EM27C040 4-Megabit (512K x 8) UVPROM

Features

- **Functional Compatible to AMD's AM27C040**
- **Fast Read Access Time – 45 ns**
- **Low-Power CMOS Operation**
  - **– 100 µA Max Standby**
  - **– 30 mA Max Active at 5 MHz**
- **JEDEC Standard Packages – 32-lead ceramic DIP**
- **5V ± 10% Supply**
- **High-Reliability CMOS Technology**
  - **– 2,000V ESD Protection**
  - **– 200 mA Latchup Immunity**
- **Rapid Programming Algorithm – 100 µs/Byte (Typical)**
- **CMOS and TTL Compatible Inputs and Outputs**
- **Integrated Product Identification Code**
- **Industrial, Extended Temperature Ranges and Military Screening**

1. Description

The EM27C040 is fabricated using high-density nonvolatile memory CMOS process and is assembled and tested in EM Semi approved assembly and test facilities. The device is offered in industrial, extended and a version screened to a military test flow.

The EM27C040 is a low-power, high-performance 4,194,304-bit UVPROM organized 512K by 8 bits. It requires only one 5V power supply in normal read mode operation. Any byte can be accessed in less than 45 ns, eliminating the need for speed reducing WAIT states on high-performance microprocessor systems.

Power consumption is typically 8 mA in active mode and less than 10 µA in standby mode.

The EM27C040 is available in industry-standard JEDEC-approved ceramic DIP packages. All devices feature two-line control (CE_{NOT}, OE_{NOT}) to give designers the flexibility to prevent bus contention.

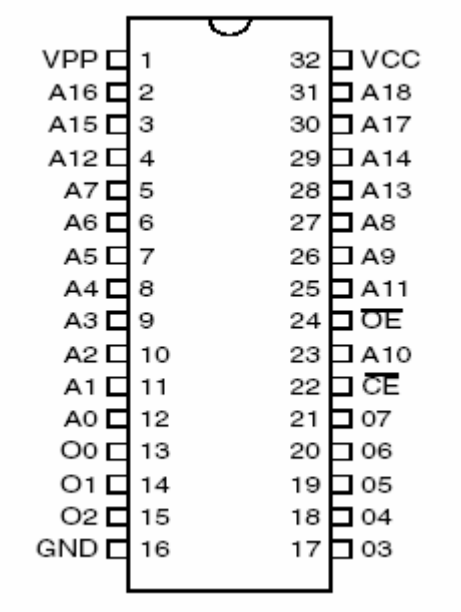
With 512K byte storage capability, the EM27C040 allows firmware to be stored reliably and to be accessed by the system without the delays of mass storage media.

EM27C040 has additional features to ensure high quality and efficient production use. The Rapid Programming Algorithm reduces the time required to program the part and guarantees reliable programming. Programming time is typically only 100 µs/byte. The Integrated Product Identification Code electronically identifies the device and manufacturer. This feature is used by industry-standard programming equipment to select the proper programming algorithms and voltages.

2. Pin Configurations

Pin Name	Function
A0 – A18	Addresses
O0 - O7	Outputs
CE_{NOT}	Chip Enable
OE_{NOT}	Output Enable

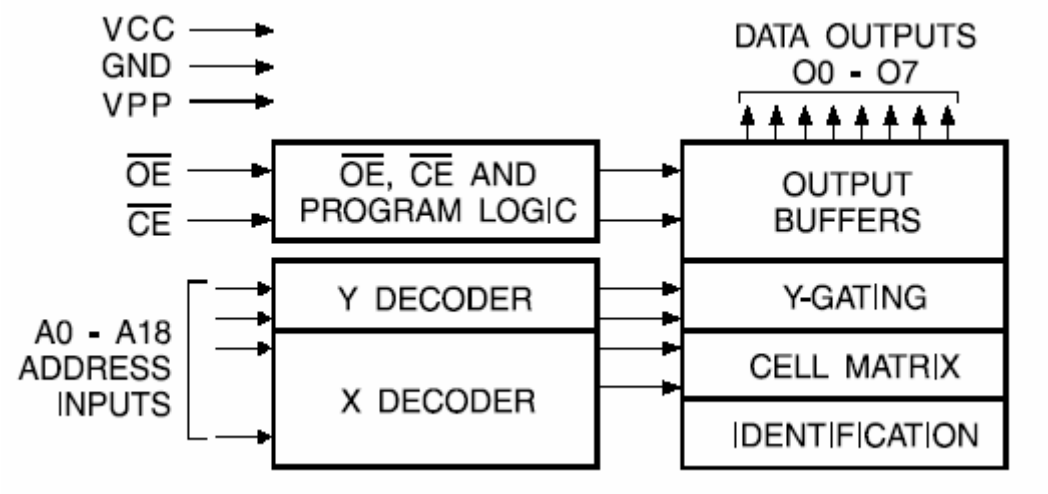
2.1 32-lead Ceramic DIP Top View



3. System Considerations

Switching between active and standby conditions via the Chip Enable pin may produce transient voltage excursions. Unless accommodated by the system design, these transients may exceed datasheet limits, resulting in device non-conformance. At a minimum, a 0.1 µF high frequency, low inherent inductance, ceramic capacitor should be utilized for each device. This capacitor should be connected between the V_{CC} and Ground terminals of the device, as close to the device as possible. Additionally, to stabilize the supply voltage level on printed circuit boards with large EPROM arrays, a 4.7 µF bulk electrolytic capacitor should be utilized, again connected between the V_{CC} and Ground terminals. This capacitor should be positioned as close as possible to the point where the power supply is connected to the array.

4. Block Diagram



5. Absolute Maximum Ratings*

Temperature Under Bias..... -55°C to + 125°C
Storage Temperature ..... -65°C to + 150°C
Voltage on Any Pin with
Respect to Ground .....-2.0V to + 7.0V
Voltage on A9 with
Respect to Ground .....-2.0V to + 14.0V
V_{PP} Supply Voltage with
Respect to Ground .....-2.0V to + 14.0V

* NOTICE:

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

6. Operating Modes

Mode/Pin	CE_{NOT}	OE_{NOT}	Ai	Vpp	Outputs
Read	V_{IL}	V_{IL}	Ai	X(1)	D_{OUT}
Output Disable	X	V_{IH}	X	X	High Z
Standby	V_{IH}	X	X	X	High Z
Rapid Program(2)	V_{IL}	V_{IH}	Ai	Vpp	D_{IN}
PGM Verify	X	V_{IL}	Ai	Vpp	D_{OUT}
PGM Inhibit	V_{IH}	V_{IH}	X	Vpp	High Z
Product Identification(4)	V_{IL}	V_{IL}	A9 =V_H(3) A0 = V_{IH} or V_{IL} A1 - A18 = V_{IL}	X	Identification Code

Notes:

1. X can be V_{IL} or V_{IH}.
2. Refer to Programming Characteristics.

3. V_H = 12.0 ± 0.5V.

4. Two identifier bytes may be selected. All Ai inputs are held low (V_{IL}), except A9 which is set to V_H and A0 which is toggled low (V_{IL}) to select the Manufacturer's Identification byte and high (V_{IH}) to select the Device Code byte.

7. DC and AC Operating Conditions for Read Operation

		EM27C040	
		-70	**-90**
Operating Temp.(Case)	Industrial	-40°C - 85°C	-40°C - 85°C
	Extended	-45°C - 115°C	-45°C - 115°C
	Military	-55°C - 125°C	-55°C - 125°C
V_{CC} Supply		5V ± 10%	5V ± 10%

8. DC and Operating Characteristics for Read Operation

Symbol	Parameter	Condition		Min	Max	Units
I_{LI}	Input Load Current	V_{IN} = 0V to V_{CC}	Ind.		±1	µA
			Ext. / Mil.		±5	µA
I_{LO}	Output Leakage Current	V_{OUT} = 0V to V_{CC}	Ind.		±5	µA
			Ext. / Mil.		±10	µA
$I_{PP1(2)}$	$V_{PP(1)}$ Read/Standby Current	Vpp = Vcc			10	µA
I_{SB}	V_{CC} (1) Standby Current	I_{SB1}(CMOS), CE_{NOT} = V_{CC} ±0.3V			100	µA
		I_{SB2}(TTL), CE_{NOT} = 2.0 to V_{CC}+0.5V			1	mA
I_{CC}	V_{CC} Active Current	f = 5 MHz, I_{OUT}= 0 mA, CE_{NOT} = V_{IL}			30	mA
V_{IL}	Input Low Voltage			-0.6	0.8	V
V_{IH}	Input High Voltage			2.0	V_{CC} + 0.5	V
V_{OL}	Output Low Voltage	I_{OL} = 2.1 mA			0.4	V
V_{OH}	Output High Voltage	I_{OH}= -400 µA		2.4		V

Note:

1. V_{CC} must be applied simultaneously with or before V_{PP}, and removed simultaneously with or after V_{PP}.

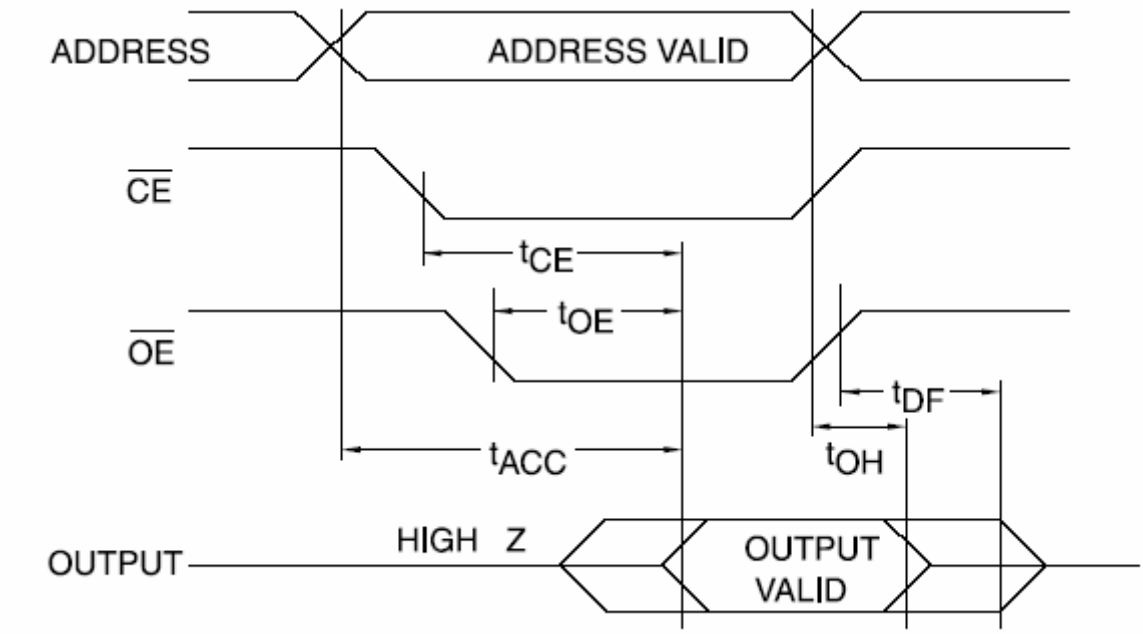
2. V_{PP} may be connected directly to V_{CC}, except during programming. The supply current would then be the sum of I_{CC} and I_{PP}.

9. AC Characteristics for Read Operation

Symbol	Parameter	Condition	EM27C040				Units
			-70		-90		
			Min	Max	Min	Max	
t_{ACC}(1)	Address to Output Delay	CE_{NOT} = OE_{NOT} = V_{IL}		70		90	ns
t_{CE}(1)	CE_{NOT} to Output Delay	OE_{NOT} = V_{IL}		70		90	ns
t_{OE}(1)	OE_{NOT} to Output Delay	CE_{NOT} = V_{IL}		30		35	ns
t_{DF}(1)	OE_{NOT} or CE_{NOT} High to Output Float, Whichever Occurred First			20		20	ns
t_{OH}	Output Hold from Address, CE_{NOT} or OE_{NOT}, Whichever Occurred First		0		0		ns

Note: 1. See AC Waveforms for Read Operation

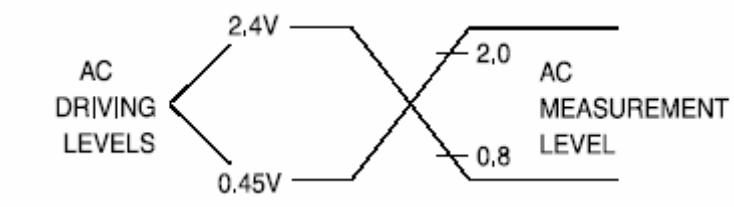
10. AC Waveforms for Read Operation(1)



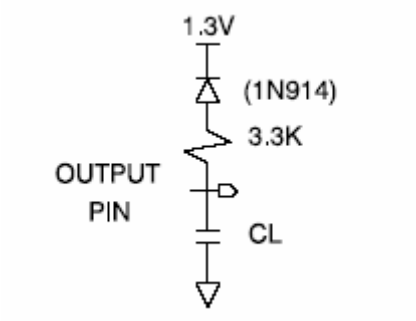
Notes:

1. Timing measurement references are 0.8V and 2.0V. Input AC drive levels are 0.45V and 2.4V, unless otherwise specified.
2. OE_{NOT} may be delayed up to t_{CE} - t_{OE} after the falling edge of CE_{NOT} without impact on t_{CE}.
3. OE_{NOT} may be delayed up to t_{ACC} - t_{OE} after the address is valid without impact on t_{ACC}.
4. This parameter is only sampled and is not 100% tested.
5. Output float is defined as the point when data is no longer driven.

11. Input Test Waveforms and Measurement Levels



12. Output Test Load



13. Pin Capacitance

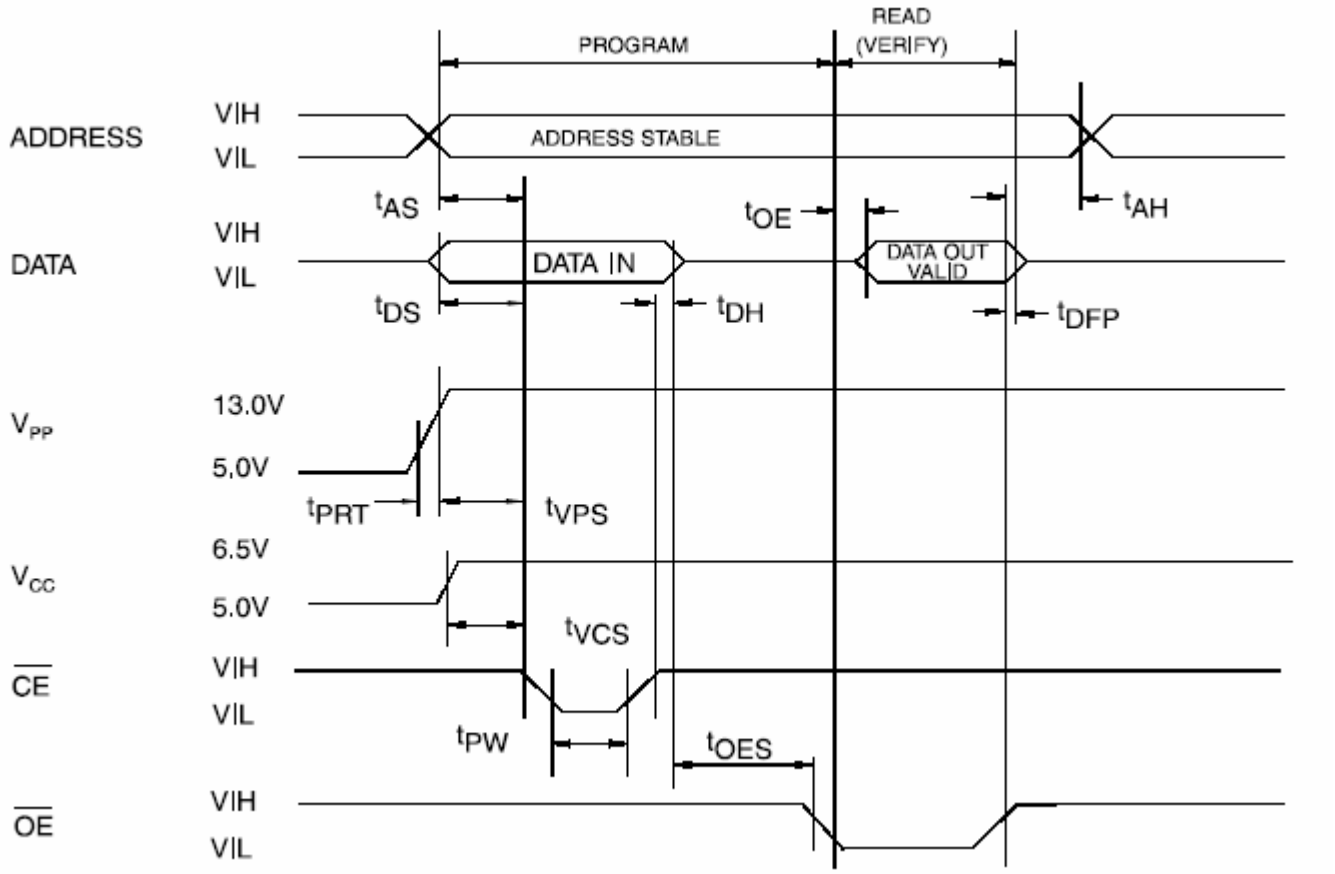
f = 1 MHz, T = 25°C (1)

Symbol	Typ	Max	Units	Conditions
C_{IN}	4	8	pF	V_{IN}= 0V
C_{OUT}	8	12	pF	V_{OUT}= 0V

Note:

1. Typical values for nominal supply voltage. This parameter is only sampled and is not 100% tested.

14. Programming Waveforms(1)



Notes:

1. The Input Timing Reference is 0.8V for V_{IL} and 2.0V for V_{IH}.

2. t_{OE} and t_{DFP} are characteristics of the device but must be accommodated by the programmer.

3. When programming the EM27C040 at 0.1 µF capacitor is required across V_{PP} and ground to suppress spurious voltage transients.

15. DC Programming Characteristics

T_A = 25 ± 5°C, V_{CC} = 6.5 ± 0.25V, V_{PP} = 13.0 ± 0.25V

Symbol	Parameter	Test Conditions	Limits		Units
			Min	Max	
I_{LI}	Input Load Current	V_{IN}= V_{IL},V_{IH}		±10	µA
V_{IL}	Input Low Level		-0.6	0.8	V
V_{IH}	Input High Level		2.0	V_{CC} + 0.7	V
V_{OL}	Output Low Voltage	I_{OL} = 2.1 mA		0.4	V
V_{OH}	Output High Voltage	I_{OH} = -400 µA	2.4		V
I_{CC2}	V_{CC} Supply Current (Program and Verify)			40	mA
I_{PP2}	V_{PP}Current	CE_{NOT} = V_{IL}		20	mA
V_{ID}	A9 Product Identification Voltage		11.5	12.5	V

16. AC Programming Characteristics

T_A = 25 ± 5°C, V_{CC} = 6.5 ± 0.25V, V_{PP} = 13.0 ± 0.25V

Symbol	Parameter	Test Conditions(1)	Limits		Units
			Min	Max	
t_{AS}	Address Setup Time		2		µs
t_{OES}	OE_{NOT} Setup Time	Input Rise and Fall Times	2		µs
t_{DS}	Data Setup Time	(10% to 90%) 20 ns	2		µs
t_{AH}	Address Hold Time	Input Pulse Levels	0		µs
t_{DH}	Data Hold Time	0.45V to 2.4V	2		µs
t_{DFP}	OE_{NOT} High to Output Float Delay(2)	Input Timing Reference Level	0	130	µs
t_{VPS}	V_{PP} Setup Time	0.8V to 2.0V	2		µs
t_{VCS}	V_{CC} Setup Time		2		µs
t_{PW}	CE_{NOT} Program Pulse Width(3)	Output Timing Reference Level	95	105	µs
t_{OE}	Data Valid from OE_{NOT}	0.8V to 2.0V		150	ns
t_{PRT}	V_{PP} Pulse Rise Time During Programming		50		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.

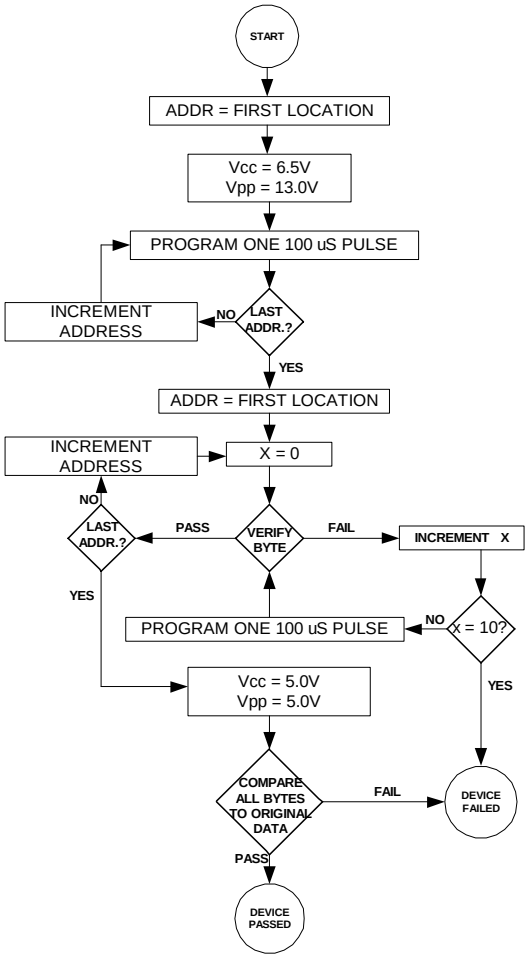
3. Program Pulse width tolerance is 100 µsec ± 5%.

17. EM27C040 Integrated Product Identification Code

Codes	Pins									Hex Data
	A0	O7	O6	O5	O4	O3	O2	O1	O0	
Manufacturer	0	0	0	0	1	1	1	1	0	1E
Device Type	1	0	0	0	0	1	0	1	1	0B

18. Rapid Programming Algorithm

A 100 µs CE_{NOT} pulse width is used to program. The address is set to the first location. V_{CC} is raised to 6.5V and OE_{NOT}/V_{PP} is raised to 13.0V. Each address is first programmed with one 100 µs CE_{NOT} pulse without verification. Then a verification/reprogramming loop is executed for each address. In the event a byte fails to pass verification, up to 10 successive 100 µs pulses are applied with a verification after each pulse. If the byte fails to verify after 10 pulses have been applied, the part is considered failed. After the byte verifies properly, the next address is selected until all have been checked. OE_{NOT}/V_{PP} is then lowered to V_{IL} and V_{CC} to 5.0V. All bytes are read again and compared with the original data to determine if the device passes or fails.



19. Ordering Information

EM27C040 – XX X X