CYPRESS SEMICONDUCTOR

64K x 8 Reprogrammable Asynchronous/Registered PROMs

Features

- **CMOS for optimum speed/power**
- **Windowed for reprogrammability**
- **High speed**
  - **— t_{SA} = 45 ns (7C287)**
  - **— t_{CO} = 15 ns (7C287)**
  - **— t_{ACC} = 50 ns (7C286)**
- **Low power**
  - **— 120 mA active**
  - **— 40 mA standby (7C286)**
- **On-chip, edge-triggered output registers (7C287)**
- **Programmable synchronous (7C287 only) or asynchronous output enable**
- **EPROM technology, 100% programmable**
- **5V ±10% V_{CC}, commercial and military**
- **TTL-compatible I/O**
- **Slim 300-mil package (7C287)**
- **Capable of withstanding >2001V static discharge**

Functional Description

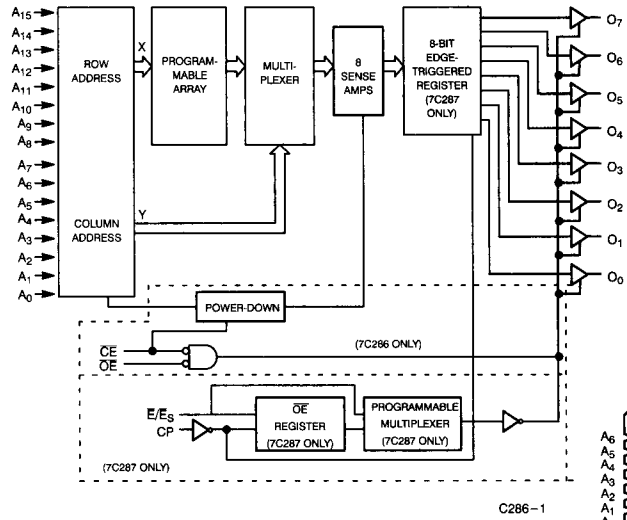
The CY7C286 and the CY7C287 are high-performance 65,536 by 8-bit CMOS PROMs. The CY7C286 is configured in the JEDEC-standard 512K EPROM pinout and is available in a 28-pin, 600-mil package. Power consumption is 120 mA in the active mode and 40 mA in the standby mode. Access time is 50 ns. The CY7C287 has registered outputs and operates in the synchronous mode. $\overline{E}$ can also be programmed into the synchronous mode, $\overline{E}_S$. It is available in a 28-pin, 300-mil package. The address set-up time is 45 ns and the time from clock HIGH to output valid is 15 ns.

Both the CY7C286 and the CY7C287 are available in a cerDIP package equipped with an erasure window to provide reprogrammability. When exposed to UV light, the PROM is erased and can be reprogrammed. The memory cells utilize proven EPROM floating-gate technology and byte-wide intelligent programming algorithms.

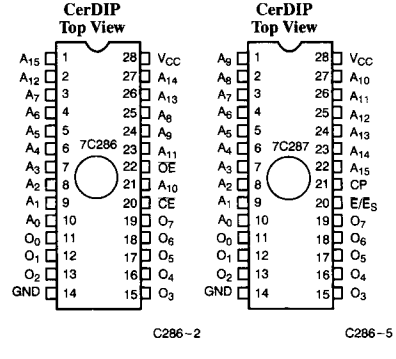
The CY7C286 and the CY7C287 offer the advantage of low power, superior performance, and programming yield. The EPROM cell requires only 12.5V for the supervoltage and low current requirements allow for gang programming. The EPROM cells allow for each memory location to be 100% tested with each location being written into, erased, and repeatedly exercised prior to encapsulation. Each PROM is also tested for AC performance to guarantee that the product will meet DC and AC specification limits after customer programming.

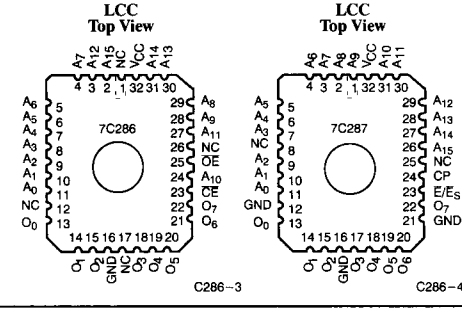
Reading the CY7C286 is accomplished by placing active LOW signals on the $\overline{OE}$ and $\overline{CE}$ pins. Reading the CY7C287 is accomplished by placing an active LOW signal on $\overline{E}/\overline{E}_S$. The contents of the memory location addressed by the address lines (A_0 – A_{15}) will become available on the output lines (O_0 – O_7) on the next rising of CP.

Logic Block Diagram



Pin Configurations





Selection Guide

		7C286–50	7C286–60	7C286–70	7C286–80
Maximum Access Time (ns)		50	60	70	80
Maximum Operating Current (mA)	Com'l	120	120	90	
	Mil		150	120	120
Maximum Standby Current (mA)	Com'l	40	40	30	
	Mil		50	40	40

		7C287–45	7C287–55	7C287–65
Maximum Set-Up Time (ns)		45	55	65
Maximum Clock to Output (ns)		15	20	25
Maximum Operating Current (mA)	Com'l	120	120	120
	Mil		150	150

Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature ..... – 65°C to +150°C

Ambient Temperature with Power Applied ..... – 55°C to +125°C

Supply Voltage to Ground Potential ..... – 0.5V to +7.0V (Pin 28 to Pin 14)

DC Voltage Applied to Outputs in High Z State ..... – 0.5V to +7.0V

DC Input Voltage ..... – 3.0V to +7.0V

DC Program Voltage (Pin 22) 13.0V

UV Exposure ..... 7258 Wsec/cm^2

Static Discharge Voltage ..... >2001V (per MIL-STD-883, Method 3015.2)

Latch-Up Current ..... >200 mA

Operating Range

Range	Ambient Temperature	V_{CC}
Commercial	0°C to +70°C	5V ± 10%
Industrial[1]	– 40°C to +85°C	5V ± 10%
Military[2]	– 55°C to +125°C	5V ± 10%

Electrical Characteristics Over the Operating Range[3]

Parameter	Description	Test Conditions		7C286–50 / 7C287–45 Min.	7C286–50 / 7C287–45 Max.	7C286–60 / 7C287–55 Min.	7C286–60 / 7C287–55 Max.	7C286–70, 80 / 7C287–65 Min.	7C286–70, 80 / 7C287–65 Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC} = Min., I_{OH} = – 2.0 mA		2.4		2.4		2.4		V
V_{OL}	Output LOW Voltage	V_{CC} = Min., I_{OL} = 8.0 mA	Com'l		0.4		0.4		0.4	V
		V_{CC} = Min., I_{OL} = 6.0 mA	Mil				0.4		0.4	
V_{IH}	Input HIGH Voltage	Guaranteed Input Logical HIGH Voltage for Inputs		2.0	V_{CC}	2.0	V_{CC}	2.0	V_{CC}	V
V_{IL}	Input LOW Voltage	Guaranteed Input Logical LOW Voltage for Inputs			0.8		0.8		0.8	V
I_{IX}	Input Load Current	GND ≤ V_{IN} ≤ V_{CC}		– 10	+10	– 10	+10	– 10	+10	µA
V_{CD}	Input Diode Clamp Voltage			Note 4						
I_{OZ}	Output Leakage Current	GND ≤ V_{OUT} ≤ V_{CC}, Output Disabled		– 40	+40	– 40	+40	– 40	+40	µA
I_{OS}	Output Short Circuit Current	V_{CC} = Max., V_{OUT} = GND[5]		– 20	– 90	– 20	– 90	– 20	– 90	mA
I_{CC} (7C286)	V_{CC} Operating Supply Current	V_{CC} = Max., I_{OUT} = 0 mA	Com'l		120		120		90	mA
			Mil				150		120	
I_{CC} (7C287)	V_{CC} Operating Supply Current	V_{CC} = Max., I_{OUT} = 0 mA	Com'l		120		120		120	mA
			Mil				150		150	
I_{SB}[6]	Standby Supply Current	V_{CC} = Max., $\overline{CE}$ = HIGH	Com'l		40		40		30	mA
			Mil				50		40	

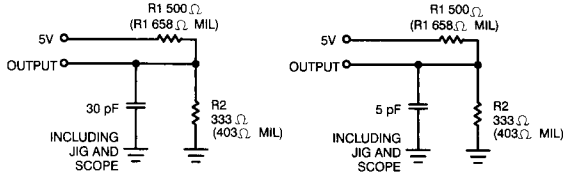
Notes:

1. Contact a Cypress representative for industrial termperature range specifications.
2. T_A is the "instant on" case temperature.
3. See the last page of this specification for Group A subgroup testing information.
4. See Introduction to CMOS PROMs for general information on testing.
5. Short circuit test should not exceed 30 seconds.
6. Only the CY7C286 has a standby mode.

Capacitance[4]

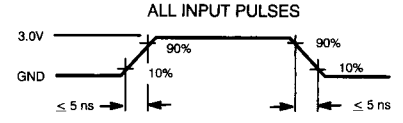
Parameter	Description	Test Conditions	Max.	Unit
C_{IN}	Input Capacitance	T_A = 25°C, f = 1 MHz, V_{CC} = 5.0V	10	pF
C_{OUT}	Output Capacitance		10	pF

AC Test Loads and Waveform[4]



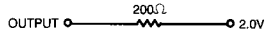
(a) Normal Load (b) High Z Load

C286-6

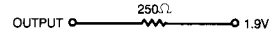


C286-7

Equivalent to: THÉVENIN EQUIVALENT



Commercial



Military

7C286 Switching Characteristics Over the Operating Range[3, 4]

Parameter	Description	7C286-50		7C286-60		7C286-70		7C286-80		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
t_{ACC}	Address Access Time		50		60		70		80	ns
t_{CE}	Output Valid from $\overline{CE}$		50		60		70		80	ns
t_{OE}	Output Valid from $\overline{OE}$		18		20		25		25	ns
t_{DF}	Output Tri-State from $\overline{CE}/\overline{OE}$		18		20		25		25	ns
t_{PU}	Chip Enable to Power-Up	0		0		0		0		ns
t_{PD}	Chip Disable to Power-Down		40		50		60		60	ns

7C287 Switching Characteristics Over the Operating Range[3, 4]

Parameter	Description	7C287-45		7C287-55		7C287-65		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
t_{SA}	Address Set-Up to Clock HIGH	45		55		65		ns
t_{HA}	Address Hold from Clock HIGH	0		0		0		ns
t_{CO}	Clock HIGH to Output Valid		15		20		25	ns
t_{HZE}	Output High Z from $\overline{E}$		15		20		25	ns
t_{DOE}	Output Valid from $\overline{E}$		15		20		25	ns
t_{PWC}	Clock Pulse Width	15		20		25		ns
t_{SEs}[7]	$\overline{E}_S$ Set-Up to Clock HIGH	12		15		18		ns
t_{HEs}[7]	$\overline{E}_S$ Hold from Clock HIGH	5		8		10		ns
t_{HZC}[7]	Output High Z from CLK/$\overline{E}_S$		20		25		30	ns
t_{COs}[7]	Output Valid from CLK/$\overline{E}_S$		20		25		30	ns

Note:
7. Parameters with synchronous $\overline{E}_S$ option.

Architecture Configuration Bits

Architecture Bit	Device	Architecture Verify D_0		Function
$\overline{E}/\overline{E}_S$	7C287	D_0	0 = Erased	Asynchronous Output Enable (Pin 20 = $\overline{E}$)
			1 = PGMED	Synchronous Output Enable (Pin 20 = $\overline{E}_S$)

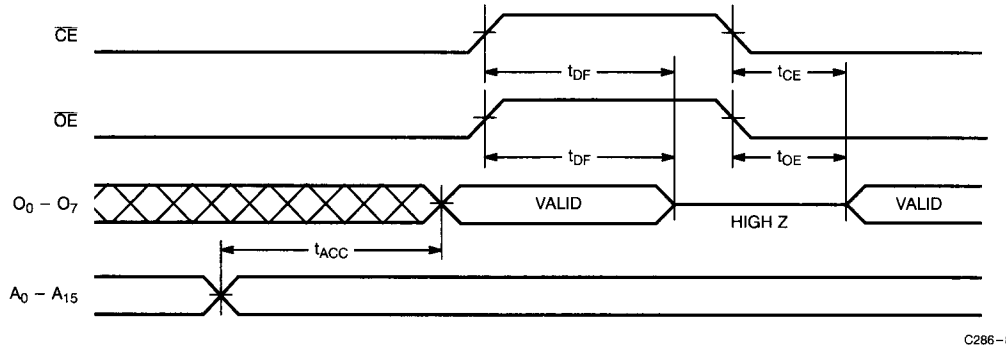
Bit Map

Programmer Address (Hex.)	RAM Data
0000	Data
.	.
.	.
FFFF	Data
10000	Control Byte

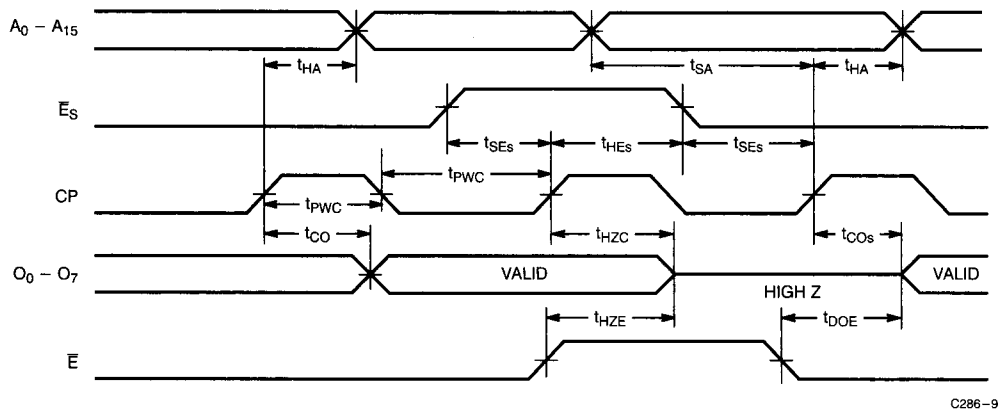
Architecture Byte (10000H)

D_7							D_0
C_7	C_6	C_5	C_4	C_3	C_2	C_1	C_0

Switching Waveform for the 7C286



Switching Waveform for the 7C287



Erasure Characteristics

Wavelengths of light less than 4000 Angstroms begin to erase the 7C286 and 7C287 in the windowed package. For this reason, an opaque label should be placed over the window if the PROM is exposed to sunlight or fluorescent lighting for extended periods of time.

The recommended dose of ultraviolet light for erasure is a wavelength of 2537 angstroms for a minimum dose (UV intensity multiplied by exposure time) of 25 Wsec/cm^2. For an ultraviolet lamp with a 12 mW/cm^2 power rating, the exposure time would be approximately 35 minutes. The 7C286 or 7C287 needs to be within 1 inch of the lamp during erasure. Permanent damage may result if the PROM is exposed to high-intensity UV light for an extended period of time. 7258 Wsec/cm^2 is the recommended maximum dosage.

Programming Modes

Programming support is available from Cypress as well as from a number of third-party software vendors. For detailed programming information, including a listing of software packages, please see the PROM Programming Information located at the end of this section. Programming algorithms can be obtained from any Cypress representative.

Table 1. CY7C286 Mode Selection

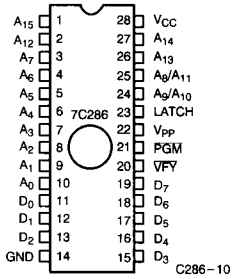
	Pin Number[8]				
	21	23	20	22	19–15, 13–11
Mode: Read or Output Disable	**A_{10}**	**A_{11}**	**$\overline{CE}$**	**$\overline{OE}$**	**$O_7 - O_0$**
Read	A_{10}	A_{11}	V_{IL}	V_{IL}	$O_7 - O_0$
Output Disable	A_{10}	A_{11}	X	V_{IH}	High Z
Output Disable & Power Down	A_{10}	A_{11}	V_{IH}	X	High Z
Mode: Other	**$\overline{PGM}$**	**LATCH**	**$\overline{VFY}$**	**V_{PP}**	**$D_7 - D_0$**
Program	V_{ILP}	V_{ILP}	V_{IHP}	V_{PP}	$D_7 - D_0$
Program Verify	V_{IHP}	V_{ILP}	V_{ILP}	V_{PP}	$O_7 - O_0$
Program Inhibit	V_{IHP}	V_{ILP}	V_{IHP}	V_{PP}	High Z
Blank Check	V_{IHP}	V_{ILP}	V_{ILP}	V_{PP}	Zeros

Table 2. CY7C287 Mode Selection

	Pin Function[8]				
	21	23	20	22	19–15, 13–11
Mode: Read or Output Disable	**CP**	**A_{14}**	**$\overline{E}$, $\overline{E}_S$**	**A_{15}**	**$O_7 - O_0$**
Synchronous Read	V_{IL}/V_{IH}	A_{14}	V_{IL}	A_{15}	$O_7 - O_0$
Output Disable – Asychronous	X	A_{14}	V_{IH}	A_{15}	High Z
Output Disable – Synchronous	V_{IL}/V_{IH}	A_{14}	V_{IH}	A_{15}	High Z
Mode: Other	**$\overline{PGM}$**	**LATCH**	**$\overline{VFY}$**	**V_{PP}**	**$D_7 - D_0$**
Program	V_{ILP}	V_{ILP}	V_{IHP}	V_{PP}	$D_7 - D_0$
Program Verify	V_{IHP}	V_{ILP}	V_{ILP}	V_{PP}	$O_7 - O_0$
Program Inhibit	V_{IHP}	V_{ILP}	V_{IHP}	V_{PP}	High Z
Blank Check	V_{IHP}	V_{ILP}	V_{ILP}	V_{PP}	Zeros

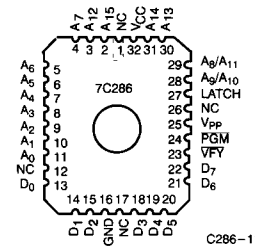
Note:
8. X = "don't care" but not to exceed V_{CC} ±5%.

DIP



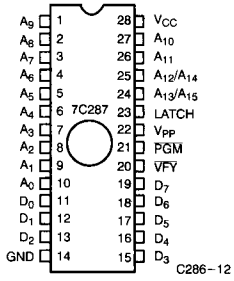
C286-10

LCC



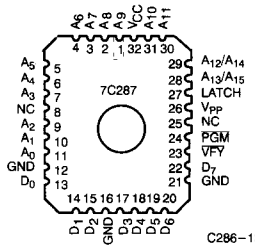
C286-11

DIP



C286-12

LCC



C286-13

Figure 1. Programming Pinouts

Ordering Information[9]

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
50	CY7C286–50PC	P15	28-Lead (600-Mil) Molded DIP	Commercial
	CY7C286–50WC	W16	28-Lead (600-Mil) Windowed CerDIP	
60	CY7C286–60PC	P15	28-Lead (600-Mil) Molded DIP	Commercial
	CY7C286–60WC	W16	28-Lead (600-Mil) Windowed CerDIP	
	CY7C286–60DMB	D16	28-Lead (600-Mil) CerDIP	Military
	CY7C286–60LMB	L55	32-Pin Rectangular Leadless Chip Carrier	
	CY7C286–60QMB	Q55	32-Pin Windowed Rectangular Leadless Chip Carrier	
	CY7C286–60WMB	W16	28-Lead (600-Mil) Windowed CerDIP	
70	CY7C286–70PC	P15	28-Lead (600-Mil) Molded DIP	Commercial
	CY7C286–70WC	W16	28-Lead (600-Mil) Windowed CerDIP	
	CY7C286–70DMB	D16	28-Lead (600-Mil) CerDIP	Military
	CY7C286–70LMB	L55	32-Pin Rectangular Leadless Chip Carrier	
	CY7C286–70QMB	Q55	32-Pin Windowed Rectangular Leadless Chip Carrier	
	CY7C286–70WMB	W16	28-Lead (600-Mil) Windowed CerDIP	
80	CY7C286–80WMB	W16	28-Lead (600-Mil) Windowed CerDIP	Military
	CY7C286–80QMB	Q55	32-Pin Windowed Rectangular Leadless Chip Carrier	

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
45	CY7C287–45PC	P21	28-Lead (300-Mil) Molded DIP	Commercial
	CY7C287–45WC	W22	28-Lead (300-Mil) Windowed CerDIP	
55	CY7C287–55PC	P21	28-Lead (300-Mil) Molded DIP	Commercial
	CY7C287–55WC	W22	28-Lead (300-Mil) Windowed CerDIP	
	CY7C287–55DMB	D22	28-Lead (300-Mil) CerDIP	Military
	CY7C287–55LMB	L55	32-Pin Rectangular Leadless Chip Carrier	
	CY7C287–55QMB	Q55	32-Pin Windowed Rectangular Leadless Chip Carrier	
	CY7C287–55WMB	W22	28-Lead (300-Mil) Windowed CerDIP	
65	CY7C287–65PC	P21	28-Lead (300-Mil) Molded DIP	Commercial
	CY7C287–65WC	W22	28-Lead (300-Mil) Windowed CerDIP	
	CY7C287–65DMB	D22	28-Lead (300-Mil) CerDIP	Military
	CY7C287–65LMB	L55	32-Pin Rectangular Leadless Chip Carrier	
	CY7C287–65QMB	Q55	32-Pin Windowed Rectangular Leadless Chip Carrier	
	CY7C287–65WMB	W22	28-Lead (300-Mil) Windowed CerDIP	

Note:

9. Most of these products are available in industrial temperature range. Contact a Cypress representative for specifications and product availability.

MILITARY SPECIFICATIONS
Group A Subgroup Testing

DC Characteristics

Parameter	Subgroups
V_{OH}	1, 2, 3
V_{OL}	1, 2, 3
V_{IH}	1, 2, 3
V_{IL}	1, 2, 3
I_{IX}	1, 2, 3
I_{OZ}	1, 2, 3
I_{CC}	1, 2, 3
I_{SB}[10]	1, 2, 3

Switching Characteristics

Device	Parameter	Subgroups
7C286	t_{ACC}	7, 8, 9, 10, 11
	t_{CE}	7, 8, 9, 10, 11
	t_{OE}	7, 8, 9, 10, 11
7C287	t_{SA}	7, 8, 9, 10, 11
	t_{HA}	7, 8, 9, 10, 11
	t_{CO}	7, 8, 9, 10, 11
	t_{DOE}	7, 8, 9, 10, 11
	t_{PWC}	7, 8, 9, 10, 11

Note:
10. CY7C286 only.

Document #: 38-00103-G