

Keysight Technologies

Find the Right Switching Solutions
for Your Test and Measurement Needs

Application Note



Introduction

RF and microwave switches are used extensively in microwave systems for signal routing between instruments and devices under test (DUT). Incorporating a switch into a switch matrix system enables you to route signals from multiple instruments to single or multiple DUTs. This makes it possible for multiple tests to be performed with the same setup, eliminating the need for frequent connects and disconnects. The entire testing process can then be automated to increase throughput in a high-volume production environment.

Abstract

No single switch can best fit all applications. Selecting the correct switch technology—platform, RF performance, reliability, switching time, power handling—to accessorize and/or complement your system setup requires an investment of time and resources. The relative advantages and disadvantages of different types of switches determine their use for specific applications. This application note will provide an overview of the types of microwave switches available and assist you in selecting the most appropriate switch type for a given application.

Selecting the Right Switch Platform

Research and development applications

R&D engineers working at their lab benches commonly need to control microwave switches. Bench-top space is limited, so a compact switching solution is very helpful. Also, project design assignments can change quickly, forcing a reconfiguration of your switch topology, sometimes in the matter of minutes.

The way R&D engineers control switches will differ depending on the stage of the design. Early in the design phase, the engineer will likely want a simple method to close switches, such as front panel push button control. As the project proceeds, it may be important to automate some of the tests to allow extended test sessions. So having a convenient method to connect your PC to the switch control unit and write programs is also important. For this situation, a switch control unit with both front panel as well as software control works best.

The bench top switch control unit is an example of a driver that works very well for a small scale switch matrix. The large front panel LCD display and push buttons allow engineers to easily control switches during initial test. As the development progresses, the GPIB, LAN, or USB interface can be utilized for software control of the switches, enabling automated testing. This is extremely helpful when an automated test needs to be run for an evening or weekend.

Another consideration is physical space and mechanical mounting of switches. In only the very simplest cases can microwave switches simply be placed on the bench-top. Most often, a microwave switch tray is needed to mount the switches. Consider the case where a flexible semi-rigid coax is used to route signals between the switches. Mechanically mounting the switches is a must to prevent flexing and damage to the cables.

When using a control unit, a sheet metal switch tray can be constructed. However, in larger scale bench-top test cases, where more switches or attenuators need to be mounted and controlled, the custom switch box with mounting area (such as the L4490A/91A) can be a good fit. The custom switch box provides not only pre-fabricated cables and simple soft front panels for easy bench-top control, but also a mechanical mounting area for the switches as well as prefabricated mounting brackets. It is highly reconfigurable, and a good choice for bench top applications where you need to control many switches and reconfigure quickly.

Design validation applications

New products need to pass extensive product validation testing, where functional testing as well as long term chamber testing will be done in the quality control (QC) lab. Design cycles are short and new products coming from the lab typically have a tight schedule. QC labs may see new products every few months and the test switching topology needs to change to accommodate them. Usually many products are placed in a temperature chamber and tested at the same time making the number of switches and signal interconnections very high. The switch unit used must be scalable and capable of managing this large number of connections. Even the physical mounting of the large microwave switches may be a challenge. As such, it is common to see larger rack-mounted switch controller assemblies in QC lab test applications.

In the QC lab, the switch controller must be easy to reconfigure to adapt to the next test assignment, and aggressive project launch schedules allow little time for product changeover. The switch unit must be easy to use, and tools need to be available for complex switch topology turn-on and debug. QC lab applications tend to use many switches, so large mechanical mounting areas are a must. The switch mounting area should also have standard bracket mounting footprints, and a large selection of pre-fabricated mounting brackets available. Standard cable sets for the microwave switches enable quick assembly and efficient long term maintenance.

The large number of switches needed in QC lab applications naturally demands switch products with a large number of drivers. It is common to see applications needing more than 64 switch drivers in one test system.

In the QC lab, software is the primary method for controlling the relays. Also, the software controlling the switch units routinely needs to be modified as new projects arrive for test. Hence, switch control units that provide extensive programming command sets, easy-to-use soft front panels, and versatile software interface choices are important.

Manufacturing applications

Manufacturing requirements of microwave and RF switch controllers are similar to quality control lab needs, except reconfiguration does not occur as often. The number of switches may be large and the software tools are required to quickly develop new test systems. Test system design and deployment schedules are typically demanding, so quick time-to-deployment is critical. Large systems such as L4490A work well in these environments. Also, it is common for manufacturing test systems to have a long production life, therefore it is important to have long term reliability. Systems configured and deployed into manufacturing environments may be expected to last as long as decades and documentation for long-term support is critical.



Modular or Custom Switch Matrix

In manufacturing, the test systems are typically replicated many times across the production floor. Consistency across the switch platforms is very helpful for system deployment and long term support.

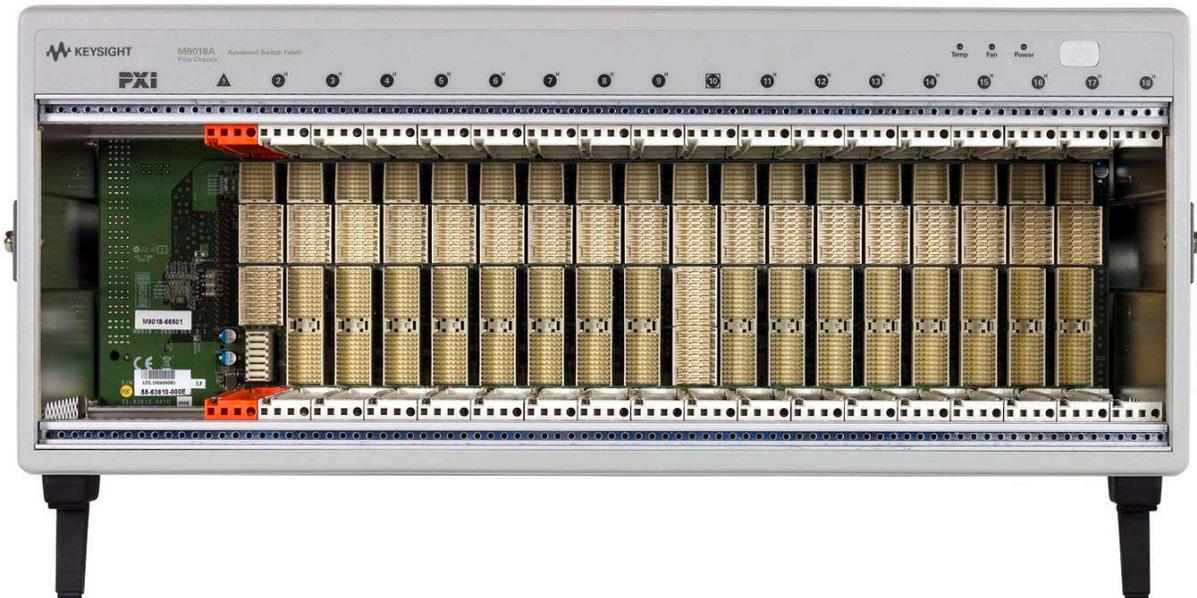
Some manufacturing systems use PXI platforms for RF and microwave instrumentation. PXI modular chassis are very compact, which helps to reduce the overall size of the test system. In cases where a few switches are required to complete a PXI based test system, PXI microwave switch modules may be the best solution. If the test system needs a significant number of switches, choosing an LXI-based switch platform is still the best approach.

If PXI RF and microwave switch modules work best in your situation, Keysight offers a line of RF and microwave PXI switch modules to complete your PXI based test systems. For more information on all of Keysight's PXI products go to www.keysight.com/find/modular.

A key factor to consider before you design your PXI switch matrix is the slot availability. The design engineer needs to select the size of the mainframe depending on the size of the switch matrix. Generally, 8-slot chassis and 16-slot chassis are available in the market today. Keysight M9018A is a 16-slot mainframe that is PXI-Hybrid compatible.

Why PXI Modular vs. Custom Switch Matrix?

The readily integrated switch modules provide flexibility for system test and manufacturing engineers. There is no need to consider the required scale of the switch driver in advance, as the switches will be driven by the supply from the mainframe. These plug and play modules reduce downtime for switch replacement and recalibration. The switch matrix could be reconfigured easily, as long as you have enough slots for the size of the switch matrix you need. Keysight M9155/6/7C provide a complete portfolio of SPDT, transfer, and SP6T switches to build any switch matrix. Better yet, a PXI modular system is easier to maintain and upgrade.



Conclusion

System test engineers that are manufacturing RF and microwave components for the aerospace and defense, satellite, broadband wireless access, and wireless communications industries face increasing pressure to maximize manufacturing throughput and reduce cost of test. Expanded capability of components requires numerous tests and more complex signal routing and monitoring capabilities.

Keysight offers a complete line of switching solutions and helps you to make the right decision for your test application, whether you design your own or have Keysight create a solution for you. Switching components are introduced in detail, followed by the various scale of switch matrix that is required in RF and microwave testing. R&D, test and design validation, and manufacturing engineers will find suitable switching solutions from Keysight.

For more information, please visit:

www.keysight.com/find/pxiswitch

Or download the application note, *“Keysight Switching Solutions for R&D, design validation, manufacturing,”* literature number, 5990-6169EN.

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