EMI Protection of a Stand-alone Information Technology Terminal

K.A.W. HOBBINS
TEMPEST Solutions Ltd.

INTRODUCTION

Requirements for acceptable levels of emissions and immunity which equipment must satisfy are continuing to become more specific and stringent. Little attention has been given to the emissions from, and perhaps the immunity of, equipment and systems which are already fitted, and whose electromagnetic interference (EMI) output is probably increasing as they age. These systems and equipment may be too expensive to be replaced, and companies must accept these less-than-ideal conditions when they introduce new equipment, most of which is required for information technology purposes.

The development of information technology equipment which can operate and survive in all the current and future world-wide electromagnetic environments is expensive in both cost and time. Thought must inevitably be given to protecting "off-the-shelf" equipment, so that it can be used more readily wherever it can be marketed, no matter what effect co-located equipment, systems and ambients may have.

CURRENT METHODS OF ELECTROMAGNETIC PROTECTION

There are three practical forms of shielding or screening hardware which can be used against the radiated aspects of the electromagnetic hazards of RFI, EMI, EMP and TEMPEST. These are: the drawer, the cabinet, and the room or enclosure. The screened drawer is a very special method of electromagnetic protection, used when the equipment to be screened is a very small part of a much larger system, and is perhaps remote from it. The drawer has a number of disadvantages, not least of which is the difficulty of confirming its screening effectiveness using common test methods and techniques. It can also be quite expensive if a small number is required and development costs cannot be distributed equitably. Nevertheless, it has its place, and if the equipment to be protected is used as the source, or as the sensor, tests can be derived which will provide a good indication of the drawer's screening effectiveness. Values greater than 80 dB over the frequency range 100 kHz to 1 GHz should generally be achievable.

A small screened room will probably satisfy emissions and immunity requirements more fully than any other enclosure.

The cabinet is the most widely used method of protecting equipment against electromagnetic hazards, probably because it is a traditional, simple method of combining items of electronic equipment, and marrying them into an easily handled package. Further, because of the quantities involved, the cabinet can be readily and cost-effectively manufactured, and it can be made aesthetically pleasing. Difficulties arise in maintaining the shielding when equipment has to be accessed and the door has to be opened. It can also be expensive when the number required is quite small. However, it has generally become the norm when considering the electromagnetic protection of electronic equipment.

There are, of course, "variations on a theme," and a very wide range of cabinets, giving varying degrees of protection, are available commercially. The RFI or EMI cabinet is usually of modular construction, consisting of extruded aluminum uprights and cross members with gasketed and bolted steel panels forming the sides, top and bottom. A steel panel is also used as a door, suitably gasketed, hinged and generally having a fairly positive latching mechanism, which maintains the screen around the door periphery. Gaskets are usually of the knitted mesh variety. These cabinets are very useful when modest values (60 to 80 dB) of screening effectiveness are required over a limited frequency range (<500 MHz).

Most manufacturers also produce a high performance cabinet, one with a high level of screening effectiveness. Such a cabinet may be referred to as an EMP cabinet or even a TEMPEST cabinet. It is more often an all-welded construction, with knife edge/labyrinthine doorways, fingerstock contacts, and an effective door latching mechanism. Testing the screening effectiveness can be somewhat difficult because of resonances and reflections caused by the cabinet size. For low frequency shielding, always required when the equipment must operate in an EMP environment, the cabinet is usually of steel, and measured values of screening effectiveness greater than 100 dB over the frequency range 100 kHz to >1 GHz are quite usual. This type of cabinet can be expensive to procure in small quantities, and the cost is normally dependent on size.

The screened room can also be of a modular or of an all-welded construction, the choice being determined by the degree of shielding required. The modular screened enclosure can be made of plywood/chipboard/plastic foam panels faced on either side by a thin sheet of galvanized steel, (0.024" or 0.6 mm), or it can be plain galvanized steel panels formed into box sections. The standard panel size is normally 8' by 4' (2.44 m by 1.22 m) or 10' by 4' (3.05 m by 1.22 m). For the steel-covered plywood construction, the panels are fitted together by folded steel girders, clamping adjacent panels at their edge. The folded box sections are bolted together directly with gasketting placed between the panels.

The door of the modular screened enclosure is the most sophisticated item, and it is manufactured so that door and doorway is the same size as a standard panel. Thus it can be placed anywhere in any of the screened room walls.

The all-welded screened room is usually quite special, and invariably procured when a very high shielding level is required at low frequencies in the magnetic field.

Testing of the screening effectiveness of a screened room is fairly straightforward using test methods based on those detailed in MIL-STD-285. A screening effectiveness of 80 to 100 dB at frequencies up to 10 GHz can usually be achieved with the modular screened room.

PROTECTION FOR A COMPUTER TERMINAL

A typical electromagnetic protection requirement is often identified when stand-alone computer terminals need to operate in a hostile electromagnetic protection task.

The computer terminal normally consists of a microprocessor into which is inserted the controlling software, a video display unit (VDU) which can be separate from the microprocessor, and a keyboard. It may also include some external signal connection to another terminal(s), and perhaps a signal interface. The most important point to recognize is that all three units that make up the terminal have to be accessed, either for some manual operation, or so that part of the unit can be seen. This situation will probably be true for most items of electronic information technology equipment.

If a shielded cabinet or drawer is chosen as the method of providing the electromagnetic protection, the following arrangements must be provided:

- gasketed flaps in the screening boundary to allow software to be inserted
- shielded windows, suitably gasketed and bonded to the screening boundary, to enable the VDU screen to be seen
- a "hardened" keyboard, with all connecting links filtered, or alternatively, consisting of fiber-optic connections.

Failure to provide these features means that whenever the actions of inserting software, observing the VDU, or operating the keyboard are carried out, the screened boundary will be breached and the screening effectiveness of the shield will be impaired. Provision of these arrangements, however, will also reduce the effectiveness of the shield or screen, such that the gasketed flap, the screened window and/or the entry/exit point of the interconnecting links, will determine the overall shielding attenuation characteristics of the protection mechanism.

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If the terminal is to be used in a TEMPEST environment, then the terminal cannot be fully operational and protected when these activities are carried out.

A COST-EFFECTIVE SOLUTION

Points which need to be addressed when considering the electromagnetic protection requirements are:

- space availablility
- power supply requirements
- heat to be dissipated
- accessibility

- signal interfacing
- size and weight of equipment
- attenuation requirements
- the shelf life of the equipment or system being protected
- cost

The quantity of heat to be dissipated will determine whether a fan is necessary. Attenuvents or the well-known matrice of waveguides-beyond-cut-off, allowing circulating air into and out of the screened enclosure, will be required, regardless of the form the electromagnetic protection takes. Mains filtering will also be necessary.

A small screened room of minimum dimensions, 4'x4'x8' high, fitted out with a small desk to accommodate the computer terminal used in the example, will probably satisfy the requirement more fully than any of the other methods of electromagnetic protection. Attenuvents near the roof and close to the floor can be fitted, as with a cabinet. The amount of heat generated by the terminal equipment will be slight, but when added to the equivalent amount of heat produced by the operator (350 watts approx.), a fan may be necessary. A suitable extraction model can be integrated with the attenuvent fitted in the roof. A mains filter, probably somewhere between 1 and 5 amps, will be required. The power requirements of the screened room, including the overhead lighting and the terminal will not be much larger than would be necessary if cabinet protection were used.

The door will be a standard screened room door, but some latching mechanism, operated from inside the room, will be necessary to ensure that the door is not opened at an inopportune moment.

Thus the operator can sit in front of the terminal and operate it in a comfortable, secure and controlled environment, without fear of the electromagnetic screening being impaired during normal operating procedures. Such an arrangement would compare very favorably, in terms of cost, with a TEMPEST cabinet, giving the added advantages of:

- no operational interruptions
- better screening performance
- security
- seclusion
- more selective environment
- better repeatability with test results
- ease of maintenance

The most important point to recognize is that the microprocessor, video display unit and keyboard have to be accessed, either for some manual operation, or so that part of the unit can be seen.

Furthermore, such an arrangement can be sited in places where space is at a premium, providing a protective and defined boundary within a normal office environment.

A small screened enclosure, with dimensions of 4' by 4' by 8' high, fitted with two attenuvents, a single access door of opening dimensions 3' by 6' high, a screened 5-amp single phase mains filter, providing screening effectiveness figures of 100 dB from about 20 kHz to 1 GHz, and aesthetically finished internally with formica covered panels, can be purchased for as little as $4,500.00.

However, the health and safety aspects of the proposed arrangement should be considered. The claustrophobic properties of such a working environment could be considerable. It may be that the personnel working in the facility would need to be specially selected, and the decor chosen to minimize distress.

Secondly, the terminal equipment would be out of sight, and therefore not immediately open to simple surveillance. The use to which the equipment is put, and the well-being of the operator would not then be so obvious. A suitably placed matrice of waveguides-beyond-cut-off could be fitted. Openings of half an inch (12 mm) can maintain the attenuation characteristics up to frequencies greater than 10 GHz, as long as the openings have a length of two inches (50 mm).

Finally, the door opening/closing/securing arrangements will probably need to be revised, and an escape hatch provided to satisfy the installation and operating environment of both room and equipment. These difficulties are not insurmountable.

KEN HOBBINS spent many years in the British Royal Navy as a Weapon and Radio Engineer Officer, after which he became the technical manager of an engineering company which specialized in building electronic and electrical installations into military vehicles. Mr. Hobbins then managed an EMC/TEMPEST test house where he and his staff performed tests on the majority of the military vehicles in service with the British Army. He designed an EMP simulator while in this post and worked extensively on the protection methods used for telecommunications and information technology equipment. Currently, Mr. Hobbins is Director of TEMPEST Solutions, Ltd. Tel: 0527-404737, and represents Pacific West Electronics of Costa Mesa, CA, in Europe.