PROGRAMMING

All of AMD's CMOS EPROMs now utilize the fast Flashrite™ programming algorithm. Programming the 256K EPROM typically takes 4 seconds, the 1 Mbit EPROM 16 seconds, and the 4 Mbit 1 minute. Bit locations may be programmed singly, in blocks or at random.

PROGRAMMING METHODOLOGY

Upon delivery or after each erasure, AMD's CMOS EPROM has all bits in the "ONE" or HIGH state. "ZEROs" are loaded into the device through the procedure of programming.

The programming mode is entered when 12.75 V ± 0.25 V is applied to the V_{PP} pin, $\overline{CE}$ and $\overline{PGM}$* are at V_{IL}, and $\overline{OE}$ is at V_{IH}.

For programming, the data to be programmed is applied 8- or 16-bits in parallel (depending upon the device organization) to the data output pins.

The flowchart on the next page shows AMD's Flashrite programming algorithm. The Flashrite algorithm reduces programming time by using 100 µs programming pulses and by giving each address only as many pulses as is necessary in order to reliably program the data. After each pulse is applied to a given address, the data in that address is verified. If the data does not verify, additional pulses are given until it verifies or the maximum pulse count is reached. This process is repeated while sequencing through each address of the device. This part of the algorithm is done at V_{CC} = 6.25 V to assure that each EPROM bit is programmed to a sufficiently high threshold voltage.

Program Verify

A program verify should be performed on the programmed bits to determine that they were correctly programmed. The verify should be performed with $\overline{OE}$ and $\overline{CE}$ at V_{IL}, $\overline{PGM}$* at V_{IH}, and V_{PP} between 12.5 V and 13.0 V.

Read Verify

After the final address is programmed, a read verify on the entire EPROM is performed at V_{CC} = V_{PP} = 5.25 V.

**Not all devices have the $\overline{PGM}$ pin.*

Figure 6-1 Flashrite Programming Flowchart

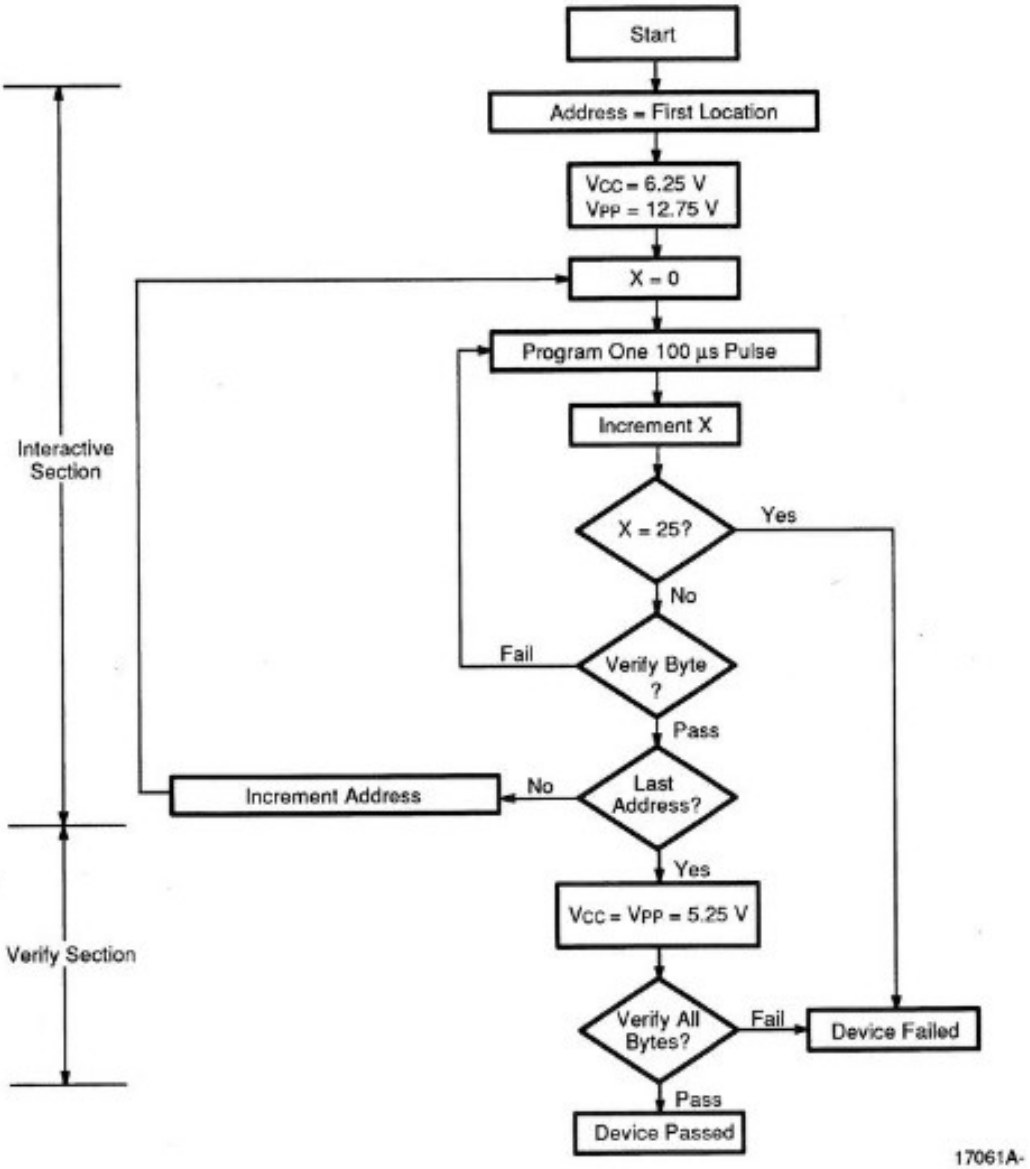


Table 6-1 **DC Programming Characteristics (T_A = +25°C ±5°C) (Notes 1, 2 and 3)**

Parameter Symbol	Parameter Description	Test Conditions	Min	Max	Unit
I_{LI}	Input Current (All Inputs)	$V_{IN} = V_{IL}$ or V_{IH}		1.0	µA
V_{IL}	Input LOW Level		−0.5	0.8	V
V_{IH}	Input HIGH Level		0.7 V_{CC}	V_{CC} + 0.5	V
V_{OL}	Output LOW Voltage During Verify	I_{OL} = 2.1 mA		0.45	V
V_{OH}	Output HIGH Voltage During Verify	I_{OH} = −400 µA	2.4		V
V_H	A9 Auto Select Voltage		11.5	12.5	V
I_{CC3}	V_{CC} Supply Current (Program & Verify)			50	mA
I_{PP2}	V_{PP} Supply Current (Program)	$\overline{CE}$ = V_{IL}, $\overline{OE}$ = V_{IH}		30	mA
V_{CC1}	Flashrite Supply Voltage		6.00	6.50	V
V_{PP1}	Flashrite Programming Voltage		12.5	13.0	V

Notes:

1. *V_{CC} must be applied simultaneously or before V_{PP}, and removed simultaneously or after V_{PP}.*
2. *When programming an AMD CMOS EPROM, a 0.1 µF capacitor is required across V_{PP} and ground to suppress spurious voltage transients which may damage the device.*
3. *Programming characteristics are sampled but not 100% tested at worst-case conditions.*

Switching Characteristics and Waveforms

These programming switching characteristics and waveforms apply to the following AMD EPROM devices: Am27C64, Am27C128, Am27C010, Am27H010, Am27LV010, Am27C1024, Am27C020, Am27LV020 and Am27C2048.

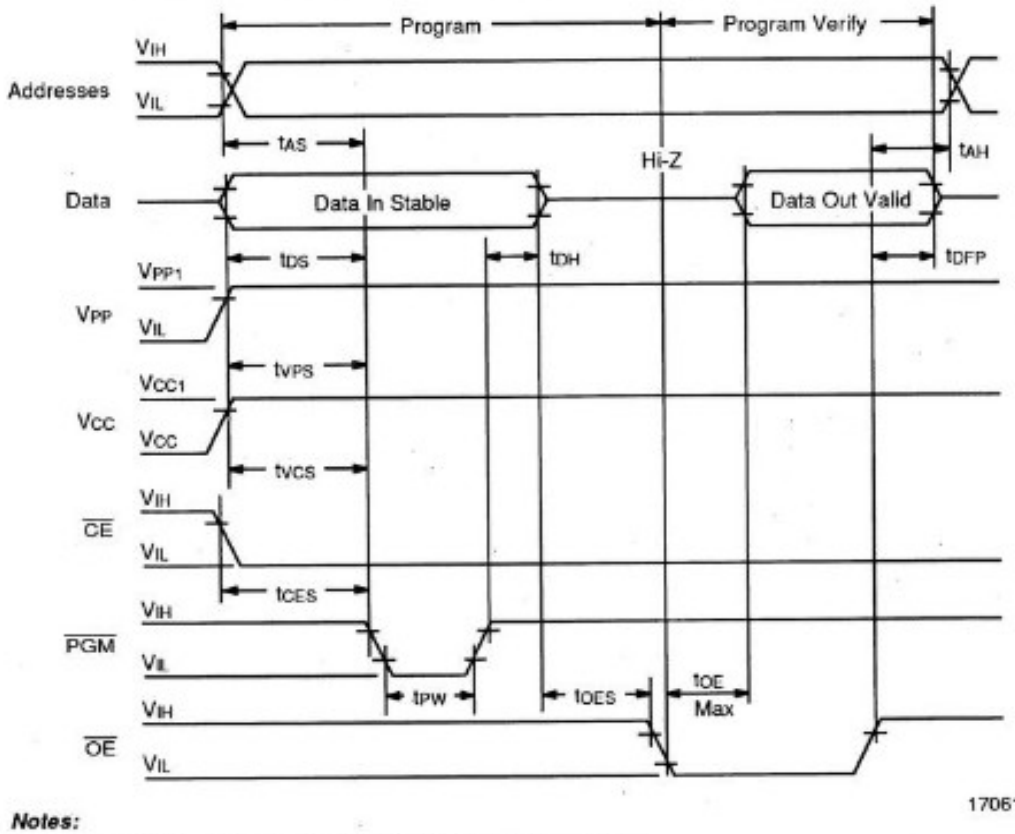
Table 6-2 **Switching Programming Characteristics (T_A = +25°C ±5°C) (Notes 1, 2 and 3)**

Parameter Symbols					
JEDEC	Standard	Parameter Description	Min	Max	Unit
t_{AVEL}	t_{AS}	Address Setup Time	2		µs
t_{DZGL}	t_{OES}	$\overline{OE}$ Setup Time	2		µs
t_{DVEL}	t_{DS}	Data Setup Time	2		µs
t_{GHAX}	t_{AH}	Address Hold Time	0		µs
t_{EHDX}	t_{DH}	Data Hold Time	2		µs
t_{GHQZ}	t_{DFP}	Output Enable to Output Float Delay	0	130	ns
t_{VPS}	t_{VPS}	V_{PP} Setup Time	2		µs
t_{ELEH1}	t_{PW}	$\overline{PGM}$ Program Pulse Width	95	105	µs
t_{VCS}	t_{VCS}	V_{CC} Setup Time	2		µs
t_{ELPL}	t_{CES}	$\overline{CE}$ Setup Time	2		µs
t_{GLQV}	t_{OE}	Data Valid from $\overline{OE}$		150	ns

Notes:

1. *V_{CC} must be applied simultaneously or before V_{PP}, and removed simultaneously or after V_{PP}.*
2. *When programming the above devices, a 0.1 µF capacitor is required across V_{PP} and ground to suppress spurious voltage transients which may damage the device.*
3. *Programming characteristics are sampled but not 100% tested at worst-case conditions.*

Figure 6-2 Flashrite Programming Algorithm Waveform (Notes 1 and 2)



Notes:

1. *The input timing reference level is 0.8 V for V_{IL} and 2 V for V_{IH}.*
2. *t_{OE} and t_{DFP} are characteristics of the device, but must be accommodated by the programmer.*

These programming switching characteristics and waveforms apply to the following EPROM devices: Am27C256, Am27H256, Am27C040, Am27C400, Am27C4096 and Am27C800.

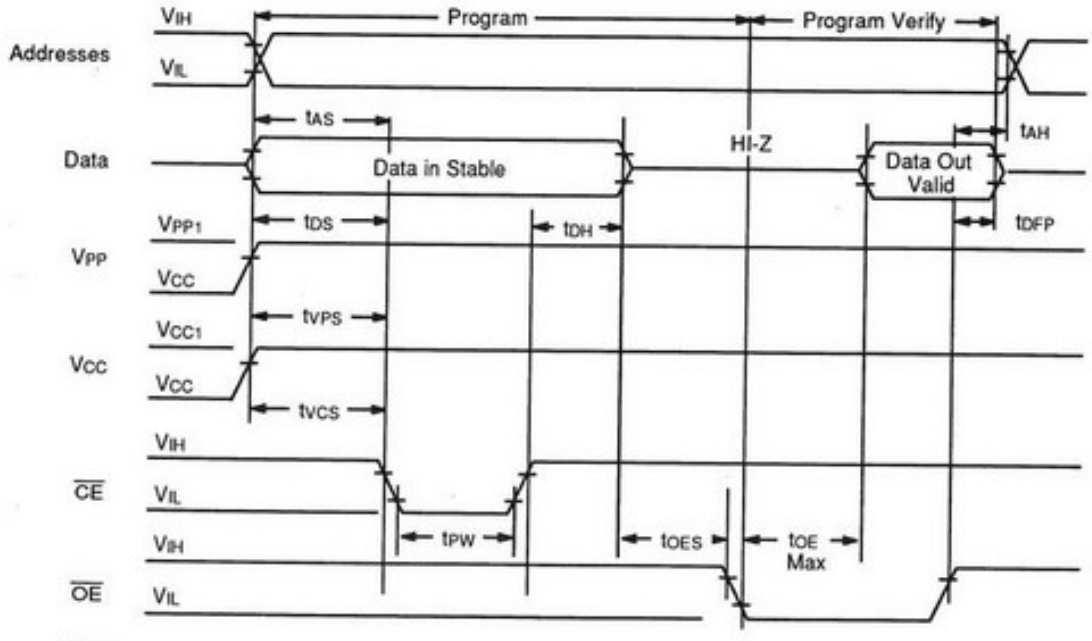
Table 6-3 Switching Programming Characteristics (T_A = +25°C ±5°C) (Notes 1, 2 and 3)

Parameter Symbols					
JEDEC	Standard	Parameter Description	Min	Max	Unit
t_{AVEL}	t_{AS}	Address Setup Time	2		µs
t_{DZGL}	t_{OES}	$\overline{OE}$ Setup Time	2		µs
t_{DVEL}	t_{DS}	Data Setup Time	2		µs
t_{GHAX}	t_{AH}	Address Hold Time	0		µs
t_{EHDX}	t_{DH}	Data Hold Time	2		µs
t_{GHQZ}	t_{DFP}	Output Enable to Output Float Delay	0	130	ns
t_{VPS}	t_{VPS}	V_{PP} Setup Time	2		µs
t_{ELEH1}	t_{PW}	$\overline{PGM}$ Program Pulse Width	95	105	µs
t_{VCS}	t_{VCS}	V_{CC} Setup Time	2		µs
t_{GLQV}	t_{OE}	Data Valid from $\overline{OE}$		150	ns

Notes:

1. *V_{CC} must be applied simultaneously or before V_{PP}, and removed simultaneously or after V_{PP}.*
2. *When programming the above devices, a 0.1 µF capacitor is required across V_{PP} and ground to suppress spurious voltage transients which may damage the device.*
3. *Programming characteristics are sampled but not 100% tested at worst-case conditions.*

Figure 6-3 Flashrite Programming Algorithm Waveform (Notes 1 and 2)



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Notes:

1. *The input timing reference level is 0.8 V for V_{IL} and 2 V for V_{IH}.*
2. *t_{OE} and t_{DFP} are characteristics of the device, but must be accommodated by the programmer.*

These programming switching characteristics and waveforms apply to the Am27C512 and Am27C080 devices.

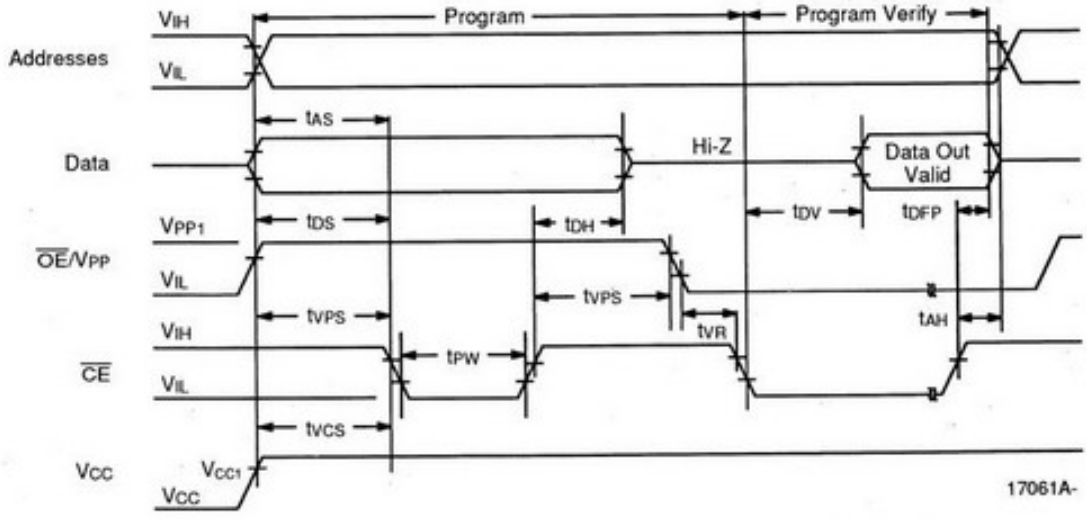
Table 6-4 Switching Programming Characteristics (T_A = +25°C ±5°C) (Notes 1, 2 and 3)

Parameter Symbols		Parameter Description	Min	Max	Unit
JEDEC	Standard				
t_{AVEL}	t_{AS}	Address Setup Time	2		µs
t_{DVEL}	t_{DS}	Data Setup Time	2		µs
t_{GHAX}	t_{AH}	Address Hold Time	0		µs
t_{EHDX}	t_{DH}	Data Hold Time	2		µs
t_{EHQZ}	t_{DFP}	Chip Enable to Output Float Delay	0	130	ns
t_{VPS}	t_{VPS}	V_{PP} Setup Time	2		µs
t_{ELEH}	t_{PW}	$\overline{CE}$ Program Pulse Width	95	105	µs
t_{VCS}	t_{VCS}	V_{CC} Setup Time	2		µs
t_{ELQV}	t_{DV}	Data Valid from $\overline{OE}$		150	ns
t_{EHGL}	t_{OEH}	$\overline{OE}/V_{PP}$ Hold Time	2		ns
t_{GLEL}	t_{VR}	$\overline{OE}/V_{PP}$ Recovery Time	2		ns

Notes:

1. *V_{CC} must be applied simultaneously or before V_{PP}, and removed simultaneously or after V_{PP}.*
2. *When programming the above devices, a 0.1 µF capacitor is required across V_{PP} and ground to suppress spurious voltage transients which may damage the device.*
3. *Programming characteristics are sampled but not 100% tested at worst-case conditions.*

Figure 6-4 Flashrite Programming Algorithm Waveform (Notes 1 and 2)



Notes:

1. *The input timing reference level is 0.8 V for V_{IL} and 2 V for V_{IH}.*
2. *t_{OE} and t_{DFP} are characteristics of the device, but must be accommodated by the programmer.*