CONTROL AND MONITORISING THE SUPPLY OF IT EQUIPMENT

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ABSTRACT
This paper provides customers with technical information needed to prepare their sites for installation and operation of hardware equipment. The customer is responsible for preparing a suitable environment for the installation and operation of the complete computer system.

INTRODUCTION
Proper site preparation and maintenance is vital to the reliability of any computer system. It is the customer's responsibility to ensure that the proper facility resources and conditions are maintained. The building electrical source should supply enough energy for the computer and any additional equipment you may purchase. The computer system should have its own dedicated power source. Provide a power distribution panel dedicated to the computer system and associated hardware. Provide isolated ground bus in this panel.

Electromagnetic compatibility requirements asked by equipment manufacturers for equipments with electronic switching power supply (P.C.; Converters; PLC) need a special design of earth potential. Practically, earth connections (electronic ground) are made based on specific algorithms and measurements. Harmonic components from power supply network can disturb each other and generate disturbing harmonics for the other equipments connected to network. Electromagnetic compatibility will be a problem in the future if the power supply network of the customers doesn't have the proper protections against this phenomenology. As a reference we made electronic earth in the following-designs: SUPPLY for SERVERS office of FDFEE Galati/ Brasov/ Craiova and Ploiesti - four cities of Romania.

The IT equipment is the product of:
- Server from IBM, (e.g: Rack Pseries R670 6,7 KVA, Pseries R570 2,8 KVA;)  
- UPS from Powervare and APC (Powervare 9305 15kVA; UPS Powervare 9305 20kVA; APC Smart UPS 5 and10 kVA;)

For control a Multifunctional Power Monitor with System Analysis was installed. Also this monitor help us supervise the proper functionality of the installation.

Multifunctional Power Monitor with System Analysis
- Features:
  - System and load analysis by measurement of harmonics, THD, asymmetry, comprehensive average and max/min values.
  - Accurate measured :U,I:0,2P,Q,S,PF, meter:0,5% F:0,02 Hz
  - 4-quadrant measurement of all values in AC system;
  - Clip-on extension module with average value and load profile recording rs-232/485 interface, modbus, synchronizing impute general format.

STUDY
The IT equipment producer demands that the site is properly prepared.

Example: In one site, three rooms were required for the IT equipment, so that the safety norms (electrical, fire-alarms and security) were satisfied.

Protective earth
As input data, in the case study for protective earth:
- there is a TN-C system (the use a combined protective earth and neutral –PEN conductor) of buildings;
- the designing installation should always be TN-S system, in our case TN-C-S.

note*: If the system is switched to TN-S or TN-C-S you should not switch back to TN-C(according to international standards IEC 50160 ).
Earthing system – Calculation and design.

A good earthing system is required for:
- protection of equipment and installation;
- EMC (electromagnetic compatibility);
- the power supply for IT and devices is properly installed

The design of the ground installation is according to Romanian standards and international standards e.g.:
P118-1992; NTE 007 -2008; STAS 12604; STAS 12604/5 ; SR EN 60.439.1; C 56.
- IEC 364-5-54:1980 Electrical installation of buildings; Power Quality & utilization Guide-
designing low voltage supply system for electromagnetic compatibility; Increasing protection by improved earthing; Power Quality-Guide for electrical design engineers.

The IT supplier’s requirements:
- less 1 volt from the receptacle case to any grounded metal structure in the building, such as a raised–floor metal structure, water pipe, building steel or similar structure;
- less 1 volt from the receptacle pin to a grounded point in the building;
- The resistance from the ground pin to building ground should be less 1.0 ohm, which indicates the presence of continuous grounding conductor.

The earthing resistance of a simple vertical electrode placed in the soil can be calculated with the following formula:

$$r_{pv} = 0.366 \frac{\rho}{l} \left(2 \frac{l}{d} + \frac{1}{2} \frac{4t + l}{4t - l}\right)$$

$$r_{pv} = \text{the resistance of a vertical earthing electrode}$$

$$l = \text{electrode length} = 3 \text{ m}$$

$$r = \text{distance from the earth electrode} = 0.8 \text{ m}$$

$$t = \text{distance from ground level to half of the electrode.}$$

$$t = \frac{l}{2} + r$$

$$\rho = \text{earth resistivity} = 100 \ \Omega \cdot \text{m}$$

$$d = \text{the effective equivalent diameter} 2 \frac{1}{2} \text{ is} \approx 0.06 \text{ mm}$$

The all resistance of a vertical earthing electrodes are:

$$R_{pv} = \frac{r_{pv}}{n \cdot \eta_v}$$

$$n = \text{number of electrodes;}$$

$$\eta_v = \text{filling factor for vertical electrodes}$$

The earthing resistance of a simple horizontal electrode placed in the soil can be calculated with the following formula:

$$r_{po} = 0.366 \frac{\rho}{l} \cdot \frac{l^2}{q \cdot B}$$

$$l = \text{electrode length}$$

$$t = \text{distance from the earth to electrode}$$

$$\rho = \text{earth resistivity} = 100 \ \Omega \cdot \text{m}$$

The all resistance of a horizontal earthing electrodes are:

$$R_{po} = \frac{r_{po}}{\eta \cdot \eta_0}$$

$$n = \text{number of electrodes;}$$

$$\eta_v = \text{filling factor for horizontal electrodes}$$

The all earthing resistance

$$R_{pa} = \frac{R_{pv} \cdot R_{po}}{R_{pv} + R_0}$$

Dissipation resistance:

$$R_{pd} = 0.56 \frac{\rho}{\sqrt{S}}$$

$$S = \text{dissipation area}$$

The equivalent resistance is:

$$R_p = \frac{R_{pa} \times R_{pd}}{R_{pa} + R_{pd}} < 1 \ \text{ohm.}$$

Power and Electrical Requirements

For the proper functioning of the IT equipment, according to the requirements imposed by the supplier and the international standards, the following measures will be taken:

a) Redesigning the architectural components of the rooms in which the servers are kept
b) Assuring an adequate power supply for the servers, the afferent utilities and the existing equipment
c) Combining the electrical wiring with the ones of the
- cooling
- fire protection
- room and building security

The server’s power supply will be made through a distribution panel, specially designed for the servers and the present equipment.

**Embedded objects 2**

![Fig.2 Panel distribution - The power supply of IT equipment.](image2.png)

The afferent equipment’s power supply will be made through a panel situated in the server room.

**Embedded objects 3**

![Fig.3 Power supply for all installation](image3.png)

The server pSeries 670 (IBM production) is designed with a fully redundant power system. Each system has two line cords attached to two power input ports which, in turn, power a fully redundant power distribution system within the system.

**Table 1**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>IEC recommendation</th>
<th>Minimum sampling</th>
<th>Observation period</th>
<th>Acceptance percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>49.5 Hz à 50.5 Hz</td>
<td>10 s</td>
<td>1 week</td>
<td>95%</td>
</tr>
<tr>
<td>Frequency</td>
<td>47 Hz à 52 Hz</td>
<td></td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

**Embedded objects 4**

![Fig.4 Power supply for server pseries 670](image4.png)

There is the dual system A/C power cords. For maximum availability, each line cord should be fed from independent power grids.

To take full advantage of redundancy/reliability that is built into the computer system, the system must be powered from two distribution panels. The possible power installation configurations are described as follows—fig. 3.

**Control and monitoring**

Each panel of equipment has incorporated a Multifunctional Power Monitor with System Analysis.

Spectral components are of frequency between 49.91 Hz and 50.06 Hz.

The voltage spectral components frequency variations recommended by IEC Power Quality are presented in table 1 accompanied by the acceptance percentage of the obtained values.

![Fig.5. Voltage spectrum for frequency](image5.png)
The variations of the voltage spectral of power supply are according to the IEC recommendations and are presented in Table 2 and fig.6.

### Table 2

<table>
<thead>
<tr>
<th>Parameter</th>
<th>IEC recommendation</th>
<th>Minimum sampling</th>
<th>Observation period</th>
<th>Acceptance percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>400 V ± 10%</td>
<td>10 min</td>
<td>1 week</td>
<td>100%</td>
</tr>
</tbody>
</table>

![Fig. 6 The line voltage spectrum $U_{rms}$](image)

**Total harmonic distortion $U_{thd}$**

The total harmonic distortion variations are within IEC Power Quality accepted values as presented in table 3 and fig.7.

### Table 3

<table>
<thead>
<tr>
<th>Parameter</th>
<th>IEC recommendation</th>
<th>Minimum sampling</th>
<th>Observation period</th>
<th>Acceptance percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonic voltage</td>
<td>8% « total harmonic distortion » (THD)</td>
<td>10 min</td>
<td>1 week</td>
<td>95%</td>
</tr>
</tbody>
</table>

![Fig. 7 Total harmonic distortion $U_{thd}$](image)

**CONCLUSIONS**

The solution is according to the IEC recommendations.

**REFERENCES**

Book citation:

Book citation:

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Paper citation: