24AA32A/24LC32A

32K I²C™ Serial EEPROM

Device Selection Table

Part Number	Vcc Range	Max. Clock Frequency	Temp. Ranges
24AA32A	1.7-5.5	400 kHz(1)	I
24LC32A	2.5-5.5	400 kHz	I, E

Note 1: 100 kHz for VCC <2.5V.

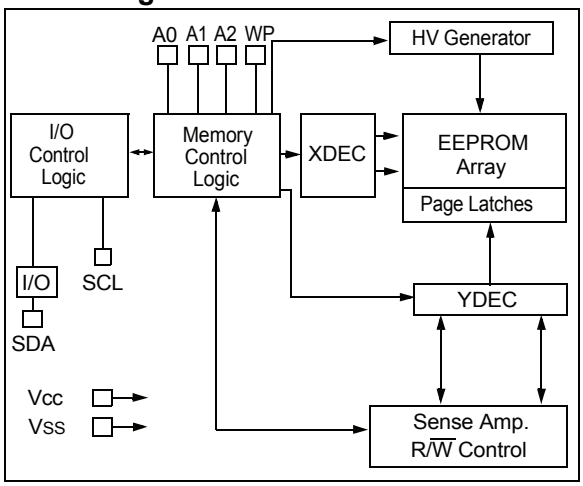
Features:

- Single Supply with Operation down to 1.7V for 24AA32A Devices, 2.5V for 24LC32A Devices
- Low-Power CMOS Technology:
  - Active current 1 mA, typical
  - Standby current 1 μA, typical
- 2-Wire Serial Interface, I²C™ Compatible
- Schmitt Trigger Inputs for Noise Suppression
- Output Slope Control to Eliminate Ground Bounce
- 100 kHz and 400 kHz Clock Compatibility
- Page Write Time 5 ms max.
- Self-Timed Erase/Write Cycle
- 32-Byte Page Write Buffer
- Hardware Write-Protect
- ESD Protection > 4,000V
- More than 1 Million Erase/Write Cycles
- Data Retention > 200 Years
- Factory Programming Available
- Packages Include 8-lead PDIP, SOIC, SOIJ, TSSOP, X-Rotated TSSOP, MSOP, DFN, TDFN, 5-lead SOT-23 and Chip Scale
- Pb-Free and RoHS Compliant
- Temperature Ranges:
  - Industrial (I): -40°C to +85°C
  - Automotive (E): -40°C to +125°C

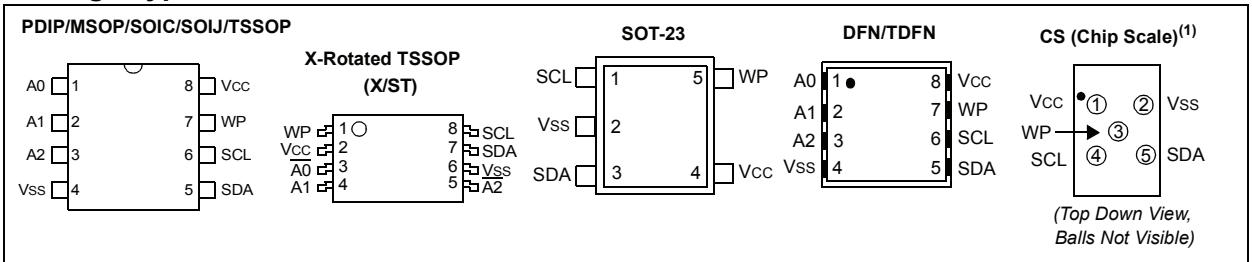
Description:

The Microchip Technology Inc. 24AA32A/24LC32A (24XX32A*) is a 32 Kbit Electrically Erasable PROM. The device is organized as a single block of 4K x 8-bit memory with a 2-wire serial interface. Low-voltage design permits operation down to 1.7V, with standby and active currents of only 1 μA and 1 mA, respectively. It has been developed for advanced, low-power applications such as personal communications or data acquisition. The 24XX32A also has a page write capability for up to 32 bytes of data. Functional address lines allow up to eight devices on the same bus, for up to 256 Kbits address space. The 24XX32A is available in the standard 8-pin PDIP, surface mount SOIC, SOIJ, TSSOP, DFN, TDFN and MSOP packages. The 24XX32A is also available in the 5-lead SOT-23 and Chip Scale packages.

Block Diagram



Package Types



Note 1: Available in I-temp, "AA" only.

*24XX32A is used in this document as a generic part number for the 24AA32A/24LC32A devices.

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1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings (†)

VCC.....6.5V

All inputs and outputs w.r.t. VSS ..... -0.3V to VCC +1.0V

Storage temperature .....-65°C to +150°C

Ambient temperature with power applied .....-40°C to +125°C

ESD protection on all pins .....≥ 4 kV

† NOTICE: Stresses above 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 those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

TABLE 1-1: DC CHARACTERISTICS

DC CHARACTERISTICS			Industrial (I): TA = -40°C to +85°C, VCC = +1.7V to +5.5V Automotive (E): TA = -40°C to +125°C, VCC = +2.5V to +5.5V				
Param. No.	**Symbol**	**Characteristic**	**Min.**	**Typ.**	**Max.**	**Units**	**Conditions**
D1	—	**A0, A1, A2, WP, SCL and SDA pins**	—	—	—	—	—
D2	VIH	High-level input voltage	0.7 VCC	—	—	V	—
D3	VIL	Low-level input voltage	—	—	0.3 VCC 0.2 VCC	V V	VCC ≥ 2.5V VCC < 2.5V
D4	VHYS	Hysteresis of Schmitt Trigger inputs (SDA, SCL pins)	0.05 VCC	—	—	V	VCC ≥ 2.5V **(Note 1)**
D5	VOL	Low-level output voltage	—	—	0.40	V	IOL = 3.0 mA, VCC = 4.5V IOL = 2.1 mA, Vcc = 2.5V
D6	ILI	**Input leakage current**	—	—	±1	µA	VIN = VSS or VCC
D7	ILO	**Output leakage current**	—	—	±1	µA	VOUT = VSS or VCC
D8	CIN, COUT	Pin capacitance (all inputs/outputs)	—	—	10	pF	VCC = 5.0V **(Note 1)** TA = 25°C, FCLK = 1 MHz
D9	ICC write	**Operating current**	—	0.1	3	mA	VCC = 5.5V, SCL = 400 kHz
D10	ICC read		—	0.05	400	µA	
D11	ICCS	**Standby current**	— —	0.01 —	1 5	µA µA	Industrial Automotive SDA = SCL = VCC = 5.5V A0, A1, A2, WP = VSS

Note 1: This parameter is periodically sampled and not 100% tested.

2: Typical measurements taken at room temperature.

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TABLE 1-2: AC CHARACTERISTICS

AC CHARACTERISTICS			Industrial (I): T_A = -40°C to +85°C, V_{CC} = +1.7V to +5.5V Automotive (E): T_A = -40°C to +125°C, V_{CC} = +2.5V to +5.5V			
Param. No.	**Symbol**	**Characteristic**	**Min.**	**Max.**	**Units**	**Conditions**
1	F_{CLK}	Clock Frequency	— —	400 100	kHz	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
2	T_{HIGH}	Clock High Time	600 4000	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
3	T_{LOW}	Clock Low Time	1300 4700	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
4	T_R	SDA and SCL Rise Time **(Note 1)**	— —	300 1000	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
5	T_F	SDA and SCL Fall Time	—	300	ns	**(Note 1)**
6	$T_{HD:STA}$	Start Condition Hold Time	600 4000	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
7	$T_{SU:STA}$	Start Condition Setup Time	600 4700	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
8	$T_{HD:DAT}$	Data Input Hold Time	0	—	ns	**(Note 2)**
9	$T_{SU:DAT}$	Data Input Setup Time	100 250	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
10	$T_{SU:STO}$	Stop Condition Setup Time	600 4000	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
11	$T_{SU:WP}$	WP Setup Time	600 4000	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
12	$T_{HD:WP}$	WP Hold Time	1300 4700	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
13	T_{AA}	Output Valid from Clock **(Note 2)**	— —	900 3500	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
14	T_{BUF}	Bus free time: Time the bus must be free before a new transmission can start	1300 4700	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
15	T_{OF}	Output Fall Time from V_{IH} Minimum to V_{IL} Maximum	20+0.1C_B —	250 250	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA32A)**
16	T_{SP}	Input Filter Spike Suppression (SDA and SCL pins)	—	50	ns	**(Notes 1 and 3)**
17	T_{WC}	Write Cycle Time (byte or page)	—	5	ms	—
18	—	Endurance	1M	—	cycles	Page mode, 25°C, V_{CC} = 5.5V **(Note 4)**

Note 1: Not 100% tested. C_B = total capacitance of one bus line in pF.

2: As a transmitter the device must provide an internal minimum delay time to bridge the undefined region (minimum 300 ns) of the falling edge of SCL to avoid unintended generation of Start or Stop conditions.

3: The combined T_{SP} and V_{HYS} specifications are due to new Schmitt Trigger inputs which provide improved noise spike suppression. This eliminates the need for a T_I specification for standard operation.

4: This parameter is not tested but ensured by characterization. For endurance estimates in a specific application, please consult the Total Endurance™ Model which can be obtained on Microchip's web site at www.microchip.com.

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FIGURE 1-1: BUS TIMING DATA

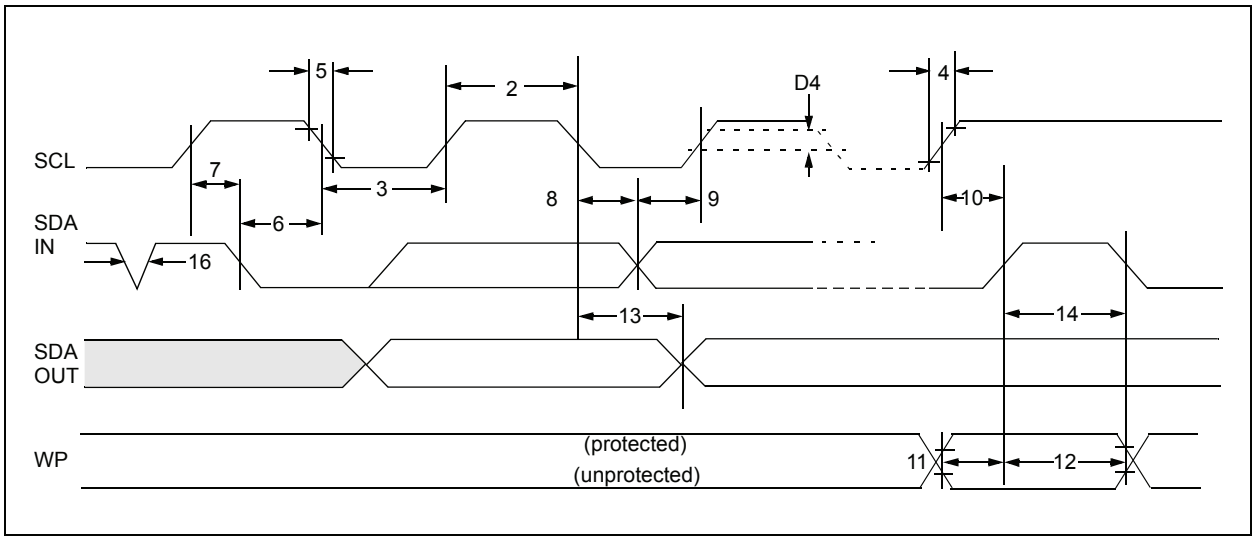
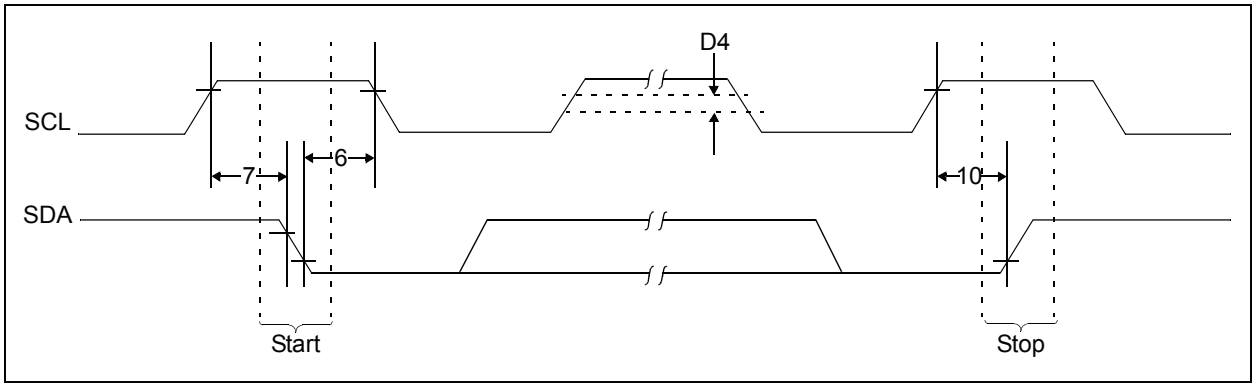


FIGURE 1-2: BUS TIMING START/STOP



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2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 2-1.

TABLE 2-1: PIN FUNCTION TABLE

Name	PDIP	SOIC	SOIJ	TSSOP	Rotated TSSOP	DFN(1)	TDFN(1)	MSOP	SOT-23	CS	Description
A0	1	1	1	1	3	1	1	1	—	—	Chip Address Input
A1	2	2	2	2	4	2	2	2	—	—	Chip Address Input
A2	3	3	3	3	5	3	3	3	—	—	Chip Address Input
VSS	4	4	4	4	6	4	4	4	2	2	Ground
SDA	5	5	5	5	7	5	5	5	3	5	Serial Address/Data I/O
SCL	6	6	6	6	8	6	6	6	1	4	Serial Clock
WP	7	7	7	7	1	7	7	7	5	3	Write-Protect Input
VCC	8	8	8	8	2	8	8	8	4	1	+1.7V to 5.5V Power Supply

Note 1: The exposed pad on the DFN/TDFN packages can be connected to VSS or left floating.

2.1 A0, A1, A2 Chip Address Inputs

The A0, A1 and A2 inputs are used by the 24XX32A for multiple device operation. The levels on these inputs are compared with the corresponding bits in the slave address. The chip is selected if the comparison is true.

Up to eight devices may be connected to the same bus by using different Chip Select bit combinations. These inputs must be connected to either VCC or VSS.

In most applications, the chip address inputs A0, A1 and A2 are hard-wired to logic '0' or logic '1'. For applications in which these pins are controlled by a microcontroller or other programmable device, the chip address pins must be driven to logic '0' or logic '1' before normal device operation can proceed. Address pins are not available in the SOT-23 and chip scale packages.

2.2 Serial Data (SDA)

SDA is a bidirectional pin used to transfer addresses and data into and out of the device. It is an open-drain terminal, therefore, the SDA bus requires a pull-up resistor to VCC (typical 10 kΩ for 100 kHz, 2 kΩ for 400 kHz)

For normal data transfer, SDA is allowed to change only during SCL low. Changes during SCL high are reserved for indicating Start and Stop conditions.

2.3 Serial Clock (SCL)

The SCL input is used to synchronize the data transfer to and from the device.

2.4 Write-Protect (WP)

This pin must be connected to either VSS or VCC. If tied to VSS, write operations are enabled. If tied to VCC, write operations are inhibited but read operations are not affected.

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3.0 FUNCTIONAL DESCRIPTION

The 24XX32A supports a bidirectional, 2-wire bus and data transmission protocol. A device that sends data onto the bus is defined as transmitter, while a device receiving data is defined as a receiver. The bus has to be controlled by a master device which generates the Serial Clock (SCL), controls the bus access and generates the Start and Stop conditions, while the 24XX32A works as slave. Both master and slave can operate as transmitter or receiver, but the master device determines which mode is activated.

4.0 BUS CHARACTERISTICS

The following **bus protocol** has been defined:

- Data transfer may be initiated only when the bus is not busy.
- During data transfer, the data line must remain stable whenever the clock line is high. Changes in the data line while the clock line is high will be interpreted as a Start or Stop condition.

Accordingly, the following bus conditions have been defined (Figure 4-1).

4.1 Bus Not Busy (A)

Both data and clock lines remain high.

4.2 Start Data Transfer (B)

A high-to-low transition of the SDA line while the clock (SCL) is high determines a Start condition. All commands must be preceded by a Start condition.

4.3 Stop Data Transfer (C)

A low-to-high transition of the SDA line while the clock (SCL) is high determines a Stop condition. All operations must be ended with a Stop condition.

4.4 Data Valid (D)

The state of the data line represents valid data when, after a Start condition, the data line is stable for the duration of the high period of the clock signal.

The data on the line must be changed during the low period of the clock signal. There is one clock pulse per bit of data.

Each data transfer is initiated with a Start condition and terminated with a Stop condition. The number of data bytes transferred between Start and Stop conditions is determined by the master device and is, theoretically, unlimited (although only the last thirty-two bytes will be stored when doing a write operation). When an overwrite does occur, it will replace data in a first-in first-out (FIFO) fashion.

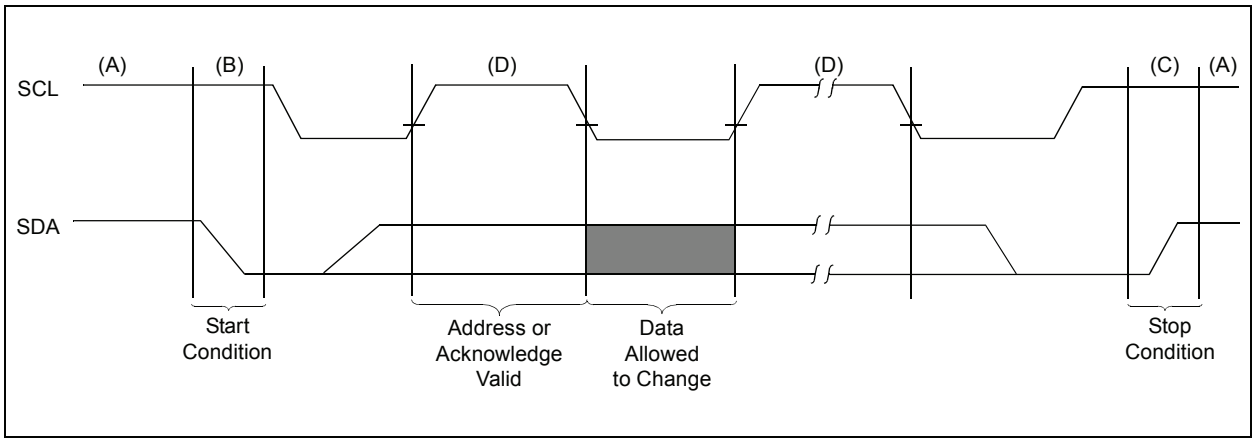
4.5 Acknowledge

Each receiving device, when addressed, is obliged to generate an Acknowledge after the reception of each byte. The master device must generate an extra clock pulse which is associated with this Acknowledge bit.

Note:	The 24XX32A does not generate any Acknowledge bits if an internal programming cycle is in progress.

The device that acknowledges, has to pull down the SDA line during the Acknowledge clock pulse in such a way that the SDA line is stable low during the high period of the Acknowledge related clock pulse. Of course, setup and hold times must be taken into account. During reads, a master must signal an end of data to the slave by not generating an Acknowledge bit on the last byte that has been clocked out of the slave. In this case, the slave (24XX32A) will leave the data line high to enable the master to generate the Stop condition.

FIGURE 4-1: DATA TRANSFER SEQUENCE ON THE SERIAL BUS



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5.0 DEVICE ADDRESSING

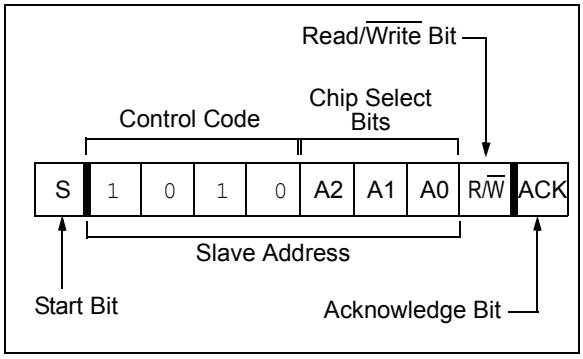
A control byte is the first byte received following the Start condition from the master device (Figure 5-1). The control byte consists of a four-bit control code. For the 24XX32A, this is set as '1010' binary for read and write operations. The next three bits of the control byte are the Chip Select bits (A2, A1, A0). The Chip Select bits allow the use of up to eight 24XX32A devices on the same bus and are used to select which device is accessed. The Chip Select bits in the control byte must correspond to the logic levels on the corresponding A2, A1 and A0 pins for the device to respond. These bits are in effect the three Most Significant bits of the word address.

For the SOT-23 and chip scale packages, the address pins are not available. During device addressing, the A1, A2, and A0 Chip Selects bits (Figure 5-2) should be set to '0'.

The last bit of the control byte defines the operation to be performed. When set to a '1', a read operation is selected. When set to a zero, a write operation is selected. The next two bytes received define the address of the first data byte (Figure 5-2). Because only A11 to A0 are used, the upper four address bits are "don't care" bits. The upper address bits are transferred first, followed by the Less Significant bits.

Following the Start condition, the 24XX32A monitors the SDA bus checking the device type identifier being transmitted and, upon receiving a '1010' code and appropriate device select bits, the slave device outputs an Acknowledge signal on the SDA line. Depending on the state of the R/$\overline{W}$ bit, the 24XX32A will select a read or write operation.

FIGURE 5-1: CONTROL BYTE FORMAT

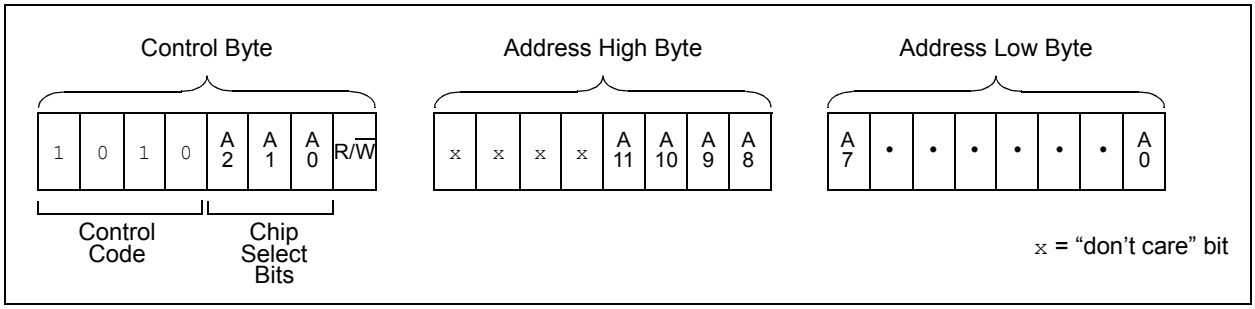


5.1 Contiguous Addressing Across Multiple Devices

The Chip Select bits A2, A1 and A0 can be used to expand the contiguous address space for up to 256K bits by adding up to eight 24XX32A devices on the same bus. In this case, software can use A0 of the control byte as address bit A12; A1 as address bit A13; and A2 as address bit A14. It is not possible to sequentially read across device boundaries.

The SOT-23 and chip scale packages do not support multiple device addressing on the same bus.

FIGURE 5-2: ADDRESS SEQUENCE BIT ASSIGNMENTS



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6.0 WRITE OPERATIONS

6.1 Byte Write

Following the Start condition from the master, the control code (4 bits), the Chip Select (3 bits), and the R/$\overline{W}$ bit (which is a logic low) are clocked onto the bus by the master transmitter. This indicates to the addressed slave receiver that the address high byte will follow once it has generated an Acknowledge bit during the ninth clock cycle. Therefore, the next byte transmitted by the master is the high-order byte of the word address and will be written into the Address Pointer of the 24XX32A. The next byte is the Least Significant Address Byte. After receiving another Acknowledge signal from the 24XX32A, the master device will transmit the data word to be written into the addressed memory location. The 24XX32A acknowledges again and the master generates a Stop condition. This initiates the internal write cycle and, during this time, the 24XX32A will not generate Acknowledge signals (Figure 6-1). If an attempt is made to write to the array with the WP pin held high, the device will acknowledge the command, but no write cycle will occur. No data will be written and the device will immediately accept a new command. After a byte Write command, the internal address counter will point to the address location following the one that was just written.

Note:	When doing a write of less than 32 bytes the data in the rest of the page is refreshed along with the data bytes being written. This will force the entire page to endure a write cycle, for this reason endurance is specified per page.

6.2 Page Write

The write control byte, word address and the first data byte are transmitted to the 24XX32A in the same way as in a byte write. However, instead of generating a Stop condition, the master transmits up to 31 additional bytes which are temporarily stored in the on-chip page buffer and will be written into memory once the master has transmitted a Stop condition. Upon receipt of each word, the five lower Address Pointer bits are internally incremented by '1'. If the master should transmit more than 32 bytes prior to generating the Stop condition, the address counter will roll over and the previously received data will be overwritten. As with the byte write operation, once the Stop condition is received, an internal write cycle will begin (Figure 6-2). If an attempt is made to write to the array with the WP pin held high, the device will acknowledge the command, but no write cycle will occur, no data will be written, and the device will immediately accept a new command.

Note:	Page write operations are limited to writing bytes within a single physical page, **regardless** of the number of bytes actually being written. Physical page boundaries start at addresses that are integer multiples of the page buffer size (or 'page size') and end at addresses that are integer multiples of [page size – 1]. If a Page Write command attempts to write across a physical page boundary, the result is that the data wraps around to the beginning of the current page (overwriting data previously stored there), instead of being written to the next page as might be expected. It is therefore necessary for the application software to prevent page write operations that would attempt to cross a page boundary.

6.3 Write Protection

The WP pin allows the user to write-protect the entire array (000-FFF) when the pin is tied to VCC. If tied to VSS the write protection is disabled. The WP pin is sampled at the Stop bit for every Write command (Figure 4-1). Toggling the WP pin after the Stop bit will have no effect on the execution of the write cycle.

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FIGURE 6-1: BYTE WRITE

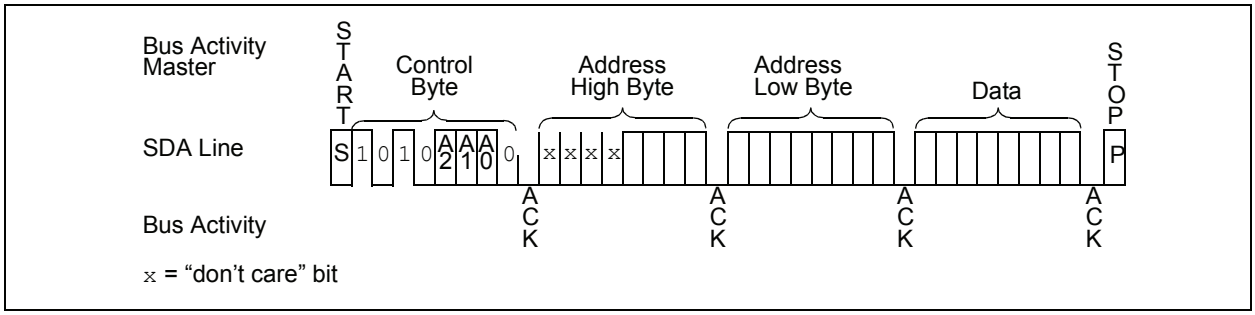
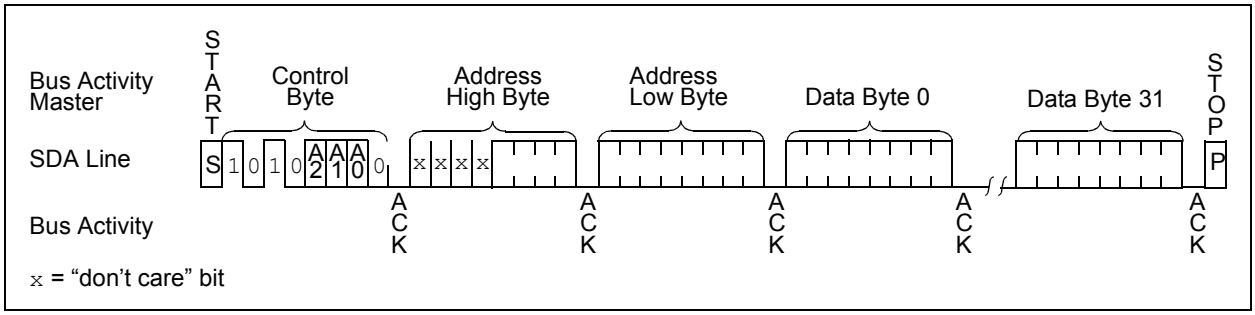


FIGURE 6-2: PAGE WRITE

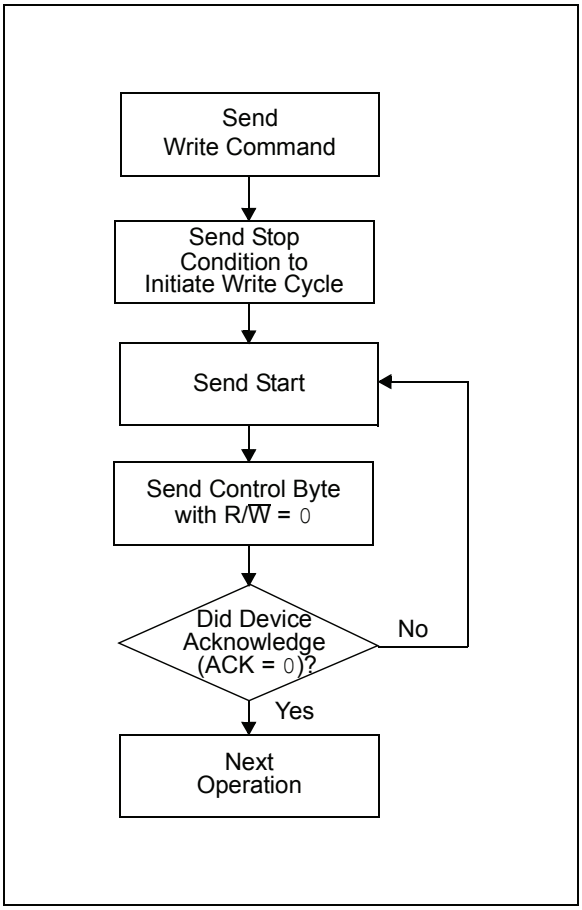


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7.0 ACKNOWLEDGE POLLING

Since the device will not acknowledge during a write cycle, this can be used to determine when the cycle is complete (this feature can be used to maximize bus throughput). Once the Stop condition for a Write command has been issued from the master, the device initiates the internally-timed write cycle. ACK polling can then be initiated immediately. This involves the master sending a Start condition followed by the control byte for a Write command (R/$\overline{W}$ = 0). If the device is still busy with the write cycle, then no ACK will be returned. If no ACK is returned, the Start bit and control byte must be re-sent. If the cycle is complete, the device will return the ACK and the master can then proceed with the next Read or Write command. See Figure 7-1 for flow diagram of this operation.

FIGURE 7-1: ACKNOWLEDGE POLLING FLOW



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8.0 READ OPERATION

Read operations are initiated in the same way as write operations, with the exception that the R/$\overline{W}$ bit of the control byte is set to '1'. There are three basic types of read operations: current address read, random read and sequential read.

8.1 Current Address Read

The 24XX32A contains an address counter that maintains the address of the last word accessed, internally incremented by '1'. Therefore, if the previous read access was to address 'n' (n is any legal address), the next current address read operation would access data from address n + 1.

Upon receipt of the control byte with R/$\overline{W}$ bit set to '1', the 24XX32A issues an acknowledge and transmits the 8-bit data word. The master will not acknowledge the transfer, but does generate a Stop condition and the 24XX32A discontinues transmission (Figure 8-1).

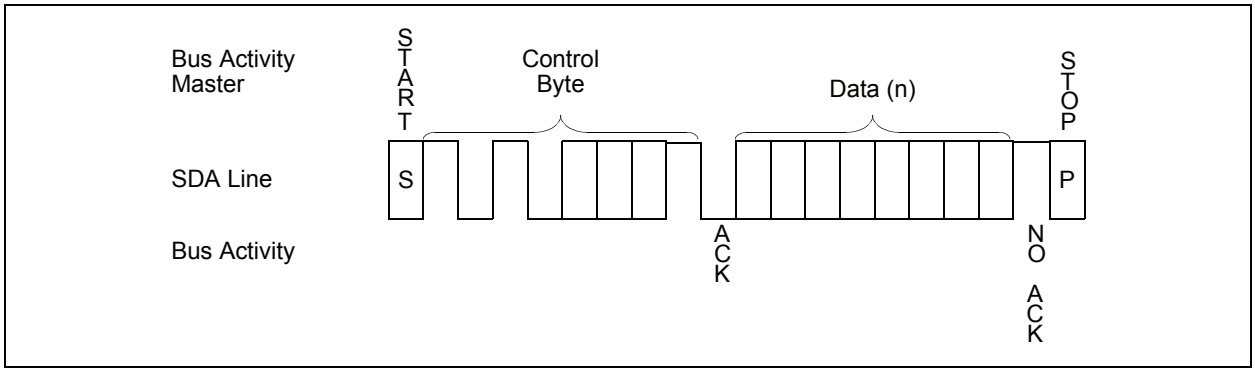
8.2 Random Read

Random read operations allow the master to access any memory location in a random manner. To perform this type of read operation, the word address must first be set. This is accomplished by sending the word address to the 24XX32A as part of a write operation (R/$\overline{W}$ bit set to '0'). Once the word address is sent, the master generates a Start condition following the acknowledge. This terminates the write operation, but not before the internal Address Pointer is set. The master issues the control byte again, but with the R/$\overline{W}$ bit set to a '1'. The 24XX32A will then issue an acknowledge and transmit the 8-bit data word. The master will not acknowledge the transfer, but does generate a Stop condition which causes the 24XX32A to discontinue transmission (Figure 8-2). After a random Read command, the internal address counter will point to the address location following the one that was just read.

8.3 Sequential Read

Sequential reads are initiated in the same way as a random read, except that once the 24XX32A transmits the first data byte, the master issues an acknowledge as opposed to the Stop condition used in a random read. This acknowledge directs the 24XX32A to transmit the next sequentially addressed 8-bit word (Figure 8-3). Following the final byte transmitted to the master, the master will NOT generate an acknowledge, but will generate a Stop condition. To provide sequential reads, the 24XX32A contains an internal Address Pointer which is incremented by '1' upon completion of each operation. This Address Pointer allows the entire memory contents to be serially read during one operation. The internal Address Pointer will automatically roll over from address FFF to address 000 if the master acknowledges the byte received from the array address FFF.

FIGURE 8-1: CURRENT ADDRESS READ



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FIGURE 8-2: RANDOM READ

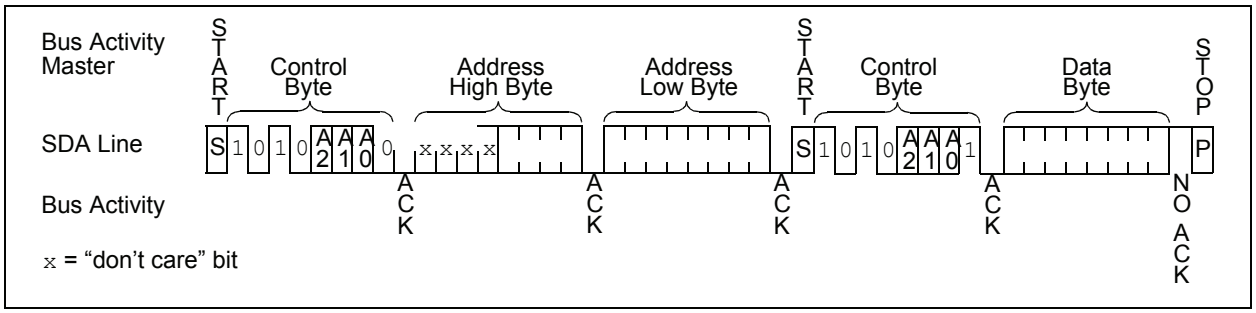
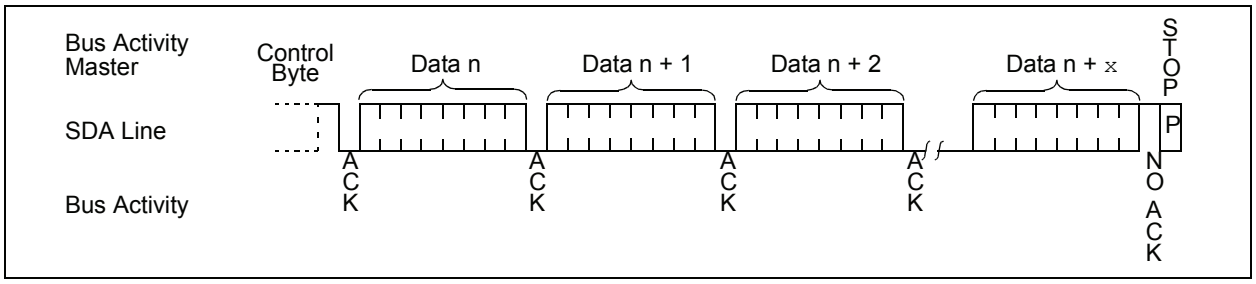


FIGURE 8-3: SEQUENTIAL READ

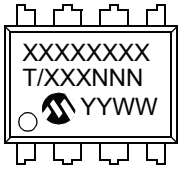


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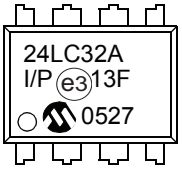
9.0 PACKAGING INFORMATION

9.1 Package Marking Information

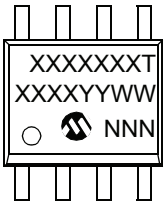
8-Lead PDIP (300 mil)



Example:



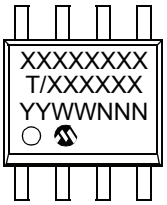
8-Lead SOIC (3.90 mm)



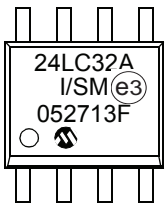
Example:



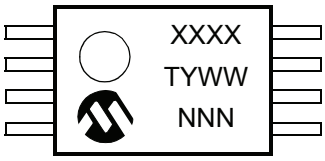
8-Lead SOIC (5.28 mm)



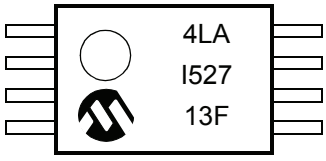
Example:



8-Lead TSSOP



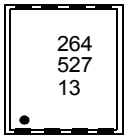
Example:



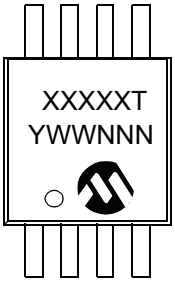
8-Lead 2x3 DFN



Example:



8-Lead MSOP



Example:

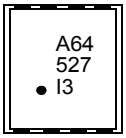


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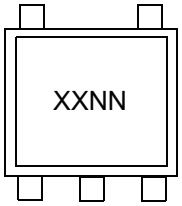
8-Lead 2x3 TDFN



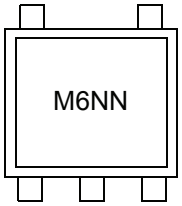
Example:



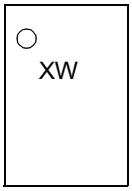
5-Lead SOT-23



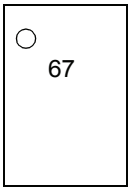
Example:



5-Lead Chip Scale



Example:



Part Number	1st Line Marking Codes								
	TSSOP	TSSOP X-Rotated	MSOP	DFN		TDFN		SOT-23	
				I Temp.	E Temp.	I Temp.	E Temp.	I Temp.	E Temp.
24AA32A	4AA	4AAX	4A32AT	261	—	A61	—	B6NN	—
24LC32A	4LA	4LAX	4L32AT	264	265	A64	A65	M6NN	N6NN

Note: T = Temperature grade (I, E).

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Legend:	XX...X	Part number or part number code
	T	Temperature (I, E)
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code (2 characters for small packages)
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)

Note: For very small packages with no room for the Pb-free JEDEC designator (e3), the marking will only appear on the outer carton or reel label.

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

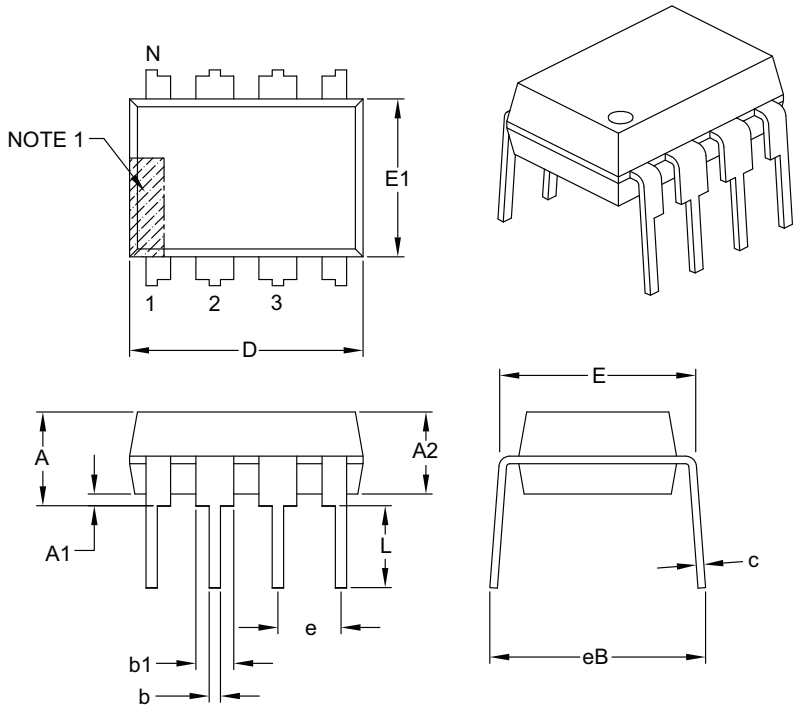
Note: Please visit www.microchip.com/Pbfree for the latest information on Pb-free conversion.

*Standard OTP marking consists of Microchip part number, year code, week code, and traceability code.

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8-Lead Plastic Dual In-Line (P) – 300 mil Body [PDIP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		INCHES		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		.100 BSC	
Top to Seating Plane	A	–	–	.210
Molded Package Thickness	A2	.115	.130	.195
Base to Seating Plane	A1	.015	–	–
Shoulder to Shoulder Width	E	.290	.310	.325
Molded Package Width	E1	.240	.250	.280
Overall Length	D	.348	.365	.400
Tip to Seating Plane	L	.115	.130	.150
Lead Thickness	c	.008	.010	.015
Upper Lead Width	b1	.040	.060	.070
Lower Lead Width	b	.014	.018	.022
Overall Row Spacing §	eB	–	–	.430

Notes:

1. Pin 1 visual index feature may vary, but must be located with the hatched area.
2. § Significant Characteristic.
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
4. Dimensioning and tolerancing per ASME Y14.5M.

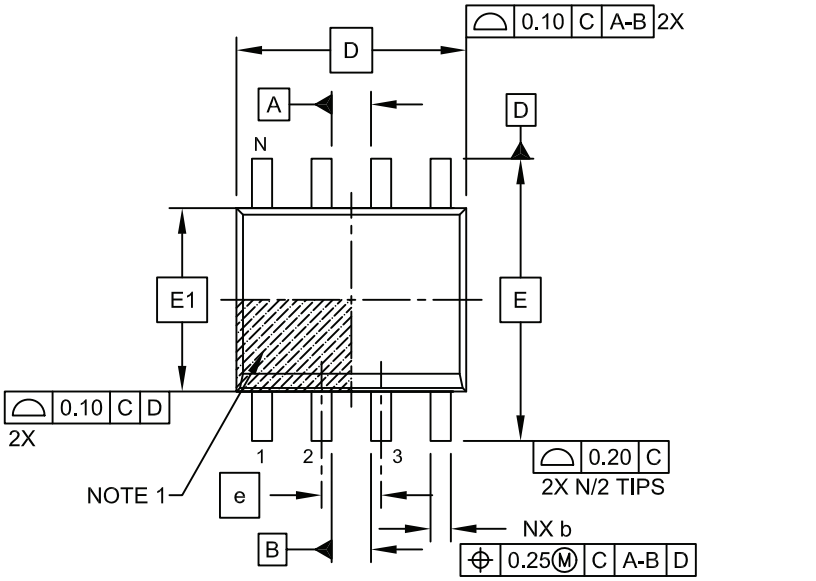
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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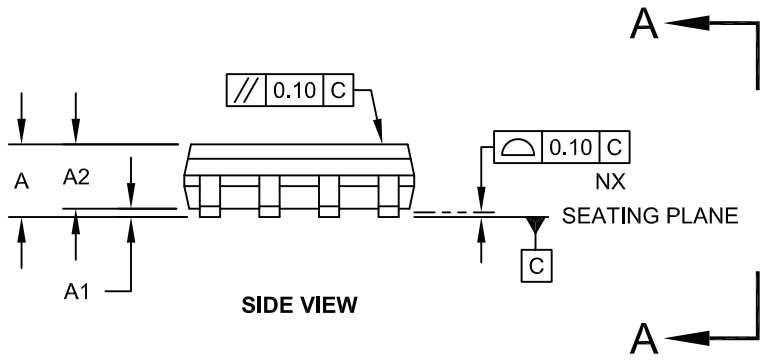
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8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm Body [SOIC]

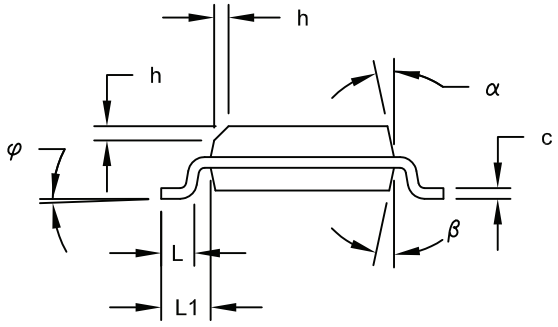
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



TOP VIEW



SIDE VIEW



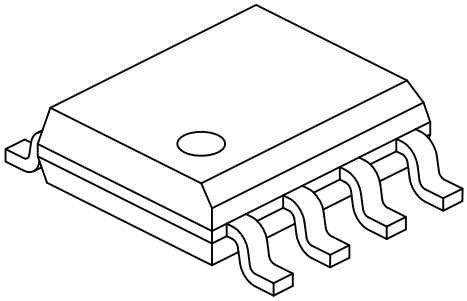
VIEW A-A

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8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		1.27 BSC	
Overall Height	A	-	-	1.75
Molded Package Thickness	A2	1.25	-	-
Standoff §	A1	0.10	-	0.25
Overall Width	E		6.00 BSC	
Molded Package Width	E1		3.90 BSC	
Overall Length	D		4.90 BSC	
Chamfer (Optional)	h	0.25	-	0.50
Foot Length	L	0.40	-	1.27
Footprint	L1		1.04 REF	
Foot Angle	φ	0°	-	8°
Lead Thickness	c	0.17	-	0.25
Lead Width	b	0.31	-	0.51
Mold Draft Angle Top	α	5°	-	15°
Mold Draft Angle Bottom	β	5°	-	15°

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

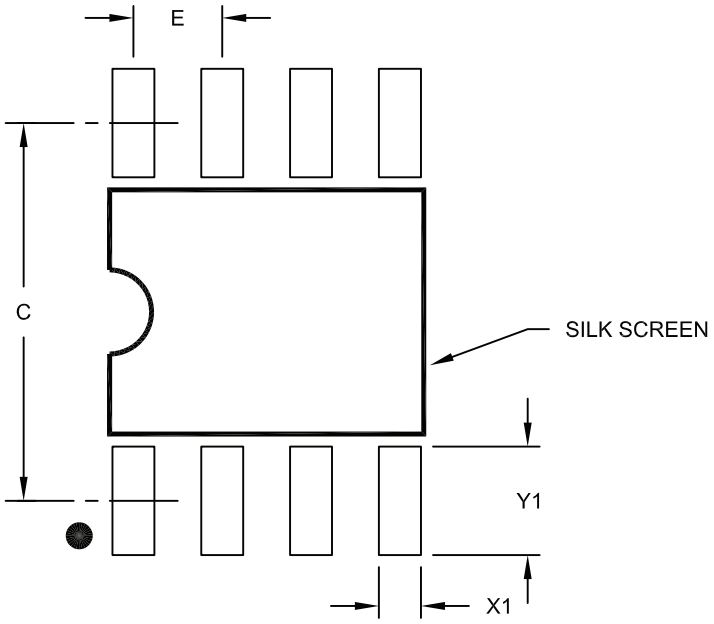
   REF: Reference Dimension, usually without tolerance, for information purposes only.

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8-Lead Plastic Small Outline (SN) – Narrow, 3.90 mm Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		1.27 BSC	
Contact Pad Spacing	C		5.40	
Contact Pad Width (X8)	X1			0.60
Contact Pad Length (X8)	Y1			1.55

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

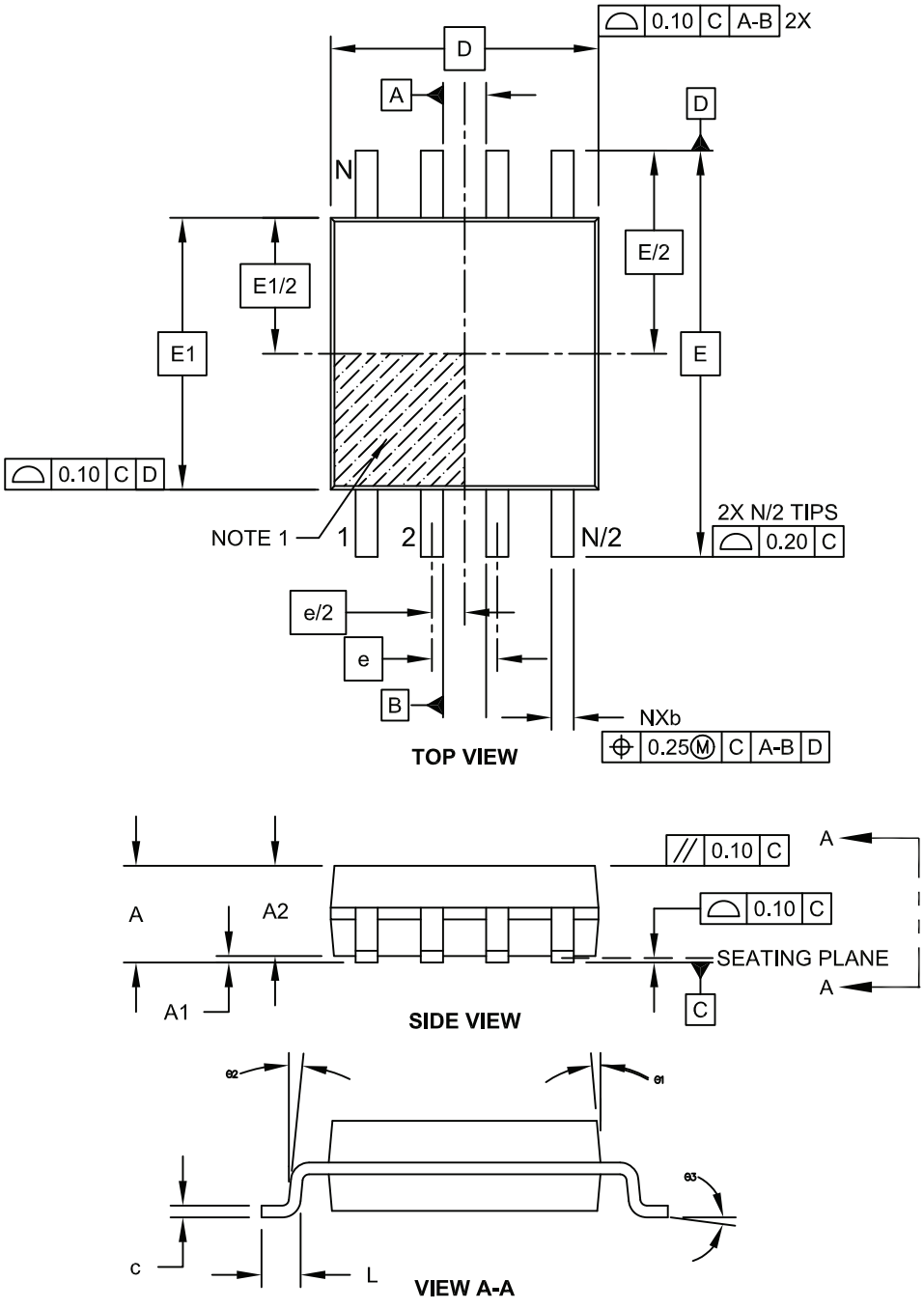
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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8-Lead Plastic Small Outline (SM) - Medium, 5.28 mm Body [SOIJ]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

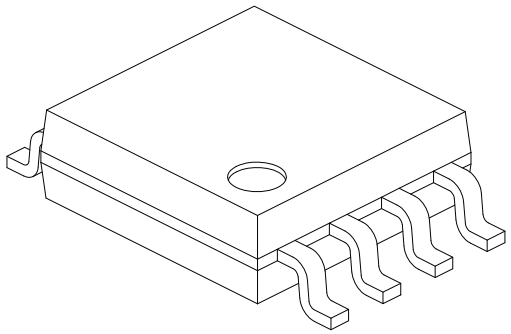


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8-Lead Plastic Small Outline (SM) - Medium, 5.28 mm Body [SOIJ]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		1.27 BSC	
Overall Height	A	1.77	-	2.03
Standoff §	A1	0.05		0.25
Molded Package Thickness	A2	1.75	-	1.98
Overall Width	E		7.94 BSC	
Molded Package Width	E1		5.25 BSC	
Overall Length	D		5.26 BSC	
Foot Length	L	0.51	-	0.76
Lead Thickness	c	0.15	-	0.25
Lead Width	b	0.36	-	0.51
Mold Draft Angle	θ1	-	-	15°
Lead Angle	θ2	0°	-	8°
Foot Angle	θ3	0°	-	8°

Notes:

1. SOIJ, JEITA/EIAJ Standard, Formerly called SOIC
2. § Significant Characteristic
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25mm per side.

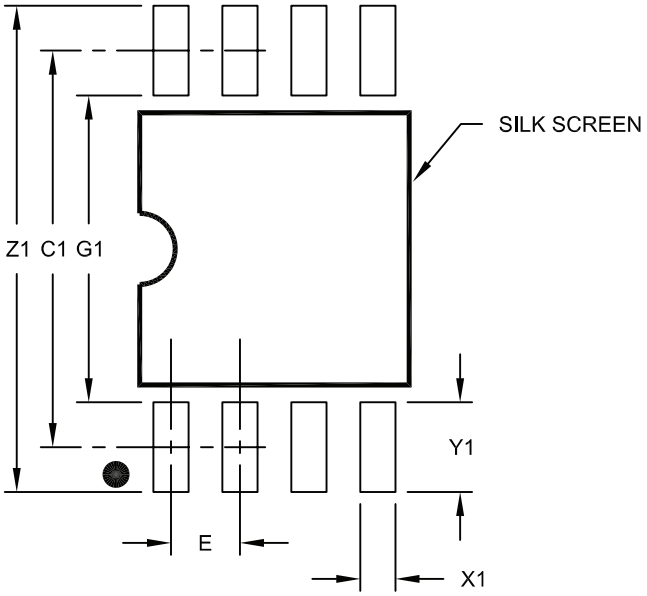
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8-Lead Plastic Small Outline (SM) - Medium, 5.28 mm Body [SOIJ]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		1.27 BSC	
Overall Width	Z1			9.00
Contact Pad Spacing	C1		7.30	
Contact Pad Width (X8)	X1			0.65
Contact Pad Length (X8)	Y1			1.70
Distance Between Pads	G1	5.60		
Distance Between Pads	G	0.62		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

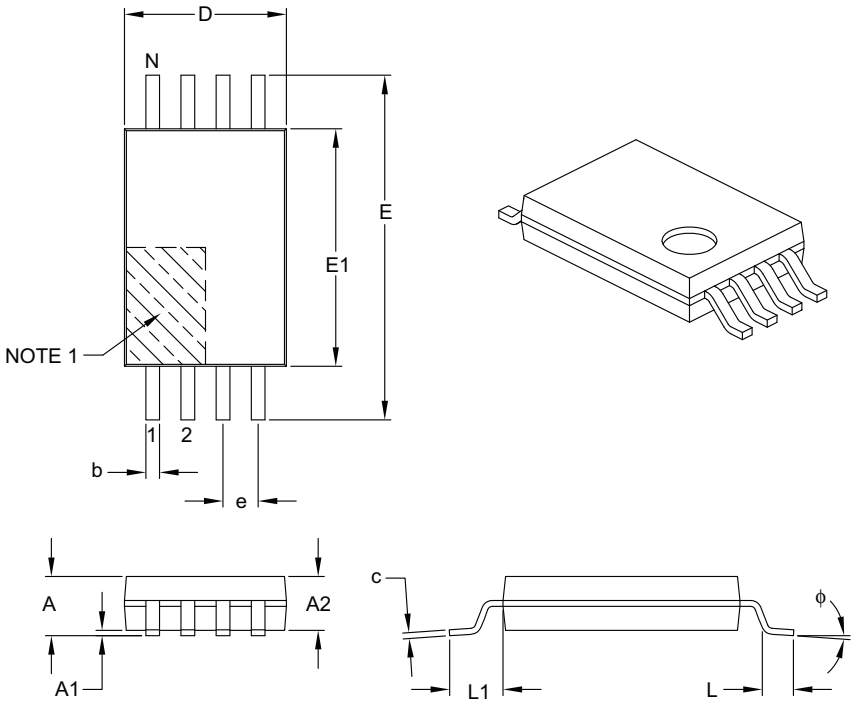
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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8-Lead Plastic Thin Shrink Small Outline (ST) – 4.4 mm Body [TSSOP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		0.65 BSC	
Overall Height	A	–	–	1.20
Molded Package Thickness	A2	0.80	1.00	1.05
Standoff	A1	0.05	–	0.15
Overall Width	E		6.40 BSC	
Molded Package Width	E1	4.30	4.40	4.50
Molded Package Length	D	2.90	3.00	3.10
Foot Length	L	0.45	0.60	0.75
Footprint	L1		1.00 REF	
Foot Angle	ϕ	0°	–	8°
Lead Thickness	c	0.09	–	0.20
Lead Width	b	0.19	–	0.30

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
3. Dimensioning and tolerancing per ASME Y14.5M.

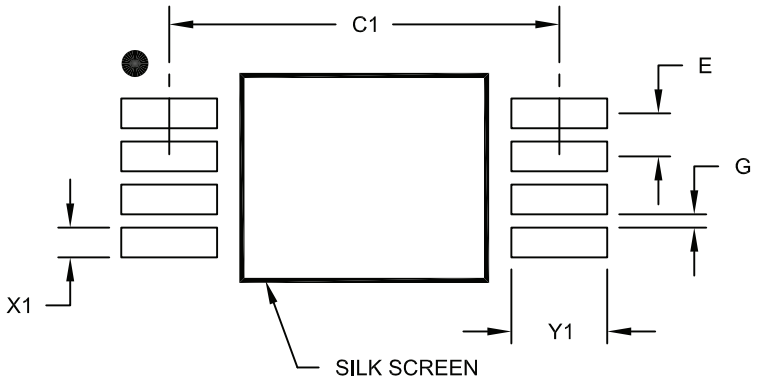
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
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8-Lead Plastic Thin Shrink Small Outline (ST) - 4.4 mm Body [TSSOP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.65 BSC	
Contact Pad Spacing	C1		5.90	
Contact Pad Width (X8)	X1			0.45
Contact Pad Length (X8)	Y1			1.45
Distance Between Pads	G	0.20		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

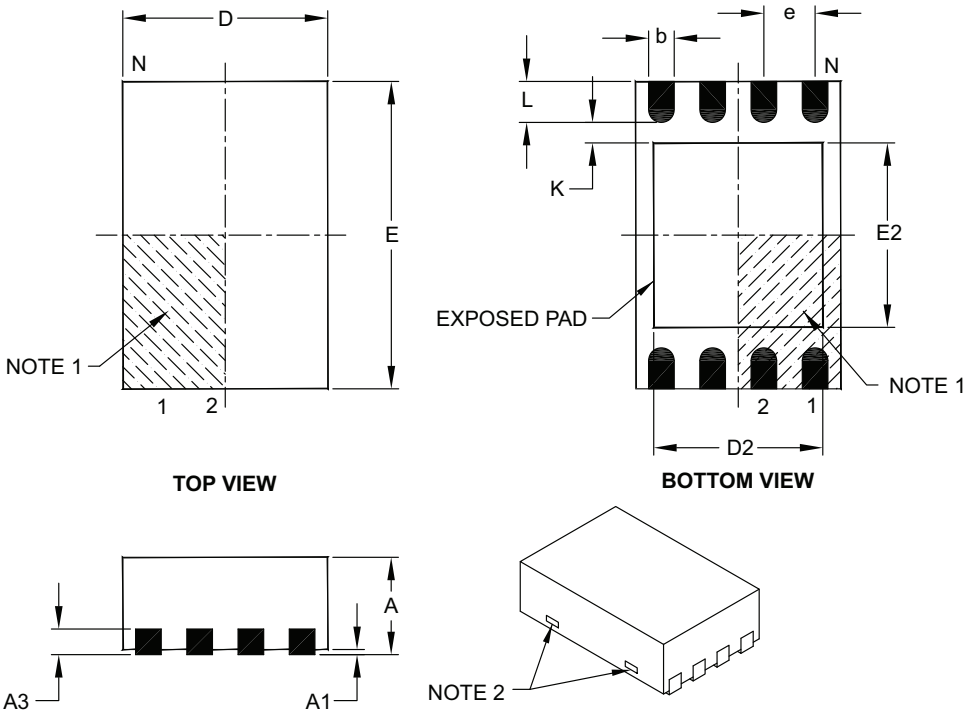
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8-Lead Plastic Dual Flat, No Lead Package (MC) – 2x3x0.9 mm Body [DFN]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		0.50 BSC	
Overall Height	A	0.80	0.90	1.00
Standoff	A1	0.00	0.02	0.05
Contact Thickness	A3		0.20 REF	
Overall Length	D		2.00 BSC	
Overall Width	E		3.00 BSC	
Exposed Pad Length	D2	1.30	–	1.55
Exposed Pad Width	E2	1.50	–	1.75
Contact Width	b	0.20	0.25	0.30
Contact Length	L	0.30	0.40	0.50
Contact-to-Exposed Pad	K	0.20	–	–

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package may have one or more exposed tie bars at ends.
3. Package is saw singulated.
4. Dimensioning and tolerancing per ASME Y14.5M.

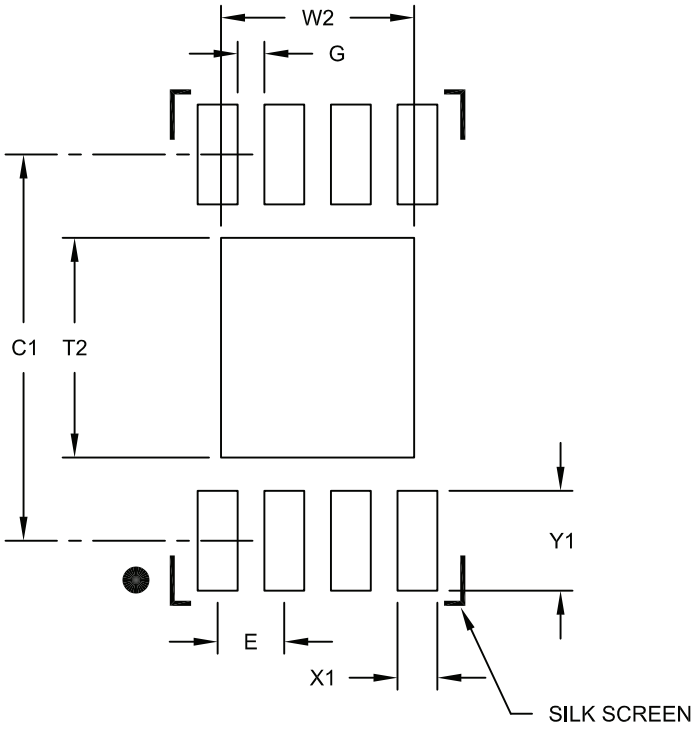
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
REF: Reference Dimension, usually without tolerance, for information purposes only.

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8-Lead Plastic Dual Flat, No Lead Package (MC) - 2x3x0.9mm Body [DFN]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	0.50 BSC		
Optional Center Pad Width	W2			1.45
Optional Center Pad Length	T2			1.75
Contact Pad Spacing	C1		2.90	
Contact Pad Width (X8)	X1			0.30
Contact Pad Length (X8)	Y1			0.75
Distance Between Pads	G	0.20		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

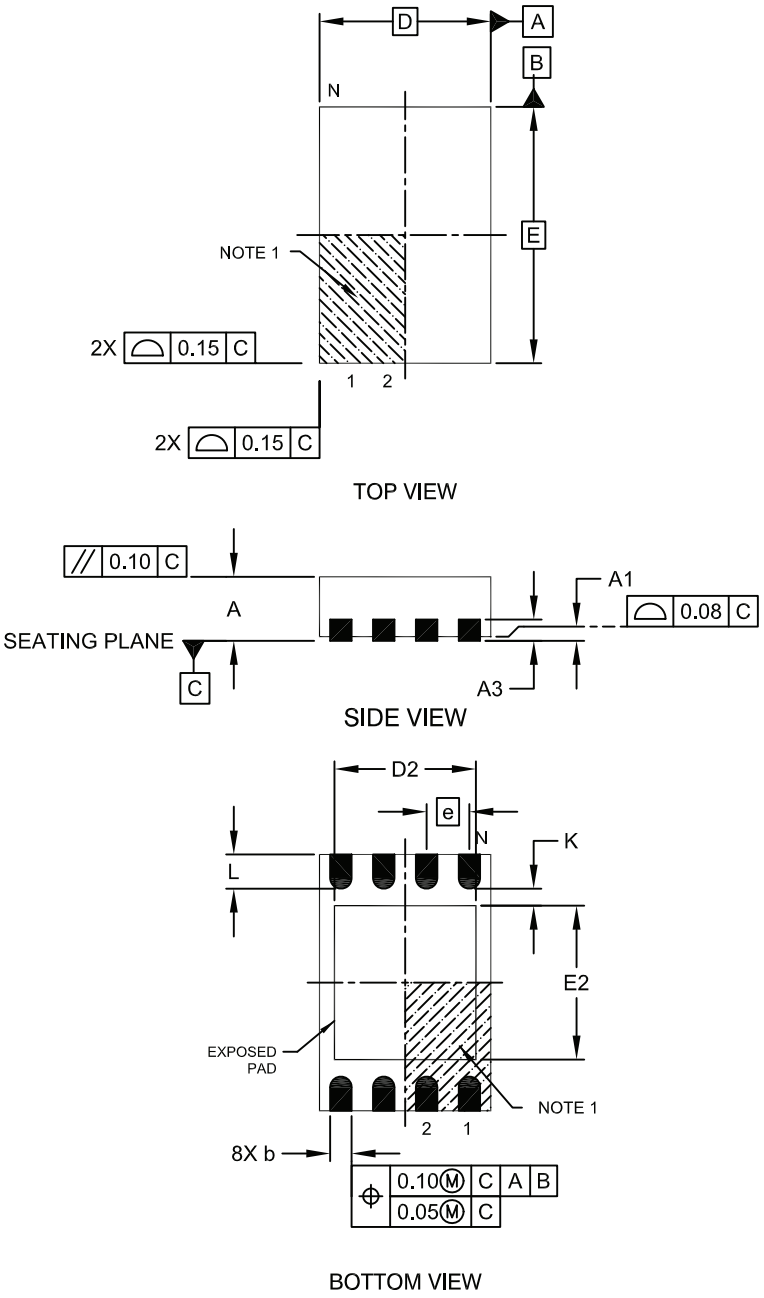
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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8-Lead Plastic Dual Flat, No Lead Package (MN) – 2x3x0.75mm Body [TDFN]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

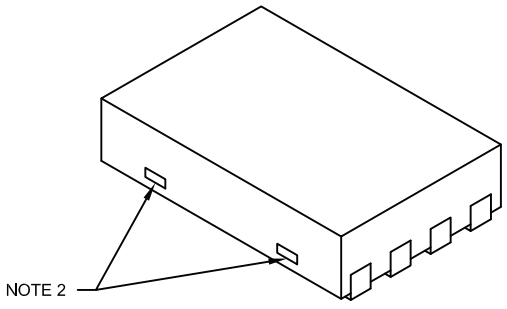


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8-Lead Plastic Dual Flat, No Lead Package (MN) – 2x3x0.75mm Body [TDFN]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		0.50 BSC	
Overall Height	A	0.70	0.75	0.80
Standoff	A1	0.00	0.02	0.05
Contact Thickness	A3		0.20 REF	
Overall Length	D		2.00 BSC	
Overall Width	E		3.00 BSC	
Exposed Pad Length	D2	1.20	-	1.60
Exposed Pad Width	E2	1.20	-	1.60
Contact Width	b	0.20	0.25	0.30
Contact Length	L	0.25	0.30	0.45
Contact-to-Exposed Pad	K	0.20	-	-

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package may have one or more exposed tie bars at ends.
3. Package is saw singulated
4. Dimensioning and tolerancing per ASME Y14.5M

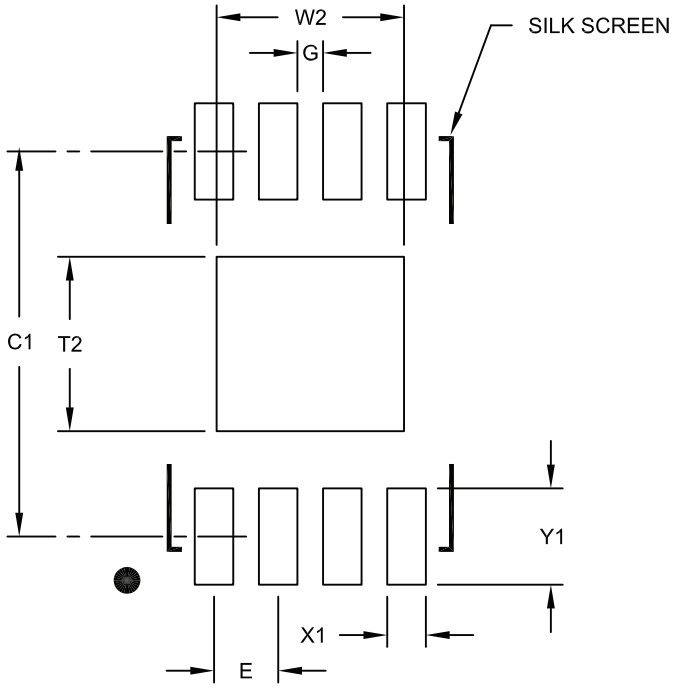
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8-Lead Plastic Dual Flat, No Lead Package (MN) – 2x3x0.75 mm Body [TDFN]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.50 BSC	
Optional Center Pad Width	W2			1.46
Optional Center Pad Length	T2			1.36
Contact Pad Spacing	C1		3.00	
Contact Pad Width (X8)	X1			0.30
Contact Pad Length (X8)	Y1			0.75
Distance Between Pads	G	0.20		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

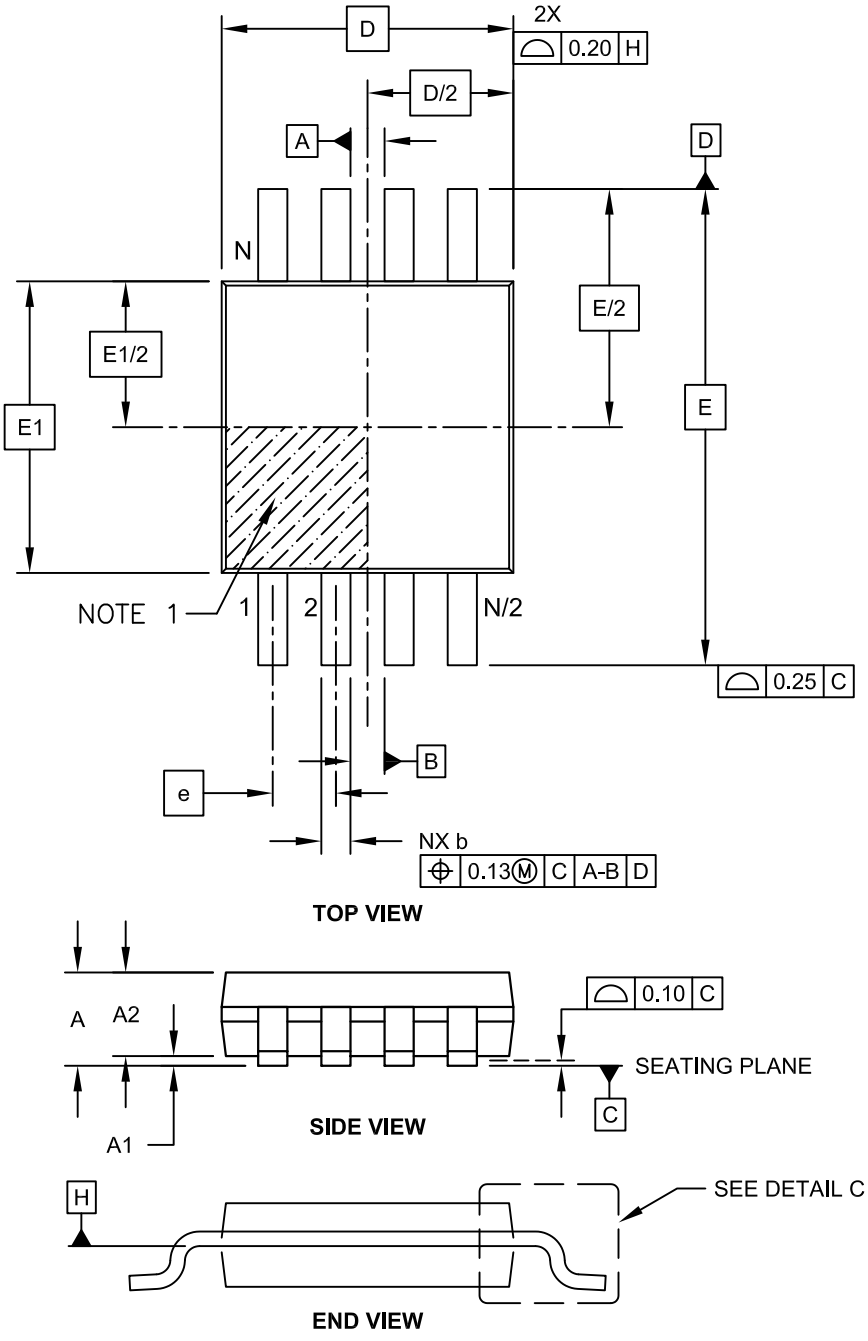
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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8-Lead Plastic Micro Small Outline Package (MS) [MSOP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

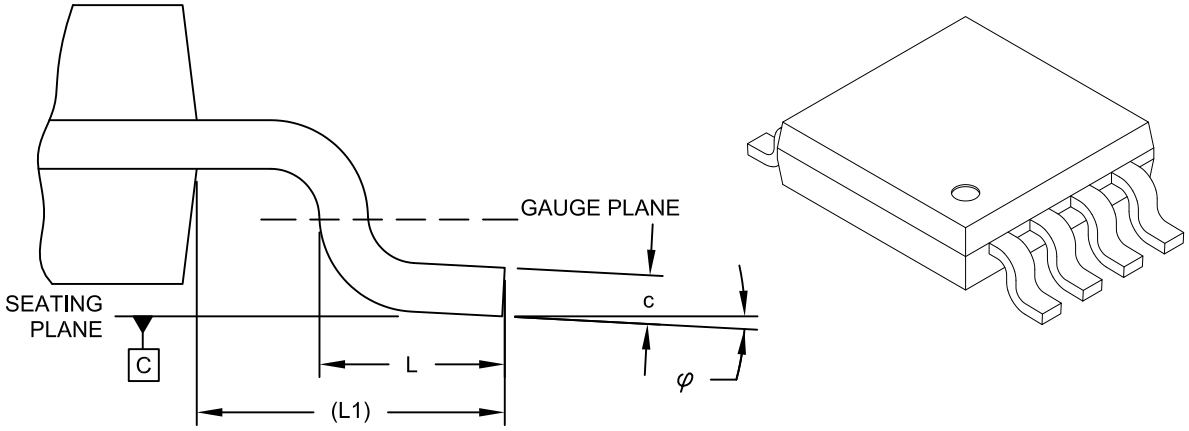


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8-Lead Plastic Micro Small Outline Package (MS) [MSOP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



DETAIL C

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e		0.65 BSC	
Overall Height	A	-	-	1.10
Molded Package Thickness	A2	0.75	0.85	0.95
Standoff	A1	0.00	-	0.15
Overall Width	E		4.90 BSC	
Molded Package Width	E1		3.00 BSC	
Overall Length	D		3.00 BSC	
Foot Length	L	0.40	0.60	0.80
Footprint	L1		0.95 REF	
Foot Angle	φ	0°	-	8°
Lead Thickness	c	0.08	-	0.23
Lead Width	b	0.22	-	0.40

Notes:

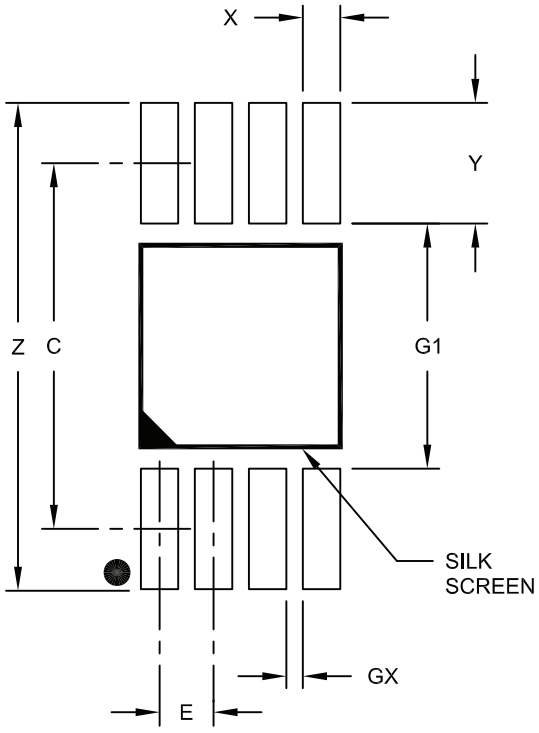
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
3. Dimensioning and tolerancing per ASME Y14.5M.
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.

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8-Lead Plastic Micro Small Outline Package (MS) [MSOP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	0.65 BSC		
Contact Pad Spacing	C		4.40	
Overall Width	Z			5.85
Contact Pad Width (X8)	X1			0.45
Contact Pad Length (X8)	Y1			1.45
Distance Between Pads	G1	2.95		
Distance Between Pads	GX	0.20		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

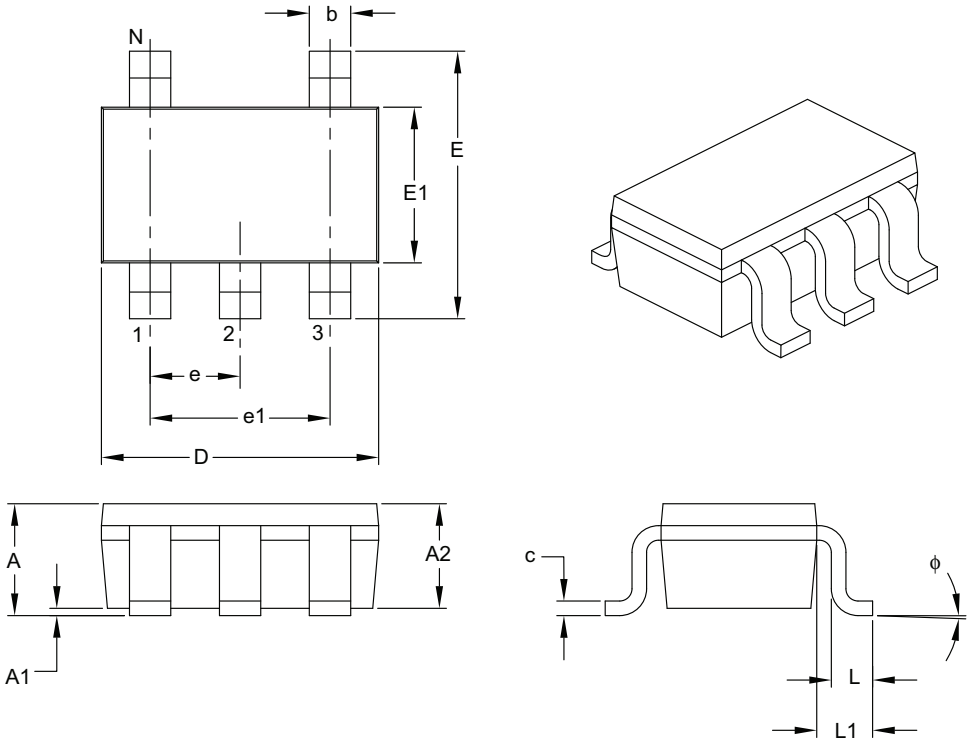
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5-Lead Plastic Small Outline Transistor (OT) [SOT-23]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		5	
Lead Pitch	e		0.95 BSC	
Outside Lead Pitch	e1		1.90 BSC	
Overall Height	A	0.90	–	1.45
Molded Package Thickness	A2	0.89	–	1.30
Standoff	A1	0.00	–	0.15
Overall Width	E	2.20	–	3.20
Molded Package Width	E1	1.30	–	1.80
Overall Length	D	2.70	–	3.10
Foot Length	L	0.10	–	0.60
Footprint	L1	0.35	–	0.80
Foot Angle	ϕ	0°	–	30°
Lead Thickness	c	0.08	–	0.26
Lead Width	b	0.20	–	0.51

Notes:

1. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.127 mm per side.
2. Dimensioning and tolerancing per ASME Y14.5M.

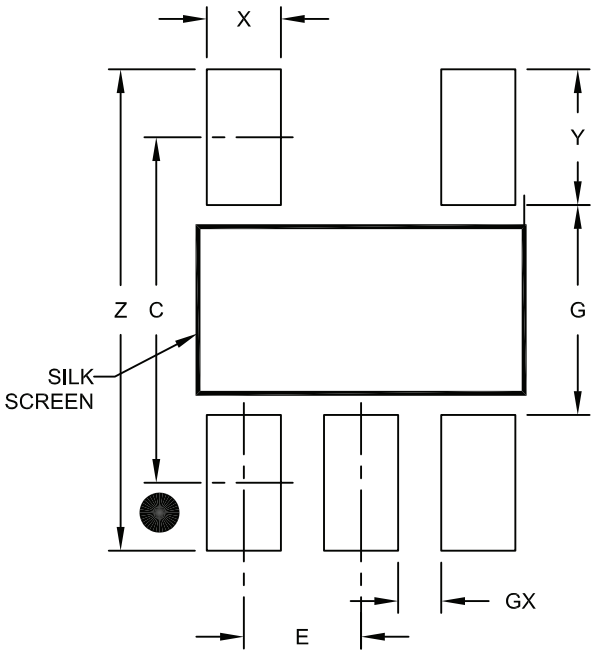
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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5-Lead Plastic Small Outline Transistor (OT) [SOT-23]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.95 BSC	
Contact Pad Spacing	C		2.80	
Contact Pad Width (X5)	X			0.60
Contact Pad Length (X5)	Y			1.10
Distance Between Pads	G	1.70		
Distance Between Pads	GX	0.35		
Overall Width	Z			3.90

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

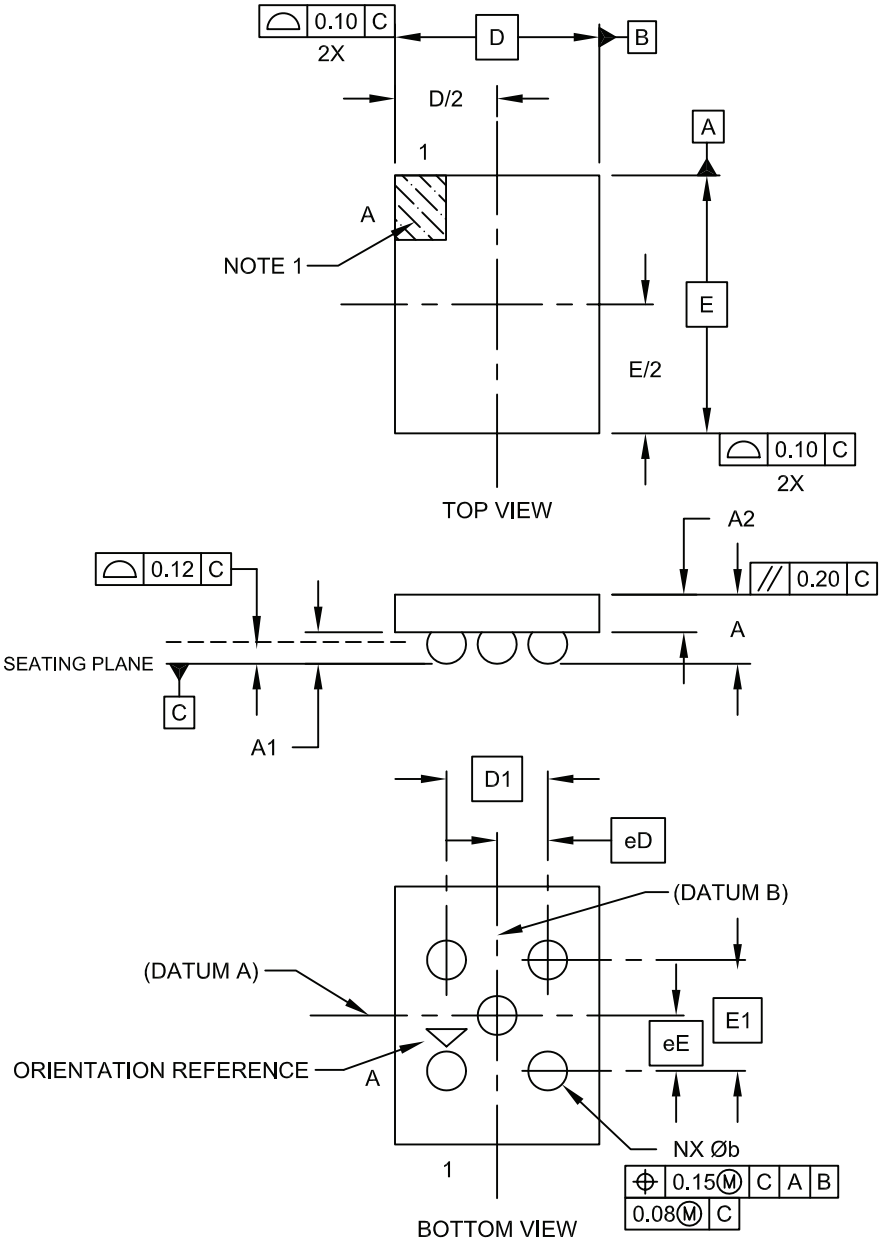
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5-Lead Chip Scale Package (CS) - [CSP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging

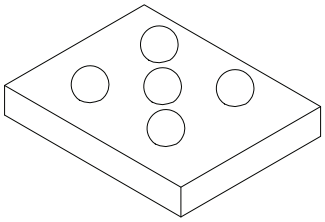


Microchip Technology Drawing C04-6004D Sheet 1 of 2

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5-Lead Chip Scale Package (CS) - [CSP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Contacts	N		5	
Adjacent Column X-Pitch	E1		0.570 BSC	
Adjacent Row Y-Pitch	D1		0.520 BSC	
Adjacent Column X-Pitch	eE		0.285 BSC	
Adjacent Row Y-Pitch	eD		0.260 BSC	
Overall Height	A	0.47	0.51	0.55
Die Height	A2	0.33	0.35	0.37
Bump Height	A1	0.14	0.16	0.18
Overall Length	E		NOTE 4	
Overall Width	D		NOTE 4	
Ball Diameter	b	0.18	0.20	0.22

Notes:

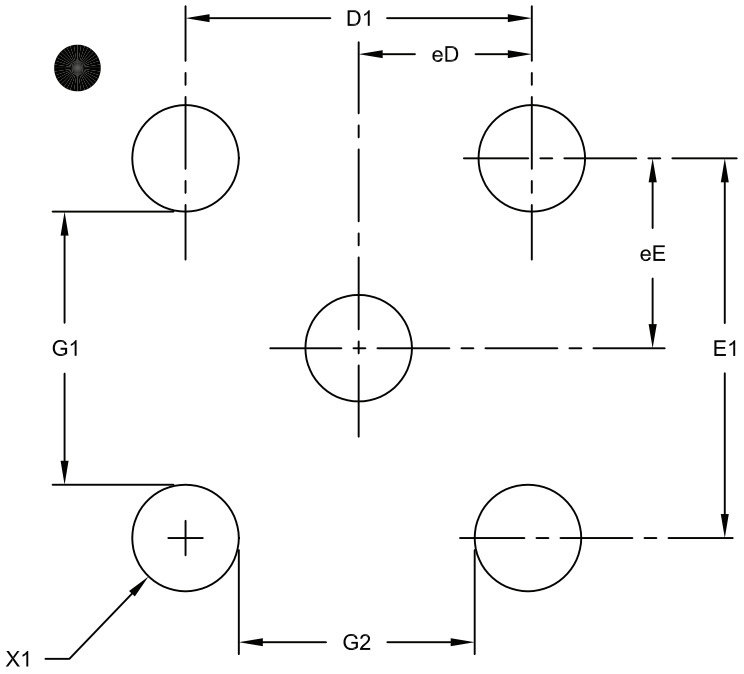
1. Orientation reference feature may vary, but must be located within the hatched area.
2. Package is saw singulated.
3. Dimensioning and tolerancing per ASME Y14.5M.
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.
4. Package size varies with specific devices. Please contact your local Microchip representative for specific details.

Microchip Technology Drawing C04-6004D Sheet 2 of 2

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5-Lead Chip Scale Package (CS) - [CSP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Contacts	N		5	
Contact Pitch Y	eE		0.285	
Contact Pitch X	eD		0.260	
Contact Pad Spacing	E1		0.570	
Contact Pad Spacing	D1		0.520	
Contact Pad Diameter (X8)	X1			0.20
Distance Between Pads	G1	0.41		
Distance Between Pads	G2	0.36		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-8004A

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APPENDIX A: REVISION HISTORY

Revision D (12/2003)

Corrections to Section 1.0, Electrical Characteristics.

Revision E (03/2005)

Added DFN package.

Revision F (08/2005)

Revised Sections 4.3, 7.2 and 7.4.

Revision G (07/2006)

Replaced 2x3 DFN (MC) Package

Revision H (02/2007)

Changed 1.8V to 1.7V; Revised Features Section; Replaced Package Drawings; Deleted Rotated TSSOP; Revised Product ID Section.

Revision J (02/2009)

Added TDFN and SOT-23 packages; Updated Package Drawings; Moved Pin Descriptions to Section 2.0; Renumbered Sections.

Revision K (12/2009)

Added Chip Scale Package.

Revision L (03/2010)

Added X-Rotated TSSOP package; Updated Package Drawings.

Revision M (02/2012)

Corrected CS package drawing aspect ratio; Revised Product ID System.

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2. How does this document meet your hardware and software development needs?

3. Do you find the organization of this document easy to follow? If not, why?

4. What additions to the document do you think would enhance the structure and subject?

5. What deletions from the document could be made without affecting the overall usefulness?

6. Is there any incorrect or misleading information (what and where)?

7. How would you improve this document?

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PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

PART NO.	X	/XX
Device	Temperature Range	Package

Device:
- 24AA32A: 1.7V, 32 Kbit I^2C Serial EEPROM
- 24AA32AT: 1.7V, 32 Kbit I^2C Serial EEPROM (Tape and Reel)
- 24AA32AX: 1.7V, 32 Kbit I^2C Serial EEPROM in alternate pinout (ST only)
- 24AA32AXT: 1.7V, 32 Kbit I^2C Serial EEPROM in alternate pinout (ST only)
- 24LC32A: 2.5V, 32 Kbit I^2C Serial EEPROM
- 24LC32AT: 2.5V, 32 Kbit I^2C Serial EEPROM (Tape and Reel)
- 24LC32AX: 2.5V, 32 Kbit I^2C Serial EEPROM in alternate pinout (ST only)
- 24LC32AXT: 2.5V, 32 Kbit I^2C Serial EEPROM in alternate pinout (ST only)

Temperature Range:
- I = -40°C to +85°C
- E = -40°C to +125°C

Package:
- P = Plastic DIP (300 mil body), 8-lead
- SN = Plastic SOIC (3.90 mm body), 8-lead
- SM = Plastic SOIJ (5.28 mm body), 8-lead
- ST = Plastic TSSOP (4.4 mm body), 8-lead
- MS = Plastic MSOP (Micro Small Outline), 8-lead
- MC = Plastic DFN (2x3x0.90 mm body), 8-lead
- MNY(1) = Plastic TDFN (2x3x0.75mm body), 8-lead
- OT = Plastic SOT-23, 5-lead (Tape and Reel only)
- CS16K(2) = Chip Scale (CS), 5-lead (I-temp, “AA” Tape and Reel only)

Note 1: “Y” indicates a Nickel Palladium Gold (NiPdAu) finish.

2: “16K” indicates 160K technology.

Examples:

a) 24AA32A-I/P: Industrial Temperature,1.7V, PDIP package

b) 24AA32A-I/SN: Industrial Temperature,1.7V, SOIC package

c) 24AA32A-I/SM: Industrial Temperature,1.7V, SOIJ (5.28 mm) package

d) 24AA32A-I/ST: Industrial Temperature,1.7V, TSSOP package

e) 24AA32AT-I/CS16K = Industrial Temperature, 1.7V, CS package, Tape and Reel

f) 24LC32A-I/P: Industrial Temperature, 2.5V, PDIP package

g) 24LC32A-E/SN: Automotive Temperature, 2.5V SOIC package

h) 24LC32A-E/SM: Automotive Temperature, 2.5V SOIJ (5.28 mm) package

i) 24LC32AT-I/ST: Industrial Temperature, 2.5V, TSSOP package, Tape and Reel

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ISBN: 9781620760154

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深圳市满度科技有限公司 Tel:150-1290-5940
Web:www.manduic.com Email:sales@manduic.com

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://www.microchip.com/support
Web Address:
www.microchip.com

Atlanta
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Fax: 408-961-6445

Toronto
Mississauga, Ontario, Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
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Fax: 44-118-921-5820

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深圳市满度科技有限公司 Tel:150-1290-5940
Web:www.manduic.com Email:sales@manduic.com