MCP102/103/121/131

Micropower Voltage Supervisors

Features

- Ultra low supply current: 1.75 µA (steady-state max.)
- Precision monitoring options of:
  - 1.90V, 2.32V, 2.63V, 2.93V, 3.08V, 4.38V and 4.63V
- Resets microcontroller in a power-loss event
- $\overline{RST}$ pin (Active-low):
  - **MCP121:** Active-low, open-drain
  - **MCP131:** Active-low, open-drain with internal pull-up resistor
  - **MCP102** and **MCP103:** Active-low, push-pull
- Reset Delay Timer (120 ms delay, typ.)
- Available in SOT23-3, TO-92 and SC-70 packages
- Temperature Range:
  - Extended: -40°C to +125°C (**except MCP1XX-195**)
  - Industrial: -40°C to +85°C (**MCP1XX-195 only**)
- Pb-free devices

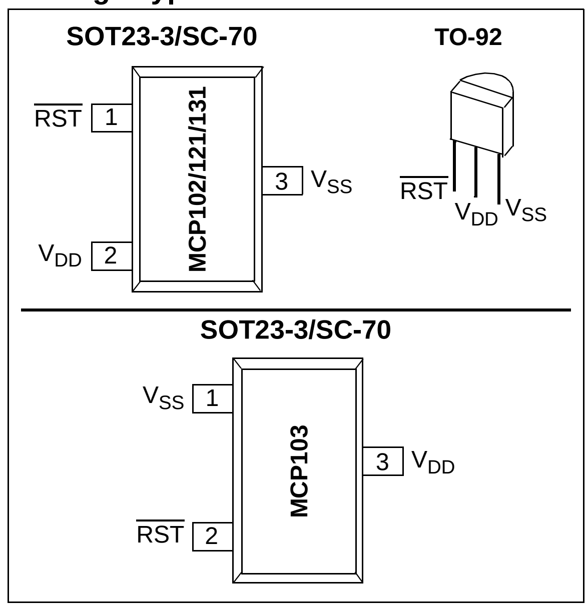
Applications

- Critical Microcontroller and Microprocessor Power-monitoring Applications
- Computers
- Intelligent Instruments
- Portable Battery-powered Equipment

General Description

The MCP102/103/121/131 are voltage supervisor devices designed to keep a microcontroller in reset until the system voltage has reached and stabilized at the proper level for reliable system operation. Table 1 shows the available features for these devices.

Package Types



Block Diagram

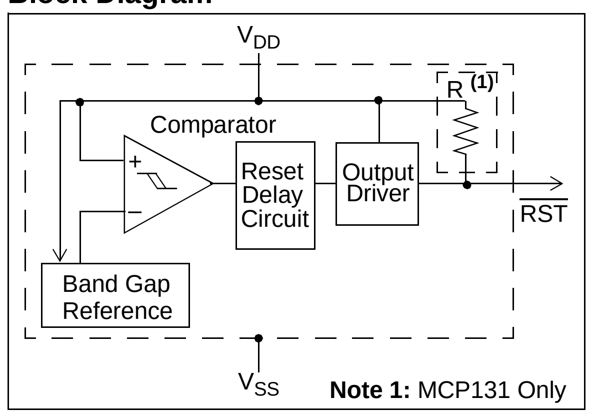


TABLE 1: DEVICE FEATURES

Device	Output		Reset Delay (typ)	Package Pinout (Pin # 1, 2, 3)	Comment
	Type	Pull-up Resistor			
MCP102	Push-pull	No	120 ms	$\overline{RST}$, V_{DD}, V_{SS}	
MCP103	Push-pull	No	120 ms	V_{SS}, $\overline{RST}$, V_{DD}	
MCP121	Open-drain	External	120 ms	$\overline{RST}$, V_{DD}, V_{SS}	
MCP131	Open-drain	Internal (~95 kΩ)	120 ms	$\overline{RST}$, V_{DD}, V_{SS}	
MCP111	Open-drain	External	No	V_{OUT}, V_{SS}, V_{DD}	See **MCP111/112** Data Sheet (DS21889)
MCP112	Push-Pull	No	No	V_{OUT}, V_{SS}, V_{DD}	See **MCP111/112** Data Sheet (DS21889)

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

V_{DD} 7.0V
Input current (V_{DD}) . . . . .10 mA
Output current ($\overline{RST}$) . . . . .10 mA
Rated Rise Time of V_{DD} 100V/µs
All inputs and outputs (except $\overline{RST}$) w.r.t. V_{SS}
. . . .-0.6V to (V_{DD} + 1.0V)
$\overline{RST}$ 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 . . . . ≥ 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} = 1V to 5.5V, R_{PU} = 100 kΩ (**MCP121** only), T_A = -40°C to +125°C.

Parameters		Sym	Min	Typ	Max	Units	Conditions
Operating Voltage Range		V_{DD}	1.0	—	5.5	V	
Specified V_{DD} Value to $\overline{RST}$ low		V_{DD}	1.0	—		V	$I_{\overline{RST}}$ = 10 uA, $V_{\overline{RST}}$ < 0.2V
Operating Current	**MCP102, MCP103,**	I_{DD}	—	< 1	1.75	µA	Reset Power-up Timer (t_{RPU}) Inactive
	MCP121		—	—	20.0	µA	Reset Power-up Timer (t_{RPU}) Active
	MCP131	I_{DD}	—	< 1	1.75	µA	V_{DD} > V_{TRIP} and Reset Power-up Timer (t_{RPU}) Inactive
			—	—	75	µA	V_{DD} < V_{TRIP} and Reset Power-up Timer (t_{RPU}) Inactive **(Note 3)**
			—	—	90	µA	Reset Power-up Timer (t_{RPU}) Active **(Note 4)**

Note 1: Trip point is ±1.5% from typical value.
2: Trip point is ±2.5% from typical value.
3: $\overline{RST}$ output is forced low. There is a current through the internal pull-up resistor.
4: This includes the current through the internal pull-up resistor and the reset power-up timer.
5: This specification allows this device to be used in PICmicro® microcontroller applications that require In-Circuit Serial Programming™ (ICSP™) (see device-specific programming specifications for voltage requirements). This specification DOES NOT allow a continuos 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 100s. Current into the V_{OUT} pin should be limited to 2 mA and it is recommended that the device operational temperature be maintained between 0°C to 70°C (+25°C preferred). For additional information, please refer to Figure 2-33.
6: This parameter is established by characterization and 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 kΩ (**MCP121** only), T_A = -40°C to +125°C.

Parameters		Sym	Min	Typ	Max	Units	Conditions
V_{DD} Trip Point	**MCP1XX-195**	V_{TRIP}	1.872	1.900	1.929	V	T_A = +25°C **(Note 1)**
			1.853	1.900	1.948	V	T_A = -40°C to +85°C **(Note 2)**
	MCP1XX-240		2.285	2.320	2.355	V	T_A = +25°C **(Note 1)**
			2.262	2.320	2.378	V	**Note 2**
	MCP1XX-270		2.591	2.630	2.670	V	T_A = +25°C **(Note 1)**
			2.564	2.630	2.696	V	**Note 2**
	MCP1XX-300		2.886	2.930	2.974	V	T_A = +25°C **(Note 1)**
			2.857	2.930	3.003	V	**Note 2**
	MCP1XX-315		3.034	3.080	3.126	V	T_A = +25°C **(Note 1)**
			3.003	3.080	3.157	V	**Note 2**
	MCP1XX-450		4.314	4.380	4.446	V	T_A = +25°C **(Note 1)**
			4.271	4.380	4.490	V	**Note 2**
	MCP1XX-475		4.561	4.630	4.700	V	T_A = +25°C **(Note 1)**
			4.514	4.630	4.746	V	**Note 2**
V_{DD} Trip Point Tempco		T_{TPCO}	—	±100	—	ppm/°C	
Threshold Hysteresis (min. = 1%, max = 6%)	**MCP1XX-195**	V_{HYS}	0.019	—	0.114	V	T_A = +25°C
	MCP1XX-240		0.023	—	0.139	V	
	MCP1XX-270		0.026	—	0.158	V	
	MCP1XX-300		0.029	—	0.176	V	
	MCP1XX-315		0.031	—	0.185	V	
	MCP1XX-450		0.044	—	0.263	V	
	MCP1XX-475		0.046	—	0.278	V	
$\overline{RST}$ Low-level Output Voltage		V_{OL}	—	—	0.4	V	I_{OL} = 500 µA, $V_{DD} = V_{TRIP(MIN)}$
$\overline{RST}$ High-level Output Voltage **(MCP102 and MCP103 only)**		V_{OH}	V_{DD} – 0.6	—	—	V	I_{OH} = 1 mA, For **MCP102/MCP103** only (push-pull output)
Internal Pull-up Resistor **(MCP131 only)**		R_{PU}	—	95	—	kΩ	V_{DD} = 5.5V
Open-drain High Voltage on Output **(MCP121 only)**		V_{ODH}	—	—	13.5 **(5)**	V	V_{DD} = 3.0V, Time voltage > 5.5V applied ≤ 100s, current into pin limited to 2 mA, 25°C operation recommended **(Note 5, Note 6)**
Open-drain Output Leakage Current **(MCP121 only)**		I_{OD}	—	0.1	—	µA	

Note 1: Trip point is ±1.5% from typical value.

2: Trip point is ±2.5% from typical value.

3: $\overline{RST}$ output is forced low. There is a current through the internal pull-up resistor.

4: This includes the current through the internal pull-up resistor and the reset power-up timer.

5: This specification allows this device to be used in PICmicro® microcontroller applications that require In-Circuit Serial Programming™ (ICSP™) (see device-specific programming specifications for voltage requirements). This specification DOES NOT allow a continuos 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 100s. Current into the V_{OUT} pin should be limited to 2 mA and it is recommended that the device operational temperature be maintained between 0°C to 70°C (+25°C preferred). For additional information, please refer to Figure 2-33.

6: This parameter is established by characterization and not 100% tested.

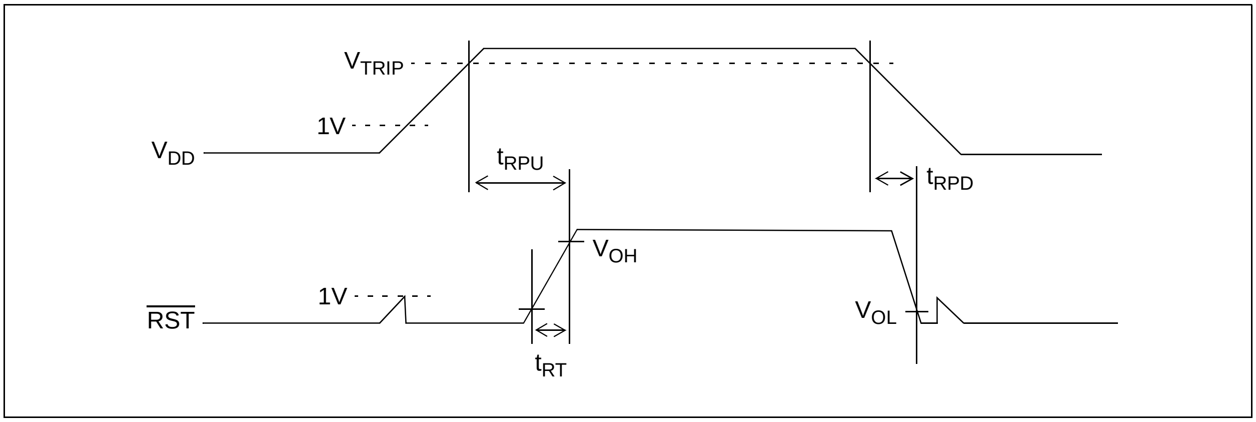


FIGURE 1-1: *Timing Diagram.*

AC CHARACTERISTICS

Electrical Specifications: Unless otherwise indicated, all limits are specified for: V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**MCP121** only), T_A = -40°C to +125°C.

Parameters	Sym	Min	Typ	Max	Units	Conditions
V_{DD} Detect to $\overline{RST}$ Inactive	t_{RPU}	80	120	180	ms	**Figure 1-1** and C_L = 50 pF
V_{DD} Detect to $\overline{RST}$ Active	t_{RPD}	—	130	—	µs	V_{DD} ramped from $V_{TRIP(MAX)}$ + 250 mV down to $V_{TRIP(MIN)}$ – 250 mV, per **Figure 1-1**, C_L = 50 pF **(Note 1)**
$\overline{RST}$ Rise Time After $\overline{RST}$ Active **(MCP102 and MCP103 only)**	t_{RT}	—	5	—	µs	For $\overline{RST}$ 10% to 90% of final value per **Figure 1-1**, C_L = 50 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 kΩ (**MCP121** only), T_A = -40°C to +125°C.

Parameters	Sym	Min	Typ	Max	Units	Conditions
Temperature Ranges						
Specified Temperature Range	T_A	-40	—	+85	ºC	**MCP1XX-195**
Specified Temperature Range	T_A	-40	—	+125	ºC	**Except MCP1XX-195**
Maximum Junction Temperature	T_J	—	—	+150	ºC	
Storage Temperature Range	T_A	-65	—	+150	ºC	
Package Thermal Resistances						
Thermal Resistance, 3L-SOT23	θ_{JA}	—	336	—	ºC/W	
Thermal Resistance, 3L-SC-70	θ_{JA}	—	340	—	ºC/W	
Thermal Resistance, 3L-TO-92	θ_{JA}	—	131.9	—	ºC/W	

2.0 TYPICAL PERFORMANCE CURVES

Note:	The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

Note: Unless otherwise indicated, all limits are specified for: V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**MCP121** only; see **Figure 4-1**), T_A = -40°C to +125°C.

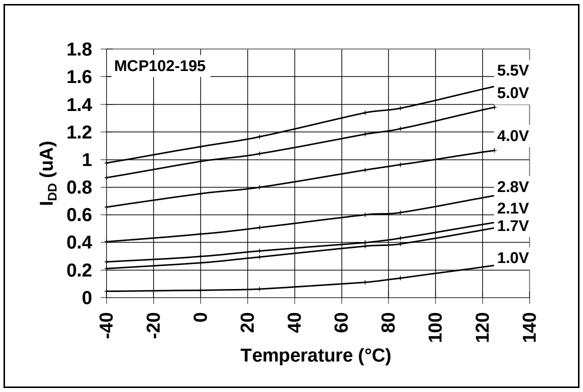


FIGURE 2-1: *I_{DD} vs. Temperature (Reset Power-up Timer Inactive) (**MCP102-195**).*

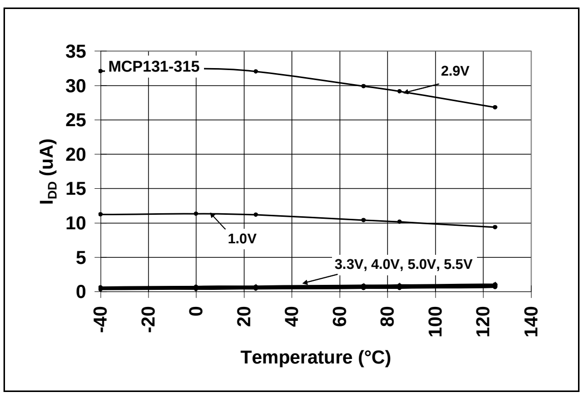


FIGURE 2-2: *I_{DD} vs. Temperature (Reset Power-up Timer Inactive) (**MCP131-315**).*

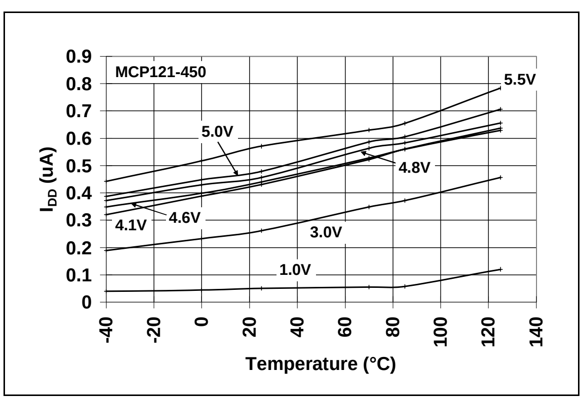


FIGURE 2-3: *I_{DD} vs. Temperature (Reset Power-up Timer Inactive) (**MCP121-450**).*

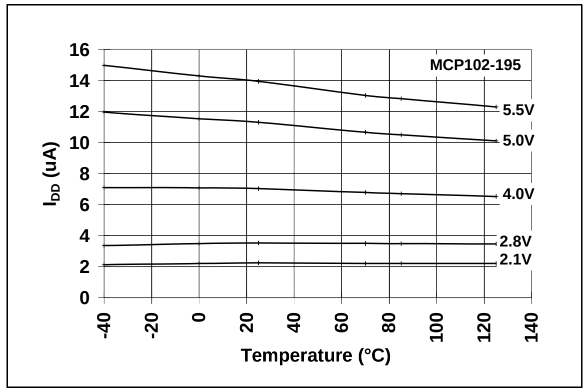


FIGURE 2-4: *I_{DD} vs. Temperature (Reset Power-up Timer Active) (**MCP102-195**).*

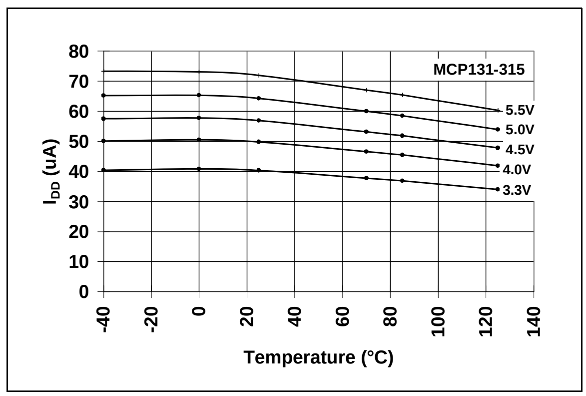


FIGURE 2-5: *I_{DD} vs. Temperature (Reset Power-up Timer Active) (**MCP131-315**).*

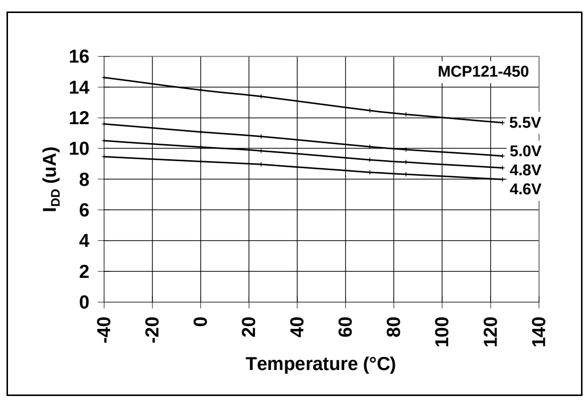


FIGURE 2-6: *I_{DD} vs. Temperature (Reset Power-up Timer Active) (**MCP121-450**).*

Note: Unless otherwise indicated, all limits are specified for: V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**MCP121** only; see **Figure 4-1**), T_A = -40°C to +125°C.

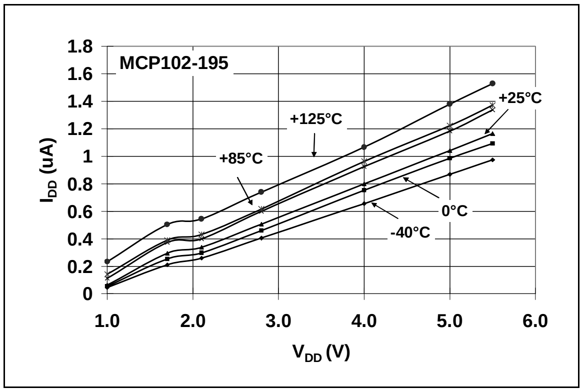


FIGURE 2-7: *I_{DD} vs. V_{DD} (Reset Power-up Timer Inactive) (**MCP102-195**).*

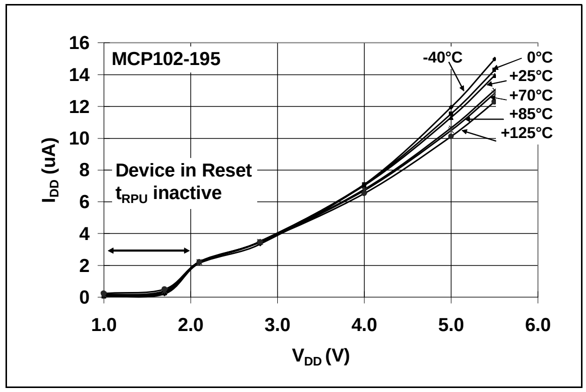


FIGURE 2-10: *I_{DD} vs.V_{DD} (Reset Power-up Timer Active) (**MCP102-195**).*

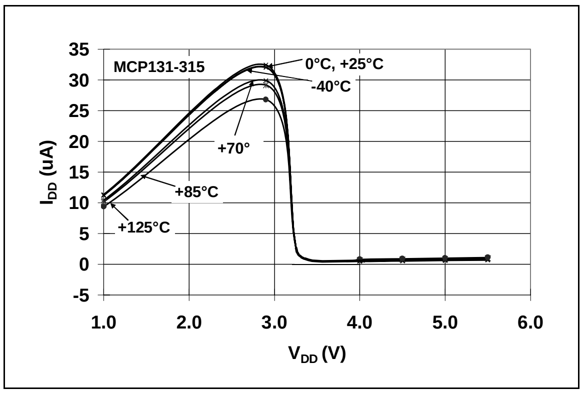


FIGURE 2-8: *I_{DD} vs. V_{DD} (Reset Power-up Timer Inactive) (**MCP131-315**).*

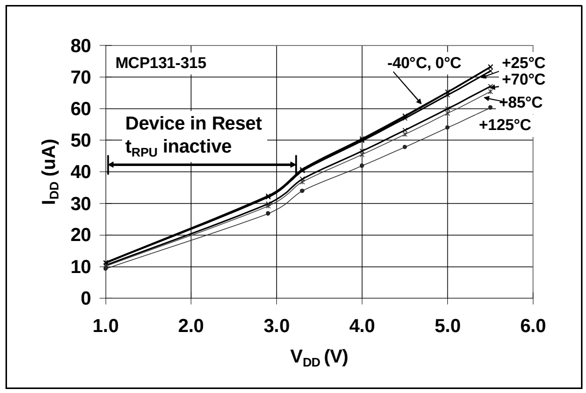


FIGURE 2-11: *I_{DD} vs.V_{DD} (Reset Power-up Timer Active) (**MCP131-315**).*

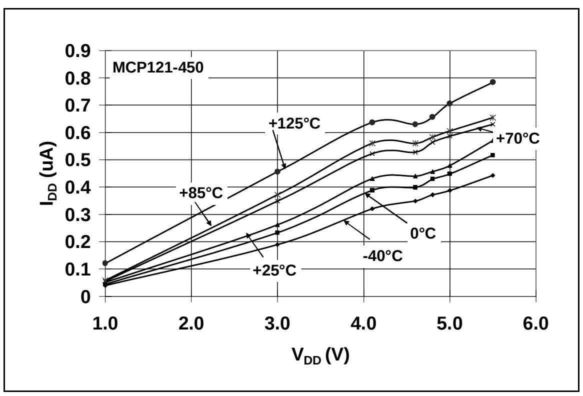


FIGURE 2-9: *I_{DD} vs. V_{DD} (Reset Power-up Timer Inactive) (**MCP121-450**).*

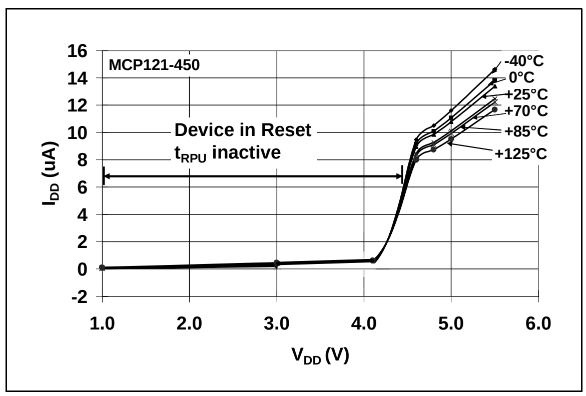


FIGURE 2-12: *I_{DD} vs.V_{DD} (Reset Power-up Timer Active) (**MCP121-450**).*

Note: Unless otherwise indicated, all limits are specified for: V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**MCP121**; see **Figure 4-1**), T_A = -40°C to +125°C.

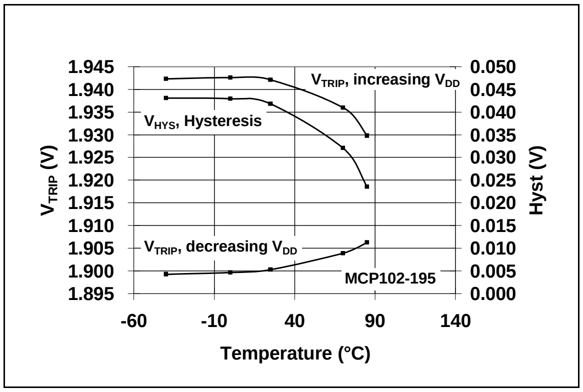


*FIGURE 2-13: V_{TRIP} vs. Temperature vs. Hysteresis (**MCP102-195**).*

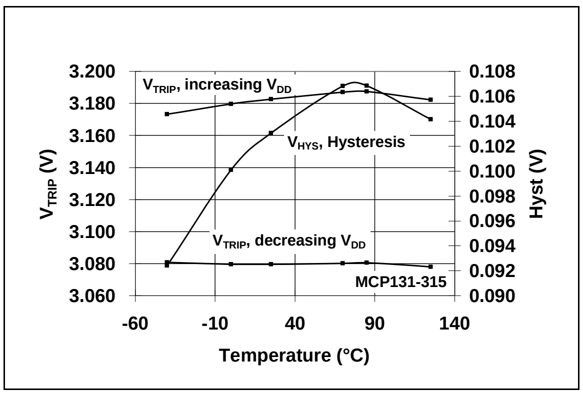


*FIGURE 2-14: V_{TRIP} vs. Temperature vs. Hysteresis (**MCP131-315**).*

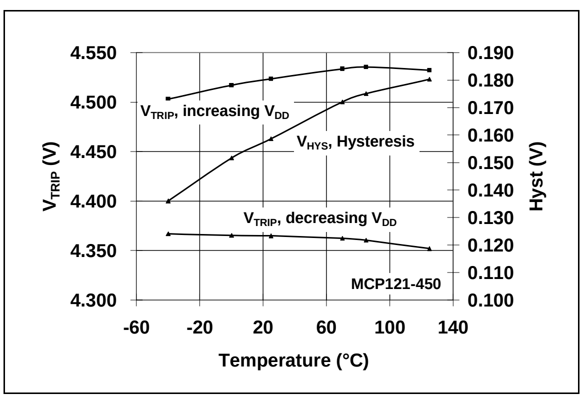


*FIGURE 2-15: V_{TRIP} vs. Temperature vs. Hysteresis (**MCP121-450**).*

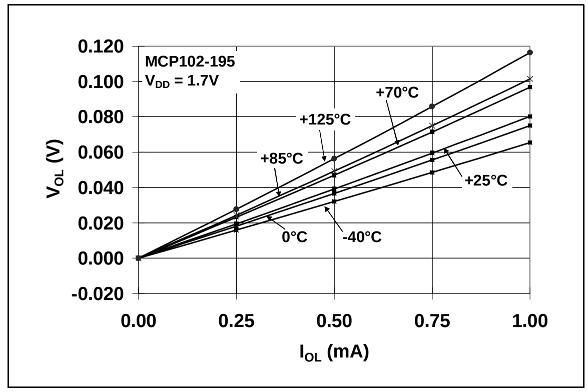


*FIGURE 2-16: V_{OL} vs. I_{OL} (**MCP102-195** @ V_{DD} = 1.7V).*

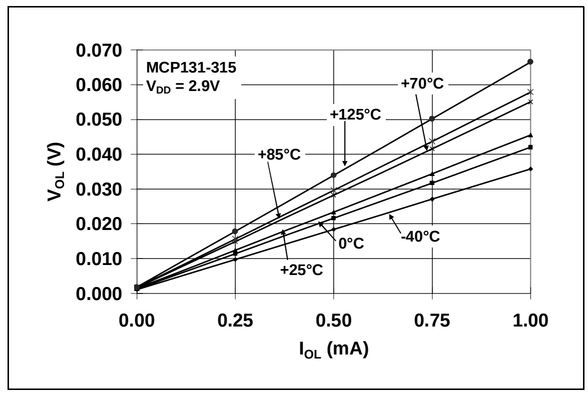


*FIGURE 2-17: V_{OL} vs. I_{OL} (**MCP131-315** @ V_{DD} = 2.9V).*

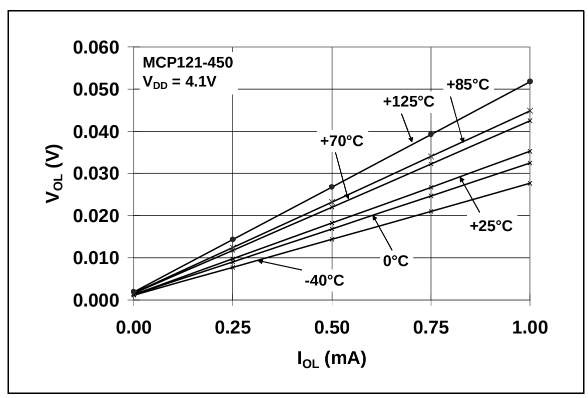


*FIGURE 2-18: V_{OL} vs. I_{OL} (**MCP121-450** @ V_{DD} = 4.1V).*

Note: Unless otherwise indicated, all limits are specified for: V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**MCP121** only; see **Figure 4-1**), T_A = -40°C to +125°C.

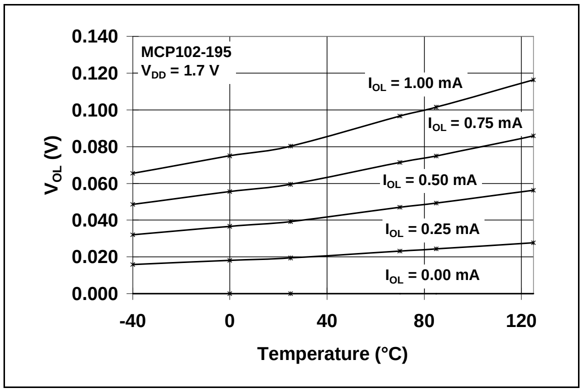


FIGURE 2-19: *V_{OL} vs. Temperature (**MCP102-195** @ V_{DD} = 1.7V).*

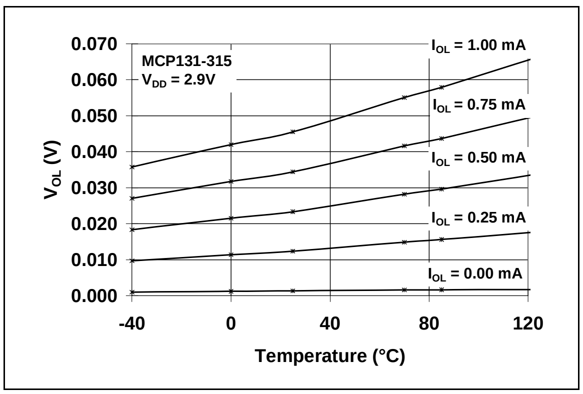


FIGURE 2-20: *V_{OL} vs. Temperature (**MCP131-315** @ V_{DD} = 2.9V).*

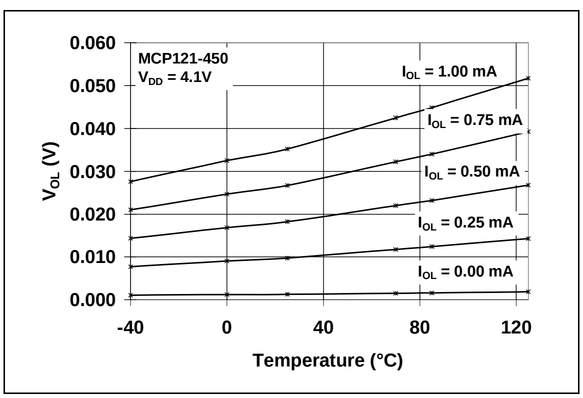


FIGURE 2-21: *V_{OL} vs. Temperature (**MCP121-450** @ V_{DD} = 4.1V).*

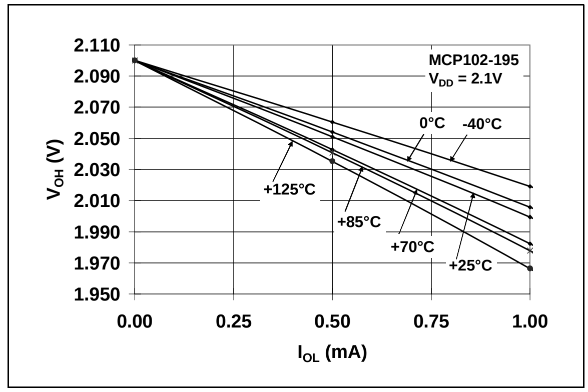


FIGURE 2-22: *V_{OH} vs. I_{OL} (**MCP102-195** @ V_{DD} = 2.1V).*

Note: Unless otherwise indicated, all limits are specified for: V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**MCP121** only; see **Figure 4-1**), T_A = -40°C to +125°C.

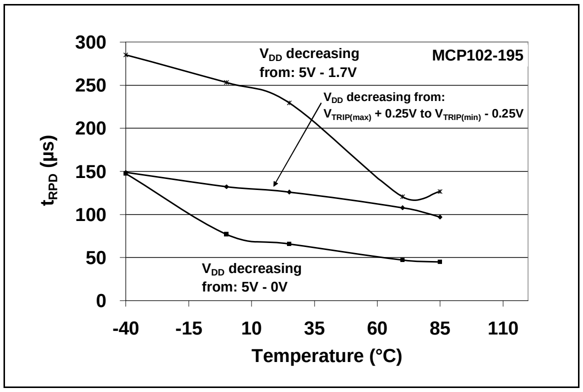


*FIGURE 2-23: t_{RPD} vs. Temperature (**MCP102-195**).*

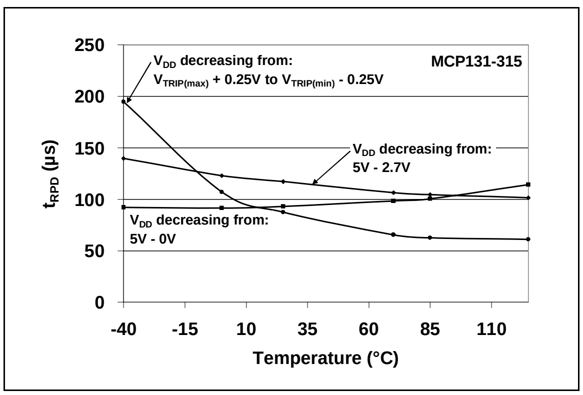


*FIGURE 2-24: t_{RPD} vs. Temperature (**MCP131-315**).*

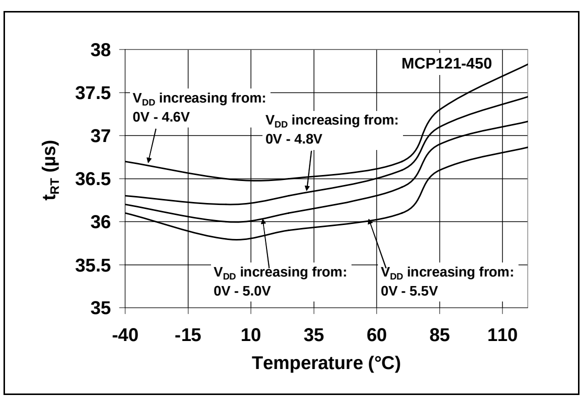


*FIGURE 2-25: t_{RPD} vs. Temperature (**MCP121-450**).*

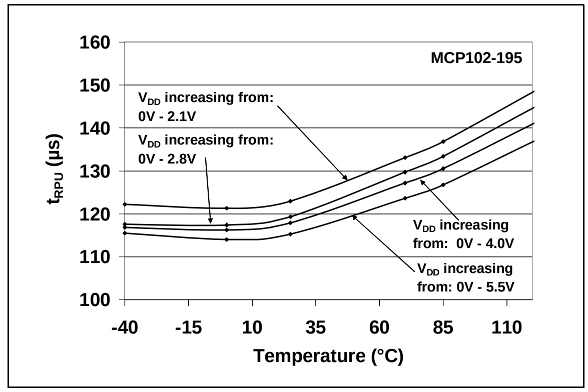


*FIGURE 2-26: t_{RPU} vs. Temperature (**MCP102-195**).*

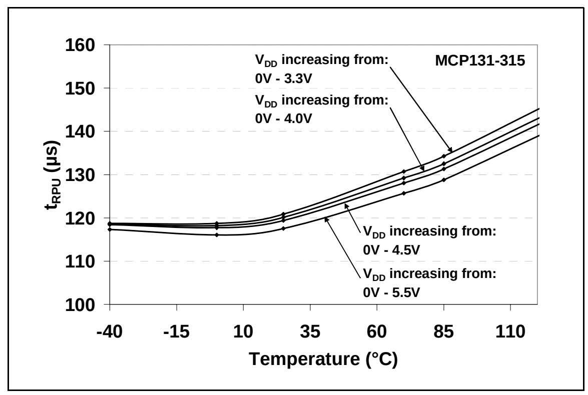


*FIGURE 2-27: t_{RPU} vs. Temperature (**MCP131-315**).*

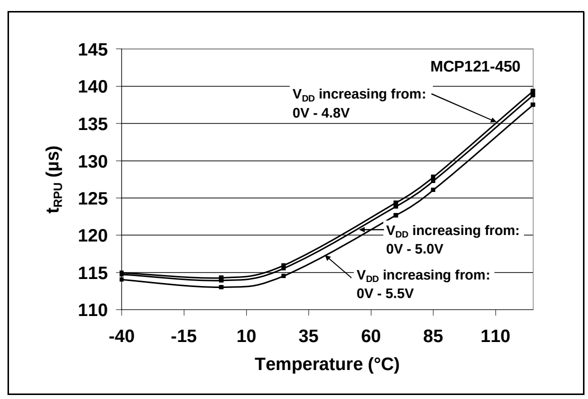


*FIGURE 2-28: t_{RPU} vs. Temperature (**MCP121-450**).*

Note: Unless otherwise indicated, all limits are specified for: V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**MCP121** only; see **Figure 4-1**), T_A = -40°C to +125°C.

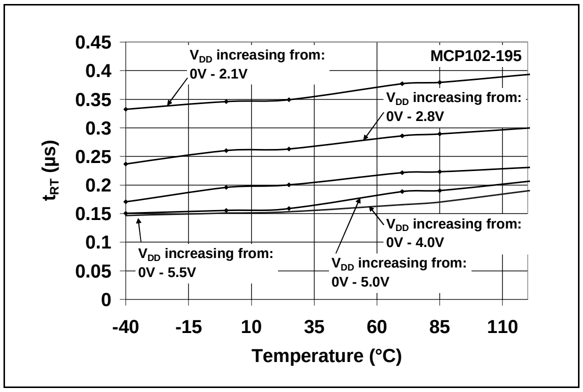


FIGURE 2-29: *t_{RT} vs. Temperature (**MCP102-195**).*

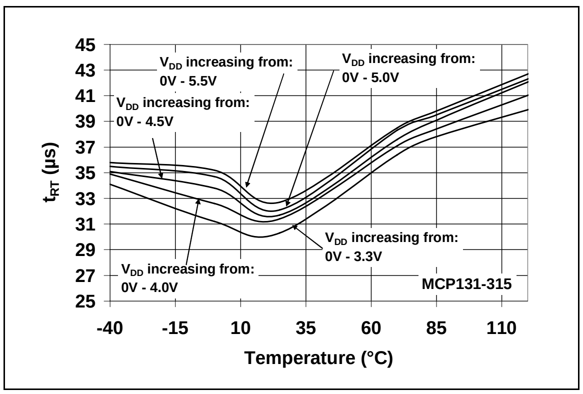


FIGURE 2-30: *t_{RT} vs. Temperature (**MCP131-315**).*

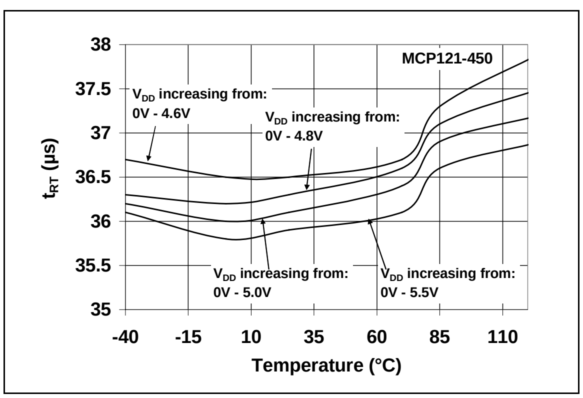


FIGURE 2-31: *t_{RT} vs. Temperature (**MCP121-450**).*

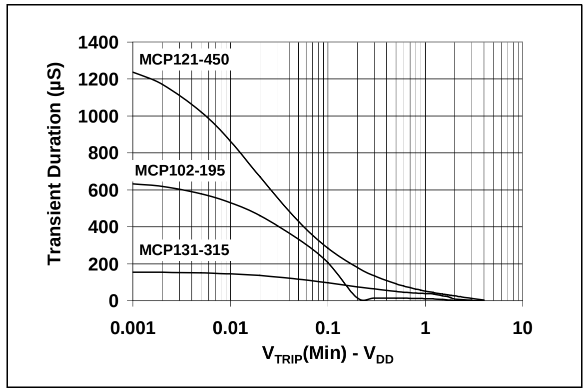


FIGURE 2-32: *Transient Duration vs. V_{TRIP} (min) - V_{DD}.*

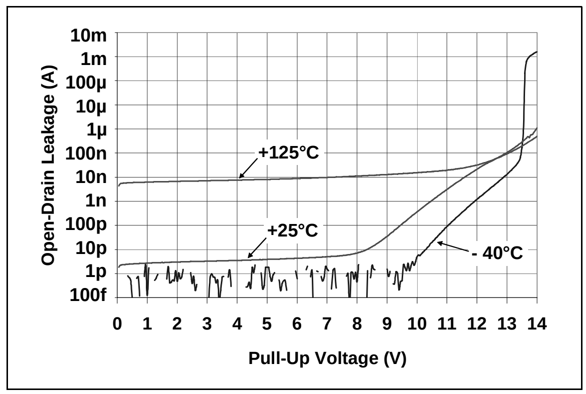


FIGURE 2-33: *Open-Drain Leakage Current vs. Voltage Applied to V_{OUT} Pin (**MCP121-195**).*

3.0 PIN DESCRIPTION

The descriptions of the pins are listed in Table 3-1.

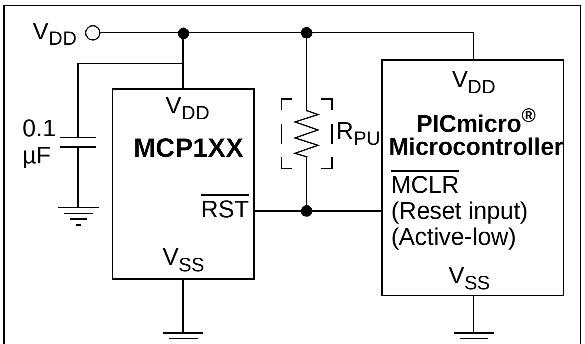
TABLE 3-1: PIN FUNCTION TABLE

Pin No.		Symbol	Function
MCP102 MCP121 MCP131	MCP103		
1	1	$\overline{RST}$	Output State **V_{DD} Falling:** H = $V_{DD} > V_{TRIP}$ L = $V_{DD} < V_{TRIP}$ **V_{DD} Rising:** H = $V_{DD} > V_{TRIP} + V_{HYS}$ L = $V_{DD} < V_{TRIP} + V_{HYS}$
2	3	V_{DD}	Positive power supply
3	2	V_{SS}	Ground reference

4.0 APPLICATION INFORMATION

For many of today's microcontroller applications, care must be taken to prevent low-power conditions that can cause many different system problems. The most common causes are brown-out conditions, where the system supply drops below the operating level momentarily. The second most common cause is when a slowly decaying power supply causes the microcontroller to begin executing instructions without sufficient voltage to sustain volitile memory (RAM), thus producing indeterminate results. Figure 4-1 shows a typical application circuit.

The MCP102/103/121/131 are voltage supervisor devices designed to keep a microcontroller in reset until the system voltage has reached and stabilized at the proper level for reliable system operation. These devices also operate as protection from brown-out conditions.



Note 1: Resistor R_{PU} may be required with the MCP121 due to the open-drain output. Resistor R_{PU} may not be required with the MCP131 due to the internal pull-up resistor. The MCP102 and MCP103 do not require the external pull-up resistor.

FIGURE 4-1: *Typical Application Circuit.*

4.1 $\overline{RST}$ Operation

The $\overline{RST}$ output pin operation determines how the device can be used and indicates when the system should be forced into reset. To accomplish this, an internal voltage reference is used to set the voltage trip point (V_{TRIP}). Additionally, there is a hysteresis on this trip point.

When the falling edge of V_{DD} crosses this voltage threshold, the reset power-down timer (T_{RPD}) starts. When this delay timer times out, the $\overline{RST}$ pin is forced low.

When the rising-edge of V_{DD} crosses this voltage threshold, the reset power-up timer (T_{RPU}) starts. When this delay timer times out, the $\overline{RST}$ pin is forced high, T_{RPU} is active and there is additional system current.

The actual voltage trip point (V_{TRIPAC}) will be between the minimum trip point ($V_{TRIPMIN}$) and the maximum trip point ($V_{TRIPMAX}$). The hysteresis on this trip point and the delay timer (T_{RPU}) are to remove any "jitter" that would occur on the $\overline{RST}$ pin when the device V_{DD} is at the trip point.

Figure 4-2 shows the waveform of the $\overline{RST}$ pin as determined by the V_{DD} voltage, while Table 4-1 shows the state of the $\overline{RST}$ pin. The V_{TRIP} specification is for falling V_{DD} voltages. When the V_{DD} voltage is rising, the $\overline{RST}$ will not be driven high until V_{DD} is at $V_{TRIP} + V_{HYS}$. Once V_{DD} has crossed the voltage trip point, there is also a minimal delay time (T_{RPD}) before the $\overline{RST}$ pin is driven low.

TABLE 4-1: $\overline{RST}$ PIN STATES

Device	State of $\overline{RST}$ Pin when:		Ouput Driver
	$V_{DD} < V_{TRIP}$	$V_{DD} > V_{TRIP} + V_{HYS}$	
MCP102	L	H	Push-pull
MCP103	L	H	Push-pull
MCP121	L	H (1)	Open-drain (1)
MCP131	L	H (2)	Open-drain (2)

Note 1: Requires External Pull-up resistor

2: Has Internal Pull-up resistor

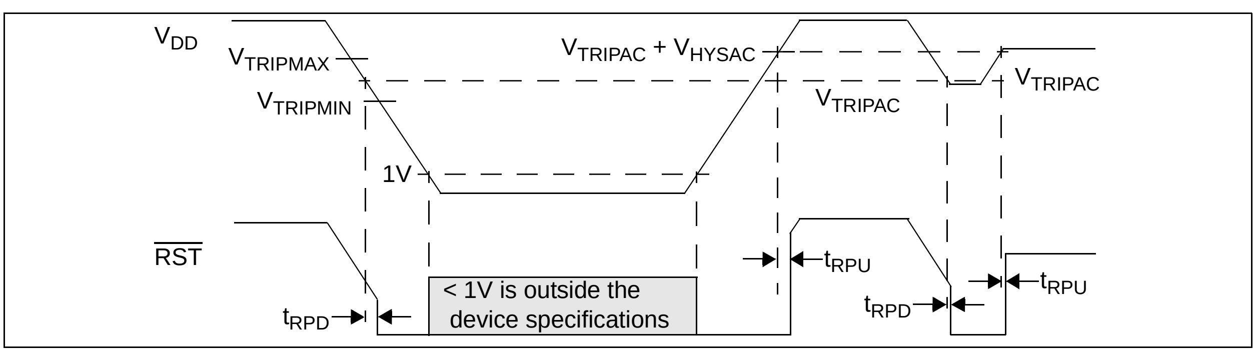


FIGURE 4-2: *$\overline{RST}$ Operation as Determined by the V_{TRIP} and V_{HYS}.*

4.2 Negative Going V_{DD} Transients

The minimum pulse width (time) required to cause a reset may be an important criteria in the implementation of a Power-on Reset (POR) circuit. This time is referred to as transient duration, defined as the amount of time needed for these supervisory devices to respond to a drop in V_{DD}. The transient duration time is dependant on the magnitude of $V_{TRIP} – V_{DD}$. Generally speaking, the transient duration decreases with increases in $V_{TRIP} – V_{DD}$.

Figure 4-3 shows a typical transient duration vs. reset comparator overdrive, for which the MCP102/103/121/131 will not generate a reset pulse. It shows that the farther below the trip point the transient pulse goes, the duration of the pulse required to cause a reset gets shorter. Figure 2-32 shows the transient response characteristics for the MCP102/103/121/131.

A 0.1 µF bypass capacitor, mounted as close as possible to the V_{DD} pin, provides additional transient immunity (refer to Figure 4-1).

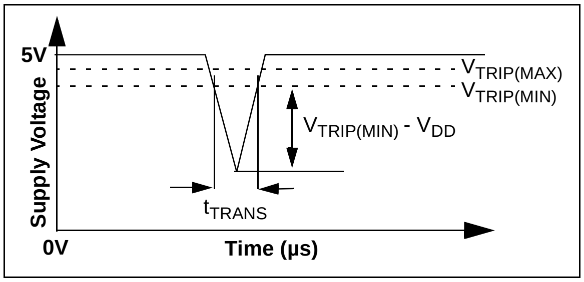


FIGURE 4-3: *Example of Typical Transient Duration Waveform.*

4.3 Reset Power-up Timer (t_{RPU})

Figure 4-4 illustrates the device current states. While the system is powering down, the device has a low current. This current is dependent on the device V_{DD} and trip point. When the device V_{DD} rises through the voltage trip point (V_{TRIP}), an internal timer starts. This timer consumes additional current until the $\overline{RST}$ pin is driven (or released) high. This time is known as the Reset Power-up Time (t_{RPU}). Figure 4-4 shows when t_{RPU} is active (device consuming additional current).

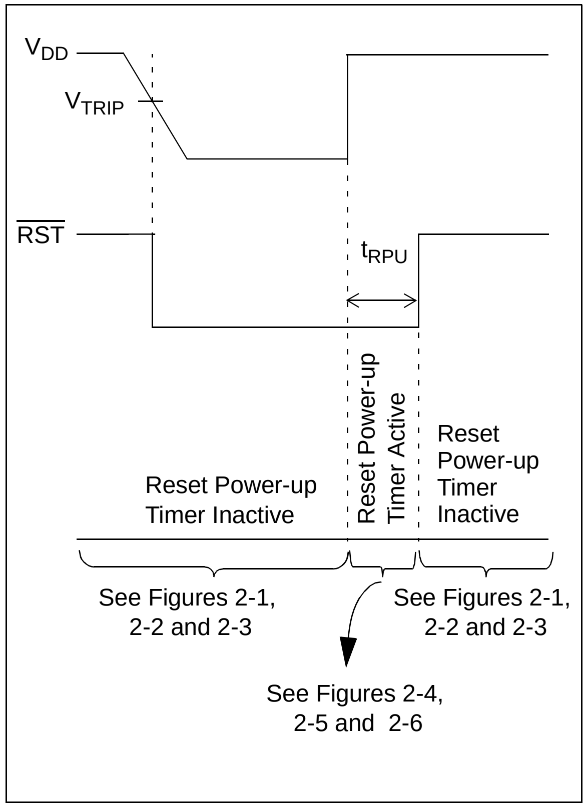


FIGURE 4-4: *Reset Power-up Timer Waveform.*

4.3.1 EFFECT OF TEMPERATURE ON RESET POWER-UP TIMER (T_{RPU})

The Reset Power-up timer time-out period (t_{RPU}) determines how long the device remains in the reset condition. This is affected by both V_{DD} and temperature. Typical responses for different V_{DD} values and temperatures are shown in Figures 2-26, 2-27 and 2-28.

4.4 Using in PICmicro® Microcontroller, ICSP™ Applications (MCP121 only)

Figure 4-5 shows the typical application circuit for using the MCP121 for voltage superviory function when the PICmicro microcontroller will be programmed via the ICSP feature. Additional information is available in TB087, *"Using Voltage Supervisors with PICmicro® Microcontroller Systems which Implement In-Circuit Serial Programming™"*, DS91087.

Note:	It is recommended that the current into the $\overline{RST}$ pin be current limited by a 1 kΩ resistor.

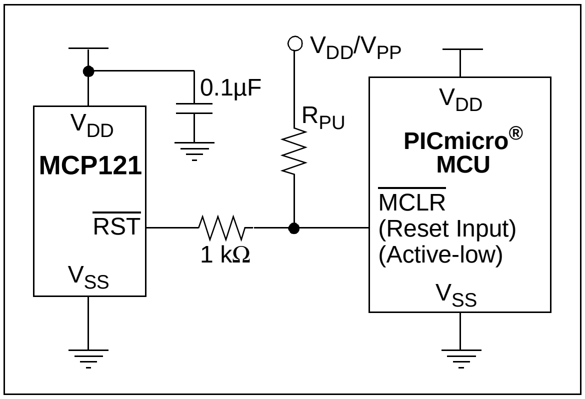
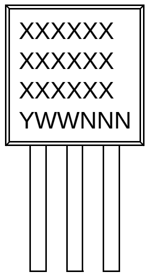


FIGURE 4-5: *Typical Application Circuit for PICmicro® Microcontroller with the ICSP™ feature.*

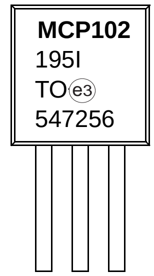
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

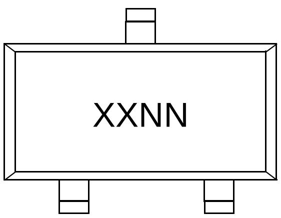
3-Lead TO-92



Example:



3-Pin SOT-23



Example:

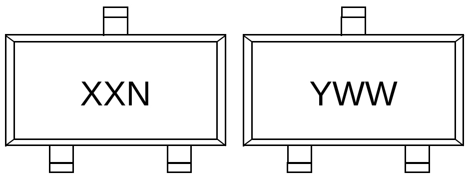
Part Number	MCP1xx =			
	MCP102	MCP103	MCP121	MCP131
MCP1xxT-195I/TT	JGNN	TGNN	LGNN	KGNN
MCP1xxT-240ETT	JHNN	THNN	LHNN	KHNN
MCP1xxT-270E/TT	JJNN	TJNN	LJNN	KJNN
MCP1xxT-300E/TT	JKNN	TKNN	LKNN	KKNN
MCP1xxT-315E/TT	JLNN	TLNN	LLNN	KLNN
MCP1xxT-450E/TT	JMNN	TMNN	LMNN	KMNN
MCP1xxT-475E/TT	JPNN	TPNN	LPNN	KPNN

Legend:		
	XX...X	Customer-specific information
	Y	Year code (last digit 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.

Package Marking Information (Continued)

3-Pin SC-70

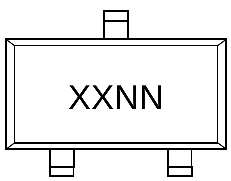


Top Side   Bottom Side

Example:

Part Number	**MCP1xx =**			
	MCP102	**MCP103**	**MCP121**	**MCP131**
MCP1xxT-195I/LB	BGN	FGN	DGN	CGN
MCP1xxT-240E/LB	BHN	FHN	DHN	CHN
MCP1xxT-270E/LB	BJN	FJN	DJN	CJN
MCP1xxT-300E/LB	BKN	FKN	DKN	CKN
MCP1xxT-315E/LB	BLN	FLN	DLN	CLN
MCP1xxT-450E/LB	BMN	FMN	DMN	CMN
MCP1xxT-475E/LB	BPN	FPN	DPN	CPN

OR

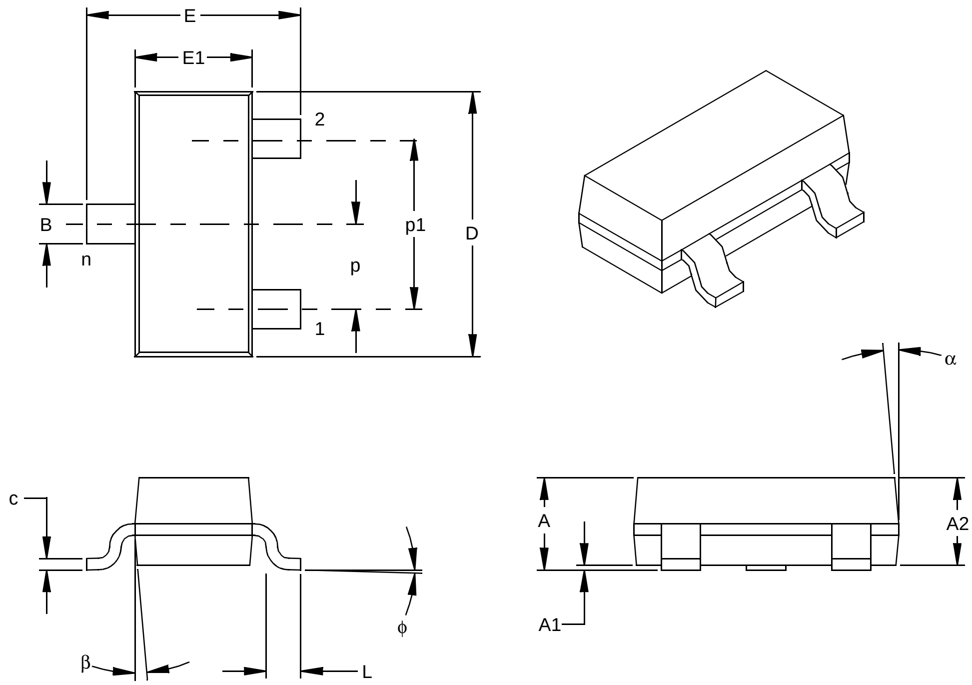


Top Side

Example:

Part Number	**MCP1xx =**			
	MCP102	**MCP103**	**MCP121**	**MCP131**
MCP1xxT-195I/LB	BGNN	FGNN	DGNN	CGNN
MCP1xxT-240E/LB	BHNN	FHNN	DHNN	CHNN
MCP1xxT-270E/LB	BJNN	FJNN	DJNN	CJNN
MCP1xxT-300E/LB	BKNN	FKNN	DKNN	CKNN
MCP1xxT-315E/LB	BLNN	FLNN	DLNN	CLNN
MCP1xxT-450E/LB	BMNN	FMNN	DMNN	CMNN
MCP1xxT-475E/LB	BPNN	FPNN	DPNN	CPNN

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

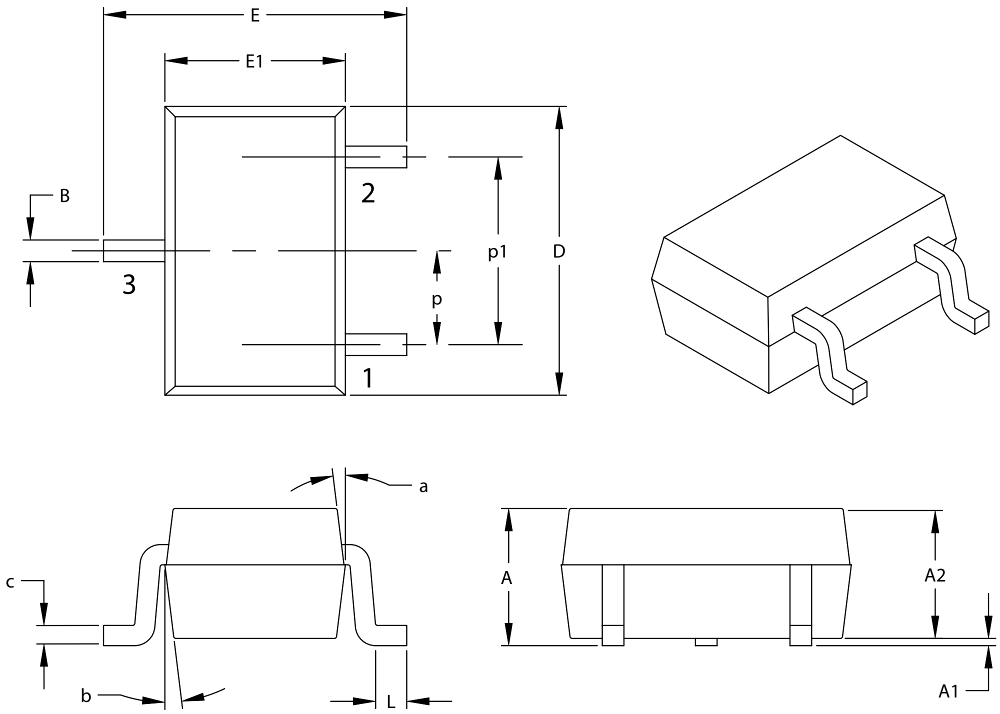


Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		3			3	
Pitch	p		.038			0.96	
Outside lead pitch (basic)	p1		.076			1.92	
Overall Height	A	.035	.040	.044	0.89	1.01	1.12
Molded Package Thickness	A2	.035	.037	.040	0.88	0.95	1.02
Standoff §	A1	.000	.002	.004	0.01	0.06	0.10
Overall Width	E	.083	.093	.104	2.10	2.37	2.64
Molded Package Width	E1	.047	.051	.055	1.20	1.30	1.40
Overall Length	D	.110	.115	.120	2.80	2.92	3.04
Foot Length	L	.014	.018	.022	0.35	0.45	0.55
Foot Angle	φ	0	5	10	0	5	10
Lead Thickness	c	.004	.006	.007	0.09	0.14	0.18
Lead Width	B	.015	.017	.020	0.37	0.44	0.51
Mold Draft Angle Top	α	0	5	10	0	5	10
Mold Draft Angle Bottom	β	0	5	10	0	5	10

* Controlling Parameter
§ Significant Characteristic

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-236
Drawing No. C04-104

3-Lead Plastic Small Outline Transistor (LB) (SC-70)



		Units	INCHES		MILLIMETERS*	
Dimension Limits			MIN	MAX	MIN	MAX
Number of Pins			3		3	
Pitch	p		.026 BSC.		0.65 BSC.	
Outside lead pitch (basic)	p1		.051 BSC.		1.30 BSC.	
Overall Height	A		.031	.043	0.80	1.10
Molded Package Thickness	A2		.031	.039	0.80	1.00
Standoff	A1		.000	.0004	0.00	.010
Overall Width	E		.071	.094	1.80	2.40
Molded Package Width	E1		.045	.053	1.15	1.35
Overall Length	D		.071	.089	1.80	2.25
Foot Length	L		.004	.016	0.10	0.41
Lead Thickness	c		.003	.010	0.08	0.25
Lead Width	B		.006	.016	0.15	0.40
Mold Draft Angle Top	a		8°	12°	8°	12°
Mold Draft Angle Bottom	b		8°	12°	8°	12°

*Controlling Parameter

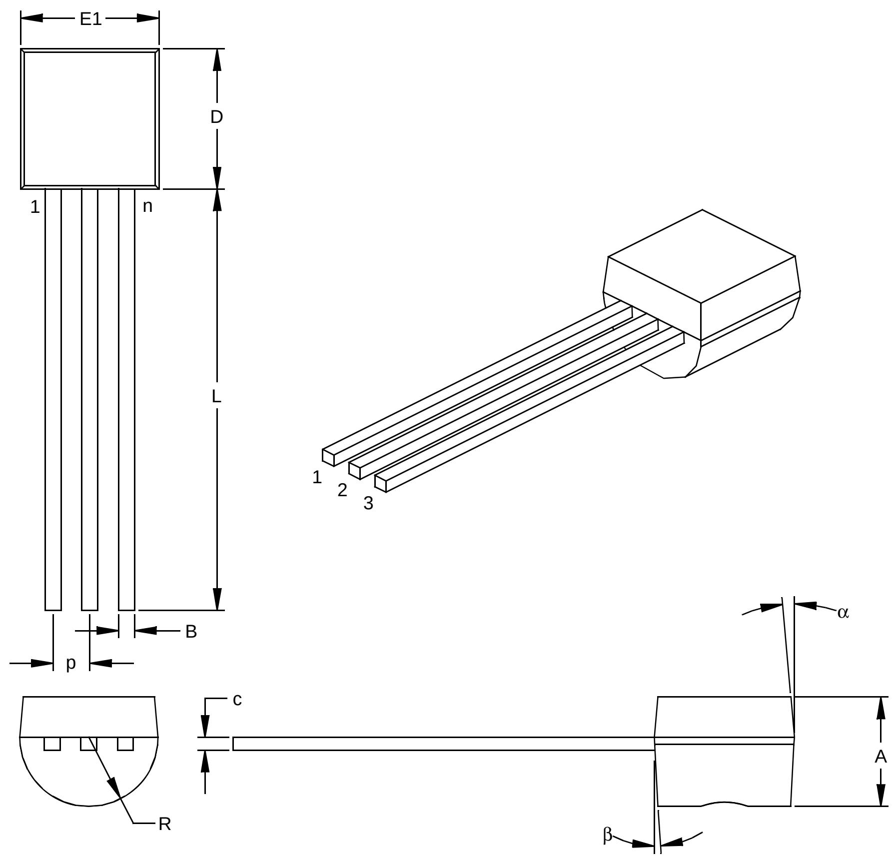
Notes:

Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" (0.127mm) per side.

JEITA (EIAJ) Equivalent: SC70

Drawing No. C04-104

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



Units		INCHES*			MILLIMETERS		
Dimension Limits		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	α	4	5	6	4	5	6
Mold Draft Angle Bottom	β	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

5.2 Product Tape and Reel Specifications

FIGURE 5-1: EMBOSSED CARRIER DIMENSIONS (8, 12, 16 AND 24 MM TAPE ONLY)

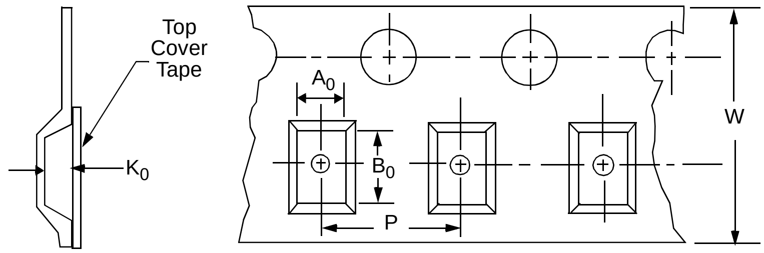


TABLE 1: CARRIER TAPE/CAVITY DIMENSIONS

Case Outline	Package Type		Carrier Dimensions		Cavity Dimensions			Output Quantity Units	Reel Diameter in mm
			W mm	P mm	A0 mm	B0 mm	K0 mm		
TT	SOT-23	3L	8	4	3.15	2.77	1.22	3000	180
LB	SC-70	3L	8	4	2.4	2.4	1.19	3000	180

FIGURE 5-2: 3-LEAD SOT-23/SC70 DEVICE TAPE AND REEL SPECIFICATIONS

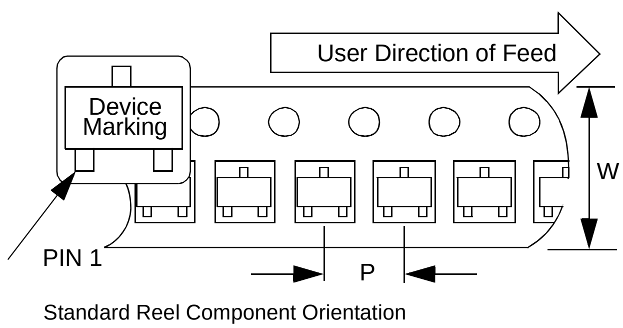
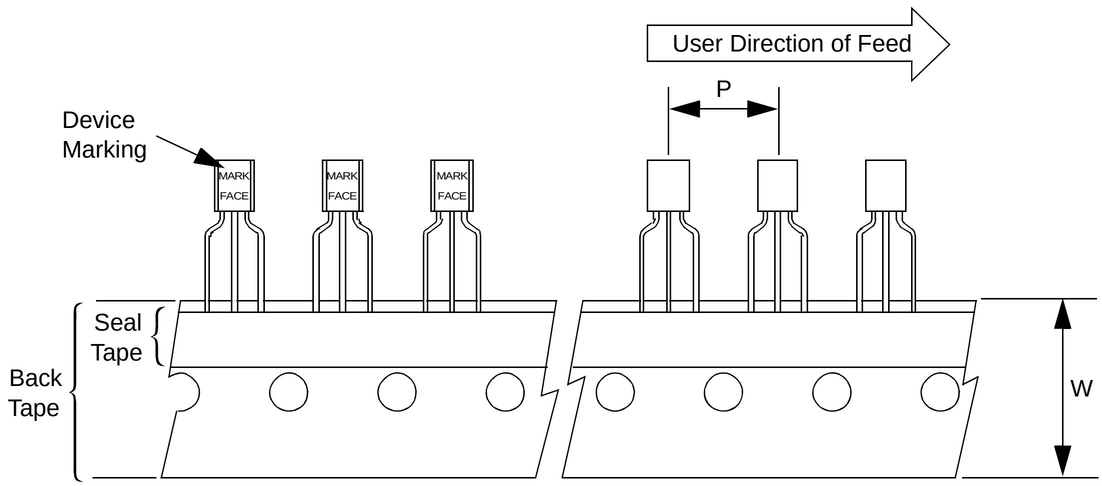


FIGURE 5-3: TO-92 DEVICE TAPE AND REEL SPECIFICATIONS



Note: Bent leads are for Tape and Reel only.

NOTES:

APPENDIX A: REVISION HISTORY

Revision B (March 2005)

The following is the list of modifications:

1. Added **Section 4.4 "Using in PICmicro® Microcontroller, ICSP™ Applications (MCP121 only)"** on using the MCP121 in PICmicro microcontroller ICSP applications.
2. Added V_{ODH} specifications in **Section 1.0 "Electrical Characteristics"** (for ICSP applications).
3. Added Figure 2-33.
4. Updated SC-70 package markings and added Pb-free marking information to **Section 5.0 "Packaging information"**.
5. Added **Appendix A: "Revision History"**.

Revision A (August 2004)

- Original Release of this Document.

NOTES:

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	XXX	X	/ XX
Device	Tape/Reel Option	Monitoring Options	Temperature Range	Package

Device:	MCP102: MicroPower Voltage Supervisor, push-pull MCP102T: MicroPower Voltage Supervisor, push-pull (Tape and Reel) MCP103: MicroPower Voltage Supervisor, push-pull MCP103T: MicroPower Voltage Supervisor, push-pull (Tape and Reel) MCP121 MicroPower Voltage Supervisor, open-drain MCP121T: MicroPower Voltage Supervisor, open-drain (Tape and Reel) MCP131 MicroPower Voltage Supervisor, open-drain MCP131T: MicroPower Voltage Supervisor, open-drain (Tape and Reel)
Monitoring Options:	195 = 1.90V 240 = 2.32V 270 = 2.63V 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:	TT = SOT-23B, 3-lead LB = SC-70, 3-lead TO = TO-92, 3-lead

Examples:

a) MCP102T-195I/TT: Tape and Reel, 1.95V MicroPower Voltage Supervisor, push-pull, -40°C to +85°C, SOT-23B-3 package.

b) MCP102-300E/TO: 3.00V MicroPower Voltage Supervisor, push-pull, -40°C to +125°C, TO-92-3 package.

a) MCP103T-270E/TT: Tape and Reel, 2.70V MicroPower Voltage Supervisor, push-pull, -40°C to +125°C, SOT-23B-3 package.

b) MCP103T-475E/LB: Tape and Reel, 4.75V MicroPower Voltage Supervisor, push-pull, -40°C to +125°C, SC-70-3 package.

a) MCP121T-315I/LB: Tape and Reel, 3.15V MicroPower Voltage Supervisor, open-drain, -40°C to +125°C, SC-70-3 package.

b) MCP121-300E/TO: 3.00V MicroPower Voltage Supervisor, open-drain, -40°C to +125°C, TO-92-3 package.

a) MCP131T-195I/TT: Tape and Reel, 1.95V MicroPower Voltage Supervisor, open-drain, -40°C to +85°C, SOT-23B-3 package.

b) MCP131-300E/TO: 3.00V MicroPower Voltage Supervisor, open-drain, -40°C to +125°C, TO-92-3 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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03/01/05