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Executive Summary

It is considered that the Ethernet Powerline Adaptors do not satisfy the essential requirements of the EMC Directive; emissions could potentially cause interference to communications equipment. This report does not consider communications services that could be affected or the range at which affects might occur. Below 30 MHz, where the emissions were highest, there are no radiated emission limits. At these low frequencies, radiation from the mains distribution network will be higher when the mains network cables become considerably longer than those tested and represent a quarter wavelength.

The operating configuration using one or two adaptors was not critical. The emissions were present at the same levels with the Ethernet cable disconnected showing the emissions to be due to the adaptors and not to the data.

Conducted emissions on the power lines and on the Ethernet cable screen exceeded the Class B limits in EN 55022, both types of Ethernet Powerline Adaptor showed similar results. The limit was exceeded on the power lines from 2 MHz to 27 MHz by up to 39.4 dB and on the Ethernet screen by up to 15 dB. There were a number of discrete notches in the over limit emission spectrum.

Radiated emissions failed by up to 10.88 dB but at a few spot frequencies only; the configurations tested were more critical to the result achieved.

Declarations of Conformity for both types of adaptor refer to the EMC Directive 2004/108/EC and refer to standard EN 55022:1998 and CISPR/I/89/CD. The latter was a draft only that has now been withdrawn and should not be referenced on a DoC; the former standard is not complied with based on the testing reported herein. For the Power Grid 902, the DoC refers to Technical Construction File identified as XXXXXXXX, this is not an acceptable reference on the DoC.

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Contents

	Page No.
1. Introduction	7
2. Test Standard	7
2.1 Equipment Tested	7
2.2 Test Configuration	9
3. Tests Applied	9
3.1 Conducted Emissions Power	9
3.2 Conducted Emissions Ethernet	10
3.3 Radiated Emissions	10
4. Results	10
4.1 Conducted Emissions Power	10
4.2 Conducted Emissions Ethernet	11
4.3 Radiated Emissions	11
5. Measurement Uncertainty	11
6. Conclusions	11

Appendix 1: RFI-Global Services Report RFI/EMC/RP73935JD01A (67 pages)13

Figures List

	Page No.
Figure 1 Comtrend Power Grid DH-10PF (Ref: CH3).....	8
Figure 2 Comtrend Power Grid 902 (Ref: CH4 identical to CH5)	9

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1. Introduction

This report describes the EMC testing performed, at the request of Ofcom, on Comtrend Ethernet Powerline Adaptors that were provided by Ofcom. These devices commonly referred to as power line transmitters (PLT) are designed to take the ethernet data interface on a RJ45 connector and adapt the data signal for transmission on the 230 V AC local mains distribution network to a second unit which converts the signal back to the Ethernet data format.

Electrical and electronic products placed on the market and that are not radio or telecommunications equipment, come within the EMC Directive 2004/108/EC which is transposed into UK legislation in Regulation 2006 No. 3418. In Paragraph 4, this requires that the essential requirements are satisfied, and for emissions, that the electromagnetic disturbance generated does not exceed a level above which radio and telecommunications equipment and other equipment cannot operate as intended.

ERA Technology specified the EMC testing to be carried out and sub contracted RFI-Global Services Ltd at Basingstoke to carry out the testing under their UKAS accreditation.

2. Test Standard

There are currently no harmonised product standards that are applicable to this type of device where data is purposely transmitted onto the mains power network. The closest product standard was considered to be EN 55022 Information Technology Equipment, on the basis that the primary function of the device is the transmission of data. An alternative would be to use the generic standard EN 61000-6-3, where there is no appropriate product standard. For the emissions, the same test methods and limits would be applicable for both standards.

These devices were not considered to come within the requirements of the Radio and Telecommunications Terminal Equipment Directive 1995/5/EC on the basis that they do not connect directly to a telecommunications network. In the event that this Directive was to be considered applicable, the emission requirements would refer back to the EN 55022 standard.

2.1 Equipment Tested

Three items of equipment were submitted for testing, each item consisting of a pair of Ethernet Powerline Adaptors designed to be plugged directly into a UK mains port and provided with a Cat 5 screened ethernet cable approximately 4 m in length.

The following models were tested:

- a) Report ref: CH3 - Comtrend Power grid DH10-PF (Ofcom Reference CC03 1408)
- b) Report ref: CH4 - Comtrend Power Grid 902 (Ofcom Reference CC01 1408)
- c) Report ref: CH5 - Comtrend Power Grid 902 (Ofcom Reference CC02 1408)

It was noted that the DH10-PF ethernet socket was metalised however this metalised area was not connected to the mains earth pin. On the 902 versions the ethernet socket was plastic.

Figures 1 and 2 show photographs of the two types tested.



Figure 1: Comtrend Power Grid DH-10PF (Ref: CH3)



Figure 2: Comtrend Power Grid 902 (Ref: CH4 identical to CH5)

2.2 Test Configuration

The equipment was initially configured to represent practical use. One unit was connected through a 1 m mains cable to the power supply, with the second unit connected 3 m away on a mains extension. The two ethernet sockets were connected to two laptop PCs through 4 m supplied cables. One computer was set up to transmit data continuously at the highest data rate with the second computer receiving the transmitted data.

Testing was also carried out with no data transmission from the computer, and then with the computer ethernet cables disconnected.

3. Tests Applied

3.1 Conducted Emissions Power

An artificial mains network was connected 1 m from the first unit. Measurements of the conducted emissions were made from 0.15 to 30 MHz on the line and the neutral. Measurements were made with the peak detector and the average detector, and then the quasi peak detector and average detector were used to determine the highest emission levels at the highest emission frequencies in accordance with the standard.

3.2 Conducted Emissions Ethernet

The ethernet screen was connected to ground using a 150 ohm resistor and the current measured on unit side of the resistor from 0.15 to 30 MHz. Measurements were made with the peak detector and the average detector, then the quasi peak detector and average detector were used to determine the highest emission levels at the highest emission frequencies in accordance with the standard.

3.3 Radiated Emissions

Measurements were made from 30 to 1000 MHz in horizontal and vertical antenna positions on a 5 m semi anechoic test site. The highest peak results were then measured with the quasi peak detector in accordance with the standard. Tests were made without rotating the units on the turntable as directed by ERA due to the physically small size of the units compared to the cable lengths.

4. Results

Appendix 1 contains the RFI-Global Services report reference RFI-EMC2-RP7953JD01A dated 17 September 2008.

The initial results with the full system functioning in a representative manner showed emissions considerably above the limit. Data transmission was inhibited with no significant difference and the two laptop computers were removed with little significant difference indicating that emissions were from the unit and were not significantly related to the data transfer function.

4.1 Conducted Emissions Power

Report sections 5.2.9 to 5.2.26 summarise the worst case emissions on the power lines. The graphical results are shown in Appendix 2 (D006 to D014).

Tests were carried out on the older unit (CH3) and both of the new units (CH4 and CH5). The results for all three units were very similar, the worst case emissions being between 2.3 MHz and 3.2 MHz. Test were carried out on the full system consisting of both units with data transfer, both units with no data transfer, two units with no ethernet connected and a single unit with no ethernet connected. Worst case emissions on the three units under the various configurations were 39.4 dB (CH3), 37.3 dB (CH4) and 36.7 dB (CH5) over the Class B limit. Emissions were over limit from 2 MHz up to 27 MHz with the over limit levels being approximately 5 dB lower at the high frequency end. There were a number of discrete notches in the over limit frequency band, these were the same on both types of unit.

4.2 Conducted Emissions Ethernet

Report sections 5.2.1 to 5.2.8 summarise the highest emissions on the ethernet cable with the associated graphs in Appendix 2 (D001 to D005).

Tests were carried out on one of each type, with data and with the laptops disconnected; the emissions were over limit on both types, the emissions being higher with the laptops disconnected with no data transfer by 5 dB.

The older model (reference CH3) was over limit between 8 MHz and 28 MHz by up to 15 dB. The new model (reference CH4) was over limit between 9 MHz and 18 MHz by 9.6 dB.

4.3 Radiated Emissions

Report sections 5.3.1 to 5.3.5 summarise the highest radiated emissions, with the associated graphs in Appendix 2 (D015 to D021).

Measurements were carried out on the older unit (CH3) and one new unit (CH4).

CH3 failed between 480 MHz and 960 MHz by up to 7.3 dB with the two units only and no data transfer and failed between 320 MHz and 960 MHz by 5.88 dB with the full system transferring data.

CH4 failed at 31.6 MHz by 7.8 dB with the two units only and no ethernet interface and failed at 239 MHz by 10.88 dB with ethernet cables connected but no data transfer.

5. Measurement Uncertainty

This is quoted in the report at Appendix 1.

6. Conclusions

Conducted emissions on both types of Ethernet power line adaptors were similar, the emissions conducted onto the mains measured as common mode from each power line to ground exceeded the limit from 2 MHz to 27 MHz, excluding the discrete notched frequency bands, by between 36.7 and 39.4 dB. The configuration was not critical, with the emissions over the limit with no Ethernet connection.

On the Ethernet data line the emissions were over the limit by up to 15 and 9.6 dB respectively on CH3 and CH4.

Radiated emissions failed by up to 10.88 dB but at a few spot frequencies only; the configurations tested were more critical to the result achieved.

It is considered that the Ethernet power line adaptors do not satisfy the essential requirements of the EMC Directive.

**Appendix 1:
RFI-Global Services Report
RFI/EMC/RP73935JD01A (67 pages)**

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