Keysight Technologies

Comparing the 34980A and PXI for Switch Measurement Applications

Application Note

KEYSIGHT TECHNOLOGIES

Introduction

Developing a new test system for switching and measurements can be challenging. You need to select a platform that will fit into your available space with the right balance of cost and performance as well as ease of setup and maintenance. This application note provides a comparison between PXI cardcage solutions and a combined system, the Keysight Keysight Technologies' 34980A switch/measure unit, so you can determine which platform best meets your needs for electronic functional test and data acquisition

This application note compares the Keysight 34980A switch/measure unit with PXI platform in functional test and data acquisition environments.

Switch/measure system characteristics

Test systems can be constructed with many complex stimuli and measurement instruments, but two components are almost always present—a digital multimeter (DMM) and a bank of relays (switches). The fundamental core of a test system is a switch/measure function, which can be implemented in three different ways:

1. Discrete instruments with cable interconnects, such as an Keysight 34410/11A standalone high-speed DMM and a separate switching system such as the Keysight 3499A/B/C switch/control mainframe
2. Cardcages, such as PXI or VXI, into which a DMM and switching cards have been placed, which requires a separate controller, such as an embedded PC or interface card connecting the cardcage to a PC.
3. Combined systems, such as the 34980A switch/measure unit, with a built-in controller, DMM, quiet analog backplane, and the ability to insert up to eight plug-in cards

This application note focuses on concepts 2 and 3:

– A PXI cardcage with controller, a 6 ½-digit DMM, and various plug-in modules

– A Keysight 34980A mainframe, with a built-in controller, front panel, built-in 6 ½-digit DMM and various plug-in modules

Choosing the Right Switch Platform for Your Application

Deciding which switch platform will best meet your needs can be a daunting task. This task is further complicated by a multitude of solutions offered by test equipment providers. Table 1 shows a high level comparison between different platforms at Keysight along with the decision criteria that will help you make an informed decision.

Table 1. Switch platform selection matrix

General Test	34970A/ 34972A	34980A	PXI	L449x/ Custom
Simple benchtop switching	●	●	○	
Ease of use (even by non-experienced programmer)	●	●		
Data acquisition software included	●	●		
Lowest cost per channel	●	●	●	○
Hardware interlocked scanning	●	●		
High speed		○	●	○
Plug-in instrument modules	○	○	●	
Low operating noise	●	●		●
Transducer-based measurements	●	●	○	
Portability	●	●	○	○
Production, manufacturing or RF				
Low-channel count (up to 50)	●	●		
Medium-channel count (up to 500)		●	●	
High-channel count (up to 5000)			●	
Integrated signal components including circulators, attenuators, couplers			○	●
Signal bandwidth (up to 26 GHz)	○	●	●	●
Signal bandwidth (up to 40 GHz)			●	●
Signal bandwidth (> 40 GHz)				●
Large-scale RF/µW matrix			○	●

● Full coverage ○ Partial coverage

To help decide which switch platform would best meet your application needs, consider the following:

– The 34970A and 34972A switch/measurement instruments are low channel count, portable, on-site data acquisition system with remote access. Because of its small size and easy mobility, it is also the product of choice for cost sensitive applications.

– For test systems that need a moderate amount of switching, the 34980A data acquisition system offers medium- to high-channel count. The 34980A provides a wide selection of switch modules plus precision voltage and current signals as well as digital input/output capability.

– For large-scale RF and microwave switching such as in design verification or manufacturing applications, the L4491A offers a highly configurable large scale switch solution.

– When test systems need to integrate additional test instruments such as high-speed digitizers or waveform generators, PXI is most convenient. The PXI instrument modules can easily plug into the cardcage and become part of the PXI solution.

Table 2 compares features of the 34980A and PXI. In this chart, instrument advantages are highlighted.

34980A vs PXI feature comparison

Table 2. 34980A vs PXI switch/measure system.

Feature	34980A	PXI
Open, multi-vendor architecture	LXI instrument	Yes
Physical size	3U	4U
Ventilation provisions	No special requirements	No special requirements
Rack mounting	EIA standard width	Varies from half-rack to standard EIA width
High-speed I/O	Industry standard LAN, USB, GPIB	PCIe
Price	Low	Med to high
Analog bus	8-wire	No
Trigger bus	Yes	Yes
Front panel	Physical and soft front panel	Soft front panel
Web GUI/soft front panel	Yes	No Web GUI
EMI shielding	Designed in and tested	Not required by specification
Hot swap cards	Yes	No
PC reboot	No	Required when cards changed
Software installation	Minimal	An estimated 2 to 4 hours
Programming support		
LabVIEW	Excellent	Excellent
Visual Studio®.NET	Excellent	Good
IVI-C	Good	Excellent
IVI-COM	Good	Excellent
SCPI	Excellent	No
Peer-to-peer module communications	No	Yes
System monitoring (power rail voltages, module exhaust temperatures, and fan speeds)	No	Yes
Available plug-in modules	21	1000's
Programming latency	1 ms	<1 µs
Data to controller bandwidth	1 MB/s	4 GB/s

Open architecture

The PXI architecture is an open, multi-vendor, backplane architecture. This means that instrument modules from any vendor can be plugged into a mainframe and then programmed from a computer to work together. Its physical and electrical properties are documented by an industry alliance (in this case, the PXI Systems Alliance, www.pxisa.org, which includes more than 60 companies that provide a mix of PXI instrumentation, test fixtures and systems integrators).

The 34980A uses an open industry standard called LAN eXtensions for Instrumentation (LXI). The LXI Consortium (www.lxistandard.org) is an association of more than 45 of the top names in the electronics industry. Rather than place the "openness" in the backplane definition as PXI does, the 34980A and other LXI-compliant products put the emphasis on industry-standard I/O connectivity such as LAN, USB, and GPIB and ease of programming in multiple development environments—this means that LXI instruments are connected to a computer using LAN, USB, or GPIB to work together. With power and cooling specifically designed for the many 34980A modules, the 34980A delivers a switch/measure system at a reasonable price. In comparison, PXI systems have open backplanes that require standards for power, cooling, bus lines, and reference clocks to be met by multiple PXI module suppliers. Custom electronics can be added to the 34980A by using a breadboard card that has a supplied backplane interface and room for you to add your own circuitry. This keeps costs low and makes it possible for the instrument to be tested thoroughly.

Size

The 34980A is a standard full-rack width, and only 3U high. Ventilation is drawn in from the sides and exhausts out the back so no additional rack space is required. For bench use, instruments can be stacked on top or on the bottom. PXI modules are "3U" or the EIA standard of 3 rack units (1U = 1.75 inches). The modules plug into PXI mainframes which are typically "4U" or a total of 7 inches high. The Keysight M9018A 16-slot PXI mainframe is 4U high and a full rack width. The Keysight mainframe is designed with rear venting so instruments can be installed directly above and below the housing in a rack giving it an advantage in the market.

Availability of cards

In addition to relays and DMMs, there are several other classes of functionality typically implemented in switch/measure systems used for electronic functional test (EFT). The 34980A provides industry-standard connectors (50- and 78-pin D-subs) for the cards which are easy to use, durable, and very reliable connections. By comparison, PXI cards typically use much smaller connectors due to the space limitations on the modules. The following cards are available in PXI format and for the 34980A:

– Digital I/O (DIO)
– Digital-to-analog converters (DACs), which are some times fast enough to use as waveform generators at low frequencies
– Frequency counters/totalizers
– Isothermal terminal blocks
– Customizable breadboard cards (useful for signal conditioning), such as those typically required by strain gauges

Switch cards come in a variety of switch types as seen in Figure 1, and are configured as multiplexers, matrices, or general purpose switches.

Switch types for bandwidth follow:

Low bandwidth (DC-100 MHz)

– FETs (high switching speed, high on-resistance, lower voltage, and current)
– Reed relays (medium switching speed, low on-resistance, medium voltage, and current; typically have high thermal EMF)
– Armature relays (lower switching speed, low on-resistance, higher voltage, and current; typically have low thermal EMF)

High bandwidth (up to 26 GHz or higher with the microwave switch driver)

– RF relays (low speed, low on-resistance, low voltage, and current)
– Microwave relays (low speed, low on-resistance, low voltage, and current)

There are many different modules from a variety of vendors covering a wide range of instrument capability including embedded PC controllers.

Cost of Ownership

Initial cost

The purchase price for the 34980A with eight empty slots, built-in LAN, GPIB, and USB interfaces as well as a 6 ½-digit DMM is US $2,591. This is significantly less than a similarly configured PXI system, which can range from approximately US $3,500 to $9,500 or more. The following table represents typical prices for similarly configured systems in 34980A and PXI.

Figure 1. A few types of switches – reed, armature, RF and FET

Table 3. Typical prices in US dollars for commonly configured systems in 34980A and PXI

	Keysight 34980A switch/measure	PXI switch/measure
Data acquisition		
100 Ch	$5,500	$15,000
300 Ch	$11,200	$23,500
500 Ch	$16,400	$31,100
1000	$28,400 (w/2nd 34980A and an additional 6U rack space)	$42,000 (1 chassis)
	Best solution for applications up to 500 multiplexer channels	Best solution when you need more than 500 multiplexer channels
	Price/channel	Price/channel
Electronic functional test		
1000 Ch	$13/Ch	$21/Ch
3000 Ch	$11/Ch	$14/Ch
4000 Ch	$11/Ch	$14/Ch
5000 Ch	$12/Ch (w 2nd 34980A and an additional 6U rack space)	$13/Ch
	Best solution for applications up to 4000 matrix channels	Best solution when you need more than 4000 matrix channels
Mixed signal test	$8,900	$15,400
Microwave switching (26.5 GHz)		
6 Ch	$7,800 (2 slots)	$12,000 (3 slots)
12 Ch	$12,900 (4 slots)	$16,200 (6 slots)
24 Ch	$23,200 (8 slots)	$24,600 (12 slots)
	Best solution for up to 24 channels; also consider the Keysight L4490A/91A for complex switch matrix systems	

Note: Approximate prices are based on actual system prices in April 2012 and subject to change.

Typical configurations consist of the following:

- Data acquisition systems—300, 500, and 1000+ channels of 100 V/1 A 2-wire multiplexer channels routed to DMM for voltage, current, and temperature measurements
- Electronic functional test—Up to 100 V signals routed through a switch matrix to provide stimulus to DUT with DUT outputs routed through switch matrix to a DMM and other instruments; digital I/O and general purpose switching can be used for other system control
- Mixed signal test—RF switching to 3 GHz to route IF and video signals; digital I/O and general purpose switching used for system control
- Microwave switching—Switching up to 26.5 GHz for routing high-frequency signals

The 34980A has a distinct advantage compared to PXI for smallest area of required rack space and hardware price in each configuration under 500 channels. The 34980A test system cost is as little as 50 to 75 percent the cost of similar PXI systems. The PXI systems have advantages for configurations that require higher channel count and when additional functionality such as digitizing or signal generation, is needed beyond what the 34980A offers. Additional factors that affect test system cost include development time, ongoing maintenance support, or where an open system is required.

Modules can be plugged into the 34980A, powered on, and switch/measure measurements taken using either the front panel or the Web interface software (a simple LAN interface with no software installed) in a matter of minutes. For PXI, the modules must be set with individual addresses and a program with written code including the module addresses is needed in order to begin making measurements. The 34980A addesses the installed modules automatically, with no need for initial setup. PXI requires a skilled technician or engineer to set up and operate where the 34980A is intuitive enough that anyone can operate with ease.

The selection of 34980A modules is shown in Table 4. Up to eight of these, in any order, can be placed in the eight slots in the 34980A mainframe. The built-in DMM does not occupy a slot. This is a significant difference between PXI and the 34980A, not just because of the price difference and slot utilization, but because the 34980A's controller, analog bus, and relay/DMM handshaking are all built-in; no additional wiring is involved. With PXI, the DMM occupies one slot, there is no analog bus, and there are no automatic handshake connections between the relay cards and the DMM. Interconnections to appropriate backplane signal is done through software created by the user. The 34980A offers the advantage of providing higher input voltages, and currents than PXI while maintaining a competitive price per channel.

Development time costs and ease of programming

Test system development takes time which results in additional cost. The 34980A has several methods of programming, all designed to make setup and programming easy, and keep development time to a minimum. These programming methods consist of front panel control, Web interface, BenchLink Data Logger Pro, Command Expert, drivers and SCPI commands. The 34980A's front panel is the easiest way to quickly get started where switch closures and measurements can be programmed using buttons and the display on the front of the instrument. In only a few button presses, it is easy to verify the operation of a switch and make measurements.

In addition, the built-in graphical Web interface (Figure 2) makes it possible to use the 34980A from your favorite Web browser without having to download any software. Simply click on the graphical switch representation to open and close switches and take readings. Built-in commands and internal handshaking between the 34980A's DMM and the switch cards makes it easier to program than the PXI systems' DMM and switch modules, which are controlled as individual instruments and each require individual addressing and specific commands.

For design validation, the Keysight 34980A offers BenchLink Data Logger software (Figure 3). The BenchLink Data Logger software can be used by experienced and inexperienced programmers alike and makes it quick and easy to setup measurements as well as collect and graph data on hundreds of channels.

The 34980A's BenchLink Data Logger Pro software provides advanced data logging and decision making capabilities in a convenient format for collecting and analyzing data without spending hours programming. The Windows-based application uses a spreadsheet environment where you identify the measurements you want to acquire, define limits and actions to be preformed, and then initiate the process. Data is then collocated, evaluated, and acted upon in real-time.

To learn more about BenchLink Data Logger Pro visit **www.keysight.com/find/34832A**

Table 4. Keysight 34980A module selection

	Number of channels	Max voltage	Max current
Multiplexers			
34980A			
34921A	40 armature	300 V	2 A
34922A	70 armature	300 V	2 A
34923A	40/80 reed	150 V	1.5 A
34924A	70 reed	150 V	1.5 A
34925A	40/80 FET	80 V	0.02 A
Keysight PXI			
M9101A	64 reed	100 V	1 A
M9102A	128 reed	100 V	1 A
M9103A	99 armature	100 V	1 A
Matrix			
34980A			
34931A	Dual 4 x 8	300 V	2 A
34932A	Dual 4 x 16	300 V	2 A
34933A	Dual/Quad 4 x 8	150 V	1.5 A
Keysight			
M9120A	4 x 32 armature	100 V	2 A
M9121A	4 x 64 reed	100 V	.5 A
M9122A	8 x 32 armature	100 V	2 A
General purpose			
34980A			
34937A	28 (C) 4 (A)	250 V	8 A
34938A	20 form A	250 V	8 A
Keysight PXI			
M9130A	26 SPDT	250 V	2 A
M9131A	64 SPDT	100 V	1 A
M9132A	50 SPST	100 V	1 A
M9133A	100 SPST	100 V	1 A
M9135A	20 SPST	125 V	5 A

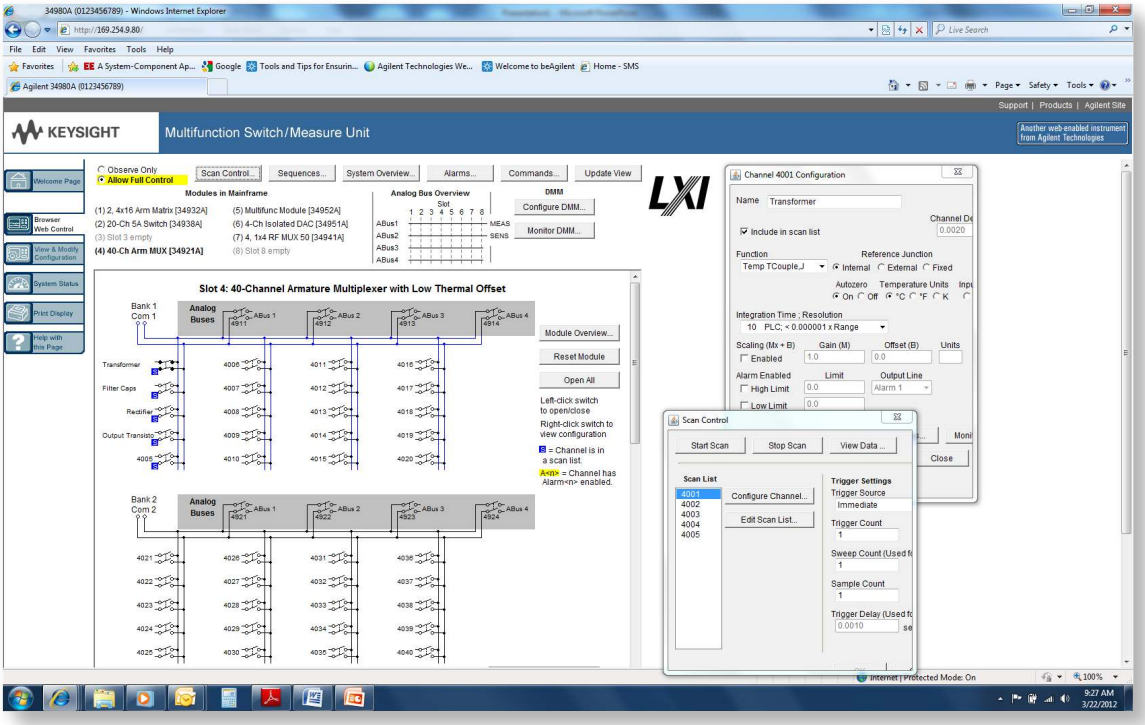


Figure 2. 34980A graphical Web interface

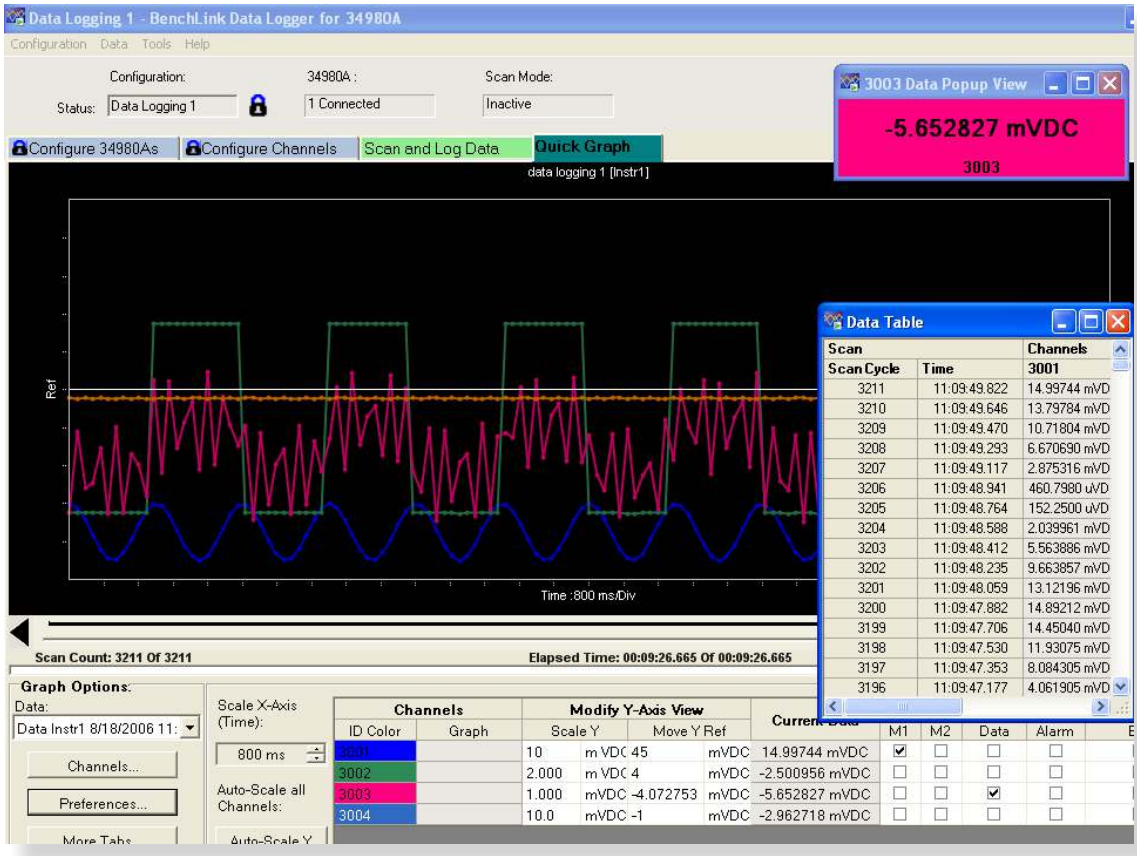


Figure 3. 34932A BenchLink Data Logger for 34980A

Command Expert for the 34980A combines instrument commands, documentation, syntax checking, and command execution all in one simple interface. The free, downloadable software works with instruments that use Standard Commands for Programmable Instrumentation (SCPI) or IVI-COM drivers. Command Expert will find instrument commands, show you complete command documentation, build instrument command sequences while verifying the command syntax. Within Command Expert you can execute the command sequences, then easily export and integrate them into the PC programming environment of choice. Learn more about Command Expert at www.keysight.com/find/commandexpert.

When developing an automated test using the 34980A, SCPI commands or software instrument drivers can also be used in any programming application environment to create test programs.

PXI mainframes and modules do not have front panel displays or controls such as knobs or buttons. Control and operation of the PXI systems must be done through a software program using instrument commands and/or instrument drivers or soft front panels.

Although NI LabVIEW and Keysight VEE Pro are popular graphical environments, a large majority of manufacturing test development is created in textual environments such as VB.NET, C#, and VC++. These modern programming environments have matured and are easy to use. Even graphical data displays are relatively simple to do using readily available graphics libraries.

Software drivers vs SCPI commands

PXI instrument drivers are used to communicate with PXI hardware and use low-level register programming that would be difficult for end-users to write. PXI hardware manufacturers provide the driver for users. Register reads and writes are executed very quickly and speed optimization is not usually required. Some PXI instruments are reliant on the PXI drivers provided with them as the sole source of instrument control.

SCPI is fast, easy-to-learn and well known for the 34980A and many basic types of instruments (such as DMM, function generator, counter, switches). SCPI is an ASCII language that can be accessed through simple VISA function calls without installing drivers. Keysight's LAN, USB, and GPIB based instruments use the built-in SCPI command language.

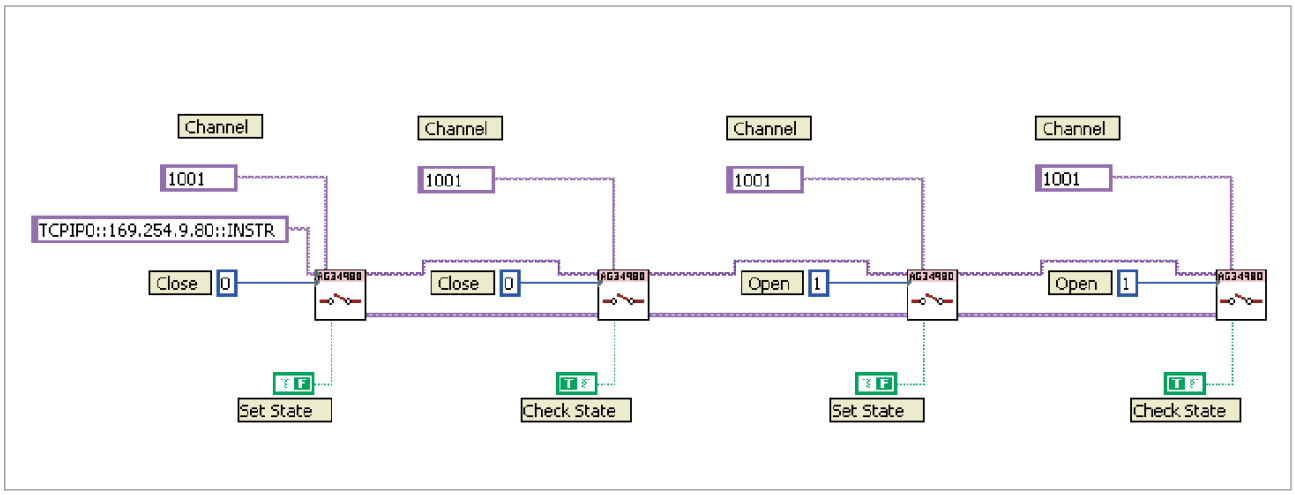
Some engineers prefer to use higher level virtual instrument (IVI) software drivers over SCPI. There are IVI-C drivers that work with several C compilers and VB6, and IVI-COM drivers that work with Visual Studio.NET and other COM-based development environments. Keysight offers both the IVI-C and IVI-COM drivers for the 34980A and Keysight PXI instruments.

Drivers that work with SCPI instruments generate SCPI commands and programmers are able to use the native SCPI commands within the driver when needed. SCPI instruments typically have more intelligence built-in to the product so complex function can be engaged using short commands that minimize I/O traffic.

Keysight PXI instruments are controlled using IVI-COM and IVI-C commands. The IVI-COM and IVI-C commands are similar to the familiar SCPI commands. The IVI-COM and IVI-C commands can also be used in any programming environment selected for the test system. Switch closures and measurements can be made with just a couple lines of code rather than connecting multiple driver nodes before switch operation is possible.

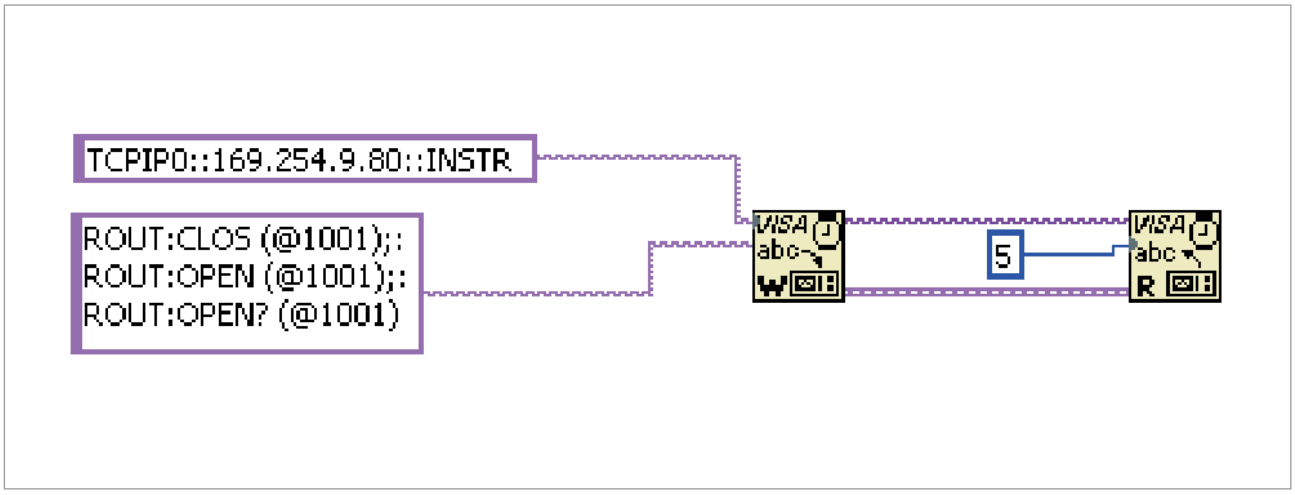
The fast execution time of modern computers has made the time required to execute calls to and from the driver to generate SCPI commands negligible so using IVI driver commands can be as fast as directly programming in SCPI.

The 34980A drivers are optimized for functionality. For the fastest throughput use the 34980A's native SCPI commands. For example, using the 34980A's LabVIEW driver it is possible to send a "close relay; test for closed; open relay; test for open" command sequence that can take nearly twice as long to execute as it would using SCPI command in a more efficient manner. Note that a simple close/open benchmark is not indicative of real data through-put which is dependent on the types of measurements that are made. The driver versus direct SCPI command concept is shown in Figure 4. For a more details see Keysight Application Note 5989-4886EN, "Optimizing Test Systems for Highest Throughput, Lowest Cost, and Easy LXI Instrument Integration."



This LabView program emits the following SCPI code:

ROUT:CLOS (@1001)	1.4 ms	(Set state)
ROUT:CLOS? (@1001)	1.3 ms	(Check state)
Read 1	1.5 ms	
ROUT:OPEN (@1001)	1.6 ms	(Set state)
ROUT:OPEN? (@1001)	1.0 ms	(Check state)
Read 1	1.5 ms	
Total	8.3 ms	(6 LAN packets)



This LabView program emits the following code:

ROUT:CLOS(@1001);:ROUT:OPEN(@1001);:ROUT:OPEN?(@1001)	1.4 ms
Read 1	2.5 ms
Total	3.9 ms(2 LAN packets)

Figure 4. LabVIEW vs SCPI programming examples

Maintenance and support costs

When designing a test system, engineers should consider the following:

– Cost/time of return-to-factory repair

– Cost/availability of loaner/rental instruments or modules

– Cost of owning spare instruments or modules

The 34980A has the advantage of being an LXI product which can be connected to the Internet and easily accessed from anywhere around the world without additional software. With proper firewall access, support engineers can connect to your 34980A and help with your test system configuration or questions via the IP address through the Web interface. PXI instruments can be accessed via the internet by connecting to LAN via a remote log-in to the attached controller which can be more difficult.

The 34980A and Keysight PXI switches provide durable, sturdy connector blocks that ensure long lasting contacts and reliable results. They are also equipped with screw terminal connections that are easy to use when modifying the test configuration or adding new test capability. Some PXI vendor's uses break out boxes that are difficult to wire initially and a great challenge to modify for test system changes.

High-quality relay switches are used on the 34980A modules and Keysight PXI cards for reliable connections and long life. When relays fail, the 34980A and Keysight PXI switches are easy to replace since the connections are through-hole. By contrast, for other vendor PXI modules, it is difficult to replace individual parts in surface mount switches, which often require the entire relay board to be replaced–a much more expensive and time consuming process if a replacement board is not readily available.

During a test system update or if a module failure occurs it is sometimes necessary to remove and/or add a new module to the instrument mainframe. For PXI, the system must be powered down, module changes made, and then rebooted. In a production environment, this can use a lot of valuable time and delay testing. The 34980A has the advantage of using a backplane that is not connected to a PC like PXI is which enables modules to be removed and inserted while power is on. Newly inserted modules are immediately recognized and the 34980A does not need to be rebooted so testing can resume much faster.

Execution speed

There are a few factors that contribute to the ability to develop a test system that is optimized for the fastest execution speed. Your test system design may be for electronic functional test or for data acquisition. Test system design will affect the ability to make measurements more quickly. Instrument control can be done using instrument commands or by using developed software drivers. Development time of the test system as well as the execution time of measurements and switch closures will be determined by the type of instrument control used. The programming environment can have a great impact on development and execution times, and some environments rely heavily on the experience of a programmer for the best time-to-completion and fastest test execution times. More information on what factors contribute to the time required for test development and affect test execution times follows.

Difference between EFT and DAQ

Similar hardware can be used in both electronic functional test (EFT) and data acquisition (DAQ) applications, but the throughput you can achieve varies greatly between them. Understanding the differenced of an EFT system versus a DAQ system is important when you compare performance specifications between the 34980A and PXI solutions because you may not achieve the test speeds expected unless you understand the use model.

EFT is a measurement scheme where stimuli are applied to a device under test (DUT) and the outputs are monitored and compared with expected responses. An EFT system is designed to connect many instruments through fast switches in an attempt to verify functionality of an electronic module, such as an automotive engine controller. In an EFT system the test process requires that switches must be closed, stimuli (including DUT power) and loads applied, a measurement taken, and relays opened. This process is repeated many times to test all input connections on the DUT. This means the overhead of individual readings and reconfiguration of the stimulus and measurement instruments must be incurred repeatedly (close relay, take a reading, open the relay). Polling is often done to make sure a reading is ready, which can add extra execution time. Results are checked against limits and failures logged. The result is that execution speeds are on the order of 50 to 250 readings per second.

The 34980A is well suited to fulfill these EFT testing requirements. The 34980A, with its selection of analog and digital source modules, precision DMM, and switches creates an effective source/measure solution ideal for EFT.

DAQ is a measurement scheme where many sensors are multiplexed into a measurement device such as a DMM. Large amounts of data may be logged for analysis later or in real time. An example is measurement of many temperatures at various points in a large DUT. In DAQ mode a voltmeter and a set of relays are programmed to perform a scanned measurement; a list of switch open/close states is downloaded into the test system, a hardware handshake links the DMM measurement to the switch setup. A "measurement complete" trigger from the voltmeter advances switches through this list. The DMM can either wait a preprogrammed delay after it sends out a "measurement complete" trigger or it can wait until it receives a hardware signal from the switches called an advance trigger, indicating that the switches have gone to their programmed state and it is OK to take a reading. This hardware handshaking makes it possible to minimize the amount of I/O data being transferred to and from each instrument. In addition, the measurement setup time is not duplicated for each switch closure as it is with EFT test systems. Instead, setup information is downloaded and a single initiation command starts the scanning operation. Because of the scanning design, the execution speed can be very high and is limited by the desired measurement resolution and the switching speed.

Fast backplane speed is only a small component of what determines the rate of readings per second in a test system. The DMM's ability to make fast measurements and the selected measurement resolution contribute to the reading rate as well as the switch closure time. Different types of switches are able to establish contact at different rates. FET switches offer some of the fastest switch closure times can achieve reading speed on the order of 1,000 channels per second. Reading throughput will be limited by the measurement time and switch rate no matter what backplane speed can be achieved.

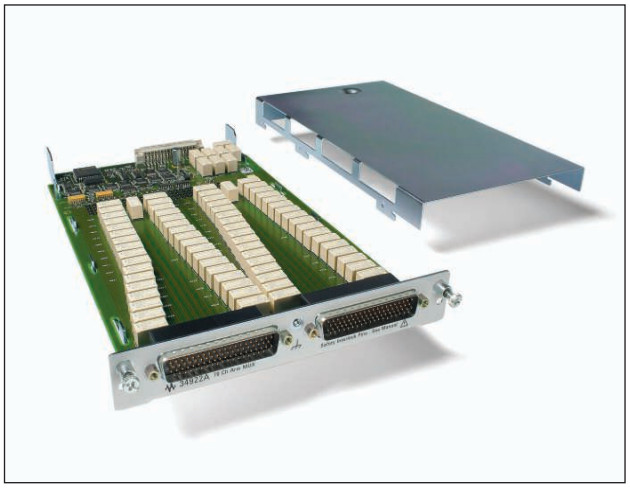


Figure 5. 34980A module 34922A, 70-Ch armature multiplexer

Conclusion

The 34980A is a low-cost, highly reliable switch measure solution designed for a variety of data acquisition and electronic functional test needs. It provides the cooling, power, shielding, and built-in functionality to perform its intended job without extra cost of open-system designs. The 34980A's industry-standard LXI architecture is focused on low cost, high speed, and ease of use.

Keysight PXI offers more channels per system with similar input voltage and current specifications to the 34980A. The Keysight 34980A and PXI switches are through-hole mounted for easy and low-cost switch replacement to minimize test maintenance and repair time.

Keysight 34980A and PXI switches include IVI-C, IVI-COM, and LabVIEW drivers along with soft front panel control for more flexibility in the way you choose to test and control the switches in the test system.

Keysight 34980A and PXI switches also have the advantage of very durable and sturdy connector blocks to ensure reliable contacts for the best results.

Summary of advantages of 34980A switch/measure platform:

- Lowest overall cost-per-channel for systems up to 500 channels
- Front panel and Web interface for easy access to measurements
- Overall best balance of voltage and current specs for the price
- Reliable measurement from robust high-pin-count interfaces

Summary of advantages of PXI switch/measure system:

- Fastest transactional speed DMM with up to 15,000 rds/sec and low latency improves test throughput
- High-density switching with integrated drivers and soft front panels deliver
- Open environment to easily add other modules not offered in the 34980A platform

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