HP 2250 Measurement and Control Processor

HEWLETT PACKARD

An intelligent analog/digital subsystem for automation applications

Technical Data

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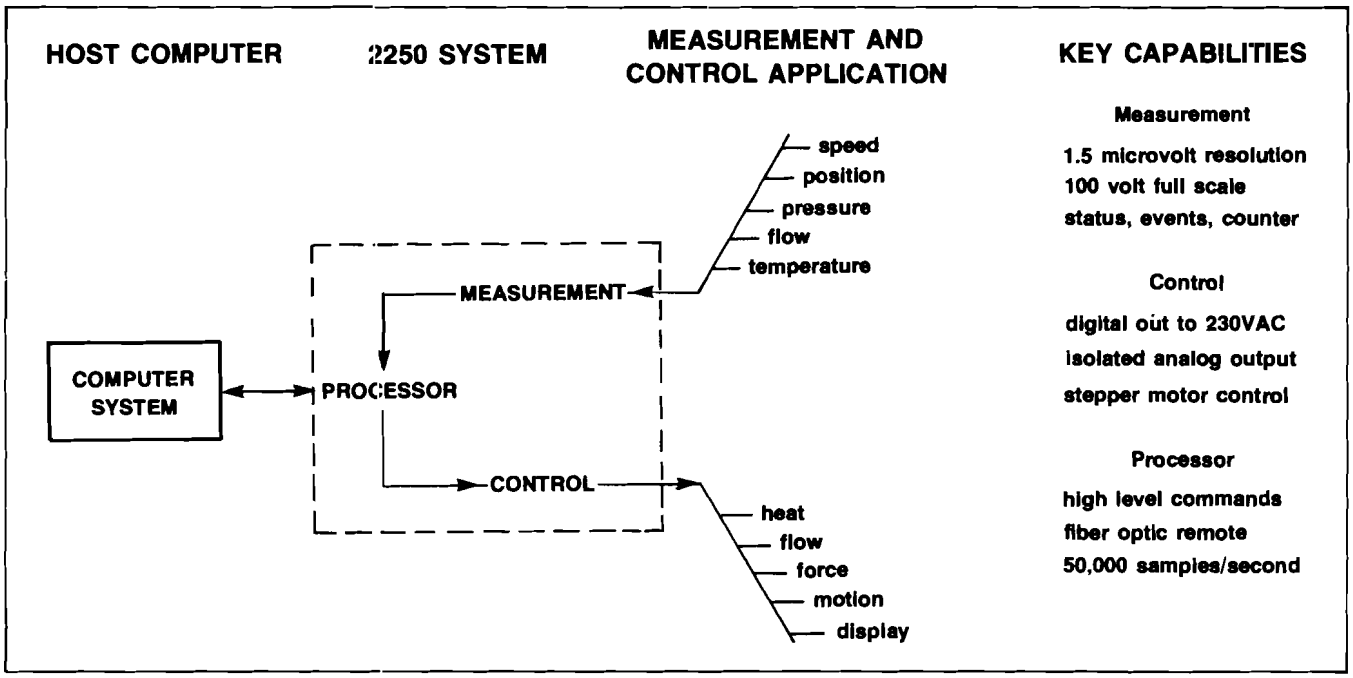
THE 2250 MEASUREMENT AND CONTROL PROCESSOR IS A KEY PART OF HEWLETT-PACKARD'S AUTOMATION SYSTEM SOLUTIONS FOR MONITORING AND CONTROL OF EXPERIMENTS, MACHINES AND PROCESSES

THE 2250 CONCEPT



Automation is one of the last keys to breaking through the productivity barrier. With automation, the maximum benefit of time and resources can be gained.

However, automation has been a complex task with the existing tools, often drawn from multiple vendors. For flexible automation, where a complete solution cannot be bought off-the-shelf, a great deal of expertise has been required in electronics and programming. These skills are generally not a natural part of the user's technology, and are also in great demand. The resulting high installed cost and scarcity of skills has limited the amount of automation in use today.

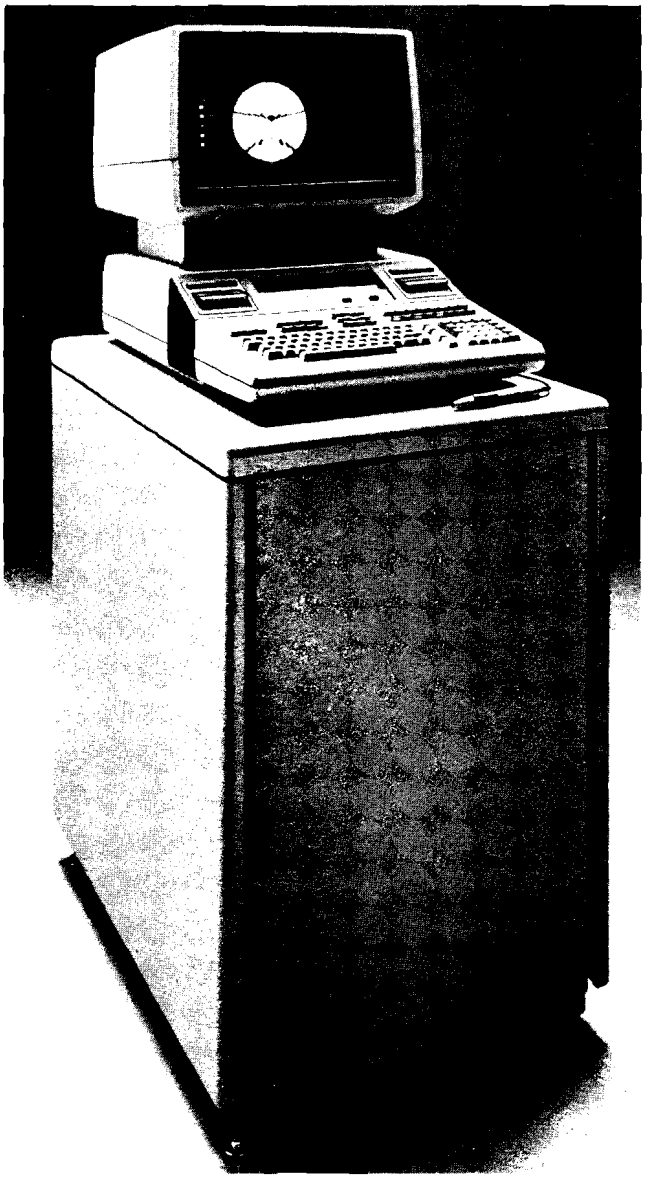
The 2250 has been designed as a system to meet these realities, attacking both the direct and implicit costs of automation in industry. It takes the sensors and actuators appropriate to your application and connects them to your choice of computer systems with solid measurement performance, end-to-end specifications and world-wide Hewlett-Packard support. The 2250 allows many demanding automation tasks to be written in the high-level computer languages preferred by industry today.

Because this solution builds on your technology, your valuable expertise is focused on optimizing the application, rather than details of implementation. We offer a partnership between the automation engineer, and Hewlett-Packard measurement and computation technology.

While the 2250 allows many applications to be approached in a very straightforward fashion, some demand extra performance in a particular area. That extra capability is accessable when needed. This Data Book covers both points of view, starting with an overview of the 2250 family and ending with detailed data sheets on all of the members.

PACKAGING TO FIT YOUR ENVIRONMENT

The 2250 can be installed on your site ready for connection to field wiring in one of these configurations:

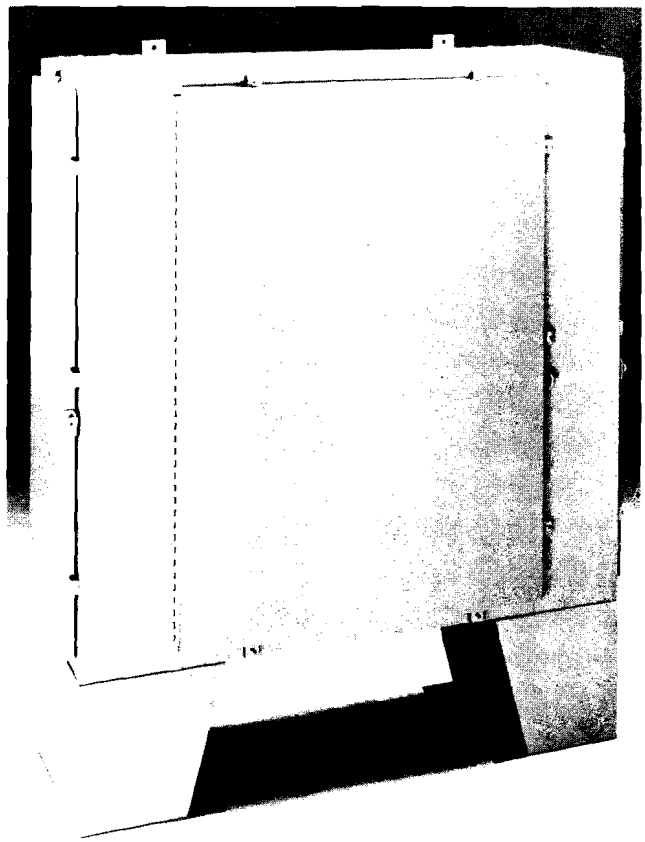


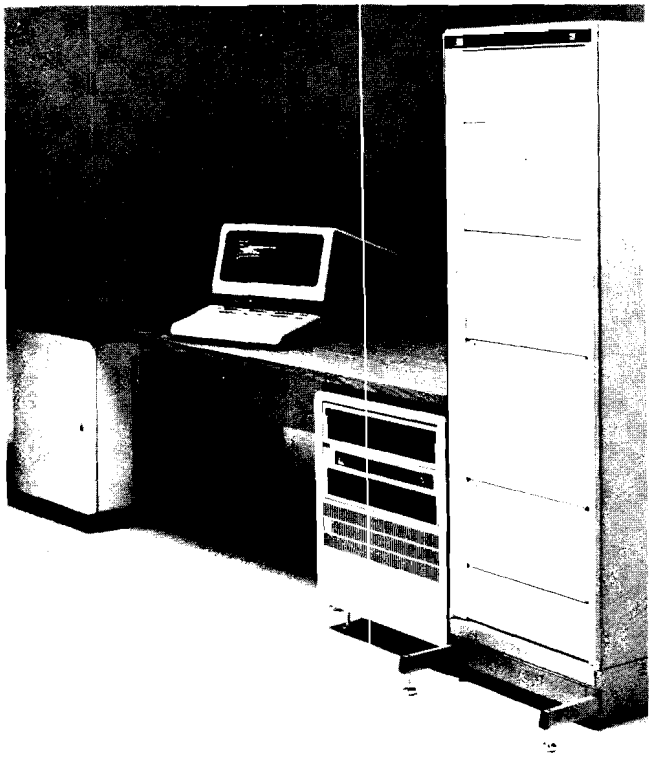
2250M — 30" racked system for smaller test and control applications requiring up to 256 measurement points. Field wiring terminations can be installed permanently or cable harnesses may be connected temporarily for roll-around use.

The 2250M will either use an HP 1000 or a Desktop Computer (shown). The Desktop is particularly suited to situations where technical users are developing their own test and analysis software in Basic and MCL/50.

2250N — Industrial cabinet suitable for manufacturing or outdoor installations. The sealed steel enclosure meets NEMA-12 specifications for protection against contaminants. No air conditioner is required, minimizing maintenance. Access to electronics is through the front door and access to field wiring terminations is through the side doors. All wiring leaves the cabinet via conduit.

The 2250N allows two system configurations: remote connection to an HP 1000 or Desktop Computer via coax or fiber optic cables, or as a DS/1000 node by installing an HP 1000 board computer inside the NEMA cabinet.





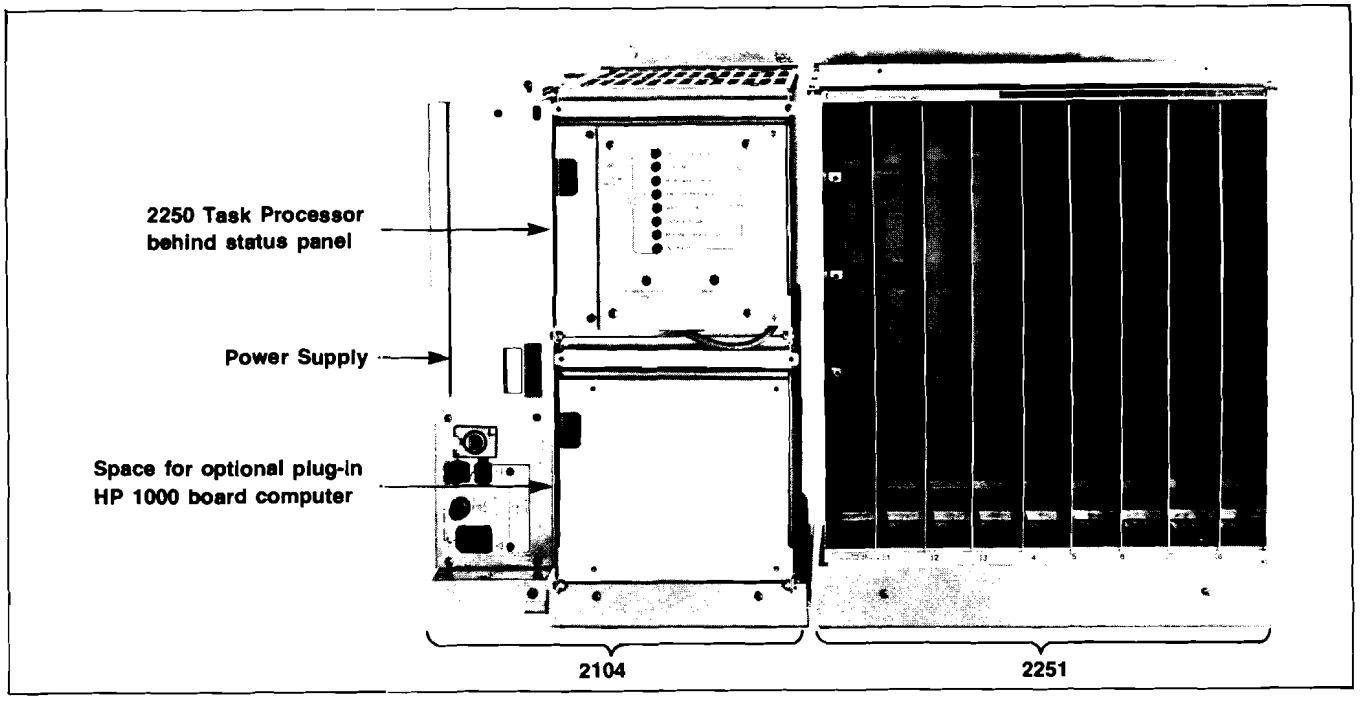
2250R — 56" racked system (at right, shown with HP 1000 Model 45 computer system) including terminations for field wiring. Can be expanded to 2048 points for application in lab facilities, complex product tests or supervisory control.

The 2250R is normally connected to a sophisticated HP 1000 Computer System, capable of graphics, signal analysis and data base management for multiple users. The system may also be part of a distributed network.

OR PACKAGE IT YOURSELF . . . . . .

If the cabinet configurations above do not meet your needs directly, you can purchase the components for mounting on your panels or 19" racks. These can include sealed industrial cabinets, as long as the internal airflow and external surface area requirements are met.

2250 COMPONENTS

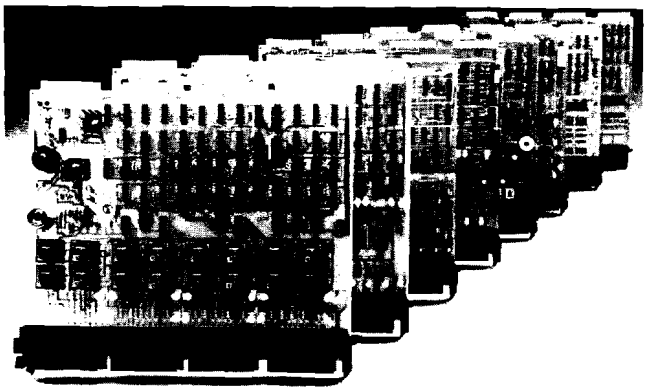


The 2104A Processor Unit has a 4 card microcomputer to run MCL/50 and down-loaded Fortran tasks: a CPU, a ROM/RAM memory card, an HP-IB interface and an interface to the 2250 Function card backplane.

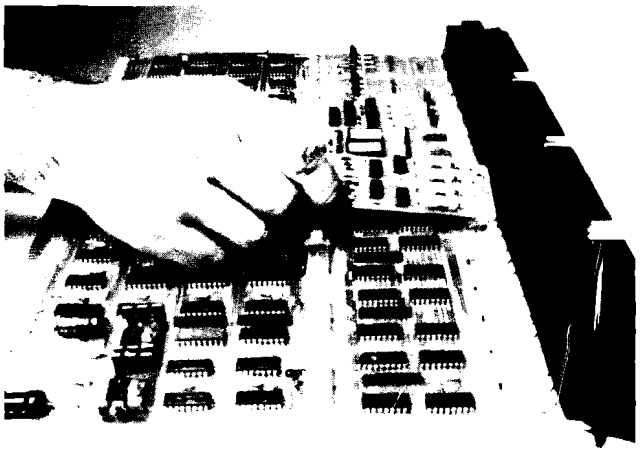
Dedicating a processor to the real world tasks assures response and simplifies system design. It also allows rapid fault diagnosis in remoted 2250s.

The 2251 Measurement and Control Unit (MCU) has space for 8 Function Cards, and up to 8 MCUs can be chained off of one 2104A Processor.

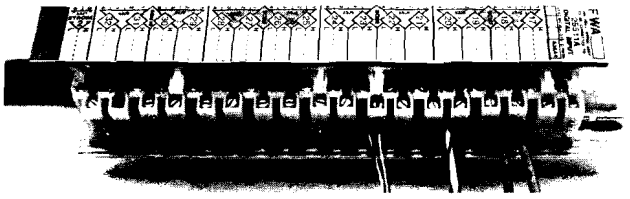
Power is distributed to the MCU at 25KHz, then transformer coupled and regulated at the load for maximum isolation of functions. Additional supplies can be added as required in large configurations.



The Function Card family provides the measurement and control functions: analog or digital, input or output. Each card handles up to 32 channels of data, where a channel is one analog signal or one digital bit.



Signal Conditioning Modules (SCM) provide the final conversion of electrical levels to match your sensors and actuators. They plug onto the Function Cards in channel groups, and provide filtering, isolation, and voltage level conversion as needed.

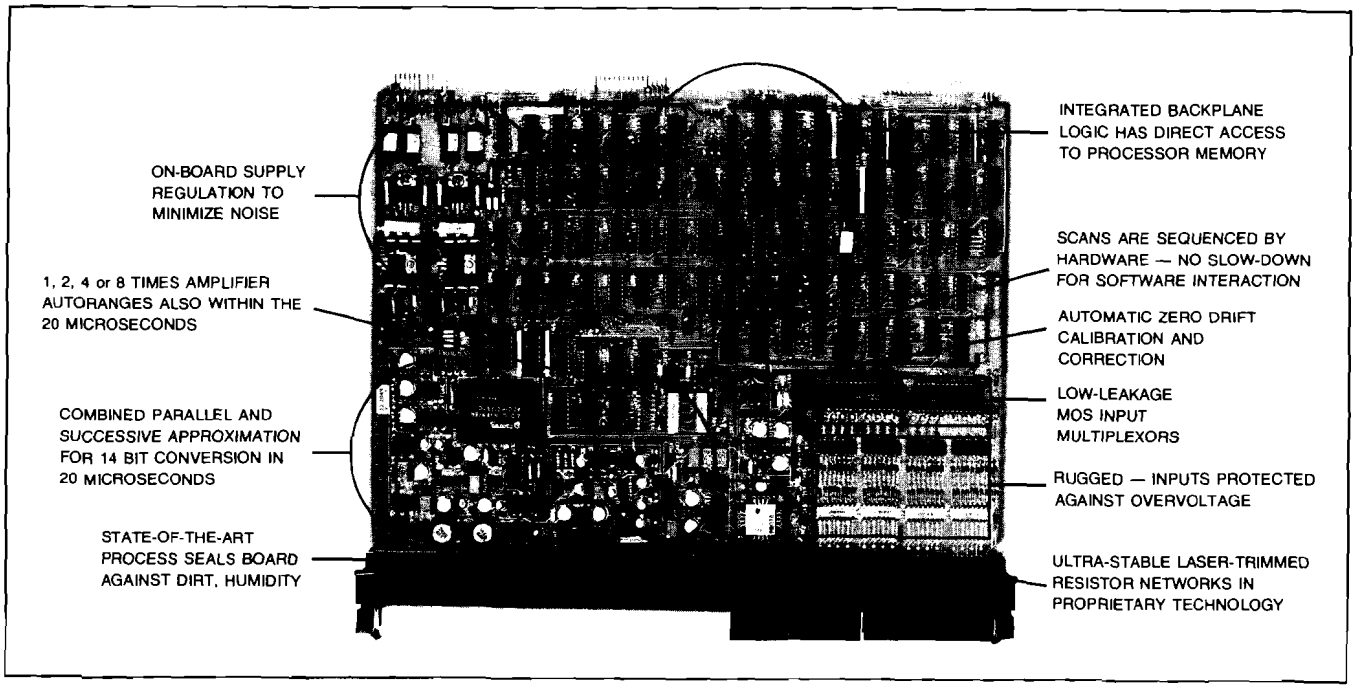


Cable harnesses connect the Function Cards to the Field Wiring Terminations. Several types are available to fit the specific needs of analog signals, digital signals or thermocouples.

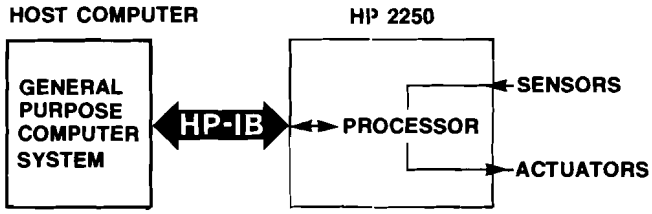
The 25501A analog-to-digital converter best illustrates the kind of technology and quality built into all of the 2250 cards. It provides fast, accurate, quiet data you can trust . . . . . .

Since the accuracy is comparable to the resolution, you can use all of the bits. And all parameters are specified over the full temperature range, including leakage-dependent parameters like crosstalk. Most of the time, the 2250 errors will be negligible compared to the sensors or control objectives, so complex error analysis will not take your time. The speed can be used in many ways: averaging to suppress external noise optimally for any source frequency, quick logging of failure events, watching noise signatures of flows, rotating machinery to warn of potential failure, or increasing productivity by reducing loop times.

HOW IS IT DONE? A combination of technology, creative circuit design and attention to details . . . . . .



The 2250 has an LSI microcomputer built-in, dedicated to measurement and control tasks. This architecture takes advantage of the declining cost of computational horsepower to simplify system implementation, making the automation engineer himself more productive . . . . .



Data moves between the computer and 2250 over the HP-IB at up to 1 Mbyte locally or 50 Kbyte over a I Km Fiber Optic cable. The HP-IB is an implementation of the IEE-488 International Interface Standard.

TASKS AND RESULTS — The computer sends one or more TASKS to the 2250 processor for execution and reads any RESULT data back. Because the detailed tasks run within the 2250, they do not depend on the timing of the host computer, nor do they impose a load upon it. Predicting how long a 2250 Task will take to execute is straightforward. Designing an automation solution is simplified, and the software on installed systems will be easier to maintain.

MCL/50 — Tasks are written in Measurement and Control Language, a set of high-level commands optimized to describe these operations. MCL/50 is a natural compliment to high-level languages optimized for computation, such as FORTRAN or BASIC, and to applications packages for graphics or signal analysis.

The MCL/50 Task is sent to the 2250 with WRITE or PRINT statements. The 2250 checks for errors and compacts the Task into a form that can be executed quickly. After execution and conversion to engineering units, the RESULTS are returned to the computer by an INPUT or READ statement.

Commands execute at high-speed, taking only a few milliseconds each. Thus it is practical to write many automation applications entirely in high-level languages while achieving performance previously available only to machinelanguage programming experts. The issue is system performance — a fast sample rate which cannot be analyzed or stored at the same rate is wasted.

DATA ACQUISITION MADE EASY — all automation solutions begin by acquiring information. The 2250 makes this a breeze:

`CLB(1); AON(1)`	calibrate and enable autoranging on the A/D in slot 1.
`PACE (0, 100)`	set the hardware pacing timer to 100 milliseconds
`REPEAT (250)`	do the measurement scan below 250 times
`WPACE`	wait for the pacing pulse enabled above
`AI (1,1,50)`	read 50 successive Analog Inputs, starting with slot 1, channel 1 and crossing cards as needed.
`NEXT!`	repeat until 250 scans completed

The readings will be converted to millivolts, corrected by zero offset errors and autoranged gain used. They will be accumulated in the 18 Kbytes of user memory in the 2250, then transferred at full HP-IB rate to the computer when done.

By adding a few MCL/50 statements, the 2250 memory can be divided into two blocks. Measurement data can be collected in one while the other is being transferred to the computer, alternating for continuous operation. The Automation Library contains utilities to move data out of the 2250 through an HP 1000 System to disc memory at the full 50,000 samples per second analog to digital conversion rate.

MCL/50 MAKES THE 2250 MORE THAN JUST A "FRONT-END" . . . . . .

Real applications generally need decision making and control added to the data acquisition task, a growth path which the 2250 makes easy. Lab experiments have parameters to set; manufacturing applications require optimization and control. Both must deal with fault conditions. Let's work through a realistic example, using a simple 2250 configuration:

card slot 1	16 high-level analog inputs
2	15 thermocouples and their isothermal reference
3	4 isolated 4-20 MA. current loop outputs
4	32 digital status inputs
5	32 digital outputs

First, let's define a free-running monitoring task:

```
TASK (1)                          name it Task 1.
DIMENSION (10, 1, 30)             define 10 variables and one 30 word buffer
B1 CLB(1); AON(1)                 calibrate and enable autorange on the A/D
RANGE (2,11,7) 50,50              set upper limits for the thermocouple inputs
  50,50,50,1000,100               at 50 mV, the isothermal reference sense at 1 volt as recommended in the 2250
                                  User's Manual, and set the millivolt signal on channel 17 to 100 mV.
REPEAT(0)                         Repeat the scans below forever
REWIND (B1); IN(B1)               prepare the buffer B1 to accept the data
REF (2,16)                        have the 2250 update its isothermal temperature
AI (1,5,9) (2,17)                 read 9 channels beginning slot 1, channel 5, plus the millivolt signal on slot 2,
                                  channel 17
JTEMP(2,11,4); KTEMP(2,15)        read 4 J thermocouples and one K-type in degrees C.
FI (4,1,2)                        read 2 fields of 16 digital inputs from slot 4.
RELEASE (B1, A)                   send the data in B1 to the computer via port A
CTIMER; PTIMER(0,15)              set hardware timer to wait 15 seconds, freeing processor for other activities
NEXT!                             go back for the next scan
```

Once the task is started, it will send the latest readings to the computer every 15 seconds until reset. The timing is controlled by the 2250 hardware clocks, and you have complete control over the timing of tasks because the processor is dedicated.

UPDATED OUTPUTS WHILE TASK IS RUNNING

If this were a supervisory control application or an experiment needing periodic parameter updates, the computer could send new output values through the 2250 without disturbing the monitoring task. For example, it could update one of the current loops by sending the following:

```
CO(5,1) 11200 !   set the first current output to
                  11.2 mA
```

It would also be possible to let other activities have access to the 2250, perhaps to control another process or to evaluate new algorithms for this one. Multiple tasks can be resident in the 2250 at any time, taking turns on execution.

EXECUTE FORTRAN ROUTINES WITHIN THE 2250

MCL/50 has logical and arithmetic capability which can be used to express simple decision or control algorithms local to the processor. However, a much more general approach is to write the algorithms in FORTRAN on a HP 1000 system and use a utility in the Automation Library to load that subroutine into the 2250's memory. These routines can do a number of useful things, such as sophisticated signal averaging, engineering unit conversions, complex limit tests, or control loop closure. In the previous example, if the computation which resulted in the 11.2 mA output setting were turned into a subroutine named CNTL, it could be connected to the MCL/50 task by inserting two statements, as shown:

```
TASK (1)                          name it Task 1.
DIMENSION (10, 1, 30)             define 10 variables and one 30 word buffer B1
CLB(1); AON(1)                    calibrate and enable autorange on the A/D
RANGE (2,11,7) 50,50              set upper limits for the thermocouple inputs
  50,50,50,1000,100               at 50 mV, the isothermal reference sense at 1 volt as recommended in the 2250
                                  User's Manual, and set the millivolt signal on channel 17 to 100 mV.
REPEAT(0)                         Repeat the scans below forever
REWIND (B1); IN(B1)               prepare the buffer B1 to accept the data
REF (2,16)                        have the 2250 update its isothermal temperature
AI (1,5,9) (2,17)                 read 9 channels beginning slot 1, channel 5, plus the millivolt signal on slot 2,
                                  channel 17
JTEMP(2,11,4); KTEMP(2,15)        read 4 J thermocouples and one K-type in degrees C.
CALL CNTL (B1,V1)                 give the subroutine the data in B1
CO (5,1) V1                       and output the newly computed V1
FI (4,1,2)                        read 2 fields of 16 digital inputs from slot 4.
RELEASE (B1, A)                   send the data in B1 to the computer via port A
CTIMER; PTIMER(0,15)              set hardware timer to wait 15 seconds, freeing processor for other activities
NEXT!                             go back for the next scan
```

EVENT INITIATED TASKS

The 2250 can also respond quickly to unusual events: digital events, counter reaching a preset value, limits exceeded, loss of computer service, power failure or errors. It can selectively notify the computer via HP-IB service request or initiate a local service Task.

If our system were controlling a process which could cause damage if temperature control is lost, there would be simple, manual safety devices in place to limit the damage. However, it might be possible to reduce the cost of repair substantially if a shutdown procedure were followed to clear out the material in process. This could be a suitable 2250 task — an orderly procedure to be attempted between the loss of primary control and activation of the ultimate safety devices. In our example, loss of control might be sensed either by a particular digital input or by one of the thermocouples:

```
TASK (1)                          name it Task 1.
DIMENSION (10, 1, 30)             define 10 variables and one 30 word buffer B1
INTERRUPT(1,7)1; ITASK(1,7,2)     enable channel 7 of the digital input to interrupt and have it initiate Task 2
CLB(1); AON(1)                    calibrate and enable autorange on the A/D
RANGE (2,11,7) 50,50              set upper limits for the thermocouple inputs
  50,50,50,1000,100               at 50 mV, the isothermal reference sense at 1 volt as recommended in the 2250
                                  User's Manual, and set the millivolt signal on channel 17 to 100 mV.
REPEAT(0)                         Repeat the scans below forever
REWIND (B1); IN(B1)               prepare the buffer B1 to accept the data
REF (2,16)                        have the 2250 update its isothermal temperature
AI (1,5,9) (2,17)                 read 9 channels beginning slot 1, channel 5, plus the millivolt signal on slot 2,
                                  channel
JTEMP(2,11,4); KTEMP(2,15)        Read 4 J thermocouples and one K-type in degrees C.
IF B1(10) 800 GOSUB(2) ENDIF      if temperature exceeds 800 degrees, execute Task 2
FI (4,1,2)                        read 2 fields of 16 digital inputs from slot
RELEASE (B1, A)                   send the data in B1 to the computer via port
CTIMER; PTIMER(0,15)              set hardware timer to wait 15 seconds, freein processor for other activities
NEXT!                             go back for the next scan
```

TASK 2, as called by ITASK

```
TASK (2)                          define the shutdown task
CO(5,1)0; DO(3,1,2) 1,1           start the shutdown by zeroing current and setting the first two digital outputs to 1
WNOW(0,45); DO(3,1,4)0,0,1,1      wait 45 seconds and complete the shutdown
SRQ(2) !                          send the HP-IB request service message to the computer
```

It is often useful to record the sequence of events following the detection of a fault because it can aid in the repair process. Or in the case of product test or pilot plant experimental runs, the logging of failure data could be highly significant. Often these failure logs must be recorded at rates much faster than the normal monitoring - a case where the 2250's local response and high speed data acquisition capability can pay dividends.

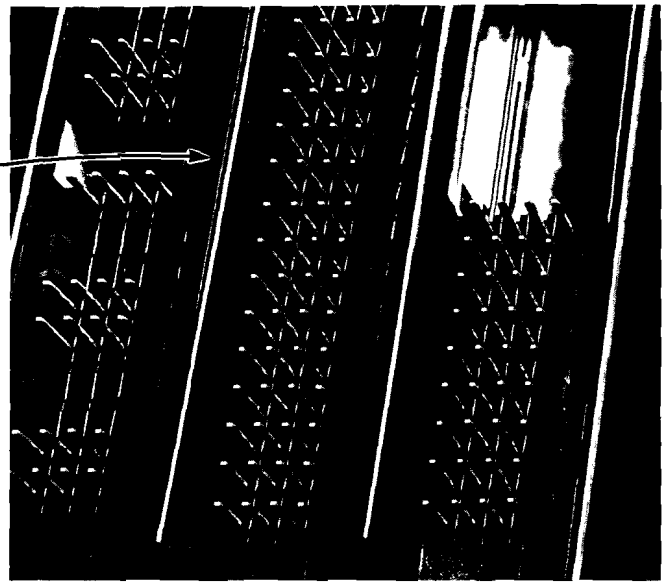
Another class of fault is having the computer go off-line for some reason, leaving the 2250 without supervisory control or a place to send its data. When this is detected, a backup Task can be in place to accumulate data internally or provide some control until the computer comes back on-line.

OPTIONAL PLUG-IN HP 1000 BOARD COMPUTER

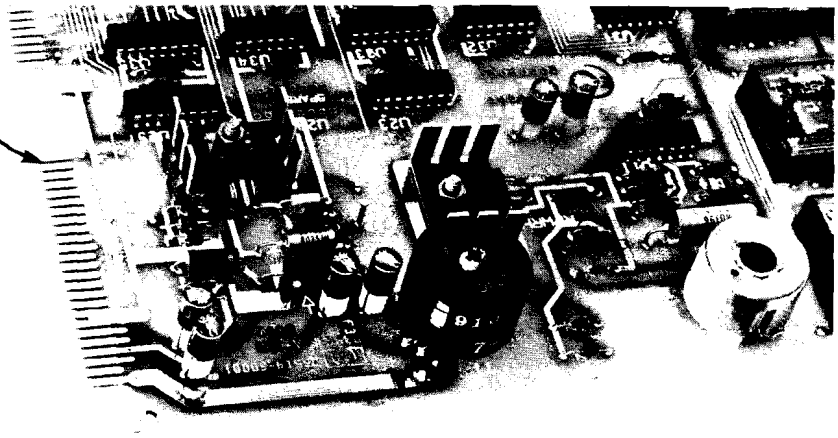
When the general-purpose computer is an L-Series HP1000, it is possible to install the processor board set within the 2250 card cage. Then you have a complete automation system in one package - rack or NEMA - and can connect peripherals, maintain Data Bases or participate in the Distributed Systems Network.

DESIGNED AS A SYSTEM FROM FIELD WIRING TERMINATIONS TO COMPUTER

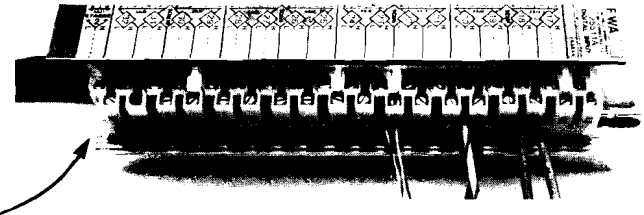
You get flexibility without compromising service, safety or performance!

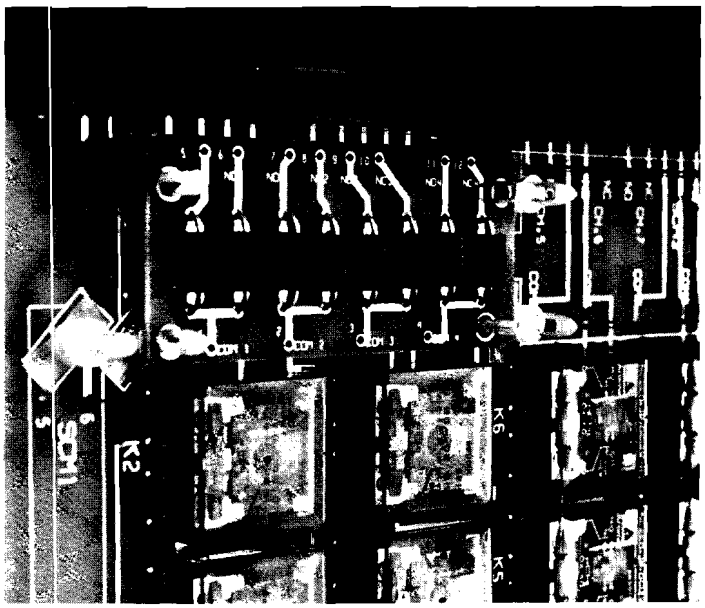


SHIELDS BETWEEN CARDS AND ISOLATED POWER SUPPLIES ALLOW ANALOG AND DIGITAL FUNCTIONS TO WORK SIDE-BY-SIDE AT FULL ACCURACY.

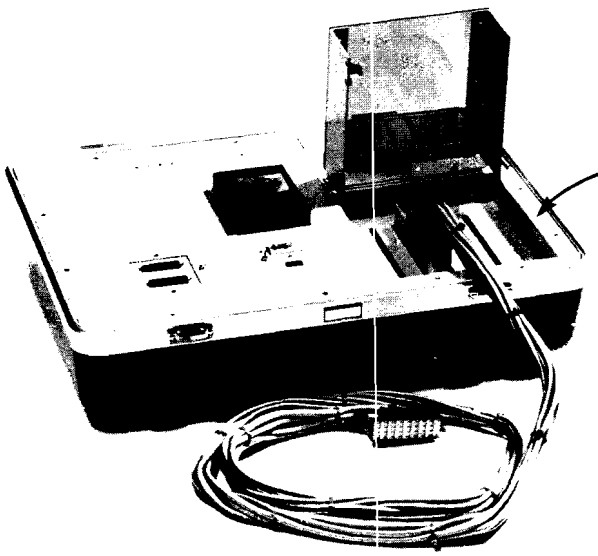


WIRE IS SIMPLY STRIPPED AND INSERTED INTO THE FIELD WIRING BLOCKS. LABELS ARE PROVIDED TO IDENTIFY THE POINTS. DISPLAY LAMPS FOR DIGITAL STATUS OR CURRENT LOOP TERMINATION RESISTORS ARE OPTIONAL.





PLUG-ON SIGNAL CONDITIONING MODULES CONFIGURE THE VOLTAGE LEVELS AND FILTER CHARACTERISTICS. THEY ARE HELD BY NYLON STANDOFFS AND HAVE GOLD-TO-GOLD GAS TIGHT CONTACTS. BECAUSE THE FUNCTION CARD HAS NO SOLDERED-IN JUMPERS OR COMPONENTS, IT CAN BE SERVICED BY BOARD EXCHANGE.



DIAGNOSTIC UNIT IDENTIFIES THE BOARD FROM A RESISTOR VALUE AND THEN TESTS IT FROM THE CARD EDGE USING THE 2250 PROCESSOR. FAULTY BOARDS ARE QUICKLY IDENTIFIED WITH A MINIMUM OF EXPERTISE OR EQUIPMENT.

REPAIR IS SIMPLE: REMOVE THE BOARD, MOVE ITS SIGNAL CONDITIONING TO AN EXCHANGE BOARD, INSTALL THE NEW BOARD AND GO! YOU HAVE MINIMUM DOWNTIME AT MINIMUM COST WHETHER YOU USE HP'S ON-SITE SERVICE OR DO IT YOURSELF.

MEASUREMENT

	A/D 25501A	MULTIPLEXORS 22502	25503	25504
NUMBER OF DIFFERENTIAL INPUTS	**16**	**32**	**32**	**16**
Input Signals	High level voltages or current loop sensing from transmitters, sensors or equipment.			
			Thermocouples or other millivolt sensors	
Voltage Range MIN	1.25V	1.25V	12.5 mV	12.5 mV
MAX	10V	10V	10V	100V
Scan Rate (Samples/sec)	50,000	50,000	20,000	1,000
Environment	Good grounding with minimum electrical interference			Poor grounds, sensors at line voltage
Common Mode Voltage	10V	10	10	300
Inputs Protected to	50V	50	50	350
Signal Conditioning Modules	No	Yes	Yes	No

	DIGITAL INPUT 25511	MULTIFUNCTION 25516	COUNTER 25512
NUMBER OF CHANNELS	**32**	**16**	**4 A/B PAIRS**
Input Signals	Switches, Actuator Monitoring, Logic Levels		
			Tachometers, Flowmeters, . . .
Status Inputs	Yes	Yes	No
Event Sense Prescale Range	1	to 256	to 32767
Totalize Range	N/A	to 256	to $2x10^9$ or $\pm$ 32767
Frequency	N/A	N/A	to 500 kHz
Period	N/A	N/A	2 s to 32 min
Input Ranges with Optional Contact Debounce Filters	Isolated 5-120 VDC or 16-230 VAC non-ioslated 5-48 VDC contact sense		

NOTES: Voltage ranges and filter characteristics are set by plug-on signal conditioning modules (SCM's). These are optional for some cards and required for signal continuity on others. See the card and SCM data sheets for details.

The charts describe the functions implemented in hardware. It is sometimes possible to implement similar operations using simple cards with MCL/50 commands, such as pulsing a digital output.

Virtually all of the functions are set programmably through MCL/50. A few cards have mode switches to set, and these will be noted on their data sheets. In no case are soldered jumpers required.

CONTROL

ANALOG OUTPUT: 12 bits, ±10 volts or 0-20 mA, all 4 channels isolated from each other and ground.

	DIGITAL OUT 25513	MULTIFUNCTION 25516	RELAY 25514	PULSE 25515
Number Of Channels	32 DC 16 AC	16 DC 8 AC	16 NO/NC pairs	4 A/B pairs 8 limits in
For Control Of	Valves, Solenoids, Logic Levels			
	Lamps, Displays			Stepper Motors, Setpoints
Output Ranges	to 60 VDC or 42 VAC with optional pullup and isolation or 120 VAC isolated		to 230 VAC or 30 VDC with arc suppression	to 60 VDC with pullup and isolation

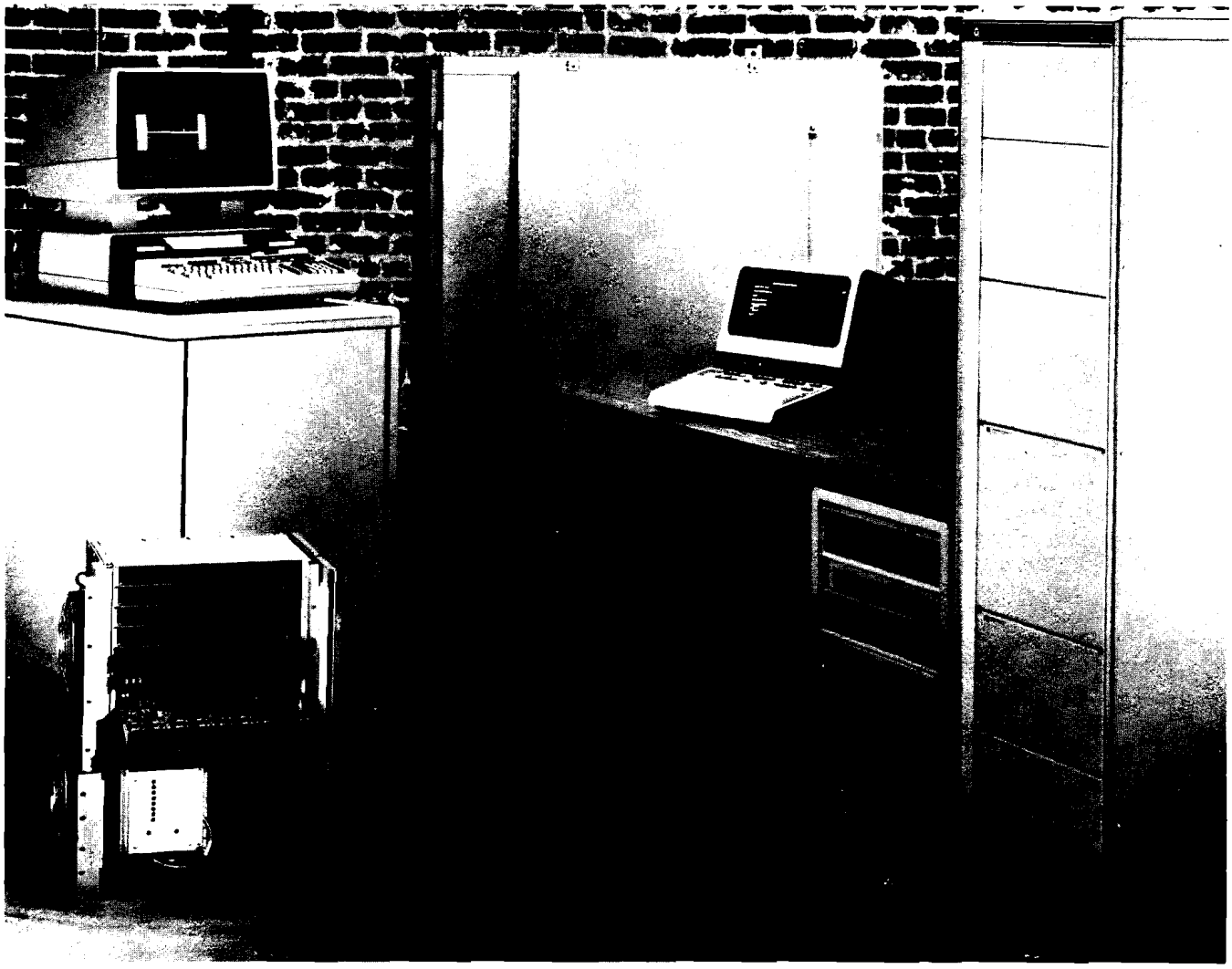
PACKAGES

CABINETS	FUNCTION CARD SLOTS	TERMINATION ASSEMBLIES	ENVIRONMENT
2250R 56" Cabinet With Processor	16	20	0-40 °C Ambient air, filtered and forced through cabinet for colling.
25575C 56" Expansion Cabinet	24	20	
25575B 56" Field Wiring Cabinet	0	45	
2250M 30" Mobile Cabinet With Processor	8	10	
2250N Industrial Cabinet With Processor	16	40	0-50 °C External ambient air. Cabinet sealed to NEMA-12 standard.
2104A + 2251AR Card Cages For Rack Mounting	8-64	N/A	Customer enclosure must provide clean air to card cage fan inlets at 0-65 °C.
2104A + 2251AN Card Cages for NEMA Panel Mounting			

NOTE: Continuous operation at maximum temperatures not recommended due to increased failure rates of semiconductor components. All packages are intended for use in non-airconditioned environments where maximum temperatures are only encountered a portion of the time. Contact Hewlett-Packard for further information on installation practices.

HEWLETT PACKARD

2250 system configuration overview



The 2250 family of products consists of integrated systems, processor units, function cards, function card frames, and signal conditioning modules. All 2250 systems offer completely integrated products in both rack-mount and NEMA* cabinets. Frames, cards, and cables are all installed and tested in system configurations. The three configurations are the 2250M/N/R.

The 2250M is a small, mobile package for laboratory use or for use in installing, testing, or troubleshooting part of an industrial process. The 2250N is in a NEMA-12 cabinet and therefore appropriate for severe environmental situations. The 2250R is a large, rackmounted system with expansion capability that allows monitoring and control of large point count processes in control room or laboratory environments.

There are two card frames that, together with the function cards, provide the large number of input/output functions available. One of the card frames is the HP 2104 Processor Unit. It is incorporated in all of the 2250 systems and is also installable in a customer's own racks or cabinets. The Processor Unit provides all the intelligence necessary for task processing, data collection, data conversion, communication with the host computer, and function card control. In addition, it provides space for a plug-in HP 1000 L-series computer. This arrangement allows standalone operation of the 2250 (with a "built-in" computer). Alternatively, the computer may be part of a larger distributed systems network which supports a complete factory automation capability.

The other card frame is the HP 2251 Measurement and Control Unit (MCU). It is installable both in 2250 systems and customer cabinets. This card frame provides the power and control signal distribution, and space for as many as eight function cards. Eight MCU's may be connected to one Processor Unit.

**NEMA is the National Electrical Manufacturer's Association*

HEWLETT PACKARD

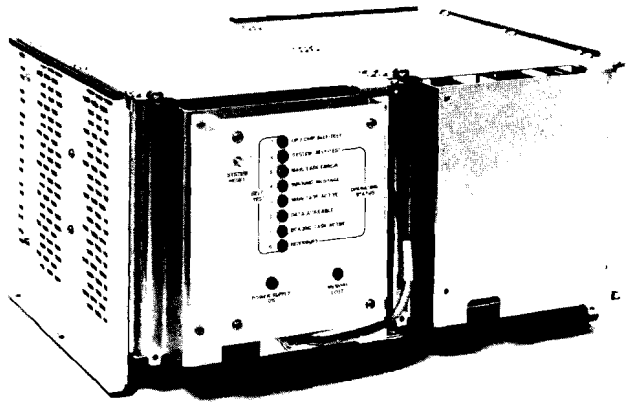
HP 2104 processor unit (rack and panel mount)

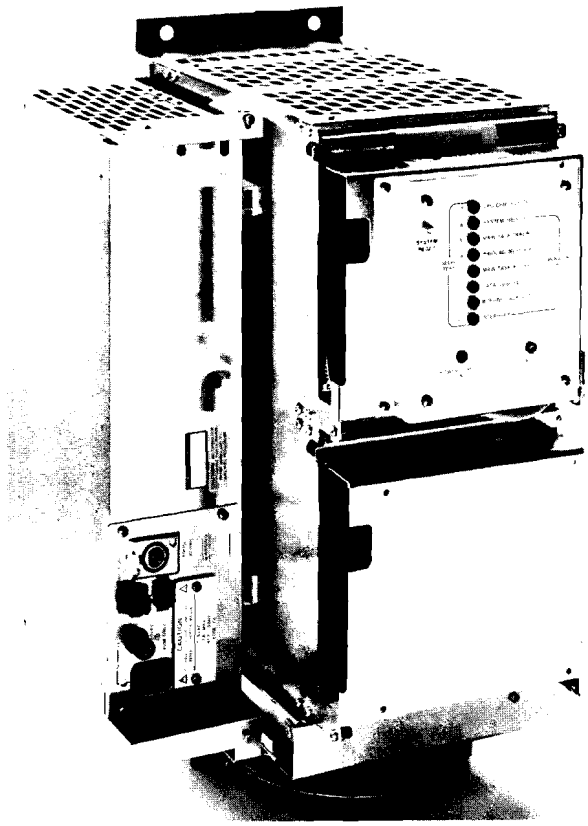
product number 2104AR/AN

Features

- 16 bit microcomputer intelligence
- Computer interface via the standard HP-IB* interface
- Support of eight, HP 2251 Measurement and Control Units (MCUs)
- Time-of-day clock
- Programmable pacing timer for scan or channel pacing
- Watchdog timer
- HP 1000 compatible for execution of downloaded FORTRAN and Assembler subroutines
- 25 kHz power supply for function cards; provides superior isolation and noise rejection
- Built-in processor self-test
- Optional plug-in battery backup for time-of-day clock and memory support
- Optional plug-in fiber optic or coax extension for remote operation in high noise environments
- Optional separate backplane supports an integral HP 1000 L-series computer for standalone or network operation

** The Hewlett-Packard Interface Bus (HP-IB) is HP's implementation of the IEEE Standard 488-1978: "Digital Interface for programmable instrumentation" and identical ANSI Standard MC1.1 (now also an IEC standard). The term "HP-IB" is also used to identify Hewlett-Packard instruments conforming with this standard.*





Description

The 2104 processor unit provides the local intelligence for computer-decoupled operation. The hardware consists of a power supply, steel frame, and four printed circuit assemblies. The PC assemblies include:

- An SOS LSI 16 bit microcomputer which does all the task processing, data computaton and conversion.
- A memory card consisting of 16K words of ROM which permanently store MCL/50, and 16K words of RAM for local storage of tasks and data. Approximately 2K of the 16K words of RAM is dynamically allocated for MCL/50 overhead.
- A measurement and control interface card which connects the processor unit to as many as eight measurement and control units. It contains the time-of-day clock, pacing timer circuitry, and input points for pacing the system with an external signal.
- An HP-IB interface card which provides the high-speed access between a host computer and the 2104 processor unit. This card does all the management of the HP-IB protocol, including recognition of primary and secondary addresses, device clear, trigger, service request, and other HP-IB messages.

In addition, the following optional capabilities may be added to the 2104 processor unit:

- A plug-in HP 1000 L-series 16 bit microcomputer (2103LK) which becomes the host computer, making the 2250 a complete measurement and control system in one cabinet.

- An HP-IB modem card that allows remote operaton of the processor unit. This card plugs into the empty slot adjacent to the HP-IB card and connects to it via a ribbon cable. Remote operation can be via either coax or fiber optic cable, depending on distance and desired performance.
- A battery backup card that plugs into any empty slot. This allows for data preservation and time-of-day clock maintenance.

Specifications

General

Computer-compatible interfaces

HP 1000 (FORTRAN, Pascal, BASIC, Assembler)
HP 9835 (BASIC)
HP 9845 (BASIC)
HP 9825 (HPL)
HP 85 (BASIC)
Computers that offer an IEEE 488 interface with both support of the "EOI" signal and Secondary Addressing

User available memory (tasks and data) >14K words (28K bytes)

Battery backup (optional)
Maximum backup time: 30 minutes (backup for time-of-day clock, power-fail/restart task and data preservation)

Note: additional backup time may be achieved with customer supplied, external batteries

Optional processor backplane
Contains 9 slots for a plug-in HP 1000 L-series computer

HP-IB interface
1Data rate: (normal) 250K words/sec. (500 bytes/sec.)
(high speed) 470K words/sec. (940K bytes/sec.)

Note: high speed operation requires certain length and unit restrictions

Messages supported: "data"
"require service"
"status byte"
"trigger"
"clear"
"abort"
Includes 2 metre HP-IB cable

Plug-in HP-IB modem (optional - plugs into slot adjacent to HP-IB card)
Coax: HP 37203L
Data rates — 25K words/sec. over 100 metres
20K words/sec. over 250 metres
7K words/sec. over 500 metres
Fiber-Optic: HP 37203L Opt. 001
Data rates — 25K words/sec. over 100 metres
19.5K words/sec. over 250 metres
12.5K words/sec. over 500 metres

System Capabilities

Clocks
Time-of-day clock:
- Format: hours, seconds, milliseconds, microseconds
- Resolution: 8 μsec
- Maximum Period: 900 days (21600 hours)
- Time to read clock: 2 msec

Pacing timer
- Format: seconds, milliseconds, microseconds
- Resolution: 2 μsec
- Maximum Period: 819 seconds

Watchdog timer
- Format: seconds
- Resolution: 125 msec
- Maximum Period: 8191 seconds

Task interval timer
- Format: hours, seconds, milliseconds, microseconds
- Resolution: 8 μsec
- Maximum period: timer is cleared at time-of-day clock rollover

External Pace Input
- Delay from external pace pulse to card enable: 4 +2/ −0 μsec
- Signal level to drive external pace input: 4.5 to 14VDC (5 to 25mA)
- Voltage available for external pace contact sensing: 5VDC +/- .25V (limited by 51 ohms)

Electrical specifications

Power requirements:	5V	12V	−12V	25kHz	Total
available power	21A	2A	.5A	180W	315.0W
2104 power consumption	9.6A	.7A	.02A	N/A	56.6W
battery backup power consumption	N/A	.2A	.01A	N/A	2.5W
HP-IB modem power consumption	.8A	N/A	N/A	.8W	4.8W
one 2251 power 90.0W consumption (typical worst case)	N/A	N/A	N/A	90W	
two 2251's power consumption (typical worst cast)	N/A	N/A	N/A	180W	180.0W

Note: Typical worst case power consumption is defined to be the worst case power drawn by a typical mix of cards. Power consumption is obviously a function of both the configuration of the 2250 and the loading of a function card. The 2104 has sufficient power for two 2251s. Power for additional 2251s should be supplied by the 25572A/B power supplies.

Input voltage (power supply and fan)
115V input voltage range 86 to 127Vrms (standard 2104)
230V input voltage range 195 to 253Vrms (2104 option 015)
Line frequency range 47 to 66 Hz
Maximum input power up to 500W (input power depends on output loading)
Power supply input current fusing 3AG normal blow 7A fuse for 115V range
3A fuse for 230V range
Power supply input line overvoltage protection misapplication or line transients 1.5 times nominal line voltage for more than one second will blow the input fuse

Environmental specifications

Temperature
Operating 0 to 65 C
Storage −40 to 75 C

Humidity 5 to 95% relative humidity, non-condensing @ 40 °C

Altitude
Operating: To 4.6 km (15,000 ft)
Non-operating: To 15.3 km (50,000 ft)

Vibration and Shock
HP 2250 products are type tested for normal shipping and handling shock and vibration (contact factory for review of any application that requires operation under continuous vibration).

Vibration: 0.38mm (0.15 in) p-p deflection over 5-55 Hz frequency range, 3 axis.

Shock, 1/2 sine, 3 axis:

Component Weight	>4.54kg (<:>10lb)
Magnitude	30g's
Duration	11ms

Physical specifications

2104AR (rack mount in standard 19" cabinets)

	inches	cm
height	14	35.56
width	19	48.26
depth	15.5	39.37

net weight 17kg (37lbs)

2104AN (panel mount for use in NEMA* cabinets)

	inches	cm
height	19.25	48.90
width	12.00	30.48
depth	15.00	38.10

net weight 17kg (37lbs)

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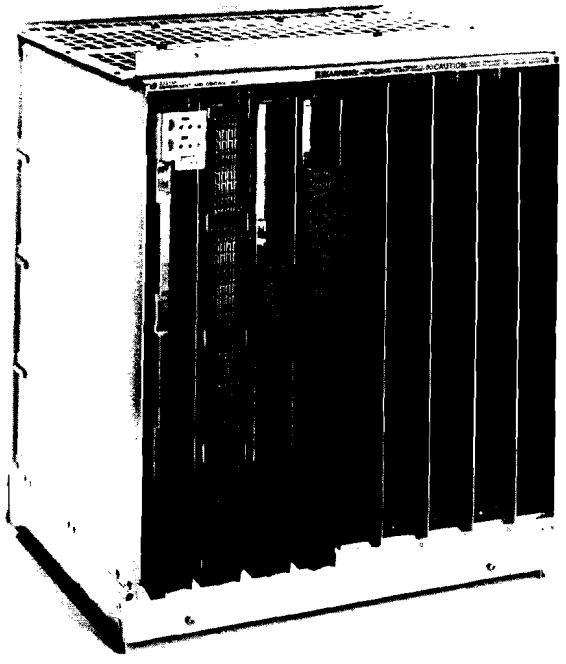
HEWLETT PACKARD

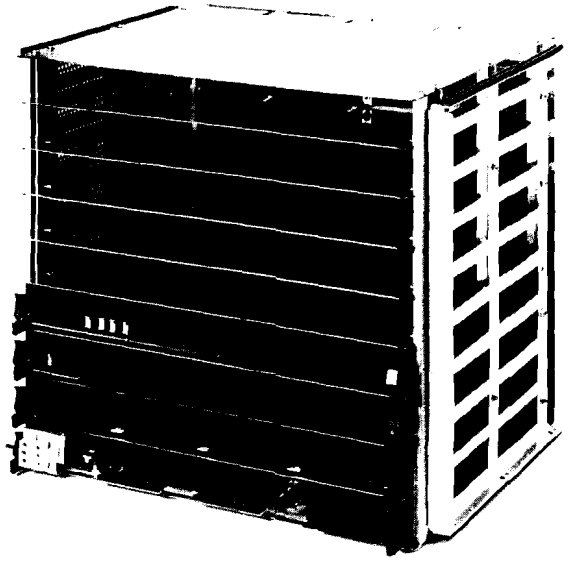
HP 2251 Measurement and control unit (rack and panel mount)

product number 2251AN/AR

Features

- Supports eight function cards in any combination
- Fully synchronous data transfers with handshake for both the processor and function card backplane provides high noise immunity
- Steel card cage with shielded card slots further increases noise immunity
- Full buffering of all signals for both backplanes
- Separate 25kHz power for precision analog circuitry
- System clock synchronization with 25kHz power supply for minimization of supply interference with system functions





Description

The 2251 hardware consists of a steel card cage and one printed circuit assembly. The PC card is a backplane interface card (BIF) that provides full signal buffering between the 2104 processor unit and the function cards. The BIF card also supports the backplane handshakes that maintain data integrity.

The Measurement and Control Unit (MCU) has slots available for 8 function cards in any combination. Each card slot is isolated from the adjacent slot by a steel shield.

Input power for the 2251 (and therefore the function cards) is 25kHz AC supplied by either the power supply in the 2104 or the additional 25572A/B power supplies. This feature allows isolation of noise sensitive functions from noise generating functions.

The power supply AC output (25kHz) is synchronized to the system clock for minimized interaction between the supply and precision analog measurements.

Specifications

General

Up to 8 2251s per 2104 processor or 2250R

function card slots per 2251

Supports up to 7 multiplexers (25502, 25503, 25504) with one 25501 ADC (the ADC must be in slot 1 to work with all 7 multiplexers)

Maximum control cable length is 32 ft.

Electrical specifications

Function card power:
Input voltage 27Vrms +8%
Maximum input power (typical worst case) 90W

Fan power:
115V input voltage range 86 to 127Vrms (standard 2251)
230V input voltage range 145 to 153 Vrms (2251 option 015)
Input frequency range 47 to 66 Hz

Environmental specifications

Temperature
Operating 0° to 65° C
Storage –40° to 75° C
Humidity 5 to 95% relative humidity non-condensing @ 40 °C

Altitude

Operating: To 4.6 km (15,000 ft)
Non-operating: To 15.3 km (50,000 ft)

Vibration and Shock

HP 2250 products are type tested for normal shipping and handling shock and vibration (contact factory for review of any application that requires operation under continuous vibration).

Vibration: 0.38mm (0.15 in) p-p deflection over 5-55 Hz frequency range, 3 axis.

Shock, 1/2 sine, 3 axis:

Component Weight	> 4.54kg (> 10lb)
Magnitude	30g's
Duration	11ms

Physical configurations

2251AR (rack mount in standard 19" cabinets)

	inches	cm
height	14	35.56
width	19	48.26
depth	17.25	43.82
net weight	15kg	(34lbs)

2251AN (panel mount for use in NEMA* cabinets)

	inches	cm
height	21.25	53.98
width	14.5	36.83
depth	15.5	39.37
net weight	15kg	(34lbs)

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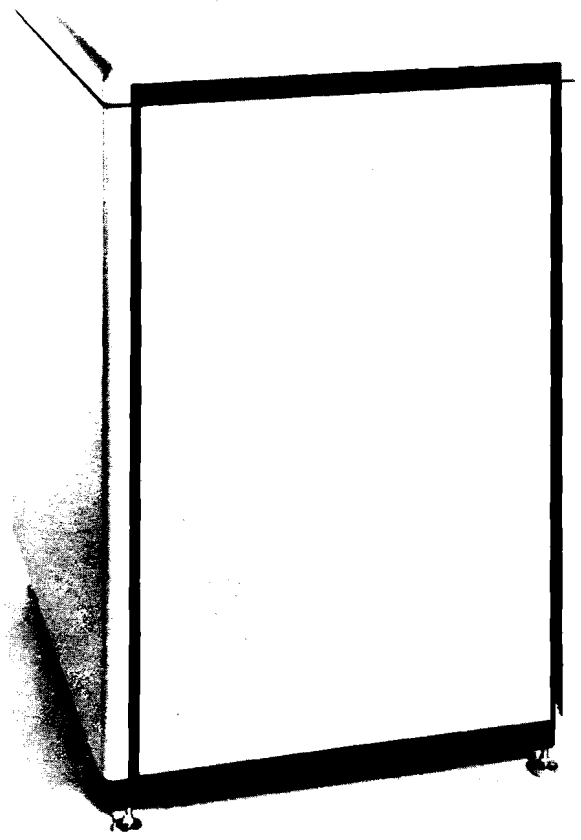
HEWLETT PACKARD

2250M Mobile measurement and control system

product number 2250M

Features

- Integrated measurement and control system in a roll-around cabinet provides ease of use in a variety of locations
- Integral mounting panels for supporting field wiring assemblies
- Space for one 2251AR
- System power distribution unit with power switch
- Steel cabinet for noise immunity



Description

The 2250M is a complete measurement and control system in a small, mobile package. This system is appropriate for small laboratory testing, local machine or process installation, and trouble-shooting. It contains a power supply, one 2104, and space for one 2251.

The 2104 processor unit provides the local intelligence for computer-decoupled operation. The hardware consists of a power supply, steel frame, and four printed circuit assemblies in a steel rack. The 2251 measurement and control unit contains one BIF (backplane interface) card, through which the processor unit communicates with measurement and control function cards, and space for 8 function cards. The function cards interface directly with the automation application.

Specifications (also see the HP 2104 data sheet)

General

Supports one 2251AR
Contains mounting space for 10 field wiring assemblies (FWAs)

Electrical specifications

Power requirements:	5V	12V	−12V	25kHz	Total
available power	21A	2A	.5A	180W	315.0W
2104 power consumption	9.6A	.7A	.02A	N/A	56.6W
battery backup power consumption	N/A	.2A	.01A	N/A	2.5W
HP-IB modem power consumption	.8A	N/A	N/A	.8W	4.8W
one 2251 power consumption (typical worst case)	N/A	N/A	N/A	90W	90.0W

Note: Typical worst case power consumption is defined to be the worst case power drawn by a typical mix of cards. Power consumption is obviously a function of both the configuration of the 2250 and the loading of a function card. The 2104 has sufficient power for two 2251s. Power for additional 2251s should be supplied by the 25572A/B power supplies.

Input voltage (power supply and fan)

115V input voltage range 86 to 127Vrms (standard 2250M)

230V input voltage range 195 to 253Vrms (2250M option 015)

Line frequency range 47 to 66 Hz

Maximum input power up to 500W (input power depends on output loading)

Power Supply input current fusing 3AG normal blow 7A fuse for 115V range; 3A fuse for 230V range

Power Supply input line overvoltage protection misapplication or line transients 1.5 times nominal line voltage for more than one second will blow the input fuse.

Environmental specifications

Temperature
Operating 0°to 40°C
Storage −40°to 75°C

Humidity 5 to 95% relative humidity, non-condensing @40°C

Altitude

Operating: To 4.6 km (15,000 ft)
Non-operating: To 15.3 km (50,000 ft)

Vibration and Shock

HP 2250 products are type tested for normal shipping and handling shock and vibration (contact factory for review of any application that requires operation under continuous vibration).

Vibration: 0.38mm (0.15 in) p-p deflection over 5-55 Hz frequency range, 3 axis.

Shock, 1/2 sine, 3 axis:

Component Weight	> 4.54kg (> 10lb)
Magnitude	30g's
Duration	11ms

Physical specifications

2250M (roll-around cabinet)

	cm.	in.
height	92.7	36.5
width	73.4	29.0
depth	81.3	32.0
net weight	100kg	(220lbs)

HEWLETT PACKARD

HP 2250N NEMA panel measurement and control system

product number 2250N

Features

- Integrated measurement and control system in an industrial NEMA-12 package
- Integral mounting panels for supporting field wiring assemblies
- Separate lockable compartments for the electronics and field wiring terminations
- Removable metal access plates allowing conduit exit and entry for field wiring
- Space for two 2251ANs
- System power distribution unit with built-in power switch
- Separate lockable compartments for electronics and field wiring
- Floor-standing or wall mountable
- Includes extra backplane for separate plug-in HP 1000 L-series computer

Description

The 2250N is a complete measurement and control system in an industrial package. This system is designed for local machine or process control in harsh factory environments. It has two separate compartments for field-wiring connections. A third compartment contains the 2104AN processor unit and room for two 2251AN MCUs (measurement and control units).

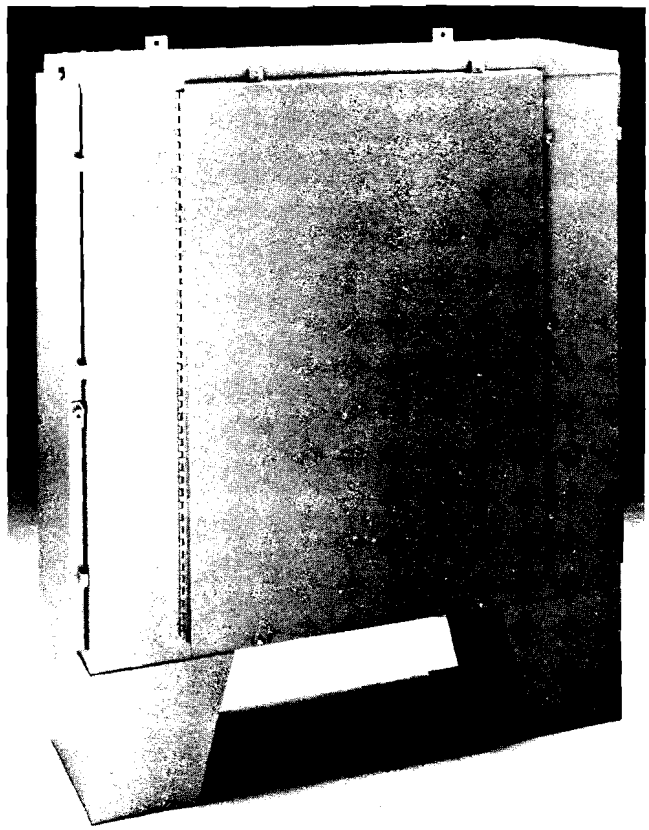
The 2104 processor unit provides the local intelligence for computer-decoupled operation. The hardware consists of a power supply, steel frame, and four printed circuit assemblies. The 2251 MCUs each contain one BIF (backplane interface) card, through which the processor unit communicates with measurement and control function cards, and space for 8 function cards. The function cards interface directly with the automation application.

The processor unit in the 2250N includes an additional backplane where an HP 1000 L-series computer can be installed. This provides the capability of having the measurement and control system and its host computer built into an industrial package. The computer may be either standalone or part of a distributed systems network.

Specifications (also see HP 2104 data sheet)

General

Contains room for two 2251ANs
Mounting space for 40 field wiring assemblies



Electrical specifications

Power requirements:	5V	12V	−12V	25kHz	Total
available power	21A	2A	.5A	180W	315.0W
2104 power consumption	9.6A	.7A	.02A	N/A	56.6W
battery backup power consumption	N/A	.2A	.01A	N/A	2.5W
HP-IB modem power consumption	.8A	N/A	N/A	.8W	4.8W
one 2251 power 90.0W consumption (typical worst case)	N/A	N/A	N/A	90W	
two 2251's power consumption (typical worst cast)	N/A	N/A	N/A	180W	180.0W

Note: Typical worst case power consumption is defined to be the worst case power drawn by a typical mix of cards. Power consumption is obviously a function of both the configuration of the 2250 and the loading of a function card. The 2104 has sufficient power for two 2251s. Power for additional 2251s should be supplied by the 25572A/B power supplies.

Input voltage (power supply and fan)
115V input voltage range 86 to 127Vrms (standard 2250N)
230V input voltage range 195 to 253Vrms (2250N option 015)
Line frequency range 47 to 66 Hz
Maximum input power up to 500W (input power depends on output loading)
Power supply input current fusing 3AG normal blow 7A fuse for 115V range
3A fuse for 230V range
Power supply input line overvoltage protection misapplication or line transients 1.5 times nominal line voltage for more than one second will blow the input fuse.

Environmental specifications

NEMA-12 environments

Temperature
Operating 0 to 50° C
Storage −40 to 75°C

Humidity 5 to 95% relative humicity, non-condensing @ 40°C

Altitude
Operating: To 4.6 km (15,000 ft)
Non-operating: To 15.3 km (50,000 ft)

Vibration and Shock

HP 2250 products are type tested for normal shipping and handling shock and vibration (contact factory for review of any application that requires operation under continuous vibration).

Vibration: 0.38 mm (0.15 in) p-p deflection over 5-55 Hz frequency range, 3 axis.

Shock, 1/2 sine, 3 axis:

Component Weight	>4.54kg (<>10lb)
Magnitude	30g's
Duration	11ms

Physical specifications

2250N (mounted in NEMA-12 enclosure)

	inches	cm
height	72	182.88
width	48	121.92
depth	20	50.80

net weight 170kg (375lbs)

HEWLETT PACKARD

HP 2250R rack-mounted measurement and control system

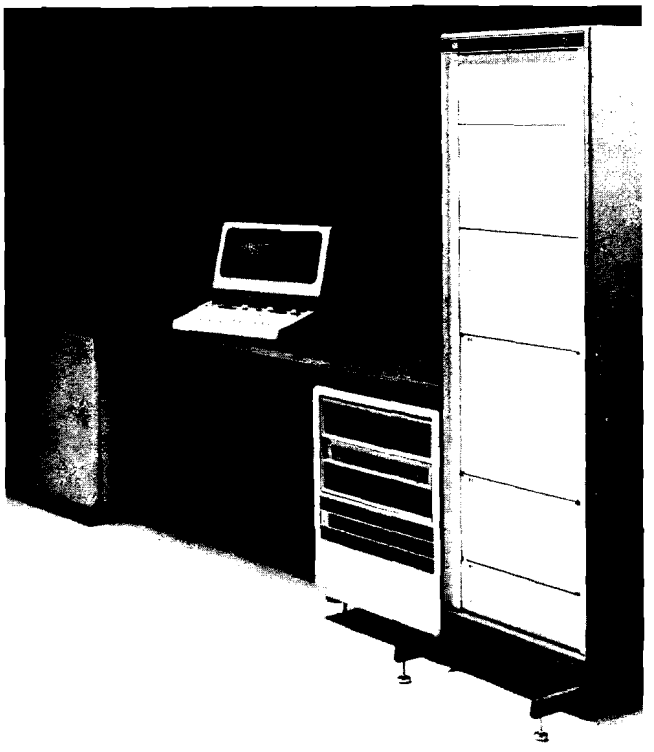
product number 2250R

Features

- Integrated measurement and control system in an upright rack cabinet with locking doors
- Integral mounting panels for supporting field wiring assemblies
- Space for two 2251AR MCUs (measurement and control units)
- System power distribution unit with built-in power switch
- Optional cabinets for up to six additional 2251 MCUs (maximum number of MCUs requires two additional cabinets)
- Optional cabinets for additional field wiring assemblies
- Includes extra backplane for separate plug-in HP 1000 L-series computer

Description

The 2250R is a complete measurement and control system in an upright, standard 19" cabinet. This system is appropriate for large point count interfacing to laboratory and industrial processes. The 2250R contains a 2104AR processor unit and room for two 2251ARs. In addition, optional cabinets may be added that expand the space available for both MCUs and field wiring assemblies (FWA).



Specifications (also see HP 2104 data sheet)

General

2250R (required)
Supports two 2251ARs
Mounting space for 20 field wiring assemblies
Total capacity: 2 MCUs, 16 function cards, 20 FWAs

2250R option 001 (one 25575B)
Additional cabinet that attaches to the 2250R with space for 45 field wiring assemblies
Total capacity: 2 MCUs, 16 function cards, 65 FWAs

2250R option 002/016 (one 25575C)
Additional cabinet that attaches to the 2250R with space for 45 field wiring assemblies
Additional cabinet including the 25kHz power supply and power distribution unit with space for three 2251ARs and 20 field wiring assemblies
Additional cabinet attached to the three MCU cabinet with space for 45 field wiring assemblies
Total capacity: 5 MCUs, 40 function cards, 130 FWAs

2250R option 003/017 (two 25575Cs, three 25575Bs)
Additional cabinet that attaches to the 2250R with space for 45 field wiring assemblies
Two additional cabinets including the 25kHz power supply and power distribution unit with space for three 2251ARs and space for 20 field wiring assemblies in each cabinet
Two additional cabinets that attach to each three-MCU cabinet with space for 45 field wiring assemblies in each cabinet
Total capacity: 8 MCUs, 64 function cards, 195 FWAs

Electrical specifications (applies to 2250R only)

Power requirements:	5V	12V	−12V	25kHz	Total
available power	21A	2A	.5A	180W	315.0W
2104 power consumption	9.6A	.7A	.02A	N/A	56.6W
battery backup power consumption	N/A	.2A	.01A	N/A	2.5W
HP-IB modem power consumption	.8A	N/A	N/A	.8W	4.8W
one 2251 power 90.0W consumption (typical worst case)	N/A	N/A	N/A	90W	
two 2251's power consumption (typical worst cast)	N/A	N/A	N/A	180W	180.0W

Note: Typical worst case power consumption is defined to be the worst case power drawn by a typical mix of cards. Power consumption is obviously a function of both the configuration of the 2250 and the loading of a function card. The 2104 has sufficient power for two 2251s. Power for additional 2251s should be supplied by the 25572A/B power supplies.

Input voltage (power supply and fan)
115V input voltage range 86 to 127Vrms (standard 2250R, option 002/003)
230V input voltage range 195 to 253Vrms (2250R option 015/016/017)
Line frequency range 47 to 66 Hz
Maximum input power up to 500W (input power depends on output loading)
Input current fusing 3AG normal blow 7A fuse for 115V range
3A fuse for 230V range
Input line overvoltage protection misapplication or line transients 1.5 times nominal line voltage for more than one second will blow the input fuse

Environmental specifications

Temperature
Operating 0 to 40°C
Storage −40 to 75°C

Humidity 5 to 95% relative humidity, non-condensing @ 40°C

Altitude
Operating: To 4.6 km (15,000 ft)
Non-operating: To 15.3 km (50,000 ft)

Vibration and Shock

HP 2250 products are type tested for normal shipping and handling shock and vibration (contact factory for review of any application that requires operation under continuous vibration).

Vibration: 0.38 mm (0.15 in) p-p deflection over 5-55 Hz frequency range, 3 axis.

Shock, 1/2 sine, 3 axis:
Component Weight >4.54kg (<>10lb)
Magnitude 30g's
Duration 11ms

Physical specifications

2250R (rack mount in standard 19" cabinets)
height 163.2 cm
width 53.3 cm
depth 99.1 cm
net weight 98kg (215lbs)

HEWLETT PACKARD

HP-MCL/50
(Measurement and Control Language)

product number 25580A

Features

- Local intelligence with over 100 application-oriented commands
- Real-time operation decoupled from the computer to provide predictable performance
- Multi-task environment
  - local storage and execution of compiled tasks
  - tasks scheduled by external events or the host computer or time and time interval
- Built-in data reduction and decision making capabilities
  - data automatically converted to engineering units
  - thermocouple linearization and conversion to °C
  - arithmetic, boolean, logical operations on user data
  - decision making based on both analog and digital limit conditions
  - high-level control structures for program branching and looping
- Downloaded HP-1000 FORTRAN or Assembler subroutines for customized data reduction, filtering, and control algorithms
- Continuous data acquisition up to 50,000 samples per second, with local buffering
- Accurate, hardware-controlled synchronization and pacing of analog and digital inputs and outputs
- Built-in time-of-day clock and watchdog timer for system integrity
- History data acquisition up to 50,000 samples/second
- Flexible management of 28K bytes of user memory for tasks and data buffers
- Built-in processor self-test
- Computer independent programming for compatibility with a wide variety of computers

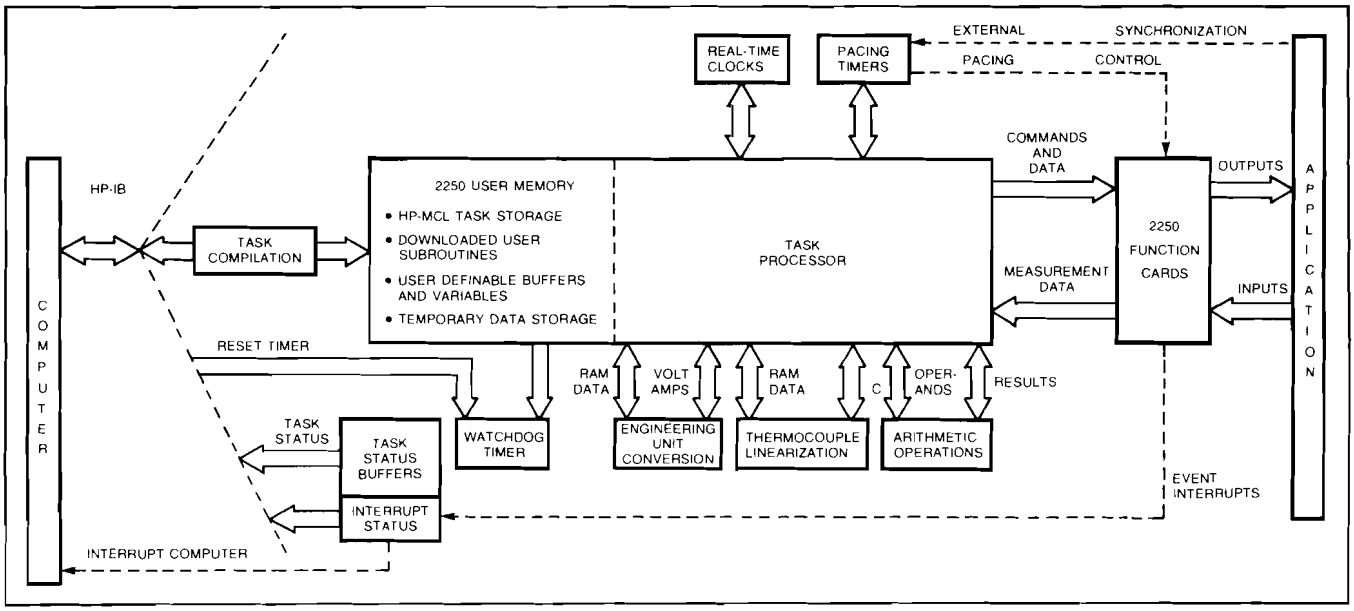
Applications

HP-MCL/50 allows the user to easily program the 2250 to perform the specific automation tasks required for an application. With HP-MCL/50, the timing of 2250 tasks can be completely decoupled from that of the computer. This leaves the host computer free to perform other operations, thus increasing total system throughput.

Description

HP-MCL/50 is a high level Measurement and Control Language designed for use with the 2250. With HP MCL/50, the 2250 is microprogrammed to accept complete tasks from the computer, compile the commands, and then execute those tasks in the real-time environment of the user's system. Tasks may include such functions as periodically gathering a group of measurements, converting the data to engineering units (volts, amps., °C), starting a control sequence at a specified time or time interval, and decision-making for closed-loop control. The 2250 is also capable of executing stored FORTRAN digital filtering or control algorithms that were previously compiled and prepared on an HP 1000 computer. All data is transferred in binary format.

The speed of measurements and control operations may be internally or externally paced on a scan or channel level. A high-speed, continuous acquisition mode allows simultane-



2250 FUNCTIONAL BLOCK DIAGRAM

ous buffered data gathering and transmission. Multiple tasks may be compiled and stored locally for later execution. Tasks may be scheduled upon interrupt from a function card or on command from another request or task. Other capabilities include history data acquisition, analog offset correction, time-of-day clock, and built-in processor self-test.

The firmware to implement HP-MCL/50 is stored in 16K words of ROM on the 2250 memory card.

Summary of HP-MCL/50 capabilities

- **Analog/digital I/O commands**
  - Easy to recognize, applications oriented
  - Separation of commands and data for convenient updating of output variables
  - Programmable analog gains
  - Parallel measurement and control operations
  - User selectable computer data formats

- **Synchronizing, timing, and pacing commands**
  - Time-of-day clock
  - Programmable internal pacing of all function cards
  - Synchronizaion with computer or external events

- **Built-in application utilities**
  - Automatic engineering unit conversions
  - Thermocouple linearization/conversion to °C (includes reference junction compensation)
  - Watchdog timer to determine system integrity

- **Application task development/control/ supervision commands**
  - Looping (REPEAT-NEXT)
  - IF...THEN...ELSE structures for decision making
  - Analog limit checking (>, <, etc.)
  - Flexible internal buffer management
  - Arithmetic capabilities: +, −, ×, ÷
  - Logical and Boolean operations AND, NOT, XOR, etc.
  - Bit manipulation routines

- **Multi-task capabilities**
  Local storage of compiled tasks task execution initiated by:
  - HP-MCL/50 GOSUB command
  - External interrupt (from function card or computer)
  - Automatic background task scheduling
  - Watchdog timer alarm

- **Optional execution of customized downloaded FORTRAN subroutines**
  - For data reduction, filtering and digital control algorithms
  - Callable from HP-MCL/50 task
  - Includes library calls such as SORT(X) and SIN(X)
  - FORTRAN or HP 1000 ASSEMBLY LANGUAGE
  - Computation using real numbers

- **System level control and data handling structures**
  - Optional user defined variables and buffers
  - Direct access to variables/buffers from the host computer, for updating control values without affecting the current task
  - Multiple communications ports for complex data handling applications (memory exchange)

- **Hardware configuration, status, control, test, and verification commands**

- **Flexible error handling and recovery**

Summary of HP-MCL/50 commands

Command and Description

AAVERAGE	average analog buffer
ABORT	enable task abort
AI	analog input
AIC	analog input card format
AID	double word analog input
AIM	microvolt analog input
AIR	real analog input
AIT	read reference temperature
AND	bit masking operator
AOFF	autorange off
AON	autorange on
BLOCK	permit multiple reading from one point
CALL	call subroutine
CASE	multi-path branching
CBUFFER	declare CONVERT data source and destination
CCONTROL	counter card control
CFN	counter card configuration
CLB	calibrate analog input
CLR	clear bit logical operator
CMP	logical bit complement operator
CNUM	set counter card average mode
CO	output analog current
CONVERT	convert raw data to engineering units
COUNT	read multifunction card counter
CPACE	set channel mode pacing
CTIMER	clear task timer
CTL	write card configuration register
DCOUNT	read double word count
DI	read digital input point
DIMENSION	declare variables and buffers
DO	digital point output
DREAD	double word read from register
DWRITE	double word write to register
EFCN	counter card configuration
ECHO	verify communications
EOFF	disable immediate-execute mode
EON	resume normal execution of commands
EXECUTE	trigger delayed data transfer
EXIT	exit a repeat loop
FCI	function card interrupt
FI	read digital input field
FO	digital field output
GAIN	set analog gain
GOSUB	run subtask
GOTO	unconditional branch
ID	MCU and function card identification
IF	relational branching
IN	store define where input is to go
INTERRUPT	enable or disable function card interrupt
IOR	bit masking operator
ITASK	assign interrupt handling task
LABEL	program control label
MOD	remaindering operator
NTASKS	define number of tasks
ONERROR	go to LABEL upon error
OUT	take output data from specified location
PACE	set scan mode pacing
PAUSE	suspend task
PCONTROL	pulse channel control
PNUMBER	set pulse number
POC	pulse channel configuration
PRATE	pulse rate configuration
PRESET	preset multifunction card counters
PTIMER	pause for task timer
RAM	read amount of available memory
RANGE	set analog range

Command and Description	
RBIT	read card register bits
RCFN	read counter card configuration
RCLOCK	read time of day clock
RCNUM	read counter card average
RCOUNT	read single word count with re-start
RCS	read card status
RDCOUNT	read double word count with re-start
RDO	read digital output configuration
READ	single word read
REF	read and set reference temperature
RELEASE	release stored data to port
REPEAT	repeat a sequence of commands
RESET	system reset
REWIND	rewind buffer
RFO	read digital output field configuration
RGAIN	read analog gain
RINTERRUPT	read interrupt configuration
ROLL	set multifunction counter rollover
ROT	logical rotate operator
RPRESET	read multifunction counter preset
RPREM	read number of remaining pulses
RTIMER	read task timer
SCLOCK	set clock
SENSE	define interrupt transition sense
SET	set bit logical operator
SKIP	move buffer pointer
SOVERRIDE	override transition sense for interrupts
SRQ	request service from computer
START	schedule task
STOP	stop task
SYN	system normalize
TASK	define resident task
TTEMP	read thermocouples
TRANSFER	set up for input or output of unchanged data
TREF	set thermocouple reference temperature
TSTAT	task status
VO	output integer voltage
WATCHDOG	set watchdog timer
WBIT	write card register bits
WEXT	wait for external strobe
WNOW	wait now
WPACE	wait for pace pulse
WPOINT	wait for digital input point
WRITE	single word write
WTIMER	wait for task timer
XOR	bit masking operator

HP-MCL/50 Example

```
PACE (1, 20, 0)                  Set Internal Pacer = 1.020000 sec.
IN(B1)                           Place data in buffer B1.
WEXT; AI(1,1,16)                 Synchronize with an external trigger, using a dummy READ.
REPEAT (0)                       Repeat indefinitely.
   REWIND (B1); IN(B1)           Prepare buffer for data.
   WPACE                         Wait for internal pace signal.
   AI(1,1,16)                    Store 16 analog inputs (pressures) in B1.
   IN(B2); JTEMP(1,17)           Read temp. from J-type thermocouple and
   RCLOCK                        Read time-of-day clock into Buffer B2.
   CALL GRAD(B1,B2)              Call downloaded FORTRAN pressure gradient routine and put coefficients
                                 into B2.
   RELEASE(B2,A)                 Return temperature, time-of-day and gradient coefficients to the computer
                                 using 2250 Port A.
   IF B2(1) < 2000 THEN
      V2 = B2(1) - V1
      V2 = V2/12                 Limit check temperature - if < 200 °then compute a new valve position and
      OUT(V2); CO(5,1)           output the current (mA.) stored in V2.
   ELSE                          If > =200 then turn on 4 display lights. Alert the computer of the Alarm Condition
      DO(6,1,4) 1,1,1,1          by sending an interrupt #1.
      SRQ(1)
      GOTO(5)                    Goto Label (5).
   ENDIF
   IF V9=1 THEN EXIT             Watch for computer to terminate the task by asynchronously setting V9 to 1.
                                 Then exit to LABEL(5).
   ENDIF
NEXT
LABEL(5)
GOSUB(3)                         Run shutdown task 3 immediately.
START(4)!                        Schedule background monitoring task #4.
```

HEWLETT PACKARD

Analog input/output capabilities

Features

- 14 bit, 50K samples/sec, autoranging analog input card
- Three expansion multiplexer cards:
  - high level, 50K samples/sec, solid state differential
  - low level, 20K samples/sec, solid state differential
  - wide range, 1000 samples/sec, guarded relay
- Independent per channel isolated voltage or current analog output card
- All inputs and outputs fully protected
- Programmed through application oriented MCL/50 commands
- Up to 50,000 samples/sec, continuous data acquisition to disc with standard HP software
- Plug-on signal conditioning modules for filtering and current loops
- Direct interfacing to thermocouples through a unique thermocouple reference connector
- Industrial screw terminations
- Complete performance specifications for a variety of applications
- All cards feature point-of-load power supply regulation and protection
- Every card communicates over a full synchronous, positive handshake 12V CMOS backplane to assure error free transactions in the noisiest environments.

Description

The 2250 analog function card family consists of four cards that interface to a variety of analog sensors and actuators commonly found in laboratory and industrial applications. Each card occupies one slot. These cards may be used with any 2250 function cards (analog or digital) within the same mainframe.

The 25501A High Speed Analog Input Card provides 16 channels of analog input. With the use of its multiplexer family (each analog input card can support up to 7 multiplexers) a single analog input card can provide up to 240 analog inputs. Any number of analog input cards and multiplexers can be used, subject to the system configuration limit of one 2250 and eight 2251's. Each ADC can be used with any combination of multiplexers.

All solid state analog input channels are differential; and protected against overvoltage. The relay multiplexer features floated and guarded channels. Plug on signal Conditioning Modules provide current loop termination and RC filtering on an eight channel bases for the solid state multiplexers.

Terminated and unterminated cable assemblies are available in eight channel assemblies. The terminated cable assemblies feature large industrial screw terminations which accommodate up to 10 gauge field wiring, well protected cable ways to help prevent field personnel from inadvertently damaging the cable assemblies, and provision for mounting current loop resistors on the termination barriers (inputs only). A unique thermocouple reference connector provides direct termination for 15 thermocouples, while HP-MCL/50 provides standard engineering unit conversion to °C for seven major thermocouple types.

All cards are used through the appropriate high level, application oriented HP-MCL/50 commands. Consult individual data sheets for more detail.

Summary of analog function cards

25501A 16 channel high speed analog card

Provides the analog-to-digital conversion capability of the 2250. It features a 50kHz ADC with 14 bit resolution and 17 bit dynamic range. The card includes 16 channels of differential multiplexing. Each channel can be programmed via HP-MCL/50 for full scale ranges of ±10V, ±5V, ±2.5V, and ±1.25V, or the user can program the card to autorange to the appropriate scale. The number of channels can be expanded to 240, using 7 multiplexer cards.

25502A 32 channel high-level solid state multiplexer

Increases the channel capacity of the 25501A in increments of 32 differential channels. Gain programmability and autoranging features are identical to the 22501A. Optional analog signal conditioning modules can be added to the card to provide RC filtering and 4-20mA current loop terminations.

25503A 32 channel low level solid state multiplexer

Provides low level analog channel expansion for the 25501A in increments of 32 differential channels. With the 25501A, the user can program (via HP-MCL/50) 25502A channels for 12 different full scale ranges from ±12.5mV to ±10V. The autoranging features of the Analog Input Card may be used with the programmable gains of the 25503. Optional signal conditioning modules provide RC filtering and 4-20mA current loop terminations.

25504A 16 channel wide range relay multiplexer

Provides floated and guarded channel expansion for the 25501A in increments of 16 channels. Multiplexing is done with reed relays that switch high, low, and guard. Gains are programmable in full scale ranges from ±12.5mV to ±100V, and the autoranging features of the Analog Input Card may be used with the programmable gains of the 25504. The card withstands common mode voltages up to ±350VDC; system backplane protection is provided up to 500V.

Analog input terminations/thermocouple reference connector

All analog cards can be used with either industrial screw termination assemblies or unterminated cables. In addition, the low level and relay multiplexers can be used with an

isothermal reference junction termination assembly for making thermocouple measurements. Thermocouple linearization and conversions to degrees centigrade are handled in HP-MCL/50 firmware.

25510A four channel isolated voltage/current analog output card

Provides four independently isolated and programmable analog outputs. Output resolution is 12 bits and channels can be programmed for either ±10V or 0-20mA or 0-10V outputs (using HP-MCL/50). The card can be used with industrial screw termination assemblies or with unterminated cables.

Analog input quick selection guide

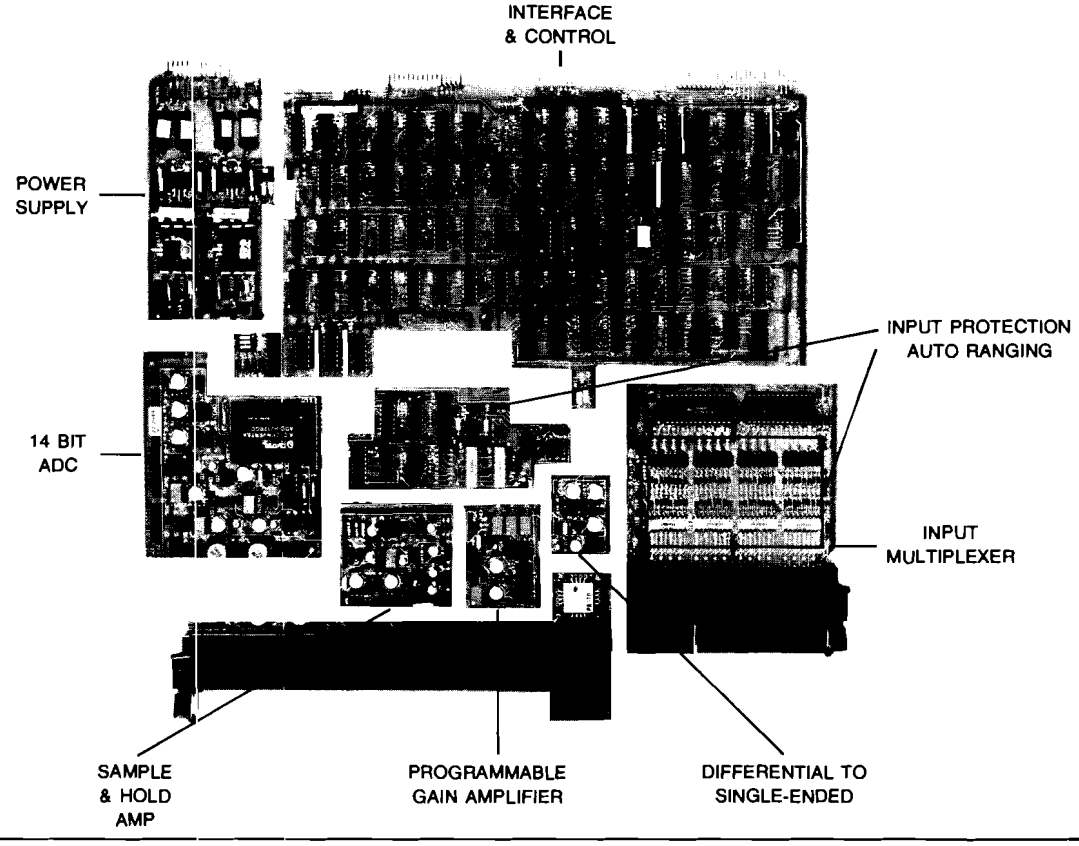
Card Signal	ADC 25501A	Multiplexers Hi Level SS 25502A	Multiplexers Lo Level SS 25503A	Multiplexers Wide Range 25504A
>10V				√
Volts/Millivolts*	√	√	√	√
Microvolts*			√	√
4-20mA	(1)	(1),(2)	(1),(2),(3)	(1),(3)
Thermocouples**			√	√
RC Filtering		(2)	(2)	(1)
Max Sampling Rate				
scan	50kHz	50kHz	20kHz	1kHz
on channel	50 kHz	50 kHz	50 kHz	10 kHz
Max Range	±10V	±10V	±10V	±100V
Min Range	±1.25V	±1.25V	±12.5mV	±12.5mV
Max Common Mode	±10V	±10V	±10V	±350V

**Thermistors, RTDs, strain guages and other sensors/transducers interfaceable on these ranges.*
***Direct thermocouple interface including reference junction and built-in linearization and conversion to °C.*
(1) Via HP supplied terminating resistors mounted on the screw terminations.
(2) Via HP supplied analog input signal conditioning modules (SCMs).
(3) Via user supplied components on SCMs or relay modules.

HEWLETT PACKARD

16 Channel high speed ADC

product number 25501A



Features

- 14 Bit Resolution
- 50,000 samples/sec.
- 16 Differential Input Channels
- Programmable Gain Amplifier
- Autoranging at the full 50,000 samples/sec
- Auto Zero
- Input Protection on all 16 differential input channels
- Accurate to within .08% over 0-65 °C

Applications

Conversion of analog signals from transducers, transmitters, temperature sensors, etc., to digital form, where high speed and resolution are required.

Description

The 25501A High Speed ADC card provides the 2250 with its basic analog to digital conversion capability. Up to 16 differential input channels may be connected (or up to 240 with 2250 series multiplexer cards).

The signals on these channels are amplified, with a gain set by the user on a per channel basis. If desired, the 25501A can autorange, (select the optimum gain) a given channel. A high speed sample and hold assures accurate conversion of the input signal even on quickly changing inputs, and a 14 bit ADC converts the amplified input signal to digital form. With the 25501A, signals from 156 microvolts to 10V can be digitized at rates up to 50,000 samples/sec.

Programming information

AI:	Return voltage from specified channel in millivolts
AIR:	Return voltage in HP-1000 real format
AID:	Return voltage in double integer format
AIC:	Return data from channel in raw card format
GAIN:	Set gain (range) on a specified channel
RGAIN:	Read gain (range) on a specified channel
AON:	Autorange on
AOFF:	Autorange off
CLB:	Perform an auto-zero cycle
RANGE:	Set analog range

Specifications

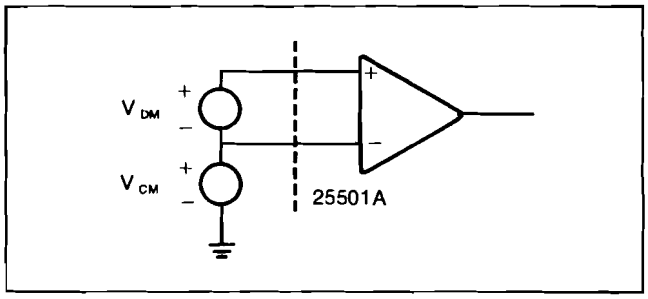
(Unless otherwise noted, all specifications at 0-65 °C, 0-90% relative humidity, non-condensing)

Input ranges and resolutions

Input Channel Span (F.S.R.)	Input Channel Range (F.S.)	Resolution (1 LSB)	PGA Gain
20V	±10V	1.25 mV	1
10V	±5V	625 μV	2
5V	±2.5V	312 μV	4
2.5V	±1.25V	156 μV	8

Common mode voltage limits

Maximum differential voltage + maximum common mode voltage must be less than or equal to ±10 volts.



Example: On the ±2.5 volt range, the maximum differential input allowed is ±2.5V, therefore:

$$V_{CM} = 10\text{-}2.5 = 7.5 \text{ volts}$$

Source impedance & imbalance; return impedance

Maximum source impedance for rated accuracy: 1K Ω

Maximum source imbalance for rated accuracy: 1K Ω

Maximum return impedance for rated accuracy: 10K Ω

Input impedance

Power on: ≥ 10M Ω shunted by ≤ 80 pf.
Power off: 1K Ω ± 10% to ground
2K Ω ± 20% to any other signal input line.

Input overload protection

No damage will occur below these levels:

Power On Steady State: Up to ±25 volts on any **one** input signal line to ground, or to any other **one** signal input line.

Derate by one volt for each additional overloaded signal input line.

Example: What is the maximum simultaneous allowable overload on 4 input channels?

There are 2 input lines per channel, therefore,

Maximum overload voltage per line = 25 - (4x2x1) = 17 volts

Transient: ±50 volts on any one input signal line to ground or to any other one signal input line, for a maximum of 10 seconds.

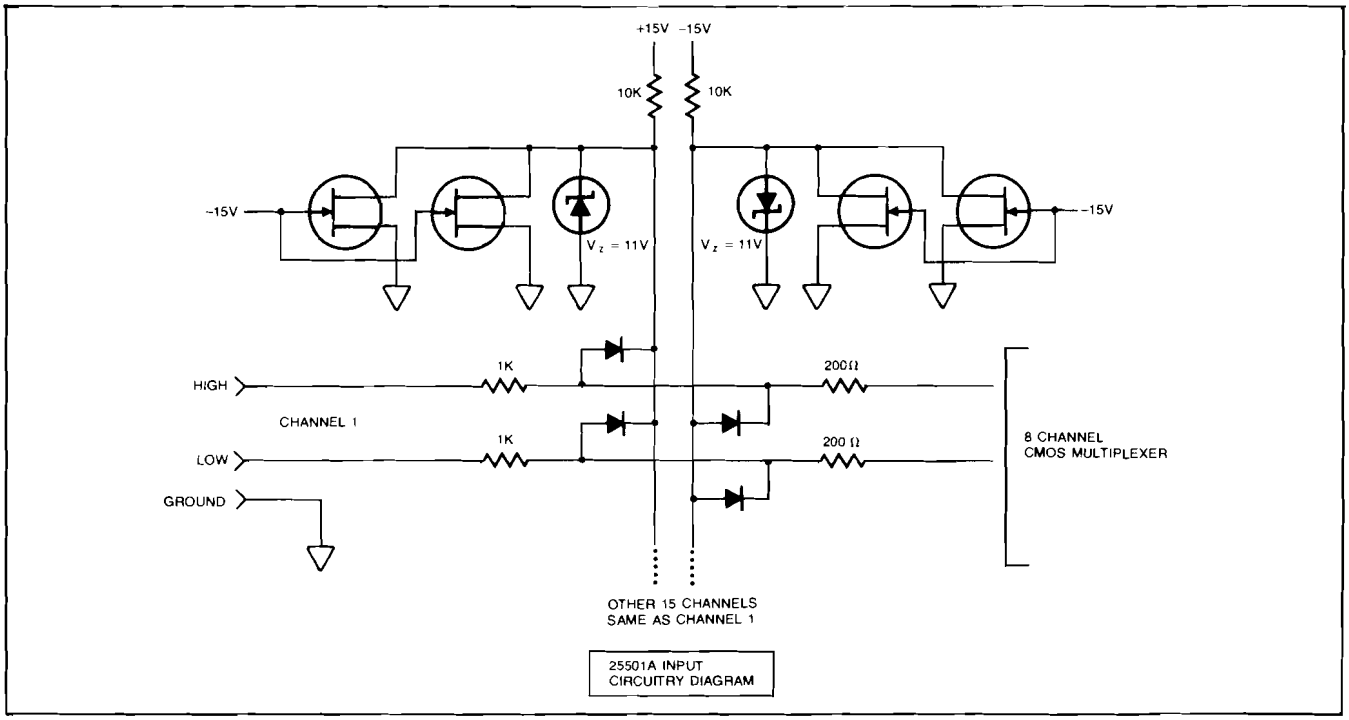
Power Off Steady State: Up to ±15 volts on any **one** input line to ground or to any other **one** input signal line.

Up to ±12.5 volts on all input lines simultaneously.

Common mode rejection and crosstalk

COMMON MODE:

Source Imbalance	Frequency	Common Mode Rejection (dB)	μV of Error Referred to Input Per 1 Volt of Common Mode
0 Ω	DC to 1 kHz	86	50
	DC to 5 kHz	76	158
	DC to 10 kHz	70	316
1K Ω	DC to 50 Hz	80	100
	DC to 100 Hz	74	200
	DC to 500 Hz	60	1000
	DC to 1 kHz	54	2 mV



25501A INPUT CIRCUITRY DIAGRAM

AC crosstalk: (Channel to adjacent channel)

Frequency	dB	μV of Error Referred to Input per 1 Volt of Signal on Adjacent Channel
DC to 2.5 kHz	96	16
5 kHz	90	32
10 kHz	84	64
25 kHz	72	250

Overload crosstalk: Readings on channels adjacent to overload channel will meet AC crosstalk specification for overload voltages within the input overload specification.

Overload recovery time: Readings within rated accuracy within 1 msec after removal of maximum overload after changing channels from overloaded to non-overloaded channel.

Accuracy

Assumes 15 minute warm-up time. After condensation, assumes 1 hour warm-up time for RH up to 95%

Static Accuracy: (DC frequency inputs) without autozero, at 25°C, 0 to 95% relative humidity, non-condensing.

Input Channel Range	Accuracy Referred to Input (±1/2 LSB) % of F.S. RTI	Volts Referred to Input
±10	±0.04	±4 mV
±5	±0.04	±2 mV
±2.5	±0.05	±1.25 mV
±1.25	±0.06	±750 μV

Temperature coefficients

Zero Temperature Coefficient		Gain Temperature Coefficient
±40 $\frac{\mu V\ RTI}{°C}$	±80 $\frac{\mu V\ RTO}{°C}$	±40 $\frac{ppm}{°C}$

Example: On the ±2.5 volt range, what is the zero drift if the temperature moves from 25°C to 35°C?

Answer: The 2.5 volt range has the PGA set to a gain of 4.

Total zero drift =

$$\text{Temp. change} \left(\frac{\text{input offset drift}}{°C} + \frac{\text{output offset drift}}{°C \times \text{gain}}\right)$$

$$= 10°C \left(\frac{40\ \mu V}{°C} + \frac{80\ \mu V}{°C \times 4}\right) = 600\ \mu V$$

Static Accuracy with autozero (CLB command) over card temperature of 0-65°C, 0-95% relative humidity, noncondensing.

Input Channel Range	Accuracy Referred to Input (± 1/2 LSB) % F.S. RTI	Volts referred to Input
±10V	±.06	±6 mV
±5V	±.06	±3 mV
±2.5V	±.07	±1.75 mV
±1.25V	±.08	±1 mV

AC Accuracy

Bandwidths are for analog signal chain up to but not including the ADC itself. Includes PGA and Sample and Hold Amplifier.

Bandwidth

Full Power Bandwidth	
Input Channel Range	B.W.
±10V	10 kHz
±5V	10 kHz
±5V	10 kHz
±1.25V	10 kHz

Small Signal Bandwidth

Input Channel Range	B.W. 0.1% Flatness	1% Flatness	−3 dB
±10V	10 kHz	45 kHz	300 kHz
±5V	10 kHz	45 kHz	300 kHz
±2.5V	10 kHz	30 kHz	200 kHz
±1.25V	10 kHz	20 kHz	125 kHz

Noise

Input Channel Range	Effective μV RMS RTI	μV p-p RTI
±10V	625 μV	3.75 mV
±5V	312 μV	1.25 mV
±2.5V	156 μV	625 μV
±1.25V	75 μV	469 μV

Sample and hold

Aperture time: ≤ 50 nsec

Settling time

Output data within 2 LSB's of final value within one conversion time, (20 μsec) for any in range combination of full scale inputs and gain changes.

Example: Channel 1 at +10 volts to
Channel 2 at −10 volts,

or

Channel 6 at +10 volts on ±10 volt range to
Channel 11 at −1.25 volts on ±1.25 volt range.

Pacing Capability

- To 50 kHz maximum, channel-to-channel or across channels, random or sequential sequencing
- Slower rates software selectable

External trigger delay

- Maximum delay from external trigger on MCI card to hold = 6 μsec maximum.
- Maximum delay uncertainty = ± 500 nanoseconds.

Autoranging capability

The 25501A autoranging capability can be selected on a card or per channel basis. Effective range means the largest voltage that will be measured on that range without going to the next highest range.

Autoranged Gain	Effective Usable Input Range (±2%)
1	±10V
2	±4V
4	±2V
8	±1V

Autoranging time: No additional conversion time required for autoranging. Does not effect throughput.

Environmental: Same as HP 2250.

Power: Consumes 12 watts maximum.

Compatible multiplexers: 25502A, 25503A, 25504A. Up to 7 of any combination of the above. If 7 multiplexers are used the ADC must be in slot 1.

25501A options

Signal Connection Provisions (one required)

011: Customer-installed screw-terminated cables for 16 channels (two 25551As)

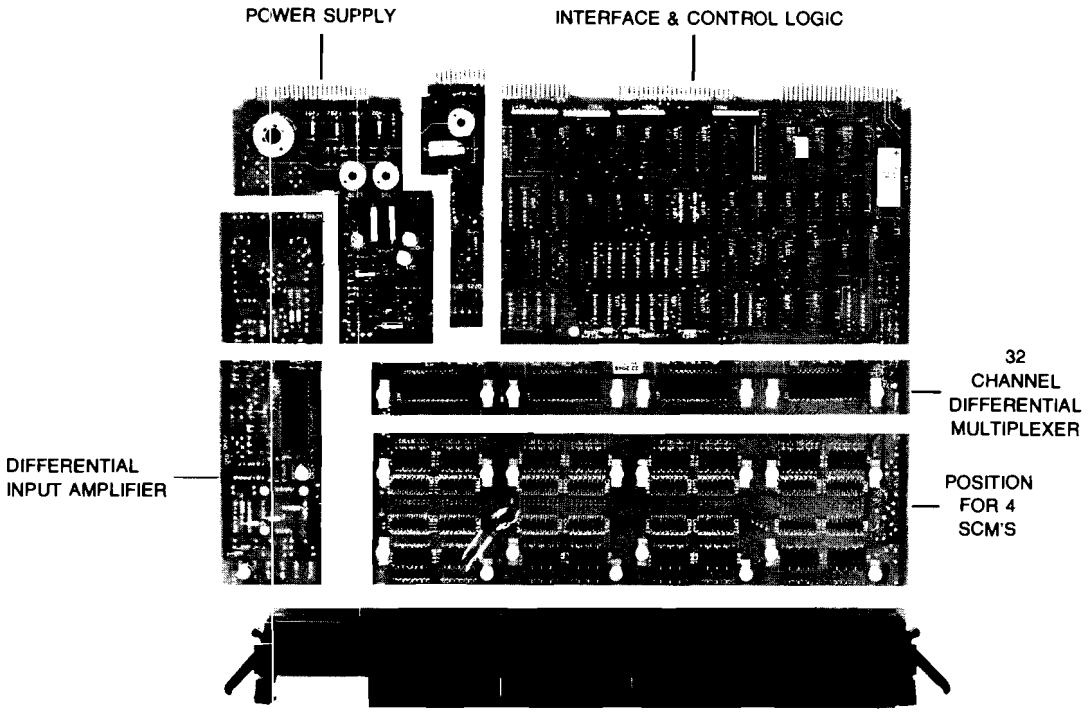
012: Customer-installed unterminated cables for 16 channels (two 25551Bs)

111: HP-installed screw-terminated cables for 16 channels (two 25551As) (2250N/M/R and 2251AN/AR on same order)

HEWLETT PACKARD

32 Channel solid state high level multiplexer

product number 25502A



Features

- 32 Differential Input Channels
- Auto Zero
- Input Filtering
- Current Loop Sense Resistors
- Input Protection
- Open Sensor Detection

Applications

This card is an expansion of the High Speed ADC, used for high level, low common mode analog inputs.

Description

The 25502A Solid State, High-Level Multiplexer Card provides the 2250 with high speed, high level analog input compatibility. It is used in conjunction with the 25501A High Speed ADC, providing 32 additional channels. With the 25501A and 25502A, signals from 156 μV to 10V can be digitized at rates up to 50 kHz. Also, user selectable signal conditioning modules may be installed on the 22502A to provide current loop sense resistors and two pole RC filters on a per channel basis.

Programming information

Command and function

AI:	Return voltage from specified channel in millivolts
AIR:	Return voltage in HP 1000 real format
AID:	Return voltage in double integer format
AIC:	Return data from channel in raw card format
GAIN:	Set gain (range) on a specified channel
RGAIN:	Read gain (range) on a specified channel
CLB:	Perform an auto-zero cycle
RANGE:	Set analog range

Specifications

(For operation with 25501 card, these specifications are accurate in the 0-65 °C range measured at the card, unless otherwise noted.)

Input ranges and resolutions:

Input Channel Span	Input Channel Range	Resolution (1 LSB)	DM*	CM**	PGA Gain
20V	±10V	1.25 mV	±10	±10	1
10V	±5V	625 μV	±5	±10	2
5V	±2.5V	312.5 μV	±2.5	±10	4
2.5V	±1.25V	156.25 μV	±1.25	±10	8

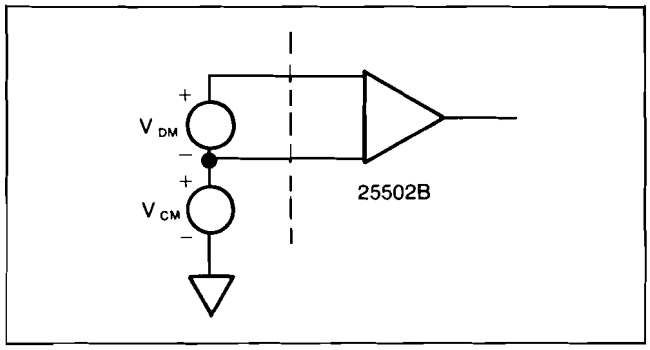
** DM = differential input voltage*
*** CM = common mode input voltage*
In all cases: /CM/ +/DM/ ≤ 10V

Input ranges and resolution: When used with 25501A.

Input Range Span F.S.R.	Input Channel Range F.S.	Resolution (1 LSB)	PGA Gain
20V	±10V	1.25 mV	1
10V	±5V	625 μV	2
5V	±2.5V	312 μV	4
2.5V	±1.25V	156 μV	8

Maximum input voltage for rated accuracy

Maximum differential and maximum common mode must be less than or equal to ±10 volts.



Example: With a common mode voltage of +4 volts, the maximum differential voltage that can be measured would be ±6 volts.

Source impedance and imbalance

Maximum source impedance for rated accuracy: 1K Ω

Maximum source imbalance for rated accuracy: 1K Ω

Maximum return impedance for rated accuracy: 10K Ω

Input impedance

Power on: ≥ 10M Ω shunted by ≤ 80 pf.
Power off: 1K Ω ± 10% to ground
2K Ω ± 20% to any other signal input line.

Input overload protection

No damage will occur below these levels:

Power On Steady State: Up to ±25 volts on any **one** input signal line to ground, or to any other **one** signal input line.

Derate by 1.0 volts for each additional overloaded signal input line.

Example: What is the maximum simultaneous allowable overload on 4 input channels?

There are 2 input lines per channel, therefore,

Maximum overload voltage per line = 25 - (4x2x1) = 17 volts

Transient: ±50 volts on any one input signal line to ground or to any other one signal input line, for a maximum of 10 seconds.

Power Off Steady State: Up to ±15 volts on any **one** input line to ground or to any other **one** input signal line.

Up to ±12 volts on all input signal lines simultaneously.

Common mode rejection and crosstalk

NOTE: Measured at screw terminations through 2 meters of coaxial cable.

Common mode

Source Imbalance	Frequency	Common Mode Rejection (dB)	μV of Error RFI per 1 Volt of Common Mode
0 Ω	DC to 30 kHz	82	79
	DC to 10 kHz	72	251
	DC to 25 kHz	62	794
1K Ω	DC to 100 Hz	76	158
	DC to 500 Hz	63	707
	DC to 5 Hz	42	7.94 mV

Channel-to-channel AC crosstalk with 1K μ source impedance.

Frequency	Crosstalk Rejection dB	μV of Error RTI per 1 Volt of Signal on Adjacent Channel
DC to 25 kHz	92	25
5 kHz	88	39
10 kHz	83	70
25 kHz	76	150

Overload crosstalk: Readings on channels adjacent to overload channel will meet AC crosstalk specification for overload voltages within the input overload specification.

Overload recovery time: Readings within rated accuracy within 1 msec after removal of maximum overload of after changing channels from overloaded to non-overloaded channel.

Accuracy

Static Accuracy (DC frequency inputs) without autocalibrate cycle at 25°C

Accuracy % of F.S.	Volts RTI
.01% ±1/2 LSB	±1 mV ±1/2 LSB

AC Accuracy (No SCMs)

Full range: 1 LSB degradation point 860 Hz
3 dB point 86 kHz

Small signal: 1 LSB degridation point 10 kHz
3 dB point > 500 kHz

Noise

Effective RMS volts RFI 1 mV
Effective RMS volts p-p RFI 25 mV

Temperature coefficients (0° - 70°C)

DRIFT % F.S. RTI/°C - .0007% / °C
DRIFT μV RTI/°C - 70 μV/°C
GAIN DRIFT % F.S. RTI/°C - .004% / °C

Residual offset after autocalibration command

% of F.S. RTI - .02%
Volts RTI - 2 mV

Power required: 10 watts

Environmental: Same as 2250 controller section

25502A options

Signal Connection Provisions (one required)

011: Customer-installed, screw-terminated cables for 32 channels (four 25551As)

012: Customer-installed unterminated cables for 32 channels (four 25551Bs)

111: HP-installed, screw-terminated cables for 32 channels (four 25551As) (2250N/M/R and 2251AN/AR on same order)

Signal conditioning (optional)

A40: Customer's signal conditioning breadboard modules (four 25540As)

B40: R-C Filter Signal Conditioning Modules (four 25540Bs)

C40: 4-20 mA Current Loop Signal Conditioning Modules (four 25540Cs)

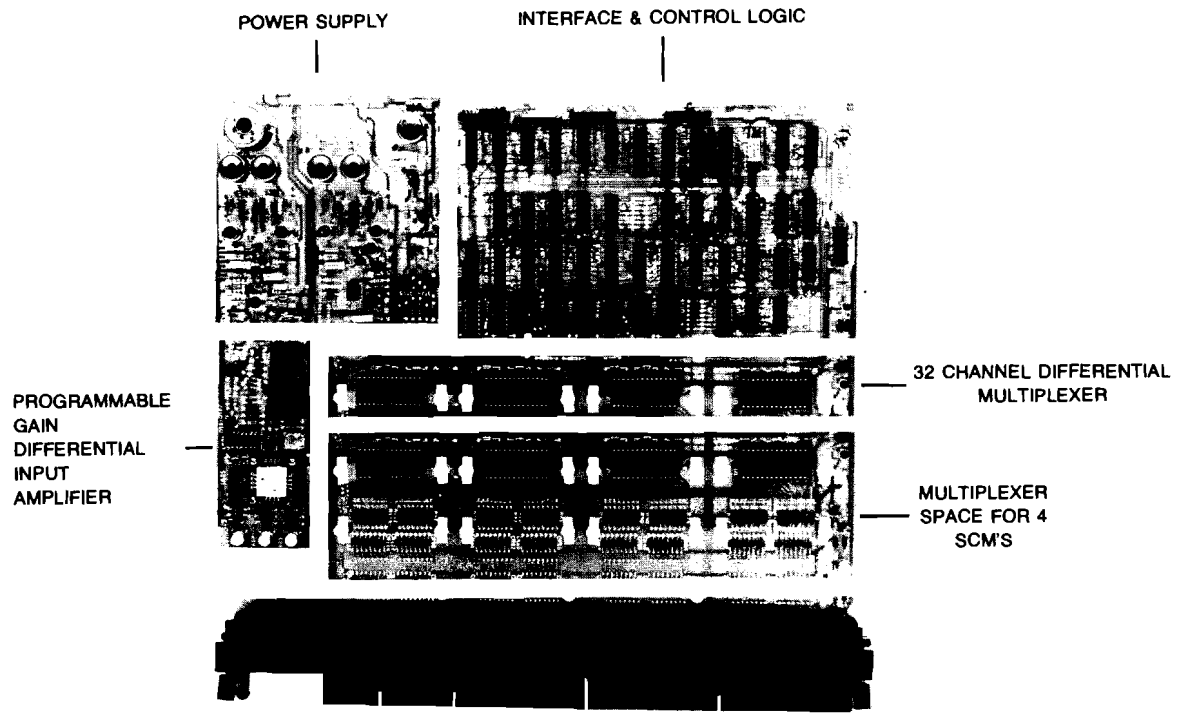
D40: 4-20 mA Signal Conditioning Modules with R-C Filters (four 25540Ds)

Z40: HP installation of one to four signal conditioning modules ordered as various 25540A/B/C/D components to provide different signal conditioning for different 25502A inputs

HEWLETT PACKARD

32 Channel solid state low level multiplexer

product number 25503A



Features

- 32 Differential Input Channels
- Programmable Gain Amplifier
- Auto Zero
- Input Filtering
- Current Loop Sense Resistors
- Input Protection
- Open Sensor Detection

Applications

This card allows the user to directly interface to low level analog signals without external amplifiers. It is an expansion of the High Speed ADC, for low level, low common mode analog inputs.

Description

The 25503A Solid State Low Level Multiplexer Card provides the 1000 AP with high speed, low level analog input capability. Used in conjunction with the 25501A High Speed ADC, each 25503A provides 32 additional channels with programmable gain set by the user on a per channel basis. With the 25501A and 25503A, signals from 1.56 μV to 10V can be digitized at rates up to 20 kHz. User selectable signal conditioning modules may be installed on the 25503A to provide current loop sense resistors and two pole RC filters on a per channel basis.

Programming information

Command and Function

AI:	Return voltage from specified channel in millivolts
AIR:	Return voltage in HP 1000 real format
AID:	Return voltage in double integer format
AIC:	Return data from channel in raw card format
GAIN:	Set gain (range) on a specified channel
RGAIN:	Read gain (range) on a specified channel
CLB:	Perform an auto-zero cycle
RANGE:	Set analog range

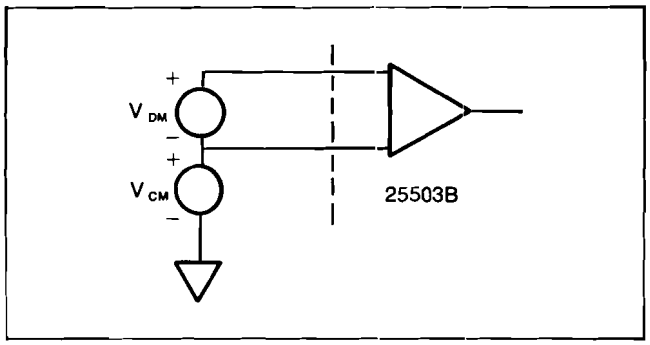
Specifications

Input ranges and resolution when used with 25501 ADC

Input Channel Span (F.S.R.)	Range (F.S.)	Resolution (1LSB)	Total PGA Gain
20V	±10V	1.25 mV	1
10V	±5V	625 μV	2
5V	±2.5V	312 μV	4
2.5V	±1.25V	156 μV	8
2V	±1 Volt	125 μV	10
1V	±500 mV	62.5 μV	20
500 mV	±250 mV	31.2 μV	40
250 mV	±125 mV	15.6 μV	80
200 mV	±100 mV	12.5 μV	100
100 mV	±50 mV	6.25 μV	200
50 mV	±25 mV	3.12 μV	400
25 mV	±12.5 mV	1.56 μV	800

Maximum input voltage for rated accuracy

Maximum differential voltage and maximum common mode voltage must be less than or equal to ±10 volts.



EXAMPLE: On the ±250 mV range, the maximum differential input input allowed is 250 mV, therefore V_{cm}(maximum) = 10-250 mV = 9.750V

Source impedance and imbalance: return impedance

Maximum source impedance for rated accuracy: 1K Ω

Maximum source impedance for rated accuracy: 1K Ω

Maximum return impedance for rated accuracy: 10K Ω

Input Impedance

Power On: ≥ 10m Ω shunted by ≤ 80 pf

Power Off: 1K Ω ± 10% to ground
2K Ω ± 20% to any other signal input line

Input overload protection

No damage will occur below these levels:

Power on steady state: Up to ±25 volts on any **one** input signal line to ground, or to any other **one** signal input line. Derate by 1.0 volts for each additional overloaded signal input line.

For example, the maximum simultaneous allowable overload on four input channels would be 17 volts, derived as follows:

25V - (4 chan × 2 signal lines × 1V) = 17V

Power on transient: ±50 volts on any one input signal line to ground or to any other one signal input line, for a maximum of 10 seconds.

Power off steady state: Up to ±15 volts on any **one** input line to ground or to any other **one** input signal line. Up to ±12.5 volts on all input signal lines simultaneously.

Common mode rejection and crosstalk

NOTE: Measured at screw terminations through 2 meters of coaxial cable.

Common mode

Source Imbalance	Frequency	Common Mode Rejection (dB)	μV of Error Referred to Input per 1 Volt of Common Mode
0 Ω	DC to 3 kHz	82	79
	DC to 10 kHz	72	251
	DC to 25 kHz	62	794
1K Ω	DC to 100 Hz	76	158
	DC to 500 Hz	63	707
	DC to 5 kHz	42	7.94

Channel-to-Channel AC crosstalk with 1K Ω source impedance

Frequency	dB	μV of Error Referred to Input PGR 1 Volt of Signal on Adjacent Channel
DC to 2.5 kHz	92	25
5 kHz	88	39
10 kHz	83	70
25 kHz	76	158

Overload crosstalk: Readings on channels adjacent to overloaded channel will meet AC crosstalk specification for overload voltages within the input overload specification.

Overload recovery time: Readings within rated accuracy within 1 msec after removal of maximum overload of after changing channels from overloaded to non-overloaded channel.

Accuracy

Static accuracy: (DC frequency inputs) without autocalibration cycle at 25°C.

Range	Accuracy %of F.S.	Volts Referred to Input
±10V	.01% ±1/2 LSB	±1 mV ±1/2LSB
±1V	.08% ±1/2 LSB	±200 μV ±1/2LSB
±0.1V	.04% ±1/2 LSB	±40 μV ±1/2LSB

AC Accuracy

BANDWITTH FULL RANGE

Input Range	1 LSB Degradation Point	3 dB Point
±10V	860 Hz	86 kHz
± 1V	430 Hz	43 kHz
±.1V	320 Hz	32 kHz

Small signal

Input Range	1 LSB Degradation Point	3 dB Point
±10V	≈ 10 kHz	> 500 kHz
± 1V	560 Hz	56 kHz
±.1V	320 Hz	35 kHz

Noise

Input Channel Range	Effective μV RMS RTI	μV p-p RTI
±10V	1 mV	2.5 mV
±1V	50 μV	250
±.1V	10 μV	70

Temperature coefficients 0°70°C

	DRIFT % F.S. RTI °C	DRIFT μV RTE °C	GAIN DRIFT % F.S. RTI °C
±10V	.0007% / °C	70 μV/°C	.004% / °C
±1V	.002% / °C	25 μV/°C	.004% / °C
±.1V	.02% / °C	20 μV/°C	.004% / °C

Residual offset after autocalibration command

Range	Resulting Offset After % of F.S. RTI	Calibration μV RTI
±10V	.02%	2mV
±1V	.03%	300 μV
±.1V	.03%	30 μV

Environmental

Same as HP 2250

25503A options

Signal Connection Provisions (one required)

011: Customer-installed, screw-terminated cables for 32 channels (four 25551As)

012: Customer-installed unterminated cables for 32 channels (for 25551Bs)

013: Customer-installed isothermal reference terminations for 32 channels (two 25594As)

014: Customer-installed isothermal reference terminations for 16 channels (one 25594A) and screw-terminated cables for 16 channels (two 25551As)

111: HP-installed screw-terminated cables for 32 channels (four 25551As) (2250N/R and 2251AN/AR on same order section)

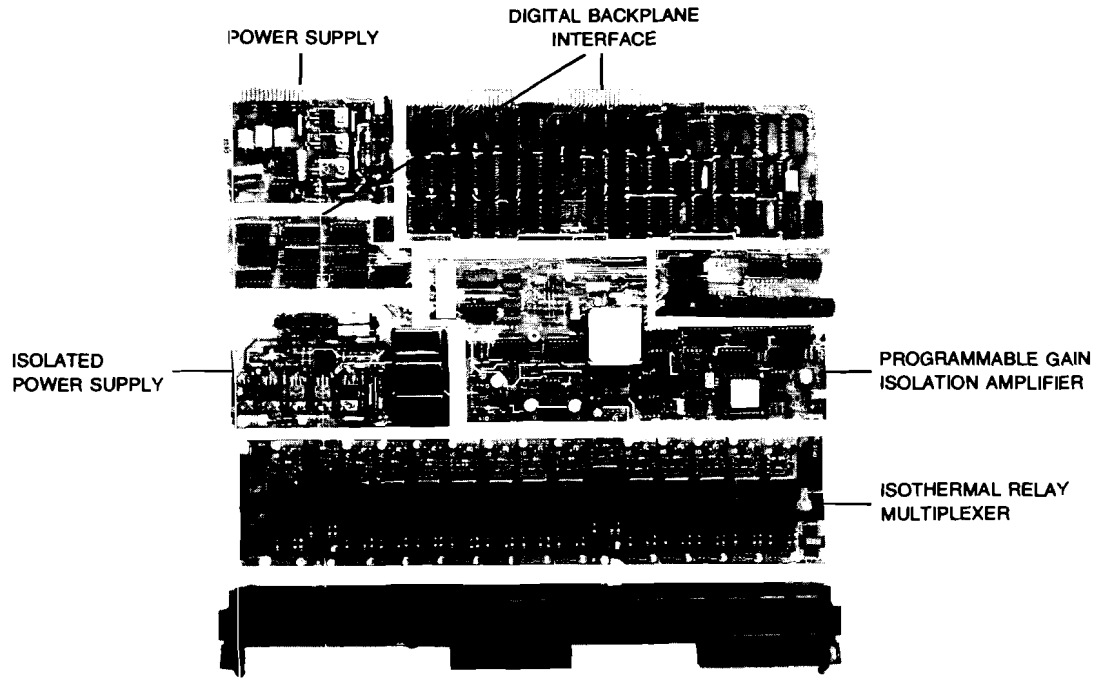
113: HP-installed isothermal reference terminations for 30 channels (two 25594As) (2250N/R and 2251AN/AR on same order section)

116: HP-installed isothermal reference terminations for 15 channels (one 25594A) and screw-terminated cables for 16 channels (two 25551As) (2250N/R and 2251AN/AR on same order section)

HEWLETT PACKARD

16 Channel relay multiplexer card — technical data

product number 25504A



Features

- 16 channels, scanning at 1 kHz
- 14 bit resolution
- Programmable full scale ranges from ±100V to ±12.4mV.
- ±350 volt peak common mode range
- Programmable open sensor detection
- Current loop option

Applications

The relay mux is viewed as a solution to the difficult measurement situations a customer may encounter. Having moderate speed and true ground isolation, the card can be applied in virtually any electrical environment for thermocouple, RTD, and other transducer measurements.

Description

The High Common Mode, Wide Range Multiplexer card provides the means for interfacing up to 112 High Common Mode Signal sources to a 2251 MCU. Each multiplexer contains 16 relay selected channels that switch high, low and guard. The card also has a programmable gain amplifier with four settings (×0.1, ×1, ×10, ×100), and provides common mode isolation via magnetic coupling to break ground loops between measurement points and the system.

The range of the card allows the user to interface directly with low level sensors such as thermocouples. An open condition on an input line can be tested with the programmable open sensor current source.

Programming information

Command and Function

AI	Return voltage from specified channel in millivolts
AIR	Return voltage in HP 1000 real format
AID	Return voltage in double integer format
AIC	Return data from channel in raw card format
GAIN	Set gain (range) on a specified channel
RGAIN	Read gain (range) on a specified channel
CLB	Perform an auto-zero cycle
RANGE	Set analog range

Specifications (preliminary)

Input range and resolution

25504A Multiplexer gain (range/resolution)

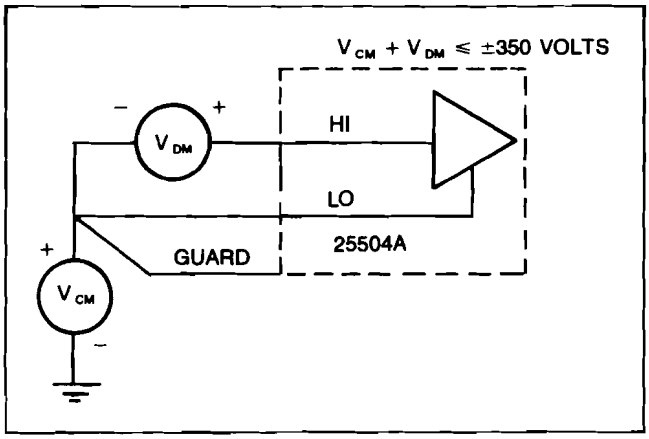
		0.1	1.0	10.0	100.0
25501A ADC GAIN	1	± 100V 12.5 mV	± 10.0V 1.25 mV	± 1.0V 125 μV	± 0.1V 12.5 μV
	2	± 50V 6.25 mV	± 5V 625 μV	± 0.5V 62.5 μV	± 0.05V 6.25 μV
	4	± 25V 3.13 mV	± 2.5V 313 μV	± 0.25V 31.3 μV	± 0.025V 3.13 μV
	8	± 12.5V 1.56 mV	± 1.25V 156 μV	± 0.125V 15.6 μV	± 0.0125V 1.56 μV

SPAN = 2 × absolute value (range).

Common mode voltage limits

Common mode voltage: 350 volts peak.

Channel-to-channel common mode voltage: 350 volts peak. The potential difference between any two channels shall never exceed 350 volts peak. If channel 1 has a +10 volt differential signal and a +100 volt common mode signal applied to it's input, then channel 2 will have no more than 110 volts minus 350 volts (–240 volts) total (sum of differential and common mode) applied to its input.



Common mode rejection and crosstalk

Effective common mode rejection*:

60 Hz 165 dB (average of ten 25501 ADC readings)*
120 Hz 140 dB (average of ten 25501 ADC readings)*

** Effective common mode rejection is defined as the sum of the common mode rejection of the 25504 relay multiplexer and the normal mode rejection provided by the 25501 A to D converter when used as a digital filter through the available MCL/50 commands. The 2250 measurement and control language, through the use of CPACE, and WPACE, allow the user to take a group of paced readings over a cycle of the common mode signal. These can then be averaged by applying the AAVERAGE command resulting in the Effective Common Mode Rejection outlined above.*

For a 60 Hz common mode signal one would set the pace rates as follows:

Common Mode Period = 16.66 msec. (1/60 Hz)
Pace Rate = 16.66/10 = 1.666 msec. (10 readings)

For an individual 25504 multiplexer the effective scan rate would be 60 Hz.

Common mode rejection (without signal averaging)

Source Imbalance	Frequency	DB
0 Ω	DC to 1 kHz DC to 5 kHz DC to 10 kHz	104 dB 90 dB 84 dB
1K Ω	DC to 50 Hz DC to 100 Hz DC to 500 Hz DC to 1 kHz	110 db 104 db 90 dB 84 db

AC crosstalk (channel to adjacent channel)

Frequency	dB
DC to: 50 Hz	–120
60 Hz	–118
100 Hz	–114

AC crosstalk (1 channel to 15 off channels)

Frequency	B
50 Hz	–97
60 Hz	–95
100 Hz	–91

Source impedance:

Maximum source impedance for rated accuracy: 1K Ω

Maximum source imbalance for rated accuracy: 1K Ω

Input impedance

Open channel: > 100 meg Ω, shunted by 3 pf

Closed channel: > 1 meg Ω all ranges, 50 pf shunt

Power off: > 100 meg Ω, 3 pf shunt

Input overload protection

1 - 100 Gain range*: (Overload occurs at ±12 volts) steady state up to 350 volts.

0.1 Gain range: Steady state up to 250 volts; power off to 350 volts

** The 25504A includes an overload circuit that opens the relay of the selected channel when a potential greater than 12 volts is applied. The returned analog data will indicate full scale overrange. Overload recovery requires initiating a new reading on the addressed channel.*

Accuracy

Static accuracy: At 25 °C without autocalibrate cycle.

Input Channel Range	Accuracy Referred to Input		
	% of F.S. RTI		Volts RTI
± 100 Volts	±0.05 %	±1/2 LSB	50.0 mV ±1/2 LSB
± 10 Volts	±0.05 %	±1/2 LSB	5.00 mV ±1/2 LSB
± 1 Volt	±0.05 %	±1/2 LSB	500 μV ±1/2 LSB
± 0.1 Volts	±0.05 %	±1/2 LSB	50 μV ±1/2 LSB

Note – a table showing 0-70 °C accuracy will be available.

Temperature coefficients (Without autorange, 0°C - 70°C)

Input Channel Range	Offset Temperature Coefficient RTI		Gain Temperature Coefficient RTI
±100	0.0007%/°C	700 μV/°C	±0.004%/°C
±10	0.0007%/°C	70 μV/°C	±0.004%/°C
±1	0.0025%/°C	25 μV/°C	±0.004%/°C
±0.1	0.02%/°C	20 μV/°C	±0.004%/°C

Static offset: (With auto calibration on 0°C - 70°C)

Input Channel	Accuracy Referred to Input	
±100	0.0005%	500 μV RTI
±10	0.0005%	50 μV RTI
±1	0.005%	50 μV RTI
±0.1	0.05%	50 μV RTI

AC Accuracy

FULL POWER BANDWIDTH	
Input Channel Range	Bandwidth
±100	5 kHz
±10	5 kHz
±1	5 kHz
±0.1	1 kHz
SMALL SIGNAL BANDWIDTH	
±100	10 kHz
±10	10 kHz
±1	10 kHz
±0.1	5 kHz

Noise

Input Channel Range	μV RMS RTI	μV P-P
±100	1000	3000
±10	500	1500
±1	100	300
±0.1	15	45

Open sensor current source

1.02 microamps ±10% (Not available on the 100 volt range)

The 25504 contains an open sensor detection current source that can be programmed to output a 1.02 microamp current. The user turns on the current source and then determines the integrity of the cards input connections by monitoring the analog readings.

Relay characteristics

Scan rate

Input Channel Range	Rate
0.1 - 1.0	1 kHz
10 - 100	500 Hz

Lifetime

Low common mode ≤ 10V: 1×10^8 operations

High common mode ≤ 250V: 1×10^7 operations

25504A options

Signal Connection Provisions (one required)

011: Customer-installed, screw-terminated cables for 16 channels (two 25551As)

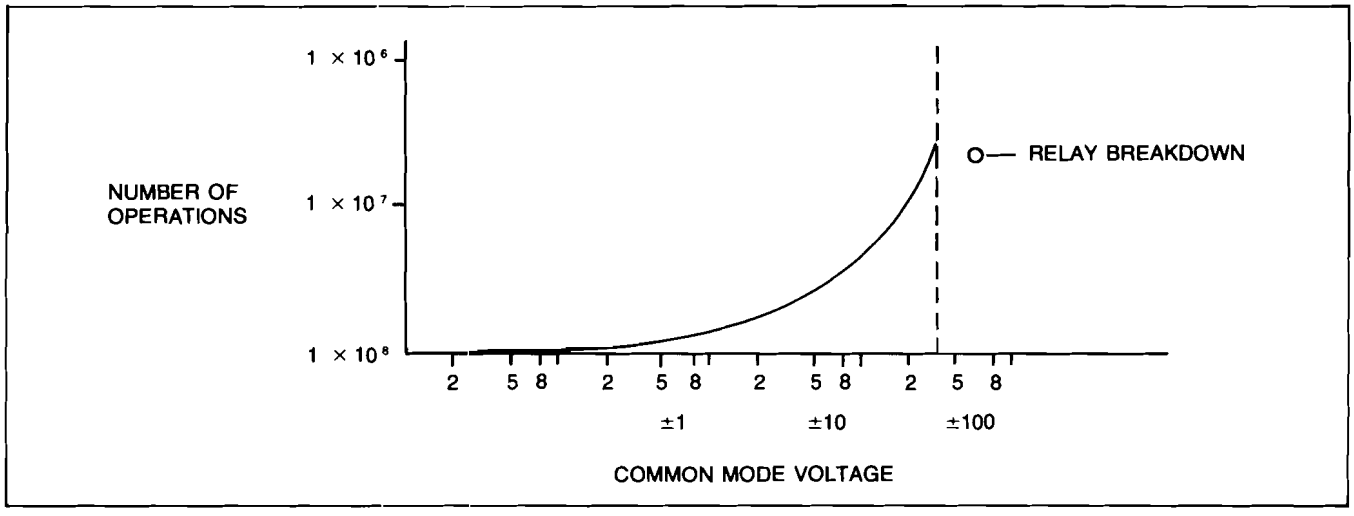
012: Customer-installed unterminated cables for 16 channels (two 25551Bs)

013: Customer-installed isothermal reference terminations for 16 channels (one 25594A)

111: HP-installed, screw-terminated cables for 16 channels (two 25551As) (2250N/M/R and 2251AN/AR on same order)

113: HP-installed isothermal reference terminations for 16 channels (one 25594A) (2250N/M/R and 2251AN/AR on same order)

Lifetime vs. common mode potential



HEWLETT PACKARD

Thermocouple reference connector

product number 25594A

Features

- Up to 15 thermocouple inputs
- Used with types J, K, T, E, R, S, and B thermocouples
- Allows any combination of thermocouple types
- Will accept up to AWG 18 wire
- Provides a voltage output proportional to the connector temperature

Applications

Provides an accurate reference junction for thermocouple measurement.

Description

The 25594A Thermocouple Reference Connector provides the 2250 with thermocouple measurement capability; up to 15 thermocouples may be connected. A low thermal gradient design maintains temperature uniformity across all 15 input channels, providing high precision*. A 16th channel is dedicated to providing a temperature reference for all connected thermocouples. Power to this circuit is provided by either the 25503A solid state low level multiplexer or the 25504A relay multiplexer. Both the power inputs and the reference voltage output have overvoltage protection.

Programming information

Command and function

REF: Read temperature of the specified reference connector.
JTEMP: Read temperature of the specified type J thermocouple.
KTEMP: Read temperature of the specified type K thermocouple.
TTEMP: Read temperature of the specified type T thermocouple.
ETEMP: Read temperature of the specified type E thermocouple.
RTEMP: Read temperature of the specified type R thermocouple.
STEMP: Read temperature of the specified type S thermocouple.
BTEMP: Read temperature of the specified type B thermocouple.

Specifications

Temperature gradient: <0.1 °C (across the entire connector)

Reference output: 10mV/°C nominal

Accuracy (0 to 70 °C): ±0.35 °C
(0 to 50 °C): ±0.25 °C

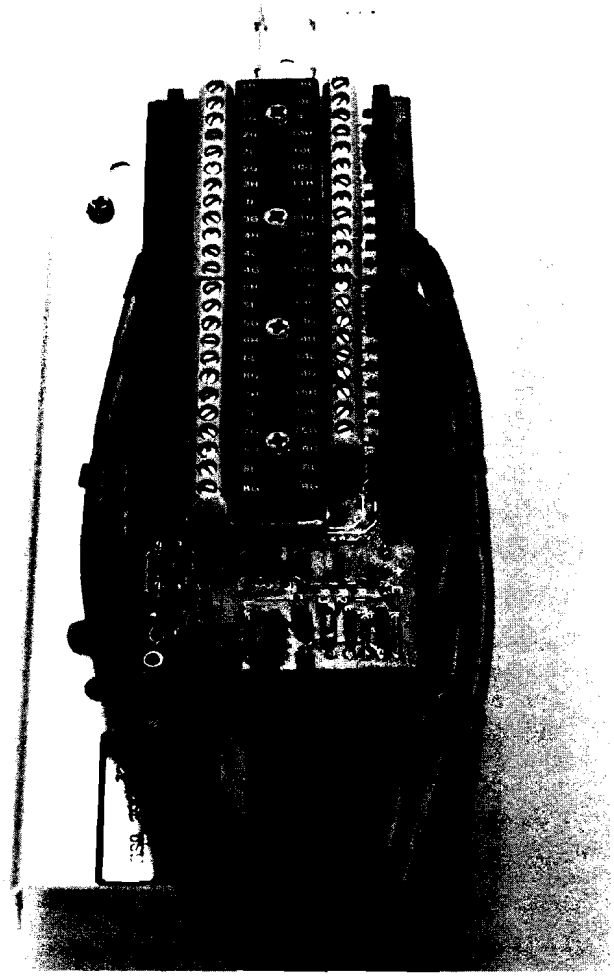
Stability: <0.3 °C/1000 hrs.

Overvoltage protection: ±80VDC for an indefinite period (power inputs)
±36VDC for an indefinite period (reference output)

Physical characteristics: PC board 16.2cm long, 5.72cm wide.

Power requirements: No external power required

Environmental: Same as 2250 measurement and control processor



Prerequisite: 2250, one 25501A ADC card, and one 25503A or 25504A multiplexer card

Hardware supplied: 25594A with 6 foot cable

Software supplied: None required

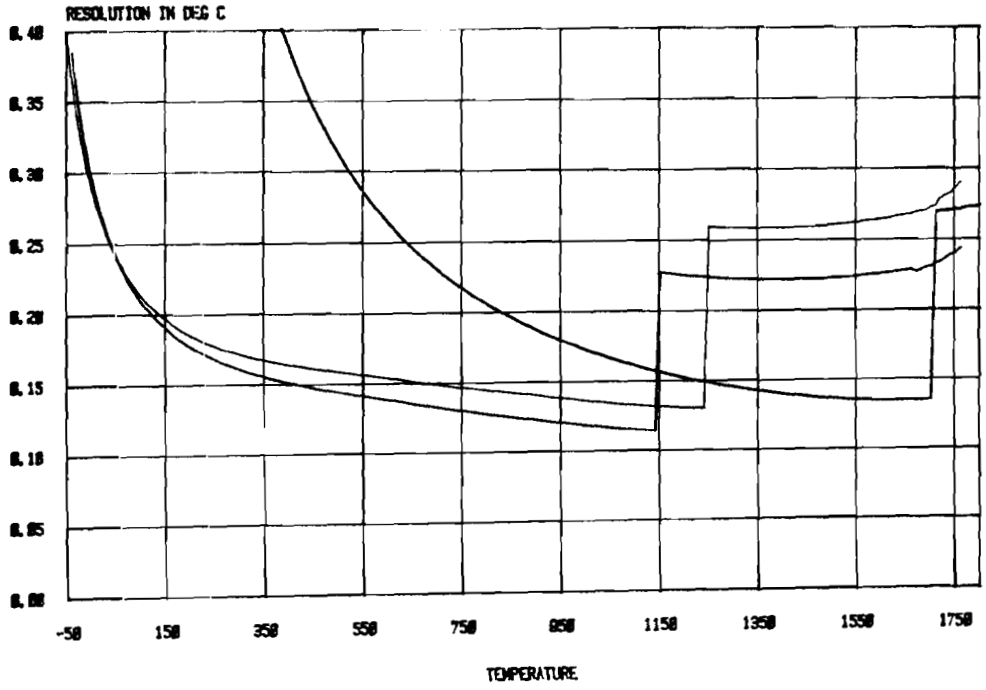
2250 THERMOCOUPLE RESOLUTION IN DEG C

NO ADC/MUX ERROR INCLUDED

R TYPE THERMOCOUPLE

S TYPE THERMOCOUPLE

B TYPE THERMOCOUPLE

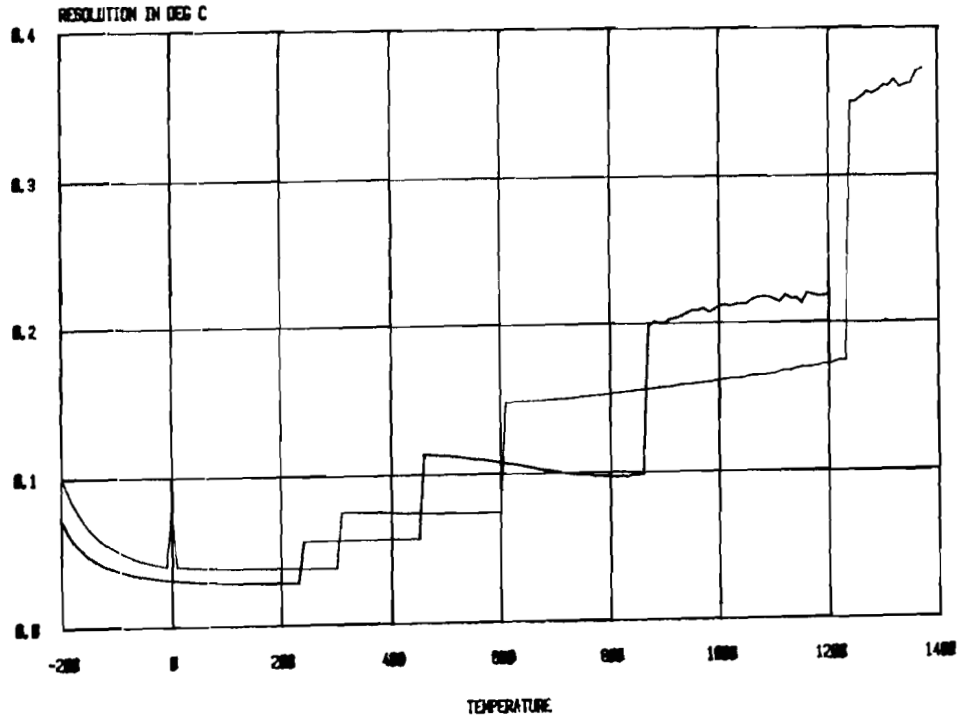


2250 THERMOCOUPLE RESOLUTION IN DEG C

NO ADC/MUX ERROR INCLUDED

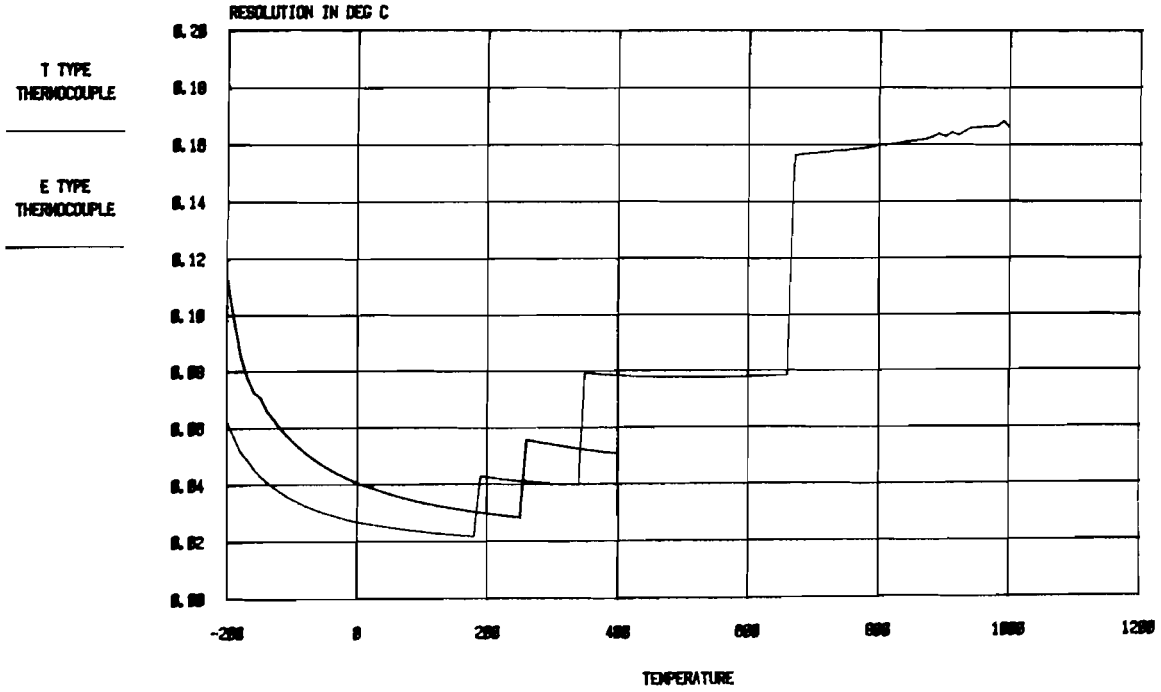
J TYPE THERMOCOUPLE

K TYPE THERMOCOUPLE



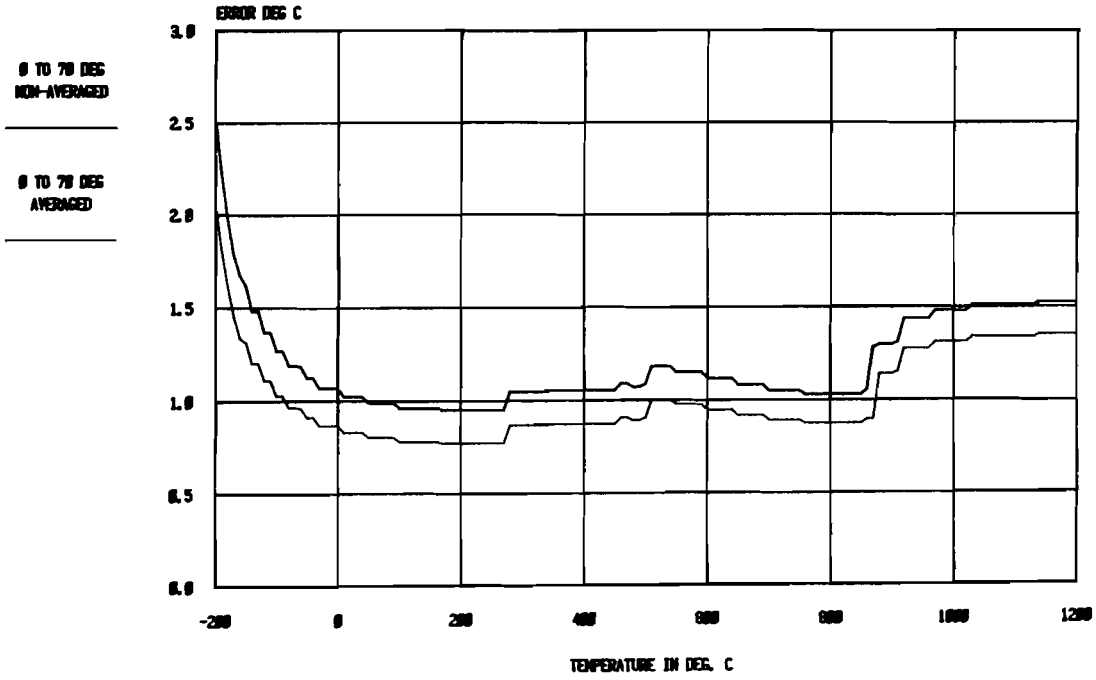
2250 THERMOCOUPLE RESOLUTION IN DEG C

NO ADC/MUX ERROR INCLUDED



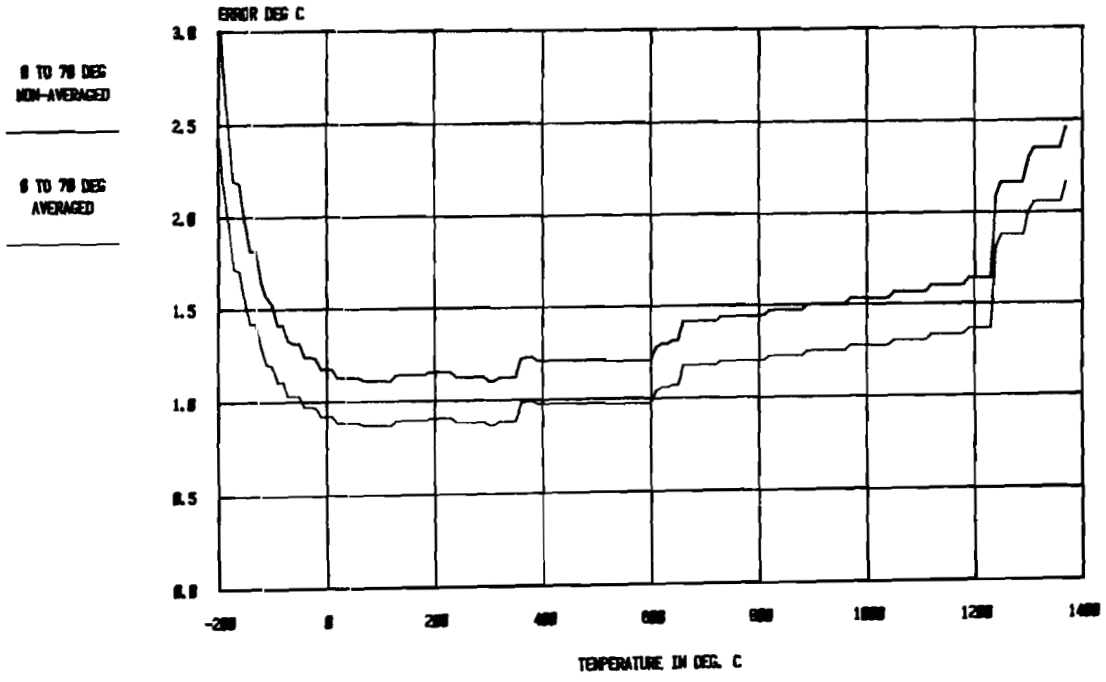
WORST CASE THERMOCOUPLE ERROR

FOR J TYPE THERMOCOUPLE



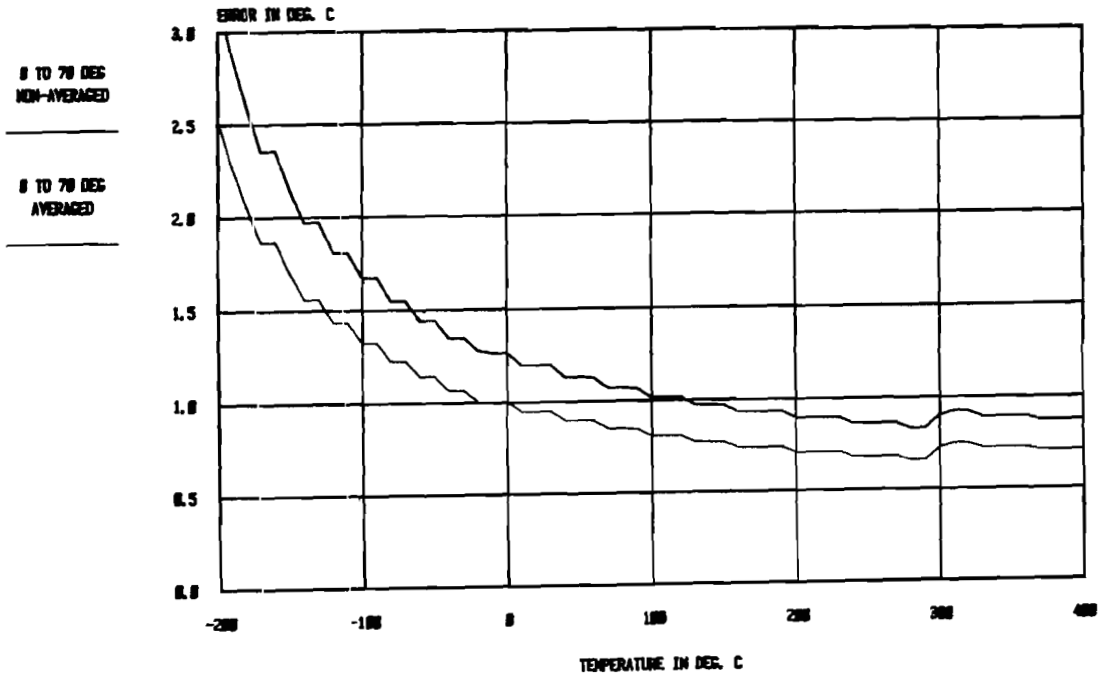
WORST CASE THERMOCOUPLE ERROR

FOR K TYPE THERMOCOUPLE



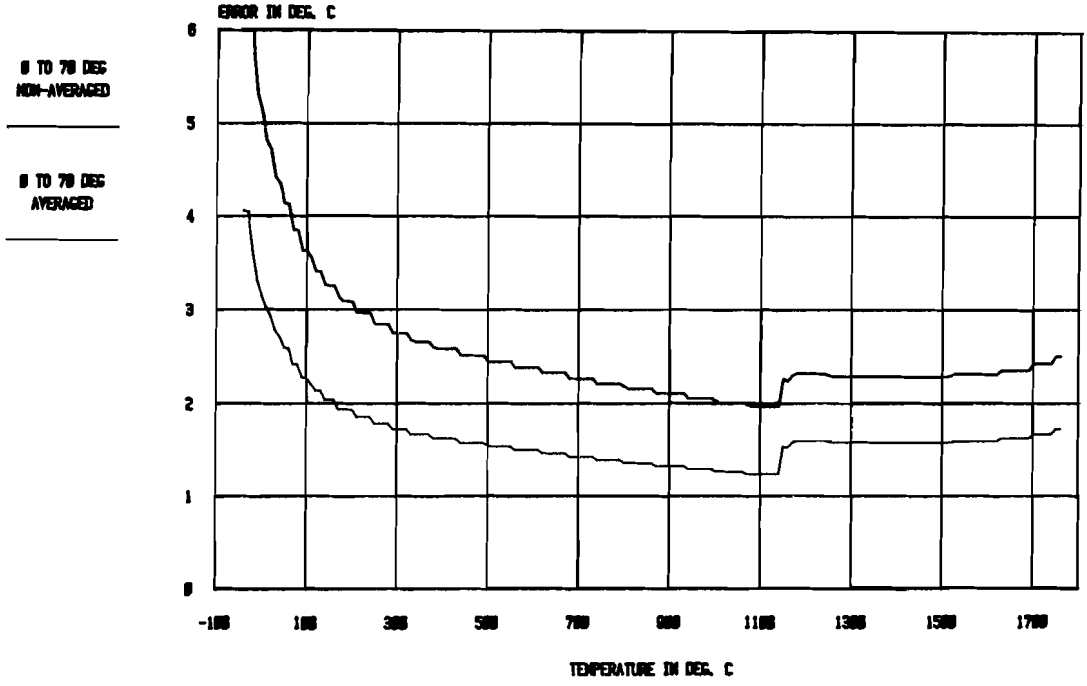
WORST CASE THERMOCOUPLE ERROR

FOR T TYPE THERMOCOUPLE



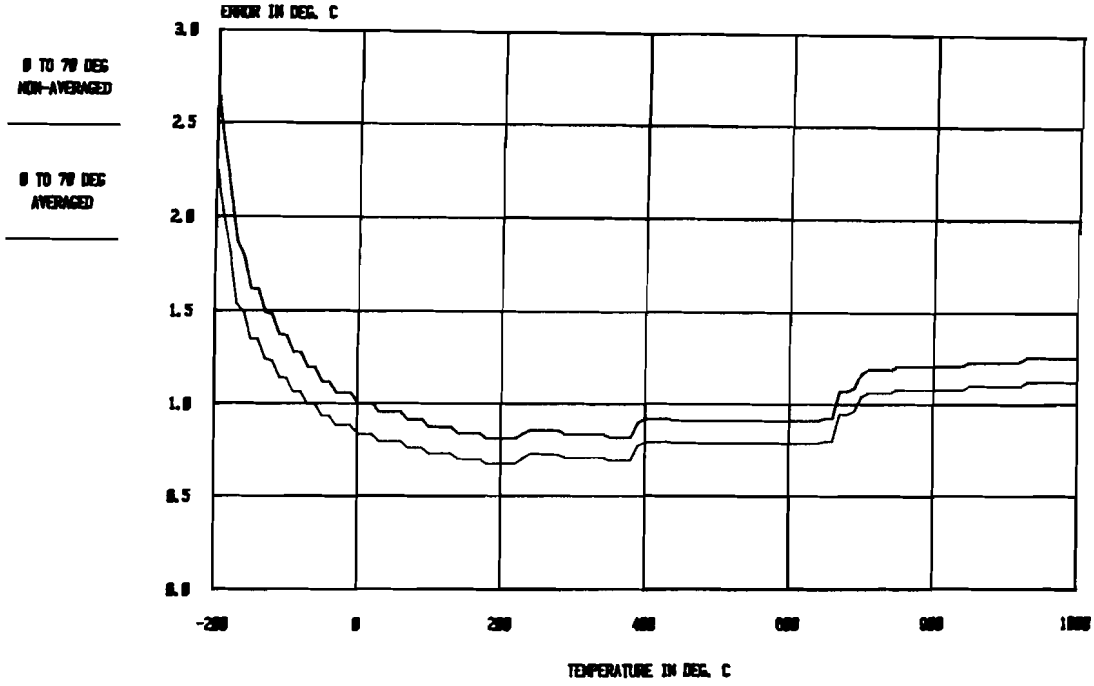
WORST CASE THERMOCOUPLE ERROR

FOR R TYPE THERMOCOUPLE



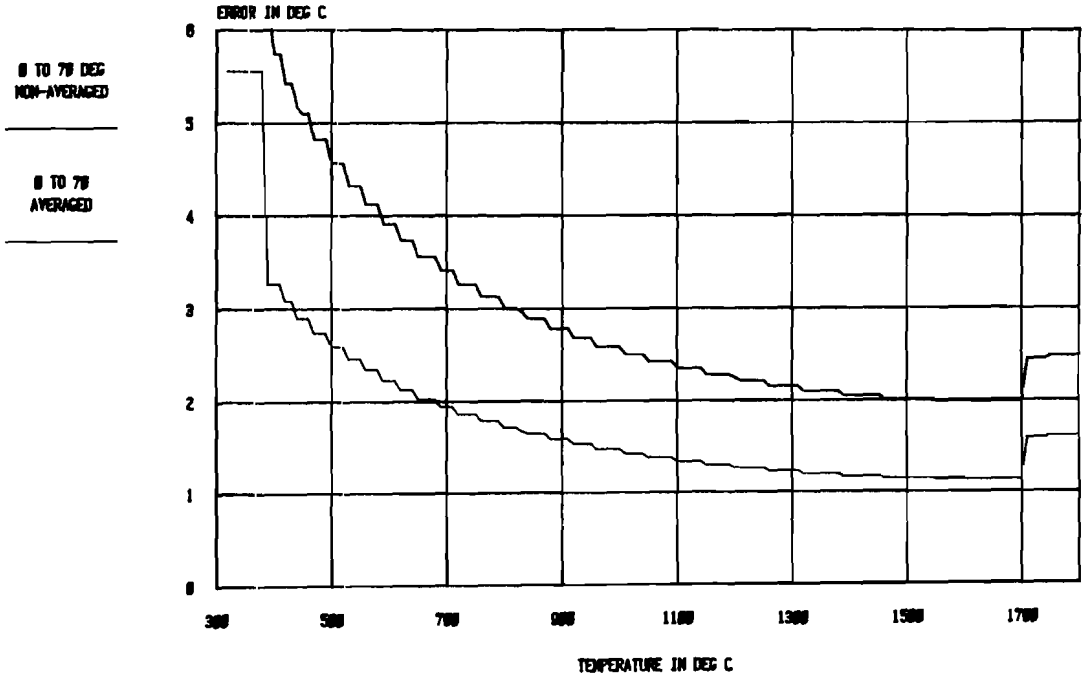
WORST CASE THERMOCOUPLE ERROR

FOR E TYPE THERMOCOUPLE



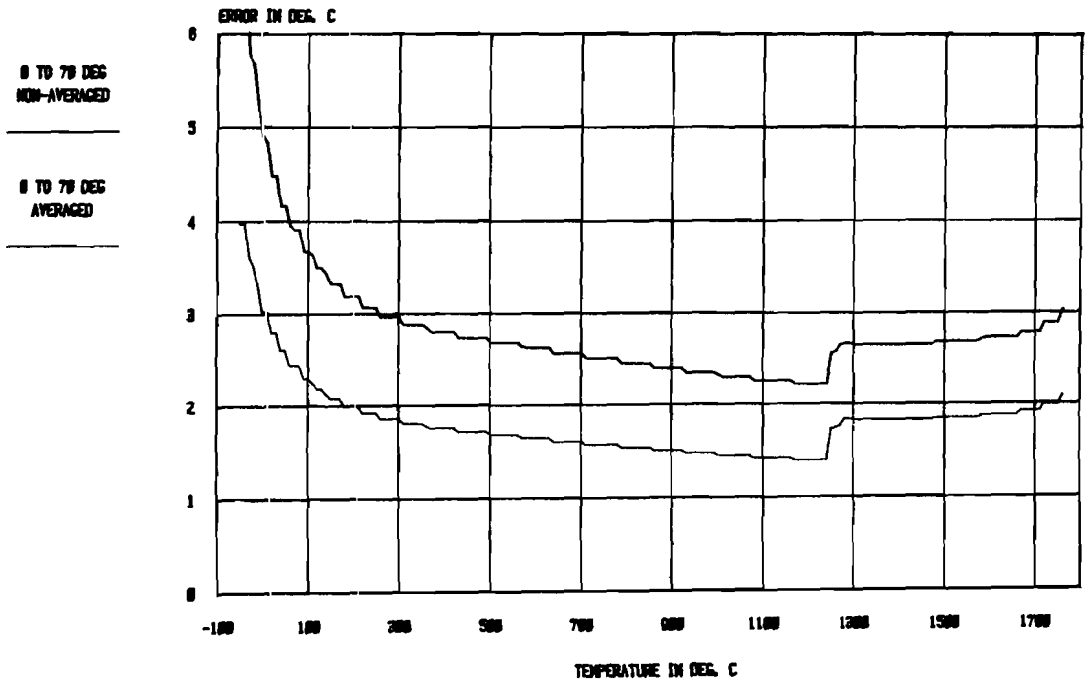
WORST CASE THERMOCOUPLE ERROR

FOR BTYPE THERMOCOUPLE



WORST CASE THERMOCOUPLE ERROR

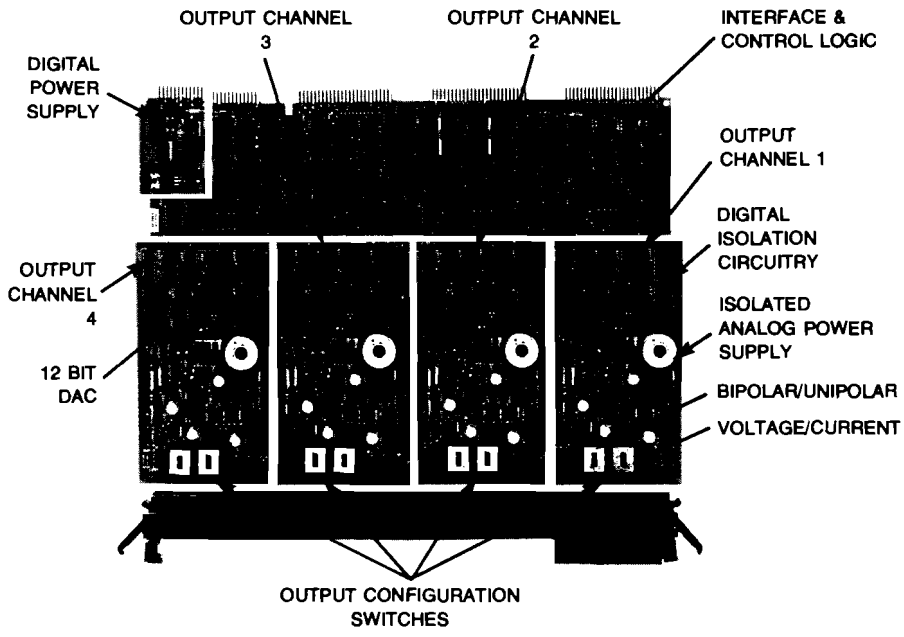
FOR S TYPE THERMOCOUPLE



HEWLETT PACKARD

4 Channel isolated voltage/ current analog output card

product number 25510A



Features

- 12 bit resolution
- 4 independent, isolated channels
- Unipolar or bipolar voltage output mode, or current output mode
- Remote sense capablity (voltage output mode)
- Buffered voltage ouputs
- 20 mA current output

Applications

Output channels are provided for proportional controllers, strip chart recorders, or any device controlled by either ±10 volt, 0-10V, 0-20mA levels or a 20mA current loop.

Description

The 25510A four channel isolated voltage/current analog output card provides the 2250 with its basic digital to analog conversion capability. It contains four output channels, each of which is electrically isolated from the other three and from ground. Each channel can be configured independently by switch settings to either voltage or current output, and for either unipolar or bipolar voltage ouput. Voltage outputs are buffered to provide up to 20mA of drive capability. Remote sense is provided to allow increased accuracy, though the card will function properly without it.

Programming information

Command and function

VO: Voltage output to specified channel, in millivolts
CO: Current output to specified channel, in microamps

Specifications

(0-70°C, 0-95% RH unless otherwise specified)

Parameter	Current (μA)	Unipolar Voltage (mV)	Bipolar Voltage
Command	CO	VO	VO
Command data range (integer)	0 to 20477	0 to 10238	−10240 to 10237
Output range	0 to 20475 μA	0 to 10237.5 mV	−10240 to 10235 mV
Compliance	20V	20 mA	±20 mA
Resolution	5 μA	2.5 mV	5 mV
Accuracy (25°C, less than 80% RH)	±5 μA	±2.5 mV	±5 mV
Recalibration required every 9 months of 18-28°C operation.			
Accuracy tempco (Includes Gain and Offset temperature coefficients)			
Below 80% RH 80 to 95% RH	±0.4 μA/ °C ±0.8	±0.2 mV/ °C ±0.4	±0.4 mV/°C ±0.8
Noise (RMS) (100 kHz bandwidth)	±2 μA	±1 mV	±2 mV
Settling Time (−FS to +FS to within 1 LSB)	300 μsec	100 μsec	100 μsec
Slew Rate	1 mA/μsec	5 V/μsec	5 V/μsec
Output protection (indefinite)	±35 VDC across any current output	Short or ±15 VDC across any voltage output	

Isolation: 400V peak common mode

Data rate (max): 31.25K words/second

Output Circuit: see next page

Power Requirement: 15.3 watts

Power dissipated (max): 18 watts

Dimensions: 35 × 29.5 × 3.5 cm

Crosstalk

AC voltages appearing on wires within the DAC cable assembly will appear on other wires within the same assembly due to capacitive coupling. The magnitude of the coupled voltage depends on the magnitude of the noise source, as well as its frequency. The 25510A DAC provides the following crosstalk attenuation from channel to channel. These values reflect measurements made at the screw terminals of a 25551A cable with no additional cabling attached. Additional cable lengths will degrade crosstalk attenuation depending on the added interchannel capacitance incurred.

f (kHz)	Attenuation (dB)	Attenuation Ratio V(crosstalk)/V(noise source)
1	−82	.00008
2	−77	.00014
5	−60	.001
10	−51	.0028
20	−42	.0079
50	−34	.02
100	−29	.035
200	−28	.04

dB values are asymptotic to −26 dB at 10 MHz

To calculate the actual crosstalk voltage

V(crosstalk) = V(noise source) x attenuation ratio

Example: The low side of an adjacent channel has 10VAC, 50 kHz of noise. The voltage appearing differentially across the channel of interest is

10 × .02 = 200 mV, 50 kHz

AC crosstalk will have little effect on DC accuracy under normal circumstances. However, if the DAC is being used for waveform synthesis, crosstalk will result in spectral impurities. The magnitudes of these impurities can be calculated using the above table. Also, if large parasitic capacitances exist across channel outputs and from outputs to the noise source, the coupled noise potentials may become large enough to upset the control application. To minimize this possibility, cables should be kept as short as possible.

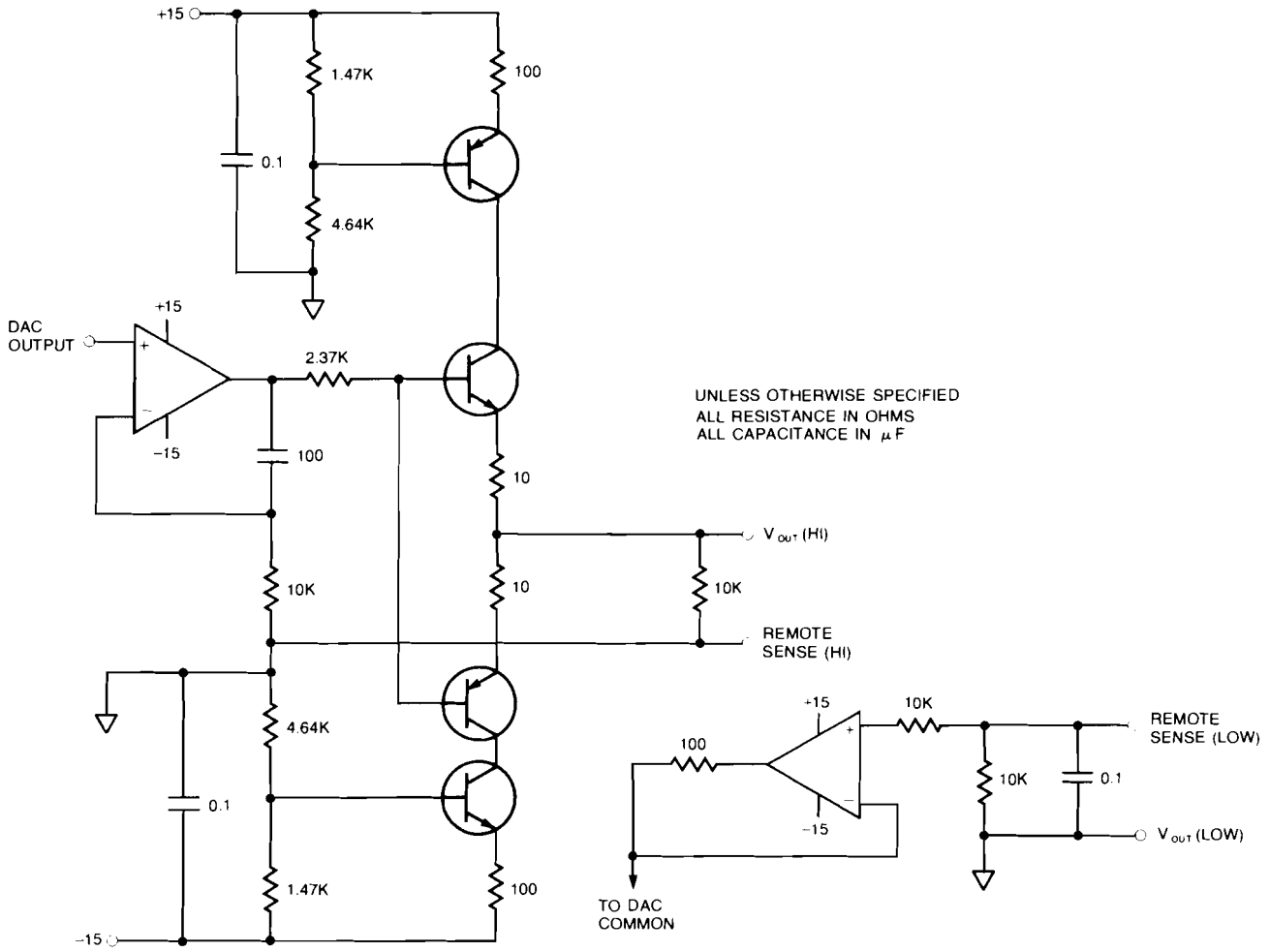
25510 options

Signal Connection Provisions (one required)

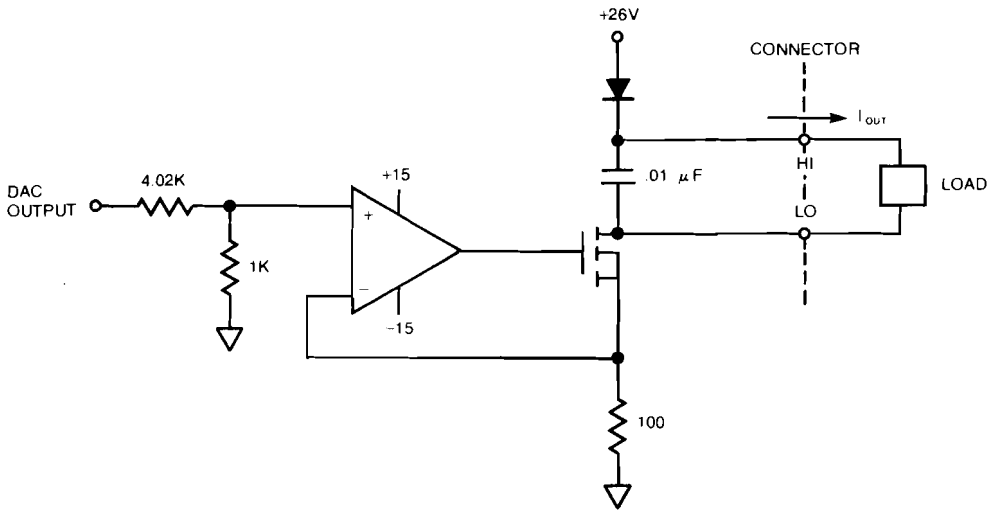
011: Customer-installed, screw-terminated cable for 4 channels (one 25551A)

012: Customer-installed unterminated cable for 4 channels (one 25551B)

111: HP-installed, screw-terminated cable for 4 channels (one 25551A) (2250N/M/R and 2251AN/AR on same order)



DAC VOLTAGE OUTPUT CIRCUIT



DAC CURRENT OUTPUT CIRCUIT

HEWLETT PACKARD

Digital input/output capabilities overview

Features

- High Noise Immunity — High Reliability Design
- Flexible — input and output signal types configurable in 4 point groups
- Isolation available for inputs and outputs on all cards
- The digital card set provides capabilities such as:
  - Interrupt on input transitions
  - Synchronize input readings and output changes to the internal strobe or external events
  - Input and output points can be programmed individually or as a 16 bit field
- Ease of programming using HP-MCL/50
- Protection — solid state switches protected against accidental abuse, and outputs protected against inductive loads

Description

The digital function card family consists of six cards which interface the 2250 to digital devices. Each card occupies one slot in any 2251, and is compatible with any 2250 function cards within that mainframe.

High noise immunity is designed into the entire 2250 system. This is especially important with the digital card family, because it often handles line voltages. At the system level, noise immunity is provided by an entirely synchronous CMOS backplane operating at 12V, careful grounding, and shielding. On the digital cards, optional input and output isolation minimizes coupling of noise to the card. Filtering is available for the inputs. Noise immunity of the cards is enhanced by on card power supply regulation, synchronous 12V CMOS logic, and careful layout. On the relay card, coupling of switching noise is further reduced by using separate supplies for relay coil power and logic with only a single point connection of their grounds, by physical separation of relays and logic circuits, and by use of arc suppression SCMs to limit switching noise.

Each card can be configured on a four point increment basis for interfacing to different signal types. This is done through Signal Conditioning Modules (SCMs) that plug directly onto the function cards. For instance, a single 32 point digital input card may interface to four TTL inputs, four 12V DC inputs, four 24V DC inputs, four 48V DC inputs, four 72V DC inputs, four 120V DC inputs, four 115V AC inputs and four 230V AC inputs through eight different SCMs. SCMs can be isolated or non-isolated.

Terminated and unterminated cable assemblies are available in sixteen point assemblies. The terminated cable assemblies feature large industrial screw terminals (which accommodate up to ten gauge field wiring), well protected cable ways to help prevent field personnel from inadvertently damaging the cable assemblies, and optional status LEDs so that critical digital I/O points can be monitored at the field termination.

All cards are accessed through the appropriate HP-MCL/50 commands. Consult individual data sheets for more detail.

Summary of digital function cards

25511A 32 point digital input card

Provides 32 digital inputs which can be AC or DC, isolated or nonisolated, using plug-on modular 4 point signal conditioning modules. Used to interface to contact closures, TTL signals, industrial relays, contactors, and various other devices, depending on the Signal Conditioning Modules chosen. Individual points or a field of 16 points can be enabled to interrupt either the 2250 or computer; event interrupt enable and transition direction are programmable. On an external strobe, input is provided for each field of 16 points for synchronization to an external event.

25512A 4 channel counter input card (preliminary)

Provides 4 identical counters which are independently software programmable to one of nine modes: prescale, totalize, extended totalize, up/down count, period, time interval, frequency ratio, and channel test. Can be used with any input SCMs to interface to devices such as shaft encoders, digital tachometers, flowmeters, and switches.

25513A 32 point digital output card

Provides solid state switching to 32 output devices (or 16 output devices when using 2 point SCMs). Outputs can be a variety of AC and DC loads depending on the SCMs chosen. Each 4 point SCM provides either open collector switches or individually isolated power switches. Each 2 point AC SCM provides solid state relay switching up to 1.5A at 120V. Used for interfacing to solenoids, displays, relays, small motors, and various other devices.

25514A 16 point relay output card

Provides 16 independently isolated, sealed form-C relays for routing external signals. SCMs provide optional arc suppression for better relay life. Interfaces to industrial circuits, motor starters, solenoids, and various other devices.

25515A 4 channel pulse output card (preliminary)

Provides pulse generation to 4 independent channels with software programmable pulse width, frequency, and acceleration/deceleration (ramping). Uses output SCMs to interface to devices such as stepper motors, pulse controlled analog controllers, and other actuators. External devices can terminate pulse trains.

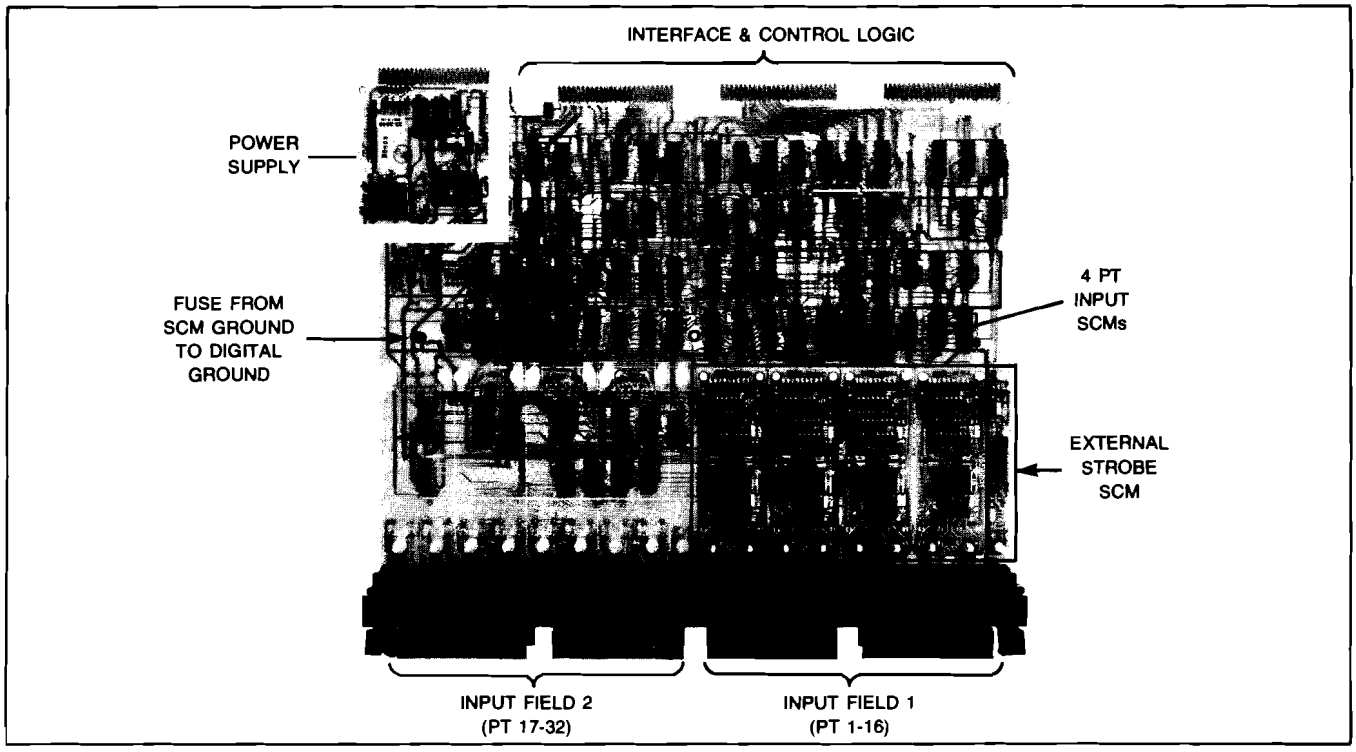
25516A 16 point in/16 point output digital multifunction card

Provides 16 digital inputs and 16 digital outputs, which are used for applications with small digital I/O requirements, or where totalize/prescale capability is needed. Input functions include those of the 32 Point Digital Input Card and the capability of prescaling or totalizing the events at each point before allowing them to interrupt.

HEWLETT PACKARD

32 point digital input card

product number 25511A



Features

- 32 digital input points/two 16 bit fields
- Interrupt detection via programmable mask and transition sense registers
- TTL, CMOS, high voltage inputs
- One external strobe per 16 bit field
- Isolated inputs to 230 VAC

Applications

Monitoring of digital data such as:

- mechanical or solid state switches
- coil/winding power sensing on relays/motors
- instruments or transducers with digital outputs
- any application in which information is contained in the absence or presence of an AC or DC voltage

Description

The 32 Channel Digital Input Card provides the capability of monitoring 32 digital points, as well as generating a system interrupt upon the occurrence of an event on any of the 32 points. Interrupts are held in two 16 bit Interrupt Registers that indicate which point generated the system interrupt.

An event is defined via software programmable registers called the Unmask, Sense, and Sense Override Registers. Using these registers, the card is told which points are enabled to detect interrupts, which transition (low-to-high or high-to-low) is to be detected, and whether to detect an event on any transition. All isolation, filtering for AC inputs, debouncing, and voltage range selection is done on the function card signal conditioning modules. In addition, two single channel input signal conditioning modules provide independent external strobes for each 16 bit field, allowing synchronization of input strobes to an external event.

Programming information

Command and function

DI:	Read a single digital input point, or sequence or points
FI:	Read a single digital input field, or sequence of fields
INTERRUPT:	Enable card interrupts
RINTERRUPT:	Read interrupt configuration
SENSE:	Define interrupt transition sense
SOVERRIDE:	Override transition sense for interrupts
WPOINT:	Wait for digital input point

Specifications

Note

These specs refer to the function card itself where the input SCMs add no additional propagation delay. However, the input SCMs, in addition to scaling the input signals up or down to the proper level, will add propagation delays to the incoming signal. Refer to the SCM specifications to select the proper signal conditioning for your application. Also see 25516A examples.

External strobe operation

Minimum detectable input pulse width from an external strobe input: 1 μsec

Maximum effective external strobe frequency: 62.5 kHz

External strobe to input data capture delay: 2 to 18 μsec

Non-external strobe

Minimum detectable input pulse: 16 μsec

Minimum setup time of data with respect to an active strobe edge: 0 μsec

Minimum Hold time of data with respect to an active strobe edge: 16 μsec

Input data read time: 42 μsec (23,800 input fields per second)

Common mode rejection ratio (isolated SCMs only) @60 Hz: −45 dB

Common mode rejection ratio (isolated SCMs only) @1 kHz: −30 dB

Crosstalk rejection ratio:	60 Hz	1 kHz
Measured across non-isolated SCM input:	−70 dB	−55 dB
Measured across isolated SCM input:	−45 dB	−30 dB

Power required: 2 watts

25511A options

Signal Connection Provisions (one required)

011: Customer-installed, screw-terminated cables for 32 channels (two 25550As)

012: Customer-installed unterminated cables for 32 channels (two 25550Bs)

111: HP-installed screw-terminated cables for 32 channels (two 25550As) (2250N/M/R and 2251AN/AR on same order)

Signal conditioning
(All modules include debounce noise filter per channel)

B35: 5V dc Non-Isolated Input Signal Conditioning modules for source input (eight 25535Bs)

C35: 12V dc Non-Isolated Input Signal Conditioning modules for source input (eight 25535Cs)

D35: 24V dc Non-Isolated Input Signal Conditioning modules for source input (eight 25535Ds)

E35: 48V dc Non-Isolated Input Signal Conditioning modules for source input (eight 25535Es)

K35: 5V dc Non-Isolated Input Signal Conditioning modules for sink input (eight 25535Ks)

L35: 12V dc Non-Isolated Input Signal Conditioning modules for sink input (eight 25535Ls)

P37: 5V dc Isolated Input Signal Conditioning modules (eight 25537Ps)

Q37: 12V dc Isolated Input Signal Conditioning modules (eight 25537Qs)

R37: 24V dc/16V rms Isolated Input Signal Conditioning modules (eight 25537Rs)

S37: 48V dc Isolated Input Signal Conditioning modules (eight 25537Ss)

T37: 72V dc Isolated Input Signal Conditioning modules (eight 25537Ts)

U37: 120V dc/72V rms Isolated Input Signal Conditioning modules (eight 25537Us)

V37: 115V rms Isolated Input Signal Conditioning modules (eight 25537Vs)

W37: 230V rms Isolated Input Signal Conditioning modules (eight 25537Ws)

Z30: HP installation of one to eight signal conditioning modules ordered as various 25535B/C/D/E/K/L and/or 25537P/R/S/T/U/V/W components to provide different signal conditioning for different 25511A inputs

HEWLETT PACKARD

4 Channel counter card (preliminary)

product number 25512A

Features

- All channel configuration and mode selection is software programmable with HP-MCL/50
- 4 independent channels
- Decodes 3 types of up/down count inputs — counts and direction, up counts and down counts, and quadrature
- Up/down count capability
- Prescale — can count down from preset number and initiate an interrupt when the count reaches zero
- Can read current count while starting a new count, without missing any data (HP-MCL/50 RCOUNT command)
- Software programmably configured to perform the following measurements:

Extended Totalize	0 to 2,147,483,647
Prescale Totalize	0 to 32767
Up-down Count	−32768 to 32767
Period & Time Interval	2 μs to 32 minutes
Frequency	0.2 Hz to 500kHz
Ratio	# of cycles on A ÷ preset # of cycles on B

- Presettable start count over full range in totalize and up-down count modes
- Period and time interval averaging over 2 to 32767 periods
- Interrupt on measurement completion and/or overflow
- Signal conditiong modules allow individual configuring of channels to directly interface to a wide variety of signals

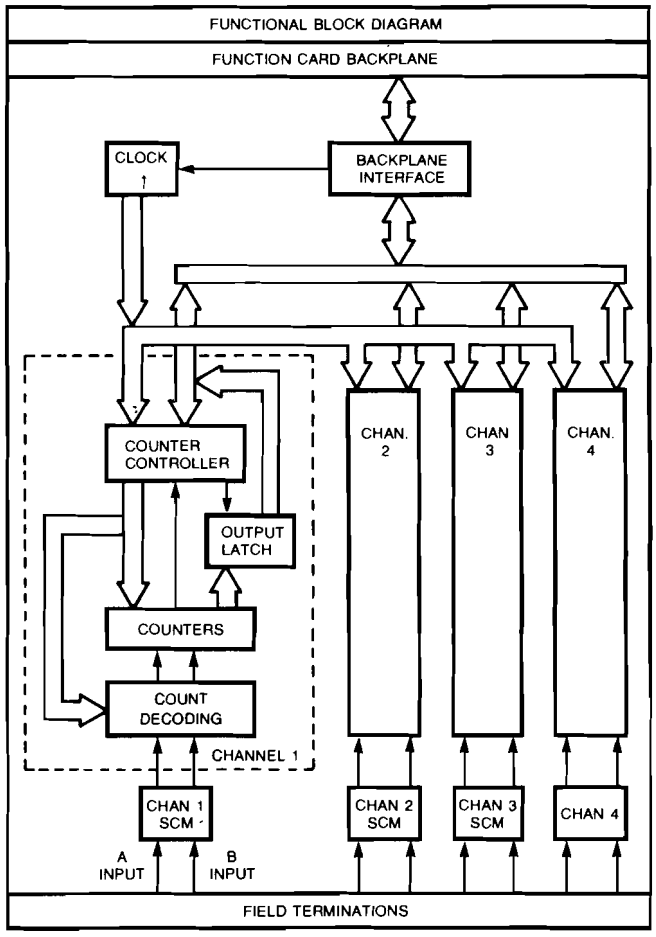
Applications

This card can be interfaced to a variety of instruments such as shaft encoders, linear encoders, proximity detectors, pulse output flow meters, laser interferometers, contact closures, TTL, and CMOS. It counts events, and measures speed, position, flow and time intervals.

Description

The counter card consists of four identical channels which are independently programmable via HP-MCL/50 to one of nine modes: prescale, totalize, extended totalize, up-down count, period, time interval, frequency, ratio, and channel test. Each channel has an A input which is used in all modes, and a B input used only in up-down count, time interval and ratio modes. The start of the measurement may be paced.

Interrupts may be programmed to occur on overflow, underflow, and measurement completion. The latter is particularly useful when making measurements of slow signals (such as frequency for a 1Hz signal) because the processor can perform other functions while waiting for results.



Each channel uses one signal conditioning module (SCM) for its A and B inputs. This allows each channel to interface to a different level or type of signal for maximum flexibility. Channels may be programmed to respond to falling or rising edges. In up-down count mode, one of three types of input can be selected: up counts and down counts, count and direction, or quadrature.

In period, frequency, time interval, prescale, and ratio modes, the channel can be configured to measure continuously, or wait for a start command before taking a measurement.

Programming information

Command and function

ECFN:	Configures all parameters of channel (range, function, etc.)
CFN:	Configures counter channel function and range
CNUM:	Set counter card average mode
RCNUM:	Read counter card average
RCFN:	Reads counter channel function
CCON:	Controls counting (start, stop, and continue)
COUNT:	Reads Count
DCOUNT:	Reads 2 Word Extended Count (extended totalize)
RCOUNT:	Reads and restarts a count without missing any counts
RDCOUNT	Reads 2 Word Extended Count (extended totalize) and restarts without missing any counts

Specifications

General

Pulse width (Tw): 1 μs min

Pulse gap (Tg): 1 μs min

Frequency: 500 kHz max

Triggering: on rise or fall of input signal. All configuration of channels such as gate time, preset, rollover, and up/down count decoding, is done via HP-MCL/50.

Totalize, Extended Totalize, and Up/Down Count

Up/down count: –32,768 to 32,767

Extended totalize: 0 to 2.147×10^9

Prescale and totalize: 0 to 32,767

Up/down rollover: to 0

Extended totalize rollover: to negative full scale(-2.147×10^9)

Totalize rollover: to negative full scale (–32,768)

Prescale rollover: to preset

Accuracy: ±1 count

Up/Down count decoding: Count and direction, up counts and down counts, or quadrature

Period and time interval

Number of periods or time intervals measured: 1 to 32,767

Accuracy: ±0.01% of reading ±1 count

Range Value	Maximum Period or Time Interval	Resolution
1	50 min	100 msec
2	5 min	10 msec
3	30 sec	1 msec
4	3 sec	100 μsec
5	300 msec	10 μsec
6	30 msec	1 μsec

Frequency

Accuracy: ±0.01% of reading ±1 count

Range Value	Max. Rate	Resolution	Gate Time
1	30 Hz	0.001 Hz	1000 sec
2	300 Hz	0.01 Hz	100 sec
3	3 kHz	0.1 Hz	10 sec
4	30 kHz	1.0 Hz	1 sec
5	300 kHz	10.0 Hz	100 msec
6	500 kHz	100.0 Hz	10 msec

Ratio

Gate time: 1 to 32,767 counts of B input

Resolution: 1/Gate Time

Range: 1 to 32,767 counts of A input

Accuracy: ±1 count

Diagnostic Software

NOTE: The following diagnostic software will be available:

Part Number	Name	Description
25595-16017	D.CNT1	25512A 4 Channel Counter Input
25595-16018	D.CNT2	25512A 4 Channel Counter Input

25512A options

Signal Connection Provisions (one required)

011: Customer-installed, screw-terminated cable for 4 channels up to four wires per channel (one 25550A)

012: Customer-installed unterminated cable for 4 channels up to four wires per channel (one 25550B)

111: HP-installed screw-terminated cable for 4 channels up to four wires per channel (one 25550A) (2250N/M/R and 2251AN/AR on same order)

Signal conditioning (optional)
(All modules include debounce noise filter per channel)

B35: 5V dc Non-Isolated Input Signal Conditioning modules for source input (four 25535Bs)

C35: 12V dc Non-Isolated Input Signal Conditioning modules for source input (four 25535Cs)

D35: 24V dc Non-Isolated Input Signal Conditioning modules for source input (four 25535Ds)

E35: 48V dc Non-Isolated Input Signal Conditioning modules for source input (four 25535Es)

K35: 5V dc Non-Isolated Input Signal Conditioning modules for sink input (four 25535Ks)

L35: 12V dc Non-Isolated Input Signal Conditioning modules for sink input (four 25535Ls)

P37: 5V dc Isolated Input Signal Conditioning modules (four 25537Ps)

Q37: 12V dc Isolated Input Signal Conditioning modules (four 25537Qs)

R37: 24V dc/16V rms Isolated Input Signal Conditioning modules (four 25537Rs)

S37: 48V dc Isolated Input Signal Conditioning modules (four 25537Ss)

T37: 72V dc Isolated Input Signal Conditioning modules (four 25537Ts)

U37: 120V dc/72V rms Isolated Input Signal Conditioning modules (four 25537Us)

V37: 115V rms Isolated Input Signal Conditioning modules (four 25537Vs)

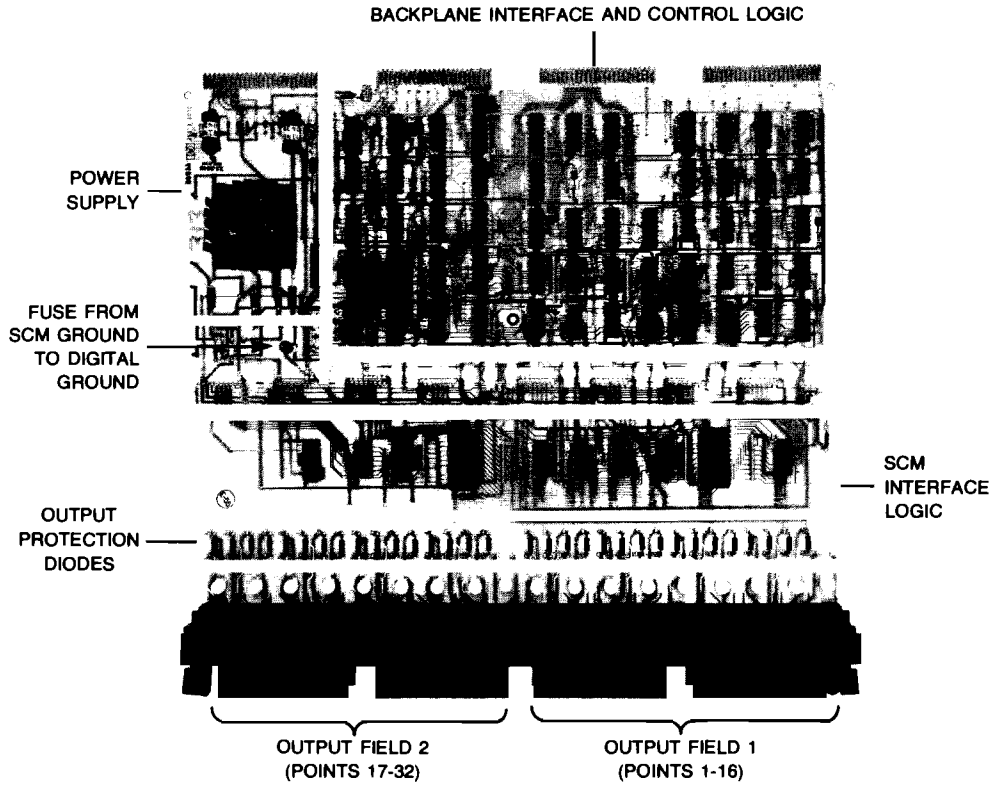
W37: 230V rms Isolated Input Signal Conditioning modules (four 25537Ws)

Z30: HP installation of one to four signal conditioning modules ordered as various 25535B/C/D/E/K/L and/or 25537P/R/S/T/U/V/W components to provide different signal conditioning for different 25512A inputs

HEWLETT PACKARD

32 Point digital output card

product number 25513A



Features

- 32 points
- Signal conditioning made flexible through the use of interchangable signal conditioning modules (SCMs), eight SCMs per card, four or two channels per SCM
- Channels programmed independently or as two 16 bit fields
- External strobe can synchronize output changes to an external event (one per 16 bit field)
- AC/DC switching to 60V peak (42 VAC), 400mA peak
- AC zero voltage switching to 120VAC, 1.5A peak (16 channels, maximum)

Applications

This card provides solid state switching of AC and DC loads such as lamps, relays, solenoids, TTL, CMOS, diplays, and small AC/DC motors.

Description

The 32 channel digital ouput card provides 32 independent output channels. The outputs can be configured in groups of four as either open drain or individually isolated MOS switches that will switch 60VDC, at 300mA. The open drain configuration has optional pullups to +5V or +12V, eliminating the need for external supply connections when driving TTL or 12V CMOS. To switch AC/DC loads up to 60VAC peak (42RMS), adjacent isolated channels may be connected by the user at the field termination. For higher level AC switching without the need for external wiring at the field terminations, the four channel SCMs may be replaced by two channel solid state relay SCMs that feature optical isolation and zero voltage switching. Two external strobe inputs allow synchronization of output changes. On power-on, or in the event of a power failure, the outputs on all of the signal conditioning modules will shut off. As long as power is maintained, data in the output registers is maintained until a field or point output is written to the card. A logic one written to an output will close the switch.

Programming information

Command and Function

DO: Write sequential digital output points
RDO: Read sequential digital output points
FO: Write sequential digital output fields 16 bits)
RFO: Read sequential digital output fields (16 bits)

Specifications

The specs below are for the function card only, and are independent of the SCM used. Certain SCMs will limit how quickly the function card/SCM combination can output data.

Legal loads: Resistive or inductive

Output data update time: 24 μsec

Maximum effective external strobe frequency: 41.7 kHz

Maximum external strobe to output delay: 2 μsec

Crosstalk rejection ratio (100k load, channel to channel):

60 Hz: –62 dB
1 kHz: –45 dB
5 kHz: –30 dB
10 kHz: –26 dB

Power required: 1 watt

Output protection: 68V zeners installed across pins 1 and 2, and across pins 3 and 4 on each output connector

25513 options

Signal Connection Provisions (one required)

011: Customer-installed screw-terminated cables for 32 channels (two 25550As)

012: Customer-installed unterminated cables for 32 channels (two 25550Bs)

111: HP-installed, screw-terminated cables for 32 channels (two 25550As) (2250N/M/R and 2251AN/AR on same order)

Signal conditioning (optional)

A44: Open Drain, Non-Isolated Output Signal Conditioning Modules (eight 25544As)

B44: 5V dc Non-Isolated Output Signal Conditioning Modules (eight 25544Bs)

C44: 12V dc Non-Isolated Output Signal Conditioning Modules (eight 25544Cs)

N43: 60V dc/42V rms Isolated Output Signal Conditioning Modules (eight 25543Ns)

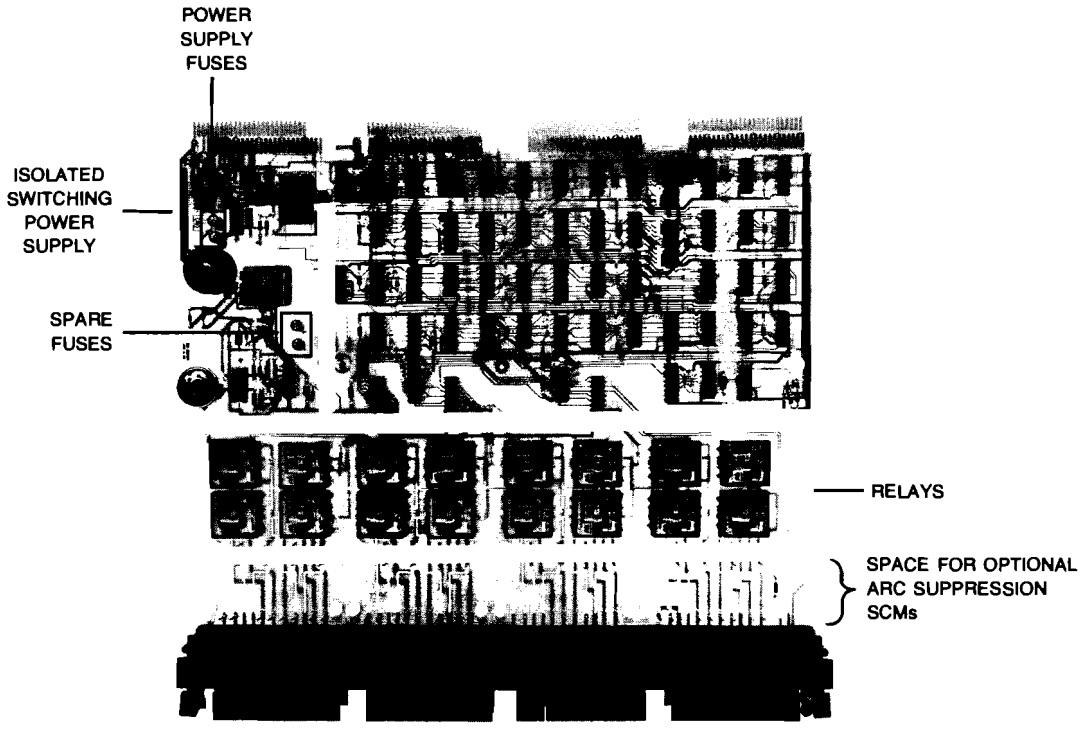
P45: 120V rms Isolated Solid-State Relay Modules (eight 25545Ps)

Z40: HP installation of one to eight signal conditioning modules ordered as various 25544A/B/C, 25543N, and/or 25545P components to provide different signal conditioning for different 25513A outputs

HEWLETT PACKARD

16 Point relay output card

product number 25514A



Features

- 16 Points of sealed 1 form C relays
- Relays can switch high (wet) or low (dry) current loads
- Switch 1.5A at 250VAC; 3.0A at 125VAC; 2.0A at 30VDC
- Relay coil power supply on card — designed to isolate switching noise
- Signal Conditioning Modules (SCMs) supply transient suppression to protect relays and minimize electrical noise. Arc suppression for four relays per SCM
- External strobe can synchronize ouput changes to an external event
- Program relays individually or as a 16 bit field

Applications

This card is used to switch AC and DC loads. Examples of these loads are motor contactors, small motor pumps, solenoids, and other loads using less than 1.5A at 250VAC, 3A at 125VAC, or 2A at 30VDC. Once a relay has been used to switch high current loads, it should not be used for low current loads.

Description

The 16 point relay card provides 16 form C relays which can be programmed independently or as a 16 bit field. Output changes may be synchronized using an external strobe or internal measurement strobe. The card has a power supply for the relay coil power. A one written to an output energizes the relay (the NO contact closes and the NC contact opens).

Programming information

Command and function

DO: Write sequential digital output points.
RDO: Read sequential digital output points.
FO: Write sequential digital output fields (16 bits).
RFO: Read sequential digital output fields (16 bits).

Specifications (0-70 °C)

Electrical life: inductive (with arc suppression) or resistive

Electrical life: inductive (with arc suppression) or resistive

No. Of Operations	Break Current Amps	Carry Current Amps	Open Circuit Voltage Volts	Operating Speed Hz
10^5	1.5	1.5	250VAC	10
10^5	3.0	3.0	125VAC	10
10^6	0.5	0.5	250VAC	30
10^6	1.0	1.0	125VAC	30
10^6	2.0	2.0	30VDC	10
10^6	1.0	1.0	30VDC	30
10^6	0.0	3.0	0.0VDC	30
10^6	Dry*	Dry*	30VDC	30
10^6	0.1	0.1	28VDC	30

**Dry – less than 1mA current*

Mechanical life: 10^7 operations

External strobe input

Minimum pulse width: 400ns + pulse width required by external strobe SCM used.

Maximum digital update rate from 2250 buffer
Sequential writes (point or field): 24 μs/write

16 Form C (SPDT) sealed general purpose relays

Operate time, maximum (opening or closing): 15 msec

Operate speed, maximum: 10-30 Hz

Contact Resistance, maximum: 0.5 ohm measured from field wiring screw termination block

Carry current, maximum: 3.0A

Break current, maximum resistive: 1.2A at 30VDC; 1.3A at 125VAC; 1.5A at 250VAC

Breakdown voltage, minimum: 1000 Vrms between open contacts
1500 Vrms between contacts and coils, and between contact sets.

Thermal offset, maximum: 100 μV at 25°C

Insulation resistance, minimum: 100M ohm between NO contact and NC contact @500VDC, 40°C, 95% R.H.

Capacitance, maximum: 10pF NC or NO to COM; 10pF Contacts to coil

Crosstalk (Measured at the field wiring terminations with a 1K Ω load)

Channel to channel: 85 dB at 60 Hz; 65 dB at 1 kHz

NO to NC: 70 dB at 60 Hz; 50 dB at 1 kHz

Power required: 11.5 watts

Power dissipated: 11.5 watts

25514A options

Signal Connection Provisions (one required)

011: Customer-installed, screw-terminated cables for 16 channels, four wires per relay (two 25550As)

012: Customer-installed unterminated cables for 16 channels, four wires per channel (two 25550Bs)

111: HP-installed, screw-terminated cables for 16 channels, four wires per channel (two 25550As) (2250N/M/R and 2251AN/AR on same order)

Signal conditioning (optional)

A39: Customer's Relay Arc Suppression Breadboard modules (four 25539As)

E39: 30V dc load Relay Arc Suppression modules (four 25539Es)

G39: 24V rms load Relay Arc Suppression modules (four 25539Gs)

H39: 115V rms load Relay Arc Suppression modules (four 25539Hs)

J39: 230V rms load Relay Arc Suppression modules (four 25539Js)

Z39: HP installation of one to four relay arc suppression modules ordered as various 25539A/E/G/H/J components to provide arc suppression for different voltage lines switched by the 25514A

HEWLETT PACKARD

4 Channel pulse generator card

(preliminary)

product number 25515A

Features

- 4 independent channels
- Programmable frequency and pulse width
- Programmable number of pulses to 32767
- Outputs for stepper motor translators
- Limit switch inputs
- Frequency ramping for stepper motor control
- MOS output drivers with optional isolation
- Paced mode
- Completely digital, insuring accuracy without drift
- Software programmable — no jumpers or switches

Applications

- Controlling device movement along 2 or more axes (such as x/y plotters)
- Computer updating setpoint of Analog Controllers
- Control of Stepper Motor Translators
- Control of pulse train input type actuators

Description

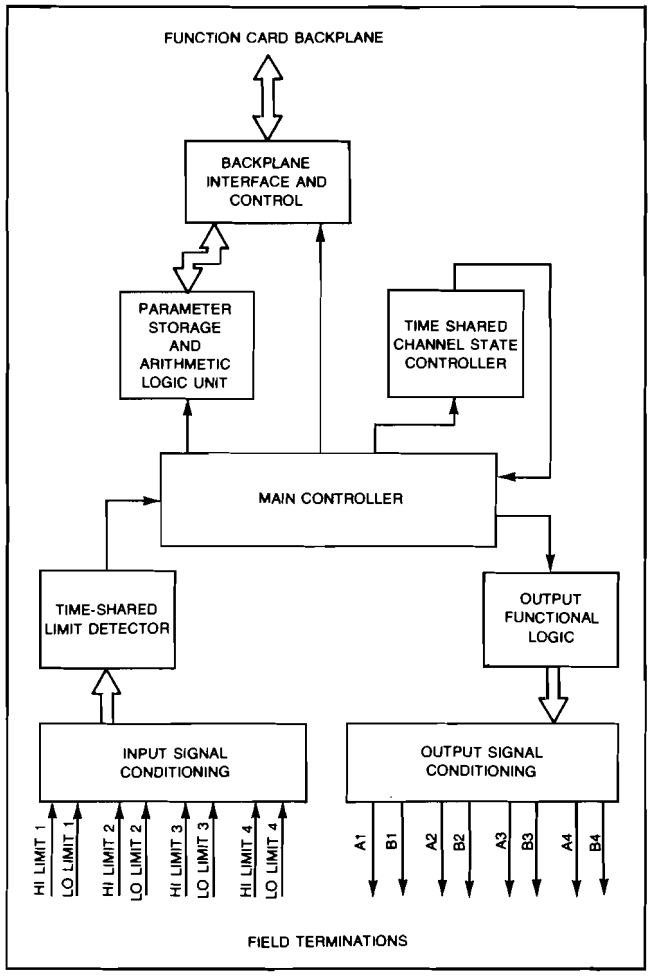
This card generates a programmable number of pulses independently on each of four channels. The following parameters are also programmable:

1. Initial pulse rate
2. Acceleration
3. Final pulse rate
4. Pulse width

Input and output signal conditioning is provided by means of the four point Signal Conditioning Modules (SCMs). See the individual SCM data sheets for details.

Two limit inputs, one for each direction, may be programmed to abort the pulse train in the corresponding direction. The sense of the limit inputs may be inverted via software. Pulse counting may be disabled by placing the card in continuous mode, in which the pulses are output continuously. The pulse rate may be changed without introducing discontinuities.

This card's primary use is to control stepper motors where the built-in frequency ramping will permit interfacing with inexpensive stepper motor translators. It can also be used to control other actuators and converters that respond to pulse train inputs, as well as analog controllers with pulse train setpoint update capability. The outputs may be programmed with software for compatibility with either Pulse-Direction or CW-CCW pulse types of stepper motor translators.



Specifications

Initial or final pulse rate range: 10K pulses/sec.

Resolution: 0.5 pulses/sec.

Acceleration range: Approximately 640K pulses/sec.

Resolution: Approximately 20 pulses/sec./sec.

Pulse width range: 3,276,700 μs

Frequency stability: TBD

Programming information

PRATE:	Pulse rate configuration
PNUMBER	Set pulse number
RPREM	Read number of remaining pulses
POC	Pulse channel configuration
PCON	Pulse channel control
INT	Enable or disable function card interrupt

25515A options

Signal Connection Provisions (one required)

011: Customer-installed, screw-terminated cable for 4 channels (one 25550A)

012: Customer-installed unterminated cable for 4 channels (one 25550B)

111: HP-installed screw-terminated cable for 4 channels (one 25550A) (2250N/M/R and 2251AN/AR on same order)

Signal conditioning for limit switch input (optional) (All modules include debounce noise filter per channel)

B35: 5V dc Non-Isolated Input Signal Conditioning modules for source input (two 25535Bs)

C35: 12V dc Non-Isolated Input Signal Conditioning modules for source input (two 25535Cs)

D35: 24V dc Non-Isolated Input Signal Conditioning modules for source input (two 25535Ds)

E35: 48V dc Non-Isolated Input Signal Conditioning modules for source input (two 25535Es)

K35: 5V dc Non-Isolated Input Signal Conditioning modules for sink input (two 25535Ks)

L35: 12V dc Non-Isolated Input Signal Conditioning modules for sink input (two 25535Ls)

P37: 5V dc Isolated Input Signal Conditioning modules (two 25537Ps)

Q37: 12V dc Isolated Input Signal Conditioning modules (two 25537Qs)

R37: 24V dc/16V rms Isolated Input Signal Conditioning modules (two 25537Rs)

S37: 48V dc Isolated Input Signal Conditioning modules (two 25537Ss)

T37: 72V dc Isolated Input Signal Conditioning modules (two 25537Ts)

U37: 120V dc/72V rms Isolated Input Signal Conditioning modules (two 25537Us)

V37: 115V rms Isolated Input Signal Conditioning modules (two 25537Vs)

W37: 230V rms Isolated Input Signal Conditioning modules (two 25537Ws)

Z30: HP installation of one to four signal conditioning modules ordered as various 25535B/C/D/E/K/L and/or 25537P/R/S/T/U/V/W components to provide different signal conditioning for different limit switch inputs to the 25515A

Signal conditioning for pulse generator output (optional)

A44: Open Drain, Non-Isolated Output Signal Conditioning Modules (two 25544As)

B44: 5V dc Non-Isolated Output Signal Conditioning modules (two 25544Bs)

C44: 12V dc Non-Isolated Output Signal Conditioning modules (two 25544Cs)

N43: 60V dc/42V rms Isolated Output Signal Conditioning modules (two 25543Ns)

P45: 120V rms Isolated Solid-State Relay modules (two 25545Ps)

Z40: HP installation of one to four signal conditioning modules ordered as various 25544A/B/C, 25543N, and/or 25545P components to provide different signal conditioning for different pulse outputs from the 25515A

Diagnostic Software

Note: The following diagnostic software will be available:

Part Number	Name	Description
25595-16015	D.PUL1	25515A 4 Channel Pulse Output
25595-16016	D.PUL2	25515A 4 Channel Pulse Output

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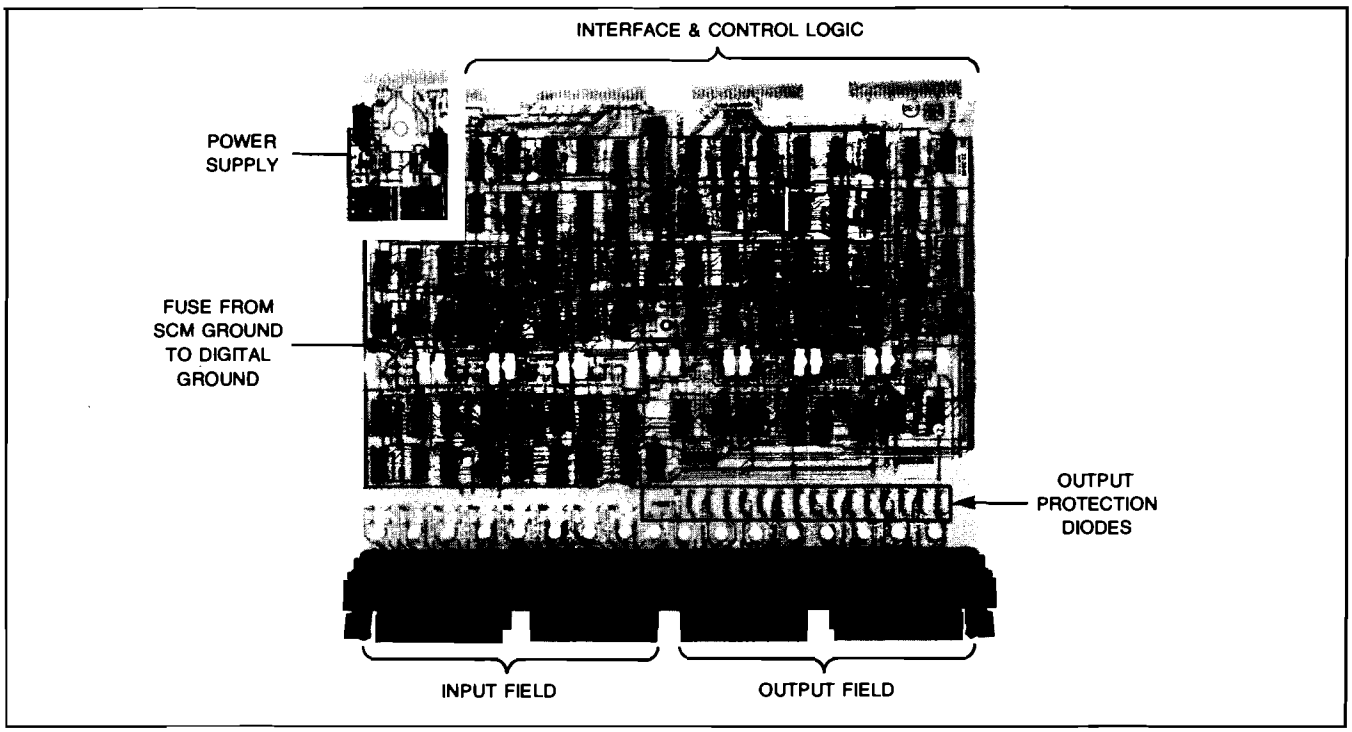
16 Point in/16 point out digital multifunction card

product number 25516A



Features

- Event prescaling or totalizing to 256, independently programmable on each input point
- Paced mode
- Wide range of signal conditioning available in the form of Signal Conditioning Modules (see individual SCM data sheets for details)
- 16 digital input points
- Point status and event sensing with programmable mask, sense and sense override registers
- External strobe
- 16 digital output points
- Two ranks of output storage

Applications

- Monitoring the state of:
  - — Mechanical or electronic switches
  - — AC or DC coil/winding power on relays/motors
  - — Instruments or transducers with digital outputs
- Interrupting the controller upon occurrence of user defined (programmable) events
- Scaling and totalizing events
- Solid state switching of AC/DC loads
- Ideal for low cost counting
- Highly useful for interface panels

Description

This card monitors 16 digital input points, and can interrupt the controller when N (1 to 256) events occur on any point. N can be chosen separately for each point. An event is defined independently for each point by programmable mask, sense, and sense override registers. To do this, a presettable, 8 bit counter is associated with each input point to pre-scale the events occurring on that point (these counters may be read at any time). Each counter may be programmed to roll over to either zero or the preset value. An additional input is provided that may be programmed as an input strobe. Optical isolation, filtering for AC inputs, debouncing, and voltage range selection are done in groups of 4 points by means of small PC board signal conditioning modules (SCMs).

16 digital outputs are provided with optional isolation, again selected in groups of four. Two ranks of output storage permit data to be verified before outputting.

This card differs from the Digital Input Card in that it has event pre-scale/totalize capability as well as output points. The DI card has twice as many input points.

Programming information

Command and function

DO:	Write sequential digital output points
FO:	Write sequential output fields
DI:	Read sequential digital inputs
FI:	Read sequential input fields
RDO:	Read sequential digital outputs
RFO:	Read sequential output fields
COUNT:	Read current counts
PRESET:	Write multifunction counter preset
RPRESET:	Read counter preset
INT:	Digital input interrupt conditions
ROLL:	Set multifunction counter rollover
SENSE:	Define interrupt transition sense
SOVER:	Override transition sense for interrupts

Specifications

Minimum detectable input pulse width (external strobe input): 1 μs

Minimum detectable input pulse width (other inputs): 16 μs

Minimum setup time of data with respect to active strobe edge: 0

Minimum hold time of data with respect to active strobe edge: 16 μs

Note that in order to determine overall card specs, those of the particular SCM used must be considered. For example using the 25535 NON-ISO DI SCM with minimum and maximum propagation delays of 0 and 28 μs respectively (without the filter) the overall Minimum Detectable Input Pulse Width for the EXTERNAL STROBE INPUT becomes 28 μs + 1 μs = 29 μs. This is for the worst case in which the propagation delay in one direction is 0 and in the other direction is 28 μs.

25516A options

Signal Connection Provisions (one required)

011: Customer-installed, screw-terminated cable for 16 channels in and 16 channels out (two 25550As)

012: Customer-installed unterminated cables for 16 channels in and 16 channels out (two 25550Bs)

111: HP-installed screw-terminated cables for 16 channels in and 16 channels out (two 25550As) (2250N/M/R and 2251AN/AR on same order)

Signal conditioning for digital inputs (optional) (All modules include debounce noise filter per channel)

B35: 5V dc Non-Isolated Input Signal Conditioning modules for source input (four 25535Bs)

C35: 12V dc Non-Isolated Input Signal Conditioning modules for source input (four 25535Cs)

D35: 24V dc Non-Isolated Input Signal Conditioning modules for source input (four 25535Ds)

E35: 48V dc Non-Isolated Input Signal Conditioning modules for source input (four 25535Es)

K35: 5V dc Non-Isolated Input Signal Conditioning modules for sink input (four 25535Ks)

L35: 12V dc Non-Isolated Input Signal Conditioning modules for sink input (four 25535Ls)

P37: 5V dc Isolated Input Signal Conditioning modules (four 25537Ps)

Q37: 12V dc Isolated Input Signal Conditioning modules (four 25537Qs)

R37: 24V dc/16V rms Isolated Input Signal Conditioning modules (four 25537Rs)

S37: 48V dc Isolated Input Signal Conditioning modules (four 25537Ss)

T37: 72V dc Isolated Input Signal Conditioning modules (four 25537Ts)

U37: 120V dc/72V rms Isolated Input Signal Conditioning modules (four 25537Us)

V37: 115V rms Isolated Input Signal Conditioning modules (four 25537Vs)

W37: 230V rms Isolated Input Signal Conditioning modules (four 25537Ws)

Z30: HP installation of one to four signal conditioning modules ordered as various 25535B/C/D/E/K/L and/or 25537P/Q/R/S/T/U/V/W components to provide different signal conditioning for different 25516A inputs

Output Signal Conditioning (optional)

A44: Open Drain, Non-Isolated Output Signal Conditioning modules (four 25544As)

B44: 5V dc Non-Isolated Output Signal Conditioning modules (four 25544Bs)

C44: 12V dc Non-Isolated Output Signal Conditioning modules (four 25544Cs)

N43: 60V dc/42V rms Isolated Output Signal Conditioning modules (four 25543Ns)

P45: 120V rms Isolated Solid-State Relay modules (four 25545Ps)

Z40: HP installation of one to four signal conditioning modules ordered as various 25544A/B/C, 25543N, and/or 25545P components to provide different signal conditioning for different 25516A outputs

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Signal conditioning modules (SCM) overview

Features

- Flexible configuration of any digital I/O card to different types of application requirements
- Four point input modules (all with optional isolation) interface to broad range of DC (0-120V) and AC (0-230V) signals
- Two, and four point output modules interface to many types of DC and AC loads
- One point strobe SCM conditions external strobe inputs on digital function cards
- Four channel modules provide convenient arc suppression to protect relays and limit noise on both NO and NC contact pairs
- Interchangeable modules can be used with different digital function cards
- Modules may be mixed or matched on any function card
- Current sensing resistors
- All optically isolated inputs feature "threshold specified" detection, with hysteresis (dead band) fully specified for all AC and DC types.
- Modularity allows easy replacement of low cost SCM without servicing entire function card and reduces replacement board inventory for those who do in-house servicing

Description

Signal Conditioning Modules (SCMs) are small printed circuit assemblies that plug on to digital I/O function cards and tailor the cards for interfacing to different types of sensors and actuators. Use of the SCMs gives maximum signal conditioning modularity to the 2250 digital I/O family.

SCMs provide input signal conditioning in increments of four points. Since different input SCMs can reside on the same digital input, counter, pulse output, and multifunction card, a single card can be interfaced to a variety of AC and DC signals. SCMs also provide optional input isolation via optical isolators.

The digital output, multifunction, and pulse output cards use two and four point output SCMs to give output switching capability for many types of AC and DC loads. The relay output card uses SCMs for relay arc suppression.

All digital I/O cards (except pulse and counter cards) can be triggered with an external strobe signal. Therefore, these cards can accept one or two external strobe SCMs for interfacing to strobe signals if necessary.

The SCM Signal Conditioning Summary indicates which signal conditioning modules may be used with the various digital function cards. Each signal conditioning module numeric product has several alpha suffixes that indicate a specific type of AC or DC signal. Consult the specific data sheets for details. Note that use of the strobe SCM does not reduce the point capacity of any function card. For example, all 32 points of the 25511A are available for inputs regardless of whether the strobe SCM is used or not.

Summary of signal conditioning module families

8 Channel analog input signal conditioning modules

The 25540 series signal conditioning modules provide 250 ohms current loop termination, and two pole low pass filters for the 25502A or 25503A solid state multiplexers.

1 Point/4 point non-isolated digital input signal conditioning modules

The 1 point/4 point non-isolated digital input signal conditioning modules serve as the electrical interface between the function cards and the digital signals found in an external environment.

1 Point/4 point isolated digital signal conditioning modules

The 1 point/4 point isolated digital input signal conditioning modules are used to condition AC/DC signals of various ranges for compatibility with the function cards.

4 Channel relay arc suppression signal conditioning modules

Each 4 channel relay arc suppression signal conditioning module provides protection for both the NO (Normally Open) and NC (Normally Closed) contacts of four relays from arcing due to switching inductive loads.

4 Channel isolated output signal conditioning module

The 25543N isolated VMOS signal conditioning module uses transformer isolation to eliminate ground loops and enable on-card CMOS logic to switch high level signals.

4 Channel DC output signal conditioning modules

The 25544A series signal conditioning modules provide the fastest switching available in the digital output SCM series, with a non-isolated external strobe-to-output switching time of 2 μs.

2 Channel solid state relay AC output signal conditioning module

The 25545P Solid State Relay Signal Conditioning Modules facilitate the switching of AC loads without requiring external wiring. This module requires four function card points for each two SCM output channels.

Signal Conditioning Summary

DESCRIPTION	OPTION NO.*	ALPHA CODE	PROD NO.	NUMBER OF MODULES PER SUPPORTED** FUNCTION CARD		
Analog Input Signal Conditioning Modules — Supported Function Cards				**25502A**	**25503A**	
Customer's breadboard input module	A40	A	25540A	4	4	
R-C Filter input module	B40	B	25540B	4	4	
4-20mA current loop input module	C40	C	25540C	4	4	
4-20mA current loop & R-C filter input	D40	D	25540D	4	4	
HP Installation of component-ordered signal conditioning modules	Z40			1-4	1-4	
Digital Input Signal Conditioning Modules — Supported Function Cards				**25511A**		**25516A**
5V dc non-isolated source input	B35	B	25535B	8		4
12V dc non-isolated source input	C35	C	25535C	8		4
24V dc non-isolated source input	D35	D	25535D	8		4
48V dc non-isolated source input	E35	E	25535E	8		4
5V dc non-isolated sink input	K35	K	25535K	8		4
12V dc non-isolated sink input	L35	L	25535L	8		4
5V dc isolated input	P37	P	25537P	8		4
12V dc isolated input	Q37	Q	25537Q	8		4
24V dc/16V rms isolated input	R37	R	25537R	8		4
48V dc isolated input	S37	S	25537S	8		4
72V dc isolated input	T37	T	25537T	8		4
120V dc/72V rms isolated input	U37	U	25537U	8		4
115V rms isolated input	V37	V	25537V	8		4
230V rms isolated input	W37	W	25537W	8		4
HP Installation of component-ordered signal conditioning modules	Z30			1-8		1-4
Digital Output Signal Conditioning Modules — Supported Function Cards				**25513A**	**25514A**	**25516A**
Open drain, non-isolated output	A44	A	25544A	8	4	4
5V dc non-isolated output	B44	B	25544B	8	4	4
12V dc non-isolated output	C44	C	25544C	8	4	4
60V dc/42V rms isolated output	N43	N	25543N	8	4	4
115V rms isolated output	P45	P	25545P	8	4	4
HP Installation of component-ordered signal conditioning modules	Z40			1-8	1-4	1-4
Relay arc suppression breadboard	A39	A	25539A	8	4	4
30V dc load relay arc suppression	E39	E	25539E	8	4	4
24V rms load relay arc suppression	G39	G	25539G	8	4	4
115V rms load relay arc suppression	H39	H	25539H	8	4	4
230V rms load relay arc suppression	J39	J	25539J	8	4	4
HP Installation of component-ordered relay arc suppression modules	Z39			1-8	1-4	1-4
Strobe Signal Conditioning Modules for Digital Input/Output (One module is required for each field of 16 outputs)				**25511A 25513A**	**25514A**	**25516A**
5V dc non-isolated source strobe			25531B	2	1	1
12V dc non-isolated source strobe			25531C	2	1	1
24V dc non-isolated source strobe			25531D	2	1	1
48V dc non-isolated source strobe			25531E	2	1	1
5V dc non-isolated sink strobe			25531K	2	1	1
12V dc non-isolated sink strobe			25531L	2	1	1
5V dc isolated strobe module			25533B	2	1	1
12V dc isolated strobe module			25533C	2	1	1
24V dc isolated strobe module			25533D	2	1	1
48V dc isolated strobe module			25533E	2	1	1
72V dc isolated strobe module			25533F	2	1	1
120V dc/72V ac strobe module			25533G	2	1	1
115V ac strobe module			25533H	2	1	1
230V ac strobe module			25533J	2	1	1

** The option number ordered with a function card provides a full complement of signal conditioning modules, all of the same type.*

*** Signal conditioning module support is as follows:*

Each analog input signal conditioning module supports 8 inputs.

Each digital input signal conditioning module supports 1 or 4 inputs, with a debounce/noise filter per input.

Each digital output signal conditioning module supports 1 or 4 outputs.

Each relay arc suppression module supports 4 outputs.

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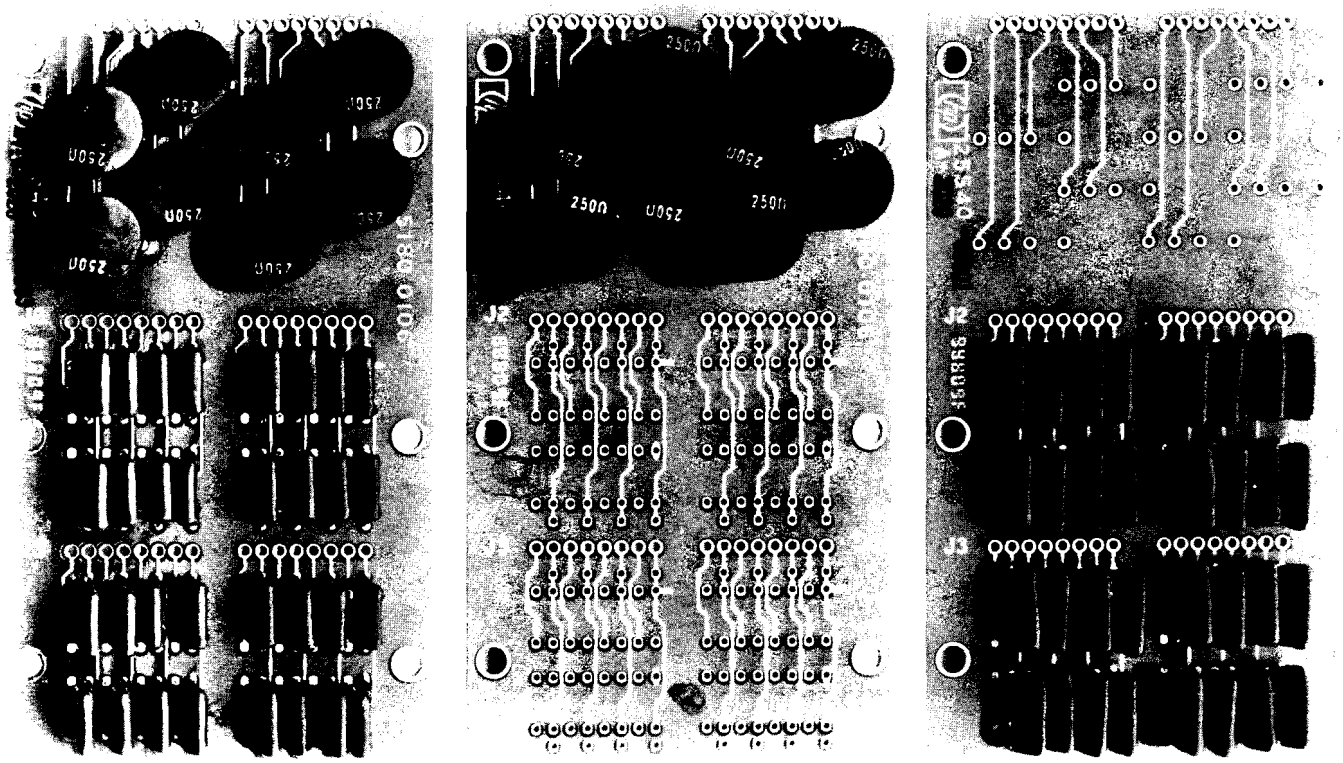
8 Channel analog input signal conditioning modules

product number 25540 A, B, C, D



Features

- 250 ohm termination resistors
- Two pole RC filters
- Space for user selected resistive termination
- Space for user selected filter capacitors

Applications

Analog current loop termination and/or input filtering.

Description

The 25540 Series Signal Conditioning Modules provide 250 ohms current loop termination, and two pole low pass filters for the 25502A or 25503A solid state multiplexers. These modules also allow space for users to mount their own current termination resistors and filter capacitors.

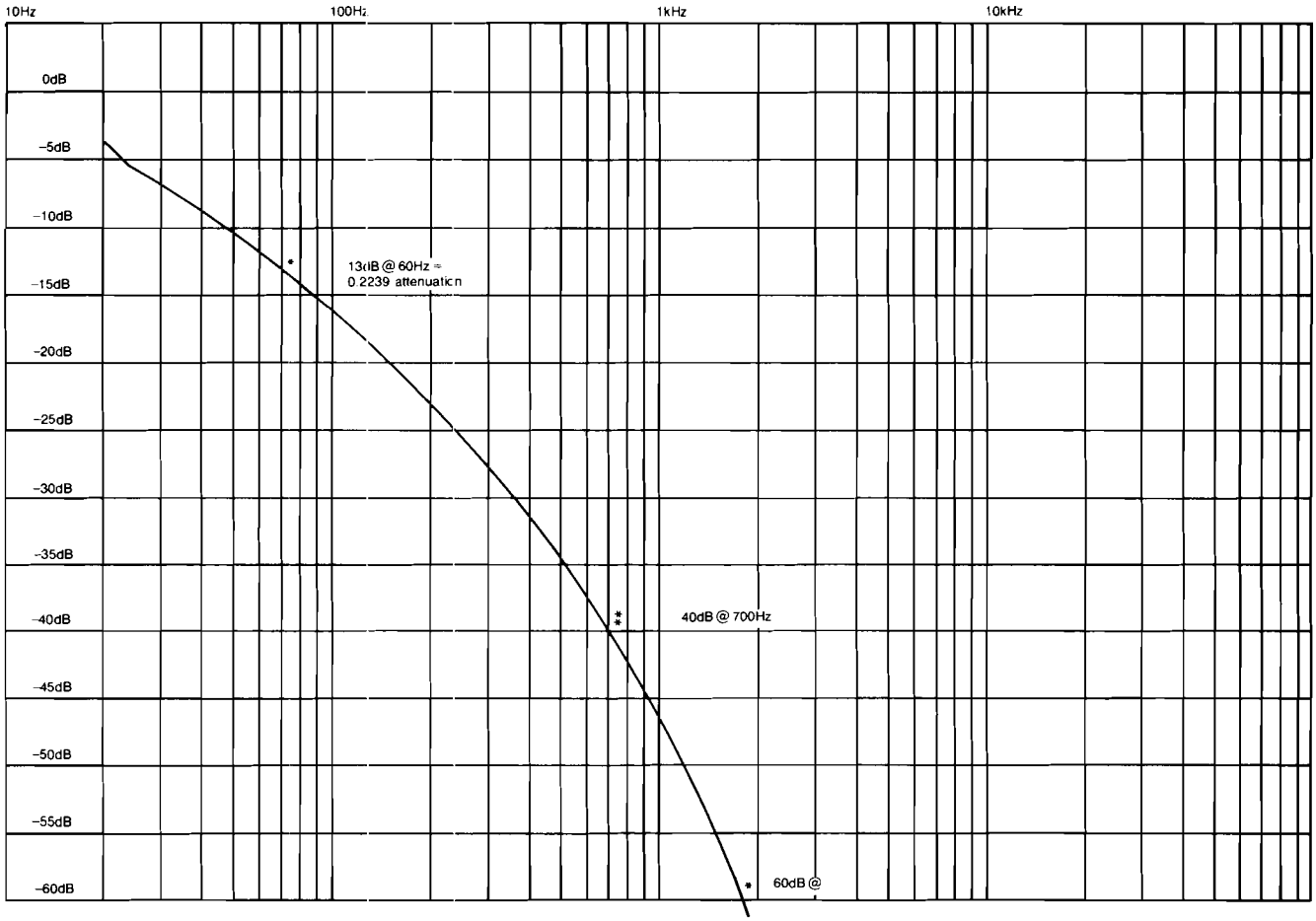
Specifications

Current loop termination: Resistance 250 ohm ± .025%; Temperature Coefficient 10PPM/C

Filter Pole Frequencies (minimum): 52Hz; 7.5Hz

	Filters	Current Termination
25540A	*	*
25540B	yes	*
25540C	*	yes
25540D	yes	yes

** Space available for user supplied components.*

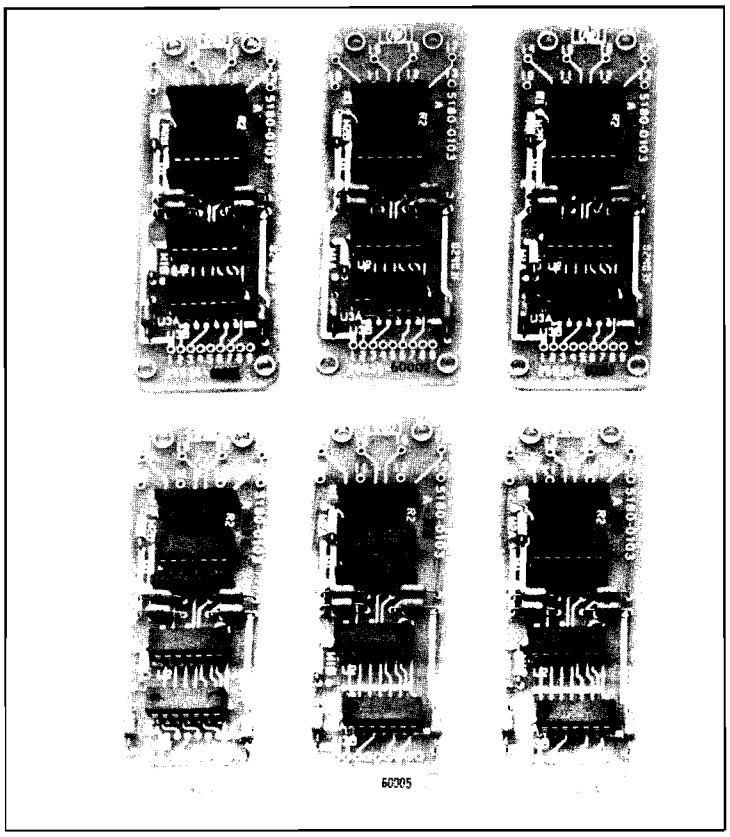


25540C and 25540D Analog SCMs Filter Frequency Characteristics

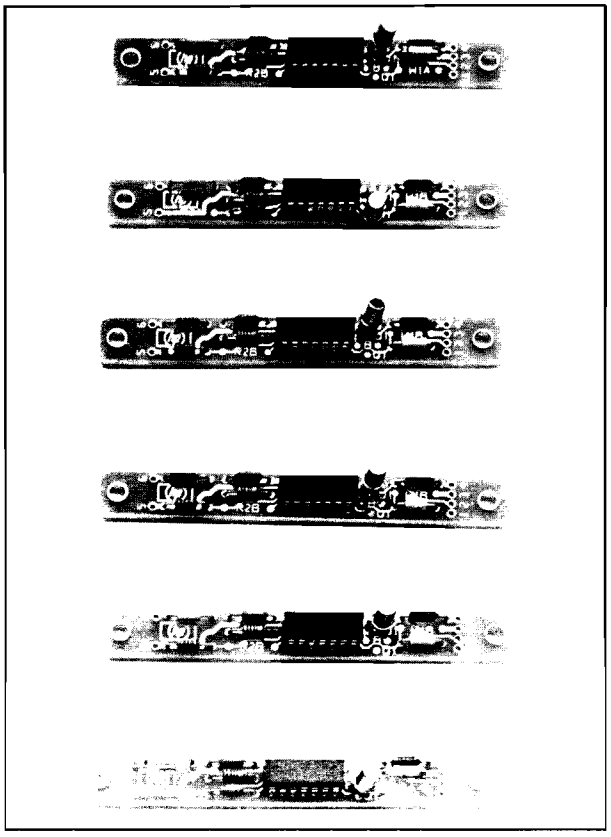
HEWLETT PACKARD

1 Point/4 Point non-isolated digital input SCM's

product number 25531/25535B,C,D,E,K,L



4 PT
NON-ISOLATED INPUT
SCMs



1 PT NON-ISOLATED
EXTERNAL STROBE
SCMs

Features

- Hysteresis
- Debounce/noise filter
- Input type/range selection
- Wet sensing of contact closures

Applications

- Limit Switch Sensing
- 5V to 48V voltage sensing
- Relay Contact Sensing

Description

The 1 Point/4 Point Non-Isolated Digital Input Signal Conditioning Modules (SCM) serve as the electrical interface between the digital signals found in the external environment and the digital function cards. Various ranges are available as described below. Hysteresis is provided for increased noise immunity. Debouncing is provided for contact closures and noise filtering. 1.5 mA (nominal) wetting current provided for contact closure sensing.

The 1 Point SCM (25531) is used for the additional single input (external strobe) found on most digital function cards.

Specifications

Static Parameters for Source Type Inputs

Product Number Suffix	Nominal Fullscale Vin (V)	Nominal Fullscale Iin (mA)	Operating Range Vin (V) Min	Operating Range Vin (V) Max	Absolute Maximum Vin (V) Min	Absolute Maximum Vin (V) Max	Rin (KΩ) Min	Rin (KΩ) Max	Turn-off Vin (V) Min	Turn-off Vin (V) Max	Turn-on Vin (V) Min	Turn-on Vin (V) Max
B	5	1.5	−10	15	−15	20	2.9	3.2	0.7	2	3	4.3
C	12	1.5	− 5	15	−10	20	8.0	8.6	1.7	4.8	7.2	10.3
D	24	1.5	− 8	28	−18	38	15.6	17.0	3.3	9.8	14.1	21.1
E	48	1.5	−16	50	−34	51	29.4	30.8	6.0	18.2	25.6	39.1

Static Parameters for Sink Type Inputs

Product Number Suffix	Nominal Open Circuit Vin (V)	Nominal Short Circuit Iin (mA)	Open Circuit Vin (V) Min	Open Circuit Vin (V) Max	Rin (KΩ) Min	Rin (KΩ) Max	Turn-on Vin (V) Min	Turn-on Vin (V) Max	Turn-off Vin (V) Min	Turn-off Vin (V) Max
K	5	−1.5	4.5	5.5	2.9	3.2	.7	2	3	4.3
L	12	−1.5	11.5	12.5	8.0	8.4	1.7	4.8	7.2	10.3

Dynamic parameters

Propagation Delay:
With filter cap: min. 15 ms; max. 53 ms.
Without filter cap: min. 500 ns; max. 28 us.

Width of Narrowest Output Pulse (Note 1):
With filter cap: min. 6.9 ms; max. 49 ms.
Without filter cap: min. 200 ns; max. 21 us.

Notes:

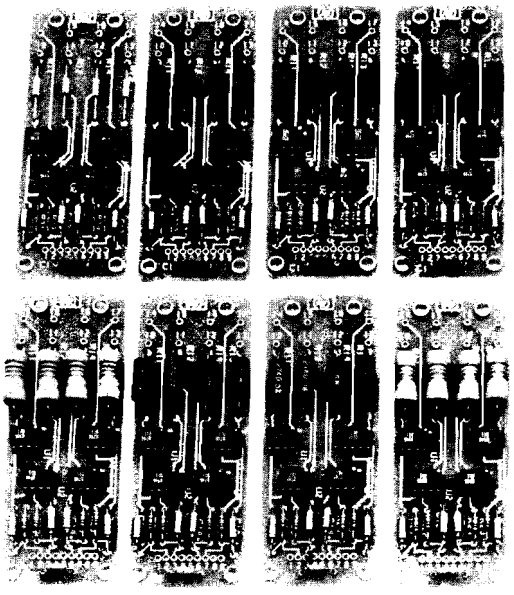
1. *Due to the pulse stretching effect of the hysteresis, if an input pulse has enough energy to be detected (i.e., if the capacitor is allowed to charge/discharge sufficiently to cross one threshold) an output pulse of width as indicated above will be produced (i.e., of width equal to the time that it takes the capacitor to discharge/charge sufficiently to cross the other threshold).*
2. *In order for an input pulse to be detected it must be wider than the maximum propagation delay. Conversely, input pulses of width less than the minimum propagation delay will be ignored.*
3. *A "TURNED-OFF" input produces a high output level which is interpreted by the function cards as a logic 0. A "TURNED-ON" input produces a low output level which is interpreted by the function cards as a logic 1. Note that open inputs, whether sink or source type, produce logic zeros.*
4. *The SCM load consists of a 56K resistor to +12V on the motherboard.*
5. *Positive current flows into the SCM input.*
6. *All products shipped with debounce filter. If no debounce is desired, the filter capacitor must be clipped off.*
7. *Source Type inputs are used to sense active circuitry that can supply current.*
8. *Sink Type Inputs are used to sense contact closures or open collector/drain type of devices.*

HEWLETT PACKARD

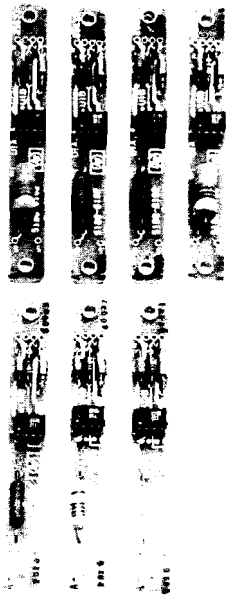
1 Point/4 Point isolated digital input SCMs

product number 25533B,C,D,E,F,G,H,J
25537P,Q,R,S,T,U,V,W

4 PT ISOLATED INPUT SCMs



1 PT ISOLATED EXTERNAL STROBE SCMs



Features

- Hysteresis
- Optical isolation with thresholds independent of LED degradation
- Debounce/noise filter
- Input range selection
- AC/DC inputs

Applications

- Limit switch sensing
- 5VDC to 230VAC voltage sensing
- Relay contact sensing
- Relay coil voltage monitoring
- Current sensing

Description

The 1 point/4 point isolated digital input Signal Conditioning Modules are used to condition AC/DC signals of various ranges for compatibility with the function cards.

The isolation is optical with threshold sensing performed prior to the LED to obtain independence from LED degradation.

Specifications

Static Parameters

Product Number Suffix	Nominal Fullscale (V) DC/AC	Nominal Input Power Dissipation (mW)	Maximum Operating Vin and Resultant Lin		DC Input Thresholds				AC Input Threshold (VAC)	
			Vin (V) DC/AC	Lin (mA) DC/AC	Turn-Off (VDC) Min	Turn-Off (VDC) Max	Turn-On (VDC) Min	Turn-On (VDC) Max	Min	Max
B,P	5/–	25/–	10/–	15/–	2.0	2.9	3.4	4.1	—	—
C,P	12/–	60/–	18/–	15/–	3.2	4.8	5.7	7.9	—	—
D,R	24/16	120/80	30/30	10/10	6.3	9.9	11.0	16.4	7.8	11.6
E,S	48/–	240/–	77/77	10/10	10.7	18.2	19.5	32.3	13.8	22.8
F,T	72/–	360/–	100/100	10/10	14.3	24.7	26.6	44.7	18.8	31.6
G,U	120/72	600/360	140/140	8/8	23.8	41.7	45.2	77.3	32.0	54.7
H,V	–/115	–/575	160/160	7/7	28.5	50.2	54.5	93.7	38.5	66.2
J,W	–/230	–/1150	250/250	5/5	56.1	99.5	108.4	188.4	76.7	133.2

For all products

Input current at nominal input voltage = 5 mA

Input TURN-ON current: min. 1.96 mA; max. 3.11 mA.

Input TURN-OFF current: min. 1.00 mA; max. 1.62 mA.

Input-output insulation leakage current: max. 1 μA at 25°C, 45% relative humidity, and Vin-out = 2500 VDC applied for 5 seconds

Dynamic parameters

Propagation delay time to logic low output level:
With filter cap: min. 400 μS; max. 1.4mS.
Without filter cap: max. 20 μs.

Propagation delay time to logic high output level:
With filter cap: min. 40mS; max. 133mS.
Without filter cap: max. 70 μs.

Width of narrowest low-going output pulse (Note 1):
With filter cap: min. 18mS; max. 123mS.

Width of narrowest high-going output pulse (Note 1):
With filter cap: min. 18 μS; max. 1.3mS.

AC input frequency range:
With filter cap: min. 47 Hz; max. 420 Hz

Notes:

1. *Due to the pulse stretching effect of the hysteresis, if an input pulse has enough energy to be detected (i.e., if the capacitor is allowed to charge/discharge sufficiently to cross one threshold) an output pulse of width as indicated above will be produced (i.e., of width equal to the time that it takes the capacitor to discharge/charge sufficiently to cross the other threshold).*
2. *In order for an input pulse to be detected it must be wider than the maximum propagation delay.*

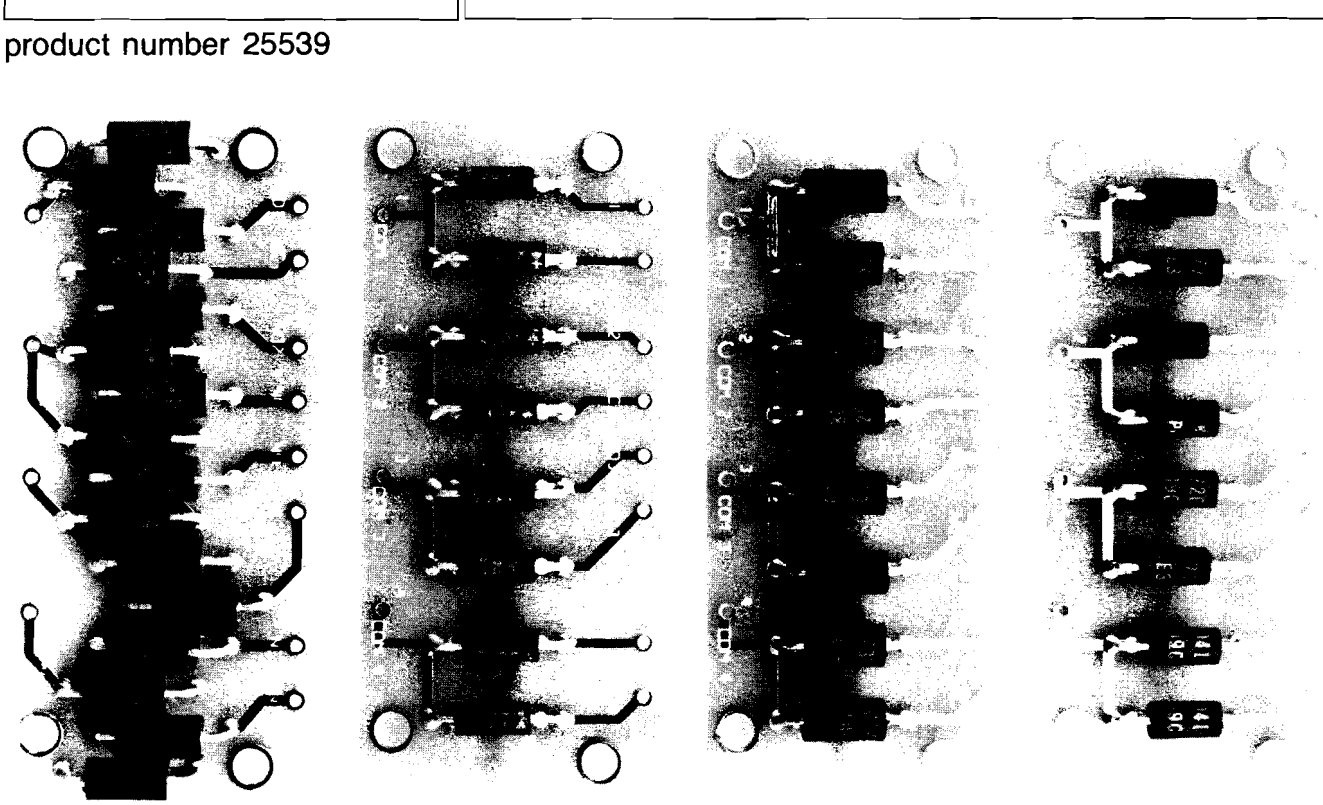
   Conversely, input pulses of width less than the minimum propagation delay will be ignored.
3. *A "TURNED-OFF" input produces a high output voltage which is interpreted by the function cards as a logic zero.*

   A "TURNED-ON" input produces a low output voltage which is interpreted by the function cards as a logic one. Note that undriven inputs produce logic zeros.
4. *The SCM load consists of a 56K resistor to +12V on the motherboard.*
5. *Positive current flows into the SCM input.*
6. *AC voltages and currents are RMS.*
7. *All products shipped with debounce filter. If no debounce is desired, the filter capacitor must be clipped off. The filter is required for AC operation.*

HEWLETT PACKARD

4 Point relay arc suppression signal conditioning module

product number 25539



Features

- Transient suppression for both the NO and NC contacts of four relays
- 25539A provides space for user supplied arc suppression components such as R-C snubber networks.
- 25539E, G, H, and I provide high speed bipolar transient suppression zener diodes for up to 30VDC, 24VAC, 115VAC, and 230VAC, respectively.

Applications

Prevents damage to relay contacts and reduces noise due to voltage spikes accompanying the switching of inductive loads such as motors and solenoids. Long cables represent an inductive load, and require arc suppression.

Description

Each four point relay arc suppression signal conditioning module provides protection for both the NO (Normally Open) and NC (Normally Closed) contacts of four relays from arcing due to switching inductive loads.

Specifications

The 25539A provides space for 2 components per relay contact. Maximum space available for the components is as follows:

	W	L	H	Lead Diameter
Component 1	2.54mm 0.1 in.	12.7mm 0.5 in.	12.7mm 0.5 in.	1.06mm 0.04 in.
Component 2	6.35mm 0.25 in.	20.3mm 0.8 in.	12.7mm 0.5 in.	1.06mm 0.04 in.

Electrical Characteristics

Maximum clamping time: 25539E, G, H, J: 5 ns.

Maximum reverse leakage at peak working voltage, 25°C: 5 μA

Peak current: 3A

25539	Peak Working VDC	Voltage VRMS	Maximum Clamping Voltage
E	±30	21.2	57
G	±37	24	68
H	±160	115	287
J	±320	230	574

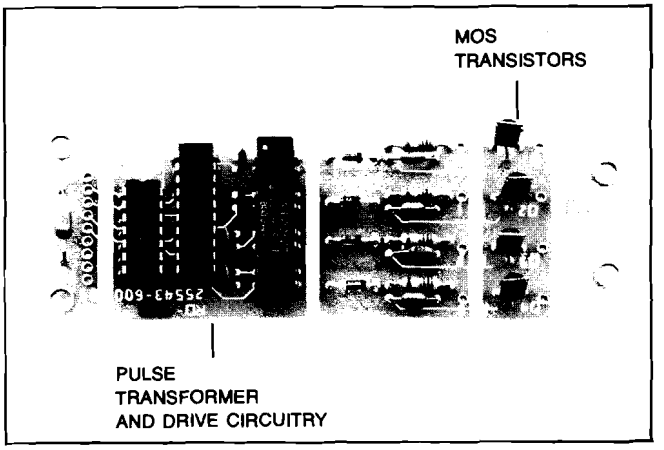
HEWLETT PACKARD

4 channel isolated output SCM

product number 25543N

Features

- 4 independent channels/card
- Compatible with the 2250 series Digital Output, Pulse and Multifunction Cards
- Pulse transformer isolation to 424V peak common mode
- Outputs protected to 60V peak



Applications

- Isolation allows switching of high common mode voltages, often found on factory floors
- MOSFETs switch up to 400mA 60VDC, 300mA
- AC signals up to 42VAC (RMS), 400mA can be switched by configuring adjacent channels back to back
- Controls motor-contacting relays and actuating solenoids

Description

The 25543N Isolated MOS SCM uses transformer isolation to eliminate ground loops and enable on-card CMOS logic to switch high level signals. Each SCM features four fully isolated channels, each of which can operate at frequencies up to 8kHz.

Specifications

Maximum logic zero output voltage: 60VDC.

Maximum Allowable Continuous Output Sink Current (mA)

Ambient Temperature	Current (mA)
25C	410
40C	375
55C	335
70C	290

Maximum rise time (μsec): 25; VDD = 60V, R(load) = 200 ohms

Maximum fall time (μsec): 2 ; VDD = 60V, R(load) = 200 ohms

Maximum turn-on delay (μsec): 2

Maximum turn-off delay (μsec): 30

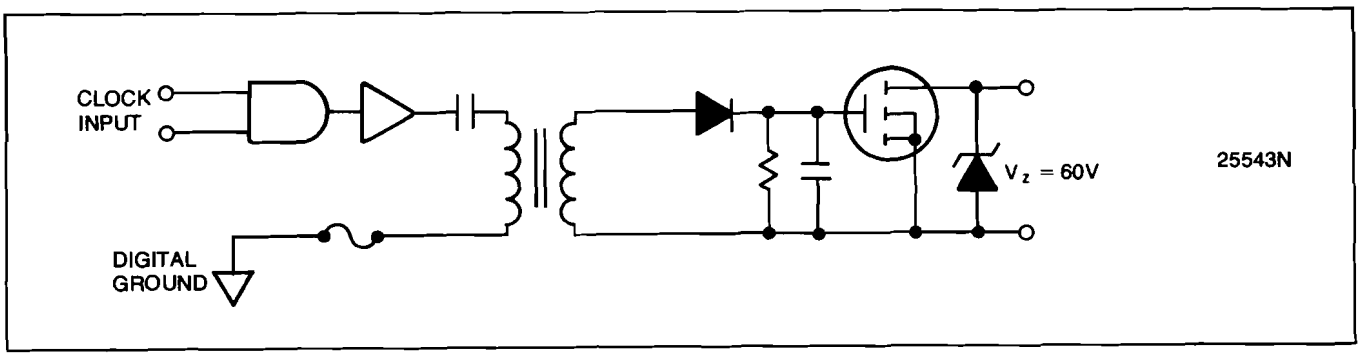
Minimum isolation, input to output: 300 RMS, 60 Hz

Max off state leakage current: 10 μA

Max switching frequency: 8 kHz

Power required (total SCM, mW): 20 @ 12V

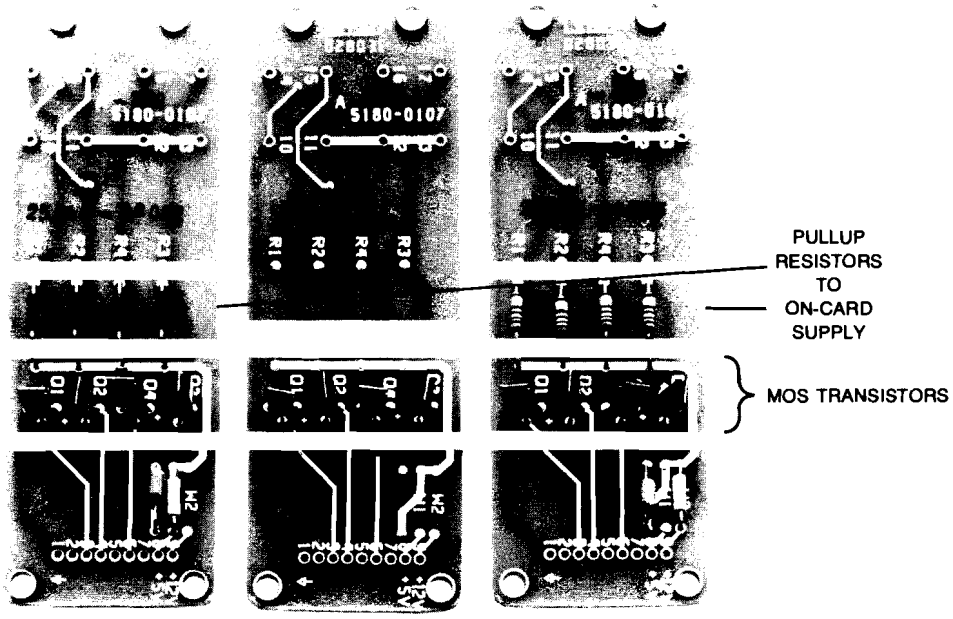
Max power dissipated (total SCM, mW): 1.8W



HEWLETT PACKARD

4 channel non-isolated DC output SCM

product number 25544 A, B, C



Features

- 4 independent channels/card
- Compatible with 2250 series Digital Output, Multifunction, and Pulse Output Cards
- High speed switching provided through MOS field-effect transistors
- Outputs are disabled (turned off) on power-on and power-off

Applications

The 25544 series signal conditioning modules plug onto the 2250 digital function cards to provide:

- Switching of DC signals up to 60V, 400mA (25544A)
- Driving TTL logic (25544B)
- Driving +12 MOS/CMOS logic (25544C)

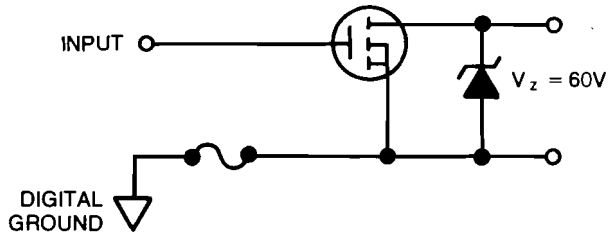
Description

The 25544A series SCMs are driven directly from CMOS logic levels on the 2250 digital function cards. They provide the fastest switching available in the digital output SCM series, with a non-isolated external strobe-to-output switching time of 2 μs. The B and C versions use pull-up resistors connected to on-card voltage regulators to drive +5 and +12 logic, and the A version is an open drain transistor with zener overvoltage protection.

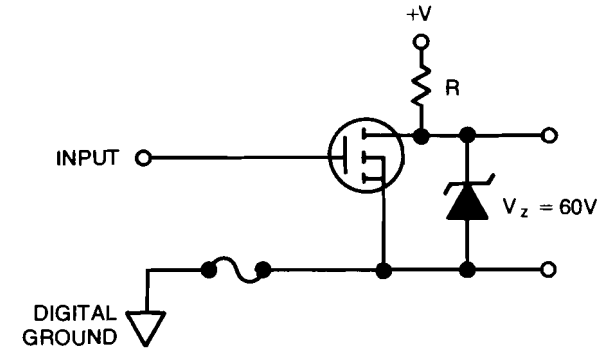
Specifications

PARAMETER	25544A MIN	25544A TYP	25544A MAX	25544B MIN	25544B TYP	25544B MAX	25544C MIN	25544C TYP	25544C MAX
Internal Pullup Voltage (V)	—	—	—	4.8	5	5.2	11.5	12	12.5
Pullup Resistance (Kohms)	—	—	—	2.1	2.15	2.2	9.9	10	10.1
Output Source Current (mA)	—	—	—	2.1	2.3		1.1	1.2	
Maximum Allowable Continuous Output Sink Current (mA)									
Ambient Temperature									
25C			410			410			410
40C			375			375			375
55C			335			335			335
70C			290			290			290
Allowable Logic Zero Output Voltage (V)	0		60	0		4.8	0		11.5
Logic One Output Voltage (V)									
Sink Current									
100 mA		.20	.25		.20	.25		.20	.25
200 mA		.40	.50		.40	.50		.40	.50
300 mA		.60	.75		.60	.75		.60	.75
Turn On/Off Delay (nsec)			15			15			15
Rise Time (μsec)*			30*			1.5			6
Fall Time (μsec)*			0.5*			0.5			0.5
Logic Zero Leakage Current (μA)		1	10		1	10		1	10
Power Required (Total SCM, mW)			0		46 @ 5V	52 @ 5V		58 @ 12V	64 @ 12V
Power Dissipated (Total SCM, W)			1.8			1.8			1.8

* For 255344A: VDD =60 VDC; R(load) =200 ohms.



25544A



25544B R = 2.15K V = 5V
25544C R = 10K V = 12V

HEWLETT PACKARD

2 Point solid state relay AC output SCM

product number 25545P

Features

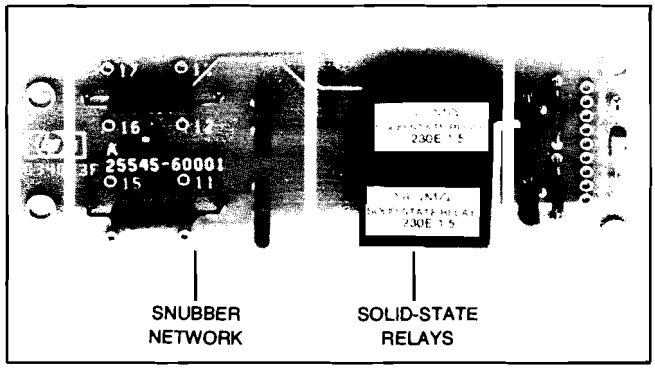
- Zero voltage turn-on reduces EMI and RFI
- Optical isolation to 2500V, input to output
- Compatible with 2250 series multifunction and digital output cards
- Snubber network insures low power factor turn-on

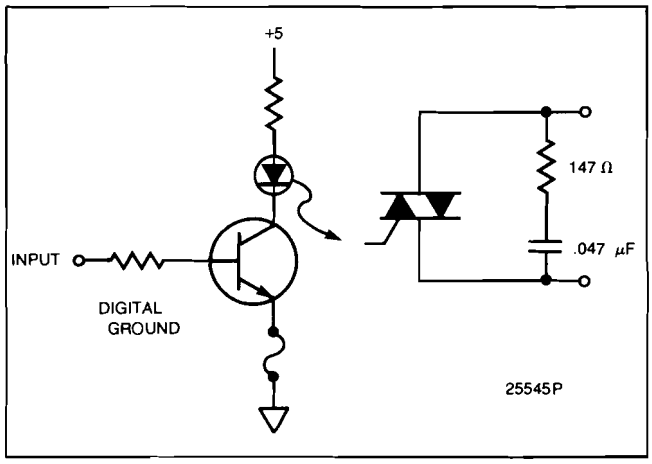
Applications

120VAC switching to 180 watts (at 25 ℃ to 40 ℃) or 90 Watts (at 70C) Small motors, Lamps, Power transformers.

Description

The 25545P Solid State Relay (SSR) SCM facilitates the switching of 120 volt AC loads up to 180 watts. The 25545P fits onto any DC output SCM location, with the wiring points identical to those of a normally open relay contact on the 25514A Relay output card. Each SCM provides two points of AC switching. Optical isolation eliminates ground loops and keeps high voltages from damaging logic components on the mother card. Zero-voltage switching make the SSR outputs ideal for switching filament lamp loads, and RC snubber networks enable inductive load switching to power factors of .30 or greater. For applications requiring a low leakage off state, the snubber networks may be clipped off by the user. Since there are no moving parts, the lifetime of the SSRs is determined by the power factor of the load, and thermal stress. When used within their rated values, the devices are rated to 10^9 operating cycles, orders of magnitude better than most electromechanical relays.





Specifications (per point at 25 ℃ card ambient unless otherwise specified)

Maximum peak repetitive off-state voltage: ±400 VDC.

RMS on-state current: 1.5A derated 25 mA per degree from 40 to 70 ℃.

Maximum dI/dt allowed: 50 A/ μsec.

Maximum off-state dV/dt allowed: 100 V/ μsec.

Peak one-cycle surge current: 50A.

Total SCM power required (from mother card): 160 mW at +5 VDC.

Maximum power dissipated (total SCM): 3.6 watts.

Maximum peak off-state current: 1 mA without snubber; 4 mA with snubber.

Maximum RMS on-state voltage (junction temp = 115C): 1.2V.

Maximum holding current: 1 mA without snubber; 4 mA with snubber.

Maximum turn-on time: 1/2 cycle.

Maximum turn-off time: 1/2 cycle.

Zero crossing voltage: ±20V peak on first half cycle; ±5V peak on subsequent half cycles.

Operating Frequency: 20 to 500 Hz.

Minimum isolation: 2500 VAC(RMS) input to output and output to case.

Maximum input/output capacitance: 4 pF.

Load power factor for guaranteed turn-on: greater than .5

Snubber network: R = 147 Ω
C = .047 μF

HEWLETT PACKARD

Diagnostic interface unit (DIU)

product number 25590A

Features

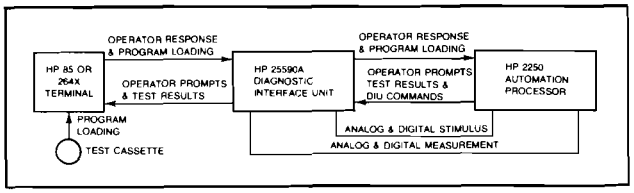
- Functionally tests all 2250 Measurement and Control Cards
- Tests performed with Signal Conditioning Modules installed
- Requires only a 264x terminal or HP 85 computer for complete, interactive offline testing
- Function card tests are cassette-based for flexibility and future expansion
- Tests are written in standard HP-1000 L-Series Diagnostic Design Language
- Programs prompt user for easy, guided test selection and operation
- Together with an accurate source and a DVM, the DIU can be used for offline Measurement and Control card calibration
- Built-in self test
- Portable and rugged

Description

The Diagnostic Interface Unit (DIU) is a dedicated, semi-automatic tester designed to perform functional tests, and to diagnose malfunctions down to the board, point, or channel level on all 2250 Function Cards. This testing is done completely off-line from any computer system, requiring only the addition of a terminal for the operator interface. The DIU is used by Hewlett-Packard field personnel for on-site service. It is also available to customers, where its functions and ease of use will be highly beneficial.

The DIU consists of analog and digital stimulus and measurement circuits which are controlled by built-in microprocessor intelligence. The microprocessor also handles the communications interface and DIU command interpretation. In all its modes of operation, the DIU acts as a peripheral to the 2250. Communication between the DIU and 2250 is through an RS 232C serial interface line which plugs into an HP 1000 L-Series Terminal Interface card, 12005B. The card, in turn, plugs into the 2250 controller backplane. The terminal connects to the DIU through a second RS 232C Serial Interface line.

Actual test programs are run by the 2250, but are loaded into the 2250 RAM memory from a tape cartridge inserted into the terminal. The test programs are written in standard HP 1000 Diagnostic Design Language (DDL). Programs output messages and data to the terminal (through the DIU) to prompt the user and show test results. The user communicates with the test programs (also through the DIU) by using the terminal keyboard. The test programs also control both the DIU and 2250 Function Cards for the required stimulus/response testing necessary to check functionality.



DIU commands

AE:	Analog Output Enable
AO:	Analog Output
AP:	Analog Pulses
AR:	Analog Read
AS:	Attenuation Select (analog output)
BM:	Binary Mode
BS:	Bank Select (digital output)
CM:	Count Mode
CO:	ID Current Output
CR:	Count Read
CS:	Control Source Select
DM:	Display Mode
DO:	Digital Output
DP:	Digital Pulses
DR:	Digital Read
EE:	Echo Check Enable
GC:	Ground Control
GS:	Gain Select
IC:	Initialization Control
IS:	Input Select (analog)
LO:	Led Output
NM:	Normal Mode
OS:	Output Select (analog)
PS:	Polarity Select
RR:	Receiver Inputs Read (digital)
RS:	Return Select (digital I/O)
SO:	Strobe Output
SP:	Strobe Pulses
SR:	Status Read
TC:	Self-Test Control
TM:	Time Mode
US:	Up Select (Pull-ups & Pull-downs)
XO:	External Control Output
XR:	External Control Inputs Read

Specifications

Operating Power: 28 VAC (nominal); 25 kHz; 50W (maximum).

HEWLETT PACKARD

2250 Diagnostic software

product number 25595A

The 2250 Diagnostic Software consists of a collection of programs that can be downloaded by cartridge tape into the RAM memory of the 2250. These programs are used for the purpose of diagnosing hardware failures in the 2250 controller section and function cards.

Diagnostics for the 2250 Function Cards are divided into 2 levels. Level 1 diagnostics consist of programs that test the internal state of the processor and function cards. Level 2 diagnostics require a DIU (Diagnostic Interface Unit), and provide a complete functional test of the function cards.

The following is a list of the 2250 diagnostic programs:

PART NUMBER	NAME	DESCRIPTION	
24397-16002	KERNL	Kernel Diagnostic for CPU functions	
25595-16001	RRACK	RRACK Memory Card Diagnostic	
25595-16002	MCIBIF	MCI & BIF Diagnostic	
24397-16003	DDL	Diagnostic Design Language	
24397-16009	HPIB	HP-IB Interface Diagnostic	
25595-16003	A.ALL1	All analog cards	(Level 1)
25595-16004	A.IN2	25501A 16 Channel Analog Input	(Level 2)
25595-16005	A.MUX2	25502A, 25503A & 25504A Mux's	(Level 2)
25595-16006	A.OUT2	25510A 4 Channel Analog Output	(Level 2)
25595-16007	D.IN1	25511A 32 Point Digital Input	(Level 1)
25595-16008	D.IN2	25511A 32 Point Digital Input	(Level 2)
25595-16009	D.OUT1	25513A 32 Point Digital Output	(Level 1)
25595-16010	D.OUT2	25513A 32 Point Digital Output	(Level 2)
25595-16011	D.RLY1	25514A 16 Point Relay Output	(Level 1)
25595-16012	D.RLY2	25514A 16 Point Relay Output	(Level 2)
25595-16013	D.MUL1	25516A 32 Point Digital Multifunction	(Level 1)
25595-16014	D.MUL2	25516A 32 Point Digital Multifunction	(Level 2)

HEWLETT PACKARD

HP 1000 Automation Library

product numbers 25581A and 25582A*

Description

The Automation Library is a collection of programs and library routines which aid in solving automation problems. The library software extends the capability and peformance of the HP 1000 Measurement and Control Processor combination.

Summary of library programs

External Subroutine Loader (LINKR)

The HP 2250 Subroutine Loader (LINKR) is used to link RTE relocatable files and produce an absolute format file suitable for downloading to the 2250. LINKR is intended to be used with the relocatable output file from HP language compilers and assemblers. Subroutines may be written in either FORTRAN or Assembly language. LINKR will run on RTE-IV or RTE-L.

High-Speed Data Acquisition Software (CDA)

This is specialized software which provides high-speed, continuous buffered data transmission to the computer. The software package is downloaded and run in the 2250. With continuous source to disc rates, up to 50,000 samples per second may be taken without loss of data. Set up and configuration software is also provided. These programs, executing on the HP 1000, simplify the setup and collection procedure required to accept data at very high rates.

Exerciser Program (MCX)

This program provides a simple interactive dialog between the programmer and 2250. MCX capabilities include: reporting status information, downloading user subroutines, and providing read/write access to buffers or variables resident in the 2250. MCL/50 commands can be sent to the 2250 from a file, or may be entered to MCX interactively. MCX will report syntax, runtime or communication errors for operator action. Result data can be formatted and displayed in integer, octal or real modes. Plus, a user expandable "help" capability makes this utility simple and efficient to use.

* *The 25582A Automation Library contains the CDA and MCX utilities, and is compatible with HP 9800 series computers. The 25581A product contains the LINKR, CDA, and MCX programs, and is compatible with all HP 1000 series computers.*

NOTES

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Printed in U.S.A. 3/81 5953-4288(52)