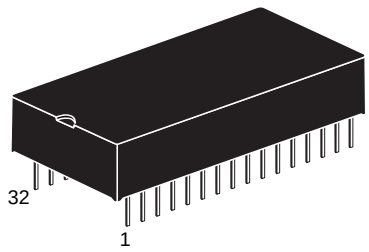
SGS-THOMSON MICROELECTRONICS

M48Z512A
M48Z512AY

4 Mb (512K x 8) ZEROPOWER® SRAM

- INTEGRATED LOW POWER SRAM, POWER-FAIL CONTROL CIRCUIT and BATTERY
- CONVENTIONAL SRAM OPERATION; UNLIMITED WRITE CYCLES
- 10 YEARS of DATA RETENTION in the ABSENCE of POWER
- AUTOMATIC POWER-FAIL CHIP DESELECT and WRITE PROTECTION
- WRITE PROTECT VOLTAGES (V_{PFD} = Power-fail Deselect Voltage):
  - M48Z512A: 4.50V ≤ V_{PFD} ≤ 4.75V
  - M48Z512AY: 4.20V ≤ V_{PFD} ≤ 4.50V
- BATTERY INTERNALLY ISOLATED UNTIL POWER IS APPLIED
- PIN and FUNCTION COMPATIBLE with JEDEC STANDARD 512K x 8 SRAMs



PMDIP32 (PM)
Module

DESCRIPTION

The M48Z512A/512AY ZEROPOWER® RAM is a non-volatile 4,194,304 bit Static RAM organized as 524,288 words by 8 bits. The device combines an internal lithium battery, a CMOS SRAM and a control circuit in a plastic 32 pin DIP Module.

The ZEROPOWER RAM replaces industry standard SRAMs. It provides the nonvolatility of PROMs without any requirement for special write timing or limitations on the number of writes that can be performed.

Table 1. Signal Names

A0-A18	Address Inputs
DQ0-DQ7	Data Inputs / Outputs
$\overline{E}$	Chip Enable
$\overline{G}$	Output Enable
$\overline{W}$	Write Enable
V_{CC}	Supply Voltage
V_{SS}	Ground

Figure 1. Logic Diagram

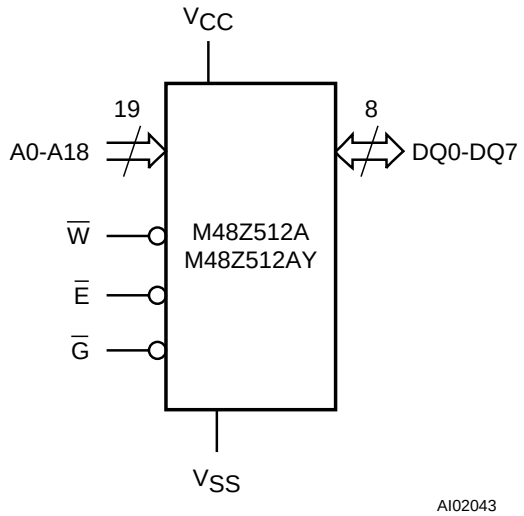


Table 2. Absolute Maximum Ratings (1)

Symbol	Parameter	Value	Unit
T_A	Ambient Operating Temperature	0 to 70	°C
T_{STG}	Storage Temperature (V_{CC} Off)	–40 to 85	°C
T_{BIAS}	Temperature Under Bias	–40 to 85	°C
T_{SLD} (2)	Lead Soldering Temperature for 10 seconds	260	°C
V_{IO}	Input or Output Voltages	–0.3 to 7	V
V_{CC}	Supply Voltage	–0.3 to 7	V

Notes: 1. Stresses greater than 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 conditions above those indicated in the operational section of this specification is not implied. Exposure to the absolute maximum rating conditions for extended periods of time may affect reliability.

2. Soldering temperature not to exceed 260°C for 10 seconds (total thermal budget not to exceed 150°C for longer than 30 seconds).

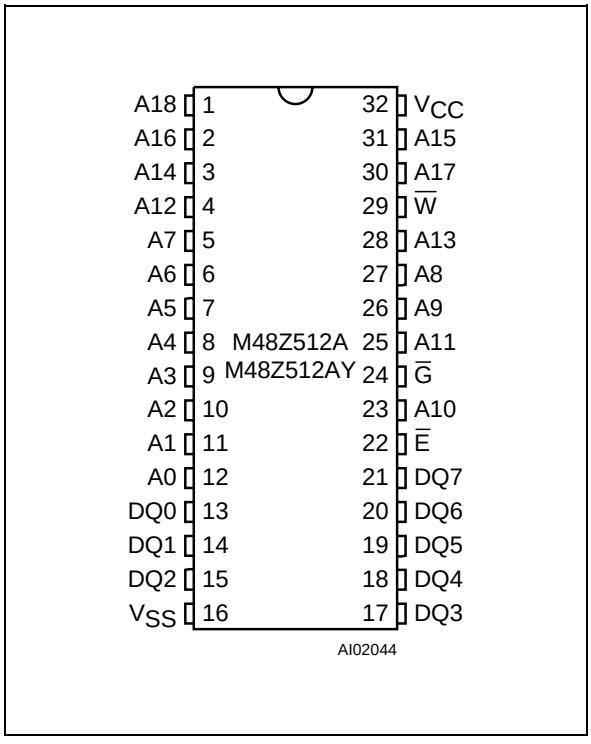
CAUTION: *Negative undershoots below –0.3 volts are not allowed on any pin while in the Battery Back-up mode.*

Table 3. Operating Modes

Mode	V_{CC}	$\overline{E}$	$\overline{G}$	$\overline{W}$	DQ0-DQ7	Power
Deselect	4.75V to 5.5V or 4.5V to 5.5V	V_{IH}	X	X	High Z	Standby
Write		V_{IL}	X	V_{IL}	D_{IN}	Active
Read		V_{IL}	V_{IL}	V_{IH}	D_{OUT}	Active
Read		V_{IL}	V_{IH}	V_{IH}	High Z	Active
Deselect	V_{SO} to V_{PFD} (min)	X	X	X	High Z	CMOS Standby
Deselect	≤ V_{SO}	X	X	X	High Z	Battery Back-up Mode

Notes: X = V_{IH} or V_{IL}; V_{SO} = Battery Back-up Switchover Voltage.

Figure 2. DIP Pin Connections



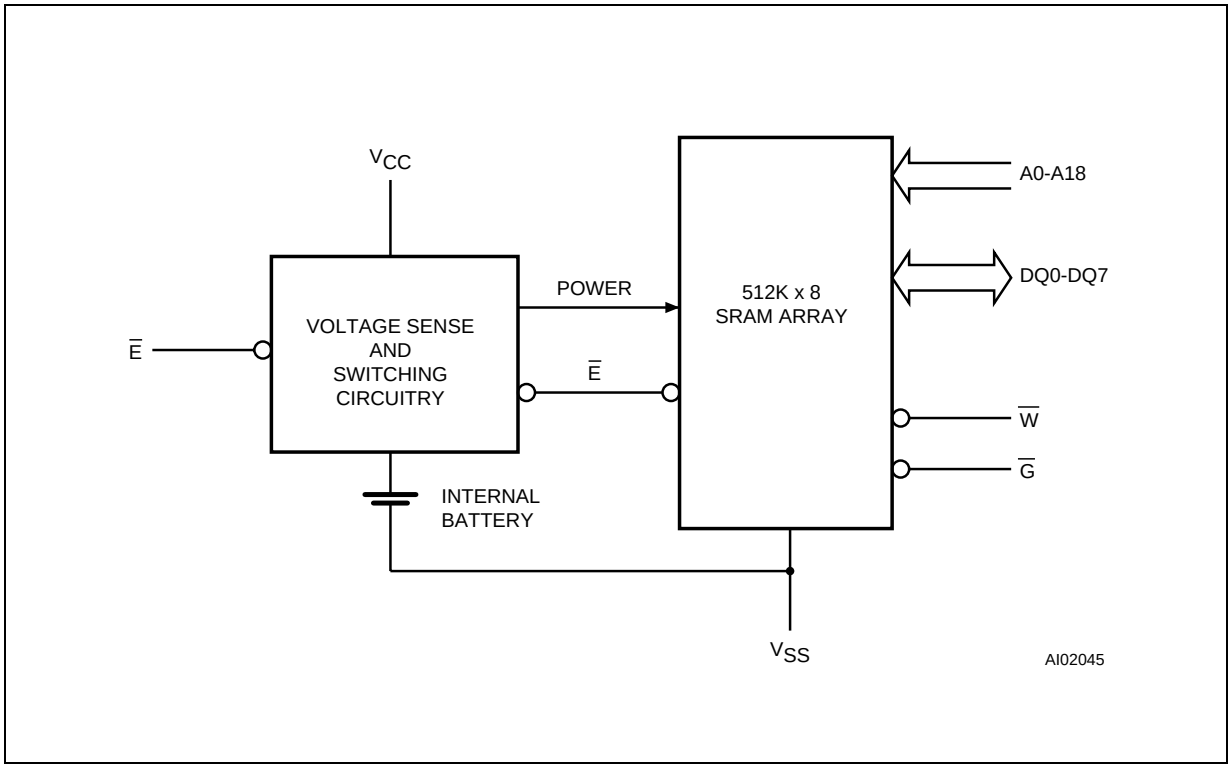
DESCRIPTION (cont'd)

The M48Z512A/512AY has its own Power-fail Detect Circuit. The control circuitry constantly monitors the single 5V supply for an out of tolerance condition. When V_{CC} is out of tolerance, the circuit write protects the SRAM, providing a high degree of data security in the midst of unpredictable system operations brought on by low V_{CC}. As V_{CC} falls below approximately 3V, the control circuitry connects the battery which sustains data until valid power returns.

READ MODE

The M48Z512A/512AY is in the Read Mode whenever $\overline{W}$ (Write Enable) is high and $\overline{E}$ (Chip Enable) is low. The device architecture allows ripple-through access of data from eight of 4,194,304 locations in the static storage array. Thus, the unique address specified by the 19 Address Inputs defines which one of the 524,288 bytes of data is to be accessed. Valid data will be available at the Data I/O pins within Address Access time (t_{AVQV}) after the last address input signal is stable, providing that the $\overline{E}$ (Chip Enable) and $\overline{G}$ (Output Enable) access times are also satisfied. If the $\overline{E}$ and $\overline{G}$ access times are not met, valid data will be avail-

Figure 3. Block Diagram



able after the later of Chip Enable Access time (t_{ELQV}) or Output Enable Access Time (t_{GLQV}). The state of the eight three-state Data I/O signals is controlled by $\overline{E}$ and $\overline{G}$. If the outputs are activated before t_{AVQV}, the data lines will be driven to an indeterminate state until t_{AVQV}. If the Address Inputs are changed while $\overline{E}$ and $\overline{G}$ remain low, output data will remain valid for Output Data Hold time (t_{AXQX}) but will go indeterminate until the next Address Access.

WRITE MODE

The M48Z512A/512AY is in the Write Mode whenever $\overline{W}$ and $\overline{E}$ are active. The start of a write is referenced from the latter occurring falling edge of $\overline{W}$ or $\overline{E}$. A write is terminated by the earlier rising edge of $\overline{W}$ or $\overline{E}$.

The addresses must be held valid throughout the cycle. $\overline{E}$ or $\overline{W}$ must return high for a minimum of t_{EHAX} from $\overline{E}$ or t_{WHAX} from $\overline{W}$ prior to the initiation of another read or write cycle. Data-in must be valid t_{DVEH} or t_{DVWH} prior to the end of write and remain valid for t_{EHDX} or t_{WHDX} afterward. $\overline{G}$ should be kept high during write cycles to avoid bus contention; although, if the output bus has been activated by a low on $\overline{E}$ and $\overline{G}$, a low on $\overline{W}$ will disable the outputs t_{WLQZ} after $\overline{W}$ falls.

Table 4. AC Measurement Conditions

Input Rise and Fall Times	≤ 5ns
Input Pulse Voltages	0 to 3V
Input and Output Timing Ref. Voltages	1.5V

Note that Output Hi-Z is defined as the point where data is no longer driven.

Figure 4. AC Testing Load Circuit

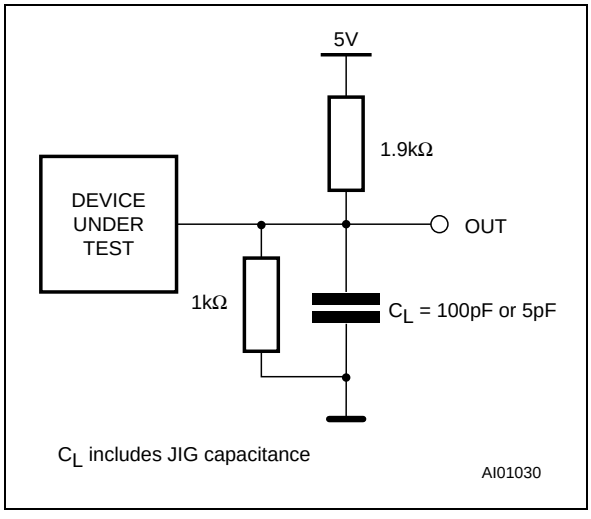


Table 5. Capacitance (1, 2)
(T_A = 25 °C, f = 1 MHz)

Symbol	Parameter	Test Condition	Min	Max	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V		10	pF
C_{IO} (3)	Input / Output Capacitance	V_{OUT} = 0V		10	pF

Notes: 1. Effective capacitance measured with power supply at 5V.
2. Sampled only, not 100% tested.
3. Outputs deselected

Table 6. DC Characteristics
(T_A = 0 to 70°C; V_{CC} = 4.75V to 5.5V or 4.5V to 5.5V)

Symbol	Parameter	Test Condition	Min	Max	Unit
I_{LI} (1)	Input Leakage Current	0V ≤ V_{IN} ≤ V_{CC}		±1	µA
I_{LO} (1)	Output Leakage Current	0V ≤ V_{OUT} ≤ V_{CC}		±1	µA
I_{CC}	Supply Current	$\overline{E}$ = V_{IL}, Outputs open		115	mA
I_{CC1}	Supply Current (Standby) TTL	$\overline{E}$ = V_{IH}		10	mA
I_{CC2}	Supply Current (Standby) CMOS	$\overline{E}$ ≥ V_{CC} – 0.2V		5	mA
V_{IL}	Input Low Voltage		–0.3	0.8	V
V_{IH}	Input High Voltage		2.2	V_{CC} + 0.3	V
V_{OL}	Output Low Voltage	I_{OL} = 2.1mA		0.4	V
V_{OH}	Output High Voltage	I_{OH} = –1mA	2.4		V

Note: 1. Outputs deselected.

Table 7. Power Down/Up Trip Points DC Characteristics (1)
(T_A = 0 to 70°C)

Symbol	Parameter	Min	Typ	Max	Unit
V_{PFD}	Power-fail Deselect Voltage (M48Z512A)	4.5	4.6	4.75	V
V_{PFD}	Power-fail Deselect Voltage (M48Z512AY)	4.2	4.3	4.5	V
V_{SO}	Battery Back-up Switchover Voltage		3		V
t_{DR} (2)	Data Retention Time	10			YEARS

Notes: 1. All voltages referenced to V_{SS}.
2. At 25°C

Table 8. Power Down/Up Mode AC Characteristics
(T_A = 0 to 70°C)

Symbol	Parameter	Min	Max	Unit
t_F (1)	V_{PFD} (max) to V_{PFD} (min) V_{CC} Fall Time	300		µs
t_{FB} (2)	V_{PFD} (min) to V_{SO} V_{CC} Fall Time	10		µs
t_{WP}	Write Protect Time from V_{CC} = V_{PFD}	40	150	µs
t_R	V_{SO} to V_{PFD} (max) V_{CC} Rise Time	0		µs
t_{ER}	$\overline{E}$ Recovery Time	40	120	ms

Notes: 1. V_{PFD} (max) to V_{PFD} (min) fall time of less than t_F may result in deselection/write protection not occurring until 200 µs after V_{CC} passes V_{PFD} (min).
2. V_{PFD} (min) to V_{SO} fall time of less than t_{FB} may cause corruption of RAM data.

Figure 5. Power Down/Up Mode AC Waveforms

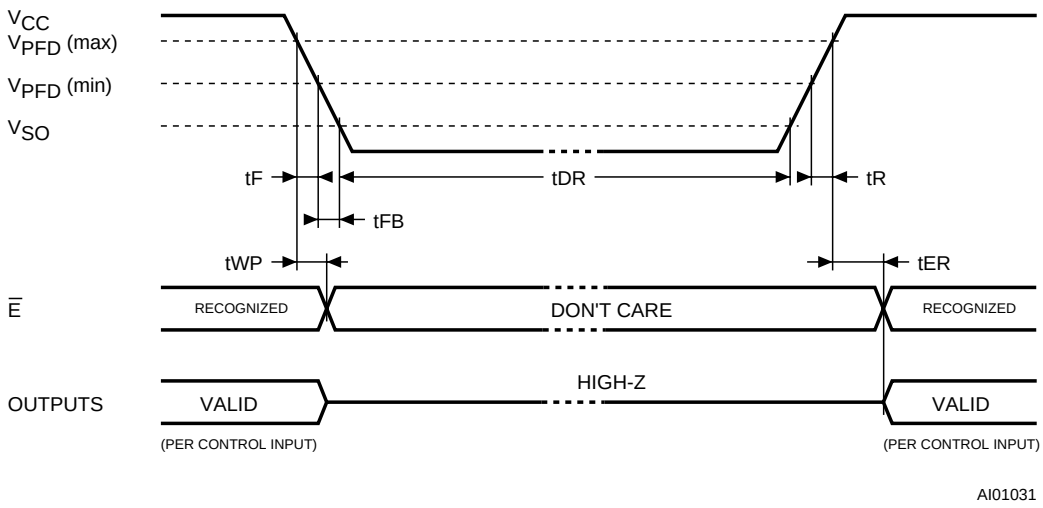
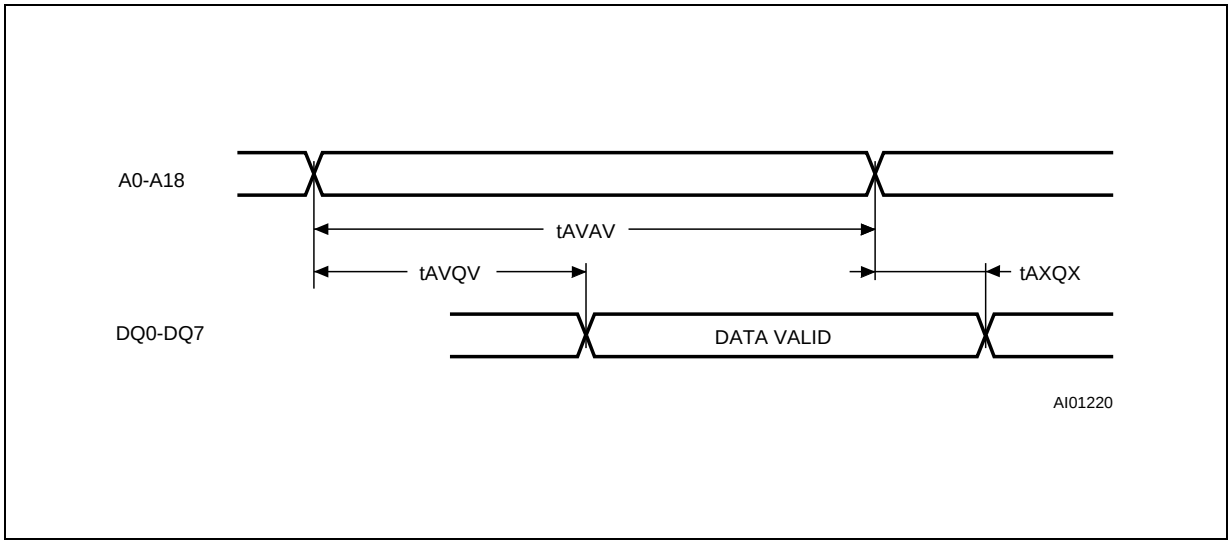


Table 9. Read Mode AC Characteristics
(T_A = 0 to 70°C; V_{CC} = 4.75V to 5.5V or 4.5V to 5.5V)

Symbol	Parameter	M48Z512A / M48Z512AY				Unit
		-70		-85		
		Min	Max	Min	Max	
t_{AVAV}	Read Cycle Time	70		85		ns
t_{AVQV} (1)	Address Valid to Output Valid		70		85	ns
t_{ELQV} (1)	Chip Enable Low to Output Valid		70		85	ns
t_{GLQV} (1)	Output Enable Low to Output Valid		35		45	ns
t_{ELQX} (2)	Chip Enable Low to Output Transition	5		5		ns
t_{GLQX} (2)	Output Enable Low to Output Transition	5		5		ns
t_{EHQZ} (2)	Chip Enable High to Output Hi-Z		30		35	ns
t_{GHQZ} (2)	Output Enable High to Output Hi-Z		20		25	ns
t_{AXQX} (1)	Address Transition to Output Transition	5		5		ns

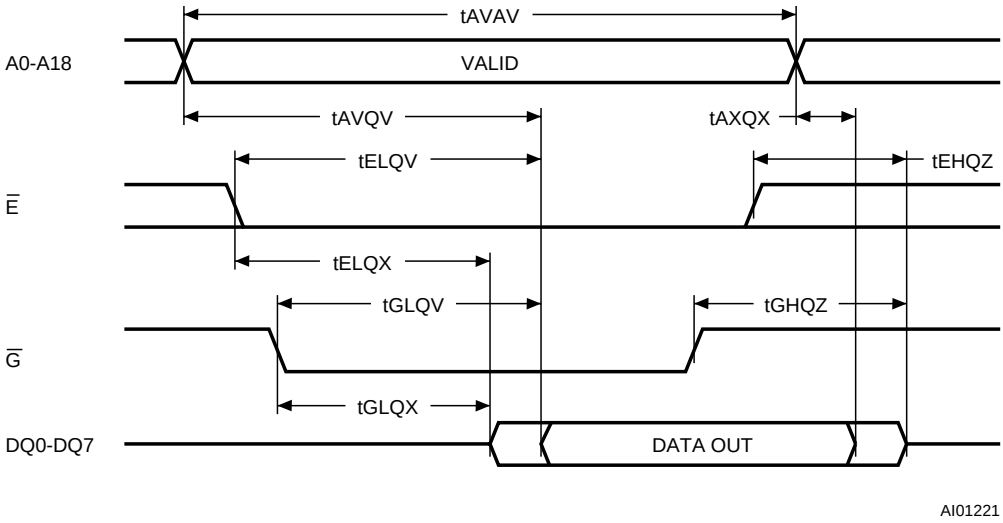
Notes: 1. C_L = 100pF (see Figure 4).
2. C_L = 5pF (see Figure 4)

Figure 6. Address Controlled, Read Mode AC Waveforms



Note: Chip Enable ($\overline{E}$) and Output Enable ($\overline{G}$) = Low, Write Enable ($\overline{W}$) = High.

Figure 7. Chip Enable or Output Enable Controlled, Read Mode AC Waveforms



Note: Write Enable ($\overline{W}$) = High.

DATA RETENTION MODE

With valid V_{CC} applied, the M48Z512A/512AY operates as a conventional BYTEWIDE™ static RAM. Should the supply voltage decay, the RAM will automatically power-fail deselect, write protecting itself t_{WP} after V_{CC} falls below V_{PFD}. All outputs become high impedance, and all inputs are treated as "don't care."

If power fail detection occurs during a valid access, the memory cycle continues to completion. If the memory cycle fails to terminate within the time t_{WP}, write protection takes place. When V_{CC} drops below V_{SO}, the control circuit switches power to the internal energy source which preserves data.

The internal coin cell will maintain data in the M48Z512A/512AY after the initial application of V_{CC} for an accumulated period of at least 10 years when V_{CC} is less than V_{SO}. As system power returns and V_{CC} rises above V_{SO}, the battery is disconnected, and the power supply is switched to external Vcc. Write protection continues for t_{ER} after V_{CC} reaches V_{PFD} to allow for processor stabilization. After t_{ER}, normal RAM operation can resume.

For more information on Battery Storage Life refer to the Application Note AN1012

Table 10. Write Mode AC Characteristics
(T_A = 0 to 70°C; V_{CC} = 4.75V to 5.5V or 4.5V to 5.5V)

Symbol	Parameter	M48Z512A / M48Z512AY				Unit
		-70		-85		
		Min	Max	Min	Max	
t_{AVAV}	Write Cycle Time	70		85		ns
t_{AVWL}	Address Valid to Write Enable Low	0		0		ns
t_{AVEL}	Address Valid to Chip Enable Low	0		0		ns
t_{WLWH}	Write Enable Pulse Width	55		65		ns
t_{ELEH}	Chip Enable Low to Chip Enable High	55		75		ns
t_{WHAX}	Write Enable High to Address Transition	5		5		ns
t_{EHAX}	Chip Enable High to Address Transition	15		15		ns
t_{DVWH}	Input Valid to Write Enable High	30		35		ns
t_{DVEH}	Input Valid to Chip Enable High	30		35		ns
t_{WHDX}	Write Enable High to Input Transition	0		0		ns
t_{EHDX}	Chip Enable High to Input Transition	10		10		ns
t_{WLQZ} (1,2)	Write Enable Low to Output Hi-Z		25		30	ns
t_{AVWH}	Address Valid to Write Enable High	65		75		ns
t_{AVEH}	Address Valid to Chip Enable High	65		75		ns
t_{WHQX} (1,2)	Write Enable High to Output Transition	5		5		ns

Notes: 1. C_L= 5pF (see Figure 4).
2. If E goes low simultaneously with $\overline{W}$ going low, the outputs remain in the high-impedance state.

POWER SUPPLY DECOUPLING and UNDER-SHOOT PROTECTION

I_{CC} transients, including those produced by output switching, can produce voltage fluctuations, resulting in spikes on the V_{CC} bus. These transients can be reduced if capacitors are used to store energy, which stabilizes the V_{CC} bus. The energy stored in the bypass capacitors will be released as low going spikes are generated or energy will be absorbed when overshoots occur. A ceramic bypass capacitor value of 0.1µF (as shown in Figure 8) is recommended in order to provide the needed filtering.

In addition to transients that are caused by normal SRAM operation, power cycling can generate negative voltage spikes on V_{CC} that drive it to values below V_{SS} by as much as one Volt. These negative spikes can cause data corruption in the SRAM while in battery backup mode. To protect from these voltage spikes, it is recommeded to connect a schottky diode from V_{CC} to V_{SS} (cathode connected to V_{CC}, anode to V_{SS}). Schottky diode 1N5817 is recommended for through hole and MBRS120T3 is recommended for surface mount.

Figure 8. Supply Voltage Protection

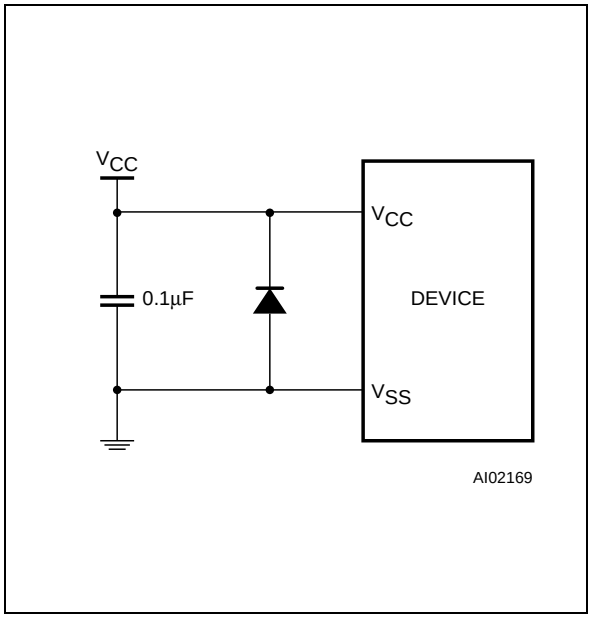
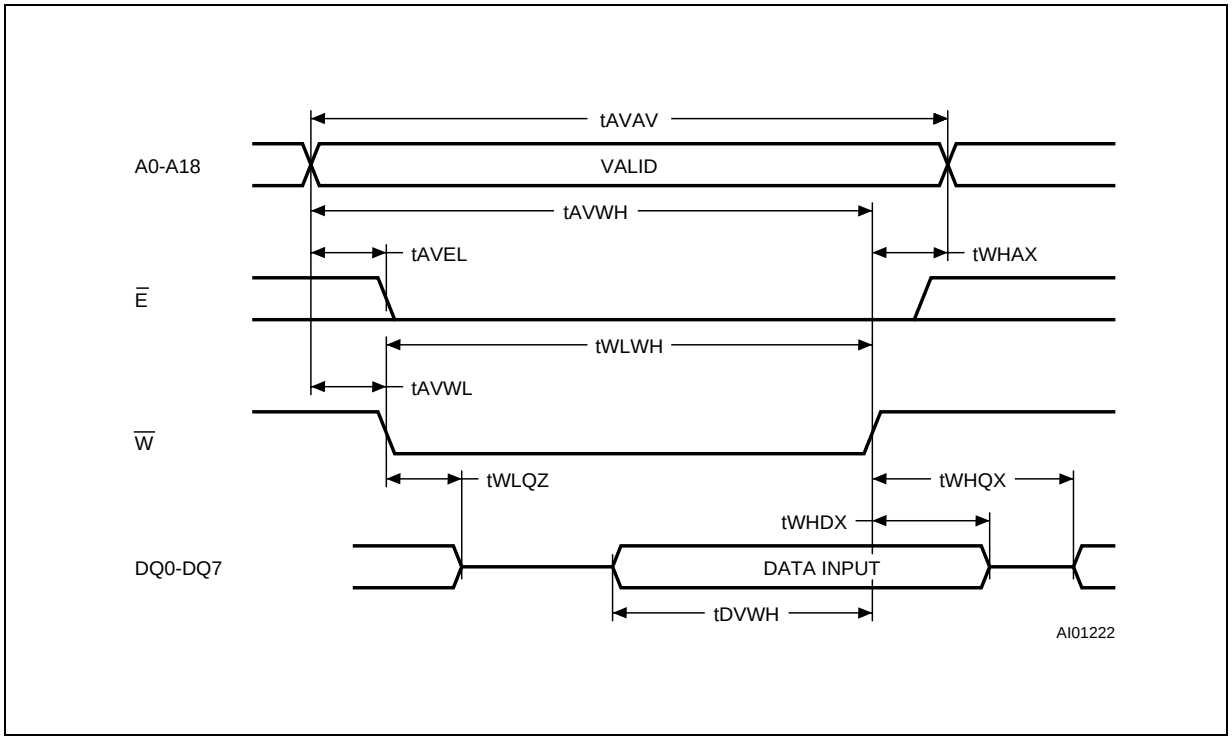
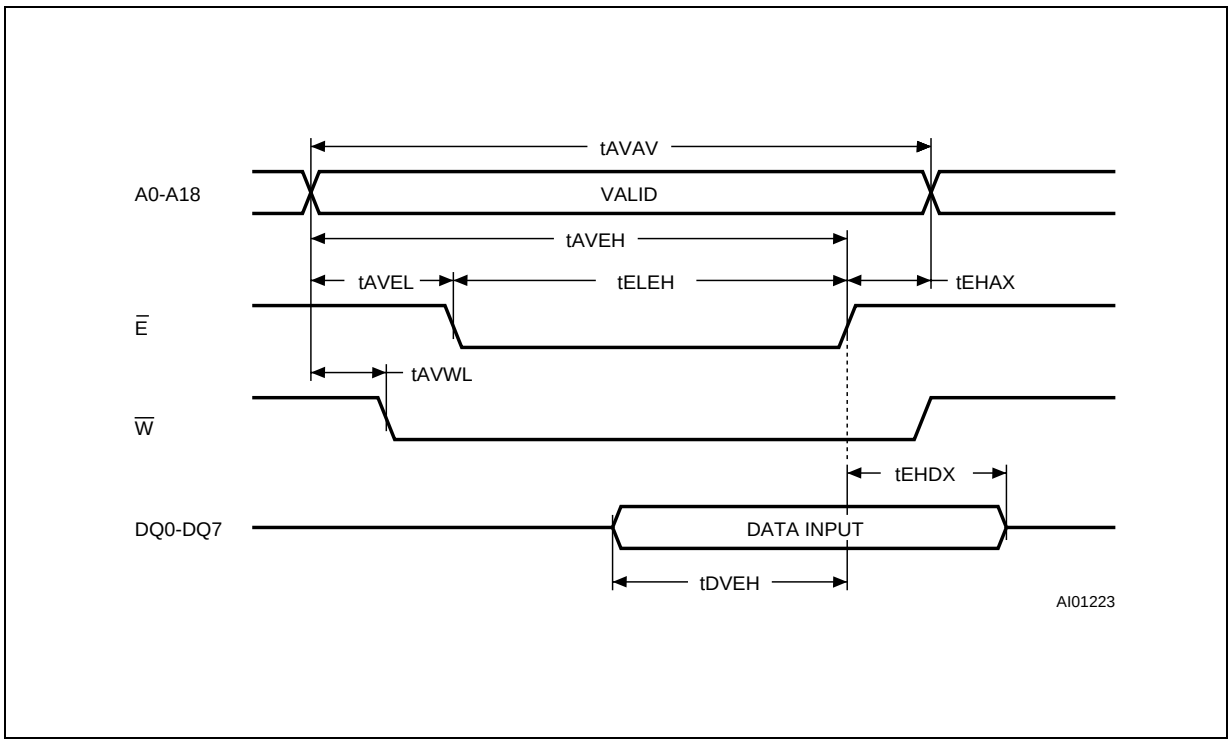


Figure 9. Write Enable Controlled, Write AC Waveforms



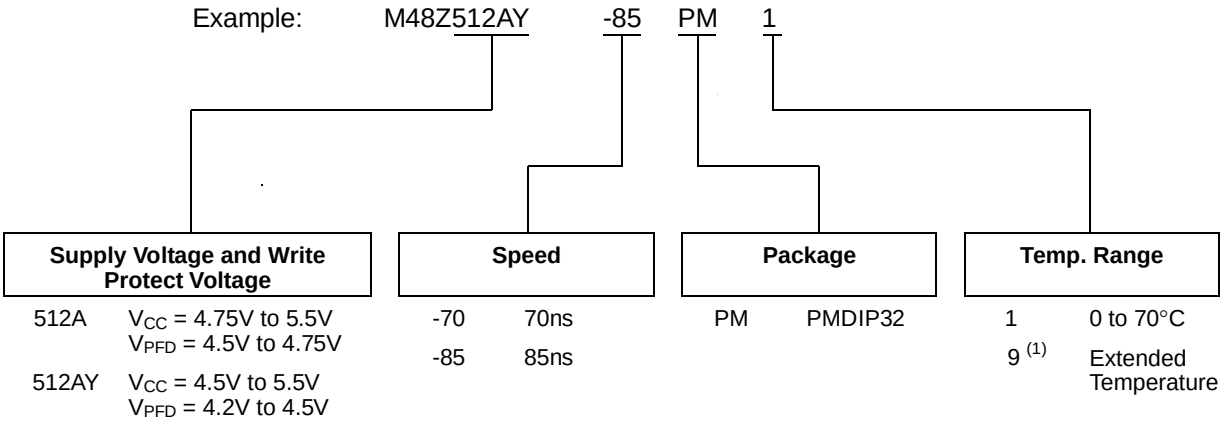
Note: Output Enable ($\overline{G}$) = High.

Figure 10. Chip Enable Controlled, Write AC Waveforms



Note: Output Enable ($\overline{G}$) = High.

ORDERING INFORMATION SCHEME



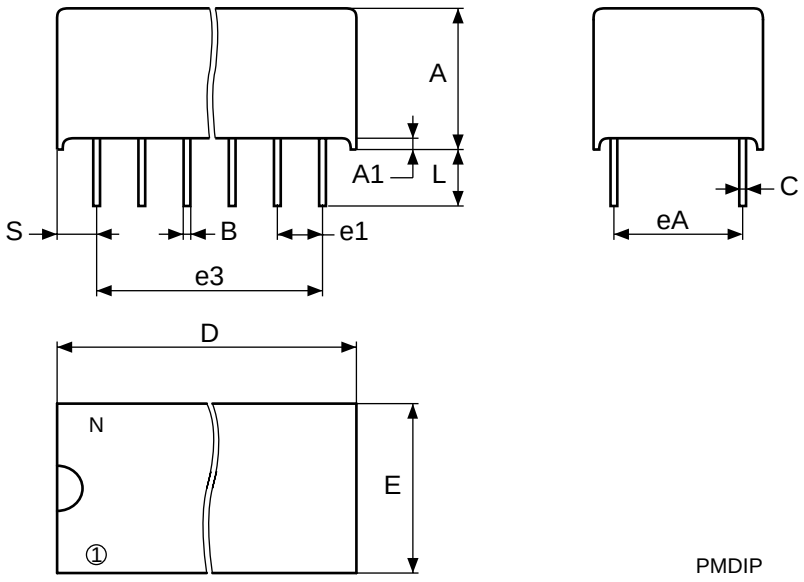
Note: 1. Contact Sales Offices for availability of Extended Temperature.

For a list of available options (Speed, Package, etc.) or for further information or any aspect of this device, please contact the SGS-THOMSON Sales Office nearest to you.

PMDIP32 - 32 pin Plastic DIP Module

Symb	mm			inches		
	Typ	Min	Max	Typ	Min	Max
A		9.27	9.52		0.365	0.375
A1		0.38	–		0.015	–
B		0.43	0.59		0.017	0.023
C		0.20	0.33		0.008	0.013
D		42.42	43.18		1.670	1.700
E		18.03	18.80		0.710	0.740
e1		2.30	2.81		0.090	0.110
e3		34.43	42.08		1.355	1.656
eA		14.99	16.00		0.590	0.630
L		3.05	3.81		0.120	0.150
S		1.91	2.79		0.075	0.110
N	32			32		

PMDIP32



PMDIP

Drawing is not to scale.