

勝特力材料 886-3-5753170
 勝特力电子(上海) 86-21-34970699
 勝特力电子(深圳) 86-755-83298787
[Http://www.100y.com.tw](http://www.100y.com.tw)

Features

- Low-voltage and Standard-voltage Operation
 - $V_{CC} = 1.7V$ to $5.5V$
- Internally Organized 256 x 8 (2K)
- Two-wire Serial Interface
- Schmitt Trigger, Filtered Inputs for Noise Suppression
- Bidirectional Data Transfer Protocol
- 1MHz (5V), 400kHz (1.7V, 2.5V, 2.7V) Compatibility
- Write Protect Pin for Hardware Data Protection
- 8-byte Page (2K) Write Modes
- Partial Page Writes Allowed
- Self-timed Write Cycle (5ms max)
- High-reliability
 - Endurance: 1 Million Write Cycles
 - Data Retention: 100 Years
- Green (Pb/Halide-free/RoHS Compliant) Package Options
- Die Sales: Wafer Form and Tape and Reel

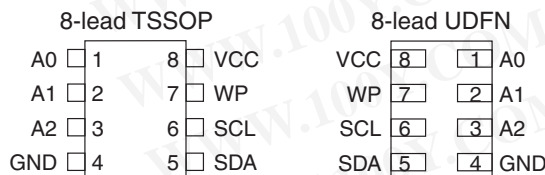
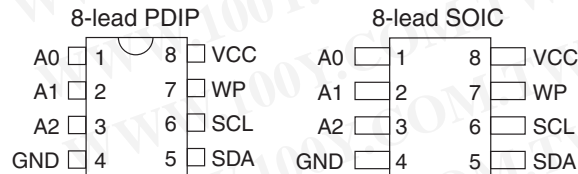
Description

The Atmel® AT24C02C provides 2048-bits of serial electrically erasable and programmable read-only memory (EEPROM) organized as 256-words of 8-bits each. The device is optimized for use in many industrial and commercial applications where low-power and low-voltage operation are essential. The AT24C02C is available in space-saving 8-lead PDIP, 8-lead TSSOP, 8-lead JEDEC SOIC, 8-lead UDFN, 5-lead SOT23 and 8-ball VFBGA packages and is accessed via a two-wire serial interface.

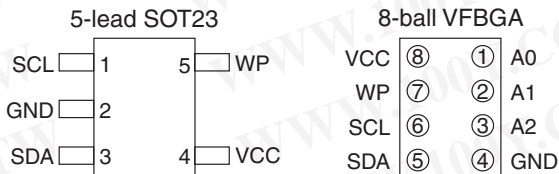
Table 0-1. Pin Configuration

Pin Name	Function
A0 - A2	Address Inputs
SDA	Serial Data
SCL	Serial Clock Input
WP	Write Protect
GND	Ground
VCC	Power Supply

Note: For use of 5-lead SOT23, the software A2, A1, and A0 bits in the device address word must be set to zero to properly communicate



Bottom View



Bottom View



Two-wire Serial Electrically Erasable and Programmable Read-only Memory

2K (256 x 8)

Atmel AT24C02C

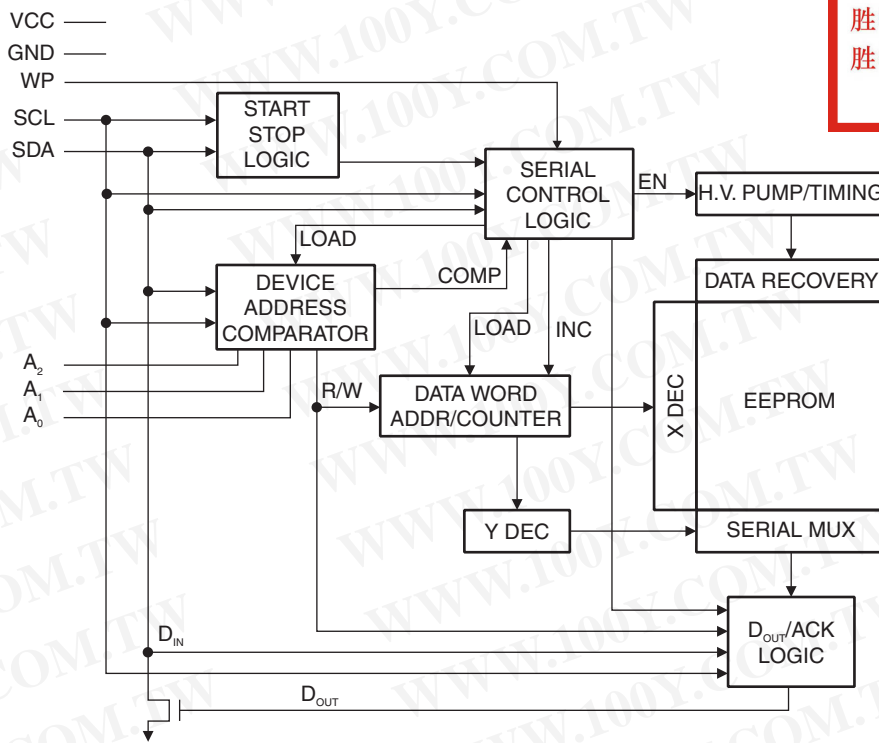


Absolute Maximum Ratings

Operating Temperature	-55°C to +125°C
Storage Temperature	-65°C to +150°C
Voltage on Any Pin with Respect to Ground.....	-1.0V to +7.0V
Maximum Operating Voltage.....	6.25V
DC Output Current	5.0 mA

*NOTICE: Stresses beyond 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 beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Figure 0-1. Block Diagram



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1. Pin Description

SERIAL CLOCK (SCL): The SCL input is used to positive edge clock data into each EEPROM device and negative edge clock data out of each device.

SERIAL DATA (SDA): The SDA pin is bidirectional for serial data transfer. This pin is open-drain driven and may be wire-ORed with any number of other open-drain or open-collector devices.

DEVICE/PAGE ADDRESSES (A2, A1, A0): The A2, A1 and A0 pins are device address inputs that are hard wired for the Atmel® AT24C02C. As many as eight 2K devices may be addressed on a single bus system (device addressing is discussed in detail under the Device Addressing section).

WRITE PROTECT (WP): AT24C02C has a write protect pin that provides hardware data protection. The write protect pin allows normal read/write operations when connected to ground (GND). When the write protect pin is connected to V_{CC}, the write protection feature is enabled and operates as shown in Table 1-1.

Table 1-1. Write Protect

WP Pin Status	Part of the Array Protected
At V _{CC}	Full (2K) Array
At GND	Normal Read/Write Operations

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2. Memory Organization

Atmel AT24C02C, 2K SERIAL EEPROM: Internally organized with 32 pages of 8-bytes each, the 2K requires an 8-bit data word address for random word addressing.

Table 2-1. Pin Capacitance⁽¹⁾

Applicable over recommended operating range from $T_A = 25^\circ\text{C}$, $f = 1.0\text{MHz}$, $V_{CC} = +1.7\text{V}$ to $+5.5\text{V}$

Symbol	Test Condition	Max	Units	Conditions
$C_{I/O}$	Input/Output Capacitance (SDA)	8	pF	$V_{I/O} = 0\text{V}$
C_{IN}	Input Capacitance ($A_0, A_1, A_2, \text{SCL}$)	6	pF	$V_{IN} = 0\text{V}$

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

Table 2-2. DC Characteristics

Applicable over recommended operating range from: $T_{AI} = -40^\circ\text{C}$ to $+85^\circ\text{C}$, $V_{CC} = +1.7\text{V}$ to $+5.5\text{V}$ (unless otherwise noted)

Symbol	Parameter	Test Condition	Min	Typ	Max	Units
V_{CC1}	Supply Voltage		1.7		5.5	V
V_{CC2}	Supply Voltage		2.5		5.5	V
V_{CC3}	Supply Voltage		2.7		5.5	V
V_{CC4}	Supply Voltage		4.5		5.5	V
I_{CC}	Supply Current $V_{CC} = 5.0\text{V}$	READ at 100kHz		0.4	1.0	mA
I_{CC}	Supply Current $V_{CC} = 5.0\text{V}$	WRITE at 100kHz		2.0	3.0	mA
I_{SB1}	Standby Current $V_{CC} = 1.7\text{V}$	$V_{IN} = V_{CC}$ or V_{SS}		0.6	3.0	μA
I_{SB2}	Standby Current $V_{CC} = 2.5\text{V}$	$V_{IN} = V_{CC}$ or V_{SS}		1.4	4.0	μA
I_{SB3}	Standby Current $V_{CC} = 2.7\text{V}$	$V_{IN} = V_{CC}$ or V_{SS}		1.6	4.0	μA
I_{SB4}	Standby Current $V_{CC} = 5.0\text{V}$	$V_{IN} = V_{CC}$ or V_{SS}		8.0	18.0	μA
I_{LI}	Input Leakage Current	$V_{IN} = V_{CC}$ or V_{SS}		0.10	3.0	μA
I_{LO}	Output Leakage Current	$V_{OUT} = V_{CC}$ or V_{SS}		0.05	3.0	μA
V_{IL}	Input Low Level ⁽¹⁾		-0.6		$V_{CC} \times 0.3$	V
V_{IH}	Input High Level ⁽¹⁾		$V_{CC} \times 0.7$		$V_{CC} + 0.5$	V
V_{OL2}	Output Low Level $V_{CC} = 3.0\text{V}$	$I_{OL} = 2.1\text{mA}$			0.4	V
V_{OL1}	Output Low Level $V_{CC} = 1.7\text{V}$	$I_{OL} = 0.15\text{mA}$			0.2	V

Note: 1. V_{IL} min and V_{IH} max are reference only and are not tested

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Table 2-3. AC Characteristics

Applicable over recommended operating range from $T_{AI} = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{CC} = +1.7\text{V}$ to $+5.5\text{V}$, $CL = 1\text{TTL Gate and } 100\text{pF}$ (unless otherwise noted)

Symbol	Parameter	1.7, 2.5, 2.7		5.0V		Units
		Min	Max	Min	Max	
f_{SCL}	Clock Frequency, SCL		400		1000	kHz
t_{LOW}	Clock Pulse Width Low	1.2		0.4		μs
t_{HIGH}	Clock Pulse Width High	0.6		0.4		μs
t_i	Noise Suppression Time		50		50	ns
t_{AA}	Clock Low to Data Out Valid	0.1	0.9	0.05	0.55	μs
t_{BUF}	Time the bus must be free before a new transmission can start	1.2		0.5		μs
$t_{HD,STA}$	Start Hold Time	0.6		0.25		μs
$t_{SU,STA}$	Start Setup Time	0.6		0.25		μs
$t_{HD,DAT}$	Data In Hold Time	0		0		μs
$t_{SU,DAT}$	Data In Setup Time	100		100		ns
t_R	Inputs Rise Time ⁽¹⁾		0.3		0.3	μs
t_F	Inputs Fall Time ⁽¹⁾		300		100	ns
$t_{SU,STO}$	Stop Setup Time	0.6		.25		μs
t_{DH}	Data Out Hold Time	50		50		ns
t_{WR}	Write Cycle Time		5		5	ms
Endurance ⁽¹⁾	5.0V, 25-C, Byte Mode	1 Million				Write Cycles

Note: 1. This parameter is ensured by characterization only

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3. Device Operation

CLOCK and DATA TRANSITIONS: The SDA pin is normally pulled high with an external device. Data on the SDA pin may change only during SCL low time periods (see Figure 5-2 on page 8). Data changes during SCL high periods will indicate a start or stop condition as defined below.

START CONDITION: A high-to-low transition of SDA with SCL high is a start condition which must precede any other command (see Figure 5-3 on page 8).

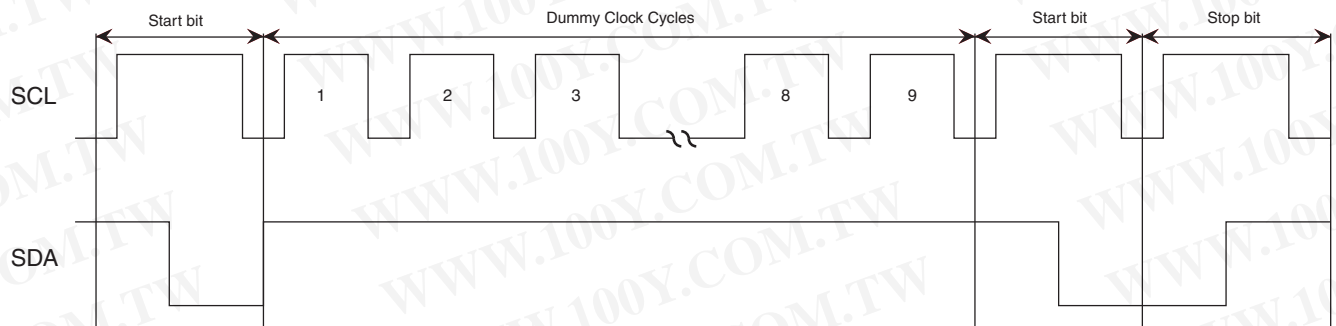
STOP CONDITION: A low-to-high transition of SDA with SCL high is a stop condition. After a read sequence, the stop command will place the EEPROM in a standby power mode (see Figure 5-3 on page 8).

ACKNOWLEDGE: All addresses and data words are serially transmitted to and from the EEPROM in 8-bit words. The EEPROM sends a zero to acknowledge that it has received each word. This happens during the ninth clock cycle.

STANDBY MODE: The Atmel® AT24C02C features a low-power standby mode which is enabled: (a) upon power-up and (b) after the receipt of the STOP bit and the completion of any internal operations.

2-Wire Software Reset: After an interruption in protocol, power loss or system reset, any 2-wire part can be reset by following these steps: (a) Create a start bit condition, (b) clock 9 cycles, (c) create another start bit followed by stop bit condition as shown below. The device is ready for next communication after above steps have been completed.

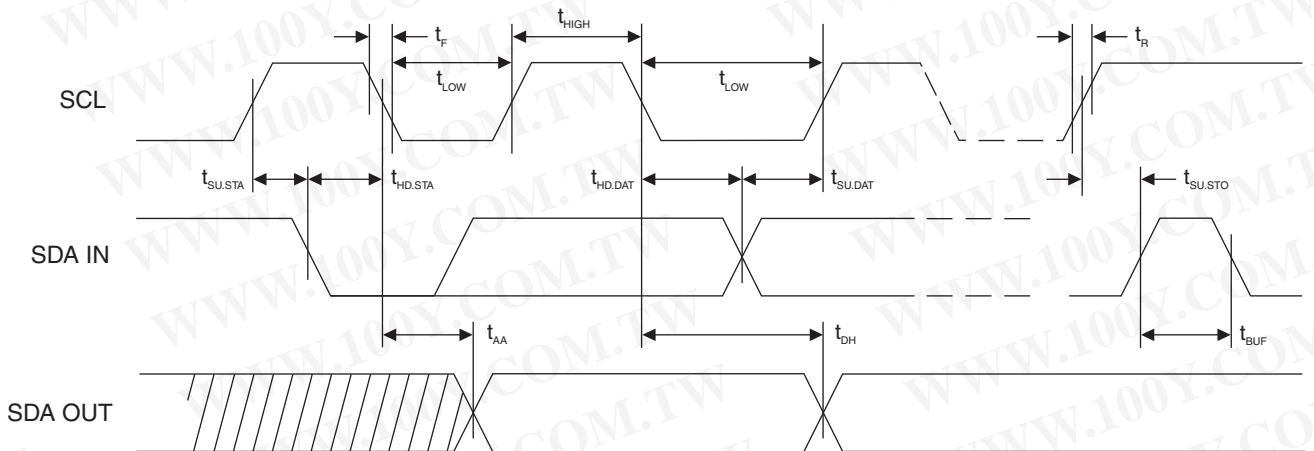
Figure 3-1. Software reset



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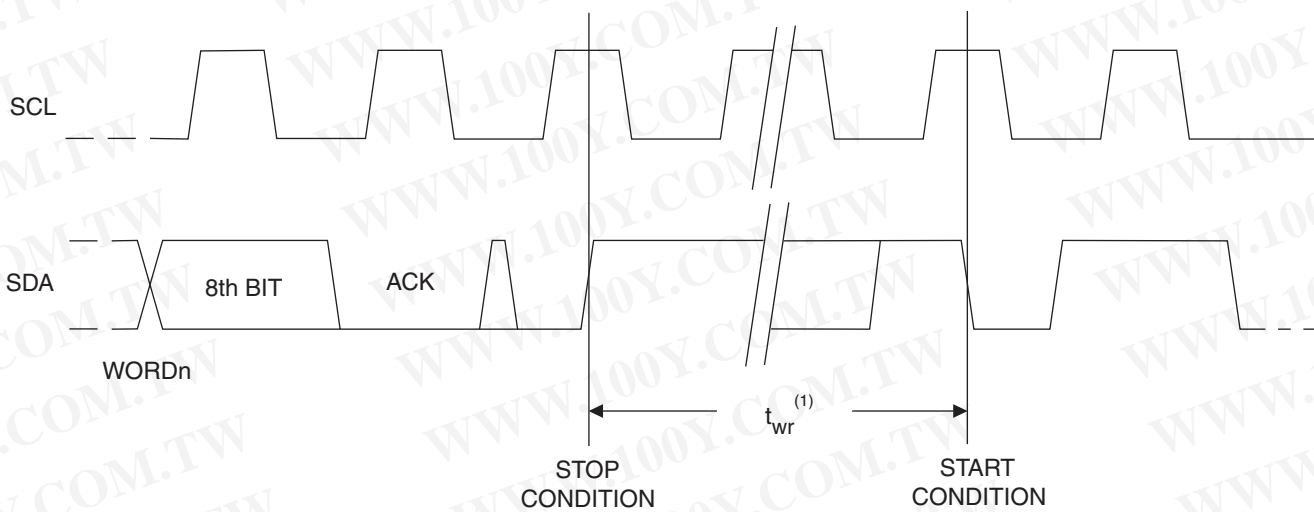
4. Bus Timing

Figure 4-1. SCL: Serial Clock, SDA: Serial Data I/O



5. Write Cycle Timing

Figure 5-1. SCL: Serial Clock, SDA: Serial Data I/O



Notes: 1. The write cycle time t_{WR} is the time from a valid stop condition of a write sequence to the end of the internal clear/write cycle

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Figure 5-2. Data Validity

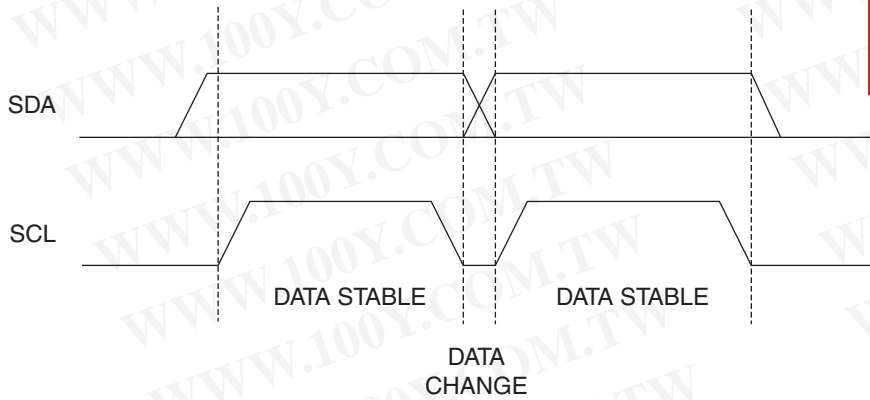


Figure 5-3. Start and Stop Definition

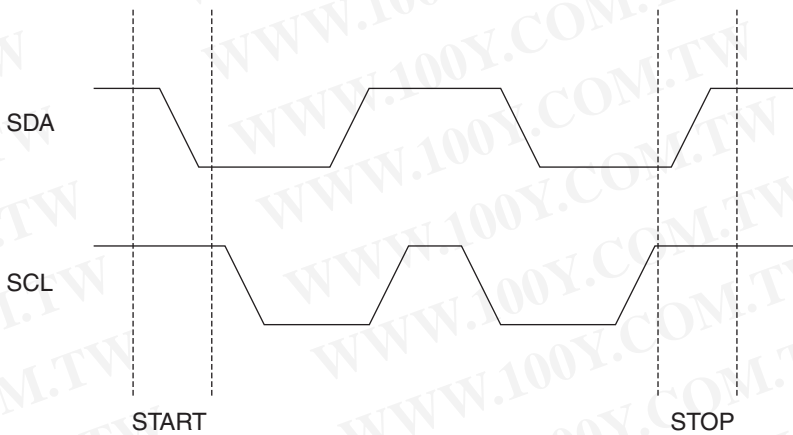
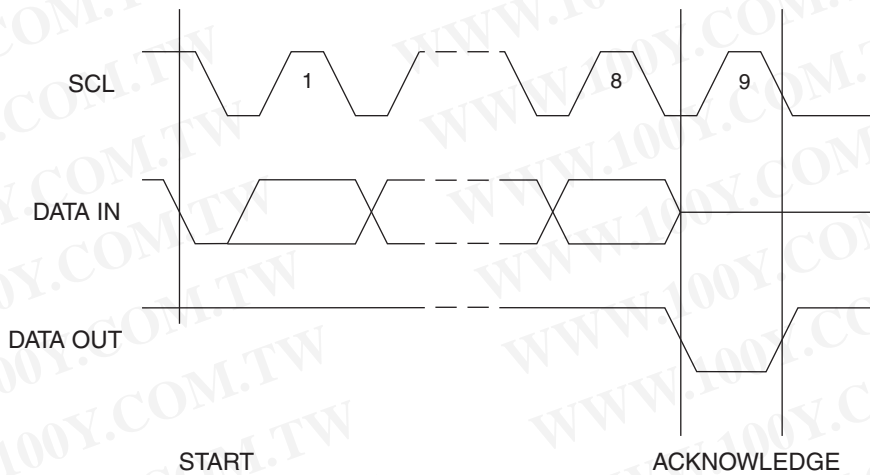


Figure 5-4. Output Acknowledge



6. Device Addressing

The 2K EEPROM device requires an 8-bit device address word following a start condition to enable the chip for a read or write operation (refer to [Figure 8-1](#)).

The device address word consists of a mandatory one, zero sequence for the first four most significant bits as shown. This is common to all the EEPROM devices.

The next three bits are the A2, A1 and A0 device address bits for the 2K EEPROM. These three bits must compare to their corresponding hard-wired input pins.

The eighth bit of the device address is the read/write operation select bit. A read operation is initiated if this bit is high and a write operation is initiated if this bit is low.

Upon a compare of the device address, the EEPROM will output a zero. If a compare is not made, the chip will return to a standby state.

7. Write Operations

BYTE WRITE: A write operation requires an 8-bit data word address following the device address word and acknowledgment. Upon receipt of this address, the EEPROM will again respond with a zero and then clock in the first 8-bit data word. Following receipt of the 8-bit data word, the EEPROM will output a zero and the addressing device, such as a microcontroller, must terminate the write sequence with a stop condition. At this time the EEPROM enters an internally timed write cycle, t_{WR} , to the nonvolatile memory. All inputs are disabled during this write cycle and the EEPROM will not respond until the write is complete (see [Figure 8-2 on page 10](#)).

PAGE WRITE: The 2K EEPROM is capable of an 8-byte page write.

A page write is initiated the same as a byte write, but the microcontroller does not send a stop condition after the first data word is clocked in. Instead, after the EEPROM acknowledges receipt of the first data word, the microcontroller can transmit up to seven data words. The EEPROM will respond with a zero after each data word received. The microcontroller must terminate the page write sequence with a stop condition (see [Figure 8-3 on page 10](#)).

The data word address lower three bits are internally incremented following the receipt of each data word. The higher data word address bits are not incremented, retaining the memory page row location. When the word address, internally generated, reaches the page boundary, the following byte is placed at the beginning of the same page. If more than eight data words are transmitted to the EEPROM, the data word address will “roll over” and previous data will be overwritten.

ACKNOWLEDGE POLLING: Once the internally timed write cycle has started and the EEPROM inputs are disabled, acknowledge polling can be initiated. This involves sending a start condition followed by the device address word. The read/write bit is representative of the operation desired. Only if the internal write cycle has completed will the EEPROM respond with a zero allowing the read or write sequence to continue.

8. Read Operations

Read operations are initiated the same way as write operations with the exception that the read/write select bit in the device address word is set to one. There are three read operations: current address read, random address read and sequential read.

CURRENT ADDRESS READ: The internal data word address counter maintains the last address accessed during the last read or write operation, incremented by one. This address stays valid between operations as long as the chip power is maintained. The address “roll over” during read is from the last byte of the last memory page to the

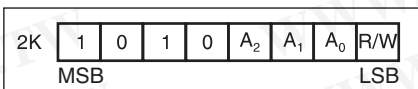
first byte of the first page. The address “roll over” during write is from the last byte of the current page to the first byte of the same page.

Once the device address with the read/write select bit set to one is clocked in and acknowledged by the EEPROM, the current address data word is serially clocked out. The microcontroller does not respond with an input zero but does generate a following stop condition (see Figure 8-4 on page 11).

RANDOM READ: A random read requires a “dummy” byte write sequence to load in the data word address. Once the device address word and data word address are clocked in and acknowledged by the EEPROM, the microcontroller must generate another start condition. The microcontroller now initiates a current address read by sending a device address with the read/write select bit high. The EEPROM acknowledges the device address and serially clocks out the data word. The microcontroller does not respond with a zero but does generate a following stop condition (see Figure 8-5 on page 11).

SEQUENTIAL READ: Sequential reads are initiated by either a current address read or a random address read. After the microcontroller receives a data word, it responds with an acknowledge. As long as the EEPROM receives an acknowledge, it will continue to increment the data word address and serially clock out sequential data words. When the memory address limit is reached, the data word address will “roll over” and the sequential read will continue. The sequential read operation is terminated when the microcontroller does not respond with a zero but does generate a following stop condition (see Figure 8-6 on page 11).

Figure 8-1. Device Address



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Figure 8-2. Byte Write

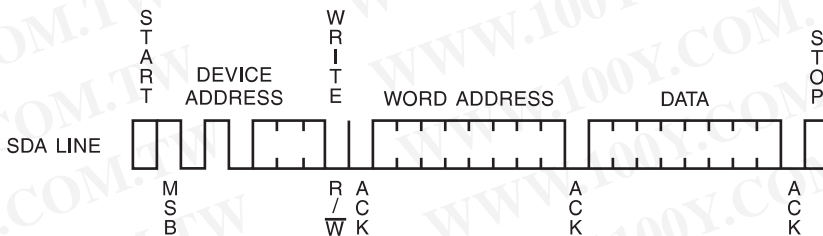
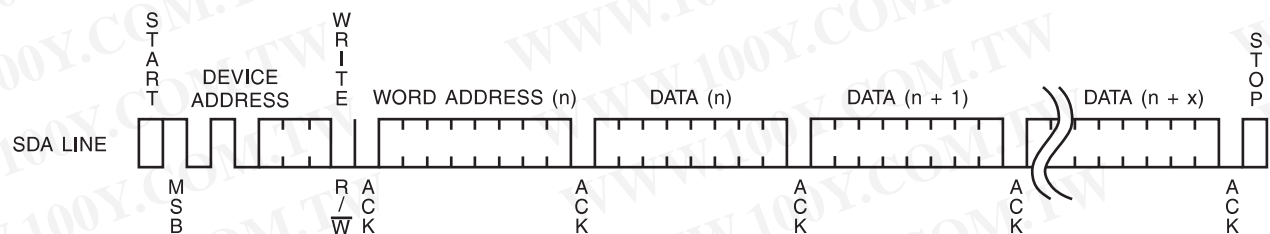


Figure 8-3. Page Write



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Figure 8-4. Current Address Read

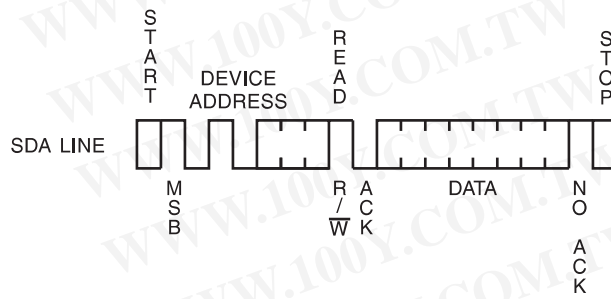


Figure 8-5. Random Read

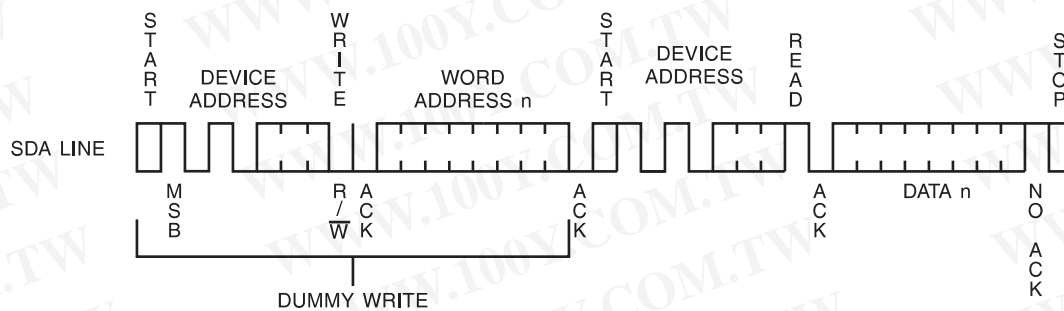
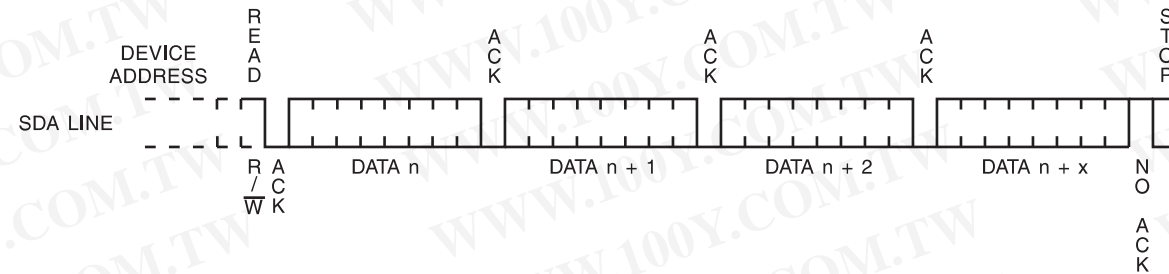
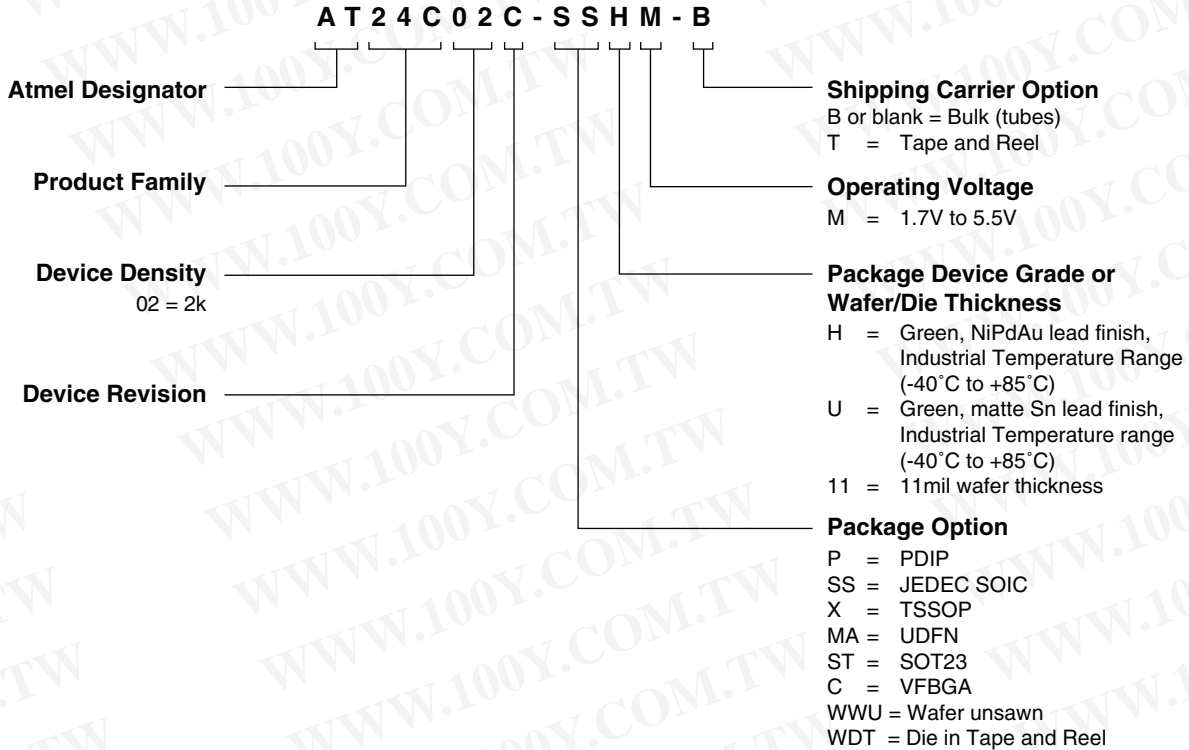


Figure 8-6. Sequential Read





9. Ordering Code Detail



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Atmel AT24C02C-MAHM

Top Mark

```

|---|---|---|
 0  2  C
|---|---|---|
 H  M  @
|---|---|---|
 Y  T  C
|---|---|---|
 *
 | PIN 1 INDICATOR (DOT)

```

02C= Device
H = Material Set
M = Voltage Indicator
@ = Country of Assembly
Y = Year of Assembly
TC = Trace Code

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Atmel AT24C02C-STUM

Top Mark

```

|---|---|---|---|---|
Line 1 -----> 2  C  M  B  U
|---|---|---|---|---|
 *
 |
 | PIN 1 INDICATOR (DOT)

```

2C = Device
M = Voltage Indicator
B = Write Protection
U = Material Set

Bottom Mark

```

|---|---|---|---|
  Y  M  T  C
|---|---|---|---|

```

Y = One Digit Year Code
M = Seal Month
TC = Trace Code

Atmel AT24C02C-CUM

Top Mark

```

Line 1 -----> 02CU
Line 2 -----> YMTC
|<--PIN 1 THIS CORNER

```

02C= Device
U = Material Set
Y = One Digit Year Code
M = Seal Month
TC = Trace Code

11. Ordering Codes

Atmel AT24C02C Ordering Information

Ordering Code	Voltage	Package	Operation Range
AT24C02C-PUM (Bulk form only)	1.7V to 5.5V	8P3	Lead-free/Halogen-free/ Industrial Temperature (-40°C to 85°C)
AT24C02C-SSHM-B ⁽¹⁾ (NiPdAu Lead Finish)	1.7V to 5.5V	8S1	
AT24C02C-SSHM-T ⁽²⁾ (NiPdAu Lead Finish)	1.7V to 5.5V	8S1	
AT24C02C-XHM-B ⁽¹⁾ (NiPdAu Lead Finish)	1.7V to 5.5V	8A2	
AT24C02C-XHM-T ⁽²⁾ (NiPdAu Lead Finish)	1.7V to 5.5V	8A2	
AT24C02C-MAHM-T ⁽²⁾ (NiPdAu Lead Finish)	1.7V to 5.5V	8Y6	
AT24C02C-STUM-T ⁽²⁾	1.7V to 5.5V	5TS1	
AT24C02C-CUM-T ⁽²⁾	1.7V to 5.5V	8U3-1	Industrial Temperature (-40°C to 85°C)
AT24C02C-WWU11 ⁽³⁾	1.7V to 5.5V	Die Sale	

- Notes:
1. "-B" denotes bulk
 2. "-T" denotes tape and reel. SOIC = 4K per reel. TSSOP, UDFN, SOT23, and VFBGA = 5K per reel
 3. For Wafer sales, please contact Atmel Sales

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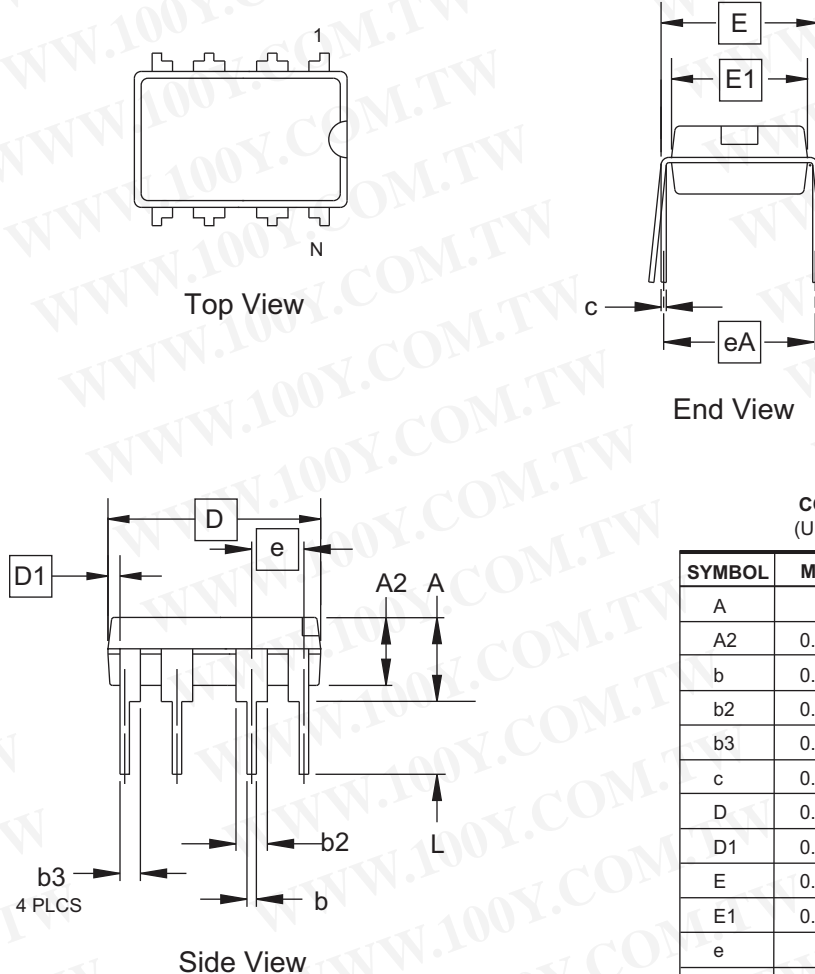
Package Type	
8P3	8-lead, 0.300" Wide, Plastic Dual Inline Package (PDIP)
8S1	8-lead, 0.150" Wide, Plastic Gull Wing Small Outline (JEDEC SOIC)
8A2	8-lead, 4.4mm Body, Plastic Thin Shrink Small Outline Package (TSSOP)
8Y6	8-lead, 2.00mm x 3.00mm Body, 0.50mm Pitch, Dual No Lead Package (UDFN)
5TS1	5-lead, 2.90mm x 1.60mm Body, Plastic Thin Shrink Small Outline Package (SOT23)
8U3-1	8-ball, die Ball Grid Array Package (VFBGA)



12. Packaging Information

8P3 – PDIP

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COMMON DIMENSIONS
(Unit of Measure = inches)

SYMBOL	MIN	NOM	MAX	NOTE
A			0.210	2
A2	0.115	0.130	0.195	
b	0.014	0.018	0.022	5
b2	0.045	0.060	0.070	6
b3	0.030	0.039	0.045	6
c	0.008	0.010	0.014	
D	0.355	0.365	0.400	3
D1	0.005			3
E	0.300	0.310	0.325	4
E1	0.240	0.250	0.280	3
e	0.100 BSC			
eA	0.300 BSC			4
L	0.115	0.130	0.150	2

- Notes:
1. This drawing is for general information only; refer to JEDEC Drawing MS-001, Variation BA for additional information.
 2. Dimensions A and L are measured with the package seated in JEDEC seating plane Gauge GS-3.
 3. D, D1 and E1 dimensions do not include mold Flash or protrusions. Mold Flash or protrusions shall not exceed 0.010 inch.
 4. E and eA measured with the leads constrained to be perpendicular to datum.
 5. Pointed or rounded lead tips are preferred to ease insertion.
 6. b2 and b3 maximum dimensions do not include Dambar protrusions. Dambar protrusions shall not exceed 0.010 (0.25mm).

07/19/10



Package Drawing Contact:
packagedrawings@atmel.com

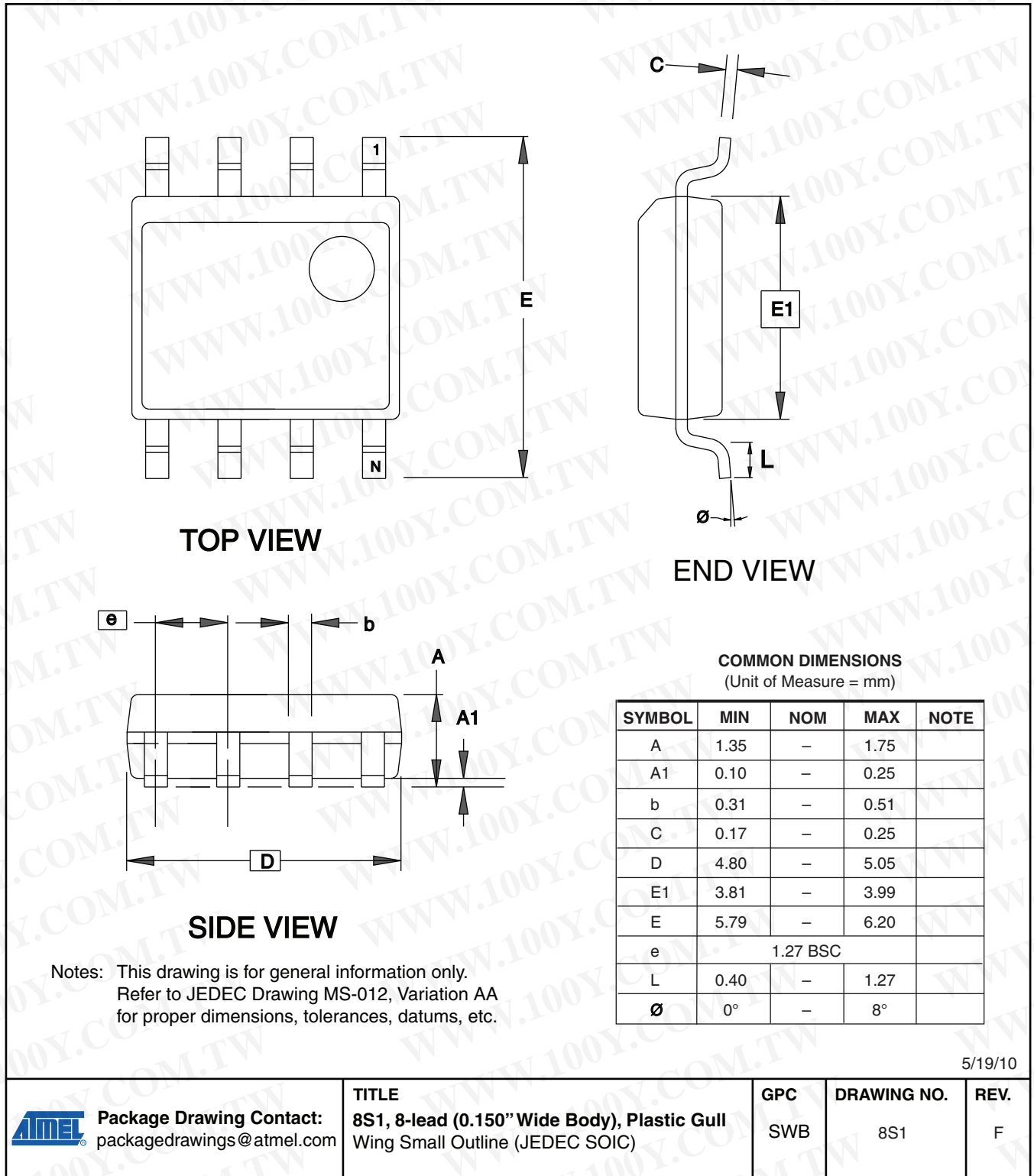
TITLE
8P3, 8-lead, 0.300" Wide Body, Plastic Dual
In-line Package (PDIP)

GPC
PTC

DRAWING NO.
8P3

REV.
C

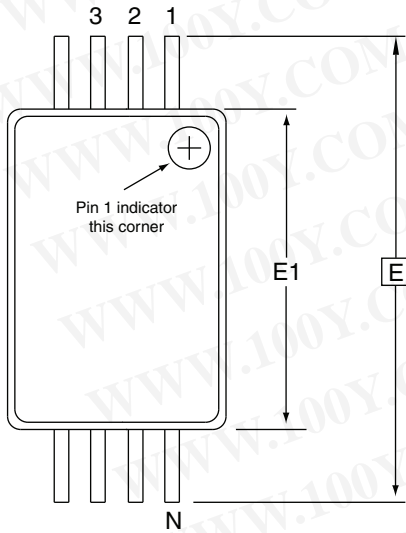
8S1 – JEDEC SOIC



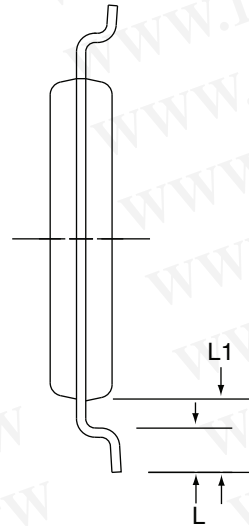
勝特力材料 886-3-5753170
 勝特力电子(上海) 86-21-34970699
 勝特力电子(深圳) 86-755-83298787
[Http://www.100y.com.tw](http://www.100y.com.tw)

8A2 – TSSOP

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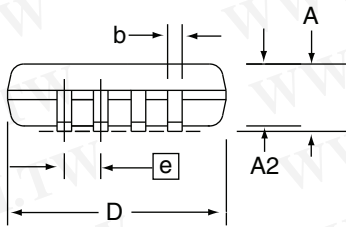
Top View



End View

COMMON DIMENSIONS
(Unit of Measure = mm)

SYMBOL	MIN	NOM	MAX	NOTE
D	2.90	3.00	3.10	2, 5
E	6.40 BSC			
E1	4.30	4.40	4.50	3, 5
A	-	-	1.20	
A2	0.80	1.00	1.05	
b	0.19	-	0.30	4
e	0.65 BSC			
L	0.45	0.60	0.75	
L1	1.00 REF			



Side View

- Notes:
1. This drawing is for general information only. Refer to JEDEC Drawing MO-153, Variation AA, for proper dimensions, tolerances, datums, etc.
 2. Dimension D does not include mold Flash, protrusions or gate burrs. Mold Flash, protrusions and gate burrs shall not exceed 0.15mm (0.006in) per side.
 3. Dimension E1 does not include inter-lead Flash or protrusions. Inter-lead Flash and protrusions shall not exceed 0.25mm (0.010in) per side.
 4. Dimension b does not include Dambar protrusion. Allowable Dambar protrusion shall be 0.08mm total in excess of the b dimension at maximum material condition. Dambar cannot be located on the lower radius of the foot. Minimum space between protrusion and adjacent lead is 0.07mm.
 5. Dimension D and E1 to be determined at Datum Plane H.

5/19/10



Package Drawing Contact:
packagedrawings@atmel.com

TITLE

8A2, 8-lead 4.4mm Body, Plastic Thin Shrink Small Outline Package (TSSOP)

GPC

TNR

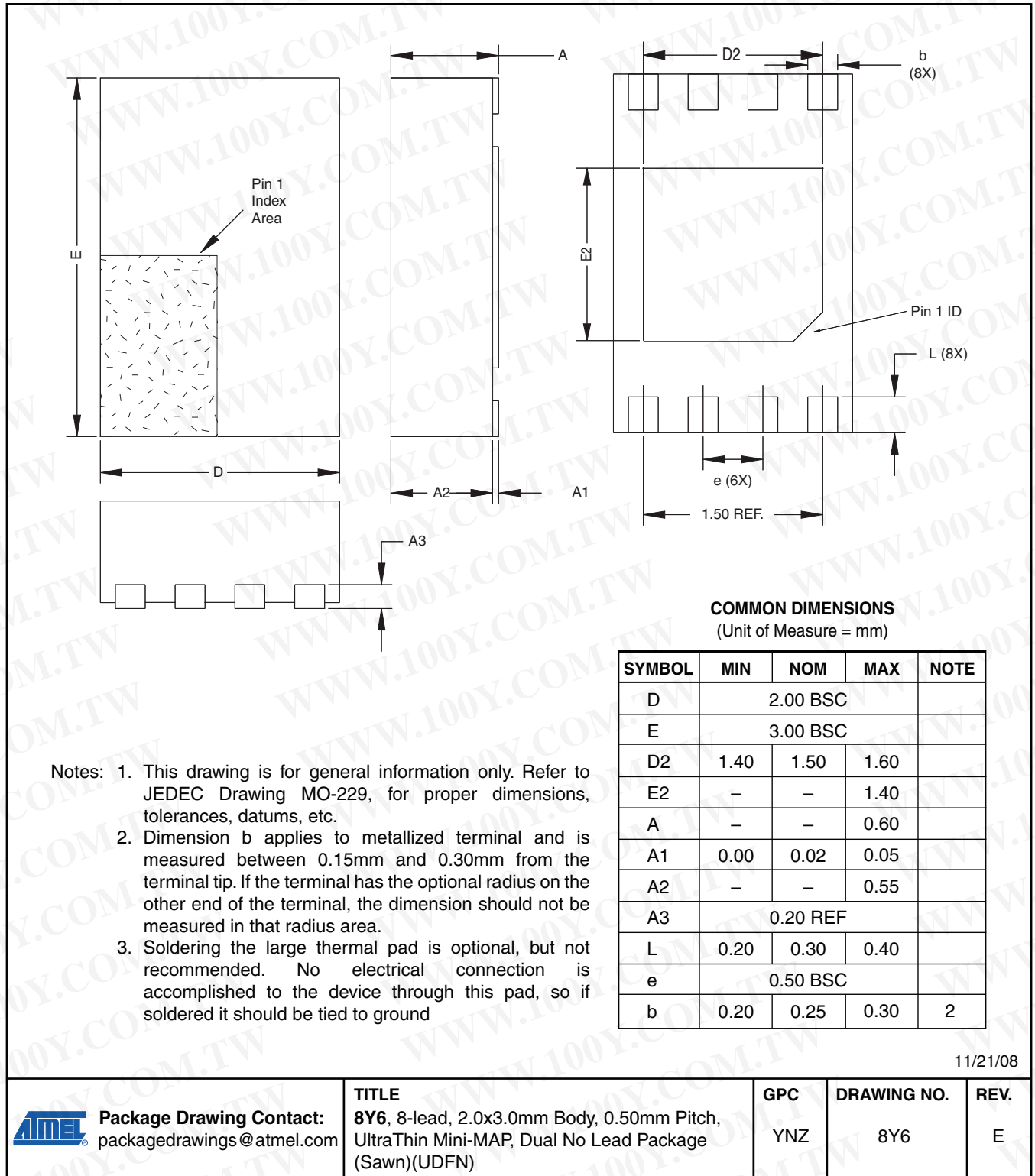
DRAWING NO.

8A2

REV.

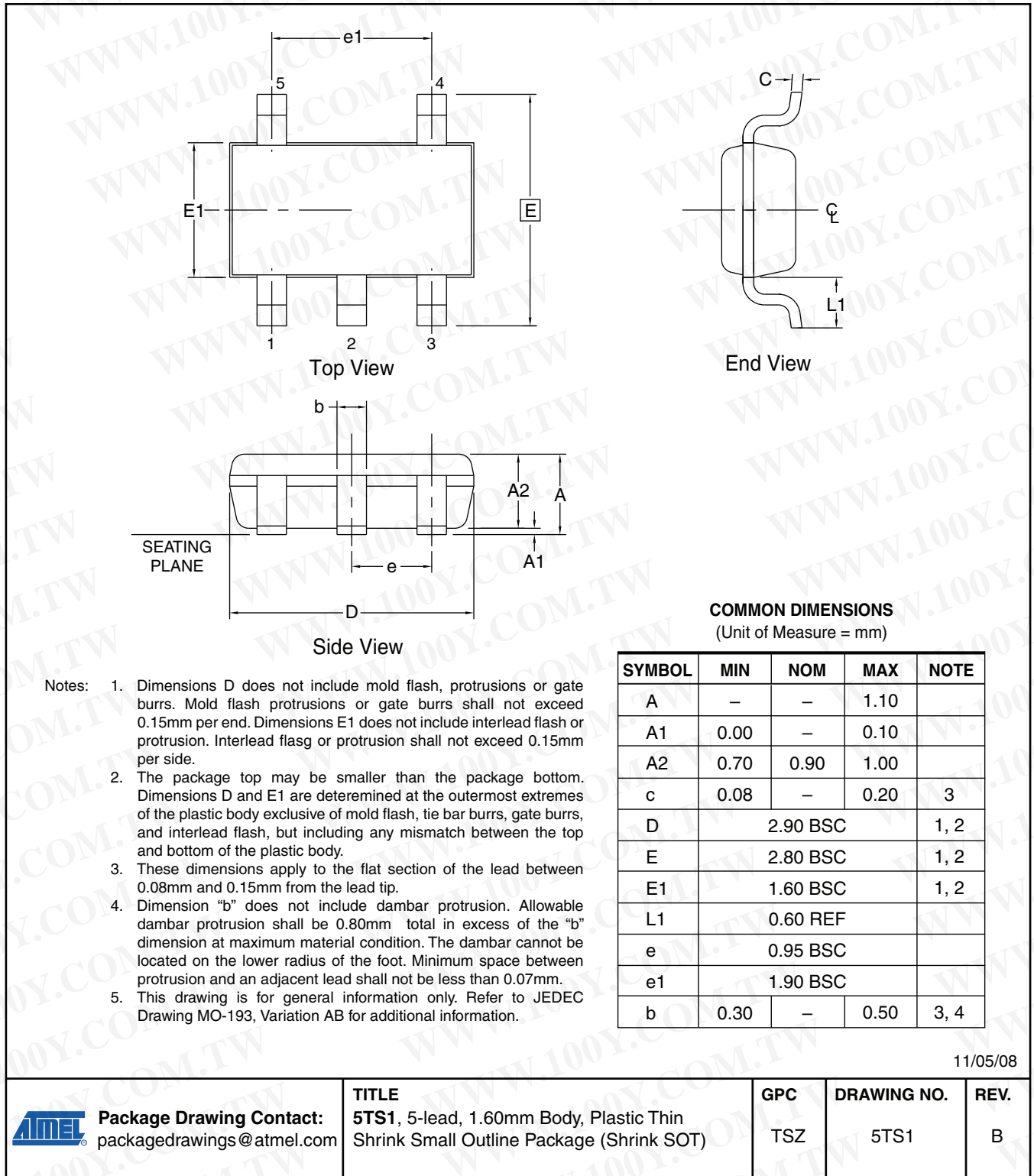
E

8Y6 - UDFN

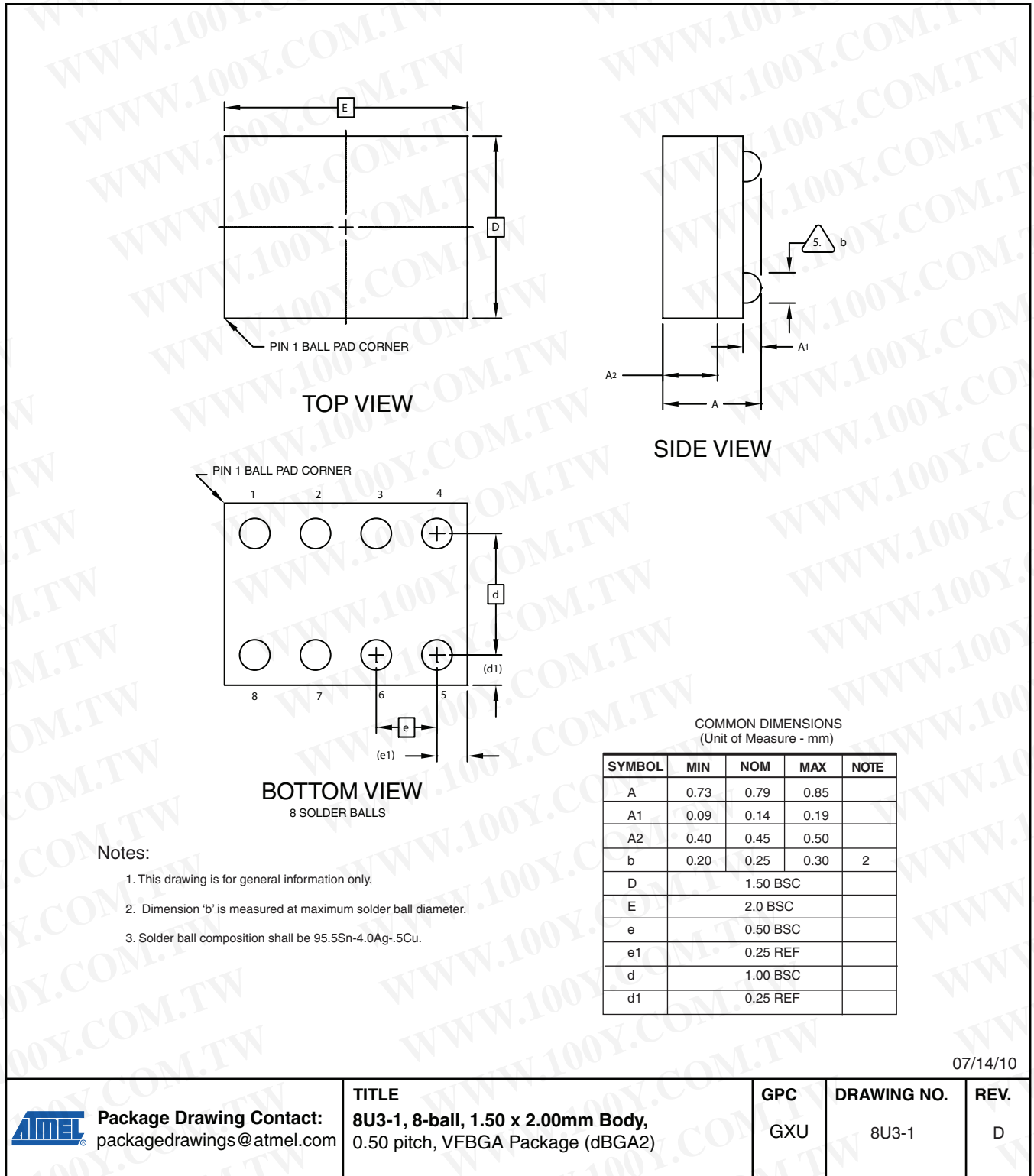


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 勝特力电子(上海) 86-21-34970699
 勝特力电子(深圳) 86-755-83298787
[Http://www.100y.com.tw](http://www.100y.com.tw)

5TS1 – SOT23



8U3-1 – VFBGA





13. Revision History

Doc. Rev.	Date	Comments
8700D	08/2010	Changed AT24C02C-XHM Part Marking from C02CM@ to 02CM @
8700C	07/2010	Ordering Information: - Changed Atmel AT24C02C-TSUM-T to Atmel AT24C02C-STUM-T - Changed Atmel AT24C02CY6-MAHM-T to Atmel AT24C02C-MAHM-T - Changed Atmel AT24C02CU3-CUM-T to Atmel AT24C02C-CUM-T Catalog Numbering Scheme, changed TS = SOT23 to ST = SOT23 Part Marking SOT23: - Changed 2CMWU to 2CMBU - Changed W = Write Protection Feature to B = Write Protection Part Marking PDIP and SOIC: Added @ = Country of Assembly Part Marking TSSOP: Replaced and removed bottom mark Part Marking UDFN: Added HM@ Remove Preliminary Status Changed t _r Max 40 to 50 in Table AC Characteristics
8700B	02/2010	Corrected Catalog Numbering Scheme and Ordering Information
8700A	12/2009	Initial Document Release

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勝特力电子(深圳) 86-755-83298787
[Http://www.100y.com.tw](http://www.100y.com.tw)

Headquarters

Atmel Corporation
2325 Orchard Parkway
San Jose, CA 95131
USA
Tel: (+1) (408) 441-0311
Fax: (+1) (408) 487-2600
www.atmel.com

International

Atmel Asia Limited
Unit 01-5 & 16, 19F
BEA Tower, Millennium City 5
418 Kwun Tong Road
Kwun Tong, Kowloon
HONG KONG
Tel: (+852) 2245-6100
Fax: (+852) 2722-1369

Atmel Munich GmbH
Business Campus
Parking 4
D-85748 Garching b. Munich
GERMANY
Tel: (+49) 89-31970-0
Fax: (+49) 89-3194621

Atmel Japan
9F, Tonetsu Shinkawa Bldg.
1-24-8 Shinkawa
Chuo-ku, Tokyo 104-0033
JAPAN
Tel: (+81) (3) 3523-3551
Fax: (+81) (3) 3523-7581

Product Contact

Technical Support
s_eepr@atmel.com

Sales Contact
www.atmel.com/contacts

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