

The good earth

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Most people realise that electrical systems, and all the metalwork in close proximity to them must be earthed. This is for safety reasons and mainly to prevent dangerous voltages appearing on metal surfaces that humans might be in contact with. If a person does touch a live contact then the current will flow to earth through that person, with potentially fatal consequences. If all metalwork is earthed then any fault voltage appearing on from faulty cabling will immediately cause a fault current to flow to earth of such magnitude that it will blow the circuit breakers.

A common problem in computer rooms occurs when people buy equipment racks, plug them into the mains and data cabling, but do not supply a dedicated earth connection. Usually, by virtue of connecting the rack to the mains via a plug and socket there will be an earth connection via the earth pin of the connector. However this is not acceptable according the Standards as it represents a temporary connection rather than a permanent one.

SI 1989 No 635 'The Electricity at Work Regulations' requires at:

Regulation 8 'Precautions shall be taken, either by earthing or by other suitable means, to prevent danger arising when any conductor (other than a circuit conductor) which may reasonably foreseeable become charged as a result of either the use of a system, or a fault in a system, become so charged',

Regulation 9 'If a circuit conductor is connected to earth or to any other reference point, nothing which might reasonably be expected to give rise to danger by breaking the electrical continuity or introducing high impedance shall be placed in that conductor unless suitable precautions are taken to prevent that danger'.

A 4 mm² (or larger) conductor must be used to supply the earth connection to the racks. Each rack must have its own dedicated connection back to the main earth terminal i.e. racks must not be daisy-chained. The frame, sides and door of the rack must all be electrically connected.

Earthing for safety and fault currents is one thing but what about high frequency noise picked up by all the dozens or hundreds of power supplies attached to all the servers and switches. All of these power supplies are trying to dump this noise this noise to earth before it reaches the dc supply side of the power supply unit.

The problem is that what is a good earth at mains 50 Hz may represent a 300 ohms or more impedance to high frequency noise and hence it won't effectively flow to earth.

In computer rooms we are used to seeing large copper bus bars attached to the wall which act as the main earthing point for the room. But what exactly are they called? I've seen clean earth, technical earth, telecommunications earth, functional earth, main earth terminal, ground window bar, telecommunications ground busbar and telecommunications main ground busbar recently quoted. My preference is for the American TGB, Telecommunication Ground Busbar, which in turns links to the TMGB at the main cable entrance to the building.

We need to achieve equipotential bonding across all the frequencies of interest in order to shunt high frequency interference to earth. A simple green/yellow wire isn't good enough. Equipotential bonding is more than just earthing. The impedance to earth is so low (across all the frequencies of

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interest) that no substantial voltage can exist from one end to another. Substantial is usually taken to mean less than one volt RMS (Root Mean Square- similar to an 'average').

The most popular method of achieving this in computer rooms is a grid of copper tape laid out on the floor of the computer room. This is called a Signal Reference Grid, SRG. It is more fully explained in *IEEE 1100 Recommended Practice for Powering and Grounding Electronic Equipment*. The SRG does provide the required low impedance at high frequencies although the closer the grid spacing the higher the frequencies it can cope with. It also acts, to some extent, as a Faraday cage, in providing an EMC screen to keep unwanted signals out.

The smaller grid spacing relates to the signal wavelength and so a smaller grid corresponds to a higher frequency. A common SRG grid is 2 foot by 2 foot or 600 mm x 600 mm thus corresponding to the floor tile and pedestal pattern it sits under; but this gives limited protection of a few tens of megahertz and would not be good enough for radar type signals in the gigahertz range (just look at the sizing of the 'SRG' in the door of your microwave oven!).

I cannot find any Standard that mandates the use of the SRG. Our own European EN 50310 *Application of equipotential bonding and earthing in buildings with information technology equipment* makes it an "...ideal goal.."

"...system reference potential plane (SRPP) conductive solid plane, as an ideal goal in potential equalising, is approached in practice by horizontal or vertical meshes. The mesh width thereof is adapted to the frequency range to be considered. Horizontal and vertical meshes may be interconnected to form a grid structure approximating to a Faraday cage."

All of the computer companies, in their installation guides and best practices statements for computer rooms, state that at the very least it is highly recommended.

If you've got screen jitter, data errors, unexplained log-offs, slow data transfers etc., think about the state of your IT earthing system.

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