

# Agilent 34980A Multifunction Switch/Measure Unit

Data Sheet



## *CONFIGURE, CONNECT, GO*

- **8-slot mainframe with 19 mix-and-match plug-in modules so you can create your own custom configuration**
- **High-performance switching: Up to 560 2-wire multiplexer channels or 1024 matrix cross-points in one mainframe**
- **Optional built-in 6 ½-digit DMM lets you make 11 measurements with up to 2000 readings/sec**
- **Easy to integrate: Built-in Ethernet, USB 2.0, and GPIB connectivity, standard connectors and software drivers for most common programming environments**

## High-performance unit provides low-cost alternative to PXI and VXI switch and measurement platforms

If you use automated test equipment for design validation or manufacturing, you now have a cost-effective alternative to PXI and VXI test-system platforms. The 34980A multifunction switch/measure unit provides comparable functionality that is much easier to use than PXI and VXI and costs less. The 34980A helps you lower your cost of test and accelerate your test-system integration and development.

The 34980A handles your system switching needs up to 20 GHz and provides basic measurements and system control. It offers optional DMM measurements, counter/totalizer functionality, digital I/O with pattern capabilities, and analog outputs with basic waveforms—all in one low-cost, compact box. And with its standard connectors and software drivers, computer-standard I/O, and Web browser interface, the 34980A easily integrates into electronic functional test and data acquisition systems.



### Flexible switching, measurements, and system control

The 34980A accommodates up to 8 plug-in modules to give you the flexibility you need. Choose from 19 different modules to define your own configuration. You can buy what you need now and add to it or reconfigure it as your requirements change.

Whether you are measuring temperature, AC or DC voltage, resistance, frequency, current, or custom measurements, the 34980A offers the functionality you need in a single box. Switch in different measurements with high-performance signal switching—no external signal conditioning is required. Choose between different switch types and topologies with frequency ranges from DC to 20 GHz. The 34980A offers high-density multiplexers for scanning multiple channels, matrices for connecting multiple points at one time, and general purpose switches for simple control and high power needs.

Use the 34980A to route individual signals or monitor multiple signals over a specified period of time—monitor a single channel or multiple channels, set alarms, and identify irregularities.

The 34980A also offers flexible choices for system control. You can control external devices such as microwave switches, attenuators, solenoids, and power relays. Or use the digital inputs to sense limit-switch and digital-bus status.

### Optimized for test systems

The 34980A has the performance you need for medium- to high-density switching/measurement applications such as design verification, functional test and data acquisition. Your signals are switched to the right measurement device without compromising signal integrity. Switch your signals to the optional internal DMM and achieve optimal throughput on switch closure time. Or, if you prefer, you can easily connect to external instruments such as DMMs, scopes, power supplies, and more. What's more, with the built-in Ethernet interface, you can control the 34980A and collect data from remote locations.

The rugged instrument comes with a variety of system-ready features:

- Web browser interface shows settings at a glance and provides remote access and control
- Self-guiding front panel to configure, troubleshoot or view data
- Low EMI and efficient system cooling
- Heavy-duty cabling and connection options
- Rack mount options
- Relay counters help predict end-of-life
- In-rack calibration for reduced maintenance time
- DMM measurement accuracies include the switch for simple calculations

**Make system connections easily and quickly** with simple, reliable connection options:

- Built-in Ethernet, USB 2.0, and GPIB connectivity
- Standard IVI and LabVIEW software drivers
- Low-cost, standard 50- or 78-pin Dsub connectors and cables
- Detachable terminal blocks with strain relief
- Mass interconnect solutions

In addition, the 34980A comes with Agilent E2094N IO Libraries Suite 14.0. Quickly establish an error-free connection between your PC and instruments—regardless of vendor. The I/O Libraries provide robust instrument control and work with the software development environment you choose.

**Easier signal routing** with four 2-wire internal analog buses. You can route your measurements directly to the internal DMM, or you can connect to external instruments through the analog bus connector on the rear of the mainframe. And since you have four 2-wire buses, you can dedicate one bus for use with the internal DMM and use the other three buses for module extensions or additional signal routing between modules, reducing your wiring needs.

You can define switch sequences to control complex signal routing and the order of switch closures. Assign a sequence, give it a name and then execute it with the name you created. You also can define lists to identify channels that should never be connected together.

External trigger capabilities make it easy for you to time and synchronize measurements and other events. This can help you determine when to begin or end an acquisition.

## Measurements you can trust

Get proven performance from Agilent instruments, with the resolution, repeatability, speed, and accuracy you've come to expect.

The 34980A offers built-in signal conditioning and modular flexibility. When you use it with the internal DMM, you can configure each channel independently for the measurements you choose. It includes a variety of features that give you confidence in your measurements:

- 6½ digits of resolution with .004% of accuracy with DC voltage measurements
- Alarms per channel—high limit, low limit, or both
- Math functions—use  $Mx+B$  for custom linear conversions and converting raw inputs
- Built-in thermocouple reference for temperature measurements (34921T)
- Time-stamped readings

**The integrated DMM** is mounted inside the mainframe and does not consume any of the eight user-available slots. You can access the DMM through any switch module that connects to the analog bus, or directly from the analog bus connector on the rear of the mainframe. The internal DMM gives you the flexibility to measure 11 types of inputs:

- Temperature with thermocouples, RTDs, or thermistors (with 34921A)
- DC and AC voltage
- 2- and 4-wire resistance
- Frequency and period
- DC and AC current

You can control the DMM directly, or configure it to work in conjunction with the switches. Each switch channel can be configured independently for measurement functions, scale factors and alarm limits. Advanced measurement features such as offset compensation, variable integration time, and delay are also selectable on a per-channel basis.

The DMM inputs are shielded and optically isolated from the 34980A's earth-referenced circuitry and computer interface, and as a result, you get up to 300 V of input isolation. This is important for reducing ground-loops and common-mode voltage errors associated with long wiring runs and floating sources.

**Simple DMM calibration** is accomplished with just the analog bus connection on the rear panel of the mainframe. You don't need to remove the mainframe from the rack or dedicate a channel for calibration.



## Modules provide flexible system stimulus and control

*System control*—with analog outputs, open-collector digital outputs, clock generation, and isolated Form-C relays for controlling external devices. Additionally, with the microwave switch/attenuator driver, high-frequency switches and attenuators can be efficiently controlled external to the 34980A mainframe.

*Analog sources*—output either voltage or current. You can configure the 4-channel isolated D/A converter as a point-to-point arbitrary waveform generator that lets you define up to 500,000 points per waveform.

*Digital patterns*—send or receive digital data from your device under test. With on-board memory you can output communication protocols and bit streams or monitor digital input patterns and interrupt when a user-defined pattern is detected.

## Standard interfaces take the hassle out of connecting to your PC

*Standard Ethernet, USB and GPIB interfaces* are included in every mainframe. Use one of the interfaces that is already available in your computer, or if you prefer, GPIB is still available.

- USB offers the quickest and easiest connection scheme—it's perfect for small systems and bench connections.
- Ethernet offers high-speed connections that allow for remote access and control. Choose a local area network to filter out unwanted LAN traffic and speed up the I/O throughput. Or take advantage of the remote capabilities and distribute your tests worldwide. Monitor, troubleshoot, or debug your application remotely.
- GPIB has many years of proven reliability for instrument communication and can be used in existing GPIB based test systems.

## Remote access and control

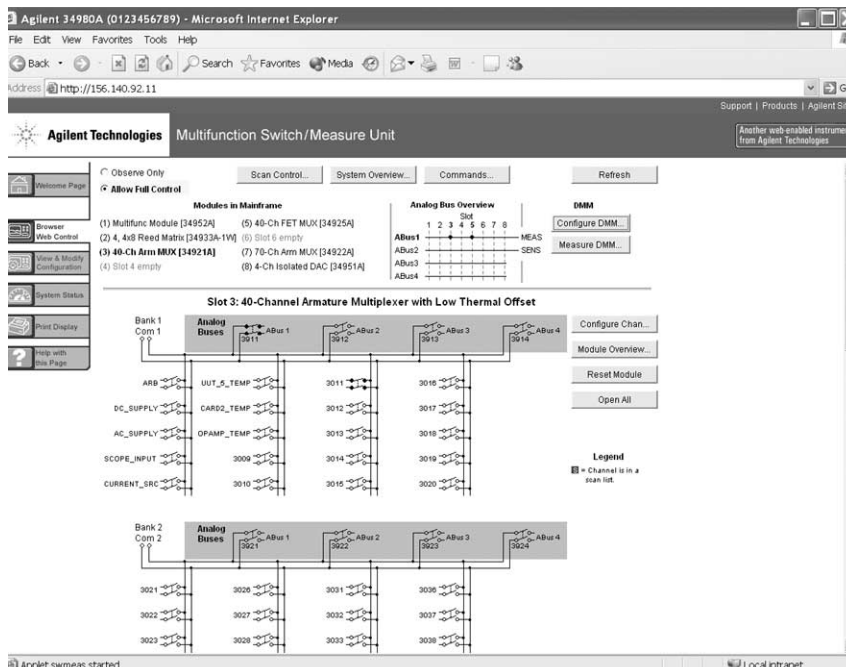
The built-in Web browser interface provides remote access and control of the instrument via a Java-enabled browser such as Internet Explorer. Using the Web interface, you can set up, troubleshoot, and maintain your system remotely.

- View and modify instrument setup
- Open, close, or monitor switches
- Send SCPI commands
- Define and execute switch sequences
- View error queue
- Get status reports on relay counts, firmware revisions, and more

Additionally, since the Web interface is built into the instrument, you can access it on any operating system that supports the Web browser without having to install any special software. Password protection and LAN lock-out are also provided to limit access.

The Web interface makes it easy to set up, troubleshoot and maintain your system remotely.

**Figure 1** The Web interface makes it easy to set up, troubleshoot and maintain your system remotely.



## Works with your choice of software

so you can save time and preserve your software and hardware investments. You can program directly with SCPI, or use IVI or LabVIEW software drivers that provide compatibility with the most popular development environments and tools:

- Agilent VEE Pro, Agilent T&M Toolkit (requires Microsoft® Visual Studio®.NET)
- National Instruments LabVIEW, LabWindows/CVI, TestStand, and Switch Executive
- Microsoft Visual Studio.NET, C/C++ and Visual Basic 6

# Power and flexibility to get your job done



Intuitive front panel with self-guiding menus

See results on bright, multiline display

6 1/2 digit DMM measurements with 11 functions

Scan multiple channels, close specified channel list, or monitor results on a single channel

Store up to 500,000 readings with timestamp

Use keypad to enter channel number or knob to scroll

Configure measurements by channel

Set up scan lists

8-slots connect to optional internal DMM

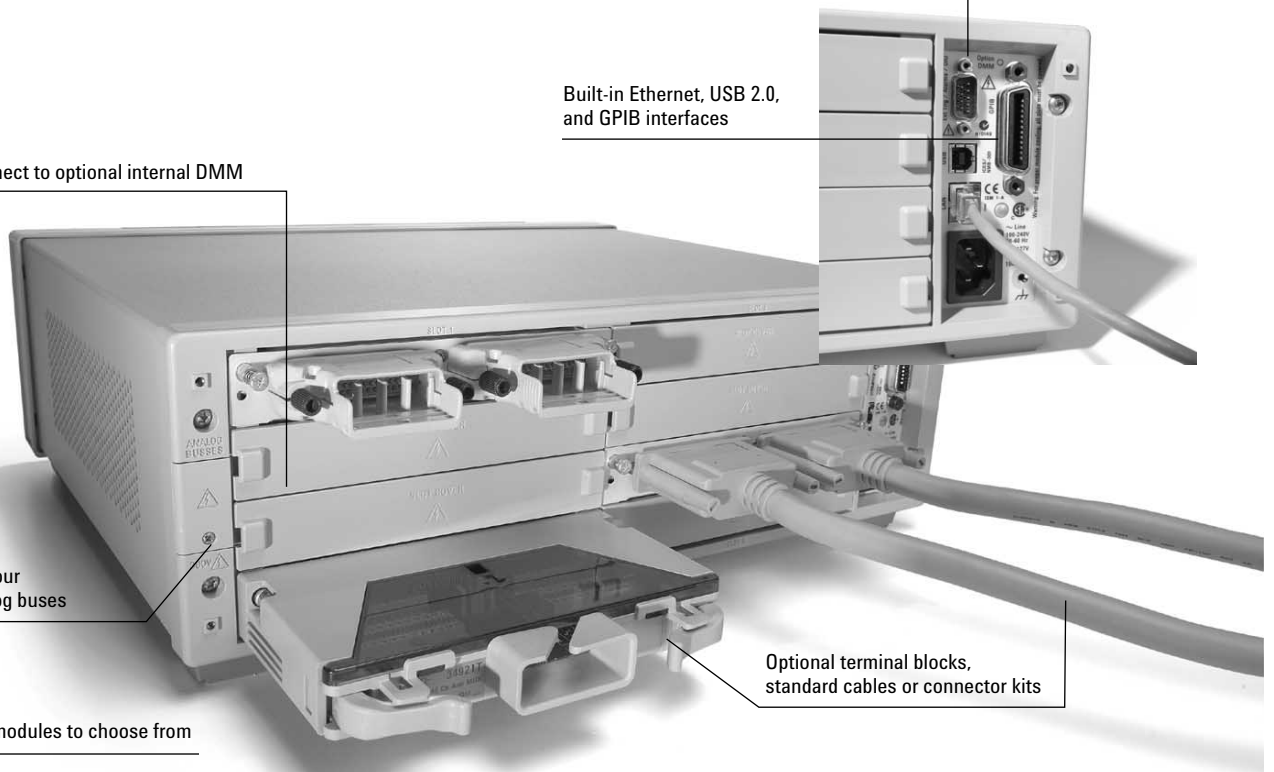
Access to four 2-wire analog buses

19 plug-in modules to choose from

External trigger to synchronize events

Built-in Ethernet, USB 2.0, and GPIB interfaces

Optional terminal blocks, standard cables or connector kits



## Mix and match 34980A modules to create your own custom configuration

The 34980A mainframe holds up to eight plug-in modules. Mix and match them to create a custom system to meet your switching and system control needs. You can easily add or replace modules as your needs change.

**Table 1. 34980A modules at a glance**

Module	Description	Max volts	Max current	BW (MHz)	Scan ch/sec	Thermal offset	Comments
<b>Multiplexer modules</b>							
34921A	40-channel armature multiplexer w/ low thermal offset	± 300V	1A	45 MHz	100	< 3 uV	Temperature reference 4 current channels Config as 2- or 4-wire
34922A	70-channel armature multiplexer	± 300V	1A	25 MHz	100	< 3 uV	Config as 2- or 4-wire
34923A	40/80-channel reed multiplexer	± 150V	0.5A	45 MHz	500	< 50 uV	Config as 1-, 2- or 4-wire
34924A	70-channel reed multiplexer	± 150V	0.5A	25 MHz	500	< 50 uV	Config as 2- or 4-wire
34925A	40/80-channel optically isolated FET multiplexer	± 80V	0.05A	1 MHz	1000	< 3 uV	Config as 1-, 2- or 4-wire
<b>Matrix modules</b>							
34931A	Dual 4x8 armature matrix	± 300V	1A	30 MHz	100	< 3 uV	Backplane expandable
34932A	Dual 4x16 armature matrix	± 300V	1A	30 MHz	100	< 3 uV	Backplane expandable
34933A	Dual/Quad 4x8 reed matrix	± 150V	0.5A	30 MHz	500	< 50 uV	Backplane expandable Config as 1- or 2-wire
<b>General-purpose modules</b>							
34937A	28-channel Form C and 4-channel Form A	300V 250AC	1A 5A	10 MHz	N/A	< 3 uV < 3 uV	
34938A	20-channel 5-amp Form A	250AC	5A	1 MHz	N/A	< 3 uV	
<b>RF and microwave modules</b>							
Module	Description	Insertion Loss	Isolation	Freq Range	VSWR	Input Impedance	Comments
34941A	Quad 1x4 50 ohm 3 GHz RF multiplexer	0.6dB	> 58dB	3 GHz	< 1.25	50 Ω	@ 1 GHz
34942A	Quad 1x4 75 ohm RF multiplexer	Contact factory				75 Ω	
34945A/ 34945EXT	Microwave switch/attenuator driver	Can drive up to 64 external switch coils; 32 SPDT switches, 8 multipoint switches, 8 attenuators, or your own combination. Expand with additional 34945EXTs.					
34946A	Dual 1x2 SPDT terminated microwave switch	< 0.42dB < 0.69dB	> 85dB > 67dB	4 GHz or 20 GHz	< 1.15 < 1.30	50 Ω	@ 4 GHz @ 20 GHz
34947A	Triple 1x2 SPDT unterminated microwave switch	< 0.42dB < 0.69dB	> 85dB > 67dB	4 GHz or 20 GHz	< 1.15 < 1.30	50 Ω	@ 4 GHz @ 20 GHz
<b>System control modules</b>		<b>Description</b>					
34950A	64-bit digital I/O with memory and counter	Eight 8-bit digital I/O channels with programmable polarity, thresholds up to 5 V, with 7 handshaking protocols and pattern memory. Two 10-MHz frequency counter/totalizers and programmable clock output to 10MHz.					
34951A	4-channel isolated D/A converter with waveform memory	Output DC voltage up to ± 16 V or DC current up to ± 20 mA. Output waveforms with a 200 kHz update rate and 16 bits of resolution. Use on-board memory to create point-to-point waveforms with more than 500,000 points.					
34952A	Multifunction module with 32-bit DIO, 2-ch D/A and totalizer	Four 8-bit digital I/O channels, two ± 12-V analog outputs, and a 100-kHz gated totalizer.					
34959A	Breadboard module	Create your own custom designs with access to the +12 V and +5 V supplies, 16 GPIO ports and 32 relay drive lines.					

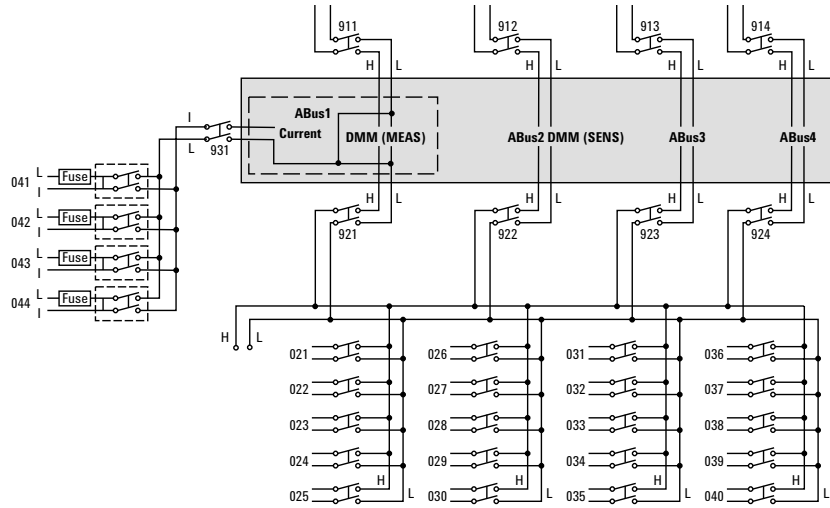
## 34980A multiplexer switch modules

The 34980A multiplexer modules can be used to connect one of many different points to a single point. You can connect to an external instrument, or scan multiple analog signals to the internal DMM.

Choose from the following features:

- 1-wire, 2-wire, or 4-wire configurations
- High voltage—up to 300 V, 1 A
- High-density—70 2-wire or 80 1-wire channels
- Bandwidths up to 45 MHz
- Temperature measurements with built-in thermocouple reference junction (34921T)
- AC or DC current measurements without external shunts
- Connections via standard 50- or 78-pin Dsub cables or detachable terminal block

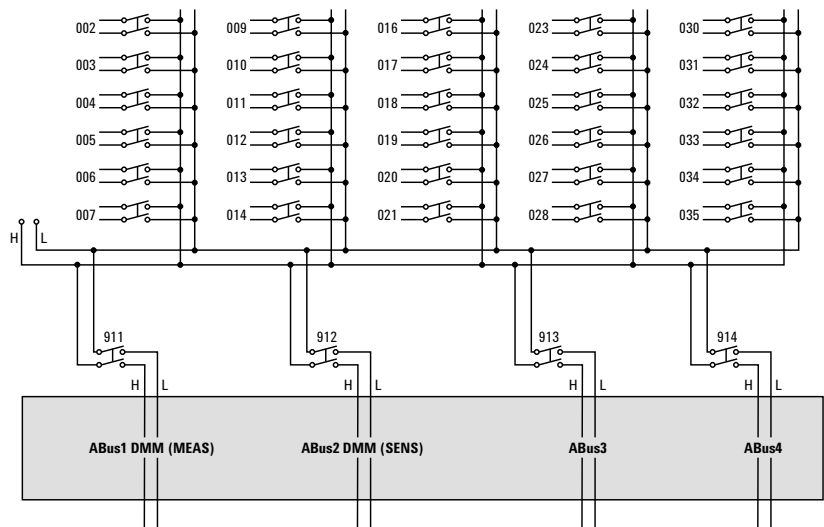
Figure 2. 34921A 40-channel armature multiplexer with low thermal offset (bank 2)



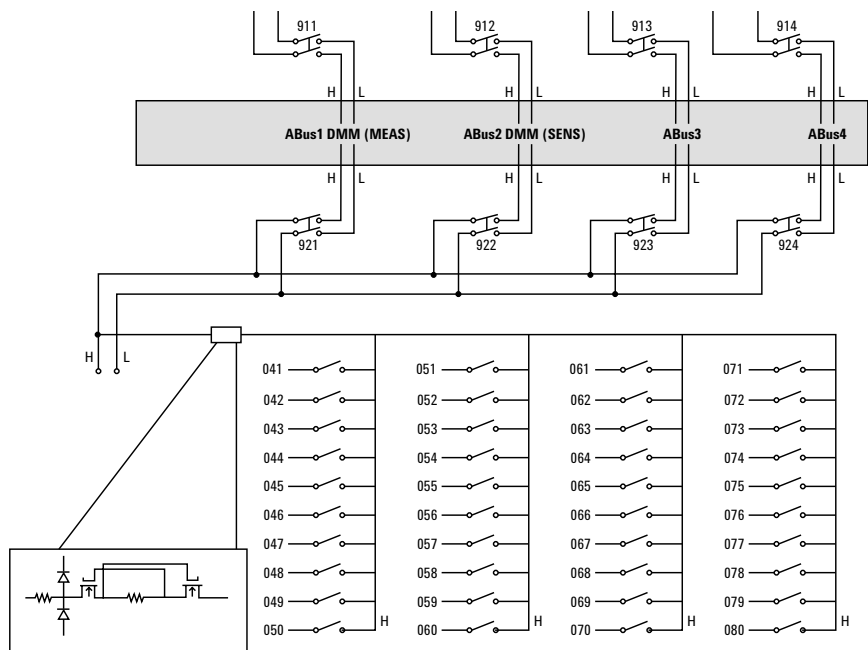
Multiple multiplexers can connect to the built-in analog buses, allowing you to scan up to 560 2-wire channels or 640 1-wire channels in a single mainframe. The 34921A also offers 4 channels for directly measuring current. Or if you need more current channels, shunts can be added to the terminal block for easy current measurements.

The multiplexer modules feature break-before-make connections to ensure that no two signals are connected to each other during a scan. Or, if you prefer, you can control switching manually to create your own switch configuration. All the multiplexer switches have a relay counter to help predict when relays need to be replaced.

**Figure 3.** 34922A 70-channel armature multiplexer (bank 1 shown)



**Figure 4.** 34925A 40/80-channel optically isolated FET mux (shown in 1-wire mode bank 2)





**Table 2.** Multiplexer selection table—specifications and characteristics\*

	<b>34921A</b>	<b>34922A</b>	<b>34923A</b>	<b>34924A</b>	<b>34925A</b>
Channels/configurations	40 2-wire 20 4-wire 4-current	70 2-wire 35 4-wire	80 1-wire 40 2-wire 20 4-wire	70 2-wire 35 4-wire	80 1-wire 40 2-wire 20 4-wire
Switch type	Armature latching	Armature latching	Reed	Reed	Optically isolated FET
<b>Input characteristics (per channel)</b>					
Max volts	± 300 V <sup>[1]</sup>	± 300 V <sup>[1]</sup>	± 150 V peak <sup>[2]</sup>	± 150 V peak <sup>[2]</sup>	± 80 V peak <sup>[2]</sup>
Max current (DC, AC RMS)					
Switch current	1 A	1 A	0.5 A	0.5 A	0.02 A <sup>[8]</sup>
Carry current	2 A	2 A	1.5 A	1.5 A	
Power (W, VA) <sup>[6]</sup>	60 W	60 W	10 W	10 W	1.6 W
Volt-Hertz limit	10 <sup>8</sup>	10 <sup>8</sup>	10 <sup>8</sup>	10 <sup>8</sup>	10 <sup>7</sup>
<b>General specifications</b>					
Offset voltage <sup>[3]</sup>	< 3 uV	< 3 uV	< 50 uV < 100 uV 1-wire	< 50 uV	< 3 uV
Initial closed channel res <sup>[3]</sup>	< 1.5 Ω	< 1.5 Ω	< 1.5 Ω <sup>[5]</sup>	< 1.5 Ω <sup>[5]</sup>	< 700 Ω
Leakage current <sup>[3]</sup>	N/A	N/A	N/A	N/A	20nA <sup>[9]</sup>
T/C cold junction accuracy <sup>[3, 10]</sup>	< 1°C	N/A	N/A	N/A	N/A
<b>AC characteristics</b>					
Bandwidth at terminal block <sup>[4]</sup>	45 MHz	25 MHz	45 MHz 10 MHz 1-wire	25 MHz	1 MHz
Crosstalk at terminal block (ch-ch) <sup>[4]</sup>					
300 kHz	-75 dB	-75 dB	-75 dB	-75 dB	N/A
1 MHz	-75 dB	-75 dB	-75 dB	-70 dB	
20 MHz	-50 dB	-50 dB	-50 dB	-45 dB	
45 MHz	-40 dB		-40 dB		
Capacitance at terminal block					
HI-LO	150 pF	250 pF	130 pF	200 pF	100pF
LO – earth	150 pF	200 pF	120 pF	170 pF	300pF (600pF 1-wire)
<b>General characteristics</b>					
Relay life, typical					
No load	100 M	100 M	1000 M	1000 M	N/A
10 V, 100 ma	10 M	10 M	10 M	10 M	N/A
Rated load	100 k	100 k	10 k	10 k	N/A
Scanning speeds <sup>[7]</sup>	100 ch/sec	100 ch/sec	500 ch/sec	500 ch/sec	1000 ch/sec
Open/ close time, typical	4 ms/4 ms	4 ms/4 ms	0.5 ms/0.5 ms	0.5 ms/0.5 ms	0.25 ms/0.25 ms
Analog bus backplane connection	Yes	Yes	Yes	Yes	Yes

[1] DC or AC RMS voltage, channel-to-channel or channel-to-earth  
 [2] Peak voltage, channel-to-channel or channel-to-earth  
 [3] Into analog bus. System errors are included in the internal DMM measurement accuracy specifications

[4] 50 Ω source, 50 Ω load, differential measurements verified with 4-port network analyzer (Sdd21)  
 [5] With in-rush resistors bypassed  
 [6] Limited to 6 W of channel resistance power loss per module  
 [7] Speeds are for 4-1/2 digits, delay 0, display off, autozero off, and within bank

[8] DC or peak AC current  
 [9] Ambient temperature < 30°C  
 [10] Includes temperature reference and temperature gradient from reference to screw terminal block. Measured under worst case heat loading of the mainframe. For remote mount of terminal card accuracy consult factory.

## 34980A matrix switch modules

The 34980A matrix modules are full cross-point matrices that allow you to connect any row to any column. This is a convenient way to connect multiple test instruments to multiple points on a device under test.

Choose from the following features:

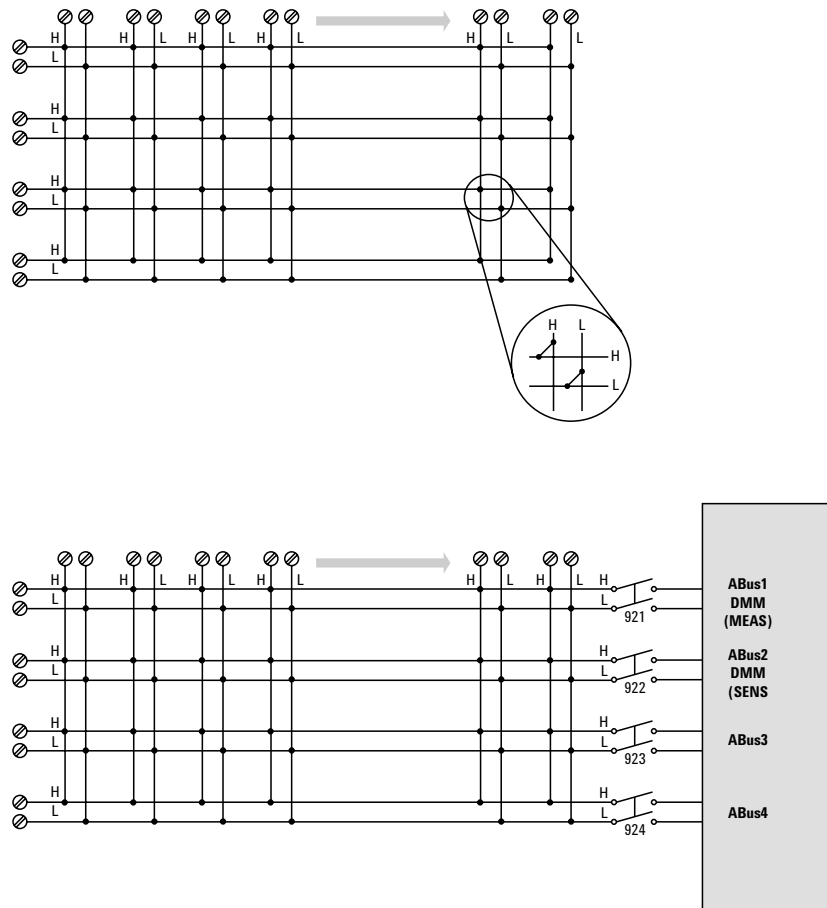
- Latching armature relays—300 V, 1 A
- High-speed reed relays—150 V, 0.5 A
- Configurable dual 4x8 or dual 4x16 modules
- Single-wire configuration (34933A)
- Analog bus expandable rows to create larger matrices
- Connections via standard 50-pin Dsub cables or detachable terminal block

Each cross-point in the matrix switch has two wires—a high and a low for the measurement. Or, if you prefer, the 34933A can be configured as a single-wire matrix, increasing the number of channels. The 34933A also has in-rush resistors on each column for added protection.

Combine multiple matrix modules through the 34980A analog buses to create a larger matrix. Two matrix rows also can be connected to the internal DMM for easy measurements.

Combine your matrix with a multiplexer switch to achieve the desired switching topology and get a lower-cost solution with better specifications. All the matrix switches include a relay counter to help predict when relays need to be replaced. Use the sequencing feature to easily change between different cross-point setups.

Figure 5. 34932A dual 4x16 armature matrix



**Table 3.** Matrix selection table—specifications and characteristics\*

	<b>34931A</b>	<b>34932A</b>	<b>34933A</b>
Channels/configurations	dual 4x8 8x8 4x16	dual 4x16 8x16 4x32	dual 4x8 8x8 4x16 quad 4x8, 1-wire
Switch type	Armature latching	Armature latching	Reed non-latching
<b>Input characteristics (per channel)</b>			
Max volts	± 300 V <sup>[1]</sup>	± 300 V <sup>[1]</sup>	± 150 V peak <sup>[2]</sup>
Max current (DC, AC RMS)			
Switch current	1 A	1 A	0.5 A
Carry current	2 A	2 A	1.5 A
Power (W, VA) <sup>[2]</sup>	60 W	60 W	10 W <sup>[7]</sup>
Volt-Hertz limit	10 <sup>8</sup>	10 <sup>8</sup>	10 <sup>8</sup>
<b>General Specifications</b>			
Offset voltage <sup>[3]</sup>	< 3 $\mu$ V	< 3 $\mu$ V	< 50 $\mu$ V < 100 $\mu$ V 1-wire
Initial closed channel res <sup>[3]</sup>	< 1.5 $\Omega$	< 1.5 $\Omega$	< 1.5 $\Omega$ <sup>[5]</sup>
<b>AC characteristics</b>			
Bandwidth at terminal block <sup>[4]</sup>	30 MHz	30 MHz	30 MHz <sup>[5]</sup> 2 MHz 1-wire
Crosstalk at terminal block (ch-ch) <sup>[4]</sup>			
300 kHz	-65 dB	-65 dB	-65 dB
1 MHz	-55 dB	-55 dB	-55 dB
20 MHz	-30 dB	-30 dB	-40 dB
Capacitance at terminal block			
HI-LO	50 pF	50 pF	80 pF
LO – earth	80 pF	80 pF	75 pF
<b>General characteristics</b>			
Relay life, typical			
No load	100 M	100 M	1000 M
10 V, 100 ma	10 M	10 M	10 M
Rated load	100 k	100 k	10 k
Open/close time	4 ms/4 ms	4 ms/4 ms	0.5 ms/0.5 ms
Analog bus backplane connection	Bank 2	Bank 2	Bank 2

[1] DC or AC RMS voltage, channel-to-channel or channel-to-earth

[2] Peak voltage, channel-to-channel or channel-to-earth

[3] Into analog bus. System errors are included in the internal DMM measurement accuracy specifications

[4] 50  $\Omega$  source, 50  $\Omega$  load, differential measurements verified (Sdd21)

[5] With in-rush resistors bypassed

[6] Limited to 6 W channel resistance power loss per module

[7] Power restrictions allow only 20 channels to be closed at one time

\* See User's Guide for additional specifications

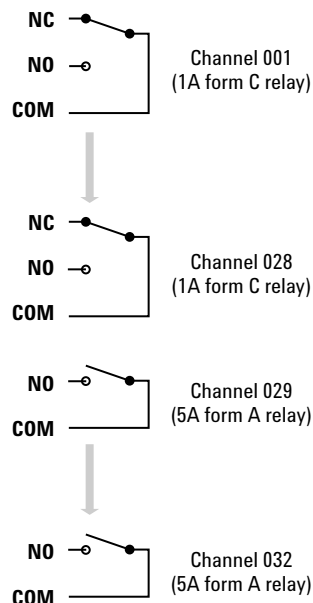
## 34980A general-purpose switch modules

The 34980A general-purpose switches can be used to route signals or to control other system devices. These switches are ideal for device actuation and switching loads or power supplies.

Choose from the following features:

- Form C channels up to 1 A, 50 W
- Form A channels up to 5 A, 150 W

**Figure 6.** 34937A 32-channel Form A/ Form C switch



- Armature latching relays
- Simultaneous channel switching
- Temperature sensor to detect overheating conditions
- Connections via standard 50-pin Dsub cables or detachable terminal block

The 34937A is the most versatile general-purpose switch with 28 Form C channels that can switch up to 1 A of current. In addition, this module has four Form A channels that can switch up to 5A of current. For power

switching applications, the 34938A has 20 5-amp channels in a Form A topology. Each Form A general-purpose switch can handle up to 150 W, enough for many power line-switching applications.

The 34937A and 34938A contain latching armature relays where multiple channels can be closed at the same time. Additionally, for switching reactive loads, the optional terminal blocks have pads for snubbing circuits.

The built-in relay counter helps predict when relays need to be replaced.

**Table 4.** GP actuator selection table—specifications and characteristics\*

	34937A	34938A
Channels/configurations	28 Form C 4 Form A	20 Form A
Switch type	Armature, latching	Armature, latching
<b>Input characteristics (per channel)</b>		
Max volts (DC, AC RMS) <sup>[1]</sup>	Form C – 300 V Form A – 30 VDC/250 VAC	30 VDC/250 VAC
Max current (DC, AC RMS)	Form C – 1 A (2 A carry) Form A – 5 A switch (8 A carry)	5 A switch (8 A carry)
Power (W, VA) <sup>[2]</sup>	Form C – 60 W Form A – 150 W	150 W
Volt-Hertz limit	10 <sup>8</sup>	10 <sup>8</sup>
<b>General specifications</b>		
Offset voltage	3 $\mu$ V	3 $\mu$ V
Initial closed channel res	Form C – 125 m $\Omega$ Form A – 50 m $\Omega$	< 60 m $\Omega$
<b>AC characteristics</b>		
Bandwidth at terminal block <sup>[3]</sup>	10 MHz	1 MHz
Channel Isolation at terminal block <sup>[3]</sup>		
100 kHz	55 dB	60 dB
1 MHz	35 dB	40 dB
10 MHz	15 dB	
Capacitance at terminal block		
CH – CH	Form C 12 pF/ Form A 10 pF	65 pF
CH – earth	Form C 21 pF/Form A 18 pF	105 pF
<b>General characteristics</b>		
Relay life no load/rated	Form C – 100 M/100 k Form A – 50 M/30 k	50 M/30 k
Open/close time	Form C – 4 ms/4 ms Form A – 10 ms/10 ms	10 ms/10 ms
Initial/reset relay state	Form C – maintain state Form A – user configurable	user configurable
Analog bus backplane connection	No	No

[1] DC or AC RMS voltage, channel-to-channel or channel-to-earth

[2] Limited to 6 W of channel resistance power loss per module

[3] 50  $\Omega$  source, 50  $\Omega$  load, differential measurements verified (S21)

\* See User's Guide for additional specifications

## 34980A RF and microwave switch modules

The 34980A offers a variety of RF and microwave switch modules—RF multiplexers, SPDT switching from DC to 20 GHz, or a switch/attenuator driver module that allows you to control switches or attenuators external to the 34980A mainframe.

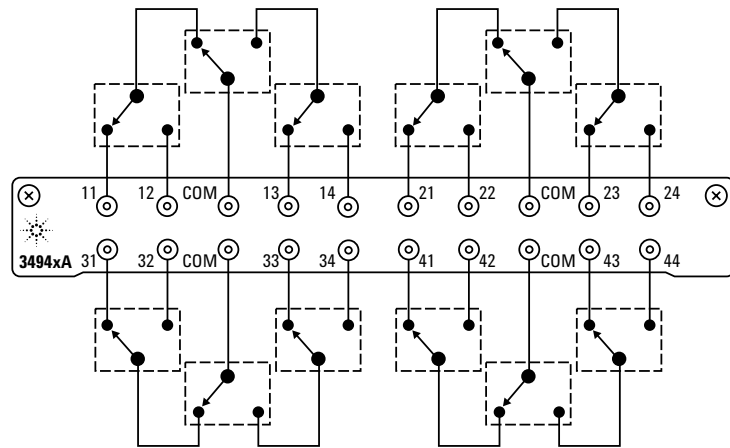
### 34941A/42A—from DC to 3 GHz—

The RF switch modules can be used to switch signals from DC to 3 GHz and above. This can be useful for switching signals between oscilloscopes, spectrum analyzers, network analyzers, and other RF test equipment.

Choose from the following features:

- 50- or 75-ohm Quad 4-channel multiplexers
- DC to 3 GHz
- 30 V, 0.5 A, 10 W

Figure 7. 34941A Quad 1x4 50 ohm 2 GHz multiplexer

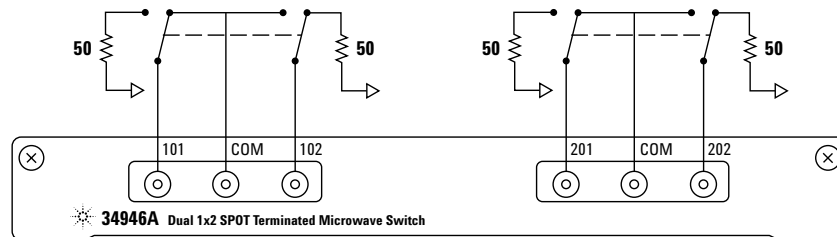


The 34941A and 34942A are configured as four independent 1x4 RF multiplexers on a single module. Multiple banks can be connected together to create a larger multiplexer—up to 97 RF multiplexer channels in a single 34980A mainframe. To prevent ground loops, individual multi-

plexers are isolated from each other and from the mainframe's chassis. However, the multiplexer channels can be chassis grounded with a simple change. Both 50-ohm and 75-ohm versions are available.

For typical switch performance graphs, contact factory.

Figure 8. 34946A dual 1x2 SPDT terminated microwave switch



### 34946A/47A—from DC to 20 GHz—

For applications where you need only a few high-frequency switches, the 34946A and 34947A offer single-pole, double-throw switches in either 4-GHz or 20-GHz options. These modules internally mount two or three independent Agilent N1810 series coaxial switches. These switches are well known for their excellent insertion loss, isolation and VSWR specifications. Switch read back capabilities allow you to query the position of the switch. You can choose higher density with the unterminated switches, or select the terminated switches to maintain impedance match.

**Table 5.** RF and microwave selection table—specifications and characteristics\*

	DC to 3 GHz		DC to 20 GHz <sup>[3]</sup>	
	34941A	34942A	34946A	34947A
Channels	quad 1x4	quad 1x4	2 SPDT	3 SPDT
Switch type	50 Ω unterminated, latching relays	75 Ω unterminated, latching relays	50 Ω terminated	50 Ω unterminated
<b>RF characteristics</b>				
Frequency range <sup>[2]</sup>	DC to 3 GHz	Contact factory	DC to 4 GHz OR DC to 20GHz	DC to 4 GHz OR DC to 20 GHz
Insertion loss (< 40 C/ 80% RH) <sup>[2]</sup>	Contact factory	Contact factory	DC to 4 GHz < 0.42dB @ 20 GHz < 0.69dB	DC to 4 GHz < 0.42 dB @ 20 GHz < 0.69 dB
VSWR <sup>[3]</sup>	Contact factory	Contact factory	DC to 4 GHz < 1.15 @ 20 GHz < 1.30	DC to 4 GHz < 1.15 @ 20 GHz < 1.30
Isolation (dB) <sup>[2]</sup>	Contact factory	Contact factory	DC to 4 GHz > 85dB at 20 GHz > 67dB	DC to 4 GHz > 85 dB at 20 GHz > 67 dB
Risetime	< 80 ps	Contact factory	N/A	N/A
Signal delay	< 1 ns	Contact factory	N/A	N/A
Capacitance	30 pF	Contact factory	N/A	N/A
Relay life	300,000 at 30V/10mA load; 100,000 at 10W load RF	Contact factory	> 5 M cycles, 1M w/drive 28-32VDC	> 5 M cycles, 1M w/drive 28-32VDC
<b>Switching characteristics</b>				
Max volts <sup>[1]</sup>	30 V	30 V	7 V DC	7 V DC
Max current	0.5A	0.5A	N/A	N/A
Max power (W)	10 W <sup>[5]</sup>	10 W <sup>[5]</sup>	1W @ 7 VDC, 50W peak <sup>[4]</sup>	1W @ 7VDC, 50W peak <sup>[4]</sup>
Offset voltage	10 uV	10 uV	N/A	N/A
Initial channel resistance	1 Ω	1 Ω	N/A	N/A
Volt-Hertz limit	2 × 10 <sup>10</sup>	2 × 10 <sup>10</sup>		
<b>General characteristics</b>				
Switching time	25 ms	25 ms	< 15 ms	< 15 ms
Connector type	SMA	Mini 75 Ω SMB	SMA	SMA
Analog bus backplane connection	No	No	No	No

[1] Channel-to-earth

[2] 50 Ω source, 50 Ω load (75 Ω for 34942A)

[3] For more detailed specifications, see the N1810TL for the 34946A and N1810UL for the 34947A

[4] 10 usec maximum duration

[5] Max power is 1 W between 30 MHz and 1 GHz for CISPR 11 compliance

\* See User's Guide for additional specifications

## 34945A/34945EXT microwave switch/attenuator driver

This module allows you to control switches attenuators, and other devices external to the 34980A. The 34945A provides the power and control signals for many of the most popular microwave switches and attenuators. One 34945A/ 34945EXT combination can drive up to 64 switch coils—that's 32 standard SPDT switches. You can add up to seven more 34945EXT boards with external power to drive up to 512 coils from a single mainframe. Multiple switch operations are performed in sequential order, or for faster, simultaneous switching, you can connect an external power supply to the 34945EXT.

Distribution boards enable simple connections to the external switches. The distribution boards plug onto the 34945EXT and are used to route the power and control signals from the driver module to the switches using standard cables.

The 34945A/34945EXT also has sensing capabilities that allows read back of the actual position of the switch or attenuator. Drive signals for LED indicators are also provided to give a visual indication of the switch position.

The following microwave switches and attenuators are supported with the distribution boards:

- N181x series SPDT switches
- 876x series SPDT switches (screw terminals)
- 87104x/106x multipoint switches
- 87406x series matrix switches
- 87204x/206x series multipoint switches
- 87606x series matrix switches
- 87222x transfer switches
- 849x series attenuators
- 8490x series attenuators
- Generic screw terminal connections

### General specifications—preliminary

#### 34945EXT switch drive (64 channels, low side drive mode)

Driver off voltage (max)	30V
Driver off leakage current	< 10 uA
Driver on current	
(continuous; 6 chans)	300 mA
(15 msec, 25% d.c.)	600 mA $T_{amb} \leq 40^{\circ}\text{C}$ 400 mA $T_{amb} > 40^{\circ}\text{C}$
Driver on voltage (max)	1.2 V

#### 34945EXT switch drive (64 channels, TTL drive mode)

Hi output voltage	3 V
Hi output current	2 mA
Lo output voltage	0.4 V
Lo input Current	20 mA

#### 34945EXT position indicator sense inputs

Channels	64
Lo input voltage (max)	0.8 V
Hi input voltage (min)	2.5 V
Input resistance	100 k $\Omega$
Maximum input voltage	30 V

#### 34945EXT switch drive power supply (34945EXT powered by 34945A)

Voltage	24 V nominal
Current	100 mA continuous + 200 mA (15 msec pulse, 25% duty cycle)

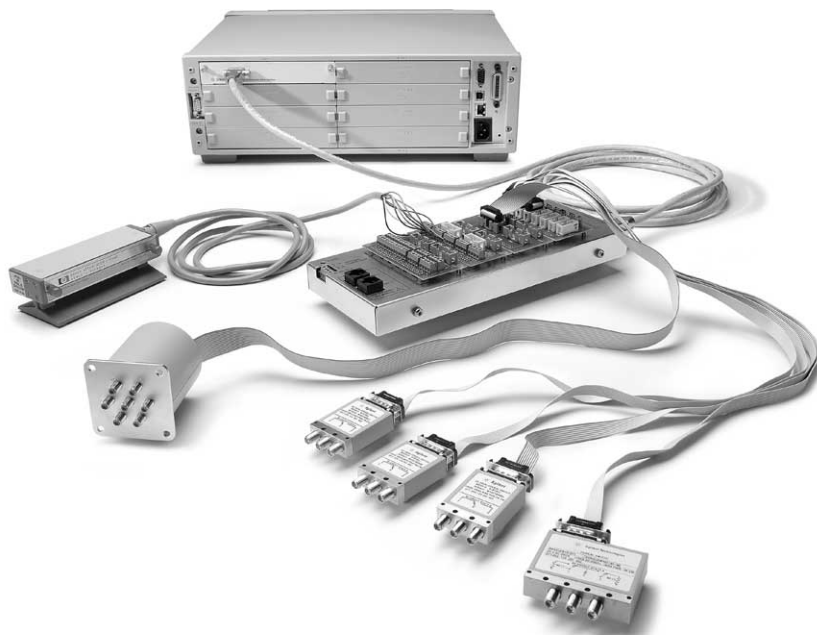
#### 34945EXT external power connection

Voltage range	4.75 V to 30 V
Current limit	2 A

#### LED indicators

Channels	64
Supply voltage	5 V nominal
LED drive current	10 mA nominal
Compliance voltage	0.8 V

Figure 9. 34945A/34945EXT microwave switch/attenuator driver



# 34980A system control modules

## 34950A 64-channel digital I/O with memory and counter

This module can be used to simulate or detect digital patterns. It has eight 8-bit digital I/O channels with handshaking, pattern memory, two 10-MHz totalizers with gate functions, and a programmable clock output.

### Digital input/output

The digital I/O bits are organized into two banks of 32-bits. The I/O bits can be configured and programmed as inputs or outputs in 8-bit channels. The digital outputs can be configured as active drive or tristate outputs with user supplied pull up resistors for up to 5 V outputs. The digital inputs have programmable thresholds up to 5 V for compatibility with most digital logic standards.

The onboard pattern memory can be used to select and output digital stimulus or bitstream patterns, or to capture external digital data. Each bank has independent memory and directional control so that one bank can output data while the other captures data. The memory can be divided into 16 Kbytes per 8-bit channel, or you can specify all the memory onto a single channel on the bank, resulting in 64 Kbytes on each bank.

Specifically, the digital I/O channels also have:

- Variable active high drive output from 1.5 V to 5 V or tristate
- Variable input thresholds from 1.5 V to 5 V
- 7 configurable handshaking protocols including synchronous, asynchronous, and strobe
- Programmable polarity
- Source or sink up to 30 mA

- Internal alarming for maskable pattern match
- 1 hardware interrupt per bank
- Connections via standard 78-pin Dsub cables or detachable terminal block

### Frequency counter/totalizer

The two channels can be used to count events, frequency, period, duty cycle, totalize, and pulse width. The counter/totalizer also includes

- Programmable gate functionality
- Programmable input thresholds levels 1.5 V to 5 V

### Digital input/output characteristics – preliminary specs, contact factory

Eight 8-bit channels: 8 bits wide, input or output, non-isolated	
Vin	1.5 V – 5 V <sup>(1)</sup>
Vout	1.5 V – 5V <sup>(1)</sup>
Iout (max)	30 mA <sup>(2)</sup>
Frequency (max)	10 MHz <sup>(3)</sup>

### Handshake lines

Vin	1.5 – 5 V <sup>(1)</sup>
Vout	1.5 – 5 V <sup>(1)</sup>
Low Voltage Range	0 – 5 V
Frequency (max)	10 MHz

(1) Configurable by 8-bit channel

(2) Current limit per bit

(3) from memory with handshaking

### Counter function characteristics

Maximum freq	10 MHz (max) 50% duty cycle
Vin	1.5 V – 5 V

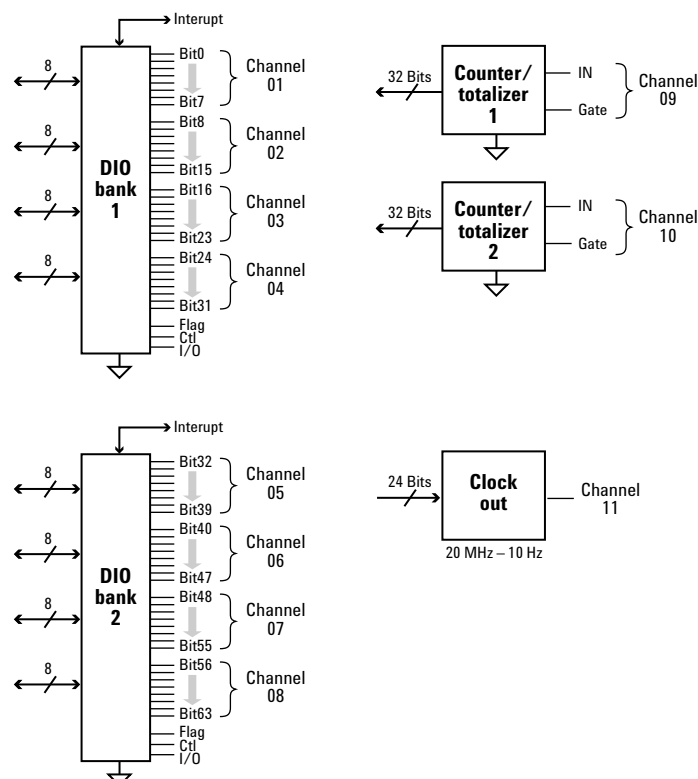
### Totalizer function characteristics

Maximum count	2 <sup>32</sup> – 1 (4,294,967,296)
Max input freq	10 MHz (max), rising or falling edge programmable
Vin	1.5 V – 5 V
Gate input	1.5 V – 5 V

### System clock generator characteristics

Frequency	10 MHz – 10 Hz configurable divide-by-n 24-bits, programmable on/off
Vout	1.5 V – 5 V
Accuracy:	100 ppm

Figure 10. 34950A 64-channel digital I/O





## 34951A 4-channel isolated D/A converter with waveform memory

This module has four independent, isolated channels that output DC voltage up to  $\pm 16$  V or DC current up to  $\pm 20$  mA. The gain and offset can be adjusted on-the-fly. Each channel can be controlled manually, or use the onboard memory to download a waveform. These waveforms can be dynamically allocated among one or more channels and output as a point-to-point arbitrary waveform generator at up to 200k points/sec. You can use the standard sine, square or ramp wave shapes provided or define your own wave shape using over 500,000 points and output to a device under test.

The calibration command connects the D/A converters to the internal DMM to be automatically calibrated. Connections to the module can be made via standard 50-pin Dsub cables or a detachable terminal block.

### General specifications

Maximum update rate:	200 kHz point-to-point
Monotonic :	to 16-bits
Isolation:	> 80 VDC/AC peak (chan-to-chassis or chan-to-chan)
Synchronization:	Software commands or external trigger
Internal/external CLK accuracy:	100 ppm
AC accuracy:	Not specified

### DC voltage

Amplitude:	$\pm 16$ V up to 10 mA
Resolution:	16-bits = 500 $\mu$ V
Amplitude accuracy (DC):	$\pm (0.05\% + 3.0$ mV (90 days, Tcal $\pm 5^\circ$ C or *Cal? $\pm 5^\circ$ C)
Ripple and noise:	< 2 mVrms, 20 Hz to 250 kHz into 10 k $\Omega$ load
Settling time:	40 $\mu$ S (-full scale to +full scale step, single channel, to rated accuracy)
Output impedance:	< 1 $\Omega$ with the load sensed

### DC current

Range:	$\pm 20$ mA
Resolution:	16-bit = 630 nA
Accuracy:	$\pm$ (% value + amps) (temperature within $\pm 5^\circ$ C of Tcal or *Cal?) 90-day: $\pm (0.09\% + 5.0$ $\mu$ A)
Ripple and noise:	< 2 $\mu$ Arms, 20 Hz to 250 kHz into 250 $\Omega$
Compliance voltage:	$\pm 12$ V
Max open circuit voltage:	< $\pm 22$ V

### Phase-locking I/O trigger characteristics

<b>Trigger input</b>	
Input level:	TTL compatible (3.3 V logic, 5 V tolerant)
Slope:	Rising or falling, selectable
Pulse width:	> 100 nS
Input impedance:	> 10 k $\Omega$ , DC coupled

### Trigger output

Level:	TTL compatible into 1 k $\Omega$ (3.3 V logic)
Output impedance:	50 $\Omega$ typical

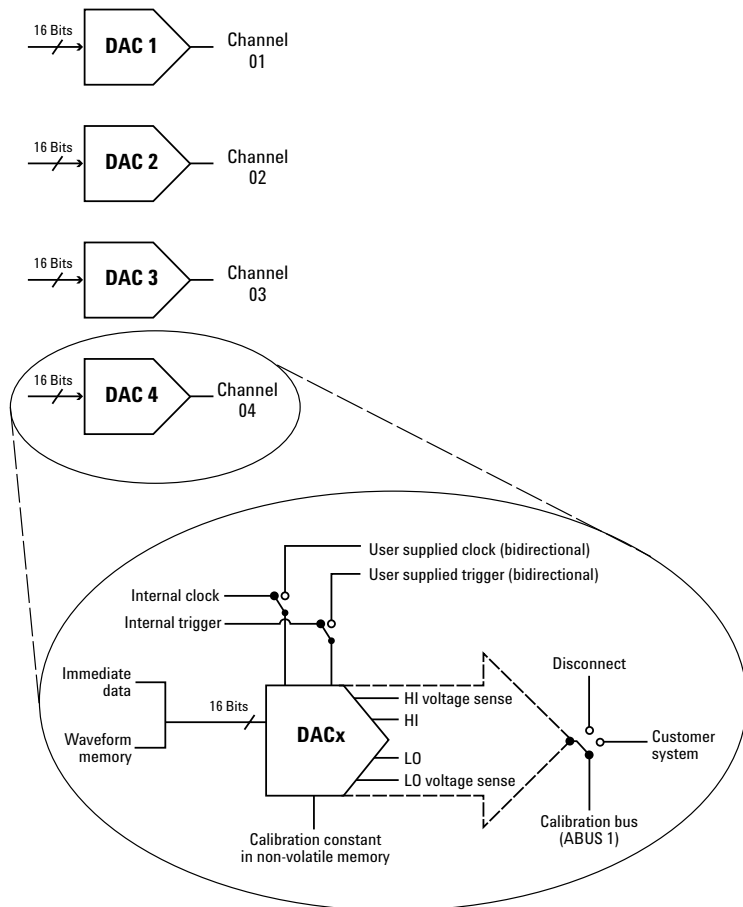
### Clock input

Input level:	TTL compatible (3.3 V logic, 5 V tolerant)
Input impedance:	> 10 k $\Omega$ , DC
Maximum rate:	10 MHz

### Clock output

Level:	TTL compatible into 1k $\Omega$ (3.3 V logic)
Output impedance:	50 $\Omega$ typical
Maximum rate:	10 MHz
Accuracy:	$\pm 100$ ppm

Figure 11. 34951A 4-channel isolated D/A converter



### 34952A multifunction module with 32-bit DIO, 2-channel D/A and totalizer

The multifunction module offers the flexibility you need for system control. The 34952A has four 8-bit digital I/O channels, a 100-kHz gated totalizer, and two  $\pm 12$  V analog outputs—all on a single earth-referenced module. The digital inputs and totalizer input may be included in a scan list. Alarm limits for the digital and totalizer inputs are evaluated continuously, capturing and logging alarm conditions even between scans. Connections can be made via standard 50-pin Dsub cables or detachable terminal block.

#### Digital input/output characteristics

Four 8-bits channels, 8 bits wide, input or output, non-isolated

Vin(L)	< 0.8 V (TTL)
Vin(H)	> 2.0 V (TTL)
Vout(L)	< 0.8 V @ Iout = -400 mA
Vout(H)	> 2.4 V @ Iout = 1 mA
Vout(H) max	< 42 V with external open drain pull-up
Alarm	Maskable pattern match or state change
Speed	4 ms (max) alarm sampling
Latency	5 ms (typical) to 34980A alarm output
Read/write speed	95/s

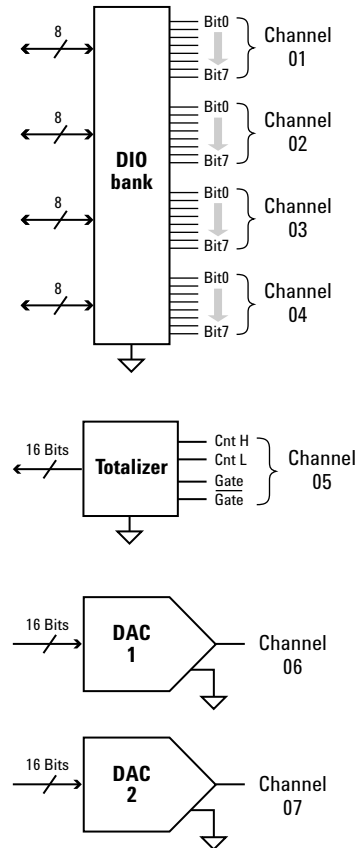
#### Totalize input characteristics

Max count	$2^{26} - 1$
Totalize input	100 kHz (max) rising or falling edge, programmable
Signal level	1 Vp-p (min) 42 Vpk (max)
Threshold	0 V or TTL
Gate input	TTL-Hi, TTL-Lo, or none
Count reset	Manual or read + reset
Read speed	85 rds/s

#### Analog output characteristics

DAC 1, 2	$\pm 12$ V, non-isolated
Resolution	1 mV
IOUT	10 mA max
Settling time	1 ms to 0.01% of output
Accuracy	$\pm$ (% of output + mV)
1 year	$\pm 5^{\circ}\text{C} 0.25\% + 20$ mV
Temp. coefficient	$\pm (0.015\% + 1\text{mV})/^{\circ}\text{C}$

Figure 12. 34952A multifunction module



## 34959A breadboard module

Use this module to create your own custom designs inside the 34980A mainframe. You can control your custom circuits with access to both the +12 V and +5 V supplies, 32 relay drive lines and two 8-bit GPIO ports. Your design can be isolated from the analog buses or connected by loading the backplane switches. Simply mount your custom PC board or other components into the space provided and connect via the two ribbon connectors provided. The module is provided with two 50- or 78-pin Dsub connector openings. For custom connections, use the detachable flat faceplates for easy modification. You can program your circuitry using standard read and write commands in SCPI.

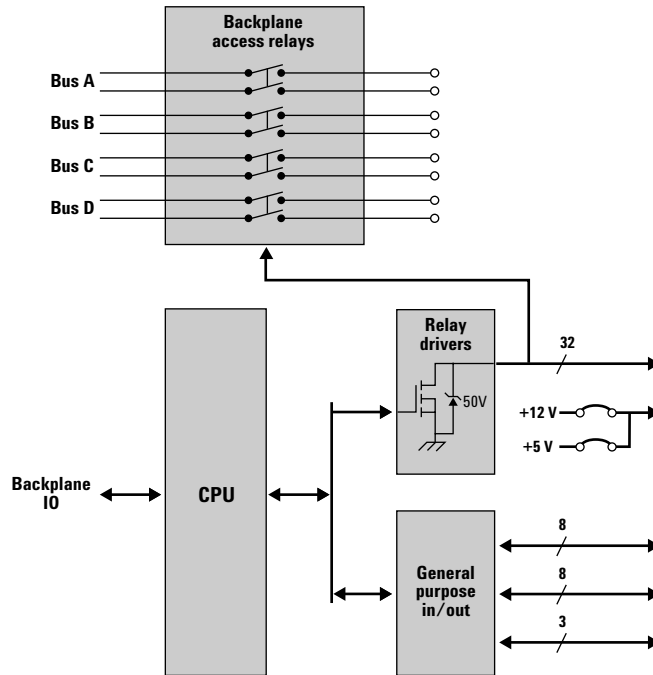
### General specifications

Max module power dissipation	6 W
Power available	
12 V regulation no load to full load	10%
5 V regulation no load to full load	5%
Max power from 12 V	6 W
Max power from 5 V	1 W
Relay drives	32, sink up to 100 mA
GPIO ports	
Chan 1:	1-8 configure byte as input or output
Chan 2:	9-16 configure bits individually as input or outputs
Chan 3:	3 output bits

Available board dimensions:

5.4 x 7.5 x either 0.9 inches height without PC board, or 0.7 inches high with PC board.

Figure 13. 34959A breadboard module



## 34980A system specifications and characteristics

(for complete specifications, see the 34980A Users Guide)

### DMM accuracy ± (% of reading + % of range)

Includes measurement error, switching error, and transducer conversion error

Function	Range <sup>[4]</sup>	Frequency, etc.	Measurement including switch error <sup>[1]</sup>				
			24 hour <sup>[2,3]</sup> Tcal ± 1°C	90 days Tcal ± 5°C	1 year Tcal ± 1°C	Temperature coefficient Tcal ± 5°C	
DC voltage (with 34921A/22A/ 31A/32A)	100.0000 mV		0.0030 + 0.0035	0.0040 + 0.0040	0.0050 + 0.0040	0.0005 + 0.0005	
	1.000000 V		0.0020 + 0.0006	0.0030 + 0.0007	0.0040 + 0.0007	0.0005 + 0.0001	
	10.00000 V		<b>0.0015 + 0.0004</b>	<b>0.0020 + 0.0005</b>	<b>0.0035 + 0.0005</b>	<b>0.0005 + 0.0001</b>	
	100.0000 V		0.0020 + 0.0006	0.0035 + 0.0006	0.0045 + 0.0006	0.0005 + 0.0001	
	300.0000 V		0.0020 + 0.0020	0.0035 + 0.0030	0.0045 + 0.0030	0.0005 + 0.0003	
True RMS AC voltage <sup>[5]</sup>	100.0000 mV to 100.0000 V	3Hz-5Hz	1.00 + 0.03	1.00 + 0.04	1.00 + 0.04	0.100 + 0.004	
		5Hz-10Hz	0.35 + 0.03	0.35 + 0.04	0.35 + 0.04	0.035 + 0.004	
		<b>10Hz-20kHz</b>	<b>0.04 + 0.03</b>	<b>0.05 + 0.04</b>	<b>0.06 + 0.04</b>	<b>0.005 + 0.004</b>	
		20kHz-50kHz	0.10 + 0.05	0.11 + 0.05	0.12 + 0.05	0.011 + 0.005	
		50kHz-100kHz	0.55 + 0.08	0.60 + 0.08	0.60 + 0.08	0.060 + 0.008	
		100kHz-300kHz <sup>[6]</sup>	4.00 + 0.50	4.00 + 0.50	4.00 + 0.50	0.20 + 0.02	
	300.0000 V	3Hz-5Hz	1.00 + 0.05	1.00 + 0.08	1.00 + 0.08	0.100 + 0.008	
		5Hz-10Hz	0.35 + 0.05	0.35 + 0.08	0.35 + 0.08	0.035 + 0.008	
		10Hz-20kHz	0.04 + 0.05	0.05 + 0.08	0.06 + 0.08	0.005 + 0.008	
		20kHz-50kHz	0.10 + 0.10	0.11 + 0.12	0.12 + 0.12	0.011 + 0.012	
		50kHz-100kHz	0.55 + 0.20	0.60 + 0.20	0.60 + 0.20	0.060 + 0.020	
		100kHz-300kHz <sup>[6]</sup>	4.00 + 1.25	4.00 + 1.25	4.00 + 1.25	0.20 + 0.05	
	Resistance <sup>[7]</sup>	100.0000 Ω	1mA	0.0030 + 0.0035	0.008 + 0.004	0.010 + 0.004	0.0006 + 0.0005
		1.000000 kΩ	1mA	0.0020 + 0.0006	0.008 + 0.001	0.010 + 0.001	0.0006 + 0.0001
		10.00000 kΩ	100uA	<b>0.0020 + 0.0005</b>	<b>0.008 + 0.001</b>	<b>0.010 + 0.001</b>	<b>0.0006 + 0.0001</b>
100.0000 kΩ		10uA	0.0020 + 0.0005	0.008 + 0.001	0.010 + 0.001	0.0006 + 0.0001	
1.000000 MΩ		5.0uA	0.002 + 0.001	0.008 + 0.001	0.010 + 0.001	0.0010 + 0.0002	
10.00000 MΩ		500nA	0.015 + 0.001	0.020 + 0.001	0.040 + 0.001	0.0030 + 0.0004	
100.0000 MΩ		500nA/10MΩ	0.300 + 0.010	0.800 + 0.010	0.800 + 0.010	0.1500 + 0.0002	
Frequency and period <sup>[8]</sup>	100mV to 300V	3Hz-5Hz	0.10	0.10	0.10	0.005	
		5Hz-10Hz	0.05	0.05	0.05	0.005	
		10Hz-40Hz	0.03	0.03	0.03	0.001	
		40Hz-300kHz	<b>0.006</b>	<b>0.01</b>	<b>0.01</b>	<b>0.001</b>	
DC current (34921 only)	10.00000 mA	< 0.1 V burden	0.005 + 0.010	0.030 + 0.020	0.050 + 0.020	0.002 + 0.0020	
	<b>100.0000 mA</b>	<b>&lt; 0.6V</b>	<b>0.010 + 0.004</b>	<b>0.030 + 0.005</b>	<b>0.050 + 0.005</b>	<b>0.002 + 0.0005</b>	
	1.000000 A	< 2V	0.050 + 0.006	0.080 + 0.010	0.100 + 0.010	0.005 + 0.0010	
True RMS AC current (34921A only)	10.00000 mA and <sup>[5]</sup>	3Hz-5Hz	1.00 + 0.04	1.00 + 0.04	1.00 + 0.04	0.100 + 0.006	
		5Hz-10Hz	0.30 + 0.04	0.30 + 0.04	0.30 + 0.04	0.035 + 0.006	
		<b>10Hz-5kHz</b>	<b>0.10 + 0.04</b>	<b>0.10 + 0.04</b>	<b>0.10 + 0.04</b>	<b>0.015 + 0.006</b>	
	100.0000 mA <sup>[9]</sup>	3Hz-5Hz	1.00 + 0.5	1.00 + 0.5	1.00 + 0.5	0.100 + 0.006	
		5Hz-10Hz	0.30 + 0.5	0.30 + 0.5	0.30 + 0.5	0.035 + 0.006	
		10Hz-5kHz	0.10 + 0.5	0.10 + 0.5	0.10 + 0.5	0.015 + 0.006	

[1] One hour warm-up and a fixed configuration with slow AC filter, sine wave input, and 6 ½ digits. Temperature within ± 5°C of temperature at calibration (Tcal between 18-28°C).

[2] 90 minute warm-up and a fixed configuration and 6 ½ digits. Temperature within ± 1°C of temperature at calibration (Tcal between 18-28°C).

[3] Relative to calibration standards

[4] 20% over range on all ranges except 300VDC and AC ranges and 1 ADC and AC current ranges

[5] For single wave input > 5% of range. For inputs from 1% to 5% of range and < 50 kHz add 0.1% of range additional error. For AC filter slow.

[6] Typically 30% of reading error at 1 MHz, limited to 1 x 10<sup>8</sup> volt-hertz

[7] For 4-wire ohms or 2-wire ohms using scaling to remove offset. Add 4 ohms additional error to 2-wire ohms function without scaling.

[8] Input > 100 mV. For 10 mV inputs multiply % of reading error x 10. For 1 sec aperture.

[9] Specified only for inputs > 10 mA. For AC filter slow.

**Temperature measurement accuracy ± (% of reading + % of range)**

Temperature	Type	1-year accuracy <sup>[1]</sup>	24 hour	Extended range <sup>[1]</sup>	1-year accuracy	Temp Coefficient
Thermocouple (34921A only, includes cold junction accuracy on terminal block)	B	1100°C to 1820°C	1.2°C	400°C to 1100°C	1.8°C	0.03°C
	E	-150°C to 1000°C	1.0°C	-200°C to -150°C	1.5°C	0.03°C
	J	<b>-150°C to 1200°C</b>	<b>1.0°C</b>	<b>-210°C to -150°C</b>	<b>1.2°C</b>	0.03°C
	K	-100°C to 1200°C	1.0°C	-200°C to -100°C	1.5°C	0.03°C
	N	-100°C to 1300°C	1.0°C	-200°C to -100°C	1.5°C	0.03°C
	R	300°C to 1760°C	1.2°C	-50°C to 300°C	1.8°C	0.03°C
	S	400°C to 1760°C	1.2°C	-50°C to 400°C	1.8°C	0.03°C
	T	-100°C to 400°C	1.0°C	-200°C to -100°C	1.5°C	0.03°C
RTD	R <sub>0</sub> from 49 Ω to 2.1 K Ω	-200°C to 600°C	0.06°C			0.003°C
Thermistor	2.2k, 5k, 10k	-80°C to 150°C	0.08°C			0.002°C

[1] For total measurement accuracy, add temperature probe error

**Typical system speeds—Contact factory**

**Single channel measurement rates—DMM reading rates**

Function	Resolution	rds/s
DCV, 2-wire resistance	4-1/2 digits (0.02 plc)	> 2000
Thermocouple	(0.02 plc) 0.1°C (1 plc)	Contact factory
RTD, thermistor	1°C (0.02 plc)	Contact factory
ACV	6-1/2 digits	250
Frequency, period	4-1/2 digits (10 ms)	Contact factory

## Measurement characteristics with optional internal DMM

### DC voltage

Measurement method	Continuously integrating multi-slope III A-D converter
A-D linearity	0.0002% of reading + 0.0001% of range on 10 V range
Input resistance 100 mV, 1 V, 10 V ranges 100 V, 300 V ranges	Selectable 10 M $\Omega$ or > 10,000 M $\Omega$ 10 M $\Omega$ $\pm$ 1%
Input bias current	< 50 pA at 25°C
Input protection	300 V all ranges

### True RMS AC voltage

Measurement method	AC coupled True RMS—measures the AC component of the input with up to 300 VDC of bias on any range
Crest factor	Maximum of 5:1 at full scale
Additional crest factor errors (non-sinewave)	Crest factor 1-2 0.05% of reading Crest factor 2-3 0.15% of reading Crest factor 3-4 0.30% of reading Crest factor 4-5 0.40% of reading
Input impedance	1 M $\Omega$ $\pm$ 2% in parallel with 150 pF
Input protection	300 Vrms all ranges

### Resistance

Measurement method	Selectable 4-wire or 2-wire ohms
Current source	referenced to LO input
Offset compensation	Selectable on 100 $\Omega$ , 1k $\Omega$ , 10k $\Omega$ ranges
Maximum lead resistance	10% of range per lead for 100 $\Omega$ and 1k $\Omega$ ranges. 1k $\Omega$ on all other ranges
Input protection	300 V on all ranges

### Frequency and period

Measurement method	Reciprocal counting technique
Voltage ranges	Same as AC voltage function
Gate time	1s, 100 ms, or 10 ms
Measurement timeout	Selectable 3 Hz, 20 Hz, 200 Hz LF limit

### DC current

Shunt resistance	5 $\Omega$ for 10 mA, 100 mA; 0.1 $\Omega$ for 1 A
Input protection	1A 250 V fuse on 34921A module

### True RMS AC current

Measurement method	Direct coupled to the fuse and shunt. AC coupled True RMS measurement (measures the ac component only)
Shunt resistance	5 $\Omega$ for 10 mA; 0.1 $\Omega$ for 100 mA, 1 A
Input protection	1A 250 V fuse on 34921A module

### Thermocouple

Conversion	ITS-90 software compensation
Reference junction type	Internal, fixed, or external
Open thermocouple check	Selectable per channel. Open > 5k $\Omega$
Thermistor	44004, 44007, 44006 series
RTD	a = 0.00385 (DIN) and a = 0.00392

### Measurement noise rejection 60 (50) Hz <sup>[1]</sup>

DC CMRR	140 dB
AC CMRR	70 dB

### Integration time Normal mode rejection <sup>[2]</sup>

200 plc/3.33 s (4 s)	105 dB <sup>[3]</sup>
100 plc/1.67 s (2 s)	100 dB <sup>[3]</sup>
20 plc/333 ms (400 ms)	95 dB <sup>[3]</sup>
10 plc/167 ms (200 ms)	90 dB <sup>[3]</sup>
2 plc/33.3 ms (40 ms)	85 dB
1 plc/16.7 ms (20 ms)	60 dB
< 1 plc	0 dB
DC CMRR 140 dB	
AC CMRR 70 dB	

[1] For 1 K  $\Omega$  unbalance in LO lead

[2] For power line frequency  $\pm$  0.08%

[3] For power line frequency  $\pm$  1% use 75 dB or  $\pm$  2.5% use 60 dB

[4] Reading speeds for 60 Hz and (50 Hz) operation

[5] For fixed function and range, readings to memory, scaling and alarms off, autozero off

[6] Maximum limit with default settling delays defeated

[7] Speeds are for 4  $\frac{1}{2}$  digits, delay 0, display off, autozero off

[8] Isolation voltage (ch - ch, ch - earth) 300 VDC, AC rms

[9] 6  $\frac{1}{2}$  digits = 22 bits, 5  $\frac{1}{2}$  digits = 18 bits, 4  $\frac{1}{2}$  digits = 15 bits

[10] Assumes relative time format (time since start of scan)

## System specifications

### Scanning inputs

Analog:	34921A, 34922A, 34923A, 34924A, and 34925A multiplexer channels
Digital:	34950A/52A digital in and totalize

### Scan triggering

Source	Interval, external, button press, software, or on monitor channel alarm
Scan count	1 to 50,000 or continuous
Scan interval	0 to 99 hours; 1ms step size
Channel delay	0 to 60 seconds per channel; 1 ms step size
External trig delay	< 2 ms. With monitor on < 200 ms
External trig jitter	< 2 ms

### Alarms

Analog inputs	Hi, Lo, or Hi + Lo evaluated each scan
Digital inputs	34950A/52A digital in maskable pattern match or state change  34950A/52A frequency and totalize: Hi limit only
Monitor channel	Alarm evaluated each reading
Alarm outputs	4 TTL compatible Selectable TTL logic Hi or Lo on fail
Latency	5 ms (typical)

### Memory

Type	Volatile
Readings	500,000 with timestamp, readable during scan
States	5 instrument states with user label
Alarm queue	Up to 20 events with channel number, reading, and timestamp

### System features

Per-channel math Min/max/average	Individual Mx+B scaling and calculated real time
Power fail recovery	Save switch states
Relay maintenance	Counts each relay closure and stores on module User resettable
Real-time clock	Battery-backed, 20-year typical life

## General specifications

Power supply	Universal 100 V to 240 V $\pm$ 10%
Power line frequency	50 – 60 Hz $\pm$ 10% automatically sensed
Power consumption	150 VA
Operating environment	Full accuracy for 0°C to 55°C Full accuracy to 80% R.H. at 40°C IEC 60664-1 pollution degree 1
Storage environment	-40°C to 70°C <sup>[1]</sup>
Mainframe dimensions	133H x 426W x 341D mm (5.25" x 16.8" x 14") Full rack, 3 units high
Mainframe weight:	8.8 kg (19.6 lbs)
Module dimensions	280 x 170 x 27 mm (11" x 6.7" x 1")
Safety conforms to	CSA, UL/IEC/EN 61010-1
EMC conforms to	IEC/EN 61326-1, CISPR 11
Warranty	1 year

## Software

### Agilent connectivity software included

Agilent IO Libraries Suite 14.0 (E2094N)

### Minimum system requirements (IO libraries and drivers)

PC hardware	Intel Pentium 100 MHz, 64 Mbyte RAM, 210 Mbyte disk space Display 800 x 600, 256 colors, CD-Rom drive
Operating system <sup>[2]</sup>	Windows® 98 SE/NT/2000/XP
Computer interfaces	Standard LAN 10BaseT/100BaseTx Standard USB 2.0 IEEE 488.2 GPIB

### Software driver support for programming languages

Software drivers:	IVI-C and IVI COM for Windows NT/2000/XP
Compatible with programming tools and environments:	Agilent VEE Pro, Agilent T&M Toolkit (requires Visual Studio.NET) National Instruments Test Stand, Measurement Studio, LabWindows/CVI, LabVIEW, Switch Executive Microsoft Visual Studio.NET, C/C++, Visual Basic 6

[1] Storage at temperatures above 40°C will decrease battery life

[2] Load IO Libraries Version M for Windows NT support

## Ordering information

	Description	Optional terminal block	Interconnect cables / connector kits	Comments
<b>Mainframe</b>				
34980A	Multifunction switch/measure mainframe—holds up to 8 plug-in modules	N/A	N/A	Only available with option "DMM" at this time
<b>Multiplexer modules</b>				
34921A	40-channel armature multiplexer w/low thermal offset	34921T	Qty 2 per module Y1135A – 1.5m Y1136A – 3m Y1139A	Order 34921T for temp reference
34923A	40/80-channel reed multiplexer	34923T (1 or 2 wire)		
34925A	40/80-channel optically isolated FET multiplexer	34925T (1 or 2 wire)		
34922A	70-channel armature multiplexer	34922T	Qty 2 per module Y1137A – 1.5m Y1138A – 3m Y1140A	
34924A	70-channel reed multiplexer	34924T		
<b>Matrix modules</b>				
34931A	Dual 4x8 armature matrix	34931T	Qty 2 per module Y1135A – 1.5m Y1136A – 3m Y1139A	
34932A	Dual 4x16 armature matrix	34932T		
34933A	Dual/quad 4x8 reed matrix	34933T (1 or 2 wire)		
<b>GP/actuator modules</b>				
34937A	32-channel Form C/Form A general-purpose switch	34937T	Qty 2 per module Y1135A – 1.5m Y1136A – 3m Y1139A	
34938A	20-channel 5-amp Form A switch	34938T		
<b>RF and microwave modules</b>				
34941A	Quad 1x4 50-ohm 2-GHz RF multiplexer	N/A	N/A	Requires standard SMA cables and adapters
34942A	Quad 1x4 75-ohm RF multiplexer	N/A	N/A	Requires mini 75 ohm cables and adapters
34945A	Microwave switch/attenuator driver	N/A	N/A	Requires 34945EXT and optional distribution boards
34946A 004 020	Dual 1x2 SPDT terminated microwave switch 4 GHz switches installed 20 GHz switches installed	N/A	N/A	Requires standard SMA cables and adapters
34947A 004 020	Triple 1x2 SPDT unterminated microwave switch 4 GHz switches installed 20 GHz switches installed	N/A	N/A	Requires standard SMA cables and adapters
<b>System measurement and control modules</b>				
34950A	64-bit digital I/O with memory and counter	34950T	Qty 2 per module Y1137A – 1.5m Y1138A – 3m Y1142A	
34951A	4-channel isolated D/A converter with waveform Memory	34951T	Qty 1 per module Y1135A – 1.5m Y1136A – 3m Y1141A	"DMM" option required for calibration Single 50 pin Dsub connector
34952A	Multifunction module with 32-bit DIO, 2-ch D/A and Totalizer	34952T		Single 50 pin Dsub connector
34959A	Breadboard module	N/A		Any terminal block can be used assuming 50 or 78 pin Dsub is used



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**Accessories**

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Y1130A Rackmount kit for 34980A, forward or reverse mount

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**Cables/connector Kits**

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Y1135A 1.5m 50pin Dsub, M/F twisted pair with outer shield cable – 300 V

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Y1136A 3m 50pin Dsub, M/F twisted pair with outer shield cable – 300 V

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Y1137A 1.5m 78pin Dsub, M/F twisted pair with outer shield cable – 300V

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Y1138A 3m 78pin Dsub, M/F twisted pair with outer shield cable – 300 V

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Y1139A Solder cup connector kit for 34921/23/25/31/32/33/37/38 –50 pin Dsub female – 125 V

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Y1140A Solder cup connector kit for 34922, 34924 – 78 pin Dsub female – 60 V

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Y1141A Solder cup connector kit for 34951, 34952 – 50 pin Dsub male – 125V

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Y1142A Solder cup connector kit for the 34950A – 78 pin Dsub male – 60 V

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**34945A accessories**

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34945EXT External driver for 34945A, one required for each 64 coils

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Y1150A 34945A distribution board for 8 N181x SPDT switches

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Y1151A 34945A distribution board for two 87104x/106x multiport or 87406B matrix switches

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Y1152A 34945A distribution board for one 87204x/206x or 87606B switch and two N181x switches

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Y1153A 34945A distribution board for two 84904/5/8x or 8494/5/6 step attenuators

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Y1154A 34945A distribution board for two 87222 transfer switches and six N181x SPDT switches

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Y1155A 34945A distribution board w/ generic screw terminals for driving 16 switch coils

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**Thermocouples/thermistors**

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34307A 10 pack of J type thermocouples

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34308A 5 pack of 10k thermistors

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For additional information please visit: <http://www.agilent.com/find/34980a>

## Related Agilent literature

Publication title	Publication type	Publication number
Agilent VEE Pro 7.0	Data sheet	5988-6302EN
Agilent W1140A-TK2 T&M Toolkit 2.0 with Test Automation	Data sheet	5989-1441EN
Agilent E2094N IO Libraries Suite 14.0	Data sheet	5989-1439EN

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