

Test Report (copy 1 of 1)
FCC Testing of the
13.56MHz RFID Device
for
Ultra Electronics

Document number 10079/TR/1

Project number 10703

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Issue	Description	Issue by	Date
1	Issue One	MJN	28 th April 2009

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This test reports relates only to the unit(s) tested

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1 Introduction

Name and address of laboratory: York EMC Services Ltd
Three Lane Ends Business Centre
Methley Road
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WF10 1PN
UKAS testing laboratory N° 1574

Name and address of client: Mr Paul Conway
Ultra Electronics
Waverley House
Hampshire Road
The Granby Estate Weymouth
DT4 9XD

The test results contained in this test report relate only to the unit(s) tested.

Equipment under test RFID device installed into a Security card-printing machine (Magicard Presto, powered by 110Vac 60Hz).

Manufacturer Ultra Electronics

PCB number (RFID device) 3509-2500

Product name (Host) Magicard Presto

Model (Host) Presto mag

Serial number (Host) 46A8363

Firmware (Host) QV0.05.1

No. tested of each item One

FCC ID:XDW3649-0001

Customer supplied test plan ref. N/A

Date of receipt of EUT 12th February 2009

Method of receipt Brought by the customer

Date(s) of test(s) 12th and 27th February 2009, 16th March 2009, 2nd April 2009 and 1st May 2009

Date(s) when EUT was out of laboratory's control None

Method of disposal Awaiting disposal

Personnel witnessing tests The tests were partially witnessed by Mr Paul Conway of Ultra Electronics.

Any other relevant information: The RFID device normally only transmits for a fraction of a second when the printer is operated in order to detect the dye film cartridge inside the printer. For testing purposes the firmware of the host printer was modified such that the RFID continuously transmits while the printer is in an idle state.

2 Test Specification

2.1 Environment

The 13.56MHz RFID device is for incorporation into various products manufactured by Ultra Electronics. Typically these products will be printing devices and used in commercial and industrial environments.

2.2 Relevant standards

Test Standard	Relevant Section	Class/limit	Test Order
CFR 47 Part 15C:2008 & ANSI C63.4:2003	Section 15.225(a) Field strength within the band 13.553MHz-13.567MHz	As specified in Section 15.225(a)	1
	Section 15.225(d) Field Strength outside the band 13.110MHz-14.010MHz	As specified in Section 15.209	2
	Section 15.225(e) Frequency tolerance of the carrier signal	As specified in Section 15.225(e)	3 & 5
	Section 15.207 Mains conducted emissions	As specified in Section 15.207(a)	4

Note 1: Only the tests listed were required by the customer.

3 Test Results

3.1 Mains conducted emissions

Mode of operation	Description	Mode No.
	13.56MHz RFID device continuously transmitting inside host printer (printer in idle mode).	1

Test standard	Test description	Class/limit
CFR 47 Part 15C:2008 Section 15.207 & ANSI C63.4:2003	Conducted emissions on ac power of host printer	As specified in section 15.207(a)

Results	Mode	Figure	Result	Comments
	1	C01	Pass	None

QP Results	Mode	Freq (MHz)	QP level (dBuV)	Comments
	1	The initial peak results were greater than 10dB below the final average limit, therefore no final quasi peak measurements were performed.		

Average Results	Mode	Freq (MHz)	Final AV level (dBuV)	Comments
	1	13.56	41.7	All other initial average measurements were greater than 10dB below the final average limit, therefore no further final average emissions measurements were performed.

Note 1: See Appendix 4 for the graphical data results.

Note 2: The Final average level was obtained by adding together the receiver reading and factors for the cables of the measuring system, the transient limiter and LISN:

$$\text{Final level (41.7) dBuV} = \text{Receiver reading (30.4)} + \text{cable and limiter losses (10.8) dB} + \text{LISN correction (0.5) dB}$$

Note 3: The graphical result shows the composite plot of both the live and neutral conductors.

Modifications	Required for this test	Modification state
	In order to pass this test the host printer was fitted with a 30uH common mode choke see Appendix 8 for details.	1

3.2 Field strength within the band 13.553MHz-13.567MHz

Mode of operation	Description	Mode No.
	13.56MHz RFID device continuously transmitting inside host printer (printer in idle mode)	1

Test standard	Test description	Class/limit
CFR 47 Part 15C:2008 Section 15.225(a) & ANSI C63.4:2003	Radiated emissions	As specified in section 15.225(a)

Results	Mode	Figure	Comments
	1	R01	Open Area Test Site result (parallel polarisation)
		R02	Open Area Test Site (OATS) (perpendicular polarisation)

Freq (MHz)	Rx dBμV	CL (dB)	Antenna factor dB/m	Result at 10m (dBμV/m)	Distance correction factor (40dB/decade)	Result at 30m (dBμV/m)	Limit At 30m (dBμV/m)	Margin (dB)	Result
13.56	22.83	0.6	19.27	42.7	19.0	23.7	84.0	60.3	Pass

Receiving antenna parallel position, receiving antenna at 1m measurement height, equipment under test at 320 degree angle.

Freq (MHz)	Rx dBμV	CL (dB)	Antenna factor dB/m	Result at 10m (dBμV/m)	Distance correction factor (40dB/decade)	Result at 30m (dBμV/m)	Limit At 30m (dBμV/m)	Margin (dB)	Result
13.56	27.83	0.6	19.27	47.7	19.0	28.7	84.0	55.3	Pass

Receiving antenna perpendicular polarisation, receiving antenna at 1m measurement height, equipment under test at 220 degree angle.

Rx = Test receiver reading (voltage dBμV) before the addition of cable loss and antenna factor.

CL = total cable loss between antenna and test receiver (dB)

Result at 10m = Field strength (dBμV/m) at a measurement distance of 10m, calculated as follows:

Field strength (dBμV/m) = Rx (dBmV) + CL(dB) + Antenna factor (dB/m)

Example (using above data):

$$= 22.83 \text{ (dBμV)} + 0.6 \text{ (dB)} + 19.27$$

$$= 42.7 \text{ dBμV/m at a 10 m measurement distance}$$

$$= 23.4 \text{ dBμV/m at a 30 m measurement distance}$$

Result at 30m : Section 15.225(a) of CFR 47 Part 15(c), States the limit to be 15,848uV/m at a test distance of 30m. The above measurement was performed at a test distance of 10m and hence the result at 10m was scaled using the extrapolation factor of **40dB/decade as stated in section 15.31(f)(2)**.

$$15,485\mu\text{V/m} \equiv 84\text{dBuV/m},$$

For the specified measurement distance of 30m the correction will be:

$$\text{Correction} = 40 * \log (10/30) = -19\text{dB}$$

Note 2: The graphical results can be found in Appendix 1, the crosses on the plot relate to the final quasi peak value.

Note 3: The above measurements were taken using a Quasi peak detector.

Modifications	Required for this test	Modification state
	None	0

3.3 Field Strength outside the band 13.110MHz-14.010MHz

Mode of operation	Description	Mode No.
	13.56MHz RFID device continuously transmitting inside host printer (printer in idle mode)	1

Test standard	Test description	Class/limit
CFR 47 Part 15C:2008 Section 15.225(d) & ANSI C63.4:2003	Radiated emissions	As specified in Section 15.209

Results	Mode	Figure	Frequency Range	Comments
	1	R03	9kHz to 30MHz	Chamber result (See Note 2)
		R04	30MHz to 1GHz	Chamber result (See Note 2)
		R05	9kHz to 30MHz	Open Area Test Site Result
		R06	30MHz to 1GHz	Open Area Test Site Result

Freq (MHz)	Rx* (dBuV)	Cable loss (dB)	Antenna factor (dB/m)	Final QP level (dBuV/m)	Antenna height (m)	Turntable angle (°)	Pol	Det	Limit*** (dBuV/m)	Margin (dB)	Result
0.0615	-53.72	0.06	19.58	-34.14	1.0	220	Perp	AV	31.8	65.9	Pass
0.1229	-63.85	0.07	19.50	-44.35	1.0	0	Perp	AV	25.8	70.1	Pass

Freq (MHz)	Rx** (dBuV)	Cable loss (dB)	Antenna factor (dB/m)	Final QP level (dBuV/m)	Antenna height (m)	Pol	Turntable angle (°)	Det.	Limit (dBuV/m)	Margin (dB)	Result
151.74	18.54	2.11	10.9	31.55	1.0	V	0	QP	43.52	11.97	Pass
151.98	18.64	2.11	10.9	31.65	1.0	V	0	QP	43.52	11.87	Pass
195.18	29.64	2.41	7.8	39.85	1.0	V	230	QP	43.52	3.67	Pass
195.54	27.33	2.42	7.8	37.55	1.0	V	160	QP	43.52	5.97	Pass
197.76	29.83	2.42	7.8	40.05	4.0	H	217	QP	43.52	3.47	Pass
198.18	28.21	2.44	7.7	38.35	1.0	V	173	QP	43.52	5.17	Pass
200.34	30.2	2.45	7.8	40.45	4.0	H	212	QP	43.52	3.07	Pass
200.70	30.1	2.45	7.8	40.35	1.0	V	158	QP	43.52	3.17	Pass
200.88	30.29	2.46	7.8	40.55	1.36	V	190	QP	43.52	2.97	Pass
200.82	32.6	2.45	7.8	42.85	1.0	V	191	QP	43.52	0.67	Pass

Det = detector, QP = Quasi-Peak, AV = Average

Pol = position of receive antenna, below 30MHz perp = loop antenna plane perpendicular to equipment under test. Above 30MHz, V = Vertical, H = horizontal

*Test receiver reading (voltage dB μ V) before the addition of cable loss and antenna factors at 300m as stated in section 15.20

Measurements were made at 10m and the data extrapolated to a 300m distance.

For the specified measurement distance of 300m the correction will be:

$$\text{Correction} = 40 \cdot \log(10/300) = -59\text{dB}$$

**Test receiver reading (voltage dB μ V) before the addition of cable loss and antenna factors at 3m as stated in section 15.209.

***According to section 15.209 of Part 15, in the frequency range 0.009MHz to 0.490MHz the limit is calculated as:

$$\text{Limit (uV/m)} = 2400 / F(\text{kHz}):$$

$$\text{At 0.0625MHz the limit at 300m is: } 2400/62.5 = 38.4\text{uV/m} = 31.8\text{dBuV/m}$$

$$\text{At 0.1229MHz the limit at 300m is: } 2400/122.9 = 19.5.4\text{uV/m} = 25.8\text{dBuV/m}$$

Note 1: The graphical data can be found in Appendix 2, the crosses on the plot relate to the final quasi peak value.

Note 2: Chamber measurements (scans) were first performed to obtain the radiated frequency data. The worse case frequencies were then measured on an Open Area Test Site (OATS) at a distance of 10 meters.

Note 3: All emissions outside the RFID band were found to be due to the printer and not the RFID device.

Modifications	Required for this test	Modification state
	None	0

3.4 Frequency tolerance of the carrier signal

Mode of operation	Description	Mode No.
	13.56MHz RFID device continuously transmitting inside host printer (printer in idle mode)	1

Test standard	Test description	Class/limit
CFR 47 Part 15C:2008 Section 15.225(e) & ANSI C63.4:2003	Frequency tolerance of the carrier signal	As specified in Section 15.225(e)

Results	Mode	Figure	Result	Comments
	1	R01	Pass	The frequency tolerance as specified in section 15.225(e) is +/-0.01%, which for a frequency of 13.56MHz is (+/-1.356kHz).

Temperature	50	40	30	20	10	0	-10	-20	Max frequency deviation
Carrier frequency (MHz)	13.562676	13.562664	13.562689	13.562702	13.562690	13.562703	13.562739	13.562714	75Hz

	102V (85%)				114V (95%)				126V (105%)				138V (115%)			
Scan Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Max amplitude of carrier	-9.139999	-9.369999	-9.119999	-9.209999	-9.259998	-9.470001	-9.259998	-9.490002	-9.16	-9.189999	-9.16	-9.07	-9.07	-8.990002	-8.830002	-9.16
Freq at max amplitude	13.562800	13.562810	13.562830	13.562810	13.562830	13.562800	13.562790	13.562810	13.562810	13.562830	13.562830	13.562830	13.562810	13.562810	13.562830	13.562830
Max Freq of scans 1 to 16	13.56283															
Min Freq of scans 1 to 16	13.56279															
Freq Deviation (Hz)	40															

Note 1: The graphical data can be found in Appendix 3. Fig 5.3.1 shows a composite plot of all scans taken whilst varying the supply voltage. Four scans were taken at approximately 2-minute intervals for each supply voltage giving a total of 16 scans.

Modifications	Required for this test	Modification state
	None	1

4 Summary

4.1 Emissions

Test Standard	CFR 47 Part 15C:2008 & ANSI C63.4:2003
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Basic Standard	Class/limit	Result
Section 15.225(a) Field strength within the band 13.553MHz-13.567MHz	As specified in Section 15.225(a)	Pass
Section 15.225(d) Field Strength outside the band 13.110MHz-14.010MHz	As specified in Section 15.209	Pass
Section 15.225(e) Frequency tolerance of the carrier signal	As specified in Section 15.225(e)	Pass
Section 15.207 Mains conducted emissions	As specified in Section 15.207(a)	Pass

Note 1: Only the tests listed were required by the customer.

4.2 Compliance statement

The 13.56MHz RFID Device, as tested and modified, was shown to meet the requirements of the standards listed in 4.1 of this report.

5 Appendices

5.1 Appendix 1 Field strength within the band 13.553MHz-13.567MHz test results

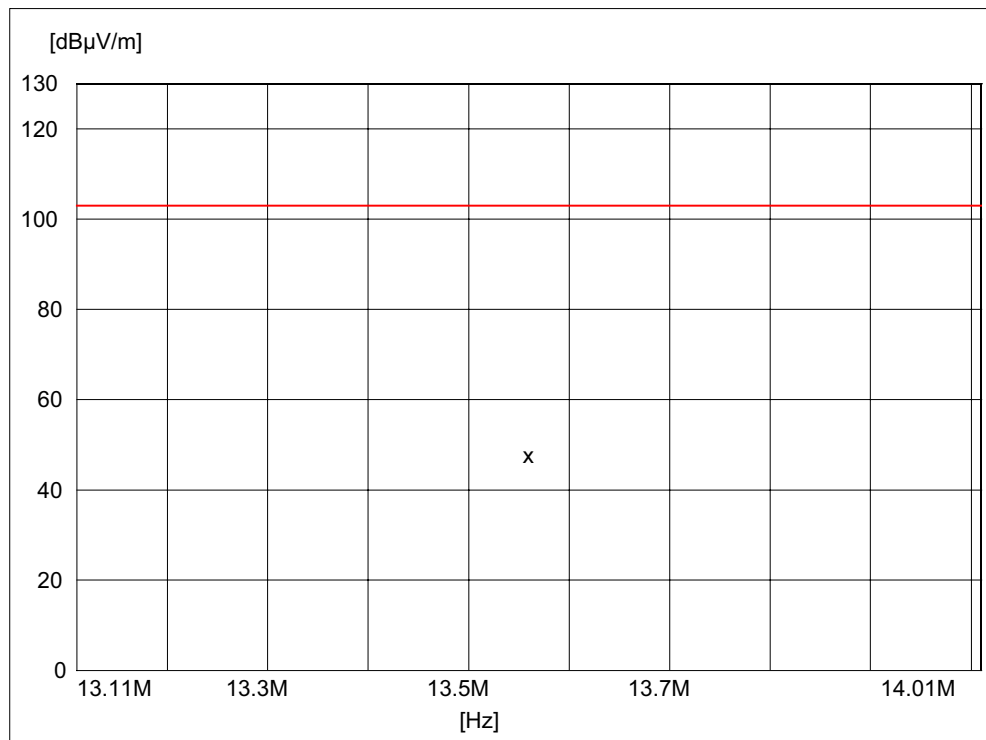


Fig 5.1 Radiated emission at 13.56MHz spot frequency (R01), Open Area Test Site result, 10m measurement distance, perpendicular polarisation

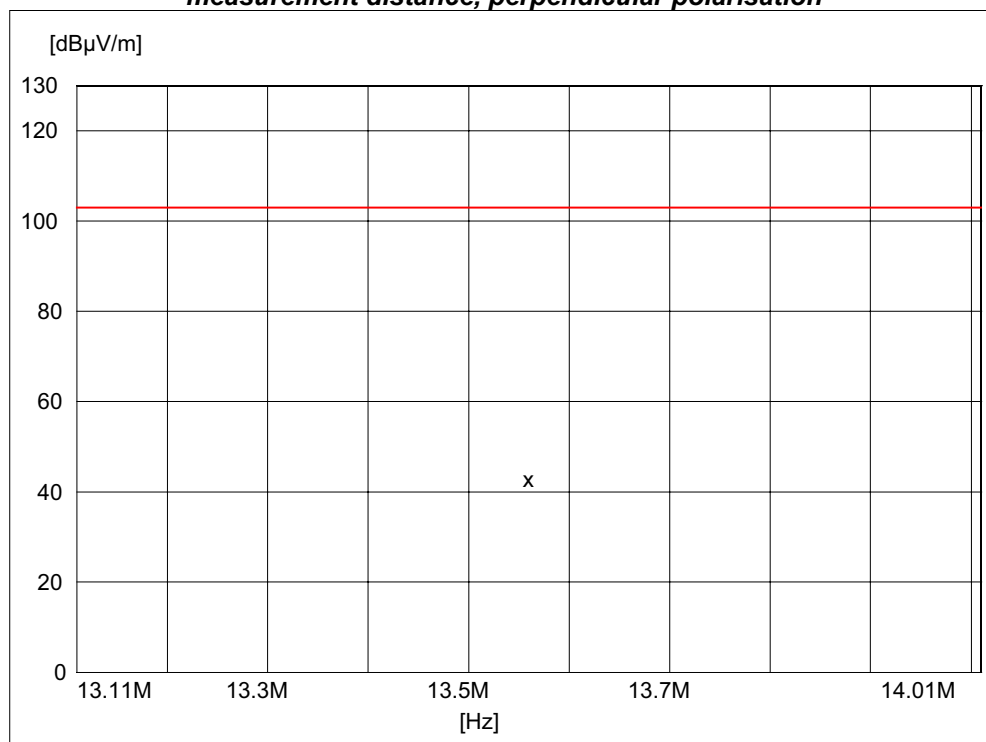


Fig 5.2 Radiated emission at 13.56MHz spot frequency (R02), Open Area Test Site result, 10m measurement distance, parallel polarisation

5.2 Appendix 2 Field Strength outside the band 13.110MHz-14.010MHz

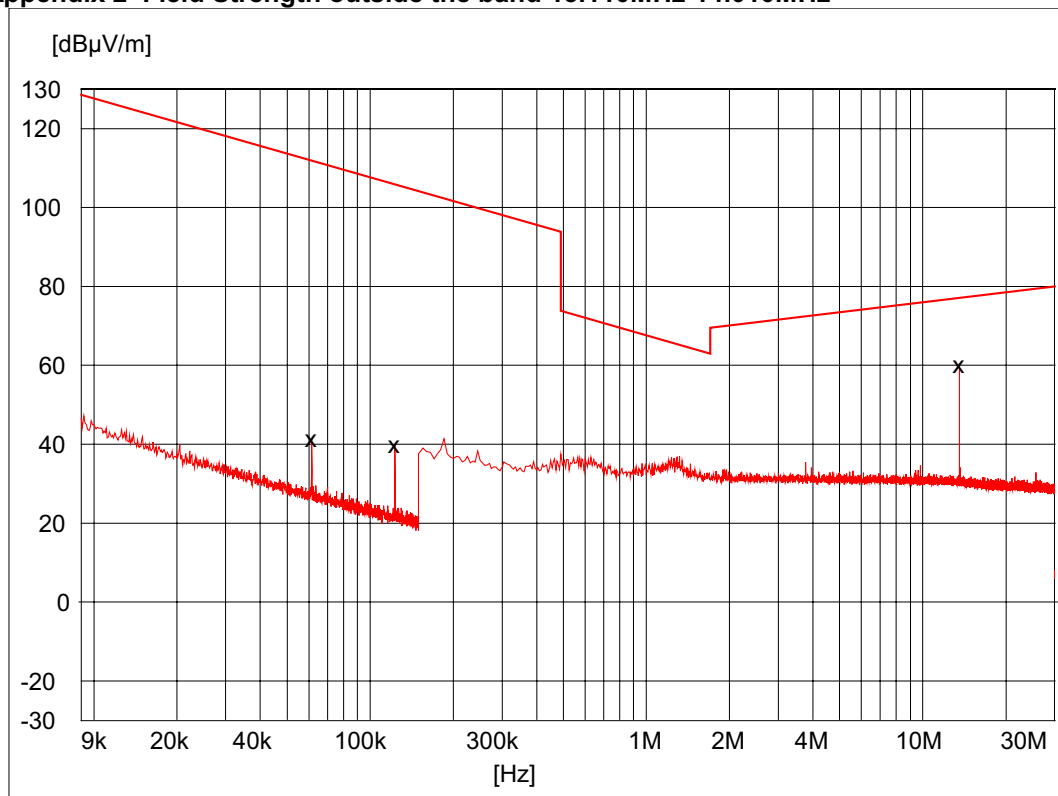


Fig 5.2.1 Radiated emissions result (Chamber R03), 9kHz to 30MHz parallel and perpendicular polarisation combined plot, 3m measurement distance

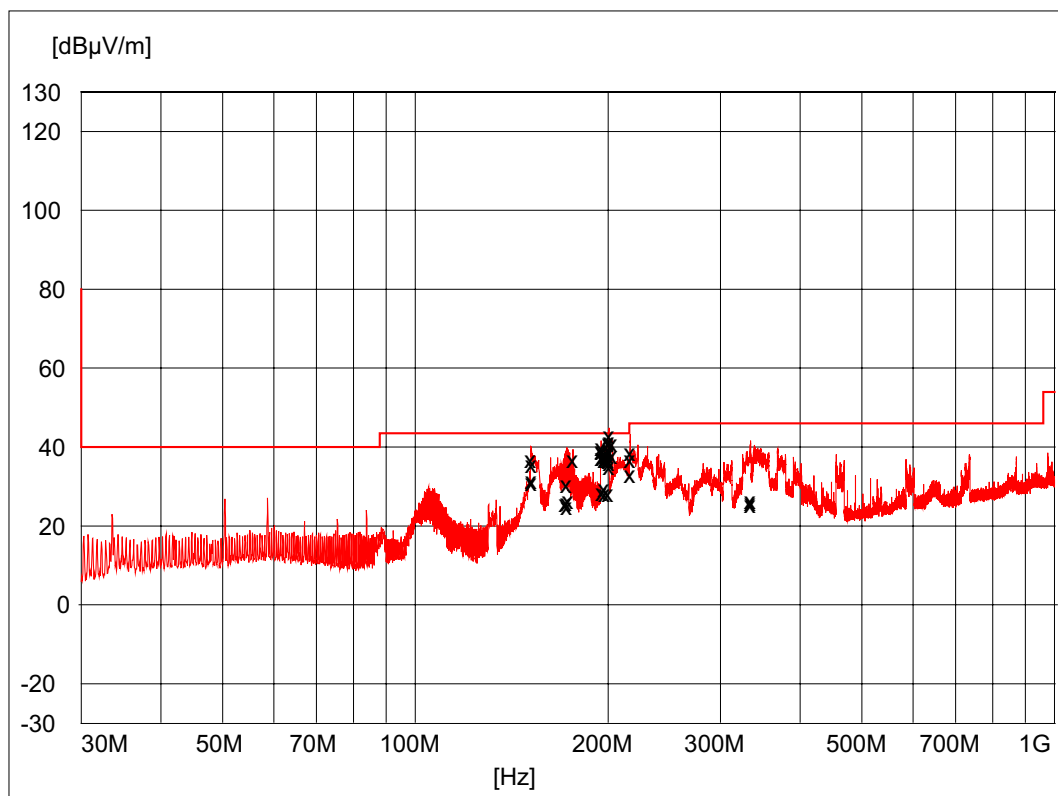


Fig 5.2.2 Radiated emissions result (Chamber R04), 30MHz to 1GHz vertical and horizontal polarisation combined plot, 3m measurement distance

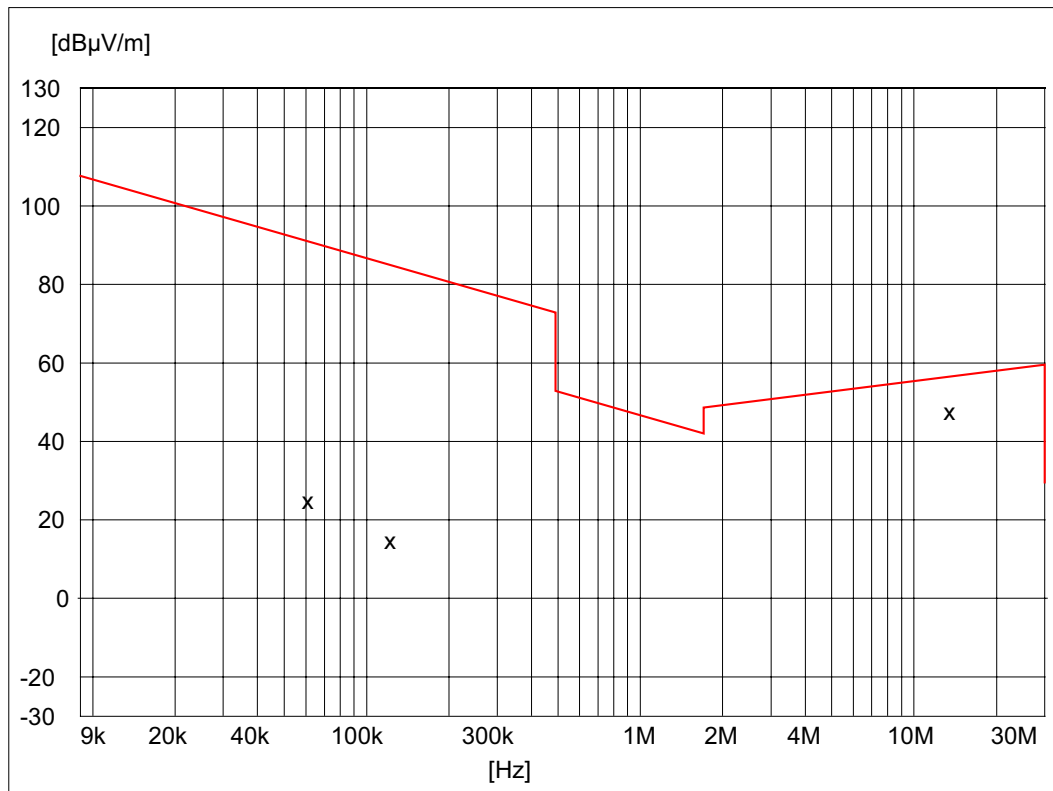


Fig 5.2.3 Radiated emissions (Open Area Test Site result R05), 9kHz to 30MHz parallel and perpendicular polarisation combined plot, 10m measurement distance

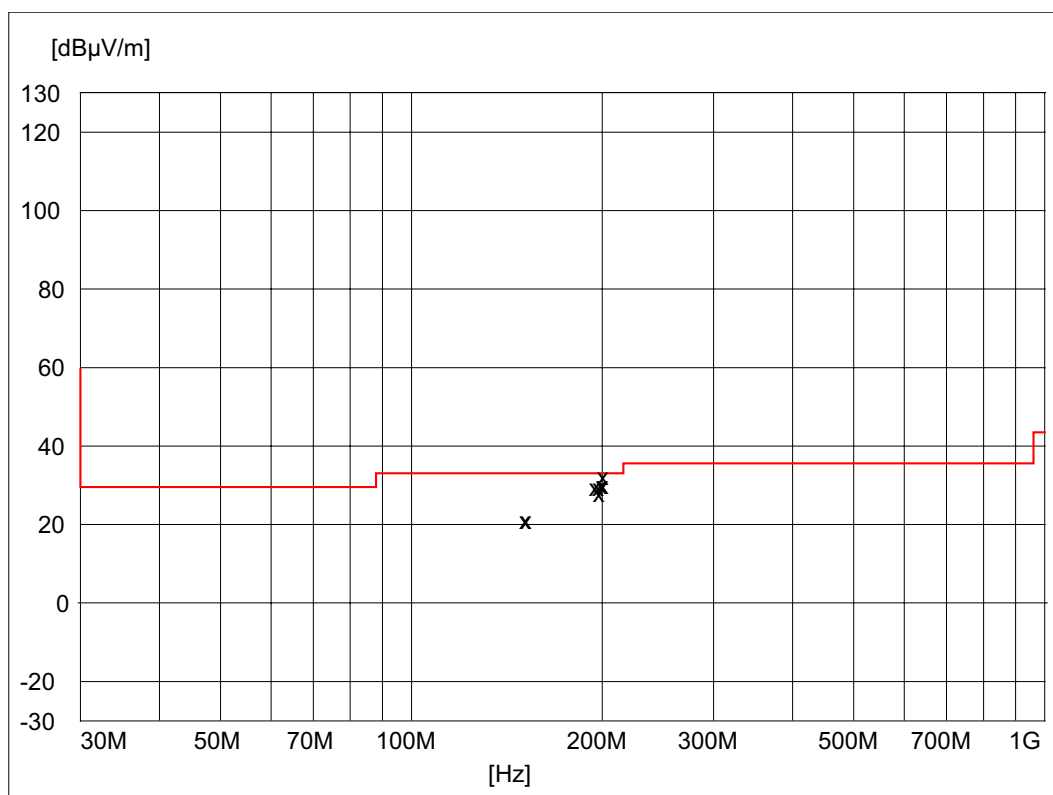


Fig 5.2.4 Radiated emissions (Open Area Test Site result R06), 30MHz to 1GHz vertical and horizontal polarisation combined plot, 10m measurement distance

5.3 Appendix 3 Frequency tolerance of the carrier signal

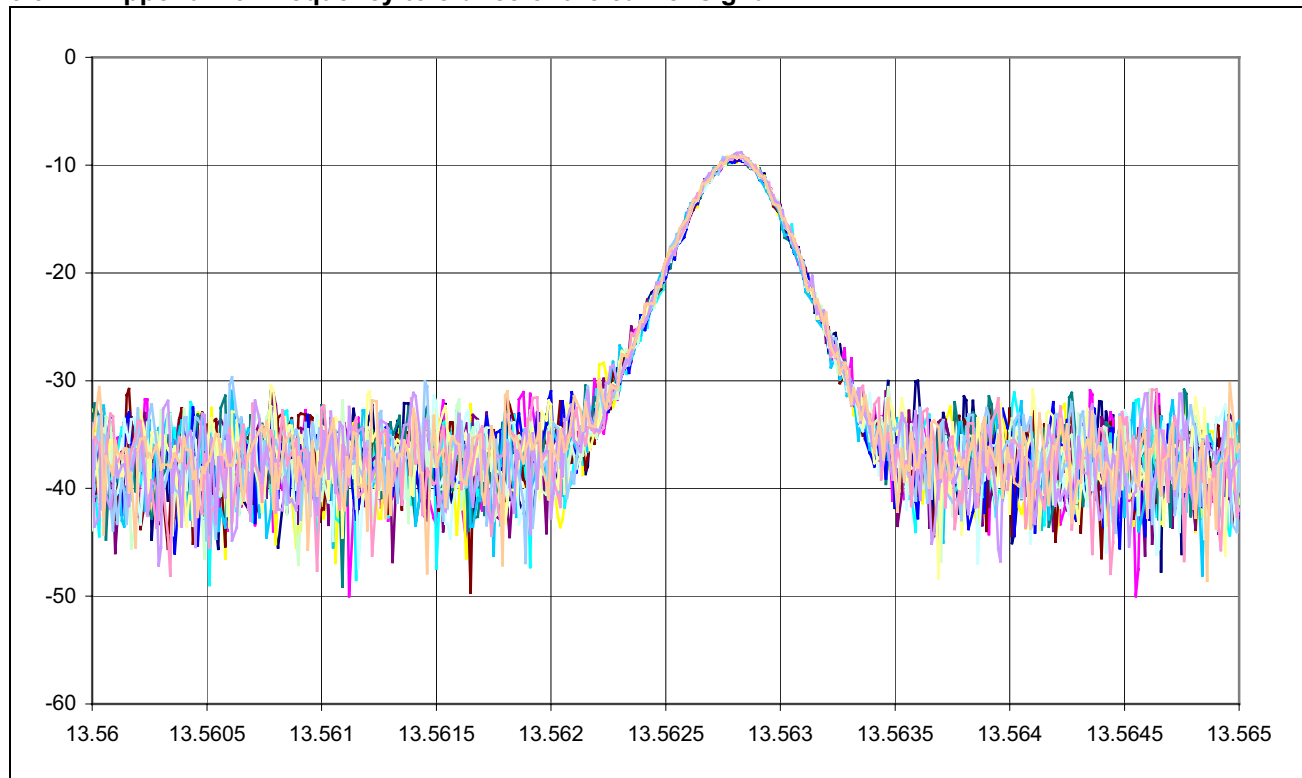


Fig 5.3.1, Frequency stability of carrier, composite plot of all scans.

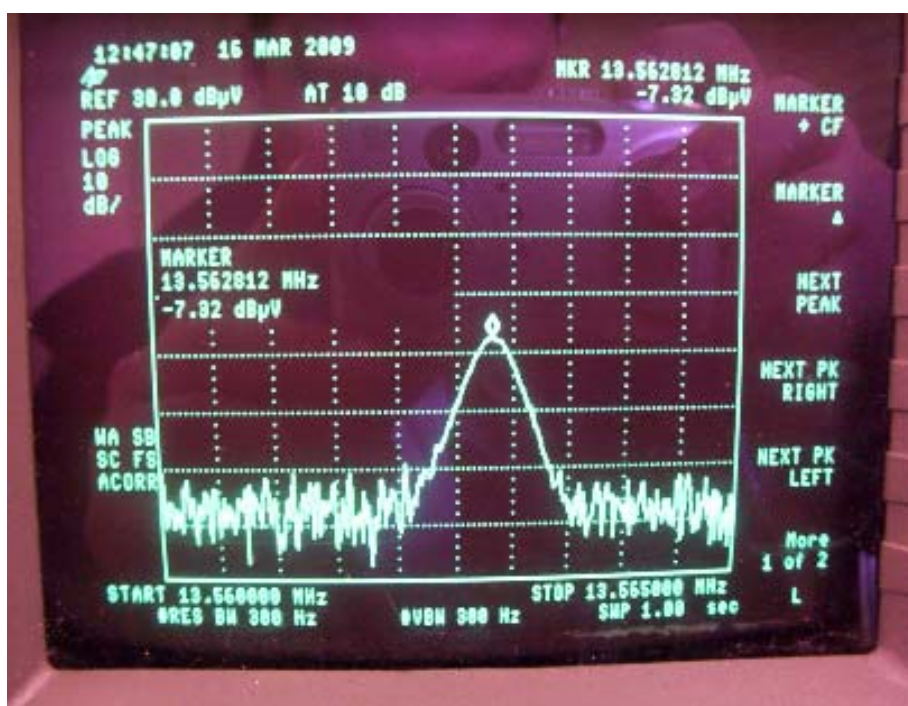


Fig 5.3.2, Frequency stability of carrier, oscilloscope screen shot of one particular scan.

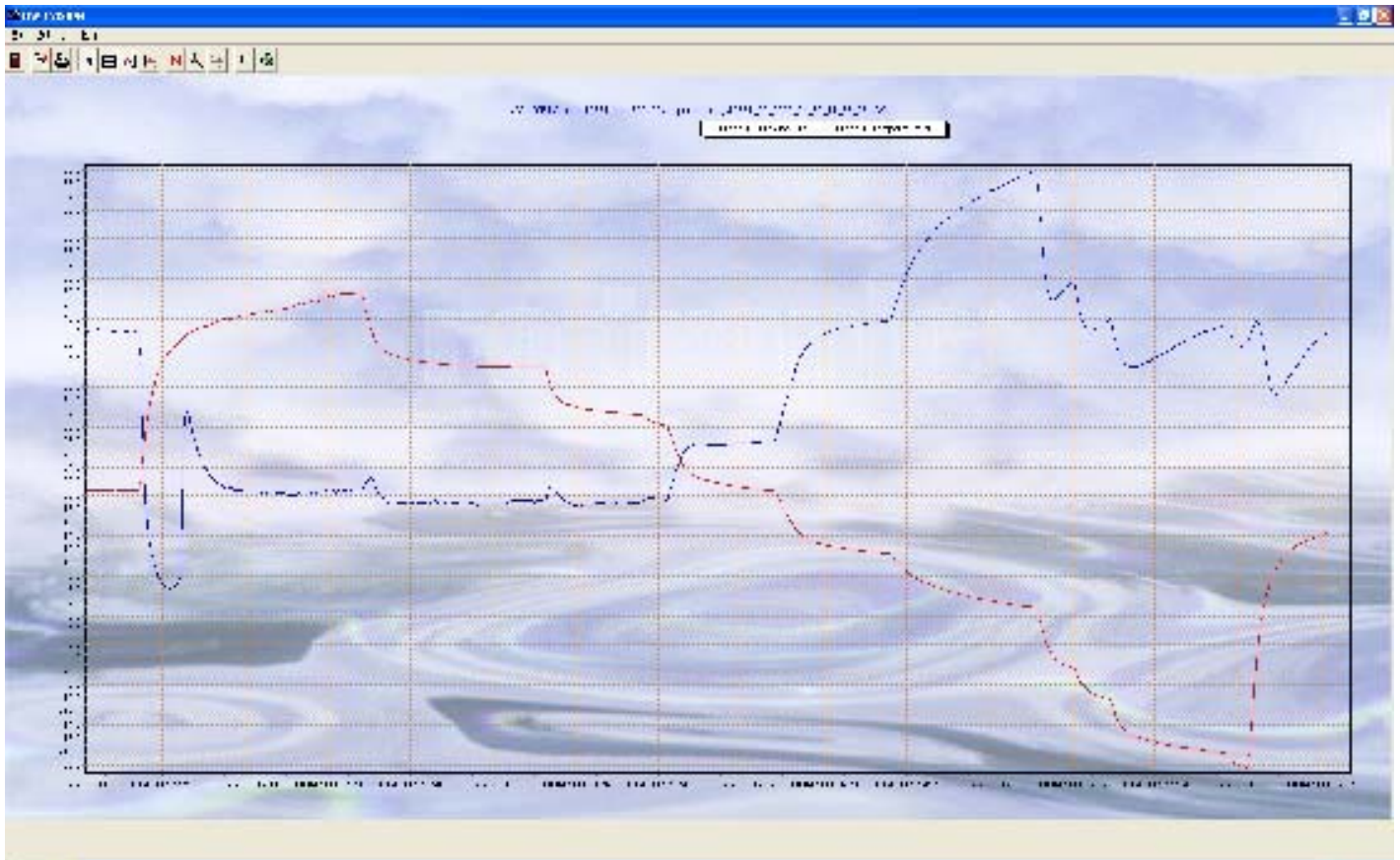


Fig 5.3.3, Frequency stability of carrier testing, temperature plot (red) and Humidity plot (blue).

5.4 Appendix 4 Conducted emissions

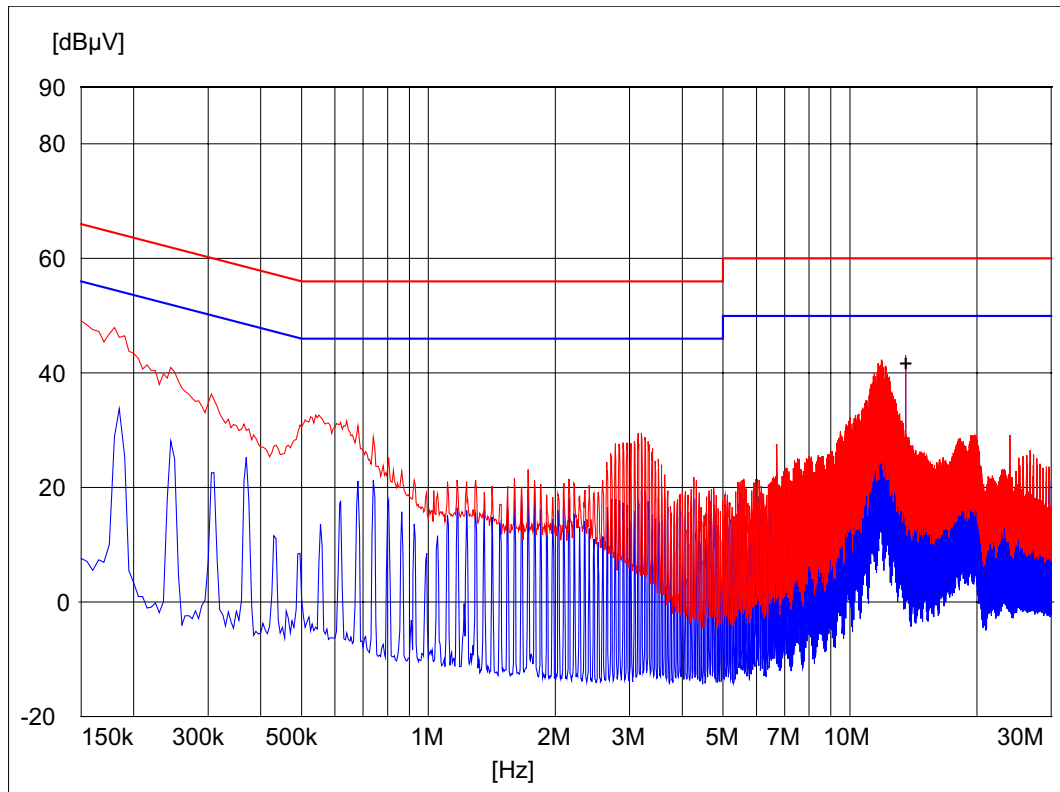


Fig 5.4.1 Conducted emissions result, C01.

Note: The blue trace relates to the initial average measurements, the red trace relates to the initial peak measurements and the cross shows the final average measurement.

5.5 Appendix 5 EUT test configurations



Photograph 5.5.1 Conducted emissions testing



Photograph 5.5.1 Conducted emissions testing



Photograph 5.5.3 Radiated emissions testing (9kHz to 30MHz), Open Area Test Site



Photograph 5.5.3 Radiated emissions testing (30MHz to 1GHz), Open Area Test Site



Photograph 5.5.4 Frequency stability testing

5.6 Appendix 6 Equipment used

Equipment	York EMC Asset No.	Cal Type	Cal date	Cal Period (Months)
Chase CBL 6111A Bilog Antenna	78167	UKAS	16th December 2008	12
Chase HLA6120 Loop Antenna	78128	NPL	5th January 2009	12
R&S ESHS 10 Receiver	79182	UKAS	8th October 2008	12
R&S ESHS 10 Receiver	78035	UKAS	29th December 2008	12
R&S ESVS 30 Receiver	78107	UKAS	23rd December 2008	12
HP 8594E Spectrum analyser	78662	UKAS	18th September 2008	24
Spitzenberger & Spies power source	78131	NCS	N/A	N/A
Chase CFL 9206 Transient Limiter	78087	In-house	25th June 2008	12
R&S ESH3 Z5 LISN	78037	UKAS	9th October 2008	12
Rotronic Hygropalm temperature probe	79537	UKAS	5 th January 2009	12
HP8549E Spectrum Analyser	78661	UKAS	5 th November 2008	12
Thermotron environment chamber	D0015	In-house	March 2009	12

5.7 Appendix 7 Customers test equipment used

Equipment	Serial number	Cal status
None	N/A	N/A

5.8 Appendix 8 Modification States

Modification state	Modification
0	As supplied by the customer.
1	In order to pass the conducted emissions test the host printer was fitted with a 30uH common mode choke on a 1-meter length supply lead shown below. In practice this choke will be fitted on the main PCB at the point of entry of the mains cable.



Fig 5.9.1, 30uH common mode choke fitted to mains supply lead

5.9 Appendix 9 Test Report History

Issue	Modification details
1	Original issue of the test report
2	N/A