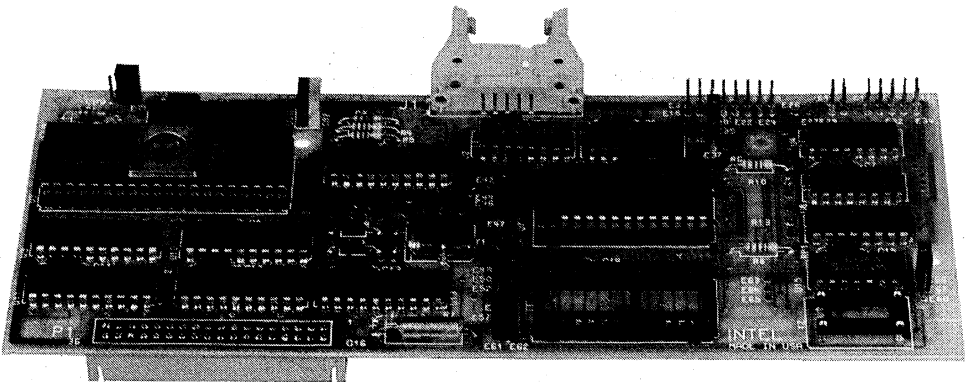




iSBX™ 344A BITBUS™ INTELLIGENT MULTIMODULE™ BOARD

- High Performance 12 MHz 8044 Controller
- Integral Firmware Including the iDCX 51 Executive Optimized for Real-Time Control Applications
- Full BITBUS™ Support
- 2 28-Pin JEDEC Memory Sites for User's Control Functions
- Low Cost, Double-Wide iSBX™ BITBUS Expansion MULTIMODULE™ Board
- Power Up Diagnostics

The iSBX 344A BITBUS Intelligent MULTIMODULE board is the BITBUS gateway to all Intel products that support the iSBX I/O Expansion Interface. Based on the highly integrated 8044 component (an 8-bit 8051 microcontroller and an SDLC-based controller on one chip) the iSBX 344A MULTIMODULE board extends the capability of other microprocessors via the BITBUS interconnect. With the other members of Intel's Distributed Control Modules (iDCM) family, the iSBX 344A MULTIMODULE board expands Intel's OEM microcomputer system capabilities to include distributed real-time control. Like all members of the iDCM family, the iSBX 344A MULTIMODULE board includes many features that make it well suited for industrial control applications such as: data acquisition and monitoring, process control, robotics, and machine control.



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OPERATING ENVIRONMENT

Intel's Distributed Control Modules (iDCM) product family contains the building blocks to implement real-time distributed control applications. The iDCM family incorporates the BITBUS interconnect to provide standard high speed serial communication between microcontrollers. The iDCM hardware products: including the ISBX 344A MULTIMODULE board, iPCX 344A board and all iRCB BITBUS Remote Controller Boards communicate in an iDCM system via the BITBUS interconnect as shown in Figure 1.

As a member of the iDCM product line the ISBX 344A MULTIMODULE board fully supports the BITBUS microcontroller interconnect. Typically, the ISBX 344A MULTIMODULE board would be part of a node (master or slave) on the BITBUS interconnect in an iDCM system. As shown in Figure 2 the ISBX 344A MULTIMODULE board plugs into any iSBC® board with an ISBX connector.

The ISBX 344A MULTIMODULE board is the hardware interface between Intel's MULTIBUS® and the BITBUS environment. With this interface the user can harness the capabilities of other Intel microprocessors e.g. 80386, 80286, 80186, 8086, 80188, 8088 in a iDCM system or extend an existing MULTIBUS system with the iDCM family.

MULTIBUS® Expansion

Typically, MULTIBUS iSBC boards have a maximum of two ISBX I/O MULTIMODULE boards with varying numbers of I/O lines. The ISBX 344A MULTIMODULE board increases the number of I/O lines that can be accommodated by a MULTIBUS system by at least an order of magnitude.

Extending BITBUS™/iDCM System Processing Capability

The ISBX 344A MULTIMODULE board allows utilization of other processors in a iDCM system to accommodate particular application requirements. The MULTIMODULE board is compatible with any ISBX connector so that any board having a compatible connector can potentially enhance system performance. Intel's DCS100 BITBUS Toolbox Software provides easy to use high performance software interfaces for iSBC boards. The iSBC 86/35, 286/12, and 188/48 boards are a few examples. Custom configurations are also possible with user customized software.

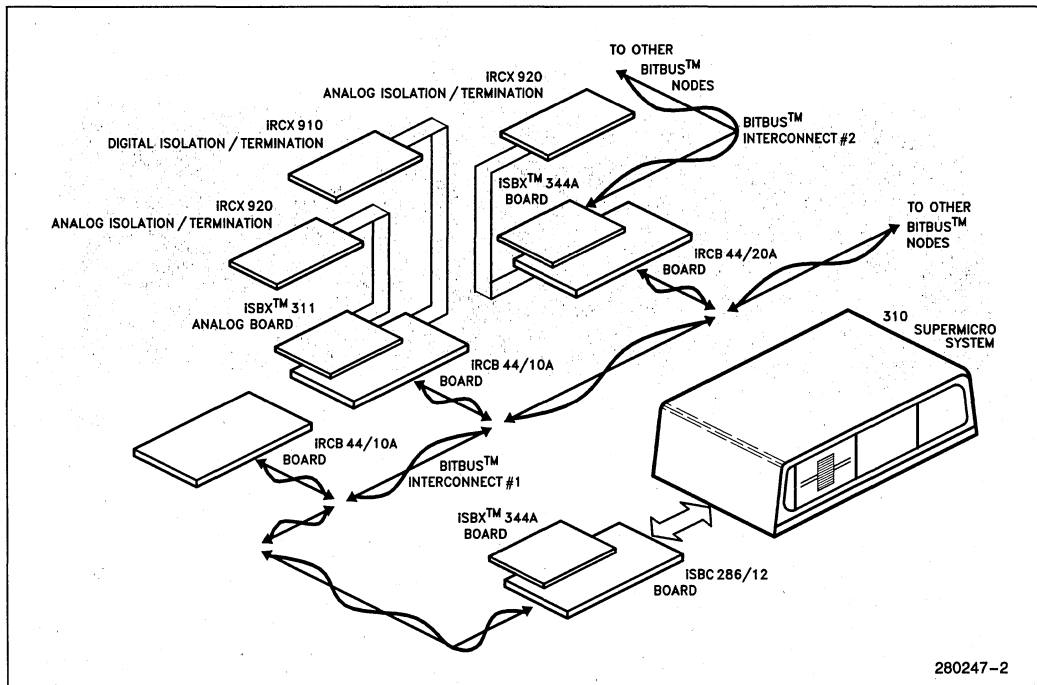


Figure 1. iDCM Operating Environment

ARCHITECTURE

Figure 3 illustrates the major functional blocks of the iSBX 344A board: 8044 BITBUS Enhanced Microcontroller (BEM), memory, BITBUS microcontroller interconnect, Byte FIFO interface, initialization and diagnostic logic.

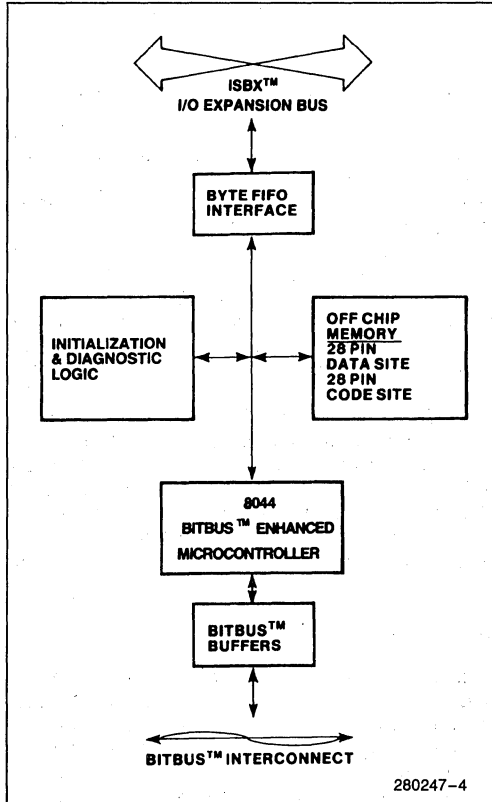


Figure 3. ISBX™ 344A Block Diagram

iDCM Controller

The heart of the iSBX 344A MULTIMODULE board's controlling and communication capability is the highly integrated 12 MHz 8044 microcontroller. The 8044 consists of the advanced 8-bit, 8051 microcontroller and a SDLC-based controller called the Serial Inter-

face Unit (SIU). This dual processor architecture allows complex control and high speed communication to be realized cost effectively.

The 8044 BEM microcontroller also includes built-in firmware known as DCM44. This firmware includes a set of functions called Remote Access and Control (RAC), a preconfigured version of the DCX51 Executive, communications software, and a power-up test procedure.

Memory

The iSBX 344A MULTIMODULE board memory consists of two internal and external memory. Internal memory is located in the on-chip memory of the iDCM controller. The iDCX 51 Executive and the remaining 8044 BEM firmware ration this resource. However, eight bytes of bit addressable internal memory are reserved for the user. Ample space is reserved for user programs and data in the iSBX 344A MULTIMODULE board external memory.

Two 28-pin JEDEC sites comprise the iSBX 344A MULTIMODULE board external memory. One site has been dedicated for data; the other for code. Table 1 lists the supported memory devices for each site. Intel's 2764 and 27128 are examples. The user may choose one of two memory configurations and specify different memory sizes by placing the proper jumpers at system initialization. The most flexible configuration option provides the user with access to the code site for program download or upload. This feature ensures expansion of an existing system is easily accommodated. For example, the addition of another conveyor to a material handling system would require adding another controller or controllers and changes to existing applications code and addition of new code.

Table 1. Supported Memory Devices

Device	Data Site	Code Site
4K x 8–64K x 8 EPROM/ROM	No	Yes
2K x 8–32K x 8 SRAM	Yes	Yes
2K x 8–16K x 8 NVRAM and E2PROM	No	Yes

BITBUS™ Microcontroller Interconnect

The ISBX 344A MULTIMODULE board fully supports the BITBUS microcontroller interconnect. The BITBUS interconnect is a serial bus optimized for control applications. The interconnect supports both synchronous and self-clocked modes of operation. These modes of operation are selectable dependent on application requirements as are the transmission rates. Table 2 shows different combinations of modes of operations, transmission rates, and distances. The SDLC-based protocol, BITBUS message format, and compatibility with Intel's other software and hardware products comprise the remainder of this established architecture. These features contribute to BITBUS reliability and usefulness as a microcontroller interconnect.

The BITBUS connection consists of one or two differential pair(s) of wires. The BITBUS interface of the iSBX 344A MULTIMODULE board consists of a half-duplex RS 485 transceiver and an optional clock source for the synchronous mode of operation.

Byte FIFO Interface

The Byte FIFO Interface on the iSBX 344A MULTIMODULE board implements the required hardware buffering between the 8044 BEM and an extension. An extension is defined as a device attached to the iSBX I/O expansion interface on the iSBX 344A MULTIMODULE board. In an iDCM system, an example of an extension is an iSBC 286/12 board which may be considered the host board in a MULTIBUS system. When used with the software handlers in the BITBUS Toolbox, implementation of this interface is complete.

For particular applications, the user may wish to develop a custom software interface to the extension or host board. On the iSBX 344A MULTIMODULE board side of the interface the iDCM firmware auto-

matically accepts messages for the FIFO. No user code is required, increasing the time available for application system development.

The Byte FIFO supports both byte and message transfer protocol in hardware via three register ports: data, command, and status. The extension side supports polled, interrupt, and limited DMA modes of operation (e.g. 80186 type DMA controllers).

Initialization and Diagnostic Logic

Like the other members of Intel's Distributed Control Modules (iDCM) product line, the iSBX 344A MULTIMODULE board includes many features which make it well suited for industrial control applications. Power up diagnostics is just one of these features. Diagnostics simplify system startup considerably, by immediately indicating an 8044 BEM or external bus failure. The LEDs used for power up diagnostics are available for user diagnostics after power up as well as to further contribute to reliable operation of the system.

Initial iSBX 344A MULTIMODULE board parameters are set by positioning jumpers. The jumpers determine the BITBUS mode of operation: synchronous, self-clocked, transmission rate, and address of the iSBX module in the BITBUS system. This minimizes the number of spare boards to be stocked for multiple nodes, decreasing stocking inventory and cost.

INTEGRAL FIRMWARE

Resident firmware located in the 8044 BEM includes: a pre-configured iDCX 51 Executive for user program development; a Remote Access and Control (RAC) function that enables user communication and control of different microcontrollers and I/O points; a communications gateway to connect the BITBUS interconnect, ISBX bus, and iDCX 51 Executive tasks; and power up diagnostics.

Table 2. BITBUS™ Microcontroller Interconnect Modes of Operation

	Speed Kb/s	Maximum Distance Between Repeaters M/ft	Maximum # Nodes Per Segment	Maximum # Repeaters Between a Master and Any Slave
Synchronous	500-2400	30/100	28	0
Self Clocked	375	300/1000	28	2
	62.5	1200/4000	28	10

Segment: Distance between master and repeater or a repeater and a repeater. Synchronous mode requires user supplied crystal.

The iDCX 51 Executive is an event-driven software manager that can respond to the needs of multiple tasks. This real-time multitasking executive provides: task management, timing, interrupt handling, and message passing services. Table 3 shows the iDCX 51 calls. Both the executive and the communications gateway allow for the addition of up to seven user tasks at each node while making BITBUS operations transparent.

The Remote Access and Control Function is a special purpose task that allows the user to transfer commands and program variables to remote BITBUS controllers, obtain the status of a remote I/O line(s), or reverse the state of a remote I/O line. Table 4 provides a complete listing of the RAC services. No user code need be written to use this function.

The services provided by the iSBX 344A MULTIMODULE board integral firmware simplify the development and implementation of complex real-time control application systems. All iDCM hardware products contain integral firmware thus supplying the user with a total system solution.

DEVELOPMENT ENVIRONMENT

Intel provides a complete development environment for the iSBX 344A MULTIMODULE board. Software development support consists of: the 8051 Software Development Package, the DCS100 BITBUS Toolbox Host Software Utilities, the DSC110 Bitware for ICE™ Support, and the DCS120 Programmer's Support Package. The 8051 Software Development Package provides the RL 51 Linker and Relocator Program, and ASM 51. PL/M 51 is also available. Hardware tools consist of the In-Circuit Emulator (ICE 5100/044).

Table 3. iDCX 51 Calls

Call Name	Description
TASK MANAGEMENT CALLS	
RQ\$CREATE\$TASK	Create and schedule a new task.
RQ\$DELETE\$TASK	Delete specified task from system.
RQ\$GET\$FUNCTION\$IDS	Obtain the function IDs of tasks currently in the system.
INTERTASK COMMUNICATION CALLS	
RQ\$ALLOCATE	Obtain a message buffer from the system buffer pool.
RQ\$DEALLOCATE	Return a message buffer to the system buffer pool.
RQ\$SEND\$MESSAGE	Send a message to specified task.
RQ\$WAIT	Wait for a message event.
MEMORY MANAGEMENT CALLS	
RQ\$GET\$MEM	Get available SMP memory.
RQ\$RELEASE\$MEM	Release SMP memory.
INTERRUPT MANAGEMENT CALLS	
RQ\$DISABLE\$INTERRUPT	Temporarily disable an interrupt.
RQ\$ENABLE\$INTERRUPT	Re-enable an interrupt.
RQ\$WAIT	Wait for an interrupt event.
TIMER MANAGEMENT CALLS	
RQ\$SET\$INTERVAL	Establish a time interval.
RQ\$WAIT	Wait for an interval event.

Table 4. RAC Services

RAC Service	Action Taken by Task 0
RESET__STATION	Perform a software reset.
CREATE__TASK	Perform an RQ\$CREATE\$TASK system call.
DELETE__TASK	Perform an RQ\$DELETE\$TASK system call.
GET__FUNCTION__ID	Perform an RQ\$GET\$FUNCTION\$IDS call.
RAC__PROJECT	Suspend or resume RAC services.
READ__I/O	Return values from specified I/O ports.
WRITE__I/O	Write to the specified I/O ports.
UPDATE__I/O	Update the specified I/O ports.
UPLOAD__MEMORY	Return the values in specified memory area.
DOWNLOAD__MEMORY	Write values to specified memory area.
OR__I/O	OR values into specified I/O ports.
AND__I/O	AND values into specified I/O ports.
XOR__I/O	XOR values into specified I/O ports.
READ__INTERNAL	Read values at specified internal RAM areas.
WRITE__INTERNAL	Write values to specified internal RAM areas.
NODE__INFO	Return device related information.
OFFLINE	Set node offline.
UPLOAD__CODE	Read values from code memory space.
DOWNLOAD__CODE	Write values to specified EEPROM memory.

NOTE:

Internal memory locations are included in the 192 bytes of data RAM provided in the microcontroller. External memory refers to memory outside the microcontroller — the 28-pin sockets of the iSBX 344A module and the iRCB 44/10A board. Each RAC Access Function may refer to multiple I/O or memory locations in a single command.

SPECIFICATIONS

CPU

8044 BITBUS Enhanced Microcontroller (BEM)

Word Size

Instruction: 8 bits

Data: 8 bits

Processor Clock 12 MHz

Instruction Execution Times

1 μ s 60% instructions

2 μ s 40% instructions

4 μ s Multiply & Divide

Memory Capacity/Addressing

iDCM Controller: Up to 64 Kbytes code

Address Range

	Option A	Option B
External Data Memory	0000H–7FFFH	0000H–7FFFH
External Code Memory	1000H–0FFFFH	8000H–0FEFFH
Internal Code Memory	0000H–0FFFH	0000H–0FFFH

Option A: Supports maximum amount of external EPROM code memory.

Option B: Supports downloading code into external RAM or EEPROM memory.

Terminations

Sockets provided on board for 1/4 Watt 5% Carbon type resistors. Resistor value to match characteristic impedance of cable as closely as possible—120 Ω or greater.

Message Size

54 bytes max

**8044 BITBUS™ Enhanced Microcontroller
(8044 + Firmware) I/O Addressing as Viewed from the 8044**

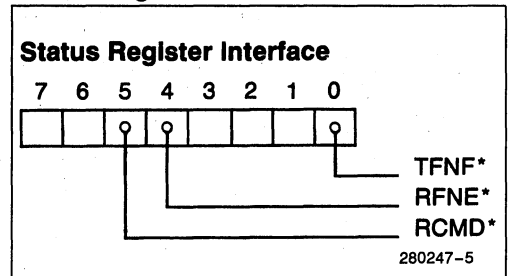
Function	Address	Read	Write	Bit	Comments
Data	FF00H	✓	✓		
Command	FF01H	✓	✓		Write sets command to extension — Read clears command from extension
Status					
-RFNF*	B3H	✓		✓	Also INT1 Input Also INTO Input
-TFNE*	B2H	✓		✓	
-TCMD*	92H	✓		✓	
LED #1	90H	✓	✓	✓	
LED #2	91H	✓	✓	✓	
RDY/NE*	B4H	✓	✓	✓	
Node Address	FFFFH	✓			
Configuration	FFFEH	✓			

**ISBX™ 344A MULTIMODULE™ Board I/O Addressing as Viewed from the
ISBX™ 344A MULTIMODULE™ Board**

Register Function	Address	Comments
Data	Base'	Read/Write
Command	Base' + 1	Write sets command from extension Read clears command to extension
Status	Base' + 2	Read Only

Interrupt/DMA Lines

Signal	Location	Interface Option
RINT	MDRQ/MINT0	INT
TINT	MINT1	INT
RCMI	OPT0	INT or DMA
RDRQ	MDRQ/MINT0	DMA
TDRQ	MINT1	DMA

Status Register Interface


Connector Options

10 Pin Plug

Flat Cable: 3M 3473-6010, TB Ansley 609-1001M, or equal

Discrete Wire: BERG 65846-007, ITT Cannon 121-7326-105, or equal

Pinout

Pin	Signal
1	+ 12V
2	+ 12V
3	GND
4	GND
5	DATA*
6	DATA
7	DCLK*/RTS*
8	DCLK/RTS
9	RGND
10	RGND

Electrical Characteristics

Interfaces

iSBX™ I/O Expansion Bus: supports the standard I/O Expansion Bus Specification with compliance level IEEE 959.

Memory Sites: Both code and data sites support the standard 28-pin JEDEC site.

BITBUS™ Interconnect: Fully supported synchronous mode at 2.4 Mbits/sec and self clocked mode for 375 kbits/sec and 62.5 kbits/sec

The iSBX 344A MULTIMODULE board presents one standard load to the BITBUS bus.

Power Requirements

0.9A at +5V ±5% (does not include power to the memory devices)

Physical Characteristics

Double-wide iSBX™ MULTIMODULE™ Form Factor

Dimensions

Height: 10.16 mm (0.4 in) maximum component height

Width: 63.5 mm (2.50 in)

Length: 190.5 mm (7.50 in)

Weight: 113 gm (4 ounces)

Environmental Characteristics

Operating Temperature: 0°C to 55°C at 200 Linear Feet/Minute Air Velocity

Humidity: 90% non-condensing

Reference Manual (NOT Supplied)

148099— iSBX 344A Intelligent BITBUS Interface Board User's Guide

Ordering Information

Part Number Description

ISBX 344A BITBUS Intelligent MULTIMODULE board