COST EFFECTIVE TESTING WITH A BRIC MATRIX

David Owen
Pickering Interfaces

Switching systems are an essential part of any test system – they are used to connect access points in the UUT to various sources and measuring devices to allow the functionality of the part to be verified. The switches may be used to provide an interface connection for a wide variety of signals, but applications requiring the highest amount of switching usually arise from what appear to be simple test requirements. It is rare for test applications to demand the switching of large numbers of RF and microwave signals or for high signal powers. The most complex switching problems usually involve “simple” verification of the presence of components, voltages, currents, the absence of short circuits or open circuits and the provision of data inputs to control the device under test. The tests themselves are not difficult – it is the number of tests and the number of access points which creates a complex test problem.

There are various approaches to solving the problem. At first sight the simplest way is to consider each access point that needs driving or measuring and connecting a switch to it that routes the signal to the various pieces of test equipment in the system. However, it quickly becomes apparent that this route requires the provision of a number of different types of switches to suit each access point.

To illustrate the problem suppose the device under test is an amplifier and switching system for controlling the signals sent to a smart antenna system. The system under test could include bistable microwave switches, amplifiers, controllable phase shifters and digital input and output devices for communicating with the rest of the system. The test system could include probes (flying probe or a bed of nails) to provide additional access points on the test target.

The purpose of the test system is primarily to ensure the system has been put together correctly from the individual components. The major component parts may have been tested at an earlier phase in manufacturing – either in house or at a suppliers facility. The test equipment could use one or more digital multimeters (DMM), digital input and output sources and perhaps some simple sources and measuring equipment to check for path continuity.

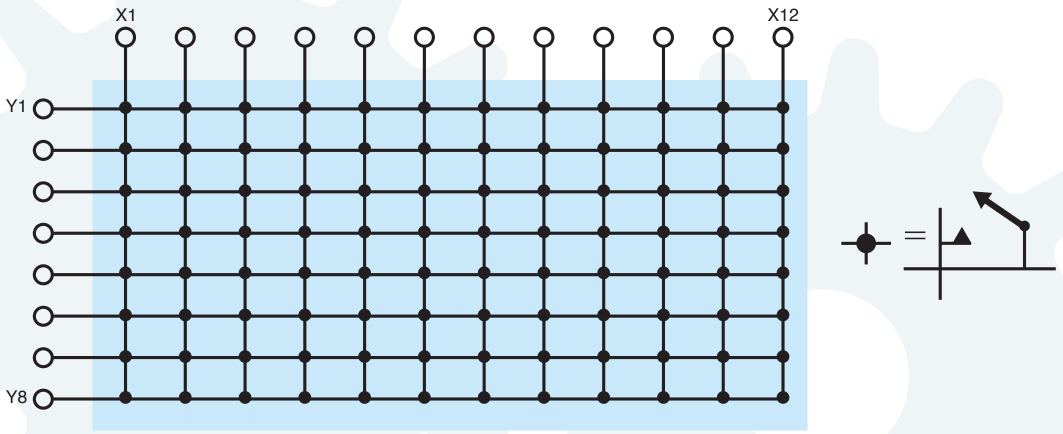
To reduce the test system size and cost the system can be implemented in a PXI chassis.

Using the simple approach to testing a multiplexer would be included to drive the bistable microwave switches. A second multiplexer can be used to detect the state of each switch using the built in read back lines - which could be a variable (switched) resistor or a digital output depending on the switch type. The microwave contacts on the switches might be checked by adding a continuity or a signal test on the selected through path. The test specification could demand that a test be performed to ensure none of the microwave coil drive lines are shorted to other elements using the continuity function on the DMM. Access could be provided by a bed of nails probing test points on the system or by test access points.

Further multiplexers need to be used to drive the other input and output functions on the assembly, providing serial control of the phase shifters, again testing to ensure only the addressed phase shifter changes state.

The test becomes steadily more complex as more requirements are found to be added to the test solution, perhaps as the result of finding unforeseen fault patterns. While the number of test cases to be handled is relatively small a solution based on separate multiplexers for the switching makes perfect sense. As the test requirements expand it becomes more difficult to use this approach and the solution requires more space to be used in the PXI chassis as the number of multiplexer or switch modules increases.

THE INEFFICIENT METHOD OF MATRIX TESTING



Example of a 12 by 8 matrix switch using 96 relays to connect 8 Y direction lines to 12 X direction lines. At each crossover point there a is relay which either connects the X columns and Y rows together, or leaves them unconnected.

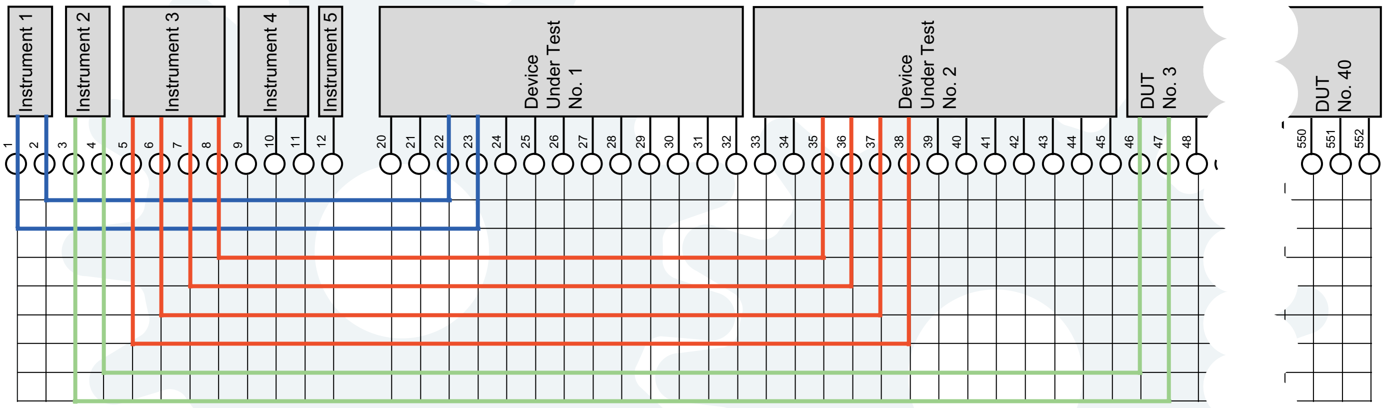
A more general approach is to use a crosspoint switch or matrix arrangement to perform the switching. In a matrix switch a set of columns (X direction) and rows (Y direction) are interconnected at each crossover point. In its simplest form the switch is normally open and applying power to the switch coil closes the contact, but other configurations are possible. The switch allows any column to be connected to any row at any point in the matrix.

The simple way of using the matrix arrangement is to arrange the device under test access points in one direction (X) and the test equipment in the other direction (Y), so that way any access point can be connected to any item of test equipment. There is no inherent limit in the number of Y rows connected to the number of X columns, though having many switches closed can clearly cause heavy device loading. The problem with this approach is that it can require a large matrix if there are a significant number of connections required to the test equipment. The technique is ideal if each test case requires that most or all of the test equipment to be used. In many cases while one test is being performed a number of items in the system are not being used – and that means a large part of the matrix is surplus at any one instant. If the test equipment requires 30 access points and the test system has 300 access point the matrix needs 9000 relays.

USING A MATRIX MORE EFFECTIVELY

There is an alternative way of configuring a matrix which can result in a more cost effective solution and to which the Pickering BRIC is ideally suited. Instead of organising the matrix so that test equipment is connected to the Y direction and the device under test access points are connected to the X direction, all of the test equipment and the access points are connected to the X axis. The Y axis is then used to interconnect various devices located on the X axis. Though the Y axis is available if required on the PXI front panel for many applications the Y outputs are not used.

The number of connections required on the Y axis is determined not by the number of test equipment connections but by the maximum number of connections required to perform a test. This will be much lower than the number of test equipment terminals, so the Y dimension of the matrix can be much lower. This results in the matrix being much more efficiently used and reduces its cost. In many systems just 8 Y axis lines for any one test will allow all the measurements and source driving to be done.



Using a matrix with the test equipment and the test access points all on the X axis. This simple example has up to 19 test axis points, but the boundary between test access points device under test access points can very easily changed

Taking the previous test example a matrix measuring 330 (300 access points and 30 test equipment points) by 8 lines requires just 2640 relays, less than 30% of the complexity required to provide full 300 by 30 access. That represents a huge saving in the cost of the switch system.

Furthermore if the test system requires expanding because the number of access points increases this can be dealt with by simply increasing the number X axis points, resulting in a proportional rather than a geometric rise in the number of relays. Similarly if the number of test access points needs to increase this can be accommodated by increasing the number of X axis locations allocated to test equipment. The dimension of the matrix is only increased in one direction, avoiding the geometric rise in relay count.

Pickering Interfaces BRIC is ideal in these circumstances. Provided the BRIC is not supplied with the maximum number of daughter cards installed it can be expanded by simply purchasing and adding more cards for the module. Provided the new test requirements do not need the number of Y axis connections (the number of simultaneous connections) to be expanded the module can be expanded to suit new test scenarios without having to replace the entire module. This flexibility also increases the chances of the same module being used in future test systems, an important consideration in applications where the product has a relatively short life in the factory or engineering areas.

SUMMARY

The effectiveness of Matrix switching can be improved through the use of BRIC modules by:

- Allocating part of the X axis to test equipment access
  - Lowers the number of relays required in the system
  - Lowers the cost
- BRIC modules allow the test complexity to expand without enforcing a system redesign and the purchase of complete new modules
- Allowing partially loaded BRIC modules to be expanded after the point of initial sale
  - Improves module re-use
  - Can avoid expensive module replacement

Contact Information

Pickering Interfaces Inc.
2900 Northwest Vine Street
Grants Pass
Oregon 97526
USA

Tel:	541 471 0700
Fax:	541 471 8828
E-Mail:	ussales@pickeringtest.com

Pickering Interfaces Ltd.
Stephenson Road
Clacton-on-Sea
CO15 4NL
United Kingdom

Tel:	+44 (0)1255-428141
Fax:	+44 (0)1255-425349
E-Mail:	sales@pickeringtest.com

Pickering Interfaces AB
Karl Nordströmsväg 31
432 53
Varberg
Sweden

Tel:	+46 340-69 06 69
Fax:	+46 340-69 06 68
E-Mail:	ndsales@pickeringtest.com

Pickering Interfaces GmbH
Buchenstrasse 15
D-77880
Sasbach
Germany

Tel:	+49 7841 66 49 10
Fax:	+49 7841 66 49 12
E-Mail:	desales@pickeringtest.com