MOSTEK

MILITARY/HIGH-REL PRODUCTS

Extended Temperature, Extended Burn-In Industrial Processing

Z80/Z80A Central Processing Unit

MKI3880-70/74

FEATURES

- ☐ 44 hr. min., 125°C burn-in plus industrial screening for greater reliability (see Figure 6 for processing description)
- ☐ –40°C to 85°C temperature range
- ☐ Two speeds
  - 2.5 MHz MKI3880(P)-70 (Z80 CPU)
  - 4.0 MHz MKI3880(P)-74 (Z80A CPU)
- ☐ Single 5-Volt supply and single-phase clock required
- ☐ Software compatible with 8080A CPU
- ☐ Complete development and OEM system product support
- ☐ Military MKB version available (-55°C/125°C)
- ☐ Typical power 625 mW

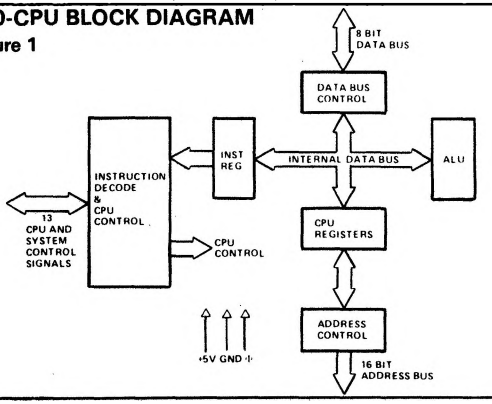
DESCRIPTION

The Mostek Z80 family of components is a significant advancement in the state-of-art of microcomputers. These components can be configured with any type of standard semiconductor memory to generate computer systems with an extremely wide range of capabilities. For example, as few as two LSI circuits and three standard TTL MSI packages can be combined to form a simple controller. With additional memory and I/O devices, a computer can be constructed with capabilities that only a minicomputer could deliver previously. This wide range of computational power allows standard modules to be constructed by a user that can satisfy the requirements of an extremely wide range of applications.

The CPU is the heart of the system. Its function is to obtain instructions from the memory and perform the desired operations. The memory is used to contain instructions and, in most cases, data that is to be processed. For example, a typical instruction sequence may be to read data from a specific peripheral device, store it in a location in memory, check the parity, and write it out to another peripheral device. Note that the Mostek component set includes the CPU and various general purpose I/O device controllers, as well as a wide range of memory devices. Thus, all required components can be connected together in a very simple manner with virtually no other external logic. The user's effort then becomes primarily one of the software development. That is, the user can concentrate on describing his problem and translating it into a series of instructions that can be loaded into the microcomputer memory. Mostek is dedicated to making this step of software generation as simple as possible. A good example of this is our assembly language in which a simple mnemonic is used to represent every instruction that the CPU can perform. This language is self-documenting in such a way that from the mnemonic the user can understand exactly what the instruction is doing without constantly checking back to a complex cross listing. Please refer to the Z80 Data Book for extensive Z80 operation documentation.

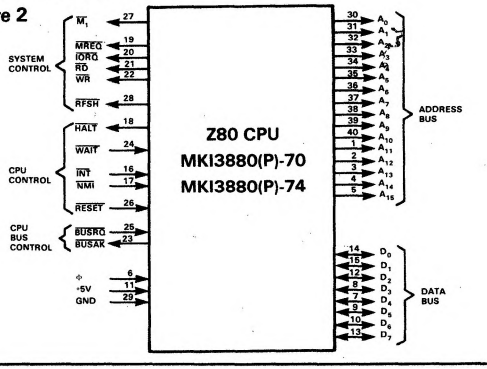
Z80-CPU BLOCK DIAGRAM

Figure 1



Z80 PIN CONNECTIONS

Figure 2



ABSOLUTE MAXIMUM RATINGS*

Temperature Under Bias ..... -40°C to +85°C
Storage Temperature ..... -65°C to +150°C
Voltage on Any Pin with Respect to Ground ..... -0.3 V to +7 V
Power Dissipation ..... 1.5 W

*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 condition above those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED DC OPERATING CONDITIONS

(T_A = -40°C to 85°C, V_{CC} = 5 V ± 5% unless otherwise specified)

SYM	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{ILC}	Clock Input Low Voltage	-0.3		0.8	V	
V_{IHC}	Clock Input High Voltage	V_{CC}-.6		V_{CC}+.3	V	
V_{IL}	Input Low Voltage	-0.3		0.8	V	
V_{IH}	Input High Voltage All inputs except NMI	2.4		V_{CC}	V	
$V_{IH(NMI)}$	Input High Voltage (NMI)	2.7		V_{CC}	V	

DC ELECTRICAL CHARACTERISTICS

(T_A = -40°C to 85°C, V_{CC} = 5 V ± 5% unless otherwise specified)

SYM	PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
V_{OL}	Output Low Voltage			0.4	V	I_{OL} = 1.8mA
V_{OH}	Output High Voltage	2.4			V	I_{OH} = -250 μA
I_{CC}	Power Supply Current			200	mA	
I_{LI}	Input Leakage Current			±10	μA	V_{IN} = 0 to V_{CC}
I_{LOH}	Tri-State Output Leakage Current in Float			10	μA	V_{OUT} = 2.4 to V_{CC}
I_{LOL}	Tri-State Output Leakage Current in Float			-10	μA	V_{OUT} = 0.4V
I_{LD}	Data Bus Leakage Current In Input Mode			±10	μA	$0 < V_{IN} < V_{CC}$

AC ELECTRICAL CHARACTERISTICS
MKI3880(P)-70 Z80-CPU
(T_A = -40°C to 85°C, V_{CC} = +5 V, ±5%, Unless Otherwise Noted)

SIGNAL	SYM	PARAMETER	MIN	MAX	UNIT	TEST CONDITIONS
Φ	t_c	Clock Period	.4	[12]	μsec	
	$t_{w(\Phi H)}$	Clock Pulse Width, Clock High	180	(D)	nsec	
	$t_{w(\Phi L)}$	Clock Pulse Width, Clock Low	180	2000	nsec	
	t_r, t_f	Clock Rise and Fall Time		30	nsec	
A_{0-15}	$t_{D(AD)}$	Address Output Delay		145	nsec	
	$t_{F(AD)}$	Delay to Float		110	nsec	
	t_{acm}	Address Stable Prior to $\overline{MREQ}$ (Memory Cycle)	[1]		nsec	C_L = 50pF
	t_{aci}	Address Stable Prior to $\overline{IORQ}$, $\overline{RD}$ or $\overline{WR}$ (I/O Cycle)	[2]		nsec	
	t_{ca}	Address Stable From $\overline{RD}$, $\overline{WR}$, $\overline{IORQ}$ or $\overline{MREQ}$	[3]		nsec	Except T3-M1
	t_{caf}	Address Stable From $\overline{RD}$ or $\overline{WR}$ During Float	[4]		nsec	
D_{0-7}	$t_{D(D)}$	Data Output Delay		250	nsec	
	$t_{F(D)}$	Delay to Float During Write Cycle		90	nsec	
	$t_{S\Phi(D)}$	Data Setup Time to Rising Edge of Clock During M1 Cycle	50		nsec	
	$t_{S\overline{\Phi}(D)}$	Data Setup Time to Falling Edge at Clock During M2 to M5	60		nsec	C_L = 50pF
	t_{dcm}	Data Stable Prior to $\overline{WR}$ (Memory Cycle)	[5]		nsec	
	t_{dci}	Data Stable Prior to $\overline{WR}$ (I/O Cycle)	[6]		nsec	
	t_{cdf}	Data Stable From $\overline{WR}$	[7]		nsec	
	t_H	Input Hold Time	0		nsec	
$\overline{MREQ}$	$t_{DL\overline{\Phi}(MR)}$	$\overline{MREQ}$ Delay From Falling Edge of Clock, $\overline{MREQ}$ Low		100	nsec	
	$t_{DH\Phi(MR)}$	$\overline{MREQ}$ Delay From Rising Edge of Clock, $\overline{MREQ}$ High		100	nsec	
	$t_{DH\overline{\Phi}(MR)}$	$\overline{MREQ}$ Delay From Falling Edge of Clock, $\overline{MREQ}$ High		100	nsec	C_L = 50pF
	$t_{w(\overline{MRL})}$	Pulse Width, $\overline{MREQ}$ Low	[8]		nsec	
	$t_{w(\overline{MRH})}$	Pulse Width, $\overline{MREQ}$ High	[9]		nsec	
$\overline{IORQ}$	$t_{DL\Phi(IR)}$	$\overline{IORQ}$ Delay From Rising Edge of Clock, $\overline{IORQ}$ Low		90	nsec	
	$t_{DL\overline{\Phi}(IR)}$	$\overline{IORQ}$ Delay From Falling Edge of Clock, $\overline{IORQ}$ Low		110	nsec	C_L = 50pF
	$t_{DH\Phi(IR)}$	$\overline{IORQ}$ Delay From Rising Edge of Clock, $\overline{IORQ}$ High		100	nsec	
	$t_{DH\overline{\Phi}(IR)}$	$\overline{IORQ}$ Delay From Falling Edge of Clock, $\overline{IORQ}$ High		110	nsec	
$\overline{RD}$	$t_{DL\Phi(RD)}$	$\overline{RD}$ Delay From Rising Edge of Clock, $\overline{RD}$ Low		100	nsec	
	$t_{DL\overline{\Phi}(RD)}$	$\overline{RD}$ Delay From Falling Edge of Clock, $\overline{RD}$ Low		130	nsec	C_L = 50pF
	$t_{DH\Phi(RD)}$	$\overline{RD}$ Delay From Rising Edge of Clock, $\overline{RD}$ High		100	nsec	
	$t_{DH\overline{\Phi}(RD)}$	$\overline{RD}$ Delay From Falling Edge of Clock, $\overline{RD}$ High		110	nsec	

AC ELECTRICAL CHARACTERISTICS (Cont.)

(T_A = -40°C to 85°C, V_{CC} = +5 V, ± 5%, unless otherwise noted)

SIGNAL	SYM	PARAMETER	MIN	MAX	UNIT	TEST CONDITIONS
	$t_{DL\Phi(WR)}$	$\overline{WR}$ Delay From Rising Edge of Clock, $\overline{WR}$ Low		80	nsec	
$\overline{WR}$	$t_{DL\overline{\Phi}(WR)}$	$\overline{WR}$ Delay From Falling Edge of Clock, $\overline{WR}$ Low		90	nsec	C_L = 50pF
	$t_{DH\Phi(WR)}$	$\overline{WR}$ Delay From Falling Edge of Clock, $\overline{WR}$ High		100	nsec	
	$t_{W(\overline{WRL})}$	Pulse Width, $\overline{WR}$ Low	[10]		nsec	
	$t_{DL(M1)}$	$\overline{M1}$ Delay From Rising Edge of Clock $\overline{M1}$ Low		130	nsec	
$\overline{M1}$	$t_{DH(M1)}$	$\overline{M1}$ Delay From Rising Edge of Clock, $\overline{M1}$ High		130	nsec	C_L = 50pF
$\overline{RFSH}$	$t_{DL(RF)}$	$\overline{RFSH}$ Delay From Rising Edge of Clock, $\overline{RFSH}$ Low		180	nsec	
	$t_{DH(RF)}$	$\overline{RFSH}$ Delay From Rising Edge of Clock $\overline{RFSH}$ High		150	nsec	C_L = 30pF
$\overline{WAIT}$	$t_{S(WT)}$	$\overline{WAIT}$ Setup Time to Falling Edge of Clock	70		nsec	
$\overline{HALT}$	$t_{D(HT)}$	$\overline{HALT}$ Delay Time From Falling Edge of Clock		300	nsec	C_L = 50pF
$\overline{INT}$	$t_{s(IT)}$	$\overline{INT}$ Setup Time to Rising Edge of Clock	80		nsec	
$\overline{NMI}$	$t_{w(\overline{NML})}$	Pulse Width, $\overline{NMI}$ Low	80		nsec	
$\overline{BUSRQ}$	$t_{s(BQ)}$	$\overline{BUSRQ}$ Setup Time to Rising Edge of Clock	80		nsec	
$\overline{BUSAK}$	$t_{DL(BA)}$	$\overline{BUSAK}$ Delay From Rising Edge of Clock, $\overline{BUSAK}$ Low		120	nsec	
	$t_{DH(BA)}$	$\overline{BUSAK}$ Delay From Falling Edge of Clock, $\overline{BUSAK}$ High		110	nsec	C_L = 50pF
$\overline{RESET}$	$t_{s(RS)}$	$\overline{RESET}$ Setup Time to Rising Edge of Clock	90		nsec	
	$t_{F(C)}$	Delay to/from Float ($\overline{MREQ}$, $\overline{IORQ}$, $\overline{RD}$ and $\overline{WRI}$)		80	nsec	
	t_{mr}	$\overline{M1}$ Stable Prior to $\overline{IORQ}$ (Interrupt Ack.)	[11]		nsec	

NOTES:

A. Data should be enabled onto the CPU data bus when RD is active. During interrupt acknowledge data should be enabled when $\overline{M1}$ and $\overline{IORQ}$ are both active.

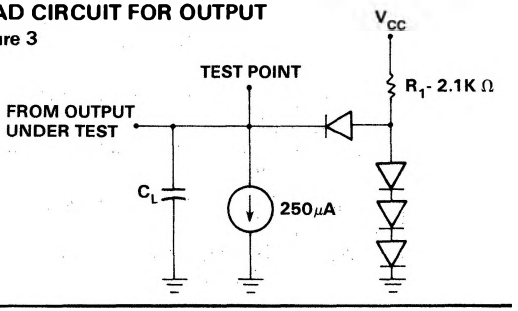
B. The $\overline{RESET}$ signal must be active for a minimum of 3 clock cycles.

C. Output Delay vs. Load Capacitance
T_A = 85°C V_{CC} = 5V ± 5%
Add 10 nsec delay for each 50pF increase in load up to a maximum of 200pF for the data bus and 100pF for address and control lines.

D. Although static by design, testing guarantees t_W (ΦH) of 200 μsec maximum.

[1] $t_{acm} = t_W(\Phi H) + t_f - 75$
[2] $t_{aci} = t_c - 80$
[3] $t_{ca} = t_W(\Phi L) + t_r - 40$
[4] $t_{caf} = t_W(\Phi L) + t_r - 60$
[5] $t_{dcm} = t_c - 210$
[6] $t_{dci} = t_W(\Phi L) + t_r - 210$
[7] $t_{cdf} = t_W(\Phi L) + t_r - 80$
[8] $t_W(\overline{MRL}) = t_c - 40$
[9] $t_W(\overline{MRH}) = t_W(\Phi H) + t_f - 70$
[10] $t_W(\overline{WR}) = t_c - 40$
[11] $t_{mr} = 2t_c + t_W(\Phi H) + t_f - 80$
[12] $t_c = t_W(\Phi H) + t_W(\Phi L) + t_r + t_f$

LOAD CIRCUIT FOR OUTPUT
Figure 3



AC ELECTRICAL CHARACTERISTICS

MKI3880(P)-74 Z80A-CPU

(T_A = -40°C to 85°C, V_{CC} = +5V, ±5%, Unless Otherwise Noted)

SIGNAL	SYM	PARAMETER	MIN	MAX	UNIT	TEST CONDITIONS
Φ	t_c	Clock Period	.25	[12]	μsec	
	$t_w(\Phi H)$	Clock Pulse Width, Clock High	110	(D)	nsec	
	$t_w(\Phi L)$	Clock Pulse Width, Clock Low	110	2000	nsec	
	t_r, t_f	Clock Rise and Fall Time		30	nsec	
A_{0-15}	$t_{D(AD)}$	Address Output Delay		110	nsec	
	$t_{F(AD)}$	Delay to Float		90	nsec	
	t_{acm}	Address Stable Prior to $\overline{MREQ}$ (Memory Cycle)	[1]		nsec	C_L = 50pF
	t_{aci}	Address Stable Prior to $\overline{IORQ}$, $\overline{RD}$ or $\overline{WR}$ (I/O Cycle)	[2]		nsec	
	t_{ca}	Address Stable From $\overline{RD}$, $\overline{WR}$, $\overline{IORQ}$ or $\overline{MREQ}$	[3]		nsec	Except T3-M1
	t_{caf}	Address Stable From $\overline{RD}$ or $\overline{WR}$ During Float	[4]		nsec	
D_{0-7}	$t_{D(D)}$	Data Output Delay		170	nsec	
	$t_{F(D)}$	Delay to Float During Write Cycle		90	nsec	
	$t_{S\Phi(D)}$	Data Setup Time to Rising Edge of Clock During M1 Cycle	35		nsec	
	$t_{S\bar{\Phi}(D)}$	Data Setup Time to Falling Edge at Clock During M2 to M5	50		nsec	C_L = 50pF
	t_{dcm}	Data Stable Prior to $\overline{WR}$ (Memory Cycle)	[5]		nsec	
	t_{dci}	Data Stable Prior to $\overline{WR}$ (I/O Cycle)	[6]		nsec	
	t_{cdf}	Data Stable From $\overline{WR}$	[7]		nsec	
	t_H	Input Hold Time	0		nsec	
$\overline{MREQ}$	$t_{DL\bar{\Phi}(MR)}$	$\overline{MREQ}$ Delay From Falling Edge of Clock, $\overline{MREQ}$ Low	20	85	nsec	
	$t_{DH\Phi(MR)}$	$\overline{MREQ}$ Delay From Rising Edge of Clock, $\overline{MREQ}$ High		85	nsec	
	$t_{DH\bar{\Phi}(MR)}$	$\overline{MREQ}$ Delay From Falling Edge of Clock, $\overline{MREQ}$ High		85	nsec	C_L = 50pF
	$t_{w(\overline{MRL})}$	Pulse Width, $\overline{MREQ}$ Low	[8]		nsec	
	$t_{w(\overline{MRH})}$	Pulse Width, $\overline{MREQ}$ High	[9]		nsec	
$\overline{IORQ}$	$t_{DL\Phi(IR)}$	$\overline{IORQ}$ Delay From Rising Edge of Clock, $\overline{IORQ}$ Low		75	nsec	
	$t_{DL\bar{\Phi}(IR)}$	$\overline{IORQ}$ Delay From Falling Edge of Clock, $\overline{IORQ}$ Low		85	nsec	C_L = 50pF
	$t_{DH\bar{\Phi}(IR)}$	$\overline{IORQ}$ Delay From Rising Edge of Clock, $\overline{IORQ}$ High		85	nsec	
	$t_{DH\Phi(IR)}$	$\overline{IORQ}$ Delay From Falling Edge of Clock, $\overline{IORQ}$ High		85	nsec	
$\overline{RD}$	$t_{DL\Phi(RD)}$	$\overline{RD}$ Delay From Rising Edge of Clock, $\overline{RD}$ Low		85	nsec	
	$t_{DL\bar{\Phi}(RD)}$	$\overline{RD}$ Delay From Falling Edge of Clock, $\overline{RD}$ Low		95	nsec	C_L = 50pF
	$t_{DH\Phi(RD)}$	$\overline{RD}$ Delay From Rising Edge of Clock, $\overline{RD}$ High		85	nsec	
	$t_{DH\bar{\Phi}(RD)}$	$\overline{RD}$ Delay From Falling Edge of Clock, $\overline{RD}$ High		85	nsec	

AC ELECTRICAL CHARACTERISTICS (Cont.)

(T_A = -40°C to 85°C, V_{CC} = +5 V, ± 5%, unless otherwise noted)

SIGNAL	SYM	PARAMETER	MIN	MAX	UNIT	TEST CONDITIONS
	$t_{DL\Phi(WR)}$	$\overline{WR}$ Delay From Rising Edge of Clock, $\overline{WR}$ Low		65	nsec	
$\overline{WR}$	$t_{DL\Phi(WR)}$	$\overline{WR}$ Delay From Falling Edge of Clock, $\overline{WR}$ Low		80	nsec	C_L = 50pF
	$t_{DH\Phi(WR)}$	$\overline{WR}$ Delay From Falling Edge of Clock, $\overline{WR}$ High		80	nsec	
	$t_{w(\overline{WRL})}$	Pulse Width, $\overline{WR}$ Low	[10]		nsec	
$\overline{M1}$	$t_{DL(M1)}$	$\overline{M1}$ Delay From Rising Edge of Clock $\overline{M1}$ Low		100	nsec	C_L = 50pF
	$t_{DH(M1)}$	$\overline{M1}$ Delay From Rising Edge of Clock, $\overline{M1}$ High		100	nsec	
$\overline{RFSH}$	$t_{DL(RF)}$	$\overline{RFSH}$ Delay From Rising Edge of Clock, $\overline{RFSH}$ Low		130	nsec	C_L = 50pF
	$t_{DH(RF)}$	$\overline{RFSH}$ Delay From Rising Edge of Clock $\overline{RFSH}$ High		120	nsec	
$\overline{WAIT}$	$t_{S(WT)}$	$\overline{WAIT}$ Setup Time to Falling Edge of Clock	70		nsec	
$\overline{HALT}$	$t_{D(HT)}$	$\overline{HALT}$ Delay Time From Falling Edge of Clock		300	nsec	C_L = 50pF
$\overline{INT}$	$t_{s(IT)}$	$\overline{INT}$ Setup Time to Rising Edge of Clock	80		nsec	
$\overline{NMI}$	$t_{w(\overline{NML})}$	Pulse Width, $\overline{NMI}$ Low	80		nsec	
$\overline{BUSRQ}$	$t_{s(BQ)}$	$\overline{BUSRQ}$ Setup Time to Rising Edge of Clock	50		nsec	
$\overline{BUSAK}$	$t_{DL(BA)}$	$\overline{BUSAK}$ Delay From Rising Edge of Clock, $\overline{BUSAK}$ Low		100	nsec	C_L = 50pF
	$t_{DH(BA)}$	$\overline{BUSAK}$ Delay From Falling Edge of Clock, $\overline{BUSAK}$ High		100	nsec	
$\overline{RESET}$	$t_{s(RS)}$	$\overline{RESET}$ Setup Time to Rising Edge of Clock	60		nsec	
	$t_{F(C)}$	Delay to/From Float ($\overline{MREQ}$, $\overline{IORQ}$, $\overline{RD}$ and $\overline{WR}$)		80	nsec	
	t_{mr}	$\overline{M1}$ Stable Prior to $\overline{IORQ}$ (Interrupt Ack.)	[11]		nsec	

NOTES:

A. Data should be enabled onto the CPU data bus when $\overline{RD}$ is active. During interrupt acknowledge data should be enabled when $\overline{M1}$ and $\overline{IORQ}$ are both active.

B. The $\overline{RESET}$ signal must be active for a minimum of 3 clock cycles.

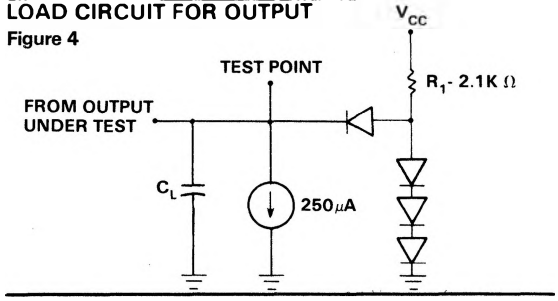
C. Output Delay vs. Load Capacitance
T_A = 85°C V_{CC} = 5V ± 5%
Add 10 nsec delay for each 50pF increase in load up to a maximum of 200pF for the data bus and 100pF for address and control lines.

D. Although static by design, testing guarantees t_w (ΦH) of 200 μsec maximum.

[1] $t_{acm} = t_w(\Phi H) + t_f - 65$
[2] $t_{aci} = t_c - 70$
[3] $t_{ca} = t_w(\Phi L) + t_r - 50$
[4] $t_{caf} = t_w(\Phi L) + t_r - 45$
[5] $t_{dcm} = t_c - 170$
[6] $t_{dci} = t_w(\Phi L) + t_r - 170$
[7] $t_{cdf} = t_w(\Phi L) + t_r - 70$
[8] $t_w(\overline{MRL}) = t_c - 30$
[9] $t_w(\overline{MRH}) = t_w(\Phi H) + t_f - 40$
[10] $t_w(\overline{WR}) = t_c - 30$
[11] $t_{mr} = 2t_c + t_w(\Phi H) + t_f - 65$
[12] $t_c = t_w(\Phi H) + t_w(\Phi L) + t_r + t_f$

LOAD CIRCUIT FOR OUTPUT

Figure 4



CAPACITANCE

T_A = 25°C, f = 1 MHz

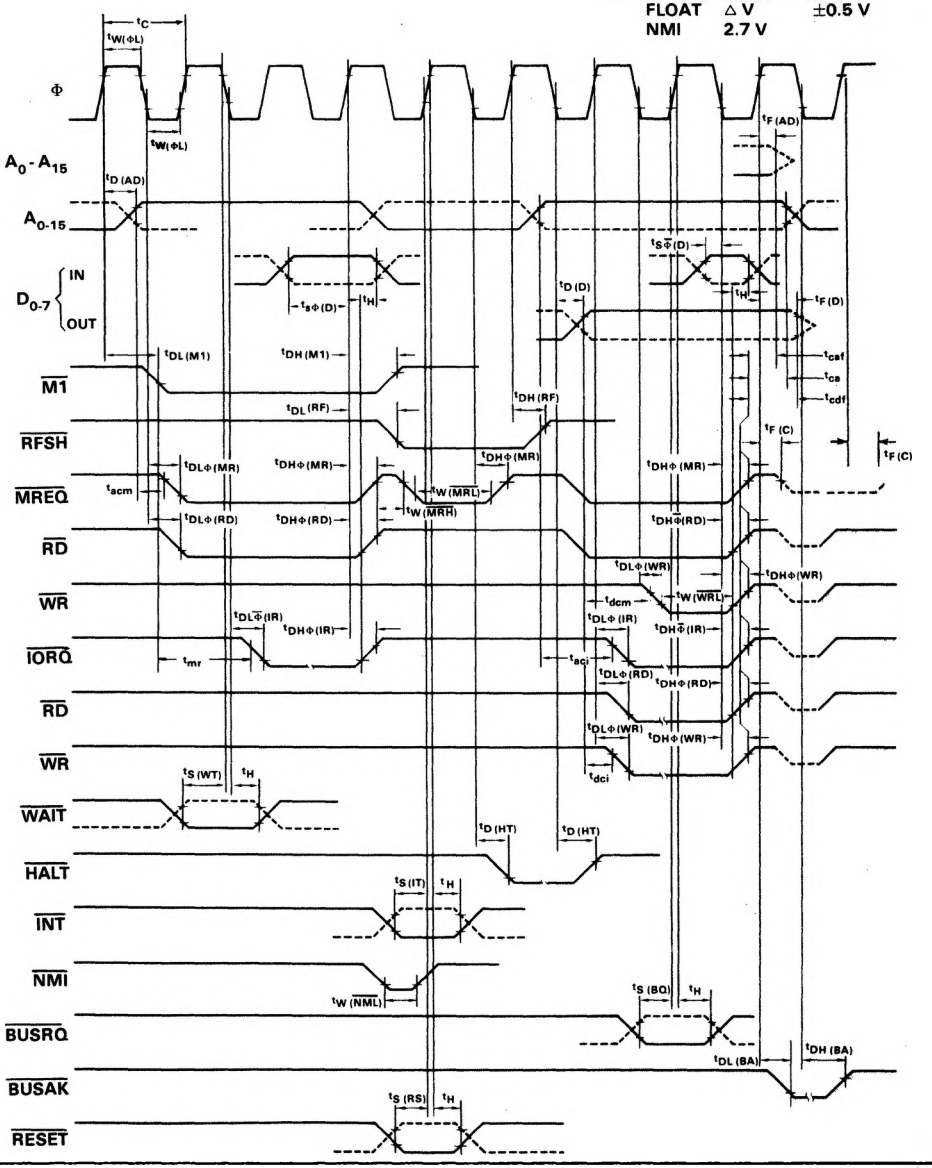
SYM	PARAMETER	MAX	UNIT	TEST CONDITIONS
CΦ	Clock Capacitance	35	pF	Unmeasured Pins
C_{IN}	Input Capacitance	5	pF	Returned to Ground
C_{OUT}	Output Capacitance	10	pF	

AC TIMING DIAGRAM

Figure 5

Timing measurements are made at the following voltages, unless otherwise specified.

	"1"	"0"
CLOCK	V_{CC}—.6	.8 V
OUTPUT	2.0 V	.8 V
INPUT	2.4 V	.8 V
FLOAT	Δ V	±0.5 V
NMI	2.7 V	



MKI INDUSTRIAL HI-REL SCREENING
Figure 6

	Screen	MIL-STD 883 Method	Reqmt.
Package Assembly	Die Inspect Pre-Seal Inspect	75X Mostek Spec. 30X-60X Mostek Spec.	100% 100%
Environmental	Temperature Cycle Centrifuge Fine Leak Gross Leak	1010 Cond. C, 5 Cycles 2001 Cond. D, 20Kg Y_1 1014 Cond. B, 1 X 10^{-7} atm cc/sec Mostek Spec.	100% 100% 100% 100%
Electrical	Electrical Screens	5005 Grp. A electrical sub-groups, testing conditions and limits which guarantee ac, dc and functional performance over the full temperature range.	100%
Voltage Stress (DRAMs only)		1015 Cond. D, 10 hrs. min., 125°C	100%
Burn-in		1015 Cond. D, 44 hrs. min., 125°C	100%
QA Acceptance	Hermeticity Electrical Tests Visual/Mechanical Solderability Pre-shipment Inspect.	Fine and gross leak samples 5005 Grp. A sample testing to guarantee performance to data sheet over full temp. range. Visual tests to guarantee marking, construction and mechanical integrity	.25% AQL .4% AQL .65% AQL LTPD 10 .65% AQL