11AA02E48

2K UNI/O® Serial EEPROM with EUI-48™ Node Identity

DEVICE SELECTION TABLE

Part Number	Density (bits)	Organization	VCC Range	Page Size (Bytes)	Temp. Ranges	Packages
11AA02E48	2K	256 x 8	1.8-5.5V	16	I	SN, TT

Features:

- Pre-programmed Globally Unique, 48-bit Node Address
- Compatible with EUI-48™ and EUI-64™
- Single I/O, UNI/O® Serial Interface Bus
- Low-Power CMOS Technology
  - 1 mA active current, typical
  - 1 µA standby current (max.)
- 256 x 8 Bit Organization
- Schmitt Trigger Inputs for Noise Suppression
- Output Slope Control to Eliminate Ground Bounce
- 100 kbps Max. Bit Rate – Equivalent to 100 kHz Clock Frequency
- Self-Timed Write Cycle (including Auto-Erase)
- Page-Write Buffer for up to 16 Bytes
- STATUS Register for Added Control:
  - Write enable latch bit
  - Write-In-Progress bit
- Block Write Protection
  - Protect none, 1/4, 1/2 or all of array
- Built-in Write Protection
  - Power-on/off data protection circuitry
  - Write enable latch
- High Reliability
  - Endurance: 1,000,000 erase/write cycles
  - Data retention: > 200 years
  - ESD protection: > 4,000V
- 3-lead SOT-23 and 8-lead SOIC Packages
- Pb-Free and RoHS Compliant
- Available Temperature Ranges:
  - Industrial (I): -40°C to +85°C

Pin Function Table

Name	Function
SCIO	Serial Clock, Data Input/Output
VSS	Ground
VCC	Supply Voltage

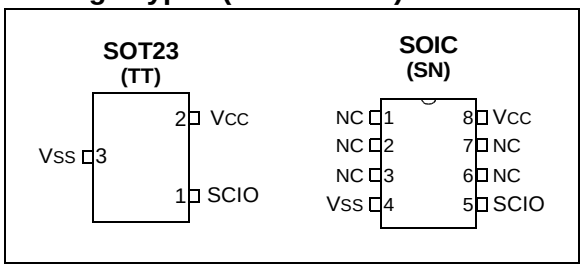
Description:

The Microchip Technology Inc. 11AA02E48 device is a 2 Kbit Serial Electrically Erasable PROM. The device is organized in blocks of x8-bit memory and support the patented* single I/O UNI/O® serial bus. By using Manchester encoding techniques, the clock and data are combined into a single, serial bit stream (SCIO), where the clock signal is extracted by the receiver to correctly decode the timing and value of each bit.

Low-voltage design permits operation down to 1.8V, with standby and active currents of only 1 uA and 1 mA, respectively.

The 11AA02E48 is available in standard 8-lead SOIC and 3-lead SOT-23 packages.

Package Types (not to scale)



Note: This document is supplemented by the "*11AAXXX/11LCXXX Family Data Sheet*" (DS22067). See **Section 2.0 "Functional Description"**.

* Microchip's UNI/O® Bus products are covered by the following patent issued in the U.S.A.: 7,376,020.

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings (†)

V_{CC}.....6.5V

SCIO w.r.t. V_{SS}..... -0.6V to V_{CC}+1.0V

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

Ambient temperature under bias.....-40°C to 85°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 an extended period of time may affect device reliability.

TABLE 1-1: DC CHARACTERISTICS

DC CHARACTERISTICS			**Electrical Characteristics:** Industrial (I): V_{CC} = 2.5V to 5.5V T_A = -40°C to +85°C; V_{CC} = 1.8V to 2.5V T_A = -20°C to +85°C			
Param. No.	**Sym.**	**Characteristic**	**Min.**	**Max.**	**Units**	**Test Conditions**
D1	V_{IH}	High-level Input Voltage	0.7*V_{CC}	V_{CC}+1	V	
D2	V_{IL}	Low-level Input Voltage Low-level Input Voltage	-0.3 -0.3	0.3*V_{CC} 0.2*V_{CC}	V V	$V_{CC} \geq$ 2.5V V_{CC} < 2.5V
D3	V_{HYS}	Hysteresis of Schmitt Trigger inputs (SCIO)	0.05*Vcc	—	V	$V_{CC} \geq$ 2.5V **(Note 1)**
D4	V_{OH}	High-level Output Voltage High-level Output Voltage	V_{CC} -0.5 V_{CC} -0.5	— —	V V	I_{OH} = -300 µA, V_{CC} = 5.5V I_{OH} = -200 µA, Vcc = 2.5V
D5	V_{OL}	Low-level Output Voltage Low-level Output Voltage	— —	0.4 0.4	V V	IoI = 300 µA, V_{CC} = 5.5V IoI = 200 µA, Vcc = 2.5V
D6	I_O	Output Current Limit **(Note 2)** Output Current Limit **(Note 2)**	— —	±4 ±3	mA mA	V_{CC} = 5.5V **(Note 1)** Vcc = 2.5V **(Note 1)**
D7	I_{LI}	Input Leakage Current (SCIO)	—	±1	µA	V_{IN} = V_{SS} or V_{CC}
D8	C_{INT}	Internal Capacitance (all inputs and outputs)	—	7	pF	T_A = 25°C, F_{CLK} = 1 MHz, V_{CC} = 5.0V **(Note 1)**
D9	I_{CC} Read	Read Operating Current Read Operating Current	— —	3 1	mA mA	V_{CC}=5.5V, F_{BUS}=100 kHz, C_B=100 pF V_{CC}=2.5V, F_{BUS}=100 kHz, C_B=100 pF
D10	I_{CC} Write	Write Operating Current Write Operating Current	— —	5 3	mA mA	V_{CC} = 5.5V V_{CC} = 2.5V
D11	Iccs	Standby Current	—	1	µA	V_{CC} = 5.5V, T_A = 85°C
D12	I_{CCI}	Idle Mode Current	—	50	µA	V_{CC} = 5.5V

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

2: The SCIO output driver impedance will vary to ensure I_O is not exceeded.

TABLE 1-2: AC CHARACTERISTICS

AC CHARACTERISTICS			Electrical Characteristics: Industrial (I): VCC = 2.5V to 5.5V TA = -40°C to +85°C VCC = 1.8V to 2.5V TA = -20°C to +85°C			
Param. No.	**Sym.**	**Characteristic**	**Min.**	**Max.**	**Units**	**Test Conditions**
1	FBUS	Serial Bus Frequency	10	100	kHz	—
2	TE	Bit Period	10	100	µs	—
3	TIJIT	Input Edge Jitter Tolerance	—	±0.08	UI	**(Note 3)**
4	FDRIFT	Serial Bus Frequency Drift Rate Tolerance	—	±0.75	% per byte	—
5	FDEV	Serial Bus Frequency Drift Limit	—	±5	% per command	—
6	TOJIT	Output Edge Jitter	—	±0.25	UI	**(Note 3)**
7	TR	SCIO Input Rise Time **(Note 1)**	—	100	ns	—
8	TF	SCIO Input Fall Time **(Note 1)**	—	100	ns	—
9	TSTBY	Standby Pulse Time	600	—	µs	—
10	TSS	Start Header Setup Time	10	—	µs	—
11	THDR	Start Header Low Pulse Time	5	—	µs	—
12	TSP	Input Filter Spike Suppression (SCIO)	—	50	ns	**(Note 1)**
13	TWC	Write Cycle Time (byte or page) —	— —	5 10	ms ms	Write, WRSR commands ERAL, SETAL commands
14	—	Endurance (per page)	1M	—	cycles	25°C, VCC = 5.5V **(Note 2)**

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

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

3: A Unit Interval (UI) is equal to 1-bit period (TE) at the current bus frequency.

TABLE 1-3: AC TEST CONDITIONS

AC Waveform:	
VLO = 0.2V	
VHI = VCC - 0.2V	
CL = 100 pF	
Timing Measurement Reference Level	
Input	0.5 VCC
Output	0.5 VCC

FIGURE 1-1: BUS TIMING – START HEADER

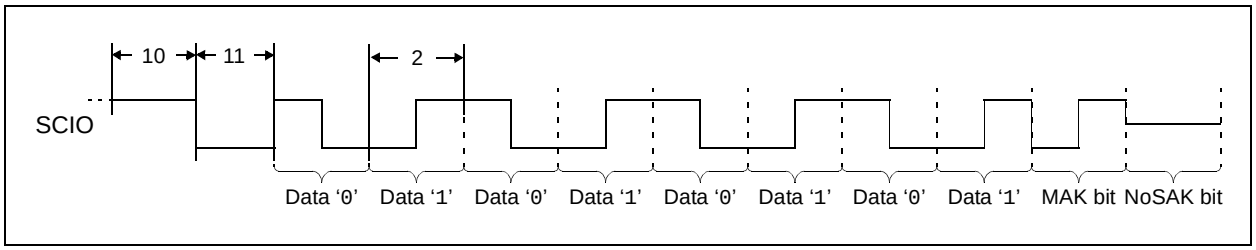


FIGURE 1-2: BUS TIMING – DATA

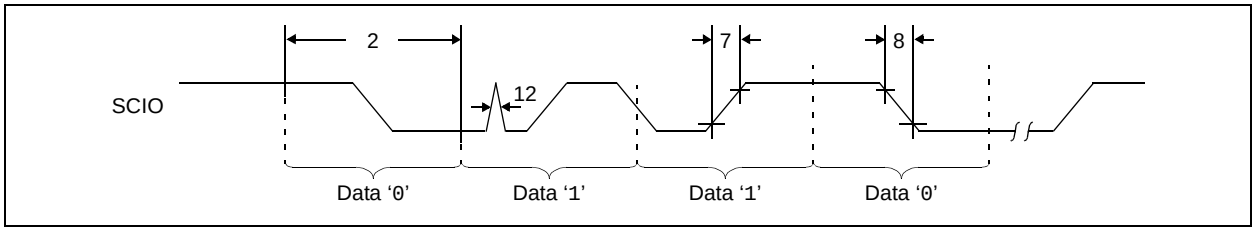


FIGURE 1-3: BUS TIMING – STANDBY PULSE

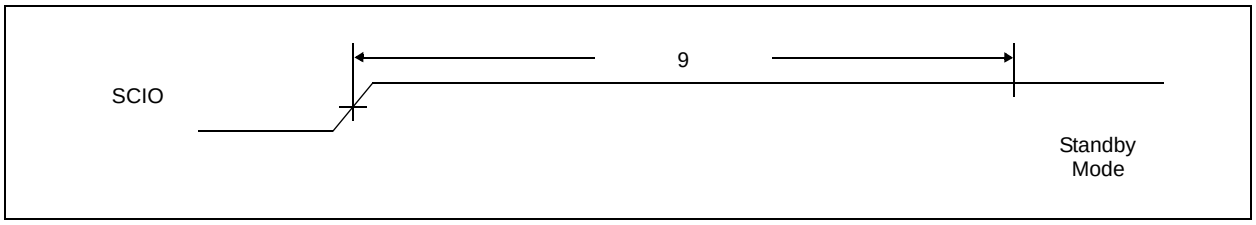
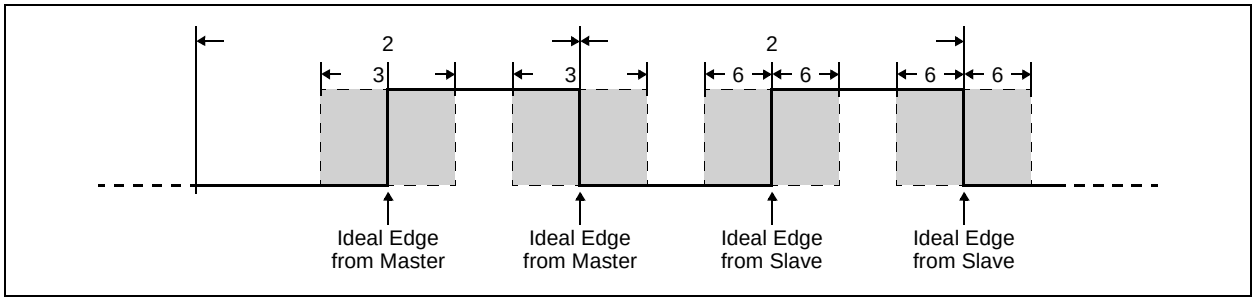


FIGURE 1-4: BUS TIMING – JITTER



2.0 FUNCTIONAL DESCRIPTION

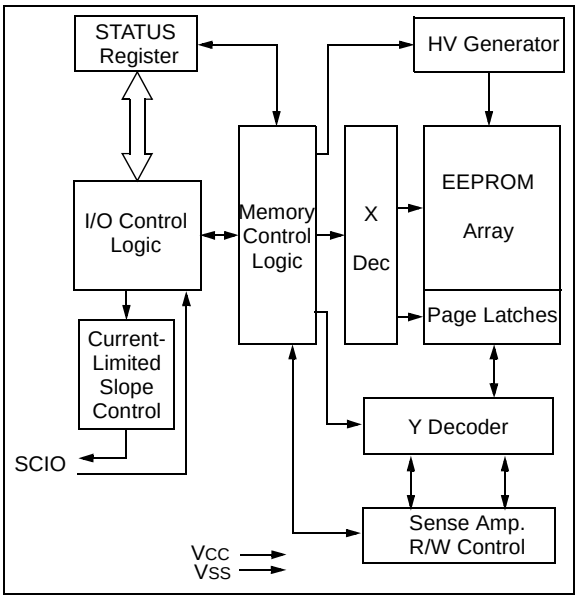
2.1 Principles of Operation

The 11AA02E48 family of serial EEPROMs support the UNI/O® protocol. They can be interfaced with microcontrollers, including Microchip's PIC® microcontrollers, ASICs, or any other device with an available discrete I/O line that can be configured properly to match the UNI/O protocol.

The 11AA02E48 devices contain an 8-bit instruction register. The devices are accessed via the SCIO pin.

Data is embedded into the I/O stream through Manchester encoding. The bus is controlled by a master device which determines the clock period, controls the bus access and initiates all operations, while the 11AA02E48 works as slave. Both master and slave can operate as transmitter or receiver, but the master device determines which mode is active.

FIGURE 2-1: BLOCK DIAGRAM

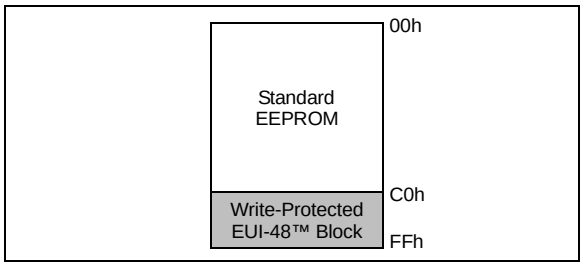


Note:	This data sheet documents only the device's features and specifications that are in addition to the features and specifications of the 11AA020 device. For information on the features and specifications shared by the 11AA02E48 and 11AA020 devices, see the "*11AAXXX/11LCXXX Family Data Sheet*" (DS22067).

3.0 PRE-PROGRAMMED EUI-48™ NODE ADDRESS

The 11AA02E48 is programmed at the factory with a globally unique, EUI-48™ and EUI-64™ compatible node address stored in the upper 1/4 of the array and write-protected through the STATUS register. The remaining 1,536 bits are available for application use.

FIGURE 3-1: MEMORY ORGANIZATION



The 6-byte EUI-48™ node address value is stored in array locations 0xFA through 0xFF, as shown in Figure 3-2. The first 3 bytes are the Organizationally Unique Identifier (OUI) assigned to Microchip by the IEEE Registration Authority. The remaining 3 bytes are the Extension Identifier, and are generated by Microchip to ensure a globally-unique, 48-bit value.

3.1 EUI-64™ Support

The pre-programmed EUI-48 node address can easily be encapsulated at the application level to form a globally unique, 64-bit node address for systems utilizing the EUI-64 standard. This is done by adding 0xFFFE between the OUI and the Extension Identifier, as shown below.

FIGURE 3-2: EUI-48 NODE ADDRESS PHYSICAL MEMORY MAP EXAMPLE

Description	24-bit Organizationally Unique Identifier			24-bit Extension Identifier		
Data	00h	04h	A3h	12h	34h	56h
Array Address	FAh					FFh

Corresponding EUI-48™ Node Address: 00-04-A3-12-34-56

Corresponding EUI-64™ Node Address: 00-04-A3-FF-FE-12-34-56

3.2 Factory-Programmed Write Protection

In order to help guard against accidental corruption of the EUI-48 node address, the BP1 and BP0 bits of the STATUS register are programmed at the factory to '0' and '1', respectively, as shown in the following table:

7	6	5	4	3	2	1	0
X	X	X	X	BP1	BP0	WEL	WIP
—	—	—	—	0	1	—	—

This protects the upper 1/4 of the array (0xC0 to 0xFF) from write operations. This array block can be utilized for writing by clearing the BP bits with a Write Status Register (WRSR) instruction. Note that if this is performed, care must be taken to prevent overwriting the EUI-48 value.

4.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 4-1.

TABLE 4-1: PIN FUNCTION TABLE

Name	3-pin SOT-23	8-pin SOIC	Description
SCIO	1	5	Serial Clock, Data Input/Output
VCC	2	8	Supply Voltage
VSS	3	4	Ground
NC	—	1,2,3,6,7	No Internal Connection

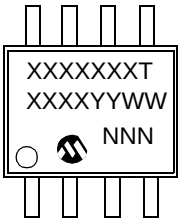
4.1 Serial Clock, Data Input/Output (SCIO)

SCIO is a bidirectional pin used to transfer commands and addresses into, as well as data into and out of, the device. The serial clock is embedded into the data stream through Manchester encoding. Each bit is represented by a signal transition at the middle of the bit period.

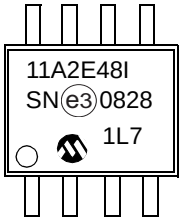
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

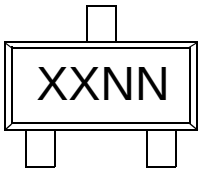
8-Lead SOIC



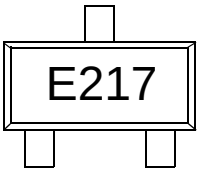
Example:



3-Lead SOT-23



Example:



Part Number	1st Line Marking Code
	SOT-23
	I Temp.
11AA02E48	E2NN

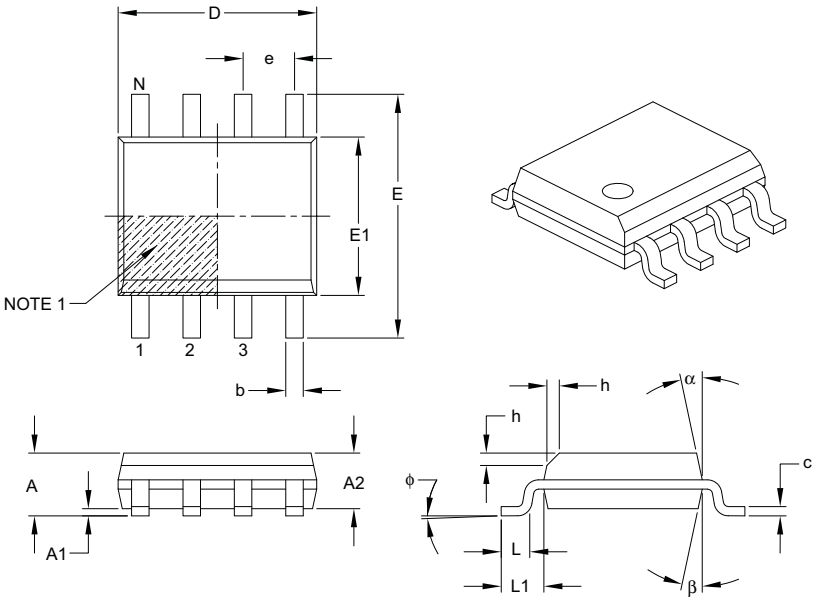
Note: NN = Alphanumeric traceability code

Legend:	XX...X	Customer-specific information
	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
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.

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 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 0.15 mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M.

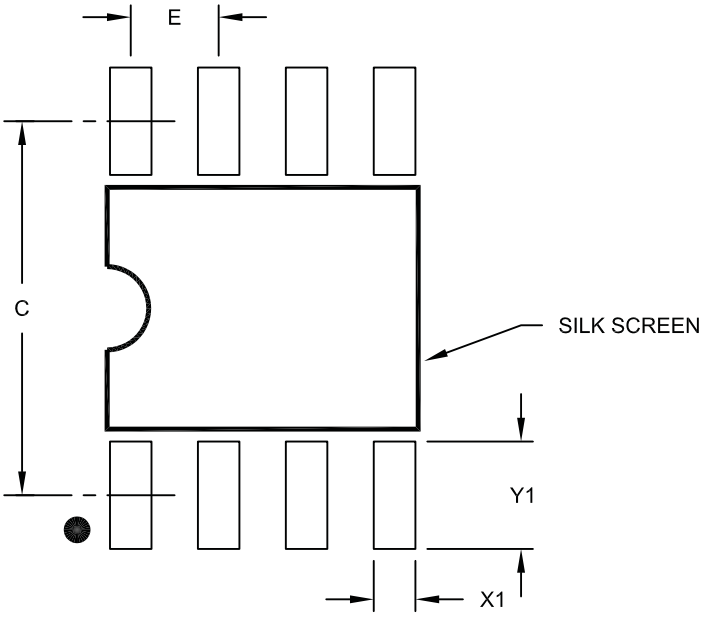
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

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

Microchip Technology Drawing C04-057B

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:

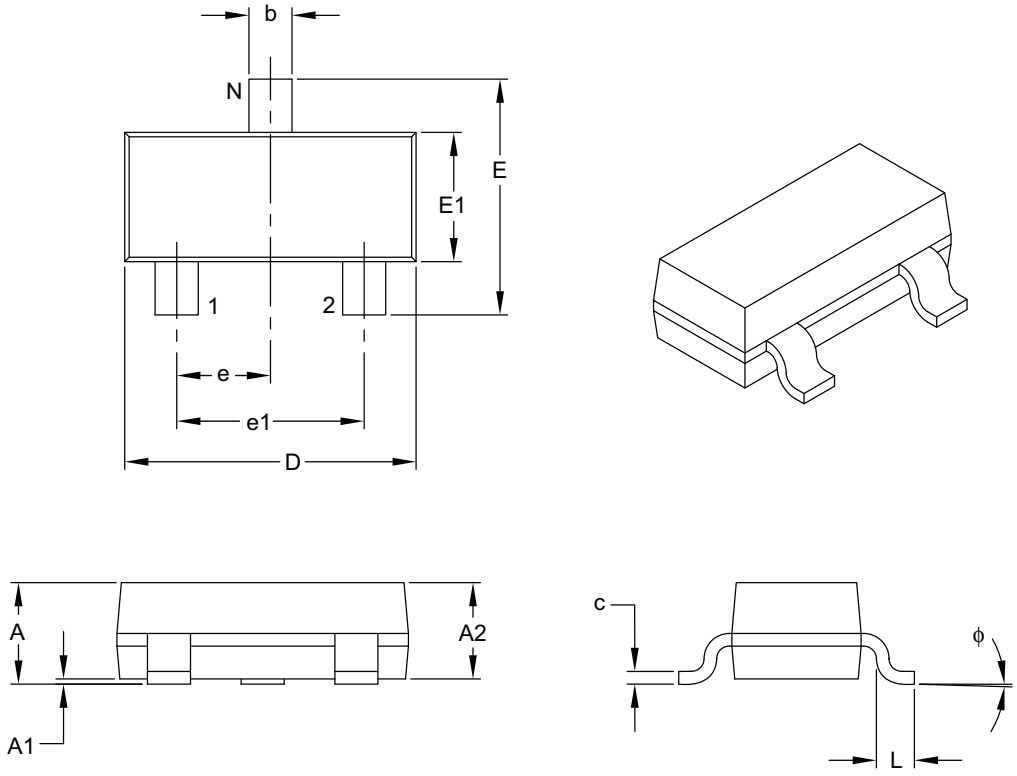
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2057A

3-Lead Plastic Small Outline Transistor (TT) [SOT-23]

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



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		3	
Lead Pitch	e		0.95 BSC	
Outside Lead Pitch	e1		1.90 BSC	
Overall Height	A	0.89	–	1.12
Molded Package Thickness	A2	0.79	0.95	1.02
Standoff	A1	0.01	–	0.10
Overall Width	E	2.10	–	2.64
Molded Package Width	E1	1.16	1.30	1.40
Overall Length	D	2.67	2.90	3.05
Foot Length	L	0.13	0.50	0.60
Foot Angle	ϕ	0°	–	10°
Lead Thickness	c	0.08	–	0.20
Lead Width	b	0.30	–	0.54

Notes:

1. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25 mm per side.
2. Dimensioning and tolerancing per ASME Y14.5M.

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

Microchip Technology Drawing C04-104B

APPENDIX A: REVISION HISTORY

Revision A (12/08)

Original release of this document.

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Device: 11AA02E48 Literature Number: DS22122A

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1. What are the best features of this document?

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

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

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

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

7. How would you improve this document?

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	—	X	/XX
Device	Tape & Reel		Temperature Range	Package

Device:	11AA02E48	=	2 Kbit, 1.8V UNI/O Serial EEPROM with EUI-48™ Node Identity
Tape & Reel:	T	=	Tape and Reel
	Blank	=	Tube
Temperature Range:	I	=	-40°C to+85°C(Industrial)
Package:	SN	=	8-lead Plastic SOIC (3.90 mm body)
	TT	=	3-lead SOT 23 (Tape and Reel only)

Examples:

a) 11AA02E48T-I/TT = 2 Kbit, 1.8V Serial EEPROM, Industrial temp., Tape & Reel, SOT-23 package

b) 11AA02E48-I/SN = 2 Kbit, 1.8V Serial EEPROM, Industrial temp., SOIC package

c) 11AA02E48T-I/SN = 2 Kbit, 1.8V Serial EEPROM, Industrial temp., Tape & Reel, SOIC package

NOTES:

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

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

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ISO/TS 16949:2002

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