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24AA044

4K I²C™ Serial EEPROM

Device Selection Table

Part Number	Vcc Range	Max Clock Frequency	Temp. Range
24AA044	1.7V-5.5V	1 MHz(1)	I, E

Note 1: 400 kHz for 1.8V ≤ VCC < 2.2V
100 kHz for VCC < 1.8V

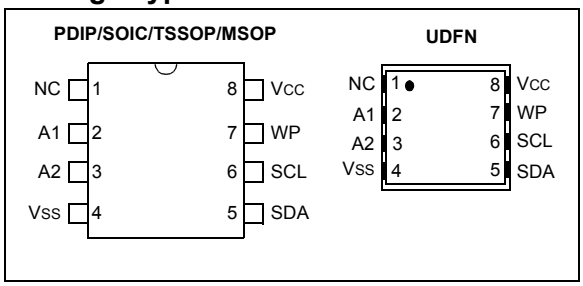
Features:

- Single Supply with Operation from 1.7V to 5.5V
- Low-Power CMOS Technology:
  - Read current 400 μA, max
  - Standby current 1 μA, max at 85°C
- 2-Wire Serial Interface, I²C™ Compatible
- Cascadable up to Four Devices
- Schmitt Trigger Inputs for Noise Suppression
- Output Slope Control to Eliminate Ground Bounce
- 1 MHz, 400 kHz, and 100 kHz Clock Compatibility
- Page Write Time 5 ms Maximum
- 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, UDFN and MSOP
- RoHS Compliant
- Temperature Ranges:
  - Industrial (I): -40°C to +85°C
  - Automotive (E): -40°C to +125°C

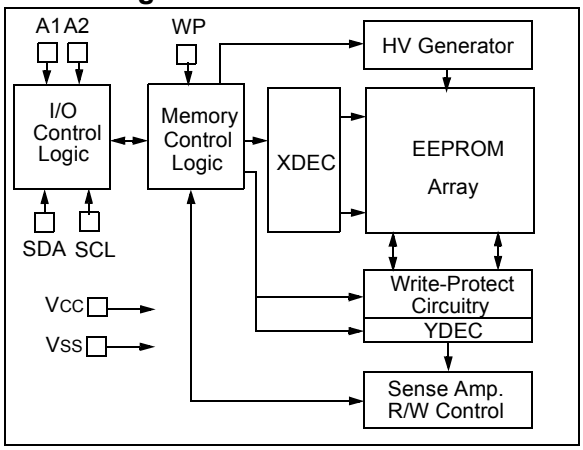
Description:

The Microchip Technology Inc. 24AA044 is a 4 Kbit Serial Electrically Erasable PROM with a voltage range of 1.7V to 5.5V. The device is organized as two blocks of 256 x 8-bit memory with a 2-wire serial interface. Low-current design permits operation with 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 four 24AA044 devices on the same bus for up to 16K bits of contiguous EEPROM memory. The device is available in the standard 8-pin PDIP, 8-pin SOIC (3.90 mm), TSSOP, 2x3 UDFN and MSOP packages.

Package Types



Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings(†)

VCC.....6.5V

All inputs and outputs w.r.t. VSS .....-0.3V to 6.5V

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. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

TABLE 1-1: DC SPECIFICATIONS

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.**	**Max.**	**Units**	**Conditions**
	—	**A1, A2, SCL, SDA and WP pins**	—	—	—	—
D1	VIH	High-level input voltage	0.7 VCC	VCC + 0.5	V	—
D2	VIL	Low-level input voltage	—	0.3 VCC 0.2 VCC	V V	VCC ≥ 2.5V VCC < 2.5V
D3	VHYS	Hysteresis of Schmitt Trigger inputs	0.05 VCC	—	V	**(Note)**
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 = 5.5V **(Note)** TA = 25°C, FCLK = 1 MHz
D8	ICC write	Operating current	—	3	mA	VCC = 5.5V
D9	ICC read		—	400	µA	VCC = 5.5V, SCL = 1 MHz
D10	ICCS	Standby current	— —	1 5	µA µA	Industrial Automotive SDA, SCL = VCC A1, A2, WP = VSS

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

TABLE 1-2: AC CHARACTERISTICS

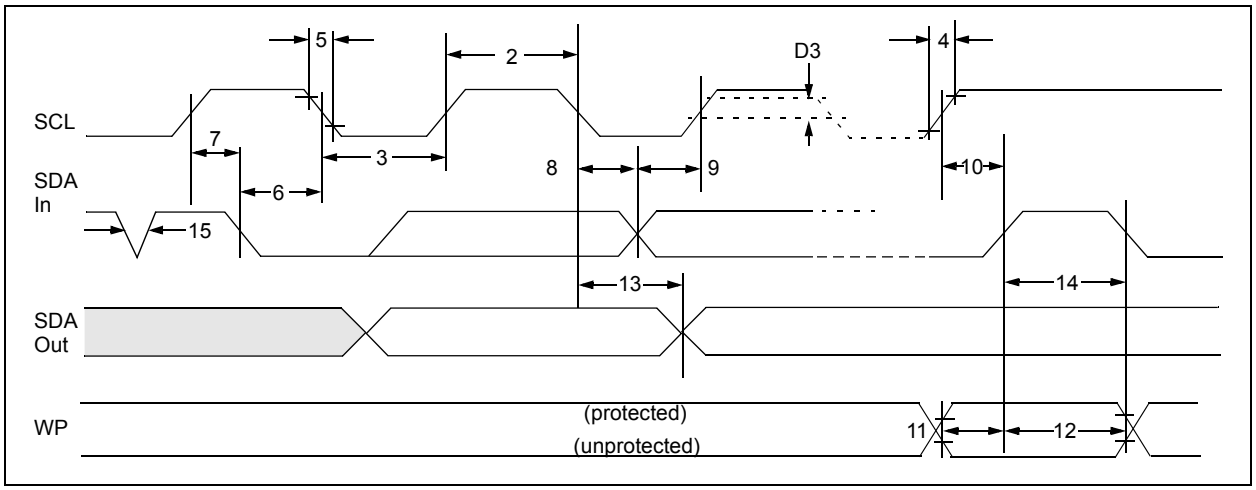
AC CHARACTERISTICS			Industrial (I): T_A = -40°C to +85°C, V_{CC} = +1.7V to +5.5V Automotive (E): T_A = -40°C to +125°C, V_{CC} = +1.7V to +5.5V			
Param. No.	**Symbol**	**Characteristic**	**Min.**	**Max.**	**Units**	**Conditions**
1	F_{CLK}	Clock frequency	— — —	100 400 1000	kHz	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
2	T_{HIGH}	Clock high time	4000 600 500	— — —	ns	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
3	T_{LOW}	Clock low time	4700 1300 500	— — —	ns	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
4	T_R	SDA and SCL rise time **(Note 1)**	— — —	1000 300 300	ns	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
5	T_F	SDA and SCL fall time **(Note 1)**	— — —	300 300 100	ns	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
6	$T_{HD:STA}$	Start condition hold time	4000 600 250	— — —	ns	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
7	$T_{SU:STA}$	Start condition setup time	4700 600 250	— — —	ns	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
8	$T_{HD:DAT}$	Data input hold time	0	—	ns	**(Note 2)**
9	$T_{SU:DAT}$	Data input setup time	250 100 100	— — —	ns	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
10	$T_{SU:STO}$	Stop condition setup time	4000 600 250	— — —	ns	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
11	$T_{SU:WP}$	WP setup time	4000 600 600	— — —	ns	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
12	$T_{HD:WP}$	WP hold time	4700 1300 1300	— — —	ns	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
13	T_{AA}	Output valid from clock **(Note 2)**	— — —	3500 900 400	ns	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
14	T_{BUF}	Bus free time: Time the bus must be free before a new transmission can start	4700 1300 500	— —	ns	1.7V ≤ V_{CC} < 1.8V 1.8V ≤ V_{CC} < 2.2V 2.2V ≤ V_{CC} < 5.5V
15	T_{SP}	Input filter spike suppression (SDA and SCL pins)	—	50	ns	**(Note 1)**
16	T_{WC}	Write cycle time (byte or page)	—	5	ms	—
17	—	Endurance	1M	—	cycles	Page mode, 25°C, V_{CC} = 5.5V **(Note 3)**

Note 1: Not 100% tested.

2: As a transmitter, the device must provide an internal minimum delay time to bridge the undefined region (minimum 200 ns) of the falling edge of SCL to avoid unintended generation of Start or Stop conditions.

3: 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.

FIGURE 1-1: BUS TIMING DATA



2.0 PIN DESCRIPTIONS

Pin Function Table

Name	PDIP	SOIC	TSSOP	UDFN	MSOP	Description
NC	1	1	1	1	1	Not Connected
A1	2	2	2	2	2	Chip Address Input
A2	3	3	3	3	3	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	+1.7 to 5.5V Power Supply

2.1 Serial Data (SDA)

SDA is a bidirectional pin used to transfer addresses and data into and out of the device. It is an open-drain terminal; therefore, the SDA bus requires a pull-up resistor to VCC (typical 10 kΩ for 100 kHz, 2 kΩ for 400 kHz and 1 MHz).

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.

2.2 Serial Clock (SCL)

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

2.3 Chip Address Inputs (A1, A2)

The levels on the A1 and A2 inputs are compared with the corresponding bits in the slave address. The chip is selected if the compare is true.

Up to four 24AA044 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.

2.4 Write-Protect (WP)

WP is the hardware write-protect pin. It must be tied to VCC or VSS. If tied to Vcc, hardware write protection is enabled. If WP is tied to Vss, the hardware write protection is disabled.

2.5 Noise Protection

The 24AA044 employs a VCC threshold detector circuit which disables the internal erase/write logic if the VCC is below 1.35V 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.

3.0 FUNCTIONAL DESCRIPTION

The 24AA044 supports a bidirectional, 2-wire bus and data transmission protocol. A device that sends data onto the bus is defined as transmitter, while a device receiving data is defined as receiver. The bus has to be controlled by a master device that generates the Serial Clock (SCL), controls the bus access and generates the Start and Stop conditions, while the 24AA044 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 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 master device and is, theoretically, unlimited (though only the last sixteen will be stored when performing a write operation). When an overwrite does occur, it will replace data in a first-in first-out fashion.

4.5 Acknowledge

Each receiving device, when addressed, is required 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 24AA044 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. 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 must leave the data line high to enable the master to generate the Stop condition (Figure 4-2).

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

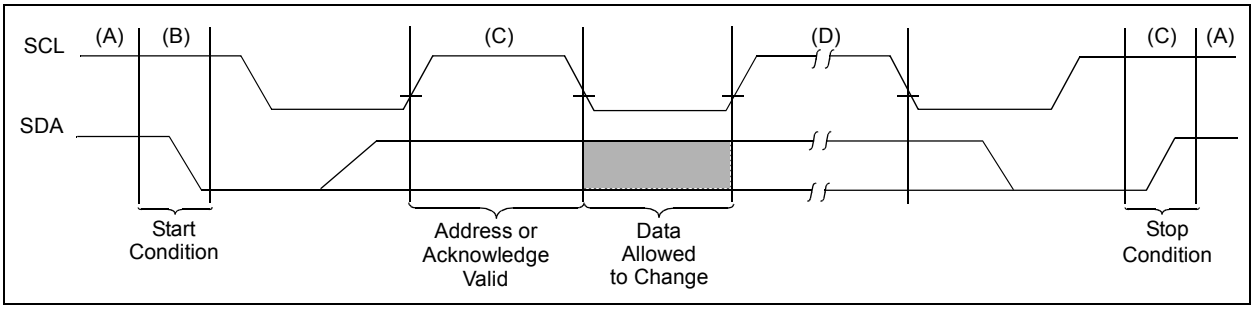
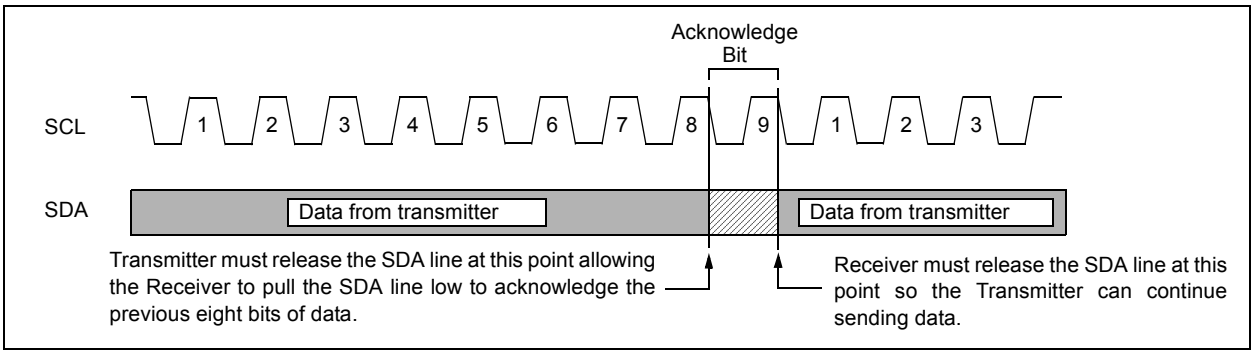


FIGURE 4-2: ACKNOWLEDGE TIMING



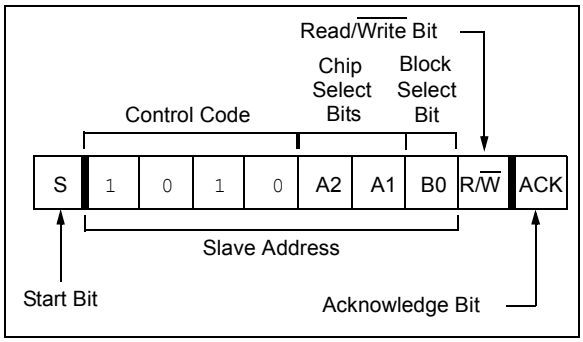
5.0 DEVICE ADDRESSING

A control byte is the first byte received following the Start condition from the master device (Figure 5-1). The control byte consists of a 4-bit control code. For the 24AA044, this is set as '1010' binary for read and write operations. The next two bits of the control byte are the Chip Select bits (A2, A1). The Chip Select bits allow the use of up to four 24AA044 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 and A1 pins for the device to respond. These bits are in effect the two Most Significant bits of the array address.

The next bit of the control byte is the block select bit (B0). This bit acts as the A8 address bit for accessing the entire array.

The last bit of the control byte defines the operation to be performed. When set to a one, a read operation is selected. When set to a zero, a write operation is selected. Following the Start condition, the 24AA044 monitors the SDA bus checking the control byte being transmitted. Upon receiving a '1010' code and appropriate Chip Select bits, the slave device outputs an Acknowledge signal on the SDA line. Depending on the state of the R/$\overline{W}$ bit, the 24AA044 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 and A1 can be used to expand the contiguous address space for up to 16K bits by adding up to four 24AA044 devices on the same bus. In this case, software can use A1 of the control byte as address bit A9, and A2 as address bit A10. It is not possible to sequentially read across device boundaries.

6.0 WRITE OPERATIONS

6.1 Byte Write

Following the Start signal from the master, the device code (4 bits), the Chip Select bits (2 bits), the block select bit (1 bit), and the R/$\overline{W}$ bit (which is a logic-low) is placed onto the bus by the master transmitter. The device will acknowledge this control byte during the ninth clock pulse. The next byte transmitted by the master is the array address and will be written into the Address Pointer of the 24AA044. After receiving another Acknowledge signal from the 24AA044, the master device will transmit the data byte to be written into the addressed memory location. The 24AA044 acknowledges again and the master generates a Stop condition. This initiates the internal write cycle and, during this time, the 24AA044 will not generate Acknowledge signals (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.

6.2 Page Write

The write control byte, array address and the first data byte are transmitted to the 24AA044 in the same way as in a byte write. However, instead of generating a Stop condition, the master transmits up to 15 additional data bytes to the 24AA044, which are temporarily stored in the on-chip page buffer and will be written into the memory once the master has transmitted a Stop condition. Upon receipt of each byte, the four lower-order Address Pointer bits are internally incremented by one.

The higher-order five bits of the array 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). 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.

Note:	When doing a write of less than 16 bytes, the data in the rest of the page is refreshed along with the data bytes being written. This will force the entire page to endure a write cycle. For this reason, endurance is specified per page.

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 must be tied to VCC or VSS. If tied to VCC, the entire array will be write-protected. If the WP pin is tied to VSS, write operations to all address locations are allowed.

FIGURE 6-1: BYTE WRITE

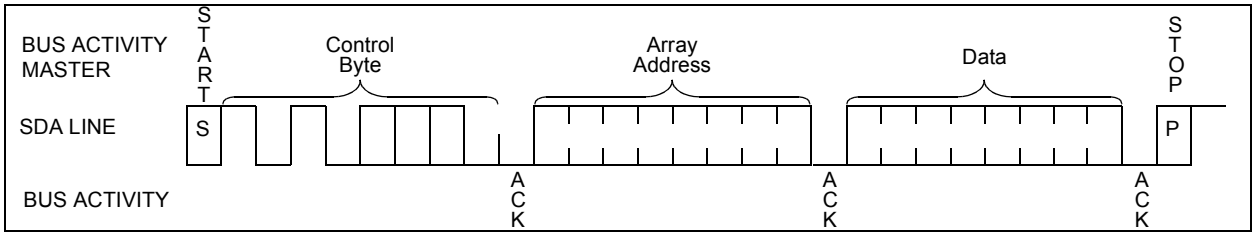
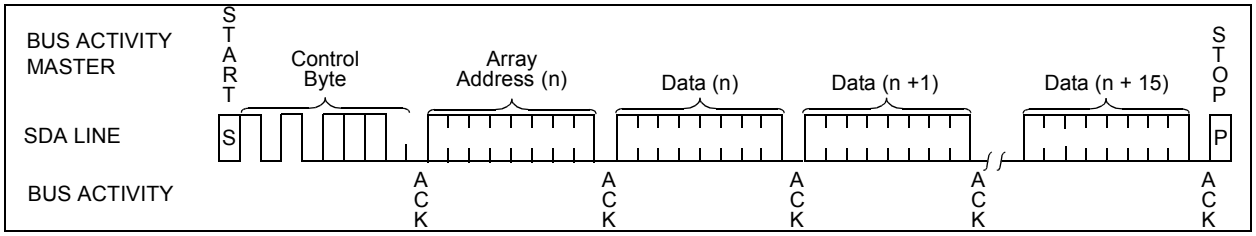


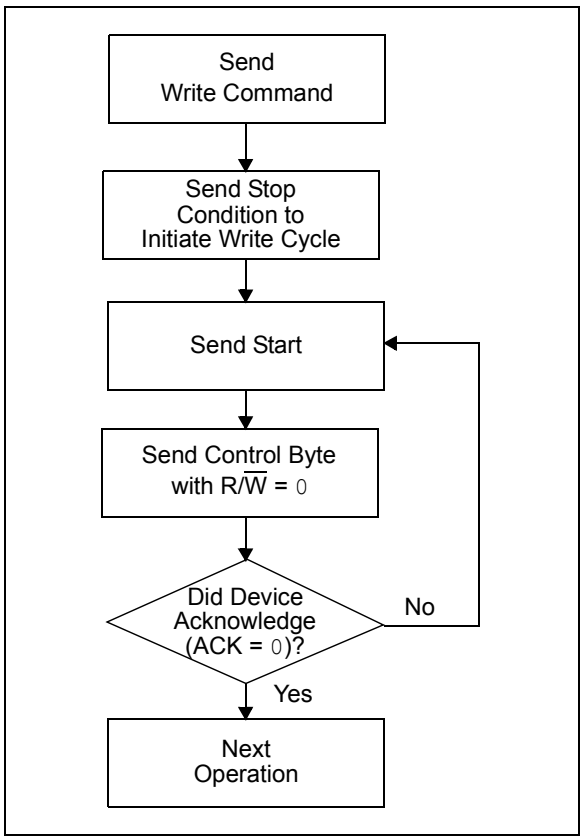
FIGURE 6-2: PAGE WRITE



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 master, the device initiates the internally-timed write cycle, with ACK polling being 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 no ACK is returned, the Start bit and control byte must be re-sent. If the cycle is complete, the device will return the ACK and the master can then proceed with the next Read or Write command. See Figure 7-1 for 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 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 24AA044 contains an address counter that maintains the address of the last data byte 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 slave address with the R/$\overline{W}$ bit set to '1', the 24AA044 issues an acknowledge and transmits the 8-bit data value. The master will not acknowledge the transfer, but does generate a Stop condition and the 24AA044 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 array address must first be set. This is accomplished by sending the array address to the 24AA044 as part of a write operation. Once the array 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 24AA044 will then issue an acknowledge and transmits the 8-bit data value. The master will not acknowledge the transfer but does generate a Stop condition and the 24AA044 discontinues transmission (Figure 8-2). After this command, the internal address counter will point to the address location following the one that was just read.

8.3 Sequential Read

Sequential reads are initiated in the same way as a random read except that after the 24AA044 transmits the first data byte, the master issues an acknowledge (as opposed to a Stop condition in a random read). This directs the 24AA044 to transmit the next sequentially-addressed 8-bit value (Figure 8-3).

To provide sequential reads, the 24AA044 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. The internal Address Pointer will automatically roll over from address 1FFh to address 000h.

FIGURE 8-1: CURRENT ADDRESS READ

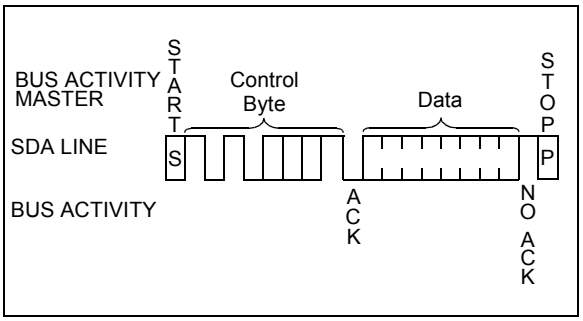


FIGURE 8-2: RANDOM READ

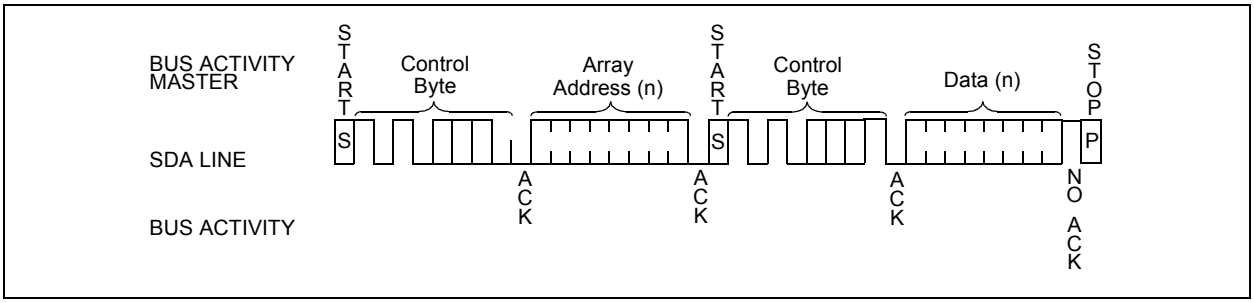
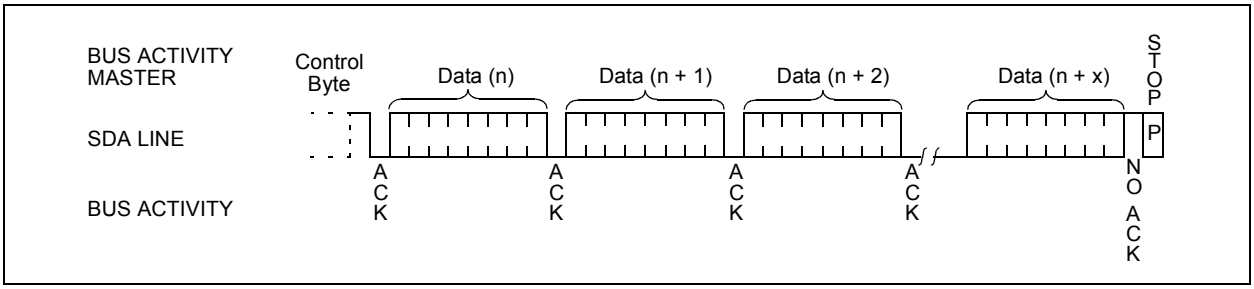


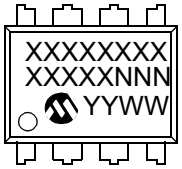
FIGURE 8-3: SEQUENTIAL READ



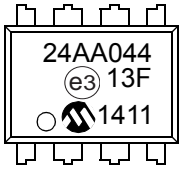
9.0 PACKAGING INFORMATION

9.1 Package Marking Information

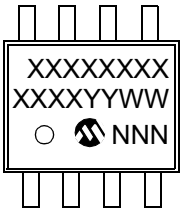
8-Lead PDIP (300 mil)



Example:

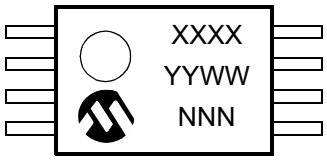


8-Lead SOIC (3.90 mm)

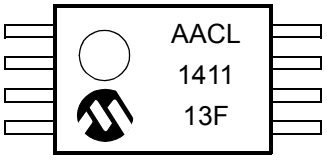


Example:

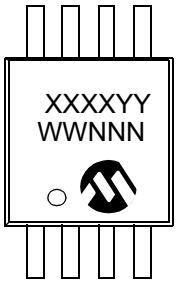
8-Lead TSSOP



Example:



8-Lead MSOP



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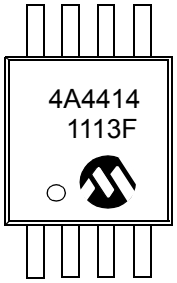
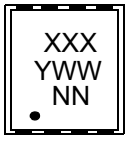
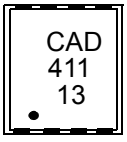


8-Lead 2x3 UDFN



Example:



Part Number	1st Line Marking Codes				
	PDIP	SOIC	TSSOP	MSOP	UDFN
24AA024	24AA044	24AA044	AACL	4A44YY	CAD

Legend:	XX...X	Part number or part number code
	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)	JEDEC® designator for Matte Tin (Sn)

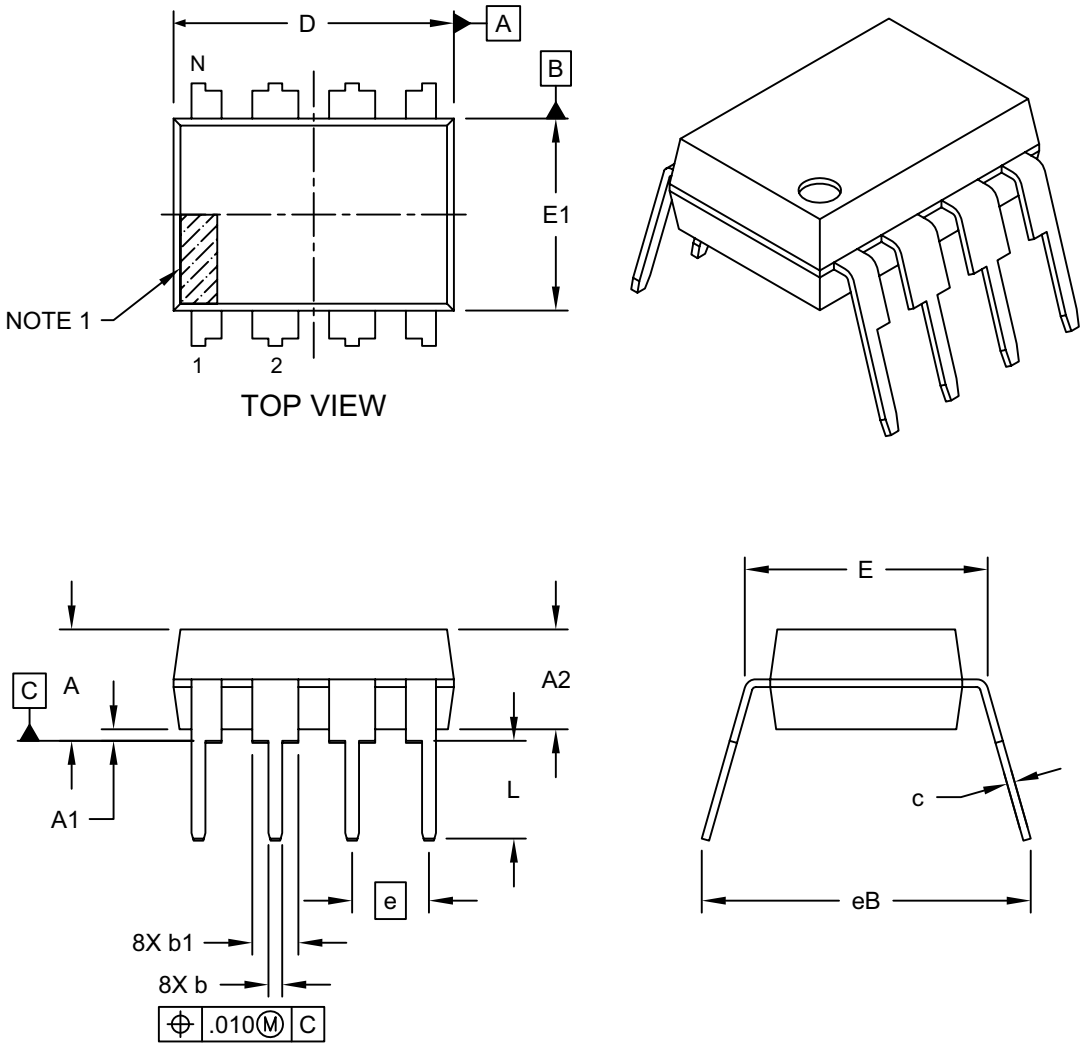
Note: For very small packages with no room for the Pb-free JEDEC designator (e3), the marking will only appear on the outer carton or reel label.

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.

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

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

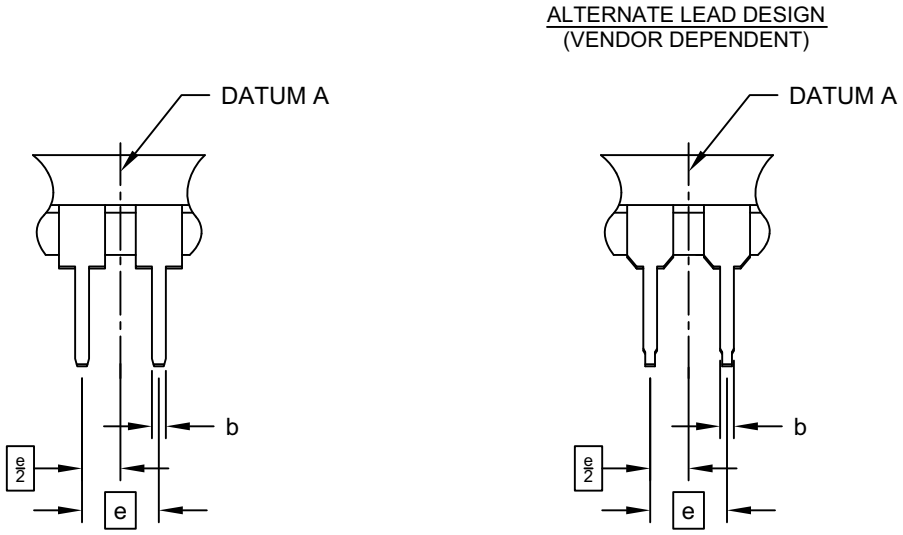
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing No. C04-018D 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:

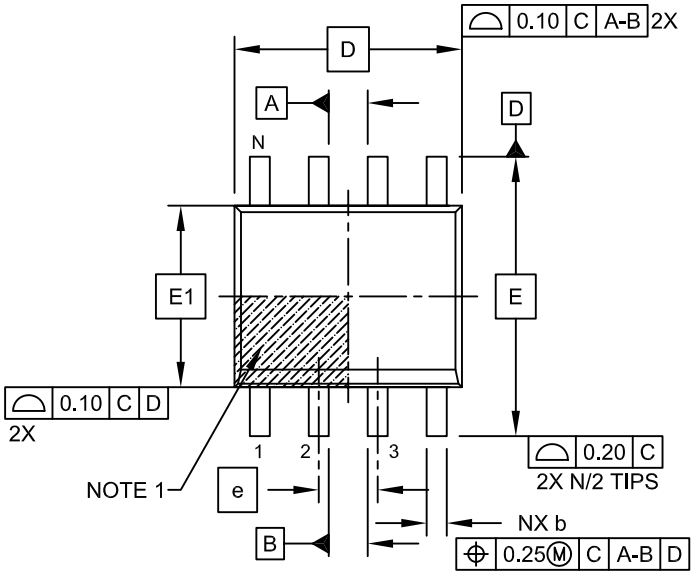
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
4. Dimensioning and tolerancing per ASME Y14.5M

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

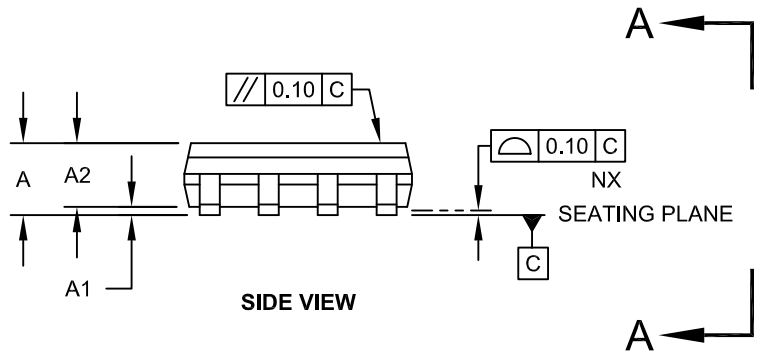
Microchip Technology Drawing No. C04-018D Sheet 2 of 2

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

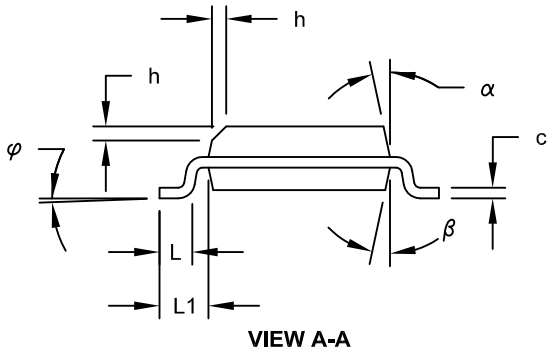
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



TOP VIEW



SIDE VIEW

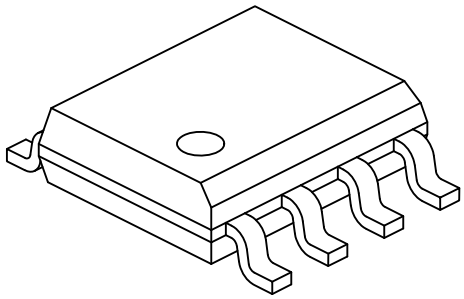


VIEW A-A

Microchip Technology Drawing No. C04-057C Sheet 1 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



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

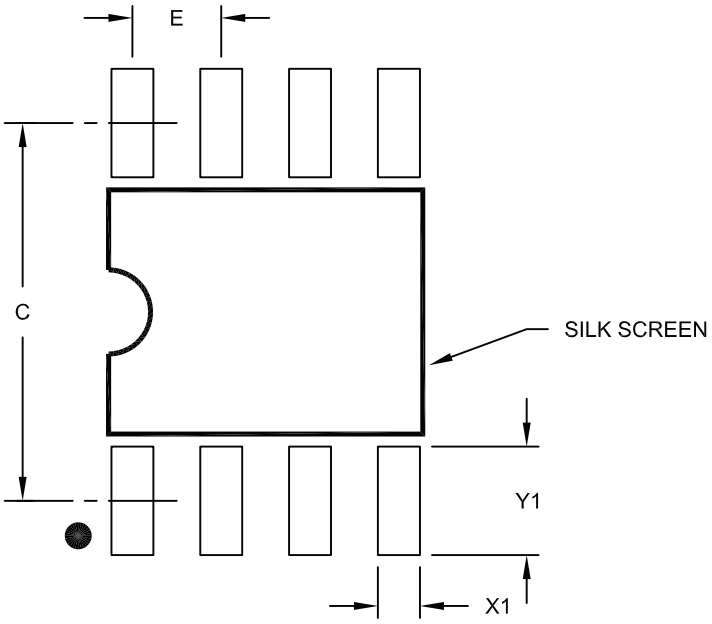
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   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:

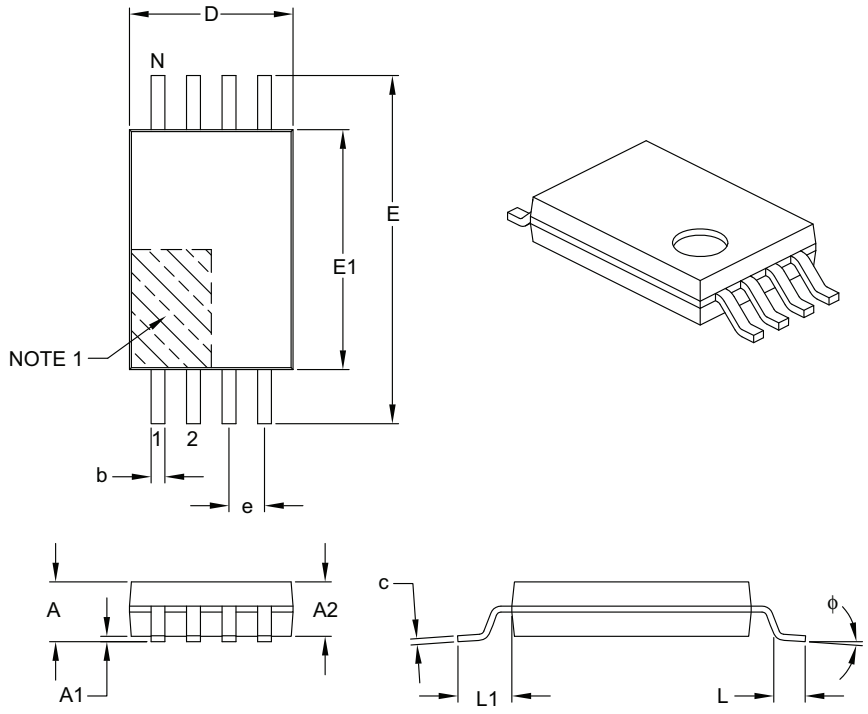
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2057A

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:

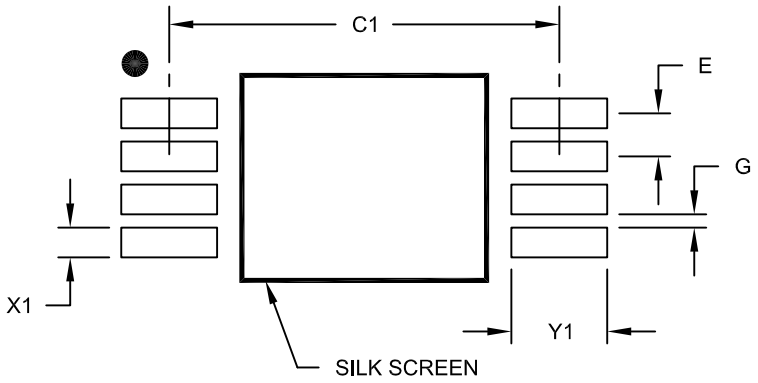
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
3. Dimensioning and tolerancing per ASME Y14.5M.

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:

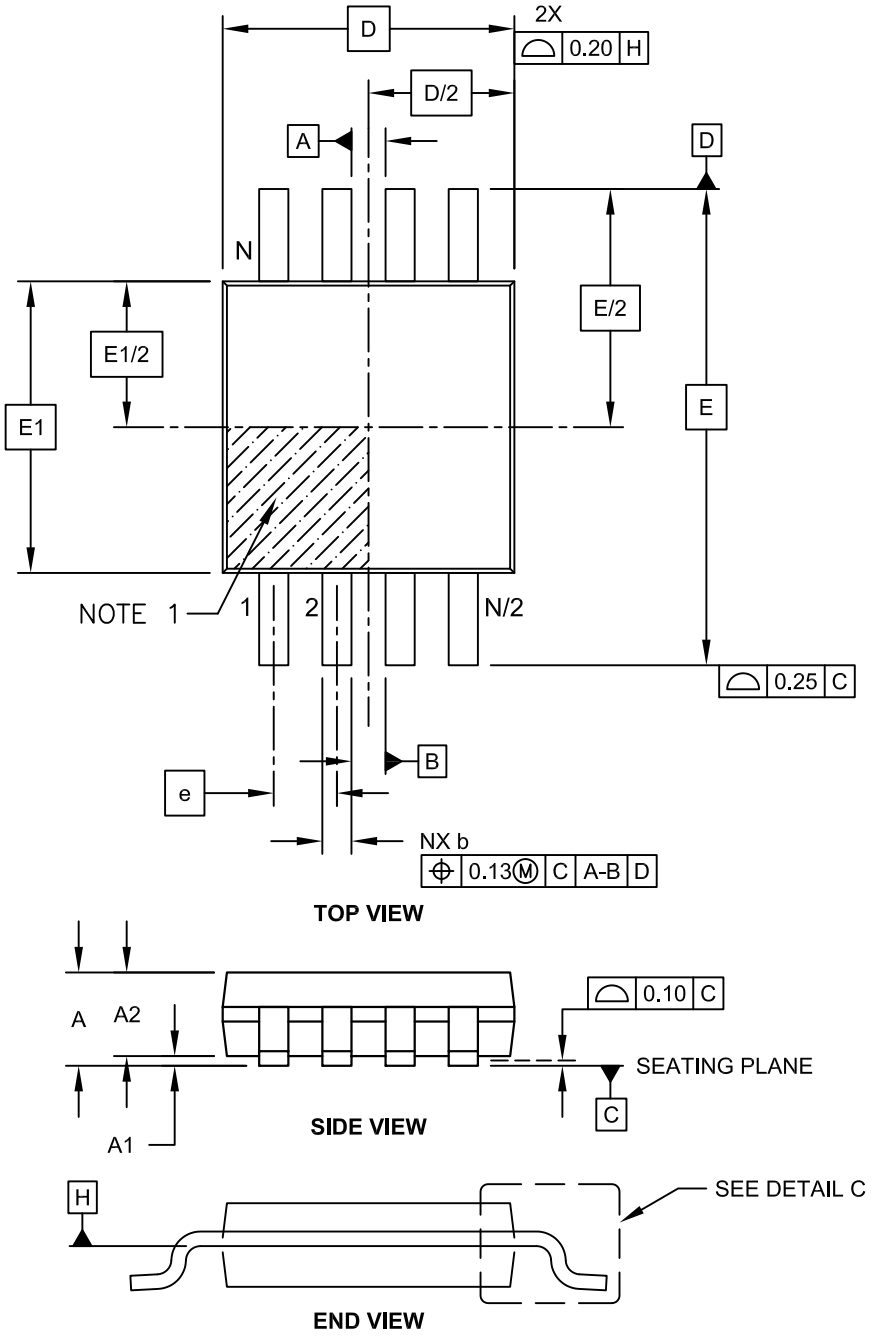
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2086A

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

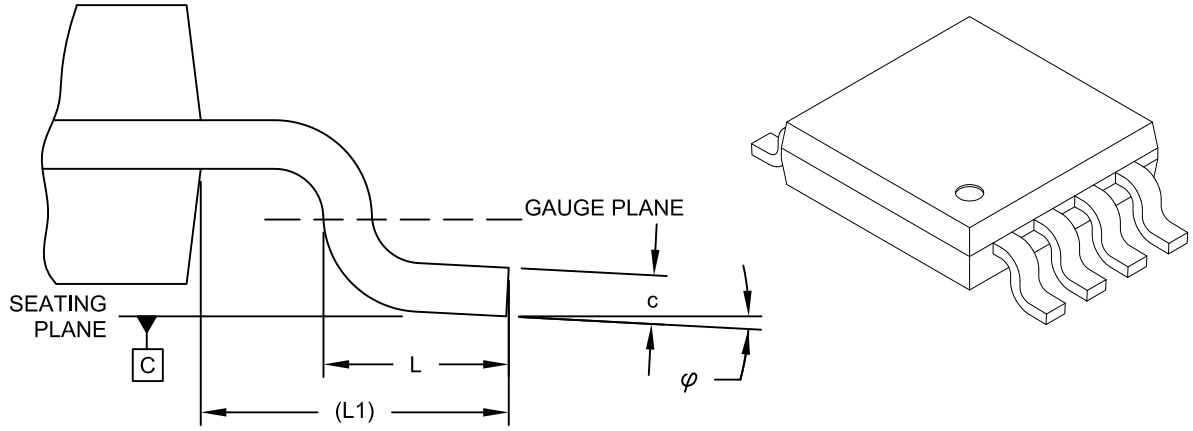
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-111C Sheet 1 of 2

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

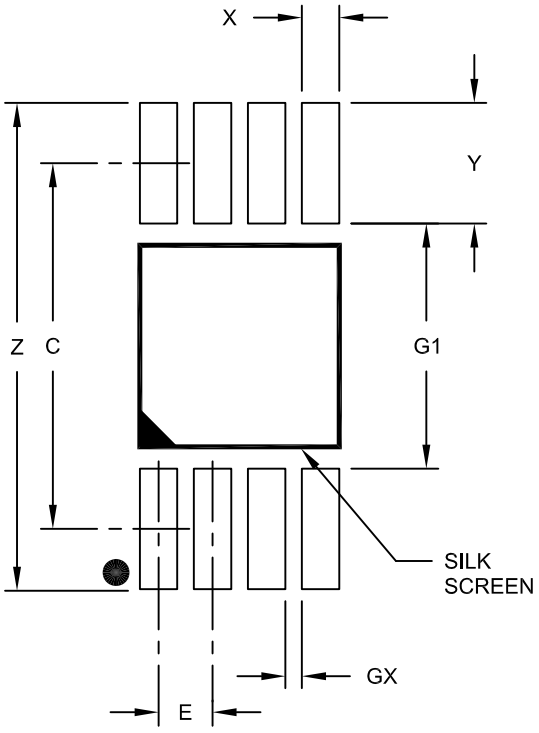
Notes:

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:

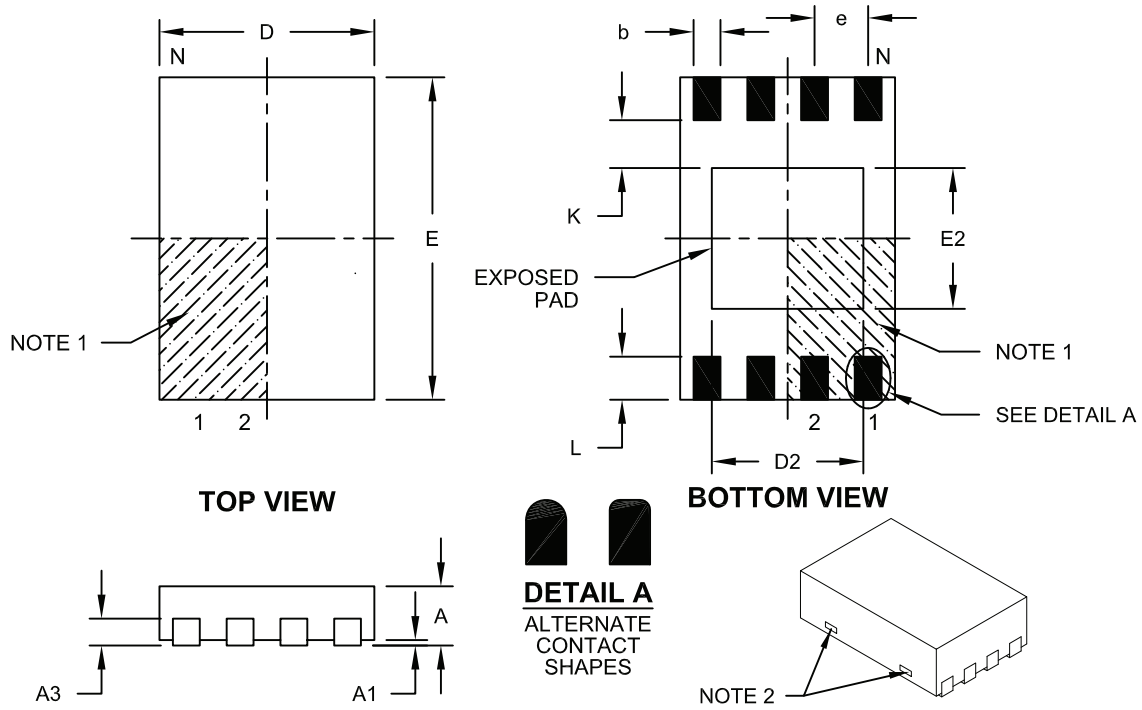
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2111A

8-Lead Plastic Dual Flat, No Lead Package (MU) – 2x3x0.5 mm Body [UDFN]

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	0.45	0.50	0.55
Standoff	A1			0.07
Contact Thickness	A3		0.127 REF	
Overall Length	D	1.95	2.00	2.05
Overall Width	E	2.95	3.00	3.05
Exposed Pad Length	D2	1.30	1.40	1.50
Exposed Pad Width	E2	1.20	1.30	1.40
Contact Width	b	0.20	0.25	0.30
Contact Length	L	0.25	0.30	0.35
Contact-to-Exposed Pad	K		0.55 REF	

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

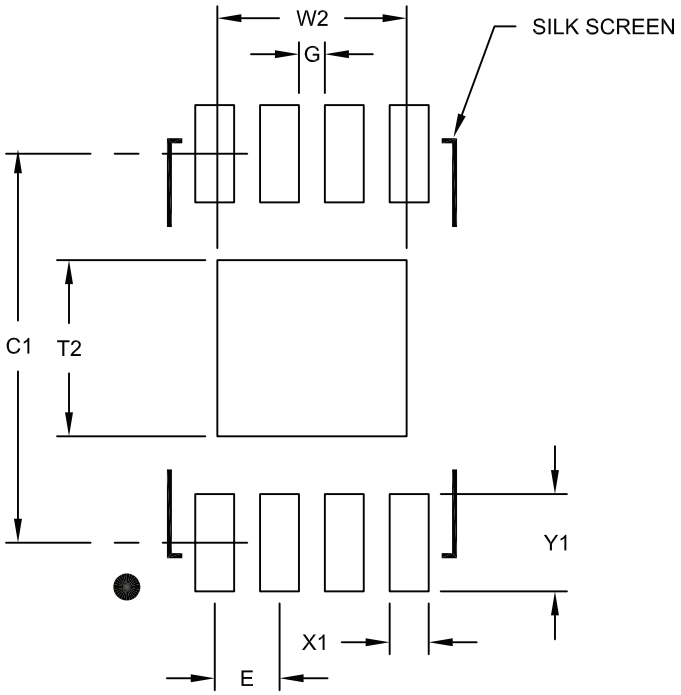
BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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

Microchip Technology Drawing No. C04-136B

8-Lead Plastic Dual Flat, No Lead Package (MU) – 2x3x0.5 mm Body [UDFN]

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. C04-2136A