

# Switch Matrix

Why buy a switch matrix from Keysight?

## Minimize Risk and Enhance Performance

An RF switch matrix provides automatic routing and signal conditioning between test equipment and the unit under test (UUT) in an RF/microwave ATE system.

Since ATE systems allow multiple measurements to be made automatically, the switch matrix decreases total measurement time and the number of manual connections to the UUT. Devices such as couplers, attenuators, amplifiers, and filters can be included in the matrix to provide signal conditioning.

Keysight Technologies, Inc. has developed a wide range of custom switch matrices; ranging from a simple 1 x 6 to a 10 x 10 non-blocking full access matrix, to complete custom switching and conditioning units. This experience allows us to cost-effectively leverage the best solution for your application.

Optimized custom switch matrices include components and design techniques that preserve the signal integrity necessary for your system application.



## Important RF design parameters include:

### Standing Wave Ratio (SWR)

- High SWR significantly reduces system performance.

### Insertion loss

- High-frequency power is expensive. Careful management of insertion loss can help control overall cost and insure consistent performance through multiple signal paths.

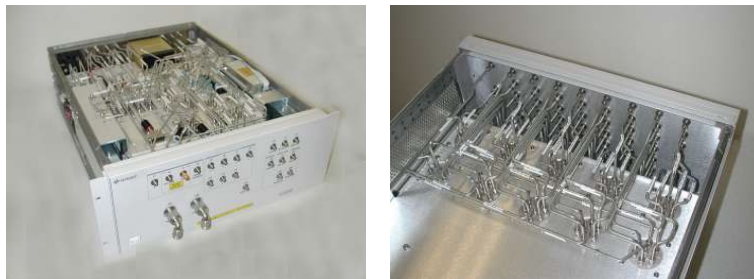


Figure 1. Optimized Switch Matrices from Keysight

### Isolation

- Low isolation degrades measurements, especially when low- and high-level signals are routed and measured at the same time.
- Phase Matching: Careful control of RF components and cables is necessary to ensure consistent signal integrity through multiple paths.

### Repeatability

- Test-set repeatability problems cannot be compensated by test software. They will directly impact measurement integrity and data correlation from system to system.
- As frequency increases, the importance of these performance parameters becomes more significant. Keysight engineers use sophisticated analysis tools to optimize predicted s-parameter performance and ensure measurement integrity in your system.



Figure 2. RF signal conditioning and switching

# What makes Keysight unique?

The keys to Keysight's exceptional switch matrix performance include our unmatched design experience, RF expertise, and our no-compromise manufacturing processes for switches, semi-rigid cables, matrix assembly and testing.

## 1. RF measurement expertise and test system experience provide the optimal design for your application

Keysight is a top supplier of RF solutions, including instruments, components, custom switch matrices, software, services and turn-key systems. This gives our engineers inside access to RF instrument measurement science and to RF component design. As a result, Keysight has unique expertise and experience to define and develop the most effective solution. Keysight system engineers have years of experience in evaluating system requirements, including technical, management and workflow.

The result is an optimized solution that will minimize critical signal degradation, leverage the available instrumentation & system resources, and address the full range of your system requirements.



**Figure 3.** RF Test System with Multiple Custom Switch Matrices



**Figure 4.** Keysight RF switches

## 2. Optimized RF component selection – for system performance and reliability

The performance of a switch matrix is primarily determined by the performance of its components, particularly the high frequency switches. Keysight system engineers specify the appropriate components for the application. In most cases we use Keysight switches. But we also use many RF components and switches from third parties.

Keysight switches have the best performance in the industry, with typical isolation of more than 90 db and SWR less than 1.2:1. Insertion loss repeatability is 0.03 db, resulting in higher measurement confidence.

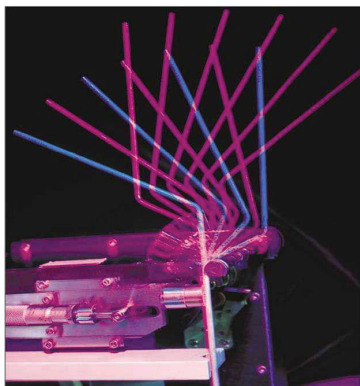
Keysight's multiport switch performance is guaranteed over a life of 5 million cycles, ensuring higher uptime for test system platforms.

The outstanding performance of our switches is the result of excellent design and rigid manufacturing tolerances. Every switch is tested for all specifications using high performance Keysight network analyzers.

### 3. Controlled manufacturing process for semi-rigid cables

Keysight's high quality switches provide the best building blocks for your matrix — and our high-quality semi-rigid cables transfer the optimum performance of these switches to your UUT.

The same Keysight manufacturing process that produces high-quality, semi-rigid coaxial cables for our RF and microwave instruments also makes the cables used in our custom switch matrices. For demanding applications such as phase matching, Keysight can tightly control cable bends, path lengths and other characteristics. For less demanding applications, Keysight can offer lower price “conformable” RF cables.



**Figure 5.** Semi-rigid cable automatic bending process



**Figure 6.** Clean design for ease of repair

### 4. Unique capabilities for your custom solution

#### Calibration

Your Keysight switch matrix solution may include the new Z2091B-300 RF Path Calibration Verification Pods. These unique pods can be used to improve the accuracy of RF measurements in situ, without the need to disconnect test cables or interrupt the test for re-calibration.

#### Built-in test

Keysight custom switch matrices may be designed with extensive built-in test. This capability includes defined line replaceable units (LRUs), a built-in controller, sources & detectors, and software to enable self-test and troubleshooting down to the signal path, switch or LRU.

#### Control interface

The typical Keysight custom switch matrix includes LAN control with a standard interface based on the Keysight 34980A Switch Platform. This graphical interface allows you to setup and control your switch matrix from anywhere on the network. If necessary, control may also be accomplished via DIO, serial or parallel bus. Optional capabilities include LED indicators, external switch drivers and alarm circuits.

Keysight can also provide a customized and highly-intuitive graphical interface that allows control of each component by clicking on its symbol in a detailed block diagram. This provides excellent visibility into operation and troubleshooting, and is often accompanied by extensive built-in-test.

## Form Factor

The typical Keysight custom switch matrix is packaged in a rack-mount enclosure with size, weight, connector type and location designed to your specifications. Keysight can also provide custom packaging. We have experience in many standard and custom form factors, including bench-top and plug-in modules.

### 5. Fully-tested solution

After your switch matrix is built, Keysight will use a Performance Series Network Analyzer to verify the S-parameter performance of every signal path over the full specified frequency range. The test data is included in the standard documentation you receive with the matrix.

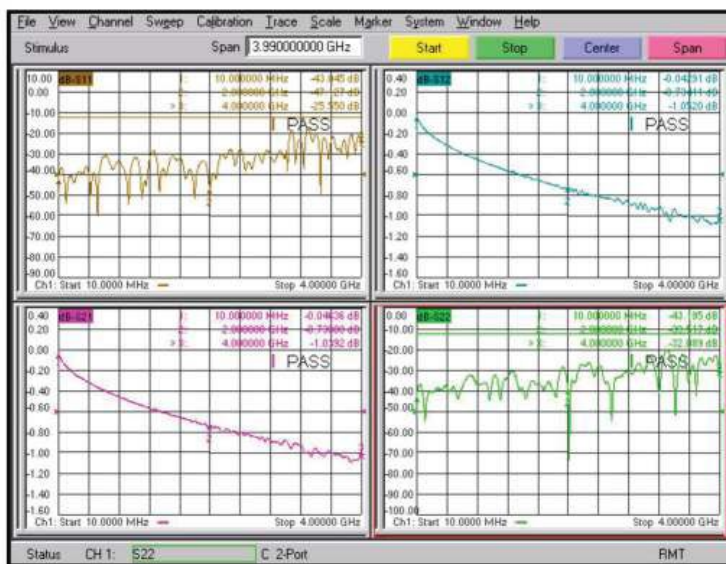


Figure 7. Sample of S-parameters final test data

## 6. Standard process for a custom solution

Keysight uses a standard ISO-certified process to capture your requirements, define your solution and complete development and delivery.

The process starts when you contact Keysight. Our sales representative works with you to understand your specific technical and management requirements. Once the requirements are documented, we will provide you with a detailed proposal including an RF block diagram, specification, price, and delivery.

As needed, we may list cost or performance improvement suggestions. After you approve the optimized proposal, our engineering team will design the switch matrix. The process typically includes checkpoint reviews where you will approve the detailed design and test plan prior to manufacturing.

Keysight will then use our standard commercial manufacturing process to build your custom switch matrix. This phase concludes with acceptance testing, customized to your requirements.



**Figure 8.** Fully assembled custom switch matrix

# How Can Keysight Help?

In today's highly competitive business world, you are faced with tough management decisions. How can Keysight help?

## Schedule management

We know that delays in your development or manufacturing processes can critically affect your success. You can't afford late delivery of the system. So let Keysight reduce the risk by providing the switch matrix. Through our experience and mature processes, we can meet your schedule.

## Resource management

Your resources are limited, and you need to concentrate your valuable engineering resources on core competencies that generate revenue. Keysight can design and manufacture a custom switch matrix for you. Keysight builds hundreds of custom switch matrices each year. Our expertise and experience can reduce the pressure on your team.

## Cost management

In a competitive marketplace, it is important to predict the cost of your system accurately. When designing a one-of-a-kind system, there may be unpredictable and hidden costs. With more than two decades of experience in providing custom switch matrices, Keysight can reduce your risk by quoting a firm price.

## Support management

Support planning is often overlooked during development of a custom switch matrix. Keysight provides documentation and services that can be used in a variety of support models, from self-maintenance to fully outsourced service and repair.

All support models rely on accurate documentation for effective system troubleshooting. Keysight provides standard documentation for your switch matrix, including an RF schematic, logic table, part locator diagram, wiring diagram, front and rear panel layouts, data sheets, replaceable parts list, and test data.

Serviceability is an important element of our designs. Plug-in options are available for most Keysight switch types, thereby reducing MTTR. Keysight coaxial switches and other components used in our matrices are off-the-shelf units found in the standard Keysight Catalog. When ordered through our QuickShip service, they have a guaranteed delivery of five days or less.

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at [www.keysight.com](http://www.keysight.com).



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