



Another EMC resource
from EMC Standards

EMI Stories 286 to 380

Helping you solve your EMC problems

EMI Stories 286 to 380

286) Electronic organ manufacturer fined for EMC non-compliance

The Enforcement Bureau of the Federal Communications Commission (FCC) has fined a Dutch company for importing and marketing in the United States electronic organs which radiated emissions in excess of U.S. limits. The company, Johannus Orgelbouw b.v. of the Netherlands, was fined US\$7000 and ordered to submit to the FCC for the next two years verification records for each model of organ which it imports into the U.S.

The matter of the emitting digital electronic organ was brought to the attention of the Enforcement Bureau in early 2003 by a competitor who claimed that other organ companies were suffering competitive harm because the company, by not complying with FCC regulations, was able to produce products less expensively. In a subsequent investigation by FCC agents, the company acknowledged that it had imported and marketed at least one model of organ that did not comply with FCC emissions limits, resulting in the Commission's action.

(From "FCC Fines Importer of Non-Compliant Electronic Organs", Conformity, News Breaks, February 2004, pp 42-43, www.conformity.com.)

287) False alarm in the Bahamas, caused by inadequate immunity of field meter

Once upon a time, when the Bahamas telephone toll center transactions were only \$175,000 US per day — and EMC engineers made a great deal less — our facilities safety manager was attending to his appointed rounds with his brand-new, brand name RF field intensity meter in hand. He wanted to make sure that the electric fields within the facility were less than the allowed maximum of 10mw/sq.cm (194 V/m). After all, our company didn't want to accidentally cook anyone that worked there. It wouldn't look good come time to renew their management contract.

Much to the safety engineer's surprise, the fields being presented by the video display units (VDUs) at the operator consoles were way above the maximums. A quick calculation disclosed that the measured field intensities were in excess of 300 V/m. Did he call anyone? Did he ask how that was possible? Of course not! Being a good safetyman, with genuine concern for the workforce, he immediately shut down the toll center. Then, he called to report his findings. Then, his boss called corporate headquarters and they called my boss and also those of six other EMC facilities that we had scattered around the world. Then seven EMC engineers, myself included, immediately reported to the Bahamas to solve this serious problem. At \$175,000 per day there was a lot of incentive to get there quickly.

We were prompt, but still didn't arrive at the same time. But when we did, we found that the first EMC engineer on the scene had already discovered that the brand-new, brand name RF field intensity meter was susceptible to the 15kHz VDU raster sweep frequency, and the toll center was back on-line. Of course, this required an appropriate celebration at a little place nearby... but that's a different story!

(“A really short ‘vacation’ in the Bahamas”, Ron Brewer, IEEE EMC Society Newsletter, Spring 2004, ‘Chapter Chatter’ section, page 8, www.ewh.ieee.org/soc/emcs.)

Numbers 288 - 298 below are taken from the Appendix to MIL-STD-464A dated 18 March 1997.

(MIL-STD-464A is entitled “Department of Defense — Interface Standard — Electromagnetic Environmental Effects — Requirements for Systems”. To obtain a free copy, type MIL-STD-464 into the Google search engine at <http://www.google.com>, and it will quickly find sites from where it can be downloaded.)

288) From MIL-STD-464A A.5.2 “Intra-system electromagnetic compatibility (EMC)”

When appropriate controls are implemented in system design, such as hardening, EMI requirements on subsystems and equipment, and good grounding and bonding practices, there are relatively few intra-system EMC problems found. Most problems that are found involve antenna-connected transmitters and receivers. Receiver performance has been degraded by

broadband thermal noise, harmonics, and spurious outputs coupled antenna-to-antenna from transmitters. Microprocessor clock harmonics radiating from system cabling and degrading receivers have been another common problem. Electromagnetic fields radiated from onboard antennas have affected a variety of subsystems on platforms.

Typical non-antenna related problems have been transients coupled cable-to-cable from unsuppressed inductive devices and power frequencies coupling into audio interphone and video signal lines. Problems due to cable-to-cable coupling of steady state noise and direct conduction of transient or steady state noise are usually identified and resolved early in the development of a system. Generation of broadband EMI on ships from electrical arcing has been a common source of degradation of antenna-connected receivers and must be controlled. Sources of the arcing have been brush noise from electrical machinery and induced voltages and currents between metallic items from antenna transmissions. Intermittent contact of the metallic items due to wind or ship motion is a contributor.

289) From MIL-STD-464A A.5.3 “External RF EME” (EME means electromagnetic environment, used in this document to mean only the radiated environment)

High-powered shipboard radars have caused interference to satellite terminals located on other ships, resulting in loss of lock on the satellite and complete disruption of communication. The interference disables the satellite terminal for up to 15 minutes, which is the time required to re-establish the satellite link. Standoff distances of up to 20 nautical miles between ships are required to avoid the problem.

A weapon system suffered severe interference due to insufficient channel selectivity in the receiver’s front end. Energy originating from electronic warfare systems and another nearby “sister” channelized weapon system (operating on a different channel but within the same passband) coupled into the victim receiver and was “processed,” severely degrading target detection and tracking capability. Installation of an electronically tuned filter immediately after the antenna countered the off-channel interference problem by: 1) eliminating receiver front-end amplifier saturation and 2) reducing overload of the system processor with extraneous in-band signals.

An aircraft lost anti-skid braking capability upon landing due to RF fields from a ground radar changing the weight-on-wheels signal from a proximity switch. The signal indicated to the aircraft that it was airborne and disabled the anti-skid system. An aircraft experienced uncommanded flight control movement when flying in the vicinity of a high power transmitter, resulting in the loss of the aircraft. If the mission profile of the aircraft and the anticipated operational EME had been more accurately considered, this catastrophe could have been averted.

Aircraft systems have experienced self-test failures and fluctuations in cockpit instruments, such as engine speed indicators and fuel flow indicators, caused by sweeping shipboard radars during flight-deck operations. These false indications and test failures have resulted in numerous unnecessary pre-flight aborts.

Aircraft on approach to carrier decks have experienced interference from shipboard radars. One such problem involved the triggering of false “Wheels Warning” lights, indicating that the landing gear is not down and locked. A wave-off or preflight abort could occur due to this EMI induced condition.

Aircrews have reported severe interference to communications with and among flight deck crew members. UHF emissions in the flight deck environment caused interference severe enough that crews could not hear each other for aircrew coordination. This problem poses a serious hazard to personnel with the potential for damage to, or loss of, the aircraft and aircrew during carrier flight deck operations.

290) From MIL-STD-464A A.5.4 “Lightning”

The effects of lightning can cause physical damage to personnel and equipment. In one of numerous documented lightning incidences, lightning appeared to enter a Navy aircraft nose, travel down the right side, and exit on top of the right vertical tail. The pilot suffered from flash

blindness for 10-15 seconds. Upon regaining his vision, the pilot noticed all cockpit electrical power was gone. After another 15 seconds had elapsed, all cockpit electrical power returned on its own, with no cockpit indications of any equipment malfunction.

In another case, lightning attached to the nose pitot tube, inducing transients that damaged all 28 volt DC systems. The pilot, disoriented, broke out of a cloud bank at 2000 feet above the ground, at 600 knots and a 45 degree dive. Nearly all cockpit instruments were dysfunctional - compass, gyrohorizon, and so forth. A secondary effect occurred but was not uncovered for several months. The lightning current path that carried the direct effects lightning current did what it was supposed to do, but the path was not inspected on landing.

Over 800 man-hours were expended to correct electrical (28 volt DC) problems but no effort went into inspecting for direct effects damage to ensure the lightning protection system was intact. The rigid coax from the front of the radome to the bulkhead had elongated and nearly torn away from its attachment point at the bulkhead due to magnetic forces involved. This damage reduced the effectiveness of the designed lightning protection. Another secondary effect was the magnetization of all ferrous material which caused severe compass errors. The entire aircraft had to be degaussed.

291) From MIL-STD-464A A.5.6.1 “Non-developmental items (NDI) and commercial items”

Several instances have been noted in ground-based applications where EMI emissions from commercial digital processing equipment have interfered with the operation of sensitive radio receivers. Of particular concern are radiated emissions from processor clock signals causing interference with communications equipment that operates from 30 to 88 MHz. Most commercial equipment is qualified by testing at a distance of three meters. The problems have been largely caused by use of the commercial items at distances of one meter or closer where the fields will be higher.

Another example is a commercial global positioning system (GPS) receiver interfering with a military GPS receiver. The out-of-band antenna emissions from the commercial receiver were picked up by the antenna of the military receiver and processed at the in-band frequency. A limited CE106 test may have identified the emission.

292) From MIL-STD-464A A.5.14 “EM Spectrum Compatibility”

Currently there are numerous incidences of co-site, intra-ship, and inter-ship interference, as well as interference with the civilian community. For example, the Honolulu Airport air traffic control radars have been degraded by shipboard radars stationed adjacent to Pearl Harbor.

A program manager developed a system without requesting spectrum certification. After development, it was discovered that the system had the potential to interfere with other critical systems. Costly EMC testing and operational restrictions resulted, impacting the ability to meet mission requirements. Both items could have been avoided if spectrum management directives had been followed.

A base communications officer funded the purchase of commercially approved equipment. The user was unable to get a frequency assignment because the equipment functioned in a frequency range authorized for only non-government operation. A second system had to be purchased to satisfy mission requirements.

293) From MIL-STD-464A A.5.7 “Electrostatic charge control”

A maintenance person was working inside a fuel tank and experienced an arc from his wrench when removing bolts. It was found that maintenance personnel were routinely taking foam mats into the tank to lie on while performing maintenance. Friction between the mat and clothing allowed a charge buildup which caused the arc. All static generating materials should be prohibited from the tank during maintenance.

Many equipment failures have been attributed to ESD damage of electronic parts.

294) From MIL-STD-464A A.5.7.1 “Vertical lift and in-flight refueling”

To protect personnel on the ground from receiving electrical shocks, it is standard practice for rotorcraft to touch the ground with the hook before it is connected to the cargo. As the cargo is

lifted, the whole system (aircraft and cargo) will become recharged. Again, when the cargo is lowered to the ground, it must touch the ground to be discharged before handling by personnel. The aircraft system and cargo often see several electrical discharges as the vertical lift process is executed.

During in-flight refueling, pilots have reported seeing arcing between the refueling probe and the fueling basket during mating. These discharges were several inches long. Based on these observations, the 300 kV number was derived. Aircraft that have experienced discharges from in-flight refueling have had upsets to the navigation system resulting in control problems.

295) From MIL-STD-464A A.5.7.2 “Precipitation static (P-static)”

A.5.7.2 A fighter aircraft was experiencing severe degradation of the UHF receiver when flying in or near clouds. Investigation revealed that the aircraft was not equipped with precipitation static dischargers. Installation of these devices solved the problem.

An aircraft had a small section of the external structure made of fiberglass. Post-flight inspections required personnel to get in close proximity to this non-conductive structural component. On several occasions, personnel received significant electrical shocks which caused them to fall from ladders and be injured. Corrective action was easily accomplished by applying a conductive paint to the surfaces exposed to airflow and personnel contact.

Static discharges from the canopy were shocking pilots on a fighter aircraft during flight. Charges accumulating on the outside of the canopy apparently migrated slowly through the dielectric material and discharged to the pilot’s helmet when sufficient charge appeared on the inside surface. A grounded conductive finish on the inside of the canopy fixed the problem. Experience with an ungrounded conductive finish aggravated the problem.

When an aircraft was flying in clouds during a thunderstorm, the pilot was unable to transmit or receive on the communications radio. Further investigations were performed with the most reasonable conclusion that the radio blanking was caused by electrostatic discharge. Several incidents were also reported where pilots and ground crews received shocks due to static discharges from aircraft canopies. These incidents occurred on the carrier deck after the aircraft had been airborne for several hours.

It was discovered on an aircraft that was experiencing p-static problems that the static dischargers had been installed using an adhesive that was not electrically conductive.

Coordination between structural and electrical engineer personnel is necessary to ensure that all required areas are reviewed. For example, a structural component on an aircraft was changed from aluminum to fiberglass and experienced electrostatic charge buildup in flight which resulted in electrical shock to ground personnel. The structural engineer made this change without proper coordination, which resulted in an expensive modification to correct the shock problem.

296) From MIL-STD-464A A.5.7.3 “Ordnance subsystems”

Explosive subsystems have been initiated by ESD caused from human contact or other sources of ESD.

297) From MIL-STD-464A A.5.8.3 “Hazards of electromagnetic radiation to ordnance (HERO)”

Several incidences onboard Navy ships involving the inadvertent firing of rockets and missiles have resulted in catastrophic loss of life and equipment. There have been numerous explosive mishap reports involving RF induced, uncommanded actuation of automatic inflators worn by aircrew personnel both on flight decks and in-flight while launching from and landing on the carrier. These problems pose a tremendous hazard to aircrews, especially those in-flight at the time of occurrence.

298) From MIL-STD-464A A.5.11.1 “Aircraft grounding jacks”

Aircraft fuel fires have been attributed to electrostatic discharge. Precisely demonstrating that an electrostatic discharge caused a mishap is usually not possible due to difficulty in reproducing conditions that were present.

Grounding jacks on aircraft in the field have been found to be electrically open-circuited with respect to the aircraft structure due to corrosion. It is important that corrosion control measures be implemented at the time of installation.

299) Patriot system interference blamed for shooting down UK fighter plane

The latest Patriot scandal concerns the deaths of the crew of Yahoo 76, a British Tornado GR-4 that was shot down by a Patriot air and missile defences unit over Kuwait on 22 March last year as it descended with another Tornado in a pre-planned “safe” corridor towards its home base west of Kuwait City.

What the data shows is that the Patriot did not initially identify the Tornado as a target at all, and that the “missile” it registered was in fact a “ghost” – an illusion probably generated by electronic interference from other nearby Patriot units. Furthermore, the Patriot detected this false target 15 kilometres east of the approaching Tornados, heading not towards the Patriot but towards a troop encampment roughly 15 kilometres to the north. If it had been heading towards the Patriot, the battery’s weapon control computer would have classified it as an Air Threat Category 1. Instead, it classified it as a Category 9, a threat level so low that the computer did not even mark it for engagement.

The Patriot’s crew, believing they were under attack, launched an Interceptor missile at the false target, which by this stage had “moved” into the vicinity of the Tornados. In the absence of any other target, the interceptor’s radar homed in on one of the planes.

(Taken from: “Unfriendly Fire”, by Theodore Postol, Professor of Science, Technology and National Security Policy at the Massachusetts Institute of Technology, New Scientist, 2 October 2004, page 23, www.newscientist.com.)

300) Electromagnetic effects due to UFOs

Reports of anomalous aerial objects (AAO) (*UFOs to the rest of us – Editor*) appearing in the atmosphere continue to be made by pilots of almost every airline and air force of the world in addition to private and experimental test pilots. This paper presents a review of 56 reports of AAO in which electromagnetic effects (E-M) take place on-board the aircraft when the phenomenon is located nearby but not before it appeared or after it had departed. These effects are not related to the altitude or airspeed of the aircraft. The average duration of these sightings was 17.5 minutes in the 37 cases in which duration was noted.

There were between one and 40 eye witnesses (average = 2.71) on the aircraft. Reported E-M effects included radio interference or total failure, radar contact with and without simultaneous visual contact, magnetic and/or gyro-compass deviations, automatic direction finder failure or interference, engine stopping or interruption, dimming cabin lights, transponder failure, and military aircraft weapon system failure. There appears to be a reduction of the E-M energy effect with the square of increasing distance to the AAO. These events and their relationships are discussed. This area of research should be concentrated on by other investigators because of the wealth of information it yields and the physical nature of AAO including wavelength/frequency and power density emissions.

(As usual, we celebrate another hundred Banana Skins with something a little more unusual, tongue-in-cheek, or just plain funny. Make up your own mind about which category this one falls into. It was taken from the Abstract for “Fifty-six Aircraft Pilot Sightings Involving Electromagnetic Effects”, by Richard F. Haines, Ph.D, Copyright 1992, <http://www.nicap.dabsol.co.uk/92apsiee.htm>, 16 Jun 03.)

301) Immunity to interference degrades over time

EMI hardness evaluations under the Navy’s Air Systems’ EMI Corrective Action Program (AEMICAP) have shown that the hardness of aircraft is degraded over time. Electrical inspections have shown numerous instances of foreign object damage, excessive chaffing of wires, and improper splicing and terminations. Bonding measurements performed over a ten year period on a Navy fighter aircraft indicates 10-15% out of specification conditions on a new aircraft, 40-60% out of specification conditions on a five year old aircraft and 70-80% out of

specification conditions on a ten year old aircraft. These out of specification bonding conditions result in inadequate termination of shields and boxes and degrade shielding effectiveness.

During EMC tests, the effects of corrosion and maintenance practices on the EMC design have been noted. For example, composite connectors were incorporated in the pylons of a Navy attack aircraft to correct a severe corrosion problem on the existing aluminum connectors. The composite connectors are more resistant to the corrosion than aluminum. They do, however, oxidize and produce a powdery residue on the connector. The maintenance personnel would then wire brush this residue, thereby eliminating the outer conductive coating, severely degrading the connector conductivity, and introducing potentially more severe corrosion problems.

(Taken from MIL-STD-464A, Appendix A.5.9 "Life cycle, E3 hardness". 'HERO' stands for Hazards of Electromagnetic Radiation to Ordnance.)

302) Early colour TV interference from early police radio handset, warns criminals

About the time of the introduction of 'Panda' cars in the UK came a new Police hi-tech system known as the Personal Radio. In many Police forces this consisted of a pair of UHF radios, a transmitter and a separate receiver. The receiver was the more interesting of the two from an EMC point of view. Crystal controlled, single frequency and not much bigger than a packet of king size cigarettes, it had a vicious local oscillator that radiated very strongly.

The introduction of Police PR radios came about at the same time as the UK was just getting switched on to colour television. Regrettably, immunity from RF interference was not one of the finer qualities of this new entertainment system. I recall being told a story by Alan who was a licensed Amateur Radio colleague who happened to be a local Policeman. Apparently, invited (?) into someone's home one day, the proud owner of his new colour television was watching a programme in glorious and over-saturated colour. Much to the annoyance of it's owner, the television suddenly reverted to a black and white picture when Alan and radio walked into the room. Alan quickly turned off his PR receiver and the colour returned. Further tests revealed that even if he stood outside the front door of the terraced house with his PR receiver switched on, the TV was determined to stay in black and white until he walked away.

Allegedly this phenomenon was quickly communicated in criminal circles. Alan told me that it was no coincidence that more than one or two criminals were seen to run out of the back door before the bobby actually knocked on the front door. It seems that the early warning system was not just confined to Fylingdales in those days!

(Sent in by Graham Eckersall, G4HFG / W4HFG, Approvals Manager, Barcrest Group, July 13 2004.)

303) Power quality problems will get worse

The widely publicized breakdowns and subsequent blackouts in the public power networks of the Northern United States and several European countries are extreme examples of phenomena that occur on a smaller scale many times every day. Studies have shown that Dips, or "brown-outs", and Interrupts, or "dropouts", in the public power supply are tending to increase in frequency in our overstretched power networks, causing further degradation in the quality of the electric power supply. The results of power interruption can cause equipment reset and data loss, resulting in such consequences as breakdown of production or even danger to life.

The situation is not going to improve in the short term. As more functions are packed into increasingly smaller volumes, power consumption inevitably increases. Further, the increased use of microprocessors means that equipment incorporating them is potentially more susceptible to power line fluctuations.

(Taken from "Dips/Interrupts Testing Gets an Update", by Martin Lutz and Nicholas Wright, Conformity, November 2004, page 12, www.conformity.com.)

304) Interference problems within a vehicle

When I sampled the Audi A3 Sportback recently with this same choice of transmissions, I could not decide which I preferred. For the GTI I emphatically opt for the conventional manual: even

with the ESP (Electronic Stability Program) disabled, in versions fitted with DSG there was excessive interference from background electronic systems. Requests via my right foot for full-throttle acceleration would often be refused for several frustrating seconds.

(Note from the Editor: DSG stands for Direct Shift Gearbox, a semi-automatic gearbox with a steering wheel-mounted 'paddle change' and no clutch.) (Taken from: "Regeneration" by Peter Dron, a motoring review of the latest VW Golf GTI, in the Daily Telegraph's Motoring section, Saturday November 6th 2004, pages 1-2, www.telegraph.co.uk.)

305) Interference can trigger airbags

Millions of cars have been recalled by the National Highway Traffic Safety Administration (NHTSA) and similar government safety agencies around the world, because of what is known as 'inadvertent air bag deployment'. This includes cars sold by virtually every leading auto manufacturers including BMW, Chrysler, Ford, General Motors, Hyundai, Land Rover, Mazda, Mercedes-Benz, Saab, Toyota, Volvo and Volkswagen.

In addition to rough roads, light jolts, stones bouncing off the road surface and light bender-fender impacts at speeds air bag deployment is unexpected, the reasons for inadvertent air bag deployment include electrical shorts, dirty electrical connections, normal Supplementary Restraint System (SRS) wear and tear, static electricity and an incoming or outgoing cell phone call.

The following incident was reported by a driver in the USA, where cellphones use the PCS system and operate at 1.9GHz: "I was holding the phone at arm's length so I could see the display to dial, in my left hand, so that it was almost touching the centre of the steering wheel when the air bag went off like a bomb. My hand was violently bent over so far that my fingers nearly touched the inside of my forearm. My head was wrenched backwards and to the left like somebody was trying to twist it off my neck. The pain of the air bag hitting my hand was excruciating; it felt like my hand was on fire and went on for what seemed like forever."

The above driver did some investigation, and concludes that: "The thinking is that, in certain circumstances, the electric current coupled into the vehicle wiring from the cell phone antenna when it is close to an air bag igniter can be enough to cause deployment of the air bag. The antenna of my cell phone was, at most, an inch-and-a-half from the centre of the steering wheel when the air bag went off. A US organization involved in EMC testing said that the field at such a small distance from a mobile phone is likely to be in the region of 70V/m."

It is impossible to say with absolute certainty that the cell phone set off the air bag. There are too many unknowns: the exact strength of the 1.9GHz current required to trigger the air bag; the exact distance of the cell phone antenna from the igniter; and the exact strength of RF field emitted from the cell phone's antenna and its coupling factors into the vehicle's wiring. *(Editor's note: But it seems very unlikely that the airbag should operate spuriously at the exact time that the cellphone was close to its igniter.)*

The Automotive EMC Directive requires whole cars sold in Europe to be tested for immunity at a minimum of 30V/m up to 1GHz, in Europe. Since the above cellphone operated at 1.9GHz it is outside the range of this testing and the susceptibility of the car's systems at this frequency is unknown. Also the testing is done with continuous wave (CW) and amplitude modulation (AM), not with the pulsed modulated (PM) signals typical of a mobile phone.

There are no legal immunity requirements for the USA – but all the reputable motorcar manufacturers apply immunity tests anyway to help reduce their risks of liability lawsuits. The EMC immunity specification employed by the manufacturer of the vehicle involved in the above requires electronic 'components' (subassemblies) to pass tests at 200V/m from 1-400MHz in a stripline or TEM cell, and 80V/m from 0-1000MHz in an anechoic chamber. Plus the whole vehicle is tested with radiated external fields at 200V/m from 6-30MHz, 140V/m from 30MHz-1.3GHz, and 70V/m from 1.3-3GHz – but these are the *external* field strengths: the fields inside the vehicle during these tests are not controlled so are unknown (the same comment applies to Automotive EMC Directive immunity testing).

The cell phone concerned operated at 1.9GHz, hence it was outside of the frequency range for the 'component' testing range – and the whole vehicle testing might not have created 1.9GHz fields at the steering wheel with field strengths comparable with those created by the close proximity of a cell phone. So neither this particular manufacturer's tests, nor tests under the Automotive EMC Directive, could be sure to reveal the susceptibility of the airbag igniter to very close proximity of a cell phone transmitting at 1.9GHz. Note that about half of the cell phones in Europe operate at 1.8GHz, using the GSM system, so this brief analysis also applies to them.

(Adapted from information sent in by Martin O'Hara of the Automotive EMC Network www.autoemc.net by email in April 2004.)

306) Cell phones interfere with Lexus sensors

After incidents where cell phone calls apparently interfered with a sensor in some 1998 Lexus GS300 and GS400 sedans, the NHTSA recalled them (No. 98V080): "Due to a manufacturing defect of the yaw rate sensor for the vehicle stability control (VSC), the VSC can operate improperly if the sensor is affected by certain electromagnetic waves, such as from a cellular phone. Should this occur, the brake can operate unexpectedly, affecting steering and speed control, increasing the risk of a vehicle crash."

(Sent in by Martin O'Hara of the Automotive EMC Network www.autoemc.net by email in April 2004.)

307) Poor power quality makes cooker switch itself on

Typically, regular voltage quality spot checks are made throughout a local distribution system with additional measurements taken when a customer asks; is there a voltage problem? Indeed, this was the initial question that prompted an investigation into the cause of a modern electric cooker switching itself on.

Initial discussions between the local Distribution Network Operator (DNO) and customer revealed that this phenomenon first took place at Easter, then July and was experienced repeatedly throughout the summer months. However, the problem did not then re-occur until late September.

Standard voltage quality analysis – to BS EN 50160 'Characteristics of voltage supply in public electric power supply networks' – simply showed an increased level of flicker, only slightly above normal levels. However, investigations did reveal that a cable-car was located some distance away from the residential area. This cable-car comprised a double lift installation, having a 65kW lift with slipping motor compensated with 20kVAr capacitor power, as well as a 75kW lift with a B6-circuit rectifier drive. Although electrically distant from the local distribution substation, the cable-car was supplied from the substation by a two-core 2×95mm² copper cable, approximately 400m long.

Further investigations indicated that the oven malfunction seemed to coincide with periods of increased cable car use, normally at peak periods in the summer. A half-day network analysis at the lift equipment connection point in the local distribution system was carried out. Oscillograms were captured when the envelope trigger or transient level trigger varied by 20% of the voltage fundamental peak, or at least 65V between the cable and earth. Results showed that these limits were exceeded by a factor of two, by commutation spikes caused by the operation of the B-6 rectifier drive of the 75kW lift when it was the only lift in use.

Going back to the cooker manufacturer revealed that the cooker's electronic oven controls initiated switching commands via pulses. It was possible that the commutation spikes – with their steep slopes and zero-crossings – were being mistaken as switch-on commands.

(Adapted from "Power Detectives", by Stephanie Horton, Engineering Manager at LEM UK Ltd, in the IEE Power Engineer Journal, October/November 2004 Issues, pages 40-41, www.theiet.org.)

(Editor's note: Keith Armstrong reports that in private communications with an officer enforcing product safety laws in a mainland European country, the officer said that they had experienced several instances of household appliances turning themselves on by mistake. This includes

appliances such as saunas, and fire safety was a significant concern. Interference was regarded as the likely culprit.)

308) Darth Vader toy switched on by low-level interference

What is electromagnetic noise and why is it proclaimed dangerous and unwanted? This extract from Ministry of Commerce's Field Offices newsletter is a graphic example of EM noise and interference (EMI) it may cause. "... A not so long time ago in a distract not so far away, a certain Technical Officer's son received a Darth Vader remote control toy for Christmas. The parents noted that this toy displayed the renowned C-Tick mark for EM Compatibility (EMC)! The children played Star Wars games until the sun set.

And that's when the real story began. You see, once the children were in bed at night, the parents could hear the occasional synthesised sound of "you underestimate the power of the dark side!". A quick check revealed all children asleep and the remote control untouched. Once a number of these occurrences had been heard, an "interference investigation" was launched.

The Technical Officer called himself back on duty and quickly found that the darned toy operated at 27.120 MHz and responded to electrical noise! This EMI could be generated from such simple things as light switches being turned off, and washing machine pumps switching during normal wash cycles..."

(Taken from "The Back Page" of the EMC Society of Australia's Newsletter, September 2004 Issue Number 27, www.emcsa.org.au.)

309) Computer company learns that EMC compliance pays

In its formative years, a major US PC manufacturer felt that FCC certification was not a barrier to marketing. Standard operating procedure was to sell while the authorisation process was in process. Then the FCC arrived to shut down the factory. The VP of Engineering met with the FCC in Washington at the last minute and worked out an agreement that kept the factory running. After that point, FCC certification and other agency approvals became a requirement before shipment was authorised. Today, that company has a world class compliance operation and I am proud to have taken part in that process.

(Richard Woods, in a correspondence on the IEEE's emc-pstc list server, 15 July 1998.)

310) Interference before World War 1

The US Military first encountered Radio Frequency Interference (RFI) some time prior to World War 1 when a radio was first installed on a vehicle.

(Warren Kesselman and Herbert Mertel, writing in the "EMC Standards Activities" section of the IEEE EMC Society Newsletter, Summer 2000 Issue, www.ewh.ieee.org/soc/emcs.)

311) New vacuum cleaner crashes car manufacturer's computer

A cleaner in the offices of a major UK car manufacturer started to use a new vacuum cleaner, plugging it into the sockets in a corridor outside the room where their stock control computer lived. Unfortunately, the mains sockets in the corridor were connected to the same branch of the power distribution as the computer, and the conducted noise from the vacuum cleaner crashed the computer. This happened ever day for some time, costing the company a great deal of money, until someone realised the vacuum cleaner was the cause of the problem.

(Anonymous, private conversation August 1994.)

312) Mains transients cause spurious switch-on of toaster, burns gas station down

Transients in the mains supply of a gas station in the USA (called a petrol station in the UK) caused the spurious switch-on a microprocessor-controlled toaster one night after the staff had all gone home. Since the microprocessor wasn't in its normal programme, it didn't switch the toaster off.

The manufacturer of the toaster had omitted to include a thermal fuse, so the gas station caught on fire and burnt down. The PCB had been designed by a UK company, and its designers were later questioned intensely by a team of US lawyers for several hours.

(Anonymous, private conversation, August 1994.)



313) Radar interference anecdotes

Our purchasing manager has a penchant for (expensive) cars. He had a '92 Peugeot 605, and whenever he drove past the military airbase at Lyneham its air bag indicator would light. This was attributed to the site's radar interfering with the car's front wheel sensors. In addition the semi-automatic gearbox would drop into sports mode... The '93 model he now has appears to be immune.

I myself suffered TV interference from ground radar when living 10 miles from Gatwick airport – bars would roll down the screen as the sweep went through.

(From Chris James, private communication, 7th July 1998.)

Banana Skins numbered 314-317 describe interference events that we might not be too surprised to hear about in or after 2015 (shown here in a blue font).

314) 2015: CE does not stand for 'China Export'

A major electronics manufacturer has been ordered to suspend all sales in the EU while it fixes EMI problems with its products. Enforcement officials impounded products in warehouses throughout the EU. The average time to fix a product's EMI problem is expected to be one month, but they have so many products that they expect it will be two years before they finish. They had argued that they thought the CE mark stood for 'China Export', said no-one had actually told them they had to comply with the EMC Directive, and that they were only doing what many of their competitors were doing anyway. The enforcement agents found these arguments unpersuasive.

(Possible electronic industry trade journal news item in 2015, or in fact in any year.)

315) 2015: Plasma beam weapon interferes with COTS

Western military forces have come to rely (unofficially) on the widespread use of consumer ('COTS') electronics such as GPS navigation, cellphones, and palmtop computers with wireless datacomms. Every soldier, sailor or pilot seems to own at least one of each, and they take them everywhere with them, including military exercises and operations. Some enterprising junior officers have even created their own 'command and control' nets, some of which seem to be much more effective than official ones.

But during a recent NATO exercise based around the new SHIVA particle-beam anti-missile tactical battlefield man-pack systems, a large proportion of this COTS equipment failed to work and the unofficial methods that had grown up around them fell apart, causing great confusion. It had not been realised by how much these facilities had come to be relied upon. As a result, the 'attacking' forces easily won the exercise, despite being on foot, armed only with weapons of Afghan war vintage, and communicating by shouting loudly.

(Possible article in Jane's Defence Weekly in 2015, <http://jdw.janes.com>.)

316) 2015: Vacuum cleaner interferes with space station navigation

A number of people who had been enjoying weightless activities in the non-spinning central hub of Virgin Space Ltd's newest hotel "Arthur C Clarke III" found themselves trapped on the 'ceiling' for 15 minutes, unable to reach the doors that were now 6 metres 'up' a smooth wall. The cause was a new cleaning droid. When it plugged itself into the wall sockets in the corridor in the engineering section a 0.5g acceleration occurred. It was later found that the corridor power sockets were on the same branch of the power bus as the navigation computer, and conducted interference from the new droid caused the asteroid-avoidance emergency thrusters to fire. The droid has refused to comment.

(Possibly from the Sunday Times News Review section, one week in 2015, www.sunday-times.co.uk.)

317) 2015: Intelligent cruise control interferes with latest silicon chips

The 30nm silicon fabrication process is now well-established and helping create many products and provide services that even ten years ago would have been considered science fiction. But investigations by York University into claims of unstable personalities in the latest models of

robotic personal companions has revealed that ICs made with 30nm silicon features are very susceptible to the 76GHz radars used by the car-train systems required by automated highway systems. 76GHz automotive radar technology first appeared in the early years of this century as 'intelligent cruise control' or 'automatic emergency braking' systems for luxury vehicles, and is now ubiquitous. York University is now seeking sponsors for a programme of investigation into low-cost techniques for shielding and filtering at 76GHz.

(Possibly from the News section of The EMC Journal in 2015, www.theemcjournal.com.)

318) New battery pack significantly reduces RF immunity of life vest, causes malfunctions

An example of a subtle change in hardware configuration to the original design concept can be found in a life vest. The life vest was fielded with a bridgewire EID that could be fired by a salt-water activated battery pack that had been hardened and certified for HERO. After introduction into the fleet, an engineering change proposal was developed, and approved, to modify the type of battery used in the battery pack. The change was not submitted for HERO consideration. When the life vests were equipped with the new battery pack and used on board Navy ships, there were reports of uncommanded activation of the vests during flight operations and on the flight deck. The subsequent investigation found that the new battery pack made the EID subsystem resonant to a ship radar system; thereby creating susceptibility problems.

(Taken from MIL-STD-464A, Appendix A.5.9 'Life cycle, E3 hardness'. 'HERO' stands for Hazards of Electromagnetic Radiation to Ordnance.)

319) Most ESD test generators do not simulate real-life ESD events

Even though all the (*ESD test*) generators have peak current values and risetimes very similar to the ones specified in the standard, some of the generators fail the equipment under test (EUT) at vastly different voltage levels from the others. A range of 1:5 is shown in the second part of this two-paper series. This indicates that even though all the generators are made in accordance with IEC 61000-4-2 they produce different ESD events leading to a serious repeatability problem when the same EUT is tested with different brand generators. The problems have been well documented although the connection between parameters and EUT failures has been speculative so far.

As the fraction of devices that use fast CMOS is increasing, and going to continue to increase in the future, changes in the ESD standard are needed. Without such changes, the growing fraction of devices that can respond to pulses having widths of tens to hundreds of picoseconds will lead to an increasing dependency of the test result on the model of ESD generator selected.

For an EUT that reacts to the lower frequency (<1GHz) current components, the effect of changing the ESD generator model should not be larger than 1:3. In fact, we have not observed any ratio of EUT failure voltages above 1:2. In contrast, modern CMOS circuits with less than 0.15µm technology can react to pulses as narrow as 50ps. These circuits will respond to the fast-changing (unintended) components of the induced voltage. The effect (*on such fast devices – Editor*) of changing the ESD generator model may be as large as 1:10, as the spectral density varies by more than 20dB, as shown in our Fig. 3. Our observations showed a 1:5 variation.

With the introduction of more and faster CMOS circuits, the large influence of the ESD generator model, shown in Fig. 4, will occur more often if the ESD standard is not improved.

How many of the ESDs will have a larger severity than the reference event? Due to the strong dependence on factors like humidity, personal activity, clothing, etc, there is no final answer. Generally, for lower voltages the typical rise times are much shorter and the rate of occurrence of ESD is larger, but fast rising ESD having less than 300ps rise time can also occur under dry conditions and fast approach speeds at voltages as high as 15kV.

These low-voltage ESDs and higher voltage ESDs having short arc-lengths show short rise times, as low as 50ps, thus their high-frequency content is much stronger. Up to now some widely used ESD generators not only covered the spectral content of the proposed reference event, but also tested for fast rising ESDs. They did not do so intentionally, but as a result of their design, which was based on incomplete understanding of the failure mechanisms in fast electronic systems and insufficient specifications.

In our opinion, the ESD standards IEC 61000-4-2 should be revised such that ESD generator performance is as similar to the reference events as possible in all their parameters. But manufacturers and users need to be aware that the standard does not cover all possible ESD events. For example, medical equipment might need to be tested using a shorter rise time to cover a larger portion of the real ESDs, notwithstanding furniture ESD or other ESD types. The standard needs to be understood as a minimum requirement, passing it does not protect against ESD related field failures.

(The above are some paragraphs taken from "Characterization of Human Metal ESD Reference Discharge Event and Correlation of Generator Parameters to Failure Levels — Part I: Reference Event" and "— Part II: Correlation of Generator Parameters to Failure Levels" by K Wang, D Pommerneke, R Chundru, T Van Doren, F P Centola, and J S Huang, IEEE Transactions on EMC Vol. 46 No. 4 November 2004, pages 498-511.)

320) Phone masts interfere with car immobilisers and alarms

Customers at two garages in Birmingham are reportedly being forced to freewheel their cars off the forecourt. 'National Tyres' and 'Car Spares', both on the city's Stratford Road, are experiencing interference from phone masts on the roof of the Centre Court office block and visitors to the sites have to push their cars nearly 100 yards out of range of the masts before starting them.

Clive Carter, from National Tyres garage, and Keith Murphy, from Car Spares, told the Birmingham Post that many customers could not start their vehicles in their forecourts. It is believed the mast's rays are interfering with car's ignition systems, immobilisers and alarms. Mr Carter said: "This has happened at least 20 times in the last year. The strange thing is that when a car is pushed down the road it starts easily. The mobile phone masts seem to be the only explanation for it."

(Taken from the HSE's internal newsletter, 7/3/05, sent in by Simon Brown)

321) Electromagnetic pulse gun stops speeding cars at 50 metres

A hi-tech device that can bring speeding cars to a halt at the flick of a switch is set to become the latest weapon in the fight against crime. Police forces in Britain and the US have ordered tests of the new system that delivers a blast of radio waves powerful enough to knock out vital engine electronics, making the targeted vehicle stall and slowly come to a stop.

David Giri, who left his position as a physics professor at the University of California in Berkeley to set up a company called ProTech, is developing a radio wave vehicle-stopping system for the US marine corps and the Los Angeles police department. Tomorrow, at the Euroem 2004 science conference in Germany, Dr Giri will describe recent trials of the device. The tests proved that the system could stop vehicles from up to 50 metres away.

The bulk of the device is designed to fit in a car boot and consists of a battery and a bank of capacitors that can store an electrical charge. Flicking a switch on the dashboard sends a burst of electricity into an antenna mounted on the roof of the car. The antenna then produces a narrow beam of intense radio waves that is directed at the vehicle ahead. When the radio waves hit the targeted car, they induce surges of electricity in its electronics, upsetting the fuel injection and engine firing signals. "It works on most cars built in the past 10 years, because their engines are controlled by computer chips," said Dr Giri. "If we can disrupt the computer, we can stop the car." A prototype is due to be ready by next summer.

The Association of Chief Police Officers confirmed that researchers at the Home Office's police scientific development branch are testing a radio wave vehicle-stopping system. "There's a potential to use this type of device to stop criminals on the road. High speed pursuits are very dangerous, especially in built-up areas," said an association spokesman.

(From "Police test hi-tech zapper that could end car chases", Ian Sample, science correspondent, Monday July 12, 2004 Guardian Unlimited © Guardian Newspapers Limited 2004.)

322) Domestic switching transients interfere significantly with some DAB radio receivers

Browsing through EMC & Compliance Journal today I am reminded of a very obvious form of RFI generated at home. We are all aware of TVs and radios being effected by vacuum cleaners, food mixers, mobile phones and the like (and some cars, but far fewer these days), but a more specific form of interference has exhibited itself ever since I was given a DAB radio for Xmas by my better half.

When switching low-energy bulbs on or off in the vicinity of the radio (but as far as 5m away) reception is, as often as not, completely halted for a second or so, a much more 'catastrophic' event than the usual crackle from conventional AM/FM radios. Such is the price of progress!

(Sent in by Dave Bethell, Principal Engineer, Anthony Best Dynamics Ltd, 12th January 2005.)

323) Self-inflicted EMC problems in the military

Banana Skin number 6 refers to EMC problems during Desert Shield and Desert Storm. EMC problems can be self inflicted; I remember seeing a radio-listener's report on a USENET forum that tactical inter-plane chatter was heard in the US on the US Navy UHF satellite outputs, apparently from aircraft in the initial attack waves of Desert Storm. This seems to have been due to frequency coordinators unknowingly assigning attack frequencies in the satellite uplink range.

(Sent in by Cortland Richmond, KA5S, May 21 2005.)

324) Small brushless DC motor interferes with microwave comms link

We had a receiver noise problem with a 'C' Band SNG van when the dish was pointing near the horizon (over the air con unit). We were getting random loss of signal (broadcasters NOT happy!). Investigation (with a spectrum analyser probe near the motor body) revealed that the (DC brushless) fan for the air-con unit was radiating a strong comb spectrum from the 150KHz-ish of it's SMPSU up to over 6GHz and a reduced level was still detectable at 14GHz! It seems that the (CE marked!) motor of Italian manufacture (used extensively for vehicle radiator cooling as well as in air-con units) recently had it's die-cast motor end plate changed to a plastic moulding (plus perhaps newer faster switching transistors?). The un-shielded motor/electronics was therefore radiating quite strongly.

Our solution was to fit a metal disc/plate over the motor hub (a screen between the source and our 1.2M dish antenna). This effected about a 20dB improvement and enabled the system to work as intended (signal now above rather than below the interference!). I suspect that if any EMC testing was performed, the type of product would suggest that only conducted and power clamp measurements should be performed and NO radiated emissions (certainly not above 1GHz). After all a DC motor cannot cause many problems can it????

Unfortunately it seems even small low power internal air circulating fans of the brushless DC type produce quite heavy conducted and some radiated RF. Some of our products have had problems with fan EMC within a unit. We now, as a matter of course tightly twist the wires and sometimes add a common mode choke to the fan feed to avoid noise on the 5V, or 12V rails corrupting signals and data within our broadcast encoders etc.

(Sent in by Dave Keston, Approvals Engineer, Vislink Communications, 20th January 2005.)

325) TV antenna boosters the cause of interference from new radio service

The new emergency services radio system, called Airwave, has been blamed for interfering with television reception, but where problems occur the fault lies with the filters on domestic aerial amplifiers. Trade and Industry minister Steven Timms, in a Parliamentary written answer, said: "Ofcom is aware of instances of interference to domestic installations from Airwave radio base stations. In all the instances so far investigated the consumer's own masthead aerial amplifier, used to boost weak signals, has had a pass-band wide enough to boost the television signal and, inadvertently, the unwanted radiocommunications signal."

Airwave is being rolled out across the Great Britain for police and public safety communications, with completion due by 2005, when existing frequencies will be withdrawn. It is a digital system based on the ETSI-approved Tetra (Terrestrial Trunked Radio) standard. Mr Timms went on: "Testing has shown that the Tetra transmitters were operating correctly and within their

designated licence parameters. In most cases a suitable filter fitted between the masthead amplifier and the TV aerial will resolve the interference, and affected residents have been advised to have such filters fitted. As a goodwill gesture Airwave has arranged for filters to be fitted to the affected television installations in certain circumstances."

("Aerial amplifiers cause Tetra TV interference", from 'EMC Industry News 2004-01-15' on the IEE's EMC Professional Network website, 18th Jan 04, www.theiet.org.)

326) Mobile phones interfere with railway signalling and ticketing

In south Jutland, the Danish state railways, DSB, have forbidden mobile phones on all marshalling yards in the district. The reason is that GSM telephones have caused the signal system to switch from green to red, and have also caused interference in the ticketing system used.

(Sent in by John Whaley, 16th May 2005)

327) Wi-Fi hotspots interfere with military radars

Northwest Florida Daily News reported that Air Force officials say high speed and wireless internet connections are interfering with their tracking radar at Eglin Air Force Base, Fla. The radar is a vital tracking tool for high-tech weapons over the Gulf of Mexico. They notified Okaloosa County officials, who responded by warning that if the interference were intentional, violators would be fined and their equipment confiscated. The troubled frequency band is in the 5.6 GHz to 5.8 GHz range.

"There are evidently people who are firing up (wireless Internet) hot spots without (Federal Communications Commission) licensing," County Manager Chris Holley said. He said Air Force officials told him the interference is infrequent but that they hope to stop the trouble before it becomes widespread.

(Taken from the "From the Grapevine" section of the Joint E3 Bulletin, Volume 11, Issue 2, April 2005, A Publication of the U.S.A. Department of Defense. The article was originally called "High Speed Net, Wi-Fi Interfering with Military Radar" and was sent in by Terry Dunford of the CAA, www.caa.co.uk. Terry would like to point out that in the UK, meteorological radars work on 5.6GHz.)

328) Many WLAN products returned to stores due to interference

Interest in using smart antennas in Wireless LAN (WLAN) and mobile networks is gathering pace, according to Tim Berghuis of US-based InterDigital Communications. Mr. Berghuis, who was demonstrating the company's AIM (adaptive interference management) antenna at the recent 3 GHz Global System for Mobile (GSM) World Congress. He stated that, "On the WLAN side there's been lots of interest; and we're seeing quite a bit of interest on the mobility side - both GSM and Code-Division Multiple Access (CDMA) 2000."

Berghuis noted that the "bigger problem" lies with WLAN, which accounts for approximately 25 percent of the products returned to stores because customers cannot get them to work. Berghuis said, "People hook it up and it's not working and we think a good portion of this is attributable to interference."

(Taken from the 'From the Grapevine' section of the 'Joint E3 Bulletin', Volume 11, Issue 2, April 2005, A Publication of the U.S.A. Department of Defense. The article was originally called "3GSM: Interest rises in Smart Antennas" and was sent in by Terry Dunford of the CAA.)

329) Vatican radio operators prosecuted

In a follow-up to a long running story, sources throughout Europe are reporting that an Italian court has convicted a Roman Catholic priest and a cardinal of polluting the atmosphere with powerful electromagnetic waves. Cardinal Roberto Tucci and Father Pasquale Borgomeo were given 10-day suspended jail sentences and ordered to pay damages and court costs. Earlier two scientific studies had suggested that the cluster of powerful broadcast towers north of Rome could be responsible for the high cancer rates in the area.

Earlier court actions were thrown out because of a now over-turned ruling that Italian courts had no jurisdiction over the Vatican, which is a separate sovereign state. Vatican Radio Program Director, the Reverend Frederico Lombardi, vowed to appeal.

(Taken from the 'EMC News' section of Interference Technology's on-line EMC newsletter, May 18 2005, <http://www.interferencetechnology.com>. A similar story "Vatican Radio officials convicted" appears in the BBC News at: <http://news.bbc.co.uk/go/pr/fr/-/1/hi/world/europe/4531247.stm>, published 2005/05/09 20:43:52 GMT.)

330) VCR/CD/DVC combo TV sends out false distress signals

This October, Chris van Rossman of Corvallis Oregon turned on his do-everything combo TV and got a big surprise—the police, the Civil Air Patrol, and the County Search and Rescue Officers knocked on his door. Apparently, Mr. van Rossman's flat screen, VCR/CD/DVC combo TV had developed some sort of strong emission (a parasitic oscillation, more than likely) at 121.5 MHz, which is a rescue frequency used by aircraft and boat distress transponders and monitored by orbiting satellites. This service uses an uncoded analog carrier detection system, and is therefore rather sensitive to unauthorized transmissions.

When the distress signal was picked up from the satellite, the information was picked up by the Air Force Coordination Center at Langley Air Force Base in Virginia. Langley in turn called the volunteer Civil Air Patrol in Oregon, which in turn contacted Benton Country Search and Rescue for help in locating the signal. Using radio direction finding equipment, the officers were able to narrow the source down to a few possible units in Mr. Rossman's apartment building. When they knocked on his door and he turned off his set to answer, the signal disappeared.

David Mandrell, the CAP squad leader had heard of similar inadvertent interference from consumer equipment, but often it was weak enough to be ignored. This particular instance of interference was unusual because it was abnormally strong. Mr. Rossman was simply warned to keep his TV turned off or face fines of potentially up to \$10,000 per day for emitting a false distress signal. He has contacted the set's manufacturer, whose technicians had never heard of a case like this, and has agreed to send him a free replacement.

(Taken from Conformity magazine, Jan 21 2005, <http://www.conformity.com>, the original article was entitled: "TV Interference Triggers Aircraft Rescue Satellite Response", and published in the Corvallis Gazette-Times, Oct. 17, 2004)

331) Illegal truck radio transmitters suspected of causing two bus accidents

It has been reported widely in the Japanese press that electromagnetic interference caused by illegally modified transceivers on trucks is suspected of causing two accidents by disabling the braking system of commuter buses. Mitsubishi Fuso Truck & Bus Corporation announced that two models of its buses are adversely affected by high-powered EMI from short distance and its braking system may not function properly under such conditions. Specifically, its braking system that detects the wheel-locking condition falsely triggers due to the EMI and thus the brake doesn't work as intended.

Two accidents were reported last year where the bus drivers reported that the brakes suddenly stopped working. However, after the police investigation, no visible malfunction was found. The manufacturer continued investigation and found that high-powered radio signals emitted by a nearby transceiver (illegally modified and thus 1,000-10,000 as strong as permitted by law for such transceivers) can interfere with its braking control unit, resulting in false information that the wheels locked due to braking. Upon this false information, it seems (my interpretation from what I read various reports) that the control unit decided to release the brakes, and thus caused unintended loss of braking.

It is not known whether such illegally modified transceivers were present nearby in two accident cases. But in other two instances where loss of braking was observed, the bus drivers saw suspicious trucks nearby. The company could reproduce the condition in live experiments, and it will refit the 2200+ cars by replacing the control unit, sensors, pipes, circuit harness, etc. I think the company should be commended for its continued investigation after the accidents.

(An extract from the Risks Digest 5 Jan 04 issue that is posted at: <http://catless.ncl.ac.uk/Risks/23.09.html>. Sent in by Simon Brown of the HSE, January 2003. The Risks Digest describes itself as a "Forum on Risks to the Public in Computers and Related Systems", current issues can be read at: <http://www.csl.sri.com/users/risko/risks.txt>.)

332) Concerns about worsening interference in medical and healthcare discussed

Is there enough regulation in the EU to avoid the potentially fatal outcomes for patients that could occur when electromedical or electronic medical devices interfere with each other or with other equipment? And are manufacturers taking enough care to ensure that they are not exposing themselves to the litigious consequences of being negligent in ensuring that such devices operate properly in the environment for which they are intended?

Those were the questions being asked on June 15 in London at the Management Forum Regulatory Update for Electromedical Device and Equipment Manufacturers in London. While actual cases of serious incidents and deaths caused by such interference are difficult to establish given the anecdotal nature of many reports, a UK study dating back to 1993, suggested there had been 23 serious incidents and two fatalities due to electromagnetic interference that year.

Unfortunately, more recent events are "hard to nail down" one regulator told the meeting, although "we know there are causes and effects, and with basic proximity testing you can prove this". Hospitals are generally reluctant to report incidents, delegates at the meeting heard, because of the fear of blame, as was the case when one surgeon answered his mobile phone in the operating theatre, causing the anaesthesia machine to reset.

Without doubt, potential interference is a growing problem and, unless something is done to keep up with the rapidly changing technological environment, manufacturers are going to find themselves increasingly at risk of being accused of lack of due diligence and even negligence.

Consultant Trevor Lewis of Medical Device Consultancy told the meeting: "We know that there is a lot [of interference] going on. Whether it is being reported is another matter. To get more people to report we should avoid apportioning blame and that may move forward the trend to report."

Mr Lewis is adamant that something needs to be done and quickly on an EU level. "I've seen this trend [of electromagnetic interference] moving forward, and I want to be able to advise my clients accordingly to make sure that they are robust from a regulatory and liability point of view," he said.

This not an issue that manufacturers can solve on their own, he insisted, since about 85% of companies operating in this area are small firms and simply cannot afford the resources to analyse the environments in hospitals into which their equipment is placed. Instead, Mr Lewis believes "it would be good if the regulators could characterise safe environments - not only in hospitals, but in homes as well".

To what extent the hospital managers are also responsible for ensuring that electromedical and electronic medical equipment is used in situations where the risk of interference is avoided, seemed unclear at the meeting.

"Very few NHS hospitals are taking this seriously," Chris Marshman, managing director of York EMC Services and chairman of the conference said. Most hospitals, he continued, have medical physics departments that would be capable of the necessary assessments yet it "seems nothing is happening and there is no co-ordination".

It is not only the decisions about where to install products that need to be taken by those in hospitals with a full understanding of the potential interference problem, it is also decisions concerning the management of the maintenance of equipment. Some clinical engineers working on equipment in accident and emergency, for example, may be unaware that if they remove the screws from an item of equipment during maintenance and then fail to put them all back, that this could change the EMC of the equipment and potentially increase risks.

So with all the risks bound up in the use of electromedical and electronic equipment, what can manufacturers do to ensure to prove that they have taken all reasonable steps in terms of addressing issues that arise through a constant risk analysis and management to avoid the risk of interference?

The key here for manufacturers is to ensure instructions for use are clear and readily available, to provide a good installation guide to ensure that the user can safely install the equipment and to use historic good practice to give indications about the careful "zoning" of equipment in the intended environment to avoid interference problems, Mr Marshman said. Also necessary is any further information that will ensure the device is EMC compliant throughout its lifetime, including flagging up in the maintenance file any essential steps, such as putting back all the screws on equipment and explaining why.

"Care is needed on both sides," Mr Marshman insisted. "The manufacturer with the instructions, and users to make sure that they know what they are doing...The duty on users is to make sure that they are doing the best they can."

Finally, a word of warning was given by Ian Cutler, senior medical devices expert and European regulatory affairs consultant to the medical devices industry. Mr Cutler reminded delegates that the healthcare environment is becoming increasingly litigious and asked the meeting to imagine what a prosecuting lawyer would ask, should an incident lead to court action. "Did you consider how X could have had an effect on your product? And, did you have enough technical data to justify your claims on performance?" would be among the likely questions and companies would be found to be totally negligent to ignore potential new sources of interference.

So, it is clear that companies operating in this sector expose themselves to being prosecution unless they are constantly updating their knowledge of potential and changing risks and applying it to products being marketed and in the field. Unless manufacturers perform constant post-market surveillance and risk management and act immediately on their findings, they could face sanctions, including criminal prosecution.

(Taken from "Is the EU underplaying the device interference problem?", Clinica – World Medical Device & Diagnostic News: Issue 1113, p8, filed 21 June 2004. Trevor Lewis can be contacted at: lewlink@btclick.com)

333) BMW screen heater interferes with car radio

Q: The rear-screen heater in my BMW 3-Series causes so much interference when switched on that it's impossible to listen to the car radio. Our local BMW dealer suggested replacing the entire rear screen as at cost of more than £600. This seems drastic. — KR from Hertfordshire.

A: This is a known problem within the trade. It stems from the fact that the rear screen includes both the heating elements and the radio aerial. The high level of electrical current required by the heating elements is being picked up by the aerial. Fortunately, it is usually possible to fit one or more electrical suppressors into the heated rear window wiring, as close as possible to the window itself. These reduce the electromagnetic interference from the screen to a level where it shouldn't interfere with the aerial. This will cost much less than a new screen.

(Taken from 'Car Clinic', Sunday Times, March 13 2005, page 26, www.sunday-times.co.uk.)

334) EMI suspected of causing cancellation of shuttle launch

Just in case anyone in the EMC community was away from the media for the last few days, electromagnetic interference is one of the suspected culprits in a fuel sensor malfunction that resulted in the cancellation of the first planned space shuttle launch earlier this month. Four hydrogen fuel sensors read either wet or dry, and a dry reading from all four sensors triggers engine cutoff and an aborted launch. After the originally scheduled flight was called off on July 13, literally hundreds of engineers tried to recreate the electromagnetic environment in which one sensor failed intermittently. Reportedly grounding was improved, and the entire craft re-examined for possible sources of EMI.

Still, the exact cause of the intermittent failure was not identified, and NASA rules were modified so that lift-off could take place with three operational sensors. Fortunately, the intermittent fuel gauge glitch did not reoccur during Tuesday's lift-off. (Sadly, as we prepare our final copy, word of foam problems and cancellation of future flights has just been released to the media.) Clearly, NASA personnel face some daunting challenges in the months ahead. Moreover, every modification to the extremely complex craft alters the EM environment in which delicate instrumentation must function.

(From Interference Technology E-News, 29 July 05, <http://www.interferencetechnology.com>.)

335) Close proximity of cell phone corrupts data in keyfob, immobilising vehicle

I've always been suspicious of admonitions to turn off mobile phones on planes, in hospitals and so on, believing them to be yet more examples of the culture of bossiness that pervades modern life. It turns out that the bossy-boots are right.

You know how it is – one minute the car is working perfectly; the next – literally – it has conked. So it was last weekend when I was trying to transport four extremely heavy lead planters, overlooked by the removers, from the old flat to the new house. Various people emerged to have a look and offer advice, including the mechanic who lives opposite (who said Londoners aren't neighbourly?), but the nature of the conking-out remained a mystery. "It sounds as if it is trying to start, but isn't." said one man, helpfully (who said men know all about cars?).

Then the AA man arrived – all yellow van and flashing lights, just like in the adverts – and solved the problem immediately. Had I, he asked, kept the car key anywhere near my mobile phone? Well, of course I had. Like most women I lug around a miniature version of my life in my handbag.

This was my mistake. The mobile phone signal had corrupted the chip in the key, disrupting the central locking system and knocking out the ignition. The thing was that none of us knew about this – not me, the neighbours, friends I have told about it, not even the mechanic. I pass on the information so that no one else finds herself stuck on a yellow line in the middle of London on a searingly hot day with a car that is going nowhere.

(From Rachel Simhon's column in the 'Diary' section of the Daily Telegraph, Saturday July 16 2005, page 23.)

336) Modern EM environment creates problems for audio induction loops - examples

Being involved in providing audio induction loops for hearing aid users, I am interested in cases of audio magnetic interference. The modern electromagnetic environment has an increasing number of these.

While installing loop systems in a building in Wolverhampton Science Park I checked for possible interference. A coil of red-coated pyrotenax cable in the ceiling was interesting. That being part of the Fire Alarm installation, I used the monitor receiver to listen to the "Break-Glass" alarm point. Again, I heard the same digital noise right across the audio range. This kind of interference is a continuous background buzz for hearing aid users wanting to use an induction loop. This compares with listening to a car radio, or to a CD with a noisy fan in the room. In practice, the magnetic field from the Break-Glass would not be a problem. But the field from the cable routing and the coil of surplus cable just above someone's head could be.

We found a similar interference in a new building in Edgbaston High School. Most of the hall is clean, but there is one corner with significant digital noise. Again, it happens to be next to a storeroom containing the displays for the fire alarms. Otherwise, in that room, the fire alarm is cleaner than at Wolverhampton.

A case which may not be an audio magnetic field (I did not have the right detector available) was at my mother-in-law's. We heard that the Hi-Fi had developed a fault, and there was a buzz. I found this buzz on the cassette deck, though the radio was clean. Moving the BT DECT cordless phone cured the problem. The wiring for this, from the power supply as well as the phone line, seems to be the main radiator. Since it is plugged in to the same mains point as the hi-fi, separating the items is difficult. It is not clear whether or not this is magnetic interference. But cassette tape play heads are susceptible to magnetic fields. For example, with separate items, placing a tape player on top of an amplifier usually causes a loud hum from magnetic coupling to the amplifier power supply.

Audio induction loops are a common "aid for the disabled" using the audio magnetic spectrum coupling to a pick-up coil in the hearing aid. The target magnetic field is 100mA/m to match normal hearing aid microphone levels. Installers, and public buildings, use monitor receivers to check loop systems. One such monitor is the Ampetronic ILR2 which allows people with normal hearing to hear what a hearing aid user would hear.

I happened to have a loop monitor with me when I was shown around the brand-new library building in Bournemouth. They have the, now ubiquitous, standard screening arrangement to detect books being smuggled past the check-out. This generates such a strong magnetic field that the nearest induction loop on the counter has to be about 4 metres away. Any closer and the noise, a constant whistle at about 1kHz or so, is intolerable for hearing aid users.

Similar anti-theft screens, the familiar pair of (usually) grey loops you walk between entering or leaving larger shops are very common. Because check-outs are near the doors, this is likely to be a problem where hearing aid loop systems are fitted. I happened to visit a major car accessory shop in Birmingham, again with a loop monitor to hand. The whistle from the security screen could be heard out in the car park.

(Sent in by Robert Higginson, 14 July 2005)

337) Audio induction loops can interfere with other equipment

Audio frequency induction loops are an aid for hearing aid users which generate an audio frequency magnetic field. Often the siting of these is very restricted because of the way a building is built. While there is a specification for the field strength, this applies to normal listening position and there can be very high fields close to the loop cable. These fields can couple into other systems and equipment. Because EMC specifications are geared up for radio frequencies or mains power, high levels of audio magnetic fields are often forgotten.

We installed a desk loop system at an enquiries desk. These are supplied as kits, with a pre-formed loop coil usually located just underneath the desk, and driven hard so that the hearing aid picks up the spill field rather than the main field inside the coil. Having set the field to give the required "head height" signal, we found that the computer was responding to the magnetic field. The keyboard had a magnetic card reader used for staff to log-on. This was interpreting the audio signal as an erroneous user-name and password. Options were limited as there was only one tidy and vandal resistant place to put the loop. The solution was to move the keyboard away from the loop installation. In its normal place, the keyboard would be exposed to magnetic fields of several amps per metre.

Several years ago we installed a sound amplification system including induction loop in a church building. They also had a video projector, used with computers and video players with no problem. Recently they bought a new lap-top computer and the supplier offered a special package deal including a new projector. The new equipment picked up "hum bars" from the loop. The computer firm, apart from comments about "new regulations for loop installations" proposed the loop amplifier being switched off. We tried a range of other projectors and there was no problem. Only the Hitachi projector supplied packaged with the computer suffered hum

bars. As an isolated equipment, a projector may pass susceptibility tests. But such equipment is never used in isolation, only as part of a system.

(Also sent in by Robert Higginson, 14 July 2005. Also see Robert's article "Are You Hearing Me? An aid for the disabled lacking EMC protection" in the UK EMC Journal, June 1998, pp 14-16, available from the archives at <http://www.compliance-club.com>.)

(The Editor notes that the immunity standard for professional audio, video and lighting equipment and systems, EN 55103-2, includes requirements for immunity testing with audio-frequency magnetic fields. But system integrators often use 'domestic' equipment that has not been made compliant with EN 55103-2, in their systems, and ignore their responsibilities under the EMC Directive by assuming that simply using CE marked items of equipment will result in a compliant system – the so-called CE + CE = CE approach, which does not work and furthermore has no legal or technical justification.)

338) Plasma screens in waiting rooms interfere with ultrasound medical diagnostics

A new hospital, commissioned in 2002, had large plasma display screens in their waiting rooms, showing fish swimming. But ultrasound diagnosis equipment in the rooms on the other side of the walls that the plasma displays were hung on suffered from interference. Close-field probing with a spectrum analyser showed significant levels of emissions leaking through the wall from the waiting room plasma displays, so they were assumed to be the culprits.

Moving the ultrasound equipment to the far side of the room from the wall shared with the waiting room reduced the level of the interference. When the interference levels are too high for a particular test, the ultrasound operators have permissions to switch the plasma displays off.

(Sent in by Clive Griffiths, 15th June 2005)

339) Wireless devices interfere with office equipment in U.S.

USA delegate opened a discussion on the new work being promulgated in the US by ANSI to address immunity concerns from wireless devices when used in close proximity to office equipment. (This had originally been raised by Goldman-Sachs who found this problem in their offices). The primary concern appears to be interference to telephone devices, although the draft ANSI standard is not limited to them alone. The standard being developed appears to be a product standard, not a basic standard. There is no chance of this being legislative but likely to remain a contractual issue.

This is a cause for concern to WG10 because of the risk of alternative test methods and attendant problems of multiple test regimes, inter-correlation, etc. It appears that this work has come about because of the lack of any immunity requirements in the US (*for household, commercial and industrial products – Editor*). Similar environments in Europe where CE marking is required have not evidenced such susceptibility.

(A report from a delegate to the WG10 Meeting 25-29 April 2005, Beijing, China, "Maintenance of 61000-4-3")

340) Lighting system capacitors cause power system resonance hence failure of crane motor

Haag cite one experience where an intermittent failure was caused when the pulse driven motor of a crane went into resonance with the compensating capacitors of a nearby lighting system. It was interesting to note that because those involved were not familiar with the possibility of such mains linked resonances, all manner of costly time-wasting investigations were carried out and sources of blame sought, before the real culprit was found.

(From "Does your system have 50Hz impedance myopia", Ron Neale, EMC Engineering Europe, March 1998, page 5.)

341) Problems of excessive recovery times following mains interruptions

The point of the voltage interruptions tests in EN 61000-4-11, and the generic and product immunity standards that call them up, is that equipment should recover from such events as if nothing had happened, or at least as if they had just been switched on for the first time. Even for older equipment that pre-dated the above immunity standards, interruptions in the mains power is a rather obvious fact of life and designers could be expected to have designed

accordingly. But recently I had to service a modified (and expensive) CD player that had some special system for background music.

There had been a 10-second-long power cut in Northampton, where it was installed, and the thing would not come back to life afterwards. Actually, it was not working when I collected it, but started working the next day (presumably after some capacitor had sufficiently discharged).

That 10-second power cut also put the Northampton traffic light system out of operation for a long time – increasing safety risks at road junctions. While working in the All Saints area of West Bromwich, we noticed several brief power cuts, the longest being perhaps only one second, and these appeared to put the traffic lights out of action for a lengthy period of time.

(Sent in by Robert Higginson, 13 September 05.)

342) Spectrum reallocation to reduce interference with emergency services radiocomms

26 January 2005: Philadelphia FOP Wants Radios Replaced; failures characterized as possible life-or-death issue. In a follow-up to a story reported earlier on InterferenceTechnology.com, major news outlets in the Philadelphia metropolitan area report that the head of the city's Fraternal Order of Police (FOP) has called on city officials to replace the two-and-a-half year old Motorola police radio system because of repeated communications failures. A report from an independent consulting firm hired by the city cited possible interference from wireless telecoms Nextel Communications and Cingular Wireless. City officials expressed reluctance to scrap the \$52 million dollar system and expressed hope that the FCC's proposed spectrum-swap for Nextel would help alleviate the problem. Meanwhile, FOP officials warned that their next press conference could bring very tragic and sobering news if the problems go uncorrected. For the FOP position on this issue, go to <http://www.fop5.org/>.

11 February 2005: Nextel, FCC Agree to Spectrum Swap to Solve Long-Standing Interference Issues. In an historic agreement, Nextel Communications will receive a new swath of spectrum from the FCC in exchange for ceding its former spectrum in the 800-MHz band. Nextel will also pay to reconfigure the airwaves it currently occupies. Presumably, this pact will put an end to the complaints from numerous public safety agencies that Nextel's signals interfere with and sometimes drown out vital police and fire radio communications. The agreement was announced by FCC Chairman Michael Powell and Nextel President Tim Donohue. Powell hailed the solution to a problem that he termed, "difficult, complex, and challenging." Donohue characterized the resolution as, "simply the right thing to do for first responders, homeland security, and for Nextel."

Specifically, Nextel will move its remaining spectrum in the 800-MHz band, bundle it together, and move it further away from the airwaves used for public safety broadcasts. The public safety broadcasters will be located next to each other within the band. Nextel will also receive new spectrum in the 1.9-GHz band, where other major wireless telecoms are located. The new spectrum is valued at \$4.8 billion, which Nextel must pay the FCC; but the telecom will receive a \$2 billion credit for the spectrum it is returning. Nextel will also receive a credit for the relocation costs it incurs; these costs have been estimated at \$1.3 billion. The transition is to begin immediately and should be completed in about three years. For the official announcement, go to www.fcc.gov.

(From Interference Technology E-News, 26 January 2005 and 11 February 2005, <http://www.interferencetechnology.com>. For the background to this issue see Banana Skin No. 281.)

343) 'Broadband over power line' (PLC) will interfere with radio astronomy

Sharing studies between the radio astronomy telescopes and the power line communication systems in the HF region. Internet: <http://www.qsl.net/jh5esm/PLC/isplc2003/isplc2003a7-4.pdf>. Summary: Radio Astronomy has frequency allocations in 13.36-13.41 MHz and 25.55-25.67 MHz on a primary basis worldwide. These bands are extensively used by radio astronomers to observe electromagnetic waves emitted by the Sun, the Jupiter and other large, gaseous planets in the solar system. The powers from a single Power Line Communication (PLC) system in the above radio astronomy bands are -33 dBW and -29.2 dBW respectively and

therefore the PLC systems seem to be a harmful interference source for the radio astronomical observation in the HF band.

It is necessary to keep an adequate separation distance to avoid harmful interference to the radio astronomy telescope, and we calculated the separation distance based on the free-propagation method. We obtained a value of 424 km. If the PLC system is widely deployed, it is sure that the interference level increase greatly and the separation distance will become much larger. Thus it was recognized that it is quite difficult to share frequencies with the PLC systems and radio astronomy telescopes, at least, in Japan, and that a new technology to dramatically reduce leaked emissions from the power lines are crucial for the PLC systems to coexist with other radiocommunications services. Authors: by M.Ohishi, J.Nakajima and M.Tokumaru

*(The above was extracted from: <http://www.arrl.org/tis/info/HTML/plc>, June 2003, which has 24 pages of information and links on PLC/PLT, also sometimes called broadband over power line (BPL). Concerned radio astronomers should also see *Banana Skin* No. 272.)*

344) Interference from lighting is an ever-increasing threat

Standard CISPR15 (EN 55015) is a special product family standard for electrical lighting and similar equipment that has served the market well for many years, but in recent times the incidence of interference from lighting has increased [1]. This has coincided with technological developments in the lighting industry [2]. With the increasing pressure for more energy efficient lighting [3] and because of requirements for more energy labeling of household lamps [4], there will be an increase in the use of technologically advanced lighting. This is the reason, why CISPR15 has been seen to be insufficient and it is under revision.

Unlike the generic standards and most other product family standards, CISPR15:2000 contains no requirements for radiated emissions from 30MHz to 1GHz. Also in Finland, it has been found that some lighting appliances are causing harmful interference to radio communications on the VHF band. Therefore these lamps and luminaires are not in compliance with the EMC Directive (EMCD), although they might fulfil the requirements of CISPR15.

Energy saving lamps (ESLs) are typical sources of interference to TV VHF broadcast receivers and also to private radiotelephone networks on the VHF band [2], [1]. Finnish EMC market surveillance authorities, the Safety Technology Authority (TUKES) and the Finnish Communications Regulatory Authority (FICORA) have received several interference complaints concerning ESL bulbs. In 2003, FICORA solved ten interference cases caused by ESLs. It is likely that these kinds of interference cases will increase in future. Fig. 1 shows the measurement results from an ESL that was intended to be used in a new conference hall in Tampere, Finland. These kinds of lamps were installed throughout the building. Radiated interference from these lamps was so high that it was not possible to use VHF radiotelephones inside. All ESLs were then replaced. The bandwidth of the interference was about 50MHz (-30 dBc points) and the interference occurred on the frequency band 159 – 209 MHz. In Finland, this band is used by many different radio services including emergency services (police, fire brigade, ambulance services, etc.).

TUKES has also received other complaints concerning interference cases caused by ESLs. Typical equipment being disturbed has been, for example, the remote control of TVs or narrow band in-house telecommunication networks using domestic 50Hz/230V electricity mains wiring. The disturbances between TVs and their remote control equipment was mostly caused on the infrared band, for which there are no requirements at all. In local telecommunication cases, conducted EMI from ESLs made it unable to use domestic electricity wiring as media for signal transmission. Also, other fluorescent lamps have caused both kinds of disturbance.

Finnish market surveillance test results with regard to ESLs have been a little better than those from Germany. According to Finnish tests, 43% of ESLs do not fulfil the standard. In Germany, 48% has failed. In ten cases, emissions from ESLs were so high that TUKES was obliged to restrict the distribution of the lamps (sales bans). Surprisingly, defects were found to be equally distributed between inexpensive and expensive ELS models.

Also in the USA, surprisingly high conducted emissions from some ESLs have been measured in the band 450kHz to 2MHz. The need for measuring was prompted by problems with AM radio reception while ESLs were in operation, and levels approaching 100dB μ V occurred at the low end of the MF band. At 1.7MHz, the levels were more reasonable, but were still in the region of 70dB μ V. The majority were reported as very high-order harmonics of the supply frequency, which suggest that the rectifier should have had shunt capacitors and/or soft recovery diodes. If these emission levels are common, where does that leave the troublesome subject of power line communication? It seems to both provide a case for relaxed limits and an indication that communication may be compromised by the very emissions that support that case! [6]

As serious problem seems to be that the ESLs originating from the Far East do not have uniform quality and quality can vary a lot between production runs. The high number of lamp and luminaire manufacturers in the Far East leads to competition between factories. There is a ready buyers market and factories are prepared to do nearly anything in order to keep their clients satisfied. It became apparent from project interviews that the importer himself could mar the quality of products e.g. through over negotiating the price down too much.

An open European market makes the importation business easy. It also tempts unskilled businessmen with dreams of big profits, and they usually make so-called 'one-off' business deals. They import a few containers of products from the Far East, distribute them quickly on the market, and then disappear. Such kinds of business change the price structure of the market, which impedes the operations of those importers who take care of their reputations by being responsible businesspersons.

The most troublesome interference case in Finland concerning metal halide lamps (MHLs), occurred in relation to a public swimming pool. The rated life time of the type of MHLs used was 10,000 hours usage, but after 2,000 hours, the sparking interferences of the lamp's electrodes during normal operation caused serious interference to TV receivers in a neighboring house. When the lamps were exchanged for new ones, the event repeated itself after about 2,000 hours. One regrettable detail was that the pool had to be once again emptied before it was possible to change the lamps.

In Finland, there has been one very serious interference case caused by a single rechargeable torch model. After about half a year's use the regulatory circuit together with the battery began to oscillate causing serious interference to one TV channel. Before identification of this problem source, many interference cases were noted all around Finland. In fact, this could be considered to be more of a battery-charger problem than a lighting interference one.

The four halogen sets we tested in 2002, fulfilled all the other testing, but they had enormous difficulties with mains harmonic currents. According to measurements made by the Swedish Authority, halogen lighting sets powered by an 'electronic transformer' might cause radiated interferences. Also, [2] supports Swedish views. It seems that almost all plasma lights do not fulfil the requirements for conducted emissions. However, they have not yet caused serious EMC problems in Finland.

(Extracts from "Lighting Interferences – An Ever Increasing Threat!", by Jyri Rjamäki, IEEE 2005 International EMC Symposium, Chicago, Aug 8-12, ISBN: 0-78-03-9380-5, pp 7-12. For more instances of interference from lamps and luminaires, see Banana Skins 19, 40, 58, 102, 158, 159, 171, 198, 218, 271 and 322.)

345) Rice cooker interferes with pacemaker, plus other examples of interference

This is an excerpt from a monthly newsletter that sends out interesting news items. I don't believe this is an April Fools' item, but then who knows? A Japanese woman's automatic rice cooker changed the settings on her pacemaker. Doctors doing a routine check up were baffled to find that the hi-tech pumping device they had implanted in the woman, 60, had been remotely adjusted. They contacted the manufacturer, who visited her home and found that a rogue rice cooker had somehow beamed signals to the device. [Source: A&A Economic Digest - April 2003 Edition, <http://www.aacb.com/edigest/>, 1 April 2003] [Quite plausible, in light of previous reported cases of electromagnetic interference on pacemakers]

--- From ACM Software Engineering Notes back issues:

- * Arthritis-therapy microwaves set pacemaker to 214, killed patient (S 5 1)
- * Retail-store anti-theft device reset pacemaker, man died (S 10 2, 11 1)
- * Pacemaker locked up when being adjusted by doctor (S 11 1)
- * Electrocauterizer disrupts pacemaker (S 20 1:20)

--- And from RISKS:

- * Stores' shoplifting gates can set off pacemakers, defibrillator (RISKS-20.05)
- * Heart pacemaker and implantable cardioverter defibrillator recalls and alerts involve 520,000 devices (S 26 6:8, RISKS-21.60)

(Sent in by Simon Brown, who saw it on the RISKS-LIST: Risks-Forum Digest Friday 4 April 2003 Volume 22 : Issue 67, FORUM ON RISKS TO THE PUBLIC IN COMPUTERS AND RELATED SYSTEMS (comp.risks), ACM Committee on Computers and Public Policy, Peter G. Neumann, moderator. Archived at <http://catless.ncl.ac.uk/Risks/22.67.html> and by anonymous ftp at <ftp.sri.com>, cd risks.)

346) Lightning strikes are a major cause of insurance claims in the U.K.

It is true that you are unlikely to be struck by lightning in the UK. But it may come as a surprise to know that around one-third of all insurance payments made by UK household insurers are compensation for damage caused by lightning strikes. Most of the damage is not caused by the direct strikes, but by the effects of more distant strikes. These produce voltage surges, most often on the mains electricity supplies, but also sometimes in telephone lines and other long cables.

(Taken from "When lightning strikes" by Jim O'Connor in Electrical Engineering magazine September 2005, page 27, <http://www.connectingindustry.com>.)

347) Cellular telephones can interfere with medical equipment – Mayo Clinic concludes

OBJECTIVE: To assess the potential electromagnetic interference (EMI) effects that new or current-generation cellular telephones have on medical devices.

MATERIAL AND METHODS: For this study, performed at the Mayo Clinic in Rochester, Minn, between March 9, 2004, and April 24, 2004, we tested 16 different medical devices with 6 cellular telephones to assess the potential for EMI. Two of the medical devices were tested with both new and old interface modules. The 6 cellular telephones chosen represent the different cellular technology protocols in use: Code Division Multiple Access (2 models), Global System for Mobile communications, Integrated Digital Enhanced Network, Time Division Multiple Access, and analog. The cellular telephones were tested when operating at or near their maximum power output. The medical devices, connected to clinical simulators during testing, were monitored by observing the device displays and alarms.

RESULTS: Of 510 tests performed, the incidence of clinically important interference was 1.2%; EMI was Induced in 108 tests (21.2%). Interference occurred in 7 (44%) of the 16 devices tested.

CONCLUSIONS: Cellular telephones can interfere with medical equipment. Technology changes in both cellular telephones and medical equipment may continue to mitigate or may worsen clinically relevant interference. Compared with cellular telephones tested in previous studies, those currently in use must be closer to medical devices before any interference is noticed. However, periodic testing of cellular telephones to determine their effects on medical equipment will be required.

(Taken from: "Cellular telephone interference with medical equipment" by Tri JL, Severson RP, Firl AR, Hayes DL, Abenstein JP. Division of Foundation Telecommunications and Network Services, Mayo Clinic College of Medicine, Rochester, MN 55905, USA. 29 Oct 05, Mayo Clin Proc. 2005 Oct;80(10):1286-90, received via: Interference Technology eNews Oct 27 2005, <http://www.interferencetechnology.com>.)

348) Five interference anecdotes from Tim Haynes

Radar-controlled gun on board a refitted warship. VHF transmissions would make the gun guidance go wild, pointing it into the superstructure etc. Lucky it wasn't loaded.

My own experience. Radio ham, transmitting on a UHF channel 433.325MHz hears own voice on a VHF transceiver, which was not normal. Received voice comes and goes with the movement of traffic. By watching the cars around, determines that it only occurs when a particular car is nearby - a Fiat Coupé. I ran this on EMC-PSTC when it happened and got Ferrari and Fiat writing to me wanting to know if it was their vehicle causing the problem. This was probably RF and switching causing the problem in the ECU of the Fiat.

Dual technology (IR and microwave) movement detectors used to control the lights in (a house / an office) would also detect radio transmission from passing cars using VHF radio. Soon the lights were going on and off like Xmas tree lights as all taxi, fire, police, ambulance drivers "blipped" their transmitters on passing.

Radio ham sitting in Tesco's car park waiting for wife to arrive with shopping. Talking on local UHF ham repeater. Man comes to his BMW7 series and with a flourish "blips" the remote unlock. Nothing happens. Another flourish. Still nothing. Walks around the car - checks number plate - yes it is his. Another flourish – nothing. Radio ham stops transmitting and leans out of the car window say "it will work now". Aggravated flourish! car unlocks and owner starts to load shopping.

Ham goes back to transmitting. Owner shoves shopping trolley into empty parking bay and gets into car. After two to three minutes, owner gets out of car and checks all doors are shut and gets back in. Gets out again and looks pitiful. Radio ham stops transmitting, leans out of window and say " it will start now!". Owner looks puzzled, gets into car and starts it first time, drives off at speed. Radio ham gets out of his old, non-electronic, car and paints another circle with black and blue quadrants in it on the front wing. Pulls flaps down on flying helmet and returns to reminiscing about days as fighter pilot. (This one is part true and part poetic license - you can decide which parts are which!)

(A collection of anecdotes sent in on 10th November 2005 by Tim Haynes.)

349) New Pentagon system suspected of interfering with garage door openers

A widespread problem with a mysterious radio signal that caused some garage doors in the Ottawa region to stop working has vanished. The powerful radio signal causing the problem stopped transmitting on Thursday afternoon, around the time CBC News contacted the U.S. Embassy to ask if it knew anything about it. The embassy denies that it had anything to do with it.

The signal was being transmitted at 390 megahertz, a frequency used by the Pentagon's new Land Mobile Radio System. The same frequency is used by garage doors openers, which started to malfunction around the city about two weeks ago. A similar problem has popped up around military bases in the States.

The world's biggest garage door manufacturer, the Chamberlain group, took the problem seriously enough to fly design engineer Rob Keller to Ottawa from its Chicago headquarters, with machinery to try to track the signal. But by the time he got there, the signal was gone.

(Sent in by Doug Milligan, Senior Control Engineer, JNUP, who found it on CBC News "Garage doors work after mysterious radio signal disappears" Mon, 07 Nov 2005 13:01:24 EST, <http://www.cbc.ca/story/canada/national/2005/11/07/garage-signal051107.html>)

350) Mobile phone ban continues on flights

The ban on the use of mobile phones by passengers on planes is set to continue. New tests by the Civil Aviation Authority confirmed that phones are still a threat to aircraft. The latest study found that the use of mobile telephones can adversely affect navigation and communication functions, producing significant errors on instrument displays and background noise on audio outputs. The CAA study recommended that as well as the usual on-board warnings about the

use of mobiles, there should also be reminder notices in airport departure lounges and warnings by check-in staff.

The research backs up reports from pilots, who have stated that interference from mobiles has caused: false notification of unsafe conditions - for example, incorrect baggage compartment smoke alarm warnings; malfunction of aircraft systems; interrupted communications due to noise in the flight crew headphones; distraction of crews from their normal duties due to increased work levels and the possibility of having to invoke emergency drills.

Dan Hawkes, an avionics specialist at the CAA who supervised the research, said: "The tests demonstrate that mobile telephone use near an aircraft's flight deck or avionics equipment bay can adversely affect systems that are essential for safe flight. "For safety reasons the current policy of prohibiting the use of mobile telephones by passengers while the aircraft's doors are closed for flight must continue."

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351) TETRA radio system interferes with amateur radio

The roll-out of Tetra (Airwave) in Manchester is making itself known. I travel down the M60 between the A627M to the west of Bury, 2 or 3 times a week. I travel back and forth to work 5 days a week using the same route. I've used the same Amateur Radio transceiver (Kenwood) in my car for the last 5 years. What has changed? At various locations on the M60 and in Oldham, Ashton and Stalybridge, the 430MHz band is unusable for a number of miles on certain roads. The only way to get rid of the damn digital out of band carrier noise, is to switch on the ctcss (continuous tone coded squelch system), probably the equivalent on switching the fog lamps on! We are finding that increasingly it is necessary to take this course of action, or listen to the noise for the next few miles.

(Sent in by Graham Eckersall of Barcrest, on 10th February 2003. Sorry it took so long, Graham!)

352) Enhanced immunity testing required to overcome telecom failures

The International Telecommunications Union publishes the ITU-T Recommendations, which include the "K Series" of recommendations on the resistability (EMC immunity) of telephone-related equipment. Recently (Nov 2004) an amendment was published to its Recommendation K.20, which covers equipment installed in telecommunications centres. It seems that despite passing the very thorough and quite tough immunity tests in K.20, including the 'enhanced levels', a new design of line card installed in 1999-2000 suffered a large number of IC failures by 2002. Three years of intensive study resulted in a new test that reproduced the type of damage seen, and cards that have been modified to pass this new test seems to be much more reliable as a result.

The new test involves applying a voltage at the AC power frequency *between* two external ports (connectors for external telecommunication cables). The generator is 'floating' – not connected to the earth of the equipment under test as in the usual K.20 tests. Coupling resistors of between 100 and 200 ohms are used, and the voltage applied for periods of around one-third of a second. The voltage is increased gradually from low levels, until it exceeds the voltage at which the secondary protection devices in the equipment operate. In the case of the failing line cards above, the damage was replicated with coupling resistors of 140 ohms and a voltage of 145V rms.

(Taken from: ITU-T Recommendation K.20, "Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents" Amendment 1, November 2004, "Floating transverse power induction and earth potential rise test for ports connected to external symmetric pair cables". ITU-T K-series Recommendations can be downloaded for a small fee by visiting <http://www.itu.int/ITU-T/publications/recs.html>, clicking on "K Protection against Interference" then scrolling down and clicking on the documents required. For manufacturers of equipment that could be connected to long signal, data or control cables, especially if those cables exit a building, applying the relevant K series immunity tests should

help improve reliability. Some of them are similar to IEC 61000-4 series tests, but some are very different and/or much tougher.)

353) Digital box interference triggers 'SOS' alert and helicopter search

A faulty TV digital box sparked a rescue mission from RAF Kinloss by sending out a signal identical to those transmitted by vessels in distress. The Kinloss site in Moray, which co-ordinates rescue operations across the UK, detected an "SOS" call from the Portsmouth area on 5 January.



A coastguard helicopter spent two hours searching the harbour area before the signal was traced to dry land. An RAF spokesman said the signal had been a "complete freak". Telecoms regulator Ofcom was asked to look into the signal and confirmed the source.

RAF spokesman Michael Mulford said the Aeronautical Rescue Co-ordination Centre at the airbase had picked up the beacon from one of five orbiting satellites. He said it was transmitting on the major emergency frequency. "We traced it to Portsmouth Harbour, checked and found out there were no vessels in the area or missing planes." The rescue centre then contacted

Ofcom, which was able to establish it was coming from a household.

"Digital boxes shouldn't be sending out signals, let alone maydays" Ofcom spokesman Mr Mulford added: "This is very very unusual, it's a complete freak and the odds of a digibox sending out such a signal must be astronomical. "The guy who owns it really should do the lottery because the chances of sending out a signal from a digibox and sending out precisely and exactly on a major emergency channel are far more than 14 million to one."

Ofcom has since removed the £50 Freeview box for tests. An Ofcom spokesman said: "This is a real one-off as digital boxes only receive signals. "They shouldn't be sending out signals, let alone maydays. The householder was happy to hand it over to our engineers who are trying to get to the bottom of the defect."

(Taken from BBC News / Scotland, Sunday, 15 January 2006, 13:03 GMT. This was sent in by both Graham Eckersall of Barcrest and by Alex McKay of Technology International (Europe) Limited, who got it from Claire Ashman of RFI.)

354) Marine mains supply harmonic distortion problems solved



The Ocean Challenger is a very high bollard pull cableship of UT746C dual role design, equipped with a Rockplough that allows for simultaneous cable lay and burial to 1.0m depth in fractured rock, 2.2m in sand/clays and 3.0m in soft soils. The Ocean Challenger's trenching operation is performed by a 2MW Remotely Operated Pipe-line Trenching Vehicle, referred to as the ROV PT1, which is capable of operating in depths of up to 2000m. The PT1 is fitted with ten 30kW electric thrusters for manoeuvring and four 300kW Jet Sword high volume flow rate electric pumps.

The electric thrusters and pumps are independently speed controlled via AC PWM VFD's (Variable Speed Drives) mounted in the surface module. These 400V AC drives are equipped with sinus output filters and 400V to 3300V step-up transformers. From the surface module the 3300V is fed down an umbilical cable to the 3300V thrusters and pump motors. The step up in voltage is required due to the voltage drops associated with very long cable runs extending as much as 2000m.

All individual PT1 drives on the ship were fitted with 3% AC line reactors to partially attenuate the harmonic currents they generate. When connected to the ship's normal power supply, the 1.5MW of AC drives produced too high a harmonic voltage distortion on the two 2800kVA shaft generators. This was partially due to the fact that generator power is more susceptible to voltage distortion than shore-based transformer power, because generators typically have much higher source impedance. With transformers, the impedance (Z) is usually in the order of 5% to 6% whereas for generators the subtransient reactance (X_d'') is typically 12% to 20%. The higher the percentage source impedance, the higher the voltage distortion (and the worse its effects) for a given harmonic load.

Historically, to operate the ROV PT1 and its 1.5MW of drives, two deck mounted external generators have had to be rented in order not to breach the Det Norske Veritas (DnV) harmonic voltage maximum limitation of 5% and to prevent possible damage to the generators. This was an expensive proposition in respect to both financial outlay and required deck space.

CTC Marine Projects asked cable handling specialists, Parkburn Precision Handling, to provide a tailored solution, and Parkburn proposed the use of Lineator™ wide spectrum filters. These high performance harmonic filters are manufactured by Canadian company Mirus International Inc. who are represented in Europe by Harmonic Solutions Co. in the UK. The Lineator™ is a patented, multi-limbed reactor with a relatively small capacitor bank whose output, when connected to AC or DC drives, produces a trapezoidal voltage which forces the input rectifier devices to conduct for a longer time period and with smaller peak currents. This has the effect of reducing the 'total harmonic current distortion' (I_{thd}) to near 5% regardless of whether the VFD is equipped with a reactor or not.

CTC Marine Projects installed 2 x 750kW Lineators™, one for each of two groups of 5 x 30kW thrusters and 2 x 300kW pump drives in a self contained deck module. During the following sea trials, ships staff monitored both the operation of the two shaft generators and the VTHD on the main switchboards. The ship's electrical engineer reported that the generators operated flawlessly and at no time did the VTHD ever rise above 1.4% and 1.6% on their respective switchboards. The installation of the two 750kW Lineators™ allowed the vessel to meet the 5% voltage distortion limit of the DnV without the need for the rented generators and the additional deck space they required.

(Extracted from "Homing in on Harmonics", an article in Offshore Engineer magazine, February 2006 Issue, pages 55-57, sent in by John Symonds of REO (UK) Ltd, on 27 Jan 06, http://www.offshore-engineer.com/the-magazine/issue-archives/february-2006/current-issue/?tx_ttnews%5Btt_news%5D=72663&cHash=d71b58786b.)

355) Piezo gas lighter controls tape player

In the kitchen we have a radio/tape/cd and recently the tapes have been playing with very poor sound quality. No amount of head cleaning has improved the sound. By chance we found that operating the piezo gun to light the gas hob fixes the problem. Must be switching some 'hiss' correction circuit for which there is no external control, button switch etc.

I think that the transient switches on something that the play button ought to switch on but doesn't. Or rather something it used to switch on but doesn't. However when you buy a radio/CD/tape including a remote all for £42 I guess you get what you pay for - it worked OK until the guarantee was over!

Sometimes when the play button is pressed the sound is OK, but frequently it isn't. When the sound is poor the piezo lighter always seems to fix it. If it is repeatable (and it seems to be so)

then it is a good demonstration that external EM threats can change the performance of an electronic circuit - in this case it is beneficial, but it might have been the other way round.

(Sent in by Dave Imeson of Compliance Europe Ltd, on 31 Jan 06.)

356) Radar dome suspected of interfering with car immobilisers and lights

Reports that a radar dome in Norfolk is causing electrical problems with cars are being investigated by the Ministry of Defence (MoD). Motorists say their engines and lights have cut out, and their speedometer dials swing up to 150mph as they drive past the Trimmingham radar unit.

Neil Crayford, who runs a garage near the dome, said in the past two months, 30 car owners had reported problems. On Monday, an MoD spokeswoman said the claims were being investigated. Mr Crayford said one night his own car's headlights and dashboard cut out for a few seconds as he drove past the dome in convoy with a colleague - who suffered the same fate.

The former RAF radar operator said: "Something must have changed - either the frequency or output - for this to happen. "I lodged an official complaint with the MoD two weeks ago, but incidents are still happening. We get about five a week, and had three more on Friday."

An MoD spokeswoman said: "We are aware of claims that the remote radar head may be interfering with car immobilisers and we are investigating. "There are other users outside the military that operate on the same frequency as the radar, but there is a possibility we could be causing some problems with cars."

(BBC News / England / Norfolk / "Fears radar dome affecting cars", <http://news.bbc.co.uk/1/hi/england/norfolk/4732096.stm>. Posted to the IEEE's emc-pstc newsgroup on 24 February 2006, by Iain Summers.)

357) Cellphones can interfere more strongly with aircraft navigation than previously believed

A study by Carnegie Mellon University researchers in the Department of Engineering and Public Policy (EPP) has found that cell phones and other portable electronic devices, like laptops and game-playing devices, can pose dangers to the normal operation of critical electronics on airplanes. The study will be featured in an article appearing in the March issue of IEEE Spectrum.



"We found that the risk posed by these portable devices is higher than previously believed," said Bill Strauss, who recently completed his Ph.D. in EPP at Carnegie Mellon. "These devices can disrupt normal operation of key cockpit instruments, especially Global Positioning System (GPS) receivers, which are increasingly vital for safe landings." Strauss is an expert in aircraft electromagnetic compatibility at the Naval Air Warfare Center in Patuxent River, Md.

With support from the Federal Aviation Administration, three major airlines and the Transportation Security Agency, EPP researchers crisscrossed the northeast United States on commercial flights, monitoring radio emissions from passenger use of cell phones and other electronic devices. They tracked these radio emissions via a broadband antenna attached to a compact portable spectrum analyzer that fit into an innocuous carry-on bag.

"A laptop computer controlled the system and logged the data," said Granger Morgan, head of the EPP Department. "While we looked primarily

at wireless phones, we also discovered that emissions from other portable electronic devices were problematic."

The researchers found that on average one to four cell phone calls are typically made from every commercial flight in the northeast United States. Some of these calls are made during critical flight stages such as climb-out, or on final approach. This could cause accidents, the investigators report.

Both Strauss and Morgan, along with Carnegie Mellon researchers Jay Apt and Dan Stancil, recommend that the Federal Communications Commission (FCC) and the FAA begin to coordinate electronic emission standards. At the moment, there is no formal coordination between the two federal agencies. The researchers also recommend routine monitoring of on-board radio emissions by flight data recorders and deploying specially designed tools for flight crews to monitor passenger use of electronic devices during final approach.

While the FCC recently suggested that it might be appropriate to allow passengers to use cell phones and other electronic devices on airplanes, Morgan disagrees.

"We feel that passenger use of portable electronic devices on aircraft should continue to be limited for the safety of all concerned," Morgan said.

(Carnegie Mellon University Press Release, Feb 28, 2006, www.cmu.edu/PR/releases06/060228_cellphone.html, Contact: Chris Swaney, +1 412-268-5776. Also featured in ITEM's Interference Technology E-News, www.interferencetechnology.com, March 4, 2006.)

358) Interference increasing in the aircraft bands

Very little has happened to Section 21 recently other than a reduction of the limits in the receiver band for certain test categories and the banning of circularly polarised antennas, with both horizontal and vertical testing being required above 25MHz. However, more significant changes are proposed for the "F" revision.

The reduction of limits was required because of the increasing interference occurring, in aircraft operation, in the aircraft receiver bands. One theory proposed by the author is that this problem has been caused by the increasing use of absorber lined chambers without an accompanying reduction in the test limits. Because the RF absorber damps out the resonances of the chamber the radiated emissions can appear lower at some frequencies. In an experiment, emissions from a simulated EUT were measured in an unlined chamber as previously allowed by early versions of DO160, and the same chamber partially lined with RF absorber. A reduction in peak emissions of up to 26dB was observed in the semi-anechoic chamber.

(Extracted from: "To DO160E and Beyond", by Dr Nigel Carter of Qinetiq, EMC-UK Conference, Newbury, October 11-12 2005, pp 127-130.)

359) EMI suspected of causing electrical meltdown

Question: I have a Rover 827 Si, bought new in Spain in 186. When I travelled to the UK recently, it suffered a major electrical meltdown and was rendered immobile. It has done little more than 40,000 miles and is otherwise in first-class condition. Is there are alternative to scrapping it?

Reply: Don't despair yet. It's possible that, while parked, the car encountered electronic interference, possibly from an illegal short-wave radio, or from police or ambulance transmitters, to which its immobiliser system was vulnerable. Try www.remotekey.co.uk or www.alarmremotes.co.uk.

("Start Wreck", in 'Honest John's' motoring questions column, The Daily Telegraph Motoring Section, 18 Feb 2006, page 10, www.telegraph.co.uk.)

360) Document shredder interferes with set-top box

Operating my personal document shredder crashes my digital TV set-top box, although it is 5 metres away. Toggling the on/off button on the set-top box restores normal operation.

(Sent in by Peter Cryer, 2nd February 2006.)

361) Lack of good PCB EMC design delays product launch

The day after attending your course on Advanced PCB Design for EMC, during which you emphasised the exponential relationship between cost of modification and the date of market introduction, I went back to my OATS and tested some more customers' products. One of them emphasised the above point – EMC testing was the last thing this manufacturer thought of, and a 16dB over Class B 'surprise' was the result.

Adding ferrites to the cables made no difference as most of the noise was radiating directly off the PCB. The company has had to engage an EMC consultant to try to fix their 8 layer board, and the product shipping has been postponed.

(Sent in by Bruce Holdsworth, Sydney, Australia.)

362) When is a dozen ferrites too many?

This job started out just the same as any. With the client present I set up the EUT on the test table, warmed up the analyser and began the test. Almost immediately I could tell the emissions from the EUT were going to exceed the 40dBuV Class A 10 metre limits. A quick look at the other frequency ranges up to 1GHz confirmed this. The emissions were over the limit everywhere. Ok I said to the client, lets take a look inside and see if we can come up with a solution. Upon opening the fairly large cabinet I was astounded to see at least a dozen clip-on ferrites randomly attached to cables. I asked why so many? The reply was "We had them back at the workshop so I just put them in".

I suggested that we should remove the ferrites and take a baseline reading and start work from there. With both hands now full of ferrites, we headed back inside. Although the EUT was still failing Class A, a quick measurement showed the emission levels had not changed! I asked the client to take ONE ferrite with him and to go out to the EUT, open the cabinet, stand to the side and to carefully touch the cables inside with out disturbing their position. (Obviously this method is suitable for low voltage equipment only) while I watched the analyser. Sure enough, as soon as he placed his hand on the offending cable the analyser readings dropped. "That's it" I called to him to clip the ferrite on that cable and the rest is history. The offending cable was a noisy RS485 cable and ONE clip-on ferrite cured the entire problem.

(Another anecdote sent in by Bruce Holdsworth, Sydney, Australia.)

363) Can interference from passenger electronic devices make aircraft unsafe? – Part 1

More and more passengers are bringing cellphones, PDAs, laptops, DVD players, and game machines on board aircraft. All of these items emit radiation and have the potential to interfere with aircraft instrumentation. More and more passengers, however, do not believe that using portable electronic devices presents a risk to passenger safety. We, on the other hand, have had our doubts that such use was safe. Over the course of three months in late 2003, we investigated the possibility that portable electronic devices interfere with a plane's safety instruments by measuring the RF spectrum inside commercial aircraft cabins. What we found was disturbing. Passengers are using cellphones, on the average, at least once per flight, contrary to FCC and FAA regulations, and sometimes during the critical flight phases of takeoff and landing.

Regulations already permit a wide variety of other portable electronic devices (PEDs) – from game machines to laptops with Wi-Fi cards, to be used in the air today. Yet our research has found that these items can interrupt the normal operation of key cockpit instruments, especially Global Positioning System (GPS) receivers, which are increasingly vital to safe landings. Two different studies by NASA further support the idea that passenger's electronic devices dangerously produce interference in a way that reduces the safety margins for critical avionics systems.

There is no smoking gun to this story: there is no definitive instance of an air accident known to have been caused by a passenger's use of an electronic device. The data support a conclusion that continued use of portable RF-emitting devices such as cellphones will, in all likelihood, someday cause an accident by interfering with critical cockpit instruments such as GPS receivers.

The study found that intermodulation between some cellular phones caused emissions in the frequency bands used by an aircraft's GPS and distance-measuring equipment. The report identified other combinations of common passenger transmitters that could potentially produce intermodulation effects in aircraft communication and navigation RF bands.

GPS-certified landing approaches are now widely used in general aviation. Though most airliners presently use instrument landing systems, use of GPS technology will increase

significantly over the next few years. There are three times as many GPS-certified approaches as instrument landing system approaches in the United States.

In March 2003, acting on a number of reports from general aviation pilots that Samsung SPH-N300 cellphones had caused their GPS receivers to lose satellite lock, NASA issued a technical memorandum that described emissions from this popular phone. It reported that there were emissions in the GPS band capable of causing interference. Disturbingly, though, they were low enough to comply with FCC emissions standards.

In one telling incident, a flight crew stated that a 30-degree navigation error was immediately corrected after a passenger turned off a DVD player and that the error reoccurred when the curious crew asked the passenger to switch on the player again. Game electronics and laptops were the culprits in other reports in which the crew verified in the same way that a particular PED caused erratic navigation indications.

(The above are some paragraphs selected from: "Unsafe at any airspeed? Cellphones and other electronics are more of a risk than you think", Bill Strauss, M Granger Morgan, Jay Apt and Daniel D Stancil, IEEE Spectrum, March 2006, pp 38-43. The IEEE paper includes many references for further information.) (Editor – the USA's 2001 DOT/Volpe report – see Banana Skins 223, 227 and 230 – said that interference, either intentional or unintentional, could deny GPS access, so I am totally amazed that GPS is permitted to be relied upon for aircraft landings! Any comments from the CAA?.)

364) Can interference from passenger electronic devices make aircraft unsafe? – Part 2

While flying home from a house-hunting trip in 1981 in a turboprop Short Bros. 360, I began feverishly working out possible mortgage payments on a cheap credit card calculator. Soon the stewardess was walking down the aisle asking if anyone had anything "electrical" they were using. I replied that I had a calculator, that was electronic but not electrical – that is, it had no motors or anything. She borrowed my calculator and took it to the cockpit.

She returned in a few minutes and admonished me with words like, "Please don't use that anymore, because when you press the keys it makes the needles in the cockpit swing around." Needless to say, I complied. As pointed out in "Plane Talk about Cellphones" [Spectral Lines, March], much of the data on signals interference in aircraft is informal and hearsay – but this is my anecdote; I witnessed it myself. I vote for keeping the ban on cellphones.

(Letter from Chris Jones responding to an editorial about the article mentioned in Banana Skin No. 363 above, in "Forum" in the IEEE Spectrum, May 2006, page 4, www.spectrum.ieee.org.)

365) Can interference from passenger electronic devices make aircraft unsafe? – Part 3

Is it safe to use cellphones on airplanes? The real question should be: "Is it safe for passengers to use any electronic equipment on airplanes?" My older notebook computer interferes with VHF Channel 11 on my TV. My newer notebook doesn't, but my older one didn't when it was new, either. And when I'm in my home office with the FM radio on, I always hear a buzz on the radio just before my cellphone rings. Granted, aircraft may not be using the VHF and FM bands, but if these devices cause interference on these bands, how can we be sure that they're not causing interference on other bands?

(Letter from Michael L Nelson responding to the article mentioned in Banana Skin No. 363 above, in "Forum" in the IEEE Spectrum, May 2006, page 4, www.spectrum.ieee.org.)

366) Airbags triggered by ESD

Holden Commodore, Statesman, Monaro and Crewman models fitted with side airbags are being recalled after some cars were found to have earthing problems which may inadvertently deploy a side airbag. Holden says the deployment can occur when the car is stationary and is caused by a static discharge as an occupant exits the car. Owners can call their Holden dealer for a simple fix, which involves fitting two small earthing springs and takes just a few minutes.

(From the "Drive" section of 'The Press', Christchurch, New Zealand, Wednesday March 15 2006, page E8.)

367) Co-location of wireless services causes interference

This veritable cocktail of spectrum and services is leading to a more challenging interference scenario – and not just in the US. As services operating in neighboring frequency bands are co-located, significant – and initially unforeseen – interference issues can arise.

This has already been observed extensively in China and Brazil, where a “cross-pollination” of 900-MHz Global System for Mobile communications (GSM) and 800-MHz code-division-multiple-access (CDMA) services exists. In such cases, GSM services have suffered significant interference – and hence quality problems – as the direct result of co-location with CDMA.

Similar issues are also being experienced by US carriers with other combinations of services – and such problems will only increase with increasing demands for wireless bandwidth and services.

(Taken from: “Filtering Compromises from Co-Located Systems”, Ganesh Krishnan and Andre Doll, Microwaves & RF, March 2006, pp 57-64)

368) Optical microphone has no emissions and is unaffected by interference

The Security Optical Microphone (SOM) from Winkelmann UK Kingfisher is used by many law enforcement agencies. Unlike traditional microphones, which can be detected using a conventional detector during a counter surveillance sweep, the SOM uses fibre optic technology and an extremely small 6mm diameter head which, when installed, is invisible to all but the most rigorous searches, and it is unaffected by interference (a major source of induced noise in conventional equipment).

(Taken from: “Breakthroughs in Defence”, Nick Morris, Electro-Optics, April/May 2006, pp 17-18).

369) Anti-jamming system for satellite operator

UK Defence specialist QinetiQ is to supply Space Communications Corporation of Japan with a geolocation system that will allow the Tokyo-based company to identify and accurately locate the source of any interference to its satellites. The US Department of Defense bought three such systems last year. Nigel Smith, QinetiQ’s satID commercial director in the USA, commented: “Satellite interference is a growing problem for both military and commercial operators and satID provides a rapid and effective solution to that problem.”

(From “Japanese Satellite operator turns to UK for anti-jamming system”, IET Communications Engineer, April/May 2006, page 4.)

370) AC motor and contactor interferes with satellite receiver around 4GHz

I have a 3 phase 480V 50A contactor and motor causing interference to a C-band satellite receiver in the 3700-4200MHz range, what are some options to prevent this?

(Question posted by JD Moats on Conformity magazine's "Ask the Experts" Noticeboard, 21 March 06, www.conformity.com)

371) FCC fines manufacturer US\$75,000 for using emergency radio bands

The Federal Communications Commission (FCC) levied a proposed forfeiture of US\$75,000 against San Jose Navigation, Inc. for marketing four models of the company's GPS signal re-radiator kits that operated on restricted frequency bands allocated for safety-of-life operations.

In this instance, the Commission acted on complaints from the National Telecommunications & Information Administration, the Department of Transportation and other federal agencies which had expressed concern that the GPS re-radiator equipment could potentially interfere with government GPS operations.

(From: "FCC Continues to Crack Down on Marketing of Unauthorized Equipment", in the News Breaks section of Conformity magazine, June 2006, page 10, www.conformity.com.)

372) FCC levies US\$1 million fine on audio equipment manufacturer for non-compliance

As we've previously reported (see Conformity May 2006, page 8) the Federal Communications Commission (FCC) recently proposed a US\$1 million forfeiture against Behringer USA, Inc. for illegally marketing over a five year period as many as 66 different models of mixers, amplifiers and digital effects processors, none of which had been verified for compliance with FCC requirements.

(From: "FCC Continues to Crack Down on Marketing of Unauthorized Equipment", in the News Breaks section of Conformity magazine, June 2006, page 10, www.conformity.com. Another news item on this can be found at: <http://www.rwonline.com/dailynews/one.php?id=8552>. The complete text of the FCC's Notice of Apparent Liability against Behringer can be found at <http://www.fcc.gov/eb/Orders/2006/FCC-06-13A1.html>, also available in Word and PDF versions.)

373) Vehicle engine management systems suffer interference

Q: My 45,000 mile four-year-old Hyundai Accent 1.3i sometimes cuts out, although it restarts almost immediately. I took the car to my local mechanic, but after three hours (and £140) he was unable to isolate the problem. He thinks the ECU might have failed.

A: This is happening to quite a lot of cars at present. It seems that powerful electric fields emitted by power lines and government establishments upset vehicle electronics – it's a particular problem when cars have CAN-bus multiplex wiring systems.

(From the "Honest John" column in the Daily Telegraph's Motoring section, Saturday May 27 2006, page 9, www.telegraph.co.uk/motoring.)

374) Light fittings can interfere with fire detectors

Fire detectors close to a light fitting may pick up electrical interference, resulting in false alarms or, even worse, the masking of a real alarm. Detectors affected must be moved.

*(From "Top 10 fiery errors", *Electrical Products and Applications* magazine, May 2006, page 17.)*

375) Major railway operators ban use of handheld radio transmitters in sensitive areas

The railway industry is very conscious of the public's perception of railway safety and for this reason there is little published information relating to interference with railway systems from hand-portable radios. Where such information is in the public domain, then the information is couched in general terms and does not make specific reference to individual incidents.

It should be noted that where the railway authorities have concerns (possibly based on experience) that interference from hand portable radio constitutes a hazard then mobile radios are excluded from areas where susceptible equipment is located.

The results of interference from hand portable radio can be broadly broken down into two areas:

- 1) Nuisance: – Interference with individual non-safety-critical systems.
 - a) Low level interference on audio systems
 - b) Interference with position detectors, e.g. internal coach door activation, automatic taps in toilets, etc.
 - c) Interference on computer systems being used on railway control and service operations. This type of interference is not covered by this paper other than instances where the susceptible equipment is part of a larger system.

- 2) System Interference: – Interference with equipment and/or systems that are essential to the operation of the railway and which may be safety critical.

System Interference: The distributed nature of railway systems together with their built-in safety features makes it difficult to isolate particular interference incidents. For this reason much of the information in the public domain is not specific. It should also be noted that the safety regimes presently in place in the railway industry would implement changes to equipment and/or operational procedures in order to reduce any safety issues to acceptable levels.

Examples of interference to railway systems that are in the public domain are:

- a) Interference with train or signalling systems. Ref [1] makes the following statement “It is not expected that mobile communications will pose a threat to these systems although it has been noted that problems have occurred with stopped trains and technicians have been advised not to use BAND III radio in these areas.”
- b) Interference with trains. Ref [4] indicates that some older electronic equipment has been found to be unexpectedly sensitive to emissions. Examples of this are the brake units fitted to HST power cars which were found to be affected by mobile telephones and NRN radio.
- c) Interference with signalling systems. Ref [9] states: “In South Jutland, the Danish state railways, DSB, have forbidden mobile phones on all marshalling yards in the district. The reason is that GSM telephones have caused the signal system to switch from green to red, and have also caused interference in the ticketing system used.”

Supporting these incidents in the public domain there are the well known restrictions within the majority of European railways against using hand-portable radios in locations which contain safety critical equipment, e.g. Signalling Equipment Rooms. Railways that are known to implement such restrictions are Network Rail, London Underground and CTRL.

While the number of reported incidents in the public domain is small, the fact that major railway operators have excluded hand portable radios from sensitive areas leads to the conclusion that there is a perceived problem with interference from hand portable radios within railway systems.

In the preamble to the EN 50121 standards (the EMC standards used by the Railway Industry to achieve conformity with the EMC Directive – Editor) the following statements are made:

Safety considerations are not covered by this standard. In special situations, where the level of disturbances may exceed the levels considered in this standard, e.g. at a special location or where a hand-held transmitter is used in close proximity to an apparatus, then special mitigation measures may have to be employed.

[1] LINK Personal Communications Programme, Collaborative Research, Electromagnetic Compatibility Aspects of Radio-based Mobile Telecommunications Systems, Final Report, <http://www.ofcom.org.uk/static/archive/ra/topics/research/topics/emc/linkpcp/index.htm>

[4] Rail Safety & Standards Board, ERTMS Engineering Interfaces, Report 02/T087/ENGE/002/TRT, August 2003, <http://www.rssb.co.uk/pdf/reports/research/ERTMS%20train%20interface%20specifications%20-%20ERTMS%20engineering%20interfaces.pdf>

[9] “Application Areas for MobilePhoneGuard™”, www.mobilephoneguard.se/eng/appl_eng.htm
(Extracted from: “The Use of Hand-Portable Transmitters in the Railway Environment” by John Whaley, presented at EMC-UK 05, Newbury, October 11-12 2005, pages 84-91 in the

conference record, copies available from Nutwood UK: send email to Pam at pam@nutwood.eu.com.)

376) Windshield washer interferes with ABS

In the development cycle of a certain automobile, it was found that the pump motor for the windshield washer was creating interference and causing an ABS warning light to activate. This vehicle's brake lines were coated with a new material which had a much higher conductivity than on older models.

It was later determined that the pump motor was generating a transient that was directly coupled to the ABS module by the new conductive coating on the brake lines. This transient was interfering with the ABS module and activating the ABS warning light.

A capacitor was placed inside the pump motor housing and the housing material was changed from plastic to aluminium to fix the problem.

(From: "The Back Page...Examples of EMC Related Problems" in the EMC Society of Australia Newsletter, June 2006, Issue No. 33, www.emcsa.org.au.)

377) Mobile phones can interfere with medical equipment

Patients are at risk if medical apparatus malfunctions due to EMC interference from mobile phones. There are several types of equipment which can be subject to interference. Infusion pumps can cause equipment malfunctions on dialysis wards, by racing or fluctuating in speed. This results in patients receiving the wrong dosage. The temperature level of incubators has been affected. Reports have been received that the temperature of incubators has been set at the maximum level. Ventilators have malfunctioned. On one occasion, an electrically-driven wheelchair was caused to move unintentionally by the communication radio in a taxi. The handicapped person involved asked the taxi driver to use his radio again to confirm that it was actually causing the wheelchair to move and it was.

(Taken from "Application Areas for MobilePhoneGuard™", www.mobilephoneguard.se/eng/appl_eng.htm)

378) Mobile phones can interfere with aircraft systems

Navigation and control instruments can be caused to malfunction. During the approach of an Alitalia aircraft at Turin airport on 31 December, 1995, one of the 160 passengers onboard switched on his mobile phone (picture), thus blocking the plane's autopilot system. There was also interference with the pilot's contact with the control tower.

The conditions were dense fog. The pilot realized what had happened and, displaying a cool nerve, was able to take manual control of the aircraft and land it without further incident. (Source: TT 960103).

(Taken from "Application Areas for MobilePhoneGuard™", www.mobilephoneguard.se/eng/appl_eng.htm)

379) TVs susceptible to the frequency and type of RF modulation

The annex to IEC 61000-4-3 explains that it was decided to use amplitude modulation (of the radiated RF test signal) and not pulse (digital) modulation as the differences were small. However, when testing televisions for immunity to GSM mobile services, the use of a 200Hz modulation was disastrous, and was only solved by using the correct 186Hz signal.

The problem arose because 200Hz was a harmonic of the television frame frequency (*which is 50Hz in the EU – Editor*). This points to the criticality of such tests, which when viewed in the wider context highlights the impracticability of simulating all digital services during RF immunity testing. So should we be looking at a new approach for RF immunity testing?

(Taken from: "Standards – are we getting what we need" by Peter Kerry, President of CISPR, EMC-UK 05, Newbury, 11-12 October 2005, pages 49-51 in the conference record, copies available from Nutwood UK: send email to pam@nutwood.eu.com.)



380) Hunting Radio Howlers – Government Vans on the Track (historical)

The wireless oscillators do not have it all their own way. Re-radiated howls which spoil reception for other listeners are to be tracked down by Government experts employing the latest methods. By the end of this month, the first of the new direction-finding motor-vans will, it is expected, be delivered to the Post Office engineers who are specially concerned with stamping out oscillation. These vans will do their best to work in couples.

The general idea is to listen to any notable howls on frame aerials. A compass bearing is taken of the quarry and the aerial is swung round until the sound reaches a minimum. This gives a still closer reading. Next, the van moves on to another spot and the procedure is repeated. The bearing, naturally, is changed (just as a lamp-post changes its apparent position as you walk past it).

Finding the 'Lair': When the bearings are plotted out on an ordnance map of the district, you will get two or more lines cutting each other and the spot where they intersect marks the 'lair' of the oscillator, or thereabouts, for an aerial is a length of wire which does not give a very exact 'fix' for this form of land navigation. Two vans, in wireless telephonic touch with each other on a wavelength that does not interfere with broadcasting, can conduct a hunt in quite a short time and the offending listener is eventually run to earth.

(Just to prove that EMI is nothing new, the above item is from the Daily Mail, 21 April 1926, reprinted in Automotive EMC Newsletter 4th June 2006, www.autoemc.net. The problem described was caused by the local oscillators in early 'superhet' radio sets, which could be re-radiated from the antenna or mains wiring and cause interference.)