HEWLETT PACKARD

Data Acquisition/1000

3054C Automatic Data Acquisition/
Control System

HP-IB
SYSTEMS

TECHNICAL DATA FEB 1981

**Precise Data Acquisition With the
Power of an HP 1000 Computer.**

Introducing You to DATA ACQUISITION/1000

Description

DATA ACQUISITION/1000 links computers, precise instrumentation and software into a powerful automated data acquisition and control system. DATA ACQUISITION/1000 provides you with HP's most versatile computers, the HP 1000 L, M, E, and F-series, and HP's most precise data acquisition system, the 3054C. The computer and instrumentation are linked together with an operating system and specially written software library to give you precise automated measurement and control with minimal programming effort.

The components of the DATA ACQUISITION/1000 system make it suitable for many applications. The precise instrumentation in the 3054C allows you to make accurate measurements of thermocouples, strain gauges and other transducers. The ability to choose from the complete family of HP computers lets you configure the computer system you need in terms of price and performance. Finally, software provided by HP links the computers and instrumentation into an integrated and powerful system.

3054C

3456A Digital Voltmeter

3497A Data Acquisition/Control Unit

30" Rack

DATA ACQUISITION/1000

INSTRUMENTATION

3054C AUTOMATIC DATA ACQUISITION/ CONTROL SYSTEM
3497A Data Acquisition/Control Unit
3456A Digital Voltmeter
30" Rack

COMPUTERS

HP 1000M, E, F Series Computer or
HP 1000L Series Computer
Computer Peripherals

SOFTWARE

RTE Computer Operating System
3054C Software Package
Additional Software Available

The Instrumentation

The 3054C supplies the measurement and control functions to the DATA ACQUISITION/1000 system. The 3054C includes the 3497A Data Acquisition/Control Unit and the 3456A Digital Voltmeter. The 3497A Data Acquisition/Control Unit is used primarily to multiplex your transducer signals to the 3456A voltmeter and to provide some control functions. The 3497A is configured to match your application by the use of plug-in assemblies that allow you to add a voltmeter, analog multiplexers, digital inputs, counters, actuators, and D/A's to your system as needed. The 3456A Digital Voltmeter is a high-precision voltmeter used to make high-accuracy measurements of transducer based signals. Both instruments communicate over HP-IB to the HP computer of your choice.

3054C Automatic Data Acquisition/ Control System

☐ 100 nanovolt resolution for measurement precision
☐ Reading rates to 300 readings per second
☐ .01°C resolution using thermocouples
☐ 20 to 1000 channels of analog multiplexing
☐ 16 to 1360 channels of digital inputs
☐ Plug-in configuration flexibility
☐ Proportional control using D/A's
☐ Actuator outputs

HP-IB
SYSTEMS

HP-IB: Not just IEEE-488, but the hardware, documentation and support that delivers the shortest path to a measurement system.

**HP 1000
Model 10**

1000 Series Computers
- ☐ Simultaneous program execution
- ☐ *Real time response to external events*
- ☐ Multiple terminals and users
- ☐ Multiple languages
- ☐ Distributed systems
- ☐ Shared resources

**HP 1000
Model 40**

2103L

The Computer

A DATA ACQUISITION/1000 system requires the use of an HP 1000 L, M, E, or F-series computer. These computers give you a flexible hardware configuration. You can choose the computer your application needs and should your needs change, you can easily add further capability. The HP 1000 L-series computers are well suited to control the 3054C because of their moderate cost and intelligent high-speed I/O. If your application requires extensive data analysis, the HP 1000 M, E, and F-series computers, with their increased computing power and memory capacity, may be the logical choice.

The Software

Software is the third element of the DATA ACQUISITION/1000 system. Included with your HP 1000 computer system is a powerful Real Time Executive (RTE) operating system. RTE lets you create custom operating environments for concurrent real time and batch processing, data base management and distributed network operation. Additional software packages are available to expand the capability of your computer system. You can use programming languages like FORTRAN (standard), BASIC or PASCAL, and dedicated software packages for distributed systems (DS/1000) or data base management (IMAGE/1000).

The DATA ACQUISITION/1000 system includes a software package written especially for the 3054C and the HP 1000 computer system. The software package includes over 35 measurement subroutines that can be used as building blocks to create a useful measurement program. The

subroutines allow you to write sophisticated programs without knowing the instrument programming codes. Also included in the 3054C software package are linearization programs for many transducers. Linearization programs are provided for all major thermocouple types, thermistors, resistance thermometer devices (RTD's), and strain gauges.

HP Software
- ☐ 3054C software package to aid in instrument verification and operation
- ☐ RTE operating system supplied with the computer
- ☐ Additional software packages available
- ☐ Wide range of support services

Engineering Design Analysis

Temperature
  Thermocouples
  RTD's
  Thermistors
  I.C. Sensors
DCV
  100 nanovolt to 100 volts
Resistance
  100 μΩ to 100 kΩ
Frequency, Period, Pulse
Width, Totalize
Digital Inputs
Digital Interrupts
Actuator Outputs
Digital Outputs
0 to 10 V Programmable D/A's
4-20 mA Programmable Current
High-Speed Digitization and Scanning

Coolant and Oil Temperature
"HOT" Spot Analysis
Exhaust Temperature
Cooling System Analysis
Battery Voltage

Continuity to Isolation

Fuel/Air Flow, RPM, Event Counter

Status Lines, Limit Switches
Interrupts
Engine Load Control,
  On/Off Valve Control
Proportional Throttle Control
Current Control Loop
Continuous Real Time Monitoring

HP 1000   3054C

A new engine design can be characterized with the DATA ACQUISITION/1000 system. You can use the control features of the system to control the test environment while the 3054C's precise measurement capability measures the performance of the new design. The HP 1000 computer gives you the capability to analyze the data. You can also use HP's IMAGE/1000 Data Base Management software package to organize and structure your data, or use GRAPHICS/1000 to present the data on an HP graphic device.

The features of the 3054C gives you the benefit of high-precision measurement capability. With .01°C temperature sensitivity and .01 microstrain sensitivity, you have the capability to detect extremely small physical changes. The counter plug-in allows you to measure RPM and totalize, and the digital input/interrupt assembly lets you detect state changes. The multiplexers let you route signals where you want them. The features of the 3054C let you solve many of your measurement problems with one product.

The 3054C also has the capability to control your test environment. Actuators are available to switch loads to the engines or turn devices on and off. The voltage D/A lets you control throttles or valves. The 4-20 mA current D/A lets you interface to current loop control systems.

For real time high-speed monitoring of the test, use the HP 1000 L-series high-speed A/D. This assembly, a plug-in to the 1000L computer, allows you to collect data on sequential channels at 55,000 channels/second. This capability can be used to digitize a transient or waveform or to monitor the performance of all eight cylinders at operating speed.

Distributed Data Acquisition and Control

HP computers can be connected to other HP computers and instrumentation to form a versatile distributed data acquisition and control network. A distributed network lets you break your automation task into intelligent functional nodes, each capable of performing independently yet still reporting to a supervisory computer. With DS/1000, HP's distributed systems software and hardware, you can locate intelligent nodes locally or hundreds of miles away.

Distributed systems combine the capabilities of HP computers, instrumentation and software. The modular structure of DS/1000 lets you select the computer you need at each location. The 2103L computer, operating without a disk or terminal, is the logical low-cost controller for a single measurement node. The 2103L computer would run measurement and control programs stand alone, only requiring the attention of a supervisory (host) computer to down-load new programs or to receive new data. A more sophisticated node would use the HP 1000 Model 9 or Model 10 computer systems. These systems include mass storage, and when used with a terminal, can be used to develop programs.

The HP 1000 M, E, and F-series computers have increased processor speed and storage capacity which makes them logical choices as supervisory computers. The faster operating speed of these computers could be used for simultaneously executing other programs, data analysis, program development and to handle communications with the satellite and other host computers. The host computers might even serve as satellites to a larger computer or act as a remote work station using RJE/1000.

DS/1000 is a software package developed to support the operation of distributed computer systems. DS/1000, required for distributed operation, allows any HP computer in the network to communicate with any other HP computer. Programs and files in one computer can be accessed or run from another computer, all under program control. This feature allows the host computer to analyze data collected by the satellite computers or to download a new program to the satellite. computer.

When used with an HP 1000 M, E, or F-series computer, DS/1000 features "Store and Forward" capability. This feature allows messages to be sent from one computer to another through a third computer without additional attention. The feature ensures that a message will be correctly transmitted down a long string of computers to its final destination, allowing you to "chain" computers together.

Features like battery backup of memory and "AUTOSTART" ensure the integrity of your distributed system. Battery backup will protect the computer memory from power failure and "AUTOSTART" lets the computer start where it left off after a power failure.

You can also distribute the location of your instrumentation. You can locate instrumentation up to 1000 meters away from the computer by using fiber optic or twisted pair HP-IB extenders. The number of data points can be increased with the 3498A Extender Chassis.
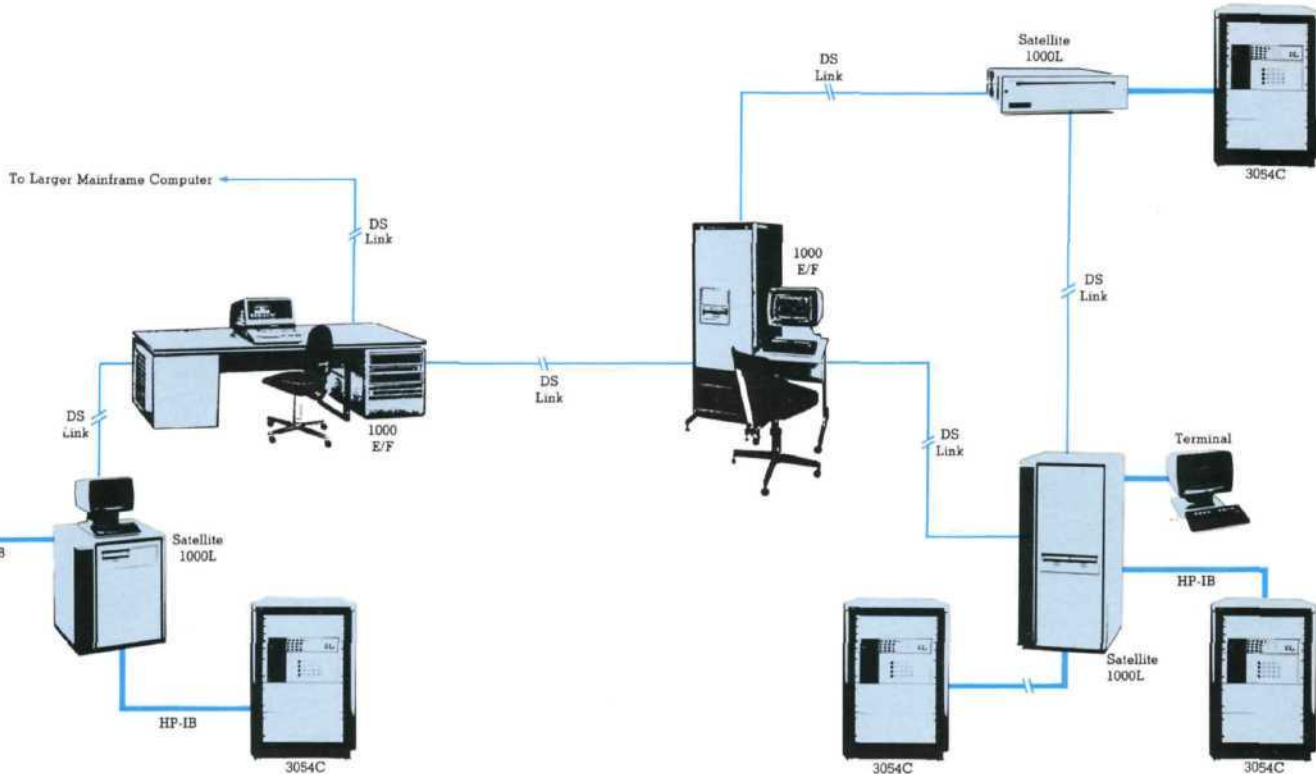
Instrument Performance
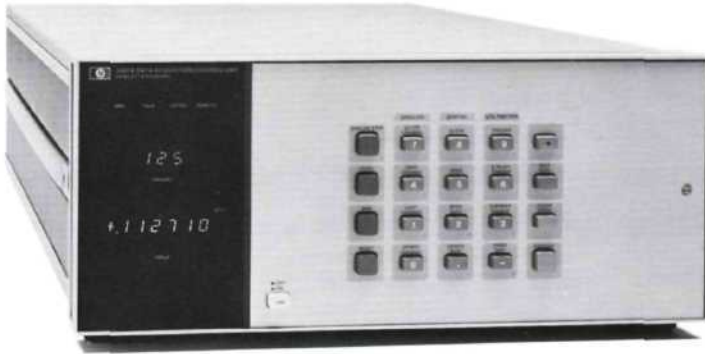
3497A Data Acquisition/Control Unit

The 3497A DATA ACQUISITION/CONTROL UNIT provides the analog multiplexing, digital monitoring and control functions for the DATA ACQUISITION/1000 system. You can custom configure your 3497A to match your requirements by choosing from a family of plug-in assemblies. The 20 Channel Relay Multiplexer Assembly multiplexes up to twenty 3-wire inputs (High, Low and Guard) to your voltmeter. An isothermal connector block is provided as an option to this assembly to allow thermocouple compensation. Assemblies are available for digital inputs/interrupts and digital and control outputs. More specialized assemblies like a 100 kHz counter and isolated programmable voltage and current D/A's are also available.

3497A Mainframe
☐ HP-IB Interface
☐ Keyboard and Display
☐ Real Time Clock
☐ 5 Slot Card Cage

The 3497A holds up to five optional assemblies. An Extender Chassis, the 3498A, is available to expand your system. Each 3498A holds up to ten assemblies. A total of 13 extenders can be controlled by one 3497A, allowing connection of up to 1000 guarded analog channels and up to 1360 digital channels.

The 3497A mainframe comes standard with a front panel keyboard and display and a real time nonvolatile clock. This quartz-based clock can issue interrupts at programmable times or intervals and can be used to measure elapsed time in addition to providing calendar and time-of-day information.

The 3456A Voltmeter in the 3054C provides a very flexible measurement solution for your data acquisition application; however, you may also elect to use the optional DVM assembly in the 3497A. This DVM gives you a 1 μV sensitive 5½ digit (16.8 bit) guarded integrated dc measurement. This DVM may be a solution for cost critical applications that can tolerate slightly less measurement performance.

More detailed information on the instrumentation and computers described here is available in literature documenting the individual products.

20 Channel Relay Multiplexer Assembly (Option 010)
☐ 20 3-wire inputs
☐ Low thermal offset ($< 2 \mu$V)
☐ 20 to 1 or 2-10 to 1 multiplexers per assembly

Relay Multiplexer Assembly with Thermocouple Compensation (Option 020)
☐ Easy sequential scanning of 20 thermocouples of the same type using hardware compensation
☐ Convenient multiplexing of 19 thermocouples of ANY type or non-thermocouple inputs using software compensation

3497A

3498A

3497A and 3498A shown with rear covers removed

16 Channel Isolated Digital Input/Interrupt Assembly (Option 050)
- ☐ 16 channel optically isolated input
- ☐ 5, 12, and 24 V logic
- ☐ 8 of the 16 lines available as interrupt
- ☐ +5 V supply to sense contact closures

100 kHz, Reciprocal Counter Assembly (Option 060)
- ☐ Period to 10 μs (100 kHz)
- ☐ Pulse width to 18 μs
- ☐ Totalize and down count
- ☐ Interrupt and control output
- ☐ Isolated input
- ☐ Fully programmable

Actuator/Digital Output Assembly (Option 110)
- ☐ 16 individually controlled form C switches
- ☐ Switch up to 1A at 100 V
- ☐ Bounceless mercury-wetted relays allow use as digital output

Dual Output 0 ±10 V Voltage D/A Converter Assembly (Option 120)
- ☐ Two individually isolated, independently programmable sources per assembly
- ☐ 13-bit resolution (2.5 mV)
- ☐ Use for voltage programming or proportional control

Dual Output 0-20/4-20 mA Current D/A Converter Assembly (Option 130)
- ☐ Two individually isolated, independently programmable sources per assembly
- ☐ 12-bit resolution (5 μA)
- ☐ Each source jumper selectable for 0 to 20 mA or 4 to 20 mA operation

5½ Digit DVM and Current Source (Option 280)
- ☐ DCV measurements to 1 μV resolution at 41 channels per second
- ☐ 100 μV resolution at 244 readings per second
- ☐ Built in current source for resistance measurements
- ☐ Fully programmable trigger, delay, number of digits
- ☐ 100 reading storage buffer
- ☐ Occupies dedicated slot in 3497A

3498A Extender (Option 298)
- ☐ Holds up to 10 plug-in assemblies
- ☐ Expand your system to 1000 analog channels and up to 1360 digital channels
- ☐ Remotely locate extenders up to 100 meters away (analog) or 25 meters away (digital)

Instrument Performance

3456A Digital Voltmeter

The 3456A Digital Voltmeter is a 3½ to 6½ digit (10.2 to 20.2 bit) integrating voltmeter with part per million resolution, 100 nanovolt sensitivity, and reading rates to 300 readings per second. The 3456A can measure DCV, ACV, 2 and 4-wire ohms, offset compensated ohms, and ratio.

The 3456A integration time may be programmed from .01 line cycles to 100 power line cycles. This flexibility allows reading speeds to 300 readings per second and common mode noise rejection of up to 140 dB. The measurement precision of the 3456A allows .01°C resolution when measuring thermocouples and .1 microstrain resolution when measuring strain gauges.

Reading and program storage is included standard with the 3456A. These features allow you to program the 3456A to perform a sequence of measurements and to store the results in internal memory. The controlling computer can then be interrupted when the measurements are finished. The 3456A provides a scanner advance signal to be used with the 3497A to allow sequential scan and read rates of 200 channels/second.

☐ Measures dc, True rms, and resistance
☐ 3½ to 6½ digit resolution
☐ 100 nanovolt sensitivity at 48 readings per second
☐ > 140 dB ECMR
☐ Analog and digital filtering
☐ Reading and program storage

HP 1000 L-Series Measurement and Control I/O Cards

Three I/O cards are available to expand the capability of your DATA ACQUISITION/1000 system when you use an HP 1000 L-series computer as your system controller. The 12060A High Level Analog Input Assembly provides the capability to digitize a waveform or up to eight sequential channels at a 55 kHz rate with 12-bit resolution. The 12061A assembly expands the input capability of the 12060A to a total of 40 channels. The 12063A assembly adds 16 isolated digital input/interrupt lines and 16 isolated Form C relay outputs to your system. Each of these assemblies occupy one slot in the HP 1000 L-series computer card cage. They are not compatible with the HP 1000M, E, or F-series computer or 3497A card cage.
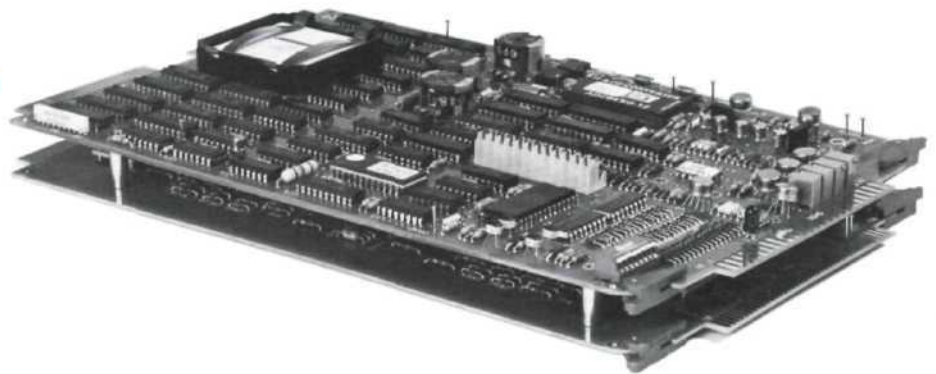
12060A High Level Analog Input Assembly

☐ 8 differential inputs
☐ Up to 55 kHz, sampling rate
☐ 4 programmable input ranges (±1.28 V to ±10.24 V)
☐ .625 mV best case resolution, 1.25 mV accuracy
☐ 12061A adds 32 differential inputs

12063A 16 Channel Input/16 Channel Ouput Digital Assembly

☐ 16 isolated input/interrupt channels
☐ 16 Form C relay outputs
☐ Programmable debounce delay
☐ Input levels to 42 Vdc

Computers

Hewlett-Packard offers two series of computers to control your DATA ACQUISITION/1000 system. The HP 1000 L-series of computers is well suited to control the 3054C due to their moderate cost and high-speed intelligent I/O. The HP 1000 M, E, F-series computer systems have greater operating speed and larger memory. They are good choices as a central "host" computer in a distributed system or in applications where there is significant data analysis.

All members of the HP 1000 family operate under HP's popular Real Time (RTE) operating system. With RTE, program execution can be scheduled with respect to time, by events, by other programs, or by the operator.

HP 1000L

HP 1000 L-series computers are ideally suited for use as a measurement node controller or as a dedicated system controller. This computer series features low cost and fast, intelligent I/O for flexibility in controlling a measurement system. The I/O performance of an HP 1000 L-series computer is better than the HP 1000 M, E, and F-series; however, the data processing speed is less.

Fast and Intelligent I/O

Each I/O card for the HP 1000 L-series uses a specially developed input/output processor that frees the central processor from involvement in I/O operations. Distributing intelligence to the I/O cards themselves provides increased I/O speed and data throughput due to simultaneous I/O transfers and individual DMA channels per card. These features allow you to collect data from instruments with one I/O card while simultaneously sending previously acquired data to a host computer using the distributed systems interface card.

Memory Expansion

The basic HP 1000 L-series processor has 64 kbytes of main memory, which is sufficient for many applications. The memory can be expanded up to 512 kbytes. The additional memory can be used for storage of extra programs and data. This allows more efficient operation because programs can be accessed from memory instead of being swapped in from a disc.

Configuration Choices

HP 1000 computers can be ordered as stand-alone computers typically used in distributed systems, or as systems with discs and terminals.
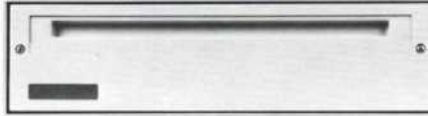
HP 2103L Computer

The 2103L is a packaged L-series computer for users designing their own rack-mounted systems. The 2103L provides a CPU board and 64 kbyte memory module in a 10-slot card cage along with the 12035A L-series power module. Eight slots are available for adding additional memory, battery backup of cards and I/O cards.

The 2103L is a logical choice for use as a measurement node controller in a distributed system. In this application the 2103L will operate without a local terminal or disc, providing low-cost local intelligence with access to the power of the entire distributed network.

Typical Distributed Node for Instrumentation Control

NOTE: Host computer must also be configured for distributed operation.

☐ 2103L Computer
☐ 12009A HP-IB Interface with option 001
☐ 12007A or 12044A HDLC Network Interfaces
12007A interfaces to modems, 12044A interfaces directly
☐ HP Modems (if required)
☐ 92070/71R Right to Reproduce RTE-L/XL on one L-series computer
☐ 91750R Right to Reproduce DS/1000 on one computer

Optional:
Additional memory is required for RTE-XL (expanded memory) operation.
☐ 2103L Option 11 – Deletes standard memory, adds 128 kbytes memory (additional memory may be added)
☐ 2103L Option 12 – Deletes standard memory, adds 512 kbytes memory

Model 10

HP 1000L Models 9 and 10

The HP 1000 Models 9 and 10 combine an L-series processor, power supply, card cage, flexible disc storage, and rack into a convenient integrated package. The combination of these parts together with a terminal and optional hard disc allows you to develop programs, analyze data and control instrumentation, all with a single low-cost computer system.

The HP 1000 Model 9 is based on two 1.2 megabyte flexible disc drives. It is best suited for applications where the computer will have a dedicated task like developing and running instrument control programs. The Model 10 is based on one 1.2 megabyte flexible disc and a 12 megabyte hard disc. The faster access time and greater capacity provided by hard disc make the Model 10 more suitable for program development and for applications that involve extensive use of disc storage. Both the Model 9 and Model 10 are available in a 30 inch cabinet and a 56 inch cabinet. The Model 9 and Model 10 may use expanded memory and the RTE-XL operating system.

HP 1000 Model 9 and 10 Systems
(configuration recommended for use in DATA ACQUISITION/1000 system)

Computer System (required)   Model 9, order 2145   Model 10, order 2146

Computer:	Mass Storage	Rack	

Consisting of:
• HP 1000 L-series Central Processor
• 64 kbyte Memory Card
• 12005A Asynchronous Serial (terminal) Interface
• 12009A HP-IB Disc Interface
• 12013A Battery Backup Card
• 16 Slot Card Cage
• 12035A Power Module
• 92070A/71A RTE-L/XL relocatable modules
• Diagnostic software
• Primary Operating System
• Documentation
	Dual 1.2 megabyte flexible disc (standard with 2145)
	or
	Single 1.2 megabyte flexible disc (standard with 2146)
	plus must order:
	  HP 7910 HR fixed disc drive, 12 megabytes
		Model 2145/46B
		  30″ steel cabinet
		Model 2145/46A
		  56″ steel cabinet	

Additional Equipment

Terminal	Interface	Equipment required for DS operation	Equipment required for Expanded memory (XL) operation
One of the following two terminals: • HP 2621A Interactive Terminal, keyboard and display only • HP 2621P Interactive Terminal with printer, keyboard and display	Additional 12009A Opt. 001 HP-IB interface for connection to the 3054C	• 12007A HDLC Interface to modems or • 12044A HDLC Direct Connect Interface • 91750E Right to Execute DS/1000	• 2145/46 Option 011 - Deletes standard memory and 92070A RTE-L operating system. Adds 128 kbyte memory module and 92071A RTE-XL operating system. Additional memory may be added by ordering up to three 128 kbyte 12003A memory array cards. • 2145/46 Option 012 - Similar to Option 011 except adds 512 kbyte memory module and 92071A operating system.

3054C Option 457 and Model 10

HP 1000M, E, and F-series Computers

The HP 1000M, E, and F-series computers are a good choice for centralized, multi-user, multi-processing applications. HP 1000M, E, and F-series computers can simultaneously support several users, languages and executing programs. The extra memory, speed, and peripheral handling capability of these computers makes them logical choices where additional computer power is required. In a distributed network, HP 1000M, E, and F-series computers are recommended as a host computer to control several satellite computers.

HP 1000 Models 40 and 45 are computer systems appropriate for use as a central computer in a distributed system. In addition to the standard Model 40 and 45, the following items are required for distributed operation.

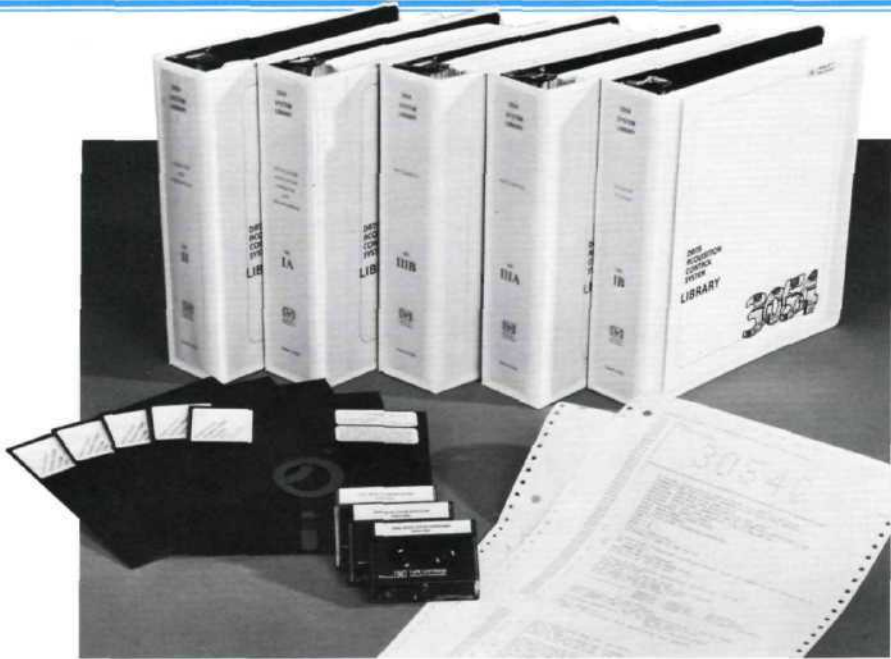☐ 91750A DS/1000 Distributed Systems Software Package
☐ 12825A Interface card for hardware linkage
  or
☐ 12794A Interface card for modem operation
☐ HP modem if required
Contact your HP representative for configuration information.

Model 40

Software and Documentation

The Complete Package

A complete documentation package for a DATA ACQUISITION/1000 system consists of the documentation supplied with the computer and peripherals, documentation supplied to describe the individual instruments and documentation supplied with the 3054C to describe the use and capability of the 3054C software library.

The 3054C Software Package

The 3054C software package consists of tested FORTRAN modules that have been specially written to allow easy operation of the HP 1000L, M, E, and F-series computers and the 3054C system. This software frees you from many programming problems and lets you make meaningful measurements faster. Programming of the 3054C is done by writing a main program that calls the 3054C program modules that are required. The 3054C software package is available on tape cartridges compatible with HP 264X series terminals for use with 1000M/E/F series computers. The software is also available on flexible discs compatible with the HP 9895A disc drive for use with 1000L series computers.

Programming Your System

Three different types of software modules are provided in the 3054C software package. There are complete measurement subprograms, conversion subprograms and utility subprograms. The measurement subprograms are written to perform a complete measurement given only a channel number and function. For example, the RTDEG (temperature using an RTD) subprogram will set up the voltmeter for 4-wire ohms, close two channels, take a reading, and then convert the reading to temperature. Programs are written for a 2.2 kΩ thermistor, a 385 Ω platinum RTD, and most thermocouple types. Programs are also provided for doing simple tasks like closing a channel and measuring dc volts. Included with the subprograms is error checking that will alert the main program when a reading becomes out of range for the particular transducer or device.

The second type of subprograms are conversion routines that can convert a voltage or resistance to a corresponding temperature or strain. These subprograms are useful when a burst of data is taken with the conversion of the data to be done later. This technique maximizes computer and instrument efficiency.

Utility programs, the third type of subprograms, are short routines that perform specialized tasks to make using the 3054C easier. For example, the voltmeters in the 3054C will return data in a "packed" data for-

mat that will be more efficient for data transfer but will need to be decoded before the data is useful. Routines to "unpack" these readings and other general purpose routines are included in the 3054C library.

Verification Routines

A significant part of the 3054C software package is the system verification/diagnostic programs. You can use these programs with the test connector provided to verify that the system is in operating condition or to help diagnose a problem should a system failure occur.
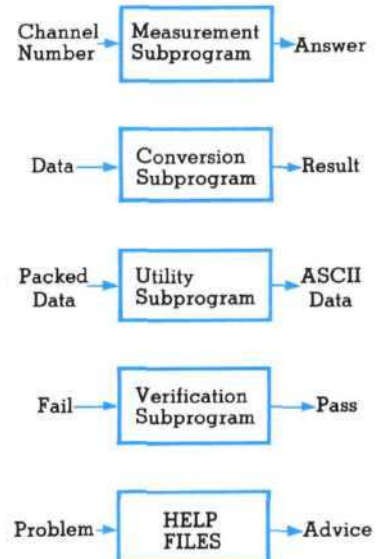
A Programming Example

The capability of the system software is best shown by a simple example. Suppose your application required scanning three J type thermocouples at channels 1, 2, and 3 and printing the temperatures. You would write a program similar to the one shown.

After this program is written, it can be compiled, loaded and run. Although the 3054C routines are written in FORTRAN, the main program can be written in any language supported on the computer.

Also included with the 3054C software package is a set of special HELP files that give detailed explanations of the 3054C functions and subroutines. For example, if you wanted an explanation of the function "TCDEG" (used above) you would type "RU,HLP,TCDEG". A summarized description would be printed on your terminal.

User Written Program

```
SAMPL   T=00003 IS ON CR00010 USING 00002 BLKS R=0000

0001  FTN4,L
0002        PROGRAM SAMPL
0003        COMMON   ERR,BUS,SCN,DVM,LGLU
0004        INTEGER ERR,BUS,SCN,DVM,LGLU
0005        REAL    TEMPS
0006  C     * Call the initialize routine first
0007        CALL INIT(0)
0008  C     * Get and print J-type T/C readings from channels 1, 2, & 3
0009        DO 20 N=1,3
0010           TEMPS = TCDEG(N,1HJ,1HC,1HS)
0011           WRITE(LGLU,10) N,TEMPS
0012   10      FORMAT(/10X,"Channel ",I1," temperature is ",F12.3)
0013   20   CONTINUE
0014        END
```

- Channel Number
- Defines a J type thermocouple
- Defines temperature to be returned in degrees C
- Defines software compensation

3054C Sample Subprogram

```
DCV     T=00004 IS ON CR00010 USING 00012 BLKS R=0000

0001  CxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxDCVxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
0002  C
0003  C     * DC voltage reading   (3456A or 3497A)
0004        REAL FUNCTION DCV(CHAN),44454-1Xxxx REV.2013 801223
0005        COMMON   ERR,BUS,SCN,DVM
0006        INTEGER ERR,BUS,SCN,DVM,CHAN,FNAM(3),IE,RIN(2),AR,BR
0007        DATA FNAM/2H D,2HCV,2H  /
0008        ERR = 1
0009        DCV = 9.9999E9
0010        IF(CHAN.LT.0)     GO TO 20
0011  C     **Close scanner channel
0012        IF(CHAN.GT.999) GO TO 1000
                           .
                           .
                           .
                           .
                           .
0032   110  FORMAT("S0F1R1P171FL0M0RS0-0STD1STN6STG1STIT3")
0033        IE = IBERR(DVM)
0034        IF(IE.NE.0) GO TO 1006
0035        CALL EXEC(100001B,DVM+100B,RIN,2)
0036        GO TO 1010
0037   120  CALL UNP56(RIN,1,DCV)
0038        RETURN
0039  1000  CALL ERROR(6,5,FNAM)
0040        RETURN
0041  1005  CALL ERROR(5,IE,SCN)
0042        RETURN
0043  1006  CALL ERROR(6,IE,DVM)
0044        RETURN
0045  1010  CALL ABREG(AR,BR)
0046        CALL ERROR(10,AR,BR)
0047        RETURN
0048        END
```

Expanded Capability

If you order one of the computer models suggested on pages 9 or 10, you will receive an RTE operating system with your computer. This operating system is all the computer software you need to run the 3054C software library. However, you may choose to expand the capability of your system by adding one of the software packages shown. Additional hardware may also be required.

Software Packages Available

RTE Operating System (supplied standard with the 2145/46 or 2176/77)	1000L 1000XL 1000M/E/F	92070A 92071A 92068A
3054C Software Package (supplied standard with the 3054C)	44454A	
DS/1000 Distributed Systems software	91750A	
IMAGE/1000 Data Base Management software for 1000 M, E, F series processors.	92069A	

Service and Support

Installation

Installation is included with the 3054C when the 3054C is installed with a new or existing HP computer system. A computer system consists of a CPU, a local terminal, and a mass storage device (floppy disc or tape cartridge drive) for loading verification programs.

Installation of the computer is included when the computer is purchased as part of a computer system like the 1000L/XL series models 2145/46 or the 1000M/E/F series models 2176/77. Installation for stand-alone computers or other equipment is available upon request and at additional charge.

Service

All the hardware components of a DATA ACQUISITION/1000 system are warranted for a period of 90 days at the customer's site. Due to the precision of the 3054C's voltmeter's, calibration and repairs requiring calibration of the 3054C will usually be done at an HP service facility.

Additional service and maintenance agreements beyond the warranty period are also available. Contact your HP representative for details.

Software Support

Hewlett-Packard offers two levels of software support: Customer Support Service and Software Subscription Service.

Customer Support Service

Customer Support Service (CSS) is HP's standard software support product. This service provides the highest level of on-going support and is designed to assist your system manager in using, updating, and maintaining HP software products. This service features:
- □ Assignment of an HP systems engineer to your account
- □ Phone in consulting service
- □ On-site resolution of HP software problems
- □ Software problem reporting
- □ Software, firmware and reference manual updates

Software Subscription Service

For those customers who do not require any systems engineering assistance, HP's Software Subscription Service (SSS) is available. This service is similar to CSS but does not include the services of an account responsible systems engineer. This service includes:
- □ Right to use software updates and firmware updates on one computer
- □ Software, firmware and reference manual updates
- □ Software problem reporting by mail
- □ Periodic notification of software status

Custom Program Development

Customer Support Service (CSS) and Software Subscription Service (SSS) only support the use and application of unmodified HP software. Should you require assistance in programming the 3054C or computer outside the scope of the 44454A software package, you may elect to purchase additional consulting services. Contact your HP representative for information.

Manual Update Service (MUS)

This service provides manual updates as required to keep your software manuals current and up-to-date.

92830A HP1000 Software Notification Service (SNS)

This service provides periodic notification of software status for all HP 1000 software via the COMMUNICATOR/1000 (6 issues/year), the HP 1000 SOFTWARE STATUS BULLETIN (24 issues/year), and the HP SOFTWARE UPDATE NOTICES (4 issues/year).

Conditions for Obtaining Support

- □ A system manager must be designated and adequately trained
- □ All system software and firmware must be at the required revision level
- □ The same level of support must be purchased for all of the software and firmware products that make up the system

Software Support Services

| Description	Customer Support Service (CSS)	Software Support Service (SSS)	Manual Update Service (MUS)
3054C			
44454A 3054C/1000 Software Package	44454T	44454S	44454Q
1000L/XL			
92070A HP 1000L RTE-L Operating System	92070T	92070S	92070Q
92071A HP 1000XL RTE-XL Operating System	92071T	92071S	92071Q
1000			
92068A RTE-IVB Operating System	92068T	92068S	92068Q
91750A DS/1000 Distributed System Software	91750T	91750S	91750Q
92069A IMAGE/1000 Data Base Management Software	92069T	92069S	92069Q

System Racks

The Standard 3054C System Includes:
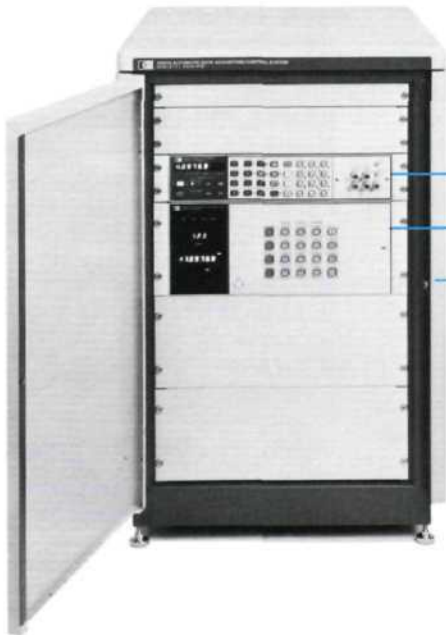
3456A Digital Voltmeter

3497A Data Acquisition/Control Unit

30" Cabinet and Power Module

System Documentation and Software

Verification Hardware and Software

Installation

Other Cabinet Configurations May Be Chosen for the 3054C System

(**Option 416**) 16" Combining Case
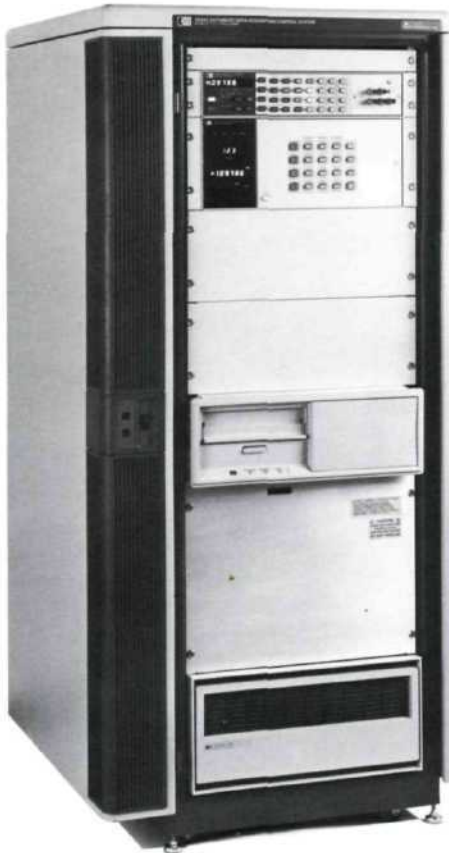
Option 457 includes the proper rack-mounting hardware for installation of a 3054C into the 56" rack supplied with the 2145/46A computer. This option should not be used to install a 3054C into the cabinet supplied with the 2176C/2177C.
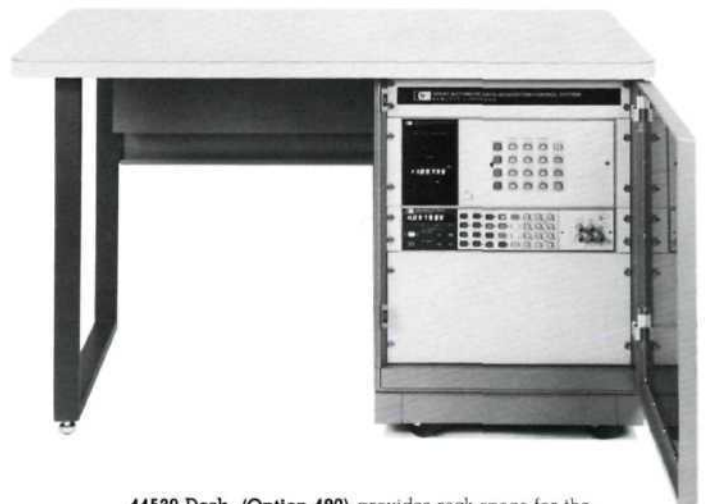
44530 Desk (Option 490) provides rack space for the instruments and a table top for software development.

Specifications

The following specifications apply to the 3054C when operated with an HP 1000L or 1000E/F series computer. Where indicated, signals are multiplexed to the 3456A or 3497A voltmeter with the 20 Channel Relay Multiplexer. Measurement performance is similar for the Relay Multiplexer with Thermocouple Compensation.

Measurement speeds are the maximum obtainable. When using the 3054C subroutines, measurement speeds are significantly slower due to error checking.

More detailed specifications on the instruments and computers are available in literature documenting the individual products.

DC VOLTAGE

3456A Digital Voltmeter with Option 010, 20 Channel Relay Multiplexer Assembly

Range	Maximum Reading	Resolution			Input Resistance
	(5½ digits)	6½ digits	5½ digits	4½ digits	
0.1 V	± .119999 V	100 nV	1 μV	10 μV	$> 10^{10}\Omega$
1.0 V	± 1.19999 V	1 μV	10 μV	100 μV	$> 10^{10}\Omega$
10.0 V	± 11.9999 V	10 μV	100 μV	1 mV	$> 10^{10}\Omega$
100.0 V	± 119.999 V	100 μV	1 mV	10 mV	10 MΩ ± .5%
170.0 V	± 170.0 V	1 mV	10 mV	100 mV	10 MΩ ± .5%

Maximum Input Voltage:
Between any two terminals: ± 170V peak
Between any terminal and chassis: ± 170V peak

Accuracy:
± (% of reading + number of counts)
Auto-zero on. Filter off. Tree-switched.
90 days: 23°C ± 5°C

Range	Number of Digits (Integration Time in Power Line Cycles, PLC)		
	6½ digits (1 PLC)	5½ digits (0.1 PLC)	4½ digits (0.01 PLC)
0.1 V	.0035 + 52	.008 + 16	0.06 + 3
1.0 V	.0025 + 7	.007 + 3	0.06 + 2
10.0 V	.0024 + 3	.007 + 2	0.06 + 2
100.0 V	.0027 + 4	.007 + 2	0.06 + 2
170.0 V	.0025 + 3	.007 + 2	0.06 + 2

For > 90 days, add (± .0006% of reading)/month to 90 day accuracy.

Temperature Coefficient:
(0°C to 18°C, 28°C to 50°C)
± (% of reading + number of counts)/°C

Range	5½ digits (0.1 PLC)
0.1 V	0.0002 + 00.2
1.0 V	0.0002 + 0.02
10.0 V	0.0002 + .002
100.0 V	0.0002 + 0.02
170.0 V	0.0002 + 0.02

*For 6½ digits (1 PLC), multiply number of counts by 10.
For 4½ digits (0.01 PLC), multiply number of counts by 0.1.*

Normal Mode Rejection (NMR):
50 Hz to 60 Hz ± 0.1%

Number of Digits Integration Time in Power Line Cycles	
6½ digits (1 PLC)	5½ digits (0.1 PLC) 4½ digits (0.01 PLC)
60 dB	0 dB

Effective Common Mode Rejection (ECMR):
With 1 kΩ imbalance in low lead, using tree switching. For DC or AC, 50 Hz or 60 Hz ± 0.1%.

Number of Multiplexer Channels (Options 10, 20)			
< 40	AC	140 dB	80 dB
	DC	105 dB	105 dB
< 100	AC	140 dB	80 dB
	DC	100 dB	100 dB
< 400	AC	135 dB	75 dB
	DC	90 dB	90 dB
< 1000	AC	130 dB	70 dB
	DC	85 dB	85 dB

Filter adds 60 dB rejection at 50 Hz. Response time is 0.65s for step input settled to within .01%.

General Information:
Speed: The maximum measurement rates for a 3456A measuring dc volts are given for a fixed channel, for sequential channels using external increment and for random channel scans using software channel selection. These rates include selecting the channel, making the measurement and transferring the reading to the computer. These speed specifications also apply to a 3456A when used to make 2-wire resistance measurements.

Maximum DC Volts Scanning Rates (channels/second)

	Line Frequency of 60 Hz (50 Hz) Computer			
	1000L		1000E,F	
Fixed Channel				
6½ Digits	47	(39)	47	(39)
5½ Digits	203	(176)	203	(178)
4½ Digits	300	(271)	300	(274)
Sequential Channels using external increment				
6½ Digits	45	(38)	43	(37)
5½ Digits	152	(137)	133	(123)
4½ Digits	200	(187)	172	(161)
Random Channels				
6½ Digits	21	(19)	22	(21)
5½ Digits	32	(30)	34	(33)
4½ Digits	31	(31)	36	(36)

3456A Buffer Memory:
Reading Storage: 4 bytes per reading for a maximum of 350 readings

Program Memory: store up to 1400 ASCII programming characters

Total Memory Size: Reading Storage + Program Memory = 1400 bytes maximum

DC VOLTAGE

Voltmeter Assembly (Optional) for 3497A with Option 010, 20 Channel Relay Multiplexer Assembly

Range	Maximum Reading (5½ digits)	Resolution 5½ digits	4½ digits	3½ digits	Input Resistance
0.1 V	±0.119999 V	1 μV	10 μV	100 μV	$10^{10}\Omega$
1.0 V	±1.9999 V	10 μV	100 μV	1 mV	$10^{10}\Omega$
10.0 V	±11.9999 V	100 μV	1 mV	10 mV	$10^{10}\Omega$
100.0 V	±119.999 V	1 mV	10 mV	100 mV	10 MΩ ±.5%

Maximum Input Voltage:
Between Hi and Lo: ±120V peak
Between Lo and guard: ±170V peak
Between any terminal and chassis: ±170V peak

Accuracy:
±(% of reading + number of counts)
Auto-zero on. Tree-switched.
90 days, 23°C ±5°C

Range	Number of Digits (Integration Time in Power Line Cycles, PLC) 5½ digits (1 PLC)	4½ digits (0.1 PLC)	3½ digits (0.01 PLC)
0.1 V	0.007 + 5	0.01 + 2	0.1 + 1
1.0 V	0.006 + 2	0.01 + 1	0.1 + 1
10.0 V	0.006 + 1	0.01 + 1	0.1 + 1
100.0 V	0.006 + 1	0.01 + 1	0.1 + 1

For > 90 days, add (±.001%) of reading)/month to 90 day accuracy.

Temperature Coefficient:
(0°C to 18°C, 28° to 50°)
±(% of reading + number of counts)/°C

Range	5½ digits (1 PLC)
0.1 V	0.00025 + 0.15
1.0 V	0.002 + 0.02
10.0 V	0.0002 + 0.01
100.0 V	0.00025 + 0.02

For 4½ digits or 3½ digits (0.1 PLC or 0.01 PLC), multiply number of counts by 0.1 and 0.01 respectively.

Normal Mode Rejection (NMR):
50 Hz or 60 Hz ±0.1%

Number of Digits (Integration Time in Power Line Cycles, PLC) 5½ digits (1 PLC)	4½ digits or 3½ digits (0.1 PLC or 0.01 PLC)
60 dB	0 dB

Effective Common Mode Rejection (ECMR):
With 1 kΩ imbalance in low lead, using tree switching. For DC or AC, 50 Hz or 60 Hz.

Number of Multiplexer Channels (Options 10, 20)			
< 40	AC	150 dB	90 dB
	DC	110 dB	110 dB
< 100	AC	150 dB	90 dB
	DC	104 dB	104 dB
< 400	AC	140 dB	80 dB
	DC	92 dB	92 dB
< 1000	AC	130 dB	70 dB
	DC	85 dB	85 dB

General Information:
Speed: The maximum measurement rates for a 3497A measuring dc volts are given for a fixed channel, for sequential channels using external increment and for random channel scans using software channel selection. These include selecting the channel, making the measurement and transferring the reading to the computer. These measurement rates also apply to the 3497A when used to make 2 and 4-wire resistance measurements.

Maximum DC Volts Scanning Rates (channels/second):

	Line Frequency of 60 Hz (50 Hz) Computer			
	1000L		1000E.F	
Fixed Channel				
5½ Digits	46	(39)	46	(39)
4½ Digits	177	(155)	177	(155)
3½ Digits	238	(212)	238	(212)
Sequential Channels using external increment				
5½ Digits	39	(25)	30	(25)
4½ Digits	108	(79)	88	(79)
3½ Digits	127	(99)	107	(99)
Random Channels				
5½ Digits	21	(16)	22	(16)
4½ Digits	31	(28)	35	(30)
3½ Digits	33	(29)	35	(32)

DVM Assembly Buffer Memory:
Packed Format: 100 readings
ASCII Format: 60 readings

RESISTANCE

3456A Digital Voltmeter With Option 010, 20 Channel Relay Multiplexer Assembly

Scanning two-wire and four-wire resistance measurements are accomplished with Option 010. This option can easily be configured for 10 channels of four-wire ohm's measurements.

Range	Maximum Reading (5½ digits)	Maximum Reading (6½ digits)	Resolution (5½ digits)	Resolution (4½ digits)	Current Through Unknown
100 Ω	119.999 Ω	100 μΩ	1 mΩ	10 mΩ	1 mA
1 kΩ	1199.99 Ω	1 mΩ	10 mΩ	100 mΩ	1 mA
10 kΩ	11.9999 kΩ	10 mΩ	100 mΩ	1 Ω	100 μA
100 kΩ	119.999 kΩ	100 mΩ	1 Ω	10 Ω	50 μA

Range	Maximum Voltage for Valid Reading	Maximum Open Circuit Voltage	Maximum Lead Resistance for 4-Wire Ohms	Maximum Offset Voltage for Offset Compensation Ohms
100 Ω	0.12 V	5.5 V	10 Ω	0.01 V
1 kΩ	1.2 V	5.5 V	100 Ω	0.1 V
10 kΩ	1.2 V	5.5 V	1 kΩ	0.1 V
100 kΩ	6 V	9.5 V	1 kΩ	0.5 V

Overload Protection:
± 170V peak, non-destructive

Accuracy:
4-wire ohms
± (% of reading + number of counts)
Auto zero ON. Filter OFF. Tree-switched.
90 days, 23°C ±5°C

	Number of Digits (Integration Time in Power Line Cycles, PLC)		
Range	6½ digits (1 PLC)	5½ digits (0.1 PLC)	4½ digits (0.01 PLC)
100 Ω	0.004 + 54	0.01 + 14	0.07 + 3
1 kΩ	0.004 + 7	0.009 + 4	0.07 + 2
10 kΩ	0.004 + 7	0.009 + 4	0.07 + 2
100 kΩ	0.004 + 4	0.009 + 3	0.07 + 2

For > 90 days, add (±0.006% of reading)/month to 90 day accuracy.

2-wire ohms: Same as 4-wire ohms except add 2Ω offset. Offset compensated ohms same as 2-wire or 4-wire ohms except that the maximum reading may be reduced by 10% for large offset voltages.

Temperature Coefficient:
(0°C to 18°C, 28°C to 50°C)
± (% of reading + number of counts)/°C

Range (5½ digits)	Temperature Coefficient
100 Ω	.0004 + .200
1 kΩ	.0004 + .020
10 kΩ	.0004 + .004
100 kΩ	.0010 + .004

For 4½ digits or 6½ digits (0.01 PLC or 1 PLC), multiply number of counts by 0.1 and 10 respectively.

Speed:
The maximum measurement rates for a 3456A measuring 4-wire ohms are given for a fixed channel, for sequential channels using external increment and for random channels scans using software channel selection. These rates include selecting the channel, making the measurement and transferring the reading to the computer. Reading rates for 3456A 2-wire ohms measurements are identical to the rates for dcV measurements.

	Line Frequency of 60 Hz (50 Hz)			
	Computer			
	1000L		1000E.F	
Fixed Channel				
6½ Digits	47	(39)	47	(39)
5½ Digits	201	(174)	201	(174)
4½ Digits	300	(265)	298	(265)
Sequential Channels using external increment				
6½ Digits	25	(21)	24	(20)
5½ Digits	103	(90)	92	(83)
4½ Digits	151	(135)	134	(121)
Random Channels				
6½ Digits	15	(13)	15	(14)
5½ Digits	29	(28)	31	(30)
4½ Digits	31	(30)	34	(33)

Voltmeter Assembly (Optional) for 3497A With Option 010

Scanning two-wire and four-wire resistance measurements is accomplished with Option 010. This option can easily be configured for 10 channels of 4-wire ohms measurements. When making resistance measurements with the Voltmeter Assembly in the 3497A, use the constant current source provided as the signal source.

Effective Resistance Range	Current Source	Voltage Range	Maximum Reading (5½ digits)	Resolution 5½ digits	Resolution 4½ digits	Resolution 3½ digits
100 Ω	1 mA	0.1 V	119.999 Ω	1 mΩ	10 mΩ	100 mΩ
1 kΩ	1 mA	1.0 V	1.19999 kΩ	10 mΩ	100 mΩ	1 mΩ
10 kΩ	100 μA	1.0 V	11.9999 kΩ	100 mΩ	1 mΩ	10 mΩ
100 kΩ	10 μA	1.0 V	119.999 kΩ	1 Ω	10 Ω	100 Ω

Overload Protection:
± 170V peak, non-destructive

Accuracy:
4-wire ohms
± (% of reading + number of counts)
Auto-zero ON. Tree-switched.
90 days, 23°C ±5°C

	Number of Digits (Integration Time in Power Line Cycles, PLC)		
Range	6½ digits (1 PLC)	5½ digits (0.1 PLC)	4½ digits (0.01 PLC)
100 Ω	0.004 + 34	0.01 + 14	0.07 + 3
1 kΩ	0.004 + 7	0.009 + 4	0.07 + 2
10 kΩ	0.004 + 7	0.009 + 4	0.07 + 2
100 kΩ	0.004 + 4	0.009 + 3	0.07 + 2

For > 90 days, add (±0.002% of reading)/month to 90 day accuracy.

2 wire ohms: Same as 4-wire ohms if the current source is connected at the terminal block.

Temperature Coefficient:
(0°C to 18°C, 28°C to 50°C)

Range	Temperature Coefficient (5½ digits)
100 Ω through 10 kΩ	(0.0028% + 0.15 counts)/°C
100 kΩ	(0.0027% + 0.02 counts)/°C

Speed:
The maximum scanning rates of the DVM Assembly in the 3497A for ohms are the same as the maximum measurement rates for the DVM Assembly in dc volts. A more detailed discussion of system timing is included in General System Information on page 21.

AC VOLTAGE

3456A Digital Voltmeter with Option 010 20 Channel Relay Multiplexer Assembly

Range	Maximum Reading (5½ digits)	Resolution 6½ digits	5½ digits	4½ digits
1.0 V	1.19999 V	1 µV	10 µV	100 µV
10.0 V	11.9999 V	10 µV	100 µV	1 mV
100.0 V	119.999 V	100 µV	1 mV	10 mV
170.0 V	170.0 V	1 mV	100 mV	

Input Impedance:
3456A Input: 1 MΩ ±0.5%, shunted by < 90 pF
Direct Switched Through Relays: 1 MΩ shunted by < 400 pF
Tree Switched Through Relays: 1 MΩ shunted by < 500 pF*

Add 12 pF each for other relay cards. Add 170 pF for each 3498A Extender.

Maximum Input Voltage:
10^8V − Hz maximum
Between any two terminals: ± 170V peak
Between any terminal and chassis: ± 170V peak

Accuracy:
± (% of reading + number of counts)
Auto zero ON. Filter OFF. Tree-switched.
For inputs > 1% of full scale and inputs with DC components < 10% of AC components
90 days, 23°C ±5°C

Frequency Filter OFF	Filter ON	Number of Digits (Integration Time in Power Line Cycles, PLC) 6½ digits (1 PLC)	5½ digits (0.1 PLC)	4½ digits (0.01 PLC)
	20 − 30 Hz	.35 + 500	.36 + 53	.41 + 7
400 Hz − 20 kHz	30 Hz − 20 kHz	.07 + 700	.08 + 73	.13 + 9
20 kHz − 50 kHz	20 kHz − 50 kHz	.17 + 1700	.18 + 173	.23 + 19
50 kHz − 100 kHz		.55 + 2900	.56 + 293	.61 + 31

For > 90 days, add ± (.004% of reading + 12 counts)/month to 90 day accuracy. For inputs with DC components > 10% of AC component, add ± (0.05% of reading + 5 counts to accuracy.

Temperature Coefficient:
(0°C to 18°C to 50°C)
± (% of reading + number of counts)/°C

For Inputs With DC Components < 10% of AC Component

6 digits (1 PLC)	5 digits (0.1 PLC)	4 digits (0.01 PLC)
(0.008 + 60)	(0.008 + 6)	(0.008 + 6)

For Inputs With DC Components < 10% of AC Component

(0.008 + 120)	(0.008 + 12)	(0.008 + 1.2)

Converter Type:
True RMS responding

Crest Factor:
7:1 at Full Scale

Response Time:
First reading to 0.1% of step size when triggered on correct range coincident with step change.

TEMPERATURE PERFORMANCE

The temperature specifications apply to the 3054C system temperature measurements taken by one of the voltmeters with inputs switched by the 3497A. The voltmeters that may be used to measure temperature are the 3456A DVM or the optional DVM Assembly for the 3497A. Temperature performance is specified for a 2.2 kΩ thermistor, a 385Ω platinum RTD, and almost every thermocouple type.

Thermocouples

Reference Junction Compensation Accuracy:
(23°C ± 5): ± 0.3°C

Temperature Coefficient:
(0° to 18°C, 28° to 50°C): ± 0.03°C

Temperature Sensing Device Output:
100 mV/0; 2.5V @ 25°C

Thermocouple Types:
J, K, T, E, R, S, B, Nicrosil-Nisil (14 awg.), Nicrosil-Nisil (28 awg.)
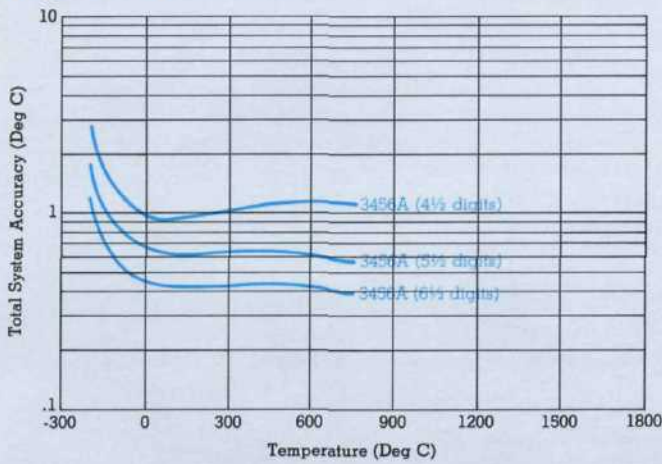
Accuracy:
The following graphs represent the total measurement accuracy specifications for the various thermocouple types. This accuracy includes the errors from reference junction compensation, temperature difference along terminals, thermal offset, voltage to temperature conversion error, and DVM accuracy. The voltage to temperature conversion for the appropriate thermocouples approximates the NBS 125 definition with eight third order polynomial equations that are continuous at the end points. The compensation type for these accuracies is either hardware or software compensation with the isothermal block at 23°C ±5°C.

Accuracies are given for the 3456A DVM and optional DVM Assembly for the 3497A. Different accuracy curves are given for the different speeds of the voltmeters. The optional multiplexing assembly that is specified for thermocouple measurements is the Relay Multiplexer Assembly with Thermocouple Compensation (Option 020).
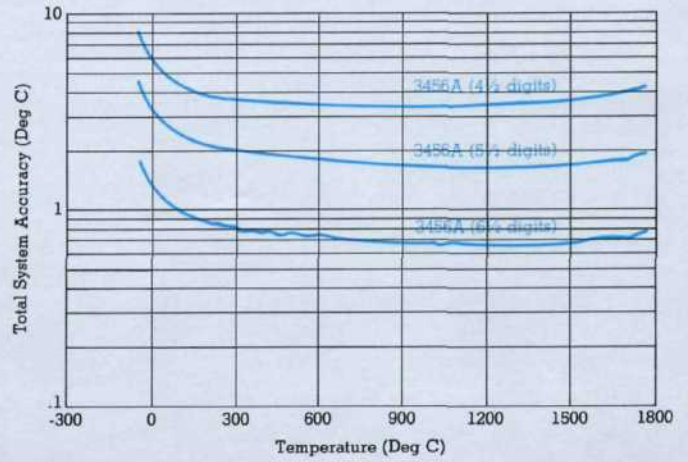
Measurement Speeds:
Measurement speeds for thermocouples, thermistors and RTD's are the same as the measurement speeds for dc volts and resistance. These speeds do not include the time necessary to convert the measured value to temperature. Conversion times are specified in the General System Information section.
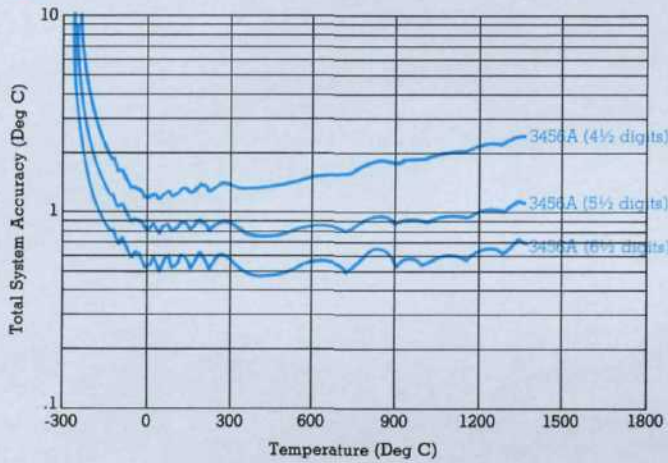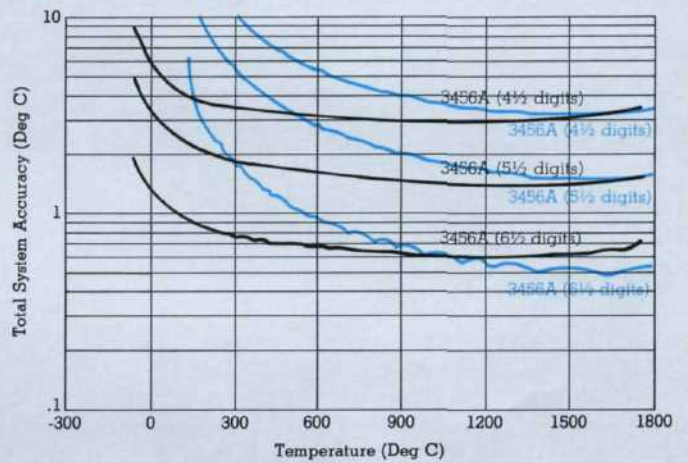
Type J "Iron-Constantan"

Total System Accuracy (Deg C) vs Temperature (Deg C)

3456A (4½ digits)
3456A (5½ digits)
3456A (6½ digits)

Type R "Platinum-Pt. 13% Rhodium"

Total System Accuracy (Deg C) vs Temperature (Deg C)

3456A (4½ digits)
3456A (5½ digits)
3456A (6½ digits)

Type K "Chromel-Alumel"

Total System Accuracy (Deg C) vs Temperature (Deg C)

3456A (4½ digits)
3456A (5½ digits)
3456A (6½ digits)

Type S "Platinum-Pt. 10% Rhodium"
Type B "Pt. 6% Rhodium-Pt. 30% Rhodium"

Total System Accuracy (Deg C) vs Temperature (Deg C)

3456A (4½ digits)
3456A (4½ digits)
3456A (5½ digits)
3456A (5½ digits)
3456A (6½ digits)
3456A (6½ digits)

Type E "Chromel-Constantan"
Type T "Copper-Constantan"

Total System Accuracy (Deg C) vs Temperature (Deg C)

3456A (4½ digits) — 3456A (4½ digits)
3456A (5½ digits) — 3456A (5½ digits)
3456A (6½ digits) — 3456A (6½ digits)

Nicrosil-Nisil (14 awg.)
Nicrosil-Nisil (28 awg.)

Total System Accuracy (Deg C) vs Temperature (Deg C)

3456A (4½ digits)
3456A (4½ digits)
3456A (5½ digits)
3456A (5½ digits)
3456A (6½ digits)
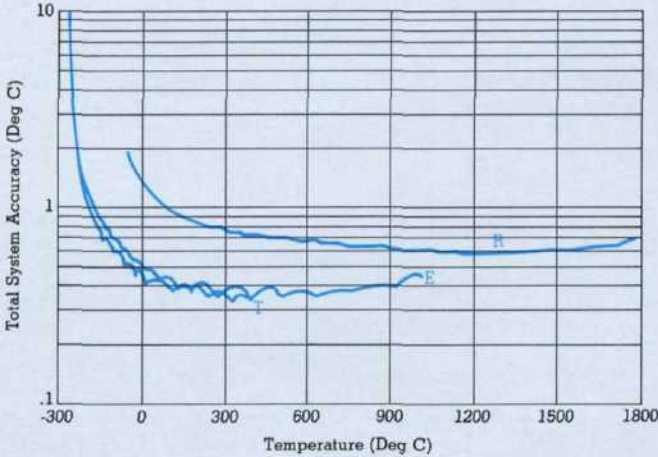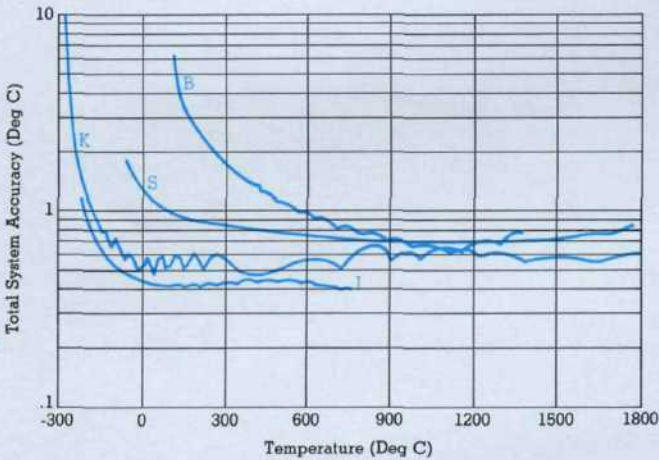3456A (6½ digits)
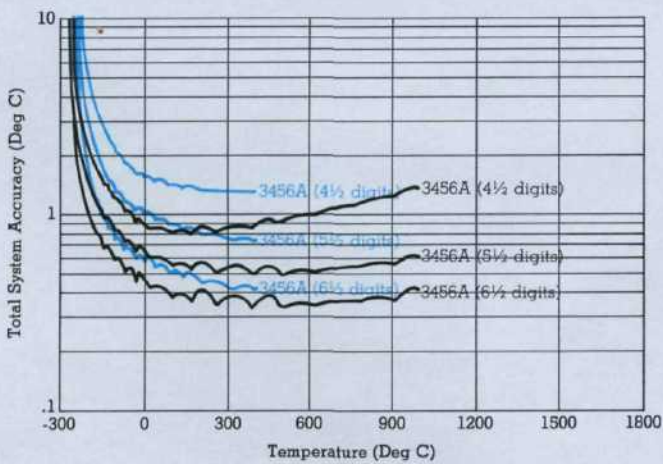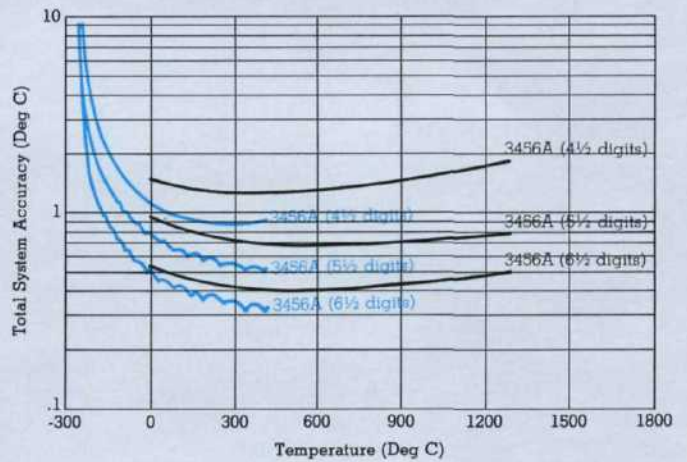
TEMPERATURE PERFORMANCE

DVM Assembly for 3497A (optional)

The DVM Assembly for the 3497A can be used to make thermocouple measurements. The following graphs are given for a 5½ digit measurement of various thermocouple types.
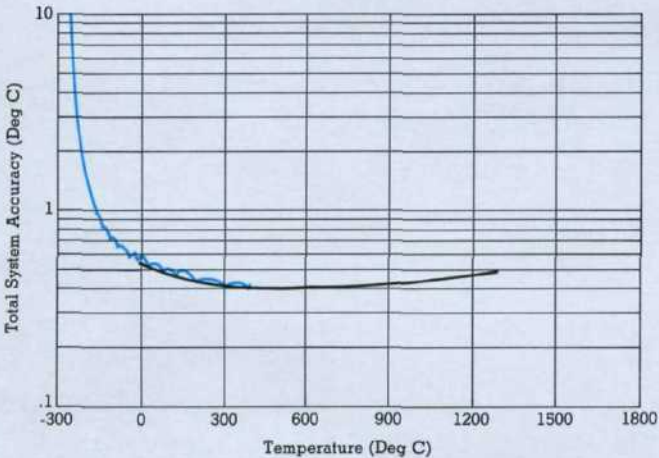
3497A (5½ digits)

3497A (5½ digits)

Nicrosil-Nisil (14 awg.)
Nicrosil-Nisil (28 awg.)

Thermistor

Type:

YSI 44004	YSI 44033
Omega 44004	Omega 44033
Fenwall UUA32J3	Fenwall UUA32J4

Interchangeability:

0.2°C	0.1°C
nominally, 2252 Ω at 25°C	

Range:
-50°C to +150°C

Accuracy:

The following graphs represent the accuracy of the 4-wire resistance measurement of the thermistor. The resistance to temperature conversion error is negligible since the equation is calculated from the specific points given by the manufacturers. Graphs are shown for various resolutions and voltmeters on two ranges.
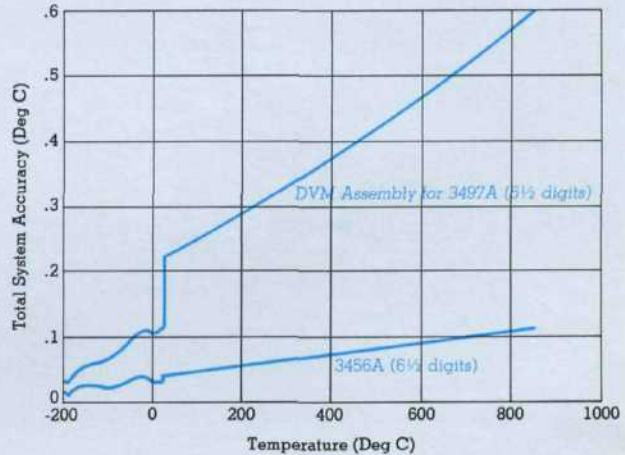

Platinum RTD

Type:
Platinum, $\alpha = 0.00385 \ \Omega/\Omega/°C$ 100 Ω at 0°C

Accuracy:

The following graphs represent the total measurement accuracy for a 4-wire resistance measurement of the RTD. This accuracy includes thermal offset, resistance to temperature conversion error, and DVM accuracy. Accuracies are given for the 3456A DVM with various resolutions and the optional DVM for the 3497A on two resistance ranges.
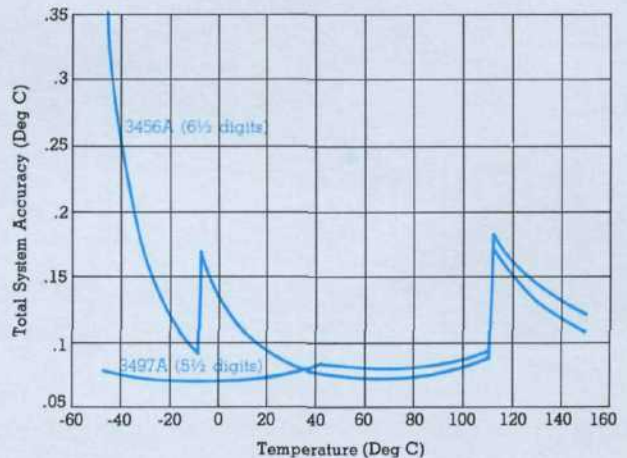
General System Information

Calculating System Timing

The times indicated below can be used as building blocks to determine general times required for a measurement. Actual times will vary depending on your program. Some guides to achieve best performance are:

1. Program the instrument configuration in advance.
2. Use only the number of digits required.
3. Turn displays and autozero off and measure on a fixed range.
4. Measure a burst of sequential points and convert them all at one time.
5. Use packed output.
6. Use voltmeter complete to externally trigger the DVM.
7. Use DMA for computer/instrument data transfers.

These times assume that the computer is not running any other programs and the computer is not interrupted during the measurement. Times are provided for the HP 1000 Models E and F only. Programs written using RTE-XL will have performance equal to that indicated for the 1000L.

Typical Operating Sequence

A typical measurement will have the following structure.
1. Set up the DVM or Scanner.
2. Close a channel.
3. Measure the signal.
4. Transfer the reading to the computer.
5. Unpack the reading.
6. Analysis of the reading.
7. Issue a control signal response.

Set Up DVM

This is the time required to program the voltmeter to a desired mode of operation plus the time to execute the command. Two times are given, one to program only a function and range, and the other to completely reprogram the voltmeter.

	Computer (in ms)	
Set Up DVM: (ms)	1000L	1000E/F
3456A		
Funct. and Range	17	17
Reprogram	63	76
3497A DVM (optional)		
Funct. and Range	24	21
Reprogram	91	93

Close a Channel

This is the time required to send channel programming data to the 3497A plus the time to execute the command.

Close Channel Times: (ms/Channel)

	Computer	
	1000L	1000E/F
Relay Assembly (Opt. 010, 020)	21	19
Actuator (Opt. 110)	28	20

The relay multiplexer assemblies may also be incremented between programmable start and stop points. These times are independent of the computer. (Note that the 3497A requires 200 ms to enable external increment).

Close Channel Times Using External Increment: (ms/channel)

Normal (AE1): 3 ms
Fast (AE2): 2 ms

Measure Time

This time is the time required by the voltmeter to make a DCV measurement. These times were taken on a fixed range with autozero, math, filter and display off.

3456A Measure Times: (ms per reading)

	Resolution					
	6½ Digits		5½ Digits		4½ Digits	
Line Frequency	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
	25	20.9	5.56	4.77	3.45	3.03

3497A DVM Measure Time: (ms/reading)

	Resolution					
	5½ Digits		4½ Digits		3½ Digits	
Line Frequency	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
	25	20	6.03	5.00	4.00	3.34

DVM Transfer Times:

The following times show the times to transfer a single or group of readings to the computer.

3456A Transfer Time: (ms/reading)

	Computer	
	1000L	1000E/F
Output Mode		
ASCII		
Multiple Readings into an array	18.1	12.1
Packed		
Multiple Readings into a buffer	6.1	6.3

3497A DVM Assembly (optional) Transfer Time: (ms/reading)

These times represent the time required to transfer a reading from the 3497A to the computer. The time to transfer a single ASCII reading is also equal to the digital input and counter transfer times.

	Computer	
	1000L	1000E/F
Output Mode		
ASCII		
Multiple Readings into an array	12.1	6.6
Packed		
Multiple Readings into a buffer	1.8	1.8

Unpack Times:

This is the time required by the computer to unpack packed data using the 3054C unpack routines.

Unpack Times: (ms/reading)

	Computer	
	1000L	1000E/F
DVM		
3456A	8.3	.27
3497A	8.4	.27

Conversion Times: (ms)

This is the time required by the computer to convert an unpacked 3456A or 3497A reading to temperature using the 3054C conversion routines.

	Computer	
	1000L	1000E/F
Thermocouple Conversion	20.8	.490
Thermistor Conversion	30.8	.550
RTD Conversion	22.6	.640

Control Output

This is the time to program either an actuator closure or to program the D/A's. It includes relay closure time for the actuators and settling time on the D/A's.

Actuator (Opt. 110)	28	ms
Voltage D/A (Opt. 120) (to within ±1 mV of final value)	100	ms
Current D/A (Opt. 130) (to within ±3 µA of final value)	100	ms

General Information

Field Installation Kits:

Option	Description	Field Installation Kit
010	20 Channel Low Thermal Relay Assembly	44421A
020	20 Channel Relay Assembly with *Thermocouple Compensation*	44422A
050	16 Channel Digital Input/Interrupt Assembly	44425A
060	100 kHz, Reciprocal Counter	44426A
110	16 Channel Actuator Digital Output Assembly	44428A
120	Dual Output 0 to ±10 V D/A Converter	44429A
130	Dual Output 0−20/4−20 mA Current D/A Converter	44430A
280	DVM Assembly for 3497A	44420A
	3054C Software Package (supplied with the 3054C)	44454A w/opt. 020, 041

Accessories:

Description	HP Part Number
Terminal connectors for:	
20 Channel Relay Multiplexer Assembly (Option 010)	03497-69542
Relay Multiplexer Assembly with Thermocouple Compensation (Option 020)	03497-69540
16 Channel Digital Input/Interrupt Assembly (Option 050)	03497-69543
16 Channel Actuator/Digital Output Assembly (Option 110)	03497-69544

Weight:

	Net Weight kg. (lbs.)	Shipping Weight kg. (lbs.)
3497A	20.4 (45)	26.3 (58)
3498A	20.4 (45)	26.3 (58)
3456A	11.5 (23)	13.4 (29)
16" Case	18 (40)	32 (70)
30" Rack	67 (150)	100 (225)
2621A		16.1 (35)
2645/48		22.7 (50)
2103L		14.1 (31)
2145		134 (294)
2146		160 (331)

Dimensions

	height mm. (in.)	width mm. (in.)	depth mm. (in.)	Power	Operating Range
3497A	190.5 (7.5)	428.5 (16.875)	520.7 (20.5)	150	0−50°C,
3498A	190.5 (7.5)	428.5 (16.875)	520.7 (20.5)	150	−95% R.H. at 40°C
3456A	89.0 (3.5)	425.5 (16.75)	527.0 (20.75)	60	
2176/77D	106 (42)	238 (94)	78.7 (31)	1745W	
2621A	44 (17)	38 (15)	66.5 (26.2)	50W	
2645/48	34.3 (13)	44.5 (18)	64.8 (26)	140W	10−40°C,
2103L	13.3 (5.3)	48.3 (19)	59.7 (23.5)	500W	80% R.H. at 25.5°C
2145/46A	158 (62)	73.4 (29)	81.3 (32)	2200W	
2145/46B	92.7 (37)	73.4 (29)	81.3 (32)	1650W	
30" Rack	909.6 (36)	621.6 (24.6)	808.6 (32)		
16" Case	423.2 (16.75)	499.0 (19.75)	636.7 (25.2)		
44530A Desk	770.6 (30.5)	1263 (50)	701.2 (27.75)		

Ordering Information

3054C/Option No.	Description	Quantity	Total Price
BASIC 3054C SYSTEM **Consisting of:**	Automatic Data Acquisition/Control System	_____	_____
Instruments:	3497A Data Acquisition/Control Unit 3456A Digital Voltmeter		
Rack:	30" Cabinet and Rack Mounting		
Software:	System Documentation and Software		
Installation:	Standard		
Ordering Information:	Select 3497A plug-in assemblies from options 010 through 130. Each 3497A can hold 5 plug-in assemblies. For more than 5 assemblies, add 3498A Extenders as needed. Each 3498A can hold up to 10 additional assemblies.		
	Select desired date format from Options 230 and 231.		
	Select power line frequency and voltage from Options 315 through 346.		
	Select software media from Option 851 or 852.		
	Order one of the computer configurations described on pages 9 or 10.		

SYSTEM OPTIONS

Analog Input Assemblies

010	20 Channel Relay Multiplexer Assembly	_____	_____
020	Relay Multiplexer Assembly with Thermocouple Compensation	_____	_____
	Must specify one of the following no-charge suboptions for each assembly ordered:		
	Suboptions:		
	A20 software compensation	N/C	_____ _____
	B20 hardware compensation for type B thermocouples	N/C	_____ _____
	E20 hardware compensation for type E thermocouples	N/C	_____ _____
	J20 hardware compensation for type J thermocouples	N/C	_____ _____
	K20 hardware compensation for type K thermocouples	N/C	_____ _____
	R20 hardware compensation for type R thermocouples	N/C	_____ _____
	S20 hardware compensation for type S thermocouples	N/C	_____ _____
	T20 hardware compensation for type T thermocouples	N/C	_____ _____

Digital Input Assemblies for the 3497A

050	16 Channel, Isolated, Digital Input/Interrupt Assembly	_____	_____
060	100 kHz, Reciprocal Counter Assembly	_____	_____

Output Assemblies

110	16 Channel Actuator/Digital Output Assembly	_____	_____
120	Dual Output 0 to ± 10 V D/A Converter Assembly	_____	_____
130	Dual Output 0-20/4-20 mA Current D/A Converter Assembly	_____	_____

Ordering Information

Data Acquisition/1000...

Precise Data Acquisition With the Power of an HP 1000 Computer.