24AA16/24LC16B

16K I²C™ Serial EEPROM

Device Selection Table

Part Number	Vcc Range	Max. Clock Frequency	Temp. Ranges
24AA16	1.7-5.5	400 kHz(1)	I, E
24LC16B	2.5-5.5	400 kHz	I, E

Note 1: 100 kHz for VCC <2.5V.

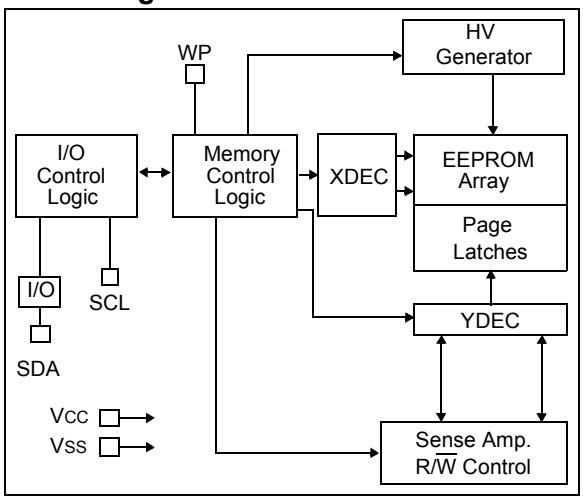
Features:

- Single Supply with Operation down to 1.7V for 24AA16 Devices, 2.5V for 24LC16B 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
- 16-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, 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

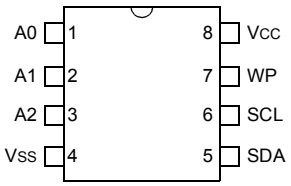
Description:

The Microchip Technology Inc. 24AA16/24LC16B (24XX16*) is a 16 Kbit Electrically Erasable PROM. The device is organized as eight blocks of 256 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. The 24XX16 also has a page write capability for up to 16 bytes of data. The 24XX16 is available in the standard 8-pin PDIP, surface mount SOIC, TSSOP, 2x3 DFN, 2x3 TDFN and MSOP packages, and is also available in the 5-lead SOT-23, and Chip Scale packages.

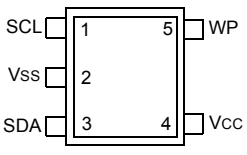
Block Diagram



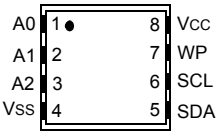
PDIP/MSOP/SOIC/TSSOP



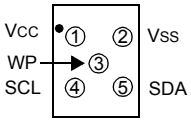
SOT-23



DFN/TDFN



CS (Chip Scale)(1)



(Top Down View, Balls Not Visible)

Note 1: Pins A0, A1 and A2 are not used by the 24XX16 (no internal connections).

2: Available in I-temp, "AA" only.

*24XX16 is used in this document as a generic part number for the 24AA16/24LC16B 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 = +1.7V to +5.5V				
Param. No.	**Symbol**	**Characteristic**	**Min.**	**Typ.**	**Max.**	**Units**	**Conditions**
		WP, SCL and SDA pins	—	—	—	—	—
D1	VIH	High-level input voltage	0.7 VCC	—	—	V	—
D2	VIL	Low-level input voltage	—	—	0.3 VCC	V	—
D3	VHYS	Hysteresis of Schmitt Trigger inputs	0.05 VCC	—	—	V	**(Note 1)**
D4	VOL	Low-level output voltage	—	—	0.40	V	IOL = 3.0 mA, VCC = 2.5V
D5	ILI	**Input leakage current**	—	—	±1	µA	VIN = VSS or VCC
D6	ILO	**Output leakage current**	—	—	±1	µA	VOUT = VSS or VCC
D7	CIN, COUT	Pin capacitance (all inputs/outputs)	—	—	10	pF	VCC = 5.0V **(Note 1)** TA = 25°C, FCLK = 1 MHz
D8	ICC write	**Operating current**	—	—	3	mA	VCC = 5.5V, SCL = 400 kHz
D9	ICC read		—	0.01	1	mA	—
D10	ICCS	**Standby current**	— —	0.3 0.01	1 5	µA µA	Industrial Automotive SDA = SCL = VCC 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} = +1.7V 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 **(24AA16)**
2	T_{HIGH}	Clock high time	600 4000	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA16)**
3	T_{LOW}	Clock low time	1300 4700	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA16)**
4	T_R	SDA and SCL rise time **(Note 1)**	— —	300 1000	ns	2.5V ≤ V_{CC} ≤ 5.5V **(Note 1)** 1.7V ≤ V_{CC} < 2.5V **(24AA16)** **(Note 1)**
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 **(24AA16)**
7	$T_{SU:STA}$	Start condition setup time	600 4700	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA16)**
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 **(24AA16)**
10	$T_{SU:STO}$	Stop condition setup time	600 4000	— —	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA16)**
11	T_{AA}	Output valid from clock **(Note 2)**	— —	900 3500	ns	2.5V ≤ V_{CC} ≤ 5.5V 1.7V ≤ V_{CC} < 2.5V **(24AA16)**
12	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 **(24AA16)**
13	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 **(24AA16)**
14	T_{SP}	Input filter spike suppression (SDA and SCL pins)	—	50	ns	**(Notes 1 and 3)**
15	T_{WC}	Write cycle time (byte or page)	—	5	ms	—
16	—	Endurance	1M	—	cycles	25°C, **(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 from Microchip's web site at www.microchip.com.

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FIGURE 1-1: BUS TIMING DATA

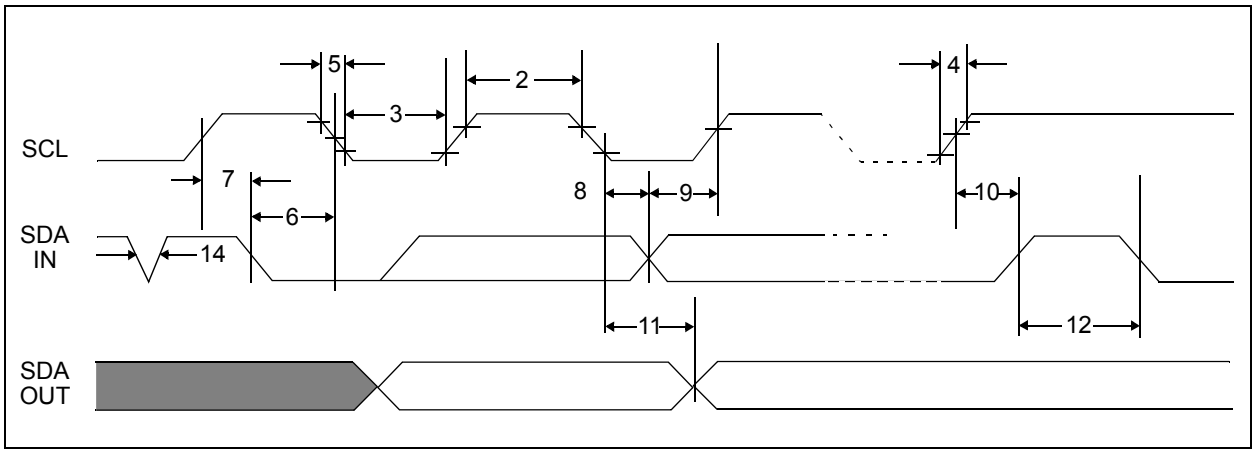
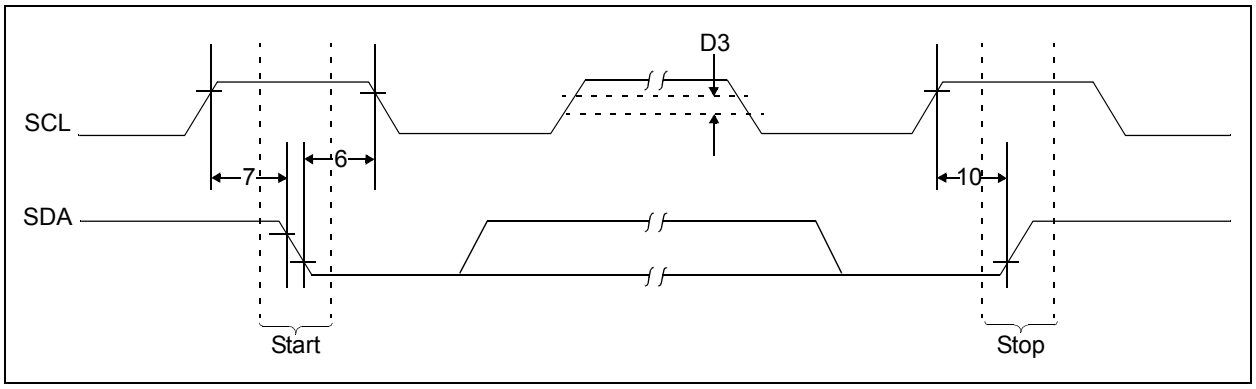


FIGURE 1-2: BUS TIMING START/STOP



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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	TSSOP	DFN	TDFN	MSOP	SOT-23	CS	Description
A0	1	1	1	1	1	1	—	—	Not Connected
A1	2	2	2	2	2	2	—	—	Not Connected
A2	3	3	3	3	3	3	—	—	Not Connected
VSS	4	4	4	4	4	4	2	2	Ground
SDA	5	5	5	5	5	5	3	5	Serial Address/Data I/O
SCL	6	6	6	6	6	6	1	4	Serial Clock
WP	7	7	7	7	7	7	5	3	Write-Protect Input
VCC	8	8	8	8	8	8	4	1	+1.7V to 5.5V Power Supply

2.1 Serial Address/Data Input/Output (SDA)

SDA is a bidirectional pin used to transfer addresses and data into and out of the device. Since it is an open-drain terminal, 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.

2.2 Serial Clock (SCL)

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

2.3 Write-Protect (WP)

The WP pin must be connected to either VSS or VCC.

If tied to VSS, normal memory operation is enabled (read/write the entire memory 000-7FF).

If tied to VCC, write operations are inhibited. The entire memory will be write-protected. Read operations are not affected.

2.4 A0, A1, A2

The A0, A1 and A2 pins are not used by the 24XX16. They may be left floating or tied to either VSS or VCC.

3.0 FUNCTIONAL DESCRIPTION

The 24XX16 supports a bidirectional, 2-wire bus and data transmission protocol. A device that sends data onto the bus is defined as a 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 24XX16 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 sixteen 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.

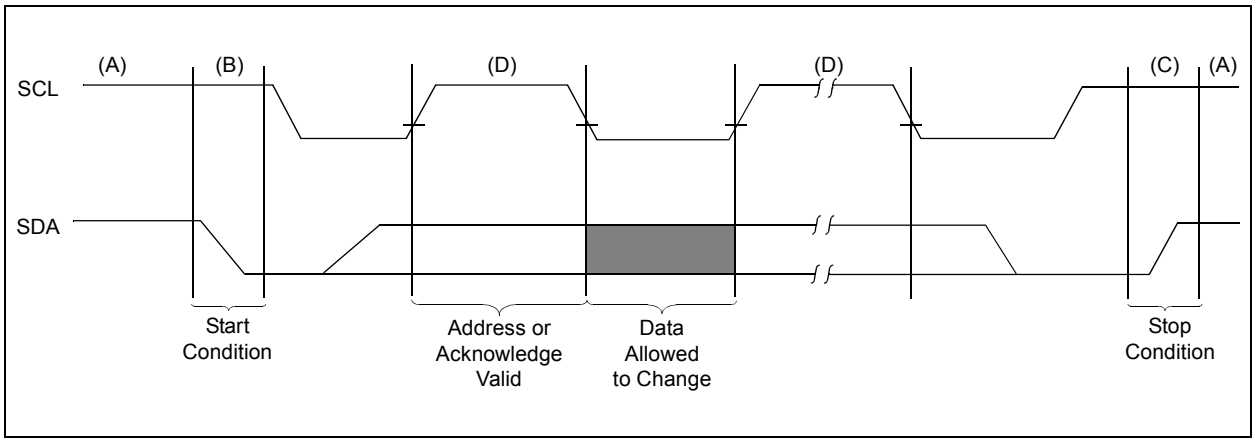
4.5 Acknowledge

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 24XX16 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 (24XX16) 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 24XX16, this is set as '1010' binary for read and write operations. The next three bits of the control byte are the block-select bits (B2, B1, B0). They are used by the master device to select which of the eight 256 word-blocks of memory are to be accessed. These bits are in effect the three Most Significant bits (MSb) of the word address. It should be noted that the protocol limits the size of the memory to eight blocks of 256 words, therefore, the protocol can support only one 24XX16 per system.

The last bit of the control byte defines the operation to be performed. When set to '1', a read operation is selected. When set to '0', a write operation is selected. Following the Start condition, the 24XX16 monitors the SDA bus, checking the device type identifier being transmitted and, upon receiving a '1010' code, the slave device outputs an Acknowledge signal on the SDA line. Depending on the state of the R/$\overline{W}$ bit, the 24XX16 will select a read or write operation.

Operation	Control Code	Block Select	R/$\overline{W}$
Read	1010	Block Address	1
Write	1010	Block Address	0

FIGURE 5-1: CONTROL BYTE ALLOCATION

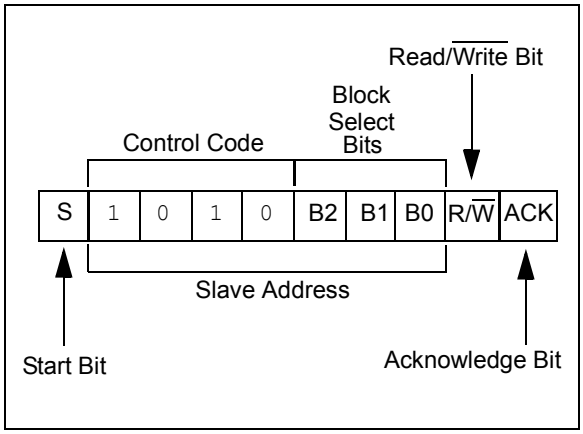
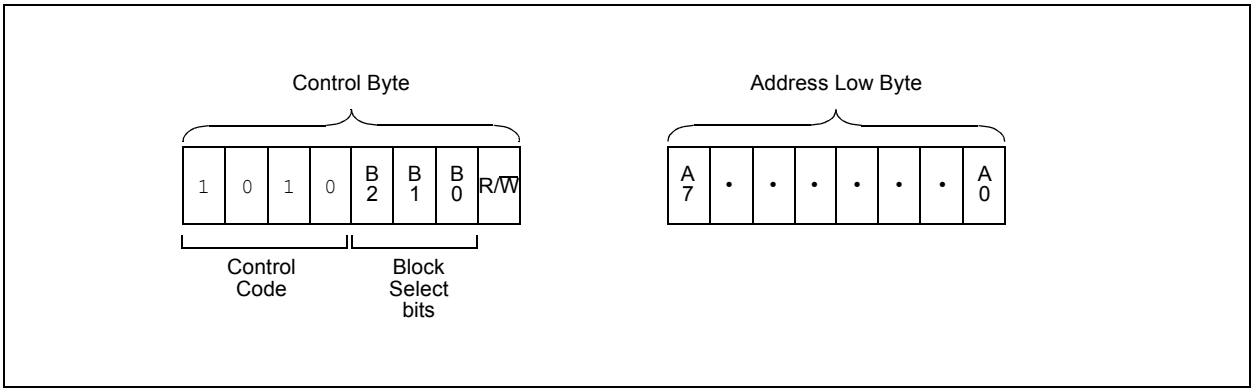


FIGURE 5-2: ADDRESS SEQUENCE BIT ASSIGNMENTS



6.0 WRITE OPERATION

6.1 Byte Write

Following the Start condition from the master, the device code (4 bits), the block address (3 bits) and the R/$\overline{W}$ bit, which is a logic-low, is placed onto the bus by the master transmitter. This indicates to the addressed slave receiver that a byte with a word address will follow once it has generated an Acknowledge bit during the ninth clock cycle. Therefore, the next byte transmitted by the master is the word address and will be written into the Address Pointer of the 24XX16. After receiving another Acknowledge signal from the 24XX16, the master device will transmit the data word to be written into the addressed memory location. The 24XX16 acknowledges again and the master generates a Stop condition. This initiates the internal write cycle and, during this time, the 24XX16 will not generate Acknowledge signals (Figure 6-1).

6.2 Page Write

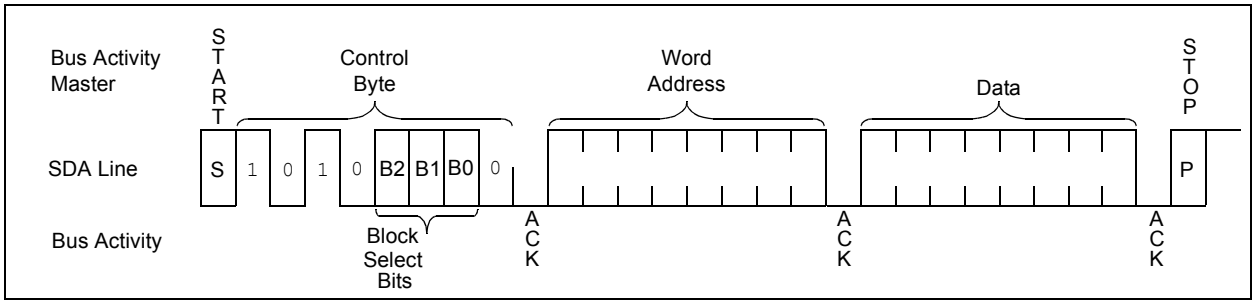
The write control byte, word address and the first data byte are transmitted to the 24XX16 in the same way as in a byte write. However, instead of generating a Stop condition, the master transmits up to 16 data bytes to the 24XX16, which are temporarily stored in the on-chip page buffer and will be written into memory once the master has transmitted a Stop condition. Upon receipt of each word, the four lower-order Address Pointer bits are internally incremented by '1'. The higher-order 7 bits of the word address remain constant. If the master should transmit more than 16 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).

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

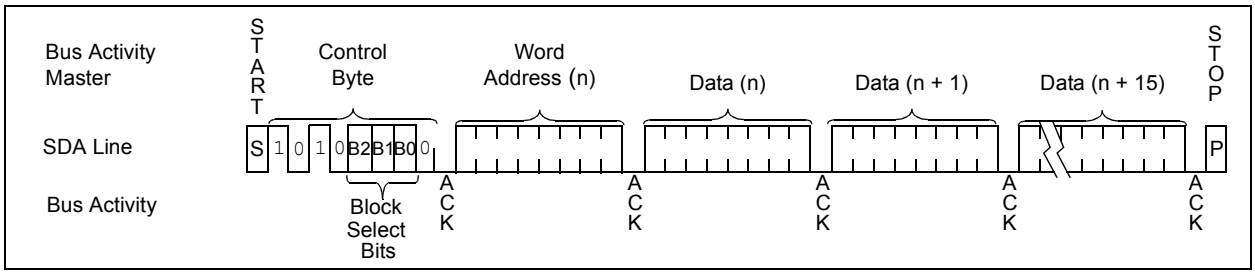
The WP pin allows the user to write-protect the entire array (000-7FF) when the pin is tied to VCC. If tied to VSS the write protection is disabled.

FIGURE 6-1: BYTE WRITE



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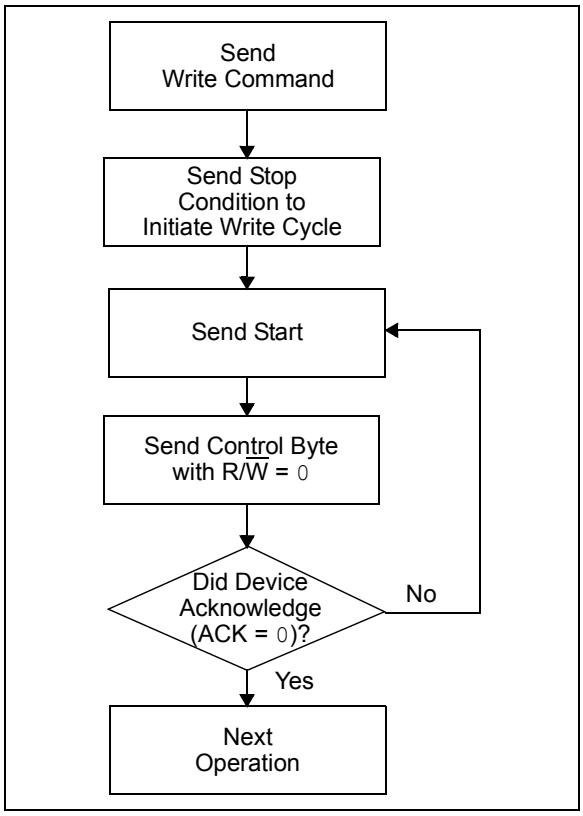
FIGURE 6-2: PAGE WRITE



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 and 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, no ACK will be returned. 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 a 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 slave address 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 24XX16 contains an address counter that maintains the address of the last word accessed, internally incremented by '1'. Therefore, if the previous access (either a read or write operation) was to address n, the next current address read operation would access data from address n + 1. Upon receipt of the slave address with R/$\overline{W}$ bit set to '1', the 24XX16 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 24XX16 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 24XX16 as part of a write operation. 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 then issues the control byte again, but with the R/$\overline{W}$ bit set to a '1'. The 24XX16 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 and the 24XX16 will discontinue transmission (Figure 8-2).

8.3 Sequential Read

Sequential reads are initiated in the same way as a random read, except that once the 24XX16 transmits the first data byte, the master issues an acknowledge as opposed to a Stop condition in a random read. This directs the 24XX16 to transmit the next sequentially-addressed 8-bit word (Figure 8-3).

To provide sequential reads, the 24XX16 contains an internal Address Pointer that is incremented by one upon completion of each operation. This Address Pointer allows the entire memory contents to be serially read during one operation.

8.4 Noise Protection

The 24XX16 employs a VCC threshold detector circuit which disables the internal erase/write logic if the VCC is below 1.5V at nominal conditions.

The SCL and SDA inputs have Schmitt Trigger and filter circuits which suppress noise spikes to assure proper device operation, even on a noisy bus.

FIGURE 8-1: CURRENT ADDRESS READ

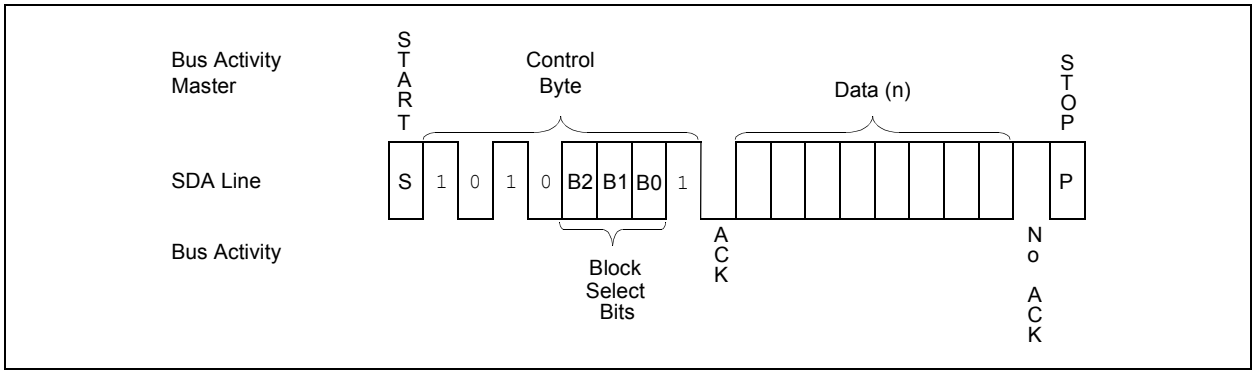


FIGURE 8-2: RANDOM READ

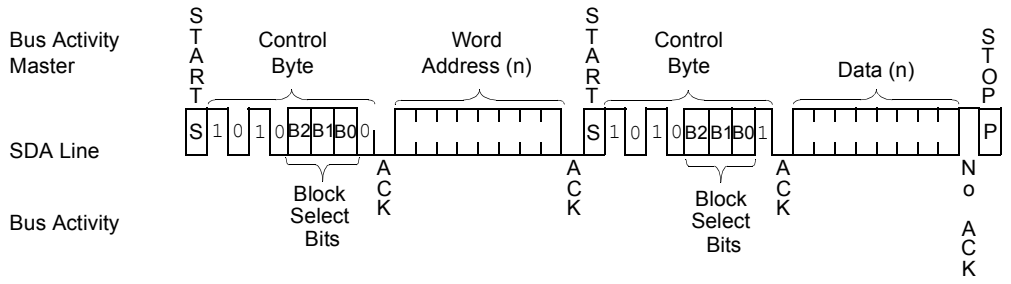
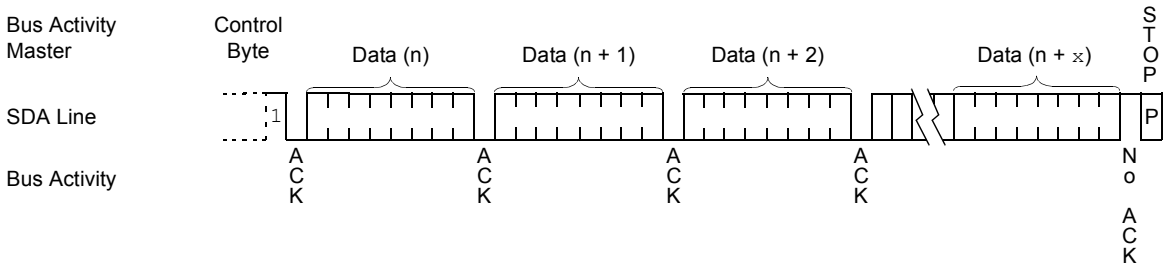


FIGURE 8-3: SEQUENTIAL READ

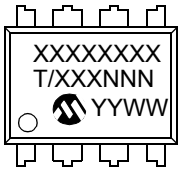


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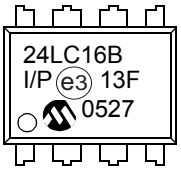
9.0 PACKAGING INFORMATION

9.1 Package Marking Information

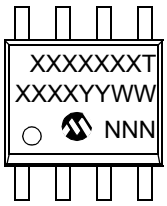
8-Lead PDIP (300 mil)



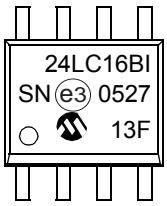
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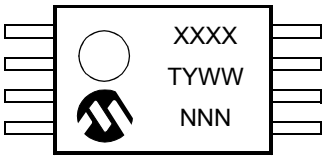
8-Lead SOIC (3.90 mm)



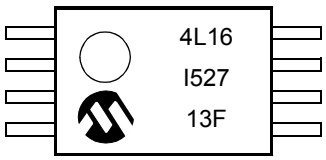
Example:



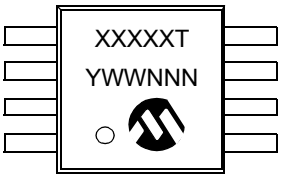
8-Lead TSSOP



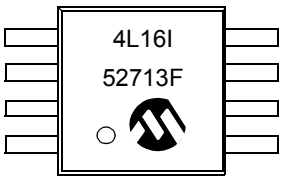
Example:



8-Lead MSOP



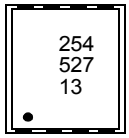
Example:



8-Lead 2x3 DFN



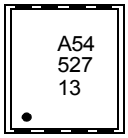
Example:



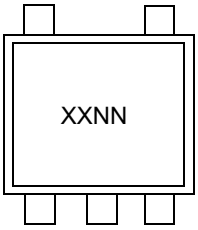
8-Lead 2x3 TDFN



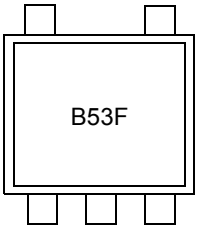
Example:



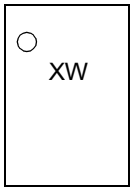
5-Lead SOT-23



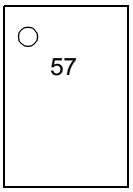
Example:



5-Lead Chip Scale



Example:



Part Number	1st Line Marking Codes							
	TSSOP	MSOP	SOT-23		DFN		TDFN	
			I Temp.	E Temp.	I Temp.	E Temp.	I Temp.	E Temp.
24AA16	4A16	4A16T	B5NN	7VNN	251	—	A51	EE9
24LC16B	4L16	4L16T	M5NN	N5NN	254	255	A54	A55

Note: T = Temperature grade (I, E)
NN = Alphanumeric traceability code

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.

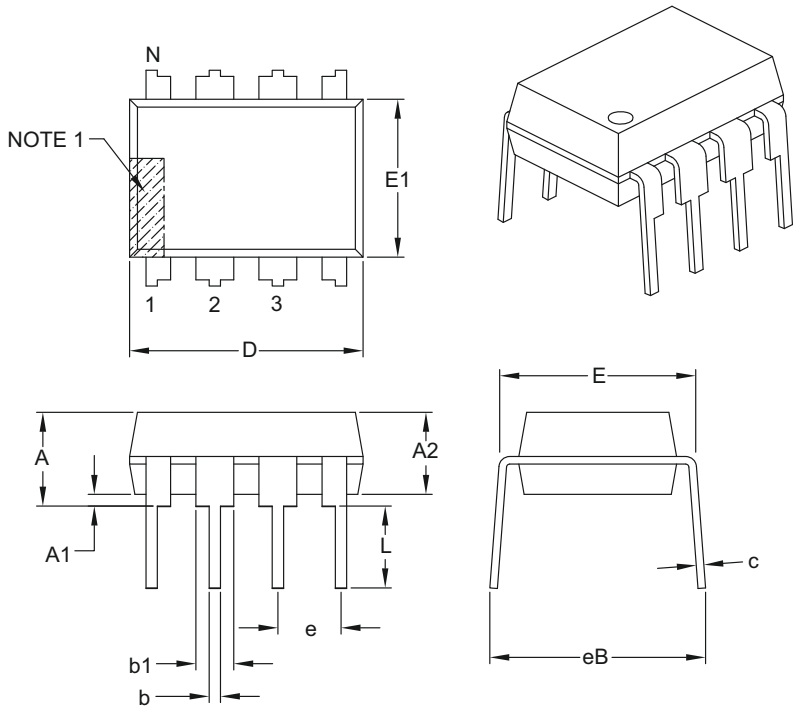
Note: Please visit www.microchip.com/Pbfree for the latest information on Pb-free conversion.

*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:

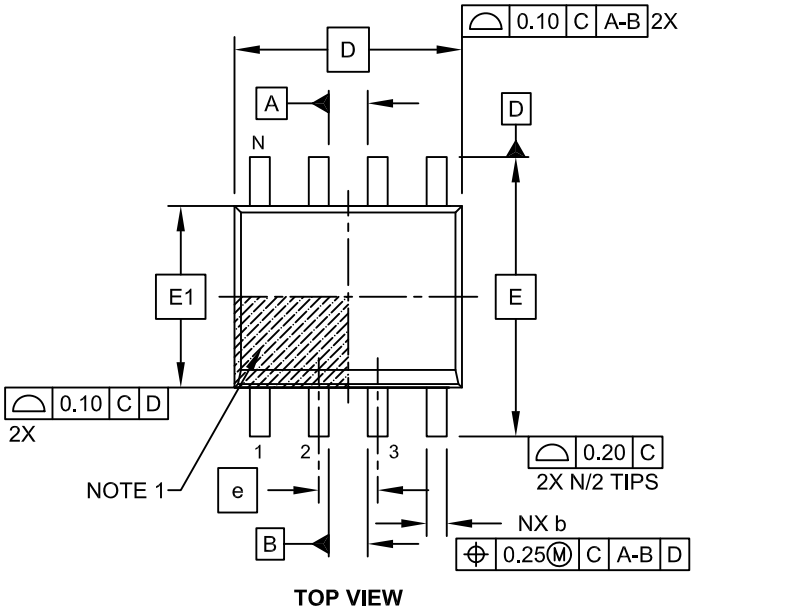
1. Pin 1 visual index feature may vary, but must be located with the hatched area.
2. § Significant Characteristic.
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
4. Dimensioning and tolerancing per ASME Y14.5M.

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

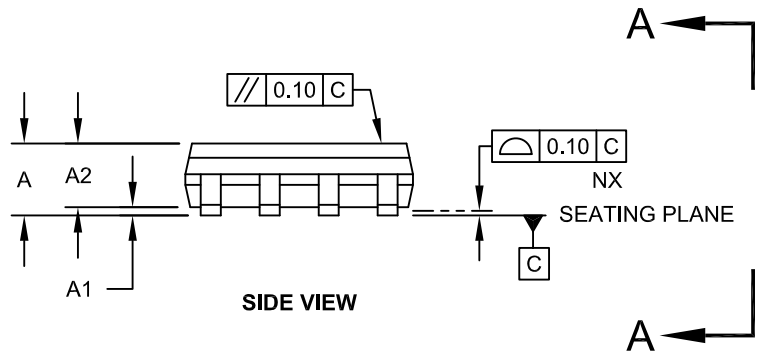
Microchip Technology Drawing C04-018B

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

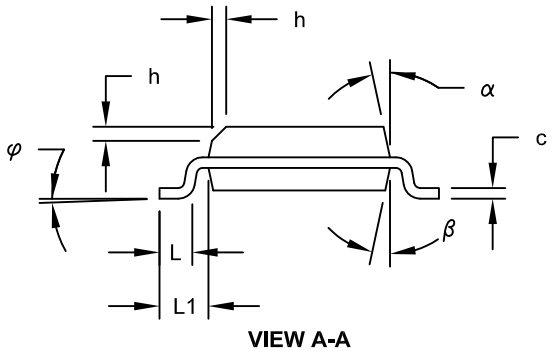
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



TOP VIEW



SIDE VIEW



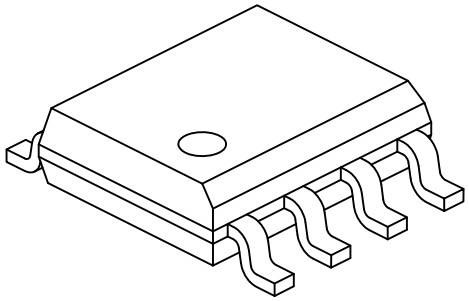
VIEW A-A

Microchip Technology Drawing No. C04-057C Sheet 1 of 2

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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

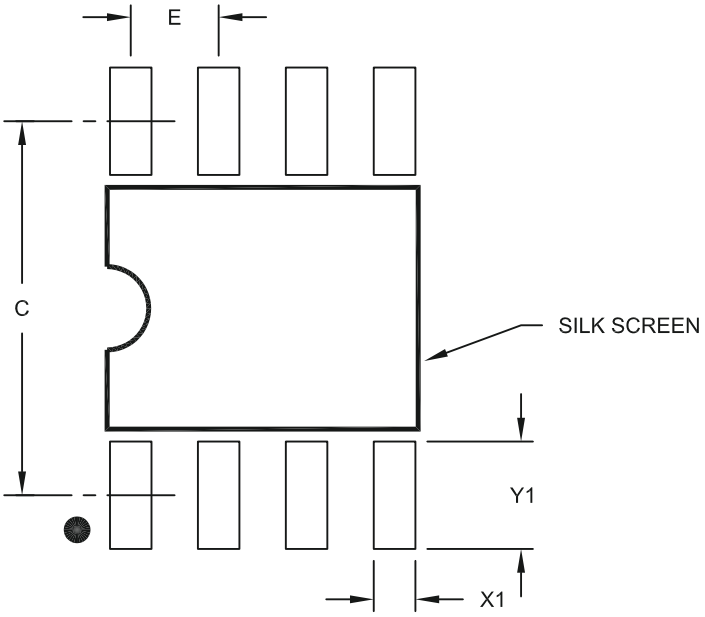
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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

Microchip Technology Drawing No. C04-057C Sheet 2 of 2

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

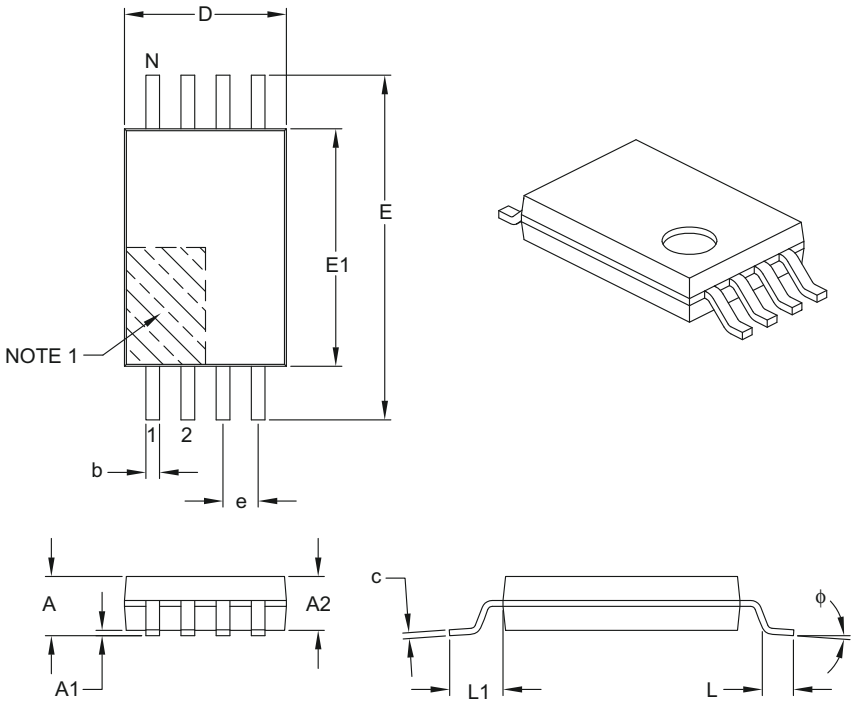
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2057A

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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:

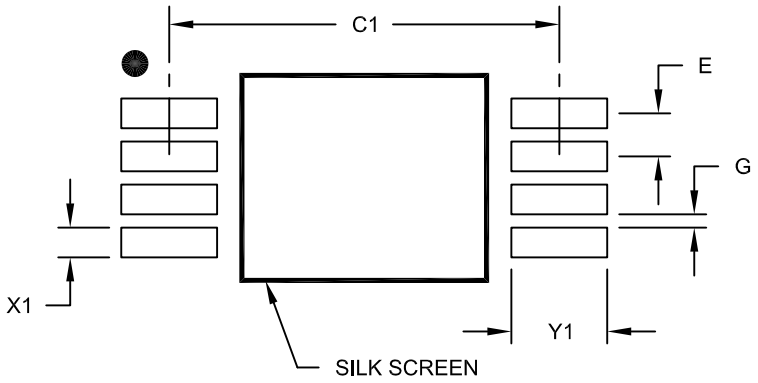
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
3. Dimensioning and tolerancing per ASME Y14.5M.

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

Microchip Technology Drawing C04-086B

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

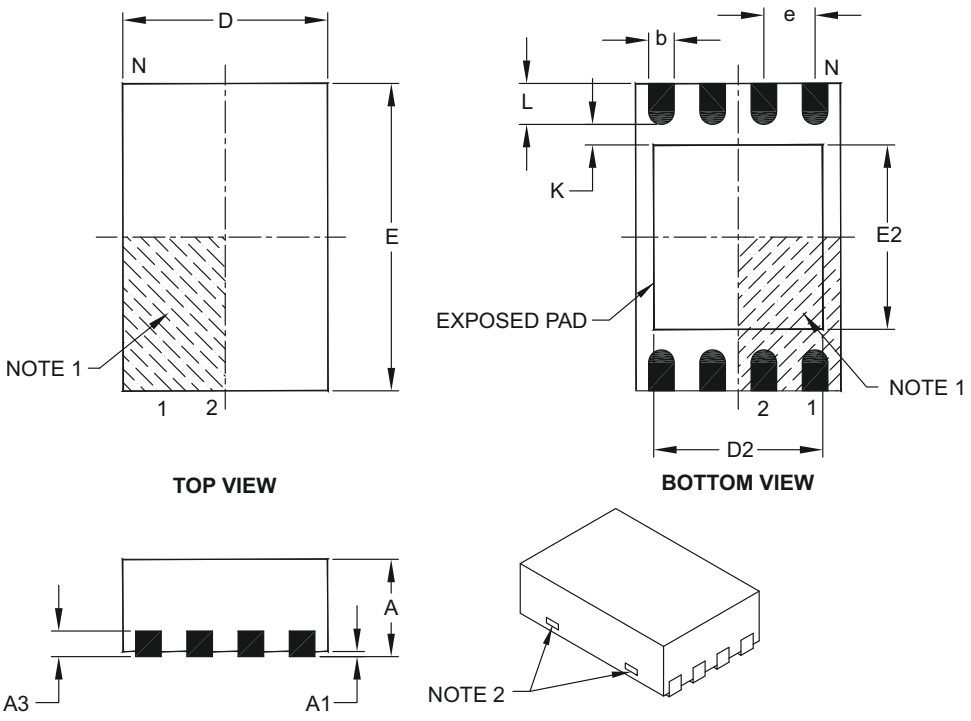
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2086A

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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.

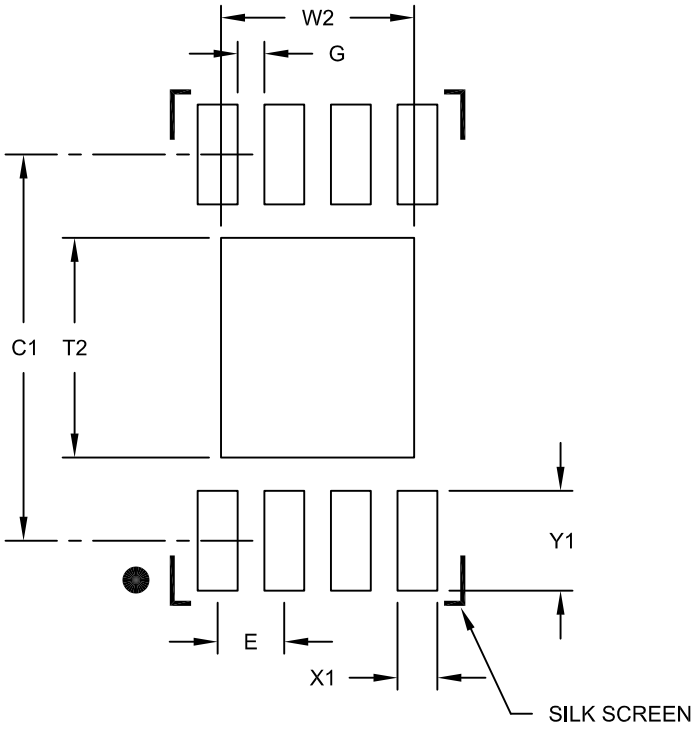
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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

Microchip Technology Drawing C04-123C

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

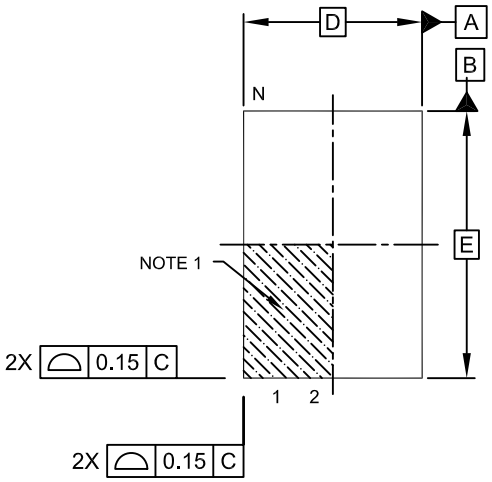
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2123B

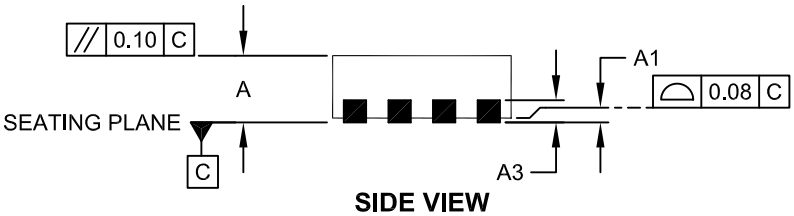
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8-Lead Plastic Dual Flat, No Lead Package (MN) – 2x3x0.75mm Body [TDFN]

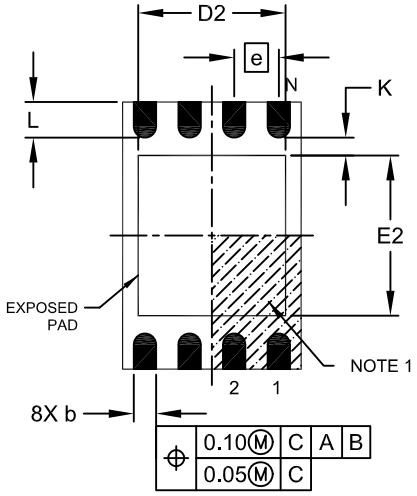
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



TOP VIEW



SIDE VIEW

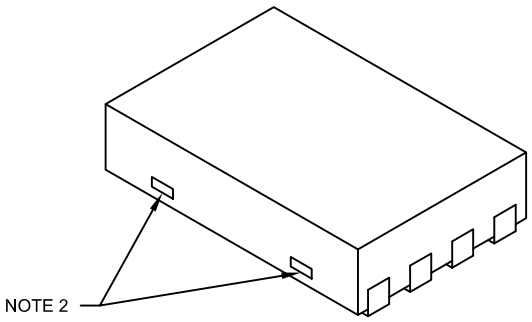


BOTTOM VIEW

Microchip Technology Drawing No. C04-129C Sheet 1 of 2

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

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

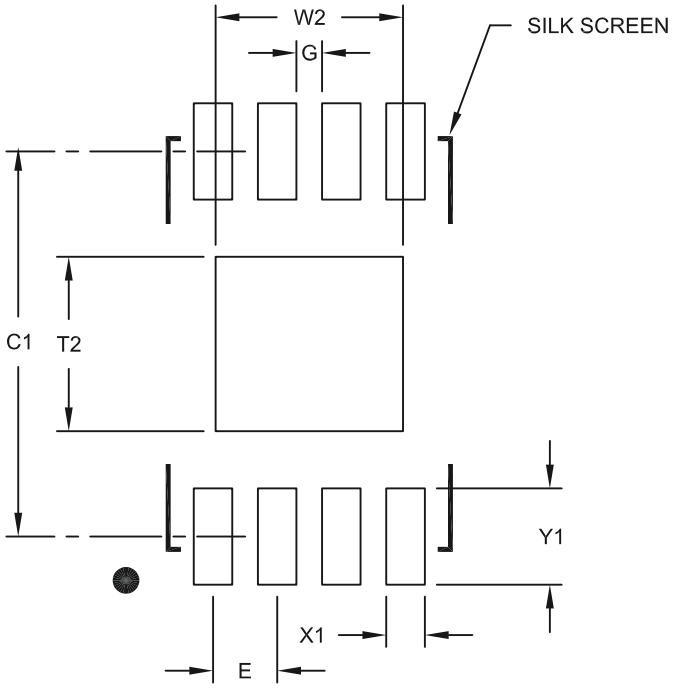
REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing No. C04-129C Sheet 2 of 2

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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:

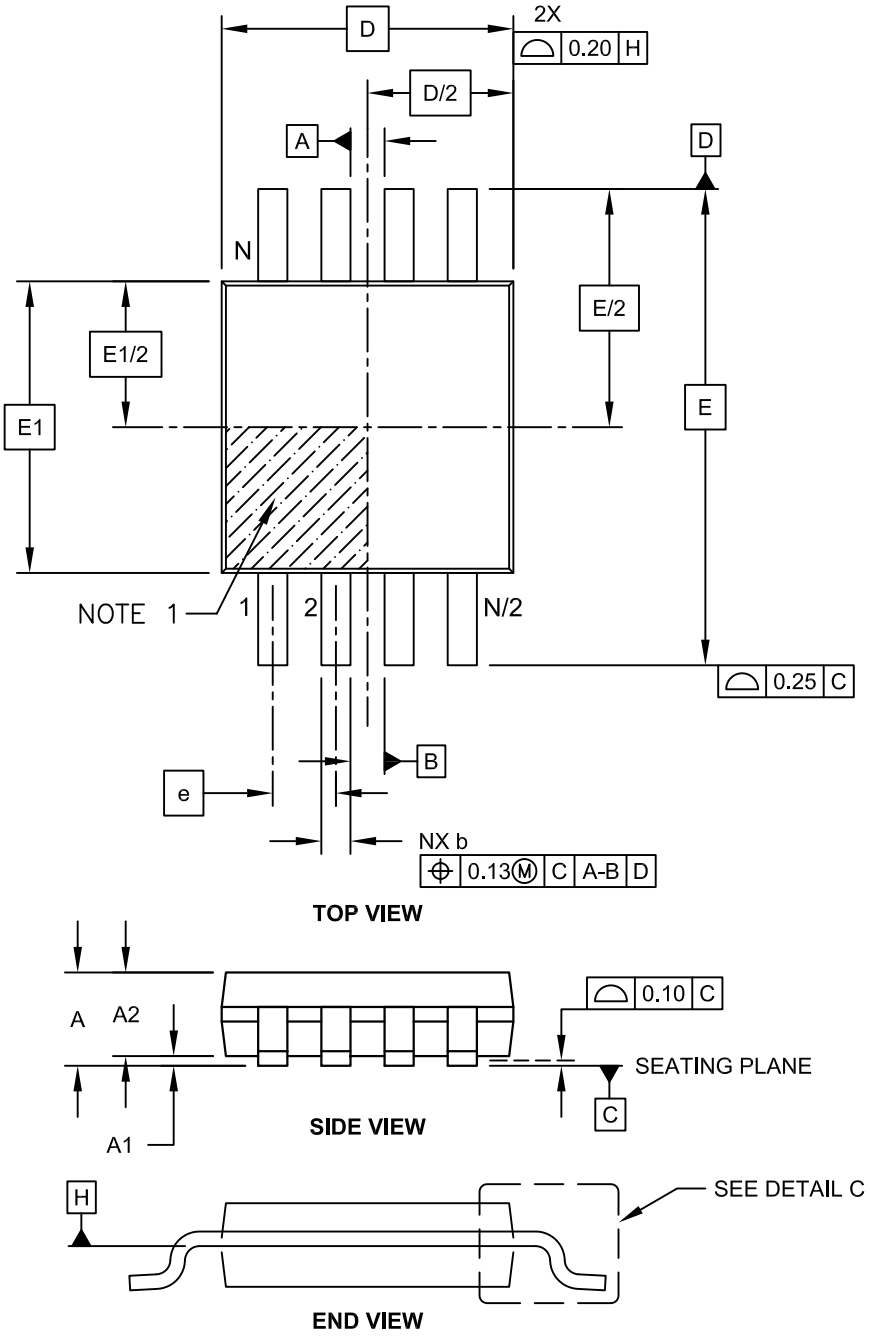
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2129A

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

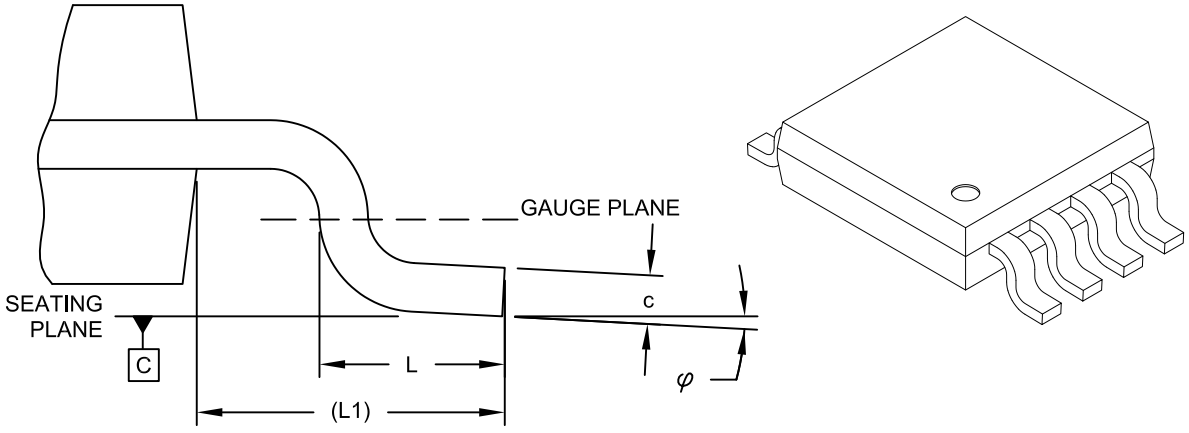


Microchip Technology Drawing C04-111C Sheet 1 of 2

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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

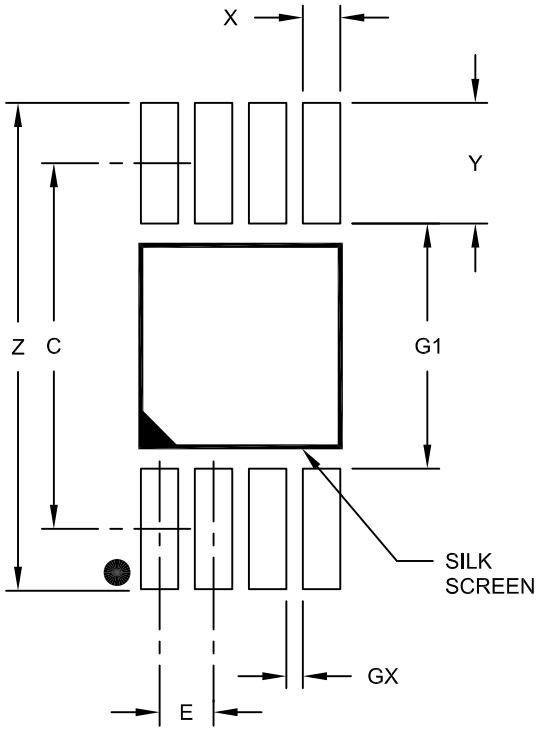
Notes:

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.

Microchip Technology Drawing C04-111C Sheet 2 of 2

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

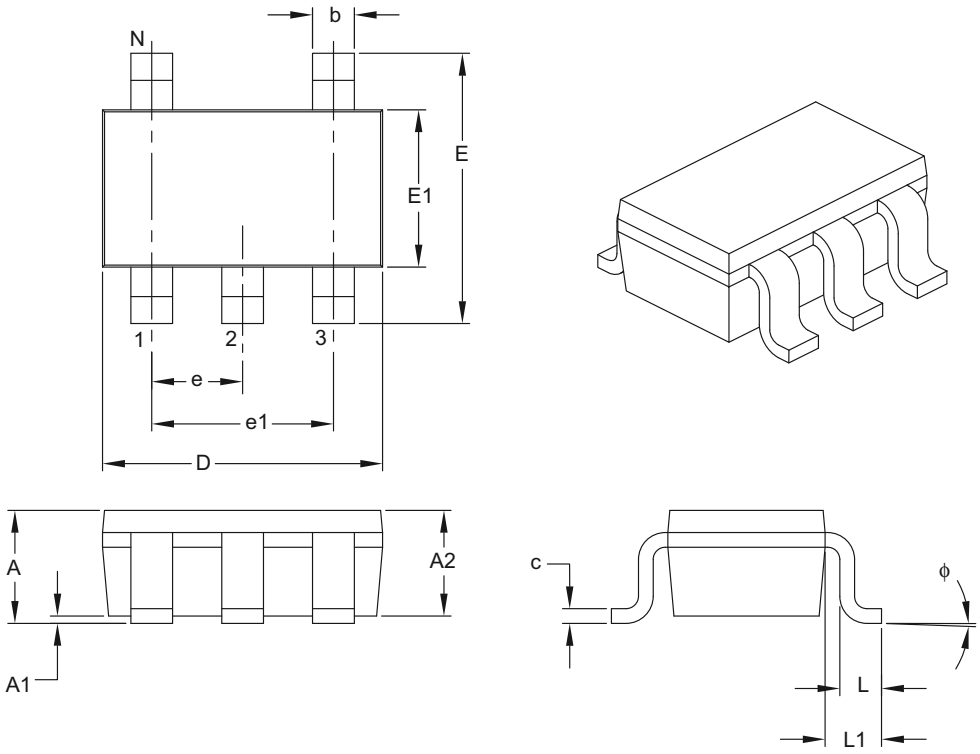
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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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



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:

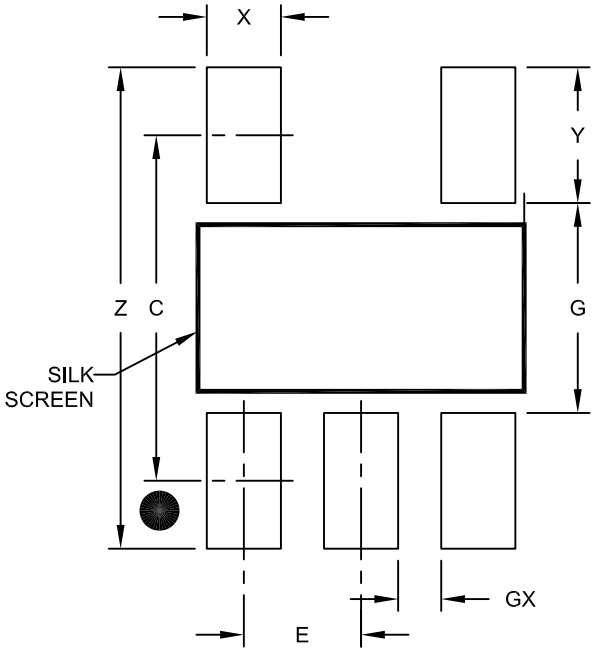
1. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.127 mm per side.
2. Dimensioning and tolerancing per ASME Y14.5M.

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

Microchip Technology Drawing C04-091B

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

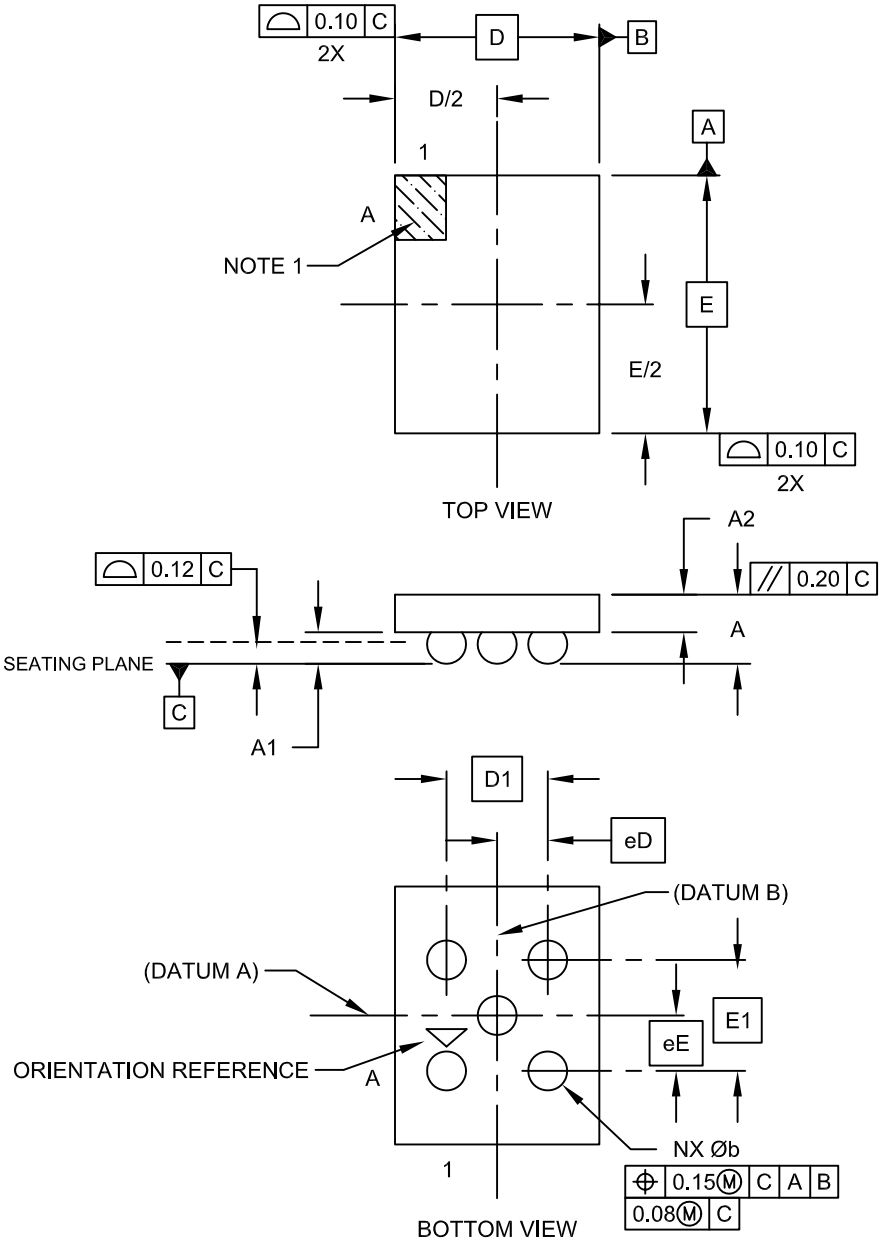
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5-Lead Chip Scale Package (CS) - [CSP]

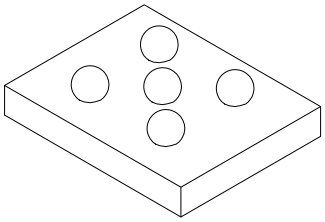
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-6004D Sheet 1 of 2

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:

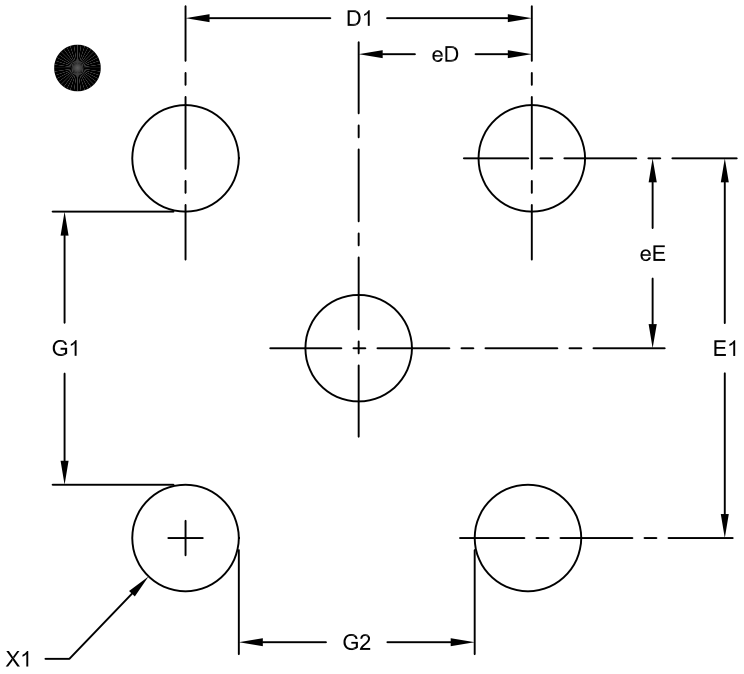
1. Orientation reference feature may vary, but must be located within the hatched area.
2. Package is saw singulated.
3. Dimensioning and tolerancing per ASME Y14.5M.
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for 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

APPENDIX A: REVISION HISTORY

Revision D (12/2003)

Corrections to Section 1.0, Electrical Characteristics.

Revision E (3/2005)

Added DFN package.

Revision F (9/2005)

Revised Figure 3-2 Control Byte Allocation; Figure 4-1 Byte Write; Figure 4-2 Page Write; Section 6.0 Write Protection; Figure 7-1 Current Address Read; Figure 7-2 Random Read; Figure 7-3 Sequential Read; Section 8.3 Write-Protect (WP).

Revision G (02/2007)

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

Revision H (01/2009)

Added TDFN Package; Updated Package Drawings.

Revision J (10/2009)

Added 5-Lead Chip Scale Package.

Revision K (01/2012)

Added Chip Scale Package; Revised Product ID System.

Revision L (12/2012)

Revised Automotive E-temp.; Product ID System.

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PART NO.	X	/XX
Device	Temperature Range	Package

	24AA16:	= 1.7V, 16 Kbit I²C Serial EEPROM
	24AA16T:	= 1.7V, 16 Kbit I²C Serial EEPROM (Tape and Reel)
	24LC16B:	= 2.5V, 16 Kbit I²C Serial EEPROM
	24LC16BT:	= 2.5V, 16 Kbit I²C Serial EEPROM (Tape and Reel)
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
	ST	= Plastic TSSOP (4.4 mm), 8-lead
	MS	= Plastic Micro Small Outline (MSOP), 8-lead
	OT	= Plastic SOT-23, 5-lead (Tape and Reel only)
	MC	= Plastic DFN (2x3x0.90 mm body), 8-lead
	MNY(1)	= Plastic TDFN, (2x3x0.75 mm body), 8-lead
	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) 24AA16-I/P: Industrial Temperature,1.7V, PDIP package

b) 24AA16-I/SN: Industrial Temperature,1.7V, SOIC package

c) 24AA16T-I/OT: Industrial Temperature, 1.7V, SOT-23 package, Tape and Reel

d) 24AA16T-I/CS16K: Industrial Temperature, 1.7V, Chip Scale package, Tape and Reel

e) 24LC16B-I/P: Industrial Temperature, 2.5V, PDIP package

f) 24LC16B-E/SN: Automotive Temp.,2.5V SOIC package

g) 24LC16BT-I/OT: Industrial Temperature, 2.5V, SOT-23 package, Tape and Reel

h) 24AA16T-E/SN: Automotive Temperature, 1.7V, SOIC package, Tape and Reel

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