

## Micropower Voltage Detector

### Features

- Ultra-low supply current: 1.75  $\mu\text{A}$  (max.)
- Precision monitoring options of:
  - 1.90V, 2.32V, 2.63V, 2.90V, 2.93V, 3.08V, 4.38V and 4.63V
- Resets microcontroller in a power-loss event
- Active-low  $V_{\text{OUT}}$  pin:
  - **MCP111** active-low, open-drain
  - **MCP112** active-low, push-pull
- Available in SOT23-3, TO-92, SC-70 and SOT-89-3 packages
- Temperature Range:
  - Extended:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  (except MCP1XX-195)
  - Industrial:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  (MCP1XX-195 only)
- Pb-free devices

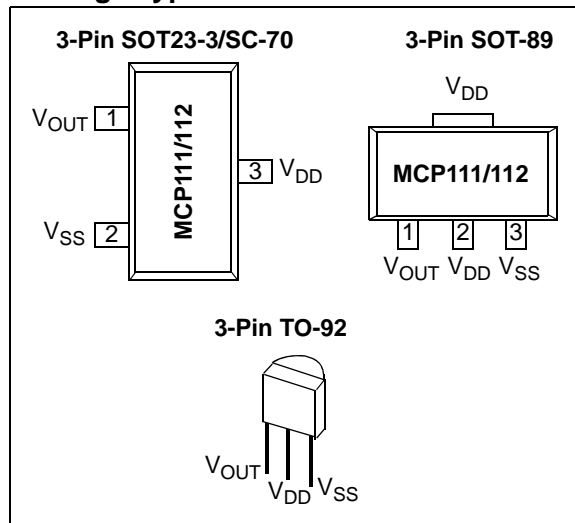
### Applications

- Critical Microcontroller and Microprocessor Power-Monitoring Applications
- Computers
- Intelligent Instruments
- Portable Battery-Powered Equipment

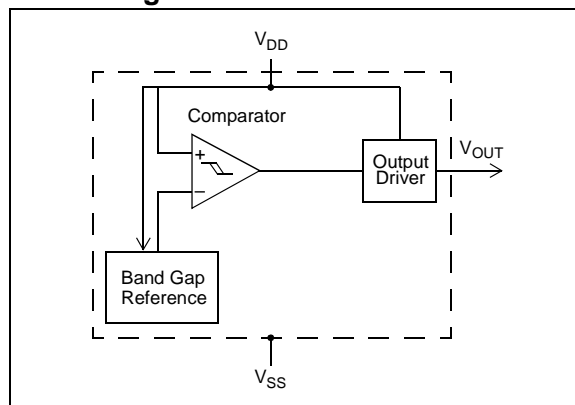
### Description

The MCP111/112 are voltage-detecting devices designed to keep a microcontroller in reset until the system voltage has stabilized at the appropriate level for reliable system operation. These devices also operate as protection from brown-out conditions when the system supply voltage drops below the specified threshold voltage level. Eight different trip voltages are available.

### Package Types



### Block Diagram



**TABLE 1: DEVICE FEATURES**

Device	Output		Reset Delay (typ)	Package Pin Out (Pin # 1, 2, 3)	Comment
	Type	Pull-up Resistor			
<b>MCP111</b>	Open-drain	External	No	$V_{\text{OUT}}, V_{\text{SS}}, V_{\text{DD}}$	
<b>MCP112</b>	Push-pull	No	No	$V_{\text{OUT}}, V_{\text{SS}}, V_{\text{DD}}$	
<b>MCP102</b>	Push-pull	No	120 ms	$\overline{\text{RST}}, V_{\text{DD}}, V_{\text{SS}}$	See <b>MCP102/103/121/131</b> Data Sheet (DS21906)
<b>MCP103</b>	Push-pull	No	120 ms	$V_{\text{SS}}, \overline{\text{RST}}, V_{\text{DD}}$	See <b>MCP102/103/121/131</b> Data Sheet (DS21906)
<b>MCP121</b>	Open-drain	External	120 ms	$\overline{\text{RST}}, V_{\text{DD}}, V_{\text{SS}}$	See <b>MCP102/103/121/131</b> Data Sheet (DS21906)
<b>MCP131</b>	Open-Drain	Internal (~95 k $\Omega$ )	120 ms	$\overline{\text{RST}}, V_{\text{DD}}, V_{\text{SS}}$	See <b>MCP102/103/121/131</b> Data Sheet (DS21906)

# MCP111/112

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings†

$V_{DD}$ .....	7.0V
Input current ( $V_{DD}$ ) .....	10 mA
Output current ( $R\overline{ST}$ ) .....	10 mA
Rated Rise Time of $V_{DD}$ .....	100V/ $\mu$ s
All inputs and outputs (except $R\overline{ST}$ ) w.r.t. $V_{SS}$ .....	-0.6V to ( $V_{DD} + 1.0$ V)
$R\overline{ST}$ output w.r.t. $V_{SS}$ .....	-0.6V to 13.5V
Storage temperature .....	-65°C to +150°C
Ambient temp. with power applied .....	-40°C to +125°C
Maximum Junction temp. with power applied .....	150°C
ESD protection on all pins .....	$\geq 2$ kV

† **Notice:** Stresses above 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 those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

### DC CHARACTERISTICS

**Electrical Specifications:** Unless otherwise indicated, all limits are specified for  $V_{DD} = 1$ V to 5.5V,  $R_{PU} = 100$  k $\Omega$  (only **MCP111**),  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameters		Sym	Min	Typ	Max	Units	Conditions
Operating Voltage Range		$V_{DD}$	1.0	—	5.5	V	
Specified $V_{DD}$ Value to $V_{OUT}$ low		$V_{DD}$	1.0	—		V	$I_{R\overline{ST}} = 10 \mu\text{A}$ , $V_{R\overline{ST}} < 0.2\text{V}$
Operating Current		$I_{DD}$	—	< 1	1.75	$\mu\text{A}$	
$V_{DD}$ Trip Point	<b>MCP1XX-195</b>	$V_{TRIP}$	1.872	1.900	1.929	V	$T_A = +25^\circ\text{C}$ ( <b>Note 1</b> )
			1.853	1.900	1.948	V	$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$ ( <b>Note 2</b> )
	<b>MCP1XX-240</b>		2.285	2.320	2.355	V	$T_A = +25^\circ\text{C}$ ( <b>Note 1</b> )
			2.262	2.320	2.378	V	<b>Note 2</b>
	<b>MCP1XX-270</b>		2.591	2.630	2.670	V	$T_A = +25^\circ\text{C}$ ( <b>Note 1</b> )
			2.564	2.630	2.696	V	<b>Note 2</b>
	<b>MCP1XX-290</b>		2.857	2.900	2.944	V	$T_A = +25^\circ\text{C}$ ( <b>Note 1</b> )
			2.828	2.900	2.973	V	<b>Note 2</b>
	<b>MCP1XX-300</b>		2.886	2.930	2.974	V	$T_A = +25^\circ\text{C}$ ( <b>Note 1</b> )
			2.857	2.930	3.003	V	<b>Note 2</b>
	<b>MCP1XX-315</b>		3.034	3.080	3.126	V	$T_A = +25^\circ\text{C}$ ( <b>Note 1</b> )
			3.003	3.080	3.157	V	<b>Note 2</b>
	<b>MCP1XX-450</b>		4.314	4.380	4.446	V	$T_A = +25^\circ\text{C}$ ( <b>Note 1</b> )
			4.271	4.380	4.490	V	<b>Note 2</b>
<b>MCP1XX-475</b>	4.561	4.630	4.700	V	$T_A = +25^\circ\text{C}$ ( <b>Note 1</b> )		
	4.514	4.630	4.746	V	<b>Note 2</b>		
$V_{DD}$ Trip Point Tempco		$T_{TPCO}$	—	$\pm 100$	—	ppm/ $^\circ\text{C}$	

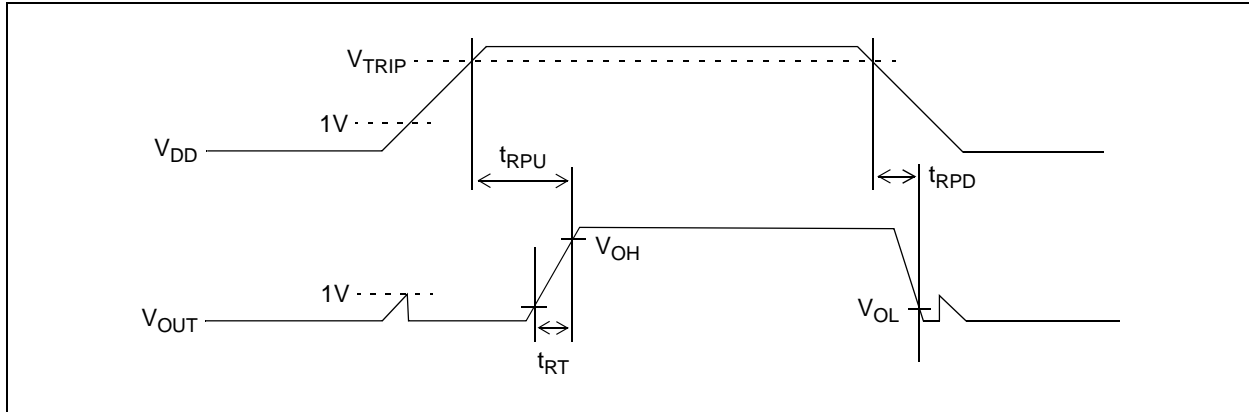
- Note 1:** Trip point is  $\pm 1.5\%$  from typical value.  
**Note 2:** Trip point is  $\pm 2.5\%$  from typical value.  
**3:** This specification allows this device to be used in PICmicro<sup>®</sup> microcontroller applications that require the In-Circuit Serial Programming<sup>™</sup> (ICSP<sup>™</sup>) feature (see device-specific programming specifications for voltage requirements). This specification DOES NOT allow a continuous high voltage to be present on the open-drain output pin ( $V_{OUT}$ ). The total time that the  $V_{OUT}$  pin can be above the maximum device operational voltage (5.5V) is 100 sec. Current into the  $V_{OUT}$  pin should be limited to 2 mA. It is recommended that the device operational temperature be maintained between  $0^\circ\text{C}$  to  $70^\circ\text{C}$  ( $+25^\circ\text{C}$  preferred). For additional information, please refer to Figure 2-28.  
**4:** This parameter is established by characterization and is not 100% tested.

## DC CHARACTERISTICS (CONTINUED)

Electrical Specifications: Unless otherwise indicated, all limits are specified for $V_{DD} = 1V$ to $5.5V$ , $R_{PU} = 100\text{ k}\Omega$ (only <b>MCP111</b> ), $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$ .							
Parameters	Sym	Min	Typ	Max	Units	Conditions	
Threshold Hysteresis (min. = 1%, max = 6%)	<b>MCP1XX-195</b>	$V_{HYS}$	0.019	—	0.114	V	$T_A = +25^\circ\text{C}$
	<b>MCP1XX-240</b>		0.023	—	0.139	V	
	<b>MCP1XX-270</b>		0.026	—	0.158	V	
	<b>MCP1XX-290</b>		0.029	—	0.174	V	
	<b>MCP1XX-300</b>		0.029	—	0.176	V	
	<b>MCP1XX-315</b>		0.031	—	0.185	V	
	<b>MCP1XX-450</b>		0.044	—	0.263	V	
	<b>MCP1XX-475</b>		0.046	—	0.278	V	
$V_{OUT}$ Low-level Output Voltage	$V_{OL}$	—	—	0.4	V	$I_{OL} = 500\text{ }\mu\text{A}$ , $V_{DD} = V_{TRIP(MIN)}$	
$V_{OUT}$ High-level Output Voltage	$V_{OH}$	$V_{DD} - 0.6$	—	—	V	$I_{OH} = 1\text{ mA}$ , For only <b>MCP112</b> (push-pull output)	
Open-drain High Voltage on Output	$V_{ODH}$	—	—	13.5 <sup>(3)</sup>	V	<b>MCP111</b> only, $V_{DD} = 3.0V$ , Time voltage > 5.5V applied $\leq 100s$ , current into pin limited to 2 mA, $+25^\circ\text{C}$ operation recommended <b>Note 3, Note 4</b>	
Open-drain Output Leakage Current ( <b>MCP111</b> only)	$I_{OD}$	—	0.1	—	$\mu\text{A}$		

- Note 1:** Trip point is  $\pm 1.5\%$  from typical value.
- Note 2:** Trip point is  $\pm 2.5\%$  from typical value.
- Note 3:** This specification allows this device to be used in PICmicro<sup>®</sup> microcontroller applications that require the In-Circuit Serial Programming<sup>™</sup> (ICSP<sup>™</sup>) feature (see device-specific programming specifications for voltage requirements). This specification DOES NOT allow a continuous high voltage to be present on the open-drain output pin ( $V_{OUT}$ ). The total time that the  $V_{OUT}$  pin can be above the maximum device operational voltage (5.5V) is 100 sec. Current into the  $V_{OUT}$  pin should be limited to 2 mA. It is recommended that the device operational temperature be maintained between  $0^\circ\text{C}$  to  $70^\circ\text{C}$  ( $+25^\circ\text{C}$  preferred). For additional information, please refer to Figure 2-28.
- Note 4:** This parameter is established by characterization and is not 100% tested.

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**FIGURE 1-1:** Timing Diagram.

## AC CHARACTERISTICS

**Electrical Specifications:** Unless otherwise indicated, all limits are specified for  $V_{DD} = 1V$  to  $5.5V$ ,  $R_{PU} = 100\text{ k}\Omega$  (only **MCP111**),  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameters	Sym	Min	Typ	Max	Units	Conditions
$V_{DD}$ Detect to $V_{OUT}$ Inactive	$t_{RPU}$	—	90	—	$\mu\text{s}$	Figure 1-1 and $C_L = 50\text{ pF}$ (Note 1)
$V_{DD}$ Detect to $V_{OUT}$ Active	$t_{RPD}$	—	130	—	$\mu\text{s}$	$V_{DD}$ ramped from $V_{TRIP(MAX)} + 250\text{ mV}$ down to $V_{TRIP(MIN)} - 250\text{ mV}$ , per Figure 1-1, $C_L = 50\text{ pF}$ (Note 1)
$V_{OUT}$ Rise Time After $V_{OUT}$ Active	$t_{RT}$	—	5	—	$\mu\text{s}$	For $V_{OUT}$ 10% to 90% of final value per Figure 1-1, $C_L = 50\text{ pF}$ (Note 1)

**Note 1:** These parameters are for design guidance only and are not 100% tested.

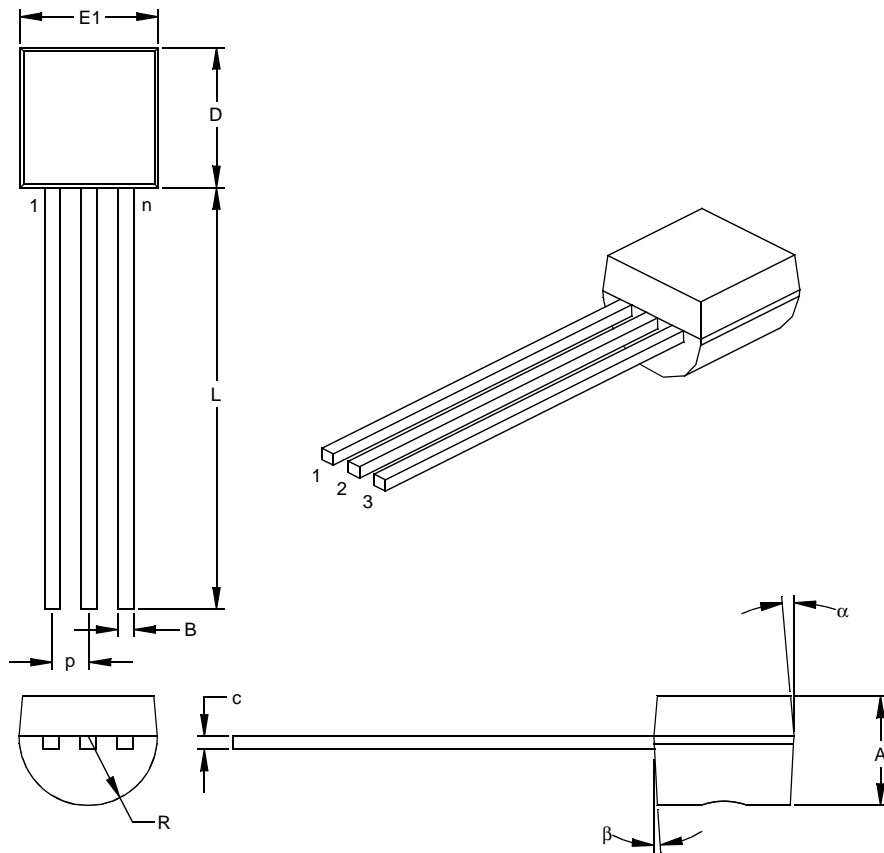
## TEMPERATURE CHARACTERISTICS

**Electrical Specifications:** Unless otherwise noted, all limits are specified for  $V_{DD} = 1V$  to  $5.5V$ ,  $R_{PU} = 100\text{ k}\Omega$  (only **MCP111**),  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameters	Sym	Min	Typ	Max	Units	Conditions
<b>Temperature Ranges</b>						
Specified Temperature Range	$T_A$	-40	—	+85	$^\circ\text{C}$	<b>MCP1XX-195</b>
Specified Temperature Range	$T_A$	-40	—	+125	$^\circ\text{C}$	Except <b>MCP1XX-195</b>
Maximum Junction Temperature	$T_J$	—	—	+150	$^\circ\text{C}$	
Storage Temperature Range	$T_A$	-65	—	+150	$^\circ\text{C}$	
<b>Package Thermal Resistances</b>						
Thermal Resistance, 3L-SOT23	$\theta_{JA}$	—	336	—	$^\circ\text{C/W}$	
Thermal Resistance, 3L-SC-70	$\theta_{JA}$	—	340	—	$^\circ\text{C/W}$	
Thermal Resistance, 3L-TO-92	$\theta_{JA}$	—	131.9	—	$^\circ\text{C/W}$	
Thermal Resistance, 3L-SOT-89	$\theta_{JA}$	—	110	—	$^\circ\text{C/W}$	

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## 3-Lead Plastic Transistor Outline (TO) (TO-92)



Dimension Limits	Units	INCHES*			MILLIMETERS		
		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		3			3	
Pitch	p		.050			1.27	
Bottom to Package Flat	A	.130	.143	.155	3.30	3.62	3.94
Overall Width	E1	.175	.186	.195	4.45	4.71	4.95
Overall Length	D	.170	.183	.195	4.32	4.64	4.95
Molded Package Radius	R	.085	.090	.095	2.16	2.29	2.41
Tip to Seating Plane	L	.500	.555	.610	12.70	14.10	15.49
Lead Thickness	c	.014	.017	.020	0.36	0.43	0.51
Lead Width	B	.016	.019	.022	0.41	0.48	0.56
Mold Draft Angle Top	$\alpha$	4	5	6	4	5	6
Mold Draft Angle Bottom	$\beta$	2	3	4	2	3	4

\*Controlling Parameter

Notes:

Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" (0.254mm) per side.

JEDEC Equivalent: TO-92

Drawing No. C04-101

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FIGURE 5-3: TO-92 DEVICES

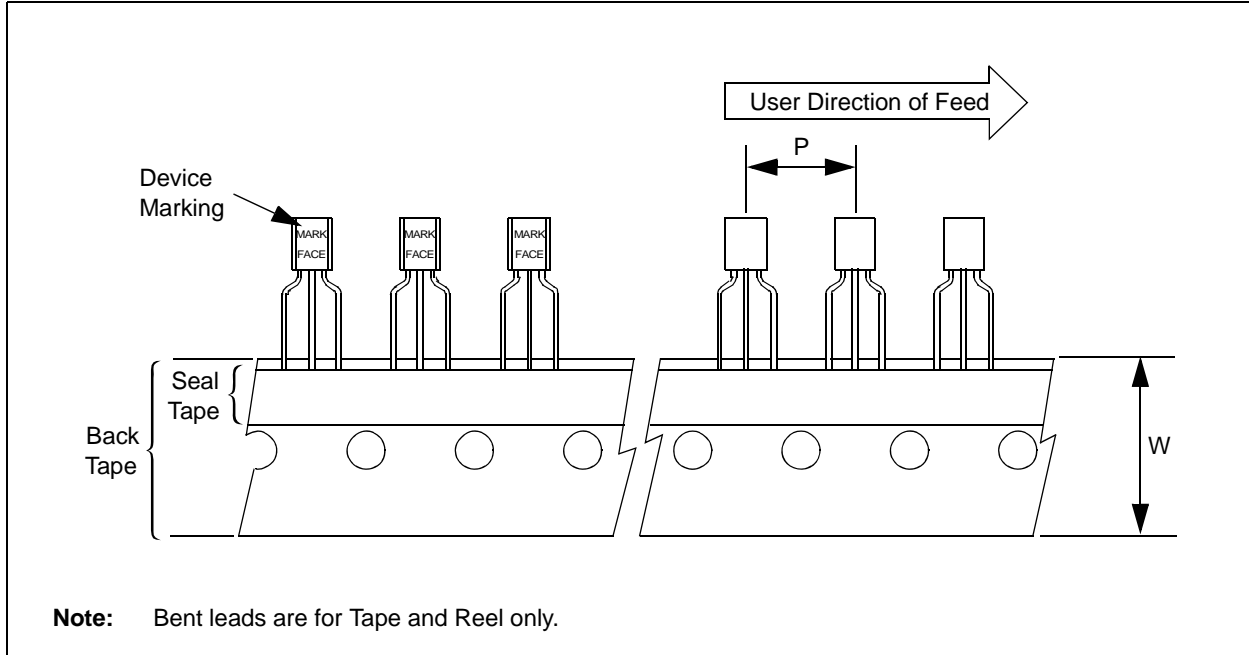
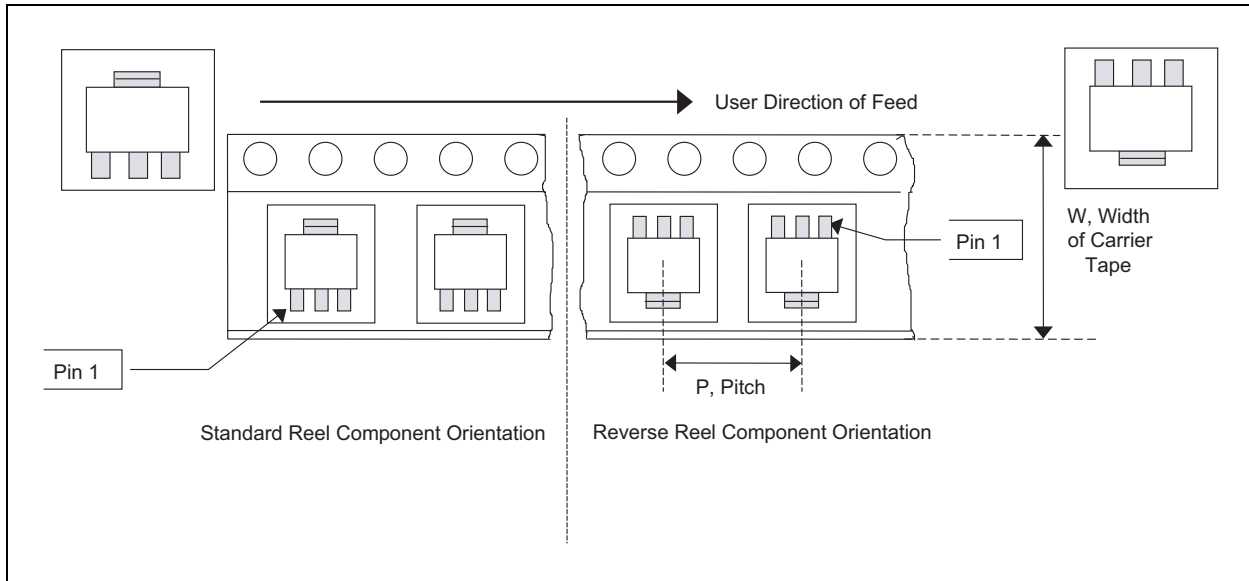


FIGURE 5-4: SOT-89 DEVICES



## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	<u>X</u>	<u>XXX</u>	<u>X</u>	<u>XX</u>
Device	Tape/Reel Option	Monitoring Options	Temperature Range	Package
Device:				
		MCP111: MicroPower Voltage Detector, open-drain		
		MCP111T: MicroPower Voltage Detector, open-drain (Tape and Reel)		
		MCP112: MicroPower Voltage Detector, push-pull		
		MCP112T: MicroPower Voltage Detector, push-pull (Tape and Reel)		
Monitoring Options:		195 = 1.90V		
		240 = 2.32V		
		270 = 2.63V		
		290 = 2.90V		
		300 = 2.93V		
		315 = 3.08V		
		450 = 4.38V		
		475 = 4.63V		
Temperature Range:			I = -40°C to +85°C (MCP11X-195 only)	
			E = -40°C to +125°C (Except MCP11X-195 only)	
Package:				LB = SC-70, 3-lead
				MB = SOT-89, 3-lead
				TO = TO-92, 3-lead
				TT = SOT-23B, 3-lead
<b>Examples:</b>				
a)	MCP111T-195I/TT:	Tape and Reel, 1.95V option, open-drain, -40°C to +85°C, SOT-23B package.		
b)	MCP111T-315E/LB:	Tape and Reel, 3.15V option, open-drain, -40°C to +125°C, SC-70-3 package.		
c)	MCP111-300E/TO:	3.00V option, open-drain, -40°C to +125°C, TO-92-3 package.		
d)	MCP111-315E/MB:	3.15V option, open-drain, -40°C to +125°C, SOT-89-3 package.		
a)	MCP112T-290E/TT:	Tape and Reel, 2.90V option, push-pull, -40°C to +125°C, SOT-23B-3 package.		
b)	MCP112T-475E/LB:	Tape and Reel, 4.75V option, push-pull, -40°C to +125°C, SC-70-3 package.		
c)	MCP112-450E/TO:	4.5V option, push-pull, -40°C to +125°C, TO-92-3 package.		
d)	MCP112-315E/MB:	3.15V option, push-pull, -40°C to +125°C, SOT-89-3 package.		