Radio Frequency Exposure Test Report

EN 62311 January 2008
Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0Hz – 300GHz) (IEC 62311:2007, modified)

802.11abg Compact Flash Card model SDC-MCF10AG

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SCOPE

The European Committee for Electrotechnical Standardization (CENELEC) publishes standards regarding the evaluation of the rf exposure hazard of wireless communications devices. An evaluation has been performed on the Summit Data Communications 802.11abg Compact Flash Card model SDC-MCF10AG, pursuant to the relevant requirements of the following harmonized EN standard(s) covering essential requirements under article 3.1 of the R&TTE Directive:

- EN 62311 January 2008 "Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0Hz – 300GHz) (IEC 62311:2007, modified)

The evaluation was performed in accordance with the standard and the following document(s):

- Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0Hz to 300 GHz) (Official Journal L199 of 30 July 1999).

OBJECTIVE

The objective of the manufacturer is to comply with the harmonized standards identified in the previous section.

STATEMENT OF COMPLIANCE

The evaluation of Summit Data Communications 802.11abg Compact Flash Card model SDC-MCF10AG, in the configurations detailed within this report, complied with the relevant requirements of EN 62311. Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Summit Data Communications 802.11abg Compact Flash Card model SDC-MCF10AG is an 802.11ag compliant wireless LAN radio Module which is designed to provide wireless local area networking connectivity. Normally, the EUT would be embedded in various types of mobile and stationary computing devices such as handheld and vehicle mounted data terminals during operation. The EUT was, therefore, placed in this position during emissions testing to simulate the end user environment. The electrical rating of the EUT is 3.3 VDC =/-5%. It's typical power consumption is 400mA (1320mW) while in transmit mode, 180mA (594mW) while in receive mode and 10mA (33mW) while in standby mode.

Manufacturer	Model	Description	Serial Number
Summit Data Communications Inc.	MCF10AG	802.11AG Mini Compact Flash Module with antenna connectors	-

OTHER EUT DETAILS

There were two antennas included in the testing:
Laird Centurion, m/n NanoBlade, pcb antenna, 3.8dBi @ 2.45GHz, 5.1dBi @ 5.25GHz, 4.5dBi @ 5.8GHz
Larson, p/n R380.500.314, Omni, 1.6dBi @ 2.4GHz, 5dBi @ 5GHz

EN 62311 ASSESSMENT METHODS

EN 62311 allows for various assessment methods, including far field calculation, near field calculation, simulation, and numerical modeling. Assessments should be made in accordance with an existing basic standard. For the purposes of the assessment detailed in this test report the basic standard EN 50383 was used. The assessment is based on power levels and antenna gains detailed in this report and taken from the following test reports against the appropriate ETSI radio standard:

Test Report	Radio Standard(s)	Issued By
R87166	EN 301 893 v1.5.1	Elliott Laboratories, An NTS Company 41039 Boyce Road, Fremont, CA. 94538-2435 USA

The assessment has only considered the intentional signals transmitted by the device. As all other emissions complied with the limits detailed in the appropriate radio standard and were significantly lower than the intentional signal it was not considered necessary to include these signals in the assessment.

EN 50383 EVALUTATION METHODS

The evaluation method first requires a determination of the antenna region(s) in which the exposure occurs, and from this determination the appropriate evaluation method (calculation or measurement) can then be used.

ANTENNA REGION

There are three regions defined in Annex A of EN 50383 – Far field region, radiating near-field region and reactive near-field region.

For each region there is a preferred (or "reference") evaluation method and possible alternatives. When an alternative method is used it typically provides a more conservative evaluation of the rf hazard.

The region is determined, based on the minimum separation distance from the device antennas to persons and the size/gain of the antenna. The minimum separation distance is based on either a distance specified in the installation/user's manual or on an evaluation of intended use.

PREFERRED EVALUATION METHODS

The preferred (reference) evaluation methods, and first and second alternatives, for each region are detailed in EN 50383 Table 1 and summarized below.

FAR FIELD CALCULATION

For calculating the field in the far-field region the free space formula below is used to determine the electric field or power flux density at a distance r from the transmitting antenna.

$$E = \frac{\sqrt{30PG}}{r}$$

$$S = \frac{PG}{4\pi r^2}$$

S = Power flux density W/m^2
E = Field Strength in V/m
P = Power in Watts
G = Gain of antenna (numeric gain)
r = distance in meters

RADIATING NEAR FIELD

When human exposure is in the radiating near-field the reference method is a SAR evaluation, as detailed above. The first alternative to SAR measurements are E-field and H-field measurements. The second alternative is a calculation, and the possible calculation methods are either the synthetic model or cylindrical wave model.
The synthetic model splits the antenna into n small sources and the field is calculated using:

$$E = \sum \alpha_n \frac{\sqrt{30.P_n G_n}}{r_n} e^{j(\gamma_n + \frac{2\pi r_n}{\lambda})}$$

E = Field Strength in V/m
P_n = Power in Watts radiated by element n
G_n = Gain of antenna element n
r_n = Distance in meters from element n

The cylindrical wave model allows direct calculation of the power flux density, S, using:

$$S = \frac{P}{\pi D r} \frac{180}{\delta}$$

S = Power flux density W/m^2
P = Power in watts radiated (W)
D = Length of antenna (m)
r = Distance in meters from the antenna

The cylindrical wave model is valid for a range of distances where r_c (the distance at which the Cylinder and far-field wave models give the same result) lies in the radiating near-field, and where the distance is less than r_c. At distances greater than r_c the far field model (refer to the far-field calculation information in the previous section) is more appropriate.

REACTIVE NEAR FIELD

When human exposure is in the reactive near-field the reference method is a SAR evaluation. If the total radiated power is below limits detailed in section 7.1.2 of EN 50383 then the device is assumed to comply and measurements are not considered necessary. Further, whole-body SAR measurement methods are not currently specified and so localized SAR evaluations are used. Localized SAR evaluations are limited to operating frequencies between 0.8 and 3 GHz, antenna apertures less than 0.6m x 0.3m and investigation distances of less than 40cm.

The alternative to SAR measurements are E-field and H-field measurements.

LIMITS

The limits are taken from the reference levels detailed in either Annex II or Annex III of *Council Recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (1999/519/EC)*. Annex III reference levels may only be used when the exposure is not highly localized.

Compliance with the basic restrictions is ensured where the ratio of the measured/calculated value to the basic restriction / reference level is less than or equal to 1.

MULTIPLE TRANSMITTERS

When the evaluation has to account for simultaneous transmissions from co-located devices the individual transmitters are evaluated separately. The sum of the individual ratios of measured/calculated value to basic restriction / reference level has to be less than 1 for compliance to be demonstrated.

EVALUATION RESULTS

SEPARATION DISTANCE

The separation distance used in the assessment was 20cm, based on the following statement in the user's manual:

"This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body."

LIMIT

As the basis for compliance is being based on the far-field model, the reference level for equivalent plane wave power density is used as the basis for determining compliance. At the operating frequencies of the device, the limits are:

Frequency Band (MHz)	Power Density W/m^2
2400-2483.5	10
5150-5350	10
5470-5725	10

CALCULATIONS

The table below contains the calculations to determine the reactive near-field, radiating near-field and far-field boundaries. It also shows the value for r_c, the distance at which the far-field and cylindrical wave models produce the same value of power flux density.

Frequency (MHz)	2462	5320	5700
Wavelength (m)	0.122	0.056	0.053
Antenna Gain (dBi)	3.8	5.1	5.1
Antenna Gain (numeric)	2.4	3.2	3.2
Antenna Length (m)	0.11	0.11	0.11
Evaluation distance (m)	0.2	0.2	0.2
Beamwidth (degrees)	360	360	360
Transmit Power (dBm)	16	13.4	15.8
Far Field Boundary	>0.20m	>0.43m	>0.46m
Radiating Near Field	0.03m < r <= 0.20m	0.01m < r <= 0.43m	0.01m < r <= 0.46m
Reactive Near-Field	r <=0.03m	r <=0.01m	r <=0.01m
r_c	0.13	0.18	0.18

For operation in the 2400-2483.5 MHz band the exposure is in the far field and so the far-field model has been used to determine the power density at the observation distance, 20m from the antenna.

Frequency (MHz)	2462
Far-Field Estimation (W/m^2)	0.19
Limit	10
Percentage of Limit	1.9%

For operation in the 5GHz band(s) the exposure evaluation is in the radiating near-field. The cylindrical model is not appropriate as the evaluation distance of 20m is at a distance that exceeds r_c, therefore the far-field model was used to provide a conservative estimate.

Frequency (MHz)	5320	5700
Far-Field Estimation (W/m^2)	0.14	0.24
Limit	10	10
Percentage of Limit	1.4%	2.4%

RESULT – SINGLE TRANSMITTER

The estimated power density at a distance of 20cm from the transmitting antenna is 0.24 W/m^2. This is 2.4% of the limit, therefore the device complies with the requirements of EN 503085, based on the evaluation methods of EN 50383 and the reference levels detailed in *Council Recommendation of 12 July 1999.*

The calculations assumed the device may operate continuously. Although the interface protocol does not limit operating duty cycle, the actual operation would not typically be 100% and so the estimates are conservative.

MEASUREMENT UNCERTAINTIES

ISO Guide 17025 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 (based on a coverage factor (k=2) and were calculated in accordance with NAMAS document NIS 81 and M3003. They have been taken from the radio test report on which the output power measurements used in the evaluation of the device were taken.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted	dBm	25 to 7000 MHz	± 0.52 dB

Appendix A Test Equipment Calibration Data

The evaluation detailed in the test report was based on calculation. No test equipment was required. The test equipment and associated measurements uncertainties used to determine the output power measurements on which this evaluation was based can be found in Elliott test report(s) R74981 and R87166.

Appendix B Test Configuration Photographs

The evaluation detailed in the test report was based on calculation. As no measurements were made, test configuration photographs are not applicable.

Appendix C Antenna Data Sheets

The evaluation detailed in the test report was based on calculations that used specific information about the gain and dimensions of the antenna(s) to be used with the device. This information is included below:

1) Radiated power in EIRP (2.4 GHz, 5.1 GHz, 5.4 GHz)
2400 – 2483.5 MHz Band 19.8dBm (95.5mWatts)
5150-5350 MHz Band 18.5dBm(70.5mWatts)
5470-5725 MHz Band 20.9 (123.0mWatts)

2) Antenna Gain details
This device has been designed to operate with the antennas listed below, and having a maximum gain of 5.1 dB. Antennas not included in this list or having a gain greater than 5.1 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.
Manufacturer: Laird Centurion
Model Name: NanoBlade
Antenna Type: PCB Omnidirectional
Gain at 2.40 GHz : 3.8 dBi
Gain at 5.25 GHz: 5.1 dBi
Gain at 5.80 GHz: 4.5 dBi
Manufacturer: Larson
Part Number: R380.500.314
Antenna Type: Dipole
Gain at 2.40 GHz : 1.6 dBi
Gain at 5 GHz: 5 dBi

End of Report

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