

**EMI Test Report**  
**Compuprint MDP 40 C**

EUT level: Pre-production

Date: 4 November 1999

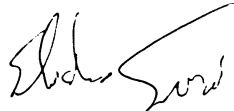
Report Nr.: RQ0475

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

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Approved by: Gianni Chiodo



Date(s) of Test: October 12 to November 3, 1999

Test performed by: Paolo Roncone

**REVISION RECORD**

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## **1.0 EQUIPMENT UNDER TEST (EUT)**

| <b>Make</b> | <b>Type/Model</b> | <b>Serial / Prototype Number</b> |
|-------------|-------------------|----------------------------------|
| Compuprint  | MDP40C            | ZCS-S45-00202                    |

### **Description**

400cps Dot Matrix Printer, 24 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 and with Canadian requirements, under Industry Canada Standard ICES-003.

## **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

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

3. 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 MDP40C 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 3 meters from the EUT - were compared with the respective class B limits specified in Part 15 of the FCC Rules (§15.107(a), §15.109(a)), in order to verify the EUT compliance with the FCC requirements.

**The subject EUT was found to meet the FCC class B limits, with a minimum margin of 5.0 dB for conducted EMI and a minimum margin of 4.0 dB for radiated EMI.**

**These results are deemed satisfactory evidence of compliance with the technical requirements under FCC Part 15 and with Industry Canada Interference-Causing Equipment Standard ICES-003.**

#### 4.1 Test Summary Table

| Ref. Standard | Class | Tests run     | Test notes     | Pass | Fail | Min. margin dB |
|---------------|-------|---------------|----------------|------|------|----------------|
| FCC Part 15   | B     | EMI Conducted | EUT power cord | X    |      | 5.0            |
| FCC Part 15   | B     | EMI radiated  | 3 m distance   | X    |      | 4.0            |

#### 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.  
RC and series R filters at the output of clock and fastest logic signals.  
Surface-mount ferrite beads on signal lines to operator panel cable.
- 2 Ferrite cores on AC power cable (on each end of the cable between the Power Supply metal box and the AC plug).
- Power Supply: Line filter (primary side) plus ferrite beads on terminals of 38V diode (secondary side).
- Conductive gaskets: on metal base frame of the printer, to provide a low impedance connection with the metal chassis.

## 5.0 TEST RESULTS

### 5.1 Conducted EMI

The final conducted emissions measurements were made while the MDP40C printer (EUT) was running via the parallel interface. Preliminary testing showed that the conducted emissions are not influenced by the type of interface running (parallel or serial).

#### Sample Calculations

The equations below show how the test results were obtained from the receiver's readings (and compared with the limit).

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

Limit level (dBμV) =  $20 \log_{10}[\text{Limit level } (\mu\text{V})]^1$

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 (EUT) power cord

| Freq.<br>[MHz] | LEVEL <sup>2</sup><br>[dBμV] |      | Line | FCC cl.<br>B LIMIT<br>[dBμV] | Margin <sup>3</sup><br>[dB] |
|----------------|------------------------------|------|------|------------------------------|-----------------------------|
|                | QP                           | AV   |      | QP                           |                             |
| 0.501          | 35.9                         |      | N    | 48                           | - 12.1                      |
| 19.41          | 41.7                         | 28.1 | N    | "                            | - 6.3                       |
| 19.46          | 41.9                         |      | N    | "                            | - 6.1                       |
| 19.51          | 42.3                         |      | N    | "                            | - 5.7                       |
| 20.09          | 43.0                         | 26.9 | N    | "                            | - 5.0                       |
| 20.25          | 42.3                         | 28.4 | N    | "                            | - 5.7                       |
| 20.30          | 42.5                         |      | N    | "                            | - 5.5                       |

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<sup>1</sup> Limit level in microvolts (μV) as specified in FCC Ch.I §15.107(a)

<sup>2</sup> QP = quasi-peak reading ; AV = average reading.

According to the FCC rules, in cases where the QP reading exceeds the limit, if the average reading is at least 6 dB below the QP reading, the QP level may be reduced by 13 dB for comparison to the limit, provided the other measurement conditions specified in the FCC rules are satisfied (§15.107(d)).

<sup>3</sup> Margin = Measured Level - Limit

### 5.1.2 Emissions on non-EUT power cords

| Freq.<br>[MHz] | LEVEL<br>[dBμV] |    | Lin <sup>a</sup> | FCC cl.<br>B LIMIT<br>[dBμV] | Margin<br>[dB] |
|----------------|-----------------|----|------------------|------------------------------|----------------|
|                | QP              | AV |                  | QP                           |                |
| 0.5082         | 37.6            |    | L                | 48                           | - 10.4         |
| 9.875          | 39.4            |    | L                | "                            | - 8.6          |
| 10.38          | 39.5            |    | L                | "                            | - 8.5          |
| 10.90          | 39.7            |    | L                | "                            | - 8.3          |
| 11.14          | 39.7            |    | L                | "                            | - 8.3          |
| 19.99          | 40.1            |    | L                | "                            | - 7.9          |
| 20.932         | 39.7            |    | L                | "                            | - 8.3          |
| 20.872         | 38.9            |    | L                | "                            | - 9.1          |

# SIRIO MDP40C - CONDUCTED EMI - Peak scan

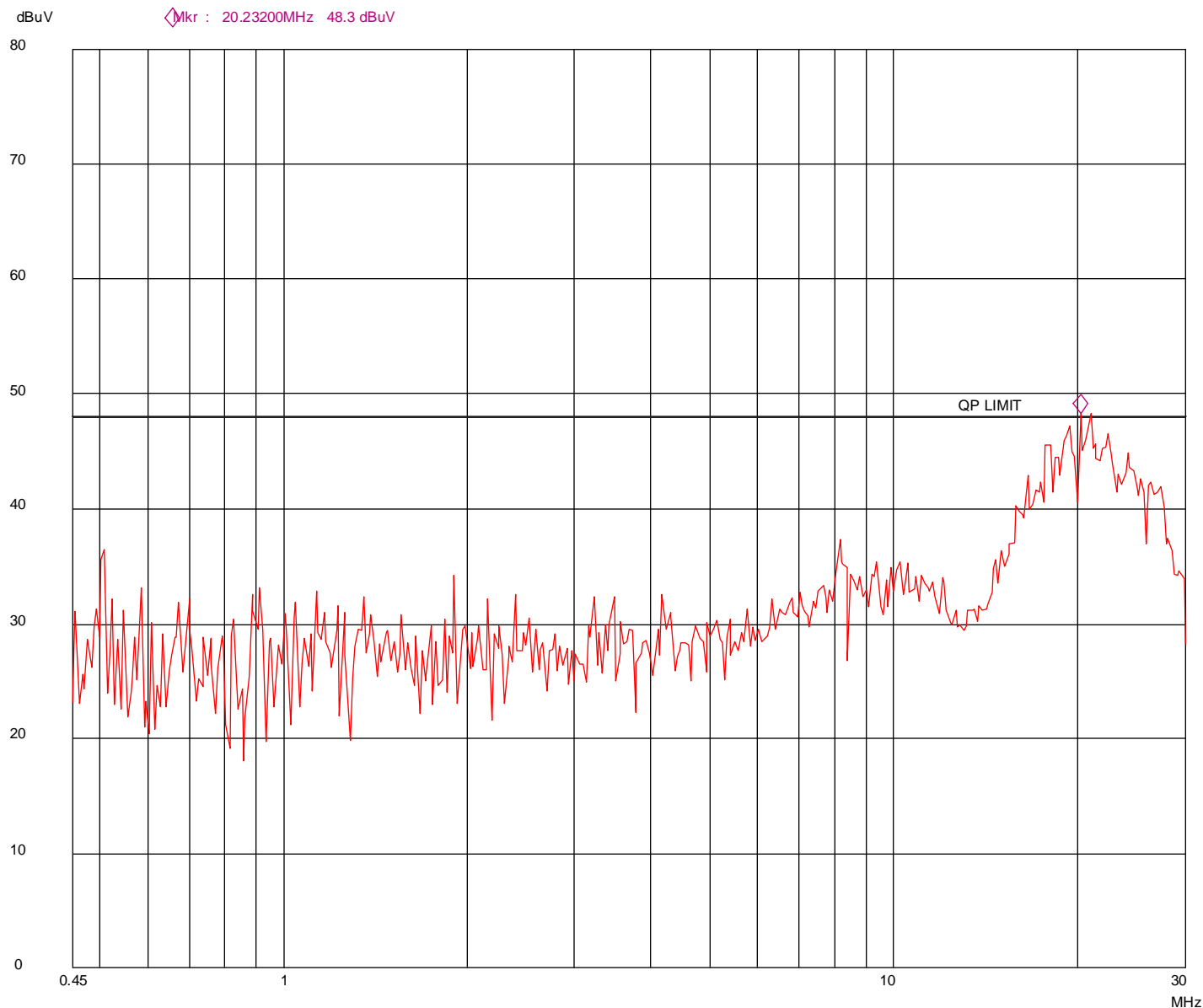
03. Nov 99 12:39

Operator: Paolo Roncone  
 Comment: EUT snZCS-S45-00202 PS SPS035L(120V) sn3  
 Main FET (Q1) pn 2SK2601 - EUT POWER CORD

LISN Schwarzbeck - HOST PC Sh425  
 Print H via par IF - Par + ser cables attached  
 Max-hold Line + Neutral - EUT cable bundled 1.5m - fin.setup

## Overview Scan Settings (1 Range)

| Frequencies |      |      | Receiver Settings |          |        |        |        |       |
|-------------|------|------|-------------------|----------|--------|--------|--------|-------|
| Start       | Stop | Step | IF BW             | Detector | M-Time | Atten  | Preamp | OpRge |
| 450k        | 30M  | 3k   | 9k                | PK       | 0.05ms | 10dBLN | ON     | 60dB  |



# SIRIO MDP40C - CONDUCTED EMI - Peak scan

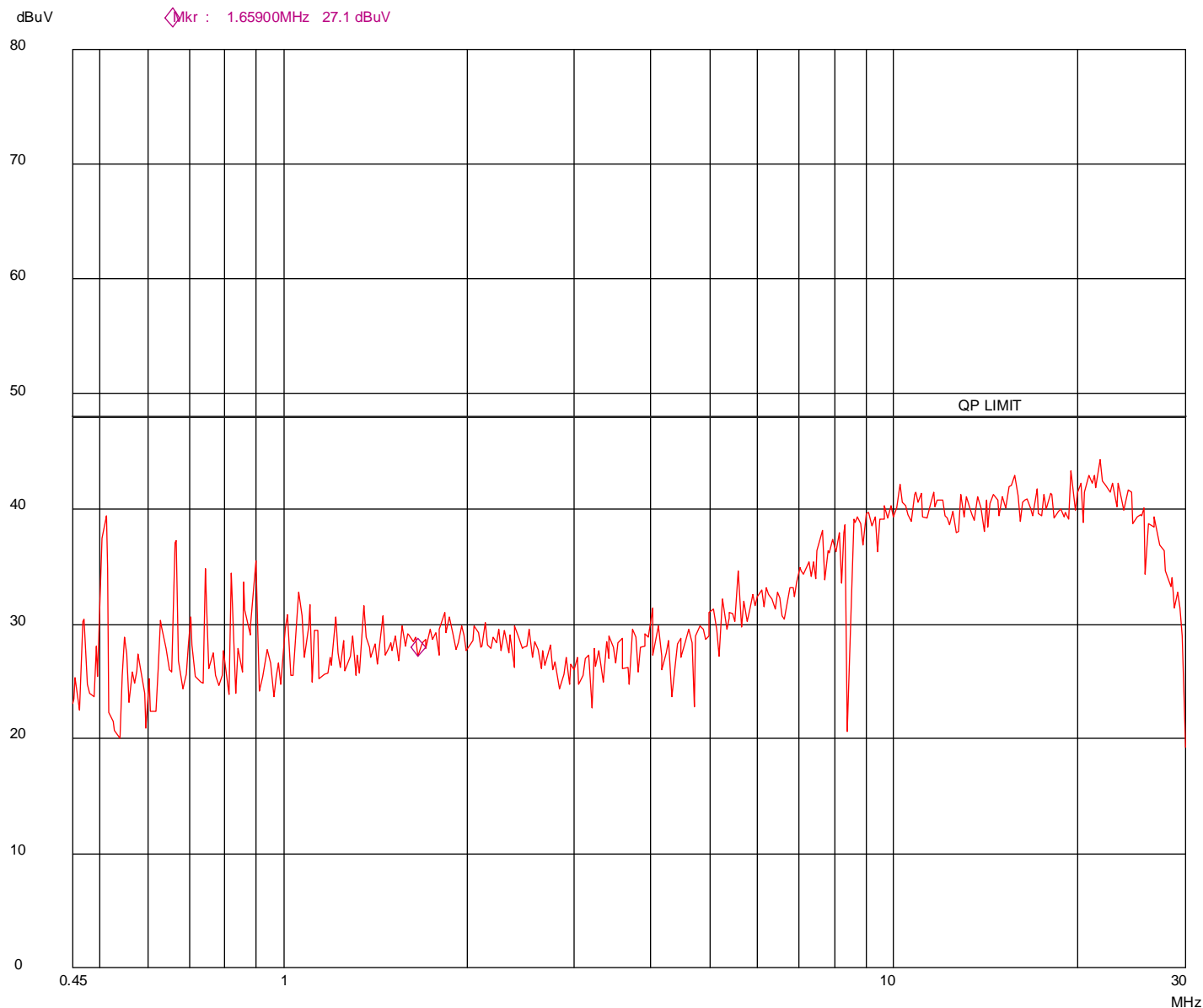
03. Nov 99 12:45

Operator: Paolo Roncone  
 Comment: EUT snZCS-S45-00202 PS SPS035L(120V) sn3  
 Main FET (Q1) pn 2SK2601 - non-EUT POWER CORDS

LISN R&S - HOST PC Sh425  
 Print H via par IF - Par + ser cables attached  
 Max-hold Line + Neutral - PC cable unbundled 2m - fin.setup

## Overview Scan Settings (1 Range)

| Frequencies |      |      |       | Receiver Settings |        |        |        |       |
|-------------|------|------|-------|-------------------|--------|--------|--------|-------|
| Start       | Stop | Step | IF BW | Detector          | M-Time | Atten  | Preamp | OpRge |
| 450k        | 30M  | 3k   | 9k    | PK                | 0.05ms | 10dBLN | ON     | 60dB  |





## 5.2 Radiated EMI

Measurement distance: 3 meters

### Sample Calculations

The equations below show how the test results were obtained from the receiver's readings (and compared with the limit).

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

Limit level (dBμV/m) =  $20 \log_{10}[\text{Limit level } (\mu\text{V/m})]$  <sup>(4)</sup>

NOTE 1: At each frequency, the highest of the levels recorded in vertical and horizontal polarization of the receiving antenna is reported. Each level was maximized (vs. EUT azimuth and antenna height).

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.

| Freq. [MHz] | E-field LEVEL [dBμV/m] |      | Polarization<br>V / H | FCC class B LIMIT [dBμV/m] | Margin [dB] |           |
|-------------|------------------------|------|-----------------------|----------------------------|-------------|-----------|
|             | 1                      | 2    |                       |                            | 1           | 2         |
| 40.7        | 33.4                   | 33.3 | V                     | 40                         | -<br>6.6    | -<br>6.7  |
| 47.0        | 32.5                   | 32.3 | V                     | "                          | -<br>7.5    | -<br>7.7  |
| 50.92       | 30.8                   | 33.5 | V                     | "                          | -<br>9.2    | -<br>6.5  |
| 58.1        | 36.0                   | 35.0 | V / H                 | "                          | -<br>4.0    | -<br>5.0  |
| 73.0        | 30.6                   | 30.3 | V                     | "                          | -<br>9.4    | -<br>9.7  |
| 82.25       | 30.1                   | 28.7 | V                     | "                          | -<br>9.9    | -<br>11.3 |
| 111.5       | 28.0                   | 27.1 | V                     | 43.5                       | -<br>15.5   | -<br>16.4 |
| 125.34      | 27.7                   | 26.3 | V                     | "                          | -<br>15.8   | -<br>17.2 |
| 134.3       | 26.9                   | 26.8 | H                     | "                          | -<br>16.6   | -<br>16.7 |
| 152.75      | 30.2                   | 29.6 | H                     | "                          | -<br>13.3   | -<br>13.9 |
| 220.6       | 35.9                   | 34.9 | H                     | 46                         | -<br>10.1   | -<br>11.1 |
| 223.26      | 34.3                   | 33.7 | H                     | "                          | -<br>11.7   | -<br>12.3 |

1 = parallel interface running

2 = serial interface running

<sup>(4)</sup> Limit levels in microvolts/meter (μV/m) as specified in FCC Ch.I §15.109(a)

## 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 3/10 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 (MDP40C 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, 80 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.

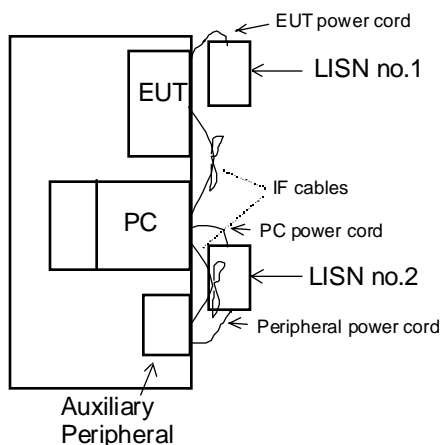
The emissions on the other power cords were measured using the second LISN.

For *radiated EMI*, the system under test was rotated 360 deg. and the receiving antenna scanned from 1 to 4 meters in height, with vertical and horizontal polarization.

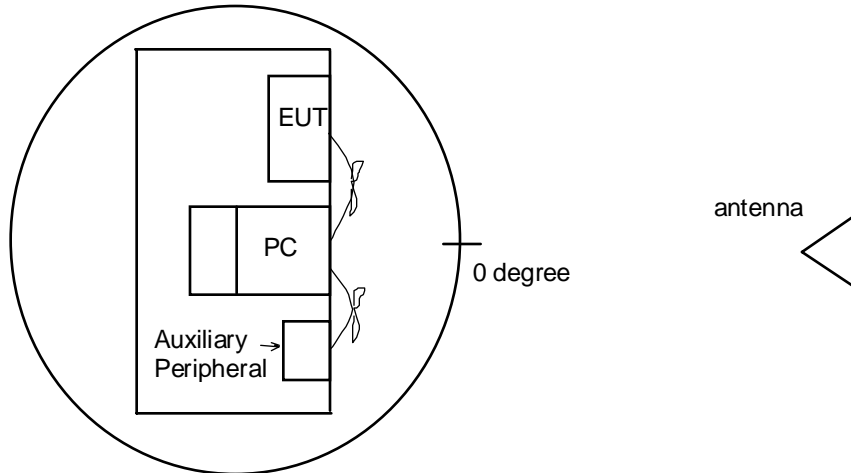
The EUT set-up and orientation was such that the rear of the system was facing the receiving antenna at the zero degree angle of rotation (see sketch below).

The radiated test distance of 3 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

*Receivers:* Rohde & Schwarz ESN 1027.3007.30 (s/n 842789/008): 10 kHz - 1000 MHz (peak scan)

Rohde & Schwarz ESH3 (s/n 879599/043): 9 kHz - 30 MHz (quasi-peak measurements)

*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 MDP40C (Equipment Under Test) – s/n ZCS-S45-00202 - FCC ID: CTZ-MDP40
- PC Zenith Z-Station 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 CONFIGURATION

**EUT:** Compuprint MDP40C - s/n: ZCS-S45-00202

**Motherboard:** 2SIRIO (cod.78407904-001)  
Oscillator frequencies: 31.3344 MHz  
Clock frequencies: 15.6672 MHz  
Bus / Control signal frequencies: 3.9168 MHz  
**Operator panel** 401POS (cod.78202062-002)

**Power Supply** Mod. SPS035L s/n 003  
Switching frequency: 65 kHz

**Ferrite cores** Two ferrite cores on each end of AC power cable from P.S. card to power inlet

**EUT power** 120V - 60 Hz