

## Features

- Precision supply-voltage monitor
  - 4.63V (PT7M78xxL)
  - 4.38V (PT7M78xxM except PT7M7803/09/10M)
  - 3.08V (PT7M78xxT)
  - 2.93V (PT7M78xxS)
  - 2.63V (PT7M78xxR)
  - 2.32V (PT7M78xxZ)
  - 2.20V (PT7M78xxY)
  - 4.00V (PT7M78xxJ)
  - 4.26V (PT7M7803/09/10M)
  - 2.25V (PT7M7823/24K)
- 200ms reset pulse width
- Debounced CMOS-compatible manual-reset input (7811, 7812, 7823, 7825)
- Reset Output Signal for Watchdog and Power Abnormal, Manual Reset
- Reset Push-Pull output (PT7M7809,7811,7823, 7824,7825)
- Reset Open-Drain output (PT7M7803)
- Voltage monitor for power-fail or low battery warning
- Guaranteed  $\overline{\text{RESET}}/\text{RESET}$  valid at  $V_{CC}=1.0V$

## Description

The PT7M78xx family microprocessor (μP) supervisory circuits are targeted to improve reliability and accuracy of power-supply circuitry in μP systems. These devices reduce the complexity and number of components required to monitor power-supply and battery functions.

The main functions are:

1. Asserting reset output during power-up, power-down and brownout conditions for μP system.
2. Detecting power failure or low-battery conditions with a 1.25V threshold detector.
3. Watchdog functions
4. Manual reset.

## Applications

- Power-supply circuitry in μP systems

## Ordering Information

Part Number	Package	Part Number	Package
PT7M7803XTE	Lead free and Green SOT23-3	PT7M7824XTAE	Lead free and Green SOT23-5
PT7M7809XTE	Lead free and Green SOT23-3	PT7M7825XTAE	Lead free and Green SOT23-5
PT7M7810XTE	Lead free and Green SOT23-3	PT7M7811XTBE	Lead free and Green SOT143
PT7M7811XTAE	Lead free and Green SOT23-5	PT7M7812XTBE	Lead free and Green SOT143
PT7M7812XTAE	Lead free and Green SOT23-5	PT7M7809XUWF	Wafer form
PT7M7823XTAE	Lead free and Green SOT23-5		

Note: "X" refers to voltage range, see below table.

### Suffix: X—Monitored Voltage

X	L	M <sup>1)</sup>	T	S	R	Z	Y	J	K <sup>2)</sup>
Reset Threshold (V)	4.63	4.38	3.08	2.93	2.63	2.32	2.20	4.00	2.25

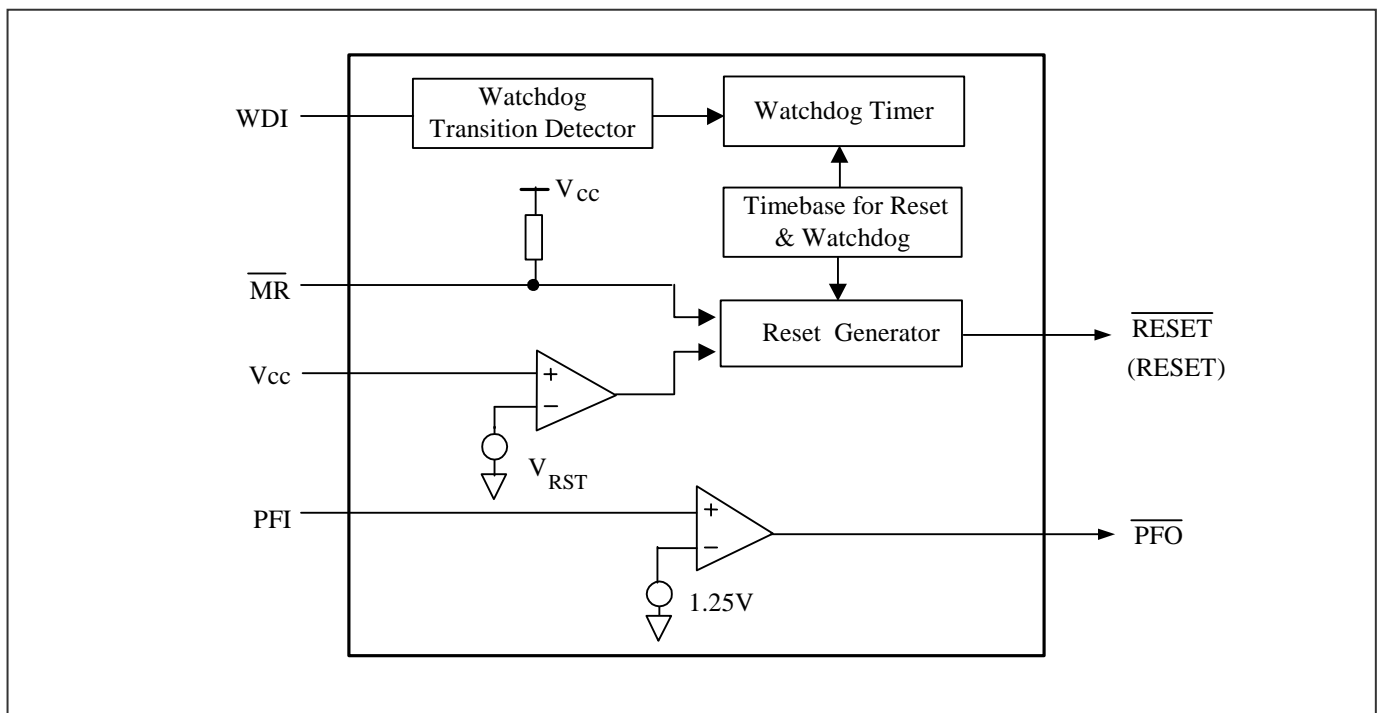
Note1): Threshold voltage=4.38V can be applied to all parts except PT7M7803/09/10M. PT7M7803/09/10M's threshold voltage is 4.26V.

2): Threshold voltage=2.25V only for PT7M7823/24K.

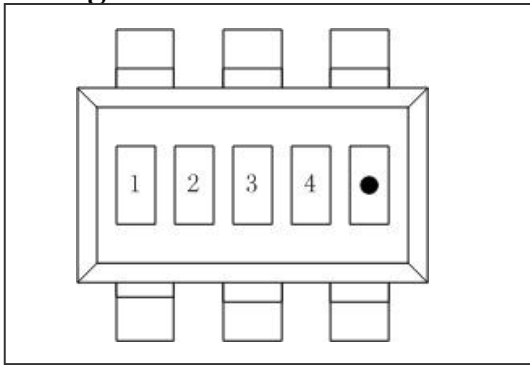
**Function Comparison**

	Part No.	$\overline{\text{RESET}}$ output		RESET output (push-pull)	Manual Reset Input	Power Fail Detector (1.25V)	Watchdog Input
		Push-Pull	Open-Drain				
1	PT7M7803	-	√	-	-	-	-
2	PT7M7809	√	-	-	-	-	-
3	PT7M7810	-	-	√	-	-	-
4	PT7M7811	√	-	-	√	-	-
5	PT7M7812	-	-	√	√	-	-
6	PT7M7823	√	-	-	√	-	√
7	PT7M7824	√	-	√	-	-	√
8	PT7M7825	√	-	√	√	-	-

**Block Diagram**



**Marking Information**



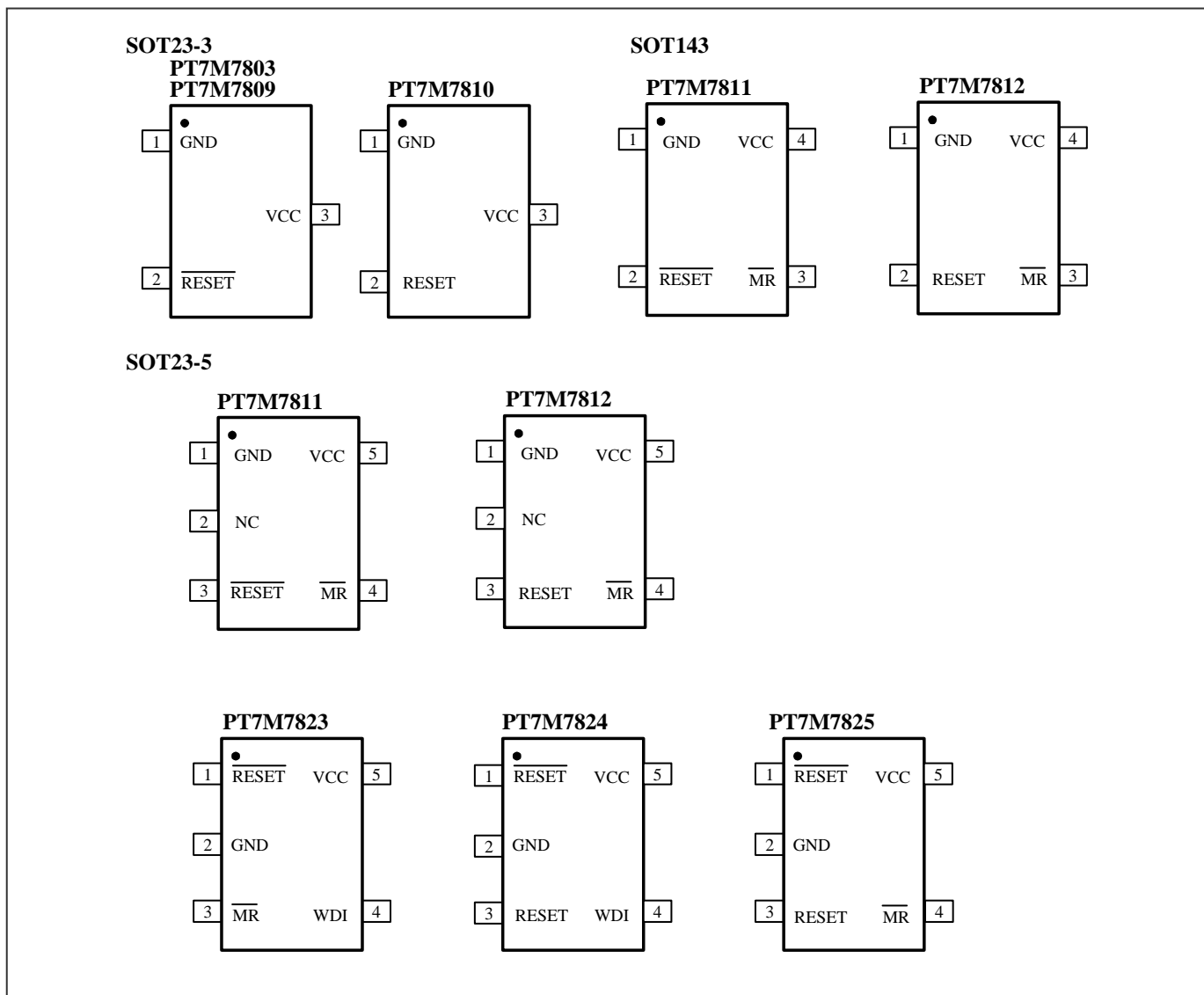
Code	Description
1 2	Part Number
3	Year
4	Work Week
●	Only for PT7M7809M

**Part Number Code**

Code 1 2	Part No	Code 1 2	Part No	Code 1 2	Part No	Code 1 2	Part No
AA	PT7M7809L	AO	PT7M7811L	BC	PT7M7803L	BQ	PT7M7824L
AB	PT7M7809M	AP	PT7M7811M	BD	PT7M7803M	BR	PT7M7824M
AC	PT7M7809T	AQ	PT7M7811T	BE	PT7M7803T	BS	PT7M7824T
AD	PT7M7809S	AR	PT7M7811S	BF	PT7M7803S	BT	PT7M7824S
AE	PT7M7809R	AS	PT7M7811R	BG	PT7M7803R	BU	PT7M7824R
AF	PT7M7809Z	AT	PT7M7811Z	BH	PT7M7803Z	BV	PT7M7824Z
AG	PT7M7809Y	AU	PT7M7811Y	BI	PT7M7803Y	BW	PT7M7824Y
jm	PT7M7809J	sf	PT7M7811J	sc	PT7M7803J	si	PT7M7824J
						mQ	PT7M7824K
AH	PT7M7810L	AV	PT7M7812L	BJ	PT7M7823L	BX	PT7M7825L
AI	PT7M7810M	AW	PT7M7812M	BK	PT7M7823M	BY	PT7M7825M
AJ	PT7M7810T	AX	PT7M7812T	BL	PT7M7823T	BZ	PT7M7825T
AK	PT7M7810S	AY	PT7M7812S	BM	PT7M7823S	CA	PT7M7825S
AL	PT7M7810R	AZ	PT7M7812R	BN	PT7M7823R	CB	PT7M7825R
AM	PT7M7810Z	BA	PT7M7812Z	BO	PT7M7823Z	CC	PT7M7825Z
AN	PT7M7810Y	BB	PT7M7812Y	BP	PT7M7823Y	CD	PT7M7825Y
se	PT7M7810J	sg	PT7M7812J	sh	PT7M7823J	sj	PT7M7825J
				mP	PT7M7823K		

**Note:** Lead free and Green package is available by adding line above the first code. For example: Part Number code of PT7M7809LTE is AA.

**Pin Configuration**



## Pin Description

Pin	Type	Description
$\overline{\text{MR}}$	I	<b>Manual-Reset: (CMOS).</b> Active low. Pull low to force a reset. Reset remains asserted for the duration of the Reset Timeout Period after MR transitions from low to high. Leave unconnected or connected to VCC if not used.
VCC	Power	<b>Supply Voltage.</b> Reset is asserted when V <sub>CC</sub> drops below the Reset Threshold Voltage (V <sub>RST</sub> ). Reset remains asserted until V <sub>CC</sub> rises above V <sub>RST</sub> and keep asserted for the duration of the Reset Timeout Period (t <sub>RS</sub> ) once V <sub>CC</sub> rises above V <sub>RST</sub> .
GND	-	<b>Ground Reference</b> for all signals.
PFI	I	<b>Power-Fail Voltage Monitor Input.</b> When PFI < V <sub>PFT</sub> , $\overline{\text{PFO}}$ goes low. Connect PFI to GND or Vcc when not used.
$\overline{\text{PFO}}$	O	<b>Power-Fail Output:</b> it gets low and sinks current when PFI is less than 1.25V; otherwise $\overline{\text{PFO}}$ stays high.
WDI	I	<b>Watchdog Input (CMOS).</b> If WDI remains high or low for the duration of the watchdog timeout period (t <sub>WD</sub> ), the internal watchdog timer trigger a reset output. Floating WDI or connecting WDI to a high-impedance three-state buffer disables the watchdog feature. The internal watchdog timer clears whenever reset is asserted or WDI occurs a rising or falling edge.
$\overline{\text{RESET}}$	O	<b>Active-Low Reset Output (Push-Pull or Open-Drain).</b> It goes low when Vcc is below the reset threshold. It remains low for about 200ms after one of the following occurs: Vcc rises above the reset threshold (VRST), the watchdog triggers a reset, or $\overline{\text{MR}}$ goes from low to high.
RESET	O	<b>The inverse of <math>\overline{\text{RESET}}</math>,</b> active high. Whenever $\overline{\text{RESET}}$ is high, RESET is low.
NC	-	<b>No connection.</b>

## Functional Description

### Reset Output

A microprocessor (μP) reset input starts the μP in a known state. Whenever the μP is in an unknown state, it should be held in reset. The supervisory circuits assert reset during power-up and prevent code execution errors during power-down or brownout conditions.

On power-up, once Vcc reaches about 1.0V,  $\overline{\text{RESET}}$  is a guaranteed logic low of 0.4V or less. As Vcc rises,  $\overline{\text{RESET}}$  stays low. When Vcc rises above the reset threshold, an internal timer releases  $\overline{\text{RESET}}$  after about 200ms.  $\overline{\text{RESET}}$  pulses low whenever Vcc drops below the reset threshold, i.e. brownout condition. If brownout occurs in the middle of a previously initiated reset pulse, the pulse continues for at least another 200ms. On power-down, once Vcc falls below the reset threshold,  $\overline{\text{RESET}}$  stays low and is guaranteed to be 0.4V or less until Vcc drops below 1.0V. Watchdog Timing Diagram shows the timing relationship.

The active-high RESET output is simply the inverse of the  $\overline{\text{RESET}}$  output, and is guaranteed to be valid with Vcc down to 1.0V.

### Watchdog Timer

The PT7M78xx watchdog circuit monitors the μP activity. If the μP does not toggle the watch-dog input (WDI) within 1.6s, reset asserts. As long as reset is asserted or the WDI input is toggled, the watchdog timer will stay clear and will not count. As soon as reset is released, the timer will start counting. WDI input pulses as short as 50ns can be detected.

Disable the watchdog function by leaving WDI unconnected or by three-stating driver connected to WDI.

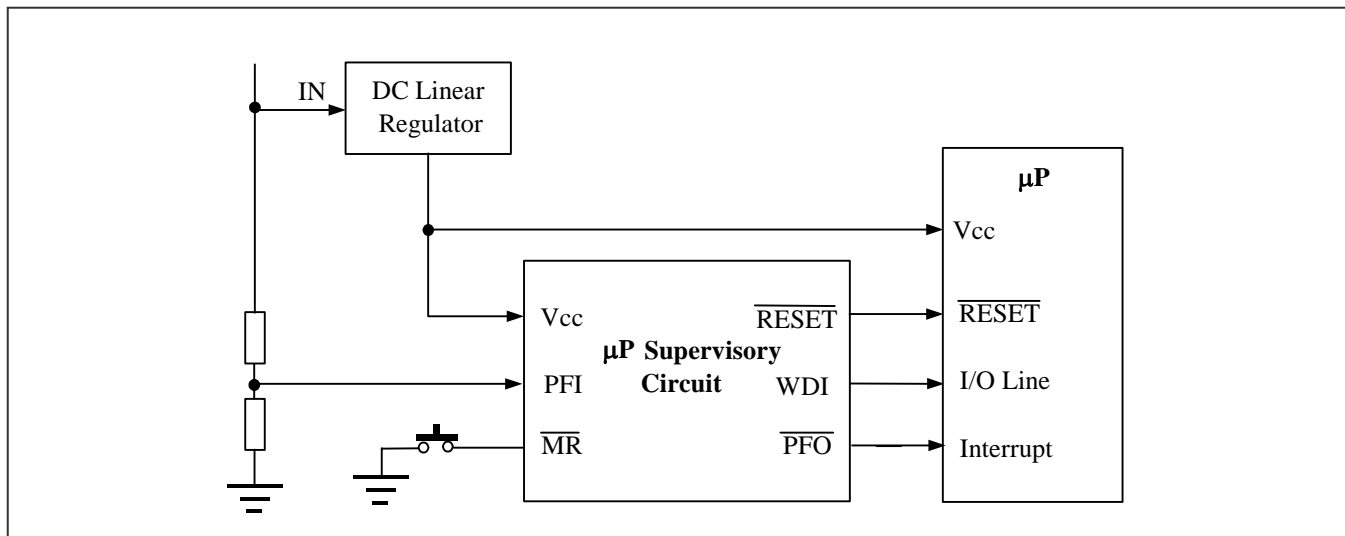
### Manual Reset

The manual-reset input ( $\overline{\text{MR}}$ ) allows reset to be triggered by a push button switch.  $\overline{\text{MR}}$  has an internal pullup resistor, so it can be left open when not used.

### Power-Fail Comparator

The power-fail comparator can be used for various purposes because its output and noninverting input are not internally connected. The inverting input is internally connected to a 1.25V reference.

### Typical Application Circuit



### Maximum Ratings

Storage Temperature .....	-65°C to +150°C
Ambient Temperature with Power Applied.....	-40°C to +85°C
Supply Voltage to Ground Potential (V <sub>CC</sub> to GND) .....	-0.3V to +7.0V
DC Input Voltage (All inputs except V <sub>CC</sub> and GND).....	-0.3V to V <sub>CC</sub> +0.3V
DC Output Current (All outputs) .....	20mA
Power Dissipation .....	320mW (Depend on package)

**Note:**

Stresses greater than those listed under 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 operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

### Recommended Operation Conditions

Sym	Description	Test Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	Supply Voltage for 78xxL/M/J	-	4.5	5.0	5.5	V
	Supply Voltage for 78xxT/S	-	3.0	3.3	5.5	V
	Supply Voltage for 78xxR/Z/Y/K	-	2.7	3.0	5.5	V
V <sub>IH</sub>	Input High Voltage	-	0.7V <sub>CC</sub>	-	-	V
V <sub>IL</sub>	Input Low Voltage	-	-	-	0.3V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature	-	-40	-	85	

**DC Electrical Characteristics**

( $V_{CC} = V_{RN} + 5\%$  to 5.5V,  $T_A = -40 \sim 85^\circ\text{C}$ , unless otherwise noted.)(Note 1)

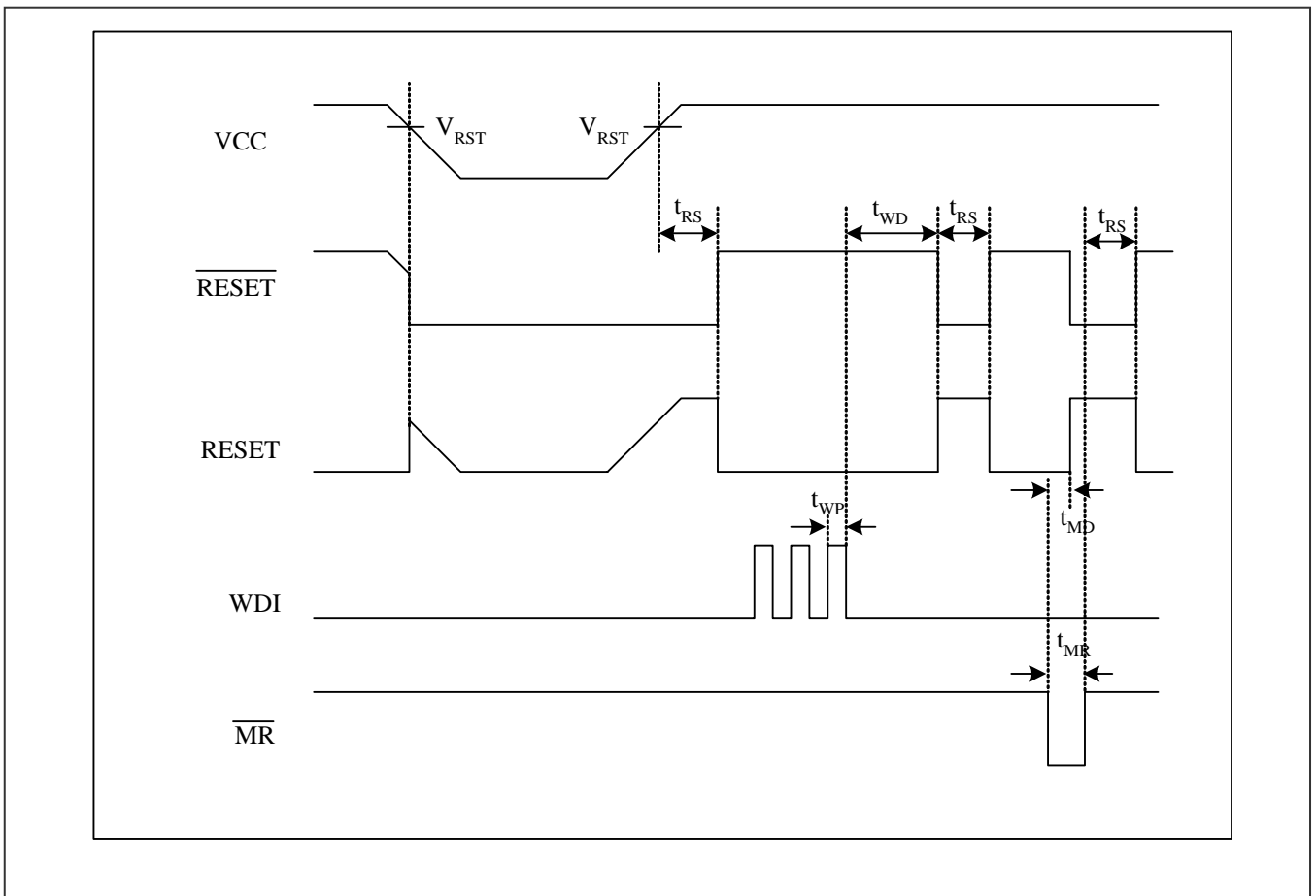
Symbol	Description	Test Conditions		Min	Typ	Max	Unit
$V_{CC}$	Operating Voltage Range	-		1.0	-	5.5	V
$I_{CC}$	Supply Current	$V_{CC} = 5V$ , No load	7803/09/10/11/12	-	10	30	$\mu\text{A}$
			7823/24/25	-	13	36	
$V_{IH}$	Input High Voltage	Pin: $\overline{\text{MR}}$ , WDI		$0.7V_{CC}$	-	-	V
$V_{IL}$	Input Low Voltage	Pin: $\overline{\text{MR}}$ , WDI		-	-	$0.3V_{CC}$	V
$V_{RST}$ ( $V_{RTH-}$ )	Threshold Voltage(Falling-edge)(Note 2)	$T_A = 25^\circ\text{C}$	78xx(except 7809R/M)	$V_{RN} - 1.5\%$	$V_{RN}$	$V_{RN} + 1.5\%$	V
			7809M	$V_{RN} - 1.1\%$	$V_{RN}$	$V_{RN} + 1.1\%$	
			7809R	$V_{RN} - 1.0\%$	$V_{RN}$	$V_{RN} + 1.0\%$	
		$T_A = -40 \sim 85^\circ\text{C}$	7809M	$V_{RN} - 1.8\%$	$V_{RN}$	$V_{RN} + 2\%$	
		$T_A = -40 \sim 85^\circ\text{C}$	78xx(except 7809M)	$V_{RN} - 2.5\%$	$V_{RN}$	$V_{RN} + 2.5\%$	
$V_{RTH+}$	Threshold Voltage(Rising-edge) (Note 2)	$T_A = -40 \sim 85^\circ\text{C}$	7809M	4.232	4.31	4.396	V
$V_{RTH}$	Reset Threshold Hysteresis (Note 2)	$V_{CC}$ varies between $V_{RN} \pm 5\%$	7823/24/25L/M	-	12	-	mV
			7823/24/25 T/S/R/K/Z/Y	-	4	-	
			Others	-	50	-	
$V_{OH}$	Output High Voltage(Except 7823/24/25)	$V_{CC} \geq 4.5V$ $I_{source} = 800\mu\text{A}$	$V_{CC} - 1.5$	-	-	V	
		$V_{CC} \geq 2.7V$ $I_{source} = 500\mu\text{A}$	$0.8 \times V_{CC}$	-	-		
		$V_{CC} \geq 1.8V$ $I_{source} = 150\mu\text{A}$	$0.8 \times V_{CC}$	-	-		
		$V_{CC} \geq 1.0V$ $I_{source} = 4\mu\text{A}$	$0.8 \times V_{CC}$	-	-		
	Output High Voltage(7823/24/25)	7823/24/25L/M, $V_{CC} = V_{RST}$ $I_{source} = 120\mu\text{A}$	$V_{CC} - 1.5$	-	-	V	
	7823/24/25T/S/R/K, $V_{CC} = V_{RST}$ $I_{source} = 30\mu\text{A}$	$0.8 \times V_{CC}$	-	-	V		
$V_{OL}$	Output Low Voltage	$V_{CC} \geq 4.5V$ $I_{sink} = 3.2\text{mA}$	-	-	0.4	V	
		$V_{CC} \geq 2.7V$ $I_{sink} = 1.2\text{mA}$	-	-	0.3		
		$V_{CC} \geq 1.0V$ $I_{sink} = 100\mu\text{A}$	-	-	0.3		
$I_{LKG}$	Open-Drain Output Leakage Current	$V_{CC} > V_{TH(MAX)}$ for 7803		-	-	1	$\mu\text{A}$
$I_{WDI}$	Average WDI Input Current (Note 3)	WDI connected to $V_{CC}$ : 5.5V		-	120	160	$\mu\text{A}$
		WDI connected to GND		-20	-15	-	
$I_{source}$	$\overline{\text{RESET}}$ Output Short-Circuit Current (only for PT7M7823/24/25)	PT7M782xL/M, $\overline{\text{RESET}} = 0V$ , $V_{CC} = 5.5V$		-	-	800	$\mu\text{A}$
		PT7M782xT/S/R/K/Z/Y, $\overline{\text{RESET}} = 0V$ , $V_{CC} = 3.6V$		-	-	400	
$r$	MR pull-up resistor (internal)	PT7M7811/7812		10	20	30	k $\Omega$
		PT7M7823/7824/7825		35	52	75	

- Note:** 1. Parameters of room temperature guaranteed by production test and parameters of full-temperature guaranteed by design.  
2. Valid for both  $\overline{\text{RESET}}$  and  $\text{RESET}$ .  $V_{RST}$  ( $V_{RTH-}$ ) is the Reset threshold voltage when  $V_{CC}$  from high to low level, and  $V_{RTH+}$  is the Reset threshold voltage when  $V_{CC}$  from low to high level.  $V_{RN}$  is nominal reset threshold voltage.  
3. WDI is internally serviced within the watchdog period if WDI is left unconnected.

**AC Electrical Characteristics**

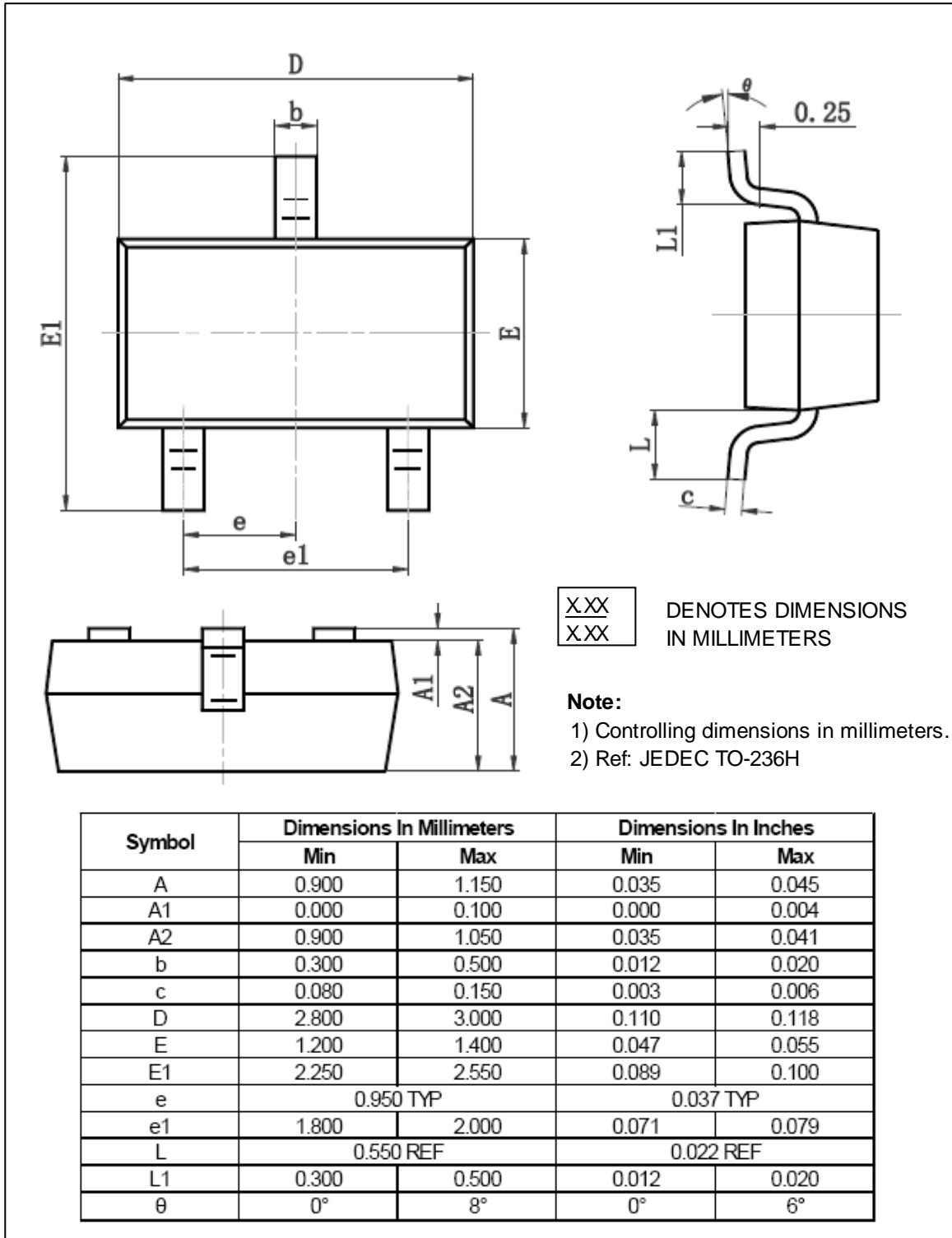
Symbol	Description	Test Conditions	Min	Typ	Max	Unit
$t_{RS}$	Reset Pulse Width	$\overline{MR}$ from low to High, $T_A=25$	140	200	400	ms
$t_{WD}$	Watchdog Timeout Period	WDI, $\overline{MR}$ tied to $V_{CC}$ , $V_{CC} > V_{RN} + 5\%$ , $T_A=25$	1.12	1.6	2.25	s
$t_{MR}$	$\overline{MR}$ Pulse Width	-	200	-	-	ns
$t_{MD}$	$\overline{MR}$ to $\overline{RESET}$ Delay	$V_{CC}=5V$	-	-	250	ns
$t_{WP}$	WDI Pulse Width	-	150	-	-	ns

**Watchdog Timing Diagram**

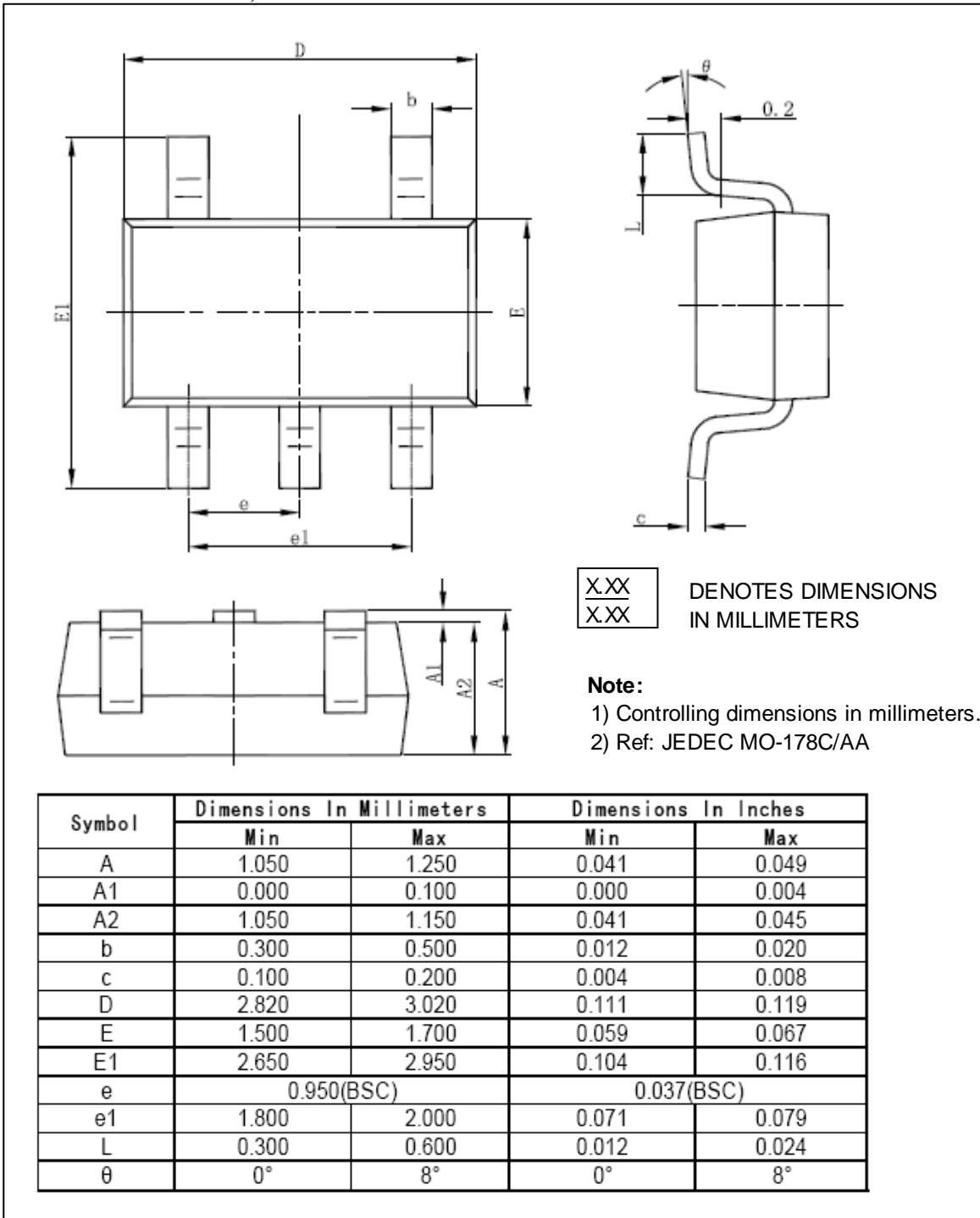




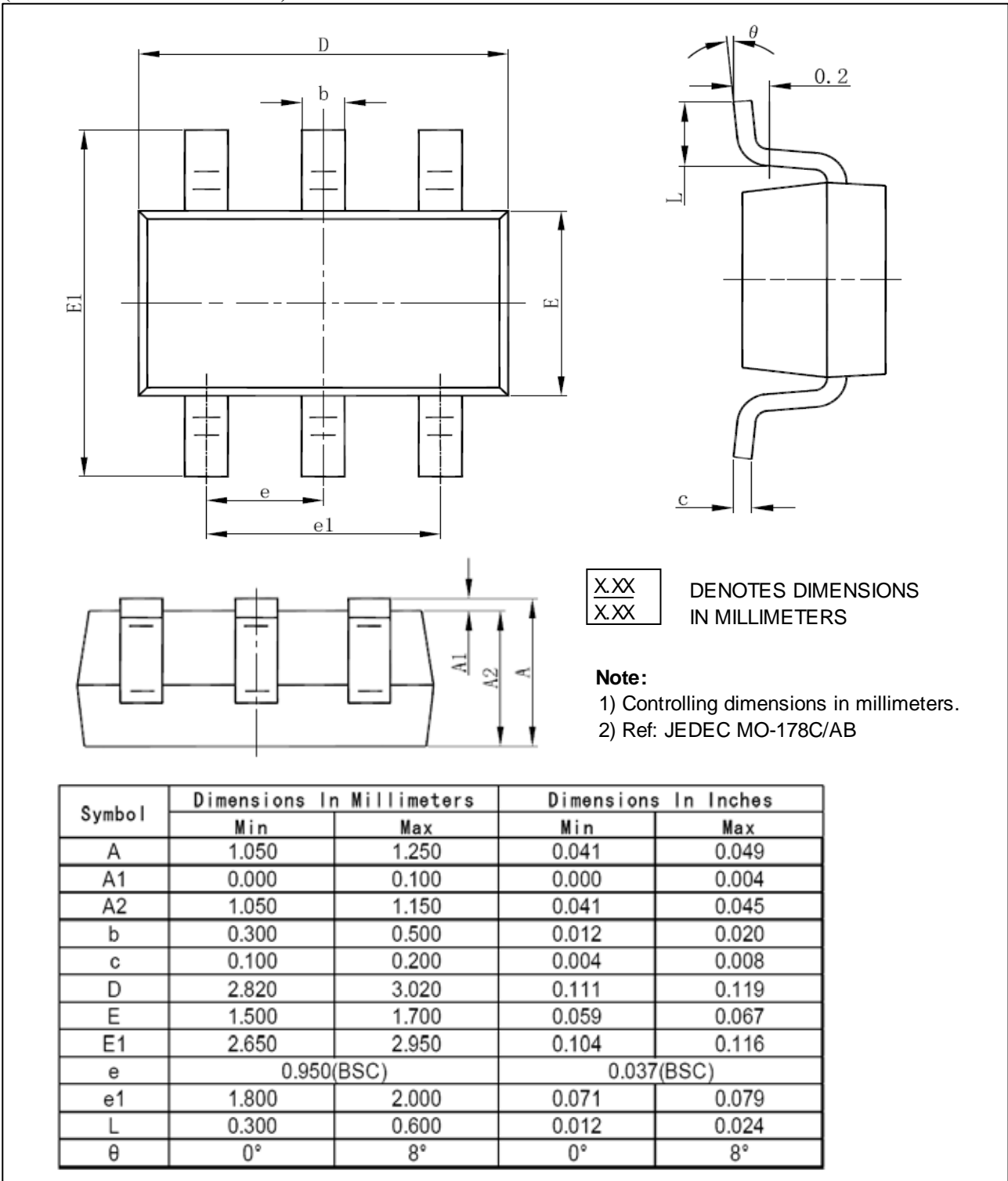
**Mechanical Information**  
 TE (Lead free and Green SOT23-3)



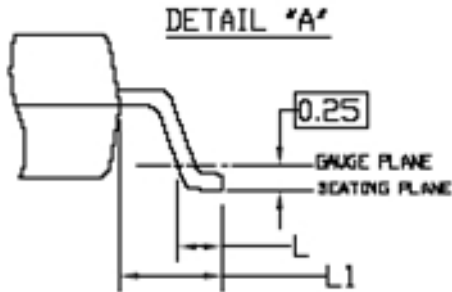
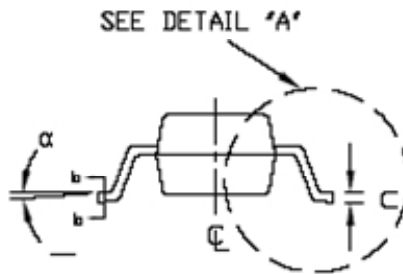
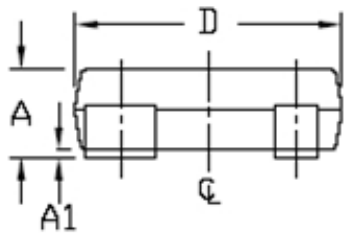
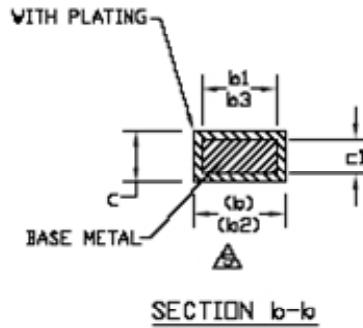
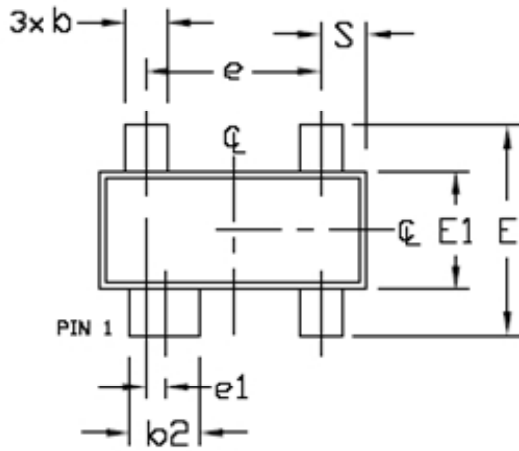
TAE (Lead free and Green SOT23-5)



**TAE (Lead free and Green SOT23-6)**



TBE (Lead free and Green SOT143)



$\frac{X.XX}{X.XX}$  DENOTES DIMENSIONS  
 IN MILLIMETERS

**Note:**

- 1) Controlling dimensions in millimeters.
- 2) Ref: JEDEC TO-253D

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.031	0.048	0.80	1.22
A1	0.000	0.006	0.01	0.15
b	0.014	0.020	0.35	0.50
b1	0.012	0.018	0.30	0.45
b2	0.030	0.035	0.76	0.89
b3	0.012	0.033	0.76	0.84
c	0.003	0.008	0.08	0.20
c1	0.003	0.006	0.08	0.16
D	0.110	0.120	2.80	3.04
E	0.083	0.104	2.10	2.64
E1	0.047	0.055	1.20	1.40
e	0.076 BSC.		1.92 BSC.	
e1	0.008 BSC.		0.20 BSC.	
L	0.016	0.024	0.40	0.60
L1	0.021 REF.		0.54 REF.	
S	0.018	0.024	0.45	0.60
$\alpha$	0°	8°	0°	8°

**Notes**

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