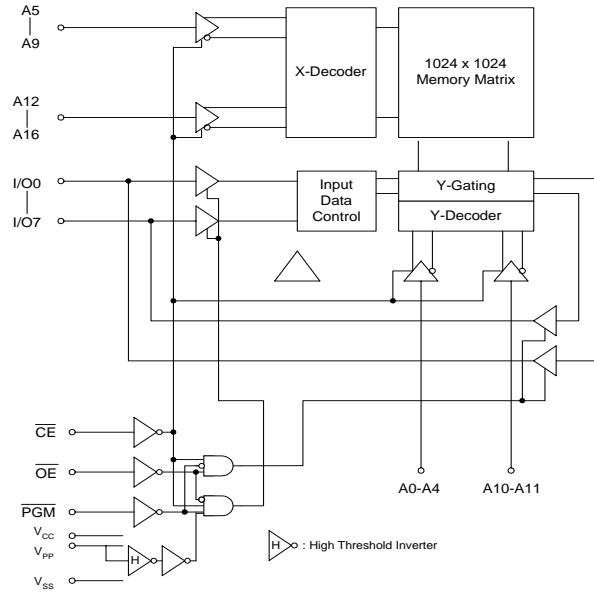
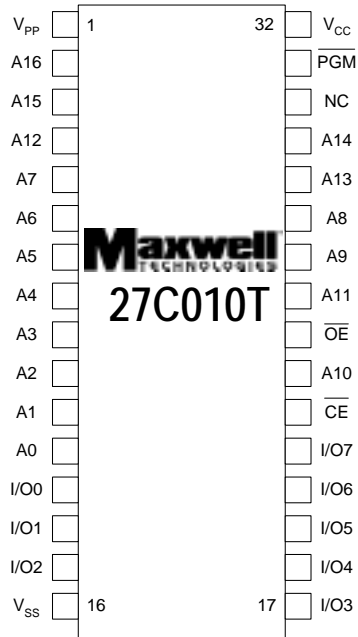


27C010T

1 Megabit (128K x 8-Bit) - OTP EPROM



Logic Diagram

FEATURES:

- 128k x 8 Bit OTP EPROM organization
- RAD-PAK® radiation-hardened against natural space radiation
- Total dose hardness:
 - >100 krad (Si), depending upon space mission
- Excellent Single Event Effects:
 - SEL_{TH} LET: > 80 MeV/mg/cm²
 - SEU_{TH} LET (read mode): >80 MeV/mg/cm²
- Package:
 - 32 pin RAD-PAK® flat pack
 - Weight - 6.0 grams
- Fast access time:
 - 120, 150, 200 ns (max) times available
- Low power consumption:
 - Active mode: 50 mW/MHz (typ)
 - Standby mode: 5µW (typ)
- High speed page and word programming:
 - Page programming time: 14 sec (typ)
- Programming power supply:
 - V_{pp} = 12.5 V ± 0.3 V
- One-time Programmable
- Pin Arrangement
 - JEDEC standard byte-wide EPROM
 - Flash memory and mask ROM compatible

DESCRIPTION:

Maxwell Technologies' 27C010T high density 1 Megabit One-time Programmable Electrically Programmable Read Only Memory microcircuit features a greater than 100 krad (Si) total dose tolerance, depending upon space mission. The 27C010T features fast address times and low power dissipation. The 27C010T offers high speed programming using page programming mode. The 27C010T is offered in JEDEC-Standard Byte-Wide EPROM pinouts, which allows socket replacement with Flash Memory and Mask ROMs.

Maxwell Technologies' patented RAD-PAK® packaging technology incorporates radiation shielding in the microcircuit package. It eliminates the need for box shielding while providing the required radiation shielding for a lifetime in orbit or space mission. In a GEO orbit, RAD-PAK provides greater than 100 krad (Si) radiation dose tolerance. This product is available with screening up to Class S.

TABLE 1. 27C010T PINOUT DESCRIPTION

| PIN | SYMBOL | DESCRIPTION |
|--|------------------|--------------------|
| 12-5, 27, 26, 23, 25, 4, 28, 29, 3, 2 | A0 - A16 | Address |
| | I/O0 - I/O7 | Input/Output |
| 22 | \overline{CE} | Chip Enable |
| 24 | \overline{OE} | Output Enable |
| 32 | V _{CC} | Power Supply |
| 1 | V _{PP} | Programming Supply |
| 16 | V _{SS} | Ground |
| 31 | \overline{PGM} | Programming Enable |
| 30 | NC | No Connection |

TABLE 2. 27C010T ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | MIN | MAX | UNIT |
|---|------------------------------------|------|------|------|
| Supply Voltage ¹ | V _{CC} | -0.6 | 7.0 | V |
| Programming Voltage ¹ | V _{PP} | -0.6 | 13.5 | V |
| All Input and Output Voltage ^{1,2} | V _{IN} , V _{OUT} | -0.6 | 7.0 | V |
| A9 Voltage ² | V _{ID} | -0.6 | 13.0 | V |
| Operating Temperature Range | T _A | -55 | +125 | °C |
| Storage Temperature Range | T _S | -65 | +150 | °C |

1. Relative to V_{SS}.

2. V_{IN}, V_{OUT}, and V_{ID} min = -1.0V for pulse width ≤ 20 ns.

TABLE 3. DELTA LIMITS

| PARAMETER | VARIATION |
|------------------|------------------------------------|
| I _{CC1} | ±10% of value specified on Table 6 |
| I _{CC2} | ±10% of value specified on Table 6 |
| I _{CC3} | ±10% of value specified on Table 6 |
| ISB | ±10% of value specified on Table 6 |

TABLE 4. 27C010T RECOMMENDED OPERATING CONDITIONS

| PARAMETER | SYMBOL | MIN | MAX | UNITS |
|-----------------------------|---------------|-------------------|---------------------------|-------|
| Supply Voltage | V_{CC} | 4.5 | 5.5 | V |
| Input Voltage | V_{IL} | -0.3 ¹ | 0.8 | V |
| | V_{IH} | 2.2 | $V_{CC} + 1$ ² | |
| Thermal Impedance | Θ_{JC} | -- | 1.27 | °C/W |
| Operating Temperature Range | T_A | -55 | +125 | °C |

1. V_{IL} min = -1.0V for pulse width \leq 50 ns.
2. V_{IH} max = $V_{CC} + 1.5$ V for pulse width \leq 20 ns.

TABLE 5. 27C010T CAPACITANCE ¹

| PARAMETER | SYMBOL | MIN | MAX | UNIT |
|--------------------|-----------|-----|-----|------|
| Input Capacitance | C_{IN} | -- | 10 | pF |
| Output Capacitance | C_{OUT} | -- | 15 | pF |

1. Guaranteed by design.

TABLE 6. 27C010T DC ELECTRICAL CHARACTERISTICS FOR READ OPERATION

($V_{CC} = 5V \pm 10\%$, $V_{PP} = V_{SS}$, $T_A = -55$ TO $+125$ °C, UNLESS OTHERWISE SPECIFIED)

| PARAMETER | SYMBOL | TEST CONDITION | SUB GROUPS | MIN | TYP | MIN | UNIT |
|----------------------------|-----------|--|------------|-----|-----|------|---------|
| Input Leakage Current | I_{LI} | $V_{IN} = 5.5V$ | 1, 2, 3 | -- | -- | 2 | μA |
| Output Leakage Current | I_{LO} | $V_{OUT} = 5.5V/0.45V$ | 1, 2, 3 | -- | -- | 2 | μA |
| Standby V_{CC} Current | I_{SB} | $\overline{CE} = V_{IH}$ | 1, 2, 3 | -- | -- | 1 | mA |
| Operating V_{CC} Current | I_{CC1} | $I_{OUT} = 0$ mA, $\overline{CE} = V_{IL}$ | 1, 2, 3 | -- | -- | 30 | mA |
| | I_{CC2} | $I_{OUT} = 0$ mA, $f = 5$ MHz | 1, 2, 3 | -- | -- | 30 | |
| | I_{CC3} | $I_{OUT} = 0$ mA, $f = 10$ MHz | 1, 2, 3 | -- | -- | 50 | |
| V_{PP} Current | I_{PP1} | $V_{PP} = 5.5V$ | 1, 2, 3 | -- | 1 | 20 | μA |
| Input Voltage | V_{IH} | | 1, 2, 3 | 2.2 | -- | -- | V |
| | V_{IL} | | 1, 2, 3 | -- | -- | 0.8 | |
| Output Voltage | V_{OH} | $I_{OH} = -400$ μA | 1, 2, 3 | 2.4 | -- | -- | V |
| | V_{OL} | $I_{OL} = 2.1$ mA | 1, 2, 3 | -- | -- | 0.45 | |

TABLE 7. 27C010T AC ELECTRICAL CHARACTERISTICS FOR READ OPERATION ¹(V_{CC} = 5V ± 10%, V_{PP} = V_{SS}, T_A = -55 TO +125 °C, UNLESS OTHERWISE SPECIFIED)

| PARAMETER | TEST CONDITION | SYMBOL | SUB GROUPS | MIN | MAX | UNIT |
|--|--|------------------|------------|----------------|-------------------|------|
| Address Access Time - 120 - 150 - 200 | $\overline{CE} = \overline{OE} = V_{IL}$ | t _{ACC} | 9, 10, 11 | -- -- -- | 120 150 200 | ns |
| Chip Enable Access Time - 120 - 150 - 200 | $\overline{OE} = V_{IL}$ | t _{CE} | 9, 10, 11 | -- -- -- | 120 150 200 | ns |
| Output Enable Access Time - 120 - 150 - 200 | $\overline{CE} = V_{IL}$ | t _{OE} | 9, 10, 11 | -- -- -- | 60 70 70 | ns |
| Output Hold to Address Change - 120 - 150 - 200 | $\overline{CE} = V_{IL}$ | t _{OH} | 9, 10, 11 | 0 0 0 | -- -- -- | ns |
| Output Disable to High-Z ² - 120 - 150 - 200 | $\overline{CE} = \overline{OE} = V_{IL}$ | t _{DF} | 9, 10, 11 | 0 0 0 | 50 50 50 | ns |

1. Test conditions:

- Input pulse levels 0.45V/2.4V
- Input rise and fall times ≤ 10 ns
- Output load 1 TTL gate + 100 pF (including scope and jig)
- Referenced levels for measuring timing 0.8V/2.0V

2. t_{DF} is defined as the time at which the output becomes an open circuit and data is no longer driven.

TABLE 8. 27C010T DC ELECTRICAL CHARACTERISTICS FOR PROGRAMMING OPERATIONS ^{1,2,3,4}
 $(V_{CC} = 6.25V \pm 0.25V, V_{PP} = 12.5V \pm 0.3V, T_A = 25^\circ C)$

| PARAMETER | SYMBOL | TEST CONDITION | SUB GROUPS | MIN | MAX | UNIT |
|----------------------------|----------|---|------------|-------------------|---------------------------|---------|
| Input Leakage Current | I_{LI} | $V_{IN} = 0V$ to V_{CC} | 1, 2, 3 | -- | 2 | μA |
| Operating V_{CC} Current | I_{CC} | | 1, 2, 3 | -- | 30 | mA |
| Operating V_{PP} Current | I_{PP} | $\overline{CE} = \overline{PGM} = V_{IL}$ | 1, 2, 3 | -- | 40 | mA |
| Input Voltage ⁵ | V_{IH} | | 1, 2, 3 | 2.2 | $V_{CC} + 5$ ⁶ | V |
| | V_{IL} | | 1, 2, 3 | -0.1 ⁷ | 0.8 | |
| Output Voltage | V_{OH} | $I_{OH} = -400 \mu A$ | 1, 2, 3 | 2.4 | -- | V |
| | V_{OL} | $I_{OH} = 2.1 mA$ | 1, 2, 3 | -- | 0.45 | |

- V_{CC} must be applied before V_{PP} and removed after V_{PP} .
- V_{PP} must not exceed 13V, including overshoot.
- Do not change V_{PP} from V_{IL} to 12.5V or 12.5V to V_{IL} when $\overline{CE} = LOW$.
- DC electrical parameters for programming operations are not tested. These parameters are guaranteed by design.
- Device reliability may be adversely affected if the device is installed or removed while $V_{PP} = 12.5V$.
- If V_{IH} is over the specified maximum value, programming operation can not be guaranteed.
- V_{IL} min = -0.6V for pulse width ≤ 20 ns.

TABLE 9. 27C010T AC ELECTRICAL CHARACTERISTICS FOR PROGRAMMING OPERATIONS ^{1,2}
 $(V_{CC} = 6.25V \pm 0.25V, V_{PP} = 12.5V \pm 0.3V, T_A = 25^\circ C)$

| PARAMETER | SYMBOL | SUB GROUPS | MIN | TYP | MAX | UNIT |
|---------------------------------------|-----------|------------|------|------|------|---------|
| Address Setup Time | t_{AS} | 9, 10, 11 | 2 | -- | -- | μs |
| Address Hold Time | t_{AH} | 9, 10, 11 | 0 | -- | -- | μs |
| Data Setup Time | t_{DS} | 9, 10, 11 | 2 | -- | -- | μs |
| Data Hold Time | t_{DH} | 9, 10, 11 | 2 | -- | -- | μs |
| Chip Enable Setup Time | t_{CES} | 9, 10, 11 | 2 | -- | -- | μs |
| V_{PP} Setup Time | t_{VPS} | 9, 10, 11 | 2 | -- | -- | μs |
| V_{CC} Setup Time | t_{VCS} | 9, 10, 11 | 2 | -- | -- | μs |
| Output Enable Setup Time | t_{OES} | 9, 10, 11 | 2 | -- | -- | μs |
| Output Disable Time | t_{DF} | 9, 10, 11 | 0 | -- | 130 | ns |
| PGM Initial Programming Pulse Width | t_{PW} | 9, 10, 11 | 0.19 | 0.20 | 0.21 | ms |
| PGM Overprogramming Pulse Width | t_{OPW} | 9, 10, 11 | 0.19 | -- | 5.25 | ms |
| Data Valid from Output Enable Time | t_{OE} | 9, 10, 11 | 0 | -- | 150 | ns |
| Output Enable Pulse During Data Latch | t_{LW} | 9, 10, 11 | 1 | -- | -- | μs |
| Output Enable Hold Time | t_{OEH} | 9, 10, 11 | 2 | -- | -- | μs |
| Chip Enable Hold Time | t_{CEH} | 9, 10, 11 | 2 | -- | -- | μs |

TABLE 9. 27C010T AC ELECTRICAL CHARACTERISTICS FOR PROGRAMMING OPERATIONS ^{1,2}

($V_{CC} = 6.25V \pm 0.25V$, $V_{PP} = 12.5V \pm 0.3V$, $T_A = 25^\circ C$)

| PARAMETER | SYMBOL | SUB GROUPS | MIN | TYP | MAX | UNIT |
|----------------|------------|------------|-----|-----|-----|---------|
| PGM Setup Time | t_{PGMS} | 9, 10, 11 | 2 | -- | -- | μs |

1. Test conditions:

- Input pulse levels 0.45V / 2.4V
- Input rise and fall times ≤ 20 ns
- Referenced levels for measuring timing 0.8V/2.0V

2. AC electrical parameters for programming operation are not tested. These are guaranteed by design.

TABLE 10. 27C010T MODE SELECTION ^{1,2}

| MODE | V_{PP} | V_{CC} | \overline{CE} | \overline{OE} | \overline{PGM} | A_0 | I/O |
|-----------------|----------|----------|-----------------|-----------------|------------------|----------|-----------|
| READ | V_{CC} | V_{CC} | V_{IL} | V_{IL} | V_{PP} | X | D_{OUT} |
| OUTPUT DISABLE | V_{CC} | V_{CC} | V_{IL} | V_{IH} | V_{IH} | X | High-Z |
| STANDBY | V_{CC} | V_{CC} | V_{IH} | X | X | X | High-Z |
| PROGRAM | V_{PP} | V_{CC} | V_{IL} | V_{IN} | V_{IL} | X | D_{IN} |
| PROGRAM VERIFY | V_{PP} | V_{SS} | V_{IL} | V_{IL} | V_{IH} | X | D_{OUT} |
| PAGE DATA LATCH | V_{PP} | V_{CC} | V_{IH} | V_{IL} | V_{IH} | X | D_{IN} |
| PAGE PROGRAM | V_{PP} | V_{CC} | V_{IH} | V_{IH} | V_{IL} | X | High-Z |
| PROGRAM INHIBIT | V_{CC} | V_{CC} | V_{IL} | V_{IL} | V_{IL} | X | High-Z |
| | V_{PP} | V_{CC} | V_{IL} | V_{IH} | V_{IH} | X | High-Z |
| | V_{PP} | V_{CC} | V_{IH} | V_{IL} | V_{IL} | X | High-Z |
| | V_{PP} | V_{CC} | V_{IH} | V_{IH} | V_{IH} | X | High-Z |
| IDENTIFIER | V_{CC} | V_{CC} | V_{IL} | V_{IL} | V_{IH} | V_{IH} | ID |

1. X = Don't care.

2. $11.5V \leq V_H \leq 12.5V$.

FIGURE 1. READ TIMING WAVEFORM

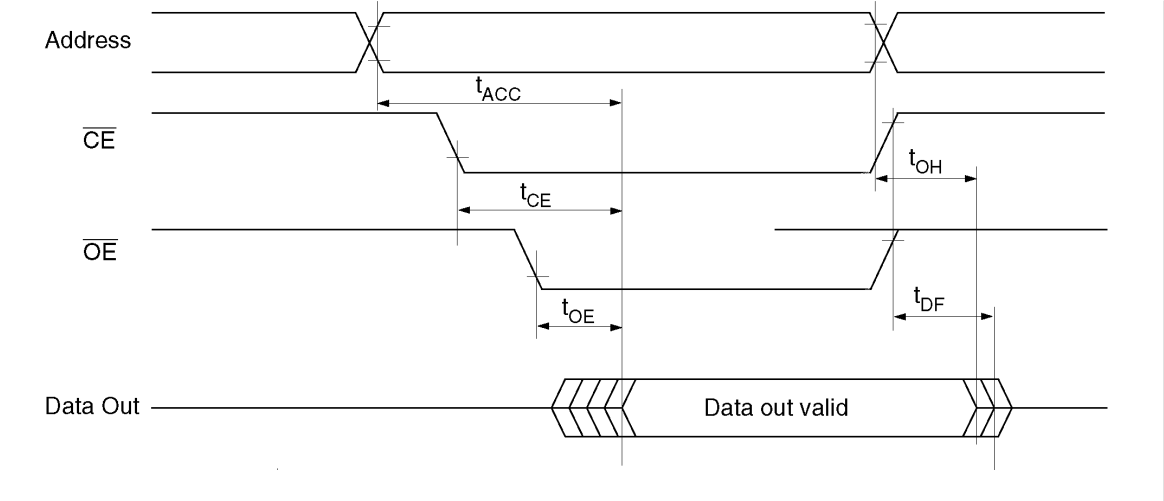


FIGURE 1.

FIGURE 2. BYTE PROGRAMMING FLOWCHART

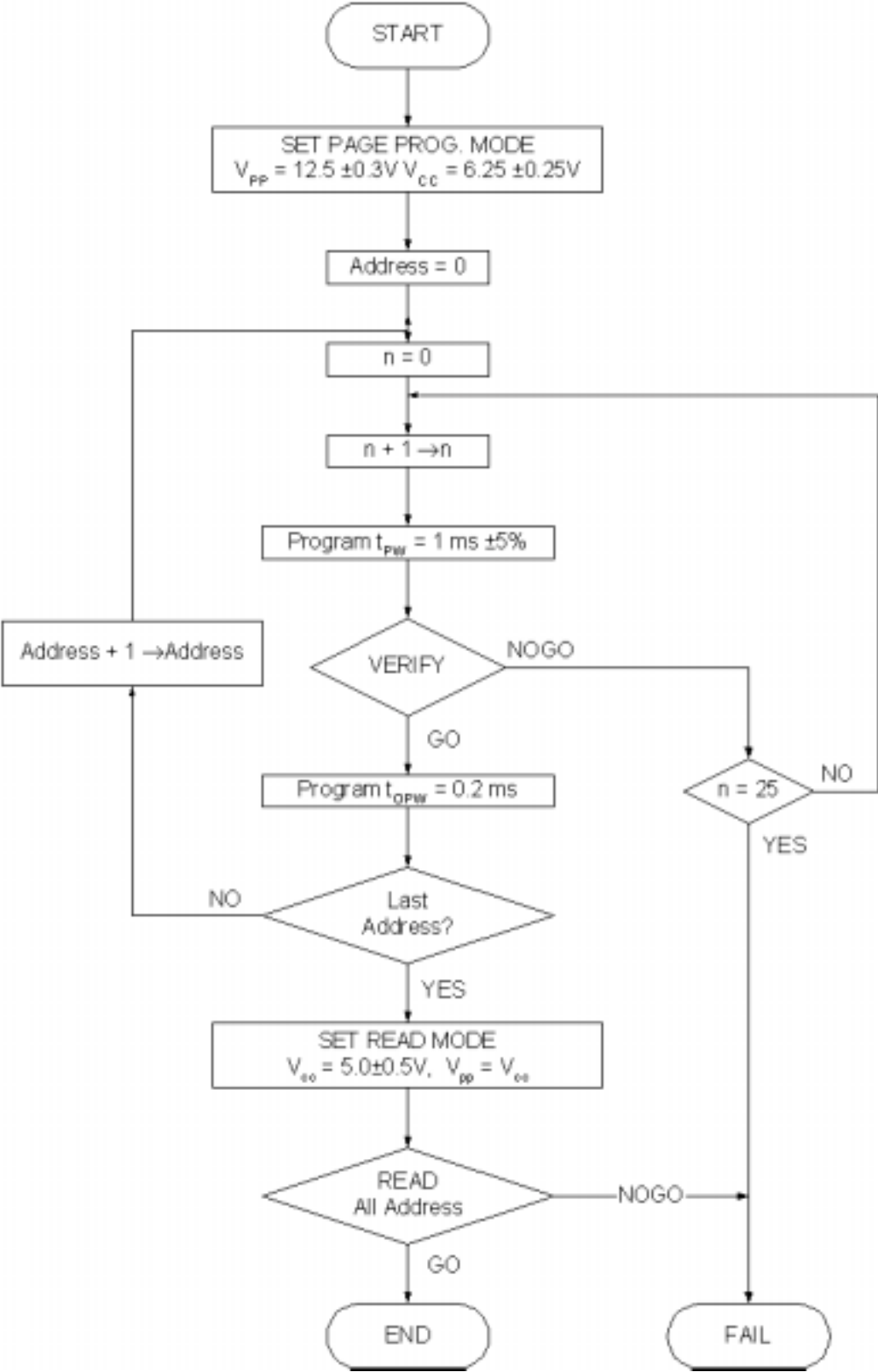


FIGURE 3. BYTE PROGRAMMING TIMING WAVEFORM

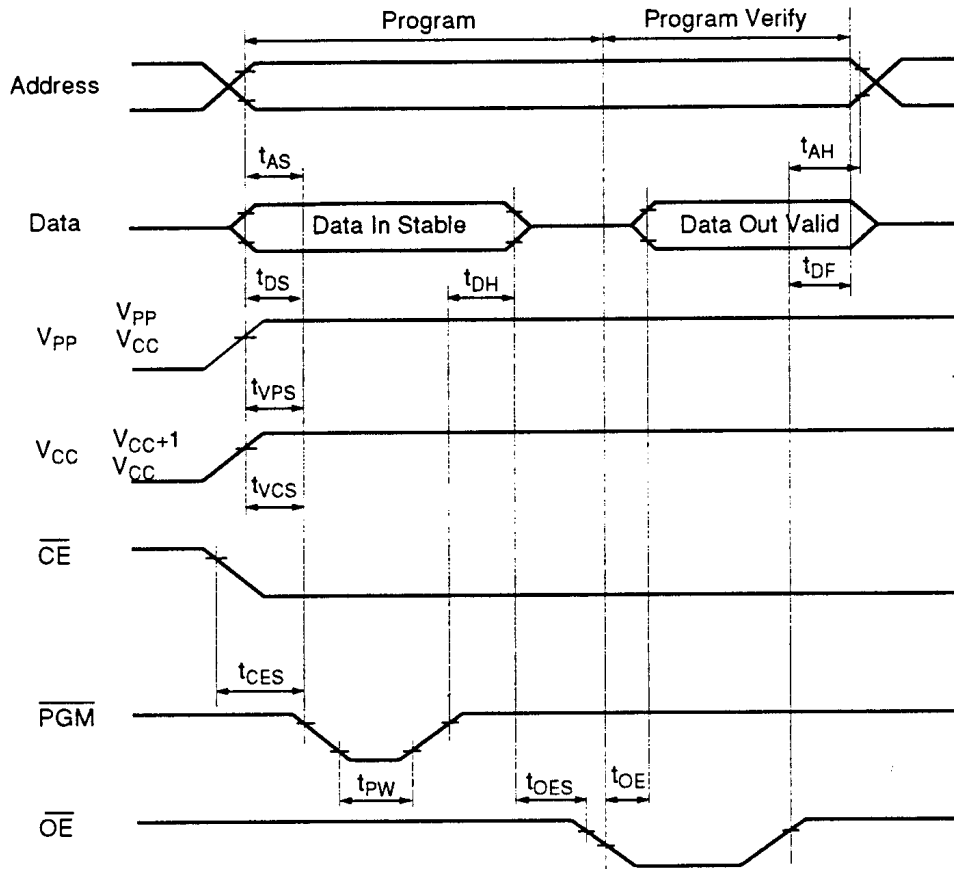


FIGURE 4. PAGE PROGRAMMING FLOWCHART

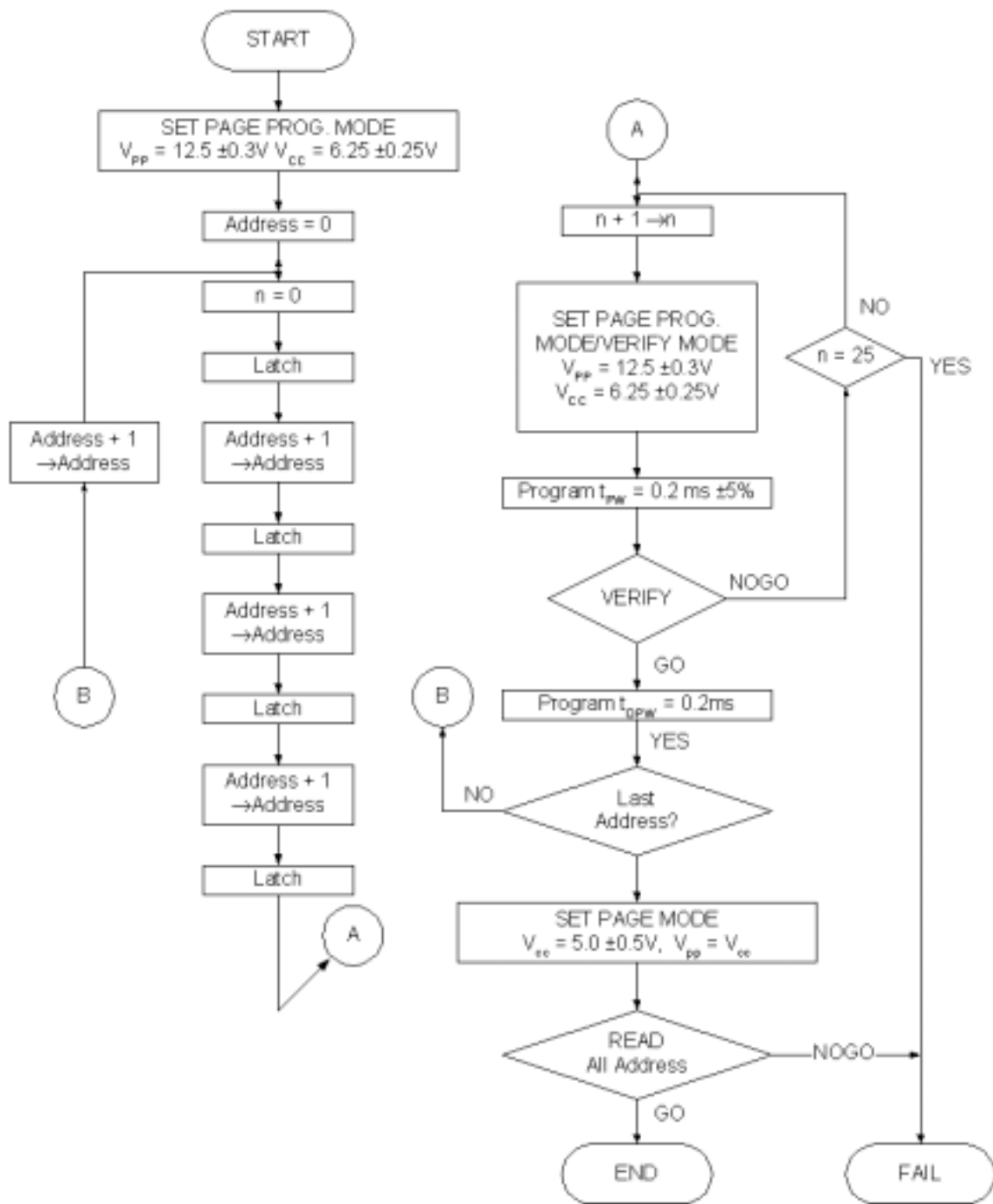
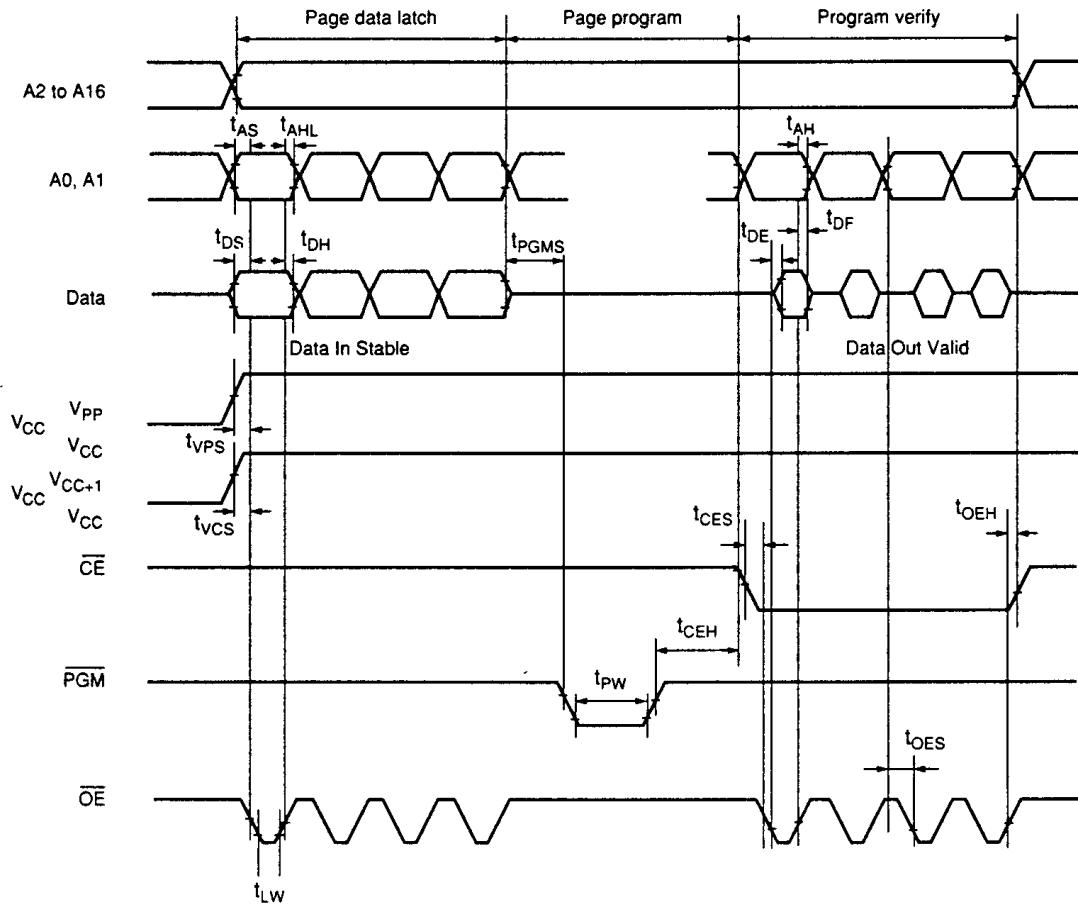
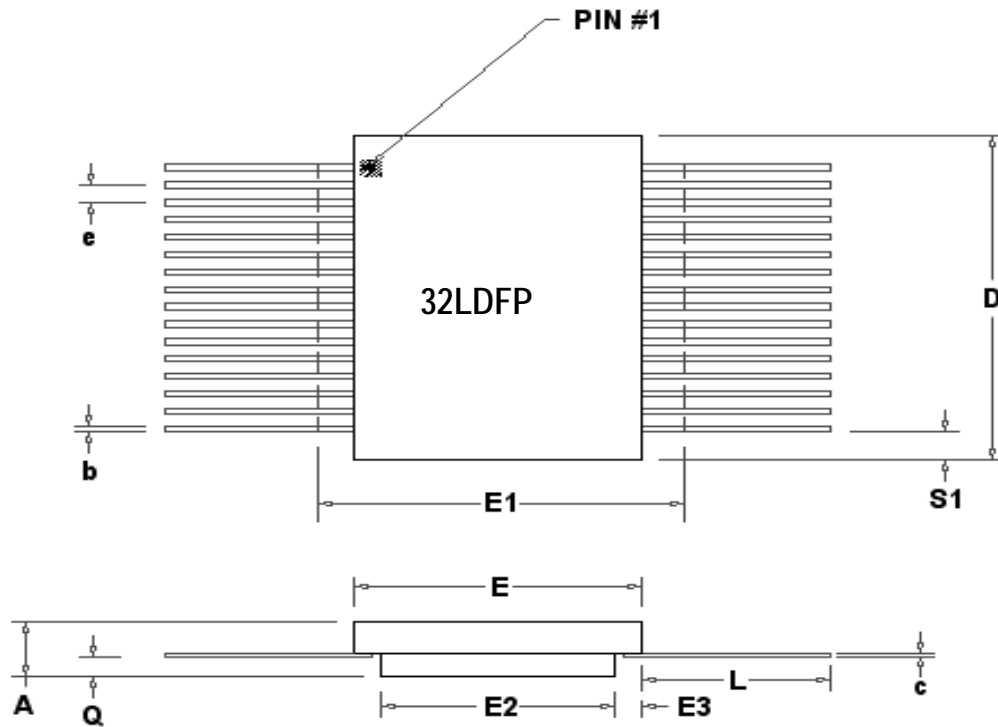


FIGURE 5. PAGE PROGRAMMING TIMING WAVEFORM





32 PIN RAD-PAK® FLAT PACKAGE

| SYMBOL | DIMENSION | | |
|--------|-----------|-------------|-------|
| | MIN | NOM | MAX |
| A | 0.194 | 0.207 | 0.220 |
| b | 0.015 | 0.017 ±.002 | 0.019 |
| c | 0.004 | 0.005 | 0.007 |
| D | 0.812 | 0.820 | 0.828 |
| E | 0.474 | 0.480 | 0.486 |
| E1 | -- | -- | 0.498 |
| E2 | 0.304 | 0.310 | 0.316 |
| E3 | 0.030 | 0.085 | -- |
| e | 0.050 BSC | | |
| L | 0.370 | 0.380 | 0.390 |
| Q | 0.067 | 0.070 | 0.073 |
| S1 | 0.005 | 0.027 | -- |
| N | 32 | | |

F32-09

Note: All dimensions in inches

Important Notice:

These data sheets are created using the chip manufacturer's published specifications. Maxwell Technologies verifies functionality by testing key parameters either by 100% testing, sample testing or characterization.

The specifications presented within these data sheets represent the latest and most accurate information available to date. However, these specifications are subject to change without notice and Maxwell Technologies assumes no responsibility for the use of this information.

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1 Megabit (128K x 8-Bit) - OTP EPROM

27C010T

Product Ordering Options

