PRELIMINARY

MX27C4000A

4M-BIT [512K x8] CMOS OTP ROM

FEATURES

- 512K x 8 organization
- Single +5V power supply
- +12.5V programming voltage
- Fast access time: 90/100/120/150 ns
- Totally static operation
- Completely TTL compatible
- Operating current: 40mA
- Standby current: 100uA
- Package type:
  - 32 pin PDIP
  - 32 pin PLCC
  - 32 pin SOP
  - 32 pin TSOP

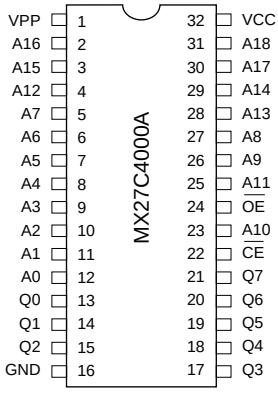
GENERAL DESCRIPTION

The MX27C4000A is a 5V only, 4M-bit, One Time Programmable Read Only Memory. It is organized as 512K words by 8 bits per word, operates from a single +5 volt supply, has a static standby mode, and features fast single address location programming. All programming signals are TTL levels, requiring a single pulse. For programming outside from the system, existing EPROM programmers may be used. The MX27C4000A supports a intelligent fast programming algorithm which can result in programming time of less than two minutes.

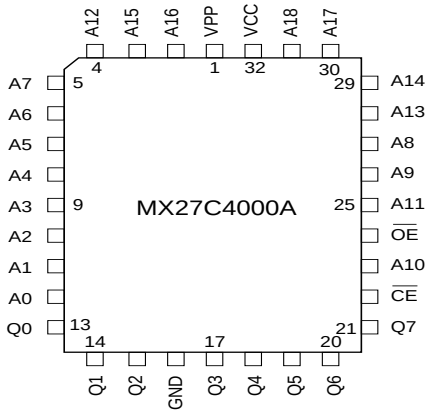
This One Time Programmable Read Only Memory is packaged in industry standard 32 pin dual-in-line plastic, 32 lead PLCC, 32 lead SOP, 32 lead TSOP packages.

PIN CONFIGURATIONS

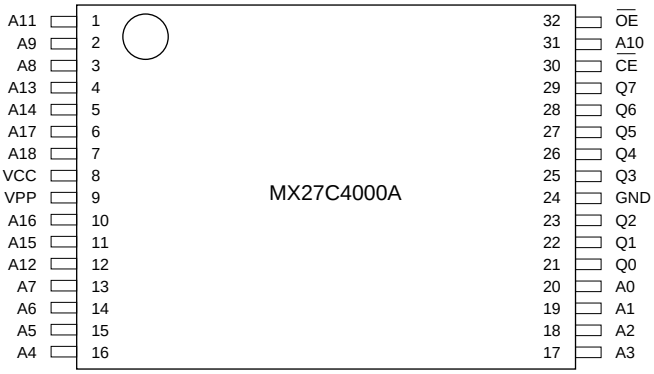
32 PDIP/SOP



32 PLCC



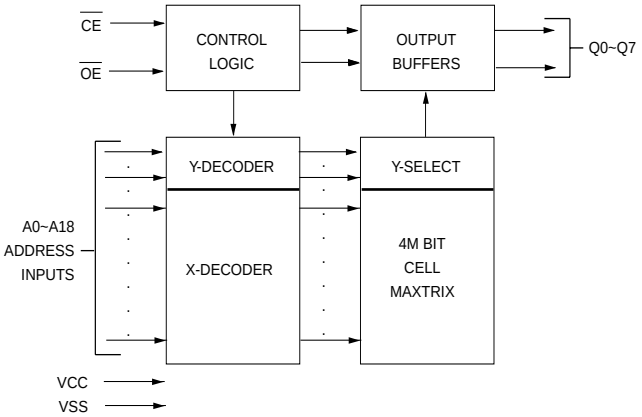
32 TSOP



PIN DESCRIPTION

SYMBOL	PIN NAME
A0~A18	Address Input
Q0~Q7	Data Input/Output
$\overline{CE}$	Chip Enable Input
$\overline{OE}$	Output Enable Input
VPP	Program Supply Voltage
VCC	Power Supply Pin (+5V)
GND	Ground Pin

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

THE PROGRAMMING OF THE MX27C4000A

When the MX27C4000A is delivered, or it is erased, the chip has all 4M bits in the "ONE" or HIGH state. "ZEROs" are loaded into the MX27C4000A through the procedure of programming.

For programming, the data to be programmed is applied with 8 bits in parallel to the data pins.

Vcc must be applied simultaneously or before Vpp, and removed simultaneously or after Vpp. When programming an MXIC OTP ROM, a 01uF capacitor is required across Vpp and ground to suppress spurious voltage transients which may damage the device.

FAST PROGRAMMING

The device is set up in the fast programming mode when the programming voltage VPP = 12.75V is applied, with VCC = 6.25 V and $\overline{OE}$ = VIH (Algorithm is shown in Figure 1). The programming is achieved by applying a single TTL low level 10us pulse to the $\overline{CE}$ input after addresses and data line are stable. If the data is not verified, an additional pulse is applied for a maximum of 25 pulses. This process is repeated while sequencing through each address of the device. When the programming mode is completed, the data in all address is verified at VCC = VPP = 5V ± 10%.

PROGRAM INHIBIT MODE

Programming of multiple MX27C4000As in parallel with different data is also easily accomplished by using the Program Inhibit Mode. Except for $\overline{CE}$ and $\overline{OE}$, all like inputs of the parallel MX27C4000A may be common. A TTL low-level program pulse applied to an MX27C4000A $\overline{CE}$ input with VPP = 12.5 ± 0.5 V and $\overline{CE}$ LOW will program that MX27C4000A. A high-level $\overline{CE}$ input inhibits the other MX27C4000As from being programmed.

PROGRAM VERIFY MODE

Verification should be performed on the programmed bits to determine that they were correctly programmed. The verification should be performed with $\overline{OE}$ and $\overline{CE}$ at VIL, and VPP at its programming voltage.

AUTO IDENTIFY MODE

The auto identify mode allows the reading out of a binary code from an OTP ROM that will identify its manufacturer and device type. This mode is intended for use by programming equipment for the purpose of automatically matching the device to be programmed with its corresponding programming algorithm. This mode is functional in the 25℃ ± 5℃ ambient temperature range that is required when programming the MX27C4000A.

To activate this mode, the programming equipment must force 12.0 ± 0.5 V on address line A9 of the device. Two identifier bytes may then be sequenced from the device outputs by toggling address line A0 from VIL to VIH. All other address lines must be held at VIL during auto identify mode.

Byte 0 (A0 = VIL) represents the manufacturer code, and byte 1 (A0 = VIH), the device identifier code. For the MX27C4000A, these two identifier bytes are given in the Mode Select Table. All identifiers for manufacturer and device codes will possess odd parity, with the MSB (Q7) defined as the parity bit.

READ MODE

The MX27C4000A has two control functions, both of which must be logically satisfied in order to obtain data

at the outputs. Chip Enable ($\overline{CE}$) is the power control and should be used for device selection. Output Enable ($\overline{OE}$) is the output control and should be used to gate data to the output pins, independent of device selection. Assuming that addresses are stable, address access time (tACC) is equal to the delay from $\overline{CE}$ to output (tCE). Data is available at the outputs tOE after the falling edge of $\overline{OE}$'s, assuming that $\overline{CE}$ has been LOW and addresses have been stable for at least tACC - tOE.

STANDBY MODE

The MX27C4000A has a CMOS standby mode which reduces the maximum VCC current to 100 uA. It is placed in CMOS standby when $\overline{CE}$ is at VCC ± 0.3 V. The MX27C4000A also has a TTL-standby mode which reduces the maximum VCC current to 1.5 mA. It is placed in TTL-standby when $\overline{CE}$ is at VIH. When in standby mode, the outputs are in a high-impedance state, independent of the $\overline{OE}$ input.

TWO-LINE OUTPUT CONTROL FUNCTION

To accommodate multiple memory connections, a two-line control function is provided to allow for:

1. Low memory power dissipation,
2. Assurance that output bus contention will not occur.

It is recommended that $\overline{CE}$ be decoded and used as the primary device-selecting function, while $\overline{OE}$ be made a common connection to all devices in the array and connected to the READ line from the system control bus. This assures that all deselected memory devices are in their low-power standby mode and that the output pins are only active when data is desired from a particular memory device.

SYSTEM CONSIDERATIONS

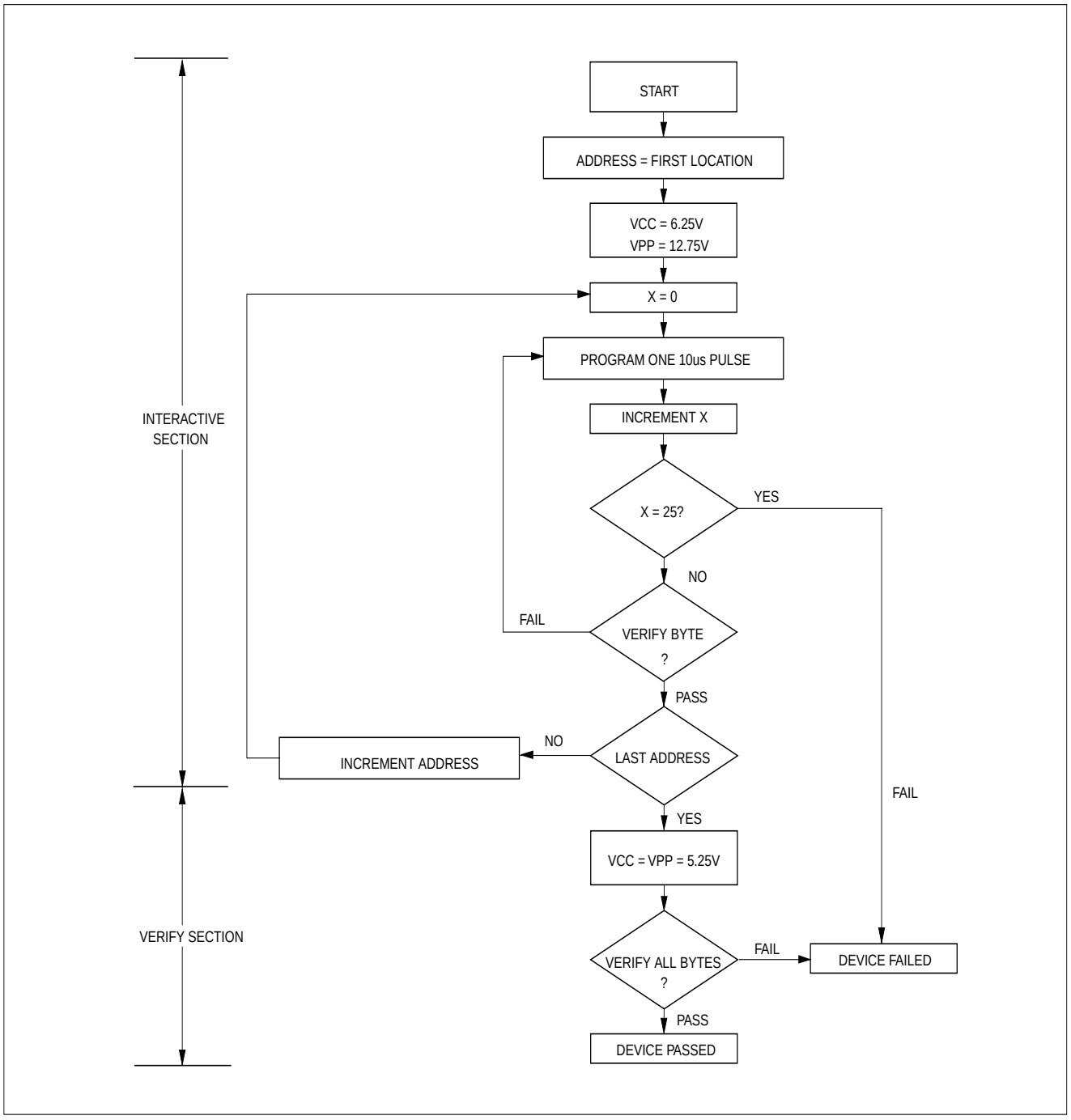
During the switch between active and standby conditions, transient current peaks are produced on the rising and falling edges of Chip Enable. The magnitude of these transient current peaks is dependent on the output capacitance loading of the device. At a minimum, a 0.1 uF ceramic capacitor (high frequency, low inherent inductance) should be used on each device between VCC and GND to minimize transient effects. In addition, to overcome the voltage drop caused by the inductive effects of the printed circuit board traces on EPROM arrays, a 4.7 uF bulk electrolytic capacitor should be used between VCC and GND for each eight devices. The location of the capacitor should be close to where the power supply is connected to the array.

MODE SELECT TABLE

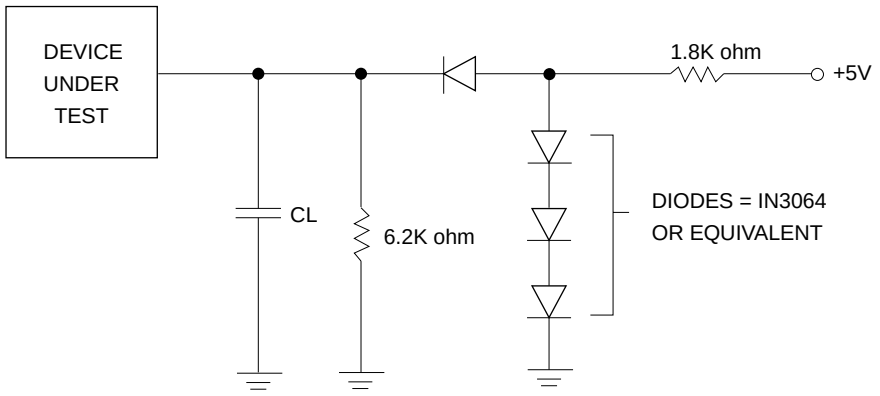
			PINS			
MODE	**$\overline{CE}$**	**$\overline{OE}$**	**A0**	**A9**	**VPP**	**OUTPUTS**
Read	VIL	VIL	X	X	VCC	DOUT
Output Disable	VIL	VIH	X	X	VCC	High Z
Standby (TTL)	VIH	X	X	X	VCC	High Z
Standby (CMOS)	VCC±0.3V	X	X	X	VCC	High Z
Program	VIL	VIH	X	X	VPP	DIN
Program Verify	VIH	VIL	X	X	VPP	DOUT
Program Inhibit	VIH	VIH	X	X	VPP	High Z
Manufacturer Code(3)	VIL	VIL	VIL	VH	VCC	C2H
Device Code(3)	VIL	VIL	VIH	VH	VCC	C0H

NOTES:
1. VH = 12.0 V ± 0.5 V
2. X = Either VIH or VIL
3. A1 - A8 = A10 - A18 = VIL(For auto select)
4. See DC Programming Characteristics for VPP voltage during programming.

FIGURE 1. FAST PROGRAMMING FLOWCHART

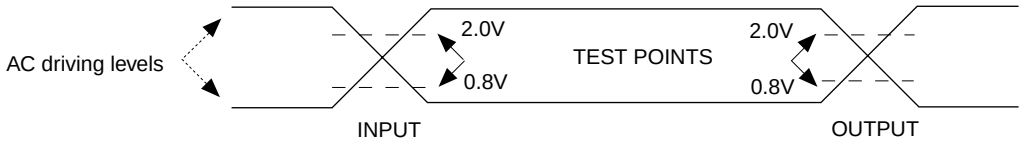


SWITCHING TEST CIRCUITS



CL = 100 pF including jig capacitance

SWITCHING TEST WAVEFORMS



AC TESTING: (1) AC driving levels are 2.4V/0.4V.
(2) Input pulse rise and fall times are ≤ 10ns.

ABSOLUTE MAXIMUM RATINGS

RATING	VALUE
Ambient Operating Temperature	-40℃ to 85℃
Storage Temperature	-65℃ to 125℃
Applied Input Voltage	-0.5V to 7.0V
Applied Output Voltage	-0.5V to VCC + 0.5V
VCC to Ground Potential	-0.5V to 7.0V
A9 & VPP	-0.5V to 13.5V

NOTICE:
Stresses greater than 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 above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended period may affect reliability.

NOTICE:
Specifications contained within the following tables are subject to change.

DC/AC OPERATING CONDITION FOR READ OPERATION

		MX27C4000A			
		-90	-10	-12	-15
Operating Temperature	Industrial	-40℃ to 85℃	-40℃ to 85℃	-40℃ to 85℃	-40℃ to 85℃
Vcc Power Supply		5V ± 10%	5V ± 10%	5V ± 10%	5V ± 10%

DC CHARACTERISTICS

SYMBOL	PARAMETER	MIN.	MAX.	UNIT	CONDITIONS
VOH	Output High Voltage	2.4		V	IOH = -0.4mA
VOL	Output Low Voltage		0.4	V	IOL = 2.1mA
VIH	Input High Voltage	2.0	VCC + 0.5	V	
VIL	Input Low Voltage	-0.3	0.8	V	
ILI	Input Leakage Current	-10	10	uA	VIN = 0 to 5.5V
ILO	Output Leakage Current	-10	10	uA	VOUT = 0 to 5.5V
ICC3	VCC Power-Down Current		100	uA	$\overline{CE}$ = VCC ± 0.3V
ICC2	VCC Standby Current		1.5	mA	$\overline{CE}$ = VIH
ICC1	VCC Active Current		40	mA	$\overline{CE}$ = VIL, f=5MHz, Iout = 0mA
IPP	VPP Supply Current Read		10	uA	$\overline{CE}$ = $\overline{OE}$ = VIL, VPP = 5.5V

CAPACITANCE TA = 25°C, f = 1.0 MHz (Sampled only)

SYMBOL	PARAMETER	TYP.	MAX.	UNIT	CONDITIONS
CIN	Input Capacitance	8	15	pF	VIN = 0V
COUT	Output Capacitance	8	15	pF	VOUT = 0V
CVPP	VPP Capacitance	18	25	pF	VPP = 0V

AC CHARACTERISTICS

		27C4000A-90		27C4000A-10		27C4000A-12		27C4000A-15			
Symbol	**PARAMETER**	**MIN.**	**MAX.**	**MIN.**	**MAX.**	**MIN.**	**MAX.**	**MIN.**	**MAX.**	**Unit**	**Conditions**
tACC	Address to Output Delay		90		100		120		150	ns	$\overline{CE}$=$\overline{OE}$=VIL
tCE	Chip Enable to Output Delay		90		100		120		150	ns	$\overline{OE}$=VIL
tOE	Output Enable to Output Delay		40		45		50		65	ns	$\overline{CE}$=VIL
tDF	$\overline{OE}$ High to Output Float, or $\overline{CE}$ High to Output Float	0	30	0	30	0	35	0	50	ns	
tOH	Output Hold from Address,$\overline{CE}$ or $\overline{OE}$ which ever occurred first		0		0		0	0		ns	

DC PROGRAMMING CHARACTERISTICS TA = 25°C ± 5°C

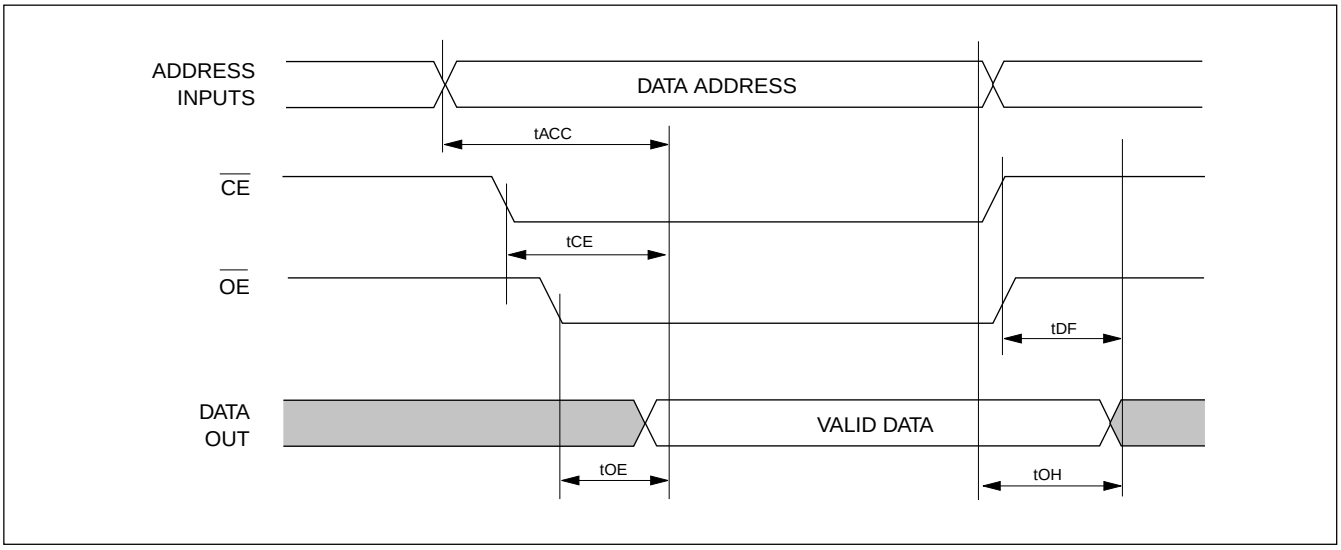
SYMBOL	PARAMETER	MIN.	MAX.	UNIT	CONDITIONS
VOH	Output High Voltage	2.4		V	IOH = -0.40mA
VOL	Output Low Voltage		0.4	V	IOL = 2.1mA
VIH	Input High Voltage	2.0	VCC + 0.5	V	
VIL	Input Low Voltage	-0.3	0.8	V	
ILI	Input Leakage Current	-10	10	uA	VIN = 0 to 5.5V
VH	A9 Auto Select Voltage	11.5	12.5	V	
ICC3	VCC Supply Current (Program & Verify)		50	mA	
IPP2	VPP Supply Current(Program)		30	mA	$\overline{CE}$ = VIL,$\overline{OE}$ = VIH
VCC1	Fast Programming Supply Voltage	6.00	6.50	V	
VPP1	Fast Programming Voltage	12.5	13.0	V	

AC PROGRAMMING CHARACTERISTICS TA = 25°C ± 5°C

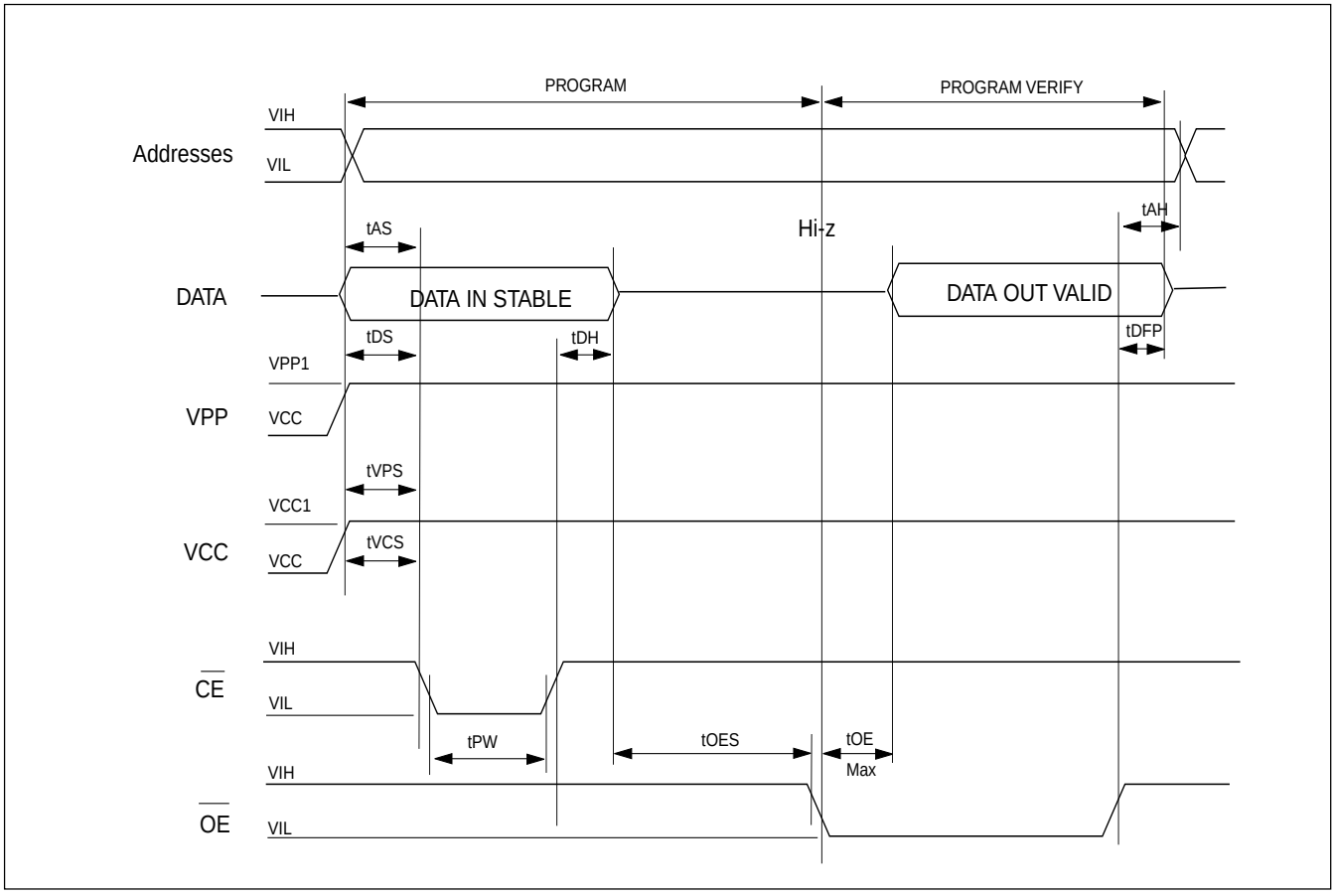
SYMBOL	PARAMETER	MIN.	MAX.	UNIT	CONDITIONS
tAS	Address Setup Time	2.0		us	
tOES	$\overline{OE}$ Setup Time	2.0		us	
tDS	Data Setup Time	2.0		us	
tAH	Address Hold Time	0		us	
tDH	Data Hold Time	2.0		us	
tDFP	Output Enable to Output Float Delay	0	130	ns	
tVPS	VPP Setup Time	2.0		us	
tPW	$\overline{PGM}$ Program Pulse Width	10	50	us	
tVCS	VCC Setup Time	2.0		us	
tOE	Data valid from $\overline{OE}$		150	ns	

WAVEFORMS

READ CYCLE



FAST PROGRAMMING ALGORITHM WAVEFORM



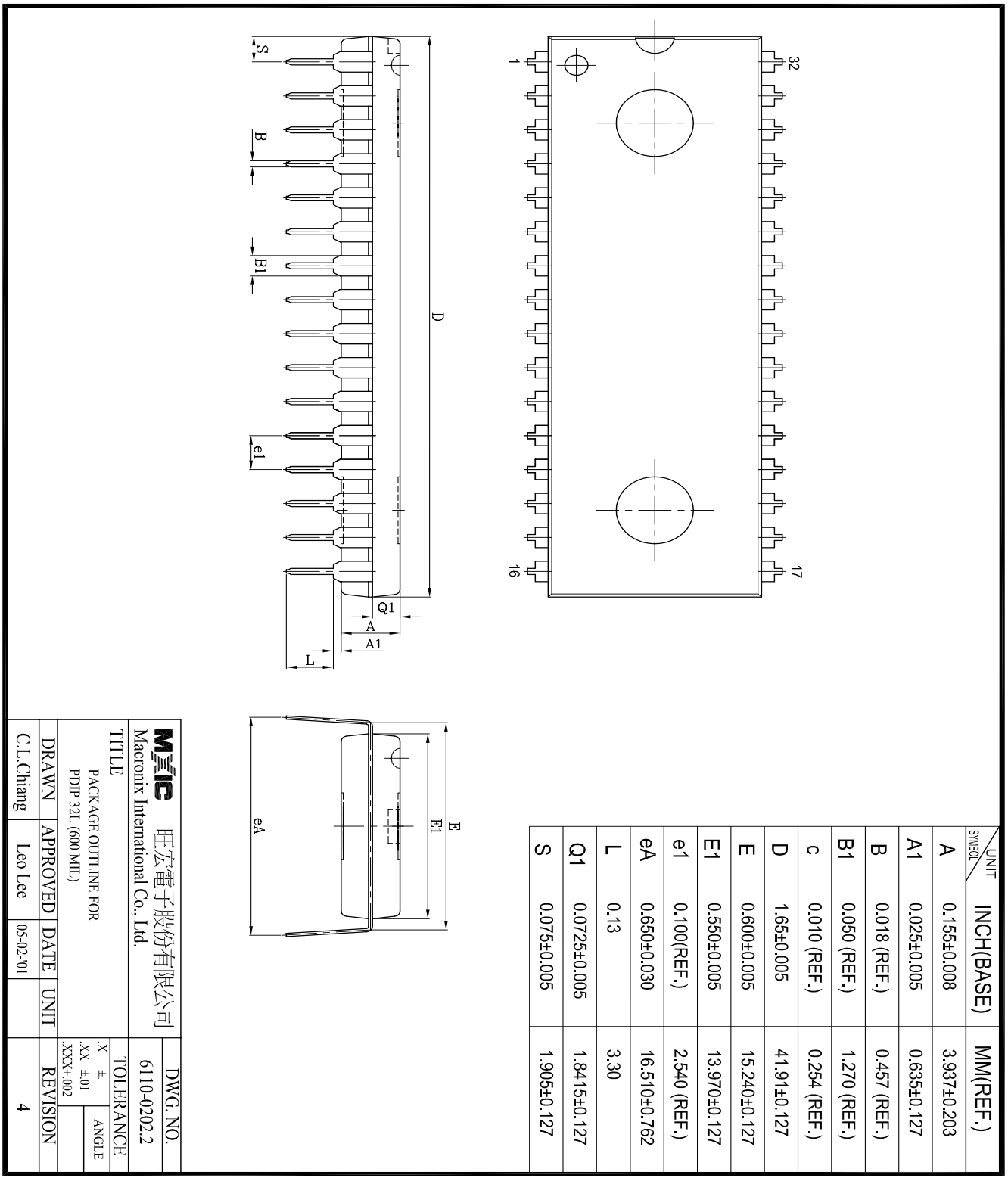
ORDERING INFORMATION

PLASTIC PACKAGE

PART NO.	ACCESS TIME (ns)	OPERATING Current MAX.(mA)	STANDBY Current MAX.(uA)	OPERATING TEMPERATURE	PACKAGE
MX27C4000APC-90	90	30	100	0℃ to 70℃	32 Pin DIP
MX27C4000AQC-90	90	30	100	0℃ to 70℃	32 Pin PLCC
MX27C4000AMC-90	90	30	100	0℃ to 70℃	32 Pin SOP
MX27C4000ATC-90	90	30	100	0℃ to 70℃	32 Pin TSOP
MX27C4000APC-10	100	30	100	0℃ to 70℃	32 Pin DIP
MX27C4000AQC-10	100	30	100	0℃ to 70℃	32 Pin PLCC
MX27C4000AMC-10	100	30	100	0℃ to 70℃	32 Pin SOP
MX27C4000ATC-10	100	30	100	0℃ to 70℃	32 Pin TSOP
MX27C4000APC-12	120	30	100	0℃ to 70℃	32 Pin DIP
MX27C4000AQC-12	120	30	100	0℃ to 70℃	32 Pin PLCC
MX27C4000AMC-12	120	30	100	0℃ to 70℃	32 Pin SOP
MX27C4000ATC-12	120	30	100	0℃ to 70℃	32 Pin TSOP
MX27C4000APC-15	150	30	100	0℃ to 70℃	32 Pin DIP
MX27C4000AQC-15	150	30	100	0℃ to 70℃	32 Pin PLCC
MX27C4000AMC-15	150	30	100	0℃ to 70℃	32 Pin SOP
MX27C4000ATC-15	150	30	100	0℃ to 70℃	32 Pin TSOP
MX27C4000API-90	90	30	100	-40℃ to 85℃	32 Pin DIP
MX27C4000AQI-90	90	30	100	-40℃ to 85℃	32 Pin PLCC
MX27C4000AMI-90	90	30	100	-40℃ to 85℃	32 Pin SOP
MX27C4000ATI-90	90	30	100	-40℃ to 85℃	32 Pin TSOP
MX27C4000API-10	100	30	100	-40℃ to 85℃	32 Pin DIP
MX27C4000AQI-10	100	30	100	-40℃ to 85℃	32 Pin PLCC
MX27C4000AMI-10	100	30	100	-40℃ to 85℃	32 Pin SOP
MX27C4000ATI-10	100	30	100	-40℃ to 85℃	32 Pin TSOP
MX27C4000API-12	120	30	100	-40℃ to 85℃	32 Pin DIP
MX27C4000AQI-12	120	30	100	-40℃ to 85℃	32 Pin PLCC
MX27C4000AMI-12	120	30	100	-40℃ to 85℃	32 Pin SOP
MX27C4000ATI-12	120	30	100	-40℃ to 85℃	32 Pin TSOP
MX27C4000API-15	150	30	100	-40℃ to 85℃	32 Pin DIP
MX27C4000AQI-15	150	30	100	-40℃ to 85℃	32 Pin PLCC
MX27C4000AMI-15	150	30	100	-40℃ to 85℃	32 Pin SOP
MX27C4000ATI-15	150	30	100	-40℃ to 85℃	32 Pin TSOP

PACKAGE INFORMATION

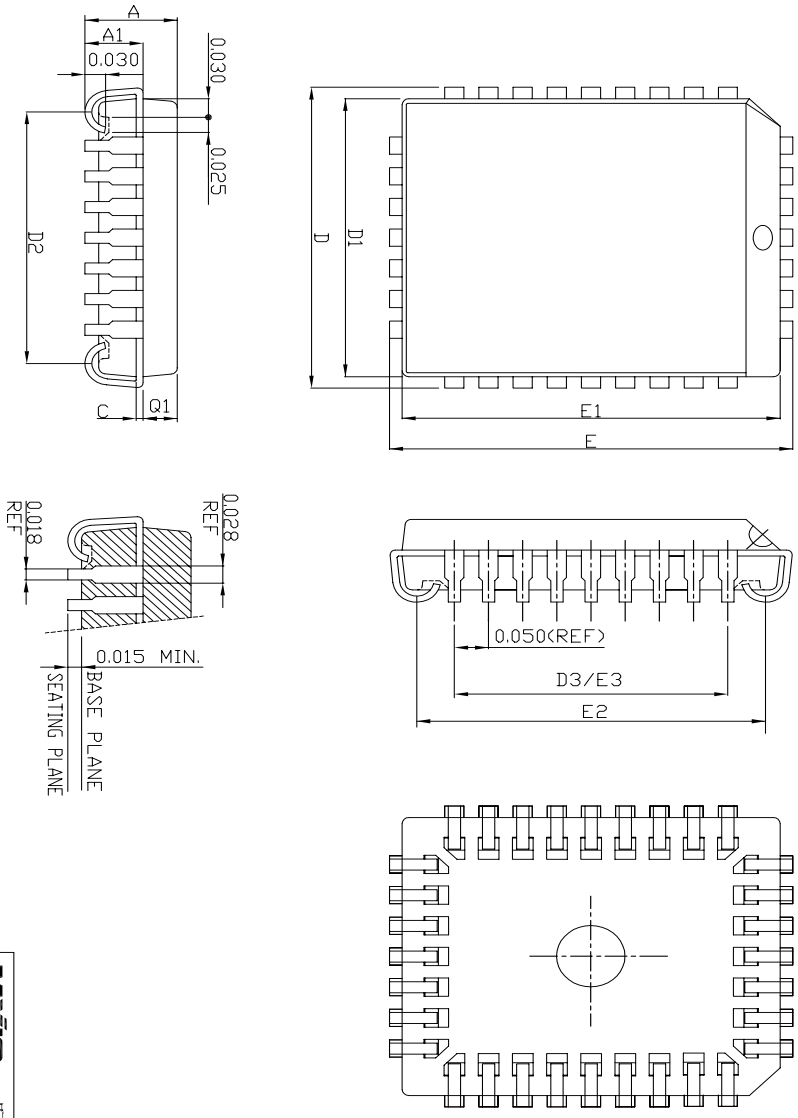
32-PIN PLASTIC DIP(600 mil)



SYMBOL / UNIT	INCH(BASE)	MM(REF.)
A	0.155±0.008	3.937±0.203
A1	0.025±0.005	0.635±0.127
B	0.018 (REF.)	0.457 (REF.)
B1	0.050 (REF.)	1.270 (REF.)
c	0.010 (REF.)	0.254 (REF.)
D	1.65±0.005	41.91±0.127
E	0.600±0.005	15.240±0.127
E1	0.550±0.005	13.970±0.127
e1	0.100(REF.)	2.540 (REF.)
eA	0.650±0.030	16.510±0.762
L	0.13	3.30
Q1	0.0725±0.005	1.8415±0.127
S	0.075±0.005	1.905±0.127

旺宏電子股份有限公司			DWG. NO.
Macronix International Co., Ltd.			6110-0202.2
TITLE			TOLERANCE
PACKAGE OUTLINE FOR PDIP 32L (600 MIL)			.X ±. ANGLE .XX ±.01 .XXX±.002
DRAWN	APPROVED	DATE	UNIT
C.L.Chiang	Leo Lee	05-02-'01	
			REVISION
			4

32-PIN PLASTIC LEADED CHIP CARRIER (PLCC)

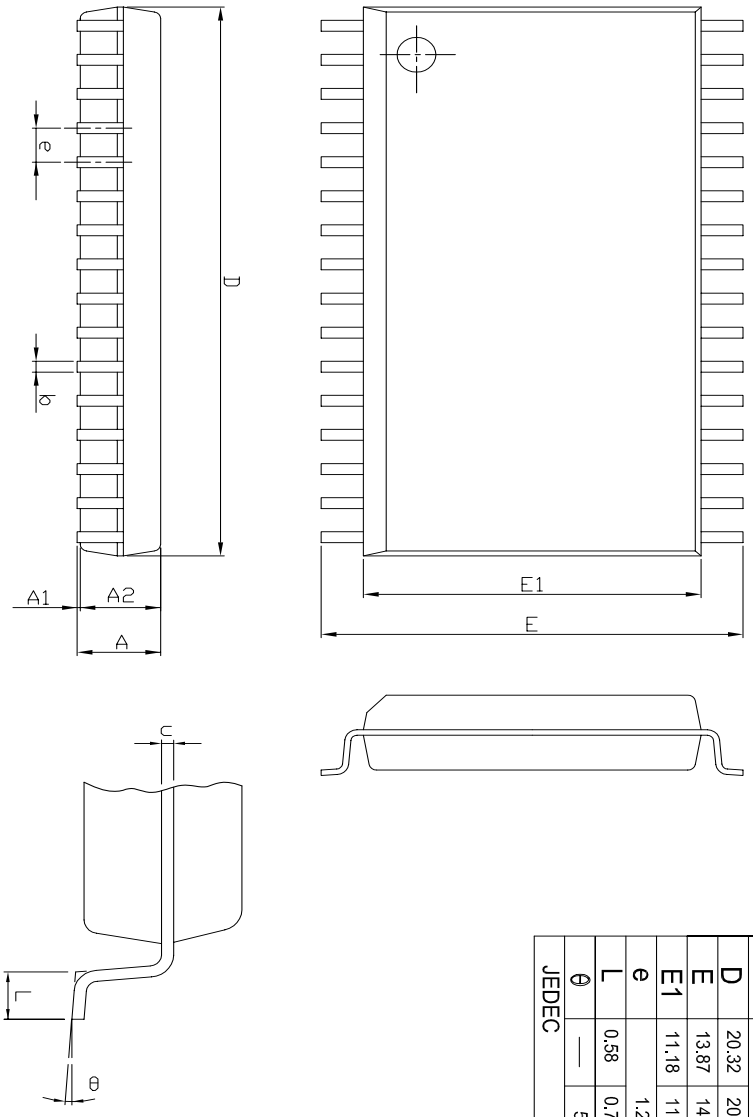


Symbol	Dimension in inch (Ref.)			Dimension in mm (Base)		
	Min	Nom	Max	Min	Nom	Max
A			0.140			3.56
A1	0.080	0.085	0.090	2.03	2.16	2.29
Q1	0.048	0.050	0.052	1.22	1.27	1.32
c		0.010(REF)			0.25(REF)	
D	0.485	0.490	0.495	12.32	12.45	12.57
D1	0.450	0.453	0.456	11.43	11.51	11.58
D2	0.400	0.410	0.420	10.16	10.41	10.67
D3		0.300(REF)			7.62(REF)	
E	0.585	0.590	0.595	14.86	14.99	15.11
E1	0.550	0.553	0.556	13.97	14.05	14.12
E2	0.500	0.510	0.520	12.70	12.95	13.21
E3		0.400(REF)			10.16(REF)	

REFERENCE DOCUMENT : JEDEC SPEC - MS-016a

旺宏電子股份有限公司			DWG. NO.
Macronix International Co., Ltd.			6110-0209.1
TITLE			TOLERANCE
PACKAGE OUTLINE FOR PLCC 32L			.X ± .XX ±.01 .XXX±.002 ANGLE ±2°
DRAWN	APPROVED	DATE	UNIT
C.L.Chiang	Dennis Chang	05-03-'01	inch
			REVISION 2

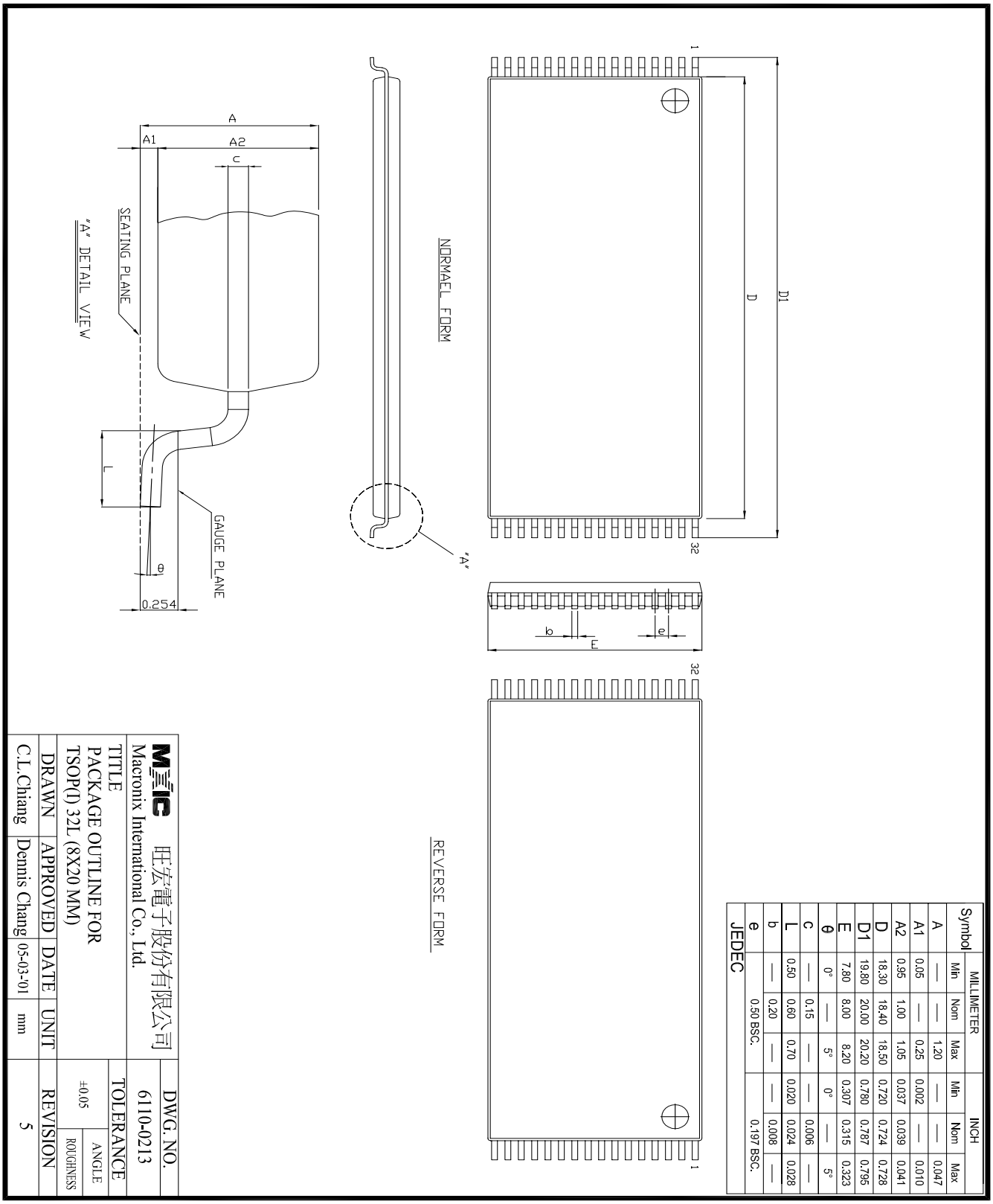
32-PIN PLASTIC SOP (450 mil)



Symbol	Dimension in mm (Base)			Dimension in inch (Ref.)		
	Min	Nom	Max	Min	Nom	Max
A	—	—	3.00	—	—	0.118
A1	0.10	—	—	0.004	—	—
A2	2.57	2.69	2.82	0.101	0.106	0.111
b		0.41REF			0.016 REF	
c		0.20 REF			0.008 REF	
D	20.32	20.45	20.57	0.800	0.805	0.810
E	13.87	14.12	14.38	0.546	0.556	0.566
E1	11.18	11.30	11.43	0.440	0.445	0.450
e		1.27 REF			0.050 REF	
L	0.58	0.79	0.99	0.023	0.031	0.039
θ	—	5°	—	—	5°	—
JEDEC						

旺宏電子股份有限公司				DWG. NO.
Macronix International Co., Ltd.				6110-0206
TITLE				TOLERANCE
PACKAGE OUTLINE FOR SOP 32L (450 MIL)				.X ±.1 ANGLE .XX ±.01 ROUGHNESS .XXX±.002
			UNIT	REVISION
DRAWN	APPROVED	DATE	INCH	2
C.L.Chiang	Dennis Chang	05-03-'01		

32-PIN PLASTIC TSOP



Symbol	MILLIMETER			INCH		
	Min	Nom	Max	Min	Nom	Max
A	—	—	1.20	—	—	0.047
A1	0.05	—	0.25	0.002	—	0.010
A2	0.95	1.00	1.05	0.037	0.039	0.041
D	18.30	18.40	18.50	0.720	0.724	0.728
D1	19.80	20.00	20.20	0.780	0.787	0.795
E	7.80	8.00	8.20	0.307	0.315	0.323
θ	0°	—	5°	0°	—	5°
c	—	0.15	—	—	0.006	—
L	0.50	0.60	0.70	0.020	0.024	0.028
b	—	0.20	—	—	0.008	—
e		0.50 BSC.			0.197 BSC.	
JEDEC						

MXIC 旺宏電子股份有限公司				DWG. NO.	
Macronix International Co., Ltd.				6110-0213	
TITLE				TOLERANCE	
PACKAGE OUTLINE FOR				±0.05	ANGLE
TSOP(I) 32L (8X20 MM)					ROUGHNESS
DRAWN	APPROVED	DATE	UNIT	REVISION	
C.L.Chiang	Dennis Chang	05-03-01	mm	5	

REVISION HISTORY

Revision No.	Description	Page	Date
1.1	Modify Fast Programming Flowchart--Program One 100us Pulse -->10us Pulse	P4	JUL/06/2000
	Modify AC Programming Characteristics--tPW 95-->10(MIN.)	P7	
1.2	Cencel 150ns speed	P1,5,6,7,10	JUL/13/2000
	Add "Advance Information"	P1	
1.3	Add tPW(MAX.):50us	P7	SEP/01/2000
1.4	Modify Absolute Naximum Ratings--Ambient Operation Temperature 0℃ to 70℃ --> -40℃ to 85℃	P6	SEP/08/2000
	Add Package type: 32PLCC	P1,9	
	Add Order Information--> -40℃ to 85℃ Operating Temperature	P9	
	Del Fast access time:100ns	P1,6,7	
1.5	To added access time 100/150ns and 32SOP/TSOP type package	P1,6,7,9,11	MAR/19/2001
	To changed ID Code from 41H to C0H	P3	
1.6	To modify Package Information	P10~13	JUL/19/2001

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