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Welcome to the ELMG News

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- Product Compliance and International Market Entry

When we talk to people about product compliance it is often the case that they are considering the product compliance after the product is developed. This is not the optimum situation but is often where people end up. How is it best to handle this case?

Well this is the $64,000 dollar question. Or the $2.5 Million dollar question.

It is typical to find that companies want to push there existing products into new international markets. It is a reasonable way to grow sales. However the market may have technical compliance requirements that prevent the product from being appropriate.

So what can ELMG do to help? Well first we can help you with working out what the requirements are, finding standards and finding the correct third party test certifier if required. Then we can assess your product to see how close or far away it is from complying. It can be the case that minimal changes can be required but more often a redesign is indicated.

At this point ELMG generally do a return on investment analysis which gives a really good indication on whether to pursue compliance for the existing product or to wait until the next product development where the opportunity exists for a better solution.

This better solution is to use an approach that designs in compliance. As the compliance requirements are design requirements they should be in the specification. Often the best way to get the design requirements is to develop an itemised test plan for your product compliance at the requirements and specification phase before the product designed is started.

Contact ELMG if you would like more information on our product compliance services.

- Finding transfer functions for Power Electronic Converters

I help occasionally with supervising some graduate students in power electronics and was recently presented with 25 pages of state space averaging working which was meant to give the open loop control transfer and the closed loop input impedance of a power converter. The algebra was not badly done and turned out to be correct. I suggested that a simulation and experimental validation would be the next step and the student did this. The student made measurements of input impedance and the open loop control transfer using the small signal injection and measuring capabilities of a spectrum analyser. The student also simulated the power converter and obtained some transfer characteristics this way. Neither the measured input impedance nor the control transfer results matched the state space average transfers or the simulations (which matched each other). The student was very perturbed. However the simulations and the state space average transfers matched each other well. I was kind of expecting this.

We then sat down and made the measurements manually with the input and output waveforms on a scope. These manual measurements matched the state space averaging and simulation results very accurately at frequencies where the transfer was measurable. The student was even more perturbed and could not believe that the “machine was wrong”.

So the question is this - how many people out there have designed controllers based on measurements from spectrum analysers without checking manually that the measurements were correct or validating the measurements with simulation? The importance of this question will become clear.

Now back to the student’s power converter. One key problem with this power converter control design was dealing with variation of the load current. The graduate student’s converter had spectrum analyser results that were inaccurate. A controller designed for the converter based on the inaccurate analyser results would have been good except at light load and high line where it would have had margin problems and so instability.

So here is the telling question. How many of you have power converters that are unstable under certain circumstances (probably light load and/or high line) when the control design based on analyser measurements says that they should be stable?

Measure the transfer of your converter manually and check to see whether the analyser is measuring accurately. Analysers sometimes do not

- Power Electronic Converter Transfer functions above the sampling frequency

Switching power converters have a switching frequency. Consider a simple triangle PWM modulator where the control input has a frequency above the frequency of the triangle. This is the classic undersampling or aliasing situation and so the output frequency from the PWM modulator will not be at the same frequency as the control input. This is typically avoided by using a low pass filter (or rate limit) on the PWM modulator input signal to stop aliasing.

Consider a single phase mains switching rectifier switching in response to the mains voltage frequency, let's say we are in Europe so 50Hz. How does this converter respond to a voltage disturbance at 227Hz as the 227Hz is above this "slow" rectifier's "sampling frequency"? The key question at this time is why would you want to know this? Well the answer is in the fact that this rectifier, and a large number of others, are connected to an AC network where there is a power quality control device, such as a sag compensator or active filter. These typically operate with fast IGBT switching at say 15 kHz. The compensator control bandwidth includes 227Hz. The response of the "slow" 50Hz converter at 227Hz is the result of a frequency cross coupling. Consider that the 50Hz converter is a frequency coupler with the prime purpose of modulating 50Hz power to DC. It also modulates at a number of other frequencies. So if there is a small 227Hz voltage superimposed on the 50Hz mains voltage what current does it cause to flow? Well the current has frequency components at 227Hz, 27Hz, 73Hz, 127Hz and 173Hz. Interestingly these currents' magnitude and phase depend on the impedance of the AC system as well as the 50Hz rectifier behaviour.

If you are interested in methods and techniques for designing interconnected power converters with widely different switching frequencies or are having instability when connecting fast power converters to slow power converters give us a call or contact us at enquiries@elmgnz.com.

- More on partitioning

It was good to get comments on the partitioning article. It seemed to have provoked response of some kind with a number of people. The responses varied from "That is a good idea!" to questions like "Yes we do this now but we'd like to partition projects across time zones and still keep that small team feeling, how do we make that work?" and further to "At what company size should we separate Engineering from Research and Development and what do we gain and loose if we do this?" These are good, if somewhat surprising, questions and they require some thought and there is no one size fits all approach. One thing to consider is that it is often the case that people outside of your company have a less biased view of the problem and possible solution. (And if it all goes badly then you can blame them).

We also got a few comments about partitioning from software people along the lines of “We just code it and that works for us”. There is no argument to counter this. However the principal risk of this approach is that some future change will not be covered in the software testing. As such this can lead to field problems.

Related to this is the fact that for embedded code it is important to accept that the failure of software is not random or stochastic but deterministic. The random failures seen in the field for embedded software are the result of random stimulus, or random stimulus timing, rather than random software behaviors. We realize that this assertion will cause some strong responses from embedded software engineers and in fact we have had the heated responses at seminars we give covering embedded software and EMC compliance. That discussion is best left there but it seems the regulators are starting to deal with this by increasing the safety test requirements for embedded software products.

From our experience we have found that partitioned software makes finding the field failure mechanisms in embedded software easier.

- From the Embedded systems FAQs page

What are the best four things to remember when doing embedded programming?

1. The processor that took men to the moon had less processing power than your microwave oven.
2. Embedded software looks like hardware to the customer.
3. Embedded code's lifetime can be more than 20 years.
4. You cannot solve the impossible problem until you have to.

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