



Another EMC resource
from EMC Standards

New EMI Stories 856 to 864

Helping you solve your EMC problems



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New EMI stories – numbers 856 – 864

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Some of these stories are extracted from official documents and reports, some are personal anecdotes, and some come from research.

Some of these EMI stories had harmless or amusing outcomes, some lost companies large amounts of time / money, even causing bankruptcy, and some caused (or could easily have caused) injuries and deaths.

My experience is that these stories only represent the very tip of a large iceberg, with unguessable costs for manufacturers and society as a whole. As electronic devices and technologies continue to advance; more (and more complex) software and wireless communications are used; as electronic systems are increasingly integrated into systems-of-systems which no person can understand fully, and even into systems-of-systems-of-systems (including the "Internet of Things", IoT, and autonomous vehicles): the only thing of which we can be certain is that EMI problems will occur more frequently and have larger impacts on cost and safety.

I hope these stories help identify possible EMI problems in advance, so that they are dealt with as part of the normal design/development procedure and don't create the embarrassment and costs of trying to correct poor EMC design after products have been shipped or systems installed.

If you have any suitable stories or know of any relevant research or reports, please tell me about them so they can be included (anonymously, if preferred) in this list.

Compiled by Keith Armstrong
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856) EMI could affect bird migrations

The internal magnetic compasses of migratory birds can be disrupted by weak, man-made electromagnetic interference, according to a new study. The unexpected effect was seen in European robins, which were unable to orient themselves in the presence of broadband, radio-frequency noise believed to be caused by AM radio and electronic signals.

Given previous theories that robins might be affected by radio-frequency magnetic fields, the European researchers experimented with reducing local electromagnetic noise by screening the bird's huts with electrified and grounded aluminium plates. This shielding reduced the interference by two orders of magnitude, while leaving the static geomagnetic field unaffected, and this restored the bird's ability to orient themselves. (Nature 10.1038/nature13290)

(Kindly sent in by Richard Marshall, who spotted "Noise could set European robin adrift", in "Frontiers", Physics World, June 2014, page 4, www.physicsworld.com.)

857) Increasing need for reliable industrial comm's to have RFI/EMI protection

The increasing need for reliable communications in factories and plants means that more and more industrial electronic equipment may require built-in radio frequency interference (RFI) immunity. At the same time, this equipment's susceptibility to the electromagnetic interference (EMI) effects of inductive load switching relays and noise induced by heavy operating equipment must be considered.

It is, however, possible that you will not know you need RFI/EMI protection until somebody keys up a radio transmitter near your device or mounts it in a noisy electrical environment and the output readings become erroneous.

(Taken from "Making the right choice", by Amplicon, in Instrumentation magazine, March 2015, pp 17-18, www.connectingindustry.com/instrumentation.)

858) Lightning strikes cause downtime for petroleum refinery

Control Engineering Europe looks at the journey taken by Tüpras Kirikkale petroleum refinery to ensure its plant is better protected from downtime due to lightning strikes in the future.

Tüpras Kirikkale petroleum refinery was established in 1986. One of the plants within the refinery contains a diesel desulphurisation (DHP) and continuous catalyst regeneration (CCR) unit.

Since commissioning, in 2007, this plant has suffered a series of electrical trips, caused by lightning strikes in the area.

To help overcome the problem the company asked experts from Yokogawa Italy to help to identify the root cause of the plant shutdowns. Following a site survey in 2013, Yokogawa collected information and measurement data to prepare a report for the company.

The report concluded that the safety system had performed a safety action because the same event had occurred in many areas of the plant – this consisted of an overvoltage on an input or output channel coming from external devices or cabling, due to lightning strikes.

Analysis of the data did not identify whether the channel overvoltage was caused by equipment installed internally in the system or by marshalling cabinets. This kind of overvoltage is considered to be a major failure of the safety input/output loop, causing the system to drive the plant in a safe condition (shutdown on emergency).

(Taken from “Eliminating downtime caused by lightning strikes”, in Control Engineering Europe, 17 February 2015, www.controleng.com/article/90631/Eliminating-downtime-caused-by-lightning-strikes.aspx.)

859) Industrial control panels more susceptible to Power Quality issues

In view of the progress of electronic development of PLCs, sensors, and the like, the electronic components (that are used to assemble industrial control panels – Editor) become more sensitive to voltage dips and interruptions.

(Taken from “Electronic circuit breakers protect 24V dc circuits in industrial control panels”, by Cristoph Wesner, Dipl.-Ing. (FH), in Control Engineering Europe, April 25, page 18, www.controleng.com/single-article/electronic-circuit-breakers-protect-24-v-dc-circuits-in-industrial-control-panels/77bcb9e83743ad6564dd6bab86e814.html.)

860) Nearly all PhotoVoltaic inverters assessed were EMC non-compliant

- The majority of EUT - 32 (58 %) - were of EU / EFTA origin.
- Approximately a third (33 %) of the EUT met the disturbance emissions compliance tests.
- Approximately a third (38 %) of the EUT met the administrative requirements (as assessed).
- All but one assessed EUT (54) were CE marked (2 were incorrectly formatted).
- A quarter (25%) of DoC was not provided, and 75 % of the DoC provided were correct.
- Nearly all (91 %) of the EUT were assessed as overall non-compliant.
- Study of emissions below 150 kHz (optional): approximately a third of the EUT (38%) were found compliant to EN 55011 Table 8 limits at mains terminals in the frequency range 9 kHz-150 kHz.
- Study of DC side (optional): approximately a half of the EUT (43%) were found compliant to EN 61000-6-3 emission requirements to the DC power port.
- From the results obtained of the solar panel inverters under test, the majority did not meet the harmonised standards that would provide a presumption of conformity with the EMCDD.
- The EUT represented a large sample of the products available on the market and it is clear that much remains to be done by manufacturers in terms of compliance.

(Taken from page 12 of “Conclusions, EMC Administrative Co-operation Working Group, Report on the 6th EMC Market Surveillance Campaign 2014, SOLAR PANEL INVERTERS (Grid-connected PV inverters and optimisers intended to be used by consumers). This document may be downloaded from



the "Member's Area" at www.emctla.com, or else Google "6th EMC Market Surveillance Campaign 2014")

861) Variability of ESD test results

The immunity to ESD of present-day electronic components and devices has further decreased due to the high sensitivity of ICs.

Electronic devices can be exposed to electrostatic discharge (ESD). The discharge process generates rapid electric and magnetic processes that can impair the function of the electronic devices. Devices are tested for their immunity to ESD using special ESD generators and test setups (EN 61000-4-2).

The effort and expense for developers to achieve ESD immunity in compliance with EN 61000-4-2 has steadily risen over recent years. The causes for this increased effort and expense are firstly the technology-related increase in sensitivity of ICs. Secondly, position changes, tilting and turning of the ESD gun yields different measurement results during ESD testing. That means even device or component tests performed with the same ESD gun will not be identical. Thirdly, it has been discovered that different types of ESD generators ("ESD guns") create different scattering in the test results. Device tests performed with different ESD generators are therefore also not always comparable.

A MORE DETAILED DESCRIPTION OF THE PROBLEM

IC sensitivity to interference is increasing. One reason for this increased sensitivity is that the structural width of ICs is shrinking. ASICs and microcontrollers are currently approaching 10 nm. Shrinking structural geometries allows higher switch speeds of the transistor cells while also reducing supply voltage. This necessarily increases IC sensitivity to interference. Increased switch speed in ICs gives rise to a greater possibility of interference from shorter disturbance pulses (less than or equal to 1 ns). Several years ago, these relatively short disturbance pulses were not an issue; they were not "seen" by the ICs.

CHANGES IN THE LENGTH OF ESD GUNS (ESD GENERATORS)

The ESD generator is typically in the shape of a gun with a metal tip. When testing "contact discharge", this metal tip is touched onto metallic parts of the test setup in order to trigger the test pulse. The current pulse introduced is relevant to the interference. It is defined in the standard EN 61004-2. Its curve shape parameters should define the interference effect during the test procedure.

In practice, the ESD gun does not necessarily obey the curve shape parameters. Interference phenomena occur that are difficult to explain. For example, certain EUT may only experience interference when the right side of the gun is facing it, while all other sides cause no interference. This would be explained by fields emanating from the gun housing that act on the EUT.

ESD guns cause rapid transient electric and magnetic fields. These fields emanate from the housing of the ESD gun and can act on the EUT during testing. The ICs of the electronic circuit will therefore react with failures according to their sensitivity. The sensitivity of ICs depends on the manufacturer and technology. The faster an IC is, the shorter disturbance pulses it can see and convert into errors. As the speed of an IC increases, so does its sensitivity to pulsed fields.

The internal structural components of ESD guns create these fields. Electric fields are generated by the switching of the high voltage switch. Magnetic fields are generated by the resulting recharge currents. (Figure 1a and Figure 1b)

The electric pulse fields couple capacitively from the gun into signal lines, test points, pads, IC pins and internally into the IC. The coupling capacity is in the fF range. Determinative of the gun's interference effect is the field strength E as well as its change over time dE/dt .

The magnetic field induces voltage in conductor loops in the electronics. These loops can exist as conductive traces on the component or inside the IC. Determinative of the interference effect is flux ϕ or $d\phi/dt$.

ESD guns contain all kinds of internal conductor systems, switches and components that can generate E or H fields. The high voltage switch of the ESD gun can switch in the range of 100 ps. The tester can hold the gun tip to the EUT at different distances and orientations. The gun housing can in some

cases rest against the EUT. The gun is deliberately turned and tilted. This brings different field generating parts of the gun closer to the electronics.

It is known from practice that ESD guns have different interfering effects depending on their type and position.

(Taken from "EMC Properties of ESD Generators", by Gunter Langer, in the In Compliance 2014 Annual Guide, pp 172-176, www.incompliancemag.com.)

862) Not all RJ45 cables and connectors have equal noise immunity

Not all cables with RJ-45 connectors meet the same specification. The table below compares cabling schemes, and reveals that the IMI connector achieves the highest noise immunity. Industrial cables with RJ-45 cables may be OK for machines, but commercial off-the shelf RJ-45 cables should not be considered for a machine to be reliable.

	Cable radiation noise immunity		Noise Immunity Conclusion
IMI STP 50m	+1800 V	-1800 V	Best
RJ-45 STP Industrial Grade 50m	+1400 V	-1400 V	Good
RJ-45 STP COTS 50m	+200 V	-100 V	Very Poor
RJ-45 UTP COTS 50m	+100 V	-100 V	Very Poor

Noise immunity comparison of various Ethernet cables with various connectors.

(Taken from "Symptoms of unreliable machine control systems", by Derek Lee, in the Industrial Ethernet book, October 2014, www.iebmedia.com/index.php?id=10429&parentid=63&themeid=255&hft=84&showdetail=true&bb=1)

863) RFI prevents smoke detectors from alarming

Two separate operating units of the United Technologies Corporation of Hartford, CT have recalled a combined total of over 140,000 smoke detectors manufactured in China.

According to a press release issued by the U.S. Consumer Product Safety Commission (CPSC), radio frequency interference (RFI) can cause the smoke detectors to fail to alert consumers of a fire. There have been no reports of incidents or injuries related to the smoke detectors, but the company has issued the product recall to prevent the risk of future incidents.

The recall involves Edwards-branded and Interlogix-branded units that have been hardwired into security systems. They were sold through alarm system, security system and electrical equipment contractors, dealers and installers for use in fire alarm systems installed in commercial buildings, hotels, apartments, schools, dormitories and homes from March 2013 through February 2014.



(Taken from "Recalled Smoke Detectors Fail to Alert", in the "News" section, on page 10 of In Compliance magazine, October 2014, <http://www.incompliancemag.com/DigEd/icm1410/>. For the

original CPSC recall notice, visit www.cpsc.gov/en/Recalls/2014/ESL-Interlogix-Hard-Wired-Smoke-Alarms-Recalled/.

The Editor comments – US magazines are always keen to mention when products recalled for safety reasons were not made in the USA. However, in this case it is likely that the RFI problem was caused by inadequate design (in a country that is not mentioned) or inadequate assembly. From time to time it is noticed that offshore electronic assemblers sometimes omit what they think are non-essential components, such as EMI filters, to save cost. Whether the design or the assembly was at fault, it is the responsibility of the company that markets the products under their own brand names to apply adequate Quality Control to ensure their customers are safe enough. And in this case, that company is not based in China.)



864) Ravens overcame headset EMI issues in Miami



The Ravens were unable to communicate to quarterback Joe Flacco's helmet Sunday.

Joe Flacco got in an extra workout running back-and-forth to the sidelines between plays Sunday afternoon.

The Ravens quarterback had to consistently jog over to the sidelines to get the play calls from Offensive Coordinator Gary Kubiak because of communication issues from the sideline to the transmitter in his helmet.

All quarterbacks wear a helmet with a radio signal transmitter inside to allow them to hear play calls from the sideline or the coach's box. But that line of communication was halted because of interference with the frequency.

"It was crackling the whole time," Head Coach John Harbaugh said. "We couldn't get our plays in and we couldn't hear from the press box. Finally we had Gary on a wire in the second half, which made his communication better, but it was really no better back to Joe."

To offset the communication barrier, Flacco had to run over to the sidelines to talk with Kubiak or the Ravens would send in the play call by changing personnel on the field.

"We were old-schooling it," Harbaugh said. "We were running plays out there and shuttling plays with players back and forth. It was a challenge."

The exact cause of the issue was unknown, but Harbaugh said it's been a common problem during Baltimore's recent trips to Miami.

"We always have trouble in Miami for some reason," Harbaugh said. "We always have trouble down there with interference, radio stations and whatever is going on down there. Hopefully that will get fixed someday, but it's been going on for years there. It must not be something that can be dealt with."



*(Posted Dec 8, 2014 by Garrett Downing, Staff Writer for BaltimoreRavens.com:
www.baltimoreravens.com/news/article-1/Ravens-Overcame-Headset-Issues-In-Miami/fbae31a0-f448-43de-8b5e-27e4d395683f#commentSystem. Also posted on 12/17/2014 as:
www.interferencetechnology.com/radio-interference-causes-headset-issues-during-football-sunday)*