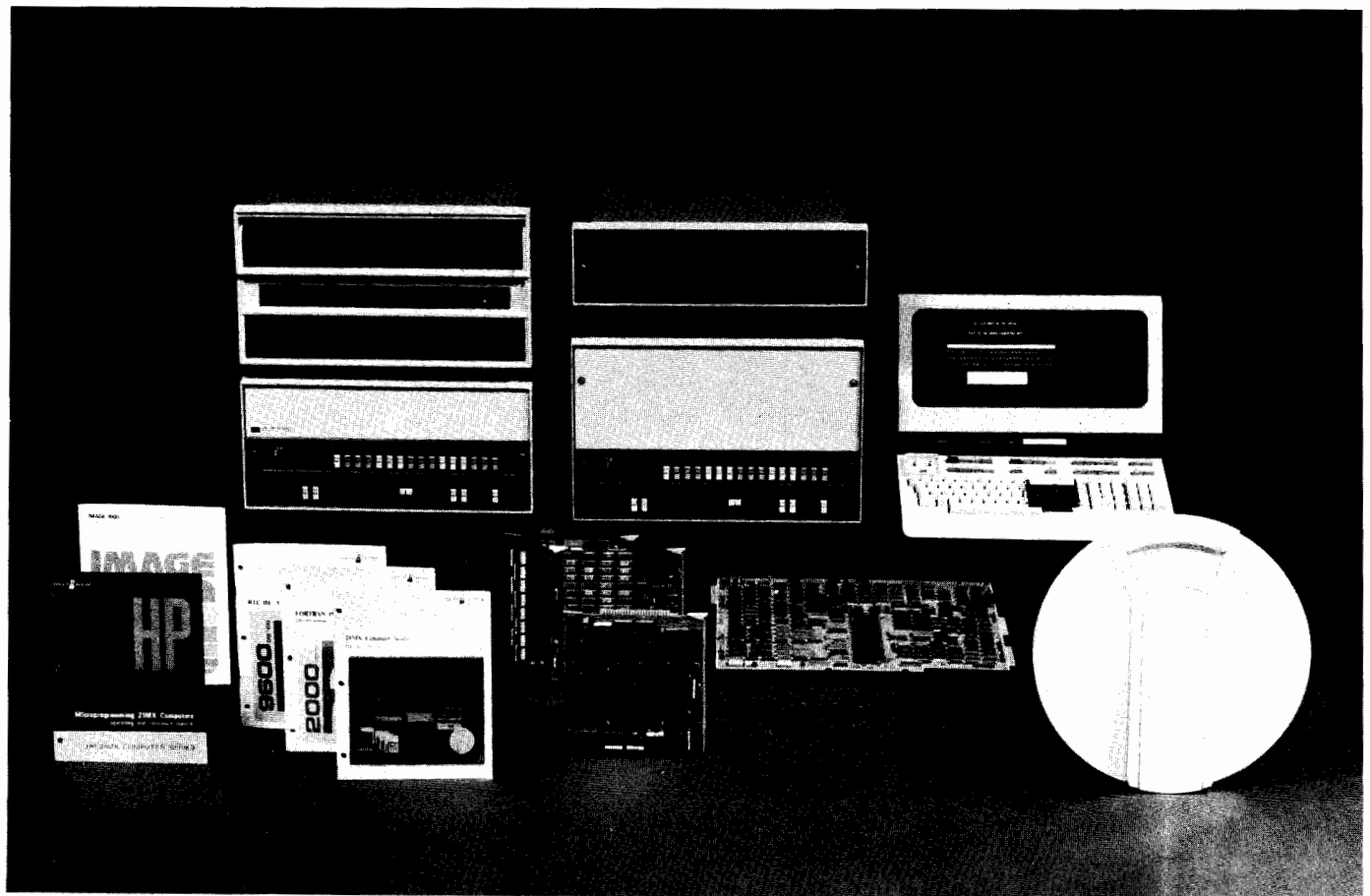
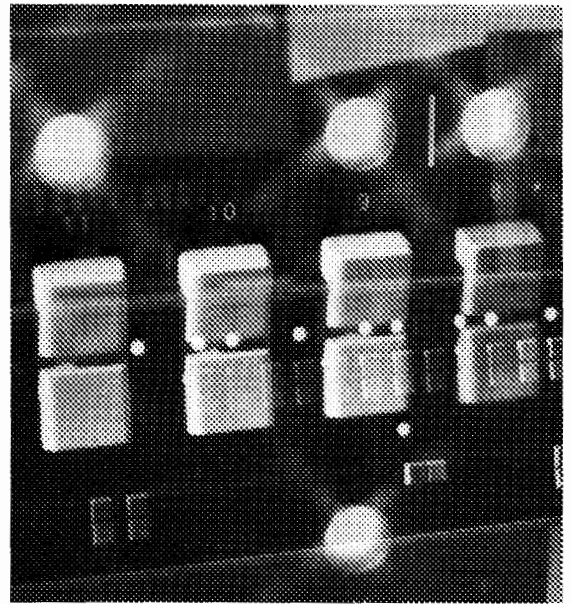
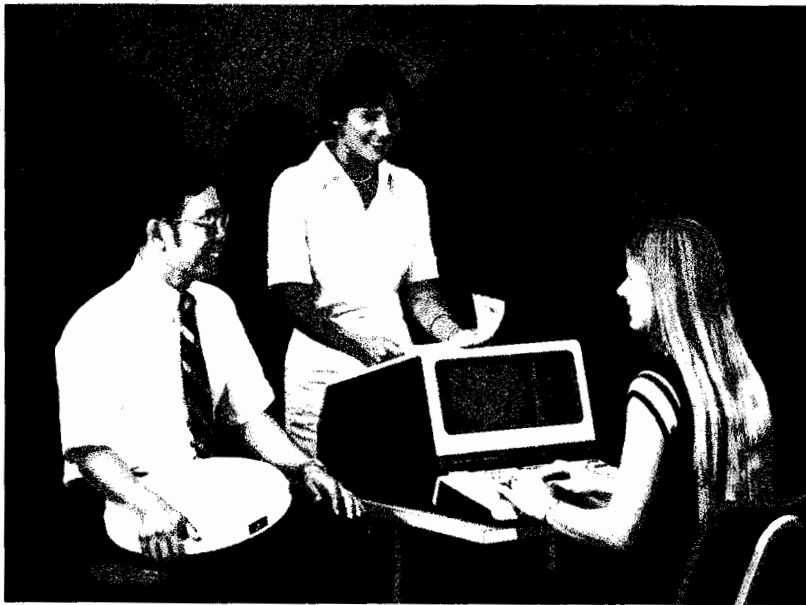


HP 21MX Computers

HEWLETT  PACKARD

A Modular Family of Computers for OEM and End User System Applications

Technical Data



Technical Data

21MX Computer Series
21MX K-Series Miniprocessor Components
Processor Accessories:
Dual Channel Port Controllers
Memory Protect
ROM Loaders
Fast FORTRAN Processor

Memory Systems:

Semiconductor Memory System
Power Fail Recovery Systems
Dynamic Mapping System

Microprogramming Accessories:

Programmable Read-Only Memory (PROM)
Writer
User Control Store
Writable Control Store

Extenders:

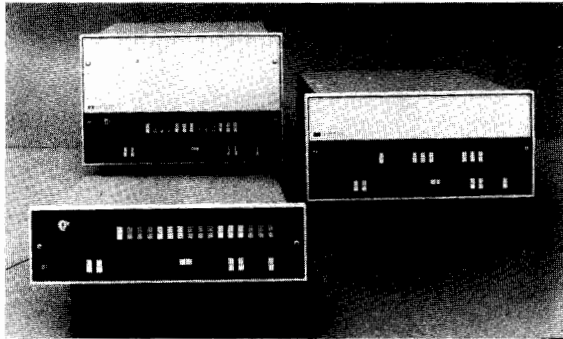
I/O Extender
Memory Extender



21MX Series Computers

models

2105A
2108A
2112A



The HP 21MX Family of processors is a flexible and powerful implementation of Hewlett-Packard's popular 2100 architecture. Standard features include a powerful instruction set with Floating Point and Data Communications Instructions, Integer Arithmetic, Automatic Parity Generation and Checking, and fully-independent Memory and I/O sections in the computer mainframe. Plug-in instructions are available to increase 21MX performance.

Utilizing the latest in 4K RAM semiconductor memory, new 16K-word memory modules feature even higher reliability and improved packaging density at a lower cost than traditional 4K and 8K modules.

Microprogramming power and speed is readily available in the form of Writable Control Store modules; it may also be permanently fused into Programmable Read-Only Memory (PROM) and plugged into processor control store.

Comprehensive 21MX software includes assemblers, compilers, and operating systems. A full line of HP-manufactured peripherals and data communications interface kits is available for tailoring complete systems around 21MX computers.

Features

- **128 powerful standard instructions including:**
 - Floating Point
 - Integer Arithmetic
 - Data Communications
 - Index Instructions
 - Memory and Register Reference
 - I/O Group
 - **Fully user-microprogrammable with complete micro-code software support**
 - **Reliable, low-cost semiconductor memory in 4K, 8K, and 16K modules, expandable to 304K**
- **Power Fail Recovery System** for automatic restart capability and for providing a minimum of 1.6 hours of memory sustaining power in the event of complete power failure
 - **A 64-word ROM Bootstrap Loader** to efficiently "boot up" systems with mainframe capacity for four selectable loaders, including paper tape and disc
 - **I/O slots that are independent of memory size and processor options**
 - **Modular design and packaging** for easy expandability and maintenance
 - **Brownout proof power supply** for high tolerance to power line variations and power interruptions
 - **Large memory capacity in compact mainframe providing:**
 - 32,768 words in the 5-1/4-inch 2105A
 - 81,920 words in the 8-3/4-inch 2108A
 - 163,840 words in the 12-1/4-inch 2112A
 - **Dynamic Mapping System** for enhanced memory capability with:
 - One-million word address space
 - Read and/or Write protection for each page
 - No degradation of memory cycle time
 - 38 new instructions for memory management
 - **Standard memory parity generation and checking** that protects programs against bit loss, resulting in reduced software development and maintenance costs

Product Specifications

PROCESSOR ARCHITECTURE

Implementation:

Vertically-microprogrammed with LSI and MSI hardware

Data Path Width:

16 bits

Standard Registers:

Accumulators: 2 (A and B), 16 bits each. Implicitly addressable, also explicitly addressable as memory locations

Index: 2 (X and Y), 16 bits each

Memory Control: 3 (T, P), 16 bits each; (M), 15 bits

Supplementary: 2 (overflow and extend), one bit each

Manual Data: 1 16-bit (display)

Instruction Types:

Memory-to-Accumulator

Memory-to-Memory

Direct Register Modification

Accumulator-to-I/O

Device Control



Instruction Formats:

Combined Single-Word
 Single-Word
 Double-Word
 Triple-Word

Instruction Expansion:

256 instruction codes are available for instruction additions.

Addressing Modes:

Direct
 Multilevel-Indirect
 Indexed
 Indirect Indexed
 Register Implicit
 Double-Word
 Single-Word
 Byte
 Bit

Bus Structure:

Separate memory data, memory address, and I/O buses tied to the unified internal processor's SBUS.

Memory Structure:

32 pages of 1024 words; with direct access to current or base (page 0) pages; indirect or indexed access to all pages.

Memory Expansion:

Paged memory address space expandable to 1024 pages of 1024 words each, using the 12976A Dynamic Mapping System.

Input/Output:

Vectored priority interrupt structure for up to four system devices and 56 I/O devices.

Input/Output Structure:

Memory and I/O Addresses	Interrupt Vector Function	Control/Access Function
0	—	Interrupt System
1	—	Program Panel
2	—	DCPC Channel 1
3	—	DCPC Channel 2
4	Power Failure	Central Interrupt Register
5	Memory Protect, Parity, DMS	Memory Protect, DMS
6	DCPC Channel 1 Completion	DCPC Channel 1
7	DCPC Channel 2 Completion	DCPC Channel 2
10	I/O Devices	I/O Devices
.	.	.
.	.	.
.	.	.
77	.	.

Instruction Execution Times:

	Minimum μ sec	Maximum μ sec
Memory Reference Group (14 total)	1.9	2.9
Register Reference Group (43 total)	2.6	2.9
I/O Group (13 total)	2.6	3.9

Extended Arithmetic Instructions (10 total)

	Minimum μ sec	Maximum μ sec
Multiply	12.3	13.0
Divide	13.6	17.5
Double Load		4.9
Double Store		4.9
Shift/Rotate	3.6	8.4
Indirect-Addressing		1.3

Index Instructions (32 total)

	Maximum μ sec
Copy A/B to X/Y	2.3
Copy X/Y to A/B	2.3
Exchange Registers A/B-X/Y	3.3
Increment/Decrement Index Registers	3.3
Load Index	*4.9
Store Index	*5.2
Load A/B Registers, Indexed	*4.9
Store A/B Registers, Indexed	*5.2
Add Memory-to-Index Registers	*4.9
Jump and Load Y	*5.5
Jump and Index Y	4.6

*Plus 1.3 μ sec/level of indirect addressing.

Data Communications Instructions (10 total)

	Setup μ sec	Execute μ sec
Load Byte	4.6	5.2
Store Byte	5.8	6.2
Move Bytes	8.8	7.3
Move Words	7.8	3.3
Compare Bytes	8.8	8.1
Compare Words	6.8	4.2
Scan for Byte	2.3	4.9
Set Bits	7.8	
Clear Bits	7.8	
Test Bits	7.1	

NOTE: Multiple execute steps may take place for each instruction set-up.

Floating Point Instructions (6 total)

	Minimum μ sec	Maximum μ sec
Add	23.7	67.6
Subtract	29.7	70.5
Multiply	47.8	56.1
Divide	61.4	77.7
Fix	6.5	12.7
Float	12.7	38.6

Control Processor:

Architecture: Hardwired
 Implementation: MSI and LSI TTL
 Control Path: 24 bits
 Data Path: 16 bits

Registers:

Standard Registers: 16
 Four are dedicated to A, B, X, and Y registers, with the remaining 12 available to microprogrammers.
 Iteration Counter: 8 bits
 Latch Register: 16 bits
 Status Flag: 1 bit

Instruction Formats:

- TYPE 1 Data Transfer and Modification
- TYPE 2 Constant Formation
- TYPE 3 Conditional Branch
- TYPE 4 Unconditional Branch

Bus Structure: Unified single bus with program access to memory data, memory address, and I/O buses

Memory Structure:

- Type: Bipolar LSI Semiconductor R/W or ROM
- Address Space: 4096 words; 16 modules of 256-words each
- Word Width: 24 bits
- Cycle Time: 325 nsec

Module Assignments:

- 0, 14, and 15 assigned to MX Base Instruction Set
- Module 1 used for Front Panel Control
- Module 2 used for DMS Instructions
- Modules 3-5 used for Fast FORTRAN
- Modules 6-11 for planned HP enhancements or user-micro-programming

Modules 12 and 13 reserved for user microroutines

Microinstructions: 211 total; up to 5 may be combined in 1 instruction cycle

- Operations: 15
- Special: 32
- ALU Arithmetic 32
- Conditional Branch: 32
- Immediate Modifier: 4
- Store-Destination: 32
- Reverse Jump Sense: 32
- S Bus-Source: 32

Execution Time

On All Instructions: 325 nsec

Memory Parity Check

Operation: Monitors all words read from memory. Utilizes 17th bit in memory. Switch-programmable to halt or ignore parity error when detected. Interrupt on error requires memory protect option. Parity error indication is displayed on the front panel.

Power Fail Interrupt

Priority: Highest priority interrupt
 Power Failure: Detects power failure and generates an interrupt to Memory Location 4 for user-written power failure routine. A minimum of 500 microseconds is provided for execution of the user-written system state save routine.

Loader Protection

All loaders reside in special ROM's separate from the control ROM, and are loaded into the last 64 words of main memory by activating front panel switches. A paper tape loader is standard and disc, terminal, or mag tape loader ROM's are optional. Four switch-selectable loader spaces are provided to accommodate other modes of operation as a user option. User-generated loaders may be written in Assembly Language, written into PROMS, and mounted in sockets on the CPU board.

Volatility Protection

AC standby mode and sustaining power for line loss of 40 milliseconds before entering power fail routine. Power Fail Recovery System provides a minimum of 1.6 hours of battery-supplied memory standby power.

Input/Output Capacity

I/O System Size	2105A	2108A	2112A
I/O Channels Standard	4	9	14
With One Extender	20	25	30
With Two Extenders	36	41	46

Memory Capacity

Memory Capacity	2105A	2108A	2112A
Mainframe (8K Modules)	16K	40K	80K
Mainframe (16K Modules)	32K	80K	160K
W/Extender (8K Modules)	0	112K	152K
W/Extender (16K Modules)	0	224K	304K

Compatibility

Instruction Set: The 21MX is upwards compatible with all previous 2100 Series minicomputers.

Program: All programs written for 2100 Series computers are compatible with the 21MX except those with timing loop dependence.

ELECTRICAL

AC Voltage: 110/220 VAC \pm 20%

Line Frequency: 47.5 to 66 Hz

Power:

Model	2105A	2108A	2112A
Power (Max.)	400W	525W	800W

Available Current to Memory, I/O, and Accessories

Model	+5	-2	+12	-12
2105A	12.8A	5.0A	1.0A	1.0A
2108A	24.8A	5.0A	1.5A	1.5A
2112A	38.8A	10.0A	3.0A	3.0A

PHYSICAL

Width: 42.6cm (16-3/4 in) behind rack mount; 48.3cm (19 in) front panel width on sides

Depth: 59.7cm (23-1/2 in); 58.4cm (23 in) behind rack mounting ears

Model	2105A	2108A	2112A
Height	13.3cm (5-1/4 in)	22.2cm (8-3/4 in)	31.1cm (12-1/4 in)
Weight	17.8Kg (39 lbs)	20.6Kg (45 lbs)	29.7Kg (65 lbs)

Power Supply

Storage After Line Failure:

Sustains processor through a line loss of 40 Msec when operating at the normal 110/220 VAC

Input Line Overvoltage Protection:

Input protection circuit in series with line fuse causes supply to crowbar for line voltages $>$ 40% above normal

Output Protection:

All voltages are protected for overvoltage and overcurrent

Output Voltage Regulation:

-2V, ± 10%; +28V, unregulated; all others, ± 5%

Thermal Sensing:

Monitors internal temperature and automatically shuts down the processor if temperature exceeds specified level

SAFETY

Models 2105A, 2108A, and 2112A are Recognized by Underwriters Laboratories Inc., and Certified by the Canadian Standards Association (with the exception of Option-015)

Required Current for Processor Accessories

	+5V	+12C	-12V	-2V
12892 Memory Protect	2A	—	—	.05A
12897 DCPC	3.3A	—	—	.05A
12909 PROM Writer	1.2A	.5A	.3A	.04A
12976A Dynamic Mapping	7.56A	0	0	0
-003†	9.22A	0	0	0
12929-001 MEM	3.9A	0	0	0
-002 DMI	1.66A	0	0	0
-003 FFP	1.66A	0	0	0
12977 FFP	3.3A	0	0	0
12978 Writable Control Store	4.6A	0	0	.15A
12979 I/O Extender Buffer Card	2.0A	0	0	1.35A
12990 Memory Extender	0	0	0	0
12992 Loader ROMS (each)	.13A	0	0	0
2102 Memory Controller	1.6A	0	0	0
12994 4K Memory Module	.5A	0	0	0
12998 8K Memory	.5A	0	0	0
13047A 2K UCS	7.39A*	0	0	0
12945A 512-Word UCS	1.66A*	0	0	0
13187A 16K Memory Module	.6A	0	0	0

*Fully loaded; refer to individual data sheets for partially loaded boards.

†Includes 12976A

ENVIRONMENTAL

Operating Temperature: 0° to 55°C (+32° to 131°F)
 Storage Temperature: -40° to 75°C (-40° to 167°F)
 Relative Humidity: 20% to 95% at 40°C (104°F), no condensation

Ventilation:

Intake: Left-hand side
 Exhaust: Right-hand side

Heat Dissipation and Ventilation:

Model		2105A	2108A	2112A
Heat	KCal/Hr. Max.	344	452	688
Dissipation	BTU/Hr. Max.	1365	1795	2730
Air Flow	Cubic Meters/Min.	5.7	5.7	11.3
	Cubic Feet/Min.	200	200	400

Altitude:

Transportable to 15,300m (50,000 ft) in non-operating condition and 4000m (15,000 ft) for operation.

Vibration and Shock:

Type tested to qualify for normal shipping and handling shock and vibration

Vibration: .30mm (.012 in) p-p,
 10-55 Hz, 3 axis

Shock: 30g, 11 Ms, 1/2 Sine, 3 axis

Contact factory for review of any application requiring operation under continuous vibration.

Product Support**HARDWARE SUPPLIED**

2105A: 2105A Microprogrammable Processor
 2108A: 2108A Microprogrammable Processor
 2112A: 2112A Microprogrammable Processor

SOFTWARE SUPPLIED

24296-60001 Diagnostic Configurator
 24396-12001 Diagnostics
 24396-12002 Diagnostics
 24396-12003 Diagnostics

DOCUMENTATION SUPPLIED

02100-90157 Diagnostic Configurator Reference Manual
 24396-14001 Diagnostic Reference Manual
 02108-90002 21MX Computer Series Reference Manual
 02108-90008 Microprogramming Manual
 02108-90004 Operators' Manual
 02108-90006 Installation and Service Manual
 02108-90014 Microprogramming Pocket Guide

INSTALLATION

The 2105A, 2108A, and 2112A are customer installed products. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

WARRANTY

HP products are warranted against defects in materials and workmanship for 90 days following date of delivery. HP will repair or replace products which prove to be defective during the warranty period. Necessary travel within countries where HP has specified availability of Computer Systems Products service facilities will be provided at no charge during the warranty period, to locations regularly served by public transportation. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

TRAINING AVAILABLE

22941A	21MX Computer Maintenance
22950A	2100 Series Assembler Programming
22960A	21MX Microprogramming

ORDERING INFORMATION

2105A	Microprogrammable Processor
2108A	Microprogrammable Processor
2112A	Microprogrammable Processor

PROCESSOR OPTIONS

21XX	
-015	230V/50 Hz Operation

Accessories and Field Upgrades

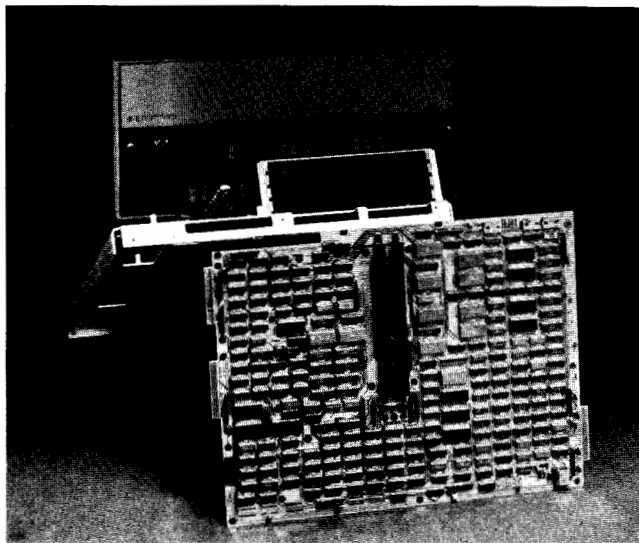
2102A	Memory Controller
12994A	4K Memory Module
12998A	8K Memory Module
13187A	16K Memory Module
12892A	Memory Protect
12897A	Dual Channel Port Controller
12976A	Dynamic Mapping System
12977A	Fast FORTRAN Processor
12978A	Writable Control Store
12909B	PROM Writer
12929A	DMS Field Upgrades
12945A	User ROM Control Store Board
12990A	Memory Extender
12991A	Power Fail Recovery for 2112A or 12990A Memory Extender
12992A	Disc Loader ROM for 7900, 2883
12992B	7905 Disc Loader ROM
12992C	2644 Terminal Loader ROM
12992D	7970 Magnetic Tape Loader ROM
12979A	I/O Extender
12944A	Power Fail Recovery System for 2105A and 2108A
13047A	2K User Control Store Board
02108-90017	Engineering Support Package





21MX K-Series Processor Components

models
2108K
12728A
12728B
12728C
12728D
12728E



The 21MX K-Series Processor offers the power, speed, and flexibility of 21MX computers, available in a convenient package for system integration. Included is the 2108K Processor Board, Instruction ROM's, Front Panel Control Assembly, and a choice of Card Cages and Backplanes.

Features

- Redundant systems hardware eliminated
- Custom control panel support
- Hidden in system for reduced support costs
- Speeds system development with full software, peripheral, and accessory support
- As a High-Performance Control Processor:
 - High-level 24-bit control processor with 325-nanosecond pipelined instruction execution
 - 211 instructions
 - 16 general-purpose registers
 - 3 Mword data bus
 - 64-device multilevel vectored priority interrupt I/O
 - Up to 32k word Read/Write storage using 2102A Memory System
- As a 21MX-Compatible Computer:
 - Compatible with the full range of 21MX processor options, peripherals, operating systems, and comprehensive software
 - 21MX Instruction Set
 - User-microprogrammable for easy access to high-performance control processor
 - Up to 32K words of 4K RAM semiconductor memory; 256K using optional Dynamic Mapping System
 - Versatile I/O structure
 - Automatic Cold Load capability

The K-Series eliminates the need for redundant systems hardware-like power supplies, control panels, and other equipment. The ability to interact directly with the processor allows designers to create custom control panels for specific applications.

The processor can also be integrated in a system, hidden from the user, which eliminates the need for programming support.

Finally, the K-Series enables users to develop, test, and demonstrate applications on a 21MX before completing system integration. This increases development efficiency and cost-effectiveness.

TWO POWERFUL PROCESSORS IN ONE PRODUCT

This 2108K Processor can be viewed at two levels. First, it is a 24-bit control processor which can perform a register-to-register add in one 325-nanosecond cycle. Further speed is achieved by fetching the next instruction from memory while the current one is being executed. This pipelining (or instruction prefetch) results in an effective doubling of processor performance. Up to five of the 211 instructions can be combined and executed in one 325-nanosecond cycle.

Another important 2108K control processor feature is the 3Mword transfer rate central bus—the S bus. It fans out to subsidiary I/O data, I/O addresses, and memory address buses. Bus transfers are controlled directly by the programmer for maximum flexibility. The powerful I/O bus is a 16-bit parallel structure with separate controls, vectored priority interrupt with programmable main memory vectors, and programmable interrupt rate testing on two levels for up to 64 devices.

The 2108K has both Read/Write and Read-Only Memory capabilities. The main R/W Memory can be modified under program control, and access for up to 32K is standard.

21MX-COMPATIBLE COMPUTER

At a second level, the 2108K Processor provides 21MX-compatible computer capabilities by adding a 12728E Instruction Set ROM. This provides access to all 21MX memory systems, I/O cards, peripherals, microprogramming tools, and instruction set. 128 instructions are available including Floating Point; Integer Arithmetic; Data Communications; Index Instructions; and I/O, Memory, and Register Reference.

This level of processor is also compatible with 21MX software languages (including high-level, assembly, and microprogramming languages); operating systems (including the

powerful RTE III real-time executive); systems utilities; and library routines to speed and simplify software development.

VERSATILE I/O STRUCTURE

The 21MX-compatible I/O structure features the multilevel vectored priority interrupt concept. The available card cages can hold either four or nine I/O cards, with a broad range of peripherals and instrumentation interfaces available.

AUTOMATIC COLD LOAD

A new feature, Automatic Cold Load, provides for a custom system initialization sequence. When the computer is powered-up and the standard Front Panel Assembly is not connected, control will be passed to a user-written ROM program. The ROM program can "cold load" main memory, perform an initialization sequence for a particular application, and monitor the system control panel.

Product Specifications

AS A CONTROL PROCESSOR

Processor: 24-bit control path,
16-bit data path

Registers:
General-Purpose: Sixteen 16 bits
Latch: One 16 bit
Loop Control Counter: One 8 bit
Flags: Three 1 bit

Instructions:
Operations: 15
Special: 32
ALU Arithmetic: 32
Conditional Branch: 32
Immediate Modifier: 4
Store-Destination: 32
Reverse Jump Sense: 32
S Bus-Source: 32

Execution Time On All Instructions:
325 nsec

Local Memory*:
Address Space: 4096 words of 24 bits
Technology: Bipolar LSI
Types: Read/Write RAM
Access Time: ROM-75 nsec
R/W RAM-110 nsec
Cycle Time: 325 nsec

Buses:
S Bus-16 bits; 3 Mword Data Rate
I/O Data Bus-16 bits; 617 Kword Data Rate
Memory Address Bus-15 bits

*Using HP-supplied Local Memory Modules

AS A COMPUTER WITH 12728E INSTRUCTION ROM

Processor: 16-bit 21MX-compatible
instruction set

Registers:
Accumulators: 2 (A&B) 16 bits
Index: 2 (X&Y) 16 bits
Flags: 2 (Overflow & Extend)
Manual Data Entry: 1 (Display) 16 bits

Instructions and Execution Times**:

	Minimum msec	Maximum msec
Memory Reference (14)	1.9	2.9
Register Reference (43)	2.6	2.9
I/O (13)	2.6	3.9
Extended Arithmetic (10)		
Multiply	12.3	13.0
Divide	13.6	17.5
Double Load		4.9
Double Store		4.9
Shift/Rotate	3.6	8.4
Indirect Addressing		1.3
Index Instructions 9 (X and Y registers) (32)		
Copy A/B to X/Y		2.3
Copy X/Y to A/B		2.3
Exchange Registers A/B-X/Y		3.3
Increment/Decrement		3.3
Index Registers		
Load Index		*4.9
Store Index		*5.2
Load A/B Registers, Indexed		*4.9
Store A/B Registers, Indexed		*5.2
Add Memory to Index Registers		*4.9
Jump and Load Y		*5.5
Jump and Index Y		4.6

*Plus 1.3 μ sec/level of indirect addressing

**Using 2102A Memory System

Data Communications (10)	Setup	Execute/Byte
Load Byte	4.6	5.2
Store Byte	5.8	6.2
Move Bytes	8.8	7.3
Move Words	7.8	3.3
Compare Bytes	8.8	8.1
Compare Words	6.8	4.2
Scan for Byte	2.3	4.9
Set Bits	7.8	
Clear Bits	7.8	
Test Bits	7.1	

Floating Point Arithmetic (6)	μ sec	μ sec
Add	23.7	67.6
Subtract	29.7	70.5
Multiply	47.8	56.1
Divide	61.4	77.7
Fix	6.5	12.7
Float	12.7	38.6

Control Memory:

Address Space: 4096 words of 24 bits; 16 256-word modules.

Modules 0,1,14, and 15 are allocated to 21MX Emulation.

Module 2 is allocated to DMS Instructions.

Modules 3,4, and 5 are allocated to Fast FORTRAN Instructions.

Modules 12 and 13 are reserved for User Microcode.

If DMS or Fast FORTRAN is not used, Modules 2 through 13 can be used for User Microcode.

Automatic Cold Load:

Provides branch to Module 11 of Control Memory on computer power-up when standard control panel is not installed.

ELECTRICAL

Input Logic Levels:

TTL Logical Low	.8 VDC Maximum
TTL Logical High	2.0 VDC Minimum

Output Logic Levels:

TTL Logical Low	.8 VDC Maximum
TTL Logical High	2.4 VDC Minimum

I/O Bus Drivers and Receivers*:

Logical Low	.8 VDC Maximum
Logical High	2.4 VDC Minimum

*Each TTL external load must have a 1.5KΩ pull-down resistor to -2V.

DC Required:

Model	+5	+12	-12	-2
2108K Processor Board	9.5A	-	-	.2A
12728C Front Panel Assembly	1.7A	-	-	-
12728E Instruction ROM	1.2A	-	-	-
12892 Memory Protect	2A	-	-	.05A
12897 DCPC	3.3A	-	-	.05A
12909 PROM Writer	1.2A	.5A	.3A	.04A
12929-001 MEM	3.9A	-	-	-
-002 DMI	1.66A	-	-	-
-003 FFP	1.66A	-	-	-
12945 User Control Store	1.66A	-	-	-
12976 DMS	3.9A	-	-	-
12977 FFP	3.6A	-	-	-
12978 Writable Control Store	4.6A	-	-	.15A
12979 I/O Extender Buffer Card	2.0A	-	-	1.35A
12990 Memory Extender	0	-	-	-
12992A Disc Loader ROM	.13A	-	-	-
2102A Memory Controller	1.91A	-	.002	-
12994A 4K Memory Module	.89A	.58A	.02	-
12998A 8K Memory Module	.89A	.62A	.02	-
13187A 16K Memory Module	.85A	.76A	.02	-

Required regulation at the Power Distribution Connector, including line, load, ripple, and noise: ±5%.

POWER SUPPLY CONTROL SIGNALS

To have the 2108K Processor Board operate properly, including power fail/auto restart capability, the power supply must provide a number of signals. These signals include:

1. A.C. line voltage within limits.
2. All D.C. voltages within limits.
3. Presence or absence of fully-charged battery back-up for memory.

PHYSICAL

2108K Board Size: 46cm x 33cm x 1.9cm
(18-1/8 in x 13 in x 3/4 in)

Weight:

2108K:	1Kg (2.1 lb)
12728A:	2.9Kg (6.3 lb)
12728B:	3.6Kg (7.8 lb)
12728C:	371g (13 oz)
12728D:	1.8Kg (4.0 lb)
12728E:	86g (3 oz)

ENVIRONMENTAL

Operating Temperature: 0° to 55°C (+32° to 131°F)
Storage Temperature: -40° to 75°C (-40° to 167°F)
Relative Humidity: 20% to 95% at 40°C (104°F), no condensation

Ventilation: Heat dissipation and ventilation requirements are as follows:

Processing Board=72 W Maximum=20cfm
ROM Board=6 W Maximum each (possible three)=2cfm each
Memory Modules (4K,8K,16K)=6 W/Memory Module Board=2cfm each
Memory Controller=12 W=3cfm

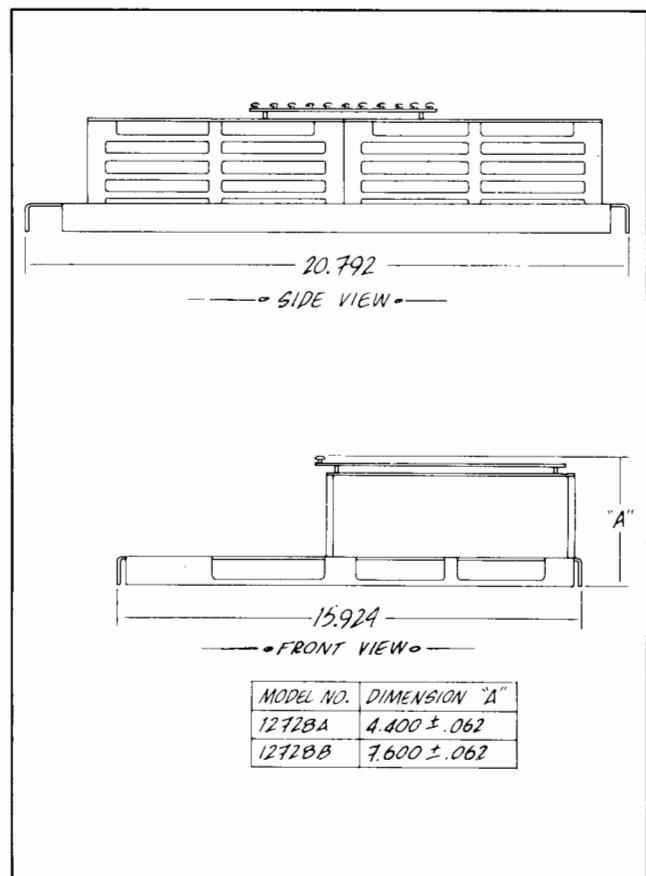
Air flow must parallel the surface of the processing board.

Vibration and Shock: Type tested to qualify for normal shipping and handling shock and vibration.

ACCESSORIES

12728A Card Cage: 8 slots (4 I/O, 1 DCPC, 1 Memory Controller, 2 Memory Module slots), Printed Circuit Backplanes, Deck, and Power Supply Connectors.

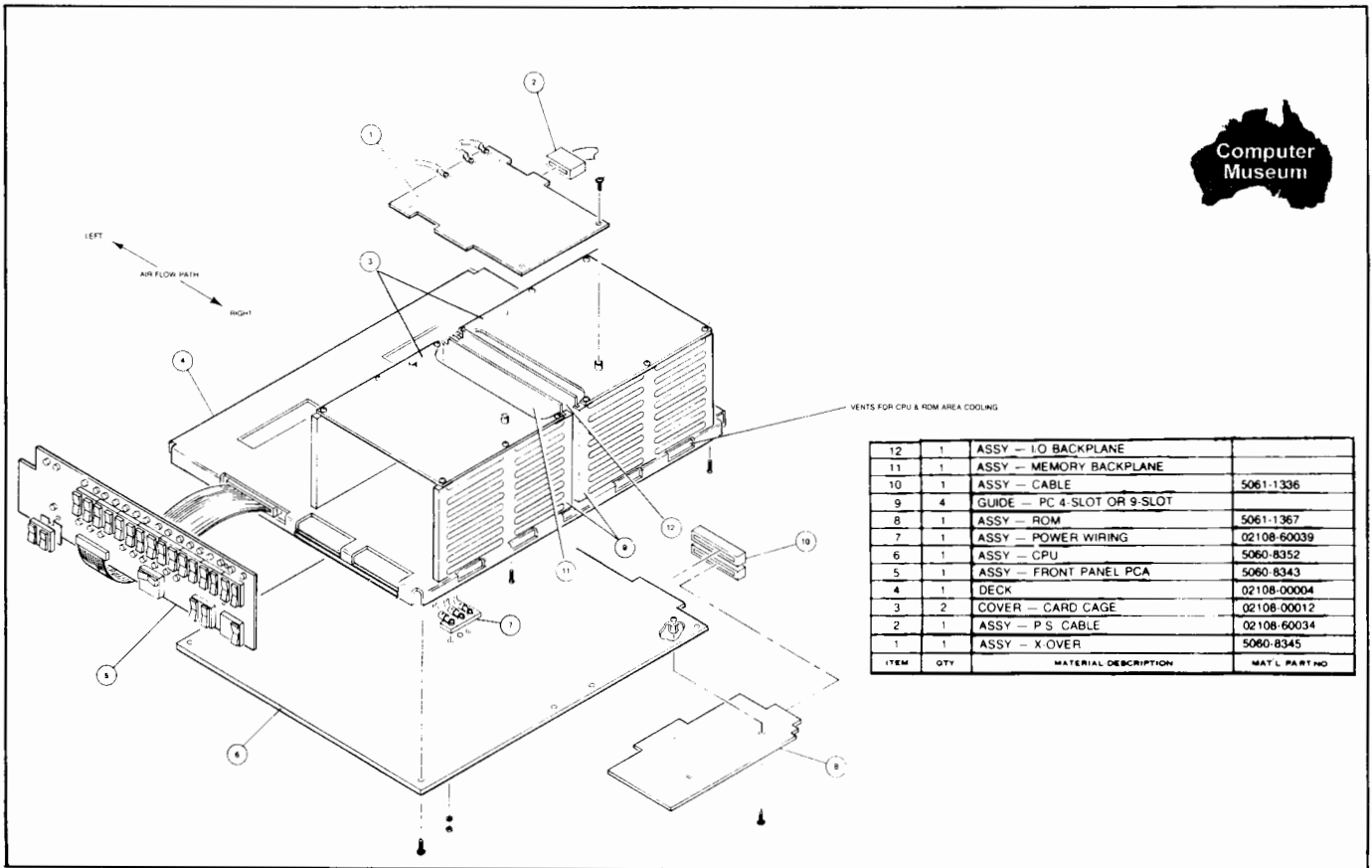
12728B Card Cage: 18 slots (9 I/O, 1 DCPC, 1 Memory Controller, 1 Memory Protect, 1 DMS, 5 Memory Module slots), Printed Circuit Backplanes, Deck, and Power Supply Connectors.



12728C Front Panel Assembly: When used with the 12728E, this assembly provides a full programmer's console.

12728D Documentation: This package completely documents the 21MX-K Series for design, service, and support activities.

12728E Base Set Instructions: These are microcode routines in READ Only Memory for use with K-Series processors to emulate all standard and extended instructions available on 21MX processors, plus Automatic Cold Load capability.



Product Support

HARDWARE SUPPLIED

- 2108 Processor Board
5060-8352 CPU Board
02108-60030 Assy Power Wiring
- 12728A Card Cage Kit: 8 slots, Backplanes, Deck, and Power Supply Connections
02108-00004 Deck
02105-40001 4/ Guide-PC, 4-Slot
02105-60002 I/O Backplane
02105-60005 Memory Backplane
02108-00012 2/ Cover Card Cage
5060-8345 Assy X-Over
02108-60034 Assy Cable Mounting Hardware
- 12728B Card Cage Kit: 18 slots, Backplanes, Deck, and Power Supply Connections
02108-00004 Deck
02108-00012 Cover Card Cage
02108-40001 4/ Guide-PC, 9-Slot
02108-60007 I/O Backplane
02108-60021 Memory Backplane
5060-8345 Assy X-Over
02108-60034 Assy Cable Mounting Hardware
- 12728C Front Panel Control Assembly
5060-8343 Assy Front Panel
- 12728E Base Set Instructions: ROM's including Extended Instruction Group
5061-1367 Assy ROM BD
2360-0113 Mounting Screws
5061-1336 Assy Cable

DOCUMENTATION

- 2108-90029 Information Sheet

INSTALLATION

Computer Systems Component Products are designed to be included as an integral part of a customer's system. They are thoroughly tested at the factory and no field installation is included.

WARRANTY

K-Series products are warranted against defects in materials and workmanship for 90 days from date of delivery. During the warranty period, Hewlett-Packard will repair or, at its option, replace products which prove to be defective provided they are returned to a designated HP repair facility.

TRAINING AVAILABLE

- | | |
|--------|-----------------------------------|
| 22941A | 21MX Computer Maintenance |
| 22950A | 2100 Series Assembler Programming |
| 22960A | 21MX Microprogramming |

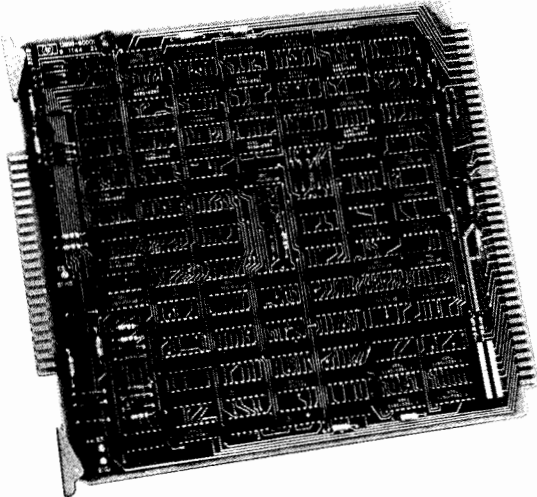
ORDERING INFORMATION

- 2108K Processor
12728A 8-slot Card Cage, Deck, and Power Supply Connection
12728B 18-slot Card Cage, Deck, and Power Supply Connection
12728C Front Panel Control Assembly
12728D Documentation Package
12728E 21MX ROM Instruction Set



21MX Dual Channel Port Controllers

models
12897A
12898A



The 12897A Dual Channel Port Controller (DCPC) for 21MX computers provides a direct port between peripheral controllers and memory. Two programmable channels can connect any I/O device to memory; these channels are program-assignable and reassignable, operating simultaneously on a cycle-stealing basis with the processor. When operating with 12976A DMS, each channel is allocated a separate automatically-enabled memory map to provide logical to physical memory address translation.

When using the DCPC with a 12979A 21MX I/O Extender, the 12898A DCPC is required. Operation and software are the same for devices in the extender and mainframe. The 12897A DCPC can be used with either 21MX or 21MX K-Series processors.

Features

- Program-assignable to any I/O channel
- Independent word count and address register for each channel
- Completely compatible with the 12976A Dynamic Mapping System
- Common DMA controllers for lower interfacing costs
- Direct data transfers to and from memory
- Operation of 12898A DCPC in I/O extenders is the same as mainframe DCPC

Product Specifications

Number of Channels: 2
Number of Memory Ports: 1
Registers per Channel: Word count register, address register

Word Size: 16 bits
Maximum Block Size: 32,768 words
Program-Assignable: To any two I/O channels
Transfer Rate: 616,666 words/sec maximum

Priority: Highest—DCPC Channel 1
Middle—DCPC Channel 2
Lowest—Processor

All logic necessary to facilitate bidirectional direct memory to I/O transfers is contained on this controller.

ELECTRICAL

The 12897A and 12998A meet all 21MX computer electrical specifications.

DC Required:

Model	+5V	-2V
12897A	3.3A	.5A
12898A	0.5A	.04A

PHYSICAL

Length: 22.1cm (8 11/16 in)
Width: 19.7cm (7 3/4 in)
Weight:
12897A: 285g (11 oz)
12898A: 171g (5 oz)

ENVIRONMENTAL

The 12897A and 12898A meet all 21MX computer specifications.

Product Support

HARDWARE SUPPLIED

12897A

12897-60001: Dual Channel Port Controller Assembly
-60002: Cable

12898A

12898-60001: Dual Channel Port Controller Assembly

SOFTWARE SUPPLIED

12897A

24322-16001: DCPC Diagnostic

DOCUMENTATION SUPPLIED

12897A

02100-90217: Diagnostic Manual
12897-90001: Installation Manual

12898A

12898-90001: Installation Manual

INSTALLATION

The 12897A and 12898A are customer installed products. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

12897A

Insert the 12897A card directly into Slot 110 of the 21MX Memory Backplane.

12898A

Insert the 12898A card directly into a dedicated slot in the 12979A I/O Extender.

CONFIGURATION INFORMATION

Slots Required: 1 each, both dedicated

CPU Options Required: None

WARRANTY

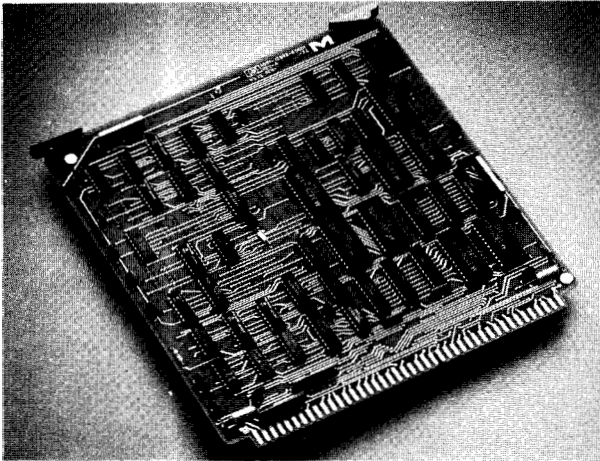
HP products are warranted against defects in materials and workmanship for 90 days following date of delivery. HP will repair or replace products which prove to be defective during the warranty period. Necessary travel within countries where HP has specified availability of Computer Systems Products service facilities will be provided at no charge during the warranty period, to locations regularly served by public transportation. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

ORDERING INFORMATION

12897A Dual Channel Port Controller

12898A Dual Channel Port Controller for 12979A I/O Extender





The 12892A Memory Protect, located in the memory section, provides an operating system with the capability to protect itself from alteration, and preserve system control of I/O functions. It offers capability to detect parity error locations by generating a parity interrupt, prevents infinite indirect addressing loops from holding off interrupt servicing, and identifies user violations when operating with the Dynamic Mapping System. The 12892A Memory Protect can be used with 21MX or 21MX K-Series processors.

Features

- Memory Protect Logic prevents memory alteration below a programmable fence address
- I/O Protect Logic provides vectored interrupt on attempted execution of I/O instructions, prevents I/O operation until interrupt is serviced, thus giving systems exclusive control of I/O and DMS operations
- Parity Error Interrupt Logic provides an interrupt on occurrence of a parity error in memory and saves the parity error address
- Parity and protect features separately enabled/disabled by standard I/O instructions
- Computer may be switch-selected to interrupt or halt on parity error
- Operates in conjunction with Dynamic Mapping to provide interrupts for paged memory violations, privileged instruction violations, or parity errors
- Indirect Level Counter allows long indirect address loops to be interrupted
- Single plug-in card

MEMORY PROTECT FENCE

Memory Protect provides capability to protect a selected block of any-sized memory, from a settable fence address

downward, against alteration by programmed instructions except those directly involving the A and B registers. Any programmed instruction except JMP may freely address the A and B registers as locations 00000 and 00001 respectively.

I/O CONTROL

With an STC 05 instruction, Memory Protect Logic prohibits the execution of all I/O instructions. This feature limits I/O operations to interrupt or DMA only. Programming the system to direct all I/O interrupts to an executive program exclusive control of the I/O system.

Memory Protect Logic is disabled automatically by any interrupt and must be re-enabled by an STC 05 instruction at the end of each interrupt subroutine.

PROGRAMMING

The following programming rules pertain to the use of Memory Protect, assuming an STC 05 instruction has been given:

- A. Location 00002 is the lower boundary of protected memory. Locations 00000 and 00001 are the A and B register addresses.
- B. JMP instructions may not reference the A or B register; however, a JSB instruction may do so.
- C. The upper boundary, memory address, is loaded into the fence register from A or B register by an OTA 05 or OTB 05 instruction, respectively. Memory locations below but not including this address are protected.
- D. Execution will be inhibited and an interrupt to location 00005 will occur if a JMP, JSB, ISZ, STA, STB or DST instruction (also CBT, JLY, JPY, MVB, MVW, SAX, SAY, SBX, SBY, STX, AND STY of the extended instruction group) either directly or indirectly addresses a location in protected memory. Execution will also be inhibited if any instruction is attempted, including HLT but excluding those addressing select code 01, the S register, and the overflow register. After three successive levels of indirect addressing, the Memory Protect Logic will allow a pending I/O interrupt.
- E. Any instruction not mentioned in Section D is legal, even if the instruction directly references a protected memory address. Indirect addressing through protected memory by those instructions listed in step D is also legal provided that the ultimate effective address is outside the protected memory area.

For more detailed information, refer to the 21MX Computer Series Reference Manual.

Product Specifications

ELECTRICAL

The 12892A meets all 21MX computer electrical specifications.

DC Required:

Model	+5V	-2V
12892A	2.0A	0.05A

PHYSICAL

Length: 22.1cm (8 11/16 in)

Width: 19.7cm (7 3/4 in)

Weight: 200g (70 oz)

ENVIRONMENTAL

The 12892A meets all 21MX computer environmental specifications.

Product Support

HARDWARE SUPPLIED

12892-60001 Memory Protect Card

SOFTWARE SUPPLIED

24324-16001 21MX Series Memory Protect Diagnostic

24325-16001 21MX Memory Parity Check Diagnostic

DOCUMENTATION SUPPLIED

12892-90001 Installation Manual

02100-90220 21MX Series Memory Protect Diagnostic Manual

02100-90221 21MX Series Memory Parity Check Diagnostic Manual

INSTALLATION

The 12892A is a customer installed product. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

Insert the 12892A board directly into Slot 111 of memory backplane. No cables required.

CONFIGURATION INFORMATION

Slots Required: 1 dedicated slot in 2108A or 2112A mainframes

CPU Options Required: None

Note: Memory Protect is not available for the 2105A processor.

WARRANTY

HP products are warranted against defects in materials and workmanship for 90 days following date of delivery. HP will repair or replace products which prove to be defective during the warranty period. Necessary travel within countries where HP has specified availability of Computer Systems Products service facilities will be provided at no charge during the warranty period, to locations regularly served by public transportation. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

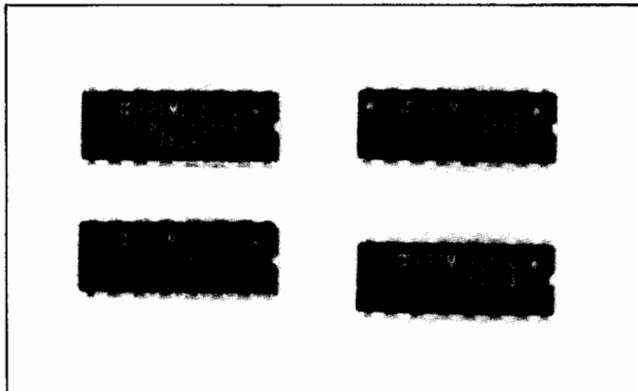
ORDERING INFORMATION

12892A Memory Protect



21MX Loader ROM's

models
12992A
12992B
12992C
12992D



The HP 21MX optional Loader ROM's consist of four independent products, each consisting of one 256 x 4 bit PROM. Two of the four ROM's allow absolute binary programs to be loaded into 21MX Memory from a 2644 Cartridge Tape or a 7970 Magnetic Tape. The remaining two ROM's are used to load programs in Disc Boot format from 7900/7901/2883 Discs or from a 7905 cartridge Disc.

Features

- Allows program loading from disc, magnetic tape, or tape cassette
- Each of the installed Loader ROM's can be selected using the switch register
- Up to three optional Loader ROM's may be used in a 21MX processor

Product Specifications

ELECTRICAL

The 12992 Loader ROM's meet all 21MX computer electrical specifications.

DC Required: 130 MA/Loader ROM (+5V)

PHYSICAL

16-pin 1K PROM integrated circuit

ENVIRONMENTAL

The 12992 Loader ROM's meet all 21MX computer environmental specifications.

Product Support

HARDWARE SUPPLIED

12992A: 12992A Loader ROM IC
12992B: 12992B Loader ROM IC
12992C: 12992C Loader ROM IC
12992D: 12992D Loader ROM IC

SOFTWARE SUPPLIED

None

DOCUMENTATION SUPPLIED

12992-90005 Installation Manual

INSTALLATION

The 12992A, 12992B, 12992C, and 12992D are customer installed products. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

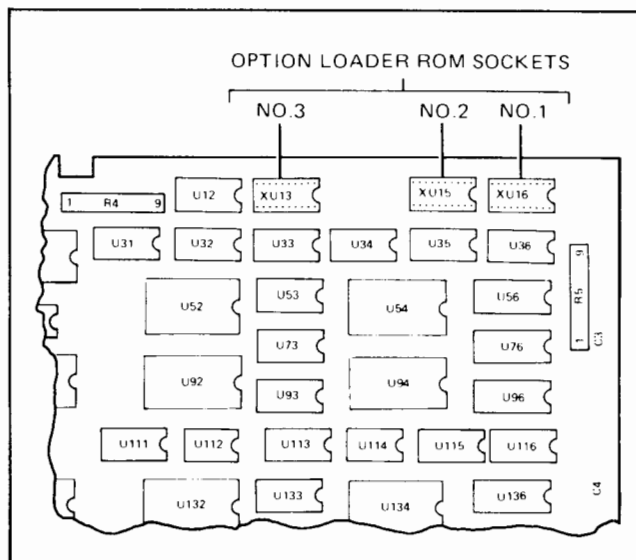
To install, remove 21MX CPU board from mainframe, insert 12992 Loader ROM in one of three optional loader ROM sockets, and reinstall CPU board.

NOTE: 12992 Loader ROM's ordered with a 21MX computer are installed at the factory.

CONFIGURATION INFORMATION

Optional loader CPU sockets required: 1/loader

Prerequisites: 21MX/4K of memory



WARRANTY

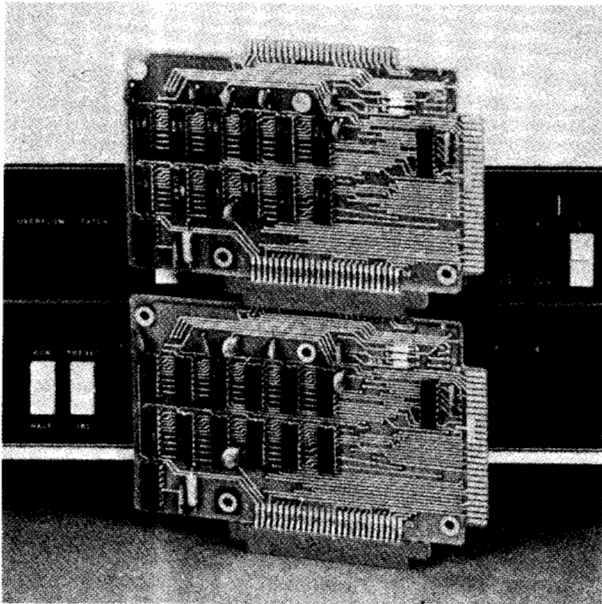
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PRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

ORDERING INFORMATION

12992A	7900A Disc ROM Loader
12992B	7905A Disc ROM Loader
12992C	2644A Cartridge ROM Loader
12992D	7970 B/E Magnetic Tape ROM Loader





The HP 12977A Fast FORTRAN Processor consists of 20 microcoded subroutines which enhance throughput efficiency of FORTRAN, other high level language programs, Assembly Language programs, and particular scientific application programs. These routines are stored in bipolar Read-Only Memory and executed by 21MX or 21MX K-Series processors.

Features

- Firmware microcode for 20 new instructions and sub-routines:
 - Extended precision floating point addition, subtraction, multiplication, division
 - Single precision to extended floating point conversion
 - Extended precision to single precision conversion
 - Extended precision move
 - Extended precision normalization and pack
 - Two and three dimensional array mapping
 - Subroutine parameter transfer
 - Conditional control transfer
- Includes library for use with FORTRAN II, FORTRAN IV, ALGOL, and Assembly Language
- Available for use with RTE, DOS-III, DOS-M, and BCS
- Provides 2 to 20-fold increase in program execution

Each Fast FORTRAN instruction has a unique instruction code associated with it. When a high level language program is compiled, a subroutine call to the program library is generated by the compiler. The library then replaces the subroutine call with the appropriate Fast FORTRAN machine code. Execution of the Fast FORTRAN code calls a firmware routine allowing the microprocessor to execute the instruction.

In Assembly Language, the machine opcodes of the Fast FORTRAN Processor and the appropriate parameter lists are used instead of the overlay library, to execute Fast FORTRAN instructions (refer to the manual "Relocatable Subroutines", HP Part Number 02116-91780). For example, when the extended precision divide routine, .XDIV, is to be executed in FFP microcode, a programmer simply replaces the Assembly Language statement JSB .XDIV by the corresponding Opcode 105204 as follows:

Assembly Language	Assembly Language
JSB .XDIV (Call Subroutine)	OCT 105204 (Call FFP Microcode)
DEF X (Result)	DEF X (Result)
DEF Y (1st Operand)	DEF Y (1st Operand)
DEF Z (2nd Operand)	DEF Z (2nd Operand)

The 12977A can be field-installed on all 21MX computers. The product includes the FFP relocatable library for RTE, DOS-III, DOS-M, and BCS to overlay the software library entry points by corresponding opcodes (105XXXB).

ELECTRICAL

The 12977A meets all 21MX computer electrical specifications.

DC Required:

Model	+5V
12977A	3.3A

PHYSICAL

Length: 15.2cm (6 in)
Width: 10.2cm (4 in)
Weight: 171g (6 oz)
Number of Cards: 2 User Control Store Cards

ENVIRONMENTAL

The 12977A meets all 21MX computer environmental specifications.

MICROCODED ROUTINES

Microcoded Routines	Description	Execution Time in $\mu\text{sec.}$		Opcode
		MINIMUM	MAXIMUM	
DBLE	Converts single to extended precision	15.28	15.28	105201
SNGE	Converts extended to single precision	20.15	65.00	105202
¹ .XMPY and XMPY	Extended Multiply	80.28 Max. non-interruptable time = 75.08 μsec	105.30	105203 and 105211
¹ .XDIV and XDIV	Extended Divide	107.90 Max. non-interruptable time = 75.08 μsec	163.15	105204 and 105212
¹ .XADD and XADD	Extended Add	42.25 Max. non-interruptable time = 75.08 μsec	130.90	105213 and 105207
¹ .XSUB and XSUB	Extended Subtract	42.25 Max. non-interruptable time = 75.08 μsec	130.98	105214 and 105210
² .DFER and .XFER	Transfers an extended precision variable to another location	9.75	13.33	105205 and 105220
.PWR2	Calculates $X * 2^N$ for real X and integer N	12.35	12.35	105225
.FLUN	Unpacks a real variable	4.23	4.23	105226
.XPAK	Normalizes, rounds and packs mantissa of an extended precision number	19.50 Max. non-interruptable time = 75.08 μsec	99.13	105206
.PACK	Normalizes a real variable	13.33	52.33	105230
.XCOM	Compliments an extended precision number	12.68	15.28	105215
..DCM	Compliments and normalizes an extended precision number	25.35 Max. non-interruptable time = 75.08 μsec	104.33	105216
DDINT	Converts extended precision real to extended integer	31.53 Max. non-interruptable time = 75.08 μsec	183.30	105217
.GOTO	Transfers control to location indicated by FORTRAN computed GOTO statement	13.00	13.00	105221
..MAP	Computes the address of a specified element of 2 or 3 dimensional array	26.98	43.88	105222
³ .ENTR .ENTP	Transfers address of parameters from a calling sequence into a subroutine list	16.25 + 3.90 * NP 15.93 + 3.90 * NP (NP = number of parameters Interruptable if number & parameters > 11)		105223 105224
.SETP	Sets a table of increasing values for DOS III	7.80 + 1.95 * Count (Interruptable if count > 30)		105227

¹The difference between .AA and AA is a return address as follows:

JSB .AA	JSB AA
DEF X	DEF * + N (Return address)
DEF Y	DEF X
Etc.	DEF Y
	.
	.
	.
	Etc. (Nth arguments)

²The difference between .DFER and .XFER is as follows:

LDA (Address of X)	JSB.DFER
LDB (Address of Y)	DEF Y
JSB .XFER	DEF X

³The difference between .ENTR and .ENTP is:

.ENTR	.ENTP
For all BCS subroutines, all DOS/RTE Utility Routines	.For all privileged routines and re-entrant routines



Product Support

HARDWARE SUPPLIED

5060-8380 FFP Module 3
5061-1328 FFP Modules 4 & 5 Mounting Hardware

SOFTWARE SUPPLIED

12977A
12977-16004
 and 21MX FFP Diagnostics (B)
12977-16005
 -421
12977-16001 21MX DOS FFP Subroutine Library (B)
12977-16002 21MX DOS FFP \$SETP System Sub-
 -423 routine (B)
12977-16003 21MX BCS FFP Subroutine Library (B)

DOCUMENTATION SUPPLIED

12977-90001 FFP Installation Manual
12977-90002 FFP Diagnostic Manual

INSTALLATION

The 12977A is a customer installed product. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

To install, remove 21MX CPU bottom cover; using screws, install both FFP modules on control store stand-offs on CPU board. Replace cover.

CONFIGURATION INFORMATION

CPU Control Store Module Locations Required: 2

WARRANTY

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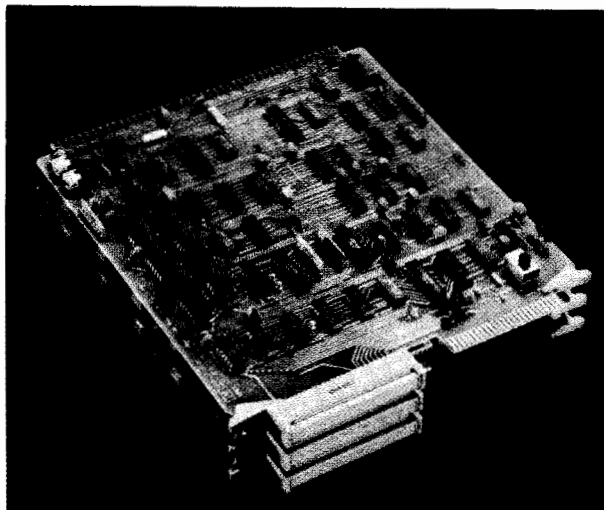
ORDERING INFORMATION

12977A Fast FORTRAN Processor



21MX Semiconductor Memory System

models
2102A
12994A
12998A
13187A



The 2102A Semiconductor Memory System is a main memory system for 21MX Series processors. It provides the latest 4K, MOS/RAM memory chip technology with extensive testing by Hewlett-Packard to assure maximum reliability. Metal Oxide Semiconductor (MOS) Memory means greater reliability, expandability, and reduced power requirements for the user. The 2102A can be used with either 21MX or 21MX K-Series processors.

Features

MAIN MEMORY

- High reliability—4K N-channel MOS/RAM memory chips
- 650-nanosecond system cycle time
- 16 bit data word with 17th bit for parity
- High density—4K, 8K, or 16K words on a single plug-in memory module

Product Specifications

MEMORY ORGANIZATION

Type: 4K, N-channel MOS/RAM memory chips

Word Size: 17 bits including parity

Configuration: One controller supports multiple plug-in memory modules

System Cycle Time: 650 nsec

Volatility Protection: 21MX Computer Series processors provide memory sustaining power for a line loss of up to 160 milliseconds. An optional Power Fail Recovery System provides memory power in case of total line failure.

Refresh Interval: All memory locations are refreshed automatically every two milliseconds.

MEMORY SYSTEM

Basic system consists of controller and interconnecting cable for a full complement of memory modules. The system plugs into the memory section of the 21MX processor. Memory is configured by using multiple 4K, 8K, and 16K modules, with a maximum of one 4K module/processor.

ELECTRICAL

DC Required :

Model	+5V CPU	+5V Mem	+12V Mem	-12V Mem
2102A	1.6A	.31A	0 A	.002A
12994A	.51A	.38A	0.577A	.020A
12998A	.51A	.38A	0.615A	.020A
13187A	.59A	.26A	0.760A	.020A

PHYSICAL

Length: 22.1 cm (8-11/16 in)

Width: 19.7 cm (7-3/4 in)

Weight: 2102A: 400 g (14 oz)

12994A: 228 g (8 oz)

12998A: 289 g (10 oz)

13187A: 314 g (11 oz)

ENVIRONMENTAL

The 2102A meets all 21MX computer environmental specifications.

Product Support



HARDWARE SUPPLIED

2102A: 5060-8360 Memory Controller
02112-60016: Cable

12994A: 5060-8369 4K Memory Module

12998A: 5060-8339 8K Memory Module

13187A: 5061-1332 16K Memory Module

SOFTWARE SUPPLIED

2102A: 24395-16001 Memory Diagnostic

DOCUMENTATION SUPPLIED

2102A: 24395-90001 Manual of Diagnostics

12994A: 12994-90001 Installation Manual

12998A: 12998-90001 Installation Manual

13187A: 13187-90002 Installation Manual

INSTALLATION

The 2102A, 12994A, 12998A and 13187A are customer installed products. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

To install, configure memory modules to desired module addresses, insert memory controller and modules in designated slots in the memory backplane of the 21MX computers, and connect cable between the controller and memory modules.

CONFIGURATION INFORMATION

Memory Slots Required:

1 for 2102A Memory Controller, plus 1/Memory Module Card.

CPU Options Required:

- A) For expansion beyond 32K words, the Dynamic Mapping System is required.
- B) To allow parity error address detection, the 12992 Memory Protect option is required.

WARRANTY

HP products are warranted against defects in materials and workmanship for 90 days following date of delivery. HP will repair or replace products which prove to be defective during the warranty period. Necessary travel within countries where HP has specified availability of Computer Systems Products service facilities will be provided at no charge during the warranty period, to locations regularly served by public transportation. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

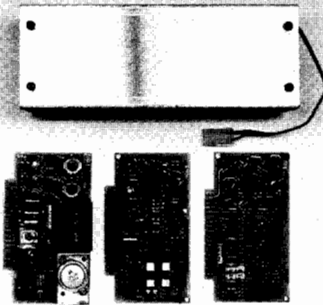
ORDERING INFORMATION

2102A	Memory System Memory Controller and Cable
12944A	Power Fail Recovery System for 2105A and 2108A
12991A	Power Fail Recovery System for 2112A Processor or 12990A Memory Extender
12994A	4K word, 650 nsec MOS/RAM Semiconductor Main Memory Module
12998A	8K word, 650 nsec MOS/RAM Semiconductor Main Memory Module
13187A	16K word, 650 nsec MOS/RAM Semiconductor Main Memory Module
02112-60016	Memory Cable (Required for field expansion of 2102A Memory System)
12990-60015	Memory Cable (Required for field expansion of 2102A Memory Systems using the 12990A Memory Extender)



21MX Power Fail Recovery Systems

models
12944A
12991A



21MX Power Fail Recovery Systems provide battery sustaining power for memory during line power outages, battery charging circuitry, and battery charge state testing. If a line power outage does not last long enough to deplete available battery charge, the contents of the MOS memory are preserved, and the power fail/auto restart feature of 21MX computers may be used to resume processing. If, on the other hand, a line power outage lasts long enough to deplete available battery charge, the Power Fail Recovery Systems prevent automatic power up, cause an automatic memory clear to eliminate false parity error indications, and signal the operator that this condition exists. Battery charge state monitoring is performed automatically and periodically when line power is applied. If the available battery charge is unable to sustain memory for at least five minutes during a line failure, an indicator on the front panel of the 21MX is activated warning the user of this condition.

Features

- Sustains memory through power failures
- Tests battery charge state and provides a low battery warning indicator
- Provides automatic memory clear on power failures lasting longer than available battery charge
- Operates throughout the entire range of 21MX environmental specifications

Product Specifications

12944A

2105A and 2108A Processors use the 12944A battery back-up system. It contains one 12-volt package of Nickel Cadmium batteries with a rating of 3.5 ampere-hours.

12991A

The 2112A Processor and 12990A Memory Extender require the 12991A battery back-up system. It contains two 12-volt packages of Nickel Cadmium batteries, each with a rating of 3.5 ampere-hours.

ELECTRICAL

The 12944A and 12991A meet all 21MX computer electrical specifications.

Power Restart:

Detects resumption of power and generates an interrupt to trap cell for user-written restart program which has been protected in memory by the sustaining battery.

Power Control and Charge Unit:

Monitors battery charge status and provides slow charge.

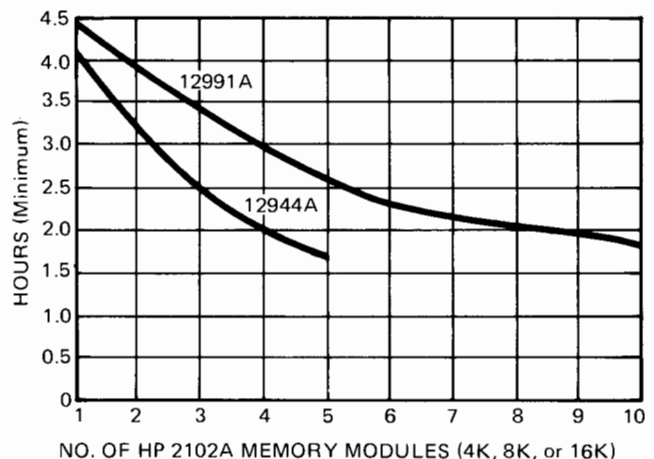
Sustaining Battery:

Type: 12 Volt Nickel Cadmium

Charging Rate: 350 MA constant current

Sustaining Time: The system will sustain memory for the length of time shown in the following graph:

MEMORY SUSTAINING TIME



Battery Charge Rate:

Approximately 16 hours to fully-charge

Battery Cycle Servicing:

Once every three-six months the battery should be completely discharged by turning line power off to the processor for over five hours.



PHYSICAL

	12944A	12991A
Weight:	2.5 Kg (5.5 lb)	5.5 Kg (12 lb)
No. of Cards:	3	1
Battery Box Size:		
Length:	19.7 cm (7-3/4 in)	27.9 cm (11 in)
Width:	22.9 cm (9 in)	22.9 cm (9 in)
Depth:	8.3 cm (3-1/4 in)	8.3 cm (3-1/4 in)

ENVIRONMENTAL

The 12944A and 12991A meet all 21MX computer environmental specifications.

Product Support

HARDWARE SUPPLIED

12944A

1420-0206	Battery Pack
5060-8346	Battery Output Assembly
5060-8347	Battery Control 1 Assembly
5060-8353	Battery Control 2 Assembly
	Mounting Hardware

12991A

1420-0206	Battery Pack
2112-60003	Battery Inverter Assembly
	Mounting Hardware

SOFTWARE SUPPLIED

None

DOCUMENTATION SUPPLIED

12944A

12944-90001 Installation Manual

12991A

12991-90001 Installation Manual

INSTALLATION

The 12944A and 12991A are customer installed products. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

To install, secure the battery pack to the back of the I/O card cage cover. Install the printed circuit cards in the power supply. Then, connect the battery cable to the processor's Battery Input Connector.

WARRANTY

HP products are warranted against defects in materials and workmanship for 90 days following date of delivery. HP will repair or replace products which prove to be defective during the warranty period. Necessary travel within countries where HP has specified availability of Computer Systems Products service facilities will be provided at no charge during the warranty period, to locations regularly served by public transportation. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

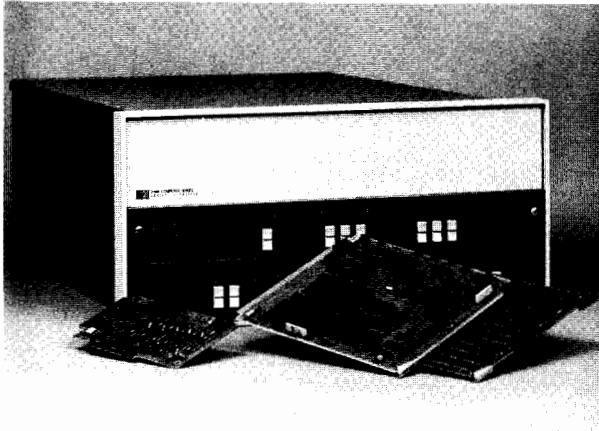
ORDERING INFORMATION

12944A

Power Fail Recovery System for 2105A and 2108A Processors

12991A

Power Fail Recovery System for 2112A processor or 12990A Memory Extender



The Dynamic Mapping System for HP 21MX computers gives the user capability to address memory configurations larger than the usual 32,768 word limitation; to provide page-by-page memory protection; and to allow programs and data to be loaded into and executed from non-contiguous pages of memory. It consists of a Memory Expansion Module and Memory Protect which are plugged into the memory section of the 21MX Computer, and the Dynamic Mapping Instructions which are mounted in the control store section of the processor.

DMS provides a 20-bit wide memory address bus which allows an addressing space of one million words of main memory, and lets the user specify each 1024 word page within the physical memory to be read and/or write protected for program security. Separate memory translation maps provide isolation of user from system and user from user. All systems using DMS execute with the same memory cycle time as systems having only 32,768 words or less of memory.

The Hewlett-Packard Fast FORTRAN Processor instructions may be added to DMS as an option.

Features

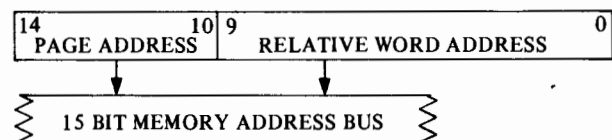
- One million word address space
 - Read and/or write protection for each page
 - No degradation of memory cycle time
 - Installed in processor mainframe, so no additional rack space required
 - May be factory installed or a plug-in field expansion
 - Four Dynamically Alterable Memory Maps
 - Two for program execution
 - Two for the Dual Channel Port Controller
- Programs may be executed from non-contiguous page locations
 - Allows DCPC to communicate to an area separate from program space
 - Allows DCPC to load or unload from non-contiguous segments of memory
 - Compatible with previous software for 21MX or 2100 Family computers
 - 38 new instructions for memory control
 - Provides independent and shared base page segments using programmable fence
 - Operating system may be given complete control of the I/O logic
 - Parity Error Interrupt logic



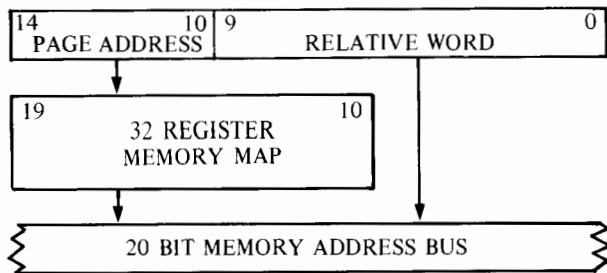
METHOD OF OPERATION

The basic addressing space of the 21MX is 32,768 words, called the "logical" memory. The amount of semiconductor memory actually installed in the computer is called the "physical" memory. A 21MX computer with DMS installed has an addressing space of one million words for physical memory. In the 21MX physical limitations prevent configuration of physical memory beyond 304K words. Dynamic Mapping allows physical memory to be mapped into logical memory via four dynamically alterable memory maps.

The basic memory addressing scheme of the 21MX provides for addressing of 32 "pages" of memory, each page being 1024 words. This memory is addressed through a 15-bit memory address bus. The upper five bits of this bus provide the page address and the lower ten bits provide the relative word address within the page.



The Memory Expansion Module of the Dynamic Mapping System converts the 5-bit page address into a 10-bit page address and thereby allows 2^{10} or 1024 pages to be addressed. The conversion is accomplished by allowing the original 5-bit page address to identify one of 32 registers within a "Memory Map". Each of these memory map registers contains the new user specified 10-bit page address. This new page address is then joined with the original 10-bit relative word address to form a 20-bit memory address.



All registers within the Memory Map are dynamically alterable. To maximize system performance capability, there are four separate memory maps in the memory expansion module, selectable under program control: User Map, System Map, and two Dual Channel Port Controller (DCPC) Maps.

Product Specifications

DYNAMIC MAPPING INSTRUCTIONS

All 38 DMS instructions are microcoded and assigned to Control Store Module 2.

MNEMONIC	DESCRIPTION	EXECUTION TIME	OPCODES
MBI	Move Bytes Into	*6.49 + 2.92W + 3.89B	105702
MBF	Move Bytes From	6.49 + 2.92W + 3.57B	105703
MBW	Move Bytes Within	6.49 + 2.92W + 2.92B	105704
MWI	Move Words Into	3.24 + 2.92W	105705
MWF	Move Words From	3.24 + 2.92W	105706
MWW	Move Words Within	3.24 + 2.92W	105707
SYA/B	Load/Store System	47.125 - 47.80	101710/105710
USA/B	Load/Store User	47.125 - 47.80	101711/105711
PAA/B	Load/Store Port A	47.125 - 47.80	101712/105712
PBA/B	Load/Store Port B	47.125 - 47.80	101713/105713
SSM	Store Status in Memory	5.84 μ s	105714
JRS	Jump and Restore Status	(9.1 - 10.4) + 1.3Z	105715
XMM	Transfer Map or Memory	9.75 + 13W	105720
XMS	Transfer Map Sequentially	8.45 to 98W	105721
XMA/B	Transfer Maps Internally	15.26 - 16.56	101722/105722
XLA/B	Cross Load	5.53 + 1.3Z	101724/105724
XSA/B	Cross Store	5.53 + 1.3Z	101725/105725
XCA/B	Cross Compare	6.18 + 1.3Z	101726/105726
LFA/B	Load Fence	3.57	101727/105727
RSA/B	Read Status	2.59	101730/105730
RVA/B	Read Violation	2.27	101731/105731
DJP	Disable and JMP	5.85 + 1.3Z	105732
DJS	Disable and JSB	6.5 + 1.3Z	105733
SJP	Enable System and JMP	5.85 + 1.3Z	105734
SJS	Enable System and JSB	6.5 + 1.3Z	105735
UJP	Enable User and JMP	5.25 + 1.3Z	105736
UJS	Enable User and JSB	6.18 + 1.3Z	105737

*W = Number of words

B = 0 If number of bytes is even

1 If number of bytes is odd

Z = Add for each level of indirect address

DYNAMIC MAPPING POWER FAIL CHARACTERISTICS

Power failure automatically enables the system map, and a minimum execution time of 500 microseconds is assured the programmer. A power fail routine should include routines to save as many maps as desired.

Upon restoration of power, all maps are disabled and none are considered valid. It is the responsibility of the power fail recovery software to restore the maps as desired.

VIOLATION REGISTER

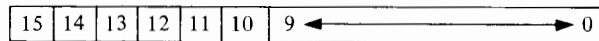
The Memory Expansion Module violation register contains information so the programmer can detect where a fault occurred in hardware or software and what steps must be taken to correct it:



15	Read Violation
14	Write Violation
13	Base Page Violation
12	DMS Privileged Instruction
7	ME-Bus Enabled
6	Maps Enabled
5	System/User Selected
0-9	Map Register

STATUS REGISTER

The Memory Expansion Module status register allows the programmer to determine whether the MEM is on or off currently, and at time of the last interrupt, as well as indicates the address for the base page fence.



15	MEM enabled at last interrupt
14	System/user selected at last interrupt
13	MEM currently enabled
12	System/user currently selected
11	DMS protected mode
10	Portion mapped
0-9	Base page fence

MEMORY PROTECT

The memory protect feature of DMS provides all the capability of HP's 12892A Memory Protect plus the capability to read and/or write protect each individual page of physical memory.

Memory Protect allows a block of logical memory of any size, from a selectable fence downward, to be protected against alteration by programmed instructions except those directly involving the A and B registers. This is in addition to the page-by-page protection provided within DMS.

Memory Protect Logic, when enabled, prohibits the execution of all I/O instructions except those referencing the switch register and the overflow register. This feature allows I/O to be controlled by interrupt only.

Although the Memory Expansion Module may perform its mapping function without the Memory Protect Board being installed, Memory Protect is required before the protect features may be used.

ELECTRICAL

The 12976A Dynamic Mapping System and 12929A Upgrade Components meet all 21MX computer electrical specifications.

DC Required:

Model	+5V
12976A	7.56A
-003	9.22A*
12929A	
-001	3.90A
-002	1.66A
-003	1.66A

PHYSICAL

Length: 12929A-001 22.1 cm (8-11/16 in)
Width: 12929A-001 19.7 cm (7-3/4 in)

Length: 12929A-002, -003 15.2 cm (6 in)
Width: 12929A-002, -003 10.2 cm (4 in)

Weight: 12976A 542 g (19 oz)
-003 628 g (22 oz)*
12929A-001 257 g (9 oz)
-002 86 g (3 oz)
-003 86 g (3 oz)

Number of Boards:
12976A: 3
-003: 1
12929A
-001: 1
-002: 1
-003: 1

*Includes 12976A

ENVIRONMENTAL

The 12976A and 12929A meet all 21MX computer environmental specifications.

Product Support

HARDWARE SUPPLIED

12929A		
-001	5060-8362	MEM Assembly
-002	5060-8380	Dynamic Mapping Instructions
-003	5061-1328	Fast FORTRAN Instructions

SOFTWARE SUPPLIED

12976A		
-003	12929-16001	DMS Diagnostic
	12977-16004	FFP Diagnostic
	12977-16005	

12929A		
-001	12929-16001	DMS Diagnostic
-002	NONE	
-003	12977-16004	FFP Diagnostic
	12977-16005	

DOCUMENTATION SUPPLIED

12976A

	12976-90001	DMS Manual
	12929-90003	DMS Diagnostic Manual
-003	12977-90001	FFP Installation Manual
	12977-90002	FFP Diagnostic Manual

12929A

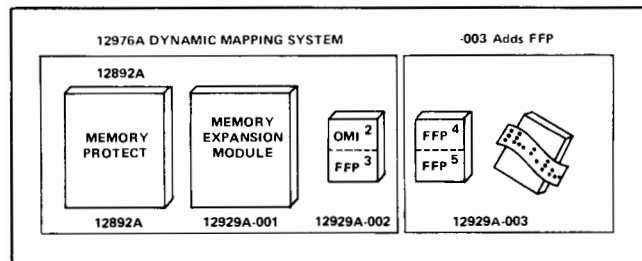
-001	12926-90001	DMS Manual
	12929-90003	DMS Diagnostic Manual
-002	12926-90001	DMS Manual
-003	12977-90001	FFP Installation Manual
	12977-90002	FFP Diagnostic Manual

INSTALLATION

The 12976A and 12929A are customer installed products. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

The HP 12976A Dynamic Mapping System is field installable by attaching the Dynamic Mapping Instructions Control Store Card to the Processor Board, and by plugging both the Memory Protect Board and the Memory Expansion Module into the memory section of the 21MX Computer.

CONFIGURATION INFORMATION



CPU Control Store Locations Required:

12976A, 12929A-002: 1

12976A-003: 2

12929A-003: 2

Slots Required: 2 dedicated slots in 2108 or 2112A memory backplane

Prerequisites: 2108A or 2112A Computer

Software Recommended: RTE-III

NOTE: +5V power supply current requirements should be reviewed prior to 12976A installation to assure sufficient power is available.

NOTE: 12976A is not available for the 2105A Computer.

WARRANTY

HP products are warranted against defects in materials and workmanship for 90 days following date of delivery. HP will repair or replace products which prove to be defective during the warranty period. Necessary travel within countries where HP has specified availability of Computer Systems Products service facilities will be provided at no charge during the warranty period, to locations regularly served by public transportation. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

ORDERING INFORMATION

12976A Dynamic Mapping System for 21MX computers (except 2105A Processor). Includes memory protect module and memory expansion instructions

-003 Adds Fast FORTRAN Processor

12929A 21MX Series upgrade components

-001 Memory Expansion Module (not available for 2105A Processor)

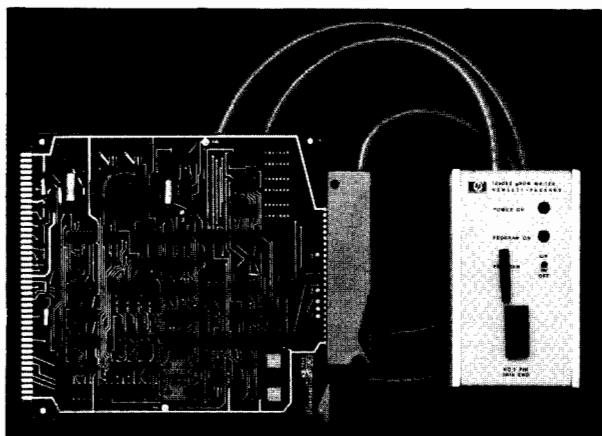
-002 Dynamic Mapping Instructions and FFP Module 3

-003 FFP Modules 4 and 5 with FFP software



21MX Programmable Read-Only Memory (PROM) Writer

model 12909B



The 12909B Programmable Read-Only Memory (PROM) Writer allows users to permanently transfer microprograms from memory to PROM chips after debugging. The PROM Writer consists of a card that inserts into an I/O slot, plus a small box used to fuse the PROM chips. It can be used with either 21MX or 21MX K-Series Processors.

Features

- 256 X 4 PROM fused without expensive special tooling.
- User control of fuse parameters provided through the system console
- Any single memory location or complete array can be written into PROM's
- Patterns from compatible ROM's copied into PROM's in a two-stage operation
- Complete fusing in ten seconds
- ROM contents printed on system console
- Runs under BCS or DOS operating system
- PROM contents verified with desired pattern stored in memory

Product Specifications

ELECTRICAL

The 12909B meets all 21MX computer electrical specifications.

DC Required:

Model	+5V	-12V	-12V	-2V
12909B	1.2A	.5A	.3A	.04A

BURN PULSE

- Rise Time: Slew rate limited 20 - 40 μ sec
- Pedestal Voltage: Value programmed by jumpers to manufacturer's specifications, tolerance $\pm 2.5\%$
- Overshoot: None
- Current Limit: Value programmed by jumpers to manufacturer's specifications, tolerance $\pm 10\%$
- Reference Voltage: 5.00V $\pm .01$ V adjustable $\pm 2\%$ T.C. + aging
- PROM Vcc: Value programmed by jumpers to manufacturer's specifications, tolerance $\pm 2.5\%$.

PHYSICAL

- Length: 22.1 cm (8-11/16 in)
- Width: 19.7 cm (7-3/4 in)
- Weight: 800 g (1-3/4 lb)

Mounting Fixture:

- Length: 5.0 cm (2 in)
- Width: 7.6 cm (3 in)
- Depth: 14.6 cm (5-3/4 in)



ENVIRONMENTAL

The 12909B meets all 21MX computer environmental specifications.

Product Support

HARDWARE SUPPLIED

- 12909-60005 12909B PROM Writer Board,
- 12909-60002 PROM Writer Mounting Fixture
- 1816-0250 Test ROM

SOFTWARE SUPPLIED

- 24287-60001, PROM Writer Control Program Rev. B
- 24287-60002 DOS Adapter for PROM Writer Control Program
- 24360-16001 Diagnostic

DOCUMENTATION SUPPLIED

- 12909-90005 Installation and Service Manual
- 12909-90009 Operating and Reference Manual
- 24360-90001 Diagnostic Manual

Installation

The 12909B is a customer installed product. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

CONFIGURATION INFORMATION

I/O Slots Required: 1

CPU Options Required: None

Software Required: 24287-60001, Rev. B PROM Writer Control Program

Software Recommended: 24287-60002 DOS Adapter for PROM Writer Control Program

NOTE: A flat surface should be available within 1.2 meters (4 feet) of the back of the system cabinet on which to set the PROM Writer Mounting Fixture.

WARRANTY

HP products are warranted against defects in materials and workmanship for 90 days following date of delivery. HP will repair or replace products which prove to be defective during the warranty period. Necessary travel within countries where HP has specified availability of Computer Systems Products service facilities will be provided at no charge during the warranty period, to locations regularly served by public transportation. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

TRAINING AVAILABLE

22960A

21MX Microprogramming

ORDERING INFORMATION

12909B PROM Writer

PROM chips ordered from specific manufacturers

Harris: 1024V-5B

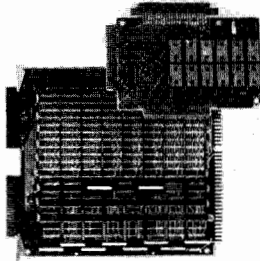
MMI: 6301

HP: 1816-0015



21MX User Control Store

model
12945A



The 12945A User Control Store Board provides 21MX or 21MX K-Series microprogrammers with two consecutive 256-word modules of non-volatile memory address space. Using an HP 12909B PROM Writer and its supporting software, microprogrammers can write their programs into programmable read-only memory chips (PROM's) and verify that their contents match the expected data pattern. They can also supply recommended vendors with necessary information for generating masked or programmed read-only memory chips compatible with the 12945A. In either case, microprograms stored in read-only memory chips are jounted on the UCS board which, in turn, is conveniently mounted beneath 21MX or 21MX K-Series processors.

When the 2108K is used as a control processor, the 12945A mounts on the processor board and provides two consecutive 256-word modules of non-volatile local memory address space. When recommended PROM's are used, the 12945A is fully-compatible with 21MX and 21MX K-Series processors, providing 325-nanosecond instruction execution times, no reduction in processor cycle time, and appropriate I/O loading characteristics.

Features

- 512 words of non-volatile address space provided for 21MX and 21MX K-Series processors
- Very cost-effective approach to adding microprograms to 21MX Series processors
- Non-volatile local memory address space provided for 2108K Processor
- Routines execute with no performance degradation from standard 325-nanosecond cycle time
- Compatible with HP microprogramming support software
- Saves main memory address space
- Provides a measure of proprietary software security
- Microprograms undisturbed by CPU programs or power failures

Product Specifications

Word Size: 24 bits
Module Size: 256 words
Module Capacity: 2 modules (must be consecutive)
Cycle Time: 325 nsec
PROMS/Module: 6
Recommended PROMS: HP: 1816-0015
Harris: 1024-5B
MMI: 6301

ELECTRICAL

The 12945A meets all 21MX computer electrical specifications.

DC Required:

Configuration	+5V
Logic Only	.1A Maximum
1 Each Module Loaded	.88A Maximum
2 Modules Fully Loaded	1.66A Maximum

PHYSICAL

Length: 15.2 cm (6 in)
Width: 10.2 cm (4 in)
Weight: 57 g (2 oz)

ENVIRONMENTAL

The 12945A meets all 21MX computer environmental specifications.

Product Support

HARDWARE SUPPLIED

12945A User Control Store Board Mounting Hardware
3 Configuration Jumpers

DOCUMENTATION SUPPLIED

12945-90001 Installation Manual



INSTALLATION

The 12945A is a customer installed product. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

21MX or 21MX K-Series computer configurations use a screw mount under processor board with side jumper connector to the 21MX Instruction Set ROM board.

2108K control processor configurations use a screw mount to the processor board with either a side jumper connector to an adjacent UCS board or a jumper connector directly to the processor board.

CONFIGURATION INFORMATION

The 12945A User Control Store Board uses one of the available processor control store board positions.

Processor Capacity*:

21MX Computers	21MX K-Series Computers	2108K Control Processor
Up to 2 Boards	Up to 2 Boards	3 Boards

*Depends on number of HP firmware accessories used and available power

WARRANTY

HP products are warranted against defects in materials and workmanship for 90 days following date of delivery. HP

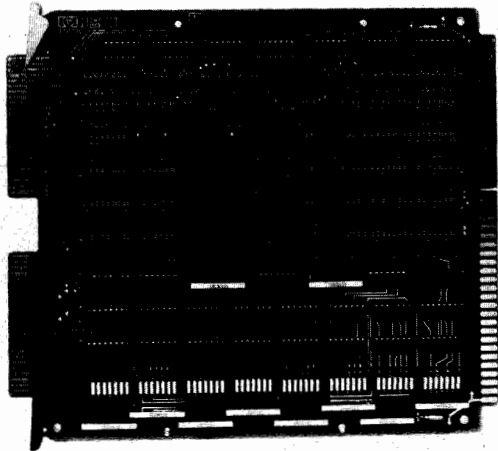
will repair or replace products which prove to be defective during the warranty period. Necessary travel within countries where HP has specified availability of Computer Systems Products service facilities will be provided at no charge during the warranty period, to locations regularly served by public transportation. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

TRAINING AVAILABLE

22960A 21MX Microprogramming

ORDERING INFORMATION

12945A User Control Store Board
5061-1336 Jumper Cable Assembly (needed only for
2108K Control Processor configurations)
1816-0015 PROMS



The 13047A 2K User Control Store Board provides 21MX or 21MX K-Series microprogrammers with eight 256-word modules of non-volatile memory address space. Module addresses are switch-selectable with a given module configurable to any address within control store address space. Using an HP 12909B PROM Writer and its supporting software, microprogrammers can write their programs into programmable read only memory chips (PROM's) and verify that their contents match the expected data pattern. They can also supply recommended vendors with necessary information for generating masked or programmed read only memory chips compatible with the 13047A. In either case, microprograms stored in read only memory chips are mounted on the UCS Board which, in turn, is conveniently installed in the I/O card cage of 21MX or 21MX K-Series computers.

An optional set of diagnostic PROM's is available for the 13047A which gives the user or HP Customer Engineer ability to thoroughly test 13047A operation. When recommended PROM's are used, the 13047A is fully-compatible with 21MX and 21MX K-Series processors, providing 325-nanosecond instruction execution times, no reduction in processor cycle time, and appropriate I/O loading characteristics.

Features

- Eight individually-configurable modules (2048 words) of non-volatile address space provided for 21MX processors
- Routines execute with no performance degradation from standard processor cycle times
- Compatible with HP microprogramming support software
- Saves main memory address space
- Provides a measure of proprietary software security
- Microprograms undistributed by CPU programs or power failures

Product Specifications

Word Size: 24 bits
 Module Size: 256 words
 Module Capacity: 8 modules (individually configurable)
 Processor Capacity*: 1 board
 Cycle Time: 325 nsec
 PROMs/Module: 6
 Recommended PROMs: HP: 1816-0015
 Harris: 1024-5B
 MMI: 6301

*Depends on available power

ELECTRICAL

The 13047A meets all 21MX computer electrical specifications.

DC Required:

Configuration	+5V
Logic Only:	1.15A
Each Module:	.78A
Fully Loaded:	7.39A

PHYSICAL

Length: 22.1cm (8 11/16 in)
 Width: 19.7cm (7 3/4 in)
 Weight: 212g (7.5 oz)

ENVIRONMENTAL

The 13047A meets all 21MX computer environmental specifications.

Product Support

HARDWARE SUPPLIED

13047A User Control Store Board
 5060-8393 Jumper Cable Assembly

DOCUMENTATION SUPPLIED

13047-90001 Installation Manual

INSTALLATION

The 13047A is a customer installed product. Hewlett-Packard will provide installation services on a time and



materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

To install, insert in I/O Select Code 10, 11, or 12 and connect jumper cable assembly to processor board.

CONFIGURATION INFORMATION

I/O Slots Required: 1 (must be Select Codes 10, 11, or 12)

CPU Options Recommended: 12909B PROM Writer

Software Recommended: 24287-60001 Rev. B PROM

WRITER Control Program

24287-60002 DOS Adapter for

PROM Writer Control Program

CPU Control Store Board Locations Used: None

NOTE 1: Users should refer to appropriate 21MX Computer Series documentation when selecting control store module addresses for the 13047A to avoid conflict with existing or planned HP microcode products.

NOTE 2: +5V power supply current available in the particular system configuration should be checked to assure sufficient +5V current capacity is available for the 13047A.

WARRANTY

HP products are warranted against defects in materials and workmanship for 90 days following date of delivery. HP will repair or replace products which prove to be defective during the warranty period. Necessary travel within countries where HP has specified availability of Computer Systems Products service facilities will be provided at no charge during the warranty period, to locations regularly served by public transportation. **NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.**

TRAINING AVAILABLE

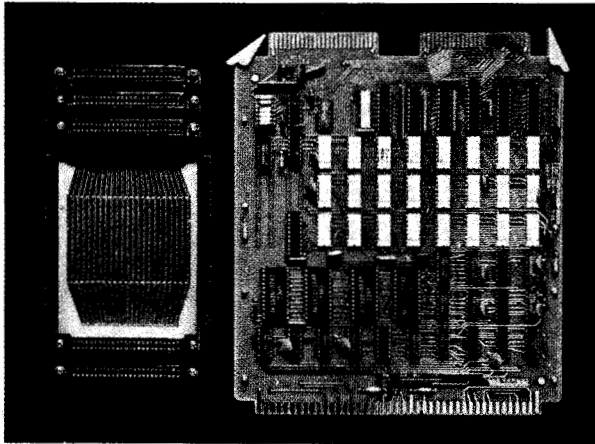
22960A 21MX Microprogramming

ORDERING INFORMATION

13047A User Control Store Board

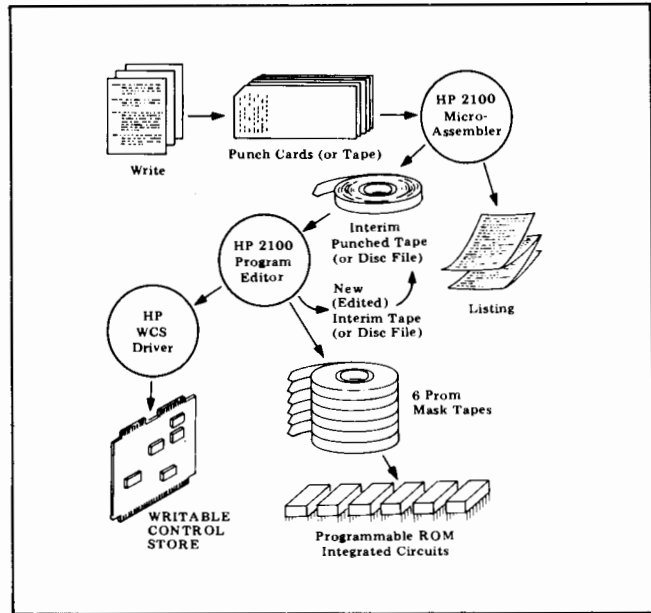
-001 Diagnostic PROM Set

1816-0015 PROMS



The 12978A Writable Control Store (WCS) Card contains semiconductor random-access memory for R/W storage of microprograms. It can be used with either 21MX or 21MX K-Series processors.

IMPLEMENTATION



Features

- Makes computer control section programmable
- 256 words of 24 bits/word for microprogram storage
- Enables full use of machine architecture, including 12 additional high-speed scratch registers
- 325-nanosecond cycle time
- Dynamically alterable under program control
- Complete software support package available
- Provides local R/W memory for the 21MX K-Series

MICROPROGRAMMING

A microprogram is a computer program written with simple, concise instructions that are stored in computer hardware or in Writable Control Store rather than main memory. The microprogram:

- Executes 2-20 times faster than ordinary software
- Allows complex software subroutines to be executed with fast control store subroutines
- Operates concurrently with main memory references; uses 24-bit, 5-field microinstruction word format:

Op Code	Spec	Alu	Store	S-Bus
---------	------	-----	-------	-------

WCS allows the programmer to:

- Store library of microprograms on disc or in main memory and transfer to WCS cards as needed
- Customize processor by microprograms to a specific purpose for duration of the microprogram execution

SAMPLE PROGRAM

This sample microprogram moves a group of main memory words from one place in memory to another. When the microprogram receives control, it is assumed that:

- The number of words to be moved is in the A-Register (in two's complement form)
- The FROM address is in the B-Register
- The TO address is in the memory location pointed to by the P-Register

The HP Assembly language-calling sequence is as follows:

```
LDA  -(number of words)
LDB  from-address
105xxx
DEF  to-address (cannot be indirect)
```



BLOCK MOVE MICROPROGRAM

MOV	P	IOR	M	Rw	GET 'TO' ADDRESS
	T	IOR	Q		PUT IT IN Q

LOOP	B	RRS	IOR	M	READ A DATA WORD
	T		IOR	S1	PUT IT IN S1

Q		IOR	S2		PUT 'TO' ADDRESS IN S2
F	S2	DEC	M	CW	ADDRESS THE 'TO' LOCATION
		JMP		OUT	(MEMORY PROTECT VIOLATION)
	S1	IOR	T		WRITE A DATA WORD TO MEMORY

B		INC	B		INCREMENT THE 'FROM' ADDRESS
Q		INC	Q		INCREMENT THE 'TO' ADDRESS
A		INC	A	TBZ	DECREMENT AND TEST THE COUNTER
		JMP		LOOP	REPEAT THE MOVE LOOP

OUT	P	INC	P	EOP	INCREMENT THE P REGISTER
		IOR			EXIT

MOV	P	IOR	M	RW	GET 'TO' ADDRESS
	T	IOR	Q		PUT IT IN Q
Check word count. If word count is zero, return to the calling program.					
LOOP	B	RRS	IOR	M	RW
	T		IOR	S1	
Read the memory address to store data word and store the address in the Scratch Register S2.					
Q	IOR	S2			PUT 'TO' ADDRESS IN S2
F	S2	DEC	M	CW	NMPV
		JMP		OUT	
S1	IOR	T			WRITE A DATA WORD TO MEMORY
Read the data word from "FROM" memory location and store the word at the memory location of "TO" address. While reading and writing data word in memory location, "TO" address is incremented.					
B	INC	B			INCREMENT THE 'FROM' ADDRESS
Q	INC	Q			INCREMENT THE 'TO' ADDRESS
A	INC	A		TBZ	DECREMENT AND TEST THE COUNTER
	JMP		LOOP		REPEAT THE MOVE LOOP
Increment the program counter and return to the calling program.					
OUT	P	INC	P	EOP	INCREMENT THE P REGISTER
		IOR			EXIT
Increment the P-register and exit.					

MICROINSTRUCTION COMMENTARY

Product Specifications

ELECTRICAL

The 12978A meets all 21MX computer specifications.

DC Required:

Model	+5V	-2V
12978A	4.6A	.15A

PHYSICAL

Length: 22.1cm (8-11/16 in)
 Width: 19.7cm (7-3/4 in)
 Weight: 342g (12 oz)

ENVIRONMENTAL

The 12978A meets all 21MX computer environmental specifications.

Product Support

HARDWARE SUPPLIED

12908-60006 12978A Writable Control Store Board
 5060-8393 Jumper Cable Assembly

SOFTWARE SUPPLIED

12978A: 12980-16001 Diagnostic
 12978A-001: 12908-90004 DOS Driver
 12978-16001 21MX Microassembler
 12978-16002 21MX Debug Editor
 24278-60001 DVR 33
 24333-60001 DOS WCS Utility

12978A-002: 12908-90003 BCS Driver
 12978-16003 21MX Microassembler
 12978-16004 21MX Debug Editor
 24277-60001 BCS Driver
 24283-60001 I/O Utility

DOCUMENTATION SUPPLIED

5951-7386 Coding Form
 12908-90013 Diagnostic Manual

INSTALLATION

The 12978A is a customer installed product. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

To install, configure WCS control store module address, insert WCS in an I/O slot, and connect the jumper cable assembly.

CONFIGURATION INFORMATION

I/O Slots Required: 1 (must be SC10, 11 or 12)

CPU Options Required: None

Software Required: 12978A-001 DOSIII Software or
 12978A-002 BCS Software

Control Store Module Configuration: The 12978A is configured to one of the 16 available control store memory addresses. As such, users should refer to 21MX processor documentation before selecting module address to avoid conflict with existing or planned HP microcode products.

WARRANTY

HP products are warranted against defects in materials and workmanship for 90 days following date of delivery. HP will repair or replace products which prove to be defective during the warranty period. Necessary travel within countries where HP has specified availability of Computer Systems Products service facilities will be provided at no charge during the warranty period, to locations regularly served by public transportation. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

TRAINING AVAILABLE

22960A 21MX Microprogramming

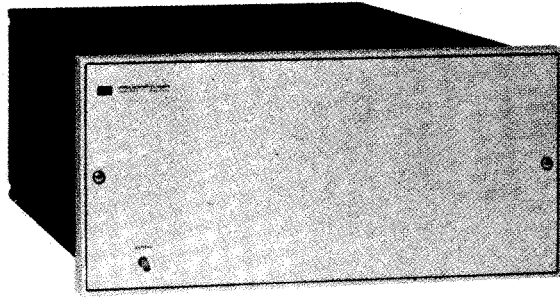
ORDERING INFORMATION

12978A Writable Control Store (12908-60006)
 Jumper Cable Assembly (5060-8393)
 12978A-001 DOS-III Software
 12978A-002 BCS Software
 5951-7386 Microcoding Form



21MX I/O Extender

model
12979A



The 12979A I/O Extender expands input and output capacity of 21MX processors by offering additional channels to accommodate standard interface cards. It is constructed using the same chassis and cabinet as the 2108 Processor.

Features

- 16 additional I/O slots/extender, with a maximum of 32 additional I/O slots
- Dual Channel Port Controller capability to each slot with 12898A accessory
- Same wide power line voltage tolerance as 21MX processors
- Full continuity of interrupt locations
- A power failure in the I/O Extender will cause a CPU power failure, assuring system integrity

The 12979A Extender has 16 I/O slots for standard interface cards. Slots also exist for adding an I/O buffer card to a second Extender, and adding the 12898A Dual Channel Port Controller for Extender I/O devices.

The I/O Extender is transparent to the programmer. Any select code may be programmed into it, and will operate with the same speed and versatility as those in the mainframe.

The first I/O slot in the Extender can be programmed to any select code, so devices can be moved from the CPU to the Extender to balance power consumption without losing mainframe select codes.

Product Specifications

ELECTRICAL

The 12979A meets all 21MX computer electrical specifications.

Line Voltage: 110 VAC ± 20%, single phase, 4A
220 VAC ± 20%, single phase, 2A

Input Line Frequency: 47.5 to 66 Hz
Power Consumption: 525 watts Maximum
Safety: The 12979A is Recognized by Underwriters Laboratories, Inc., and Certified by the Canadian Standards Association (with the exception of Option -015).

POWER SUPPLY

Storage After Line Failure: I/O Extender continues normal operation through temporary power interruptions of up to 40 milliseconds
Input Line Over-Voltage Protection: Input crowbar trips circuit breaker at line voltage 40% above normal
Output Regulation: All voltages are protected for over-voltage and over current
Thermal Sensing: Monitors internal temperature and automatically shuts down if temperature exceeds safe level

PHYSICAL

Length: 22.2cm (8-3/4 in) in rack mount
Width: 48.2cm (19 in) front panel width
42.5cm (16-3/4 in) behind front panel
Depth: 59.6cm (23-1/2 in) rack space
62.1cm (24-1/2 in) overall
Weight: 16kg (35 lbs)

Power Available to I/O Slots:

+28V	+12V	+5V	-2V	-12V
0.1A	3.5A	33.0A	5.0A	3.5A

Power Required from CPU:

	+5V	-2V
I/O Buffer Card	2.0A	1.35A

ENVIRONMENTAL

The 12979A meets all 21MX computer environmental specifications.

Ambient Temperature Range:

Operating: 0° to 55°C (32° to 131°F)
Non-operating: -40°C to 75°C (-40°F to 167°F)
Relative Humidity: 20 to 95% at 40°C (104°F), no condensation

Altitude:

Operating: 4600m (15,000 ft)
Non-operating: 15,300m (50,000 ft)

Vibration & Shock:

a) Type-tested to qualify for normal shipping and for handling shock and vibration:
Vibration: 0.3mm (0.012 in) P-P, 10 to 50 Hz, 3 axis
Shock: 30G, 11Ms, 1/2 sine, 3 axis



b) Contact factory for review of any application involving operating under continuous vibration.

Ventilation:

Air Flow: 6.8 cubic m (200 cubic ft)/min.; intake on left side; exhaust on right side
Heat Dissipation: 450 kcal (1800 BTU)/hr maximum

Product Support

HARDWARE SUPPLIED

12979A I/O Extender
02155-60003 I/O Buffer Card
12979-60006 Cable
12979-60008 Cable
5060-8387 Power Control Cable

SOFTWARE SUPPLIED

12979-16001 Diagnostic

DOCUMENTATION SUPPLIED

12979-90006 Installation and Service Manual
12979-90010 Diagnostic Manual
12979-90007 12979A Operating and Reference Manual

INSTALLATION

The 12979A is a customer installed product. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

To install, mount 12979A in rack less than 6 feet from the 21MX Computer. Connect power control cable between I/O Extender and CPU; then insert I/O Buffer Card in first unused CPU mainframe I/O slot. Then configure I/O Extender control card to first select code desired in the I/O Extender; connect I/O control signal flat cable between I/O Extender and CPU Board in 21MX mainframe; and connect cable between I/O Buffer Card in 21MX I/O Backplane and the I/O Extender control card.

CONFIGURATION INFORMATION

CPU I/O Slots Required: 1/I/O Extender
CPU Options Required: None
Minimum Required Rear Cable Clearance: 7.6cm (3 in)
Minimum Air Intake/Exhaust Side Clearance: 5.7cm (2-1/4 in)
Maximum Separation Between Processor and I/O Extender: 1.8m (6 ft)

WARRANTY

HP products are warranted against defects in materials and workmanship for 90 days following date of delivery. HP will repair or replace products which prove to be defective during the warranty period. Necessary travel within countries where HP has specified availability of Computer Systems Products service facilities will be provided at no charge during the warranty period, to locations regularly served by public transportation. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

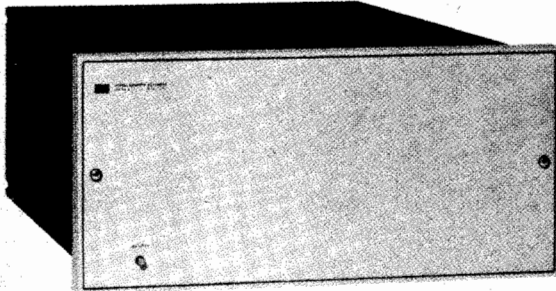
ORDERING INFORMATION

12979A I/O Extender
-015 220V Operation
12898A DCPC for I/O Extender



21MX Memory Extender

model
12990A



The 12990A Memory Extender provides for expansion of 21MX computer memory capacity. The extender has space for nine additional semiconductor memory modules in a compact 22.2cm (8-3/4 in) frame. Up to 73,728 words may be added using 8K modules or 147,456 words using 16K modules. It is constructed using the same chassis and cabinet as the 21MX Processor.

Features

- Memory access and cycle time not affected with the addition of a 12990A
- Space for nine additional semiconductor memory modules
- Low physical profile—22.2cm (8-3/4 in) high
- Ease of installation—only three cables are required, and memory modules plug-in
- Brownout-proof power supply included
- Uses no CPU mainframe power
- Optional Power Fail Recovery System installs inside the extender frame
- Power failure in Memory Extender causes a CPU power failure to assure system integrity

Product Specifications

ELECTRICAL

The 12990A meets all 21MX computer electrical specifications.

Line Voltage: 110 VAC \pm 20%, single phase, 4A
220 VAC \pm 20%, single phase, 2A

Input Line Frequency: 47.5 to 66 Hz

Power Consumption: 300 W maximum

Safety: The HP 12990A is Recognized by Underwriters Laboratories, Inc., and Certified by the Canadian Standards Association (with the exception of Option 15).

POWER SUPPLY

Storage After Line Failure:

Memory Extender continues normal operation through temporary power interruptions of up to 160 milliseconds.

Input Line Over-Voltage Protection:

Input crowbar trips circuit breaker at line voltage 40% above normal.

Output Regulation:

All voltages are protected for over-voltage and over current.

Thermal Sensing:

Monitors internal temperature and automatically shuts down if temperature exceeds safe operating level.

PHYSICAL

Length: 22.2cm (8-3/4 in) in rack mount

Width: 42.6cm (16-3/4 in) behind rack mount
48.3cm (19 in) front panel width

Depth: 59.7cm (23-1/2 in) overall

58.4cm (23 in) behind rack mounting ears

Weight: 18.3Kg (40 lbs)

ENVIRONMENTAL

The 12990A meets all 21MX computer environmental specifications.

Operating Temperature: 0° to 55°C (+32° to 131°F)

Relative Humidity: 20-95% at 40°C (104°F), no condensation

Storage Temperature: -40°C to 75°C (-40° to 167°F)

Ventilation Air Flow: 5.7 cubic m/(200 cubic ft)/min.;
intake on left side; exhaust on right

Heat Dissipation: 258 Kcal (1024 BTU)/hr maximum

Altitude:

Operating: 4600m (15,000 ft)

Non-operating: 15,300m (50,000 ft)

Vibration: .30mm (.012 in) p-p 10-55 Hz, 3 axis

Shock: 30g, 11 Ms, 1/2 sine, 3 axis

Contact factory for review of any applications requiring operation under continuous vibration.

Product Support

HARDWARE SUPPLIED

12990A Memory Extender

12990-60011 Cable

12990-60014 Power Control Cable



SOFTWARE SUPPLIED

None

DOCUMENTATION SUPPLIED

12990-90003 Installation Manual

INSTALLATION

The 12990A is a customer installed product. Hewlett-Packard will provide installation services on a time and materials cost basis. Customers desiring this installation service should contact their local Hewlett-Packard sales office.

To install, remove 21MX Computer from the rack. Remove the bottom cover of the 12990A and 21MX Computer; exchange them and reinstall the covers. Install the 21MX and 12990A in the rack, with the 12990A directly below the 21MX. Connect power control cable, between the 12990A and 21MX, configure additional memory modules, install memory modules in 21MX and 12990A, then attach flat cable between Memory Controller and memory modules.

CONFIGURATION INFORMATION

Mainframe Card Slots Required: None

CPU Options Required: Dynamic Mapping System (12976A)

Software Required: None

Software Recommended: RTE-III Operating System

Mounting: The 12990A must be mounted in the rack directly below the 21MX processor.

NOTE: The 12990A is not compatible with the HP 2105A.

WARRANTY

HP products are warranted against defects in materials and workmanship for 90 days following date of delivery. HP will repair or replace products which prove to be defective during the warranty period. Necessary travel within countries where HP has specified availability of Computer Systems Products service facilities will be provided at no charge during the warranty period, to locations regularly served by public transportation. NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

ORDERING INFORMATION

12990A	Memory Extender
-015	230 Volt Operation
12991A	Power Fail Recovery System



Sales and service from 172 offices in 65 countries.
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