

## 8MB Synchronous Fast Static RAM Module

The MCM72F10 (2MB) is configured as 1M x 72 bits. It is packaged in a 168-pin dual-in-line memory module DIMM. The module uses Motorola's 3.3 V, 256K x 18 bit flow-through BurstRAMs.

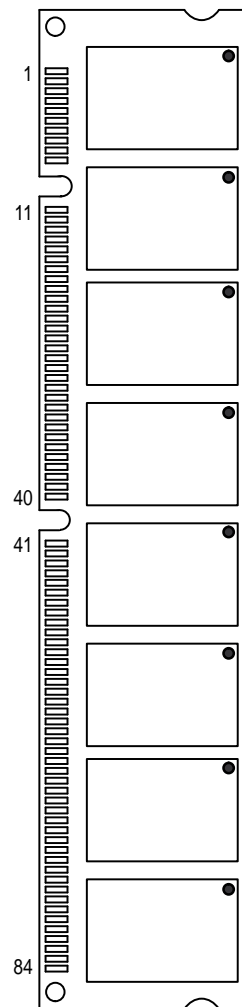
Address (A), data inputs (DQ, DP), and all control signals except output enable (G) are clock (K) controlled through positive-edge-triggered noninverting registers.

Write cycles are internally self-timed and initiated by the rising edge of the clock (K) input. This feature provides increased timing flexibility for incoming signals. Synchronous byte write (W) allows writes to either individual bytes or to both bytes.

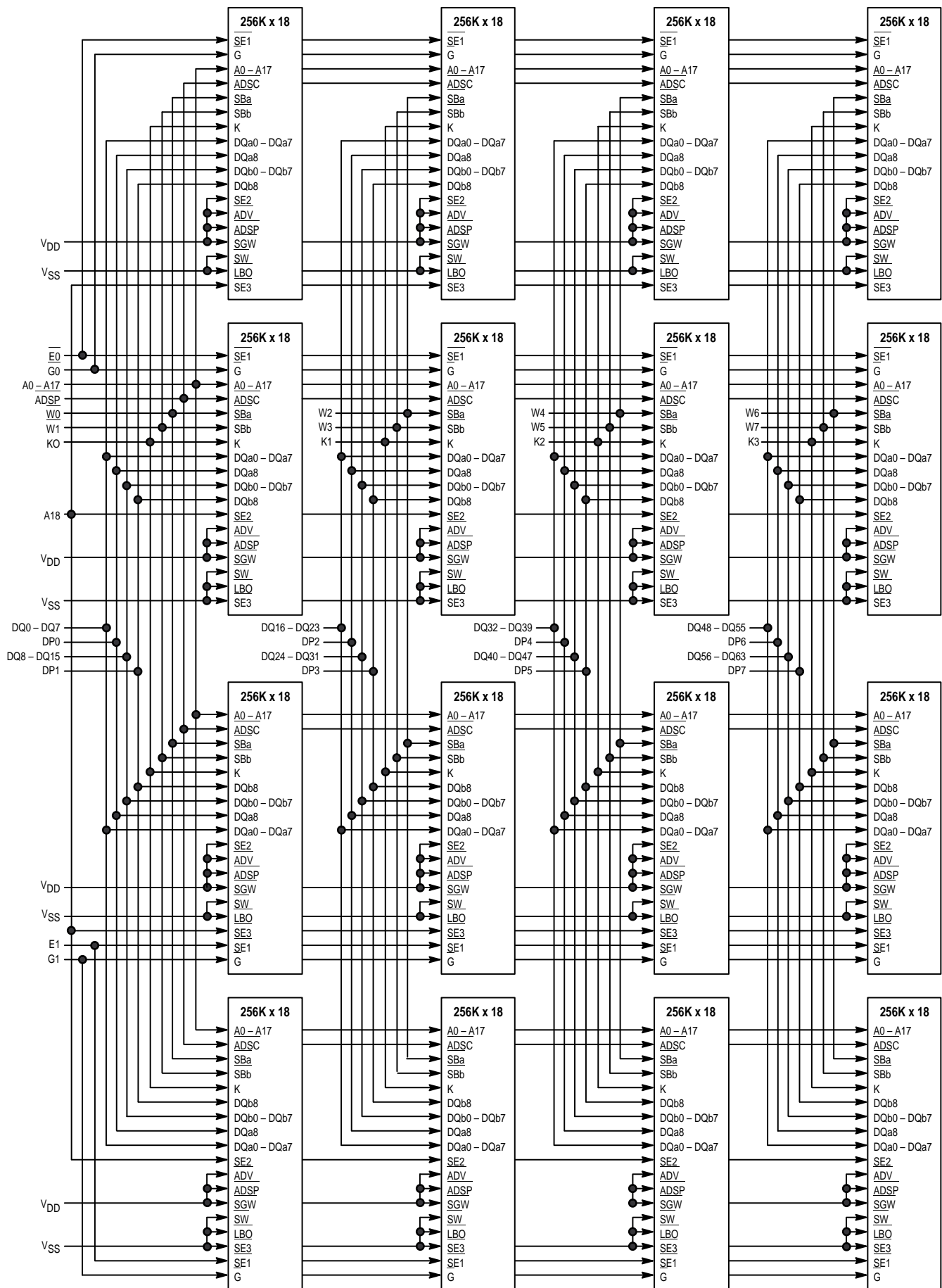
- Single 3.3 V + 10%, - 5% Power Supply
- Plug and Pin Compatibility with 1MB, 2MB, and 4MB
- Multiple Clock Pins for Reduced Loading
- All Inputs and Outputs are LVTTTL Compatible
- Byte Write Capability
- Fast SRAM Access Times: 8/9/12 ns
- High Quality Multi-Layer FR4 PWB With Separate Power and Ground Planes
- Amp Connector, Part Number: 390064-4
- 168-Pin DIMM Module

### MCM72F10

168-LEAD DIMM  
CASE TBD  
TOP VIEW



### BLOCK DIAGRAM



**PIN ASSIGNMENT  
168-LEAD DIMM  
TOP VIEW**

VSS	1	85	VSS
DQ63	2	86	DP7
DQ62	3	87	DQ61
VDD	4	88	VSS
DQ60	5	89	DQ59
DQ58	6	90	DQ57
VSS	7	91	VSS
DQ56	8	92	DP6
DQ55	9	93	DQ54
VSS	10	94	VDD
DQ53	11	95	DQ52
DQ51	12	96	DQ50
VSS	13	97	VSS
DQ49	14	98	DQ48
DP5	15	99	DQ47
VDD	16	100	VSS
DQ46	17	101	DQ45
DQ44	18	102	DQ43
VSS	19	103	VSS
DQ42	20	104	DQ41
DQ40	21	105	DP4
VSS	22	106	VDD
DQ39	23	107	DQ38
DQ37	24	108	DQ36
VSS	25	109	VSS
DQ35	26	110	DQ34
DQ33	27	111	DQ32
VSS	28	112	VSS
K3	29	113	K2
VSS	30	114	VSS
DP3	31	115	DQ31
DQ30	32	116	DQ29
VDD	33	117	VSS
DQ28	34	118	DQ27
DQ26	35	119	DQ25
VSS	36	120	VSS
DQ24	37	121	DP2
DQ23	38	122	DQ22
VSS	39	123	VDD
DQ21	40	124	DQ20

DQ19	41	125	DQ18
VSS	42	126	VSS
DQ17	43	127	DQ16
DP1	44	128	DQ15
VDD	45	129	VSS
DQ14	46	130	DQ13
DQ12	47	131	DQ11
VSS	48	132	VSS
DQ10	49	133	DQ9
DQ8	50	134	DP0
VSS	51	135	VDD
DQ7	52	136	DQ6
DQ5	53	137	DQ4
VSS	54	138	VSS
DQ3	55	139	DQ2
DQ1	56	140	DQ0
VDD	57	141	VSS
NC	58	142	NC
A18	59	143	A17
VSS	60	144	VSS
A16	61	145	A15
A14	62	146	A13
VSS	63	147	VDD
A12	64	148	A11
A10	65	149	A9
VSS	66	150	VSS
A8	67	151	A7
A6	68	152	A5
VDD	69	153	VSS
A4	70	154	A3
A2	71	155	A1
A0	72	156	ADSP
VSS	73	157	VSS
K1	74	158	K0
VSS	75	159	VSS
W7	76	160	W6
W5	77	161	W4
VSS	78	162	VSS
W3	79	163	W2
W1	80	164	W0
VSS	81	165	VDD
G1	82	166	G0
E1	83	167	E0
VSS	84	168	VSS

## PIN DESCRIPTIONS

Pin Locations	Symbol	Type	Description
59, 61, 62, 64, 65, 67, 68, 70, 71, 72, 143, 145, 146, 148, 149, 151, 152, 154, 155	A0 – A18	Input	Synchronous Address Inputs: These inputs are registered and must meet setup and hold times.
156	ADSP	Input	Synchronous Address Status Controller: Initiates read, write, or chip deselect cycle.
15, 31, 44, 86, 92, 105, 121, 134	DP0 – DP7		Synchronous Parity Data Inputs/Outputs.
2, 3, 5, 6, 8, 9, 11, 12, 14, 17, 18, 20, 21, 23, 24, 26, 27, 32, 34, 35, 37, 38, 40, 41, 43, 46, 47, 49, 50, 52, 53, 55, 56, 87, 89, 90, 93, 95, 96, 98, 99, 101, 102, 104, 107, 108, 110, 111, 115, 116, 118, 119, 122, 124, 125, 127, 128, 130, 131, 133, 136, 137, 139, 140	DQ0 – DQ63	I/O	Synchronous Data Inputs/Outputs.
83, 167	E0, E1	Input	Synchronous Chip Enable: Active low to enable chip. Negated high — blocks ADSP or deselects chip when ADSC is asserted.
82, 166	G0, G1	Input	Asynchronous Output Enable Input: Low — enables output buffer. High — DQx pins are high impedance.
29, 74, 113, 158	K0 – K3	Input	Clock: This signal registers the address, data in, and all control signals except G and LBO.
76, 77, 79, 80, 160, 161, 163, 164	W0 – W7	Input	Synchronous Byte Write Inputs: x refers to the byte being written (byte a, b).
4, 16, 33, 45, 57, 69, 94, 106, 123, 135, 147, 165	V <sub>DD</sub>	Supply	Power Supply: 3.3 V + 10%, – 5%. Must be connected on all modules.
1, 7, 10, 13, 19, 22, 25, 28, 30, 36, 39, 42, 48, 51, 54, 60, 63, 66, 73, 75, 78, 81, 84, 85, 88, 91, 97, 100, 103, 109, 112, 114, 117, 120, 126, 129, 132, 138, 141, 144, 150, 153, 157, 159, 162, 168	V <sub>SS</sub>	Supply	Ground.
58, 142	NC		No Connection: There is no connection to the chip.

## DATA RAM MCM69F618A SYNCHRONOUS TRUTH TABLE (See Notes 1, 2, 3, and 4)

Next Cycle	Address Used	E	ADSP	G	DQx	WRITE
Deselect	None	1	0	X	High-Z	X
Begin Read	External Address	0	0	0	DQ	Read
Read	Current	X	1	1	High-Z	Read
Read	Current	X	1	0	DQ	Read
Begin Write	External	0	0	X	High-Z	Write
Write	Current	X	1	X	High-Z	Write

### NOTES:

1. X = don't care, 1 = logic high, 0 = logic low.
2. Write is defined as any Wx low.
3. G is an asynchronous signal and is not sampled by the clock K. G drives the bus immediately ( $t_{GLQX}$ ) following G going low.
4. On write cycles that follow read cycles, G must be negated prior to the start of the write cycle to ensure proper write data setup times. G must also remain negated at the completion of the write cycle to ensure proper write data hold times.

**ABSOLUTE MAXIMUM RATINGS** (See Note 1)

Rating	Symbol	Value	Unit
Power Supply Voltage	$V_{DD}$	- 0.5 to + 4.6	V
Voltage Relative to $V_{SS}$ (See Note 2)	$V_{in}, V_{out}$	- 0.5 to $V_{DD} + 0.5$	V
Input Voltage Three State I/O (See Note 2)	$V_{IT}$	$V_{SS} - 0.5$ to $V_{DD} + 0.5$	V
Output Current (per I/O)	$I_{out}$	$\pm 20$	mA
Power Dissipation	$P_D$	4.6	W
Temperature Under Bias	$T_{bias}$	- 10 to + 85	°C
Storage Temperature	$T_{stg}$	- 55 to + 125	°C

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.

## NOTES:

1. 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.
2. This is a steady-state DC parameter that is in effect after the power supply has achieved its nominal operating level. Power sequencing can not be controlled and is not allowed.
3. Power dissipation capability is dependent upon package characteristics and use environment. See Package Thermal Characteristics.

**PACKAGE THERMAL CHARACTERISTICS — PBGA**

Rating	Symbol	Max	Unit	Notes
Junction to Ambient (@ 200 lfm)	$R_{\theta JA}$	41 19	°C/W	1, 2
Junction to Board (Bottom)	$R_{\theta JB}$	11	°C/W	3
Junction to Case (Top)	$R_{\theta JC}$	19	°C/W	4

## NOTES:

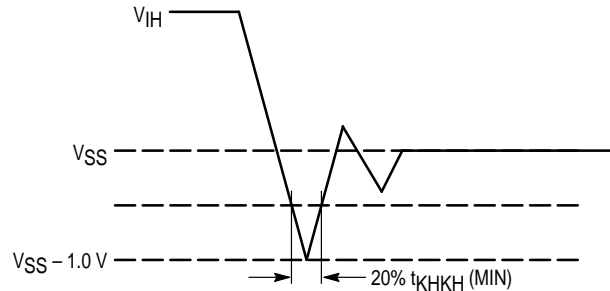
1. Junction temperature is a function of on-chip power dissipation, package thermal resistance, mounting site (board) temperature, ambient temperature, air flow, board population, and board thermal resistance.
2. Per SEMI G38-87.
3. Indicates the average thermal resistance between the die and the printed circuit board.
4. Indicates the average thermal resistance between the die and the case top surface via the cold plate method (MIL SPEC-883 Method 1012.1).

**DC OPERATING CONDITIONS AND CHARACTERISTICS**  
 (3.6 V  $\geq$  V<sub>DD</sub>  $\geq$  3.1 V, T<sub>J</sub> = 20 to + 110°C, Unless Otherwise Noted)

**RECOMMENDED OPERATING CONDITIONS** (Voltages Referenced to V<sub>SS</sub> = 0 V)

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage (Operating Voltage Range)	V <sub>DD</sub>	3.135	3.3	3.6	V
Input High Voltage	V <sub>IH</sub>	1.7	—	V <sub>DD</sub> + 0.3	V
Input Low Voltage	V <sub>IL</sub>	-0.3*	—	0.7	V

\* V<sub>IL</sub>  $\geq$  -2.0 V for t  $\leq$  t<sub>KHKH</sub>/2.



**Figure 1. Undershoot Voltage**

**DC CHARACTERISTICS**

Parameter	Symbol	Min	Max	Unit
Input Leakage Current (0 V $\leq$ V <sub>in</sub> $\leq$ V <sub>DD</sub> )	I <sub>kg(I)</sub>	—	$\pm$ 1.0	$\mu$ A
Output Leakage Current (0 V $\leq$ V <sub>in</sub> $\leq$ V <sub>DD</sub> )	I <sub>kg(O)</sub>	—	$\pm$ 1.0	$\mu$ A
Output Low Voltage (I <sub>OL</sub> = + 8.0 mA)	V <sub>OL</sub>	—	0.4	V
Output High Voltage (I <sub>OH</sub> = - 4.0 mA)	V <sub>OH</sub>	2.4	—	V

**POWER SUPPLY CURRENTS**

Parameter	Symbol	Min	Max	Unit
AC Supply Current (Device Selected, All Outputs Open, Cycle Time $\geq$ t <sub>KHKH</sub> min)	I <sub>DDA</sub>	—	3580 3480 3380	mA
CMOS Standby Supply Current (Deselected, Clock (K) Cycle Time $\geq$ t <sub>KHKH</sub> )	I <sub>SB1</sub>	—	3040	mA
Clock Running Supply Current (Deselected, Clock (K) Cycle Time $\geq$ t <sub>KHKH</sub> , All Other Inputs Held to Static CMOS Levels V <sub>in</sub> $\leq$ V <sub>SS</sub> + 0.2 V or $\geq$ V <sub>DD</sub> - 0.2 V)	I <sub>SB2</sub>	—	1360	mA

**CAPACITANCE** (f = 1.0 MHz, dV = 3.0 V, T<sub>J</sub> = 20 to 110 °C, Periodically Sampled Rather Than 100% Tested)

Parameter	Symbol	Typ	Max	Unit
Input Capacitance	C <sub>in</sub>	74 42 26	90 50 30	pF
I/O Capacitance	C <sub>I/O</sub>	38	42	pF

**MASS** (Periodically Sampled Rather Than 100% Tested)

Parameter	Max	Unit
Mass	36	g

**AC OPERATING CONDITIONS AND CHARACTERISTICS**  
 (3.6 V ≥ V<sub>DD</sub> ≥ 3.1 V, T<sub>J</sub> = 20 to + 110°C, Unless Otherwise Noted)

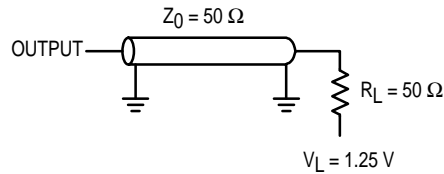
Input Timing Measurement Reference Level ..... 1.25 V      Output Timing Reference Level ..... 1.25 V  
 Input Pulse Levels ..... 0 to 2.5 V      Output Load ..... See Figure 2 Unless Otherwise Noted  
 Input Slew Rate (See Notes 1 and 2) ..... 1.0 V/ns      Output Rise/Fall Time ..... 1.8 ns

**DATA RAMs READ/WRITE CYCLE TIMING** (See Notes 1, 2, and 3)

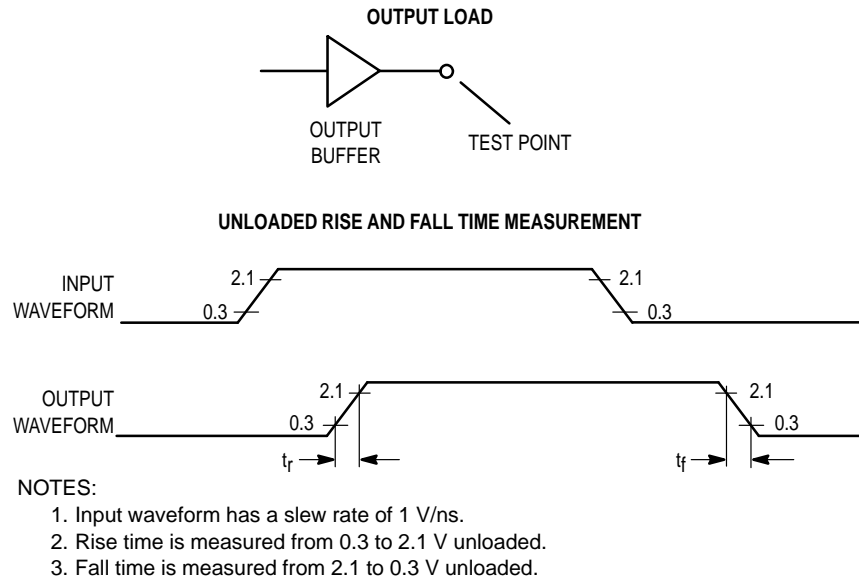
Parameter	Symbol	MCM72F10-8		MCM72F10-9		MCM72F10-12		Unit	Notes
		Min	Max	Min	Max	Min	Max		
Cycle Time	t <sub>KHKH</sub>	10	—	11	—	16.6	—	ns	
Clock Access Time	t <sub>KHQV</sub>	—	8	—	9	—	12	ns	4
Output Enable to Output Valid	t <sub>GLQV</sub>	—	3.5	—	3.5	—	5	ns	4
Clock High to Output Active	t <sub>KHQX1</sub>	0	—	0	—	0	—	ns	4, 5, 6, 7
Clock High to Output Change	t <sub>KHQX2</sub>	2	—	2	—	2	—	ns	4, 6
Output Enable to Output Active	t <sub>GLQX</sub>	0	—	0	—	0	—	ns	4, 5, 6
Output Disable to Q High-Z	t <sub>GHQZ</sub>	—	3.5	—	3.5	—	3.5	ns	4, 5, 6
Clock High to Q High-Z	t <sub>KHQZ</sub>	2	3.5	2	3.5	2	3.5	ns	4, 5, 6, 7
Clock High Pulse Width	t <sub>KHKL</sub>	4	—	4.5	—	5	—	ns	
Clock Low Pulse Width	t <sub>KLKH</sub>	4	—	4.5	—	5	—	ns	
Setup Times: Address ADSP Data In Write Chip Enable	t <sub>AVKH</sub> t <sub>ADKH</sub> t <sub>DVKH</sub> t <sub>WVKH</sub> t <sub>EVKH</sub>	2	—	2	—	2	—	ns	
Hold Times: Address ADSP, ADSC, ADV Data In Write Chip Enable	t <sub>KHAX</sub> t <sub>KHADX</sub> t <sub>KHDX</sub> t <sub>KHWX</sub> t <sub>KHEX</sub>	0.5	—	0.5	—	0.5	—	ns	

**NOTES:**

1. In setup and hold times, write refers to either any  $\overline{SBx}$  and  $\overline{SW}$  or  $\overline{SGW}$  is low. \_\_\_\_\_
2. Chip enable is defined as SE1 low, SE2 high, and SE3 low whenever ADSP or ADSC is asserted.
3. All read and write cycle timings are referenced from K or G.
4. Tested per AC Test Load (Figure 2).
5. Measured at ± 200 mV from steady state. Tested per High-Z Test Load (Figure 2).
6. This parameter is sampled and not 100% tested.
7. At any given voltage and temperature, t<sub>KHQZ</sub> (Max) is less than t<sub>KHQX1</sub> (Min) for a given device and from device to device.

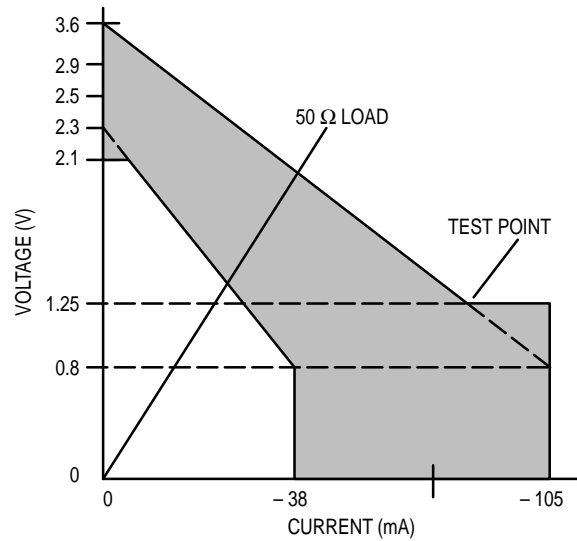


**Figure 2. AC Test Load**

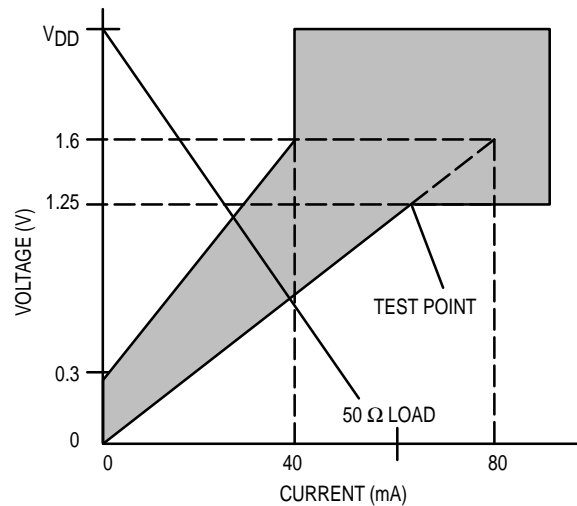


**Figure 3. Unloaded Rise and Fall Time Characterization**

PULL-UP		
VOLTAGE (V)	I (mA) MIN	I (mA) MAX
-0.5	-38	-105
0	-38	-105
0.8	-38	-105
1.25	-26	-83
1.5	-20	-70
2.3	0	-30
2.7	0	-10
2.9	0	0
3.4	0	0
3.6	0	0



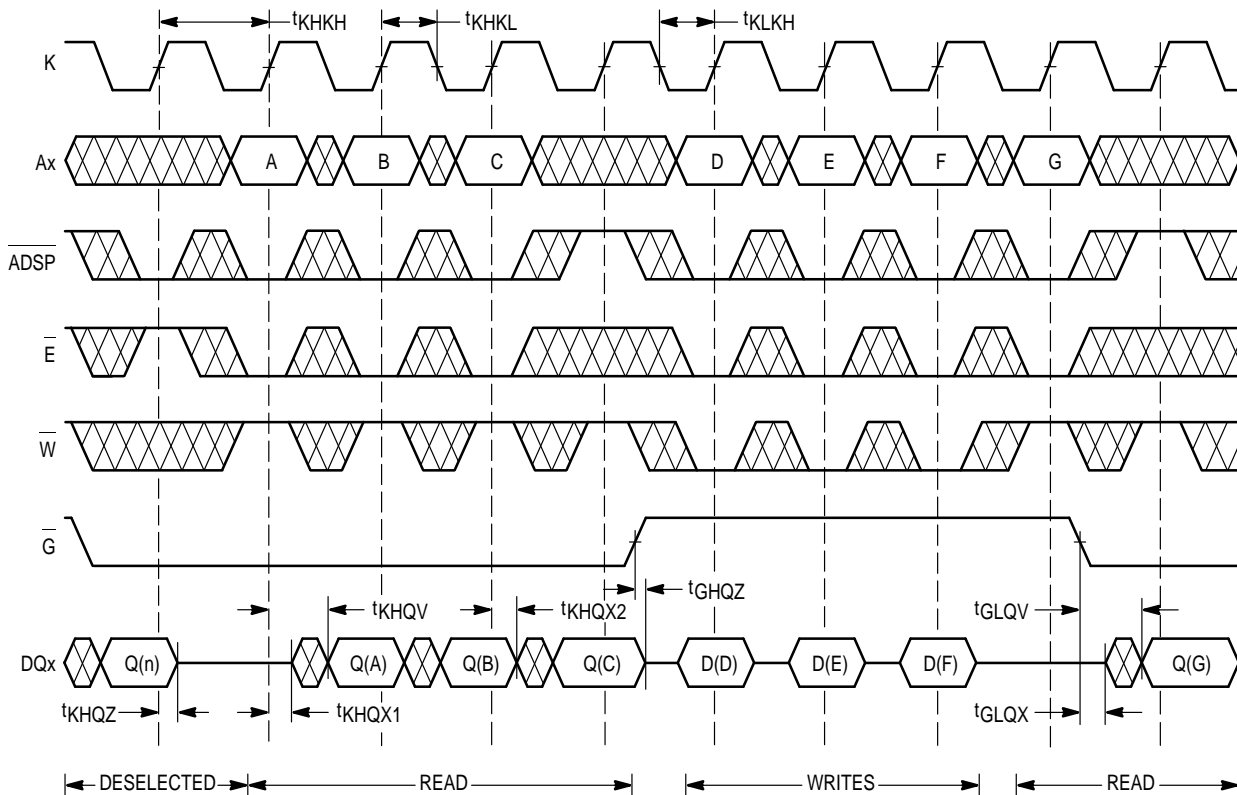
PULL-DOWN		
VOLTAGE (V)	I (mA) MIN	I (mA) MAX
-0.5	0	0
0	0	0
0.4	10	20
0.8	20	40
1.25	31	63
1.6	40	80
2.8	40	80
3.2	40	80
3.4	40	80
3.6	46	120



**Figure 4. Output Buffer Characteristics**

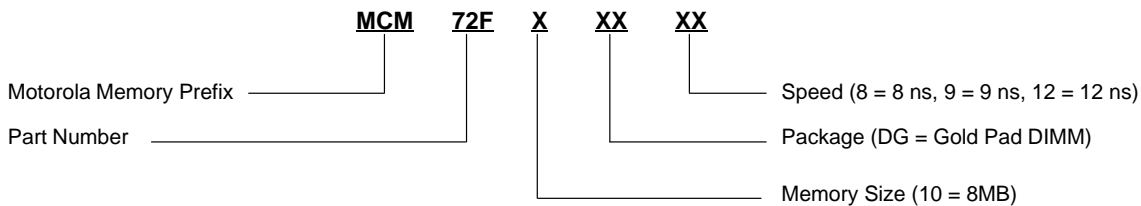


### READ/WRITE CYCLES



### ORDERING INFORMATION


(Order by Full Part Number)



Full Part Numbers — MCM72F10DG8    MCM72F10DG9    MCM72F10DG12

## PACKAGE DIMENSIONS

DG PACKAGE  
CASE TBD

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