

8243 MCS®-48 INPUT/OUTPUT EXPANDER

■ 0°C TO 70°C Operation

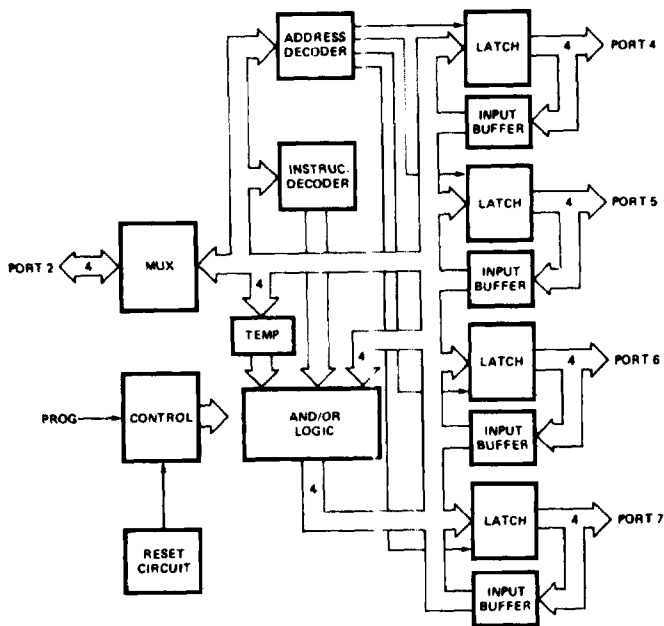


Figure 1. 8243 Block Diagram

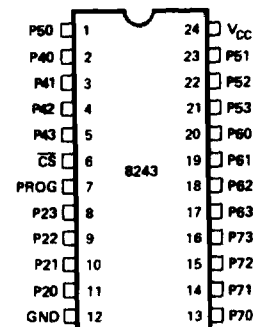


Figure 2. 8243 Pin Configuration

Table 1. Pin Description

Symbol	Pin No.	Function
PROG	7	Clock Input. A high to low transition on PROG signifies that address and control are available on P20–P23, and a low to high transition signifies that data is available on P20–P23.
$\overline{CS}$	6	Chip Select Input. A high on CS inhibits any change of output or internal status.
P20–P23	11–8	Four (4) bit bi-directional port contains the address and control bits on a high to low transition of PROG. During a low to high transition, P2 contains the data for a selected output port if a write operation, or the data from a selected port before the low to high transition if a read operation.
GND	12	0V supply.
P40–P43	2–5	Four (4) bit bi-directional I/O ports.
P50–P53 P60–P63 P70–P73	1, 23–21 20–17 13–16	May be programmed to be input (during read), low impedance latched output (after write), or a tri-state (after read). Data on pins P20–P23 may be directly written, ANDed or ORed with previous data.
V _{CC}	24	+5V supply.

1

FUNCTIONAL DESCRIPTION

General Operation

The 8243 contains four 4-bit I/O ports which serve as an extension of the on-chip I/O and are addressed as Ports 4–7. The following operations may be performed on these ports:

- Transfer Accumulator to Port.
- Transfer Port to Accumulator.
- AND Accumulator to Port.
- OR Accumulator to Port.

All communication between the 8048 and the 8243 occurs over Port 2 (P20–P23) with timing provided by an output pulse on the PROG pin of the processor. Each transfer consists of two 4-bit nibbles:

The first containing the “op code” and port address and the second containing the actual 4-bits of data. A high to low transition of the PROG line indicates that address is present while a low to high transition indicates the presence of data. Additional 8243’s may be added to the 4-bit bus and chip selected using additional output lines from the 8048/8748/8035.

Power On Initialization

Initial application of power to the device forces input/output Ports 4, 5, 6, and 7 to the tri-state and Port 2 to the input mode. The PROG pin may be

either high or low when power is applied. The first high to low transition of PROG causes the device to exit power on mode. The power on sequence is initiated if V_{CC} drops below 1V.

P21	P20	Address Code	P23	P22	Instruction Code
0	0	Port 4	0	0	Read
0	1	Port 5	0	1	Write
1	0	Port 6	1	0	ORLD
1	1	Port 7	1	1	ANLD

Write Modes

The device has three write modes. MOVD Pi, A directly writes new data into the selected port and old data is lost. ORLD Pi, A takes new data, OR’s it with the old data and then writes it to the port. ANLD Pi, A takes new data, AND’s it with the old data and then writes it to the port. Operation code and port address are latched from the input Port 2 on the high to low transition of the PROG pin. On the low to high transition of PROG data on Port 2 is transferred to the logic block of the specified output port.

After the logic manipulation is performed, the data is latched and outputted. The old data remains latched until new valid outputs are entered.

Read Mode

The device has one read mode. The operation code and port address are latched from the input Port 2

on the high to low transition of the PROG pin. As soon as the read operation and port address are decoded, the appropriate outputs are tri-stated, and the input buffers switched on. The read operation is terminated by a low to high transition of the PROG pin. The port (4, 5, 6 or 7) that was selected is switched to the tri-stated mode while Port 2 is returned to the input mode.

Normally, a port will be in an output (write mode) or input (read mode). If modes are changed during operation, the first read following a write should be ignored; all following reads are valid. This is to allow the external driver on the port to settle after the first read instruction removes the low impedance drive from the 8243 output. A read of any port will leave that port in a high impedance state.

ABSOLUTE MAXIMUM RATINGS*

Ambient Temperature Under Bias 0°C to 70°C
 Storage Temperature - 65°C to + 150°C
 Voltage on Any Pin
 with Respect to Ground - 0.5V to + 7V
 Power Dissipation 1 Watt

NOTICE: This data sheet contains preliminary information on new products in production. It is valid for the devices indicated in the revision history. The specifications are subject to change without notice.

**WARNING: Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.*

D.C. CHARACTERISTICS $T_A = 0^\circ\text{C to } 70^\circ\text{C}, V_{CC} = 5\text{V} \pm 10\%$

Symbol	Parameter	Min	Typ	Max	Units	Test Conditions
V_{IL}	Input Low Voltage	-0.5		0.8	V	
V_{IH}	Input High Voltage	2.0		$V_{CC} + 0.5$	V	
V_{OL1}	Output Low Voltage Ports 4-7			0.45	V	$I_{OL} = 4.5\text{ mA}^*$
V_{OL2}	Output Low Voltage Port 7			1	V	$I_{OL} = 20\text{ mA}$
V_{OH1}	Output High Voltage Ports 4-7	2.4			V	$I_{OH} = 240\text{ }\mu\text{A}$
I_{IL1}	Input Leakage Ports 4-7	-10		20	μA	$V_{in} = V_{CC}\text{ to } 0\text{V}$
I_{IL2}	Input Leakage Port 2, CS, PROG	-10		10	μA	$V_{in} = V_{CC}\text{ to } 0\text{V}$
V_{OL3}	Output Low Voltage Port 2			0.45	V	$I_{OL} = 0.6\text{ mA}$
I_{CC}	V_{CC} Supply Current		10	20	mA	(Note 1)
V_{OH2}	Output Voltage Port 2	2.4				$I_{OH} = 100\text{ }\mu\text{A}$
I_{OL}	Sum of All I_{OL} From 16 Outputs			72	mA	4.5 mA Each Pin

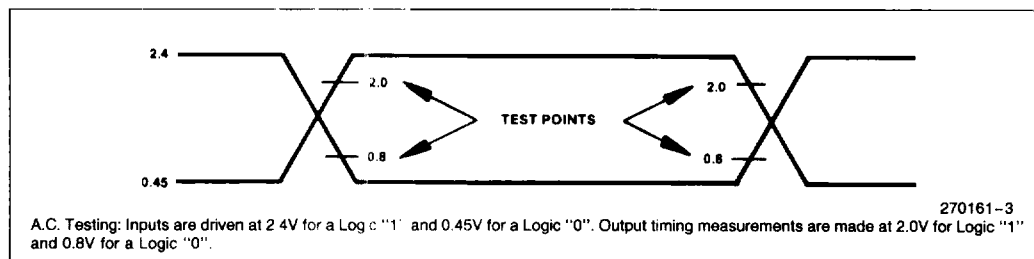
*Refer to Figure 3 for additional sink current capability.

A.C. CHARACTERISTICS $T_A = 0^\circ\text{C to } 70^\circ\text{C}$, $V_{CC} = 5V \pm 10\%$

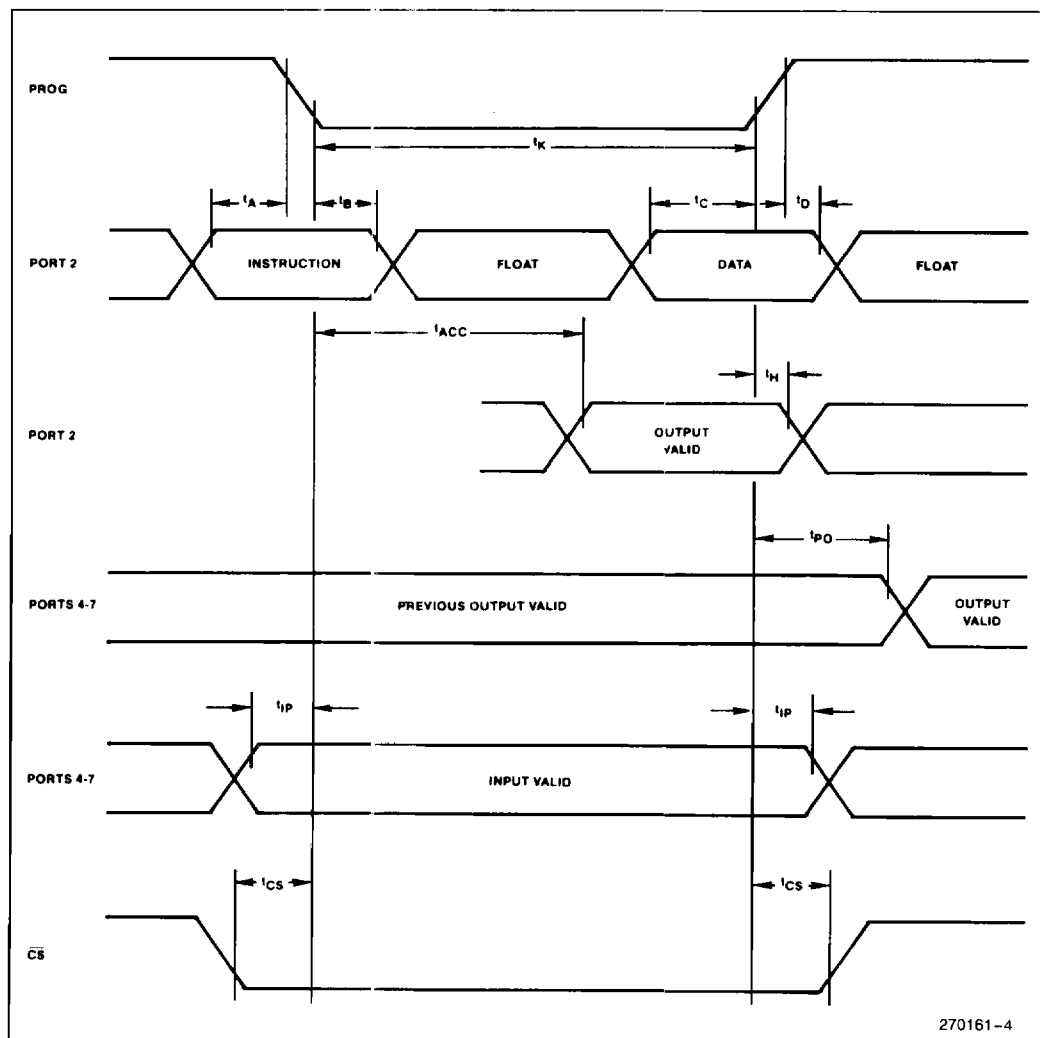
Symbol	Parameter	Min	Max	Units	Test Conditions
t_A	Code Valid before PROG	50		ns	80 pF Load
t_B	Code Valid after PROG	60		ns	20 pF Load
t_C	Data Valid before PROG	200		ns	80 pF Load
t_D	Data Valid after PROG	20		ns	20 pF Load
t_H	Floating after PROG	0	150	ns	20 pF Load
t_K	PROG Negative Pulse Width	700		ns	
t_{CS}	CS Valid before/after PROG	50		ns	
t_{PO}	Ports 4–7 Valid after PROG		700	ns	100 pF Load
t_{LP1}	Ports 4–7 Valid before/after PROG	100		ns	
t_{ACC}	Port 2 Valid after PROG		650	ns	80 pF Load

NOTE:

1. I_{CC} (-40°C to 85°C EXPRESS options) 15 mA typical/25 mA maximum.



WAVEFORMS



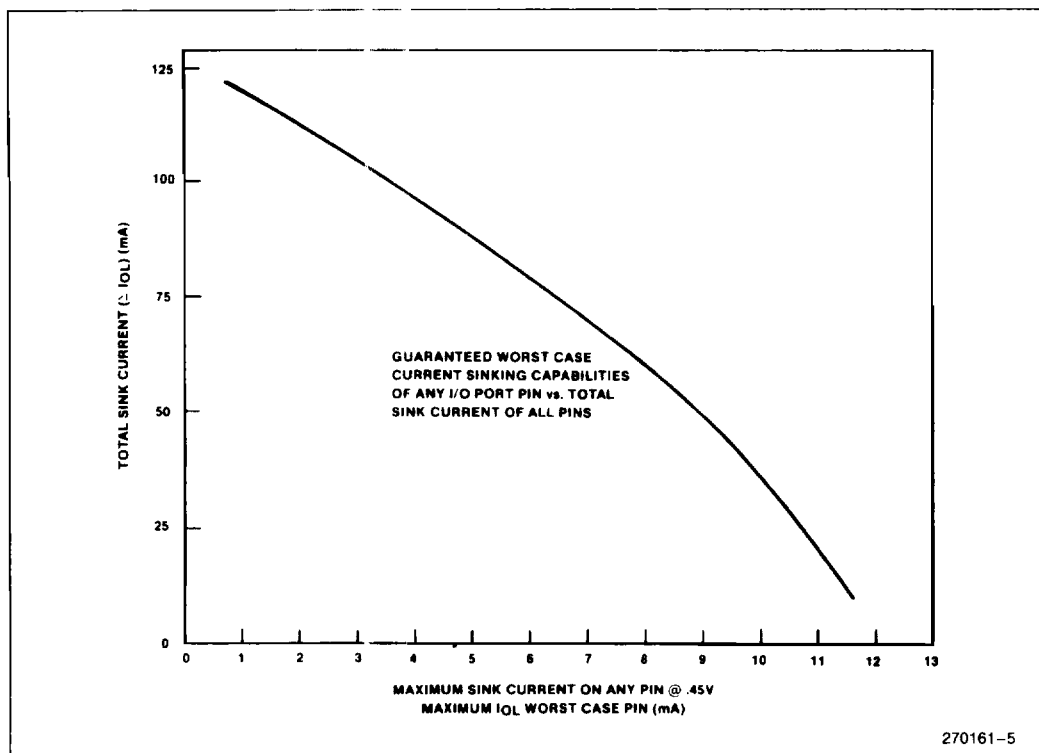


Figure 3. 8243 Current Sink Capability

Sink Capability

The 8243 can sink 5 mA @ 0.45V on each of its 16 I/O lines simultaneously. If, however, all lines are not sinking simultaneously or all lines are not fully loaded, the drive capability of any individual line increases as is shown by the accompanying curve.

For example, if only 5 of the 16 lines are to sink current at one time, the curve shows that each of those 5 lines is capable of sinking 9 mA @ 0.45V (if any lines are to sink 9 mA the total I_{OL} must not exceed 45 mA or five 9 mA loads).

Example: How many pins can drive 5 TTL loads (1.6 mA) assuming remaining pins are unloaded?

$$I_{OL} = 5 \times 1.6 \text{ mA} = 8 \text{ mA}$$

$$\epsilon I_{OL} = 60 \text{ mA from curve}$$

$$\# \text{ pins} = 60 \text{ mA} \div 8 \text{ mA/pin} = 7.5 = 7$$

In this case, 7 lines can sink 8 mA for a total of 56 mA. This leaves 4 mA sink current capability which can be divided in any way among the remaining 8 I/O lines of the 8243.

NOTE:

A10 to 50 K Ω pullup resistor to +5V should be added to 8243 outputs when driving to 5V CMOS directly.

Example: This example shows how the use of the 20 mA sink capability of Port 7 affects the sinking capability of the other I/O lines.

An 8243 will drive the following loads simultaneously.

2 loads—20 mA @ 1V (Port 7 only)

8 loads—4 mA @ 0.45V

6 loads—3.2 mA @ 0.45V

Is this within the specified limits?

$$\epsilon I_{OL} = (2 \times 20) + (8 \times 4) + (6 \times 3.2) = 91.2 \text{ mA}$$

From the curve: for $I_{OL} = 4 \text{ mA}$, $\epsilon I_{OL} \cong 93 \text{ mA}$. Since $91.2 \text{ mA} < 93 \text{ mA}$ the loads are within specified limits.

Although the 20 mA @ 1V loads are used in calculating ϵI_{OL} , it is the largest current required @ 0.45V which determines the maximum allowable ϵI_{OL} .

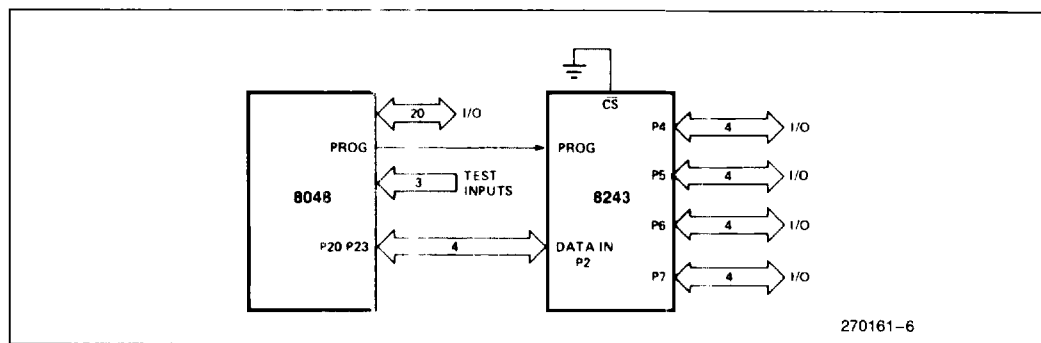


Figure 4. Expander Interface

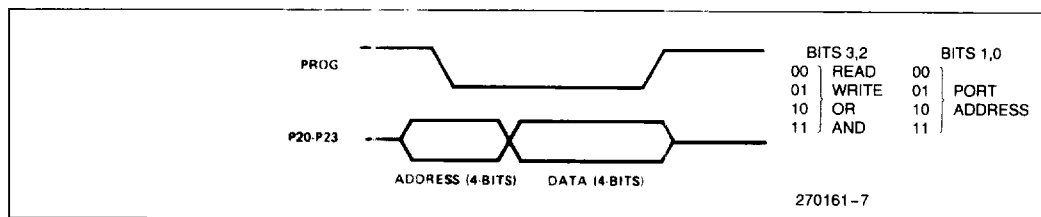


Figure 5. Output Expander Timing

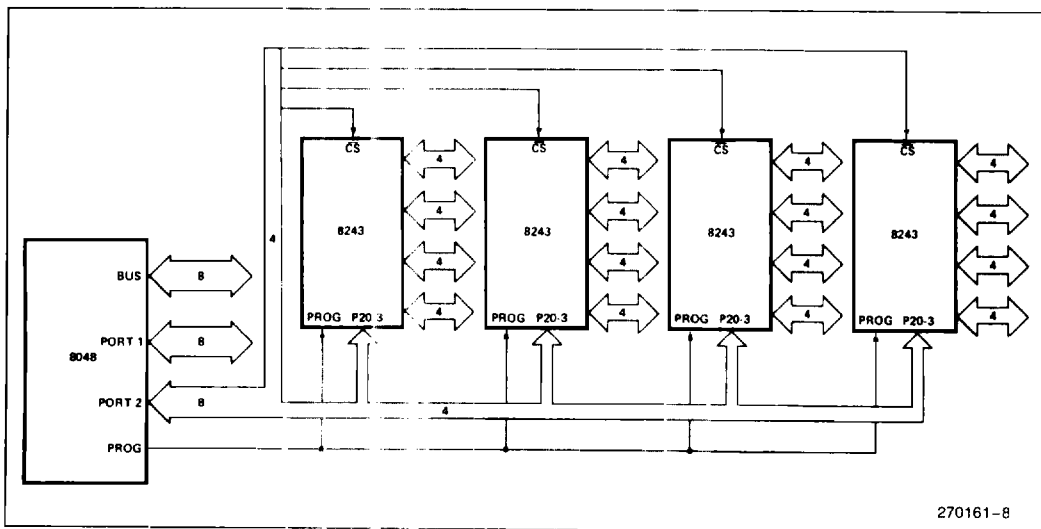


Figure 6. Using Multiple 8243's