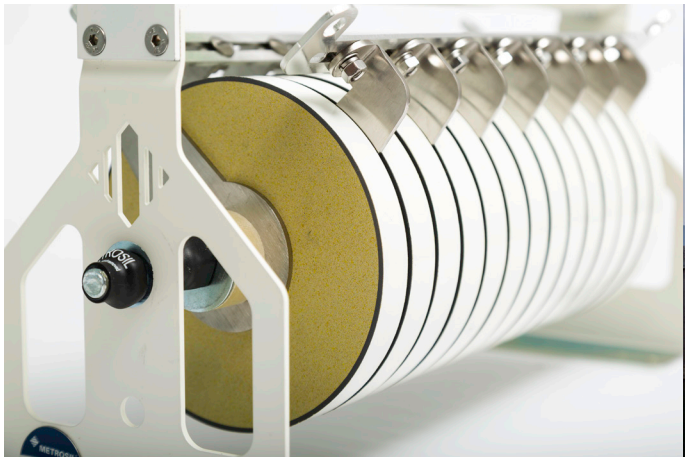
METROSIL®
PROTECTION BUILT-IN

# **METROSIL** IN EXCITER DISCHARGE SYSTEMS



An exciter in a synchronous generator is used to provide the DC supply to the electromagnetic field winding, which is mounted on the rotor of the generator. In order to prevent damage being sustained to excitation systems during shut down, a suitable means to discharge the energy stored in the field coil must be available. For many years, Metrosil silicon carbide varistors have provided a reliable solution for exciter discharge applications, being used by many leading OEMs in world flagship power projects.

Transients may be generated in excitation systems when the voltage to the field coil is removed, causing a rapid decrease in current with time. The energy stored in the coil tries to maintain the magnitude of the current by creating a large back electromotive (EMF) force, which may be many times larger than the supply voltage and, if uncontrolled, may be sufficiently large enough to damage other components in the system.

A method of controlling the magnitude of the back EMF, is to dissipate the energy / current stored in the coil into an appropriate load, consisting of either a resistor or a varistor, such as a Metrosil. During a discharge event, the coil acts as a current source that discharges with time into the load. The voltage generated across the load can then be controlled and is proportional to the resistance of the load and the current flowing through it.

## WHY METROSIL?

Metrosil offers a high speed solution to the discharge of excitation systems. This is due to the degree of non-linearity in the V-I characteristics of the discs.

As well as offering short discharge times, Metrosil can also be used in high energy applications, since the discs may be easily matched. 'Matching' describes how the variation in the electrical properties of the discs determines the sharing of current and energy within a Metrosil. Should the discs not be matched accordingly within an assembly, then this may lead to uneven current and energy distributions within it, limiting the rating of the assembly or possibly leading to failure. Difficulties in matching with highly non-linear varistors limits their utilisation to low energy applications. Metrosil combines the ideal characteristics of non-linearity and energy absorption capability for exciter discharge applications.

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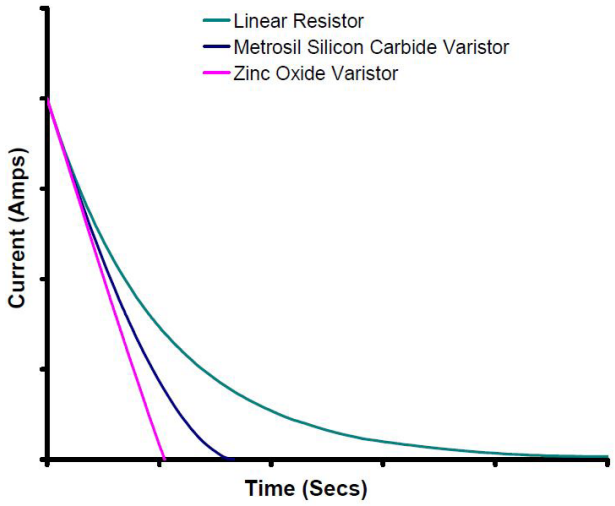


Figure 1 - Discharge Time Characteristics for Different Discharge Resistors

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## CUSTOMISED SOLUTIONS

For medium to large exciter discharge applications, it is common to switch in the exciter discharge system at the same time as switching out the supply voltage. This may be achieved via a thyristor crowbar control system or a field breaker. This method is commonly used in static excitation systems.

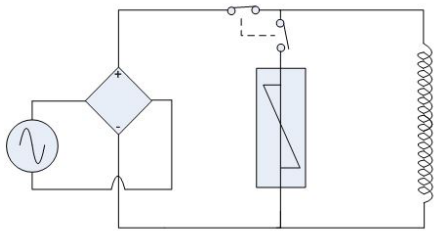

Figure 2 - Typical arrangement of a switched exciter discharge circuit

In order to design a customised unit for an exciter discharge application, the user defines the following parameters of the system:

- Required protection voltage under discharge conditions
- Maximum discharge current from the field coil
- Energy stored in the field coil

Considerations towards the protection voltage and energy to be dissipated should also be made with regards to three phase short circuit currents, which may be up to three times the magnitude of the maximum discharge current.

An appropriate unit may then be defined by our Metrosil engineers. Most units use 150mm diameter discs, which are connected in series and parallel arrangements, depending on the required electrical parameters. The number of discs and their thickness depends on the application details.

## ALTERNATIVE EXCITER DISCHARGE SYSTEMS

Customised units for permanently connected and brushless exciter discharge systems, as used on smaller synchronous generators, can be supplied. In these applications, a wider range of parameters must be considered, including:

- Power dissipation under normal operating conditions
- Leakage current considerations
- The mechanical stability of the unit

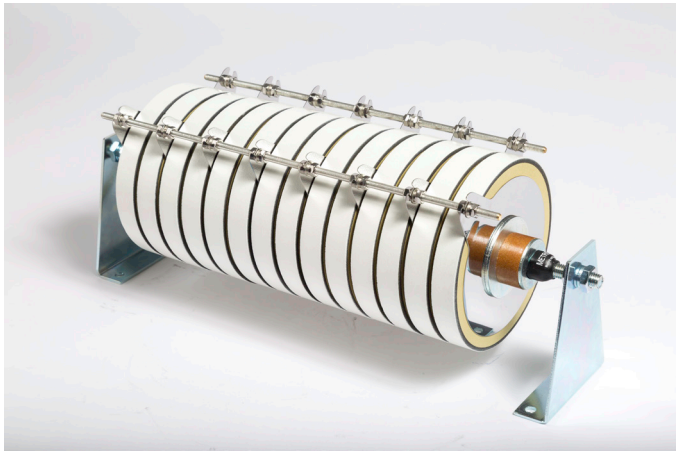

Figure 3 - Metrosil 6000 Series

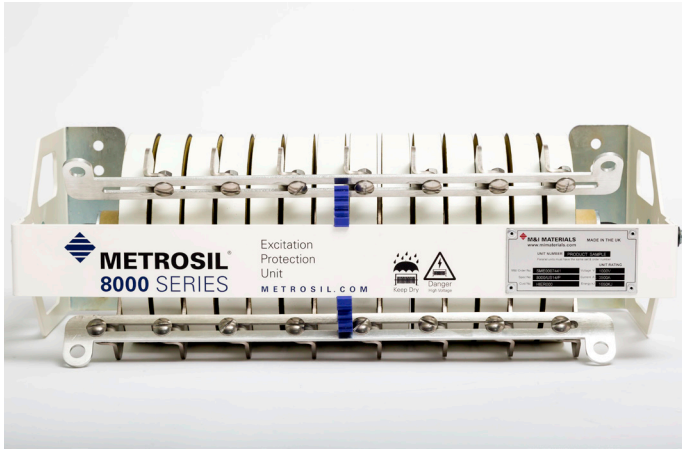


Figure 4 - Metrosil 8000 Series

Figure 5 - Metrosil 9000 Series

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