MILITARY TEMP.

M8080A

SINGLE CHIP 8-BIT N-CHANNEL MICROPROCESSOR

The M8080A is functionally compatible with the Intel® 8080.

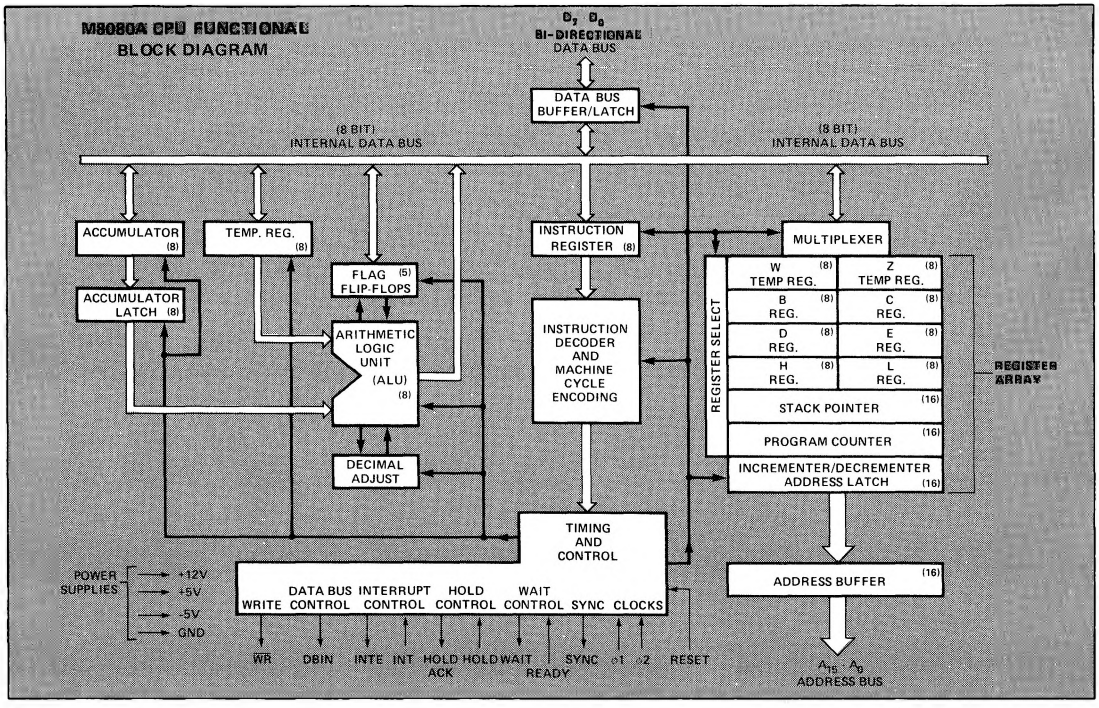
- **Full Military Temperature Range −55°C to +125°C**
- **±10% Power Supply Tolerance**
- **2 μs Instruction Cycle**
- **Powerful Problem Solving Instruction Set**
- **Six General Purpose Registers and an Accumulator**
- **Sixteen Bit Program Counter for Directly Addressing up to 64K Bytes of Memory**
- **Sixteen Bit Stack Pointer and Stack Manipulation Instructions for Rapid Switching of the Program Environment**
- **Decimal, Binary and Double Precision Arithmetic**
- **Ability to Provide Priority Vectored Interrupts**
- **512 Directly Addressed I/O Ports**
- **TTL Drive Capability**

The Intel® M8080A is a complete 8-bit parallel central processing unit (CPU). It is fabricated on a single LSI chip using Intel's n-channel silicon gate MOS process. This offers the user a high performance solution to control and processing applications.

The M8080A contains six 8-bit general purpose working registers and an accumulator. The six general purpose registers may be addressed individually or in pairs providing both single and double precision operators. Arithmetic and logical instructions set or reset four testable flags. A fifth flag provides decimal arithmetic operation.

The M8080A has an external stack feature wherein any portion of memory may be used as a last in/first out stack to store/retrieve the contents of the accumulator, flags, program counter and all of the six general purpose registers. The sixteen bit stack pointer controls the addressing of this external stack. This stack gives the M8080A the ability to easily handle multiple level priority interrupts by rapidly storing and restoring processor status. It also provides almost unlimited subroutine nesting.

This microprocessor has been designed to simplify systems design. Separate 16-line address and 8-line bi-directional data busses are used to facilitate easy interface to memory and I/O. Signals to control the interface to memory and I/O are provided directly by the M8080A. Ultimate control of the address and data busses resides with the HOLD signal. It provides the ability to suspend processor operation and force the address and data busses into a high impedance state. This permits OR-tying these busses with other controlling devices for (DMA) direct memory access or multi-processor operation.



ABSOLUTE MAXIMUM RATINGS*

Temperature Under Bias	-55°C to +125°C
Storage Temperature	-65°C to +150°C
All Input or Output Voltages With Respect to V_{BB}	-0.3V to +20V
V_{CC}, V_{DD} and V_{SS} With Respect to V_{BB}	-0.3V to +20V
Power Dissipation	1.7W

**COMMENT: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

D.C. CHARACTERISTICS

T_A = -55°C to +125°C, V_{DD} = +12V ±10%, V_{CC} = +5V ±10%, V_{BB} = -5V ±10%, V_{SS} = 0V, Unless Otherwise Noted.

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Condition
V_{ILC}	Clock Input Low Voltage	$V_{SS}-1$		$V_{SS}+0.8$	V	
V_{IHC}	Clock Input High Voltage	8.5		$V_{DD}+1$	V	
V_{IL}	Input Low Voltage	$V_{SS}-1$		$V_{SS}+0.8$	V	
V_{IH}	Input High Voltage	3.0		$V_{CC}+1$	V	
V_{OL}	Output Low Voltage			0.45	V	I_{OL} = 1.9mA on all outputs,
V_{OH}	Output High Voltage	3.7			V	I_{OH} = 150μA.
$I_{DD\,(AV)}$	Avg. Power Supply Current (V_{DD})		50	80	mA	Operation
$I_{CC\,(AV)}$	Avg. Power Supply Current (V_{CC})		60	100	mA	T_{CY} = .48 μsec
$I_{BB\,(AV)}$	Avg. Power Supply Current (V_{BB})		.01	1	mA	
I_{IL}	Input Leakage			±10	μA	$V_{SS} \leqslant V_{IN} \leqslant V_{CC}$
I_{CL}	Clock Leakage			±10	μA	$V_{SS} \leqslant V_{CLOCK} \leqslant V_{DD}$
I_{DL} [2]	Data Bus Leakage in Input Mode			-100 -2.0	μA mA	$V_{SS} \leqslant V_{IN} \leqslant V_{SS}+0.8V$ $V_{SS}+0.8V \leqslant V_{IN} \leqslant V_{CC}$
I_{FL}	Address and Data Bus Leakage During HOLD			+10 -100	μA	$V_{ADDR/DATA} = V_{CC}$ $V_{ADDR/DATA} = V_{SS} + 0.45V$

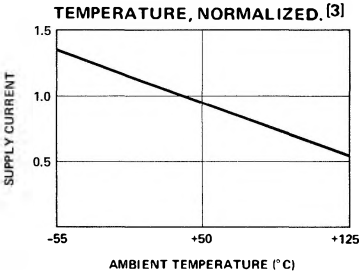
CAPACITANCE

T_A = 25°C $V_{CC} = V_{DD} = V_{SS}$ = 0V, V_{BB} = -5V

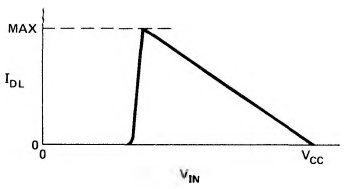
Symbol	Parameter	Typ.	Max.	Unit	Test Condition
C_ϕ	Clock Capacitance	17	25	pf	f_c = 1 MHz
C_{IN}	Input Capacitance	6	10	pf	Unmeasured Pins
C_{OUT}	Output Capacitance	10	20	pf	Returned to V_{SS}

NOTES:
1. The RESET signal must be active for a minimum of 3 clock cycles.
2. When DBIN is high and $V_{IN} > V_{IH}$ an internal active pull up will be switched onto the Data Bus.
3. ΔI supply / ΔT_A = -0.45%/°C.

TYPICAL SUPPLY CURRENT VS. TEMPERATURE, NORMALIZED. [3]



DATA BUS CHARACTERISTIC DURING DBIN



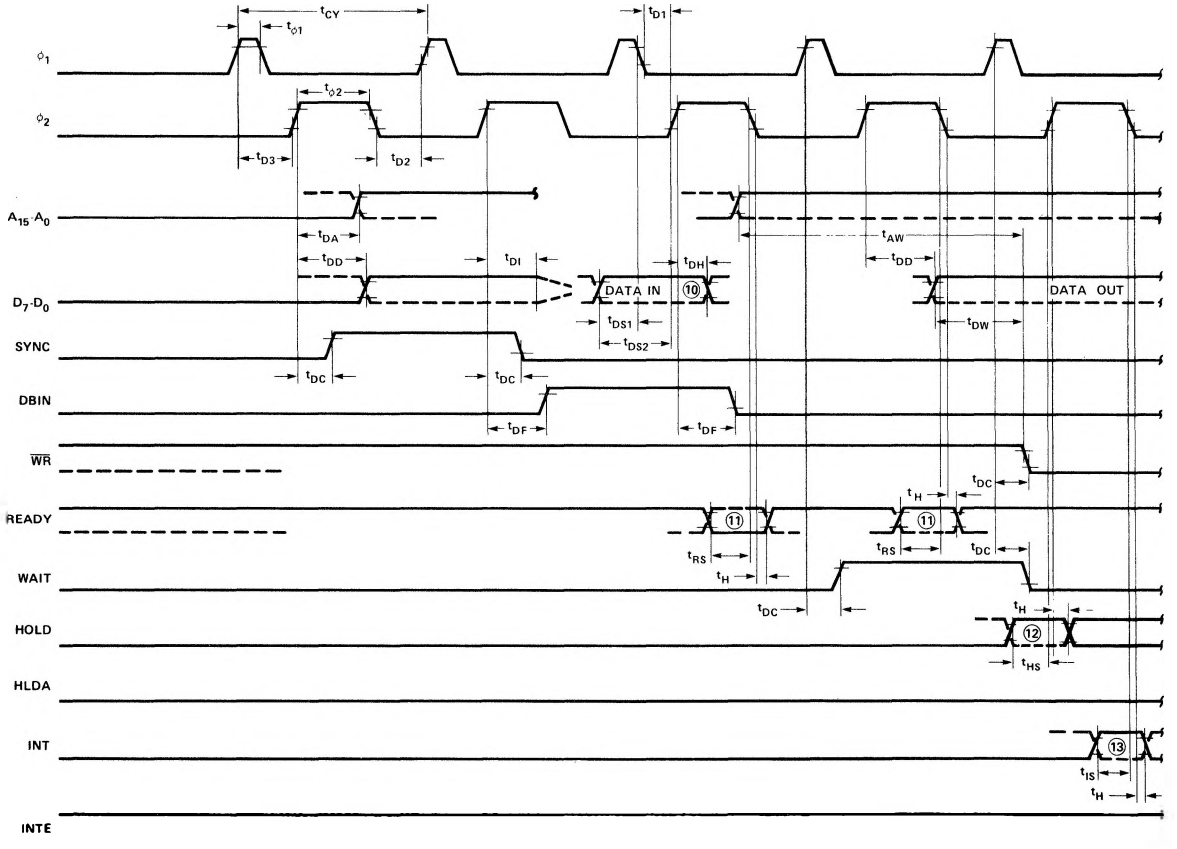
A.C. CHARACTERISTICS

T_A = -55°C to +125°C, V_{DD} = +12V ±10%, V_{CC} = +5V ±10%, V_{BB} = -5V ±10%, V_{SS} = 0V, Unless Otherwise Noted.

Symbol	Parameter	Min.	Max.	Unit	Test Condition
t_{CY}[3]	Clock Period	0.48	2.0	μsec	
t_r, t_f	Clock Rise and Fall Time	0	50	nsec	
$t_{\phi 1}$	ϕ_1 Pulse Width	60		nsec	
$t_{\phi 2}$	ϕ_2 Pulse Width	220		nsec	
t_{D1}	Delay ϕ_1 to ϕ_2	0		nsec	
t_{D2}	Delay ϕ_2 to ϕ_1	80		nsec	
t_{D3}	Delay ϕ_1 to ϕ_2 Leading Edges	80		nsec	
t_{DA}[2]	Address Output Delay From ϕ_2		200	nsec	C_L = 50pf
t_{DD}[2]	Data Output Delay From ϕ_2		220	nsec	
t_{DC}[2]	Signal Output Delay From ϕ_1, or ϕ_2 (SYNC, $\overline{WR}$, WAIT, HLDA)		140	nsec	
t_{DF}[2]	DBIN Delay From ϕ_2	25	150	nsec	
t_{DI}[1]	Delay for Input Bus to Enter Input Mode		t_{DF}	nsec	
t_{DS1}	Data Setup Time During ϕ_1 and DBIN	30		nsec	

TIMING WAVEFORMS[14]

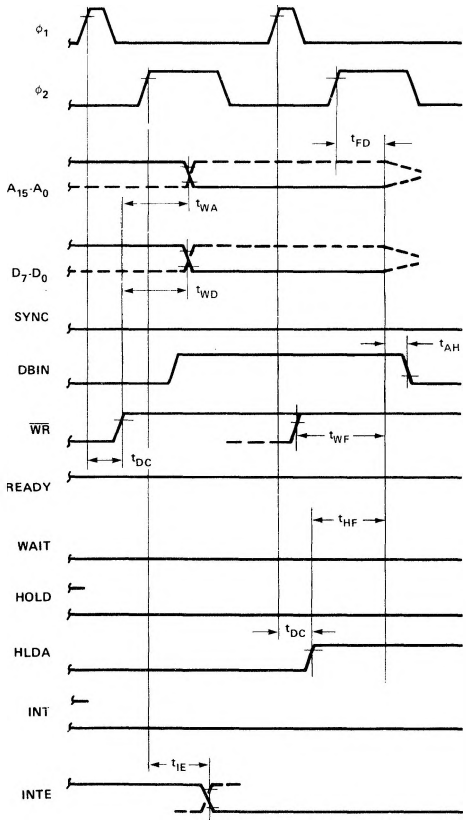
(Note: Timing measurements are made at the following reference voltages: CLOCK "1" = 7.0V, "0" = 1.0V; INPUTS "1" = 3.0V, "0" = 0.8V; OUTPUTS "1" = 2.0V, "0" = 0.8V.)



A.C. CHARACTERISTICS (Continued)

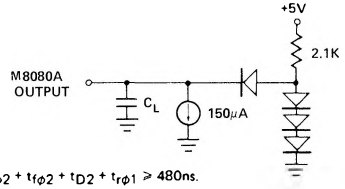
T_A = -55°C to +125°C, V_{DD} = +12V ±10%, V_{CC} = +5V ±10%, V_{BB} = -5V ±10%, V_{SS} = 0V, Unless Otherwise Noted.

Symbol	Parameter	Min.	Max.	Unit	Test Condition
t_{DS2}	Data Setup Time to ϕ_2 During DBIN	130		nsec	
t_{DH} [1]	Data Hold Time From ϕ_2 During DBIN	[1]		nsec	
t_{IE} [2]	INTE Output Delay From ϕ_2		200	nsec	C_L = 50pf
t_{RS}	READY Setup Time During ϕ_2	120		nsec	
t_{HS}	HOLD Setup Time to ϕ_2	140		nsec	
t_{IS}	INT Setup Time During ϕ_2 (During ϕ_1 in Halt Mode)	120		nsec	
t_H	Hold Time From ϕ_2 (READY, INT, HOLD)	0		nsec	
t_{FD}	Delay to Float During Hold (Address and Data Bus)		130	nsec	
t_{AW} [2]	Address Stable Prior to $\overline{WR}$	[5]		nsec	C_L = 50pf
t_{DW} [2]	Output Data Stable Prior to $\overline{WR}$	[6]		nsec	
t_{WD} [2]	Output Data Stable From $\overline{WR}$	[7]		nsec	
t_{WA} [2]	Address Stable From $\overline{WR}$	[7]		nsec	
t_{HF} [2]	HLDA to Float Delay	[8]		nsec	
t_{WF} [2]	$\overline{WR}$ to Float Delay	[9]		nsec	
t_{AH} [2]	Address Hold Time After DBIN During HLDA	-20		nsec	



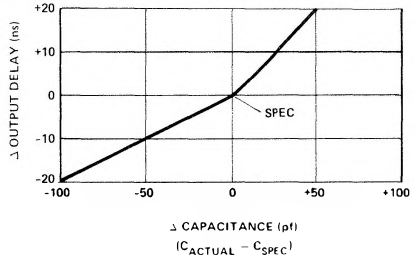
NOTES:

1. Data input should be enabled with DBIN status. No bus conflict can then occur and data hold time is assured. t_{DH} = 50 ns or t_{DF}, whichever is less.
2. Load Circuit.



3. $t_{CY} = t_{D3} + t_{r\phi2} + t_{\phi2} + t_{f\phi2} + t_{D2} + t_{r\phi1} \geq 480$ns.

TYPICAL Δ OUTPUT DELAY VS. Δ CAPACITANCE



4. The following are relevant when interfacing the M8080A to devices having V_{IH} = 3.3V:
   a) Maximum output rise time from .8V to 3.3V = 100ns @ C_L = SPEC.
   b) Output delay when measured to 3.0V = SPEC +60ns @ C_L = SPEC.
   c) If $C_L \neq$ SPEC, add .6ns/pF if $C_L > C_{SPEC}$, subtract .3ns/pF (from modified delay) if $C_L < C_{SPEC}$.
5. $t_{AW} = 2\,t_{CY} - t_{D3} - t_{r\phi2} - 140$nsec.
6. $t_{DW} = t_{CY} - t_{D3} - t_{r\phi2} - 170$nsec.
7. If not HLDA, $t_{WD} = t_{WA} = t_{D3} + t_{r\phi2} + 10$ns. If HLDA, $t_{WD} = t_{WA} = t_{WF}$.
8. $t_{HF} = t_{D3} + t_{r\phi2} - 50$ns.
9. $t_{WF} = t_{D3} + t_{r\phi2} - 10$ns
10. Data in must be stable for this period during DBIN · T_3. Both t_{DS1} and t_{DS2} must be satisfied.
11. Ready signal must be stable for this period during T_2 or T_W. (Must be externally synchronized.)
12. Hold signal must be stable for this period during T_2 or T_W when entering hold mode, and during T_3, T_4, T_5 and T_{WH} when in hold mode. (External synchronization is not required.)
13. Interrupt signal must be stable during this period of the last clock cycle of any instruction in order to be recognized on the following instruction. (External synchronization is not required.)
14. This timing diagram shows timing relationships only; it does not represent any specific machine cycle.