1985 CONTROLLER CONCEPTS

VOLUME 2

Multibus
Multibus II
VMEbus
Qbus/Unibus
DG Nova/Eclipse
Perkin-Elmer/T.I.

Peripheral Concepts

1985 CONTROLLER CONCEPTS

VOLUME 2

Peripheral Concepts, Inc.
18003-G2 Skypark Circle
Irvine, California 92714
(714)250-9510

c 1985 Peripheral Concepts, Incorporated. All Rights Reserved. Reproduction by any means, electronic or mechanical, is strictly prohibited. Disclosure to other parties, in whole or in part, other than Peripheral Concepts original subscriber or client requires prior written permission. All information is believed to be reliable but no guarantee is expressed or implied as to its accuracy and/or completeness.

FOREWORD

The 1985 peripheral controller market has expanded into new areas, and so has this year's edition of Controller Concepts. Several new sections have been added this year, including Host Adapters and Inbedded controllers in Volume 1 and VMEbus controllers in this volume.

The VMEbus is a leading contender for the rapidly growing 32 bit microcomputer market. With solid roots in Europe, VME has already made impressive gains in the U.S. workstation and CAD/CAM markets. While there is excitement about VME's future, its success is by no means guaranteed. The VMEbus section examines some of the factors that can profoundly affect the VME controller business over the next few years.

In other areas as well, this year's edition has been greatly expanded. We have presented an in-depth technical discussion of new host interfaces. We have also provided a much more detailed product matrix. Some new forecasting categories have been added. The Multibus and VMEbus statistics have been broken down by drive interfaces (i.e. ST506, ESDI, SMD, QIC, Pertec). For the DEC-compatible controllers, additional breakdowns by bus type (Q-bus/Unibus) and by business type (OEM/Captive) have been included. It is therefore not surprising that we ended up splitting the report in two separate volomes. The first volume contains SASI/SCSI, IBM-PC/XT/AT, Host Adapters, and Imbedded Controllers.

The accuracy of our work depends upon the the level of support we receive from the industry. We are indeed grateful for the overwhelming support we received during our field research earlier this year. We are also thankful for the many suggestions regarding our 1984 report. Most of those have been incorporated in this year's edition.

Please give us a call if you have any suggestions, questions, or need additional information. We can also provide "custom" reports or do further investigation into a particular niche market.

Vipul Mehta

TABLE OF CONTENTS

INTRODUCTION

How the Report is Organized INTRO-1
A Guide to Interpreting the Numbers INTRO-3
Market Trends INTRO-4
Total Revenue Forecasts INTRO-8
Total Shipment Forecasts INTRO-9
Revenue Share..... INTRO-10

THE DEC COMPATIBLE HOST INTERFACES

Introduction DEC-1
A New Breed Of Computers DEC-4
DEC Mass Storage Configurations DEC-6
Compatibility Issues DEC-7
Product Definition DEC-9
Market Trends DEC-10
Revenue Breakdown - Q-bus Vs Unibus DEC-15
Revenue Breakdown - OEM Vs. Captive DEC-16
Technology Trends DEC-17
Competing Technologies DEC-20
ey Assumptions DEC-22
Market Share Analysis DEC-23
Revenue Forecasts DEC-24
Shipment Forecasts DEC-25

MINICOMPUTER COMPATIBLE INTERFACES

Introduction MINI-1
Revenue Forecasts MINI-3
Shipment Forecasts MINI-4

Data General Compatible Interfaces
Introduction DG-1
Market Overview/ Trends DG-2
Product Definition DG-4
Market Share Analysis DG-4

Perkin-Elmer Compatible Interfaces
Introduction PE-1
Market Trends/ Forecasts PE-2
Market Shares PE-3

Texas Instruments Compatible Interfaces TI-1

Peripheral Concepts

THE MULTIBUS HOST INTERFACE

Introduction MULTIBUS-1
Bus Characteristics - Multibus I MULTIBUS-4
Bus Characteristics - Multibus II MULTIBUS-5
Product Definition MULTIBUS-7
Market Trends MULTIBUS-8
Technology Trends MULTIBUS-12
Competing Technologies MULTIBUS-15
Key Assumptions MULTIBUS-17
Market Share Analysis MULTIBUS-18
Revenue Forecasts MULTIBUS-19
Shipment Forecasts MULTIBUS-20
Revenue Breakdown By Drive Interface MULTIBUS-21

THE VMEBUS HOST INTERFACE

Introduction VME-1
Technical Characteristics VME-3
Product Definition VME-11
Market Trends VME-12
Technology Trends VME-17
Competing Technologies VME-20
Key Assumptions VME-22
Market Share Analysis VME-23
Revenue Forecasts VME-24
Shipment Forecasts VME-25
Revenue Breakdown By Drive Interface VME-26

PRODUCT MATRIX

Introduction PRODUCTS-1
DEC PRODUCTS-3
MINI PRODUCTS-42
MULTIBUS PRODUCTS-56
VME PRODUCTS-71
Manufacturers' Index PRODUCTS-81

MANUFACTURERS' PROFILES MAN-1

IBM, IBM-PC, PC/XT, and PC AT are trademarks of International Business Machines Corporation.

DEC, PDP, LSI, VAX, Q-bus, Unibus, Massbus and CMI are trademarks of Digital Equipment Corporation.

NOVA, ECLIPSE and ECLIPSE/MV are trademarks of Data General Corporation.

Multibus, Multibus II and iRMX are trademarks of Intel Corporation.

INTRODUCTION

How the Report is Organized

Controller Concepts is partitioned by host interface. All controllers, regardless of the type of peripherals they control (i.e., Winchester, Floppy, Tape, etc.) are grouped within a section by the type of computer or host interface they support. Each chapter also presents its data independently, so you can skip around or start at any chapter without missing any pertinent information on the interface of interest. The Total Forecast section contains a numerical and analytical summary of all the chapters. Also included in this section are the total market numbers from Controller Concepts Volume 1, which contains SASI/SCSI, IBM-PC/XT/AT, Host Adapters and Imbedded Controllers. In this way, the reader can get an idea of the total controller market as well as the impact of the individual markets listed in this volume.

The host interfaces covered in Controller Concepts (Vol 2) are:

DEC Busses- These peripheral controllers are board-level products which support the Q-bus, Unibus or any other interfaces used on Digital Equipment computers. Controllers purchased by DEC from third party suppliers for incorporation into subsystems or for resale, are also included. Controllers used internally by manufacturers to build subsystems have been reported under the "captive" category.

Minicomputer- These peripheral controllers are board-level products which support host interfaces for Data General, Perkin-Elmer and Texas Instruments minicomputers. Controllers purchased by these computer manufacturers from third party suppliers are also included.

Multibus- These peripheral controllers are board level products which support the Multibus-I (IEEE- 796) or Multibus-II interfaces. Controller shipments from Intel have been included. Controllers that are "private labeled" by Intel from outside vendors have been credited to the source supplier.

VMEbus- These peripheral controllers are board level products which support the VMEbus or its extensions approved by the VMEbus International Trade Association.

Most sections are then further divided into the types of peripherals that the controller supports:

Winchester- Controller products supporting one or more winchester or rigid disk drives of various form factors.

Floppy- Controller products which support only floppy disk interfaces of various capacities and form factors.

Tape- Controller products which support 1/4 inch, 1/2 inch, data cassette, or any other sequential access streaming or start/stop tape drive.

Multifunction- Controller products which support more than one type of peripheral such as Floppy/Winchester, Winchester/ Tape, and Winchester/Floppy/Tape controllers.

Some sections have further breakdowns unique to that interface. These breakdowns are described in the associated chapters.

There are also two other sections:

Product Matrix- A detailed list of all controller products in production or scheduled for production by the first quarter of 1986. The products are again grouped by host interface.

Manufacturers' Profiles- A brief description of each supplier and the product lines manufactured.

A Guide to Interpreting the Numbers

To save time in analyzing revenue and shipment numbers, keep the following points in mind:

Constant Dollars- All revenues are listed in 1985 Dollars with no discount rates applied.

Calendar Years- All revenues/shipments are reported in calendar years, not fiscal years. Make appropriate adjustments to your situation.

Manufacturers- All revenues/shipments represent products manufactured by U.S. companies for world-wide consumption, regardless of the physical location of the manufacturing facility. Included are imports by overseas manufacturers intended for U.S. consumption. In other words, the destination of product is always the U.S.

Market Shares- All market share data is listed in revenues for calendar year 1984.

Captive Products- Captive products listed are those controllers used in other products manufactured by the same supplier for internal consumption. For example, a board-level controller supplier who also manufactures subsystems, will ship some of their board-level production "buried" in the subsystems.

Market Trends

Peripheral Concepts estimates the total controller market/all categories to be:

	1984	1985	1986	1987	1988
REVENUES ($)	512.4M	581.9M	693.1M	826.3M	979.2M
SHIPMENTS	12.1M	15.2M	18.6M	22.0M	26.1M

Revenues of the peripheral controller market are expected to produce a compound annual growth of 17.6% from 1984 to 1988. From 1984 to 1985, revenue growth was 13.6%, down significantly from the 1983-84 period. The sluggish growth experienced in the computer industry certainly affected the overall controller market growth, but their was also a lag of 6-9 months before most suppliers experienced a downturn in new and existing orders. With few exceptions, the second quarter of 1985 revealed the strongest decline. Flat growth is now occuring during the third quarter, so it is likely that the worst is over.

A moderate recovery is expected during the second and third quarters of 1986, with an estimated 19.1% annual growth rate from 1985 levels. Year-to-year revenue growth is expected to stabilize within the 19.0% to 19.5% range through 1987. Unit shipments are a different story. An impressive 22.8% increase over 1984 levels are projected for 1985, increasing to 36.4% annually by 1988. The main driving factor is the introduction of many new semiconductor controller products, both in OEM and imbedded controller segments. Compound unit growth rate for

the forecast period is estimated at 19.4% for chips, 29.6% for board-level products. By 1989, total revenues for all controller products will break the Billion Dollar mark.

The DEC compatible controller segment accounted for 48.5% of all revenues generated in 1984, or roughly $73.85 Million. The second strongest market was the Multibus at 30.6%, with revenues of $46.48 Million. In third place was the Minicomputer controller market, with 17.3%. The emerging VMEbus market accounted for a tiny 3.6%, or $5.53 Million in revenues.

By 1988, revenues from DEC-compatible controllers will reach $132.1 Million, but its market share will drop slightly to 45.1%. The Multibus-I/II market will maintain in its number two position, but with a smaller 26.7% share of the market. VMEbus controllers will exhibit a dramatic growth, capturing 17.8% of the total market, or $52.03 Million. The Non-DEC minicomputer market share will decline to 10.4% in 1988. It is important to note that every single category will register a net growth in revenues for the 1984-88 period.

The VMEbus controller market is clearly the fastest growing category, with a compound annual growth in revenues of 75.1%. Explosive growth projections for super microcomputers, fueled by the workstation and CAD/CAM markets, will contribute most to this dramatic upswing in VMEbus controller revenues. A shift towards smaller Q-bus based DEC computers will result in lower average selling prices for compatible controllers. Consequently, revenue share for DEC controllers will

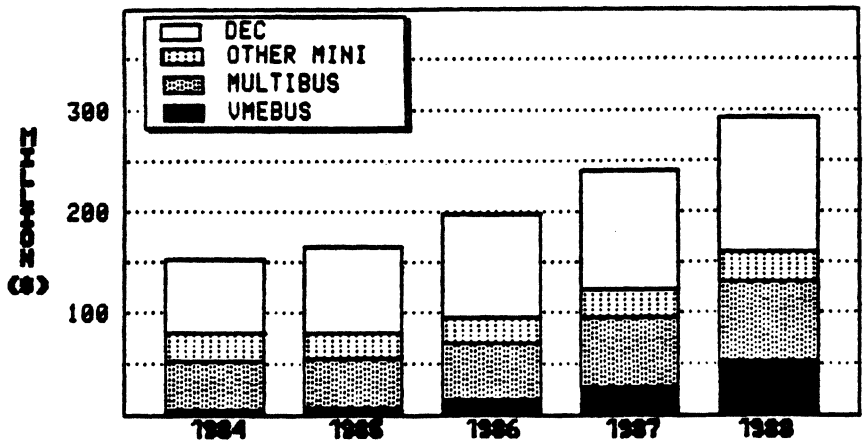
decline slightly, but the growth in shipments will remain strong. A severe decline in revenues for Texas Instruments controllers and a greater move towards captive controllers, will shrink the market share of Non-DEC minicomputer compatible controllers. Competing busses, particularly the VME, will slow the growth rate of the Multibus controller market in the future.

There were 17 manufacturers offering 153 DEC-compatible products in 1984, or nine products per company. In the minicomputer market, 8 suppliers offered 56 products, or seven products per company. Corresponding numbers for the Multibus market were 13 suppliers and 58 products, or 4.46 products per company. Lastly, 19 companies offered 40 VMEbus compatible controllers in 1984, or 2.1 products per company. The total number of products, and particularly, the number of products per company is an indicator of the maturity level of a category. As the market becomes more stable, only a limited number of suppliers remain, and each supplier offers a broader range of products. Applying that rule, DEC was the most mature market, followed by other minicomputers, Multibus, and VMEbus.

Finally, the markets covered in this volume (DEC Compatible, Minicomputer, Multibus and VMEbus) will account for 28.2% of the controller market in 1985, or $164.08 Million. the remaining 71.8% ($417.84 Million) is shared among the SASI/SCSI, IBM-PC/XT/AT, Host Adapters, semiconductors, and Imbedded Controllers. Market segments covered in each of the two volumes will continue to maintain their respective shares. In 1988, controllers covered in this volume will

generate $292.71 Million, or 29.9%. The total market will reach $979.17 Million in that year. Interestingly, the compound annual growth rates for the two markets will be nearly equal, 17.8% for controllers covered in this volume and 17.5% for controllers covered by Volume 1.

Peripheral Concepts



TOTAL CONTROLLERS -ALL CATEGORIES

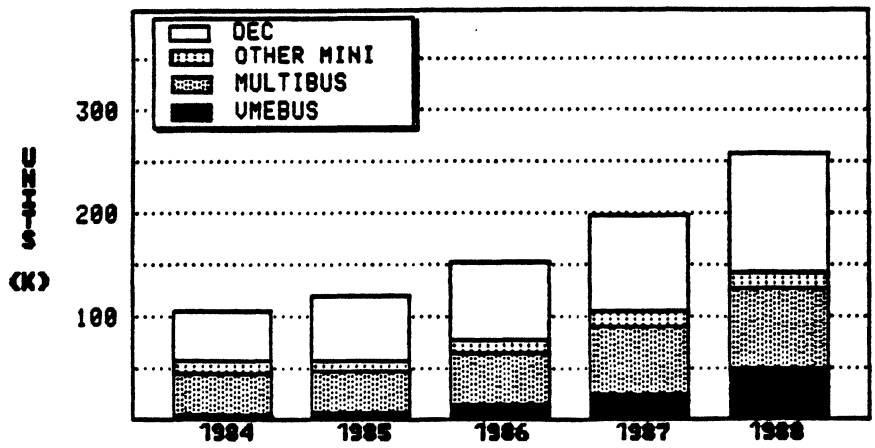
REVENUE SUMMARY

	<——REVENUES BY PRODUCT TYPE ($000)——>										
	ACTUAL		<—— FORECAST ——>								
	1984		1985		1986		1987		1988		1984-88
CONTROLLER TYPE:											CAGR:
	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	
DEC-COMPATIBLE	73,850	48.5	83,686	51.0	101,728	51.5	116,711	48.7	132,108	45.1	15.6%
OTHER MINICOMPUTER	26,272	17.3	24,401	14.9	25,980	13.1	28,535	11.9	30,510	10.4	3.8%
MULTIBUS I/II	46,481	30.6	47,550	29.0	55,880	28.3	66,900	27.9	78,060	26.7	13.8%
VMEbus	5,538	3.6	8,449	5.1	13,981	7.1	27,694	11.5	52,038	17.8	75.1%
TOTAL REVENUES ($000)	$152,141	100%	$164,086	100%	$197,569	100%	$239,840	100%	$292,716	100%	17.8%
ANNUAL GROWTH RATE		—		7.9%		20.4%		21.4%		22.0%	

OTHER MARKETS:											
	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	CAGR:
TOTAL REVENUES ($000)	152,141	29.7	164,086	28.2	197,569	28.5	239,840	29.0	292,716	29.9	17.8%
OTHER [1]	360,264	70.3	417,846	71.8	495,488	71.5	586,508	71.0	686,461	70.1	17.5%
TOTAL MARKET ($000)	$512,405	100%	$581,932	100%	$693,057	100%	$826,348	100%	$979,177	100%	17.6%
ANNUAL GROWTH RATE		—		13.6%		19.1%		19.2%		18.5%	

[1] Includes SASI/SCSI, IBM-PC, Host Adapters, Imbedded, and Non-captive Semiconductor Shipments (Vol I).

SOURCE: PERIPHERAL CONCEPTS, INC.



TOTAL CONTROLLERS -ALL CATEGORIES

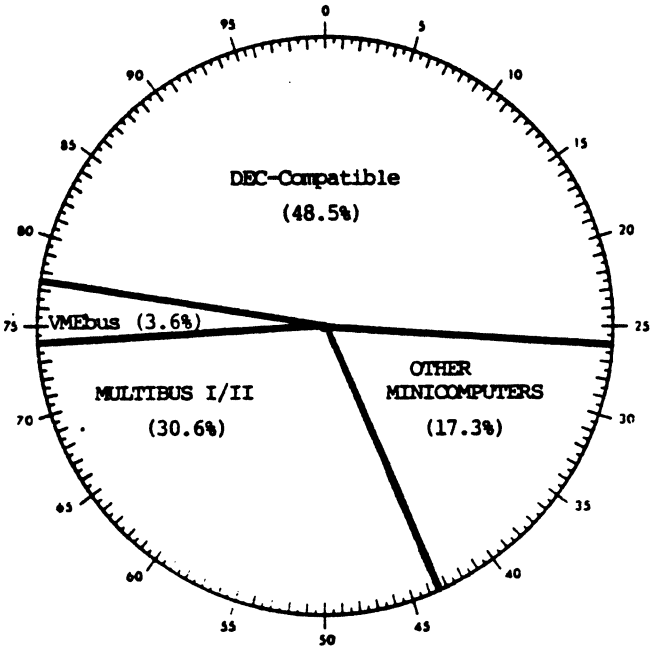
SHIPMENT SUMMARY

	←SHIPMENTS BY PRODUCT TYPE (000)→										
	ACTUAL		←FORECAST→								
	1984		1985		1986		1987		1988		1984-88
CONTROLLER TYPE											CAGR:
	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	
DEC-COMPATIBLE	49.1	46.7	59.9	50.1	76.7	50.3	95.3	47.7	115.5	44.6	23.8%
OTHER MINICOMPUTER	11.4	10.8	10.7	8.9	11.9	7.8	13.9	7.0	15.3	5.9	7.6%
MULTIBUS I/II	39.2	37.3	41.1	34.4	50.8	33.3	64.8	32.5	78.9	30.5	19.1%
VMEbus	5.5	5.2	7.9	6.6	13.0	8.5	25.6	12.8	49.3	19.0	73.0%
TOTAL SHIPMENTS (000)	105.2	100%	119.6	100%	152.4	100%	199.6	100%	259.0	100%	25.3%
ANNUAL GROWTH RATE		—		13.7%		27.4%		31.0%		29.8%	

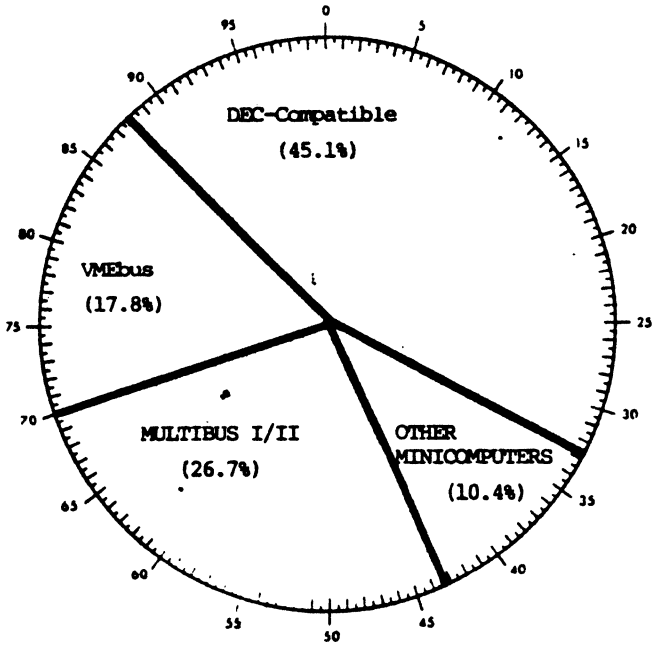
OTHER MARKETS:											
	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	CAGR:
TOTAL SHIPMENTS (000)	105.2	.9	119.6	.8	152.4	.8	199.6	.9	259.0	1.0	25.3%
OTHER [1]	12,025.4	99.1	15,085.5	99.2	18,366.8	99.2	21,779.2	99.1	25,812.3	99.0	21.0%
TOTAL MARKET (000)	12,130.6	100%	15,205.1	100%	18,519.2	100%	21,978.8	100%	26,071.3	100%	21.1%
ANNUAL GROWTH RATE		—		25.3%		21.8%		18.7%		18.6%	

[1] Includes SASI/SCSI, IBM-PC, Host Adapters, Imbedded, and Non-captive Semiconductor Shipments (Vol I).

SOURCE: PERIPHERAL CONCEPTS, INC.



1984 Market Share
Total Revenues: $152.1M



1988 Market Share
Total Revenues: $292.7M

1984-88 CAGR:
17.8%

THE DEC-COMPATIBLE HOST INTERFACES

Introduction

In 1963, Digital Equipment Corporation brought the forerunner of today's minicomputer to the market. Called the PDP-5, this computer retailed for $27,000. This was indeed a breakthrough in an industry where the average base price of most machines were over $100,000. Within two years after the PDP-5, DEC introduced a mass producible version, the PDP-8, with a price tag of $18,000. The machine was an instant success. Further price reductions over the next several years made the popular PDP-8 the first computer to break the under $10,000 price tag.

But it was not until 1970 that the minicomputer market was born. Digital introduced a new machine in the series, called the PDP-11. This model offered a much greater speed/performance than its predecesors, along with a 16-bit word size. The PDP-11 was equipped with a new backplane bus called the Unibus. Since that time, the Unibus has remained the standard bus on many new additions to the PDP family. Even today, it remains one of the most successful line of computers in the world.

Another mass storage interface that quickly gained popularity was the Q-bus. First introduced on the LSI-11 series of microcomputers, the Q-bus became the standard for the smaller, economical DEC systems. The Q-bus computers typically support lower capacity peripherals and slower networking speeds than the Unibus.

Peripheral Concepts

The majority of all new microcomputers coming from DEC are now Q-bus based. Nearly half of today's 16 bit microcomputer systems use the Q-bus.

Standardization of the Unibus and the Q-bus on DEC computers created a lucrative market for add-on products. Independent suppliers rallied behind the two busses and offered many products such as memory boards, controllers, and subsystems. These products often delivered a higher performance at a lower price tag than those offered by DEC. Users who could not afford to wait for long delivery times also turned to the after market suppliers. Some of the initial products however, had some drawbacks.

Earlier controllers were difficult to use and were not truly "DEC-compatible". Controller operation was not transparent to the computer's operating system, i.e., they required the users to add special "patches" or modifications to the software. With the introduction of "emulating" controllers in the late seventies, all of that changed. The emulating controllers mimicked DEC's proprietary subsystem products requiring no software changes. Users could attach the less expensive, industry standard Storage Module Disk (SMD) drives to these controllers instead of the single-sourced, higher-priced DEC drives.

The DEC-compatible controller market is a mature market. Compatibility is rarely an issue anymore, since almost all products offer emulation. Clear leaders have also emerged for each segment. An industry shakeout

occured in the early eighties and since then, there have been no more casualties.

However, things are far from dull. Many new systems and storage architectures have been introduced by Digital over the past two years. And many more are coming which will profoundly alter the size and structure of the future DEC controller market.

Peripheral Concepts

A New Breed of Computers

Products introduced by DEC within the last two years have set the tone for the next generation of systems. The VAX series has emerged as the flagship product. The VAX, which was DEC's first product for the 32 bit computer market, has become the yardstick for performance at the high end. Today, the VAX computer line covers an entire spectrum of applications.

All of the VAXs use a 32 bit architecture as well as DEC's own proprietary operating system called VMS. The most popular VAX products include the 11/730 at the low end, and the 11/750 and 11/780 at the high end. All of these machines support the Unibus, although the 11/750 and the 11/780 use 32 bit local busses for memory transfers. A newer member, the VAX 11/785 was introduced in mid 1984. This was followed by the machine popularly rumored as "Venus" which was finally announced in November 1984 as the VAX-8600. The 8600 is by far the most powerful VAX addition with a 4.6 Mega-Instructions-Per-Second (MIPS) performance level versus 1.0 MIPS found on the 11/780. The VAX-8600 also supports Unibus and will work with the existing storage products.

The "MicroVAX" series made its debut in 1983 with the MicroVAX-I. This was the first of the VAX line to use the Q-bus interface. The MicroVAX-I suffered from some significant bottlenecks, especially from the poor performance of its RQDX1 disk controller. The MicroVAX-II, announced in May of this year, had resolved many of the shortcomings

Peripheral Concepts

of the MicroVAX-I. This machine brings the performance of the VAX-11/780 and the power of VMS software to the workstation market, its main application. The MicroVAX-II uses a private 32 bit bus for high speed memory transfers, while retaining the Q-bus for I/O operations. The disk controller used (RQDX2) provides a much higher performance level than the original RQDX1. Many independent suppliers have introduced disk and tape controllers for the MicroVAX line.

It is important to note that there are significant differences between the VAXs and the MicroVAXs. Operating system software for the MicroVAX is MicroVMS, which is incompatible with standard VMS. The VAX-11 series supports clustering, larger than 100 Mbyte disk drives, and 64 or more users, none of which are supported by the MicroVAXs. These features are aimed to keep the larger VAXs "in business", thereby protecting the Unibus-compatible market.

Several new computers in the PDP series were also introduced within the past year. The top of the line, the Unibus-based PDP-11/84, started shipping in the first quarter of 1985. Delivering the performance of a PDP-11/70 at one-third the price, the 11/84 will quickly replace the aging 11/70.

The MicroPDP-11 series introduced in mid-84, also made the switch to the Q-bus. The three MicroPDPs (in order of performance) are the 11/SV, the 11/23, and the 11/73. In June of 1985 the MicroPDP-11/83 was announced, using an 18 MHz version of the J-11 processor. The 11/83 delivers 50% more performance than the 11/73.

Peripheral Concepts

DEC Mass Storage Configurations

The captive DEC controllers (those supplied by DEC with peripherals) connect the Unibus, Q-bus, or other busses with DEC disk drives. The Massbus is the only exception, since subsystems with built-in controllers can only be connected to it. On the other hand, controllers from the independent vendors connect the Unibus or the Q-bus with an industry standard disk drive such as an SMD or a 9-track Pertec-compatible tape drive.

Unibus based computers include most of the members of the PDP-11 series and the VAX 11/730. DEC captive controllers for the PDP-11 include the RP11E (for older RP02/03 type drives), the RK611 (for RK06/07 drives), and the RL11 (for RL01/02 drives). The VAX 11/730 uses both the RK611 and the RL11, plus the UDA50 controller for the RA series disk drives. The PDP-11s can also be adapted to the Massbus using the RH11 adapter.

Q-bus based computers include all of the LSI-11 series, the new MicroPDP-11s, and the MicroVAXs. These computers use the same peripherals (RP, RK and RL series) as the Unibus systems with corresponding Q-bus controllers. The Micro series can also use the RD family of disk drives with RQDX controllers.

Computers like the VAX 11/750 and the 11/780 that do not have a "backplane" Unibus or Q-bus, require the RH750/780 adapters to the Massbus. Alternatively, the HSC50 controller can be used between the local VAX bus (CMI) and a DSA-compliant drive. The independent

supplier normally bypasses the local VAX busses and instead, offer Unibus controllers for use with a Unibus adapter.

Compatibility Issues

In the DEC world, the controller is much more than a serial to parallel conversion between the host computer and the peripheral device. Like all other peripheral controllers, DEC-compatible controllers must comply with the physical and electrical requirements of the bus they support. In addition, these controllers must also support one or more DEC operating systems. The DEC systems' diagnostics software must also work with the controller.

Software drivers from DEC are designed for specific characteristics of their own captive controllers and subsystems. The compatible controller must fully emulate these hardware characteristics while remaining completely transparent to the computer. Often times, controllers from independent suppliers support drives with higher speeds and/or capacities than DEC drives. Once again, for true compatibility, no hardware or software changes should be required.

Newer storage architectures have made these compatibility issues even more important. DEC's Digital Storage Architecture (DSA) is a framework that covers mass storage devices and controllers under the Mass Storage Control Protocol (MSCP). Within this framework, all DSA drives are compatible with DSA controllers. Any drive can be connected to any controller and drives can be mixed on the same controller. All

drives are dual-ported and can be connected to two different controllers.

Under the MSCP protocol, the controller plays a very key role. The operating system disk server treats the peripheral simply as a class of device. It has no knowledge of the drive's physical characteristics. The peripheral itself only performs simple data recording and playback. Thus, the controller not only transfers data to/from the peripheral device, but it is also responsible for the handling of drive characteristics, managing the flow of data to/from the host, and validating data integrity.

Examples of MSCP controllers include the UDA50, the HSC50, and the RQDX2 for the Unibus, VAX bus (CMI), and Q-bus, respectively. The captive RA80/81 and RA60 disk drives are DSA compatible. Many MSCP compatible controllers have now been introduced by independent suppliers. These controllers support MSCP on one end, and work with industry standard disk and tape drives on the other.

Product Definition

Products and forecasts within this category refer to controller board-level products that have a DEC-compatible port on the host side, and various drive interfaces on the drive side. Examples of products and manufacturers in this category include:

Advanced Electronic Design	Winc-05/05, Flex-02
Andromeda Systems	RDC, SDC, UDC, WDC-11 Series
Aviv Corporation	DFC/TFC 800 & 900 Series
Computer Storage Technology	CS-300, TC-200
Distributed Logic Corp	DQ/DU 100, 200, 400 & 600 MV 100 & 200 Series
Emulex Corporation	SC 02/03, SC 12/21/31, TC SC700 & SC7000 Series, QD01, QT12
General Robotics	RXV21, SMV11/22, MWV11/22, STV11
MDB Systems	MLSI & MDB Series
Micro Technology, Inc.	MS, MX, MLV, & MXV Series
Mini Computer Technology	EDC24, MCT1300, SMV15
Plessey Peripherals	FCV, XC/XCV, DC/DCV Series
Qualogy	D41XX, D8120, D82XX
Scientific Micro Systems	FWD 0101/0106, FWD 1101/1106
Sigma Information Systems	RSV31, TSV11, RQD11 A/B
Spectra Logic Corp.	12, 15, 21, 25, 111, 121
Webster Computer	PCLV11J, SMDQ11A, SRDQ11B
Wespercorp	DC, TC, TD, TDQ Series

Peripheral Concepts

Market Trends

Peripheral Concepts estimates the total market to be:

	1984	1985	1986	1987	1988
REVENUES	$ 73,850K	83,686K	101,728K	116,711K	132,108K
SHIPMENTS	49.1K	59.9K	76.7K	95.3K	115.5K

Despite the sluggish computer market, revenues from DEC-compatible controllers grew almost 25% during the 1983-1984 period. This year, revenue growth will slow to 13.3%. Shipments will grow at a healthy 22.0% rate during 1985, reflecting lower overall prices for DEC controllers. Lower prices will not result from drastic erosions, but from a change in product mix in favor of Q-bus. The introduction of several new systems by Digital in 1985 will fuel market growth at a faster rate over the next two years. Revenue growth for the 1985-1986 period will be 21.6% with a corresponding unit growth of 28.0%. Unit shipments will grow 24.3% in 1987, followed by a 21.2% growth in the following year.

For the 1984-1988 forecast period, compound annual growth is expected to be 15.6% in revenues, 23.8% in shipments. Our projections for revenues have been lowered slightly from last year's predictions, but the shipment forcast essentially remains the same. The variation has been caused by a faster growth in Q-bus controllers than anticipated, which command lower Average Selling Prices (ASP). As indicated in

Figure 1.1, Q-bus controllers will account for 78.8% and 85.9% of all DEC controllers in 1986 and 1987, respectively. In the following year, Unibus controllers will dwindle to a mere 8.8% of the total market.

Winchester controllers remain the revenue leaders in this segment with 57.4% share of 1984 revenues. Over the next four years, winchester controllers will continue at slightly under 60% share. Tape controllers, which accounted for 23.6% share in 1984, will also remain stable at 23-24% share through 1988. Multifunction controllers will exhibit growth beginning in 1987, as the Micro series systems ship in high volume. The 11.2% multifunction share this year will account for a 14.1% share by 1988. Revenues from multifunction controllers will double during this period.

Floppy controllers will turn heavily captive, causing a steady decline in the floppy-only controller market over the next four years. In 1984, floppy-only controllers accounted for 7.7% of revenues and 13.8% of shipments. By 1988, these numbers are expected to decline to 2.9% and 4.8%, respectively. The integration of floppy control functions on multifunction products will also contribute to this decline.

There is a moderate level of captive activity in the DEC-compatible controller market. Companies that use their controllers in captive subsystems include Scientific Micro Systems, Plessey Peripherals, Qualogy, and Aviv Corporation. The two leading controller manufacturers, Emulex Corporation and Distributed Logic, do not have a

Peripheral Concepts

significant subsystems business. Figure 1.2 shows the projections for captive and non-captive controller markets.

For all manufacturers, captive consumption of controllers in 1984 was 6.8K units. On an "if sold" basis, this represents $10.66 million, or 12.6% of the total revenues for 1984. The captive segment will exhibit a gradual growth through 1988, reaching 17.2% of the total revenues in 1988. This represents a compound annual growth of 26.5% for the 1984-1988 period. Compound growth for shipments will be higher at 34.2% for the same period. The growing subsystems market for the Micro series will account for most of this growth.

The ASP for DEC controllers will decline through 1988. The overall ASP will actually decline faster than the selling prices of individual functional categories, primarily as a result of the shift towards Q-bus. Tape-only controllers will experience the most price erosion, a negative compound growth of -10.3% during the 1984-1988 period. This will be followed by the winchester-only category at -7.3% with multifunction controllers at -4% for the same period. Product maturity and declining volumes will keep the pricing of floppy-only controllers relatively stable.

Distribution channels for DEC-compatible controllers are primarily a "direct" sale. The business is weighted more towards the OEM than the end-user. Digital Equipment is one of the biggest OEM customers. The company is buying disk controller boards for the MicroVAX computer from an after-market supplier. Subsystems manufacturers, such as

System Industries and U.S. Design Corporation, also make volume purchases of controllers from third party vendors. Many large users of DEC computers in the scientific and defense communities buy storage hardware from independent suppliers and integrate these systems in-house. Sales of DEC-compatible controllers through traditional distributors was a small portion of the total market and will remain so for the next several years.

Gross margins have been quite comfortable in the past, but will come under pressure as the market moves more towards Q-bus. However, relatively lower volumes and higher performance requirements will keep this segment from experiencing the severe price erosions of the SCSI and IBM-PC markets. Increasing complexities of DEC's storage architectures have resulted in longer development times and higher (ts. Consequently, some private label activities have already begun and this is likely to increase.

The Proprietary nature of DEC's new storage architecture (and the companys' recent legal actions) have created some uncertainty in the future of the compatible controller industry. After distributing documentation for MSCP to several controller manufacturers last year, the company abruptly withdrew further access to these specifications. As a result, the development of new MSCP-compatible controllers became extremely difficult. In July of this year, Digital Equipment filed a suit to protect the MSCP patent. Controller companies with MSCP controllers are now facing an uncertain product line. However, it seems unlikely that this "stalemate" situation will continue for very

long. We expect DEC to offer some type of licensing arrangement for MSCP products within the next six months.

We also expect the company to move more aggressively in an effort to capture a larger share of the peripherals market, controllers and subsystems included. This effort will be particularly intense at the high end. It will take a great deal of technical expertise and clever market timing to compete effectively with DEC. Those companies that are simply riding under DEC's "price and delivery umbrella" may face difficult times in the near-term.

Overall, things are looking much brighter for the DEC-compatible business than last year. A flurry of new computer introductions has provided a significant growth potential. As these new systems begin to ship in volume, the need for after market storage controllers will grow proportionally.

Despite failures in the personal computer market, DEC has managed to gain further momentum in the mini- and high-performance microcomputer markets. This will fuel additional growth in the controller market over the next few years.

DEC COMPATIBLE CONTROLLER REVENUES

Q-BUS Vs. UNIBUS

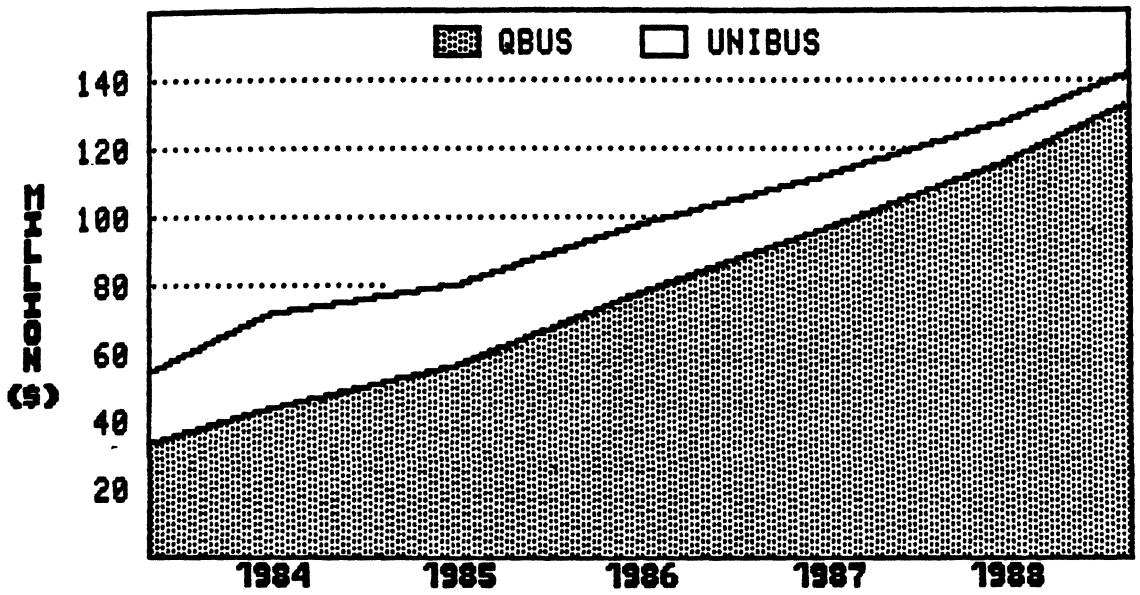


FIGURE 1.1

DEC-COMPATIBLE CONTROLLERS

REVENUE BREAKDOWN BY BUS TYPE

	REVENUES ($000)										
	ACTUAL		FORECAST								
	1984		1985		1986		1987		1988		1984-88
TYPE OF DEC BUS	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	CAGR:
Q-bus	$47,311	64.1%	$58,664	70.1%	$80,162	78.8%	$100,255	85.9%	$120,482	91.2%	26.3%
Unibus	$26,539	35.9%	$25,022	29.9%	$21,566	21.2%	$16,456	14.1%	$11,626	8.8%	-18.6%
TOTAL	$73,850	100.0%	$83,686	100.0%	$101,728	100.0%	$116,711	100.0%	$132,108	100.0%	15.6%
ANNUAL GROWTH RATE		—		13.3%		21.6%		14.7%		13.2%	

SOURCE: PERIPHERAL CONCEPTS, INC.

Peripheral Concepts

DEC COMPATIBLE CONTROLLER REVENUES

OEM Vs. CAPTIVE

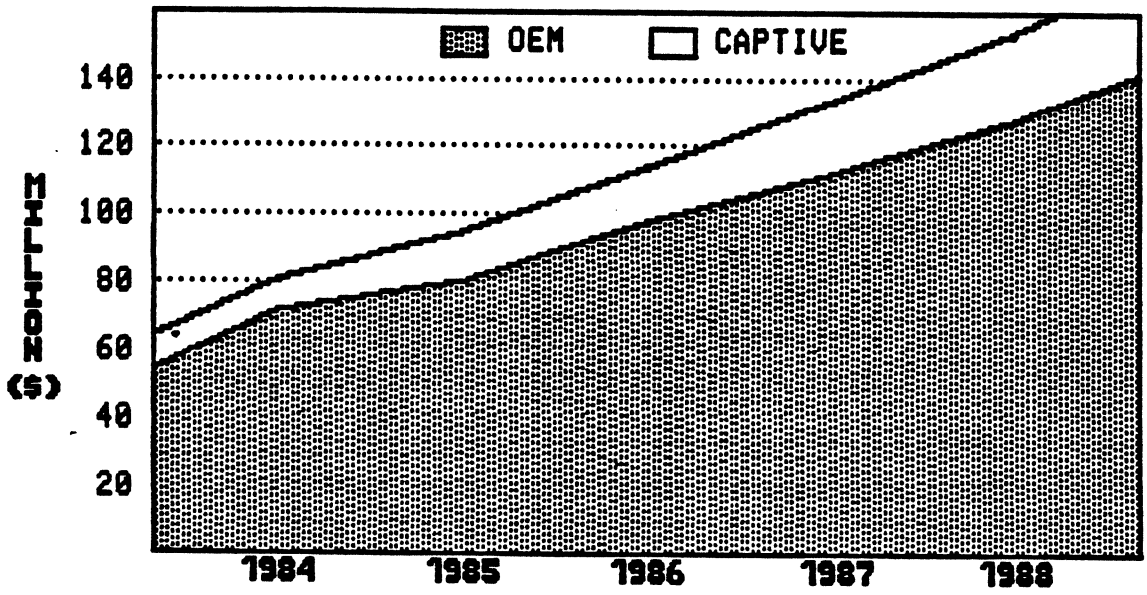


FIGURE 1.2

DEC-COMPATIBLE CONTROLLERS

REVENUE BREAKDOWN BY BUSINESS TYPE

	← REVENUES ($000) →										
	ACTUAL		← FORECAST →								
	1984		1985		1986		1987		1988		1984-88
CATEGORY	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	CAGR:
Captive (If Sold)	$10,668	12.6%	$13,100	13.5%	$16,550	14.0%	$21,400	15.5%	$27,350	17.2%	26.5%
Non Captive	$73,850	87.4%	$83,686	86.5%	$101,728	86.0%	$116,711	84.5%	$132,108	82.8%	15.6%
TOTAL	$84,518	100.0%	$96,786	100.0%	$118,278	100.0%	$138,111	100.0%	$159,458	100.0%	17.2%
ANNUAL GROWTH RATE		—		14.5%		22.2%		16.8%		15.5%	

SOURCE: PERIPHERAL CONCEPTS, INC.

Technology Trends

There has been little change in the basic architecture for DEC controllers in the last four years. Most DEC-compatible controllers are based on a "micro-engine" concept, whereas the core of the controller is designed with a microprocessor and firmware in read-only memories. Using this basic architecture, a family of products can be designed with only firmware changes. This flexibility is particularly important where emulation of a variety of storage products is key to success. For this reason, microprocessor based designs will remain the backbone of future DEC controller hardware.

Storage Module Disk (SMD) drives in the 8 and 14 inch form factors have dominated the DEC-compatible market in the past. New high speed SMD drives will help extend this dominance for the next three to four years. Most SMD controllers introduced during 1985 support the faster 2.4 Megabytes/second speed. The development of drives utilizing IPI-2 interface has been slower than expected. We expect the impact of IPI-2 drives in this market will not occur until late 1987 or early 1988.

For the smaller DEC systems, high capacity 5-1/4 inch disk drives with the ST506/412 interface are becoming popular. DEC has recently become a consumer of 85 Megabyte ST506 drives from an OEM peripheral supplier. This will result in a healthy growth for high performance ST506/412 controllers, both in stand-alone and multifunction configurations. Controllers supporting small winchesters with the ESDI interface were introduced earlier this year. This market is not

Peripheral Concepts

expected to be significant prior to the end of 1986, when volume production and second-sourcing of these products begin to occur.

The 9-track Pertec tape drives remain the leading secondary storage medium for DEC systems. This situation will not change during the next three to four years. The TK50 tape cartridge (introduced along with the MicroVAX-II) has had very little response. This cartridge may be used by DEC for software distribution purposes in the future, but its widespread usage seems unlikely.

Another promising candidate for tapes may be the cartridge developed by Electronic Processors (and second sourced by Fujitsu). But this too, cannot succeed without direct support from Digital. A lower cost implementation of IBM's 3480 cartridge drive has the potential to become a standard in this market, but we don't expect this to materialize before 1987-1988.

The Quarter-inch cartridge products are finding niche applications in the Q-bus microcomputer market. Streaming drives with the QIC type interfaces have been used with some Micro series computers, but they have failed to capture any significant market share. In this marketplace, cartridge drives with start/stop capabilities (such as CDC's Sentinel and Kennedy's 6455) are more suitable. Both controller and subsystems products are now available for use with these tape drives.

Standard mass storage busses and architectures are key to the compatible controller market. With the introduction of DSA, the next

generation architecture has become quite clear. To support DSA and the MSCP protocols, more sophisticated controllers will be needed.

Future controllers will perform many more tasks than they have in the past. At the same time, emulation requirements have become less stringent and more predictable.

The future of the next generation "BI" bus is a bit questionable, but it is rumored to be slated for introduction on the MicroVAX-III. The BI may be too complex and too expensive to implement. The available technical data on the BI indicates that several LSI devices, including some propietary DEC chips, will be needed to interface with the new bus. To receive widespread after-market support, the BI must overcome many hurdles.

Peripheral Concepts

Competing Technologies

In the past, entering the computer business was a major venture that only a few could afford. Traditionally, a computer company had to develop and manufacture computer hardware, add-ons, software and accessories. This required enormous resources. Today, many companies develop only the key system components and integrate the rest using standard hardware and software. By doing so, these companies can offer added value for targeted markets without requiring elaborate resources. Sun Microsystems and Apollo Computer are doing just that in the engineering workstation and CAD/CAM market. This is the market where the new MicroVAX computers are positioned. DEC faces a formidable challenge from these "supermicro" makers who will effectively compete against the Q-bus with their Multibus I/II and VMEbus-based machines.

IBM is expected to enter the workstation market in 1986. AT&T has also become a contender with their 3B series computers. The more traditional DEC rivals, such as Data General and Prime Computer, will certainly try to capture a share of this growing business with competitive products. The ability of the Q-bus systems to penetrate this market before the competition gains momentum is key to the future success. DEC has the advantage of early market entry and will be leveraged to win some key accounts.

Competition at the high end has not changed much. DEC has a substantial share of the scientific market, primarily with the high

d VAXs. IBM is the main competitor, followed by Data General. For the niche markets, companies like Hewlett Packard, Perkin Elmer, and Gould SEL offer competing products. A number of new "Super-minicomputer" companies have been formed in the past couple of years, but their future impact on the market remains unknown until products are announced.

Many DEC-compatible controller manufacturers are looking at the competing products and formulating strategies. So far, none of the controller suppliers have made a strong committment to non-DEC products. The VMEbus controller market has attracted the most serious attention, but no products have yet materialized. Most suppliers are busy concentrating their efforts to meet the challenge of supporting DEC's new mass storage architectures.

Peripheral Concepts

Key Assumptions

- The Introduction of several new DEC systems during 1985 will help fuel market growth for the next four years, primarily,.from the Q-bus based systems.
- The Unibus controller market will continue to decline. The shift towards the Q-bus will reduce overall selling prices.
- The introduction of the MicroVAX line will boost the growth of multifunction controllers, and lower projections for the tape-only segment during 1986 and 1987.
- DEC's patent claims for the MSCP will not adversely impact the controller market.

CALENDAR 1984 MARKET SHARE
REVENUES BY MANUFACTURER

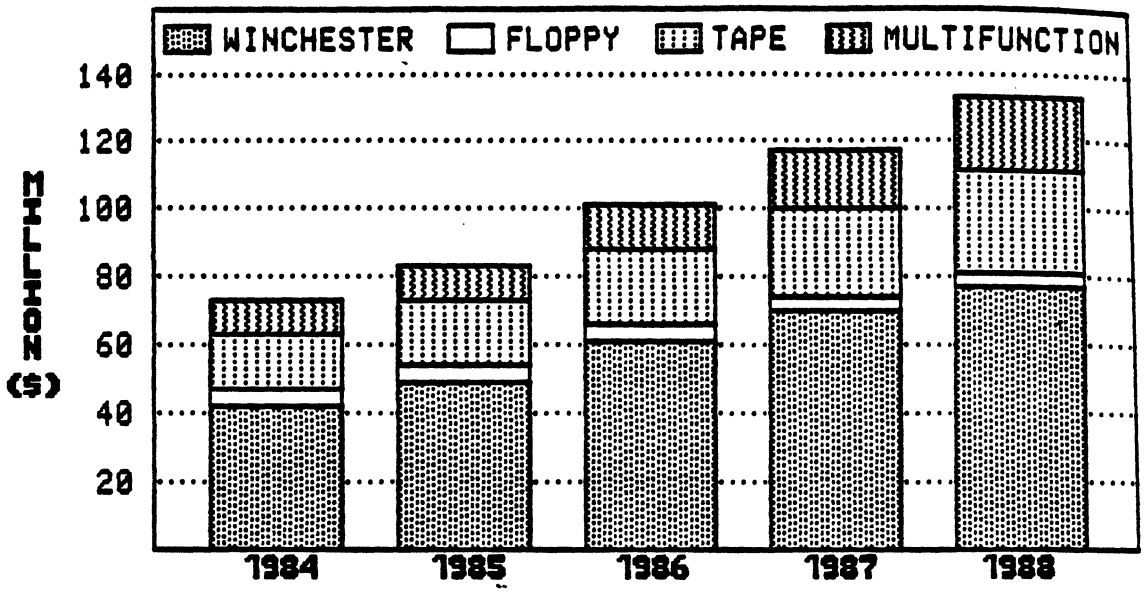
MANUFACTURER	MARKET SHARE (%)
Emulex	38.6
Distributed Logic Corp.	23.9
Scientific Micro Systems	5.1
Plessey Peripherals	4.9
Micro Technology, Inc.	3.3
Andromeda Systems	3.3
Sigma Informations Systems	3.2
Wespercorp	3.1
Spectra Logic Corp.	2.7
MDB Systems	2.4
Qualogy	2.4
OTHER	7.1
TOTALS	100.0 %

Market Share Analysis

In calendar year 1984, Emulex and Dilog once again captured over 60% of the DEC-compatible controller market. Emulex is by far the most dominant force in this market, with 38.6% share. Dilog generated more than four times the revenues from DEC-compatible controllers than the next contender, Scientific Micro Systems. The rest of the market remained quite fragmented as another nine suppliers captured between 2% and 5% of the market. Five other vendors had less than 2% market share each.

At least three companies, Computer Storage Technology/E.F. Industries, Minicomputer Technology, and Wespercorp are passive participants in the DEC-compatible controllers. These companies have no plans to offer new products into the DEC market, they are simply sustaining their mature products. After shifting the emphasis to DEC subsystems in 1983, Plessey Peripherals has become active in board-level controllers once again.

If the captive consumption were factored in, Qualogy would rank number five with its significant subsystems business. During 1985, no significant shifts in market positions are expected. Revenues for 1985 will be higher at Micro Technology and Andromeda, whereas Dilog will experience some decline.

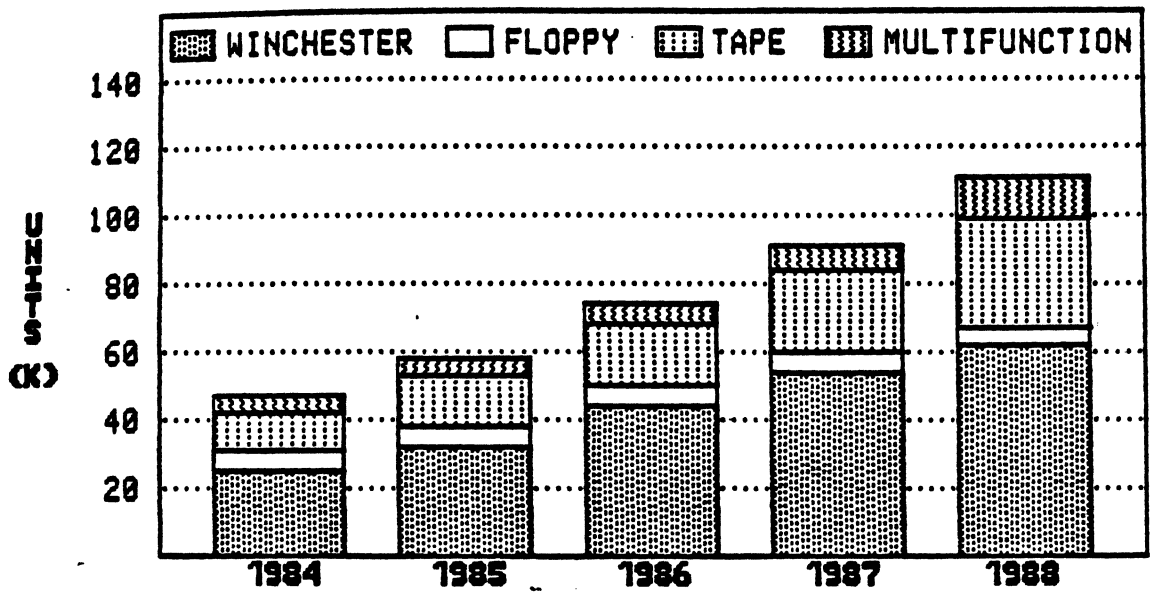


DEC-COMPATIBLE CONTROLLERS

REVENUE SUMMARY

	<——REVENUES BY PRODUCT TYPE ($000)——>										
	ACTUAL		<—— FORECAST ——>								
	1984		1985		1986		1987		1988		1984-88
CONTROLLER TYPE											CAGR:
	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	
Winchester	42,429	57.5	48,554	58.0	61,230	60.2	69,802	59.8	77,481	58.6	16.2%
Floppy	5,670	7.7	5,448	6.5	5,186	5.1	4,584	3.9	3,897	2.9	-8.9%
Tape	17,401	23.6	20,324	24.3	24,267	23.9	27,834	23.8	32,037	24.3	16.5%
Multifunction	8,350	11.3	9,360	11.2	11,045	10.9	14,491	12.4	18,693	14.1	22.3%
TOTAL REVENUES ($000)	$73,850	100%	$83,686	100%	$101,728	100%	$116,711	100%	$132,108	100%	15.6%
ANNUAL GROWTH RATE		—		13.3%		21.6%		14.7%		13.2%	

SOURCE: PERIPHERAL CONCEPTS, INC.



DEC-COMPATIBLE CONTROLLERS

SHIPMENT SUMMARY

	<——SHIPMENTS BY PRODUCT TYPE (000)——>										
	ACTUAL		<—— FORECAST ——>								
	1984		1985		1986		1987		1988		1984-88
CONTROLLER TYPE											CAGR:
	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	
Winchester	25.3	51.5	32.2	53.8	43.6	56.8	54.1	56.8	62.7	54.3	25.5%
Floppy	6.8	13.8	7.0	11.7	7.0	9.1	6.5	6.8	5.6	4.8	-4.7%
Tape	12.2	24.8	15.5	25.9	19.9	25.9	25.9	27.2	34.6	30.0	29.8%
Multifunction	4.8	9.8	5.2	8.7	6.2	8.1	8.8	9.2	12.6	10.9	27.3%
TOTAL SHIPMENTS (000)	49.1	65%	59.9	65%	76.7	66%	95.3	64%	115.5	59%	23.8%
ANNUAL GROWTH RATE		—		22.0%		28.0%		24.3%		21.2%	

SOURCE: PERIPHERAL CONCEPTS, INC.

Peripheral Concepts

MINICOMPUTER COMPATIBLE INTERFACES

Introduction

The success of Digital Equipment Corporation in the minicomputer business prompted many companies to enter the market. By 1975, there were several new start-ups getting established, each trying to take a piece of this fast growing market. An inevitable price war began, followed by a shake-out period. Many companies went out of business, some were acquired, and others decided to stay and serve the smaller niche markets. Several generations of machines had come and gone before the shakeout settled.

Three of the major "Non-DEC" survivors were Data General, Perkin-Elmer, and Texas Instruments. These companies had maintained backwards compatibility throughout their various generations of minicomputers. This not only helped them survive in the market, but created an after-market for add-on products. In particular, plug-compatible controllers.

The Non-DEC minicomputer market is relatively small. In 1984, the combined revenues from the Data General, Perkin-Elmer, and Texas Instruments controller market was $26.3 Million. Over half was generated from Data General controllers; the balance about equally divided between Perkin-Elmer and Texas Instruments. Due to the sluggish computer market over the past year, revenues will actually decline. Computer shipments have shown some improvements in the latter

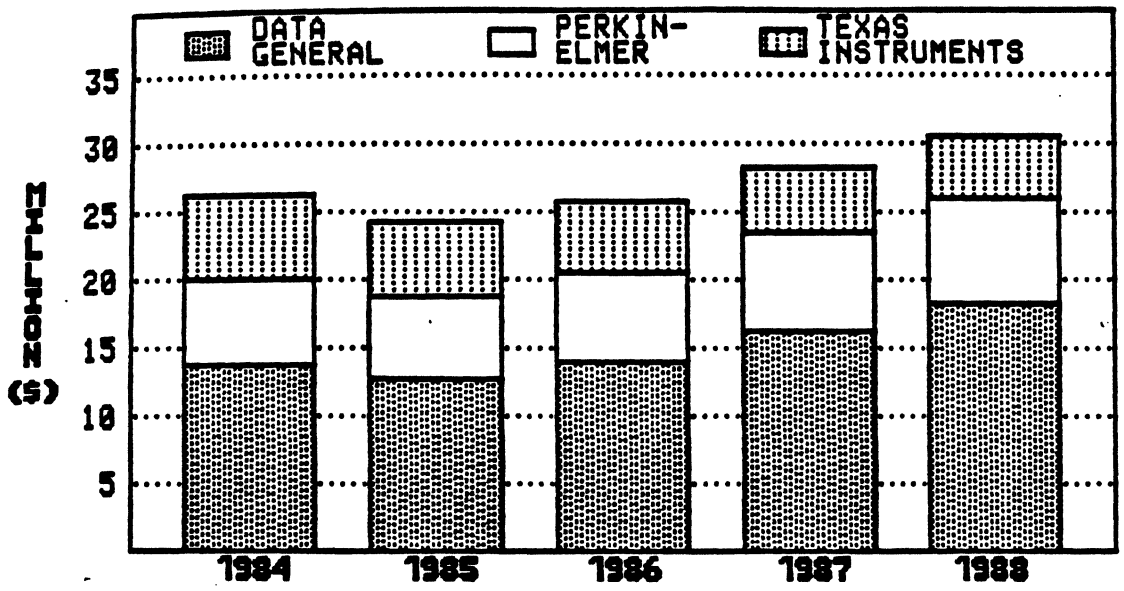
Peripheral Concepts

half of 1985, resulting in a 6.5% revenue growth from 1985-1986. Thereafter, the growth will be a steady 9.8% during 1987 and 6.9% during 1988. For the 1984-88 period, compound annual growth is estimated at 3.8% for revenues, 7.6% for shipments. A steady decline in Texas Instruments compatible controllers will be responsible for this relatively low growth rate.

Each individual minicomputer controller market is primarily affected by the performance of the corresponding computer supplier. Generally speaking though, this market follows some of the same rules typical of the DEC-compatible market. Erosions in average selling prices are minimal. But ASP's are declining between 3% and 8% a year, depending upon the category.

The floppy controller market for these minicomputers is totally captive, and therefore, no after-market exists for floppy-only controller boards. Almost all winchester controllers support the Storage Module Drive (SMD) interface, with tape controllers mainly supporting the 9-track tape Pertec interface. This will continue to be the case. The following table shows revenues by function of the Non-DEC minicomputer controller market in calendar year 1984:

	Winchester	Tape	Multifunction
Data General	$7,415K	$4,242K	$2,105K
Perkin-Elmer	$3,894K	$2,376K	$ 0K
Texas Instruments	$1,525K	$ 615K	$4,100K



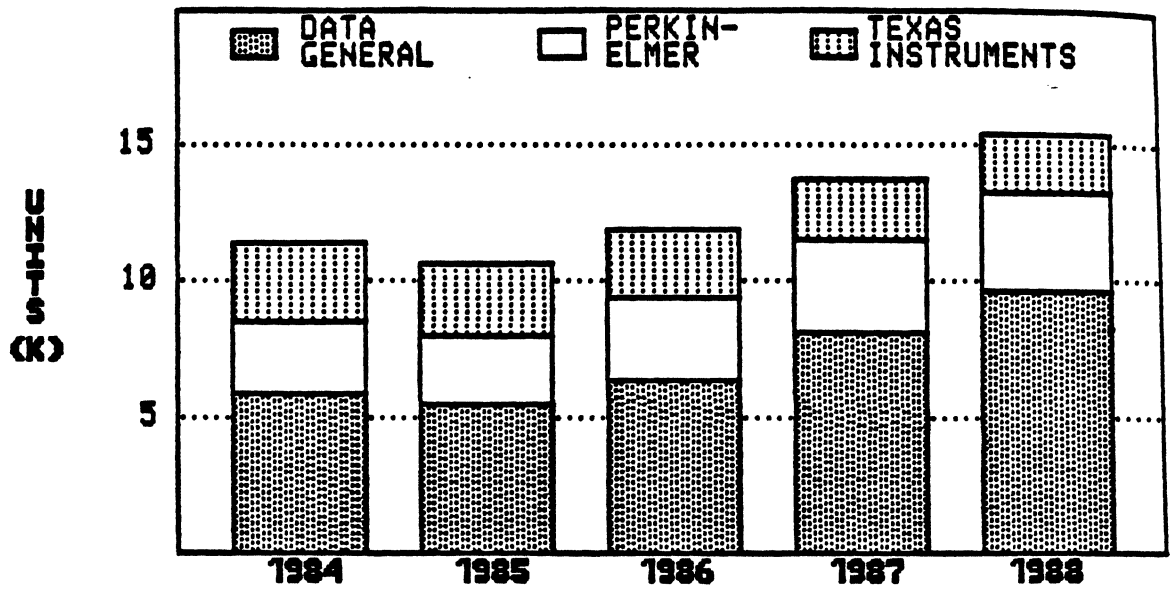
MINICOMPUTER CONTROLLERS

REVENUE SUMMARY

	<——REVENUES BY PRODUCT TYPE ($000)——>										
	ACTUAL		<—— FORECAST ——>								
	1984		1985		1986		1987		1988		1984-88
CONTROLLER TYPE											CAGR:
	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	
Data General	13,762	52.4	12,850	52.7	14,000	53.9	16,350	57.3	18,300	60.0	7.4%
Perkin-Elmer	6,270	23.9	5,891	24.1	6,630	25.5	7,210	25.3	7,860	25.8	5.8%
Texas Instruments	6,240	23.8	5,660	23.2	5,350	20.6	4,975	17.4	4,350	14.3	-8.6%
TOTAL REVENUES ($000)	$26,272	100%	$24,401	100%	$25,980	100%	$28,535	100%	$30,510	100%	3.8%
ANNUAL GROWTH RATE		—		-7.1%		6.5%		9.8%		6.9%	

SOURCE: PERIPHERAL CONCEPTS, INC.

Peripheral Concepts



MINICOMPUTER CONTROLLERS

SHIPMENT SUMMARY

	←SHIPMENTS BY PRODUCT TYPE (000)→										
	ACTUAL		←FORECAST→								
	1984		1985		1986		1987		1988		1984-88
CONTROLLER TYPE											CAGR:
	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	
Data General	5.9	51.8	5.5	51.4	6.4	53.8	8.2	59.0	9.6	62.7	12.9%
Perkin-Elmer	2.7	23.7	2.6	24.3	3.0	25.2	3.4	24.5	3.7	24.2	8.2%
Texas Instruments	2.8	24.6	2.6	24.3	2.5	21.0	2.3	16.5	2.0	13.1	-8.1%
TOTAL SHIPMENTS (000)	11.4	100%	10.7	100%	11.9	100%	13.9	100%	15.3	100%	7.6%
ANNUAL GROWTH RATE		—		-6.1%		11.2%		16.8%		10.1%	

SOURCE: PERIPHERAL CONCEPTS, INC.

DATA GENERAL COMPATIBLE INTERFACES

Introduction

Data General entered the minicomputer market in the late sixties with the NOVA product line. In 1974, the company introduced its higher performance Eclipse series. This was followed by the first 32-bit offering, the Eclipse MV, in 1980. Within a short period, Data General established itself as one of the leading minicomputer manufacturers. In spite of fierce competition and industry shake-outs, DG has maintained good growth rate. Today, its revenues have exceeded the billion dollar mark.

Data General's MV10000 system set a new price/performance standard, about $70,000 for each Mega Instruction Per Second (MIPS) of performance. A new member, the MV/10000SX, was added in early 1985. A more powerful version, the MV/12000 (which will compete with DEC's VAX-8600) is expected to be introduced before year-end.

At the lower-end of the Eclipse MV line is the MV/4000SC. Introduced in late 1984, this system is priced for the workstation market. The company also introduced a portable, personal computer about the same time, but it hasn't enjoyed the success of the MV line.

All of DG's MV series computers support an operating system called the Advanced Operating System/Virtual Storage (AOS/VS) and DG's own version of Unix called the DG/UX.

Peripheral Concepts

Market Overview/Trends

Data General machines use two standard interfaces, the Data Channel (DCH) and the high-speed Burst Multiplexer Channel (BMC). Controllers from independent suppliers usually connect these interfaces to industry standard SMD disk drives and/or 9-track tape drives. Compatible controllers also support Data General's software as well as emulate the captive subsystems products.

Revenues for Data General compatible controllers in 1984 were $13.76 Million. This level will decline an estimated 6.6% in 1985, but will show a moderate recovery in 1986. Market growth for the 1987-1988 period will be higher, largely due to expansion of the current product line. Total revenues are expected to reach $18.3 Million annually by 1988. Compound growth rate over the forecast period will be 7.4% for revenues, 13.1% for shipments.

Winchester controllers led the 1984 market, accounting for 53.9% revenue share, followed by tape controllers with 30.8% share. Multifunction controllers accounted for 15.3%, but significant growth is expected in multifunction products over the next four years. For 1985, an estimated 28.5% of revenues will be generated by multifunction products.

While support of high performance SMD drives will continue over the next three years (especially those controllers supporting the 2.5 Megabytes/sec data rates) smaller drives with the Enhanced Small Disk Interface (ESDI) interface will appeal to the low-end user. In 1987,

an estimated 8% of all controllers shipped will support the ESDI interface. In the area of tape, use of 9-track drives will continue to dominate this market, as the QIC type cartridge drives are expected to have a small impact.

Product Definition

Products and forecasts within this category refer to controller board-level products that have a Data General minicomputer compatible host interface, and various drive interfaces for peripherals. Examples of products and manufacturers in this category include:

Aviv Corporation	TFC 712, 715, 716
Bytronix	B234, 450, 455, 505, 525
Computer Storage Technology	15X12, 3512
Mini Computer Technology	MCT 20XX & 24XX Series, EDC22 SMC 12/902, TDC 802
Spectra Logic Corp.	Spectra 10, 20, 30 Spectra 17/27/120/210 Plus
Wespercorp	DC221, TC120
Zetaco	DC 295/297, TC-133 BMX-1/2/3, ZDF-1

Market Share Analysis

In 1984, Zetaco was the leader in the DG compatible controller market with a 31.4% share, followed by Spectra Logic with a 22.6% share. It is expected that these two manufacturers will continue to hold over 50% of the market through 1985. Wespercorp is the third largest supplier, as most of its revenues come from older products. Bytronix performed well at the lower-end, with controllers for the ST506/412 type disk drives and QIC-02 compatible tape drives. Although Mini Computer Technology offered two new products last year, the company's

future emphasis will be on microcomputer controllers. Computer Storage Technology/E.F. Industries is a passive participant in this market, inheriting many of their products from the old Datum line.

Zetaco was also the leader in the winchester-only configuration, with nearly 40% market share. Spectra Logic dominated the multifunction configuration, with almost half the revenues for this segment. In the area of tape-only controllers, Wespercorp, Aviv, and Zetaco each held about 20% share. With many new products introduced this year, we expect both Spectra Logic and Zetaco to strengthen their respective positions in the winchester-only and multifunction categories.

CALENDAR 1984 MARKET SHARES
REVENUES BY MANUFACTURER

MANUFACTURER	MARKET SHARE (%)
Zetaco	31.4%
Spectra Logic	22.6%
Wespercorp	11.6%
Bytronix	11.4%
Aviv Corp.	7.1%
Mini Computer Tech	6.1%
OTHER	9.8%
TOTAL	100.0%

Peripheral Concepts

PERKIN-ELMER COMPATIBLE INTERFACES

Introduction

Perkin-Elmer systems are really descendants of Interdata, the company that is credited with the introduction of the first 32-bit minicomputer. The original Interdata 7/32 and 8/32 computers made the 32 bit minicomputer popular at the high end. In 1974, they were replaced by the 3200 Series. Traditionally, Perkin-Elmer computers have done well in the scientific markets, particularly for simulation applications. The company also offers Unix based systems for the low end, but these have not been as successful as the 3200 products.

The latest emphasis at Perkin-Elmer is on parallel processing capabilities. Multi-processing systems have been offered by P-E for about three years now, and two new members were added to the 3200MPS family in 1985. Recently, the company announced the top of the line 3280MPS known as the "Cruncher".

Perkin-Elmer computers use two interfaces, the Multiplexer Channel and the Selector Channel (SELCH). Independent controller suppliers offer disk and tape controllers that connect both of these P-E busses to industry standard disk and tape drives.

Peripheral Concepts

Examples of products and manufacturers in this category include:

Computer Storage Technology	15X42
Macrolink	201800, 201100, Macro-3
Mini Computer Technology	TDC803/813, SMC 903
Spectra Logic Corp.	Spectra 14, 34
Wespercorp	TC-140

Market Trends/Forecasts

Total revenues from Perkin-Elmer compatible controllers for 1984 were $6.27 Million. The market will remain virtually flat in 1985. The introduction of several new systems and controller products will cause a 12.5% growth in 1986, but this is likely to stabilize at a 9% level in the following two years.

Most of the growth will come from high performance disk controllers. SMD disk drives with 2.5 and 3 Megabytes/sec speeds are becoming popular for P-E machines. Since most P-E controllers are targeted at high end applications, disk controllers for the smaller drives will not find widespread acceptance. The 9-track Pertec interface will continue to dominate tape controllers. Since the Perkin-Elmer architecture cannot support multifunction controllers, this segemnt does not exist in the P-E world.

CALENDAR 1984 MARKET SHARES
REVENUES BY MANUFACTURER

MANUFACTURER	MARKET SHARE (%)
Spectra Logic Corp.	44.6%
Macrolink	28.4%
Wespercorp	11.9%
Mini Computer Tech	2.0%
OTHER	13.1%
TOTALS	100.0%

In calendar 1984, the P-E compatible controller market was dominated by Spectra Logic and Macrolink. Spectra Logic had the lion's share of winchester-only controllers with 71.8% of revenues, while Macrolink led the tape-only category with a 65.2% share. Wespercorp accounted for 11.9% of revenues, mainly on the strength of its older tape controller product line. Mini Computer Technology is simply sustaining its earlier SMD products.

Peripheral Concepts

TEXAS INSTRUMENTS COMPATIBLE INTERFACES

After-market suppliers have long been offering disk, tape, and multifunction controllers for TI's 990 and 600 series minicomputers. Lately however, Texas Instruments seems to be de-emphasizing the minicomputer market in favor of microcomputers systems. The controller market for TI computers will continue to decline over the forecast period. Revenues for this category, which totalled $6.24 Million in 1984, will drop to an estimated $4.35 Million by 1988.

Controllers currently available for Texas Instrument minicomputers include:

Spectra Logic Corp.	Spectra 16, 26, 36, 46 Spectra 116, 126 Plus
Zetaco	990-SMD+, MZT-3

Spectra Logic is the leading after-market supplier of TI compatible controllers with a 75.3% share in 1984. Spectra was also the sole source of multifunction controllers, which accounted for 65.7% of the total revenues for the same period. The company also supplies the captive controller needs for Texas Instruments. Zetaco was the second largest supplier with a 17.3% market share.

Peripheral Concepts

THE MULTIBUS HOST INTERFACE

Introduction

The Multibus interface was first defined by Intel Corporation (Santa Clara, CA) for use within the company's microprocessor development systems. It was formally named "Multibus" in 1976 when Intel introduced the iSBC 80/10 single board computer. The bus specifications were placed in the public domain, making it one of the first "open architecture" microcomputer busses. This prompted the development of new products and applications. Many after-market suppliers entered the Multibus compatible industry, offering CPUs, memory boards, controllers, and other system components. By the end of the 1970's, the Multibus interface became the most popular microcomputer bus. Nearly fifty independent vendors were supplying a variety of products.

Today, that number has more than quadrupled. In 1983, the Institute of Electrical & Electronics Engineers approved the Multibus as its IEEE-796 standard, further promoting the bus by establishing clear standards guidelines.

Multibus fits into "mid-range" systems. Typical Multibus systems are smaller and less powerful than traditional minicomputers, but offer higher performance than personal computers. Most initial Multibus applications were in the scientific computing, graphics system, and industrial process-control segments. Today, the Multibus dominates the

Peripheral Concepts

supermicro computers used in engineering workstations and CAD/CAM applications.

Multibus has gone through many changes and enhancements over the years. The interface started as an eight bit bus, reflecting the bus size of microprocessor chips at that time. Later, when sixteen bit microprocessors emerged, the Multibus specifications were upgraded to support the new bus width. Today, the Multibus (or Multibus-I as it sometimes called), is actually a set of busses. In addition to the system bus, it consists of other I/O busses such as iLBX, iSBX, Multichannel and Bitbus. These are described later in this chapter.

The evolution of Multibus continues. In response to the new breed of 32 bit microprocessors, the next generation bus, called the Multibus-II, was defined in October 1983. Multibus-II is a powerful bus that supports 32 bit wide data paths and advanced architectural features such as multi-processing.

In addition to the standard system components like CPUs, memories, and controllers, a variety of application-specific hardware and software have been developed. These include Math Processors, Analog to Digital Converters, Communications Processors, Speech Recognition Boards, and Graphics Controllers. Two operating systems, Xenix/Unix and Intel's iRMX, are the most popular for Multibus systems. A wide range of applications software is now commonly available.

Many integrated circuits have been developed to support the original Multibus. Semiconductors are available from Intel, Advanced Micro

Devices, Zilog, Siemens, and others. Two LSI devices for the tibus-II have already been defined by Intel; a Bus Arbiter Controller (BAC) and a Message Interrupt Controller (MIC). NCR Corporation and Siemens are also getting ready to offer additional devices for Multibus-II. Although Motorola is backing its own VMEbus, a significant number of Multibus products use Motorola's 68000 microprocessor.

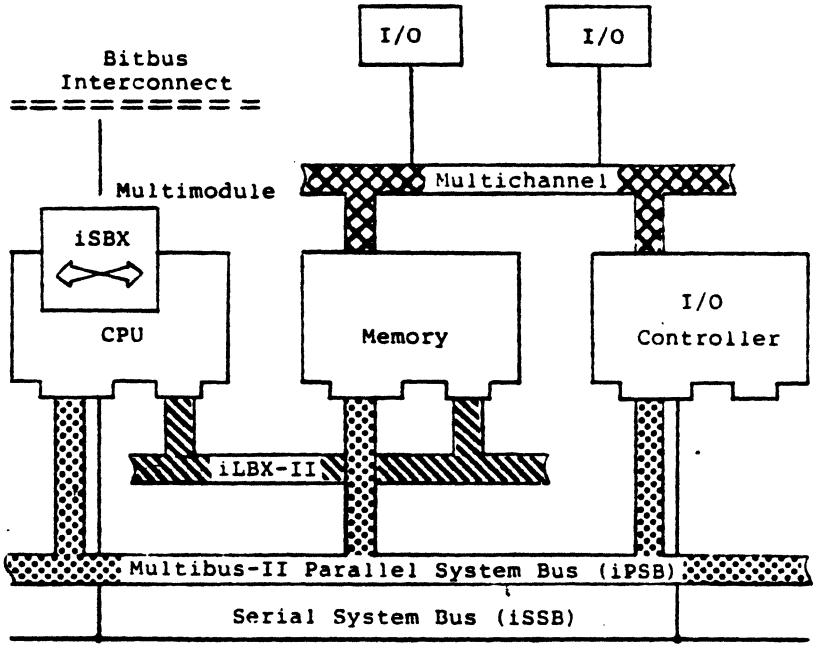


FIGURE 3.1

MULTIBUS SYSTEMS ARCHITECTURE

Peripheral Concepts

Bus Characteristics - Multibus-I

The Multibus system bus is an asynchronous bus that permits 8 or 16 bit data transfers. A typical Multibus module has a form factor of 6.75 inches long and 12 inches wide, with a set of signals on two edge card connectors. The first connector (P1) has 86 pins and contains most system bus signals. A second connector (P2) has 60 pins and contains four address extension lines plus room to implement the iLBX bus.

There are sixteen bi-directional data lines used for 8 or 16 bit transfers. There are also 24 address lines which provide direct access to up to 16 Megabytes memory. Data and address lines are not multiplexed, they are physically separate signals. Nine control lines carry system clocks, master/slave communications signals, and reset lines. In addition, there are eight dedicated interrupt lines and one interrupt acknowledge line. For bus control and arbitration, six bus exchange lines are provided. The arbitration process is centralized for the Multibus-I.

Several I/O busses have also been defined for the Multibus system. For direct access to memory, the Local Bus Extension ("iLBX") is used. This bus off-loads the system bus and provides high speed access to the memory. The "iSBX" expansion bus is used to connect smaller circuit cards called "multimodules" to the CPU board. The iSBX provides additional functionality without replacing an entire module. The "Multichannel" I/O bus provides a separate data path for DMA type

I/O activities. Similar to the SCSI concept, this bus can relieve the host of I/O overhead. A serial bus called the "Bitbus" has also been defined, primarily for industrial control applications.

Bus Characteristics - Multibus-II

Multibus-II retains all of the basic signal characteristics of Multibus-I. The structure for auxiliary busses is also similar. The Parallel System Bus ("iPSB") and the Local Bus Extension ("iLBX-II") are similar to the system bus and the iLBX for Multibus-I, except these are 32 bits wide. Multibus-II also has a Serial System Bus ("iSSB"). The I/O expansion bus (iSBX) and the Multichannel are exactly the same as those for Multibus-I. A typical Multibus-II system is shown in Figure 3.1.

There are however, other differences between the two busses. Mechanical dimensions are different, so one can not upgrade to Multibus-II simply by interchanging boards. The Multibus-II modules use the Eurocard form factor with DIN connectors to the backplane, rather than card edge connections.

Multibus-II can support 32 bit wide data paths, unlike the 16 bit limit of Multibus-I. But Multibus-II does not physically separate the data and address lines, but time-multiplexes the two on the same set of pins, adding parity to enhance data reliability. Multibus-II also implements a synchronous protocol (which increases noise immunity), but this imposes a top limit on the throughput. However, the maximum

bandwidth of 40 MBytes/second is more than adequate for today's supermicro systems.

The arbitration process is "distributed" for Multibus-II as opposed to the centralized scheme used by Multibus-I. Distributed arbitration allows as many discrete levels of arbitration as there are slots in the system. Interrupts are virtual and not dedicated. This means rather then sending interrupts on dedicated lines, they are written into designated memory locations. Multibus-II also permits data transfers in bursts, thereby improving bus utilization.

In addition to the basic specification, the Multibus-II architecture also defines a message-passing protocol. The hardware definition of this protocol will help resolve some confusion that can arise in multi-processing environments. Overall, Multibus-II incorporates many advanced architectural features that will support the next generation of supermicro computers.

Product Definition

Products and forecasts within this category refer to controller board-level products that have a Multibus-I or Multibus-II port for host communications, and various drive-level interfaces for peripheral control. The majority of controllers on the market today are Multibus-I compatible. Examples of products and manufacturers in this category include:

Aviv Corporation	TFC 505
Central Data	CD21/4XXX Series
Ciprico	Rimfire & Tapemaster Series
Comark	MT80, 86, MF85
Data Technology Corporation	5186, 5286, 5486
Intel	iSBC 2XX Series
Interphase Corporation	SMD21XX, Storager
Konan	Taisho 6000
Mini Computer Technology	4300, 4500, 4510
Qualogy	Ramtrac Series, MicroCharge
Scientific Micro Systems	FWD 800X Series
Wespercorp	MB-506, MB-SMD, MB-QIC2
Xylogics	4XX Series

Peripheral Concepts

Market Trends

Peripheral Concepts estimates the total market to be:

	1984	1985	1986	1987	1988
REVENUES $	46,481K	47,550K	55,880K	66,900K	78,060K
SHIPMENTS	39.2K	41.1K	50.8K	64.9K	78.9K

The Multibus controller market for 1985 will essentially remain flat, both in terms of revenues and shipments. Future growth projections have been revised on the downward side. The primary reason is the lower than anticipated level of support for Multibus-II. New design activities have been slow, both at Intel and at the independent controller houses. This delay will force some system manufacturers to switch to competing busses, particularly the VMEbus.

We still expect the Multibus-I/II controller revenues to grow through 1988, but at a slower, compound annual rate of 13.8% from 1984 through 1988. Shipments for the same period will grow at a brisker 19.1%. A peak in year-to-year revenue growth is expected at 19.7% from 1986-87. Thereafter, the year-to-year growth rate will slow down slightly to 16.7% for the 1987-88 period. Declining ASP (Average Selling Price) will keep the growth in unit shipments moderately ahead of revenue growth. From 1987-88, shipments will grow a solid 27.6% on a year-to-year basis.

It is important to note that although we have lowered our growth rate projections, the absolute size of the market is larger than our 1984 forecasts. This is primarily due to the inclusion of non-captive Multibus products manufactured by Intel and Scientific Micro Systems. Consequently, equivalent revenues for calender 1983 would have been $33.7 million, instead of the $18.6 million reported previously. The 1985-88 revenue and shipment forecasts must therefore be interpreted accordingly.

Multifunction controllers will exhibit the most impressive growth, followed by the winchester-only products. Multifunction controllers, which made up 25.8% of all shipments in 1984, will account for an estimated 43.2% of all units shipped in 1988. Revenues for the winchester-only and tape-only segments will grow at compound annual rates of 8.3% and 10.9% respectively from 1984 through 1988. New products supporting emerging disk and tape interfaces will keep the single function controllers from being replaced by the multifunction boards. However, shipments of floppy-only controllers will continue to decline over the next four years at a compound annual rate of 11.1%. This decline will be particularly strong from 1987-88, with an estimated 18.9% on a year-to-year basis.

Most new SMD (Storage Module Drive) disk controllers will support the higher transfer rate disk drives from Fujitsu and Control Data. Such enhancements will hold the price erosion for Winchester controllers at a compound annual rate of 5.9% from 1984 through 1988. By mid-1986, most vendors will offer controllers supporting the ESDI interface.

However, it is expected that revenues from ESDI controllers will remain under 10% of the total market for 1986. The proliferation of cartridge tape drives will cause ASP's for tape-only controllers to decline 13.5% from 1985 through 1987.

The Multibus controller business was predominantly an OEM business in 1984, and will remain so in the coming years. The majority of Multibus-based peripheral controller buyers are system integrators and VARs (Value Added Resellers) rather than end-users. They accounted for almost 87% of all Multibus controllers sold in 1984. Less than 10% of all products were sold through distributors in this same period. Manufacturers in the workstation and CAD/CAM markets represent the high volume users of commercially available Multibus mass storage controllers. These include Apollo Computer, Sun Microsystems, and Prime Computer.

There is very little captive activity in the Multibus market. Companies such as Qualogy, Intel, and Scientific Micro Systems do offer Multibus subsystems using their own controller boards, but the number of units consumed by subsystems is small when compared to the overall market. In the area of tape, Aviv Corporation offers tri-density tape subsystems using captive controllers. Other market leaders including Xylogics, Ciprico, and Interphase currently do not offer Multibus subsystem products.

With increasing levels of sophistication, controller development programs are costing more and taking longer to complete. Consequently,

some Multibus suppliers have opted to acquire certain products to round out their product lines, rather than develop everything in-house. Intel for example, has been known to private label SMD disk controllers from Xylogics. Such second-tier market activities will benefit the end-users by providing alternate sources for some popular products. Advanced Micro Devices has left the Multibus add-on market this year, licensing their products to Central Data Corporation.

Most future supermicro designs will be based on 32 bit busses. Thus, the use of Multibus-I will certainly decline. In order for Multibus-II to win future designs, a strong support from Intel and the major after-market suppliers will be required. During 1985, Intel has been less than aggressive in promoting the Multibus-II. The number of silicon products and board-level designs introduced so far, have not been adequate to insure market success. Unless this situation changes within the next 18-24 months, Multibus-II will miss a critical market window.

The Multibus market as a whole is still large and growing. It will account for approximately 39.7% of the 1985 market for supermicros and low-end minis. This is indeed a huge installed base to draw from.

Peripheral Concepts

Technology Trends

There are currently no technical changes taking place in Multibus controller architectures. Most of the new design activity is aimed at providing added functionality and higher performance. To that end, the controllers are constantly striving to keep up with the advances in computer architecture as well as higher-speed peripherals.

New SMD controllers are supporting the 2.4 Megabytes/second data rate of the Fujitsu Eagle-XP disk drive. Some are even targeting to the 3 Megabytes/sec speed of the newer Control Data drives. Many controller vendors are getting ready to offer products supporting small winchesters, particularly, those products with the ESDI interface. We don't expect a significant number of 10 Megabit/sec type ESDI drives to ship in 1985. Next year however, there will be a definite market for ESDI controllers. It should be noted that developing an ESDI controller is not a particularly difficult task, since the data separator (which is the most technically-difficult portion of today's 5-1/4 inch ST506/412 disk controller designs) resides within the disk drive.

Winchester controllers will continue to use on-board cache memory and other techniques to meet the faster access time requirements of supermicros. Clever buffering schemes will remain popular to support non-interleaved disk operations. Features to improve reliability, such as defect management and transparent error processing, will also become standard on most winchester disk controllers.

Tape controllers for the 9-track "Pertec" interface remain the revenue leader, generating 88.6% of tape controller revenues for 1984. Although this is an older technology, and the drives are too bulky for today's smaller systems, a large installed base and universal format compatibility (IBM/ANSI) has protected this market. However, the smaller 1/4 inch cartridge tape drives are certainly gaining acceptance, including the QIC-02, 3M's HCD-75, and Kennedy's Pico-bus. But data interchange is still difficult to maintain, as these products do not have any format compatibilities. The added intelligence of these interfaces also makes the drives more expensive. Eventually, we expect the cartridge drives with the device level QIC-36 interface (and QIC-24 format) to be more popular than the other versions.

IBM's 3480 cartridge is a very promising candidate for eventual replacement of 9-track tapes. Both the drive and the formatter complexities will have to be reduced for a lower cost implementation of the existing 3480 technology. Considering the technical challenges, controllers for the 3480 type drives will not be widely available until 1988. In the meantime, both the 9-track reels and the 1/4 inch cartridges will continue to serve the Multibus market.

The majority of floppy controller chips now available incorporate on-chip data separation. Thus, the floppy function can be easily accomodated on the CPU or winchester controller boards. As a result, the stand-alone floppy controller boards will experience a sharp decline over the next several years.

Peripheral Concepts

Reductions in controller circuitry, using gate array and standard-cell technologies, is opening up more "real estate" on controllers that will likely be used for additional functions. For example, many new multifunction controllers now support winchester and tape drives on a single board. As the use of SMT (Surface Mount Technology) grows, combinations of memory, mass storage control, and networking will also become possible. But due to the added complexities on these new products, features like power-up confidence test and self diagnostics will become necessary for easy fault isolation.

Some Multibus suppliers (Intel included) are providing the Small Computer Systems Interface (SCSI) to the CPU board. The SCSI port allows users to connect off-the-shelf SCSI controllers and "generic" peripherals to satisfy mass storage requirements. While this method simplifies system integration and expansion, the presence of an intermediate bus can degrade overall system performance. Consequently, use of SCSI will not be very popular in high performance Multibus systems.

Competing Technologies

Traditionally, the Multibus has been an OEM microcomputer bus. It has competed primarily with Digital Equipment's Q-bus. But the competition has not always been so direct. The Q-bus began as a 16 bit minicomputer bus and was positioned above the earlier Multibus applications. The Multibus has largely been a system integrator's bus. Systems components are typically fitted together for a specific Multibus application. Therefore, in the past, the two busses have managed to serve different niches.

This may not be the case in the future. Newer Q-bus based computers from Digital Equipment are targeted at the workstation market, which up until now has been a Multibus territory. DEC's pricing for the new MicroVAX and the MicroPDP computers has been very aggressive. With a strong marketing push, DEC can become a significant factor in the workstation market. During 1986, expect IBM to offer a product to address this segment as well. Multibus is likely to have a tough uphill battle to retain its dominance over the long term.

Another area where the Multibus has done well is in industrial process control. In this arena, the STD bus has been the main competitor against Multibus. The STD offers compact size and a lower cost implementation, but it is an older standard in desperate need of upgrading. The VMEbus, which has done very well in Europe, is now challenging the Multibus in the U.S. industrial control market.

The VMEbus is also a formidable challenger for the next generation 32 bit supermicro busses. It has already made impressive in-roads into this market. Key design-ins have been won at leading companies in the workstation and CAD/CAM markets. Technologically speaking, the VMEbus is not any more or less superior to Multibus-II. Although there are architectural differences, both busses are well suited for the next generation supermicro needs. However, the VMEbus has quickly capitalized on its success in the European market. Stable specifications and establishment of the manufacturer and user groups has helped the VMEbus gain considerable momentum in the past two years. Many traditional Multibus controller maufacturers like Xylogics, Interphase, and Central Data, are supporting the VMEbus in addition to Multibus-II.

Even with a strong challenge from the VMEbus, Multibus-II can still bounce back. It enjoys a large installed base of loyal Multibus users. It now needs a strong marketing push. Intel must take a leadership role and finalize all specifications within the Multibus-II architecture. It must also get support through a wide range of board and silicon products to gain back the lost ground. Capturing the 32 bit supermicro market now hinges more on marketing savvy and solid product support rather than just on technical merit.

Peripheral Concepts

Key Assumptions

- After following the sluggish computer industry in 1985, the Multibus controller market will recover in 1986. Introduction of Multibus-II based silicon and board products will help the market in 1986/87.
- Momentum gained by the VMEbus and introduction of the MicroVAX-II will slow the growth for Multibus-II products.
- Wider acceptance of multifunction controllers will cause a decline in the growth of single function controllers beginning in 1986.

CALENDAR 1984 MARKET SHARE
REVENUES BY MANUFACTURER

MANUFACTURER	MARKET SHARE (%)
Intel	26.9
Xylogics	24.0
Ciprico	17.3
Interphase Corporation	10.1
Qualogy	9.3
Scientific Micro Systems	4.7
Data Technology Corporation	3.4
Central Data	2.3
Others	2.0
TOTAL	100.0 %

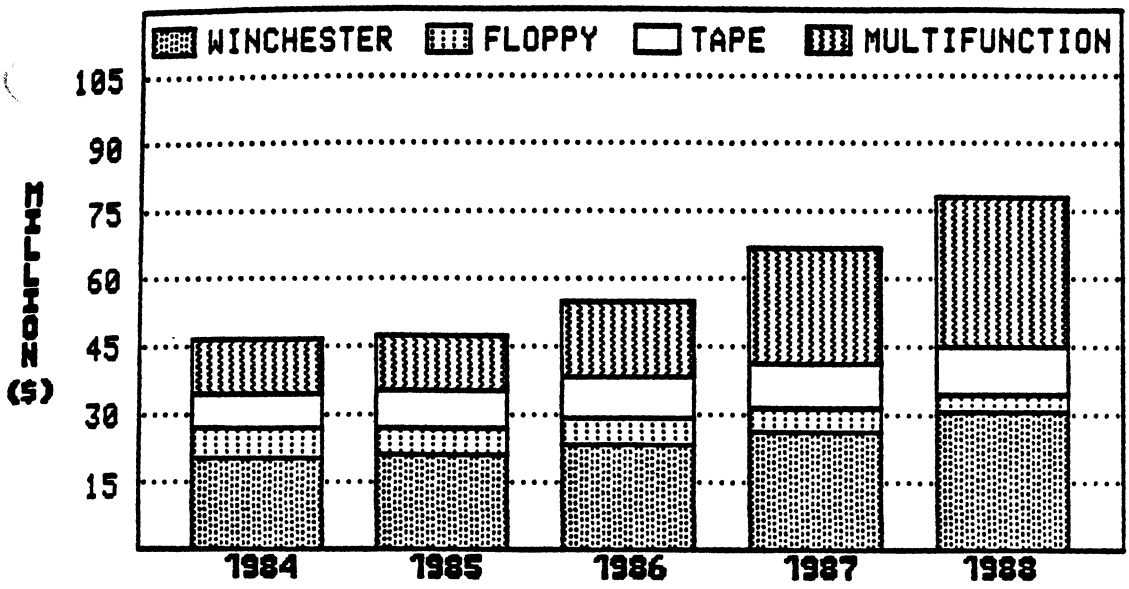
Peripheral Concepts

Market Share Analysis:

Intel was the 1984 market leader in Multibus controllers with over a quarter of the total revenues. Intel was by far the leader in Floppy only controllers, almost ten times larger than the nearest competitor in that category. Xylogics was a close second in overall market share with a strong position in Winchester only controllers. Ciprico was the leader in Tape only controllers with over 70% share of that market segment. In the Multifunction category, Qualogy shipped the most controllers, followed by Scientific Micro Systems.

Interestingly, in all categories except multifunction controllers, the first two market leaders controlled more than 75% of the total market for that category. In the multifunction category, it first took five players to make up the 75% market.

For calender year 1985, Peripheral Concepts expects Xylogics to further strengthen its position in the Winchester controller market. We expect Intel's shipments of Floppy only controllers to decline. However, its Multifunction controllers will show significant growth. The Multifunction controller market will continue to be shared by multiple vendors in 1985/86. They include Qualogy, Scientific Micro Systems, Intel, Xylogics, Interphase and Data Technology Corporation.



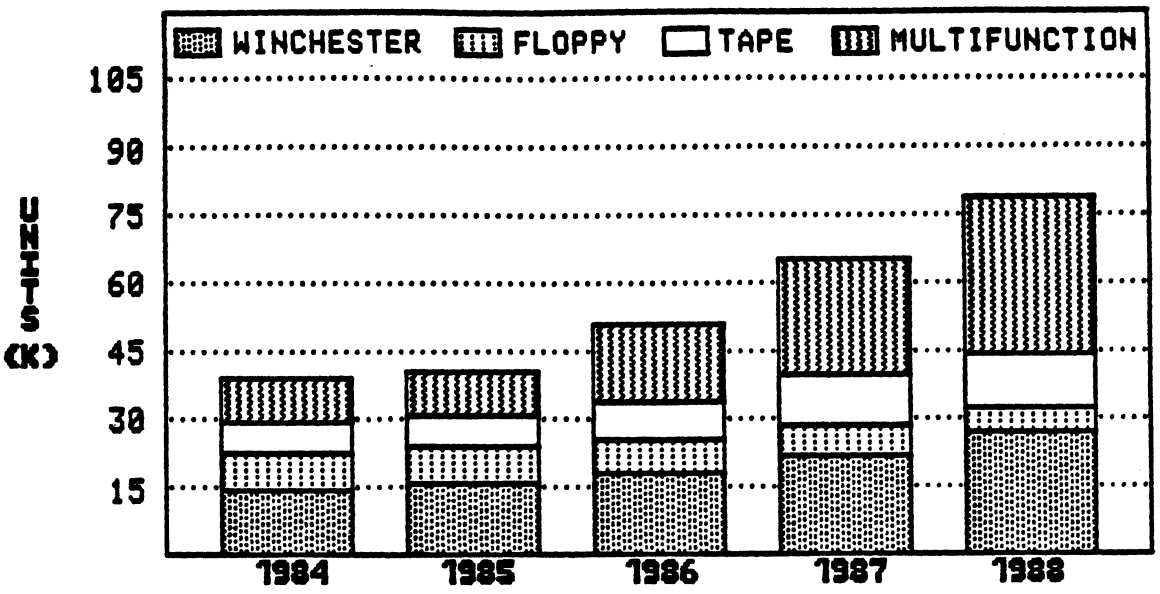
MULTIBUS CONTROLLERS

REVENUE SUMMARY

	<----------REVENUES BY PRODUCT TYPE ($000)---------->										
	ACTUAL		<---------- FORECAST---------->								
	1984		1985		1986		1987		1988		1984-88
CONTROLLER TYPE											CAGR:
	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	
Winchester	20,180	43.4	21,300	44.8	23,450	42.0	26,600	39.8	30,560	39.1	10.9%
Floppy	6,842	14.7	6,180	13.0	5,830	10.4	5,050	7.5	4,150	5.3	-11.7%
Tape	7,966	17.1	8,120	17.1	9,000	16.1	9,950	14.9	10,950	14.0	8.3%
Multifunction	11,493	24.7	11,950	25.1	17,600	31.5	25,300	37.8	32,400	41.5	29.6%
TOTAL REVENUES ($000)	$46,481	100%	$47,550	100%	$55,880	100%	$66,900	100%	$78,060	100%	13.8%
ANNUAL GROWTH RATE		--		2.3%		17.5%		19.7%		16.7%	

SOURCE: PERIPHERAL CONCEPTS, INC.

Peripheral Concepts



MULTIBUS CONTROLLERS

SHIPMENT SUMMARY

	<----------SHIPMENTS BY PRODUCT TYPE (000)---------->										
	ACTUAL		<---------- FORECAST ---------->								
	1984		1985		1986		1987		1988		1984-88
CONTROLLER TYPE											CAGR:
	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	
Winchester	14.1	36.0	15.6	38.0	18.1	35.6	22.3	34.4	27.1	34.3	17.7%
Floppy	8.6	21.9	8.2	20.0	7.8	15.4	6.6	10.2	5.4	6.8	-10.9%
Tape	6.4	16.3	6.7	16.3	8.6	16.9	10.9	16.8	12.3	15.6	17.7%
Multifunction	10.1	25.8	10.6	25.8	16.3	32.1	25.0	38.6	34.1	43.2	35.6%
TOTAL SHIPMENTS (000)	39.2	100%	41.1	100%	50.8	100%	64.8	100%	78.9	100%	19.1%
ANNUAL GROWTH RATE		--		5.0%		23.6%		27.6%		21.8%	

SOURCE: PERIPHERAL CONCEPTS, INC.

Peripheral Concepts

MULTIBUS CONTROLLERS

REVENUES BREAKDOWN BY DRIVE INTERFACE

	ACTUAL		FORECAST								
	1984		1985		1986		1987		1988		1984–88
INTERFACE TYPE											
Winchester Only:	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	
ST506	4,319	21.4	4,303	20.2	4,244	18.1	4,389	16.5	4,645	15.2	1.8%
ESDI	0	0.0	746	3.5	1,946	8.3	4,096	15.4	6,295	20.6	—
SMD	15,357	76.1	16,039	75.3	17,072	72.8	17,902	67.3	18,978	62.1	5.4%
Other	504	2.5	213	1.0	188	.8	213	.8	642	2.1	—
TOTAL REVENUES ($000)	$20,180	100%	$21,301	100%	$23,450	100%	$26,600	100%	$30,560	100%	10.9%
ANNUAL GROWTH RATE		—		5.6%		10.1%		13.4%		14.9%	
Tape Only	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	
QIC	709	8.9	926	11.4	1,215	13.5	1,582	15.9	1,500	13.7	20.6%
Pertec	7,058	88.6	6,934	85.4	7,470	83.0	7,761	78.0	7,709	70.4	2.2%
Other	199	2.5	260	3.2	315	3.5	607	6.1	1,741	15.9	72.0%
TOTAL REVENUES ($000)	$7,966	100%	$8,120	100%	$9,000	100%	$9,950	100%	$10,950	100%	8.3%
ANNUAL GROWTH RATE		—		1.9%		10.8%		10.6%		10.1%	

SOURCE: PERIPHERAL CONCEPTS, INC.

Peripheral Concepts

THE VMEBUS HOST INTERFACE

Introduction

Before the mid-seventies, computers were designed around proprietary interfaces. The era of the so called "open architecture" did not begin until the advent of microprocessors. These powerful devices made computers more affordable, opening up many new applications. To aid the development of new microprocessor-based products, semiconductor vendors often provided development systems. The interfaces used on these systems were usually placed in the public domain. Many system integrators and after-market suppliers eventually developed their own products based on these interfaces. Intel Corporation's Multibus was the first such "open architecture" with its roots in a microprocessor development system.

The VMEbus is a second generation microcomputer interface. Like the Multibus, it was initially defined by a microprocessor manufacturer, Motorola Semiconductor Products in Phoenix, Arizona. The predecessor of the VMEbus is known as VERSAbus. This interface was first promoted by Motorola in 1978 as a system bus for the MC68000 microprocessor development system. VERSAbus was designed to take advantage of powerful architectural features of the 16 bit MC68000 microprocessor, and to provide an easy migration path to upcoming 32-bit systems.

The VMEbus was actually born as a result of the European effort to promote a physical board standard (IEC297-3) for use within the EEC.

Peripheral Concepts

In 1980, Motorola in Munich, Germany worked actively to define a version of VERSAbus to fit within the popular Eurocard format. In 1981, this bus was formally announced as the Versa Module Europe, or VME, at the Hanover Fair in Munich. The final bus specifications for the VME were jointly developed by Motorola, Mostek, Signetics (Philips), and Thomson-EFCIS. Standardization of the VMEbus via IEEE is currently being pursued by the P1014 committee.

The VMEbus has quickly gained popularity in Europe. Most initial products that first appeared in the early eighties, were primarily for industrial process control applications. In the United States, VME is just beginning to make its mark. The "generic" products, such as Single Board Computers (SBCs) and memories, were the first to emerge. There are now many "application-specific" products. By the end of 1985, over a hundred vendors will be supplying various components for VME systems worldwide. A user/vendor group has also been formed in the U.S. (V.I.T.A.) to further promote the market for VMEbus products.

VME carries no patents or trademarks. The specifications are not copyrighted. Anyone can use the VMEbus to develop new products without obtaining a license or paying any royalty fees.

The size of today's VME controller market is small, but growth projections are impressive: As with any emerging standard, there is some confusion about the capabilities of the VMEbus. To help understand the pros and cons, a detailed technical discussion of the VMEbus architecture has been included in the following section.

Technical Characteristics

Figure 4.1 depicts the various signals of the VMEbus. A single wide VME board uses one 96 pin DIN connector (P1). All data and control lines for a 16 bit VME system reside on this connector. A dual wide board has an additional connector (P2) which allows expansion to a 32 bit system. Functionally, VMEbus signals can be divided into four categories - Data Transfer Bus, Arbitration Bus, Interrupt Bus, and Utility Bus.

Data and Address Paths: VME can support data paths of 8, 16 or 32 bits wide. Data is transferred over lines D00 thru D31. D00-D15 are on the P1 connector, whereas D16-D31 are on the P2 connector. The width of the data path is determined by the logic levels of LWORD, A01, DS0, and DS1 lines.

The address is transmitted over thirty two (A01 thru A31) address lines. Twenty four of these lines are on P1 and the balance are on P2. An address of 16, 24, or 32 bits can be selected by manipulating the AM01-AM05 signals.

Peripheral Concepts

VMEbus Signals

<------ Connector P1 ------>				<------ Connector P2 ------>		
Row A	Row B	Row C	Pin	Row A	Row B	Row C
D00	BBSY-	D08	1	DB00	+5V	DB01
D01	BCLR-	D09	2	DB02	GND	DB03
D02	ACFAIL-	D10	3	DB04	RES	DB05
D03	BG0IN-	D11	4	DB06	A24	DB07
D04	BG0OUT-	D12	5	DB08	A25	DB09
D05	BG1IN-	D13	6	DB10	A26	DB11
D06	BG1OUT-	D14	7	DB12	A27	DB13
D07	BG2IN-	D15	8	DB14	A28	DB15
GND	BG2OUT-	GND	9	DB16	A29	DB17
SYSCLK	BG3IN-	SYSFAIL-	10	DB18	A30	DB19
GND	BG3OUT-	BERR-	11	DB20	A31	DB21
DS1-	BR0-	SYSRESET-	12	DB22	GND	DB23
DS0-	BR1-	LWORD-	13	DB24	+5V	DB25
WRITE-	BR2-	AM5-	14	DB26	D16	DB27
GND	BR3-	A23	15	DB28	D17	DB29
DTACK-	AM0	A22	16	DB30	D18	DB31
GND	AM1	A21	17	READ	D19	RES
AS-	AM2	A20	18	IRQ-	D20	RES
GND	AM3	A19	19	LWORD/A12	D21	RES
IACK-	GND	A18	20	A02/A14	D22	A01/A13
IACKIN-	SERCLK	A17	21	A04/A16	D23	A03/A15
IACKOUT-	SERDAT	A16	22	A06/A18	GND	A05/A17
AM4	GND	A15	23	A08/A20	D24	A07/A19
A07	IRQ7-	A14	24	A10/A22	D25	A09/A21
A06	IRQ6-	A13	25	RES	D26	A11/A23
A05	IRQ5-	A12	26	RES	D27	LAS-
A04	IRQ4-	A11	27	RES	D28	UAS-
A03	IRQ3-	A10	28	RES	D29	UDS-
A02	IRQ2-	A09	29	RES	D30	LDS-
A01	IRQ1-	A08	30	RES	D31	DERR-
-12V	+5VSTDBY	+12V	31	SMACKIN-	GND	ACK-
+5V	+5V	+5V	32	SMRQ-	+5V	SMACKOUT-

Figure 4.1
VMEbus Signals

The address and data lines are physically separate signals and are not "multiplexed" on the VMEbus. In a multiplexed system, both data and address are transmitted over the same physical lines during different time intervals. The advantage of a multiplexed system is that it can be implemented using fewer connector pins, but the transfer rate (speed) for multiplexed systems can degrade under certain conditions.

VME is an asynchronous bus which simply means that data, address, and control lines are considered valid on their own edges, and are not qualified with a system clock. Asynchronous protocol enables the VME to be throttled at high speeds without setting any top limit for bus frequency. Thus, the speed at which information can flow over the VMEbus depends upon the speed of the individual boards taking part in the data transfer.

This does not mean that an asynchronous bus has no limitations on speed. There are two limiting factors. The first is a finite set-up, propagation, and access time associated with individual components. This limitation can improve with the selection of faster components. The second factor involves delays associated with the backplane signal paths and capacitances. This is difficult to improve upon, and sets a theoretical speed limit of 57.1 Megabytes/second for the VMEbus. The practical limit using today's chip technology, is about 30 Megabytes/sec. Asynchronous systems in general, are more susceptible to noise spikes on control lines.

Peripheral Concepts

Arbitration: In a multi-processing environment, there is more than one "Master" that can gain control of the bus. The protocol that determines how the control of the bus will be granted to a requesting device is called arbitration. The VME has a "centralized" arbitration scheme. Under this scheme, there is only one global "Arbiter" per system. This Arbiter determines which of the requesting boards ("Requester") will become the next Master. The Arbiter is located in slot one of the VMEbus and is often combined with the CPU board.

There can be up to 20 boards capable of becoming Masters. Each one of these boards must have the intelligence circuits to request bus control. Thus, each master has a Requester on-board. The VMEbus defines two types of Requesters - Release When Done (RWD) and Release On Request (ROR). The RWD Requester will keep control of the bus until a Master completes an operation. The ROR type Requester will relinquish bus control when another Master requests it. The user can implement the Requester scheme that will best suit the functional importance of a given board.

There are also three types of Arbiters - Priority, Round Robin, and Single Level. A priority Arbiter monitors the four Bus Request lines (BR0-BR3) and grants the bus to the Requester with the highest priority. A Requester with BR0 has the lowest priority. The Arbiter grants the bus by activating one of the Bus Grant In (BG0IN-BG3IN) lines. The Requester accepts bus control by activating a corresponding Bus Grant Out (BG0OUT-BG3OUT) line. If two boards are wired for the same priority, then the board closest to slot 1 in the daisy chain will gain bus control.

A Round Robin Arbiter assigns bus mastership based upon a rotating priority. Thus if the current Master is BR"N", then the next master will be BR"N-1", and the next will be BR"N-2" and so on. In this scheme, each master has an equal opportunity to gain access to the bus, making it useful for time-sharing applications.

A Single Level Arbiter monitors only the BR3 request line. When the Arbiter detects an active BR3, it grants the bus by activating BG3IN. Since the BGxIN lines are daisy chained, BG3 propagates through the chain and allows individual boards to respond with a BG3OUT. Thus, the board physically closest to slot 1 always has a higher priority, whereas the board in slot 20 has the lowest.

The drawbacks of a centralized arbitration structure such as the one described above, is that it limits the number of discrete arbitration levels. Often times, the ability of a board at the bottom of the daisy chain to gain bus control is restricted. Centralized arbitration also requires dedicated Arbiter hardware in slot one. But once in place, it need not be duplicated on each board.

Interrupt Handling: When a system component performing a task needs that task to be serviced, it "interrupts" the system. The system then must recognize an interrupt and respond to it. An interrupt can be handled in two different ways: by providing dedicated hardware that will process all interrupt requests, or by passing a messege block between bus Masters and letting them respond to the request. The VMEbus uses the dedicated interrupt hardware method.

Interrupt handling works similar to arbitration. The Interrupt handler monitors seven Interrupt Request lines (IRQ1-IRQ7). Each board designed to interrupt ("Interrupter"), has its own IRQx line. The board with IRQ7 has the highest priority. If the bus can be released, the Handler activates Interrupt Acknowledge (IACK), followed by other handshaking to complete a message transfer. The Interrupt Handler can be configured either as a Single or Distributed handler. The Distributed Handler supports anywhere from two to seven Handlers. Each Handler in turn, can take care of one or more IRQ lines.

Utilities: The utility portion of the system bus contains power (+5V/3A, +12V/1A, and -12V/1A) along ground lines, System Clock, System Reset, and AC Fail lines. These signals provide power, timing, and diagnostics functions for the system.

Mechanical: The VME system employs a "pin and socket" method for connection to the backplane. It is the Eurocard form factor. A "single" board is 100mm x 160mm and a "dual" board is 233.3mm x 160mm in size. A variety of compatible board lengths and depths have been developed for different applications.

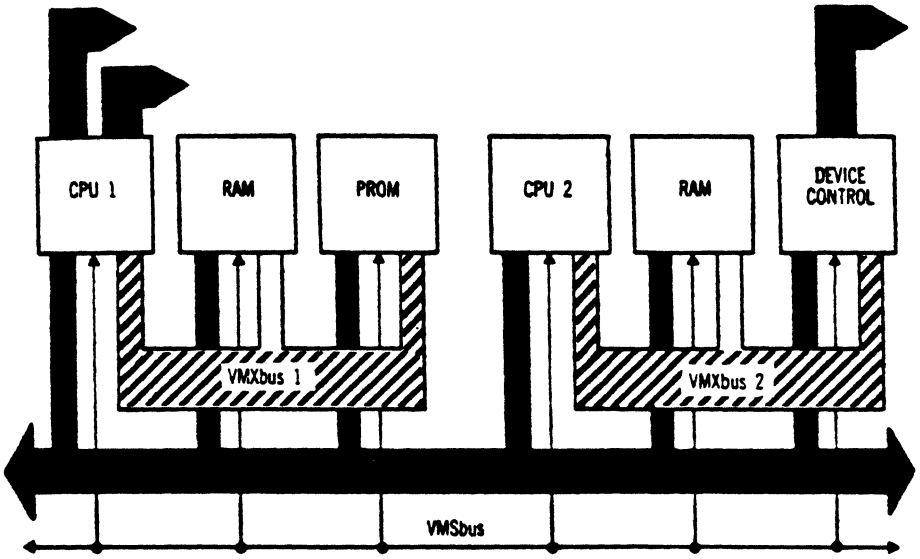


Figure 4.2

Secondary Busses: In addition to the system bus, two additional busses, the VMX and the VMS have been defined. A typical system configuration is shown in Figure 4.2.

The VME Memory Expansion (VMX) bus is a high speed parallel bus that provides a private data path between the processor and memory. Use of the VMX for CPU to memory data transfers can help off-load the system bus. Only one primary Master (usually a CPU) and one secondary Master (usually a DMA board) are allowed on the VMX. Up to six functional modules can be

Peripheral Concepts

connected in each VMX group. A typical example of a VMX group is a CPU, RAM board, a mass storage controller with DMA, and a CRT controller.

Functionally, VMX is very similar to the VMEbus. It allows up to 32 bit data transfers, but there are only twelve address lines. These can be multiplexed for a total of 24 address bits, accessing up to 16 Megabytes of memory. VMX has no interrupt handling capability, but this will probably be added in the future.

The VMS is a serial bus. It provides an alternate communication path between system modules. It is not intended to replace local area networking, which allows transmission over much longer distances. VMS uses only two lines, clock and data. It can support speeds up to 3 Megabits/second running along a cable or a backplane.

The VMS is a "self arbitrating" bus. When a device wishes to transmit over the VMS, it sends the bits and also monitors the data. If other devices are also transmitting at that time, the data will collide. Thus, the data transmitted will be different than the data monitored. When this happens, the transmitting device will back off and try again until no collisions are detected.

As a local communications or "party line" bus, the VMS makes more bandwidth available for the system bus. It can also be used to implement diagnostics and fault tolerance. If a module malfunction is detected, that module can be disconnected via the VMS bus without crippling the entire operation of the system bus.

Product Definition

Products and forecasts within this category refer to controller board-level products that use the VMEbus as the host interface and various peripheral interfaces for mass storage control. Examples of products and manufacturers in this category include:

Basu Inc.	FDC01, FDC02
Data-Sud Systems	FDCONT-1, HDCONT-1
Dual Systems	V9TRK, Optimatrack
DY-4 Systems	DVME 712/715, SVME 716
Elect Modular Systems	MTC-1, HD-1
Force Computer	SYS68K/WFC-1
General Micro Systems	GMS V09
Hamilton Std Digital Systems	MK 75803, 75805
Integrated Solutions	VME-QIC2/8
Interphase	V/SMD 3200, V/TAPE 3209
Ironics	IV-3275
Microproject	7509-7, 7550-2
Mini Computer Technology	MCT 6020, 6090, 6600, 6700
Mizar	VME 7400, 8400
Motorola	MVME 3XX Series, MVME 435A
Plessey Microsystems	PME WFC-1
Sigen	DC-5, DC-7
Signetics	SMVME 4300A
Xylogics	715, 772

Peripheral Concepts

Market Trends

Peripheral Concepts estimates the total VMEbus controller market to be:

	1984	1985	1986	1987	1988
REVENUES ($)	5,538K	8,449K	13,981K	27,694K	52,038K
SHIPMENTS	5.04K	7.45K	12.02K	23.62K	45.86K

The VMEbus mass storage controller market was virtually non-existent in 1983. In 1984, over 5,000 controller boards were shipped. The market will continue to grow this year, and experience an even stronger growth in 1986. During 1985 to 1986, revenue growth will be an impressive 65.5%, followed by an even steeper 98.1% gain in 1986-1987. The market will grow at a slightly slower rate of 87.9% in the 1987-1988 period. But from 1984 to 1988, there will be close to a ten fold increase in the size of the market, from $5.5 Million in 1984 to over $52 Million in 1988. This represents a compound annual growth rate of 75.1%, making VME controllers one of the fastest growing segments in the controller business.

Unit shipments will also exhibit strong growth. This year, nearly 7.5K units will be shipped, an increase of 47.8% over last year. In 1987, we expect the year-to-year growth rate to peak at 96.5%, with shipments totalling 23.6K units. Nearly 46K units will be shipped in 1988. CAGR during the 1984-88 period is estimated at 73.7%. This rate is about equal to the revenue growth for the same period. Generally speaking, shipments grow at a faster rate than the revenues, indicating a decline in prices as volumes go up. In the case of VME though, a change in product mix will

keep the shipments in line with revenue growth. A multifunction controller will replace two individual controllers, resulting in a slower net shipment growth.

Although the forecast for the next two years remains very upbeat for VME controllers, the real growth will actually occur in the following years. New design activities are in a high gear now, and this will result in the availability of new systems in 1986-1987 period. Engineering workstations using the VMEbus will also debut by that time, creating strong demand for mass storage controllers.

There will be little or no erosion in Average Selling Prices (ASP) during 1985 and 1986. VMEbus controllers are still not in volume production. In addition, controller suppliers will try to hold margins steady through next year. After that, competitive pressures will force the prices downwards. We expect ASPs for winchester controllers to drop by 20.6% during the 1986-88 period. For the same period, multifunction controller prices will drop by a more modest 12.3%.

A changing product mix will keep the average ASP stable through 1988. Two high priced controller categories, winchester only and multifunction, will both increase their share of the market during the 1984-88 period, keeping average prices higher. In general, VME controllers will remain more performance-oriented than price-sensitive. Although the price/performance ratio will continuously improve during the next few years, a severe decline in average selling prices is unlikely.

Peripheral Concepts

Winchester-only controllers generated 23.9% of revenues in calender 19:, mostly from the lower-end ST506 type controllers. With the introductio of controllers for new generations of disk drives (expected early next year), the growth for the winchester-only category will reach 95.3% in 1985-1986, and 110.6% in the following year.

Tape controllers made up a relatively small (7.5%) of the total controllers shipped in 1984. The growth for 1985 will continue at a modest 35.6%. But the availability of more and more tape products will cause the tape-only category to grow at an estimated 86.2% rate in 1986, and at even higher rates in the subsequent years. Cartridge tape controllers accounted for 55% of the 1984 shipments of tape-only products. The future growth of cartridge tape controllers will however, be limited, as high-end VME systems begin using more 9 track drives.

Floppy-only controllers took the lion's share of the 1984 VMEbus market. They accounted for approximately 60% of all units shipped, generating 43.5% of the total revenues for this segment. It is not unusual for this emerging market, because most initial systems are equipped with only a floppy disk drive. Stand-alone floppy controllers will continue to grow at a healthy rate over the forecast period. Unit shipments will grow 86.5% from 1985 through 1987. Revenues will grow 67.1% during the same period, reflecting a growing decline of prices. As the floppy control function is integrated on multifunction boards, the growth of floppy-only controllers will slow down considerably beyond 1987. Revenues for floppy-only controllers will actually peak in 1988 and then decline rapidly.

Multifunction controllers accounted for 25% of all controllers shipped in 1984. All existing multifunction controllers support the 5-1/4 inch ST506 class of winchester and the SA460 type floppy disk drive. Availability of a wider variety of multifunctions (in particular, disk/tape controllers), will spur additional market growth beyond 1986. We expect multifunction controller revenues to grow at 146.1% rate in 1986-1987. In 1988, multifunction revenues will surpass those of winchester-only controllers. Nearly 40% of the total revenues will come from multifunction products.

Most VME controllers are currently being manufactured by system suppliers. Some of these controllers were primarily evaluation tools and were not particularly optimized for performance. Some suppliers offered an SCSI (Small Computer System Interface) port, allowing the user to put together a system using readily available SCSI controllers. Many companies gained a quick entry by acquiring controller products through licensing. For example, Plessey Microsystems marketed Force Computers' products under private label. Interphase Corporation and Hamilton Standard Digital Systems (formerly Mostek) co-developed an SMD disk controller that is also being marketed by Motorola. Controllers sold by companies such as Force, Data-Sud, Electronic Modular Systems and others are designed and/or produced in Europe.

The new entrants into the VME controller market will continue to be current suppliers of Multibus controllers. Xylogics, Interphase, Minicomputer Technology, and Central Data have announced VME products. For these companies, it is a logical extension of their traditional business. With their expertise in high performance controllers and

Peripheral Concepts

established distribution channels, they will change the character of the VMEbus controller market over the next few years.

Like the Multibus, VME is also a system integrator's bus and will remain so in the future. Over 76% of VME controllers last year were sold to system integrators. These companies in turn, put together value-added systems and sold to end users. The remaining 24% of controllers were sold through distributors and sales representatives. These shares will not change significantly in 1985, but during the 1986 and 1987 period, controller sales to OEM system integrators will increase to 79% and 84%, respectively.

Technology Trends

So far, no firm architecture has emerged for VMEbus controller designs. Indeed, most initial "controllers" were actually adapters for the popular SCSI bus. This provided a fast and convenient way to attach peripheral devices to VMEbus systems. The use of SCSI as a mass storage bus may be more than just an interim solution. Low and medium performance VME systems can greatly benefit by using SCSI. For example, a system with heavy bus traffic can perform disk/tape transfers over SCSI, thereby off-loading the system bus. Use of an I/O bus such as SCSI also saves "slots" that may be valuable for heavily loaded system configurations.

However, for very high performance applications, the use of an intermediate bus such as SCSI reduces efficiencies. Controllers which interface peripherals directly to the VMEbus will continue to offer the highest performance. The majority of controllers under development today fit into this category. New controllers will use an architecture similar to that used currently on Multibus-based controllers, consisting of microprocessors or bit-slices to create the basic "engine". This engine then has the capability to be used in a variety of different control functions.

The majority of winchester controllers in 1984 and 1985 were for smaller 5-1/4 inch disk drives with ST506 interface. Several controllers for Storage Module Drives (SMD) are being introduced later this year. These controllers will support data rates of 2.5 Megabytes/second and higher. In 1986, SMD disk controllers will dominate the winchester-only category.

Small disk drives with the ESDI interface are just emerging and will be available in volume by mid 1986. This will spur the demand for ESDI controllers. Nearly a quarter of the Winchester controllers shipped for the VMEbus in 1987 will use the ESDI interface.

Since VME supermicros will be used in applications requiring high performance, VME disk controllers must incorporate features that improve access time and reliability. Techniques such as on-board cache, DMA capability, and defect management will become typical features for VME disk controllers.

Tape controllers with the "Pertec" type interface (9 track tape drives) will gain considerable market share in 1986-1987, serving as companion products for SMD disk controllers. If standardization efforts on 1/2 inch tape cartridges (such as IBM's 3480) materialize, controllers for those drives will result in a strong market for VME.

The availability of higher density gate arrays and VLSI chips now allow implementation of multiple functions on a single board. Multifunction controllers supporting the winchester/floppy combination are available today, and winchester/tape combinations will appear by mid 1986. Most disk/tape controllers will continue to support small winchesters (ST506 or ESDI) and 1/4" cartridge tape drives. The SMD disk/9 track tape combination will not be very popular because of the need to maximize performance at the high end.

Unix and its derivatives have an early lead as the operating system of choice for VME. Unix System V is particularly popular. Some vendors also

offer the CP/M-68K operating system. If Unix indeed becomes the dominant operating system, it will solve many compatibility issues that have plagued other busses similar to VME.

Most VME systems today are based on the 68000 microprocessor family. This will continue to be the case. There are some interesting exceptions, though. Some VME systems have been built using other microprocessors including DEC's J-11 chip set. This approach however, will be limited to applications where dual compatibility is required.

Competing Technologies

The most direct competitor for the VMEbus is Multibus-II. Ever since the VMEbus was first introduced, it has been a subject of comparison and debate with the Multibus-II. While both busses are well suited to serve the potentially large market for next generation super microcomputers, VMEbus has taken an early lead over Multibus-II. In order for the VMEbus to maintain that lead, a lot of things will have to fall in place over the next couple of years.

To compete effectively, the VMEbus must continue to win key design-ins in the 32 bit microcomputer market. It is important to note that it wasn't necessarily the technical superiority that generated early momentum for VME, Rather it was the lack of support for Multibus-II. There is a large installed base of Multibus-I users, and they will require solid technical reasons to switch to a new architecture. Semiconductor support and applications software are two areas where VME faces a "catch-22" situation. Up front investments must be made to develop LSI devices as well as applications software, but the volume has not been established to justify the expense. Without these, the market will not grow. But overall, the VMEbus is well positioned to win the Multibus-II battle.

A significant portion of the supermicro and low-end minicomputer market is controlled by Digital Equipment's Q-bus. The Q-bus is currently positioned in a higher priced market than VME and poses no immediate threat. However, new Q-bus systems such as the MicroVAX are aggressively priced and have the potential to compete directly with VME predicated

upon further price cuts. Initially, DEC will target the MicroVAX marketing effort towards existing Q-bus users, who have an investment in DEC software and add-ons. During this window, the VME must consolidate its position so that it can co-exist with Q-bus systems. Any competitive product from IBM in the workstation market will threaten all contenders, and VME is no exception.

Other 32 bit busses such as the Futurebus and Texas Instrument's NuBus have failed to gain widespread support. The use of these busses will be limited to special applications, such as those in defense and artificial intelligence. We don't expect these busses to compete in the general purpose super microcomputer market in the future.

Key Assumptions

- A growing availability of VME systems will fuel the growth of controllers over the next three years.
- Competition from Multibus-II and MicroVAX products will impact the rate of growth in 1987-1988.
- The proliferation of multifunction controllers will slow down overall shipment growth in 1986-1987 and cause slower price erosion of average selling prices.

CALENDER 1984 MARKET SHARES
REVENUES BY MANUFACTURER

MANUFACTURER	MARKET SHARE (%)
Motorola	31.6
Force Computer	20.7
Hamilton Std Dig Sys	12.0
Data-Sud	8.9
Signetics	4.1
OTHER	22.7
TOTAL	100.0 %

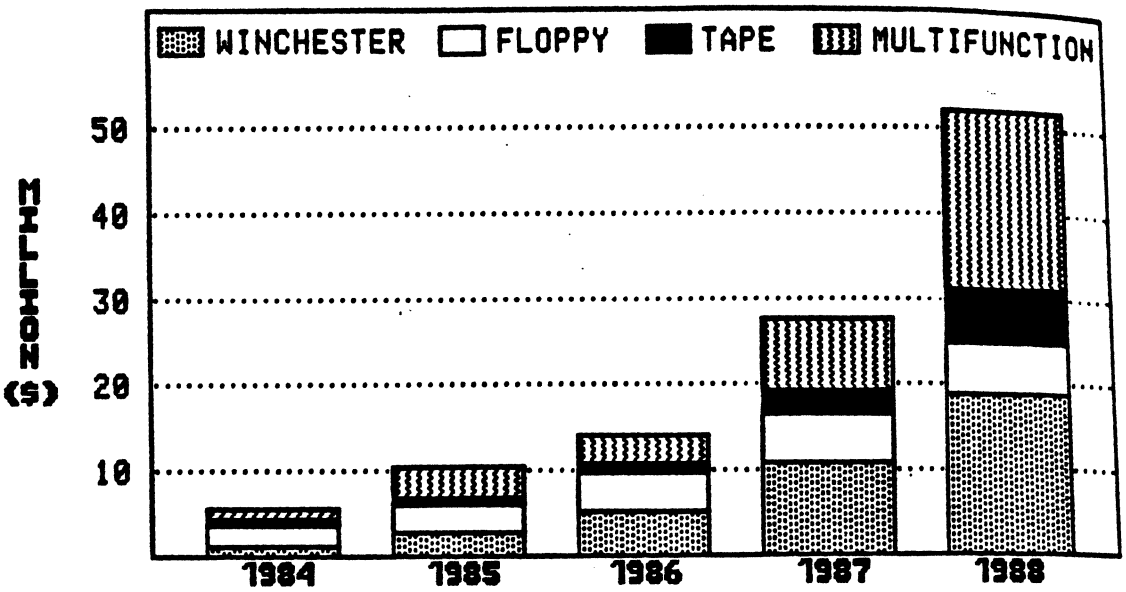
arket Share Analysis

Like any other emerging business, the VMEbus controller market was severely fragmented in 1984. Although Motorola and Force Computer commanded over half the 1984 revenues, controllers still represented a small portion of each company's business. No one supplier made a push to become the leader in VME controller products during 1984. The infant state of the market is also evident from the fact that 22.7% of revenues were generated by a number of small companies whose individual contribution was less than four percent each.

Market shares for 1984 must be viewed with the above facts in mind. When a market is new, constantly changing and fragmented, the numbers could be misleading. As the VMEbus controller market matures over the next couple of years, market shares will become more stable.

For 1985, the picture will hardly change. New players in the VMEbus controller market have not yet made an impact. Towards the early part of next year, companies like Xylogics and Interphase will begin volume shipments, considerably changing the structure of the market. Independent controller houses will begin to establish market leadership positions, replacing system manufacturers currently in that role. Over the next year, key OEM contracts for VME system components will be awarded. At that time, the long term market leaders will emerge.

Peripheral Concepts

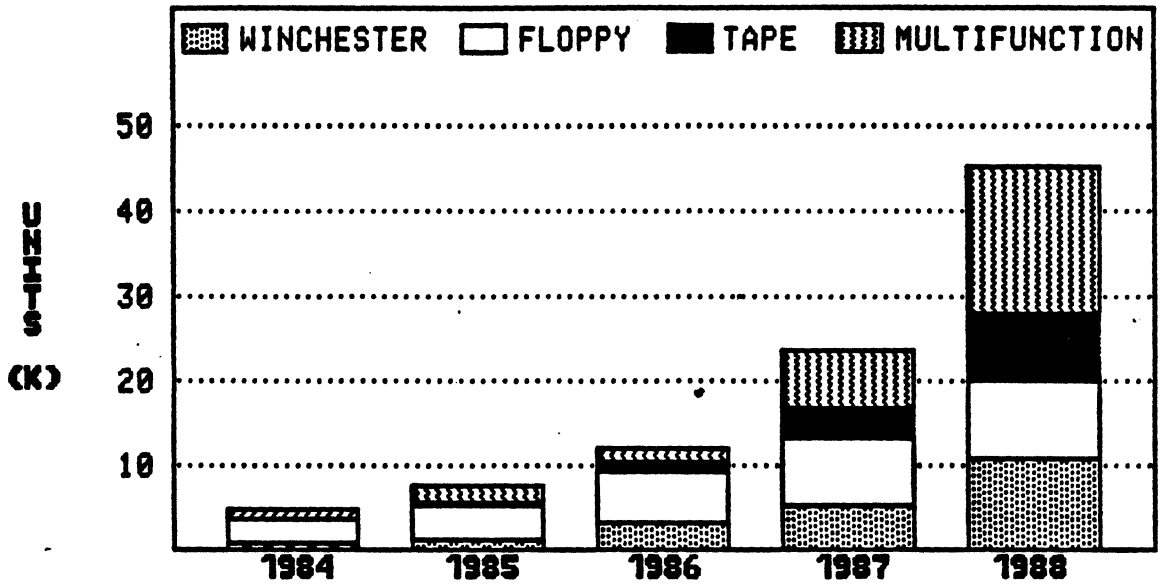


VMEbus CONTROLLERS

REVENUE SUMMARY

	<——REVENUES BY PRODUCT TYPE ($000)——>										
	ACTUAL		<—— FORECAST ——>								
	1984		1985		1986		1987		1988		1984-88
CONTROLLER TYPE											CAGR:
	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	
Winchester	1,324	23.9	2,579	30.5	5,036	36.0	10,607	38.3	18,976	36.5	94.6%
Floppy	2,411	43.5	3,356	39.7	4,408	31.5	5,611	20.3	5,960	11.5	25.4%
Tape	418	7.5	567	6.7	1,056	7.6	2,909	10.5	6,370	12.2	97.6%
Multifunction	1,385	25.0	1,947	23.0	3,481	24.9	8,567	30.9	20,732	39.8	96.7%
TOTAL REVENUES ($000)	$5,538	100%	$8,449	100%	$13,981	100%	$27,694	100%	$52,038	100%	75.1%
ANNUAL GROWTH RATE		—		52.6%		65.5%		98.1%		87.9%	

SOURCE: PERIPHERAL CONCEPTS, INC.



VMEbus CONTROLLERS

SHIPMENT SUMMARY

	← SHIPMENTS BY PRODUCT TYPE (000) →										
	ACTUAL		← FORECAST →								
	1984		1985		1986		1987		1988		1984-88
CONTROLLER TYPE											CAGR:
	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	UNITS(K)	(%)	
Winchester	.6	10.9	1.1	13.9	2.3	17.7	5.4	21.1	11.1	22.5	107.4%
Floppy	3.0	54.5	4.3	54.4	6.0	46.2	8.0	31.2	9.3	18.9	32.7%
Tape	.5	9.1	.6	7.6	1.2	9.2	3.6	14.1	8.2	16.6	101.2%
Multifunction	1.4	25.5	1.9	24.1	3.5	26.9	8.6	33.6	20.7	42.0	96.1%
TOTAL SHIPMENTS (000)	5.5	100%	7.9	100%	13.0	100%	25.6	100%	49.3	100%	73.0%
ANNUAL GROWTH RATE		—		43.6%		64.6%		96.9%		92.6%	

SOURCE: PERIPHERAL CONCEPTS, INC.

Peripheral Concepts

VMEbus CONTROLLERS

REVENUES BREAKDOWN BY DRIVE INTERFACE

	← REVENUES BY PRODUCT TYPE ($000) →										
	ACTUAL		← FORECAST →								
	1984		1985		1986		1987		1988		
INTERFACE TYPE											
Winchester Only:	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	
ST506	1,282	96.8	2,396	92.9	3,535	70.2	5,091	48.0	7,609	40.1	56.3
ESDI	0	0.0	0	0.0	317	6.3	1,676	15.8	4,270	22.5	-
SMD	42	3.2	183	7.1	1,183	23.5	3,702	34.9	6,338	33.4	250.7
Other	0	0.0	0	0.0	0	0.0	138	1.3	759	4.0	-
TOTAL REVENUES ($000)	$1,324	100%	$2,579	100%	$5,035	100%	$10,607	100%	$18,976	100%	94.6%
ANNUAL GROWTH RATE		—		94.8%		95.2%		110.7%		78.9%	
Tape Only	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	REV($K)	(%)	
QIC	230	55.0	264	46.6	339	32.1	736	25.3	1,522	23.9	60.4%
Pertec	180	43.1	285	50.3	660	62.5	1,969	67.7	4,032	63.3	117.6%
Other	8	1.9	18	3.2	57	5.4	204	7.0	815	12.8	217.7%
TOTAL REVENUES ($000)	$418	100%	$567	100%	$1,056	100%	$2,909	100%	$6,369	100%	97.6%
ANNUAL GROWTH RATE		—		35.6%		86.2%		175.5%		118.9%	

SOURCE: PERIPHERAL CONCEPTS, INC.

PRODUCT MATRIX

This section details manufacturer's products which are in production or will enter production before the first quarter of 1986. The products are segmented into DEC, Minicomputer, Multibus I/II and VMEbus sections. Within each section, products are alphabetized by manufacturer.

Although most current controller products are listed, those being phased out of production have been omitted. Likewise, products for which the manufacturer could not supply pricing have not been included since these products may be too new for availability data or are sold only on a custom basis.

The product data presented here has been compiled from manufacturer's specifications and/or phone inquiry to personnel at each company. We have checked all data for accuracy. Inevitably, ommissions and/or errors occur. If such is the case, please contact us, so we can correct them prior to the next edition.

Within each category, products are classified as Winchester-only, Tape-only, Floppy-only or Multifunction. Use the following guidelines while interpreting individual categories.

Drive Characteristics

Type of interface used, maximum number of drives supported, sector sizes and error detection/correction techniques are listed. For tape drives, "Pertec" interface implies industry standard 9 track reel type drives, with or without formatter. If the controller supports formatted drives, error detection and correction carry "In The Formatter" comment.

Host Characteristics

Identifies the host computer bus, size of buffer and interleave factor for disk sectors.

For DEC controllers, type of DEC bus (Q Bus/Unibus), supported and model numbers of DEC products emulated are listed. For Minicomputer, name of the computer company and the computer bus supported by the controller are listed.

For Multibus and VMEbus, level of bus support, such as width of data and address paths supported by the controller is listed.

Physical Characteristics

Physical size of the board and power requirements are listed in this section. The following form factors apply :

DEC:

Dual Width Board -	5.22" W x 8.9" L x 0.5" H (2 Connectors)
Quad Width Board -	10.44" W x 8.9" L x 0.5" H (4 Connectors)
Hex Width Board -	15.70" W x 8.9" L x 0.5" H (6 Connectors)

Minicomputer:

Data General -	15.0" W x 15.0" L x 0.5" H
Perkin-Elmer -	15.0" W x 15.0" L x 0.5" H
Texas Instruments -	14.2" W x 10.8" L x 0.5" H

Multibus-I:	-	6.75" W x 12.0" L x 0.5" H
Multibus-II:	Single -	3.94" W x 8.66" L x 0.5" H (Eurocard)
	Dual -	9.18" W x 8.66" L x 0.5" H (Eurocard)
VMEbus:	Single -	3.94" W x 6.30" L x 0.5" H (Eurocard)
	Dual -	9.18" W x 6.30" L x 0.5" H (Eurocard)

Availability/Price: Current availability as of August 1985 and single piece or list prices are provided.

Comments: Some comments have been added for those controllers with characteristics that does not fit into the above categories. If a tape controller is simply a coupler, that fact is noted in the comments field.

MANUFACTURER	ADVANCED ELEC DESIGN	ADVANCED ELEC DESIGN	ADVANCED ELEC DESIGN	ANDROMEDA SYSTEMS
MODEL NUMBER	FLEX-02	WINC 05/05	WINC 05/08	SDC11
CONTROLLER TYPE	Floppy Only (8 Inch)	Multifunction (Winchester/Floppy)	Multifunction (Winchester/Floppy)	Winchester Only (5-1/4 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SA800	ST506, SA460	ST506, SA800	ST506
Maximum # Drives	2 Floppies	2 Winchesters, 2 Floppies	2 Winchesters, 2 Floppies	4 Winchesters
Sector Sizes -Bytes	256 Through 1K	128 Through 1K	128 Through 1K	Programmable
Error Detection	N/A	N/A	N/A	N/A
Error Correction	N/A	N/A	N/A	N/A
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Q Bus
DEC Emulation	RX01/02	RL01/02, RX02, RX50	RL01/02, RX02, RX50	RL02
Size of Buffer	N/A	N/A	N/A	N/A
Minimum Interleave	N/A	2:1 (Winchester)	2:1 (Winchester)	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One Dual Width Board	One Dual Width Board	One Dual Width Board	One Dual Width Board
Power Supply	+5V DC @ 3.5A Max +12V DC @ 0.1A Max	+5V DC @ 4.5A Max +12V DC @ 0.1A Max	+5V DC @ 4.5A Max +12V DC @ 0.1A Max	+5V DC @ 2.5A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$975/1's	$1,575/1's	$1,575/1's	$1,395/1's
COMMENTS				Block Mode DMA

Peripheral Concepts

MANUFACTURER	ANDROMEDA SYSTEMS	ANDROMEDA SYSTEMS	ANDROMEDA SYSTEMS	ANDROMEDA SYSTEMS
MODEL NUMBER	WDC11-B	WDC11-C	WDC11-D	RDC11
CONTROLLER TYPE	Multifunction (Winchester/Floppy)	Multifunction (Winchester/Floppy)	Multifunction (Winchester/Floppy)	Winchester Only (5-1/4" Fixed/Removable)
DRIVE CHARACTERISTICS				
Drive interface	SA1000/ST506 (Winch), SA800/450 (Floppy)	SA1000/ST506 (Winch), SA800/450 (Floppy)	SA1000/ST506 (Winch), SA800/450 (Floppy)	ST506
Maximum # Drives	4 Winch, 2 Floppies (Must Be Similar Type)	4 Winch, 2 Floppies (Must Be Similar Type)	4 Winch, 2 Floppies (Must Be Similar Type)	4 Winchesters
Sector Sizes -Bytes	128 Through 1K	128 Through 1K	128 Through 1K	128 Through 1K
Error Detection	N/A	N/A	N/A	N/A
Error Correction	N/A	N/A	N/A	N/A
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Q Bus
DEC Emulation	RK05 (Winchester), RX02 (Floppy)	RL01/02 (Winchester), RX02 (Floppy)	RP02 (Winchester), RX02 (Floppy)	MSCP, RD Type Winchester
Size of Buffer	N/A	N/A	N/A	N/A
Minimum Interleave	3:1	3:1	3:1	2:1
PHYSICAL CHARACTERISTICS				
Form Factor	One Dual Width Board	One Dual Width Board	One Dual Width Board	One Dual Width Board
Power Supply	+5V DC @ 2.7A Typ +12V DC @ 0.1A Max	+5V DC @ 2.7A Typ +12V DC @ 0.1A Max	+5V DC @ 2.7A Typ +12V DC @ 0.1A Max	+5V DC @ 2.5A Typ
Availability	Now	Now	Now	1Q 1985
OEM Price (U.S.)/QTY	$1,595/1's	$1,595/1's	$1,595/1's	$1,695/1's
COMMENTS				Block Mode DMA

FACTURER	ANDROMEDA SYSTEMS	AVIV	AVIV	AVIV
MODEL NUMBER	UDC11	TFC 925	TFC 825	DFC 907A
CONTROLLER TYPE	Multifunction (Winchester/Floppy)	Tape Only (9 Track)	Tape Only (9 Track)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	ST506, SA800/460	Pertec	Pertec	SMD
Maximum # Drives	4 Winch/Floppies In Any Combination	4 Tape Drives	4 Tape Drives	4 Winchesters
Sector Sizes -Bytes	128 Through 1K	Up To 64K	Up To 64K	Programmable
Error Detection	N/A	N/A (In The Formatter)	N/A (In The Formatter)	32 Bit ECC
Error Correction	N/A	N/A (In the Formatter)	N/A (In the Formatter)	11 Bit Burst
Flaw Skipping	N/A	N/A (Block Re-writes)	N/A (Block Re-writes)	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Unibus	Q Bus
DEC Emulation	MSCP, RX50 Floppy and RD Type Winchester	TS-11	TS-11	RH11/70 With RM02/05
Size of Buffer	N/A	N/A	16K	2K
Minimum Interleave	2:1	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One Dual Width Board	Single Hex Width Board	Single Hex Width Board	Single Quad Width Board
Power Supply	+5V DC @ 2.5A Typ	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max	+5V DC @ 6.5A Max -12V DC @ 0.7A Max
Availability	1Q 1985	2Q 1985	Now	Now
OEM Price (U.S.)/QTY	$1,795/1's	$2,800/1's	$2,800/1's	$2,850/1's
COMMENTS	Block Mode DMA	Tri Density Tape Coupler Up To 200 ips Speeds, Supports MicroVax	Tri Density Tape Coupler Up To 200 ips Speeds	

MANUFACTURER	AVIV	AVIV	AVIV	AVIV
MODEL NUMBER	DFC 907B	DFC 807A	DFC 807B	DFC 807C
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD	SMD (1.8 MBytes/sec)	SMD (1.8 MBytes/sec)	SMD (1.8 MBytes/sec)
Maximum # Drives	4 Winchesters	4 Winchesters	4 Winchesters	4 Winchesters
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Unibus	Unibus	Unibus
DEC Emulation	RK711 With RK07 Drives	RH11 With RM02/05	RK711 With RK07 Drives	RM03/05
Size of Buffer	2K	2K	2K	2K
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Hex Width Board	Single Hex Width Board	Single Hex Width Board
Power Supply	+5V DC @ 6.5A Max -12V DC @ 0.7A Max	+5V DC @ 7.0A Max -5V DC @ 0.7A Max	+5V DC @ 7.0A Max -5V DC @ 0.7A Max	+5V DC @ 7.0A Max -5V DC @ 0.7A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$2,850/1's	$3,600/1's	$3,600/1's	$3,600/1's
COMMENTS				Optimized For VAX 780

MANUFACTURER	AVIV	AVIV	AVIV	AVIV
MODEL NUMBER	DFC 808A	DFC 808B	DFC 607A	DFC 607B
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD (1.8 MBytes/sec)	SMD (2.4 MBytes/sec)	SMD (1.8 Mbytes/sec)	SMD (1.8 MBytes/sec)
Maximum # Drives	4 Winchesters	4 Winchesters	4 Winchesters	4 Winchesters
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Unibus	Unibus	CMI Bus	CMI Bus
DEC Emulation	RM02/05	RM02/05	RH750 With RM03/05	RH750 With RP06
Size of Buffer	8K	8K	6K	6K
Minimum Interleave	2:1	2:1	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Hex Width Board	Single Hex Width Board	Extended Hex Board	Extended Hex Board
Power Supply	+5V DC @ 7.0A Max -5V DC @ 0.7A Max	+5V DC @ 7.0A Max -5V DC @ 0.7A Max	+5V DC @ 9.0A Max -5V DC @ 0.7A Max	+5V DC @ 9.0A Max -5V DC @ 0.7A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$4,400/1's	$4,400/1's	$8,950/1's	$8,950/1's
COMMENTS			For Use With VAX-11/750 Computers	For Use With VAX-11/750 Computers

MANUFACTURER	AVIV	COMPUTER STORAGE TECH	COMPUTER STORAGE TECH	DISTRIBUTED LOGIC CORP (DILOG)
MODEL NUMBER	TFC 805	CC-300	TC-200	DQ 619
CONTROLLER TYPE	Tape Only (9 Track)	Tape Only (1/4 Inch Cartridge)	Tape Only (9 Track)	Floppy Only (5-1/4" Inch)
DRIVE CHARACTERISTICS				
Drive interface	STC 1953	QIC-02	Pertec	SA450
Maximum # Drives	4 Tape Drives	1 Tape Drive	4 Tape Drives	2 Floppies
Sector Sizes -Bytes	Up To 64K	512 Bytes	Up To 2K	256 Through 1K
Error Detection	N/A (In The Formatter)	N/A (In The Formatter)	CRC, Parity	N/A
Error Correction	N/A (In the Formatter)	N/A (In The Formatter)	Single Track (PE Only)	N/A
Flaw Skipping	N/A (Block Re-writes)	N/A (Block Re-writes)	N/A (Block Re-writes)	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Unibus	Q-Bus	Unibus	Q Bus
DEC Emulation	TM-11	TM-11	TM-11	RX02
Size of Buffer	4K FIFO	512 Bytes	64 Bytes	One Sector
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Hex Width Board	One Dual Width Board	Single Hex Width Board	One Dual Width Board
Power Supply	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max	+5V DC @ 8.5A Typ	+5V DC @ 2.3A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$9,100/1's	$1,800/1's	$3,000/1's	$895/1's
COMMENTS	Tri Density Tape Coupler Up To 125 ips Speeds	Supports 30/90 ips Tape Speeds	Supports NRZI/PE Tape Drives With 25-125 ips Speeds	Supports Double Sided/ Double Density Drives

MANUFACTURER	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)
MODEL NUMBER	DQ 419	DQ 342	DQ 132	DU 342
CONTROLLER TYPE	Floppy Only (8 Inch)	Tape Only (1/4 Inch Cartridge)	Tape Only (9 Track)	Tape Only (1/4 Inch Cartridge)
DRIVE CHARACTERISTICS				
Drive Interface	SA800/850	CDC Sentinel	Pertec	CDC Sentinel
Maximum # Drives	2 Floppies	2 Tape Drives	4 Tape Drives	2 Tape Drives
Sector Sizes -Bytes	256 Through 1K	N/A	Up to 2K	N/A
Error Detection	N/A	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)
Error Correction	N/A	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)
Flaw Skipping	N/A	N/A (Block Re-writes)	N/A (Block Re-writes)	In The Formatter
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Unibus
DEC Emulation	RX02	TS-11/TU80/TSV05	TS-11/TSV05	TS-11/TU80
Size of Buffer	N/A	N/A	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One Dual Width Board	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board
Power Supply	+5V DC @ 2.5A Max	+5V DC @ 3.5A Typ	+5V DC @ 4.0A Max	+5V DC @ 3.5A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$895/1's	$1,350/1's	$1,350/1's	$1,550/1's
COMMENTS		500KB/sec Tape Speeds	Tri Density Tape Coupler Up To 125 ips Speeds	500KB/sec Tape Speeds

MANUFACTURER	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)
MODEL NUMBER	DU 132	DU 130	DQ 130	DQ 330
CONTROLLER TYPE	Tape Only (9 Track)	Tape Only (9 Track)	Tape Only (9 Track)	Tape Only (1/4 Inch Cartridge)
DRIVE CHARACTERISTICS				
Drive interface	Pertec	Pertec	Pertec	Kennedy 6455
Maximum # Drives	4 Tape Drives	8 Tape Drives	8 Tape Drives	1 Tape Drive
Sector Sizes -Bytes	Up to 2K	Up to 2K	Up to 2K	N/A
Error Detection	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)
Error Correction	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)
Flaw Skipping	N/A (Block Re-writes)	N/A (Block Re-writes)	N/A (Block Re-writes)	In The Formatter
HOST CHARACTERISTICS				
DEC Bus Type	Unibus	Unibus	Q Bus	Q Bus
DEC Emulation	TS-11/TU80	TM-11	TM-11	TM-11/TS03
Size of Buffer	1K	N/A	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board
Power Supply	+5V DC @ 4.0A Max	+5V DC @ 3.5A Typ	+5V DC @ 4.0A Max	+5V DC @ 3.5A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,550/1's	$1,630/1's	$1,630/1's	$1,670/1's
COMMENTS	Tri Density Tape Coupler Up To 125 ips Speeds	Coupler For 12.5-125 ips NRZ/PE Formatted Drives	Coupler For 12.5-125 ips NRZ/PE Formatted Drives	

MANUFACTURER	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)
MODEL NUMBER	DQ 214	DQ 215	MV 342	DQ 656
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Tape Only (1/4 Inch Cartridge)	Winchester Only (5-1/4 Inch)
DRIVE CHARACTERISTICS				
Drive Interface	SMD	SMD	CDC Sentinel	ESDI
Maximum # Drives	2 Winchesters	2 Winchesters	1 Tape Drive	2 Winchesters
Sector Sizes -Bytes	Programmable	Programmable	N/A	128 Through 1K
Error Detection	56 Bit ECC	56 Bit ECC	N/A (In The Formatter)	CRC
Error Correction	11 Bit Burst	11 Bit Burst	N/A (In The Formatter)	32 Bit ECC
Flaw Skipping	Track Level	Track Level	In The Formatter	Track Level
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Q Bus
DEC Emulation	RL01/02	RK06/07	TK25 Format Compatible	RK06/07
Size of Buffer	One Sector	One Sector	1K FIFO	One Sector
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board	One Dual Width Board
Power Supply	+5V DC @ 3.5A Typ +12V DC @ 0.3A Typ	+5V DC @ 3.5A Typ +12V DC @ 0.3A Typ	+5V DC @ 4.0A Max	+5V DC @ 3.5A Typ +12V DC @ 0.3A Typ
Availability	Now	Now	Now	3Q 1985
OEM Price (U.S.)/QTY	$1,670/1's	$1,670/1's	$1,750/1's	$1,850/1's
COMMENTS		Micro PDP11 Compatible	Supports MicroVAX	

Peripheral Concepts

MANUFACTURER	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)
MODEL NUMBER	DQ 614	DQ 634	DQ 615	DQ 228
CONTROLLER TYPE	Winchester Only (5-1/4 Inch)	Winchester Only (5-1/4 Inch)	Winchester Only (5-1/4 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	ST506	ST506/DMA Systems	ST506	SMD (2 MBytes/sec)
Maximum # Drives	2 Winchesters	2 (One ST506 and/or One DMA Systems)	2 Winchesters	2 Winchesters
Sector Sizes -Bytes	Programmable	128 Through 1K	128 Through 1K	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	56 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	12 Bit Burst
Flaw Skipping	Track Level	Track Level	Track Level	Track Level
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Q Bus
DEC Emulation	RL01/02	RL01	RKQ6/07	RM02/05/80
Size of Buffer	One Sector	One Sector	One Sector	One Sector
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One Dual Width Board	One Dual Width Board	One Dual Width Board	Single Quad Width Board
Power Supply	+5V DC @ 3.5A Typ +12V DC @ 0.3A Typ	+5V DC @ 3.5A Typ +12V DC @ 0.3A Typ	+5V DC @ 4.0A Typ +12V DC @ 0.3A Typ	+5V DC @ 3.5A Typ +12V DC @ 0.3A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,885/1's	$1,885/1's	$1,950/1's	$2,090/1's
COMMENTS			Supprts Micro PDP-11	

MANUFACTURER	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)
MODEL NUMBER	DU 215	DU 142	MV 132	DQ 413
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Tape Only (9 Track)	Tape Only (9 Track)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD	Pertec	Pertec	Priam I/O
Maximum # Drives	2 Winchesters	4 Tape Drives	4 Tape Drives	2 Winchesters
Sector Sizes -Bytes	Programmable	Up to 2K	Up To 2K	Programmable
Error Detection	56 Bit CRC	N/A (In The Formatter)	N/A (In The Formatter)	In The Drive
Error Correction	11 Bit Burst	N/A (In The Formatter)	N/A (In The Formatter)	In The Drive
Flaw Skipping	Track Level	N/A (Block Re-writes)	N/A (Block Re-writes)	Track Level
HOST CHARACTERISTICS				
DEC Bus Type	Unibus	Unibus	Q Bus	Q Bus
DEC Emulation	RK06/07	TS-11/TU80	None	RP02/03
Size of Buffer	One Sector	4K	1K FIFO	One Sector
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board
Power Supply	+5V DC @ 3.5A Typ -15V DC @ 0.5A Typ	+5V DC @ 4.0A Max	+5V DC @ 4.0A Typ	+5V DC @ 3.5A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$2,090/1's	$2,150/1's	$2,310/1's	$2,375/1's
COMMENTS		Tri Density Tape Coupler Up To 125 ips Speeds	Supports MicroVAX	

MANUFACTURER	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)
MODEL NUMBER	DQ 414	DQ 120	DQ 226	MV 210
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Tape Only (7 or 9 Track)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	Priam I/O	Pertec	SMD (2.5 MBytes/sec)	SMD (1.9 MBytes/sec)
Maximum # Drives	2 Winchesters	4 Tape Drives	2 Winchesters	2 Winchesters
Sector Sizes -Bytes	Programmable	N/A	Programmable	Programmable
Error Defection	In The Drive	LRC, CRC	56 Bit ECC	56 Bit ECC
Error Correction	In The Drive	None	11 Bit Burst	11 Bit Burst
Flaw Skipping	Track Level	N/A	Track Level	Track Level
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Q Bus
DEC Emulation	RL01/02	TM-11	MSCP	"DM" Type Devices
Size of Buffer	One Sector	FIFO	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board
Power Supply	+5V DC @ 3.5A Typ	+5V DC @ 3.5A Max	+5V DC @ 4.7A Typ +12V DC @ 0.3A Typ	+5V DC @ 3.5A Typ +12V DC @ 0.3A Max
Availability	Now	Now	3Q 1985	Now
OEM Price (U.S.)/QTY	$2,375/1's	$2,425/1's	$2,500/1's	$2,675/1's
COMMENTS		800bpi NRZ Tape Only, Up to 112.5 ips Speeds	Micro PDP/VAX Compatible	Supports MicroVAX

MANUFACTURER	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)	DISTRIBUTED LOGIC CORP (DILOG)
MODEL NUMBER	DU 218	DQ 202A	DU 202A	DU 216
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD	SMD	SMD	SMD
Maximum # Drives	4 Winchesters	2 Winchesters	2 Winchesters	4 Winchesters
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Programmable
Error Detection	32 Bit ECC	N/A	N/A	32 Bit ECC
Error Correction	11 Bit Burst	N/A	N/A	11 Bit Burst
Flaw Skipping	N/A	Track Level	Track Level	Sector or Track Level
HOST CHARACTERISTICS				
DEC Bus Type	Unibus	Q Bus	Unibus	Unibus
DEC Emulation	RM02/05	RP02/03	RP02/03	RK06/07
Size of Buffer	1.5K	N/A	N/A	Six Sectors
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Hex Width Board	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board
Power Supply	+5V DC @ 7.5A Max -12V DC @ 0.6A Max	+5V DC @ 3.5A Typ +12V DC @ 0.3A Typ	+5V DC @ 3.5A Typ +12V DC @ 0.3A Typ	+5V DC @ 3.5A Typ -15V DC @ 0.5A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$2,725/1's	$2,830/1's	$2,830/1's	$4,950/1's
COMMENTS		LSI-11 Compatible	LSI-11 Compatible	

MANUFACTURER	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION
MODEL NUMBER	TC02	TC05	QT12	TC12
CONTROLLER TYPE	Tape Only (9 Track)	Tape Only (1/4 Inch Cartridge)	Tape Only (1/4 Inch Cartridge)	Tape Only (9 Track)
DRIVE CHARACTERISTICS				
Drive interface	Pertec	CDC Sentinel	QIC-02	Pertec
Maximum # Drives	4 Tape Drives	1 Tape Drive	1 Tape Drive	4 Tape Drives
Sector Sizes -Bytes	Up to 2K	512 Bytes	512 Bytes	Up to 2K
Error Detection	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter
Error Correction	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)
Flaw Skipping	N/A (Block Re-writes)	In The Formatter	N/A (Block Re-writes)	N/A (Block Re-writes)
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Unibus
DEC Emulation	TS-11	TS-11	TS11/TSV05	TS-11
Size of Buffer	N/A	3.5K	16K	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Quad Width Board	One Dual Width Board	Single Quad Width Board
Power Supply	+5V DC @ 5.0A Max	+5V DC @ 6.0A Max	+5V DC @ 3.0A Typ	+5V DC @ 5.2A Max
Availability	Now	Now	3Q 1985	Now
OEM Price (U.S.)/QTY	$1,200/1's	$1,200/1's	$1,300/1's	$1,400/1's
COMMENTS	Coupler For 25-125 ips NRZ/PE Drives, Supports MicroVAX & MicroPDP	Coupler For 8000bpi/55 ips Streaming Tape Drive	Supports MicroVAX and MicroPDP	Tri Density Tape Coupler Up To 125 ips Speeds

MANUFACTURER	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION
MODEL NUMBER	TC15	SC02/A Series	SC02/C Series	SC02/L Series
CONTROLLER TYPE	Tape Only (1/4 Inch Cartridge)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive Interface	CDC Sentinel	SMD	SMD	SMD
Maximum # Drives	1 Tape Drive	2 Winchesters	2 Winchesters	2 Winchesters
Sector Sizes -Bytes	N/A	Programmable	Programmable	Programmable
Error Detection	N/A (In The Formatter)	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	N/A (In The Formatter)	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A (Block Re-writes)	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Unibus	Q Bus	Q Bus	Q Bus
DEC Emulation	TS-11	RP11E Controller With RP02/RP03 Drives	RK611 Controller With RK06/07 Drives	RLV11/12 Controller With RL01/02 Drives
Size of Buffer	3.5K	512 Bytes	512 Bytes	512 Bytes
Minimum Interleave	N/A	3:1	3:1	3:1
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board
Power Supply	+5V DC @ 6.0A Max	+5V DC @ 5.7A Max	+5V DC @ 5.7A Max	+5V DC @ 5.7A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,400/1's	$1,500/1's	$1,500/1's	$1,500/1's
COMMENTS	Coupler For 8000bpi/55 ips Streaming Tape Drive			

MANUFACTURER	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION
MODEL NUMBER	TC03	QD01	SC03/BX	SC03/MS
CONTROLLER TYPE	Tape Only (9 Track)	Winchester Only (5-1/4 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	Pertec	ST506	SMD (1.8 MBytes/sec)	SMD (1.8 MBytes/sec)
Maximum # Drives	4 Tape Drives	2 Winchesters	2 Winchesters	2 Winchesters
Sector Sizes -Bytes	Up To 64K	512 Bytes	Programmable	Programmable
Error Detection	N/A (In The Formatter)	48 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	N/A (In The Formatter)	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A (Block Re-writes)	Sector Level	Sector Level	Sector Level
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Q Bus
DEC Emulation	TS-11 3.5K	MSCP	RM02/RM03/RM05, RM80, RP06	MSCP
Size of Buffer	N/A	16K	8K	12 Sectors
Minimum Interleave	N/A	1:1	1:1	1:1
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	One Dual Width Board	Single Quad Width Board	Single Quad Width Board
Power Supply	+5V DC @ 6.0A Max	+5V DC @ 2.6A Max	+5V DC @ 6.5A Max	+5V DC @ 6.5A Max
Availability	3Q 1985	3Q 1985	Now	3Q 1985
OEM Price (U.S.)/QTY	$1,600/1's	$1,650/1's	$1,800/1's	$2,000/1's
COMMENTS	Tri Density Tape Coupler To 125 ips Speeds, Micro VAX & MicroPDP Support	Supports MicroVAX and MicroPDP		

MANUFACTURER	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION
MODEL NUMBER	TC13	SC12/A Series	SC12/C Series	SC12/L Series
CONTROLLER TYPE	Tape Only (9 Track)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive Interface	Pertec	SMD	SMD	SMD
Maximum # Drives	4 Tape Drives	2 Winchesters	2 Winchesters	1-2 Depending on Model
Sector Sizes -Bytes	Up Tp 64K	Programmable	Programmable	Programmable
Error Detection	N/A (In The Formatter)	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	N/A (In The Formatter)	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A (Block Re-writes)	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Unibus	Unibus	Unibus	Unibus
DEC Emulation	TS-11	RP11E Controller With RP02/03 Drives	RK611 Controller With RK06/07 Drives	RLV11/12 Controller With R101/02 Drives
Size of Buffer	3.5K	1K	1K	1K
Minimum Interleave	N/A	3:1	3:1	3:1
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board
Power Supply	+5V DC @ 5.2A Max	+5V DC @ 5.7A Max	+5V DC @ 5.7A Max	+5V DC @ 5.7A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$2,000/1's	$2,800/1's	$2,800/1's	$2,800/1's
COMMENTS	Tri Density Tape Coupler Up To 125 ips Speeds			

MANUFACTURER	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION
MODEL NUMBER	SC12/V Series	SC21/B Series	SC21/C Series	SC21/V Series
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD	SMD	SMD	SMD
Maximum # Drives	2 Winchesters	4 Winchesters	4 Winchesters	4 Winchesters
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Unibus	Unibus	Unibus	Unibus
DEC Emulation	RK711 Controller With RK06/07 Drives	RH11 Interface With RM02/05, RP06 Drives	RK611 Controller With RK06 Drives	RM03/05
Size of Buffer	1K	2K	2K	2K
Minimum Interleave	3:1	3:1	3:1	3:1
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Hex Width Board	Single Hex Width Board	Single Hex Width Board
Power Supply	+5V DC @ 5.7A Max	+5V DC @ 8.0A Max -15V DC @ 0.7A Max	+5V DC @ 8.0A Max -15V DC @ 0.7A Max	+5V DC @ 8.0A Max -15V DC @ 0.7A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$2,800/1's	$3,800/1's	$3,800/1's	$3,800/1's
COMMENTS				

[illegible]	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION
[illegible] NUMBER	SC31/BX Series	TC7000	SC41	SC71/BX Series
[illegible] TYPE	Winchester Only (8 or 14 Inch)	Tape Only (9 Track)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)
DRIVE [illegible]				
[illegible] interface	SMD	Pertec/STC	SMD	SMD
[illegible] # Drives	4 Winchesters	8 (Pertec), 4 (STC) Tape Drives	4 Winchesters	1-4 Depending on Model
Sector Sizes -Bytes	Programmable	Up to 64K	Programmable	Programmable
Error Detection	32 Bit ECC	N/A (In The Formatter)	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	N/A (In The Formatter)	11 Bit Burst	11 Bit Burst
Slip Skipping	N/A	N/A (Block Re-writes)	N/A	N/A
HOST [illegible] TERISTICS				
DEC Bus Type	Unibus	CMI, SBI Via V-Master	Unibus	Cache Bus/ Unibus
DEC Emulation	RH11 With RM02/03/05, or RM80 (VAX), RP06 (PDP)	TM03 Controller With TU77 Drives	MSCP	RM03/05, RP06
Size of Buffer	8K	512 Bytes	42 Sectors	8K
Minimum Interleave	1:1	N/A	1:1	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Hex Width Board	Extended Hex Board	Single Hex Width Board	3 Board Set, Plus an Interconnect Bd to RH70
Power Supply	+5V DC @ 8.0A Max -15V DC @ 0.7A Max	+5V DC @ 10.0A Max	+5V DC @ 7.5A Typ	+5V DC @ 11.0A Max -15V DC @ 1.0A Max
Availability	Now	Now	3Q 1985	Now
OEM Price (U.S.)/QTY	$4,300/1's	$4,500/1's	$4,900/1's	$7,950/1's
COMMENTS		Tri Density Tape Coupler Up To 125 ips Speeds		Designed For PDP11/70

MANUFACTURER	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION
MODEL NUMBER	SC72/BX Series	SC7002	SC750/B2 Series	SC750/B3 Series
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD (1.8 MBytes/sec)	SMD (2.4 MBytes/sec)	SMD (1.8 MBytes/sec)	SMD (1.8 MBytes/sec
Maximum # Drives	4 Winchesters	4 Winchesters	4 Winchesters	4 Winchesters
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A	Sector Level	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Cache Bus/ Unibus	CMI, SBI Via V-Master	CMI Bus	CMI Bus
DEC Emulation	RM03/05, RP06, RM80	RM03/05, RM80	RP05/06	RM03/05, RM80
Size of Buffer	8K		512 Bytes	512 Bytes
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	3 Board Set, Plus an Interconnect Bd to RH70	Extended Hex Board	Extended Hex Board	Extended Hex Board
Power Supply	+5V DC @ 11.0A Max -15V DC @ 1.0A Max	+5V DC @ 11.0A Max	+5V DC @ 10.0A Max -15V DC @ 0.7A Max	+5V DC @ 10.0A Max -15V DC @ 0.7A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$7,950/1's	$8,950/1's	$8,950/1's	$8,950/1's
COMMENTS	Designed For PDP11/70		For VAX-11/750	For VAX-11/750

MANUFACTURER	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION	EMULEX CORPORATION
MODEL NUMBER	SC7000/B1 Series	SC750/B1 Series	SC780/B2	SC788
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive Interface	SMD (2 MBytes/sec)	SMD (1.8 MBytes/sec)	SMD (1.8 MBytes/sec)	SMD (1.8 MBytes/sec)
Maximum # Drives	4 Winchesters	8 Winchesters	4 Winchesters	8 Winchesters
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	CMI, SBI Via V-Master	CMI Bus	SBI Bus	SBI Bus
DEC Emulation	RM03/05, RM80	RM03/05, RM80	RP06	RM03/05/80
Size of Buffer	12 Sectors	512 Bytes	512 Bytes	512 Bytes
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Extended Hex Board	Extended Hex Board	Extended Hex Board	Extended Hex Board
Power Supply	+5V DC @ 11.0A Max -15V DC @ 0.7A Max	+5V DC @ 10.0A Max -15V DC @ 0.7A Max	+5V DC @ 10.0A Max -15V DC @ 1.0A Max	+5V DC @ 10.0A Max -15V DC @ 1.0A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$8,950/1's	$9,950/1's	$13,500/1's	$14,500/1's
COMMENTS	For Use With VAX-11/750 or 11/780	For VAX-11/750	Must Be Used With V-Master/780 Adapter	Must Be Used With V-Master/780 Adapter

MANUFACTURER	GENERAL ROBOTICS	GENERAL ROBOTICS	GENERAL ROBOTICS	GENERAL ROBOTICS
MODEL NUMBER	RXV21	STV11	MWV11	SMV11
CONTROLLER TYPE	Floppy Only (5-1/4 or 8 Inch)	Tape Only (1/4 Inch Cartridge)	Winchester Only (5-1/4 Inch)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	SA800/450	QIC-02	ST506	SMD
Maximum # Drives	2 Floppies	2 Tape Drives	2 Winchesters	2 Winchesters
Sector Sizes -Bytes	256 Through 1K	512 Bytes	128 Through 1K	Programmable
Error Detection	N/A	N/A (In The Formatter)	N/A	N/A
Error Correction	N/A	N/A (In The Formatter)	N/A	N/A
Flaw Skipping	N/A	N/A (Block Re-writes)	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Q Bus
DEC Emulation	RX01, RX02	TS-11	RL01/02	RM02/05, RP02, RK06/07
Size of Buffer	N/A	N/A	One Sector	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One Dual Width Board	One Dual Width Board	Single Quad Width Board	Single Quad Width Board
Power Supply	+5V DC @ 2.5A Max	+5V DC @ 2.5A Typ	+5V DC @ 4.3A Typ +12V DC @ 0.6A Typ	+5V DC @ 3.5A Max +12V DC @ 0.3A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,000/1's	$1,000/1's	$1,500/1's	$1,750/1's
COMMENTS	Supports Double Sided/ Double Density Drives			

[illegible]	GENERAL ROBOTICS	GENERAL ROBOTICS	MDB SYSTEMS	MDB SYSTEMS
[illegible]	MWV22	SMV22	MLSI-TS11	MLSI-STS11
[illegible] TYPE	Winchester Only (5-1/4 Inch)	Winchester Only (8 or 14 inch)	Tape Only (9 Track)	Tape Only (1/4 Inch Cartridge)
[illegible] CHARACTERISTICS				
[illegible] interface	ST506	SMD (2.5 MBytes/sec)	Pertec	CDC Sentinel
[illegible] 8 Drives	2 Winchesters	2 Winchesters	8 Tape Drives	1 Tape Drive
Sector Sizes -Bytes	128 Through 1K	Programmable	Up To 64K	N/A
Error Detection	N/A	N/A	N/A (In The Formatter)	N/A (In The Formatter)
Error Correction	N/A	N/A	N/A (In The Formatter)	N/A (In The Formatter)
Flaw Skipping	N/A	N/A	N/A (Block Re-writes)	In The Formatter
[illegible] TERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Q Bus
DEC Emulation	RL01/02, RM02/03	RM03/05	TS-11/TSV05	TS-11/TSV05
Size of Buffer	N/A	N/A	16K Cache	16K Cache
Minimum Interleave	N/A	1:1 (Up To 1.8MB/sec)	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board
Power Supply	+5V DC @ 4.3A Typ +12V DC @ 0.6A Typ	+5V DC @ 3.5A Max +12V DC @ 0.3A Typ	+5V DC @ 6.5A Max	+5V DC @ 6.5A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,750/1's	$2,000/1's	$1,895/1's	$1,895/1's
COMMENTS			Tri Density Tape Coupler Up To 125 ips Speeds	

MANUFACTURER	MDB SYSTEMS	MDB SYSTEMS	MDB SYSTEMS	MDB SYSTEMS
MODEL NUMBER	MLSI-RK11	MLSI-RM11	MLSI-DK11-RM	MLSI-DK11-RP
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD	SMD	SMD (2.4 MBytes/sec)	SMD (2.4 MBytes/sec)
Maximum # Drives	2 Winchesters	2 Winchesters	2 Winchesters	2 Winchesters
Sector Sizes -Bytes	Programmable	Programmable	Programmable	128 Through 1K
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Q Bus
DEC Emulation	RK06/07	RM02/03, RM80	RM03/05, RM80	RP06
Size of Buffer	1.5K	1.5K	1.5K	1.5K
Minimum Interleave	N/A	N/A	1:1 (15MHz Disk Rates)	1:1 (15MHz Disk Rates)
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board
Power Supply	+5V DC @ 7.0A Max +12V DC @ 0.4A Max	+5V DC @ 7.0A Max +12V DC @ 0.4A Max	+5V DC @ 9.5A Max +12V DC @ 0.6A Max	+5V DC @ 9.5A Max +12V DC @ 0.6A Max
Availability	Now	Now	1Q 1985	1Q 1985
OEM Price (U.S.)/QTY	$2,000/1's	$2,000/1's	$2,330/1's	$2,330/1's
COMMENTS				

;TURER	MDB SYSTEMS	MDB SYSTEMS	MDB SYSTEMS	MDB SYSTEMS
MODEL NUMBER	MLSI-TM11	MDB-TM11	MDB-RM11-Q	MDB-DK11-RM
CONTROLLER TYPE	Tape Only (9 Track)	Tape Only (9 Track)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	Pertec	Pertec	SMD	SMD (1.8 MBytes/sec)
Maximum # Drives	4 Tape Drives	4 Tape Drives	2 Winchesters	4 Winchesters
Sector Sizes -Bytes	Up to 2K	Up to 2K	Programmable	Programmable
Error Detection	Parity, CRC	Parity, CRC	32 Bit ECC	32 Bit ECC
Error Correction	Single Track	Single Track	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A (Block Re-writes)	N/A (Block Re-writes)	N/A	N/A
HOST CTERISTICS				
DEC Bus Type	Q Bus	Unibus	Unibus	Unibus
DEC Emulation	TM-11	TM-11/TU10	RM02/03/05	RM02/03/05
Size of Buffer	16K	16 Byte	1.5K	1.5K
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Hex Width Board	Single Quad Width Board	Single Hex Width Board
Power Supply	+5V DC @ 7.0A Max	+5V DC @ 7.0A Max	+5V DC @ 7.0A Max +12V DC @ 0.4A Max	+5V DC @ 6.5A Max +12V DC @ 0.4A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$2,600/1's	$2,950/1's	$3,200/1's	$3,900/1's
COMMENTS	Formatter/Controller For NRZ/PE Tape Drives Up To 125ips Speeds	Formatter/Controller For NRZ/PE Tape Drives Up To 125ips Speeds		

MANUFACTURER	MDB SYSTEMS	MICRO TECHNOLOGY INC	MICRO TECHNOLOGY INC	MICRO TECHNOLOGY INC
MODEL NUMBER	MDB-DK11-RP	MXV22	MXV22M	MXV50
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Floppy Only (8 Inch)	Floppy Only (5-1/4" Inch)	Floppy Only (5-1/4" Inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD (1.8 MBytes/sec)	SA800	SA460	SA460
Maximum # Drives	4 Winchesters	4 Floppies	4 Floppies	4 Floppies
Sector Sizes -Bytes	Programmable	256 Through 1K	256 Through 1K	256 Through 1K
Error Detection	32 Bit ECC	N/A	N/A	N/A
Error Correction	11 Bit Burst	N/A	N/A	N/A
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Unibus	Q Bus	Q Bus	Q Bus
DEC Emulation	RP06	RX01/02	RX02	RX50
Size of Buffer	1.5K	One Sector	One Sector	One Sector
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Hex Width Board	One Dual Width Board	One Dual Width Board	One Dual Width Board
Power Supply	+5V DC @ 7.0A Max +12V DC @ 0.4A Max	+5V DC @ 2.5A Typ	+5V DC @ 2.5A Typ	+5V DC @ 2.5A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$3,900/1's	$875/1's	$875/1's	$965/1's
COMMENTS		22 Bit Addressing, Single/Double Density	Single/Double Density, 22 Bit Addressing	Single/Double Density, 22 Bit Addressing

MANUFACTURER	MICRO TECHNOLOGY INC	MICRO TECHNOLOGY INC	MICRO TECHNOLOGY INC	MICRO TECHNOLOGY INC
MODEL NUMBER	MLV11M	MLV11	MX22	MSV05
CONTROLLER TYPE	Winchester Only (5-1/4 Inch)	Winchester Only (8 Inch)	Floppy Only (5-1/4 or 8 Inch)	Tape Only (1/4 Inch Cartridge)
DRIVE CHARACTERISTICS				
Drive interface	ST506	SA1000	SA800/460	QIC-02
Maximum # Drives	4 Winchesters	4 Winchesters	4 Floppies	4 Tape Drives
Sector Sizes -Bytes	128 Through 1K	128 Through 1K	256 Through 1K	512 Bytes
Error Detection	56 Bit ECC	56 Bit ECC	N/A	N/A (In The Formatter)
Error Correction	11 Bit Burst	11 Bit Burst	N/A	N/A (In The Formatter)
Flaw Skipping	Sector Level	Sector Level	N/A	N/A (Block Re-writes)
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Unibus	Q Bus
DEC Emulation	RL01/02	RL01/02	RX01/02	TSV05
Size of Buffer	N/A	One Sector	One Sector	16K
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One Dual Width Board	One Dual Width Board	Single Quad Width Board	One Dual Width Board
Power Supply	+5V DC @ 4.5A Max	+5V DC @ 4.5A Max	+5V DC @ 2.5A Typ	+5V DC @ 3.5A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$975/1's	$975/1's	$1,045/1's	$1,425/1's
COMMENTS			Single/Double Density, 22 Bit Addressing	On Board DMA, Compatible With Block Mode

Peripheral Concepts

MANUFACTURER	MINI COMPUTER TECHNOLOGY	MINI COMPUTER TECHNOLOGY	MINI COMPUTER TECHNOLOGY	PLESSEY PERIPHERAL SYSTEMS
MODEL NUMBER	MCT1300	SMV15	EDC24	CTCV11A
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Tape Only (1/4 Inch Cartridge)
DRIVE CHARACTERISTICS				
Drive interface	SMD (2 MBytes/sec)	SMD	SMD	QIC-02
Maximum # Drives	2 Winchesters	2 Winchesters	2 Winchesters	1 Tape Drive
Sector Sizes -Bytes	Programmable	Programmable	Programmable	512 Bytes
Error Detection	32 Bit Fire Code	32 Bit Fire Code	32 Bit Fire Code	N/A (In The Formatter)
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	N/A (In The Formatter)
Flaw Skipping	N/A	N/A	N/A	N/A (Block Re-writes)
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Unibus	Q Bus	Q Bus
DEC Emulation	RK06/07	RK06	RK06	None
Size of Buffer	2 Sectors, Ping Pong	Dual 512 Bytes	Dual 512 Bytes	N/A
Minimum Interleave	1:1	1:1	1:1	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Hex Width Board	Single Quad Width Board	One Dual Width Board
Power Supply	+5V DC @ 6.5A Max	+5V DC @ 6.5A Max	+5V DC @ 6.5A Max	+5V DC @ 2.4A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$2,900/1's	$3,400/1's	$3,600/1's	$460/1's
COMMENTS				

MANUFACTURER	PLESSEY PERIPHERAL SYSTEMS	PLESSEY PERIPHERAL SYSTEMS	PLESSEY PERIPHERAL SYSTEMS	PLESSEY PERIPHERAL SYSTEMS
MODEL NUMBER	XC21/31	XCV21/31	FCV21	DCV06B
CONTROLLER TYPE	Floppy Only (5-1/4 or 8 Inch)	Floppy Only (5-1/4 or 8 Inch)	Winchester Only (5-1/4 Inch)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	SA850/460	SA850/460	ST506	SMD
Maximum # Drives	4 Floppies	4 Floppies	4 Winchesters	2 Winchesters
Sector Sizes -Bytes	256 Through 1K	256 Through 1K	128 Through 1K	Programmable
Error Detection	N/A	N/A	32 Bit ECC	ECC
Error Correction	N/A	N/A	11 Bit Burst	Syndrome Generation
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Unibus	Q Bus	Q Bus	Q Bus
DEC Emulation	RX02	RX02	RL02	RK06
Size of Buffer	N/A	N/A	N/A	Three Sectors
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Quad Width Board	One Dual Width Board	Two Quad Width Boards
Power Supply	+5V DC @ 4.0A Max	+5V DC @ 4.0A Max	+5V DC @ 6.0A Max	+5V DC @ 7.0A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$840/1's	$850/1's	$900/1's	$1,305/1's
COMMENTS			On Board SCSI Port	

MANUFACTURER	PLESSEY PERIPHERAL SYSTEMS	PLESSEY PERIPHERAL SYSTEMS	PLESSEY PERIPHERAL SYSTEMS	PLESSEY PERIPHERAL SYSTEMS
MODEL NUMBER	DCV12	DCV03	DCV51	DC02B
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Winchester Only (5-1/4 Inch)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD	SMD (1.8 MBytes/sec)	ST506	SMD (1.8 MBytes/sec)
Maximum # Drives	1 Winchester	2 Winchesters	4 Winchesters	4 Winchesters
Sector Sizes--Bytes	Programmable	Programmable	128 Through 1K	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A	Track Level	N/A	Track Level
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Unibus
DEC Emulation	RL02	RM02/03/05	MSCP	RM02/05
Size of Buffer	Three Sectors	Three Sectors	8K	Three Sectors
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Two Quad Width Boards	Two Quad Width Boards	Single Quad Width Board	Single Hex Width Board
Power Supply	+5V DC @ 7.0A Max	+5V DC @ 7.0A Typ	+5V DC @ 6.0A Max	+5V DC @ 9.0A Typ -15V DC @ 0.7A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,305/1's	$1,615/1's	$1,690/1's	$1,925/1's
COMMENTS	Supports Amcodyne Removable Cartridge SMD Drive		Supports Plessey Storage Architecture (PSA)	

MANUFACTURER	PLESSEY PERIPHERAL SYSTEMS	PLESSEY PERIPHERAL SYSTEMS	QUALOGY	QUALOGY
MODEL NUMBER	DCV50	DC50	D 8120	D 4120
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Tape Only (1/4 Inch Cartridge)	Floppy Only (5-1/4" Inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD	SMD	Kennedy 6455	SA460
Maximum # Drives	4 Winchesters	4 Winchesters	1 Tape Drive	2 Floppies
Sector Sizes -Bytes	Programmable	Programmable	512 Bytes	256 Through 1K
Error Detection	32 Bit ECC	32 Bit ECC	N/A (In The Formatter)	N/A
Error Correction	11 Bit Burst	11 Bit Burst	N/A (In The Formatter)	N/A
Flaw Skipping	N/A	N/A	In The Formatter	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Unibus	Q Bus	Q Bus
DEC Emulation	MSCP	MSCP	TS-11/TSV05	RX02
Size of Buffer	8K	8K	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Quad Width Board	One Dual Width Board	One Dual Width Board
Power Supply	+5V DC @ 6.0A Max	+5V DC @ 6.0A Max	+5V DC @ 3.0A Max	+5V DC @ 3.7A Max +12V DC @ 0.09A Max
Availability	3Q 1985	4Q 1985	Now	Now
OEM Price (U.S.)/QTY	$1,790/1's	$1,995/1's	$1,195/1's	$1,250/1's
COMMENTS	Supports Plessey Storage Architecture (PSA)	Supports Plessey Storage Architecture (PSA)		Single/Double Sided

MANUFACTURER	QUALOGY	QUALOGY	QUALOGY	QUALOGY
MODEL NUMBER	D 4140	D 8250	D 8255	D 8260
CONTROLLER TYPE	Floppy Only (8 Inch)	Multifunction (Winchester/Tape)	Multifunction (Winchester/Tape)	Multifunction (Winchester/Tape)
DRIVE CHARACTERISTICS				
Drive interface	SA800	ST506 (Winchester), Kennedy 6455 (Tape)	ST506 (Winchester), Kennedy 6455 (Tape)	ST506 (Winchester), Kennedy 6455 (Tape)
Maximum # Drives	2 Floppies	1 Winchester, 1 Tape Drive	1 Winchester, 1 Tape Drive	2 Winchesters, 1 Tape Drive
Sector Sizes -Bytes	256 Through 1K	128 Through 1K	128 Through 1K	128 Through 1K
Error Detection	N/A	ECC	ECC	ECC
Error Correction	N/A	8 Bit Burst	8 Bit Burst	8 Bit Burst
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Q Bus
DEC Emulation	RX02	None	None	None
Size of Buffer	N/A	N/A	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One Dual Width Board	Single Quad Width Board	Single Quad Width Board	Single Quad Width Board
Power Supply	+5V DC @ 3.7A Max +12V DC @ 0.09A Max	+5V DC @ 6.1A Max +12V DC @ 0.15A Max	+5V DC @ 6.1A Max +12V DC @ 0.15A Max	+5V DC @ 6.1A Max +12V DC @ 0.15A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,250/1's	$2,200/1's	$2,200/1's	$2,200/1's
COMMENTS	Single/Double Sided	Supports LSI-11 Only	Supports MicroVAX	Supports MicroVAX

TURER	SCIENTIFIC MICRO SYSTEMS	SCIENTIFIC MICRO SYSTEMS	SCIENTIFIC MICRO SYSTEMS	SCIENTIFIC MICRO SYSTEMS
EL NUMBER	FWD 0106	FWD 1106	FWD 0101	FWD 1101
NTROLLER TYPE	Multifunction (Winchester/Floppy)	Multifunction (Winchester/Floppy)	Multifunction (Winchester/Floppy)	Multifunction (Winchester/Floppy)
DRIVE CHARACTERISTICS				
rive interface	ST506 (Winchester), SA860/460 (Floppy)	ST506 (Winchester), SA860/460 (Floppy)	SA1000 (Winchester), SA850 (Floppy)	SA1000 (Winchester), SA850 (Floppy)
aximum # Drives	2 Winchesters, 2 Floppies	2 Winchesters, 2 Floppies	2 Winchesters, 2 Floppies	2 Winchesters, 2 Floppies
Sector Sizes -Bytes	128 Through 1K	128 Through 1K	128 Through 1K	128 Through 1K
Error Detection	ECC	ECC	ECC	ECC
Error Correction	6 Bit Burst	6 Bit Burst	6 Bit Burst	6 Bit Burst
Flaw Skipping	Sector Level	Sector Level	Sector Level	Sector Level
HOST TERISTICS				
DEC Bus Type	Q Bus	Unibus	Q Bus	Unibus
DEC Emulation	None	None	None	None
Size of Buffer	N/A	N/A	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One Dual Width Board And One Quad Width Board	One Dual Width Board And One Quad Width Board	One Dual Width Board And One Quad Width Board	One Dual Width Board And One Quad Width Board
Power Supply	+5V DC @ 7.6A Max For Both Boards	+5V DC @ 7.8A Max For Both Boards	+5V DC @ 7.6A Max For Both Boards	+5V DC @ 7.8A Max For Both Boards
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,900/1's	$1,900/1's	$2,100/1's	$2,100/1's
COMMENTS				

MANUFACTURER	SIGMA INFO SYSTEMS	SIGMA INFO SYSTEMS	SIGMA INFO SYSTEMS	SIGMA INFO SYSTEMS
MODEL NUMBER	SDC RXV31	STC TSV11	SDC RQD11-A	SDC RQD11-B
CONTROLLER TYPE	Floppy Only (5-1/4 or 8 Inch)	Tape Only (1/4 Inch Cartridge)	Winchester Only (5-1/4 Inch)	Winchester Only (5-1/4 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SA850/460	CDC Sentinel	ST506	ST506
Maximum # Drives	2 Floppies	2 Tape Drives	1 Winchester	2 Winchesters
Sector Sizes -Bytes	256 Through 1K	N/A	128 Through 1K	128 Through 1K
Error Detection	N/A	N/A (In The Formatter)	N/A	N/A
Error Correction	N/A	N/A (In The Formatter)	N/A	N/A
Flaw Skipping	N/A	In The Formatter	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Q Bus
DEC Emulation	RX01/02	TS-11/TSV05	MSCP	MSCP
Size of Buffer	N/A	N/A	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One Dual Width Board	One Dual Width Board	One Dual Width Board	One Dual Width Board
Power Supply	+5V DC @ 2.7A Typ	+5V DC @ 3.75A Max	+5V DC @ 2.6A Typ	+5V DC @ 2.6A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,025/1's	$1,495/1's	$1,695/1's	$1,695/1's
COMMENTS	Supports Double Sided/ Density Floppies	A Separate, Drive-Mount Formatter Available		

MANUFACTURER	SPECTRA LOGIC CORP	SPECTRA LOGIC CORP	SPECTRA LOGIC CORP	SPECTRA LOGIC CORP
MODEL NUMBER	SPECTRA 15 PLUS	SPECTRA 25 PLUS	SPECTRA 12	SPECTRA 111 PLUS
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Multifunction (Winchester/Tape)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD (2.5 Mbytes/sec)	SMD (2.5 MBytes/sec) Pertec (Tape)	SMD (2 MBytes/sec)	SMD (2.5 MBytes/sec)
Maximum # Drives	2 Winchesters	2 Winchesters, 4 Tapes	4 Winchesters	4 Winchesters
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Unibus	Unibus
DEC Emulation	RM02/05/80, RP06 (Disk)	RM02/05, RM80 (Disk), TS-11 (Tape)	RK06/07	RM02/05, RP06
Size of Buffer	6.14K	12 Sectors	1.5K	14 Sectors
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Quad Width Board	Single Quad Width Board	Single Hex Width Board	Single Hex Width Board
Power Supply	+5V DC @ 7.0A Typ	+5V DC @ 7.0A Typ	+5V DC @ 8.0A Typ -15V DC @ 0.3A Typ	+5V DC @ 8.0A Max -15V DC @ 0.7A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$2,700/1's	$3,200/1's	$4,000/1's	$4,000/1's
COMMENTS		Coupler For Tape Drives With Speeds To 1 MB/sec	Supports VAX Computers	

MANUFACTURER	SPECTRA LOGIC CORP	SPECTRA LOGIC CORP	WEBSTER COMPUTER CORP	WEBSTER COMPUTER CORP
MODEL NUMBER	SPECTRA 21	SPECTRA 121 PLUS	PCLV11-J	SRQD11-B
CONTROLLER TYPE	Multifunction (Winchester/Tape)	Multifunction (Winchester/Tape)	Tape Only (1/4 Inch Cartridge)	Winchester Only (5-1/4 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD (2 MBytes/sec), Pertec (Tape)	SMD (2.5 MBytes/sec), Pertec (Tape)	QIC-02	ST506
Maximum # Drives	4 Winchesters, 8 Tapes	4 Winchesters, 4 Tapes	2 Tape Drives	2 Winchesters
Sector Sizes -Bytes	Programmable	Programmable	512 Bytes	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	N/A (In The Formatter)	N/A
Error Correction	11 Bit Burst	11 Bit Burst	N/A (In The Formatter)	N/A
Flaw Skipping	N/A	N/A	N/A (Block Re-writes)	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Unibus	Unibus	Q Bus	Q Bus
DEC Emulation	RK06/07 Extended (Disk), TS-11 (Tape)	RM02/05, RP04-07(Disk), TS-11 (Tape)	None	MSCP
Size of Buffer	1.5K (Disk), 64B (Tape)	14 Sectors	8K ROM	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Hex Width Board	Single Hex Width Board	One Dual Width Board	One Dual Width Board
Power Supply	+5V DC @ 10.0A Max -15V DC @ 0.7A Typ	+5V DC @ 8.0A Typ -15V DC @ 0.7A Typ	+5V DC @ 2.5A Typ +12V DC @ 0.25A Typ	+5V DC @ 2.6A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$4,200/1's	$5,000/1's	$872/1's	$1,443/1's
COMMENTS	Coupler For Tape Drives With Speeds To 320KB/sec	Coupler For Tape Drives With Speeds To 1 MB/sec	22 Bit Addressing, On Board 4 Channel Serial Interface	22 Bit Addressing

MANUFACTURER	WEBSTER COMPUTER CORP	WESPERCORP	WESPERCORP	WESPERCORP
MODEL NUMBER	SMDQ11-A	TDQ-III	TDQ-IV	TD-III
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Tape Only (9 Track)	Tape Only (9 Track)	Tape Only (9 Track)
DRIVE CHARACTERISTICS				
Drive interface	SMD (2.5 MBytes/sec)	Pertec	STC or Telex	Pertec
Maximum # Drives	2 Winchesters	1 Tape Drive	1 Tape Drive	4 Tape Drives
Sector Sizes -Bytes	Programmable	Up To 64K	Up To 64K	Up To 64K
Error Detection	ECC	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)
Error Correction	10 Bit Burst	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)
Flaw Skipping	Sector Level	N/A (Block Re-writes)	N/A (Block Re-writes)	N/A (Block Re-writes)
HOST CHARACTERISTICS				
DEC Bus Type	Q Bus	Q Bus	Q Bus	Unibus
DEC Emulation	MSCP	TSV05	TSV05	TS-11
Size of Buffer	Multiple Sector	64K Cache	64K Cache	64K
Minimum Interleave	1:1	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One Dual Width Board	Single Quad Width Board	Single Quad Width Board	Single Hex Width Board
Power Supply	+5V DC @ 4.0A Max	+5V DC @ 6.0A Typ	+5V DC @ 6.0A Typ	+5V DC @ 7.0A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$2,000/1's	$1,550/1's	$1,550/1's	$1,983/1's
COMMENTS	22 Bit Addressing	Tri Density Tape Coupler Up To 200 ips Speeds	Tri Density Tape Coupler Up To 200 ips Speeds	Tri Density Tape Coupler Up To 125 ips Speeds

MANUFACTURER	WESPERCORP	WESPERCORP	WESPERCORP	WESPERCORP
MODEL NUMBER	TD-IV	DC-251	TC-151	DC-231A
CONTROLLER TYPE	Tape Only (9 Track)	Winchester Only (8 or 14 inch)	Tape Only (9 Track)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	Pertec	SMD	Pertec	SMD
Maximum # Drives	1 Tape Drive	2 Winchesters	8 Tape Drives	4 Winchesters
Sector Sizes -Bytes	Up To 64K	Programmable	Up To 2K	Programmable
Error Detection	N/A (In The Formatter)	32 Bit ECC	CRC, Parity	ECC
Error Correction	N/A (In The Formatter)	11 Bit Burst	Single Track	8 Bit Burst
Flaw Skipping	N/A (Block Re-writes)	N/A	N/A (Block Re-writes)	N/A
HOST CHARACTERISTICS				
DEC Bus Type	Unibus	Q Bus	Q Bus	Unibus
DEC Emulation	TS-11	RM02 (RM05, RP04/05/06, RK06/07 Optional)	TM-11	RM02 (RM05, RP04/05/06, RK06/07 Optional)
Size of Buffer	64K Cache	1.5K	33 Bytes	2K
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Single Hex Width Board	Single Quad Width Board	Single Quad Board (NRZ), Plus Dual Board For PE	Single Hex Width Board
Power Supply	+5V DC @ 7.0A Typ	+5V DC @ 6.0A Max	+5V DC @ 9.0A Max	+5V DC @ 9.4A Max -15V DC @ 0.5A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,983/1's	$2,095/1's	$3,040/1's	$3,150/1's
COMMENTS	Tri Density Tape Coupler Up To 200 ips Speeds		Supports NRZI/PE Tape Drives 25-125 ips Speeds	

MANUFACTURER	WESPERCORP			
MODEL NUMBER	TC-131			
CONTROLLER TYPE	Tape Only (9 Track)			
DRIVE CHARACTERISTICS				
Drive interface	Pertec			
Maximum # Drives	8 Tape Drives			
Sector Sizes -Bytes	Up To 2K			
Error Detection	CRC, Parity			
Error Correction	Single Track			
Flaw Skipping	N/A (Block Re-writes)			
HOST CHARACTERISTICS				
DEC Bus Type	Unibus			
DEC Emulation	TM-11			
Size of Buffer	33 Words			
Minimum Interleave	N/A			
PHYSICAL CHARACTERISTICS				
Form Factor	Single Hex Width Board			
Power Supply	+5V DC @ 7.0A Max			
Availability	Now			
OEM Price (U.S.)/QTY	$3,300/1's			
COMMENTS	Supports NRZI/PE Tape Drives 25-125 ips Speeds			

MANUFACTURER	AVIV CORPORATION	AVIV CORPORATION	AVIV CORPORATION	AVIV CORPORATION
MODEL NUMBER	TFC 712	TFC 715/A	TFC 715/B	TFC 716
CONTROLLER TYPE	Tape Only (9 Track)	Tape Only (9 Track)	Tape Only (9 Track)	Tape Only (9 Track)
DRIVE CHARACTERISTICS				
Drive interface	Pertec	STC 1953	STC 1953	Telex 6253
Maximum # Drives	8 Tape Drives	4 Tape Drives	4 Tape Drives	4 Tape Drives
Sector Sizes -Bytes	Up To 2K	Up To 64K	Up To 64K	Up To 64K
Error Detection	CRC, Parity	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)
Error Correction	Single Track	N/A (In The Formatter)	N/A (In The Formatter)	N/A (In The Formatter)
Flaw Skipping	N/A (Block Re-writes)	N/A (Block Re-writes)	N/A (Block Re-writes)	N/A (Block Re-writes)
HOST CHARACTERISTICS				
Minicomputer	Data General	Data General	Data General	Data General
Bus Support	Data Channel	Data Channel	Data Channel	Data Channel
Device Emulation	D6 6021	D6 6021	D6 6125	D6 6021
Size of Buffer	FIFO	16K FIFO	16K FIFO	16K FIFO
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board
Power Supply	+5V DC @ 4.5A Typ	+5V DC @ 5.5A Typ	+5V DC @ 5.5A Typ	+5V DC @ 5.5A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$3,500/1's	$3,950/1's	$3,950/1's	$9,850/1's
COMMENTS	Supports Tape Speeds Up To 125 ips	Tri Density Tape Coupler 125 ips Tape Speeds	Tri Density Tape Coupler 125 ips Tape Speeds	Tri Density Formatter & Controller, Supports Up to 125 ips Speed

MANUFACTURER	BYTRONIX CORPORATION	BYTRONIX CORPORATION	BYTRONIX CORPORATION	BYTRONIX CORPORATION
MODEL NUMBER	B 505	B 234	B 450	B 525
CONTROLLER TYPE	Tape Only (1/4 inch Cartridge)	Winchester Only	Winchester Only (8 or 14 inch)	Multifunction (Winchester/Tape)
DRIVE CHARACTERISTICS				
Drive interface	QIC-02	Diablo/Western Dynex	SMD	ST506/QIC-02
Maximum # Drives	4 Tape Drives	4 Winchesters	4 Winchesters	3 Winchesters, 4 Tape Drives
Sector Sizes -Bytes	512 Bytes	128 Through 1K	128 Through 1K	128 Through 1K
Error Detection	N/A (In The Formatter)	None	None	32 Bit ECC
Error Correction	N/A (In The Formatter)	None	None	11 Bit Burst
Flaw Skipping	N/A (Block Re-writes)	N/A	N/A	N/A
HOST CHARACTERISTICS				
Minicomputer	Data General	Data General	Data General	Data General
Bus Support	Data Channel	Data Channel	Data Channel	Data Channel
Device Emulation	None	DG 4234	None	None
Size of Buffer	N/A	None	None	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board
Power Supply	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,000/1's	$1,068/1's	$1,450/1's	$1,520/1's
COMMENTS		Supports 5MB Fixed/ 5MB Removable Drives		

MANUFACTURER	BYTRONIX CORPORATION	COMPUTER STORAGE TECH (DIV OF E.F. INDUSTRIES)	COMPUTER STORAGE TECH (DIV OF E.F. INDUSTRIES)	COMPUTER STORAGE TECH (DIV OF E.F. INDUSTRIES)
MODEL NUMBER	B 455	3512	15X12	15X42
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Tape Only (9 Track)	Tape Only (7 or 9 Track)	Tape Only (7 or 9 Track)
DRIVE CHARACTERISTICS				
Drive interface	SMD	Pertec	Pertec	Pertec
Maximum # Drives	4 Winchesters	4 Tape Drives	8 Tape Drives	4 Tape Drives
Sector Sizes -Bytes	128 Through 1K	Up To 2K	Up To 2K	Up To 2K
Error Detection	ECC	N/A (In The Formatter)	LRC, CRC, Parity	LRC, CRC, Parity
Error Correction	8 Bit Burst	N/A (In The Formatter)	Single Track	Single Track
Flaw Skipping	N/A	N/A (Block Re-writes)	N/A	N/A (Block Re-writes)
HOST CHARACTERISTICS				
Minicomputer	Data General	Data General	Data General	Perkin-Elmer
Bus Support	Data Channel	Data Channel	Data Channel	SELCH, Mux
Device Emulation	None	D6 6021	None	None
Size of Buffer	128 Bytes	16 Bit	64 Bytes	64 Bytes
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board
Power Supply	+5V DC @ 5.0A Max	+5V DC @ 3.0A Max	+5V DC @ 4.0A Max	+5V DC @ 5.0A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,670/1's	$1,800/1's	$2,850/1's	$3,450/1's
COMMENTS	Optional QIC-02 Tape Interface	Coupler For NRZ/PE Tape Drives, Supports Up To 125 ips Speed	NRZI/PE Formatter and Controller, Supports Up to 125 ips Speed	Supports NRZI/PE Tape Drives, Supports Up To 125 ips Speed

MANUFACTURER	MACROLINK, INC.	MACROLINK, INC.	MACROLINK, INC.	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)
MODEL NUMBER	201800	201100	MACRO-3	MCT 2410
CONTROLLER TYPE	Tape Only (9 Track)	Tape Only (9 Track)	Winchester Only (8 or 14 inch)	Multifunction (Winchester/Tape)
DRIVE CHARACTERISTICS				
Drive Interface	Pertec	STC	SMD (3 MBytes/sec)	Priam "Smart/E" (Disk), QIC-02 (Tape)
Maximum # Drives	4 Tape Drives	4 Tape Drives	4 Winchesters	4 Winchesters, 1 Tape Drive
Sector Sizes -Bytes	Up To 64K	Up To 64K	Programmable	128 Through 1K
Error Detection	N/A (In The Formatter)	N/A (In The Formatter)	32 Bit ECC	In The Drive
Error Correction	N/A (In The Formatter)	N/A (In The Formatter)	11 Bit Burst	In The Drive
Flaw Skipping	N/A (Block Re-writes)	N/A (Block Re-writes)	N/A	N/A
HOST CHARACTERISTICS				
Minicomputer	Perkin-Elmer	Perkin-Elmer	Perkin-Elmer	Data General
Bus Support	SELCH, Mux	SELCH, Mux	SELCH, Mux	Data Channel
Device Emulation	800/1600 bpi Tape	800/1600 bpi Tape	IDC, MSM	None
Size of Buffer	3 Bytes	4K	768 Bytes	N/A
Minimum Interleave	N/A	N/A	1:1	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board
Power Supply	+5V DC @ 1.5A Typ	+5V DC @ 1.5A Typ	+5V DC @ 8.0A Typ	+5V DC @ 5.0A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,225/1's	$1,500/1's	$3,275/1's	$2,225/1's
COMMENTS	Coupler For Tri Density Tape Drives	Coupler For Tri Density Tape Drives		

MANUFACTURER	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)	MINI COMPUTER [illegible] (DIV. E-H [illegible])
MODEL NUMBER	MCT 2025	MCT 2040	MCT 2420	TDC 803
CONTROLLER TYPE	Tape Only (9 Track)	Tape Only (9 Track)	Multifunction (Winchester/Tape)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	Pertec, STC, Telex	STC, Telex	Priam "Smart/E" (Disk), Pertec (Tape)	CDC Trident
Maximum # Drives	1 Tape Drive	1 Tape Drive	4 Winchesters, 1 Tape Drive	4 Winchesters
Sector Sizes -Bytes	Up To 64K	Up To 64K	128 Through 1K	Programmable
Error Detection	N/A (In The Formatter)	N/A (In The Formatter)	In The Drive	CRC
Error Correction	N/A (In The Formatter)	N/A (In The Formatter)	In The Drive	N/A
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
Minicomputer	Data General	Data General	Data General	Perkin-Elmer
Bus Support	BMC (4307Mode), DCH	Data Channel	Data Channel	16 Bit
Device Emulation	6026, 4307, 6021 (Opt'n)	4307, 6021	None	None
Size of Buffer	16K Std, 64K Optional	16K Std, 64K Optional	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board
Power Supply	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max
Availability	3Q 1985	Now	Now	Now
OEM Price (U.S.)/QTY	$2,300/1's	$2,300/1's	$2,575/1's	$2,825/1's
COMMENTS	Tri Density Tape Coupler 200 ips Tape Speeds	Tri Density Tape Coupler 125 ips Tape Speeds	Also Has On-Board RS232, TTY and Centronics Printer Interfaces	

MANUFACTURER	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)
MODEL NUMBER	TDC 802	MCT 2414	SMC 902	TDC 813
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Multifunction (Winchester/Tape)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	CDC Trident	Priam "Smart/E" (Disk), QIC-02 (Tape)	SMD	CDC Trident
Maximum # Drives	4 Winchesters	4 Winchesters, 1 Tape Drive	2 Winchesters	4 Winchesters
Sector Sizes -Bytes	Programmable	128 Through 1K	Programmable	Programmable
Error Detection	CRC	In The Drive	CRC	CRC
Error Correction	N/A	In The Drive	N/A	N/A
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
Minicomputer	Data General	Data General	Data General	Perkin-Elmer
Bus Support	Data Channel	Data Channel	Data Channel	32 Bit
Device Emulation	None	None	None	None
Size of Buffer	N/A	N/A	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board
Power Supply	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$2,825/1's	$2,850/1's	$2,900/1's	$3,000/1's
COMMENTS		Also Has On-Board RS232, TTY, 4 Port Mux and Printer Interfaces		

Peripheral Concepts

MANUFACTURER	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)
MODEL NUMBER	SMC 903	SMC 12	EDC 22	Spectra 34
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Tape Only (9 Track)
DRIVE CHARACTERISTICS				
Drive interface	SMD	SMD	SMD	Pertec
Maximum # Drives	2 Winchesters	4 Winchesters	4 Winchesters	4 Tape Drives
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Up To 64K
Error Detection	CRC	32 Bit Fire Code	32 Bit Fire Code	N/A (In The Formatter)
Error Correction	N/A	11 Bit Burst	11 Bit Burst	N/A (In The Formatter)
Flaw Skipping	N/A	N/A	N/A	N/A (Block Re-writes)
HOST CHARACTERISTICS				
Minicomputer	Perkin-Elmer	Data General	Data General	Perkin-Elmer
Bus Support	Multiplexer Channel	Data Channel	Data Channel	SELCH Family
Device Emulation	None	None	606X	OS16/32, Xelos
Size of Buffer	N/A	N/A	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board	One 7" x 15" Board
Power Supply	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max	+5V DC @ 2.0A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$3,000/1's	$3,400/1's	$3,750/1's	$1,225/1's
COMMENTS				Tri Density Tape Coupler

MANUFACTURER	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)
MODEL NUMBER	Spectra 36	Spectra 30	Spectra 14	Spectra 10/D
CONTROLLER TYPE	Tape Only (9 Track)	Tape Only (9 Track)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	Pertec	Pertec	SMD (2 MBytes/sec)	CMD (2 MBytes/sec)
Maximum # Drives	4 Tape Drives	4 Tape Drives	4 Winchesters	4 Winchesters
Sector Sizes -Bytes	N/A	Up To 64K	Programmable	Programmable
Error Detection	N/A (In The Formatter)	N/A (In The Formatter)	32 Bit ECC	32 Bit ECC
Error Correction	N/A (In The Formatter)	N/A (In The Formatter)	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A (Block Re-writes)	N/A (Block Re-writes)	N/A	Sector Level
HOST CHARACTERISTICS				
Minicomputer	Texas Instruments	Data General	Perkin-Elmer	Data General
Bus Support	TILINE	Data Channel	SELCH Family	Data Channel
Device Emulation	TI 979	DG 6021	MSM-80, MSM-300	DG 6067
Size of Buffer	N/A	N/A	1.5K	1.5K
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One 10.8" x 14.2" Board	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board
Power Supply	+5V DC @ 5.0A Typ	+5V DC @ 5.0A Typ	+5V DC @ 7.0A Typ	+5V DC @ 7.0A Typ -5V DC @ 0.7A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,500/1's	$1,500/1's	$3,180/1's	$3,400/1's
COMMENTS	Coupler for TI990,BS600, BS800 Series Computers	Tri Density Tape Coupler		

MANUFACTURER	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)
MODEL NUMBER	Spectra 10/A	Spectra 210-Plus	Spectra 16	Spectra 20/D
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Multifunction (Winchester/Tape)
DRIVE CHARACTERISTICS				
Drive interface	SMD (2 MBytes/sec)	SMD (2.5 MBytes/sec)	SMD (2 MBytes/sec)	CMD (2 MBytes/sec), Peretc (Tape)
Maximum # Drives	4 Winchesters	4 Winchesters	4 Winchesters	4 Winchesters, 8 Tape Drives
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	Sector Level	Sector Level	N/A	Sector Level
HOST CHARACTERISTICS				
Minicomputer	Data General	Data General	Texas Instruments	Data General
Bus Support	Data Channel	Data Channel	TILINE	Data Channel
Device Emulation	D6 6067	606X, 616X, 6122, 6214	CD1400, DSB0/300	6021, 6067
Size of Buffer	1.5K	N/A	1K	1.5K
Minimum Interleave	N/A	1:1	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One 15" x 15" Board	One 15" x 15" Board	One 10.8" x 14.2" Board	One 15" x 15" Board
Power Supply	+5V DC @ 7.0A Typ -5V DC @ 0.7A Typ	+5V DC @ 8.0A Typ -5V DC @ 0.7A Typ	+5V DC @ 9.0A Typ -12V DC @ 0.7A Typ	+5V DC @ 8.0A Max -5V DC @ 0.7A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$3,400/1's	$3,700/1's	$3,800/1's	$4,200/1's
COMMENTS			For TI 990/600 Series Computers	PE/NRZ Tape Coupler

MANUFACTURER	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)
MODEL NUMBER	Spectra 20/A	Spectra 46	Spectra 26	Spectra 120-Plus
CONTROLLER TYPE	Multifunction (Winchester/Tape)	Multifunction (Winchester/Tape)	Multifunction (Winchester/Tape)	Multifunction (Winchester/Tape)
DRIVE CHARACTERISTICS				
Drive interface	SMD (2 MBytes/sec), Peretc (Tape)	SMD (2 MBytes/sec), Archive (Tape)	SMD (2 MBytes/sec), Pertec (Tape)	SMD (2.5 MBytes/sec), Pertec (Tape)
Maximum # Drives	4 Winchesters, 8 Tape Drives	4 Winchesters, 4 Catridge Tape Drives	4 Winchesters, 4 Tape Drives	4 Winchesters, 8 Tape Drives
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	Sector Level	N/A	N/A	Sector Level
HOST CHARACTERISTICS				
Minicomputer	Data General	Texas Instruments	Texas Instruments	Data General
Bus Support	Data Channel	TILINE	TILINE	Data Channel
Device Emulation	6021, 6067	CD1400, DS80/300	CD1400, DS80/300, TI979	606X, 616X, 6021, 6125
Size of Buffer	1.5K	1K (Disk), 64B (Tape)	1K (Disk), 64B (Tape)	N/A
Minimum Interleave	N/A	N/A	N/A	1:1
PHYSICAL CHARACTERISTICS				
Form Factor	One 15" x 15" Board	One 10.8" x 14.2" Board	One 10.8" x 14.2" Board	One 15" x 15" Board
Power Supply	+5V DC @ 8.0A Max -5V DC @ 0.7A Max	+5V DC @ 9.0A Max -12V DC @ 0.7A Max	+5V DC @ 9.0A Max -12V DC @ 0.7A Max	+5V DC @ 8.0A Max -5V DC @ 0.7A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$4,200/1's	$4,500/1's	$4,500/1's	$4,500/1's
COMMENTS	PE/NRZ Tape Coupler	For TI 990/BS600 Series Computers	For TI 990/BS600 Series Computers	Tri Density Tape Coupler

MANUFACTURER	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)	SPECTRA LOGIC CORP (DIV OF CIPHER DATA)
MODEL NUMBER	Spectra 17-Plus	Spectra 116	Spectra 27-Plus	Spectra 126 Plus
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)	Multifunction (Winchester/Tape)	Multifunction (Winchester/Tape)
DRIVE CHARACTERISTICS				
Drive interface	SMD (2.5 MBytes/sec)	SMD (2 MBytes/sec)	SMD (2.5 MBytes/sec), Pertec (Tape)	SMD (2.5 MBytes/sec), Pertec (Tape)
Maximum # Drives	4 Winchesters	2 Winchesters	4 Winchesters, 8 Tape Drives	2 Winchesters, 4 Tape Drives
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	Sector Level	N/A	Sector Level	Sector Level
HOST CHARACTERISTICS				
Minicomputer	Data General	Texas Instruments	Data General	Texas Instruments
Bus Support	BMC	TILINE	BMC, Data Channel	TILINE
Device Emulation	606X, 616X, 6122, 6214	WD900	606X, 616X, 6122, 6214	WD900, MT3200
Size of Buffer	N/A	28 Sectors	N/A	14K (Disk), 64B (Tape)
Minimum Interleave	1:1	N/A	1:1	1:1
PHYSICAL CHARACTERISTICS				
Form Factor	One 15" x 15" Board	One 10.8" x 14.2" Board	One 15" x 15" Board	One 10.8" x 14.2" Board
Power Supply	+5V DC @ 10.0A Typ -5V DC @ 0.7A Typ	+5V DC @ 8.0A Typ -12V DC @ 0.7A Typ	+5V DC @ 10.0A Max -5V DC @ 0.7A Max	+5V DC @ 8.0A Max -12V DC @ 0.7A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$4,500/1's	$4,800/1's	$5,300/1's	$5,500/1's
COMMENTS		For TI 990 & BS600/900 Computers	Tri Density Tape Coupler	Tri Density Tape Coupler For TI 990, BS 600/900 Series Computers

MANUFACTURER	WESPERCORP (DIV OF WESPERGROUP)	WESPERCORP (DIV OF WESPERGROUP)	WESPERCORP (DIV OF WESPERGROUP)	ZETACO, INC.
MODEL NUMBER	DC-221	TC-140	TC-120	TC-133
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Tape Only (7 or 9 Track)	Tape Only (7 or 9 Track)	Tape Only (9 Track)
DRIVE CHARACTERISTICS				
Drive interface	SMD	Pertec	Pertec	Pertec
Maximum # Drives	4 Winchesters	4 Tape Drives	8 Tape Drives	4 Tape Drives
Sector Sizes -Bytes	Programmable	Up To 2K	Up To 2K	Up To 64K
Error Detection	32 Bit ECC	CRC, Parity	CRC, Parity	N/A (In The Formatter)
Error Correction	8 Bit Burst	Single Track (PE Only)	Single Track	N/A (In The Formatter)
Flaw Skipping	Track Level	N/A (Block Re-writes)	N/A (Block Re-writes)	N/A (Block Re-writes)
HOST CHARACTERISTICS				
Minicomputer	Data General	Perkin Elmer	Data General	Data General
Bus Support	Data Channel	SELCH, Multiplexer	Data Channel	Data Channel
Device Emulation	606X Family	None	D6 6021	D6 6021, 6125
Size of Buffer	2 Sectors	66 Bytes	66 Bytes	1K
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board
Power Supply	+5V DC @ 8.3A Typ -5V DC @ 1A Typ	+5V DC @ 6.0A Typ	+5V DC @ 4.8A Typ +15V DC @ 0.05A Typ	+5V DC @ 3.0A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$3,300/1's	$3,410/1's	$3,410/1's	$1,490/1's
COMMENTS		Supports NRZ/PE Tape Drives With Speeds To 125 ips	Supports NRZ/PE Tape Drives With Speeds To 125 ips	Tri Density Tape Coupler

Peripheral Concepts

MANUFACTURER	ZETACO, INC.	ZETACO, INC.	ZETACO, INC.	ZETACO, INC.
MODEL NUMBER	MZT-3	BMX-2	DC-295	DC-297
CONTROLLER TYPE	Tape Only (9 Track)	Tape Only (9 Track)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	Pertec	Pertec	SMD (2 MBytes/sec)	SMD (2.5 MBytes/sec)
Maximum # Drives	4 Tape Drives	8 Tape Drives	4 Winchesters	4 Winchesters
Sector Sizes -Bytes	Up To 64K	Up To 64K	Programmable	Programmable
Error Detection	N/A (In The Formatter)	N/A (In The Formatter)	32 Bit ECC	32 Bit ECC
Error Correction	N/A (In The Formatter)	N/A (In The Formatter)	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A (Block Re-writes)	N/A (Block Re-writes)	N/A	N/A
HOST CHARACTERISTICS				
Minicomputer	Texas Instruments	Data General	Data General	Data General
Bus Support	TILINE	BMC, DCH	Data Channel	Data Channel
Device Emulation	979A, MT1600/3200	DG 6026, 4307	606X, 616X, 6122, 6214	606X, 616X, 6122, 6214
Size of Buffer	256 Bytes	256 Bytes	2 Sectors	2 Sectors
Minimum Interleave	N/A	N/A	1:1	1:1
PHYSICAL CHARACTERISTICS				
Form Factor	One 10.8" x 14.2" Board	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board
Power Supply	+5V DC @ 3.0A Typ	+5V DC @ 6.0A Typ	+5V DC @ 6.3A Typ -5V DC @ 0.7A Typ	+5V DC @ 6.3A Typ -5V DC @ 0.7A Typ
Availability	Now	Now	Now	3Q 1985
OEM Price (U.S.)/QTY	$1,675/1's	$1,995/1's	$3,200/1's	$3,495/1's
COMMENTS	Tri Density Tape Coupler Supports 990/BS600/800 Series Computers	Tri Density Tape Coupler 2 MB/sec Tape Speeds		

MANUFACTURER	ZETACO, INC.	ZETACO, INC.	ZETACO, INC.	ZETACO, INC.
MODEL NUMBER	990-SMD+	ZDF-1	BMX-3	BMX-1
CONTROLLER TYPE	Winchester Only (8 or 14 inch)	Multifunction (Winchester/Tape)	Winchester Only (8 or 14 inch)	Winchester Only (8 or 14 inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD (2 MBytes/sec)	SMD (2 MBytes/sec), Pertec (Tape)	SMD (2.5 MBytes/sec)	SMD (2 MBytes/sec)
Maximum # Drives	4 Winchesters	4 Winchesters, 8 Tape Drives	4 Winchesters	4 Winchesters
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Programmable
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
Minicomputer	Texas Instruments	Data General	Data General	Data General
Bus Support	TILINE	Data Channel	BMC	BMC, DCH
Device Emulation	CD1400, DS80/300	606X, 616X, 6021, 6125	606X, 616X, 6122, 6214	DG 606X, 6122, 616X
Size of Buffer	2 Sectors	2 Sectors, 1K (Tape)	3 Sectors	3 Sectors
Minimum Interleave	1:1	1:1	1:1	1:1
PHYSICAL CHARACTERISTICS				
Form Factor	One 10.8" x 14.2" Board	One 15" x 15" Board	One 15" x 15" Board	One 15" x 15" Board
Power Supply	+5V DC @ 5.2A Typ -12V DC @ 0.17A Typ	+5V DC @ 8.0A Max -5V DC @ 0.5A Max	+5V DC @ 8.0A Typ -5V DC @ 0.45A Typ	+5V DC @ 8.0A Typ -5V DC @ 0.5A Typ
Availability	Now	Now	2Q 1985	Now
OEM Price (U.S.)/QTY	$3,500/1's	$4,195/1's	$4,500/1's	$4,500/1's
COMMENTS	Supports TI990, BS600, BS800 Computers	Tri Density Tape Coupler		

MANUFACTURER	CENTRAL DATA CORP	CENTRAL DATA CORP	CENTRAL DATA CORP	CENTRAL DATA CORP
MODEL NUMBER	CD21/4015	CD21/4055	CD21/4120	CD21/4130
CONTROLLER TYPE	Floppy Only (8 Inch)	Floppy Only (5-1/4 Inch)	Floppy Only (5-1/4 or 8 Inch)	Floppy Only (5-1/4 or 8 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SA850	SA450	SA850/450	SA850/450
Maximum # Drives	4 Floppies	4 Floppies	Four 5-1/4 Inch and Four 8 Inch Concurrently	Four 5-1/4 Inch and Four 8 Inch Concurrently
Sector Sizes -Bytes	256 Through 1K	256 Through 1K	256 Through 1K	256 Through 1K
Error Detection	N/A	N/A	N/A	N/A
Error Correction	N/A	N/A	N/A	N/A
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
Support Level	D8/M24 (Master)	D8/M24 (Master)	D8/M24 (Master)	D8/M24 (Master)
Size of Buffer	N/A	None	One Sector	One Track
Host Transfer Rate	N/A	N/A	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches
Power Supply	+5V DC @ 1.6A Max +/-12V DC @ 0.01A Max	+5V DC @ 1.6A Max +12V DC @ 0.01A Max	+5V DC @ 4.4A Max +12V DC @ 0.02A Max	+5V DC @ 4.4A Max +12V DC @ 0.02A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$435/1's	$435/1's	$1,040/1's	$1,185/1's
COMMENTS	Single/Double Density		Single or Double Sided, Single or Double Density	Single or Double Sided, Single or Double Density

MANUFACTURER	COMARK CORPORATION	INTEL	INTEL	INTEL
MODEL NUMBER	MF85	iSBC 204	iSBC 208	iSBX 218A
CONTROLLER TYPE	Floppy Only (5-1/4 or 8 Inch)	Floppy Only (5-1/4 or 8 Inch)	Floppy Only (5-1/4 or 8 Inch)	Floppy Only (5-1/4 or 8 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SA850/460	SA850/400	SA850/400	SA850/400
Maximum # Drives	Four 8 Inch and Three 5-1/4" Floppies	2 (Single Sided), 1 (Double Sided)	4 Floppies	4 Floppies
Sector Sizes -Bytes	Programmable	256 Through 1K	256 Through 4K	128 Through 4K
Error Detection	N/A	CRC	N/A	CRC
Error Correction	N/A	N/A	N/A	N/A
Flaw Skipping	N/A	N/A	N/A	N/A
HOST CHARACTERISTICS				
Support Level	20 Bit Addressing	N/A	On Board iSBX Expansion	N/A
Size of Buffer	None	N/A	N/A	N/A
Host Transfer Rate	N/A	N/A	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 7.5 inches Width: 3.15 inches Height: 0.83 inches
Power Supply	+5V DC @ 2.5A Max +12V DC @ 1.0A Max	+5V DC @ 2.5A Max	+5V DC @ 3.0A Max	+5V DC @ 1.7A Max
Availability	Now	Now	Now	Now
Price (U.S.)/QTY	$695/1's	$860/1's	$1,170/1's	$540/1's
COMMENTS	Supports Dual Density/ Dual Sided Floppies, Has On Board Math Processor	Single Density Only, Option to Double # of Drives	Single or Double Sided, Single or Double Density	Provides Backup For iSBC215 Winchester Controller

MANUFACTURER	INTERPHASE	CENTRAL DATA CORP	CIPRICO INC	CIPRICO INC
MODEL NUMBER	SDC 2203	CD21/4300	Rimfire 44A	Rimfire 45A
CONTROLLER TYPE	Floppy Only (5-1/4 or 8 Inch)	Multifunction (Winchester/Floppy/Tape)	Multifunction (Winchester/Tape)	Multifunction (Winchester/Tape)
DRIVE CHARACTERISTICS				
Drive interface	SA850/460	ST506 (Winch), SA850/450 (Floppy), QIC-02 (Tape)	ANSI BSR X3.101 (Disk), QIC-02 (Tape)	ANSI BSR X3.101 (Disk), Pertec (Tape)
Maximum # Drives	4 Floppies	4 Winchesters, 4 Tapes 4 Floppies	8 Winchesters, 4 Tapes	8 Winchesters, 4 Tape Drives
Sector Sizes -Bytes	256 Through 1K	128 Through 1K	128 Through 1K	128 Through 1K
Error Detection	N/A	32 Bit ECC	32 Bit ECC	N/A
Error Correction	N/A	11 Bit Burst	5 Bit Burst	N/A
Flaw Skipping	N/A	Track Level	N/A	N/A
HOST CHARACTERISTICS				
Support Level	None	D16/M24 (Master)	24 Bit Addressing	24 Bit Addressing
Size of Buffer	None	2K (Std), 8K (Optional)	None	None
Host Transfer Rate	N/A	10 MB/sec	N/A	N/A
Minimum Interleave	N/A	1:1	N/A	N/A
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches
Power Supply	+5V DC @ 3.0A Max	+5V DC @ 3.9A Max	+5V DC @ 2.5A Typ	+5V DC @ 2.5A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,795/1's	$1,300/1's	$1,995/1's	$2,095/1's
COMMENTS	Also has SCSI port And On Board Cache, Single or Double Density	Optimized for Unix, On Board Cache, Optional iLBx DMA Interface	Auto Backup/Restore	

MANUFACTURER	DATA TECHNOLOGY CORP	DATA TECHNOLOGY CORP	INTEL	INTERPHASE
MODEL NUMBER	5286	5486	iSBC 214	STORAGER
CONTROLLER TYPE	Multifunction (Winchester/Floppy)	Multifunction (Winchester/Floppy/Tape)	Multifunction (Winchester/Floppy/Tape)	Multifunction (Winchester/Floppy/Tape)
DRIVE CHARACTERISTICS				
Drive interface	ST506 (Winchester), SA450 (Floppy)	ST506 (Winch), SA450 (Floppy), QIC-02 (Tape)	ST506 (Winch), SA450 (Floppy), QIC-02 (Tape)	ST506/412HP/ESDI (Winch) SA460 (Floppy), QIC-02
Maximum # Drives	2 Winchesters, 2 Floppies	2 Winchesters, 2 Floppy, 1 Cartridge Tape	2 Winchesters, 4 Floppies, 4 Tapes	2 Winchesters, 2 Floppy, 2 Tape Drives
Sector Sizes -Bytes	128 Through 1K	128 Through 1K	128 Through 1K	128 Through 1K
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	Track Level	Track Level	N/A	Track Level
HOST CHARACTERISTICS				
Support Level	8/16 Data, 16/20/24 Add	8/16 Data, 16/20/24 Add	20/24 Bit Addressing	24 Bit Addressing
Size of Buffer	N/A	16K	32K Cache	16K
Host Transfer Rate	1.6 MB/sec	1.6 MB/sec	N/A	3 MB/sec DMA
Maximum Interleave	Programmable	1:1	N/A	1:1
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches
Power Supply	+5V DC @ 4.6A Max	+5V DC @ 4.0A Max	+5V DC @ 4.5A Max	+5V DC @ 5.0A Max +/-12V DC @ 0.05A Max
Availability	Now	Now	Now	Now
Price (U.S.)/QTY	$620/1's	$780/1's	$1,450/1's	$1,695/1's
COMMENTS			iRMX/XENIX Support	Unix Optimized, On Board Cache, Image Backup

MANUFACTURER	KONAN	MINI COMPUTER TECH	QUALOGY	QUALOGY
MODEL NUMBER	Taisho 6000	MCT 4510	MicroCHARGE 5214	Ramtrac 5217
CONTROLLER TYPE	Multifunction (Winchester/Floppy)	Multifunction (Winchester/Tape)	Multifunction (Winchester/Floppy)	Multifunction (Winchester/Floppy/Tape)
DRIVE CHARACTERISTICS				
Drive interface	ST506, SA850/SA450, FloppyTape	ST506, QIC-02	ST506 (Winchester), SA460 (Floppy)	ST506 (Winch), SA460 (Floppy), QIC-02 (Tape)
Maximum # Drives	4 Winchesters, 4 Floppy, or 1 Floppy+1 FloppyTape	3 Winchesters, 4 Cartridge Tapes	2 Winchesters, 2 Floppies	2 Winch, 2 Floppies, 1 Tape
Sector Sizes -Bytes	128, 256, or 512	Programmable	128 Through 1K	128 Through 1K
Error Detection	CRC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	ECC (Winch)	5 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	N/A	Sector Level	N/A	N/A
HOST CHARACTERISTICS				
Support Level	24 Bit Addressing	24 Bit Addressing	24 Bit Addressing	24 Bit Addressing
Size of Buffer	N/A	N/A	N/A	N/A
Host Transfer Rate	N/A	N/A	N/A	N/A
Minimum Interleave	N/A	1:1	1:1	1:1
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 7.10 inches Width: 12.0 inches Height: 0.600 inches	Length: 7.10 inches Width: 12.0 inches Height: 0.600 inches
Power Supply	+5V DC @ 4.0A Max +12V DC @ 0.1A Max	+5V DC @ 2.5A Max +/-12V DC @ 0.05A Max	+5V DC @ 6.0A Max +12V/-5V DC @ 0.1A Max	+5V DC @ 6.0A Max -5/+12V DC @ 0.1A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$795/1's	$1,165/1's	$1,145/1's	$1,345/1's
COMMENTS			4 Arbitration Modes	

MANUFACTURER	QUALOGY	QUALOGY	QUALOGY	SCIENTIFIC MICRO SYSTEMS
MODEL NUMBER	Ramtrac 5317	Ramtrac 6217	Ramtrac 7217	FWD 8001
CONTROLLER TYPE	Multifunction (Winchester/Floppy/Tape)	Multifunction (Winchester/Floppy/Tape)	Multifunction (Winchester/Floppy/Tape)	Multifunction (Winchester/Floppy)
DRIVE CHARACTERISTICS				
Drive interface	ESDI (Winch), SA460 (Floppy), QIC-02 (Tape)	ST506 (Winch), SA850 (Floppy), QIC-02 (Tape)	SA1000 (Winch), SA850 (Floppy), QIC-02 (Tape)	SA1000 (Winchester), SA850 (Floppy)
Maximum # Drives	2 Winch, 2 Floppies, 1 Tape	2 Winch, 2 Floppies, 1 Tape	2 Winch, 2 Floppies, 1 Tape	2 Winchesters, 2 Floppies
Sector Sizes -Bytes	128 Through 1K	128 Through 1K	128 Through 1K	128 Through 1K
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	6 Bit Burst Correction
Flaw Skipping	N/A	N/A	N/A	Track Level
HOST CHARACTERISTICS				
Support Level	24 Bit Addressing	24 Bit Addressing	24 Bit Addressing	16/20/24 Bit Addressing
Size of Buffer	N/A	N/A	N/A	N/A
Host Transfer Rate	N/A	N/A	N/A	N/A
Minimum Interleave	1:1	1:1	1:1	N/A
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 7.10 inches Width: 12.0 inches Height: 0.600 inches	Length: 7.10 inches Width: 12.0 inches Height: 0.600 inches	Length: 7.10 inches Width: 12.0 inches Height: 0.600 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches
Power Supply	+5V DC @ 6.0A Max -5/+12V DC @ 0.1A Max	+5V DC @ 6.0A Max +12V/-5V DC @ 0.1A Max	+5V DC @ 6.0A Max -5/-12/+12V DC @ 0.1A	+5V DC @ 5.0A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,495/1's	$1,345/1's	$1,345/1's	$1,300/1's
COMMENTS				iSBC 215/iSBX 218 Compatible

MANUFACTURER	SCIENTIFIC MICRO SYSTEMS	SCIENTIFIC MICRO SYSTEMS	SCIENTIFIC MICRO SYSTEMS	WESPERCORP
MODEL NUMBER	FWD 8006	FWD 8007	FWD 8008	MB506/1000
CONTROLLER TYPE	Multifunction (Winchester/Floppy)	Multifunction (Winchester/Floppy/Tape)	Multifunction (Winchester/Floppy/Tape)	Multifunction (Winchester/Floppy)
DRIVE CHARACTERISTICS				
Drive interface	ST506, SA850/450	ST506 (Winch), SA850/450 (Floppy), QIC-02 (Tape)	ESDI (Winch), SA850/450 (Floppy), QIC-02 (Tape)	SA1000/ST506 (Winch), SA450 (Floppy)
Maximum # Drives	2 Winchesters, 2 Floppies	2 Winchesters, 2 Floppies, 1 Tape	2 Winchesters, 2 Floppies, 1 Tape	3 Winchesters, 4 Floppies
Sector Sizes -Bytes	128 Through 1K	128 Through 1K	128 Through 1K	128 Through 1K
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit ECC
Error Correction	6 Bit Burst Correction	6 Bit Burst	6 Bit Burst Correction	11 Bit Burst
Flaw Skipping	Track Level	Track Level	Track Level	N/A
HOST CHARACTERISTICS				
Support Level	16/20/24 Bit Addressing	16/20/24 Bit Addressing	16/20/24 Bit Addressing	8/16 Bit Data Path
Size of Buffer	N/A	N/A	One Track	1K
Host Transfer Rate	N/A	N/A	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	Programmable
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches
Power Supply	+5V DC @ 5.2A Max	+5V DC @ 5.0A Typ	+5V DC @ 5.0A Typ	+5V DC @ 3.5A Typ
Availability	Now	Q4 1985	Q1 1986	Now
OEM Price (U.S.)/QTY	$1,200/1's	$1,000/1's	$1,200/1's	$1,060/1's
COMMENTS	Intel iSBC215 Compatible	Intel iSBC214 Compatible	Intel iSBC214 Compatible	

MANUFACTURER	XYLOGICS	XYLOGICS	AVIV CORPORATION	CENTRAL DATA CORP
MODEL NUMBER	421	422	TFC 505	CD21/4029
CONTROLLER TYPE	Multifunction (Winchester/Tape)	Multifunction (Winchester/Tape)	Tape Only (9 Track)	Tape Only (1/4" Cartridge)
DRIVE CHARACTERISTICS				
Drive interface	ST506 (Winchester), QIC-02 (Tape)	ESDI (1.2 MBytes/sec), QIC-02 (Tape)	Pertec/STC	QIC-02
Maximum # Drives	2 Winchesters, 4 Tapes	2 Winchesters, 4 Tapes	4 Tape Drives	4 Tape Drives
Sector Sizes -Bytes	256 Through 1K	256 Through 1K	Up To 64K	512 Bytes
Error Detection	32 Bit CRC	32 Bit ECC	N/A (In the Formatter)	N/A (In the Formatter)
Error Correction	11 Bit Burst	11 Bit Burst	NA (In the Formatter)	NA (In the Formatter)
Flaw Skipping	N/A	Sector Level	Block Re-writes	Block Re-writes
HOST CHARACTERISTICS				
Support Level	N/A	N/A	24 Bit Addressing	D8/M24 (Master)
Size of Buffer	4K(Disk), 512(Tape)	4K(Disk), 512(Tape)	4K (32K Optional)	None
Host Transfer Rate	2.5 MB/sec (DMA)	2.5 MB/sec (DMA)	2.5 MB/sec	N/A
Minimum Interleave	1:1	1:1	N/A	N/A
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches
Power Supply	+5V DC @ 6.0A Max	+5V DC @ 6.0A Max	+5V DC @ 4.5A Max	+5V DC @ 1.8A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,695/1's	$1,795/1's	$3,800/1's	$310/1's
COMMENTS			Tri Density Tape Coupler Up To 200 ips Speeds	On Board DMA

MANUFACTURER	CIPRICO INC	CIPRICO INC	CIPRICO INC	CIPRICO INC
MODEL NUMBER	Pico-Mate	Quartermaster	Rimfire 75T	Tapemaster 1000
CONTROLLER TYPE	Tape Only (1/4" Cartridge)	Tape Only (1/4" Cartridge)	Tape Only (1/4 Inch Cartridge)	Tape Only (9 Track)
DRIVE CHARACTERISTICS				
Drive interface	Kennedy 6455	QIC-02	3M HCD-75	Pertec
Maximum # Drives	2 Tape Drives	4 Tape Drives	4 Tape Drives	8 Tape Drives
Sector Sizes -Bytes	N/A	512 Bytes	N/A	Up To 64K
Error Detection	N/A (In the Formatter)	N/A (In the Formatter)	N/A (In the Formatter)	N/A (In the Formatter)
Error Correction	NA (In the Formatter)	NA (In the Formatter)	NA (In the Formatter)	NA (In the Formatter)
Flaw Skipping	N/A	Block Re-writes	Block Re-writes	Block Re-writes
HOST CHARACTERISTICS				
Support Level	24 Bit Addressing	24 Bit Addressing	24 Bit Addressing	24 Bit Addressing
Size of Buffer	None	None	N/A	1K (4K Optional)
Host Transfer Rate	N/A	N/A	N/A	4 MB/sec
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches
Power Supply	+5V DC @ 2.5A Typ	+5V DC @ 2.0A Typ	+5V DC @ 2.5A Typ	+5V DC @ 5.0A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,190/1's	$550/1's	$995/1's	$1,890/1's
COMMENTS	Tapemaster Compatible, 1/2" Tape Emulation		On Board Back-up and Restore	Tri Density Tape Coupler Tape Speeds to 1.5MB/sec

MANUFACTURER	CIPRICO INC	COMARK CORPORATION	COMARK CORPORATION	INTEL
MODEL NUMBER	Tapemaster A	MT80	MT86	iSBX 217C
CONTROLLER TYPE	Tape Only (9 Track)	Tape Only (9 Track)	Tape Only (9 Track)	Tape Only (1/4" Cartridge)
DRIVE CHARACTERISTICS				
Drive interface	Pertec	Pertec	Pertec	QIC-02 or 3M HCD-75
Maximum # Drives	8 Tape Drives	8 Tape Drives	8 Tape Drives	4 Tape Drives
Sector Sizes -Bytes	Up To 64K	Up to 2K	Up To 65K	512 Bytes
Error Detection	N/A (In the Formatter)	N/A (In the Formatter)	N/A (In the Formatter)	N/A (In the Formatter)
Error Correction	NA (In the Formatter)	NA (In the Formatter)	NA (In the Formatter)	NA (In the Formatter)
Flaw Skipping	Block Re-writes	Block Re-writes	Block Re-writes	Block Re-writes
HOST CHARACTERISTICS				
Support Level	24 Bit Addressing	On Board DMA	24 Bit DMA	N/A
Size of Buffer	4-16K (Optional)	1K (8K Optional)	N/A	N/A
Host Transfer Rate	N/A	N/A	N/A	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 3.70 inches Width: 3.08 inches Height: 0.809 inches
Power Supply	+5V DC @ 3.0A Typ	+5V DC @ 3.5A Max	+5V DC @ 3.5A Max	+5V DC @ 2.0A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,790/1's	$895/1's	$895/1's	$495/1's
COMMENTS	Tri Density Tape Coupler Start/Stop or Streaming	Coupler For NRZ/PE Tape Drives, Up to 125 ips Speed	Coupler For NRZ/PE Tape Drives Up to 125 ips Speeds	Mates With iSBC 215, Up To 90 KB/sec Speed

MANUFACTURER	WESPERCORP	XYLOGICS	CIPRICO INC	CIPRICO INC
MODEL NUMBER	MB-QIC-2	472	Rimfire 1200	Rimfire 50
CONTROLLER TYPE	Tape Only (1/4 Inch Cartridge)	Tape Only (9 Track)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	QIC-02	Pertec	SMD (2.5 MBytes/sec)	SMD (1.8 MBytes/sec)
Maximum # Drives	4 Tape Drives	8 Tape Drives	4 Winchesters	4 Winchesters
Sector Sizes -Bytes	512 Bytes	Up To 2K	Programmable	Programmable
Error Detection	N/A (In the Formatter)	N/A (In the Formatter)	48 Bit ECC	48 Bit ECC
Error Correction	NA (In the Formatter)	NA (In the Formatter)	16 Bit Burst	16 Bit Burst
Flaw Skipping	Block Re-writes	Block Re-writes	N/A	N/A
HOST CHARACTERISTICS				
Support Level	8/16 Bit Data Path	16/20/24 Bit Address	24 Bit Addressing	24 Bit Addressing
Size of Buffer	2K	2K (8K Optional)	32K Cache	8-32K (Optional)
Host Transfer Rate	N/A	3 MB/sec DMA	N/A	N/A
Minimum Interleave	N/A	N/A	1:1	N/A
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches
Power Supply	+5V DC @ 2.0A Typ	+5V DC @ 5.0A Max	+5V DC @ 4.6A Typ -12V DC @ 0.6A Typ	+5V DC @ 4.0A Typ -5V DC @ 0.75A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$890/1's	$1,695/1's	$2,195/1's	$1,775/1's
COMMENTS		Tri Density Tape Coupler Up To 125 ips Speeds		

MANUFACTURER	DATA TECHNOLOGY CORP	INTEL	INTEL	INTEL
MODEL NUMBER	5186	iSBC 215	iSBC 2156	iSBC 220
CONTROLLER TYPE	Winchester Only (5-1/4 Inch)	Winchester Only (5-1/4, 8 or 14 Inch)	Winchester Only (5-1/4 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	ST506	ANSI X379/1226	ST506	SMD
Maximum # Drives	2 Winchesters	4 Winchesters	2 Winchesters	4 Winchesters
Sector Sizes -Bytes	128 Through 1K	128 Through 1K	Programmable	128 Through 1K
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	32 Bit Fire Code
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	Track Level	N/A	N/A	Track Level
HOST CHARACTERISTICS				
Support Level	8/16 Data, 16/20/24 Add	N/A	N/A	20 Bit Addressing
Size of Buffer	N/A	One Sector	One Sector	One Sector
Host Transfer Rate	1.6 MB/sec	N/A	N/A	N/A
Minimum Interleave	1:1	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches
Power Supply	+5V DC @ 4.0A Max	+5V DC @ 3.25A Max -5/+12V DC @ 0.15A Max	+5V DC @ 4.52A Max -5/+12V DC @ 0.15A Max	+5V DC @ 3.25A Max -5V DC @ 0.75A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$495/1's	$2,750/1's	$1,650/1's	$2,750/1's
COMMENTS		Mates with iSBC 217/218	Mates with iSBC 217/218, Configured as iSBC215 & A Data Separator Board	

MANUFACTURER	INTEL	INTERPHASE	INTERPHASE	INTERPHASE
MODEL NUMBER	iSBC 226	SMD 2180	SMD 2181	SMD 2190
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD (2 MBytes/sec)	SMD	SMD (2.4 MBytes/sec)	SMD (2.4 MByets/sec)
Maximum # Drives	2 Winchesters	4 Winchesters	4 Winchesters	4 Winchesters
Sector Sizes -Bytes	1024 Only	128, 256 or 512	Programmable	Programmable
Error Detection	32 Bit ECC	ECC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	8 Bit Burst	11 Bit Burst	11 Bit Burst
Flaw Skipping	Sector Level	Track Level	Bad Track Mapping	Track & Sector Level
HOST CHARACTERISTICS				
Support Level	24 Bit Addressing	20 Bit Addressing	24 Bit Addressing	24 Bit Addressing
Size of Buffer	One Sector	None	One Sector	16K
Host Transfer Rate	N/A	N/A	N/A	N/A
Minimum Interleave	1:1	N/A	2:1	1:1
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches
Power Supply	+5V DC @ 6.2A Max -12V DC @ 0.6A Max	+5V DC @ 3.75A Max -5V DC @ 0.6A Max	+5V DC @ 3.75A Max -5V DC @ 0.6A Max	+5V DC @ 3.75A Max -5V DC @ 0.6A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$2,700/1's	$1,995/1's	$2,250/1's	$2,250/1's
COMMENTS				Unix Optimized, On Board Cache

MANUFACTURER	INTERPHASE	MINI COMPUTER TECH	MINI COMPUTER TECH	WESPERCORP
MODEL NUMBER	WDC 2881	MCT 4300	MCT 4500	MB-SMD
CONTROLLER TYPE	Winchester Only (8 Inch)	Winchester Only (8 or 14 Inch)	Winchester Only (5-1/4 or 8 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	ANSI	SMD	SA1000/ST506	SMD (2.1 MBytes/sec)
Maximum # Drives	4 Winchesters	4 Winchesters	4 Winchesters	4 Winchesters
Sector Sizes -Bytes	Programmable	Programmable	Programmable	Programmable
Error Detection	32 Bit ECC	16 Bit CRC	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	Retry	5 Bit Burst	11 Bit Burst
Flaw Skipping	Track Level	Sector Level Map	Sector Level	Track Level
HOST CHARACTERISTICS				
Support Level	24 Bit Addressing, DMA	24 Bit Addressing	24 Bit Addressing	8/16 Bit Data Path
Size of Buffer	None	N/A	N/A	1.5KB
Host Transfer Rate	N/A	N/A	N/A	N/A
Minimum Interleave	Software Selectable	1:1	1:1	Programmable
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches
Power Supply	+5V DC @ 3.75A Max	+5V DC @ 4.5A Max -12V DC @ 1.0A Max	+5V DC @ 2.5A Max +/-12V DC @ 0.05A Max	+5V DC @ 7.0A Max -12V DC @ 0.75A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,695/1's	$1,035/1's	$1,035/1's	$2,100/1's
COMMENTS				Intel iSBC220 Compatible

MANUFACTURER	XYLOGICS	XYLOGICS		
MODEL NUMBER	450	451		
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Winchester Only (8 or 14 Inch)		
DRIVE CHARACTERISTICS				
Drive interface	SMD (1.9 MBytes/sec)	SMD (2.4 MBytes/sec)		
Maximum # Drives	4 Winchesters	4 Winchesters		
Sector Sizes -Bytes	128 Through 1K	256 Through 1K		
Error Detection	32 Bit ECC	32 Bit ECC		
Error Correction	11 Bit Burst	11 Bit Burst		
Flaw Skipping	Sector Level	Sector Level		
HOST CHARACTERISTICS				
Support Level	16/20/24 Bit Addressing	16/20/24 Bit Addressing		
Size of Buffer	2K (8K Optional)	2K (8K Optional)		
Host Transfer Rate	3 MB/sec DMA	3 MB/sec DMA		
Minimum Interleave	1:1	1:1		
PHYSICAL CHARACTERISTICS				
Physical Dimensions	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches	Length: 6.75 inches Width: 12.0 inches Height: 0.500 inches		
Power Supply	+5V DC @ 6.0A Max -5V DC @ 0.6A Max	+5V DC @ 6.0A Max -5V DC @ 0.6A Max		
Availability	Now	Now		
OEM Price (U.S.)/QTY	$2,295/1's	$2,495/1's		
COMMENTS				

MANUFACTURER	BASU INC	BASU INC	DATA-SUD SYSTEMS	DATA-SUD SYSTEMS
MODEL NUMBER	FDC-01	FDC-02	DSSE FDCONT-1	DSSE HDCONT-1
CONTROLLER TYPE	Floopy Only (5-1/4 or 8 inch)	Floppy Only (5-1/4 or 8 inch)	Floppy Only (5-1/4 or 8 inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SA850/460	SA850/460	SA850/460	SMD
Maximum # Drives	4 Floppies	4 Floppies	2 Floppies	2 Winchesters
Sector Sizes -Bytes	256-1K	256-1K	256-1K	128-1K
Error Detection	CRC	CRC	N/A	N/A
Error Correction	N/A	N/A	N/A	N/A
Flaw Skipping	N/A	N/A	N/A	N/A
VMEBUS CHARACTERISTICS				
Support Level	Interrupter	N/A	N/A	8/16 Bit Data Paths
Size of Buffer	2K RAM, 8K EPROM	4K	4K (Optional)	128 Bytes
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Dual High Eurocard	Piggy Back Board	Dual High Eurocard	Two Dual High Eurocards
Power Supply	+5V DC @ 4.0A Typ	+5V DC @ 1.0A Max	+5V DC @ 1.2A Max +12V DC @ 0.025A Max	+5V DC @ 5.0A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,426/1's	$350/1's	$895/1's	$2,140/1's
COMMENTS	Single/Double Density, Optional SASI Port	Single/Double/Quad Density	EXORdisk III Compatible, Single/Dual Sided, Single/Dual Density	

MANUFACTURER	DUAL SYSTEMS	DUAL SYSTEMS	DY-4 SYSTEMS INC	DY-4 SYSTEMS INC
MODEL NUMBER	Optimatrack 32	V9TRK	DVME 712	DVME 715
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Tape Only (9 Track)	Floppy Only (5-1/4 or 8 Inch)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD (2.4 MBytes/sec)	Pertec	SA850/460	SMD (2.4 MBytes/sec)
Maximum # Drives	3 Winchesters	8 Tapes	4 Floppies	2 Winchesters
Sector Sizes -Bytes	512-4K	Up To 64K	256-1K	Programmable
Error Detection	32 Bit ECC	N/A (In The Formatter)	N/A	32 Bit ECC
Error Correction	11 Bit Burst	N/A (In The Formatter)	N/A	11 Bit Burst
Flaw Skipping	N/A	Block Re-writes	N/A	N/A
VMEBUS CHARACTERISTICS				
Support Level	24/32 Bit Addressing	24/32 Bit Addressing	8/16 Bit Data Paths	Requester/ Interrupter
Size of Buffer	512K	Two 512 Byte FIFOs	64K DRAM	64K DRAM
Minimum Interleave	1:1	N/A	N/A	1:1
PHYSICAL CHARACTERISTICS				
Form Factor	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard
Power Supply	15V DC @ 3.0A Max -12V DC @ 0.5A Max	+5V DC @ 5.0A Typ	+5V DC @ 4.0A Max +/-12V DC @ 0.15A Max	+5V DC @ 6.0A Max
Availability	Q3 1985	Q3 1985	Now	Now
OEM Price (U.S.)/QTY	$2,990/1's	$1,250/1's	$1,450/1's	$2,697/1's
COMMENTS		Tri Density Tape Coupler	On Board DMA Control, On Board SIO, SASI and RS-232 Ports	On Board DMA Control, On Board Track Buffer Sockets for EPROM (32K)

MANUFACTURER	DY-4 SYSTEMS INC	ELECTRONIC MODULAR SYSTEMS	ELECTRONIC MODULAR SYSTEMS	FORCE COMPUTERS
MODEL NUMBER	SVME 716	HD-1	MTC-1	SYS68K/WFC-1
CONTROLLER TYPE	Tape Only (9 Track)	Winchester Only (5-1/4 Inch)	Tape Only (9 Track)	Multifunction (Winchester/Floppy)
DRIVE CHARACTERISTICS				
Drive interface	Pertec	ST506	Pertec	ST506 (Winchester), SA460 (Floppy)
Maximum # Drives	2 Tapes	4 Winchesters	2 Tapes	3 Winchesters, 4 Floppies
Sector Sizes -Bytes	Up To 2K	128-1K	N/A	128-1K
Error Detection	N/A (In The Formatter)	32 Bit Fire Code	N/A (In The Formatter)	32 Bit ECC
Error Correction	N/A (In The Formatter)	11 Bit Burst	N/A (In The Formatter)	5 Bit Burst
Flaw Skipping	Block Re-writes	N/A	Block Re-writes	N/A
VMEBUS CHARACTERISTICS				
Support Level	32 Bit Addressing	Interrupter	8/16 Bit Data Paths	A32:D16, A24:D16
Size of Buffer	128K (512K Optional)	Two sectors	128K	One Sector
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard
Power Supply	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max	+5V DC @ 5.0A Max	+5V DC @ 3.0A Max
Availability	Q1 1985	Now	Now	Now
OEM Price (U.S.)/QTY	$2,100/1's	$1,495/1's	$1,850/1's	$1,380/1's
COMMENTS	On board DMA control Sockets for EPROM (64K) Tri Density Coupler	On board DMA Control Optimized for Unix Double Eurocard		

MANUFACTURER	GENERAL MICRO SYSTEMS	HAMILTON STD DIG SYSTEMS (FORMERLY MOSTEK)	HAMILTON STD DIG SYSTEMS (FORMERLY MOSTEK)	INTEGRATED SOLUTIONS
MODEL NUMBER	GMS V09	MK 75803	MK 75805	VME-QIC2/8
CONTROLLER TYPE	Multifunction (Winchester/Floppy)	Floppy Only (5-1/4 or 8 inch)	Winchester Only (8 or 14 Inch)	Tape Only (1/4 Inch Cartridge)
DRIVE CHARACTERISTICS				
Drive interface	ST506 (Winchester), SA460 (Floppy)	SA850/460	SMD (3 MBytes/sec)	QIC-02
Maximum # Drives	3 Winchesters, 4 Floppies	4 Floppies	2 Winchesters	1 Tape
Sector Sizes -Bytes	128-1K	256-1K	Programmable	512 Bytes
Error Detection	32 Bit ECC	N/A	32 Bit ECC	N/A (In The Formatter)
Error Correction	11 Bit Burst	N/A	11 Bit Burst	N/A (In The Formatter)
Flaw Skipping	N/A	N/A	N/A	Block Re-writes
VMEBUS CHARACTERISTICS				
Support Level	N/A	Master/Slave A24/D16	16/24/32 Bit Addressing	N/A
Size of Buffer	512K	256 Bytes	12K Cache	32K Cache
Minimum Interleave	N/A	N/A	1:1	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard
Power Supply	+5V DC @ 2.5A Typ	+5V DC @ 3.0A Max	+5V DC @ 3.0A Typ -12V DC @ 0.5A Typ	+5V DC @ 2.0A Max
Availability	Q4 1985	Now	Now	Now
OEM Price (U.S.)/QTY	$2,995/1's	$714/1's	$2,260/1's	$2,000/1's
COMMENTS		Single/Double Sided, Single/Double Density Floppies		Also Has On Board RS232 Serial Ports And Real Time Clock

MANUFACTURER	INTEGRATED SOLUTIONS	INTERPHASE CORPORATION	INTERPHASE CORPORATION	IRONICS INC
MODEL NUMBER	VME-TC 50	V/SMD 3200	V/TAPE 3209	IV-3275
CONTROLLER TYPE	Tape Only (1/4 Inch Cartridge)	Winchester Only (8 or 14 Inch)	Tape Only (9 Track)	Winchester Only (8 or 14 Inch)
DRIVE CHARACTERISTICS				
Drive interface	QIC-02	SMD (3 MBytes/sec)	Pertec	SMD (3 MBytes/sec)
Maximum # Drives	2 Tapes	2 Winchesters	8 Tapes	2 Winchesters
Sector Sizes -Bytes	Up To 64K	Programmable	Up To 64K	Programmable
Error Detection	N/A (In The Formatter)	32 Bit ECC	N/A (In The Formatter)	32 Bit ECC
Error Correction	N/A (In The Formatter)	11 Bit Burst	N/A (In The Formatter)	11 Bit Burst
Flaw Skipping	Block Re-writes	N/A	Block Re-writes	N/A
VMEBUS CHARACTERISTICS				
Support Level	N/A	32 Bit Data/ Address	32 Bit Data/ Address	Master, Interrupter
Size of Buffer	N/A	12K	8K (128K Optional)	N/A
Miniaum Interleave	N/A	1:1	N/A	1:1
PHYSICAL CHARACTERISTICS				
Form Factor	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard
Power Supply	+5V DC @ 2.0A Max	+5V DC @ 3.0A Max -12V DC @ 0.5A Max	+5V DC @ 4.0A Typ	+5V DC @ 5.0A Max
Availability	Now	Now	Q4 1985	Q2 1985
OEM Price (U.S.)/QTY	$2,000/1's	$2,995/1's	$1,795/1's	$2,995/1's
COMMENTS		On Board DMA & Cache	Tri Density Tape Coupler	On board DMA & Cache, Unix Optimized

MANUFACTURER	MICROPROJECT CORPORATION	MICROPROJECT CORPORATION	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)
MODEL NUMBER	2501-7509-7	2501-7550-2	MCT 6020	MCT 6090
CONTROLLER TYPE	Tape Only (9 Track)	Winchester Only (8 or 14 Inch)	Tape Only (9 Track)	Tape Only (1/4 Inch Cartridge)
DRIVE CHARACTERISTICS				
Drive interface	Pertec	SMD	Pertec	DEI Funnel
Maximum # Drives	2 Tapes	2 Winchesters	8 Tapes	1 Tape
Sector Sizes-Bytes	N/A	Programmable	Up To 64K	N/A
Error Detection	N/A (In The Formatter)	N/A	N/A (In The Formatter)	CRC
Error Correction	N/A (In The Formatter)	N/A	N/A (In The Formatter)	HDLC Type
Flaw Skipping	Block Re-writes	N/A	Block Re-writes	N/A
VMEBUS CHARACTERISTICS				
Support Level	B/16/32 Bit Data Paths	N/A	Arbiter, Interrupter	N/A
Size of Buffer	4K	2K	16,32 or 64K	N/A
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard
Power Supply	+5V DC @ 2.6A Typ	+5V DC @ 2.6A Typ -12V DC @ 0.4A Typ	+5V DC @ 3.0A Max	+5V DC @ 3.0A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$1,595/1's	$2,695/1's	$2,075/1's	$545/1's
COMMENTS	Coupler Only	On Board 16 bit DMA	Tri Density Tape Coupler Up To 200 ips Speeds	Supports 30/90 ips Tape Speeds

MANUFACTURER	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)	MINI COMPUTER TECHNOLOGY (DIV. E-H INTERNATIONAL)	MIZAR CORPORATION	MIZAR CORPORATION
MODEL NUMBER	MCT 6600	MCT 6700	VME 7400	VME 8400
CONTROLLER TYPE	Multifunction (Winchester/Tape)	Multifunction (Winchester/Tape)	Multifunction (Winchester/Floppy)	Floppy Only (5-1/4 or 8 inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD (3 MBytes/sec), Fujitsu 2415A/EPI (Tape)	ESDI (Winchester), Fujitsu 2451A/EPI (Tape)	ST506 (Winchester), SA460 (Floppy)	SA850/460
Maximum # Drives	2 Winchesters, 1 Tape	2 Winchesters, 1 Tape	4 Winchesters, 4 Floppies	4 Floppies
Sector Sizes -Bytes	Programmable	Programmable	128-1K	256-1K
Error Detection	32/48 Bit ECC	32/48 Bit ECC	32 Bit ECC	N/A
Error Correction	11 Bit Burst	11 Bit Burst	8 Bit Burst	N/A
Flaw Skipping	Sector Level	Sector Level	N/A	N/A
VMEBUS CHARACTERISTICS				
Support Level	16/32 Bit Data Transfers	16/32 Bit Data Transfers	N/A	Interrupter
Size of Buffer	32K Cache	32K Cache	Dual Ping Pong	None
Minimum Interleave	N/A	N/A	1:1	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard	Single High Eurocard
Power Supply	+5V DC @ 4.0A Max	+5V DC @ 4.0A Max	+5V DC @ 3.7A Typ	+5V DC @ 0.7A Typ
Availability	Q4 1985	Q3 1985	Q3 1985	Now
OEM Price (U.S.)/QTY	$2,075/1's	$2,075/1's	$2,295/1's	$400/1's
COMMENTS			On Board DMA	Single/Double Density, Single/Double Sided

MANUFACTURER	MOTOROLA INC	MOTOROLA INC	MOTOROLA INC	MOTOROLA INC
MODEL NUMBER	MVME 315	MVME 319	MVME 320	MVME 350
CONTROLLER TYPE	Floppy Only (5-1/4 or 8 inch)	Floppy Only (or FloppyTape)	Multifunction (Winchester/Floppy)	Tape Only (1/4 Inch Cartridge)
DRIVE CHARACTERISTICS				
Drive interface	SA850/460	SA850/460, or Cipher Floppy Tape	ST506 (Winchester), SA850/460 (Floppy)	QIC-02
Maximum # Drives	4 Floppies	1 FloppyTape+2 Floppies, or 4 Floppies	2 Winch/ 2 Floppies, or 4 Floppies	2 Tapes
Sector Sizes-Bytes	256-1K	256-1K	128-1K	512 Bytes
Error Detection	N/A	N/A	32 Bit ECC	N/A (In The Formatter)
Error Correction	N/A	N/A	11 Bit Burst	N/A (In The Formatter)
Flaw Skipping	N/A	N/A	Sector Level	Block Re-writes
VMEBUS CHARACTERISTICS				
Support Level	Requester/ Interrupter	N/A	Requester/ Interrupter	Requester/ Interrupter
Size of Buffer	2K-8K	32 KB	1K	16K
Minimum Interleave	N/A	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard
Power Supply	+5V DC @ 4.0A Max +/-12V DC @ 0.5A Max	+5V DC @ 4.6A Max +/-12V DC @ 0.05A max	+5V DC @ 2.6A Typ +/-12V DC @ 0.02A Typ	+5V DC @ 5.0A Typ
Availability	Now	Now	Now	Q4 1985
OEM Price (U.S.)/QTY	$1,295/1's	$1,395/1'S	$1,650/1's	$1,700/1's
COMMENTS	On Board DMA, SCSI Port For Hard Disk Control	On Board DMA, SCSI Port For Hard Disk Control		Two Serial Ports

MANUFACTURER	MOTOROLA INC	MOTOROLA INC	PLESSEY MICROSYSTEMS	SIGEN CORPORATION
MODEL NUMBER	MVME 360	MVME 435A	PME WFC-1	DC-5
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Tape Only (9 Track)	Multifunction (Winchester/Floppy)	Winchester Only (5-1/4 or 8 inch)
DRIVE CHARACTERISTICS				
Drive interface	SMD (3 MBytes/sec)	Pertec	ST506 (Winchester), SA850/460 (Floppy)	SA1000/ST506
Maximum # Drives	2 Winchesters	2 Tapes	3 Winchesters, 4 Floppies	4 Winchesters
Sector Sizes -Bytes	Programmable	Up to 2K	128-1K	128-1K
Error Detection	32 Bit ECC	N/A (In The Formatter)	32 Bit ECC	32 Bit ECC
Error Correction	11 Bit Burst	N/A (In The Formatter)	5 Bit Burst	11 Bit Burst
Flaw Skipping	Sector Level	Block Re-writes	N/A	N/A
VMEBUS CHARACTERISTICS				
Support Level	32 Bit Data/ Address	N/A	A32:D16, A24:D16	Master A24/D16
Size of Buffer	12K	4K	One Sector	512 Bytes
Minimum Interleave	1:1	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Dual High Eurocard	Single High Eurocard	Dual High Eurocard	Dual High Eurocard
Power Supply	15V DC @ 3.0A Max -12V DC @ 0.5A Max	+5V DC @ 5.0A Typ	+5V DC @ 3.0A Max	+5V DC @ 3.0A Typ -12V DC @ 0.5A Typ
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$3,200/1's	$875/1's	$1,141/1's	$1,200/1's
COMMENTS	On Board DMA & Cache	NRZ/PE Tape Drives, ips Speeds, Motorola I/O Channel Compatible		On Board DMA

MANUFACTURER	SIGEN CORPORATION	SIGNETICS CORPORATION	XYLOGICS	XYLOGICS
MODEL NUMBER	DC-7	SMVME 4300A	751	772
CONTROLLER TYPE	Winchester Only (8 or 14 Inch)	Multifunction (Winchester/Floppy)	Winchester Only (8 or 14 Inch)	Tape Only (9 Track)
DRIVE CHARACTERISTICS				
Drive interface	SMD	ST506 (Winchester), SA850/460 (Floppy)	SMD	Pertec
Maximum # Drives	2 Winchesters	2 Winchesters, 2 Floppies	2 Winchesters	1 Tape
Sector Sizes -Bytes	Programmable	128-1K	Programmable	Up To 64K
Error Detection	32 Bit ECC	32 Bit ECC	32 Bit ECC	N/A (In The Formatter)
Error Correction	11 Bit Burst	11 Bit Burst	11 Bit Burst	N/A (In The Formatter)
Flaw Skipping	N/A	N/A	N/A	Block Re-writes
VMEBUS CHARACTERISTICS				
Support Level	16/24/32 Bit Addressing	A24/D16 (M), A16/D8 (S)	32 Bit Data/ Address	32 Bit Data/ Address
Size of Buffer	64 Bit FIFO	N/A	8K	8K
Minimum Interleave	1:1	N/A	N/A	N/A
PHYSICAL CHARACTERISTICS				
Form Factor	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard	Dual High Eurocard
Power Supply	+5V DC @ 3.0A Typ -12V DC @ 0.5A Typ	+5V DC @ 3.0A Typ +/-12V DC @ 0.06A Typ	+5V DC @ 6.0A Max -5V DC @ 0.6A Max	+5V DC @ 5.0A Max
Availability	Now	Now	Now	Now
OEM Price (U.S.)/QTY	$2,400/1's	$1,450/1's	$2,695/1's	$1,795/1's
COMMENTS		Also Supports SyQuest Removable Winchester and Cipher's FloppyTape	Supports Scatter/Gather Command	Tri Density Tape Coupler Up To 200 ips Speeds

MANUFACTURER	DEC	Other Mini	Multibus	VMEbus	SASI/SCSI*	IBM-PC/XT/AT*	Host Adapter*	LSI*
Adaptive Data Systems					X		X	X
Advanced Elec. Design	X							
Advanced Storage Concepts					X			
Ampro Computers, Inc.					X			
Andromeda Systems	X							
Archive Corporation						X		
AVIV Corporation	X	X	X					
BASU, Inc.				X				
Bytronix Corporation		X						
Centan Corporation					X	X		
Central Data Corporation			X					
Ciprico, Inc.			X					
Comark Corporation			X					
Computer Storage Technology	X	X						
Data Technology Corp.			X		X	X	X	X
Data-Sud Systems				X				
Distributed Logic Corp.	X							
Distributed Processing					X			
Dual Systems				X				
DY-4 Systems, Inc.				X				
Electronic Modular				X				
Emulex Corporation	X				X		X	
Force Computers				X			X	
Fujitsu America, Inc.					X			
General Micro Systems				X				
General Robotics	X							
Hamilton Std. Dig. Systems				X				
Hitachi Ltd.								X
Integrated Solutions, Inc.				X			X	
Intel Corporation			X					X
Interphase Corporation			X	X		X		
Ironics, Inc.				X				
Konan Corporation			X		X	X		

MANUFACTURER	DEC	Other Mini	Multibus	VMEbus	SASI/SCSI*	IBM-PC/XT/AT*	Host Adapter*	LSI*
Macrolink, Inc.		X						
MDB Systems	X							
Micro Technology Inc.	X							
Microproject Corporation				X			X	
Mini Computer Technology	X	X	X	X				
Mizar, Incorporated				X			X	
Motorola, Inc.				X				
National Semiconductor								X
NCR Corporation					X		X	X
NEC Electronics USA								X
PEP Modular Computer							X	
Plessey Microsystems	X			X			X	
Qualogy	X		X					
Scientific Micro Systems	X		X		X	X	X	X
Sigen Corporation				X		X		
Sigma Information Systems	X						X	
Signetics Corporation				X				X
Spectra Logic Corporation	X	X						
Standard Microsystems Corp.								X
Sunol Systems						X		X
Sysgen Corporation					X			
TD Systems, Inc.							X	
Wangtek					X	X		
Webster Computer Corp.	X							
Wespercorp	X	X	X					
Western Digital Corp.					X	X		X
Xebec Corporation					X	X	X	
Xylogics			X	X				
Zetaco, Incorporated		X						

*Controller Concepts Volume I

MANUFACTURERS' PROFILES

Advanced Electronics Design, Inc.
440 Potrero Avenue
Sunnyvale, CA 94086
408-733-3555

AED offers multifunction and floppy controllers for DEC computers. The company's primary business is color graphics systems.

Andromeda Systems
9000 Eton Avenue
Canoga Park, CA 91304
213-709-7600

Founded in 1976, Andromeda is a supplier of a range of add-on products for DEC's microcomputers. Their controller offerings include winchester and multifunction products, including the newly announced controllers supporting the MSCP protocol.

Aviv Corporation
26 Cummings Park
Woburn, MA 01801
617-933-1165

Primarily a supplier of tri-density tape subsystems for minicomputers, Aviv offers disk and tape controllers for DEC, Data General and Multibus systems.

BASU, Inc.
2025 Gateway Place
Suite 200
San Jose, CA 95110
408-998-2888

Subsidiary of a German company, Basu is a supplier of VME system components, including floppy disk controllers.

Peripheral Concepts

Bytronix Corporation
2701 East Chapman
Fullerton, CA 92631
714-871-8763

The company offers Data General compatible disk and tape controllers. Bytronix also supplies add-on memory and other products for Data General computers.

Central Data Corporation
1602 Newton Drive
Champaign, IL 61820
217-359-8010

Founded in 1978, Central Data supplies a wide range of Multibus products, including floppy, tape and multifunction controllers. In late 1984, the company acquired the entire Multibus product line from Advanced Micro Devices. Central Data is also expected to enter the VMEbus market.

Ciprico Inc.
2955 Xenium Lane
Plymouth, MN 55441
612-559-2034

Founded in 1978 as Computer Products Corporation (CPC), Ciprico is the leading supplier of Multibus tape controllers. The company also offers multifunction controllers for the Multibus and recently introduced advanced SMD disk controllers.

Comark Corporation
93 West Street
Medfield, MA 02052
617-35-8161

Comark manufactures a line of Multibus compatible floppy and tape controllers.

Computer Storage Technology
Division of E.F. Industries
12624 Daphne Avenue
Hawthorne, CA 90250
213-777-4070

CST is a supplier of tape controllers and subsystems for DEC, Data General and IBM computers. These products were originally acquired from Datum Corporation.

Data-Sud Systems
2219 S. 48th Street, Ste J
Tempe, AZ 85282
602-345-0940

Data-Sud was one of the early entrants in the VMEbus market. The company offers floppy and winchester controllers for the VMEbus.

Data Technology Corporation
2775 Northwestern Parkway
Santa Clara, CA 95051
408-496-0434

DTC supplies a broad range of peripheral controllers. In addition to SCSI, which it co-invented, the company offers controllers for IBM-PC and Multibus. Their Multibus product line includes winchester and multifunction controllers.

Distributed Logic Corporation
1555 S. Sinclair Street
Anaheim, CA 92806
714-937-5700

Founded in 1978, Dilog is the leading supplier of controllers for DEC's Q-bus. The company is a supplier of captive controllers to DEC. Dilog also offers controllers for DEC's Unibus.

Dual Systems
2530 San Pablo Ave.
Berkeley, CA 94702
415-549-3854

Founded in 1979 as a computer system manufacturer, Dual Systems offers winchester and tape controllers for the VMEbus. The company also offers add-on products for the S-100 bus.

DY-4 Systems Inc.
1475 S. Bascom Avenue
Campbell, CA 95008
408-377-9822

DY-4 is a Canadian supplier of a broad range of VME products. The company's controller products include floppy, tape and winchester controllers.

Electronic Modular Systems
4546 Beltway
Dallas, TX 75234
214-392-3473

EMS is a supplier of VMEbus products. The company has recently introduced a winchester and a tape controller, both designed in Germany.

Emulex Corporation
3545 Harbor Blvd.
Costa Mesa, CA 92626
714-662-5600

Established in 1978, Emulex is the number one supplier of DEC compatible controllers. Their product line includes a variety of disk and tape controllers and subsystems for DEC's Q-bus and Unibus. The company also manufactures communications products for DEC and IBM-PC computers. Emulex is a supplier of controllers and subsystems for the SCSI bus.

Force Computers, Inc.
2041 Mission College
Ste. 150
Santa Clara, CA 95054
408-988-8686

Force is a leading supplier of VMEbus products. Their controller offering includes winchester and multifunction products. Although headquartered in California, most of Force's products are designed and produced in Germany.

General Micro Systems
4740 Brooks St.
Montclair, CA 91763
714-621-7532

GMS is a new entrant in the VMEbus controller market. The company offers a multifunction controller.

General Robotics
57 North Main Street
Hartford, WI 53027
414-673-6800

Now in its eleventh year of operation, General Robotics supplies controllers, subsystems and other add-ons for DEC's Q-bus. The company has a stong overseas business.

Hamilton Standard Digital Systems/United Technology
1215 West Crosby Road
Carrollton, TX 75006
214-466-7329

Formerly a part of Mostek, HSDS offers a full line of VMEbus products. The company markets a floppy and a winchester controller for the VMEbus.

Integrated Solutions Inc.
2240 Lundy Ave.
San Jose, CA 95131
408-943-1902

Integrated Solutions is a systems manufacturer. The company offers two tape controller products for the VMEbus.

Intel Corporation
5200 NE Elam Young Parkway
Hillsboro, OR 97123
503-640-7157

Intel is a leading manufacturer of semiconductors and the inventor of Multibus. Its OEM modules division offers Multibus based hardware, software and accessories. Their controller products include winchester, floppy and multifunction controllers.

Interphase
2925 Merrel Road
Dallas, TX 75229
214-350-9000

Incorporated in 1977, Interphase is a leading supplier of Multibus controllers. The company has also entered the VMEbus controller market with a tape and a disk controller that is being second sourced by two other vendors. Interphase also offers controller and subsystem products for the IBM-PC.

Ironics, Inc.
742 Cascadilla Street
Ithaca, NY 14850
607-277-4060

Ironics is a supplier of a range of products for the VMEbus including a winchester disk controller.

Konan Corporation
1425 North 27th Avenue
Phoenix, AZ 85009
602-269-2649

Founded in 1978, Konan is a supplier of controller boards for the Multibus, SCSI and IBM-PC markets.

Macrolink, Inc.
1150 E. Stanford Ct.
Anaheim, CA 92805
714-634-8080

Macrolink is a supplier of add-on products for Perkin-Elmer computers. The company is a leader in P-E compatible tape controllers and last year introduced a disk controller.

MDB Systems
1995 N. Batavia Street
Orange, CA 92665
714-998-6900

Formed in 1970 as a systems supplier, MDB Systems now offers controllers, interface modules and other hardware for DEC, Data

General, IBM Series/1, Multibus and Perkin-Elmer computers. Their controller products are limited to DEC Q-bus/Unibus compatible disk and tape controllers.

Micro Technology Inc.
1620 Miraloma Ave.
Placentia, CA 92670
213-544-7552

MTI manufactures controllers and subsystems for DEC's Q-bus. The company is a leading supplier of floppy controllers and also offers dual-wide winchester and tape controllers for the Q-bus.

Microproject Corp
3 Malaga Cove Plaza
Palos Verdes Estates, CA 90274
213-544-7552

Microproject is the U.S. arm of the Dutch company Manudax. Their controller products include disk and tape controllers for the VMEbus.

Mini Computer Technology
696 E. Trimble Road
San Jose, CA 95131
408-942-1616

Minicomputer Technology, a subsidiary of E-H International, is a supplier of controllers for a variety of minicomputers including DEC, Data General and Perkin-Elmer. The company has also entered the VMEbus controller market with tape and multifunction controllers.

Mizar Inc.
302 Chester Street
St. Paul, MN 55107
612-224-8941

Mizar is a full line supplier of VMEbus products. Their controller products include floppy and multifunction controllers.

Motorola
2900 S. Diablo Way
Tempe, AZ 85282
602-438-3006

Primarily a semiconductor manufacturer, Motorola co-developed the VMEbus. The company offers a wide range of VME products, and is the leading supplier of peripheral controllers.

Plessey Peripheral Systems, Inc.
17312 Gillette Avenue
Irvine, CA 92714
714-540-9115

Plessey Peripherals is a supplier of DEC compatible controllers and subsystems. The company recently announced several controllers supporting an architecture similar to the Digital Storage Architecture from DEC.

Qualogy
2241 Lundy Avenue
San Jose, CA 95131
408-946-5800

Founded in 1974 as Data Systems Design, the company is a supplier of controllers and a leader in subsystems for DEC's Q-bus. The company entered the Multibus compatible controller market in 1982 and now offers a line of multifunction controllers.

Scientific Micro Systems
339 N. Bernardo
Mt. View, CA 94048
415-964-5700

Primarily a supplier of subsystems for the DEC market, the company also offers multifunction controllers for Q-bus, Unibus and Multibus. With its acquisition of OMTI two years ago, SMS has become a leading supplier of SCSI and IBM-PC compatible controllers.

Sigen Corporation
1800 Wyatt Drive Ste 6
Santa Clara, CA 95054
408-988-2527

Sigen was an early entrant into the VMEbus controller market. The company licensed its products to other manufacturers and remained inactive in the market last year. Sigen will once again market VMEbus controllers this year.

Sigma Information Systems
6505C Serrano Avenue
Anaheim, CA 92807
714-632-0474

Sigma is a leading supplier of floppy disk controllers for DEC's Q-bus. The company also offers winchester controllers and other Q-bus compatible add-on products. Many of Sigma's products are licensed from other manufacturers.

Signetics
811 E. Arques Avenue
Sunnyvale, CA 94086
408-739-7700

Signetics, primarily a semiconductor manufacturer, offers a multifunction controller for the VMEbus. Signetics is part of the Dutch conglomerate Philips.

Spectra Logic Corp
297 North Bernardo Ave.
Mt. View, Ca 94043
415-964-2211

Founded in 1979, Spectra Logic was acquired by Cipher Data Products last year. The company offers peripheral controllers for DEC, Data General, Perkin-Elmer and Texas Instruments minicomputers. Spectra is a leader in multifunction controllers, particularly in the Data General and Texas Instruments markets.

Webster Computer Corp.
333 Cobalt Way
Suite 106
Sunnyvale, CA 94086
408-749-1089

Webster is a supplier of dual-width controller boards for DEC's Q-bus. Their current offerings include winchester and tape controllers.

Webster has licensed its products to other companies in the DEC compatible market.

Wespercorp
14511 New Myford Road
Tustin, CA 92680
714-730-6250

Founded in 1975 as Western Peripherals, the company offers disk, tape and multifunction controllers for DEC, Data General, Perkin-Elmer and Multibus computers. Wespercorp is a leading supplier of printer controllers for minicomputers.

Xylogics
144 Middlesex Tpke.
Burlington, MA 01803
617-272-8140

Established in 1975, Xylogics is a leading supplier of Multibus controllers. Their product line includes disk, tape and multifunction controllers. This year, the company announced its support for Multibus-II and also introduced peripheral controllers for the VMEbus.

Zetaco, Inc.
6850 Shady Oak Road
Eden Prairie, MN 55344
612-941-9480

Founded as Custom Systems in 1972, Zetaco is a leading supplier of disk, tape and multifunction controllers for Data General and Texas Instruments minicomputers.