Using Multiple 34980A/34970A Mainframes for Faster Scanning

Application Note 1561

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Introduction

For many datalogging applications, you can use the Agilent 34980A multifunction switch/measure unit or the Agilent 34970A data acquisition/switch unit mainframes and choose from a variety of measurement and switching modules to meet your needs. If you need more speed or more channels for scanning than these instruments provide, you can use multiple 34980A or 34970A mainframes to achieve both objectives. For example, with ten 34970As, you can measure 480 channels in less than 1 second.[1] Using multiple mainframes to perform simultaneous data logging (also called parallel processing) is possible because each 34980A and 34970A mainframe has its own DMM and control circuitry.

This application note explains how to use multiprocessing with the 34980A and the 34970A to increase channel count and increase scanning speed.

Multiprocessing for faster scanning speeds

Using multiple mainframes allows you to make multiple measurements simultaneously and thereby speed up the scan time. If you configure multiple 34970As — which have internal DMM that can be used for scanning — and trigger them at the same time, all DMMs will be running and making measurements simultaneously. At the end of a completed scan, we can retrieve data from each instrument in turn. Using this technique, we can achieve 500 channels/sec scanning rates with the 34970A. For larger channel counts, you can use the 34980A the same way to achieve high channel count and high scanning rates.

1. All timing data shown in this application note were estimated from empirical data using a 2.7-GHz Pentium® 4 PC, and an Agilent 82350A GPIB card. Your actual results will differ depending on the I/O interface, development environment, and PC you use.

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Figure 1 depicts the process for operating multiple mainframes in parallel. The time required to complete all scans is the sum of:

1. The time it takes to process configuration commands
2. The measurement time of the one instrument with the longest measurement time
3. The sum of the time it takes to read the data for all mainframes

In reality, the process is not completely parallel. The configure command is send to each instrument in turn, and it is processed almost simultaneously. Removing the data from the instrument at the end of the last scan is done sequentially, rather than simultaneously. Because the computer reading the data has only one GPIB card, the data must be read one instrument at a time.

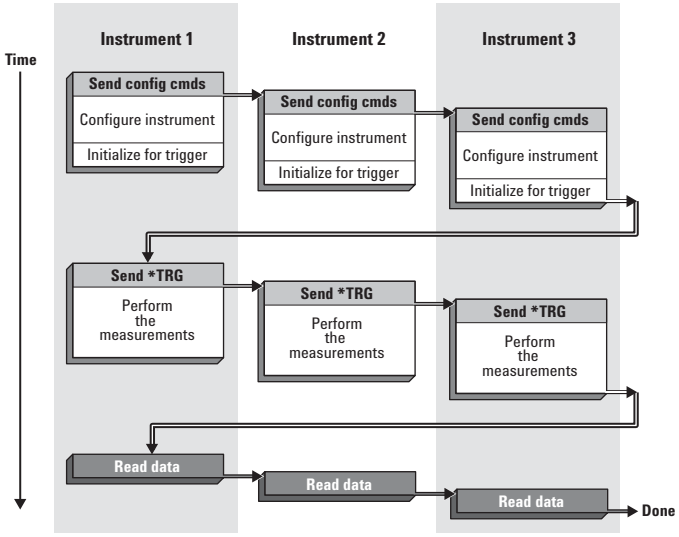

Figure 1:
Simplified program flow diagram to show parallel processing of measurements to decrease test time.

Programming for parallel processing

To use parallel processing, you set up the instruments to take a measurement, and then trigger them. When the measurement is complete, you remove the data from all the instruments.

The configuration is done only once, but the measurement might be repeated numerous times. Once the configuration is complete, a trigger (***TRG**) is sent to start the measurement. Since the trigger command is very short and takes little time, the measurements are almost simultaneous. On completion of the measurements, the data is read. Use the ***OPC?** Command to test for completion of the configuration or the scan. When the instrument replies, the configuration or scan is complete. The **Fetch?** command will retrieve all the data at the end of the scan. Alternately, the **Data:Remove?** command can retrieve individual readings before the scan is complete.

For information on how to program the 34980A for scanning, see Application Note 1557, *Creating Datalogging Applications in Microsoft Excel.*

Estimated scan times for the 34970A

You can calculate the approximate time required for a scan of multiple 34970A mainframes (with three 34902A reed MUX modules each) using the equation

$t = 300 + 65(n)$

where n is the number of mainframes and t is the time in milliseconds.

This equation is based on the assumption that you are using 34902A modules (reed relays), you have channel delay turned on, and you are using DC volts (no range change) and a resolution of $4\frac{1}{2}$ digits. See **Table 1**.

Number of 34970As	1	2	4	7	10
Time for scan (ms)	362	429	560	762	950
Number of channels	48	96	192	336	480
Channel per second	132	224	343	444	503

Table 1:
Parallel processing example. Times for reading the results of multiple 34970As running at the same time. Configuration time is not included (DC, $4\frac{1}{2}$ digits, fixed range, autozero off, using the 34902A)

Estimated scan times for the 34980A

Table 2 below gives the formulas for estimating times (in ms) based on the number of channels and number of 34980A mainframes you use. The times were calculated using the DC function on all channels, fixed range, autozero off, and channel delay on. Turning delay off can decrease the per-channel measure time by approximately 1 ms. When you use multiple functions in any one mainframe, the measurement time increases for each additional function.

Let's look at a 34980A example. One 34980A can be loaded with eight 34924A reed MUX modules. With this setup, you can scan 8 x 70 = 560 channels in about 11 seconds with 5½ digit resolution (60-Hz line frequency). To reduce the total time, you can use two 34980A mainframes with four 34924A modules per mainframe. This will reduce the total scan time for 560 channels to 5.7 seconds, as shown in **Table 3** below. Reducing the number of modules on each mainframe will further decrease the total time.

For a discussion of maximizing throughput in your system, see Application Note 1465-7, *Test-System Development Guide: Maximizing System Throughput and Optimizing System Deployment.*

		FET MUX		Reed MUX		Armature MUX	
Integration time: 60/50 Hz (NPLC)		0.33/.04 (.02)	16.7/20 (1)	0.33/0.4 (.02)	16.7/20 (1)	0.33/0.4 (.02)	16.7/20 (1)
Configure		<20 ms					
Measure time:	**60 Hz**	2.35 c + 16	19.1 c + 33.3	2.79 c + 8	19.4 c + 36	10.17 c + 15.3	27.0 c + 16
	50 Hz	2.42 c + 16	22.5 c + 33.3	2.86 c + 8	22.7 c + 36	10.24 c + 15.3	30.3 c + 16
Read data time		0.34r + 7.5n					

Table 2:
Estimated time in ms to scan 34980As.
c = number of channels in one mainframe
r = number of total channels to read
n = number of mainframes

Number of mainframes	1	2	3	4	8
Modules per main frame	8	4/4	2/3/3	2/2/2/2	1 each
Time for measurement	10.864	5.468	4.110	2.752	1.394
Read data time	.198	.205	.213	.22	.25
Total time	11.1 sec	5.7 sec	4.3 sec	2.97 sec	1.64 sec
Channel per second	51	99	130	188	341

Table 3:
Effect of multiple mainframes on scanning rate for 560-channel system. Configuration time is not included. Time for measurement is calculated for the one main frame with the largest channel count (or scan time). The read data time is calculated for all channels and all mainframes.

Using additional mainframes for higher channel count

One 34970A mainframe can support up to 60 2-wire channels, and a single 34980A mainframe can support up to 560 2-wire channels. You can increase the channel count by using multiple mainframes. Agilent 34970A BenchLink software and Agilent 34970A IntuiLink for Excel software allow you to use multiple 34970As to perform simultaneous scanning without writing any code. If you are using the 34980A, you need custom software to manage multiple mainframes.

Conclusion

Using multiple mainframes and parallel processing is a strategy to reduce data acquisition time or increase channel count. As the number of channels and modules are reduced in each mainframe, the amount of parallel processing increases and thereby reduces the acquisition time and increases the effective scan rate.

Related Agilent literature

Publication title	Publication type	Publication number	Web address
34980A Multifunction Switch/Measure Unit	Data sheet	5989-1437EN	http://cp.literature.agilent.com/litweb/pdf/5989-1437EN.pdf
34970A Data Acquisition Unit	Data sheet	5965-5290EN	http://cp.literature.agilent.com/litweb/pdf/5965-5290EN.pdf
Creating Datalogging Applications in Microsoft Excel	Application note	5989-2722EN	http://cp.literature.agilent.com/litweb/pdf/5989-2722EN.pdf
Test-System Development Guide: Maximizing System Throughput and Optimizing System Deployment	Application note	5988-9822EN	http://cp.literature.agilent.com/litweb/pdf/5988-9822EN.pdf

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