24AA014H/24LC014H

1-Kbit I²C Serial EEPROM with Half-Array Write-Protect

Device Selection Table

Part Number	Vcc Range	Maximum Clock	Temperature Range	Available Packages
24AA014H	1.7V-5.5V	400 kHz(1)	I	MS, P, SN, MNY, ST
24LC014H	2.5V-5.5V	1 MHz	I, E	MS, P, SN, MNY, ST

Note 1: 100 kHz for Vcc < 1.8V

Features

- Single-Supply with Operation down to 1.7V for 24AA014H devices, 2.5V for 24LC014H devices
- Low-Power CMOS Technology:
  - 400 µA active current, maximum
  - 1 µA standby current, maximum (I-temp)
- Organized as a Single Block of 128 Bytes (128 x 8)
- Two-Wire Serial Interface Bus, I²C Compatible
- Schmitt Trigger Inputs for Noise Suppression
- Output Slope Control to Eliminate Ground Bounce
- 100 kHz and 400 kHz Compatibility
- 1 MHz Compatibility (24LC014H Only)
- Page Write Time: 5 ms, Maximum
- Self-Timed Erase/Write Cycle
- 16-Byte Page Write Buffer
- Hardware Write Protection for Half Array (40h-7Fh)
- Cascadable up to Eight Devices
- High Reliability:
  - More than 1 Million Erase/Write Cycles
  - Data Retention > 200 Years
  - ESD Protection > 4000V
- Factory Programming Available
- RoHS Compliant
- Temperature Ranges:
  - Industrial (I): -40°C to +85°C
  - Extended (E): -40°C to +125°C

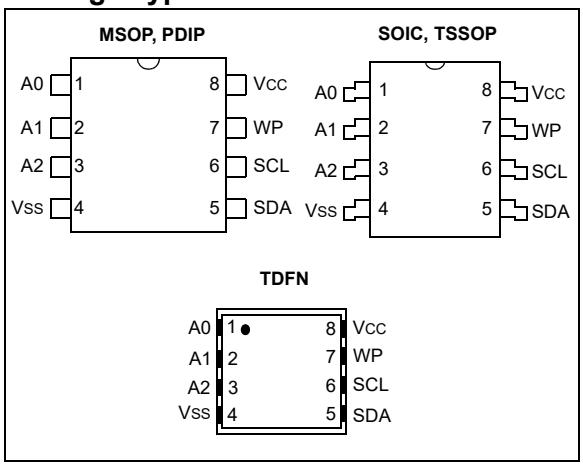
Packages

- 8-Lead MSOP, 8-Lead PDIP, 8-Lead SOIC, 8-Lead TDFN and 8-Lead TSSOP

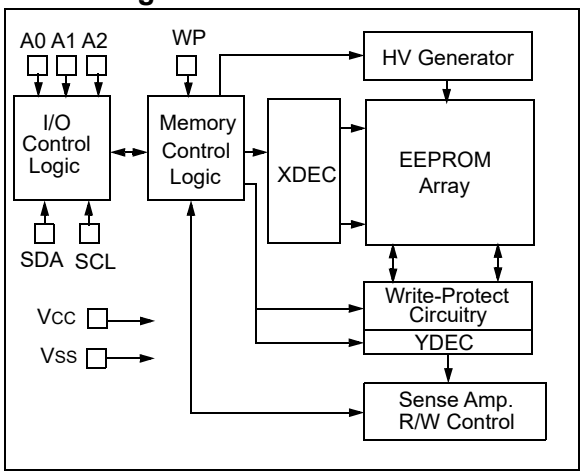
Description

The Microchip Technology Inc. 24AA014H/24LC014H is a 1-Kbit Serial Electrically Erasable PROM (EEPROM). The device is organized as a single block of 128 x 8-bit memory with a two-wire serial interface. Its low-voltage design permits operation down to 1.7V, with maximum standby and active currents of only 1 µA and 400 µA, respectively. The device has a page write capability for up to 16 bytes of data. Functional address lines allow the connection of up to eight 24AA014H/24LC014H devices on the same bus for up to 8 Kbits of contiguous EEPROM memory.

Package Types



Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings (†)

VCC.....6.5V

All inputs and outputs w.r.t. VSS .....-0.6V 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): VCC = +1.7V to 5.5V TA = -40°C to +85°C** **Extended (E): VCC = +2.5V to 5.5V TA = -40°C to +125°C**			
Param. No.	**Symbol**	**Characteristics**	**Minimum**	**Maximum**	**Units**	**Conditions**
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 = 4.5V IOL = 2.1 mA, VCC = 2.5V
D5	ILI	Input Leakage Current	—	±1	µA	VIN = VSS or VCC, WP = Vss
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, f = 1 MHz
D8	ICC Read	Operating Current	—	400	µA	VCC = 5.5V, SCL = 400 kHz
	ICC Write		—	3	mA	VCC = 5.5V
D9	ICCS	Standby Current	—	1	µA	VCC = 5.5V, SDA = SCL = VCC WP = VSS, A0, A1, A2 = VSS

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

TABLE 1-2: AC CHARACTERISTICS

AC CHARACTERISTICS			Industrial (I): V_{CC} = +1.7V to 5.5V T_A = -40°C to +85°C Extended (E): V_{CC} = +2.5V to 5.5V T_A = -40°C to +125°C			
Param. No.	**Symbol**	**Characteristic**	**Minimum**	**Maximum**	**Units**	**Conditions**
1	F_{CLK}	Clock frequency	—	100	kHz	1.7V ≤ V_{CC} < 1.8V
			—	400	kHz	1.8V ≤ V_{CC} ≤ 5.5V
			—	1000	kHz	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)**
2	T_{HIGH}	Clock high time	4000	—	ns	1.7V ≤ V_{CC} < 1.8V
			600	—	ns	1.8V ≤ V_{CC} ≤ 5.5V
			500	—	ns	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)**
3	T_{LOW}	Clock low time	4700	—	ns	1.7V ≤ V_{CC} < 1.8V
			1300	—	ns	1.8V ≤ V_{CC} ≤ 5.5V
			500	—	ns	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)**
4	T_R	SDA and SCL rise time	—	1000	ns	1.7V ≤ V_{CC} < 1.8V **(Note 1)**
			—	300	ns	1.8V ≤ V_{CC} ≤ 5.5V **(Note 1)**
			—	300	ns	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)** **(Note 1)**
5	T_F	SDA and SCL fall time	—	1000	ns	1.7V ≤ V_{CC} < 1.8V **(Note 1)**
			—	300	ns	1.8V ≤ V_{CC} ≤ 5.5V **(Note 1)**
			—	300	ns	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)** **(Note 1)**
6	$T_{HD:STA}$	Start condition hold time	4000	—	ns	1.7V ≤ V_{CC} < 1.8V
			600	—	ns	1.8V ≤ V_{CC} ≤ 5.5V
			250	—	ns	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)**
7	$T_{SU:STA}$	Start condition setup time	4700	—	ns	1.7V ≤ V_{CC} < 1.8V
			600	—	ns	1.8V ≤ V_{CC} ≤ 5.5V
			250	—	ns	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)**
8	$T_{HD:DAT}$	Data input hold time	0	—	ns	**Note 2**
9	$T_{SU:DAT}$	Data input setup time	250	—	ns	1.7V ≤ V_{CC} < 1.8V
			100	—	ns	1.8V ≤ V_{CC} ≤ 5.5V
			100	—	ns	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)**
10	$T_{SU:STO}$	Stop condition setup time	4000	—	ns	1.7V ≤ V_{CC} < 1.8V
			600	—	ns	1.8V ≤ V_{CC} ≤ 5.5V
			250	—	ns	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)**
11	$T_{SU:WP}$	WP setup time	4000	—	ns	1.7V ≤ V_{CC} < 1.8V
			600	—	ns	1.8V ≤ V_{CC} ≤ 5.5V
			600	—	ns	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)**
12	$T_{HD:WP}$	WP hold time	4700	—	ns	1.7V ≤ V_{CC} < 1.8V
			600	—	ns	1.8V ≤ V_{CC} ≤ 5.5V
			600	—	ns	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)**
13	T_{AA}	Output valid from clock	—	3500	ns	1.7V ≤ V_{CC} < 1.8V **(Note 2)**
			—	900	ns	1.8V ≤ V_{CC} ≤ 5.5V **(Note 2)**
			—	400	ns	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)** **(Note 2)**
14	T_{BUF}	Bus free time: Time the bus must be free before a new transmission can start	1300	—	ns	1.7V ≤ V_{CC} < 1.8V
			4700	—	ns	1.8V ≤ V_{CC} ≤ 5.5V
			4700	—	ns	2.5V ≤ V_{CC} ≤ 5.5V **(24LC014H)**
16	T_{SP}	Input filter spike suppression (SDA and SCL pins)	—	50	ns	24AA014H **(Note 1 and Note 3)**
17	T_{WC}	Write cycle time (byte or page)	—	5	ms	

AC CHARACTERISTICS			Industrial (I): VCC = +1.7V to 5.5V TA = -40°C to +85°C Extended (E): VCC = +2.5V to 5.5V TA = -40°C to +125°C			
Param. No.	**Symbol**	**Characteristic**	**Minimum**	**Maximum**	**Units**	**Conditions**
18		Endurance	1,000,000	—	cycles	+25°C, VCC = 5.5V, Page mode **(Note 4)**

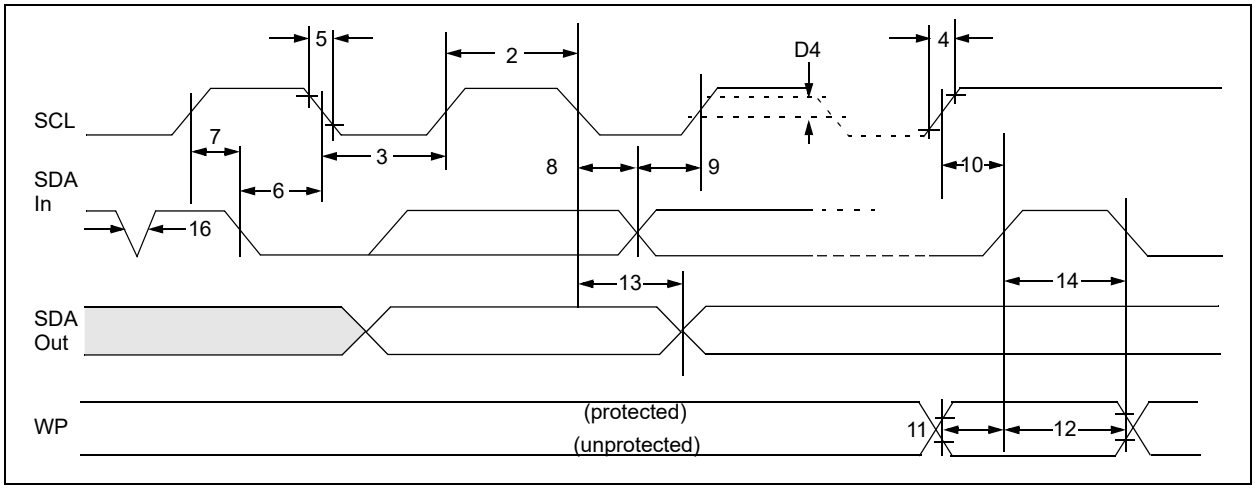
Note 1: Not 100% tested. CB = total capacitance of one bus line in pF.

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 TSP and VHYS specifications are due to new Schmitt Trigger inputs, which provide improved noise spike suppression. This eliminates the need for a TI specification for standard operation.

4: This parameter is not tested but ensured by characterization.

FIGURE 1-1: BUS TIMING DATA



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	MSOP	TDFN(1)	Function
A0	1	1	1	1	1	User Configurable Chip Address Input
A1	2	2	2	2	2	User Configurable Chip Address Input
A2	3	3	3	3	3	User Configurable Chip Address Input
VSS	4	4	4	4	4	Ground
SDA	5	5	5	5	5	Serial Address/Data I/O
SCL	6	6	6	6	6	Serial Clock
WP	7	7	7	7	7	Write-Protect Input
VCC	8	8	8	8	8	Power Supply

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

2.1 Chip Address Inputs (A0, A1, A2)

The A0, A1 and A2 inputs are used by the 24AA014H/24LC014H for multiple device operations. The levels on these inputs are compared with the corresponding bits in the client address. The chip is selected if the compare is true. Up to eight 24AA014H/24LC014H 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.

2.2 Serial Address/Data Input/Output (SDA)

This 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 the 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)

WP is the hardware write-protect pin. It must be tied to VCC or VSS. If tied to VCC, the hardware write protection is enabled and will protect half of the array (40h-7Fh). If the WP pin is tied to VSS the hardware write protection is disabled.

2.5 Noise Protection

The 24AA014H/24LC014H employs a VCC threshold detector circuit that disables the internal erase/write logic if the VCC is below 1.5 volts at nominal conditions.

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

3.0 FUNCTIONAL DESCRIPTION

The 24AA014H/24LC014H supports a bidirectional, two-wire bus and data transmission protocol. A device that sends data onto the bus is defined as transmitter and a device receiving data as receiver. The bus has to be controlled by a host device that generates the Serial Clock (SCL), controls the bus access and generates the Start and Stop conditions while the 24AA014H/24LC014H works as client. Both host and client can operate as transmitter or receiver, but the host 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 bit of data per clock pulse.

Each data transfer is initiated with a Start condition and terminated with a Stop condition. The number of the data bytes transferred between the Start and Stop conditions is determined by the host device and is, theoretically, unlimited, though only the last 16 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) principle.

4.5 Acknowledge

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

Note:	The 24AA014H/24LC014H 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. Moreover, setup and hold times must be taken into account. A host must signal an end of data to the client by not generating an Acknowledge bit on the last byte that has been clocked out of the client. In this case, the client must leave the data line high to enable the host to generate the Stop condition (Figure 4-2).

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

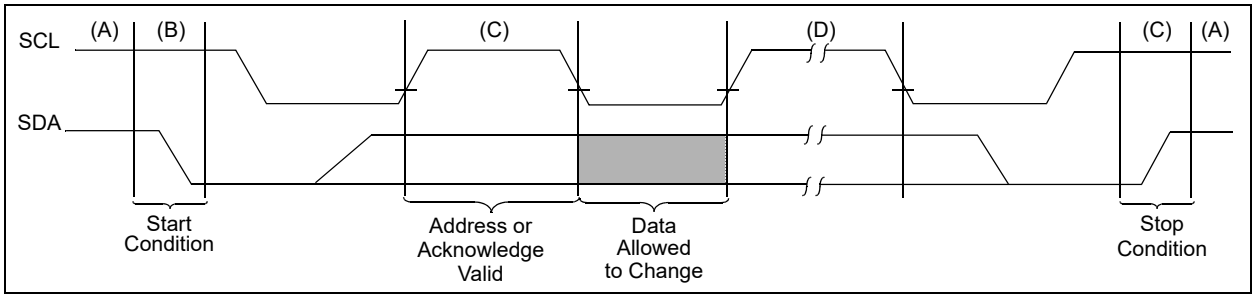
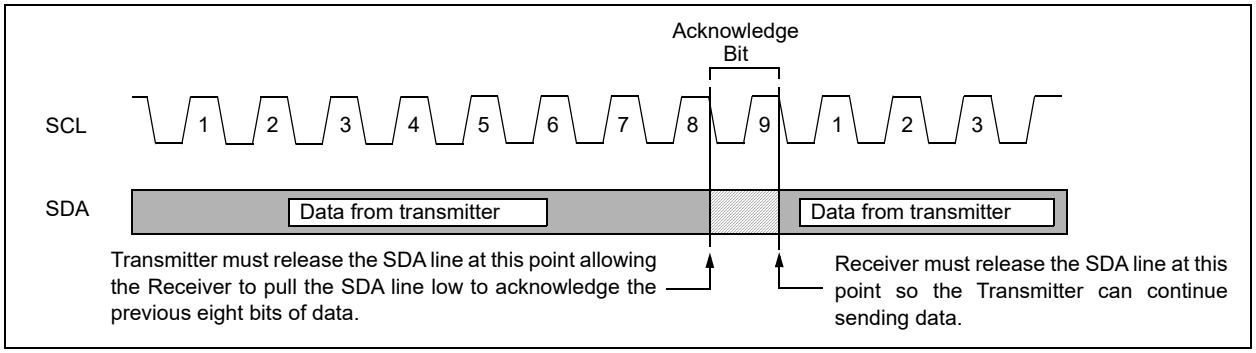


FIGURE 4-2: ACKNOWLEDGE TIMING



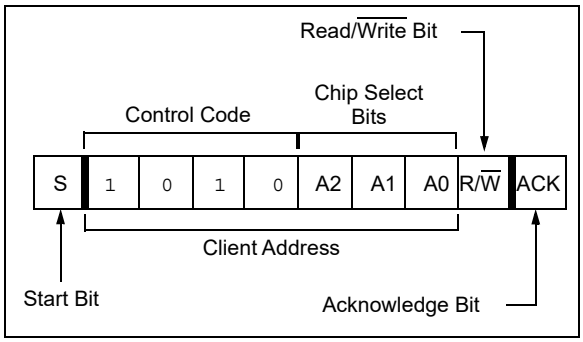
5.0 DEVICE ADDRESSING

A control byte is the first byte received following the Start condition from the host device. The control byte consists of a four-bit control code; for the 24AA014H/24LC014H 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 24AA014H/24LC014H 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. The combination of the 4-bit control code and the next three bits are called the client address.

The last bit of the control byte is the Read/$\overline{\text{Write}}$ (R/$\overline{\text{W}}$) bit and it defines the operation to be performed. When set to a '1', a read operation is selected. When set to a '0', a write operation is selected. The next byte received defines the address of the first data byte (Figure 5-2). Because only A6 to A0 are used, the upper address bit is a "don't care".

Following the Start condition, the 24AA014H/24LC014H monitors the SDA bus, checking the control byte being transmitted. Upon receiving a valid client address and the R/$\overline{\text{W}}$ bit, the client device outputs an Acknowledge signal on the SDA line. Depending on the state of the R/$\overline{\text{W}}$ bit, the 24AA014H/24LC014H will select a read or write operation.

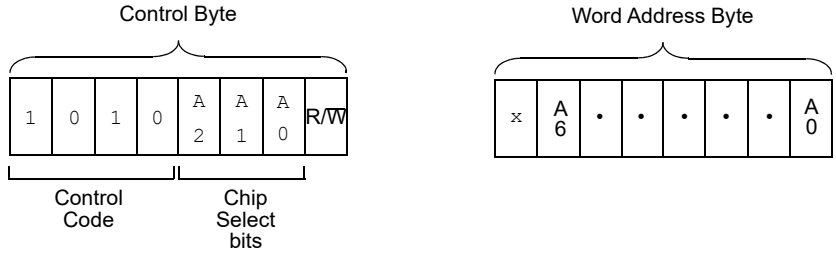
FIGURE 5-1: CONTROL BYTE FORMAT



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 8 Kbits by adding up to eight 24AA014H/24LC014H devices on the same bus. In this case, software can use A0 of the control byte as address bit A7, A1 as address bit A8, and A2 as address bit A9. It is not possible to sequentially read across device boundaries.

FIGURE 5-2: ADDRESS SEQUENCE BIT ASSIGNMENTS



6.0 WRITE OPERATIONS

6.1 Byte Write

Following the Start signal from the host, the device code (4 bits), the Chip Select bits (3 bits) and the R/$\overline{W}$ bit (which is a logic low) are placed onto the bus by the host transmitter. The device will acknowledge this control byte during the ninth clock pulse. The next byte transmitted by the host is the word address and will be written into the Address Pointer of the 24AA014H/24LC014H. After receiving another Acknowledge signal from the 24AA014H/24LC014H, the host device will transmit the data word to be written into the addressed memory location. The 24AA014H/24LC014H acknowledges again and the host generates a Stop condition. This initiates the internal write cycle and the 24AA014H/24LC014H will not generate Acknowledge signals during this time (Figure 6-1). If an attempt is made to write to the protected portion of the array when the hardware write protection has been enabled, the device will acknowledge the command, but no data will be written. The write cycle time must be observed even if write protection is enabled.

6.2 Page Write

The write-control byte, word address and the first data byte are transmitted to the 24AA014H/24LC014H in the same way as in a byte write. But instead of generating a Stop condition, the host transmits up to 15 additional data bytes to the 24AA014H/24LC014H that are temporarily stored in the on-chip page buffer and will be written into the memory once the host has transmitted a Stop condition. Upon receipt of each word, the four lower order Address Pointer bits, which form the byte counter, are internally incremented by one.

The higher order four bits of the word address remain constant. If the host should transmit more than 16 bytes prior to generating the Stop condition, the Address Pointer 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 protected portion of the array when the hardware write protection has been enabled, the device will acknowledge the command, but no data will be written. The write cycle time must be observed even if write protection is enabled.

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 that the application software prevent page write operations that would attempt to cross a page boundary.

6.3 Write Protection

The WP pin must be tied to VCC or VSS. If tied to VCC, half of the array will be write-protected (40h-7Fh). If the WP pin is tied to VSS, write operations to all address locations are allowed.

FIGURE 6-1: BYTE WRITE

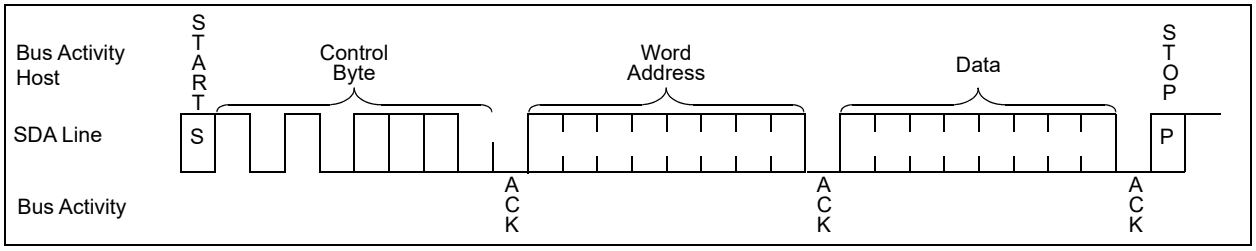
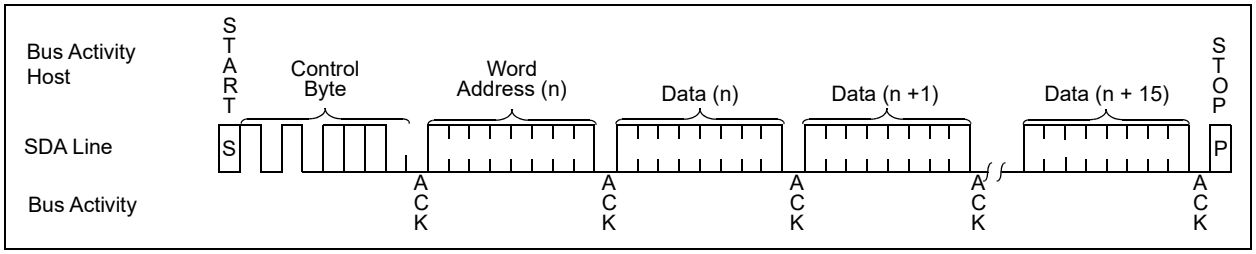


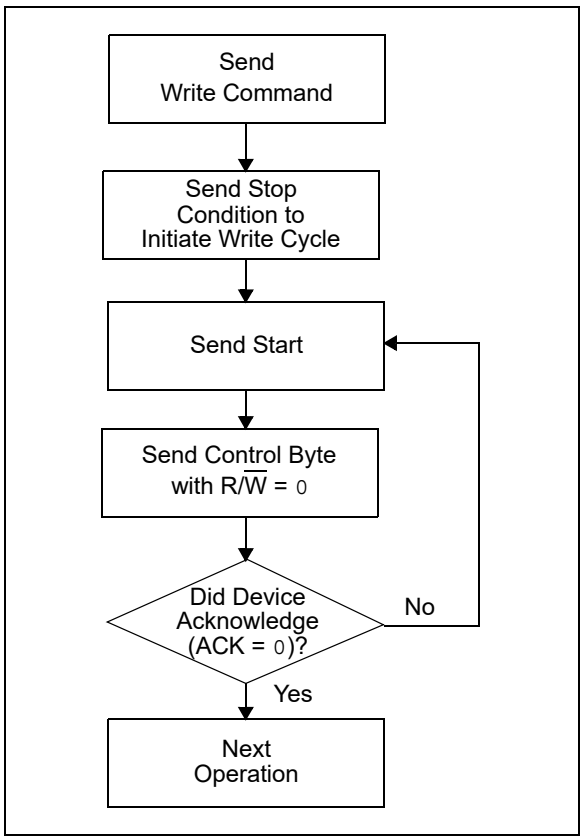
FIGURE 6-2: PAGE WRITE



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 host, the device initiates the internally-timed write cycle and ACK polling can be initiated immediately. This involves the host 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 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 host 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



8.0 READ OPERATIONS

Read operations are initiated in the same way as write operations, with the exception that the R/$\overline{W}$ bit of the client 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 24AA014H/24LC014H contains an Address Pointer that maintains the address of the last word accessed, internally incremented by one. Therefore, if the previous read access was to address n, the next current address read operation would access data from address n + 1. Upon receipt of the client address with the R/$\overline{W}$ bit set to '1', the 24AA014H/24LC014H issues an acknowledge and transmits the 8-bit data word. The host will not acknowledge the transfer, but does generate a Stop condition and the 24AA014H/24LC014H discontinues transmission (Figure 8-1).

8.2 Random Read

Random read operations allow the host 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 done by sending the word address to the 24AA014H/24LC014H as part of a write operation.

Once the word address is sent, the host generates a Start condition following the acknowledge. This terminates the write operation, but not before the internal Address Pointer is set. The host then issues the control byte again but with the R/$\overline{W}$ bit set to a '1'. The 24AA014H/24LC014H will then issue an acknowledge and transmits the eight-bit data word. The host will not acknowledge the transfer, but does generate a Stop condition and the 24AA014H/24LC014H discontinues transmission (Figure 8-2). After this command, the internal Address Pointer 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 after the 24AA014H/24LC014H transmits the first data byte, the host issues an acknowledge as opposed to a Stop condition in a random read. This directs the 24AA014H/24LC014H to transmit the next sequentially addressed 8-bit word (Figure 8-3).

To provide sequential reads the 24AA014H/24LC014H contains an internal Address Pointer which is incremented by one at the 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 07Fh to address 000h.

FIGURE 8-1: CURRENT ADDRESS READ

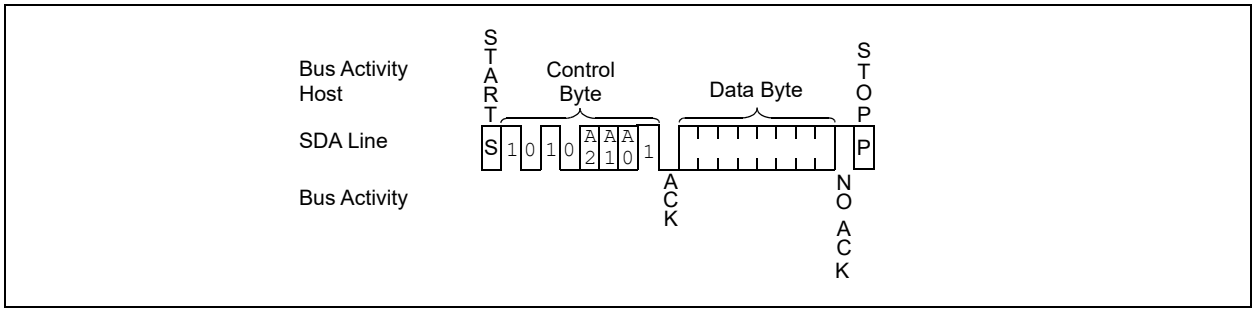


FIGURE 8-2: RANDOM READ

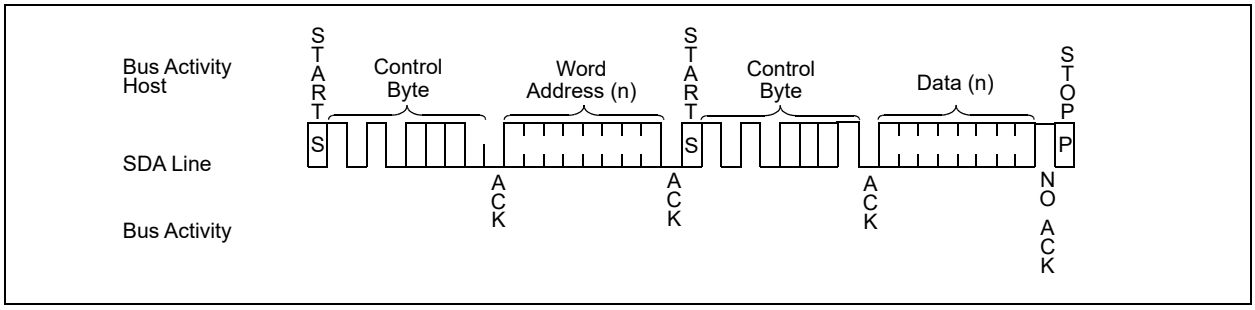
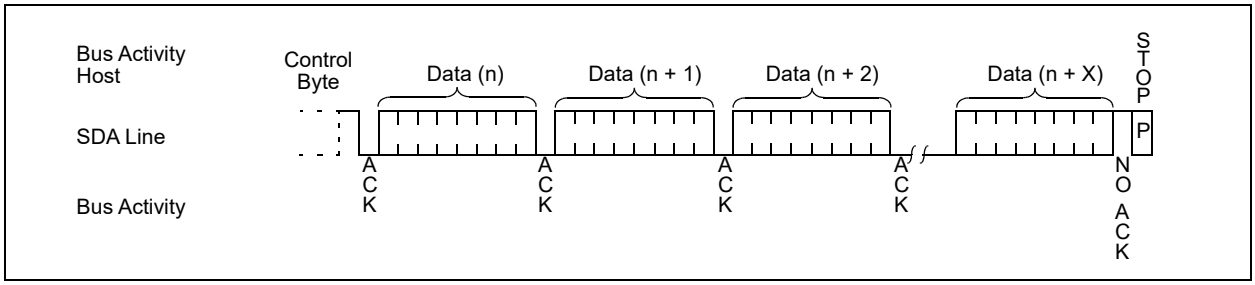


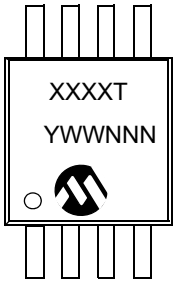
FIGURE 8-3: SEQUENTIAL READ



9.0 PACKAGING INFORMATION

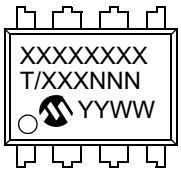
9.1 Package Marking Information

8-Lead MSOP

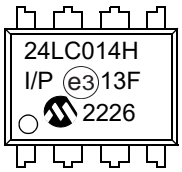


Example

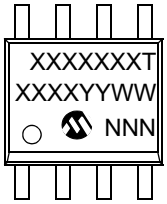
8-Lead PDIP (300 mil)



Example

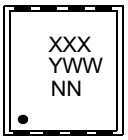


8-Lead SOIC (3.90 mm)



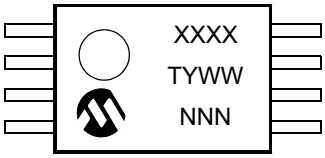
Example

8-Lead 2x3 TDFN

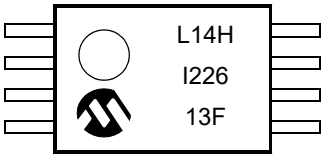


Example

8-Lead TSSOP



Example



Part Number	1st Line Marking Codes			
	TSSOP	MSOP	TDFN	
			I-Temp	E-Temp
24AA014H	A14H	4A14HT	AK1	—
24LC014H	L14H	4L14HT	AK4	AK5

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)	RoHS-compliant JEDEC® designator for Matte Tin (Sn)

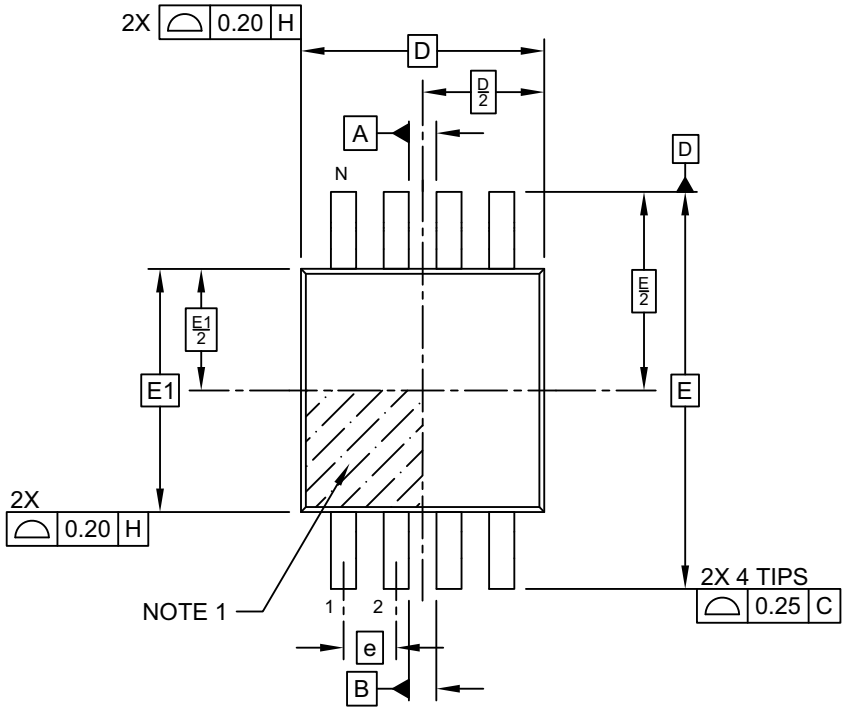
Note: Standard OTP marking consists of Microchip part number, year code, week code, and traceability code.

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

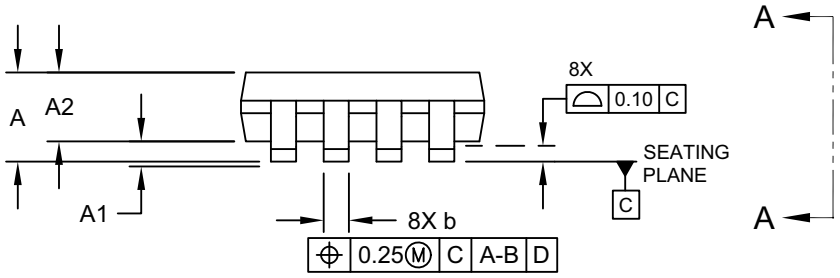
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

8-Lead Plastic Micro Small Outline Package (MS) - 3x3 mm Body [MSOP]

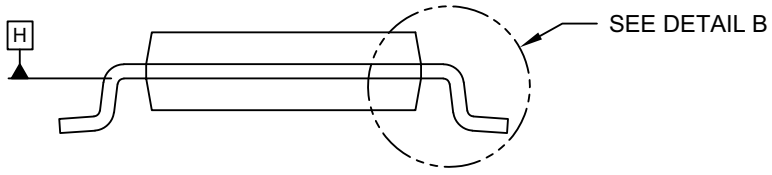
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



TOP VIEW



SIDE VIEW

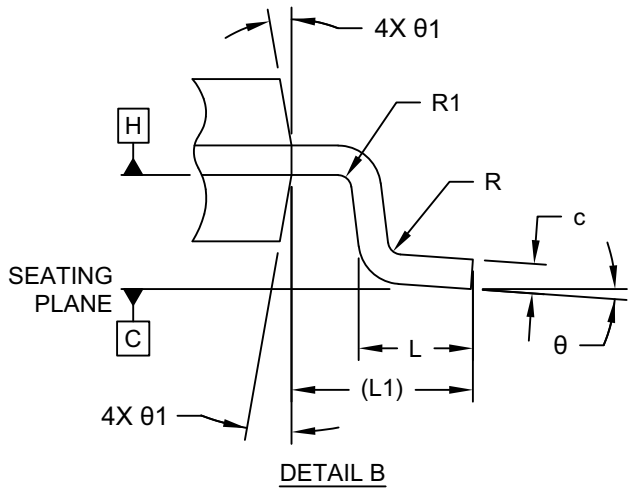


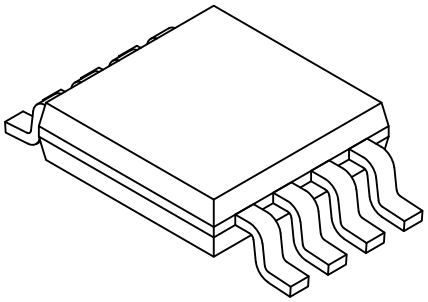
VIEW A–A

Microchip Technology Drawing C04-111-MS Rev D Sheet 1 of 2

8-Lead Plastic Micro Small Outline Package (MS) - 3x3 mm Body [MSOP]

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 Terminals	N		8	
Pitch	e		0.65 BSC	
Overall Height	A	–	–	1.10
Standoff	A1	0.00	–	0.15
Molded Package Thickness	A2	0.75	0.85	0.95
Overall Length	D		3.00 BSC	
Overall Width	E		4.90 BSC	
Molded Package Width	E1		3.00 BSC	
Terminal Width	b	0.22	–	0.40
Terminal Thickness	c	0.08	–	0.23
Terminal Length	L	0.40	0.60	0.80
Footprint	L1		0.95 REF	
Lead Bend Radius	R	0.07	–	–
Lead Bend Radius	R1	0.07	–	–
Foot Angle	θ	0°	–	8°
Mold Draft Angle	θ1	5°	–	15°

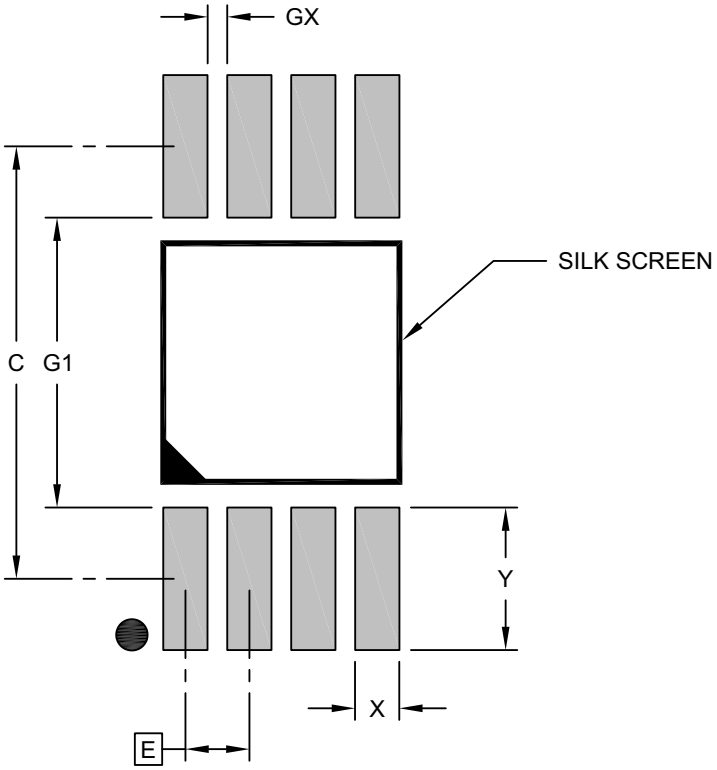
Notes:

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 C04-111-MS Rev D Sheet 2 of 2

8-Lead Plastic Micro Small Outline Package (MS) - 3x3 mm Body [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	
Contact Pad Width (X8)	X			0.45
Contact Pad Length (X8)	Y			1.45
Contact Pad to Contact Pad (X4)	G1	2.95		
Contact Pad to Contact Pad (X6)	GX	0.20		

Notes:

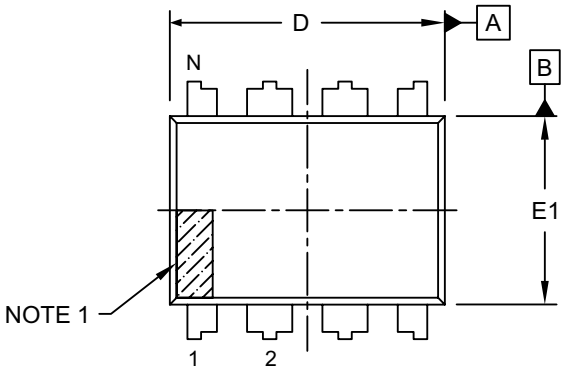
1. Dimensioning and tolerancing per ASME Y14.5M

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

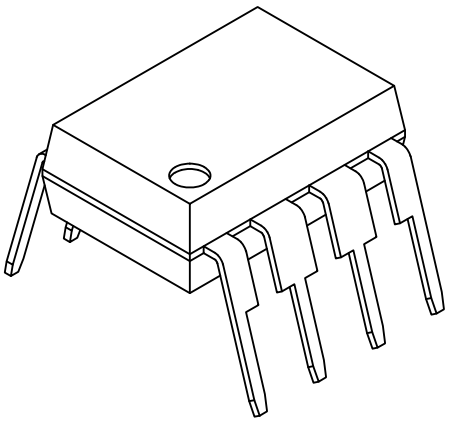
Microchip Technology Drawing C04-2111-MS Rev D

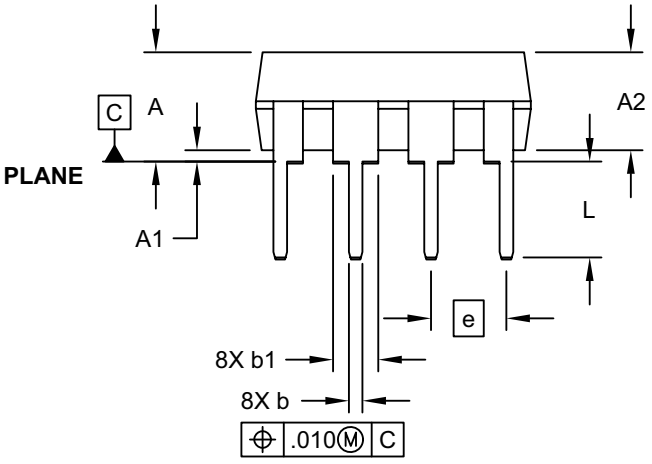
8-Lead Plastic Dual In-Line (P) - 300 mil Body [PDIP]

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

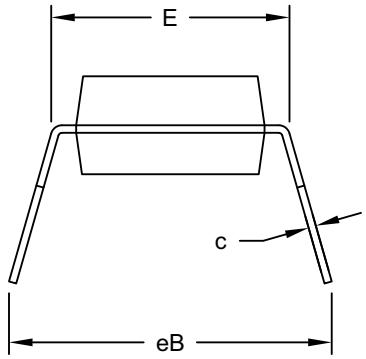


TOP VIEW





SIDE VIEW

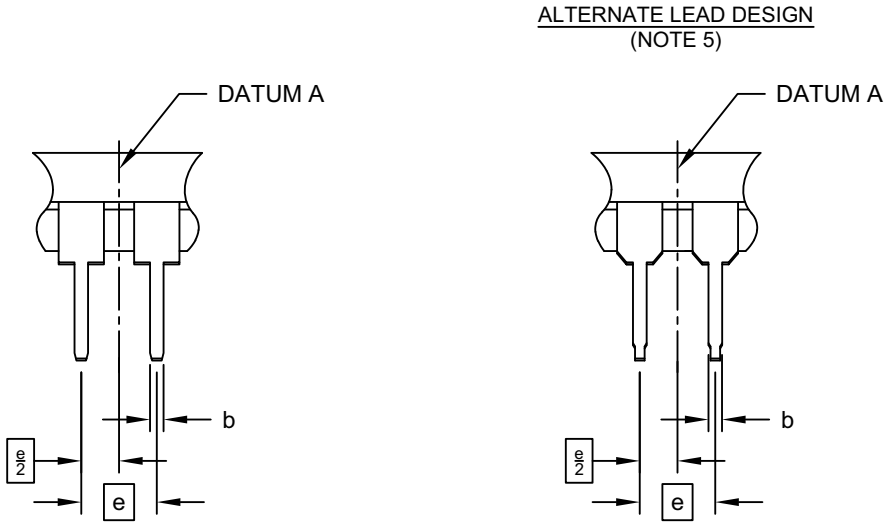


END VIEW

Microchip Technology Drawing No. C04-018-P Rev F Sheet 1 of 2

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

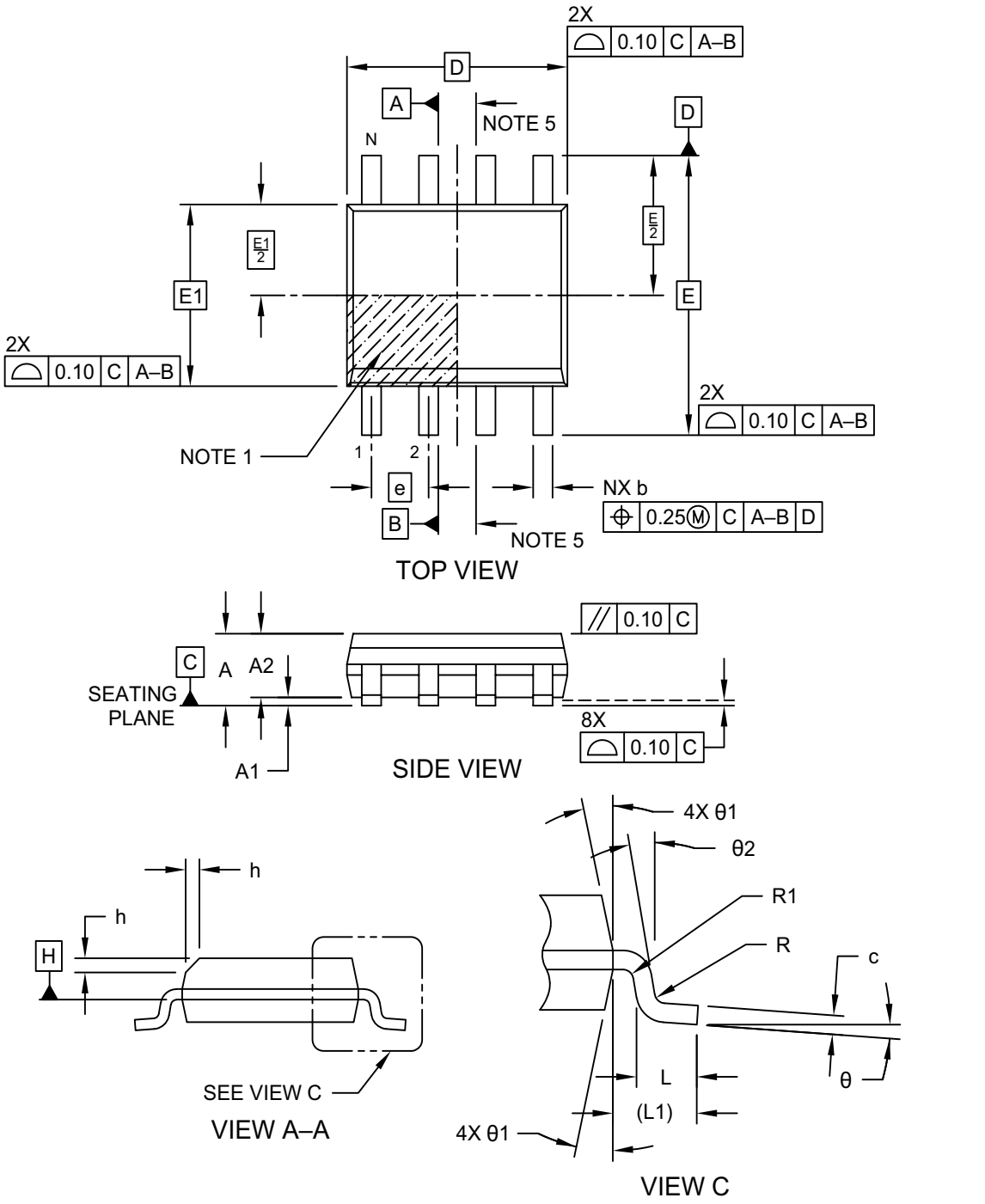
Notes:

1. Pin 1 visual index feature may vary, but must be located 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 .010" per side.
4. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
5. Lead design above seating plane may vary, based on assembly vendor.

Microchip Technology Drawing No. C04-018-P Rev F Sheet 2 of 2

8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

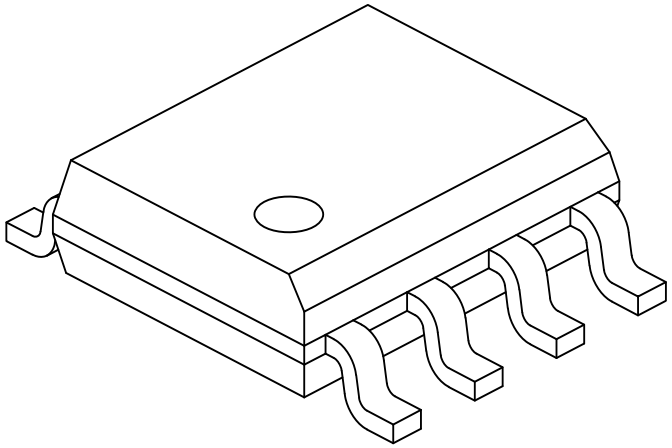
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing No. C04-057-SN Rev K Sheet 1 of 2

8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) 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	
Lead Thickness	c	0.17	–	0.25
Lead Width	b	0.31	–	0.51
Lead Bend Radius	R	0.07	–	–
Lead Bend Radius	R1	0.07	–	–
Foot Angle	θ	0°	–	8°
Mold Draft Angle	θ1	5°	–	15°
Lead Angle	θ2	0°	–	–

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

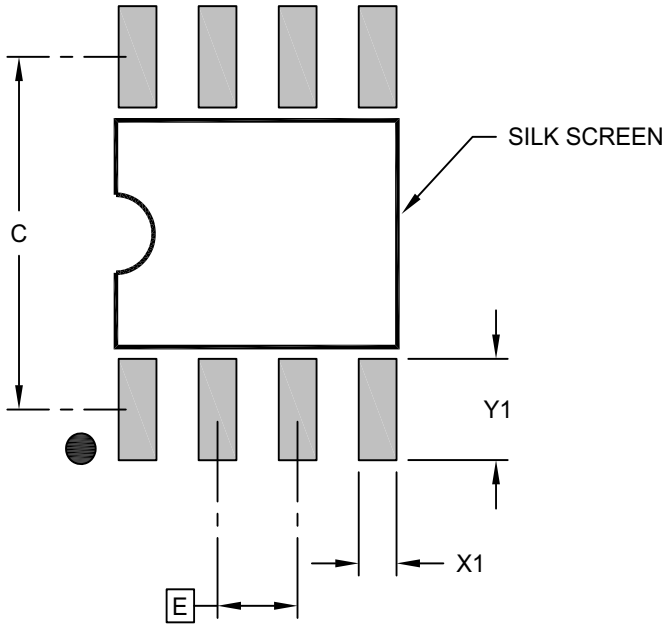
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.
5. Datums A & B to be determined at Datum H.

Microchip Technology Drawing No. C04-057-SN Rev K Sheet 2 of 2

8-Lead Plastic Small Outline (SN) - Narrow, 3.90 mm (.150 In.) 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:

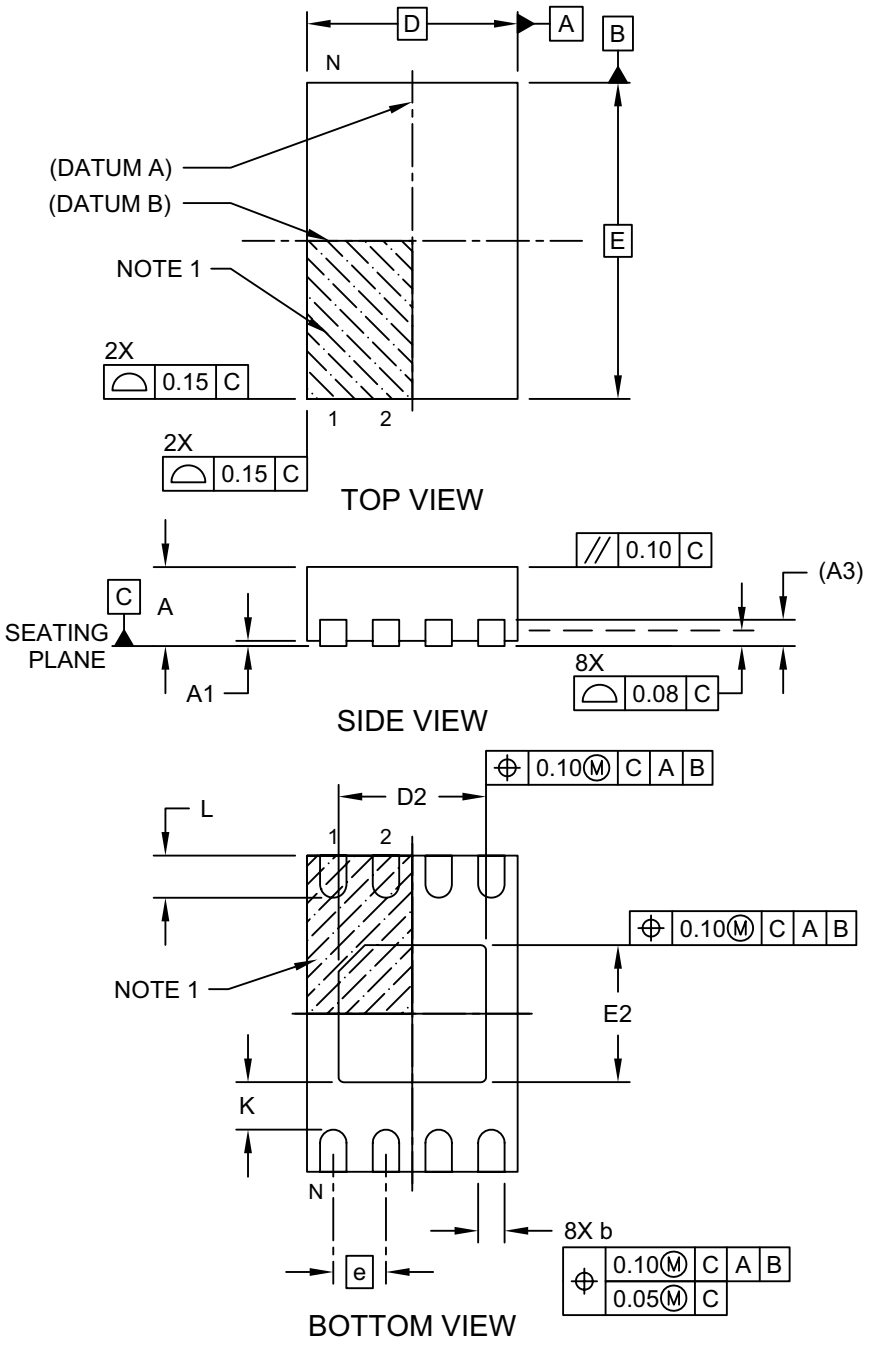
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing C04-2057-SN Rev K

8-Lead Plastic Dual Flat, No Lead Package (MN) – 2x3x0.8 mm Body [TDFN]
With 1.4x1.3 mm Exposed Pad (JEDEC Package type WDFN)

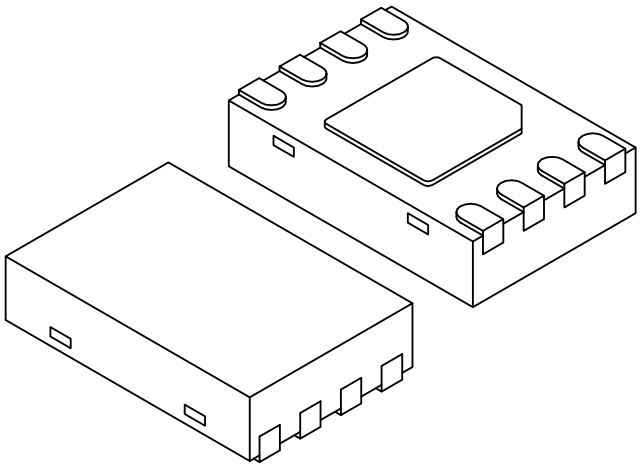
Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing No. C04-129-MN Rev E Sheet 1 of 2

8-Lead Plastic Dual Flat, No Lead Package (MN) – 2x3x0.8 mm Body [TDFN] With 1.4x1.3 mm Exposed Pad (JEDEC Package type WDFN)

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	1.35	1.40	1.45
Exposed Pad Width	E2	1.25	1.30	1.35
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

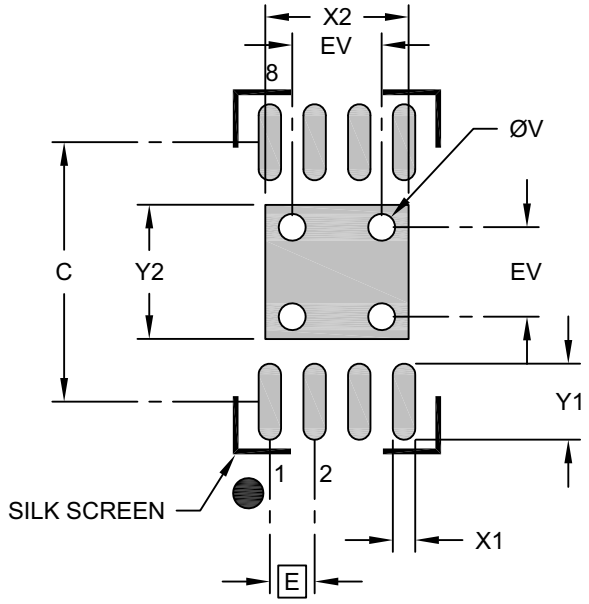
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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

Microchip Technology Drawing No. C04-129-MN Rev E Sheet 2 of 2

8-Lead Plastic Dual Flat, No Lead Package (MN) – 2x3x0.8 mm Body [TDFN] With 1.4x1.3 mm Exposed Pad (JEDEC Package type WDFN)

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	X2			1.60
Optional Center Pad Length	Y2			1.50
Contact Pad Spacing	C		2.90	
Contact Pad Width (X8)	X1			0.25
Contact Pad Length (X8)	Y1			0.85
Thermal Via Diameter	V		0.30	
Thermal Via Pitch	EV		1.00	

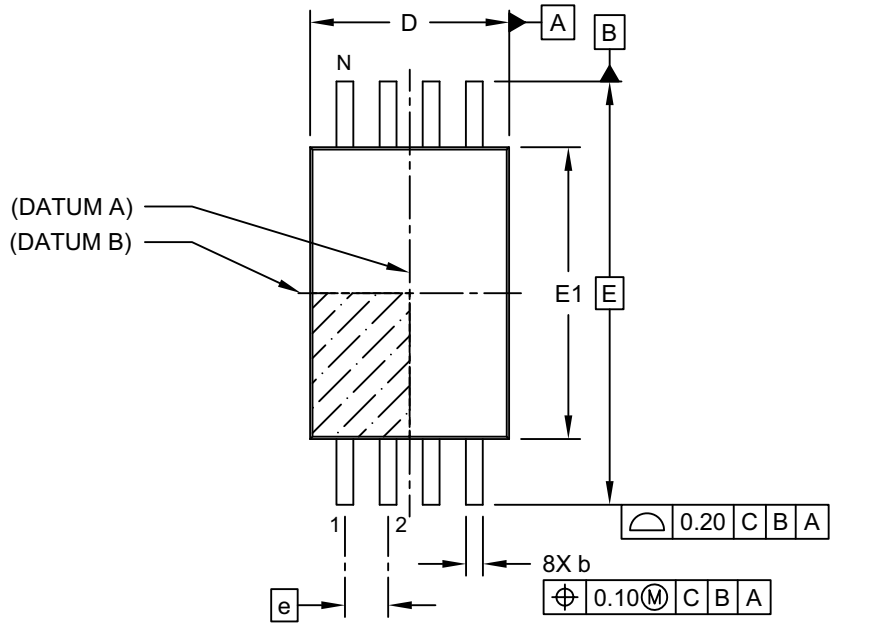
Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
2. For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

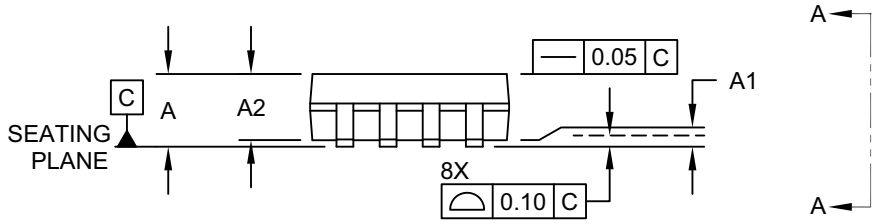
Microchip Technology Drawing No. C04-129-MN Rev. B

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

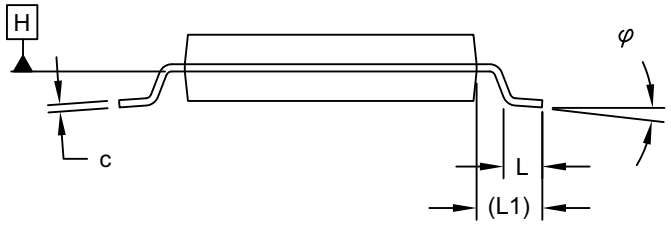
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



TOP VIEW



SIDE VIEW

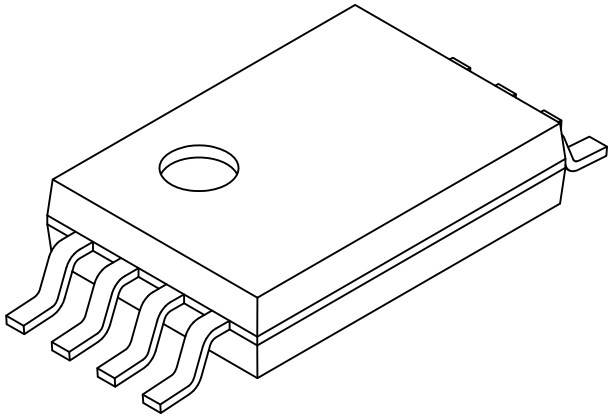


VIEW A-A

Microchip Technology Drawing C04-086 Rev C Sheet 1 of 2

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	-	-
Overall Width	E		6.40 BSC	
Molded Package Width	E1	4.30	4.40	4.50
Overall Length	D	2.90	3.00	3.10
Foot Length	L	0.45	0.60	0.75
Footprint	L1		1.00 REF	
Lead Thickness	c	0.09	-	0.25
Foot Angle	φ	0°	4°	8°
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 0.20mm per side.
3. Dimensioning and tolerancing per ASME Y14.5M

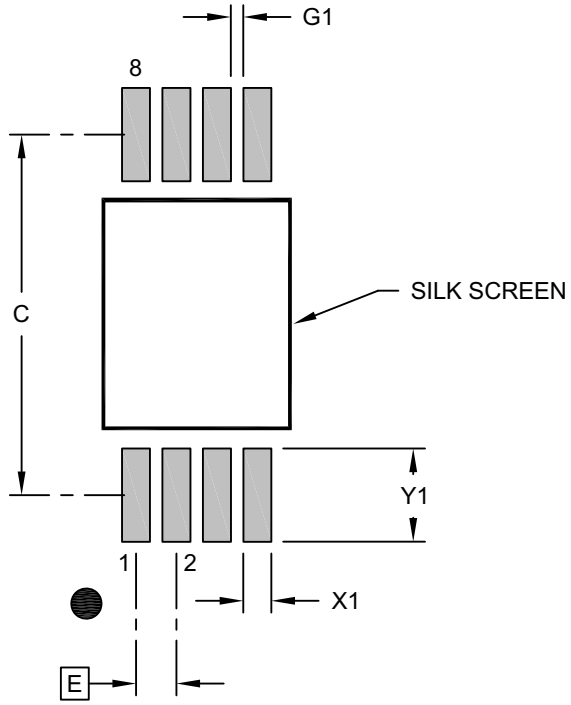
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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

Microchip Technology Drawing C04-086 Rev C Sheet 2 of 2

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	C		5.80	
Contact Pad Width (X8)	X1			0.45
Contact Pad Length (X8)	Y1			1.50
Contact Pad to Center Pad (X6)	G1	0.20		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
2. For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

Microchip Technology Drawing C04-2086 Rev B

APPENDIX A: REVISION

Revision C (09/2022)

Updated formatting to current template; Replaced terminology “Master” and “Slave” with “Host” and “Client” respectively; Updated MSOP, PDIP, SOIC, TDFN and TSSOP package drawings.

Revision B (09/2008)

Added new pin function table; Corrections on DC Characteristics Table; Updated Section 2.3.

Revision A (03/2008)

Original release.

THE MICROCHIP WEBSITE

Microchip provides online support via our website at www.microchip.com. This website is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the website contains the following information:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQ), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip website at www.microchip.com. Under "Support", click on "Customer Change Notification" and follow the registration instructions.

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or Field Application Engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the website at: https://microchip.com/support

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](1)	–X	/XX
Device	Tape and Reel Option	Temperature Range	Package

Device:	24AA014H 24LC014H	= 1.7V, 1-Kbit Addressable Serial EEPROM = 2.5V, 1-Kbit Addressable Serial EEPROM	
Tape and Reel Option:	Blank T	= =	Standard packaging (tube or tray) Tape and Reel(1)
Temperature Range:	I E	= =	-40°C to +85°C (Industrial) -40°C to +125°C (Extended)
Package:	MS P SN MNY(2) ST	= = = = =	Plastic Micro Small Outline Package, 8-Lead (MSOP) Plastic Dual In-Line – 300 mil Body, 8-Lead (PDIP) Plastic Small Outline - Narrow, 3.90 mm Body, 8-Lead (SOIC) Plastic Dual Flat, No Lead Package - 2x3x0.75mm Body, 8-Lead (TDFN) (Tape and Reel only) Plastic Thin Shrink Small Outline – 4.4 mm, 8-Lead (TSSOP)

Examples:

a) 24AA014H-I/P: Industrial Temperature, 1.7V, PDIP package.
b) 24AA014H-I/SN: Industrial Temperature, 1.7V, SOIC package.
c) 24AA014HT-I/ST: Tape and Reel, Industrial Temperature, 1.7V, TSSOP package.
d) 24LC014H-I/P: Industrial Temperature, 2.5V, PDIP package.
e) 24LC014HT-E/SN: Tape and Reel, Extended Temperature, 2.5V, SOIC package.
f) 24LC014HT-I/MS: Tape and Reel, Industrial Temperature, 2.5V, MSOP package.

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

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

Note the following details of the code protection feature on Microchip products:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is “unbreakable”. Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.

For information regarding Microchip’s Quality Management Systems, please visit www.microchip.com/quality.

Trademarks

ISBN: 978-1-6683-1159-2

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:
https://www.microchip.com/support
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX
Tel: 512-257-3370

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Novi, MI
Tel: 248-848-4000

Houston, TX
Tel: 281-894-5983

Indianapolis
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC
Tel: 919-844-7510

New York, NY
Tel: 631-435-6000

San Jose, CA
Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto
Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

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

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880- 3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4485-5910
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-72400

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7288-4388

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820