



M68AF031A

256 Kbit (32K x 8) 5.0V Asynchronous SRAM

FEATURES SUMMARY

- SUPPLY VOLTAGE: 4.5 to 5.5V
- 32K x 8 bits SRAM with OUTPUT ENABLE
- EQUAL CYCLE and ACCESS TIME: 55, 70ns
- LOW STANDBY CURRENT
- LOW V_{CC} DATA RETENTION: 2V
- TRI-STATE COMMON I/O
- AUTOMATIC POWER DOWN
- PACKAGES
 - SO28, PDIP28, TSOP28 Standard and Reverse Pinout.
 - TSOP28 Standard Available in Lead-Free Version

Figure 1. Packages

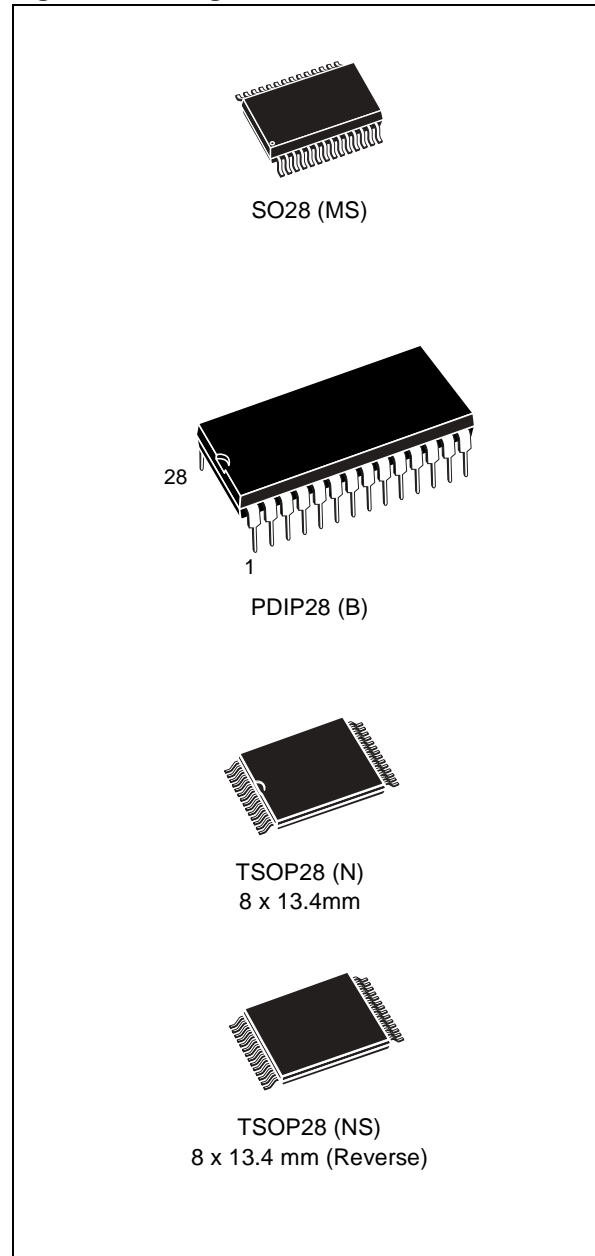


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SUMMARY DESCRIPTION

The M68AF031A is a 256 Kbit (262,144 bit) CMOS SRAM, organized as 32,768 bytes. The device features fully static operation requiring no external clocks or timing strobes, with equal address access and cycle times. It requires a single 4.5 to 5.5V supply. This device has an automatic power-down feature, reducing the power consumption by over 99% when deselected.

The M68AF031A is available in SO28 (28-lead Small Outline), PDIP28 (28-pin Plastic Dual-In-

Line) and TSOP28 (28-lead Thin Small Outline, Standard and Reverse Pinout) packages.

In addition to the standard version, the TSOP28 Standard package is also available in Lead-free version (standard and Tape & Reel packing), in compliance with JEDEC Std J-STD-020B, the ST ECOPACK 7191395 Specification, and the RoHS (Restriction of Hazardous Substances) directive. It is also compliant with Lead-free soldering processes.

Figure 2. Logic Diagram

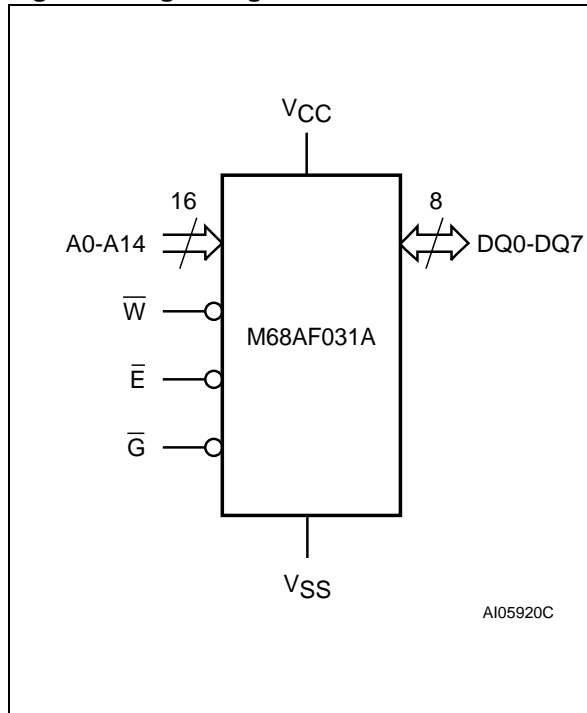


Table 1. Signal Names

| | |
|-----------------|--------------------------|
| A0-A14 | Address Inputs |
| DQ0-DQ7 | Data Input/Output |
| \bar{E} | Chip Enable |
| \bar{G} | Output Enable |
| \bar{W} | Write Enable |
| V _{CC} | Supply Voltage |
| V _{SS} | Ground |
| NC | Not Connected Internally |

Figure 3. SO Connections

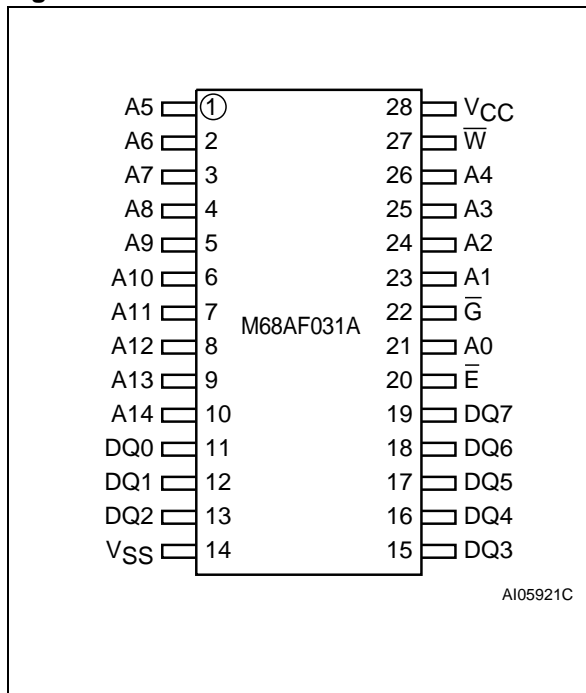


Figure 5. TSOP Connections (Normal)

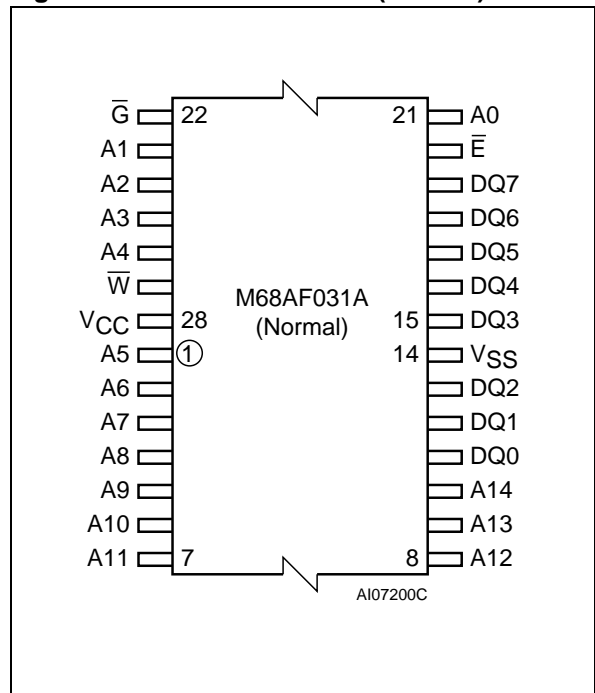


Figure 4. DIP Connections

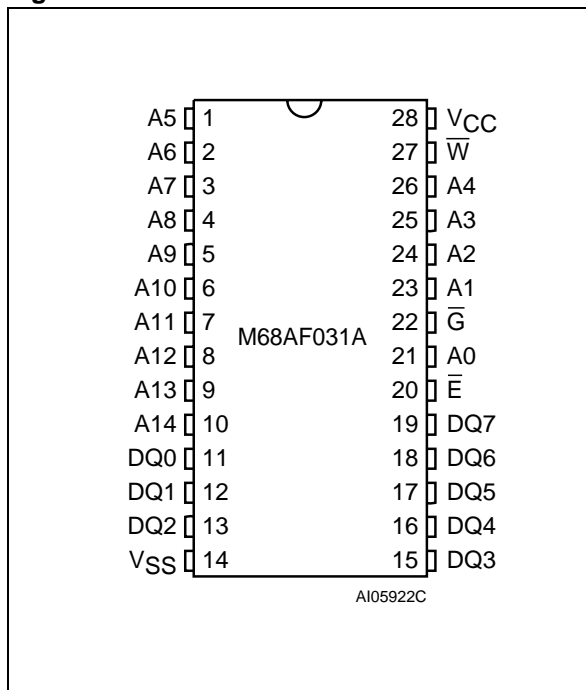


Figure 6. TSOP Connections (Reverse)

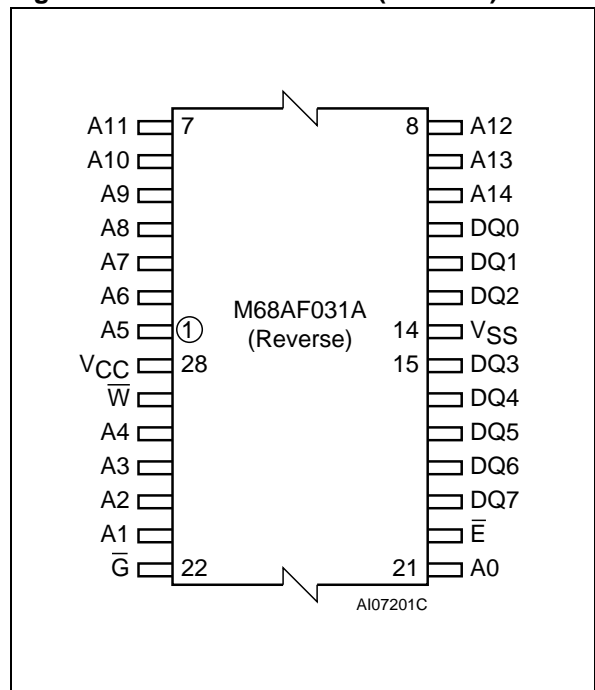
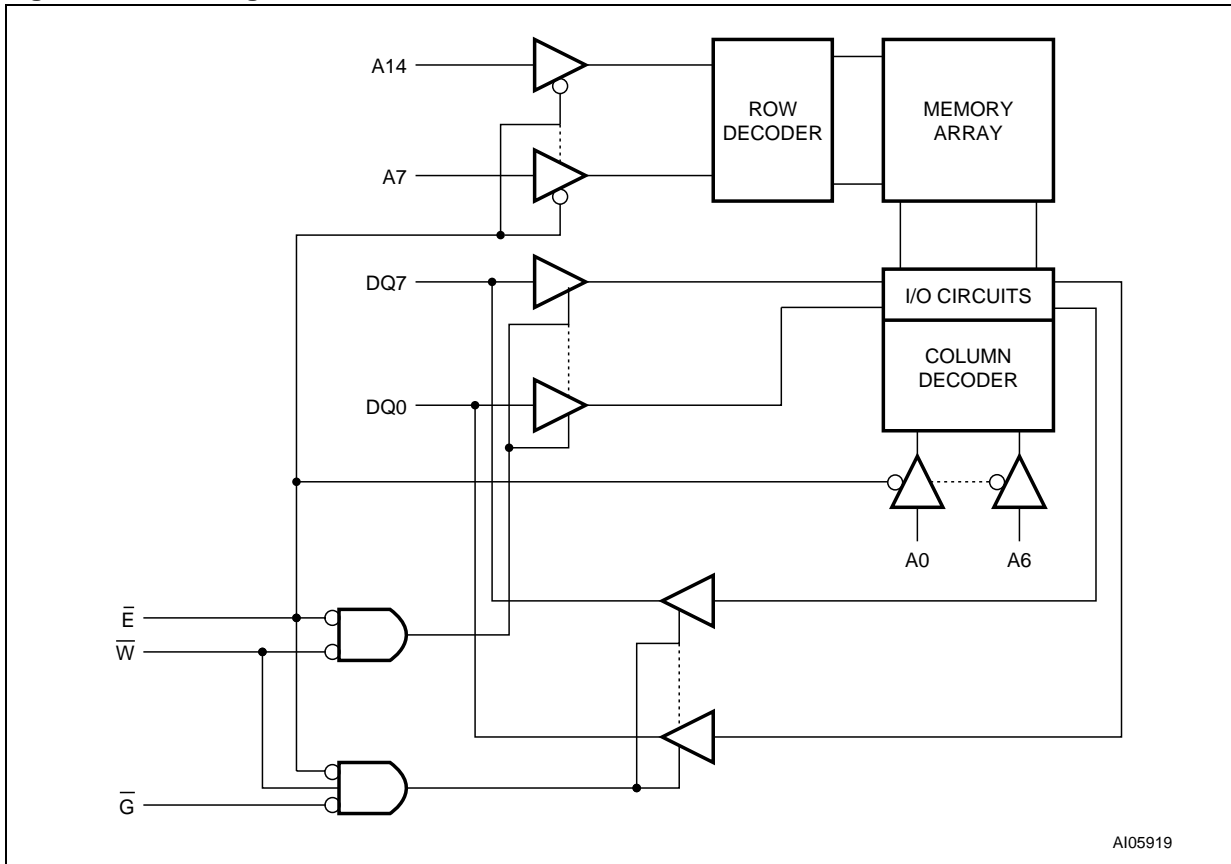


Figure 7. Block Diagram



MAXIMUM RATING

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 im-

plied. Exposure to Absolute Maximum Rating conditions for periods greater than 1 sec periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

Table 2. Absolute Maximum Ratings

| Symbol | Parameter | Value | Unit |
|----------------|-----------------------------------|------------------------|------|
| $I_O^{(1)}$ | Output Current | 20 | mA |
| P_D | Power Dissipation | 1 | W |
| T_A | Ambient Operating Temperature | -55 to 125 | °C |
| T_{LEAD} | Lead Temperature during Soldering | (1) | °C |
| T_{STG} | Storage Temperature | -65 to 150 | °C |
| V_{CC} | Supply Voltage | -0.5 to 6.5 | V |
| $V_{IO}^{(2)}$ | Input or Output Voltage | -0.5 to $V_{CC} + 0.5$ | V |

Note: 1. One output at a time, not to exceed 1 second duration.

2. Up to a maximum operating V_{CC} of 6.0V only.

3. Compliant with the JEDEC Std J-STD-020B (for small body, Sn-Pb or Pb assembly), the ST ECOPACK® 7191395 specification, and the European directive on Restrictions on Hazardous Substances (RoHS) 2002/95/EU.

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 Measure-

ment 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 3. Operating and AC Measurement Conditions

| Parameter | | M68AF031A |
|--|---------|---|
| V _{CC} Supply Voltage | | 4.5 to 5.5V |
| Ambient Operating Temperature | Range 1 | 0 to 70°C |
| | Range 6 | -40 to 85°C |
| Load Capacitance (C _L) | | 100pF |
| Output Circuit Protection Resistance (R ₁) | | 3.0kΩ |
| Load Resistance (R ₂) | | 3.1kΩ |
| Input and Output Timing Ref. Voltages | | V _{CC} /2 |
| Input Rise and Fall Times | | 1ns/V |
| Input Pulse Voltages | | 0 to V _{CC} |
| Output Transition Timing Ref. Voltages | | V _{RL} = 0.3V _{CC} ; V _{RH} = 0.7V _{CC} |

Figure 8. AC Measurement I/O Waveform

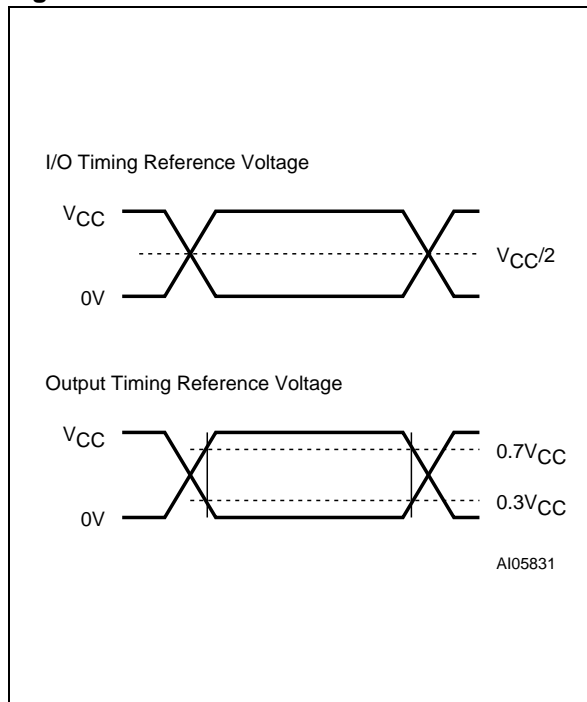


Figure 9. AC Measurement Load Circuit

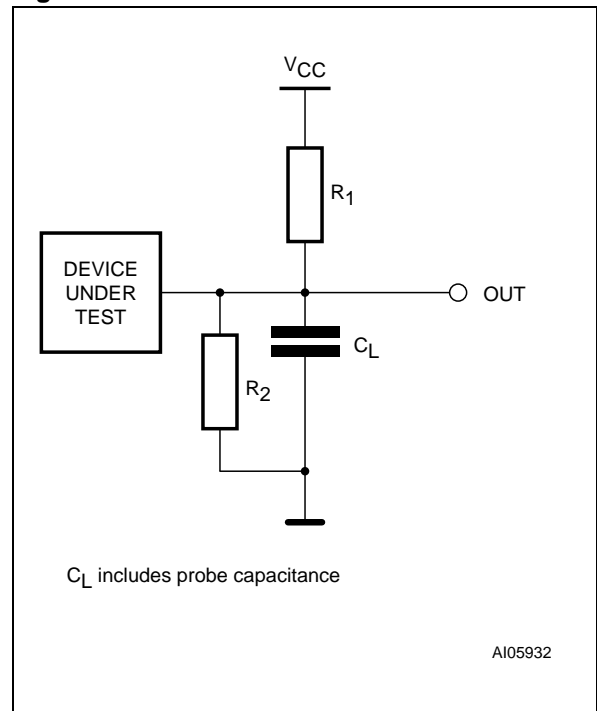


Table 4. Capacitance

| Symbol | Parameter ^(1,2) | Test Condition | Min | Max | Unit |
|------------------|---|-----------------------|-----|-----|------|
| C _{IN} | Input Capacitance on all pins (except DQ) | V _{IN} = 0V | | 6 | pF |
| C _{OUT} | Output Capacitance | V _{OUT} = 0V | | 8 | pF |

Note: 1. Sampled only, not 100% tested.
2. At T_A = 25°C, f = 1 MHz, V_{CC} = 5.0V.

Table 5. DC Characteristics (M68AF031A-55 and M68AF031A-70)

| Symbol | Parameter | Test Condition | Min | Typ | Max | Unit |
|-----------------------------------|-----------------------------|---|---------|-----|-----------------------|------|
| I _{CC1} ^(1,2) | Operating Supply Current | V _{CC} = 5.5V, f = 1/t _{AVAV} , I _{OUT} = 0mA | | | 50 | mA |
| I _{CC2} ⁽³⁾ | Operating Supply Current | V _{CC} = 5.5V, f = 1MHz, I _{OUT} = 0mA | | | 5 | mA |
| I _{SB} | Standby Supply Current CMOS | V _{CC} = 5.5V, f = 0, E ≥ V _{CC} - 0.2V | Range 1 | 0.1 | 5 | μA |
| | | | Range 6 | 0.1 | 10 | μA |
| I _{LI} | Input Leakage Current | 0V ≤ V _{IN} ≤ V _{CC} | -1 | | 1 | μA |
| I _{LO} ⁽⁴⁾ | Output Leakage Current | 0V ≤ V _{OUT} ≤ V _{CC} | -1 | | 1 | μA |
| V _{IH} | Input High Voltage | | 2.2 | | V _{CC} + 0.3 | V |
| V _{IL} | Input Low Voltage | | -0.3 | | 0.8 | V |
| V _{OH} | Output High Voltage | I _{OH} = -1.0mA | 2.4 | | | V |
| V _{OL} | Output Low Voltage | I _{OL} = 2.1mA | | | 0.4 | V |

Note: 1. Average AC current, cycling at t_{AVAV} minimum.
2. E = V_{IL}, V_{IN} = V_{IL} OR V_{IH}.
3. E ≤ 0.2V, V_{IN} ≤ 0.2V OR V_{IN} ≥ V_{CC} - 0.2V.
4. Output disabled.

OPERATION

The M68AF031A has a Chip Enable power down feature which invokes an automatic standby mode whenever Chip Enable is de-asserted (\bar{E} = High). An Output Enable (\bar{G}) signal provides a high speed tri-state control, allowing fast read/write cy-

cles to be achieved with the common I/O data bus. Operational modes are determined by device control inputs \bar{W} and \bar{E} , as summarized in the Operating Modes table (see [Table 6., Operating Modes](#)).

Table 6. Operating Modes

| Operation | \bar{E} | \bar{W} | \bar{G} | DQ0-DQ7 | Power |
|-----------------|-----------|-----------|-----------|-------------|----------------------|
| Deselected | V_{IH} | X | X | Hi-Z | Standby (I_{SB}) |
| Read | V_{IL} | V_{IH} | V_{IL} | Data Output | Active (I_{CC}) |
| Write | V_{IL} | V_{IL} | X | Data Input | Active (I_{CC}) |
| Output Disabled | V_{IL} | V_{IH} | V_{IH} | Hi-Z | Active (I_{CC}) |

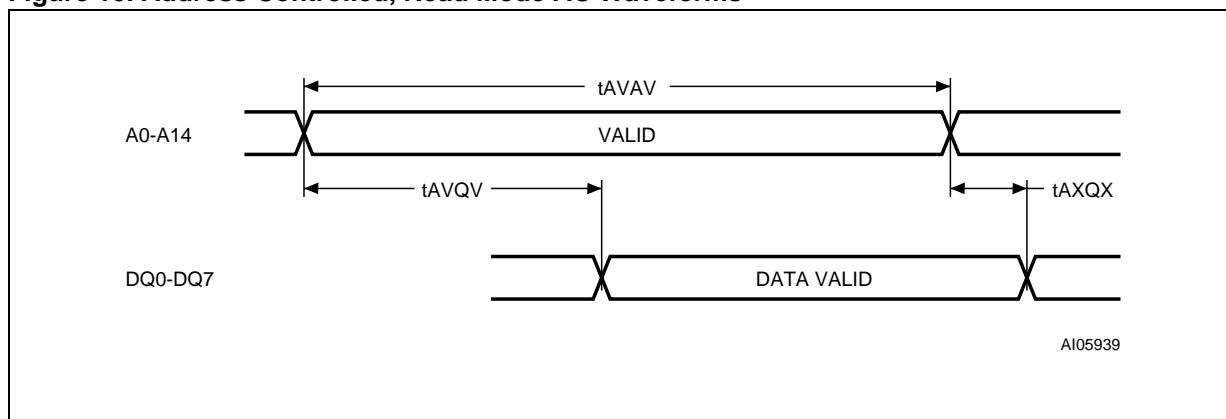
Note: 1. X = V_{IH} or V_{IL} .

Read Mode

The M68AF031A is in the Read mode whenever Write Enable (\bar{W}) is High with Output Enable (\bar{G}) Low, and Chip Enable (\bar{E}) is asserted. This provides access to data of the 262,144 locations in the static memory array, specified by the 15 address inputs. Valid data will be available at the eight output pins within t_{AVQV} after the last stable

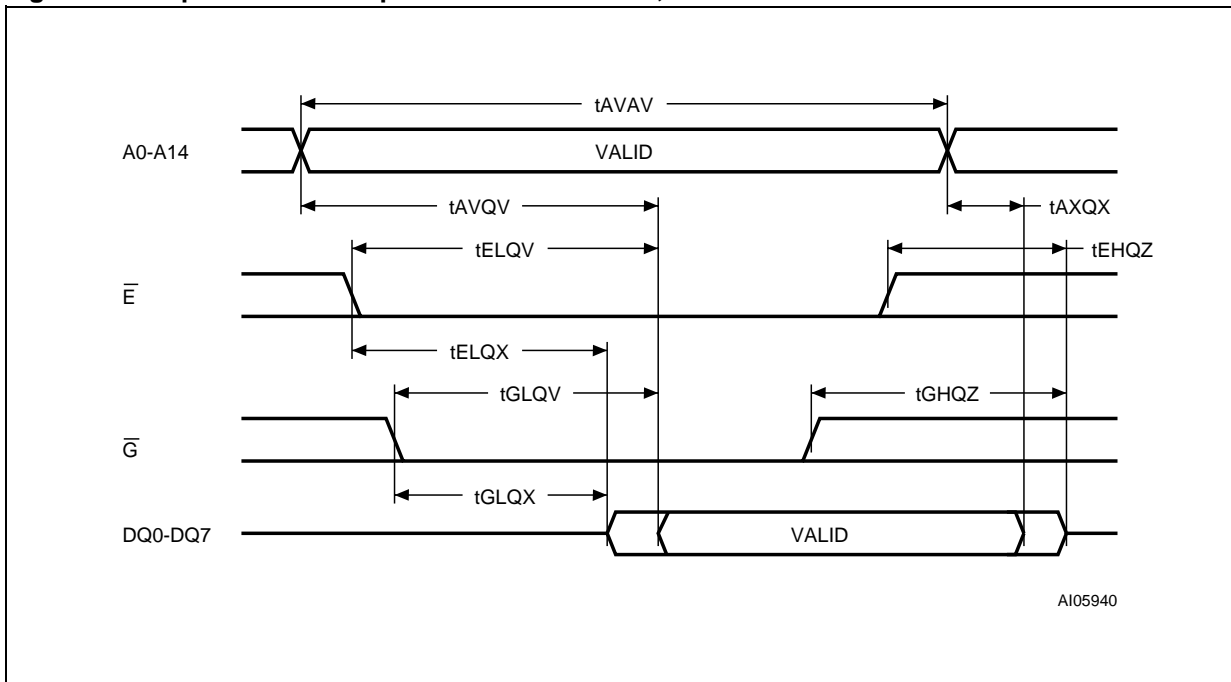
address, providing \bar{G} is Low and \bar{E} is Low. If Chip Enable or Output Enable access times are not met, data access will be measured from the limiting parameter (t_{ELQV} or t_{GLQV}) rather than the address. Data out may be indeterminate at t_{ELQX} and t_{GLQX} but data lines will always be valid at t_{AVQV} .

Figure 10. Address Controlled, Read Mode AC Waveforms



Note: \bar{E} = Low, \bar{G} = Low, \bar{W} = High.

Figure 11. Chip Enable or Output Enable Controlled, Read Mode AC Waveforms.



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

Figure 12. Chip Enable Controlled, Standby Mode AC Waveforms

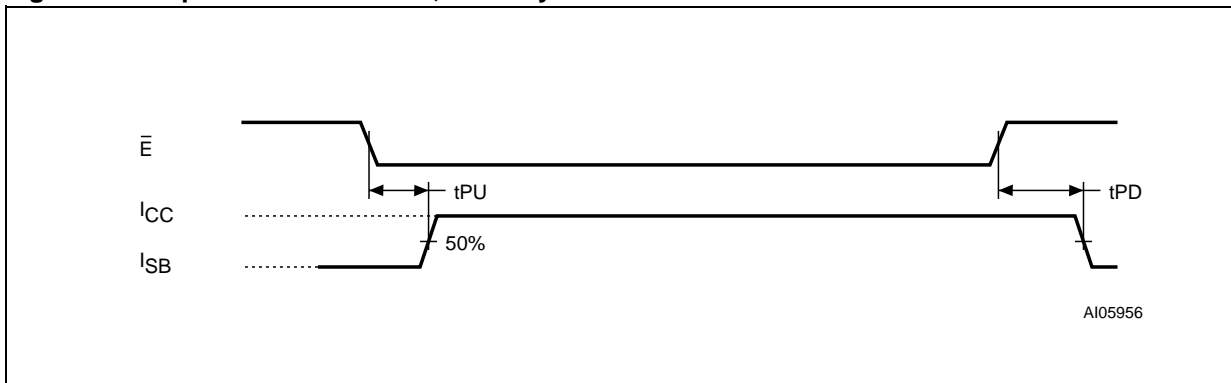


Table 7. Read and Standby Mode AC Characteristics

| Symbol | Parameter | M68AF031A | | | | Unit |
|------------------------------------|--|-----------|------|------|------|------|
| | | 55 | | 70 | | |
| | | Min. | Max. | Min. | Max. | |
| t _{AVAV} | Read Cycle Time | 55 | | 70 | | ns |
| t _{AVQV} | Address Valid to Output Valid | | 55 | | 70 | ns |
| t _{AXQX} ⁽¹⁾ | Data hold from address change | 5 | | 5 | | ns |
| t _{EHQZ} ^(2,3) | Chip Enable High to Output Hi-Z | | 20 | | 25 | ns |
| t _{ELQV} | Chip Enable Low to Output Valid | | 55 | | 70 | ns |
| t _{ELQX} ⁽¹⁾ | Chip Enable Low to Output Lo-Z | 5 | | 5 | | ns |
| t _{GHQZ} ^(2,3) | Output Enable High to Output Hi-Z | | 20 | | 25 | ns |
| t _{GLQV} | Output Enable Low to Output Valid | | 25 | | 35 | ns |
| t _{GLQX} ⁽¹⁾ | Output Enable Low to Output Transition | 5 | | 5 | | ns |
| t _{PD} ⁽⁴⁾ | Chip Enable High to Power Down | | 55 | | 70 | ns |
| t _{PU} ⁽⁴⁾ | Chip Enable Low to Power Up | 0 | | 0 | | ns |

- Note: 1. Test conditions assume transition timing reference level = 0.3V_{CC} or 0.7V_{CC}.
 2. At any given temperature and voltage condition, t_{GHQZ} is less than t_{GLQX} and t_{EHQZ} is less than t_{ELQX} for any given device.
 3. These parameters are defined as the time at which the outputs achieve the open circuit conditions and are not referenced to output voltage levels.
 4. Tested initially and after any design or process changes that may affect these parameters.

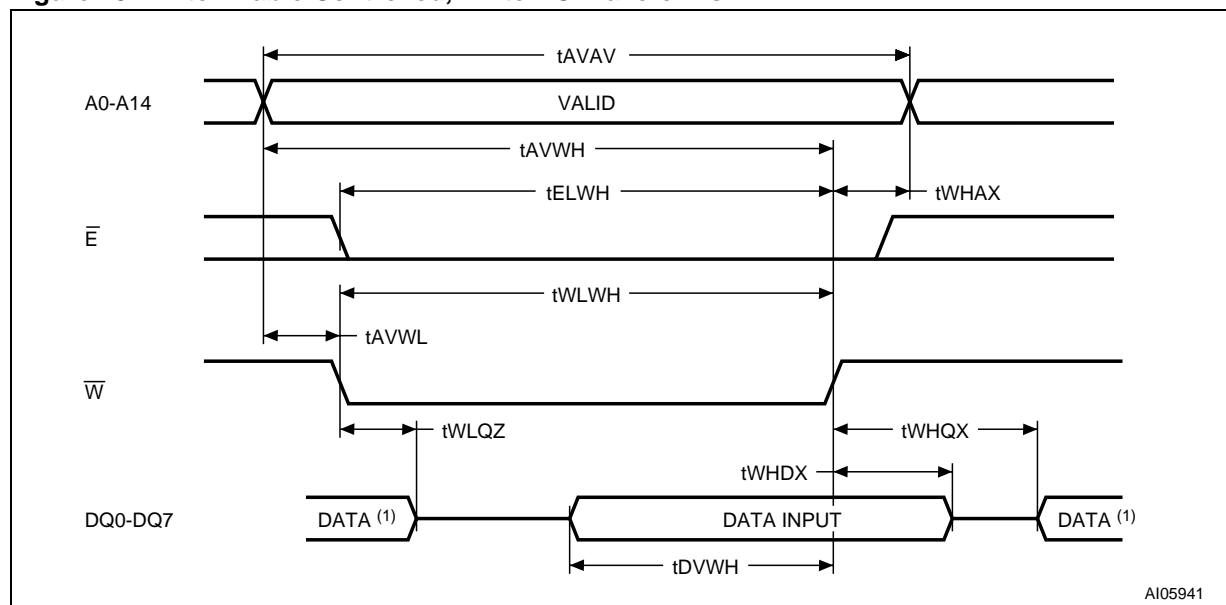
Write Mode

The M68AF031A is in the Write mode whenever the \bar{W} and \bar{E} are Low. Either the Chip Enable input (\bar{E}) or the Write Enable input (\bar{W}) must be deasserted during Address transitions for subsequent write cycles. When \bar{E} (\bar{W}) is Low, write cycle begins on the \bar{W} (\bar{E})'s falling edge. Therefore, address setup time is referenced to Write Enable or Chip Enable as t_{AVWL} and t_{AVEL} respectively, and is determined by the latter occurring edge.

The Write cycle can be terminated by the earlier rising edge of \bar{E} or \bar{W} .

If the Output is enabled ($\bar{E} = \text{Low}$, $\bar{G} = \text{Low}$), then \bar{W} will return the outputs to high impedance within t_{WLQZ} of its falling edge. Care must be taken to avoid bus contention in this type of operation. Data input must be valid for t_{DVWH} before the rising edge of Write Enable, or for t_{DVEH} before the rising edge of \bar{E} , whichever occurs first, and remain valid for t_{WHDX} and t_{EHDX} respectively.

Figure 13. Write Enable Controlled, Write AC Waveforms



Note: 1. During this period DQ0-DQ7 are in output state and input signals should not be applied.

Figure 14. Chip Enable Controlled, Write AC Waveforms

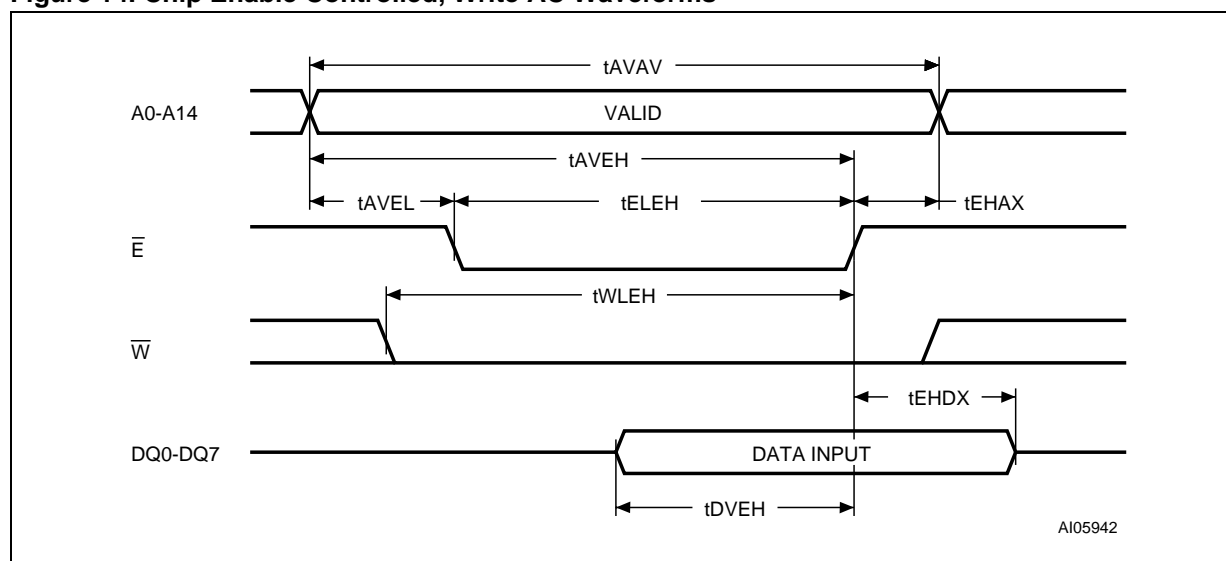


Table 8. Write Mode AC Characteristics

| Symbol | Parameter | M68AF031A | | | | Unit |
|------------------------------------|---|-----------|------|------|------|------|
| | | 55 | | 70 | | |
| | | Min. | Max. | Min. | Max. | |
| t _{AVAV} | Write Cycle Time | 55 | | 70 | | ns |
| t _{AVEH} | Address Valid to Chip Enable High | 45 | | 60 | | ns |
| t _{AVEL} | Address valid to Chip Enable Low | 0 | | 0 | | ns |
| t _{AVWH} | Address Valid to Write Enable High | 45 | | 60 | | ns |
| t _{AVWL} | Address Valid to Write Enable Low | 0 | | 0 | | ns |
| t _{DVEH} | Input Valid to Chip Enable High | 25 | | 30 | | ns |
| t _{DVWH} | Input Valid to Write Enable High | 25 | | 30 | | ns |
| t _{EHAX} | Chip Enable High to Address Transition | 0 | | 0 | | ns |
| t _{EHDX} | Chip enable High to Input Transition | 0 | | 0 | | ns |
| t _{ELEH} | Chip Enable Low to Chip Enable High | 45 | | 60 | | ns |
| t _{ELWH} | Chip Enable Low to Write Enable High | 45 | | 60 | | ns |
| t _{WHAX} | Write Enable High to Address Transition | 0 | | 0 | | ns |
| t _{WHDX} | Write Enable High to Input Transition | 0 | | 0 | | ns |
| t _{WHQX} ⁽¹⁾ | Write Enable High to Output Transition | 5 | | 5 | | ns |
| t _{WLEH} | Write Enable Low to Chip Enable High | 45 | | 60 | | ns |
| t _{WLQZ} ^(1,2) | Write Enable Low to Output Hi-Z | | 20 | | 25 | ns |
| t _{WLWH} | Write Enable Low to Write Enable High | 45 | | 50 | | ns |

Note: 1. At any given temperature and voltage condition, t_{WLQZ} is less than t_{WHQX} for any given device.
 2. These parameters are defined as the time at which the outputs achieve the open circuit conditions and are not referenced to output voltage levels.

Figure 15. Low V_{CC} Data Retention AC Waveforms

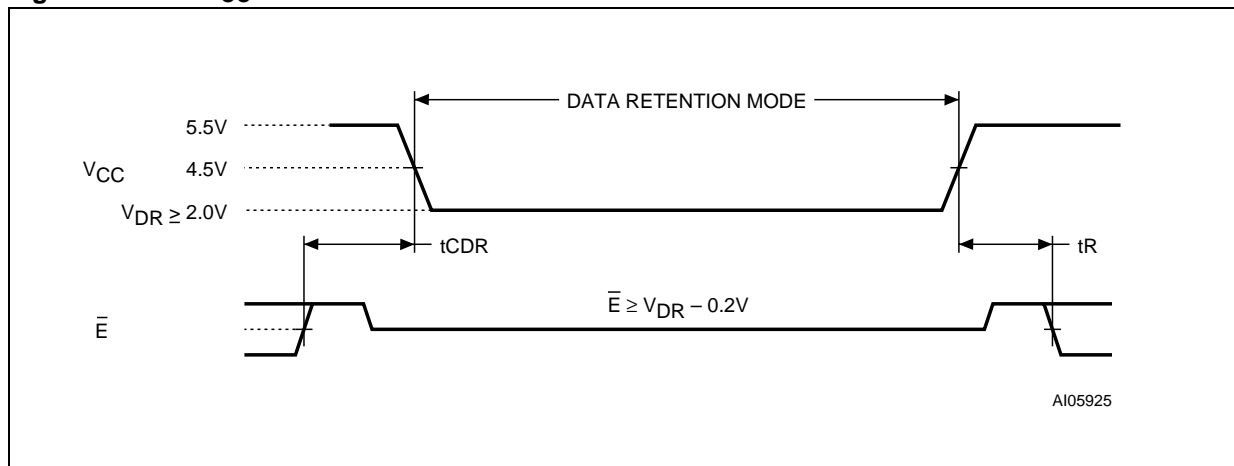


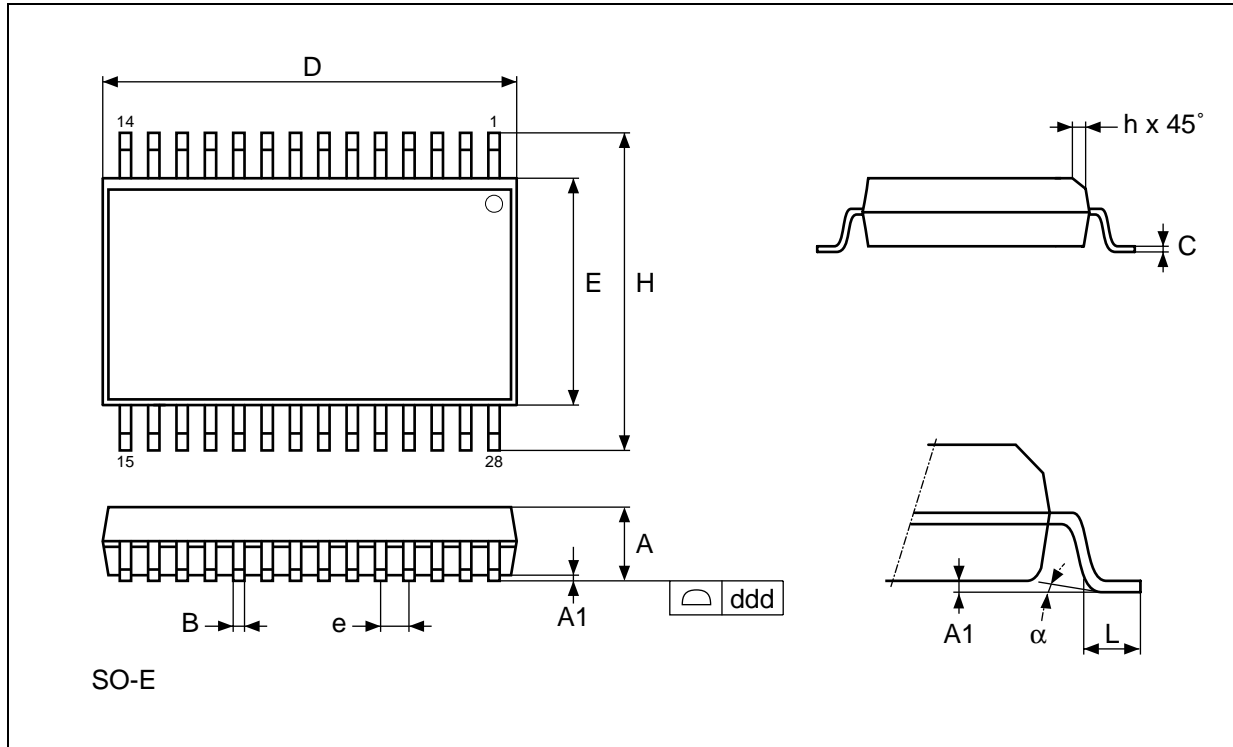
Table 9. Low V_{CC} Data Retention Characteristics

| Symbol | Parameter | Test Condition | Min | Typ | Max | Unit |
|-----------------------------------|--|---|-------------------|-----|-----|------|
| I _{CCDR} ⁽¹⁾ | Supply Current (Data Retention) | V _{CC} = 2.0V, $\bar{E} \geq V_{CC} - 0.2V, f = 0$ ⁽³⁾ | | | 6 | μA |
| t _{CDR} ^(1,2) | Chip Deselected to Data Retention Time | | 0 | | | ns |
| t _R ⁽²⁾ | Operation Recovery Time | | t _{AVAV} | | | ns |
| V _{DR} ⁽¹⁾ | Supply Voltage (Data Retention) | $\bar{E} \geq V_{CC} - 0.2V, f = 0$ | 2.0 | | | V |

Note: 1. All other Inputs at V_{IH} ≥ V_{CC} - 0.2V or V_{IL} ≤ 0.2V.
 2. Tested initially and after any design or process changes that may affect these parameters. t_{AVAV} is Read cycle time.
 3. No input may exceed V_{CC} + 0.2V.

PACKAGE MECHANICAL

Figure 16. SO28 - 28 lead Plastic Small Outline, 300 mils body width, Package Outline

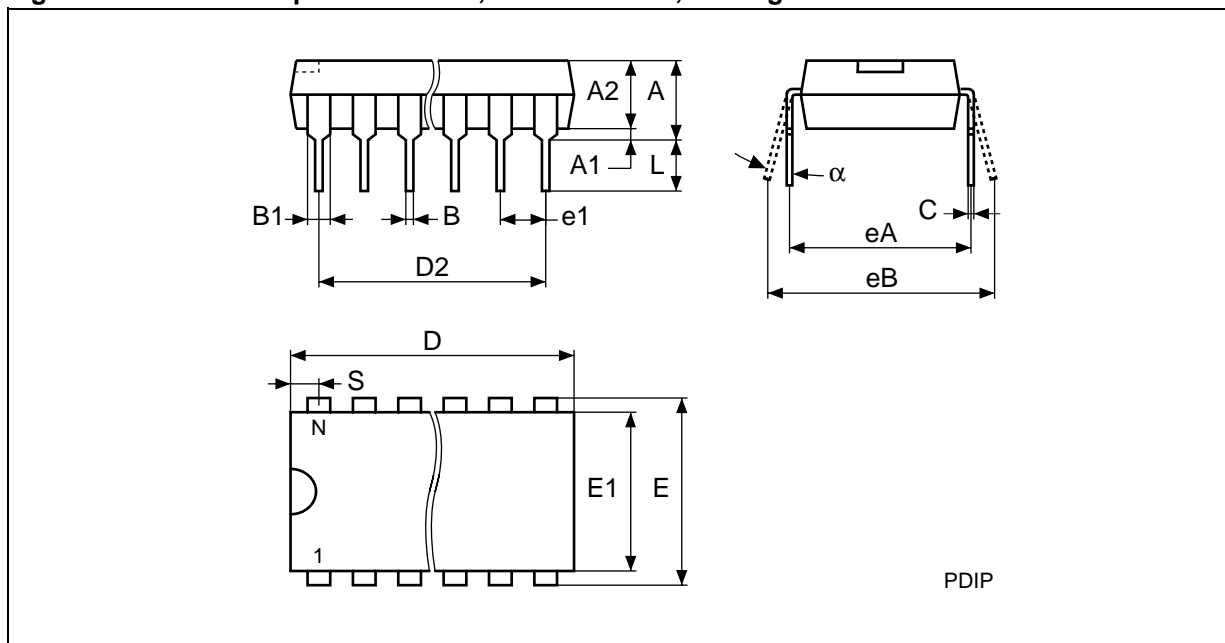


Note: Drawing is not to scale.

Table 10. SO28 - 28 lead Plastic Small Outline, 300 mils body width, Package Mechanical Data

| Symbol | millimeters | | | inches | | |
|--------|-------------|-------|-------|--------|-------|-------|
| | Typ | Min | Max | Typ | Min | Max |
| A | | 2.38 | 2.79 | | 0.094 | 0.110 |
| A1 | | 0.05 | 0.35 | | 0.002 | 0.014 |
| A2 | | 2.28 | 2.43 | | 0.090 | 0.096 |
| B | | 0.35 | 0.50 | | 0.014 | 0.020 |
| C | | 0.20 | 0.30 | | 0.008 | 0.012 |
| D | | 18.03 | 18.41 | | 0.710 | 0.725 |
| ddd | | | 0.10 | | | 0.004 |
| E | | 7.39 | 7.62 | | 0.291 | 0.300 |
| e | 1.27 | - | - | 0.050 | - | - |
| H | | 11.68 | 12.19 | | 0.460 | 0.480 |
| L | | 0.79 | 1.27 | | 0.031 | 0.050 |
| α | | 0° | 8° | | 0° | 8° |
| N | | 28 | | | 28 | |

Figure 17. PDIP28 - 28 pin Plastic DIP, 600 mils width, Package Outline

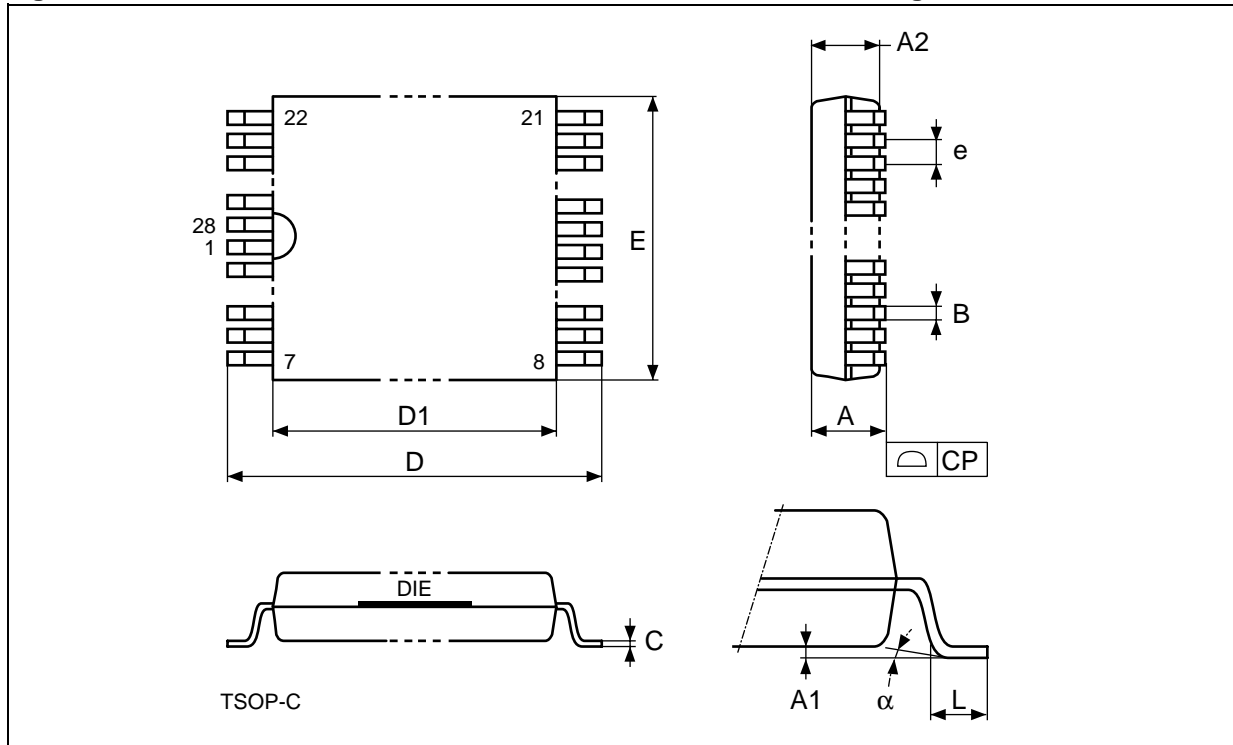


Note: Drawing is not to scale.

Table 11. PDIP28 - 28 pin Plastic DIP, n600 mils width, Package Mechanical Data

| Symbol | millimeters | | | inches | | |
|--------|-------------|-------|-------|--------|-------|-------|
| | Typ | Min | Max | Typ | Min | Max |
| A | | – | 5.08 | | – | 0.200 |
| A1 | | 0.38 | – | | 0.015 | – |
| A2 | | 3.56 | 4.06 | | 0.140 | 0.160 |
| B | | 0.38 | 0.51 | | 0.015 | 0.020 |
| B1 | 1.52 | – | – | 0.060 | – | – |
| C | | 0.20 | 0.30 | | 0.008 | 0.012 |
| D | | 36.83 | 37.34 | | 1.450 | 1.470 |
| D2 | 33.02 | – | – | 1.300 | – | – |
| E | 15.24 | – | – | 0.600 | – | – |
| E1 | | 13.59 | 13.84 | | 0.535 | 0.545 |
| e1 | 2.54 | – | – | 0.100 | – | – |
| eA | 14.99 | – | – | 0.590 | – | – |
| eB | | 15.24 | 17.78 | | 0.600 | 0.700 |
| L | | 3.18 | 3.43 | | 0.125 | 0.135 |
| S | | 1.78 | 2.08 | | 0.070 | 0.082 |
| α | | 0° | 10° | | 0° | 10° |
| N | | 28 | | | 28 | |

Figure 18. TSOP28 - 28 lead Normal Pinout Plastic Small Outline, Package Outline

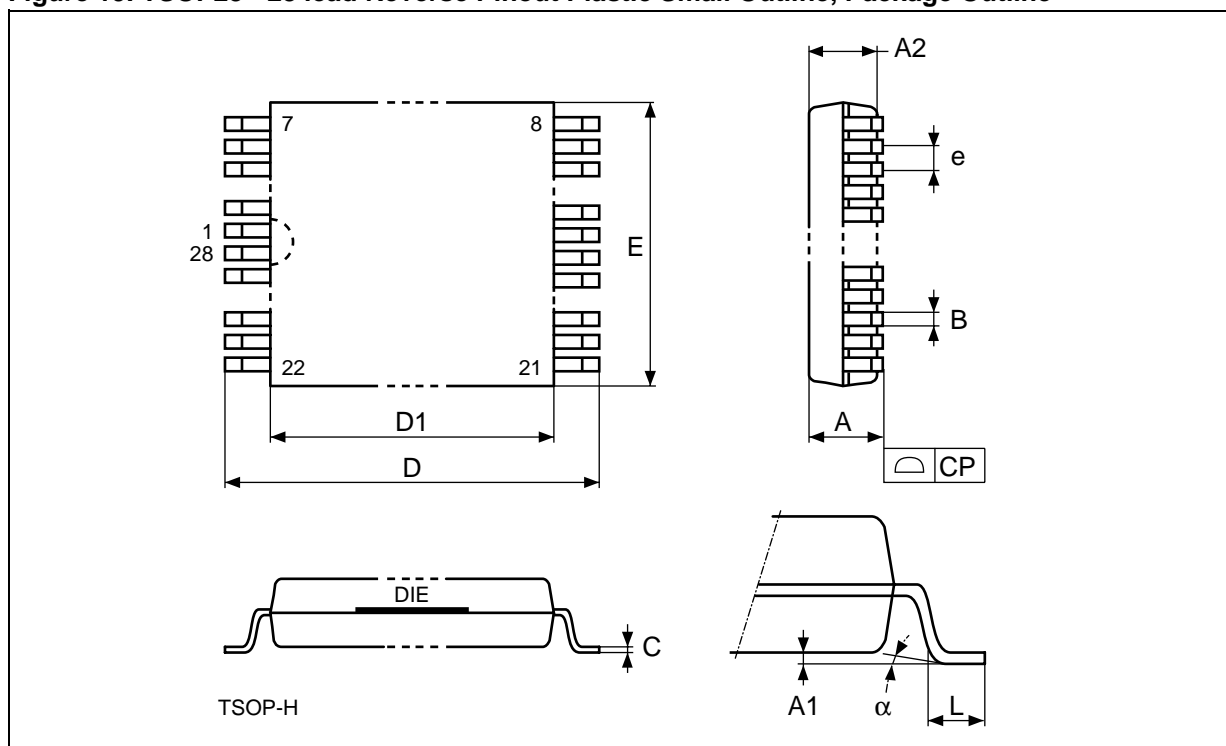


Note: Drawing is not to scale.

Table 12. TSOP28 - 28 lead Normal Pinout Plastic Small Outline, Package Mechanical Data

| Symbol | millimeters | | | inches | | |
|--------|-------------|-------|-------|--------|--------|--------|
| | Typ | Min | Max | Typ | Min | Max |
| A | | | 1.200 | | | 0.0472 |
| A1 | | 0.050 | 0.150 | | 0.0020 | 0.0059 |
| A2 | | 0.910 | 1.050 | | 0.0358 | 0.0413 |
| B | 0.220 | | | 0.0087 | | |
| C | | 0.100 | 0.210 | | 0.0039 | 0.0083 |
| CP | | | 0.100 | | | 0.0039 |
| D | 13.400 | – | – | 0.5276 | – | – |
| D1 | 11.800 | – | – | 0.4646 | – | – |
| E | 8.000 | – | – | 0.3150 | – | – |
| e | 0.550 | – | – | 0.0217 | – | – |
| L | | 0.300 | 0.700 | | 0.0118 | 0.0276 |
| alpha | | 0 | 5 | | 0 | 5 |
| N | 28 | | | 28 | | |

Figure 19. TSOP28 - 28 lead Reverse Pinout Plastic Small Outline, Package Outline



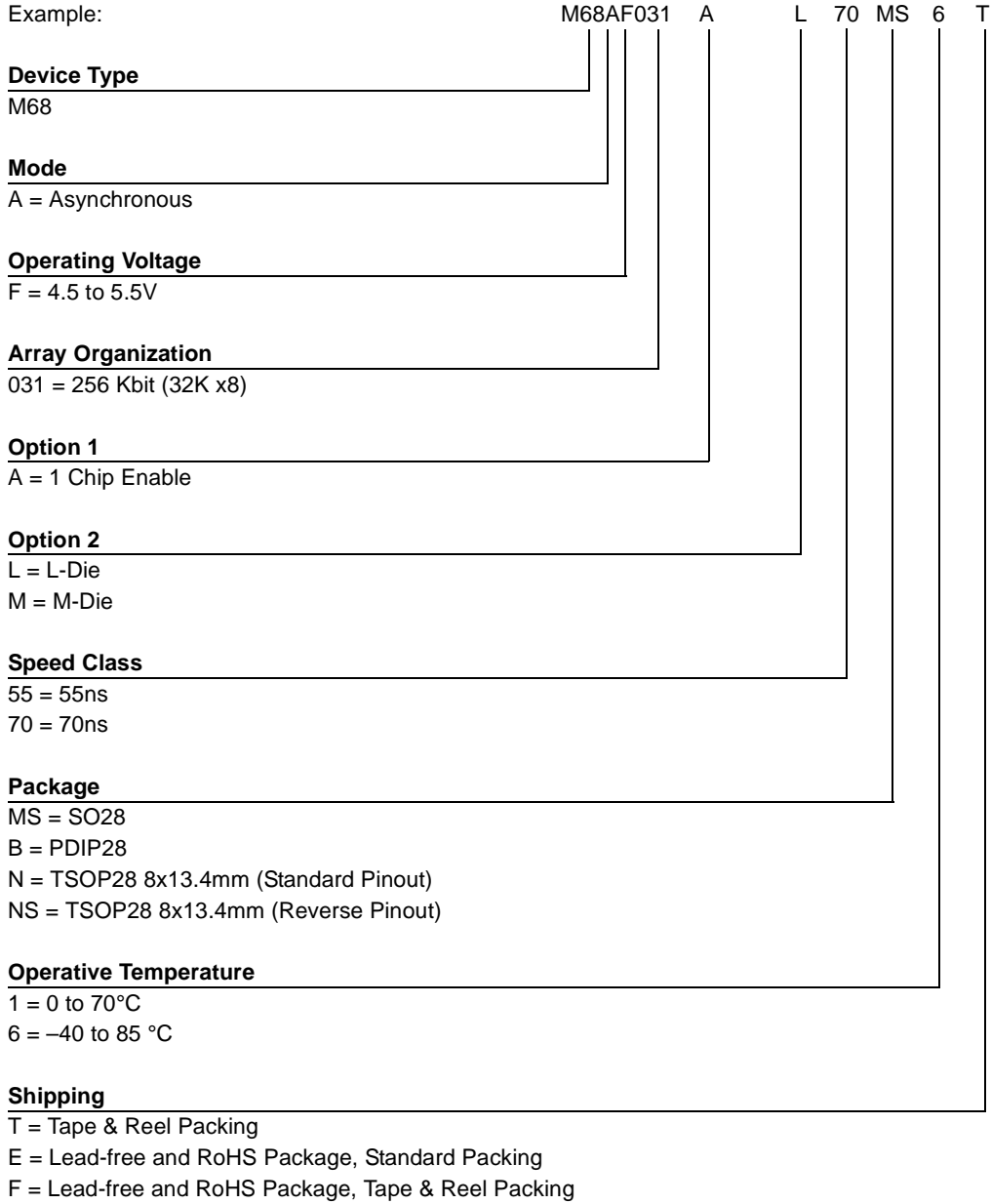
Note: Drawing is not to scale.

Table 13. TSOP28 - 28 lead Reverse Pinout Plastic Small Outline, Package Mechanical Data

| Symbol | millimeters | | | inches | | |
|----------|-------------|-------|-------|--------|--------|--------|
| | Typ | Min | Max | Typ | Min | Max |
| A | | | 1.200 | | | 0.0472 |
| A1 | | 0.050 | 0.150 | | 0.0020 | 0.0059 |
| A2 | | 0.910 | 1.050 | | 0.0358 | 0.0413 |
| B | 0.220 | | | 0.0087 | | |
| C | | 0.100 | 0.210 | | 0.0039 | 0.0083 |
| CP | | | 0.100 | | | 0.0039 |
| D | 13.400 | – | – | 0.5276 | – | – |
| D1 | 11.800 | – | – | 0.4646 | – | – |
| E | 8.000 | – | – | 0.3150 | – | – |
| e | 0.550 | – | – | 0.0217 | – | – |
| L | | 0.300 | 0.700 | | 0.0118 | 0.0276 |
| α | | 0 | 5 | | 0 | 5 |
| N | 28 | | | 28 | | |

PART NUMBERING

Table 14. Ordering Information Scheme



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

REVISION HISTORY

Table 15. Document Revision History

| Date | Version | Revision Details |
|--------------|---------|---|
| January 2002 | -01 | First Issue |
| 07-Feb-2002 | -02 | I _{SB} clarified |
| 08-Feb-2002 | -03 | TSOP28 Package removed AC Measurement Load Circuit changed (Figure 9) Operating and AC Measurement Conditions clarified (Table 3) |
| 06-Mar-2002 | -04 | Document status changed to Data Sheet |
| 19-Apr-2002 | -05 | Absolute Maximum current value added (Table 2) Operating and AC Measurement Conditions clarified (Table 3) |
| 26-Apr-2002 | -06 | Absolute Maximum Ratings Table clarified (Table 2) Operating and AC Measurement Conditions Table clarified (Table 3) DC Characteristics Table clarified (Table 5) Write Mode AC Characteristics Table clarified (Table 8) Low V _{CC} Data Retention AC Waveforms clarified (Figure 15) Low V _{CC} Data Retention Characteristics Table clarified (Table 9) |
| 20-May-2002 | -07 | DC Characteristics Table clarified (Table 5) Low V _{CC} Data Retention Characteristics Table clarified (Table 9) |
| 29-May-2002 | -08 | TSOP28 8x13.4mm Standard and Reverse pinout added (Figure 1, 5, 6, Table 12) |
| 02-Oct-2002 | 8.1 | Revision numbering modified: a minor revision will be indicated by incrementing the digit after the dot, and a major revision, by incrementing the digit before the dot (revision version 08 equals 8.0). New part number added. |
| 09-Oct-2002 | 8.2 | Datasheet number simplified. |
| 23-Apr-2003 | 8.3 | 55ns speed-class added |
| 27-May-2004 | 9.0 | Package outline and package mechanical data added for TSOP28 Reverse package. |
| 05-Nov-2004 | 10.0 | TSOP28 Standard Lead-free version added in FEATURES SUMMARY , SUMMARY DESCRIPTION . T _{LEAD} parameter added in Table 2. , Absolute Maximum Ratings . Standard Lead-free option added in Table 14. , Ordering Information Scheme . |
| 15-Nov-2004 | 11.0 | TSOP28 Lead-free Tape & Reel version added in FEATURES SUMMARY , SUMMARY DESCRIPTION . Lead-Free Tape & Reel option added in Table 14. , Ordering Information Scheme . |

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