



Microdata Interface

Byte I/O Controller Model 2510,8710

GENERAL DESCRIPTION

The multipurpose Byte I/O Controller is used for interfacing a variety of input and output devices with the Micro 800 or Micro 1600 Series Computers. The unit includes independent input and output controllers. Both controllers provide either positive true or negative true logic to the I/O devices. The unit is capable of executing simultaneous and independent input and output operations in either the program mode, or in the concurrent block transfer mode. All data transfers are in 8-bit parallel byte form.

Both the input and the output controller are capable of initiating program interrupts when an error condition, device stop, or device malfunction is detected, or at the end of a block transfer. I/O device status information, including status bits derived from status lines connected to each device, can also be sent to the computer in response to a status function code from the computer.

APPLICATION INFORMATION

In the most common application, the Byte I/O Controller is used with an optical paper tape reader and a high-speed paper tape punch. Other input/output devices compatible with the controller include buffered line printers, CRT displays, and card readers. Special devices that require both input and output data transfers can also utilize the controller.

The Byte I/O Controller is suitable for use with input or output devices having data rates up to 50 kilobytes per second for the Micro 800 and up to 55 kilobytes per second for the Micro 1600. Suitability of the controller for specific applications may be determined by analyzing the specification data on the back page.

STANDARD FEATURES

- Buffered input and output data lines. Data is held until next data transfer is executed.
- Three Modes of Operation:
 - Program Mode.
 - Program Mode with Interrupt on Character.
 - Concurrent Mode for Block Transfers.
- Independent input and output controllers.
- Status Lines:
 - Output Device – Five lines, including three device error lines.
 - Input Device – Four lines, including two device error lines.
- Interrupts with programmable arm/disarm:
 - Program Mode – Interrupt on data ready or device stop.
 - Concurrent Mode – Interrupt on disconnect, device error, or malfunction.
- Status Information to Computer: 8-bit status byte from input or output controller includes bits derived from status lines, plus controller mode and status.
- Selectable positive true or negative true logic for data, data strobe and data ready.
- High logic level for output data lines and data strobe is selectable (+12V or +5V).
- Computer-controlled stop and go device control lines for each device.
- Device Addressing: Output Controller address (odd) is one higher than Input Controller address (even). Input Controller address may be any even-numbered value between hexadecimal 00 and 1F. Device address modification is achieved by changing jumpers on the controller printed circuit board. Standard addresses are 02 (input device) and 03 (output device).

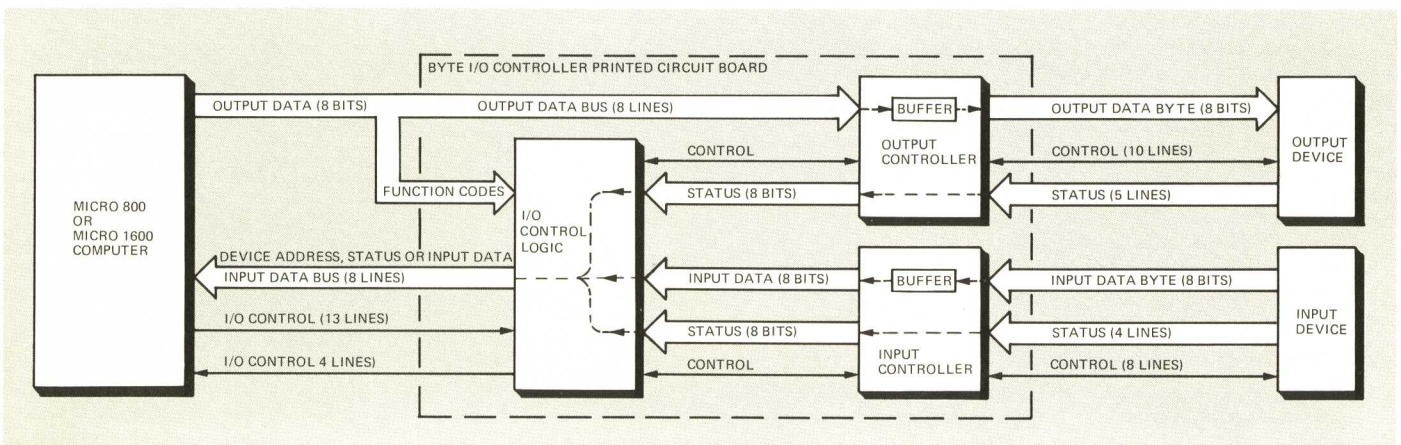


Figure 1. System Block Diagram

FUNCTIONAL DESCRIPTION

Function Codes

All operations in the controller are initiated by function code (I/O Command) bytes from the computer. The presence of a function code on the output data bus is indicated by a Control Out pulse from the computer. The five least significant bits (bits 4 thru 0) of the function code byte contain the address of the device for which the function code is intended. The three most significant bits (bits 7 thru 5) contain the function code. The function codes for the input and output controllers are defined as follows:

Code (Bits 7-5)	Input Controller	Output Controller
0	Initiate input transfer of one data byte in the program mode.	Initiate output transfer of one data byte in the program mode.
1	Initiate transfer of input Controller Status Byte to computer.	Initiate output transfer of Controller Status Byte to computer.
2	Initiate input transfers in concurrent (block transfer) mode. Interrupt is armed unless a Disarm Interrupt device order is subsequently received. Code 2 also starts the input device.	Not Used.
3	Arm Interrupt in program mode.	Arm Interrupt in program mode.
4	Disconnect concurrent mode and/or stop input device. An interrupt is initiated if interrupt is armed.	Disconnect concurrent mode and/or stop output device. An interrupt is initiated if interrupt is armed.
5	Disarm Interrupt.	Disarm Interrupt.
6	Start input device.	Initiate output transfers in concurrent mode. Interrupt is armed unless a Disarm Interrupt device order is subsequently received. Code 6 also starts the output device.
7	Not Used.	Start output device.

The function code is specifically addressed to either the input or the output controller, and the addressed controller executes the order.

Output Data Transfers in Program Mode

Initially, function code 7 is sent to start the output device. Function code 0 must then be sent prior to each data transfer. If interrupt on character is desired, function code 3 (arm interrupt) must precede function code 0. The interrupt occurs when the Ready signal from the output device goes true. The computer responds to the interrupt by sending function code 3 (to arm the controller for the next interrupt), followed by function code 0 (to initiate the data transfer). The output data byte is then stored in the controller on the leading edge of a Data Out pulse from the computer. Finally, on the trailing edge of Data Out, a Data Strobe pulse is issued to the output device and the output device accepts the output data byte.

If desired, function code 4 may be sent to stop the output device after data transfers are completed. This action also initiates an interrupt (if interrupt is armed).

Input Data Transfers in Program Mode

Initially, function code 6 is sent to start the input device. Function code 0 must then be sent prior to each data transfer. If interrupt on character is desired, function code 3 (arm interrupt) must precede function code 0. The interrupt is initiated following receipt of a Data Strobe pulse from the input device. On the trailing edge of the Data

Strobe pulse, the input data byte is stored in the controller. Subsequently, the computer issues function code 0 to initiate the data transfer to the computer. Following function code 0, the computer issues a Data In pulse, indicating that the data has been accepted. The Data In pulse produces a Data Transfer Acknowledge pulse to notify the device that the transfer is completed. If a second Data Strobe is received before the data transfer is completed, a Read Error condition exists, and a low Read Error signal is supplied to the input device.

If desired, function code 4 may be sent to stop the input device after data transfers are completed. This action also initiates an interrupt (if interrupt is armed).

Data Transfers in Concurrent Mode

Receipt of function code 2 addressed to the input controller, or receipt of function code 6 addressed to the output controller, initiates the concurrent mode of operation in the associated controller. The associated device receives a GO signal. Each occurrence of a Data Strobe from the input device (input controller in concurrent mode), or each occurrence of a true Ready signal from the output device (output controller in concurrent mode), initiates a Concurrent I/O request to the computer. The computer responds by generating a Concurrent Acknowledge pulse. The controller responds to this pulse by sending an address byte (twice the device address) to the computer. Upon receipt of the address byte, the computer generates Data In or Data Out to transfer the data between the controller and the computer. Data transfers continue in this manner until a Disconnect function code (code 4) is received from the computer. The disconnect function code also stops the device.

Unless a Disarm Interrupt function code (code 5) is received, interrupts are initiated in the concurrent mode when any of the following conditions occur:

- A Device Error condition is detected on the status lines from the device being operated in the concurrent mode.
- A Read Error condition occurs while the input controller is operating in the concurrent mode.
- A Disconnect function code is received.

Interrupts

Interrupts are armed (enabled) by a Concurrent Mode, Device Start, or Arm Interrupt function code. Once armed, the addressed controller remains in the armed state until one of the following conditions occurs:

Input Controller

- Data Strobe is received in program mode.
- Disconnect function code is received.
- Error status line from input device is active in concurrent mode.
- Read error condition is detected in concurrent mode.

Output Controller

- Ready signal true in program mode.
- Disconnect device order is received.
- Error status line from output device is active in concurrent mode.

When any of these conditions occurs, the associated controller moves to the wait state and sends an External Interrupt Request pulse to the computer. The computer responds by returning an Interrupt Acknowledge pulse, causing the controller to move to the active state. Also, the controller sends an address byte (twice the device address) to the computer. The controller remains in the active state until one of the following function codes is received:

- Disconnect.
- Disarm Interrupt.
- Arm Interrupt.
- Concurrent Mode.

A Disconnect or Disarm Interrupt function code moves the controller to the disarmed state; a Concurrent Mode or Arm Interrupt function code returns the controller to the armed state.

Status Data Transfers

In response to a Status Function function code (code 1), the addressed controller issues an 8-bit status byte to the computer. Definitions of the bits in the status byte are as follows:

PHYSICAL DESCRIPTION

The Byte I/O Controller is contained on a single printed circuit board that plugs into the mainframe or expansion chassis of the Micro 800 or Micro 1600 series computer. Connections to the input and output devices are made by means of cables connected directly to printed circuit edge connectors on the rear of the board.

SPECIFICATIONS

Models:

Micro 800 Computer — Model 8710 Byte I/O Controller
 Micro 1600 Computer — Model 2510 Byte I/O Controller

Power Requirements: +5V @ 1.5 amperes from Micro 800 or Micro 1600 computer power supply.
 (for controller)

Environmental Requirements:
 Temperature: 0°C to 50°C (ambient)
 Humidity: 10–90% relative humidity without condensation.

Maximum Cable Lengths: 20 feet (10-foot cable and connectors are supplied with Model 2510)
 (between controller and input/output devices)

Circuit Board Size: Micro 800 computer: 8.575" x 10.5"
 Micro 1600 computer: 8.575" x 12.5"

Interface Signals (for Device Interfaces)

Signal	Input Device	Output Device
Data Lines	High = +2.4 to +5.0V; Low = 0.0 to +0.4V No source current required for high level; 7 ma sink current required for low level. Positive true or negative true data may be selected.	High = +5.0 or +12.0V (selectable) Low = 0.0 to +0.4V Source impedance is 2 Kohm; sink capability is 50 ma. Positive true or negative true data may be selected.
Non-Data Output Signals to Device	High = +2.4 to +5.0V; Low = 0.0 to +0.4V; source impedance is 1 Kohm; sink capability is 50 ma to ground.	
Data Transfer Acknowledge	A high level notifies device that data transfer is completed.	Not Applicable.
Data Transfer Enable	Not Applicable.	A low level notifies the device that a data byte is coming. Data Strobe 1 occurs approximately 800 nsec. later.
Data Strobe	High or low may be selected as the active state. Minimum strobe duration is 800 nsec. Data is accepted and stored in controller on trailing edge of strobe. Strobe has same characteristics as input data lines.	High or low may be selected as the active state. Two strobes are available as follows: Data Strobe 1 — Pulse leading edge of Data Out, and continues until ready line from devices goes false. Data Strobe 2 — Adjustable pulse width that occurs on trailing edge of Data Out. For both strobes, data will be present on output data lines a minimum of 800 nsec. before the leading edge of the strobe.
Block Transfer	A low level notifies the device that data transfers are in the concurrent mode.	Not Applicable.

Signal	Input Device	Output Device
Ready Signal	The Data Strobe pulse serves as the ready signal for the input device.	When output device is ready to accept data, a true (selectable high or low) Ready signal must be supplied to the controller. Trailing edge of Ready resets Data Strobe 1. Ready signal is terminated on controller board to a 1 Kohm resistor connected to +5V.
Rear Error	A low level notifies the device that a read error condition is present (more than one Data Strobe received while a single data transfer is in process).	Not Applicable.
Status Lines	Four, including two device error lines.	Five, including three device error lines.
Device Control Signals	A high GO signal is sent to device upon receipt of a Device Start or Concurrent Mode function code. A high STOP signal is sent to the device upon receipt of a Disconnect function code (code 4).	
Interrupt Control Signals	When a controller is in the armed or wait state, a high Interrupt Enable is supplied to the device. While the controller is in the wait or active state, an Interrupt Hold signal (high for input device, low for output device) is supplied to the device.	



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