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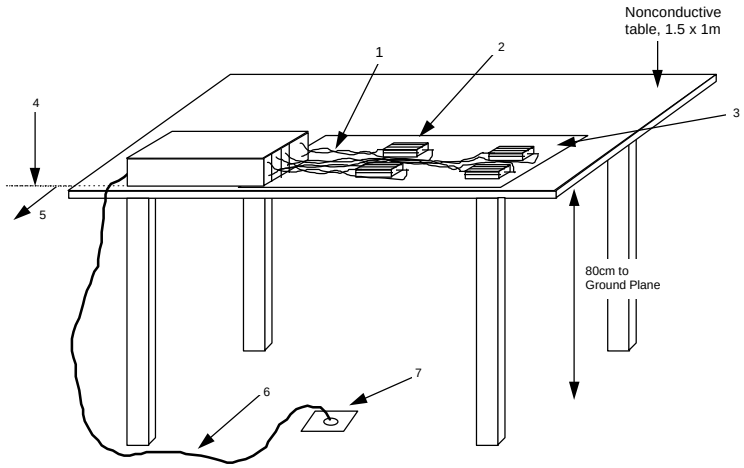
Application Note Number 8

Product: **MVP Range**
Application Overview: **Installation of MVP power supplies for optimum radiated EMC performance**

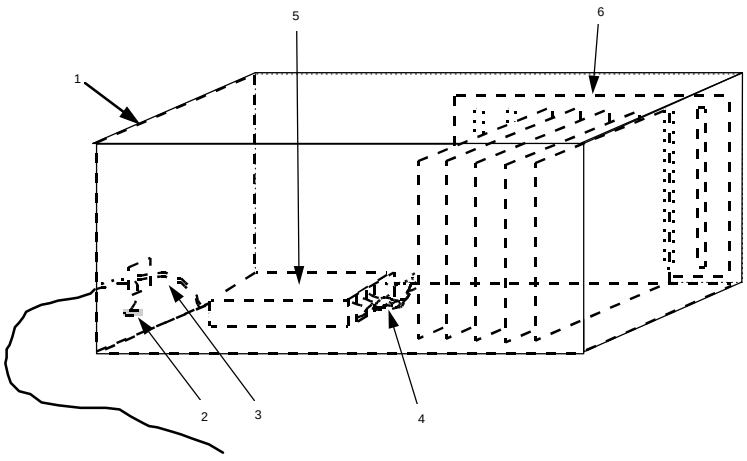
Originator: B. Lewis Location: Stourbridge, UK Date: 14/10/97

Schematic



1. Interconnecting cables between output and load are twisted together for each output and then all output interconnections bundled together forming a bundle 1m long.
2. Resistive load elements mounted on an electrically conductive plate.
3. The load plate is electrically bonded to the PSU chassis.
4. The rear of all components of the system under test shall be located flush with the rear of the table.
5. No vertical conducting wall used.
6. Power cords drape to the floor and are routed over to receptacle.
7. If LISNs are kept in the test set-up for radiated emissions, it is preferred that they be installed under the ground plane with the receptacle flush with the ground plane.

Fig. 1. Perspective view of radiated emissions test set-up for MVP. Reference has been made to ANSI C63.4-1992



1. Increased attenuation of the radiated emissions can be achieved by careful design of the apparatus enclosure.
2. Apparatus enclosure securely bonded to supply earth connection.
3. Mains supply wiring routed as far away as possible from PSU load wiring and active electronic circuitry.
4. PSU load wiring twisted together for each output and all output wiring bundled together as far as possible between the PSU and the load equipment.
5. Case of the PSU securely bonded to the apparatus enclosure. This can be achieved via the PSU mounting fixings.
6. Power supply tracking on backplanes and other equipment printed circuit boards form current loops with minimum length and enclosed area. Local capacitive supply decoupling used on boards incorporating high frequency circuits.

Fig. 2. Example installation of MVP PSU illustrating recommendations for optimisation of radiated EMC.

Description

Great care has been taken during the design of the MVP range to ensure that the EMC performance is of the highest standard. This is illustrated by the fact that line conducted emissions are well below the Curve B limits of EN55022 as shown in Fig. 3. Furthermore, tests of the MVP in isolation have yielded excellent radiated emission results as shown in Fig.4.

In terms of the radiated emissions, it must be borne in mind that whilst the MVP range is constructed in an electrically conductive chassis, it is, in effect, an open frame Power Supply Unit. The Installation and Operating instructions which are supplied with every MVP model state that the MVP "...is intended for use as a component part of other equipment." This is partly related to safety requirements but also in recognition of the fact that the radiated emissions from the power supply system will be substantially dependant on the nature of the installation. For example, the orientation of the supply and load wiring can have a substantial impact on the emissions.

The principles of good EMC design are illustrated in Fig 2 and can be summarised as follows:

1. Build in good EMC from the outset and eliminate poor EMC at source.

The principles of good EMC have been incorporated in the MVP design, as can be seen from the results presented in this application note. Using a PSU which performs well in it's own right, such as Astec's MVP range, will greatly reduce the challenges to be met in achieving good system EMC.

2. Take care with grounding and earthing.

It is important to take care with the earthing of system elements to avoid setting up high frequency current loops which will, in turn, cause emissions from the system.

3. Minimise length and area of high frequency current loops.

In addition to the possibility of earth loops, it must be recognised that the load connections from the PSU are, in effect, high frequency current loops. Keeping these connections short and tightly coupled will minimise the radiating effect of these loops and also minimise the coupling effect highlighted in point 4.

4. Minimise coupling of HF circuits to potential external radiators.

For example, the mains input wiring can be viewed as an antenna. Any HF signals coupled to it within the apparatus enclosure will be radiated outside the apparatus enclosure. Good practice, therefore, would be to keep the mains input wiring physically isolated from any circuits carrying high frequency signals, including load connections from the PSU. Where this is not possible, screening of the mains input wiring will have a substantially beneficial effect on minimising the pick-up. This principle will equally apply to any signal connection intended to pass beyond the apparatus enclosure boundary.

5. Don't allow EMI out.

Any residual radiated emissions can be restricted to the apparatus by careful design of the enclosure. A well earthed, conductive enclosure can give orders of magnitude attenuation of radiated emissions. It must be borne in mind, however, that any slots or gaps in the enclosure will allow transmission of radiation at wavelengths below 4 times their length. This means that any such gaps greater than about 75mm in length will be transparent to radiated emissions within the band specified in EN55022.

Further containment of emissions can be achieved by adding capacitive decoupling across any wiring at the boundary of the apparatus. This technique can be used to overcome the effects of pick-up as described in point 4 above and specialised, "feedthrough" capacitors are available for this very purpose. Similar benefits can also be achieved by using ferrite clamps or similar specialised suppression devices.

Care must be taken, however, when using EMI filters for mains filtering at the apparatus boundary. Inappropriate selection of such filter elements can cause more problems than they solve, since circuit resonance can be set up between the external filter and the EMI filter built into the PSU for conducted emission suppression. these resonance can lead to the appearance of unexpected "peaks" in the apparatus emissions spectra.

There is no doubt that in order to minimise the impact of achieving good EMC, the installation, construction and wiring of the PSU and the equipment to be powered must be considered from the outset. Too often, the EMC performance of an apparatus is compromised because of insufficient care during the early stages of the system design. By taking care and following good EMC design principles from the start, optimum radiated EMC performance can be achieved with little cost penalty in terms of additional time and expense required to "fix" the EMC once the system functional design is complete.

Schematic

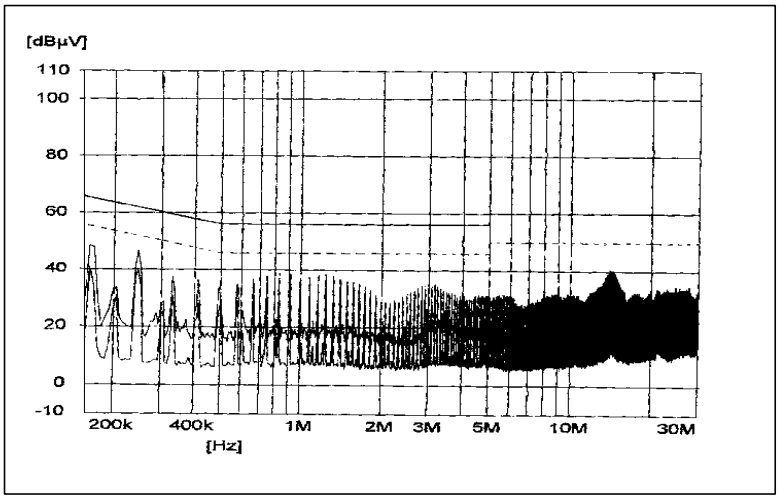


Fig. 3. Plot of MVP Conducted Emissions showing Curve B limits of EN55022

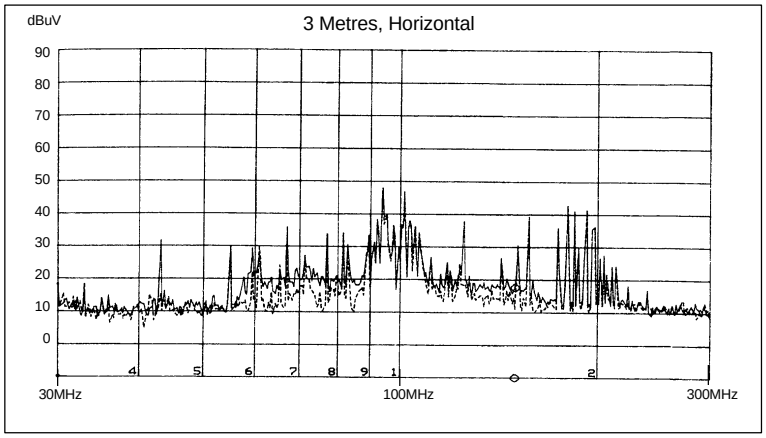


Fig. 4a Horizontal polarisation

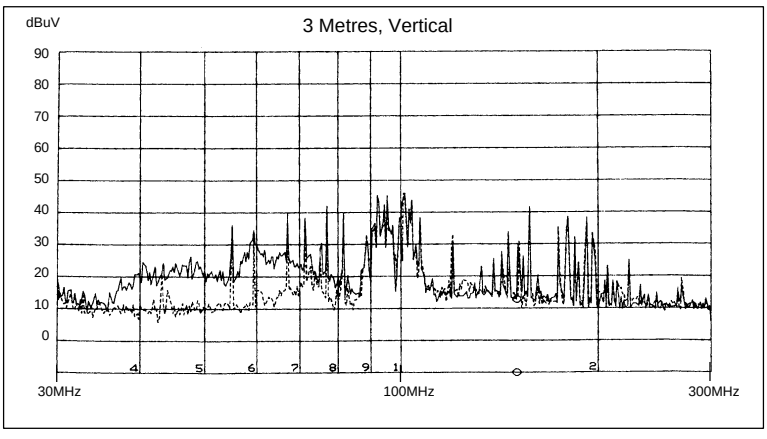


Fig. 4b Vertical polarisation

Fig. 4. Plot of MVP Radiated Emissions tested using set-up of Fig. 1
N.B. The dotted curves in the above plots represent background emissions detected at the open field test site.