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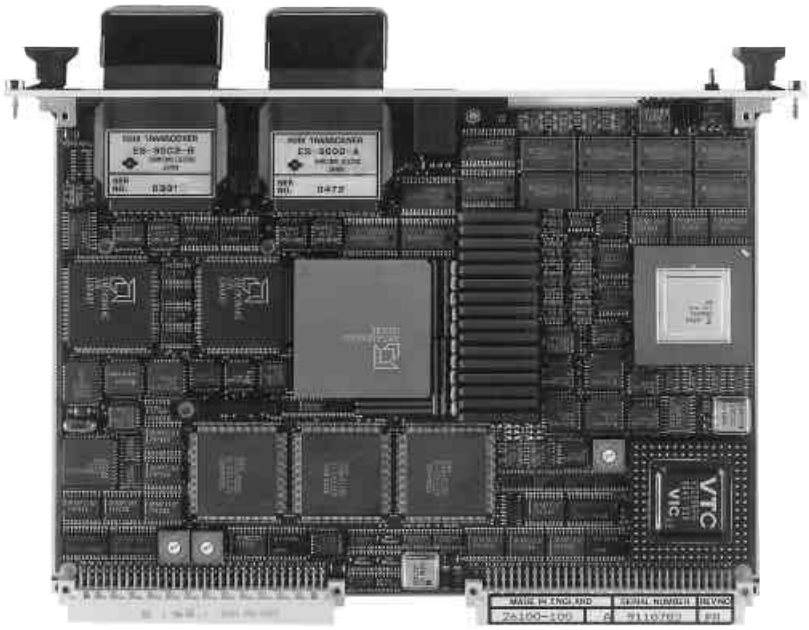
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FDDI SERIES

High-speed Fiber Distributed Data Interface Controllers

The Fiber Distributed Data Interface (FDDI) offers a robust, secure network topology with high bandwidth and powerful networking facilities for systems developers. Running at a data rate of 100 Megabits per second (Mbps) over fiber optic or copper twisted pair cable, FDDI offers up to ten times the speed of Ethernet, excellent noise immunity, and a timed-token passing protocol which guarantees each node access to the network. It is ideal for bandwidth intensive applications such as database servers, CAD/CAM, graphics imaging, real-time data acquisition and backbone networks.



FDDI-1 controller

Practical data rates in excess of 10 Mbytes/sec are now possible between up to 500 stations located 2km apart using FDDI, while interoperability with existing networks such as Ethernet or Token Ring can be readily achieved through the use of TCP/IP or other industry standard protocols.

For many applications, but especially in defense or telecommunications, the security and reliability offered by FDDI can be just as important as performance. FDDI includes fault tolerant features which automatically ensure continuous network operation by incorporating redundant data paths in dual attach configurations.

Specializing in high performance products for data communications and networking, Radstone offers a broad range of VME-based FDDI products to meet the needs of systems developers and integrators. Our latest generation of VMEbus and VME64 controllers combine state-of-the-art silicon with optimized software drivers and libraries for almost every conceivable application.

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Key Features

- Dual or Single Attach Station with 100 Mbps network bandwidth
- MIC or ST Optical fiber connectors
- Optional TP-PMD Twisted Pair copper connection
- MIL-STD-2204 SAFENET capabilities
- Front mount cabling (FDDI-1)
- Rear mount cabling with P2 Transition Module (FDDI-1P)
- 25MHz SPARClite RISC processor
- AMD Supernet-2 FDDI Chipset
- 8 Mbyte on-board memory
- Dedicated DMA control with hardware checksum generation
- Optional 1 Mbyte Static RAM
- CAM interface for frame stripping in bridging/routing applications
- 1 Mbyte on-board field upgradeable Flash EPROM
- ISO 8802-2 LLC and Media Access Control (MAC) Host Interface
- Self test diagnostics (BIT)
- SMT 6.2 or 7.3 Station Management software
- Device drivers for VxWorks, Solaris, UNIX STREAMS, OSF/1, LynxOS and other operating systems
- Support for TCP/IP and other network protocols
- Optional on-board VxWorks implementation

Product Overview

Based on a common architecture, Radstone's FDDI Series controllers provide a fully compliant single-slot solution for dual or single-attached FDDI/VME applications.

Available with a choice of MIC, ST or TP-PMD connectors, the FDDI Series offers maximum flexibility for cabling schemes using either optical fiber or twisted pair wiring, and is also designed for use in MIL-STD-2204 SAFENET applications.

Radstone's FDDI Series comprises two fully compatible FDDI/VME controllers: the FDDI-1, which is designed for front-mounted cabling, and the FDDI-1P, which offers rear-mounted connections using a P2 Transition Module. In addition, the FDDI-1P offers the latest-generation VME64 bus interface for compatibility with all high performance processors.

The FDDI Series offers the highest possible sustained performance levels through a powerful combination of 25MHz SPARClite™ RISC engine and dedicated DMA channels, combining 100Mbps network access with high speed VME data transfers.

Extensive software facilities include ISO Logical Layer Control (LLC) and TCP/IP network drivers for VxWorks™, Solaris™, UNIX™ STREAMS and other operating systems. In addition, system integration is simplified by on-board Built-In Test (BIT) diagnostics software and low-level SMT network monitor facilities.

For more sophisticated bridging/routing applications, an optional Content-Addressable Memory (CAM) interface supports frame stripping for multiple network addresses.

Board Architecture

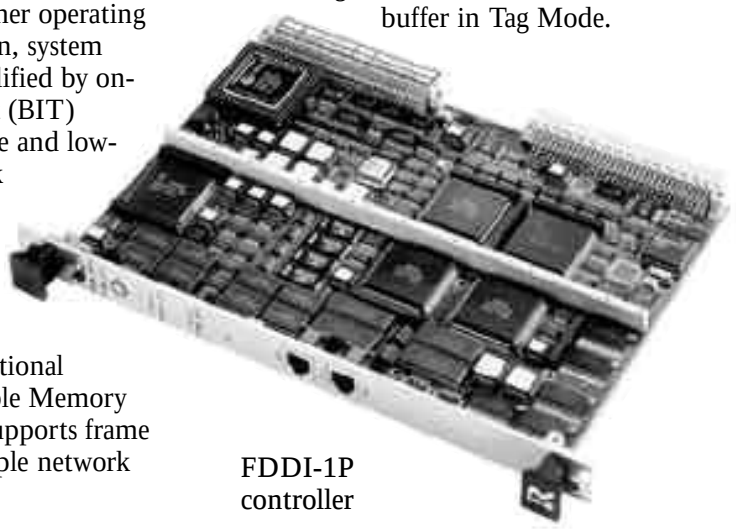
SPARClite Processor

The SPARClite™ has been designed specifically for use in embedded applications such as the FDDI Series. It has an instruction set which is upwardly compatible with other SPARC family processors and delivers a sustained 23 MIPS at 25 MHz. Incorporated on the chip are 2 Kbytes each of instruction and data cache with cache locking mechanisms for determinism. This facility is used extensively on the FDDI Series boards to lock key modules such as interrupt handlers into cache. Other key features of the SPARClite pertaining to the FDDI Series are low power consumption and fast interrupt response time.

SUPERNET-2

This latest generation AMD SUPERNET-2 chipset is implemented in a 1 MAC, 2 PHY configuration which permits full duplex operation at 100 Mbit/s for both dual (DAS) or single attach (SAS) FDDI networks. MAC functions are implemented in hardware by the FORMAC+ device, which is coupled to a dedicated 128 Kbyte SRAM buffer for frame queueing and transmission.

The FDDI Series uses the SUPERNET-2 chipset to achieve lowest possible latency operation by using the FORMAC+ and SRAM buffer in Tag Mode.



FDDI-1P controller

This avoids the need to pre-determine packet length before starting an FDDI transfer, and enables data transfers to start before the entire frame has been received.

Local Static RAM
For highest possible performance, an optional 1 Mbyte of 35ns Static RAM can be dedicated to the SPARClite processor. This enables higher speed operation for protocol processing or specialized user applications, which can be downloaded to execute directly from SRAM as required.

Dynamic RAM
The main DRAM array is central to the architecture, its large capacity being the key to system-level performance, especially for receiving frames. This memory comprises a 32-bit wide, two-way bank interleaved 8 Mbyte DRAM array closely coupled to FDDI and VMEbus interfaces. This multi-ported memory is used as buffer storage between VMEbus and the FDDI network. Burst mode access to the 2 interleaved banks of DRAM yields a total memory bandwidth of 100 Mbyte/s transfers and eliminates processor overhead for data movement.

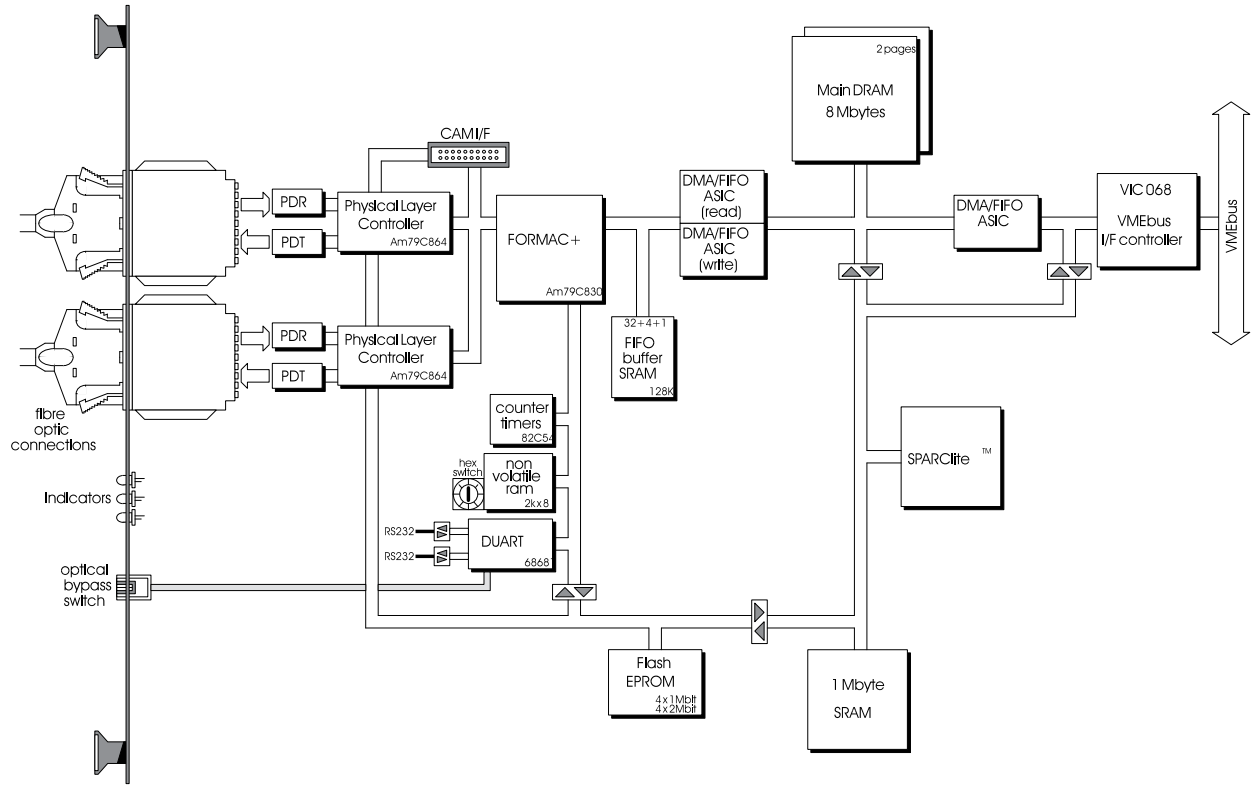
DMA Protocol Controller
Data movement and DRAM access is accomplished by three Enhanced RAM Interface Controller (ERIC) ASICs. These combine low latency DMA controllers with an on-chip 128 byte FIFO buffer, capable of sustaining transfer rates into memory of 100 Mbytes/sec. Each ERIC also includes hardware checksum generation logic to reduce the overhead in protocol processing, and can handle non-contiguous and non-aligned data movement directly.

CAM Card
This optional frame stripping module is designed for use in bridging applications, where the board must recognize and remove frames from the ring on behalf of other stations. The CAM card automatically matches up to 1280 addresses and connects to the main board via a 40 way connector.

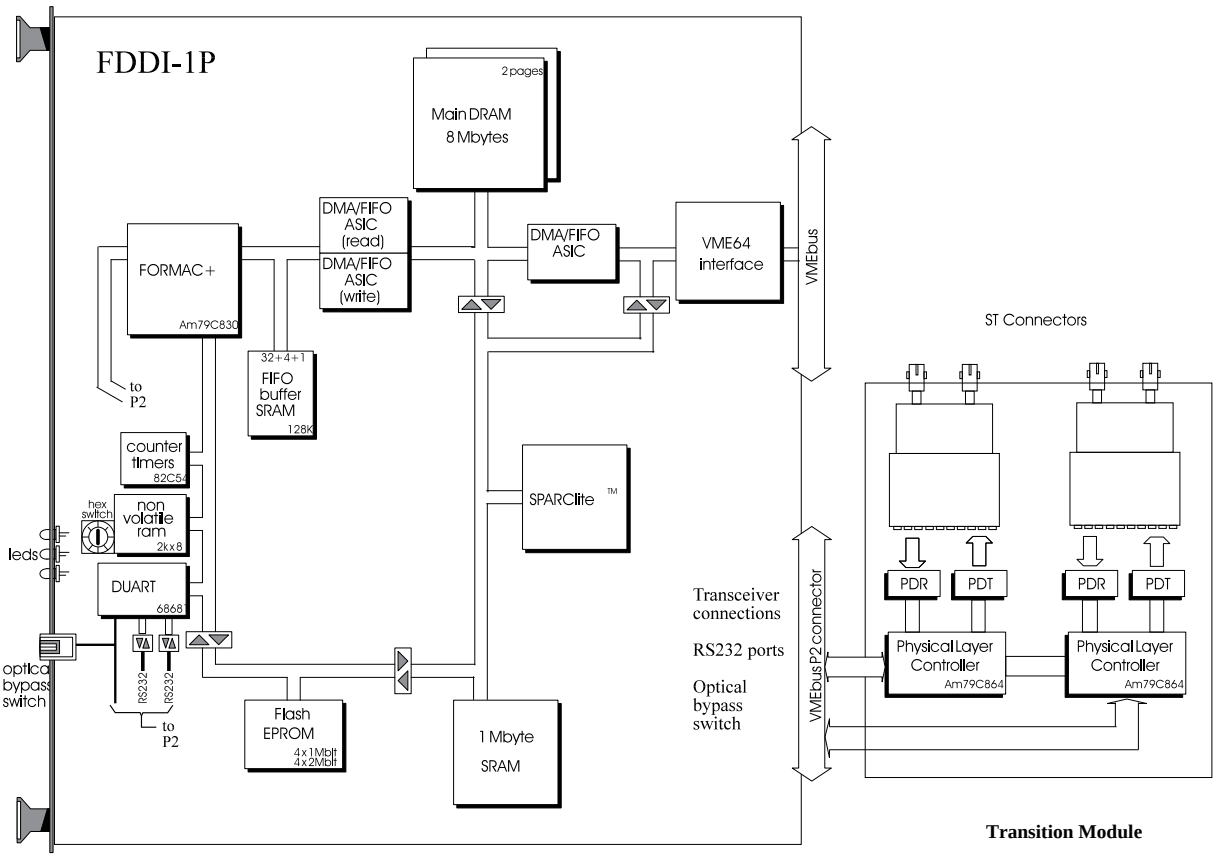
Media Connection

MIC Optical Connector
The FDDI MIC is the standard latching duplex fiber optic connector defined in the ANSI X3.166-1990 specification. The MIC connector is particularly recommended for front-panel mounting on the FDDI-1 board, as this keyed connector greatly simplifies cable plant management.

ST Optical Connector
The ST connector is a locking 'BNC' type fiber optic connector occasionally used for FDDI attachment. It is physically smaller than the standard MIC connector and is recommended for internal cabling such as the FDDI-1P Transition Module.
The FDDI-1 board can be supplied with front-panel mounted ST connectors if required.



FDDI Block Schematic



FDDI-1P Block Schematic

TP-PMD

The FDDI Series can be optionally specified with twisted pair wiring schemes rather than optical attachment. Compatible with the proposed ANSI TP-PMD 2.0 standard, the copper transceivers used employ a scrambled MLT-3 encoding scheme to give 100 Mbps over Shielded Twisted Pair (STP) cable or data grade Unshielded Twisted Pair (UTP-5) cable. A range of 100m is possible using low cost 150Ω STP cable, Type 1 or 2, while up to 50m can be achieved using 100Ω UTP-5 cables such as ATT1061.

SAFENET

The MIL-STD-2204 Survivable Adaptable Fiber Optic Embedded Network (SAFENET) specification is in the process of standardization to provide a reliable, redundant network for future generation naval systems.

RAW (10000 frames of 4096 bytes)

Transmit	84.46 Mbits/s	(2638 frames/sec)
Receive	87.33 Mbits/s	(2673 frames/sec)

TTCP (number of blocks = 10000)
Host Processor = Motorola MC88110 (UNIX SVR4.3)

Packet size	UDP(tx)	UDP(rx)	TCP(tx)	TCP(rx)
16384	—	—	26.91	26.94
8192	59.24	28.90	25.27	25.31
4096	47.15	27.62	26.91	26.96
2048	29.75	25.02	26.66	26.71
1024	22.65	19.40	25.87	26.01

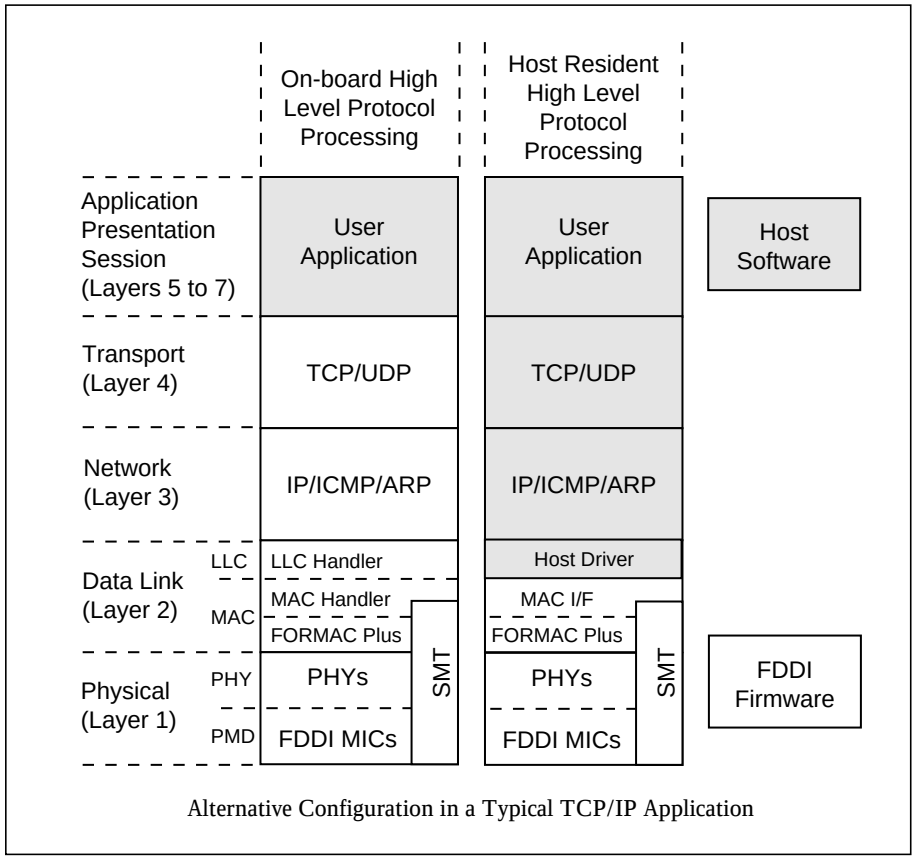
All results in Mbits/s
TCP and UDP figures are limited by the host processor

Latency of frames to/from VMEbus

Latency	Frame size (100 bytes)	(4500 bytes)
Receive	253µs	473µs
Transmit	156µs	552µs

Propagation delay of the station - 1280ns

FDDI-1 Series Performance



Alternative Configuration in a Typical TCP/IP Application

The FDDI Series offers a true commercial off-the-shelf (COTS) solution to designing systems today to meet the SAFENET specification. Optical power requirements for Class 1 compliance can be met using the standard MIC or ST transceivers. SMT 7.3 provides the necessary prioritization and synchronous working facilities.

More rugged applications may demand use of a MIL-28879 Trunk Coupling Unit (TCU). FDDI-1P has the facility to provide hermetically-sealed pigtailed fiber connections to the TCU using a specialized P2 Transition Module.

Optical Bypass
The FDDI Series incorporates circuitry for switching common optical bypass devices such as AMP 501916-3 or equivalent. This ensures optical continuity for the fiber if a node fails or is powered down. FDDI stations can also be connected by means of a concentrator if required.

FiberWare

FDDI Series boards are normally supplied with Radstone FiberWare™ installed and ready-to-run from on-board Flash. This firmware provides the efficient MAC Host Interface used by device drivers for Solaris, VxWorks etc., together with Station Management (SMT) and an SMT Monitor providing ring management functions.

Station Management (SMT)
Station Management (SMT) software provides the control necessary for each station to manage the processes underway in the various FDDI layers so that a station can work co-operatively as a part of an FDDI network. SMT provides services such as connection management, station insertion and removal, configuration management, fault isolation and recovery, scheduling policies and collection of statistics.

Fiberware SMT is based on the highly regarded XLNT Manager™ from XDI, which fully conforms with ANSI Station Management specifications. FDDI Series controllers can be supplied with either SMT 6.2 or SMT 7.3 software as required.

Media Access Control (MAC) Host Interface
FDDI data frames are handled by the Media Access Control (MAC) Interface which represents the network-specific part of the OSI data link layer specification. The efficient ring-buffer interface is designed to be used with a variety of host-based transport and network services, including ISO 8802-2 Logical Link Control (LLC) and higher level protocols including TCP/IP.

The MAC Interface is used by device drivers for Solaris™, VxWorks™ and other operating systems, requiring just 2 VME accesses to initiate a typical transfer, compared with alternative Command Parameter Block structures which can take as many as 12 long-word accesses. This reduces overheads by up to 10% for the smaller frames typical of TCP/IP traffic, and also improves command latency.

Boot Monitor
The standard firmware provides an FDDI Boot Monitor. This acts as the initial boot software for the board and includes facilities for self-test diagnostics (BIT), Flash programming and board configuration. It also enables board resident software to be easily upgraded in the field.

VxWorks Bootrom
For software developers using the FDDI Software Developers Kit, a VxWorks Bootrom can be factory-installed to run from on-board Flash. This Bootrom replaces the standard Fiberware.

Device Drivers

Solaris
The Solaris™ operating environment is a leading 32-bit implementation of the UNIX operating system for SUN SPARC workstations. Radstone's VMEbus FDDI driver for Solaris provides ISO Logical Layer Control (LLC) and TCP/IP support for VME/SPARC single board computers or SUN workstations using an SBus to VME adaptor.

VxWorks
Wind River System's VxWorks™ Distributed Real-time operating system provides fast and deterministic performance on a wide variety of VME single board computer architectures including 680x0, SPARC™, Alpha AXP™ and PowerPC™ platforms.

The VxWorks driver for FDDI Series provides ISO 8802-2 Logical Layer Control (LLC) and TCP/IP support for use with VME processor boards running either V5.0 or V5.1 VxWorks. The driver provides full interoperability with existing VxWorks Backplane or Ethernet networks with full support for IP routing.

OSF/1
Digital's DEC OSF/1 AXP is a POSIX compatible 64-bit operating system for Alpha AXP platforms. Suitable for development or real-time use, it supports the OSF Application Environment (AES), SVID, X.11, MOTIF and 1003.4 real-time extensions. The FDDI driver for OSF/1 provides ISO 8802-2 Logical Layer Control and TCP/IP protocol support either for DECstation 3000 (using Turbochannel to VMEbus adaptor) or Digital's AXPvme64 and AXPvme160 single board computers.

UNIX STREAMS
This STREAMS-based driver, originally developed for UNIX SVR4, is designed to ease integration of the FDDI Series into a range of different systems. The DLPI 2.0 STREAMS driver provides ISO 8802-2 Logical Layer Control and supports TCP/IP or higher level protocols.

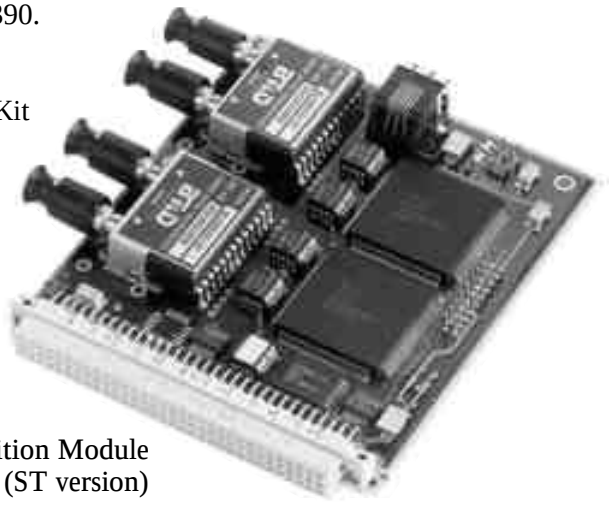
LynxOS
Lynx Real-time Systems Incorporated's LynxOS is a UNIX-compatible real-time operating system that adheres to popular industry standards such as POSIX. It supports X-Windows, MOTIF, NFS, TCP/IP and STREAMS, and is available for many different processor architectures including Hewlett Packard PA-RISC™, SPARC, PowerPC and Motorola 680x0 implementations. An FDDI Series driver is available for use with LynxOS, supporting ISO 8802-2 Logical Layer Control with TCP/IP or higher level protocols.

Network Driver Library (NDL)
Designed to ease the integration of FDDI Series with other operating systems or software, the Network Driver Library provides a rich set of portable functions written in 'C' language, including routines to send or receive FDDI frames, connect to interrupts etc. It includes all the necessary software for ISO 8802-2 Logical Layer Control and transmission of IP and ARP over FDDI in accordance with RFC1390.

FDDI Software Developers Kit
The FDDI Software Developer's Kit (FSDK) is intended for OEMs who wish to develop highly specialized software, routing algorithms or custom protocol code to execute directly on the FDDI Series boards.

By using the FSDK, customers can readily develop board-resident FDDI code without intimate knowledge of the underlying hardware. The kit comprises a validated board support package (bsp) for Wind River Systems' VxWorks™ software development environment, specifically ported to the SPARClite processor used on FDDI Series. The FSDK includes all the necessary Station Management (SMT) software for use with VxWorks, together with example access routines for TCP/IP and MAC-level framing.

VxWorks provides convenient user 'hook' routines, which can be used to examine packets as they arrive from the ring. This could be used to control filtering of special frames, routing of frames to different VME processors or similar low-level functions.
For further details on the FSDK, please contact your nearest Radstone Sales representative.



FDDI-1P Transition Module
(ST version)

Standards Compliance

ISO 9314-1:1989, Information processing systems - Fibre Distributed Data Interface (FDDI) - Part 1: Token Ring Physical Layer Protocol (PHY)

ISO 9314-2:1989, Information processing systems - Fibre Distributed Data Interface (FDDI) - Part 2: Token Ring Media Access Control (MAC)

ISO 9314-3:1990, Information processing systems - Fibre Distributed Data Interface (FDDI) - Part 3: Token Ring Physical Layer Medium Dependent (PMD)

ANSI X3T9/90-X3T9.5/84-49 Rev 6.2 (Draft), FDDI Station Management (SMT)

ANSI X3T9/92-067 Rev 7.3 (Draft), FDDI Station Management (SMT)

ANSI X3T9-5 TP-PMD V2.0 (Draft), FDDI Twisted Pair Physical Media Dependent Layer (TP-PMD)

ISO 8802-2:1989, Information processing systems - Local area networks - Part 2: Logical link control (LLC)

RFC:1390, Transmission of IP and ARP over FDDI [8802-2 LLC and Sub-Network Access Protocol (SNAP)]

SPECIFICATIONS

	FDDI-1	FDDI-1P
Optical Connection	MIC or ST connector Front mount	ST connector Rear mount
Optical Transition Module	N/A	P2XF (VME P2)
TP-PMD (copper) Connection	STP 9 way D-type UTP RJ11 connector	optional
FDDI Interface	Dual (DAS) or Single (SAS) Attach	Dual (DAS) or Single (SAS) Attach
Optical Fiber	62.5/125µm multimode fiber 9/125µm single-mode fiber (optional)	62.5/125µm multimode fiber 9/125µm single-mode fiber (optional)
Station Management (SMT)	SMT 6.2 or SMT 7.3	SMT 6.2 or SMT 7.3
Processor Clock frequency Instruction/Data Cache Performance	Fujitsu MB86930 SPARClite 25MHz (synchronous operation) 2Kbyte/2Kbyte 23 MIPS	Fujitsu MB86930 SPARClite 25MHz (synchronous operation) 2Kbyte/2Kbyte 23 MIPS
Memory Processor SRAM Local DRAM PROM DMA control DMA FIFO	 1 Mbyte 35ns, two clock access 8 Mbytes, 80ns DRAM 1 Mbyte FLASH, 32-bit 100 Mbyte/sec, 32-bit synchronous 128 Bytes	 1 Mbyte 35ns, two clock access 8 Mbytes, 80ns DRAM 1 Mbyte FLASH, 32-bit 100 Mbyte/sec, 32-bit synchronous 128 Bytes
FDDI Control Buffer RAM	AMD FORMAC+ (Supernet-2) 128 Kbyte 70ns SRAM	AMD FORMAC+ (Supernet-2) 128 Kbyte 70ns SRAM
Bypass Switch Connector Counter/timer Serial I/O	RJ11 (AMP 501916-3) 82C54 three 16-bit counter/timers 68681 DUART, 2 ports	RJ11 (AMP 501916-3) 82C54 three 16-bit counter/timers 68681 DUART, 2 ports

Ordering Information

PME FDDI-1

PME FDDI-1/212	FDDI-1, 8 Mbyte DRAM, VME, SRAM
PME FDDI-1/202	FDDI-1, 8 Mbyte DRAM, VME
PME FDDI-1/UG	FDDI-1 User Guide

Options

SAS Connector	MIC Connector, SAS ST Connector, SAS STP Connector, SAS UTP Connector, SAS
DAS Connector	MIC Connector, DAS ST Connector, DAS STP Connector, DAS UTP Connector, DAS
SMT	SMT 6.2 SMT 7.3

PME FDDI-1P

PME FDDI-1P/212	FDDI-1P, 8 Mbyte DRAM, VME64, SRAM
PME FDDI-1P/202	FDDI-1P, 8 Mbyte DRAM, VME64
P2XF-ST/DAS	P2 Module, DAS, ST Connector
P2XF-ST/SAS	P2 Module, SAS, ST Connector
FDDI-1P/UG	FDDI-1P User Guide
SMT	SMT 6.2 SMT 7.3

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