Microdata Interface

General-Purpose I/O Controller Model 2511,8705

GENERAL DESCRIPTION

The General-Purpose I/O Controller can be used for most interface applications not covered by standard controllers. By extending software and firmware control out to discrete machine control lines, the unit permits software to be employed for solving difficult hardware interface problems.

A total of 32 input and 32 output lines are provided to external devices for communication with Micro 800 or Micro 1600 series computers. These lines are divided into four groups, or channels which are accessed by channel select function codes from the computer. Each output data line is separately buffered.

Data transfers are accomplished in the program mode of byte transfer, utilizing the Byte I/O Interface of the computer. A single input or output data transfer operation consists of the transfer of an 8-bit byte between the computer and the selected channel. First, the computer issues a function code containing the number (0 thru 3) of the selected channel. Then, the computer issues a Data In or Data Out pulse to effect the input or output transfer.

During an output transfer, the 8-bit byte from the computer is loaded into the output register of the selected channel when Data Out occurs, and an output data strobe is issued to the device. During an input transfer, the 8 input lines from the selected channel are scanned by an input multiplexer, and the resulting input byte is supplied to the computer when Data In occurs.

An interrupt line from the external device(s) is provided for each of the four channels. When an interrupt line is active, an external interrupt request is issued to the computer, provided that an interrupt was armed by a function code from the computer.

STANDARD FEATURES

- 32 computer-controlled, buffered, output data or control lines to external device(s)
- 32 input data or sense lines from external device(s)
- Negative true logic is used for input and output data lines
- Input and output lines are divided into four channels each containing 8 input and 8 output lines. Channel selections are made under computer control.
- Separate output data strobe for each channel
- Output data lines for each channel may be ungated, or may be gated by output data strobe.
- 4 independent interrupt lines from external device(s) are combined into a single interrupt request line. Interrupts are armed or disarmed under computer control.
- Standard device address is hexadecimal 08. Device address modification is accomplished by changing jumper connections on printed circuit board.
- Normal input and output terminations (open collector drive) are suitable for distances up to 30 feet.

OPTIONAL FEATURES

By special order, a modification can be provided permitting the input lines to be driven with normal DTL or TTL gates, provided that the cable length is less than 3 feet.

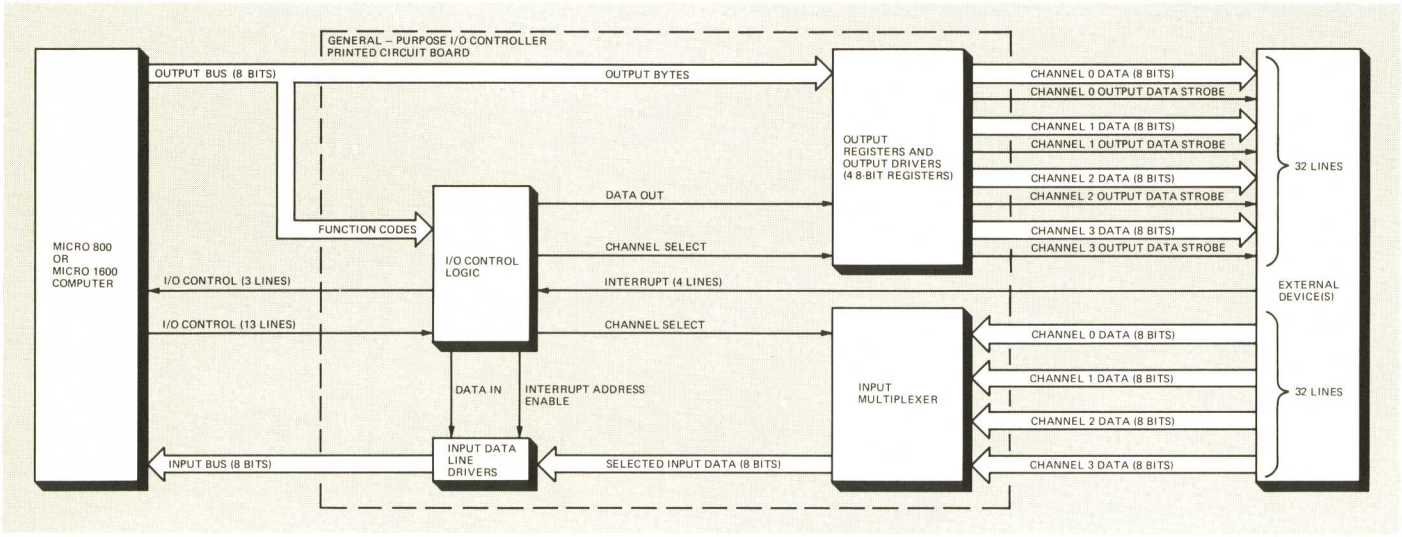


FIGURE 1 SYSTEM BLOCK DIAGRAM

APPLICATION INFORMATION

The General-Purpose I/O Controller can be used for interfacing multiplexer-analog-to-digital converters (MUX-ADC's), digital-to-analog converters (DAC's), incremental tape drives, process control systems, and miscellaneous low-speed peripheral devices with the Micro 800 and Micro 1600 series computers. Additionally, the unit can be used to "widen" the I/O channel of the computer from the normal 8-bit word length to a word length of up to 32 bits. This capability permits the use of a variety of "full-word" devices with the Micro 800 and Micro 1600 series computers.

The output data channels of the interface can be used to send either data or discrete control signals to external devices. The input data channels may be used for sending data, status information, and input or output data requests from external devices to the computer. Four interrupt lines are also available for initiating external interrupts.

The two examples below show how the General-Purpose I/O Controller is used with a MUX-ADC and a Magnetic Tape Cassette.

MUX-ADC Application

In this application, the General-Purpose I/O Controller is used to communicate with a MUX-ADC. Any one of up to 256 analog signal channels may be accessed by a multiplexer address word sent via output channel 0 of the interface. The multiplexer (MUX) responds by connecting the designated analog signal channel to the analog-to-digital converter (ADC). Gain control codes sent over output channel 1 set the gain of the ADC. Output channel 2 is used to issue a Convert Command (random addressing) or a Channel Advance and Convert Command (sequential addressing) to the ADC. For random addressing, a separate multiplexer address word must be sent for each ADC conversion. For sequential addressing, the analog signal channels are accessed sequentially, starting from the initial multiplexer address issued by the computer.

A 1 in bit 0 of the output channel 2 is defined as a Convert Command; a 1 in bit 1 is defined as a Channel Advance and Convert Command. Upon receipt of either command, the ADC converts the analog signal selected by the MUX to its digital equivalent. When conversion is complete, the ADC issues an End of Convert (EDC) interrupt to the interface, which responds by generating an external interrupt request to the computer. The computer responds by executing an input data transfer from input data channel 3 of the interface, which is connected to the ADC output. If the ADC output contains more than 8 bits, the computer would execute input data transfers sequentially from more than one input channel (channels 0-3).

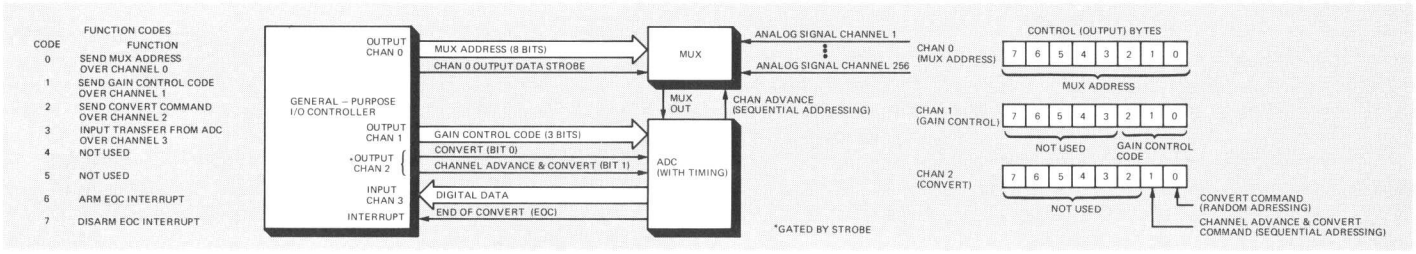


FIGURE 2 MUX–ADC APPLICATION

Magnetic Tape Cassette Application

In this example, the General-Purpose I/O Controller is used to communicate with four magnetic tape cassette units (tape decks). A read, write, file mark write, rewind, file mark search, or stop tape operation may be performed on any of the four tape decks. Only one tape deck can be operated on at any given time.

Output channel 0 is used to send a Status In command by activating the line (status in) to one of the four tape decks. The selected tape deck responds by placing a status byte on the status bus to Input Channel 0. The computer then executes a status in input data transfer from channel 0 to accept the status byte.

Output Channel 1 is used to send function commands to the tape decks. The code in bits 0 and 1 of the function command byte indicates the tape deck to which the command is addressed. Bits 2 thru 7 contain the function command for the addressed tape deck.

During a write operation, Output Channel 3 is used to transfer write data bytes from the computer to the selected tape deck. The computer is notified that the selected tape deck is ready to accept a write data byte when the status byte from the tape deck contains a 1 in bit 1.

During a read operation, Input Channel 2 is used to transfer data bytes from the selected tape deck to the computer. The computer is notified that the selected tape deck is ready to

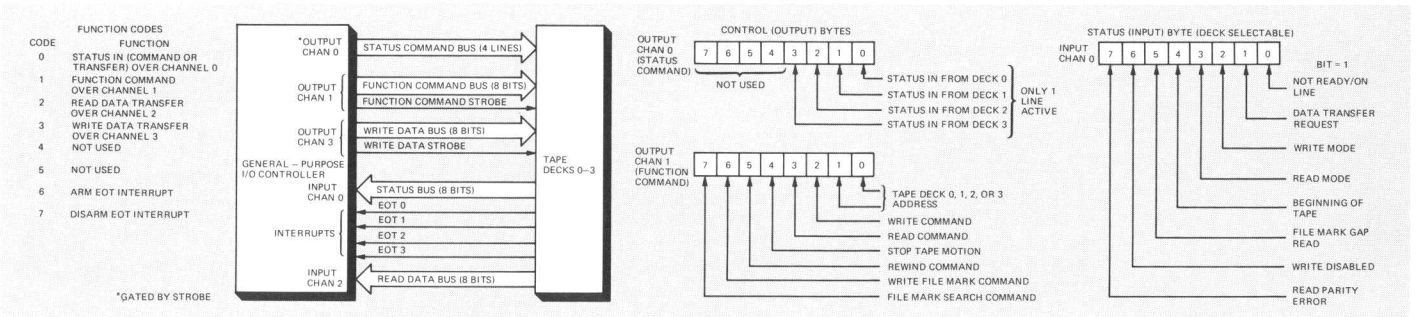


FIGURE 3 MAGNETIC TAPE CASSETTE APPLICATION

send a read data byte when the status byte from the tape deck contains a 1 in bit 1.

An End of Tape (EOT) condition in the selected tape deck causes the associated EOT interrupt line to become active. The computer would usually respond by issuing a rewind command to the tape deck. Completion of rewind is indicated by a 1 in bit 4 (beginning of tape) of the status byte.

A file mark search operation is initiated when the computer issues a file mark search function command to a tape deck. Completion of the file mark search is indicated by a 1 in bit 5 (file mark gap read) of the status byte.

FUNCTIONAL DESCRIPTION

The I/O Control Section of the controller processes function code (I/O command) bytes from the computer, and also processes interrupts from the external device. Function codes are identified by a Control Out pulse from the computer. The function code byte is an 8-bit byte containing the device address (normally hexadecimal 08 unless address jumpers are changed) in bits 4 thru 0, and a function code in bits 7 thru 5. Function codes are as follows:

Function Code (Bits 7 - 5)	Function
0	Select Channel 0 for input or output transfer
1	Select Channel 1 for input or output transfer
2	Select Channel 2 for input or output transfer
3	Select Channel 3 for input or output transfer
4	Not Used
5	Not Used
6	Arm Interrupt (allows interrupts to occur)
7	Disarm Interrupt (prevents interrupts from occurring)

When function code 0, 1, 2, or 3 is received, the code is decoded to select one of the four channels. For an output transfer, the computer issues an output data byte and a Data Out pulse following the function code, causing the output byte to be loaded into the output register of the selected channel. The Data Out pulse also produces an Output Data Strobe from the selected channel. For an input transfer, the computer issues a Data In pulse following the function code, causing the Input Multiplexer to gate the data on the input data lines from the selected channel to the computer input bus.

When function code 6 is received, an external interrupt request is generated when any of the four interrupt lines from the external device is active. Once an external interrupt request is issued, another interrupt cannot be initiated until another arm interrupt function is received. If interrupts are not desired, the computer issues function code 7 (disarm interrupt).

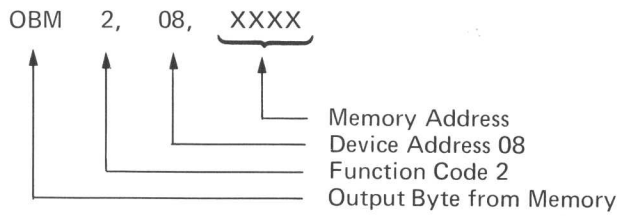
PROGRAMMING THE CONTROLLER

In the Micro 800 and Micro 1600 series computers, the following six basic I/O commands are used for communicating between the computer and the controllers:

MNEMONIC	COMMAND
OBA	Output Byte from A Register
OBB	Output Byte from B Register
OBM	Output Byte from Memory
IBA	Input Byte to A Register
IBB	Input Byte to B Register
IBM	Input Byte to Memory

When writing commands in assembly language, the instruction mnemonic is followed by a 3-bit function code and a 5-bit device address. In the case of OBM and IBM commands, a 15-bit memory address is also required. The 3-bit function code specifies a function to be performed by a controller, and the device address specifies which controller is to perform the function.

Assembly Language Example



Instruction List

The command set used with the General Purpose I/O Controller is listed in the following table:

MNEMONIC	MACHINE CODE (HEX)	
IBA 0,8	3108	Channel 0 to A Register
IBB 0,8	3208	Channel 0 to B Register
IBM 0,8,addr	3308*	Channel 0 to M Register
IBA 1,8	3128	Channel 1 to A Register
IBB 1,8	3228	Channel 1 to B Register
IBM 1,8,addr	3328*	Channel 1 to M Register
IBA 2,8	3148	Channel 2 to A Register
IBB 2,8	3248	Channel 2 to B Register
IBM 2,8,addr	3348*	Channel 2 to M Register
IBA 3,8	3168	Channel 3 to A Register
IBB 3,8	3268	Channel 3 to B Register
IBM 3,8,addr	3368*	Channel 3 to M Register
OBA 0,8	3908	A Register to Channel 0
OBB 0,8	3A08	B Register to Channel 0
OBM 0,8,addr	3B08*	M Register to Channel 0
OBA 1,8	3928	A Register to Channel 1
OBB 1,8	3A28	B Register to Channel 1
OBM 1,8,addr	3B28*	M Register to Channel 1
OBA 2,8	3948	A Register to Channel 2
OBB 2,8	3A48	B Register to Channel 2
OBM 2,8,addr	3B48*	M Register to Channel 2
OBA 3,8	3968	A Register to Channel 3
OBB 3,8	3A68	B Register to Channel 3
OBM 3,8,addr	3B68*	M Register to Channel 3
OBA 6,8	39C8	Arm Interrupt
OBA 7,8	39E8	Disarm Interrupt

*Plus 15-bit address.

PHYSICAL DESCRIPTION

The General-Purpose 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 computers. 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.

OUTPUT TERMINATIONS

Line drivers for the output data lines are DTL power gates having an open collector output. The near-end termination is a 1K-ohm resistor connected to +5V, providing a 0V to +5V voltage swing. When the cable length from the near-end termination to the receiving element is more than 3 feet, a far-end termination, as shown in the diagram, is recommended. With the far-end termination, the voltage swing is 0V to +3V.

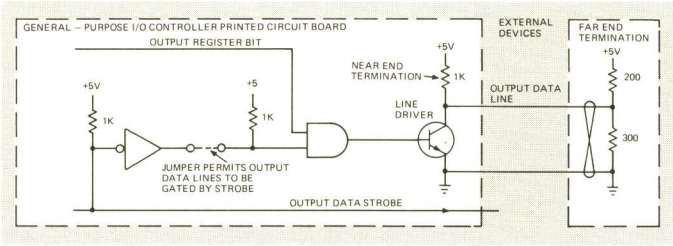


FIGURE 4 OUTPUT TERMINATIONS

OUTPUT DATA TIMING

Separate output data strobes are provided for each channel. Data from the computer is stored in an Output Register within 30-40 nsec after the leading edge of the 880-nsec-wide Data Out pulse from the computer. Approximately 150 nsec after the leading edge of Data Out, the leading edge of the Output Data Strobe occurs. This pulse also has a width of approximately 880 nsec. If the jumper shown in Figure 4 is connected the width of the output data pulses will be the same as the width (880 nsec) of the Output Data Strobe.

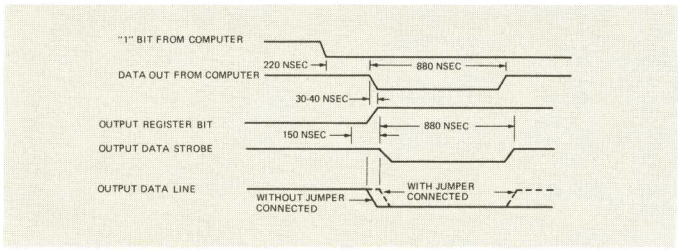


FIGURE 5 OUTPUT DATA TIMING

INPUT DATA LINE TERMINATIONS

The Input Multiplexer is provided with the normal input data line terminations shown in the diagram. This normal termination is suitable for open collector drivers over cable lengths of up to 30 feet. The voltage swing with this termination is 0V to +3V.

By special order, the normal termination can be replaced by a simple pull-up to +5V, allowing the inputs to be driven with normal TTL or DTL gates, provided that the cable length is no greater than 3 feet. The voltage swing with the special pull-up termination is 0V to +5V.

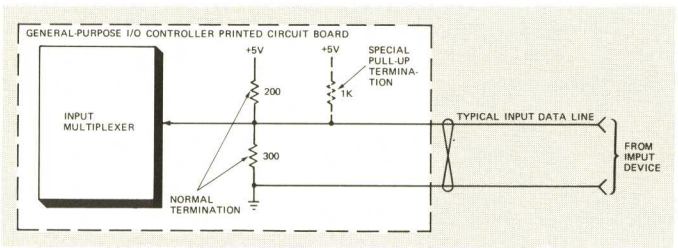


FIGURE 6 INPUT TERMINATIONS

SPECIFICATIONS

Models:

Micro 800 Computer – Model 8705 General-Purpose I/O Controller

Micro 1600 Computer – Model 2511 General-Purpose I/O Controller

Power Requirements:	+5V, 975 to 1700 milliamperes (Nominal 1300 milliamperes)
Printed Circuit Board Size:	Micro 800 series computer: 8.575" x 10.5" Micro 1600 series computer: 8.575" x 12.5"
Environmental	
Temperature:	0°C to 50°C
Humidity:	10-90% without condensation

Output Lines to External Device:	Far-End Termination	With Far-End Termination
	1=0 ±0.5V	1=0 ±0.5V
	0=+5 ±0.5V	0=+3 ±0.5V

Input Lines From External Device:	Normal Termination	Special Pull-up Termination
	1=0 ±0.5V	1=0 ±0.5V
	0=+3 ±0.5V	0=+3 ±0.5V

CONNECTOR DATA FOR MODEL 8705

Output Data Lines:	Channel 0	Channel 1	Channel 2	Channel 3
Bit 7	P3-B01	P3-A07	P2-B21	P2-B12
Bit 6	P3-B04	P3-B13	P2-A17	P2-A14
Bit 5	P3-B02	P3-B11	P2-A18	P2-B13
Bit 4	P3-A01	P3-A05	P2-A19	P2-B11
Bit 3	P3-A03	P3-A09	P2-B22	P2-B19
Bit 2	P3-B03	P3-A10	P2-A21	P2-A16
Bit 1	P3-B05	P3-A08	P2-A20	P2-A13
Bit 0	P3-B07	P3-B10	P2-A22	P2-A11
Output Data Strobe:	P3-A04	P3-B06	P2-B17	P2-B20
Input Data Lines:				
Bit 7	P2-A07	P2-B07	P2-A06	P2-B06
Bit 6	P2-A08	P2-B08	P2-A10	P2-B10
Bit 5	P3-A22	P3-B22	P3-A11	P3-B21
Bit 4	P2-A01	P2-B01	P2-A02	P2-B02
Bit 3	P3-A20	P3-A19	P3-B19	P3-A18
Bit 2	P2-A03	P2-A04	P2-B04	P2-A05
Bit 1	P3-A15	P3-B15	P3-A14	P3-A13
Bit 0	P3-B16	P3-A16	P3-A17	P3-B18
Interrupt Lines*:	P3-A11	P3-B12	P3-A12	P3-B08

*Not necessarily associated with a specific channel.

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