The 8 Most Important Oscillator Parameters

Editorial: Could Wi-Fi Become Obsolete?

Product Highlights

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<table>
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<th>Connector Series</th>
<th>Frequency Range</th>
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<td>1.85mm</td>
<td>DC-65 GHz</td>
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<td>2.92mm</td>
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<td>2.4mm</td>
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22: Feature Article
The 8 Most Important (and Fundamental) Oscillator Parameters
By Jim Holbrook

What is the first thing you think of when selecting electronic components? Chances are it’s the processor or something else central to the system. The timing component may be the last thing on your mind, even though the clock provides the heartbeat on which all signals in the system are dependent.

Selecting these essential timing components may appear to be a straightforward process, but there are a number of factors to consider that affect system performance. So what are the most important specifications and considerations? Here’s a short list of the top oscillator parameters and why they’re important. Of course there are more details to consider, so we’ve created an in-depth glossary that covers a broader range of oscillator characteristics.

The most basic parameter for any oscillator is the frequency. It is the repetition rate (cycle) of the signal output from the oscillator and is measured in Hertz (Hz), i.e. cycles per second. Currently, SiTime’s oscillators are available in frequencies as low as 1 Hz for low-power devices and as high as 725 MHz. The frequency of SiTime’s oscillators is programmable within this range to 6 decimals of accuracy. The use of custom frequencies can optimize system performance. Frequency can be factory programmed, programmed by key distributors, or programmed for lower volumes in the customer’s lab using an oscillator programmer.
Loss is critical in millimeter wave applications, and IW manufactures the range of lowest attenuation/phase stable coax to maintain your signal’s integrity. From K-band to E-band, our family of coax was developed using IW’s proprietary EPTFE lamination process to ensure the lowest cable loss across the mmWave spectrum:

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Operating Freq. (GHz)</th>
<th>Atten. (max) dB/ft. dB/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1801</td>
<td>30</td>
<td>0.49 / 1.62</td>
</tr>
<tr>
<td>1701</td>
<td>38</td>
<td>0.57 / 1.88</td>
</tr>
<tr>
<td>1571</td>
<td>40</td>
<td>0.64 / 2.09</td>
</tr>
<tr>
<td>1501</td>
<td>40</td>
<td>0.75 / 2.46</td>
</tr>
<tr>
<td>1401</td>
<td>50</td>
<td>1.02 / 3.34</td>
</tr>
<tr>
<td>1251</td>
<td>70</td>
<td>2.14 / 7.02</td>
</tr>
<tr>
<td>0471</td>
<td>110</td>
<td>4.95 / 16.23</td>
</tr>
</tbody>
</table>

With a broad selection of interconnects including 3.5mm, 2.92mm, 2.4mm, 1.85mm, SMP and SMPM interfaces, plus jacketing and armoring options, IW Microwave delivers reliable custom cable assembly solutions to suit a diverse range of applications from satellite communications systems to 5G test.

Talk to us or your local representative about how you can get connected at millimeter wave frequencies with the lowest attenuation cable available!


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We’re how the microwave industry gets connected!
There are many claims that 5G will provide adequate coverage both outdoors and within the confines of homes, offices, shopping malls, convention centers, factories, tunnels, and all manner of interior habitats. 5G at 4 gigabits per second (Gbps) is touted to be faster than Wi-Fi IEEE 802.11ac (Wi-Fi 5) at 1.3 Gbps. But IEEE 802.11ax (Wi-Fi 6) might be 9.6 Gbps, faster than 5G.

New Orthogonal Frequency-Division Multiple Access (OFDMA) features are supposed to allow multiple clients to transmit simultaneously, increasing network capacity by up to 4 times greater than 11ac. But practically speaking, will this speed be achievable in most Wi-Fi environments? One “bottleneck” is the existing cabling infrastructure and the speed of the switch port that the access point (AP) is connected to. If, for example the home connection is 300 Mbps, 802.11ax will be of no advantage. So improved APs seem to be an absolute necessity for better Wi-Fi.

Microwaves, both Wi-Fi and from 5G cellular sites, have difficulty penetrating walls, curtains, foliage and other objects. Also, data rates decrease with increasing distance due to lower SNR for a given modulation scheme. Increasing transmit power can help somewhat, with consequences of increased noise, equipment cost, power consumption, and legal limits on Effective Radiated Power (ERP). This is typically 500 watts (+57 dBm) and practically 100 watts (+50 dBm).

Using licensed bands, with heritage business ties to the telephone industry, mobile service providers pay to use the spectrum and require a complex network of connected base stations to provide wide areas over cellular coverage. In order to operate profitably, the providers must serve many customers using multiple channels in a given frequency band. This is the service to which emerging 5G, preceded by 1G, 2G, 3G, 4G LTE, refers.

The other primary means to reach your smart phone, when not so mobile, is Wi-Fi that uses unlicensed spectrum and has its roots in the computer industry. If you can connect in a public place, it is usually free of charge to the user. At home the cost to an internet provider is often bundled with television and landline telephone service, which increasingly comes in many flavors. The router power is quite low -- 100 milliwatts (20 dBm) average. The radio signal tends to be in the house or building. This permits a significant amount of neighboring spectral reuse. So typically, a consumer of internet pays two internet providers, and limits data fees when mobile by using “free” Wi-Fi in stores, hotels, restaurants, medical facilities (sometimes restricted), and increasingly on urban sidewalks.
There is an interesting split between Wi-Fi and 5G in use of frequency bands. Does the average user care about this? No. Many customers are unaware that a smart phone is a radio operating on multiple frequencies. Customers care about fast and affordable internet access from anywhere. The operators/providers are concerned with supplying reliable internet service everywhere with predictable costs and customer satisfaction. The cellular network to Wi-Fi connection off-load or switch-over is becoming more of a gray area.

Historically, telephone service suppliers delivered cellular service to the home or building -- what happens inside is the consumer’s obligation. Also, cellular mobile service requires a subscriber identification module (SIM) card that connects to subscriptions and prevents illegal connectivity. Wi-Fi does not require a SIM card.

Complicating this conundrum of 5G vs. Wi-Fi is the impact of internet of things (IoT). The new Wi-Fi 6 has a distributed concept, or Wi-Fi mesh, that aids in providing good service in every room using multiple routers. But note that 5G seems to promote IoT connectivity. Would this be mostly functional outdoors?

Then there is the FRITZ!Box 6890 LTE made by German company AVM. Having its own SIM card, it uses LTE to provide a permanent hotspot in a selected home. The hotspot, of course, can connect laptops, tablets, game consoles, baby monitors, televisions, thermostats, oven ranges, lighting and anything else that can connect to a Wi-Fi network. To use this practically, it would be best to have unlimited, affordable monthly data charges. Could this be the solution, eliminating Wi-Fi as we know it?

There are other questions, such as having no back-up wired or fiber internet service. Will over-the-air bandwidth be adequate? What are the good and bad implications of millimeter-wave operations and where will it be deployed? What about service interruptions/reliability/redundancy? With increased dependency on the internet, care will have to be taken to avoid lock-out of critical functions that could even mean denied access to your computer, home, garage, or automobile.

Incidentally, I believe we will see invisible antennas printed on sheet rock, floor and ceiling tiles, among other building materials. Roll-out of new capabilities will likely require diligence and care. Will the cell towers win, Wi-Fi dominate -- or will the status quo prevail?
Meetings and Events

2019 IEEE International Symposium on Phased Array System & Technology (PAST)
15 - 18 October 2019, Waltham, Massachusetts, USA
Sponsors: Boston Section; IEEE Aerospace and Electronic Systems Society; IEEE Antennas and Propagation Society; IEEE Microwave Theory and Techniques Society
Field of Interest: Aerospace; Communication, Networking and Broadcast Technologies; Components, Circuits, Devices and Systems; Fields, Waves and Electromagnetics; Geoscience

2019 IEEE BiCMOS and Compound semiconductor Integrated Circuits and Technology Symposium (BCICTS)
3 - 6 November 2019, Nashville, Tennessee, USA
Field of Interest: Components, Circuits, Devices and Systems; Photonics and Electrooptics

2019 CLASTECH
1 November 2019, Proud Bird Events Center, Los Angeles, California, USA
CLASTECH is an annual technical symposium highlighting recent developments in RF and microwave technologies as a joint effort by the local chapters of the IEEE Microwave Theory and Techniques Society (MTT-S) and the Antennas and Propagation Society (APS). Exhibit floor open from 7:30 a.m. to 3:30 p.m.; technical talks from 8:30 a.m. to 3 p.m. http://www.clastech.org/

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Pulsed RF Power Semiconductor Device Markets Will Exceed $300 Million by 2024

Markets for pulsed RF power devices up to 4 GHz will show continued moderate and steady growth over the next five years and exceed US$300 million by 2024, despite current economic and political turmoil. While their association with consumer spending fuels the volatility of many global electronics markets, pulsed RF power device markets are supported by quite different priorities. Pulsed RF power transmitters generate tremendous amounts of power in small bursts that are useful for radar, airborne collision avoidance systems, and military IFF equipment.

“Aampleon, NXP, and Wolfspeed are among the RF power semiconductor manufacturers on a quest to find markets unrelated to mobile wireless infrastructure,” says Lance Wilson, Research Director at ABI Research. “Device prices in wireless infrastructure are flattening out and more profitable areas are being searched for.”

The airborne transportation safety market and military market are both experiencing solid growth in pulsed RF power device shipments. The markets use the devices for military radar, weather and marine applications, and in the current worldwide upgrade of the air traffic control system. The avionics transponder and air navigation market segments are also seeing growth, which is further lifted by the overall worldwide air traffic control upgrade. Intrinsically less “optional” than many consumer markets, these segments are therefore less sensitive to economic upheavals than consumer-driven markets, although they are not totally immune to the macro economy.

There are several vendors who are already focused to varying extents on the pulsed high-power marketplace. These include Integra Technologies, Microsemi, Qorvo, and again Wolfspeed.

Understanding this, several semiconductor manufacturers are attempting to enter this market space, however, some factors may complicate their efforts. Pulsed RF power device markets are becoming very competitive technologically: gallium nitride devices are vying for market share along with the more established silicon and gallium arsenide-based technologies. Many companies are rushing into these markets and all vendors are developing GaN products of some form. Qorvo, Sumitomo Electric Device Innovations, and Wolfspeed are already producing GaN devices in volume. ABI Research speculates that there may not be the market size to support them all.

“Undoubtedly, some consolidation will continue to occur beyond what already has happened,” concludes Wilson. “While not guaranteed success, those companies that have track records working with government agencies and defense contractors will have an advantage over those that are new entrants.”

—ABI Research
abiresearch.com

 Shipments of Bluetooth Powered IoT Devices to Exceed Smartphones by 2024

Projected growth across several areas including the smart home, wearables, beacons, healthcare, smart cities, automotive, and commercial building automation, are beginning to help accelerate Wi-Fi and Bluetooth’s share of shipments transition away from smartphones and consumer electronics toward IoT devices. By 2024, IoT end markets will represent 31% of total Bluetooth and 27% of Wi-Fi device shipments, up from 13% and 10%, respectively, in 2018.

“Bluetooth will continue to grow in other areas, such as speakers, headsets, mobile and PC accessories, and both technologies will continue to push into other consumer electronics devices such as connected toys and home entertainment. However, the IoT is beginning to take an increasingly significant share of the market,” says Andrew Zignani, Principal Analyst, ABI Research.

Key IoT opportunities for Bluetooth will be found within asset management and location services in devices such as beacons and personal trackers. These are anticipated to grow from around 2% of the Bluetooth market in 2018 to over 8.5% by 2024. Bluetooth enabled wearable devices are also expected to break the 400 million device barrier by 2024, with increased traction in smartwatches, activity trackers, smart clothing, and hearables. Wi-Fi-enabled wearables are also expected to reach over 250 million units by this time. The smart home will be one of the quickest growing markets for both Wi-Fi and Bluetooth technologies. Wi-Fi-enabled smart home devices are expected to grow from 5% in 2018 to nearly 16% by 2024 and Bluetooth will rise from 4% to 13% in the same period, with traction in voice-control front ends, smart appliances, smart lighting, sensor devices, video cameras, and others.

—ABI Research
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World’s Most Powerful RF Emulator to Become National Wireless Research Asset

Over the past three years, DARPA’s Spectrum Collaboration Challenge (SC2) has relied on a custom-built virtual testbed called the Colosseum to host thousands of competitive matches and scrimmages, which will include the final match to determine the winner of the $2 million grand prize. Supporting SC2’s mission to reimagine new spectrum access strategies in which radio networks autonomously collaborate to determine how the RF spectrum should be used moment-to-moment required the development of a research environment capable of emulating communication signals at real-world scope and scale.

Working with engineers at John Hopkins University Applied Physics Lab (JHU APL) and National Instruments (NI), DARPA constructed a 256-by-256 RF channel emulator that can calculate and simulate in real-time more than 65,000 channel interactions among 256 wireless devices. This massive emulator is at a scale never before realized – 20x more total RF bandwidth than currently available in commercial systems. To replicate an array of complex RF environments – from open fields to dense cities – that put the competitors’ radio designs through their paces, the Colosseum relies on 128 two-antenna software-defined radios and 64 field programmable gate arrays (FPGAs).

Residing in a 30-foot by 20-foot server room on the campus of JHU APL in Laurel, Maryland, the Colosseum first opened its virtual doors in April 2017. Now in its final year of competition, SC2 is set to host its championship event at MWC19 Los Angeles on October 23. During the event, attendees will have an opportunity to see the Colosseum up close in the MWC19 Los Angeles exhibit hall. The emulator will travel from Laurel to Los Angeles for the three-day event to run the final competitive matches of the competition from the show floor.

Following SC2’s finale, the Colosseum’s work as a research and development testbed will continue under new management. This unique system will transition to its new home at Northeastern University, through the National Science Foundation’s (NSF) Platforms for Advanced Wireless Research (PAWR) program. The PAWR program enables experimental exploration of robust new wireless devices that seek to revolutionize the nation’s wireless ecosystem while sustaining U.S. leadership and economic competitiveness for decades to come.

“NSF’s PAWR program is the perfect partner to carry on the legacy of Colosseum,” said Paul Tilghman, the DARPA program manager leading SC2. “We are thrilled to see the Colosseum live on as a critical testbed for national research and development, providing academic institutions, defense labs, federally funded R&D centers, and industry with a means of exploring at-scale, proof-of-concept ideas to improve current and future generations of wireless technologies.”

The transition of the Colosseum to the PAWR program is part of NSF’s ongoing investment in wireless research, including EARS (Enhancing Access to the Radio Spectrum) and, more recently, SpecEES (Spectrum Efficiency, Energy Efficiency, and Security: Enabling Spectrum for All). Over the last decade, NSF has cumulatively invested more than $150 million in this area.

“This transition will serve as a key stepping stone for an experimenter to gain confidence in their spectrum usage prior to open testing outdoors using the PAWR platforms,” said Thyaga Nandagopal, NSF deputy division director for Computing and Communication Foundations and PAWR program director. “In its new home as part of the PAWR family at Northeastern University, the Colosseum will significantly augment NSF’s ongoing investments to stimulate spectrum research, providing an important resource for the broader wireless research community.”

—DARPA

Reinventing the Network Stack for Compute-Intensive Applications

Computing performance has steadily increased against the trajectory set by Moore’s Law, and networking performance has accelerated at a similar rate. Despite these connected evolutions in network and server technology however, the network stack, starting with the network interface card (NIC) – or the hardware that bridges the network/server boundary – has not kept pace. Today, network interface hardware is hampering data ingest from the network to processing hardware. Additional factors, such as limitations in server memory technologies, mem-
DC to 40 GHz

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In the News

The true bottleneck for processor throughput is the network interface used to connect a machine to an external network, such as an Ethernet, therefore severely limiting a processor’s data ingest capability,” said Dr. Jonathan Smith, a program manager in DARPA’s Information Innovation Office (I2O). “Today, network throughput on state-of-the-art technology is about 10^14 bits per second (bps) and data is processed in aggregate at about 10^14 bps. Current stacks deliver only about 10^10 to 10^11 bps application throughputs.”

Addressing the bottleneck between multiprocessor servers and the network links that interconnect them is increasingly critical for distributed computing. This class of computing requires significant communication between computation nodes. It is also increasingly relied on for advanced applications such as deep neural network training and image classification.

To accelerate distributed applications and close the yawning performance gap, DARPA initiated the Fast Network Interface Cards (FastNICs) program. FastNICs seeks to improve network stack performance by a factor of 100 through the creation of clean-slate networking approaches. Enabling this significant performance gain will require a rework of the entire network stack – from the application layer through the system software layer, down to the hardware.

“There is a lot of expense and complexity involved in building a network stack – from maximizing connections across hardware and software to reworking the application interfaces. Strong commercial incentives focused on cautious incremental technology advances across multiple, independent market silos have dissuaded anyone from addressing the stack as a whole,” said Smith.

To help justify the need for this significant overhaul, the FastNICs programs will select a challenge application and provide it with the hardware support it needs, operating system software, and application interfaces that will enable an overall system acceleration that comes from having faster NICs. Under the program, researchers will work to develop, implement, integrate, and validate novel, clean-slate network subsystems.

Part of FastNICs will focus on developing hardware systems to significantly improve aggregate raw server datapath speed. Within this research area, researchers will design, implement, and demonstrate 10 Tbps network interface hardware using existing or road-mapped hardware interfaces. The hardware solutions must attach to servers via one or more industry-standard interface points, such as I/O buses, multiprocessor interconnection networks, and memory slots, to support the rapid transition of FastNICs technology. “It starts with the hardware; if you cannot get that right, you are stuck. Software can’t make things faster than the physical layer will allow so we have to first change the physical layer,” said Smith.

—DARPA
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Junkosha is launching two interconnects, the MWX3 series and the MWX161. The MWX3 series is designed for high end military communication and radar systems and features characteristics including excellent temperature phase and amplitude stability, meaning it has the strongest properties for use in the harshest of environments. In addition, the new MWX161 interconnect reaches up to the 67 GHz range, and has been designed for connecting to a 16-port VNA. This is due to the small diameter of the interconnect. To add to its ease of connection, a torque driver is available to mount it onto the narrow pitch connector arrangement board.

Typical uses for the MWX161 include multiport VNAs where space between the cables is at a premium; narrow pitch RF matrix switches that route RF signals between multiple inputs and multiple outputs; and multiple connector device under test (DUT) boards which serve as an interface circuit between the automatic test equipment and the device under test.

Junkosha
junkosha-mwx.com

Broadband Conicals

Gowanda Electronics announces an expansion of its conical product line. The new broadband microwave RF conical inductors – C102 & C182 – are available in Surface Mount (SM) and Flying Lead (FL) configurations to enhance utility in the electronics design community, especially for communication applications.

The performance ranges provided by these new wire-wound conical series - C102FL, C102SM, C182FL and C182SM – include inductance from 0.47 µH to 10.7 µH, DCR ohms from 0.19 to 7.10 and current rating mA DC from 150 to 815. All four series have been outgassing tested per ASTM E595 and meet the TML requirement of 1.0% max.

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Design smaller and more efficiently with National Instruments QuickSyn synthesizers. The revolutionary phase-refining technology used in QuickSyn synthesizers enables blazing fast switching speeds, very low spurious and phase noise performance, wide frequency range, and small footprint.

VNA Cal Kit

For vector error correction procedures with your existing vector network analyzers, OML offers precision millimeter waveguide calibration kits with coverage from 50 GHz to 0.5 THz in three configurations: Universal, Standard, and Standard plus Sliding Load (except WR-02.2).

Universal: The VxxCAL is the premium calibration kit that supports the most calibration techniques.

Standard: In contrast, the VxxCAL1, our most economical solution, contains 1 load, 1 short, 1 1/4 wavelength shim, and 1 waveguide section. The Standard calibration kit satisfies TRL, SOLT, SSoLo, and SSoL for one and two port calibrations.

Standard plus Sliding Load: If you prefer a sliding loading calibration (e.g., SSoLs), OML also offers the VxxCAL2 that adds a manually adjustable load to the Standard configuration.

OML
omline.com
**ATC 531Z Broadband Multilayer Capacitors**

*Low Insertion Loss from 16 KHz to 30 GHz*

**Advantages:**
- Broadband Performance
- Low insertion Loss
- Flat Frequency Response
- Excellent Return Loss
- Unit-to-Unit Performance Repeatability
- Rugged Ceramic Construction

**Features:**
- EIA 0201 Case Size
- Capacitance: 100 nF
- Operating Frequency: 16 KHz to 30 GHz
- Insertion Loss: <0.5 dB typ.
- Low Loss X5R Dielectric
- Voltage Rating: 16 WVDC
- Solderable SMT Terminations
- RoHS Compliant

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**531Z Insertion Loss (S21)**

**531Z Return Loss (S11)**
Broadband Horn Antenna
Model SAV-053503140-2F-U5-QR is a quad-ridged, dual polarized broadband horn antenna that operates from 5 to 50 GHz. The antenna offers a typical gain of 11 dBi and a typical 3 dB beamwidth of 40° on both the E-plane and H-plane, respectively. The antenna supports both linear and circular polarized waveforms.

The antenna features a compact design and provides an M3 screw and a mounting plate for flexible mounting capacity. The RF ports are equipped with two female 2.4 mm connectors.

SAGE Millimeter
sagemillimeter.com

ONA: Flexibility, Customization
Anritsu Company introduced the ME7848A Opto-electronic Network Analyzer (ONA) system, a flexible solution integrating the VectorStar® vector network analyzer (VNA) with an O/E calibration detector and E/O converters that conducts cost-effective E/O, O/E and O/O measurements on optical devices operating at 850 nm, 1310 nm, and 1550 nm. Incorporating a modular approach, the ME7848A provides engineers with an unprecedented level of flexibility and the ability to customize the system with their own devices to meet specific test requirements, for significant time and cost benefits.

The ME7848A modular system provides engineers with the ability to design optimal opto-electronic solutions and speed time-to-market by improving first-time yields. In addition to the VectorStar VNA operating up to 40 GHz and 70 GHz, the solution consists of the MN4765B O/E calibration module detector and MN4775A E/O modulator. Because the system is modular, the E/O modulator can be added when necessary, for added cost efficiency.

Anritsu
anritsu.com

See website for complete specifications and our complete line of bias tees.

<table>
<thead>
<tr>
<th>Freq. Range</th>
<th>Isolation (dB) min.</th>
<th>Insertion Loss (dB) max.</th>
<th>Current (mA) max.</th>
<th>VSWR max.</th>
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# MMIC Fixed Equalizers

## DC to 20 GHz

- Absorptive
- 2x2mm QFN and Bare Die

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DC to 6 GHz

DC to 20 GHz
The clock provides the heartbeat on which all signals in the system are dependent.

By Jim Holbrook

What is the first thing you think of when selecting electronic components? Chances are it’s the processor or something else central to the system. The timing component may be the last thing on your mind, even though the clock provides the heartbeat on which all signals in the system are dependent.

Selecting these essential timing components may appear to be a straightforward process, but there are a number of factors to consider that affect system performance. So what are the most important specifications and considerations? Here’s a short list of the top oscillator parameters and why they’re important. Of course there are more details to consider, so we’ve created an in-depth glossary that covers a broader range of oscillator characteristics.

**Frequency**

The most basic parameter for any oscillator is the frequency. It is the repetition rate (cycle) of the signal output from the oscillator and is measured in Hertz (Hz), i.e. cycles per second. Currently, SiTime’s oscillators are available in frequencies as low as 1 Hz for low-power devices and as high as 725 MHz. The frequency of SiTime’s oscillators is programmable within this range to 6 decimals of accuracy. The use of custom frequencies can optimize system performance. Frequency can be factory programmed, programmed by key dis-
tributors, or programmed for lower volumes in the customer's lab using an oscillator programmer.

Frequency Stability

Frequency stability is a fundamental performance specification for oscillators. It is typically expressed in parts per million (ppm) or parts per billion (ppb) which is referenced to the nominal output frequency. It represents the deviation of output frequency from its ideal value due to external conditions; therefore, a smaller stability number means better performance. The definition of external conditions can differ for different oscillator categories, but it usually includes temperature variation and initial offset at 25°C. It may also include frequency aging over time, solder down frequency shift, and may include electrical conditions such as supply voltage variation and output load variation.

Jitter and Phase Noise

Phase noise and its time domain counterpart jitter are often considered the most important characteristics of an oscillator after frequency stability. Phase noise and jitter have a direct impact on system performance, affecting such parameters as bit error ratio (BER) in serial data systems. Phase noise measures clock noise in the frequency domain and jitter measures the noise impact on the clock in the time domain.

Because jitter and phase noise are the main contributors to system timing errors, it's critical to account for this clock noise when evaluating the total timing budget. This is not necessarily a simple matter. Oscillator manufacturers do not all specify jitter in the same way. Jitter requirements vary by application and there are various types of jitter and different integration ranges for integrated phase jitter which is measured in the frequency domain.

To help sort this out, the SiTime glossary includes definitions for cycle-to-cycle (C2C) jitter, integrated phase jitter (IPJ), long-term jitter, period jitter, and phase noise. And the SiTime application note, Clock Jitter Definitions and Measurement Methods, provides even more information. SiTime also offers an online Phase Noise and Jitter Calculator that generates phase noise plots families at specific frequencies. The integrated phase jitter (IPJ) can also be calculated for standard integration ranges as well as user specified integration ranges.
Oscillators

Some specialized oscillators, such as OCXOs are housed in significantly larger packages, often measuring 25.4 x 25.4 mm, and can range from 9.7 x 7.5 mm to 135 x 72 mm.

Output Signal Format

Chipset vendors may specify the required output signal mode for timing chips, or the system designer may have some leeway. Output types fall into two categories: single-ended or differential. Single-ended oscillators are lower cost and easier to implement, but they have limitations. They are somewhat sensitive to board noise and are therefore typically better suited for frequencies below 166 MHz. LVCMOS is the most common single-ended output type which swings rail-to-rail. SiTime also offers NanoDrive™ output, which is similar to LVCMOS, but has programmable output swing down to 200 mV to match the input requirements of the downstream chip, and to minimize power consumption.

Differential signaling is a more expensive option, but it enables better performance and is preferred for higher frequency applications. Since any noise common to both differential traces will be zeroed out, this mode is less sensitive to external noise and it generates lower levels of jitter and EMI. The most commonly used differential signal types are LVPECL, LVDS, and HCSL.

Supply Voltage

Supply voltage, specified in volts (V), is the input power required to operate the oscillator. Supply voltage powers the oscillator through the VDD pin and is sometimes referred to as VDD. Standard voltages for single-ended oscillators include 1.8, 2.5, and 3.3V. Voltages for modern differential oscillators typically range between 2.5 and 3.3V. SiTime offers oscillators that operate as low as 1.2V for regulated supply applications such as coin-cell or super-cap battery backup. The supply voltage of most SiTime oscillator families is programmable, which reduces the need for external components such as level translators or voltage regulators.

Supply Current

Supply current is the maximum operating current of an oscillator. It is measured in microamps (µA) or milliamps (mA) at the maximum and sometimes nominal supply voltage. Typical supply current is measured without load.
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Operating Temperature

The operating temperature range specifies the ambient temperature under which the device is expected to operate, and meet the datasheet specifications. Common temperature ranges are listed below.

- Commercial, Automotive Grade 4: 0°C to 70°C
- Extended Commercial: -20°C to 70°C
- Industrial, Automotive Grade 3: -40°C to 85°C
- Extended Industrial, Automotive Grade 2: -40°C to 105°C
- Automotive Grade 1: -40°C to 125°C
- Military: -55°C to 125°C
- Automotive Grade 0: -40°C to 150°C

Packages

Oscillators are usually housed in metal, ceramic, or plastic packages. And they’re available in a variety of industry-standard package dimensions. The pad (pin) arrangements may vary among vendors, but the overall x-y dimensions are standardized. Here’s a list of common oscillator package sizes for single-ended oscillators, which usually have 4 pins. Differential oscillators, which have 6 pins, are typically available in the larger packages: 3225, 5032, and 7050.

- 2016: 2.0 x 1.6 mm
- 2520: 2.5 x 2.0 mm
- 3225: 3.2 x 2.5 mm
- 5032: 5.0 x 3.2 mm
- 7050: 7.0 x 5.0 mm

Some specialized oscillators, such as OCXOs are housed in significantly larger packages, often measuring 25.4 x 25.4 mm, and can range from 9.7 x 7.5 mm to 135 x 72 mm.

In addition to these standard package sizes, SiTime offers a few unique packages to solve difficult design challenges. One is a tiny 1508 (1.5 mm x 0.8 mm) chip-scale package (CSP), which is the smallest oscillator package available. Another option is a leaded SOT23-5 package for applications that require higher board-level reliability and easier visual inspection during board assembly.

Other Parameters

The eight parameters listed above are the most common factors used when selecting an oscillator. But depending on the application, there can be many more characteristics and features that are important to consider. These include EMI reduction features, pull range options for fine-tuning frequency, start-up time, and quality/reliability (Q, DPPM, MTBF, FIT rate).

And for high-performance applications, there are a number of additional stability-related specifications to consider beyond basic frequency stability. These include aging, frequency vs temperature slope (ΔF/ΔT), thermal hysteresis, Allan deviation, Hadamard variance, holdover, and retrace.

To learn about these parameters and more, see the SiTime glossary – one of the most extensive oscillator definition guides available.

About the Author

Jim Holbrook serves as Director, Customer Engineering, at SiTime.
The future holds unforeseen challenges. Lowest latency communications can help overcome the toughest challenges. Analog Devices’ system-level expertise in RF, microwave and millimeter wave technology helps unlock the entire wireless spectrum, and the opportunities that come with it. Learn more at analog.com/RF.

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Engineering Design Kits for the 0505C/P and 1111C/P cases sizes are available in magnetic and non-magnetic terminations. For other case sizes, samples are available. Please contact PPI directly.

For case sizes available in microstrip, axial and radial ribbon, and axial and radial wire leads, please contact PPI directly. PPI is a manufacturer of high-performance RF/Microwave passive components for the Medical, Semiconductor, Military, Broadcast, and Telecommunications industries.

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Logus Microwave
logus.com
MeasureWare Revolutionizes Precision Measurement

Analog Devices announced the release of MeasureWare, a plug and play suite of hardware measurement kits and software studio tools to help fulfill the growing need for precision measurement across multiple industries including precision agriculture, machine health monitoring, electrochemistry and other areas requiring precise measurement. The introduction of MeasureWare marries ADI’s electronic engineering experience with those who require real-time data insights yet may lack the time or expertise to digest corresponding datasheets or do complex firmware development.

MeasureWare solutions are built to interface devices with the world around them, allowing users to more effectively measure the datasets necessary to their respective projects, such as temperature, weight, humidity, pH, pressure, etc. MeasureWare also offers flexibility to adjust and change measurement parameters as a project evolves. These solutions are currently being applied across such diverse applications as bee health monitoring, industrial monitoring, beverage production and cold chain for medication.

Analog Devices
analog.com

Benchtop YIG Synthesizers

Micro Lambda Wireless has increased the offerings for its high-performance, low phase noise benchtop frequency synthesizers. In sync with its evolving catalog of YIG synthesizer components, the custom-tuned benchtop YIG synthesizer line now offers RF and microwave designers working at frequencies up to 20 GHz the chance to upgrade their test benches with the best technology at their specific bands.

Offering up to -125 dBc/Hz @ 10 kHz offset phase noise at a carrier frequency of 10 GHz, these frequency synthesizers set the standard for phase noise performance. They are also capable of tuning speeds up to 50 uS over wide bands, and offer output power levels of +15 dBm, with power leveling in frequency bands up to 10 GHz.

Micro Lambda Wireless
microlambdawireless.com
Broadband Conicals

Gowanda Electronics expanded its broadband conical product line. The new broadband microwave RF conical inductors – C102 & C182 – are available in Surface Mount (SM) and Flying Lead (FL) configurations to enhance utility in the electronics design community.

Gowanda’s new series were developed to address market needs and industry trends calling for ever-increasing performance from broadband conical components. They are designed for use in communication applications for bias T’s (filter signals, remove noise), broadband chip manufacturing, communication platforms, high frequency, microwave circuitry, RF test set-ups, test & measurement, test gear, test instrumentation and transmission amplifiers.

Gowanda Electronics
gowanda.com

17 - 40 GHz Block Up and Down Converters

Norden Millimeter’s next generation of broader band block up and down converters is used for extending the frequency range of existing ELINT, COMINT, RADAR, and Testing systems. These new converters cover the 17-26.5 GHz and 25.5-40 GHz bands with a full 1 GHz overlap with existing 18GHz systems and at the transition between bands.

The upconverter has independent input IF and output RF attenuation for over 60 dB of gain control. These attenuators are controlled by parallel attenuation bits on a rear power/control multi-pin connector. Both converters offer best in class spur free dynamic range.

The units use a single frequency external LO signal of 14.4 GHz.

Norden Millimeter
nordengroup.com
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Power Divider

PMI Model No. APD-8-100M-28V is an Amplified 8-Way Power Divider that operates at the frequency range of 100 MHz. This model has a typical output port to port isolation of 25 dB and a maximum insertion loss of 4 ± 1.5 dB. Other specifications VSWR In/Out: 2:1 Max; Noise Figure: 9 dB Max; Input Power P1dB: +13 dBm Typ. - Measured +14.5 dBm; Input Power: +20 dBm Max. (Survival); Output Port to Port Isolation: 25 dB Typ. - Measured 33 dB and Power Supply: +28 V @ +750 mA Max. - Measured 172 mA. It is outfitted with SMA female connectors in a housing measuring 4.00” x 2.00” x 0.55”.

Planar Monolithics Industries
pmi-rf.com

Ka-Band Amplifier MMICs

Custom MMIC introduced two new Ka-band amplifier MMICs to its growing portfolio of higher frequency packaged products. Both the CMD242K4 (Distributed Amplifier) and CMD299K4 (Low Noise Amplifier) operate up to 40 GHz while being packaged in a small 4x4 mm air-cavity QFN plastic package designed for surface mount applications. This new “K” series designation signifies a new high frequency plastic package being utilized by Custom MMIC for 20 GHz and above products demanded by aerospace, defense and instrumentation customers.

Custom MMIC
custommmic.com
Continuing Education: Your Key to Success

Studies reveal that within each 3-5 year period, one-half of an engineer’s technical knowledge becomes obsolete. New graduates soon discover that university education provides only the foundation of knowledge that is realistically needed to perform well in the industry. Continued education is a must for survival in today's competitive market. Application of modern computer-aided engineering to RF and microwave circuit and system design is vital to manufacturing products with high quality and yield. Modernization of the design laboratory and production floor is critical to maintaining a competitive edge.

A well-planned continuing education program will enable your company to meet these goals. As a recognized international leader in continuing education, Besser Associates is dedicated to serving the needs of RF and wireless professionals.

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Our Instructors

Besser Associates instructors are recognized experts in their field. They are top-notch design engineers, skilled in both technology and the art of instructing. With an average of more than 20 years of education and practical first-hand experience, our instructors bring a wealth of training and information to the courses they present. Equally important, our trainers communicate effectively; they know how to reach both novice and veteran professionals.

Besser Associates
besserassociates.com
E-Book: MW and RF Design

The Third Edition of Microwave and RF Design (A Multi-Volume Set), authored by Professor Michael Steer of North Carolina State University, is a comprehensive free OpenAccess electronic textbook focusing on RF systems design. It is intended for advanced undergraduate and graduate students, as well as professionals. The textbook covers microwave components, as well as how they fit into modern radio, radar, and sensor systems. It enables the student to achieve a good understanding of how system-level decisions affect component and subsystem design and how the capabilities of technologies, components, and subsystems impact system design.

NI AWR

RF and Microwave Components

Herotek has been a quality supplier of RF and Microwave components since 1982. Herotek is a broad-based, high technology company supplying parts for the Military, Industrial and Commercial markets with designs from DC to 75 GHz. It offers standard products as well as thousands of custom designs, and is happy to match existing products. Herotek offers Detectors, Comb Generators, Limiters, Switches, GaAsFet Amplifiers (Broadband, Low Noise, and Power) and integrated subsystems of many types, including up and down converters, multipliers, harmonic mixers, and transceivers.

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Product Highlights

Multi-Unit Testbed for Emulating RF Environments

The first compact, modular, isolated system for testing wireless devices without an anechoic chamber.

Companies involved in designing and building products and systems for wireless protocols are all too familiar with the problem of economically testing their electronics in a repeatable RF environment. Open air testing is time consuming and unreliable. Repeat visits to third-party test facilities can cause scheduling delays and high costs.

With the Multi-Unit Testbed, manufacturers of wireless products for 5G cellular networks and handsets, Wi-Fi, Bluetooth, Zigbee and other wireless protocols can lower test costs by as much as 90%, vs. third-party testing. Other applications include: robotics, tele-medicine, military communications and drones.

An Equipto innovation for manufacturers of wireless technology

MULTI-UNIT TESTBED (MUT) FOR EMULATING RF ENVIRONMENTS!

First modular, isolated system for testing wireless devices without an anechoic chamber.

With the MUT, manufacturers of wireless products for 5G cellular networks and handsets, Wi-Fi, Bluetooth, Zigbee and other wireless protocols can lower test costs by as much as 90%, vs. third-party testing. Other applications include: robotics, tele-medicine, military communications and drones.

This “MUT” is a thoroughbred!

- Based on the proven technology of Equipto that exceeds requirements of toughest TEMPEST MIL standards
- Controllable wireless testbed emulates RF environments
- Compact, modular design adapts to test requirements
- Completely blocks outside signals and isolates internal tests
- Eliminates time consuming open-air testing
- Custom-sized and configured to individual requirements
- 120dB shielding up to 6 GHz, 100dB deep into microwave
- Provides the confidence you need for certification success

High Power RF Amp

Aethercomm Model Number SSPA 0.001-1.000-500-RM is a high power, rack mounted, RF amplifier that operates from 1 MHz to 1000 MHz minimum and is packaged in a rugged, rack mounted enclosure. Peak output power is up to 500 watts at P3dB. watts across the band at saturation. Standard features include automatic level control (ALC), and a touch screen for monitoring and control. This broadband RF amplifier rack mounted system operates from a +208 Vac single phase. This broadband unit operates in a laboratory environment. A thermal management system is designed and included in each rack to ensure high reliability.

Aethercomm
aethercomm.com
VNA Extension Modules
OML offers three configurations of the VNA Frequency Extension Module to expand your existing Keysight or Anritsu vector network analyzer to millimeter frequencies: T/R, T, and S. Depending on your S-parameter needs, refer to the following block diagrams to configure our module(s) with your existing VNA test port(s). With flexible ordering configurations, we can satisfy your preferences for economical and high performance needs.

OML
omlinc.com

mmWave Solution
Analog Devices introduced a solution for millimeter wave (mmWave) 5G with the highest available level of integration to reduce design requirements and complexity in the next generation of cellular network infrastructure. The new mmWave 5G chipset includes the 16-channel ADMV4821 dual/single polarization beamformer IC, 16-channel ADMV4801 single-polarization beamformer IC and the ADMV1017 mmWave UDC.

Analog Devices
analog.com

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Product Highlights

USB, I2C & SPI Power Sensor
LadyBug Technologies’ LB5900 series patented No-Zero before use RF Power Sensors offer coverage from 9 kHz to 40 GHz. The thermally stabilized sensors do not drift or interrupt measurements to zero. The product’s broad frequency range combined with exceptional sensitivity make them ideal for satellite, radar, EMC testing along with defence applications and general testing.

The sensor line offers optional SPI / I2C connectivity. This allows users to make calibrated power measurements in compact instruments and ATE systems that do not include a PC.

LadyBug Technologies LLC
ladybug-tech.com

RF and Microwave Subsystems
Founded in 2009, SignalCore, Inc. is a privately held company based in Austin, Texas. SignalCore designs and manufactures high quality, instrument grade RF and microwave subsystems. We serve customers worldwide in the industries of measurement, communications, aerospace, defense, academia, and electronics manufacturing.

Our extensive engineering knowledge and experience in the design and manufacturing of high performance RF and microwave solutions ensures that our products are of the highest quality and reliability in the industry.

SignalCore
signalcore.com

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Our extensive engineering knowledge and experience in the design and manufacturing of high performance RF and microwave solutions ensures that our products are of the highest quality and reliability in the industry.

SignalCore
signalcore.com
AMCOM offers a variety of Solid State Power Amplifiers (SSPA) for different power levels and operating frequencies. The connectorized modules are offered in compact sizes and are suitable for many applications such as radar, instrumentation and broadband jamming. Also, AMCOM offers a custom design service to meet customers' requirements for their own specific applications. The table below shows some of AMCOM's standard products:

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<td>AM003040SF-4H</td>
<td>0.05-3GHz</td>
<td>24-28V</td>
<td>3.5A</td>
<td>43dB</td>
<td>41dBm</td>
<td>42dBm</td>
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<tr>
<td>AM004042SF-2H</td>
<td>0.05-4GHz</td>
<td>40-50V</td>
<td>1.5A</td>
<td>24dB</td>
<td>40dBm</td>
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<td>AM042644SF-3H</td>
<td>0.3-2.6GHz</td>
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<td>2.7A</td>
<td>24dB</td>
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<tr>
<td>AM153042SF-4H</td>
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<td>2-18GHz</td>
<td>32-40V</td>
<td>3.4A</td>
<td>26dB</td>
<td>36.5dBm</td>
<td>41dBm</td>
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<tr>
<td>AM07511242SF-3H</td>
<td>7.5-11.2GHz</td>
<td>12-15V</td>
<td>5.5A</td>
<td>23dB</td>
<td>40.5dBm</td>
<td>41.5dBm</td>
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<tr>
<td>AM08513241SF-3H</td>
<td>8.5-13.2GHz</td>
<td>12-15V</td>
<td>6A</td>
<td>25dB</td>
<td>40.5dBm</td>
<td>41.5dBm</td>
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<td>AM00010037UM-1H</td>
<td>0.05-10GHz</td>
<td>+28, -2V</td>
<td>0.3A</td>
<td>13dB</td>
<td>30dBm</td>
<td>37dBm</td>
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<tr>
<td>AM30040031SF-3H</td>
<td>30-40GHz</td>
<td>+6, -0.6V</td>
<td>1A</td>
<td>17dB</td>
<td>27dBm</td>
<td>31dBm</td>
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For more detailed information please visit: www.amcomusa.com

Discrete Power GaN HEMTs and More

AMCOM RF Transistors include Discrete Power GaN HEMTs, GaAs FET (good linearity at back-off) and GaAs pHEMT (good power density and efficiency).

AMCOM has all the expertise, manpower, space, and equipment for manufacturing state-of-the-art products. Some of our capabilities are: active device design, MMIC design, and power amplifier module design. In addition, we are experts in device/MMIC packaging, module assembly and RF/DC testing. For active devices, we either procure parts such as silicon LDMOS, or GaN HEMT; or we use a semiconductor foundry to fabricate our own proprietary device/MMIC.

One of our specialty products is high-power, broadband, high-efficiency power amplifiers.

AMCOM was established in December 1996 by a group of microwave designers experienced in both microwave circuit design and microwave device fabrication technology. It is located in Gaithersburg, Maryland, USA, about 20 miles northwest of Washington, DC.

The company has earned a reputation as a leading edge microwave design organization that includes power FETs, MMIC power amplifiers, as well as high-power amplifier modules with RF and DC connectors that are ready to be used in microwave systems. One of our specialty products is high-power, broadband, high-efficiency power amplifiers.

AMCOM
amcomusa.com
Simulation Software

COMSOL Multiphysics® is a general-purpose simulation software for modeling designs, devices, and processes in all fields of engineering, manufacturing, and scientific research. In addition to using multiphysics modeling for your own projects, you can also turn your models into simulation applications and digital twins for use by other design teams, manufacturing departments, test labs, customers, and more.

The platform product can be used on its own or expanded with functionality from any combination of add-on modules for simulating electromagnetics, structural mechanics, acoustics, fluid flow, heat transfer, and chemical engineering. The add-on modules and LiveLink™ products connect seamlessly for a modeling workflow that remains the same regardless of what you are modeling.

COMSOL
comsol.com

In 1 design, both electrothermal effects and structural deformation are at play.

Microwave transmitters rely on filters to maintain a desired frequency output, but thermal drift can affect their operation. In order to optimize the design of these components, engineers need to predict their performance under real-world conditions. Multiphysics modeling can be used to evaluate the electrothermal and structural effects of microwave filters — simultaneously.

The COMSOL Multiphysics® software is used for simulating designs, devices, and processes in all fields of engineering, manufacturing, and scientific research. See how you can apply it to microwave designs.

comsol.blog/microwave-filters

Interconnect Solutions

Experience the Delta Difference. Delta Electronics is a leading global provider of innovative RF, microwave and millimeter wave interconnect solutions. We're proud to deliver a world-class customer experience - what we call the Delta Difference, by focusing on four key areas: Purpose, Process, People and Products/Solutions. The products we make keep people safe, connected, and informed in every type of environment. Knowing that our work makes a difference to people in mission critical situations around the world gives Delta a strong sense of purpose and pride.

Delta Electronics
deltarf.com

Get info at www.HFeLink.com

40  High Frequency Electronics
Planar Monolithics Industries, Inc.

Broadband Frequency Discriminators

PMI is an industry leader in the design and manufacturing of RF and Microwave Frequency Discriminators offering a robust line of products that range up to 18.0 GHz. A wide selection of standard models with various options are available including Digital or Analog output. Visit our website for a full listing of Frequency Discriminators.

https://www.pmi-rf.com/categories/frequency-discriminators

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<td>DFD-2G18G-5512 Digital</td>
<td>2.0 - 18</td>
<td>1 MHz/bit</td>
<td>50 ns</td>
<td>-60 to +15</td>
<td>2.0:1</td>
<td>+5 VDC @ 1480 mA, +5 VDC @ 30 mA, +12 VDC @ 800 mA</td>
</tr>
<tr>
<td>FD-30M-6M-1515 Analog</td>
<td>30 MHz</td>
<td>1000 mV/ MHz ± 5% into 50 Ohms</td>
<td>120 ns</td>
<td>-10 to 0</td>
<td>1.09:1</td>
<td>+15 VDC @ 79 mA, +15 VDC @ 51 mA</td>
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<td>FD-70M-50M-1212 Analog</td>
<td>70 MHz</td>
<td>100 mV/ MHz ± 5% into 50 Ohms</td>
<td>50 ns</td>
<td>-10 to 0</td>
<td>1.1:1</td>
<td>+12 VDC @ 77 mA, +12 VDC @ 48 mA</td>
</tr>
<tr>
<td>FD-1G-500M-55-SFF Analog</td>
<td>1 GHz</td>
<td>10 mV/Hz Typ into 93 Ohms</td>
<td>10 ns</td>
<td>-10 to 0</td>
<td>2:0:1</td>
<td>+5 VDC @ 25 mA, -5 VDC @ 70 mA</td>
</tr>
<tr>
<td>FD-0518-10-118 Analog</td>
<td>1.0 - 18</td>
<td>75 - 450 mV/GHz</td>
<td>20 ns</td>
<td>+10 ± 0.1</td>
<td>2.0:1</td>
<td>+15 VDC @ 875 mA, +15 VDC @ 150 mA</td>
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<tr>
<td>FD-0518-10-204G Analog</td>
<td>2.0 - 4</td>
<td>1 V/GHz</td>
<td>20 ns</td>
<td>+10 ± 0.1</td>
<td>1.5:1</td>
<td>+15 VDC @ 75 mA, +15 VDC @ 75 mA</td>
</tr>
<tr>
<td>FD-0518-10-3D13DSG Analog</td>
<td>3.1 - 3.5</td>
<td>50 MHz/ GHz</td>
<td>10 ns</td>
<td>+10 ± 0.1</td>
<td>1.68:1</td>
<td>+15 VDC @ 15 mA, +15 VDC @ 15 mA</td>
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<tr>
<td>FD-0518-10-48-OPT3R5GSRSG Analog</td>
<td>3.5 - 5.5</td>
<td>1 V/GHz</td>
<td>20 ns</td>
<td>+10 ± 0.1</td>
<td>1.35:1</td>
<td>+15 VDC @ 38 mA, +15 VDC @ 10 mA</td>
</tr>
<tr>
<td>FD-0518-10-618 Analog</td>
<td>6.0 - 18</td>
<td>50 MHz/ GHz</td>
<td>20 ns</td>
<td>+10 ± 0.1</td>
<td>1.5:1</td>
<td>+15 VDC @ 50 mA, +15 VDC @ 50 mA</td>
</tr>
<tr>
<td>FD-0518-10-812 Analog</td>
<td>8.0 - 12</td>
<td>50 MHz/ GHz</td>
<td>5 ns</td>
<td>+10 ± 0.1</td>
<td>1.44:1</td>
<td>+15 VDC @ 11 mA, +15 VDC @ 11 mA</td>
</tr>
<tr>
<td>FD-0518-10-1218 Analog</td>
<td>12.0 - 18</td>
<td>50 MHz/ GHz</td>
<td>20 ns</td>
<td>+10 ± 0.1</td>
<td>1.5:1</td>
<td>+15 VDC @ 58 mA, +15 VDC @ 12 mA</td>
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SGMC Microwave’s 2.4mm to 2.92mm between-series precision grade NMD connectors are designed for use with microwave applications requiring excellent performance up to 40 GHz. NMD connectors are ruggedized test-port connectors that specially designed to stabilize the test port cable during testing on many network analyzers. Pictured are four different NMD configurations.

SGMC Microwave
sgmcmicrowave.com

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Keysight announced the CXG X-Series Radio Frequency (RF) Vector Signal Generator (CXG), which delivers advanced performance, is standards-compliant, and meets the demands of engineers designing IoT and general-purpose devices at a reasonable price.

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COMSOL Multiphysics® Version 5.5 to Be Released in November

Earlier this month staff from HFE met with COMSOL staffers Bernt Nilsson, Senior VP of Marketing; Associate Professor Ulf Olin, Technology Specialist; and Mia Johansson, PR and Communications Manager. This meeting was held at the COMSOL Conference, Boston, a three-day event with over 300 attendees. The conference embraced not only RF, electromagnetics, semiconductors, optics and photonics, but also numerous other physics disciplines in the COMSOL offerings. More than 50 technical mini-courses were complemented by panel sessions and workshops.

Among topics discussed was the release of Version 5.5 next month. In this version of COMSOL Multiphysics® the Design Module provides an entirely new sketching tool for easier creation and more versatile parametric control of geometry models. New and updated solvers speed up a wide range of simulations. New features that may be of interest to our readers are Topology Optimization, and Multiscale Ray and Wave Optics, Piezoelectric Shells, and PCB Ports.

The Ray Optics Module can now be combined with the RF Module for simultaneous full-wave and ray-tracing simulations. According to COMSOL, this enables multi-scale modeling, such as a waveguide beaming into a large room, where using a full-wave simulation would be computationally prohibitive, taking weeks to solve. Combining the AC/DC Module and the Composite Materials Module, users can now analyze layered materials with both dielectric and piezoelectric layers in thin structures. In the RF Module, a set of new ports for vias and transmission lines makes setup much faster and provides more control to the user for modeling printed circuit boards.

If you have interest in modeling and simulation with seamless connection between disciplines such as electromagnetics, packaging, and heat transfer, this is a good product and supporting conference to attend. HFE was pleased to be a media sponsor for the event.

—Tom Perkins
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**PRODUCT SPOTLIGHT**

**Designer’s Kit Features 100 LTCC Filters, 2.4 and 5 GHz**

Mini-Circuits Designer’s Kit K1-LTCC-WBZ+ is a comprehensive collection of lowpass filters, highpass filters, bandpass filters, diplexers, and balun-filters designed for Wi-Fi, Bluetooth, and Zigbee applications in the 2.4- and 5-GHz bands. Based on low-temperature-cofired-ceramic (LTCC) construction, the assortment contains five each of 20 different models for a total of 100 components covering the two frequency ranges. As an example, model LPGE-252R+ is a lowpass filter with low typical insertion loss of only 0.3 dB across its 2.4-to-2.5-GHz passband. It has three stopbands each with high rejection: 44 dB from 4.8 to 5.0 GHz, 40 dB from 7.2 to 7.5 GHz, and 37 dB from 9.6 to 10.0 GHz. At higher frequencies, model BPNK-542R+ is a bandpass filter with just 1.0 dB typical insertion loss across its 4.9 to 5.9-GHz passband. It provides 40-dB typical rejection of unwanted signals from DC to 2.7 GHz and 34-dB rejection from 9.8 to 12.0 GHz. All the filters in the kit are RoHS compliant. The rugged filters are designed to handle power levels as high as 2 W (+33 dBm).

**Class AB Amplifier Powers 600 to 6000 MHz**

Mini-Circuits’ model ZHL-5W-63-S+ is a coaxial Class AB medium-power amplifier with high gain from 0.6 to 6.0 GHz. Typical gain across the full bandwidth is 45 dB with gain flatness of ±3.5 dB. The RoHS-compliant, GaN-based amplifier provides +35-dBm output power at 3-dB compression and +37-dBm saturated output power. It has a typical output third-order intercept point (OIP3) of +42 dBm. The noise performance is consistent across the wide bandwidth, with a typical noise figure of 12 dB. The typical input VSWR is 2.50:1 while the typical output VSWR is 3.50:1. Suitable for mobile communications, satellite communications (satcom), and test-and-measurement applications, the 50-Ω amplifier is supplied in a compact aluminum housing with female SMA connectors. It measures 7.25 × 4.33 × 3.34 in. (184.15 × 109.98 × 84.836 mm) excluding the connectors or optional heatsink and draws 3 A typical current from a +28-V dc supply. It is designed to handle input power as high as +7 dBm without damage and has an operating temperature range of 0 to +60°C.

**Rugged Coaxial Amplifier Boosts 10 to 2000 MHz**

Mini-Circuits’ model ZHL-10W-202-S+ is a high-power Class AB amplifier capable of 10 W saturated output power from 10 to 2000 MHz. The coaxial amplifier delivers typical output power of +40 dBm at 3-dB compression, with typical output third-order intercept (IP3) of +45 dBm. It provides 50-dB gain with typical gain flatness of ±2 dB across the wide frequency range and typical noise figure of 10 dB. The 50-Ω amplifier exhibits typical input and output VSWR of 2.0:1. Its self-protection circuitry guards against damage from reverse-polarity operation as well as open and short conditions; the amplifier operates safely with input levels as high as +5 dBm and can handle input levels as high as -16 dBm into short or open loads. The rugged RoHS-compliant amplifier is available with or without a heatsink, measuring 6.426 × 4.065 × 1.18 in. (163.22 × 103.25 × 30.00 mm) without the heatsink and with female SMA connectors. It draws typical current of 1.5 A from a 28-V dc supply and is designed for operating temperatures from -20 to +60°C.

**Linear Amp Holds Gain Flat from 26 to 40 GHz**

Mini-Circuits’ model ZVE-403-K+ is a compact Class A linear amplifier with broad frequency range of 26 to 40 GHz. It offers 22-dB typical gain across the full bandwidth, with typical gain flatness of ±2 dB. The four-stage amplifier delivers +19-dBm typical output power at 1-dB compression and +21-dBm typical output power at 3-dB compression, with typical output third-order intercept (OIP3) of +28 dBm. The 50-Ω amplifier exhibits typical input and output VSWR with typical noise figure of 9 dB. It can operate with supply voltages from 11 to 14 dB, drawing 300 mA typical current from a 12-V dc supply. The unconditionally stable, RoHS-compliant amplifier is equipped with K-type (2.92-mm) coaxial connectors. The amplifier is supplied in a rugged housing measuring 1.2 × 0.46 × 0.45 in. (30.48 × 11.58 × 11.43 mm), not including the connectors or an optional heat sink. It is designed for an operating temperature range of -40 to +60°C.
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ADAPTERS • CABLE CONNECTORS • RECEPCTACLES • CUSTOM DESIGNS

Including These Connector Series

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