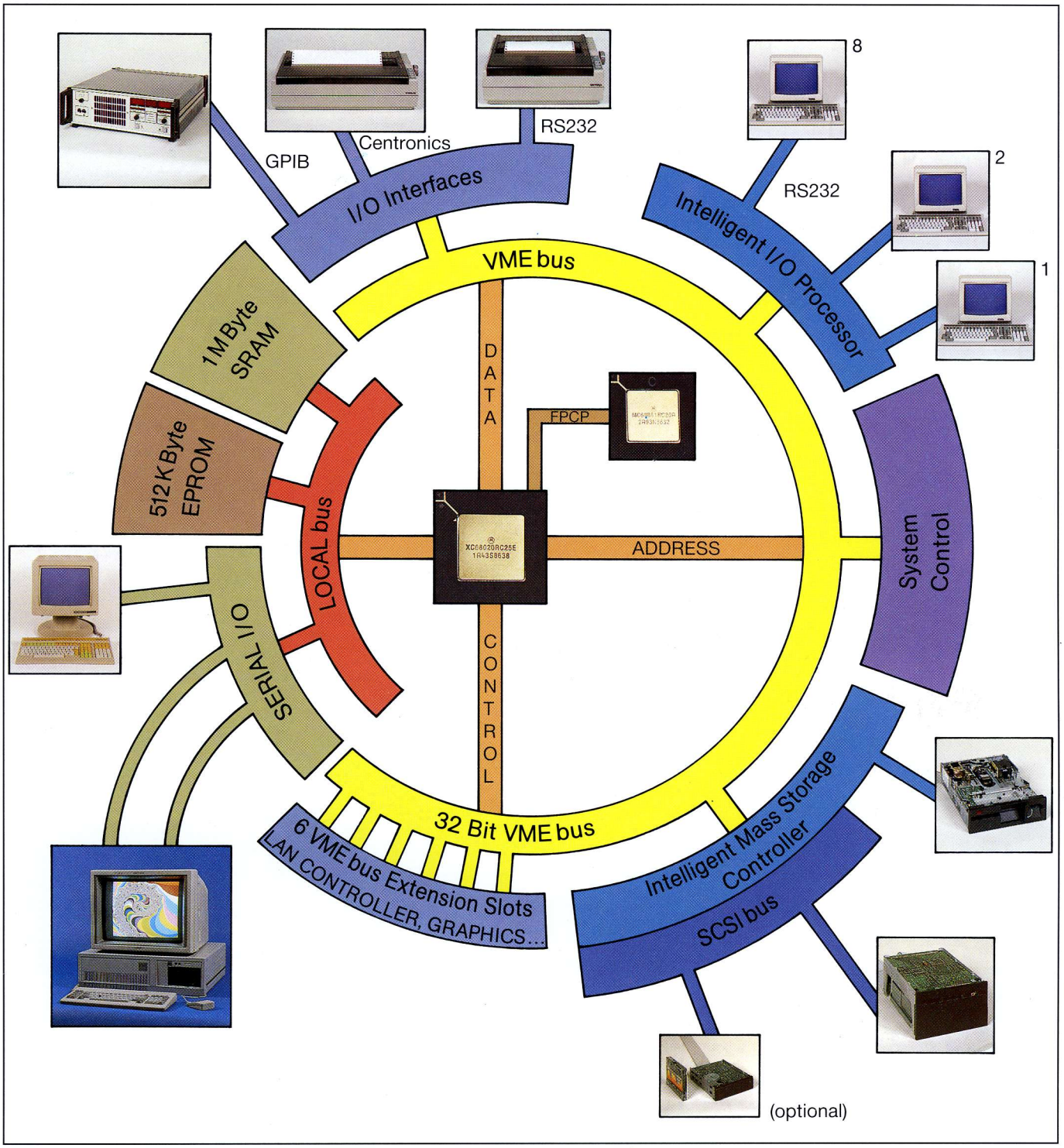
FORCE COMPUTERS®

FOCUS 32

PDOS* System 21



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FOCUS 32

General Information

The FOCUS 32 series of products are full 32 bit target and development systems based on the VMEbus.

All the serial I/O communications to the terminals or host computers as well as the mass memory device control are made via intelligent controller boards.

The PDOS* System 21 consists of a high speed processor board featuring a 68020 CPU (20 or 25MHz) running constantly without the insertion of wait states out of 1Mbyte static RAM.

Floating point operations are supported via the Floating Point Co-Processor 68881 (20MHz) increasing the throughput of the system.

A constant computing rate of 3 to 5 million instructions per second is available for the user of the Real Time Operating System PDOS*.

The multi-user multi-tasking operating system features lowest overhead for task switching in combination with an ultra fast exception/interrupt handling.

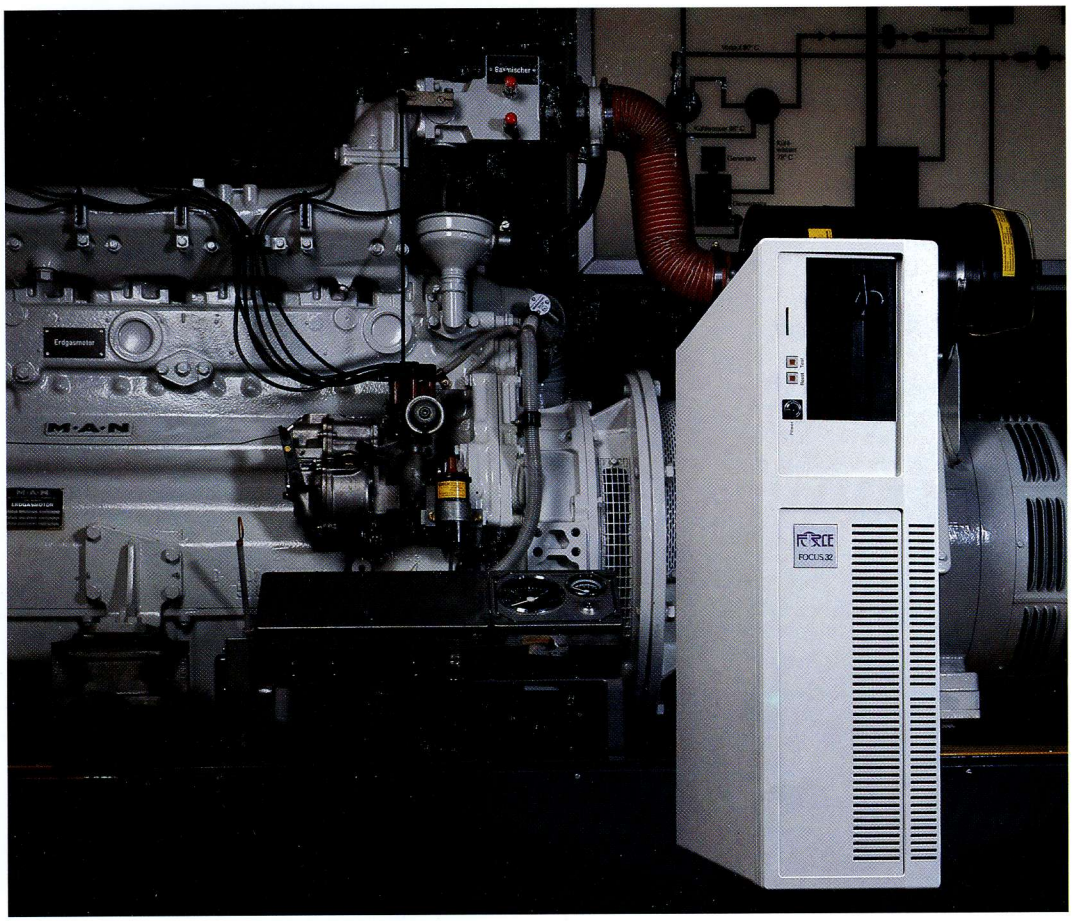
A Centronics parallel and a RS232 serial printer interface as well as a GBIP (IEEE 488) interface are installed and supported by the operating system.

The 8 serial I/O channels for connection of user terminals are controlled by a separate 68010 processor exonerating the Main Central Processing Unit from I/O handling.

Maximum data throughput to the hard disk and the floppy disk drive is provided through the Intelligent SCSI controller board featuring a 128Kbyte data puffer for hashing and caching. A local 68010 CPU and a DMA controller offer a data throughput of 1.5Mbyte per second to the installed 170Mbyte hard disk.

The PDOS* System 21 offers 12 double-height VMEbus slots where 6 slots are used and 6 slots are left open for application dependent extensions.

Photo of the PDOS*System 21



1. Features of the PDOS* System 21

1.1 Main Processor

- 20MHz 68020 (PDOS* System 21A) or 25MHz 68020 (PDOS* System 21B)
- 8 EPROM sockets providing a maximum capacity of 512Kbyte
- Full 32bit address and data path for all memory accesses (SRAM, EPROM and global RAM)

1.2 Floating Point Arithmetic

- Full IEEE P754 draft 10.0 compatible Floating Point Co-Processor installed (FPCP 68881 with 20MHz)

1.3 Main Memory

- 1Mbyte of high reliable static RAM
- Zero Wait State operation for all read and write transfers of the CPU (20 and 25MHz) to the static RAM

1.4 Mass Storage Controller

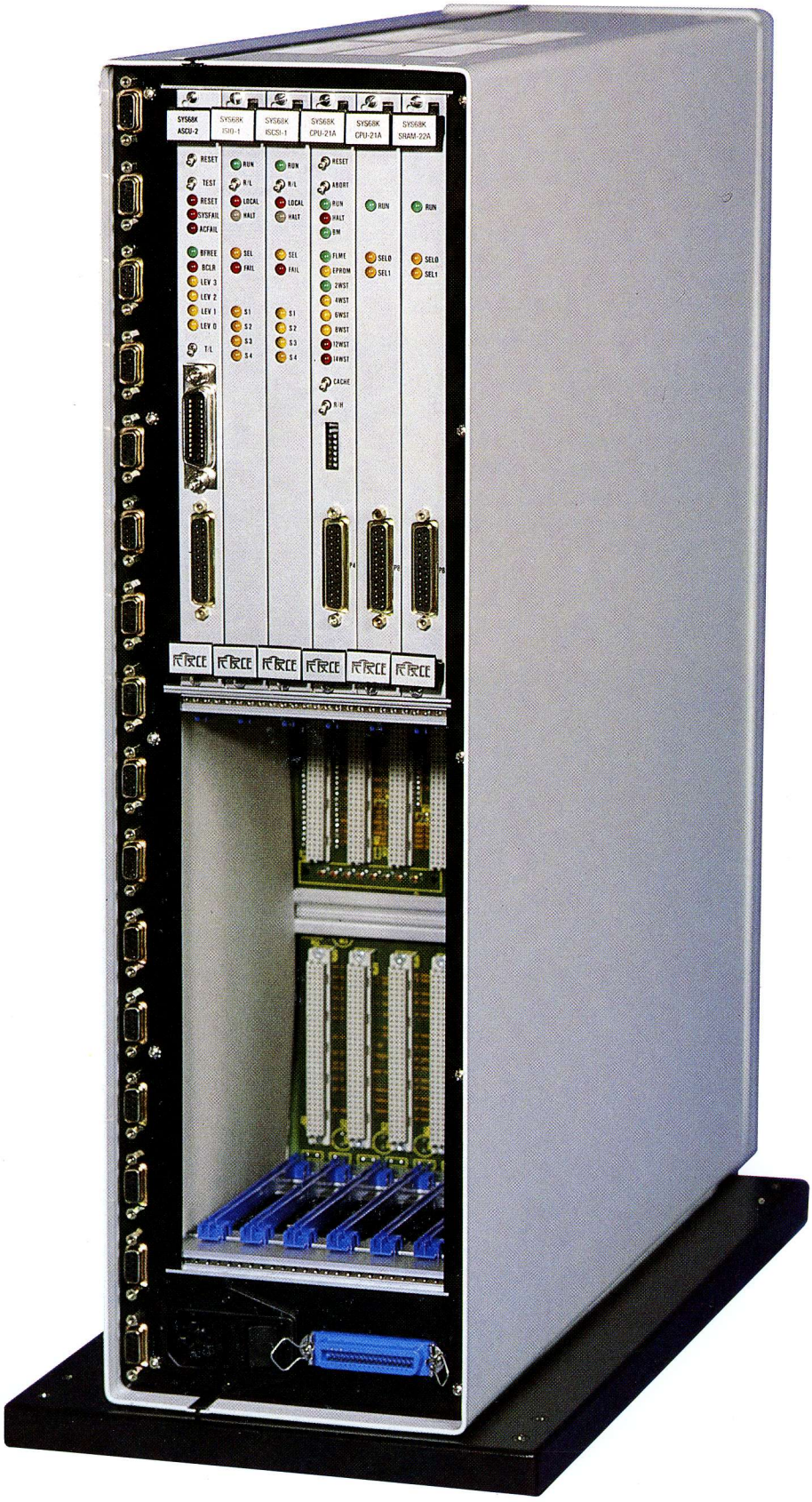
- Intelligent controller built with a 68010 CPU and a 68450 DMA controller
- Full SCSI compatible interface providing data transfer rates of up to 1.5Mbyte/s
- Floppy disk interface (SA460 compatible)
- Enhanced firmware supporting data hashing and caching within the 128Kbyte Dual Ported static RAM

1.5 Mass Storage Media

- 170Mbyte SCSI compatible Winchester disk providing a data transfer rate of 1.5Mbyte/s. Average access time of less than 23ms
- 1Mbyte floppy disk drive with SA460 compatible interface

1.6 Serial I/O Interfaces

- 8 RS232 interfaces controlled via an intelligent controller board (local 68010). Full duplex data transfers on all 8 channels at up to 19200 baud. 128Kbyte Dual Ported Buffer storage area built with SRAMs.
- 1 RS232 interface acting as the Master Console under direct control of the main CPU.
- 1 RS232/422 interface under direct control of the main CPU for high speed data transfers.
- All serial I/O ports feature software programmable baud rate and protocol selection (SDLC, HDLC, X.25, Asynchronous, Synchronous).



1.7 Dedicated I/O Interfaces

- 1 serial printer interface (RS232 compatible) with software selectable baud rate.
- 1 Centronics printer interface (parallel).
- 1 GPIB/IEEE488 interface with talker/listener and controller function.
- 1 RS232/422 link to other computers for up/down-loading of data/programs.

1.8 System Control Functions

- 4-level bus arbiter
  - Round Robin mode
  - Prioritized mode
  - Prioritized Round Robin mode
- Software programmable real-time clock with on-board battery backup.
- Watchdog timers for
  - Arbitration
  - Interrupt Acknowledge cycles
  - Standard Read/Write cycles
- Power monitor and handling of SYSRESET and ACFAIL.
- Software controlled shutdown of the system.
- Front panel switches for system RESET and ABORT.
- Front panel indicators for
  POWER ON
  VME ACCESS
  USER MODE
  MASS STORAGE ACCESS
  SYSFAIL
- Key switch for main power, removable in ON and OFF position.

1.9 VMEbus Functions

- 32 address signals
- 32 data signals
- 7 interrupt Request signals
- 4 Level Bus Arbitration
- 20 Mbyte/s maximum data transfer rate
- 16 Layer motherboard

1.10 System Environment

- 460 W power supply
- 110/220 V Input Voltage
- 2 independent cooling fans
- 6 VMEbus boards installed
- 6 VMEbus slots for extensions
- Dimensions Height 170 mm
  Depth 540 mm
  Breadth 600 mm

2. PDOS* Operating System Overview

The SYS68K/PDOS* is a powerful multi-user, multi-tasking, Real Time Operating System (RTOS). PDOS* consists of a small real time kernel (6 Kbyte) which provides synchronization and control of events occurring from the hardware using semaphores, events, messages, mailboxes and suspension primitives.

The file management module supports named file access with sequential, random and shared accesses. The details of the PDOS* functions are listed below:

2.1 PDOS* Kernel

PDOS* is written in assembly language for fast, efficient execution. The small kernel provides multi-tasking, Real-Time Clock, event processing, and memory management functions. Ready tasks are scheduled using a prioritized, round-robin method. The line A exception vector is used to interface over 74 system primitives to a user task.

Multi-Tasking execution environment: Tasks are the components comprising a real-time application. Each task is an independent program that shares the processor with other tasks in the system. Tasks provide a mechanism that allows a complicated application to be subdivided into several independent, understandable, and manageable modules. Real-time, concurrent tasks are allocated in 2Kbyte increments. The task system overhead for each task is only 1.25 Kbyte.

2.2 Intertask Communication & Synchronization

Semaphores and events provide a low overhead facility for one task to signal another. Events can be used to indicate availability of a shared resource, timing pulses, or hardware interrupt occurrences. Messages and mailboxes are used in conjunction with system lock, unlock, suspend, and event primitives. PDOS* provides timing events that can be used in conjunction with desired events to prevent system outlocks. Other special system events signal character inputs and outputs.

2.3 Memory Requirements

PDOS* is very memory efficient. The PDOS* kernel, file manager, and user monitor utilities require only 24 Kbytes of memory plus an additional 4Kbytes for system buffers and stacks. The hardware dependent part takes an additional 8Kbyte of memory. Further memory reduction can be achieved by linking the user application to a 6 Kbyte PDOS* kernel for a small, ROMable, standalone, multi-tasking module.

2.4 File Management

The PDOS* file management module provides sequential, random, read only, and shared access to named files on a secondary storage device. These low overhead file primitives use a linked, random access file structure and a logical sector bit map for allocation of secondary storage. No file compaction is ever required. Files are time stamped with date of creation and last update. Up to 32 files can be simultaneously opened. Complete device independence is achieved through read and write logical sector primitives.

2.5 Command Line Interpreter

A resident command line interpreter allows multiple commands to be entered on a single line. Command utilities such as append, define, delete, copy, rename, and show file are also resident and can be executed without destroying current memory programs. Other functions resident in the PDOS * monitor include setting the baud rate of a port, checksumming memory, creating tasks, listing tasks, files and open file status, asking for help, setting file level, file attributes, interrupt mask, and system disk, and directing console output.

2.6 Interrupt Management

The PDOS* kernel handles user console, system clock, and other designated hardware interrupts. User consoles have interrupt driven character I/O with type ahead. A task can be suspended pending a hardware or software event. PDOS* will switch control to a task suspended on an external event within 100 microseconds after the occurrence of the event (provided the system mask is high enough). Otherwise, a prioritized round-robin scheduling of ready tasks occurs in 10 millisecond intervals.

2.7 Support Tools

Numerous support utilities including virtual screen editors, assembler, linker, macroprocessor, disk diagnostics, link, recovery and disk cataloging are additional standard functions in the PDOS*. Single stepping, multiple break points, memory snap shots, save and restore task commands, and error trapping primitives are provided for program debugging.

2.8 Language Support

The following languages are available under PDOS*:

Assembler: A macro assembler with the full 68020 and 68881 instruction set is included in the PDOS* system.

C: A complete implementation of the C-language as defined by Kenigham and Ritchie is available as an option. Extensions include most of the PDOS* primitives to support the real time features of PDOS*. The compiler supports 68020 as well as the Floating Point Co-Processor 68881.

FORTRAN77: Full 1977 ANSI Version of the FORTRAN language is available as an option. The FORTRAN compiler can generate code for the 68000/68010 or the 68020 with support of the 68881.

PASCAL: Full Jensen/Wirth implementation of the ISO PASCAL standard is available as an option.

2.9 Benchmarks of the PDOS* System 21B

Type	Time	Type	Time
Sieve 100 iterations	2.77	Set system event with context switch	25.2 μs
Ackermann 100 loops	13.98	Change task priority	18.8 μs
Fibonacci 100 loops Floating point	6.7 19.18	Read time	13.0 μs
Context switch time	20.6 μs	Send and receive 4 bytes	35.8 μs
Set system event	12.9 μs	Send and receive 64 bytes Task Synchronization	117.0 μs 116.1 μs

3. Hardware Description

3.1 Main Processor Board

The 68020 CPU is installed as the main CPU of the PDOS* System 21. The 68020 is a full 32 bit processor offering a computing power of 2-4 MIPS (20MHz) respectively 3-5 MIPS at 25MHz.

A high speed static RAM (1Mbyte) guarantees this throughput, because all bus cycles to the RAM of the 68020 are executed without the insertion of wait states. The 1Mbyte static RAM guarantees highest reliability, data security and throughput through the 32 bit data path. 8 EPROM sockets ,also with a 32 bit data path, allow the storage of application dependent programs with a maximum size of 512Kbyte.

A Floating Point Co-Processor (FPCP 68881) supports all floating point instructions with single, standard, double and extended precision (80 bit) defined in the IEEE P754 draft 10.0. In addition, the 20MHz Co-Processor offers 35 arithmetic, trigonometrical and logarithmic instructions.

A local timer, included in the PI/T (68230) is used as the time base of the operating system. The local interrupts coming from the 3 serial I/O interfaces and the PI/T can be routed to a free software programmable level via a special on-board hardware.

One RS232 compatible serial I/O interface built with the multiprotocol communication controller (MPCC 68561) is used as the master console for the PDOS* based system.

The second serial interface (RS232/422 compatible) is configured for communication to a host computer and/or other FORCE systems. Up- and down-load programs are installed under the operating system to ease installation and usage.

The third serial I/O interface (RS232 or RS422) can be used for high speed data communication to other machines using HDLC, SDLC or asynchronous protocols (38400 baud or synchronous data rate of up to 2Mbit/s).

The block diagram of the SYS68K/CPU-21B shows the structure of the board.

Block Diagram of the SYS68K/CPU-21B

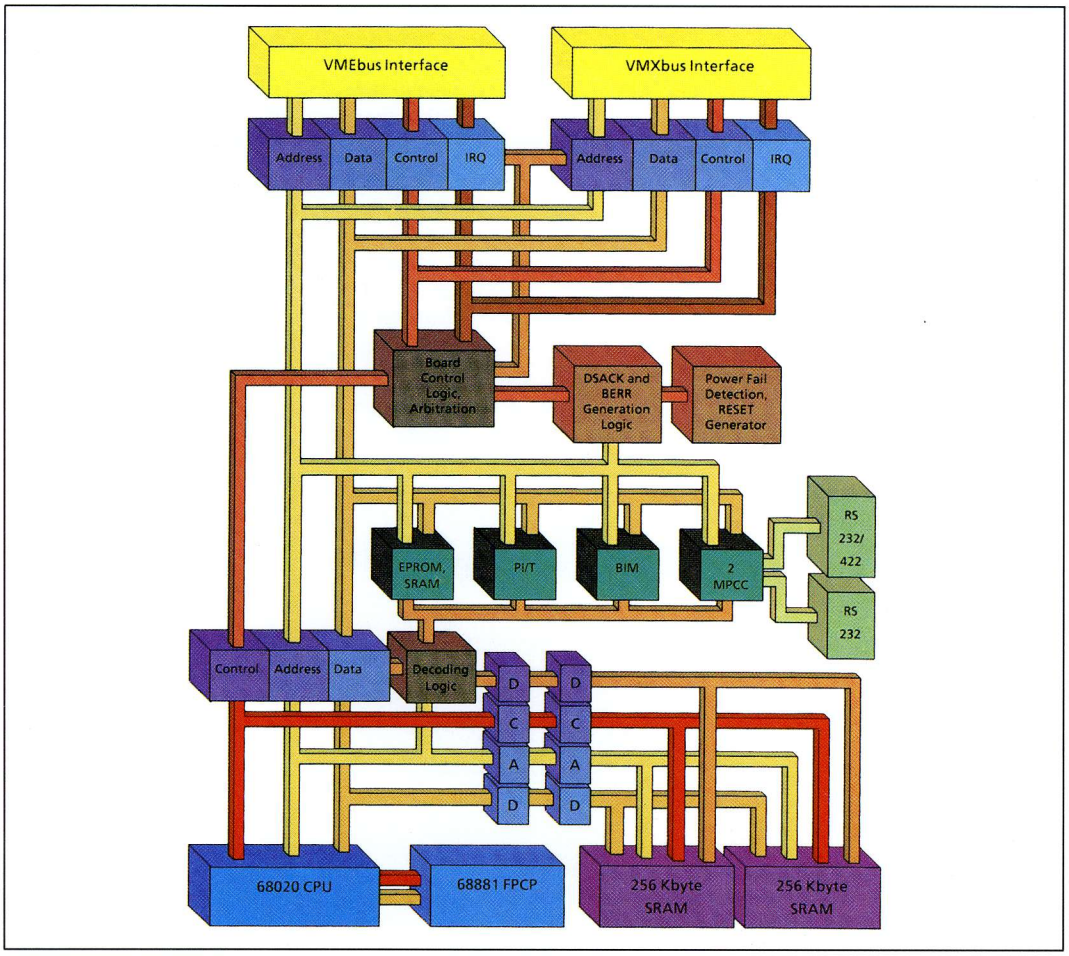
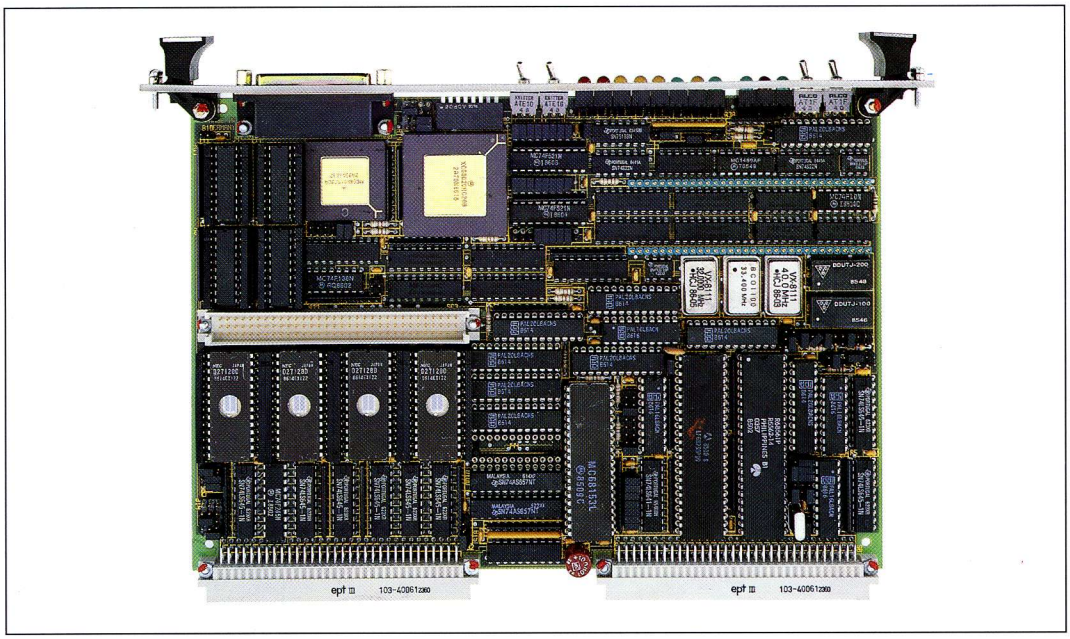


Photo of the SYS68K/CPU-21B



3.2 Mass Storage Devices

The PDOS* System 21 contains an intelligent mass memory controller board, the SYS68K/ISCSI-1. It is built around the 16/32 bit 68010 CPU and the 68450 four channel DMA controller. Both, the DMA controller and the CPU access the 128Kbyte Dual Ported static RAM without the insertion of wait states, which guarantee maximum performance. The CPU executes the firmware housed in two EPROMs constantly without the insertion of wait states and provides hashing and caching of data. The SCSI bus controller (NCR 5386) and the bus driver/receiver chip (NCR 8310) provide a constant data transfer rate of 1.5Mbyte/s together with the DMA controller.

A 5 1/4" Winchester disk with an unformatted capacity of 170Mbyte is installed inside the system. The data transfer rate of 1.5Mbyte per second of the Winchester and the controller board offers together with the average access time of 23ms, maximum system performance.

The Floppy Disk Controller (WD1772) installed on the ISCSI-1 board controls the 5 1/4" floppy disk drive (half height) available on the front side of the system.

The on-board handling firmware allows copying of data from the floppy disk to the Winchester disk or to the optionally available streamer without interfering the activities of the main CPU.

3.3 The Serial I/O Controller

To reduce the overhead of the main CPU handling the terminals or other RS232 devices, an intelligent serial I/O controller board, the SYS68K/ISIO-1 is installed in the PDOS* System 21.

The board is built around the 68010 CPU, running constantly without any wait states out of the EPROM (128Kbyte capacity) and out of the Dual Buffered Dual Ported RAM. This allows to run on all 8 serial I/O channels, full duplex at a baud rate of 19200 baud without loosing any data. Hardware or software handshake, various synchronous and asynchronous protocols as well as the baud rate of each channel are software programmable.

The 128Kbyte Dual Ported static RAM allows to store the line buffers on the board for each channel which reduces the overhead of the VMEbus activities.

Single character, a line editor, block moves and data conversions are available as standard commands within the firmware of the ISIO-1 board.

The eight RS232 compatible I/O channels are available on the rear side of the system via 9 pin D-sub connectors.

The following table lists all the supported signals per channel:

PIN	Input	Output	Signal	Description
1	x		DCD	Data Carrier Detect
2	x		RXD	Receiver Data
3		x	TXD	Transmit Data
4		x	DTR	Data Terminal Ready
5	x	x	GND	Signal GND
6	x	x	DSR	Data Set Ready
7		x	RTS	Request to Send
8	x		CTS	Clear to Send
9	–	–	–	Not Connected

3.4 The System Control Functions

All system control functions as well as dedicated interfaces are installed on the SYS68K/ASCU-2 at slot 1 of the PDOS* System 21.

A serial and a parallel printer interface are installed to support Centronics as well as RS232 compatible printers.

The IEEE488 interface allows controlling of industrial measurement machines. The Talker, Listener as well as the Controller mode are supported via the included software driver and the used 7210 chip.

Time and date are stored within the on-board Real Time Clock (58167). The battery guarantees correct operation for more than two years.

A 4 level bus arbiter provide efficient bus arbitration for the main CPU and optional VMEbus boards. To avoid system failures, a watchdog timer for bus arbitration, interrupt acknowledge and standard access cycles are installed on the board.

3.5 System Environment

All VMEbus boards are connected via a specially designed motherboard providing interconnection to the power supply, the mass memory storage devices and the front panel switches/indicators.

The 16 layer motherboard uses special shielding mechanism to reduce cross talking and to reduce the noise level of each signal trace. The J1 and J2 functions of the VMEbus motherboard are combined in the single backplane providing optimised power distribution through 4 separate power layers.

The interconnection between the VMEbus based controller boards and the I/O interfaces as well as the mass memory drives is made via indirect connectors. The supply voltage of the mass memory drives is also made on the motherboard to guarantee lowest noise levels on the supply voltage.

A total of 16 serial I/O channels with 9 pin D-sub connectors are available on the rear side of the system where 8 of them are supported through the installed ISIO-1 board and 8 of them are preconfigured to be used in conjunction with an optional ISIO-1 board (to be installed at slot 12).

A 25 pin D-sub connector for the serial printer and the Centronics connector for a parallel printer are also available on the rear side of the system.

Control of the system is provided on the front side using the key switch for the main power and the RESET as well as the TEST switch. Visual control is provided through the 5 indicators which are also available on the front side of the system.

Two independent metal enclosures assure mechanical stability as well as lowest scattered radiation. There are two independent fans, one for the VMEbus boards and one for the mass memory storage devices as well as for the power supply assuring proper cooling. A temperature sensor is installed between the VMEbus boards to switch off the DC power if the temperature is higher than 60 degrees C to avoid damage of the components.

The power supply installed in the system provides a supply current of 64A at +5V, 10A at +12V and 2A at -12V. The main voltage is 110V or 220V with a range of ±10%.

The PDOS* System 21 consists of 12 slots where 6 are left open for application dependent extensions.

4. Extensions

The PDOS* System 21 can be upgraded by adding application dependent modules such as a graphic board set and a graphic software package (GKS) or a streamer providing a fast system backup. Global memory using dynamic or static RAMs, additional I/O interfaces or network controllers can also be installed using the VMEbus for interfacing.

4.1 Streamer

A 120Mbyte SCSIbus compatible streamer can be installed on the front side of the system without the need for an additional controller board. The handling software for the streamer is installed on each system. The system is preconfigured with the mounting equipment and cable assembly for easy installation and usage of the streamer.

4.2 Graphics

High resolution graphics are supported via the graphics option which includes the SYS68K/AGC-1 board and the GKS package. The SYS68K/AGC-1 board set supporting display formats of up to 1600 x 1280 pixels (64MHz pixel frequency). 16 different colours can be selected out of a palette of 16 million colours using this resolution.

The Advanced CRT Controller 63484 using the dual access mode to the 2Mbyte video memory provides a maximum drawing speed of 2M pixel/s. Using 256 different colours out of 16 million, the maximum display format of the AGC-1 board set is 1024 x 800 (32MHz pixel frequency).

The GKS level 2b running under PDOS* conforms to the DIN 66252 and the ISO 7942 standard. The GKS package can be interfaced from the FORTRAN 77 as well as from the C programming language. Device drivers for colour printers, a mouse, digitizer and keyboard are included in source code form to adapt the software to the application dependent needs.

4.3 Memory Extension

Dynamic memory can be added using the DRAM-E3M1 or DRAM-E4M4 boards providing 1Mbyte, respectively 4Mbyte of global memory. The access time on read/write cycles is 245/65ns.

Static memory with battery backup of up to 1 year can be added by using the SRAM-4, 4A or 4B boards. The memory capacity is 256K, 512K or 1Mbyte at a read/write access time of 210/80ns.

All memory boards have a full 32 bit data and address path conforming to the VMEbus specification. Read Modify Write as well as aligned and unaligned transfers are supported.

4.4 Tower Extension

Mounting equipment for the FOCUS series of products and an additional module allows the usage of the system as a "Tower" as shown in the data sheet.

Photo of the desk top version

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Specifications

Main CPU of PDOS* System 21A Main CPU of PDOS* System 21B	68020 68020	20MHz 25MHz
Floating Point Co-Processor	68881	20MHz
Main Memory	SRAM	1Mbyte
No of Wait States	0	Constantly
EPROM	8 sockets/32 bit	512Kbyte
Serial I/O Interfaces Master Console Host Computer High speed Data Link Terminal Interfaces via ISIO-1 9 pin D-sub connectors	 1 1 1 8 16	 RS232 RS232/422 RS232/422 RS232 Pre-Configured
Mass Memory		
Winchester Capacity Transfer Speed Average Access Time	170Mbyte 130Mbyte 1.5Mbyte/s 23ms	unformatted formatted 5ms Track-to-Track
Floppy Disk	1Mbyte	unformatted
Intelligent Controller board Interfaces	SCSIbus	SA460
Real Time Clock with battery backup	58167	
Printer Interface	RS232 Centronics	Serial Parallel
GPIB Interface	IEEE 488	
Bus System Total No. of slots Used VMEbus Boards No of free slots	VMEbus 12 ASCU-2 ISIO-1 ISCSI-1 6	A32:D32 6+6 CPU-21A/B CPU-21A/B SRAM-22A/B
Power Requirements	110 220	6.5 A (avg) 3.2 A (avg)
Spurious Radiation conforms to	VDE 0871/Class B	
Security Level conforms to	VDE 0806/IEC 380	
DC Power Specification	+5V +12V −12V	64A (max.) 10A (max.) 2A (max.)
Surge Current	12A at 220V 22A at 110V	
Main Voltage	100 – 120V 200 – 240V	690 W 192 KJ/h
Enclosure Dimensions	Height 170 mm Depth 540 mm Breadth 600 mm	6.7 inch 21.3 inch 23.7 inch
Weight	40kg	88lbs
Operating Temperature	5–45 degrees C	
Storage Temperature	5–95 degrees C	non-operation
Relative Humidity	10–70%	non-condensing

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Ordering Information

PDOS* System 21A Part No. 640021	FORCE FOCUS 32 with 20MHz 68020 CPU Board and PDOS*
PDOS* System 21B Part No. 640022	FORCE FOCUS 32 with 25MHz 68020 CPU Board and PDOS*
PDOS* System 21/UM Part No. 800118	User Manual of the PDOS* System 21

Hardware Extensions

SYS68K/STR-120 Part No. 700040	120Mbyte SCSIbus compatible streamer
SYS68K/AGC-1 Part No. 400020	High Resolution Graphics Board Set (2 slots)
SYS68K/ISIO-1 Part No. 310030	Additional 8 channel serial I/O controller board to be installed at slot 12
SYS68K/DRAM-E3M1 Part No. 200004	1Mbyte dynamic RAM board with byte parity check
SYS68K/DRAM-E4M4 Part No. 200110	4Mbyte dynamic RAM board with byte parity
SYS68K/SRAM-4B Part No. 200502	1Mbyte static RAM board including battery backup
SYS68K/CABLE-9/25 Part No. 700031	8 cable adaptors from 9 pin D-sub connector to 25 pin D-sub connector
FOCUS 32 TOWER Part No. 700041	Mounting equipment for usage of the FOCUS systems as a tower

Software Extensions

SYS68K/PDOS*-C020 Part No. 140031	C Compiler for PDOS*
SYS68K/PDOS*-FOR020 Part No. 140041	FORTRAN-77 Compiler for PDOS*
SYS68K/PDOS*-PAS020 Part No. 140021	PASCAL Compiler for PDOS*
SYS68K/GKSGRAL-P2B1 Part No. 160000	GKS level 2b for FORTRAN 77 and C under PDOS*

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