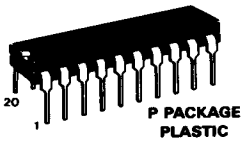
MCM6168

4K x 4 Bit Static Random Access Memory



P PACKAGE
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The MCM6168 is a 16,384-bit static random access memory organized as 4096 words of 4 bits, fabricated using Motorola's second-generation high-performance silicon-gate CMOS (HCMOS III) technology. Static design eliminates the need for external clocks or timing strobes, while CMOS circuitry reduces power consumption and provides greater reliability. Fast access time makes this device suitable for cache and other high speed applications.

The chip enable ($\overline{E}$) pin is not a clock. In less than a cycle time after $\overline{E}$ goes high, the part enters a low-power standby mode, remaining in that state until $\overline{E}$ goes low again. This feature provides reduced system power requirements without degrading access time performance.

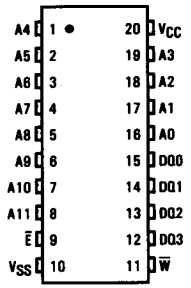
The MCM6168 is available in a 300 mil, 20 lead plastic dual-in-line package with the standard JEDEC pinout.

- Single 5 V Supply, ±10%
- 4K x 4 Bit Organization
- Fully Static—No Clock or Timing Strobes Necessary
- Three State Output
- Fast Access Time (Maximum):

	Address	Chip Enable
MCM6168-45	45 ns	45 ns
MCM6168-55	55 ns	55 ns
MCM6168-70	70 ns	70 ns

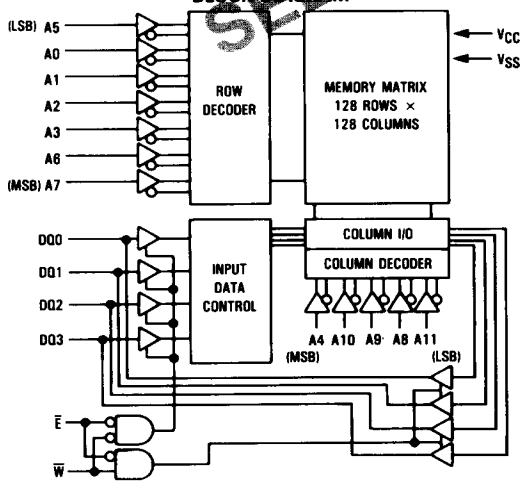
- Low Power Operation: 80 mA Max (Active)
  20 mA Max (Standby—TTL Levels)
  2 mA Max (Standby—CMOS Levels)
- Fully TTL Compatible

PIN ASSIGNMENT



PIN NAMES	
A0-A11	Address Input
W	Write Enable
E	Chip Enable
DQ0-DQ3	Data Input/Output
VCC	+5 V Power Supply
VSS	Ground

BLOCK DIAGRAM



TRUTH TABLE

$\overline{E}$	$\overline{W}$	Mode	V_{CC} Current	I/O Pin
H	X	Not Selected	ISB1, ISB2	High-Z
L	H	Read	I_{CC}	D_{out}
L	L	Write	I_{CC}	D_{in}

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high-impedance circuit.

ABSOLUTE MAXIMUM RATINGS (See Note)

Rating	Symbol	Value	Unit
Power Supply Voltage	V_{CC}	−0.5 to +7.0	V
Voltage Relative to V_{SS} for Any Pin Except V_{CC}	V_{in}, V_{out}	−0.5 to V_{CC} +0.5	V
Output Current (per I/O)	I_{out}	±20	mA
Power Dissipation (T_A = 25°C)	P_D	1.0	W
Temperature Under Bias	T_{bias}	−10 to +85	°C
Operating Temperature	T_A	0 to +70	°C
Storage Temperature	T_{stg}	−55 to +125	°C

NOTE: Permanent device damage may occur if ABSOLUTE MAXIMUM RATINGS are exceeded. Functional operation should be restricted to RECOMMENDED OPERATING CONDITIONS. Exposure to higher than recommended voltages for extended periods of time could affect device reliability.

DC OPERATING CONDITIONS AND CHARACTERISTICS

(V_{CC} = 5.0 V ±10%, T_A = 0 to 70°C, Unless Otherwise Noted)

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Supply Voltage (Operating Voltage Range)	V_{CC}	4.5	5.0	5.5	V	
Input High Voltage	V_{IH}	2.0	—	V_{CC} +0.3	V	1
Input Low Voltage	V_{IL}	−0.3	—	0.8	V	1, 2

DC CHARACTERISTICS

Parameter	Symbol	Min	Max	Unit	Notes
Input Leakage Current (All Inputs, V_{in} = 0 to V_{CC})	$I_{lkg(I)}$	—	±1.0	μA	
Output Leakage Current ($\overline{E}$ = V_{IH} or $\overline{W}$ = V_{IL}, V_{out} = 0 to V_{CC})	$I_{lkg(O)}$	—	±2.0	μA	3
Power Supply Current ($\overline{E}$ = V_{IL}, I_{out} = 0 mA)	I_{CC}	—	80	mA	3
TTL Standby Current ($\overline{E}$ = V_{IH})	I_{SB1}	—	20	mA	
CMOS Standby Current ($\overline{E}$ ≥ V_{CC} −0.2 V, V_{in} ≤ 0.2 V or ≥ V_{CC} −0.2 V)	I_{SB2}	—	2	mA	
Output Low Voltage (I_{OL} = 8.0 mA)	V_{OL}	—	0.4	V	
Output High Voltage (I_{OH} = −4.0 mA)	V_{OH}	2.4	—	V	

CAPACITANCE (f = 1.0 MHz, T_A = 25°C, Periodically Sampled Rather Than 100% Tested)

Characteristic		Symbol	Typ	Max	Unit
Input Capacitance	All Inputs Except $\overline{E}$	C_{in}	3	5	pF
	$\overline{E}$		5	7	
I/O Capacitance		$C_{I/O}$	5	7	pF

NOTES:
1. Address rise and fall times while the chip is selected are 50 ns maximum.
2. V_{IL}(min) = −0.3 V dc; V_{IL}(min) = −3.0 V ac (pulse width ≤ 20 ns).
3. Input levels less than −0.3 V or greater than V_{CC} +0.3 V will cause I/O and power supply currents to exceed maximum rating.

AC OPERATING CONDITIONS AND CHARACTERISTICS

(V_{CC} = 5 V ±10%, T_A = 0 to +70°C, Unless Otherwise Noted)

Input Timing Measurement Reference Level . . . . . 1.5 V
Input Pulse Levels . . . . . .0 to 3.0 V
Input Rise/Fall Time . . . . . 5 ns

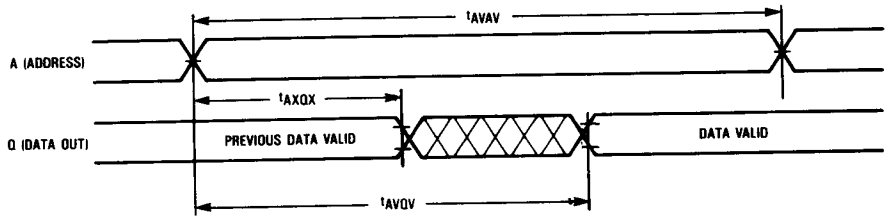
Output Timing Measurement Reference Level . . . . .0.8 and 2.0 V
Output Load . . . . . Figure 1A Unless Otherwise Noted

READ CYCLE (See Note 1)

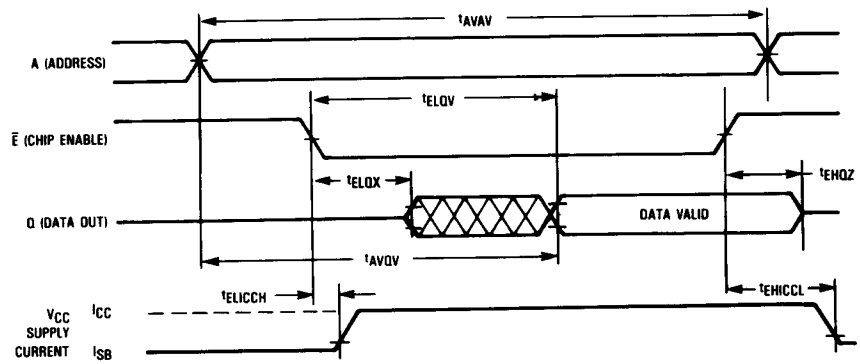
Parameter	Symbol		MCM6168-45		MCM6168-55		MCM6168-70		Unit	Notes
	Standard	Alternate	Min	Max	Min	Max	Min	Max		
Read Cycle Time	t_{AVAV}	t_{RC}	45	–	55	–	70	–	ns	
Address Access Time	t_{AVQV}	t_{AA}	–	45	–	50	–	60	ns	
$\overline{E}$ Access Time	t_{ELQV}	t_{ACS}	–	45	–	55	–	70	ns	
$\overline{E}$ Low to Output Active	t_{ELQX}	t_{LZ}	10	–	10	–	10	–	ns	2, 3
$\overline{E}$ High to Output High-Z	t_{EHQZ}	t_{HZ}	0	15	0	20	0	25	ns	2, 3
Output Hold from Address Change	t_{AXQX}	t_{OH}	5	–	5	–	5	–	ns	
Power Up Time	t_{ELICCH}	t_{PU}	0	–	0	–	0	–	ns	
Power Down Time	t_{EHICCL}	t_{PD}	–	45	–	55	–	70	ns	

NOTES:
1. $\overline{W}$ is high for read cycle.
2. Transition is measured ±500 mV from steady-state voltage with load of Figure 1B.
3. This parameter is sampled and not 100% tested.
4. Device is continuously selected ($\overline{E} = V_{IL}$).
5. Addresses valid prior to or coincident with $\overline{E}$ going low.

READ CYCLE 1 (See Note 4 Above)



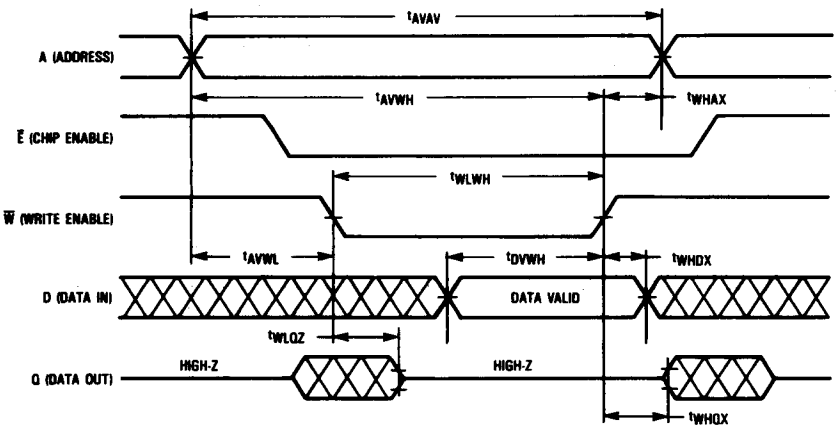
READ CYCLE 2 (See Note 5 Above)



WRITE CYCLE 1 ($\overline{W}$ Controlled; See Note 1)

Parameter	Symbol		MCM6168-45		MCM6168-55		MCM6168-70		Unit	Notes
	Standard	Alternate	Min	Max	Min	Max	Min	Max		
Write Cycle Time	t_{AVAV}	t_{WC}	40	–	50	–	60	–	ns	
Address Setup Time	t_{AVWL}	t_{AS}	0	–	0	–	0	–	ns	
Address Valid to End of Write	t_{AVWH}	t_{AW}	35	–	45	–	55	–	ns	
Write Pulse Width	t_{WLWH}	t_{WP}	35	–	45	–	55	–	ns	
Data Valid to End of Write	t_{DVWH}	t_{DW}	15	–	20	–	25	–	ns	
Data Hold Time	t_{WHDX}	t_{DH}	3	–	3	–	3	–	ns	
Write Low to Output High-Z	t_{WLQZ}	t_{WZ}	–	20	–	25	–	30	ns	2, 3
Write High to Output Active	t_{WHQX}	t_{OW}	5	–	5	–	5	–	ns	2, 3
Write Recovery Time	t_{WHAX}	t_{WR}	5	–	5	–	5	–	ns	

NOTES:
1. A write occurs during the overlap of $\overline{E}$ low and $\overline{W}$ low.
2. Transition is measured ±500 mV from steady-state voltage with load in Figure 1B.
3. Parameter is sampled and not 100% tested.



AC TEST LOADS

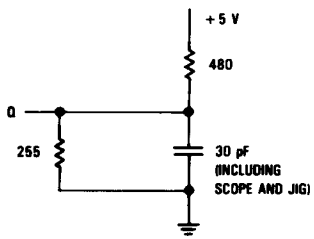


Figure 1A

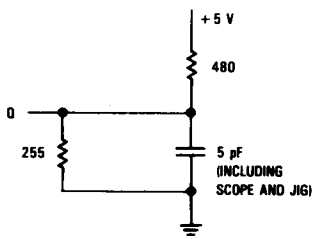


Figure 1B

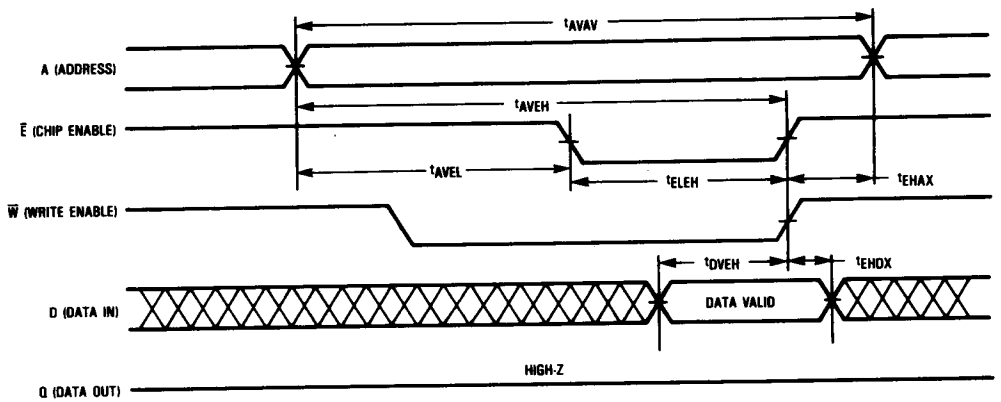
TIMING LIMITS

The table of timing values shows either a minimum or a maximum limit for each parameter. Input requirements are specified from the external system point of view. Thus, address setup time is shown as a minimum since the system must supply at least that much time (even though most devices do not require it). On the other hand, responses from the memory are specified from the device point of view. Thus, the access time is shown as a maximum since the device never provides data later than that time.

WRITE CYCLE 2 ($\overline{E}$ Controlled; See Note 1)

Parameter	Symbol		MCM6168-45		MCM6168-55		MCM6168-70		Unit	Notes
	Standard	Alternate	Min	Max	Min	Max	Min	Max		
Write Cycle Time	t_{AVAV}	t_{WC}	40	–	50	–	60	–	ns	
Address Setup Time	t_{AVEL}	t_{AS}	0	–	0	–	0	–	ns	
Address Valid to End of Write	t_{AVEH}	t_{AW}	35	–	45	–	55	–	ns	
Write Pulse Width	t_{ELEH}	t_{CW}	35	–	45	–	55	–	ns	2, 3
Data Valid to End of Write	t_{DVEH}	t_{DW}	15	–	20	–	25	–	ns	
Data Hold Time	t_{EHDX}	t_{DH}	3	–	3	–	3	–	ns	
Write Recovery Time	t_{EHAX}	t_{WR}	5	–	5	–	5	–	ns	

NOTES:
1. A write occurs during the overlap of $\overline{E}$ low and $\overline{W}$ low.
2. If $\overline{E}$ goes low coincident with or after $\overline{W}$ goes low, the output will remain in a high impedance condition.
3. If $\overline{E}$ goes high coincident with or before $\overline{W}$ goes high, the output will remain in a high impedance condition.



ORDERING INFORMATION
(Order by Full Part Number)

MCM 6168 X XX

- MCM — Motorola Memory Prefix
- 6168 — Part Number
- X — Package (P = Plastic DIP)
- XX — Speed (45 = 45 ns, 55 = 55 ns, 70 = 70 ns)

Full Part Numbers — MCM6168P45
MCM6168P55
MCM6168P70