Applications

RF/microwave switches find use in a wide variety of signal routing applications for test and measurement systems. Typical applications include:

- Selection of multiple signal sources to one output
- Selection of multiple input signals to one measurement instrument
- Transfer switching to insert or remove a device in a signal path
- Matrix switching of multiple inputs and outputs

Technology

Agilent electromechanical coaxial switches feature low insertion loss, high isolation, broadband performance, long life and exceptional repeatability. Agilent coaxial switches are all designed with an “edge-line” coaxial structure. This transmission line structure provides for movement of the edge-line center conductor between two fixed, continuous ground planes. The main advantage of this innovation is that the moving contacts can be easily activated, yet maintain high isolation and low insertion loss.

The RF contact configuration is designed for controlled wiping action. Since the outer conductor is not part of the switching function, repeatability and life are enhanced. The switching action occurs typically within 15 to 30 milliseconds, after which permanent magnets latch the contacts to retain the new switch position.

Key specifications

- Frequency range
- Input power
- Insertion loss
- Isolation
- SWR
- Repeatability
- Life

Frequency range

One of the main advantages of electromechanical switches is that they transmit signals all the way down to dc. The top frequency limits are set by the size of the coaxial structure and connectors. Various Agilent models are available up to 40 GHz. Parameters such as insertion loss, isolation and SWR behave in a predictable manner. Typically, these parameters will linearly degrade at higher frequencies.

Input power

The ability of a switch to handle power depends very much on the materials used for the signal carrying components of the switch and on the switch design. Two switching conditions should be considered: “hot” switching and “cold” switching. Hot switching occurs when RF/microwave power is present at the ports of the switch at the time of the switching function. Cold switching occurs when the signal power is removed before activating the switching function.

Hot switching causes the most stress on internal contacts, and can lead to premature failure. Cold switching results in lower contact stress and longer life, and is recommended in situations where the signal power can be removed before switching.

Insertion loss

Insertion loss for electromechanical switches is very low, ranging from 0.1 dB at low frequencies to 1.5 dB at high frequencies. This performance distinguishes them from solid-state switches which range from 0.5 dB to 6 dB. Factors that influence loss are: path length, types of material used on signal carrying surfaces, contact wear, corrosion or other contamination. Insertion loss can play an important role whether high or low power are present. In high-power systems, this additional loss may require that the source power be increased to compensate. In receiver applications, the effective sensitivity of the system is reduced by the amount of insertion loss. In other systems, additional power may not be available, due to the prohibitive cost of supplying more power.
Isolation

High isolation in switches is important to almost every measurement application, because it prevents unwanted signals from interfering with the desired signal. Isolation is the amount that the unwanted signal is attenuated before it is detected at the port of interest. Agilent switches have high isolation, with typical values >90 dB to 18 GHz and >50 dB to 26.5 GHz. High isolation can be particularly important in measurement systems where signals from sources are being routed. If too much power from an unselected source is allowed to flow through a device under test, measurement results will not be accurate.

SWR

The standing wave ratio (SWR) of a switch specifies how well the connectors and switching signal path are matched to an ideal 50-ohm transmission line. Low SWR is crucial in test set design when signal routing configurations involve multiple components in series, thereby adding to measurement uncertainty. SWRs of 1.1 to 1.5 are typical in Agilent switches.

Repeatability

Repeatability plays an important role in any test system. In test applications where accuracies of less than a few tenths of a dB are required, the system designer must consider the effects of switch repeatability in addition to test equipment capabilities. In automated test systems where switches are used for signal routing, every switch will add to the repeatability error. Such errors cannot be calibrated out of the system due to their random nature. Agilent switches are designed for high repeatability, 0.03 dB maximum over 5 million cycles.

Repeatability is a measure of the change in a specification from cycle to cycle over time. When used as a part of a measurement system, switch repeatability is critical to overall system measurement accuracy. Repeatability can be defined for any of the specifications of a switch, which includes: insertion loss, reflection, isolation and phase. Insertion loss repeatability is specified for all Agilent switches, as this tends to be the specification most sensitive to changes in switch performance.

Factors that affect insertion loss repeatability include:

- Debris
- Contact pressure
- Plating quality
- Contact shape and wiping action

Debris is generated in a switch when two surfaces come in contact during movement. The debris may find its way between contacts, causing an open circuit. Agilent has developed processes that control contamination and debris generation to minimize these effects.

Switch contacts are typically gold plated to maximize conductivity and minimize surface corrosion. Special plating materials, surface finish, contact shape and wiping pressure all combine to minimize surface effects on insertion loss repeatability.

Contact resistance is inversely proportional to contact pressure. Insufficient pressure increases life but also increases contact loss. Too much pressure damages the contact surfaces, with little insertion loss improvement. Contact surface wiping provides a means for breaking through surface corrosion and moving debris away from the contacts. This allows the switch to clean the contact surfaces with each switch cycle.

Life

The life of a switch is usually specified in cycles, i.e. the number of times it switches from one position to another and back. Agilent determines life by cycling switches to the point of degradation. Typically, Agilent switches, in life cycle tests, perform to specifications for at least twice as many cycles as warranted.

Four Agilent switch families have a specified life of 5 million cycles. This long life results in lower cost of ownership by reducing periodic maintenance, downtime and repairs.

Agilent offers a broad line of coaxial switches, covering up to 40 GHz, for use in test and measurement applications. All switches use magnetically-latched solenoids and are primarily designed with break-before-make RF contacts for test simplicity.
Agilent Technologies’ Test and Measurement Support, Services, and Assistance

Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlie Agilent’s overall support policy: “Our Promise” and “Your Advantage.”

Our Promise
Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

Your Advantage
Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and onsite education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

www.agilent.com/find/emailupdates
Get the latest information on the products and applications you select.

Agilent T&M Software and Connectivity
Agilent’s Test and Measurement software and connectivity products, solutions and developer network allows you to take time out of connecting your instruments to your computer with tools based on PC standards, so you can focus on your tasks, not on your connections. Visit www.agilent.com/find/connectivity for more information.

By internet, phone, or fax, get assistance with all your test & measurement needs

Phone or Fax

United States:
(tel) 800 452 4844

Canada:
(tel) 877 894 4414
(fax) 905 282 6495

China:
(tel) 800 810 0189
(fax) 800 820 2818

Europe:
(tel) (31 20) 547 2323
(fax) (31 20) 547 2390

Japan:
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Korea:
(tel) (82 2) 2004 5004
(fax) (82 2) 2004 5115

Latin America:
(tel) (395) 269 7500
(fax) (395) 269 7599

Taiwan:
(tel) 0800 047 866
(fax) 0800 286 331

Other Asia Pacific Countries:
(tel) (65) 6375 8100
(fax) (65) 6838 0252
Email: tm_asia@agilent.com

Online Assistance:
www.agilent.com/find/assist

Product specifications and descriptions in this document subject to change without notice.
Printed in USA December, 2000