Enersol™ Mechanism

Intro:

In the field of electromagnetic compatibility several trends point to a growing necessity of EMC engineering. These trends, directed to functional upgrading or reducing cost, inevitably also contribute to an increasing level of electromagnetic interference (EMI) emissions.

What is Enersol™ Plates?

Enersol™ Plates are ceramic compounds consisting of variety metals combined with some metallic elements. Enersol Europe BV. Belgium holds the rights of the product distribution in EU. **Enersol™ Plates** do not conduct electricity; in fact, the material boasts the right electrical resistance as they also have the right magnetic permeability to allow it work as its mechanism which will be further explained in this sheet. This resistance to electricity makes Enersol™ an excellent tool to assist with the reduction of electromagnetic interference (EMI) for many electronic devices, inductive loads, power electronics circuits…etc.

Why we need Enersol™ Plates?

In power conversion: change from linear to switch-mode supplies (high switching frequency, noise (harmonics)) and increase of switching frequencies. Together with the increasing use of electronics this leads to a general EMC degradation and consequently EMC legislation is becoming stricter world-wide.

Of course, the first step to avoid interference problems is a good design practice, to tackle the problem right from the start. This can be insufficient if the interference is directly related to the inherent operating principle and too late if the interference is detected not earlier than in the final design phase. In such cases extra suppression components are necessary, like **Enersol™ Plates. Enersol™ Plates** provide a solution to many problems of conducted and (indirectly) radiated interference. They can be applied almost anywhere, by being installed on wire or cable, even if the cables are shielded.

No ground connections are necessary as **Enersol™ Plates** are connected in series with the interfering circuit and not in parallel as in the case of other filters. The wideband, lossy impedance makes **Enersol™ Plates** well-suited as RF suppressor components.

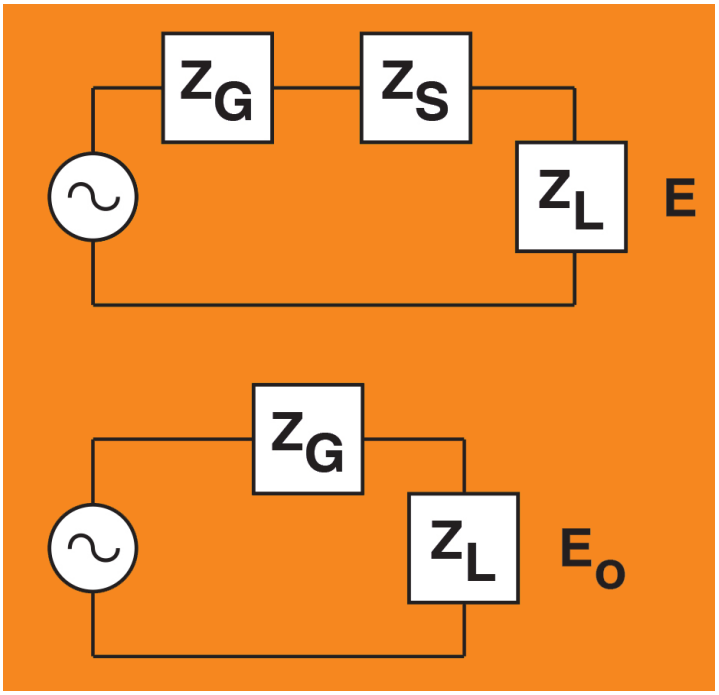
General principles of EMC

Regulations

Historically, all EMI regulations stated emission limits only. These define the maximum level of interference allowed as a function of frequency. In case of conducted interference, it applies to the voltage on all inputs and outputs of the equipment, in case of radiated interference it applies to the field strength at a certain distance.

Suppression with Enersol™ Plates

At RF frequencies an **Enersol™ Plate** shows a high impedance which suppresses unwanted interference. The resulting voltage over the load impedance will be lower than without suppression component, the ratio of the two is the insertion loss (Fig. 1.)



(Fig.1.)

The insertion loss is expressed as :

$$IL = 20 \cdot \log_{10}(E_0/E)\ [\mathrm{dB}]$$
$$= 20 \cdot \log_{10} \frac{|Z_G + Z_L + Z_S|}{|Z_G + Z_L|}\ [\mathrm{dB}]$$

The decibel (dB) as a unit is practical because interference levels are also expressed in dB. However, insertion loss depends on source and load impedance, so it is not a pure product parameter like impedance (Z). In the application, source and load impedance generally are not 50 Ω resistive. They might be reactive, frequency dependent and quite different from 50 Ω.

Insertion loss is a standardized parameter for comparison, but it will not predict directly the attenuation in the application.

At low frequency, an Enersol™ Plate is a low-loss, constant self-inductance. Interferences occur at elevated frequencies and there the picture changes. Losses start to increase and at a certain frequency, the product resonant frequency, permeability drops rapidly, and the impedance becomes almost completely resistive. At higher frequencies it even behaves like a lossy capacitor.

While for most applications the operating frequency should stay well below this resonance, effective interference suppression is achieved up to a much higher frequency.

The impedance peaks at the resonant frequency and the Enersol™ Plate is effective in a wide frequency band around it.

The material choice follows from the critical interference frequencies; ideally, they will coincide with the product resonance frequency, the top of the impedance curve. According to Snoek's law, this resonant frequency is inversely proportional to the initial permeability, which gives us a guide for material choice. The whole RF spectrum can be covered with **Enersol™ Plates.**

Preferred applications of Enersol™ Plates:

Mainly

With the ever-increasing demand of interference suppression, **Enersol™ Plates** shall be applied on each end-user DB (the closest to the source, machine…etc.).

Some other cases

Also, those applications where both high operating temperatures (140ºC) and high currents are involved e.g. power lines in industrial, but especially automotive environments. Suppressing of interference signals along these lines can be achieved by inserting **Enersol™ Industrial Plates.**

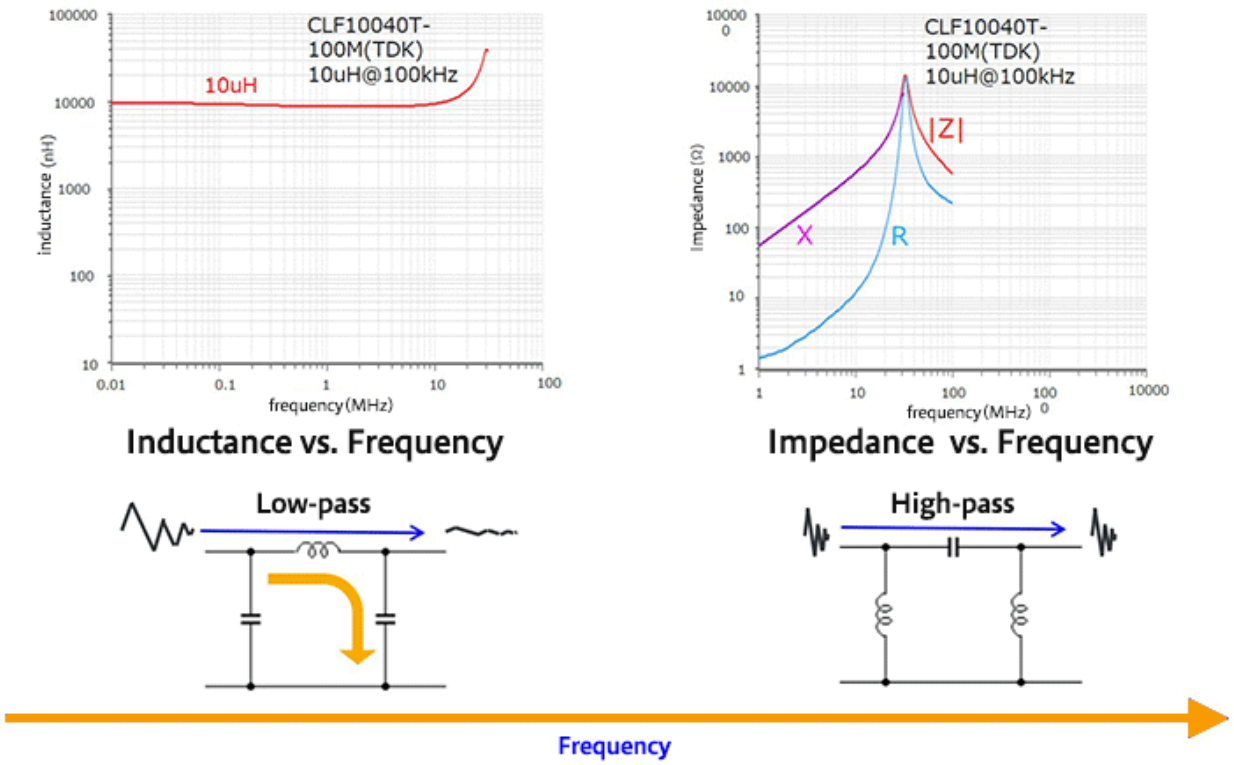
Why it is still effective to install Enersol™ Plates even if you have a different kind of filters/inductors installed? To answer this, please see the next page.

Enersol™

Basic Characteristics of Enersol™ Compared to Inductors & Noise Countermeasures Using Them

Dealing with Noise Using Inductors:

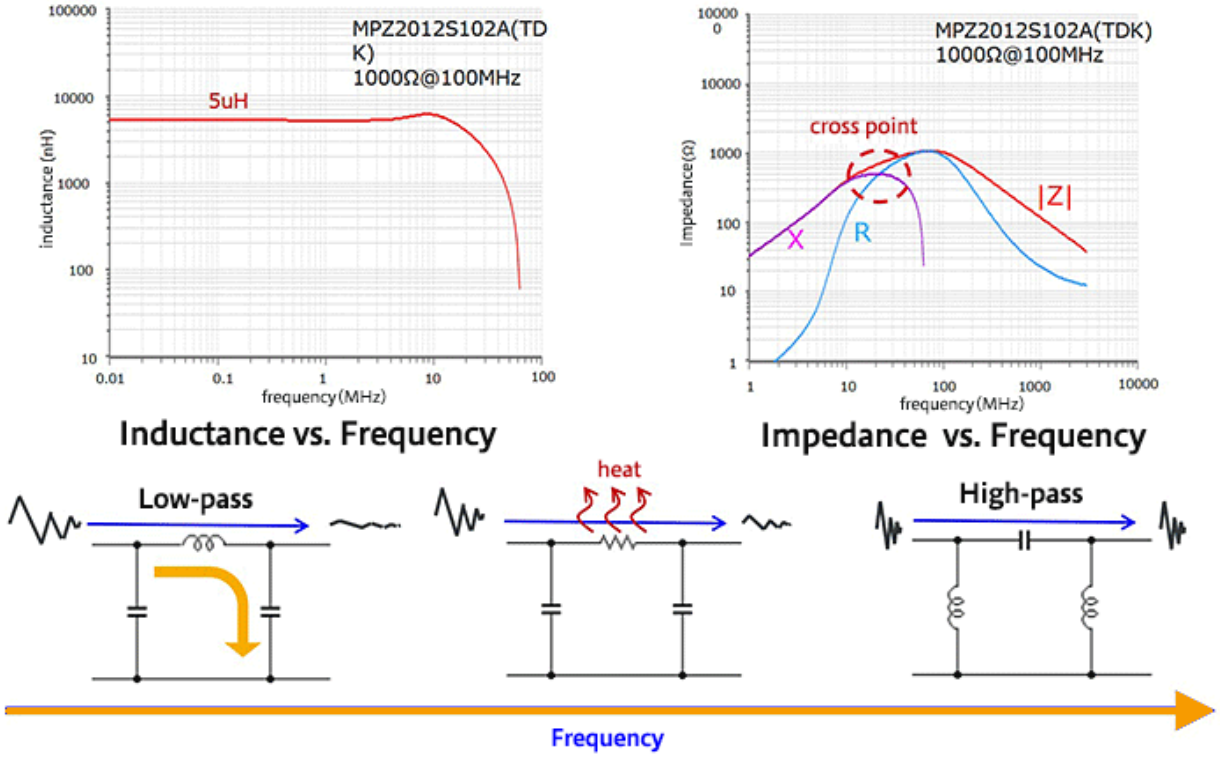
When capacitors alone are insufficient to adequately eliminate noise, the use of inductors is considered. However, here we explain π filters that use inductors. In the low-frequency range, such filters act as a low-pass filter based on an inductor and a capacitor. At higher frequencies the inductor behaves like a capacitance and the capacitor behaves as an inductor, so that



the filter functions as a high-pass filter, and therefore there is no noise elimination effect.

Dealing with Noise Using Enersol™ Plates:

Enersol™ Plates also basically function as a low-pass filter in the low frequency range. Referring to the graph on the right side, there is a point at which the reactance declines and crosses the resistance component. If the band exceeds this point, called the cross point, the **Enersol™ Plate** functions as a resistor, and serves to convert noise into heat. This is a major difference from filters that in use. In still higher-frequency regions, the **Enersol™ Plate** functions as a high-pass filter, similarly to the filters in-use.



Because **Enersol™ Plates** convert noise into heat in addition to shunting noise away, they can be expected to provide excellent noise elimination performance.

So, as a conclusion at this stage we can say that the noise attenuation plate (Enersol™) has a power reduction effect when installed at the breaker closest to the load. By cleaning the sine wave from EMI noise as the paper shows which will improve the sine wave and help reducing the consumed energy.

More tests and investigations to be conducted are to clarify the estimated amount of savings.