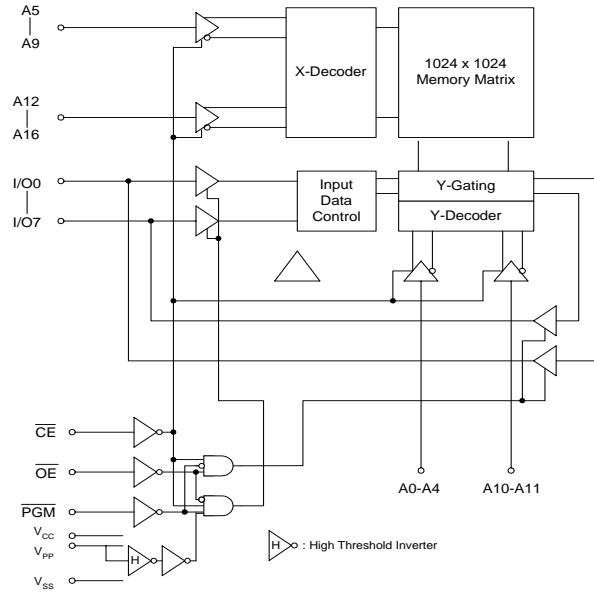
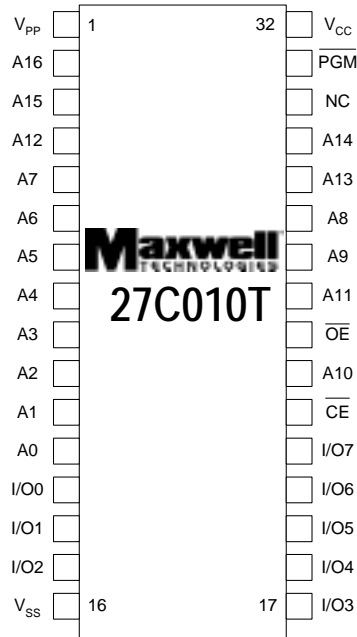


# 27C010T

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



Logic Diagram

### FEATURES:

- 128k x 8 Bit OTP EPROM organization
- RAD-PAK<sup>®</sup> radiation-hardened against natural space radiation
- Total dose hardness:
  - >100 krad (Si), depending upon space mission
- Excellent Single Event Effects:
  - SEL<sub>TH</sub> LET: > 80 MeV/mg/cm<sup>2</sup>
  - SEU<sub>TH</sub> LET (read mode): >80 MeV/mg/cm<sup>2</sup>
- Package:
  - 32 pin RAD-PAK<sup>®</sup> 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<sub>pp</sub> = 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<sup>®</sup> 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 <sup>1</sup>	$V_{CC}$	-0.6	7.0	V
Programming Voltage <sup>1</sup>	$V_{PP}$	-0.6	13.5	V
All Input and Output Voltage <sup>1,2</sup>	$V_{IN}, V_{OUT}$	-0.6	7.0	V
A9 Voltage <sup>2</sup>	$V_{ID}$	-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  $\leq$  20 ns.

TABLE 3. DELTA LIMITS

PARAMETER	VARIATION
$I_{CC1}$	$\pm 10\%$ of value specified on Table 6
$I_{CC2}$	$\pm 10\%$ of value specified on Table 6
$I_{CC3}$	$\pm 10\%$ of value specified on Table 6
ISB	$\pm 10\%$ 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 <sup>1</sup>	0.8	V
	$V_{IH}$	2.2	$V_{CC} + 1$ <sup>2</sup>	
Thermal Impedance	$\Theta_{JC}$	--	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 <sup>1</sup>

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	$\mu A$
Output Leakage Current	$I_{LO}$	$V_{OUT} = 5.5V/0.45V$	1, 2, 3	--	--	2	$\mu A$
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	$\mu A$
Input Voltage	$V_{IH}$		1, 2, 3	2.2	--	--	V
	$V_{IL}$		1, 2, 3	--	--	0.8	
Output Voltage	$V_{OH}$	$I_{OH} = -400$ $\mu A$	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 <sup>1</sup>(V<sub>CC</sub> = 5V ± 10%, V<sub>PP</sub> = V<sub>SS</sub>, T<sub>A</sub> = -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 <sub>ACC</sub>	9, 10, 11	-- -- --	120 150 200	ns
Chip Enable Access Time - 120 - 150 - 200	$\overline{OE} = V_{IL}$	t <sub>CE</sub>	9, 10, 11	-- -- --	120 150 200	ns
Output Enable Access Time - 120 - 150 - 200	$\overline{CE} = V_{IL}$	t <sub>OE</sub>	9, 10, 11	-- -- --	60 70 70	ns
Output Hold to Address Change - 120 - 150 - 200	$\overline{CE} = V_{IL}$	t <sub>OH</sub>	9, 10, 11	0 0 0	-- -- --	ns
Output Disable to High-Z <sup>2</sup> - 120 - 150 - 200	$\overline{CE} = \overline{OE} = V_{IL}$	t <sub>DF</sub>	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<sub>DF</sub> 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 <sup>1,2,3,4</sup>  
 $(V_{CC} = 6.25V \pm 0.25V, V_{PP} = 12.5V \pm 0.3V, T_A = 25^\circ C)$

PARAMETER	SYMBOL	TEST CONDITION	SUB GROUPS	MIN	MAX	UNIT
Input Leakage Current	$I_{LI}$	$V_{IN} = 0V$ to $V_{CC}$	1, 2, 3	--	2	$\mu A$
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 <sup>5</sup>	$V_{IH}$		1, 2, 3	2.2	$V_{CC} + 5$ <sup>6</sup>	V
	$V_{IL}$		1, 2, 3	-0.1 <sup>7</sup>	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  $\leq 20$  ns.

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

PARAMETER	SYMBOL	SUB GROUPS	MIN	TYP	MAX	UNIT
Address Setup Time	$t_{AS}$	9, 10, 11	2	--	--	$\mu s$
Address Hold Time	$t_{AH}$	9, 10, 11	0	--	--	$\mu s$
Data Setup Time	$t_{DS}$	9, 10, 11	2	--	--	$\mu s$
Data Hold Time	$t_{DH}$	9, 10, 11	2	--	--	$\mu s$
Chip Enable Setup Time	$t_{CES}$	9, 10, 11	2	--	--	$\mu s$
$V_{PP}$ Setup Time	$t_{VPS}$	9, 10, 11	2	--	--	$\mu s$
$V_{CC}$ Setup Time	$t_{VCS}$	9, 10, 11	2	--	--	$\mu s$
Output Enable Setup Time	$t_{OES}$	9, 10, 11	2	--	--	$\mu s$
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	--	--	$\mu s$
Output Enable Hold Time	$t_{OEH}$	9, 10, 11	2	--	--	$\mu s$
Chip Enable Hold Time	$t_{CEH}$	9, 10, 11	2	--	--	$\mu s$

TABLE 9. 27C010T AC ELECTRICAL CHARACTERISTICS FOR PROGRAMMING OPERATIONS <sup>1,2</sup>

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

PARAMETER	SYMBOL	SUB GROUPS	MIN	TYP	MAX	UNIT
PGM Setup Time	$t_{PGMS}$	9, 10, 11	2	--	--	$\mu s$

1. Test conditions:

- Input pulse levels 0.45V / 2.4V
- Input rise and fall times  $\leq 20$  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 <sup>1,2</sup>

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

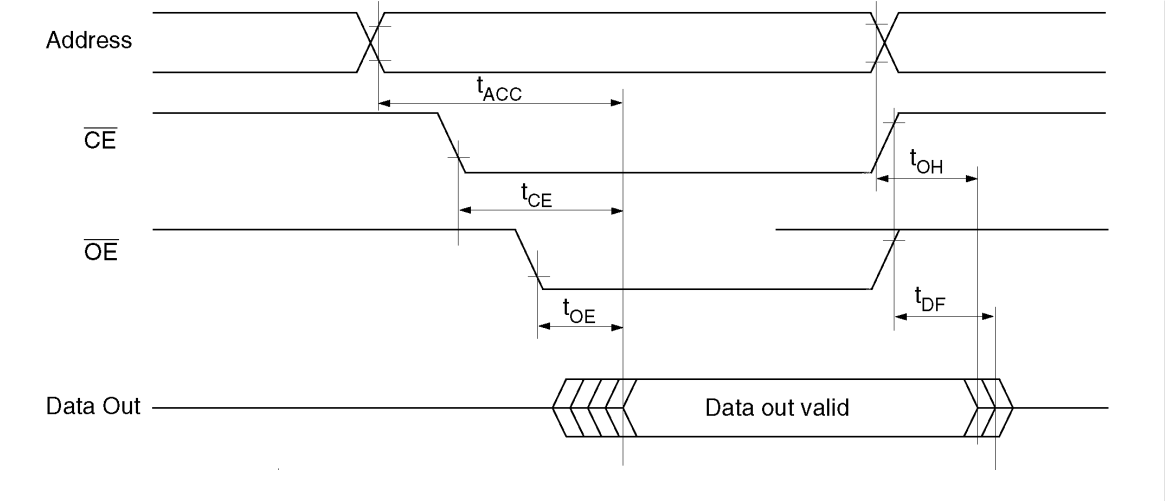


FIGURE 1.

FIGURE 2. BYTE PROGRAMMING FLOWCHART

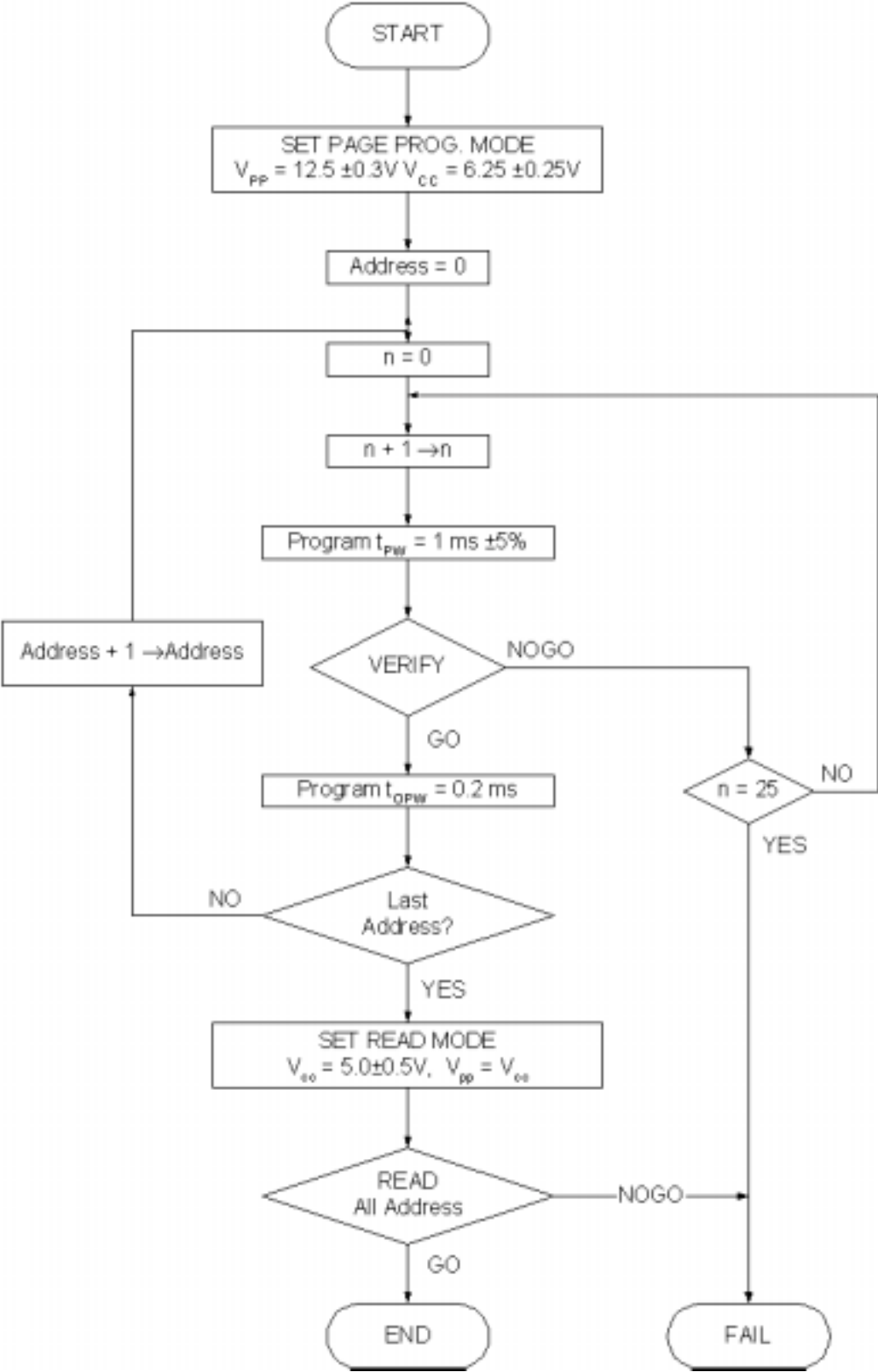




FIGURE 3. BYTE PROGRAMMING TIMING WAVEFORM

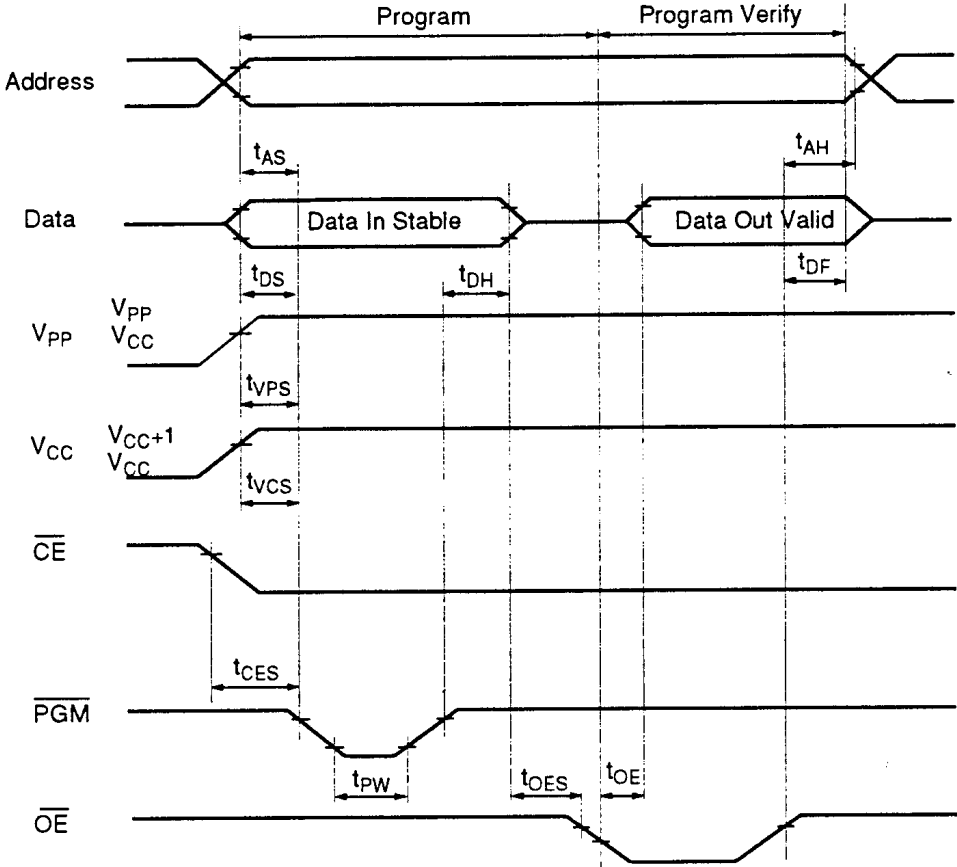
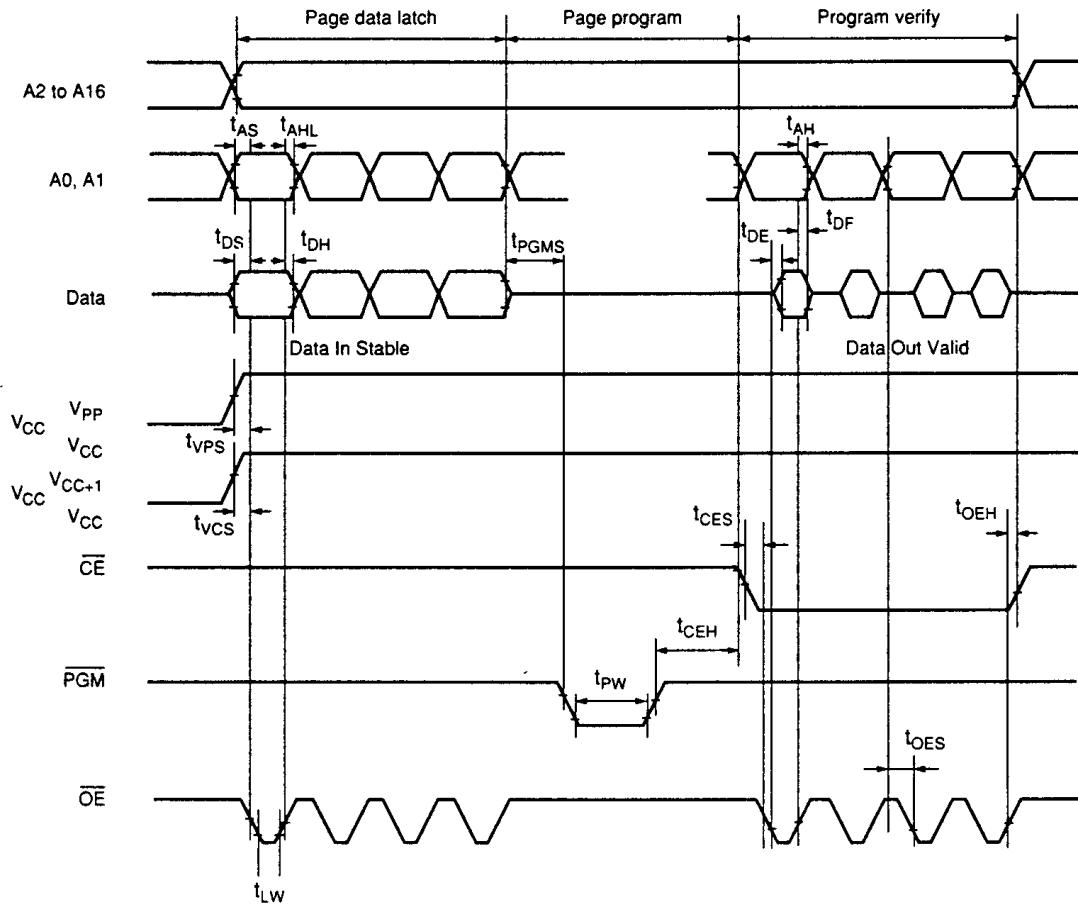
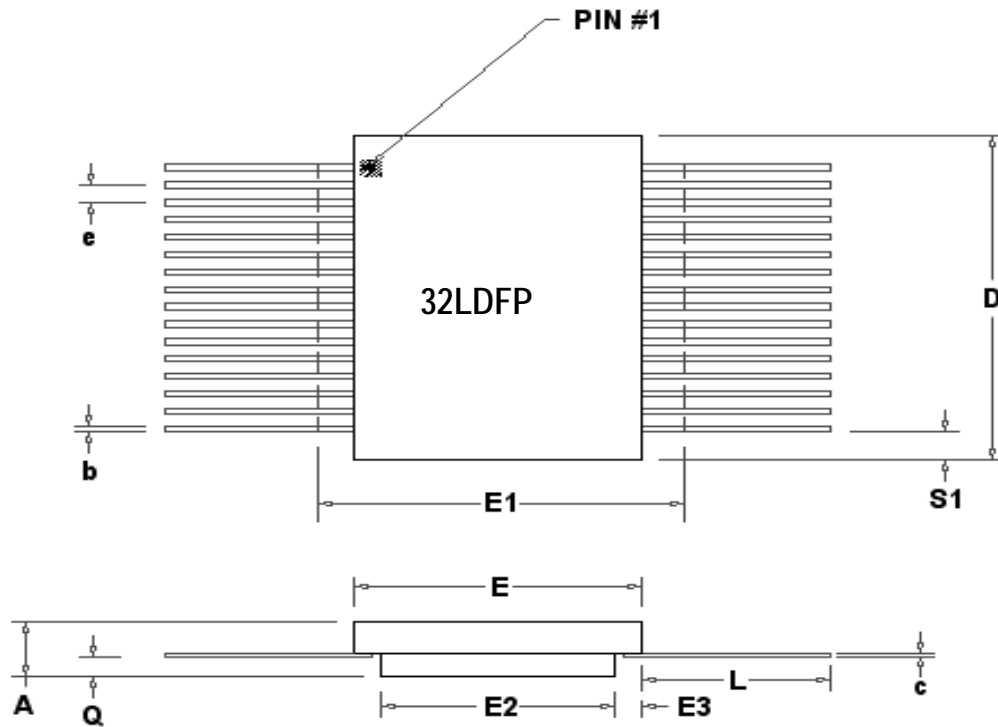




FIGURE 5. PAGE PROGRAMMING TIMING WAVEFORM





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

