



Another EMC resource
from EMC Standards

Banana Skins 901 - 910

Helping you solve your EMC problems

Banana Skins 901-910, 22 July 2022

Banana Skins numbers 1-855 were first published in The EMC Journal, www.theemcjournal.com, where they have had 36 million hits! They are now being republished (with permission) by In Compliance magazine, www.incompliance.mag.com. Numbers 856-900 were published as 'EMI Stories' at www.emcstandards.co.uk/emi-stories.

Numbers 901 onwards will be a regular feature in EMC Aware magazine, every quarter.

Some of these stories are extracted from official documents and reports, some are personal anecdotes, and some come from research. Some of these EMI Stories had harmless or amusing outcomes, some lost companies large amounts of time / money, even causing bankruptcy, and some caused (or could easily have caused) injuries and deaths.

My experience is that these stories only represent the very tip of a large iceberg, with unguessable costs for manufacturers and society as a whole. As electronic devices and technologies continue to advance; more (and more complex) software and wireless communications are used; as electronic systems are increasingly integrated into systems-of-systems which no person can understand fully, and even into systems-of-systems-of-systems (including the "Internet of Things", IoT, and autonomous vehicles): the only thing of which we can be certain is that EMI problems will occur more frequently and have larger impacts on cost and safety.

I hope these stories help identify possible EMI problems in advance, so that they are dealt with as part of the normal design/development procedure and don't create the embarrassment and costs of trying to correct poor EMC design after products have been shipped or systems installed.

If you have any suitable stories or know of any relevant research or reports, please tell me about them so they can be included (anonymously, if preferred) in this list.

Compiled by Keith Armstrong, keith.armstrong@cherryclough.com

901) A case study that shows the value of pre-compliance EMC testing

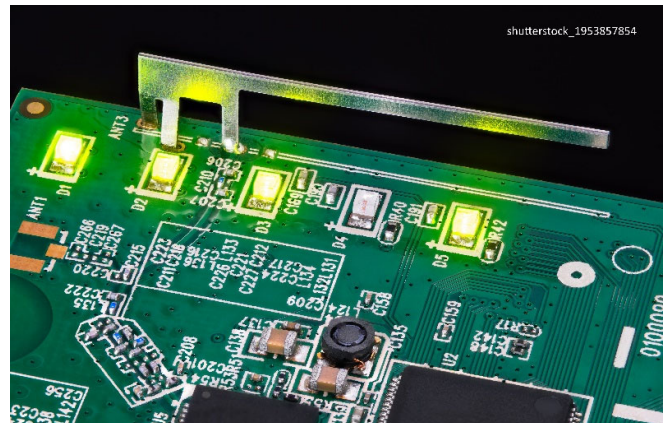
In the first example, 42 Technology were appointed to re-develop an established small personal radio device with the aim of improving its robustness and reducing manufacturing costs. However, as this product was already on the market the development cycle had a very short lead time. There were also constraints on the product dimensions so that current customers would be satisfied with the new design.

To keep costs down we tried to develop a simple PCB solution, which followed reference designs, but it didn't have a good enough ground return path to radiate effectively.

Ultimately, the unit failed on the third harmonic emissions and forced a more complex PCB re-spin. In an attempt to limit the potential cost increases, we then developed both monopole and chip antenna variants.

In the end, a more complex PCB with a monopole antenna had to be used because there wasn't sufficient space to isolate the chip antenna from the rest of the PCB.

This process resulted in a very rushed and stressful development cycle with a product solution that wasn't the lowest cost option.



Things could have gone worse, but the lesson here is that a longer development cycle, with fewer constraints from earlier versions, could well have led to a smoother compliance process and lower product manufacturing costs.

(Taken from: "Getting ahead of the game", by Rowan Beale, in New Electronics magazine, June 2022, www.newelectronics.co.uk/content/features/getting-ahead-of-the-game)

902) Another case study that shows the value of pre-compliance EMC testing

In the second example, we were appointed to help turn a prototype that hadn't undergone any pre-compliance into a certified product.

The client had rapidly developed a prototype to solve a customer's requirement for their system. After finding great success with it, they wanted to produce a larger quantity of units but certified for other target markets and customers.

During pre-compliance testing, it immediately became apparent that the prototype architecture would never pass formal compliance tests.

Additionally, an antenna added by the customer to the product also meant there was an infinite number of ways to test it for FCC compliance because the end user could change the antenna length according to their specific needs.

It was a major blow when the client realised their product would need a full redesign, the installation process would need completely changing and the timescales were not achievable; particularly as they had end-customers waiting who thought the solution was only a few months away. All these issues could have been alleviated with pre-compliance measurements before releasing the prototype.

(Also taken from: "Getting ahead of the game", by Rowan Beale, in New Electronics magazine, June 2022, www.newelectronics.co.uk/content/features/getting-ahead-of-the-game)

903) EMI's potentially dangerous impact on pacemakers

Significant advances have been made in electronic technology for pacemakers/ICDs. Implementing hermetic shielding, filtering, bipolar sensing, and algorithms, all designed to reject sources of EMI, have really helped return patients with pacemakers back to active lives in their communities after pacemaker/ICD implantation.

However, new technologies have increased concern about interference with the pacemaker/ICD function. It's important for doctors and medical technicians to keep updated regarding the potential risks of EMI from modern external sources with respect to proper pacemaker/ICD function.

(Taken from: "EMI's Potentially Dangerous Impact on Pacemakers" by Steve Taranovitch, in Electronic Design magazine, 22 December 2021, from: <https://www.electronicdesign.com/power-management/whitepaper/21183432/electronic-design-emis-potentially-dangerous-impact-on-pacemakers>)

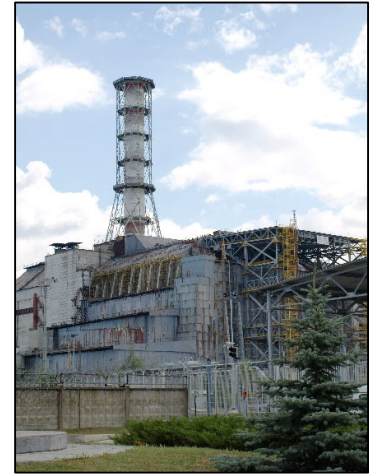
904) Chernobyl radiation spikes could have been EMI

High levels of radiation seen during the Russian capture of the Chernobyl nuclear power plant in Ukraine on 24 February were initially put down to tanks stirring up radioactive dust, but researchers now believe this contamination may never have happened.

Instead, interference between wireless radiation sensors and unidentified equipment may have been to blame.

..... "We've hypothesised that the cause may well be to do with electromagnetic frequencies being used by the military, and it could be Russian or Ukrainian military around that time, actually interfering with the reception of data," says Wood.

(Taken from "Chernobyl spikes called into doubt", by Matthew Sparkes, in New Scientist magazine, 16 April 2022, www.newscientist.com)



905) Legal requirements for resilient power systems

In recent years, strengthened legislation, particularly in the USA and EU, has seen power and utility companies having to consider electromagnetic interference (EMI) and electromagnetic pulse (EMP) threats within their sites.

Legislation now dictates that the resilience of power systems against interruption or damage caused by EMI or EMP has to be considered, and so this regularly appears on end-user risk registers.

..... Whilst the effects of localised tactical EMP attacks are likely to be less dramatic than strategic EMP ones, it is clear that the threat and probability of local attacks are far greater.

It is widely acknowledged that the likelihood of such EMP occurrences being planned by bad actors with differing motives and targets has also significantly increased. Company HQs, banks, finance houses, and commodity and stock exchanges may readily be singled out for attack.

..... Disturbingly, at an organisational level, S&C Electric's 2018 State of Commercial & Industrial Power Reliability report found that 18% of companies surveyed had experienced a loss of more than \$100,000 as a result of their worst (power) outage, whilst half of customers surveyed had endured outages lasting more than one hour during the past year.

The same survey revealed that 25% of companies reported experiencing at least one outage per month. Again, the view is widely held that a percentage of such system downtime is as a result of EMI or EMP activity.

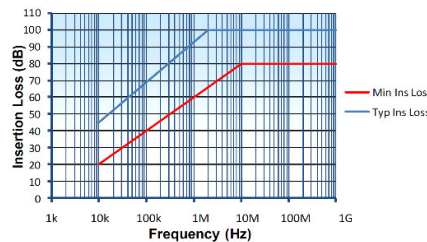
..... In addition to the losses attributed to outages, the punitive damages that can now be levied on organisations, following recent legislation such as the Network and Information Security (NIS) EU Law published in May 2018, mean that consideration of the detrimental impacts of electromagnetic interference can no longer be ignored.



MPE
Quality. Reliability. Performance.

1200A SINGLE LINE HEMP FILTER DS33738

Insertion Loss



<https://www.mpe.co.uk/wp-content/uploads/2013/06/HEMP-1200A-Filter-issue-8.pdf>



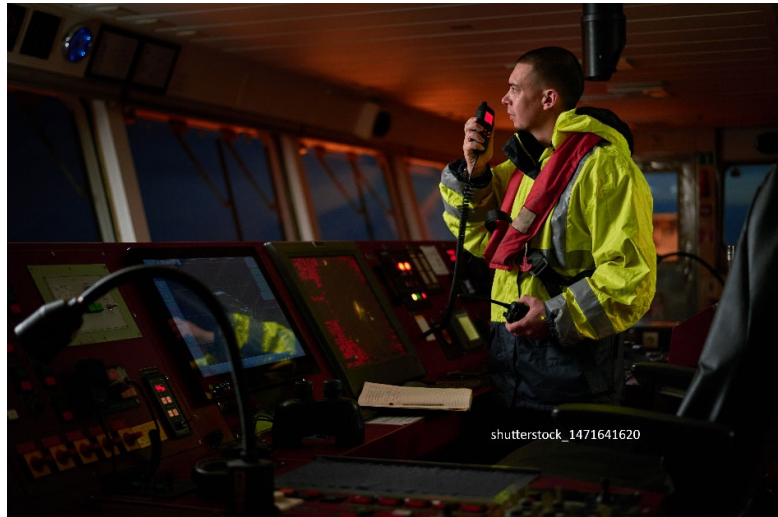
(Taken from: "Ensuring Resilience Within Power Applications", Paul Currie, Director, MPE Ltd, Liverpool, in Power Systems & Design, May 2022, available: <https://www.powersystemsdesign.com/pages/digital-magazines/73#Europe>)

906) LED lighting interferes with Maritime VHF-FM radio and Automatic Identification Systems (AIS)

The United States Coast Guard has sounded the alarm over the potential for light-emitting diode (LED) lighting on vessels to compromise reception on VHF frequencies used for radiotelephone, Digital Selective Calling (DSC) and Automatic Identification System (AIS).

The distance at which the LED lighting starts to have an impact and whether the issue is limited to certain makes of lighting or navigation equipment. The United States Coast Guard has asked the United States marine industry to provide more detail of known incidents.

Due to their energy-saving capability and longer service life, LED lights are commonly used for navigation lighting, searchlights and floodlights, as well as interior and exterior lighting—including those used for visual effect.



The United States Coast Guard said that in one case, radio-frequency interference caused by LED lighting created a hazard that led to a serious safety incident.

"The maritime rescue coordination centre in a United States port was unable to contact a ship that was involved in a traffic separation scheme incident by VHF radio. That ship also experienced very poor AIS reception. Other ships have also experienced degradation of their VHF receivers (including AIS), caused by their LED navigation lights. LED lighting installed near VHF antennas has also been found to reduce reception."

(Taken from: "LED lighting found to interfere with VHF-FM radio and AIS reception", a report by the Australian Government's Maritime Safety Authority (AMSA) on 2nd February 2022, updated 3rd <https://www.amsa.gov.au/safety-navigation/navigation-systems/led-lighting-found-interfere-vhf-fm-radio-and-ais-reception>)

907) Apple says keep these products a 'safe distance' away from medical devices

iPhone 12 models and MagSafe accessories should be kept a "safe distance" away from medical devices, Apple says. It's possible for magnets and electromagnetic fields to interfere with pacemakers and other medical devices when in close contact.

Apple has expanded its list of products to keep a safe distance away from medical devices such as implanted pacemakers and defibrillators due to potential magnetic interference.

In a support document updated Friday, the company says the iPhone 12, Apple Watch, AirPods and other products should be kept at least 6 inches apart from medical devices, or more than 12 inches apart if wirelessly charging.



The document, spotted earlier by MacRumors, notes that medical devices such as “implanted pacemakers and defibrillators might contain sensors that respond to magnets and radios when in close contact.” The company advised people to consult with physicians and medical device makers for specific guidance. Here’s the full list from Apple:

AirPods and Charging Case; AirPods and Wireless Charging Case; AirPods Pro and Wireless Charging Case; AirPods Max and Smart Case;

Apple Watch; Apple Watch bands with magnets; Apple Watch magnetic charging accessories
HomePod; HomePod mini

iPad; iPad Mini; iPad Air; iPad Pro; iPad Smart Covers and Smart Folios; iPad Smart Keyboard and Smart Keyboard Folio; Magic Keyboard for iPad; iPhone and MagSafe accessories

iPhone 12

MagSafe accessories

Mac Mini; Mac Pro; MacBook Air; MacBook Pro

iMac

Apple Pro Display XDR

Beats Flex; Beats X; PowerBeats Pro; UrBeats3

(From “Apple says keep these products a 'safe distance' away from medical devices” by Carrie Mihalcik, June 28, 2021, posted on CNET: <https://www.cnet.com/tech/mobile/apple-says-keep-these-products-a-safe-distance-away-from-medical-devices/>)

908) Yet another story about unscientific earthing/grounding

A major science campus needing a ‘quiet ground’ for sensors for frequencies of 1MHz or so. Because their campus was chock-full of high-energy scientific research facilities, they did not feel that it could provide a “quiet enough ground”, so they ran about 150m of very heavy-duty copper from their scientific research project to a fresh ‘earthing pit’ in a nearby field, where it was connected to several earth electrodes embedded in a conductive grout.

100m of very heavy-duty copper cable would have a series inductance of about 100 microhenries, which means that – ignoring any impedance due to the earth electrodes in their pit – at 1 MHz it would have achieved a ‘ground impedance’ of about 630 Ohms.

However, a good ‘ground’ or ‘earth’ at radio frequencies is usually assumed to need an impedance of much less than 1 Ohm, so their very costly ‘quiet ground’ (*so-called!*) could not have provided a low-enough impedance, except for frequencies well-below 1.6 kHz!

(From an EMC Consultant who wishes to remain anonymous, May 2020)

909) Solar panels jam police walkie-talkie network

Translated from the original Dutch by www.DeepL.com/Translator (free version):

Solar panels are also jammers in the faltering walkie-talkie system of the police. This is confirmed by the Ministry of Justice and Security, which has recruited additional experts to solve the problems.

Agents throughout the country are still experiencing problems with the C2000 walkie-talkie system that was renewed at the end of January. At crucial moments, the walkie-talkie is out of range. In Amsterdam, this led to precarious situations last week.

Agents who wanted to ask for reinforcements because a suspect might be carrying a firearm were unable to establish a connection.

Other police officers were trapped in a porch because they could not make contact. In the meantime, a crazy man threw flammable liquids out of the window. Similar connection problems exist throughout the country and seem to be concentrated in Rotterdam, the East of the Netherlands and Brabant, except in Amsterdam.

The disturbances in the network sometimes appear to be caused by the inverters of solar panels, justice confirms when asked. These are mainly solar panels that do not comply with the guidelines or have been installed incorrectly.

(Kindly sent in by Prof. dr. ir. Davy Pissoort, head of the Flanders Mechatronics Engineering Center (FMEC), KU Leuven, Bruges Campus, Spoorwegstraat 12, B-8200 Brugge, Belgium, who first saw it in an email from Prof. dr. ir, Ing. Frank Leferink, Acting chair Telecommunication Engineering Group, University of Twente, Netherlands, and Director of EMC at Thales, Netherlands, see: <https://www.ad.nl/binnenland/zonnepanelen-stoorzenders-voor-haperend-portofoonnetwerk-politie~aed43488/>)



910) Vancouver music recording studio plagued by 6 months of unexplained EMI

Vancouver's Armoury Studios has been hosting international musicians for more than two decades. World-famous acts like Kiss, Avril Lavigne and Busta Rhymes have recorded out of the Kitsilano studio. But for the past six months, unexplained radio interference has been threatening to ruin the studio's reputation.

When staff try to record, high-pitched interference can be heard through the wired microphones, making it difficult for music engineers to capture the desired sounds. "We've

already lost money. We're already paying a lot for tech. It's wasted time in sessions and we've even lost sessions," said chief engineer and manager Paul Silveira.

ISED came to investigate and, according to Dixon, the ISED member wondered whether the interference might be coming from cellphone towers on top of a nearby building. The towers belong to Rogers which denies its equipment is at fault.

"ISED asked Rogers to do a shutdown of their towers. I was there and, when they did, it was completely quiet [the interference was gone]," said Dixon. Once the towers were turned back on, he says, the interference returned, but the mystery of how it was happening remained. Ultimately, neither ISED or Rogers was able to determine the exact cause of the interference.

CBC News has seen correspondence from both Rogers and ISED that confirm the telecom is operating within its licensed band and power levels. In an email, the Rogers investigator raised several possibilities, including someone in the neighbourhood using an illegal cell signal booster but nothing has been conclusive. "It is up to the Studio to fix the problem," wrote an ISED member in a separate email to Armoury Studios.

(Kindly sent in by world-renowned EMC Consultant Pat Andre, of Andre Consulting, Incorporated, www.andreconsulting.com, who saw the article "World-class Vancouver recording studio plagued by 6 months of unexplained radio interference" by Joel Ballard of CBC News, that was posted on Jun 05, 2021, see www.cbc.ca/news/canada/british-columbia/armoury-studios-plagued-by-radio-interference-1.6054498.

Note: "ISED" is short for Innovation, Science and Economic Development Canada, the Canadian regulatory body for the radio frequency spectrum.)