Another EMC resource
from EMC Standards

EMI Stories 666 to 760

Helping you solve your EMC problems

9 Bracken View, Brocton, Stafford ST17 0TF T:+44 (0) 1785 660247 E:info@emcstandards.co.uk

EMI Stories 666 to 760

666) Timely EMC fix on a satellite helped a lifetime's career

The knowledge of having an EMC background can help all of you; in particular, what I am going to talk about is how it helped me in my career. When I first began my career back in 1951, for the first few years all I did was make EMC measurements. And then, one day, my boss quit for greener pastures and there was just a younger engineer and myself there at a large engineering design and development organization. I really knew nothing about EMC principles. I knew about measurements, but I didn't know about principles. I had joined the IRE at the time as a student in college. I became active in the IRE and I looked to those people to help me gain knowledge in EMC. I was really helped. It was very challenging to me. It was invigorating and frustrating, but I learned many things.

After I learned, a company in Massachusetts made me an offer I couldn't refuse. So I left RCA and went to Massachusetts. I was there for a while and since it was not my cup of tea, I left. I eventually came back to RCA at the RCA Space Center in Hightstown, New Jersey. It was called the RCA Astro-Electronic Division. They didn't pay any attention to EMC, and I didn't work as an EMC engineer. I had gotten out of EMC, but I was sucked back in by an event that changed my career, and really helped me.

I was working as a Reliability Engineer on a weather satellite for about three years. At that time, the weather satellites were relatively simple. Later generations were designed to give you the five-day weather forecast, but in those days they primarily were built to give hurricane warnings. But they kept on being improved to give you more and more data. Anyway, they built this weather satellite for the U.S. Air Force, but before they could ship the satellite, it had to pass ground simulation tests. Now, you have to understand that the way these satellites work, when it is overhead, what it does is it transmits the data directly to the Earth. But when it goes over the horizon, at that point the data is put on a tape recorder and the tape recorder then feeds it to a transmitter that transmits it to the next ground station. During these final simulation tests, they turned on both the transmitter and the tape recorder. The transmitter, low and behold, kills the tape recorder. Nothing intelligible came out of the tape recorder. There was a panic because that satellite had to be shipped in several weeks. If they didn't ship it, there would be a lot of penalties monetarily and they might lose their turn on the launching pad. So, they had a team of managers, including the Chief Engineer of the Division, trying to solve the problem. But they weren't using EMC principles. They kept turning the antenna of the transmitter around and kept trying to operate the tape recorder in a different way. None of these things worked. Then, someone remembered that several years ago I had worked in EMC. I was told to put a "bunny-suit" on and go in the clean area and see what I could do about this satellite. Of course, they didn't pay any attention to me at the time because I was just an engineer, and they were all high level managers. So after they got tired they all walked out. There was one manager there, the manager of the design review team (because at RCA Astro, before you could release a design for space it had to undergo a design review process). He asked me, "Can you really solve this problem?"

I said, "Gee...I haven't done this work for three years so I don't know whether or not I can solve it. But if you want me to try, I need several things. First of all, I need priority in purchasing. I don't want to go through any red tape to buy anything I need. Second, I need priority in the model shop; I want to be able to build a fixture over night and try it right away. Third, I need a mechanical engineer assigned to me so that whatever we come up with we can implement as a final design. He said, "You got it."

This tape recorder was actually a sealed unit because it had to be vacuum protected. That made it easy for me. We couldn't change the tape recorder, so, what we did is we designed an add-on box. This add-on box had three compartments; one compartment was for signal wires separated from the other two compartments. The second compartment was for command and control wires. The third compartment was for power signals. Each of the compartmental wires had to go through a bulkhead that was within this add-on unit. There were filters mounted on

the bulkhead and the filters were of different strength depending on whether it was a signal wire, or a command and control wire, or a power wire. Then the big day came. We turned on both the tape recorder and the data transmitter and it worked (readable data was coming from the tape recorder). Somebody said, “Oh, I bet someone forgot to turn the transmitter on.” The transmitter was turned on...and it worked.

Following that, I became the go-to guy. Whenever there was an EMC problem they came to me. Whenever there was a proposal, they put my name in the proposal. I came up with a set of ground rules for EMC principles that the division had to follow. I got the blessing of the chief engineer that they had to be followed. Twenty years later, when I left RCA to retire, they were still following those EMC principles. This really helped me because several weeks after this event I went back to work as a Reliability Engineer; that was my job. Two weeks later I got a commendation letter. Several months later I got a call from the chief engineer’s office. I was invited to a dinner and I was to bring my wife. I was presented with an engineering excellence achievement award.

This helped me in other ways. There was a brutal layoff later on and since I had received this engineering excellence award they couldn’t lay me off, so I survived. What happened later on, I believe happened because of the recognition I received from this event. I became a group manager where I had responsibility for parts engineering, both passive parts and active parts, and for materials engineering. I was also responsible for reliability analyses and predictions, and for the failure analysis lab. And, yes, last but not least I was also responsible for EMC.

(Taken from “EMC War Story – by EMC Society Founder Vincent Mancino”, in the IEEE EMC Society Newsletter, Issue 216, “Winter 2008”, April 2008, page 60, www.emcs.org/acstrial/newsletters/winter08/war_story.html)

667) HDMI fails to meet the demands of low EMI

In recent years, the popularity of high-definition, multi-channel audio and video has grown rapidly. Radiation resulting from transmission of high-definition, multi-channel audio and video data at high frequencies often interferes with the operation of surrounding digital circuitry. Most existing audio video connectors and cables fail to meet the demands of low EMI at today’s and near future high clock and data speeds. One such existing connector intended for transmission of high definition multi-channel video and audio data is the High Definition Multimedia interface, which fails to meet the EMI requirements at high clock speeds.

(Taken from “Effects of skew on EMI for HDMI connectors and cables”, By Chaitanya Sreerama of Intel Corporation, Hillsboro, USA, in a paper presented at the IEEE 2006 International EMC Symposium, Portland, Oregon, USA, in August 2006, Conference Record: ISBN: 1-4244-0294-8, http://ieeexplore.ieee.org/iel5/11175/36004/01706346.pdf?arnumber=1706346)

668) How vulnerable are we to GPS jamming?

‘At the next left, you have arrived at the wrong destination!’ Just how vulnerable are we to the loss of GPS signals, and what can we do to reduce the risk from natural or malicious jamming? Christine Evans-Pughe finds out.

In January 2007 Captain Matthew Blizard, commander of the US Coast Guard Centre of Excellence for navigation (NAVCEN), reported the loss of GPS signals in the port of San Diego. Not only had the navigation equipment for general aviation stopped working but local telephone switches and cellular telephone operations were disrupted, and the hospital’s mobile paging system went down.

It took Blizard and his colleagues three days to pinpoint the source – a two-hour US Navy training exercise in communications jamming between tow ships in the area. When the Navy technicians found problems with the GPS systems on the ship under attack, they stopped the exercise but didn’t report the incident beyond their usual channels. No one told the GPS Operations Centre in Colorado (GPSOC) or VAVCEN about the exercise because the jamming was not meant to be in the GPS L-band.

A GPS jamming attack on the ship THV Galatea two years later off Newcastle-upon-Tyne showed some of the more subtle effects of jamming. Under low-power jamming, at about the

same level as the real GPS signal, the ship's GPS-driven bridge instruments showed plausible but wrong positions and velocities. No alarms went off to indicate malfunction. As the jammer power was turned up, all the GPS-fed systems failed including the electronic chart display, the autopilot, the maritime distress safety system, the radar, the gyro-compass and the Automatic Identification System, according to the General Lighthouse Authority who conducted the trial.

Vulnerabilities

If the Royal Academy of Engineering's recent headline-grabbing report 'Global Navigation Space Systems: reliance and vulnerabilities' is anything to go by, such scenarios are becoming more likely because of the availability of cheap GPS jammers. A £40, 10mW device bought off the internet, for instance, could stop a handheld receiver anything up to 10km away from acquiring a GPS lock. In the US, for example, one truck driver who didn't want his bosses knowing where he was used a jammer in his cab and caused daily interruptions to a GPS navigation system used by Newark airport in New Jersey.

One sign that the RAE's concerns are well founded is that the MoD has this year opened up its GPS jamming trials, which are usually for navigational warfare tests, to academia and industry. Qinetiq will be providing systems to generate a variety of signals for the session, which will take place at Sennybridge in the Brecon Beacons, Wales, between May and June.

"We need the hilly terrain so we can keep the jamming signals low. By putting the jammers close to the antennas, we can even operate in two or three different areas at the same time down in the valley," Qinetiq's business manager Peter Soar told a meeting in March about GNSS vulnerabilities at the UK's National Physical Laboratory.

Reflecting US government concerns about the economic impact of the disruption or loss of GPS signals, the US Department of Homeland Security has just surveyed 15 critical infrastructure sectors and found GPS essential to 11 of them, although it took many months to reach that conclusion, according to James Calverly, the Department of Homeland Security's director of outreach.

Position and time

GPS signals are used extensively as an accurate timing source, which was why telecoms and paging networks were affected by the San Diego Port incident. During the 2007 JAMFEST trial held at America's White Sands Missile Range, a series of 30-minute tests on GPS-disciplined quartz and rubidium oscillators showed all of them would have drifted outside the 1 x 1011 frequency offset requirements of the Stratum 1 clocks used to synchronise telecommunications systems in less than an hour, under every jamming scenario.

Power distribution networks, banking and financial trading system, broadcasting and industrial-control networks all use GPS timing in this way too, making them equally vulnerable to unintentional or deliberate (the civilian equivalent of navigational warfare) interference.

"The financial markets, for instance, rely on a globally synchronised time-stamping mechanism to ensure fair trading," explains the RAE report's author, Dr Martyn Thomas. "Trading systems might be detecting very small differences in prices between commodities on different exchanges and buying in high volume on one and selling on the other. Since lots of people are in competition trading on different continents, for these activities to work you need to know whose order is getting in first."

For these reasons, efforts are underway to encourage the use of back-up timing sources and to put in place ways of detecting, locations and mitigating sources of interference.

(Taken from "Jam Today", by Christine Evans-Pughe, IET Engineering & Technology, May 2011, pp 78-81, www.EandTmagazine.com)

669) The ultimate EM threat – "killer stars" – overload satellites' electronics

We know of well over 1000 pulsars. The number of quiet neutron stars must be vastly more. Even at the present rate of star formation, given the 10-billion-year life of the Galaxy's disk,

there should be at least 100 million of them. There is probably one nearby, sliding silently past us, of no danger whatsoever.

The tiniest fraction, fewer than 20 known, are the extraordinary magnetars, which have magnetic fields so powerful as to be lethal at a distance of 1000 kilometers. Though they ally themselves with the remnants of supernovae, how they are created is uncertain. One strong suggestion is that they are the progeny of the most massive of stars, which lose so much matter through winds as they evolve as hypergaints that they don't have enough mass left to become black holes. If the progenitor stars were rapidly spinning so as to create the intense magnetic fields, they turn into magnetars instead. But, once again, we really don't know.

We do know the effects they can have, however. As spins of ordinary pulsars slow (the one in the Crab being a prime example), they undergo periodic "glitches" in which the rotations suddenly—and temporarily—speed up. The cause is thought to be a relatively modest "starquake", in which the strong magnetic fields re-adjust the neutron-star outer crusts. Magnetars, with magnetic fields up to 1000 times those of ordinary pulsars, take this behaviour to an extraordinary extreme.

As rare as magnetars are, they have an even rarer subset known as "soft gamma-ray repeaters", or (to add to the alphabet soup) SGRs. Only five are known, and one of these is in our nearby companion galaxy, the Large Megellanic Cloud. Brief X-ray pulses reveal them to be long-period (many seconds) pulsars, placing them in the magnetar clan. If the Crab pulsar has a thing called "starquake", it's hard to know what word to use for these things.

On August 27, 1998, SGR 1900+14 in Aquila (the numbers are coordinates) launched one of the greatest stellar attacks ever seen on Earth, from a mega-starquake, in which twisted magnetic fields attempting to re-align themselves cracked the magnetar's crust. In a pulse that lasted less than a second, the resulting flood of gamma rays hitting us overloaded satellites' electronics, and amazingly ionised the Earth's upper atmosphere. Within a few hundred seconds, the event and its aftermath were all over with. SGR 1900+14 is 20,000 light-years away.

On December 27, 2004, SGR 1806-20 (in Sagittarius) outdid its Auila cousin by a factor of 100. For a brief instant, a couple tenths of a second, an outburst of energy the equivalent of half a million years'-worth of sunlight shone on us with the apparent light of more than a full moon (in gamma rays: you could not have seen it). Once again, many satellites and the upper air took a huge hit. SGR 1806+20 is estimated to be 50,000 light-years away, on the other side of the Galaxy. And it was not the first time! The magnetar had previously popped in 1974. And it will most likely do it again before these pages turn brittle with age.

(Taken from "Heaven's Touch – from killer stars to the seeds of life, how we are connected to the universe", by James B Kaler, Princeton University Press 2009, ISBN: 978-0-691-12946-4.)

670) How EMI can become a problem

Electromagnetic Interference (EMI) can become a problem when emitted electromagnetic fields interfere with the operation of other electronic equipment. Electromagnetic fields are radiated from sources such as equipment for television, cellular telephone, radio communication, computer, radar, and other devices. EMI could also take place due to distant sources such as radio transmitters, antennas, and lightning, which make incident electromagnetic fields similar to plane waves.

Common examples of EMI include disturbances in television reception, mobile communication equipment, medical, military, and aircraft devices, in which interference could disturb or jam sensitive components, destroy electric circuits, and prompt explosions and accidents.

(Taken from: "Simple device for electromagnetic interference shielding effectiveness measurement", by Horacio Vasquez, Laura Espinoza, Karen Lozana, Heinrich Folz and Shuying Yang, IEEE EMC Society Newsletter, Issue 220, "Winter 2009", www.emcs.org/acstrial/newsletters/winter09/pp2.pdf)

671) Lightning strikes to aircraft still an expensive and important problem

As aircraft safety becomes more and more critical, the risk of lightning strikes is becoming a more important problem for designers. Hannah Jeffrey looks at a new test regime that allows the effects of such an event to be simulated.

On average every civil aircraft is struck by lightning once a year. That may not sound serious – most passengers would suggest there are more pressing things to worry about when flying these days besides the chance of a lightning strike – however (sufferers of aviophobia – fear of flying – should look away now), lightning can cause planes to fall out of the sky. "The first known example I have is a Boeing 747, which was hit by lightning over Madrid in the 1970s or late 60s," says Chris Jones, technologist consultant in the electromagnetic engineering department of BAE Systems. "It literally just fell out of the sky when the wing exploded. It may not happen that often but the potential for damage is quite serious." He suggests this is also a significant problem for military aircraft: "Strike rates for planes carrying out military roles vary – the Nimrod flies close to the sea in rigid patterns, so it can have a high strike rate, but Eurofighters don't tend to fly where they could be high by lightning." Accidents do of course happen, but, scaremongering aside, serious electrical faults can be caused by lightning strikes and, as electronic systems within aircraft become more numerous and increasingly safety critical, this is progressively becoming a more important problem for designers and manufacturers in the aerospace industry to consider. "You have tens of boxes with hundreds of functions," says Jones, "and for many of these just interrupting their function could result in the loss of the aircraft. But also we are using more carbon fibre composites in the construction of aircraft now, particularly in military aircraft. Whereas the aluminium previously used was more like a solid wall and you only had to worry about holes in the – it reflected most of the energy – carbon fibre is more like a window, so you're letting some of the energy through. There is therefore an increased possibility of damage and the aircraft is more vulnerable."

Testing

According to Jones, "Civil aviation regulations require a plane to be safe for 1011 flying hours at least and the figures are similar for military craft." However, it is more expensive to test military aircraft and yet, because their electronic systems are often much more complicated and sensitive than those in civil aircraft, they can require more rigorous testing. Until recently in the UK, says Jones, "Military aircraft testing of this sort was carried out quite haphazardly. In this country it was only really in the process of research that it was considered. I only know of the experimental version of the Jaguar fly-by-wire and the prototype Eurofighter being tested. Before, there was no lightning clearance, only electromagnetic compatibility." (EMC – the requirement that electrical equipment resist the influence of electromagnetic emissions in the surrounding environment and not generate interference itself, in order to comply with certain standards). He continues: "You had to make assumptions but these were reasonable assumptions. Nevertheless, in the late 1970s NATO countries lost on average one plane a year." Lately we have been doing better, he reassures, but this is still an expensive and important problem.

(Taken from "Strike it lucky" by Hannah Jeffreys, Engineering magazine, Aerospace section, www.engineeringmagazine.co.uk. Sorry, the date of the reference has been lost, probably 2008 or 2009 - Editor.)

672) Some types of MR16 LED lamps interfere with DAB radio reception

To Peter Metcalfe of Metecc, August 19, 2011 at 16:59:59

I have been advised to contact you as you have done extensive testing on LED lights for Trading Standards. I would like to know what types of MR16 LED lights do NOT destroy the DAB radio signal in my house. (I have just bought 30 MR16s and whenever I switch any of them on, the DAB radio loses signal and is useless. I also get some mild interference on the FM radio.

To Peter Metcalfe of Metecc, 21 August 2011 at 12:32

Thank you for your comprehensive response.

Yes, I discovered that the 230V LEDs are fine - I bought 36 of them from the same company (internet / mail order), and they have not caused any problems with my radio. They are GU10 80 LED by Mirrorstone.

The problem bulbs are MR16 LEDs - I bought 9 x 4W and 21 x 6W. They came in a small unmarked white box, no manufacturer shown, and just marked CE and RoHS. They don't show AC/DC.

I shall certainly take your advice and return the MR16 LEDs tomorrow, and demand my money back. The company has already said that they would be happy to do that, but, given that they have been 100% helpful so far, I wanted to give them a chance to find some non DAB interfering MR16 LEDs to sell to me.

The company told me that it was unaware of the DAB interference issue, and was going back to its supplier / manufacturer. The company also told me it was not aware of any regulations regarding compliance with radio interference. (By the way, if they do tell me they have found non DAB interfering LED bulbs, how can I tell if that is true, short of buying them and trying them? What marking / Standard should be shown to prove compliance with UK Law?)

From what you have said, it sounds like I shall either need to put up with the cost of running the MR16 Halogens, or I shall need to get an electrician in to adapt the MR16 fittings so they can take GU10 LEDs - by removing the transformer. Do you have any better suggestion?

I spent a lot of Friday trying to find someone who was knowledgeable about this issue. The order of my enquiries was as follows – each one suggesting the next one:

a) The Consumers Association (Which?)

b) Ofcom

c) Consumer Direct

d) British Standards Institute (who first suggested Trading Standards, but I noted that their phone number was the same as Consumer Direct)

e) UKAS

f) NEMKO Ltd

g) Hursley EMC, where Julian Jones suggested that I contact you.

Thank you again for your help. I would be very interested to hear your suggestion for a solution to the problem of replacing MR16 Halogens. Meanwhile I shall speak again to those companies I spoke to on Friday and try to interest them in this issue, as I don't want anyone else caught out in the same way. Equally I would be upset if my neighbours in adjoining houses did the same and knocked out my DAB. I am going to ask them whether their DABs have been affected in the last week, and apologise if necessary.

To Peter Metcalfe of Mettec, 21 August 2011 at 17:11

I just switched on all the MR16s, and found that one of my neighbours (the other one doesn't have DAB) had no reception. I then switched them all off again, and DAB reception in his house was fine again.

(Extracts from an email correspondence forwarded to Banana Skins by Peter Metcalfe of Mettec, www.metecc.eu, the other party wished to remain anonymous.)

673) European Space Agency Shuts Down Illegal Transmitters

An international effort to shut down radio signals that have occasionally been blocking the instrument on ESA's Soil Moisture and Ocean Salinity (SMOS) water satellite is improving the quality of the mission's data.

The SMOS satellite carries a passive radiometer that operates in the 1400–1427 MHz frequency range (L-band) of the electromagnetic spectrum. It shows 'brightness temperature' that corresponds to microwave radiation emitted from Earth's surface. From this information,

the amount of moisture held in the surface layers of soil and salinity in the surface waters of the oceans.

According to radio regulations set by the International Telecommunications Union (ITU), 1400–1427 MHz is alloted to the Earth Exploration Satellite Service, space research and radio astronomy; other transmissions in this band are prohibited.

Soon after SMOS was launched, the data revealed there were many signals being transmitted within this protected passive band, rendering some of the data unusable for scientific purposes. The mission has not been reaching its full potential because significant amounts of data have had to be discarded.

As a result of ESA's strategies, 90 of these transmitters have been turned off. Most of these were in Europe but investigations continue in more than 35 countries worldwide.

(Copied from Interference Technology Magazine, www.interferencetechnology.com/lead-news/article/european-space-agency-shuts-down-illegal-transmitters.html, 06/15/11 04:58 PM. Learn more from: www.redorbit.com/news/space/2064081/smos_gains_clearer_view_as_illegal_transmitters_sut_down/)

674) Military radios interfering with garage door openers

US homeowners are encountering some unusual problems with their garage doors. The Pentagon may be to blame. Not because of any grand conspiracy theory, but rather the mundane use of a radio frequency the military hadn't used much before.

US homeowners in coastal Orange County, California, are among the latest to discover this quirk. There, signals from Naval Weapons Station Seal Beach have been interfering with garage door openers as far as half a mile (0.8 kilometres) away since March.

That's when testing began on a new radio system that will allow the base to network with local fire and police agencies during emergencies. The frequency falls in the range of 380-399.9 MHz, a band long reserved for the Department of Defence but rarely used.

"We hadn't had the need to use these frequencies before. As a result, garage door manufacturers began using them because they were pretty quiet," said Gregg Smith, a spokesman for the Navy station. "With the explosion of communications technology over the past 20 years, the DOD has been squeezed to use bands it didn't need to use before."

Reports of interference with garage door openers near military installations have been reported from Rhode Island to San Diego to Hawaii.

"Out of the blue, the garage door just stopped working," said Bill Davey, 51, of Norco. "We changed all the batteries in the remotes. When it still didn't work, it was like 'What's going on here?'"

The culprit was a Navy installation a quarter-mile (0.4 kilometres) away.

The Federal Communications Commission allows the so-called unlicensed use of frequencies for low-power purposes such as garage door openers and vehicle key fobs as long as they don't interfere with government communications systems, Smith said.

Smith said he's fielded 16 complaints from people near the Seal Beach base, but he assumes the interference is affecting many more. People can buy a device to retrofit their openers to another frequency; Davey's cost $US60.

"Once you explain how it all works, folks aren't happy, but they've been understanding," Smith said.

(Kindly sent in by Chris Zombolas, of EMC Technologies Pty Ltd, who operate EMC test labs in Melbourne and Sydney, Australia, and Auckland, New Zealand. Written by Mike Anton of the Los Angeles Times, reported in the Sydney Morning Herald, June 3, 2011 - 8:38AM, www.smh.com.au/technology/technology-news/military-radios-interfering-with-garage-door-openers-20110602-1fj5d.html. Read more: www.smh.com.au/technology/technology-news/military-radios-interfering-with-garage-door-openers-20110602-

1fj5d.html#ixzz1OCjQqMdb. Also reported by Interference Technology Magazine at: www.interferencetechnology.com/lead-news/article/seal-beach-navy-transmitters-control-residents-garage-doors.html as "Seal Beach Navy Transmitters Control Residents' Garage Doors" posted 06/01/11 09:06 AM, which referred to an ABC article: http://abclocal.go.com/kabc/story?section=news/local/orange_county&id=8157525&rss=rss-kabc-article-8157525)

675) Excessive emissions from Plasma TVs despite passing relevant tests

22 September 2011 at 08:42

Hi John and Keith. On a different subject I recently had to complain to OFCOM about noise across the lower HF spectrum at home (roughly 1.5 to 6 MHz), the problem turned out to be 2 plasma TV's, the level being radiated was similar to PLT. OFCOM walked away from this Plasma TV problem saying there was nothing they could do. Best regards, Tim.

22 September 2011 at 09:25

Hi Tim and Keith. CISPR are aware of this issue. Radiated emissions from plasma TVs below 30 MHz has been a concern for a couple of years. It's a difficult challenge from a standards point of view.

However, this seems like further evidence that OFCOM are relinquishing their responsibilities regarding EMC/interference. Best regards, John.

22 September 2011 at 09:40

Hello John and Keith. The attitude of OFCOM was that the TVs in question exhibited the CE mark, one was a LG set, not sure about the other, they may well have passed Radiated Emissions above 30MHz and Conducted below, but because the standard does not call up a radiated emissions test below 30MHz then the equipment must be OK even though the devices are causing significant spectrum pollution.

It's interesting to note that Panasonic do acknowledge that they have a problem and in some cases have removed and replaced the offending sets. Best regards, Tim.

22 September 2011 at 12:26:16

Hello Tim and Keith. That is exactly the issue with large plasma TVs. They pass the testing in EN 55013 (radiated above 30 MHz and conducted below). They are perfectly compliant with the standards and the many TV manufacturers that I know are highly responsible in making sure their products do meet standards. However, the discharge arcing of the plasma is causing radiation below 30 MHz, which is not picked up in the tests of EN 55013.

The problems CISPR have is to create a test for near field measurements (electric or magnetic or both). Where to measure, repeatability issues and various other issues are in the mix also. Best regards, John.

24 Sep 2011

Hello Keith and Tim. This issue has been discussed several times at BSI, not just in CISPR. The concern to address this also seems to be fading because plasma TVs are now considered to be old technology with the recent advances achieved in LED TV. I believe that many TV manufacturers are no longer making plasma TVs. Best regards, John.

(Extracted from an email discussion between Tim Hague of Amplifier Research, thague@arworld.us, John Davies of EMC Goggles, john-davies@emcgoggles.com, and Keith Armstrong, cherryclough@aol.com, the editor of Banana Skins.)

676) EU Spectrum Policy Does Not Answer Interference Questions

Latest negotiations that pave the way for a coherent set of rules on new spectrum use are poised to help the EU achieve the much talked about Digital Agenda. The Commission has made a clear call to Member States to put in place procedures to promote coexistence between new and existing services. But the latest text of the new Radio Spectrum Policy Programme (RSPP) falls short of capitalizing upon efficient use of spectrum if new services interfere with existing services.

The latest developments give hope that the European Commission wishes to promote competition, investment and the efficient use of spectrum. However, back in 2009, Cable Europe issued a call to the Commission and EU member states to take interference to a range of existing services into account. In the current absence of an answer of how to respond to potential interference, future spectrum challenges for consumers will need to be examined more closely.

Cable Europe published a News Release in Brussels on 15 November 2011, entitled "Getting European Spectrum Policy Right Through Coexistence — EU deal leaves key questions on coexistence between new & existing services unanswered; Who's responsible if new services create interference?"

In this document they said: "However, back in 2009, Cable Europe issued a call to the Commission and EU member states to take interference to a range of existing services into account. In the current absence of an answer of how to respond to potential interference, future spectrum challenges for consumers will need to be examined more closely."

"The interference issue is not new. It was signaled to the European Commission and national administrations as soon as it was identified," says Cable Europe Labs Managing Director, Peter Percosan. "Spectrum in Europe is something that almost every single EU citizen relies upon daily in some form. Given its importance, it is disappointing to see that interference has not been given adequate attention on the technical level. Technical bodies, such as CEPT, have an important role to play in ensuring coexistence. However, CEPT has not agreed to look into interference with consumer equipment as we anticipate new spectrum needs for new technologies such as cognitive radio. We all know that there will be a growing cocktail of devices and getting those to work together is critical for Europe and its Digital Agenda."

(Taken from www.interferencetechnology.com/standards-update/article/eu-spectrum-policy-does-not-answer-interference-questions.html 11/17/11 11:10 AM and www.cableeurope.eu/uploads/MediaRoom/documents/111115_gs_News%20Release_EU%20Spectrum%20developments%20FINAL.pdf.)

677) Electromagnetic Interference Enables/Disables GM Airbags; GM Forgets to Inform Customers

What happens when you put your iPad on the front passenger seat of a 2012 Buick Enclave?

That depends on which General Motors (GM) source you consult. In May, the automaker sent out a Technical Service Bulletin warning that when "certain electronic devices" such as computers, MP3 players and cell phones are placed in the front passenger seat of a wide range of recent models, the front passenger airbag indicator may illuminate, enabling the airbag, and activating the seatbelt reminder light and warning chime – due to electromagnetic interference (EMI). Even though that iPad only weighs 1.5 pounds, the seat sensor suddenly thinks that this designated seating position is occupied. More recently, an OnStar operator told a GM owner that if a passenger is seated in the right front seat with an electronic device in his or her lap, EMI may disable the airbag. In other words, if the sensor correctly perceives that an occupant is in the seat, then interference from the iPad tells the sensor to turn the airbag off. In complaints reported to SRS GM owners said electronic devices held by a front seat passenger turned off the passenger airbag.

"We called OnStar and spoke to a tech," said one owner. "He confirmed that this can be caused by cell phones and cell towers." If one consults the owner's manual of a 2012 Buick Enclave (which is among the models covered in the May 25 TSB), it warns: "The front passenger safety belt reminder light and chime may turn on if an object is put on the seat such as a briefcase, handbag, grocery bag, laptop, or other electronic device. To turn off the reminder light and/or chime, remove the object from the seat or buckle the safety belt." Is this a warning about lightweight objects triggering a seatbelt sensor? Does the seat sensor confuse an iPhone with an occupant too small for safe protection from the airbag? Or, more likely, is this an obfuscated EMI warning? The owner's manual is silent on this caution.

The May 25 TSB covers 12 models over the 2009-2012 model years. It warns “some electronic devices placed on the front passenger seat may interfere with the electric field generated by the PPS system, causing it to enable (turn ON) the passenger airbag and turn on the safety belt reminder light and chime” – even though the seat is not occupied.

The electronic device does not necessarily need to be turned on to cause this condition.” It also cautions techs: “Never rest the diagnostic scan tool or components on the passenger front seat or touch the passenger front seat while the diagnostic scan tool is in contact with your body. This may cause the SIR lamp to illuminate while holding the diagnostic scan tool because your body can transfer the electronic ‘noise’ to the sensor mat in the passenger front seat.” (This may explain what happens when a right front seat passenger uses a cell phone.)

The fix was to simply clear the codes – which could relate to a variety of error messages involving the seat sensor or the ECU – and send the customer on his way.

If the GM owner lives in the Texas Panhandle, however, the problem is worse, and requires a more intensive fix. On May 25, 2011, the automaker issued a second and unusual warning for techs in Texas. This TSB warned that the airbag warning light could behave erratically in the presence of EMI. “This condition may be caused by possible electromagnetic interference in the Amarillo, Texas area from external sources such as aviation airspace traffic radar, creating erratic sensor information to the SDM,” the bulletin said.

This TSB covered 18 models in the 2010 and 2011 model years. In this case, the techs were required to amend the sensor by adding ferrite clamp beads (Laird Part No. HFA100049-0A2) on either side of the inflatable restraint sensor wire harness.

There are several international voluntary standards and vehicle manufacturers have set their own criteria governing EMI, but no Federal Motor Vehicle Safety Standard. But as the world goes ever more wireless, are automakers and NHTSA keeping up?

According to EMI Expert Keith Armstrong, “some vehicle manufacturers’ standard tests only apply to the normal operating functions of the components and subsystems. For example, an airbag should not operate, a speedometer should show the correct speed within specified tolerances, etc., but they lack requirements to test the correct operation of safety systems, by stimulating them with a signal that should make them operate, and check that they always do operate as designed whilst exposed to EM disturbances.”

As the transformation of an automobile continues from a collection of mechanical parts to a computer on wheels with communication interfaces to non-vehicle wireless devices from the driver and passengers inside, or from sources outside the vehicle, today’s vehicles are expected to function correctly in a very noisy electrical environment.

(Taken from: The Safety Record, Volume 8, Issue 3, November 2011, published by Safety Research and Strategies, Inc., www.safetyresearch.net.)

678) Early mobile phone interfered with aircraft navigation

Vic Eliason, while remeniscing on the daily "VCY Today" on an American radio station VCY America, told of the early days. What has grown into VCY America began about 50 years ago with borrowed equipment - they did not even own a microphone stand.

Vic remembers their first cell-phone. It weighed about 9 lbs, and had a 5 watt transmitter. This made it useful for outside broadcasts. But they soon learned not to use it in an aircraft. It interfered with the navigation equipment, and every time they pressed the "TALK" button, the aeroplane would veer off course as the pilot adjusted to what the navigation instruments showed.

(Kindly sent in by Robert Higginson, a regular contributor to Banana Skins, who produced the above summary from memory immediately following the broadcast VCY Today on VCY America when presenter Vic Eliason reminisced about the early days of that station which began 50 years ago.)

679) RF susceptibility of Phantom II Aileron-Rudder Interconnect (ARI)

Like many UMR graduates, Doug went to St. Louis to work for McDonnell Aircraft, eventually McDonnell-Douglas, and now Boeing. Mr. Mac probably rolled over in his grave after the Boeing takeover/merger (many say that MacAir took over Boeing, but that is out of scope for this profile).

One of his most enduring of the MacAir educational experiences dealt with the RF susceptibility of position-transducer-fed flight control avionics. The Phantom II (F/RF-4) aircraft was in production during that era and included an Aileron-Rudder Interconnect (ARI) circuit.

Signals from position transducers on each aileron were added, amplified, and used to control a hydraulic valve to add a small amount of rudder when turning. The Wright Brothers had a mechanical method to do the same to connect their wing warp and rudder on the original Wright Flyer. The hip cradle controlled it – they literally flew by the seat of their pants.

Emissions from on-board communications transmitters would couple into the wiring between the aileron position transducers and the ARI amplifier at the vertical stabilizer base. It even happened once during an important sales flight when the Shah of Iran came to St. Louis to purchase some F-4s.

He was flying the back seat of an RF-4 and noted controls for the high-frequency (HF) radio. The Shah received permission from the pilot to operate aeronautical mobile on the HF ham bands using his ham radio license. It was embarrassing when his ham transmission caused the rudder to move.

Doug was taught that there is no such thing as an uncommanded flight control surface movement. Increased wire shielding and ARI amplifier filtering fixed the problem. Doug participated in the ARI and nine additional air safety investigations during his five years at MacAir.

(One of several anecdotes of aircraft EMI mentioned in "EMC Personality Profile — Introducing Douglas J. Hughes" by Bill Duff, Associate Editor, IEEE EMC Society Newsletter, Fall 2004, www.ieee.org/organizations/pubs/newsletters/emcs/fall04/personality.html. Doug is still involved in EMI investigations, as an independent, and his email is w3ho@aol.com.)

680) Reason why pilots ban use of personal electronics below 10,000 feet

In USA Today's "Ask the Captain" column, a reader challenged in-flight electronics rules, questioning whether electronics with low EMF emissions, such as electronic book readers, cell phones and computers, interfere with in flight instrumentation. The reader points out that American flights with GoGo inflight wireless access points are enabled throughout the flight. From takeoff to landing these wireless access points are continuously operating and emitting their wireless signals.

The concern of the FAA is that an electronic emitter could cause unintended consequences to navigation receivers or other aircraft systems, said John Cox, a retired airline captain with U.S. Airways who runs his own aviation safety consulting company. Ongoing changes in electronics make it very difficult to test all the devices to ensure their safety, and during some phases of flight, the navigation system is more sensitive than others, Cox said. "An example is during an approach for landing using the Instrument Landing System (ILS). The display uses microvolts to displace a needle showing the extended centerline of the runway. As the airplane flies the ILS course, the needle becomes more sensitive (think of it as a cone with the top of the cone at the runway)."

The FAA has developed criteria for electronic devices proving their safety, but it is much more difficult for the FAA to evaluate the effects of the use of untested electronics. Hence, the ban on all electronic devices below 10,000 feet.

(From "Retired Captain Answers Challenge to In-Flight Electronics Rules" at www.interferencetechnology.com/lead-news/article/retired-captain-answers-challenge-to-in-flight-electronics-rules.html, 10/05/11 03:25 PM, which references the original USA Today story

at:http://travel.usatoday.com/experts/cox/story/2011-10-03/Ask-the-Captain-A-reader-challenges-in-flight-electronics-rules/50634340/1?csp=Dailybriefing.)

681) Inflight Wi-Fi hits more turbulence

Inflight Wi-Fi and cellphone services - which transmit low power microwave radio signals within an aircraft's fuselage – have already been criticised by security engineers for providing a ready means for terrorists to remotely detonate explosives. Now the technology has been found to be interfering with flight critical electronics too.

This latest finding was made by Boeing while testing inflight Wi-Fi equipment for use on its next generation 737 twin-engined aircraft. The Seattle-based plane maker found that a certain type of new, brighter cockpit display made by Honeywell of Torrance, California, could go blank when an inflight wireless system, made by Aircell of Itasca, Illinois, was used nearby.

"Blanking of the display units was reported during electromagnetic interference certification testing of wireless broadband systems (Wi-Fi) on various 737NG airplanes," Boeing said in a statement issued today.

The firm adds it has not delivered any aircraft using the technology and will not activate any passenger Wi-Fi systems in future planes across its whole range of aircraft until Honeywell has made its new displays Wi-Fi proof.

In 2000, the British Civil Aviation Authority borrowed a couple of airliners - a Boeing 737 from British Airways and a 747 from Virgin Atlantic - and generated simulated GSM cellphone signals in them. As New Scientist reported, they found that avionics equipment in the cockpit were susceptible to high levels of interference - the first "scientific proof" there was an issue, said the CAA.

Commercial pressures to allow lucrative wireless services on board, however, led to the development of electromagnetic shielding standards for avionics equipment, designed to ensure that emerging portable electronic devices like smartphones and laptops using 3G and Wi-Fi connectivity did not cause problems.

It was while testing to the US Federal Aviation Administration's relevant standard that Boeing found the Aircell system interfering with the new "phase three" Honeywell multifunction cockpit displays, which are brighter then their predecessors.

The interference happened at Wi-Fi signal levels that are higher than is normally emitted by phones and laptops, Boeing says, but it is quite possible for consumer equipment not to perform to specification and kick out too much power - so no chances could be taken.

"We have identified a fix and are working to ensure that temporary blanking does not occur when displays are exposed to elevated levels of electrical energy," a Honeywell spokesman told New Scientist.

The FAA is on the case. "We are aware of some issues involving interference between Honeywell flight displays and in-flight Wi-Fi that surfaced during certification testing," says Les Dorr, FAA spokesman. "We are currently working with both manufacturers to examine the technical data and test results. After a thorough review, we will consider if further safety action is necessary."

(From "Inflight Wi-Fi hits more turbulence" by Paul Marks, New Scientist, 20:39 10 March 2011. www.newscientist.com/blogs/onepercent/2011/03/inflight-wi-fi-hits-more-turbu.html.)

682) My neighbour's telly has broken my car!

An £80 TV transmitter box is being blamed for 140 cases of car key fobs failing over the past year.

Ofcom says that the 'TV senders', which plug into a satellite receiver and send the signal wirelessly to other TVs in the house, can jam the key fobs of an entire street's worth of cars.

It happened recently on Dimond Road in Southampton, when residents were baffled one Saturday morning to find that their cars wouldn't unlock.

The amount of fobs that had simultaneously failed suggested that battery failure on each was too coincidental.

Ofcom was called out to investigate, and found that one house had a TV sender.

A spokesman said that a "leakage" from the device, transmitting at the same frequency as the key fobs, was to blame. It asked the resident to switch the faulty box off, which worked – all the fobs began to work again instantly.

According to Ofcom, it has to send teams of people door-knocking when a case is reported on a street, to see how many people have been affected and work out who has the offending box.

So the moral is: if your neighbor insists on watching Sky in his bedroom without paying for Multiroom, the least you can do is buy an old car...

(Kindly sent in by Sandy Armstrong, from AOL's autoblog, by Mark Nichol, Nov 4, 2011. This report closes the case reported below – dated 12 October 2011.)

Electronic car key fobs have mysteriously stopped working along part of a Southampton street, according to residents. On Saturday, people living on Dimond Road in the Bitterne Park area found their fobs would not open their cars.

Madeleine Wentworth said: "It's really annoying, I don't like not knowing what's causing it."

It is thought the problem is being caused by interference with the radio frequencies used by the fobs. Brian Deadman described it as "baffling" and said his key fob worked perfectly well away from Dimond Road.

Neighbours have speculated about the interference being caused by a mobile phone mast or the nearby Southampton International Airport. An airport spokesperson said it had not changed any of its frequencies.

Ofcom said residents could contact them and log a complaint which they would investigate to pinpoint the cause of the interference.

A spokesman said it was likely to be due to a signal from a malfunctioning electronic device "leaking" on to the spectrum of the key fobs.

AA technical specialist Steve Evans said the motoring organisation received about 40 call-outs over key fobs not working each month in the south – usually caused by flat fob or car batteries, or radio interference.

Mr Evans said: "If it is a problem with radio interference, try getting closer to the car and then try walking around the car - the receivers are placed in different places on different cars."

(Taken from: "Electronic car key fobs fail on Southampton street" *BBC News, Hampshire & Isle of Wight, 12 October 2011, 13:42 ET, www.bbc.co.uk/news/uk-england-hampshire-15278838. This was very kindly sent in on 13 October 2011 by Tim Williams of ELMAC Services, www.elmac.co.uk; Claire Ashman, EMC test lab assessor for the United Kingdom Assessment Service (UKAS), and Les McCormack of Atkins. Les also provided some solutions he was involved in some time ago, at: http://yorkemc.co.uk/research/low-power-radio/LPD_Guide.pdf, and http://yorkemc.co.uk/research/low-power-radio/LPR.pdf.)*

683) Domestic products interfere massively with AM and FM reception

"The article shows a very nice antenna. I've built several less sophisticated than that design already and they don't get the job done. What I really want to do is put an FM antenna on the roof complete with amplifiers and rotor.

The current system with any antenna in the room has to fight off local interference, especially from the new electric blanket.

It seems like FCC class B requirements are no longer being enforced, especially on cheap import products. The control on the electric blanket is the second new product we have gotten that massively interferes with all the radio broadcast bands, both FM and AM reception."

(Kindly supplied by Steve Webb of SELEX Galileo, on 18 October 2011, the second reply, from Ed Weldon: http://cr4.globalspec.com/thread/72947/FM-Radio-External-Antenna-Connector?frmtrk=cr4digest.)

684) M2M GSM module interferes with its own and a neighbouring machine

At the moment, our lab is facing the problem of an M2M (machine-to-machine) GSM module perturbing the machine itself !!! (The reason is bad termination of a shielded cable ... once more.) Also, it is perturbing a sensor on a nearby machine.

(Taken from private correspondence with Keith Armstrong, 20 September 2011. The author wishes to remain anonymous. M2M, like RFID, is a rapidly growing "business opportunity", and M2M suppliers estimate its global market size for GSM transmitters to be double that for cellphones, visit: en.wikipedia.org/wiki/M2M.)

The Editor writes: This Banana Skin highlights a very important issue for the RF immunity of safety-related electronic systems, until now designed to meet quite low RF field strengths, e.g. 3V/m or 10V/m, on the basis that operators will not use their cellphones or walkie-talkies nearby. This is called creating an "RF Exclusion Zone", and I doubt that they have ever worked very well unless actively and continuously enforced – see Banana Skin number 684 (below) and 651 (July 2011).

But with RFID readers soon being used almost everywhere for operational reasons, and M2M transmitters invisibly embedded into items of equipment, as well as wireless transmitters hidden in items that one doesn't think of as a cellphone or walkie-talkie (e.g. laptops, e-book readers) – the days of the RF Exclusion Zone are clearly numbered.

Philip Keebler of the prestigious EPRI thinks so, anyway, and he has written two articles in In Compliance magazine about what should replace it: "Eliminating the Need for Exclusion Zones in Nuclear Power Plants, Part 1", June 2011: www.incompliancemag.com/index.php?option=com_content&view=article&id=699:eliminatingthe-need-for-exclusion-zones-in-nuclear-power-plants&catid=26:design&Itemid=130, and "Part 2": 10 July 2011, www.incompliancemag.com/index.php?option=com_content&view=article&id=737:eliminating-the-need-for-exclusion-zones-in-nuclear-power-plants-part-2&catid=26:design&Itemid=130.

685) Russian Satellite Crash May Have Been Caused By EMI

A Russian Geo-IK-2 satellite launch failed "because of possible external electromagnetic interference from a sea-, land- or air-based source."

The satellite was launched by a rocket converted from a SS-19 intercontinental ballistic missile that apparently did its job sufficiently well, but an additional Briz-KM booster malfunctioned.

Finally, the Geo-IK-2 was boosted to an abnormal 370 to 1,020 km elliptical orbit. The satellite's solar batteries unfolded and contact was established, but it could not function properly.

A "reliable space industry source" told Interfax news agency that the Briz-KM booster failed during the Geo-IK-2 launch "because of possible external electromagnetic interference from a sea-, land- or air-based source" while the platform was on the other side of the globe out of sight of the Russian control center (Interfax, February 14). Of course, only the grand old enemy – the US – could have sabotaged the Geo-IK-2 launch by a presumed death-beam – to undermine Russia's possible GLONASS (GPS) independence.

(From http://www.interferencetechnology.com/lead-news/article/russian-satellite-crash-may-have-been-caused-by-emi.html, 03/09/11 02:16 PM and also from : http://politicom.moldova.org/news/russias-glonass-positioning-system-cannot-work-properly-217776-eng.html.)

686) Gym machines that throw runners off due to EMI

In a message dated 15/02/2012 10:53:16 GMT Standard Time, john-davies@emcgoggles.com writes:

I dealt with a real EMC problem where some running machines in gyms would suddenly stop unexpectedly, dangerously throwing their runners off the machines. After a bit of work I

discovered that heavy and slow runners were causing fluctuations on the mains supply. This in turn would cause a glitch in the software of other machines. The software was modified to be more robust and the problem was solved.

With a mains dips and interruptions generator, I was able to replicate the fluctuations produced by a heavy, slow runner, and I caused the running belt to stop. I was also able to observe that the software fix eliminated this problem.

If I recall correctly, the software fix was related to a "watch-dog" function.

In a message dated 16/02/2012 12:32:41 GMT Standard Time, richard.marshall99@btinternet.com writes:

More specifically, John's quoted problem is almost certainly associated with the determination of the zero-crossing point of the mains voltage waveform . The timing of this is being used for timing one (victim) machine's power control and is being disturbed by a strange current waveform being drawn by the other (culprit) machine.

The problem could have been fixed in either the analogue or digital domains. The analogue solution would have involved discrete components – possibly quite large ones. The digital solution would have involved a software phase-locked loop.

Over the years I have had two clients for whom this specific problem had very serious implications!

I do not see any conflict between my views from outside and John's view from inside. In the EMC world we often have to express opinions or take actions from inadequate data.

(Taken from an email thread with the permission of John Davies of EMC Goggles Ltd, www.emcgoggles.com, and Richard Marshall of Richard Marshall Ltd, www.design-emc.co.uk, both highly experienced and independent EMC expert consultants.)

687) Urban Wi-Fi interference

British telecom regulator Ofcom has commissioned a report that concludes that Wi-Fi performance in central London can be up to four times slower than that found in less densely populated areas.

Although users of Wi-Fi have blamed nearby networks for much of the interference in the 2.4-GHz Wi-Fi band, the authors of the report pin the primary sources of interference on cautious parents using analog baby monitors, tired citizens watching retransmitted TV in their bedrooms, and microwave ovens.

The report notes that in central London, there are too many networks with resends, beacons, and housekeeping filling 90 percent of the data frames sent over Wi-Fi, thus leaving only 10 percent for users' data.

Another source of Wi-Fi trouble is caused by London's "Free Public Wi-Fi" points that are sending out beacon frames ten times more frequently than they should (every 0.01204 seconds) resulting in a significant amount of traffic on the Wi-Fi band.

Further complicating the situation is the fact that the makers of inexpensive unlicensed devices such as analog baby monitors or remote switches have no real incentive to develop more expensive digital models that cause less interference.

The entire 93-page report can be viewed online at: http://stakeholders.ofcom.org.uk/market-data-research/technology-research/research/exempt/wifi/. "Estimating the utilisation of key license-exempt bands spectrum bands", Final report, Issue 3, April 2009, for Ofcom by Mass Consultants Ltd, Cambridge, UK, systems@mass.co.uk, MC/SC0710/REP003/3, 149 pages.

(From: http://www.interferencetechnology.com/news/top-stories/single-news-article/article/urban-wifi-interference.html)

688) Vacuum cleaner upsets burglar alarm system

I have just disposed of an Orek upright vacuum cleaner which we were given as every time I used it set off the internal alarm on our burglar alarm system which could only be turned off by a full power down reset by the engineer. Normal keyboard reset codes had no eefect.

The burglar alarm system is pre EMC Directive being around 15 years old. It was cheaper to buy a new vacuum cleaner than replace the alarm system. I certainly wasn't going to pull up the floorboards to harden the system.

(Kindly sent in on 18 Oct 2007 by Nigel Carter, now retired from QinietiQ.)

Ooops – this is a repeat of #517 !!!

689) Nintendo DS Health & Safety Precautions

WARNING - Radio Frequency Interference

The Nintendo DS can emit radio waves that can affect the operation of nearby electronics, including cardiac pacemakers.

- Do not operate the Nintendo DS within 9 inches of a pacemaker while using the wireless feature.
- If you have a pacemaker or other implanted medical device, do not use the wireless feature of the Nintendo DS without first consulting your physician or the manufacturer of your medical device.
- Observe and follow all regulations and rules regarding use of wireless devices in locations such as hospitals, airports, and on board aircraft. Operation in those locations may interfere with or cause malfunctions of equipment, with resulting injuries to persons or damage to property.

(From: http://www.nintendo.com/consumer/manuals/precautions_ds_english.jsp)

690) Ferry electronics out of control

Perhaps the most serious design failing was the lack of a backup power supply for the microprocessor. Whenever the CPU shut down temporarily during a power transient, it would start up again with its memory in a random state – and the ferry would be out of control. If the captain spotted the failure, he could switch to manual control, but no alarm existed for the condition.

Starting up a motor, or even putting a quarter in a vending machine on board with a faulty ground, was enough to trigger the failure, which in some instances disengaged the propellers, and in others, randomly changed the propeller blade angles. Moving the blades to certain positions could cause the ferry to reverse direction, but usually it would simply overload the engine and shut it down.

Intermixing of system grounds contributed to the problem. In one boat, a chafed wire grounded a circuit and made it possible to change propeller pitch by starting an engine or to start an engine by changing propeller pitch. Also, although drawings called for it, no shielding for electrical noise was installed on most cables.

Poor software and hardware documentation and inexplicable differences between ferries frustrated troubleshooting, Davis said.

Installing a dc power supply for the control system and software changes eliminated some of the more embarrassing failures, but problems persisted. Even though a pneumatic control system experimentally installed on a Issaquah-class boat in 1984 reacted more slowly than the digital system the digital system and required more periodic maintenance (replacing seals, for example), a 1986 Lockheed Shipbuilding Co. study recommended switching to pneumatics to improve reliability.

The agency chose a hybrid system that operates electrically from control handles to control cabinet to improve reaction time, but operates pneumatically from cabinet to propellers and engine governors, which would last longer because of gentler treatment.

After a trial last summer on one ferry, assistant deputy director Terry McCarthy said the agency was "ecstatic" about the success of the pneumatic system supplied by Mathers Contol Inc., Seattle, and has recently retrofitted another Issaquah ferry with the same system.

(Taken from IEEE Spectrum magazine, Feb 1990.)

691) Interference onboard the Crystal Ocean

The Crystal Ocean is an oil production storage and off take vessel that is moored (without anchors) over an oil well on the sea floor, using satellite positioning along with bow, stern and centre thrusters. Crude oil is pumped from the oil well and natural gas is separated and forced back into the well. The crude oil is then pumped to the shuttle tanker Basker Spirit, moored 1.5 km away.

Located on board the Crystal Ocean are 4 large diesel driven generators which power all of the vessels electrical systems including thrusters, pumps and hydraulics. The reliable operation of these generators is critical for positioning and operation of this vessel. UHF radios are used on board to enable the crew to communicate with each other. It had been observed by crew members that when these radios were used near the AC power generators, the generators would intermittently shut down without warning. Compliance Engineering Pty Ltd was called in to investigate and resolve this interference issue.

To enable investigations to be performed without impeding the vessels operation, one of the AC power generators was removed from service. A UHF radio was operated around this generator instigating a shut down. The UHF radio appeared to have the greatest effect when operated in the vicinity of electrical cabling attached to the generator. The amplitude and direction of the UHF radios signal was not configurable, and further investigations required a repeatable method of simulating and applying the interference to individual cables.

An RF Signal Generator (with variable output level and modulation capabilities), RF Power Amplifier and RF Injection Clamp were configured to form a controlled interference generating system (500 MHz with 1 kHz modulation). The interfering signal was applied to various cables, each of which caused the generator to cease operation. However, it made little difference as to which cable the interfering signal was applied to, as all cables appeared to efficiently cross couple the RF signal. During application of the simulated interference it was observed that the generators speed gauge behaved erratically, displaying a speed inconsistent with the actual rotational speed of the generator.

The generator was immobilised and the injection clamp positioned around the speed pickup sensor cable, above the metal housing of the flywheel. An oscilloscope was used to examine the control signals within the generator's junction box (with and without the interfering signal applied) to identify signals supplied to the PLC and Load Sharing/Speed Controller, located in the control room above. With the generator immobilised and with the interfering signal applied, a 5V signal was present on the output lines from the speed pickup sensors. It was evident that the interference was inducing a false speed signal, which was processed by the PLC and Load Sharing/Speed Controller.

The interference mechanism was identified:

The UHF radios carrier frequency (500 MHz) is coupled onto unshielded cabling (directly or indirectly via cross coupling) attached to the speed pickup sensors. The speed sensors internal amplifier circuit demodulates the carrier frequency rendering the modulation signal (1 kHz in this case). The modulation signal is then amplified and fed back to the PLC and Load Sharing/Speed Controllers, which interpret the signal to be outside normal operating conditions, forcing the generator to shut down.

Cables interconnecting the vessels generators and PLC and Load Sharing/Speed Controllers are all unshielded. Transients produced by high current switching on power cables may be induced onto signal lines, causing interference issues that have not been investigated.

Recommendations to remedy the interference were presented:

Initially the unshielded cables interconnecting between the speed pickup sensors and the PLC and Load Sharing/Speed Controllers should be replaced with twisted pair shielded cables. This is expected to provide a substantial improvement to the generators immunity to RF interference. At a later stage all unshielded cabling interconnecting the generators and their controllers should be replaced with twisted pair shielded cable, with the shield terminated at both ends. The speed sensors used have plastic female push connectors, which do not allow

for the cables shield to be terminated. The speed sensors should be upgraded to the FA2J version, which are fitted with a metal canon connector (14-5PN VG95234), providing a 360 degree termination for the cable shield.

It is commonly recognised that circuits which are the most prone to RF interference are typically those with sensitive analog inputs (as opposed to digital circuits), as has been observed in this example.

(Taken from: EMC Society of Australia, Newsletter, Issue 39, Dec 2007 and http://www.compeng.com.au/document_library/interference_onboard_crystal_ocean.aspx.)

692) Robot car loses GPS due to EMI from video screen

Not all went according to plan. Tartan Racing's winning vehicle refused to start, after its GPS receivers lost the signal from the satellites, and hence their ability to produce a reliable position estimate.

The problem was later traced to electro-magnetic interference from a large video screen nearby.

(Taken from: Engineering & Technology magazine, http://eandt.theiet.org, December 2007, page 11, describing a race for driverless vehicles.)

693) Cement mixer dumps load due to CB Radio interference

A cement truck complete with spinning mixer stops at an intersection. A semi, equipped with a CB radio pulls alongside and a convertible stops behind the cement truck.

While waiting for the light to change, the semi starts talking on his CB. The CB's signal activates the cement mixer, which dumps its load of wet cement into the convertible.

(Kindly sent in by Dr Antony Anderson, Dec 2007 – source: Jeff Bennett – Business writer, Detroit Free Press, 5 Dec 2002)

694) Airport navigation disrupted by domestic coffee machine

In the 1970s new domestic electronic Mr Coffee machines caused interference that disrupted the navigation systems at Baltimore and Washington DC airports and forced both airports to shut down for two hours every morning.

(Kindly sent in by Dr Antony Anderson, Dec 2007 – source: Jeff Bennett – Business writer, Detroit Free Press, 5 Dec 2002.

695) Black Hawk helicopter knocked out of the sky by radio waves

The Army's most advanced helicopter can be knocked out of the sky by routine radio waves from microwave towers, radio antennas and radars. Investigators believe that such radio waves made five of the army's UH-60 Black Hawks nose dive into the ground since 1982 killing 22 servicemen.

Navy Sea Hawks, with improved protection against electromagnetic interference, did not appear to suffer from the same problem.

(Kindly sent in by Dr Antony Anderson, Dec 2007 – source: The Boston Globe, 8 Nov 1987.)

696) Protecting valuable assets from CM currents

A typical application for the Sinus Filter Plus++ is for protecting the bearings of an underground pump motor used in a combined geothermal/solar panel heating system. The cable run from the frequency inverter to the pump is necessarily very long and the water column provides a low impedance path back to ground, which encourages current pulsing through the motor bearings. To replace or repair such a pump would also prove a very costly exercise. The filter is connected to the output terminals of the frequency inverter to reduce the damaging common-mode disturbances; the general EMC performance of the equipment is also greatly improved.

Bearing failure isn't the only problem that can be solved by applying Sinus Filter Plus++. Water abstraction bore holes are often sited in remote locations; in the middle of a forest for example, and the cable run to the pump motor is usually over a long distance. The high-frequency

common-mode disturbances flow back along the path of lowest impedance, to earth through the water pipe as shown in the diagram.

One of the conditions of the abstraction license is that an accurate record is maintained of the water pumped out of the bore hole. However, the high-frequency interference causes the metering equipment to give inaccurate measurements – a problem that can be solved by fitting the REO filter.

(Taken from: DPA Magazine, 1 Feb 2008, http://www.dpaonthenet.net/article/13506/Protecting-valuable-assets.aspx)

697) Ground based air-conditioning system interfered Aircraft communication channel

Abstract—This paper describes a very unusual cause of VHF band interference and the technique for how the source of radiation was determined. An electronic circuit that controls a motor driven air intake flap of an air-conditioner heat exchanger, “mutated” into a broadband VHF transmitter, jamming a large segment of the VHF band.

I. INTRODUCTION

Pilots on aircraft NATO 1 (N1) reported multiple squelch breaks on radio VHF 5. This specific feature occurred during taxi, takeoff and landing with the radio tuned to the main operating base Geilenkirchen tower frequency of 140.075 MHz. When the VHF radio squelch opened, a very loud buzzing was heard on the headset. Furthermore, this fault was reported only intermittently by the pilots, as it did not occur on some days. Because the phenomenon could not be isolated and eliminated in an adequate time frame, aircraft commanders refused to fly N1 until the problem was solved.

II. FACT-FINDING

A spectrum analyzer (SA) connected to the dual band antenna VHF 5 of N1 (parked at spot 10) showed a broad band of spectral lines cluttering above and below the tower frequency of 140.075 MHz (see Fig. 1). A similar measurement was done on the legacy aircraft 444, which was parked on spot 9 (see Fig. 2).

III. LOCATING THE SOURCE OF INTERFERENCE

In order to avoid a possible ground loop with the SA, the external power source and the ground potential of the aircraft, a battery operated DC to AC converter was used to apply power to the SA. All aircraft power was shut down and the aircraft power cable was disconnected. The test result was virtually the same as shown in Figure 1 above. It was now clear that the defect was an externally generated VHF band-jamming signal. The signal source was pinpointed to the area inside Hangar 1 by use of a handheld VHF band radio scanner. The buzzing signal was heard at all locations inside and in front of Hangar 1 and towards the runway. Hangar 1 is located 300 meters away from the center of the runway. However the buzzing signal could be received at both ends of the runway. The length of the runway is more than 3000 meters. With

the SA, a plot was taken inside Hangar 1 (see Fig. 3). The audio output of the handheld scanner was measured with an oscilloscope (see Fig. 4 and 5) in order to determine the modulation type of the interfering signal.

IV. FINDING THE SOURCE OF INTERFERENCE

In order to confirm that the signal source was located somewhere inside Hangar 1 it was decided to completely shut down the mains power from the adjacent Building 217 and Hangar 1 on the next day. The test result is shown in Fig. 6 and 7.

During the power shut down time of Hangar 1, a plot was also taken at the VHF 5 antenna on aircraft N1. The distance between the aircraft N1 and Hangar 1 is about 200 meters (see Fig. 8).

V. TRIANGULATE THE INTERFERENCE

The challenge was now to find the actual source that generated this kind of interference. With the assistance of the StOV-German Garrison Administration’s electricians and air conditioning specialists, Hangar 1 was powered down again. Power was reapplied to the Hangar in discrete

sections in an effort to localize the source. The interference returned when power was applied to the air conditioning system. The air conditioning specialists attempted to isolate the subsystem that was causing the interference. While the handheld scanner was monitored, various functions were switched off and back on. The interference coincided with power being removed and restored to the motor control circuit that moves a flap inside of one of the heat exchangers mounted on the roof of Hangar 1. Heat exchanger 24 was identified as the originator and was inspected on the roof of the building (see Fig. 9)

The motor driven air intake flaps control the airflow inside each of the heat exchangers. The suspected motor assembly was removed for further investigation (see Fig. 10).

All heat exchangers mounted on the roof were inspected with the handheld scanner. The results revealed a second assembly showing similar symptoms. It was also removed for further investigation.

The bench test for the above-mentioned flap controller confirmed that the electronic motor control circuitry had “mutated” to become a broad band VHF air band transmitter when the flap reached the mechanical limit at the flap open position (see Fig. 11 and 12).

VI. TROUBLESHOOTING THE MOTOR CONTROL UNIT

It was necessary to reengineer the schematic diagram of the circuit board in order to fully understand the circuit function of the motor control unit and to isolate the failing mechanism (see Fig. 13 and 16).

VII. OBSERVATIONS

The circuit operates with 24 VAC under normal conditions. When the circuit is operated with 24 VDC instead and the clockwise motor rotation is stopped, the circuit begins to oscillate at a stable frequency of 133.5 MHz (see Fig. 14).

VIII. FUNCTIONAL DESCRIPTION OF MOTOR CONTROL CIRCUIT AND TROUBLESHOOTING

The circuit consists of a constant current source, which supplies 50 mA of current to the connected DC motor. Connecting 24 VAC between KL2 pin 1 and 2 supplies 17 VDC across the motor terminals KL1 pin 1 and 2. The current is regulated to 50 mA and causes the motor to turn in a clockwise direction. The flap moves to the upper mechanical limit, which forces the motor to stop. The resistance across the motor decreases and, due to the current regulation of the voltage across the motor, drops to 7 VDC to prevent the motor from overloading. At that moment the circuit starts to oscillate at VHF frequencies. A 50 Hz (20ms) AC ripple is riding on the bias current to the base of transistor T1, which produces a combination of pulse and amplitude modulation.

This modulation generates multiple radio frequency side bands (see Fig. 11 and 12). Connecting 24 VAC between KL2 pin 1 and 3 supplies 17 VDC with reversed polarity across the motor terminals KL1 pin 1 and 2. The motor turns counterclockwise and the flap stops at the lower mechanical limit. No oscillation occurs at this point.

Troubleshooting the circuit was difficult because probing the circuit with an oscilloscope stopped the oscillation at almost any test point. For example, oscillation stopped when the emitter of T1 was measured. C1 and C2 were therefore removed for the measuring of their capacitance. Both values were well within limits. Reinstalling the capacitors in reverse positions stopped the oscillation at both mechanical flap stops. Measuring the equivalent series resistance (ESR) values indicated the location of the problem. C1 had a twice as high ESR as C2. In addition, the circuit board layout adds some instability due to the design of the trace between T1 and R4 (see Fig. 15).

IX. RF-COUPLING PATH

The electrical control central that provides power to all motor control circuits is located in a separate room inside Hangar 1. It supplies 24 VAC motor control signals and ground to the motor control circuits on the roof of Hangar 1 via unshielded cables (30 to 50 meters long vertically mounted). Measurements were taken with an RF-current probe at the cable that was

connected to the defective motor control circuit reviled, that the cable was the radiating element. This explained the large transmitting range of the oscillating circuitry.

X. CONCLUSION

Because of flight safety considerations the motor control units in all heat exchangers were replaced with a newer model.

BIOGRAPHY

Norbert Kohns was born in Weißenthurm, Germany, in 1949. For 25 years, he has been employed as a NATO civilian. Currently he serves as a Principal Technician and Maintenance Instructor of the NATO AWACS Electronic Support Measures shop, located at the NATO Airbase in Geilenkirchen, Germany.

In addition, he is the focal point of EMI/EMC related issues of the NATO E-3A fleet.

(Taken from the EMC Society Newsletter, Issue 215, Fall 2007, For the figures, see: http://www.emcs.org/acstrial/newsletters/fall07/practical_papers.pdf)

698) LORAN saved, provides backup when GPS interfered with

The Long Range Aid to Navigation (LORAN) system (originally LRN for Loomis Radio Navigation, after it's inventor, Alfred Lee Loomis) has been around for decades, with roots that go back to World War II and that era's naval warfare. Simply put, it is a terrestrial, radio-based navigation system that uses the time intervals between the reception of signals to triangulate a user's position.

The venerable system has modern value: the greater capabilities of the new enhanced Loran (eLoran) make it a much-needed independent, redundant backup to GPS, and one less susceptible to interference than GPS is.

(Taken from: GPS World, 8 Feb 2008. http://www.gpsworld.com/wireless/news/loran-saved-money-questions-remain-3849.)

699) Avoiding motor drive interference with TV filming and transmission

The fan itself sits in a plant room and is powered by a large ABB motor and a 160kW ABB low harmonic drive. This low harmonic specification is necessary to minimise interference with TV filming and transmission equipment used at all matches at the ground.

(Taken from an article about the engineering used in Arsenal's Emirates Stadium, in: The Engineer, 11-24 Feb 2008. http://www.theengineer.co.uk/news/gunning-for-perfection/304509.article.)

700) Quantum Consciousness and Energy Medicine

Energy-related practices have been around for many thousands of years within indigenous tribes and various cultures. 'Life as Energy' has even been a construct in our Western minds for millennia, but in the last century it has congealed as science through quantum physics. This advanced physics model reveals that we are electromagnetic fields. In the 21st century, quantum medicine is being applied for self-healing, and the possibilities are limitless.

We have yet to utilize these constructs fully, but we are slowly catching on. We know, for example, that there are energy frequencies which are harmful to us, like living under high power wires and being too close to TVs, computers and cell phones. We also know that some energy frequencies are helpful. Energy frequencies can be quite powerful tools for healing.

$E = mc^2$

'Ninety-nine percent of who you are is invisible and untouchable.' (R. Buckminster Fuller)

Einstein's physics presented us with the knowledge that everything in the universe is the energy of light. Matter is simply frozen light. We are not bodies with an energy field surrounding us, but expansive electromagnetic fields of light within which a small part of us vibrates at a visible frequency.

Within this vast field, there is a blueprint that holds the "tensegrity" or tensile structure of our Being together - from cells to cosmos. This set of interacting mathematical and geometric

shapes is called our sacred geometry. Quantum age energy medicine affects all levels of our electromagnetic fields - subatomic, cellular, physical, subtle, and spatial, including our geometric blueprint, the life force itself and beyond. It is able to do that merely by holding an expanded awareness.

(Taken from a webpage by Virginia Leslie, MA: http://home.mindspring.com/~kiva4/id4.html.)

(We always celebrate each 100th Banana Skin with something a little humorous – but perhaps we should be more sensitive, and say: something from outside the world of Electromagnetic Compatibility engineering!)

701) Snooping through the power socket

Power sockets can be used to eavesdrop on what people type on a computer. Security researchers found that poor shielding on some keyboard cables means useful data can be leaked about each character typed.

By analysing the information leaking onto power circuits, the researchers could see what a target was typing. The attack has been demonstrated to work at a distance of up to 15m, but refinement may mean it could work over much longer distances.

Hotel attack: 'Our goal is to show that information leaks in the most unexpected ways and can be retrieved," wrote Andrea Barisani and Daniele Bianco, of security firm Inverse Path, in a paper describing their work.

The research focused on the cables used to connect PS/2 keyboards to desktop PCs. Usefully, said the pair, the six wires inside a PS/2 cable are typically "close to each other and poorly shielded". This means that information travelling along the data wire, when a key is pressed, leaks onto the earth wire in the same cable. The earth wire, via the PC's power unit, ultimately connects to the plug in the power socket, and from there information leaks out onto the circuit supplying electricity to a room.

Even better, said the researchers, data travels along PS/2 cables one bit at a time and uses a clock speed far lower than any other PC component. Both these qualities make it easy to pick out voltage changes caused by key presses.

A digital oscilloscope was used to gather data about voltage changes on a power line and filters were used to remove those caused by anything other than the keyboard.

"The PS/2 signal square wave is preserved with good quality... and can be decoded back to the original keystroke information," wrote the pair in a paper describing their work. They demonstrated it working over distances of 1, 5, 10 and 15m from a target, far enough to suggest it could work in a hotel or office.

"The tests performed in the laboratory represent a worst case scenario for this type of measurement, which along with acceptable results emphasizes the feasibility of the attack on normal conditions," they added. The pair said their research was "work in progress" and expect the equipment to get more sensitive as it is refined. The attack is due to be demonstrated at the Black Hat conference that takes place in Las Vegas from 25-30 July.

(Taken from: BBC News 13 July 2009. http://news.bbc.co.uk/1/hi/technology/8147534.stm)

702) In-flight calls still on hold

As the summer holiday season begins, the UK Civil Aviation Authority (CAA) is reminding air passengers that using mobile phones is still forbidden on nearly all flights.

Although some airlines have introduced 'mobile phone systems' on a number of their aircraft, the use of mobile phones generally remains prohibited on the majority of aircraft.

Passengers who find themselves on board an aircraft modified to allow mobile phone use will be informed by the cabin crew and given instructions on how and where their phone can be used.

Any passenger who disobeys a cabin crew instruction to turn off a mobile phone is committing an offence, which could result in prosecution.

Research carried out by the CAA found that the use of mobile telephones can adversely affect navigation and communication functions, producing significant errors on instrument displays and background noise on pilot radios. The research endorses evidence from pilots, who have complained that interference from mobiles has caused:

- False notification of unsafe conditions, e.g. false baggage compartment smoke alarm warnings;
- Malfunction of aircraft systems;
- Interrupted communications due to noise in the flight crew headphones; and
- Distraction of crews from their normal duties due to increased work levels and the possibility of having to invoke emergency drills.

Bob Jones, Head of Flight Operations at the CAA, said: "The safety risks of using a mobile on board an aircraft are well-established. Yes, some airlines are currently testing various systems, but this does not weaken in any way the ban on phones being used on board the vast majority of UK aircraft."

"Unless specifically told otherwise, passengers must not text or phone while the cabin doors of an aircraft are closed. Safety is the number one concern of the aviation industry, therefore mobile phones will remain banned until the technology that allows their safe use is installed."

Notes to Editors:

- BMI, Ryanair, Air France, TAP Portugal, Qantas, Emirates and British Airways are among the airlines currently using or planning to trial on-board mobile phone systems on some aircraft. These trials are being closely monitored by the relevant aviation safety regulators.
- Some other airlines allow the use of mobile phones on-board if they can be put in 'flight mode', which disables any calls and texts. However, like any electronic device, these should still be turned off for take-off and landing and when instructed.
- Detailed research on the effects of mobile phones on aircraft electronic systems carried out by the CAA can be found at http://www.caa.co.uk/docs/33/capap2003_03.pdf
- The CAA is the UK's specialist aviation regulator. Its activities include: making sure that the aviation industry meets the highest technical and operational safety standards; preventing holidaymakers from being stranded abroad or losing money because of tour operator insolvency; planning and regulating all UK airspace; and regulating airports, air traffic services and airlines and providing advice on aviation policy from an economic standpoint.

(Taken from the CAA report dated 16 June 2009: http://www.caa.co.uk/application.aspx?catid=14&pagetype=65&appid=7&newstype=n&mode=detail&nid=1776)

703) Could Smart Technology Imperil the Power Grid?

Advanced electrical meters and other smart grid devices may help cut electricity consumption in homes and businesses, but some are worried this technology may also make the nation's power network more vulnerable to attack.

Experts are warning that the government will step in unless the power industry protects itself from certain threats, such as a major solar storm that triggers an electromagnetic pulse in the atmosphere, disabling all satellite, radio and telephone communications and causing nationwide power blackouts.

From: Interference Technology, 4/6/2012, http://72.29.76.194/~interfer/could-smart-technology-imperil-power-grid. Visit the Mother Nature Network to learn more. http://www.mnn.com/earth-matters/politics/stories/smart-technology-may-increase-grids-vulnerability)

704) House Subcommittee Cautions on EMP and Cyber-Attacks

On Tuesday, July 21, 2009, a subcommittee of the U.S. House of Representatives' Committee on Homeland Security heard testimony about the nation's vulnerability to an EMP (electromagnetic pulse) attack or a cyber-attack on power grids.

The Subcommittee on Emerging Threats, Cybersecurity, and Science and Technology heard from witnesses drawn from both industry and government about precautions, or lack thereof, for protecting the U.S. infrastructure from the massive interference and disruption that would result from detonating an atomic device causing a burst of radiation (EMP) or from an attack launched by "hackers" to paralyze modern life and commerce by compromising the computer-based controls of electric power suppliers—events that could disrupt commerce, communications, and all the conveniences that are the underpinnings of modern life.

Both subcommittee chair Yvette Clarke (D, NY) and Homeland Security chair Benny G. Thompson (D, MS) gave sobering reports on the current state of preparedness. Rep. Clarke indicated that after a three-year study, the members had reached one conclusion. "The electric industry has failed to appropriately protect against the threats we face in the 21st Century."

Rep. Thompson noted, "There is a massive computer espionage campaign being launched against the United States by our adversaries. Intelligence suggests that countries seek or have developed weapons capable of destroying our grid." Find the complete list of witnesses and a video transcript of the hearing on the Committee website.

(From: Interference Technology, 4/6/2012, http://72.29.76.194/~interfer/house-subcommittee-cautions-on-emp-and-cyber-attacks)

705) Examples of incompatibility with EE&CS limits from testing

Careful study and analysis of conducted train emissions can give a lot of information about the train's compatibility or otherwise with EE&CS limits. Some examples are given here where there were incompatibilities identified from train testing for a variety of track circuit types operating at various frequencies. These examples are all from outside of the UK.

Figure 3 is an interesting example of the noise measured across an FS2500 track circuit intermediate receiver when three different forms of traction technology trains passed over the receiver. The FS2500 track circuit is an FSK coded track circuit operating at one of four centre frequencies, 1700Hz, 2000Hz, 2300Hz and 2600Hz. Lock up of the receivers were experienced, due to passage of 3 phase drive traction trains over the receiver. Due to the coding of this type of track circuit, WSF is unlikely and the problem in this case was RSF of the track circuits. This did however cause serious service disruption requiring technician call out to reset the receivers in the event of the lock ups occurring.

The first trace was for a conventional camshaft technology train. This type of train was the mainstay of traction control before the advent power electronics technologies. In essence the DC traction motor voltage is controlled by switching in and out resistors. There are no characteristic operating frequencies. The DC supply voltage is connected across the motors and the resistors which are progressively switched out to increase the voltage across the motors themselves. The control is actually more complex than this - with parallel series reconnection of the motors and weak field operation; however it is the switching events that are the most significant in terms of harmonic emissions. Their interference waveform is characterised by low level broadband noise associated with switching transients. This noise was picked up by the 1700Hz receiver and seen as voltage peaking at 1.5mV.

The second trace was for a chopper controlled train. This technology still utilises DC traction motors but Gate Turn Off (GTO) thyristor power semiconductors are used to switch (or chop) the DC voltage on and off, thus varying the net DC voltage applied to the motors. A fixed chopping frequency is used (or a number of fixed frequencies) and this results in a characteristic high level emission at the chopping frequency. Their interference waveform is similar to conventional camshaft traction (low level broadband noise) with the addition of specific harmonics related to the fixed chopping frequency, seen in the second trace as a peak of 11mV at approximately 1570Hz. Whilst the peak is relatively high at 1570Hz, this characteristic is known and it is possible to choose the chopping frequency to specifically avoid any known signalling frequencies.

The third trace was for a 3 phase drive technology train utilising IGBT (Insulated Gate Bipolar Transistor) inverters to control AC traction motors. In contrast to DC traction motors whose

speed are controlled by the voltage applied to them, AC traction motor speed is controlled by varying the frequency and the voltage applied to them. The inverter fundamental frequencies vary between about 50Hz to 594Hz and at harmonics of these frequencies, therefore sweeping right through the FS2500 frequency band. The level measured was up to 10mV right through the 1700Hz receiver band and was the cause of the periodic lock ups of the receiver.

The solution to the problem was either to reduce the train emissions, which is always difficult if the train is already in service, or to reduce the susceptibility of the receivers. It is pointed out at this point that it is perfectly possible to design a 3 phase drive train to meet susceptibility requirements for FS2500 track circuits. The problem was a combination of the IGBT switching pattern not optimised to minimise harmonics in the 1700Hz band combined with poor bonding arrangements. In addition to this the FS2500 intermediate receivers were of a poor design being susceptible to common mode rail currents whereas the parent receiver is not.

This demonstrates the importance of good design from the earliest point in the project to avoid problems only being discovered on the track. In this particular case modifications were made to the infrastructure (the intermediate receivers) this being simpler and less costly than train modifications.

(Taken from: 'Traction Compatibility with EE & CS Infrastructure' by Adrian Hines of Railway Technology Consultants Ltd, a paper he presented at EMC-UK 2008, Newbury.)

706) RFID can interfere with medical systems

Context. Health care applications of autoidentification technologies, such as radio frequency identification (RFID), have been proposed to improve patient safety and also the tracking and tracing of medical equipment. However, electromagnetic interference (EMI) by RFID on medical devices has never been reported.

Objective. To assess and classify incidents of EMI by RFID on critical care equipment.

Design and Setting Without a patient being connected, EMI by 2 RFID systems (active 125 kHz and passive 868 MHz) was assessed under controlled conditions during May 2006, in the proximity of 41 medical devices (in 17 categories, 22 different manufacturers) at the Academic Medical Centre, University of Amsterdam, Amsterdam, the Netherlands. Assessment took place according to an international test protocol. Incidents of EMI were classified according to a critical care adverse events scale as hazardous, significant, or light.

Results. In 123 EMI tests (3 per medical device), RFID induced 34 EMI incidents: 22 were classified as hazardous, 2 as significant, and 10 as light. The passive 868-MHz RFID signal induced a higher number of incidents (26 incidents in 41 EMI tests; 63%) compared with the active 125-kHz RFID signal (8 incidents in 41 EMI tests; 20%); difference 44% (95% confidence interval, 27%-53%; P < .001). The passive 868-MHz RFID signal induced EMI in 26 medical devices, including 8 that were also affected by the active 125-kHz RFID signal (26 in 41 devices; 63%). The median distance between the RFID reader and the medical device in all EMI incidents was 30 cm (range, 0.1-600 cm).

Conclusions. In a controlled nonclinical setting, RFID induced potentially hazardous incidents in medical devices. Implementation of RFID in the critical care environment should require on-site EMI tests and updates of international standards. *(This is the abstract of the paper 'Caring for the Critically Ill Patient', by R van der Togt, E J van Lieshout, R Hensbroek, E Beinat, J M Binnekade and P J M Bakker, in JAMA, 2008;299(24):2884-2890. doi: 10.1001/jama.299.24.2884, free download from http://jama.ama-assn.org/content/299/24/2884.full.)*

707) It's the hardware. No, the software. No, it's ESD!

The author's experiences that have connected fab problems with ESD events:

- Wafer transfer robots that stop or drop wafers
- Shutdowns of diffusion furnaces
- A wafer fab experiencing so many lockups that its software-engineering staff could not keep up with its work load

- Track system lockups
- Stepper alignment errors and lockups

A manufacturer of microprocessors was experiencing random equipment problems with one of nine steppers, which commanded the attention of in-house engineers and the equipment manufacturer's field service engineers for almost six months. Software upgrades and major components were replaced without finding a solution. Measurements with a 500MHz digitising oscilloscope finally detected a spurious signal on the power supply line of the stepper that had not been seen with lower-bandwidth test equipment. The random nature of the signal finally pointed to EMI as the possible cause of the problem.

Using an electrostatic measurement tool to determine the presence of static charge located the cause of the problem in less than an hour. The factory static control program specified using static dissipative wall panels to avoid the presence of charged insulators, but one of the wall panels above the stepper was not connected to ground. When charged, this large isolated conductor discharged to the nearby grounded wall framing. The conducted EMI from the ESD event was causing the equipment interrupts.

Our experiences have revealed other scenarios where EMI was causing process equipment problems (other examples are listed in the table):

• In several facilities, tool problems were related to discharges from ungrounded ceiling panels that were supported by a grounded ceiling grid. Signals were radiating from ESD events at the corners of the panels and were conducted through power lines to overhead lighting to the circuit breaker box and then out to the tool being affected. This conduction path was a serious problem because the signal could be transmitted over a large distance without the 1/r2 attenuation that is characteristic of transmitted EMI. In one case, the tool was a wafer prober and it was reporting calibration failures. The problem was located with a DSO and a wideband antenna test set. Grounding the ceiling panels eliminated the tool problem.

• In a 2000 ft^2 photolithography area, four steppers were experiencing unexplained lockups, one a number of times each day, the others randomly. Measurements with an EMI locator indicated signals throughout the room, particularly near the ceiling channels. Not surprisingly, the highest-level signals were found in the vicinity of the stepper experiencing the most frequent lockups. Checking the equipment grounding revealed a top cover panel that was not attached, but rather rested on the top of the equipment, and was very close to one of the ceiling-mounted air ionizers. When this panel was removed, all the EMI signals in the room disappeared and there were no further lockups in any of the steppers. It was apparent that the ungrounded panel was being charged by the nearby ionizer, and was then discharging to the grounded frame of the stepper near the ceiling. This ESD event signal was picked up and conducted around the room by the ceiling channel (Fig. 2).

• There are many instances where conductive parts of wet benches are isolated from ground by attaching them to insulating materials. Inevitably these conductors become charged triboelectrically due to contact with other materials. Once charged, they will discharge the next time another conductor contacts them. The result is random lockups of the wet bench control electronics.

• A reticle inspection unit was locking up approximately five times per week. It was theorized that when reticles or reticle pods come into the tool highly charged, ESD events are inevitable. Under the assumption that the unexplained lockups were ESD-related, an ionizing bar was installed in the load/unload station of the tool. Since the reticles and pods are both composed of excellent insulators (plastic and quartz), grounding them will not eliminate charge, Charge neutralization with ionizers is the only option. When the rate of lockup with and without the addition of ionization was analyzed, it revealed a 50% reducution with the latter (Fig. 3). To investigate the origin of the residual lockups, ionization was placed on the ceiling of the room in the vicinity of the inspection station. This resulted in a second 50% reduction in the lockup rate. This indicates that ESD events even in the adjacent area tools were also causing the tool under

investigation to lock up. Owing to the large distance from the adjacent tools to the one experiencing the lockups (~4m), the EMI path was almost certainly conducted.

• A wafer-transfer tool was locking up frequently. It was determined that the wafer cassette loaded into the tool came from a spin-rinser-drier. The cleaning process in this tool resulted in wafers and Teflon cassettes charged to over 20kV. Placing the cassettes on a work-in-progress rack under an ionizing bar for 120sec before putting them into the transfer tool eliminated the lockups.

Conclusion

Equipment lockups will continue to occur despite the best efforts of the software and hardware designers to anticipate the complexity of the semiconductor-manufacturing process. With increasing frequency, however, equipment interrupts are coming from other sources, such as EMI due to ESD. Many equipment failures are the result of random ESD events and a great deal of production and engineering time is wasted pursuing phantom software problems.

(Taken from the article with a similar title by Arnold Steinman and Lawrence B Levit, of Ion Systems Inc., Berkeley, California, published in a Supplement publication to Solid State Technology, May 1999. For many more articles and papers on ESD and other issue in semiconductor manufacture by Lawrence B Levit, visit http://www.lblscientific.com/publications.html.)

708) Error message! How mobile phones distort measurements

The awareness that the interference resistance of measuring systems is very dependent on the configuration and the installation on site has not been sufficiently taken into account in the normative requirements.

This discrepancy is based on the fact that the European testing requirements worked out several years ago do not sufficiently take into account the actual present-day disturbance source situation due to the spread of radio receivers and mobile phones.

Due to this technical requirement and also the possible political consequences, a revision of the respective standards was initiated in which PTB is participating.

For the determination of new normative limiting values and for the assessment of the interference resistance of measuring devices on site by the verification authorities, metrologically traceable EMC tests on site are necessary, for which there has not been a measuring device available up to now.

(Taken from: PTB (Physikalisch-Technische Bundesanstalt), 17 September 2008. www.ptb.de/en/aktuelles/archiv/presseinfos/pi2008/pitext/pi080917.html)

709) How cellphones can interfere with low-frequency electronics such as ECGs

EMI or RFI sources continue to become more prevalent in our world. This type of noise can invade even the low frequency analog circuits. The source of this radiated noise interference can be found wherever electric or magnetic fields exist.

The proliferation of intentional and unintentional EMI radiators can wreak havoc on your circuits. The signals from these radiators are not out to contaminate your circuits, but you may want to keep your low-noise systems out of harm's way. Imagine a doctor using an ECG (electrocardiogram) diagnostic tool to get a good look at your heart. This high precision measurement is also low-frequency, so the electronics don't extend past 1MHz. However, if you are connected to an ECG tool with a poor EMI design and your physician answers his cell phone during the test, you may have cause for concern.

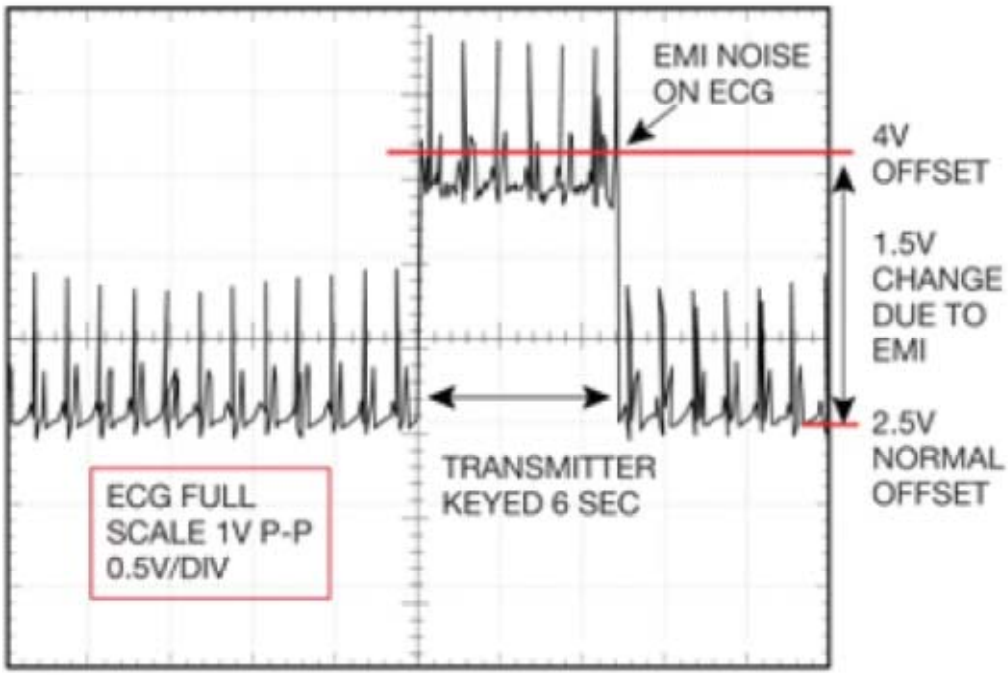


Figure 1 EMI from a cell phone can cause a 1.5V change from normal on an ECG. The ECG diagnostic tool senses a heart while a 0.5W, 470MHz transmitter turns on and off just one and a half feet away.

Figure 2 An engineer's precision, low-level ECG cardiotachometer board took the measurements for Figure 1.

The heart's input signal to the system is approximately 0.25 mV p-p. This small signal requires an instrumentation amplifier's gain of approximately 6000V/V. The good news is that the results in Figure 1 do not represent the performance of a doctor's office ECG-measurement tool. This measurement was actually taken in an engineer's lab from the board in Figure 2.

Don't fall into this EMI trap. Take care to create boards and use components that are EMI-resilient, regardless of your analog or digital circuit's bandwidth. When an EMI source is

present in the vicinity of your application circuit, it may create a response to the radiating source.

How did the radiated noise from the phone get into the measurement with such a low-frequency board? In EMI terms, three elements are at work with this type of problem: a radiation source, a coupling path for the radiation signal to travel through, and a receptor. The radiation source in this example is the cell phone. The EMI signals may come through the air or be conducted across your PCB and originate from unexpected sources. EMI, or RFI, surrounds a receptor either by direct conduction or through fields. These fields couple directly into the circuit's connecting wires and PCB traces, where they are converted to conducted RFI.

Acknowledgment: Special thanks to John Brown for the ECG board and data.

(Taken from: "EMI problems? Just the facts, please", by Bonnie Baker, in EDN, February 16, 2012, www.edn.com/article/520893-EMI_problems_Just_the_facts_please.php?cid=NL_UBM+Electronics. Editor's note: Unfortunately, Ms Baker doesn't mention how it can happen that RFI at frequencies very much higher than a circuit's operating bandwidth, can result in signal errors within its bandwidth. The reason is demodulation in the non-linearities naturally present in the PN junctions in the circuit's semiconductors – the very same principle that has been used for over 100 years now to receive radio, TV and radar signals. Essentially, every low-frequency analogue circuit can be regarded as a number of radio receivers connected to PCB traces and cables that act as antennas for the local E and H fields.)

710) Uncontrolled Acceleration of Light Vehicle when 2-Way Radio was used

Mine Type: All Mine Types.

Incident: A recently introduced 4 x 4 vehicle accelerated when the button on the vehicle's 2-way radio was depressed. This was subsequently repeated several times and confirmed the incident.

While using the radio to transmit at the same time as the vehicle was engine braking down a slope, the vehicle slowed still further.

Again, after using the radio several times to transmit, the vehicle emergency engine management mode automatically initiated, resulting in a top speed of approximately 15 kph.

Equipment: Equipment involved included both the fitted VHF mine compliant radio and a hand held radio.

Hazard: A light vehicle exhibited uncontrolled movements while the onboard 2-way radio was being used.

Cause: Preliminary investigations have been conducted by the vehicle sales technical services manager. The problem appears to be related to electromagnetic interference with the electronic throttle positioning sensor. Similar issues have been found on certain aftermarket cruise control components.

Comments: Additional information will be released as it becomes available during the investigation.

Recommendations: All mine sites should audit their vehicle fleets to determine if the problem exists, and if so, formulate procedures to reduce the risk to an acceptable level.

Chris Skelding, Manager, Safety and Health – Central

Contact: Kevin Clough, District Inspector of Mines, +61 7 4967 0869

Please ensure all relevant people in your organisation receive a copy of this Safety alert. Any such advice supplied to site should reach those who require it, and it should also be placed on the mine notice boards.

See more Safety alerts and Safety bulletins at http://mines.industry.qld.gov.au/mining/safety-alerts-bulletins.htm *(Editor's note: this is the latest URL, 9 July 2012, not the one originally used)*.

(This is a copy of Mines Inspectorate Safety Alert 213, "Uncontrolled Acceleration of Light Vehicle when 2-Way Radio was used", originally published 28 November 2008, by the Queensland government, Australia www.dme.qld.gov.au, kindly sent in on the 30th May 2012 by our regular contributor Chris Zombolas of EMC Technology Pty Ltd, www.emctech.com.au.)

711) RFID frequently interferes with other medical technologies

Regardless of the foregoing arguments about RFID as supportive or disruptive innovation in various applications in healthcare settings, there is one consideration that opens up the possibility for new entrants to introduce disruptive innovation. Current RFID technology frequently interferes with other medical technologies.

A 2008 study conducted in The Netherlands was the first to consider the problem of electromagnetic interference by RFID tags on other medical devices [47]. After testing 2 different RFID systems against 41 different medical devices, the researchers found 34 incidents of interference in 123 tests.

Despite limitations inherent in the study, the U. S. Food and Drug Administration, manufacturers, and healthcare providers are investigating the problem further [9]….

[9] DiConsiglio, John, 2008. "Much ado about RFID", Materials Management in Health Care 17:11, pp. 28-30, www.matmanmag.com/matmanmag_app/jsp/articledisplay.jsp?dcrpath=MATMANMAG/Article/data/11NOV2008/0811MMH_FEA_Technology&domain=MATMANMAG

[47] van der Togt, Remko, Erik Jan van Lieshout, Reinout Hensbrock, E. Beinat, J. M. Binnekade, and P. J. M. Bakker, 2008. "Electromagnetic Interference From Radio Frequency Identification Inducing Potentially Hazardous Incidents in Critical Care Medical Equipment", JAMA: Journal of the American Medical Association 299, pp. 2884-2890, www.ncbi.nlm.nih.gov/pubmed/18577733)

(Taken from pages 171-2 of "RFID Technology as Sustaining or Disruptive Innovation: Applications in the Healthcare Industry" by Karen Crooker, Dirk Baldwin and Suresh Chalasani, in the European Journal of Scientific Research, ISSN 1450-216X Vol.37 No.1 (2009), pp.160-178, www.eurojournals.com/ejsr.htm. Editor's note: In their document: "The Importance of Using Wireless Engineers Who Understand Patient Care and RFID Technology", www.infologix.com/pdf/infologix-rfid-jama-response.pdfInfologix rubbished [47] claiming, amongst other things, that it took no consideration of the way wireless devices are used in healthcare premises. However, I have to say that their arguments do not take into account reasonably foreseeable misuse, as required by IEC 61508 and its many 'daughter' standards, and (more specifically) as required by Clause 4 of ISO 14971 "Medical devices — Application of risk management to medical devices". Their arguments also do not take into account the very rapidly increasing use of medical devices outside of the traditional healthcare premises, for instance: at work; shopping; travelling, etc., where RFID devices are increasingly likely to be used by people who are not medically trained and who are probably also unaware of the possibility that medical devices may be in close proximity.)

712) First Product Completes Medical Device RFID Susceptibility Testing

MET Labs has completed testing on the first product to be submitted to the Medical Device RFID Susceptibility Program. The Program – co-developed by MET Labs and the U.S. Food and Drug Administration (FDA) under the auspices of AIM Healthcare Initiative (HCI) – is designed to determine potential adverse events of radio frequency identification (RFID) emissions on electronic medical devices.

The patient-worn battery-operated vital sign monitoring device was tested at MET's Santa Clara, California laboratory. It passed six of seven tests, demonstrating a hard fault when subjected to 860-960 MHz frequency RFID at 54 V/m, as specified in ISO/IEC 18000-6 Type C.

Testing was performed with the RF parameters that emit the minimum and maximum occupied band-width. The testing ranged from 134.2 kHz at 160 A/m to 2.45 GHz at 54 V/m.

Interested medical device manufacturers that have not expressed interest in the past are still eligible for participation in the program. For more information about MET Laboratories, please visit www.METLabs.com.

(Taken from Business News, on page 64 of IN Compliance magazine, April 2012, http://www.incompliancemag.com/DigEd/inc1204/offline/download.pdf)

713) Fears of TV interference from 4G cellphone roll-out

Thousands of television viewers in Shropshire could suffer problems with their digital reception if the Government pushes through plans for a more hi-tech mobile phone network, Freeview bosses have warned.

According to the company, an estimated 202,218 homes in the Central region, which includes Shropshire, could be at risk of interference with their viewing from the planned new 4G mobile phone network.

Ofcom is proposing that 4G coverage should be rolled out to cover at least 98 per cent of the population to deal with increased demand as smartphone and mobile data broadband use continues to rise. But Freeview bosses claim that the new network could lead to 'deterioration of signal, a loss of channels, or blank screens' for viewers.

The company, the UK's biggest digital TV provider, has warned that Government plans to set up a £180 million fund to help counter the effects does not go far enough. Officials said that based on figures calculated by Deloitte for the Ofcom consultation, industry estimates put the total cost of providing and installing filters to mitigate interference on main and second sets at almost double the amount.

The company is now asking for the Government to revise its plans for the rollout so that mobile operators are responsible for the full costs associated with protecting television services.

Ilse Howling, managing director of Freeview, said: "We strongly believe that Freeview homes in the Midlands should not be subject to further inconvenience and additional cost to make way for mobile broadband. The Government has committed to recouping the cost of protecting viewers from interference, using proceeds from the 4G mobile auction. However, this will still leave viewers to bear a substantial proportion of the cost.

(From: www.shropshirestar.com/news/2012/06/14/fears-new-phones-network-will-hit-shropshire-tv-reception, Thursday 14th June 2012, 10:59AM BST. Also see a similar story about TVI from the 4G roll-out in the Westcountry: www.thisiscornwall.co.uk/New-phone-networks-hit-TV-reception/story-16446342-detail/story.html.)

714) CFL lamps interfere with broadcasting receivers

The Crosstalk America broadcast as a phone-in current-affairs show, often hosted by veteran broadcaster Vic Eliason, now in his mid seventies. It is produced in the main studio complex of the VCY America network, in Milwaukee, Wisconsin. On 3rd February 2012, Vic digressed while talking to studio guest Larry Pratt.

Vic – "Now we have an interesting story here. Here at the studios yesterday we had a test done." Vic explained that this was due to new regulations requiring energy-efficient lighting to replace the old fluorescent fittings.

"And so we found out that to re-do our building here, and our broadcast buildings, would be in excess of $38,000. Over 400 light fixtures here in this one building. Well, at any rate, what came out of this is that we said, "Well, bring in a test unit." And they brought in this test unit, and we – in that studio - turned on a receiver that would be used in the field of news-gathering, and found that 21 places on the dial were being obscured by the fixtures, by the r.f. signal that was going out, literally interfering with our ability to use a news-gathering radio."

Vic – "If we have 400 light fixtures, that's 800 of those little transmitters in a building that is sensitive to broadcast equipment. And you can't do it."

After a comment from Larry about having stockpiled the old-style lamps, Vic joked about lighting for the studios which would not cause interference. "Well, I think we're going to go out and get some kerosene lanterns. I did my homework in high-school up to eleventh grade in kerosene lights. So we may be running our studios with kerosene lights."

(Kindly sent in by our regular contributor Robert Higginson, on 11 Feb 2012)

715) LED Lighting tested with MIL STD 461F to prevent MRI Scanner EMI

Incandescent Lighting: A Solution Based On Compromise

Since AC-powered luminaires and dimming systems are known to generate Electromagnetic Interference (EMI), DC-powered, fixed-output incandescent luminaires became the lighting systems of preference within magnetic resonance imaging (MRI) suites.

Although this is an effective technique for mitigating EMI, it negatively impacts such important factors as power consumption, lumen output, lamp life and occurrences of sudden lamp failure – all of which increase both operation and maintenance costs and the MRI's operational downtime. In addition, the use of fixed-output severely restricts staff control of illumination levels.

LED Lighting: The Superior Alternative

Today's solid-state, DC-powered LED sources solve the EMI issues that make fluorescent lamps unsuitable for MRI area use. Recent advances in LED technology make this source a superior alternative to incandescent lamps as well. When compared to a typical150-watt incandescent installation with a 750-hour rated lamp life, white LED systems average 50,000 hours – or 66 times – more life than incandescents.

LEDs even exceed the rated life of both compact and most linear fluorescents. LEDs are also far more energy efficient than incandescents and gradually lose their efficacy (unlike heated-filament counterparts) preventing the interruption of MRI usage for lamp replacement.

Finally, Kenall's LED fixtures are dimmable, giving the MRI suite technicians the ability to tailor illumination levels to both preference and the specific function being performed at any given time.

EMI Transmission

One of the most problematic areas of lighting MRI suites has historically been EMI.

Not only are MRI systems highly sensitive to EMI emissions from lighting fixtures and other electrical devices, MRI scanners themselves emit RF pulses that can negatively affect the operational performance of lighting equipment and the lifespan of certain light sources.

When EMI from light fixtures, AC voltage, or dimming systems is present, it can adversely affect the performance of the MRI system, rendering its output unusable.

On the other hand, when the MRI scanner emits its own RF pulses they can create EMI that defeats the operational integrity of traditional light sources by causing unwanted lamp flicker and premature source burnout.

It is for reasons such as these that fluorescent sources and AC power are rarely installed in MRI suites, having been replaced in most cases by low voltage DC incandescent. While this change by itself has been successful in mitigating some EMI related issues, it has not solved all problems. In order to achieve an appropriately lit MRI environment free of problematic EMI, all potential sources of interference must be either successfully controlled or eliminated altogether.

Dimming

Dimming is an important feature for both operational safety and patient comfort in MRI suites. When scanning is performed, low light levels are appropriate as they create a more relaxed and comfortable ambience for patients. Conversely, higher light levels are needed for maintenance and other staff functions. Despite this need, even DC-powered dimming is often omitted from MRI suites due to potential EMI issues caused by voltage changes, as well as lamp flicker caused by MRI-originated EMI.

Kenall engineers have successfully solved these problems by designing and integrating special shielding systems inside the luminaires, allowing a problem-free, 0-10 volt full-range dimming capability on any system such as the Lutron Graphik Eye®, or other scene controllers, when installed per our instructions.

RFI Susceptibility and Compatibility

Unlike the European Community (EC), the U.S. has no government standards for RF compatibility between MRI systems and other electrical devices, nor do we have government-based programs for testing the susceptibility of one device to the RF of another. It is therefore up to the lighting manufacturer to determine the RFI potential between the luminaires and the MRI system being used. Not only must the effect of the luminaire(s) on the MRI be identified, the effect of the MRI's RF transmissions on the lighting systems must be identified as well.

To minimize the luminaire's potential effect on the MRI and vice-versa, the first step is to shield the fixture's interior to keep potential RF from escaping while also preventing the MRI's RF from affecting the luminaire. Step two is to pragmatically determine how the MRI and luminaire perform together.

Only with the combination of expert design and empirical knowledge can the specifier and user be assured of compatibility between the devices. Kenall MRI fixtures not only have the most effective shielding developed to date, they've been field-verified as compatible with systems from the world's foremost MRI systems manufacturers.

EMI Test Procedure: MIL-STD-461F NSF

To ensure Kenall luminaires for MRI/imaging suites are not producing EMI emission levels that could jeopardize the integrity of MRI images, refer to MIL STD-461F as a guideline, specifically RE102. RE102 is a radiated emissions test that covers the frequency ranges of interest. The RE102 test procedure is also suited for this application due to the set-up commonality it shares with existing MRI rooms. The test measures emissions one meter away from the luminaire in units of dB microvolts per meter.

Immunity/Susceptibility:

Another consideration is the immunity or susceptibility of a device. Ensuring our luminaires do not interfere with the MRI is part of the objective. MRI scanners put out emissions that exceed 200 V/m, which can couple onto power and control lines and can interfere with the DC supply current energizing the LED light source. The sensation the human eye experiences when this happens is commonly known as flicker. To eliminate this potential

situation, it is imperative that the lighting system and installation be configured to avoid harmful absorption and transmission of electrical pulses.

How we protect our product:

Assuming the system is properly designed and installation instructions are followed, the only path MRI scanner emissions have left to penetrate is through the luminaire itself. The first line of defense is the integrity and construction of the housing; Kenall's housings are aluminum, which has low resistivity and therefore an excellent shield. The housings are fabricated in-house and inspected to ensure no gaps exist that may leave the circuit board vulnerable to interference.

Finally, our robust electronic drivers are designed to withstand many small transients that exist on supply lines. These design properties ensure our products withstand pulses from 3.0T MRI units as well as emission levels in excess of 300 V/m as measured by an independent EMC test lab.

Electromagnetic Interference (EMI) Testing & Military Standard 461F

The most comprehensive, widely recognized and acknowledged domestic EMI standard is Military Standard MIL-STD-461F, a mandatory standard for military hospitals and other EMI-sensitive military facilities and a voluntary standard for public and private facilities applications. MIL STD testing measurements cover both radiated and conducted emissions, in addition to maximum allowable amounts of emitted energy based on both frequency range and field strength.

The MIL-STD-461F testing procedures and requirements appropriate to light fixtures are found under Navy and Air Force Limits for Electronic Devices, with the specific testing information for conducted emissions outlined in CE 102-1 and for radiated emissions in RE 102-4. While both are designed to emulate worst case operating conditions, both the test procedures and the standards themselves are logical and reasonable.

Kenall MedMaster fixtures have been tested and proven to be in compliance with MIL-STD-461F (Air Force/ Navy Fixed) by an independent laboratory (DLS Electronic Systems, Inc.) accredited by both NIST and the U.S. DOC. Copies of test reports are available from Kenall.

(Taken from the Kennal Catalogue: "LED Lighting for MRI Imaging Suites", http://www.kenall.com/LED-Lighting-for-MRI-Imaging-Suites.khtml?cid=518&iid=6251, downloaded 4 July 2012.)

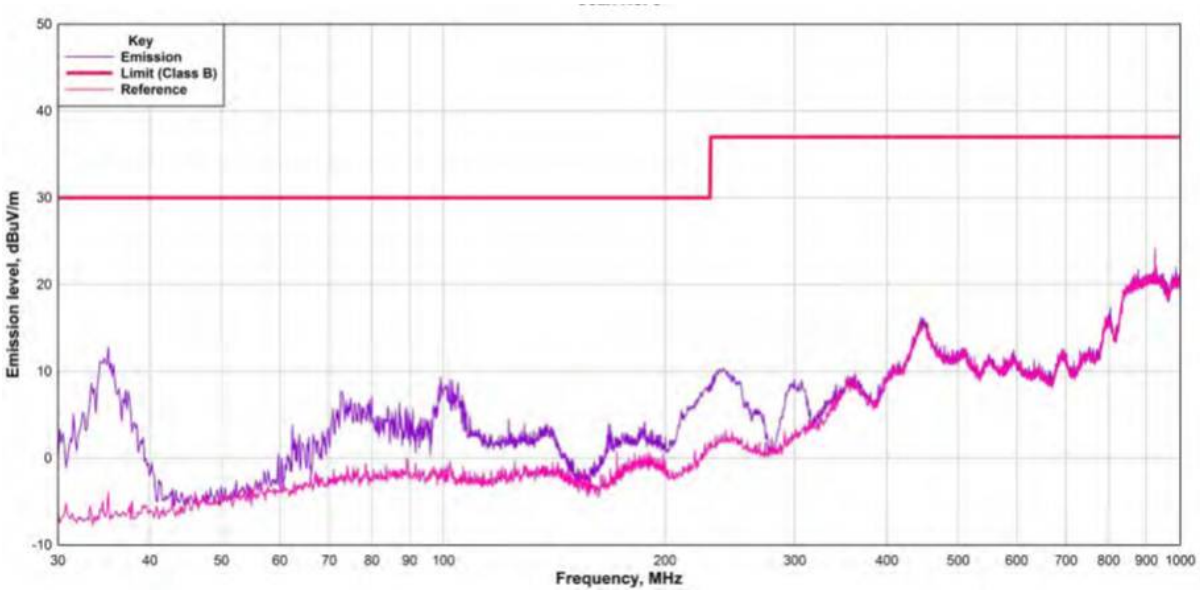
716) Controlling Marine radio EMI from LED bulbs

The Marinebeam Constant-Current chipset uses the newest wave-shaping technologies for controlling the current to the LED clusters without creating nasty Electro-Magnetic Interference (EMI).

Typical LEDs current-control methods via switch-mode converters can contribute significantly to both conducted and radiated Radio Frequency (RF) emissions, which can interfere with VHF, FM, SSB and GPS radios on board.

This EMI is typically due to manufacturer's using standard LED driver IC's which create sharp spikes in the switching frequency wave-forms, that emit RF into the air, and EMI through the wiring. This problem is compounded by poor design of the typical LED emitter boards, where the traces tend to work as mini-antenna. We address both of these important issues in our LED driver and board design.

Because our LED arrays are meant to be used on boats, where RF interference can be catastrophic, Marinebeam is using the latest technologies to reduce any RF or EMI emissions. With smartphones, airplanes and automobiles now using high-performance LEDs for illumination and backlighting, EMI issues are being addressed more responsibly by the leaders in the industry. Marinebeam is leveraging the newest wave-shaping technologies emerging in these markets to ensure we have great performing low-EMI products for our boats.



(From http://store.marinebeam.com/contolling-emi-in-led-bulbs.html, downloaded 4 July 2012)

717) Operational problems with aftermarket 2-way radios

There have been numerous incidents where poorly-shielded vehicles have developed operational issues (braking, cruise control, etc.) due to aftermarket two-way radios being installed.

(Taken from "Why are there so many standards", by Steve Hayes, Jack McFadden, Steve O'Steen, Kenneth Wyatt and David Zimmerman, in Interference Technology's on-line magazine, 11 June 2012, www.interferencetechnology.com/why-are-there=so-many=emc-standards-3.)

718) EMC problems in Formula 1 racing

"EMC has been one of the big problems with electronic systems in Formula 1,"said Lyon, who developed electronic control systems during his time with the Brawn and Renault F1 teams.

(Taken from "Driving ambitions" by Justin Cunningham and Graham Pitcher, New Electronics magazine, 24 April 2012, pages 14-17, www.newelectronics.co.uk.)

719) LightSquared denied backing by FCC

Originally, the US telecoms regulator, the Federal Communications Commission (FCC), put LightSquared on the fast track through a January 2011 decision that it hoped would rapidly create a new 4G rival for the dominant terrestrial cellular operators, Verizon and AT&T. That LightSquared's satellite-based service would bring mobile communications to rural communities also fitted well with Obama's policy of avoiding the US becoming a nation of digital haves and have-nots.

There was just one problem. The original LightSquared signal specification interfered with the Global Positioning System (GPS). Cue howls of outrage from the military, air traffic controllers and many powerful logistics players like FedEx – that latter group also containing some of Washiongton's bigger-spending lobbyists.

Falcone has long insisted that the GPS issue can be resolved before any launch, but in April, the FCC effectively removed its backing. LightSquared has been struggling ever since.

The key political issue is how the FCC could have specifically promoted LightSquared if it either did know about the GPS issue or before sufficient research had been done to uncover it. After all, GPS is by definition ubiquitous. As with Solyndra, government aggressively backed a technology that simply hadn't undergone enough due diligence.

(Taken from "Technology may prove a double-edged sword for Obama Campaign, in IET Engineering & Technology magazine, June 2012, page 15, www.EandTmagazine.com. The Editor writes: For some history on Lightsquared please look back at Banana Skin number 647, on page 15 of the July 2011 issue of the EMC Journal. Has everyone using GPS for controlling critical systems (including the entire banking system!) understood how very vulnerable it is to interference, and taken appropriate steps to manage the resulting risks effectively? The necessary information has been in the public domain and discussed in trade publications such as GPS World at least since the Volpe report (see Banana Skin numbers 223, 224, and 227 through 232 in "The First 500 Banana Skins" book at http://www.nutwooduk.co.uk/BananaSkins.aspx or purchase from www.emcacademy.org/books.asp, yet I keep meeting engineers designing major transport systems and the like who seem to think GPS is a 100% reliable service. There are many other Banana Skins that concern the unreliability of GPS (and/or Galileo, its European equivalent) due to EMI, including number 720, below.)

720) Northern Lights interfere with satellites including GPS

Oslo University scientists have developed miniature instruments that could provide useful insights into how the Northern Lights interfere with satellites.

The Northern Lights occur when electrically charged solar winds collide with plasma clouds at altitudes of 80-500km. Turbulent conditions found within plasma clouds during the Northern Lights can reflect or completely block radio signals being sent to and from satellites.

Tor André Bekking, the Oslo University research fellow who is responsible for the electronics and algorithms, said "The instrumentation uses four miniaturised cylindrical probes to measure electron density with plasma clouds."

The device – dubbed 'm-NLP' – measures electron density at a rate of 7kHz so that scientists can look more closely at what is happening in the plasma cloud.

"It is an improvement on previous instrumentation, because it gives the absolute electron density at 1m spatial resolution, compared with….the kilometre scale," said Bekking. "By having measurements of absolute electron density down to metre scale, we can, for the first time, see the smallest thinkable structures in the ionosphere, which is the height region where the Northern Lights occur.'

'The reason we want to investigate these structures is that if you have a structure that is half the size of the wavelength of the radio signal you are transmitting, you will experience backscattering and scintillation of the received signal,' said Bekking. 'For GPS this will result in reduced accuracy, and during solar storms the users can experience no GPS signal lock in high-latitude areas.'

The new device will be attached to 20 of the 50 CubeSat satellites that Bekking said are set to be launched in 2014.

(Taken from "Light touch to deal with interference", by Sam Shead, The Engineer, 28 May 2012, page 12, www.theengineer.co.uk. Also see number 653. Well-educated readers may know the Northern Lights better as the Aurora Borealis.)

721) Strongest Solar Flare of Summer Creates Strong Radio Blackout

The sun unleashed two major solar storms in a single week this month and more are expected to follow. The most recent X-class solar flare erupted toward Earth, sending a wave of charged particles that have amped up northern lights displays and caused a strong radio blackout for some high-frequency communications systems. Effects on communications were felt within minutes of the flare reaching its peak, according to the Space Weather Prediction Center.

The solar flares are erupting from Active Region 1520, an area on the sun 186,411 miles long and currently facing Earth. AR1520 also promises more storms in the near future as it is only halfway across the face of the sun so far.

(From: www.interferencetechnology.com/strongest-solar-flare-of-summer-creates-strong-radio-blackout/ 07/18/2012, learn more from "Powerful outburst on the sun sends a blast our way" by

Tariq Malik, Managing editor , NBCnews.com, updated 7/12/2012 7:17:13 PM ET, www.msnbc.msn.com/id/48166317/ns/technology_and_science-space/#.UAV3t_XMRdA, follow Space.com Managing Editor Tariq Malik on Twitter@tariqjmalik. Follow Space.com on Twitter @Spacedotcom.)

722) Titanic sinking's large loss of life related to EMI

The 15th of April 2012 is the 100th anniversary of the sinking of the RMS Titanic in the North Atlantic Ocean. This article is a brief explanation of how "radio frequency interference" contributed to the totality of the disaster at sea.

The RMS Titanic had a powerful wireless telegraph on board for the convenience of passengers wanting to send messages ahead to their families. The wireless telegraphs were also used for operations of the ship.

The Titanic actually had two 1500 Watt spark-gap wireless telegraphs located in the radio room on the Bridge Deck. The Bridge Deck was the third deck from the top and the top weight-bearing deck as well as the uppermost level of the hull. One of the wireless telegraphs was used for transmitting messages and the other was used for receiving messages. The receiving unit was located in a soundproof booth so the operator could more clearly hear the incoming signals.

The signals were transmitted through two parallel wires strung between the two ship's masts about 15 meters above the funnels to avoid the corrosive smoke from the engines. The system was one of the most powerful in the world at that time and had a range of up to 1,000 miles. It was owned and operated by the Marconi Company and was intended primarily for the passengers.

The two wireless operators were supposed to operate the units on a 24-hour basis; both sending and receiving, primarily, messages for the passengers. As a side-effort, the operators also transmitted and received professional ship messages on weather reports and ice warnings.

The story has been told that many ships in the vicinity of the Titanic had turned off their wireless telegraphs because the powerful signal from the Titanic created "interference" in their wireless systems.

When the Titanic was sinking, she sent distress signals via wireless, rockets, and lamps. However, the ships that had turned their wireless systems off did not hear the distress signals. The ships that heard the wireless distress signals were too far away to help in a timely manner.

If the ships close to the Titanic had left their wireless systems "on", it is possible that many more passengers could have been saved. As it was, only 710 people survived the disaster and over 1500 people lost their lives due to the cold water and hypothermia conditions.

Most notably, the Californian was a ship that was in sight of the Titanic. The Californian had stopped for the night because of the iceberg dangers. The Californian had warned the Titanic about the ice pack but the senior wireless operator of the Titanic rebuked the Californian wireless operator. The Californian wireless operator then went to bed and slept. He was awakened at 5:30 am and asked by his captain to try and contact the Titanic. But, the Titanic had sunk at 2:20 am so no response was heard. However, he heard from other ships that the Titanic had been lost.

As a result of the disaster, the world established the International Convention for the Safety of Life at Sea (SOLAS) which included basic covenants on the number of lifeboats per ship and the training of ship's employees on the use and launching of the lifeboats.

Basic regulations were also implemented on wireless power and frequency allocation as well as stipulations that the wireless equipment was to be manned 24 hours a day.

(Taken from: "The Titanic and Radio Frequency Interference" by Dan Hoolihan, Chair of the IEEE EMC Society History Committee, in the IEEE Electromagnetic Compatibility Magazine, Volume 1, Quarter 2, 2012, page 39.)

723) RFID at 13.56MHz interferes with electronic X-Ray unit

Just FYI, I was recently on a job where a 13.56 MHz inventory control system, used in a hospital ER, was interfering with an electronic XRay unit. The source/victim distance was about 3 to 4 meters. The sensor, roughly 16X24" wirelessly communicated to the AP at the nurse station.

The RFID unit was used to track supply carts and patients who might wander off.

Since the immunity specs stop at 26MHz for this device, it would not have been tested, naturally (as there are normally no cables).

With the wide rollout of RFID systems, perhaps a look at a spot test at that common 13.56 MHz frequency may bear some consideration.

(From an email on November 19, 2011, from Mike Violette to the Jeff Silberberg, secretary of IEC TC62A MT23, responsible for the EMC standards for medical equipment and systems. Mike is with EMC Washington Laboratories & American Certification Body, mikev@wll.com,and the job he refers to is discussed more fully in "Keep Looking", In Compliance Magazine, www.incompliancemag.com/index.php?option=com_content&view=article&id=919:keep-looking&catid=60:reality-engineering&Itemid=200)

724) Products suffers two failure modes due to surges

[Manufacturer] reports two failure modes for issues with a device that communicates wirelessly with an implanted pacemaker or defibrillator and sends the data over phone lines to a secure computer account.

The device experienced electrical overstress damage from an externally sourced electrical surge within the environment, such as a power outage or lightning storm, and manufacturing quality issues.

These failures exhibit the following problems: loss of power, the power cord becomes warm or hot to touch and/or emits a burning smell (2 reports of patient getting burned), the LED on the power cord does not illuminate, power brick is deformed/melted from the heat, power brick emits a high pitched noise.

The firm reports 1,141 complaints related to electrical overstress damage and 500 complaints regarding manufacturing quality issues in the past two years.

They report this issue is being addressed by replacing power supplies with performance concerns, initiating a supplier corrective action, and by utilizing a new model of power brick supplied by [manufacturer] with a metal oxide varistor (MOV) in future [device] models. The new model of power brick is expected to improve both manufacturing quality issues and electric surge immunity. The new power brick may require a premarket submission or may be considered for a potential recall.

(From a private email on November 17, 2011, from Jeff Silberberg, secretary of IEC TC62A MT23, responsible for the EMC standards for medical equipment and systems to the Editor and the rest of MT23.)

725) Israelis might use EMP weapon against Iran

Israel could cripple Iran's power grid with electromagnetic pulses (EMPs) as part of a concerted attack to halt the Islamic Republic's military nuclear programme, it was claimed last week.

The possible use of such a weapon to send Iran "back to the Stone Age" has been raised in several quarters as a debate rages among Israel's politicians about whether a swift strike should be launched to stop Iran developing nuclear weapons.

The technology behind EMP, which is regarded as non-lethal, has been known for decades. An intense burst of gamma energy… ….with the potential to "fry" electronic devices and circuits. Although the potential of EMP was first noted as a side effect of high-altitude nuclear tests in the 1950s and 1960s, a pulse can also be produced by non-nuclear means such as a microwave generator.

Such a pulse could knock out the power grid and communications for transport, financial and emergency services.

Uzi Rubin, who helped develop Israel's anti-missile defence shield said: "The use of a nuclear device even for non-lethal use such as EMP is out of the question. There are methods to operate EMP from the ground." He said it could be used to take out Iran's radar system.

(Extracts from "Israeli gamma pulse 'could send Iran back to the Stone Age", by Uzi Mahnaimi, in "News, World" the Sunday Times, 9 September 2012, page 28, www.thesundaytimes.co,uk/news. The Editor writes – Any country with a Smart Grid or a predominance of Smart Meters would be much more vulnerable than Iran to EMP attacks, something that seems to be being overlooked in the rush towards implementing these new technologies.)

726) EMI problems with Smart Meters

One of the challenges that have already surfaced is EMI problems with solid state meters. Some utility customers in the US have experienced EMI problems with some meters. The majority of the cases reported involved high-frequency, low-power radiated emissions from the meters interfering with consumer electronic equipment. A few of the EMI cases were conducted problems.

Utilities in Germany, Italy, Sweden and The Netherlands have also experienced bi-directional EMI problems with solid-state utility revenue meters. Several problems were reported involving conducted emissions below 200 kHz from photovoltaic (PV) inverters which caused accuracy problems with the meters installed on the facilities where the PV systems were in use.

Other types of equipment (e.g., electronic lamp dimmers) besides PV inverters have also interfered with the operation of solid-state meters. Other problems involved interference to end-use equipment such as baby monitors and consumer electronic equipment.

The International Electrotechnical Commission (IEC) has already responded to documented EMI cases with solid-state meters by engaging the fast-track development of a new immunity standard to determine the immunity of meters to conducted disturbances.

This draft standard describes a test method for low-frequency (i.e., 2 kHz to 150 kHz) conducted disturbances in the differential mode. The draft standard under development, IEC 61000, Part 4-19: Testing and measurement techniques – Test for immunity to conducted, differential mode disturbances in the frequency range from 2 kHz to 150 kHz at w.c. ports to be issued in mid-2013 is a basic EMC immunity standard in the 61000 series of EMC standards promulgated by the IEC. It will likely serve as a catalyst in the near future for the development of product-specific EMC immunity standards such as one specifically for solid-state utility revenue meters.

(Taken from: "Meshing Power Quality and Electromagnetic Compatibility for Tomorrow's Smart Grid", Philip F. Keebler, Energy Utilization – Power Delivery Sector, Electric Power Research Institute (EPRI), pkeebler@epri.com, in IEEE Electromagnetic Compatibility Magazine – Volume 1 – Quarter 2, 2012, http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6244982.)

727) Increasing levels of EMI 2kHz - 9kHz on AC power distribution networks

As long as no other way is known to meet very strict compatibility requirements for permissible harmonic emission than using huge passive filter circuits (necessarily tuned to higher frequencies,(i.e. usually >1kHz), the probability increases that problems occur in the lower frequency range. This is caused by resonances with the consequence of overload and voltage stress for all electric components being used in the network itself (generators, transformers, capacitors, cables, etc.) and for all components being connected thereto.

In the past a lot of examples have shown that overload or voltage stress problems on electric components were predominantly caused by resonances or cumulating effects instead of loads issued from the normal operating conditions of electric equipment which operate correctly or

from voltage distortion levels which occur under normal operating conditions of the equipment without such effects.

Conventional equipment with non-linear load characteristic draw non-linear currents from the power supply system which contain low order harmonics (usually <1.5 kHz).The probability that overload and stress problems occur increases rapidly when the non-linear current with a given frequency encounters to a resonance in the network with the same frequency.

Since decades the technicians pay attention to avoid such coincidences if imaginably possible. If filter circuits had to be installed in the past (for improving the power factor for example), it was strictly noted that the filtering procedure were started at the lowest frequency before filter circuits for higher frequencies were allowed to be switched on. The target was all the time to avoid resonances in the lower frequency range if possible. As lower the natural damping effect of the network is, as higher is the need to follow this rule.

To follow it in the range of 2 kHz to 9 kHz is very difficult and mostly impossible. The application of filter measures in a great extent is inevitable if the requirement for the compliance of a low distortion level for a specific frequency is very strict. The current praxis is therefore to install huge filter circuits with focus on a dedicated frequency in order to fulfill the requirements at the given target and to disregard undesired effects at this stage which might occur in the network later on by the mentioned coincidence with other equipment (in case of new installations or changing the network configuration for example).

(Taken from Clause A.7, "Impact of additional AIC filter measures in the range of 2 kHz to 9 kHz", in IEC/TS 62578 Ed2 Committee Draft dated 23 March 2012, published by the IEC as 77A/793/INF on 22 June 2012.)

728) Astronomers want to use the moon as an EMI shield

An astronomy team from the University of Colorado is hoping that the far side of the moon will offer their telescopes immunity from radio interference as they explore the origins of the universe.

The only way to observe these dark ages of the universe' past is to look for faint radio signals from neutral hydrogen, which filled the early universe. To do so telescopes need to receive radio waves at frequencies below 100 megahertz, and interference from radio sources on Earth such as FM radio and the planet's ionosphere can disturb these signals. Telescopes behind the moon, however, would not have to contend with Earth's ionosphere or radio chatter.

If selected as a mission by NASA, the Dark Ages Radio Explorer will orbit the moon at an altitude of 200 kilometres. It will collect neutral-hydrogen signals between 40 and 120 megahertz, which corresponds to 80 million to 420 million years after the big bang.

(Taken from www.interferencetechnology.com/astronomers-look-to-the-far-side-of-the-moon-for-rf-immunity, 07/02/2012. Learn more from "Far side of the moon offers quiet place for telescopes" by Anil Ananthaswamy, updated 15:43 03 July 2012, New Scientist Magazine issue 2871, at www.newscientist.com/article/mg21428713.300-far-side-of-the-moon-offers-quiet-place-for-telescopes.html)

729) Cellphone tower frequencies disabled after emergency communications disrupted

ATT temporarily disabled a frequency emitted by 16 towers in Oakland Calif., Tuesday, Aug. 21, after the signals interfered with emergency responder radio communications.

The towers caused radio failures in police cars and fire trucks when they were within a quarter to half mile radius, David Cruise, Oakland's public safety systems adviser, said.

FCC confirmed the interference and ATT shut down the 850MHz frequency on the towers last week – which only affected 2G customers with older phones.

The city is investigating other failures in communications involving interference.

(Taken from www.interferencetechnology.com/att-disables-tower-frequencies-after-emergency-communications-disrupted, 08/23/2012. To learn more, read "Oakland police radio culprit: cell towers", by Matthai Kuruvila, updated 10:32 a.m., Tuesday, August 21, 2012, in the San Francisco Chronicle: http://www.sfgate.com/crime/article/Oakland-police-radio-culprit-cell-

towers-3802585.php or http://www.sfgate.com/crime/article/Oakland-police-radio-culprit-cell-towers-3802585.php#ixzz24SfA46bZ)

730) HDMI emissions caused by badly-made cables

Feedback from the people attending the EMC Academy training sessions at EMC-UK 2012 on the 9th and 10th of October frequently mentioned that they were having problems with the EMC of HDMI connections.

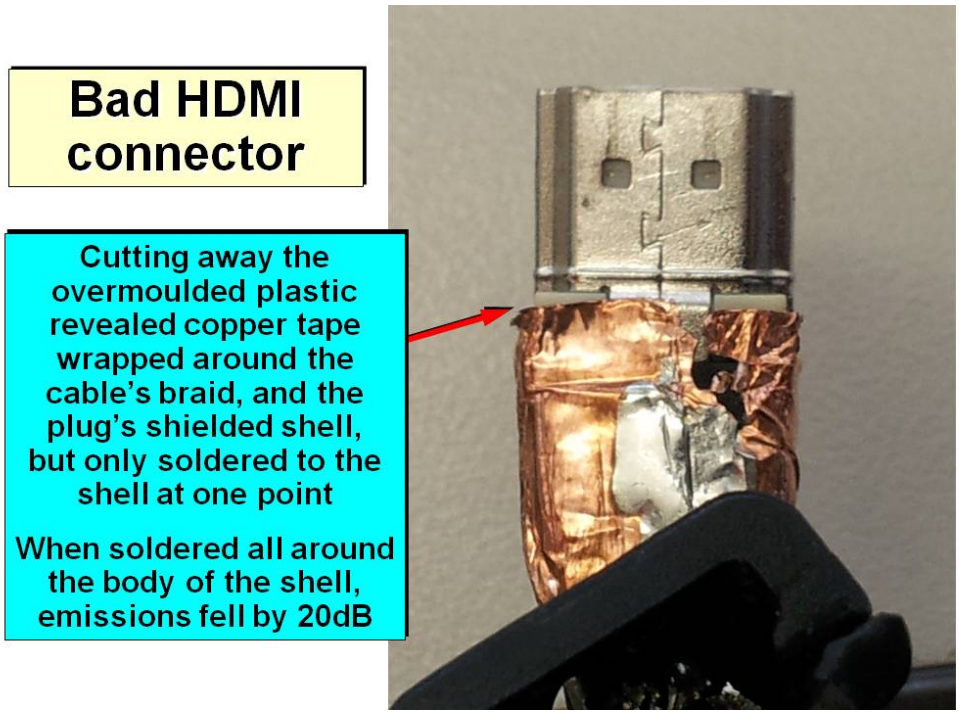
Wim Ophelders, in charge of Image Processing, Signal Integrity and EMC in the Research & Development department of Océ-Technologies B.V. in The Netherlands, has also recently been investigating the causes of excessive emissions from HDMI interconnections, and sent in the annotated photograph below on 12th November 2012.

Wim found that soldering the wrapped copper foil properly, i.e. all around the connector shells at both ends of the cable, reduced the emissions he had thought were caused by other aspects of his HDMI-connected product by so much that it now passed its EMC tests.

If this poor cable assembly is typical of purchased HDMI cables, it could well be the cause of many of the complaints about the poor EMC of this type of interconnection.

Most EMC test lab managers have long experience with poorly-constructed cables sold as "shielded" types, some of which contain shields that are not even connected to the connector shells at the ends!

A particular problem is that even if a purchased cable has good shielding performance when used with a prototype product, future batches supplied for production can suffer degraded shielding due to incorrect assembly – but of course it is impossible to tell by visual inspection because the cable-connector joints are overmoulded with opaque plastic.



Unless cables can be purchased with transparent overmoulding, the only ways to ensure that a product's EMC performance (and legal compliance) has not been hugely compromised by the poor quality of purchased cables are:

- Assemble your own cables, don't buy them, so that you control the quality of your EMC-critical cables yourself.
- X-ray a random sample of cables from each batch delivered, checking their internal assembly is correct before accepting them into the company stores. Although a costly

solution, it may be most cost-effective because the X-ray machine can be used to check the correct assembly of any/all other components/assemblies supplied for manufacture, and also a big help in avoiding assembling with counterfeit parts.

- Using a spectrum analyser with tracking generator, two clamp-on current probes and a cable termination box fitted with two HDMI sockets, check that a random sample of cables from each batch delivered measure the same as the 'known good' example of the same cable that is known to help ensure that products pass their EMC tests.

731) Digital Media Players interfere with pacemaker telemetry

Background: Contemporary implantable heart rhythm devices communicate multiple complex data simultaneously using radiofrequency telemetry. Interference in communication can expose them to the risk of potential corruption, leading to adverse clinical consequences.

Methods & Results: We studied the characteristics of interference with uplink (real time intracardiac electrograms, marker channel, and stored histograms) and downlink (attempt to program a change in the lower rate limit, the pacing mode, and the ventricular lead configuration) data transmission between the wand and the pacemaker caused by digital media players (iPods—Photo and 3G) in 50 patients. We also measured and characterized worst-case magnetic field emissions (MFE) from the wand (≤0.4 μT), pacemaker (≤0.004 μT), and iPod (≤0.05 μT) during telemetry to understand the modulation techniques and safety protocols employed during data transmission.

Telemetry interference (TI) manifested as high frequency spikes (24.4%), blanking (17.7%) and interruption (22.2%), or delay (17.6%) in transmission with warning on programmer's screen. TI occurred in 25.6% of patients when the iPod was "on" and in 13% even with the iPod turned "off." There were no inaccuracies in downlinked data when the downlink communication was successful. Wanded telemetry utilizes low-frequency (30–300 kHz) radiowaves and simple digital modulation techniques at relatively slow rates for "sequential" data transmission protected by a continuous "handshake." Emissions from iPods in that range interrupt the telemetry link but are too weak to cause pacemaker malfunction through corruption of vital data.

Conclusion: Low-power MFE from iPods can produce interference with establishment and maintenance of a telemetry link and can cause TI with transmission of real time data, but because of continuous check protocols, do not corrupt the stored and vital downlink data. (PACE 2009; 1–9)

(From "Characteristics of Telemetry Interference with Pacemakers Caused by Digital Media Players" by ASHOK J. SHAH, M.D., JOSEPH D. BRUNETT, PH.D.,* JAY P. THAKER,† MEHUL B. PATEL, M.D.,* VALDIS V. LIEPA, PH.D.,* KRIT JONGNARANGSIN, M.D.,† and RANJAN K. THAKUR, M.D.‡ *Thoracic and Cardiovascular Institute, Sparrow Health System, Michigan State University, Lansing, Michigan; †Department of Electrical Engineering and Computer Science; and ‡Division of Cardiovascular Medicine, University of Michigan, Ann Arbor, Michigan, PACE 2009, Wiley Periodicals, Inc., www.ncbi.nlm.nih.gov/pubmed/20059718.)*

732) Smart grids use wireless to avoid EMI

As one of the very few smart metering providers, Kamstrup A/S (Skanderborg, Denmark) offers RF-communication in their smart metering system and has done so for more than ten years. Seen from Kamstrup's point of view, the reason why wireless systems prevail in smart grid technology is simple: RF works – a plain fact which is being corroborated by numerous, high-performing RF-based systems from all over the world.

In the past, Kamstrup offered RF and PLC solutions together, but has now terminated its PLC program as RF very soon began to show much more convincing results. The evidence is plenty. Sweden was one of the first countries to roll out smart meters nationwide, and now the Swedish case study offers experience to learn from. Many utilities who first opted for a PLC solution have afterwards switched to an RF-solution as PLC showed poor performance on

meter readings, of which 60 to 90% was traceable to grid disturbances. Some have chosen to mend the problem by installing expensive filters.

Some PLC providers therefore take reservations against grid disturbances when guaranteeing 100% performance claiming disturbances to be a separate problem to be dealt with and thus pushing it back to the utility. But the fact is that cables are simply a hard environment for communication. The increased disturbance level in the grid which caused many PLC networks to fail in Sweden could for a large part be traced to the massive exchange of incandescent light-bulbs with low-energy light bulbs.

All electric devices which are connected to the grid are also potential sources of grid disturbance as they not only consume power from the grid, but also return electromagnetic disturbances. The Electromagnetic Compatibility-directive (EMC) regulates how much disturbance electric devices may cause. But even though the equipment which is now causing problems in Sweden may comply with the EMC-directive, it is still liable to influence a PLC-based meter reading system because the communication unit in the meter is affected by the total amount of disturbances generated by all installed equipment in a house. So, when substantial changes happen simultaneously – like the out-phasing of the incandescent light bulb – the meter reading system can be affected in spite of the regulatory fulfilments of the individual product.

(Taken from "Smart Grids turn to wireless systems" by Gert Skriver, in Electronic Engineering Times Europe, October 2012, page 51, www.eetimes.com/design/smart-energy-design/4398388/Smart-grids-turn-to-wireless-systems)

733) Apollo mission programme EMC problems

Forty-three years after first landing on the moon and with the recent death of Neil Armstrong I thought I would relate some anecdotes on Electromagnetic Interference associated with the successful Apollo mission program.

The Apollo 7 mission was to be a test flight with a 3 man crew and the first time the Saturn 1B rocket was used. A problem was encountered with the rendezvous radar and the telemetry systems which delayed the mission.

Filters supplied to the Kennedy Space Centre did not fix the problem. Attempts to tune the coaxial connection between the radar dish and the electronics package lessened the interference with the telemetry system, but resulted in a new interference with the abort guidance system

During the Apollo 12 and 14 missions a colour camera was introduced with less than spectacular performance. The new replacement camera to be used for the Ground Commanded Television Assembly had interference emanating from voice and telemetry subcarriers in the middle of the video bandpass.

Eventually a cancellation process was implemented that removed the offending voice and telemetry subcarriers from the lunar module downlink.

The above examples illustrate that EMC has been critical to many major endeavours. As with the space program, EMC in cutting edge projects will force engineers to push the envelope. The challenge presented by these tasks is what motivates engineers.

(Mark Mifsud, "Message from the Chairman", EMC Society of Australia Newsletter, issue 58, September 2012.)

734) Conducted Interference reduction from Compact Fluorescent Lamps

One of the most popular light sources used in houses, industries, stores, hospitals, universities, laboratories and magazines are the lamps of low pressure. One example is the Compact Fluorescent Lamp (CFL) presenting larger efficiency in terms of energy and brightness [1].

Nevertheless, the introduction of nonlinear electronic circuits in the lighting industry has also increased the electromagnetic interference (EMI) incidence. The lighting appliances, like CFL's that is broadly used, increase significantly the current and voltage harmonic levels as well as

the high frequency components. It leads as consequence the interference and deterioration in equipments and circuits.

The interference from CFL's in receivers of TV VHF [5], systems with remote control [6] and relays in substations have been reported. In the last case it causes an involuntary energized relays.

[5] J. Rajamaki, "Lighting Interferences – An Ever Increasing Threat! Will the Proposed Changes in CISPR 15 Correct the Situation?" in EMC'05, 2005, p. 7-12.

[6] W.A. Anderson, E. E. Hammer and A. Serres "The Interaction of Infra-Red Controls and Electronic Compact Fluorescent Lamps" in IAS'95, p2066-2068, vol. 3.

*(Taken from "*Conducted Interference reduction from Compact Fluorescent Lamps*" by P.I.L. Ferreria, G. Fontgalland, G.F. Aragao, A.R.Z. Nascimento, R.C.S. Freire, and S.E. Barbin, 2010 Asia-Pacific International Symposium on Electromagnetic Compatibility, April 12-16, 2010, Beijing, China, ISBN: 978-1-4244-5263-9.)*

735) Electronic Damage

When a cosmic ray passes through an electronic circuit, its energy may cause a transient error to occur. This can be a problem for the electronics found in satellites, spacecraft and even aircraft. A cosmic ray may have caused the flight control system of a Quantas flight to malfunction in 2008. The aircraft plunged hundreds of metres, causing injuries to many of those on board, but was landed safely.

Software systems in aircraft have since been redesigned to average out sudden power spikes of the kind that a cosmic ray might induce. A cosmic ray is believed to have caused a malfunction two years ago aboard the Voyager 2 spacecraft, which was launched in 1977.

(Taken from "Electronic Damage", in New Scientist Issue 2885, 6 October 2012, www.newscientist.com.)

736) Cat 6 copper vs fibreoptic Ethernet in industry

Copper, now commonly installed in Cat 6 (or higher) formats, is frequently deployed in areas where there are low levels of electromagnetic interference (EMI). Local equipment rooms (LERs) containing servers, workstations and PLC interfaces, are typical applications. But when the network extends beyond these confines, such as between LERs, the distances spanned between links, the levels of EMI the cabling may be exposed to and the ground potential between facilities, where galvanic isolation may be desired, have to be considered, as they will have significant impact on the operation of a copper network.

It is at this point, says, Mr Jones, that decisions are likely to be made whether to use copper or fibre media. Fibre optics removes many of the negative aspects of copper cabling. It offers greater range than copper, it is inherently immune to EMI, it permits galvanic isolation between facilities that are at different ground potentials and it is becoming more cost competitive, given the significant rise in copper prices in recent years.

(From "Network media: economic and technical selection issues", Industrial Ethernet Book, Sept 2012,
www.iebmedia.com/ethernet.php?id=8900&parentid=74&themeid=255&hft=72&showdetail=true&bb=1)

737) Noise from multiple ASDs corrupts cable test system

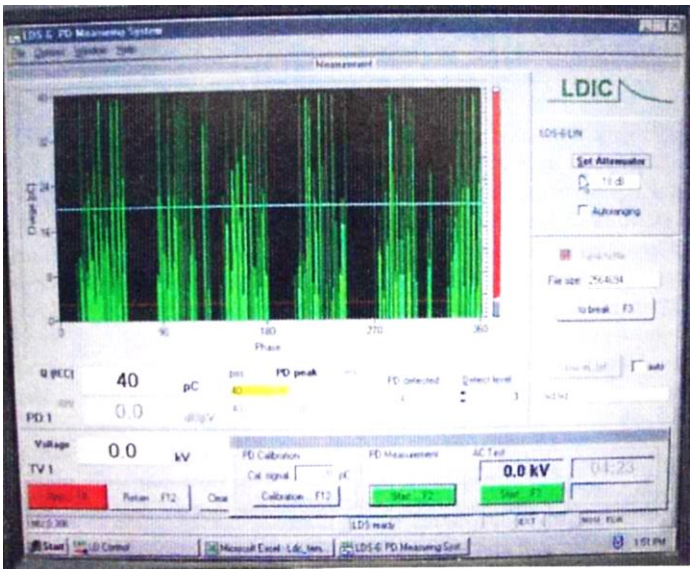
A popular manufacturer of electrical cables used for high-voltage overhead and underground cabling systems installed a new production line for a new type of cable. The new line utilized a variety of adjustable speed drivers (ASDs) to control the raw cable materials (two 1-horsepower ASDs), the heating and extrusion process (two 400-horsepower ASDs), and the cable take-up reel (teo 1-horsepower ASDs). The size of the line was such that the distance between the ASDs was significant. The two ASDs used to control the heating and extrusion process were closest to the large electrical subpanel that provided power to the production line. The two ASDs that controlled the unwinding of the raw materials were next, followed by the two ASDs that controlled the take-up reel. The line power for the two large ASDs (400 h.p.) was not in a

conduit run, but was hung from a cable mounting system on the ceiling. Hence, these cables were long and unshielded.

Before the finished cable rolled up on the reel could be shipped to the customer, the cable underwent a partial discharge test. A partial discharge test is used to determine any leakage along the entire length of the cable. If the partial discharge test reveals a charge flow of more than 5 picocoulombs, the cable fails the test. If the test reveals a flow of less than that amount, the cable passes the test. The availability of the partial discharge test setup in the plant is a vital piece of equipment to ensure that cable reels are shipped on time.

Upon startup of this new production line, use of the partial discharge test setup revealed a problem. As shown in Figure 1, the partial discharge test system revealed a leakage much larger than five picocoulumbs. In fact, the test yielded a leakage of almost 40 picocoulombs, eight times the acceptable level. Plant engineers were concerned that the partial discharge test system was not working properly and decided that this system could not be used until someone determined the reason for the unacceptable test results.

In response to the problem, the plant staff began seeking the cause of the erroneous readings on the test monitor. Connections to the equipment were investigated. This partial discharge test



system was switched with another one in the plant, and the same problem reoccurred near the new production line. The probe to the partial discharge system was also checked. Cable reels that failed the test at the problem location were taken to the other partial discharge test system and passed the test there. The manufacturer of the partial discharge system was called in, but could not determine the cause of the erroneous readings. A partial discharge test expert was also called in, and still the problem remained unsolved. After several months of investigation, the plant engineer turned to the local utility for some assistance. The local utility called upon EMC engineers to investigate the problem and to determine the cause of the problem.

Measurements were performed at the area of the line input to the ASD nearest the partial discharge test system, and a custom designed filter had to be manufactured and installed. After the EMC investigator left, the filter was installed by the electrical contractor at the step-down transformer; however, interference problems still occurred. Upon a re-examination of the filter installation, the EMC investigators quickly realised that the contractor had not followed the guidelines provided b y the team. To control the radiated and conducted emissions, the filter must be installed directly at the ASD (as close to the input terminals as possible), and the transformer must be located next to the filter to ensure proper emissions attenuation. Once corrective actions were taken, the interference was reduced and found to be at acceptable levels with all systems operating as shown in Figure 7.

Application of a 5-amp ground noise filter on the ground line of the 15-horsepower drive resulted in a reduction of noise emissions on the ground lne as shown in Figure 8. The emissions reduction, which was as much as 30dB, also reduced the background noise on the partial discharge system.

Summary

The combined radiated-conducted emissions from each of the drives in the plant affected the background noise level of the partial discharge system. The noise level was too high for the two to coexist without some mitigation measures. Even if the original installation of the 15-horsepower drive closest to the partial discharge system had contained an isolation transformer and second power line filter adjacent to the drive, the noise from the other drives would have rendered the test system non-usable. Inspection of the plant area, including the partial discharge test system, prior to the installation of the new cable manufacturing assembly line might have revealed this issue. Still, the key factor that might have helped avoid this problem would be the basic realization that partial discharge systems are indeed sensitive to emissions from devices such as drives. Shorter main conductor runs to the drives would also have helped.

The technology of the ground noise filter

The ground noise filter is a patented technology essentially comprised of a specially designed core with a few turns of solid copper wire wrapped around the core, all in parallel with a resistor. The core and turns provide an inductive impedance to the ground impedance connected to the filter. Although the filter technology is simple, it has been shown in many examples to resolve ground-related EMI problems.

(Taken from: "Case 1" in "Case Studies of EMI elimination and ground noise reduction using ground noise filters", by Philip F Keebler and Kermit O Phipps of EPRI Electromagnetic Compatibility Laboratory, Knoxville, Tennessee, published in Interference Technology EMC Directory and Design Guide 2009, pages 102-118.)

738) Quieting down for electronic HID lighting

High-frequency electronic lamp ballast systems are being used more frequently in commercial and industrial facilities to provide a source of energy-efficient fluorescent and HID (High Intensity Discharge) lighting. Lamp and ballast manufacturers have designed many of these systems to provide high-efficiency lighting systems.

A college recently installed universal-voltage electronic HID ballasts in the gymnasium where basketball games were played. These high-efficiency electronic HID ballasts were installed to replace existing 400 watt high-pressure sodium (HPS) magnetic ballasts. After 100 percent replacement of ballasts to alleviate component-related ballast failures, the ballasts continued to fail. Following limited power quality monitoring efforts by a consulting organization, the fixture manufacturer and the ballast manufacturer suspected that there could be wiring and grounding issues within the facility. Failure of fixtures and ballasts in the gymnasium rendered the basketball court unusable if the light levels became too low. Repair of the fixtures and ballasts started to become a regular task before weekly basketball games could be played.

Our objective was to conduct a detailed on-site investigation to determine if there were wiring and grounding issues present at the college facility where these failures occurred with such frequency. We conducted a tw0-day on-site investigation of the wiring and grounding system that provides power to the lighting branch circuits used to power the ballasts.

Emissions reduction at the lighting panel

Because the level of conducted emissions was high at the ground within the panel, the investigators elected to install a 5-amp ground noise filter on the panel's main ground conductor. The installation of this filter would reduce this level of emissions and would help separate the ground of the lighting panel from the ground of the ASD panel. Figure 11 illustrates the level of conducted emissions on the ground of the lighting panel prior to the installation of the 5-amp filter (top graph) and after the installation of the filter (bottom graph). As one can see, the reduction of emissions is approximately 20 to 30 dB depending upon frequency. The installation of the filter reduced the noise emissions on the ground at the light fixtures where the electronic ballasts were used. Failures of the ballast diminished.

(Taken from: "Case 2" in "Case Studies of EMI elimination and ground noise reduction using ground noise filters", by Philip F Keebler and Kermit O Phipps of EPRI Electromagnetic Compatibility Laboratory, Knoxville, Tennessee, published in Interference Technology EMC

Directory and Design Guide 2009, pages 102-118. For details of the technology of the ground noise filter, see Banana Skin number 737.)

739) External noise currents interrupt critical operations

The situation

A major building materials distribution company supplies construction projects throughout a large sector of the building industry. In fact, this entity has become the largest single source provider of environmental remediation, construction, packaging, and janitorial products in the Western United States.

The building materials company experienced serious unusual and unexplained malfunctions of end-use electrical and electronic equipment and of power distribution equipment such as circuit breakers of various sizes and their uninterruptible power supplies (UPSs). Such malfunctions had interrupted power to building loads, telecommunications, internet traffic, server operation, and the operation of the fire alarm system.

Summary

After the customer implemented the recommended changes to the wiring and ground system (including the installation of the ground noise filters), the equipment malfunctions and dropped telephone, network, and internet connections were eliminated. These filters, combined with the wiring and grounding changes, helped to isolate the customer's facility and equipment from noise from the outside electromagnetic environment.

(Taken from: "Case 3" in "Case Studies of EMI elimination and ground noise reduction using ground noise filters", by Philip F Keebler and Kermit O Phipps of EPRI Electromagnetic Compatibility Laboratory, Knoxville, Tennessee, published in Interference Technology EMC Directory and Design Guide 2009, pages 102-11. For details of the technology of the ground noise filter, see Banana Skin number 737.)

740) EM environment limitations in the safety information for a new smartphone,

Do not use your device near other electronic devices

Most electronic devices use radio frequency signals. Your device may interfere with other with other electronic devices.

Do not use your device near a pacemaker

- Avoid using your device with a 15cm range of a pacemaker, if possible, as your device can interfere with the pacemaker.
- To minimise possible interference with a pacemaker, use your device only on the side of your body that is opposite the pacemaker.

Do not use your device in a hospital or near medical equipment that can be interfered with by radio frequency

If you use medical equipment, contact the equipment manufacturer before using your device to determine whether or not the equipment will be affected by radio frequencies emitted by the device.

If you use a hearing aid, contact the manufacturer for information about radio interference

The radio frequency emitted by your device may interfere with some hearing aids. Before using your device, contact the manufacturer to determine whether or not your hearing aid will be affected by radio frequencies emitted by the device.

Turn off the device in potentially explosive environments

Turn off the device in potentially explosive environments instead of removing the battery

- Always comply with regulations, instructions and signs in potentially explosive environments
- Do not use your device at refuelling points (petrol stations), near fuels or chemicals, of in blasting areas.

- Do not store or carry flammable liquids, gases, or explosive materials in the same compartment as the device, its parts or accessories.

Turn off your device when on an aircraft

Your device may interfere with the aircraft's electronic navigation instruments.

Your device may interfere with automotive equipment

Electronic devices in your car may malfunction, due to radio interference from your device. Contact the manufacturer for more information.

Do not store your device near magnetic fields

- Your device may malfunction or the battery may discharge from exposure to magnetic fields.
- Magnetic stripe cards, including credit cards, phone cards, passbooks, and boarding passes, may be damaged by magnetic fields.
- Do not use carrying cases or accessories with magnetic closures or allow your device to come into contact with magnetic fields for extended periods of time.

(Taken from the "Safety Information" section of the User Manual of the latest model of a popular and highly-regarded smartphone, purchased in September 2012. Notice that the smartphone user is required to be knowledgeable about EM environments and potentially explosive atmospheres, and to be continually monitoring their EM environment for magnetic fields, with no maximum level specified. Also, the requirement to not use the phone "near other electronic devices" gives no guidance on what is too near. If the word "near" means the same as in the normal EMC emissions and immunity standards that are used to provide compliance with the EMC Directive, this effectively means the user instructions do not permit the smartphone to be used in any modern home, office or train.)

741) Action taken against Alternative "Energy Medicine" devices

After reports in the national media, spearheaded by the Seattle Times, about the widespread fraud and health perils inflicted on American patients by the makers of electrical devices touted as miracle cures for serious diseases such as cancer and AIDS, the Food and Drug Administration (FDA) has banned importation of the EPFX.

This desktop device is manufactured in Hungary by William Nelson, a federal fugitive who fled the country in 1996 when faced with felony fraud charges. Another electrical device under investigation is the PAP-IMI (Pap-Ion Magnetic Inductor), a 260-pound electric pulsing machine that's been linked to patient injuries and deaths. The latter is the invention of Prof. Panos Pappas, a Greek inventor and non-physician. Both these devices are based on the belief that the human body consists of energy fields and that altering those fields can improve or restore health. Apart from the obvious dangers of subjecting the ill and injured to electrical charges, physicians note the perils of delaying or rejecting medical care that might have helped.

Now the U.S. House of Representatives, Committee on Energy and Commerce's, Subcommittee on Oversight and Investigations, has instructed the FDA to provide all relevant records on these devices, their makers, and distributors. Of particular concern, is the loophole posed by the use of Institutional Review Boards (IRBs). Makers of both these devices appear to have hired private companies of medical professionals (IRBs) to evaluate their devices and to qualify them for use on patients. Examination by an IRB is not the equivalent of FDA approval, but can be used by the unscrupulous to defraud the gullible or desperate. View the entire Congressional letter online.

(Taken from: 'FDA, Congressional Sub-Committee Take Action Against Alternative "Energy Medicine" Devices', Interference Technology eNews, December 27, 2007, www.interferencetechnology.com. For more information, also see "Congress Asked to Investigate Quack Devices - Device Watch", www.devicewatch.org/reg/inslee.pdf; http://en.wikipedia.org/wiki/List_of_topics_characterized_as_pseudoscience; http://www.camlawblog.com/promo/speaking/legal-boundaries-and-ethics-in-energy-work.)

742) Radio Mast EMI Case Headed to Court

A farmer in Purnim, a township in Victoria, Australia, is on his way to the Supreme Court in his battle against broadcasting company Ace Radio over the location of transmission masts. Independent testing carried out by EMC Technologies showed electromagnetic interference was occurring in the house, and the farmer claims the radio towers are interfering with his telephone, fax, computer and radio and affecting his animals.

PURNIM farmer John Howard is on his way to the Supreme Court in his battle against Ace Radio and Moyne Shire Council over the location of radio masts. Mr Howard, who lost a Victorian Civil Administrative Tribunal (VCAT) appeal on the matter, has been granted leave to appeal to the Supreme Court of Victoria. Two Ace Radio transmission masts on a property opposite Mr Howard's house on Blighs Road were built 126 metres and 58 metres closer to his house than the original planning permit specified. The towers are also 11 metres taller than the original specification and have 15 guy wires instead of eight. Permission to vary the position was given verbally by a Moyne Shire officer. Ace Radio, which owns Coast FM and 882 3YB, and Moyne Shire Council are named as respondents in the case, due to be heard in May. Mr Howard has a document from the Minister for Planning Justin Madden that says: "Changes to a planning permit can not be verbally approved under Victorian planning legislation. "The permit was retrospectively amended on June 16 this year, after the towers had been built, following a review by VCAT.

Mr Howard said the towers were causing interference with his telephone, fax, computer and radio as well as affecting his animals.

The revised siting of the masts put them closer to power lines that connect to Mr Howard's house, which he believed to be a factor in the interference. Independent testing commissioned by Ace Radio and carried out by EMC Technologies, showed electromagnetic interference was occurring in the house.

Mr Howard said his bore pump had blown up twice and an electric fence had been damaged during thunderstorms since the installation of the masts. The report by EMC Technologies said the ground current associated with lightning strikes could affect equipment connected to the mains. Mr Howard wants the towers moved to their originally planned positions or his house and sheds relocated. Moyne Shire has estimated the cost of moving the buildings at $880,000.Mr Howard said the battle had already cost $500,000."I stand to lose the farm over this," Mr Howard said. "I have done nothing wrong and I'm determined to see that the council is held responsible for the action of its officer who gave verbal consent when he had no right to do so." Moyne Shire chief executive Brett Stonestreet declined to comment.

(Taken from Interference Technology magazine's on-line newsletter, http://72.29.76.194/~interfer/radio-mast-emi-case-headed-to-court/, 12/16/09 03:37 PM, and from the original article from The Standard newspaper: "Supreme Court Date Set", by Steve Hynes, Nov. 25, 2009, 10:33 a.m. http://www.standard.net.au/story/740348/supreme-court-date-set/.)

743) Interference Stymies Radio Test

The BBC has released a report on its year-long test of digital medium wave (DMW) radio (or digital radio mondiale (DRM) radio) that is reported to offer a more robust signal that carries for greater distances than analog radio broadcasting.

The trial was held in southwest England using the frequency of BBC Radio Devon and was codenamed project Mayflower.

Volunteer listeners reported favorably on the quality of daytime broadcasts, but attempts at broadcasting after sunset were another story.

Nighttime changes in the atmosphere allow for distant off-shore signals to interfere with DRM, which in turn ceases to decode the signal causing an interruption in reception.

BBC spokesman said that the problem would require re-planning the transmission network and/or the building of new transmitters.

Industry analysts have concluded that the switchover from analog radio broadcasts is still some time away. The entire 11- page report on Project Mayflower has been posted online: http://downloads.bbc.co.uk/devon/pdfs/project-mayflower-summary-report.pdf.

From the official report:

Given the additional interference to medium-wave services from distant interferers which is apparent at night-time, the night-time coverage was always expected to be smaller than the daytime coverage. Indeed, the DRM coverage at night is larger than the equivalent 'clean' AM coverage at night.

It is important to note that the frequency we were using for DRM at Plymouth is particularly susceptible to interference from distant transmissions, although it is not atypical of the situation that occurs on many AM frequencies assigned to BBC Local and network radio in the UK. In some areas, the frequency allocated may be very much clearer of interference and so the difference between daytime and night-time reception will be less marked: it is possible that the frequency allocated to BBC Radio Scotland (810 kHz) is one such example.

However, a difference between the daytime and night-time coverage of the transmission will always present a problem, even if the night-time coverage is greater than the claimed AM coverage at the moment. This is for three principal reasons.

First, the enormous area which appears to be served by DRM during the day means that the contrast between the night-time and daytime coverage is even greater and potentially affects even more people. Medium-wave transmitters are typically planned on the edges of cities, so that the main centre of population is comfortably within the night-time coverage area of the AM. However, if DRM is capable of serving a wide-area then it stands to reason that neighbouring centres of population – previously outside both daytime and night-time coverage – will now be daytime only.

Second, whilst the night-time coverage of DRM is greater than the equivalent 'clean' AM coverage, it is apparent that the technical limit of AM coverage is not the same as the limit at which listeners will stop listening to it. Thus, listeners will tolerate much more cross-talk from interfering sources than is catered for in international planning standards, even more so if it is content that they especially wish to hear.

Similarly, listeners will listen to field-strengths well below the international limits even if the result is audio which is covered in static and noise. For this reason, the area in which listeners expect to be able to receive AM at night is almost the same as the area in which they can receive it during the day; and is very much bigger than the technical limit of AM coverage.

Third, the failure mode of DRM is – as with all digital systems – dramatic. The transition from working perfectly to not working at all is fairly sudden, even considering that DRM is designed to provide a measure of graceful degradation for longer than some other digital systems. Thus, listeners who previously received a degraded, interfered-with AM service at night now received nothing. At other times, given the dramatic fluctuation in interfering signal strength, listeners

found the radio services dropping out – or burbling, or becoming 'metallic' in sound – and taking some while to restore, despite any actions they took.

(Taken from" Interference Stymies Radio Test" in Interference Technology Magazines on-line newsletter: http://72.29.76.194/~interfer/interference-stymies-radio-test/, 05/27/09 04:36 PM, and from http://downloads.bbc.co.uk/devon/pdfs/project-mayflower-summary-report.pdf.)

744) James C Klouda, RFI expert

Jim, it will be recalled, recognized at a very early stage the need for testing electronics and receivers for radio frequency interference.

Interestingly, his first real world application of his EMC background was at the start of his EMC career in the early 1950's. He had just graduated from the Illinois Institute of Technology and took a job at Chicago Aerial Survey in Chicago. There was interference to a new aerial camera aboard a US Air Force bomber. The camera caused interference to the bomber's autopilot programming.

Jim was called and after review of the situation had shielding installed by the manufacturer's camera. This solved the problem and there were no further EMC issues with the autopilot system. From that point on he became the RFI expert.

(Taken from "Completed Careers", by Don Hierman, Associate Editor, IEEE Electromagnetic compatibility magazine, Volume 1, Quarter 3, 2012, page 58, http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=06347052.)

745) Beer Blacks Out TV

In a reprint of a United Press International Dispatch (dated May 31, 1962), it was stated: "Rochdale, England – Television sets in the neighborhood of the Dog and Partridge pub are back to normal now that they discovered that the trouble was caused by beer.

Engineers found interference was caused every time the barkeeper drew a beer from one of the pub's seven spigots, so they 'neutralized' the spigot."

(Taken from "50-25-10 Years Ago: A Review of EMC Society Newsletters, by Dan Hoolihan, Associate Editor, IEEE Electromagnetic compatibility magazine, Volume 1, Quarter 3, 2012, page 22, http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=06347047.)

746) Oops, that was a 1,550 Amp Lightning test, not 150 Amp!

Pat André of André Consulting, Inc. shared a story that reminds us that it is good practice to ask more questions, even if the answers seem obvious, to get the needed solution. As usual, the story is told from Mr. André's perspective.

"While consulting for a client, I was approached by a different company who was performing lightning testing at the same laboratory as my client's. This company was having a great deal of difficulty passing a lightning test. When I saw the unit and the test they were trying to pass, my first question was, "Can you shield these cables?" I was told no.

The unit was small, and although the test levels were not very high, the size of the transient suppression required to pass this test would not have fit inside the box. So we tried several other filtering techniques, with very little success. Therefore, in desperation, I questioned the client more about the shielding issue, with the thought of approaching their customer and requesting if we could shield the signal cables in question.

They told me it was not the customer who said they could not shield the cables, but another consultant - who was worried about "ground loops" (What?). Once I was clear on this, we went to their engineering laboratory, grabbed some overbraid, and shielded the signal lines, assuring both ends of the shield were well bonded to the connectors.

Back at the testing laboratory, the test engineer and the head engineer from my client's company were both weary after many failures. So, starting at a low level, 100 amperes injected current, they slowly worked their way up to the test limit of 150 amperes.

After passing at 140 amperes, the test engineer said, "Okay, are you ready for 150 amperes, the full test level?" We all assured him that we were ready. When the test engineer initiated the

test, we immediately heard a large BANG! We watched in stunned disbelief as sparks flew and smoke escaped from each connector.

My client looked like he was ready to change careers, hanging his head in defeat. At that point, the test engineer turned to me and apologetically said, “Oops. That was 1,550 amperes.”

Now that I knew the reason for the sparks and smoke, I turned to the customer engineer and said, “Wait, this may be okay. Check the unit. Is it still working?” After a moment, he said, “Yep. It’s working fine!”

I told the customer engineer that I could get off his payroll at that point, since his unit appeared to pass at 10 times the test level. But, he would have none of that. He told me that I was to sit there and watch the rest of the four hours of testing. The rest of the morning was quiet, and I almost felt guilty for invoicing them for that time. Almost. I was just glad I pursued the shielding question.”

(Taken from “Chapter Chatter” by Todd Robinson, Associate Editor, IEEE Electromagnetic compatibility magazine, Volume 1, Quarter 3, 2012, page 8, http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=06347045.)

747) Nikon D800 Wireless Memory Card Issues Caused By RF Interference

Eye-Fi, the manufacturer of SD memory cards and SDHC cards with Wi-Fi, has released a solution to an issue that prevented their cards from working with the Nikon D800 and D800E.

In early October, Eye-Fi confirmed a compatibility issue that impacted the use of Direct Mode in the Nikon D800. Though the two products were marketed as compatible, consumers were “unable to use Eye-Fi’s Direct Mode, and in some cases unable to use any of the card’s Wi-Fi capabilities as all.”

According to an Eye-Fi representative, the company determined the issue was caused by interference emanating from the unique USB 3 connector inside the camera. The update provided by Eye-Fi changes the card’s broadcast channel to prevent further interference issues.

“By default, Direct Mode broadcasts on channel six. In the D800, due to noise that’s coming from the USB 3 interface, we needed to broadcast on channel 11,” Ziv Gillat, Eye-Fi co-founder, said.

More details from Imaging Resource:

Makers of the Eye-Fi wireless memory cards this week released a fix to an issue that kept their cards from working fully with the Nikon D800 and D800E. The problem, according to an Eye-Fi representative, is caused by noise coming from inside the camera, specifically from the D800's unique new USB 3 connector. Posted on Monday, the update works around the issue by changing the card's broadcast channel.

Eye-Fi's Direct Mode allows a direct connection to devices that can't create a Wi-Fi hotspot.

Early last month, reports surfaced of an issue with Eye-Fi's WiFi-connected SD cards, when used in the full-frame Nikon D800 and D800E digital SLRs. Although the two products were said by their makers to be compatible, users found themselves unable to use Eye-Fi's Direct Mode, and in some cases to use any of the card's Wi-Fi capabilities at all. Now, Eye-Fi has issued a fix, and a statement from Eye-Fi co-founder Ziv Gillat published by The Phoblographer suggests that radio frequency interference from the D800 body is to blame.

"By default," said Gillat, "Direct Mode broadcasts on channel six. In the D800, due to noise that’s coming from the USB 3 interface, we needed to broadcast on channel 11."

Nikon's D800 is the first DSLR with USB 3.0 connectivity, but Eye-Fi has discovered that it can interfere with the default channel used by its Wi-Fi connected flash cards.

Nikon's D800 is the first DSLR with USB 3.0 connectivity, but Eye-Fi has discovered that it can interfere with the default channel used by its Wi-Fi connected flash cards.

Although the problem prevented use of Direct Mode with the D800 and D800E bodies, there was no risk of data loss; images were still written to the flash card, even if they could not be transmitted wirelessly.

Some users have reported more general problems with Wi-Fi beyond the Direct Mode, though, and Eye-Fi's fix doesn't specifically address this. (Nor could problems in other modes be addressed by firmware, if the problem is indeed caused by RF interference on specific channels, as the channel is set by the access point, not the client.) Of course, if you are having problems beyond Direct Mode and have access to the router, it would seem logical that configuring it to use channel 11 -- if too many adjacent networks aren't already using that channel -- would be likely to help the situation.

More details on the firmware update can be found on the Eye-Fi website.

(Taken from www.interferencetechnology.com/nikon-d800-wireless-memory-card-issues-caused-by-rf-interference/, 12/19/2012, and also from Imaging Resource: "D800 compatibility problems caused by RF interference, says Eye-Fi", by Mike Tomkins, posted Wednesday, November 21, 2012 at 7:31 PM EST www.imaging-resource.com/news/2012/11/21/d800-compatibility-problems-caused-by-rf-interference-says-eye-fi. Also of interest is the Nikon Rumors site: http://nikonrumors.com/2012/11/20/eye-fi-cards-now-compatible-with-the-nikon-d800-camera.aspx/.)

748) "Survival of the Fittest" – EMC in Electric Power Substations

When a short circuit occurs in a transmission substation (usual definition – voltages above 100,000 volts), the resulting fault current is spectacular. In some substations, it may be as high as 80,000 amperes.

Let's assume the fault was caused by the flashover of a porcelain insulator supporting a section of the high voltage power line a few towers away from the substation, due to a buildup of sea salt. The protective relays monitoring this transmission line detect this abnormally high current, and close their "trip" contacts – which then cause both the high voltage circuit breakers connected to this transmission line to open – and thus "clear the fault".

But while the fault exists, this high current is flowing from the tower to ground, then through the earth back to the substation. And since there is a finite (non-zero) resistance to "true earth ground", this causes the entire substation ground matt voltage to rise. However, this is a 60 Hertz voltage, and adequate insulation - in control circuits and electromechanical protective relays - for this well recognized "ground potential rise" has been defined for years in protective relay standards (e.g. ANSI C37.90).

It is the time to "clear" (interrupt) high fault currents - and particularly three phase faults - that determine how long a given electric utility (or an interconnection of several utilities) can remain stable after the fault has cleared.

In the late 1950s, high voltage circuit breakers began being manufactured with a guaranteed fault clearing time of two cycles (at 60 Hz) or less - and at a modest premium over three cycle breakers. This was a substantial improvement, and many were installed. But due to the inertia of its moving parts, there are finite limits to the operating speed of electro-mechanical protective relays. So with the invention of the transistor, there was an immediate interest in utilizing these "static" (no moving parts) components in new designs of transmission line protective relays, as they held the promise of saving another full cycle (16.67 milliseconds) off the overall operating time of the relay/circuit breaker combination.

Beginning in the late 1950s, General Electric and Westinghouse designed and built "static terminals" whose designs were thoroughly tested on model power system simulators. These simulators were vital "proof testing" tools to examine all varieties of single phase, double phase, line-ground, line-line, and three phase faults at various distances on two and three terminal lines. They did operate much faster, and were beginning to be widely deployed. Then the transistor components in these "static terminals" began to fail – and with no apparent connection to any high current (short circuit) event at or near the substation. What a mystery!

Even more troubling was the fact that the failures were occurring on static terminals in relay control houses, often many feet/meters from the high voltage bus work. The failures were in the transistors connected to the VT, CT, and DC control conductors in the control house.

Slowly energizing or de-energizing just one of the capacitance elements (e.g. capacitor banks, coupling capacitor voltage devices, circuit breaker bushing capacitance) as shown in Figure 1 can create the oscillatory Surge Withstand Capability (SWC) transient. Because of the slow moving switch, the result is a sequence of flash-overs (energizing) followed by decaying oscillations to zero, then repeated until the switch is fully closed or open.

The rise time was in the micro-second range to a peak of several kV, the oscillations in the 1 Megahertz range decaying to 50% in a few cycles, with repeats at many times per second. This transient now is a part of IEEE standard C37.90.1 as the "oscillatory SWC test". From its beginning in 1974, the required peak voltage for this transient test has been 2.5 kV at all locations (indoor and outdoor).The comparable IEC standard (IEC 60255-28) requires this level for outdoor installations, but only 50% of that for indoor installations.

In the mid 1970s, at Philadelphia Electric's Eddystone Generating Station, a control technician was beginning the task of tuning the excitation system of one of the 380,000 kW supercritical steam turbine-generators. He was bent over the excitation system's control panel, and his 5 watt "walkie-talkie" transceiver was clipped to the belt at the center of his back. When he pressed the "Push to Talk" button on his microphone, his back (and the radio's antenna) was much less than 1 metric meter from a static transformer differential relay for the unit's step-up transformer. The relay had been designed to meet the then current RF immunity level in IEEE Std C37.90.2 (10 volts/meter).

That standard also included, in boldtype, a "Caution" statement alerting users to maintain a separation distance of at least one (metric) meter between a transceiver's antenna and any sensitive equipment. However, with less than half that separation distance, the RF field strength at the relay was much higher than 10 V/m. The relay incorrectly operated, and the turbine-generator tripped off line. The next revision of IEEE standard C37.90.2-1995 raised the required immunity level to 35 V/m – which is the RF field strength from a 5 watt transmitter's antenna at a distance of 50 centimeters (~ 6 inches) where it remains today.

In spite of repeated attempts by electric utility engineers who are members of their county's IEC TC 95 delegation, the immunity level specified in IEC standard 60255-26 "for measuring relays and relay systems" remains at 10 V/m.

In the late 1970's, a vacuum tube based automatic synchronizing relay failed catastrophically. More specifically, a transient of unknown origin had caused a hole to be burned through the glass envelope of a vacuum tube in its operating circuitry.

The failed relay was mounted on the control panel for a barge mounted peaking gas turbine-generator at the Consolidated Edison's Gowanus Generating Station. There was no voltage on

the barge higher than 15 kV, and even so, the relay design had been tested and met the oscillatory SWC test (now in IEEE Std C37.90.1). William E. Kotheimer was able to replicate the failure; he burned a similar hole in the vacuum tube's glass envelope. But this time, with an even better storage oscilloscope, he was able to capture the source of the transient. It was the seemingly innocuous DC auxiliary relay on the same panel - a GE HFA six pole hinged armature auxiliary relay designed for use in interlocking circuits. There was no operating speed requirement as the most important design criterion was low battery drain. In some applications, the relay might remain energized for weeks or months. The manufacturer's catalog listed the 125 V coil as 2000 ohms (thus a low battery drain of 62.5 milliamps).The catalog included no information as to the coil's inductance. After all, it was just a simple auxiliary relay.

The transients were generated when a slowly opening external contact attempted to interrupt that 60+ milliamp current through the HFA relay's 25 henry operating coil. As the external contact energizing the relay slowly opens, the stored inductive energy in its 25 H operating coil raises the voltage across the contact until it arcs over and the DC current resumes. This scenario keeps repeating until the external contact has opened far enough so that the arcing stops. But now, the stored energy in that relay coil is released to charge the stray capacitance of the relay panel wiring connected to the positive terminal of the HFA coil.

Now the rise time was much faster (5 nanoseconds vs. 75 ns) to a peak of 4 kV (vs. 2.5 kV), and lasted longer (1 minute for each polarity versus 2 seconds). Even more troublesome was that some of the Zener diodes that had been used in relays as mini-transient suppressors of the oscillatory SWC test did not conduct fast enough to dissipate the energy in the fast transient voltage wave form, and partially punctured. This created a high resistance leakage path, and successive fast transients created more paths until the Zener failed thermally from excessive heat from the leakage current. This failure mode was difficult to diagnose, as the thermal failures occurred hours or days after the last fast transient.

The fast transient oscillatory SWC test was added to IEEE standard C37.90.1 in 1989. This 4 kV test voltage is required whether the installation is indoor or outdoor. Note IEC 602555-26 reduces the test level 50% for indoor installations.

(Taken from: '"Survival of the Fittest" – EMC in Electric Power Substations' by John T. Tengdin, P.E., OPUS Consulting Group, j.t.tengdin@ieee.org, Co-Chair, IEEE Power and Energy Society (PES) Working Group C2 (Substations), published in the IEEE Electromagnetic Compatibility Magazine – Volume 1 – Quarter 2, http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6244983.)

749) Pocket Wi-Fi hotspots paralyse Chinese metro lines

Shenzhen Metro is blaming customer Wi-Fi for disruptions to its service. The subway system for the city of Shenzhen in Guangdong province, China, depends on the unlicensed 2.4GHz band to link up its signalling systems.

Following network failures in October, and a trial blocking of 3G signals earlier this month, the Shenzhen tube operating company wrote to China's regulator asking for permission to block the signal. Caijing magazine [1] reports that permission has now been refused, leaving Metro bosses at a loss on how to resolve the issue - which has seen two lines of the network repeatedly shut down and threatens other systems around China.

Customer Mi-Fi devices create Wi-Fi hotspots that are backhauled over China Mobile's 3G network, and they're very popular, particularly in Shenzhen - which, the South China Morning Post tells us, accounts for 80 per cent of sales [2]. That's the legit kit, which only nudges the 100mW legal cap, but engineers trying to keep the network running reckon black-market devices are kicking out three times that amount. They add that once eight of either kind come into range then the Metro's signalling system stops.

2.4GHz is reserved, globally, for unlicensed ISM (Industrial, Scientific and Medical) use, largely because it was considered worthless as it gets absorbed by water and because the band is rife with interference from microwave ovens. However, radio is a lot cleverer these days, and Wi-Fi

is squeezing every cent out of the spectrum while Bluetooth dances around it, and numerous door locks, remote controls and other consumer devices fill any gaps which remain.

Originally it was the unlicensed nature of the band which made it so popular, but these days it is also the low cost of the kit. International standardisation means a Wi-Fi router, Bluetooth headset, or just a radio chip, can be sold anywhere - providing massive economies of scale.

There's also the freedom from regulatory process. Set up a link at 5.8GHz and (in the UK) you'll have to fill in forms and register each transmitter, but do the same thing at 2.4GHz and there's zero paperwork, making deployment quicker and cheaper.

The combination of these things drove Shenzhen Metro to connect up its signalling system at 2.4GHz, only to discover that it is now polluted with customer connections.

And Shenzhen is far from alone in its plight, as the same band is used by metro systems all over China, which will similarly fail once Mi-Fi devices become popular.

Blocking the 3G signal shuts down the devices, but it's hardly a sensible solution as it aggravates commuters. However, shifting to a licensed band will be expensive - both in terms of the equipment it will require and the frequencies in which it can operate.

Links: http://english.caijing.com.cn/2012-11-20/112296950.html; www.scmp.com/news/china/article/1084297/shenzhen-metro-shuts-3g-service-day-after-trains-inexplicably-stop

(Taken from "Pocket Wi-Fi hotspots paralyse Chinese metro lines. Using free band to run trains oddly didn't turn out well" By Bill Ray in The Register, http://www.theregister.co.uk/2012/11/21/wi_fi_knockout/?goback=%2Egde_3828357_member_188377735, also at: www.theregister.co.uk/2012/11/21/wi_fi_knockout/, and very kindly sent in by both Les McCormack and Chris Zombolas. Another link is: http://tinyurl.com/bwag996.)

750) High Power Microwave Missile Disables Computer Systems in Boeing Test

Aerospace company Boeing has successfully completed initial testing on a non-explosive missile that emits high powered microwaves to disable computer and electrical systems. The Counter-Electronics High-Power Advanced Missile Project (CHAMP) was tested at the Utah Test and Training Range by members of Boeing Phantom Works, the U.S. Air Force Research Laboratory and Raytheon Ktech.

In the initial test, CHAMP was fired at a two story building built on the test range and emitted a burst of high power microwaves that knocked out rows of personal computers and electrical systems inside the building. The television cameras set up to record the test were also disabled. CHAMP hit a total of seven targets with high power microwaves over a one-hour time period.

According to Keith Coleman, CHAMP program manager for Boeing Phantom Works, the successful completion of testing "marks a new era in modern-day warfare" where the technology may be used to disable the enemy's electronic and data systems before any troops or aircraft arrive. Boeing hopes that the project will change modern warfare by defeating electronic targets with little or no collateral damage.

(Taken from www.interferencetechnology.com/high-power-microwave-missile-disables-computer-systems-in-boeing-test/, 10/23/2012, for more info, visit: www.boeing.com/Features/2012/10/bds_champ_10_22_12.html)

751) Nine people killed in train collision, $12m damage, due to spurious (parasitic) oscillation

Abstract: On Monday, June 22, 2009, about 4:58 p.m., eastern daylight time, inbound Washington Metropolitan Area Transit Authority Metrorail train 112 struck the rear of stopped inbound Metrorail train 214. The accident occurred on aboveground track on the Metrorail Red Line near the Fort Totten station in Washington, D.C. The lead car of train 112 struck the rear car of train 214, causing the rear car of train 214 to telescope into the lead car of train 112, resulting in a loss of occupant survival space in the lead car of about 63 feet (about 84 percent of its total length). Nine people aboard train 112, including the train operator, were killed.

Emergency response agencies reported transporting 52 people to local hospitals. Damage to train equipment was estimated to be $12 million.

Investigation Synopsis: The National Transportation Safety Board's investigation found that the Metrorail automatic train control system stopped detecting the presence of train 214 (the struck train), which caused train 214 to stop and also allowed speed commands to be transmitted to train 112 (the striking train) until the collision. This loss of detection occurred because parasitic oscillation in the General Railway Signal Company (GRS)/Alstom Signaling Inc. (Alstom) track circuit modules was creating a spurious signal that mimicked a valid track circuit signal, thus causing the track circuit to fail to detect the presence of train 214. The investigation found that the track circuit modules did not function safely as part of a fail-safe train control system because GRS/Alstom did not provide a maintenance plan that would detect anomalies in the track circuit signal, such as parasitic oscillation, over the modules' service life and prevent these anomalies from being interpreted as valid track circuit signals.

The investigation examined two near-collisions in 2005 near the Rosslyn Metrorail station that were the result of a loss of train detection. The track circuit in that case failed to detect the presence of stopped trains between the Foggy Bottom and Rosslyn stations. Tests on the circuit modules from the Rosslyn event conducted in 2009 as part of the Fort Totten investigation showed that the Rosslyn modules exhibited parasitic oscillation, and archived data showed that the Rosslyn track circuit had experienced this problem from as far back as 1988 (the earliest time from which data were available). In response to the Rosslyn event, WMATA developed, and issued technical bulletins requiring the use of an enhanced circuit verification test procedure. However, none of the WMATA technicians interviewed as part of this investigation was familiar with the enhanced procedure.

(Taken from: "Collision of Two Washington Metropolitan Area Transit Authority Metrorail Trains Near Fort Totten Station, Washington, D.C., June 22, 2009", Railroad Accident Report NTSB/RAR-10/02, National Transportation Safety Board, Washington, DC,. 2010, www.ntsb.gov/doclib/reports/2010/RAR1002.pdf.)

752) The costs of poor power quality, a CIGRE/CIRED report

Many professionals, including industry regulators, consultants, system and installation designers, maintenance managers, production managers, and financial managers, are concerned about the impact of the costs of poor power quality on businesses and how these costs can be managed.

Techniques for avoiding or reducing the impact of power quality issues are well known and the cost of their deployment relatively easily determined. However, assessing the potential cost impact of power quality (PQ) issues is difficult because, for example, the incidence of problems, the response of equipment, and the effect on process continuity are statistical in nature and are difficult to quantify. Although there have been numerous case studies, there has been, so far, no consensus on how the calculation or assessment of these costs should be approached.

This report provides a methodology for examining the economic framework for PQ. It will enable all interested parties to establish costs and benefits of PQ improvement and mitigation measures in a consistent and open manner.

Studies in the USA

In year 1993, Clemmensen [46] provided the first-ever PQ cost estimate for U.S. manufacturing sector. The estimate derived that annual spending on industrial equipment due to PQ problems could sum up to $26 billion dollars for the U.S. manufacturing sector. It was estimated that for every manufacturing sales dollar, 1.5 to 3 U.S. cents (i.e., 1.5% - 3%) are spent to mitigate PQ problems.

A few years later in 1998, Swaminathan and Sen [46], in a Sandia National Laboratory report, estimated that U.S. annual power interruption cost reaches $150 billion. This estimate was based on a 1992 Duke Power outage cost survey in the U.S. that manipulated industrial electricity sales as the basis for the estimate.

Later in year 2001, EPRI's Consortium for Electric Infrastructure to Support a Digital Society (CIEDS) [47] produced a report based on a Primen survey in the United States. The report identified three sectors of the U.S. economy that are particularly sensitive to power disturbances:

- The Digital Economy (DE): telecommunications, data storage and retrieval services, biotechnology, electronics manufacturing, and the financial industry.
- Continuous Process Manufacturing (CPM): paper, chemicals, petroleum, rubber and plastic, stone, clay and glass, and primary metals.
- Fabrication and Essential Services (F&ES): all other manufacturing industries, plus utilities and transportation facilities.

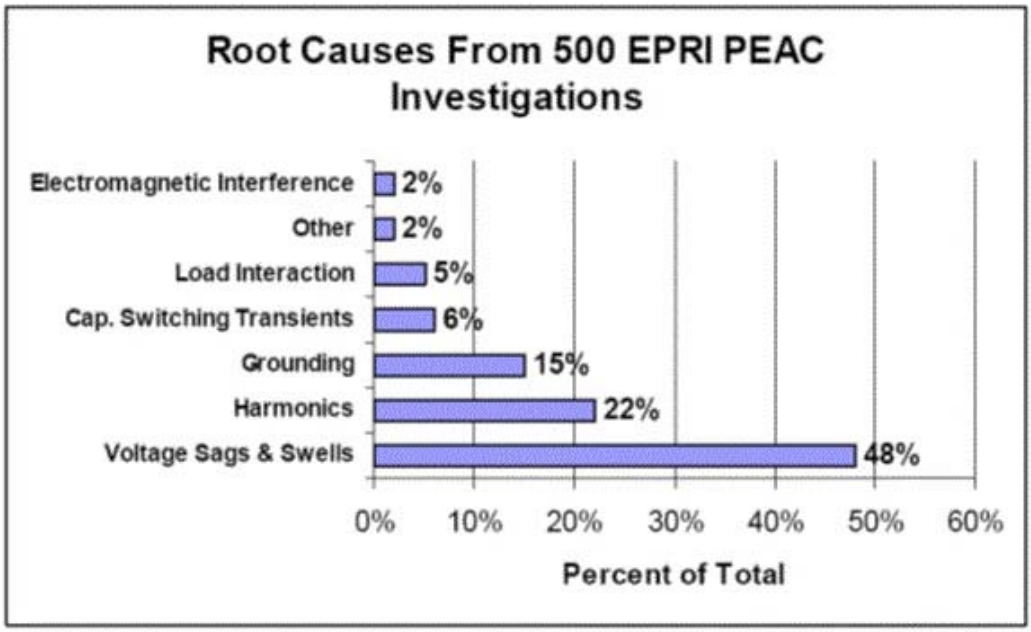


Figure 5.1 Breakdown of the power quality phenomena found in more than 500 EPRI investigations

These three sectors collectively lose $45.7 billion a year due to outages and another $6.7 billion a year due to other PQ phenomena. It is estimated that the U.S. economy losses between $104 billion to $164 billion due to outages and another $15 billion to $24 billion due to PQ phenomena.

(Some extracts from the Introduction to "Economic Framework For Power Quality", CIGRE/CIRED Joint Working Group, C4.107, June 2011, ISBN: 978- 2- 85873- 157-2, available from http://www.scribd.com/doc/71715649/467-Economic-Framework-for-Power-Quality. Also see "THE ECONOMICS OF POWER QUALITY – A SYSTEMATIC FRAMEWORK FOR THE ASSESSMENT", by José Luis Gutiérrez Iglesias, The Members of JWG C4.1071, and Alex McEachern, C I R E D 19th International Conference on Electricity Distribution Vienna, 21-24 May 2007, Paper 910, http://www.cired.be/CIRED07/pdfs/CIRED2007_0910_paper.pdf)

753) Earth's magnetic field reversal possible – knocking out satellites

Could we be witnessing the start of a reversal of Earth's geomagnetic field? That's the tentative suggestion from computer models created by Peter Olson and Renaud Deguen of John Hopkins University in Baltimore, Maryland (Nature Geoscience, DOI: 10.1038/ngeo1506). A reversal could expose us to solar winds capable of knocking out power grids.

(Taken from "Magnetic reversal?" in the "60 Seconds" column of New Scientist, 7 July 2012, page 7, www.newscientist.com. The geological record shows that the earth's magnetic field has reversed many times in the past, so it is expected to reverse again in the future. When it changes, it seems to change quite quickly, with a period of low or zero field inbetween. Many satellites would also be exposed to increased radiation, shortening their operational lives, in such a situation - Editor.)

754) Only 17.3% of LED lighting products sold in the EU complied with EMC Directive in 2011

Eighteen national market surveillance authorities (MSAs) involved in EMC ADCO participated in the campaign which was conducted between the 1st of January and the 30th of June 2011.

A hundred and sixty-eight (168) products were obtained and evaluated. Ninety one (91) LED lighting equipment products were of Chinese origin, whereas the origin of sixty-five (65) products could not be determined.

Technical compliance with harmonised standards

The notion of "compliance" is to be understood as compliance with an applicable harmonised standard.

The results of the technical compliance with the applicable harmonised standards showed large differences:

- Rather low compliance with the emissions limits: 61.5% of the tested, one hundred and sixty-six (166) products were found to be compliant
- There was a better level of compliance with the immunity limits: 91.5% of the tested, forty-six (46) products were found to be compliant.

Within this market surveillance campaign an additional study on harmonic current emissions (EN61000-3-2) was carried out. When applying the same harmonic limits as those for compact fluorescent lamps, one out of two samples, 46% of the assessed LED lighting equipment failed. This is clear evidence for the need of a prompt amendment of EN61000-3-2.

Administrative compliance

The overall administrative compliance was only 28.8% and, mainly regarded the CE marking and the Declaration of Conformity (DoC) requirements.

Almost 9% of the assessed LED lighting equipment did not carry the CE marking, whereas almost 24% were either not CE marked or did not carry a correct CE marking (format and size) as required.

Declarations of Conformity were available for 125 (74.4%) of the assessed LED lighting equipment with almost half of them having major deficiencies (e.g. missing reference to the Directive, incorrect Directive, identification of the product, incorrect standards, not issued by the manufacturer and/or authorised representative, etc.). Overall, for 67 (39.9%) of these products an acceptable Declaration of Conformity was presented.

General

In general, the level of compliance of the LED lighting equipment with the technical and administrative requirements was considered insufficient. Overall, only 29 (17.3%) of the products were in line with both technical and administrative requirements. The assessment of the technical documentation and of the immunity requirements were performed on an optional basis, the results of this assessment have not been taken in account in the overall level of compliance. This means that the overall level of compliance could be lower if both requirements had been assessed.

(Taken from "Final Report on the 4th Joint Cross-Border EMC market Surveillance Campaign (2011), LED Lighting Products" by the EMC Administrative Co-operation Working Group, which can be downloaded from http://ec.europa.eu/enterprise/sectors/electrical/files/emc/ms-campaign-fourth_en.pdf. Also of interest, are: www.youtube.com/watch?v=-FNIM-jXUPc and www.emcrules.com/2011/07/radio-interference-from-led-lighting.html. Dinex Lighting reckon that their LED lighting has Zero EMI emissions: www.ioonline.net/ioonlinetest/dinexlighting.aspx, presumably because their luminaires are simply strings of LEDs, requiring external power control that will create EMI emissions! The problem of emissions above 30MHz from modern lighting technologies was somewhat anticipated by: http://www.ofcom.org.uk/static/archive/ra/topics/research/topics/emc/8056cr2.pdf.)

755) Only 50% of consumer electronics sold in the EU complied with the EMC Directive in 2009/10

A total of 159 products were evaluated: 49 LCD televisions, 8 Plasma televisions, 39 Blu-Ray players and 63 DVD players.

Overall technical compliance with the requirements of the harmonised standards was low at 50%. For emissions only, 72% were compliant and for immunity only, 69% were compliant. There were wide variations in the level of compliance between products.

Declarations of Conformity (DoC) were obtainable for only 81% of products. Of these, only 80 % were correct, with 15% containing major deficiencies.

Compliance rates differed widely between tested product categories, ranging between 20 and 56%.

Blue-ray players (available mainly from major companies) score significantly better than DVD-players (large low-cost segment) both in technical and administrative compliance.

However, there is no similar tendency in the case of Plasma/LCD TVs.

The generally poor results for DVD players and for the immunity of plasma TVs have substantially reduced the overall compliance of all tested categories to 34%.

Country of origin could not be determined for 11% of the samples.

(Taken from: "Report on the Joint Cross-Border EMC Market Surveillance Campaign 2009/10 on Consumer Entertainment Electronics Products", the 3rd EMC Market Surveillance Campaign by the EMC Administrative Co-operation Working Group, which can be downloaded from: http://ec.europa.eu/enterprise/sectors/electrical/files/emc/ms-campaign-third_en.pdf.)

756) EMC Crime

It is becoming common worldwide for criminals to jam wireless datacomms in factories, bringing production to a halt. They only stop jamming when paid to. (There was a paper on this at Hanover EMC this year.)

(Kindly sent in by Dipl.-Ing. Werner Grommes, on 14 June 2012)

757) Disconnecting the battery to recover from EMI

I was testing a cellphone for immunity to EMI, it failed, but I was unable to recover normal functioning by switching it off and on – I had to remove its battery, then put it back in.

This is an increasing problem with cars, their microprocessors get into a state that can't be recovered from, and – as they are continuously powered (i.e. never off, just in standby) – the vehicle battery has to be disconnected to reset them properly.

(Kindly sent in by Dipl.-Ing. Werner Grommes, on 14 June 2012. Also see number 758 below.)

758) EMI flattens limousine batteries

The first CAN busses were installed in high-end automobiles ("limousines"), which were often to be found parked at airports.

EMI from the airport radars caused the CAN busses to wake up out of their standby (low current) mode (see Number 757 above), and because the radar swept over the car park about

once every second the increased current demand from the awakened CAN busses flattened the battery very quickly.

(Told to the Editor by Wim Ophelders, Océ Technologies' SI and EMC expert, on November 8th 2012.Also see number 757 above.)

759) Cellphones interfere with photocopiers

When people with cellphones in their pockets operate photocopiers, it is sometimes found that the copier malfunctions.

(An anecdote told during the "Scitech" meeting of IEC TC62A MT23 (Medical Device EMC) held in Carlsbad, California, 19-23 March 2012. The generic and product immunity standards listed under the EMC Directive all exclude "the close proximity of mobile radio transmitters" and only test at 3V/m or 10V/m at cellphone frequencies, very much lower fields than a cellphone can create near to it. However, to test for close-proximity radio transmitters it is not enough to use far-field methods such as IEC 61000-4-3 and merely wind up the test level – because the ratio of the electric and magnetic fields is all wrong. This is why the Ford Motor Company and Schwarzbeck developed a near-field test suitable for simulating the close proximity of cellphones and other portable radio transmitters, which Ford added to their Component EMC Specification in 2009 (download ww.fordemc.com/docs/download/EMC_CS_2009rev1.pdf and read test method RI115), which is now being developed into ISO and IEC radiated immunity test methods – Editor.)

760) Lighting control system interferes with washing machine

One member described how their new washing machine suffers interference from his lightning control system. He has to switch both the lighting controller and washing machine off, then switch the washing machine on and get it washing, then he can turn the lighting controller back on again without upsetting the washing machine.

(Another anecdote told during the "Scitech" meeting of IEC TC62A MT23 (Medical Device EMC) held in Carlsbad, California, 19-23 March 2012.)