A87C257
256K (32K x 8) CHMOS LATCHED EPROM

Automotive

- **Extended Automotive Temperature Range: −40°C to +125°C**
- **CHMOS/NMOS Microcontroller and Microprocessor Compatible**
  - **87C257-Integrated Address Latch**
  - **Universal 28 Pin Memory Site, 2-line Control**
- **120 ns Maximum Access Time**
- **CMOS and TTL Compatible**
- **Low Power**
  - **30 mA Max. Active**
  - **100 μA MAx. Standby**
- **Fast Programming**
  - **Quick-Pulse Programming Algorithm**
  - **Programming Time as Fast as 4 Seconds**
- **Noise Immunity Features**
  - **± 10% V_{CC} Tolerance**
  - **Maximum Latch-up Immunity Through EPI Processing**
- **Available in 28-Pin Cerdip Package**
  - **Compact 32 Lead PLCC**

(See Packaging Spec., Order #231369)

Intel's 87C257 CHMOS EPROM is a 256K-bit 5V only memory organized as 32,768 8-bit words. It employs advanced CHMOS*III-E circuitry for systems requiring low power, high speed performance, and noise immunity. The 87C257 is optimized for compatibility with multiplexed address/data bus microcontrollers such as Intel's 16 MHz 80C51, 80C152, 80C252, and 8 MHz 80C196.

The 87C257 incorporates latches on all address inputs to minimize chip count, reduce cost, and simplify design of multiplexed bus systems. The 87C257's internal address latch allows address and data pins to be tied directly to the processor's multiplexed address/data pins. Address information (inputs A_0–A_{14}) is latched early in the memory-fetch cycle by the falling edge of the ALE input. Subsequent address information is ignored while ALE remains low. The EPROM can then pass data (from pins O_0–O_7) on the same bus during the last part of the memory-fetch cycle.

The 87C257 is offered in a ceramic DIP and PLCC packages, providing flexibility in prototyping and R&D environments. The 87C257 employs the Quick-Pulse Programming™ Algorithm for fast and reliable programming.

Intel's EPI processing achieves the highest degree of latch-up protection. Address and data pin latch-up prevention is provided for stresses up to 100 mA from −1V to V_{CC} + 1V.

In order to meet the rigorous environmental requirements of automotive applications, Intel offers the 87C257 in extended Automotive temperature range. Operational characteristics are guaranteed over the range of −40°C to +125°C ambient.

*HMOS and CHMOS are patented processes of Intel Corporation.

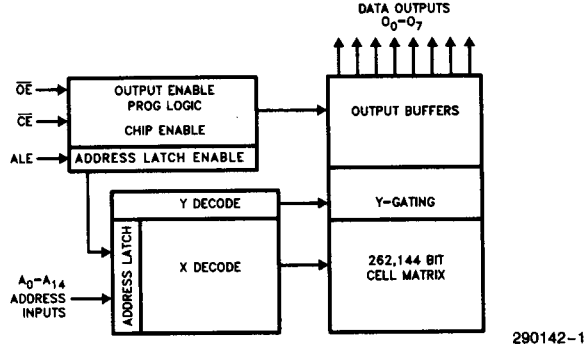


Figure 1. Block Diagram

August 1992
Order Number: 290142-004

Pin Names

A_0–A_{14}	ADDRESSES
O_0–O_7	OUTPUTS
$\overline{OE}$	OUTPUT ENABLE
$\overline{CE}$	CHIP ENABLE
ALE/V_{PP}	Address Latch Enable/V_{PP}
N.C.	NO CONNECT
D.U.	DON'T USE

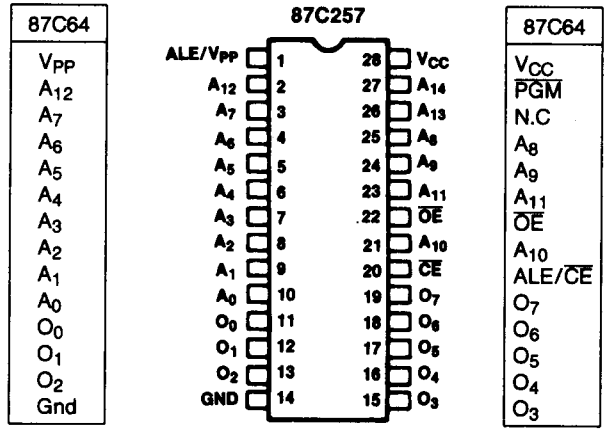


Figure 2. DIP Pin Configuration

NOTE:
Intel "Universal Site"-Compatible EPROM Pin Configurations are Shown in the Blocks Adjacent.

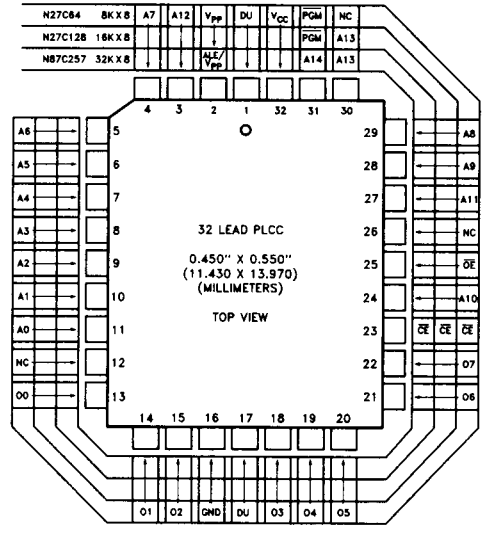


Figure 3. PLCC Lead Configuration

NOTE:
Intel "Universal Site"-Compatible EPROM Pin Configurations are Shown in the Blocks Adjacent.

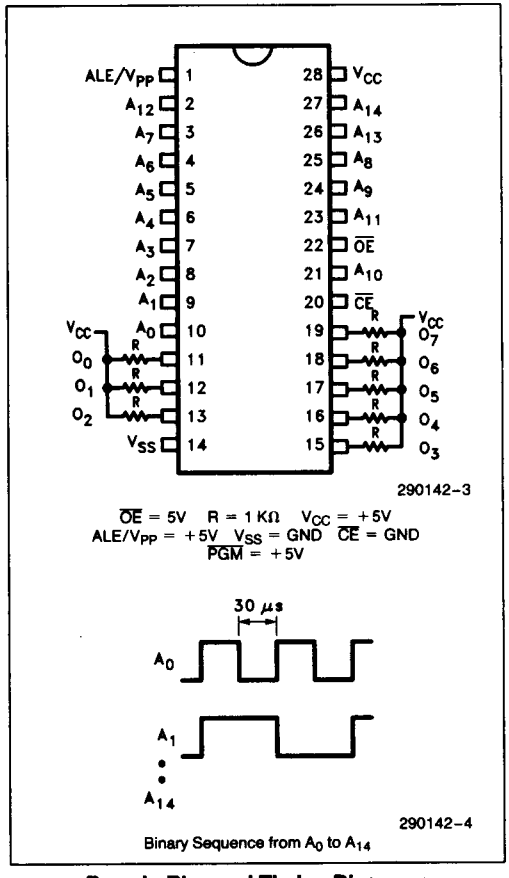
AUTOMOTIVE TEMPERATURE EPROMs

Intel automotive EPROMs have received additional processing to enhance product characteristics. The automotive temperature range is −40°C to +125°C during operating modes.

AUTOMOTIVE OPTIONS

Versions

Speed Versions	Packaging Options	
	Cerdip	PLCC
−120V10	AD	AN
−200V10	AD	AN



Burn-In Bias and Timing Diagrams

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ABSOLUTE MAXIMUM RATINGS*

Operating Temperature During Read ..... −40°C to +125°C
Temperature Under Bias ..... −40°C to +125°C
Storage Temperature ..... −65°C to +150°C
Voltage on any Pin with Respect to Ground ..... −2V to +7V(1)
Voltage on A_9 with Respect to Ground ..... −2V to +13.5V(1)
V_{PP} Supply Voltage with Respect to Ground During Programming ..... −2V to +14.0V(1)
V_{CC} Supply Voltage with Respect to Ground ..... −2V to +7.0V(1)
Maximum Junction Temperature (T_J) ..... 140°C
Maximum Thermal Resistance Junction to Ambient (θ_{JA}): Cerdip ..... 40°C/W

NOTICE: This is a production data sheet. The specifications are subject to change without notice.

**WARNING: Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.*

READ OPERATION

DC CHARACTERISTICS TTL and NMOS Inputs −40°C ≤ T_A ≤ +125°C

Symbol	Parameter		Notes	Min	Typ(2)	Max	Units	Test Condition
I_{LI}	Input Load Current				0.01	±1.0	µA	V_{IN} = 0V, 5.5V
I_{LO}	Output Leakage Current				0.01	±10	µA	V_{OUT} = 0V, 5.5V
I_{SB}	V_{CC} Current Standby with Inputs—	Switching				10	mA	$\overline{CE}$ = ALE = V_{IH}
		Stable				1.0	mA	$\overline{CE}$ = V_{IH}, ALE = V_{IL}
I_{CC_1}	V_{CC} Current Active		4			30	mA	$\overline{CE}$ = V_{IL}, ALE = V_{IH} f = 5 MHz, I_{OUT} = 0 mA
V_{IL}	Input Low Voltage (±10% Supply)		1	−0.5		0.8	V	
V_{IH}	Input High Voltage (±10% Supply)			2.0		V_{CC} + 0.5	V	
V_{OL}	Output Low Voltage					0.45	V	I_{OL} = 2.1 mA
V_{OH}	Output High Voltage			2.4			V	I_{OH} = −400 µA
I_{OS}	Output Short Circuit Current		5			100	mA	

DC CHARACTERISTICS CMOS Inputs −40°C ≤ T_A ≤ +125°C

Symbol	Parameter		Notes	Min	Typ(2)	Max	Units	Test Condition
I_{LI}	Input Load Current				0.01	±1.0	µA	V_{IN} = 5.5V
I_{LO}	Output Leakage Current				0.01	±10.0	µA	V_{OUT} = 05, 5.5V
I_{SB}	V_{CC} Current Standby with Inputs—	Switching	3			6	mA	$\overline{CE}$ = ALE = V_{IH}
		Stable				100	µA	$\overline{CE}$ = V_{IH}, ALE = V_{IL}
I_{CC_1}	V_{CC} Current Active		4			15	mA	$\overline{CE}$ = V_{IL}, ALE = V_{IH} f = 5 MHz, I_{OUT} = 0 mA
V_{IL}	Input Low Voltage (±10% Supply)			−0.2		0.8	V	
V_{IH}	Input High Voltage (±10% Supply)			0.7 V_{CC}		V_{CC} + 0.2	V	
V_{OL}	Output Low Voltage					0.4	V	I_{OL} = 2.1 mA
V_{OH}	Output High Voltage			V_{CC} − 0.8			V	I_{OH} = −2.5 mA
I_{OS}	Output Short Circuit Current		5			100	mA	

NOTES:
1. Minimum DC input voltage is −0.5V. During transitions, the inputs may undershoot to −2.0V for periods less than 20 ns. Maximum DC voltage on output pins is V_{CC} + 0.5V which may overshoot to V_{CC} + 2V for periods less than 20 ns.
2. Typical limits are at V_{CC} = 5V, T_A = +25°C.
3. $\overline{CE}$ is V_{CC} ±0.2V. All other inputs can have any value within spec.
4. Maximum current value is with outputs O_0 to O_7 unloaded.
5. Output shorted for no more than one second. No more than one output shorted at a time. I_{OS} is sampled but not 100% tested.

READ OPERATION

AC CHARACTERISTICS[1] $-40°C \le T_A \le +125°C$

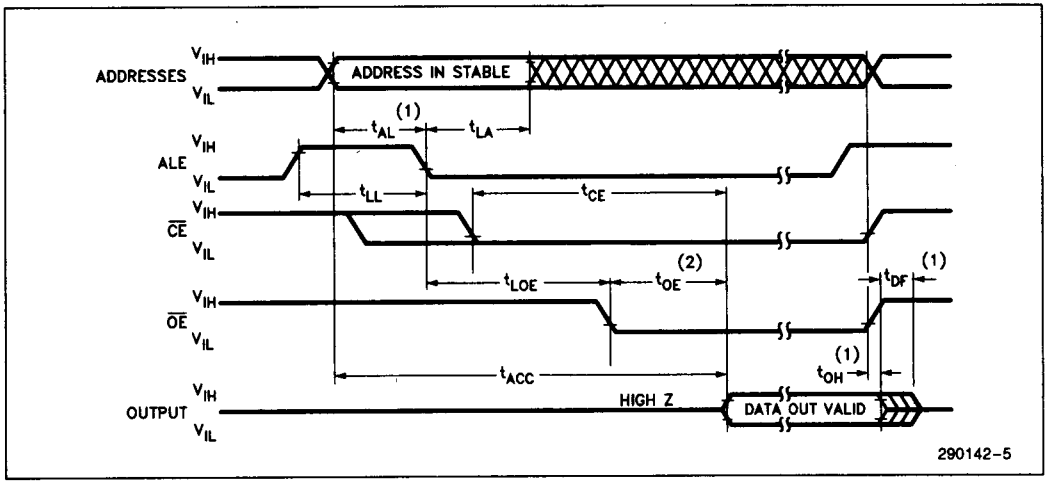
Versions		$V_{CC} \pm 10\%$	87C257-120V10		87C257-200V10		Units
Symbol	Characteristic		Min	Max	Min	Max	
t_{ACC}	Address to Output Delay			120		200	ns
t_{CE}	$\overline{CE}$ to Output Delay			120		200	ns
t_{OE}	$\overline{OE}$ to Output Delay			55		75	ns
t_{DF}[2]	$\overline{OE}$ High to Output High Z			30		40	ns
t_{OH}[2]	Output Hold from Addresses, $\overline{CE}$ or $\overline{OE}$ Change-Whichever is First		0		0		ns
t_{LL}	Latch Deselect Width		50		50		ns
t_{AL}[2]	Address to Latch Set-Up		15		15		ns
t_{LA}	Address Hold from LATCH		30		30		ns
t_{LOE}	ALE to Output Enable		30		30		ns

NOTES:
1. See AC Testing Input/Output Waveforms for timing measurements.
2. Guaranteed and sampled.

AC CONDITIONS OF TEST

Input Rise and Fall Times (10% to 90%) ..... 10 ns
Input Pulse Levels ..... V_{OL} to V_{OH}
Input Timing Reference Level 1.5V
Output Timing Reference Level ..... V_{IL} and V_{IH}

AC WAVEFORMS



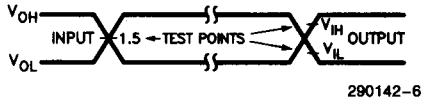
NOTES:
1. This parameter is only sampled and is not 100% tested.
2. $\overline{OE}$ may be delayed up to $t_{CE}-t_{OE}$ after the falling edge of $\overline{CE}$ without impact on t_{CE}.

CAPACITANCE[1] T_A = 25°C, f = 1.0 MHz

Symbol	Parameter	Max	Units	Conditions
C_{IN}	Address/Control Capacitance	6	pF	V_{IN} = 0V
C_{OUT}	Output Capacitance	12	pF	V_{OUT} = 0V

NOTE:
1. Sampled. Not 100% tested.

AC TESTING INPUT/OUTPUT WAVEFORM



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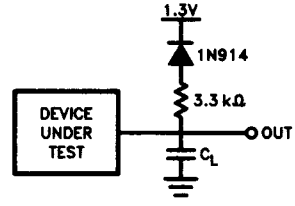
AC testing inputs are driven at V_{OH} for a Logic "1" and V_{OL} for a Logic "0". Timing measurements are made at V_{IH} for a Logic "1" and V_{IL} for a Logic "0".

AC TESTING LOAD CIRCUIT



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C_L = 100 pF
C_L Includes Jig Capacitance

DEVICE OPERATION

Table 1 lists 87C257 operating modes. Read mode requires a single 5V power supply. All input levels are TTL or CMOS except A_9 in Intelligent Identifier mode and V_{PP}.

Table 1. Mode Selection

Pins / Mode	$\overline{CE}$	$\overline{OE}$	A_9	A_0	ALE/ V_{PP}	V_{CC}	Outputs
Read	V_{IL}	V_{IL}	X[1]	X	X	5.0V	D_{OUT}
Output Disable	V_{IL}	V_{IH}	X	X	X	5.0V	High Z
Standby	V_{IH}	X	X	X	X	5.0V	High Z
Programming	V_{IL}	V_{IH}	X	X	(Note 4)	(Note 4)	D_{IN}
Program Verify	V_{IH}	V_{IL}	X	X	(Note 4)	(Note 4)	D_{OUT}
Optional Program Verify	V_{IL}	V_{IL}	X	X	V_{CC} (Note 4)	(Note 4)	D_{OUT}
Program Inhibit	V_{IH}	V_{IH}	X	X	(Note 4)	(Note 4)	High Z
Intelligent Identifier[3] -Manufacturer	V_{IL}	V_{IL}	V_H[2]	V_{IL}	X	V_{CC}	89 H
Intelligent Identifier[3] -87C257	V_{IL}	V_{IL}	V_H[2]	V_{IH}	X	V_{CC}	24 H

NOTES:
1. X can be V_{IL} or V_{IH}.
2. V_H = 12.0V ±0.5V.
3. A_1–A_8, A_{10-12} = V_{IL}, A_{13-14} = X.
4. See Table 2 for V_{CC} and V_{PP} programming voltages.

Read Mode

The 87C257 has two control functions; both must be logically active to obtain data at the outputs. Chip Enable ($\overline{CE}$) is the power control and the device-select. Output enable ($\overline{OE}$) gates data to the output pins by controlling the output buffer. When the address is stable (ALE = V_{IH}) or latched (ALE = V_{IL}), the address access time (t_{ACC}) equals the delay from $\overline{CE}$ to output (t_{CE}). Outputs display valid data t_{OE} after the falling edge of $\overline{OE}$, assuming t_{ACC} and t_{CE} times are met.

The 87C257 reduces the hardware interface in multiplexed address-data bus systems. Figure 4 shows a low power, small board space, minimal chip 87C257/microcontroller design. The processor's multiplexed bus (AD_{0-7}) is tied to the 87C257's address and data pins. No separate address latch is needed because the 87C257 latches all address inputs when ALE is low.

The ALE input controls the 87C257's internal address latch. As ALE transitions from V_{IH} to V_{IL}, the last address present at the address pins is retained. The $\overline{OE}$ control can then enable EPROM data onto the bus.

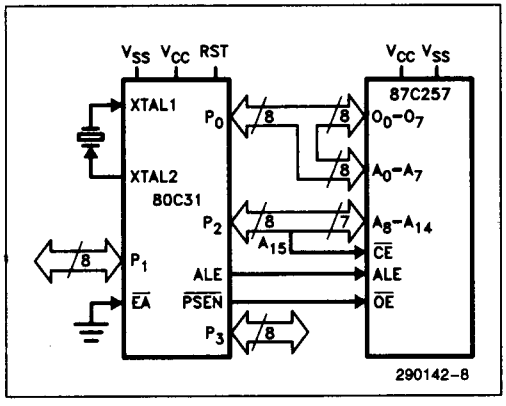

Figure 4. 80C31 with 87C257 System Configuration

Standby Mode

The standby mode substantially reduces V_{CC} current. When $\overline{CE}$ = V_{IH}, the standby mode places the outputs in a high impedance state, independent of the $\overline{OE}$ input.

Two Line Output Control

EPROMs are often used in larger memory arrays. Intel provides two contol inputs to accommodate multiple memory connections. Two-line control provides for:

a) the lowest possible memory power dissipation, and

b) complete assurance that output bus contention will not occur.

To efficiently use these two control inputs, an address decoder should enable $\overline{CE}$, while $\overline{OE}$ should be connected to all memory-array devices and the system's $\overline{READ}$ control line. This assures that only selected memory devices have active outputs while deselected memory devices are in low-power standby mode.

SYSTEM CONSIDERATIONS

EPROM power switching characteristics require careful device decoupling. System designers are interested in three supply current (ICC) issues—standby current levels, active current levels, and transient current peaks produced by falling and rising edges of Chip Enable. Transient current magnitudes depend on the device outputs' capacitive and inductive loading. Two-Line Control and proper decoupling capacitor selection will suppress transient voltage peaks. Each device should have a 0.1 μF ceramic capacitor connected between its V_{CC} and GND. This high frequency, low inherent-inductance capacitor should be placed as close as possible to the device. Additionally, for every eight devices, a 4.7 μF electrolytic capacitor should be placed between V_{CC} and GND at the array's power supply connection. The bulk capacitor will overcome voltage slumps caused by PC board trace inductances.

PROGRAMMING MODES

Caution: Exceeding 14V on V_{PP} will permanently damage the device.

Initially, and after each erasure, all EPROM bits are in the "1" state. Data is introduced by selectively programming "0s" into the desired bit locations. Although only "0s" are programmed, the data word

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can contain both "1s" and "0s". Ultraviolet light erasure is the only way to change "0s" to "1s".

The programming mode is entered when V_{PP} is raised to its programming voltage (see Table 2). Data is programmed by applying an 8-bit word to the output pins (O_{0-7}). Pulsing $\overline{CE}$ to TTL-low while $\overline{OE} = V_{IH}$ will program data. TTL levels are required for address and data inputs.

Program Inhibit

The Program Inhibit mode allows parallel programming of multiple EPROMs with different data. With V_{PP} at its programming voltage, a $\overline{CE}$-low pulse programs the desired EPROM. $\overline{CE}$-high inputs inhibit programming of non-targeted devices. Except for $\overline{CE}$ and $\overline{OE}$, parallel EPROMs may have common inputs.

Program Verify

With V_{PP} and V_{CC} at their programming voltages, a verify (read) determines that bits are correctly programmed. The verify is performed with $\overline{CE} = V_{IH}$ and $\overline{OE} = V_{IL}$. Valid data is available t_{OE} after $\overline{OE}$ falls low.

Intelligent Identifier Mode

The Intelligent Identifier Mode will determine an EPROM's manufacturer and device type. Programming equipment can automatically match a device with its proper programming algorithm.

This mode is activated when programming equipment forces 12V ±0.5V on the EPROM's A_9 address line. With A_1-A_8, $A_{10}-A_{12} = V_{IL}$ (A_{13-14} are don't care), address line $A_0 = V_{IL}$ will present the manufacturer's code and $A_0 = V_{IH}$ the device code (see Table 1). When $A_9 = V_H$, ALE need not be toggled to latch each identifier address. This mode functions in the 25°C ±5°C ambient temperature range required during programming.

ERASURE CHARACTERISTICS (FOR CERDIP EPROMS)

Exposure to light of wavelength shorter than 4000 Angstroms (Å) begins EPROM erasure. Sunlight and some fluorescent lamps have wavelengths in the 3000–4000Å range. Constant exposure to room-level fluorescent light can erase an EPROM in about 3 years (about 1 week for direct sunlight). Opaque labels over the window will prevent unintentional erasure under these lighting conditions.

The recommended erasure procedure is exposure to 2537Å ultraviolet light. The minimum integrated dose (intensity x exposure time) is 15 Wsec/cm^2. Erasure time using a 12000 μW/cm^2 ultraviolet lamp is approximately 15 to 20 minutes. The EPROM should be placed about 1 inch from the lamp. The maximum integrated dose is 7258 Wsec/cm^2 (1 week @ 12000 μW/cm^2). High intensity UV light exposure for longer periods can cause permanent damage.

CHMOS NOISE CHARACTERISTICS

System reliability is enhanced by Intel's CHMOS EPI-process techniques. Protection on each data and address pin prevents latch-up; even with 100 mA currents and voltages from -1V to $V_{CC} + 1$V. Additionally, the V_{PP} pin is designed to resist latch-up to the 14V maximum device limit.

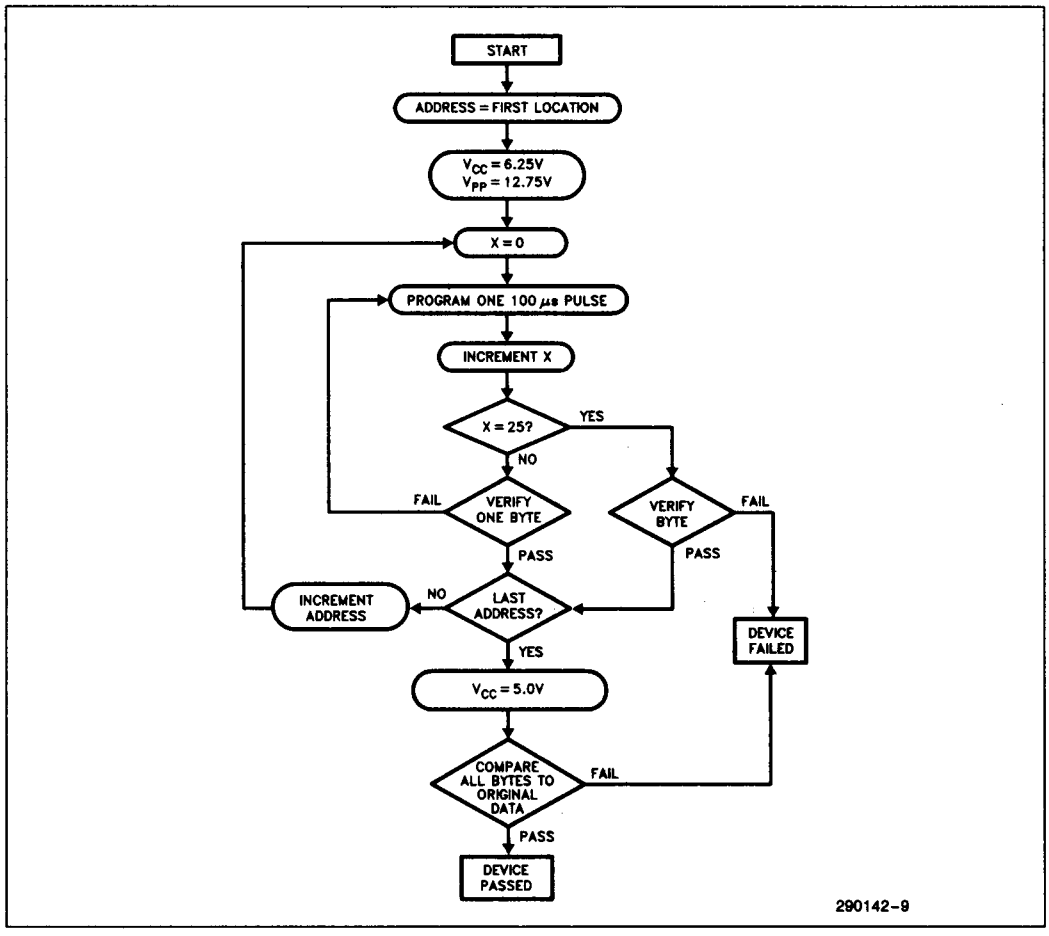


Figure 5. Quick-Pulse Programming Algorithm

Quick-Pulse Programming Algorithm

The Quick-Pulse Programming algorithm programs Intel's 87C257 EPROM. Developed to substantially reduce production programming throughput time, this algorithm can program a 87C257 in under four seconds. Actual programming time depends on the PROM programmer used.

The Quick-Pulse Programming algorithm uses a 100 microsecond initial-pulse followed by a byte verification to determine when the addressed byte is correctly programmed. The algorithm terminates if 25 100µs pulses fail to program a byte. Figure 5 shows the Quick-Pulse Programming algorithm flowchart.

The entire program-pulse/byte-verify sequence is performed with V_{CC} = 6.25V and V_{PP} = 12.75V. When programming is complete, all bytes should be compared to the original data with V_{CC} = 5.0V.

Alternate Programming

Intel's 27C256 Quick-Pulse Programming algorithms will also program the 87C257. By overriding a check for the Intelligent Identifier, older or non-upgraded PROM programmers can program the 87C257. See Intel's 27C256 data sheets for programming waveforms of these alternate algorithms.

In addition to the Quick-Pulse Programming Algorithm, the 87C257 has also been characterized for the Quick-Board Programming Algorithm. The Quick-Board Programming Algorithm was developed for specific automotive applications using Intel's 1.0 micron EPROM products. Contact the factory or an automotive sale representative for any information regarding the Quick-Board Programming Algorithm.

DC PROGRAMMING CHARACTERISTICS $T_A = 25°C \pm 5°C$

Table 2

Symbol	Parameter	Limits			Test Conditions
		Min	Max	Unit	
I_{LI}	Input Current (All Inputs)		1.0	μA	$V_{IN} = V_{IL}$ or V_{IH}
V_{IL}	Input Low Level (All Inputs)	−0.2	0.8	V	
V_{IH}	Input High Level	2.0	$V_{CC} + 0.5$	V	
V_{OL}	Output Low Voltage During Verify		0.4	V	$I_{OL} = 2.1$ mA
V_{OH}	Output High Voltage During Verify	$V_{CC} - 0.8$		V	$I_{OH} = -400$ μA
I_{CC2}(3)	V_{CC} Supply Current		30	mA	
I_{PP2}(3)	V_{PP} Supply Current (Program)		50	mA	$\overline{CE} = V_{IL}$
V_{ID}	A_9 Intelligent Identifier Voltage	11.5	12.5	V	
V_{PP}(1)	Programming Voltage	12.5	13.0	V	
V_{CC}(1)	Supply Voltage During Programming	6.0	6.5	V	

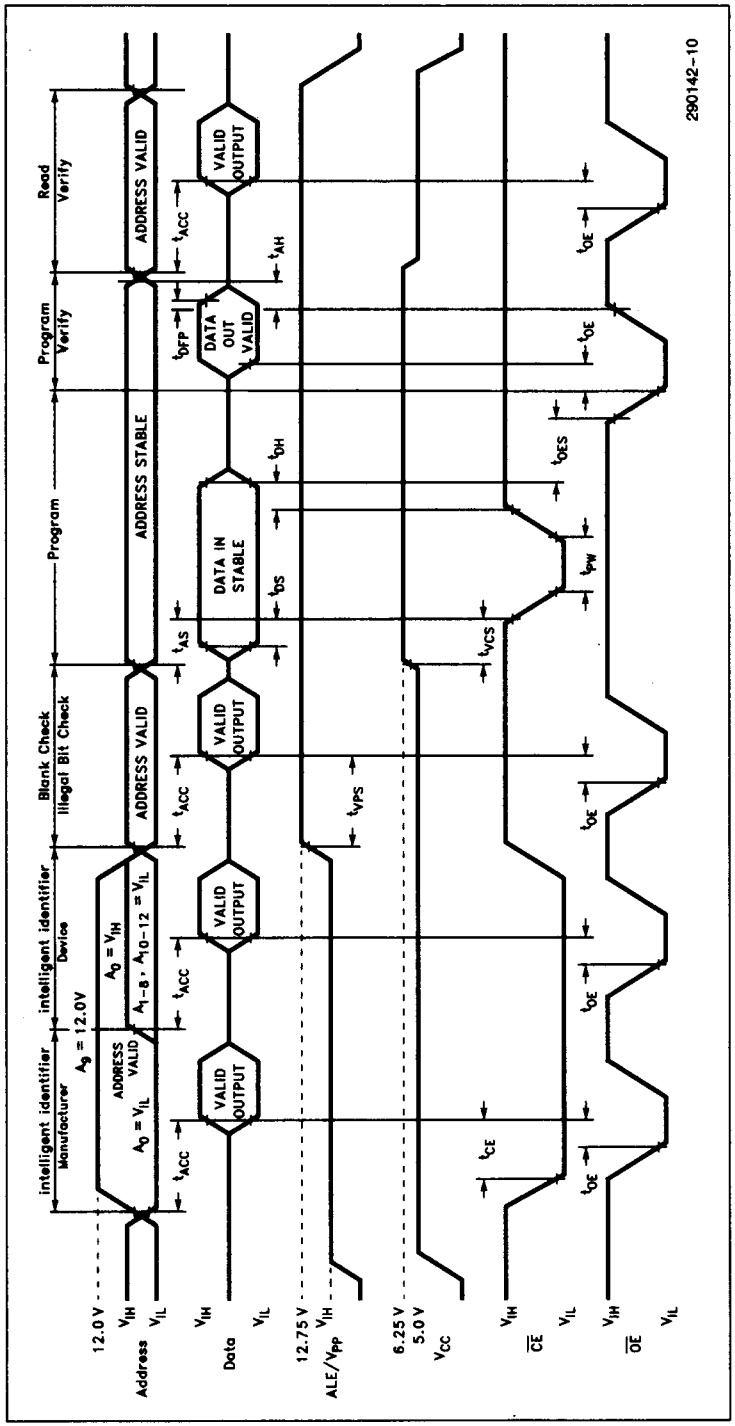
AC PROGRAMMING CHARACTERISTICS

$T_A = 25°C \pm 5°C$; see Table 2 for V_{CC} and V_{PP} voltages.

Symbol	Parameter	Limits				Conditions
		Min	Typ	Max	Unit	
t_{AS}	Address Setup Time	2			μs	
t_{OES}	$\overline{OE}$ Setup Time	2			μs	
t_{DS}	Data Setup Time	2			μs	
t_{AH}	Address Hold Time	0			μs	
t_{DH}	Data Hold Time	2			μs	
t_{DFP}(2)	$\overline{OE}$ High to Output Float Delay	0		130	ns	
t_{VPS}(1)	V_{PP} Setup Time	2			μs	
t_{VCS}(1)	V_{CC} Setup Time	2			μs	
t_{PW}	$\overline{CE}$ Program Pulse Width	95	100	105	μs	
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. This parameter is only sampled and is not 100% tested. Output Float is defined as the point where data is no longer driven—see timing diagram.
3. The maximum current value is with outputs O_0 to O_7 unloaded.

PROGRAMMING WAVEFORMS



NOTES:
1. The input timing reference level is V_{IL} = 0.8V and V_{IH} = 2V.
2. t_{OE} and t_{DFP} are device characteristics but must be accommodated by the programmer.
3. To prevent device damage during programming, a 0.1 μF capacitor is required between V_{PP} and ground to suppress spurious voltage transients.
4. During programming, the address latch function is bypassed whenever V_{PP} = 12.75V or $A_9 = V_H$. When V_{PP} and A_9 are at TTL levels, the address latch function is enabled, and the device functions in read mode.
5. V_{PP} can be 12.75V during Blank Check and Final Verify; if so, $\overline{CE}$ must be V_{IH}.

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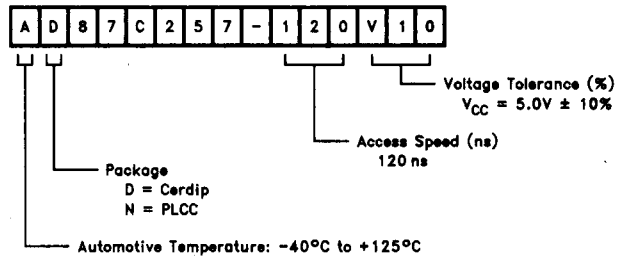
ORDERING INFORMATION



Valid Combinations:
AD87C257-120V10 AN87C257-120V10
AD87C257-200V10 AN87C257-200V10

REVISION HISTORY

Number	Description
004	Added the 120 ns speed bin