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EMI Stories 761 - 855

Helping you solve your EMC problems

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EMI Stories 761 to 855

761) 5V/m measured at 2m below Hospital Emergency Room lights

These high field strengths – nearly double the immunity test level in the Medical EMC standard IEC 60601-1-2, all editions up to 3 – are said to often cause problems for ECGs (electrocardiograms – i.e. heart monitors) connected to patients who are under such lights.

The radiated noise spectrum from the lamps is below 30MHz, presumably caused by switched-mode lamp power controllers.

Dimmer controls also create EMI problems, it seems they are tested at their "full on" position – which is probably the least noisy setting – rather than tested at the worst-case emissions found over their operating range.

(Taken from a presentation describing a survey of the EM environments in three hospitals, by Hasnain Hassanali of Intertek Semko AB and Magnus Stridsman, at the "Scitech" meeting of IEC TC62A MT23 (Medical Device EMC) held in Carlsbad, California, 19-23 March 2012).

762) Proposed wireless broadband network may interfere with GPS Frequencies used to track hurricanes

In an effort to emerge from bankruptcy, wireless network company LightSquared Inc. has proposed a new plan for sharing radio signals utilized by weather facilities to accurately track storms like Hurricane Sandy. The new plan is salvaged from an earlier proposal for a satellite-based wireless broadband network that was blocked by the FCC over concern that it would interfere with global-positioning system navigation technology.

According to Peter Minnett, a professor of meteorology and physical oceanography at the University of Miami, the frequencies that LightSquared is interested in sharing are a "really important component of successful hurricane forecasting, responsible for producing the [satellite] imagery on all the TV broadcasts." A U.S. agency stated that frequencies used for weather forecasting should not be shared for wireless mobile services purposes due to the potential for interference, while weather forecasters are concerned that the public could be deprived of critical information if the frequencies are shared.

The company aims to begin offering limited high-speed data service over the radio signals it would share with weather facilities and increase use over a wider range of frequencies after the FCC develops a plan to avoid the interference concerns that stalled the wireless company's initial proposal.

(Taken from www.interferencetechnology.com/proposed-wireless-broadband-network-may-interfere-with-gps-frequencies-used-to-track-hurricanes/, 10/31/2012. For more information, see "LightSquared Looks to Airwaves Tracking Sandy for Revival" by Todd Shields and Tiffany Kary on October 29, 2012, in Bloomberg News: www.businessweek.com/news/2012-10-29/lightsquared-looks-to-airwaves-tracking-sandy-for-revival)

763) Research proves tin foil hats don't provide good RF shielding for your head

The longstanding mythology around the use of tin foil hats to block the government and extra-terrestrials from reading or controlling a person's thoughts using radio waves dates back to the late 1920s. The scientific logic is that the foil helmets act as a Faraday cage, an enclosure comprised of a conducting material that prevents external electrostatic charges and electromagnetic radiation from entering by distributing them around the exterior of the cage. However, the typical foil hat

does not fully enclose a person's head as an effective Faraday cage would and is ineffective at blocking radio frequency electromagnetic radiation.

In 2005, a group of MIT students tested the effectiveness of foil helmets at blocking various radio frequencies by constructing three different helmet designs out of layers of aluminum foil.

Using a radio frequency signal generator and a receiver antenna placed on various parts of their subjects' heads, the students examined the strength of the transmissions.

The students discovered that though the helmets shielded the wearers from the majority of tested radio waves, they amplified certain frequencies, including those in the 2.6 GHz (allocated for mobile communications and broadcast satellites) and those in the 1.2 GHz (allocated for aeronautical radio-navigation) bands.

(Taken from www.interferencetechnology.com/research-proves-tin-foil-hats-do-prevent-increase-ease-of-mind-control/, 11/01/2012. For more information, visit The Atlantic, http://www.theatlantic.com/health/archive/2012/09/tin-foil-hats-actually-make-it-easier-for-the-government-to-track-your-thoughts/262998/. Please note that reading or controlling minds using radio frequencies is an urban myth that should not be taken seriously – however, this research shows that if it was possible (which it isn't!) wearing a tinfoil hat would only make it easier – Editor.)

764) Helicopter overflight triggers implanted defibrillator

A colleague in Norfolk is keen on football and together with a friend was watching a match in which his two boys were playing. Suddenly the friend was lifted violently up and backwards, falling on the grass well behind him, clutching his chest. Those who saw this collapse were sure he had been shot. He had not been shot, but his cardiac defibrillator had gone into overdrive for some reason. Why? The football pitch was near an RAF base in Norfolk - a MATZ where both planes and helicopters were stationed. The football ground was under the flight path, and a helicopter was flying overhead at just that moment. This happened to the same person on two occasions, both of them seen by my colleague. Cardiologists found nothing wrong with him.

We should not be surprised at this effect as for many years cardiologists have been drawing attention to the effects of magnets and magnetic fields on pacemakers. A most important Editorial was written by Krit Jongnarangsin in the journal 'Heart Rhythm' in 2009. His team at the University of Michigan also drew attention to the hazards of commercially available Neodymium magnets. Jewellery and objects that contain this type of magnet can be inadvertently placed over an implanted device and may cause interaction. In trials, all 41 patients with pacemakers and 29 with ICDs experienced interference when neodymium magnets were placed only 3 cms from the implanted device.

(Kindly sent in by Anne Silk on 25th February 2013.)

765) EMI to airbags causes Toyota to recall over 1 million vehicles

Toyota has recalled more than 1 million Corolla, Corolla Matrix and Pontiac Vibe models across the globe due to faulty air bags that could deploy accidentally without warning.

According to a "defect information report" submitted to the National Highway Traffic Safety Administration (NHTSA) by Toyota, the air bag control module can experience a short circuit "when exposed to high inductive electrical noise from various vehicle electrical components."

Toyota has confirmed 18 U.S. cases of abrasion-type injuries resulting from the faulty air bag deployment. Two accidents have also been reported by customers in Japan, but Toyota has not confirmed the authenticity of the reports.

Toyota plans to add a filter to the airbag control module in all recalled vehicles to prevent interference.

(Taken from: Interference Technology's on-line news report, www.interferencetechnology.com/toyota-issues-vehicle-recall-due-to-electrical-interference/, 02/01/2013. For more information visit the New York Times: http://wheels.blogs.nytimes.com/2013/01/30/toyota-recalling-1-million-vehicles-for-air-bag-and-

wiper-problems/?ref=automobiles, January 30, 2013, 11:11am; and the NHTSA: http://www-odi.nhtsa.dot.gov/owners/SearchResults.action?searchType=ID&targetCategory=R&searchCriteria.nhtsa_ids=13V029&refurl=email.)

766) Passenger electronics cause flight changes

Disturbances of flight instruments causing trajectory deviations appear when one or several passengers switch on electronic devices.

FAA Aviation Safety Reporting System has reported 12 cases of interference in aircraft due to personal electronic devices since 2002.

(Taken from "EMC Part3 measurement methods Oct12" by Alexandre Boyer, http://www.alexandre-boyer.fr/alex/enseignement/EMC_Part3_measurement_methods_Oct12.ppt. Alexandre reports the first sentence as being originally published in "Air et Cosmos", April 1993.)

767) Vacuum cleaner interferes with Spacelab

During a Spacelab mission in 1985, the crew decided to use the middeck vacuum cleaner instead of the one in the lab. Switching the middeck vacuum on caused the voltage to drop and the Remote Acquisition Unit to shut off. In preflight EMI tests, the vacuum cleaner had not been tested and should not have been used in the lab. This case shows how careful and attentive one must when dealing with EMC.

(Copied from NASA Reference Publication 1374 "Electronic Systems Failures and Anomalies Attributed to Electromagnetic Interference", by R.D Leach and M. B Alenxander, Editor, available from: http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19960009442_1996109442.pdf, and also from: http://www.cvel.clemson.edu/pdf/nasa-rp1374.pdf)

768) 50 billion Machine-to-Machine (M2M) cellphones by 2020

Developer Community: Ideas catalyst for M2M developers

Q: Why is Deutsche Telekom placing so much emphasis on M2M innovation?

A: We are convinced that the M2M market will boom over the coming years. According to information from the OECD, the number of networked machines will rise to approximately 50 billion in 2020.

(Taken from: Connectingindustry.com/electronics, September 2012. The answer was attributed to Jurgen Hase, Head of Deustche Telecom's M2M Competence Centre. Editor's note: *M2M essentially means cellphones embedded in items of equipment to provide them with full-time datacommunications, and 50 billion of them are going to make a considerable addition to the noise in the EM environment.)*

769) Neutron susceptibility of chips used in avionics

In addition, when designing systems, engineers could look at building in greater redundancy and being more selective with components. Research has shown that microprocessor chips vary in their neutron susceptibility by up to 10-fold.

"The tricky thing is that manufacturers can change their processes quite a lot without avionics engineers even knowing about it; electrically they'll do the same function but from this point of view [neutron susceptibility] they change quite dramatically.", said Ryden.

(Taken from: "Weather Warnings, Quinetiq gauges effects of storms on airliners", by Andrew Czyzewski, in The Engineer, Aerospace Special, October 2012, page 6, www.theengineer.co.uk.)

770) ESD effects on oscilloscopes – time goes backwards!

When debugging designs or making electrical measurements of noise, especially ESD, we often assume the only equipment in the room that works perfectly is our measurement equipment. This assumption can be wrong and when it is, the bad data that results can add significantly to the time needed to get to the cause of a design problem. Examples of ESD

interference to oscilloscopes are described and one innovative approach to minimizing EMI induced error is shown.

Figure 1 shows an attempt to measure a waveform associated with an ESD event using a high bandwidth analog scope many years ago. Almost every engineer or technician trying to make such a measurement in that time frame obtained a plot like Figure 1. The plot was taken using a 1 GHz bandwidth Tektronix 7104 analog scope with a camera mounted on the scope to capture the waveform. The 7104 was the last of the analog scopes in general use just before digital scopes became fast enough to take over most lab measurements.

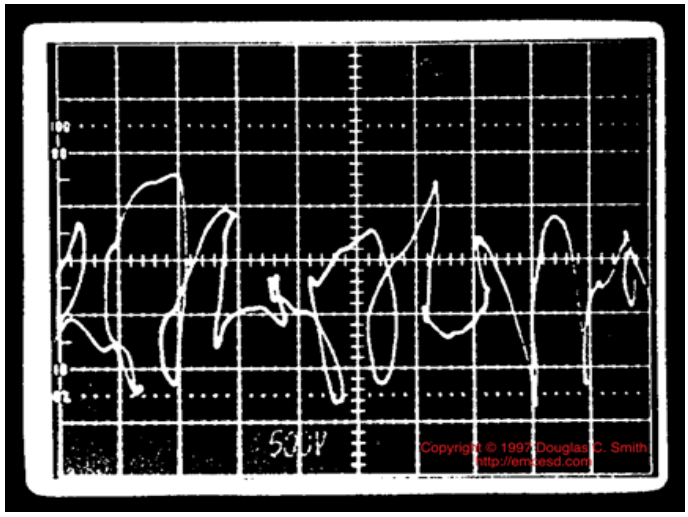


Figure 1: Example of ESD Induced Error in an Analog Oscilloscope

In the plot of Figure 1, time appears to go backwards! What really happened was that the very strong fields generated by the ESD simulator interacted directly with the electron beam in the oscilloscope, overriding what the scope deflection systems were trying to do. The result drove the electron beam all over the screen, resulting in the strange waveform in the figure. People quickly learned to put these scopes in a Faraday Cage when making ESD measurements. The Faraday Cage shielded the scope from the ESD generated fields, and the desired waveform was obtained.

These days we use digital scopes with solid state displays that don't use electron beams the way analog scopes did, but it is still possible to get EMI induced error in scope measurements. One example can be seen in my Technical Tidbit article September 2004, Mobile Phone Response to EMI from Small Metal ESD. One of the figures from that article is reproduced in Figure 2.

Figure 2: Example of ESD Induced Error in a Digital Oscilloscope

(Vertical scale = 5 Volts/div, Horizontal scale = 5 ns/div)

The plot in Figure 2 was the voltage induced into a small dipole antenna tuned to about 1800 MHz in response to jingling coins in a plastic bag. The desired signal is the tall spike in the middle of the plot. But notice the "hash" noise starting about 10 ns before the spike. This noise traveled over the direct path through the air from the ESD events into the scope electronics.

The hash starts earlier because the propagation time is faster for the air path than through several feet of coax cable the desired signal had to travel through. To fix this and similar

problems one can use a Faraday Cage around the scope or simply move the scope further away from the source of the EMI, jingling coins in this case.

Figure 3 shows one solution by a friend of mine, Jon Barth of Barth Electronics in Boulder City, NV, to the problem of ESD interference to his scope and PC while trying to measure the calibration waveform of an ESD simulator.

ESD noise was getting into the connection between his PC and the scope, making data acquisition nearly impossible.

The copper tape and aluminum foil shield did the job for him and is much simpler to implement quickly than a Faraday Cage.

Figure 3: Makeshift Shield to Prevent ESD Induced Measurement Error

EMI can manifest itself in other ways as well including crosstalk between scope channels when trying to measure a high amplitude signal and a small one on different channels at the same time. I have even seen, back in the early 1990s, a scope change its state because its control circuits were not immune to the effects of ESD. The results of this problem were quite evident though so there is little danger of bad data from this cause.

The effects of EMI on analog and digital scopes are quite different, but in both cases, significant measurement error can occur if care is not taken.

Don't assume your measurement equipment is working perfectly, especially around ESD. Be on the lookout for error creeping into your measurements.

(Taken from: "Electromagnetic Interference (EMI) Effects on Measurement Equipment - ESD Effects on Oscilloscopes", by Douglas C. Smith, in Incompliance Magazine, Nov 2012, http://www.incompliancemag.com/index.php?option=com_content&view=article&id=1251:electromagnetic-interference-emi-effects-on-measurement-equipment-esd-effects-on-oscilloscopes&catid=71:technical-tidbits&Itemid=215. For more Technical Tidbits, please visit Doug's site, http://emesd.com.)

771) Lightning interferes with high-speed trains, killing 40 and injuring 191

Forty people died and 191 were injured in the crash near Wenzhou, on a high-speed line connecting cities along the south-east coast. A train that had stalled on a viaduct after losing power in a lightning strike was hit from behind by another. Some coaches plunged from the bridge to the ground below.

The head of Shanghai Railway Bureau, An Lusheng, said the signalling system at Wenzhou South failed to turn the green light to red, after it was struck by lightning. He failed to explain why the second train was not warned that there was a stalled train in its path or whether the system had a back-up to automatically issue a warning to stop in such situations.

(Taken from "China backpedals on high-speed rail expansion plans" by William Dennis, in Engineering & Technology magazine, Sep 2011, page 16, www.EandTmagazine.com.)

772) EMI may stop people from using their cars

As cars feature more and more electronics, EMC testing is becoming more stringent.

But while there is an understandable focus on the electronics which control the car, spare a thought for the humble key fob. "It's going to be an area where there will be much more

testing," he concluded. "There's so much going on in the 433MHz band that people may not be able to get into their cars because of all the interference."

(Taken from "Eliminating interference", by Graham Pitcher, in New Electronics magazine, 27 Sep 2011, pages 21-22, www.newelectronics.co.uk.)

773) TV switch-over triggers rush to see emissions from rare stars

US skies are clearer than usual after the switch in June from analogue to digital TV freed up a chunk of the radio spectrum. Astronomers are now rushing to see what they can find before transmissions from cellphone companies and others fill the space.

Prior to the switch-over, naturally occurring radio waves at frequencies between 700 and 800 megahertz were obscured by analogue TV signals, preventing astronomers from investigating the universe using this band. Now a receiver has been installed at the Arecibo Observatory in Puerto Rico to take advantage of the new-found clarity.

The window is giving astronomers their first radio views of galaxies that thrived when the universe was about half its present age. They hope to measure how much hydrogen – the raw material for new stars – the galaxies had. "It's a once-in-a-lifetime opportunity to see galaxies in that range," says Arecibo researcher Chris Salter. "We're able to see an epoch that hasn't been observed before with radio eyes."

The new window may also help in the hunt for pulsars – neutron stars that emit beams of radio waves from their poles. In this part of the spectrum, their beams are less impeded by interstellar electrons, which can scatter radio waves.

This boosts the chances of spotting rare examples of these stars. "We're looking for pulsar exotica," says Duncan Lorimer of West Virginia University in Morgantown. He and his colleague Mitch Mickaliger are hoping to find a pulsar orbiting a black hole, as as-yet-undiscovered pairing that could be used to test general relativity.

This radio window won't be open for long, though. Much of the new band has already been auctioned off, and astronomers at Arecibo might only get a year of clear skies, says Donald Campbell of Cornell University in Ithca, New York.

(Taken from: "TV switch-over triggers rush to see rare stars" by Rachel Courtland, in New Scientist, 7 Nov 2009, www.newscientist.com.)

774) Spacecraft EMC – "Traditional Anomalies"

During the first Space Shuttle mission (STS-88) to the International Space Station, VHF transmissions from ground stations interfered with radio communications of crew performing extravehicular activities.

(Taken from: "Space Environmental Effects and Spacecraft EMC", by Matthew McCollum, NASA, Marshall Space Flight Center, http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20040120952_2004116614.pdf)

775) Marine radio transmissions stop traffic

Boat owners in Dartmouth made themselves very unpopular with motorists in November. Every time they broadcast on marine radio, it caused a set of temporary traffic lights on North Embankment Road to reset to red in both directions, causing massive traffic jams. Engineers had to be called to manually restore the lights each time it happened. So power does give way to sail, after all.

(Taken from: "The power of radio", in the Bosun's Bag column on page 168 of Practical Boat Owner, Issue 483, March 2007, which was very kindly sent in by Harold Smart of Harold Smart & Associates, on 27 September 2007.)

776) Backwards resistor acts as antenna, picks up EMI

However, most of the boards that had failed in testing seemed to be fully operational, but had excess noise. In examining signals on all the nodes throughout the circuit, everything looked normal, but the meter readout was unstable. Although its mean reading was correct, it

erratically jumped around. I examined the circuit operation, then looked at the defective board alongside one that was working properly. Then I saw it: a resistor installed backwards.

To minimize board space, the assemblers mounted the resistors – mostly axial-leaded 1/8W resistors – on the board standing up. The first amplifier stage had two resistors to set its gain. The resistor going from the negative input of the amplifier to ground had been assembled with the lead going to the amplifier input facing into the air. In this configuration, the lead became an antenna that allowed the injection of interference directly into the input of the first amplifier stage – the source of the excess noise.

We inspected the rest of the amplifier boards; most had the resistor in backward. We added a note to the board's test procedure to carefully check the position of this resistor before beginning the electrical tests.

(Taken from "The eyes have it", by Jerome Jonston, in Tales From The Cube, EDN Europe. July 2007, www.edn-europe.com.)

777) Class D audio amplifiers and EMI

Class D amplifiers are frequently referred to as digital amplifiers, but some designs are better described as switching amplifiers. They essentially consist of a switch-mode power supply, supplying current into the load (loudspeaker) under the control of the audio input waveform, with the output being low-pass filtered in a similar manner to digital-to-analogue converters.

In self-powered loudspeakers they can find willing partners because of their small size, low cost, and low heat generation. However, they still can be prone to the emission of troublesome electromagnetic interference (EMI) because of the high switching frequency used, (and the whole concept of switching itself). Of course, they all must meet current electromagnetic compatibility (EMC) regulations, just like the office fax machine and digital radio/alarm clock but, as this is being written, those devices must often be switched off in order to clearly hear the BBC World Service on a small portable radio.

Fast switching always generates harmonics into the megahertz regions, and such emissions have a great potential to interfere with nearby electronic equipment. In other words, compliance with EMC regulations is one thing, but being a good neighbour with the rest of the sensitive equipment in a recording studio is another thing. This is especially so when 'vintage' equipment is in use, designed before there was a need to even think about digital switching transients. Nevertheless, as times goes on, improvements will be made, and Class D amplifiers are steadily progressing.

(Taken from: "Loudspeakers: Effects of amplifiers and cables – Part 3", by Philip Newell and Keith Holland, in Audio DesignLine, www.eetimes.com/design/audio-design/4015819/Loudspeakers-Effects-of-amplifiers-and-cables--Part-3, 5 September 2007.)

778) Loudspeaker cables as antennas, injecting noise into audio amplifiers

RFI: can be very important; if you spectrum analyse (I work up to 1.5 GHz) the dominant RFI is about 1 MHz for many loudspeaker cables. Many amplifiers are no longer anything you would recognise by 100 KHz, never mind the 1 MHz, and the RF gets in the output terminals and intermodulates around the feedback loop. A speaker cable is often a good medium-wave aerial.

Cables vary greatly in how they dump RF interference into the amplifier output port. The Zobel filter has little effect as it is generally buffered by 10 ohms. If the RFI doesn't get in the positive line, it common modes the ground line.

At 1 MHz or more, the RFI hardly cares what kind of amplifier it is.

(Taken from a quotation by Martin Colloms in "Loudspeakers: Effects of amplifiers and cables – Part 6", by Philip Newell and Keith Holland, in Audio DesignLine, http://www.eetimes.com/design/audio-design/4015822/Loudspeakers-Effects-of-amplifiers-and-cables--Part-6, 26 September 2007.)

779) Devastating HERO problems in the US Navy

(HERO is the US military acronym for Hazards of Electromagnetic Radiation to Ordnance, and of course "ordnance" is essentially bombs and missiles, which these days are all electronically fused, making EMC a rather important issue! – Editor.)

Harry Gaul reports that all had an exciting time at the February 19th IEEE EMC Society Phoenix Chapter meeting held at the Marriott Mountain Shadows in Scottsdale. Mike Hatfield of the Naval Surface Warfare Center Dahlgren Division gave a presentation on reverberation chambers.

Mike spoke on "How to conduct electromagnetic effects testing using a microwave oven and a pair of dice, or, a statistical approach for conducting system electromagnetic vulnerability assessments." Mike began his talk with a short history of actual devastating HERO problems in the Navy followed by an in-depth look at the statistical basis for repeatability in mode-tuned chambers as a function of the number of tuner positions.

(Taken from the IEEE EMC Society newsletter, issue 201, Spring 04, page 18, www.emcs.org/acstrial/newsletters/spring04/index.html. Information on future meetings of the Phoenix EMC Chapter is available from their website: www.ewh.ieee.org/r6/phoenix/phoenixemc/. For more information on HERO and other military RADHAZ (radiation hazards) issues, visit http://www.phys.hawaii.edu/~anita/new/papers/militaryHandbook/radhaz.pdf.)

780) The energy-saving LED bulb that switched off the radio

We get sent some weird and wonderful tales of products going wrong, but one story piqued our interest so much that we just had to send it to the lab to test it out. Can you help us shed more light on the mystery?

Last year we received this intriguing message: 'I recently changed six halogen down-lighters to more energy efficient LED bulbs. Unfortunately when the lights were switched on, the DAB signal on my radio was wiped out!'

To try and figure out this conundrum, we sent a batch of cheap, generic 12V LED bulbs to our lab and found that when a digital radio was placed within a few metres of the switched-on bulbs the signal went fuzzy. When the radio was placed within a few centimetres of the LED bulbs, it cut out all together.

The plot thickens

LEDs are ultra energy efficient light bulbs that can last up to twenty years and have been hailed as the future of home lighting.

It seems our members are not the only ones who have had this problem. There are other accounts of LED bulbs affecting radios, with AVForums also collecting stories. Nick Tooley shared his experience: 'I had the same problems with LED bulbs wiping out DAB reception and tried several types of bulbs, but to no avail.'

And it seems that the issue may not just be limited to digital radios – TVs may also be affected. After fitting LED down-lighters in his kitchen, Jackord noticed the following problem: 'While the lights are much better, we then by accident noticed that the digital TV would not work (I was complaining that we had no reception at all, did not make any sense, began to think that there had been some sort of catastrophic disaster which stopped the TV stations from broadcasting…lol) then someone turned off the ceiling lights in the kitchen and, hey presto, on came the TV.'

(Taken from "The energy-saving LED bulb that switched off the radio" by Becky Pritchard, Senior Home Researcher, Energy & Home section, Which? Magazine, 17 March 2013, http://conversation.which.co.uk/energy-home/led-bulb-radio-interference-dab-test, kindly sent in by long-term "Banana Skinner" Graham Eckersall. There is a lot of official activity on the issue of EMI from LED lamps, in which the EMCIA is heavily involved, www.emcia.org.)

781) French Fashion Label to Debut Electromagnetic Wave-Blocking Menswear

A French fashion label has announced the upcoming release of men's suits reportedly capable of blocking electromagnetic waves produced by cell phones and other portable electronic devices.

"This is the first [commercial] use of technological materials in everyday men's clothing that doesn't cause discomfort," Benjamin Anin of Smuggler's research and development department said.

"Until now, this type of very specific material was more rudimentary and only used by certain professionals who were particularly exposed."

A French fashion label has announced the upcoming release of men's suits reportedly capable of blocking electromagnetic waves produced by cell phones and other portable electronic devices.

(Image: Smuggler)

According to the company, the new material took three years to develop and is comprised of fabric interwoven with non-allergenic nickel, stainless steel, aluminum and faux gold. The material was developed in collaboration with the XLIM Institute in Limoges, France and is reportedly capable of blocking 90 percent of electromagnetic waves emitted by portable electronic devices.

The material will make its debut as part of Smuggler's spring-summer 2013 collection.

(Taken from an article with the same title, written by Aliza Becker, 03/21/2013, published in Interference Technology's on-line newsletter, www.interferencetechnology.com/french-fashion-label-to-debut-electromagnetic-wave-blocking-menswear/. For more information, visit Expatica: www.expatica.com/fr/news/french-news/french-fashion-firm-develops-suit-that-blocks-electromagnetic-waves_261681.html.)

782) "World's First" Automatic GPS Backup Demonstrated in Maritime Jamming Trial

The ACCSEAS, a European Union part-funded project involving 11 partners from the North Sea Region, announced this month that technology designed to automatically counter the threat of GPS jamming in maritime shipping and transport vessels has been successfully demonstrated for the first time.

The new counter-jamming technology employs eLoran, an extension of the LORAN technology developed by U.S. scientists that enables ships and aircraft to determine their speed and location from low frequency radio signals transmitted by fixed land-based radio beacons.

The ACCSEAS, a European Union part-funded project, announced this month that technology designed to automatically counter the threat of GPS jamming in maritime shipping and transport vessels has been successfully demonstrated for the first time.

(Image: Vichaya Kiatying-Angsulee / FreeDigitalPhotos.net)

According to ACCSEAS, during a series of tests aboard the THV Galatea sailing out of Harwich, UK, a "prototype resilient PNT (positioning, navigation and timing) system" demonstrated the capability to automatically switch over from GPS to eLoran without interruption when presented with interference, enabling the ship to continue as normal. This latest trial was built upon results collected by two previous trials conducted by the General Lighthouse Authorities (GLA) in 2008 and 2010, which examined the impact of GPS service denial.

The success of the European Union's trial comes at a point in time where the unauthorized use of inexpensive jamming devices continues to grow, while maritime navigation systems continue to rely increasingly on GPS satellites for accurate and safe navigation.

A separate, 24-month study recently launched by the UK government identified more than 60 instances of GPS jamming equipment in passing vehicles over a period of six months using roadside monitoring systems. Other research also identified the potential of interference from developing windfarms along the coastlines with maritime navigation systems. While interference poses a minor problem for average users who may temporarily lose the ability to access turn-by-turn driving directions or satellite map applications, the potential impact is much more serious and potentially life-threatening to the aerospace and maritime industries.

However, despite the increase in identified jamming cases, no one really knows how much GPS jamming is happening, David Last of the General Lighthouse Authorities, one of the partners in the ACCSEAS project, told TechWeekEurope.

"As far as we can see, in the UK at the moment it's mostly individuals using the so-called 'personal privacy devices.' If you're a white van driver and want to do a bit of moonlighting,' but your company installs tracking systems in its fleet, you buy one of these things, plug it in the cigarette lighter socket, and it jams GPS in the vehicle and a certain distance around it," he said.

Martyn Thomas, vice president of the Royal Academy of Engineering, believes it is important to continue to strengthen GPS anti-jamming capabilities for the future in general, regardless of where issues with jamming equipment are appearing now.

"GPS and other satellite navigation systems are deeply embedded in several critical sectors such as telecommunications, power distribution and high frequency financial trading, in addition to transport," he said. "The dangerous over reliance on GPS makes it a potential common point of failure for very many systems, so any technology that can provide resilience to these systems should be welcomed across the board."

(Taken from an article with the same title, written by Aliza Becker, 03/20/2013, published in Interference Technology's on-line newsletter,www.interferencetechnology.com/worlds-first-automatic-gps-backup-demonstrated-in-maritime-jamming-trial. For more information, visit ACCSEAS (http://www.accseas.eu) and Tech Week Europe: www.techweekeurope.co.uk/interview/gps-jamming-eloran-failover-109868.)

783) Subaru cars that can gas people due to remote engine starter damage

This letter serves to acknowledge Subaru of America, Inc.'s notification to the National Highway Traffic Safety Administration (NHTSA) of a safety recall which will be conducted pursuant to Federal law for the product(s) listed below. Please review the following information to ensure that it conforms to your records as this information is being made available to the public. If the information does not agree with your records, please contact us immediately to discuss your concerns.

Makes/Models/Model Years:

SUBARU/IMPREZA/2012-2013	SUBARU/LEGACY/2010-2013
SUBARU/OUTBACK/2010-2013	SUBARU/XV CROSSTREK/2013
Mfr's Report Date: February 22, 2013	NHTSA Campaign Number: 13V-061

Components:

ELECTRICAL SYSTEM, EQUIPMENT

Potential Number of Units Affected: 47,419

Problem Description:

Subaru is recalling certain model year 2010-2012 Legacy and Outback vehicles equipped with an automatic or CVT transmission and an Audiovox remote engine starter (RES) accessory, certain model year 2012-2013 Impreza vehicles equipped with a CVT transmission and an Audiovox remote engine starter (RES) accessory, and certain model year 2013 XV Crosstrek vehicles equipped with a CVT transmission and an Audiovox remote engine starter (RES) accessory.

Additionally included are certain model year 2013 Legacy and Outback vehicles that may have received replacement RES fobs.

If the RES fob is dropped, the fob may malfunction and randomly transmit an engine start request without pressing the button.

Consequence:

The engine may inadvertently start and run for up to fifteen minutes. The engine may continue to start and stop until the fob battery is depleted, or until the vehicle runs out of fuel. If the vehicle is parked in an enclosed area, there is a risk of carbon monoxide buildup which may cause headaches, dizziness or, in extreme cases, unconsciousness and/or asphyxiation.

Remedy:

Subaru will notify owners, and dealers will replace the RES key fobs, free of charge. The recall is expected to begin by the end of April 2013. Owners may contact Subaru at 1-800-782-2783 for more information.

Notes:

Original equipment keyless entry fobs integrated on the vehicle key are not affected. Subaru's recall campaign number is WQF-42.

(Taken from a letter from NHTSA to Subaru America, Inc., dated March 7, 2013, at http://www-odi.nhtsa.dot.gov/acms/cs/jaxrs/download/doc/UCM434360/RCAK-13V061-5804.PDF. Kindly sent in by Brian Kirk on 19th March 2013, who saw an article about it on the CNN Money programme on the 17th March.)

784) An EMI fixer's tale

A few years ago, when I had recently joined a high-speed test equipment manufacturer, I was assigned to take a production-ready (and very promising) product through EMI scans. The product needed to undergo EMI compliance testing before being shipped.

This product, which was housed in a rack-mount 8U metal chassis, consisted of a control card, a communication card, and several line cards. Micro coaxial cables connected internal high-speed circuitry to external ICs under test.

Since this was not my design, I prepared for the EMI scans by studying the schematics, the layout of the boards and the backplane, the mechanical aspects of the chassis, and the seating of cards in the chassis for possible areas of EMI leakage. The product was designed to test ICs at several hundred megahertz and to capture the outputs of ICs containing hundreds of pins at 5-psec timing resolution. As a result, the line cards were full of high-precision clock circuitry, high-speed/low-skew clock and pin drivers, and high-speed ADCs and DACs.

One thing that stood out was that the product was not well-designed for passing EMI emissions test. The power-supply filtering on the line cards was highly inadequate, and the grounding was multi-point, with the entire front side of the chassis connected to signal_ground at different points on each line card. It was apparent that my EMI scan was going to involve a long fight.

An EMI pre-scan proved my suspicions. Radiated emissions exceeded FCC Class A requirements by 10 to 12 dB at various frequencies in the range 100 MHz through 1.5 GHz.

I tried the usual fixes—plugged and unplugged several line cards and cables, added ferrite clamps to power and other slower cables, wrapped high-speed input/output (I/O) cables around ferrites, and so forth—but none of these actions made any significant difference. I added more filtering to clock oscillators and drivers and changed single-stage filters to twostage cascaded filters, and something interesting started to happen. As I doubled the filter stages, EMI levels would go down at some frequencies but shoot up at some other frequencies.

It got very frustrating and I spent several days and late nights in the EMI test lab trying to catch this moving target. When I attached long, hanging wires to the chassis to act as antennas, I saw no difference in electromagnetic radiation. It was possible that the entire chassis was somehow acting as one big antenna.

I knew that high-speed currents from multiple signal_ground connections were flowing along the front edge of the chassis. But why would they circulate all over the chassis instead of following the path of least impedance?

I removed all line cards and opened up the chassis. I noticed that the chassis and signal_ground of the backplane were shorted together even when no line cards were present.

Then I took out the plug-in power modules one at a time. There were two of them, one on either side of the chassis, plugged in from the back. When I took out both, the short between chassis and signal_ground was gone. This had to have serious EMI implications.

The two power modules were shorting the signal_ground to the chassis at two ends of the chassis that were 16 inches apart, near the backplane power connectors. The high-speed return currents in the signal_ground of the backplane were free to circulate not just along the front edge of the chassis but also along the back edge, or effectively throughout the entire chassis. The chassis had become an antenna and was radiating instead of shielding the internal circuitry.

Opening up a power module showed the cause of this. Return for 12V power (also the signal_ground for the backplane) was electrically attached to the inside of the metal housing of the power module. I disconnected these returns and plugged the power modules back in.

There were no more shorts.

A subsequent EMI scan showed that the offending emissions were now down from 12 dB to 4 dB for all frequencies in the spectrum. My job was not over yet, but this was a good start.

Over the next few days, I was able to reduce the EMI for a partially populated system down to acceptable limits.

(Taken from "Tracking a moving target" by Anoop Hegde, in Tales From the Cube, in EDN magazine, February 27, 2013, www.edn.com/electronics-blogs/tales-from-the-cube/4406439/Tracking-a-moving-target.)

785) Black Hawk helicopter EMC/RFI susceptibility

The cover story of the IEEE EMC Society Newsletter of Winter 1988, Issue Number 136, was titled “EMC Makes Headlines”. The story was about the U.S. Army’s UH-60 Black Hawk heliucopter and itys susceptibility to EMI/RFI. The Knight-Ridder News Service broke the story in November of 1987 based on a three-month investigation.

The story presented strong evidence that most, if not all, of the sudden crashes that have killed 22 servicemen since 1982 were caused by flying close to radar antennas, radio or microwave towers, and in one case, an illegal CB transmitter.

Black Hawk’s electronically-controlled flight control system, as well as much of the rest of its avionics, was said to be both susceptible to EMCI/RFI and inadequately shielded.

The Navy version of the UH-60, the Sea Hawk, was reported to have suffered from the same condition until the Navy required the contractor, Sikorsky Aircraft Company, to provide greater shielding of the Navy models.

Follow-up stories several days later reported that the Army is now requiring that all future Black Hawk logic modules be shielded like the Navy version and old modules replaced.

(Taken from “EMC Society History” by Daniel D. Hoolihan, Associate Editor, Chair of the EMC Society History Committee, in the 2013 IEEE Electromagnetic Compatibility Magazine, Volume 2, Quarter 1, http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6512214.)

786) Smart Grid interference problems in Sweden

Examples of lack of EMC in relation to evolving smart grid technologies have been reported in Sweden.

Kilowatt-hour meters in households sending data signals through power lines have caused interference with, for example, dimmer controlled lamps and electrical appliances.

There are also cases reported where electrical apparatuses in households have interfered with electronic kilowatt-hour meters with adverse errors in registration of energy. *(But adverse for who? – Editor.)*

Power electronics in wind power plants have emitted disturbances interfering with transfer of kilowatt-hour meter readings as signals on power lines.

(Taken from the Chapter entitled “Field Experiences with Smart Grid Technology” in the article “Low Frequency EMC and Power Quality”, by Dr Magnus Olofssun, in In Compliance Magazine’s 2013 Annual Guide, page 93, www.incompliancemag.com.)

787) Conducted emissions from HVAC motor drives cause false MRI Scanner readings

Conducted emissions (CE) are currents that travel on circuit wiring or conductive portions of assemblies and structures. For example, noise from a vehicle alternator is conducted along primary vehicle wiring to radio thus affecting radio performance. CE may also be due to conductive chassis as electrical paths (sometimes unintentional). Example – parasitic capacitance between a switching transistor and heat sink completes current path resulting in CE current. Depending on the wiring length and frequency of CE noise, this may result in a radiated emission as well.

A deviation type of CE and can occur due to the use of various types of electromechanical devices (solenoid relays). For example, variable frequency electric drives (VFD) were installed on a HVAC system in a renovation of an older medical facility. During the renovation, MRI machines were also installed.

False readings from the MRI machines were then taken by medical personnel. The quickest solution was to install a separate electrical service for the MRI machines.

(Taken from “Chapter Chatter, Rock River Valley”, compiled by Todd Robinson, in the 2013 IEEE Electromagnetic Compatibility Magazine, Volume 2, Quarter 1, http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6512209.)

788) New US Defense radios interfered with tens of thousands of garage-door openers

The military's main concern was interference. Microstimulators would have to operate in the same spectrum as high-power defense systems. "We're talking about megawatt radars," says Fred Moorefield, who was IRAC's Air Force representative and the main liaison between the Alfred Mann Foundation and the military.

No one worried, he says, about one-milliwatt microstimulators wiping out the military's air-defense system. Rather, the scenario Moorefield and others feared most was that the radars would disable the microstimulators, with the disastrous outcome of both injuring patients and inciting empathetic lawmakers to kick the military out of the band.

At the time, the military was facing a watered-down version of this very issue: Since their rollout began in 2004, new defense radios had reportedly impaired tens of thousands of garage-door openers, which used some of the military's spectrum on a secondary basis.

(Taken from "Peaceful Coexistence – The trials of a small team of engineers who set out to reanimate paralyzed limbs demonstrate the virtues of dynamic spectrum sharing", by Ariel Bleicher, in IEEE Spectrum (International Edition) April 2013, http://spectrum.ieee.org/telecom/wireless/peaceful-coexistence-on-the-radio-spectrum.)

789) Electric and hybrid vehicle chargers interfere with pacemakers

On 19th March, 2013, the Japan Ministry of Health, Labour and Welfare issued a notice about possible malfunction of pacemakers and ICDs near chargers for electric vehicles (EV) and plug-in hybrid vehicles (PHV).

A summary of the experiment was reported in the Pharmaceuticals and Medical Devices Safety Information No. 302 issued in June 2013.

25 models of implantable cardiac pacemakers and implantable cardioverter-defibrillators (ICDs) were tested with slow chargers (Mode 2 and Mode 3) and a fast charger for EVs/PHVs.

In the experiment, when those pacemakers/ICDs were set to single-pole detection mode, 12 models of tested 25 models of pacemakers/ICDs were affected near the fast charger and 10 models of tested 25 models were affected near each of the slow chargers.

The maximum distance where effects to the pacemakers/ICDs were observed were 53cm for the fast charger, and 12.5cm and 7.5cm for the Mode 2 and Mode 3 slow chargers respectively.

When those pacemakers/ICDs were set to two-pole detection mode, 2 models were affected near the Mode 2 slow charger. The effects observed include inhibition of pacing pulses and generation of unexpected pacing pulses. The observed effects diminished when the pacemakers/ICDs were moved away from the chargers.

With the notice, users of pacemakers/ICDs will be advised not to use fast chargers and not to come near fast chargers, and not to put their bodies close to the slow chargers and its cables when using those chargers.

Manufactures and importers/distributors of chargers and EVs/PHVs will also requested to warn the users about the risk, through instruction manuals, warning labels, etc.

(Kindly provided by Banana Skins' long-term correspondent in Japan, Tom Sato, on the 29th June 2013. The Japan Ministry of Health, Labour and Welfare notice issued of 19th March 2013 can be downloaded from http://www1.mhlw.go.jp/kinkyu/iyaku_j/iyaku_j/anzenseijyouhou/302-2.pdf, but is in Japanese.)

790) Faulty fridge light caused widespread interference a with telephone network

A faulty fridge light is being blamed for a network telephone problem in Wangaratta, in northern Victoria.

The network has been plagued by interference for weeks.

Telstra technicians used hand-held antennas to track down the radio frequency noise, that was causing widespread drop-outs. They found static from a faulty light in a fridge was to blame.

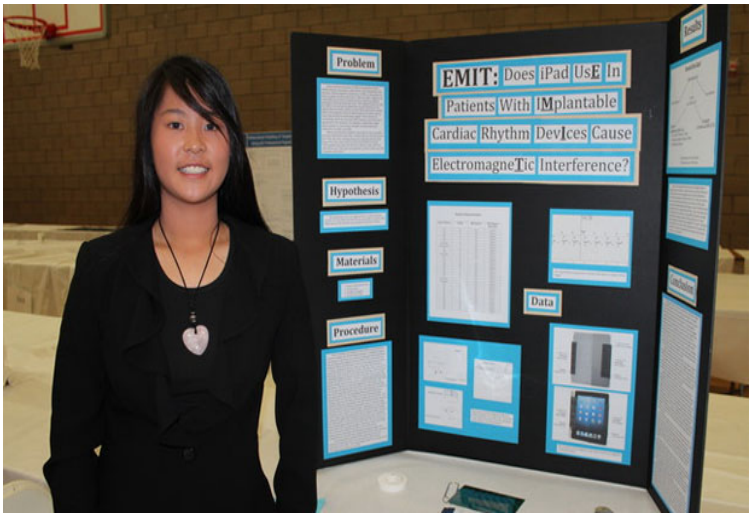
Telstra's Max Jennings says the home owner was taken aback when told his fridge was causing the interference. "I don't think he could believe that it was his fridge that was doing it,"

he said. "But he was very good about it and once we disabled the light, the interference source disappeared. "He can still have his cold beer."

Mr Jennings says an "enormous range" of rogue appliances can cause disruptions. "There's things called mercury vapour lamps which are often used in retail premises, domestic TV installations is a big one, even large electronic advertising signs can cause interference," he said.

(From www.abc.net.au/news/2013-06-04/fridge-light-blamed-for-phone-interference/4732534, first posted Tue Jun 4, 2013 2:23pm AEST, updated Tue Jun 4, 2013 4:02pm AEST, which was kindly provided by Banana Skins' long-term correspondent in Australia, Chris Zombolas of EMC Technology Pty Ltd, on the 6th June 2013.)

791) Study suggests Apple iPad 2 accessories could interfere with implanted cardiac devices,



A study presented at Heart Rhythm 2013 by high school freshman Gianna Chien *(pictured)* suggests that the magnets in Apple's iPad 2 tablet and accessories could interfere with cardiac devices.

Session: Poster Session II, Thursday, May 09, 2013, 9:30 AM -12:00 PM

Presentation: PO02-17 - iPad Use Can Cause Electromagnetic Interference in Patients with Implantable Cardiac Rhythm Devices

Location: Exhibit Hall

Author(s): Gianna Chien, Teri Kozik, RN, PhD, Therese Connolly, RN, BSN, Gurinder S. Grewal, MD and Walter Chien, MD. Central Valley Arrhythmia, Stockton, CA, St.Joseph Medical Center, Stockton, CA

Abstract:

Introduction: Electromagnetic interference (EMI), caused by an external signal, is a transient disruption or alteration in a cardiac rhythm device (CRD).

Multiple electronic devices have been studied to determine if they create EMI on CRDs. Magnets can create EMI and the iPad manufactured by Apple, Inc., a recently introduced tablet, has magnets imbedded in both the body and cover.

We are currently studying whether the iPad2 can cause EMI in various CRDs by either introducing noise/oversensing and/or triggering magnet mode in these devices.

Apple's iPad 2 with magnetic "Smart Cover." *(Image: Apple)*

Methods: We first tested the effect of the iPad2 on CRDs in their original packages. Trigger of magnet mode was noted by programmers supplied by device manufacturers. If magnet mode was triggered, the position of the iPad2 in reference to the device was noted. We then studied human subjects with implanted CRDs. These included subjects with defibrillators, pacemakers or loop recorders. The iPad2 effects were studied with the cellular data on and also off on the original programming settings and again on the most sensitive programming settings including unipolar sensing configuration in pacemakers. Subjects held the iPad2 at reading distance and also on top of his/her chest to mimic falling asleep while using the iPad2.

Results: iPad2 caused triggering of magnet mode on defibrillators in their package suspending anti-tachycardia therapy. A total of 19 subjects at this time have been studied including: 16 subjects with defibrillators, two subjects with pacemakers and one subject with a loop recorder. Devices tested were manufactured by St. Jude Medical and Medtronic. Two defibrillator subjects showed magnet mode trigger and one additionally had magnet mode trigger followed by initiation of the non-invasive program stimulation mode. Overall, 18.8% of the patients with defibrillators had magnet mode trigger from iPad2. No noise or oversensing was seen in packaged or implanted CRDs. No effects were seen in pacemaker or loop recorder so far.

Conclusions: iPad2 can trigger magnet mode in defibrillators and therefore suspension of anti-tachycardia therapy. Other devices with imbedded magnets are likely to cause similar interference. To date, this study suggests that interference is possible and care should be taken by individuals handling iPads with CRDs.

Disclosures: G. Chien: None. T. Kozik: I - Research Grants; 0; St. Jude Medical. T. Connolly: None. G.S. Grewal: None. W. Chien: A - Consulting Fees/Honoraria; 1; St. Jude Medical. I - Research Grants; 2; St. Jude Medical.

(The above is tken from Gianna Chien et al's study, which is available from: www.abstractsonline.com/Plan/ViewAbstract.aspx?mID=3068&sKey=4a1780d2-d99a-475f-a6e9-8228f59e7e2d&cKey=4df92828-f029-492d-8e59-88cdd1e57823&mKey=%7bCA11C8B6-ED27-4A20-953E-64F913C9A29D%7d. The Medtronic press release below is taken from a link provided by an article on the above study by Aliza Becker of Interference Technology magazine on 05/14/2013, which is available at www.interferencetechnology.com/apple-ipad-2-could-interfere-with-implanted-cardiac-devices-study-suggests.)

Press Release: Medtronic Issues Statement on iPad Interference Study

Medtronic's current internal analysis and testing shows iPad technology presents no risk of electromagnetic interference with Medtronic implantable cardiac rhythm devices when used per manufacturer's instructions. However, as a precaution, patients implanted with a pacemaker or ICD are advised to follow Apple and Medtronic labeling recommendations and maintain a distance of 6 inches (15 cm) between the iPad and implanted device.

ICD Therapy suspension and Asynchronous Pacing of IPG can be triggered by exposure to a magnet with a static magnetic field greater than 10 gauss. This is a standard functionality of most ICD and IPG (pacemaker) devices.

Medtronic proactively communicates to patients to avoid placing any magnet near the device implanted area. Since the covers of iPads often use magnets to secure them to the tablet, the presentation at Heart Rhythm 2013 is a good reminder for patients to remain vigilant on new technology and its accessories and maintain a distance of 6 inches between an iPad and implanted pacemaker or ICD.

At this time, Medtronic is not aware of any incidence of iPad interference with its implanted cardiac devices.

792) Common circuit design flaws that cause operational problems (problems fixed long ago are still showing up in designs)

Abstract: Common circuit design flaws at the board and system level cause many operational problems. Some of these flaws were understood and fixed years ago, yet still show up in designs. A few common problems of this type are discussed and examples given.

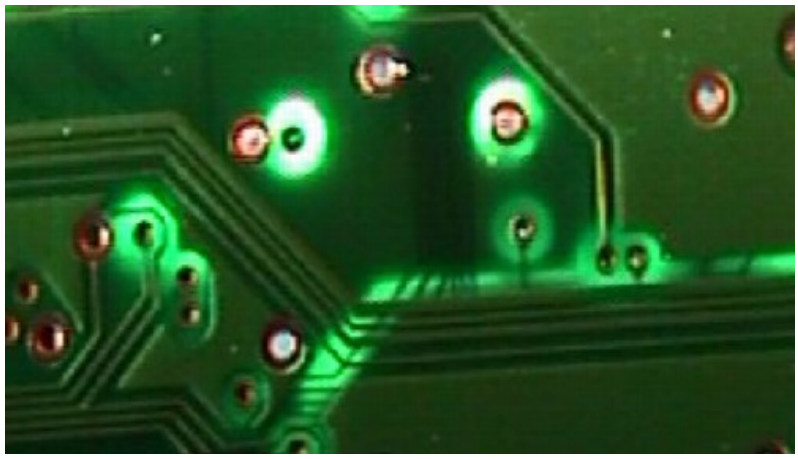


Figure 1. Circuit board with common design flaw

Discussion: In my consulting work, I see a lot of operational problems in systems that are caused by common circuit design flaws. In this Technical Tidbit, several of these flaws are discussed and examples are shown. A thread that runs through many of these examples, and my consulting work, are problems caused by attempting to separate "grounds" into different regions with "single point" connections between them. An example might be to separate a printed wiring board, PWB, ground plane into analog and digital areas.

There are a few relatively rare cases where grounds must be split apart, but when this is done a great deal of care must be taken to avoid problems. In most cases I have seen, separating grounds caused operational problems in a system. Grounds should be separated only if absolutely necessary and with concrete evidence (preferably based upon measurements) that doing so is required. Application notes in device manuals sometimes give incorrect advice on this topic.

So, let's start with my favorite problem, ground plane breaks on a PWB.

1. Ground plane breaks:

Figure 1 above shows a small section of a PWB with a light shining through the board so breaks in the power/ground planes can be easily seen.

Notice paths crossing a break in the power/ground planes at random. There are many effects of doing this covered in the linked articles at the bottom of this page. The situation is illustrated in Figure 2.

Figure 2 shows a layout diagram of a small test board, about 10 cm by 15 cm, that is used in a number of my Technical Tidbits.

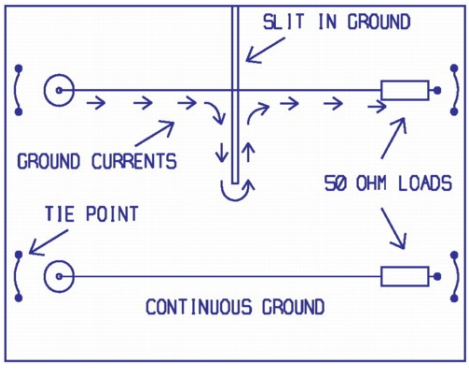


Figure 2. Drawing of Test Board With Slotted Ground

The bottom signal path is over a continuous ground plane whereas the top path crosses a 5 cm slot in the solid copper planes. The board has two planes with an identical break in each. The plane on the back side of the board is not used but is shorted to the top plane by the BNC connectors on the left end of each path.

All signals form a loop, from source to load and back again and it is the "back again" that often leads to problems. In this case, the returning current for the bottom path forms a long (the length of the signal path) but very thin loop, just a few mils in height. However, for the upper path, the returning current to the source must pass around the end of the slot in the ground plane and in doing so forms a substantial loop. The many bad effects of this loop are described in the Technical Tidbits linked at the bottom of the page and include slowed risetime, increased crosstalk to other paths, EMI emissions, and susceptibility to ESD and radiated RF fields. Figures 3 and 4 show two more examples of paths crossing plane breaks that cut all the way through the board. It is amazing to me that such features still show up in board designs today.

Figure 3. Another Circuit Board Example of Signals Crossing Plane Breaks

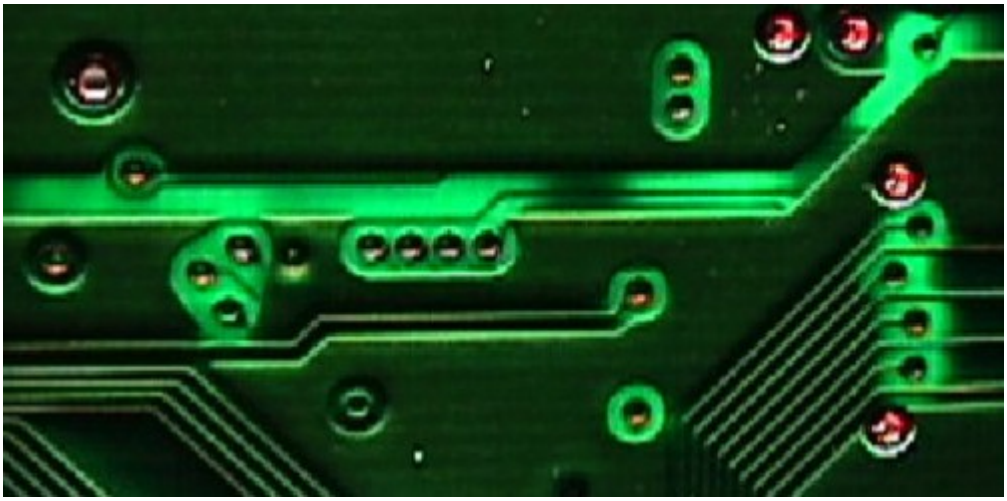


Figure 4. Third Circuit Board Example of Signals Crossing Plane Breaks

In Figure 4 there are two interesting features. The smaller one is the vertical field of vias near the lower right corner of the picture. The cutouts in the power and ground planes for these vias are large enough to overlap and form a slot in the planes. If there was enough room to get the horizontal signals in-between the vias, then there is a good chance that paths could also pass between the vias on the power and ground layers to slice up the slot into smaller pieces. Although I can't tell if this was done on this board, I doubt those paths were added.

The larger feature to note in Figure 4 is the horizontal slot between the digital and analog areas of the board (complete with a few signals paths in the break!). The designers thought the break was necessary to avoid digital noise getting into sensitive small signal analog circuits. Needless to say this board had a lot of problems including excessive emissions. When all plane breaks were filled in, the board worked perfectly (no analog problems) and emissions were reduced.

2. Single point grounding of printed wiring boards:

This feature of system design is more common than I would expect and often causes operational problems. Figure 5 shows a board from an old disk drive mounted on a copper clad board for test purposes. The results of injecting ESD at the lower left are described in my May 2002 Technical Tidbit and they are not what many engineers expect. Single point grounding of the board (the upper right connection was used in the test) resulted in a lot of current ringing at about 200 MHz due to the ESD hit. The board and copper plane formed a nice parallel plate capacitor and with the single connection point inductance formed a high Q tuned circuit at 200 MHz, not a desirable thing to do. Adding the other three connections to the copper plane raised the resonant frequency to about 500 MHz and the upper right corner connection became very quiet compared to the case where it was the only connection.

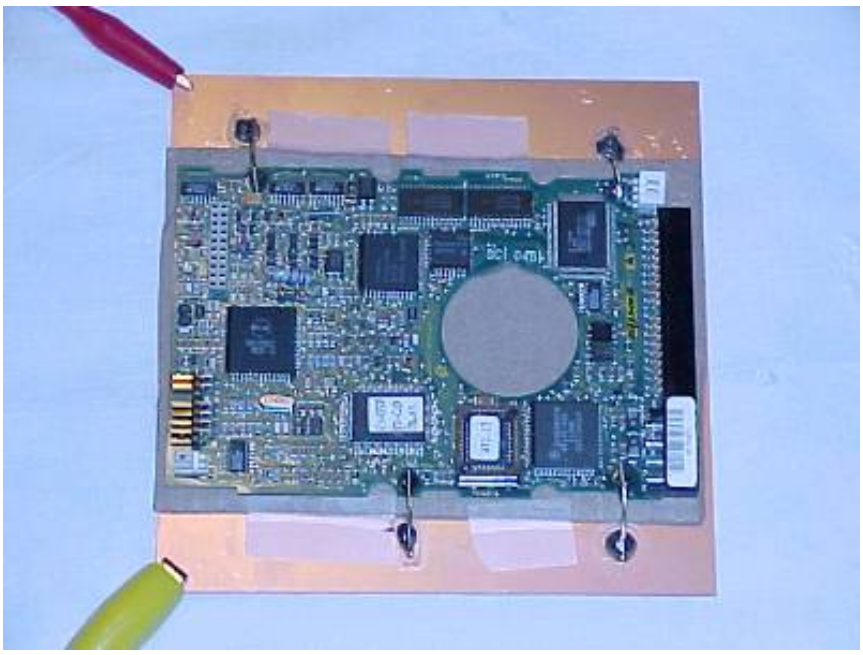


Figure 5. A Disk Drive Board Mounted Over a Copper Plane

Figure 6 shows a related example that occurs in a lot of the equipment I see. All the boards in a system are isolated from chassis except for one at a single point. This is even worst than the case shown in Figure 5. ESD to one board travels through all boards on the way to the chassis with the current path modified the the capacitance between the boards and the chassis. This case is discussed in greater detail in my March 2007 Technical Tidbit.

It is a very rare case where this system architecture is really necessary. In every case I have seen, a better alternative was available to meet system requirements.

One example would be the use of an isolated interface for those connections that really need isolation and then connect the boards securely to the chassis in many places. In rare cases, one of the chassis connections may cause a problem, and when it does, treat that case as an exception and analyze what is happening. It is a lot easier to remove an existing connection than to add a new one to a design.

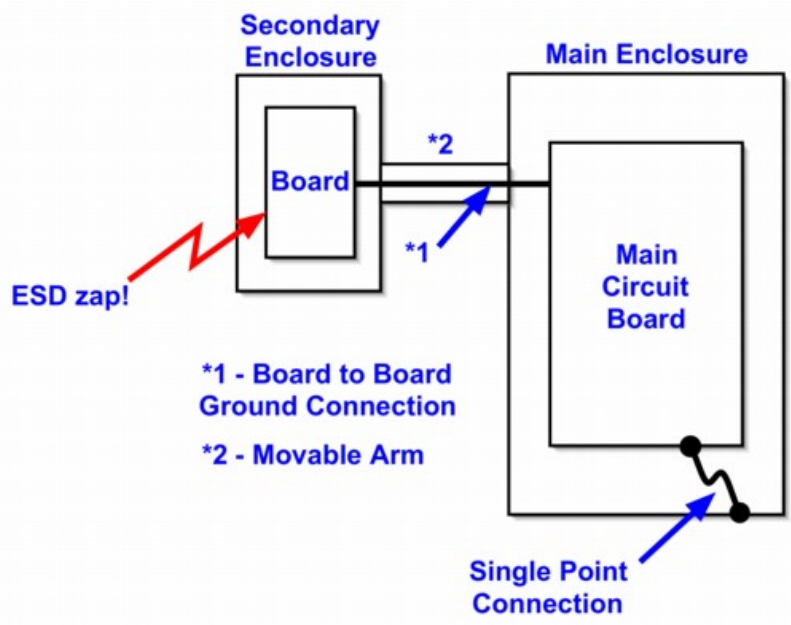


Figure 6. Circuit Boards Isolated From Chassis Ground Except at a Single Point

3. Processor reset lead routing:

This one occurs too often for comfort. I have seen processor reset leads routed all over a processor board, bad enough in itself, and then extended to a noisy I/O board as well! Recently, I worked on a case where a 10 cm reset trace on a four layer board caused the circuit to reset in response to an ESD event across the room.

The fix was to filter the reset with an RC filter near the processor. Remember, when it comes to ESD, lead lengths of one cm can be too long, for example in the RC filter example.

4. Ground bounce induced emissions problems:

Most chip packages with large chips within, such as a processor, have ground bounce on the chip relative to the board of tens of millivolts. This is enough to make all circuit traces on the board leaving the IC package RF hot to the point of causing excessive emissions.

The typical scenario is where a processor is driving an LED. Being a dc signal, the LED path is routed with no regard to high frequency effects, such as crossing ground plane breaks. However, the IC package ground bounce makes the LED signal hot enough to radiate and cause emissions failures during compliance testing.

Don't do this! Buffering or filtering the LED signal will solve the problem.

5. Off-spec use of protection components:

My final example is using components that are not specified for the application, My August 2005 Technical Tidbit describes an example of a lighting TVS protection device used for ESD protection. Small surface mount and leaded inductors have their characteristics specified at a few MHz and then we use them at hundreds of MHz.

My May 2000 Technical Tidbit shows a method of evaluating small inductors to mitigate the effects of ESD. In that article, it was shown that the best effect was obtained by placing a smaller inductor in series with a larger one.

Summary:

Some of the most frequent circuit design flaws I see in my consulting work have been described. In some cases, the problem was understood and solved years ago and yet still shows up in current circuit designs.

(This June 2007 article was copied with Doug Smith's permission from his webpage: www.emcesd.com/tt2007/tt060207.htm. Links to Technical Tidbit articles with more information on common circuit design flaws – and much else – are provided by his wonderful website http://www.emcesd.com. But beware: a quote from a visitor to this site is: "Every time I browse your site, I never get any work done. I spend hours on it and get in trouble". Doug Smith is based in Los Gatos, California, and his email address is doug@dsmith.org.)

793) Microwave Signal May Have Caused Presidential Inauguration Video Interference

Officials have reported that interference with a microwave signal may have been the cause of audio and video problems experienced during President Obama's inauguration in mid-January.

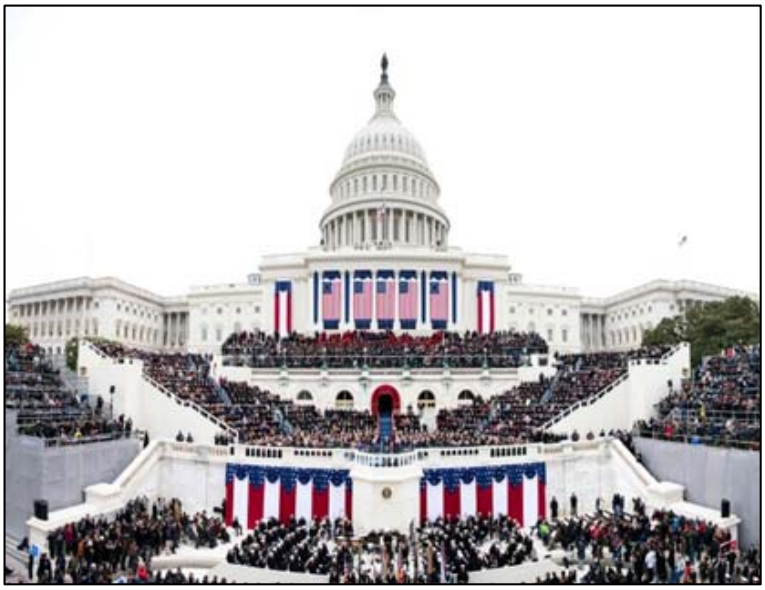


Image: Lawrence Jackson/The White House

The interference problems affected one of 12 giant video screens erected for the ceremony, and officials have thus far been unable to determine the source of the interference.

According to Tom Sharkoski, CP Communications engineering manager for the event, a channel was dedicated specifically for the inauguration feed and no equipment failure was discovered.

"My heart goes out to all those people [that were unable to view the inauguration], especially those who may have traveled great distances to witness [the] event," he said.

Sharkoski added that crews located in the same area as the malfunctioning video screen were unable to communicate on their walkie-talkies while the screen was experiencing problems.

Joe Raedle/Getty Images – President Barack Obama is seen on a jumbotron during his public swearing in ceremony during his Inauguration on Jan. 21, 2013. Interference with a microwave signal may have caused one of the giant screens to fail.

(Taken from the Interference Technology article www.interferencetechnology.com/microwave-signal-may-have-caused-presidential-inauguration-video-interference 01/28/2013. For more

information, visit the Washington Post for the original article by Mary Pat Flaherty published on January 26, 2013, at www.washingtonpost.com/local/what-caused-jumbotron-failure-at-inauguration-remains-unknown/2013/01/26/7f29bb80-672a-11e2-93e1-475791032daf_story.html.

794) LTE Cellular Tower Interference onto Satellite Ground Station down links

Interference will arise as a result of the LTE and LTE Advanced cellular 4th generation build-out now occurring on a global basis. I made several assumptions and modeled the cumulative power spectral density of ALL the user hand sets around each LTE-A cell tower, and their interference to noise onto each federal earth station site in physical proximity to that federal earth station.

Since we DO know the LAT LON of each Federal Earth Station, but do NOT know where the locations of the LTE-A cell towers will be located, we assumed circles of zones for coordination and for exclusion, where cellular towers will be prohibited (hard to prohibit the hand sets, but if there is no cell tower to provide them service, then interference is not as much of a problem) and coordinated.

We found the polar federal earth stations to present a problem, since their antennas are not fixed (pointed at a single location in the sky), but move across a program track where they most likely WILL intercept power from the cumulative user hand sets. The exclusion zone for GEOSYNC was 30-35 km while the exclusion zone for polar was 300-400 km, which is as you may know is a non-starter with the cellular companies. Hence, polar sites will by definition experience problems with their data downloads on polar tracks and interference mitigation strategies must be employed, such as space (multiple antenna) diversity, filtering, etc.

The software used to formulate the user hand set PSD and CDF was Excel while the software tool used to model the interference was Visualyse (Transfinite Systems in the UK). I found the task to be a very complex issue, probably the most complex of my career, and do look forward to further work in this field.

(Kindly provided by Tim Cash on 2nd September, cash.tim@gmail.com, www.linkedin.com/in/timcash/.)

795) Some FCC Part 15 interference problems

For example, some of the telecom companies have banned or restricted WLAN devices from their switching stations because their equipment (Part 15 unintentional radiator devices) are subject to interference from WLAN devices. The problem is not the WLAN devices themselves but the fact that the industry immunity standard used in testing these devices does not use 'real world' transmitter emissions from a WLAN.

In First Report and Order 01-278, the commission required that radar detectors be certified (they were exempt as a receiver operating over 960 MHz). This action was to avoid a serious field complaint from VSAT (satellite terminal) operators whose services were being disrupted by radar detectors. Occasionally, the FCC has requested that a WISP (wireless Internet service provider) operating Part 12 WLAN equipment cease operation until a specific interference problem has been fixed.

(Taken from the article "A look at Part 15 interference problems" by David A case NCE, NCT, Cisco Systems Inc., in Interference Technology magazine's EMC Directory & Design Guide 2005. www.interferencetechnology.com.)

796) Fluorescent lamps with HF ballasts emit three different types of conducted interference

Power quality is a subject that has received a lot of attention during the last 10 to 20 years, both in industry and in academia. Power quality concerns interaction between the power grid and its customers and between the power grid and equipment connected to it, reflected in voltages and currents.

Research and other developments in this area have to a great extent concentrated on relatively slow and low-frequency phenomena, with the main emphasis being on voltage dips (reductions in voltage magnitude with duration between about 50 ms and several seconds) and low-

frequency harmonics (waveform distortion by frequency components up to about 2 kHz). These phenomena are reasonably well understood and several standards cover the area.

For higher-frequency phenomena, above 2 kHz, there is no such general understanding, nor is there anything close to a complete set of standards covering this area. Modern energy efficient equipment connected to the grid, like fluorescent lamps but also solar panels, often uses switching technology, with switching frequencies that can range from a couple of kHz up to several hundreds of kHz. The grid is also used for communication of e.g. meter readings, system controls etc. This so-called power-line communication is using the same frequency range.

The main frequency range of interest for this thesis has been the range from 2 to 150 kHz. There are two completely different measurement methods covering this frequency range: time-domain based and frequency-domain based. Time domain based measurements are used throughout the thesis. This gives an opportunity to choose between different analysing tools where among others the joint time-frequency domain has shown to be a useful tool for describing waveform distortion in our frequency range of interest.

The majority of the measurements presented in this thesis have been directed towards fluorescent light powered by high frequency ballasts. This type of load has been, due to stringent harmonic limits, one of the first to use a more advanced switching technology called active power factor correction. This technique is also getting more frequently used in other small-power equipment, like computers. Installations of lights in stores etc. normally contain a large number of ballast connected together and the interaction is of importance, for example for setting emission and immunity standards.

The measurements on ballasts presented in this work have shown that distortion in the frequency rage 2-150 kHz comes in three types: narrowband distortion; wideband distortion; and recurrent oscillations. The recurrent oscillations are a new type of power quality disturbance that had not been recognized as such before.

The recurrent oscillations, which resemble commutation notches, have never been described for high-volume equipment used by non-industrial customers. In larger groups of lamps, of a different type as used in the laboratory experiment the recurrent oscillations have been shown to reach up to about 5 V in peak.

The measurements further have shown that the three types of distortion spread in a completely different way from the individual devices to the grid. This knowledge is essential for the setting of emission requirements on energy-efficient equipment.

(Extracted from the Abstract and Conclusions sections of "On High-Frequency Distortion in Low-Voltage Power Systems", PhD Thesis by Anders Larsson, Division of Energy Engineering, Department of Engineering Sciences and Mathematics, Luleå University of Technology, Printed by Universitetstryckeriet, Luleå 2011, ISSN: 1402-1544, ISBN 978-91-7439-218-0, www.ltu.se, download from http://pure.ltu.se/portal/en/publications/on-highfrequency-distortion-in-lowvoltage-power-systems(f614e609-6938-4bd0-a656-eece9cf3e2c2).html*)*

797) Garage Door Opener Interference on the Increase

There have been several instances of interference with garage door opener remotes at houses located near military installations, the FCC reports in a recent Public Notice (DA 05-4242). When the interference occurs, the controllers don't work properly. Either the range is diminished, or they stop working entirely. Hardwired manual controls are unaffected.

Legally, the garage door industry doesn't have a case, because the openers are regulated under FCC Part 15, which grants them "at sufferance" rights of operation. They can't cause interference *(I'm sure this means they are not permitted to, and not that it is impossible for them to do so – Editor)*, and they have to tolerate any interference from licensed services. Still, there's the law and there's public relations – a lot of homeowners are upset, as well as the manufacturers of the affected equipment.

Here's what's going on technically. The problem is that the receivers used in these garage door systems are usually rather simple super-regenerative units. Super-regenerative receivers can

be surprisingly sensitive, considering how simple they are, but they have a major weakness: They are highly unselective, and can easily be captured by signals within 10MHz of their desired operating frequency.

This has both a strength and a weakness in this application, The strength is that the receiver and transmitting controller don't have to be precisely aligned in frequency. The weakness is that any nearby strong signal over a fairly wide frequency range – such as those from the military base radios – will interact with the receiver and may over-ride the desired controller signal, blocking communications between them.

For security reasons, the DoD (Department of Defense) doesn't want to publish the exact frequencies in use, which makes it difficult to design around. There is a technical solution – to build more selective receivers and to more precisely align their operating frequencies. The FCC may do that through a formal rulemaking in the future, affecting many types of devices operating in the range of approximately 225 to 400MHz. In the meantime, the FCC, the Department of Defense, and the National Telecommunications and Information Administration are working with device manufacturers to minimize consumer impact – possibly by developing substitutable receiver/transmitter pairs that can work at different frequencies from those in local use.

(Taken from Conformity magazine, April 2005, Newsbreaks, page 10. Conformity Magazine used to provide a wonderful archive of articles on EMC and other issues, which was maintained for some time by a 3rd Party after it folded. However, even that seems to have disappeared now, which is a great pity. Web searches now seem to only find the February and June 2006 editions in 'nxtbook' format.)

798) Cellphones still interfere with hearing aids

Over the years, hearing aids and telephones have led a sometimes troubled coexistence. Positioning the telephone earpiece near the hearing aid microphone is sometimes awkward and, due to design constraints of the hearing aid, can lead to squeals of acoustic feedback.

Several decades ago, many hearing aids began to incorporate magnetic sensing coils known as "telecoils" that responded to the stray audio frequency magnetic field from the telephone receiver, instead of to its acoustic output. This coupling mode can yield a clearer sound and avoids picking up ambient noises. Its importance led to federal regulations in the U. S. pursuant to the 1988 Hearing Aid Compatibility (HAC) Act (Public Law 100-394) that, among other things, mandated minimum requirements for telephones' magnetic fields.

Cell phones, however, were exempt from these HAC requirements. With the advent of widespread cell phone use, the exemption for wireless devices was later partially lifted [1].

As digital cell phones began to replace analog phones in the 1990's, radio frequency interference (RFI) quickly emerged as a major compatibility consideration. The primary RFI concern was then and remains audio-frequency interference related to the amplitude modulation (AM) envelope of the RF field of the wireless device (WD), which can undergo square-law detection by various semiconductor junctions within the hearing aid in both the microphone and the telecoil operating modes.

The most interfering WD transmission protocols are those that employ some form of time division multiplexing, where the carrier is repeatedly pulsed on for only a portion of the transmission time. This pulsing typically occurs at repetition rates near or within the audio frequency band. A prime example is GSM [2] modulation, which pulses with a 1/8 duty cycle at a 216.7 Hz repetition rate.

(From "Radio Frequency Immunity Testing of Hearing Aids" by Stephen D. Julstrom, Linda K. Kozma-Spytek and Brian B. Beard, in IEEE Electromagnetic Compatibility Magazine – Volume 2 – Quarter 2 – 2013, from: http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6550935.)

799) Flash-over causes problems for spacecraft

Pyrotechnic ("pyro") firing circuits typically require special attention, particularly in conservative designs. The greatest threat associated with grounding in such circuits is the phenomenon known as "pyro ground-fault currents".

Chassis currents as high as 20A may flow through the spacecraft chassis or structure during pyro firing events. This current is produced by a short-circuit formed between the positive lead of the EIED (also known as a bridge-wire actuated device) bridge wire through the ionized conductive path created when it is fired (this phenomenon occurs quite frequently, in about 25% of all firing events, and was shown to be the cause of several spacecraft anomalies and failures).

In a direct-energy-transfer system (pyrotechnic devices switched directly from the main battery bus) that is not isolated by a deliberate turn-off switch, this ground fault current could continue indefinitely. The ground fault current could also result in momentary near total power loss as well as magnetic field interference, coupling into adjacent sensitive circuits.

(Taken from Chapter 10.4.3.2 "Spacecraft Internal Grounding Considerations", in "Grounds for Grounding, A Circuit-to-System Handbook" by Elya B. Joffe and Kai-Sang Lock, IEEE/Wiley, 2010, ISBN: 978-0471-66008-8.)

800) Spinor and Tosion fields, and human health

(Every 100th Banana Skin is chosen either for its humour or its claims to stretch recognised boundaries. This is one of the latter – Editor.)

Receiving gifts is fundamentally more fraught than giving them. Consider the plight of Aaron Watson, puzzled recipient of a "Forpost 1" – claimed to provide protection from "adverse effects of…electromagnetic radiation of TV sets, PC monitors and other electronic devices". Er, thanks for the thought.

Website www.spinor.kiev.ua depicts the Forpost 1 as a stick-on disk. The unique selling proposition, distinguishing this from other stick-ons, is protection against the "torsion (information) component" of the electromagnetic field.

Of 380 web pages turned up by searching "torsion component" and "electromagnetic fields", many talk of "bioenergy" and "new energy technologies". We see none from an actual scientist.

The mechanism is – as always with these thingies – mysterious. US Patent 6563043 describes an "outer body, a salt solution, and a ring". The ring "generates a first right torsion field" and may be a "topological resonator". Its topology is interesting: it may be "cylindrical in cross-section".

Aaron offers to send the device to the Feedback Kitchen lab to find out what is inside it. We accept – as soon as he finds a way of explaining to his mother-in-law where the gift went.

(The above is from 'Feedback', New Scientist, 24/31 Dec 2011, page 96, www.newscientist.com. The Editor thought he should provide Banana Skin readers with at least the starting points for investigating whether the dismissive tone of the above item was justified, see below…)

The Editor found the text and pictures below at http://spinor.kiev.ua/eng/index.php?p=8

The Forpost-1

"Device for human protection against negative impact of a Torsion Field"

The "Spinor device"

This is also a "device for human protection against negative impact of a Torsion Field"

The Forpost-1 device provides reliable and user-friendly protection from adverse effects of the torsion (information) component of electromagnetic radiation of TV sets, PC monitors and other electronic devices.

Recent studies revealed that the torsion (information) component of radiation of TV sets (PC monitors) is the most substantial factor affecting the human health.

Prolonged exposure of the torsion (information) component of TV set's, PC monitor's radiation can deteriorate one's health, cause headache, excessive fatigue, weak vision and memory, sleep disorder, reduction of the blood levels of leukocytes and lymphocytes, immunity disorders; it adversely affects the endocrine and reproductive system.

Children and pregnant women are most vulnerable to effects of torsion (information) fields.

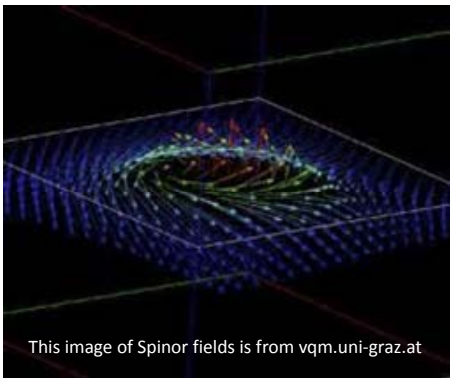
The Forpost-1 device neutralizes harmful effects of torsion (information) component of radiation of TV sets (PC monitors, etc.) and creates a biologically safe area around a TV set (any other electronic device).

"Forpost-1" device can be used for neutralization of the negative influencing of electronics of cars, trolley buses and subway trains electronic systems.

The text on the Spinor device is identical to the text on the "Torsion device" above. Investigating the documents in the 'Library' at http://spinor.kiev.ua/eng/index.php?p=8 led the Editor to an article containing the following text:

The article describes the research work aimed at the creation of new technologies based on the Kozyrev's ideas and realized at the International Scientific Research Institute of Cosmic Anthropology [Kaznacheev V.P., 1999].

The part of the preliminary work had been done at the Medical Institute of Novosibirsk, at the Institute of Clinic and Experimental Medicine of SB RAMS during 40 years. The scientists constructed a generator irradiating ether-dynamic stream of ether (vacuum) heterogeneity described in the works by D'atlov V.L. [1988], Akimov A.E., Shipov G.I. [1996], Dmitriev A.N. [1997], etc.



If such generator "twists" ether (vacuum) stream to the left (anticlockwise) (left torsion fields), then tissue cultures (human cells), [Kaznacheev V.P., 1999], begin actively reproduce, while the synthesis of albumen and polysaccharides goes in its ordinary way.

During the alteration of the ether (vacuum) stream rotation direction to the right (right torsion fields) the following effect is initiated: there are no mitoses, however, albumen synthesis in cells, the activity of their genomes are incredibly high in all cases.

(The above text is taken from an article by Kaznacheev V.P. published in "Physics of consciousness and life, cosmology and astrophysics", №1,2002, Kyiv (International Scientific Research Institute of Cosmic Anthropoecology, 2, Academic. Timakov Str., Novosibirsk, Russia, 630117, www.isrica.org/. The names Akimov and Shipov also appear later in this item.)

Visiting www.isrica.org to try to find out what Anthropoecology is, the Editor found the following:

The main program objectives of the Institute are the study of living matter and intelligence on the planet Earth as cosmo- planetary phenomenon to study the effect of cosmic factors on the evolution and human health, development and testing of new methods for predicting, diagnosing, drugless prevention and correction of intractable helio-dependent diseases and accelerated aging of the human body.

In recent years, scientists of ISRICA have created an unique holographic technology which has not analogues in the world, which allows to use of living systems directly absorb cosmic energy and convert it into energy of its vital functions, enhancing protein synthesis, productivity, reproduction and resistance to many diseases.

Investigating 'spinor fields' and 'torsion fields', the Editor found that they are associated with quantum mechanics and anti-matter. The following gives a flavour, and some pretty graphics…..

The space of real spinor fields of a given mass m>0 in Minkowski space is the direct sum of two irreducibly invariant subspaces under the connected Poincaré group P. These subspaces admit unique P-invariant positive-energy complex unitarizable structures, in terms of which they are unitarily and canonically equivalent to the conventional "left electron" and "right positron" subspaces defined by the Dirac equation.

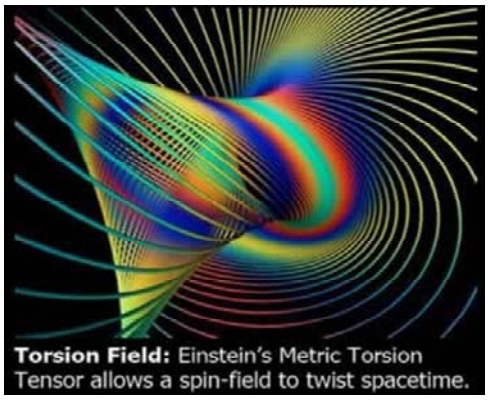
(The above is taken from: "Real Spinor Fields and the Electroweak Interaction", Irving Segal, Journal of Functional Analysis, Volume 154, Issue 2, 20 April 1998, Pages 542–558, www.sciencedirect.com/science/article/pii/S0022123697932134.)

Torsion field can refer to:

- A torsion tensor in differential geometry.
- The field used in Einstein–Cartan theory and other alternatives to general relativity that involve torsion of spacetime
- Torsion field (pseudoscience), a field alleged to make faster-than-light communication and paranormal phenomena possible phenomena possible

(The text above is taken from http://en.wikipedia.org/wiki/Torsion_field.)

(Following up on the pseudoscience angle, the text below is taken from http://en.wikipedia.org/wiki/Torsion_field_(pseudoscience).)



This image of a Torsion field from: www.holographicarchetypes.weebly.com

A torsion field (also called axion field, spin field, spinor field, and microlepton field) is a pseudoscientific[1] theory of energy in which the quantum spin of particles can be used to cause emanations lacking mass and energy to carry information through a vacuum at one billion times the speed of light.

The theory, conceived in the Soviet Union by a group of physicists in the 1980s, is loosely based on Einstein-Cartan theory and some variant solutions of Maxwell's equations.[2]

The group, led by Anatoly Akimov and Gennady Shipov,[3] began the research as the state-sponsored Center for Nontraditional Technologies.

However, the group disbanded in 1991 when their research was exposed as a fraud and an embezzlement of government funding by Ye. B. Aleksandrov; yet, for unknown reasons Akimov and Shipov received financing for torsion field research from the Russian Ministry of Science from 1992 to 1995 and from the Russian Ministry of Defense from 1996 to 1997, and continued further secretly,[2] as a private enterprise called The International Institute for Theoretical and Applied Physics (later called UVITOR).[4]

UVITOR is operating from Bangkok, Thailand since 2005 and appears to offer medical products and services on its premise.[5] The torsion field research has secured support from a number of prominent Thai academics and the national funding agency.[6][7]

Presently championed outside of established scientific research due to its lack of scientific recognition, the theory has been used to proclaim faster-than-light travel (FTL), extra-sensory perception (ESP), homeopathy, levitation, and other paranormal phenomena, and has been used to provide a rationale for the purported functioning of miracle cures and similar products.

Detailed description

In physics, a field is an assignment of a quantity (vector, tensor, or spinor) to every point of the space containing it. The word torsion refers to any variable that describes rotation. Thus, torsion fields do exist.

For example, an electromagnetic wave with circular polarization or the stress tensor of a solid body under torsion stress can be described as torsion fields, although such usage is rare. Spinor fields, in particular fermionic fields, are existing concepts from particle physics and quantum field theory.

Beyond this established research, advocates of the scientific spin field or torsion field theories claim that spin-spin interaction — itself a well-studied quantum phenomenon — can be transmitted through space similar to electromagnetic waves, does not carry mass or energy but only information, and does so at speeds of up to 109 times the speed of light.

At the same time they claim that spin-spin interaction is carried by neutrinos — which have very little mass and high energy — that it does not interact with matter but, at the same time, can be generated and detected easily.[8]

Applications

Despite the fact that several contradictions have been identified in the basic postulates of these theories [9] (as have several statements that are considered nonsensical by mainstream science[9]), torsion field theory has been embraced by some as the scientific explanation of homeopathy, telepathy, telekinesis, levitation, clairvoyance, ESP, and other paranormal phenomena.[10]

The harnessing of torsion fields has been claimed to make everything possible from miracle cure devices (including devices that cure alcohol addiction [11]) to working perpetual motion machines, stargates, [12] UFO propulsion analogs, and weapons of mass destruction (WMDs).[13] Some such devices, in particular the miracle cure boxes, have been patented,[14] manufactured and sold.

Torsion field theories are sometimes presented as alternatives to general relativity. Examples of this include the Einstein-Cartan Theory and gauge theories of gravitation for the Poincaré and the affine groups, which seek to add torsion of space-time to the curvature-based description of gravity; and thereby predict a multitude of new physical effects.

However, the predicted effects of such alternative theories are either infinitesimal or directly contradict the experimental evidence.[15] It may be shown that space-time curvature and torsion are alternative ways of describing the gravitational field and are completely interchangeable, while attempts to account for them simultaneously produce inconsistencies.[16]

(The Editor wonders whether he would have become much wealthier (well, just wealthy would be nice!) quickly and with little effort, if he had pursued a career in pseudoscience like some of the gentlemen or ladies mentioned above. It seems that all you need to do is learn enough about some complex issues in quantum physics to bluff with them, claim they can be used to create new weapons, and get unlimited funding. Even when one government throws you out as a fraud and a charlatan, it seems that this does not prevent other governments from funding you. However, there may be a real basis for such rubbish to provide real health benefits via the placebo effect.)

801) Interference caused by gas insulated switchgear (GIS)

The quantification of emission levels from gas insulated equipment during switching events is found to be important for the EMC design of control devices operating in such harsh EM environment and hence to ensure reliable operation of the systems.

Malfunctions of the primary/secondary equipment have been reported by many authors during switching operations in a GIS due to induced/conducted voltages on control circuits.

(Taken from: "Computation of EMI Fields in a High Voltage Gas Insulated Substation during Switching Operations", by M M Rao, M J Thomas and B P Singh, presented at the IEEE International EMC Symposium, Boston, MA, USA, 18-22 August 2003, ISBN: 0-7803-7835-0/03.)

802) Guided missiles need shielding to protect from ambient EM fields

If it becomes apparent that ordnance does not comply with the environmental conditions given in the standards as it is the case with some equipment that is in use in NATO countries for several years methods of shielding have to be considered.

Examples are some types of guided missiles like MILAN which was developed more than thirty years ago and which has been shown to be sensitive to RF electromagnetic fields. For three decades the missile system has been the backbone of anti-tank defense in almost forty countries. Infantry forces will continue to rely on MILAN well beyond the year 2005.

Considering the large number of MILAN in use it is nearly impossible to try to harden the missile itself and ensure safe operation in difficult RF environment. Mostly however this is not necessary because it seems unlikely that the ordnance is exposed to strong fields during the short time of operation. During storage and especially transport there exist possibilities of shielding.

(Taken from "The safety of ordnance in high frequency and pulsed electromagnetic fields", by M Koch and W Zappe, in EMC Society of Australia Newsletter, Sep 2004 Issue Number 27, page 11, www.engineersaustralia.org.au/emcsa#news.)

803) PWM motor drives interfere with digital multimeters

However, a standard true-rms multimeter cannot reliably read the output side of a PWM (pulse width modulated) drive, because the VSD applies a non-sinusoidal PWM voltage to the motor.

A true-rms DMM reads the heating effect of the non-sinusoidal voltage applied to the motor, while the output voltage reading from the motor controller only displays the rms value of the fundamental component (typically 30-60 Hz).

The causes of this discrepancy are bandwidth and shielding. Many of today's true-rms digital multimeters have bandwidths up to 20kHz or more, causing them to respond not only to the fundamental component – which is what the motor responds to – but to all of the high-frequency components generated by the VSD.

And if the DMM is not shielded against high-frequency noise, the drive's high noise levels can make the measurement discrepancies worse. The combination of the bandwidth and shielding issues means that many true-rms meters display reading up to 20-30% higher than indicated by the drive controller.

(From "Driving for test accuracy" by Fluke, in the "Troubleshooting" section of Drives & Controls magazine, October 2005, www.drivesncontrols.com.)

804) Vehicle tracking system GPS jammer interferes with Newark Airport: $42,500 fine

3. On August 3, 2012, the Enforcement Bureau (Bureau) received a complaint from the Federal Aviation Administration (FAA) reporting that the Port Authority of New York and New Jersey (Port Authority) had been experiencing interference during pre-deployment testing of a ground-based augmentation system (GBAS) at Newark Liberty International Airport (Newark Airport).7

The GBAS provides enhanced navigation signals to aircraft in the vicinity of an airport for precision approach, departure procedures, and terminal area operations.

4. An agent from the Bureau's New York Office investigated the matter at Newark Airport on August 4, 2012. While driving toward the Guard Post India Gate at the Newark Airport, the agent determined, using direction finding techniques, that a red Ford F-150 pickup truck with New Jersey license plates (Red Ford) was emanating radio signals within the restricted 1559 to 1610 MHz band allocated to the Radionavigation-Satellite service and used by the GPS satellite navigation system.

The signals emanating from the vehicle were blocking the reception of GPS signals by the GPS receivers used in the GBAS. Port Authority police and security personnel, working closely with the FCC agent, stopped the Red Ford at the gate. Using handheld direction finding equipment, the FCC agent confirmed that strong wide-band emissions in the restricted 1559 to 1610 MHz band were emanating from the Red Ford.

The FCC agent interviewed the driver, who identified himself as Gary Bojczak and admitted that he owned and operated the radio transmitting device that was jamming GPS transmissions. Mr. Bojczak claimed that he installed and operated the jamming device in his company-supplied vehicle to block the GPS-based vehicle tracking system that his employer installed in the vehicle.

Mr. Bojczak voluntarily surrendered the jammer to the FCC agent. After the jammer was removed from the Red Ford and turned off, the agent confirmed that the unauthorized signals had ceased.

12. In light of the disruption caused to sensitive aeronautical navigation equipment designed to protect public safety, we apply a 50 percent upward adjustment to the base forfeiture amount for interference, resulting in a proposed forfeiture of $42,500.26

(Extracts from FCC 13-106, 2nd August 2013, kindly sent in by Peter Warburg, a Principal Engineer with General Dynamics Broadband, http://transition.fcc.gov/Daily_Releases/Daily_Business/2013/db0802/FCC-13-106A1.pdf.)

805) Conducted Emissions in Distribution Systems (1 kHz-1 MHz)

With the advancements in power electronics and power converters more and more loads on distribution systems are connected via power converters. This is particularly true for energy efficient lighting and variable frequency drives. Renewable generation is another growth area in distribution systems, which also tends to be connected to the grid via power converters. The

proportion of non-linear devices connected to distribution systems is therefore rapidly increasing and may already be over 60% [1].

At the same time, there is an increase in communications and control equipment closely associated with power systems for the smart grid and micro grid concepts. There is therefore a concern that significant conducted emissions from these nonlinear devices on the power system may lead to EMC problems.

Already problems due to increased transformer losses have been reported and other evidence of equipment damage [2, 3]. Assessing the level of electromagnetic interference due to conducted emissions on power systems is very problematical due to the large variability in the operation and connection of generators and loads. The cabling and overhead line characteristic impedance can also vary from 30-300 ohms. This is quite different from other environments where the connected equipment does not change and the propagation impedance is constant (e.g. 377 ohms for radiation or 50 ohms communications transmission lines). There is thus a significant range of uncertainties associated with the assessment of conducted emissions both in measurement and the assessment of the cumulative effect of the devices. To date theoretical prediction of cumulative effects of the emissions have not been fully successful.

Currently suitable standards are under development, but this article shows that there are many uncertainties associated with these conducted emissions. The first is that modern power converters connected to motors or generators have a large range of operating conditions which needs to be considered. Second, the power networks themselves also have a large range of properties both dynamic and static characteristics and a statistical approach to their impact needs to be developed.

Third, the emission from modern converters varies with time due to the action of active power factor correction and methods of measuring this such as STFT needs to be standardised. Finally, to date no satisfactory method for assessing the complete system performance without measuring or modeling the complete system has yet been developed.

[1] J. C. Das, “Power System Analysis: Short-Circuit Load Flow and Harmonics”, CRC Press, 2011.

[2] R. B. Timens, F. J. K. Buesink, V. ’Cuk, J. F. G. Cobben, W. L. Kling and F. B. J. Leferink., ‘Harmonic Distortion in a New Building due to a Multitude of Electronic Equipment’, 2011 IEEE International Symposium on EMC, Long Beach, CA, USA.

[3] T. Sels, J. Declercq, J. Lopez-Roldan, D. van Dommelen, and R. Belmans, "The impact of repetitive combined voltages with low and high fundamental frequencies on the ageing of cast resin," in Proc. Int. Conf. on Electricity Distribution (CIRED), Turin, June 2005.

(Extracted from: Conducted Emissions in Distribution Systems (1 kHz-1 MHz), by Prof. David Thomas, Vice-Chair IEEE EMC Society TC 7 – Low Frequency EMC, in the IEEE EMC Society Magazine Volume 2 Quarter 2, 2013, pp101-104, from: http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=06550941.)

806) An EMC crisis during a teleconference at Goldman Sachs

The story goes that an all-important board meeting had trouble getting input on year-end figures due to noise on a teleconference connection.

It turned out that many of the electronic devices carried by board members were of the continuous-polling type, and the constantly emitted RF signals were being converted to audio noise inside the teleconference equipment.

A board member was assigned to investigate the circumstances, which resulted in the initiation and development of an ANSI standard for the RF immunity of office equipment.

(An extract from: “An update on the C63 standards” by Thomas Mullineaux, Evaluation Engineering, Dec 2005, www.evaluationengineering.com/articles/200512/an-update-on-the-c63-standards.php)

807) Medical immunity test standard initiated after wheelchair suffered EMI

The ANSI C63.18 standard describes a recommended method of testing medical equipment for immunity against common emitters such as cellphones and walkie-talkies.

The standard actually was initiated after an electric wheelchair took off on its own when a police officer in a nearby cruiser keyed the radio set.

(Another extract from: "An update on the C63 standards" by Thomas Mullineaux, Evaluation Engineering, Dec 2005, www.evaluationengineering.com/articles/200512/an-update-on-the-c63-standards.php)

808) Lightning strike bounces along road, causes many TVs to fail

No doubt like many readers, I have accumulated, over the years, a number of cordless power tools, and their associated chargers.

Earlier this year, I was rather surprised to find that two chargers had failed simultaneously. In one, the primary winding of the transformer had gone open circuit, in the other, the rectifier had failed, and it was producing AC not DC.

I subsequently found that the battery that was in the charger with the failed primary was refusing to accept charge from a new, healthy charger. I made these discoveries shortly after an intense lightning storm, which, given that we are supplied off an underground network, should not have impacted on the supplied voltage. Less than a week later, a cordless phone failed inexplicably. At the time of the storm, it was resting in its mains-powered charger.

Many years ago, in a previous house, a lightning strike was actually seen bouncing down the road, following which a television mains transformer failed, as did those belonging to a number of neighbours. This was easily established, as one of them was a television repair man, who got the repair work from the rest of us.

Such simultaneous failures seem beyond the realm of coincidence, and the availability of multiway sockets with anti-surge protection for (typically) computers and peripherals seems to suggest that such events are not uncommon. I use one for the computer, and have, as yet, encountered no similar problems there.

Is there more anecdotal evidence of such events?

Does the apparent excursion of supply voltage outside statutory limits come within the definition of spikes, and hence beyond the responsibility of the DNO *(i.e. Distribution Network Operator – Editor)*?

More specifically, is there any readily available device which will protect an entire domestic installation, rather than individual appliances or groups of appliances?

(From: "When lightning strikes" by Chris Tigwell, BSc CEng MIET, IET Power Engineer, Volume 20, Issue 5, October 2006, page 13, DOI: 10.1049/pe:20060512, Print ISSN 1479-8344, Online ISSN 1741-0517, at: http://digital-library.theiet.org/content/journals/10.1049/pe_20060512?crawler=true)

809) Turning-off IPhone was critical, say pilots citing interference

The regional airliner was climbing past 9,000 feet when its compasses went haywire, leading pilots several miles off course until a flight attendant persuaded a passenger in row 9 to switch off an Apple Inc. (AAPL) iPhone.

"The timing of the cellphone being turned off coincided with the moment where our heading problem was solved," the unidentified co-pilot told NASA's Aviation Safety Reporting System about the 2011 incident. The plane landed safely.

Public figures from U.S. Senator Claire McCaskill to actor Alec Baldwin have bristled at what they say are excessive rules restricting use of tablets, smartphones, laptops and other devices during flights.

More than a decade of pilot reports and scientific studies tell a different story. Government and airline reporting systems have logged dozens of cases in which passenger electronics were suspected of interfering with navigation, radios and other aviation equipment.

The FAA in January appointed an advisory committee from the airline and technology industries to recommend whether or how to broaden electronics use in planes. The agency will consider the committee's recommendations, which are expected in July, it said in a statement.

Laboratory tests have shown some devices broadcast radio waves powerful enough to interfere with airline equipment, according to NASA, aircraft manufacturer Boeing Co. (BA) and the U.K.'s Civil Aviation Authority.

Airlines Split

Even Delta Air Lines Inc. (DAL), which argued for relaxed rules, told the U.S. Federal Aviation Administration its pilots and mechanics reported 27 suspected incidents of passenger electronics causing aircraft malfunctions from 2010 to 2012. Atlanta-based Delta said it couldn't verify there was interference in any of those cases.

The airline industry has been divided. Delta said in its filing that it welcomes more electronics use because that's what its passengers wanted. United Continental Holdings Inc. said it preferred no changes because they'd be difficult for flight attendants to enforce.

CTIA-The Wireless Association, a Washington trade group representing mobile companies, and Amazon.com Inc. (AMZN), the Seattle online retailer that sells the Kindle e-reader, urged the U.S. FAA last year to allow wider use of devices. Personal electronics don't cause interference, CTIA said in a blog post last year.

10,000 Feet

Passengers' use of technology and wireless services "is growing by leaps and bounds" and should be expanded as long as it is safe, the Consumer Electronics Association, an Arlington, Virginia-based trade group, said in its filing to the FAA last year.

Federal Communications Commission Chairman Julius Genachowski agreed in a Dec. 6 letter to the FAA.

Broader use of on-board electronics would help providers of approved aircraft Wi-Fi services by letting passengers use them longer. Gogo Inc. (GOGO), based in Itasca, Illinois, says it has 82 percent of that market in North America, and Qualcomm Inc. (QCOM) on May 9 won permission from the FCC to proceed with a planned air-to-ground broadband service for Wi-Fi equipped planes.

The FAA prohibits use of electronics while a plane is below 10,000 feet, with the exception of portable recording devices, hearing aids, heart pacemakers and electric shavers.

Once a flight gets above that altitude, devices can be used in "airplane mode," which blocks their ability to broadcast radio signals, according to the FAA. There's an exception for devices that aircraft manufacturers or an airline demonstrates are safe, such as laptops that connect to approved Wi-Fi networks.

Inflight Wi-Fi

The potential risks from personal electronic devices are increasing as the U.S. aviation system transitions to satellite-based navigation, according to the FAA. In order to improve efficiency, planes will fly closer together using GPS technology.

As a result, interference from electronics "cannot be tolerated," the agency said last year.

While sticking with its prohibitions on use during some phases of flight, the FAA starting in 2010 issued guidelines allowing broader use of personal electronics.

Following techniques suggested by RTCA Inc., a Washington-based non-profit that advises the FAA on technology, airlines have been able to install Wi-Fi networks allowing passengers to browse the Web in flight.

No Tolerance

Four in 10 airline passengers surveyed in December by groups including the CEA said they want to be able to use electronic devices in all phases of flight. Thirty percent of passengers in that same study said they'd accidentally left on a device during a flight.

McCaskill, a Missouri Democrat, has called for lifting restrictions on non-phone devices such as the Kindle if passengers keep them in airplane mode, Drew Pusateri, her spokesman, said in an interview. The existing rules are “ridiculous,” she said. “I was aware from the research that’s been done that there has never been an incident of a plane having problems because of someone having a device on in the cabin,”.

The dangers from radio waves interfering with electronic equipment has been known for decades.

A fire aboard the aircraft carrier USS Forrestal in 1967 killed 134 people, when a rocket on a fighter jet accidentally fired after a radar beam triggered an electronic malfunction, according to a 1995 NASA review.

GPS Useless

Restrictions on U.S. commercial aircraft began in 1966 after research found some portable radios interfered with navigation equipment, according to the FAA’s request last year for comments on whether it should change existing rules.

In one 2004 test, a now-discontinued Samsung Electronics Co. wireless phone model’s signal was powerful enough to blot out global-positioning satellites, according to NASA. The device, which met all government standards, was tested because a corporate flight department had discovered the phone rendered a plane’s three GPS receivers useless, NASA’s researchers reported.

While incidents haven’t led to any commercial accidents and are difficult to recreate afterward, they continue to pile up. A log kept by the Montreal-based International Air Transport Association airline trade group recorded 75 cases of suspected interference from 2003 to 2009, Perry Flint, a spokesman for the group, said in an interview.

Ghost Theories

Peter Bernard Ladkin, a professor of computer networks at the University of Bielefeld in Germany, compiled similar accounts from pilots in Europe, he said in an interview.

“These are serious, conscientious pilots,” Ladkin said. “They know what they’re doing. They don’t subscribe to theories about ghosts or something.”

Damaged devices have transmitted on frequencies they weren’t designed for, according to David Carson, an associate technical fellow at Boeing who has participated in industry evaluations of electronics.

If those radio waves reach an antenna used for navigation, communication or some other purpose, it may distort the signal it’s supposed to receive.

Inflight Wi-Fi systems are safe in part because devices connect to them at low power levels, according to Carson, who was co-chairman of an RTCA panel that produced testing standards.

Devices searching for a faraway connection, such as a mobile phone trying to connect to a ground network in flight, send out more powerful radio waves, he said.

Pilots’ IPads

Airlines such as Delta and Alaska Air Group Inc. (ALK) have used the FAA guidelines to allow their pilots to carry Apple iPads to replace paper charts and manuals. McCaskill and others have used that as an example of why passengers should be allowed to use tablet computers during landing and takeoff.

One difference is that airlines don’t purchase tablet models that use connections through wireless phone networks. Similar devices used by passengers haven’t been tested for safety in the passenger compartment, Carson said. Plus, there’s no guarantee passengers will put the devices into airplane mode or the devices haven’t been damaged, he said.

“Something a passenger brings in, you don’t know if it fell in a mud puddle or they put a bigger battery in,” he said.

The RTCA group recommended against allowing passengers to use devices during taxi, landing and takeoff, Carson said.

The Association of Flight Attendants, the U.S.'s largest union for those workers, told the FAA last year that electronic devices should be stowed during those critical phases of flight, just as bags and purses must be.

Any decision should be based on science, not on politics or passengers' desires to stay connected, John Cox, a former airline pilot who is chief executive officer of the Washington-based consulting firm, Safety Operating Systems, said in an interview.

"The question is: Do we want to do aviation safety based on lack of testing and certification standards?" Cox said.

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To contact the editor responsible for this story: Bernard Kohn at bkohn2@bloomberg.net

(From: "Turning Off IPhone Critical to Pilots Citing Interference", Bloomberg, 13/08/2013, at: www.bloomberg.com/news/print/2013-05-15/turning-off-iphone-critical-to-pilots-citing-interference.html)

810) ESD bites the Blackberry

The Wall Street Journal recently reported that some models of the popular Blackberry wireless e-mail device have experienced ESD problems this winter. The paper reported that some users found that their units would shut off in cold weather, requiring a time consuming restart which interrupts the desirable "always on" operation and results in delayed e-mails.

Apparently, the problem isn't terribly severe as these things go. Research in Motion, the Blackberry's manufacturer, says it receives only a few complaints a week, which is a tiny fraction of its subscribers (RIM recently reported that the number of its subscribers broke the one-million barrier). Moreover, while either a reset or a trip to the unit's cradle is necessary to fix the problem, only time is lost – not valuable data, and the device is undamaged. Many of us who have worked with ESD problems have experienced a lot worse!

It is an unfortunate fact that in the winter environment very high electrostatic potentials can be generated *(when below-zero temperatures lower the humidity of the air to less than 25% - Editor)*. These voltages may substantially exceed the levels commonly called out in ESD standards. Careful design and testing to these standards provides some measure of protection, but, alas, there is no absolute guarantee in the real world.

(From: "ESD Bites the Blackberry", Conformity, April 2004. Unfortunately, the wonderful archive of Conformity magazine articles that a kind person kept on the web for some years after the demise of that magazine, is no longer available. However, there are various references to possible ESD problems with Blackberry phones on the 'crackberry' forum – try: http://forums.crackberry.com/blackberry-torch-9800-f209/strange-battery-activity-electric-shocks-807755/ and http://forums.crackberry.com/general-blackberry-discussion-f2/esd-bad-your-blackberry-418803/.)

811) Space dust suspected of causing EM pulses that disable satellites

A Stanford researcher claims to have discovered the reasoning behind why some satellites inexplicably fail without extensive or visible damage.

Although impacts with large space objects in space remain a potential cause, according to aeronautics and astronautics assistant professor Sigrid Close, the most likely cause of satellite failure is impacts from fast-moving micro-meteoroids known as "space dust" that turn into "a quasi-neutral gas of ions and electrons known as plasma" when they collide with other objects in space. Close theorized that this "plasma" has the potential to create an electromagnetic pulse that can damage and even completely disable any satellite it collides with.

"Spacecraft transmit a radio signal, so they can receive one that might potentially disable them," Close said. "So, our question was: Do these plasmas emit radio signals, and if so, at what frequencies and with what power?"

During experiments at the Max Planck Institute for Nuclear Physics in Germany, researchers fired dust particles at speeds of 60 km/s towards targets representing satellites. The

experiments confirmed that “when these particles hit, they create a plasma or quasi-neutral gas of ions and electrons, and that plasma can then emit in the radio frequency range,” Close said.

According to Close, the next step will be to prove that the effects occur similarly in space as they do in the laboratory, using an experiment being designed in cooperation with James Smith and Henry Garrett of NASA’s Jet Propulsion Laboratory.

Close believes that the discovery could help explain the loss of older satellites, such as the disappearance of the European Space Agency’s Olympus communication satellite in 1993, and could help to create design modifications that may better protect satellites from electronic systems failure in the future.

(From: “EMP Blasts Emitted by “Space Dust” Determined as Cause for Satellite Failure” by Aliza Becker, Interference Technology, 03/05/2013, www.interferencetechnology.com/emp-blasts-emitted-by-space-dust-determined-as-cause-for-satellite-failure. For more information, visit Stanford University: http://news.stanford.edu/pr/2013/pr-space-dust-threat-022613.html.)

812) An EMI-related safety accident in a gypsum mine

A gypsum mine bought some Intrinsically Safe [redacted] *(redacted – Editor)* handheld radios on 80MHz FM (principally because of their IP rating and rugged cases).

They accessed the mine via a surface drift which had a large cable winch installed at the top to assist the ascent and descent of Landrover personnel carriers and wheeled excavators up the 30deg incline. The winch was operated by pushbuttons on a cable pendant, the winch supervisor held the pendant whilst attaching or detaching the winch cable to the vehicle and there had been some incidents where the operator was nearly pulled into the winch drum.

So one handheld radio was fitted into a box and controlled the winch via tone filters, detectors and relays, the winch supervisor wore another radio fitted with up/down and stop/go buttons coupled to tone generators, and a portable unit was thrown into each vehicle as it coupled on to the rope.

The idea was that the winch operator and vehicle units had both to be generating a ‘go’ tone before the winch would move. All designed by an ‘electronics expert’ on the company staff.

The problem was that the tone detectors were simple band-pass audio filters followed by a diode detector and also that the nearby RAF station used 80MHz AM for their airfield security.

Then came a slight change in local BBC Radio 2 frequency, intermodulation between the RAF and Radio 2 frequencies landed on top of the winch receiver frequency, this is an FM radio so it would output lots of white noise in this situation, noise that would pass straight through the tone filters and cause the relays to operate.

To be really unsafe it required the winch operator to be cleaning the winch cable on the main drum at the same time as the RAF transmitted, but it did eventually happen – with awful consequences.

Of course it was the fault of the [redacted] *(redacted – Editor)* radios and the HSE Inspector took a lot of convincing otherwise, but eventually the system at the gypsum mine was issued with a prohibition notice……but the mining company did not think to apply it to all their installations, until it happened again.

(Kindly provided by Peter Burne, on the 13th September 2013.)

813) EMI Named as Cause in Ferry Crash Lawsuit

A 2011 ferry crash could be the result of inadequate electromagnetic shielding.

BC Ferries is suing a German manufacturer of ship control systems in connection with a 2011 incident in which a ferry rammed a dock in Nanaimo, British Columbia, Canada

The British Columbian ferry operator is seeking [1] at least $4 million in damages from SAM Electronics GmbH for the Dec. 20, 2011 crash at Duke Point, which injured seven passengers and nine crew members and required several months' worth of repairs.

In its court document, BC Ferries alleges that an isolating amplifier in the bow propulsion pitch control system, which controls the angle of the propeller blades, was not properly shielded against electromagnetic interference, resulting in the crash. In addition, the controls for the equipment were difficult to decipher and no audible alarm to warn the crew of danger was available.

An investigative report [2] released by Canada's Transportation Safety Board following the accident also said that the equipment malfunctioned, but added that the problem in the propulsion controls was missed because crew members did not follow proper procedures for testing the equipment before docking.

The ferry struck the Duke Point dock at a speed of approximately 5.6 knots, resulting in damage to both the vessel and the dock. The ferry was reportedly out of service for 23 days, while the dock was closed for repairs for three months.

BC Ferries has since implemented a variety of new systems and operating procedures designed to prevent similar accidents and better prepare the crew in the event of a problem.

[1] https://s3.amazonaws.com/s3.documentcloud.org/documents/997138/civil-claim-b-c-ferries-vs-sam-electronics-gmbh.pdf,
also https://www.documentcloud.org/documents/997138-civil-claim-b-c-ferries-vs-sam-electronics-gmbh.html

[2] http://www.tsb.gc.ca/eng/rapports-reports/marine/2011/M11W0211/m11w0211.pdf

(From a report of the same name by Aliza Becker on 12/23/2013 in Interference Technology's eNews magazine, www.interferencetechnology.com/ferry-crash-emi.)

814) EMI filters pass individual equipment tests, but resonate when in a system

Recently, a power system manufacturer and a customer (a major aircraft prime contractor to the military) collaborated in resolving an interaction problem in a complex system. A custom airborne PDU incorporated an EMI filter designed to meet the aircraft's EMI attenuation specification with adequate margin. The filter passed its lab test easily. The individual aircraft equipment items met their individual EMC requirements.

The combined aircraft equipment system showed some excessive EMI noise that should easily have been suppressed to within specification when buffered by the PDU filter. When the two systems were mated, the equipment was expected to meet the EMI specifications readily. Surprisingly, the EMI increased drastically and at a low frequency of about 45kHz (and at higher multiples of that frequency).

Individual systems were, on by one, cycled on and off to determine which was affecting the pattern. When the aircraft computer was shut down, the EMI disappeared. The aircraft computer had its own EMI filter to reduce the noise from its SMPS.

The investigation disclosed that the aircraft computer EMI filter was resonating with the power distribution unit's EMI filter at the problem frequency. The filter engineer was able to redesign the PDU EMI filter in the field and to move its resonance to a point where it would not resonate with the aircraft's computer filter.

These types of problems can occur whenever there are significant modifications to a complex system, and they require due diligence from the design team.

(From an article entitled "EMI considerations for Power Distribution Units" by James F McNulty, of Marway Power Systems, in Interference Technology's 2003 Annual Guide, www.interferencetechnology.com)

815) Low voltage LED string triggers shop's burglar alarm

There is a new comment on the post "The energy-saving LED bulb that switched off the radio". http://conversation.which.co.uk/energy-home/led-bulb-radio-interference-dab-test/

Author: Dave D Comment:

Interesting that this congo should resurface again: yesterday I went to my local electrical retailers for a few oddments and noticed that he had his managed alarm system engineer in, tinkering with the controls.

As I always have a chat with the proprietor anyway we got talking and after a while the alarm engineer came and asked to speak to Phil. The conversation as along the lines of:

"When did you first get these false alarms?" ... "about 3 weeks ago, about midnight" ....

"Does it happen every day?" ... "yes" ... "about the same time?" .... "yes" .....

"And always the same zone?" .... "yes" ..... "the shop windows?" ..... "yes"....

The engineer went away for a while and was poking around in the shop window and then came back to ask:

"It looks like you've recently had the lights changed over the window?" .... yes, that was about 3 or 4 weeks ago"....."what sort did you have before?" .... "Fluorescent tubes".....

The engineer went away again, and then came back.

"I think I've solved it, do your window lights automatically switch off late at night ?" ... "Yes, about 11:30ish"

"I think it's these new spotlights you've had in, the driver unit is near to the alarm cables and I think it's causing interference when it switches on and off"

"Why doesn't it set the alarm off when they switch on then?" ....

"What time do they come on?" .... "about 9:00 in the morning" ...

"And are you usually here before they come on?" ... "oh yes, about half an hour before" ...

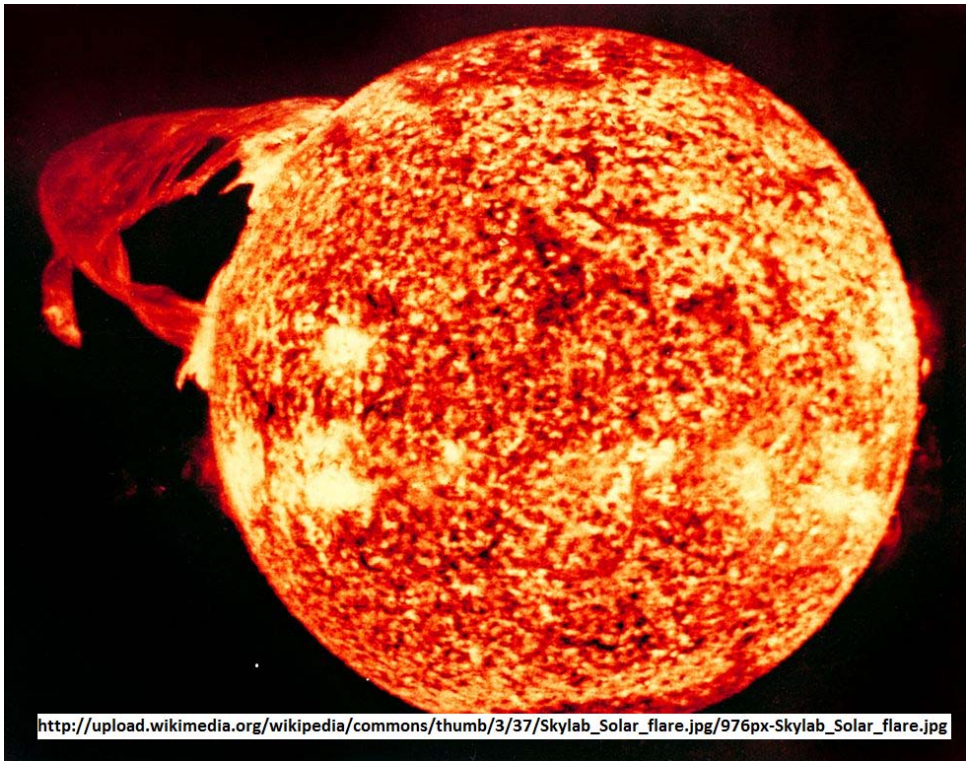
"So the alarm is not set when the lights come on ?" ..... "ah, I see what you are saying!"

Engineer and shopkeeper then locked shop door briefly, switched off window lights, set alarm and switched on window lights ..... sirens blaring, lights flashing .....

So it seems that the LED driver unit for the little low voltage LED track of lights over the window causes EMF (or EMI) triggering burglar alarms too.

(Kindly supplied by Richard Marshall, of Richard Marshall Ltd., www.design-emc.co.uk, on 5 November 2013. Which? magazine says "see all comments on this post here: http://conversation.which.co.uk/energy" but this is a list of hundreds of posts and I found it easier to go straight to http://conversation.which.co.uk/energy-home/led-bulb-radio-interference-dab-test – Editor.)

816) Satellites Need Better Shielding from Space Weather



Scientists are investigating the effects of extreme space weather on geostationary satellites with the intention of better preventing electronics failure.

In a new study published in Space Weather, researchers from the Massachusetts Institute of Technology (MIT) say that solar flares, geomagnetic storms and other forms of electromagnetic radiation may be to blame for up to 26 failures in eight geostationary satellites owned by London-based telecommunications company Inmarsat that took place over 16 years of operation.

Geostationary satellites orbit at the same rate as the Earth's rotation, which allows the satellites to maintain a constant location relative to the planet throughout their lifetime while providing access to television, Internet and communication services. Designed to last for up to 15 years, the satellites are heavily shielded to protect sensitive electronic components from solar radiation; however, say MIT researchers, over time radiation can penetrate the shielding and affect the performance of these components.

"If we can understand how the environment affects these satellites and we can design to improve the satellites to be more tolerant, then it would be very beneficial not just in cost, but also in efficiency," Whitney Lohmeyer, a graduate student in MIT's Department of Aeronautics and Astronautics, said. Lohmeyer and Kerri Cahoy, an assistant professor of aeronautics and astronautics, are working together to evaluate how sensitive satellite components are to the weather conditions in space, and how these conditions contribute to satellite failure.

Results from the study indicated that the majority of the Inmarsat satellite failures overlapped with periods of high-energy electron activity during declining phases of the solar cycle. The researchers believe that this particle flux may have accumulated in the satellites over time, creating internal charging that damaged the amplifiers responsible for strengthening and relaying signals back to Earth. While most satellites carry back-up amplifiers, says Lohmeyer, over time this supply may run out.

"Once you get into a 15-year mission, you may run out of redundant amplifiers," she said. "If a company has invested over $200 million in a satellite, they need to be able to assure that it

works for that period of time. We really need to improve our method of quantifying and understanding the space environment, so we can better improve design."

Today, engineers design satellites using radiation models to predict how much radiation a satellite in a particular orbital path may be exposed to during its lifetime. But these radiation models aren't perfect, says Cahoy.

"Space weather is a lot more dynamic than models predict, and there are many different ways that charged particles can wreak havoc on your satellite's electronics," she said. "The hard part about satellites is that when something goes wrong, you don't get it back to do analysis and figure out what happened."

As users continue to demand more capabilities, engineers will need to ensure that increasingly complex satellites remain adequately protected from solar radiation. Understanding the connection between space weather conditions and the effects on satellite components will help guide these design improvements.

(From "Satellites Need Better Shielding from Space Weather, Say Researchers" by Aliza Becker in Interference Technology's eNews magazine, 09/17/2013, www.interferencetechnology.com/satellites-need-better-shielding-from-space-weather-say-researchers. See more at: http://web.mit.edu/newsoffice/2013/space-weather-effects-on-satellites-0917.html.)

817) RFI team keeps LTE working

LBA Group, Inc. has announced its technical consultancy unit, Lawrence Behr Associates, Inc., has formed a highly-equipped, rapid response RF interference remediation team to meet the time-sensitive interference mitigation needs of wireless carriers and their customers.

"New LTE systems are very sensitive to interference from sources such as CFL bulbs, FM broadcast transmissions, utility supervisory control and data acquisition (SCADA) systems, and even rusty bolts," Chris Horne, PhD., LBA chief technical officer and leader of the new team, said. "LBA can not only find the source of interference but also help negotiate a solution if the interference source is coming from a third party."

(Taken from "RF Interference Remediation Team Keeps LTE Services Working" published as www.interferencetechnology.com/rf-interference-remediation-team-keeps-lte-services-working on 12/17/2013.)

818) ARRL petitions FCC to shut down BPL in Virginia

The American Radio Relay League (ARRL) has called on the Federal Communications Commission (FCC) to shut down a broadband over powerline (BPL) system currently being operated by ComTek Communications Technology for City of Manassas, Virginia.

The Manassas deployment of a high-speed internet BPL was formally launched last October, approximately one year after the FCC adopted new rules governing the deployment of BPL systems. Proponents of the Manassas system hailed it as "the first large-scale commercial BPL deployed in North America". But the ARRL and others have complained bitterly that the city's system has produced intolerable levels of interference with amateur radio operations, even during the two year trial period leading up to the system's official debut.

According to the ARRL, field tests conducted by both the US Department of the Navy and by radio amateurs located in and around the city have determined that the BPL system "was an interference generator at distances of hundreds of feet from modems on overhead power lines."

In its filing to the FCC's Office of Engineering and Technology (OET) and the agency's Enforcement Bureau, the ARRL argued that "whatever actions either Manassas Power or Communications Technologies Inc. might have taken to relieve the problem have not been successful…the system must be shut down, pending successful resolution of the severe interference."

(Taken from an article of the same name published in Conformity magazine, Jan 2006, www.conformity.com. In the UK, BPL technologies are more usually called powerline communications, PLC.)

819) Electromagnetic Radiation Powers Smartphone Case

A new smartphone case prototype on display at the Consumer Electronics Show in Las Vegas featured a unique way to signal an incoming call that makes use of the cell phone's electromagnetic radiation.

Concepter's Lune smartphone case detects when a call is being received based on the wavelength of the phone's GSM signal and alerts the user by illuminating a ring of green LEDs on the back of the case, using only the phone's electromagnetic field as its power source. The company reportedly declined to reveal the inside of the case or further specifics as to how it functions.

While the prototype case on display was made for an iPhone, Concepter is planning to make versions for other types of phones, as well as install differently colored LEDs for other notifications such as SMS messages. The company is expected to place the Lune smartphone case on crowdfunding website Kickstarter later this month.

(Taken from www.interferencetechnology.com/electromagnetic-radiation-powers-smartphone-case/, Video: VentureBeat, 01/13/2014, also see: http://venturebeat.com/2014/01/08/this-iphone-case-uses-electromagnetic-radiation-to-power-its-led-notification-lights.)

(The Editor says – This sort of thing has been tried before with LEDs that twinkled fitted to cellphone antennas, but they distorted the radiated energy and caused harmonics that were not compatible with the GSM emission standards – see Banana Skin No. 107 in "The first 500 Banana Skins" (available from www.compliance-club.com/BananaSkins.aspx and www.emcacademy.org/books.asp) where it says "Tests carried out by the Radiocommunications agency on two 900 MHz cellphones fitted with twinkling antennas showed that…..the ERP of the second harmonic…..exceeded the ETS 300 577 maximum".)

820) EMI problems and in-situ EMC testing

Performing EMC tests on large electronic equipment can be problematic especially if the EUTs can't be moved. It doesn't matter how large a test chamber may be, some EUTs must be tested in situ. Here are a few examples.

• New York City Hospital magnetic field susceptibility problem: This was caused by an underground subway passing adjacent to a neurosurgical operating room and turned out to be magnetic loop coupling from improper installation.

• RF emissions problems from an induction furnace used for annealing a moving 60-inch web of sheet steel: This turned out to be a radiation hazard issue.

• The tunnel radio system interference within Boston's Big Dig: This was an intermodulation problem.

• An Ohio coal-fired power plant control system susceptibility problem resulting from an instrumentation upgrade from vacuum tubes to solid state: One volt of noise on a 250-V plate supply is not nearly as much of a problem as it is on a 5-V logic device.

• Interference from an unattended telephone switching center in Iowa to local TV reception in a three-block radius when it was changed over from code switches to a computer-controlled digital switching system: More subscriber features, more subscriber problems.

In all of these cases, the system being tested is the combination of the installed EUT and its surrounding RF environment/equipment. Because the installed RF environment is part of the system, tests and examinations have to be done in situ; that is, tested in place. This often happens with large-scale system installations and generally is accompanied by the unexpected.

Everywhere you want to set up an antenna there is a wall, a column, a power line, a piece of equipment, and high-level RF signals that exceed the spec limit for the test. Plus in an industrial environment, the RF ambient always is changing, which makes it extremely difficult to determine what's the EUT and what's ambient.

(Taken from an article entitled "A Look at In Situ EMC Testing - Part 1" by Ron Brewer, EMC/ESD Consultant, in Evaluation Engineering magazine, November 2010, www.evaluationengineering.com/articles/201011/a-look-at-in-situ-emc-testing-part-1.php)

821) Bright Spark

When playing with a piezoelectric spark device from a lighter, I created a spark between it and a radiator and noticed two effects. Firstly, the room lights flickered – the dimmer switch for my lights was partly on and this may be a factor. Second, when I produced the spark, it caused the computer to think that the devices plugged into its USB ports had been removed. Is there any reason for these effects?

(A question posed by Ben Phoenix, in the Last Word column on page 65 of the New Scientist magazine, 14 December 2013, www.newscientist.com/topic/lastword. Yes there is! – Editor.)

822) South-East England in danger of blackouts

Eaton Power Quality's latest Blackout tracker report has shown that the South east of England suffered more power blackouts than any other region in the UK in 2011.

The annual report, which is now available via www.eaton.com/blackoutuk, uses reported power outage information from news services, newspapers, websites and personal accounts to analyse the impact of power outages in the UK.

According to Eaton's research, power outages in the UK have a major impact on businesses and can cause significant productivity and financial losses each time they occur. Over 33% of companies take more than a day to recover and monetary losses range between £12,676 and £316,900. The research also found that 90% of companies that experience a computer disaster and don't have a survival plan, go out of business within 18 months and 15% of businesses experiencing power outages lose over £1.2m.

Eaton's Paul Norgate commented, "The report demonstrates that the best way for businesses to protect themselves is to develop a power protection plan which will help mitigate against the significant losses a power outage can bring. UPSs play a key role in this plan because they effectively offer a form of insurance against power failures. However, like any hardware, it is important to ensure that the specification of the product you use is up to date and therefore ready to cope with the challenges posed by both today's, and tomorrow's, potential outages."

(Taken from the article "South east England in danger of blackouts", in Electrical Engineering magazine, June 2013, www.connectingindustry.com/electricalengineering.)

823) New defibrillators suffer EMI that could threaten patients' lives

Your email reminded me of exactly the sort of problem that you predicted, but was a real threat to the patient's life rather than just the nuisance I described earlier.

My hospital has just got lots of new defibrillators. A patient in the cardiac catheterisation laboratory was having an arrhythmia investigated using a mapping system that used an electro-magnetic positioning system to say where the intra-cardiac catheter was. A ventricular tachycardia was deliberately induced.

When the new defibrillator was switched on, it failed its self check. Subsequent investigation showed that the electro-magnetic positioning system was the cause. Similar models also failed. Older defibrillators did not have the same fault.

Fortunately for the patient, overdrive pacing resolved the arrhythmia as our efficient Medical Physics Department had removed the older defibrillators, which were immune to interference.

The incident is being investigated and you may hear about it through other channels.

(An email to the UK's medical standards BSI committee, from Dr David H T Scott, Pask Certificate of Honour, Consultant Cardiothoracic Anaesthetist and Intensive Care Specialist, Department of Anaesthetics, The Royal Infirmary of Edinburgh, EH16 4SA, reproduced here with his permission. **Note:** *Dr Scott retains the copyright of this text, please contact him at david.scott@ed.ac.uk if you wish to copy or re-use it.)*

824) Real-world transients in automotive power networks are seldom like test specifications

An example of a common problem is simple everyday inductive kickback.

In both theory and in practice, most DUTs that withstand these kinds of immunity test won't have problems once they are built into the vehicle.

However, real-world switching pulses are seldom exactly like the narrowly-defined pulses defined in ISO 7637 or the OEM specifications. Thus, during vehicle-level testing some DUTs that have previously been found to conform to the immunity tests defined therein, experience problems during pulses found in the actual vehicle.

(Taken from the article "Designing an automotive pulsed immunity network" by Tim Horacek of Teseq, in EMC Test magazine, Nov 2012.)

825) Live 4G-Freeview Interference Tests Suggest Better Performance Than Expected

A trial 4G network installed near Birmingham, UK has reportedly performed better than expected, alleviating fears over initial reports released late last year suggesting that up to 2.3 million homes could be affected by interference with the Freeview TV signals.

A total of 15 out of 22,000 households reported issues with their television signals that were determined to be related to interference. All issues were mitigated with the installation of a filter to block 4G signals at 800 MHz. Freeview services utilize the 700 MHz spectrum range.

A second, larger test covering 170,000 households and businesses will take place in southeast London early next week.

"These larger tests are essential to help improve our forecast model and the way we'll tackle potential issues caused by 4G at 800 MHz. We are extremely grateful to viewers in southeast London for their help with these important tests," Simon Beresford-Wylie, chief executive of at800, said.

Households experiencing interference with their television signal during the test are asked to contact at800.

(Taken from an article by Aliza Becker posted as www.interferencetechnology.com/live-4g-freeview-interference-tests-suggest-better-performance-than-expected, on 04/11/2013.)

826) Dutch Cable Companies Blame 4G for TV Interference

Cable companies in the Netherlands are claiming 4G wireless networks may be affecting their television broadcast signals.

Certain frequencies used by the fourth generation mobile network technology are also employed by television broadcasters to deliver content over cable, the Netherlands Broadcasting Foundation (NOS) said this week. There have been complaints in some cities about problems with both local and international channels.

Cable customers are reportedly being advised to get better insulated cables to reduce the potential of interference, which could get worse as 4G services expand to more areas of the country, NOS said.

The first 4G services were rolled out in the Netherlands in 2012.

As the wireless technology market continues to grow, interference between TV signals and wireless networks will only increase. In the UK last year, concern over a nationwide 4G network installation stemmed from initial reports that suggested (see article below) up to 2.3 million homes with Freeview cable television service could be affected by interference, while in December customers of Time Warner Cable linked blurry, distorted television screens to nearby use of the Verizon LTE service.

(Taken from an article by Aliza Becker, posted as www.interferencetechnology.com/dutch-cable-companies-blame-4g-tv-interference on 02/12/2014.)

827) Interference with railway track circuits causes rail accidents

In general, the track circuit transmitter of AC railways is fed by DC (Sweden), even harmonic (100 Hz, 6th harmonic of 16 2/3 Hz supply, Switzerland) or inter-harmonics (105 Hz, used in 16 2/3 Hz fed traction system, Norway) and that for DC railways use AC at various frequencies. In some railways, the audio frequency ranges are also used (9.5-14.5 kHz [2]).

The basic assumption behind selecting this type of source as transmitter is that in AC traction system, there will be no DC or even harmonic components and in DC railway, there will be no AC component. Since audio frequency track circuit uses a band quite high compared to the power frequency and its lower order harmonics, it was also assumed that there can not be any interfering high frequency current components at that band originating from the traction power sources. However with time, interference issues were noticed and reported by railway engineers and there have been reports of accidents as well because of the false signalling triggered by the interference between the return current of the train propulsion system and the tracks circuits [78]. In Chapter 5, the presence of DC components and even harmonics because of the arcing in the pantograph is explained. This interfering current could be from other sources like the power electronic drives of the train propulsion system, geomagnetic induced current, interference from track side non railway sources, nearby railways or presence of neighboring industries etc. The false signalling can be classified as [15]:

— False occupancy – Where the signalling system will falsely display red light even if there in no train and

— False unoccupancy – Where a false green light will be displayed (Fig.7.4) although there is a train on the track.

False occupancy is comparatively more common and can lead to reduced reliability, service interruption and delay in operation. false unoccupancy is quite rare, but can result in collisions and accidents which could be disastrous.

As shown in Figs. 1.6(a) and 1.6(b), the track circuit relay coil has to be energized for a green signal and de-energized to make a red signal.

If it is somehow de-energized because of interference current, it will lead to false unoccupancy as shown in Fig. 7.4 and vice versa. For this to happen, the interference current should have the same frequency content as the transmitter and same signal characteristics. As discussed in Chapter 5, the pantograph arcing distorts the current waveform which contains a wide band of harmonic contents, including DC components, even harmonics and inter-harmonics. In general the resulting interference reduces the operational reliability of the functioning of the track circuit.

However to cause interference which may trigger false signalling with the track circuit, the signal characteristics should be identical which is quite uncommon because of different signal processing techniques used in track circuits (modulations techniques coding/decoding etc.).

[78] T. Konefal, D. A. J. Pearce, C. A. Marshman, and L. M. McCormack, \Potential electromagnetic interference to radio services from railways," Final Report, Mar. 2002. [Online]. Available: http://www.yorkemc.co.uk/research/railways.

(Taken from "Conducted and Radiated Electromagnetic Interference in Modern Electrified Railways with Emphasis on Pantograph Arcing", the Doctoral Thesis by Surajit Midya, Doctoral Thesis in Electrical Systems, Stockholm, Sweden 2009, Electromagnetic Engineering, KTH Electrical Engineering, SE-100 44 Stockholm, Sweden, www.etk.ee.kth.se, TRITA-EE 2009:029, ISSN 1653-5146, ISBN 978-91-7415-345-3.)

(Editor – Did you notice the sentence: "For this to happen, the interference current should have the same frequency content as the transmitter and same signal characteristics." Like many (but not all!) engineers in the railway industry, this author assumes that only direct interference can occur – ignoring the possibilities for demodulation and intermodulation to cause interference – also see number 570.)

828) Recent adverse events related to EMI in hospitals in Östergötland, Sweden

Trends

• More and more departments want to use mobile phones in close proximity.

• Manufacturers offer more and more systems that use wireless datacommunications.

• Patients want to use smartphones, computers and video games during treatment.

• The use of energy efficient solutions increase (lights...).

Immunity

• [redacted] (and [redacted]).

• Alarm code 33 intermittent in OR.

• Long time test by DCE (Department of Clinical Engineering) – no alarms.

• Alarm can be triggered by diathermia.

ESD (28/02/11)

• Pulse oximeter.

• Several models of [redacted] experience repeatedly circuit board failure.

• Display shows ERR SpO2.

• Repair by the manufacturer.

• The fault is still present. The manufacturer then adds a little metal part on the connector so the user may be discharged.

• One of the devices sometimes restarts.

• DCE finds that the problem with restart can be repeated by a contact ESD discharge.

• Several units have had this problem.

Emissions (08/07/11)

• When changing the position of the [redacted], [redacted] medical bed, the humidifier ([redacted]) alarms. The two alarms indicates problems with the power supply. The alarms stops but the temperature drops from 37º C to 32º C. It takes a long time to rise the temperature to 37º C again. As a result there is much more water collected in the expiratory tube and the respiratory device filter gets filled with water and needs to be change more often than the usual (1 time every 24 h).

• The investigation shows that the problem occurs when the new [redacted] heat cable ([redacted]) is used. The problem does not occur with the old cable ([redacted]).

• The event is not related to humidifier, bed or location, it can be repeated no matter what combination is used.

• The failure can also be repeated even when the equipments are connected to different electrical mains groups.

• The failure can also be repeated in another part (location) of the hospital.

• The only common cause is the new heat cable ([redacted]).

Mobile phone interference (30/05/11)

• Mobile phone interference with patient monitor system ([redacted]).

• Four children in neonatal intensive care emergency room with full monitoring.

• When a parent's mobile phone started to ring all monitors stopped working.

Distorted saturation readings (16/10/10)

• During several occurrences during the night all three patient monitors shows a pulse of 220-250 on the pulse oximetry but normal pulse on the ECG. Control shows normal pulse but the monitor continues to show very high values.

• During the incidents it was observed that a relative was using a 3G modem to connect to the internet instead of using the patient LAN.

ECG disturbance (27/09/10)

• [redacted] patient monitor [redacted] module.

• Interference in the patient monitoring ECG in operation room.

• ECG monitoring is not working correctly. Lots of disturbance and signal only in one lead. We changed all equipment but with no success.

Alarm problem 2006

• Anaesthesia workstation [redacted].

• No sound alarm from the monitor part, disturbance on [redacted] monitor. The alarm sound is very weird during testing. A mobile phone was observed 2-3 m from the anaesthesia workstation.

Telemetry drop outs (present)

• New 2.4GHz telemetry in cardiology department, suffers intermittent drop-outs.

(Copied from "Recent known adverse events related to EMC in Sweden", by Magnus Stridsman, MSc, Safety Manager, Department of Clinical Engineering, County Council of Östergötland, Sweden, which he presented at the meeting of IEC SC62A MT23, held in Carlsbad California on 19-23 March 2012 (MT23 is the IEC Maintenance Team responsible for IEC 60601-1-2: Medical electrical equipment – Part 1-2: General requirements for basic safety and essential performance – Collateral standard: Electromagnetic disturbances – Requirements and tests, which was published at Edition 4 in February 2014. The names of the medical equipment manufacturers and model numbers concerned have been redacted.)

829) Detecting where IEMI attacks are coming from

Electromagnetic fields can interfere with or damage electronic devices. Electromagnetic radiation is invisible to people. A new measuring instrument can now determine the strength, frequency, and direction of the attack.

The researchers there (at the Fraunhofer Institute for Technological Trend Analysis INT – Editor) are concentrating on the question of how EMP attacks can be detected. They have developed a measurement instrument for this purpose that is capable of determining the strength, frequency, and direction of electromagnetic attacks. The engineering requirements are steep: the detector must measure very high field strengths from very short pulses, yet not be destroyed or damaged itself.

Identifying the type, location, and duration of the attacks

Four specialized antennas make up the INT demonstration instrument that sample the environment around the subject device to be protected. Each of these covers a quadrant of 90 degrees and detects all types of electromagnetic sources. A high-frequency module preconditions the signals for measurement and determines when the electromagnetic pulse started and stopped.

A computer in a monitoring station connected via an optical conductor then calculates the values for the signal and presents them on a screen. “We identify the type and location of the source of the invisible attack as well as its duration as though we had a sixth sense. Those affected by the attack can use this information to mount a rapid and appropriate protective response,” explains Jöster.

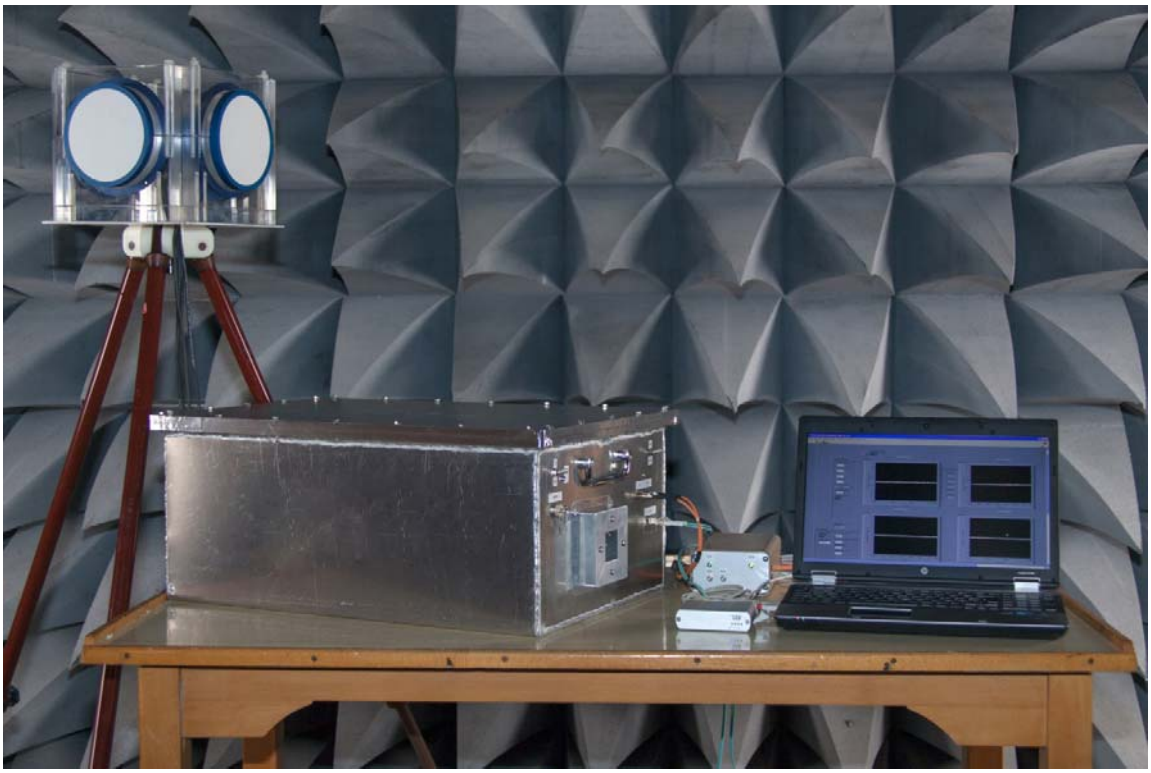


Figure: Tools for defending against electromagnetic attack (right to left): an antenna set (on tripod) for sensing the environment, a RF measuring device for conditioning the signals and a computer that calculates the relevant data.

The threat scenarios are real: criminals disrupt computer networks of banks, exchanges, and companies. They cause confusion in order to bypass monitoring points or overcome alarm systems, enabling them to penetrate into secure areas. Individual cases of these kinds of attacks have already been documented: thieves used electromagnetic waves to crack the security systems of limousines in Berlin. Their weapons are no larger than a suitcase. High-power microwave sources are suitable for those kinds of attacks, for example. Depending on the field strength, the attacker using these high-power microwaves can be located several meters from the target of the attack. “Located In the right position, it is enough to press a button to trigger the pulse. Just like in Ocean’s Eleven or Matrix, the electronic systems nearby can fail or be damaged,” as Jöster describes the danger.

Electronic devices can withstand a certain amount of radiation. This is measured in volts per meter (V/m) – called the electromagnetic compatibility (EMC). Otherwise, they would not operate reliably. Every device could interfere with others in its immediate vicinity. Depending on the category of usage, they therefore have to fulfil specific EMC requirements. These are significantly higher for industrial applications than for common things like Smartphones, televisions, or stereo equipment.

One example where safety is important is automotive engineering. “The importance of electronic components will continue to increase in the future. Completely shielding individual

devices from electromagnetic radiation would certainly be theoretically possible, but much too expensive though. Systems are needed that can detect these kinds of attacks. If you know what is attacking, you can also react correctly to it," according to Jöster.

(Taken from "Defending against electromagnetic attacks" by Michael Jöster of the Fraunhofer Institute for Technological Trend Analysis INT in Euskirchen, just south of Cologne, Germany, in Research News Dec 02, 2013, www.fraunhofer.de/en/press/research-news/2013/december/Defending-against-electromagnetic-attacks.html. This was also reported in an article by Eliza Becker, in Interference Technology's on-line newsletter on 12/03/2013, at www.interferencetechnology.com/new-tool-detects-traces-electromagnetic-attacks. IEMI is the IEC 61000-5-1 acronym for Intentional Electromagnetic Interference.)

830) Always ask, even if the answer seems obvious

Oops – a repeat of number 746, sorry!

831) Exploding harmonic filter capacitor causes Queen Mary 2 to drift for 1 hour

SYNOPSIS

At 0425 on 23 September 2010, as RMS Queen Mary 2 (QM2) was approaching Barcelona, an explosion occurred in the vessel's aft main switchboard room. Within a few seconds, all four propulsion motors shut down, and the vessel blacked out shortly afterwards. Fortunately, the vessel was clear of navigational hazards and drifted in open sea.

The emergency generator started automatically and provided essential supplies to the vessel, and it was quickly established that the explosion had taken place in the aft harmonic filter (HF) room, situated within the aft main switchboard. The aft main switchboard was isolated, main generators were restarted and the ship was able to resume passage at 0523, subsequently berthing in Barcelona at about 0900. No one was injured.

The accident caused extensive damage to the aft HF and surrounding structure. Two water-mist fire suppression spray heads were activated, one in the aft harmonic filter room and the other in the aft main switchboard room.

The explosion was triggered by deterioration in the capacitors in the aft HF. Internal arcing between the capacitor plates developed, which vaporised the dielectric medium causing the internal pressure to increase, until it caused the capacitor casing to rupture. Dielectric fluid vapour sprayed out, igniting and creating the likely conditions for an arc-flash to occur between the 11000 volt bus bars that fed power to the aft HF.

A current imbalance detection system, which was the only means to warn against capacitor deterioration, was found to be inoperable, and it was evident that it had not worked for several years.

The electrical disturbance from the capacitor failure caused its circuit breaker to open and isolate the aft HF from the electrical network. It was not possible to determine the exact cause of the subsequent blackout because the option for storing historical data concerning blackouts was not chosen at build. However, it is considered most likely that the disruption within the aft HF at the time of the accident caused general instability in the electrical network which could not be contained and led to the generators shutting down.

Lloyd's Register (Europe, Middle East and Asia) (LR) has been recommended to take forward proposals to the International Association of Classification Societies to:

• Establish a requirement for all new vessels fitted with harmonic mitigation equipment to model the effect of its loss and provide data to crew so that appropriate corrective action can be taken in such circumstances.

• Require on-line or periodic monitoring of harmonic distortion of voltage on all vessels with high voltage power systems to give early warning against potential problems.

• Develop requirements to detect and mitigate against the failure of high-energy storage devices and to ensure that protection devices of critical items are fail safe.

The Maritime and Coastguard Agency has been recommended to produce specific guidance regarding the harmful effects of excessive harmonic distortion in electrical networks and to update the Code of Safe Working Practices for Merchant Seamen to raise awareness about the hazards of arc-flash in high voltage equipment.

QM2's manager, Carnival UK have also been recommended to: improve the standards of protection against the effect of harmonic distortion and component failure; and, to review the machinery alarm systems fitted to QM2 in order to identify and prioritise those alarms which indicate failure conditions that could significantly affect the safety of the vessel.

RMS Queen Mary 2. Photo courtesy of Jörn Prestien.

(Extracts taken from: "Report on the investigation of the catastrophic failure of a capacitor in the aft harmonic filter room on board RMS Queen Mary 2 while approaching Barcelona 23 September 2010. VERY SERIOUS MARINE CASUALTY REPORT NO 28/2011 December 2011" available from http://www.maib.gov.uk/publications/investigation_reports/2011/qm2.cfm, along with a set of Annexes. Editor – I find it interesting that they had a procedure for checking and recording the current monitors on the harmonic filter capacitors, but no procedure for what to do when their readings were wrong!)

832) Radar interfered with early pacemakers

Dan Hoolihan: Also I think you mentioned to me that in your career you did some work with pacemaker companies and, in general, what kind of testing did you do on those and what kind of results were you looking for?

Jim Toler: Okay. Our introduction to that came through a company called Cordis, a pacemaker manufacturer in Miami, that I am not sure is still in business. But a Dr. Peter Harjean came to Georgia Tech looking for help. His concern was the possibility that pulsed radar systems might, in some way, alter the pulse of an implanted pacemaker. So, Peter made it possible for me to go to a number of medical conferences and meet pacemaker manufacturers. He took me there and introduced me to them. They, then, began to bring their pacemakers to Georgia Tech for EMI or EMC evaluations.

We struggled with how to test them. Out in just the air is not anything close to their normal installation location. So we devised a solution of saline to kind of represent, at least a composite, of body tissues and put them in a saline solution and put the lead out horizontally. We had a number of different high-powered radar systems at Georgia Tech so we exposed them to that environment in that kind of a solution. Interestingly, the first test involved a unit that was the largest — world's largest — sales unit. In terms of sales volume it was the world's best pacemaker. When we turned on the first radar, the pulse rate of the radar altered the pulse rate of the pacemaker.

Dan Hoolihan: Not so good.

Jim Toler: So we began working then with pacemaker design as well as pacemaker testing. The design problems were not overpowering, they basically involved conventional filtering and shielding, but it had to be done in a biologically compatible [way] with tissue. That all had to be a consideration. So, we wound up with a rather extensive testing program for pacemaker manufacturers, both here and abroad. It was a learning experience for all of us and I made some very good friends in the process.

Dan Hoolihan: Did you also, then, get involved with the, for example, microwave oven issue? Microwave ovens and pacemakers?

How was your research with radars related to that?

Jim Toler: The microwave oven is, of course, a continuous wave field, not a pulsed wave field. So we had suspicions from the beginning that their effect might not be as great from microwave ovens. Although, those were the things that were feared at the time. But, we had an array of microwave ovens, and the tests began with the door closed. Then the door was opened by a certain amount and radiation levels went up, of course. Then opened by more and more. And pacemakers weren't, generally, interfered with by microwave ovens. We pretty well proved that and established that point and relieved some of the concern with the microwave oven exposure. It was a public concern at the time, but not so much from technical or engineering point of views.

(Extracts taken from: "Interview with Jim Toler at the 2013 IEEE International Symposium on EMC" by Dan Hoolihan under the pen name "Espresso Engineering", published in the 2014 IEEE Electromagnetic Compatibility Magazine – Volume 3 – Quarter 1, available from http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6798791)

833) Pennsylvania Voting Machine Malfunction EMI Related?

The recent election night proved to be a test for even the most determined voters. In addition to the long, slow-moving polling lines and the haphazard solutions put hastily into place for hurricane-ravaged areas of the Northeast, voters were also subjected to electronic voting machine malfunctions in several states across the country. In Pennsylvania, a voting machine was "taken out of service" after a YouTube video published by user "centralpavote" revealed the machine's touch screen incorrectly registering votes for President Barack Obama as votes for Republican presidential candidate Mitt Romney.

The video submitter explains in the description section for the video that he attempted to select the checkbox beside President Obama's name several times and each time, Romney's name was highlighted instead.

"Being a software developer, I immediately went into troubleshoot mode. I first thought the calibration was off and tried selecting Jill Stein to actually highlight Obama. Nope … I asked the voter on either side of me if they had any problems and they reported they did not," he said.

According to Alfred Poor, a display technology expert and a contributing editor with Information Display, many electronic devices equipped with a touch screen utilize a technology known as "projected capacitance" that relies on the build-up and exchange of an electrical charge between two conductors and "the fact that an electromagnetic field 'projects' above the plane of the conductive sensor layer."

Even covering the touch module with a sheet of glass will not inhibit its ability to sense when a conductor is near. Poor explains that "when you touch the screen with your finger, it steals a little of the charge from each layer of conductors at that point … because each conductor is checked separately, it is possible to identify multiple simultaneous touch points."

However, Poor cautions that the system of conductors "is susceptible to electrical noise from electromagnetic interference" and can misread which signals are from actual touch points, resulting in possible unintended performance of the electronic device.

At this time, officials have not determined the cause of the electronic voting machine malfunction in Pennsylvania.

(Taken from www.interferencetechnology.com/pennsylvania-voting-machine-malfunction-emi-related, 11/08/2012. For more information, visit The Raw Story: www.rawstory.com/rs/2012/11/06/pa-voting-machine-taken-out-of-service-for-flipping-votes-to-romney-report and PC Advisor (http://www.pcadvisor.co.uk/news/digital-home/3405657/how-it-works-technology-of-touch-screens/).

834) LED street lamps interfere with TV and radio in Japan

Actually, in 2010, poor reception of analogue TV and audio broadcasting occurred after LED lamps were installed in a shopping street in Japan [2] .

(Taken from "Measurement and Modelling of Electromagnetic Noise from LED Light Bulbs" by Y Matsumoto et al in the 2013 IEEE Electromagnetic Compatibility Magazine – Volume 2 – Quarter 4, available from http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6714699. Reference [2] is [2] S. Kanno, N. Hirasawa and Y. Akiyama, "A study on the correlation between common mode voltage measured by using CDNE and radiated electromagnetic field strength emitted from LED bulbs>>, IEICE Tech. Rep., EMCJ 2011-12, pp. 13-17, Dec. 2011".)

835) Good reasons for using fibre-optical cables to solve industrial EMI

Fiber optic solutions are immune to electromagnetic interference (EMI), spikes, surges and ground loops. The data isn't traveling along a copper wire; it's carried by a beam of light. This is invaluable in industrial applications, for example, where the electric motors on the machinery can generate powerful magnetic fields. Wi-Fi and cellular networking confer similar advantages.

But remember that extending your data communications range via copper wire increases the risk for unwanted electrical events. The greater the distance between connected devices, the more likely it is that they will have different building ground references and the associated risk for ground loops. If the cable is installed in an industrial environment and passing machinery along the way, greater range also creates more opportunities for EMI.

Copper wire networks should be protected with surge suppression and isolation. Surge suppressors limit spikes between the signal and ground line and should be deployed as a first line of defense on power supply lines. Current models can be DIN rail mounted or connected directly to a cabinet, with surge protection ratings of up to 39 kA and less than 1 ns response time.

But when the ground line rises, as it does in ground loop events, you'll need isolation. Isolators convert data signals either to pulses of light or an electrical field, and then back again. Spikes

and surges are stopped at the isolation zone. Isolators protect power lines by transforming VDC power to AC, then back again.

(An extract from: "Five options to extend reach of your Ethernet network" by Mike Fahrion, who is the director of product management at B&B Electronics www.bb-elec.com, published in the Industrial Ethernet Book Issue 79 / 46, November 2013, pages 36-37, available at http://www.iebmedia.com/index.php?id=9869&parentid=63&themeid=255&hft=79&showdetail=true&bb=1.)

836) US Navy problems with EMI in 1955

Radiofrequency interference (RFI) is caused by some machine tools and portable tools, as well as by induction heaters and RF stabilized arc welders. The newer types of electronic-controlled machine tools can be the victims of RFI. It is a coming problem in the metalworking field, and forebodes trouble for those who ignore the possibilities. Although there has been much work done on interference for many years, the machine-tool phase of RFI started about 1½ years ago…

By the time radio interference from welders and induction heaters became a recognized and fairly well controlled problem, Navy engineers working with highly sensitive receiving equipment found that something was still causing trouble.

Interference can be generated by any number of electrical disturbances – both natural and man-made. But this specific interference was traced to certain kinds of electrical equipment associated with some machine tools.

MANY FORMS

Interference can take many forms, and can be caused by a wide range of electrical devices, including regular radio broadcasting and receiving equipment. However, there are few cases where broadcasting stations or amateur transmitters are major offenders because each is assigned its own frequency or band on which to operate. If the station strays, the operator is sure to hear about it.

The source of most of the trouble caused by machine tools is from electrical devices which produce current surges that radiate on frequencies used by regular broadcasters or the Navy.

These can be sparks between switch contacts, hums from induction mechanisms, static from buzzers, and other similar racket. Much of this is simply side effects from the mechanisms; not particularly desirable to the machine owner, but doing (he may think) no harm.

But it does. Generated RFI is transmitted like a regular radio signal, and can be received by regular radio equipment.

DISTANT DISRUPTION

An interference signal from an industrial plant may ruin ground-to-air communications at an airport many miles away. The pilot of a plane using ILA (Instrument Landing Approach) or GCA (Ground-Controlled Approach) would be helpless if uncontrolled interference were to blanket out his communications.

There is one case on record, among many, where an electronic device in an Oregon plant disrupted air-to-ground communications in Georgia.

SPARKING

Most "electrical noise" is caused by sudden changes in the flow of electricity, sparking, or current surging – which often produce undesirable effects. If sparking is designed out of the system, control devices can be simplified.

One good example of this is in fluorescent lamp starters, long a source of erratic RF noise and a product that needed improvement. One small company, working on fluorescent lamp designs,

developed an improved and RFI-free lamp fixture. It was found that lamps in this design lasted several times as long as ordinary fluorescent lamps and the company now sell them for applications where interference is undesirable.

Interference is not just a Navy problem, although the Navy has done considerable research on the subject and is relatively well informed. The problem of interference affects many industries and many kinds of equipment.

CURRENT SURGES

For example, the Navy found that some of their computers came up with impossible answers to problems. After a lot of digging around, they found that arcing fluorescent lamps were sending current surges back into the power line, where they were picked up by the computing machines and added into columns of figures. The computing machines were what might be called extremely vulnerable in this case and it has been possible to redesign their control systems so that they do not pick up line interference and convert it into false answers.

There is a silly side to RFI, too. A New York paper reported that a hotel guest was almost convinced his room had a ghost. Actually, his hearing aid was picking up a radio call for a bellboy, sent out by the inside radio system at the hotel.

The hearing aid should not have been able to receive radio calls – it is supposed to be an amplifier, and no more. No doubt, it has long since been repaired and adjusted.

(Extracts taken from: "Radiofrequency Interference—A Problem of Automatic Machine Control" by Charles D. Emerson, Associate Editor, American Machinist and Leonard W. Thomas, Interference Reduction Section, Bureau of Ships, from Bureau of Ships Journal, May 1956, as adapted from American Machinist, November 7, 1955 – as republished in "Quasies and Peaks" in the 2013 IEEE Electromagnetic Compatibility Magazine – Volume 2 – Quarter 4, available from: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6714693.)

837) Effects of RFID emissions in Health Care

By early 2009, the auto-ID industry association hopes to publish a set of methodologies that can be used to determine the impact of tag and reader transmissions on medical devices, drugs, blood and human physiology.

"There have been a number of different studies or tests done [studying the effects of RF in health-care settings]," says Dan Mullen, AIM Global's president, "and to the members of the REG's credit, we have decided to create a set of test protocols that are repeatable and consistent that the industry can look at and use to determine whether there are any concerns or issues."

Mullen cites several studies unveiled in July—particularly one conducted by researchers at Indiana University Purdue University Indianapolis (IUPUI) and by RFID consulting and systems integration firm BlueBean, and another conducted by researchers at the University of Amsterdam's Academic Medical Center in the Netherlands as part of a government research project, and published in the Journal of the American Medical Association (JAMA).

Both studies examined whether electromagnetic radiation from RFID systems would disrupt infusion pumps, EKG monitors and other medical equipment. Their findings, however, differed. The IUPUI/BlueBean study discovered no problems with electromagnetic interference (EMI) (see New RFID Study Finds No Interference With Medical Devices), while the Dutch study did find incidents of EMI by RFID on critical-care equipment in a non-clinical setting (see Researchers Warn RFID May Disrupt Medical Equipment).

"At a certain point, we realized we needed to do something about this," says Craig Harmon, the REG chairperson, and president and CEO of Q.E.D. Systems. Harmon says he and others had received a number of calls regarding the IUPUI/BlueBean and University of Amsterdam studies, and that industry concern greatly spurred action by AIM Global. The organization initially felt the

U.S. Food and Drug Administration (FDA) should lead the effort, but later changed its mind upon meeting with FDA representatives who acknowledged such an initiative could take two or three years.

"We can't afford to wait that long," Harmon says. "I'm not aware of anyone who is saying RFID is being banned in hospitals, but I have heard—and this is more rumor than being able to point to one specific example—that some health-care organizations are delaying the use of the technology."

The REG will develop three test protocol suites: one for medical devices (implantables and wearables); a second for clinical instrument susceptibility; and a third for pharmaceuticals, biologics, blood products and human physiology. The protocols will initially focus on radio frequency identification systems based on any of 11 different RFID standards, including ISO 11785 (which employs the 125 kHz frequency band), ISO 14443 and ISO 15693 (13.56 MHz), and ISO 18000-6C and EPC Gen 2 (860-960 MHz), as well as IEEE 802.11, or Wi-Fi (2.45 GHz).

To accomplish its mission, the REG will collaborate with three leading universities in the field of RFID: Georgia Institute of Technology, the University of Pittsburgh and the University of Texas at Arlington. The group hopes to have test protocols ready in the next six months or so, Harmon says, but the effort will take time.

Once the REG completes its work on the test protocols, it plans to submit them to the FDA for comment and approval. AIM then hopes to make the test protocols available to testing facilities, labs and universities. Details are still being worked out in terms of how the protocols will be licensed, but Harmon says that under collaboration agreements, the protocols will be owned by the companies and university participants directly involved in their development—though who these would be has not yet been determined.

(Extracts taken from: "AIM Global to Develop Protocols for Testing Effects of RFID Emissions in Health Care" by Beth Bacheldor in the RFID Journal, www.rfidjournal.com/articles/view?4384.)

838) Documented Criminal Usage of Electromagnetic Tools

In 1999 URSI Commission E defined criminal activities using electromagnetic tools as an intentional malicious generation of electromagnetic energy introducing noise or signals into electric and electronic systems, thus disrupting, confusing or damaging these systems for terrorist or criminal purposes. In order to underline the intentional character the electromagnetic compatibility community coined for these kinds of actions the term Intentional Electromagnetic Interference (IEMI).

Public literature [2, 3, 4] has reported eight criminal usages of electromagnetic tools:

1. In Japan, criminals used an EM disruptor to interfere with the computer of a gaming machine and falsely triggered a win.
2. In St. Petersburg, a criminal used an EM disruptor to disable a security system of a jeweler store. The reports mentioned that building the EM disruptor posed a technological challenge similar to assemble a home microwave oven.
3. In Kizlyar, Dagestan, Russia, Chechen rebel command disabled police radio communication using RF jammers during a raid.
4. In multiple European cities (e.g. Berlin) criminals used GSM-Jammers to disable the security system of limousines.
5. In Russia, Chechen rebels used an EM disruptor to defeat a security system and gain access to a controlled area.
6. In London, UK, a city bank was the target of a blackmail attempt whereby the use of EM disruptors was threatened to be used against the banks IT-system.

7. In the Netherlands an individual disrupted a local bank IT network because he was refused loan. He constructed a briefcase-size EM disruptor, which he learned how to build from the internet. Bank officials did not realize that they had been attacked or what had caused the disruption until the assailant was caught.
8. In Moscow, the normal work of one automatic telephone exchange station has been stopped as a result of remote injection of a voltage in to a telephone line. As a result two hundred thousand people had no phone connection for one day.

There have also been several documented incidents caused by EM devices that could be employed by criminals or terrorists [2, 5]. On the target side results of susceptibility investigations as well as reports on observed electromagnetic effects show that IEMI attacks might result in serious consequences or catastrophic situations.

…..In the cases of the suppressed police radio communication as well as the Russian security system the consequences are unknown. In case 2 and 4 the IEMI attacks resulted in some economic loss, as intended by criminals. The case of IEMI attack on the computer system of the NL bank resulted in more serious consequences. In addition to repair costs and loss of data, the loss of confidence in the reliability of the bank resulted in a long term economic damage. The situation was worsened by the fact that the IEMI attack has been undetected for a certain period of time.

…….The IEMI cases presented clearly point out that today the threat by (criminal) IEMI attacks on electronic systems already exists. IEMI sources and their components are available on the free market and the knowledge needed for the assembly as well as the operation can be gained from open literature and the internet. Available IEMI sources are small and highly mobile, e.g. they are able to come close to the target systems. Those systems generate an EM environment that is capable to cause at least a malfunction or (temporary) set up of electronic components. The caused effects might be used to prepare the actual criminal activity.

As electromagnetic fields propagate through material without any alteration of the material IEMI attacks barely leave useful and provable traces. In addition, the complexity of systems often hinders error analysis and received error pattern point to internal causes. Build in test systems are optimized to identify internal errors and malfunctions. As a consequence unpredicted conditions will be mapped to predicted (internal) errors.

A user of a system which is subjected to IEMI environment is unlikely to have any sensation or perception of the (external) electromagnetic stress. With the lack of an indication of the threat and in combination with misleading error patterns the user is perhaps more likely to blame faulty hardware or software errors, rather than an ongoing IEMI attack. Consequently, any IEMI counterattack measure depends on a monitoring of the (external) electromagnetic fields that enables an independent indication of high electromagnetic stress that belongs to IEMI attacks.

(Three extracts from: "What can be learned from documented Intentional Electromagnetic Interference (IEMI) Attacks?" by Frank Sabath, Federal Ministry of Defense, Armament Directorate IV 6, Fontainengraben 150, 53123 Bonn, Germany, Frank.Sabath@ieee.org,presented at the General Assembly and Scientific Symposium, 2011 XXXth URSI , vol., no., pp.1-4, 13-20 Aug.2011, available from www.ursi.org/proceedings/procGA11/ursi/E03-9.pdf.)

839) NATO Denies Involvement in Aircraft Radar Jamming

A statement from NATO made public last week denies involvement in the brief disappearance of dozens of aircraft from air traffic control radars in several European countries earlier this month.

Air-traffic controllers in Austria, Germany, Slovakia and the Czech Republic reported data on the position, direction, height and speed of aircraft disappeared temporarily from radar systems

on June 5 and June 10. The outages posed no serious danger to people on the aircraft travelling at high altitude.

"We saw random outages of aircraft detection within the system of the so-called secondary radar lasting several tens of seconds and up to several minutes. But, thanks to the complete coverage of air space also through classic primary radars, we constantly had information about the positioning of airplanes and operational safety was not threatened," Richard Kilma, spokesman for the Czech Air Navigation Service, told Reuters.

An Austro Control spokesman said 13 planes crossing Austrian airspace were affected—10 in the first incident and three in the second—but that he heard 50 aircraft in total were impacted across Europe. Austrian air-traffic controllers handled the outage by communicating with the planes by radio and taking steps to ensure continued air traffic safety, including increasing the distances between planes.

The Slovak state Air Traffic Services company claimed the problem was connected to a planned military exercise with the goal of interrupting radio-communication frequencies.

"This activity also caused the temporary disappearance of several targets on the radar display, while in the meantime the planes were in radio contact with air traffic controllers and continued in their flight normally."

"Immediately after the identification of the problem with the displays, the side organizing the exercises was contacted and the exercise was stopped."

It did not identify the military force in question, which Austrian media said was the NATO western military alliance.

NATO, in response to a request for comment from Reuters, said that training involving "localized and low-power jamming" was conducted over Hungary during the June 2-6, but denied any jamming exercises on June 5.

"Our assessment is that NATO did not cause any interference with civilian air traffic control frequencies. When NATO conducts such exercises, we coordinate our activities with relevant civilian authorities and only use frequencies provided to us by the host nation," a NATO military officer said.

In the wake of the disappearance of Malaysian Airlines flight MH370 in March, there has been a growing focus on improving the tracking of passenger aircraft. At a Meeting in May, The International Civil Aviation Organization (ICAO) set a September deadline for implementation plans for temporary solutions announced it will begin considering new international standards to improve airline flight tracking in the long-term. Other technologies, such as satellite tracking technology, have also been brought to the forefront as a possible replacement for more traditional approaches.

The incidents are reportedly being handled by Eurocontrol, the European air navigation safety organization, and EASA, the European air safety agency.

(Copied from "NATO Denies Involvement in Aircraft Radar Jamming", in Interference Technology's on-line magazine, 25th June 2014, www.interferencetechnology.com/nato-denies-involvement-aircraft-radar-jamming.)

840) Who or what jammed the remote controls in Cowper Way?

A problem for people living in a cul-de-sac in Southcote was pressing all their buttons, but they didn't have the remotest idea what was wrong. Using the TV remote control indoors in Cowper Way was fine, but using a remote control outside simply did not work.

People living in the cul-de-sac, which runs right up to the railway line, naturally blamed a Network Rail communications mast which looms over the area.

Mike Cooper, 63, retired, of Cowper Way, said last week: “We think the mast is jamming the signal. It has been going on for about two years. It comes and goes. About two weeks ago the problem came back and nothing would work. You can’t use a remote control for the garage door or for the security lights outside. You also can’t lock the car doors with the ignition key until you are standing right by the car – so what is the point of that?”

Mr Cooper’s biggest problem was caused by the garage doors which would not open at all. He said: “Fortunately I had not put my car inside, otherwise I would have really been stuck.”

But Geoff Ifferlif, 70, who also lives in the cul-de-sac said on Monday: “It seems to have stated working again now, but none of the remote controls worked for about a week and a half. Of course, British Rail (Network Rail) say it is not their fault, We can’t prove it is them, but it seems to be the only explanation.” A number of people living in the cul-de-sac have made complaints to Network Rail in the past about the problem.

However, next door neighbour Matt Gower revealed this this week that the problem may well lie elsewhere. He told the Reading Post that the glitch rang a bell with a BT engineer, who suggested it might be caused by an electronic doorbell. Mr Gower said: “Everything is all right now, I think they found it was the doorbell that was doing it and have fixed it.”

A Network Rail spokeswoman Anne Marie Batson said, when the matter was first raised: “That’s a new one on me but I’ll ask the question.” She later came to say the issue appeared to have been resolved and their equipment was not to blame.

(From the article “Not remotely amused by a jammed signal…” by Linda Fort in the Reading Post dated 7th April 2014, kindly sent in by John Davies (the Editor of the EMC Journal).)

841) Rolling stock EMI study aims to update railway standards (1)

As part of a recently-completed European Union study on the effects of multi-source electromagnetic interference on trains, a British consulting company has helped redesign the way that conformance to railway electromagnetic compatibility (EMC) standards is determined.

The project in question, a two-year study known as TREND (Test of Rolling Stock Electromagnetic Compatibility for Cross-Domain Interoperability), arose from the need to address the electromagnetic emissions from rolling stock (or wheeled vehicles), as well as from electronics on-board trains and from nearby structures, that can affect. These emissions can cause aggravating and even dangerous interoperability issues that affect railway signaling systems, and are insufficiently addressed by current EN50121 European standards.

TREND’s goals, as stated on the project’s website, were twofold: to design “a test setup that enables the harmonization of freight and passengers rolling stock approval tests for electromagnetic compatibility (EMC) focusing not only on interferences with broadcasting services but also on railway signaling systems,” and to “identify and design the cross acceptance test sites on electrified and non-electrified lines that reproduce representative worst case conditions for steady state and transient behaviors.”

These “worst-case conditions,” such as pantograph bouncing or transients caused by discontinuities in the feeding or track circuit systems, were of particular importance to the project, as such scenarios receive minimal attention from current European standards despite causing significant problems on railways that waste precious time and resources and create dangerous safety conditions due to lapses in signaling.

According to TREND, the stakes for this project are high, as “the previously commented problems might cause an estimated reduction of 10 percent of the availability in the most crowded lines.”

Engineers at York EMC Services (YES), an engineering consultancy in York, England partnered with TREND to test and evaluate existing EMC standards, as well as the worst-case conditions that might slip past them.

"Even in trains that are tested fully to the EN50121 series of EMC standards and pass, problems can arise when in service. If this should occur, the technical solutions are not always straightforward," Rob Armstrong, Ph.D, consultant engineer at YES said in an editorial published in Rail Engineer. "In addition, the question of who is responsible for the lack of compliance can be difficult to answer and agree on; for example, is the rolling stock manufacturer responsible due to excess emissions, or the infrastructure manufacturer for inadequate immunity?"

Eva Karadimou, an EMC engineer at YES, told Engineering & Technology. "We looked at 900 MHz because that's used for GSM, and also at 1.5 GHz. The standard covers up to 1 GHz, and we wanted to see if there's a need to go above that. We've shown that there is."

(Taken from: "Study Highlights Need to Re-Evaluate Railway EMC Standards" by Melanie Abeygunawardana, in Interference Technology's online magazine, 24th June 2014, www.interferencetechnology.com/study-highlights-need-to-re-evaluate-railway-emc-standards)

842) Rolling stock EMI study aims to update railway standards (2)

Currently rolling stock electromagnetic emissions is a major concern for train manufacturers and railway infrastructure operators. Available harmonized EMC standards (EN50121-2, EN50121-3-1 and EN50121-3-2) do not completely address interoperability issues caused by rolling stock interferences with signalling systems (GSM-R, BTM, LTM) and even with broadcasting and identification signals such as DVB, WiFi, RFID, for instance. Moreover, these standards do not cover representative worst-case conditions derived by transients in the rolling stock behaviour typically generated by feeding and track circuits' discontinuities.

On one hand this situation causes an important waste of time and resources for train manufacturers when integrating rolling stocks and signalling systems. And moreover in already tested trains, occasionally problems may still arise. Then, not only the responsibilities but also the technical solutions are not straight forward. The duration of the field testing employed to solve this kind of problems and to go through the certification process may vary between 3 months and 12 months. And the cost of the complete process may vary between 25k€ to 1,5M€.

On the other hand, railway infrastructure operators suffer the railway infrastructure availability reduction caused by the rolling stock electromagnetic incompatibility with the safety critical signalling systems. The previously commented problems might cause an estimated reduction of 10% of the availability in the most crowded lines.

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(Extracts from the document available from CEIT: www.ceit.es/en/areas-of-r-a-d/electronics-and-communications/embedded-systems-a-networks/test-of-rolling-stock-electromagnetic-compatibility-for-cross-domain-interoperability-trend)

843) Railway EMI Case Study on emissions from a 25kV overhead

This section aims to highlight the previously illustrated point that detailed interference at a distance from a metropolitan railway in the UK. This is based on a report written for OFCOM in 2002 by York EMC Services [9].

The Urban Transport Study Group (UTSG), which is a subset of TC9X (relevant CENELEC study group for EMC in Railways) was set up to look at issues relating to urban light rail schemes where the separation between the railway and the potential non-railway victim system is typically much less than for a main line railway.

For example, in a light rail scheme like the Manchester Metro, the trams can run along specially equipped public roads. In this case, emissions from the tram system were found to cause audible interference to LW and MW broadcasts at distances less than about 20m from the tramlines. At distances over 30m, the interference had dropped below the noise floor. The issue was identified by hearing audible interference at a specified separation distance between non-railway victim system and the light rail line.

In order to mitigate the EMC problems, theoretical studies were conducted to analyse the issues. The scope included LW, MW, FM, and DAB broadcasting radio technologies.

CISPR 18-2 contains general information about the effects of interference on AM broadcasting. It is likely that a signal-to-interference ratio of around 20dB would be required to prevent any noticeable degradation in the quality of the reception, whereas a signal-to-interference ratio of around 10dB may be required before complaints are received.

The minimum usable field strength for LW and MW broadcasting in Europe is around 1mV/m (60dBµV/m) [8], so the absolute limits on the interference are 40dBµV/m for no significant degradation to sound quality, and 50dBµV/m for a level of interference likely to produce complaints.

The minimum recommended signal strength for FM reception in the absence of interference is 48dBµV/m [9]. In large cities this figure increases to 74dBµV/m, and in rural areas to 54dBµV/m (these figures conform to CISPR-22 standards: this does not include railways). However, in the UK, a minimum signal level of 60dBµV/m is normally assumed.

Digital Audio Broadcasting has received signal strength of 35dBµV/m, but a protection ratio requirement of only 6.5dB, so that interference levels of around 28.5dBµV/m should be tolerable without significant degradation in service.

A non-adequate separation between the Light Railway network and non-railway equipment, combined with high emissions from the Railway were found to be the main culprits involved in this particular case. It is worth noting that the emissions from the railway were still below the relevant EN50121 limits.

[9] Potential Electromagnetic Interference to Radio Services from Railways, Final Report (AY4110) T. Konefal, D. A.J. Pearce, C.A. Marshman, L.M. McCormack, York EMC Services for the Radiocommunications Agency 2002. (Note: reference [9] in the actual report is incorrect. The correct reference is given here - Editor.)

(Taken from "4.4.1. Case Study on emissions from a 25kV overhead" in TREND – TEST OF ROLLING STOCK ELECTROMAGNETIC COMPATIBILITY FOR CROSS-DOMAIN INTEROPERABILITY, REPORT D5.3, D5.4 and D5.5 Representative worst case condition, Representative worst case rolling stock condition, Conditions and limits of rolling stock emission". Report date : 30 April 2013m. Author(s): Iñigo Adin, Juan Melendez, Virginie Deniau, Hassene Fridhi, Rob Armstrong, Eva Karadimou and Emilio Rodriguez. Partners contributed : CEIT, IFSTTAR, Y-EMC, LTU. Contact: Iñigo Adin, CEIT, iadin@ceit.es, download from www.trend-eu.org/deliverables/resultsdeliverables.html)

844) Drawbacks of the EN 50121-x series of EMC test standards

16.2.2. Transient and Continuous Emissions

One of the main outcomes from the 2002 report [13] is the conclusion that the limits present in the EN50121-X: 2000 standard are insufficient to ensure compatibility with existing radio services. Most influences are covered, but the limits are deemed to not be sufficient. Since the introduction of the 2006 version of the EN-50121 series of standards, the emission limits stated in part 2 have not changed.

The limits given in the EN50121-2 are derived from trackside measurements of emissions from moving trains and as such are a combination of transient and continuous emissions; the transient emissions (for example, due to pantograph bounce) may be significantly larger in amplitude than the continuous emissions. However, EN50121-2 actually means that rolling stock manufacturers can legitimately allow continuous emissions (my emphasis – Editor) to emanate from rolling stock up to these limits.

If rolling stock does emit continuously at the appropriate limit then the chance of interference to radio services is greatly increased, as shown in the study [14], where interference was predicted 15km away from a 25kV AC railway, on FM radio services, using the limit from EN50121-2. The rolling stock rarely emits continuously at a level that causes severe interference to broadcasting services, as if that were the case then reported interference cases would be much higher. The fact that reported issues are low suggests that the emissions that interfere with broadcasting services are transient in nature. The problem arises if the rolling stock emits continuously below the limit but high enough to interfere with broadcasting services, which with the current limits is possible.

In an attempt to reduce this problem, the 2006 standard introduced a stationary emissions requirement in order to separate the transient and continuous emissions, as the stationary test allows the use of the quasi-peak measurement system, which is much more useful for measuring disturbance to radio systems. However this does not solve the issue of separating the transient and continuous emissions for the moving train test.

16.2.3. On board systems, RFID, WIFI and GSM

On board systems operating in the radio frequency region (such as freight RFID and WIFI) come under the heading of ‘intentional transmitters’ and as such are not required to meet emissions limits set out in EN-50121. However, there is no mention within the EN50121 series of standards of the interference effects when using these systems.

Interference from broadcasting services that affect the railway system (i.e. rolling stock immunity) on board the train is severely lacking in the EN-50121 standard set. There is no provision for protection from mobile phones within the passenger compartment other than the assumption (not stated) that any passenger borne equipment would have passed the relevant emission requirements. On board WIFI is not mentioned at all on the European standards, although in some cases the WIFI frequencies are within an OFCOM (Office of communications) designated unrestricted band, meaning there is no limit on emissions in these bands [13]. However, there is still potential to interfere at these unrestricted frequencies and therefore a need for on-board train immunity testing; this is missing from the current standard. There are immunity limits for mobile telephony with regards to interference to signalling and telecommunication systems (in EN50121-4) but not regarding on-board immunity.

The signalling and telecommunication standard (EN-50121-4) is set up to allow immunity testing at mobile telephony frequencies, however the standard only requires testing up to 2.5GHz, which does not encompass the new 4G mobile networks at 2.6GHz or 802.11a at 5.2 GHz. Emission limits from the railway system as a whole (EN-50121-2) are applied from 9kHz to 1GHz, there being no guidelines on limits above 1GHz and therefore potential for interference onto any system that utilises higher frequencies, such as mobile telephony upper bands, 3G and 4G, and both onboard and station based wireless systems. Throughout the

EN50121 series of standards, emission limits are defined for lower top frequencies than for immunity levels, except in the case where immunity limits are not present, for example immunity of the whole train.

Etc….

18.1 Drawbacks of EMC Standards

The flexibility of the EN50121-X: 2006 series of standards could be seen as an advantage, as it is easier to obtain the conditions according to the standard for the tests to be done. However, it is not given that new vehicles tested according to EN 50121 will not have EMC problems when introduced onto existing networks. Etc….

[13] Potential Electromagnetic Interference to Radio Services from Railways, Final Report (AY4110) T. Konefal, D. A.J. Pearce, C.A. Marshman, L.M. McCormack, York EMC Services for the Radiocommunications Agency 2002. (Note: the reference [13] listed in the actual report is incorrect – the correct reference is given here. Also, there are three places in the text where a different document is referenced as [14], but the document actually listed as [14] at the end of the report is not one of them! I haven't checked out the other references - Editor.)

(Extracts from "TREND – TEST OF ROLLING STOCK ELECTROMAGNETIC COMPATIBILITY FOR CROSS-DOMAIN INTEROPERABILITY, REPORT D.3.1 and D3.2: Drawbacks of Current Harmonised EMC Approval Tests & Other electromagnetic influences." Report date: 24 February 2012. Author(s): V. Deniau, J. Rodriguez, S. Niska, D. Galar,, A. Morant,, Å. Wisten, I. Adin, R. Armstrong, Partners contributed : IFSTTAR, CAF, TV, LTU, CEIT, Y-EMC, Contact : Diego Galar, Technical University of Luleå, SE-971 87 LULEÅ Sweden, +46 920 49 24 37, Diego.galar@ltu.se. Downloaded from: www.trend-eu.org/deliverables/resultsdeliverables.html)

845) Cars 'possessed' as locks turn on and off by themselves

Car owners in Cornwall have claimed their vehicles are "possessed" after their locking system began turning on and off on their accord, trapping one child inside and leaving many stranded without transport.

Residents of Summercourt, a small village near Newquay, claim the community has been struck by paranormal activity with around 30 cars locking and unlocking themselves.

The bizarre occurrences, which have seen the village dubbed the "Summercourt Triangle" in reference to Bermuda, began six months ago and have been explained by radio interference.

Mike Parris, an expert from car technology firm SBD, said remote locking systems are vulnerable to interruption and that the Cornwall incidents were not unique.

He said: The most probable cause is accidental radio interference, which is not unheard of.

(Taken from an article of the same name by Oliver Duggan, 3:19PM BST 06 Jun 2014, www.telegraph.co.uk/motoring/news/10881319/Cars-possessed-as-locks-turn-on-and-off-by-themselves.html. In the paper copy delivered on 7th June, this article was on page 11 and was titled: 'Possessed cars leave villagers spooked'.)

846) EMI and early video games

In the IEEE Consumer Electronics Magazine – April 2014 there was an article on "The 2014 IEEE Edison Medal Recipient." It was a story about Dr. Ralph Baer, the father of video games, and it was a very entertaining and informative article. What "caught my eye" were a couple of paragraphs in the article that discussed EMC.

The first one was: "When Coleco Telestar, another first generation video game system, did not pass interference tests needed for the Federal Communications Commission approval, the company turned to Sanders and Ralph in hopes that Ralph's experience would be able to help

them. Ralph found their solution within the week. Coleco received its Federal Communications Commission approval, and Coleco Telestar sold more than one million units in 1976."

The second one was: "Usually, we had only minor problems that could easily be fixed by moving wires around or with a solder joint here or there (we always brought tools). So there we were one day in the mid-1980s, demonstrating a prototype to a toy company in Chicago. We arrived, and as we had done many times in the past, started setting up and testing our demo units. Immediately, our prototype started playing music, and, mind you, we had not programmed it to do so, in fact the unit was turned off! As it turns out, the wires in our crude prototype were acting as an antenna, picking up a powerful local radio station – very embarrassing, but, we talked our way through it."

(Taken from "EMC Society History" by Daniel D. Hoolihan, Associate Editor, Chair of the EMC Society History Committee, published in the IEEE Electromagnetic Compatibility Magazine, Vol. 3 Quarter 2, 2014, page 30, http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?reload=true&punumber=5962381.)

847) Chaotic oscillations seen in a CMOS inverter with RF excitation

This study demonstrates the presence of chaotic oscillations in standard CMOS circuits. At radio-frequencies, ordinary digital circuits can show unexpected nonlinear responses. We examine a CMOS inverter coupled with electrostatic discharging (ESD) protection circuits, designed with 0.35 μm CMOS technology, for evidence of its chaotic oscillations. As the circuit is directly driven by a radio-frequency signal, the circuit enters a chaotic dynamic regime when the input frequency is higher than the maximum operating frequency of CMOS inverter. We observe an aperiodic signal, a broadband spectrum, and a complex spectrum.

…..many scientists and engineers exert great effort to tame these sensitive and often unpredictable behaviors occurring in their circuits. Examples of this phenomenon have been a subject of study in EMI community, and are often encountered when the electronics suffer from instability, which may have originated from both intentional and unintentional microwave sources.

The effect of microwave signals interfering with electronic systems is not an entirely new concern. Previous studies show that various physical mechanisms have caused instabilities when a circuit is excited by microwave signals. Many studies [12] [13] report rectifications of radio frequency (RF) signals by bipolar and field-effect transistors.

It is also reported that the nonlinear parasitic capacitance of electrostatic dischargings (ESDs) degrades a linearity performance [14]. A latch-up effect in semiconductor devices is presented due to EMI [15]. In addition to these low-order instabilities, some findings are reported about the high-order instabilities like spurious oscillations or unstable oscillations, which are unpredictable and difficult to understand [16] [17]. Highly nonlinear power amplifiers are often exposed to these phenomena, when they are driven under large RF signals [18].

(Two extracts from: "Chaotic Oscillations in a CMOS Inverter Coupled With ESD Protection Circuits Under Radio Wave Excitation" by Myunghwan Park, J.C. Rodgers and D.P. Lathrop, in IEEE Trans. EMC, Vol. 56, Iss. 3, June 2014, pages 530 – 538, ISSN: 0018-9375, http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6750052)

848) EMI at Saturn 1 launch in 1964

The Associated Press (AP) carried an article on January 29, 1964 relating to the delay in launching of the Saturn 1 rocket due to radio interference. The part of the AP dispatch which mentioned this is as follows: "The shot was delayed more than an hour by radio interference which affected a tracking-radar and the radio frequency on which the range safety officer would send a signal to destroy the rocket in case it strayed off course. The radar trouble was traced to a ship off shore which turned off its signal when it was advised, and the other interference was cleared up soon afterward.

When the trouble arose the countdown had reached 13 minutes, but one system aboard the rocket had to be turned off during the wait, so the count was set back to 25 minutes when it was resumed. The massive vehicle was intended to propel into orbit a 37,700 pound satellite, nearly three times as heavy as any previous man-made satellite."

(Taken from "Fifty Years Ago – May 1964 – Newsletter Number 33 – IEEE Professional Technical Group on Electromagnetic Compatibility (PTG-EMC)" by by Daniel D. Hoolihan, Associate Editor, Chair of the EMC Society History Committee, published in the IEEE Electromagnetic Compatibility Magazine, Vol. 3 Quarter 2, 2014, page 31, http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?reload=true&punumber=5962381.)

849) Problems with UHF tuners in 1964

An article from Electronics (February 21, 1964) stated the following: "FCC hopes makers of uhf tuners can come up with solutions to the problem of oscillator interference within a year. FCC's 500 microvolts per meter radiation limit for TV receivers clashed somewhat with the law requiring all sets being sold in interstate commerce to be equipped with uhf receivers after April 30, 1964.

Rather than revoke its rule, the FCC climbed out of the box by agreeing to continue the 1000 uV/m radiation limit until April 30, 1965. In the meantime, it is calling for research on tuner design and radiation suppression. The commission's determination to back strongly uhf/TV broadcasting was evident in a decision last week denying a permit for a vhf translator to serve Asheville, NC. FCC told Spartan Broadcasting Co. that it would look favorably on a uhf translator, or a second uhf station. Asheville already has one uhf station."

(Taken from "Fifty Years Ago – May 1964 – Newsletter Number 33 – IEEE Professional Technical Group on Electromagnetic Compatibility (PTG-EMC)" by by Daniel D. Hoolihan, Associate Editor, Chair of the EMC Society History Committee, published in the IEEE Electromagnetic Compatibility Magazine, Vol. 3 Quarter 2, 2014, page 31, http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?reload=true&punumber=5962381.)

850) FAA Orders Airlines to Replace Over 1,300 Cockpit Display Units

The U.S. Federal Aviation Administration (FAA) is ordering airlines to replace more than 1,300 display units in cockpits in Boeing Co. airplanes to avoid interference from Wi-Fi, cellular and electronic devices within the next five years. These displays were produced by Honeywell International Inc. It is crucial that these units function correctly because they are responsible for providing navigation, altitude and airspeed information to pilots and co-pilots.

"The display units were susceptible to interference from Wi-Fi frequencies. Independent tests conducted by the agency and Boeing both showed blanking on the screens when Wi-Fi devices were used near them. The displays are also susceptible to transmissions from mobile phones, weather radar and mobile satellite communications," the FAA said.

However; Steve Brecken, Honeywell spokesman, does not agree. He stated that no display screens were affected by Wi-Fi interference.

"The only known occurrence was during a developmental test conducted on the ground. We worked with Boeing and addressed any concerns in 2012 with new display hardware," he said.

It will cost more than 14 million dollars to replace all of the display units; each unit costs more than one thousand dollars.

(Taken from: www.interferencetechnology.com/faa-orders-airlines-replace-1300-expensive-display-units 10/23/2014, which was based on the Reuters article "U.S. orders airlines to replace cockpit displays on 1,300 Boeing airplanes" published on September 30, 2014 11:35 PM, reported by http://news.yahoo.com/u-orders-airlines-replace-cockpit-displays-1-300-020623861--sector.html.)

851) French Railways interfere with Large Hadron Collider

Banana Skin #844 reminds me of reading some time ago that the scientists at CERN had started to observe occasional 'blips' in the readings from their Large Hadron Collider's super-sensitive instrumentation. These did not yield any explanation when first investigated by their scientists, who had, however, observed that they generally occurred at about the same times each day, and that the traces were always of similar shape.

The media soon opened up with stories of 'little green men' in deep space trying to communicate or interfere with the experiments, without pausing to think that they could be of terrestrial origin in some way.

Came a weekend when a few of the scientists put in some overtime, and noticed that the blips were fewer in number, and sometimes occurred at times which did not correspond with the weekday ones.

One of them was probably, like me, a railway fan, so on a hunch called in at Geneva's main railway station to pick up a timetable for the (then) newly-introduced Paris-Geneva TGV service, and quickly discovered a correlation between the blips recorded at CERN and the TGV Paris-bound departure times.

The most difficult part, by far, of the subsequent investigation was finding a collaborative SNCF running inspector to arrange for one of the scientists to 'ride shotgun' in the TGV cabs to check the times when the trains left the 'classic' line and the driver applied 'full welly' for the high speed northbound run. The correlation proved to be exact. The instantaneous power surge on the 25kV overhead – for the fraction of a second it needed for the traction systems to start responding – did not remotely include enough "I2t" energy to trip any of SNCF's onboard or trackside protection kit.

Designing the filter to remove the traces was, of course, complete simplicity.

(Kindly sent in by Kevin Carleton-Reeves, who described himself as a "practising railfan" on 1st October 2014.)

(NOTE: it seems most likely that Kevin meant to say LEP instead of LHC, because a paper on interference from TGVs to the LEP is at: http://cds.cern.ch/record/309231/files/sl-96-036.pdf. This information was provided in March 2015 by Tom Sato of Japan.)

852) A fix for ESD problems with a USB3 device

Basically we found that the "ESD protected" data interface device in our product could get itself into a number of non-working states occasionally after ESD strikes – state machine or microcode in the device gets into a state where it is live but not communicating data (i.e. the control path still worked but the data path had stopped).

We found ways to detect these stall conditions and worked with the device manufacturer to determine how to restart the communications. So by polling for these conditions and correcting when required we can auto-recover.

(Kindly sent in by a designer who wishes to remain anonymous, in July 2014. Editor – in my training courses I always point out that ESD protected data devices, or the transient suppression devices marketed for protecting them against ESD, only protect from actual damage. The sales data for these devices doesn't make clear that other techniques will probably be needed a) to prevent false data from occurring, and b) to allow the functionality of the data interface to recover in a sufficiently short time to meet Performance Criterion B.)

853) Canadian Air Force helicopters suffer EMI

A Canadian military Sikorsky CH-148 Cyclone conducts test flights in Halifax harbour in 2010. (Image: Andrew Vaughan/Canadian Press) (Got picky!)

Electromagnetic interference concerns are hampering progress on a Canadian Air Force project.

According to The Canadian Press, the Canadian government has refused to accept four CH-148 Cyclone test helicopters currently parked at the Canadian Forces facility in Shearwater, N.S., on the basis that they are “non-compliant.” Designed by Sikorsky Aircraft Corporation, the twin-engine CH-148 Cyclone helicopters are slated to replace the CH-124 Sea Kings, which have been in operation since 1963.

However, the Canadian news outlet reports, defense sources with intimate knowledge of the program have elaborated on the public report, saying that certain flight systems, including a computer that runs the engines, are not considered sufficiently shielded against powerful electromagnetic waves. The electromagnetic waves could potentially scramble the digital instruments and shut down the engines.

A Canadian military Sikorsky CH-148 Cyclone conducts test flights in Halifax harbour in 2010. (Image: Andrew Vaughan/Canadian Press)

Earlier this year, the directorate of airworthiness at the Department of National Defence and the Canadian Armed Forces cited electromagnetic compatibility, electromagnetic vulnerability and electromagnetic interference concerns in its decision to impose flight restrictions on the CH-148 Cyclone helicopters.

“Each of them [the concerns] are potential show-stoppers,” a defense source, who asked for anonymity, told The Canadian Press.

“The vulnerability depends on the frequency and the strength of the signal. You have the potential of losing your instruments and not knowing where you are, and having to take visual cues from outside your aircraft to get down safely.”

Air Force engineers and government officials are increasingly skeptical regarding whether or not the shielding problem can be sufficiently remedied in a reasonable amount of time. Initially scheduled to be ready for service in 2008, only a few Cyclone helicopters have thus far been delivered for testing. The project is five years behind schedule and over-budget.

"The aircraft was not designed from the ground up with this kind of shielding in mind," the defense source told The Canadian Press. "Military aircraft, the skin of military aircraft, [is] sometimes embedded with a fine copper screen or mesh to prevent the intrusion of electromagnetic interference." The CH-148 Cyclone helicopters, however, are based on a less-rugged civilian design.

Sikorsky declined to comment on the technical concerns on the basis that the contract forbids the company from publicly discussing certain aspects of the program. Public Works, who manages the contract on behalf of National Defence, similarly declined to offer specific details, saying only that they are working on the problem.

"At some point, someone should say enough is enough," defense expert Michael Byers, of the University of British Columbia, said. Byers documented the Conservative government's struggles with the Cyclones in a report earlier this year. "The question is, when are they going to stop messing around and deliver a highly functioning maritime helicopter for the men and women of the Canadian Forces?"

John Dawson adds: "Several years ago we tested several Canadian helicopters for compatibility with our US Navy shipboard EM environments. The lesson learned, you get what you specify. If EMC is not integrated into the early design, it's going to fail. Fixing after the fact, is always cost prohibitive. It's always cheaper to do it right the first time, then to pay over and over again to build band aids."

(Taken from www.interferencetechnology.com/canadian-air-force-helicopters-beset-with-emi-woes by Aliza Becker, 09/19/2013. More information at: www.cbc.ca/news/politics/new-cyclone-choppers-beset-with-technical-snags-1.1700828. The comment by John Dawson was timed at 3:03 pm on 09/19/2013.)

854) PCs' EM emissions can carry information that can be picked up nearby

To the best of our knowledge, this paper is the first to show that EM information leakage from modern laptops and desktops (with no peripherals attached) is indeed possible and is relatively easy to achieve.

The experiments were performed on three laptop systems and one desktop system with different processors (Intel Centrino, Core 2, Core i7, and AMD Turion), and show that both active (program deliberately tries to cause emanations at a particular frequency) and passive (emanations at different frequencies happen as a result of system activity) EM side-channel attacks are possible on all the systems we tested.

Furthermore, this paper showed that EM information leakage can reliably be received at distances that vary from tens of centimeters to several meters including the signals that have propagated through cubicle or structural walls.

Finally, this paper showed how activity levels and data values used in accessing different parts of the memory subsystem (off-chip memory and each level of on-chip caches) affect the transmission distance.

(Taken from: "Experimental Demonstration of Electromagnetic Information Leakage From Modern Processor-Memory Systems", by Alenka Zajić, Senior Member, IEEE, and Milos Prvulovic, Senior Member, IEEE, in IEEE Transactions on EMC, Vol. 56, No. 4, August 2014 pp885-893.)

855) ATC (Automatic Train Control) abnormal behaviour in mining areas due to EMI

1.7 SS2: Spot Signalling Systems: Abnormal Behaviour in Mining Areas

1.7.1. Name: ATC (Automatic Train Control) abnormal behaviour in mining areas

1.7.2. Date: 2003

1.7.3. Participant/Customer/Involved body: LTU and MTAB (mining train operator for LKAB mines)

1.7.4. Nature of the EMI: The ATC transmitter is disturbed by a 'heap of iron balls' underneath the locomotive. The locomotive stops, and the ATC has to be switched off in the mining area.

Figure 18 The ATC transmitter disturbed by a 'heap of iron balls' underneath the locomotive.

1.7.5. How did the interested party identify the EMI? The locomotive stopped where it crossed over a heap of iron (composed of pellets that fall down in the loading process).

1.7.6. How did you, the participant, deal with the EMI? The ATC radio was switched off when the train approaches a heap and switched on again when the train has passed.

1.7.7. What was the main source of the EMI? The heap of ore was acting as EM mirror and reflected EM waves were disturbing the transceiver of the system.

1.7.8. What steps were taken to prevent repeat occurrence? The ATC radio is switched off as a routine in these mining areas due to the frequency of appearance of these heaps.

1.7.9. Reasons why there may have been an issue with EMI: In high enough numbers, the small balls of Iron make up a perfect EM mirror where all EM waves are reflected. Since the ATC transceiver is less than one meter away from this EM mirror the disturbances are very high.

1.7.10. Likelihood of repeat occurrence or similar issue after participant involvement: The issue is not solved and the routine of switch off is still active. The phenomenon described in this case study is easily applicable to any other spot signalling system which has to transmit a signal to awake the balise or the emitting cable. Some of the cab signalling systems used in European lines considered for Interoperability have been listed in the previous case study (SS1).

(A small extract from the 36-page document that is TREND Report D2.1 "Collection of EMI Experiences and establishment of qualitative relationships", 20 December 2011, from: www.trend-eu.org/deliverables/resultsdeliverables.html. TREND is "Test of Rolling Stock Electromagnetic Compatibility for Cross-Domain Interoperability".)