



WHITE PAPER

# Comparisons: DAQ970A/DAQ973A to 34970A/34972A

## Data Acquisition System

The Keysight DAQ970A/DAQ973A is the next generation of data acquisition system (DAQ) for users of the Keysight 34970A or 34972A. The DAQ970A/DAQ973A design provides higher performance and greater flexibility while maintaining compatibility with the 34970A and 34972A.

The DAQ970A/DAQ973A improves the user experience with a color LCD, internal module calibration, and improved temperature accuracy and measurement speeds. A new DAQM900A solid-state multiplexer module is available for higher scanning speed. A new DAQM909A four-channel simultaneous sampling digitizer module captures fast transient signals from electromechanical devices.



## Introduction

The 34970A and 34972A are legacy data acquisition and switching systems. Both designs provide ease of use with low cost per channel, modular flexibility, standard connectivity, and impressive measurement performance. They also offer the best combination of price and measurement performance.

The next-generation DAQ970A/DAQ973A builds on the proven design of the 34970A/34972A.

## Features

- Built-in advanced 6½-digit digital multimeter (DMM) and signal conditioning; no external boxes required; improved accuracy and speed
- The ability to measure very low current ranges; 1  $\mu\text{A}$  DC and 100  $\mu\text{A}$  AC and higher resistance range 1000  $\text{M}\Omega$
- 11 measurement types that the 34970A/34972A can measure, as well as new diode, capacitance, and strain measurements
- Auto-calibration, which compensates for drifts in the internal DMM or on the DAQM907A multifunction module or on the DAQM909A simultaneous sampling module caused by time and temperature changes
- An intuitive LCD screen and soft keys for easy configuration and measurement displays in multiple formats: number, bar meter, trend chart, and histogram
- Scan rate of up to 450 channels/sec with a new DAQM900A solid-state multiplexer module
- 10 times more accurate and higher resolution DAC output and two additional voltage- and current-sensing channels with the DAQM907A multifunction module
- 24-bit sampling rate of 800 kSa/s with a new DAQM909A four-channel digitizer module
- 20 computed channels that performs mathematical operations on readings from measurement channels, or other computed channels
- Test automation without programming using BenchVue's DAQ software



**Sample more signals, faster and dynamically, with DAQ970A/DAQ973A improvements:**

- Up to 2x scan rate speed improvement; up to 450 ch/sec
- Up to 100x reading rates improvement to I/O interface and memory
- Up to 10x internal memory reading scans
- Up to 55% accuracy improvements for resistance
- Up to 75% accuracy improvements for AC voltage
- Up to 90% accuracy improvement for AC current

## Compatibility

The DAQ970A/DAQ973A design is compatible with the 34970A/34972A, with several exceptions. See Table 1 for product comparisons.

These are just some areas where the DAQ970A/DAQ973A is equivalent to the 34970A/34972A:

- 1. Functions and ranges** – The DAQ970A/DAQ973A is a superset of 34970A/34972A capability. See below for differences.
- 2. Measurement accuracy and resolution** – The DAQ970A/DAQ973A's specifications are as accurate or better, with few exceptions. See Table 2.
- 3. SCPI compatibility** – The DAQ970A/DAQ973A will work with SCPI programs written for the Keysight 34970A/34972A. See below for programming considerations and differences.
- 4. Mechanical size** – Height, width, and depth dimensions are the same as the 34970A/34972A.
- 5. Accessories** – Rack-mount kit accessories are compatible with both products. However, there are new part numbers for the rack-mount kits to be color-compatible with the DAQ970A/DAQ973A.
- 6. Manufacturing** – Both DAQs have the same rigorous quality standards and manufacturing process controls.
- 7. Service and support from Keysight** – Our worldwide team is available to help you calibrate your DAQ970A/DAQ973A or answer any questions about either instrument. Get peace of mind with Keysight's standard three-year warranty.

Model	DAQ970A/DAQ973A	34970A/34972A
Slots	3	3
Built-in DMM	<b>New:</b> Auto calibration 6 1/2-digit resolution	6 1/2-digit resolution
Multiplexer scan rate	Up to 450 channels per second	Up to 250 channels per second
Types of measurements	Measures and converts 14 different input signals: <ul style="list-style-type: none"> <li>• <b>New:</b> Capacitance and diode test</li> <li>• Temperature with thermocouples</li> <li>• RTDs and thermistors</li> <li>• DC/AC volts</li> <li>• 2- and 4-wire resistance</li> <li>• Frequency and period</li> <li>• DC/AC current</li> <li>• <b>New:</b> Direct strain and bridge strain</li> </ul>	Measures and converts 11 different input signals: <ul style="list-style-type: none"> <li>• Temperature with thermocouples</li> <li>• RTDs and thermistors</li> <li>• DC/AC volts</li> <li>• 2- and 4-wire resistance</li> <li>• Frequency and period</li> <li>• DC/AC current</li> </ul>
Added ranges	1000 M $\Omega$ range for resistance 1 $\mu$ A range for DC current 100 $\mu$ A, 1 mA ranges for AC current Square wave input for frequency	No additional ranges
Display	Color LCD/GUI	Single-line alphanumeric display
Modules	<b>New:</b> 20-ch solid-state switch multiplexer (mux) 20-ch armature switch mux 16-ch reed switch mux 20-ch actuator/switch 4x8 matrix switch Dual 4-ch RF mux 50 $\Omega$ Multifunction module 40-ch armature switch mux <b>New:</b> 4-ch simultaneous sampling digitizer	20-ch armature switch mux 16-ch reed switch mux 20-ch actuator/switch 4x8 matrix switch Dual 4-ch RF mux 50 $\Omega$ /75 $\Omega$ Multifunction module 40-ch armature switch mux
Digitizer	Up to 50 kSa/s using internal DMM single channel digitizer Up to 800 kSa/s using the DAQM909A module	Do not have this feature
Computed channels	20 channels capable of performing math operations (channels 401 through 420) Supported math operations (addition, subtraction, multiplication, division, reciprocal, power, square root)	Do not have this feature
PC-based BenchVue DAQ application software	BenchVue configures and controls tests, displays results, and collects and exports data for further analysis BenchVue DAQ application software has additional time and frequency domain analysis functionality when used with the DAQM909A module in the DAQ970A or DAQ973A mainframe	
Interface	DAQ970A: USB (front/back panel), LAN DAQ973A: USB (front/back panel), LAN, GPIB	34970A: GPIB, RS-232 34972A: USB (back panel), LAN

Table 1. Key product comparisons between DAQ970A/DAQ973A and 34970A/34972A.

Model	DAQ970A/ DAQ973A	34970A/34972A	Remarks
<b>1-year accuracy (%)</b>	<b>Accuracy ± (% of reading + % of range)</b>	<b>Accuracy ± (% of reading + % of range)</b>	
DCV (1 V)	0.0035 + 0.0006	0.0040 + 0.0007	13% improvement
DCV (300 V)	0.0040 + 0.0020	0.0045 + 0.0030	20% improvement
Resistance (1 kΩ)	0.0040 + 0.0007	0.008 + 0.001	48% improvement
Resistance (1 MΩ)	0.0070 + 0.0005	0.008 + 0.001	17% improvement
Resistance (100 MΩ)	0.350 + 0.001	0.800 + 0.010	57% improvement
Resistance (1000 MΩ)	3.500 + 0.001	Out of range	
DCA (1 A)	0.080 + 0.010	0.080 + 0.010	Same
ACV (up 100 V range at 10 Hz to 20 kHz)	0.05 + 0.02	0.06 + 0.04	30% improvement
ACV (up to 300 V range at 10 Hz to 20 kHz)	0.05 + 0.06	0.06 + 0.08	21% improvement
ACA (up to 1 mA range at 5 kHz to 10 kHz)	0.10 + 0.04	0.30 + 0.04	59% improvement
ACA (up to 1 A range at 5 kHz to 10 kHz)	0.10 + 0.04	0.30 + 0.5	83% improvement
Frequency (1 kHz to 300 kHz)	0.007	0.01	
<b>Temperature accuracy (°C)</b>			
Thermocouple (J type)	1.0 °C	1.0 °C	General improvements
Thermocouple (K type)	0.9 °C	1.0 °C	
Thermocouple (R type)	0.5 °C	1.2 °C	
RTD (R0 from 49 Ω to 2.1 kΩ)	0.05 °C	0.06 °C	
Thermistor (2.2 kΩ, 5 kΩ, 10 kΩ)	0.1 °C	0.08 °C	
<b>Max measurement speed (single-ch ASCII readings – DCV, ohms)</b>			
	50,000 readings per second	500 readings per second	100x faster
<b>Internal memory</b>			
	1,000,000 scan readings	100,000 scan readings	10x more
<b>DAC output</b>			
Voltage output	0.027 output + 4.4 mV	0.25 output + 20 mV	10x improvement

Table 2. Key specifications comparison between DAQ970A/DAQ973A and 34970A/34972A.

## Differences

### Physical/functional differences

1. DAQM908A single-ended mux card does not support thermocouple temperature measurements.
2. Removing a card when power to the DAQ970A/DAQ973A is on causes an immediate power-on reset of the mainframe.
3. All the modules DAQ970A/DAQ973A offers cannot be used on 34970A/34972A mainframe and vice versa.

### Programming differences

1. Alarm as a trigger source. The alarm trigger condition on the DAQ970A/DAQ973A re-evaluates with every sweep. It will trigger for as long as an alarm condition remains true. The 34970A required that the alarm condition go away and then come back to generate a new trigger event. For backward compatibility, you can restore the 34970A or 34972A model behavior for alarm triggering by setting **SYST:PERSONa:MODEl** to 34970A or 34972A.
2. Allowed values of **TEMP:TRAN:RTD:RES:REFerence** are limited to values of either 100  $\Omega$  or 1 k $\Omega$   $\pm$  1%.
3. In resistance temperature detector (RTD) measurements, support for the alpha .000391 RTD type (as specified by the **TEMP:TRAN:RTD:TYPE** command) is not available. DAQ970A/DAQ973A gives an "Illegal parameter value" error if any numeric value other than 385 is specified as a parameter to the **TEMP:TRANsducer:RTD:TYPE** command.
4. The scan list does not allow digital input and totalizer channels when **INST:DMM:STATe** is off.
5. Attempts to add a digital channel to the scan list that has a current configuration as an output will generate an error. Using **ROUTE:SCAN** to put a digital channel into the scan list in the 34970A/34972A would silently switch the channel to input mode when configured as an output. DAQ970A/DAQ973A will give an error such as +308, "Channel not able to perform requested operation; Chan 201."
6. **ROUTE:MONitor:DATA?/DATA:FULL?** will return 9.91E37 (NaN) if the monitor channel has taken no measurement rather than waiting for a measurement to occur. The 34970A/34972A will wait until a measurement is available. However, there is no guarantee of how long this may take, and the user's program may hit a VISA timeout before it occurs.
7. **ROUTE:CLOSe?** and **ROUTE:OPEN?** will return an error when querying the state of channels on a mux card that is devoted to a scan.
8. In DAQ970A/DAQ973A, the mapping of measurement resolution to NPLC in DC functions is different from the 34970A/34972A. If you set the aperture using **CONFigure/MEASure <range>, <resolution>**, or use the **SENSe:<function>:RESolution** command, the result may be a shorter NPLC value on the DAQ970A/DAQ973A than on the 34970A/34972A. In particular, the result may be a fractional NPLC value (NPLC < 1) on the DAQ970A/DAQ973A, where the 34970A/34972A would select a 1 PLC aperture. Line cycle rejection can be lost, increasing susceptibility to power line-related noise.

9. The DAQ970A/DAQ973A will not disable alarms (that is, **CALC:SCAL:LIMit{UPPer | LOWer}**) when **UNIT:TEMP** changes. You can still obtain this behavior of the 34970A/34972A using the **SYST:PERSONa:MODEl** setting.
10. The **DEFault/\*RST** value of **CALC:LIMit:UPPer** will be 0.0 for totalizer channels, to be consistent with all other channel types. In the 34970A/34972A, the \*RST value of the upper limit on totalizer channels was 1.0 when all other channel types had a default value of 0.0.

## Conclusion

The next-generation DAQ970A/DAQ973A data acquisition system is here. It offers improvements over its predecessor in measurement speed and accuracy over multiple types of signals. It comes with a user-friendly LCD screen and soft buttons to enable you to easily configure your test setup and display measurements in multiple formats. It offers additional ranges compared with its predecessor, such as measuring low AC and DC current and high resistance. BenchVue DAQ application software now comes with the Test Flow application, which allows you to automate your test without programming, and the time- and frequency-domain analysis functionality.

The DAQ970A/DAQ973A is the next-generation 34970A/34972A data acquisition system. You can easily replace the 34970A/34972A with the DAQ970A/DAQ973A. The DAQ970A/DAQ973A offers ease of use with its interface and the simplicity of automating your test without programming, letting you focus on your primary work — designing your products.

To learn more about DAQ970A/DAQ973A, please visit [www.keysight.com/find/daq](http://www.keysight.com/find/daq).

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