MOTOROLA
SEMICONDUCTOR TECHNICAL DATA

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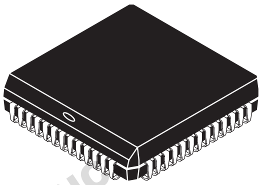
by MCM67M618B/D

MCM67M618B

Advance Information

64K x 18 Bit BurstRAM Synchronous Fast Static RAM

With Burst Counter and Self–Timed Write



FN PACKAGE
PLASTIC
CASE 778–02

The MCM67M618B is a 1,179,648–bit synchronous static random access memory designed to provide a burstable, high–performance, secondary cache for the MC68040 and PowerPC™ microprocessors. The MCM67M618B (organized as 65,536 words by 18 bits) is fabricated using Motorola's high–performance silicon–gate BiCMOS technology. The device integrates input registers, a 2–bit counter, high speed SRAM, and high drive capability outputs onto a single monolithic circuit for reduced parts count implementation of cache data RAM applications. Synchronous design allows precise cycle control with the use of an external clock (K). BiCMOS circuitry reduces the overall power consumption of the integrated functions for greater reliability.

Addresses (A0 – A15), data inputs (DQ0 – DQ17), and all control signals, except output enable ($\overline{\text{G}}$), are clock (K) controlled through positive–edge–triggered noninverting registers.

Bursts can be initiated with either transfer start processor ($\overline{\text{TSP}}$) or transfer start cache controller ($\overline{\text{TSC}}$) input pins. Subsequent burst addresses are generated internally by the MCM67M618B (burst sequence imitates that of the MC68040) and controlled by the burst address advance ($\overline{\text{BAA}}$) input pin. The following pages provide more detailed information on burst controls.

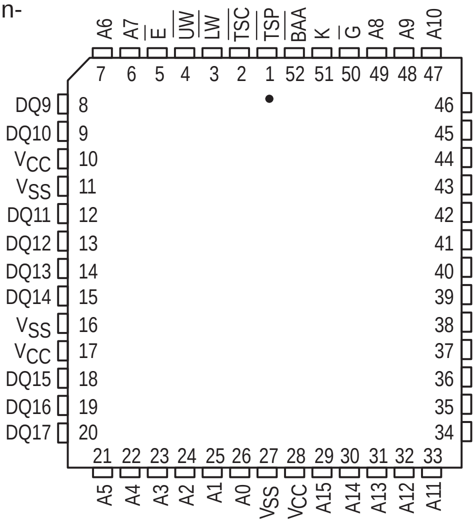
Write cycles are internally self–timed and are initiated by the rising edge of the clock (K) input. This feature eliminates complex off–chip write pulse generation and provides increased flexibility for incoming signals.

Dual write enables ($\overline{\text{LW}}$ and $\overline{\text{UW}}$) are provided to allow individually writeable bytes. $\overline{\text{LW}}$ controls DQ0 – DQ8 (the lower bits), while $\overline{\text{UW}}$ controls DQ9 – DQ17 (the upper bits).

This device is ideally suited for systems that require wide data bus widths and cache memory.

- Single 5 V ±5% Power Supply
- Fast Access Time: 9 ns Max
- Byte Writeable via Dual Write Strobes
- Internal Input Registers (Address, Data, Control)
- Internally Self–Timed Write Cycle
- $\overline{\text{TSP}}$, $\overline{\text{TSC}}$, and $\overline{\text{BAA}}$ Burst Control Pins
- Asynchronous Output Enable Controlled Three–State Outputs
- Common Data Inputs and Data Outputs
- High Board Density 52–PLCC Package
- 3.3 V I/O Compatible

PIN ASSIGNMENT



PIN NAMES

A0 – A15	Address Inputs
K	Clock
$\overline{\text{BAA}}$	Burst Address Advance
$\overline{\text{LW}}$	Lower Byte Write Enable
$\overline{\text{UW}}$	Upper Byte Write Enable
$\overline{\text{TSP}}$, $\overline{\text{TSC}}$	Transfer Start
$\overline{\text{E}}$	Chip Enable
$\overline{\text{G}}$	Output Enable
DQ0 – DQ17	Data Input/Output
V_{CC}	+5 V Power Supply
V_{SS}	Ground

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

The PowerPC name is a trademark of IBM Corp., used under license therefrom.

This document contains information on a new product. Specifications and information herein are subject to change without notice.

REV 2
9/21/99

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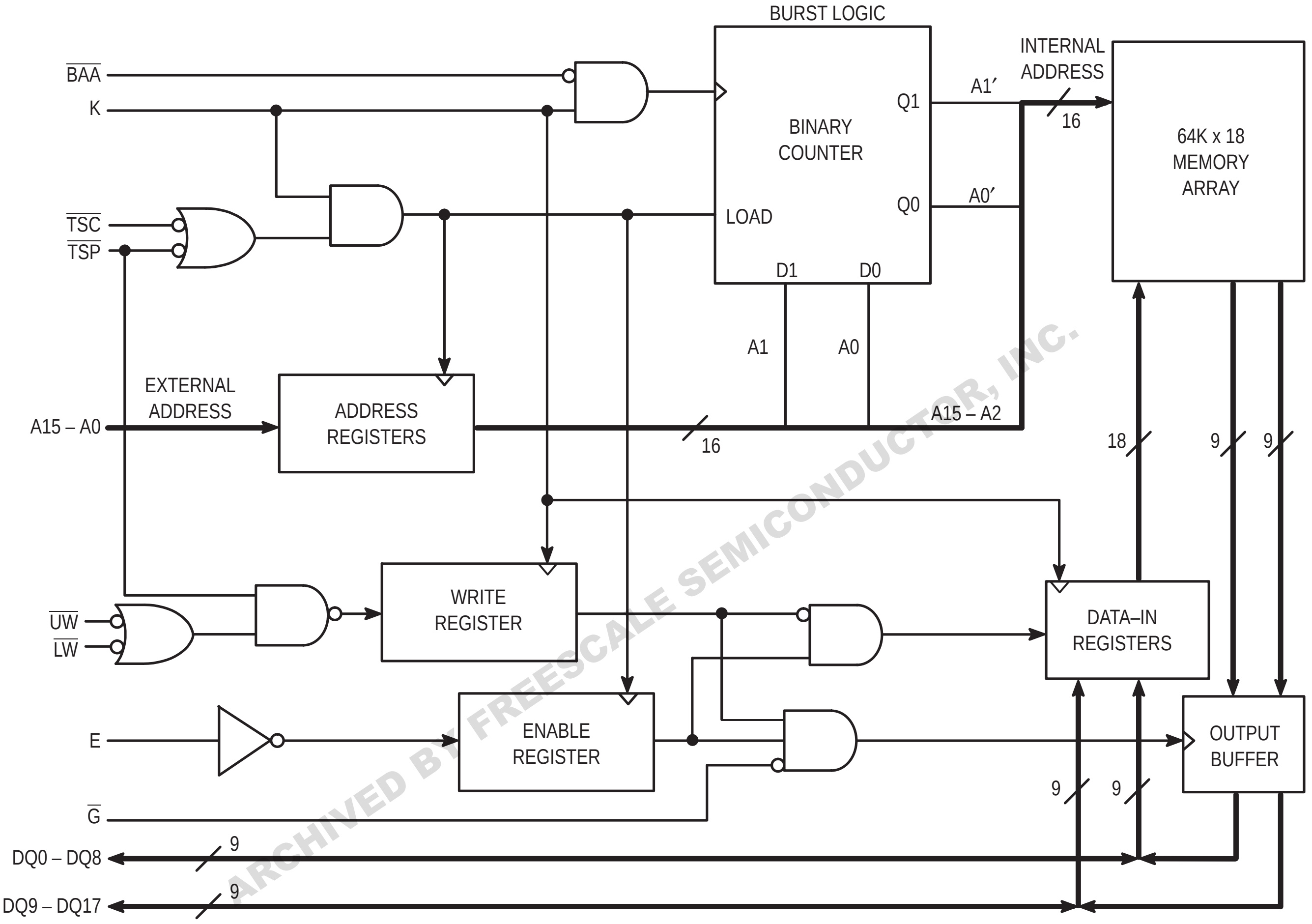
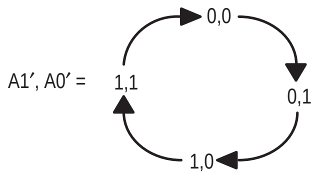
BLOCK DIAGRAM (See Note)


BURST LOGIC
BINARY COUNTER
Q1
Q0
LOAD
D1
D0
A1′
A0′
INTERNAL ADDRESS
16
64K x 18 MEMORY ARRAY
BAA
K
TSC
TSP
A1
A0
EXTERNAL ADDRESS
A15 – A0
ADDRESS REGISTERS
16
A15 – A2
18
9
9
UW
LW
WRITE REGISTER
DATA–IN REGISTERS
E
ENABLE REGISTER
OUTPUT BUFFER
G
9
9
DQ0 – DQ8
9
DQ9 – DQ17
9

NOTE: All registers are positive–edge triggered. The $\overline{\text{TSC}}$ or $\overline{\text{TSP}}$ signals control the duration of the burst and the start of the next burst. When $\overline{\text{TSP}}$ is sampled low, any ongoing burst is interrupted and a read (independent of $\overline{\text{W}}$ and $\overline{\text{TSC}}$) is performed using the new external address. Alternatively, a $\overline{\text{TSP}}$–initiated two cycle WRITE can be performed by asserting $\overline{\text{TSP}}$ and a valid address on the first cycle, then negating both $\overline{\text{TSP}}$ and $\overline{\text{TSC}}$ and asserting $\overline{\text{LW}}$ and/or $\overline{\text{UW}}$ with valid data on the second cycle (see Single Write Cycle in WRITE CYCLES timing diagram).
When $\overline{\text{TSC}}$ is sampled low (and $\overline{\text{TSP}}$ is sampled high), any ongoing burst is interrupted and a read or write (dependent on $\overline{\text{W}}$) is performed using the new external address. Chip enable ($\overline{\text{E}}$) is sampled only when a new base address is loaded. After the first cycle of the burst, $\overline{\text{BAA}}$ controls subsequent burst cycles. When $\overline{\text{BAA}}$ is sampled low, the internal address is advanced prior to the operation. When $\overline{\text{BAA}}$ is sampled high, the internal address is not advanced, thus inserting a wait state into the burst sequence accesses. Upon completion of a burst, the address will wrap around to its initial state. See **BURST SEQUENCE TABLE**. Write refers to either or both byte write enables ($\overline{\text{LW}}$, $\overline{\text{UW}}$).

BURST SEQUENCE GRAPH (See Note)


A1′, A0′ =
0,0
0,1
1,0
1,1

NOTE: The external two values for A1 and A0 provide the starting point for the burst sequence graph. The burst logic advances A1 and A0 as shown above.

SYNCHRONOUS TRUTH TABLE (See Notes 1, 2, and 3)

$\overline{E}$	$\overline{TSP}$	$\overline{TSC}$	$\overline{BAA}$	$\overline{LW}$ or $\overline{UW}$	K	Address	Operation
H	L	X	X	X	L–H	N/A	Deselected
H	X	L	X	X	L–H	N/A	Deselected
L	L	X	X	X	L–H	External Address	Read Cycle, Begin Burst
L	H	L	X	L	L–H	External Address	Write Cycle, Begin Burst
L	H	L	X	H	L–H	External Address	Read Cycle, Begin Burst
X	H	H	L	L	L–H	Next Address	Write Cycle, Continue Burst
X	H	H	L	H	L–H	Next Address	Read Cycle, Continue Burst
X	H	H	H	L	L–H	Current Address	Write Cycle, Suspend Burst
X	H	H	H	H	L–H	Current Address	Read Cycle, Suspend Burst

NOTES:

1. X means Don't Care.
2. All inputs except $\overline{G}$ must meet setup and hold times for the low–to–high transition of clock (K).
3. Wait states are inserted by suspending burst.

ASYNCHRONOUS TRUTH TABLE (See Notes 1 and 2)

Operation	$\overline{G}$	I/O Status
Read	L	Data Out
Read	H	High–Z
Write	X	High–Z — Data In
Deselected	X	High–Z

NOTES:

1. X means Don't Care.
2. For a write operation following a read operation, $\overline{G}$ must be high before the input data required setup time and held high through the input data hold time.

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

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}	±30	mA
Power Dissipation	P_D	1.6	W
Temperature Under Bias	T_{bias}	–10 to 85	°C
Ambient 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.

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.

This BiCMOS memory circuit has been designed to meet the dc and ac specifications shown in the tables, after thermal equilibrium has been established.

This device contains circuitry that will ensure the output devices are in High–Z at power up.

DC OPERATING CONDITIONS AND CHARACTERISTICS

(V_{CC} = 5.0 V ±5%, T_A = 0° to 70°C, Unless Otherwise Noted)

RECOMMENDED OPERATING CONDITIONS (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

* V_{IL} (min) = –0.5 V dc; V_{IL} (min) = –2.0 V ac (pulse width ≤20.0 ns) for I ≤ 20.0 mA.

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

DC CHARACTERISTICS AND SUPPLY CURRENTS

Parameter	Symbol	Min	Max	Unit
Input Leakage Current (All Inputs, V_{in} = 0 to V_{CC})	$I_{lkg(I)}$	—	±1.0	µA
Output Leakage Current ($\overline{G}$ = V_{IH})	$I_{lkg(O)}$	—	±1.0	µA
AC Supply Current (Device Selected, All Outputs Open, Freq = Max)	I_{CCA}	—	275	mA
CMOS Standby Supply Current (Device Deselected, Freq = 0, V_{CC} = Max, All Inputs Static at CMOS Levels $V_{in} \leq V_{SS}$ + 0.2 V or ≥ V_{CC} – 0.2 V)	I_{SB1}	—	95	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	3.3	V

NOTE: Good decoupling of the local power supply should always be used. DC characteristics are guaranteed for all possible 68040 and PowerPC bus cycles.

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

Parameter	Symbol	Min	Typ	Max	Unit
Input Capacitance	C_{in}	—	4	5	pF
Input/Output Capacitance	$C_{I/O}$	—	6	8	pF

AC OPERATING CONDITIONS AND CHARACTERISTICS

(V_{CC} = 5.0 V ±5%, T_A = 0° to 70°C, Unless Otherwise Noted)

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

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

Parameter	Symbol	MCM67M618B–9		Unit	Notes
		Min	**Max**		
Cycle Time	t_{KHKH}	15	—	ns	
Clock Access Time	t_{KHQV}	—	9	ns	4
Output Enable to Output Valid	t_{GLQV}	—	5	ns	
Clock High to Output Active	t_{KHQX1}	6	—	ns	
Clock High to Output Change	t_{KHQX2}	3	—	ns	
Output Enable to Output Active	t_{GLQX}	0	—	ns	
Output Disable to Q High–Z	t_{GHQZ}	—	6	ns	5
Clock High to Q High–Z	t_{KHQZ}	3	6	ns	5
Clock High Pulse Width	t_{KHKL}	5	—	ns	
Clock Low Pulse Width	t_{KLKH}	5	—	ns	
Setup Times: Address Address Status Data In Write Address Advance Chip Enable	t_{AVKH} t_{TSVKH} t_{DVKH} t_{WVKH} t_{BAVKH} t_{EVKH}	2.5	—	ns	6
Hold Times: Address Address Status Data In Write Address Advance Chip Enable	t_{KHAX} t_{KHTSX} t_{KHDX} t_{KHWX} t_{KHBAX} t_{KHEX}	0.5	—	ns	6

NOTES:

1. In setup and hold times, W (write) refers to either one or both byte write enables $\overline{LW}$ and $\overline{UW}$.
2. All read and write cycle timings are referenced from K or $\overline{G}$.
3. $\overline{G}$ is a don't care when $\overline{UW}$ or $\overline{LW}$ is sampled low.
4. Maximum access times are guaranteed for all possible MC68040 and PowerPC external bus cycles.
5. Transition is measured ±500 mV from steady-state voltage. This parameter is sampled rather than 100% tested. At any given voltage and temperature, t_{KHQZ} max is less than t_{KHQZ1} min for a given device and from device to device.
6. This is a synchronous device. All addresses must meet the specified setup and hold times for ***ALL*** rising edges of K whenever $\overline{TSP}$ or $\overline{TSC}$ is low, and the chip is selected. All other synchronous inputs must meet the specified setup and hold times for ***ALL*** rising edges of K when the chip is enabled. Chip enable must be valid at each rising edge of clock for the device (when $\overline{TSP}$ or $\overline{TSC}$ is low) to remain enabled.

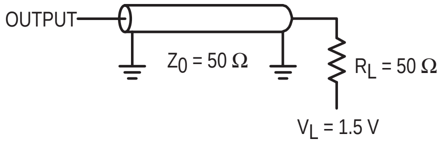
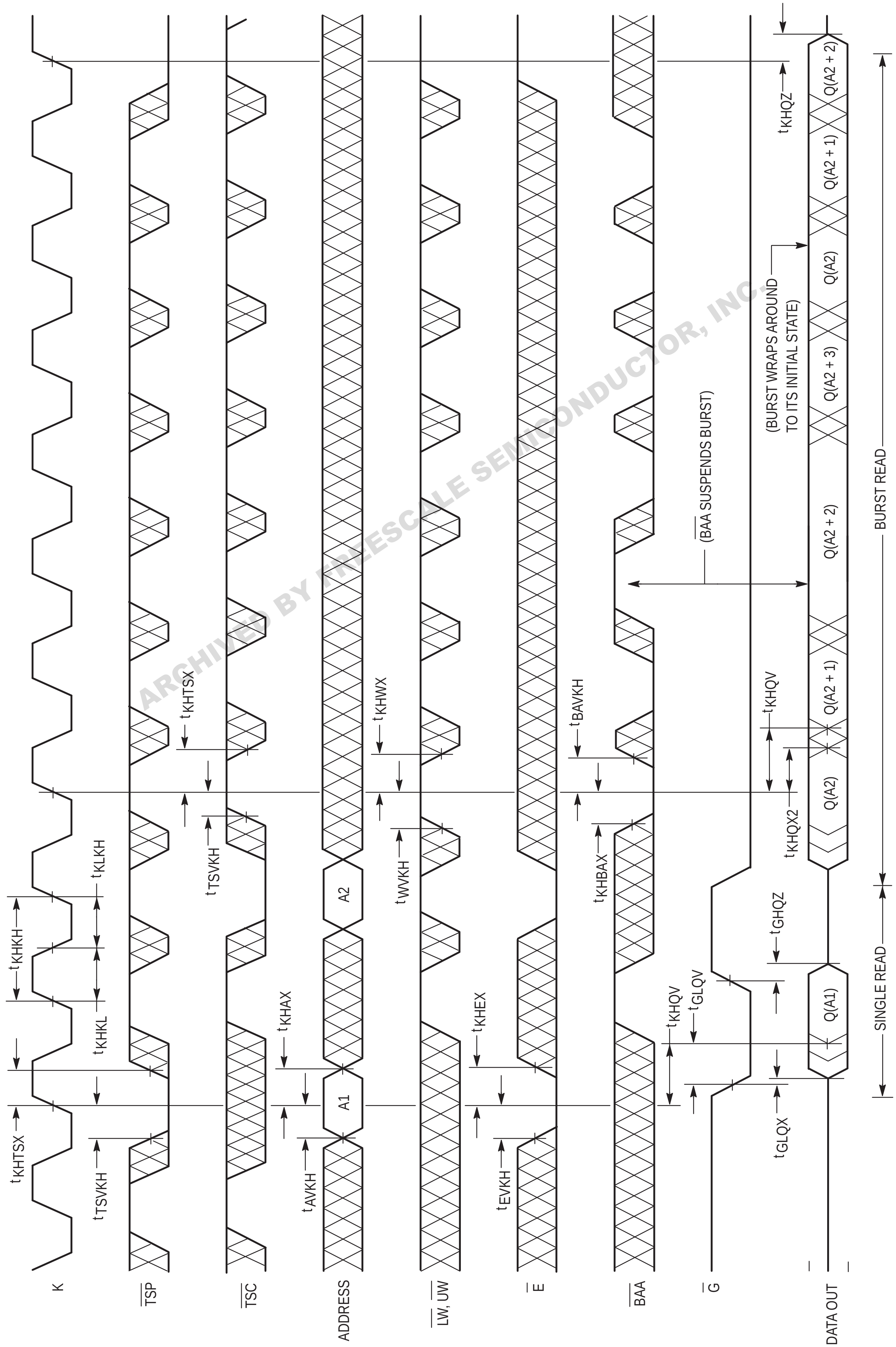


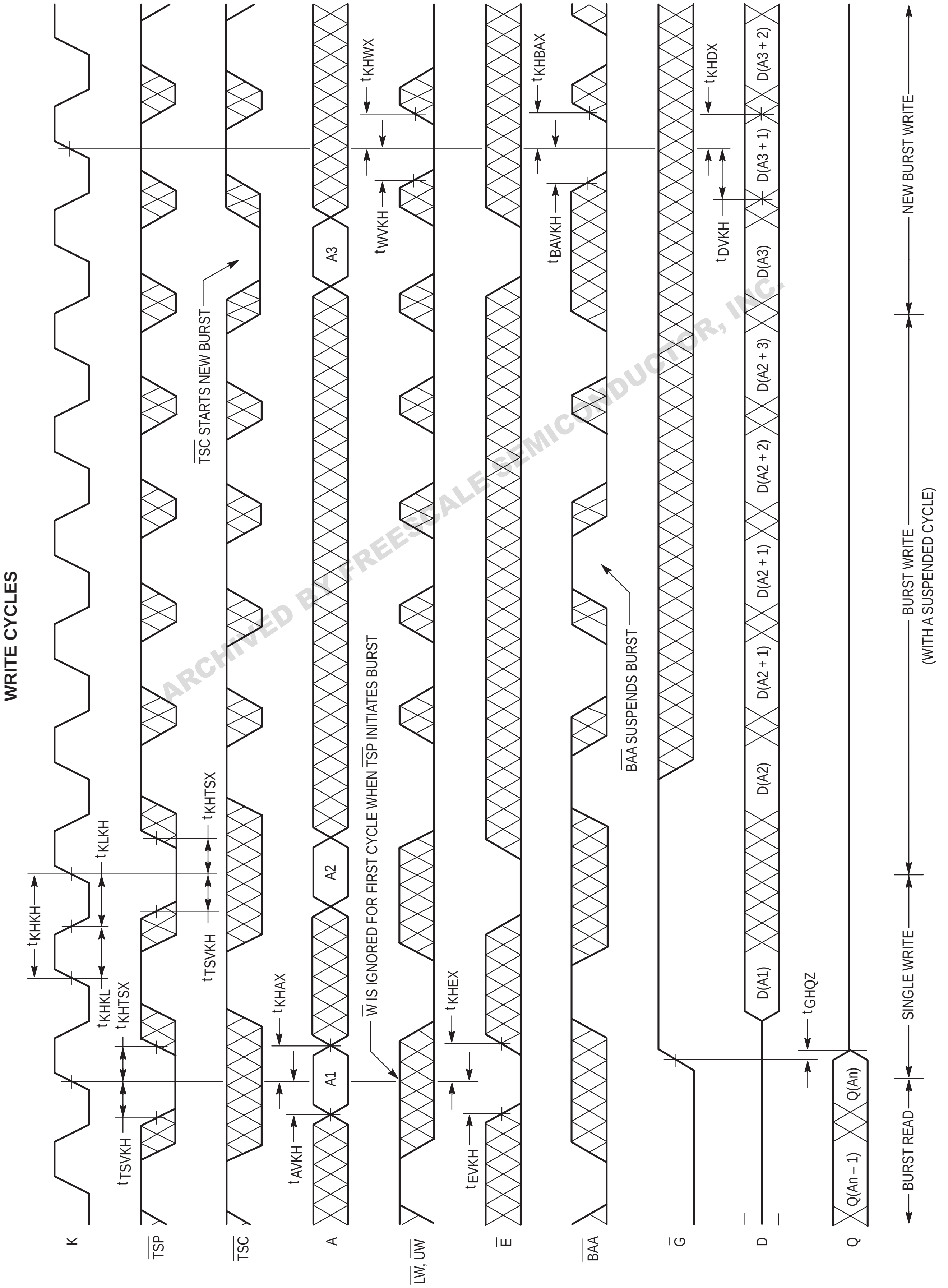
Figure 1. Test Load

READ CYCLES

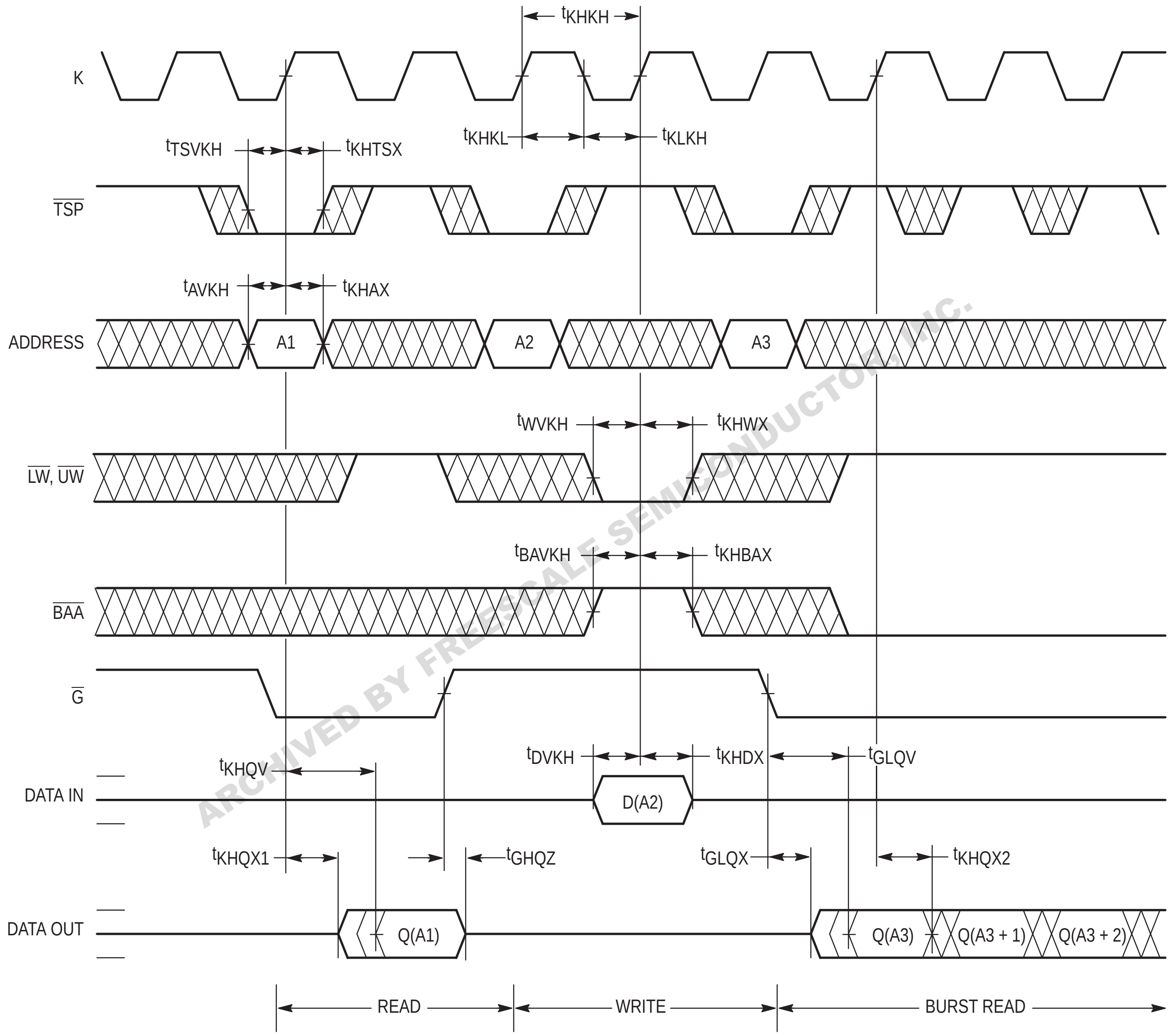

K
TSP
TSC
ADDRESS
LW, UW
E
BAA
G
DATA OUT
t_{KHTSX}
t_{TSVKH}
t_{KHKL}
t_{KHKH}
t_{KLKH}
t_{AVKH}
t_{KHAX}
t_{TSVKH}
t_{KHTSX}
t_{EVKH}
t_{KHEX}
t_{WVKH}
t_{KHWX}
t_{KHBAX}
t_{BAVKH}
t_{GLQX}
t_{KHQV}
t_{GLQV}
t_{GHQZ}
t_{KHQX2}
t_{KHQV}
t_{KHQZ}
A1
A2
Q(A1)
Q(A2)
Q(A2 + 1)
Q(A2 + 2)
Q(A2 + 3)
Q(A2)
Q(A2 + 1)
Q(A2 + 2)
(BAA SUSPENDS BURST)
(BURST WRAPS AROUND TO ITS INITIAL STATE)
SINGLE READ
BURST READ

NOTE: Q(A2) represents the first output data from the base address A2; Q(A2 + 1) represents the next output data in the burst sequence with A2 as the base address.

WRITE CYCLES

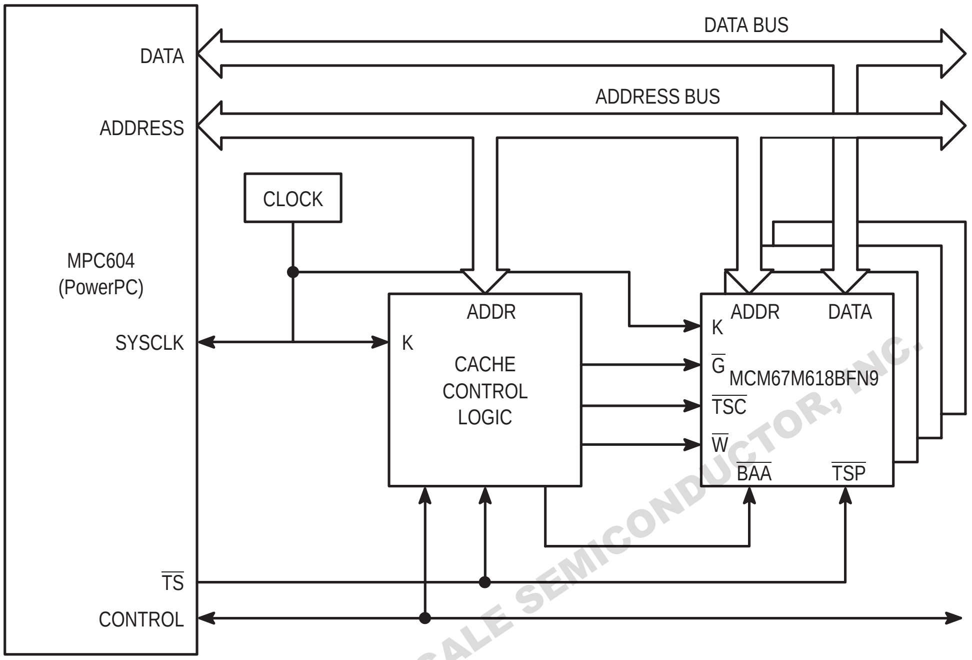

K
TSP
TSC
A
LW, UW
E
BAA
G
D
Q
tKHKH
tKLKH
tKHKL
tKHTSX
tTSVKH
tTSVKH
tKHTSX
tAVKH
tKHAX
tEVKH
tKHEX
tKHWX
tWVKH
tKHBAX
tBAVKH
tKHDX
tDVKH
tGHQZ
A1
A2
A3
W IS IGNORED FOR FIRST CYCLE WHEN TSP INITIATES BURST
TSC STARTS NEW BURST
BAA SUSPENDS BURST
D(A1)
D(A2)
D(A2 + 1)
D(A2 + 1)
D(A2 + 2)
D(A2 + 3)
D(A3)
D(A3 + 1)
D(A3 + 2)
Q(An – 1)
Q(An)
BURST READ
SINGLE WRITE
BURST WRITE
(WITH A SUSPENDED CYCLE)
NEW BURST WRITE

COMBINATION READ/WRITE CYCLE ($\overline{E}$ Low, $\overline{TSC}$ High)



tKHKH
K
tTSVKH
tKHTSX
tKHKL
tKLKH
TSP
tAVKH
tKHAX
ADDRESS
A1
A2
A3
tWVKH
tKHWX
LW, UW
tBAVKH
tKHBAX
BAA
G
tKHQV
tDVKH
tKHDX
tGLQV
DATA IN
D(A2)
tKHQX1
tGHQZ
tGLQX
tKHQX2
DATA OUT
Q(A1)
Q(A3)
Q(A3 + 1)
Q(A3 + 2)
READ
WRITE
BURST READ

APPLICATION EXAMPLE


DATA BUS
ADDRESS BUS
DATA
ADDRESS
MPC604
(PowerPC)
SYSCLK
$\overline{TS}$
CONTROL
CLOCK
ADDR
K
CACHE
CONTROL
LOGIC
ADDR
DATA
K
$\overline{G}$
MCM67M618BFN9
$\overline{TSC}$
$\overline{W}$
$\overline{BAA}$
$\overline{TSP}$

512K Byte Burstable, Secondary Cache
Using Four MCM67M618BFN9s with a 66 MHz MPC604 PowerPC

Figure 2.

ORDERING INFORMATION

(Order by Full Part Number)

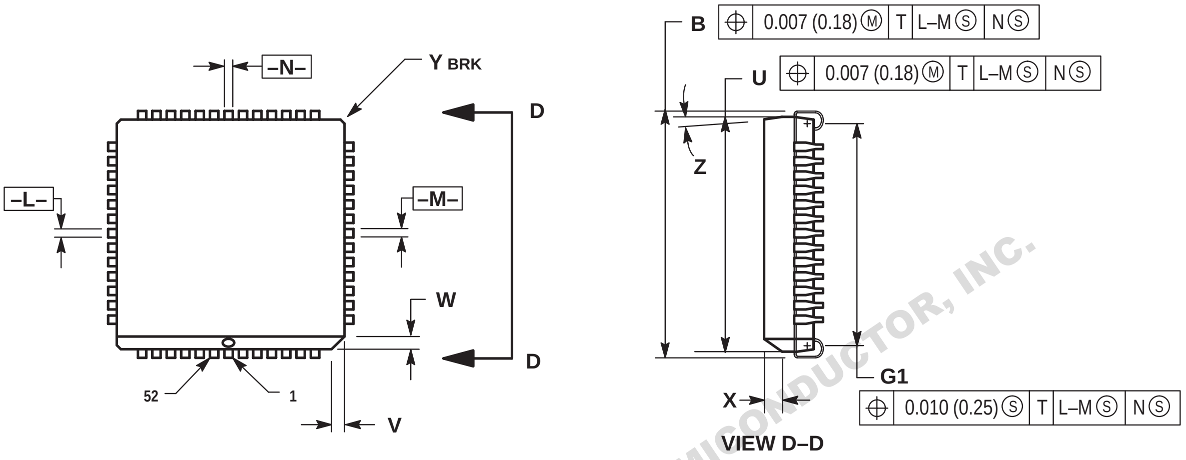
MCM **67M618B** **XX** **XX**

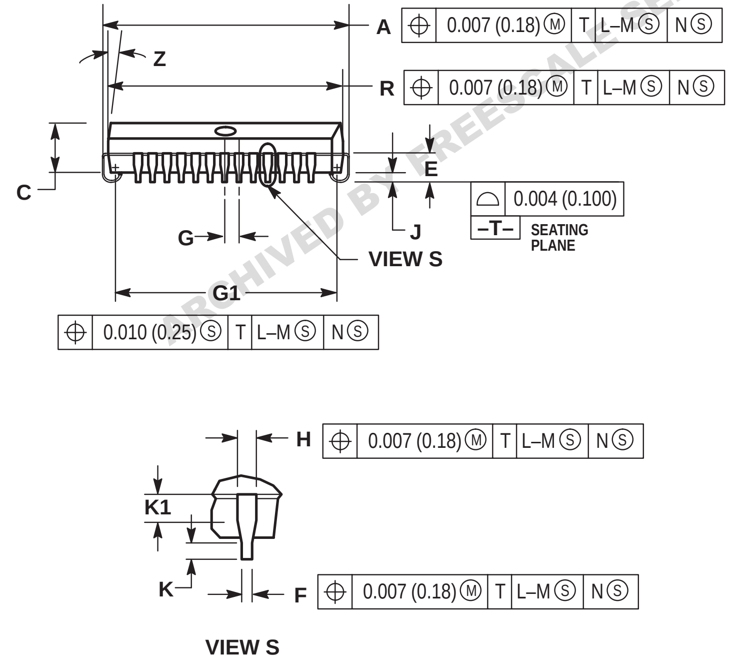
Motorola Memory Prefix — MCM
Part Number — 67M618B
Package (FN = PLCC) — XX
Speed (9 = 9 ns) — XX

Full Part Number — MCM67M618BFN9

PACKAGE DIMENSIONS

FN PACKAGE
52–LEAD PLCC
CASE 778–02


B
0.007 (0.18) Ⓜ T L–M Ⓢ N Ⓢ
U
0.007 (0.18) Ⓜ T L–M Ⓢ N Ⓢ
–N–
Y BRK
D
–L–
–M–
Z
W
D
52
1
V
X
G1
0.010 (0.25) Ⓢ T L–M Ⓢ N Ⓢ
VIEW D–D


A
0.007 (0.18) Ⓜ T L–M Ⓢ N Ⓢ
Z
R
0.007 (0.18) Ⓜ T L–M Ⓢ N Ⓢ
C
E
0.004 (0.100)
–T–
SEATING PLANE
G
J
VIEW S
G1
0.010 (0.25) Ⓢ T L–M Ⓢ N Ⓢ
H
0.007 (0.18) Ⓜ T L–M Ⓢ N Ⓢ
K1
K
F
0.007 (0.18) Ⓜ T L–M Ⓢ N Ⓢ
VIEW S

NOTES:
1. DATUMS –L–, –M–, AND –N– DETERMINED WHERE TOP OF LEAD SHOULDER EXITS PLASTIC BODY AT MOLD PARTING LINE.
2. DIMENSION G1, TRUE POSITION TO BE MEASURED AT DATUM –T–, SEATING PLANE.
3. DIMENSIONS R AND U DO NOT INCLUDE MOLD FLASH. ALLOWABLE MOLD FLASH IS 0.010 (0.250) PER SIDE.
4. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
5. CONTROLLING DIMENSION: INCH.
6. 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.
7. 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).

	INCHES		MILLIMETERS	
DIM	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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