Technical Information

Switching and Control

Achieving required system accuracies and precision requires selection of appropriate instruments, creativity in designing test methods, and careful attention to specifications and error terms. Most test system designs are complex enough that it is in the designer's best interest to minimize the number of uncontrolled variables. To accomplish this, the system switch performance should be tightly specified.

Special consideration should be given to tests that approach the specified limits of accuracy, resolution, or sensitivity of the measurement or sourcing instruments. These generally represent the "most critical test requirements," and switching should be selected to support these tests. A system designed to perform against the "most critical test requirements" will usually satisfy other test requirements as well.

How Do I Specify a Switch System for My Application?

Whether you are designing your own switching system or preparing to contact Keithley's applications department for assistance, you need to define certain parameters for your test system and understand how you want everything interconnected.

First, define your parameters. This includes:

- Measurements—List all the required measurement types and accuracies.
- Sources—List all the sources required.
- Quantity—List the number of terminals on the DUT and how many devices are involved.
- Signal characteristics—List signal types, levels and frequency, and impedance requirements.
- Speed—What are the speed requirements?
- Environment—Temperature, humidity, etc.
- Communication interface—GPIB, RS-232, Ethernet, USB

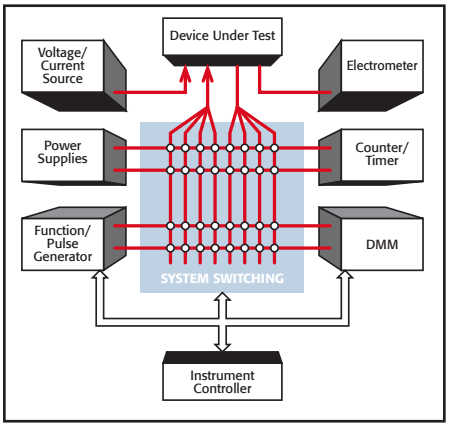

Figure 1. General Purpose Test System

Next, sketch the system. Given the number of terminals on the device and the number of instruments (source and measure), develop a picture of what type of switch and configuration will be needed. This is likely to be an iterative process as you identify what types of switching equipment are actually available.

Once you have done the groundwork, you are ready to configure the switching for your test system:

- Determine the appropriate switch and switch card configurations
- Select the appropriate switch system
- Select source and measure equipment
- Select cables and/or other accessories
- Identify need for fuses, limit resistors, diodes, etc.
- Determine the uncertainties and compare them with the required accuracies

Switching Configurations

The variety and size of switching configurations available determine the efficiency of the final switching design, including the amount and complexity of cabling and interconnect at the time of system integration. These are the basic building blocks of any switching system.

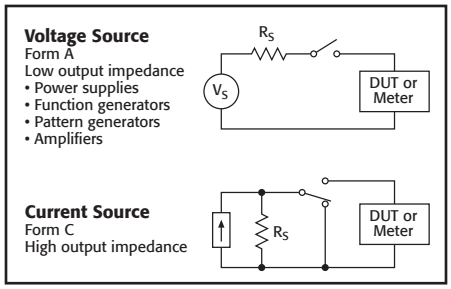

Figure 2. Example Switching Configurations

A switching configuration can be described by the electrical property being switched, its mechanical construction, or its function in the test system (Figure 2). These descriptions of the signal paths or electrical interconnects are necessary for laying out and wiring the test system.

A matrix switch (Figure 3) is the most versatile type of system switching. But first, a word on terminology here — Do not confuse a switch matrix (often called a switching mainframe) with a matrix switch. With a matrix switch, any input can be connected to any output, singly or in combination. This helps minimize the need for complex wiring and interconnect systems and can simplify the DUT interface. Although a matrix switch will work in virtually any switching application, it should not necessarily be your first choice of switch configuration.

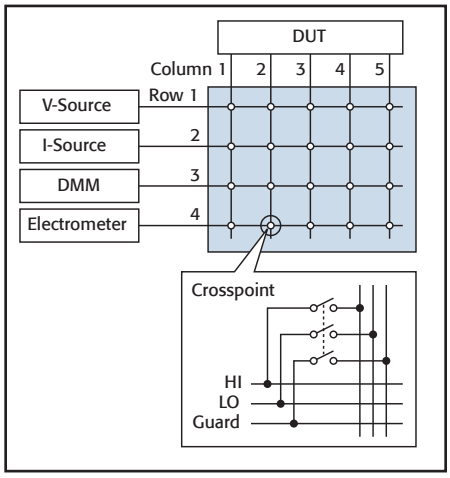

Figure 3. Matrix Switch

Consider an example where you need to connect four different instruments to ten different test points on a device-under-test. If you need to be able to connect any combination of instruments to any combination of test points at any time, then you do need a matrix switch. But, if you only need to connect one instrument to one test point at any time, then you can combine a four-to-one multiplexer with a one-to-ten multiplexer to make your connections. The multiplexer approach only uses 14 relays, while the full matrix uses 40. If you simply choose a matrix switch for the second example, you will end up paying for 26 relay channels you don't need. Careful planning can result in a more compact and economical switch system.

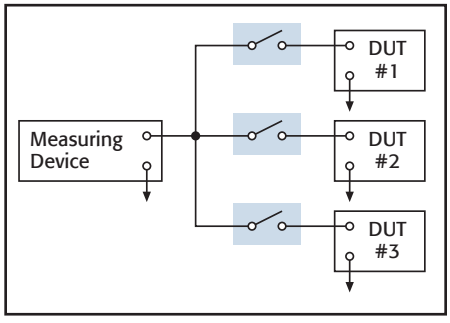

Figure 4. Multiplex Switch