



Another EMC resource
from EMC Standards

EMI Stories 96 to 190

Helping you solve your EMC problems

EMI Stories 96 to 190

- 96)** Cochlea implants are small electronic devices placed under the skin to assist hearing. Unfortunately, they are prone to interference, such as the security checks at shop entrances and airline security, which can damage an implant. People with cochlea implants have also been told not to use mobile phones.
- 97)** The (UK) government is trying to encourage people to use public transport. An incentive to use public transport would be punctuality. BT is investigating an idea which would enable the time of arrival of the bus to be checked by using either the web or a mobile phone or pager. The bus would be fitted with a GPS tracker so that its position could be monitored. This technology would be useful but in large cities GPS on buses might not be that reliable, due to the interference.
- 98)** Electronic tagging takes the form of a small bracelet worn around the wrist or ankle. Presently the (UK) Home Office is the main user of electronic tagging, keeping track of prisoners in the community. Children could be fitted with a tagging bracelet before setting off to walk to school and parents could be notified if the child wanders off the route, via mobile phone or pager. The problem with this would be when the GPS signal was interfered with and incorrectly showed that the child was off the route. This interference is likely to take place in cities. These problems already occur with prisoner tagging. (*For more on GPS problems see Banana Skin No. 29.*)
- 99) EMI claimed to be a possible cause for crash of TWA800**
Elaine Scarry has found some common threads in the crashes of TWA 800, Swissair 111, and Egyptair 990, that indicate a significant possibility that they were brought down by electromagnetic interference from military aircraft or ships on exercise. This possibility does not appear to be under consideration by the accident investigators for these incidents.
Read her articles in the New York Review of Books by going to <http://www.nybooks.com> and then searching their archives using the author's name: Scarry.
- 100) My neighbour has had a new heart pacemaker fitted – every time he makes love my garage doors open**
(*Attributed to Bob Hope, 1975. We try to find amusing or off-beat items for our 100th Banana Skins.*)
- 101) Poor power quality costs businesses in Europe €13-20billion a year.**
This estimate is from the European Copper Development Association, and is the first attempt to pin down the cost in Europe of voltage deviations, transients, interruptions, and harmonics, says the organisation. These problems are increasing because of the growing use of equipment such as switch-mode power supplies, variable-speed drives, and high-frequency lighting, it adds.
The use of such polluting equipment means that 70-80% of power quality problems are caused by operations on sites, rather than by external effects, says the institute. Problems produced by poor-quality power include glitches in computers, burnt-out motors, failed transformers and fires caused by high neutral currents.
(*From Electrical Review, 4th July 2000, page 3, www.electricalreview.co.uk.*)
- 102) Harmonics from low-voltage lighting can cause overheating**
In the lighting industry, simple switch-mode power supplies with AC outputs, often called "electronic transformers", are used increasingly to operate 12 volt lamps from the mains supply. In a retail store 50-100 of these units each rated around 50W would not be uncommon.
Most of these devices claim to meet the EMC Directive individually and are CE marked. However if a number of these devices are operating in one location, then their total emissions can be shown to exceed the limits for both RF and harmonics, sometimes by a large margin.
There are already instances of other equipment malfunctioning, and of sine wave distortion causing conventional transformers to overheat (due to enhanced core losses). I have

experience of a building which had recently been fitted with about 50 off 50W “electronic transformers”, the harmonic emissions from which so distorted the mains supply waveform that conventional transformers powered from the same mains distribution overheated.

Clearly, this is not just an EMC issue, but a significant safety concern. But my experience so far is that lighting equipment manufacturers, on the whole, don't seem to understand this significance of this problem, and that installers could not care less.

(From Fane Murray, 4th September 2000.)

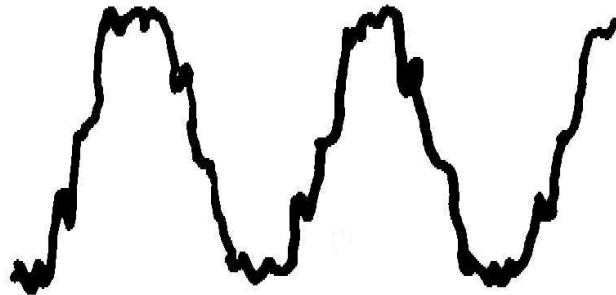
103) Panel Building Industry ‘hazy’ about EU Directives

Another common problem is that of knowledge of Directives. Some contenders appear to have a hazy understanding of the EMC and LV Directives for example.

(Stuart Wetherall, Publisher, writing about the ‘Panel Builder of the Year Awards in Panel Building Magazine, September 2000 pages 12 to 20.)

104) Poor mains waveform quality in Israel

Just a note of thanks for your illuminating series in EMC Journal. As an electrical layman I found them helpful when trying to analyse my 10-year dissatisfaction with the Israeli brand of mains, which seems to contain harmonics from 9th upwards (see the sketch below).



Not only does the mains supply show obvious clipping, ringing, crest flattening and zero-volt crossover distortion, but the thick line (represented by my crude felt-tip trace) resolves itself into stable “carrier wave” oscillations at 10kc to 10MC (which is why my AM radio gives off sounds like a buzz-saw at BBC World and other frequencies). “What in the developed world would constitute a road-hazard, in the developing world often has to serve as the road”.

(From Nick Maroudas PhD (ChemEng) DIC, 2nd October 2000)

105) Interference with racing car video

Video cameras in racing cars provide exciting live pictures for TV, but the image is often spoilt by interference.

(From New Scientist, 30th September 2000, www.newscientist.com.)

106) 1998 Grand Prix suffered interference

In the lead-up to the 1998 Grand Prix, electrical storms caused a spike in the power supply which sent major ripples across the facility’s feed lines – crashing all race control computers. After the ensuing chaos, the problem was rectified and the race proceeded as scheduled but the experience left the Silverstone management adamant that this type of disturbance would not be repeated at future events.

(From “Grand Prix UPS weathers the storms”, Electrical Products September 2000 page 34, Electrical Products & Applications: www.imlgrouponthenet.net.)

107) Twinkling antennas cause high levels of emissions

‘Twinkling antennas’ are a recent innovation in the mobile phone market. They incorporate one or more Light Emitting Diodes (LEDs), which are intended to illuminate when the mobile phone is transmitting. Reports from Mobile Phone companies using the 1800 MHz band have highlighted cases of interference from 900 MHz GSM mobiles. It has been suggested that the non-linear characteristics of the LEDs will cause a transmitting twinkling antenna to radiate harmonics.

(Tests carried out by the Radiocommunications agency on two 900 MHz cellphones fitted with twinkling antennas showed that.....) the ERP of the second harmonic.....exceeded the ETS 300 577 maximum.

(From EMC Matters, published by Brian Jones: emc@brianjones.co.uk. The full report of Project 564 and many other interesting documents may be found by hunting around the (legacy) Radiocommunication Agency's website hosted on Ofcom's site at: <http://www.ofcom.org.uk/static/archive/ra/rahome.htm>.)

108) Industrial microwave oven interferes with cell phone base station

In the UK 886 to 906MHz has been allocated as a band suitable for the operation of Industrial Scientific and Medical (ISM) equipment. ISM machines are at present allowed to emit 120dB μ V/m (i.e. 1Volt/metre) measured at 30 metres from the wall of the building housing the equipment over this frequency range. This presents a problem as it occupies part of the band allocated to mobile phone operators.

The main users of the ISM band are organisations operating industrial microwave ovens. The ovens are used in food production although other uses such as vulcanising rubber are also on record. High power magnetrons are used as the source of microwave energy, the magnetrons are designed to operate at 896MHz. For process purposes the ovens are normally conveyor fed.

Consequently depending on the size of product being treated a large aperture exists at each end of the oven allowing relatively high levels of microwave energy to be emitted. The channel 30 mobile to base-station frequency coincides with the magnetron centre frequency. The second oven at Griffith laboratories is of particular interest as the emissions are known to disturb the operation of a base station located in the vicinity.

(Extracted from: "Industrial Microwave Oven (ISM) Emissions and Mitigation Techniques", Dr D Welsh, Proceedings of EMC York 2000, 10-11 July 2000, www.yorkemc.co.uk.)

109) Australian telco has problems with inadequate immunity to EMI

The current Australian regime (for EMC compliance) only covers emissions requirements, but there has been extensive discussion about whether immunity should also be made mandatory.a submission from a major telecommunications network company (Telstra) outlined difficulties it has experienced in dealing with customer equipment susceptible to interference.

The ACA mandates interoperability, safety, and emissions standards but telecoms carriers have little control over the EMC quality of equipment connected to their network.

(From Chris Zombolas of EMC Technologies Pty Ltd: "Australian framework comes under review", Approval, Sep/Oct 2000 pp7-8.)

110) EMI problems with early electronic ABS

When Ford began the development of an electronic anti-lock braking system in 1982, their engineers noted certain "concerns" about its behaviour when subjected to high levels of interference. *(Ed: Such as those created by mobile radio transmitters of around 100W, either on-board or mounted on nearby vehicles.)* Not only was it liable to fail, bad enough if a driver had come to rely on it, but it could do so in a particularly nasty manner, deactivating the system.

(Tom Shelley: "Screening protects anti-skid brakes", Eureka May 1987, pp36-37, www.eurekamagazine.co.uk.)

111) High field strengths near vehicles' on-board transmitters

Fields in and around vehicles with onboard transmitters (at the maximum legal power of 110W) range mostly between 10 and 300 V/m, with some exceptions. Field strengths in and around vehicles adjacent to vehicles with transmitters range mostly between 5 and 100 V/m.

(From "How does EMI affect automotive electronics?" Microwaves, April 1980, pp 96, www.mwrf.com.)

112) Mobile phone use not recommended on aircraft

I'm tempted to think your article about mobile phones on aeroplanes was itself a flight from reality (19 August, p 18). The problem with cellphones is that they radiate at moderate powers which are capable of upsetting the operation of any of the semiconductors in any of the electronic systems in the aircraft.

Try this little experiment: phone a friend using your POT (plain old telephone landline) and then phone someone else using your cellphone. Hold the cellphone at various distances from the POT handset and its cables and see how far away it has to be before you can't hear the "blippety-blip" noises on the POT. According to the reported statements in the article, the possibility of interference in these little experiments would be "very low" when in fact it almost always occurs.

(Keith Armstrong: "Mobile menace", letters, New Scientist, 9 September 2000, www.newscientist.com.)

113) Mobile phones cause interference on the flight deck

As a captain of a brand new Boeing 737 aircraft, I can assure readers that the effects of mobile phones are very noticeable on the flightdeck. The chief problem is a series of rapid beeps from the handset when it "checks in" with a base-station. The handset does not need to be making or finishing a call to perform this function, it only needs to be switched on. The interference manifests itself as a loud and annoying interference, but since some of our navigation equipment works on the same frequencies, interference with navigational capabilities cannot be ruled out.

Another more worrying source of cellphone interference was not even mentioned in your report – mobile phones in air-traffic control centres. We had a case the other week on a Spanish sector where a mobile phone in the air-traffic control centre was continuously trying to check in with its base station and the interference was totally blocking the frequency.

Mobile telephones are an airborne menace, but you have to ask why aircraft systems are not better protected against interference in the first place. Thunderstorms can saturate our old-fashioned (but new) AM radios with static, and the ADF navigation equipment will direct the aircraft straight towards the nearest thunderstorm instead of the airfield. Is this really the high-tech field of aviation?

(Ralph Ellis: "Mobile menace", letters, New Scientist, 9 September 2000, www.newscientist.com.)

114) HV transmission lines cause shock hazards for nearby swimming pools

In general, an above ground pool is 6 to 12 times more hazardous than an in ground pool. Of the cases investigated, the majority of hazardous situations associated with pools were found to be above ground pools in close proximity to transmission line towers. It was recommended that all pools of the above ground type in close proximity to transmission lines be removed immediately.

(D.J.Woodhouse, K.D Newland, W.D. Carman, all from Energy Australia: "Development of a risk management policy for transmission line easements", ERA's Earthing 2000 conference, 21-22 June 2000, pp 6.7.7, www.era.co.uk.)

115) Radio transmitting station interferes with railway train brakes

A European train operator had a problem on a section of track near a radio transmitting station. When a certain type of locomotive was passing by the radio station its main circuit breaker would open, causing it to brake. It was found out that the temperature sensors within the traction motors picked up the radio signal. The cables to these sensors weren't screened. A modification to this would have been very expensive as the sensors are mounted within the winding of the motors.

The solution chosen was to increase the time window for the signal to be above a certain limit before the control would take action. Due to the long time constant of the thermal behaviour of the system, this solution was acceptable and sufficient. *(Sent in by Jennifer Cortese, Melbourne, Australia, December 2000)*

116) Diesel engine spurious start-up caused by taxicab transmitter

I was lying on my back underneath a diesel engine (part the emergency power generator of a hospital) with the sump off, doing some work on the bearings. There was not a lot of room between the engine and the floor. The diesel generator was turned off, that is to say the OFF pushbutton on the control panel had been pressed and the controlling PLC's display showed the OFF condition.

Suddenly, the diesel's starter motor operated and the engine began to run, with the crankshaft whirling around a couple of inches above my nose. Very cautiously, I slid out from underneath. I discovered that a 'bush taxi' that called at the hospital was responsible. These bush taxis had extra powerful radio transmitters fitted, so they could stay in touch with their base when very far away in the bush. Keying the powerful transmitter at the hospital entrance created enough interference for the generator's controlling PLC to think it had received the start command.

(Attendee at an EMC seminar in Sydney, Australia, November 2000.)

117) AS\$8 million machine spurious start-up caused by transients

We were close to finishing the construction of an eight-million-dollar mining machine in a cavern in Australia. The operators of the mine had a central control room from which they wished to be able to exert manual control over any machine in the mine, even though the machines were automatic or had local control. Accordingly, the mine operators ran their own cables from their control room and connected them to spare inputs and outputs on the PLC for each new machine, also making the necessary software modifications themselves.

Suddenly, while we were standing by the machine, it started up of its own accord. Luckily, no-one was working on it at the time, although they could have been, but it was still a very serious issue as the machine had not yet been filled with lubricant and could easily have been wrecked. It turned out that no special precautions had been taken with the cables from the control room to the PLC, or with the software changes, and a transient interference with the new cables had caused our machine to start up unexpectedly.

(A different attendee at an EMC seminar in Sydney, Australia, November 2000.)

118) Spurious start-up of machine with 5 metre blades

I was visiting a company that made cutting machinery for carpet manufacturers. These machines had blades 5 metres wide, and very sharp. Adjusting the blades to get a good cut over the whole 5 metre width involved careful adjustments, and I noticed that some of the engineers would lie under the blade while making these adjustments.

I also noticed that the control panel (which used low-cost PLCs and not safety-critical types) was in 'single step mode' during these adjustments, and not 'locked-out' at its main electrical supply disconnect. I asked the Chief Engineer if they had ever had one of these machines start up on its own when in this mode, and he said that it had been known to happen, presumably due to transient noise on its mains supply or picked up by its cables.

(From an EMC Consultant who wishes to remain anonymous, February 2001)

119) Possibility of UWB interfering with GPS

I just had to write to you about the [November] editorial "Whose spectrum?". It is right on the mark. However, I would like to point out that there is another crucial difference between ultra-wideband (UWB) devices and hair dryers in addition to the list that Charlie Trimble so appropriately collected; if you choose to shield the hair dryer or otherwise filter its electromagnetic emissions, it still functions as a hair dryer!

If in the future, UWB is (heaven help us) given the desired rulemaking, becomes as pervasive as that industry dreams it will, and then is found to jam GPS at large distances, there will be no technical remedy, just a face-off between two competing industries. To follow the thread of your editorial, if we must grant UWB an FCC Part 15 exclusion just because we have a precedent with other emitters in the band, then we are truly facing a spectral "tragedy of the commons".

(Stephen Lazar of The Aerospace Corporation, writing to the editor of GPS World magazine, Page 6 of their January 2001 edition, www.gpsworld.com/gpsworld.)

(Editor's note: 'ultra-wideband' radio communications devices use a train of very brief pulses occupying many MHz, even GHz of spectrum simultaneously, using time-domain techniques to distinguish one transmission from another unlike traditional radio that uses frequency domain techniques. Their transmitted spectra look like wideband white noise at relatively low power, and the effect of large numbers of them is to raise the noise floor considerably, to the point where the weak signals from GPS could be jammed. Also see Banana Skins December 1998 issue. The same technology is also capable of being used as a 'personal radar' useful for all sorts of things, such as checking someone's heartbeat without contact, or detecting people through walls. We will no doubt be hearing a lot more about UWB in the future.)

120) How EMC techniques saved hundreds of millions of dollars

The new series of Australian banknotes have a plastic film embedded in them, RF welded into place. When the new bank note production line was first used, the emissions from the RF welder (dielectric heater) upset other printing machines and ruined large numbers of banknotes. They called me in and I fixed the problem, improving their productivity and saving them from burning hundreds of millions of misprinted dollars!

(From Chris Zombolas, EMC Technologies Pty Ltd, Melbourne, Australia, www.emctech.com.au.)

121) Police Frequency Freaks Hospital

Further to confirmation that mobile 'phones can indeed interfere with the navigation systems and electronics on board aircraft, news arrives that the UK's new £2.5 billion national police radio network is being urgently tested amid fears that it will interfere with vital hospital equipment and breath-test and radar speed machines. Until it is checked, police have been told to turn their new radios off in hospitals and near other vital equipment. There could also be problems at airports, ports and even in police control rooms.

The network uses a digital radio system called TETRA, or Terrestrial Trunk Radio. The handsets send out pulses at frequent intervals to the nearest masts, identifying their presence, but the pulses can affect the electronics of some types of equipment. The alarm was raised when Jersey police, who are already using Tetra, reported possible problems with their speed and drink-drive equipment. Scientists at the Defence Evaluation and Research Agency (DERA) have been commissioned to discover the level of interference and what else the radios could affect.

(From: The Times, January 2001, sent in by Harold Smart who saw it in the Royal Institute of Navigation Journal, January/February 2000 issue, www.ion.org.)

122) Interference clouds future of multi-billion police radio project

Police from the channel island of Jersey, which is going through pre-implementation testing of the TETRA technology, is advising its officers to be much more careful about using the equipment than was the case with previous kit. Because of fears of interfering with hospital

equipment, the States of Jersey police have imposed tough rules on using equipment and ordered the lowest powered handset available.

The testing also threw up concerns that, according to a statement issued by the Jersey Police, "if a speed detection device suffered external radio interference, it was rendered inoperative". There are also concerns about breath testing devices. According to reports police are being advised that they can only do breath tests 10m from handsets or 35m from more powerful car transmitters. This has raised concerns that the system, the price of which has already been a source of discontent with the old bill, will be turned off in many situations.

The Police Federation has raised concerns that operational effectiveness and even police safety will be damaged, and not improved, by the introduction of the technology. A spokeswoman for the suppliers of the technology, BT Quadrant, said that the equipment used complied with international standards. She compared the equipment to GSM phones which also have to be turned off in hospitals.

(Extracted from an article posted in The Register on 22nd Jan 01 by John Leyden, <http://www.theregister.co.uk/content/5/16266.html>, sent in by Graham Eckersall, G4HFG.)

123) Police radios can trigger positive breath test

If you're ever asked to do a breath test by the police you might do well to insist that they turn off their radios before you blow into their breathalyser. The advice comes from an ex-copper who wrote to us after we printed a story about police concerns about interference from next-generation handsets (see above – editor). He writes: "When at the Metropolitan Police training school, it was taught that PCs should not press the PTT (push to talk) button on the personal radio whilst waiting the requisite forty seconds for the lights to (hopefully) go red. Never. "Oh, no - indeed. Definitely not. Especially if the subject was being 'grievy'. Honest."

He adds that the idea that that a PC might surreptitiously give a quick burst of transmit on his radio whilst his partner was administering the breath test to an uncooperative suspect, was similarly frowned upon. Its worth noting here that, at least in Britain, the actual charging and conviction of drink driver suspects relies on a different test which is administered at police station. Our correspondent explains the technique was used to annoy awkward customers. "This merely gave the opportunity to cause inconvenience, spend time filling out the forms, apologise profusely and sincerely (again, honest) afterwards, give the driver back the keys to his car and advise him where he might find a cab to drive him back to it. At four in the morning. "Oh dear. Terribly sorry, but we are not insured to give you a lift if you are not a prisoner anymore. Sir. No cash on you, then it's a long walk back, in the rain," he added.

Another reader, who worked for the St. John Ambulance, a first-aid volunteer service, recounts a time on duty when he saw a policeman using his radio to trigger a positive result on a breath test. Apparently it was all a bit of innocent fun and the guy was using the trick in a rather strange attempt to chat up a woman he fancied. Our man in the St. John's Ambulance service says that ambulance radios can have the same effects on breathalysers. It's not that we condone drink drivers, but if you're ever pulled up (and assuming you're not too drunk in the first place) now you know what to look out for. Lets be careful out there.

(Article by John Leyden in the Register, <http://www.theregister.co.uk/content/archive/16413.html>, posted on the 26th January 01, sent in by Graham Eckersall, G4HFG.)

124) Pacemaker users get digital radio warning

A reader was taken aback when he took delivery of digital radio handset from Motorola that contained a series of warnings for pacemaker users. The Motorola d700 handsets, which will be used in a Terrestrial Trunk Radio (TETRA) digital communications project, contain recommendations from the Health Industry Manufacturers Association which advise a minimum separation of 15cm between a handset and a pacemaker.

This advice, albeit well intentioned, leads to a number of surprising tips. Pacemaker users should not keep handsets in their breast pockets and furthermore should "use the ear opposite the pacemaker to minimise the potential for interference". It goes on: "if you have any reason to

suspect that interference is taking place" with a pacemaker you should "turn the handset OFF immediately" -- that's if you've not been hit by shortness of breath, of course. We gather there's also warnings about hearing aids, "other medical devices", explosives, and a range of other things, which leads our reader to conclude that "it's hardly surprising people are scared of these things".

A health and safety expert at Motorola confirmed the information and pointed out, quite reasonably, that the instructions are part of the training it provides its users to make sure its equipment is used safely. He said that "similar power levels" were used by Tetra and GSM equipment, which means that interference levels were "not horrifically different", though higher, than older analogue technologies commonly in use today by emergency services, the chief market for Tetra.

So, should pacemaker users avoid mobile phones? Well the issue seems to have more to do with the electrical immunity, or lack of it, associated with a particular pacemaker -- whose manufacturers ought to provide concerned users with all the information they need. It makes you think though.

(Article by John Leyden in The Register, <http://www.theregister.co.uk/content/2/17357.html>, posted on 5th March 01, sent in by Graham Eckersall, G4HFG.)

125) People around the globe are fascinated with Bremerton's tale of a bizarre electronic failure

The widespread failure of keyless remote entries on vehicles around Bremerton last week has sparked interest far beyond the local community — thanks to the ubiquity of the World Wide Web and nationally syndicated talk radio. Since the story first ran Saturday in The Sun, it has been broadcast by two nationwide radio programs that focus on bizarre phenomena — "Coast to Coast with Art Bell" and "The Jeff Rense Show." It also has been posted on numerous Web sites, including The Sun's (www.thesunlink.com), and reprinted in other newspapers.

The widespread posting has fuelled a flood of responses from all over the country — and even from as far away as Russia and Croatia. Meanwhile, the strange incident remains a hot topic in West Sound as residents try to solve the mystery and add to the list of impacts beyond the mass failure of remote entry devices. The outage, which went from about 4 p.m. March 21 until about 6:30 a.m. Monday, apparently was caused by interference with the short-range UHF radio signals transmitted by small hand-held keyless remote devices to an unlocking receiver in the vehicle.

The source of that interference remains a mystery, however. The Federal Communication Commission believes the local military presence is "very possibly" the source of the disruption, said a government official familiar with the agency's investigation into the outage. Although Navy officials still insist they can find no link between the interference and USS Carl Vinson's recent return to Bremerton, most responses sent to The Sun reflect a widespread belief that the military presence is to blame for the disruption. They also question whether the interference might have caused other problems — and that still might be occurring.

Some samples of responses:

- An ex-Navy technician wrote: "You know as well as I do that an active electronic countermeasures (ECM) was inadvertently left aboard a ship docked at the shipyard, causing remote car lock devices to be inoperative. That's what 'jammers' are supposed to do. It is not a coincidence that the effect occurred when (USS) Carl Vinson arrived, and then when the sailors went back to the ship Monday and took a good look around, they turned it off."
- A computer buff in Izakovic, Croatia, wrote that electromagnetic emissions from U.S. Navy warships fry his Internet modem whenever they pull into the local harbor. He now is on his fourth modem and suspects that similar emissions caused the interference in the Bremerton area. "Bremerton mystery is not a mystery at all. U.S. Navy has in operation VTRPE radar and IR/visual/radar satellite detection shielding technology (which causes the problem)."
- Two Bremerton readers reported that something has been interfering periodically with the radio signal that controls their household atomic clocks. The clocks display the exact time, as

broadcast continually over several radio frequencies between 2.5 and 20 MHz from a transmitter in Colorado that is linked to the U.S. Naval Observatory's atomic clock. One clock owner said the problem has persisted intermittently even after the keyless remotes began working again Monday.

Other readers reported problems with TV reception, car alarms and computer microchips in Bremerton and Port Orchard last week during the period of disruption.

- Employees of state and local government agencies reported that their radio systems experience periodic failures in the Bremerton and Bangor areas. "We've called (PSNS), and they won't tell us one way or the other," one respondent wrote via e-mail. "If we knew when they were testing it would help."
- A respondent who identified himself as a "Russian geophysicist" sent an e-mail from Moscow suggesting other possible sources of the disruption, such as rogue TV signals or police communications gear.

(Article by Lloyd A. Pritchett, The SUN newspaper of Bremerton, Wash. USA, March 2001, <http://www.thesunlink.com/news/2001/march/03302mystery.html>, sent in by Graham Eckersall, G4HFG, who saw it referred to in the ARRL news (US ham radio organisation) in April 01.)

126) Mobile phones can trigger remote-controlled explosives

In the corner of the town square, four GIs huddle behind a wall. Someone yells: "Incoming!" A huge explosion lifts the ground, raining down heavy clods of earth that hurt if you don't turn your back. "Glad I moved you up?" smirks the director, Tony To, having advised a more sheltered vantage point than that previously adopted. The crew set up for the next shot. A warning: mobile phones off. Incoming calls can trigger remote-controlled explosives.

(Extracted from an article by Jeff Dawson, in the Sunday Times TV and Radio Guide, 13th May 01, page 4. Jeff was watching a programme about the second world war being made.)

127) Two lightning incidents

After a lightning strike to a factory, a servo-operated packaging machine was found to be operating backwards. It continued to operate at full speed even when its guards were opened, despite supposedly having a hard-wired safety system.

(Contributor wishes to remain anonymous, May 01.)

Late last year, lightning struck in the car park area of a UK Building Society's town centre headquarters. Large voltage surges knocked out the security cameras, and were transmitted to other electronic equipment in three buildings via the connecting cables. Once they had entered the building's electrical systems, the voltage surges damaged the security system, fire alarm and distributed computer equipment.

Latent damage was also caused to the interface between the fire alarm and the radio tag-operated automatic door system, but this went unnoticed at the time. The problem was identified only when a fire alarm went off some weeks later and staff were unable to exit through the automatic doors. Fortunately it was a false alarm.

(Taken from "Don't lose your data in a flash" by Tony Harrison, Electrical Review, Vol. 227 No 12, 10-30 June 94, page 90, www.electricalreview.co.uk)

128) The indications are that lightning strikes are on the rise in Europe.

And it can be expected that damage from these strikes will also be on the rise.

(Taken from "Markets for Power Line Surge Suppressors in Europe" by Christopher Lanfear, PCIM Europe, Nov 2000, Page 34.)

129) Seven EMI incidents reported by Dag Björklöf

Today we can easily find examples of more or less serious electromagnetic problems:

- The magnetic field caused by ground currents in the water pipe system makes it impossible to use sensitive electronic instruments in part of a hospital building.

- A patient-coupled infusion pump is damaged by electro-static discharge, but thankfully the alarm system is not affected, and a nurse is alerted.
- An operation using a plastic welding machine cause interference with a patient monitoring and control system; the monitor fails to detect that circulation has stopped in the patient's arm, which later has to be amputated.
- A wheelchair carrying a handicapped man goes out of control when it comes close to a radio station antenna mast, and eventually the occupant is ejected into the street.
- A robot starts running amok due to a radio control transmitter, smashing all equipment within its reach. *(Editor's note: always make sure the mains isolation switch for a robot is outside its possible reach!)*
- Interference from a passing truck with a radio transmitter causes a crane to drop its load on a person.
- A passenger's laptop causes a plane's navigation system to malfunction, causing the aircraft to go off course.

(Taken from "Immunity testing: Examining requirements and test methods" by Dag Björklöf, Compliance Engineering European Edition's 1999 Annual Reference Guide, page 51, www.ce-mag.com.)

130) Illegal CB transmitters on trucks

Radiocommunication Agency (RA) officials obtained convictions against truck drivers for using illegal citizens band (CB) radios. The convictions came as a result of an official stake out of two truck stops on the M4 highway in Wiltshire, U.K., last October.

(Taken from: "Enforcement Efforts Around the World" Conformity 2001, page 209, www.conformity.com.) (Editor's note: Almost certainly these truckers were using illegal high-power boosters, capable of creating very high field strengths over large distances. Not a good idea when incidents such as described in the 6th bullet of No. 129 above can occur.)

131) Bluetooth and Wi-Fi can interfere with each other

The co-existence of Bluetooth and Wi-Fi in the 2.4GHz Industrial Scientific and Medical (ISM) band was discussed at the recent Wireless Symposium in San Jose. Because the simultaneous operation of these two systems can interfere with each other, the search is on for ways to improve their performance when they are in proximity.

As explained by Jim Lansford of Mobilian Corp. (Hillsboro, OR), these two technologies (known as WPAN and WLAN) are headed for significant growth. "Co-existence has become a significant topic of analysis and discussion throughout the industry", says Lansford. "With both of them expecting rapid growth, co-location of Bluetooth and Wi-Fi devices will become increasingly likely." "They create in-band coloured noise for one another. Neither was designed with specific mechanisms to combat the interference from the other. Bluetooth assumes it will hop away from bad channels. WLAN (802.11b) assumes that if it fails, two Wi-Fi stations tried to transmit at the same time."

(Extracted from "Living in a Wireless World" by Sherrie Steward, Compliance Engineering, March/April 2001, page 10, www.ce-mag.com.)

132) Interference in the 2.4GHz band

Any time you have more sources of RF energy, the EMC design must accommodate with greater immunity. One area of growth is the use of the 2.45GHz band, where such activity as Bluetooth, cordless phones, HomeRF, new RF lighting, and other systems are all vying for use and must work with each other's ambients. There have been claims of interference, but this situation is still coming to a boil. It is only a matter of time before products with lesser immunity in this band will not work together at all user locations.

(Taken from "EMC in a High-Frequency World" by Donald N. Heirman, Compliance Engineering, Jan/Feb 2001, page 30, www.ce-mag.com.)

133) 15 percent of all computer server crashes can be attributed to electromagnetic interference.

(Taken from "The EMC Building: design and construction strategies" by Jose M Rio, ITEM Update 2000, page 28, www.interferencetechnology.com.)

134) Problems with GPS reception caused by interference

It can clearly be seen from table 1 that GPS receivers are very sensitive compared to the others (GSM and Bluetooth) and not surprisingly, this means they are more prone to interference. For military applications this problem is largely solved by the use of controlled reception pattern antennas which electronically 'point' the antenna at the satellite, boosting the signal to interference ratio by typically 30dB.

GPS signals can be interfered with by harmonic interference from commercial TV stations and mobile telephone base-stations. In some countries, including Germany, Austria and Hungary the GPS frequency band is also shared by local fixed radio services and GPS reception is impossible in some (small) areas of Hungary for this reason.

(Taken from "GSM, GPS and Bluetooth in an Automotive Environment" by Dr Peter Miller, Euro-EMC's EMC seminars 3-5 April 2001.)

135) Catastrophic emissions from cable TV in German aeronautical security bands

In spite of using coaxial cables in cable TV distribution systems there is a lot of shield leakage, based on technical imperfections and ageing. Catastrophic emissions in the aeronautical security bands are jamming Germany. LANs and WANs are growing increasingly, adding to this critical situation.

(Taken from "Megabits Per Second on 50Hz Power Lines" by Diethard Hansen, IEEE EMC Society Newsletter, January 01, www.ewh.ieee.org/soc/emcs/.)

136) Interference possibilities between AM radio broadcasting and telcom xDSL

According to her study (Kate Harris, International Switching Symposium 2000, Birmingham, UK) measured ADSL data rates suffer as much as a 2000-b/sec drop when exposed to RFI, which can occur in the bands where DSL networks and AM broadcast share the same spectrum. In North America, this sharing occurs at the medium-wave AM broadcast band. The downstream bands of ADSL and ADSL.lite intersect with AM radio broadcasts in the 535-1104 kHz and 535 – 552 kHz ranges, respectively. There is no overlap between their upstream bands and AM radio broadcast. In fact, the narrow overlap of ADSL.lite and AM radio enables minimum capacity loss in ADSL.lite services when combined with low-pass filtering and modern RFI immunity.

In Europe, however, the upstream band of symmetric high-bit-rate DSL (SHDSL) does share spectrum with AM radio, at the long-wave AM band. And the downstream bands of ADSL and ADSL.lite overlap the long-wave AM band in addition to the medium-wave AM band. Therefore, DSL networks in Europe must contend with a broader RFI threat.

According to Eckert, regulatory agencies are more concerned about egress (interference with AM radio caused by the DSL systems) rather than ingress (interference experienced by the DSL system from AM radio transmissions). But because DSL services are 'white' and not concentrated in a carrier, interference produced by these services sounds like white noise, making it difficult for AM radio users to identify the problems as interference. Complaints received by a regulatory body would not necessarily pin-point the origin of the interference or the use of a DSL product as the culprit. So regulatory bodies have been slow to act, which has in turn slowed standards work.

(Taken from "Addressing the Risk of RFI to and from DSL Networks" in Compliance Engineering Jan/Feb 2001, pages 12 and 14, www.ce-mag.com.)

137) Electronic article surveillance (EAS) can interfere with implanted medical devices

Additional areas being investigated by the FDA include electronic article surveillance (EAS) machines and their impact on implantable medical devices. The EAS machines are utilised as

anti-theft devices in the exits of many retail stores. There have been instances caused by the interaction of these electromagnetic machines and implanted medical products.

(Taken from "Update on Medical Devices and EMC" by Daniel D Hoolihan, ITEM 2000, page 84, www.interferencetechnology.com.)

138) Unusual types of ESD

Two unusual forms of ESD, internal chair discharges and metal-to-metal discharges from "jingling change" have caused severe field problems in electronic equipment. These forms of ESD are not covered by any current standard.

- When a person rises from a chair, charges are generated on both the surface of the chair seat and internally that can cause ESD events to occur inside of the chair. These discharges are between metal parts of the chair that are not electrically connected to each other. The discharges cause intense electromagnetic fields to be radiated from the metal parts of the chair, usually the legs. This radiation has been shown to be capable of disrupting the operation of nearby electronic equipment.

This effect was first reported in 1993 by Honda and Smith. Most chairs I have observed with this effect produce about a dozen discharges over the first 10 to 15 seconds after a person rises from the chair. However, some office chairs are capable of producing several hundreds of discharges over as much as a minute. Just purchasing "ESD safe" chairs alone will not eliminate the problem.

I have personally observed an "ESD safe" chair in a factory emitting this type of interference. Since 1993, many types of equipment have been affected by this phenomenon, including communications equipment, computer equipment, even critical equipment in the field of aviation.

- When small pieces of metal, such as a pocket change, move around inside of an insulating pouch such as a pocket or plastic bag, they generate different charges. When they touch, small ESD events are generated, for the most part too small to be seen. I have measured risetimes of the fields to be smaller than 100 picoseconds, with sub-nanosecond pulse widths.

With the increasing speed of electronic circuits, many types of circuits have become susceptible to this form of interference. I have caused upset by shaking a plastic sandwich bag with a handful of pocket change near communications equipment, a 100MHz PC, and some consumer electronics. In one case, shaking a bag of coins 3 feet from a rack of equipment caused dozens of red LEDs to light!

(Taken from "Unusual Forms of ESD and Their Effects" by Doug Smith, Conformity 2001, page 203. The article originally appeared in the 1999 EOS/ESD Symposium Handbook, and can be downloaded from <http://www.emcesd.com>.)

139) Intercepting and reconstructing VDU monitor signals at 1km or more

You might be interested to note that it is possible to intercept VDU emanations at 1km for monochrome and more for RGB. Both figures are likely to be greater using sophisticated technical means.

(Taken from a discussion about TV detector vans and TEMPEST in The Register, www.theregister.co.uk, 4th March 2001 by Andrew Orlowksi, sent in by Graham Eckersall.)

140) Computers and earthing/grounding impedances at high frequencies

In a newly-constructed financial dealing room, the earthing was done as per IEE Protective Earthing (BS7671). After 2 weeks the US made computer equipment failed. US engineers said it was due to leakage currents from their ITE. Protective bonding for safety is only concerned with 50Hz currents, and is not adequate for modern computers which need a lower earth impedance at higher frequencies because of earth leakage from their mains filters.

In a large computer installation earth leakages (alone) of 70A have been measured at the main earthing terminal, and they are rarely less than 10A.

(From Peter Smith's presentation of his paper "Protective or Clean Earthing – a Potential Difference" at ERA's Earthing 2000 Conference 2000, Solihull, 21/22 June 2000, www.era.co.uk.)

141) Experiences with filtering RS232

We have a product used in-vehicle for vehicle handling testing (see the SR30 robot stuff on our website if you're interested). One version has a control box that incorporates the closed-loop position controller, servo-amp, interlocks etc and communicates with a remote lap-top, usually part of the end-users data capture system to select the test type and set-up and to upload any test information captured in the controller card.

Early experience suggested that separating the ground references of the remote equipment (normally cigarette-lighter powered) and our control system (direct battery powered; it takes up to 100A instantaneously but has a tare drain of 5A) were a good idea, to prevent the inevitable fighting over the apparent vehicle chassis '0V' reference. We therefore installed the proprietary opto-isolated serial comm's card supplied by the controller manufacturer and used a shielded comm's lead (RS232) with the shield connected at one end only – our end in fact.

Six of these units had performed quite happily in the field (and flew through the fairly arduous 30V/m tests used in automotive EMC testing) but the seventh seemed to be very sensitive to the particular laptop/power unit combination used. Very regularly the serial comm's would lock up when the PWM servo amp was enabled.

With the unit back at our base the symptoms were all too readily reproduced on the end user's laptop (but not with the newish Dell used in all our testing). Looking at the serial comm's lead I noticed something different about the 9-pin D-type connector at our end; it had been fitted with a flexible push-in capacitive filter 'thingy', of the type available from RS and used on some of our equipment.

As this was not (and had not been) part of the standard assembly I removed it, and the serial comm's problem was instantly solved!

I can only imagine that this 'thingy' was not acting as a filter but was acting as a convenient means for noise to be injected onto the cores of the serial comm's lead. The connections entering our control case are on the isolated side of the opto card, referenced to the 0V potential of the remote laptop. The connector shell is referenced to our case and its control 0V potential, therefore if our case potential moves relative to the RS232 cores (as I can only imagine it must be when the amplifier is enabled) the capacitors in the filter will act as convenient low impedances directly injecting noise onto the cores.

Fitting the filter 'thingy' at the laptop end is, of course, the thing to do and moving the shield connection to that end should also help, otherwise the transfer capacitance twixt shield and cores could also be a problem in much the same way as the capacitive filter!

(From Dave Bethell, Anthony Best Dynamics Ltd, www.abd.uk.com, 25th June 01)

142) Intermodulation of two broadcast transmitters interferes with automatic garage doors

We have news from down-under about things that bump and grind in the night... Australia's ABC TV and Sydney's new FM radio station 'Nova 96.9' have unwittingly joined forces to meddle with automatic garage doors. VK2WI reports that hundreds of radio-controlled garage doors across Sydney have been overloaded by the ABC and Nova transmissions and some are refusing to open and close. In several cases the doors have developed a life of their own, randomly opening and closing at all hours. The reason is that Nova broadcasts on 96.9MHz and the ABC TV sound signal is on 69.75MHz.

When the two signals mix in an overloaded door receiver, the result is a 27.15MHz signal, which passes straight through most door receivers which are tuned to 27.145MHz, only 5kHz different. This causes erratic behaviour, dependent upon signal content, and the doors open and close in sympathy. Perhaps the designer has sleepless nights, too!

(From Graham Eckersall G4HFG / W4HFG 6th July 01, who got it from the 'News' section of the RSGB website, www.rsgb.org.)

143) Radio transmitters interfere with photographic cameras

Subject: Bizarre Solution... What you describe is a common problem to commercial-radio technical folk. Proximity to active radio-transmitting antennas can cause really wild things to happen to electronic circuits such as the metering portions of your 645 Pro. (It's interesting to note that even some very well-designed and expensive electronic test equipment can be rendered essentially useless by these strong radio-frequency fields.)

The wiring within your camera (it may be nothing more than a centimetre or so of printed-circuit land on a fiberglass circuit board) acts as an antenna. The signal it picks up can then be rectified (changed from a radio signal to a small D.C. voltage) and this voltage can, in turn, add to or subtract from the small voltage generated or controlled by the light-sensing elements in your camera metering system. I would guess that if it adds, you get underexposure; if it subtracts, you get overexposure. It will depend upon exactly how the rectification occurs in the camera circuit.

A parallel case of this type of interference occurs when an automobile with a radio-controlled door lock is located near a high-powered radio or television transmitting tower. Often, it's impossible to unlock the car using the small, keychain-type device because of the same type of effect. In some cases, a particular program signal will trigger the car alarm! The tops of some of those California hills are loaded with radio transmitters and can contain very strong radio-frequency (RF) fields. It would be my guess that the metal housings of some cameras would shield the internal electronics from RF effects.

Of course, a plastic housing offers little such shielding. At best, even a metal-bodied camera would be subject to "radio interference." It can be pretty squirrely stuff! Radio signals and light are both forms of electromagnetic radiation and the inverse square law works for both. The best cure, therefore, is increasing the distance between your camera and the transmitters. As a radio engineer, I've learned long ago that you just can't do certain things close in. Hope this simple explanation helps.

(David Mehall, 22 Aug 1996, from an email thread on photography.)

144) Video surveillance system interferes with car central locking and security

Gun Wharf, a leisure centre in Portsmouth, opened in Easter 2001. It had an underground car park, and the car park had a video surveillance system. It seems that electromagnetic emissions from the video system would often interfere with car central-locking and security systems – locking the cars as soon as they were unlocked, or just not allowing them to be unlocked at all. Many people had to leave their cars in the car park and take taxis home.

(From Anne Cameron, Alenia Marconi Systems, 6th July 01)

145) Electromagnetic weapons could be used for Information Warfare

A relatively recent (1997) definition of Information Warfare given by the Ministry of Defence is: "The deliberate and systematic attack on critical information activities to exploit information, deny services to the authorised user, modify and corrupt data." The issues involved reach well beyond the realm of military warfare, extending to e-business, e-commerce, e-finance and e-government. The power, water and food distribution systems, the emergency services, air traffic control systems, the banking sector and the financial markets, to name but a few, are all dependant on networked digital systems for effective communication and control.

It is a sobering reflection that 'the most advances society in the world is really only four meals away from anarchy, and if you could attack a society through its computers to cause the breakdown of the mechanisms, the infrastructure, which cause it to run, you will bring about mass deaths.'⁴

Line of sight devices. Two distinct classes of line-of-sight devices have been described. The first is a form of low-energy radio-frequency (LERF) jammer, which can be used to temporarily disrupt digital electronic circuits at close range (of the order of metres). Since any cable or circuit component in an electronic system is in principle an unintended antenna, capable of both transmitting and receiving at its characteristic frequency, a low-energy wide spectrum RF field

will contain with high probability frequencies matching the resonant frequencies of critical circuit components.

If this is the case then the system would go into 'random output mode'; its behaviour would be impossible to predict, but could range from single recoverable processing error to total loss of the RAM contents.¹⁵ A parts list and circuit design for such a low-tech device was posted on an Internet bulletin board in 1995 and described at InfoWarCon in 1996. The device was subsequently built and tested in the UK to check the veracity of its design.¹⁰

The second class of device is the high-energy radio-frequency (HERF) gun or non-nuclear electromagnetic pulse (NN-EMP) cannon, which can permanently damage digital circuits at longer ranges (or the order of a kilometre) by blasting them with a pulse of microwave energy in the Gigahertz frequency range. The MOS chips are effectively 'fried' by this process. HERF technology is high-tech and remains the subject of classified military research.

However, the unclassified technology had been reviewed and discussed in detail.¹⁶ In order to protect (or 'harden') systems against RF attack they need to be entirely enclosed in a Faraday cage, ideally including the electrical power feeds and communications links, since these can act as antennas for the RF field or EM transients.

Eavesdropping and surveillance. Since a cable or circuit component can act as a transmitting antenna, unshielded computers and networks are liable to leak compromising RF emanations that are a potential source of intelligence. Passive intelligence gathering from unshielded systems (EIlnt) has been given the name TEMPEST (transient electromagnetic pulse emanation standard, see Reference 16, note 3) while emanations specifically arising from the CRT screens of VDUs are known as van Eck radiation after the scientist who was able to demonstrate remote reconstruction of the screen contents using low-tech equipment.¹⁷

It has been pointed out that malicious software could be used to infiltrate a target system, obtain critical information, and encode it in the system's Tempest emanations in order to broadcast it back to the attacker.¹⁸

Summary and prospects. The threats to, vulnerabilities of, and impacts on critical national infrastructures (CNI) are real and capable of assessment, although in practice this is a complex and challenging task, the more so since information warfare possesses several characteristics of that are not shared by conventional warfare: it is global (there are no borders); it is precise (surgical strikes are possible); it is un-proportionate (the cost of attack is much less than the cost of defence).¹⁹

Some of the accounts of information warfare carried by the media have been exaggerated or are inaccurate, but this must not deflect us from addressing the crucial issues of defining, developing, and deploying critical infrastructure protection (CIP) policies and strategies.

(Extracted from "Information Warfare: battles in cyberspace", by Richard E Overill, IEE Computing and Control Engineering Journal, June 2001, pp125 – 128, www.theiet.org. There was a lot about hackers and such, which has been omitted from this extract.)

146) Case #22804: Lead boxes – Good for Kryptonite, bad for CRT monitors.

A prestigious New York Hotel had upgraded their check-in and reservation computers to modern PCs with colour CRT monitors. One unit's screen, in the managers office, was nearly impossible to read due to a wavy image. Magnetic fields at up to 60 milligauss were found at the monitor location and were coming from a power company electrical vault under the sidewalk outside. Some monitors can be disturbed by as little as 10 milligauss.

Due to some bad advice, the hotel had an aluminium box built (didn't work), then a lead box (didn't work either but at least now the monitor was protected from Superman's X-ray vision). Eventually they came to us and our standard five-sided 'ImageGuard' CRT monitor enclosure did the trick.

(From the Journal of Magnetic Shield Case Studies, an in-house advertising medium published by the Magnetic Shield Corporation, www.magnetic-shield.com.)

147) Financial risks and EMC compliance

Silicon Film Technologies, the firm developing a digital 'film' that fits in a standard SLR camera body, has suspended operations because of failure to meet EMC standards. "The failure of certification tests in the summer delayed Silicon Film's anticipated revenues, but development expenses continued," said Robert Richards, president and CEO of Irvine Sensors, the firm's largest creditor.

Last week Silicon Film said it had met the FCC emissions requirements but could not conform to the stricter European standards. "We believe at least some of those stricter standards must be met for a successful product launch," added Richards. If alternative finance is not found, the firm – 51 per cent owned by Irvine Sensors – will go onto liquidation.

(From Electronics Weekly, 19th September 2001, www.electronicweek.com.)

148) A make of residual current detector (RCD) tripped out by walkie talkies

A particular make of 30mA RCD units fitted in plastic consumer units in site contractor's portable cabins would trip when the walkie-talkies used by the contractors were keyed within 1 metre distance. Replacing them with a different make of RCD solved the problem.

(From Chris Byrne of CB Electrical Engineers Ltd.)

149) Numerous stories of external RF sources interfering with aircraft

The penetration of high-intensity radiated fields (HIRF) into conducting enclosures via apertures is an EMI issue that is relevant to all aviation. The stories are numerous, of disrupted communications, disabled navigation equipment, etc., due to the effects of sources external to the aircraft.

(Extracted from "HIRF penetration through apertures: FDTD versus measurements" by Stavros V Georgakopoulos, Craig R Bircher and Constantine A Balanis, IEEE Transactions on EMC, Vol. 43 No. 3 August 2001 page 282.)

150) EMI and the selection of heat-sink thermal gaskets

It should be emphasised that changing heat-sink gasket material as an EMI mitigation strategy is limited to cases in which the heat-sink patch resonance constitutes a significant part of the overall coupling mechanism. Even then, it is necessary to ensure that the shifted patch-resonance does not coincide with a clock harmonic.

Despite these limitations, there are at least two commercial products in which the substitution of one electrically insulating heat sink gasket for another (of the same size but different composition) has resulted in significantly reduced EMI at certain troublesome frequencies. In one of these cases, this reduction was sufficient to allow the product to meet FCC requirements.

(Extracted from "EMI considerations in selecting heat-sink thermal gasket materials", Huang et al., IEEE Transactions on EMC, Vol. 43 No. 3 August 2001 page 259.)

151) EMI issues loom for future development of single-electron semiconductors

Each year the size of transistors shrinks, thereby improving performance (*but not EMC performance!* – Editor). Yet, according to Technology Review, transistors must be big enough for electrons to pass through. Preparing for an inevitable impasse, Toshiba has demonstrated a transistor that can turn on and off based on the movement of a single electron. Unlike other quantum-level transistors, the device operates at room temperature. It's also the first successful hybrid circuit, mixing single-electron transistors with traditional metal-oxide transistors, which are required to boost the weak quantum-level signal.

Chips based on the circuit should offer blazing performance and low power consumption. Before building a full-fledged processor, researchers face challenges such as finding a way to protect the chips from the disrupting effects of stray electromagnetic fields, electrical discharges, and physical movement. Hybrid chips should be available for use by 2010.

(From Electromagnetic News Report, July/August 2001, Pages 11-12, www.7ms.com.)

152) 50 years ago: ignition systems to be suppressed

The Postmaster General's Advisory Committee on Wireless Interference from Ignition Systems has now presented its report. The Committee devoted its attention in the main to the abatement of interference with the television services of the BBC from ignition systems, including those used in motor vehicles, motor boats, fixed or portable stationary engines, motor mowers, tractors, etc. The Committee's recommendations are based on the assumption that all reasonable measures will be taken to reduce the susceptibility to interference of receiving installations.

They recommend that ignition equipment, when installed as intended, should not radiated an interference-producing field which exceeds 50 microvolts per metre in the 40-70 megacycles per second frequency band, measured on specified equipment at a point not less than ten metres distant. The committee advise that suppression to this amount can be achieved with negligible effect on the mechanical performance of the engine. In the case of about 60 per cent of existing motor cars the Committee think that the required degree of suppression can be achieved by fitting a single resistor costing about 2s 6d.

(From: Council Notices, The Journal of the IEE, September 1951, www.theiet.org.) (Editor's note: 2s 6d is equivalent to 12.5p now, or about 18 cents US. Of course in 1951 this amount of money was worth a lot more than it is now.)

Items 153-159 below are provided by Keith Armstrong of Cherry Clough Consultants, and come from various speakers at the "War Stories" forum held on the 17th August 2001 at the IEEE's 2001 International EMC Symposium held in Montreal, Canada.

153) Magnetic fields from set-top box interfere with TV

An early set-top box was found to interfere with the picture of the TV it was placed on top of, but only after 2 to 5 minutes. The designers had spent months making sure that the emissions from the product were very low. Then they found that the product caused the same interference when no cables were plugged into it, and then even when it was switched off!

It turned out to be due to the magnetic fields from the stereo speakers in the TV. Placing any metal object on top of the TV caused similar interference problems, after a few minutes.

154) Furniture ESD crashes computers

A particular computer manufacturer had a software lab that checked the compatibility of their new products with a number of applications. With one new product the evaluation systems shut down when the testing staff left the room. The new product at that time consisted of a motherboard and HDD with no enclosure, plus the usual keyboard, monitor and mouse.

It turned out to be caused by the induction field developed by the static charge between the staff and their furniture when they stood up (not a spark, just a changing 'static' field). This field interfered with sensitive circuits on the exposed motherboard and caused the shutdown.

155) EMC test results varied with cloud cover

Testing the shielding effectiveness (SE) of an aircraft on an OATS (Open Area Test Site). The engineers had shielded a wheel well using aluminium foil and a ground strap and were confused by random variations in the SE of up to 20dB. These variations were eventually noticed to correlate with the clouds passing in the sky, but at night there were no variations in the measured SE.

The problem was eventually found to be caused by corrosion between the grounding surfaces. Heating and cooling of the aircraft's metalwork due to the sunlight and shade caused by the clouds caused the quality of the electrical bond at the corroded grounding surfaces to vary, causing corresponding variations in the SE of the wheel well. It proved possible to simulate the problem by banging the aircraft with a length of 2x4.

156) Amplifier IC's lead-frame and bond wires very susceptible around 950MHz

A new non-invasive blood pressure monitor was an electronic version of the old 'cuff' method. While testing it for RF immunity it would fail to measure at all between 950 and 1000MHz. It was found that its pressure sensor was outputting misleading signals during the test, despite being a

standard part that had been used for many years without problems (or so claimed its salesperson). The pressure sensor had a 6-pin package, with 2 unused pins marked “do not connect”. Copper tape over the transducer and its pins made the problem go away. The problem was then isolated to just three of its pins, one of which was a compensation capacitor for the sensor’s internal amplifier. An engineer working for the Japanese company that made the sensor said that he had seen the problem before in an automotive application.

The N/C pins were connected to the inputs of the internal amplifier and used for performance checks during production testing. The pins were acting as antennas, picking-up the external RF field and injecting it into the internal amplifier at its most sensitive point, where it would be inevitably rectified (demodulated) by the semiconductor junctions in the amplifier’s IC and cause major shifts in DC operating points. Even with these pins cut off from the package the problem still remained – the amplifier was so sensitive that the internal leads and the bond wires to the IC still made effective antenna at 950MHz.

Eventually the sensor was modified by the manufacturer so that it did not have this problem. In the meantime one year’s worth of production of the new product suffered the additional cost of \$20 per unit for a shielding can and its fitting.

157) Tape recorder interferes with aircraft control system

We put a tape recorder into a drone aircraft used for surveillance. When the tape recorder came on, the drone nose-dived. The 10kHz bias oscillator for the tape recorder was exactly the same frequency as was used by the aircraft’s control system, and this caused the problem. The moral of this story is to avoid using standard frequencies.

158) How many EMC engineers does it take to change a light bulb? No. 1.

A 20 Amp 20 Volt power supply for a medical xenon lamp had to meet EU emissions standards. The PSU was to be fitted in various boxes, some of which could be plastic, so needed not to have to rely on any shielding from its enclosure. The output of the PSU had a 50 microHenry choke in series, to generate the high voltage which would ‘kick-start’ the discharge in the xenon lamp. Unfortunately, 20mA of RF common-mode current was measured the lamp cable!

After a lot of work on the power supply, to no avail, someone tried a different type of lamp and found that the RF noise was 40dB less. Three other types of lamp were also found to be 40dB less noisy. Then other xenon lamps of the same type as the original noisy one were tried and found to be 40dB quieter too. So it seems that all xenon lamps are not created equal.

By the way, the answer was: four engineers.

159) How many EMC engineers does it take to change a light bulb? No. 2.

We had designed a shoe repair kit for use by the US army. The only electrical item in it was a standard domestic-type incandescent filament lamp that ran from 110V 60Hz, so the squaddies could repair their shoes at night. Unfortunately, our regular contact with the military was on an assignment elsewhere and we had to deal with a novice who didn’t understand EMC at all and insisted that we had to fully test the shoe repair kit to MIL-STD-461, the US military’s EMC standard.

He would not be moved by our arguments that the testing was a waste of time. He was following the procedure and it was more than his job’s worth to believe us when we said that it didn’t need testing as it was bound to pass. So we had to do the tests.

Imagine our surprise when our shoe repair kit failed its emissions test by a significant amount at 45MHz! We soon discovered, of course, that this was due to the light bulb. When we contacted Sylvania, its manufacturers, we eventually discovered that around 1% of all incandescent light bulbs (not just Sylvania types) had VHF oscillations, typically occurring between 28 and 45MHz and caused by a ‘monode’ gas plasma oscillator occurring in the very hot gas close to the coiled filament.

The emission frequency could not be predicted because there was no configuration control during manufacture for the aspect of the filament construction that caused the VHF oscillation. As far as we know, this 1% problem with incandescent filament light bulbs is still around.

We don't remember what the answer was in number of engineers, but it was quite a few.

Items 160 - 169 have been very sent in by David Blake BSc CEng MIEE, Managing Director of Electronic Design Solutions Ltd – a compendium of interference problems and their solutions over 30 years.

160) Interference with TV sound from unused set-top box

This is a supplement to Banana Skin no 153 in Issue 37. The stereo speakers on our television had been making rude reverberating noises for some time, particularly so when the sound was moderately loud in the bass. On reading in Banana Skin 153 about the metal chassis of an early set-top box causing picture interference, I removed the old set-top box, which we never use, from our T.V. and the sound is now OK. So it seems that interference from a metal plate above the television set can affect the sound as well as the picture.

161) Noise from alternator in motor-generator set causes computer malfunctions

In the mid 1960s, a London bank was experiencing malfunctions in its new mainframe computer. On the assumption that the cause was mains-borne interference from extraneous sources, a motor alternator set had been installed at the bank to isolate the computer from the mains. That done, the malfunctions continued. So they asked Eric Langham for help.

He found radio frequency ringing on the mains input to the computer, triggered by abrupt changes in alternator volt drop apparently brought about by sudden changes in load current during operation. The addition of R-C snubbers across the three phase input to the computer eliminated the RF ringing and cured the problem. *(Told to David by Eric Langham, Chartered Electrical Engineer.)*

162) Mains power noise causes 250hp fan to vary speed

Small amplitude hunting of the speed of the DC thyristor drive of a 250 hp extraction fan was largely unaffected by experimenting with the values of the R-C stabilising circuit around its speed error amplifier. Then, quite suddenly, the hunting stopped - coincidentally, it transpired, with the chief electrician switching on the automatic power factor correction system in the electrical sub station as the factory load increased.

With hindsight, it is apparent now that cyclic voltage dips in the electric mains originating from commutation in other phase angle controlled thyristor power equipment had been delaying the latching of the thyristors in the fan drive (which were fired by trains of short pulses) until the introduction of the power factor correction capacitors reduced the amplitude of the dips. *(From when David was Senior Systems Engineer for E M Langham, Chartered Electrical Engineer, 1962-79.)*

163) Inadequate contact suppression caused interference with guillotine control

Various guillotines cutting material to length were frequently making double strokes. The source of the trouble was found to be RFI generated when the output contact of the length counter switched the initiating relay in the guillotine control. The contact had originally been suppressed by an R-C snubber comprising 100 ohms in series with 0.1 microfarads connected across it inside the counter. In some counters these components had blown up and were open circuit!

Bench testing of the several types of relay used in the guillotines showed that the original capacitor was too small, in some cases, to limit the peak voltage transient to within its own voltage rating. The shortcoming was cured by connecting appropriate R-C snubbers in parallel with the coils of the guillotine relays. *(Yet another from when David was with E M Langham, Chartered Electrical Engineer.)*

164) Missing low-cost capacitor causes costly machine shutdowns

In the early 1980s, an electronically controlled flying saw occasionally (perhaps once or twice during an eight hour run) switched itself off whilst cutting slowly moving heavy density material into short lengths. Each event cost some £1000 in lost output whilst the scrap material was

cleared and production restored. At the end of an all-night vigil, the user's systems control manager traced the cause to be the false triggering of an integrated circuit monostable in the 24 volt DC control sequencing logic, coincident with a brief period of heavy regeneration of the thyristor controlled main DC drive during its operating cycle.

Bursts of thyristor commutation current generated disturbances which caused radio frequency ringing at the output of an autotransformer which had been installed to match the 430 volt factory supply to the 380 volt rated German electrics.

RFI was breaking through into the 24 volt DC supply because a small capacitor, shown on the circuit diagram, had been omitted by the manufacturer. Critically damping the autotransformer output leakage inductance by R-C snubbers and installing the missing capacitor effected a complete cure. *(From when David was Systems Control Manager at the Cape Insulation Rocksil Works in Stirling, 1979 to 1987.)*

165) Furnace heat control interferes with oxygen sensor

Variations in the analogue output signal of a flue gas oxygen monitor operating from a probe in the waste gas duct of a glassmaker's furnace were traced to common mode interference from the furnace heating phase angle controlled electric boost. The coupling was found to be directly conductive and its effect dependent upon probe temperature.

Operation adequate for using the probe signal to control the combustion air/oil ratio was achieved by re-siting the probe further away from the furnace and its boost electrodes in a less hot part of the flue. *(Another from when David was at the Cape Insulation Rocksil Works.)*

166) Defective contactor interfered with thyristor heating controller

The cause of sporadic false firing of its thyristors which, when it occurred, switched the output of a single phase heating controller to full power was under investigation. Then the problem suddenly ceased when the firm's electrical engineer, acting quite independently, discovered and disabled a defective electrical contactor in the mains power factor control system. *(Another from when David was at the Cape Insulation Rocksil Works.)*

167) Incorrect installation of screened cables causes problems with machine

The output thyristors in photocell detectors in the rolling unit of a multi-section pipe making machine were failing to latch on immediately and delaying the response of the control system. Cure was effected by re-routing their screened cables directly back to the control cubicle through dedicated individual steel conduits. Then the same defect was found elsewhere on the machine. Detailed investigation revealed that the manufacturer's technician had installed and earthed all the screened cabling in a manner contravening his firm's explicit documented instructions.

So, during a fortnight's shutdown brought about by the need to carry out other remedial work, the user's electricians revamped the screened cable terminations and cured all the associated malfunctions. *(Yet another from when David was at the Cape Insulation Rocksil Works.)*

168) Switch interferes with crane control system

The inverter powering the hoist drive of an overhead travelling crane frequently tripped during long travel, coincidentally with the operation of a limit switch which directly switched a tungsten filament indicator bulb in the driver's cabin. RFI from the switch was found to be injecting a false motor speed feedback pulse train into the control system and transiently grossly mismatching the inverter voltage and frequency output to the needs of the motor.

The malfunction was cured by removing the lamp bulb as the crane driver did not need the indication. *(From when David was Managing Director of Pace (Stirling) Ltd - consulting engineers – from 1987 to 1998.)*

169) Walkie talkie interferes with crane hoist's load cell

When checking the calibration of load cell equipment in the hoist mechanism of an overhead travelling crane, it was found that its electronic signal converter could be made to give any value of analogue output voltage between zero and full scale (10 volts) dependent upon the proximity and orientation of the tester's walkie-talkie radio. No remedial investigation was undertaken

because no personnel would be on the crane during normal operations and maintenance staff now knew not to use a walkie-talkie there.

Possible effects from other sources of RFI, such as inverter drives, were not looked for because the equipment performed reasonably enough in normal circumstances. (*Another from when David was Managing Director of Pace (Stirling) Ltd.*)

170) Some thoughts on EMC and safety, and the security of bank accounts

Personally, I could list a ton of stuff that would instil fear and loathing amongst the faintest of EMC hearts. Sitting in a jet airliner at the end of the runway readying for take-off and watching the cabin lights dim slightly in sync with the sweep of the main radar dish just a couple of hundred yards away. ESD events in the kitchen area of the airliner causing the phone in the cockpit at the other end of the plane to ring making the pilot pickup to answer. ESD events in the control tower of an airport causing the computer and other essential equipment to crash. Enough spurious radiation events to require laptops and cell phones to be turned off upon takeoff or landing.

Why am I and hundreds of others trusting our lives on something so ... sensitive? But we think nothing of dialling up the cell phone inside a car packed with digital controls for things like the brakes, the accelerator, gas control ... The automobile industry does its best to test for the severest of electrical events with lightning simulations. But what about internal to the car less than a meter away? And by the way, do they allow cell phones and laptops in that airport control tower? Do they have conductive floors and require people to wear ESD proof shoes? Define safety related issues? Does it necessarily have to do with physical safety? How about the spurious radiation from an ATM being decoded by someone nearby to gain access to your bank account to drain it?

(Posted by Doug McKean on emc-pstc@ieee.org, 2nd Jan 2002)

171) Some examples of interference in residential environments

EMC? Ha! I've replaced the incandescent lamp on my bedside table with a new energy-saving compact fluorescent lamp. With the lamp on, I cannot listen to even the strongest AM radio station on my clock radio (on the same bedside table) due to the lamp interference. This must not be the usage contemplated by EMC requirements.

My TV and stereo are more-or-less integrated (they are in close proximity). On New Year's Day, I wanted to listen to the radio version of the football game description while watching the TV. With the TV on, I cannot listen to even the strongest AM radio station due to the TV interference. This must not be the usage contemplated by EMC requirements.

I take my Grundig portable radio with me when I travel. Most hotels have sufficient interference sources that I cannot listen to AM radio, and sometimes not even FM radio (with lights and TV off!). This must not be the usage contemplated by EMC requirements. EMC? Ha!

(Posted by Rich Nute on emc-pstc@ieee.org, 3rd Jan 2002. Rich is based in the USA.)

I have it from a message on the RFI@contesting.com list that Phillips bulbs produce less RF noise than others. I can't vouch for that, however.

(One of the replies to the above, from Cortland Richmond, 3rd Jan 02)

172) An example of the 'Pin 1 Problem' causing interference in professional audio systems

The Sound Dept. was asked to design sound effects for a fairly standard play. To deliver the sound effects, sixteen amplifier/loudspeaker positions were required, six of them on stage. All went well during the rehearsals and during the first day of production. The sound designer seemed to have done a good job, so I went back to my office to plan a touring season. But on the second day of production, I was summoned to the stage by the director of the play. His artists could not concentrate on what they were doing because of loud clicks coming from the on-stage loudspeakers.

Sure enough, every time someone used the lift to and from the fly floor, a loud noise could be heard in every loudspeaker on the stage. The problem was traced to the input cables for the amplifiers. The input cables were neatly taped to the floor, following the line of the set.

Unfortunately, the cables ran parallel with the lift power wiring, which was under the stage and out of sight. On inspection it was found that the input cables to the amplifiers ran parallel with the lift wiring for at least seven meters. Every time the lift was used, the magnetic field generated by the switching current, coupled with the amplifier cable shields and the switching noise was injected into the input circuit of each amplifier. When the input cables were re-routed, the noise was reduced, but did not totally disappear.

Some years later I found out why. In each case, the cable shield was only connected to ground at one end. This is still the most common method used for trying to control low frequency noise, such as hum or buzz, for equipment that connects the cable shield to the internal circuit 0V conductor (this is now known as "the pin 1 problem" because the three-pin XLR style connectors used in pro-audio connect the cable screen to pin 1).

Each cable shield was thus an excellent receiving antenna for frequencies whose wavelengths were a small fraction of the cable length. The switching noise was duly induced in the cable shields and the noise currents delivered to the output connectors of the mixing console (the cable shields being disconnected at the amplifier ends), where the noise was injected into the mixing console ground conductors. Thus the switching noise was added to the signals delivered from the mixer to all sixteen power amplifiers.

(From Tony Waldron, Technical Manager of Cadac Electronics Ltd, www.cadac-sound.com, recalling an incident when he was Head of Sound at the Royal National Theatre in 1986.)

173) DECT phone interferes with computer

Today I heard about a case where an ISDN terminal was susceptible to a DECT phone next to it while a 900 MHz GSM did not cause anything. This was in the field, not in test lab. In test lab my experience is that if it passes below 1GHz it also passes above it.

(Posting from Ari Honkala to emc-pstc@ieee.org, 10th Jan 02)

Try putting a mobile phone next to your computer mouse! Even more fun if the computer has speakers!

(One of the replies to the above, from Peter Flowerdew, 10th Jan 02. We recommend making sure all data is backed up on removable media before trying this or other interference experiments on PCs, MACs, or other computers.)

174) Electronic Article Surveillance (EAS) system resets pacemaker

The Japanese Ministry of Health, Labour and Welfare announced that there was a case where the operation of a heart pacemaker was influenced by the electromagnetic field from an anti-pilferage device when the patient walked through the exit of a library. Fortunately, the effect was to reset the personalised parameters in the pacemaker to the initial (non-personalised) settings, and the patient didn't feel discomfort with that.

The ministry believes that risk of hazard caused by electromagnetic interference between pacemakers and anti-pilferage devices is low, and a recommendation to the patients was not to stay long time near anti-pilferage devices. The information source was: articles on newspapers (Asahi, Yomiuri, Mainichi, etc.) at 17 January 2002, and Pharmaceuticals and Medical Devices Safety Information No.173 (January 2002) from the ministry.

(From: Tom Sato, 19th Jan 02. Tom's website <http://homepage3.nifty.com/tsato/> is a great source of EMC information in Japanese.)

175) Digital cell phones interfere more with pacemakers than older analogue types

Scientific studies have reported increased interference effects in pacemakers caused by digital phones that did not occur with the older analog technology. Cell phones have decreased in size so that they are often carried in a shirt pocket directly adjacent to an implanted medical device. There are a number of wireless technologies in use today which involve different combinations of power levels and modulation schemes.

(From "Immunity testing for Active Implantable Cardiovascular Devices" by Daniel D. Hoolihan of Hoolihan EMC Consulting, <http://www.emcexpert.com>, ITEM 2001, p45, www.interferencetechnology.com.)

176) Financial risks of poor power quality (1)

The inability to trade can result in large losses that far exceed the cost of the operation. In a recent example a claim for £10m compensation was made as a result of a 20 minute power interruption.

(From "Introduction to Power Quality" by David Chapman of the Copper Development Association, in "The Power Quality and Application Guide", published by The Power Quality Partnership at <http://www.cda.org.uk/PQP/pqag.htm>.)

177) Financial risks of poor power quality (2)

It is estimated that power quality problems cost industry and commerce in the EU about €10 billion per annum while expenditure on preventative measures is less than 5% of this.

(From "The Cost of Poor Power Quality" by David Chapman of the Copper Development Association, in "The Power Quality and Application Guide", published by The Power Quality Partnership at <http://www.cda.org.uk/PQP/pqag.htm>.)

178) Financial risks of poor power quality (3)

There are no official statistics on the severity and distribution of voltage dips but some medium scale measurements are now in progress and can be expected to yield valuable information in due course. One study, carried out by a major generator, measured voltage disturbances at 12 sites with demand between 5 and 30MVA.

In a ten-month period 858 disturbances were logged, 42 of which resulted in disruption and manufacturing loss. Although all 12 sites were low technology manufacturing operations making low added value products the financial loss totalled €600,000 (average €14,300 per event or €50,000 per site), with the highest individual loss of €165,000. The table below gives some typical values:

Industry	Typical financial loss per event
Semiconductor production	€3,800,000
Financial trading	€6,000,000 per hour
Computer centre	€750,000
Telecommunication centre	€30,000 per minute
Steel works	€350,000
Glass industry	€250,000

(From "The Cost of Poor Power Quality" by David Chapman of the Copper Development Association, in "The Power Quality and Application Guide", published by The Power Quality Partnership at <http://www.cda.org.uk/PQP/pqag.htm>.)

179) Adjacent channel interference problems with U.S. emergency services' radiocom system

In the USA, many of the emergency services (fire, police, ambulance, etc.) use a radio system which operates at 800MHz. The base-stations for these systems are often quite widely spread, to reduce the cost to the public purse. These systems are known to suffer from 'adjacent-channel' interference, which seems to be on the increase due to crowding of the spectrum. The interference has resulted in documented cases where officers or other have been put at risk. The main problem appears to be intermodulation in the RF front-ends of the handsets, caused by out-of-band signals from other licensed transmitters.

It is often forgotten that most radio receivers achieved their narrow channel bandwidths in the intermediate frequency processing stages, and that the bandwidth of the earlier stages is much wider, making them prone to interference from powerful signals at nearby frequencies.

(Taken from: "Interference to Public Safety 800MHz Radio Systems, Interim Report to the FCC, Dec 24, 2001" which can be downloaded from http://www.apco911.org/afc/project_39/interim_report.pdf)

180) Locked BMW interferes with digital TV

Question: When my BMW 330Ci is locked, it causes interference to my digital TV service - despite being parked about 30ft from the dish. My wife's Mercedes-Benz doesn't cause this, no

matter where it is parked. I was thinking of swapping her Merc for an X5, but two BMWs parked on the drive at once might limit my evening's entertainment to Scrabble. I'm sure I could get the dish moved, at a cost, but I shouldn't need to do that. I.B., via email.

Reply: There is an EC directive about electronic interference that came into force several years ago. Either your car's alarm immobiliser system or the dish/TV receiver does not conform to it.

(Honest John's Agony column, Daily Telegraph Motoring Section, Saturday 30/03/2002, page 10, www.telegraph.co.uk.)

181) Two navy warships nearly collided when the radar of one disabled the steering of another

The minehunter HMAS Huon went out of control and veered across the bow of the frigate HMAS Anzac. Huon – the first of six state-of-the-art coastal minehunters – lost its steering as a result of electromagnetic interference (EMI) from Anzac and passed ahead of the frigate “at close range” according to an Auditor-General’s report last week. The previously unreported incident occurred in June 2000 while the warships were sailing to Singapore.

The near-collision was used in the Australian National Audit Office report to highlight shortcomings in the testing and evaluation of new defence equipment, especially in the navy, leading to the installation of only partially tested systems. “The incident prompts questions concerning the adequacy of EMI testing during developmental testing and evaluation and whether the services should complete more extensive operational testing and evaluation before integrating new platforms into defence exercises,” the report stated.

The ANAO report rejected Defence Department claims that such testing was expensive and not necessarily cost-effective and said that T&E (testing and evaluation) should be conducted as early as possible in order that risks could be reduced before they became dangerous. “In extreme cases, inadequate T&E could have tragic consequences,” the report said.

(Extracted from “Loose radar blips nearly sink ships” by Wayne Smith, The Courier Mail (Brisbane, Queensland, Australia) Friday February 1st 2002, sent in by Chris Zombolas of EMC Technologies Pty Ltd, Melbourne, Australia, March 2002, www.emctech.com.au.)

182) Experiences of interference in U.S. residential environments

Currently, appliances in the U.S. do not need to meet any EMC compliance standards. Since U.S. appliance manufacturers can (and do) produce domestically used products without any regard for EMI suppression, how serious is the EMC problem in the U.S.? It’s difficult to know the entire scope of the problem, but a few examples have come to our attention. For example, the new 2.4GHz portable phones will not function near laundry rooms when certain models of washing machines are running. This problem is easily overcome by not using these portables near these washers. A little inconvenient, but not intolerable.

In another case, a company that imports and distributes microwave ovens asked us to investigate complaints that some of their microwave ovens were turning on by themselves. The cause was a surge on the power line, probably caused by the air conditioning system turning on. The solution was not simple and required units to be recalled and fitted with a hardware and software modification. The costly remedy was necessary because, in this case, the susceptibility of the appliance electronics created a safety hazard.

In Europe, EMC issues will continue to be managed through the existing EMC Directive, so European manufacturers will remain quite familiar with designing and developing next-generation products that are EMC compliant. Without such a directive here, U.S. manufacturers will need to institute good EMC practices to ensure a more EMC friendly environment for smart, networked appliances.

(Extracted from “Smart Appliances and EMC – Good EMC practices necessary to prevent smart homes from being chaotic homes” by Nissen Isakov, president of LCR Electronics, Norristown, Pa. USA, writing in Appliance Manufacturer magazine, March 2002 issue, pages 16-17.)

183) Examples of interference problems with automobiles

More electronics means more risk from externally generated electromagnetic interference (EMI) and from EMI generated by systems in the vehicle that are adjacent or interconnected. The effects can be quite serious: on certain highway overpasses in Europe, the engines of some vehicles have been shut off when their control units encountered high EMI levels from, among other things, high-voltage lines beneath the roadway, reported David Ladd. He is communications manager at Siemens VDO Automotive (Auburn Hills, Mich., USA), which operates an electromagnetic compliance testing lab. "These problems must be identified and corrected before the vehicle goes into production," he emphasized.

Because of these risks, the auto industry is re-evaluating its requirements and testing for new sources of EMI. Suppliers are increasingly relied upon to develop expertise in managing potential risks during the early stages of engine control unit development, noted Ladd. And the growing use of optical-fibre databuses is eliminating one possible source of EMI problems.

(Extracted from "Can you trust your car?" by Ivan Berger, Contributing Editor, IEEE Spectrum, April 2002, pp41-45.)

184) CB radio used to intentionally jam early electronic ignition systems

It reminds me of a weakness of the original Bosch "Jetronic" electronic injection system as used as OEM equipment on various European cars in the late 1960s to mid 1970s (this was at a time when the good ol' carburetted American V8 was still the norm here).

A common stunt was that people with (illegal) 50 Watt transmitter boosters attached to their CB radio, would drive up beside a Bosch-injected VW or Volvo or whatever, toot the horn to get the driver's attention, then hold up the CB's microphone for the guy to see, and (with a flourish) key the transmitter. The injection system in the "victim's" car would immediately stop and his car would die until the transmitter was keyed off! Now, THAT'S EMI susceptibility!

(Extracted from a posting on emc-pstc@ieee.org in the thread: "RE: Automotive standards" by Bob Wilson of Vancouver, 5th April 2002.)

185) Magnetic fields near to mains transformers

Take a large poorly built transformer or solenoid and push the core hard up against the equipment housing and you could well exceed 0.7mT nearby. Several metres from a train (0.7mT) is less likely but not impossible. These figures should be borne in mind the next time you read about the dangers of the magnetic fields from overhead power lines. I have several times seen building site welders sitting on their transformers with their testicles dangling over the gap and I haven't seen welders dropping like flies.

(Extracted from a posting on emc-pstc@ieee.org in the thread: "RE: Teslars??" by Nick Rouse, 8th February 2002).

186) NASA report on aviation incidents involving passenger electronic devices (PEDs)

NASA runs an Aviation Safety Reporting System (ASRS) to which pilots and other aircrew can voluntarily report incidents. On 1st May 2002 they released a report of 50 incidents taken from the ASRS which involve the use of Passenger Electronic Devices (PEDs), but not all of the reported incidents concern electromagnetic interference.

This report is very useful when you need to show people that some PEDs can interfere with some aircraft systems and communications. You can download it from: http://asrs.arc.nasa.gov/report_sets/ped.pdf.

(From Gary Fenical of Laird Technologies, USA, www.lairdtech.com)

187) One of the aviation incidents reported in the NASA ASRS PED report (see item 186 above)...

Aircraft: DC9. While at cruise FLT FL3100 we noted the onset of multiple anomalies with independent and interrelated onboard electronic systems. The radar altimeter began flagging and sweeping, the GPWS and TASCII annunciated 'FAIL', the VORS flagged, despite good idents and, by and large, rational signals.

Tests of the equip were otherwise satisfactory so we made announcements requesting that certain PEDs (cellphones, pagers, TVs and radios) be verified in a depowered condition, and the flight attendants did a 'PED Walk' in the cabin. The problems initially vanished but then reappeared, and we repeated the process this time requesting that all PEDs be depowered.

The 3rd and final PED walk revealed that several pagers had to be depowered by battery removal, and there was a computer in use with an external battery pack. (No incoming calls to pagers were admitted to.) After this, the anomalous indication vanished for good and all systems operated normally (including the GND VOT signals).

188) Another aviation incident taken from the NASA ASRS PED report (see item 186 above)...

Aircraft: DC9. During CLBOUT from BDL, the captain's radar altimeter flagged and the TCASII and GPWS subsequently annunciated 'FAIL'. The problem continued throughout the CLB to FL350 whereupon I had time to ask a flight attendant to do a PAX electronic device walk. She discovered that a Sony Video Walkman was in use in seat XX. After the Sony was shut off, the problems cleared up. The item was a Sony GVA-500 Video Walkman.

189) Just one more aviation incident taken from the NASA ASRS PED report (see item 186 above)...

Aircraft: Brasilia EMB120. I experienced interference with VOR navigation reception. We found a PAX in seat XA operating a 300MHz Toshiba Protégé Laptop computer. We had her discontinue the use of the computer and normal reception was restored. I have had previous problems with Toshiba computers that are used in row X. I will not limit the use of PAX electronic devices yet, however I now immediately check to see if a laptop is on when experiencing navigation problems.

Callback conversation with the reporter revealed the following info: the reporter stated that the same exact incident happened on a different EMB120 at row X and with a Toshiba laptop computer. That time, they were at McAllister VOR, when the needles on the MFD (Multifunction display) went crazy and were spinning in circles. In both cases, it was spinning in circles on both NAV1 and NAV2. The reporter guessed it was a laptop computer causing it and had the flight attendant check it out and had the person turn it back on to see what would happen, and the instruments resumed almost a normal position, but it was 40 degrees off from ATC.

He said row X is the first row behind the trailing edge of the wing. With this particular incident, he is 90 percent sure that the PAX did turn her computer back on afterwards, but they were almost on top of the new VOR, so he believes that's why it didn't interfere again with the navigation. The reporter speculates that perhaps the Toshiba laptop computer and the VOR had the same or similar frequencies.

190) Pop-up toasters in Dorset speak Russian

Villagers in Dorset were baffled when their pop-up toasters began to speak Russian. Phones and other electrical appliances in Hooke also chatter away in foreign languages and play music. The phenomenon has been blamed on a powerful radio transmitter in nearby Rampisham that transmits BBC World Service.

John Dalton, chairman of the parish council, says: "I've heard foreign voices through an electric organ. And I was amazed when I got the World Service signature tune through a toaster".

(From "Weirdness of the Week" in the Sunday Times' 'News Review', 12th May 2002, page 4.12, www.sunday-times.co.uk.)