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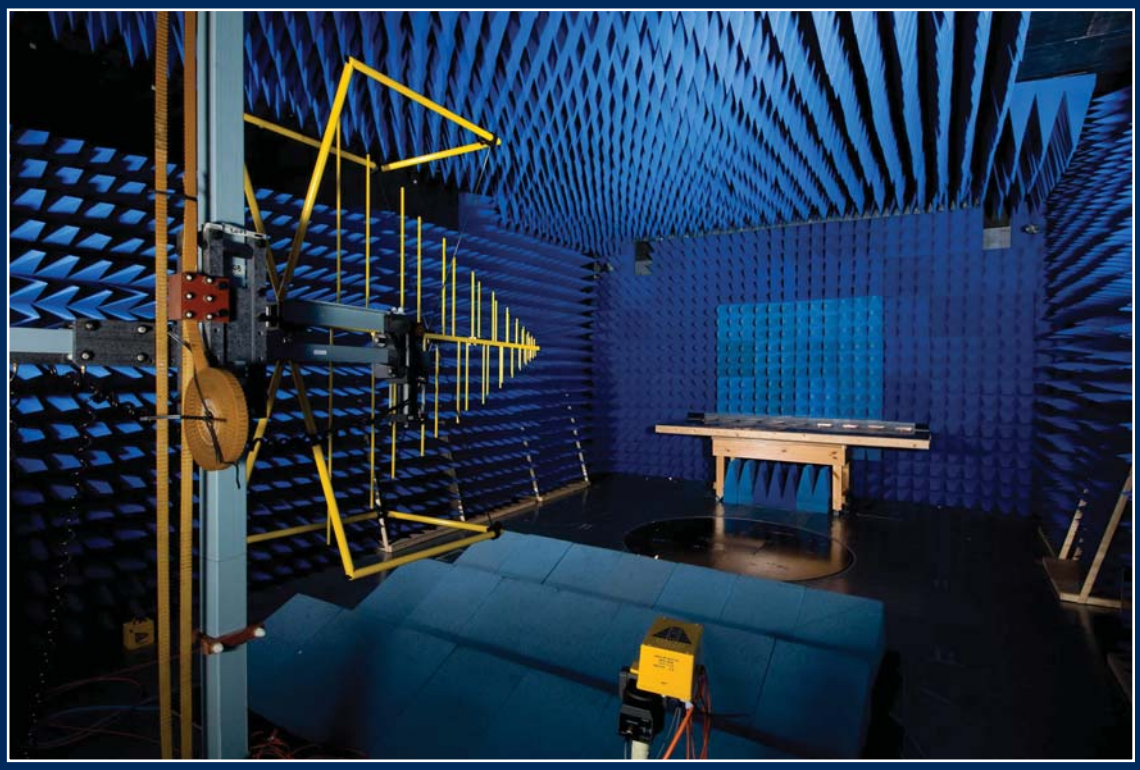
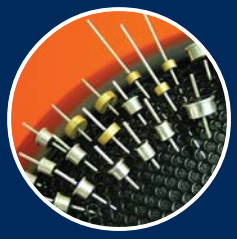
Issue 97 November 2011





ISSN 1748-9253

Automotive EMC Requirements for Electric and Hybrid Vehicles
See page 19

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What's In This Issue

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EMC UK 2012 — www.emcuk.co.uk

emc ACADEMY — EMC Training for Industry by Industry — www.emcacademy.org

News

Farnborough International Ltd confirm confidence in Airshow as more companies book their presence for 2012

As the deadline to book space for Farnborough International Airshow 2012 approaches, organiser Farnborough International Ltd (FIL) confirms its expectation of a buoyant exhibition and announces sales figures are up on those from the same time in the last show cycle with many companies upsizing the scale of their presence. This trend is reflected across all industry sectors with the Space Zone doubling in size, and a number of SME exhibitors growing from shell-scheme stands to self-build space.

With only nine months remaining until the opening of the show, FIL is confident that the forthcoming Farnborough International Airshow (FIA) - which takes place 9-15 July 2012 - will see an even higher proportion of exhibitors upgrading from hall space to corporate hospitality chalets. A significant number of new exhibitors have also signed up for the show since space went on sale in June this year.

FIL is certain that its continued focus on show developments and innovations plays a major factor in FIA's success. Examples of the company's initiative and forward-thinking include the introduction of a bespoke Aviation Security Zone for FIA 2012 and the increased size and scope of the Unmanned Systems Showcase which was introduced with great success in 2010. Other key existing elements of the show to benefit from development and further investment include the military delegations programme - the quality and breadth of which FIA is known for throughout the world, a newly developed civil delegations programme and the MoD Engagement Zone (MEZ) which was another highly successful concept pioneered by FIL in 2010.

FIL Chief Executive, Shaun Ormrod, said: "Farnborough International Airshow clients undoubtedly recognise the show as an important part of their company marketing strategy. As organisers we strive to deliver a robust, value for money event which continues to develop and responds to industry demands and trends."

Ormrod continued: "We have also recently experienced a surge of interest from the emerging economies of the BRIC countries and are currently working closely with them on a partnership level to maximise their FIA involvement."

www.farnborough.com

AMETEK acquires EM Test

AMETEK, Inc. has acquired the parent company of EM Test (Switzerland) GmbH, a privately held manufacturer of electronic test and measurement equipment headquartered in Reinach, Switzerland for CHF 83 million ($93 million). EM Test is a global leader in equipment used to perform electrical immunity and electromagnetic compatibility testing. EM Test has expected annual sales of approximately CHF 37 million ($41 million).

"EM Test is an excellent addition to our test and measurement equipment business. It serves as a valuable platform for growth in the highly attractive market for electrical immunity testing and emissions measurement," notes Frank S. Hermance, AMETEK Chairman and Chief Executive Officer.

EM Test manufactures a full line of conducted electromagnetic compatibility (EMC) test equipment, including electrical fast transient generators, electrostatic discharge simulators, surge generators, waveform simulators and multifunctional generators. Its products are used in test applications by a wide range of industries to ensure that electronic and electrical products are not susceptible to external electromagnetic disturbances and do not generate electromagnetic disturbances that might affect other products or instruments.

EM Test joins AMETEK as part of the Programmable Power division of its Electronic Instruments Group (EIG) - a recognized leader in advanced monitoring, testing, calibrating, and display instruments. AMETEK EIG sells its instruments to the process and analytical, aerospace, power, and industrial markets worldwide and had 2010 sales of $1.3 billion.

www.ametek.com www.emtest.com

UK Magnetics Society 25th Ewing Event

7 December 2011
National Railway Museum
York

The Ewing Lecture will be presented by Professor Roy Chantrell of the Department of Physics, University of York . This lecture will be preceded by an afternoon seminar given by four equally eminent speakers entitled Magnetism Writ Small. Following the seminar will be the opportunity to enjoy a buffet supper served with wine.

The programme can be downloaded from: **http://www.ukmagsoc.org.uk/forthcoming-seminars.html**

Front Cover

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Circle middle, Syfer, page 16
Circle bottom, Rohde & Schwarz, page 18

Secretariat for EMCIA

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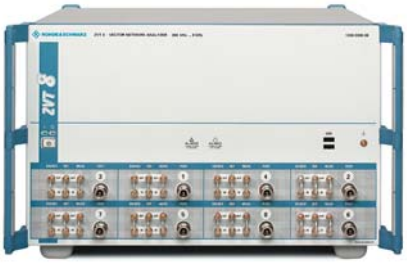
Rohde & Schwarz UK supplies vector network analysers for revolutionary breast cancer screening research

Rohde & Schwarz has supplied high speed vector network analysers to Bristol University spin-out Micrima for the clinical trials of their revolutionary breast cancer screening technique.

MARIA (Multistatic Array processing for Radiowave Image Acquisition) is an ultra wideband radio system that can be used to detect tumours by generating high-resolution 3D images of the human breast. The technique which avoids exposing women to X-ray radiation, is fast and inexpensive. It is also expected to be better at identifying breast cancer in younger women.

Professor Ian Craddock and Professor Alan Preece from Bristol University developed the wideband antenna array, which lies comfortably beneath the breast. The array connects via a switch matrix to the test ports of a R&S ZVT8 Vector Network Analyzer, which takes fast frequency sweep measurements. Post-processing is carried out on a computer using software developed by the research group.

Roy Johnson, Executive Chairman of Micrima, said: "The new 3D breast screening platform under development aims to be safer, more convenient and more economically



viable in a greater number of countries, in addition to providing a practical solution to screening women below the age of 50."

Funding from Micrima has enabled the radar-based breast imaging system to undergo further technical development and clinical trials. The first set of clinical trials have just concluded. Conducted at Frenchay Hospital's Breast Care Centre in Bristol in collaboration with Dr Mike Shere, as well as Southmead Hospital in Bristol, they have been very successful.

Commented Professor Ian Craddock from Electrical & Electronic Engineering at Bristol University: "Current mammography systems play an important role in the detection of breast cancer but suffer from relatively high missed- and false-detection rates, and involve uncomfortable compression of the breast."

He added: "Speed of measurement is critical for this application. We were therefore very impressed by the fast measurement capability offered by the R & S ZVT8 8 Port Network Analyser. The analyser's parallel data acquisition across 16 receivers has enabled us to reduce measurement time from a little over one minute to nine seconds, which is good news for patients and for screening throughput."

"In addition to the R&S ZVT's speed, its ability to emulate other network analyzers has meant that the Bristol team has been able to get up to speed with the new instrument much faster," said Jamie Lunn, Rohde & Schwarz UK's RF & Microwave product specialist. He concluded: "We are immensely proud that our instrumentation is being used to progress such a valuable research goal."

Micrima's goal is to create a compact, low cost version of the MARIA system that could be situated in GP surgeries and mobile screening units. With breast cancer being the most common cause of death for women aged between 35 and 59 in Europe, it is hoped by all involved that the technique may eventually ensure that all women, regardless of age, could be routinely screened.

www.rohde-schwarz.co.uk

News and Information

New Regional Sales Manager for ETS-Lindgren

ETS Lindgren Ltd, the Stevenage based subsidiary of the American parent, is expanding its sales support in line with ever increasing business. ETS Lindgren is a world leader in electromagnetic compatibility providing customers with detection, measurement, shielding and control. The company also manufactures a wide range of antenna measurement systems.

Key to the expansion of current sales activity is the appointment of Garry Perren as Regional Sales Manager. Garry has very wide experience in the EMC market initially as an engineer at Toshiba in Plymouth and subsequently in varied technical sales roles initially with Rohde & Schwarz and latterly with Rainford EMC Systems.

Ken Foan, Sales & Marketing Director EMEA for ETS Lindgren announced the new appointment, "Garry's experience will enable us to improve our service to customers in a number of key territories. We welcome Garry to the organisation and wish him every success." In his new role Garry will provide support to both distributors and customers in the UK, Scandinavia and Israel.

Ken Foan, Sales & Marketing Director EMEA for ETS Lindgren (on right) congratulates Garry Perren on his appointment as Regional Sales Manager for ETS Lindgren

Garry is a family man with many interests including football, he is a level 2 FA coach and runs many football teams.

Banana Skins Issue 96, September 2011

We received an email from Adam Mallaby, Brand Reputation and Social Media Public Relations, npower, who was very concerned to read the article headline 'Pelican crossing blights prepayment card's cash' printed on page 10 of the EMC Journal, September 1st.

He stated, "the chip inside the prepayment card is the same as that in a mobile phone SIM card. If what has been printed was true then no one's phone would work when they used a pelican crossing.

All of our chips are fully compliant with industry standards and having checked with the manufacturers of the pre-payment cards against what has been printed, this is not factual or true, and we would like to see a retraction being printed in the next issue."

Banana Skins merely prints reports of (alleged) EMI, so if this item was incorrect we apologise but suggest he takes it up with the original publisher.

Two New Appointments at AR

AR RF/Microwave Instrumentation has announced that Jay Osselburn has joined the company as a Senior Product-Engineer for the "A" Series of RF power amplifiers. These amplifiers offer coverage up to 400 MHz and power up to 16,000 watts and beyond.

Mr. Osselburn brings over 20 years of experience in the RF industry to his new position at AR. His background includes designing and developing RF amplifier and transmitter systems, as well as leading the teams of engineers working on these products. His most recent work was as a Senior Project Engineer at Innovation Engineering, Inc., and throughout his career, he has worked at a variety of engineering companies creating products that have helped to move the RF industry forward.

Also joining AR RF/Microwave Instrumentation is Carl Mueller who has been appointed to the position of Applications Engineer for the company's EMI Receiver, Conducted Immunity Systems, and test software. Mr. Mueller will provide customer support and will also be involved in system development.

Mueller comes to AR with more than 20 years of experience in military systems integration and testing. He has worked as Principle System Engineer on radar warning receivers, communication jamming systems, and aircraft simulated training systems. His background includes extensive client contact, including on-site customer training.

Mr. Mueller worked for AEL, Tracor, Marconi, BAE Systems, Cobham, and ACC-SORT Systems prior to joining AR.

Banana Skins...

Editor's note: The volume of potential Banana Skins that I receive is much greater than can possibly be published in the Journal, and no doubt they are just the topmost tip of the EMI iceberg. Keep them coming! But please don't be disappointed if your contribution doesn't appear for a while, or at all. Even using four pages in every EMC Journal I can't keep up!

667 HDMI fails to meet the demands of low EMI

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

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

668 How vulnerable are we to GPS jamming?

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

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

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

A GPS jamming attack on the ship THV Galatea two years later off Newcastle-upon-Tyne showed some of the more subtle effects of jamming. Under low-power jamming, at about the same level as the real GPS signal, the ship's GPS-driven bridge instruments showed plausible but wrong positions and velocities. No alarms went off to indicate malfunction. As the jammer power was turned up, all the GPS-fed systems failed including the electronic chart display, the autopilot, the maritime distress safety system, the radar, the gyro-compass and the Automatic Identification System, according to the General Lighthouse Authority who conducted the trial.

Vulnerabilities

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

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

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

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

Position and time

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

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

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

For these reasons, efforts are underway to encourage the use of back-up timing sources and to put in place ways of detecting, locations and mitigating sources of interference.
(Taken from "Jam Today", by Christine Evans-Pughe, IET Engineering & Technology, May 2011, pp 78-81, www.EandTmagazine.com)

669 The ultimate EM threat – "killer stars" – overload satellites' electronics
We know of well over 1000 pulsars. The number of quiet neutron stars must be vastly more. Even at the present rate of star formation, given the 10-billion-year life of the Galaxy's disk, there should be at least 100 million of them. There is probably one nearby, sliding silently past us, of no danger whatsoever.

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

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

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

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

On December 27, 2004, SGR 1806-20 (in Sagittarius) outdid its Auila cousin by a factor of 100. For a brief instant, a couple tenths of a second, an outburst of energy the equivalent of half a million years'-worth of sunlight shone on us with the apparent light of more than a full moon (in gamma rays: you could not have seen it). Once again, many satellites and the upper air took a huge hit. SGR 1806+20 is estimated to be 50,000 light-years away, on the other side of the Galaxy. And it was not the first time! The magnetar had previously popped in 1974. And it will most likely do it again before these pages turn brittle with age.
(Taken from "Heaven's Touch – from killer stars to the seeds of life, how we are connected to the universe", by James B Kaler, Princeton University Press 2009, ISBN: 978-0-691-12946-4.)

670 How EMI can become a problem
Electromagnetic Interference (EMI) can become a problem when emitted electromagnetic fields interfere with the operation of other electronic equipment. Electromagnetic fields are radiated from sources such as equipment for television, cellular telephone, radio communication, computer, radar, and other devices. EMI could also take place due to distant sources such as radio transmitters, antennas, and lightning, which make incident electromagnetic fields similar to plane waves. Common examples of EMI include disturbances in television reception, mobile communication equipment, medical, military, and aircraft devices, in which interference could disturb or jam sensitive components, destroy electric circuits, and prompt explosions and accidents.
(Taken from: "Simple device for electromagnetic interference shielding effectiveness measurement", by Horacio Vasquez, Laura Espinoza, Karen Lozana, Heinrich Folz and Shuying Yang, IEEE EMC Society Newsletter, Issue 220, "Winter 2009", www.emcs.org/acstrial/newsletters/winter09/pp2.pdf)

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

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

Testing

According to Jones, "Civil aviation regulations require a plane to be safe for 1011 flying hours at least and the figures

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

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

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

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

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

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

Thank you for your comprehensive response.

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

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

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

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

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

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

a) The Consumers Association (Which?)
b) Ofcom
c) Consumer Direct
d) British Standards Institute (who first suggested Trading Standards, but I noted that their phone number was the same as Consumer Direct)
e) UKAS
f) NEMKO Ltd
g) Hursley EMC, where Julian Jones suggested that I contact you.

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

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

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

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

673 European Space Agency Shuts Down Illegal Transmitters

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

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

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

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

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

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

674 Military radios interfering with garage door openers

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

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

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

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

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

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

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

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

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

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

(Kindly sent in by Chris Zombolas, of EMC Technologies Pty Ltd, who operate EMC test labs in Melbourne and Sydney, Australia, and Auckland, New Zealand. Written by Mike Anton of the Los Angeles Times, reported in the Sydney Morning Herald, June 3, 2011 - 8:38AM, www.smh.com.au/technology/technology-news/military-radios-interfering-with-garage-door-openers-20110602-1fj5d.html. Read more: www.smh.com.au/technology/technology-news/military-radios-interfering-with-garage-door-openers-20110602-1fj5d.html#ixzz1OCjQqMdb. Also reported by Interference Technology Magazine at: www.interferencetechnology.com/lead-news/article/seal-beach-navy-transmitters-control-residents-garage-doors.html as "Seal Beach Navy Transmitters Control Residents' Garage Doors" posted 06/01/11 09:06 AM, which referred to an ABC article: http://abclocal.go.com/kabc/story?section=news/local/orange_county&id=8157525&rss=rss-kabc-article-8157525)

675 Excessive emissions from Plasma TVs despite passing relevant tests

22 September 2011 at 08:42

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

22 September 2011 at 09:25

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

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

22 September 2011 at 09:40

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

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

22 September 2011 at 12:26:16

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

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

24 Sep 2011

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

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

Banana Skins

Banana Skins are kindly compiled for us by Keith Armstrong.

If you have any interesting contributions that you would like included please send them, together with the source of the information to: keith.armstrong@cherryclough.com

Although we use a rather light hearted approach to draw attention to the column this in no way is intended to trivialise the subject. Malfunctions due to incorrect EMC procedures could be life threatening.

John Woodgate's Column

All quiet…

It has been customary for CISPR and IEC TC77 to meet annually and consecutively at the same venue, but this year, after a certain exchange of compliments, CISPR and its sub-committees except CISPR/D met in Seoul in mid-October but TC77 and its sub-committees met during the IEC General Meeting in Melbourne, Australia at the end of October.

So, what happened? At the top level, CISPR and TC77 itself, not a lot, it appears, which is good, because a lot of top-level activity probably bodes ill. CISPR is looking at its internal 'ways and means' but hasn't come to any firm conclusion yet on possible changes. The number of CISPR standards and the average number of pages have, not surprisingly, grown greatly over the last 20 years or so, and several of the standards involve complex and potentially controversial issues, so that when agreement is reached, no-one is inclined to say 'but the text is rather obscure and should be clarified', because that can open up controversy again.

However, due to the much larger number of people now trying to use these standards, and especially because industry is at last beginning to realise that EMC has to be designed-in, not expensively imposed on an alleged finished design, pleas for clarification have increased considerably. Circuit designers are not experts on EMC jargon and require explanations in more familiar terms.

CISPR

A Working Group will be set up to deal with Smart Grid issues. For some undisclosed region, the IEC roadmap for Smart Grid originally set EMC standards as 'low priority'. Is this a further insertion of the 'PLT wedge' - in other words, is there a high-level consensus that EMC regulation has gone too far and needs reining back? Perhaps not; a less alarming explanation is that EMC standards can't be finalized (although they can certainly be worked on) before the system parameters are established. While it is certainly correct that controls must not be established on the basis of incomplete system data, even this isn't too reassuring - the PLT system parameters were established first and so far the EMC requirements have more or less been beaten into submission to them. The process **should** be interactive, of course, the system should be developed with full participation of EMC experts. After the successful development of porcine aviation, of course.

The method of testing non-earthed EUTs for ESD has been queried. This is hardly a surprise, because plausible models of the effects of a static discharge to a non-earthed device are numerous (and every single one of them is right, of course), so the standard method can always be queried. More research, as they say, is needed.

A questionnaire will be circulated on this subject and another on the need for conducted emission control below 150 kHz. Further initial work will be done on radiated emissions below 30 MHz. Methods of measurement exist for magnetic fields, but some interference cases may be due to electric fields, and their measurement (repeatably) is much more challenging.

Reports of the CISPR/A/ /B and /I meetings are not available at the time of writing.

CISPR/D met in the USA in October 2010 and has no meeting this year, but in future is expected to meet more frequently than annually. This committee deals with EMC of vehicles, excluding highway vehicles (which are studied by ISO along with the mechanical engineering aspects). A revised Scope was agreed. Work is on-going on EMC of electric and hybrid vehicles, for development of CISPR 12/EN 55012. CISPR 25/EN 55025 is also under revision.

CISPR/F met in Seoul. The advent of Smart Grid requires attention to be paid to emissions from household appliances and the like in the frequency range 9 kHz to 150 kHz and immunity also in this frequency range. CISPR 14-1/EN 55014-1 has a new Amendment 2, about induction hobs. These were previously dealt with in CISPR 11/EN 55011 and for a transition period, manufacturers may apply that standard or the amended one. CISPR 14-1 is undergoing a full revision at present, prompted by the number of approved and proposed amendments exceeding two.

A revision of CISPR 14-2/EN 55014-2 is also in progress. The revision of CISPR 15/EN 55015 will proceed to the FDIS stage. Because this introduces a third amendment, it should result in a new (8th) Edition. A full revision is also planned, which will presumably be a 9th Edition, introducing requirements in the frequency range above 300 MHz.

There is a new 2-part Technical Report for emissions from electronic control gear on the way. TR CISPR 30-1 is a test method for control gear for fluorescent lamps and TR CISPR 30-2 applies to control gear for discharge lamps other than fluorescent.

Acting on a CISPR/A recommendation, CISPR/F will introduce, by reference to IEC 61000-4-22, measurement of emissions and immunity in fully-anechoic rooms (FARs).

CISPR/H deals with the Generic Standards, among other things. Interpretation Sheets have been issued on the December 2010 editions of IEC 61000-6-3 and -4. These clarify how measurement uncertainty is to be taken into account. However, further revisions are required, because of new decisions about standards texts on uncertainty.

The revision of CISPR TR 31 on the characteristics of radio services is nearing completion. New work is required on CISPR 16-4-4 on measurement uncertainty. This is a huge and complicated subject, and not immune to controversy. There is a school of thought that says that uncertainty correction should be applied to the calibration of test instruments, and not applied to measurement of equipment.

In CISPR/I, the new CISPR 32 on multimedia product emissions is considered to be near the end of its development; the FDIS (final vote) was circulated on 7 October 2011.

However, this may not be the end of the process, as there are other issues still not at the voting stage. The struggle with the complex CISPR 35 on multimedia product immunity continues and is by no means finished. Significant changes appear still to be necessary.

Meanwhile the standards that the above are intended to replace still need attention. CISPR 13 and 20 both need changes; CISPR 13 needs to take into account radiated emissions below 30 MHz from plasma TVs. A PAS (Publicly Available Specification) is likely, because of doubt about the best method of measurement. CISPR 22 and 24 also need updating; one issue is that clarification of the term 'balanced line' is required. I hope it is understood that balanced lines remain balanced even with no signal; the 'balance' is an impedance balance, the line and its terminations forming a balanced bridge.

All aboard!

Moving now rapidly from Korea to Australia, IEC TC77 and its sub-committees SC77A , B and C met in Melbourne.

TC77

TC77 has a new Chairman, and the Secretary was absent due to illness, so the meeting was rather different from previous.
The Generic standards IEC 61000-6-1 and -2 will undergo maintenance. It is not yet clear what may be changed. A questionnaire will circulate about converting IEC TS 61000-6-5 into a standard. IEC TS 61000-1-2 has to be reviewed under IEC rules, and it may need amendment. Tow questionnaires will be produced.

IEC 61000-4-1 may be changed from a standard to a freely-available information document. It is a good, if perforce superficial, introduction to EMC standards.

SC77A

The Plenary meeting agreed to cancel two Technical Report projects (or one merged one) on which I have been struggling to make progress for (it seems like) 4 centuries. At one time, they would have been useful, but things have moved on and they are more or less redundant now. However, I've kept all my material on them so that if they were to be revived for any reason ... The 'overview' project IEC TR 61000-3-1 is also cancelled.

There will be one more look at whether a separate standard for interharmonic emissions (IEC 61000-3-9) is required or not. This is tied up with the 'grouping' of interharmonics with harmonics, which is technically very questionable (it treats interharmonics close to even harmonics very differently in respect of limits from those close to odd harmonics). However, it seems that some manufacturers can make their products meet the 'grouped' limits now, which was not possible in the past.

The subject of emissions in the range 2 to 9 kHz will continue to be studied.

SC77B

Key points from the meeting report are:

- IEC 61000-4-3 will be revised to take non-uniformity of the electric field into account. This may be quite difficult
- IEC 61000-4-4, -5 and -6 are already under revision;
- Maintenance of IEC 61000-4-9 and -10 has not been started yet;
- A project on immunity to broadband signals initially failed for lack of support, but will be revived now that sufficient support is assured;
- A New Work proposal on measuring radiation from close-by sources is being prepared and is urgently needed;
- A discrepancy now exists between IEC 6000-4-6, which calls for an elevated ground plane, and IEC 61000-4-4, which has had the ground plane deleted. There is concern that the test method in IEC 61000-4-4 does not take into account the effects of long cables.;
- IEC 61000-4-20 and -21 will both undergo a maintenance review;
- Papers on a four-port TEM waveguide for emission and immunity testing and on reverberation chambers with diffusers were presented.
- Attention was drawn to the IEC policy on transitional periods for the implementation of standards (mostly safety and EMC standards) referred to in national or regional regulations. In the IEC Supplement to the ISO/IEC Directives, provision is made for a special text to be inserted in the Foreword of such standards:

  NOTE The attention of National Committees is drawn to the fact that equipment manufacturers and testing organizations may need a transitional period following publication of a new, amended or revised IEC publication in which to make products in accordance with the new requirements and to equip themselves for conducting new or revised tests.

  It is the recommendation of the [IEC] committee that the content of this publication be adopted for implementation nationally not earlier than X months/years from the date of publication.

SC77C

Again, key points in the absence of the meeting report at the press deadline:

- IEC 61000-2-4 requires a major update;
- Work on updating IEC 61000-5-1 and -2 requires support form SC77A and SC77B experts;
- IEC 61000-4-33 requires amendment in respects of measurement uncertainty;
- New work may include a guide to HEMP standards and a report on geomagnetic storm phenomena.

Menagerie acquisition

A new animal has appeared in the menagerie of IEC committees - Project Committee 118 - Smart Grid user interface. One hopes that few users will actually come into physical contact with the Smart Grid - if they do, TC64 or TC108 will have much work to do!

Project committees prepare individual standards not falling within the scope of an existing technical committee. Once the standard(s) is/are published, the project committee is disbanded. The national body which held the secretariat is responsible for the maintenance of the standard(s) according to the usual procedures.

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Know Your Standards

Time to be specific

Having looked in previous issues of the Journal at standards bodies and the ways that standards can be divided into types and classes, it's time to look at specific standards, and for EMC, the two biggies are CISPR 16 and IEC 61000-4, both divided into many Parts and Sections.

CISPR 16

This once was a standard of a modest 50 pages or so, but expanded to well over 100 and now is a multi-part standard with numerous sub-divisions. It is developed by CISPR/A - Radio-interference measurements and statistical methods, except for CISPR TR/16-4-4, which is developed by CISPR/H.

There follows is a list of the current publications *at the time of writing.* The list is continually updated, and is freely available on the public part of the IEC web site. There is little point in citing one of the very long direct URLs, but you can drill down through the structure:

www.iec.ch -> Dashboard Finder -> Technical Committee -> CISPR/CIS/A -> Projects/Publications -> Publications
There you will find all the amendments and corrigenda, as well as details of bilingual (English/French) and monolingual (English, French or Spanish) editions, together with Stability Dates - the date before which no change to the standard is expected.

This search works for **all** IEC and CISPR technical committees and sub-committees, of course, not just for CISPR/A.

Components of CISPR 16

A publication code such as CISPR 16-1-1 indicates:

CISPR - Originating body

16 - Publication number

1 - Part number

1- Section number

Note: Sub-divisions of the text of a standard are *clauses*, not *sections* or even *chapters* (which may be a mistranslation from German). Some standards with a long history still have 'chapters' as *major* divisions of the text.

A package of all of CISPR 16 can be purchased from IEC, but you have to be very rich:

CISPR 16-SER Edition 1.0 (2011-10-13) Specification for radio disturbance and immunity measuring apparatus and methods - ALL PARTS

Most people not in test houses need only selected publications:

CISPR 16-1-1 Edition 3.1 (2010-11-10) Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus

CISPR 16-1-2 Edition 1.2 (2006-08-11) Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-2: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Conducted disturbances

CISPR 16-1-3 Edition 2.0 (2004-06-28) Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-3: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Disturbance power

CISPR 16-1-4 Edition 3.0 (2010-04-27) Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Antennas and test sites for radiated disturbance measurements

CISPR 16-1-5 Edition 1.0 (2003-11-19) Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-5: Radio disturbance and immunity measuring apparatus - Antenna calibration test sites for 30 MHz to 1 000 MHz

CISPR 16-2-1 Edition 2.1 (2010-12-16) Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements

CISPR 16-2-2 Edition 2.0 (2010-07-28) Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-2: Methods of measurement of disturbances and immunity - Measurement of disturbance power

CISPR 16-2-3 Edition 3.1 (2010-08-23) Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements

CISPR 16-2-4 Edition 1.0 (2003-11-20) Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-4: Methods of measurement of disturbances and immunity - Immunity measurements

CISPR/TR 16-3 Edition 3.0 (2010-08-10) Specification for radio disturbance and immunity measuring apparatus and methods - Part 3: CISPR technical reports

CISPR/TR 16-4-1 Edition 2.0 (2009-02-23) Specification for radio disturbance and immunity measuring apparatus and methods - Part 4-1: Uncertainties, statistics and limit modelling - Uncertainties in standardized EMC tests

CISPR 16-4-2 Edition 2.0 (2011-06-08) Specification for radio disturbance and immunity measuring apparatus and methods - Part 4-2: Uncertainties, statistics and limit modelling - Measurement instrumentation uncertainty

CISPR/TR 16-4-3 Edition 2.1 (2007-01-18) Specification for radio disturbance and immunity measuring apparatus and methods - Part 4-3: Uncertainties, statistics and limit modelling - Statistical considerations in the determination of EMC compliance of mass-produced products

CISPR/TR 16-4-4 (**developed by CISPR/H**) Edition 2.0 (2007-07-16) Specification for radio disturbance and immunity measuring apparatus and methods - Part 4-4: Uncertainties, statistics and limit modelling - Statistics of complaints and a model for the calculation of limits for the protection of radio services

CISPR/TR 16-4-5 Edition 1.0 (2006-10-25) Specification for radio disturbance and immunity measuring apparatus and methods - Part 4-5: Uncertainties, statistics and limit modelling - Conditions for the use of alternative test methods

These publications have been written (and some repeatedly partly re-written) over the years by numerous people, so there are inconsistencies in language and style. CISPR intends to deal with this, but don't hold your breath!

The intention, also, is to collect into CISPR 16-1 and -2 all except the most specialized methods of measurement from other CISPR standards. Those from CISPR 13, 20, 22 and 24 that qualify have already been included or soon will be.

One point to beware of is the risky mixing in some of these standards of decibels and impedances in ohms. I pointed the problem out through BSI some years ago and it seemed to be accepted that a change was necessary, but later the comment was rejected. Even so, I believe it is valid. Consider :

$$V = IR$$

Convert to dB: the multiplier must clearly be 20 for all:

$$20\lg V = 20\lg I - 20\lg R$$

Now consider:

$$W = V^2/R$$

Convert to dB:

$$10\lg W = 10\lg(V^2) - 10\lg R$$

The multiplier must clearly be 10.

So, to convert 150 ohms to dB (which is needed as a correction factor in some calculations), do you multiply 2.18 by 10 or 20? Rather than mixing decibels with ohms, the correction can just be expressed as a number, explaining that it is derived from the 150 ohm impedance.

CISPR TR/16-3

This Technical Report is not widely known, but it is well worth study. It explains a lot about EMC and CISPR standards that isn't explained elsewhere. It isn't adopted by CENELEC, but it is published by BSI. Unfortunately, it is quite costly.

IEC 61000-4

This also needs a whole article to do it justice, so that will have to wait for the next issue.

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Rohde & Schwarz presents new 600 MHz oscilloscope in its R&S RTO high-performance family

The R&S RTO models with 1 GHz and 2 GHz bandwidths appeal to users with high measurement accuracy, operating convenience and speed. These features are also in great demand for applications at bandwidths below 1 GHz. This is why **Rohde & Schwarz** has added a 600 MHz model to its high-performance oscilloscope family. Jörg Fries, Director of the Oscilloscopes Subdivision at Rohde & Schwarz, explains: "The new 600 MHz version of the R&S RTO is a unique solution that enables users to perform complex in-depth analyses even in the lower bandwidth range."

For its R&S RTO high-performance product line, Rohde & Schwarz created a special ASIC with realtime processing of the digitized measurement results. Thanks to its

parallel processing capability, this ASIC attains an unrivalled processing speed that makes it possible to analyze one million waveforms per second. Conventional oscilloscopes capture signals during only 0.5 % of the acquisition cycle but Rohde & Schwarz has increased the active acquisition time by a factor of 20, to 10 % of an acquisition cycle. Even with this high acquisition rate, all of the setting options and analysis functions remain available for measurements without reducing speed.

Rohde & Schwarz also used a new approach when designing the trigger system. Due to the all-digital trigger architecture, a technology first, the trigger and the captured data share a common signal path and a common time base. The result is exceptionally low trigger jitter and exact assignment of the trigger to the signal.

The low-noise frontend and the single-core A/D converter in the R&S RTO scope also help to ensure high accuracy. The A/D converter operates at 10 Gsample per second and achieves an exceptionally high dynamic range of more than seven effective bits. The result is minimal signal distortion and low inherent noise.

A new standard in user friendliness is offered by the R&S RTO's remarkably simple touchscreen operation that has rapidly become popular in the market. The clever screen design includes semitransparent dialog boxes, preview icons with live waveforms and a configurable toolbar. It lets users accomplish even complex measurement tasks quickly and efficiently. The 10.4 inch touchscreen strikes the right balance between usability and compactness.

For more information on the oscilloscopes, **visit www.scope-of-the-art.co.uk**

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Murata develops front end modules for Wi-Fi® and Bluetooth® Applications

Murata have announced the launch of its latest frontend modules for Wi-Fi® and Bluetooth® applications. Murata's Microwave Monolithic Integrated Devices (MMID®) integrate the company's power amplifier, low noise amplifier and switching product into single packages for both the 2.45GHz and 5GHz bands (respectively numbered MDFE2PFA-022 and MDFE2PFA-023). The modules can be combined with a highly integrated, single chip radio – such as the Broadcom BCM4330 chipset – to provide a connectivity solution for the cellular phone, portable device, and person computer markets.

For the engineer, Murata's MMID series enables a complete system to be achieved with minimal components. The line is extremely flexible, with the ability to support 802.11b/g and Bluetooth and/or 802.11a. Designers can also use one or both front end modules to mix and match wireless networks with minimal design resources. This reduces the complexity of design and greatly improves time to market. Other benefits include optimized performance at low current consumption to save battery life. Further, the miniaturized size allows for a compact design, providing the small and thin end products that consumers demand.

"Murata is uniquely positioned to do this work because of our vast number of customizable solutions for Wi-Fi and Bluetooth. From complete highly integrated modules and sub modules to discrete components, we have the balanced technology and vast experience to provide the most advanced, complete product portfolio with quick time-to-market," stated Keisuke Katabuchi, Product Manager, Europe, RF product , Murata Europe. "Murata's MMID series is tremendously flexible in terms of shape and size, allowing for placement just about anywhere on the board where there is space. The fact that they are already proven with Broadcom's BCM4330 chipset speaks volumes about market demand."

The lead-time for samples is two to three weeks and 12 to 14 weeks for production quantities.

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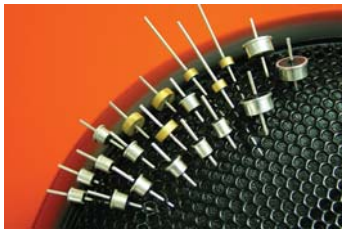
High capacitance, low profile, panel mount capacitors for EMI filtering

Leading UK passive component manufacturer, **Syfer**, has announced the availability of a number of important extensions to its already wide range of solder-in panel mount EMI filters. Advanced in-house research and development has resulted in the introduction of a series of discoidal capacitor versions, which offer the advantage of high capacitance values, up to several microfarads, in a compact and robust package.

Ideal as low-profile, panel mount filters, the SFSS devices are constructed with a discoidal capacitor soldered to a feedthrough pin. They are offered with a choice of C0G/NP0 or X7R ceramic dielectrics. Available in 5 different diameters (2.3mm, 2.8mm, 3mm, 5mm and 8.75mm), capacitance values range from 10pF to an impressive 2.2µF. Working voltages range from 50V to 3kV and operating temperature range is -55 to 125°C. These devices are able to withstand a solder-in temperature of 250°C.

Syfer maintains its global reputation for performance, offering the highest voltage and capacitance for any given size. For designers looking for space saving solutions, Syfer's solder-in EMI filter ranges allow the specification of smaller parts when compared to competitive offerings. Custom



devices can also be produced on request.

Aimed primarily at manufacturers of EMI filters, these low cost, yet robust and reliable devices will also meet the demands of equipment manufacturers in the communications, industrial, military/aerospace and sensors markets.

The SFSS discoidal series joins the existing SFSR, SFST and SFSU ranges of feedthrough EMI filters for soldering direct to a chassis or panel, suitable for hole diameters of 2.9mm, 3.5mm and 5.8mm respectively. Featuring a metal body and epoxy encapsulation, they offer superior filtering performance in a robust package. Working voltages are from 50Vdc to 500Vdc. Manufactured in the UK at Syfer's Norwich facility, these fully RoHS compliant capacitors are available immediately on an 8 to 14 week lead time, depending on the quantity and specification ordered.

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www.syfer.com

New Powerline Filters

ETS Lindgren Ltd, the Stevenage based subsidiary of the American parent, has announced a new series of multi-purpose radio frequency (RF) 40 GHz power line filters. The filters are designed for the highest performance required by defence and commercial applications. ETS Lindgren is a world leader in electromagnetic compatibility providing customers with detection, measurement, shielding and control. The company also manufactures a wide range of antenna measurement systems.

The N600X series filters from ETS Lindgren are ideal for screened room and anechoic chambers to ensure both incoming and outgoing power supplies do not compromise the chamber's shielding performance. They are also ideal filters for TEMPEST applications where a high degree of protection is required to obtain maximum security. In addition, the new filters meet the most stringent NATO requirements for electromagnetic pulse (EMP) applications.

A notable performance feature of the N600X series filters is superior insertion loss of 100 dB from 14 kHz to 40 GHz at full load. This provides better attenuation performance for electromagnetic interference (EMI), radio frequency interference (RFI), high intensity radiated fields (HIRF) and intentional electromagnetic interference (IEMI) requirements. Other notable features include low power dissipation and compact, rugged construction with all filter networks RF sealed in high quality electro-tin plated steel cases.

The new filters are now available with ratings of 440/250 VAC, from 16 A to 200 A, and are suitable for 400 Hz supplies. Multiple line filters are available in panels for dual power applications with two filtered lines or three phase power requirements, with four filtered lines.

Announcing the new filter range Sergio Longoria, Senior Filters Engineer for ETS-Lindgren in the USA, stated "ETS-Lindgren's new power line filters offer proven 100 dB of attenuation from 14 kHz right up to 40 GHz in addition to providing EMP protection. This is critical when a filter is used in a secure environment where protection against electromagnetic pulse is essential. While other filter manufacturers offer 80 dB of attenuation over a reduced range such as 10 MHz to 1 GHz, our customers now demand better performance. We worked hard to design a new, robust line of filters and confirmed performance through extensive testing at our world headquarters, an ISO 9001:2000 certified facility in Cedar Park, Texas, USA."

All Model N600X filters are ROHS compliant and are CE marked for compliance with the low voltage directive. Custom designs are available upon request. Standard warranty is two years.

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emcia Member

New range of Multifunctional High Voltage DC Electronic Loads

Telonic Instruments have introduced a new range of high quality multifunctional electronic and evaluation equipment manufactured by Japan based Kikusui. Designated the PLZ-4WH series they are designed primarily for use in the automotive industry with electric vehicles (EV) and hybrid electric vehicles (HEV).

The range supports input voltages up to 650V and is used to evaluate EV and HEV in vehicle chargers, DC/DC converters, battery cells and power supplies for high voltage DC electric supply systems. It is able to operate PFC tests on European and other three phase 400V system input power supplies as well as evaluating and testing high voltage parts relating to such equipment.

This innovative range has six operation modes, constant current, resistance, voltage, power, constant current + constant voltage and constant resistance + constant voltage modes

The range comprises of four models with an operating voltage of 650V and current of 100A with power of 165/1000W. Up to 9kW/450A can be obtained by connecting with the maximum of four PIZ2004WHB boosters.

Other features include voltage and current monitor output, switching operation, soft start, elapsed time display, auto load off timer, remote sensing, external load on / off control input. Also included overvoltage, overcurrent, overpower, overheat, undervoltage and reverse protection.

The front panel has an easy to operate controls with an easy to see L.C.D. display on which tests can be set up quickly. In addition an insulated type current monitor terminal has been built in to the front panel that makes measuring voltage and current simple.

All units are equipped with USB, GPIB and RS-232C functions for incorporating into a variety of inspection systems.

For further information contact Bob or Doug Lovell on 0118 978 6911 or doug@telonic.co.uk

Tel: +44 (0)118 978 6911
doug@telonic.co.uk
www.telonic.co.uk

PRODUCT GALLERY

New high-end R&S FSW analyzer features minimum phase noise, maximum bandwidth and superb operating convenience

The R&S FSW signal and spectrum analyzer from **Rohde & Schwarz** outperforms all comparable high-end instruments on the market in both RF performance and bandwidth. For the first time, developers are able to view multiple measurement applications at a glance as well as analyze signal interactions – two important features that make complex measurement tasks significantly easier.

The high-end R&S FSW signal and spectrum analyzer comes in three models that cover the frequency ranges 2 Hz to 8 GHz, 13 GHz or 26.5 GHz. The R&S FSW was specially designed to meet the requirements of development laboratories in the aerospace, defence and communications industries. The result is reflected in its excellent technical features.

The practical 12.1" touchscreen is the first feature that catches users' attention. The MultiView function allows users to display the results

of different applications on the touchscreen at the same time, enabling them to keep track of even the most complex signal analyses and find errors more easily. An additional benefit is the elimination of time-consuming switching between measurement applications.

At 10 kHz carrier offset, the R&S FSW achieves a phase noise specification of less than –137 dBc (1 Hz), which is up to 10 dB less than comparable instruments on the market. This is especially important for developers of RF components and complete systems for radar applications. By taking advantage of the analyzer's excellent phase noise specification, they can achieve more stable radar signals. Equipped with the R&S FSW-K6 option, the R&S FSW also supports comprehensive analysis of pulsed signals, e.g. for radar applications. Its broad analysis bandwidth of up to 160 MHz allows the R&S FSW to measure wideband, hopping and chirp signals, which makes it ready today for the requirements of tomorrow's wireless standards such as the 802.11ac. Developers can also detect spurious emissions extremely quickly with the R&S FSW thanks to its low inherent noise and its ability to rapidly analyze wide frequency ranges, even when using narrow resolution bandwidths.

The R&S FSW is the perfect instrument for developers of wireless communications base stations and components. They especially appreciate the analyzer's broad 160 MHz demodulation bandwidth and multi-standard radio analysis function: The combination of these two features in a single instrument makes it possible for the first time to simultaneously measure multiple mobile radio and wireless standards at different frequencies. Users can easily spot signal interaction among the standards. Josef Wolf, Director of the Spectrum Analysis, Network Analysis and EMC Subdivision at Rohde & Schwarz, points out: "These measurements are essential for multi-standard base stations of the future. That is why we have integrated the multi-standard radio analyzer into the R&S FSW. This feature, combined with the large touchscreen display, provides functionality that is unique on the market. The optimum analyzer for tomorrow's developments is now available today."

Visit **www.rohde-schwarz.com/product/fsw** for more information.

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contact.uk@rohde-schwarz.com
www.rohde-schwarz.com

New TESEQ CDNE Coupling/Decoupling Network for Emission Testing

Teseq, a leading developer and provider of instrumentation and systems for EMC emission and immunity testing, has developed a new coupling/decoupling (CDNE) network for emissions testing.

The publication of EN 55015, based on CISPR 15 A1 Ed 7, has introduced an independent method of measurement of radio disturbance characteristics of electrical lighting equipment. This method specifies the use of a coupling/decoupling network (CDN) as defined in IEC 61000-4-6 for emission measurement in the frequency range 30 to 300 MHz.

An analysis of results of testing with existing CDN designs showed the need for closer CDN impedance tolerances. A standard working group was founded for improving the CDN design and for transferring the new emissions measuring equipment requirements to CISPR 16-1-2 and methods to CISPR 16-2-1.

The result describes a specific coupling/decoupling network for emissions (CDNE). In addition to closer tolerances for the asymmetrical impedance, the phase angle, symmetrical impedance and the internal attenuation are also defined.

Teseq's CDNE series fulfils these new requirements and offers improved reproducibility for current EN 55015 measurements.

Tel: 0845 074 0660
uksales@teseq.com
www.teseq.com

New Product Catalog available from AR

AR RF/Microwave Instrumentation has unveiled its latest corporate - product catalog, now available in either CD form or as a hard copy catalog. Significant innovations, as well as the company's core products - such as amplifiers, amplifier systems, complete EMC testing solutions, antennas, field probes, and more - are included.

The Virtual CD provides a comprehensive overview of AR products, including data sheets, application notes, ads, press releases, EMC equations & conversion charts, plus the company's new full line catalog. The hard copy catalog features AR RF/Microwave Instrumentation products along with sections covering AR Modular RF, AR Receiver Systems, and AR Europe.

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Automotive EMC Requirements for Electric and Hybrid Vehicles

By Peter Phillips Manager EMC Engineering, Carl Wayland EMC Technical Manager & Steven Clegg Senior Compliance Engineer and Notified Body, MIRA Ltd

Introduction

The current concerns over the environment and the rising costs of fuel have re-focussed the efforts of vehicle manufacturers in the development of alternative power train systems for vehicles. This in turn has lead to the need to re-evaluate the EMC test requirements for the automotive industry. Recently we have seen a growth in vehicles that can spend many hours each day plugged into the national electrical infrastructure. The standards bodies have been working towards a revised set of test requirements for these vehicles that will; in time; replace the current automotive directive.

This document will cover the new requirements for the automotive industry that are being introduced as a result of this change in technology.

Background

The automotive directive underwent its last significant change in 2004 with the introduction of brake cycle testing and extended frequency range for radiated susceptibility testing. Since then further advances in technology have seen the more common use of high voltage electrical drive systems in future vehicle design. As this technology advances the requirements for EMC testing have also evolved at a similar pace to ensure ongoing compatibility between vehicles and the electromagnetic spectrum. The development of UNECE Regulation 10.04 has been underway and the latest version is due to come into force late in October 2011. This paper will outline some of the fundamental additions to the test requirements for vehicle using the new electric propulsion technology. These changes have been proposed in response to the need to 'plug in' vehicles to the electricity grid to provide the charge required for the drive system.

The vehicles types covered by this standard include the traditional automotive petrol and diesel engines, the term 'new term propulsion' system in now intended to cover all types of drive system for the vehicle. There are a number of key propulsion systems being developed at the current time, these include; all electric, where the vehicle is powered from on vehicle batteries and charging will usually take place via a connection to the main power grid through a battery charger device although currently capacitive charging is being looked at. The term 'hybrid electric systems' cover vehicles that use a combination of petrol (or diesel) and electric drive systems, these power trains can also come in a number of forms, the first is a hybrid system that may use a smaller petrol engine to power the front wheels and an electric motor to power the rear wheels. The second type of hybrid vehicle is known as a 'range extended hybrid', this is where the combustion engine is used to generate electricity onboard the vehicle, this energy is then used to power electric motors which provide the drive momentum. See figure 1 below

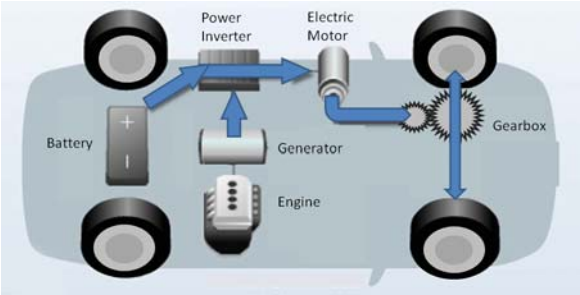

Figure 1. Range extended hybrid vehicle configuration

Specification Update

This paper will concentrate on the vehicle level requirements; changes have been included in the latest version of UNECE Reg 10 for gaining the relevant type approval mark for components.

The new requirements that form part of UNECE Regulation 10.04 will include 6 new Annexes, in addition further clarification to the text of the document has been made to cover the new types of propulsion systems, the new term, "RESS" which means the rechargeable energy storage system that provides electric energy for electric propulsion of the vehicle.

Consideration is made within this specification update for the interaction of the vehicle with the mains grid, hence the applicability of the latest EMC standards should apply. The new automotive Regulation adopts a number of the generic standards to ensure ongoing EMC compliance. With this in mind, it could be stated that a plug in electric vehicle should now be CE marked. However the current system of type approval will continue with the application of the E mark.

Vehicle type approval shall be applied for both RESS and the Coupling system for charging the RESS as they are both considered as electrical / electronic systems.

Additional Test Requirements

The main amendments to REG 10.3 regarding test requirements for electric vehicles has been operational modes to existing annexes and then the addition of annex's 11 to 16 to consider the connection to the power grid. The following section gives a brief over view of each annex.

Annex 11 Method(s) of testing for emission of transients of harmonics generated on AC power lines from vehicle

This test is intended to measure the level of harmonics generated by vehicle in configuration "RESS charging mode coupled to the power grid" through its AC power lines in order to ensure it is compatible with residential, commercial and light industrial environments.

If not otherwise stated in this annex the test shall be performed according to:

(a) IEC 61000-3-2 for input current in charging mode ≤ 16 A per phase for class A equipment,

(b) IEC 61000-3-12 for input current in charging mode > 16 A and ≤ 75 A per phase.

The vehicle shall be in configuration "RESS charging mode coupled to the power grid" at rated power between 20% and 100% preferably at 80% of its initial value of the AC current.

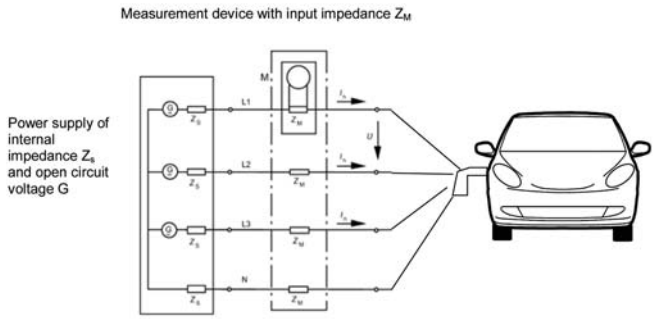

Figure 2. Vehicle in configuration "RESS charging mode coupled to the power grid" - Three-phase charger test set-up

Annex 12. Method(s) of testing for emission of voltage changes, voltage fluctuations and flicker on AC power lines from vehicle

This test is intended to measure the level of voltage changes, voltage fluctuations and flicker generated by vehicle in configuration "RESS charging mode coupled to the power grid" through its AC power lines in order to ensure it is compatible with residential, commercial and light industrial environments. If not otherwise stated in this annex the test shall be performed according to:

(a) IEC 61000-3-3 for rated current in "RESS charging mode" ≤ 16 A per phase and not subjected to conditional connection

(b) IEC 61000-3-11 for rated current in "RESS charging mode" > 16 A and ≤ 75 A per phase and subjected to conditional connection

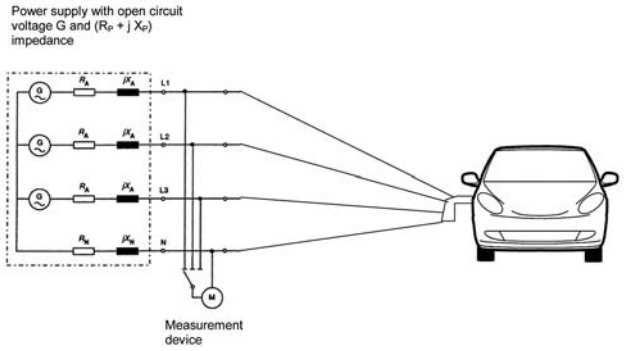

Figure 3. Vehicle in configuration "RESS charging mode coupled to the power grid"

Annex 13. Method(s) of testing for emission of radio frequency conducted disturbances on AC or DC power lines from vehicle.

The test method described in this annex shall be applied to vehicles in configuration "RESS charging mode coupled to the power grid".

This test is intended to measure the level of radio frequency conducted disturbances generated by vehicle in configuration "RESS charging mode coupled to the power grid" through its AC or DC power lines in order to ensure it is compatible with residential, commercial and light industrial environments.

If not otherwise stated in this annex the test shall be performed according to CISPR 16-2-1.

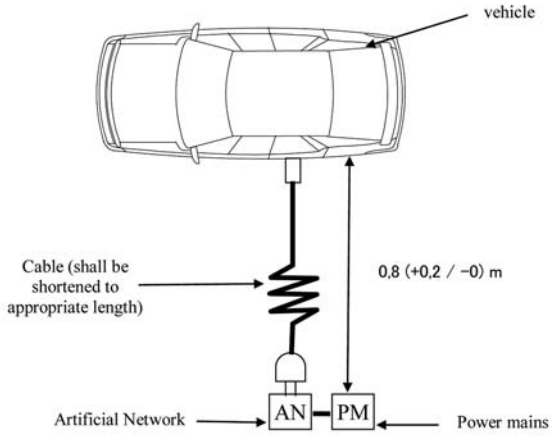

Figure 4. Vehicle in configuration "RESS charging mode coupled to the power grid"

The vehicle shall be in configuration "RESS charging mode coupled to the power grid" at rated power between 20% and 100% preferably at 80% of its initial value of the AC current.

Annex 14. Method(s) of testing for emission of radio frequency conducted disturbances on network and telecommunication access from vehicle

This test is intended to measure the level of radio frequency conducted disturbances generated by vehicle in configuration "RESS charging mode coupled to the power grid" through its network and telecommunication access in order to ensure it is compatible with residential, commercial and light industrial environments.

If not otherwise stated in this annex the test shall be performed according to CISPR 22.

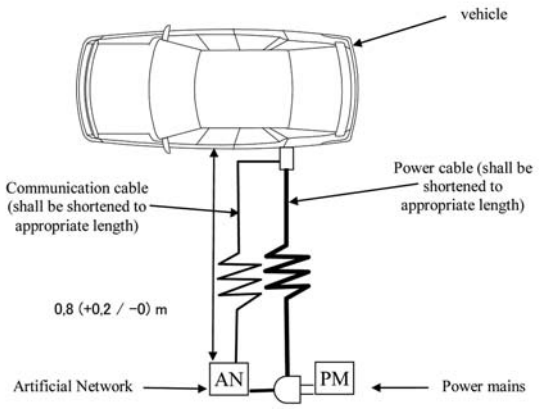

Figure 5. Vehicle in configuration "RESS charging mode coupled to the power grid"

Annex 15. Method(s) of testing for immunity of vehicles to electrical fast transient / burst disturbances conducted along AC and DC power lines

This test is intended to demonstrate the immunity of the vehicle electronic systems. The vehicle shall be subject to electrical fast transient/burst disturbances conducted along AC and DC power lines of the vehicle as described in this annex. The vehicle shall be monitored during the tests.

If not otherwise stated in this annex the test shall be performed according to IEC 61000-4-4: 2nd edition 2004.

The vehicle shall be immobilized, engine OFF and in charging mode.

"RESS in charging mode" vehicle test conditions	Failure criteria
The RESS shall be in charging mode. The RESS state of charge shall be agreed in between the manufacturer and the Technical Service.	Vehicle sets in motion, **overloading of the connected battery system**

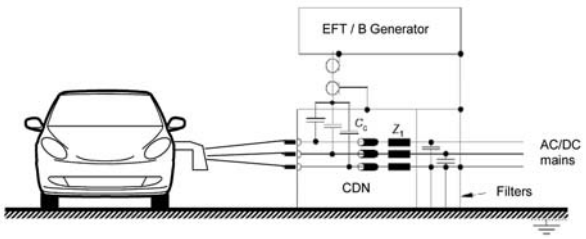

Figure 6. Vehicle in configuration "RESS charging mode" coupled to the power grid coupling on AC/DC power lines

Annex 16. Method(s) of testing for immunity of vehicles to surges conducted along AC and DC power lines"

This test is intended to demonstrate the immunity of the vehicle electronic systems. The vehicle shall be subject to surges conducted along AC and DC power lines of the vehicle as described in this annex. The vehicle shall be monitored during the tests.

If not otherwise stated in this annex the test shall be performed according to IEC 61000-4-5: 2nd edition 2005.

The vehicle shall be in an unladen condition except for necessary test equipment.

The vehicle shall be immobilized, engine OFF and in charging mode.

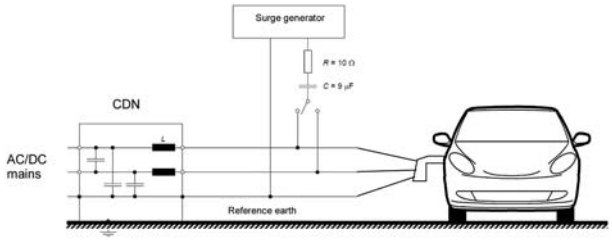

Figure 7. Vehicle in configuration "RESS charging mode coupled to the power grid" - Coupling between lines for DC or AC (single phase) power lines

Vehicle Test Modes

Broadband Radiated Emissions

The requirements for broadband radiated emissions have been amended to take into consideration alternate propulsion systems

RESS Charging Mode

The additional test requirements now look at the interaction of the vehicle whilst charging and the connection to the mains grid.

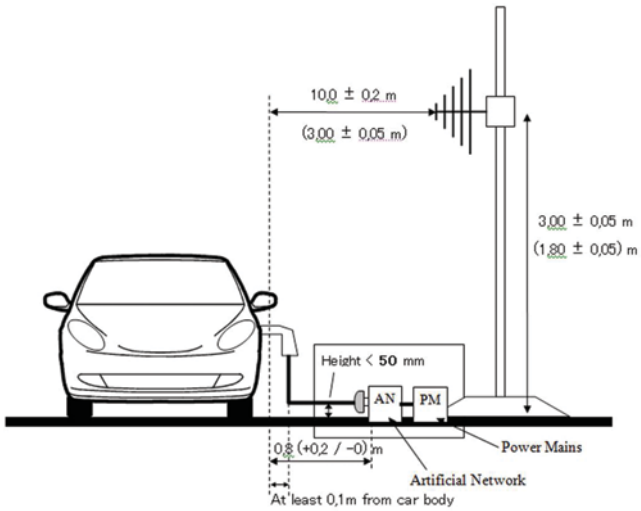

Figure 8. Vehicle in configuration "RESS charging mode" coupled to the power grid

Propulsion system operating mode

Internal Combustion Engine CISPR12 fifth edition 2001

Vehicle Condition – Broadband Radiated Emissions All Broadband Equipment shall be switched on	
Number of cylinders	Engine speed (±10%)
1	2 500 rev/min
>1	1 500 rev/min

Electric vehicle CISPR12 fifth edition 2001

Vehicle Condition – Broadband Radiated Emissions All Broadband Equipment shall be switched on
Driven on a dynamometer without a load, or on non-conductive axle stands, with a constant speed of 40 km/h, or the maximum speed, if this is less than 40 km/h. Tests to be carried out under two distinct modes - road load simulation and regenerative Additional Mode as per UNECE Regulation 10.04.Vehicle in configuration "RESS in charging mode coupled to the power grid". This vehicle shall be in battery charging mode at rated power until the AC or DC current reached at least 80 per cent of its initial value

Hybrid vehicle CISPR12 Fifth Amendment 1 2005

Vehicle Condition – Broadband Radiated Emissions All Broadband Equipment shall be switched on
Both the electrical and the internal combustion propulsion systems functioning to operate the vehicle at 40 km/h. If this is not possible, the vehicle shall be tested with the internal combustion engine operating at the speeds identified above and the electric propulsion system operating the vehicle at 40 km/h or the maximum speed if this is less than 40 km/h. Tests to be carried out under two distinct modes - road load simulation and regenerative

The additional test operating conditions for broadband radiated emissions testing present additional difficulties for the EMC test laboratories. The required use of a dynamometer to allow a recreation of a dynamic operational mode now increases the complexity of the laboratory requirements. Dynamometers capable of providing drive to the vehicle will also assist in the testing or regenerative brake systems and provide an alternative charging mechanism during the test program.

Narrowband Radiated Emissions

The requirements for Narrowband emissions have been modified to permit electric vehicles to be tested without the batteries discharging

- 2009/19/EC Annex V – CISPR 12 (5th edition 2001) or to CISPR 25 (2nd edition 2002).
- UNECE 10.04 Annex 4 – CISPR 12 (amendment 1, fifth edition 2005).

This test is designed to record emissions which would be generated from microprocessor-based systems (clock frequencies in excess of 9 KHz) and other narrowband sources. The test is carried out with the ignition switch on (engine not operating) and all narrowband sources which can be switched on permanently by the driver or passenger which have an internal oscillator > 9 kHz or repetitive signals should be in normal operation.

The tests conditions for an electric vehicle can be simulated in the same fashion as outlined above in which the vehicle is in standby mode (sufficient charge to maintain systems in on state).

Radiated Immunity

An additional mode of operation has been added in which the vehicle shall be in charging mode. The state of charge shall be agreed between the manufacturer and the Technical Service. The failure criteria adapted is that the vehicle sets in motion.

The substitution method according to ISO 11451-1, third edition 2005 and Amendment 1:2008 shall be used to establish the test field conditions."

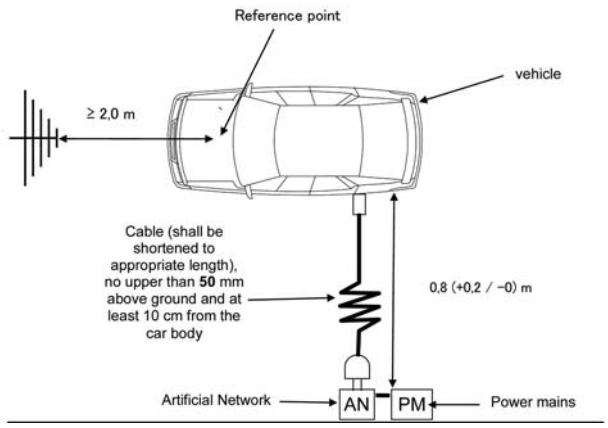

Figure 9. Vehicle in configuration "RESS in charging mode coupled to the power grid"

New Immunity test mode for Hybrid and EV Regeneration mode testing

The regulation 10.03, Annex VI, paragraph 2.1.2 states that 'Other vehicle systems, which can affect immunity related functions, must be tested in a way to be agreed between manufacturer and Technical Service.' In order to cover this requirement for Hybrid and EVs the immunity performance of the vehicle in the distinctive Braking Regeneration mode needs to be verified. This is because in many EV systems the traditional engine braking effect is recreated by applying an electric field to the armature of the electric drive system, this will cause the vehicle to slow down as if you had re-engaged a traditional combustion engine. If an ABS event is detected the braking regulation UNECE Reg 13 H requires the field to be removed from the electric motors, this can cause an unexpected change in the perceived braking performance of the vehicle. Therefore this phenomena needs to be assessed during full vehicle testing.

Conclusion

The new automotive regulations bring together the European EMC regulations for all electrical and electronic equipment and the current automotive EMC directive; with the desire to ensure that moving forward the vehicles of the future can work in harmony with the mains grid and all other electrical systems connected to it.

The 04 series of amendments to UN Regulation No. 10 is expected to entry into force on 28 October 2011. This date must be confirmed by the UN Office of Legal Affairs (OLA) through a Depositary Notification, however due to translation issues with the document this date is probably going to be delayed. It is expected that there will be a 3 year transition period before this comes into force and replaces EC/ 2004/104 as the key automotive type approval requirement for Europe.

The requirement to essentially CE mark the charging point of the vehicle and the introduction of additional test modes will only increase the test burden for vehicle manufactures.. The introduction of EV and HEV technology has already proven challenging for EMC compliance through the development cycles of these vehicle to-date at MIRA Ltd we are experiencing component suppliers also expressing a desire to test HV sub systems using a LV automotive specification. These are currently being worked on in the standards committee and will be excluded in the next release of REG 10.05 which will encompass EV component. All of this additional testing leads to a more compliant future with reduced development cycles as the technology moves forward.

The introduction of other types of fuel systems such as hydrogen should not require any additional changes to these regulations as it should simply provide an alternative store of energy to drive the electric motors.

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Putting the business case for wireless communications

By Martin Poppelaars, VP EMEA Sales, Lantronix

Martin Poppelaars, VP EMEA Sales, Lantronix. The company builds wireless networking into virtually any electronic device with a serial interface, and offers easy installation and high performance with a fraction of the footprint of competing solutions.

Companies in just about every industry are looking to wireless technology to connect serial devices and avoid the high cost of installing cable. Low-cost wireless links reduce installation and maintenance costs and provide mobility. However, designing an effective wireless-networking solution requires an understanding of today's complex wireless technologies, their benefits, and their trade-offs.

With wireless technologies becoming increasingly pervasive in the marketplace, companies may be looking to these as a key business driver for 2012. But before any investment is made, it's important to take stock of the reasons for your businesses to go wireless in the first place. What technologies are currently available, where are they used, and what concrete benefits do they bring? In exploring this, the true value of wireless for your business can de determined, and the right purchase can be made.

Worth the investment

Local Area Networks (LANs) run on wire cable. Wire is expensive to install and difficult to reconfigure for changes in the production environment. It does not allow for mobility, and there are certain places it simply cannot go. For instance, running cable throughout a factory floor is extremely difficult if not impossible. Because of these limitations, WLANs (wireless LANs) have become a hot commodity, revolutionising the way we work and do business today.

Data applications running over wireless networks can be found everywhere in our daily lives. They are particularly attractive to industries where certain functions are difficult to perform because of large areas, harsh operating conditions, or other restrictions. For example, wireless applications are ideally suited for pharmaceutical manufacturing applications, where an ultra-clean environment is required to monitor, control, and configure equipment.

The real-world benefits of wireless, however, can be seen across almost every industry. Some specific examples include the following:

Healthcare

Increasing hospital efficiency. Using Lantronix technology, emergency-room doctors can examine a seriously injured patient, order x-rays, have the patient transferred to surgery, and receive the x-rays electronically in the operating room.

The Medical and Healthcare industries are aggressively seeking productivity gains as a result of the current nursing and doctor shortage. With this situation expected to worsen as baby boomers age and require more care, an increasing number of medical and healthcare industries are modifying their processes by building convincing wireless return on investment (ROI) models. Use of computer-based physician order entry (CPOE) and bar-code scanning for medications is expected to expand over the next few years and wireless communications networks are essential to their success.

As news of medical mistakes become more public, wireless applications are also becoming a key component in improving accuracy and quality of care in hospitals. Now hospital emergency-room doctors can examine a seriously injured patient, order x-rays, have the patient transferred to surgery, and receive the x-rays electronically in the operating room. In addition, physicians can remotely check a patient's status, test results, medication schedules, or other information based on

up-to-date entries made by nurses on their rounds. Quality of care improves dramatically as patient information is more accessible wirelessly and as more accurate information is recorded by immediate record keeping.

Retail

Retailers work in increasingly competitive environments, and as a result, are seeking ways to improve productivity, reduce costs, and generate incremental revenue. WLANs and the applications that run over them offer proven solutions. Popular examples include multimedia kiosks and self-service displays that employ audio, video, animation, and graphics to run point of sale (POS) and information applications. By improving the timeliness and flow of information, these wireless solutions lead to better overall customer satisfaction and increased profitability.

A major music store, for example, has set up wireless kiosks that provide real-time streaming of music videos, seasonal fashion displays, ticket-selling services, local web access, on-line music sampling, and other content residing on a video server.

In the future, retailers will be able to install RFID (radio frequency identification device) readers into their store shelves. With these readers, retailers will have the capability to detect when the shelves are empty and need to be restocked – all via wireless communication.

Transport

Before wireless, checking in a rental car was a lengthy procedure that took far too long. In addition, the mass of paperwork that had to be manually entered on a daily basis was getting out of control. Worse still, returned vehicles would stay on the premises for hours before being able to be turned around and re-rented. These companies needed a real-time solution to help improve their rental-return process, and WLANs are allowing them to accomplish strategic business goals in new and innovative ways.

For example, to reduce the costs of vehicle damage, a major rental-car agency is using a wireless system that allows damaged cars to be inspected and an appraisal prepared within two minutes. The company estimates that it will save millions of pounds per year on unrecovered costs. It also ensures that crucial customer information and signatures are not lost.

Manufacturing

Productivity improvements. Inventory management. Quality control. All are common challenges found in virtually every manufacturing facility today. From automotive to warehouse environments, the need to attach essential devices such as PLCs, CNC/DNC equipment, process and quality control equipment, pump controllers, barcode operator displays, scales and weighing stations, printers and machine vision systems is common. Wireless networks offer the solution for all these challenges.

For example, a major facility control centre had problems operating process-control equipment on a legacy network that was independent of the LAN. To network-enable all of the process control equipment at the support centre would have required more than 1,500 feet of wiring and conduit spanning multiple buildings, a costly and time-intensive project. Instead, wireless device servers have been integrated to Ethernet-enable all of the equipment in the support centre. This solution also delivers significant time-savings, as over 500 PCs in the support centre have access to real-time information as it is generated by the process control equipment. This eliminates the need for a technician to patrol the floor and monitor each device individually, and speeds the response time when a failure occurs.

These examples prove that businesses of all types are finding that wireless networks meet the high availability and capacity requirements needed for their specific applications. Once a decision is made to deploy a wireless system, the overriding question then becomes one of standards.

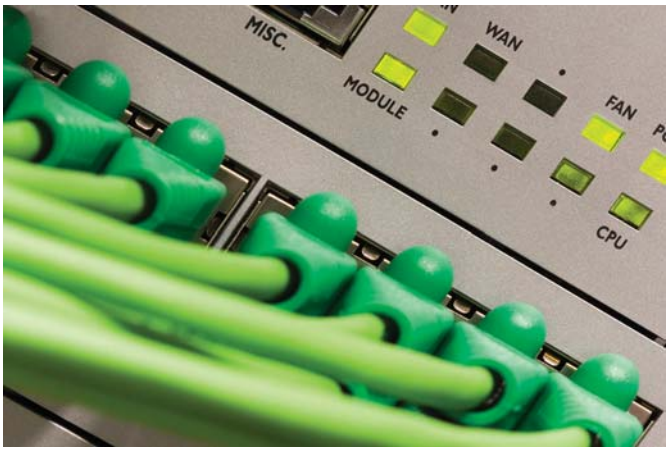
Bring your wireless up to standard

Today's popular wireless-networking standards are various and can prove very difficult to choose between. There are, however, important differences that are worth exploring in greater detail:

900 MHz technology

This is an unlicensed spectrum that has been commonly and traditionally used for portable phones, microwaves and wireless internet services.

Internationally, the 900 MHz band is widely used for Global System for Mobile Communications (GSM) mobile telephone systems or military communications. As a result, companies with sites around the globe cannot standardise on 900 MHz-based solutions for all locations. But the 900 MHz band suffers from a lack of interoperability, as vendors employ proprietary radio protocols. The industry, on the other hand, is moving towards standards-based systems, with multi-vendor support for common WLAN infrastructures. By contrast, Wi-Fi consumers are not restricted to a single vendor for upgrades and expansion of their WLAN systems.



Less cable, less cost. Businesses of all types are finding that wireless networks meet the high availability and capacity requirements needed for their specific applications. Once a decision is made to deploy a wireless system, the overriding question then becomes one of standards.

Wi-Fi

In a mixed wireless network environment, it is important to select standards- based wireless products that are able to exchange and use information. Wi-Fi is a generic term that refers to any type of 802.11 network, the term is promoted by the Wi-Fi Alliance. Therefore, any products tested and approved as "Wi-Fi Certified®" by the Wi-Fi Alliance are certified as interoperable with each other, even if they are from different manufacturers. A user with a Wi-Fi Certified product can also use any brand of access point with any other brand of client hardware that is also Wi-Fi certified. Users benefit from this interoperability by not being locked into one vendor's solution.

Bluetooth

Named after the Viking, Harald Bluetooth, bluetooth is a short-range (10 metre) frequency-hopping protocol that links devices. Designed to operate in noisy frequency environments, bluetooth uses a fast acknowledgement and frequency-hopping scheme to make a link robust. It avoids interference from other signals by hopping to a new frequency after transmitting or receiving a packet. Compared with other systems in the same frequency band, bluetooth hops faster and uses shorter packets. As a short-range, low-cost, wireless solution, bluetooth requires less operating power than most other devices. However, because it shares a specific radio spectrum, there is potential for interference with consumer appliances that operate in the same spectrum, such as cordless phones, microwaves and baby monitors.

Picking the right partner

Over the past decade, wireless local area networks have played a key role in revolutionising the use of technology in our society. In the office and at home, and now across most business infrastructures, wireless connectivity is permeating every aspect of our lives. But as has been demonstrated, there are an abundance of complexities associated with wireless connectivity. The effort involved in understanding this technology and bringing it to embedded solutions can be daunting, time-consuming and expensive.

It is therefore important for organisations to seek out providers that can simplify the process. To capitalise on the growth in this space, they need a convenient, cost- effective, and easy-to-install solution for adding wireless connectivity to their embedded designs.

Finding a provider that offers the flexibility to suit specific wireless requirements, with the ability to add connectivity modules to any product quickly and easily, is an important place to start.

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EMC design of high-frequency power "switchers" and "choppers"

Design techniques for high frequency (HF) output rectifiers

One of a number of "Stand Alone" articles on the EMC design of switch-mode and PWM power converters of all types

By Keith Armstrong, Cherry Clough Consultants Ltd, www.cherryclough.com

Issues 93 – 96 of The EMC Journal carried earlier parts of this "Stand Alone" series, which is my attempt to cover the entire field including DC/DC and AC/DC converters, DC/AC and AC/AC inverters, from milliwatts (mW) to tens of Megawatts (MW), covering *all* power converter applications, including: consumer, household, commercial, computer, telecommunication, radiocommunication, aerospace, automotive, marine, medical, military, industrial, power generation and distribution; whether they are used in modules, products, systems or installations.

I also aim to cover hybrid & electric automobiles, electric propulsion/traction; "green power" (e.g. LED lighting); and power converters for solar (PV), wind, deep-ocean thermal, tidal, etc.

If you read the earlier parts of this series in previous issues of the EMC Journal, you will notice that the numbering of figures has changed, and the numbering of the sections does not correspond to the number of the published part of the series (e.g. this is the fifth part and it covers Section 6). I hope you can forgive me for this lack of consistency.

I will generally not repeat stuff I have already published, instead providing appropriate references to material published in the EMC Journal [14] and my recently-published books based on those articles [15].

6 EMC design of HF output rectifiers

6.1 Schottky, "soft-switching", or synchronous rectifiers

All PN-junction rectifiers and diodes generate switching noise. They create brief bursts of noisy reverse current every cycle, while their minority carriers decay in reverse voltage mode.

(Minority carriers are often called "holes", but according to my Physics of Semiconductors lecturer in 1970 they are really electrons orbiting atomic nuclei in forbidden energy bands, i.e. negative-mass electrons – anti-matter!)

While a rectifier is reverse-biased but its minority carriers have not yet decayed completely, it is effectively "shorting-out" the power supply, and it is hardly surprising that this causes EMI.

So the best rectifiers are Schottky types, because they have no minority carriers and so are much quieter than PN junction "silicon" rectifiers. Schottky rectifiers made of silicon-carbide (SiC) are now available up to 1.2kV, and when used in existing designs to replace PN junction silicon rectifiers have been found to need fewer snubbing and filtering components.

SiC Schottky rectifiers cost more than PN junction silicon types, but this is another example of where focussing on the BOM cost alone can lead to more costly products, see [12]. The real cost of the EMI suppression components that are required is usually only found towards the end of a project, when a pre-production prototype is put in an EMC test lab.

(Leaving EMC to the end of the project is very bad project-risk and financial-risk management, but it is what most companies, whose managers mistakenly think lowest-BOM cost is important, actually do.)

At such a late stage in a project it is often considered too risky to make changes to the design, so all that can be done is to throw EMI suppression at the prototype until it passes the test (risking the possibility that the suppression components can't actually be fitted inside the enclosure).

In this situation, the usual result of trying to keep the BOM cost low by using silicon rectifiers rather than SiC shottkies, is that the components that have to be added to suppress the rectifier noise cost more than the additional cost of using SiC shottkies in the first place/earlier in the design.

But not all silicon rectifiers are equal. When using silicon rather than Schottky, we will generally get lower emissions by using the so-called "soft switching" types of fast rectifiers, as shown by Figure 6.1-1.

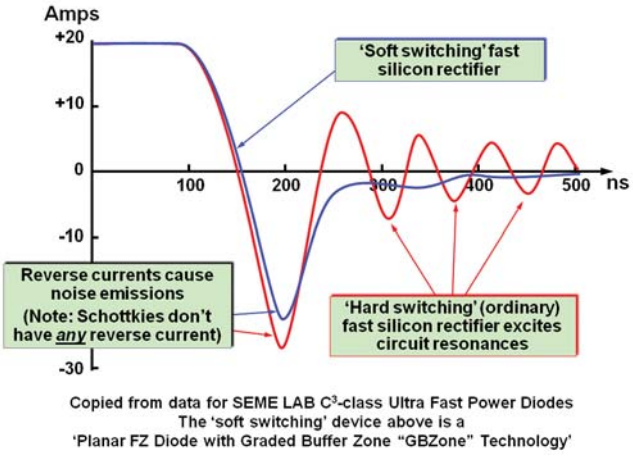

Figure 6.1-1 Comparing reverse currents of ordinary and soft-switching fast rectifiers

Synchronous rectifiers use PowerFETs instead of silicon rectifiers. But they create similar emissions problems to silicon PN diodes, in this case caused by the "shoot-through" currents

caused by crossover conduction – when they short the power rails out momentarily, rather like the reverse recover current in a PN junction – causing noise and exciting resonances.

Schottky rectifiers are generally much quieter, but probably not as thermally efficient as synchronous rectification.

6.2 Using snubbers

The purpose and general design of snubbers was covered in Section 2.4 and its Figure 2C, published in Issue 94 of the EMC Journal [42]. It did not suggest any values for the snubber components, because they are best predicted by using computer-aided circuit simulators working with detailed component parameters (not generic library devices) that also take the impedances of the PCB's copper traces and any wiring into account.

Lacking such sophisticated simulators – as most of us do despite the fact that it is easy to make a very good financial case for purchasing such simulators and being trained to use them effectively – we are left with experimenting to find the best combinations of R and C for suppressing emissions without causing too much heat loss.

We don't need to tie up an EMC test lab while we optimize snubber values, because we can get very close indeed by experimenting at our own test bench using true high-voltage-rated galvanically-isolated ("floating") differential oscilloscope probes or a close-field probe with an oscilloscope or spectrum analyser, to monitor overshoots and ringing, in a similar manner to the discussion on this in Section 2.6 of [42].

HF output rectifiers that use SiC Schottky devices will probably not need snubbing at all – saving the cost of those components and also improving the thermal efficiency of the power converter.

Figure 6.2.1 shows various resistor-capacitor (RC) snubber designs for use with different types of HF output rectifier circuits. Synchronous rectifier technologies are not shown, but will generally need snubbing in a similar manner.

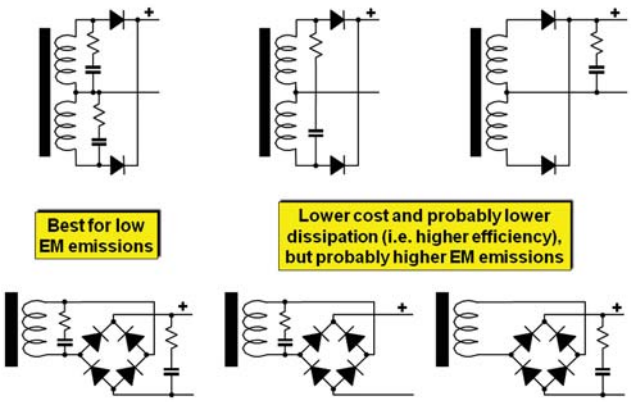

Figure 6.2-1 Snubber designs for different types of HF output rectifiers

If the circuits of Figure 6.2-1 don't work as well as hoped, it may be due to the circuit's strays or parasitic, and it could be worthwhile experimenting with other locations for snubbers to see if they work better, before redesigning the power converter's PCB layout to something that is better controlled (a subject that will be discussed in a later article).

Actual snubber performance at radio frequencies (RF) is limited by the types of components used, and by the way they are assembled and connected to the circuit they are snubbing.

Resistors suffer from heating and self-inductance problems, so we use low-inductance power resistors that are correctly rated for their peak and RMS voltages, peak and RMS currents, and peak and continuous RMS power dissipation in the highest ambient temperatures they will experience.

We generally avoid all wirewound types (even if their suppliers claim they have low-inductance), and for the best RF don't even use spirally-toleranced resistors, but prefer SMD chip resistors (not MELF, because they use spiral tolerancing) or large-area thick/thin film resistors printed on flat ceramic substrates.

I have seen metal-oxide film power resistors fail open-circuit due to RF energy at the point where they are cut spirally to bring their value within tolerance, so such types are best avoided for snubbers.

Capacitors suffer from self-inductance, self-resonance, and pulse handling capacity problems, and the best type of dielectric is ceramic, preferably the C0G or NP0 types. In plastic-dielectric capacitors Teflon® or polypropylene are the best types. For snubbers it is important that we only use capacitors with suitable *dV/dt* <u>and</u> *dI/dt* ratings, and good capacitor manufacturers will be able to provide appropriate tables to help us design reliable snubbers. Never assume that because components work well enough on a prototype, that they therefore be reliable in production.

An array of smaller capacitors in parallel generally works better at higher frequencies, and can cost less too.

Snubbers should be mounted directly to the terminals of the switching device concerned. Leads, traces, and wires all have inductance, so if using leaded components make sure their leads are short when they are assembled. For this reason, surface mounted parts are wonderful for snubbers.

When we have to use wires to connect a snubber to the circuit it is snubbing, we must always design so that we can use twisted pairs for the whole length of the cable (or at least as long a length as we can).

PCB traces used to connect snubber components to a circuit can have as much inductance as a wire, so we always take care to keep them as short and wide as is practical and route them at all times over a plane on an adjacent PCB layer plane that carries their return current. It may even help to use closer trace-plane spacing than we would normally.

Remember, $V = L\, dI/dt$, and any length of conductor – whether component lead, wire or PCB trace that is not in intimate proximity with the conductor carrying all of its return current – adds inductance at up to 1nH per millimetre of length. So, for example, if we had 10mm of such conductor carrying, say, 40A peak with a risetime of 20ns, the ability of our snubber

components to control the overvoltages caused by circuit resonances would degrade by up to 20V.

Where snubbers would have to be too large or costly or dissipate too much power, using an appropriately-rated output inductor could be a big help, and this is discussed next.

6.3 Output inductors

An output inductor helps to smooth the output waveform and reduce emissions, and in this section we are only concerned with its use in reducing emissions caused by the HF output rectifier.

When the sized inductor has a large enough value its flux will never decrease to zero and the result will be that it will force half-sinewave (approximately) voltages to appear at the secondary winding that feeds the HF output rectifiers.

Half-sinewaves have much less harmonic content than the switching waveforms without any inductance, but the zero crossings of the half-sines are discontinuous and so will still generate some common-mode (CM) and differential-mode (DM) RF noise that can be emitted from the circuit.

However, using a *balanced* output inductor with a large enough value will force the AC voltages at the secondary winding that feeds the HF output rectifiers to become full sinusoids (approximately) at the switching frequency, with correspondingly low levels of harmonics, reducing output rectifier emissions much more as a result.

Figure 6.3-1 shows these two ways of using inductors in an HF output rectifier, with sketches of the corresponding waveforms at the AC input of the diode bridge assuming sufficiently large values of inductance. The inductance must be large enough that the flux does not go to zero even on the lowest value of load current, and it must not saturate even with the highest value of load current, even when the inductor is running at its highest temperature.

Notice the directions of the windings on the balanced inductor design – the two inductor windings can be combined on a single magnetic core as a differential-mode choke to reduce PCB area and BOM cost. (It is not a common-mode choke.)

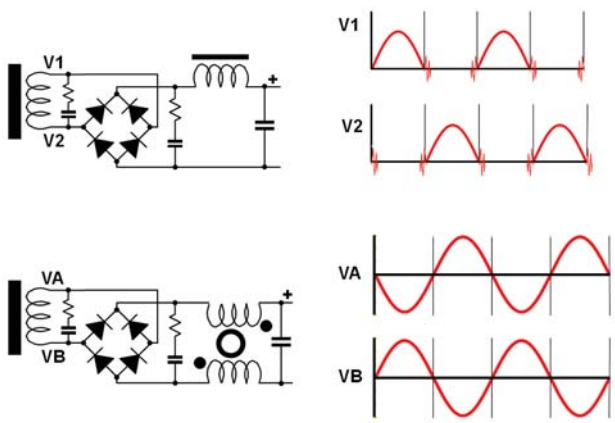

Figure 6.3-1 Examples of the use of unbalanced and balanced output inductors

Unlike the isolating transformer, the magnetic flux in an adequately-dimensioned HF output inductor never goes to zero, so its magnetic core will need an airgap, the subject of the next section.

Obviously, output inductors are not small or low-cost, but their use might help solve problems that cannot be cost-effectively dealt with by other methods, and they also help provide a much less noisy unregulated DC output voltage.

6.4 Inductor core shapes

Inductors that need energy storage, such as the HF output inductor discussed above, traditionally store it in the air using gapped rod- or bobbin-style cores, but for low magnetic (H) field emissions they should ideally use closed magnetic circuits. Unfortunately, magnetic energy cannot be stored in a high-permeability material, so for good EMI we need to use inductors with core types that have much less stray (leakage) flux when measured at a distance:

a) Toroids using iron powder (or similar materials) in a resin binder, which store their energy in the microscopic gaps distributed throughout their bodies.

b) E-cores or pot cores with air gaps in their central limbs, completely surrounded by their windings.

   The stray flux from gapped cores can be further reduced by creating an *external* shorted turn by wrapping a substantial copper tape around the whole transformer and soldering its ends together.

   The direction of wrapping the tape is important, so if adding the shorted-turn makes no difference, try it again with the direction of wrapping rotated by 90 degrees.

   Because ferrite cores are resistive, and so could radiate electric fields as a result of stray capacitance coupling to the *dV/dt* of the windings, emissions might be reduced further by connecting this tape to the output circuit's 0V reference.

c) Any type of core fitted with a suitable magnetic shield.

   Instead of a shorted *external* turn of copper tape, as much (or better) reduction of EMI can be achieved by fitting a shielding can over an output inductor or isolating transformer, bonded on all four sides to a continuous 0V reference plane underneath.

   Some suppliers offer shielded inductors for power converters, but some use ferrite instead of metal – which means that additional work might be required to reduce their electric-field emissions.

Figure 6.4-1 shows our example power converter's PCB assembly (see Figures 3B, 3C and 3D in [64]) fitted with a toroidal iron-powder output inductor, and an E-core isolating transformer with an air gap in the middle of its central limb.

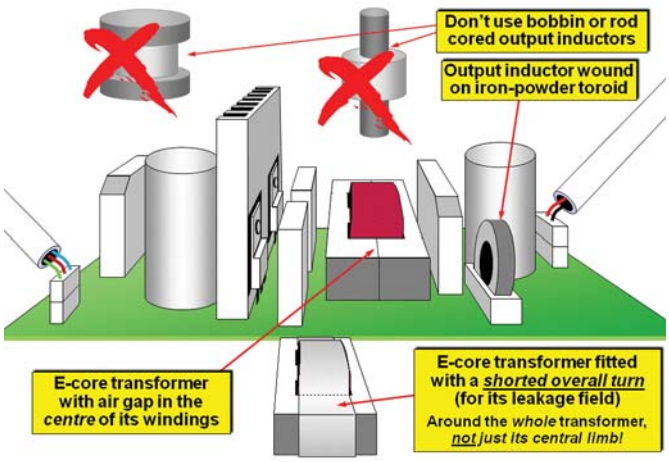

Figure 6.4-1 Example PCB assembly using E-core transformer with central air-gap, plus an added output inductor

That's it for this issue of the EMC Journal.

The next topic in this "stand-alone" series will deal with filtering the inputs and outputs.

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[14] Keith Armstrong's earlier articles are available from the archives at www.theemcjournal.com

[15] Textbooks by Keith Armstrong and others are available from www.emcacademy.org/books.asp

[42] "EMC Design of High-Frequency Power 'Switchers' and 'Choppers'", Keith Armstrong, The EMC Journal, Issue 94, May 2011, pp 39-50, available from the archives at www.theemcjournal.com

[64] "EMC Design of High-Frequency Power 'Switchers' and 'Choppers' – Design techniques for HF isolating transformers", Keith Armstrong, The EMC Journal, Issue 95, July 2011, available from the archives at www.theemcjournal.com

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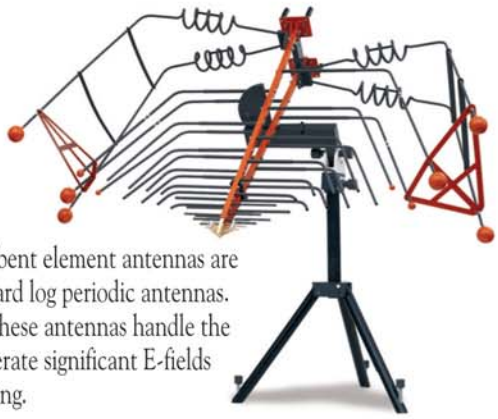

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