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About TTI, Inc.

Why Acquire RF & Microwave Components From TTI?
TTI, Inc. is the world’s largest distributor of passive and interconnect components. The combination of extensive inventory and the best RF & Microwave line-up in the industry allows TTI to provide you practically all your RF & Microwave component requirements. TTI’s value proposition stems from the basic strategy of focusing on a specific range of products and striving to be the best at what we do. No other company offers the unique combination of benefits that TTI provides.

Product Knowledgeable Experts
In addition, TTI has a team of specialists with more experience in RF & Microwave products than any other distributor. All TTI employees participate in company-wide training programs. Over the years, our people have become the most product-knowledgeable in the industry. Our sales team is a valuable resource to any customer that is dealing with the complexities of RF & Microwave components.

The 80/20 Rule
The parts we sell comprise 80-85% of the components used in electronic equipment. But, because they’re so inexpensive, these same parts represent only about 5-10% of the total cost. When customers rely on TTI to supply passive, interconnect, and electromechanical components, they solve 80% of their potential problems. Then, customers are free to focus on semiconductors, subassemblies, and PCBs where there is a better return on their efforts.

Broader & Deeper Inventories
TTI maintains extensive inventories. We stock more than 200,000 parts with more than 80% available for immediate delivery. That’s more passive and interconnect parts than from any other source. And our product department makes sure that the parts we stock are the right parts, the ones our customers need today.

Close Supplier Relationships
We partner with the leading manufacturers in the world. We have structured our supply base in order to establish a partnership with each manufacturer. As a group, they allow TTI to provide the best AVL coverage imaginable. And the suppliers we have chosen are the companies that lead the industry into new component technologies. For our customers, this means that TTI has the ability to enlist the help of a manufacturer to solve any potential design problems.

Quality & Reliability
TTI offers its customers a 30 year commitment to quality and service excellence. Whenever possible, TTI has taken advantage of technology to shorten process times and prevent opportunities for errors. We have been ISO 9002 registered since 1993, and we implemented Total Quality Management in 1989. Today, we have one global documentation system and every TTI branch and warehouse throughout the world follows the same processes. Year after year, customers rate our quality and management practices to be among the very best in the industry. We encourage you to contact your local sales branch to find out more about our quality systems and results.

Services & Special Programs
There probably isn’t a service you need that TTI can’t provide. From component labeling to in-plant stores, TTI helps customers find, buy, receive, and use components in the most cost efficient way. For more information on part modification, electronic information exchange, and supply chain management programs contact a TTI branch location today.
RF & Microwave Connector Basics

An RF connector is that part of a transmission system which allows for the coupling or uncoupling of system components. A mated pair consists of a plug (usually containing the coupling ring and male contact) and a jack (with the opposite interface).

There are three basic ways to categorize RF connectors:
- Cable connectors—plugs and jacks that terminate cable
- Receptacles—plugs and jacks terminate to printed circuit boards, panels, or equipment chassis
- Adapters—used to join two or three incompatible units in—or between—series

All three categories are available in several configurations (right angle, flange mount, etc.)

Choosing A Connector
There are several factors that will determine the choice of connector series and style. Cable and frequency range are the primary factors. It is good engineering practice to try and match the connector size (diameter) and cable diameter as closely as possible in order to minimize reflections. The larger the difference between cable diameter and connector diameter, the worse the performance will be. Reflections will generally increase as a function of frequency, and smaller connectors will generally perform well at higher frequencies.

Frequency Range
Frequency range will determine the connector series used. Consult the chart on page 5 to see the various connector series and their standard frequency ranges. In general, it is advisable to use push-on or bayonet style connectors at low frequencies, typically below 6 GHz. Threaded connectors should be used for high performance, low noise applications.

Cable & Impedance
The cable that is specified will generally determine the impedance of the connector used. 50 and 75 ohms are the standard impedances used by most designers, and several connector series come in both 50 ohm and 75 ohm versions. At frequencies below 500 Mhz or so, 50 ohm connectors can be used on 75 ohm cable (and vice versa) with acceptable performance levels. The reason for doing this is that 50 ohm connectors are generally less expensive due to their greater usage.

Aside from trying to match the cable and connector as closely as possible in size to minimize reflections, connector interface and dielectric materials are also important considerations. Line to line and air interfaces such as the SMA and Type N give excellent high frequency, low reflection performance. Overlapping dielectric interfaces such as BNC and SMB are usually limited in performance vs. frequency. The usual figure of merit for a connector’s performance is its Reflection Coefficient. This is a measure of how much signal is reflected back from the connector. It can be expressed in terms of Reflection Coefficient, VSWR (Voltage Standing Wave Ratio) and Return Loss.

Power & Voltage
Power and voltage requirements are also a factor determining the connector to be used in a particular application. High power applications will dictate the use of large diameter connectors. Average power handling is normally limited by the cable’s power specification and is usually determined empirically. The voltage breakdown level of the connector limits peak power. Power handling capability will diminish as a function of frequency and altitude.
## RF & Microwave Connector Products Selection Chart

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<th>MoLex Type</th>
<th>Tyco Type</th>
<th>Impedance (Ohms)</th>
<th>Coupling Method</th>
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<td>SMT</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>50Ω</td>
<td>Snap-On</td>
<td>Ultra Low-Profile, Small Footprint</td>
<td>Easy snap-on/snap-off mating</td>
<td>WLAN, Bluetooth, PDA, Notebook Computers, GPS, Portable Devices, Remote Measuring Equipment</td>
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<tr>
<td>MMCX</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>50Ω</td>
<td>Snap-On</td>
<td>Broadband Performance, Surface Mountable</td>
<td>Quick Connect / Disconnect, T&amp;R for pick and place</td>
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<tr>
<td>SMPM</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>50Ω</td>
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<td></td>
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<td>SMC</td>
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<td>MoLex</td>
<td>Tyco</td>
<td>50Ω</td>
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<td>Tyco</td>
<td>50Ω &amp; 75Ω</td>
<td>Snap-On</td>
<td>Small</td>
<td></td>
<td>Base Stations, Telecom, GPS, Radios, WLAN, Automotive</td>
</tr>
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<td>SMB Mini</td>
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<td>MoLex</td>
<td>Tyco</td>
<td>75Ω</td>
<td>Snap-On</td>
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<td></td>
</tr>
<tr>
<td>SSMA</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>50Ω</td>
<td>Threaded</td>
<td>Small, High Frequency</td>
<td></td>
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<tr>
<td>SMP</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>50Ω</td>
<td>Snap-On</td>
<td>Small, High Frequency</td>
<td></td>
<td>Military/Commercial Radio</td>
</tr>
<tr>
<td>SMA</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>50Ω</td>
<td>Threaded</td>
<td>Durable, Small</td>
<td></td>
<td>Base Stations, Telecom, GPS, Radios, WLAN, Instrumentation</td>
</tr>
<tr>
<td>BMA</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>50Ω</td>
<td>Push-On</td>
<td>Blind Mate</td>
<td></td>
<td>Equipment Racks, Modular Instrumentation</td>
</tr>
<tr>
<td>QMA</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>50Ω</td>
<td>Snap-On</td>
<td>Push-Pull, SMA Performance</td>
<td>Positive “Snap”</td>
<td>Base Stations, Telecom, GPS</td>
</tr>
<tr>
<td>BNC Mini</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>75Ω</td>
<td>Bayonet</td>
<td></td>
<td>40% smaller than standard BNC</td>
<td>Routers, Switch Equipment, Base Stations, Telecom, GPS</td>
</tr>
<tr>
<td><strong>Miniature</strong></td>
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<td>F/G</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>75Ω</td>
<td>Multiple</td>
<td>Threaded/Push-On</td>
<td></td>
<td>CATV, Cable Modems</td>
</tr>
<tr>
<td>BNC</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>50Ω &amp; 75Ω</td>
<td>Bayonet</td>
<td>Quick Coupling</td>
<td>Economical</td>
<td>Computer, LAND Systems, Broadcast, HDTV, Telecom, Wireless Networks, Medical Equipment, Instrumentation</td>
</tr>
<tr>
<td>MHV</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>NM</td>
<td>Bayonet</td>
<td>Non-Impedance Controlled</td>
<td>High Voltage</td>
<td>Military, Aerospace, Nuclear</td>
</tr>
<tr>
<td>SHV</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>NM</td>
<td>Bayonet</td>
<td>Non-Impedance Controlled</td>
<td>High Voltage</td>
<td>Military, Aerospace, Nuclear</td>
</tr>
<tr>
<td>TNC</td>
<td>Amphenol</td>
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<td>Tyco</td>
<td>50Ω &amp; 75Ω</td>
<td>Threaded</td>
<td>Durable</td>
<td></td>
<td>Computer, LAND Systems, Antennas, Mil/Aero, Medical Equip., Instrumentation</td>
</tr>
<tr>
<td><strong>Standard</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>50Ω</td>
<td>Threaded</td>
<td>Durable</td>
<td>Weatherproof, Economical</td>
<td>Antennas, Base Stations, Mil/Aero, Air-Frame</td>
</tr>
<tr>
<td>7/16</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>50Ω</td>
<td>Threaded</td>
<td>High Voltage</td>
<td>Good Performance</td>
<td>Antennas, Base Stations, Lightning Protection</td>
</tr>
<tr>
<td>Precision</td>
<td>Amphenol</td>
<td>MoLex</td>
<td>Tyco</td>
<td>50Ω</td>
<td>Multiple</td>
<td>2.4, 2.92, 3.5, &amp; 7mm Interfaces</td>
<td></td>
<td>High Performance RF</td>
</tr>
</tbody>
</table>
Leader In Innovation
Amphenol RF is a leading international supplier of components and systems for radio frequency interconnection applications in the fields of Wireless Telecommunications, Automotive, Military/Aerospace, Internet and Broadband Communications. Amphenol RF products are engineered, manufactured and sold worldwide providing customers with a complete global RF solution.

To produce coaxial connectors and cable assemblies both high volume and in high quality, Amphenol RF utilizes the most advanced manufacturing technology in the industry, coupled with employee and vendor training in Statistical Process Control (SPC). The result is on-time delivery of price competitive products, which meet the most exacting military and commercial system requirements.

AMC
The Amphenol Micro Coaxial (AMC) Connectors are manufactured for use in applications with 50Ω impedance requirements and designed to meet the needs of the WLAN marketplace. AMC connectors are low profile (2.5mm off the board), offer an extremely small board footprint (3mm x 3mm) and have easy snap-on/snap-off mating. With performance of up to 6GHz, the AMC line is intended for use with the entire group of 802.11a/b/g equipment. AMC plugs are available only as cable assemblies, with the option of a double-ended jumper, a single-ended pigtail, or an AMC plug to an alternate connector (MMCX, SMA, etc.). AMC adapters are available to reverse polarity TNC, BNC and SMA.

MMCX
The MMCX is a micro-miniature connector series with a lock-snap mechanism allowing for 360 degrees rotation enabling flexibility in PCB layouts. The micromate family of products is a 6 GHz 50 Ω interconnect system. MMCX connectors conform to the European CECC 22000 specification.

A range of connectors are available including surface mount, edge card, and cable connectors.

SMP
The SMP interface is a subminiature interface in the same scale as MMCX connectors but offering a frequency range of DC to 40 GHz. It is commonly used in miniaturized high frequency coaxial modules and is offered in both push-on and snap-on mating styles.

The interface is an excellent choice for PC board to board interconnects. For these applications, the interface series offers an interesting solution by utilizing a male connector on each of the PC boards and a female-to-female adapter mounted in between.
complete the connection. The female adapter is often called a bullet and is necessary to provide a flexible link between the male connectors. This flexible link allows .020 inches of radial float and .010 inches of axial float. Typically, one male connector will be specified as a snap on interface and the other as a push on. This ensures that the bullet adapter remains fixed in the same male connector if the PC boards are separated. The bullets are available in multiple lengths to allow for different board spacing.

**SlimLine BNC**
Amphenol RF’s SlimLine BNC connectors are ideal for the telecommunication and broadband applications for higher connector densities while preserving the positive characteristics of the Amphenol full-size BNC’s for 75 Ω systems. This allows 40% more interconnects in the same area. The SlimLine BNC series provides a positive locking bayonet system and was specifically designed to be a drop-in replacement and used with the Telco DS3 application and is compatible with the present field installer tooling and strip dimensions.

**TNC**
Developed in the late 1950s, the TNC stands for Threaded Neill Concelman and is named after Amphenol engineer Carl Concelman. Designed as a threaded version of the BNC, the TNC series features screw threads for mating. TNC are miniature, threaded weatherproof units with a constant 50 Ω impedance and they operate from 0-11 GHz.

There are two types of TNC connectors: Standard and Reverse Polarity. Reverse polarity is a keying system accomplished with a reverse interface, and ensures that reverse polarity interface connectors do not mate with standard interface connectors. Amphenol accomplishes this by inserting female contacts into plugs and male contacts into jacks. Other manufacturers may use reverse threading to accomplish reverse polarity keying.

**Type N**
Named after Paul Neill of Bell Labs after being developed in the 1940s, the Type N offered the first true microwave performance. The Type N connector was developed to satisfy the need for a durable, weatherproof, medium-size RF connector with consistent performance through 11 GHz.

There are two families of Type N connectors: Standard N (coaxial cable) and Corrugated N (helical and annular cable). Their primary applications are the termination of medium to miniature size coaxial cable, including RG-8, RG-58, RG-141, and RG-225. RF coaxial connectors are the most important element in the cable system. Corrugated copper coaxial cables have the potential to deliver all the performance your system requires, but they are often limited by the performance of the connectors.
Molex RF & Microwave Connector Division

Molex is a complete RF & Microwave connector supplier with complete design support for custom solutions, modified standard and standard products. From small quantities to high volume production, Molex has a diverse product offering and flexible manufacturing facilities that focus on giving customers what they want. If a solution is not available in our thousands of standard designs, our engineering staff is available to create a custom product solution that fits the application.

We offer a wide variety of standard products, many of which are in the catalog, for some of the most common configurations in the industry today. The RF & Microwave Connector Division provides all series, styles and configurations of RF connectors, including microminiature, subminiature, miniatures and large. Of the 208 known design types, we offer 80%. Even if Molex RF doesn’t have a specific design, we can provide it without high minimums and typically in six weeks or less.

Our facilities are located in Mooresville, Indiana (a suburb of Indianapolis) and Taipei, Taiwan. These ISO 9001 registered facilities utilize the latest CNC technologies for quick tooling changeover and improved cost efficiencies. Our lead times are as much as 40% less than the industry standard. We provide small quantities, prototypes and custom products from Indiana and high volume, economical product from Taiwan.

In addition to providing products that are hard to find or being obsoleted by other manufacturers, Molex RF is adding to our product offering with the following new products.

7/16 and Type N for Large Coax

These connectors offer low Intermodulation Distortion and are available in a variety of configurations for corrugated and flexible cables as well as panel mount styles for cellular components. We also offer jumper cables, fully tested for return loss and IMD, as required.

Improved QMA connector

Molex RF has taken a relatively new connector, QMA, and improved it for use in wireless applications. We offer plugs and jacks of this snap-on connector that replaces SMA threaded styles in systems up to 6 GHz. The Molex design provides improved connector retention from the industry typical 15 pounds axial force to over 45 pounds. The benefit is enhanced reliability and less chance that a critical RF cable will be disconnected accidentally by pulling or tugging on the cable. Our QMA plugs are compatible with other manufacturer’s QMA jacks.
**Combination D-Sub**
We are in the process of developing and introducing a combination D-Sub connector that will soon to be available with power, signal and RF coax contacts. The RF contacts will be capable of operating above 1 GHz and will be suitable for systems working up to 6 GHz. The contacts will be offered for coax and PCB termination styles.

**SMPM Connector**
Molex is developing a miniature SMP connector that will have similar snap-on features in a smaller size, with capability of working to 65 GHz. This connector is comparable to the GPPO and SSMP.

**Between Series Adapters**
Molex Between-Series Adapters provide transitions between popular coaxial connectors. The design of these adapters includes a minimum length consistent with good electrical performance. Its small size and low VSMR permit a wide range of applications.

Adapters are provided in stainless steel with passivated finish, nickel-plated brass, and nickel-plated beryllium copper. Dielectric are TFE Fluorocarbon, and the center contacts are produced in gold-plated beryllium copper.

**SMB Subminiature Connector**
Molex SMB 50 Ohm connectors are a subminiature connector series designed for applications operating to 4 GHz. This series includes a snap on interface that is controlled by industry standard specifications and is easy to connect and disconnect. Mechanical stability is provided by the SMB interface, and its relatively small size allows it to be used in applications where space is limited, like telecommunications equipment, instrumentation, and commercial broadcast equipment.

**BMA Blind Mate**
We have developed a Molex version of an industry standard blind mate connector commonly known as the BMA. This connector series offers axial and radial mis-alignment tolerances that make them ideal for gang mating multiple RF connectors at the same time. The Molex BMA is intermateable with offerings from other manufacturers.

**Micro Coax**
To address the need in wireless systems for a very small, low cost RF interconnect, Molex is introducing a stamped and molded connector that is very low profile. This connector will compete with common connectors in the industry such as the Hirose U.FL style. The cable connector is offered only as a cable pigtail or cable assembly.
A Leader In Innovation
Tyco Electronics RF Coaxial Solutions for Communications Equipment combines the best products from industry leading brand names like Omni Spectra, M/A-COM, Siemens E.C., GreenPar, and AMP. We have integrated these into one cohesive set of RF products focused primarily on wireless, wireline carrier, and enterprise networking sectors of the world telecom equipment market.

Tyco Electronics broadest selection of RF connectors and coaxial cable assemblies provides you with a solution for every interconnection requirement. Type N and 7/16 connectors are used where high power and rugged reliability are required, typically as antenna feeds, filter/combiner I/O’s, and power amplifier outputs. SMA, SMB, and TNC connectors are the primary cable interface for inner cabinet routing and are available in panel mount, board mount, and cable terminations. Subminiature connectors such as MCX, OSMP, DIN, and Blind Mate provide panel-to-board and backplane connections. Finally, our micro miniature OSMT, SSMT, and MMCX series provide excellent board-to-board and card edge to board solutions.

SMA
AMP offers a complete line of SMA connectors designed for performance to 18 GHz to satisfy the growing demand for SMA connectors in the wireless communications industry. The SMA product line offers stainless steel bodies, as well as non-ferrous metals. Various plating options are available, including Gold and White Bronze. The SMA interface is fully compatible with Mil-C-39012.

To satisfy the broad range of commercial applications, SMA connectors are available in a broad range of standard configurations including: straight and right angle cable applied plugs, bulkhead cable jacks, two and four hold flange mount panel jacks, straight and right angle PCB mount jacks and various between and in series adapters. Numerous packaging and testing options are also available to meet specific system criteria as well.

Additionally, standard military approved (QPL) interfaces are offered as well, and includes connectors for semi-rigid cable and micro strip applications.

The three piece SMA offering is designed especially for applications in cellular infrastructure where InterModulation Products (IMP) must be minimized. By limiting nonlinearity within the connectors, IMP is reduced and increased channel capacity can be offered.
Snap-On SMA Series of RF Connectors
Tyco Electronics’ next generation high performance RF products QMA (Snap On SMA) connectors series offers the same high quality and performance currently found in the standard Tyco SMA series but does not require the coupling nut torque. By integrating a snap on feature to the design, denser packaging can be achieved, and the overall applied cost is dramatically reduced. The QMA connector series is excellent for communications as well as industrial applications. The QMA offering is designed for 100 mating cycles, operates through 6 GHz, and is completely intermateable with competitive QMA offerings. This new QMA product is not intermateable with standard SMA interfaces.

QMA connectors are available in a broad range of standard configurations, including PcB and panel mount, flexible and semi-rigid cable, and adapters. Other options can be reviewed as well, including additional cable sizes, PCB surface mounting, and tape and reel packaging. The QMA connector series is a cost effective solution for the challenging demands of today’s commercial marketplace, with applications including cellular base station, handsets, and test and measurement.

BNC
The AMP BNC RF connector family with bayonet locking coupling provides highly reliable, quick connect and disconnect coaxial connections. Exclusive single and O crimp terminations allow positive insulation grip and require absolutely no soldering, providing terminations at a very low overall applied cost. Available in both 50 and 75 ohm versions, these connectors feature numerous styles including cable plugs and jacks, adapters and printed circuit board connectors. In addition to a variety of crimp type terminations, connectors are furnished in field replaceable and twist-on styles. These connectors accept a wide range of coaxial cables and are intermateable with industry standard connectors designed to MIL-C-39012 specifications.

AMP can also supply low-cost alternatives with an extensive commercial type product line. A lower cost consumer series product offers the capability to supply center contacts in strip form and allow for automated center contact crimp technology. All connectors are designed around the mil-specifications, but utilize low-cost materials, offering comparable mechanical and electrical performance.

1.0/2.3
Miniature coaxial connectors series 1.0/2.3 (CECC 22230 and IEC169-29) coaxial connectors are devised to meet the requirements of compact electronic instrumentation. All plugs and jacks with Z = 50 Ohms are designed for a number of different 50 Ohm and 75 Ohm cables. Due to the large demand, the series 1.0/2.3 has also been optimized as a 75 Ohm design into the GHz range. The different types of coupling mechanism, such as screw on, slide-in and latching coupling permit space-saving installation.
RF & Microwave Component Basics

Microwave Basic Terminology
Microwave (MW) refers to electromagnetic energy having a frequency higher than 1 gigahertz (billions of cycles per second), corresponding to a wavelength shorter than 30 centimeters.

Radio Frequency (RF) is a term that refers to alternating current (AC) having characteristics such that, if the current is input to an antenna, an electromagnetic (EM) field is generated suitable for wireless broadcasting and/or communications.

These frequencies cover a significant portion of the electromagnetic radiation spectrum, extending from nine kilohertz (9 kHz), the lowest allocated wireless communications frequency (it's within the range of human hearing), to thousands of gigahertz (GHz).

Microwave Components
Microwave Components are a set of products that are used in the front-end of a radio. The very basic function of Microwave Components are to form analog operations on a base signal in order to send them through the airwaves and receive them again in their original state. Some of these functions include up-converting to a carrier frequency (Voltage Controlled Oscillators), filtering unwanted signals (Surface Acoustic Wave, Dielectric, and LC Filters), radiating signals (Antennas), separating frequencies (Duplexers, Duplexers, and Switches), splitting signals (Hybrid Couplers and Power Dividers), and monitoring power (Couplers).

Antennas—Converts a signal flowing in a printed circuit to an airborne wave.

SAW Filters—Cause a substrate to vibrate, allowing a surface wave to move across the chip. Only a specific frequency will vibrate across. Most costly with best performance.

Dielectric Filters—A series of resonators that are tuned and matched to each other that allow certain signals to pass while others are attenuated. Moderate cost and performance.

LC Filters—A resonant circuit that is created by inductors [L] and capacitors [C] in one package to allow certain signals to pass while others are attenuated. Low cost with simple performance.

Duplexers—Two dielectric filters in one package that are near in frequency that allows wanted signals to continuously flow through the device. This allows you to talk and listen at the same time in a cellular telephone.

Diplexers—Two basic filters in one package that pass lower signals and higher signals that work to separate a wide signal into two paths.

Switches—A device that changes the signal direction between two paths and is usually used to change between sending information and receiving information.

Couplers—“Peel off” a known amount of power to feed into a monitoring component to increase or decrease the power from the amplifier.

Baluns—Transforms a 2-line input (BALanced) to a single-ended output (UNbalanced). Most integrated components (ICs) require a balanced input while most passive products are single-ended.
**Isolators**—Allow signals to flow in one direction only to block reflected signals from entering sensitive components and overloading them.

**Voltage Controlled Oscillators (VCO)**—Provide a reference frequency as a low frequency signal like voice is up-converted to a high frequency in order to transmit it over the airwaves.

**What is ISM2.4 and ISM5.8?**
ISM2.4 and ISM5.8 are frequency bands within the I.S.M. designation. Industrial Scientific and Medical bands were allocated to provide unlicensed frequency spectrums for systems to be developed without paying a usage fee for the band. The ISM2.4 band is allocated from 2400 MHz to 2500 MHz (2450 ± 50 MHz). Any subset of frequencies within that range may be used for a given system. The ISM5.8 band is 5.725 MHz to 5.825 MHz and any subset of frequencies within that range may be used for a given system.

**Bluetooth™**
Bluetooth™ is being promoted as the de-facto standard and specification for short-range connectivity. It is targeted as a low cost, short-range universal radio link between mobile PCs, cellular phones, PDAs and other portable devices.

The creation of the Bluetooth™ specification was the result of collaboration between some major telecom and computer companies including; Ericsson, Intel, Nokia, Motorola, Toshiba, 3Com, Microsoft, Lucent and IBM.

**HomeRF™**
HomeRF™ is an open industry specification for unlicensed RF digital communications. It is designed to provide a broad range of interoperable consumer devices anywhere in and around the home.

The system would allow for multiple devices within the home (i.e. one or more PCs, appliance controls, baby monitors, clocks, cordless phones, interactive TVs, computer peripherals, PDAs, etc.) to all be linked via a wireless connection. Compliant radios take the form of WLAN (Wireless Local Area Network) cards, gateways and cordless phones.

**IEEE802.11b**
This is a wireless local area networking (WLAN) standard that is an extension to Ethernet. It is primarily designed for environments where high-speed (11 Mbps) connections are required. This technology allows for high-speed connectivity between mobile, handheld and desktop computers, and corporate networks and the Internet without requiring a direct wire connection. It has seen wide adoption within manufacturing environments, warehouse control, education, financial, healthcare and retail sales.

**IEEE802.11a**
This is a high data rate WLAN standard at the 5 GHz band that is now emerging. Data rates are projected to be on the order of 25 - 40Mbps.

**Global Positioning System (GPS)**
GPS allows for real-time position identification with an accuracy of 3 to 100 meters at any time. It also offers a way to determine precise time better than a few hundred nanoseconds almost anywhere on the surface of the earth.

The GPS system consists of a constellation of 24 satellites distributed such that there are four visible at any time, anywhere in the world. These satellites orbit the earth at an altitude of about 10,900 miles and at an inclination of 55 degrees. This orbit translates to an orbital period of 12 hours. This allows for precisely determining the position of the user in longitude, latitude, and altitude. The frequency allocation for standard GPS is 1563.42 to 1587.42 MHz (1575.42 ± 12 MHz).
**A World Leader In Innovation**

AVX, a recognized leader in the global passive electronic component and interconnect products industry, is at the forefront of technology, design, manufacturing and supply. AVX provides significant competitive advantage to customers, including global manufacturing and distribution logistics provided by 24 manufacturing facilities in 12 countries. This assures customers of an efficient balance of demand and production capability, in response to just-in-time inventory requirements. With research and development centers in five locations around the world (United States, Northern Ireland, England, France and Israel), AVX has fostered customer relationships involving the design and production technology for new and advanced devices to fulfill the latest application requirements.

AVX continues to invest heavily in R&D, bringing many new products to the market during the past year and holding over 175 active patents worldwide. AVX is set apart from the competition by its broad array of Passive specialty products that include ceramic and tantalum capacitors, connectors, thick and thin film capacitors, thin film inductors, resistors, and integrated passive components. AVX also has the advantage of the partnership with Kyocera Corporation of Japan and the wide breadth of products, as well as technology, that they offer. AVX provides a unique balance of high volume commodity products and the increasingly innovative Advanced Product offerings.

**High Performance Solutions**

AVX strives to be the leader in all component segments we offer. RF & Microwave components, is a key thrust area of business for us. We offer a broad line of high performance RF & Microwave capacitors in a wide range of sizes, styles, and ratings.

Thin Film products represent the “state-of-the-art” in RF Capacitors, Inductors, Directional Couplers, and Low Pass Filters. Unique thin-film technology provides components that exhibit excellent batch-to-batch repeatability of electrical parameters at RF frequencies. The Accu P series of capacitors are available in ultra-tight tolerances (± 0.02pF) as well as non-standard capacitance. The Accu L series of inductors are ideally suited for applications requiring extremely high Q and high current capability. AVX’s directional couplers cover the frequency range of 800 MHz to 3 GHz and feature low insertion loss and highly accurate coupling factors. Another major series of microwave capacitors available are multilayer ceramic and porcelain capacitors for frequencies from 10 MHz to 4.2 GHz.

AVX also offers high performance SAW Filters which have low loss and high attenuation characteristics; the SF series delivers advanced voice quality to complement the latest technologies in mobile phones such PCs, Cellular and GPS.
| **AVX RF & Microwave Products** |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| **Type**        | **Series**      | **Function**    | **Applications** | **Features & Benefits** |
| Thin-Film Capacitor | Accu-P          | Impedance Matching | Cellular, Satellite GPS, Communications VCO’s, Matching Networks | Repeatability, Tight Tolerance, High Power Handling |
| SMD High-Q RF Inductor | Accu-L          | Impedance Matching | Cellular, Satellite GPS, Communications VCO’s, Matching Networks | Repeatability, Tight Tolerance, High Power Handling |
| Thin-Film Directional Couplers | CP 0402/0603 | Power measurement for amplifier control | Mobile Communications, Satellite TV Receiver, GPS Vehicle Location System, Wireless LAN | Low Profile, Self Alignment During Reflow, High Directivity, Low Parasitics |
| 3dB 90° Couplers DB0805 | Splitter or Combiner | Balanced Amplifiers Signal Distribution | | Miniature Size 0805, Low Loss, High Isolation, 10 W Power Handling, Surface Mountable |
| Microwave MLC’s | AQ              |                 | Cellular, Satellite GPS, Communications VCO’s, Matching Networks | 500 to 100 WVDC, Tight Tolerance, High Power Handling |
| High-Q, High RF Power MLC | HQC Series Sizes A, B, C & E | | Cellular, Satellite GPS, Communications VCO’s, Matching Networks | 4000 to 100 WVDC, Tight Tolerance, High Power Handling, Lowest ESR, Ceramic |
| SAW Filters | SF30 (3.0 x 3.0 mm) | SMD RF SAW Filter | Telecom GPS Band (1575 MHz) | Low Profile Package |
| | SF25 (2.5 x 2.0 mm) | SMD RF SAW Filter | Telecom GPS Band (1575 MHz) | Low Profile Package |
| | SF16 (1.6 x 1.4 mm) | SMD RF SAW Filter | Telecom GPS Band (1575 MHz) | Low Profile Package |
| | PAFC | SMD RF SAW Filter | Automotive and Consumer | Low Profile Package |

**Latest Technology**
- Increased The Capacitance Value On The 0402 & 0201 Size
- Increased The Capacitance Value On The 0402 & 0201 Size
- Decreased Size and Directivity
- Smallest Available In The Market
- GPS Unbalance Type Front End: SF30-1575F6U003
- Interstage: SF30-1575S6U003
- PCS Unbalance Type Rx: SF30-1960M6UU00
- Tx: SF30-1880M6UU00
- Tx-half: SF30-1880H8UU00
- GPS Unbalance Type Front End: SF25-1575F4U00
- Interstage: SF25-1575S4U00
- PCS Balance Type Rx: SF25-1960MSUB01
- PCS Unbalance Type Tx-half: SF25-1880HSUU00
- GPS Unbalance Type Front End: SF16-1575F4U00
- Interstage: SF16-1575M4UU00
- PCS Balance Type Rx: SF16-1960M5UB01
Committed To Quality & Development
Murata is a global leader in the design, manufacture and sale of ceramic-based passive electronic components and modules. Committed to the development of advanced electronic materials and leading edge, multi-functional, high-density modules Murata utilizes gallium arsenide (GaAs) and multi-layer LTCC technology as core components of next generation products. By virtue of its fully integrated production system, which covers all stages from raw materials to finished product, Murata has accumulated wide-ranging versatile expertise in various technologies associated with functional materials. Vertical integration with circuit design technology, processing and production technology, and measurement and evaluation technology, has allowed us to develop hybrid ICs “HIC” and products based on ceramic multi-layer technology. Presently, the horizon of our development activities is extending to include the planned commercialization of integrated module products.

Innovating Miniaturization and Integration
As more functions are incorporated into modern handheld devices, the need for smaller and more highly integrated components are required. Many designers are utilizing modular designs to reduce the part count, allow for design flexibility, and to increase the functionality of wireless devices. Murata continues to miniaturize our microwave discrete components and also to integrate those into both LTCC and organic modules. Murata also has the capability to mount a variety of active components from external or internal sources. This expertise allows for full system on a chip modules not only integrating the passives, but also incorporating the RF and baseband IC’s into the high-density, functional package.

One-Stop Shopping
More and more equipment manufacturers are reducing the number of suppliers to reduce costs and to streamline the supply and logistics channel. Murata offers a broad line of Microwave components for many of today’s mainstream and emerging wireless standards. Designers can select from Dielectric, LC, and SAW Filters, Baluns, Couplers, Isolators, Antennas, and even connectors and cable assemblies for discrete designs. Alternatively, Murata also develops and manufactures highly integrated modules and submodules for GSM, CDMA, W-CDMA, and 802.11 such as SAW and Dielectric Duplexers, Voltage Controlled Oscillators, Phase Locked Loop Modules, Front-End Switching Modules, and BluetoothTM Modules.

Materials Are At The Core
As a pioneer in the development of dielectric ceramic materials, Murata now has developed microwave compounds with superior characteristics. In addition, it has established advanced techniques for thin-film forming and micro-processing, as well as for microwave circuit design.
<table>
<thead>
<tr>
<th>Type</th>
<th>Series</th>
<th>Function</th>
<th>Applications</th>
<th>Benefits</th>
<th>Latest Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dielectric Duplexer</td>
<td>DFY Series</td>
<td>Allows Talk and Listen At the Same Time. (Duplexer)</td>
<td>Base stations, WLL, MMDS, W-CDMA, CDMA800/1900</td>
<td>Good Performance, Bigger Size</td>
<td>Size Reduction To Compete With SAW &amp; F-Bar. Customization Where Applicable.</td>
</tr>
<tr>
<td>Dielectric Duplexer</td>
<td>DFC21G57LDJAB, DFCB21G57LCJAA, DFCB21G57LBJAB, DFCB21G57LDJAA, DFCB22G32LBJAA, DFCB23G32LBJAA, DFCB23G33LBJAA</td>
<td>Removes Unwanted Signals. (Filters)</td>
<td>SDARS, GPS, Base stations 802.11a WLAN WLL, MMDS, STB</td>
<td>Good Attenuation, Moderate Skirts, Good Insertion Loss</td>
<td>Customization Where Applicable.</td>
</tr>
<tr>
<td>SAW Duplexer</td>
<td>SAY Series</td>
<td>Allows Talk and Listen At the Same Time. (Duplexer)</td>
<td>CDMA800, AMPS, W-CDMA</td>
<td>Small package Good Performance</td>
<td>Shrinking the Size By Chip Scale Packages</td>
</tr>
<tr>
<td>SAW Filter</td>
<td>SAFCH345HAM0T00, SAFCH355HAM0T00, SAFCH355MAL0T00, SAFSD1G7FAT000, SAFSE1G57AB0T00, SAFSE1G57AB0T10, SAFSE1G57KA0T05, SAFSE1G57KC0T00</td>
<td>Removes Unwanted Signals. (Filters)</td>
<td>GPS, GSM, CDMA, W-CDMA (RF Filter) SDARS, 802.11a WLAN CDMA, W-CDMA GSM(IF Filter)</td>
<td>Small Size, Good performance, Moderate Cost</td>
<td>Shrinking The Size By Chip Scale Packages, Integration Into FEM</td>
</tr>
<tr>
<td>SAW Resonator</td>
<td>SARCC315M008XL0, SARCC315M008XMO, SARCC350M008XP0, SARCC350M008XTL0, SARCC433M928XLM0, SARCC433M928XMO, SARCC433M928XP0</td>
<td>Provides A Stable Reference Frequency.</td>
<td>RKE, TPM5, GDO, Security</td>
<td>Small Size, Good Performance</td>
<td>Size Reduction To 3x3mm (SC33 package)</td>
</tr>
<tr>
<td>VCO, PLL &amp; RF Sub-modules</td>
<td>MQK, MQL, MQR, MQE9, MQW, HFQ, HFX</td>
<td>Provides A Stable Reference Frequency For Down And Up Converting Signals. Used In The Synthesizer Portion Of The Block Diagram.</td>
<td>Highly Customized With Focus Around The IC For CDMA W-CDMA, iDEN</td>
<td>Simple And Flexible Module Compared To Designing A Discrete Solution</td>
<td>Size Reduction While Integrating More Functions. Offer Small Number Of Standardized Values To Cover More Applications.</td>
</tr>
<tr>
<td>Multi-layer Products</td>
<td>LDC, LDB, LFB, LFD</td>
<td>Coupler, Balun, LC filter, Diplexer</td>
<td>Wireless, Bluetooth, 802.11a/b/g, GSM, CDMA</td>
<td></td>
<td>Size Reduction, Integrated Balun.</td>
</tr>
<tr>
<td>GaAs Products</td>
<td>XM, MF</td>
<td>Greatly Increases Output Power With Little Noise. Switches Between Talk And Listen Or Between Two Systems.</td>
<td>802.11a/b/g WLAN, 5GHz Cordless phone, Bluetooth</td>
<td></td>
<td>Integrating into LTCC To Make Combo Modules And No-Match Modules</td>
</tr>
<tr>
<td>Connector, Antenna &amp; Isolator</td>
<td>MM, MX</td>
<td>Move Signals From PCB To PCB Or RF Test Point.</td>
<td>Various</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>CE</td>
<td>Allows Signal To Flow In Only One Direction.</td>
<td>CDMA, EDGE</td>
<td></td>
<td>Shrinkig The Isolator Size</td>
</tr>
<tr>
<td></td>
<td>LDA31, ANC</td>
<td>Converts Electrical Signals Into Electromagnetic Signals</td>
<td>802.11a/b/g, Bluetooth, GPS</td>
<td></td>
<td>Shrinkig The Antenna Size And Moving To Copper Elements To Reduce The Cost</td>
</tr>
</tbody>
</table>
At the Leading Edge
Pulse is one of the largest magnetic component design and manufacturing companies. With over 19,000 employees worldwide and an extensive line of state-of-the-art magnetic solutions for local area network, power, automotive, telecommunications and RF/Cable applications, Pulse has become a leading global supplier of magnetic components to OEMs and contract manufacturers.

RF Components Quality & Compatibility
Pulse offers a comprehensive line of RF magnetic components to the worldwide OEM market. They include RF diplexers, splitters, combiners, directional couplers, balun transformers, as well as chip inductors.

The components can be used in a variety of worldwide RF applications such as modem gateways, CATV or Satellite Set top Box, Fiber to the Premise (FTTP), Personal Computer (PC) Video, and Video equipment designs. By working closely with leading IC manufacturers, Pulse components are either certified or conformant to each specification to ensure quality and compatibility designs.

Innovations Through Distribution & Technologies
As the result of today’s globalization, technologies are developing and changing at a “neck-breaking” speed. Pulse’s engineering design centers and manufacturing facilities in North America, Europe and Asia leverage each other’s expertise as well as local technologies to innovate Pulse product offerings.

Pulse supplies product to a broad customer base. Sales and service operations in the United States, Canada, United Kingdom, France, Italy, Singapore, Taiwan, and Hong Kong, as well as authorized distributors and representatives worldwide, support Pulse customers around the globe.

“Swap & Play” Components
Many of Pulse components share the same foot-print with different electrical performances. This approach allows manufacturers to minimize development costs as well as maximize product market coverage.

Lead-Free Components
According to the 2nd EU Lead-Free Soldering Technology Roadmap published by Soldertec Global earlier this year—December 2003 is the time that, on average, every electronics assembly manufacturer is expected to have released at least one lead-free product onto the European market. As International Communities are sourcing for lead-free components compliant, many Pulse components have been designed and produced with lead-free initiatives in mind.

Pulse is ready to supply manufacturers with lead-free components today. These Pulse lead-free components are designed to meet or exceed existing applicable lead-free standards.
# Pulse RF & Microwave Products

<table>
<thead>
<tr>
<th>Series</th>
<th>Function</th>
<th>Applications</th>
<th>Benefits</th>
<th>Latest Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diplex Filters</td>
<td>Splits the Upstream frequencies from the Downstream frequencies</td>
<td>Tuner ICs, Video-On-Demand, Pay-Per-View, Integrated Modems</td>
<td>Replaces “Canned Tuner” which held a single tuner, diplexer and balun transformers.</td>
<td>Custom shielded diplexers; improved port-to-port isolation in custom products.</td>
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<tr>
<td>CX6002</td>
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<tr>
<td>CX6007</td>
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<tr>
<td>CX6008</td>
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<tr>
<td>CX6016</td>
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<tr>
<td>Transformers &amp; Baluns</td>
<td>Convert balanced amplifier output to unbalanced coaxial cable.</td>
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<tr>
<td>CX2024</td>
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<tr>
<td>CX2040L</td>
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<tr>
<td>CX2078</td>
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<td>CX2072</td>
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<tr>
<td>CX2073</td>
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<tr>
<td>Balun Transformers</td>
<td>C2079 (Coming Soon)</td>
<td>Satellite Receiver</td>
<td>Higher frequencies than Cable STB's</td>
<td></td>
</tr>
<tr>
<td>RF/Splitter/ Combiners (i.e. Power Dividers)</td>
<td>Splits TV signal into two signals, each to separate tuners.</td>
<td>Picture-in-Picture, On-Screen Guides, Data Modem Analog, Signal Tuning Digital, Signal Tuning, PVR, TV Output Port</td>
<td>Uses multiple tuners instead of single &quot;Can&quot;. Separate tuner is required for each of the functions.</td>
<td>Multiport Splitters (3-way, 4-way)</td>
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<tr>
<td>C4006</td>
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<tr>
<td>CX4011</td>
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<td>CX4004</td>
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<tr>
<td>CX4012</td>
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<tr>
<td>C4020*</td>
<td>*(Differential Mode)</td>
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<tr>
<td>Directional Couplers</td>
<td>Splits TV signal into two signals, each to separate tuners. Signal is split into lower power level on port 2.</td>
<td></td>
<td></td>
<td>Family of lower cost directional couplers</td>
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<tr>
<td>C3027</td>
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<tr>
<td>CX3030</td>
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<td>CX3039</td>
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</tbody>
</table>

Only a portion of the available products are shown. Additional packages and products are available, call TTI, Inc. for details.
Design & Manufacturing Leadership
Spectrum Control is a leader in the design and manufacture of control products and systems used to condition, regulate and govern electronic performance. Over the past several years, we have leveraged our core electromagnetic interference (EMI) filtering expertise to offer customers a broad line of signal, power, and frequency control products. Operations are conducted currently in three reportable segments: signal integrity products; power integrity products and management systems; and frequency control products.

Signal Integrity Products Group
Our Signal Integrity Products Group designs and manufactures a broad range of low pass EMI filters, surface mount EMI filters, filtered arrays, filtered connectors, gaskets, and specialty ceramic capacitors. Our Power Integrity Products and Management Systems Group designs and manufactures numerous power integrity products (power line filters, power entry modules, multi-section filters, power terminal blocks, and custom power filter assemblies) and power management systems (power distribution units, remote power management systems, fuse interface panels, breaker interface panels, and custom power distribution systems). The recently developed Frequency Control Products Group designs and manufactures ceramic resonators and bandpass filters, ceramic patch antennas, duplexers, lumped element filters, cavity filters, waveguide filters, and related products and systems.

Signal & Power Integrity Group
As a vertically integrated producer of ceramic capacitors and filters, we continue to provide the widest range of discrete EMI filters, filtered connectors, ferrite inductors and filtered power products. In addition, we have extended our ceramic technology to develop our line of wireless components.

Spectrum Control’s Power products highlighted in this guide have many applications in industries such as telecommunications, medical, industrial equipment, power supplies, elevator equipment, vending equipment, gaming machines, traffic control, secure communications, UPS, digital equipment, appliance, power amplifier, measuring instruments and various military applications.

Frequency Control Products Group
In order to extend our line of microwave products, we recently acquired FSY Microwave, including all products and design expertise. The new Spectrum FSY Microwave family of SPECWAVE components and systems provides a wide range of frequency control solutions.

SPECWAVE is now a broad family of wireless components including ferrite beads and inductors, ceramic inductors, chip capacitors, ceramic substrates, ceramic resonators, resonator discs, LC filters, duplexers, bandpass filters, antenna elements and value added services. These new wireless components are available with a wide range of performance characteristics and sizes to provide designers the flexibility to satisfy varied filtering and real estate concerns.
## Spectrum Control RF & Microwave Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Series</th>
<th>Application</th>
<th>Function</th>
<th>Features &amp; Benefits</th>
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<tbody>
<tr>
<td>Power Surface Mount (PSM) Filters &amp; Square Surface Mount (SSM) Filters</td>
<td>PSM, SSM</td>
<td>Power Amplifiers, Power Supplies, Temperature &amp; Motor Controls, High Current Bus Lines, and Driver Circuits</td>
<td>Current Rating: PSM 20 Amps (FT), and 10 Amps (PI); SSM 10 Amps</td>
<td>Insertion Loss Range: Effective filtering to 18 GHz in a shielded application</td>
</tr>
<tr>
<td>Microwave Discrete Filters</td>
<td>SCI-99xx, 54-874</td>
<td>Ideal for Microwave Applications Such As Attenuators and Oscillators. Perform Well in High Impedance Circuits Where Large Capacitance Values Are Not Practical</td>
<td>Small Size Options: Solder-In, Press-In, 2-56 Threaded</td>
<td>Insertion Loss Range: Effective filtering to 18 GHz in a shielded application</td>
</tr>
<tr>
<td>Resin Sealed/ Solder-in Capacitors and Filters</td>
<td>51-7 54-7 12xx-xxx, SCI-31xx</td>
<td>Telecommunications Equipment, Transceivers, Microwave Filters, Industrial Control Systems, Multi-Circuit Filter Assemblies</td>
<td>Cost Effective: Resin sealed filters provide environmental protection at low cost</td>
<td>Insertion Loss Range: Effective filtering to 18 GHz in a shielded application</td>
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<tr>
<td>Filter Plate Assemblies</td>
<td>52-898-52-978-92-970-</td>
<td>Telecommunications Equipment, Cellular Base Stations, Linear Power Amplifiers, Cellular Microcell Repeaters, Industrial &amp; Scientific Remote Sensory, and Medical Equipment</td>
<td>Total Reduced Costs: Economical method of meeting EMC requirements</td>
<td>Insertion Loss Range: Effective insertion loss from 1 MHz to 18 GHz with proper installation</td>
</tr>
<tr>
<td>Coaxial Ceramic Resonators/ Inductors</td>
<td>CR</td>
<td>All Wireless Equipment</td>
<td>Broad Performance Ranges: 0.4 to 5 GHz frequencies, Q Value from 200 - 800, Temperature stable devices</td>
<td>Design Options: Variety of sizes from 2mm-12mm to meet applications specific needs 1/2 wave and 1/4 wave design options</td>
</tr>
<tr>
<td>Bandpass Filters and Duplexers (Resonator Type)</td>
<td>BP, DP</td>
<td>Land Mobile Radios, Cellular and Satellite Transceivers, CATV Equipment</td>
<td>Broad Performance Ranges: 0.4 to 6 GHz frequencies, Suitable for 50 or 75 Ohm systems</td>
<td>Design Options: Flexibles design for Small to large volumes, 2 to 9 pole designs from 300 MHz To 6 GHz; various resonator widths to meet performance expectations</td>
</tr>
<tr>
<td>Bandpass Filters and Duplexers (Monoblock Type)</td>
<td>MB, MD</td>
<td>Land Mobile Radios, Cellular and Satellite Transceivers, WLAN, GPS Systems, Cellular Handsets &amp; Radio Systems</td>
<td>Broad Performance Ranges: 0.4 to 5 GHz Frequencies, Suitable for 50 Ohm systems, Broad Temperature Range: Suitable for commercial and military requirements</td>
<td>Design Options: Flexible designs for medium to large volumes, 2 to 12 pole designs for aggressive specifications from 300 MHz to 6 GHz</td>
</tr>
</tbody>
</table>
**Glossary**

**Amplitude**: The magnitude of variation in a changing quantity from its zero value. The word required modification—as with adjectives such as peak, maximum, RMS, etc., to designate the specific amplitude in question.

**Analog**: The traditional method of transmitting voice signals where the radio wave is based on electrical impulses, which occur when speaking into the phone.

**Antenna**: An array of metal rods or wires used to intercept radio waves and convert them into electrical currents. In microwave applications, this is often a parabolic reflector with an associated feed mechanism.

**Bandwidth**: The range of frequencies for which performance falls within specific limits.

**Base Station**: The fixed transmitters/receiver with which a mobile radio transceiver establishes a communication link to gain access to the public-switched telephone network.

**BNC (Bayonet Neill Concelman)**: Coaxial connector with bayonet coupling mechanism. Available in 50 Ohm and 75 Ohm versions. Frequency range DC-4 GHz (50 Ohm) and DC-1 GHz (75 Ohm), respectively. Named after Amphenol Engineer Carl Concelman, and Bell Labs Engineer Paul Neill.

**Bulkhead**: A term used to define a mounting style of connectors. Bulkhead connectors are designed to be inserted into a panel cutout from the rear (component side) or front side of the panel.

**Code-Division Multiple-Access (CDMA)**: A digital technology that uses a low-power signal “spread” across a wide bandwidth. A call is assigned a code instead of a certain frequency. In identifying the code and a low-power signal, a large number of callers can use the same group of channels.

**Coaxial Cable**: A transmission line consisting of two concentric conductors insulated from each other. In its flexible form it consists of either a solid or stranded center conductor surrounded by a dielectric. A braid is then woven over the dielectric to form an outer conductor. A protective plastic covering is placed on top of the braid.

**Contact Resistance**: Measurement of electrical resistance of mated contacts when assembled in a connector under typical service use. Electrical resistance is determined by measuring from the rear of the electrical area of one contact to the rear of the mating contact (excluding both crimps) while carrying a specified test current.

**Contact Retention**: Defines minimum axial load in either direction which a contact must withstand while remaining firmly fixed in its normal position within an insert.

**Coplanarity**: The distance between the lowest and highest lead when the connector is laying in its seating plane.

**Crimp**: Act of compressing (deforming) a connector ferrule around a cable in order to make an electrical connection.

**Conversion Loss**: The ratio (in dB) of the IF output power of a mixer to the RF input power. All conversion loss measurements and specifications are normally based on the mixer being installed in a system with wideband 50 ohm resistive terminations on all ports and a stated LO signal power level being applied.

**Coupler**: A Waveguide device used to sample the microwave transmissions by means of coupling (combining) signals asymmetrically. May be of the crossguide or directional variety. Available at various coupling levels (typically 10 to 50 dB below the signal of interest).

**Cut-off Frequency (fc)**: The frequency, above which other than the TEM mode may occur. The transmission characteristics of cables above their cut-off frequency may be unstable.

**Cycle**: One complete sequence of values of an alternating quantity, including a rise to maximum in one direction and of return to zero. The number of cycles occurring in one second is called the frequency.

**Decibel (dB)**: A relative unit without dimensions calculated as ten times the logarithm to the base 10 of a power ratio or as twenty times the logarithm to the base 10 of a voltage ratio. Note: What is commonly measured as VSWR in the RF world is referred to as return loss and measured in dB in the CATV industry.

**Dielectric (in cable)**: The insulation between inner and outer conductor. It significantly influences electrical characteristics such as impedance, capacitance, and velocity of propagation.

**Dielectric Constant**: Electrical property of a material that describes its behavior in an electric field. The dielectric constant of the dielectric is the most important design parameter for coaxial cables and determines dimensions, losses and propagation characteristics.

**Dielectric Strength**: The voltage which an insulating material can withstand before breakdown occurs.

**Digital**: Pertaining to the utilization of discreet integral numbers in a given base to represent all the quantities that occur in a problem or a calculation. It is possible to express in digital form all information stores, transferred or processed by a dual-state condition; e.g., on-off, open-closed and true-false.

**Digital Modulation**: A method of transmitting an analog (continuously variable) signal using the computer's binary code, 0s and 1s. Digital transmission offers a cleaner signal than analog technology. Cellular systems providing digital transmission are currently in operation in several locations.

**Distortion**: An unwanted change or addition to a signal or waveform when it is amplified. This definition excludes noise which is an extraneous signal superimposed on the desired signal.

**Dummy Load**: A dissipative device used at the end of a transmission line or waveguide to convert transmitted energy into heat, so essentially no energy is radiated outward or reflected back to its source.

**Electromagnetic Interference (EMI)**: Unintentional interfering signals generated within or external to electronic equipment. Typical sources could be power-line transients, noise from switching-type power supplies and/or spurious radiation from oscillators. EMI is suppressed with power-line filtering, shielding, etc.

**Ferrule**: A short tube to make solderless connections to shielded or coaxial cable (e.g. as in crimping).

**Flange**: A projection extending from, or around the periphery of, a connector and provided with holes to permit mounting the connector to a panel, or to another mating connector half.

**Frequency**: The number of cycles per second of an electromagnetic transmission. 1 hertz (Hz) = 1 cycle per second; 1 kilohertz (kHz) = 1,000; 1 megahertz (MHz) = 1,000,000; 1 Gigahertz (GHz) = 1 billion.

**Frequency Modulation (FM)**: A scheme for modulating a carrier frequency in which the amplitude remains constant but the carrier frequency is displaced in frequency proportionally to the amplitude of the modulating signal. An fm broadcast is practically immune to atmospheric and man-made interference.

**Gigahertz (GHz)**: One billion cycles per second (1x10⁹).
Harmonic Signals: Signals which are coherently related to the output frequency. In general, these signals are integer multiples of the output frequency.

Hertz (Hz): International standard term for cycles per second. Named after the German physicist Heinrich R. Hertz (e.g. 60 cycles per second is equal to 60 hertz or 60 Hz).

Impedance: Characteristic property of a transmission line describing the ratio between electric and magnetic fields.

Impedance Match: A condition in which the impedance of a component or circuit is equal to the internal impedance of a transmission line. This gives maximum transfer of energy from the source to the load, as well as minimum reflection and distortion.

Inductance: The property of a circuit or circuit element that opposes a change in current flow, thus causing current changes to lag behind voltage changes. It is measured in Henrys.

Insertion Loss: The loss in load power due to the insertion of a component, connector or devise at some point in a RF transmission system. Generally expressed in decibels as the ratio of the power received at the load before insertion of the apparatus, to the power received at the load after insertion.

Isolator: A device that permits microwave energy to pass in one direction while providing high isolation to reflected energy in the reverse direction. Used primarily at the input of communications-band microwave amplifiers to provide good reverse isolation and minimize VSWR. Consists of microwave circulator with one port (port 3) terminated in the characteristic impedance.

Insulation Resistance: The electrical resistance of the insulating material (determined under specified conditions) between any pair of contacts, conductors, or grounding device in various combinations.

Intermodulation (IMD): A phenomenon that occurs when two or more fundamental frequencies are present in an electronic circuit.

Ku-Band: The portion of the microwave spectrum (12,000-18,000 MHz) used in many newer video satellite transmissions, particularly in Direct Broadcast Satellite (DBS) systems designed for home reception.

Line Impedance: Impedance as measured across the terminals of a transmission line; frequently the characteristic impedance of the line.


MHV (Miniature High Voltage): Coaxial connector with bayonet coupling mechanism. Working voltage 2.2 kV DC.

Microwave: That portion of the electromagnetic spectrum lying between the far infrared and conventional radio frequency range. The microwave frequency range extends from 1 GHz to 300 GHz. Microwaves are usually used in point-to-point communications because they are easily concentrated into a beam.

MMCX: Miniature Microcoax connector with snap-on coupling mechanism. Available in 50 Ohm and 75 Ohm versions. Frequency range DC-6 GHz.

Noise Figure (NF): The ratio (in dB) between the signal-to-noise ratio applied to the input of the microwave component and the signal-to-noise ratio measured at its output. It is an indication of the amount of noise added to a signal by the component during normal operation. Lower noise figures mean less degradation and better performance.

Ohm: The unit of measurement for electrical resistance. A circuit is said to have a resistance of one ohm when an applied emf of one volt causes a current of one ampere to flow.

Output Frequency: The frequency of the desired output of the component. The undesired frequency components may include harmonics, subharmonics, 3/2 harmonics or nonharmonic spurious signals.

Output Power: The minimum and/or maximum output power at the output frequency under all specified conditions. Usually the specified conditions are temperature, load, VSWR and supply voltage variations. It is typically expressed in dBm or milliwatts (mW).

Permeability (magnetic): The measure of how much better a material is than air as a path for magnetic lines of force. Air is assumed to have a permeability of 1.

Power Amplifier: The final stage of amplification in a radio, the purpose of which is to raise the signal to the level required by the antenna system.

Power Divider: A passive resistive network that equally divides power applied to the input port between any particular number of output ports without substantially affecting the phase relationship or causing distortion.

Press-Fit Contact: An electrical contact which can be pressed into a hole in an insulator, printed board (with or without plated-through holes), or a metal plate.

Propagation Delay: Time required for an electronic digital device, or transmission network to transfer information from its input to its output.

Pulse: A change in the level, over a relatively short period of time, of a signal whose value is normally constant.

Pulse Amplifier: Amplifiers specifically optimized and characterized for fast pulse droop and minimum overshoot—to handle complex input waveforms and pulse-modulating RF signals.

Pulse Width: The length of time that the pulse voltage is at the transient level. Electronic pulse widths are usually in the millisecond (10^-3), microsecond (10^-6) or nanosecond (10^-9) range.

Q: Generally a measure of the sharpness of the resonance or frequency selectivity of a tuned circuit or filter.

Quantization: The representation of a continuous quantity, such as a sound wave, by a series of numeric values.

Reflection Loss: The part of a signal which is lost due to reflection of power at a line discontinuity.

RF: Radio Frequency - Generally referring to any frequencies at which the radiation of electromagnetic energy is possible. Also used as designation for frequencies at which the radiation of electromagnetic energy is possible. Also used as designation for frequencies below approximately 50 to 100 MHz (100 - 300 MHz is very high frequency, 300 MHz - 1000 MHz is ultra-high frequency, 1000 MHz and up is microwave).

RF Leakage: RF Leakage is defined as the amount of energy which “leaks” from the connector and/or component. Although RF Leakage will vary with frequency, it is typically tested at only one frequency. Leakage, like Insertion Loss, is expressed in dB. Very large negative dB values indicate that the device does not radiate much energy.
Screening Effectiveness: Ratio of the power fed into a coaxial cable to the power transmitted by the cable through the outer conductor.

Self-Align: Design of two mating parts so that they will engage in the proper relative position.

Self-Alignment: The tendency of leads to center themselves on solder pads due to the surface tension of the liquid solder.

SHV (Safe High Voltage): Coaxial connector with bayonet coupling mechanism. Working voltage 5 kV DC.

Signal-to-Noise Ratio (S/N): The ratio of signal power to noise power in a specified bandwidth, expressed in dB.

Skin Effect: The phenomenon wherein the depth of penetration of electric currents into a conductor decreases as the frequency of the current increases.

SMA (Subminiature A): 50 ohm - subminiature coaxial connector with screw type coupling mechanism. Frequency range DC-18 GHz.

SMB (Subminiature B): Subminiature coaxial connector with snap-on coupling mechanism. Frequency range DC-4 GHz.

SMC (Subminiature C): Subminiature coaxial connector with screw type coupling mechanism. Frequency range DC-10 GHz.

SMS: Subminiature coaxial connector with slide-on coupling mechanism. Frequency range DC-4 GHz.

Solder Contact: A contact or terminal with a cup, hollow cylinder, eyelet or hood to accept a wire for a conventional soldered termination.

Spring-Finger Action: Design of a contact, as used in a printed circuit connector or a socket contact, permitting easy, stress-free spring action to provide contact pressure and/or retention.

Standing-Wave: Distribution of current and voltage on a transmission line, resulting from two sets of waves traveling in opposite directions.

Spectrum: The complete range of electromagnetic waves that can be transmitted by natural sources such as the sun, and man-made radio devices. Electromagnetic waves vary in length and therefore have different characteristics. Longer waves in the low-frequency range can be used for communications, while shorter waves of high frequency show up as light. Spectrum with even shorter wavelengths and higher frequencies are used in X rays.

Substrate: The wafer of ceramic on which the thin-film circuit is deposited in hybrid microwave integrated circuit construction.

Transition: A waveguide device used to convert from waveguide to coaxial transmission lines.

Transmission Loss: The decrease of loss in power during transmission of energy from one point or another. Usually expressed in decibels.

Transponder (i.e. satellite): One communications satellite "channel" consisting of an uplink receiver, intermediate signal processing components and downlink transmitter. One transponder may be configured to carry many different signals.

Triaxial Cable: A cable consisting of one center conductor and two outer concentric conductors (with an insulating layer separating them). Notable for increased shielding efficiency.

Twinaxial Cable: Two conductors that are insulated from one another, twisted together and surrounded by a common shield.

UG: Symbol used to describe coaxial connectors that were made to a government specification. This specification is now obsolete.

UHF: Coaxial connector with screw type coupling mechanism invented in the 1930’s by Amphenol engineer E. Clark Quackenbush for use in the radio industry. Non-defined impedance. Frequency range DC.

Ultra High Frequency (UHF): A Federal Communications Commission designation for the band from 300 MHz to 3,000 MHz (3GHz) on the radio spectrum.

UMTS: Universal Mobile Telecom Systems.

Very High Frequency (VHF): A Federal Communications Commission designation for the band from 30 to 300 MHz on the radio spectrum.

Velocity of Propagation: The speed of an electrical signal down a length of cable compared to speed in free space expressed as a percentage.

Voltage: The term most often used to designate electrical pressure that exists between two points and is capable of producing a flow of current when a closed circuit is connected between the two points. Voltage is measured in volts, millivolts, microvolts and kilovolts. The terms electromotive force (emf), potential, potential difference and voltage drop are often referred to as voltage.

VSWR (Voltage Standing Wave Ratio): A unitless ratio ranging from 1 to infinity, expressing the amount of reflected energy. A value of one indicates that all of the energy will pass through, while any higher value indicates that a portion of the energy will be reflected.

WAN: Wide Area Network

Watt: A unit of electrical or acoustical power. Electrical power is the product of voltage and current. Acoustical power is proportional to sound-pressure intensity.

Wavelength: The distance, measured in the direction of propagation, of a repetitive electrical pulse or waveform between two successive points that are characterized by the same phase of vibration.

Wave Soldering: The most widely used mass soldering process, primarily for through-hole boards, where the board is passed over a wave of solder which laps against the bottom of the board to wet the metal surfaces to be joined.

WLAN: Wireless local area network. A computer network that allows the transfer of data and the ability to share resources, such as printers, without the need to physically connect each node with wires. WLANs may also offer mobility within an office or similar environment.

WLL: Wireless Local Loop.

WPBX: Wireless private branch exchange. The WPBX offers business users the ability to make and receive calls using cordless telephones anywhere on a company’s premises.


YIG: Yttrium-Iron Garnet is a synthetic crystalline ferrite containing yttrium and iron (Y3Fe5O12). If a single crystal sphere of YIG is immersed in a magnetic field, and RF energy is coupled into it via a magnetic loop, the crystal will resonate at a frequency linearly proportional to the magnetic field strength. In practical YIG-tuned oscillators and filters, the magnetic field is derived from an electromagnet and the resonant frequency of the YIG sphere is proportional to the current flowing through the magnetic coil.