AT93C46D/AT93C46E

Three-Wire Serial EEPROM 1-Kbit (128 x 8 or 64 x 16)

Features

- Low-Voltage Operation:
  - V_{CC} = 1.8V to 5.5V
- User-Selectable Internally Organized as 128 x 8 (1K) or 64 x 16 (1K)
- Non-Selectable Internal Organization as 64 x 16 (1K), AT93C46E Only
- Industrial Temperature Range: -40°C to +85°C
- Three-Wire Serial Interface
- 2 MHz Clock Rate (5V)
- Self-Timed Write Cycle within 5 ms Maximum
- High Reliability:
  - Endurance: 1,000,000 write cycles
  - Data retention: 100 years
- Green Package Options (Lead-free/Halide-free/RoHS compliant)
- Die Sale Options: Wafer Form and Tape and Reel

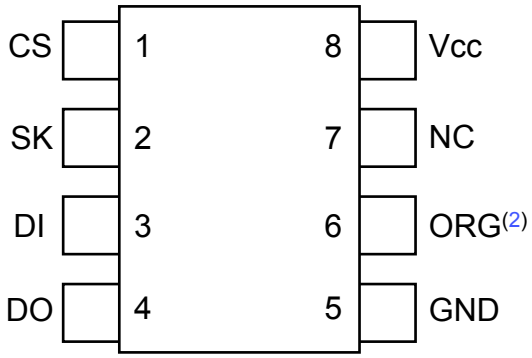
Packages

- 8-Lead PDIP, 8-Lead SOIC, 8-Lead TSSOP, 8-Pad UDFN and 8-Ball VFBGA

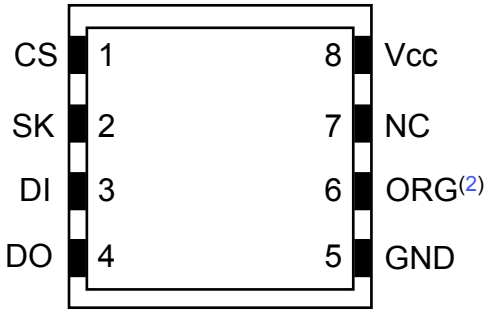
Table of Contents

1. Package Types (not to scale)

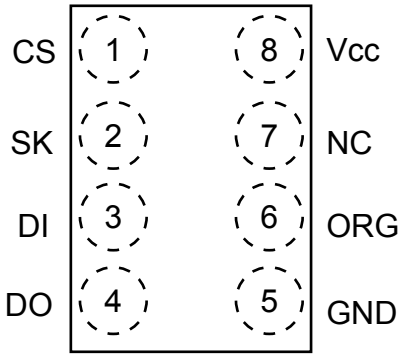
8-lead PDIP/SOIC/TSSOP
(Top View)



8-pad UDFN(1)
(Top View)



8-ball VFBGA(1)
(Top View)



Note:

1. This package is only available on the AT93C46D.
2. ORG pin is No Connect (NC) on the AT93C46E device.

2. Pin Descriptions

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

Table 2-1. Pin Function Table

Name	8-Lead PDIP	8-Lead SOIC	8-Lead TSSOP	8-Pad UDFN(1)	8-Ball VFBGA	Function
CS	1	1	1	1	1	Chip Select
SK	2	2	2	2	2	Serial Data Clock
DI	3	3	3	3	3	Serial Data Input
DO	4	4	4	4	4	Serial Data Output
GND	5	5	5	5	5	Ground
ORG(2)	6	6	6	6	6	Internal Organization
NC	7	7	7	7	7	No Connect
V_{CC}	8	8	8	8	8	Device Power Supply

Note:

1. The exposed pad on this package can be connected to GND or left floating.
2. The Internal Organization (ORG) pin is a No Connect (NC) on the AT93C46E device.

2.1 Chip Select (CS)

The Chip Select (CS) pin is used to control device selection. The AT93C46D/AT93C46E is selected when the CS pin is high. When the device is not selected, data will not be accepted via the Serial Data Input (DI) pin, and the Serial Output (DO) pin will remain in a high-impedance state.

2.2 Serial Data Clock (SK)

The Serial Data Clock (SK) pin is used to synchronize the communication between a master and the AT93C46D/AT93C46E. Instructions, addresses or data present on the Serial Data Input (DI) pin is latched in on the rising edge of SK, while output on the Serial Data Output (DO) pin is also clocked out on the rising edge of SK.

2.3 Serial Data Input (DI)

The Serial Data Input (DI) pin is used to transfer data into the device. It receives instructions, addresses and data. Data is latched on the rising edge of the Serial Data Clock (SK).

2.4 Serial Data Output (DO)

The Serial Data Output (DO) pin is used to transfer data out of the AT93C46D/AT93C46E. During a read sequence, data is shifted out on this pin after the rising edge of the Serial Data Clock (SK).

This pin also outputs the Ready/Busy status of the part if CS is brought high after being low for a minimum of t_{cs} and an erase or write operation has been initiated.

2.5 Ground (GND)

The ground reference for the power supply. The Ground (GND) pin should be connected to the system ground.

2.6 Internal Organization (ORG)

The Internal Organization (ORG) pin is used to select between the x16 or x8 memory organizations of the device. When the ORG pin is tied to V_{CC}, the x16 memory organization is selected. When the ORG pin is tied to GND, the x8 memory organization is selected.

If the ORG pin is left unconnected and the application does not load the input beyond the capability of the internal 1 MΩ pull-up resistor, then the x16 organization is selected.

Note: This pin is a No Connect (NC) on the AT93C46E.

2.7 Device Power Supply (V_{CC})

The Device Power Supply (V_{CC}) pin is used to supply the source voltage to the device. Operations at invalid V_{CC} voltages may produce spurious results and should not be attempted.

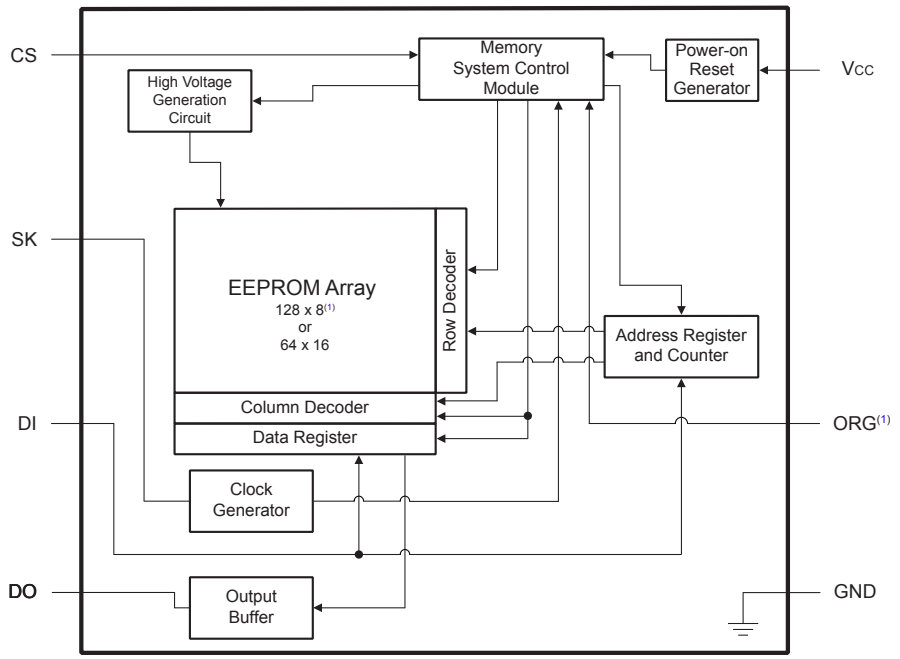
3. Description

The AT93C46D provides 1,024 bits of Serial Electrically Erasable and Programmable Read-Only Memory (EEPROM) organized as 64 words of 16 bits each (when the ORG pin is connected to V_{CC}) and 128 words of 8 bits each (when the ORG pin is tied to ground). The device is optimized for use in many industrial and commercial applications where low-power and low-voltage operations are essential. The AT93C46D is available in space-saving 8-lead PDIP, 8-lead SOIC, 8-lead TSSOP, 8-pad UDFN and 8-ball VFBGA packages. All packages operate from 1.8V to 5.5V.

The AT93C46E provides 1,024 bits of Serial Electrically Erasable and Programmable Read-Only Memory (EEPROM) organized as 64 words of 16 bits each only. The AT93C46E does not offer the ORG pin so organization is not user-selectable on this device. The device is optimized for use in many industrial and commercial applications where low-power and low-voltage operations are essential. The AT93C46E is also available in space-saving and 8-lead PDIP, 8-lead SOIC and 8-lead TSSOP packages. All packages operate from 1.8V to 5.5V.

The AT93C46D/AT93C46E is enabled through the Chip Select (CS) pin and accessed via a three-wire serial interface consisting of Data Input (DI), Data Output (DO), and Serial Data Clock (SK). Upon receiving a `READ` instruction at DI, the address is decoded, and the data is clocked out serially on the DO pin. The write cycle is completely self-timed, and no separate erase cycle is required before write. The write cycle is only enabled when the part is in the Erase/Write Enable state. When CS is brought high following the initiation of a write cycle, the DO pin outputs the Ready/Busy status of the part.

3.1 Block Diagram



Note:

1. The organization of the AT93C46E is not selectable by the ORG pin and defaults to 64x16. If the x16 organization is the mode of choice and pin 6 (ORG) is left unconnected, Microchip recommends using AT93C46E device.

4. Electrical Characteristics

4.1 Absolute Maximum Ratings

Temperature under bias	-55°C to +125°C
Storage temperature	-65°C to +150°C
V_{CC}	6.25V
Voltage on any pin with respect to ground	-1.0V to +7.0V
DC output current	5.0 mA
ESD protection	2 kV

Note: 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 these or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

4.2 DC and AC Operating Range

Table 4-1. DC and AC Operating Range

AT93C46D/AT93C46E		
Operating Temperature (Case)	Industrial Temperature Range	-40°C to +85°C
V_{CC} Power Supply	Low-Voltage Grade	1.8V to 5.5V

4.3 DC Characteristics

Table 4-2. DC Characteristics(1)

Parameter	Symbol	Minimum	Typical	Maximum	Units	Test Conditions
Supply Voltage	V_{CC1}	1.8	—	5.5	V	
Supply Voltage	V_{CC2}	2.7	—	5.5	V	
Supply Voltage	V_{CC3}	4.5	—	5.5	V	
Supply Current	I_{CC1}	—	0.5	2.0	mA	V_{CC} = 5.0V, Read at 1 MHz
Supply Current	I_{CC2}	—	0.5	2.0	mA	V_{CC} = 5.0V, Write at 1 MHz
Standby Current (1.8V Option)	I_{SB1}	—	0.4	1.0	µA	V_{CC} = 1.8V, CS = 0V
Standby Current (2.7V Option)	I_{SB2}	—	6.0	10.0	µA	V_{CC} = 2.7V, CS = 0V
Standby Current (5.0V Option)	I_{SB3}	—	10.0	15.0	µA	V_{CC} = 5.0V, CS = 0V
Input Leakage Current	I_{IL}	—	0.1	1.0	µA	V_{IN} = 0 to V_{CC}
Output Leakage Current	I_{LO}	—	0.1	1.0	µA	V_{IN} = 0 to V_{CC}

.....continued

Parameter	Symbol	Minimum	Typical	Maximum	Units	Test Conditions
Input Low-Voltage	V_{IL1}	-0.6	—	0.8	V	2.7V ≤ V_{CC} ≤ 5.5V (Note 2)
Input High-Voltage	V_{IH1}	2.0	—	V_{CC} + 1	V	2.7V ≤ V_{CC} ≤ 5.5V (Note 2)
Input Low-Voltage	V_{IL2}	-0.6	—	V_{CC} x 0.3	V	1.8V ≤ V_{CC} ≤ 2.7V (Note 2)
Input High-Voltage	V_{IH2}	V_{CC} x 0.7	—	V_{CC} + 1	V	1.8V ≤ V_{CC} ≤ 2.7V (Note 2)
Output Low-Voltage	V_{OL1}	—	—	0.4	V	2.7V ≤ V_{CC} ≤ 5.5V, I_{OL} = 2.1 mA
Output High-Voltage	V_{OH1}	2.4	—	—	V	2.7V ≤ V_{CC} ≤ 5.5V, I_{OH} = -0.4 mA
Output Low-Voltage	V_{OL2}	—	—	0.2	V	1.8V ≤ V_{CC} ≤ 2.7V, I_{OL} = 0.15 mA
Output High-Voltage	V_{OH2}	V_{CC} - 0.2	—	—	V	1.8V ≤ V_{CC} ≤ 2.7V, I_{OH} = -100 µA

Note:

1. Applicable over recommended operating range from: T_A = -40°C to +85°C, V_{CC} = 1.8V to 5.5V (unless otherwise noted).
2. V_{IL} min and V_{IH} max are reference only and are not tested.

4.4 AC Characteristics

Table 4-3. AC Characteristics(1)

Parameter	Symbol	Minimum	Typical	Maximum	Units	Test Conditions
Clock Frequency, SK	f_{SK}	0	—	2	MHz	4.5V ≤ V_{CC} ≤ 5.5V
		0	—	1	MHz	2.7V ≤ V_{CC} ≤ 5.5V
		0	—	250	kHz	1.8V ≤ V_{CC} ≤ 5.5V
High Time, SK	t_{SKH}	250	—	—	ns	2.7V ≤ V_{CC} ≤ 5.5V
		1000	—	—	ns	1.8V ≤ V_{CC} ≤ 5.5V
Low Time, SK	t_{SKL}	250	—	—	ns	2.7V ≤ V_{CC} ≤ 5.5V
		1000	—	—	ns	1.8V ≤ V_{CC} ≤ 5.5V
Minimum CS Low Time	t_{CS}	250	—	—	ns	2.7V ≤ V_{CC} ≤ 5.5V
		1000	—	—	ns	1.8V ≤ V_{CC} ≤ 5.5V
CS Setup Time	t_{CSS}	50	—	—	ns	2.7V ≤ V_{CC} ≤ 5.5V, Relative to SK
		200	—	—	ns	1.8V ≤ V_{CC} ≤ 5.5V, Relative to SK
DI Setup Time	t_{DIS}	100	—	—	ns	2.7V ≤ V_{CC} ≤ 5.5V, Relative to SK
		400	—	—	ns	1.8V ≤ V_{CC} ≤ 5.5V, Relative to SK
CS Hold Time	t_{CSH}	0	—	—	ns	Relative to SK

.....continued

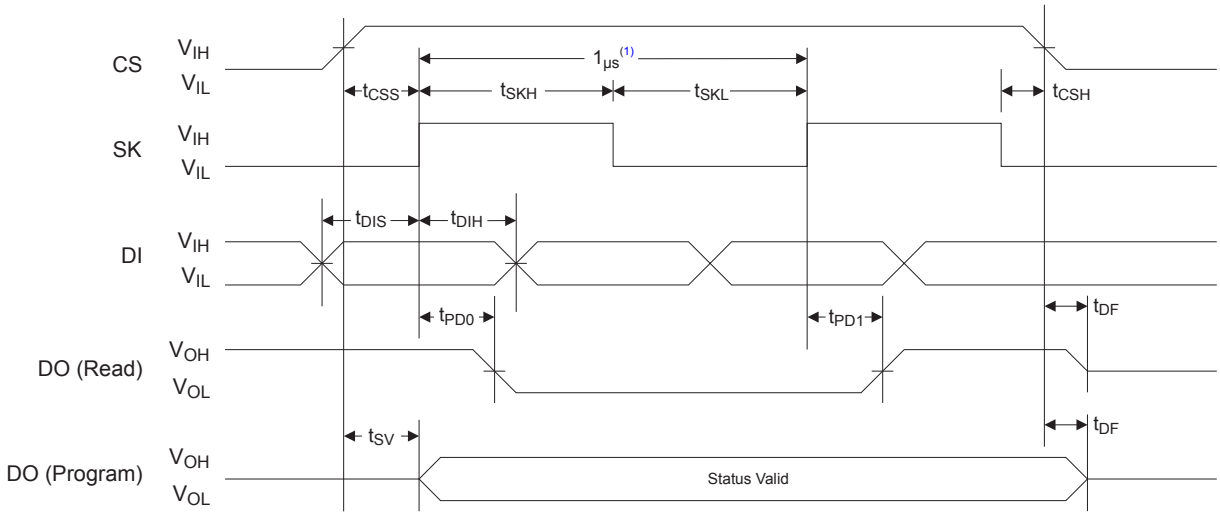
Parameter	Symbol	Minimum	Typical	Maximum	Units	Test Conditions
DI Hold Time	t_{DIH}	100	—	—	ns	2.7V ≤ V_{CC} ≤ 5.5V, Relative to SK
		400	—	—	ns	1.8V ≤ V_{CC} ≤ 5.5V, Relative to SK
Output Delay to 1	t_{PD1}	—	—	250	ns	2.7V ≤ V_{CC} ≤ 5.5V
		—	—	1000	ns	1.8V ≤ V_{CC} ≤ 5.5V
Output Delay to 0	t_{PD0}	—	—	250	ns	2.7V ≤ V_{CC} ≤ 5.5V
		—	—	1000	ns	1.8V ≤ V_{CC} ≤ 5.5V
CS to Status Valid	t_{SV}	—	—	250	ns	2.7V ≤ V_{CC} ≤ 5.5V
		—	—	1000	ns	1.8V ≤ V_{CC} ≤ 5.5V
CS to DO in High-Impedance	t_{DF}	—	—	100	ns	4.5V ≤ V_{CC} ≤ 5.5V, CS = V_{IL}
		—	—	150	ns	2.7V ≤ V_{CC} ≤ 5.5V, CS = V_{IL}, AT93C46E
		—	—	250	ns	2.7V ≤ V_{CC} ≤ 5.5V, CS = V_{IL}, AT93C46D
		—	—	400	ns	1.8V ≤ V_{CC} ≤ 5.5V, CS = V_{IL}
Write Cycle Time	t_{WP}	0.1	3	5	ms	1.8V ≤ V_{CC} ≤ 5.5V

Note:

1. Applicable over recommended operating range from T_A = -40°C to +85°C, V_{CC} = as specified, C_L = 1 TTL Gate and 100 pF (unless otherwise noted).

4.5 Synchronous Data Timing

Figure 4-1. Synchronous Data Timing



Note:

1. This is the minimum SK period.

4.6 Electrical Specifications

4.6.1 Power-Up Requirements and Reset Behavior

During a power-up sequence, the V_{CC} supplied to the AT93C46D/AT93C46E should monotonically rise from GND to the minimum V_{CC} level, as specified in Table 4-1, with a slew rate no faster than 0.1 V/µs.

4.6.1.1 Device Reset

To prevent inadvertent write operations or any other spurious events from occurring during a power-up sequence, the AT93C46D/AT93C46E includes a Power-on Reset (POR) circuit. Upon power-up, the device will not respond to any commands until the V_{CC} level crosses the internal voltage threshold (V_{POR}) that brings the device out of Reset and into Standby mode.

The system designer must ensure the instructions are not sent to the device until the V_{CC} supply has reached a stable value greater than or equal to the minimum V_{CC} level. Additionally, once the V_{CC} is greater than or equal to the minimum V_{CC} level, the bus master must wait at least t_{PUP} before sending the first command to the device. See Table 4-4 for the values associated with these power-up parameters.

Table 4-4. Power-up Conditions(1)

Symbol	Parameter	Min.	Max.	Units
t_{PUP}	Time required after V_{CC} is stable before the device can accept commands	100	—	µs
V_{POR}	Power-on Reset Threshold Voltage	—	1.5	V
t_{POFF}	Minimum time at V_{CC} = 0V between power cycles	500	—	ms

Note:

1. These parameters are characterized but they are not 100% tested in production.

If an event occurs in the system where the V_{CC} level supplied to the AT93C46D/AT93C46E drops below the maximum V_{POR} level specified, it is recommended that a full power cycle sequence be performed by first driving the V_{CC} pin to GND, waiting at least the minimum t_{POFF} time and then performing a new power-up sequence in compliance with the requirements defined in this section.

4.6.2 Pin Capacitance

Table 4-5. Pin Capacitance(1)

Symbol	Test Condition	Max.	Units	Conditions
C_{OUT}	Output Capacitance (DO)	5	pF	V_{OUT} = 0V
C_{IN}	Input Capacitance (CS, SK, DI, ORG)	5	pF	V_{IN} = 0V

Note:

1. This parameter is characterized but is not 100% tested in production.

4.6.3 EEPROM Cell Performance Characteristics

Table 4-6. EEPROM Cell Performance Characteristics

Operation	Test Condition	Min.	Max.	Units
Write Endurance(1)	T_A = 25°C, V_{CC} = 5.0V	1,000,000	—	Write Cycles
Data Retention(1)	T_A = 55°C	100	—	Years

Note:

1. Performance is determined through characterization and the qualification process.

5. Device Commands and Addressing

The AT93C46D/AT93C46E is accessed via a simple and versatile three-wire serial communication interface. Device operation is controlled by seven instructions issued by the Host processor. A valid instruction starts with a rising edge of CS and consists of a Start bit (SB), followed by the appropriate opcode, and the desired memory address location.

Table 5-1. AT93C46D/AT93C46E Instruction Set

Instruction	SB	Opcode	Address		Data		Comments
			X8(1)	X16(1)	X8	X16	
READ	1	10	A_6-A_0	A_5-A_0			Reads data stored in memory at specified address.
EWEN	1	00	11XXXXX	11XXXX			Write Enable must precede all programming modes.
ERASE	1	11	A_6-A_0	A_5-A_0			Erases memory location A_N-A_0.
WRITE	1	01	A_6-A_0	A_5-A_0	D_7-D_0	D_{15}-D_0	Writes memory location A_N-A_0.
ERAL	1	00	10XXXXX	10XXXX			Erases all memory locations. Valid only at V_{CC3}. See Table 4-2.
WRAL	1	00	01XXXXX	01XXXX	D_7-D_0	D_{15}-D_0	Writes all memory locations. Valid only at V_{CC3}. See Table 4-2.
EWDS	1	00	00XXXXX	00XXXX			Disables all programming instructions.

Note:

1. The 'X' in the address field represent a "don't care" bit, and must be sent to the device.

Table 5-2. Organization Key for Timing Diagrams

I/O	AT93C46D/AT93C46E (1K)	
	x8(1)	x16
A_N	A_6	A_5
D_N	D_7	D_{15}

Note:

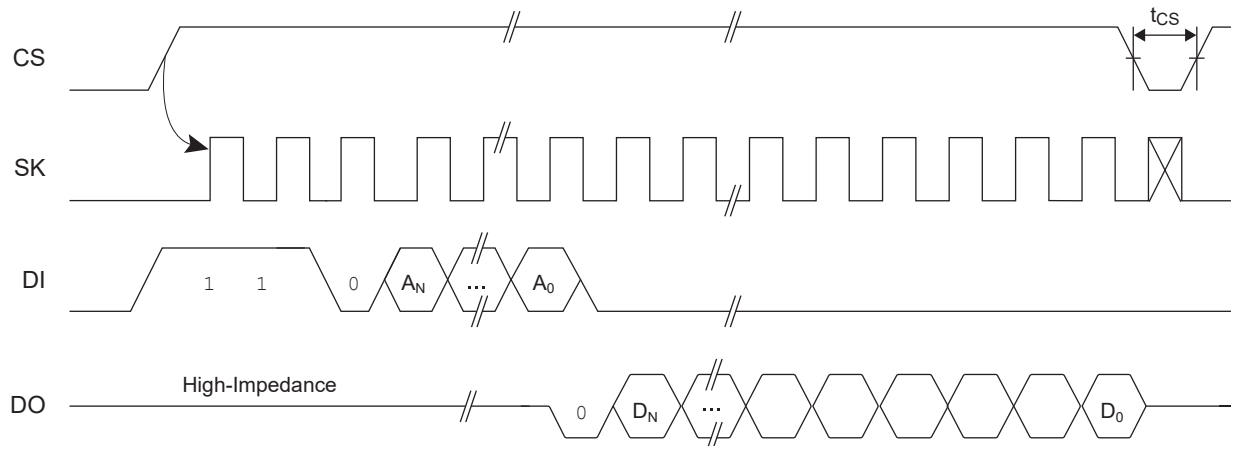
1. The internal organization of the AT93C46E is x16 only.

5.1 Read Operation (READ)

The READ instruction contains the address code for the memory location to be read. After the instruction and address are decoded, data from the selected memory location is available at the DO pin. Output data changes are synchronized with the rising edges of the SK pin.

Note: A dummy bit (logic '0') precedes the 8-bit or 16-bit data output string.

Figure 5-1. READ Timing

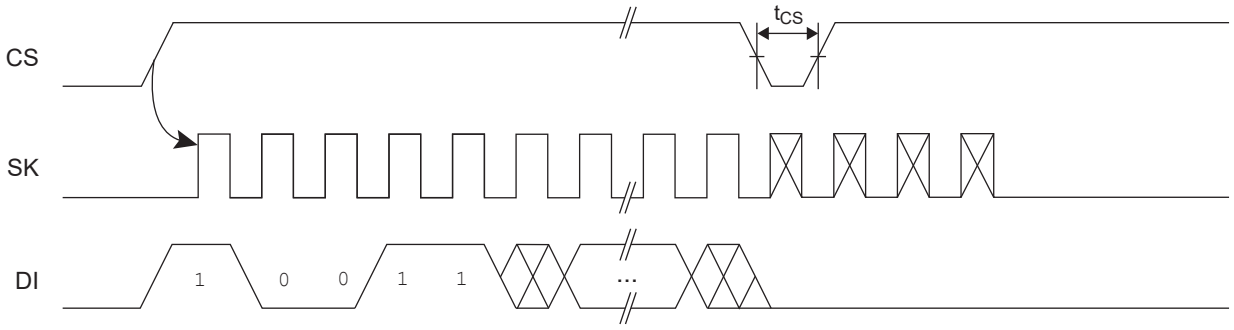


5.2 Erase/Write Enable (EWEN)

To ensure data integrity, the part automatically goes into the Erase/Write Disable (EWDS) state when power is first applied. An Erase/Write Enable (EWEN) instruction must be executed first before any programming instructions can be carried out.

Note: Once in the write enabled state, programming remains enabled until an EWDS instruction is executed, or V_{CC} power is removed from the part.

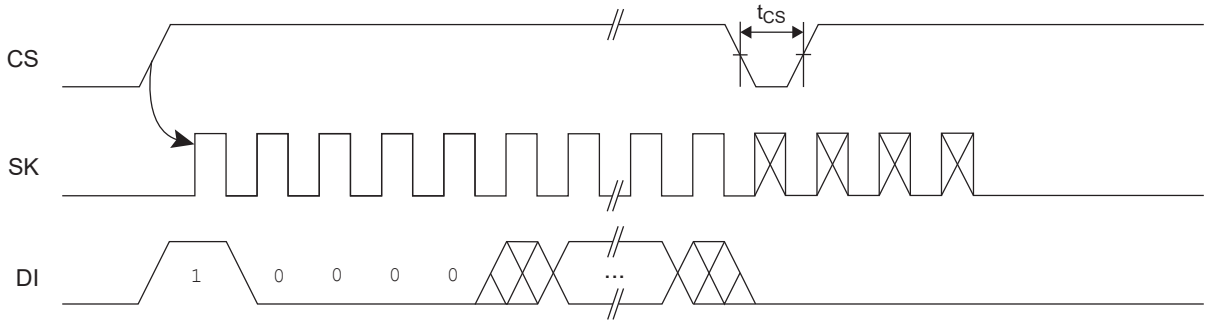
Figure 5-2. EWEN Timing



5.3 Erase/Write Disable (EWDS)

To protect against accidental data disturbance, the Erase/Write Disable (EWDS) instruction disables all programming modes and should be executed after all programming operations. The operation of the READ instruction is independent of both the EWEN and EWDS instructions and can be executed at any time.

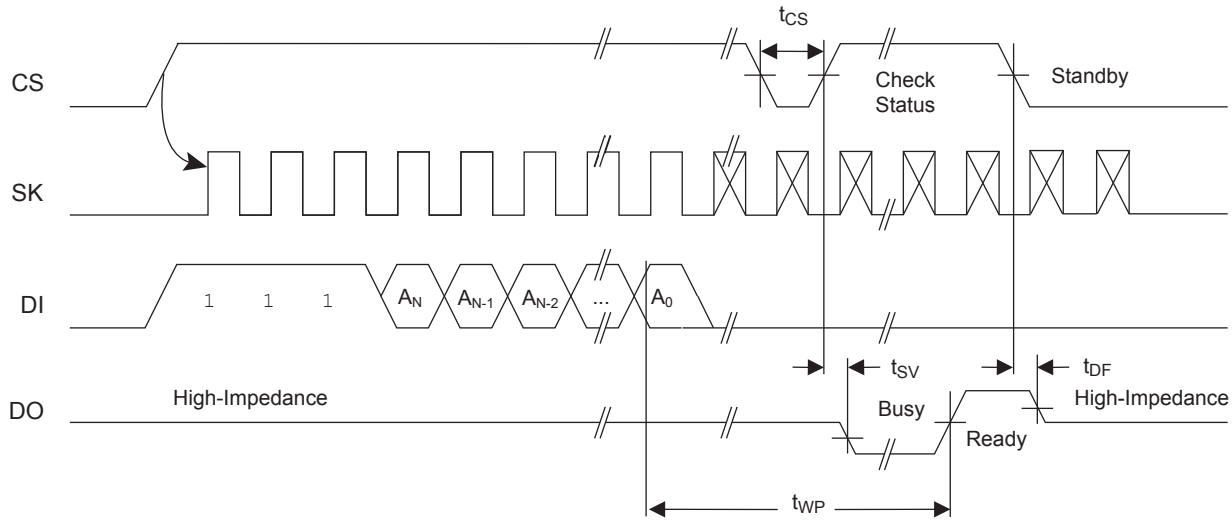
Figure 5-3. EWDS Timing



5.4 Erase Operation (ERASE)

The ERASE instruction programs all bits in the specified memory location to the logic '1' state. The self-timed erase cycle starts once the ERASE instruction and address are decoded. The DO pin outputs the Ready/Busy status of the part if CS is brought high after being kept low for a minimum of t_{CS}. A logic '1' at the DO pin indicates that the selected memory location has been erased, and the part is ready for another instruction.

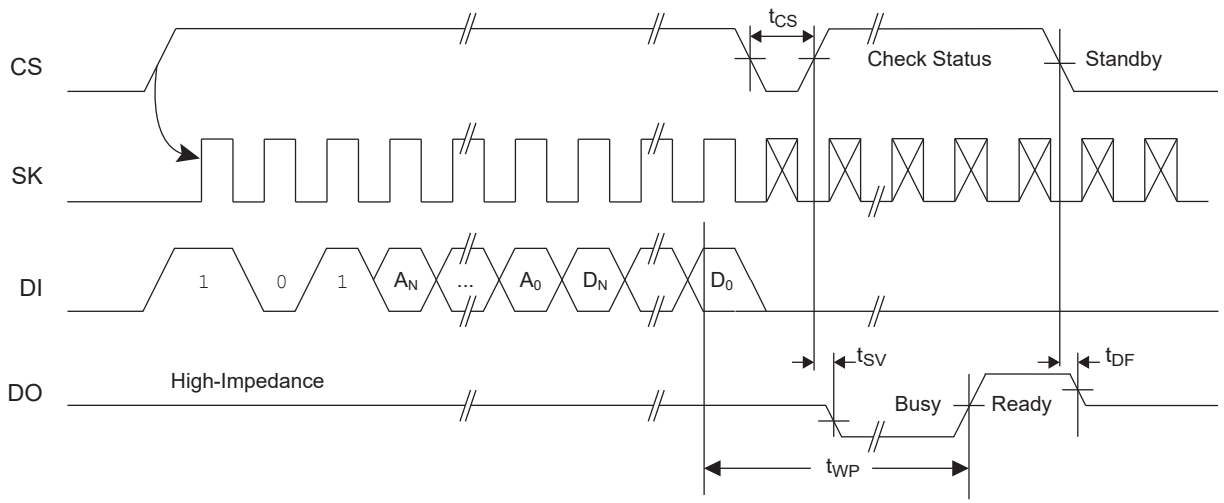
Figure 5-4. ERASE Timing



5.5 Write Operation (WRITE)

The WRITE instruction contains the 8 bits or 16 bits of data to be written into the specified memory location. The self-timed programming cycle, t_{WP}, starts after the last bit of data is received at DI pin. The DO pin outputs the Ready/Busy status of the part if CS is brought high after being kept low for a minimum of t_{CS}. A logic '0' at DO indicates that programming is still in progress. A logic '1' indicates that the memory location at the specified address has been written with the data pattern contained in the instruction, and the part is ready for further instructions. A Ready/Busy status cannot be obtained if CS is brought high after the end of the self-timed programming cycle, t_{WP}.

Figure 5-5. WRITE Timing

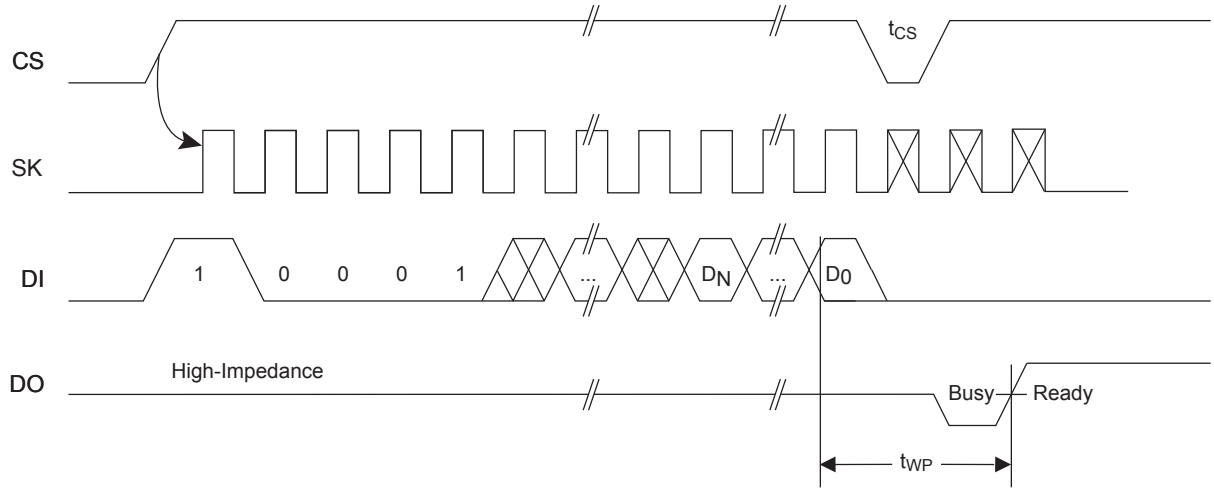


5.6 Write All (WRAL)

The Write All (WRAL) instruction programs all memory locations with the data patterns specified in the instruction. The DO pin outputs the Ready/Busy status of the part if CS is brought high after being kept low for a minimum of t_{CS}.

Note: The WRAL instruction is valid only at V_{CC3} (see Table 4-2).

Figure 5-6. WRAL Timing

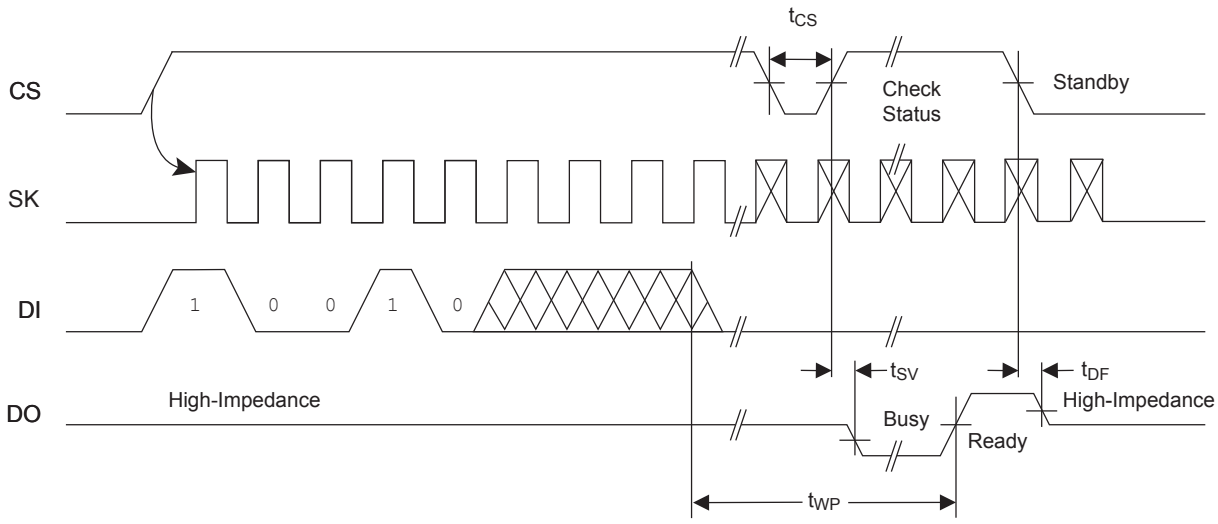


5.7 Erase All (ERAL)

The Erase All (ERAL) instruction programs every bit in the memory array to the logic '1' state and is primarily used for testing purposes. The DO pin outputs the Ready/Busy status of the part if CS is brought high after being kept low for a minimum of t_{CS}.

Note: The ERAL instruction is valid only at V_{CC3} (see Table 4-2).

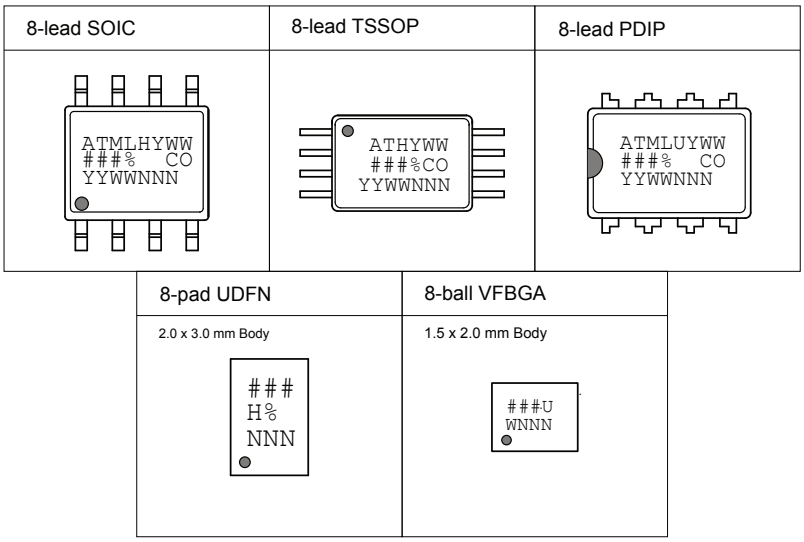
Figure 5-7. ERAL Timing



6. Packaging Information

6.1 Package Marking Information

AT93C46D and AT93C46E: Package Marking Information



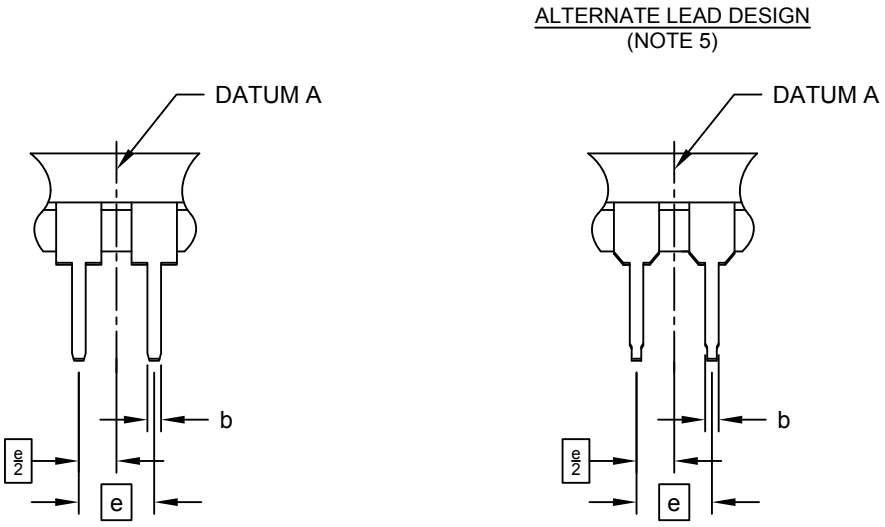
Note 1: ● designates pin 1

Note 2: Package drawings are not to scale

Catalog Number Truncation					
AT93C46D		Truncation Code ###: 46D			
AT93C46E		Truncation Code ###: 46E			
Date Codes					**Voltages**
YY = Year		Y = Year		WW = Work Week of Assembly	% = Minimum Voltage
16: 2016	20: 2020	6: 2016	0: 2020	02: Week 2	L: 1.8V min
17: 2017	21: 2021	7: 2017	1: 2021	04: Week 4	
18: 2018	22: 2022	8: 2018	2: 2022	...	
19: 2019	23: 2023	9: 2019	3: 2023	52: Week 52	
Country of Origin		**Device Grade**			**Atmel Truncation**
CO = Country of Origin		H or U: Industrial Grade			AT: Atmel ATM: Atmel ATML: Atmel
Lot Number or Trace Code					
NNN = Alphanumeric Trace Code (2 Characters for Small Packages)					

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

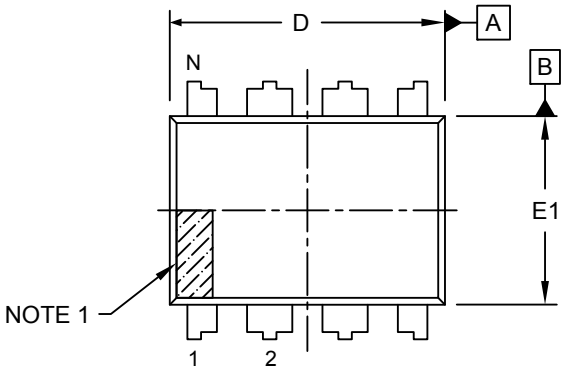
Notes:

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.

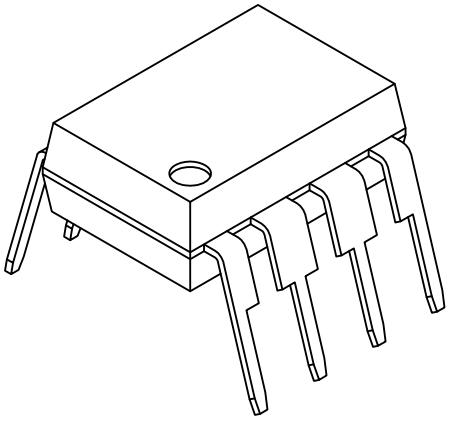
Microchip Technology Drawing No. C04-018-P Rev E Sheet 2 of 2

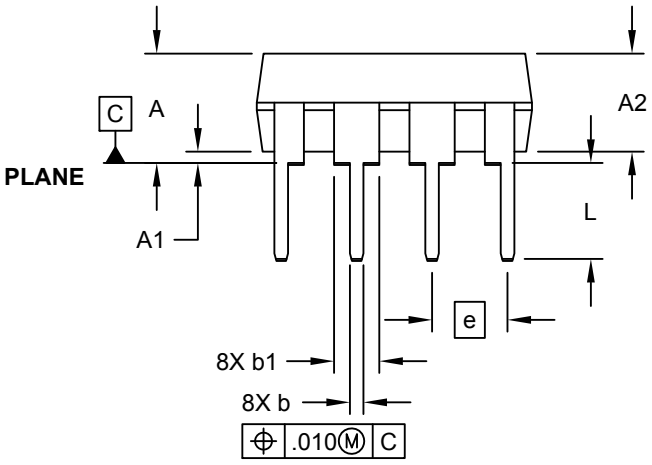
8-Lead Plastic Dual In-Line (P) - 300 mil Body [PDIP]

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

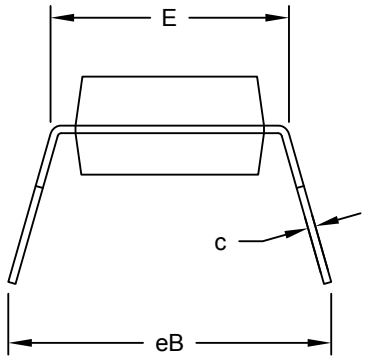


TOP VIEW





SIDE VIEW

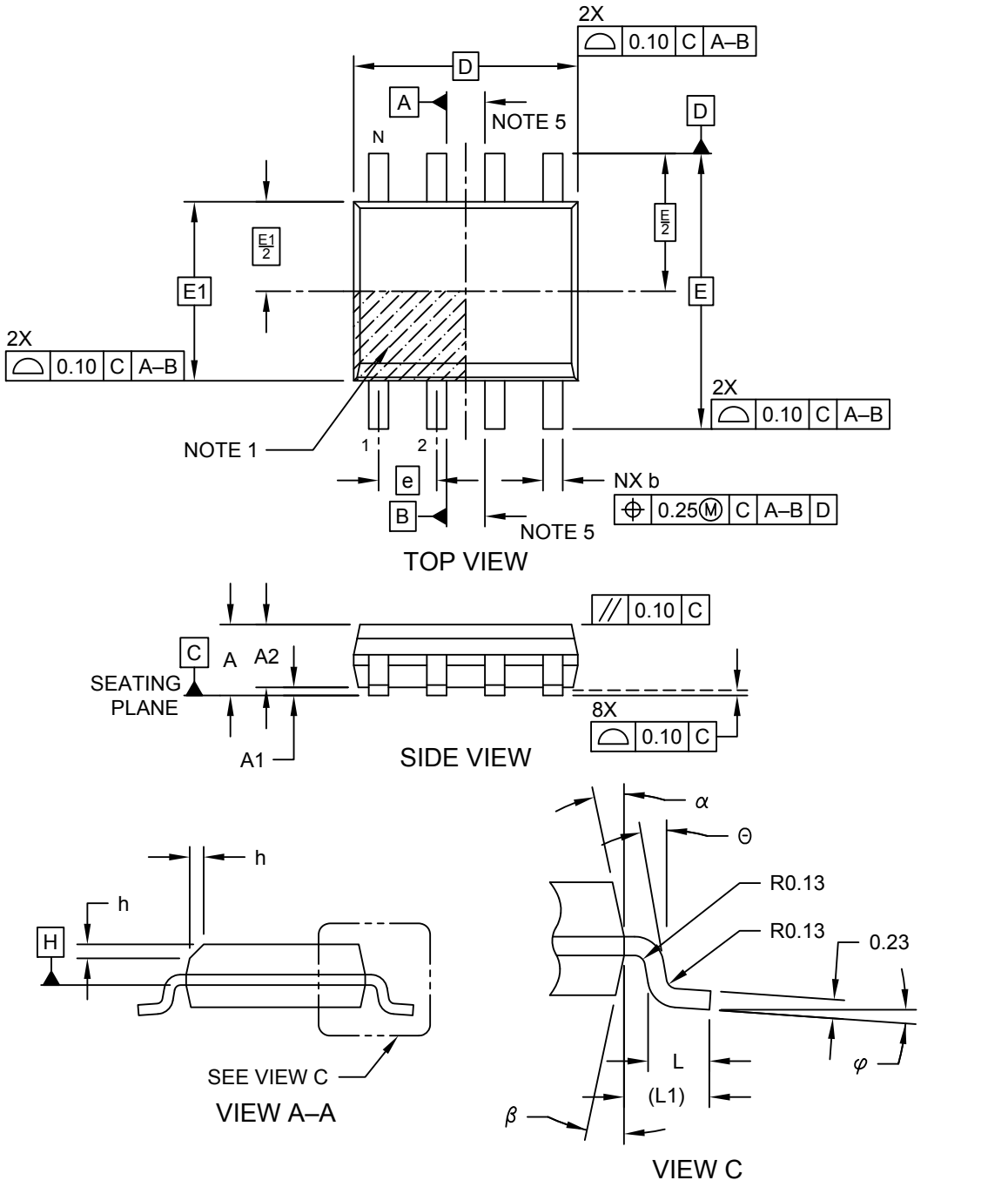


END VIEW

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

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

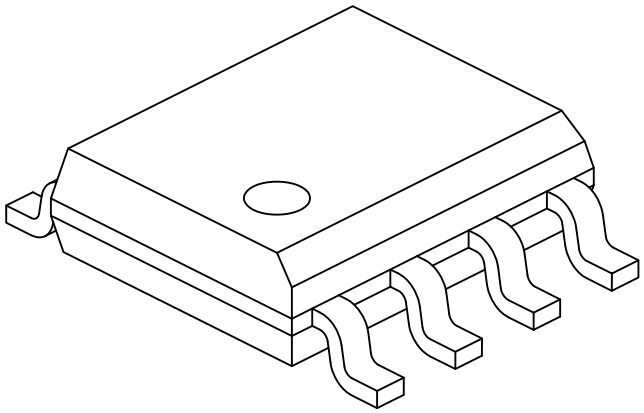
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing No. C04-057-SN Rev F 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	
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

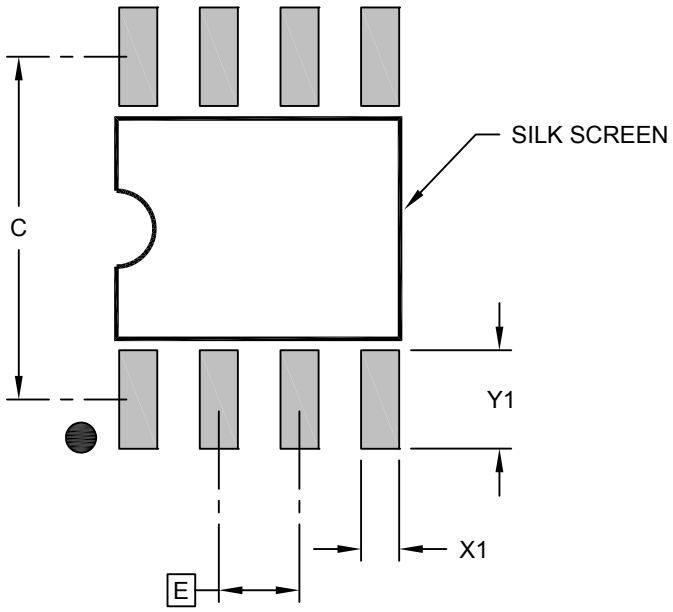
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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

Microchip Technology Drawing No. C04-057-SN 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



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:

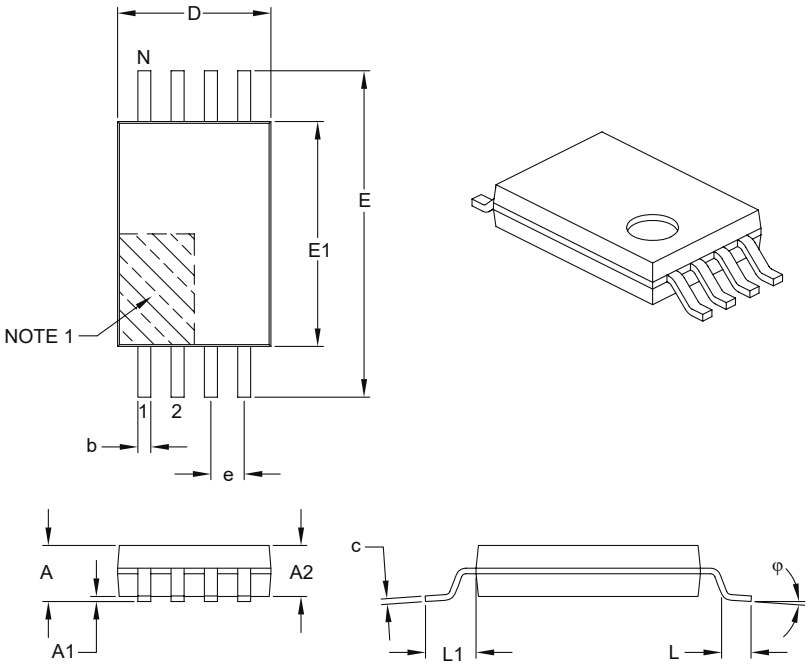
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing C04-2057-SN Rev F

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:

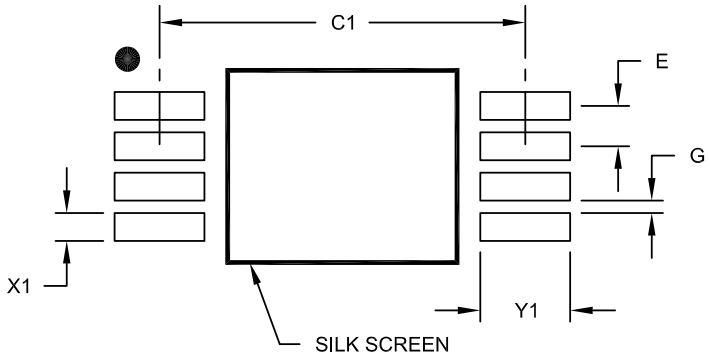
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
3. Dimensioning and tolerancing per ASME Y14.5M.

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:

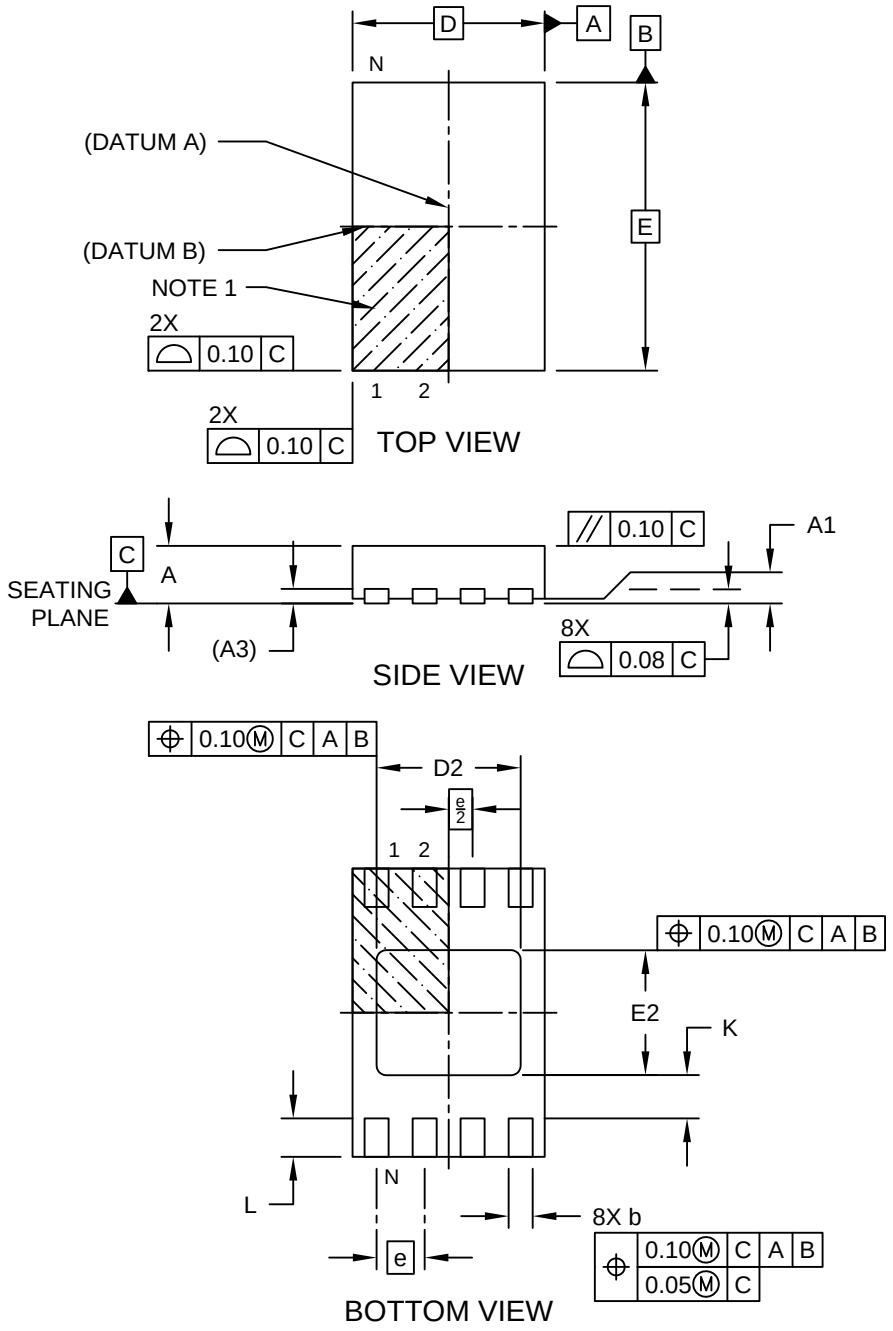
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2086A

8-Lead Ultra Thin Plastic Dual Flat, No Lead Package (Q4B) - 2x3 mm Body [UDFN]
Atmel Legacy YNZ Package

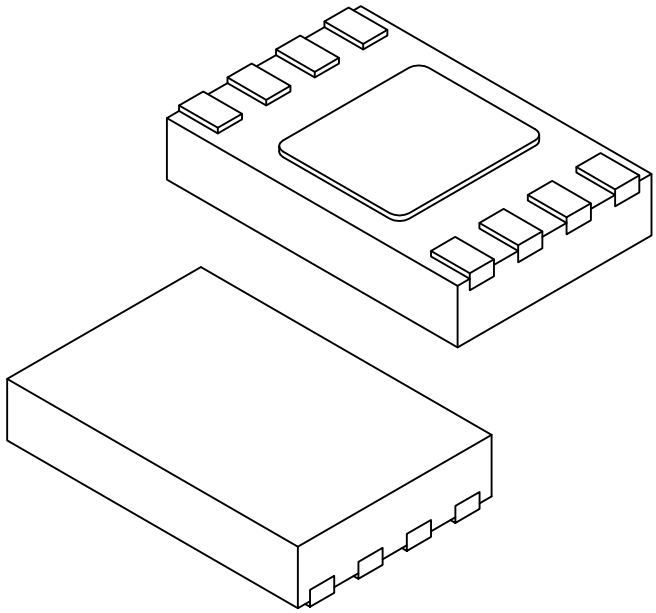
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-21355-Q4B Rev A Sheet 1 of 2

8-Lead Ultra Thin Plastic Dual Flat, No Lead Package (Q4B) - 2x3 mm Body [UDFN] Atmel Legacy YNZ Package

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		0.50 BSC	
Overall Height	A	0.50	0.55	0.60
Standoff	A1	0.00	0.02	0.05
Terminal Thickness	A3		0.152 REF	
Overall Length	D		2.00 BSC	
Exposed Pad Length	D2	1.40	1.50	1.60
Overall Width	E		3.00 BSC	
Exposed Pad Width	E2	1.20	1.30	1.40
Terminal Width	b	0.18	0.25	0.30
Terminal Length	L	0.35	0.40	0.45
Terminal-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 is saw singulated
3. Dimensioning and tolerancing per ASME Y14.5M

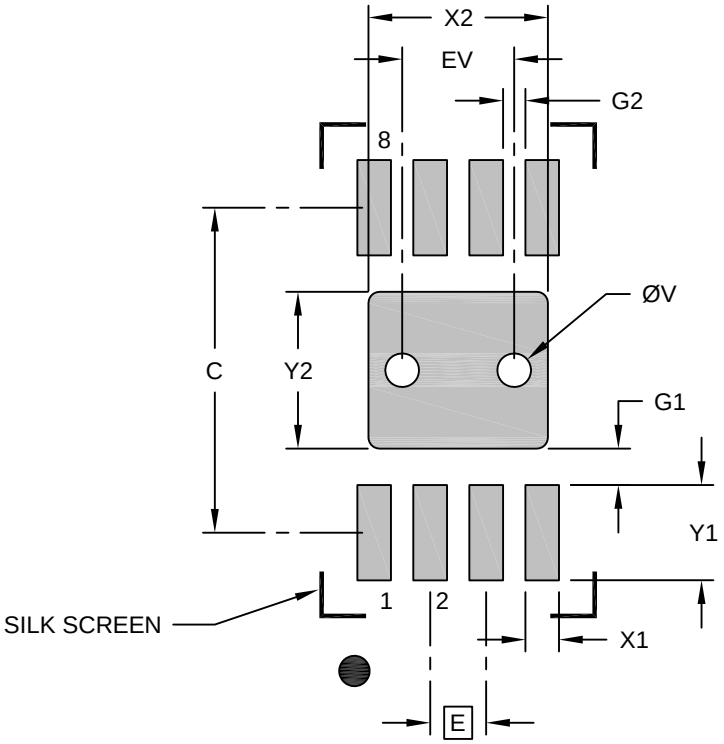
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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

Microchip Technology Drawing C04-21355-Q4B Rev A Sheet 2 of 2

8-Lead Ultra Thin Plastic Dual Flat, No Lead Package (Q4B) - 2x3 mm Body [UDFN]
Atmel Legacy YNZ Package

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			1.40
Contact Pad Spacing	C		2.90	
Contact Pad Width (X8)	X1			0.30
Contact Pad Length (X8)	Y1			0.85
Contact Pad to Center Pad (X8)	G1	0.20		
Contact Pad to Contact Pad (X6)	G2	0.33		
Thermal Via Diameter	V		0.30	
Thermal Via Pitch	EV		1.00	

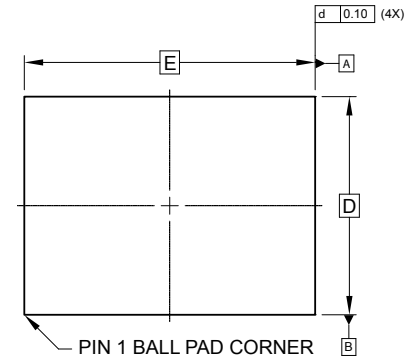
Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

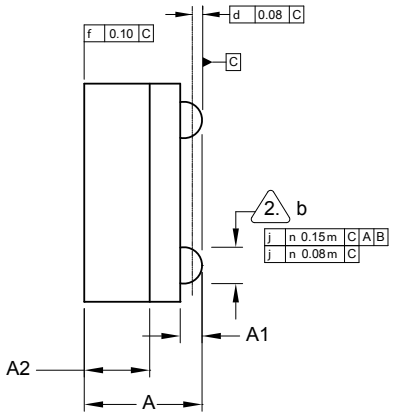
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

2. For best soldering results, thermal vias, if used, should be filled or tented to avoid solder loss during reflow process

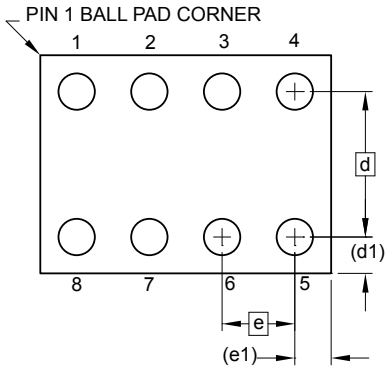
Microchip Technology Drawing C04-21355-Q4B Rev A



TOP VIEW



SIDE VIEW



BOTTOM VIEW
8 SOLDER BALLS

Notes:

1. This drawing is for general information only.
2. Dimension ‘b’ is measured at maximum solder ball diameter.
3. Solder ball composition shall be 95.5Sn-4.0Ag-.5Cu.

COMMON DIMENSIONS
(Unit of Measure - mm)

SYMBOL	MIN	NOM	MAX	NOTE
A	0.73	0.79	0.85	
A1	0.09	0.14	0.19	
A2	0.40	0.45	0.50	
b	0.20	0.25	0.30	2
D	1.50 BSC			
E	2.0 BSC			
e	0.50 BSC			
e1	0.25 REF			
d	1.00 BSC			
d1	0.25 REF			

7/1/14

	TITLE	GPC	DRAWING NO.	REV.
	8U3-1, 8-ball, 1.50mm x 2.00mm body, 0.50mm pitch, Very Thin, Fine-Pitch Ball Grid Array Package (VFBGA)	GXU	8U3-1	G

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

7. Revision History

Revision B (February 2020)
Updated section content throughout for clarification. Updated test conditions values. Updated SOIC (SN) package drawing.

Revision A (July 2019)
Updated to the Microchip template. Microchip DS20006224 replaces Atmel documents 5193 and 5207. Updated Package Marking Information. Removed lead finish designation. Updated trace code format in package markings. Updated section content throughout for clarification. Updated the 8U3-1 VFBGA package drawing. Updated the PDIP, SOIC, TSSOP and UDFN package drawings to Microchip format.

Atmel AT93C46E 5207 Revision F (January 2015)
Updated ordering information section.

Atmel AT93C46D 5193 Revision H (January 2015)
Added the UDFN expanded quantity option and the ordering information section. Updated the 8MA2 and 8P3 package drawings.

Atmel AT93C46E 5207 Revision E (October 2014)
Added the part markings and ordering code detail. Updated the package outline drawings and the 8A2 to 8X. Updated the template, Atmel logos, and the disclaimer page.

Atmel AT93C46D 5193 Revision G (August 2014)
Updated package drawings, template, logos, and disclaimer page.

Atmel AT93C46E 5207 Revision D (January 2008)
Removed the ‘preliminary’ status.

Atmel AT93C46D 5193 Revision F (January 2008)
Removed the ‘preliminary’ status.

Atmel AT93C46E 5207 Revision C (November 2007)
Modified the ‘max’ value in AC Characteristics table.

Atmel AT93C46D 5193 Revision E (November 2007)
Modified the ‘max’ value in AC Characteristics table.

Atmel AT93C46E 5207 Revision B (August 2007)
Modified Part Marking Schemes.

Atmel AT93C46D 5193 Revision D (August 2007)
Moved Pinout figure. Added new feature for Die Sales. Modified Ordering Information table layout. Modified Park Marking Schemes.

Atmel AT93C46D 5193 Revision C (June 2007)
Updated to new template. Added Product Markup Scheme. Added Technical email contact. Corrected Figures 4 and 5.

Atmel AT93C46D 5193 Revision B (February 2007)
Added ‘Ultra Thin’ description to 8-lead Mini-MAP package.

Atmel AT93C46E 5207 Revision A (January 2007)
Initial document release.

Atmel AT93C46D 5193 Revision A (January 2007)
Initial document release.

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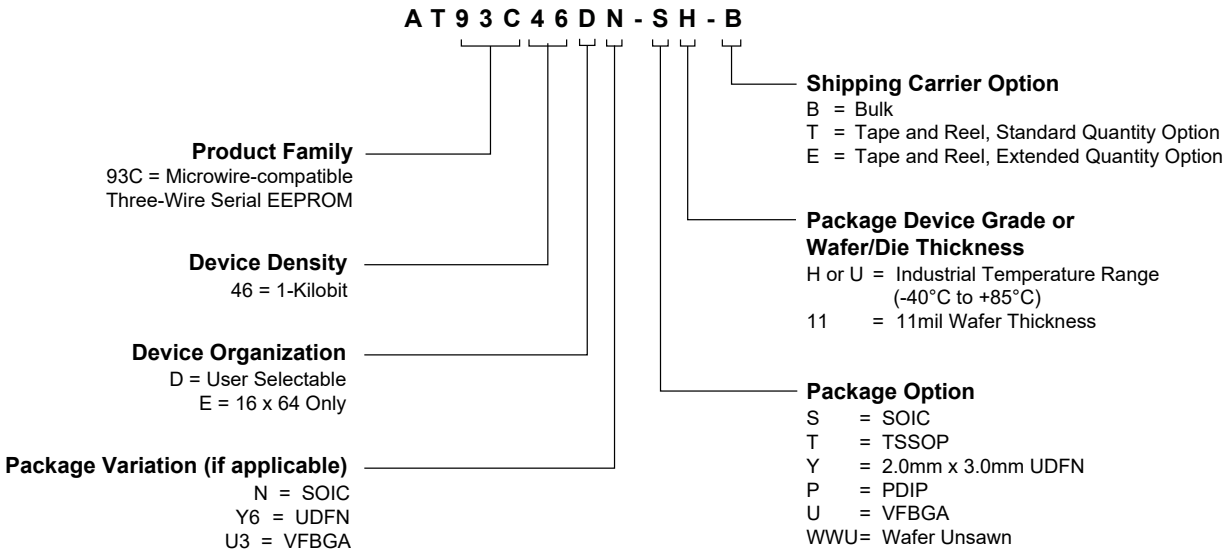

Note: Refer to the automotive data sheet for automotive grade ordering information.

Examples

Device	Package	Package Drawing Code	Package Option	Organization	Shipping Carrier Option	Device Grade
AT93C46DN-SH-B	SOIC	SN	S	User Selectable	Bulk (Tubes)	Industrial Temperature (-40°C to 85°C)
AT93C46EN-SH-T	SOIC	SN	S	16 X 64	Tape and Reel	
AT93C46E-TH-B	TSSOP	ST	T	16 X 64	Bulk (Tubes)	
AT93C46D-TH-T	TSSOP	ST	T	User Selectable	Tape and Reel	
AT93C46DY6-YH-T	UDFN	Q4B	Y	User Selectable	Tape and Reel	
AT93C46DY6-YH-E	UDFN	Q4B	Y	User Selectable	Extended Qty., Tape and Reel	
AT93C46E-PU	PDIP	P	P	16 X 64	Bulk (Tubes)	
AT93C46DU3-UU-T	VFBGA	8U3-1	U	User Selectable	Tape and Reel	

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