### **Features**

- Fast Read Access Time 45 ns
- Low-Power CMOS Operation
  - 100 μA Max Standby
  - 30 mA Max Active at 5 MHz
- JEDEC Standard Packages
  - 40-lead PDIP
  - 44-lead PLCC
  - 40-lead VSOP
- Direct Upgrade from 512K (AT27C516) EPROM
- 5V ± 10% Power Supply
- High-Reliability CMOS Technology
  - 2000V ESD Protection
  - 200 mA Latchup Immunity
- Rapid Programming Algorithm 100 μs/Word (Typical)
- CMOS and TTL Compatible Inputs and Outputs
- Integrated Product Identification Code
- Industrial and Automotive Temperature Ranges
- Green (Pb/Halide-free) Packaging Option

### 1. Description

The AT27C1024 is a low-power, high-performance 1,048,576 bit one-time program-mable read-only memory (OTP EPROM) organized 64K by 16 bits. It requires only one 5V power supply in normal read mode operation. Any word can be accessed in less than 45 ns, eliminating the need for speed reducing WAIT states. The by-16 organization make this part ideal for high-performance 16- and 32-bit microprocessor systems.

In read mode, the AT27C1024 typically consumes 15 mA. Standby mode supply current is typically less than 10  $\mu$ A.

The AT27C1024 is available in industry-standard JEDEC-approved one-time programmable (OTP) plastic PDIP, PLCC, and VSOP packages. The device features two-line control  $(\overline{CE}, \overline{OE})$  to eliminate bus contention in high-speed systems.

With high density 64K word storage capability, the AT27C1024 allows firmware to be stored reliably and to be accessed by the system without the delays of mass storage media.

Atmel's AT27C1024 have 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  $\mu s/word$ . 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.



1-Megabit (64K x 16) OTP EPROM

AT27C1024



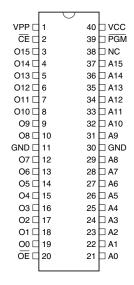


## 2. Pin Configurations

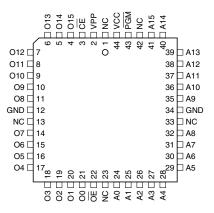
Pin Name	Function
A0 - A15	Addresses
O0 - O15	Outputs
CE	Chip Enable
ŌĒ	Output Enable
PGM	Program Strobe
NC	No Connect

Note: Both GND pins must be connected.

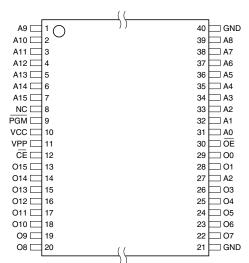
### 2.1 40-lead PDIP Top View



### 2.3 44-lead PLCC Top View



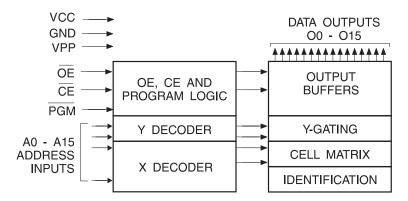
## 2.2 40-lead VSOP Top View - Type 1



## 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  $\mu F$  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  $\mu F$  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 Bias55° C to + 125° C	
Storage Temperature65° C to + 150° C	
Voltage on Any Pin with Respect to Ground2.0V to + 7.0V <sup>(1)</sup>	
Voltage on A9 with Respect to Ground2.0V to + 14.0V <sup>(1)</sup>	
V <sub>PP</sub> Supply Voltage with Respect to Ground2.0V to + 14.0V <sup>(1)</sup>	

\*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.

Note: 1. Minimum voltage is -0.6V DC which may undershoot to -2.0V for pulses of less than 20 ns. Maximum output pin voltage is  $V_{CC} + 0.75V$  DC which may overshoot to +7.0V for pulses of less than 20 ns.





## **Operating Modes**

Mode/Pin	CE	ŌĒ	PGM	Ai	$V_{PP}$	Outputs
Read	$V_{IL}$	$V_{IL}$	X <sup>(1)</sup>	Ai	Х	D <sub>OUT</sub>
Output Disable	Х	$V_{IH}$	X	X	X	High Z
Standby	V <sub>IH</sub>	Х	Х	X	X <sup>(5)</sup>	High Z
Rapid Program <sup>(2)</sup>	$V_{IL}$	V <sub>IH</sub>	V <sub>IL</sub>	Ai	V <sub>PP</sub>	D <sub>IN</sub>
PGM Verify	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IH</sub>	Ai	V <sub>PP</sub>	D <sub>OUT</sub>
PGM Inhibit	V <sub>IH</sub>	Х	Х	X	V <sub>PP</sub>	High Z
Product Identification <sup>(4)</sup>	V <sub>IL</sub>	V <sub>IL</sub>	х	$A9 = V_H^{(3)}$ $A0 = V_{IH} \text{ or } V_{IL}$ $A1 - A15 = V_{IL}$	V <sub>cc</sub>	Identification Code

Notes: 1. X can be  $V_{IL}$  or  $V_{IH}$ .

- 2. Refer to Programming Characteristics.
- 3.  $V_H = 12.0 \pm 0.5 V$ .
- 4. Two identifier words 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 word and high  $(V_{IH})$  to select the Device Code word.
- 5. Standby  $V_{CC}$  current ( $I_{SB}$ ) is specified with  $V_{PP} = V_{CC}$ .  $V_{CC} > V_{PP}$  will cause a slight increase in  $I_{SB}$ .

## **DC and AC Operating Conditions for Read Operation**

		AT270	C1024
		-45	-70
Operating Temp. (Case)	Ind.	-40° C - 85° C	-40° C - 85° C
	Auto.		
V <sub>CC</sub> Power Supply		5V ± 10%	5V ± 10%

## **DC and Operating Characteristics for Read Operation**

Symbol	Parameter	Condition	Min	Max	Units	
	Innut I and Comment	\/ 0\/ to \/	Ind.		±1	μΑ
l <sub>Li</sub>	Input Load Current	$V_{IN} = 0V \text{ to } V_{CC}$	Auto.		±5	μΑ
	Output Lackage Current	\/ 0\/ to \/	Ind.		±5	μΑ
I <sub>LO</sub>	Output Leakage Current	$V_{OUT} = 0V \text{ to } V_{CC}$	Auto.		±10	μΑ
I <sub>PP1</sub> (2)	V <sub>PP</sub> <sup>(1))</sup> Read/Standby Current	$V_{PP} = V_{CC}$		10	μΑ	
	V (1) Standby Current	$I_{SB1}$ (CMOS), $\overline{CE} = V_{CC}$		100	μΑ	
I <sub>SB</sub>	V <sub>CC</sub> <sup>(1)</sup> Standby Current	$I_{SB2}$ (TTL), $\overline{CE}$ = 2.0 to		1	mA	
I <sub>CC</sub>	V <sub>CC</sub> Active Current	f = 5 MHz, I <sub>OUT</sub> = 0 mA	CE = V <sub>IL</sub>		30	mA
V <sub>IL</sub>	Input Low Voltage			-0.6	0.8	V
V <sub>IH</sub>	Input High Voltage			2.0	V <sub>CC</sub> + 0.5	V
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 2.1 mA			0.4	V
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -400 μA	2.4		V	

1.  $V_{CC}$  must be applied simultaneously or before  $V_{PP}$  and removed simultaneously or after  $V_{PP}$ . Notes:

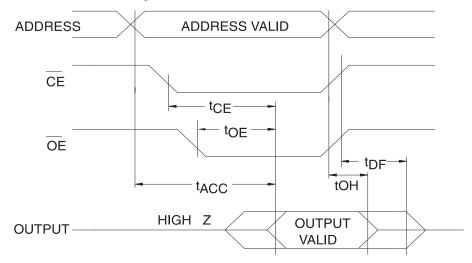
2.  $V_{PP}$  may be connected directly to  $V_{CC}$ , except during programming. The supply current would then be the sum of  $I_{CC}$  and  $I_{PP}$ .

## 9. AC Characteristics for Read Operation

				AT27C1024			
			-45 -70		70		
Symbol	Parameter C	ondition	Min	Max	Min	Max	Units
t <sub>ACC</sub> <sup>(1)</sup>	Address to Output Delay C	E = OE = V <sub>IL</sub>		45		70	ns
t <sub>CE</sub> <sup>(1)</sup>	CE to Output Delay	E = V <sub>IL</sub>		45		70	ns
t <sub>OE</sub> <sup>(1)</sup>	OE to Output Delay	E = V <sub>IL</sub>		20		25	ns
t <sub>DF</sub> <sup>(1)</sup>	OE or CE High to Output Float, Whiche	OE or CE High to Output Float, Whichever Occurred First				25	ns
t <sub>OH</sub>	Output Hold from Address, $\overline{\text{CE}}$ or $\overline{\text{OE}}$ , Occurred First	Output Hold from Address, CE or OE, Whichever			7		ns

Note: 1. See AC Waveforms for Read Operation.

# 10. AC Waveforms for Read Operation<sup>(1)</sup>



Notes: 1. Timing measurement reference level is 1.5V for -45. Input AC drive levels are  $V_{IL} = 0.0V$  and  $V_{IH} = 3.0V$ . Timing measurement reference levels for all other speed grades are  $V_{OL} = 0.8V$  and  $V_{OH} = 2.0V$ . Input AC drive levels are  $V_{IL} = 0.45V$  and  $V_{IH} = 2.4V$ .

- 2.  $\overline{OE}$  may be delayed up to  $t_{CE}$   $t_{OE}$  after the falling edge of  $\overline{CE}$  without impact on  $t_{CE}$ .
- 3.  $\overline{OE}$  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.





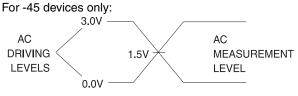
## 11. Pin Capacitance

 $f = 1 \text{ MHz}, T = 25^{\circ}C^{(1)}$ 

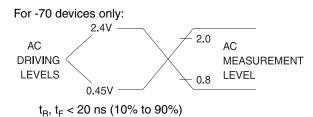
Symbol	Тур	Max	Units	Conditions
C <sub>IN</sub>	4	10	pF	$V_{IN} = 0V$
C <sub>OUT</sub>	8	12	pF	$V_{OUT} = 0V$

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

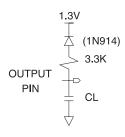
## 12. Input Test Waveforms and Measurement Levels



 $t_{R}$ ,  $t_{F} < 5$  ns (10% to 90%)

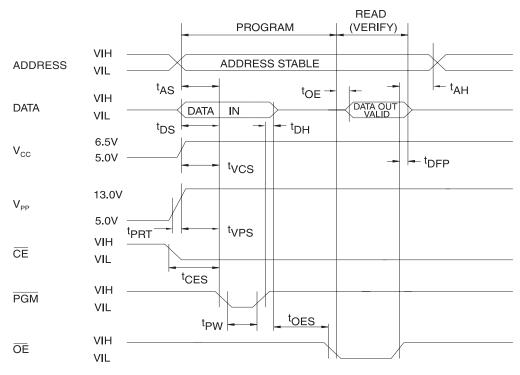


## 13. Output Test Load



Note: 1.  $C_L = 100 \text{ pF}$  including jig capacitance except -45 devices, where  $C_L = 30 \text{ pF}$ .

## 14. Programming Waveforms<sup>(1)</sup>



- Notes: 1. The Input Timing Reference is 0.8V for  $V_{\rm IL}$  and 2.0V for  $V_{\rm IH}$ .
  - 2.  $t_{OE}$  and  $t_{DFP}$  are characteristics of the device but must be accommodated by the programmer.
  - 3. When programming the AT27C1024 a 0.1  $\mu$ F capacitor is required across  $V_{PP}$  and ground to suppress sputious voltage transients.

# 15. DC Programming Characteristics

 $T_A = 25 \pm 5^{\circ}C$ ,  $V_{CC} = 6.5 \pm 0.25V$ ,  $V_{PP} = 13.0 \pm 0.25V$ 

			Lir	Limits	
Symbol	Parameter	Test Conditions	Min	Max	Units
ILI	Input Load Current	$V_{IN} = V_{IL}, V_{IH}$		±10	μΑ
V <sub>IL</sub>	Input Low Level		-0.6	0.8	V
V <sub>IH</sub>	Input High Level		2.0	V <sub>CC</sub> + 0.1	V
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 2.1 mA		0.4	V
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -400 μA	2.4		V
I <sub>CC2</sub>	V <sub>CC</sub> Supply Current (Program and Verify)			50	mA
I <sub>PP2</sub>	V <sub>PP</sub> Supply Current	$\overline{CE} = \overline{PGM} = V_{IL}$		30	mA
V <sub>ID</sub>	A9 Product Identification Voltage		11.5	12.5	V



## 16. AC Programming Characteristics

 $T_A = 25 \pm 5^{\circ} \, C, \ V_{CC} = 6.5 \pm 0.25 V, \ V_{PP} = 13.0 \pm 0.25 V$ 

			Liı	mits	
Symbol	Parameter	Test Conditions <sup>(1)</sup>	Min	Max	Units
t <sub>AS</sub>	Address Setup Time		2		μs
t <sub>CES</sub>	CE Setup Time		2		μs
t <sub>OES</sub>	OE Setup Time	Input Rise and Fall Times	2		μs
t <sub>DS</sub>	Data Setup Time	(10% to 90%) 20 ns	2		μs
t <sub>AH</sub>	Address Hold Time	Input Pulse Levels	0		μs
t <sub>DH</sub>	Data Hold Time	0.45V to 2.4V	2		μs
t <sub>DFP</sub>	OE High to Output Float Delay <sup>(2)</sup>		0	130	ns
t <sub>VPS</sub>	V <sub>PP</sub> Setup Time	Input Timing Reference Level 0.8V to 2.0V	2		μs
t <sub>VCS</sub>	V <sub>CC</sub> Setup Time	0.00 to 2.00	2		μs
t <sub>PW</sub>	PGM Program Pulse Width <sup>(3)</sup>	Output Timing Reference Level	95	105	μs
t <sub>OE</sub>	Data Valid from OE	0.8V to 2.0V		150	ns
t <sub>PRT</sub>	V <sub>PP</sub> Pulse Rise Time During Programming		50		ns

Notes: 1.  $V_{CC}$  must be applied simultaneously or before  $V_{PP}$  and removed simultaneously or after  $V_{PP}$ 

## 17. Atmel's AT27C1024 Integrated Product Identification Code

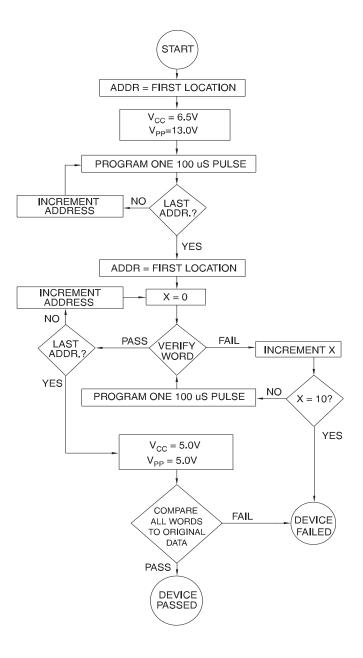
	Pins						Hex				
Codes	Α0	O15-O8	07	<b>O</b> 6	<b>O</b> 5	04	О3	02	01	00	Data
Manufacturer	0	0	0	0	0	1	1	1	1	0	001E
Device Type	1	0	1	1	1	1	0	0	0	1	00F1

<sup>2.</sup> 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.

<sup>3.</sup> Program Pulse width tolerance is 100  $\mu$ sec  $\pm 5\%$ .

## 18. Rapid Programming Algorithm

A 100  $\mu$ s  $\overline{PGM}$  pulse width is used to program. The address is set to the first location.  $V_{CC}$  is raised to 6.5V and  $V_{PP}$  is raised to 13.0V. Each address is first programmed with one 100  $\mu$ s  $\overline{PGM}$  pulse without verification. Then a verification/reprogramming loop is executed for each address. In the event a word fails to pass verification, up to 10 successive 100  $\mu$ s pulses are applied with a verification after each pulse. If the word fails to verify after 10 pulses have been applied, the part is considered failed. After the word verifies properly, the next address is selected until all have been checked.  $V_{PP}$  is then lowered to 5.0V and  $V_{CC}$  to 5.0V. All words are read again and compared with the original data to determine if the device passes or fails.







# 19. Ordering Information

## 19.1 Standard Package

tacc	t <sub>ACC</sub> (mA) (ns) Active Standby				
			Ordering Code	Package	Operation Range
			AT27C1024-45JI	44J	Industrial
45	30	0.1	AT27C1024-45PI	40P6	(-40° C to 85° C)
			AT27C1024-45VI	40V <sup>(1)</sup>	
			AT27C1024-70JI	44J	Industrial
70	30	0.1	AT27C1024-70PI	40P6	(-40° C to 85° C)
			AT27C1024-70VI	40V <sup>(1)</sup>	

Note:

Not recommended for new designs. Use Green package option.

## 19.2 Green Package (Pb/Halide-free)

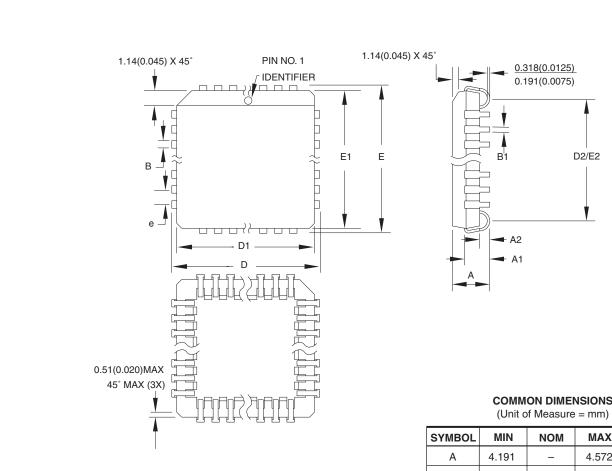
t <sub>ACC</sub>	I <sub>CC</sub> (mA)				
(ns)	Active	Standby	Ordering Code	Package	Operation Range
45	30	0.1	AT27C1024-45JU AT27C1024-45PU	44J 40P6	Industrial (-40° C to 85° C)
70	30	0.1	AT27C1024-70JU AT27C1024-70PU	44J 40P6	Industrial (-40° C to 85° C)

Note: 1. The 40-lead VSOP package is not recommended for new designs.

	Package Type		
44J	44-Lead, Plastic J-Leaded Chip Carrier (PLCC)		
40P6	40-Lead, 0.600" Wide, Plastic Dual Inline Package (PDIP)		
40V	40-Lead, Plastic Thin Small Outline Package (VSOP) 10 x 14 mm		

## 20. Packaging Information

#### 44J - PLCC 20.1



Notes:

- 1. This package conforms to JEDEC reference MS-018, Variation AC.
- 2. Dimensions D1 and E1 do not include mold protrusion. Allowable protrusion is .010"(0.254 mm) per side. Dimension D1 and E1 include mold mismatch and are measured at the extreme material condition at the upper or lower parting line.
- 3. Lead coplanarity is 0.004" (0.102 mm) maximum.

COMMON	<b>DIMENSIONS</b>
/Linit of M	occuro – mm)

SYMBOL	MIN	NOM	MAX	NOTE
Α	4.191	-	4.572	
A1	2.286	-	3.048	
A2	0.508	_	_	
D	17.399	-	17.653	
D1	16.510	-	16.662	Note 2
Е	17.399	-	17.653	
E1	16.510	-	16.662	Note 2
D2/E2	14.986	_	16.002	
В	0.660	-	0.813	
B1	0.330	_	0.533	
е	1.270 TYP			

10/04/01

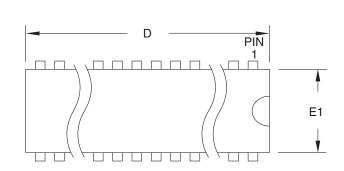
TITLE		
<b>44J</b> , 44-lead,	Plastic J-leaded	Chip Carrier (PLCC)

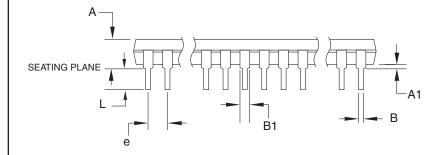
DRAWING NO.	REV
44J	В

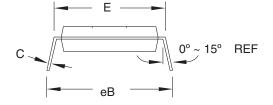




### 20.2 40P6 - PDIP







Notes:

- 1. This package conforms to JEDEC reference MS-011, Variation AC.
- 2. Dimensions D and E1 do not include mold Flash or Protrusion. Mold Flash or Protrusion shall not exceed 0.25 mm (0.010").

### **COMMON DIMENSIONS**

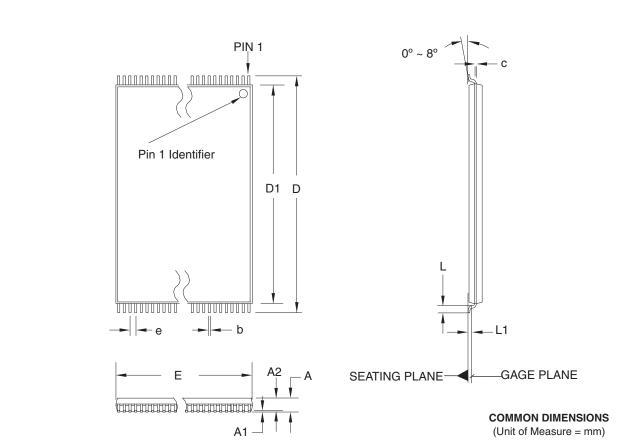
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
Α	_	_	4.826	
A1	0.381	_	_	
D	52.070	_	52.578	Note 2
E	15.240	_	15.875	
E1	13.462	_	13.970	Note 2
В	0.356	_	0.559	
B1	1.041	_	1.651	
L	3.048	_	3.556	
С	0.203	_	0.381	
eB	15.494	_	17.526	
е	2.540 TYP			

09/28/01

		TITLE	DRAWING NO.	REV.
4	2325 Orchard Parkway San Jose, CA 95131	40P6, 40-lead (0.600"/15.24 mm Wide) Plastic Dual Inline Package (PDIP)	40P6	В

### 20.3 40V - VSOP



Notes:

- 1. This package conforms to JEDEC reference MO-142, Variation CA.
- 2. Dimensions D1 and E do not include mold protrusion. Allowable protrusion on E is 0.15 mm per side and on D1 is 0.25 mm per side.
- 3. Lead coplanarity is 0.10 mm maximum.

SYMBOL	MIN	NOM	MAX	NOTE
Α	_	_	1.20	
A1	0.05	_	0.15	
A2	0.95	1.00	1.05	
D	13.80	14.00	14.20	
D1	12.30	12.40	12.50	Note 2
E	9.90	10.00	10.10	Note 2
L	0.50	0.60	0.70	
L1	0.25 BASIC			
b	0.17	0.22	0.27	
С	0.10	_	0.21	
е	0.50 BASIC			

10/18/01

ı	 	TITLE	DRAWING NO.	REV.
	2325 Orchard Parkway San Jose, CA 95131	<b>40V</b> , 40-lead (10 x 14 mm Package) Plastic Thin Small Outline Package, Type I (VSOP)	40V	В





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