.0	37.0	h	68.3	-31.3	Note 3	0	1.1	Note 4

Note, at PCDAC=12 the third harmonic was 0.2dB above the radiated limit of 54dBuV/m.

EUT On Center Channel (5.25 GHz) pcdac=12

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
15750.0	52.5	v	54.0	-1.5	Avg	325	1.2	Note 2
15750.0	51.4	h	54.0	-2.6	Avg	311	1.3	Note 2
4200.0	46.0	v	54.0	-8.0	Pk	15	1.9	Note 2, 5 - Pk level, avg limit
4200.0	44.5	h	54.0	-9.5	Pk	0	1.0	Note 2, 5 - Pk level, avg limit
15750.0	63.8	v	74.0	-10.2	Pk	325	1.2	Note 2
15750.0	63.3	h	74.0	-10.7	Pk	311	1.3	Note 2
21000.0	43.3	v	54.0	-10.7	Avg	293	1.2	Note 2
4200.0	42.9	v	54.0	-11.1	Avg	15	1.9	Note 2
10500.0	55.7	h	68.3	-12.6	Note 3	240	1.8	Note 4
10500.0	55.6	v	68.3	-12.7	Note 3	280	1.7	Note 4
21000.0	56.8	v	74.0	-17.2	Pk	293	1.2	Note 2

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EMC Test Data

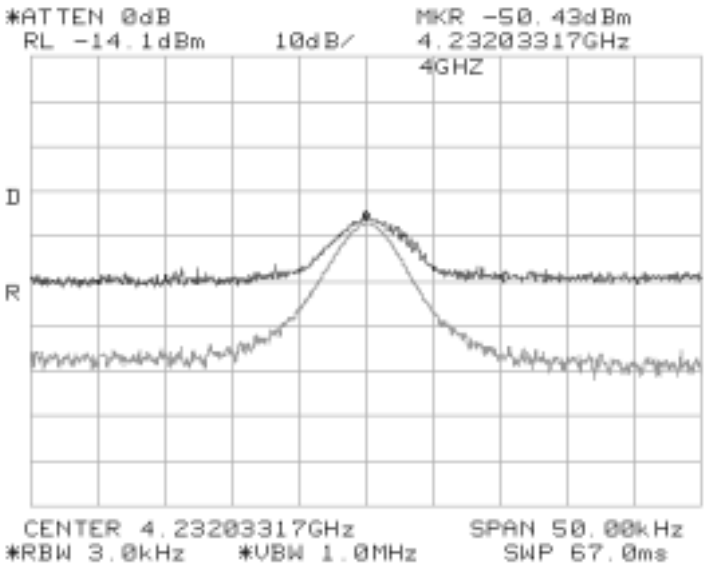
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

EUT On Highest Channel Available (5.29 GHz), Reduced output power to PCDAC 10:

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
15870.0	52.4	v	54.0	-1.6	Avg	10	1.4	Note 2
15870.0	51.2	h	54.0	-2.8	Avg	0	1.6	Note 2
15870.0	66.0	v	74.0	-8.0	Pk	10	1.4	Note 2
15870.0	64.3	h	74.0	-9.7	Pk	0	1.6	Note 2
4232.0	43.7	v	54.0	-10.3	Pk	320	1.7	Note 2, 5 - Pk level, avg limit
4232.0	42.8	h	54.0	-11.2	Pk	300	1.7	Note 2, 5 - Pk level, avg limit
21160.0	42.6	v	54.0	-11.4	Avg	285	1.3	Note 2
10580.0	55.8	v	68.3	-12.5	Note 3	250	1.7	Note 4
10580.0	54.9	h	68.3	-13.4	Note 3	300	1.4	Note 4
21160.0	40.3	h	54.0	-13.7	Avg	300	1.3	Note 2
21160.0	55.4	v	74.0	-18.6	Pk	285	1.3	Note 2
21160.0	53.1	h	74.0	-20.9	Pk	300	1.3	Note 2

Note 1:	For emissions falling in the restricted bands detailed in 15.205 the general limits of 15.209 apply. For all other emissions the limit is EIRP < -27dBm (equivalent to a field strength at 3m of 68dBuV/m)
Note 2:	Signal is in a restricted band
Note 3:	Restricted Band Peak Measurements: Resolution and Video BW: 1 MHz, Restricted Band Average Measurements: Resolution Bw: 1MHz and Video Bw: 10 Hz. All other measurements, RBW = 1MHz and VBW = 3MHz, video averaging on (100 samples).
Note 4:	Signal does not fall in a restricted band.
Note 5:	This measurement was made using a resolution bandwidth of 3 kHz The instrumentation noise floor was too high to allow measurements with RBW = 1MHz because a preamplifier could not be used (with the EUT operating the intentional signal would overload the amplifier and there is no low pass filter with sufficient shape factor to reject the intentionally trasmitted signal but pass the spuroius signal). The signal was a narrowband signal (as verified during the conducted antenna measurements) and so the amplitude (peak/average) in a 3kHz bandwidth would be the same as that in a 1MHz bandwidth (please refer to the plot below). The peak reading has been compared with the average limit.

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B



Plot showing LO signal at 4GHz measured using RBW = 1MHz and RBW = 3kHz. Amplitude of the signal does not change with resolution bandwidth.

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

FCC Part 15 Subpart E Tests: Normal Mode

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test:	12/18/2001 - 12/19/2001	Config. Used:	PC Card #3
Test Engineer:	Juan M. / Vishal / Mark	Config Change:	
Test Location:	SVOATS# 4	Host Unit Voltage	

General Test Configuration

The EUT was located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT unless stated otherwise.

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators and cables used.

Ambient Conditions:

Temperature: 10°C

Rel. Humidity: 89%

Summary of Results: Normal Mode

Run #	Test Performed	Limit	Result	Comments
1	Output Power	15.407(a) (1), (2)	pass	13.2dBm / 12.7dBm
2	Power Spectral Density (PSD)	15.407(a) (1), (2)	pass	1.2dBm/MHz / -0.1dBm/MHz
2	Power Spectral Density (PSD)	RSS 210	pass	8.2dBm/MHz
3	26dB Bandwidth	15.407	pass	28.2 - 41.8 MHz
3	20 dB Bandwidth	RSS 210	pass	17.7 - 26 MHz
4	Peak Excursion Envelope	15.407(a) (6)	Pass	Peak to average excursion < 13dB
5	Antenna Conducted - Out of Band Spurious	15.407(b)	pass	All emissions below the 27dBm/MHz limit
6	RE, 1000 - 40000 MHz - Spurious Emissions	15.407(b)(6)	pass	-.1dB @ 15780MHz

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

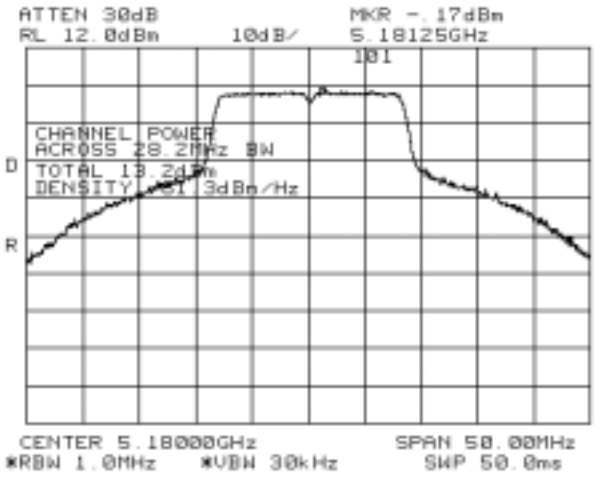
No deviations were made from the requirements of the standard.

Run #1: Output Power

Antenna Gain: 4 dBi

Channel	Frequency (MHz)	PC_DAC	Output Power (dBm)	FCC Limit (dBm) (note 3)	Comments
Low	5180	10	13.2	17.0	Note 2
	5180	10	13.2	17.0	Note 1/ (101)
Mid	5260	12	12.1	24.0	Note 2
	5260	12	12.7	24.0	Note 1 / (102)
High	5320	8	11.0	24.0	Note 2
	5320	8	11.8	24.0	Note 1

Note 1:	Measured using spectrum analyzer's power measurement function (RBW = 1MHz, VBW = 30kHz) which summed the power over the occupied bandwidth (26dB bandwidth).
Note 2:	Measured using a Power Meter with a thermal sensor
Note 3:	RSS 210 limit is 23dBm in the 5.15 to 5.25 GHz band, 6dB higher than the FCC limit. This limit is based on the emission bandwidth and operating frequency.



Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Run #2: Power Spectral Density

Antenna Gain: 4 dBi

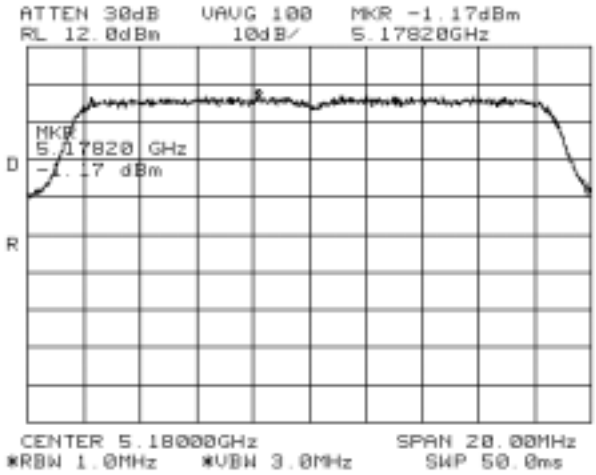
PCDAC	Frequency (MHz)	Power Spectral Density (dBm/MHz)	FCC Limit (dBm) note 2	Peak Power Spectral Density (dBm)	
10	5180	-1.17	4.0	8.17	Note 1
12	5260	-0.13	11.0	8.03	Note 1
8	5320	-0.97	11.0	7.87	Note 1

Note 1:	The above measurements were made using RBW = 1MHz, VBW = 3MHz, video averaging on. To demonstrate compliance with RSS 210, the peak PSD was also measured using RBW= VBW=1MHz, video averaging off during the peak excursion measurements (run #4). The peak PSD (meausred with RBW=VBW=1MHz) of **8.2 dBm** did not exceed the maximum permitted average PSD of 10dBm (5.15 to 5.25 GHz band) or 11dBm (5.25-5.35GHz band) so no restriction is placed on the output power or average PSD with respect to RSS 210.
Note 2:	RSS 210 limit is 10dBm/MHz in the 5.15 to 5.25 GHz band, 6dB higher than the FCC limit.

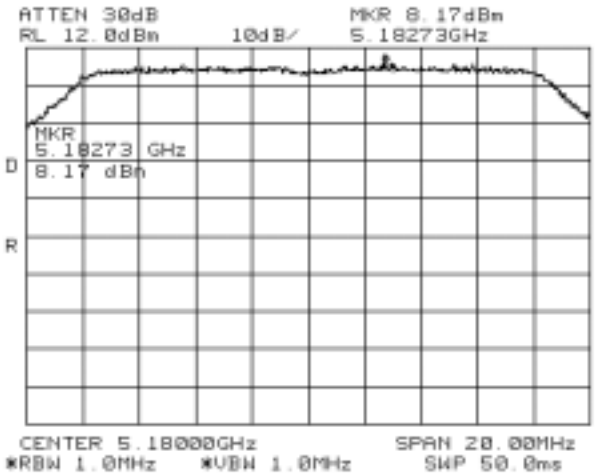
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Plots Showing Power Spectral Density (RBW = 1MHz, VBW = 3 MHz, video averaging ON)

FCC Power Density

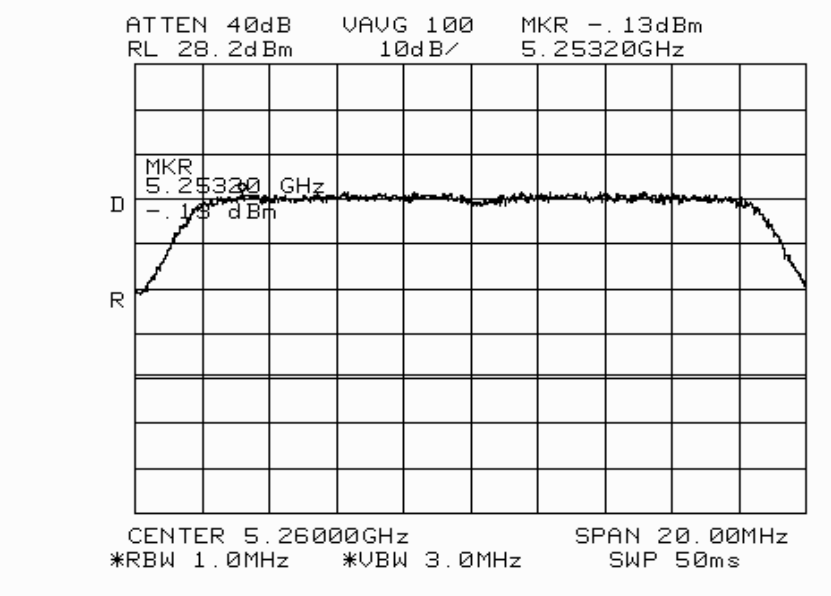


Canada Power Density

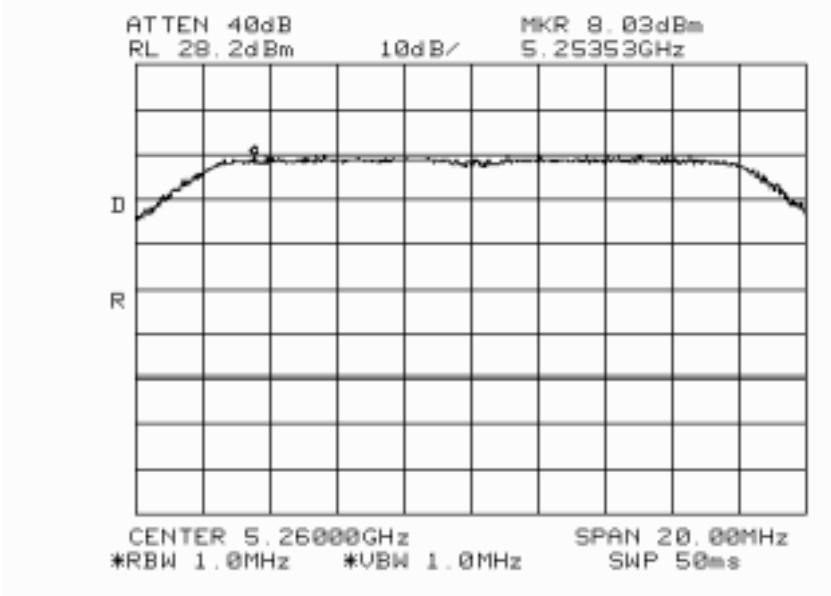


Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

FCC Power Density

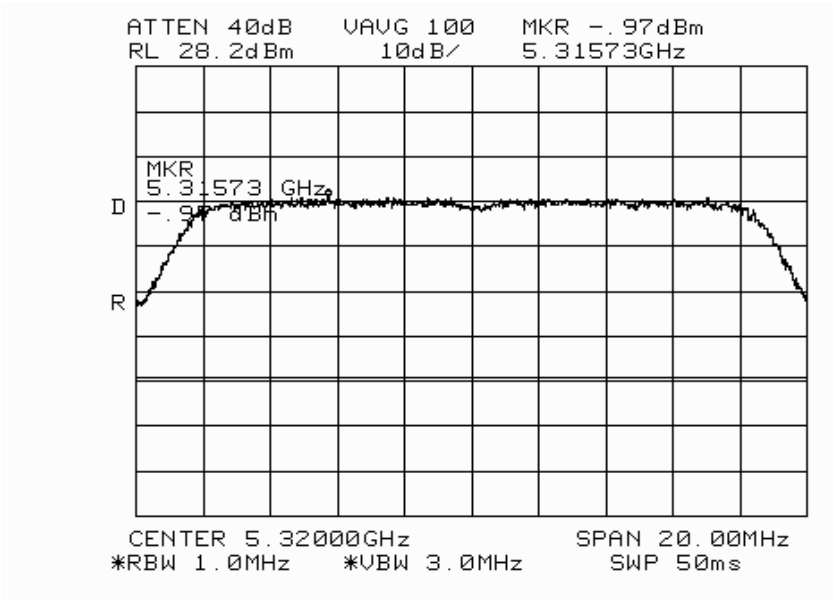


Canada Power Density

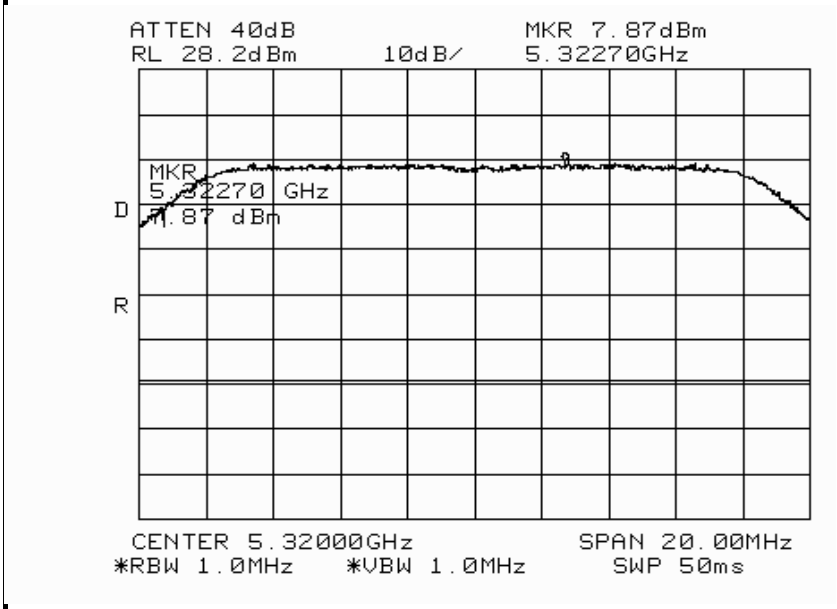


Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

FCC Power Density



Canada Power Density

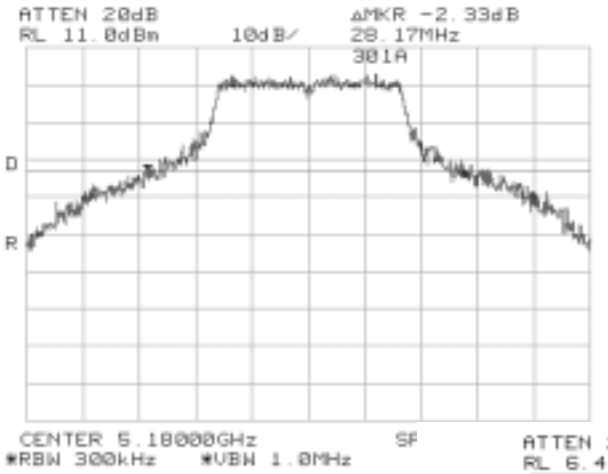


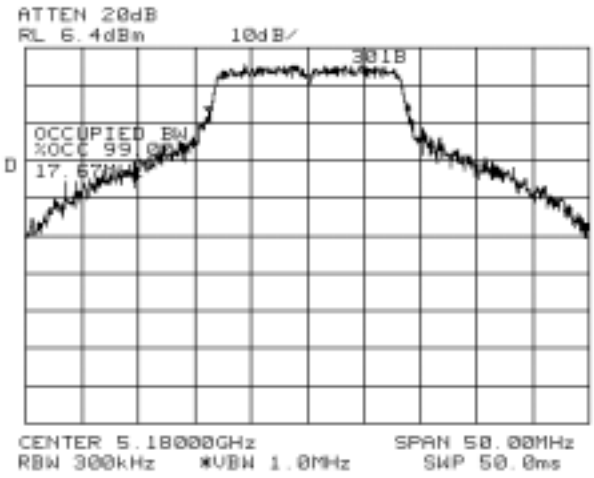
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Run #3: Signal Bandwidth

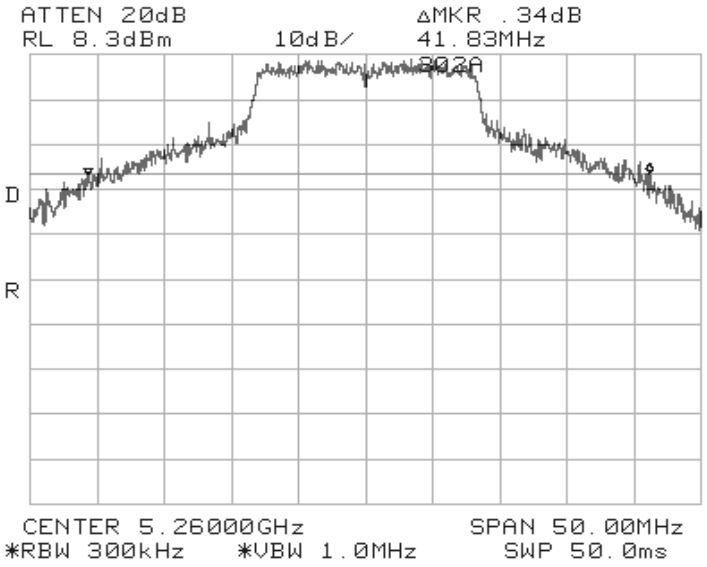
Channel	Frequency (MHz)	Resolution Bandwidth	26 dB Signal Bandwidth (MHz)	20 dB Signal Bandwidth (MHz)	Graph reference #
low	5810	300 kHz	28.17	17.67	301A and 301B
mid	5260	300 kHz	41.83	26.08	302A and 302B
high	5320	300 kHz	39.58	21.67	303A and 303B

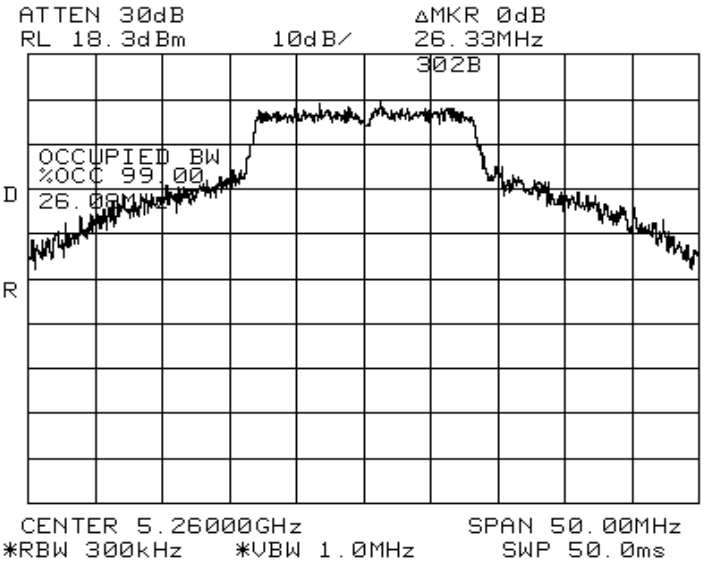
Plots Showing Signal Bandwidth



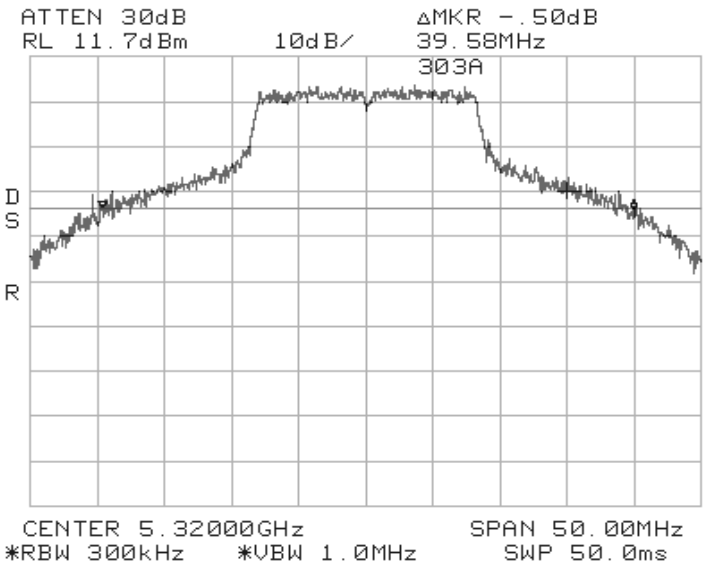


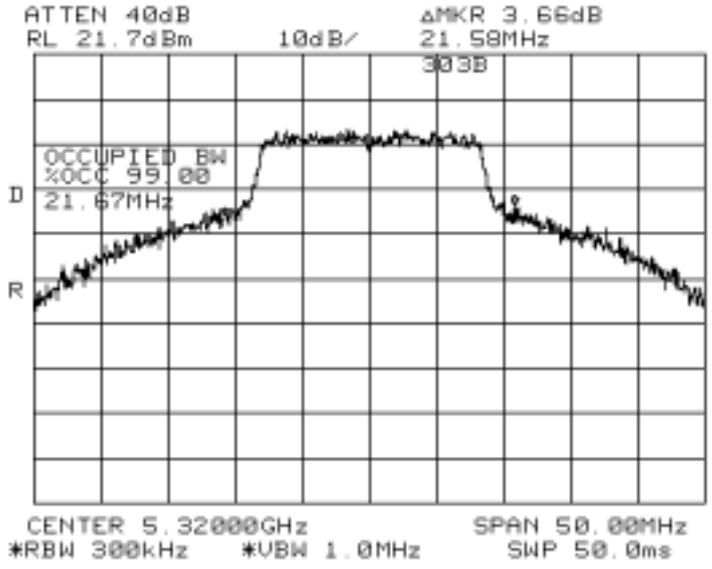
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B





Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B





Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

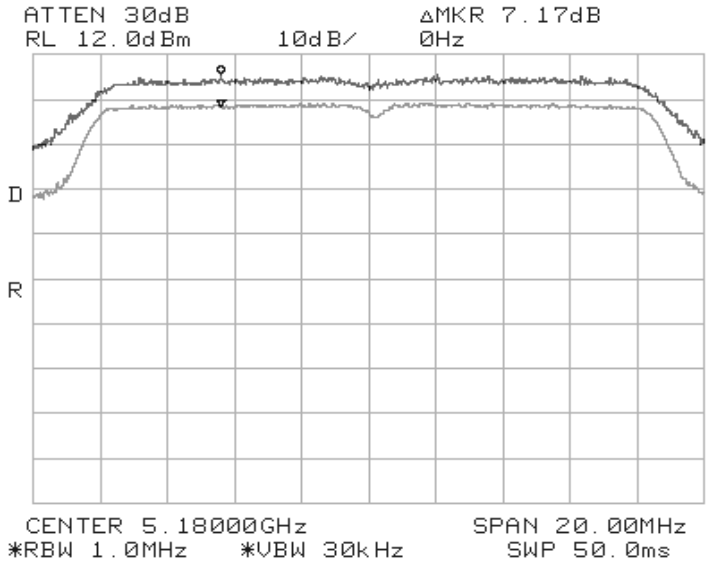
Run #4: Peak Excursion Measurement

Plots Showing Peak Excursion

Trace A: RBW = VBW = 1MHz

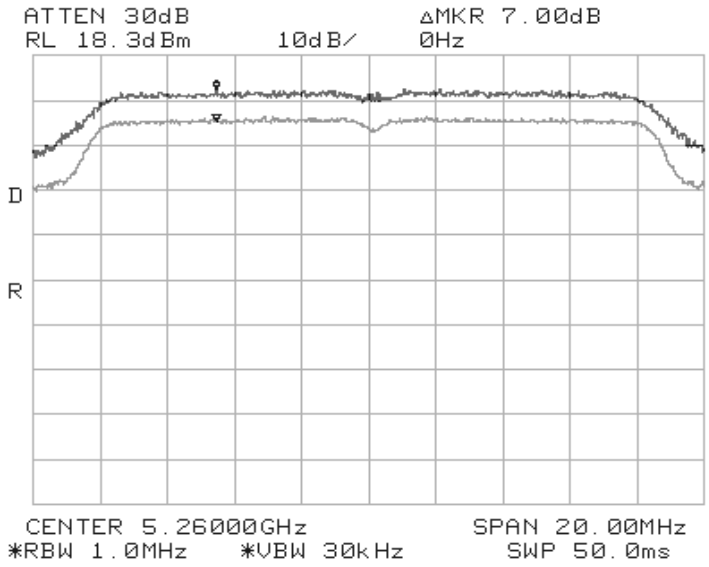
Trace B: RBW = 1 MHz, VBW = 30kHz

Low Channel; Peak Excursion = 7.17 dB



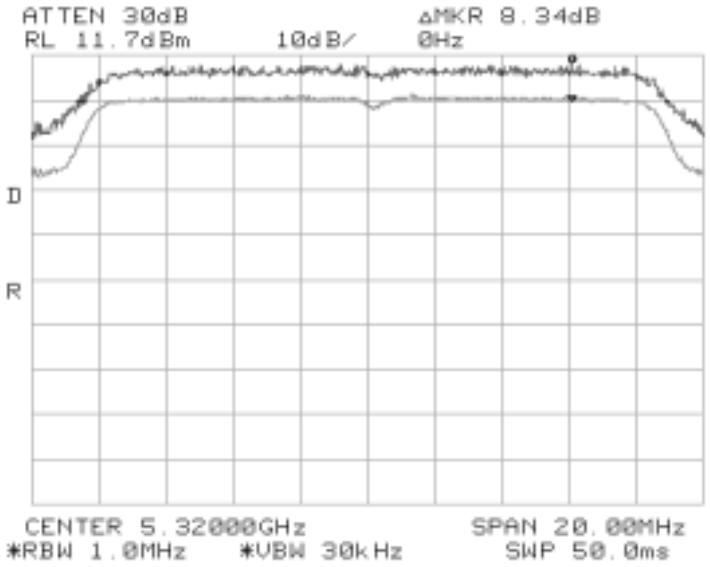
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Middle Channel; Peak Excursion =7.00 dB



Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

High Channel; Peak Excursion =8.34 dB



Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Run #5: Out Of Band Spurious Emissions - Antenna Conducted

The antenna gain of the radios integral antenna is 3.9 dBi. The EIRP limit is -27dBm/MHz for all out of band signals that do not fall in restricted bands. A limit of -30.9 dBm was, therefore, used for signals not in restricted bands and close to the intentional band with the assumption that the antenna gain was equal to 3.9 within 100 MHz of the upper and lower band edges. For signals removed from the band edge by more than 100MHz, radiated measurements were made (refer to run #6) if the signal amplitude exceeded -37dBm.

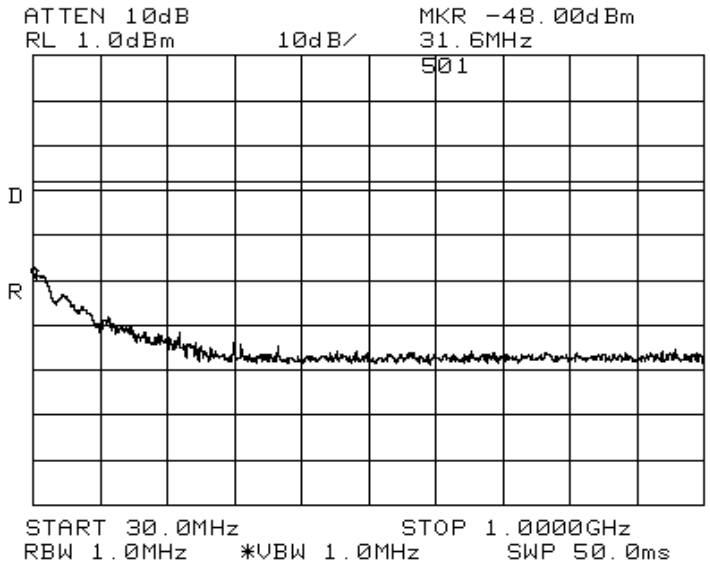
Channel	Frequency (MHz)	Frequency Range	Highest Spurious Signal	Graph reference #
low	5180	30 - 1000 MHz	Note 4	501
		1 to 5.15 GHz	3096 (Note 2), 4140 (Note 1)	502
		5.25 to 10 GHz	6.216 (Note 3)	503
		10 GHz to 20 GHz	10350 (Note 3), 15530 (Note 1)	504
		20 GHz to 40 GHz	None	505
mid	5260	30 - 1000 MHz	Note 4	506
		1 to 5.25 GHz	3160 (Note 2), 4209 (Note 1)	507
		5.35 to 10 GHz	6311 (Note 3)	508
		10 GHz to 20 GHz	10520 (Note 3), 15780(Note 1)	509
		20 GHz to 40 GHz	None	510
high	5320	30 - 1000 MHz	Note 4	511
		1 to 5.30 GHz	3193 (Note 2), 4254 (Note 1)	512
		5.34 to 10 GHz	6381 (Note 3)	513
		10 GHz to 20 GHz	10630 (Note 1), 15950 (Note 1)	514
		20 GHz to 40 GHz	None	515

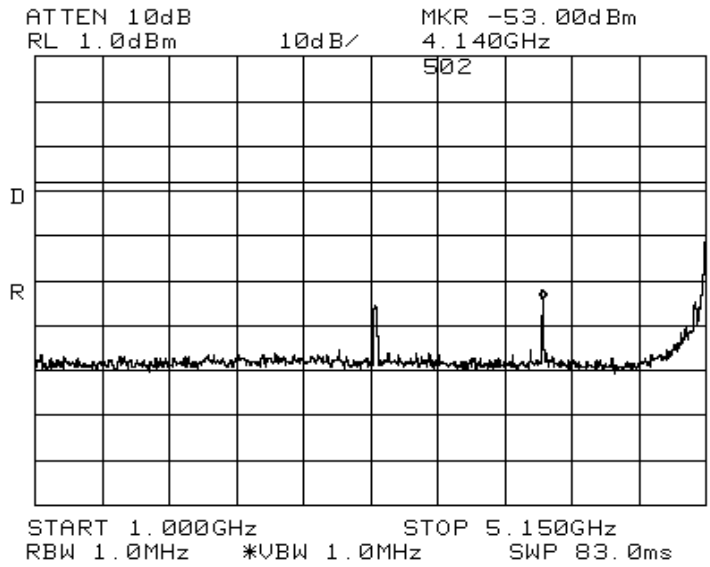
Note 1:	Signal is in a restricted band. Refer to run #6 for field strength measurements.
Note 2:	Signal is not in restricted band. Limit is -27dBm eirp. As the signal strength is significantly lower than -27dBm no field strength measurements required.
Note 3:	Signal is not in restricted band. Limit is -27dBm eirp. Although the signal strength is significantly lower than -27dBm field strength measurements were made (refer to run #6)
Note 4:	All spurious signals in this frequency band measured during digital device radiated emissions test.

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

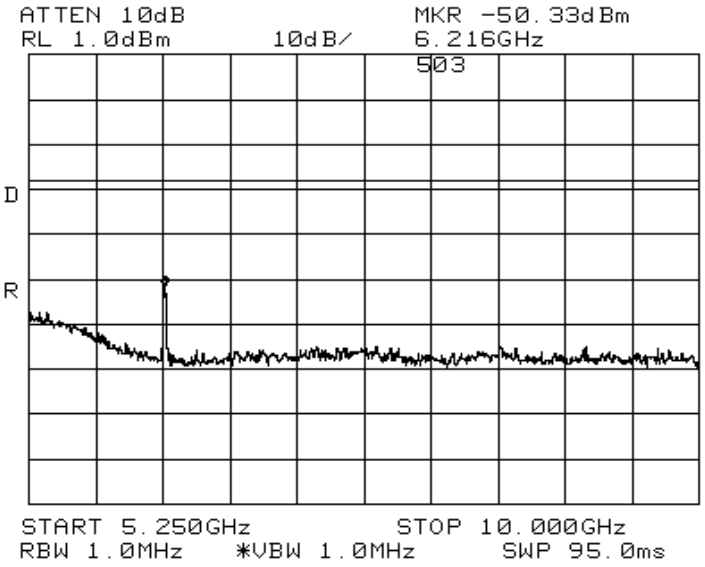
Plots Showing Out-Of-Band Emissions (RBW=VBW=1MHz)

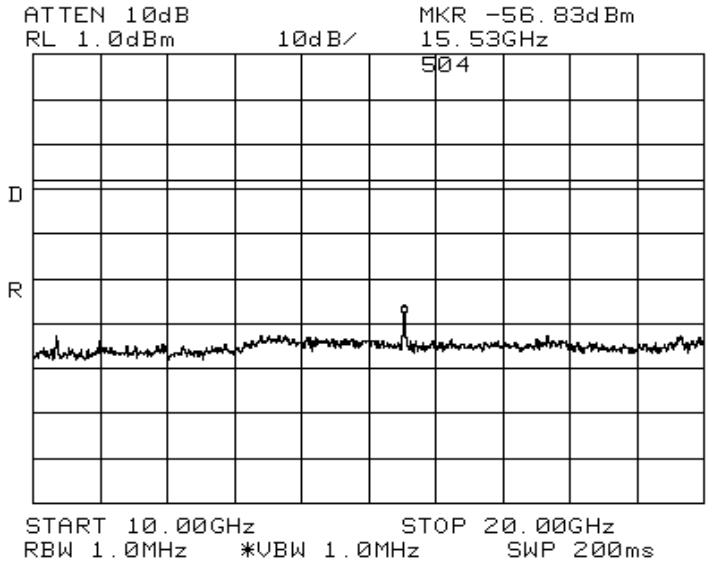
EUT operating at 5.18 GHz:



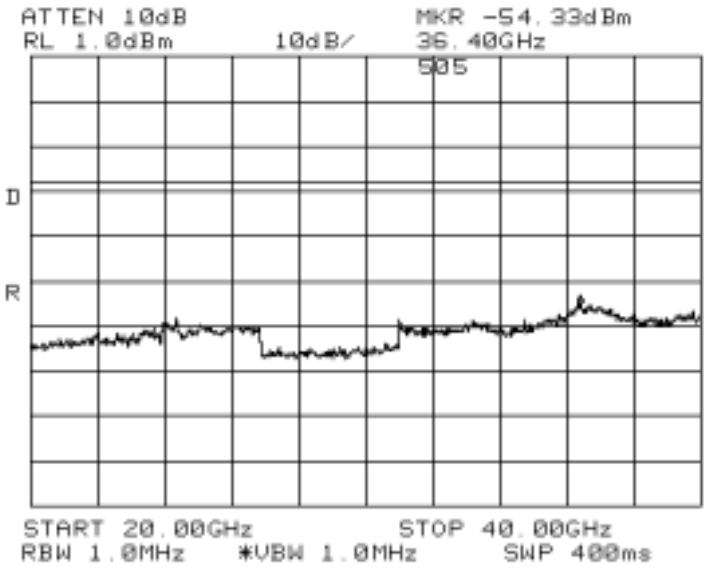


Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

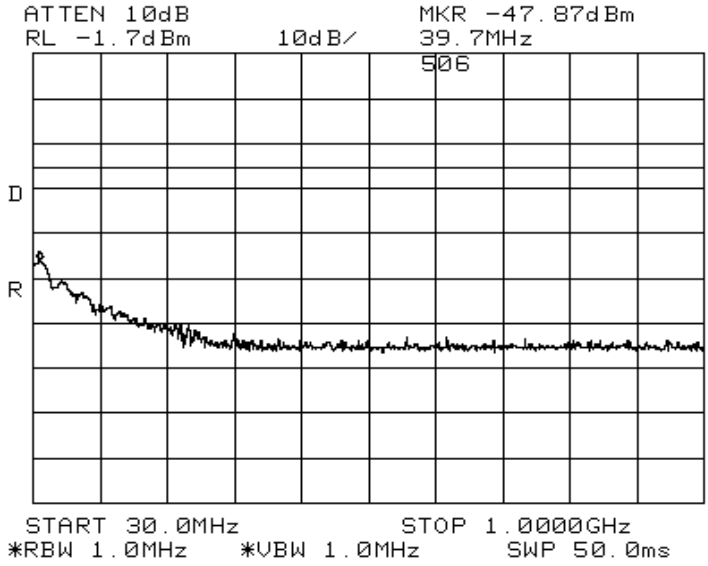




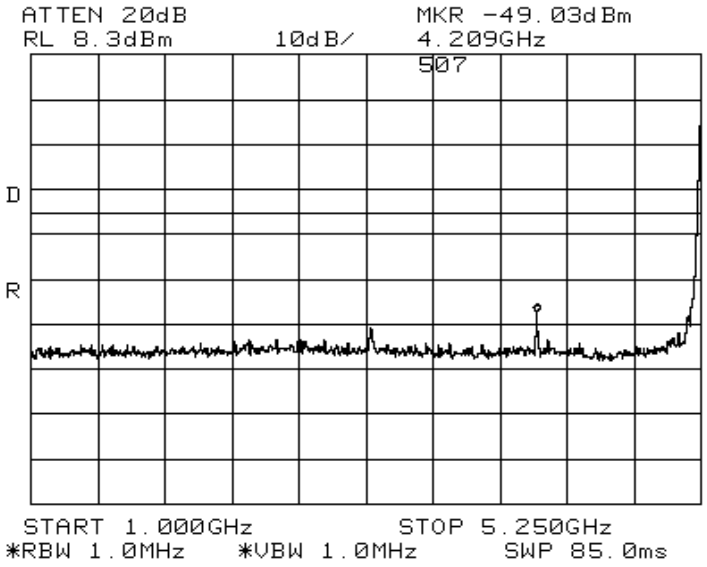
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

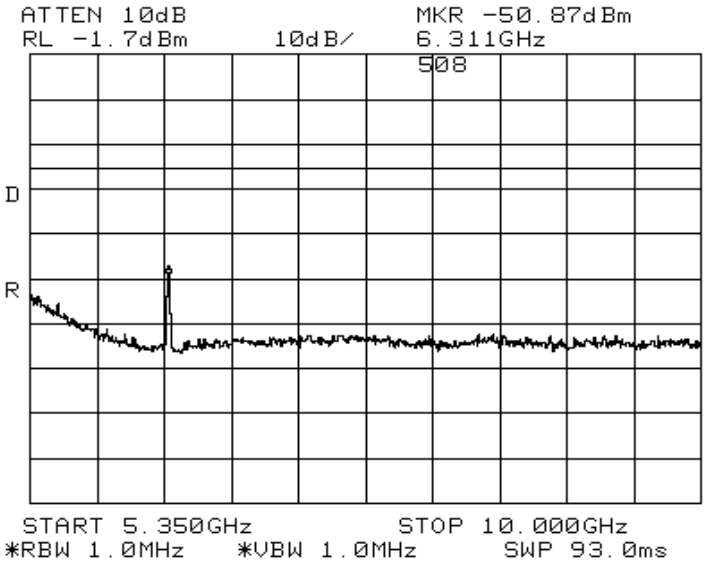


EUT operating at 5.26GHz:

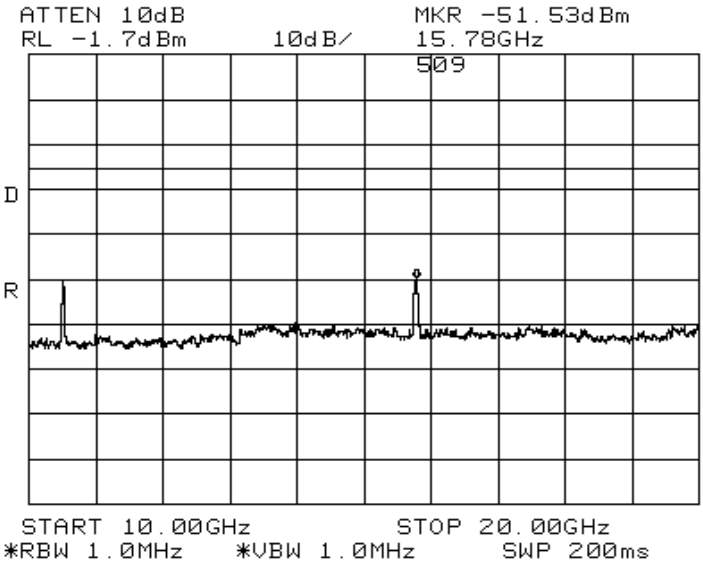


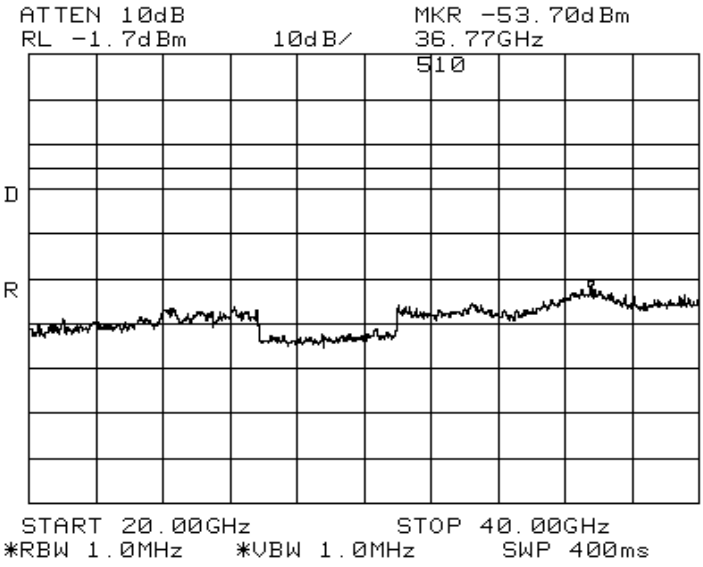
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B





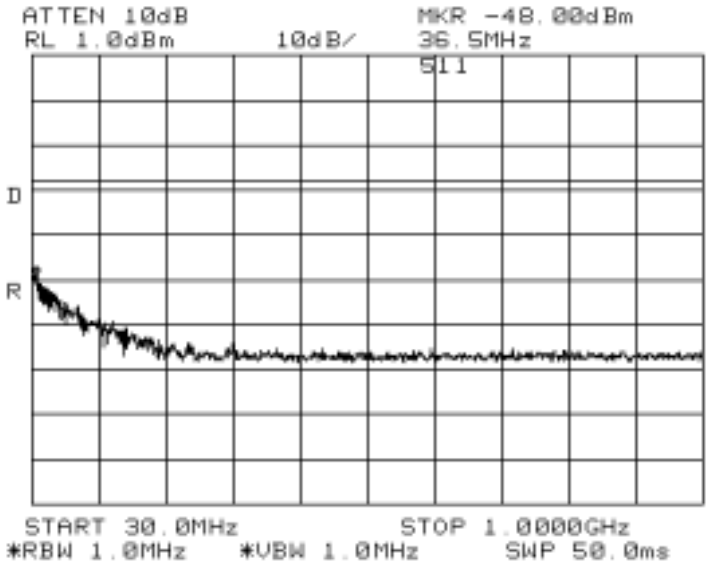
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

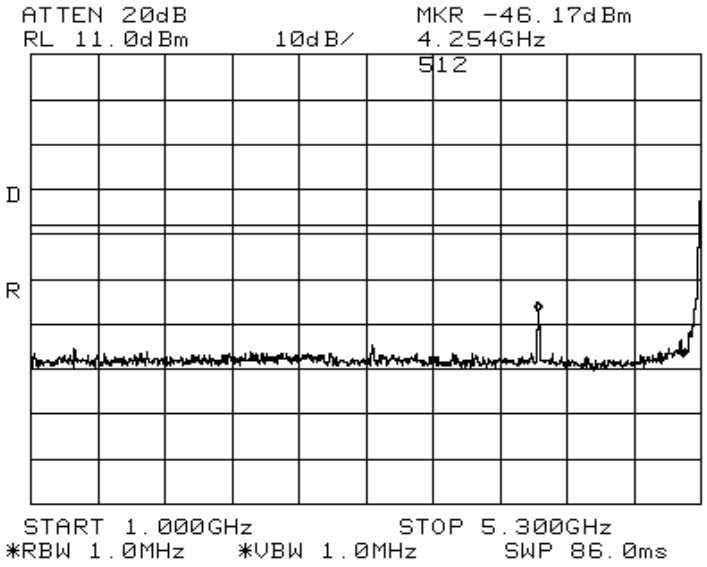




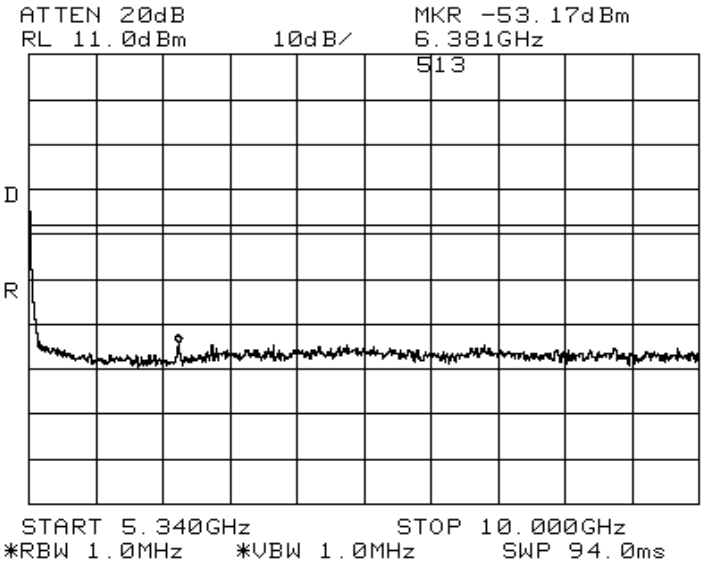
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

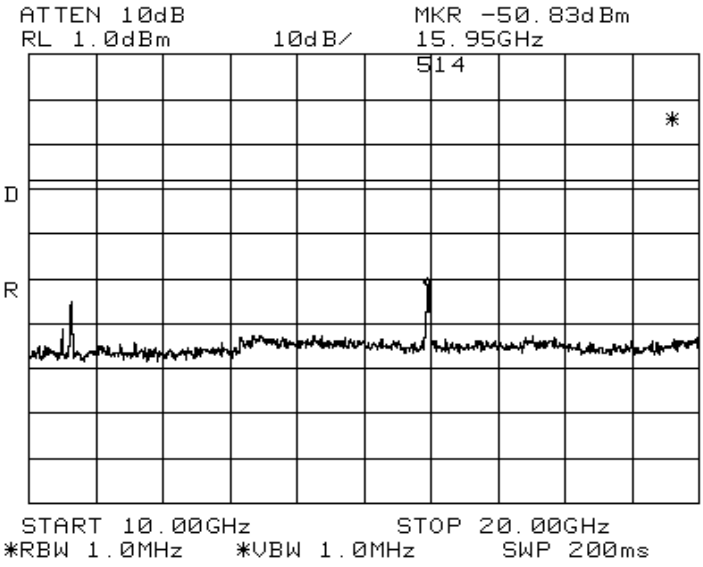
EUT operating at 5.32GHz:



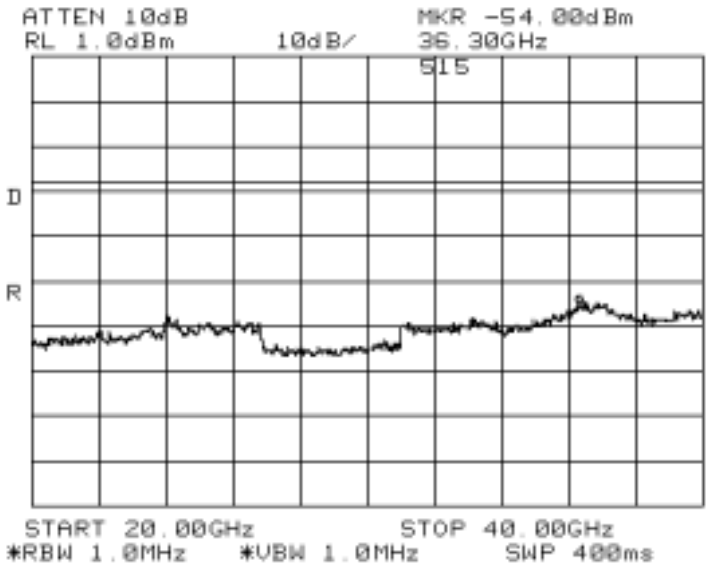


Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B





Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B



Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

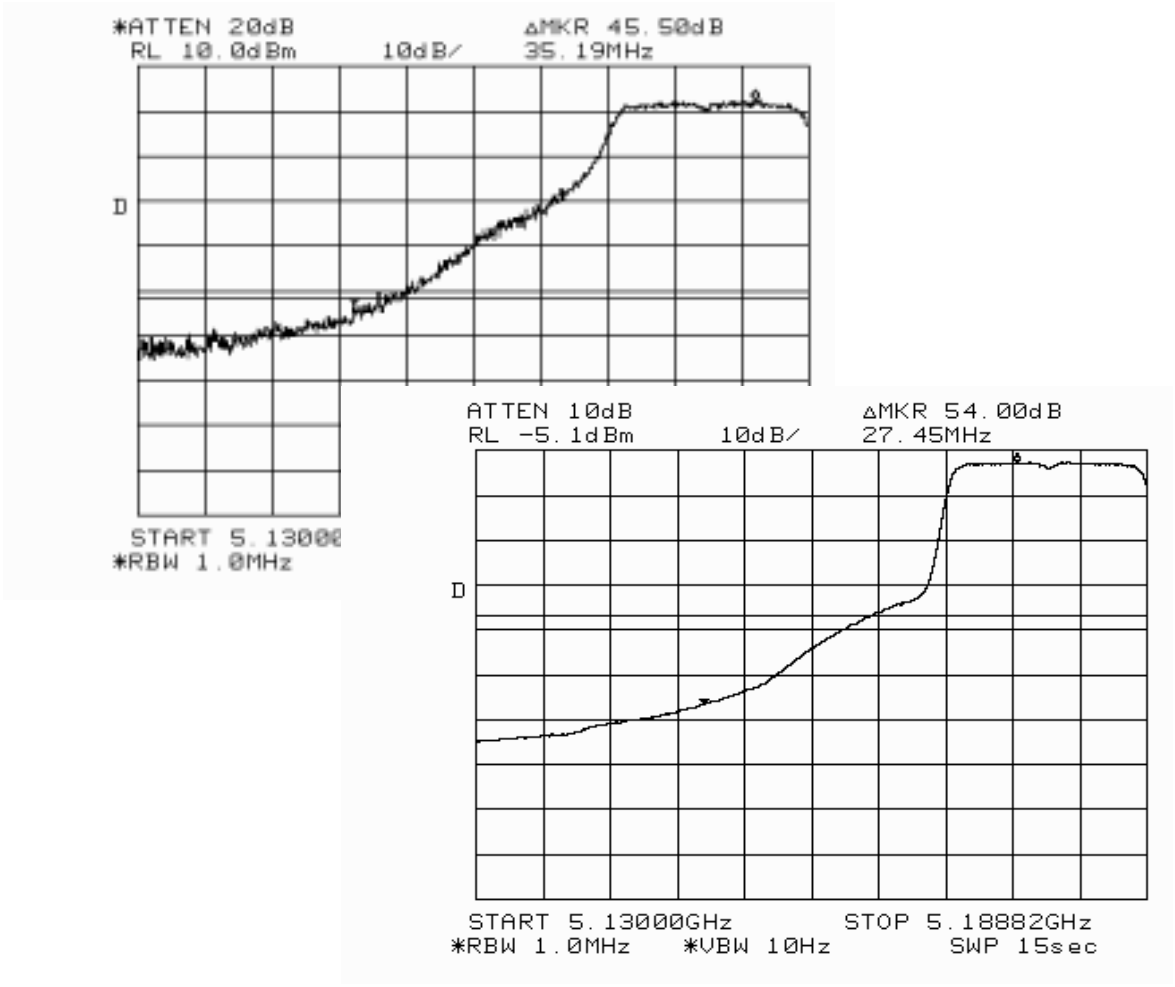
Band Edge Measurements:

For signals in the restricted bands immediately above and below the 5.15 to 5.35 GHz allocated band a measurement was made of the amplitude of the spurious emissions with respect to the intentional signals. The relative amplitude, in dBc, was then applied to the average and peak field strength of the intentional signal made on the OATS to calculate the field strength of the unintentional signals.

Plots Showing Out-Of-Band Emissions (Peak RBW=VBW=1MHz; Average RBW = 1MHz, VBW = 10Hz)

5.15 GHz band edge, EUT operating at 5.18GHz (lowest channel), PCDAC=10

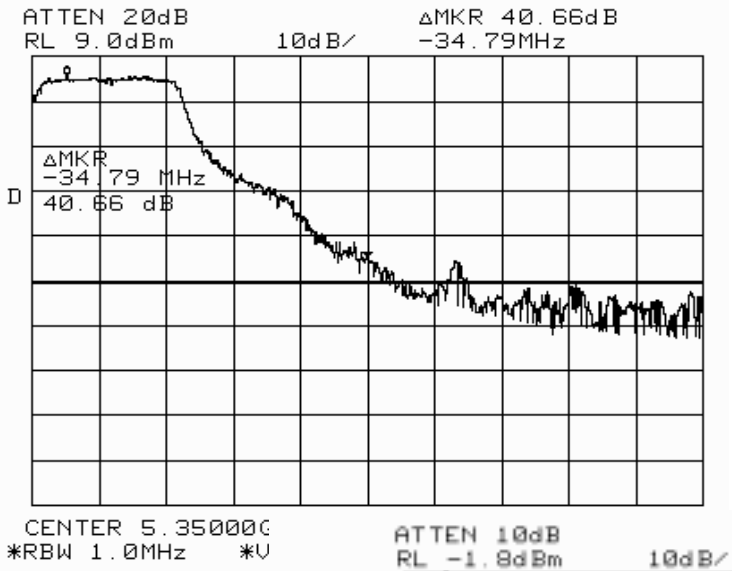
The highest signal within 50 MHz of the 5.15 GHz band was -45.50 dBc (Peak) / -54.0 dBc (Average)

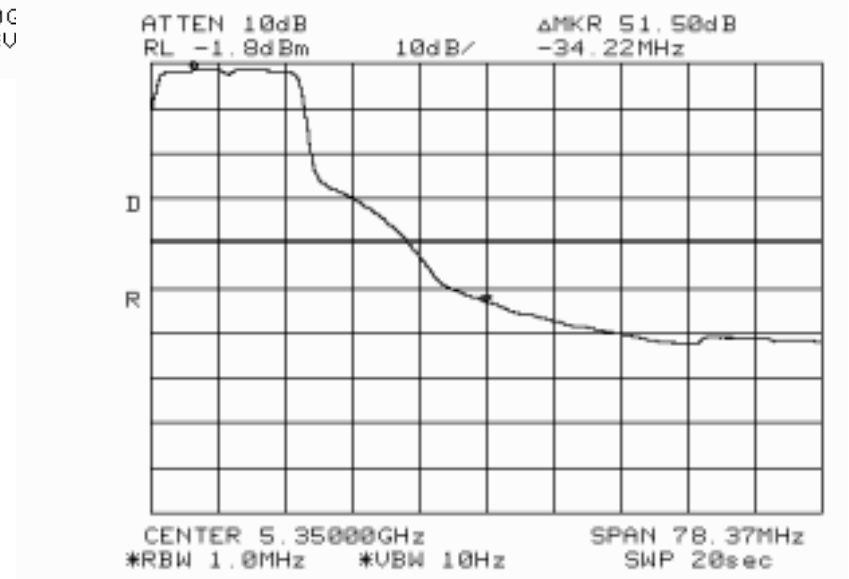


Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

5.35 GHz band edge EUT operating at 5.32GHz PCDAC = 8:

The highest signal in the 5.35 to 5.46 GHz band was -40.7dBc (Peak) / -51.5dBc (Average)





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EMC Test Data

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Run #6a: Radiated Spurious Emissions, 1000 - 40000 MHz Normal Mode

Spurious emissions from 30 - 1000 MHz were measured while performing emissions measurements of the digital device

Limit for emissions in restricted bands:	54dBuV/m (Average)	74dBuV/m (Peak)
Limit for emissions outside of restricted bands:	EIRP < -27dBm/MHz	(68dBuV/m)

Fundamental signal measurements (to calculate the band edge field strengths):

EUT On Lowest Channel Available (5.18 GHz), PCDAC=10

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments	
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
5176.899	110.4	V			Pk	290	1.7		
5176.283	101.7	V			Avg	290	1.7		

EUT On Highest Channel Available (5.32 GHz), PCDAC = 8, Unit number 3

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments	
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
5317.833	108.9	V			Pk	312	1.9		
5318.422	100.0	V			Avg	312	1.9		

Band Edge Field Strength Calculations using PCDAC=10 for low channel and PCDAC = 8 for high channel:

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5150.0	64.9	v	74.0	-9.1	Pk	290	1.7	Note 1
5150.0	47.7	v	54.0	-6.3	Avg	290	1.7	Note 1
5350.0	68.2	v	74.0	-5.8	Pk	312	1.9	Note 2
5350.0	48.5	v	54.0	-5.5	Avg	312	1.9	Note 2

Note 1:	EUT operating on the lowest channel available in the 5.15 - 5.25 MHz band. Signal level calculated using the relative measurements in run #5 (-43.50 dBc for peak and -54dBc for average) applied to the highest peak and average field strength measurements of the fundamental signal level.
Note 2:	EUT operating on highest channel available in the 5.25 - 5.35 MHz band. Signal level calculated using the relative measurements in run #5 (-40.7 dBc for peak and -51.5 dBcdBc for average) applied to the highest peak and average field strength measurements of the fundamental signal level.

Elliott

EMC Test Data

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

Run #6b: Radiated Spurious Emissions, 1000 - 40000 MHz Normal Mode
EUT On Lowest Channel Available (5.18 GHz), PCDAC=10

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
15540.0	52.5	v	54.0	-1.5	Avg	307	1.2	Note 2
20720.0	50.0	h	54.0	-4.0	Avg	110	1.3	Note 2
20720.0	49.7	v	54.0	-4.3	Avg	110	1.3	Note 2
15540.0	46.6	h	54.0	-7.4	Avg	290	1.5	Note 2
10360.0	60.2	v	68.3	-8.1	Note 3	254	1.4	Note 4
10360.0	59.8	h	68.3	-8.5	Note 3	269	1.5	Note 4
15540.0	64.8	v	74.0	-9.2	Pk	307	1.2	Note 2
20720.0	64.2	v	74.0	-9.8	Pk	110	1.3	Note 2
20720.0	64.0	h	74.0	-10.0	Pk	110	1.3	Note 2
15540.0	59.9	h	74.0	-14.1	Pk	290	1.5	Note 2
4144.0	38.3	v	54.0	-15.7	Pk	270	1.5	Note 2, 5 - Peak reading, avg limit

EUT On Center Channel (5.26 GHz), PCDAC = 12

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
15780.0	53.9	v	54.0	-0.1	Avg	293	1.4	Note 2
15780.0	50.9	h	54.0	-3.1	Avg	327	1.4	Note 2
15780.0	67.5	v	74.0	-6.5	Pk	293	1.4	Note 2
10520.0	60.8	v	68.3	-7.5	Note 3	263	1.5	Note 4
21040.0	45.8	v	54.0	-8.2	Avg	100	1.2	
10520.0	59.3	h	68.3	-9.0	Note 3	237	1.4	Note 4
21040.0	44.4	h	54.0	-9.6	Avg	60	1.2	
15780.0	63.3	h	74.0	-10.7	Pk	327	1.4	Note 2
4208.0	41.9	v	54.0	-12.1	Pk	310	1.7	Note 2, 5 - Peak reading, avg limit
4208.0	41.8	h	54.0	-12.2	Pk	290	1.7	Note 2, 5 - Peak reading, avg limit
21040.0	60.7	v	74.0	-13.3	Pk	100	1.2	
21040.0	58.7	h	74.0	-15.3	Pk	60	1.2	

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EMC Test Data

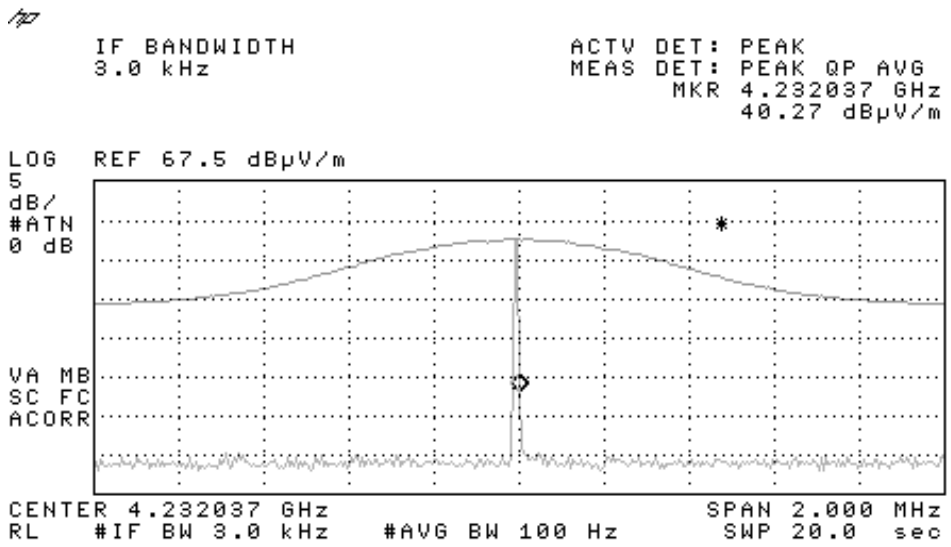
Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B

EUT On Highest Channel Available (5.32 GHz), PCDAC = 8, Unit number 3

Frequency	Level	Pol	15.209 / 15.407		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
15950.0	53.3	v	54.0	**-0.7**	Avg	255	1.4	Note 2
10640.0	52.4	v	54.0	-1.6	Avg	265	1.4	Note 2
10640.0	49.7	h	54.0	-4.3	Avg	275	1.5	Note 2
15950.0	49.3	h	54.0	-4.7	Avg			Note 2
10640.0	68.7	v	74.0	-5.3	Pk	265	1.4	Note 2
15950.0	66.6	v	74.0	-7.4	Pk	255	1.4	Note 2
4256.0	45.8	v	54.0	-8.2	Pk	307	1.7	Note 2, 5 - Peak reading, avg limit
10640.0	64.4	h	74.0	-9.6	Pk	275	1.5	Note 2
4256.0	44.0	h	54.0	-10.0	Pk	250	1.7	Note 2, 5 - Peak reading, avg limit
21280.0	42.9	v	54.0	-11.1	Avg	55	1.3	Note 2
15950.0	62.3	h	74.0	-11.7	Pk			Note 2
21280.0	40.7	h	54.0	-13.3	Avg	350	1.4	Note 2
21280.0	56.7	v	74.0	-17.3	Pk	55	1.3	Note 2
21280.0	53.3	h	74.0	-20.7	Pk	350	1.4	Note 2

Note 1:	For emissions falling in the restricted bands detailed in 15.205 the general limits of 15.209 apply. For all other emissions the limit is EIRP < -27dBm (equivalent to a field strength at 3m of 68dBuV/m)
Note 2:	Signal is in a restricted band
Note 3:	Restricted Band Peak Measurements: Resolution and Video BW: 1 MHz, Restricted Band Average Measurements: Resolution Bw: 1MHz and Video Bw: 10 Hz. All other measurements, RBW = 1MHz and VBW = 3MHz, video averaging on (100 samples).
Note 4:	Signal does not fall in a restricted band.
Note 5:	This measurement was made using a resolution bandwidth of 3 kHz The instrumentation noise floor was too high to allow measurements with RBW = 1MHz because a preamplifier could not be used (with the EUT operating the intentional signal would overload the amplifier and there is no low pass filter with sufficient shape factor to reject the intentionally trasmitted signal but pass the spuroius signal). The signal was a narrowband signal (as verified during the conducted antenna measurements) and so the amplitude (peak/average) in a 3kHz bandwidth would be the same as that in a 1MHz bandwidth (please refer to the plot below). The peak reading has been compared with the average limit.

Client:	D-Link Corporation	Job Number:	J45652
Model:	Cardbus	T-Log Number:	T45735
		Proj Eng:	Mark Briggs
Contact:	Shinglin Chung		
Spec:	FCC 15 B & E	Class:	B



Plot showing LO signal at 4GHz measured using RBW = 1MHz and RBW = 3kHz. Amplitude of the signal does not change with resolution bandwidth.

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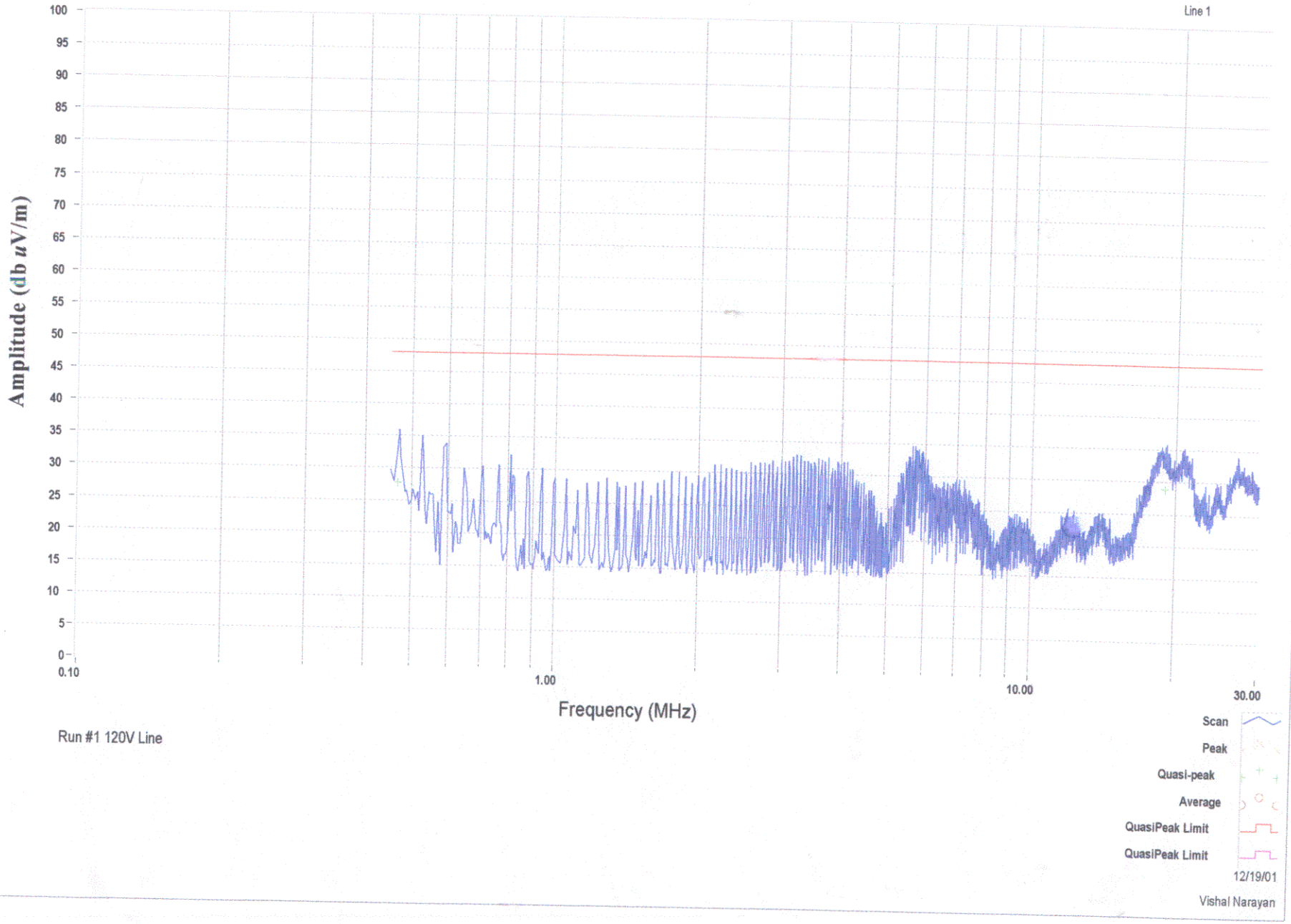
SVOATS #2: D-Link Corporation Cardbus Run 1

T45735

Spec:
FCC-B

Mains Lead
Line 1



Run #1 120V Line

12/19/01

Vishal Narayan

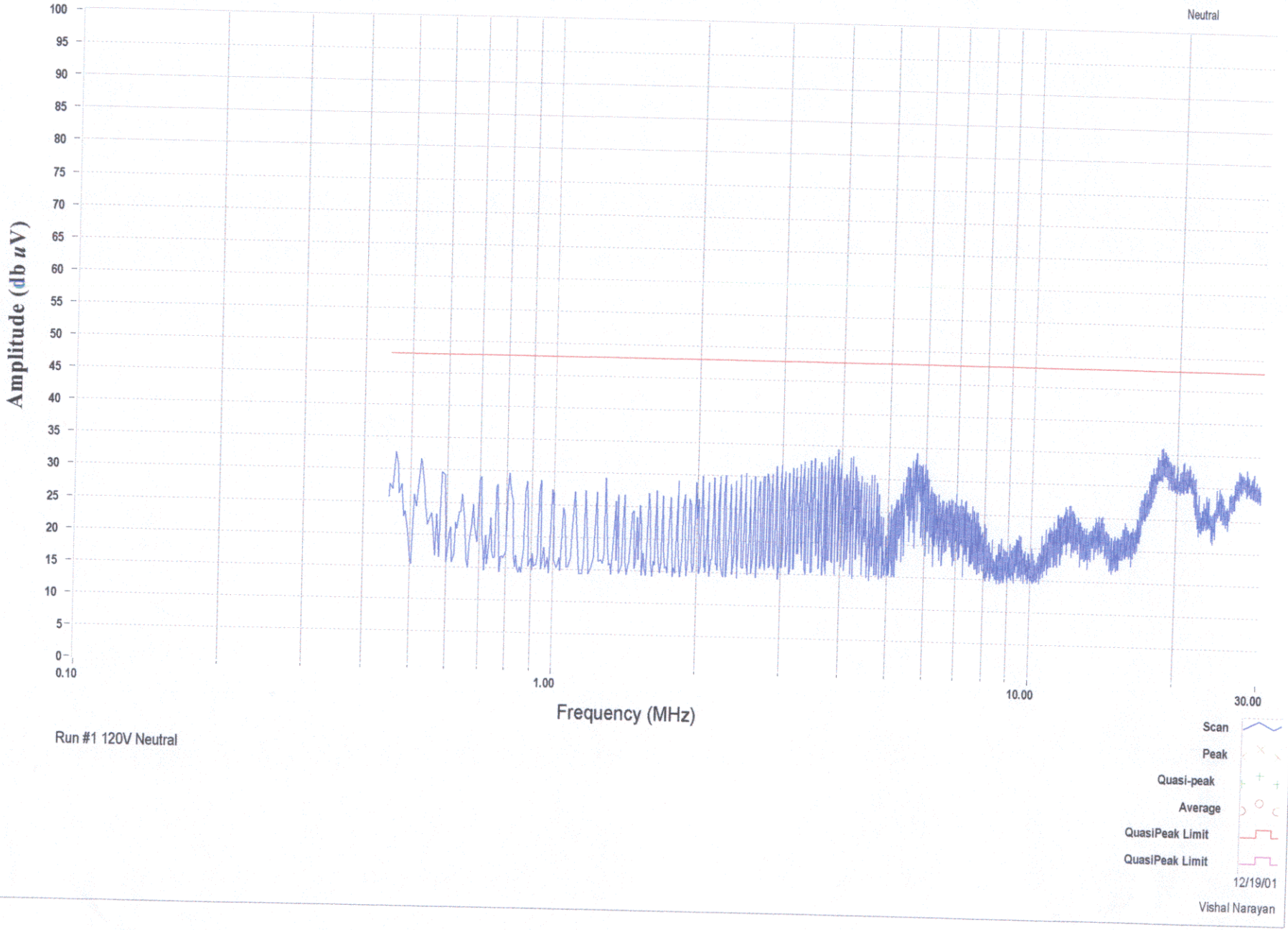
Elliott

SVOATS #2: D-Link Corporation Cardbus Run 1

T45735

Spec:
FCC-B

Mains Lead
Neutral



Run #1 120V Neutral

12/19/01

Vishal Narayan