

HIGH FREQUENCY

E L E C T R O N I C S

SOFTWARE-DESIGNED INSTRUMENTS REVOLUTION

IN THIS ISSUE:

Statistical Analysis for On-Site RF
Power Measurement

Guest Editorial: MM-Waves, Past,
Present, and Future

Book Review: Controlling Radiated
Emissions

New Products

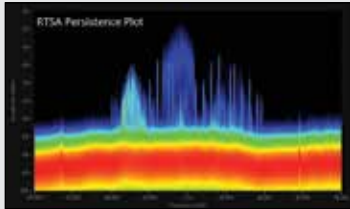
Product Highlights

HIGH FREQUENCY

ELECTRONICS

22

Feature Article



Software-Designed Instrument Revolution

By Bill Driver and Vimal M. Fernandez

Software-designed instrumentation is helping achieve record test-time reductions.

30

Feature Article



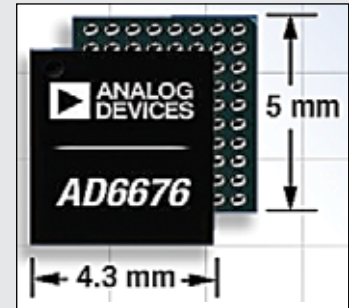
Statistical Analysis for On-Site RF Power Measurement

By Tim Holt

Today's multi-function RF power meter bears little resemblance to the earliest versions.

16

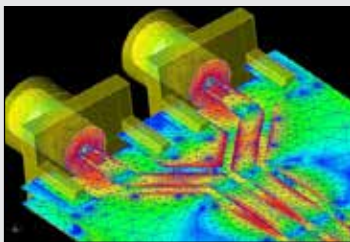
Featured Products



Including Analog Devices, Pulse Electronics, Planar Monolithic Industries, Coilcraft, Rohde & Schwarz.

36

New Products



Featuring Keysight Technologies, OML, SAGE Millimeter, Renaissance Electronics, Anritsu, Hittite.

12

In The News



Highlighting the Terahertz Monolithic Integrated Circuit, AR, dB Control, Custom MMIC, and more.

60

Guest Editorial



SAGE Millimeter CEO Yonghui Shu on the future of millimeter-wave.

6 Editorial

12 In the News

16 Featured Products

8 Meetings & Events

36 New Products

64 Advertiser Index

Millimeter-wave: Its Past, Present and Future



Yonghui Shu
President and CEO
SAGE Millimeter

The millimeter-wave spectrum has many advantages over its lower-frequency microwave counterpart. Widely accepted to comprise 30 to 300 GHz, millimeter-wave offers smaller wavelength and wider bandwidth. Each feature has its own advantages. Small wavelength is attractive to users because it allows more available spectrum; is the choice technology for small components used in missiles, satellites, and aircraft; and has narrower beamwidth that allows greater angular resolution and precision in target tracking and discrimination. Wider bandwidth results in higher data rates in communications systems; higher range resolution and target identification in radar systems; greater sensitivity and resolutions in passive image systems; and higher immunity to jamming and interference.

“Niche” Technology?

Despite all of these advantages, millimeter-wave technology has always been seen as expensive and even unapproachable. The newness of the technology led many to consider the marketplace as “niche.” Traditionally, this frequency spectrum was mainly used for military, aerospace and scientific research programs and equipment. The applications were generally limited to weapon guidance, seekers, radars, military communication equipment, remote control, remote sensing, radiometry, material science and research and development.

However in recent years, technological advances—especially those improvements related to simulation and design tools, semiconductor device performance and consistency and manufacturing methods—have allowed millimeter-wave technology up to 100 GHz, to reach the final stage of maturity. I believe that millimeter-wave technologies are finding **increasing** opportunities in traditional military and aerospace system applications and **explosive** opportunities in commercial applications. Today, the excitement surrounding “internet connectivity,” “safety and security,” “smart homes,” and

“smart clothing” shows that millimeter-wave technologies and products have more commercial and consumer-oriented applications than we have ever experienced. Research and development in the areas of high data rate communications, passive imaging, transportation safety and management systems, automotive ACC radar, security systems, commercial small satellites and test/measurement equipment, etc., confirms that the industry is healthy and growing.

MM-Wave Customer Base Expanding

SAGE Millimeter has empirical data to support these trends. This year, our customer list is not limited to government agencies, defense contractors, large commercial manufacturers, research organizations, and universities; it has also expanded to internet service providers, smart phone and wireless network manufacturers, and semiconductor manufacturers. We know that more development and demand will emerge in the frequency bands of 58 to 64 GHz and 71 to 86 GHz. That’s why we feel that 2015 will be an important year for the millimeter-wave industry as our technology matures and applications become more clearly defined.

Perhaps one of the most promising commercial applications in 2015 and beyond is E-band products for “Last Mile” along with V Band “WiGig” because of how they will liberate users. As we become increasingly inseparable from our smartphones, the demand for faster media streaming and delivery will push the industry to provide solutions. With this technology, users who previously had to rely upon wired connections can now experience the same quality of connectivity with much less infrastructure and cost. The technologies in these frequency bands are becoming more mature, and consumers are pushing for both more cost-effectiveness and higher quality. Meantime, I expect that traditional applications in the area of military and aerospace will benefit from commercial development and will become increasingly robust as we continue to understand how this technology becomes more affordable.

Multi-Disciplinary Coordination

In order to complement these trends, industry leaders, government agencies, and legislators are working together to make this transition a reality. Of course, our

(Continued on page 64)

▶ ADVERTISER INDEX

Company	Page	Company	Page
Advanced Switch Technology	45	Mini-Circuits	2, 3
Aeroflex Inmet.....	1	Mini-Circuits	21
AMCOM.....	26	Mini-Circuits	23
AmpliTech.....	24	Mini-Circuits	31
Avtech	45	Mini-Circuits	37
CEL.....	25	Mini-Circuits	62, 63
Cernex.....	18	Molex	C3
Coilcraft	11	National Instruments	5
C. W. Swift & Associates	C2	Pulsar Microwave	20
C. W. Swift/SRI Connector Gage	29	RelComm Technologies	33
dBm.....	7	RF Bay.....	45
Dudley Lab	45	Richardson RFPD	27
Fairview Microwave.....	15	SAGE Millimeter	13
Herotek	14	Satellink	44
IMS2015	61	Sector Microwave	45
IW Microwave	35	SGMC Microwave	39
Keysight Technologies	17	Skyworks	C4
Keysight Technologies	19	Wenteq Microwave.....	45
Micro Lambda Wireless	9		
Microwave Components.....	41		

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HIGH FREQUENCY DESIGN | Guest Editorial

(Continued from page 60)

industry's challenges have and always will be continued technological advancement and skilled personnel development. On the technology side, our industry is no different from any other—we need to continue to study, innovate, and improve.

Specific goals include developing higher frequency and higher performance semiconductors, designing and implementing better packaging and manufacturing techniques, and reducing cost. The larger challenge that needs to be addressed is the shortage of experienced and next-generation RF and microwave engineers and technicians who are specially trained to address technology, product development and realization challenges.

It was recently reported that the average RF engineer is 51 years old and has worked in the industry for 25 years. This confirms my opinion, published previously, that educational institutions and career-development centers need to collaborate with industry leaders to

design new course works and programs focused on practical skill development. These programs need to mirror those found in other disciplines such as IT, programming, and mechanical engineering. Because our industry is unique and specialized, real attention needs to be given to students so that they can enter the industry with not only a strong foundation in theory, but also the hands-on ability necessary for success.

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