

# 128K x 9 Bit Synchronous Dual I/O Fast Static RAM

The MCM67D709 is a 1,179,648 bit synchronous static random access memory organized as 131,072 words of 9 bits, fabricated using Motorola's high-performance silicon-gate BiCMOS technology. The device integrates a 128K x 9 SRAM core with advanced peripheral circuitry consisting of address registers, two sets of input data registers and two sets of output latches. This device has increased output drive capability supported by multiple power pins.

Asynchronous inputs include the processor output enable ( $\overline{POE}$ ) and the system output enable ( $\overline{SOE}$ ).

The address inputs (A0 – A16) are synchronous and are registered on the falling edge of clock (K). Write enable ( $\overline{W}$ ), processor input enable ( $\overline{PIE}$ ) and system input enable ( $\overline{SIE}$ ) are registered on the rising edge of clock (K). Writes to the RAM are self-timed.

All data inputs/outputs, PDQ0 – PDQ7, SDQ0 – SDQ7, PDQP, and SDQP have input data registers triggered by the rising edge of the clock. These pins also have three-state output latches which are transparent during the high level of the clock and latched during the low level of the clock.

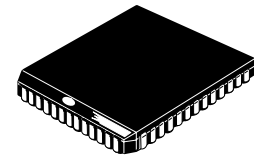
This device has a special feature which allows data to be passed through the RAM between the system and processor ports in either direction. This streaming is accomplished by latching in data from one port and asynchronously output enabling the other port. It is also possible to write to the RAM while streaming.

The MCM67D709's dual I/Os can be used in x9 separate I/O applications. Common I/Os PDQ0 – 7, PDQP and SDQ0 – 7, SDQP can be treated as either inputs (D) or outputs (Q) depending on the state of the control pins. In order to dedicate PDQ0 – 7, PDQP as data (D) inputs and SDQ0 – 7, SDQP as outputs (Q), tie  $\overline{SIE}$  and  $\overline{POE}$  high.  $\overline{SOE}$  becomes the asynchronous  $\overline{G}$  for the outputs.  $\overline{PIE}$  will need to track  $\overline{W}$  for proper write/read operations.

This device is ideally suited for pipelined systems and systems with multiple data buses and multi-processing systems, where a local processor has a bus isolated from a common system bus.

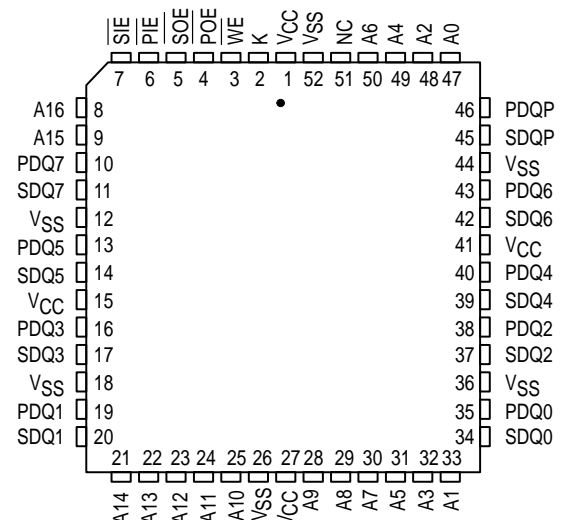
- Single 5 V  $\pm$  5% Power Supply
- 88110/88410 Compatibility: –16/60 MHz, –20/50 MHz
- Self-Timed Write Cycles
- Clock Controlled Output Latches
- Address and Data Input Registers
- Common Data Inputs and Data Outputs
- Dual I/O for Separate Processor and Memory Buses
- Separate Output Enable Controlled Three-State Outputs
- 3.3 V I/O Compatible
- High Board Density 52 Lead PLCC Package
- Can be used as Separate I/O x9 SRAM

## MCM67D709



**FN PACKAGE  
PLASTIC  
CASE 778-02**

### PIN ASSIGNMENTS

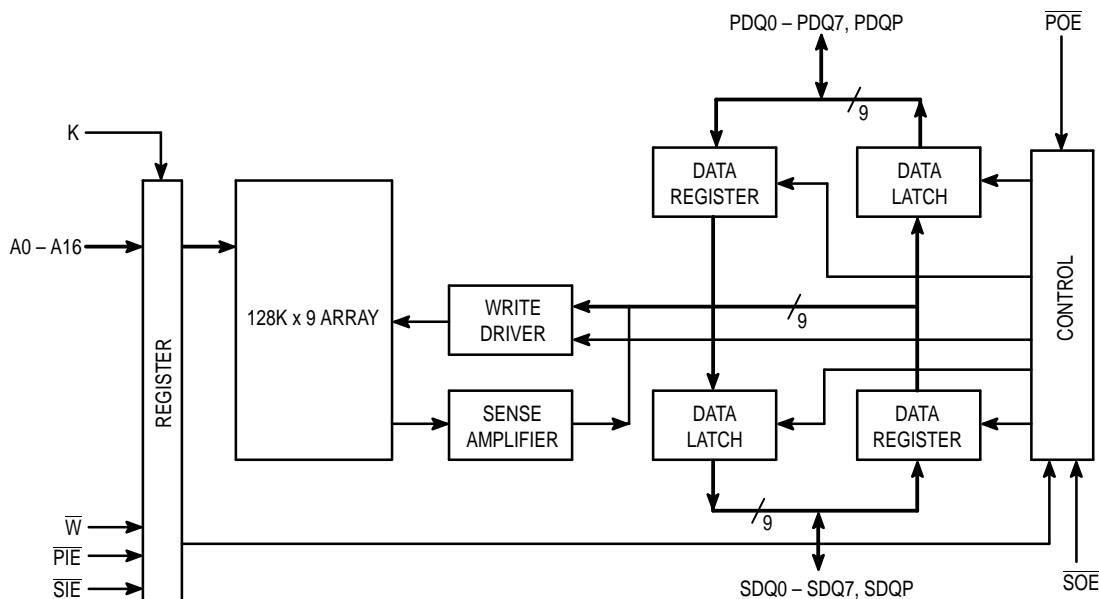


### PIN NAMES

A0 – A16	Address Inputs
K	Clock Input
$\overline{W}$	Write Enable
$\overline{PIE}$	Processor Input Enable
$\overline{SIE}$	System Input Enable
$\overline{POE}$	Processor Output Enable
$\overline{SOE}$	System Output Enable
PDQ0 – PDQ7	Processor Data I/O
PDQP	Processor Data Parity
SDQ0 – SDQ7	System Data I/O
SDQP	System Data Parity
VCC	+ 5 V Power Supply
VSS	Ground
NC	No Connection

All power supply and ground pins must be connected for proper operation of the device.

## BLOCK DIAGRAM



**FUNCTIONAL TRUTH TABLE** (See Notes 1 and 2)

$\bar{W}$	$\overline{PIE}$	$\overline{SIE}$	$\overline{POE}$	$\overline{SOE}$	Mode	Memory Subsystem Cycle	PDQ0 – PDQ7, PDQP Output	SDQ0 – SDQ7, SDQP Output	Notes
1	1	1	0	1	Read	Processor Read	Data Out	High-Z	3
1	1	1	1	0	Read	Copy Back	High-Z	Data Out	3
1	1	1	0	0	Read	Dual Bus Read	Data Out	Data Out	3
1	X	X	1	1	Read	NOP	High-Z	High-Z	
X	0	0	X	X	N/A	NOP	High-Z	High-Z	2, 4
0	0	1	1	1	Write	Processor Write Hit	Data In	High-Z	2, 5
0	1	0	1	1	Write	Allocate	High-Z	Data In	2, 5
0	0	1	1	0	Write	Write Through	Data In	Stream Data	2, 6
0	1	0	0	1	Write	Allocate With Stream	Stream Data	Data In	2, 6
1	0	1	1	0	N/A	Cache Inhibit Write	Data In	Stream Data	2, 6
1	1	0	0	1	N/A	Cache Inhibit Read	Stream Data	Data In	2, 6
0	1	1	X	X	N/A	NOP	High-Z	High-Z	4
X	0	1	0	0	N/A	Invalid	Data In	Stream	2, 7
X	0	1	0	1	N/A	Invalid	Data In	High-Z	2, 7
X	1	0	0	0	N/A	Invalid	Stream	Data In	2, 7
X	1	0	1	0	N/A	Invalid	High-Z	Data In	2, 7

**NOTES:**

1. A '0' represents an input voltage  $\leq V_{IL}$  and a '1' represents an input voltage  $\geq V_{IH}$ . All inputs must satisfy the specified setup and hold times for the falling or rising edge of K. Some entries in this truth table represent latched values. Other possible combinations of control inputs not covered by this note or the table above are not supported and the RAMs behavior is not specified.
2. If either  $\overline{IE}$  signal is sampled low on the rising edge of clock, the corresponding  $\overline{OE}$  is a don't care, and the corresponding outputs are High-Z.
3. A read cycle is defined as a cycle where data is driven on the internal data bus by the RAM.
4. No RAM cycle is performed.
5. A write cycle is defined as a cycle where data is driven onto the internal data bus through one of the data I/O ports (PDQ0 – PDQ7 and PDQP or SDQ0 – SDQ7 and SPDQ), and written into the RAM.
6. Data is driven on the internal data bus by one I/O port through its data input register and latched into the data output latch of the other I/O port.
7. Data contention will occur.

**ABSOLUTE MAXIMUM RATINGS** (Voltages Referenced to  $V_{SS} = 0$  V)

Rating	Symbol	Value	Unit
Power Supply	$V_{CC}$	- 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)	$I_{out}$	$\pm 30$	mA
Power Dissipation	$P_D$	2.0	W
Temperature Under Bias	$T_{bias}$	- 10 to + 85	$^{\circ}C$
Operating Temperature	$T_A$	0 to +70	$^{\circ}C$
Storage Temperature	$T_{stg}$	- 55 to + 125	$^{\circ}C$

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.

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.

**DC OPERATING CONDITIONS AND CHARACTERISTICS**

( $V_{CC} = 5.0$  V  $\pm 5\%$ ,  $T_A = 0$  to + 70 $^{\circ}C$ , Unless Otherwise Noted)

**RECOMMENDED OPERATING CONDITIONS AND SUPPLY CURRENTS** (Voltages referenced to  $V_{SS} = 0$  V)

Parameter	Symbol	Min	Max	Unit
Supply Voltage (Operating Voltage Range)	$V_{CC}$	4.75	5.25	V
Input High Voltage	$V_{IH}$	2.2	$V_{CC} + 0.3^{**}$	V
Input Low Voltage	$V_{IL}$	- 0.5*	0.8	V
Input Leakage Current (All Inputs, $V_{in} = 0$ to $V_{CC}$ )	$I_{lkg(I)}$	—	$\pm 1.0$	$\mu A$
Output Leakage Current (POE, SOE = $V_{IH}$ )	$I_{lkg(O)}$	—	$\pm 1.0$	$\mu A$
AC Supply Current (All Inputs = $V_{IL}$ or $V_{IH}$ , $V_{IL} = 0.0$ V and $V_{IH} \geq 3.0$ V, $I_{out} = 0$ mA, Cycle Time $\geq t_{KHKH}$ min)	$I_{CCA}$	—	280 260	mA
				MCM67D709-16: $t_{KHKH} = 16$ ns MCM67D709-20: $t_{KHKH} = 20$ ns
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	3.3	V

\*  $V_{IL}$  (min) = - 0.5 V dc;  $V_{IL}$  (min) = - 2.0 V ac (pulse width  $\leq 20$  ns) for  $I \leq 20.0$  mA.

\*\*  $V_{IH}$  (max) =  $V_{CC} + 0.3$  V dc;  $V_{IH}$  (max) =  $V_{CC} + 2.0$  V ac (pulse width  $\leq 20$  ns) for  $I \leq 20.0$  mA.

**CAPACITANCE** ( $f = 1.0$  MHz,  $dV = 3.0$  V,  $T_A = 25^{\circ}C$ , Periodically Sampled Rather Than 100% Tested)

Parameter	Symbol	Typ	Max	Unit
Input Capacitance (All Pins Except I/Os)	$C_{in}$	5	6	pF
Input/Output Capacitance (PDQ0 – PDQ7, SDQ0 – SDQ7, PDQP, SDQP)	$C_{out}$	6	7	pF

## AC OPERATING CONDITIONS AND CHARACTERISTICS

( $V_{CC} = 5.0\text{ V} \pm 5\%$ ,  $T_A = 0\text{ to } +70^\circ\text{C}$ , Unless Otherwise Noted)

Input Timing Measurement Reference Level ..... 1.5 V      Output Measurement Timing Level ..... 1.5 V  
 Input Pulse Levels ..... 0 to 3.0 V      Output Load ..... See Figure 1A Unless Otherwise Noted  
 Input Rise/Fall Time ..... 3 ns

### READ CYCLE (See Note 1)

Parameter		Symbol	Processor Frequency		60 MHz		50 MHz		Unit	Notes
					MCM67D709-16		MCM67D709-20			
			Min	Max	Min	Max				
Read Cycle Time Clock High to Clock High		$t_{KHKH}$	16	—	20	—	ns	1, 2		
Clock Low Pulse Width		$t_{KLKH}$	5	—	5	—	ns			
Clock High Pulse Width		$t_{KHKL}$	7	—	7	—	ns			
Clock High to Output Valid		$t_{KHQV}$	—	6	—	7.5	ns	3		
Clock (K) High to Output Low Z After Write		$t_{KHQX1}$	0	—	0	—	ns			
Output Hold from Clock High		$t_{KHQX2}$	2	—	3	—	ns	3, 4		
Setup Times:	A	$t_{AVKL}$	2	—	2	—	ns			
	$\overline{W}$	$t_{WHKH}$	2	—	2	—	ns			
	$\overline{PIE}$	$t_{PIEHKH}$	2	—	2	—	ns			
	$\overline{SIE}$	$t_{SIEHKH}$	2	—	2	—	ns			
Hold Times:	A	$t_{KLAX}$	2	—	2	—	ns			
	$\overline{W}$	$t_{KHWX}$	2	—	2	—	ns			
	$\overline{PIE}$	$t_{KHPIEX}$	2	—	2	—	ns			
	$\overline{SIE}$	$t_{KHSIEX}$	2	—	2	—	ns			
Output Enable High to Q High-Z		$t_{POEHQZ}$ $t_{SOEHQZ}$	0	6	0	8	ns	4		
Output Hold from Output Enable High		$t_{POEHQX}$ $t_{SOEHQX}$	2	—	5	—	ns	4		
Output Enable Low to Q Active		$t_{POELQX}$ $t_{SOELQX}$	0	—	0	—	ns	4		
Output Enable Low to Output Valid		$t_{POELQV}$ $t_{SOELQV}$	—	5	—	6	ns			

#### NOTES:

1. A read is defined by  $\overline{W}$  high for the setup and hold times.
2. All read cycle timing is referenced from K,  $\overline{SOE}$ , or  $\overline{POE}$ .
3. K must be at a high level for outputs to transition.
4. Transition is measured  $\pm 500\text{ mV}$  from steady-state voltage with output load of Figure 1B. This parameter is sampled and not 100% tested. At any given voltage and temperature,  $t_{POEHQZ}$  is less than  $t_{POELQX}$  for a given device, and  $t_{SOEHQZ}$  is less than  $t_{SOELQX}$  for a given device.

### AC SPEC LOADS

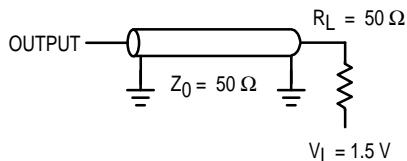


Figure 1A

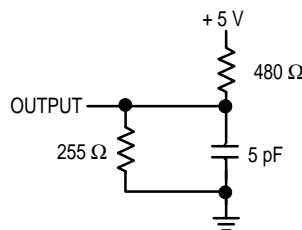
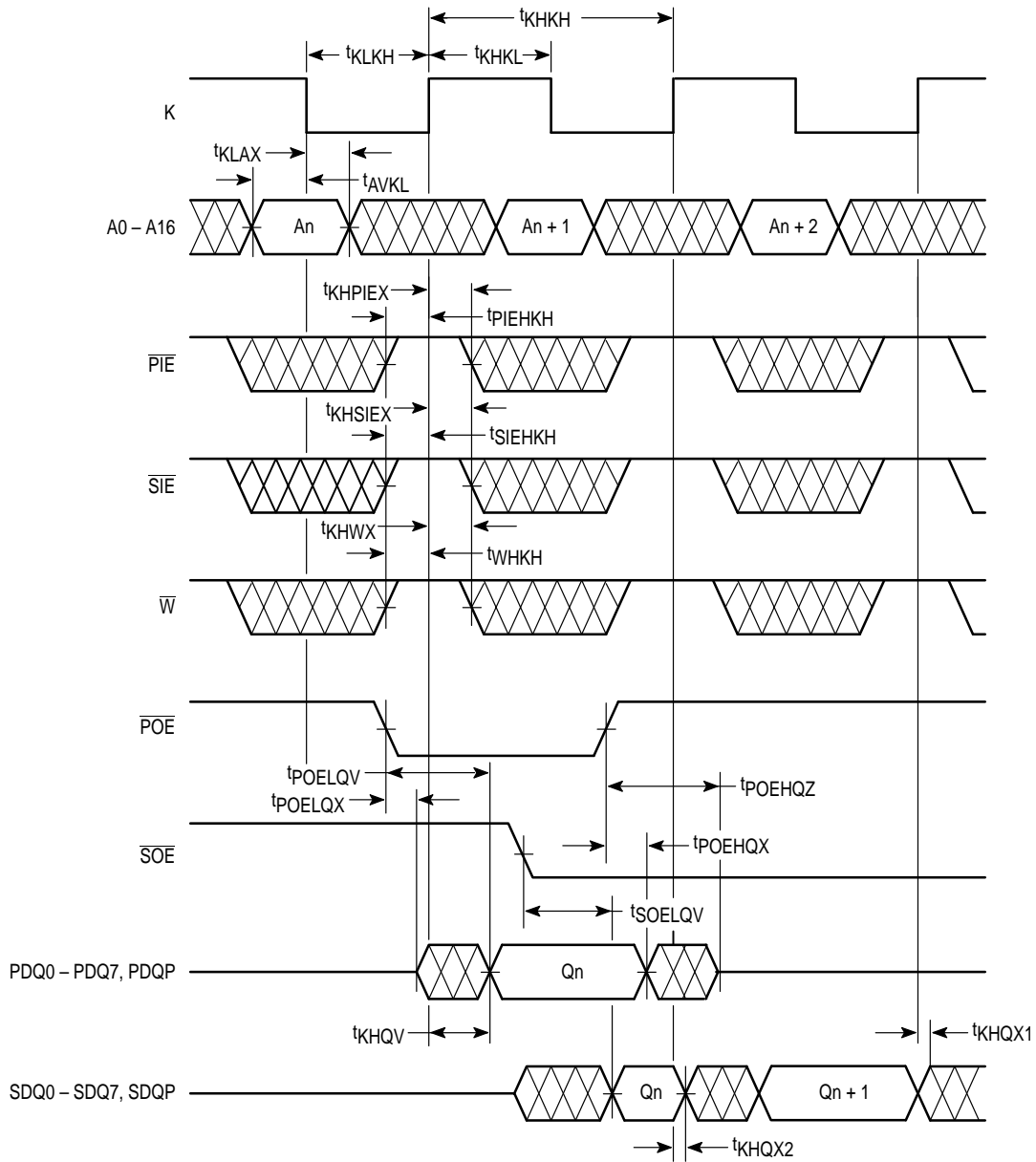


Figure 1B

**READ CYCLE (See Note)**



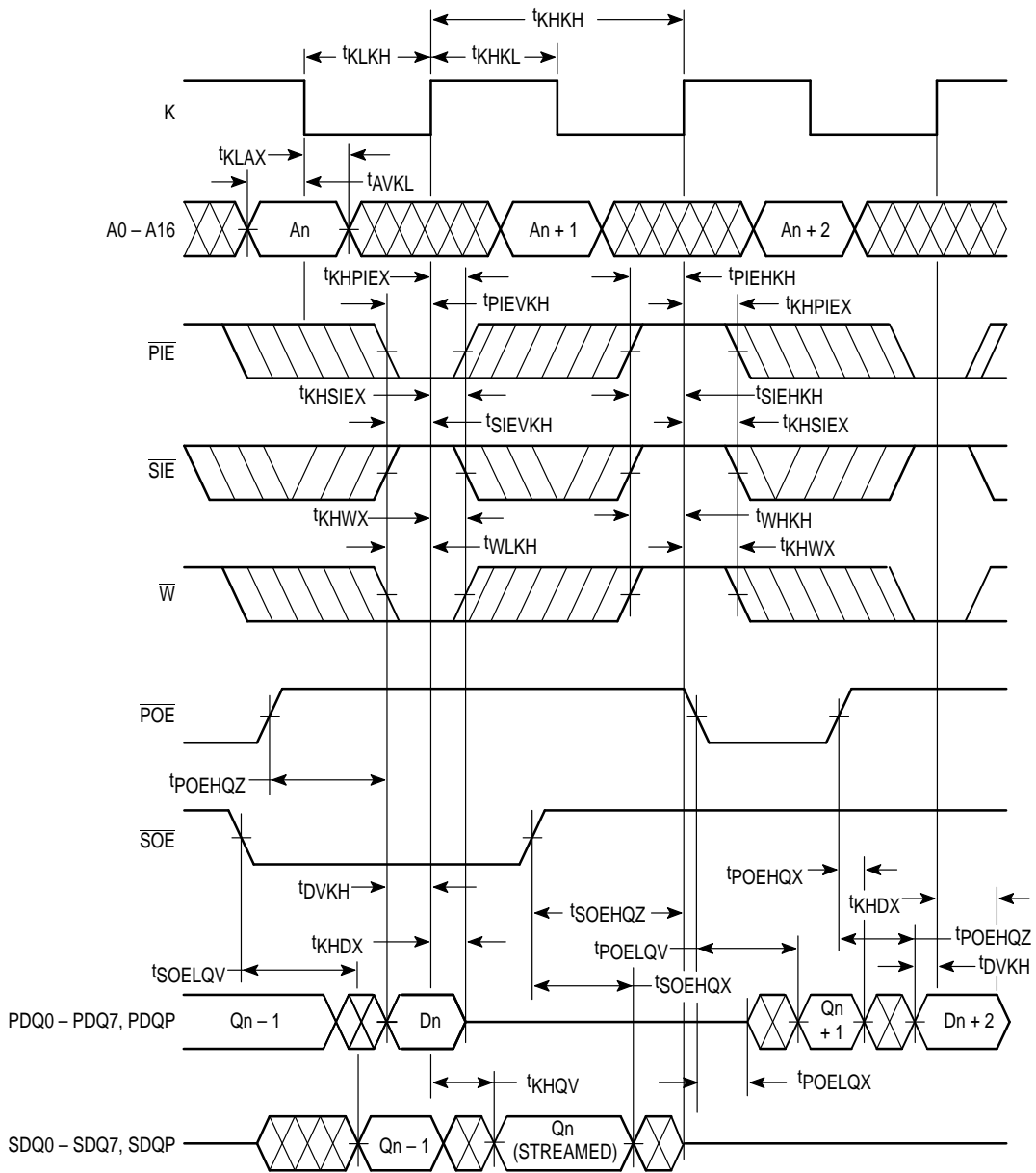
**WRITE THROUGH – READ – WRITE** (See Note 1)

Processor Frequency		60 MHz		50 MHz		Unit	Notes
Parameter	Symbol	MCM67D709–16		MCM67D709–20			
		Min	Max	Min	Max		
Write Cycle Times	t <sub>KHKH</sub>	16	—	20	—	ns	1, 2
Clock Low Pulse Width	t <sub>KLKH</sub>	5	—	5	—	ns	
Clock High Pulse Width	t <sub>KHKL</sub>	7	—	7	—	ns	
Clock High to Output High–Z ( $\overline{W} = V_{IL}$ and $\overline{SIE} = \overline{PIE} = V_{IH}$ )	t <sub>KHQZ</sub>	—	8	—	8	ns	3, 4
Setup Times: SDQ0 – SDQ7, SDQP, PDQ0 – PDQ7, PDQP	A $\overline{W}$ $\overline{PIE}$ $\overline{SIE}$ t <sub>AVKL</sub> t <sub>WLKH</sub> t <sub>PIEVKH</sub> t <sub>SIEVKH</sub> t <sub>DVKH</sub>	2 2 2 2 2	—	2 2 2 2 2	—	ns	
Hold Times: SDQ0 – SDQ7, SDQP, PDQ0 – PDQ7, PDQP	A $\overline{W}$ $\overline{PIE}$ $\overline{SIE}$ t <sub>KLAX</sub> t <sub>KHWX</sub> t <sub>KHPIEX</sub> t <sub>KHSIEX</sub> t <sub>KHDX</sub>	2 2 2 2 2	—	2 2 2 2 2	—	ns	
Write with Streaming ( $\overline{PIE} = \overline{SOE} = V_{IL}$ or $\overline{SIE} = \overline{POE} = V_{IL}$ ) Clock High to Output Valid	t <sub>KHQV</sub>	—	5	—	7	ns	5
Output Enable High to Q High–Z	t <sub>POEHQZ</sub> t <sub>SOEHQZ</sub>	0	6	0	8	ns	6
Output Hold from Output Enable High	t <sub>POEHQX</sub> t <sub>SOEHQX</sub>	2	—	5	—	ns	6
Output Enable Low to Q Active	t <sub>POELQX</sub> t <sub>SOELQX</sub>	0	—	0	—	ns	6
Output Enable Low to Output Valid	t <sub>POELQV</sub> t <sub>SOELQV</sub>	—	5	—	6	ns	

**NOTES:**

1. A write is performed with  $\overline{W} = V_{IL}$  for the specified setup and hold times and either  $\overline{PIE} = V_{IL}$  or  $\overline{SIE} = V_{IL}$ . If both  $\overline{PIE} = V_{IL}$  and  $\overline{SIE} = V_{IL}$  or  $\overline{PIE} = V_{IH}$  and  $\overline{SIE} = V_{IH}$ , then this is treated like a NOP and no write is performed.
2. All write cycle timings are referenced from K.
3. K must be at a high level for the outputs to transition.
4. Transition is measured  $\pm 500$  mV from steady–state voltage with output load of Figure 1B. This parameter is sampled and not 100% tested.
5. A write with streaming is defined as a write cycle which writes data from one data bus to the array and outputs the same data onto the other data bus.
6. Transition is measured  $\pm 500$  mV from steady–state voltage with output load of Figure 1B. This parameter is sampled and not 100% tested. At any given voltage and temperature, t<sub>POEHQZ</sub> is less than t<sub>POELQX</sub> for a given device, and t<sub>SOEHQZ</sub> is less than t<sub>SOELQX</sub> for a given device.

WRITE THROUGH — READ — WRITE



**STREAM CYCLE** (See Note 1)

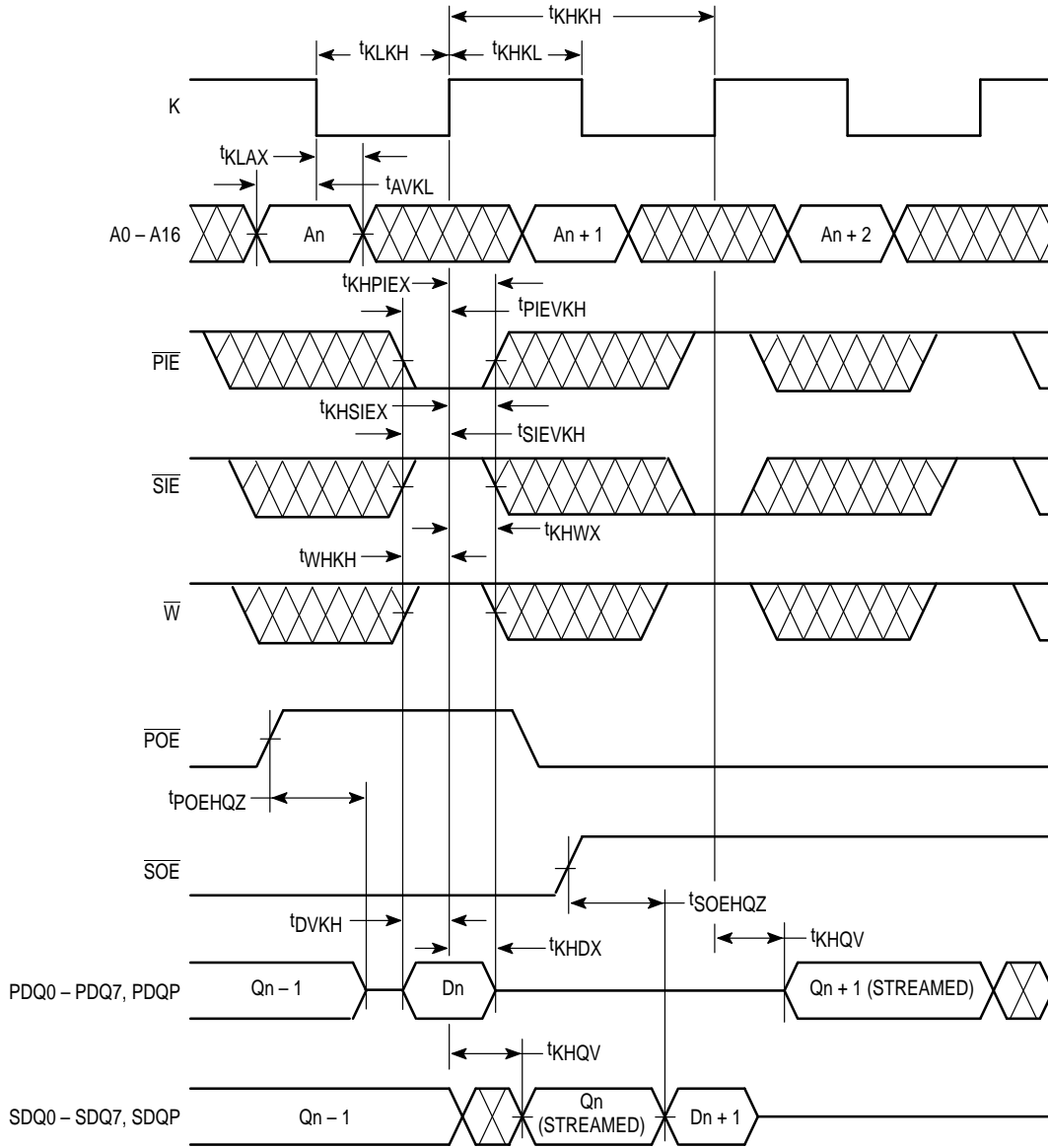
Parameter		Processor Frequency	60 MHz		50 MHz		Unit	Notes
		Symbol	MCM67D709-16		MCM67D709-20			
			Min	Max	Min	Max		
Stream Cycle Time		t <sub>KHKH</sub>	16	—	20	—	ns	1, 2
Clock Low Pulse Width		t <sub>KLKH</sub>	5	—	5	—	ns	
Clock High Pulse Width		t <sub>KHKL</sub>	7	—	7	—	ns	
Stream Access Time		t <sub>KHQV</sub>	—	6	—	7	ns	
Setup Times: SDQ0 – SDQ7, SDQP, PDQ0 – PDQ7, PDQP	A	t <sub>AVKL</sub>	2	—	2	—	ns	
	$\overline{W}$	t <sub>WHKH</sub>	2	—	2	—	ns	
	$\overline{PIE}$	t <sub>PIEVKH</sub>	2	—	2	—	ns	
	$\overline{SIE}$	t <sub>SIEVKH</sub>	2	—	2	—	ns	
		t <sub>DVKH</sub>	2	—	2	—	ns	
Hold Times: SDQ0 – SDQ7, SDQP, PDQ0 – PDQ7, PDQP	A	t <sub>KLAX</sub>	2	—	2	—	ns	
	$\overline{W}$	t <sub>KHWX</sub>	2	—	2	—	ns	
	$\overline{PIE}$	t <sub>KHPIEX</sub>	2	—	2	—	ns	
	$\overline{SIE}$	t <sub>KHSIEX</sub>	2	—	2	—	ns	
		t <sub>KHDX</sub>	2	—	2	—	ns	
Output Enable High to Q High-Z		t <sub>POEHQZ</sub> t <sub>SOEHQZ</sub>	0	6	0	8	ns	3
Output Enable Low to Q Active		t <sub>POELQX</sub> t <sub>SOELQX</sub>	0	—	0	—	ns	3
Output Enable Low to Output Valid		t <sub>POELQV</sub> t <sub>SOELQV</sub>	—	5	—	6	ns	

NOTES:

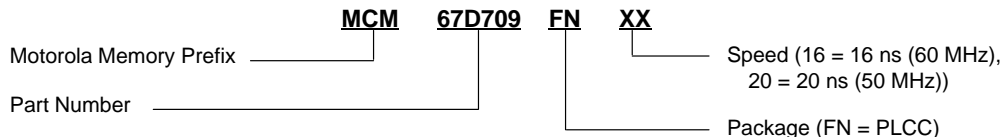
1. A stream cycle is defined as a cycle where data is passed from one data bus to the other data bus.
2. All stream cycle timing is referenced from K.
3. Transition is measured  $\pm 500$  mV from steady-state voltage with output load of Figure 1B. This parameter is sampled and not 100% tested. At any given voltage and temperature, t<sub>POEHQZ</sub> is less than t<sub>POELQX</sub>, t<sub>SOEHQZ</sub> is less than t<sub>SOELQX</sub>, for a given device.




## STREAM CYCLE



**ORDERING INFORMATION**  
**(Order by Full Part Number)**

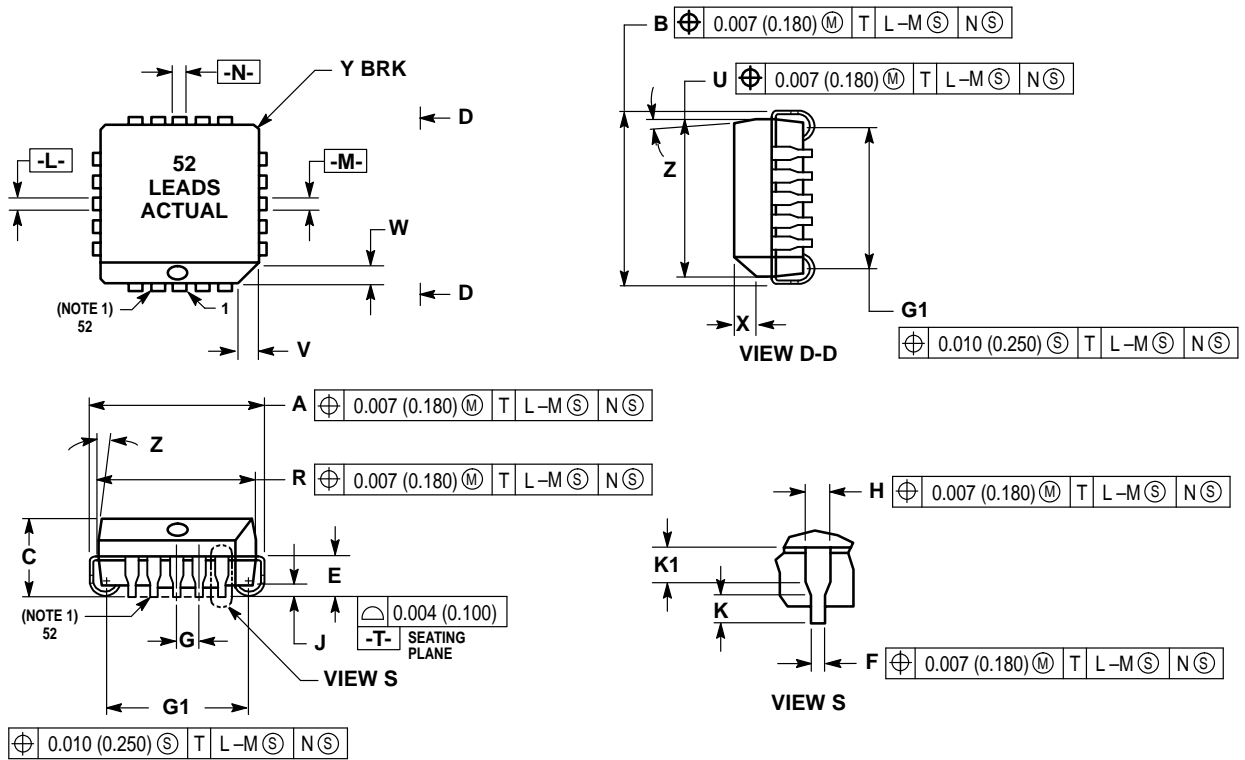


Full Part Numbers — MCM67D709FN16 MCM67D709FN20

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# PACKAGE DIMENSIONS

**FN PACKAGE  
52-LEAD PLCC  
CASE 778-02**



**NOTES:**

1. DUE TO SPACE LIMITATION, CASE 778-02 SHALL BE REPRESENTED BY A GENERAL (SMALLER) CASE OUTLINE DRAWING RATHER THAN SHOWING ALL 52 LEADS.
2. DATUMS -L-, -M-, AND -N- DETERMINED WHERE TOP OF LEAD SHOULDER EXITS PLASTIC BODY AT MOLD PARTING LINE.
3. DIM G1, TRUE POSITION TO BE MEASURED AT DATUM -T-, SEATING PLANE.
4. DIM R AND U DO NOT INCLUDE MOLD FLASH. ALLOWABLE MOLD FLASH IS 0.010 (0.250) PER SIDE.
5. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
6. CONTROLLING DIMENSION: INCH.
7. THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM BY UP TO 0.012 (0.300). DIMENSIONS R AND U ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY.
8. DIMENSION H DOES NOT INCLUDE DAMBAR PROTRUSION OR INTRUSION. THE DAMBAR PROTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE GREATER THAN 0.037 (0.940). THE DAMBAR INTRUSION(S) SHALL NOT CAUSE THE H DIMENSION TO BE SMALLER THAN 0.025 (0.635).

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.785	0.795	19.94	20.19
B	0.785	0.795	19.94	20.19
C	0.165	0.180	4.20	4.57
E	0.090	0.110	2.29	2.79
F	0.013	0.019	0.33	0.48
G	0.050 BSC		1.27 BSC	
H	0.026	0.032	0.66	0.81
J	0.020	—	0.51	—
K	0.025	—	0.64	—
R	0.750	0.756	19.05	19.20
U	0.750	0.756	19.05	19.20
V	0.042	0.048	1.07	1.21
W	0.042	0.048	1.07	1.21
X	0.042	0.056	1.07	1.42
Y	—	0.020	—	0.50
Z	2°	10°	2°	10°
G1	0.710	0.730	18.04	18.54
K1	0.040	—	1.02	—

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◇ CODELINE TO BE PLACED HERE

MCM67D709/D

