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MCP111/112

Micropower Voltage Detector

Features

- Ultra-Low Supply Current: 1.75 µA (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_{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°C to +125°C (**except MCP1XX-195**)
  - Industrial: -40°C to +85°C (**MCP1XX-195 Only**)
- Pb-Free Devices

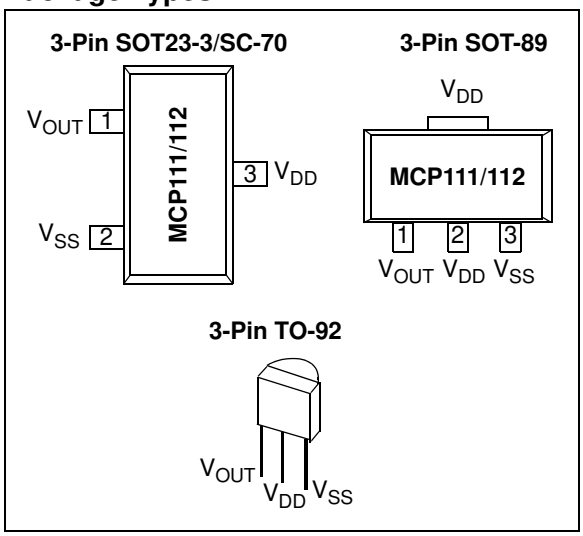
Applications

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

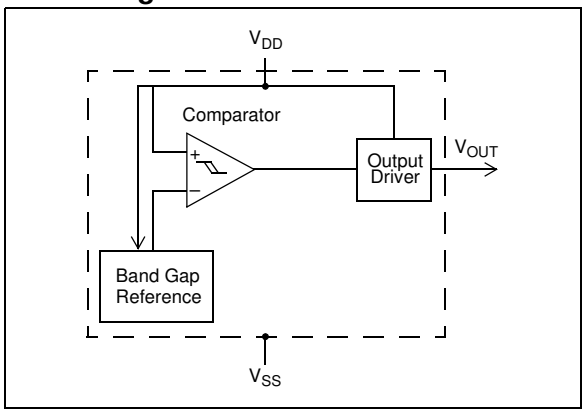
General Description

The 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



DEVICE FEATURES

Device	Output		Reset Delay (typ.)	SOT-23/SC70 Package Pin Out (Pin # 1, 2, 3)	Comment
	Type	Pull-up Resistor			
MCP111	Open-drain	External	No	V_{OUT}, V_{SS}, V_{DD}	
MCP112	Push-pull	No	No	V_{OUT}, V_{SS}, V_{DD}	
MCP102	Push-pull	No	120 ms	$\overline{RST}$, V_{DD}, V_{SS}	See **MCP102/103/121/131** Data Sheet (DS20001906)
MCP103	Push-pull	No	120 ms	V_{SS}, $\overline{RST}$, V_{DD}	See **MCP102/103/121/131** Data Sheet (DS20001906)
MCP121	Open-drain	External	120 ms	$\overline{RST}$, V_{DD}, V_{SS}	See **MCP102/103/121/131** Data Sheet (DS20001906)
MCP131	Open-Drain	Internal (~95 kΩ)	120 ms	$\overline{RST}$, V_{DD}, V_{SS}	See **MCP102/103/121/131** Data Sheet (DS20001906)

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 (only **MCP111**), T_A = -40°C to +125°C.

Parameters		Symbol	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	$I_{\overline{RST}}$ = 10 µA, $V_{\overline{RST}}$ < 0.2V
Operating Current		I_{DD}	—	< 1	1.75	µA	
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-290		2.857	2.900	2.944	V	T_A = +25°C **(Note 1)**
			2.828	2.900	2.973	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	

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

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

3: This specification allows this device to be used in PIC® microcontroller applications that require the In-Circuit Serial Programming™ (ICSP™) 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°C to 70°C (+25°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 kΩ (only **MCP111**), T_A = -40°C to +125°C.

Parameters		Symbol	Min.	Typ.	Max.	Units	Conditions
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-290		0.029	—	0.174	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	
V_{OUT} Low-level Output Voltage		V_{OL}	—	—	0.4	V	I_{OL} = 500 µA, V_{DD} = $V_{TRIP(MIN)}$
V_{OUT} High-level Output Voltage		V_{OH}	V_{DD} – 0.6	—	—	V	I_{OH} = 1 mA, For only **MCP112** (push-pull output)
Open-drain High Voltage on Output		V_{ODH}	—	—	13.5 (3)	V	**MCP111** only, V_{DD} = 3.0V, Time voltage > 5.5V applied ≤ 100s, current into pin limited to 2 mA, +25°C operation recommended **Note 3**, **Note 4**
Open-drain Output Leakage Current (**MCP111** 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: This specification allows this device to be used in PIC® microcontroller applications that require the In-Circuit Serial Programming™ (ICSP™) 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°C to 70°C (+25°C preferred). For additional information, please refer to Figure 2-28.

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

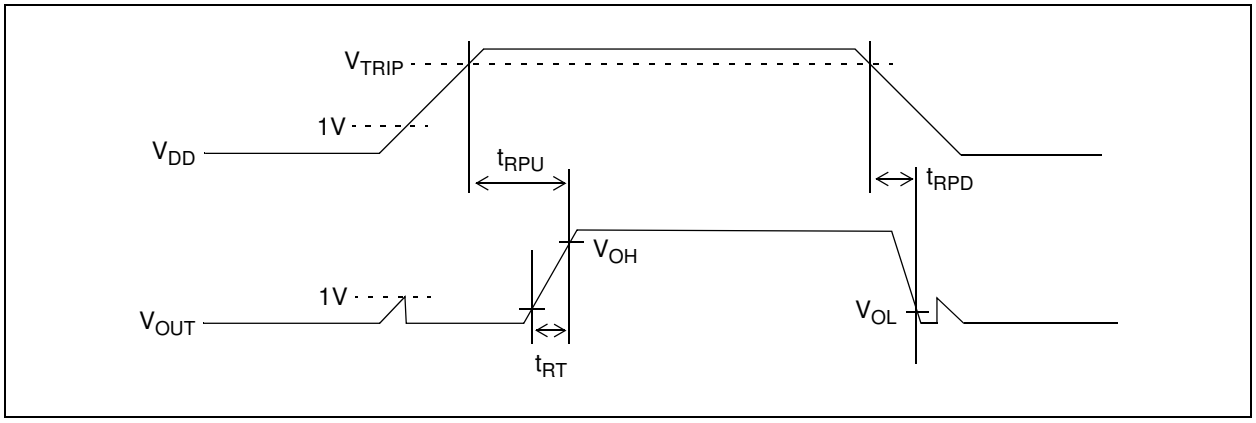


FIGURE 1-1: *Timing Diagram.*

AC CHARACTERISTICS

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

Parameters	Symbol	Min.	Typ.	Max.	Units	Conditions
V_{DD} Detect to V_{OUT} Inactive	t_{RPU}	—	90	—	µs	Figure 1-1 and C_L = 50 pF (Note 1)
V_{DD} Detect to V_{OUT} 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)
V_{OUT} Rise Time After V_{OUT} Active	t_{RT}	—	5	—	µs	For V_{OUT} 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 (**MCP111** only), T_A = -40°C to +125°C.

Parameters	Symbol	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Specified Temperature Range	T_A	-40	—	+85	°C	**MCP1XX-195**
Specified Temperature Range	T_A	-40	—	+125	°C	Except **MCP1XX-195**
Maximum Junction Temperature	T_J	—	—	+150	°C	
Storage Temperature Range	T_A	-65	—	+150	°C	
Package Thermal Resistances						
Thermal Resistance, 3L-SOT23	θ_{JA}	—	336	—	°C/W	
Thermal Resistance, 3L-SC-70	θ_{JA}	—	340	—	°C/W	
Thermal Resistance, 3L-TO-92	θ_{JA}	—	131.9	—	°C/W	
Thermal Resistance, 3L-SOT-89	θ_{JA}	—	110	—	°C/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 (only **MCP111**; see **Figure 4-1**), T_A = -40°C to +125°C.

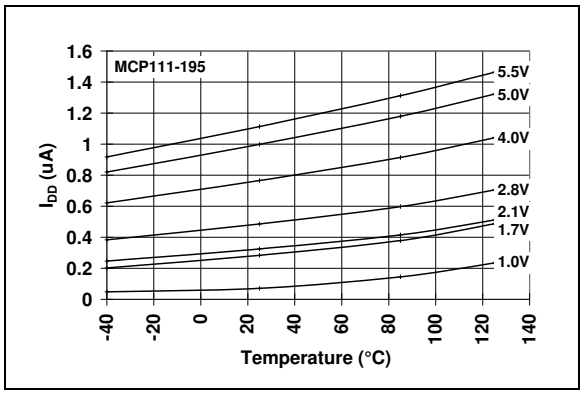


FIGURE 2-1: *I_{DD} vs. Temperature (**MCP111-195**).*

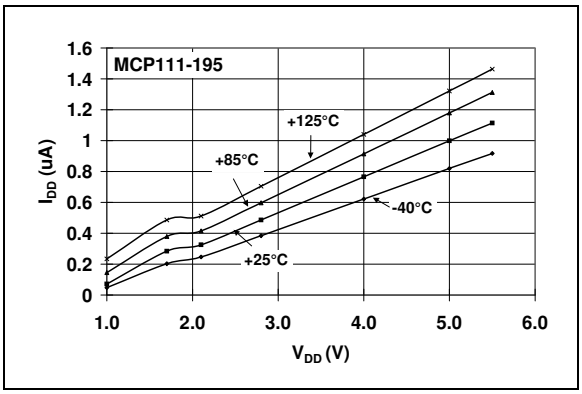


FIGURE 2-4: *I_{DD} vs. V_{DD} (**MCP111-195**).*

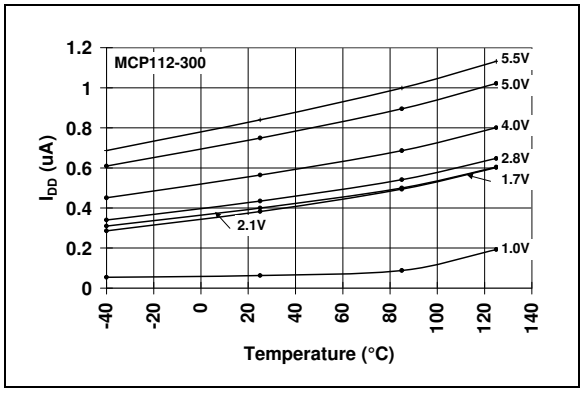


FIGURE 2-2: *I_{DD} vs. Temperature (**MCP112-300**).*

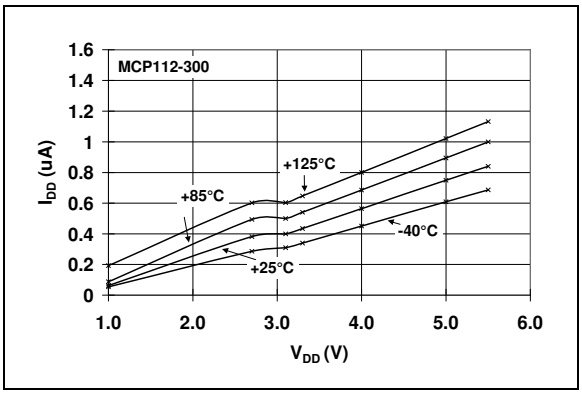


FIGURE 2-5: *I_{DD} vs. V_{DD} (**MCP112-300**).*

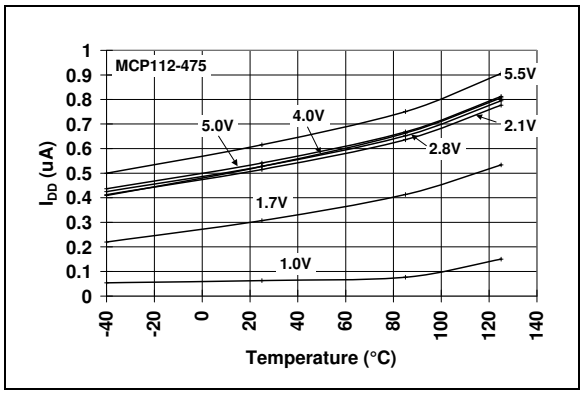


FIGURE 2-3: *I_{DD} vs. Temperature (**MCP112-475**).*

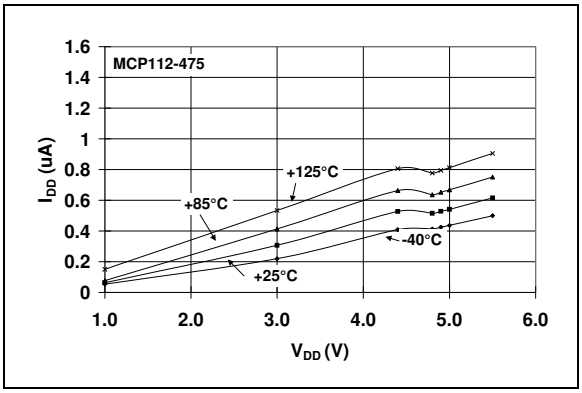


FIGURE 2-6: *I_{DD} vs. V_{DD} (**MCP112-475**).*

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (only **MCP111**; see **Figure 4-1**), T_A = -40°C to +125°C.

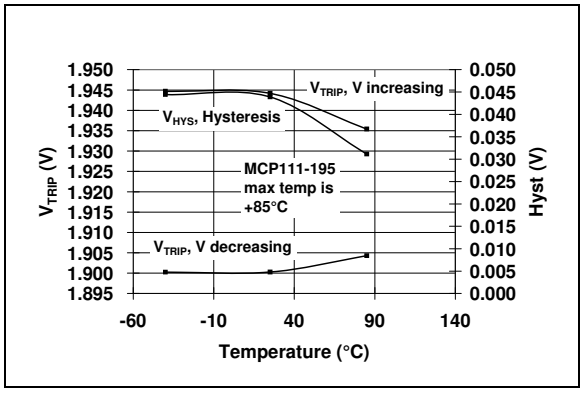


FIGURE 2-7: *V_{TRIP} and V_{HYST} vs. Temperature (**MCP111-195**).*

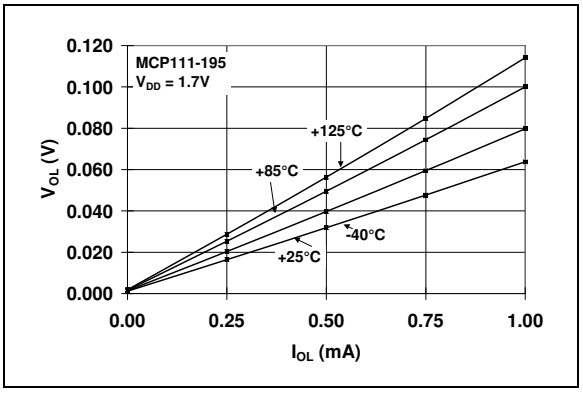


FIGURE 2-10: *V_{OL} vs. I_{OL} (**MCP111-195** @ V_{DD} = 1.7V).*

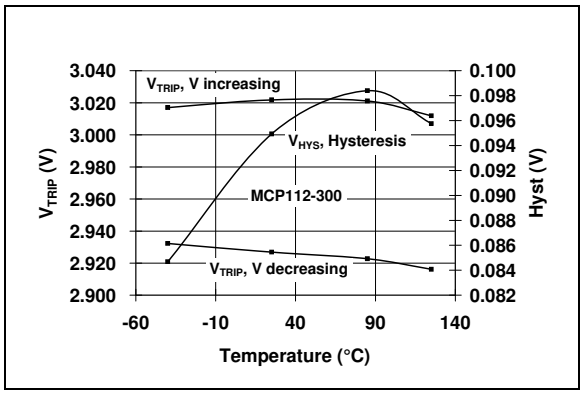


FIGURE 2-8: *V_{TRIP} and V_{HYST} vs. Temperature (**MCP112-300**).*

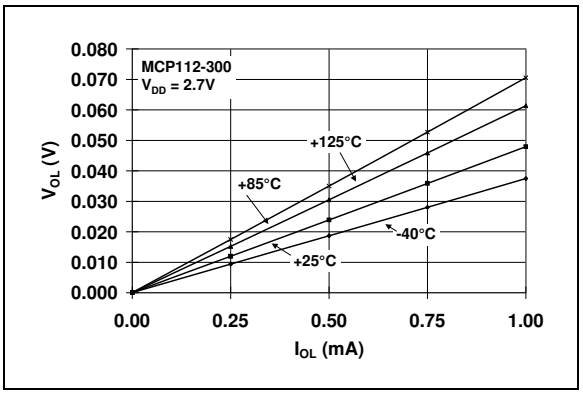


FIGURE 2-11: *V_{OL} vs. I_{OL} (**MCP112-300** @ V_{DD} = 2.7V).*

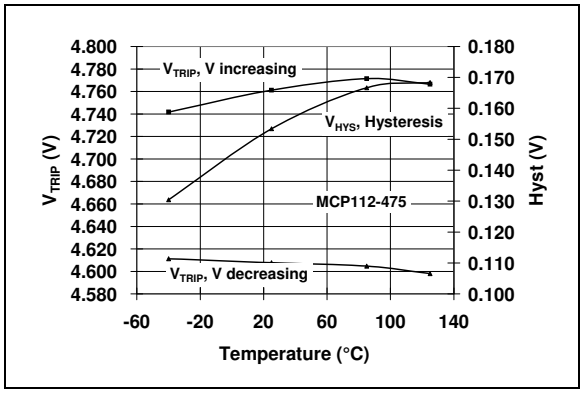


FIGURE 2-9: *V_{TRIP} and V_{HYST} vs. Temperature (**MCP112-475**).*

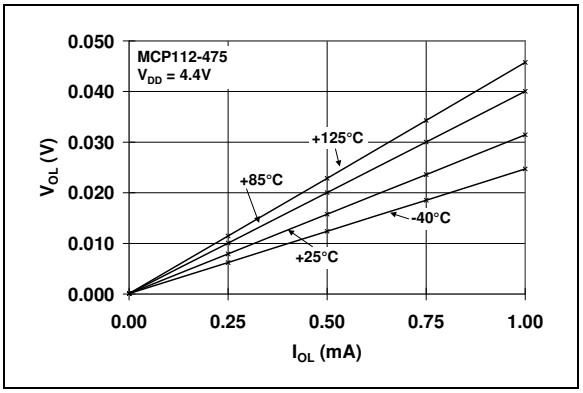


FIGURE 2-12: *V_{OL} vs. I_{OL} (**MCP112-475** @ V_{DD} = 4.4V).*

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**only MCP111**; see **Figure 4-1**), T_A = -40°C to +125°C.

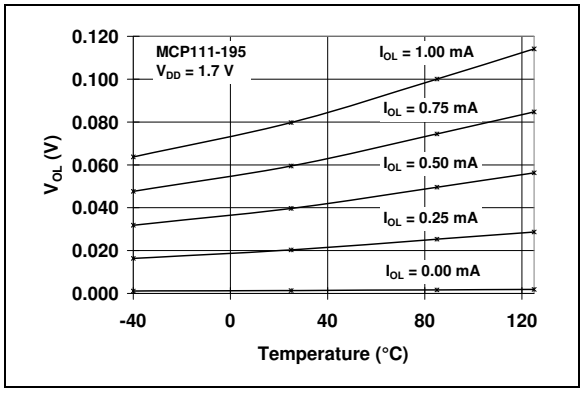


FIGURE 2-13: *V_{OL} vs. Temperature (**MCP111-195** @ V_{DD} = 1.7V).*

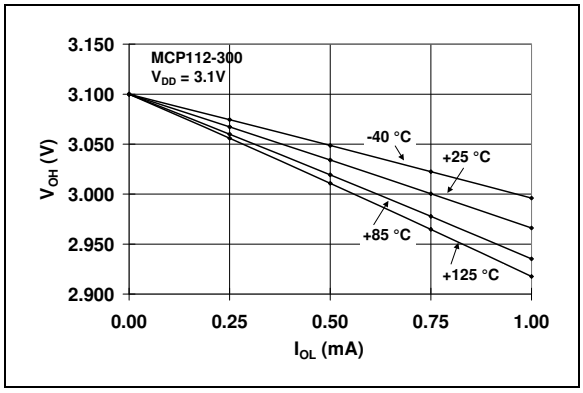


FIGURE 2-16: *V_{OH} vs. I_{OH} (**MCP112-300** @ V_{DD} = 3.1V).*

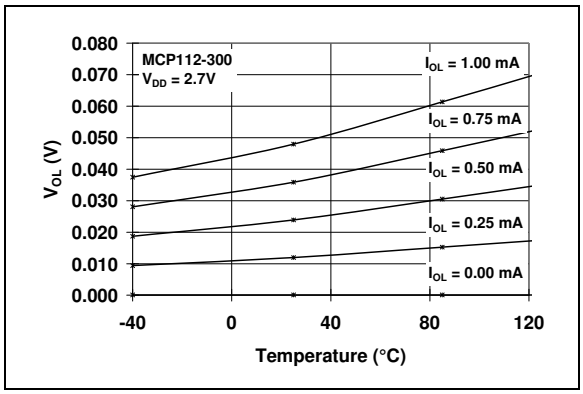


FIGURE 2-14: *V_{OL} vs. Temperature (**MCP112-300** @ V_{DD} = 2.7V).*

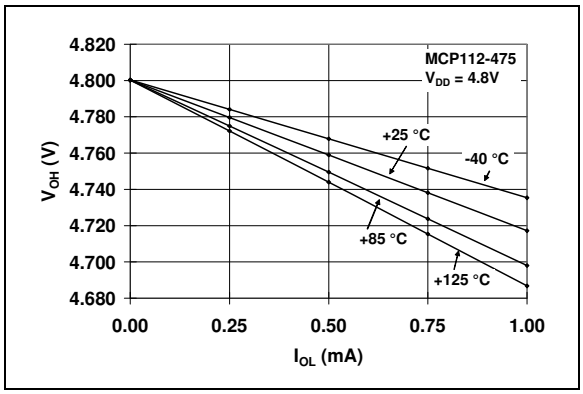


FIGURE 2-17: *V_{OH} vs. I_{OH} (**MCP112-475** @ V_{DD} = 4.8V).*

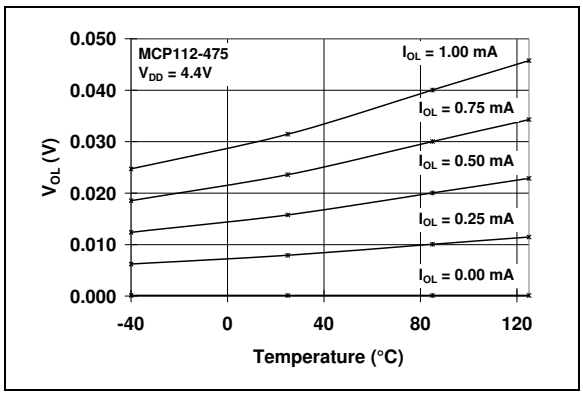


FIGURE 2-15: *V_{OL} vs. Temperature (**MCP112-475** @ V_{DD} = 4.4V).*

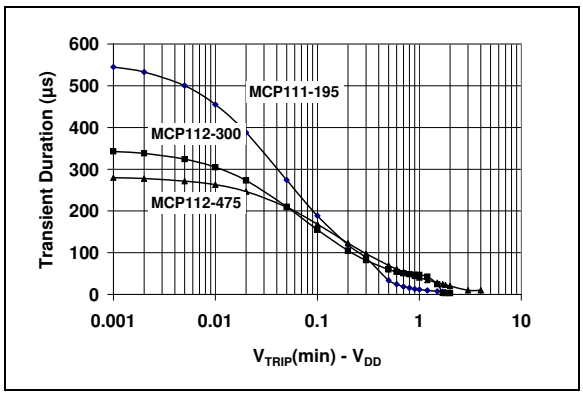


FIGURE 2-18: *Typical Transient Response (25 °C).*

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**only MCP111**; see **Figure 4-1**), T_A = -40°C to +125°C.

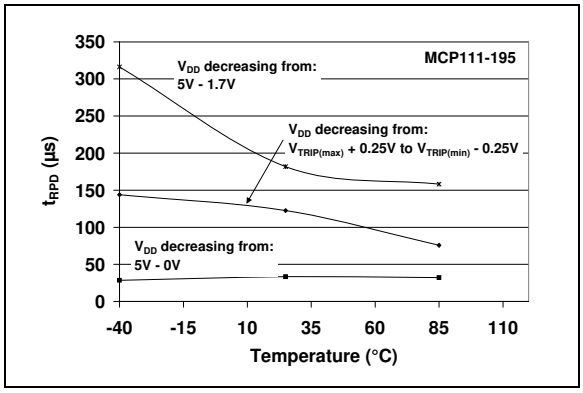


FIGURE 2-19: *t_{RPD} vs. Temperature (**MCP111-195**).*

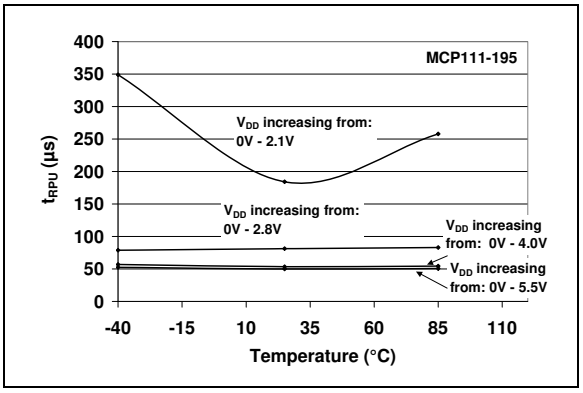


FIGURE 2-22: *t_{RPU} vs. Temperature (**MCP111-195**).*

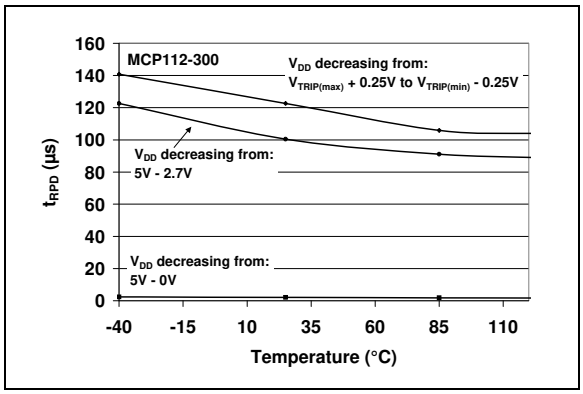


FIGURE 2-20: *t_{RPD} vs. Temperature (**MCP112-300**).*

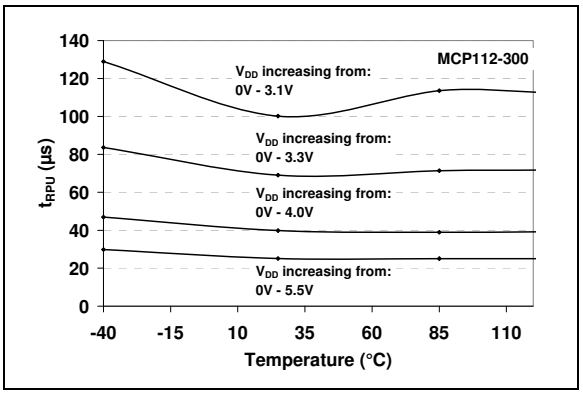


FIGURE 2-23: *t_{RPU} vs. Temperature (**MCP112-300**).*

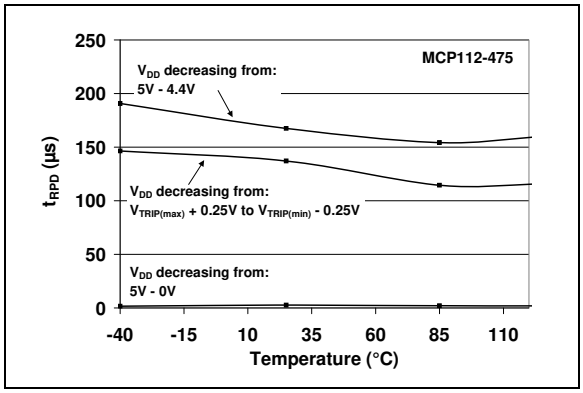


FIGURE 2-21: *t_{RPD} vs. Temperature (**MCP112-475**).*

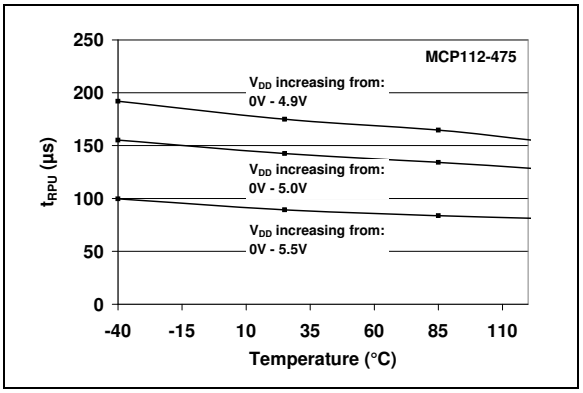


FIGURE 2-24: *t_{RPU} vs. Temperature (**MCP112-475**).*

Note: Unless otherwise indicated, all limits are specified for V_{DD} = 1V to 5.5V, R_{PU} = 100 kΩ (**only MCP111**; see **Figure 4-1**), T_A = -40°C to +125°C.

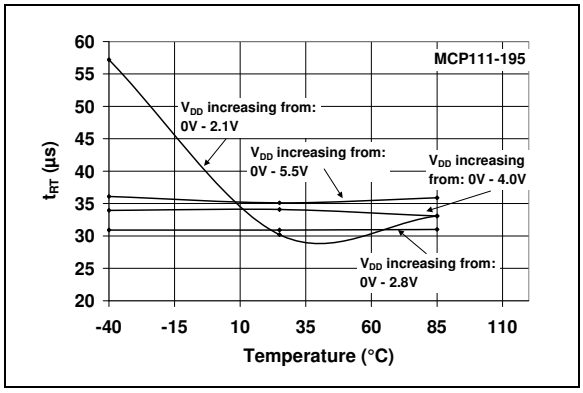


FIGURE 2-25: *t_{RT} vs. Temperature (**MCP111-195**).*

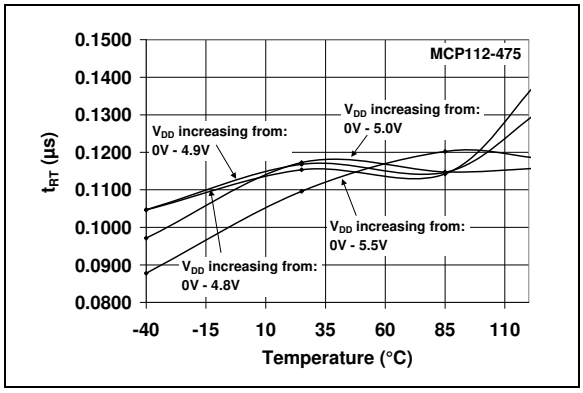


FIGURE 2-27: *t_{RT} vs. Temperature (**MCP112-475**).*

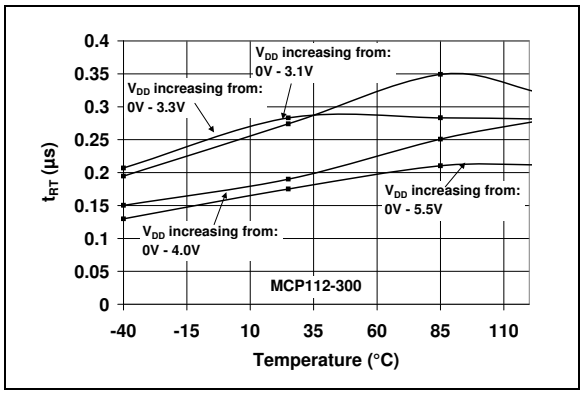


FIGURE 2-26: *t_{RT} vs. Temperature (**MCP112-300**).*

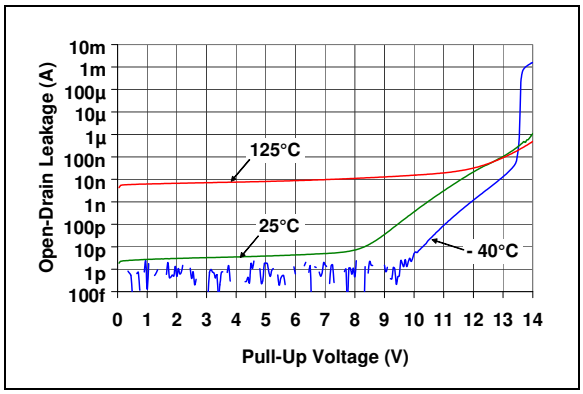


FIGURE 2-28: *Open-Drain Leakage Current vs. Voltage Applied to V_{OUT} Pin (**MCP111-195**).*

3.0 PIN DESCRIPTION

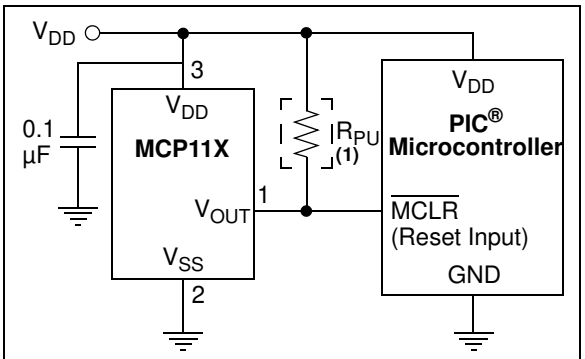
The descriptions of the pins are listed in Table 3-1.

TABLE 3-1: PIN FUNCTION TABLE

Pin Number			Symbol	Function
SOT-23-3 SC-70	SOT-89-3	T0-92		
1	1	1	V_{OUT}	**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	3	V_{SS}	Ground reference
3	2	2	V_{DD}	Positive power supply
—	4	—	V_{DD}	Positive power supply

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 is a brown-out condition, 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 SRAM, thus producing indeterminate results. Figure 4-1 shows a typical application circuit.



Note 1: R_{PU} may be required with the MCP111 due to the open-drain output. Resistor R_{PU} is not required with the MCP112.

FIGURE 4-1: *Typical Application Circuit.*

4.1 V_{TRIP} Operation

The voltage trip point (V_{TRIP}) is determined on the falling edge of V_{DD}. The actual voltage trip point (V_{TRIPAC}) will be between the minimum trip point ($V_{TRIPMIN}$) and the maximum trip point ($V_{TRIPMAX}$). There is a hysteresis on this trip point to remove any "jitter" that would occur on the V_{OUT} pin when the device V_{DD} is at the trip point.

Figure 4-2 shows the state of the V_{OUT} pin as determined by the V_{DD} voltage. The V_{TRIP} specification is for falling V_{DD} voltages. When the V_{DD} voltage is rising, the V_{OUT} pin will not be driven high until V_{DD} is at $V_{TRIP} + V_{HYS}$.

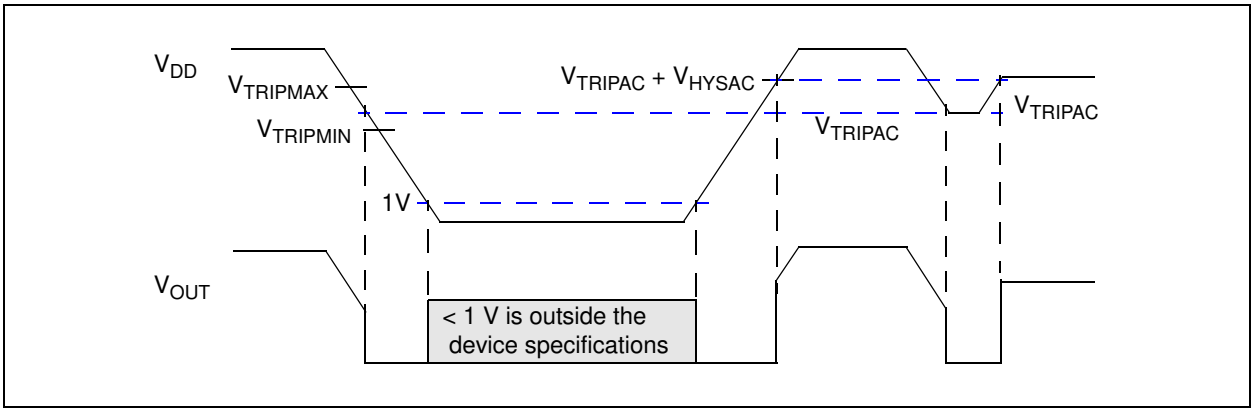


FIGURE 4-2: *V_{OUT} Operation as Determined by the V_{TRIP} and V_{HYS}.*

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 dependent 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 MCP111/112 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 2-18 shows the transient response characteristics for the MCP111/112.

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).

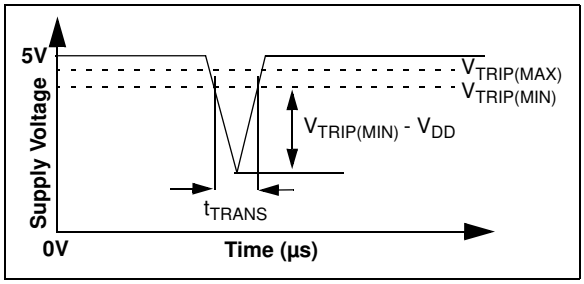


FIGURE 4-3: *Example of Typical Transient Duration Waveform.*

4.3 Effect of Temperature on Time-Out Period (t_{RPU})

The time-out period (t_{RPU}) determines how long the device remains in the reset condition. This is affected by both V_{DD} and temperature. The graph shown in Figures 2-22, 2-23 and 2-24 show the typical response for different V_{DD} values and temperatures.

4.4 Using in PIC® Microcontroller ICSP™ Applications (MCP111 only)

Figure 4-4 shows the typical application circuit for using the MCP111 for voltage supervisory function when the PIC microcontroller will be programmed via the In-Circuit Serial Programming™ (ICSP) feature. Additional information is available in TB087, *"Using Voltage Supervisors with PIC® 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.

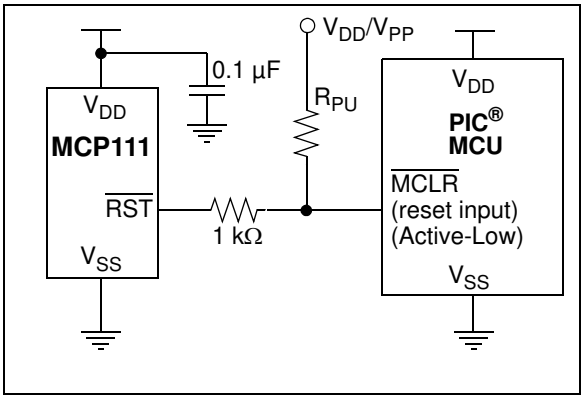
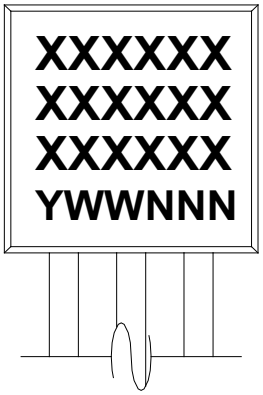


FIGURE 4-4: *Typical Application Circuit for PIC® Microcontroller with the ICSP™ feature.*

5.0 PACKAGING INFORMATION

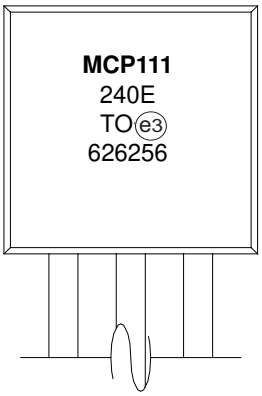
5.1 Package Marking Information

3-Lead TO-92

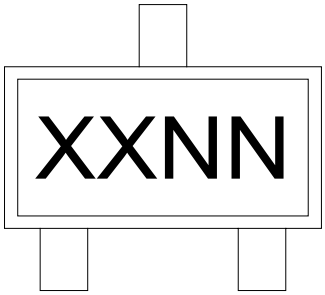


Device	Code
MCP111-240E/TO	240E
MCP111-270E/TO	270E
MCP111-290E/TO	290E
MCP111-300E/TO	300E
MCP111-315E/TO	315E
MCP111-450E/TO	450E
MCP111-475E/TO	475E
MCP111-195I/TO	195I

Example:

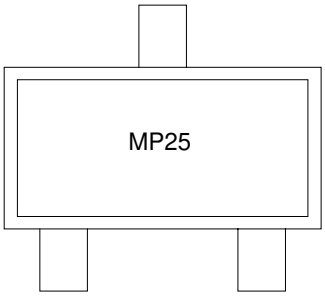


3-Lead SOT-23



Device	Code
MCP111T-195I/TT	MPNN
MCP111T-240ETT	MQNN
MCP111T-270E/TT	MGNN
MCP111T-290E/TT	NHNN
MCP111T-300E/TT	MJNN
MCP111T-315E/TT	MKNN
MCP111T-450E/TT	MLNN
MCP111T-475E/TT	MMNN
MCP112T-195I/TT	MRNN
MCP112T-240ETT	MSNN
MCP112T-270E/TT	MANN
MCP112T-290E/TT	MBNN
MCP112T-300E/TT	MCNN
MCP112T-315E/TT	MDNN
MCP112T-450E/TT	MENN
MCP112T-475E/TT	MFNN

Example:

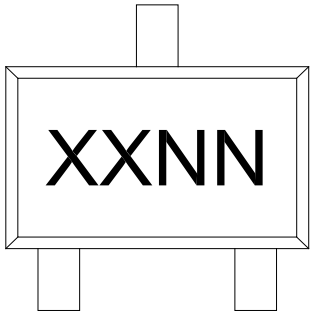


Legend:	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on 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.

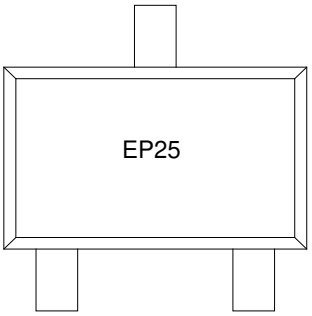
Package Marking Information (Continued)

3-Lead SC-70

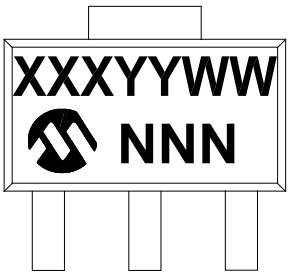


Device	Code
MCP111T-195I/LB	EPNN
MCP111T-240E/LB	EQNN
MCP111T-270E/LB	EGNN
MCP111T-290E/LB	EHNN
MCP111T-300E/LB	EJNN
MCP111T-315E/LB	EKNN
MCP111T-450E/LB	ELNN
MCP111T-475E/LB	EMNN
MCP112T-195I/LB	ERNN
MCP112T-240E/LB	ESNN
MCP112T-270E/LB	EANN
MCP112T-290E/LB	EBNN
MCP112T-300E/LB	ECNN
MCP112T-315E/LB	EDNN
MCP112T-450E/LB	EENN
MCP112T-475E/LB	EFNN

Example:

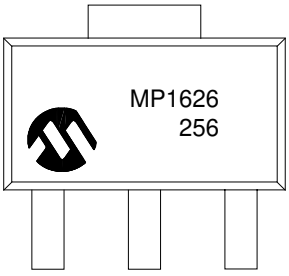


3-Lead SOT-89



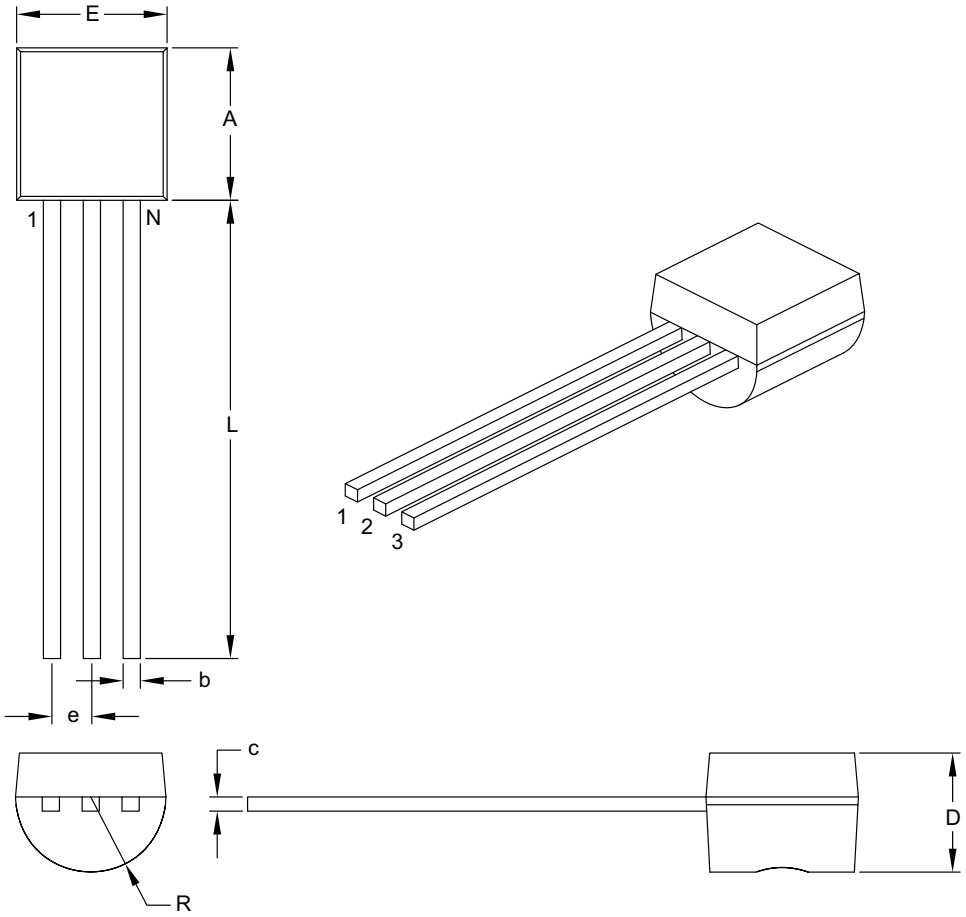
Device	Code
MCP111T-195I/MB	MP
MCP111T-240EMB	MQ
MCP111T-270E/MB	MG
MCP111T-290E/MB	NH
MCP111T-300E/MB	MJ
MCP111T-315E/MB	MK
MCP111T-450E/MB	ML
MCP111T-475E/MB	MM
MCP112T-195I/MB	MR
MCP112T-240EMB	MS
MCP112T-270E/MB	MA
MCP112T-290E/MB	MB
MCP112T-300E/MB	MC
MCP112T-315E/MB	MD
MCP112T-450E/MB	ME
MCP112T-475E/MB	MF

Example:



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

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



Units		INCHES	
Dimension Limits		MIN	MAX
Number of Pins	N	3	
Pitch	e	.050 BSC	
Bottom to Package Flat	D	.125	.165
Overall Width	E	.175	.205
Overall Length	A	.170	.210
Molded Package Radius	R	.080	.105
Tip to Seating Plane	L	.500	–
Lead Thickness	c	.014	.021
Lead Width	b	.014	.022

Notes:

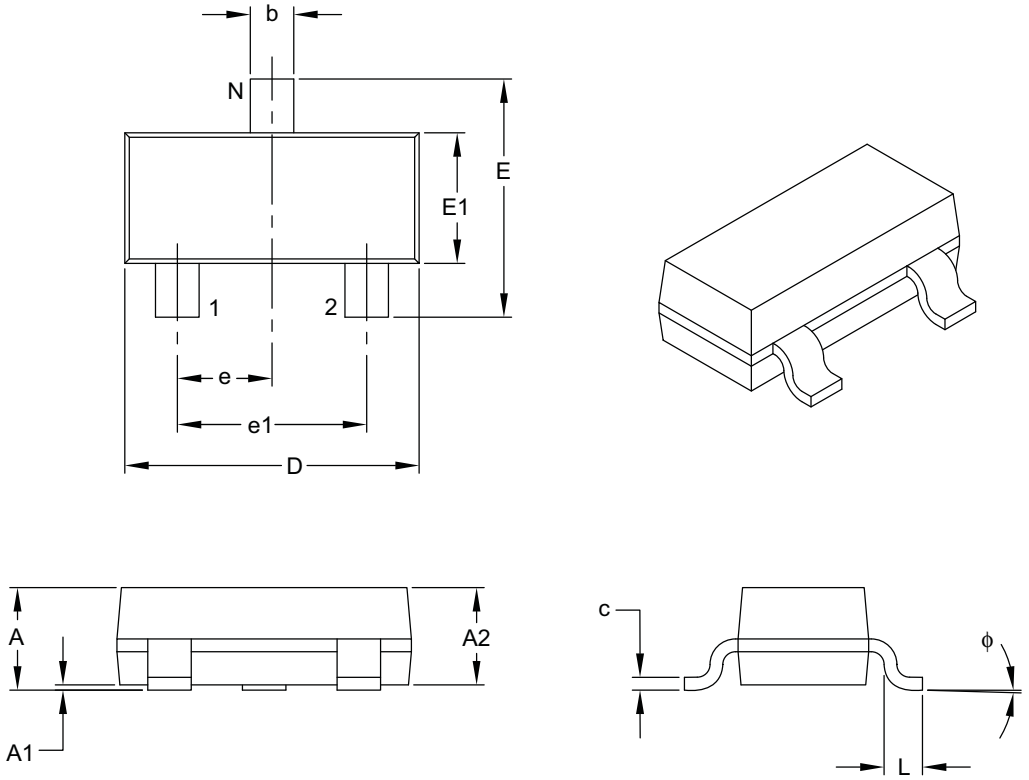
1. Dimensions A and E do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" per side.
2. Dimensioning and tolerancing per ASME Y14.5M.

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

Microchip Technology Drawing C04-101B

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

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



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

Notes:

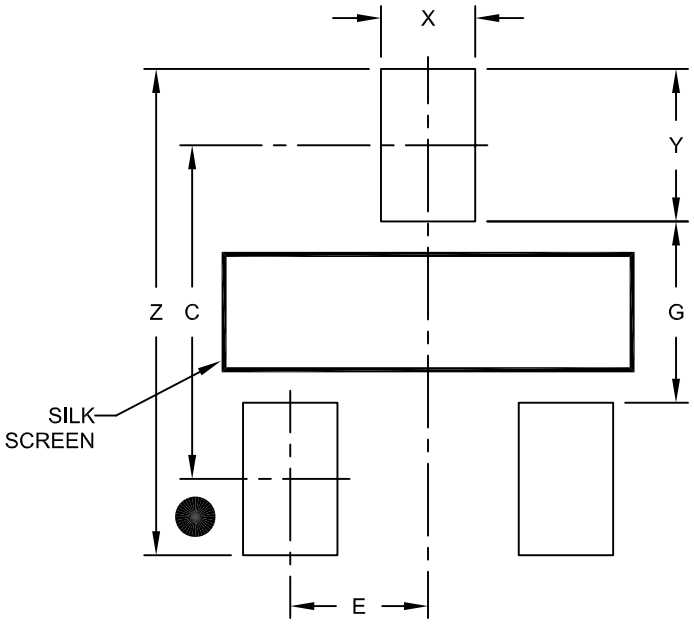
1. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25 mm per side.
2. Dimensioning and tolerancing per ASME Y14.5M.

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

Microchip Technology Drawing C04-104B

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

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



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.95 BSC	
Contact Pad Spacing	C		2.30	
Contact Pad Width (X3)	X			0.65
Contact Pad Length (X3)	Y			1.05
Distance Between Pads	G	1.25		
Overall Width	Z			3.35

Notes:

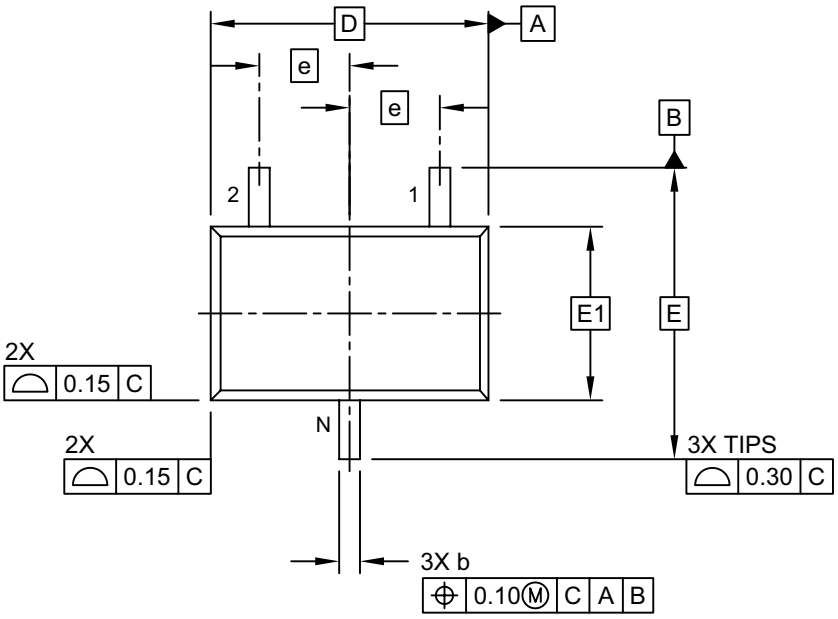
1. Dimensioning and tolerancing per ASME Y14.5M

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

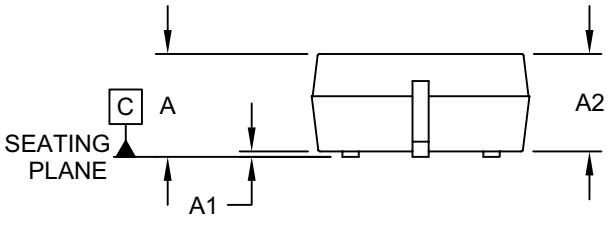
Microchip Technology Drawing No. C04-2104A

3-Lead Plastic Small Outline Transistor (LB) [SC70]

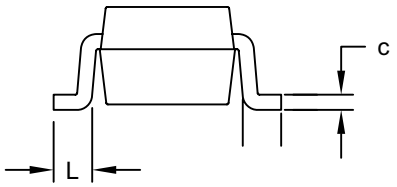
Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



TOP VIEW



SIDE VIEW

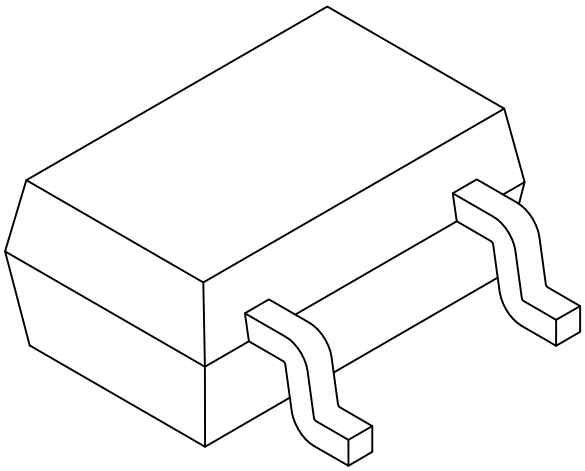


END VIEW

Microchip Technology Drawing C04-060C Sheet 1 of 2

3-Lead Plastic Small Outline Transistor (LB) [SC70]

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



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		3	
Pitch	e		0.65 BSC	
Overall Height	A	0.80	-	1.10
Standoff	A1	0.00	-	0.10
Molded Package Thickness	A2	0.80	-	1.00
Overall Length	D		2.00 BSC	
Exposed Pad Length	D2	2.50	2.60	2.70
Overall Width	E		2.10 BSC	
Exposed Pad Width	E1		1.25 BSC	
Terminal Width	b	0.15	-	0.40
Terminal Length	L	0.10	0.20	0.46
Lead Thickness	c	0.20	-	0.26

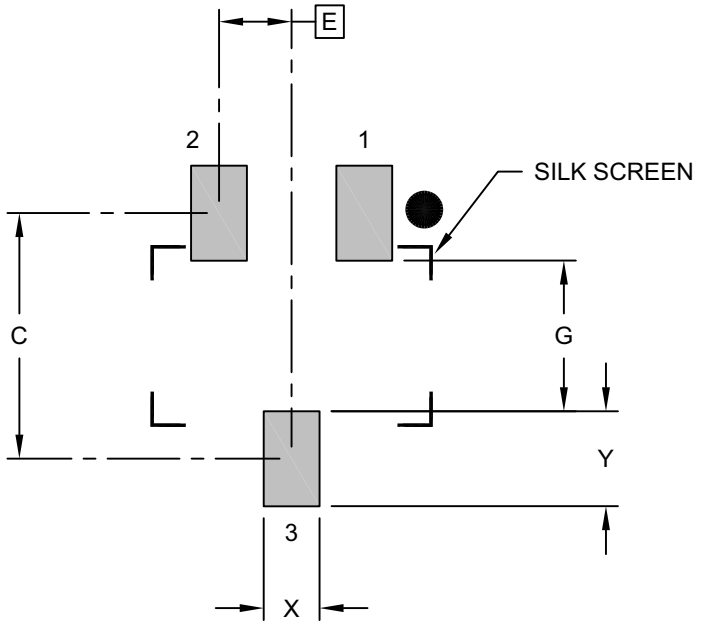
Notes:

1. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
2. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-060C Sheet 2 of 2

3-Lead Plastic Small Outline Transistor (LB) [SC70]

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



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	0.65 BSC		
Contact Pad Spacing	C		2.20	
Contact Pad Width	X			0.50
Contact Pad Length	Y			0.85
Distance Between Pads	G	1.25		

Notes:

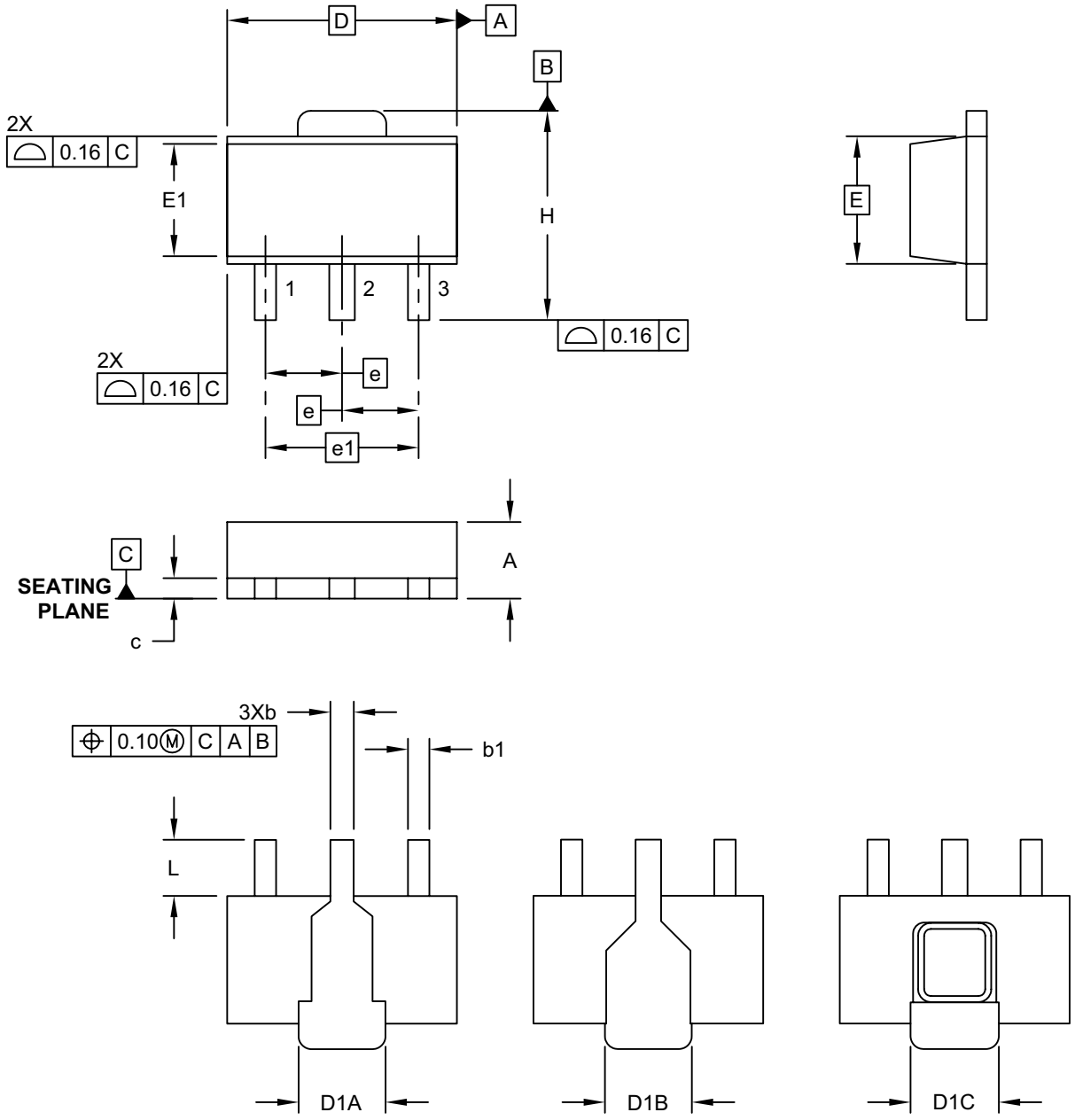
1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2060B

3-Lead Plastic Small Outline Transistor (MB) - [SOT-89]

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

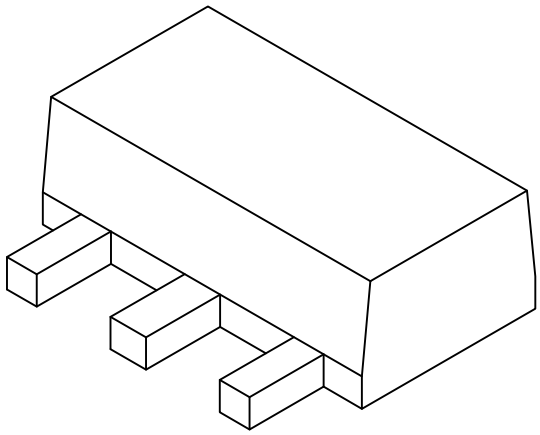


OPTIONAL BACKSIDE PATTERNS — PARTS MAY BE SUPPLIED WITH ANY PATTERN SHOWN

Microchip Technology Drawing C04-029C Sheet 1 of 2

3-Lead Plastic Small Outline Transistor (MB) - [SOT-89]

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



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Leads	N		3	
Pitch	e		1.50 BSC	
Outside Lead Pitch	e1		3.00 BSC	
Overall Height	A	1.40	1.50	1.60
Overall Width	H	3.94	4.10	4.25
Molded Package Width at Base	E		2.50 BSC	
Molded Package Width at Top	E1	2.13	2.20	2.29
Overall Length	D		4.50 BSC	
Tab Length (Option A)	D1A	1.63	1.73	1.83
Tab Length (Option B)	D1B	1.40	1.60	1.75
Tab Length (Option C)	D1C	1.62	1.73	1.83
Foot Length	L	0.79	1.10	1.20
Lead Thickness	c	0.35	0.40	0.44
Lead 2 Width	b	0.41	0.50	0.56
Leads 1 & 3 Width	b1	0.36	0.42	0.48

Notes:

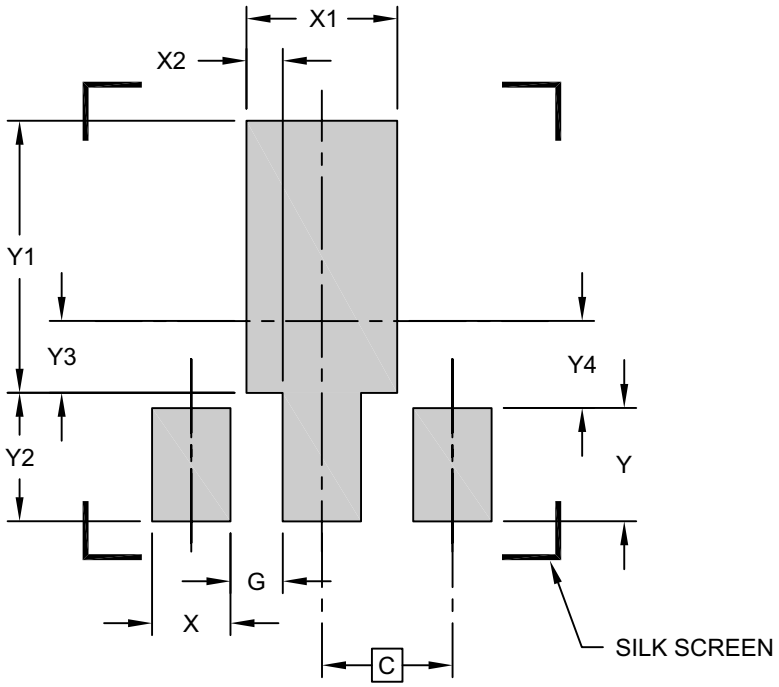
1. Dimensions D and E do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.127mm per side.
2. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing C04-029C Sheet 2 of 2

3-Lead Plastic Small Outline Transistor (MB) - [SOT-89]

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



RECOMMENDED LAND PATTERN

Units	MILLIMETERS		
Dimension Limits	MIN	NOM	MAX
C		1.50 (BSC)	
X (3 PLACES)		0.900	
X1		1.733	
X2 (2 PLACES)		0.416	
G (2 PLACES)		0.600	
Y (2 PLACES)		1.300	
Y1		3.125	
Y2		1.475	
Y3		0.825	
Y4		1.000	

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing C04-2029C

5.2 Product Tape and Reel Specifications

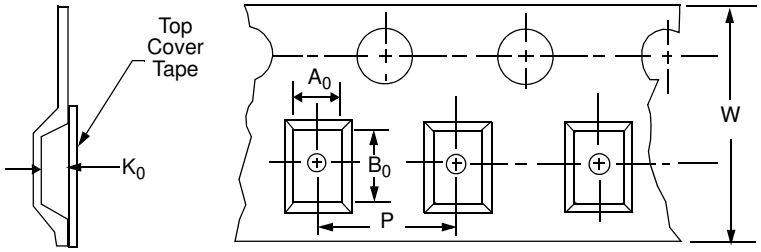


FIGURE 5-1: *Embossed Carrier Dimensions (8, 12, 16 and 24 mm tape only).*

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-23B	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

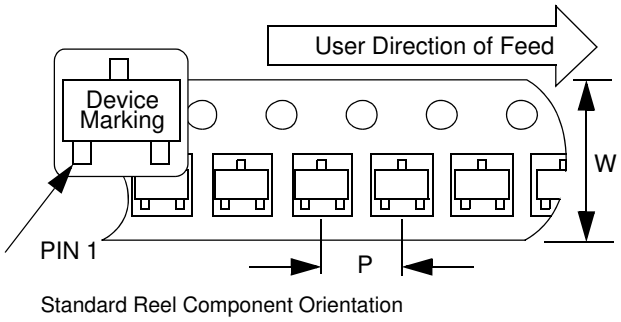
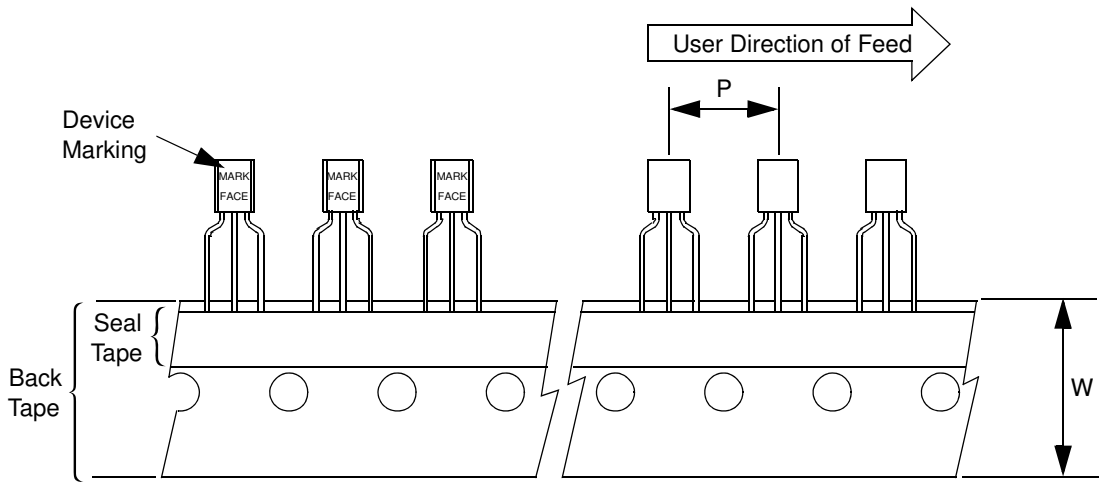


FIGURE 5-2: *3-Lead SOT-23/SC70 Device Tape and Reel Specifications.*



Note: Bent leads are for Tape and Reel only.

FIGURE 5-3: *TO-92 Devices.*

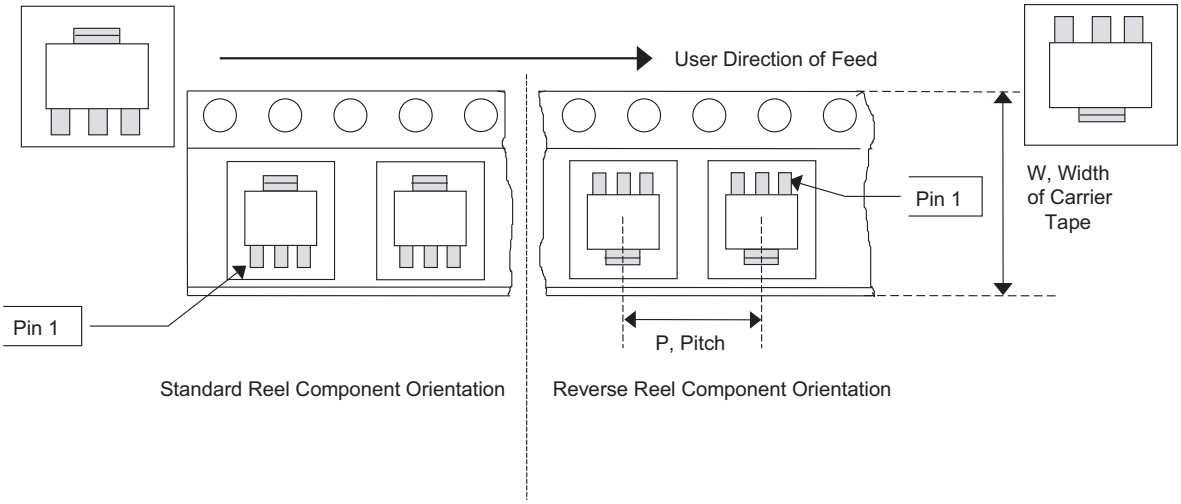


FIGURE 5-4: *SOT-89 Devices.*