EMI Test Report

Printer Compuprint mod. 9088

EUT level: Pre-production

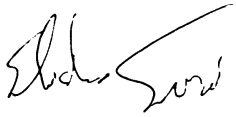
Date: July 13, 1999

Report Nr.: RQ0394

Test Facility : Site No.1 (FCC Code 31040/SIT) of Compuprint SpA
Via ai Laboratori Olivetti 79/81 - 20010 Pregnana Milanese (MI)

Written by : Paolo Roncone

Approved by: Gianni Chiodo



Date(s) of Test: July 9 to July 13, 1999

Test performed by: Paolo Roncone

REVISION RECORD

REV	DATE	DESCRIPTION	PAGES
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1.0 EQUIPMENT UNDER TEST (EUT)

Make	Type/Model	Serial / Prototype Number
Compuprint	9088	004

Description
1100 cps Dot Matrix Printer, 18 needles printhead, with parallel (Centronics) and serial (RS-232) interface, intended primarily for use in office and business environments.

2.0 TEST OBJECTIVES

To verify the EUT compliance with the technical requirements under Part 15 of the FCC Rules, with Canadian requirements, under Industry Canada Standard ICES-003, and with all technical requirements based on CISPR 22 emissions limits (class B).

3.0 REFERENCE DOCUMENTS

1. FCC: CFR 47 Ch. I (10-1-98 Edition): Part 15 (Radio Frequency Devices) - Subpart A (General); Subpart B (Unintentional Radiators)
2. Industry Canada: ICES-003: Digital Apparatus / NMB-003: Appareils numériques
3. EMCAB-3 Issue 3: Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003
4. CISPR 22 (2.ed-1993): Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment

The test was performed according to the following procedure excluding section 5.7, section 9 and section 14:

5. ANSI C63.4-1992: “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz”

4.0 TEST SUMMARY AND RESULTS

The 9088 printer was tested as running while attached to a Personal Computer via parallel (Centronics) and via serial (RS-232) interface.
The test configuration, cables and operations were selected following the referenced documents (section 3.0) and within the range of typical customer applications (see section 6.0 for details).
The EUT radio frequency emissions - conducted onto the AC power line and radiated, measured at 10 meters from the EUT - were compared with the class B limits specified in CISPR 22, in order to verify the EUT compliance with all applicable standards, including the FCC and Canadian requirements, as allowed by the FCC rules (Ch.1 §15.107(e), §15.109(g)) and by ICES-003.

The 9088 printer was found to meet CISPR 22 Class B limits with a minimum margin of 7 dB for conducted EMI and a minimum margin of 4.7 dB for radiated EMI.

These results are deemed satisfactory evidence of compliance with the technical requirements under FCC Part 15, with Industry Canada Interference-Causing Equipment Standard ICES-003 and with all requirements based on CISPR 22 Class B emissions limits.

4.1 Test Summary Table

Ref. Standard	Class	Tests run	Test notes	Pass	Fail	Min. margin dB
CISPR 22	B	EMI Conducted		X		7
CISPR 22	B	EMI radiated	10 m distance	X		4.7

4.2 EMI Suppression Components

The following components are specifically used in the subject EUT, in order to meet the requirements of the referenced standards (class B limits) with good safety margins:

- Motherboard:
  IMI SM530 Spread Spectrum Clock Generator: used to spread the RF energy of clock and all clock-related signals.
  Six ceramic capacitors (1000pF) between Drain and Source pins of the MOS transistors driving the carriage motor.
  RC and series R filters at the output of clock and fastest logic signals.
  Surface-mount ferrite beads on signal lines to following cables: op.panel; future options; sensors; optional rear tractor.
- Power Supply:
  Line Filter with two X capacitors, two Y capacitors and one CM inductance. Ceramic capacitor (220pF) across terminals of diodes DD21. Ceramic capacitor (100pF) between Drain and Source of transistor M21. Ferrite beads on terminals of diodes DD300 and DD21.
- Ferrite cores on the following cables:
  op. panel cable; future options cable; sensors cable; optional rear tractor cable; carriage motor cable; paper motor cable; carriage motor fan cable; AC power cable (between the Power Supply PCB and the AC plug): one toroidal core on line/neutral wires and one cilindrical core on earth (green/yellow) wire.

5.0 TEST RESULTS

5.1 Conducted EMI

Sample Calculations

The equation below shows how the test results were obtained from the receiver's readings.

Final level (dBµV) = Receiver Reading (dBµV)+ Cable Loss (dB)

NOTE: At each frequency, the highest of the levels recorded on the line and neutral conductors is reported.

5.1.1 ***Emissions on the printer 9088 (EUT) power cord***

5.1.1.1 Parallel Interface running

Freq. [MHz]	LEVEL[1] [dBµV]		Line	CISPR 22 class B LIMIT [dBµV]		Margin[2] [dB]
	QP	AV		QP	AV	
0.1705	52		1	65	55	-13
0.1934	54	46	0	63.9	53.9	-7.9
0.254	47		1=0	61.7	51.7	-14.7
4.978	37.3		1	56	46	-18.7
6.38	40.4		"	60	50	-19.6
7.019	38.0		"	"	"	-22
21.923	41.5		1=0	"	"	-18.5
28.188	40.2		0	"	"	-19.8

1 QP = quasi-peak reading ; AV = average reading.
AV reading is reported only when the QP reading exceeds the AV limit. If the QP reading is below the AV limit, the EUT is deemed to meet both limits and the AV measurement is not required (ref. CISPR22, section 5)

2 Margin = Measured Level - Limit

5.1.1 ***Emissions on the printer 9088 (EUT) power cord*** (cont.)

5.1.1.2 Serial Interface running

Freq. [MHz]	LEVEL [dBµV]		Line	CISPR 22 class B LIMIT [dBµV]		Margin [dB]
	QP	AV		QP	AV	
0.1723	52		1	64.9	54.9	-12.9
0.1915	54.8	47	0	64	54	-7
0.253	47		1	61.7	51.7	-14.7
4.912	37.3		"	56	46	-18.7
6.316	40.5		"	60	50	-19.5
7.016	38.9		"	"	"	-21.1
21.923	41.2		1=0	"	"	-18.8
28.188	40.0		"	"	"	-20

5.1.2 *Emissions on non-EUT power cords*

5.1.2.1 Parallel Interface running

Freq. [MHz]	LEVEL [dBµV]		Line	CISPR 22 class B LIMIT [dBµV]		Margin [dB]
	QP	AV		QP	AV	
0.1556	41.8		N=L1	65.7	55.7	-23.9
0.2727	42.3		N	61.1	51.1	-18.8
0.4299	36		"	57.4	47.4	-21.4
0.508	38.4		"	56	46	-17.6
0.664	37		N=L1	"	"	-19
6.312	42.1		"	60	50	-17.9
7.142	39.9		"	"	"	-20.1
21.925	40.8		L1	"	"	-19.2

5.1.2.2 Serial Interface running

Freq. [MHz]	LEVEL [dBµV]		Line	CISPR 22 class B LIMIT [dBµV]		Margin [dB]
	QP	AV		QP	AV	
0.1566	42		N=L1	65.6	55.6	-23.6
0.2725	42.5		N	61.1	51.1	-18.6
0.508	39		"	56	46	-17
0.664	37		N=L1	"	"	-19
6.505	41.5		"	60	50	-18.5
6.82	39.8		"	"	"	-20.2
21.925	40.1		N	"	"	-19.9

5.2 Radiated EMI

Measurement distance: 10 meters

Sample Calculations

The equation below shows how the test results were obtained from the receiver's readings.

E-field level (dBµV/m) = Receiver Reading (dBµV) + Antenna factor (dB/m) + Cable Loss (dB)

NOTE 1: At each frequency, the highest of the levels recorded in vertical and horizontal polarization of the receiving antenna is reported.

NOTE 2: At each frequency, the EUT was powered off and back on, in order to check the ambient (non-EUT) noise level. The E-field level with EUT off is specified in parentheses when it is less than 6 dB below the level with EUT on.

5.2.1 ***Parallel Interface running***

Freq. [MHz]	E-field LEVEL [dBµV/m]	Pol. V/H	Antenna Heigth m	Rotation angle deg.	CISPR 22 class B LIMIT [dBµV/m]	Margin [dB]
31.05	22.4 (17)	V	1	225	30	-7.6
33.9	23.2	"	"	135	"	-6.8
37.4	25.3	"	"	"	"	-4.7
40.4	23.3	"	"	"	"	-6.7
44.3	23.5	"	"	"	"	-6.5
47.0	23.3	"	"	180	"	-6.7
62.67	22.9 (21.4)	"	"	0	"	-7.1
109.67	24.5 (22.2)	"	"	"	"	-5.5
152.75	21	H	4	338	"	-9
156.67	20	"	"	"	"	-10
180.17	23.7 (22.8)	V	1	0	"	-6.3
188.01	22.2 (21.0)	"	"	"	"	-7.8
195.84	23.3 (22.1)	"	"	"	"	-6.7
211.51	21.1 (19.1)	"	"	"	"	-8.9
219.34	23.0 (22.1)	"	"	"	"	-7
227.17	21.2 (17.5)	"	"	"	"	-8.8

5.2.2 ***Serial Interface running***

Freq. [MHz]	E-field LEVEL [dBµV/m]	Pol. V/H	Antenna Heigth m	Rotation angle deg.	CISPR 22 class B LIMIT [dBµV/m]	Margin [dB]
31.05	19.6 (16.4)	V	1	225	30	-10.4
33.9	19.8	“	“	135	“	-10.2
37.4	25.0	“	“	“	“	-5
40.4	21.6	“	“	“	“	-8.4
44.3	19.9	“	“	“	“	-10.1
47.0	21.6	“	“	180	“	-8.4
62.67	21.2 (20.1)	“	“	0	“	-8.8
109.67	24.7 (23.3)	“	“	“	“	-5.3
152.75	21	H	4	338	“	-9
156.67	20	“	“	“	“	-10
180.17	23.6 (22.4)	V	1	0	“	-6.4
188.01	21.8 (21.1)	“	“	“	“	-8.2
195.84	23.3 (22.1)	“	“	“	“	-6.7
211.51	21.9 (17.9)	“	“	“	“	-8.1
219.34	23.2 (20.8)	“	“	“	“	-6.8
227.17	20.8 (14.9)	“	“	“	“	-9.2
235.008	19.5 (17.4)	“	“	“	37	-17.5

6.0 TEST METHOD AND SET-UP

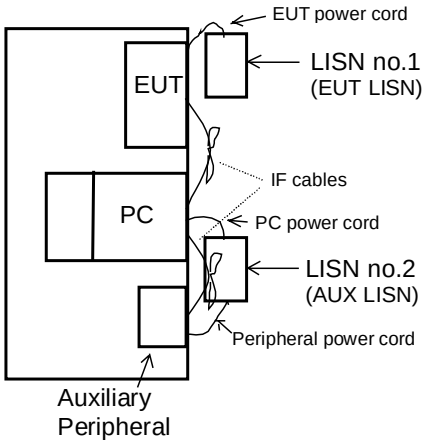
EMI tests were performed in Compuprint's proprietary EMC test facility, with a shielded room (used for conducted EMI) and a 10 meter open area test site (radiated EMI). The site is filed with the FCC data- base as Site No.1 (ref. 31040/SIT).

The EUT (9088 printer) was tested as part of a typical table-top system, with a Personal Computer driving the EUT and an additional peripheral device connected to the same PC. The auxiliary peripheral was an FCC certified printer, with a parallel and a serial interface port.
When testing the EUT printer on the parallel interface, the auxiliary printer was connected to the PC serial port and powered on. When testing the EUT printer on the serial interface, the auxiliary printer was connected to the PC parallel port and powered on.
The EUT system was tested on a 0.8 m high wooden table. All cables were arranged as specified in ANSI C63.4 (sec.6 and figs. 9(a) and 9(c)). Cables were moved, where appropriate, to maximize emissions.
The EUT was tested using an "H" pattern, 136 columns on continuous form. This thoroughly exercises the EUT and its functions.

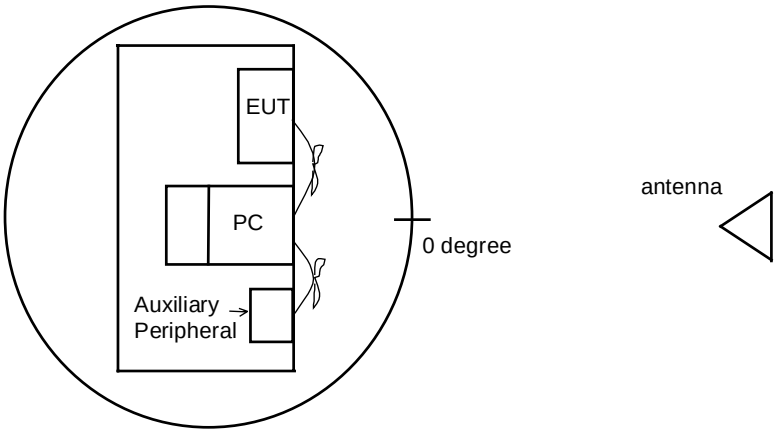
For *conducted EMI*, the EUT system was placed 0.4 m from a vertical wall of the shielded room, and kept at least 0.8 m from any other metal surface, as specified in ANSI C63.4 (sec.7.2.1 and fig.9(a)). The EUT power cord was connected to one LISN (Line Impedance Stabilization Network, as defined in ANSI C63.4, sec.4.1.2). The power cords of the PC and of the other units in the system were connected to a multiple outlet and powered through a second LISN. The conducted emissions on each current-carrying conductor of the EUT AC power cord were measured using the first LISN.
The emissions on the other power cords were measured using the second LISN.

For *radiated EMI*, the EUT system was rotated 360 deg. and the receiving antenna scanned from 1 to 4 meters in height, with vertical and horizontal polarization.
The EUT set-up and orientation was such that the rear of the system was facing the receiving antenna at the zero degree angle of rotation (see sketch below).
During preliminary testing the configuration of the EUT that maximizes the emissions was found to be the one with the optional rear tractor connected. This configuration was used for final testing.
The radiated test distance of 10 meters was measured as the horizontal distance between the receiving antenna and the boundary of the EUT system, as specified in FCC Part 15 (§ 15.31(f)).

6.1 Sketches



Conducted test layout (top view)



Radiated test layout (top view)

6.2 Test Equipment

Conducted EMI
Receiver: Rohde & Schwarz ESH3 (s/n 879599/043): 9 kHz - 30 MHz
LISN #1: NSLK 8128 Schwarzbeck (9002-090000012), on EUT (printer) power cord
LISN #2: Rohde & Schwarz ESH3-Z5 (9103-0910009), on power cords of PC and auxiliary devices.

Radiated EMI
Receiver : Rohde & Schwarz ESN 1027.3007.30 (s/n 842789/008): 10 kHz - 1000 MHz
Antennas: Rohde & Schwarz HK116 (s/n 843562/06) biconical (20 - 300 MHz)
EATON Mod. 96005 (s/n 2490) log-periodic (200 - 1000 MHz)

7.0 EUT SYSTEM

- Printer Compuprint 9088 (Equipment Under Test) - s/n 004 - FCC ID: CTZ-VG1100
- PC Zenith Z-Staton 425 Sh - mod.IKS-4427 100/250V 50/60Hz - FCC ID: IFO-ZDESK425 s/n:XVAPQHO1552
- Video unit Zenith model ZCM-1390 120/230V 50/60Hz – FCC ID: AT09M7CM1390 s/n: 822NB0032TOG
- Keyboard: Zenith model B-0110 - FCC ID: GJK101WN-5 - s/n: 163-0089-2T A4390
- Auxiliary printer (with parallel and serial ports): Memorex-Telex – FCC ID: CTZ-970 s/n: ZCS-R70-00357 120-240V 50/60 Hz
- Parallel (Centronics) IF cable: pn 158392-4 (IEEE 1284 compliant) - 3m shielded
- Serial (EIA 232) IF cable: Misco pn 2329 - 3m shielded
- AC Power cables: standard, non shielded

8.0 EUT (Printer Compuprint 9088) CONFIGURATION

Motherboard:	4VG960 (cod.78408394-001)
Oscillator frequencies:	31.3344 MHz
Clock frequencies:	15.6672 MHz
Bus / Control signal frequencies:	3.9168 MHz
Operator panel	GX2INT (cod.78404029-001)
Power Supply	Cod. 78202081; 100-240 V; 50-60 Hz
Switching frequencies:	65 kHz (Converter forward); 60 KHz (Converter boost)
Options installed	Rear tractor
EUT power	120 V - 60 Hz