COMPARISON OF HEMP AND TEMPEST FILTER PERFORMANCE REQUIREMENTS

HEMP (High Altitude Electromagnetic Pulse) Filters

HEMP protection of equipment is achieved by use of a shield to prevent damage due to direct radiation of the HEMP pulse, plus HEMP filters to remove induced HEMP pulses from incoming cables. HEMP filters have to reduce very high energy high current incoming pulses to a low safe level which will not cause damage to protected equipment. To do this they need to have a very good pulse attenuating response such as defined in Mil-Std-188-125 and Def-Stan-59-188. Mil-Std-188-125 has no specific insertion loss requirement for HEMP filters, but defines filter performance in terms of residual current, dI/dt, and root integral, for a given applied pulse.

However, for a HEMP filter to meet the residual pulse requirements and also to avoid compromising the shielding effectiveness requirement of the HEMP shield as defined in Mil-Std-188-125, it is considered that a HEMP filter needs to have an insertion loss performance of 20dB at 10kHz and 80dB from 10MHz to 1GHz, which is the same as the specified shielding effectiveness. In order to have the required level of pulse attenuation performance, it is necessary for the filter to have an inductive input and a high energy transient suppressor at its input. The source impedance of the HEMP pulse will not be 50 ohms, which is the normally accepted measurement impedance for EMI filters, so this also needs to be taken into account.

Summary of HEMP filter requirements

1. High current, high energy pulse attenuation performance is required from filter, even when source impedance is not 50 ohms.
2. Filter needs to have inductive input.
3. Filter needs high energy fast acting transient suppressor at input end.
4. Insertion loss performance of 20dB at 10kHz and 80dB from 10MHz - 1GHz.
5. Good low impedance ground connection is needed to carry away high energy high current pulses.
6. Filter inductors must not saturate at line current with pulse current superimposed.

TEMPEST Filters (For prevention of eavesdropping)

TEMPEST filter requirements are very different to those for HEMP filters. In simple terms TEMPEST is the requirement to prevent eavesdropping of confidential information. This is achieved in two ways. Firstly, a shield is needed to prevent direct radiation of signals which may be picked up by an eavesdropper. Secondly, a TEMPEST filter is required on all electrical cables leaving the shielded area to remove conducted intelligible signals which may be superimposed on the cables, so that the signals cannot be conducted out of the area and interrogated by unauthorised personnel.

MPE Limited
www.mpe.co.uk
sales@mpe.co.uk
+44 151 632 9100

Because signals will have coupled onto cables, they will already be of a small magnitude but need to be reduced further very significantly to a level where no intelligible information can be extracted from them. Therefore, unlike HEMP applications, TEMPEST requirements do not require a filter with good pulse performance but one with a very high level of insertion loss over a wide frequency range to reduce the levels of superimposed signals to an insignificant level.

To offer a high level of TEMPEST performance, a filter with an insertion loss of 100dB from 14kHz to 10GHz is usually considered to be ideal. Lower performance levels are often acceptable depending on the location of the filters within the installation. However, just fitting a filter is only part of the requirement for a good TEMPEST installation. It is also necessary to consider the location, mounting and grounding arrangements for the filter to ensure that when the filter diverts the intelligible signals to ground, they cannot recouple to other external cables in a way which can be interrogated. The earth cable should also not be accessible for interrogation of signals before they pass to ground.

There is a lot of detailed information available on this, much of which is classified, but the local TEMPEST expert for the installation should be able to offer specific advice for an individual installation.

Summary of TEMPEST filter requirements

1. Pulse performance is not needed but good continuous wave insertion loss performance is needed over a wide frequency range, normally in a 50 ohm system.
2. TEMPEST filters are normally capacitive input (but inductive is not detrimental).
3. Signals to be removed are low magnitude and low energy but need to be reduced to a much lower level so that they are not intelligible.
4. No transient suppressors are needed.
5. Insertion loss requirement is normally 100dB from 14kHz to 10GHz.
6. A good low impedance ground is needed to shunt intelligible signals to ground.
7. The location and nature of the ground connection needs careful consideration to avoid secondary pick up due to earth currents.
8. The filter must not saturate with mains current, but the signal current is so low it will not cause additional saturation.

COMBINED HEMP AND TEMPEST FILTERS

MPE can offer extended performance HEMP filters which will meet the insertion loss and pulse performance requirements of both HEMP and TEMPEST applications.

For the most stringent levels of TEMPEST protection it is usually preferred to have a separate smaller TEMPEST shield and boundary well inside the HEMP shield. This provides an extra level of TEMPEST protection because the TEMPEST ground is contained inside a second protected area so is better controlled and there is increased physical distance from the outer boundary.

However, when the HEMP boundary shield is already within a controlled area with physical separation from the outside world, the user may choose to use a combined HEMP and TEMPEST shield and filters.

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In this case the extended performance ranges of HEMP filters from MPE are ideal. They offer 100dB performance from 14kHz to >18GHz and because of the proprietary design of feedthrough capacitors used within the filters, they will also offer very significant performance to beyond 40GHz.

MPE HEMP power filters are available with this performance in current ratings of 6A to 400A in single and three phase versions, and also in 800A and 1200A designs in three phase versions.

MPE can also offer HEMP filters for telephone and signal lines with a similar performance.

Summary of combined HEMP and TEMPEST filter requirements

1. Filters must have TEMPEST insertion loss performance normally 100dB from 14kHz to 10GHz.
2. Filters needs to have inductive input and high energy transient suppressors.
3. Good low impedance ground is needed in a controlled environment.
4. Careful consideration should be given to ground location and arrangement from a TEMPEST viewpoint

MPE FILTERS SUITABLE FOR COMBINED HEMP AND TEMPEST APPLICATIONS

Standard catalogue ranges of filters are available for this combined requirement and are documented in the following catalogues:

1. HEMP Power Line Filters, Standard and Extended Performance issue 6
   (covers 6A - 400A Single and Three phase)
2. HEMP Power Line Filter 800A Extended Performance (Three Phase) issue 2
3. HEMP Power Line Filter 1200A Extended Performance (Three Phase) issue 2
4. HEMP Control Line Filters issue 3
5. HEMP Telephone Line Filters issue 3

All of these catalogues are available for download from the MPE website in the download section under HEMP Filter Datasheets.

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