

# Ensemble IO Mezzanine Series IOM-120 and IOM-140 sFPDP XMC

## Quad- or Dual-Channel Fiber-Optic Serial Front-Panel Data Port (sFPDP)

- High levels of speed and connection density
- Support for all four front-panel data port (FPDP) data modes
- Ideal for streaming sensor input or data output
- Configuration flexibility with two DMA engines per channel (send and receive)
- Programmable for data distribution without processor intervention
- Available in air-cooled and conduction-cooled variants



The Ensemble™ IO Mezzanine Series IOM-120 and IOM-140 (IOM-1x0) sFPDP XMC from Mercury Computer Systems brings enhanced performance and flexibility to external I/O in a serial RapidIO®-based streaming I/O XMC (Switched Mezzanine Card, VITA 42.2-2006). Providing 2.5 Gbaud of full-duplex bandwidth per channel and two or four channels per card, the IOM-1x0 Module offers high levels of speed and connection density.

With fiber connection distances of up to 150 m and latency as low as 4 μs, the IOM-1x0 Module is ideally suited as the real-time digital interface for sensor input or data output in a serial RapidIO system.

### Compatibility

The IOM-1x0 Module implements the Serial Front-Panel Data-Port (sFPDP) protocol, as specified by VITA 17.1-2003. It supports all four sFPDP framing modes. This implementation of the standard makes the IOM-1x0 Module compatible with products supporting any subset of the VITA 17.1-2003 protocol. The module is software-compatible with RACE++® Series RINOJ-F products, easing migration from the legacy I/O daughtercards, while offering significant improvements in speed and configuration flexibility.

### I/O Intelligence

The IOM-1x0 Module is more than an ordinary digital interface: each channel can be programmed for data distribution without processor intervention. The interface can sense signals in the input data stream that indicate sensor mode changes and route data appropriately for each mode. Each mode can be made to correspond with an application-defined direct memory access (DMA) command packet (CP) chain. These command packets cause the channel's DMA controller to route the data to a predefined destination anywhere within the RapidIO switch fabric.

This data-driven distribution takes advantage of information available at the source. DMA command packets can be chained together to automatically distribute sequential data packets to different processors or endpoints on the RapidIO fabric.

### sFPDP Interface

sFPDP supports a mapping of the FPDP protocol onto the Fibre Channel physical layers (FC-0 and FC-1). Serial data is transmitted at 2.5 Gbaud over the fiber. The IOM-1x0 Module achieves a sustained data rate of 247 MB/s per channel, when the data packets are kept large on both the fiber side and the RapidIO side of the interface.

The serial protocol provides optional error checking and flow control. The optional error checking is accomplished with a cyclic redundancy check (CRC-32), included in each packet sent over the serial line. The optional flow control feature enables the receiving end of the fiber interface to send flow control commands through its output port back to the data transmitter. If flow control is not used, only a single fiber per data channel is required.

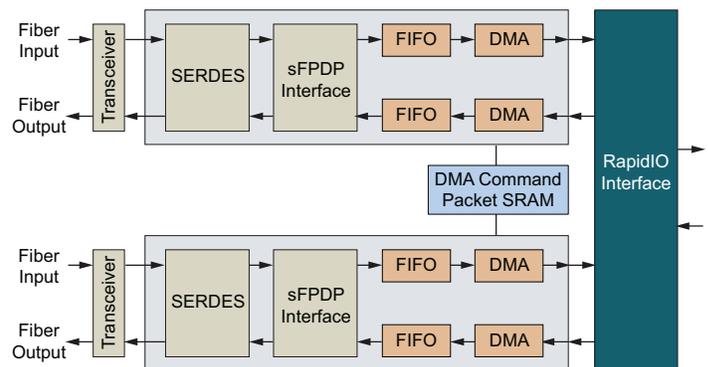


Figure 1. XMC Channel block diagram

The IOM-1x0 Module converts two or four channels of full-duplex sFPDP data into a single RapidIO channel. Because this device is implemented as XMC, it can occupy an XMC-compatible site on any modules that support serial RapidIO over the J5 connector.

### Linked-List DMA Controller

The IOM-1x0 Module includes a linked-list DMA controller for intelligent control of data distribution. Lists of DMA command packets control the linked-list DMA controller. Because they are constructed once at setup time and can be initiated multiple times within the time-critical portion of the application, such chains of transfer requests are very valuable for repetitive, high-speed transfers. In many applications, once the DMA controller is set up, it can run autonomously, scattering or gathering data among a large number of processing nodes with no processor intervention.

### I/O Management Software

Mercury provides a data transfer facility layered on top of the standard Mercury Interprocessor Communication System (ICS). This facility consists of a set of user-callable I/O control functions. These functions are used to define I/O transfer requests (DMA command packets) and to link such requests into a chain that is then automatically executed by the designated I/O device.

Each command packet (CP) specifies the RapidIO route, address, and maximum word count for the transfer, as well as some control information. The route in each CP can specify either a single RapidIO endpoint or, in the case of an input stream, multiple RapidIO endpoints. By chaining command packets together into a linked list, an incoming stream can be parceled out among a large number of endpoints. Transfers of up to 4 GB in length can be implemented.

Synchronization between the IOM-1x0 Module and the application program can be accomplished by queuing a transfer request that includes status information at the desired synchronization point in the DMA chain. This block of status information is written to the local memory of the synchronizing processor. The processor can then poll on the receiving memory location for block of status information. The IOM-1x0 Module can also be synchronized with a processor via mailbox interrupts.

### Data-Frame Management

The IOM-1x0 Module allows the sensor to frame data into “epochs.” Any sensor can define its own epoch boundary based on what makes sense for that type of sensor and on how the data will be used by the processing system. In the case of radar data, these epochs are likely to be coherent processing intervals. In the case of images, an epoch is likely to be a line or a frame of an image.

The IOM-1x0 Module supports the four sFPDP data-framing options: unframed, single-frame, dynamic-size repeating frame, and fixed-size repeating frame.

### Data-Driven Frame Processing

Many modern sensors change modes during operation. When a sensor changes modes, the processing system must make the corresponding mode change at the correct time. The sensor can also use the first word of each epoch to indicate its current mode. The IOM-1x0 Module in “cable header” mode can use this word to index to a particular DMA command packet chain, then initiate the chain without processor intervention. (See Figure 2.) This allows each configuration of the sensor to have a dedicated DMA chain and a completely different data distribution from other modes.

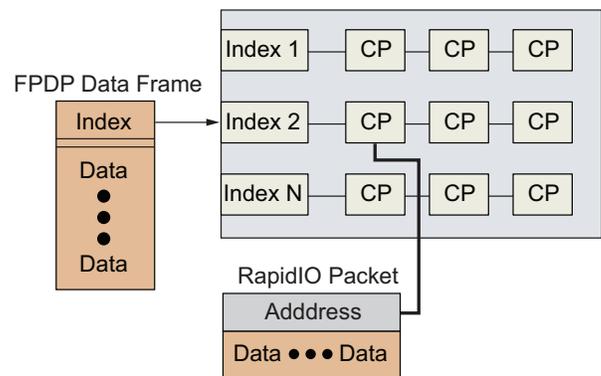


Figure 2. XMC CMA CP Chain

When the sensor mode changes are known in advance, the IOM-1x0 Module can be programmed to switch DMA chains for the next mode through the use of branching at the end of an sFPDP frame or “epoch.” This branching capability can also be used for error handling, when the end of the sFPDP frame occurs before it is expected.

With some input interfaces, missing or extra data can cause the interface to lose sync with an input data stream until a processor intervenes. The IOM-1x0 Module minimizes the system upset by localizing the effects of anomalies in the input stream. To do this, the module can re-synchronize its DMA controller to the incoming data at each data frame (epoch boundary). This re-synchronization is done by the hardware with no processor intervention. In the event that an end-of-epoch marker is lost due to a media error, the maximum word count in the DMA CP prevents data from being written past the end of the buffer.

## Conquering Latency

The IOM-1x0 Module can be configured to give a latency of less than 4  $\mu$ s from when data arrives at the interface to when it is on a processing node ready to be processed. The main feature that enables this low latency is the linked-list DMA CP processing of the IOM-1x0 Module's DMA controller. By cycling through lists of DMA commands created during initialization, the module can autonomously distribute the data without any processor intervention.

Two additional features ensure that low-latency operation is maintained. First, a programmable threshold tells the DMA controller when to start emptying its input FIFO. If the FIFO has more than the specified amount of data, the DMA controller starts emptying the FIFO. Second, the IOM-1x0 Module includes a programmable timer that causes any remaining data to be emptied from the input FIFO, if no input data arrives within the specified length of time.

## Full-Duplex Operation

Each interface can operate in full-duplex mode. In addition, there are separate DMA controllers for transmit and receive on each channel, that is, two DMA controllers per channel (up to eight per card). If desired, transmit and receive can be synchronized on each channel.

## Copy Mode

The IOM-1x0 Module can loop any data arriving through its receive fibers directly onto its corresponding transmit fiber. Copy mode is useful for systems in which it is desirable to record the incoming data. When copy mode is enabled, the module can both distribute the data to nodes and pass it on to another device or chassis for recording.

## Specifications

### Supported Configurations

Ensemble HCD5220 with Serial RapidIO XMC option  
Ensemble HCD6220 with Serial RapidIO XMC option  
Ensemble SFM7180

### Configuration Options

Channels	2 or 4
Serial RapidIO interface	Configurable to 2.5 or 3.125 Gbaud
Media	62.5/125 or 50/125 micron
Wavelength	850 nm
Connector type	LC
Distance	Up to 150 m, depending on configuration

### Software Support

MultiCore Plus® (MCP)  
Driver software package for MCP included  
ICS package required

## Electrical

FIFO channel	
Input	16K x 35 bits
Output	2K x 34 bits
DMA command packets SRAM	128K x 32 bits per channel
Data rate	2.500 or 1.0625 Gbaud
Power Dissipation	
2-channel	8W (approximately)
4-channel	12W (typical)

## Mechanical

XMC Style Daughtercard	
Size	6.5" x 2.9"

## Environmental

### Air Cooled L0 Commercial

Temperature	
Operating	0°C to 40°C
Storage	-40°C to 85°C
Humidity	10-90% non-condensing
Altitude	
Operating	10,000 ft (maximum)
Shock	
z-axis: 20g, 11 ms, half-sine;	
x-, y-axes: 32g, 11 ms, half-sine;	

### Conduction Cooled L3

Temperature	
Operating	-40°C to +40°C
Storage	-55°C to +125°C
Humidity	5-95% non-condensing, 100% condensing
Altitude	
Operating	10,000 ft (maximum)
Shock	
z-axis: 50g, 11 ms, half-sine;	
x-, y-axes: 80g, 11 ms, half-sine;	

\*Rugged L1 also available.

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