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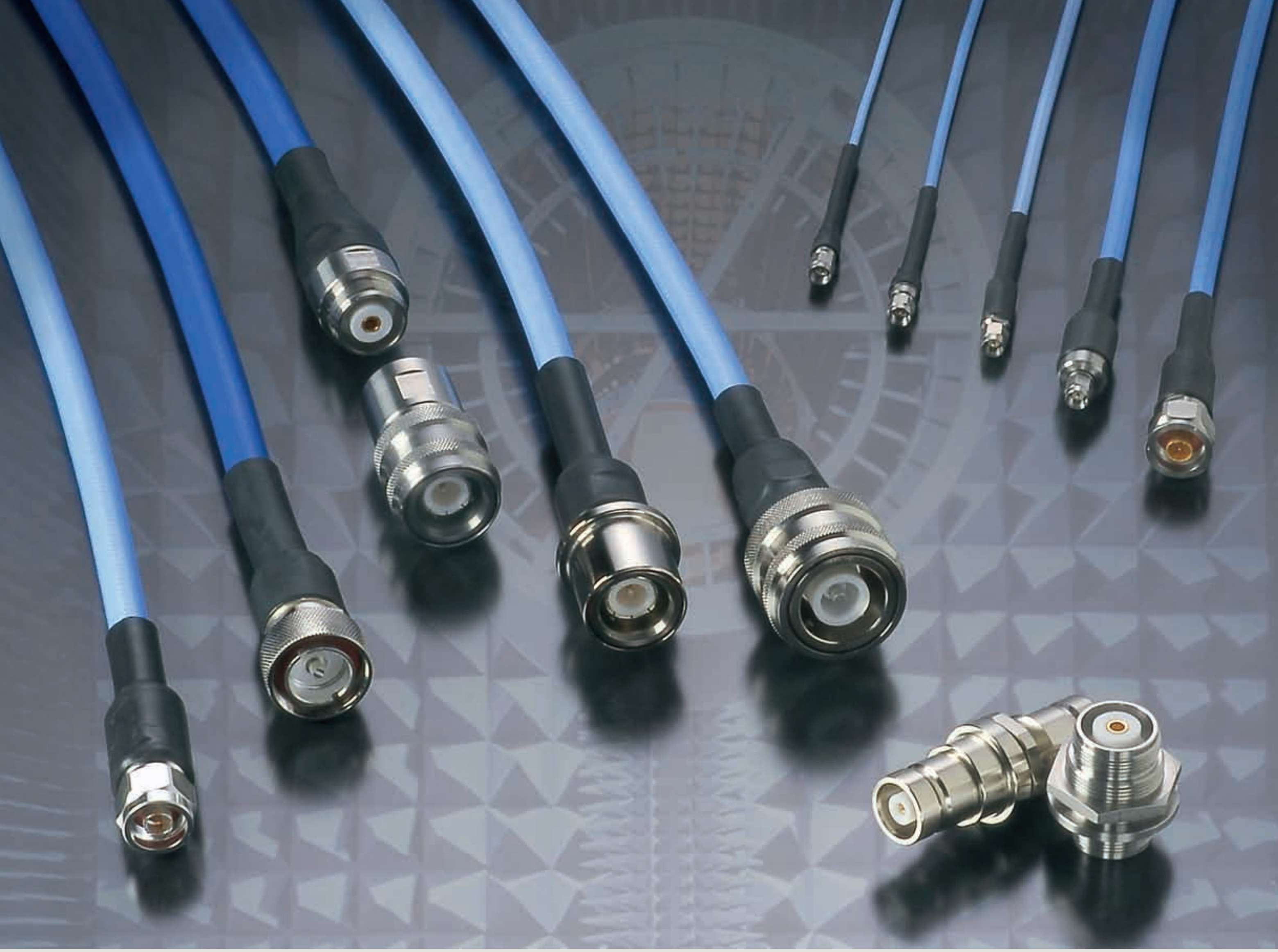

IN COMPLIANCE

In Compliance Magazine
ISSN 1948-8254 (print)
ISSN 1948-8262 (online)
is published by

Same Page Publishing Inc.
531 King Street, Suite 5
Littleton, MA 01460-1279
tel: (978) 486-4684
fax: (978) 486-4691

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In Compliance Magazine subscriptions are free to qualified subscribers in North America.

Subscriptions outside North America are $129 for 12 issues. The digital edition is free.

Please contact our circulation department at circulation@incompliancemag.com

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News in Compliance

FCC News

FCC Issues Citation for Radiating Light Fixture

The owner of a Texas beauty salon has been issued a citation by the Enforcement Bureau of the U.S. Federal Communications Commission (FCC) for operating a lighting fixture that created harmful interference to radio communications services.

The citation stems from a July 2013 investigation by agents of the Bureau's South Central Region into reports of interference with licensed cellphone communications at 705 MHz. Using a spectrum analyzer and a hand-held antenna, agents confirmed that the interfering signals were emanating from an overhead lighting fixture at the Perfect Cuts Salon in San Antonio, TX. Ronald Bethany, the owner of the salon, told agents that he was aware of the problem, and had contacted the fixture's manufacturer to replace the lighting.

However, Bethany refused Bureau agents' request to conduct onsite testing to verify the interference complaint. Bethany also subsequently refused the Bureau's instructions to address the interference, saying that it was not causing him any problems and that he would not repair or replace the fixture unless paid to do so.

Under the conditions of the FCC's citation, Bethany is subject to monetary fines and forfeiture of equipment if he continues to operate the light fixture.

The complete text of the Commission's *Citation and Order* is available at incompliancemag.com/news/1312_01.

FCC Proposes $14 Million in Penalties for Lifeline Program Violations

The U.S. Federal Communications Commission (FCC) has proposed more than $14.4 million in monetary forfeitures against five wireless Lifeline service providers who allegedly established multiple Lifeline wireless phone service subscriptions for individual consumers, in violation of the program's rules.

The Commission issued Notices of Apparent Liability (NALs) in September 2013 against Icon Telecom, Inc., TracFone Wireless, Inc., Assist Wireless, LLC, Easy Telephone Services, and UTPhone, Inc. In each instance, the Commission says that the carriers knew or should have known that targeted consumers were already participants in the Lifeline program, and therefore ineligible for multiple subscriptions under Lifeline program rules

The proposed monetary forfeitures were based on the number of unlawful payment requests made by each respective carrier, which was then adjusted upward by three times the total duplicate payments requested.

Established in 1985, the Lifeline program provides discounted wireless service subscriptions to low-income consumers. However, evidence of widespread abuse led the Commission to overhaul the program in 2012, and to aggressively pursue investigations of duplicate service and fraud. The Commission says that its actions to date have eliminated more than 1.1 million duplicate Lifeline subscriptions, and that continued enforcement efforts will result in savings of over $2 billion over a three year period.

FCC News

FCC Releases Consumer Complaints Report for Q1 2013

The U.S. Federal Communications Commission (FCC) has released its report on inquiries and complaints made by consumers to the agency's Consumer & Government Affairs Bureau during the quarter ending March 31, 2013.

The Bureau regularly tracks inquiries and complaints from consumers on matters within the scope of the Commission's jurisdiction. The Bureau is particularly interested in instances of "cramming" (the placing of unauthorized, misleading or deceptive charges on a telephone bill) and "slamming" (the practice of changing a subscriber's telecommunications service provider or calling plan without the subscriber's permission). The Commission also tracks violations of the Federal Telephone Consumer Protection Act (TCPA), which includes regulations covering both the "Do Not Call" registry and unsolicited fax advertisements.

During the period from January through March 2013, the Bureau received a total of 39,762 TCPA-related complaints in connection with wireline telecommunications services, and an additional 26,308 TCPA-related complaints in connection with wireless services. Of the wireline TCPA complaints, 20,584 (51.8%) involved violations of the "Do Not Call" registry, and 2508 were connected with unsolicited faxes.

In addition to complaints, the Bureau also received 4864 TCPA-related inquiries in connection with wireline services, and an additional 215 TCPA-related inquires in connection with wireless services.

The complete text of the Commission's most recent quarterly report is available at incompliancemag.com/news/1312_02.

News in Compliance

European Union News

EU Releases Recent RAPEX Stats on Unsafe Consumer Products

The Commission of the European Union (EU) has released statistics for September 2013 on notices of unsafe consumer products that have been processed through the EU's rapid information system (RAPEX).

According to the Commission's report, 149 notifications of products posing serious risks to consumers were received through the RAPEX system during the month. Of the notifications received, 33 were related to the product category of clothing, textiles and fashion items (22%), and 27 were related to toys (18%). There were also 10 notifications related to unsafe electrical appliances and equipment, accounting for 7% of the total notifications of products posing serious risks.

Regarding the country of origin identified in connection with products posing serious risks, more than half (94 notifications, or 63%) of all notifications were related to products originating from China, including Hong Kong. Another 22 notifications (15%) related to unsafe products originated in EU Member States. Thirteen notifications (9%) failed to identify any country of origin.

To view the complete text of the EU Commission's most recent report on RAPEX statistics, go to incompliancemag.com/news/1312_03.

EU Commission Revises Standards List for R&TTE Directive

The Commission of the European Union (EU) has published an updated list of standards that can be used to demonstrate compliance with the essential requirements of Directive 1999/5/EC, covering radio equipment and telecommunications terminal equipment (R&TTE).

According to the Directive, 'radio equipment' is defined as any product capable of communication via emission and/or reception of radio waves. 'Telecommunications terminal equipment' is any device intended to be connected directly or indirectly to the public telecommunications network. The scope of the Directive also includes certain medical devices and active implantable medical devices.

The extensive list of Cenelec and ETSI standards was published in October 2013 in the *Official Journal of the European Union*, and replaces all previously published standards lists for the Directive.

The revised list of standards can be viewed at incompliancemag.com/news/1312_04.

EU Commission Updates Standards List for Toy Safety Directive

The Commission of the European Union (EU) has published an updated list of standards that can be used to demonstrate conformity with the essential requirements of its directive relating to the safety of toys (88/378/EEC).

According to the Directive, a toy is defined as "any product or material designed or clearly intended for use in play by children of less than 14 years of age." The scope of the Directive includes electric toys that are powered by a nominal voltage up to and including 24 V, and requires sufficient protections for such devices to prevent the risk of electric shock and/or burns.

The most recently updated list of CEN standards for the Directive was published in October 2013 in the *Official Journal of the European Union*, and replaces all previously published standards lists for the Directive.

The revised list of standards can be viewed at incompliancemag.com/news/1312_05.

> The Commission of the European Union has released recent statistics on notices of unsafe consumer products that have been processed through RAPEX, the EU's rapid information system. The EU has also published updated standards lists for the R&TTE Directive and the Toy Safety Directive.

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News in Compliance

CPSC News

Surge Protectors Recalled

Schneider Electric IT Corporation (formerly known as American Power Conversion, or APC) of West Kingston, RI has announced the recall of about 15 million of its APC-brand surge/arrest surge protectors manufactured in China and the Philippines.

According to the company, the surge protectors can overheat, smoke and melt, posting a fire and burn hazard to consumers. Schneider says that it has received 700 separate reports of the surge protectors overheating and melting, including 55 claims of property damage from smoke and fire. In addition, there have been 13 reports of injuries, including smoke inhalation and contact burns from touching overheated surge protectors.

The surge protectors affected by this recall were sold at Best Buy, Circuit City, CompUSA and other stores nationwide from January 1993 through December 2002 for between $13 and $50.

Additional information about the specific surge protectors included in this recall is available at incompliancemag.com/news/1312_06.

Crate and Barrel Recalls Hanging Pendant Lamps

Euromarket Designs, Inc. of Northbrook, IL, doing business as Crate and Barrel, has recalled about 19,000 hanging pendant lamps manufactured in China.

Crate and Barrel says that the wires in the recalled pendant lamps may be connected incorrectly because labels indicating the wires' polarity can fall off or be mislabeled, a situation that could potentially expose consumers to fire and shock hazards. The company has received four reports of lamps shorting out, including minor property damage and a minor burn.

The pendant lamps were sold at Crate and Barrel stores nationwide, and through the company's website and catalog, from January 2009 through July 2013, for between $149 and $249.

More information about this recall is available at incompliancemag.com/news/1312_07.

Tablet Power Adaptors Recalled Due to Fire Hazard

Southern Telecom, Inc. of Brooklyn, NY is recalling about 21,000 A/C adaptors included with Internet tablets manufactured in China.

Southern Telecom reports that the A/C adaptors can overheat, posing a fire and burn hazard to consumers. The company says it has received approximately 10 reports of the adaptor overheating, but no reports of injuries or property damage.

The recalled A/C adaptors were included with the Polaroid PMID709 seven-inch Internet tablet. The tablets and accompanying adaptors were sold at Big Lots retail stores in July 2013 for $90.

Further details about this recall are available at incompliancemag.com/news/1312_08.

You Can't Make This Stuff Up

Bionic Man Debuts at Smithsonian

The bionic man is no longer the stuff of comic books and television shows. Instead, an operating robot with a human face and artificial body parts is now on display at the Smithsonian Air and Space Museum in Washington, D.C.

Reportedly the culmination of decades of research, the 6-foot tall robot has been constructed entirely from bionic body parts and synthetic organs on loan from biomedical innovators, and features a complete and fully-functional circulatory system. The robot has artificial intelligence capacity similar to the Siri application on Apple's iPhone, and is controlled from a remote computer via Bluetooth wireless connections.

Assembly of the bionic man began more than a year ago in August 2012, and the completed robot made its debut at New York's Comic Con convention in October 2013. It will be on display at the Smithsonian through December 2013.


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MR. Static

Induction

What it means to ESD

BY NIELS JONASSEN, sponsored by the ESD Association

Can an uncharged, insulated conductor have a voltage of, say, 1000 V? Can a charged, insulated conductor have zero voltage? The answer common to both of these seemingly paradoxical questions is yes, if we're dealing with the concept of induction. In this article, we'll discuss induction in its two forms and examine a series of practical examples which point to the fact that induction is a subject relevant to and worthy of ESD investigation.

INTRODUCTION

Associate Professor Neils Jonassen authored a bi-monthly static column that appeared in *Compliance Engineering Magazine*. The series explored charging, ionization, explosions, and other ESD related topics. The ESD Association, working with *In Compliance Magazine* is re-publishing this series as the articles offer timeless insight into the field of electrostatics.

Professor Jonassen was a member of the ESD Association from 1983-2006. He received the ESD Association *Outstanding Contribution Award* in 1989 and authored technical papers, books and technical reports. He is remembered for his contributions to the understanding of Electrostatic control, and in his memory we reprise "Mr. Static".

~ The ESD Association

TYPES OF INDUCTION

In the world of electricity we have two kinds of induction: electromagnetic induction and electrostatic induction.

Electromagnetic Induction

Electromagnetic induction is the phenomenon that a time-varying magnetic field creates, or rather induces—an electromotive force expressed in Faraday's law of induction as

$$E_i = -\frac{d\Phi}{dt}$$

where Φ is the magnetic flux through a surface and E_i is the electromotive force induced along a curve bordering the surface. Electromagnetic induction is the basis for all (or nearly all) electrical power production.

Electrostatic Induction

Electrostatic induction describes the static effect of an electric field on a conductor.

EXAMPLES

An insulated, uncharged conductor B is in the field from a positively charged insulator A (see Figure 1). The field from A will cause electrons in B to move to the side of B that faces A. These electrons make up the bound induced charge. This charge cannot be removed as long as B is in the field from A. The corresponding excess positive charge—the free induced charge—is located on the opposite side of B. But the total charge on B is still zero, as is the field inside B. The free induced charge (positive) creates an electric field outside of B, with the field lines eventually terminating on some grounded object. If this field is integrated from B to a ground point, we will get a positive figure, which, by definition, is the voltage of B. Thus we have an uncharged conductor with a positive voltage.

In Figure 2 we have the same situation as in Figure 1, except that now the conductor is grounded. Consequently the voltage of B is zero. But because B still has the negative, bound induced charge, we have a negatively charged conductor with zero voltage. If the ground connection is broken, and B is moved away from the neighborhood of A (in an insulated way), B will still have its negative charge, giving B a negative voltage.

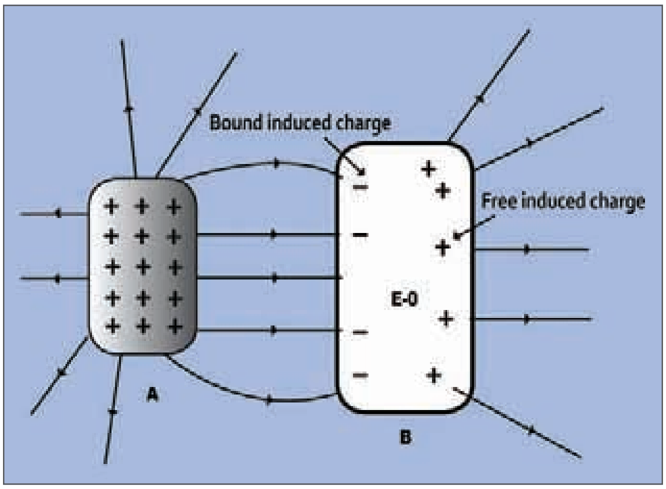

Figure 1: Insulated conductor in the field from a charged insulator

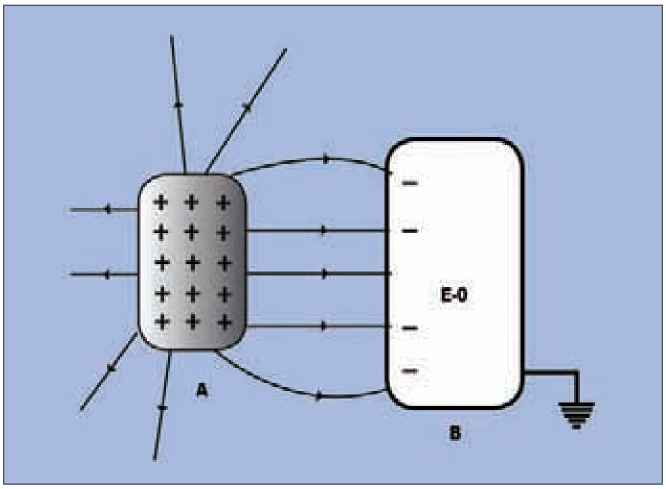

Figure 2: Grounded conductor in the field from a charged insulator

MR. Static

Remembering that field lines have no problem penetrating insulating materials is important to ensure induced charges and their effects are tracked.

We describe this process as B having been charged by induction. Let's illustrate the first part of this scenario with a practical example.

Figure 3 shows an operator holding a piece of positively charged insulative material. The operator is standing on an insulating floor covering backed by a grounded layer that is more-or-less conductive. The charge from the material will, by induction, bind a negative charge on the operator. Since the operator has no excess charge, a positive charge of the same numerical magnitude as the negative charge will cause the operator to have a positive voltage. The field lines from the operator's positive charge will run through the floor covering to the grounded underlayer. That is, at least some of them will go there. Other field lines may go to the walls of the room.

The field distribution suggested in Figure 3 is somewhat misleading. The major part of the electric flux (i.e., the number of field lines) from the operator will run from the undersides of the operator's feet through the floor covering to a conductive, grounded layer. (Remembering that field lines have no problem penetrating insulating materials is important here to ensure induced charges and their effects are tracked.) Therefore, the situation shown in Figure 3 is that of an uncharged person being charged to a positive voltage just by virtue of being near a charged piece of material.

The question now is, why might this pose a greater risk (or nuisance) than just having the charged piece of material around in the absence of insulated conductors? The reason is as follows: any direct discharge in the field from the material's surface will be a low energy-density discharge (corona or brush), which normally will have only minor harmful effects. But if the charged material binds by induction a charge of just 1 mC on the operator, the operator will carry about 5000 V and be able to dissipate an energy in his environment of about 2 mJ, or 10 times the minimum ignition energy for most mixtures of organic vapors with atmospheric air. Of course if the operator drops the material and just walks away, the operator is uncharged, has no voltage, and is considered to be safe. But if the operator accidentally gets grounded during the work, he loses the free charge and may walk away with an excess (negative) charge, carrying the risk for an energetic spark discharge.

A practical example of dangerous induction charging (Figure 4) is an operator pouring powder (resin) from a plastic-lined bag into a tank containing explosive vapors (acetone). The operator, who is not grounded, is uncharged during the entire operation. The resin charges the plastic lining of the bag, and the field from the bag induces a charge on the operator and gives him a voltage. When the operator accidentally touches the tank, a spark discharge occurs, resulting in an explosion that hurts the operator badly.

Figure 3: Insulated operator handling a charged piece of insulative material

Figure 4: Ungrounded operator handling insulative materials in an unsafe environment

Potential Harmful Effects for the Electronics Industry

There are also many examples of electrostatic induction's harmful effects in the electronics arena. A simple example is that of an ungrounded operator being near a piece of charged

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Among the ESD damage models, the field-induced model is still viewed with skepticism by some people in the electronics industry. They don't believe that fields can induce high-enough voltages in components and circuits to cause breakdown.

material of any kind. The operator will, by induction, be charged to a voltage (although the operator's total charge may be zero), and if this person then touches a grounded component the resulting current pulse may destroy the component.

But let's look at a somewhat more-complicated example (see Figure 5). Here we have a positively charged object—an insulator in this case (the field lines are not perpendicular to the surface). Near this object is an electronic component or device. The field from the charged object binds by induction a negative charge on an insulated, conductive part (a) of the component. The total charge on (a) is zero; thus, a positive charge numerically equal to the negative one resides on the other side of (a) and creates a field through the insulative, or rather, dielectric, layer, to the grounded part of the component (c). The critical part in this situation is the field through the dielectric. If this field is high enough, a breakdown happens. This is known as field-induced damage.

Among the ESD damage models, the field-induced model is still viewed with skepticism by some people in the electronics industry. They don't believe that fields can induce high-enough voltages in components and circuits to cause breakdown. But with dielectric layers getting thinner and thinner, and, consequently, with field strengths at the edges of the conductive layers getting higher, breakdown does become more and more likely.

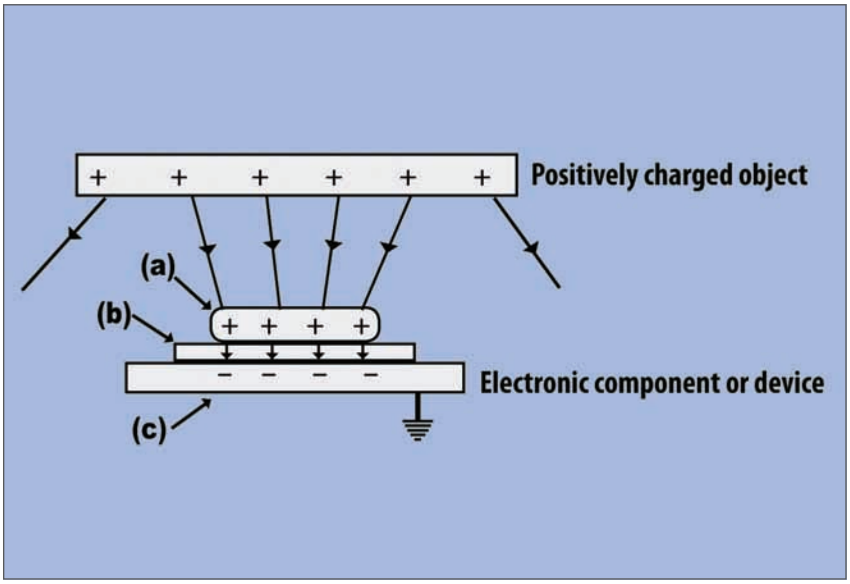


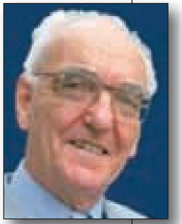
Figure 5: Field-induced damage where (a) is an insulated, conductive part of the component, (b) is an insulative (dielectric) layer, and (c) is a ground (conductive) part.

CONCLUSION

The concept of electrostatic induction may seem somewhat elusive. On a more scholarly level it demonstrates that the concept of electric fields is by far more fundamental, and often much more useful, than the more-earthbound concept of voltage. The field from a charged body may cause another body to have a voltage, although it has no charge, and the field from a charged body may cause another body to have a charge, although it has no voltage.

Hopefully I have demonstrated that although the concept of induction may look like a good target for an academic exercise, sometimes it also has practical and damaging consequences that make it an obvious topic of consideration for any ESD (or, at least, electrostatic) investigation.

(the author)



NIELS JONASSEN, MSC, DSC, worked for 40 years at the Technical University of Denmark, where he conducted classes in electromagnetism, static and atmospheric electricity, airborne radioactivity, and indoor climate. After retiring, he divided his time among the laboratory, his home, and Thailand, writing on static electricity topics and pursuing cooking classes. Mr. Jonassen passed away in 2006.

REALITY Engineering

A Jungle Survival Story

BY MIKE VIOLETTE

Long before EMC was his interest and, I daresay, his passion, Dad flew airplanes for a living. It was during an era unto its own. Norm had a load of stories and loved to tell them, throwing in an occasional embellishment. His flight training was in Big Springs, Texas "where elephants went to die," as he would say. Four or so thousand hours of flight time included the fast and high kind of flying and low and slow kind. In either case, flying airplanes takes loads of preparation.

One of his stories was how he scored a cold beer during jungle survival training during Vietnam. Getting that cold pop in the middle of the night--in the middle of the jungle--had something to do with proper preparations, too.

But before we get to that, a bit more about planes. One of the planes my Dad liked to reminisce about was the F-106 Delta Dart and ***when you kicked that afterburner, man did you go!*** With a landing approach speed of 180 knots, it was a ***fun plane to fly.***

Peruse airplane collections and designs from the late 50s and 60s and one finds a veritable box of chocolates of flying machines. Contrary to the Swiss Army-Knife approach of today's procurement—witness the F-35 Joint Strike Fighter where a single design concept forms a platform for all the services—the heydays of experimental airplane design gave birth to dozens of different birds of various breeding: engineering Darwinism.

Models such as the F-80, F-100 and their derivatives were rolled quickly through development and into (oftentimes brief) production. The pioneering designs that came out of the adolescent jet age demanded that designers and engineers bang together real hardware to be built, tested, proved (and crashed). Research into aerodynamics, propulsion and materials science leaned heavily on the trial and error method. Contrast this with today's reliance on computer modeling and simulation to design complex airframes that give agility and stealth to multi-multi-million dollar airplanes. No matter, whether on the test stand or in RAM, it's all Real Engineering.

Lockheed-Martin's Skunkworks has been a cradle of airplane design since the 1950s (and is the birthplace of the remarkable still-flying U2, the *maybe* retired SR-71 Blackbird spy planes and, more recently, the F-35). Much of the material science for high-flying faster-than sound and radar invisibility came out of the sprawling complex near Palmdale, CA.

F-106 © Peter Mancus 1976 / www.cloud9photography.us

TIME IN SE ASIA

Anyway, Dad got checked out in a dozen or so airplanes (he told me once how many, but I forget). He spent much of his time driving a C-123 "Provider" supply plane during the Vietnam War, flying nine hundred and ninety-six takeoffs and landings (that number, I remember and it's an even number) during that very turbulent year of 1968. He arrived a few weeks before the launch of the Tet Offensive ***when all hell broke loose***, an attack that set the US back on its heels a bit. (When his year was up, he had a few more days to kill at Cam Ranh Bay; he told me that one of his buddies was making a couple of flights and would my Dad like to make it an even 1000. His reply was ***not no, but hell no!***)

C-123 "Provider"   photo by Dan Simonsen / Shutterstock.com

REALITY Engineering

The C-123 was a two-engine prop job (low and slow) with a crew of three plus a loadmaster. Dad sat in the front left seat and ***after a few hundred landings you knew when the wheels were inches above the runway. I could feel the ground through my seat.***

The loadmaster was positioned in the back with his headset trunked to the cockpit. His job was to drop the ramp and get rid of whatever they were delivering. Many airstrips (and the US operated out of hundreds of 'aerodromes' during our engagement there) were in non-too friendly places, so one didn't dawdle. It was for this reason that the C-123 was fitted with auxiliary jet pods for short takeoff and landing operations.

Get down, unload and get out.

One time we set down at Khe Sanh, the wheels touched and we started our rollout to unload our cargo of jet fuel. The loadmaster dropped the door and suddenly there was a bunch of holy *&$%#! over the intercom. Turns out, as the wheels hit, three mortars dropped in behind them, landing on the runway. ***Wham! Wham! Wham!*** **<u>That</u> was a close call.**

JUNGLE JUICE

Back to the beer: One of the rights of passage all aircrews going to Vietnam had to endure was a couple of weeks of jungle survival training—pretty critical knowledge if your plane suddenly can't fly any more.

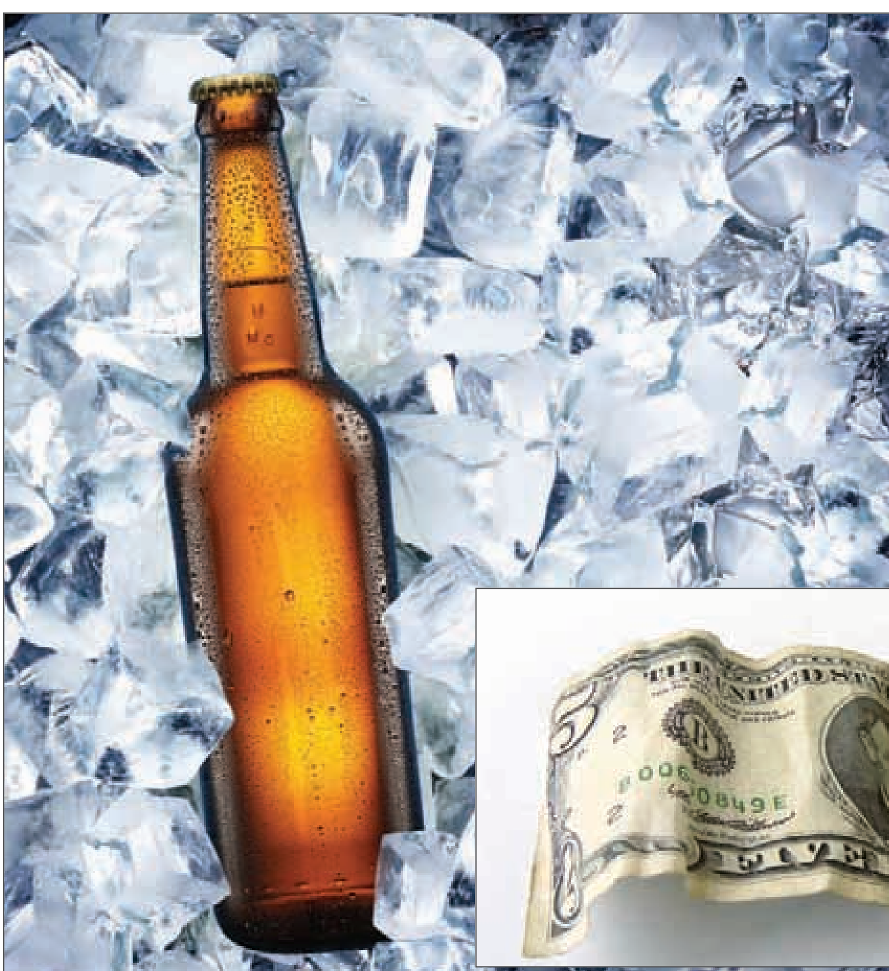
Survival training was conducted at Clark Air Force Base in the Philippines, Dad's first stop after leaving the States around Christmas '67 at the ripe old age of thirty-three (well above the average age of infantry running around the paddies). In a letter back home to mom he related that ***everyone is coming through here. Last night I ran into Tommy and Dick at the Officers Club.***

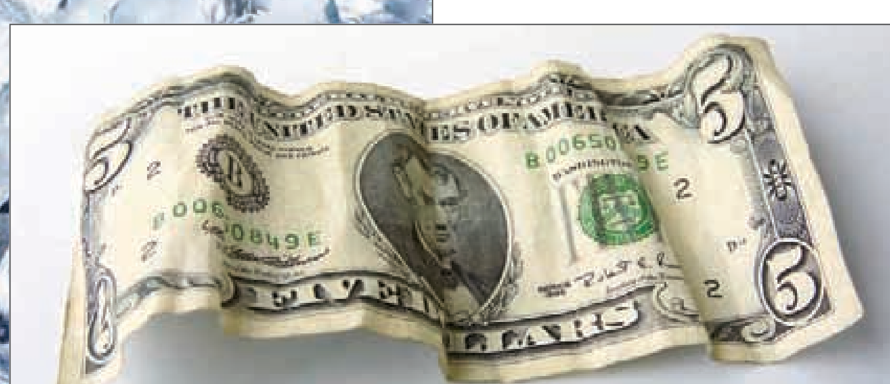
Clark AFB had some of the busiest air operations at the time and was operational until its lease ran out. Mount Pinatubo blew its stack and tons of ash all over the area in 1991. The US withdrew operations that year, but in June 2012 US forces returned to the area in response to China's attempt to claim territorial waters in the South China Sea. The base is located on the Philippine Island of Luzon. Local native peoples, the Kalinga, have the run of the jungle. ***Friendlies***.

Training included survival and evasion and included instruction on what to eat, camouflage techniques and how to resist if captured.

As part of the 'final exam' Norm and two other guys were ***left in the jungle with a parachute, a sidearm, a knife and some rations,*** and their training.

"You want beer?" he asked. "Five dollars for you."





They were also given five bucks.

After spreading out in tall grass each guy hunkered down within earshot of the others. It was a moonless night and they tried to ***make ourselves invisible, using the training we just received.*** For a few hours it was quiet and my Dad settled off to sleep when he heard a rustling sound and the sound of metallic banging. Now, my Dad never handled a gun in my presence, but I gather that he had his service revolver out. The foliage shook.

A local Kalinga entrepreneur spread apart the fronds covering his hiding spot and peered in, smiling and holding up a sack.

"You want beer?" he asked. "Five dollars for you."

Ah, that's what the five bucks was for! Who could resist?

It was San Miguel beer and it was cold. Preparations pay off.

Fortunately, he survived the survival training and, more importantly for EMC and so many reasons, the war.

AUTHOR'S NOTE

Mike Violette started Washington Labs with Norm Violette in November 1989. ***Italics*** indicate quotes from Norm and should be regarded as 'faithful paraphrase' because I heard the stories several times. You get the idea (but any factual errors are mine).

(the author)

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More Speed, More Insight: Use of FFT-based EMI Test Receivers for EMI Compliance Measurements

FFT-based EMI test receivers can be used for EMI compliance measurements in accordance with Amendment 1 to 3rd Edition of CISPR 16-1-1 if this standard is referenced in the product standard. The use is motivated by reducing the scan time by several orders of magnitude and to get more insight due to the possibility of applying longer measurement times and enhanced measurement functions like spectrum in persistence mode. For precise and reproducible measurements the use of preselection filters is highly recommended.

BY JENS MEDLER

Traditional EMI test receivers are used for measuring a signal within the IF bandwidth during the set measurement time. This results in a long scan time for the entire frequency range as the measurement time per frequency point needs to be quite long to capture intermittent emissions. FFT-based receivers measure the emitted signals in frequency segments much wider than the measurement bandwidth. The actual measurement bandwidth is achieved via a FFT filter bank and a bank of weighting detectors. This approach offers the following benefits:

- Time needed for measurement of electromagnetic emissions is significantly reduced by approximately the number of filters used with the FFT filter bank plus the time needed by the test receiver to switch frequency. This reduces test time up to several orders of magnitude without degradation of accuracy.
- Allows application of longer measurement times, e.g. for measuring intermittent signals.
- Makes enhanced measurement functions like spectrogram and spectrum in persistence mode applicable.

With the publication of Amendment 1 to 3rd Edition of CISPR 16-1-1 [1] in June 2010 FFT-based measuring instruments were introduced for EMI compliance measurements. The publication in the basic standard is a prerequisite that the method can be used by product standards. This is already the case for emission measurement on sound and television broadcast receivers and associated equipment (CISPR 13:2006), lighting equipment (CISPR 15:2013) and for multimedia equipment (CISPR 32:2012). A detailed explanation about the applicability is given in the section *How a Basic Standard Comes into Force*.

The selection of the measurement time using a FFT-based EMI test receiver needs attention when measuring broadband disturbance and intermittent signals. Furthermore, the use of RF preselection filters is highly recommended for maximum dynamic range and to avoid overload. This is particularly true for quasi-peak measurements of weak pulsed signals in the presence of high amplitude signals. Guidance is given in the section *Timing and Dynamic Range Considerations using FFT-based EMI Test Receivers*.

CONCEPT OF CISPR 16-1-1

Currently CISPR 16-1-1 uses a "black box approach" to define specifications for measuring apparatus. This means that all stated specifications in CISPR 16-1-1 must be met by the measuring apparatus, independent of the selected implementation or technology, in order to be considered suitable for measurements in accordance with CISPR standards.

To reflect this approach, a new definition of the term **"measuring receiver"** has been added in Amendment 1:2010-06 to CISPR 16-1-1:2010-01 [1], it says:

> *"instrument, such as a tunable voltmeter, an EMI receiver, a spectrum analyzer or a FFT-based measuring instrument, with or without preselection, that meets the relevant parts of this standard".*

As a consequence a FFT-based measuring instrument that meets the requirements of CISPR 16-1-1:2010 and its Amendment 1:2010 can be used for EMI compliance measurements. Generally, this comprises the parameters input impedance, detectors, bandwidth, overload factor, VSWR, absolute sine-wave voltage accuracy, response to pulses, overall selectivity, intermodulation effects, receiver noise, and screening.

In addition to the above general requirement the FFT-based measuring instrument shall sample and evaluate the signal continuously during the measurement time. This is essential for capturing impulsive disturbance and intermittent signals. It disqualifies the use of digital storage oscilloscopes for EMI compliance measurements due to the existence of blind times.

Product Standard	Reference to CISPR 16-1-1	Stability Date
CISPR 11:2010 (Ed. 5.1) — product standard for industrial, scientific and medical equipment (ISM)	CISPR 16-1-1:2006 and its Amendments 1:2006 and 2:2007	2014
CISPR 12:2009 (Ed. 6.1) — product standard for vehicles, boats and internal combustion engines (protection of off-board receivers)	CISPR 16-1-1:2006	2014
CISPR 13:2009 (Ed. 5.0) — product standard for sound and television broadcast receivers and associated equipment	CISPR 16-1-1:2006 and its Amendments 1:2006 and 2:2007	2014
CISPR 14-1:2011 (Ed. 5.2) — product standard for household appliances and electric tools	CISPR 16-1-1:2003	2014
CISPR 15:2009 (Ed. 7.2) — product standard for electrical lighting and similar equipment	CISPR 16-1-1:2003	2013
CISPR 15:2013 (Ed. 8.0) — product standard for electrical lighting and similar equipment	CISPR 16-1-1:2010 and its Amendment 1:2010	2016
CISPR 22:2008 (Ed. 6.0) — product standard for information technology equipment (ITE)	CISPR 16-1-1:2006 and its Amendments 1:2006 and 2:2007	2017
CISPR 25:2008 (Ed. 3.0) — product standard for vehicles, boats and internal combustion engines (protection of on-board receivers)	CISPR 16-1-1:2006 and its Amendments 1:2006 and 2:2007	2014
CISPR 32:2012 (Ed. 1.0) — product standard for multimedia equipment	CISPR 16-1-1:2010 and its Amendment 1:2010	2015
IEC 61000-6-3:2010 (Ed. 2.1) — generic standard for residential, commercial and light-industrial environments	CISPR 16-1-1:2010	2014
IEC 61000-6-4:2010 (Ed. 2.1) — generic standard for industrial environments	CISPR 16-1-1:2010	2014

Table 1: Dated References to CISPR 16-1-1

HOW A BASIC STANDARD COMES INTO FORCE

Basic standards come into force with dated or undated normative references in product standards:

- If the reference is undated, the latest edition of the standard shall apply.
- If the reference is dated, the specific edition of the basic standard shall apply.

CISPR 13:2006 (Ed. 4.2) has undated references to basic standard CISPR 16-1, whereas all other CISPR product standards and IEC generic standards for emission measurements have dated references, see Table 1.

Therefore, the users of CISPR 13:2006 (Ed. 4.2), CISPR 15:2013 (Ed. 8.0) and CISPR 32:2012 (Ed. 1.0) can immediately employ a FFT-based measuring instrument for EMI compliance measurements if the instrument meets the requirements of CISPR 16-1-1:2010 and its Amendment 1:2010 (Ed. 3.1). For most of the other standards it may be possible to update the references in 2014. CISPR 22 will not be amended any further and will be replaced by CISPR 32 in 2017. For this reason, pure FFT-based measuring instruments will still not be suitable for compliance measurements for quite a long time.

To gain from the dramatically increased measurement efficiency of FFT based receiver technology it is beneficial to use an EMI test receiver, which combines the traditional EMI receiver concept with the FFT-based time-domain scan function in one device. Even if the product standard does not yet allow the FFT based measurement, the method can be used for pre-qualification measurement followed by a measurement according to the traditional analog receiver method at the frequencies identified as critical. (See Figure 1).

TIMING AND DYNAMIC RANGE CONSIDERATIONS USING FFT-BASED EMI TEST RECEIVERS

Two different approaches for implementation of FFT-based receivers are possible:

- The oscilloscope approach digitizing the RF signal directly using a high dynamic range AD converter
- The receiver approach using a wide band IF design and digitizing the IF signal.

The limitation with the oscilloscope approach is the AD converter, which

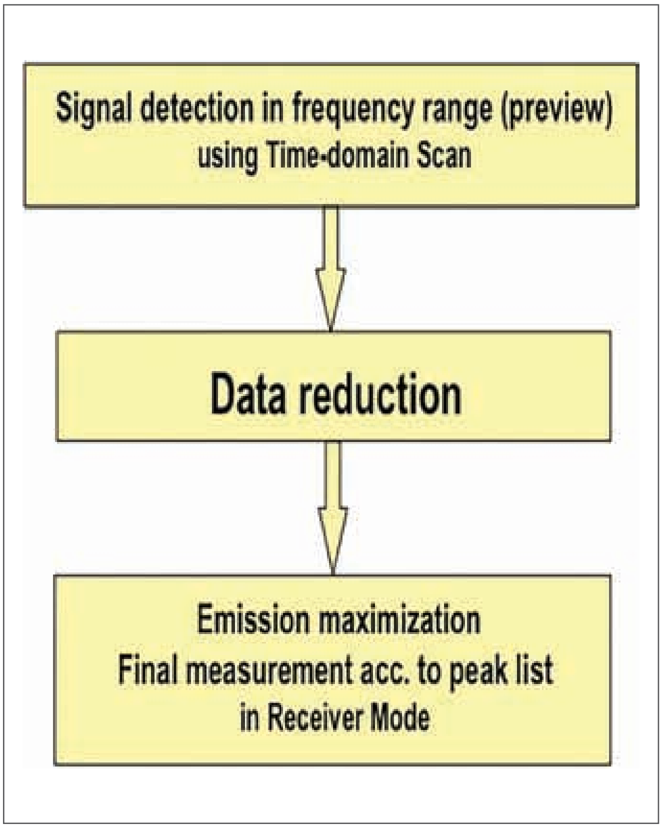

Figure 1: EMI compliance measurements using Time-domain Scan if the product standard does not refer to CISPR 16-1-1:2010 and its Amendment 1:2010

A better approach which guarantees the required performance is to combine both types in one instrument, e.g. direct AD conversion up to 30 MHz input frequency and using e.g. a 30 MHz wide IF with a traditional receiver concept.

needs to have a very high resolution and a high sampling rate to cope with the dynamic range requirements set by CISPR 16 and the bandwidth. Considering some margin for input filtering for a 1 GHz receiver an AD converter with 2.5 GHz sampling rate is needed. To meet the CISPR 16 requirements at minimum 16 bit resolution is necessary. Such AD converters are currently not available. Therefore, auto-range routines and software measures are necessary to get close to the required performance.

A better approach which guarantees the required performance is to combine both types in one instrument, e.g. direct AD conversion up to 30 MHz input frequency and using e.g. a 30 MHz wide IF with a traditional receiver concept. That way the bandwidth to digitize is limited to 30 MHz putting lower and feasible demands on the AD converter.

This concept offers the following advantages:

- High dynamic range by limited bandwidth and availability of high resolution and high dynamic 16 bit AD converter.
- Upper frequency limit of the receiver not limited by the AD converter sampling frequency.
- The bandwidth filtering and all weighting detectors can operate in real-time, i.e. the complete conducted or radiated emission spectrum can be displayed w/o any interruptions or time gaps.
- Above 30 MHz the frequency range of interest is subdivided into several segments of e.g. 25 MHz, which are measured sequentially.
- Long maximum dwell time by low sampling rate, e.g. up to 100 s.
- Thanks to the limited frequency band used for the FFT an RF pre-selector can be used. It protects the receiver input from overload due to high out of band signals and guarantees correct measurement of weak disturbance signals in presence of strong signals

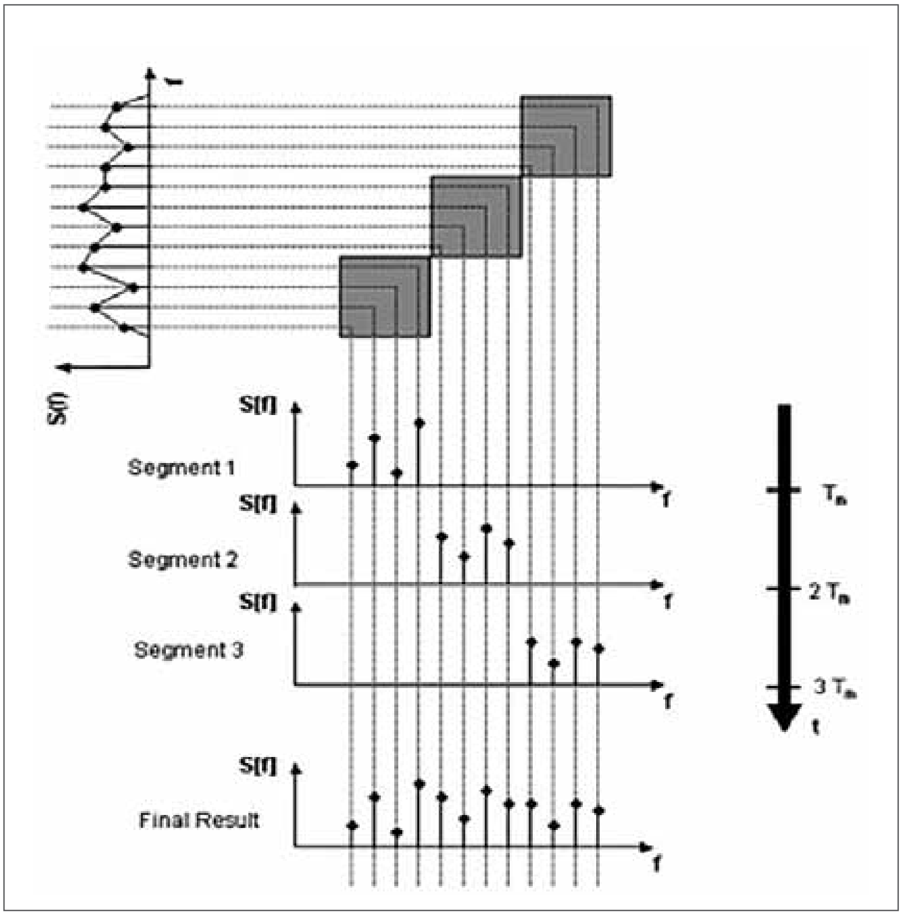

Figure 2: FFT scan in sequence, Source: CISPR 16-2-3 [2]

As a consequence a FFT-based EMI test receiver combines a filter bank with N parallel filters and the stepped frequency scan using a step width according to the FFT width. For this purpose the frequency range of interest is divided into several segments that are measured sequentially, see Figure 2. The scan time T_{scan} is calculated as:

$$T_{scan} = T_m N_{seg} \quad (1)$$

where

T_m is the measurement time for each segment, and

N_{seg} is the number of segments

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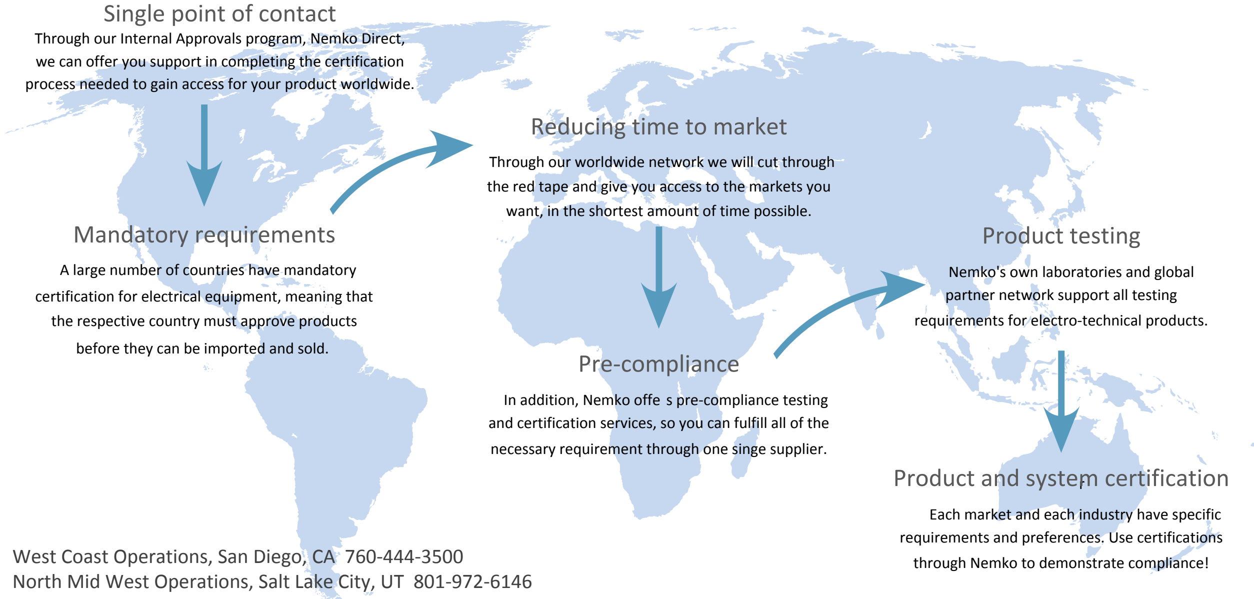

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The measurement time T_m is to be selected longer than the pulse repetition interval of impulsive noise for a correct measurement. If the measurement time is too short pulses are missed, which may result in enormous measurement result errors. In a worst case the measuring receiver may not capture the disturbance signal at all. This is particularly fatal if the segment size has a large width, e.g. 25 MHz or more.

If the pulse repetition interval is unknown, multiple scans with various

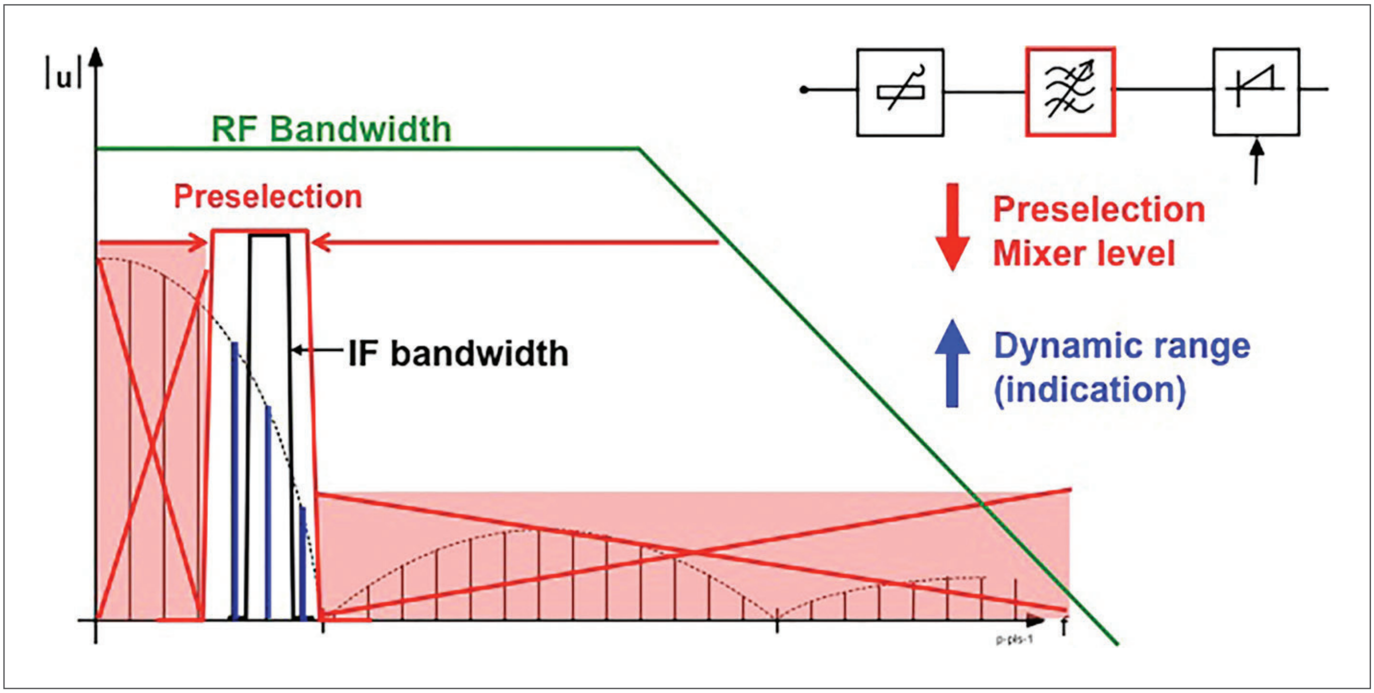

Figure 3: Principle of preselection

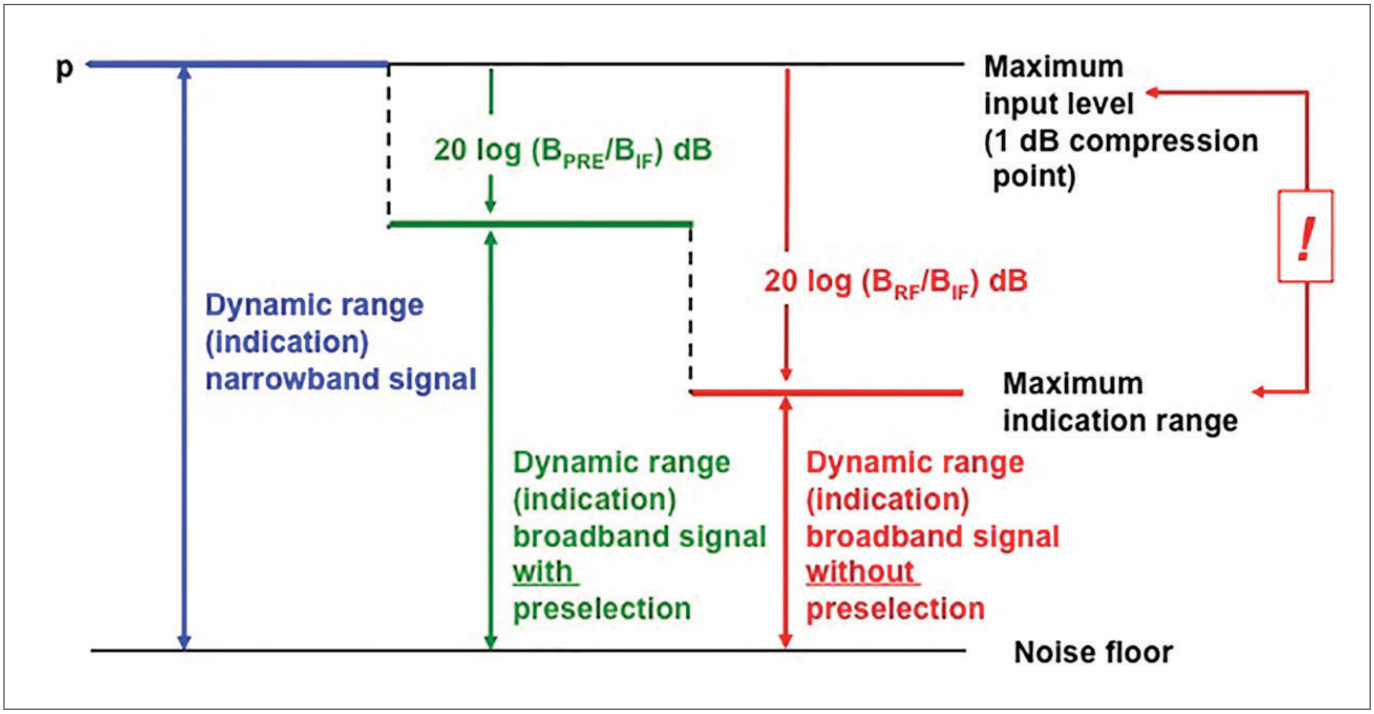

Figure 4: Dynamic range and bandwidth factor

measurement times using a "maximum hold" function are necessary to determine the spectrum envelope. For low repetition impulsive signals, several (e.g. 10 to 50) scans will be necessary to fill up the spectrum envelope of the broadband component. The correct measurement time can also be determined by increasing it until the difference between maximum hold and clear/write displays is below e.g. 2 dB.

Generally the EMI test receiver must be equipped with preselection filters for providing a sufficient dynamic range for quasi-peak measurements of pulse signals with a low pulse repetition frequency (PRF) and particularly to **protect the input circuit of the instrument from overload or damage when measuring weak disturbance signals in the presence of high amplitude signals** or strong broadband signals with a bandwidth that is much wider than the instrument's measurement bandwidth, see Figure 3.

A preselection filter of this type should provide at least 30 dB of attenuation at the frequency of the strong signal. A number of such filters are required to cover the frequency range 9 kHz to 6 GHz.

The dynamic range is limited on the bottom line by the displayed noise level at the requested resolution bandwidth, e.g. 120 kHz in CISPR band 30 MHz to 1000 MHz. The upper limit is the 1 dB compression point of the first mixer. This maximum dynamic range can be used to measure a continuous-wave (CW) signal (narrowband signal) only. If a high level broadband signal is measured, there will be very high levels of distortion products due to nonlinearities of the mixer.

As a consequence, the maximum intermodulation-free input level (maximum indication range) is reduced by the bandwidth factor. See Figure 4.

Example: The bandwidth factor without preselection is about 26 dB using an IF filter bandwidth B_{IF} = 50 MHz and assuming that the bandwidth of the broadband signal is equal to the RF bandwidth of the EMI test receiver B_{RF} = 1 GHz. The bandwidth factor is about 6 dB using a preselection filter with a bandwidth B_{PRE} = 100 MHz, hence **the maximum indication range is 20 dB higher** than without preselection.

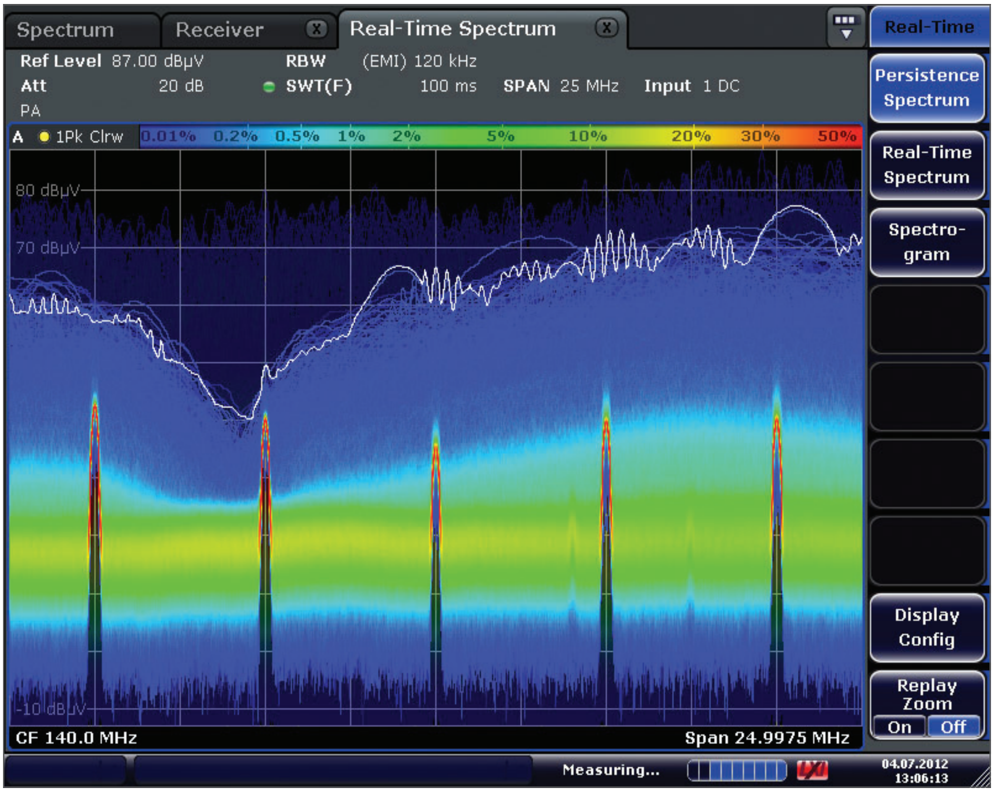

Figure 5: Example of a FFT-based EMI test receiver in persistence mode

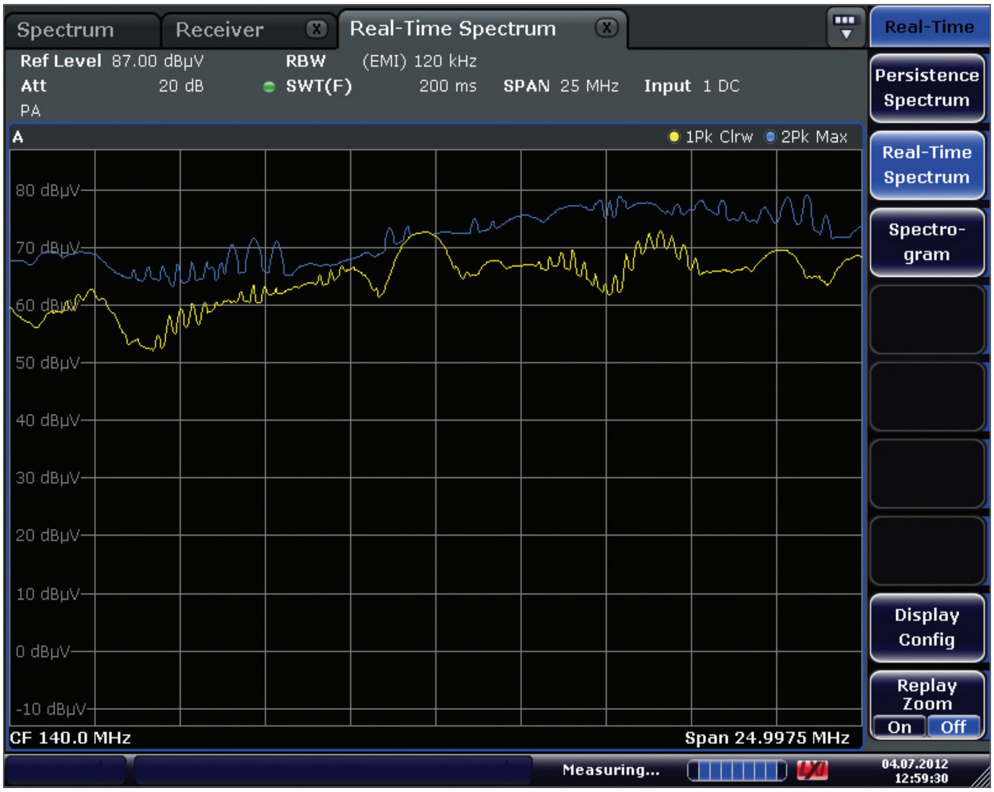

Figure 6: Example of a FFT-based EMI test receiver in real-time spectrum mode. The yellow trace represents the current spectrum, the blue trace Max Hold

MORE SPEED WITH TIME-DOMAIN SCAN AND MORE INSIGHT WITH PERSISTENCE MODE

A new generation of FFT-based EMI test receivers have been developed for CISPR 16 compliant disturbance measurements. Utilizing a FFT-based time-domain scan, the test receivers can deliver measurement speeds up to 6000 times faster than instruments using the traditional single channel filtering approach.

Frequency scans in the CISPR bands using the peak detector can be performed in just a few milliseconds and even with quasi-peak and average detector it takes just seconds which makes preview measurements with peak detector obsolete. The fast measurement speed is particularly useful if the equipment under test can be operated only during a short period of time, e.g. a starter motor in cars. The time saved can also be used for applying longer measurement times in order to reliably detect narrowband intermittent signals or isolated pulses.

In persistence mode, these FFT-based EMI test receivers write the seamless spectra into a single diagram, see Figure 5.

The color of each pixel indicates how often a specific amplitude occurs at a specific frequency. Frequently occurring signals can be shown in red, for example, and sporadic ones in blue. If signals no longer occur at a specific frequency with a specific amplitude, the corresponding pixel disappears after a user-definable persistence period. This allows users to clearly distinguish between pulsed disturbances, which are present only for very brief periods, and continuous disturbances. In addition, different pulsed disturbances can easily be distinguished from one another.

Example: The shown disturbance spectrum in Figure 5 is caused by an electric motor with poor EMI suppression. A second pulsed disturbance is clearly visible, while it cannot be identified in conventional analyzer mode as it is hidden by the broadband disturbance, see Figure 6.

CONCLUSIONS

FFT-based EMI test receivers can be used for EMI compliance measurements in accordance with Amendment 1 to 3rd Edition of CISPR 16-1-1 if this standard is referenced in the product standard or if the reference is undated. Therefore, the users of CISPR 13:2006 (Ed. 4.2), CISPR 15:2013 (Ed. 8.0) and CISPR 32:2012 (Ed. 1.0) can immediately employ a FFT-based measuring instrument for EMI compliance measurements. The users of other standards can use the fast time-domain scan to speed up the time consuming preview measurements.

The use of FFT-based EMI test receivers is motivated by reducing the scan time by several orders of magnitude and to get more insight due to the possibility for applying longer measurement times and enhanced measurement functions like spectrum in persistence mode.

For precise and reproducible measurements the use of preselection filters is highly recommended.

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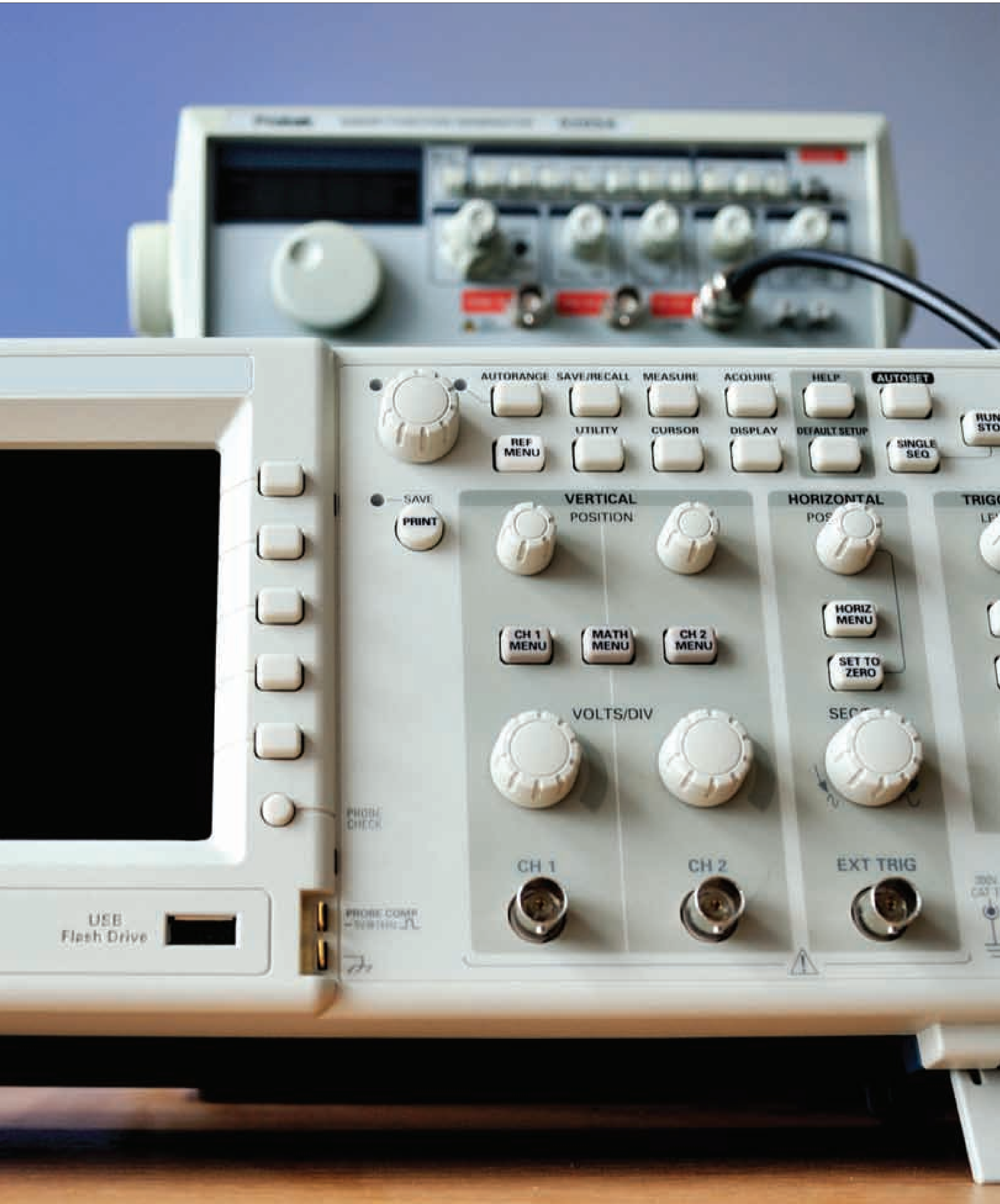
1. Amendment 1:2010-06 to CISPR 16-1-1:2010-01 (Edition 3) Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus
2. Amendment 1:2010-06 to CISPR 16-2-3:2010-04 (Edition 3) Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements

(the author)

JENS MEDLER joined Rohde & Schwarz in 1996. He is responsible for the standardization and application support of EMI test receivers and accessories for both hardware and software and is active member of various CISPR Subcommittees since 1999.

This includes CIS/A on EMC measurement instrumentation and methods, CIS/D on equipment on vehicles and internal combustion engine powered devices and CIS/I on information technology equipment, multimedia equipment and receivers. Since April 2007 he is acting as Secretary of CIS/A WG2; the CISPR Working Group on EMC measurement methods, statistical techniques and uncertainty. He is recipient of the IEC 1906 Award.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Problems That Can Arise in a Working EMC Laboratory, and How Pre-test Verifications Can Help

This article describes some of the everyday issues that can arise in a working EMC test laboratory which may affect the quality of the measurements made and illustrates these with real-life examples that demonstrate the importance of robust pre-test verifications. The main focus is on emissions testing, as this is perhaps the area where most problems can occur without being detected. The article also looks at how using various types of reference source during pre-test verifications can help identify those problems and prevent invalid measurements being made.

BY M. ANSLOW AND D. R. CULLEN

Test laboratories, in particular those accredited to quality standards such as ISO 17025, engage in regular checks to ensure that their equipment and test setups are working correctly. Having been established and proven, the test setup may be altered as individual items are replaced or reconfigured, or where equipment is shared and moved around between tests. The possibility of variation creeping into the results arises through the additional wear and tear on connectors and cables, or if the setup is configured incorrectly, right up to the equipment itself being damaged in transit or through misuse.

Equipment in an EMC test laboratory is calibrated at periodic intervals, typically on an annual basis, although the actual intervals may vary. This confirms that the equipment is operating within its published specifications and also, in the case of non-adjustable items such as cables or antennas, gives a set of values or factors that are necessary to correctly interpret the measurements subsequently made using that equipment. Such calibrations are effectively a snapshot of the equipment's performance, which may degrade over time. The more sophisticated equipment may include self-calibration functions, but these may not be as comprehensive as a full calibration and are unlikely to verify the test system as a whole.

The human factor cannot be overlooked either, for example applying the wrong settings or configuration for a particular test, or applying the wrong correction factors for the equipment used. Laboratory test procedures will aim to minimize the chances of this happening (e.g. checklists) or the likelihood of the wrong results being released (e.g. counter signing), whilst training such as iNARTE, and other proficiency test programs, help promote professionalism and attention to detail, but mistakes can still happen.

These and other influences on the quality of measurement results means there is a need to ensure a degree of confidence in the test environment, the test equipment and the way it is set up before it is used to measure the characteristics of unknown Equipment Under Test (EUT). This can be achieved with regular pre-test verification checks, which already feature in some test standards such as EN 61000-4-3 and Defence Standard 59-411.

EXAMPLES OF PROBLEMS THAT MAY BE ENCOUNTERED IN A TEST LABORATORY

Equipment failure

Like all complex equipment, there is a myriad of problems that may affect the performance of the equipment. RF test environments also face a subtle problem in that they may only exhibit a degraded performance rather than an outright failure mode. In this case, equipment failure may be defined in terms of its expected behaviour, namely some event leading to complete or partial change in equipment characteristics.

Physical damage

As well as potential mechanical problems where physical knocks and other damage may overtly affect the performance of the equipment, RF connections can also exhibit a degraded performance rather than an outright open or short circuit failure mode. RF connectors are also particularly vulnerable where high frequency work pushes the use of ever-shrinking connector sizes. Problems can arise due to the damage caused by snagging a cable and compromising its screen or shield at the connector ferrule, or to parametric errors caused by tightening the connector to the incorrect level of torque. The former can be seen sometimes with external signals leaking into otherwise “sealed” anechoic room signal paths, whilst the latter may manifest as frequency dependant nulls appearing in the system response.

Equipment that is moved around is vulnerable to damage, and the spontaneous and unwanted influence of gravity could earn a chapter on its own.

Electrical damage

In common with most electrical equipment, incorrect power supplies, electrostatic discharges and transient overvoltages can cause a catastrophic failure of the equipment. While this can usually be detected, there are situations where the failure could be overlooked, for example where damage to an amplifier may only result in reduced gain. High-frequency radiated emissions testing often uses a preamplifier in the receive path between the antenna and the receiver, and for best signal-to-noise performance this should be placed in the circuit as close to the antenna as possible. Physically this could mean that the amplifier is situated underneath the ground plane or flooring on which the antenna mast is positioned, and therefore it cannot be seen or easily examined, so a loss in gain of a few dB may go undetected for some time unless the system is tested as a whole and with knowledge of the characteristics of the other equipment in the signal path. For emissions testing this loss of gain would naturally lead to lower signal strengths being recorded during testing. For immunity testing, which operates in a closed-loop system where the E-field is monitored by a frequency insensitive probe, maintaining a fixed field intensity using an amplifier with reduced gain may result in the power being distributed across harmonics of the intended signal. This would have the effect of reducing the field intensity of the intended signal frequency (under-testing) whilst simultaneously exposing the EUT to unwanted threat signals at higher frequencies (over-testing).

Similarly, overloaded inputs and unloaded outputs may also cause partial failure or loss of performance, such as selectively burned-out attenuator banks on analyzer inputs or amplifiers with reduced gain due to soft breakdown of the output drive stage.

Old age or extended “normal” use

Even in the absence of abuse, equipment aging can cause drifting characteristics that may be masked by self-calibration routines. In the immediate term this may invalidate a calibration beyond a relatively short period e.g. performing a self-calibration on power-up, on test equipment that takes several minutes to stabilize. If the rate of long-term drift increases, there may come a point at which the annual recalibration cycle may need to be shortened.

Example equipment failure – mains PSU

In this example, Figure 1 (page 36) shows the output voltage from a 230V 50Hz a.c. power supply used in a EN 61000-3-3 mains flicker test setup. A fault in the power supply stability led to a slow oscillation in the voltage produced that was greater in magnitude than the flicker disturbance being measured. However, because the frequency of oscillation was so low, this only showed up in the test results as an increased D_{max} value and did not translate through to the short-term flicker disturbance value P_{st}.

Repeatability and consistency

The reasonable aim for repeat measurements of the same EUT would

be for them to lie within the stated measurement uncertainty of the test, assuming of course that the EUT is itself stable. Well thought-out and comprehensive test procedures help to improve the repeatability of such measurements by clearly defining parameters that could cause these changes, such as cable layouts, EUT and (if applicable) antenna positions, and these can be supported by physical constraints such as cable guides and winding formers, documentation templates such as checklists and procedural templates such as pre-programmed test routines.

Where there is room for interpretation or ambiguity in the process that could lead to variation in the results, the test setup or procedure may need to be more rigorously defined. For example, adapting a radiated emissions test procedure covering 30 MHz to 1 GHz testing to cover measurements above 1 GHz may need to consider the increased accuracy with which the EUT must be placed in order to achieve consistent results, and that bore-sighting the receive antenna becomes increasingly important. The detail to which such variables need to be commented on is especially important where the test setup is changed, through multipurpose use or regular reconfiguration such as using the same test chamber for performing conducted and radiated emissions and immunity testing on the same EUT.

As well as the effects of damage and aging on test equipment already discussed, the environment poses a threat to the stability of the measurement system. Threats to the infrastructure exist due to weather, temperature variation and proximity to other equipment; EMC test instruments are not exempt from EMC, after all. Test setups using chambers or open test sites inevitably feature some hard-to-see signal cabling that may not be subject to regular checks. Again, aging or wear and tear can affect the integrity of the test environment, a good example being the carbon-loaded foam absorber in a FAR, which is fragile and easily damaged. A few points knocked off in passing may not contribute a significant error, but the effect would clearly be cumulative.

Example test setup problem 1 – Repeatability and consistency

This example is from a fully anechoic room that was used for both radiated emissions and immunity testing, so undergoing occasional changes to the arrangement of support equipment and absorber placement. The room was known to have a more rippled response from around 600 MHz up, compared to a similar room, but what was not known was the cause or whether there was any variability in the magnitude. It was noted that an EMC hardened camera was used during immunity testing, and that a little-used floor level patch panel in the chamber wall at the EUT end of the room had not been covered with ferrite. Moving the camera and covering the patch panel with spare ferrite tiles together could be seen to have an effect of a couple of dBs, enough to raise concerns about

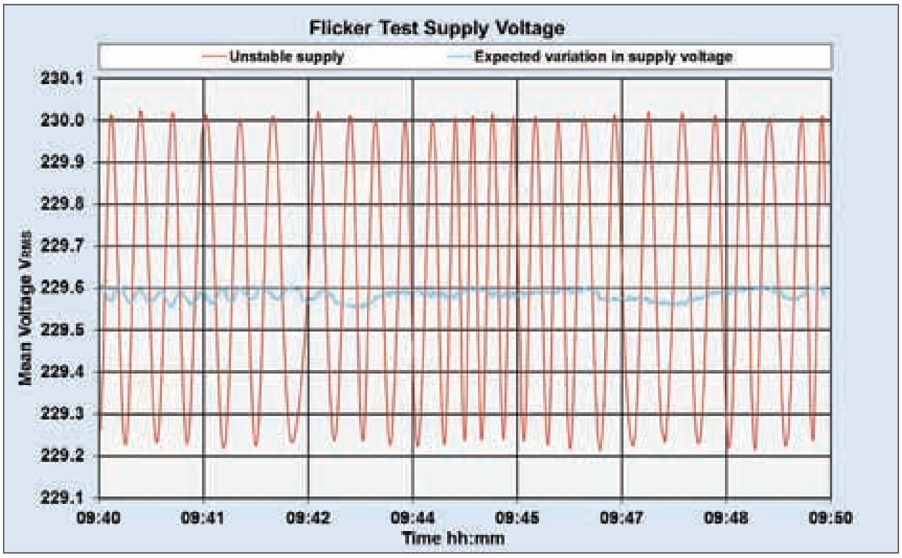

Figure 1: Output voltage from a faulty supply used for mains flicker testing

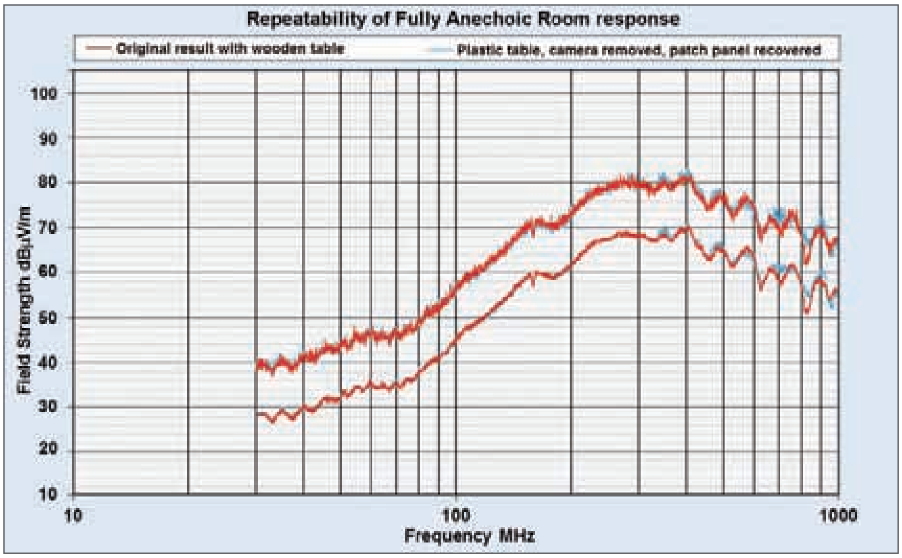

Figure 2: Example of the effect of reconfiguring a Fully Anechoic Room

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the accuracy of the measurement being made where the permissible uncertainty for the overall system is only a few dBs.

The greatest variation was noted when it was found that using a plastic table instead of a wooden one to support the EUT resulted in a reduction of around 3dB in the null at 820 MHz, and now both plastic and wooden tables used in the laboratory have been replaced by low-density polystyrene blocks as required by the latest version of certain test standards.

Example test setup problem 2 - environment

The results in Figure 3 were taken from a radiated emissions test using an Open Area Test Site (OATS). Apart from the ambient transmissions from taxis and mobile phones, radio stations and other broadcasters, the response was expected to be relatively smooth. Ripples in the response were observed at the lower end of the spectrum, which raised concerns and triggered an investigation into the cause. There had been a fair amount of rain the previous day, and a quick search found that a pair of N-type connectors coupling the antenna cable to the underground cable run had become contaminated by water and fine mud particles. Cleaning the connectors made a significant improvement, and they were replaced to be certain of no longer-term issues.

These examples further highlight the fact that problems may result in frequency dependent or otherwise restricted case symptoms, and that it is necessary to exercise as much of the system as possible when making pre-test checks.

Equipment out of calibration

Regular calibration is a key requirement of quality management systems such as ISO 17025 and ISO 9001. When it comes to applying the results to the test operation they give a snapshot of the equipment performance, and consideration of the detail of the calibration is needed, as well as a strategy for monitoring changes that may occur between calibrations.

It is worth considering what is meant by an item of equipment being "out of calibration". To the manufacturer of the equipment it may mean that the equipment is operating outside its acceptable specification. To the user it may also mean that the equipment is operating outside its expected specification or that it has gone beyond its expected calibration period.

For example, a signal generator may have quoted level accuracy of within ±1dB and also level flatness of ±1dB across its frequency range, suggesting a worst case error of ±2dB (with relevant statistical weighting) be fed into the measurement uncertainty budget. However the former might only be calibrated at a single frequency, the latter at a single output level. A comprehensive calibration of the equipment at the factory might check across a range of both settings to ensure that each section of the attenuator bank maintained its value across the

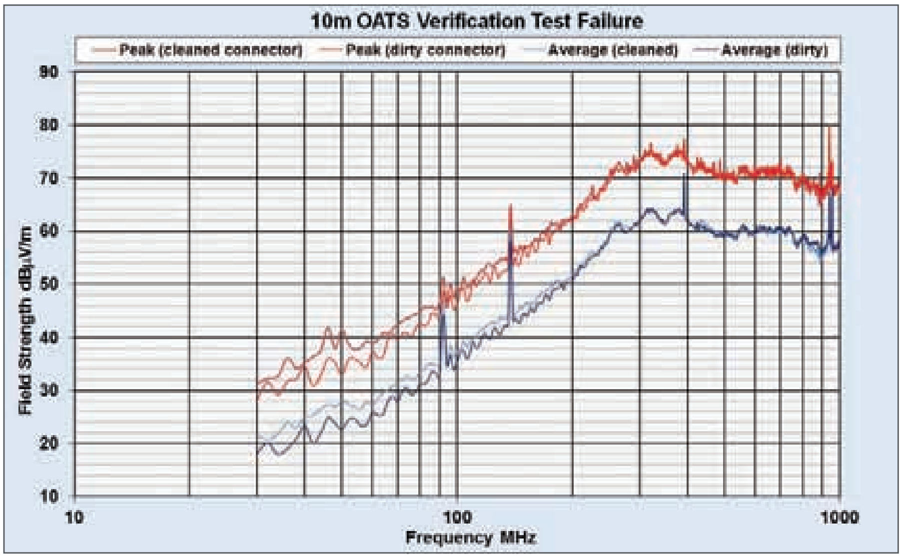

Figure 3: Example of environmental effect on an Open Area Test Site measurement

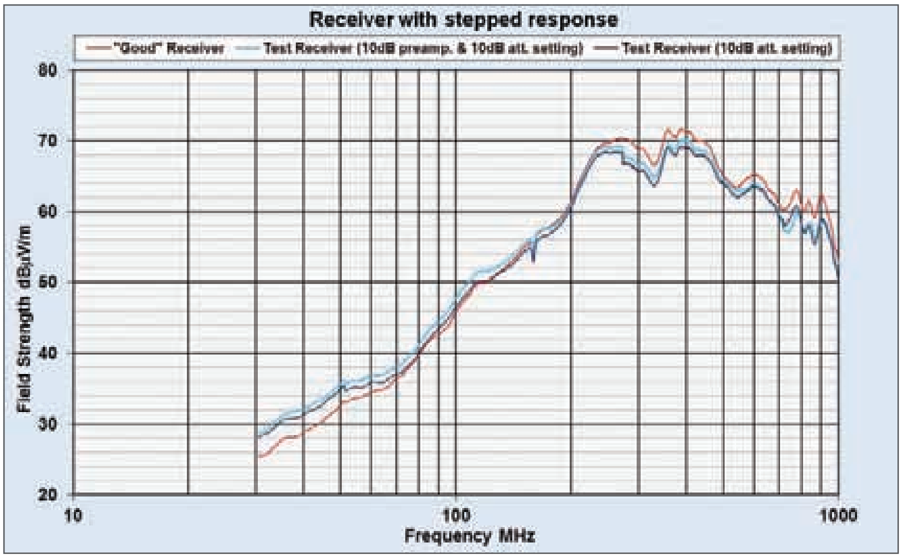

Figure 4: Example of an anomalous receiver response

frequency range. A comprehensive recalibration might repeat this to ensure that a single attenuator bank has not developed a frequency dependent value due to, say, a cracked chip resistor.

Example calibration problem

This example shows the response of two receivers used for emissions measurements in a fully anechoic room.

During pre-test checks using a broadband reference generator, two steps in the response at 275 MHz and 720 MHz, both showing some frequency dependency and giving an accumulated error of up to 4dB at the higher frequencies, could clearly be seen from one of the receivers. The receiver in question was quarantined and sent for recalibration, although no error was found under the recalibration procedure and it was returned with the same response.

In this case, the equipment is reported to be still within the manufacturer's specification, even though it can clearly be seen that different results could be obtained from two calibrated devices beyond what would be acceptable for the budgeted measurement uncertainty. To carry on using the equipment either an "error factor" could be applied in the case of a known, predictable and stable variation or the uncertainty budget increased in the case of known but unpredictable variations.

Operator error

The final problem area to consider here is the human factor. Everyone makes mistakes and in spite of training, experience and competencies mapped under quality management systems the occasional error slips through. These include using the wrong settings or setup for a particular test, or leaving gaps in record-keeping during testing that lead to confusion over which correction factors to apply. Errors become increasingly possible when multi-purpose test equipment is reconfigured, new unfamiliar tests are being introduced (for example >1 GHz testing) or changes to the test standard are not implemented.

Managing the risks associated with measurements can be helped by a robust proficiency testing plan that periodically exercises all aspects of the test system, including the personnel, using blind testing of known artefacts. Inter-laboratory proficiency testing can also help to improve situations where internal consistency does not translate to consistency between different laboratories.

Errors may also be the result of unclear instructions that are open to interpretation or do not sufficiently specify certain criteria. Arguably this is not operator error, but a deficiency in the test procedure or process. It is unfortunately also possible that operator indifference may be the cause, which might be helped through training.

Operator error – example

One example encountered involved a pre-test check on an open area test site that threw up a rippled response similar to that shown in Figure 3. After checking the cables and connectors for water ingress but finding nothing untoward, it was noticed that the ripples were much less noticeable on the vertically polarized test scan. The root cause was then quickly traced to a 1.5 m metal bar used to secure the second, rear-facing doors of the EUT hut, which the operator had forgotten to take off that morning.

VERIFICATION SOURCES FOR PRE-TEST CHECKS

The purpose of pre-test verification

The purpose of a verification test is to reduce the risk of problems such as those described above being overlooked, and thus ensure a degree of confidence in the test environment, the test equipment and the way it is set up before it is used to measure unknown EUT.

A distinction needs to be made between verification tests and calibrations. Calibrations will require absolute values to be known at some point; for example, to calibrate an emissions test setup it will be necessary to be able to compare the measured signal level reported by the test equipment against a known signal level. A typical verification strategy would be to measure the output from a reference source following a full calibration of the test equipment, setup and environment, and then use this as a baseline measurement (with uncertainty budget considered) for subsequent pre-test, daily or weekly checks. This strategy, being a relative test, exploits the absolute accuracy of the initial site calibration and only requires the verification source to be both stable and strong enough to avoid signal-to-noise issues.

An example of this would be in determining the previously shown effect on emissions measurements caused by the table supporting the EUT. CISPR 16-1-4:2010 Section 5.5.2 requires this effect to be considered and describes the process for calculating it. The full calibration procedure uses a signal generator and biconical antenna to produce an E-field both with and without the support table present, and uses the difference to calculate a value to be applied in the measurement uncertainty budget. Once this has been done, subsequent verification checks can be carried out, using a reference generator fitted with a rod antenna mounted horizontally on the table, to give a quick and strong indication of any variation that might occur due to using a different table or altering its position between EUT tests.

Aside from any requirements directly stated in the test standard, to be of benefit to the laboratory the pre-test verification has four main criteria to meet:

- must be accurate to within the order of the test measurement uncertainty
- must be repeatable
- should exercise as much of the complete test setup as possible
- should ideally be quick to perform, to minimize the effective downtime of the test facility

Immunity tests may be considered simpler than emissions testing, simply because the tester is looking for a gross response from a system with a known and quantified stimulus, unlike emissions testing which is looking for a quantifiable response from an unknown stimulus. Electrostatic discharge (ESD) test standard EN 61000-4-2 requires a pre-test verification to be carried out, which involves checking that the ESD generator gun discharges into a spark gap. Fast transient and surge generators can be checked using little more than a digital storage scope to verify that the pulses produced have the correct rise/fall times, magnitude and repetition characteristics. Pre-test verification for radiated immunity tests to EN 61000-4-3 have been discussed previously [*In Compliance*, September 2012] and remain difficult to achieve comprehensively in practice without being significantly simplified. The remainder of this article will therefore focus on emissions test setups.

For emissions testing, substituting the EUT in a test setup with a stable reference signal or disturbance prior to the test proper, addresses these requirements, with the added benefit of minimizing extra setup or reconfiguration time. During verification checks a full or partial test can be carried out depending on the time available, which may only be a few minutes in a busy commercial environment. The results can then be checked against the baseline levels to give a degree of confidence that the setup is functioning normally. The results from these tests should also be saved and used to monitor long term trends in the test system performance or environment, and provide evidence to accreditation authorities that ongoing checks and balances are being performed.

Reference signal sources; a comparison

A reference signal source used for verification purposes should be easy and quick to set up, stable, providing clear indication of the system performance and, ideally, covering the full frequency range of the test under consideration.

Methods for generating stable signals over a wide frequency range include:

- Adjustable signal generators
- Harmonic (comb) generators
- Continuous (statistical white noise) generators

One possible method is to use a calibrated radio frequency signal generator coupled into the measurement system, recording the measured signal at different frequencies. This can provide a very flexible solution, but the signal generator needs to be set up and adjusted. Together with associated cabling this may require significant user (or software) input to provide a working system.

An alternative is to use a purpose-built device. Typically these are broadband signal generators that are designed to have known, stable characteristics, and that generate feature-rich signals (usually comb or noise) in order to exercise as much of the test range as possible at the same time.

The choice between different types of reference signal for verification of radiated or conducted test environments is important from the point of view of checking as many aspects of the setup as possible within the time available. Broadband stochastic noise provides a continuous output throughout the spectrum, which helps to avoid any frequency-related features being overlooked (Figure 5). The random nature of the noise means that it can also be used to distinguish between filter bandwidths and different types of detectors.

Alternatively, comb signal sources provide discrete frequency components that also allow the accuracy of frequency measurements to be checked,

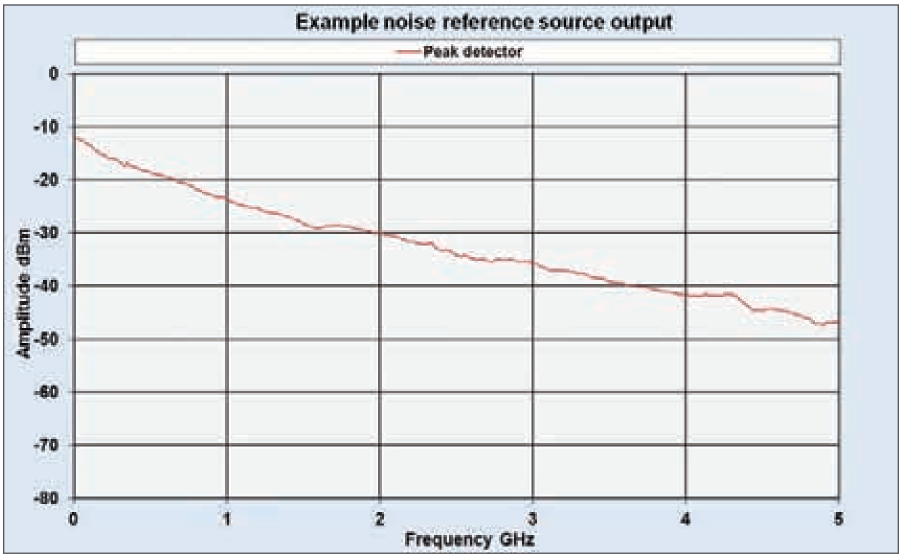

Figure 5: Example noise reference source output

and also provides a greater signal-to-noise separation to be achieved by reducing the measurement bandwidth (Figure 6). Where both noise and comb signals are available, this gives greater flexibility and a broader scope of verification tests than single-function noise or comb types. Some considerations for the use of each type of generator are discussed in the following section.

It is also useful for the reference source to represent characteristics of the EUT, if it is to indicate variations in the test environment that may affect EUT testing. For example, perfect isotropic radiators unaffected by nearby artifacts rarely exist in real equipment. Wooden, plastic or polystyrene supports may in practice be used interchangeably to accommodate different equipment being tested in a FAR or Semi-Anechoic Chamber (SAC), so using a rod antenna laid across the EUT support table or stand will help indicate the difference in any interaction between it and the equipment, cabling or internal circuit traces. Such variations may not always have been fully accounted for in the test's uncertainty budget, although CISPR 16-1-4:2010 now includes a requirement to do so.

Examples of using reference sources

Broadband noise reference signals

A benefit of the noise output is that because the spectral output is continuous, the presence of any features or defects in the system response can be observed across the frequency range of interest without anything being missed. The equipment can also be set to take readings with any step size.

Figure 3 (previous section) shows the benefit of using continuous noise, where the ripples associated with a failed connector on an Open Area Test Site (OATS) are instantly noticeable compared to the previously established baseline response. Even if no previous response had been available for comparison, the rippled response would have been sufficient to cause concern regarding the operation of the OATS.

The graphs below also show another feature of noise, namely that it will produce different readings on an analyzer or receiver depending on the type of detector (Figure 7) and the measurement bandwidth used (Figure 8). This property of noise can be exploited during verification to allow these parameters to be quickly evaluated. As a rule of thumb, a peak detector will give the maximum response, the average detector the lowest, with quasi-peak in between. Knowing this can help defuse some of the confusion that can arise from the different options appearing on a receiver or spectrum analyzer, such as the different averages available to the operator (for example; average voltage detector, average power detector, average of n peak detector sweeps).

Something to consider when using a noise output is that measurements may require averaging over a number

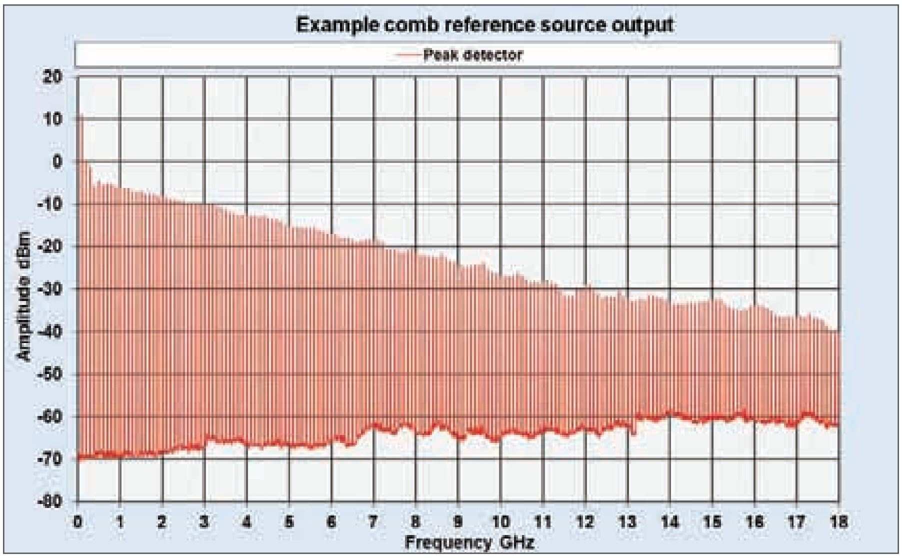

Figure 6: Example comb reference source output

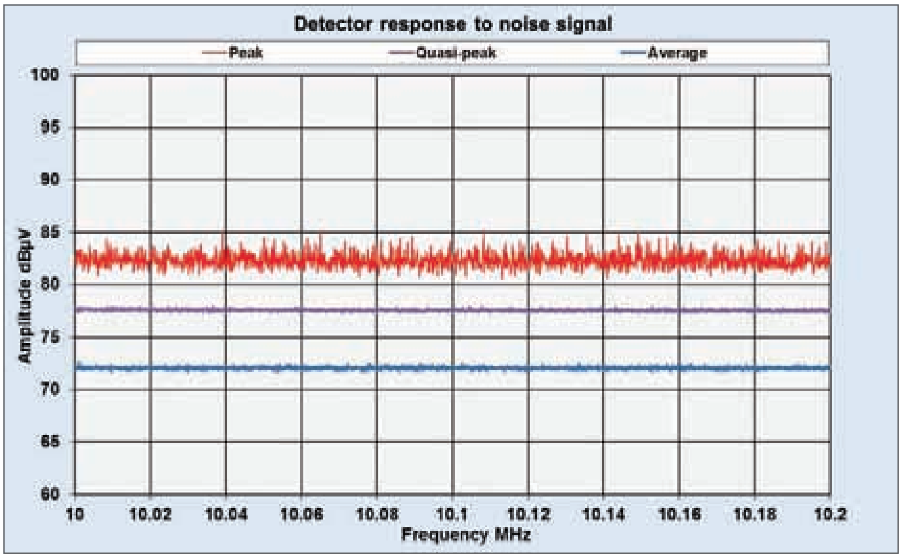

Figure 7: Response of peak, quasi-peak and average detectors to a noise signal

of sweeps and/or video filtering, in order to reduce the "noisiness" of the signal level and thus extract the mean amplitude. Also, the signal-to-noise ratio is unaffected by a change in measurement bandwidth, but is affected by the level of attenuation used. Reducing the measurement bandwidth to increase signal-to-noise separation will not work with a noise signal.

Broadband comb reference signals

Unlike noise, a comb signal is based on a narrow pulse waveform which, when examined in the frequency domain, appears as broadband signal containing the harmonics of the repetition rate of the pulse signal.

The main advantage of using a comb signal is that both ambient noise and signal output can be viewed simultaneously. The output does not require averaging or filtering to determine the signal level and therefore a quick visual check of the level using a peak detector can be made. The energy that is present in the output spectrum is contained within the comb pickets and so the output frequency range is not limited to the same extent as for noise generators, where the spectrum is continuous. This is one reason why wide frequency range devices operating up to many GHz are predominantly harmonic generators.

The measured output level of a comb signal does not vary as much when changing the detector type or resolution bandwidth compared with the noise source, provided this bandwidth contains only one spectral peak, and so the comb signal is less helpful when it comes to verifying detector and bandwidth operation. However, the continuous-wave (CW) nature of the individual pickets in the signal allows both the frequency and amplitude accuracy of the test equipment to be verified, which cannot be achieved using noise.

Because the signal produced has gaps in between the pickets, the noise-floor of the system is visible. Hence, if the measurement bandwidth is decreased, then the signal-to-noise ratio (SNR) is increased (Figure 9). The downside is that if these gaps are too large, sharp resonances or other narrow-band phenomena may not be seen. As can also be seen from Figure 9, a stable CW signal with low residual frequency modulation can also be used to define the shape of the measurement bandwidth filter, which is of value in checking that multiple pole filters are correctly tuned and aligned together.

It is important to note that, when measuring a comb signal, the analyzer step size and start/end frequency must be set to include the relevant harmonic peaks. A comb generator producing signals derived from a commonly available reference oscillator of, say, 64 MHz will produce signals that are harmonics of that frequency, many of which risk being missed by a receiver making spot-frequency measurements every 5 MHz using a narrow measurement bandwidth, as might be used as a pre-test check.

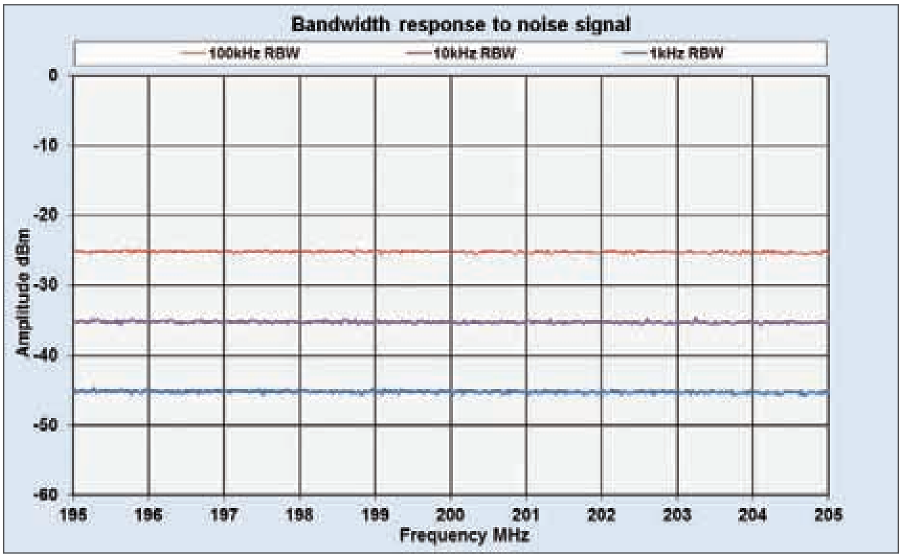

Figure 8: Response of varying measurement bandwidths to a noise signal

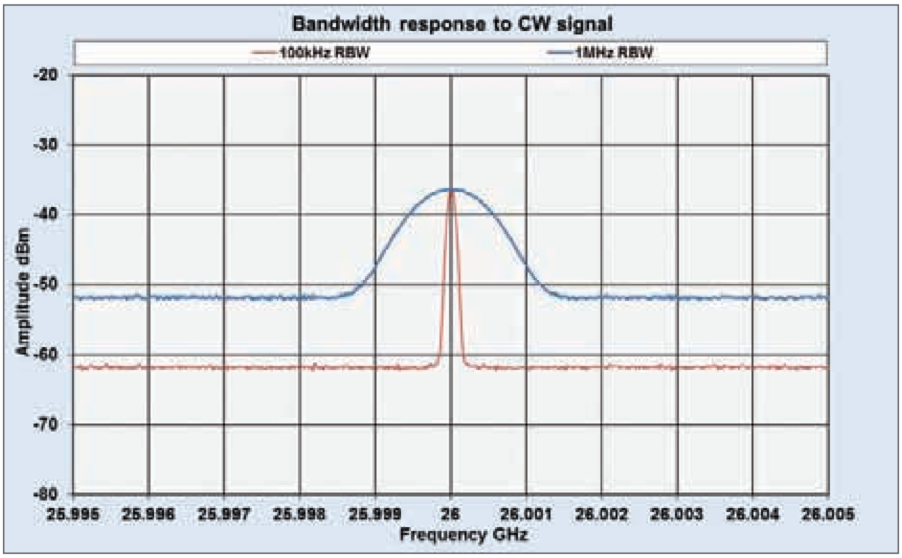

Figure 9: Effect of resolution bandwidth on signal to noise ratio with CW signal

Harmonics and flicker

The reference sources discussed so far are applicable to most common radiated and conducted emissions EMC test environments, but the reasons given for carrying out pre-test verification apply to the other corners of the test laboratory as well.

In addition to measuring the radio frequency interference from the mains power port of an EUT as part of the conducted emissions test, lower frequency distortion of the supply current and voltage may also need to be evaluated. It would also be of benefit to verify the equipment used to carry out mains current harmonic distortion (EN 61000-3-2) and voltage "flicker" (EN 61000-3-3) tests, however fully exercising the measuring equipment is only practical during periodic calibrations.

The availability of proprietary sources for verifying and monitoring the performance of harmonics and flicker measuring equipment is limited, and some pre-test verifications have been performed using homebrew solutions based on half-wave rectifiers and resistive loads to generate harmonic rich load currents. The stability of such resistive loads is called into question when temperature sensitive or non-linear devices are used, such as filament lamps [9]. In addition, half-wave rectifiers generate predominantly even-order harmonics, whereas most mains-powered electronic equipment employs AC to DC voltage conversion, using full-wave rectification to feed a reservoir capacitor, and this topology generates predominantly odd-order harmonics. This may be significant when assessing the results or using the pre-test to exercise any standards-based software used to both run the test setup and automatically assess the performance of the EUT.

For voltage disturbance measurements, the specification of the flickermeter described in EN 61000-4-15 makes it difficult to predict the expected value of flicker from a known waveshape, without extensive calculation and analysis. Hence the verification for this test is probably best left as a simple repeatability exercise using a stable source of disturbance.

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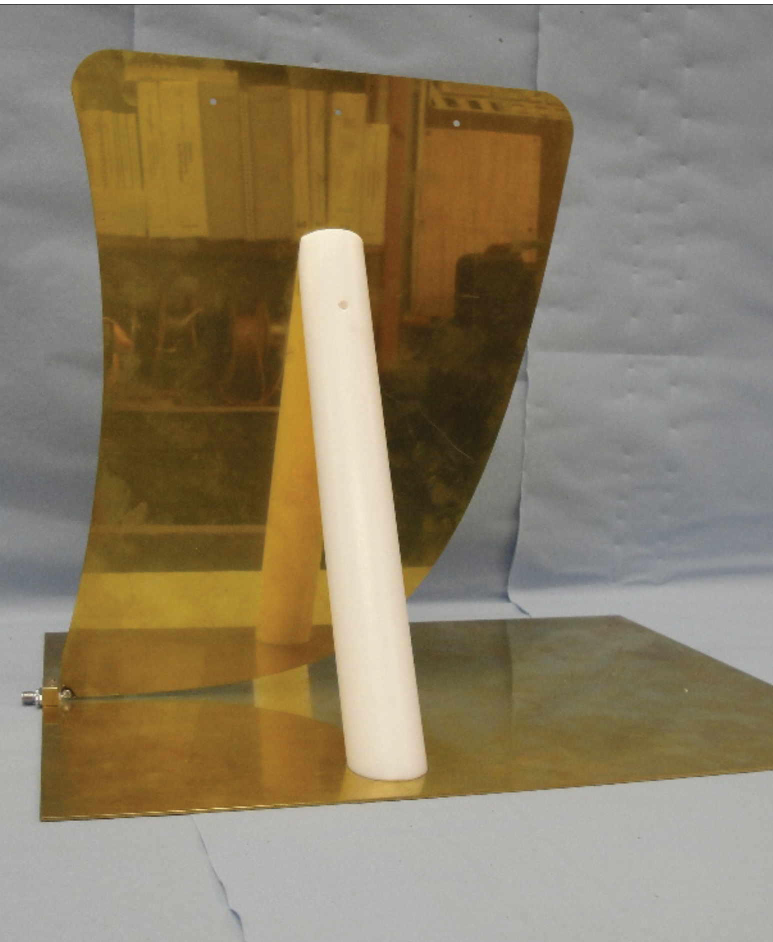

A Wide-band Hybrid Antenna for Use in Reverberation Chambers

This article describes the design and performance of a wide-band hybrid antenna suitable for use in reverberation chambers. The antenna is characterized over the frequency range 100 MHz to 25 GHz showing that it performs well above 200 MHz although its ultimate highest operating frequency has not been established.

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In most cases the antennas used in reverberation chambers are of types that were originally designed for other test environments or other applications. In particular, the radiation pattern of an antenna used in a reverberation chamber is of less importance, since in a well stirred chamber the average antenna pattern tends to isotropic and the vector averaged input reflection coefficient is identical to the free-space value. We therefore consider the ideal antenna to be one with a compact form-factor, which has a low reflection coefficient whilst operating over the full frequency range of a typical chamber.

In this paper we describe a hybrid antenna that operates in the frequency range from 200 MHz to 25 GHz as defined by the magnitude of its input reflection coefficient (S_{11}) being less than 0.316 (-10 dB). The antenna is designed to exhibit high efficiency and can be operated mounted either within the working volume of the chamber or as a wall mounted antenna.

The antenna is a hybrid structure operating at lower frequencies as a broadband monopole and at higher frequencies as an exponential taper or Vivaldi antenna (Vivaldi antenna – a name inspired by the cross-section of a Baroque trumpet and given to the antenna by its inventor Peter Gibson, a keen amateur musician, on the 300th anniversary of the composer Vivaldi's birth in 1978) [1]. The overall dimensions of the antenna described here are 375 mm by 300 mm by 300 mm (LxWxH). The structure could be scaled to accommodate different frequency ranges.

The wideband performance of the antenna ensures that all the advantages associated with such performance, the decrease in test time associated with no antenna changes and the associated improvements to cable and connector reliability, are available.

In this article we present a description of the basic antenna structure along with data illustrating its measured and modelled performance both inside and outside a reverberation chamber.

An image of the hybrid antenna structure is shown in Figure 1. The ground-plane has dimensions of 375 mm by 300 mm. The hybrid monopole-Vivaldi structure has a height of 302 mm and a total width of 250 mm. It is fabricated from 600 µm thick brass sheet. This is fed against the ground-plane through a 50 Ω SMA receptacle visible at the left-hand side of the ground-plane. In order to achieve the maximum operating bandwidth and efficiency, the antenna has no balun. The exponential taper on the monopole -Vivaldi structure is a simple exponential of the form:

$$y = ae^{bx} \qquad (1)$$

Here the scale constants a and b are chosen such that the height, y, is 1 mm where x is zero and y is 300 mm where x is 250 mm. The circular curve of radius 500 mm starting 20 mm directly above the feed point, with a chord of 262 mm shown in Figure 1 is chosen to increase the electrical length of the antenna in its low frequency monopole mode in order to improve the input reflection coefficient at 200 MHz. The top corners are rounded with a 20 mm radius which exactly meets the end of the circular curve on the back edge and intersects the exponential on the front edge.

The dielectric supports of the monopole-Vivaldi structure are made from 30 mm diameter PTFE rod and are placed away from the Vivaldi taper to minimise dielectric loss. Figure 2 shows a close-up view of the feed point of the antenna with the SMA receptacle mounted in the feed block which has a 5 mm square cross-section.

A NUMERICAL MODEL OF THE ANTENNA

In order to verify the operation of the antenna and to allow for subsequent optimization a method-of-moments (MoM) model using the CONCEPT program has been used to examine the surface currents on the antenna and to predict the input reflection coefficient [2].

Figure 1: Photograph of the hybrid antenna structure

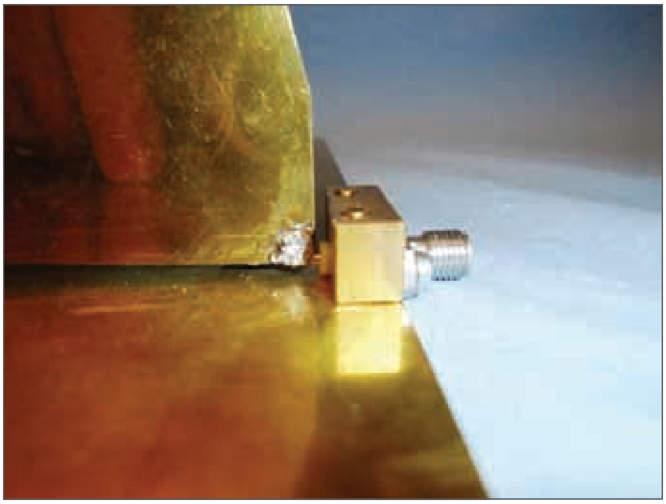

Figure 2: Close-up view of the antenna feed

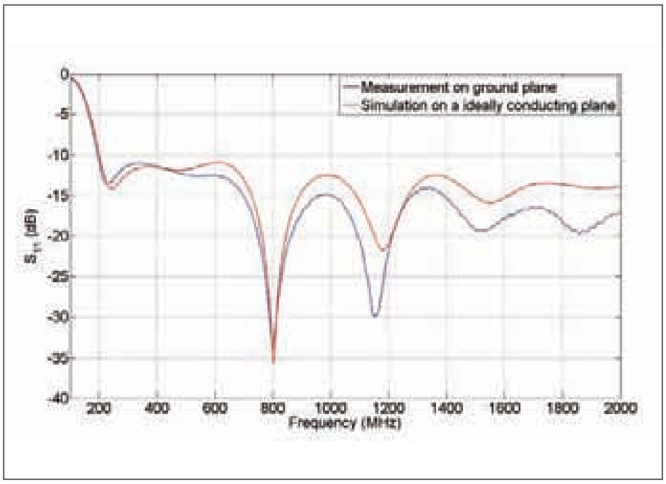

Figure 3: Comparison of measured and modelled input reflection coefficient (S_{11})

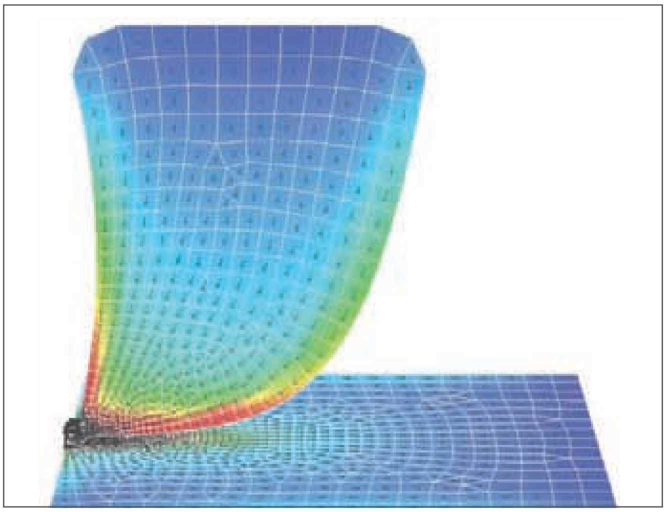

Figure 4: Current distribution at 200 MHz

The structure was modelled using an unstructured quadrilateral mesh generated by the Gmsh program [3]. The global segmentation size was set at about 20 mm in order to produce a mesh that was valid to 2 GHz. The segmentation size around the feed point and edge of the exponential taper was about 1 mm in order to model the rapid current gradients at these locations. The coaxial feed was modelled using a short wire between the end of the taper on the vertical plate and a small closed metallic block representing the SMA connector and its housing. A 50 Ω impedance voltage source was impressed on the end of the source wire adjacent to the block. Convergence of the mesh was verified by reducing both global segmentation size and that near the feed wire.

The input reflection coefficient predicted by the model compared to the measured value, in the frequency range from 100 MHz to 2 GHz, is shown in Figure 3. The antenna was placed on an extended metal ground-plane on an open-area test site (OATS) for this measurement. It is clear from Figure 3 that the model accurately captures the measured antenna input reflection coefficient.

Figure 4 shows the computed current distribution on the antenna at 200 MHz. Here the monopole-Vivaldi structure is operating in its monopole mode. The current density reduces towards the top of the structure and all the phase indicating arrows are in the same direction. Significant current flows up each edge of the structure. Note that in this and subsequent diagrams the colour is indicative of the current density with the spectrum going from red (high) to blue (low). In Figure 5 the current density around the feed block is shown. The source wire is shown in blue.

Figure 6 shows the current distribution at 1 GHz. Here it can be observed that the current is crowded towards the exponential edge of the structure indicating that the antenna is operating in its Vivaldi mode. The phase indicating arrows show regions of phase reversal as would be expected in this mode.

The transition region between the two modes appears well controlled. The key to it is the dominant operation of the Vivaldi mode at the frequency where the monopole would become a half-wave in length. The left-hand edge of the structure shown in the preceding figures has been lengthened by incorporating the curve in order to increase the structure's length. From Figure 3 it can be seen that the quarter-wave resonance in the monopole mode is at 250 MHz, indicating a half-wave response at 500 MHz.

Examination of Figure 7 showing the current distribution at 400 MHz demonstrates that the Vivaldi mode has become established at this frequency, significantly below the half-wave monopole frequency.

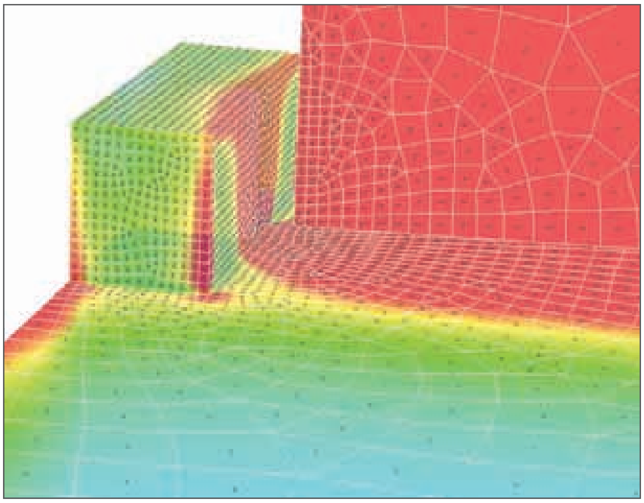

Figure 5: Detail of the current distribution at 200 MHz over the feed block

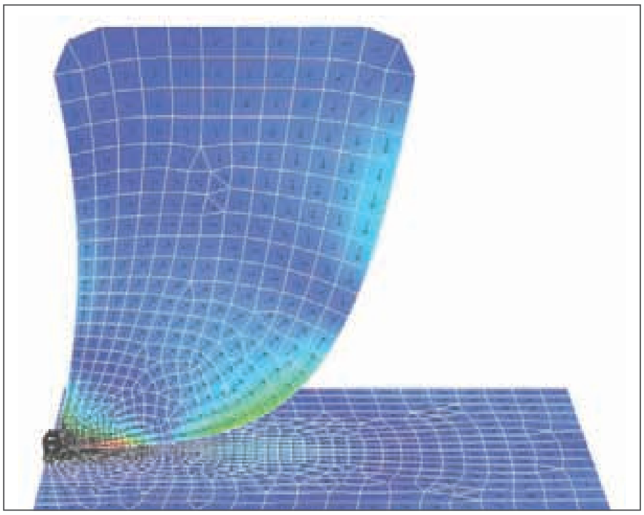

Figure 6: Current distribution at 1 GHz

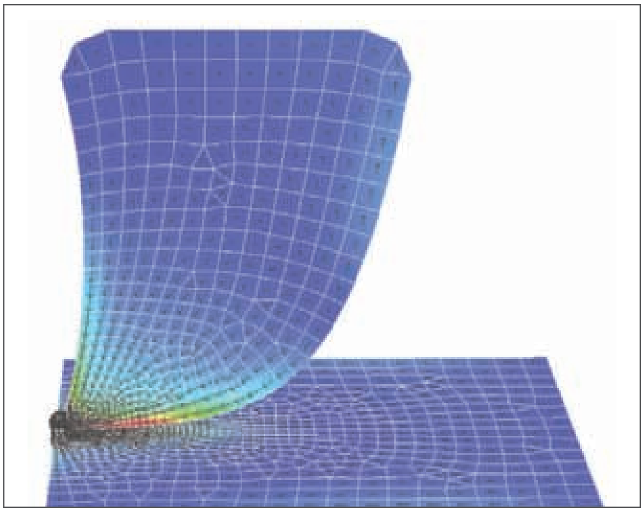

Figure 7: Current distribution at 400 MHz

MEASUREMENTS OF THE ANTENNA'S PERFORMANCE

Figure 8 is an image of the antenna undergoing free-space measurements on the OATS. It is placed on an 800 mm polystyrene block above outdoor pyramidal absorbers. Note the inclusion of the ferrite choke on the feed cable. The graph in Figure 9 shows input reflection coefficient measurements (S_{11}) from 100 MHz to 6 GHz with the choke at three different positions on the cable and with no choke present. These data indicate that the lack of a balun is not significant when the antenna is operated in this manner. Modelling results indicated that the fraction of the total feed current present on the feed cable is typically less than 10 % of the total, with the antenna in free space, which we expect to be the worst-case condition.

Figure 10 shows a comparison of the measured input reflection coefficient in the frequency range from 100 MHz to 1 GHz with the antenna in free-space and placed on the OATS ground-plane. It can be seen that the target reflection coefficient is met from 200 MHz on the ground-plane whilst a usable reflection coefficient (S_{11} of -5 dB) is obtained at 200 MHz when the antenna is operated in free-space.

The data from 1 GHz to 15 GHz are similar in both free-space and on the ground-plane. The full frequency range of the antenna can be seen in Figure 11. These data show the free-space reflection coefficient from 100 MHz to 25 GHz. The measurements from 1 GHz to 25 GHz were made in an

Figure 8: Free space measurement on an OATS

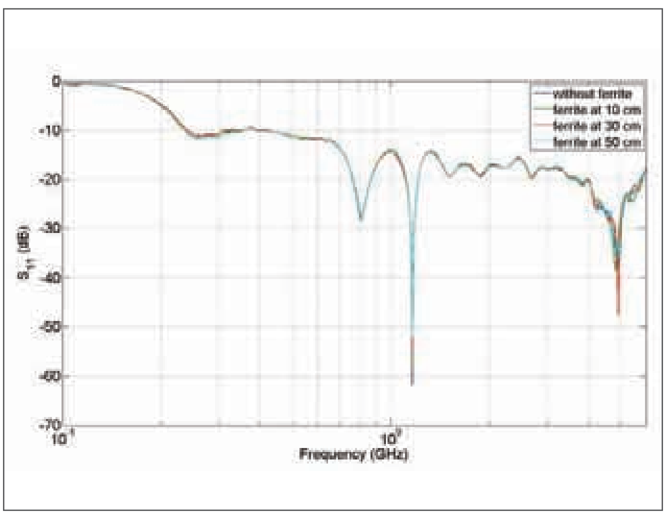

Figure 9: Free space reflection coefficients of the antenna with and without ferrite chokes on the feed cable

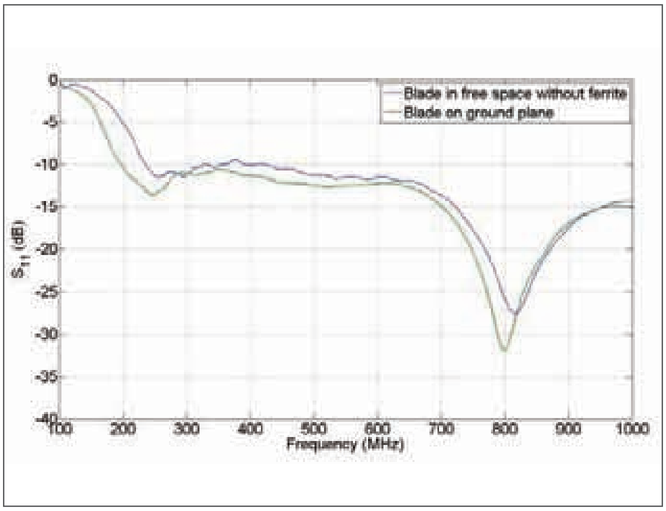

Figure 10: Input reflection coefficient (S_{11}) of the antenna up to 1 GHz

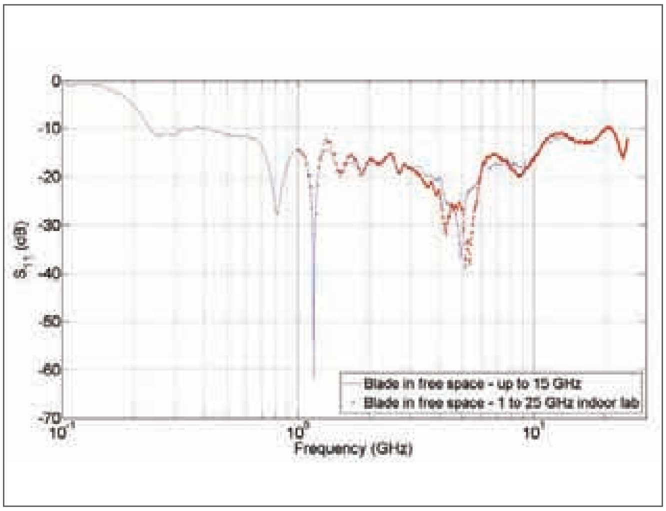

Figure 11: Free-space reflection coefficient (S_{11}) of the antenna from 100 MHz to 25 GHz

indoor laboratory where the higher frequency network analyzer was situated. The antenna was hooded with absorber.

The agreement between the outdoor free-space measurement and the indoor free-space measurement is acceptable and the performance of the antenna is maintained to 25 GHz (S_{11} < 0.316, -10 dB).

REVERBERATION CHAMBER MEASUREMENTS

Figure 12 (top) shows the antenna mounted on polystyrene in a reverberation chamber whilst Figure 12 (bottom) shows it on the floor of the chamber. The reverberation chamber has dimensions 4.8 m × 3.3 m × 2.2 m. The chamber has been demonstrated to have a lowest usable frequency of 200 MHz according to the field uniformity criteria detailed in IEC 61000-4-21.

Input reflection coefficient measurements were made with the antenna in these two locations. The vector average of these measurements over a complete stirrer rotation with 200 stirrer positions was taken and then over a frequency window of 50 MHz (100 data points) to further reduce the statistical variation.

Figure 13 shows the comparison of the free-space input reflection coefficient measurements taken on the OATS and the vector average values taken with the antenna in the reverberation chamber as in Figure 12 (upper).

Figure 14 shows comparable data for the antenna operated in the ground-plane mode both on the OATS and in the reverberation chamber. In both Figure 13 and Figure 14 there is good agreement between the two measurement

Figure 12: The antenna in the reverberation chamber: in the top photograph the antenna is mounted well clear of the chamber wall while in the bottom photograph it is in contact with the floor.

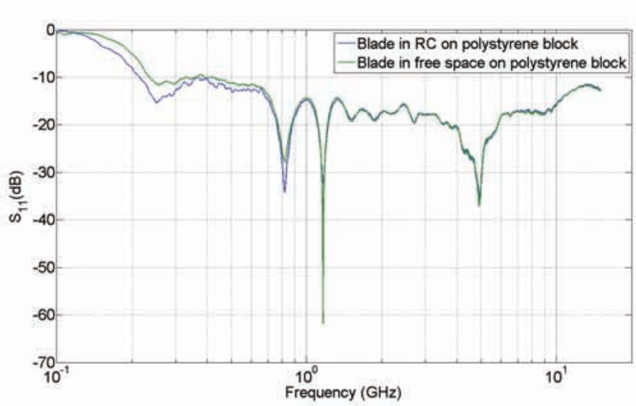

Figure 13: Comparison of input reflection coefficients for free-space mode

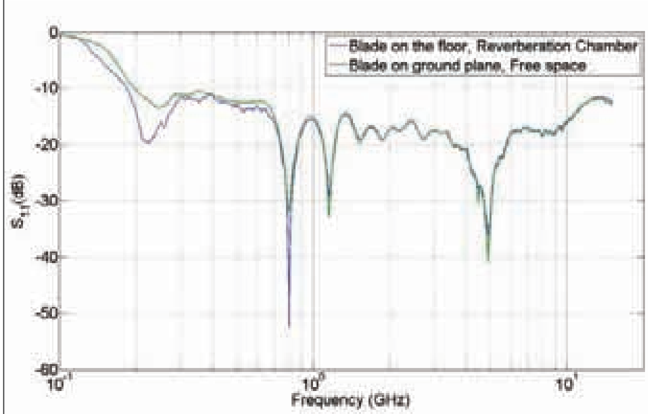

Figure 14: Comparison of input reflection coefficients for ground-plane mode

In this article we have described the structure and performance of a new class of hybrid antenna specifically designed to offer wideband performance, with a low reflection coefficient, in a reverberation chamber, where the shape of the radiation pattern is not important.

environments. This is to be expected as the vector average of the input reflection coefficient in the chamber over one stirrer rotation should be identical to the free-space input reflection coefficient [4].

The moving average function used in the frequency domain reduces the number of points it uses, linearly, towards the ends of the data-set so no averaging occurs at 100 MHz and 15 GHz. At 100 MHz the antenna reflection coefficient is large so this is of little consequence. At 15 GHz the average produced by the 200 stirrer positions is adequate so again the consequence is minimal. The largest difference between the reverberation chamber and free space results occurs between 200 and 400 MHz where the number of independent stirrer positions is expected to be small.

CONCLUSIONS

In this article we have described the structure and performance of a new class of hybrid antenna specifically designed to offer wideband performance, with a low reflection coefficient, in a reverberation chamber, where the shape of the radiation pattern is not important. The antenna structure is such that it should offer a high level of efficiency as care has been taken to ensure that no dielectric material is present in areas where electric fields are at their maximum and no balun is used . The performance of the antenna has been demonstrated both by measurement in a reverberation chamber and in free-space over the frequency range from 200 MHz to 25 GHz and as such the antenna potentially replaces three existing antennas in this application, i.e. a biconical dipole, a log-periodic dipole array and a ridged waveguide horn. The antenna has been shown to operate in two modes. The first is as a broadband monopole from 200 MHz to around 400 MHz. The second is as a Vivaldi style structure from around 400 MHz to 25 GHz. Modelling the antenna using CONCEPT has demonstrated the two mode operation. We are currently undertaking optimization of the antenna structure to further improve its performance and efficiency measurements are as yet incomplete. The current SMA connector feed has been used to allow us to explore the high frequency performance, whilst a larger diameter connector could be used if higher power capability is required.

ACKNOWLEDGMENT

We gratefully acknowledge the assistance of Pratik Deshpande with measurements and the work carried out by students Peter Ludlow and Robert Salmon of the Department of Physics, University of York whose work on earlier Vivaldi antennas provided insight into the new design.

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BUSINESS News

Aeroflex Launches Complete WCDMA Handset Simulator

Aeroflex Limited, a wholly owned subsidiary of Aeroflex Holding Corp., announced that the TM500 Test Mobile family now provides full-stack WCDMA handset simulation capability that is scalable from testing and verifying the performance of small cells right up to multi-handset, multi-cell network capacity performance testing. The new WCDMA handset simulator shares a common platform with the TM500 LTE and LTE-A simulators, and also supports emulation of real data services. For more information, contact your local Aeroflex sales office by visiting or calling Aeroflex Sales at (800) 835-2352 [US], +44 (0)1438 742200 [UK] or info-test@aeroflex.com.

Agilent Technologies Announces RF and Microwave Industry-Ready Student Certification Program

Agilent Technologies Inc. announced the RF and Microwave Industry-Ready Student Certification program, developed in conjunction with the University of South Florida, a founding partner. The program, a collaboration between universities and industry, recognizes students who have demonstrated RF/MW design and measurement expertise. The Agilent RF/MW Industry-Ready Student Certification program uses Agilent EEsof EDA software design tools and instruments. Program requirements are available at www.agilent.com/find/eesof-university.

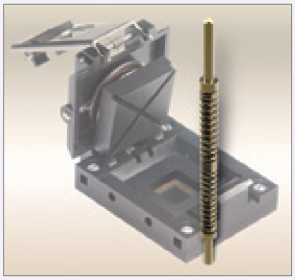
Alliance Memory Releases 2M x 32 and 4M x 32 High-Speed CMOS SDRAMs

Alliance Memory has extended its 64M and 128M lines of high-speed CMOS synchronous DRAMs (SDRAM) with a new 2M x 32 device in the 90-ball 8-mm by 13-mm by 1.2-mm TFBGA package and a 4M x 32 device in the 86-pin 400-mil plastic TSOP II package. The devices released provide reliable drop-in, pin-for-pin compatible replacements for a number of similar solutions in industrial, telecom, and consumer products requiring high memory bandwidth. For more information, visit www.alliancememory.com.

Ametherm Introduces New NTC Thermistor Probe Assemblies With Ring Lugs for Secure Surface Mounting

Ametherm introduced a new series of NTC thermistor probe assemblies with ring lug terminals for high-accuracy temperature sensing and measurement. Completely customizable to meet the specific needs of any application, PANR series devices are available in a variety of housings and lead wire gauges while providing fast response times and up to 4 KV of isolation voltage. For more information or to request a sample, visit www.ametherm.com or call 800-808-2434.

Aries Electronics Announces Probes on 0.2MM Pitch



Aries Electronics has announced its latest addition to its socket spring probe repertoire with new probes capable of contacting devices on 0.2mm pitch. These new probes enable socketing (for test and burn-in applications) for many new device packages and bare-die being designed and made on this pitch. For more detailed specifications, visit www.arieselec.com/products/overview-csp-bga-sockets.htm.

BVM Mobile Announces 1U Ruggedized Rack Mount Server Optimized for In-Vehicle Applications

BVM Mobile, part of the BVM Group, has developed the VRS-100, a low power 1U 19-inch rack mounted server/workstation platform, designed primarily for use in emergency services' vehicles as a mobile control room server or as a platform for a mobile first-responder incident center. The vehicle-optimized 250W PSU operates from 9-30VDC. The VRS-100 draws less than 1.5mA on standby, allowing it to be continuously powered-on. Controlled by the ignition switch or a main system switch the PSU provides intelligent shutdown, crank protection and battery deep discharge prevention, protecting the system from transients and voltage brownouts and the battery from premature damage. For full information, visit www.bvm-mobile.com/ProductDetail.asp?fdProductId=909.

Cree SiC MOSFETs Revolutionize HEV/EV Power Converters

Cree, Inc. announced that Shinry Technologies, a premier high-tech enterprise focused on energy efficient applications in transportation and lighting, employed Cree's 1200V C2M family of SiC MOSFETs in its new, high-efficiency, hybrid electric and electric vehicle (HEV/EV) power converters to achieve industry-leading 96 percent efficiency. According to Shinry Technologies, Cree's C2M SiC MOSFETS also enabled a 25 percent reduction in product size and reduced peak power losses by over 60 percent compared to the traditional silicon versions. For more information, please visit www.cree.com/power or contact a local Cree sales person or distributor.

EM Software & Systems-S.A. (Pty) Ltd announces the release of FEKO Suite 6.3

FEKO Suite 6.3 delivers several new solver features as well as improvements of the user interface. FEKO users can find more detail in the FEKO Suite 6.3 download area or consult the release notes which can be found in the FEKO Suite 6.3 installation directory. FEKO Suite 6.3 is immediately available for existing FEKO customers with active Maintenance & Support contracts. A FREE 45 day evaluation, including technical support, can also be arranged. For more information, visit www.feko.info.

HV TECHNOLOGIES, Inc. Adds EMC Regional Sales Manager

HV TECHNOLOGIES has announced the appointment of Gene Arbogast to their EMC team as an EMC Regional Sales Manager. Arbogast is a veteran US Navy surface warfare officer, special duty cryptologic officer, and engineering electronics subspecialist. Most recently, Gene has been engaged in numerous consulting assignments for federal government clients, including those clients responsible for national security and information technology policy development and coordination. The EMC department can be reached at emcsales@hvtechnologies.com with any questions.

Interpower's New International Power Source for Product Testing

Interpower introduced their new International Power Source (IPS) at the IEEE Symposium on Product Compliance Engineering (ISPCE). The International Power Source is an AC power source that can be used to verify product design and test your products for export. The Interpower International Power Source provides a low-cost, convenient source of AC power at various operating voltages and frequencies found around the world (typically 110-240VAC/50-60Hz) which is important for testing any products that are exported. For more specifications, visit www.interpower.com/ic/products/international-power-source.

Laird Releases New Version of Laird Connection Manager (LCM)

Laird has announced the release a new version of the popular Laird Connection Manager (LCM). Previous versions of LCM (formerly known as Summit Client Utility, or SCU) have been used to configure and manage Laird's Wi-Fi radios on over a million business-critical devices used in the world's most challenging environments. LCM version 4, which is available beginning with 40 Series radio modules, configures and manages both the Wi-Fi (dual-band 802.11n) and Bluetooth (2.1) components of the module. To view the User's Guide for the new version of LCM, visit www.lairdtech.com/Products/Embedded-Wireless-Solutions/Documentation/LCM-Users-Guide.

Telcron Announces Lab Reviews to Offer a Voice on 3rd Party Testing Lab Experiences

Telcron has announced a lab reviews tool for the benefit of electronics manufacturers that are seeking to engage with third party testing labs. The lab review tool on pre-certification and certification testing that manufacturers can use to assign a "good", "better", "best" rating or perhaps "bad", "worse" and "worst" rating if need be, that would help other manufacturers contemplating such lab selection decisions for their equipment in the future. Visit www.telcron.net/lab-reservations/lab-review to find out more and submit reviews.

TÜV Rheinland Opens New Household Appliance Testing Lab in Newtown, CT

TÜV Rheinland has opened a new laboratory in Newtown, Conn., offering manufacturers of electrical and battery-operated household appliances the CB Scheme testing and certification services according to the IEC 60335-1 standard. Products tested will include vacuums; clippers and shavers; kitchen machines such as toasters and blenders; personal care tools for hair and face; battery chargers; pumps; whirlpool baths and spas; and vending machines. For more information about TÜV Rheinland, visit www.tuv.com/us.

Saelig Announces Wireless Transmission Checker

Saelig Company, Inc. has introduced the RF-id SOLO, which quickly and accurately determines the frequency of virtually any wireless transmitter, providing a simple and accurate way to read the frequencies of wireless audio and industrial communications equipment. The compact handheld RF-id SOLO instantly reads both analog and digital wireless single-carrier transmission frequencies from 50MHz to 2.5GHz. Contact Saelig at (585) 385-1750, via email at info@saelig.com or visit www.saelig.com for detailed specifications, free technical assistance, or additional information.

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