



The Agilent 34980A A Low Cost Alternative to VXI & PXI

Application Note



Introduction

The Agilent 34980A Switch Subsystem is a very good lower cost alternative to VXI and PXI for systems with up to 1120 two wire channels (two 34980A mainframes). The 34980A is optimized for low to medium complexity/speed test applications and can be viewed as a bigger, better, and faster version of the highly successful Agilent 34970A with many usability enhancements. Putting the switching and DMM functions in a low cost mainframe that doesn't need the expensive, high speed VXI or PXI backplane can significantly reduce the test system hardware cost. More than 1000 readings/sec scan/measurements

speeds can be achieved with the 34980A and this is adequate for most test applications. Combining the 34980A with high performance stand alone instrument products is often more cost effective and in some cases uses less rack space. The Agilent 33220A Function/Arbitrary Waveform Generator and the N6700 Series Modular Power System for example, also have modern high speed interfaces and have better cost/performance than similar instruments in VXI and PXI. The 34980A also brings the "Front Panel" back to switch/measure instruments. Unlike VXI and PXI, an integrated front panel allows for manual operation right out of the box.

Switch Configurations

The fifteen different switch modules available for the 34980A system listed in the Plug-in Modules table (pg. 3) along with the four selectable two wire analog busses on the backplane offer great configuration flexibility. For low frequency matrix switching, the matrices can be combined to create larger matrices via the four analog buses. The 34933A reed relay matrix module has four 4x8 one wire matrix building blocks that can be used as independent matrices or can be combined with banks on additional cards to form virtually any size NxM matrix.



34980A System Ease of Integration

Hardware: Removable terminal blocks allow easy removal of a module for testing or replacement without labor intensive rewiring, or you can substitute multi-conductor cables that mate to the industry standard D sub connectors on the module faceplates and wire these directly to your test fixture or a custom interface panel. Accessory 1.5 and 3 meter, 300V cables are available. For the best possible AC performance, there is a third connection option in the form of a connector kit that can be used with shielded twisted pair cable for each channel. The mainframe can be mounted with the back or the front flush with the other rack instruments as is often desirable in test system racks.

Software: G drivers are provided for direct compatibility with LabVIEW. IVI-C and IVI COM drivers are provided for direct compatibility with Visual Basic, and Visual C++, which are the other most commonly used test system programming languages.

Computer Interface: LAN and USB interfaces make special interfaces and their software that must be added to the computer unnecessary. A GPIB interface is also provided for compatibility with other instruments in the test system.

Measurements

The optional DMM for the 34980A is essentially an enhanced version of the widely used Agilent 34401A bench DMM, which provides excellent performance and noise immunity. The DMM is mounted internally leaving all 8 mainframe slots for other modules. Each measurement can be time stamped and transferred over the bus to the user's computer; stored internally in the system memory; or can be scaled and displayed as the measurements are acquired. Each channel can be configured with high and low limits that can activate an alarm when the input signal is out of the limits.

34980A Measurement Capabilities

- DC and AC Volts
- DC and AC Current
- 2 and 4 wire resistance
- Temperature – Thermocouples (B,E,J,K,N,R,S,T), RTD's, and Thermistors
- Frequency and Period
- 4 alarms for High/Low or both limits for each channel
- Digital I/O
- Analog Outputs including low frequency Arbitrary Waveform

Memory

The volatile mainframe memory can store 500,000 readings with timestamps, 5 instrument states with user labels, and up to 20 alarm events with channel number, reading value, and time stamp.

Mainframe, Front Panel, and Drivers

The 34980A has many advantages over VXI and PXI with built-in LAN, USB2, and GPIB interfaces plus a front panel and powerful GUI web interface for troubleshooting, allowing manual operation right out of the box. It

provides IVI-C (next generation PnP) and IVI-COM along with drivers. For LabVIEW programmers, a native LabVIEW (G) driver is also supplied. The 34980A has a built-in native SCPI driver and is an IEEE 488.2 instrument, making it easy to program via any programming language capable of sending ASCII command strings through the I/O interface to the instrument.

The eight slot 5 1/4" high (3U) full rack width rugged steel frame and module housing provide superior RFI shielding to the Aluminum typically used in VXI and PXI mainframes. Easy to use universal terminal block accessory products (often called headers or hoods) are available. Alternatively, cables with standard 50- and 78-pin D sub connectors that mate directly to the 34980A modules are also available as accessory products. These cables do a large part of the test fixture wiring task for the user. Four two wire analog busses on the 34980A mainframe backplane can be used to interconnect modules and external instruments.

Programmable relays are provided to connect the plug-in switch modules to the analog bus or to isolate them from other modules. The user has direct access to these analog busses via a 9-pin D sub connector on the back of the mainframe. This is a very important advantage for the 34980A switch system over many competitive products that require the user to make complex wiring interconnections. Even with all these additional features, the Agilent 34980A system hardware cost per channel is significantly lower than VXI and PXI alternatives as illustrated in the Example Configurations section below.

The 34980A front panel and sophisticated GUI web interface are very useful for test system debugging and troubleshooting.

This Web based GUI is not just a command execution window, but rather a remote front panel that allows full instrument control and configuration. The front panel and remote web interface are an important advantages over VXI and PXI systems particularly where the computer is remote from the test equipment rack. In addition, all of the switch modules have relay cycle counters that the user can query to monitor when any relay is approaching the end of it's useful life or when to do a scheduled path resistance check.

Programming is significantly different than VXI in that the modules are slot addressed rather than using a switch selectable logical address. This is the same approach successfully proven in the 34970A. The advantage of this syntax is that modules sent in for calibration or repair will go back into the customer's system without the need to find the logical address previously used and change it from the factory default logical address used in the Agilent Service Center test system. Although PXI doesn't use either slot addressing or address switches, you do have to reboot the computer every time you shut down the PXI frame to do anything with a PXI module. Powering down the 34980A has no effect on the computer other than causing an operating 34980A program to halt. Simple programming techniques allow the program to exit gracefully and notify the operator that the 34980A has been powered down. Up to five user states can be stored and recalled. The current state is always saved to a sixth state (state 0) when the 34980A is powered down. Reed relays and FET switches always open in the power down state, but armature relays maintain their latest state. At power up, state 0 is selected by default unless another one of the saved states has been selected to be the power on state.

Plug-in Modules:

34921A	40-channel armature multiplexer with low thermal offset
34922A	70-channel armature multiplexer
34923A	40/80-channel reed multiplexer
34924A	70-channel reed multiplexer
34925A	40/80-channel optically isolated FET multiplexer
34931A	Dual 4x8 2-wire armature matrix
34932A	Dual 4x16 2-wire armature matrix
34933A	Dual 2-wire or Quad 1-wire 4x8 reed matrix
34937A	28-channel 1A form C + 4-channel 5A form A switch
34938A	20-channel 5A form A switch
34941A	Quad 1x4 50 Ohm 2 GHz RF multiplexer
34942A	Quad 1x4 75 Ohm 2 GHz RF multiplexer
34945A	Microwave Switch/Attenuator Driver
34946A	Dual 1x2 SPDT terminated Microwave switch (4GHz or 20GHz)
34947A	Triple 1x2 SPDT unterminated Microwave switch (4GHz or 20GHz)
34950A	64-bit digital I/O with memory and counter
34951A	4-channel Isolated DAC with Waveform memory
34952A	Multifunction module with 32-bit digital I/O, 2-ch DAC & Totalizer
34959A	Breadboard module



Example Configurations:

The following 4 examples are generic real world configurations suggested by customers for comparison and were not selected to fit any manufacturer's system. The intent is to show that the Agilent 34980A may have a significant hardware cost advantage for other configurations. The NI PXI system component prices were taken from the National Instruments web site on August 13, 2004. There may be other PXI/SCXI component system alternatives. This comparison is based on basic functionality and price only. Each application will have detailed performance requirements that should be evaluated against the component specifications and system performance specifications as required.

1. Low Frequency System

- a. DMM
- b. 200 multiplexer channels
 - 30 thermocouple channels
 - 30 4-wire resistance channels
 - 110 two wire voltage channels
- c. 30 GP switch channels - form A (SPST) 1 A, 120 VAC
- d. 8x64 two wire matrix switch

Agilent 34980A Solution:

34980A Mainframe X2	\$3700
34980A option 001 DMM	\$500
34921A 40 ch 2-wire armature multiplexer with isothermal reference	\$795
34921T Terminal block	\$225
34924A 70 ch reed relay multiplexer X3	\$4485
34924T Terminal block X3	\$525
34937A 32 ch GP relay (28 1A form C + 4 5A form A)	\$895
34937T Terminal Block 34937A	\$225
34932A Dual 4x16 armature relay 2 wire matrix X4	\$5980
34932T Terminal block X4	\$900
Total	\$18,230

Agilent VXI Solution:

E8401A 13 slot Mainframe	\$4162
E8491B IEEE-1394 PC Ling to VXI with option 001 PCI IEEE-1394 card	\$2826
E1411B DMM	\$2151
[E1476A 64 ch 3 wire reed relay multiplexer with terminal block X4]	[S9608]
E8460A 128 ch 2 wire reed relay multiplexer X2	\$5760
E8460A-012 crimp & insert terminal block X2	\$650
E1463A 32 channel form C GP relay (5A)	\$1848
E1466A 4x64 armature relay 2 wire matrix X2	\$11,432
Total	\$32,677

NI PXI Solution:

PXI-1031 18 slot mainframe	\$4495
PXI-8330 & PCI 8330 MXI3 interface kit	\$1495
PXI-4070 DMM	\$1995
PXI-2530 64 ch multiplexer X4	\$6780
TB-2630 terminal block for PXI-2530 X4	\$980
PXI-2570 40 ch form C GP relay (1A)	\$1295
779038-01 cable connector for PXI-2570	\$395
PXI-2530 4x16 2 wire matrix X8	\$13560
TB-2631 X8	\$1960
Total	\$32,955

2. Mixed Signal System Example

- a. 40 Low frequency GP Switch channels
- b. 32 Digital I/O channels
- c. 24 RF switch channels

Agilent 34980A Solution:

34980A Mainframe		\$1850
34937A 32 channel form C GP Switch	X2	\$1790
34937T terminal block for 34937A	X2	\$450
34950A 64 bit Digital I/O module		\$995
34950T terminal block for 34950A		\$175
34941A Quad 1x4 50 Ohm 1.5 GHz Switch	X2	\$3190
Total		\$8275

Agilent VXI Solution:

E8408A 4 Slot Mainframe		\$2483
E8491B IEEE-1395 PC Link to VXI with option 001 PCI IEEE-1394 card		\$2826
E8491B-001 PCI IEEE-1394 card		\$571
E1458A 96 bit digital I/O		\$2364
E1442A 64 channel form C Switch		\$2437
E1442A-010 terminal block for E1442A		\$263
E1472A Six 1X4 50 Ohm 1.3 GHz Switch		\$2483
Total		\$13,427

NI PXI Solution:

PXI-1031 18 slot mainframe		\$4495
PXI-8330 & PCI 8330 MXI3 interface kit		\$1495
PXI-2570 40 channel SPDT Switch		\$1295
779038-01 cable connector for PXI-2570		\$395
PXI-2590 one 1X4 50 Ohm 1.3 GHz Switch	X6	\$2970
[SCXI-1191 Quad 4X1	X2]	[\$7990]
778546-01 Switch Management Software		\$995
PXI-6533 32 bit digital I/O		\$1195
778242-01 terminal block for PXI-6533		\$195
Total:		\$13,035

3. High Frequency Example

- a. 12 20 GHz microwave switch channels
- b. 40 multiplexer channels
- c. DMM
- d. 30 GP switch channels
- e. 16 digital inputs and 16 digital outputs

Agilent 34980A Solution:

34980A 8 slot mainframe	\$1850
34980A-DMM	\$500
34923A 40/80 Channel Reed Relay Multiplexer	\$995
34923T Terminal Block for 34923A	\$225
34947A 20 GHz Triple 1X2 unterminated Switch X4	\$6400
34937A GP Switch	\$895
34937T Terminal Block for 34937A	\$225
34952A Multifunction – 32 bit digital I/O/Totalizer plus 2 DAC channels	\$695
Total	\$11,785

Agilent VXI Solution:

E8408A 6 slot Mainframe	\$2483
E8491B IEEE-1394 PC Link to VXI with option 001 PCI IEEE-1394 card	\$2826
E1411B DMM	\$2151
E1476A 64 Channel Reed Relay Multiplexer	\$2402
E1463A 32 channel form C switch	\$1848
[E1368A 18 GHz Triple 1X2 unterminated Switch X4]	[\$10,896]
E1339A 72 channel relay driver	\$1083
E1403C B-to-C size adaptor	\$484
Agilent N1810UL 20 GHz microwave switch X12	\$3991
E1458A 96 channel digital I/O	\$2364
Total	\$19,632

NI PXI Solution: *No microwave switches (>4 GHz BW) available from NI. Use switch driver and Agilent N1810UL external microwave switch for comparison*

PXI-1042 8 slot chassis	\$1995
PXI-8331 MXI4 high speed serial interface kit with 3m copper cable	\$1495
PXI-2567 Switch Driver for up to 64 external switches	\$995
Agilent N1810UL 20 GHz microwave switch X12	\$3991
PXI-4070 DMM	\$1995
PXI-2530 64 Channel Reed Relay Multiplexer	\$1695
TB-2630 terminal block for PXI-2530	\$245
PXI-2570 40 ch form C GP relay (1A)	\$1295
779038-01 cable connector for PXI-2570	\$395
PXI-6533 32 bit digital I/O	\$1195
778242-01 terminal block for PXI-6533	\$195
Total	\$15,491

4. Data Acquisition Example

- a. 30 channels of thermo-couple inputs
- b. 10 channels of RTD inputs
- c. 10 voltage inputs
- d. 10 four wire resistance inputs
- e. 4 frequency inputs (<4 MHz)
- f. 20 digital state inputs
- g. 10 digital totalize inputs

Note: All systems will have "sweet spots" that put them in the best light compared to alternative. This is a random example configuration proposed prior to looking at any alternative system configurations. This provides a general cost comparison, but each application should be evaluated independently.

Agilent 34980A System solution:

34980A Mainframe with DMM option		\$2350
34921A 40 channel Armature Multiplexer		\$795
34921T terminal block for 34921A		\$225
34922A 70 channel Armature Multiplexer		\$1295
34922T terminal block for 34922A		\$175
34950A 64 bit Digital I/O with memory and two 5 MHz counter channels	X2	\$1195
34950AT terminal block for 34950A	X2	\$175
34952A Multifunction module with 32 bit digital I/O and totalizer		\$695
34952T terminal clock for 34952A		\$175
Total		\$7080

Agilent VXI System Solution:

E8408A 13 slot VXI mainframe		\$2483
E8491B IEEE-1395 PC Link to VXI with option 001 PCI IEEE-1394 card		\$2826
E1411B DMM module		\$2151
E1476A 64 channel reed relay multiplexer module	X2	\$2402
E1330B Quad 8 bit digital I/O module		\$868
E1332A 4 channel Counter/Totalizer module		\$1082
E1403C B-to-C size adaptor module	X2	\$968
Total		\$12,780

National Instruments PXI Solution:

PXI-1010 combination chassis 8 PXI and 4 SCXI slots		\$2795
MXI3 or MXI4 interface		\$1495
PXI-4070 DMM		\$1995
SCXI-1127 64 channel multiplexer		\$995
SCXI-1331 terminal block for SCXI 1127		\$180
Cable, HV8-BAN4(1m)		\$50
PXI-2530 64 channel multiplexer		\$1695
778733-01 terminal block for PXI-2530		\$245
PXI-6533 32 bit digital I/O		\$1195
778242-01 terminal block for PXI-6533		\$195
PXI-6602 Counter/Timer X2		\$1590
776844-01 terminal block for PXI-6602		\$590
Total		\$13,020



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