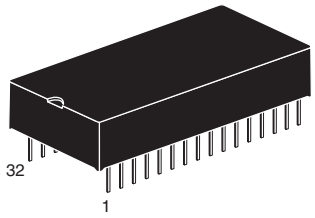
M48Z128
M48Z128Y, M48Z128V

5.0 V or 3.3 V, 1 Mbit (128 Kbit x 8) ZEROPOWER® SRAM

Features

- Integrated, ultra 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
- Battery internally isolated until power is first applied
- Automatic power-fail chip deselect and WRITE protection
- WRITE protect voltages:
  (V_{PFD} = power-fail deselect voltage)
  - M48Z128: V_{CC} = 4.75 to 5.5 V
    4.5 V ≤ V_{PFD} ≤ 4.75 V
  - M48Z128Y: V_{CC} = 4.5 to 5.5 V
    4.2 V ≤ V_{PFD} ≤ 4.5 V
  - M48Z128V: V_{CC} = 3.0 to 3.6 V
    2.8 V ≤ V_{PFD} ≤ 3.0 V
    (contact ST sales office for availability)
- Pin and function compatible with JEDEC standard 128 K x 8 SRAMs
- RoHS compliant
  - Lead-free second level interconnect



PMDIP32 module (PM)

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1 Description

The M48Z128/Y/V ZEROPOWER® RAM is a 128 Kbit x 8 non-volatile static RAM organized as131,072 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 to provide a highly integrated battery-backed memory solution.

The M48Z128/Y/V is a non-volatile pin and function equivalent to any JEDEC standard 128 K x 8 SRAM. It also easily fits into many ROM, EPROM, and EEPROM sockets, providing the non-volatility of PROMs without any requirement for special WRITE timing or limitations on the number of WRITEs that can be performed. The 32-pin, 600 mil DIP module houses the M48Z128/Y/V silicon with a long-life lithium button cell in a single package.

Figure 1. Logic diagram

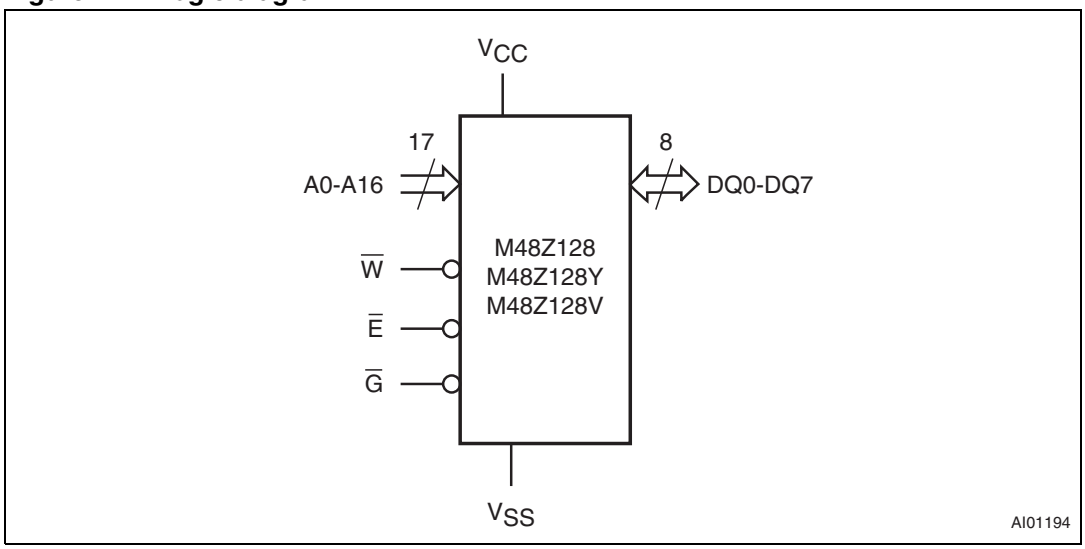


Table 1. Signal names

A0-A16	Address inputs
DQ0-DQ7	Data inputs / outputs
$\overline{E}$	Chip enable input
$\overline{G}$	Output enable input
$\overline{W}$	WRITE enable input
V_{CC}	Supply voltage
V_{SS}	Ground
NC	Not connected internally

Figure 2. DIP connections

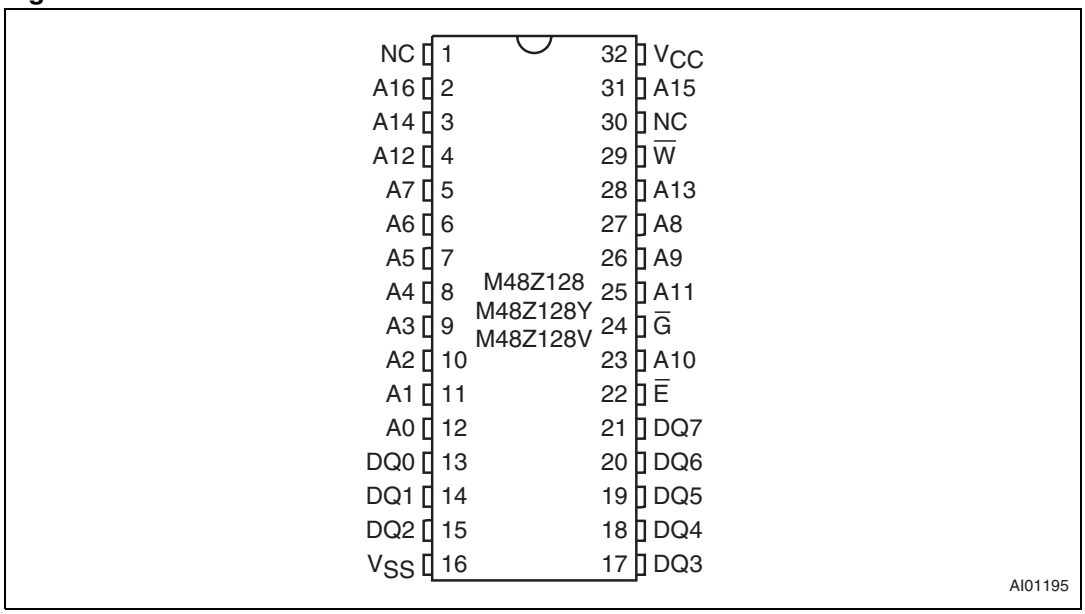
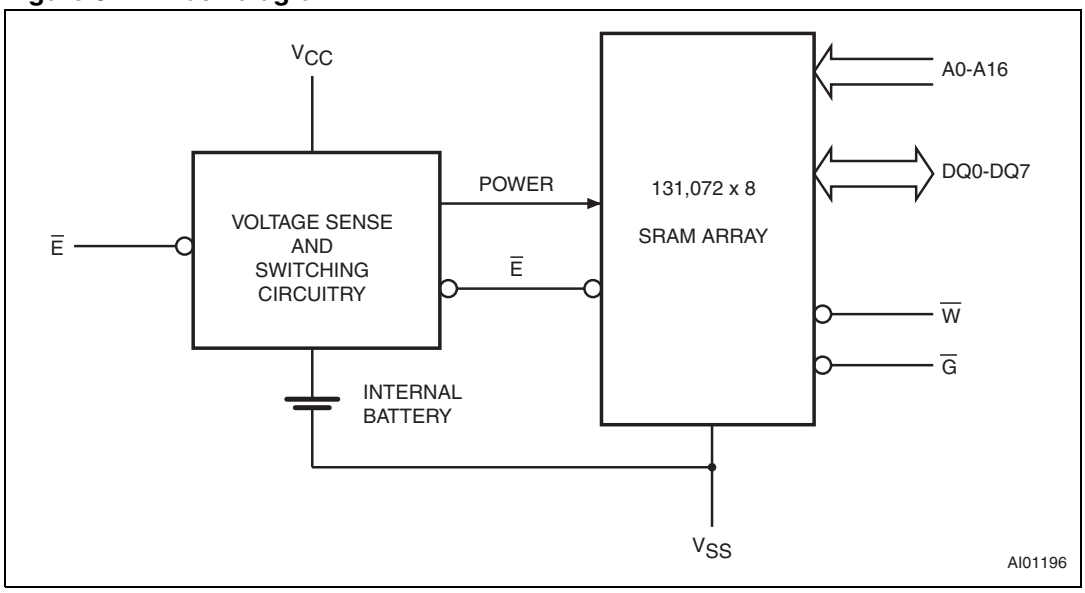


Figure 3. Block diagram



2 Operating modes

The M48Z128/Y/V also has its own power-fail detect circuit. The control circuitry constantly monitors the single V_{CC} 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 operation brought on by low V_{CC}. As V_{CC} falls below the switchover voltage (V_{SO}), the control circuitry connects the battery which maintains data until valid power returns.

Table 2. Operating modes

Mode	V_{CC}	$\overline{E}$	$\overline{G}$	$\overline{W}$	DQ0-DQ7	Power
Deselect	4.75 to 5.5 V or 4.5 to 5.5 V or 3.0 to 3.6 V	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)(1)	X	X	X	High Z	CMOS standby
Deselect	$\leq V_{SO}$(1)	X	X	X	High Z	Battery backup mode

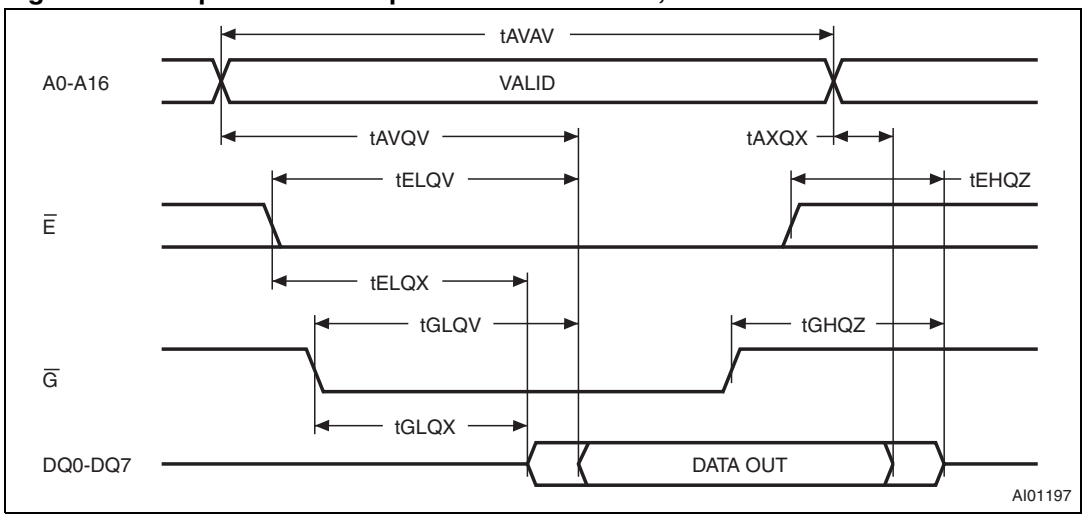
1. See *Table 10 on page 15* for details.

Note: X = V_{IH} or V_{IL}; V_{SO} = battery backup switchover voltage.

2.1 READ mode

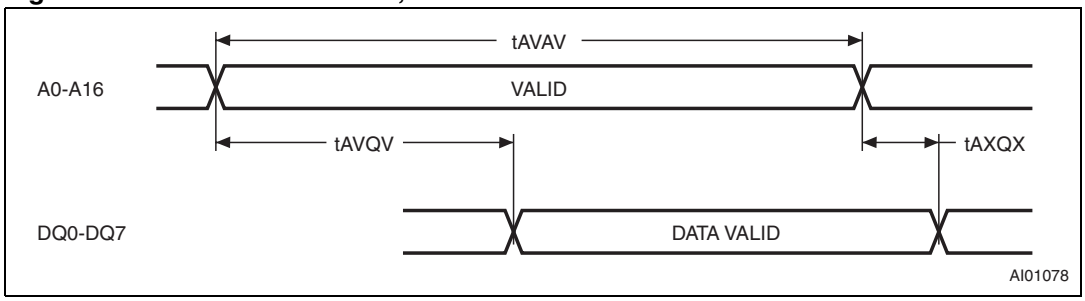
The M48Z128/Y/V is in the READ mode whenever $\overline{W}$ (WRITE enable) is high and $\overline{E}$ (chip enable) is low. The device architecture allows ripple-through access of data from eight of 1,048,576 locations in the static storage array. Thus, the unique address specified by the 17 address inputs defines which one of the 131,072 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 $\overline{E}$ 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 available 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.

Figure 4. Chip enable or output enable controlled, READ mode AC waveforms



Note: WRITE enable ($\overline{W}$) = high.

Figure 5. Address controlled, READ mode AC waveforms



Note: Chip enable ($\overline{E}$) and output enable ($\overline{G}$) = low, WRITE enable ($\overline{W}$) = high.

Table 3. READ mode AC characteristics

Symbol	Parameter[1]	M48Z128/Y		M48Z128/Y/V		M48Z128/Y/V		Unit
		–70		–85		–120		
		Min	Max	Min	Max	Min	Max	
t_{AVAV}	READ cycle time	70		85		120		ns
t_{AVQV}	Address valid to output valid		70		85		120	ns
t_{ELQV}	Chip enable low to output valid		70		85		120	ns
t_{GLQV}	Output enable low to output valid		35		45		60	ns
t_{ELQX}[2]	Chip enable low to output transition	5		5		5		ns
t_{GLQX}[2]	Output enable low to output transition	3		3		3		ns
t_{EHQZ}[2]	Chip enable high to output Hi-Z		30		35		45	ns
t_{GHQZ}[2]	Output enable high to output Hi-Z		20		25		35	ns
t_{AXQX}	Address transition to output transition	5		5		10		ns

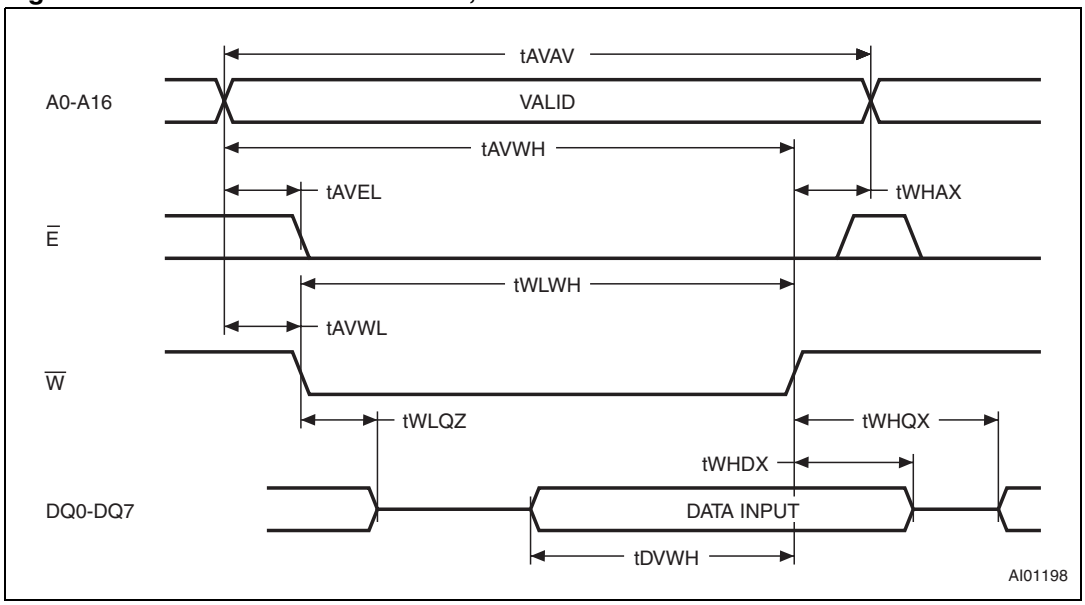
1. Valid for ambient operating temperature: T_A = 0 to 70 °C; V_{CC} = 4.75 to 5.5 V, 4.5 to 5.5 V, or 3.0 to 3.6 V (except where noted).
2. C_L = 5 pF.

2.2 WRITE mode

The M48Z128/Y/V 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 $\overline{E}$.

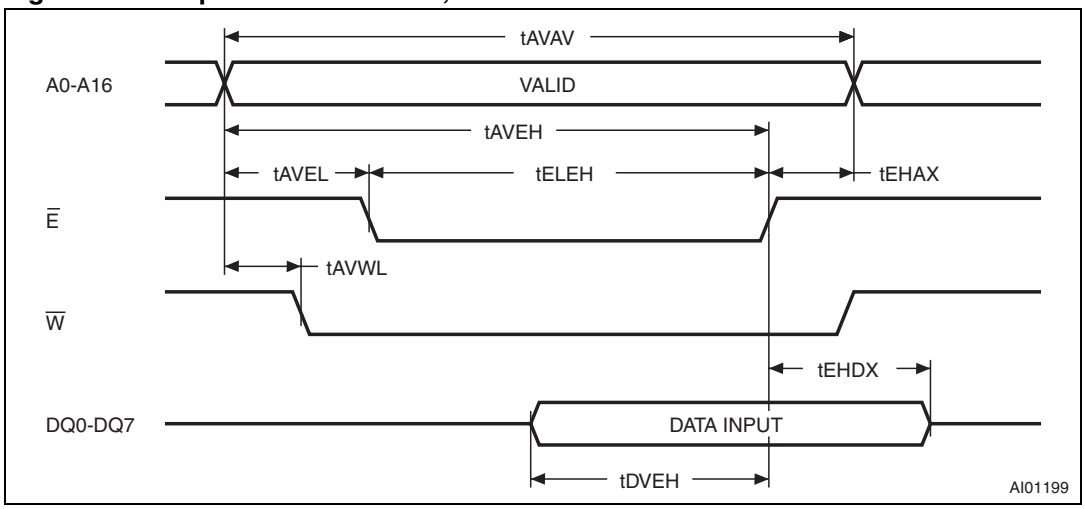
The addresses must be held valid throughout the cycle. $\overline{E}$ or $\overline{W}$ must return high for minimum of t_{EHAX} from $\overline{E}$ or t_{WHAX} from $\overline{W}$ prior to the initiation of another READ or WRITE cycle. Data-in must be valid t_{DVWH} prior to the end of WRITE and remain valid for t_{WHDX} or t_{EHDX} 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.

Figure 6. WRITE enable controlled, WRITE AC waveforms



Note: Output enable ($\overline{G}$) = high.

Figure 7. Chip enable controlled, WRITE AC waveforms



Note: Output enable ($\overline{G}$) = high.

Table 4. WRITE mode AC characteristics

Symbol	Parameter[1]	M48Z128/Y		M48Z128/Y/V		M48Z128/Y/V		Unit
		–70		–85		–120		
		Min	Max	Min	Max	Min	Max	
t_{AVAV}	WRITE cycle time	70		85		120		ns
t_{AVWL}	Address valid to WRITE enable Low	0		0		0		ns
t_{AVEL}	Address valid to chip enable low	0		0		0		ns
t_{WLWH}	WRITE enable pulse width	55		65		85		ns
t_{ELEH}	Chip enable low to chip enable high	55		75		100		ns
t_{WHAX}	WRITE enable high to address transition	5		5		5		ns
t_{EHAX}	Chip enable high to address transition	15		15		15		ns
t_{DVWH}	Input valid to WRITE enable high	30		35		45		ns
t_{DVEH}	Input valid to chip enable high	30		35		45		ns
t_{WHDX}	WRITE enable high to input transition	0		0		0		ns
t_{EHDX}	Chip enable high to input transition	10		10		10		ns
t_{WLQZ}[2][3]	WRITE enable low to output Hi-Z		25		30		40	ns
t_{AVWH}	Address valid to WRITE enable high	65		75		100		ns
t_{AVEH}	Address valid to chip enable high	65		75		100		ns
t_{WHQX}[2][3]	WRITE enable high to output transition	5		5		5		ns

1. Valid for ambient operating temperature: T_A = 0 to 70 °C; V_{CC} = 4.75 to 5.5 V, 4.5 to 5.5 V or 3.0 to 3.6 V (except where noted).
2. C_L = 5 pF.
3. If $\overline{E}$ goes low simultaneously with $\overline{W}$ going low, the outputs remain in the high impedance state.

2.3 Data retention mode

With valid V_{CC} applied, the M48Z128/Y/V 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 M48Z128/Y/V 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 V_{CC}. 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.

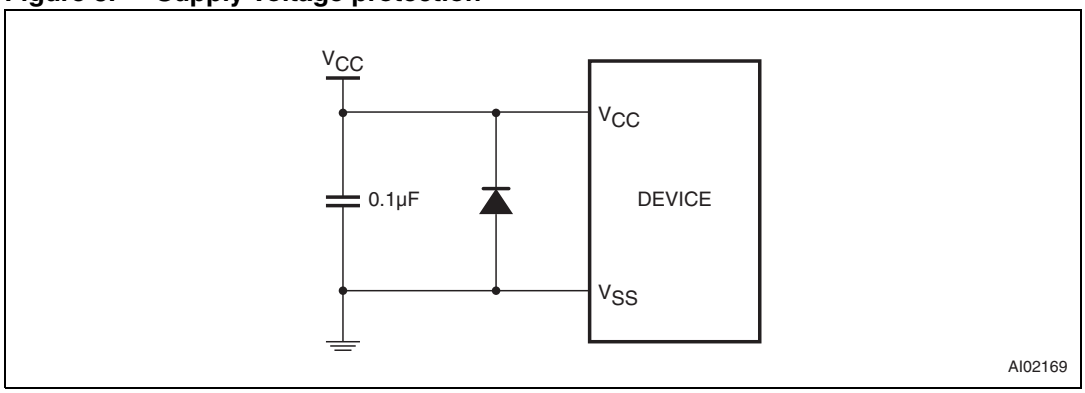
For more information on battery storage life refer to the application note AN1012.

2.4 V_{CC} noise and negative going transients

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 0.1 µF (see *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, ST recommends connecting 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



3 Maximum ratings

Stressing the device above the rating listed in the absolute maximum ratings table may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 5. Absolute maximum ratings

Symbol	Parameter		Value	Unit
T_A	Ambient operating temperature		0 to 70	°C
T_{STG}	Storage temperature (V_{CC} off, oscillator off)		–40 to 85	°C
T_{BIAS}	Temperature under bias		–10 to 70	°C
T_{SLD}(1)	Lead solder temperature for 10 seconds		260	°C
V_{IO}	Input or output voltages		–0.3 to 7	V
V_{CC}	Supply voltage	M48Z128/Y	–0.3 to 7.0	V
		M48Z128V	–0.3 to 4.6	V
I_O	Output current		20	mA
P_D	Power dissipation		1	W

1. Soldering temperature of the IC leads is to not exceed 260 °C for 10 seconds. In order to protect the lithium battery, preheat temperatures must be limited such that the battery temperature does not exceed +85 °C. Furthermore, the devices shall not be exposed to IR reflow.

Caution: *Negative undershoots below –0.3 V are not allowed on any pin while in the battery backup mode.*

4 DC and AC parameters

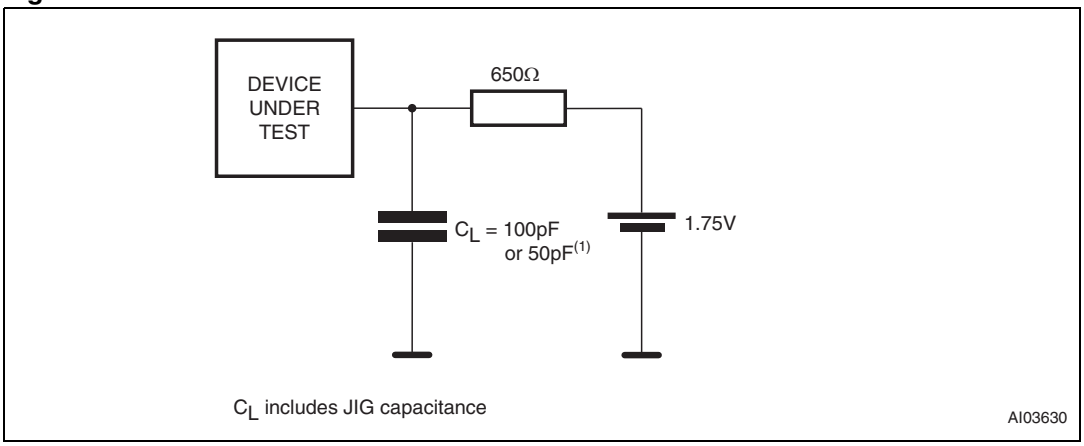
This section summarizes the operating and measurement conditions, as well as the DC and AC characteristics of the device. The parameters in the following DC and AC characteristic tables are derived from tests performed under the measurement conditions listed in the relevant tables. Designers should check that the operating conditions in their projects match the measurement conditions when using the quoted parameters.

Table 6. Operating and AC measurement conditions

Parameter	M48Z128/Y	M48Z128V	Unit
Supply voltage (V_{CC})	4.75 to 5.5 V or 4.5 to 5.5	3.0 to 3.6	V
Ambient operating temperature (T_A)	0 to 70	0 to 70	°C
Load capacitance (C_L)	100	50	pF
Input rise and fall times	≤ 5	≤ 5	ns
Input pulse voltages	0 to 3	0 to 3	V
Input and output timing ref. voltages	1.5	1.5	V

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

Figure 9. AC measurement load circuit



1. 50 pF for M48Z128V (3.3 V).

Table 7. Capacitance

Symbol	Parameter(1)(2)	Min	Max	Unit
C_{IN}	Input capacitance	-	10	pF
C_{IO}(3)	Input / output capacitance	-	10	pF

1. Effective capacitance measured with power supply at 5 V (M48Z128/Y) or 3.3 V (M48Z128V); sampled only, not 100% tested.
2. At 25 °C, f = 1 MHz.
3. Outputs deselected.

Table 8. DC characteristics

Sym	Parameter	Test condition(1)	M48Z128/Y		M48Z128V		Unit
			–70 / –85 / –120		–85 / –120		
			Min	Max	Min	Max	
I_{LI}	Input leakage current	$0 V \le V_{IN} \le V_{CC}$		±1		±1	µA
I_{LO}(2)	Output leakage current	$0 V \le V_{OUT} \le V_{CC}$		±1		±1	µA
I_{CC}	Supply current	$\overline{E} = V_{IL}$ Outputs open		105		50	mA
I_{CC1}	Supply current (standby) TTL	$\overline{E} = V_{IH}$		7		4	mA
I_{CC2}	Supply current (standby) CMOS	$\overline{E} = V_{CC} - 0.2 V$		4		3	mA
V_{IL}	Input low voltage		–0.3	0.8	–0.3	0.6	V
V_{IH}	Input high voltage		2.2	V_{CC} + 0.3	2.2	V_{CC} + 0.3	V
V_{OL}	Output low voltage	I_{OL} = 2.1 mA		0.4		0.4	V
V_{OH}	Output high voltage	I_{OH} = –1 mA	2.4		2.2		V

1. Valid for ambient operating temperature: T_A = 0 to 70 °C; V_{CC} = 4.75 to 5.5 V, 4.5 to 5.5 V, or 3.0 to 3.6 V (except where noted).
2. Outputs deselected.

Figure 10. Power down/up mode AC waveforms

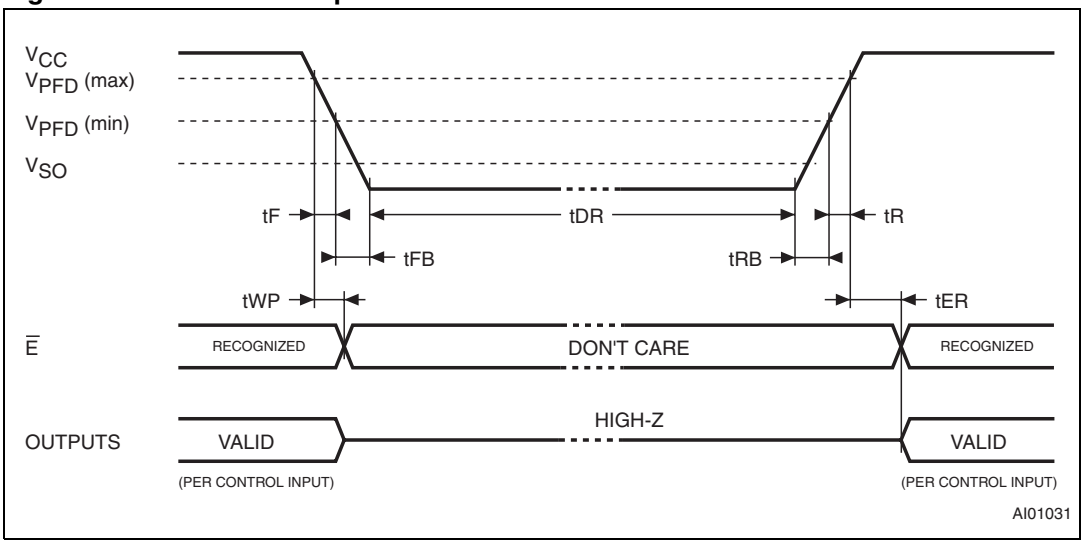


Table 9. Power down/up AC characteristics

Symbol	Parameter(1)		Min	Max	Unit
t_F(2)	V_{PFD} (max) to V_{PFD} (min) V_{CC} fall time		300		µs
t_{FB}(3)	V_{PFD} (min) to V_{SS} V_{CC} fall time	M48Z128/Y	10		µs
		M48Z128V	150		
t_R	V_{PFD} (min) to V_{PFD} (max) V_{CC} rise time		10		µs
t_{RB}	V_{SS} to V_{PFD} (min) V_{CC} rise time		1		µs
t_{WP}	Write protect time	M48Z128/Y	40	150	µs
		M48Z128V	40	250	
t_{ER}	$\overline{E}$ recovery time		40	120	ms

1. Valid for ambient operating temperature: T_A = 0 to 70 °C; V_{CC} = 4.75 to 5.5 V, 4.5 to 5.5 V, or 3.0 to 3.6 V (except where noted).
2. 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).
3. V_{PFD} (min) to V_{SS} fall time of less than t_{FB} may cause corruption of RAM data.

Table 10. Power down/up trip points DC characteristics

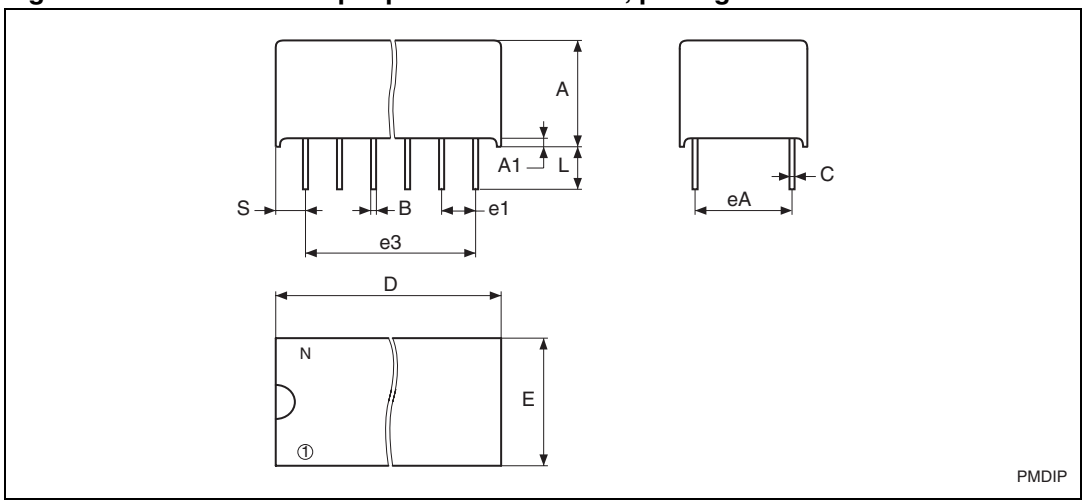
Symbol	Parameter(1)(2)		Min	Typ	Max	Unit
V_{PFD}	Power-fail deselect voltage	M48Z128	4.5	4.6	4.75	V
		M48Z128Y	4.2	4.3	4.5	V
		M48Z128V	2.8	2.9	3.0	V
V_{SO}	Battery backup switchover voltage	M48Z128/Y		3.0		V
		M48Z128V		2.5		V
t_{DR}(3)	Expected data retention time		10			YEARS

1. All voltages referenced to V_{SS}.
2. Valid for ambient operating temperature: T_A = 0 to 70 °C; V_{CC} = 4.75 to 5.5 V, 4.5 to 5.5 V, or 3.0 to 3.6 V (except where noted).
3. At 25 °C; V_{CC} = 0 V.

5 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*. ECOPACK® is an ST trademark.

Figure 11. PMDIP32 – 32-pin plastic DIP module, package outline



Note: Drawing is not to scale.

Table 11. PMDIP32 – 32-pin plastic DIP module, package mechanical data

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		2.29	2.79		0.090	0.110
e3	38.1			1.5		
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		

6 Part numbering

Table 12. Ordering information scheme

Example: M48Z 128Y –70 PM 1

Device type

M48Z

Supply voltage and write protect voltage

128 = V_{CC} = 4.75 to 5.5 V; V_{PFD} = 4.5 to 4.75 V

128Y = V_{CC} = 4.5 to 5.5 V; V_{PFD} = 4.2 to 4.5 V

128V(1) = V_{CC} = 3.0 to 3.6 V; V_{PFD} = 2.8 to 3.0 V

Speed

–70 = 70 ns (for M48Z128/Y)

–85 = 85 ns (for M48Z128/Y/V)

–120 = 120 ns (for M48Z128/Y/V)

Package

PM = PMDIP32

Temperature range

1 = 0 to 70 °C

Shipping method

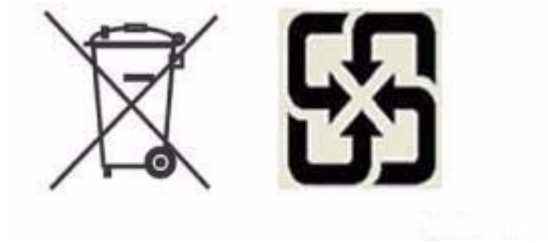
blank = ECOPACK® package, tubes

1. Contact local ST sales office for availability

For other options, or for more information on any aspect of this device, please contact the ST sales office nearest you.

7 Environmental information

Figure 12. Recycling symbols



This product contains a non-rechargeable lithium (lithium carbon monofluoride chemistry) button cell battery fully encapsulated in the final product.

Recycle or dispose of batteries in accordance with the battery manufacturer's instructions and local/national disposal and recycling regulations.

Please refer to the following web site address for additional information regarding compliance statements and waste recycling.

Go to www.st.com/nvram, then select "Lithium Battery Recycling" from "Related Topics".

8 Revision history

Table 13. Revision history

Date	Revision	Changes
May-1999	1	First issue
13-Apr-2000	2	Document layout changed; surface-mount chip set solution added
20-Jun-2000	2.1	t_{GLQX} changed (*Table 3*)
19-Jul-2000	2.2	M48Z128V added
14-Sep-2001	3	Reformatted; added temperature information (*Table 7*, *8*, *3*, *4*, *9*, *10*)
07-Nov-2001	3.1	Remove chipset option from ordering Information (*Table 12*)
20-May-2002	3.2	Modify reflow time and temperature footnotes (*Table 5*)
18-Nov-2002	3.3	Modifying SMT solution text (Figure 2, *4*;*Table 2*)
17-Sep-2003	3.4	Remove references to M68ZXXX (obsolete) parts (*Figure 4*; *Table 2*); update disclaimer
22-Feb-2005	4	Reformatted; IR reflow, SO package updates (*Table 5*)
20-Jul-2010	5	Reformatted document; updated *Features*, *Section 3: Maximum ratings*, *Table 11*, *12*; added ECOPACK® text to *Section 5*; added *Section 7: Environmental information*; removed SOH28, SNAPHAT® housing and all references from datasheet.

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