# 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

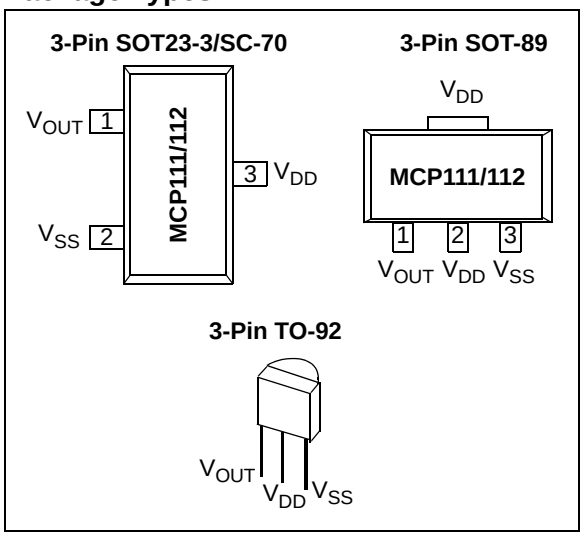
### Applications

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

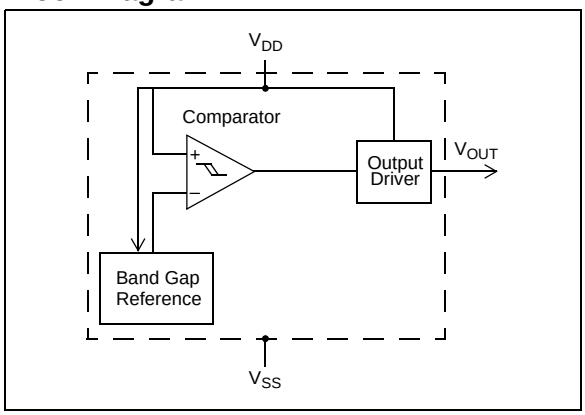
### General Description

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.

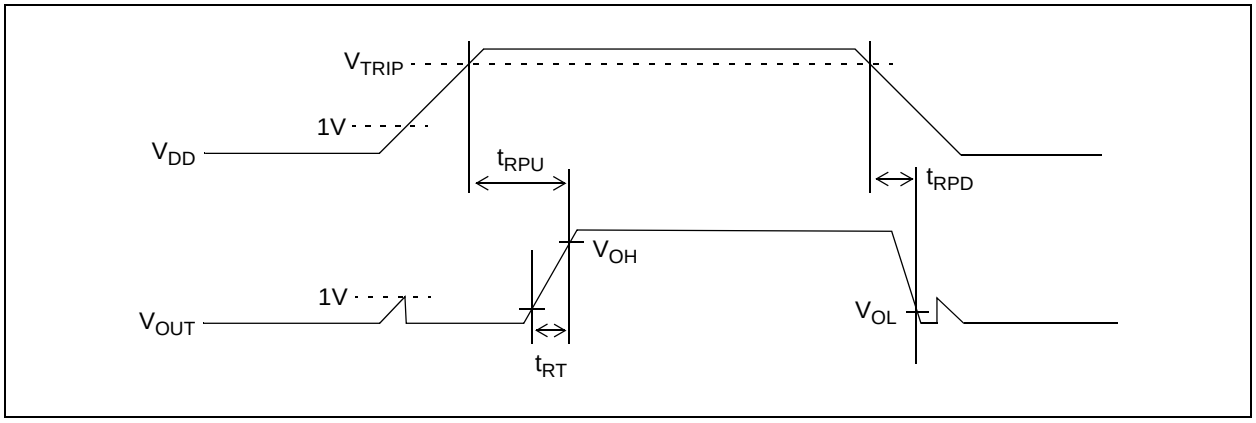



***FIGURE 1-1:*** *Timing Diagram.*

## 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 | $\theta_{JA}$ | — | 336 | — | °C/W | |
| Thermal Resistance, 3L-SC-70 | $\theta_{JA}$ | — | 340 | — | °C/W | |
| Thermal Resistance, 3L-TO-92 | $\theta_{JA}$ | — | 131.9 | — | °C/W | |
| Thermal Resistance, 3L-SOT-89 | $\theta_{JA}$ | — | 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.

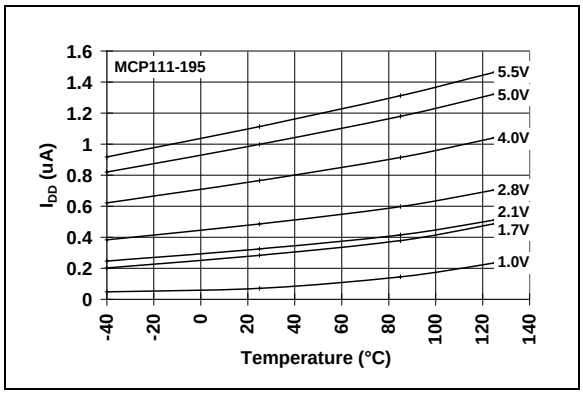



***FIGURE 2-1:*** *$I_{DD}$ vs. Temperature (**MCP111-195**).*

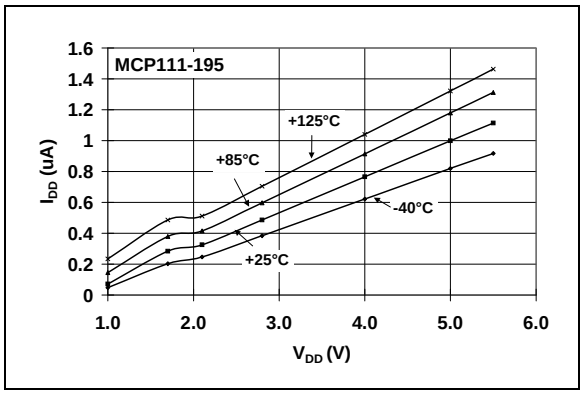



***FIGURE 2-4:*** *$I_{DD}$ vs. $V_{DD}$ (**MCP111-195**).*

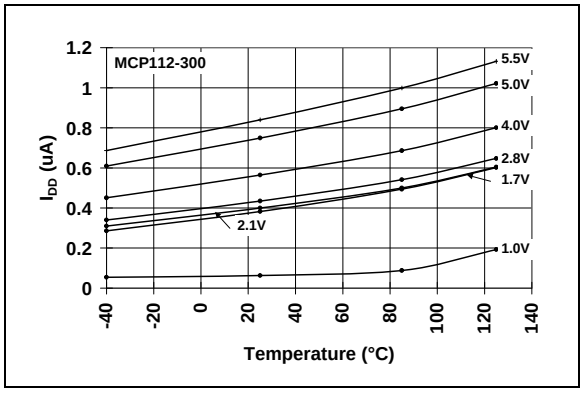



***FIGURE 2-2:*** *$I_{DD}$ vs. Temperature (**MCP112-300**).*

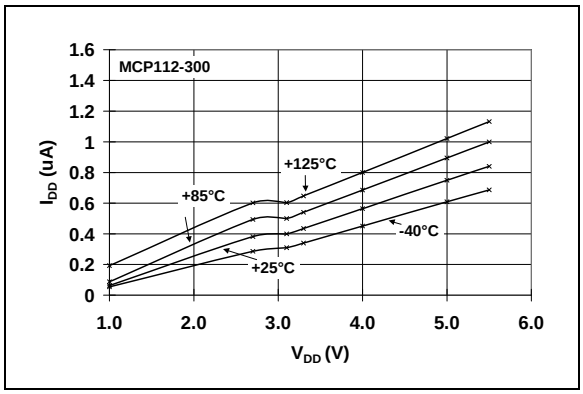



***FIGURE 2-5:*** *$I_{DD}$ vs. $V_{DD}$ (**MCP112-300**).*

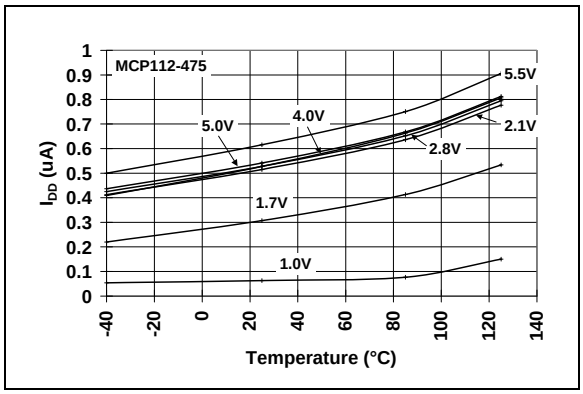



***FIGURE 2-3:*** *$I_{DD}$ vs. Temperature (**MCP112-475**).*

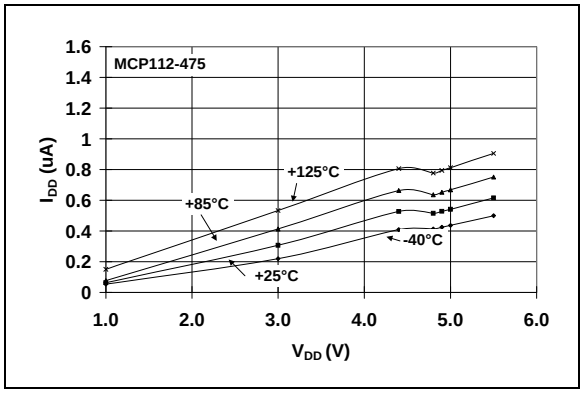



***FIGURE 2-6:*** *$I_{DD}$ vs. $V_{DD}$ (**MCP112-475**).*

**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.

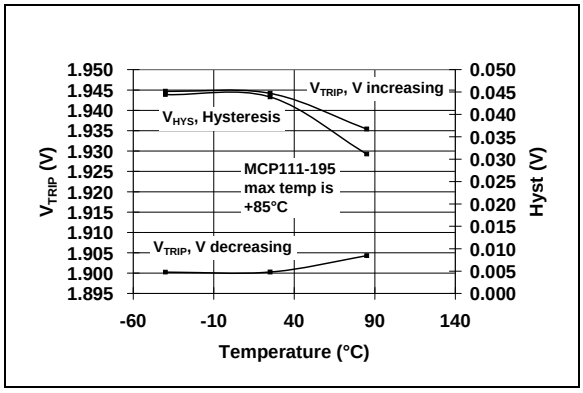



***FIGURE 2-7:*** *$V_{TRIP}$ and $V_{HYST}$ vs. Temperature (**MCP111-195**).*

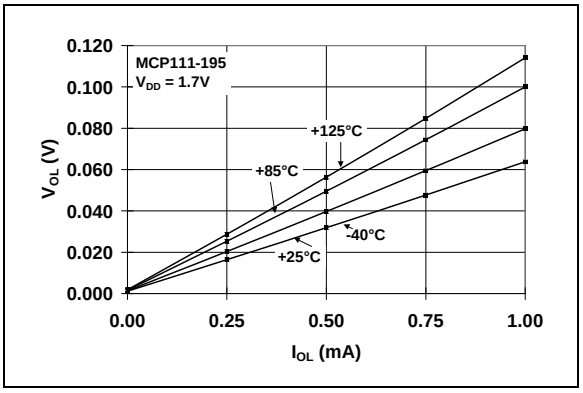



***FIGURE 2-10:*** *$V_{OL}$ vs. $I_{OL}$ (**MCP111-195** @ $V_{DD}$ = 1.7V).*

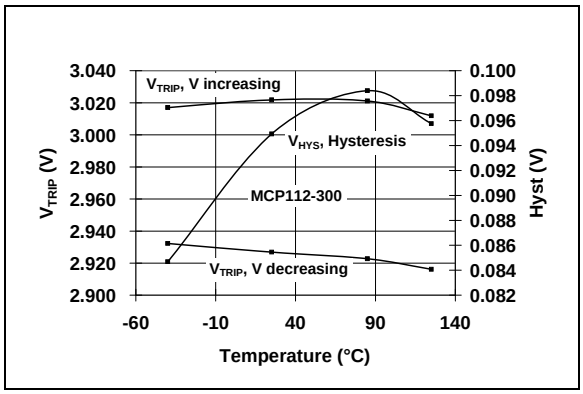



***FIGURE 2-8:*** *$V_{TRIP}$ and $V_{HYST}$ vs. Temperature (**MCP112-300**).*

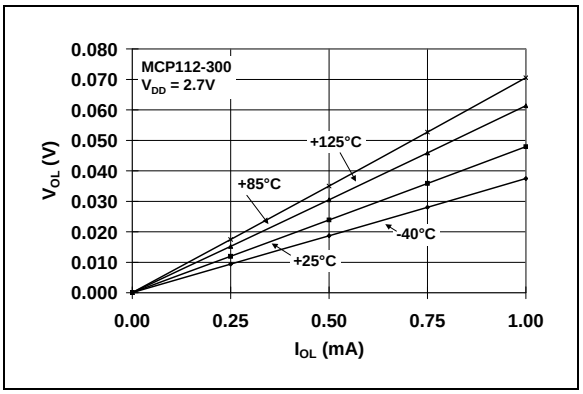



***FIGURE 2-11:*** *$V_{OL}$ vs. $I_{OL}$ (**MCP112-300** @ $V_{DD}$ = 2.7V).*

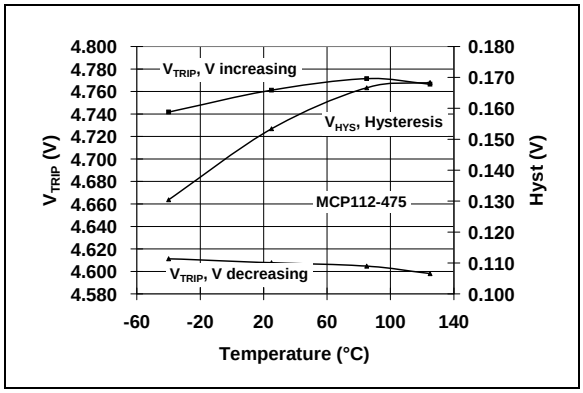



***FIGURE 2-9:*** *$V_{TRIP}$ and $V_{HYST}$ vs. Temperature (**MCP112-475**).*

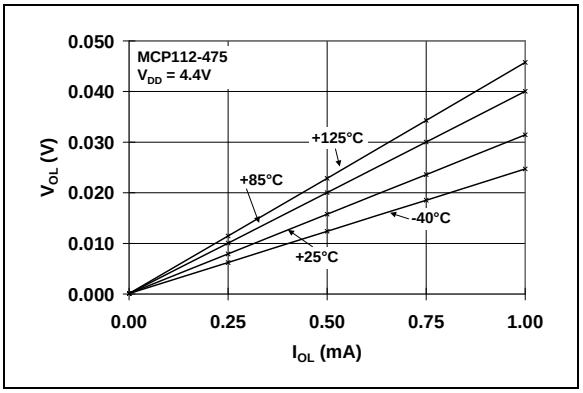



***FIGURE 2-12:*** *$V_{OL}$ vs. $I_{OL}$ (**MCP112-475** @ $V_{DD}$ = 4.4V).*

**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.

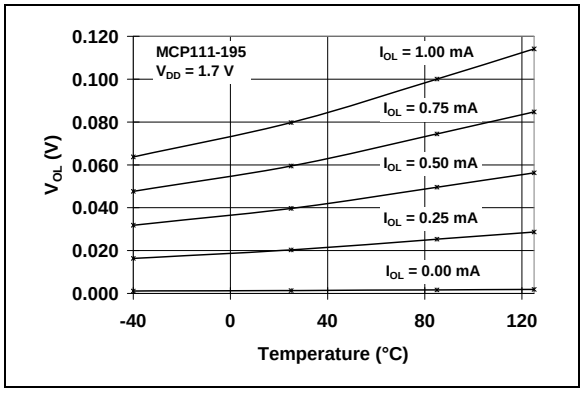



***FIGURE 2-13:*** *$V_{OL}$ vs. Temperature (**MCP111-195** @ $V_{DD}$ = 1.7V).*

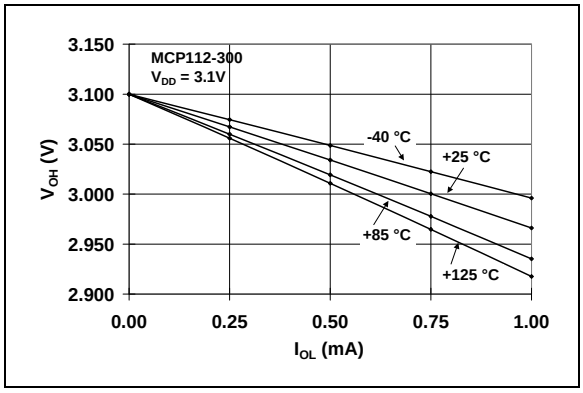



***FIGURE 2-16:*** *$V_{OH}$ vs. $I_{OH}$ (**MCP112-300** @ $V_{DD}$ = 3.1V).*

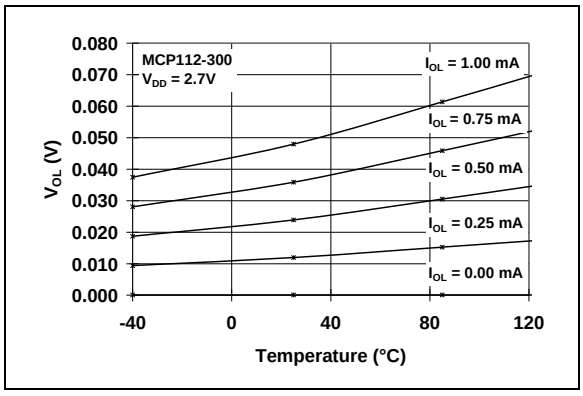



***FIGURE 2-14:*** *$V_{OL}$ vs. Temperature (**MCP112-300** @ $V_{DD}$ = 2.7V).*

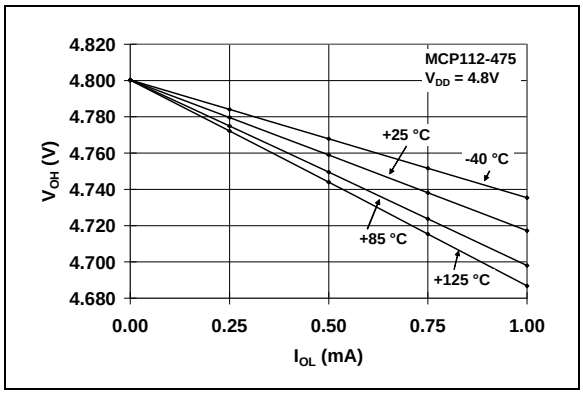



***FIGURE 2-17:*** *$V_{OH}$ vs. $I_{OH}$ (**MCP112-475** @ $V_{DD}$ = 4.8V).*

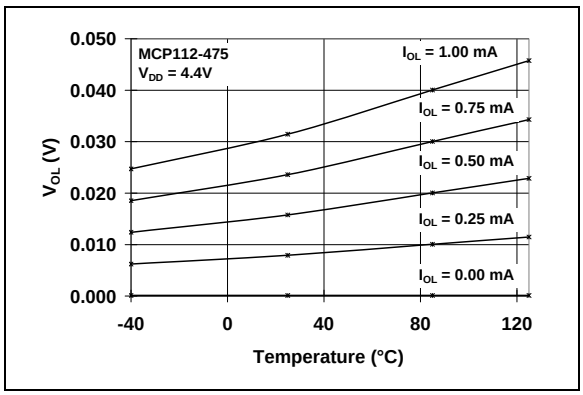



***FIGURE 2-15:*** *$V_{OL}$ vs. Temperature (**MCP112-475** @ $V_{DD}$ = 4.4V).*

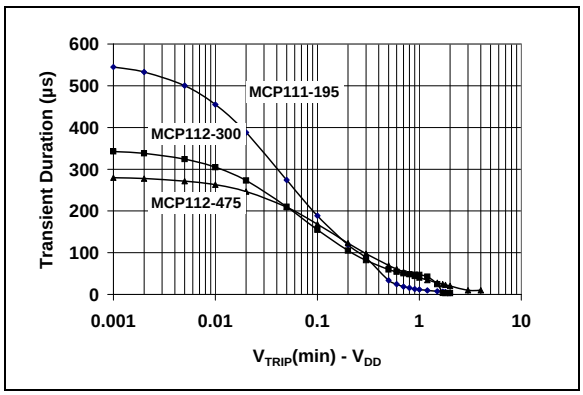



***FIGURE 2-18:*** *Typical Transient Response (25 °C).*

**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.

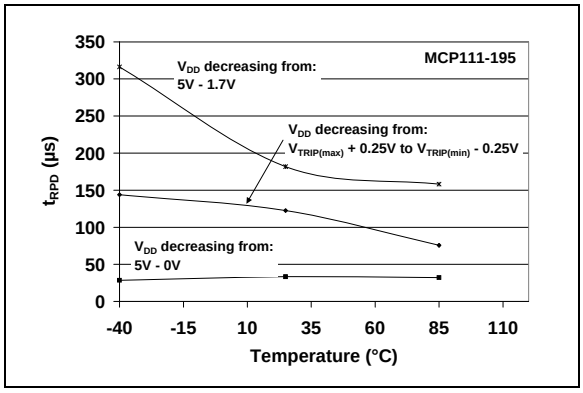



***FIGURE 2-19:*** *$t_{RPD}$ vs. Temperature (**MCP111-195**).*

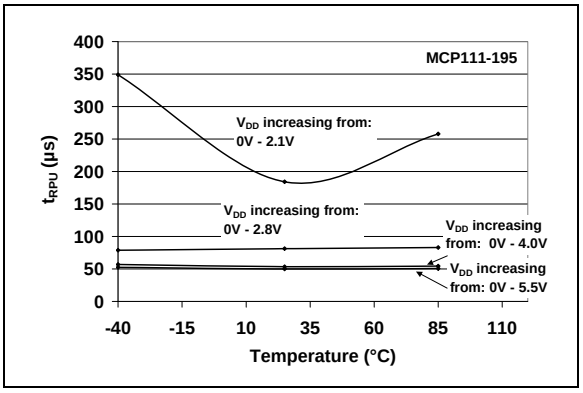



***FIGURE 2-22:*** *$t_{RPU}$ vs. Temperature (**MCP111-195**).*

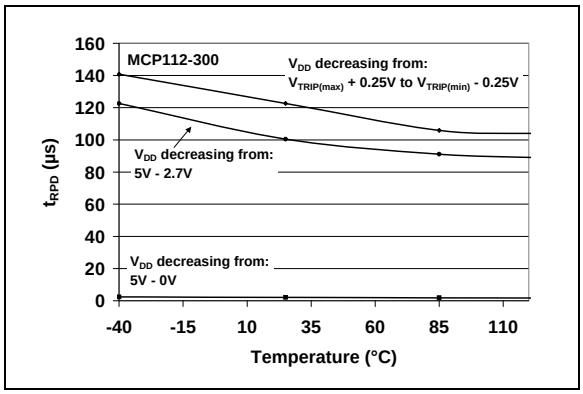



***FIGURE 2-20:*** *$t_{RPD}$ vs. Temperature (**MCP112-300**).*

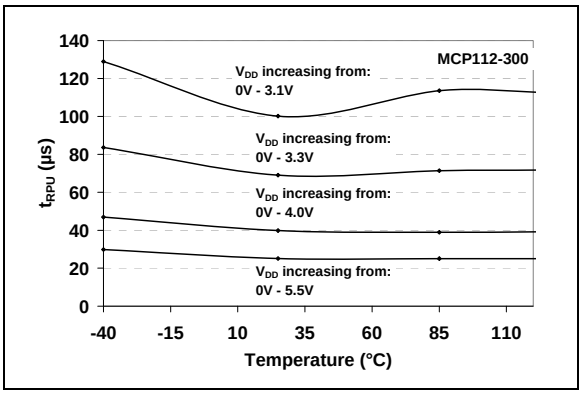



***FIGURE 2-23:*** *$t_{RPU}$ vs. Temperature (**MCP112-300**).*

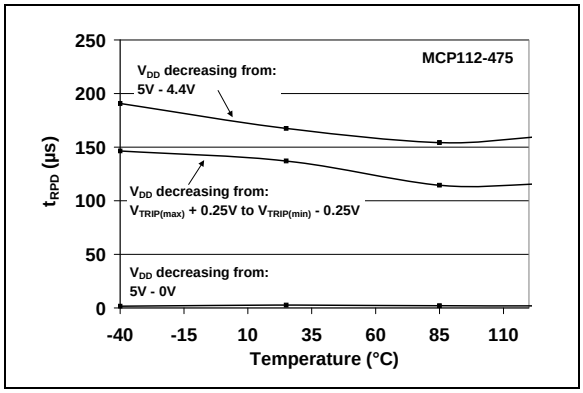



***FIGURE 2-21:*** *$t_{RPD}$ vs. Temperature (**MCP112-475**).*

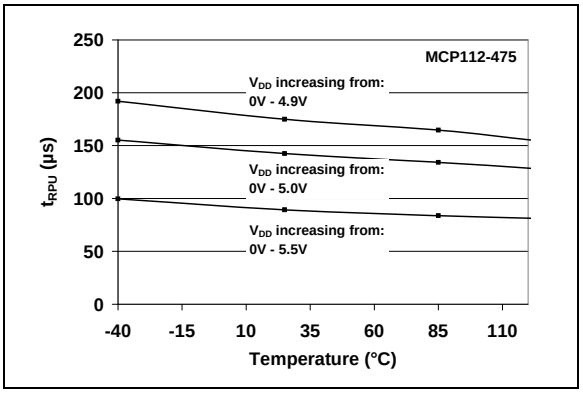



***FIGURE 2-24:*** *$t_{RPU}$ vs. Temperature (**MCP112-475**).*

**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.

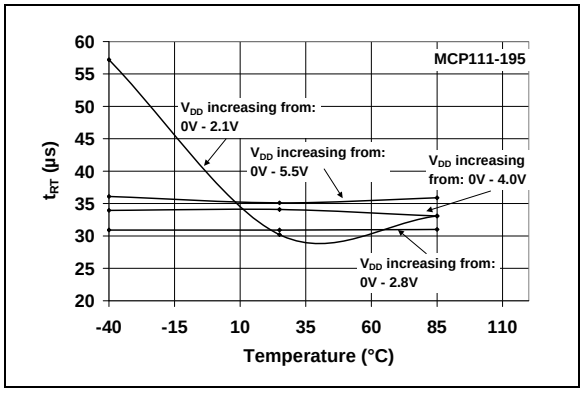



***FIGURE 2-25:*** *$t_{RT}$ vs. Temperature (**MCP111-195**).*

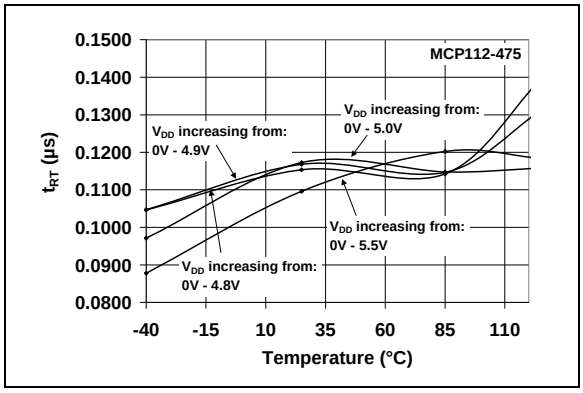



***FIGURE 2-27:*** *$t_{RT}$ vs. Temperature (**MCP112-475**).*

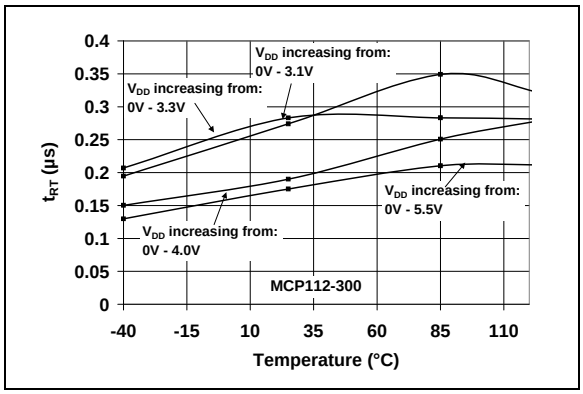



***FIGURE 2-26:*** *$t_{RT}$ vs. Temperature (**MCP112-300**).*

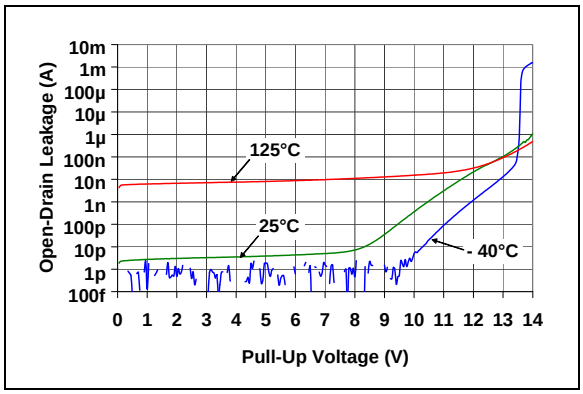



***FIGURE 2-28:*** *Open-Drain Leakage Current vs. Voltage Applied to $V_{OUT}$ Pin (**MCP111-195**).*

## 3.0 PIN DESCRIPTION

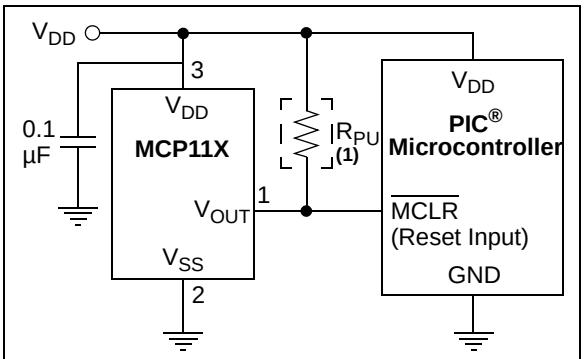
The descriptions of the pins are listed in Table 3-1.

**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**<br>**$V_{DD}$ Falling:**<br>H = $V_{DD} > V_{TRIP}$<br>L = $V_{DD} < V_{TRIP}$<br><br>**$V_{DD}$ Rising:**<br>H = $V_{DD} > V_{TRIP} + V_{HYS}$<br>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 $V_{TRIP} + V_{HYS}$.

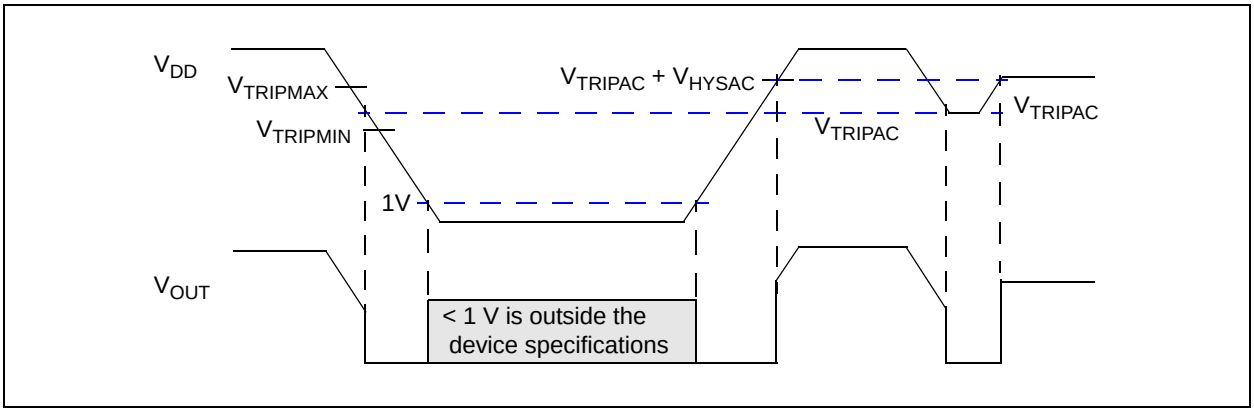



***FIGURE 4-2:*** *$V_{OUT}$ Operation as Determined by the $V_{TRIP}$ and $V_{HYS}$.*

### 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).

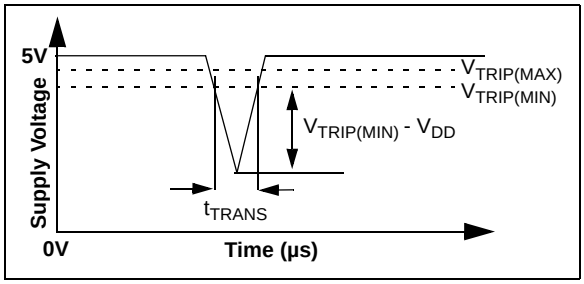



***FIGURE 4-3:*** *Example of Typical Transient Duration Waveform.*

## 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. |
|---|---|

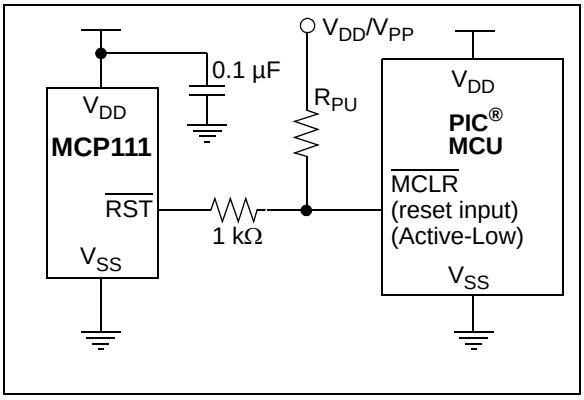
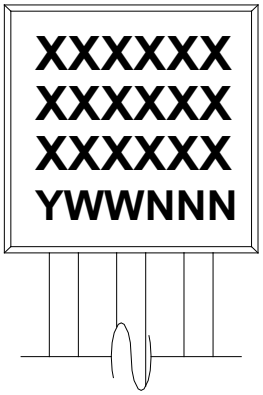



***FIGURE 4-4:*** *Typical Application Circuit for PIC® Microcontroller with the ICSP™ feature.*

## 5.0 PACKAGING INFORMATION

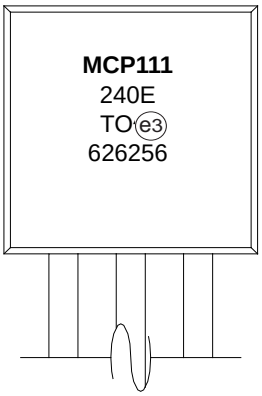
### 5.1 Package Marking Information

3-Lead TO-92

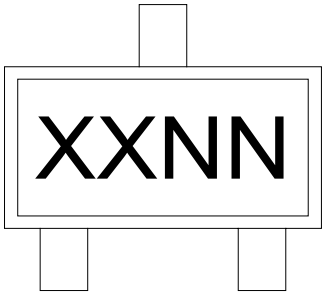



| Device | Code |
|---|---|
| MCP111-240E/TO | 240E |
| MCP111-270E/TO | 270E |
| MCP111-290E/TO | 290E |
| MCP111-300E/TO | 300E |
| MCP111-315E/TO | 315E |
| MCP111-450E/TO | 450E |
| MCP111-475E/TO | 475E |
| MCP111-195I/TO | 195I |

Example:

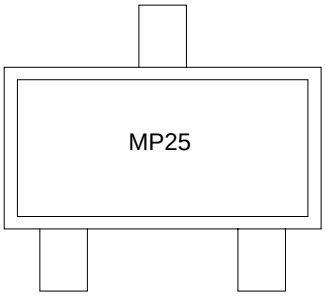



3-Lead SOT-23




| 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:

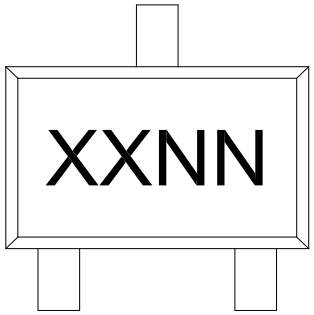



| | | |
|---|---|---|
| **Legend:** | XX...X | Customer-specific information |
| | Y | Year code (last digit of calendar year) |
| | WW | Week code (week of January 1 is week ‘01’) |
| | NNN | Alphanumeric traceability code |
| | (e3) | Pb-free JEDEC designator for Matte Tin (Sn) |
| | * | This package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

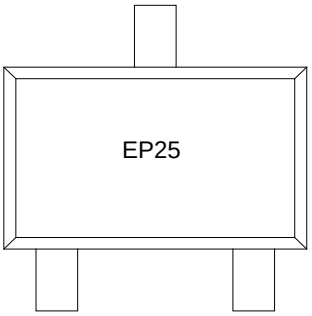
## Package Marking Information (Continued)

3-Lead SC-70

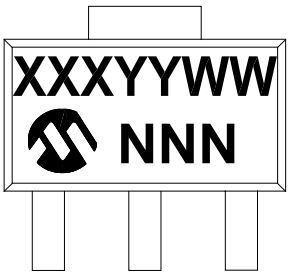



| Device | Code |
|---|---|
| MCP111T-195I/LB | EPNN |
| MCP111T-240E/LB | EQNN |
| MCP111T-270E/LB | EGNN |
| MCP111T-290E/LB | EHNN |
| MCP111T-300E/LB | EJNN |
| MCP111T-315E/LB | EKNN |
| MCP111T-450E/LB | ELNN |
| MCP111T-475E/LB | EMNN |
| MCP112T-195I/LB | ERNN |
| MCP112T-240E/LB | ESNN |
| MCP112T-270E/LB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

Example:

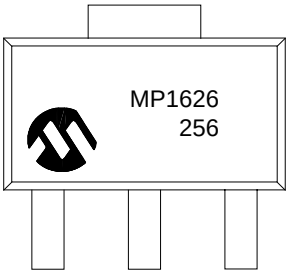



3-Lead SOT-89



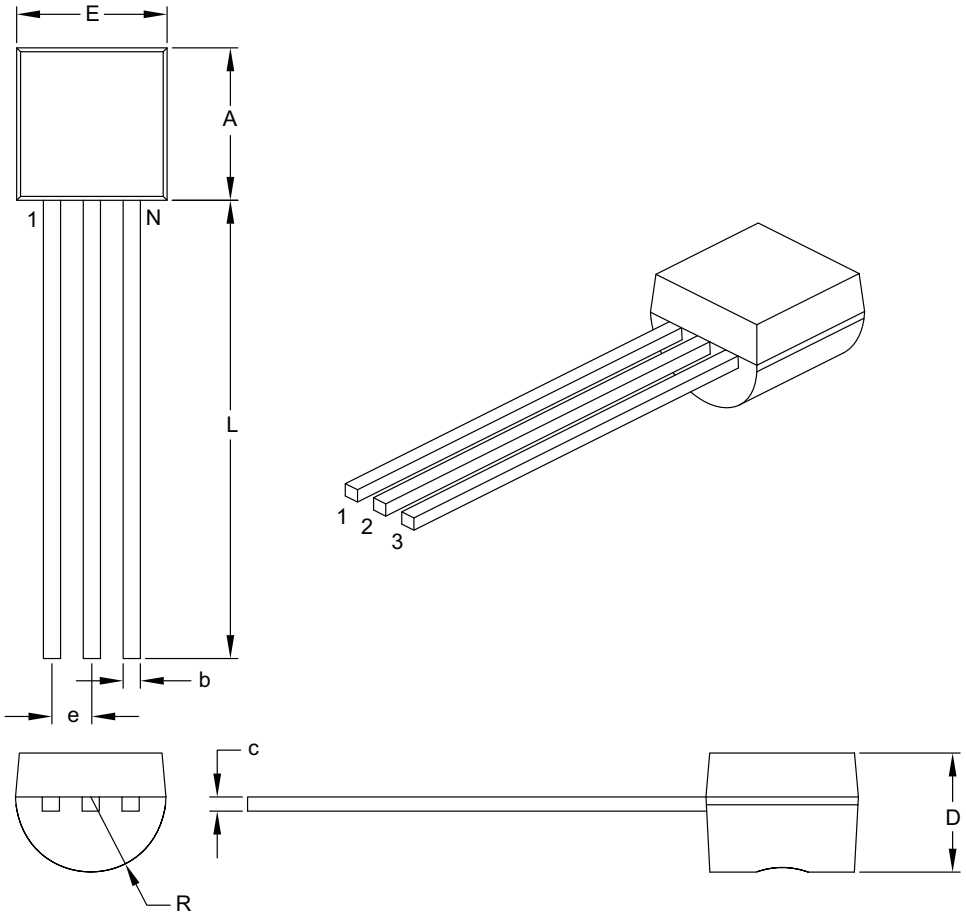

| Device | Code |
|---|---|
| MCP111T-195I/MB | MP |
| MCP111T-240EMB | MQ |
| MCP111T-270E/MB | MG |
| MCP111T-290E/MB | NH |
| MCP111T-300E/MB | MJ |
| MCP111T-315E/MB | MK |
| MCP111T-450E/MB | ML |
| MCP111T-475E/MB | MM |
| MCP112T-195I/MB | MR |
| MCP112T-240EMB | MS |
| MCP112T-270E/MB | MA |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

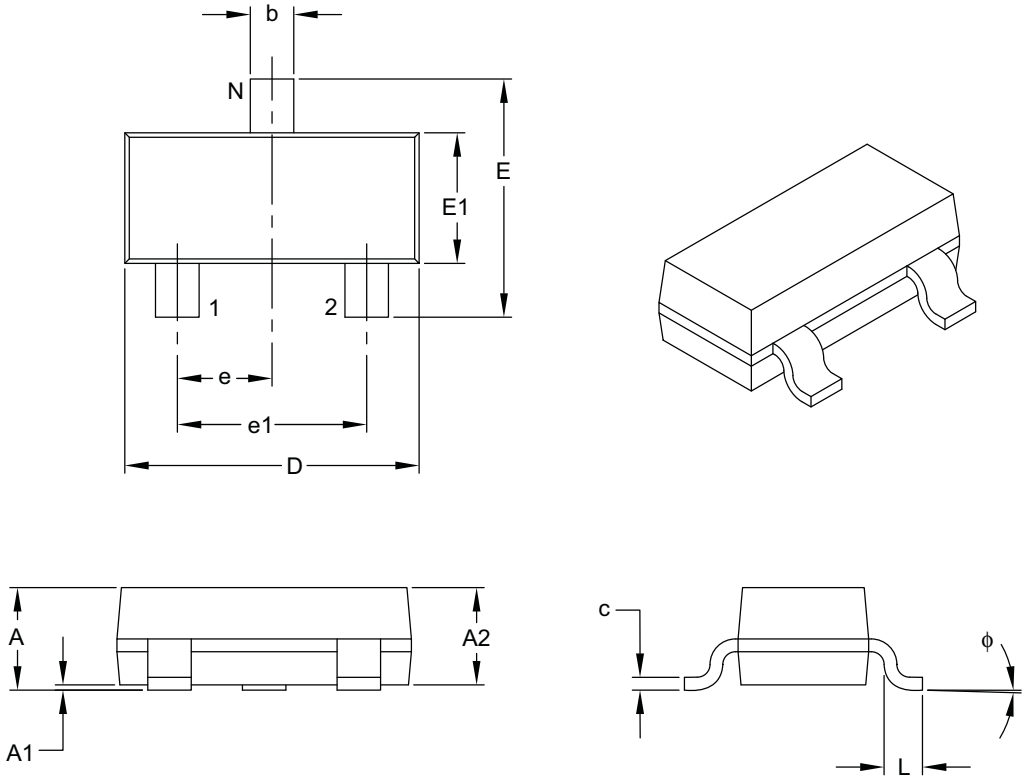
1. Dimensions A and E do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" per side.
2. Dimensioning and tolerancing per ASME Y14.5M.

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:**

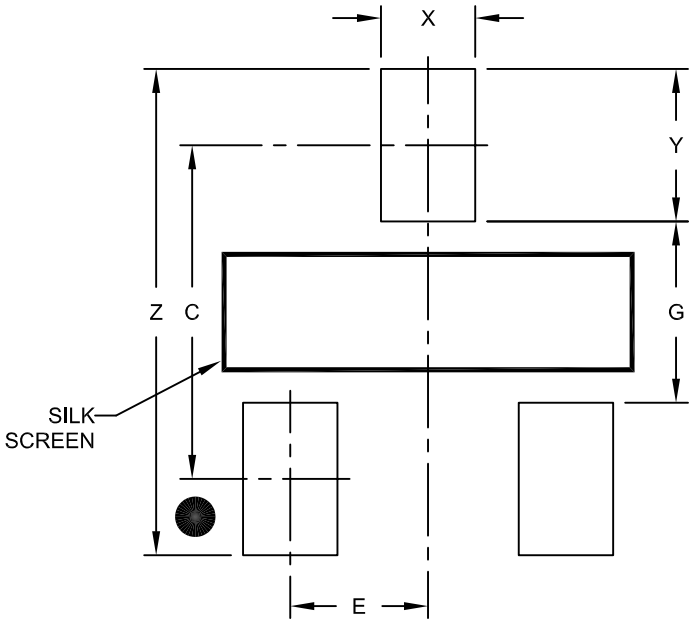
1. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25 mm per side.
2. Dimensioning and tolerancing per ASME Y14.5M.

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:

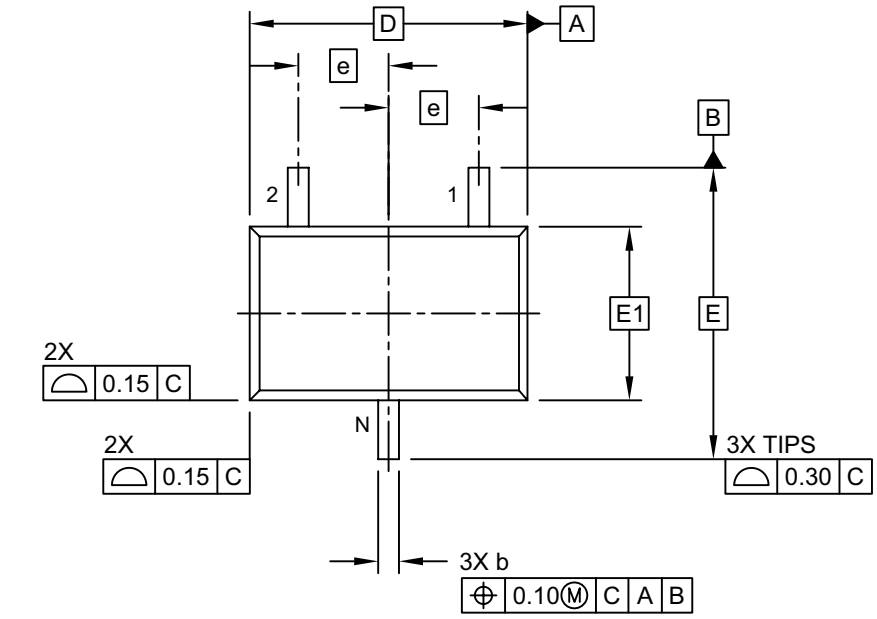
1. Dimensioning and tolerancing per ASME Y14.5M

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

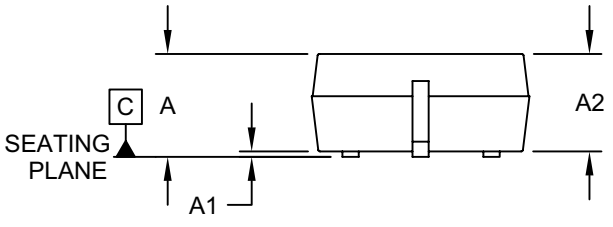
Microchip Technology Drawing No. C04-2104A

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

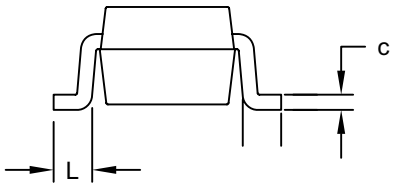
**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging




TOP VIEW




SIDE VIEW

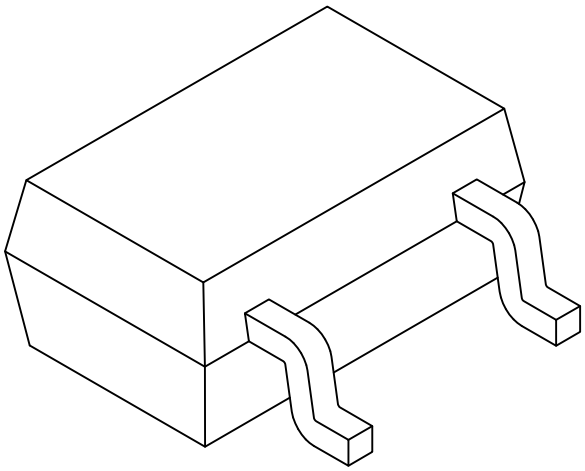



END VIEW

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 |

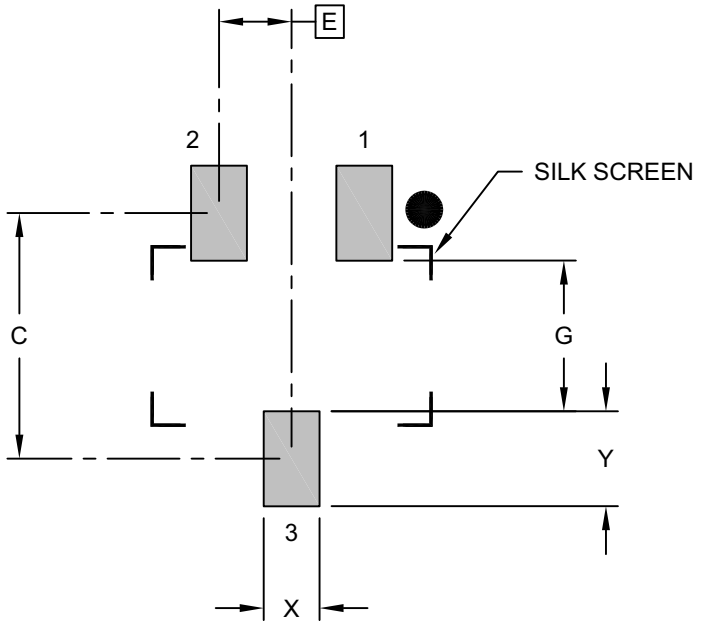
Notes:

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:

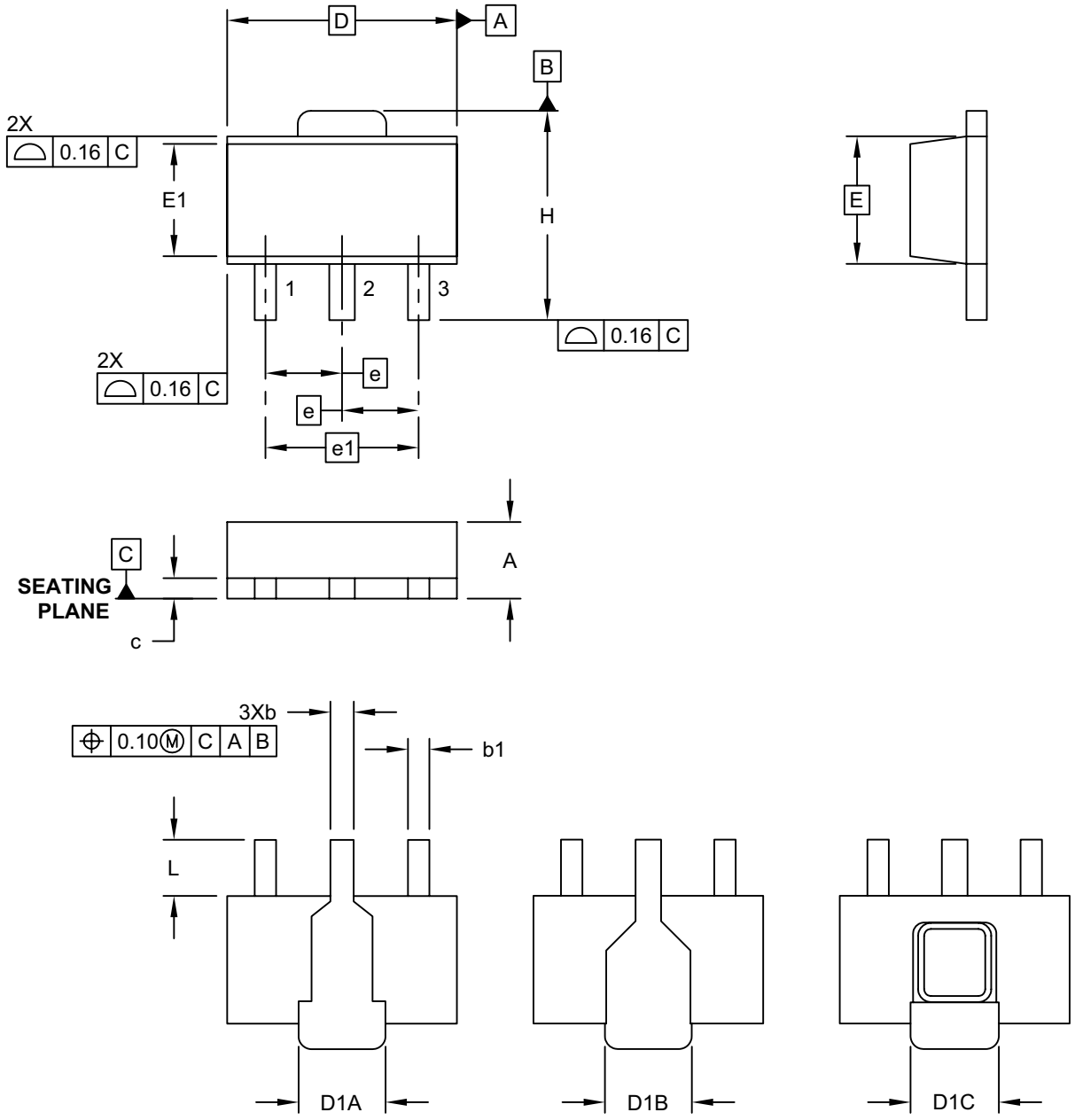
1. Dimensioning and tolerancing per ASME Y14.5M

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

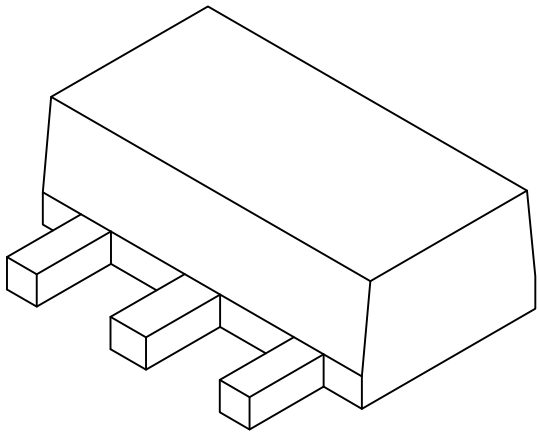



OPTIONAL BACKSIDE PATTERNS — PARTS MAY BE SUPPLIED WITH ANY PATTERN SHOWN

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:

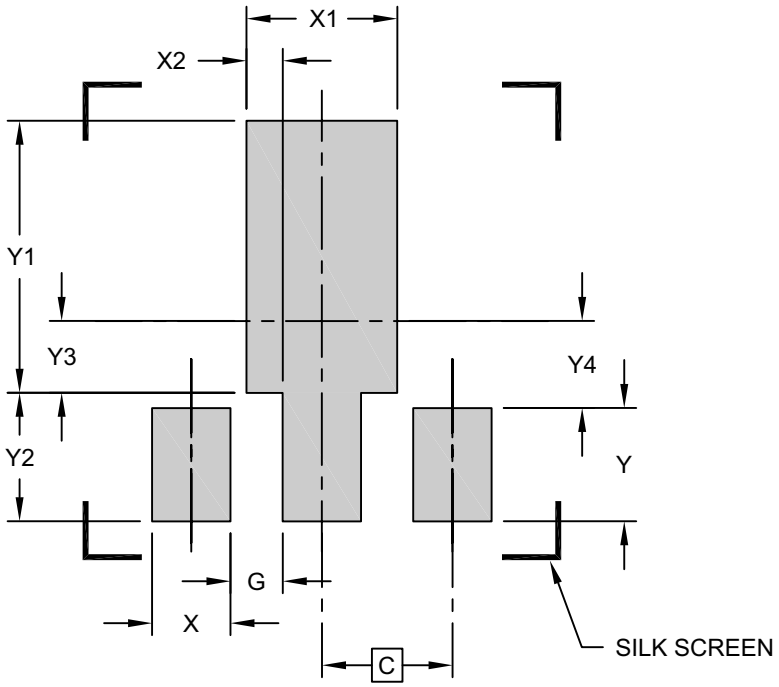
1. Dimensions D and E do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.127mm per side.
2. Dimensioning and tolerancing per ASME Y14.5M

   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

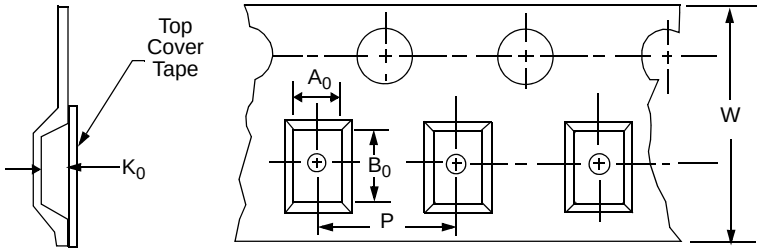



***FIGURE 5-1:*** *Embossed Carrier Dimensions (8, 12, 16 and 24 mm tape only).*

### 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 |

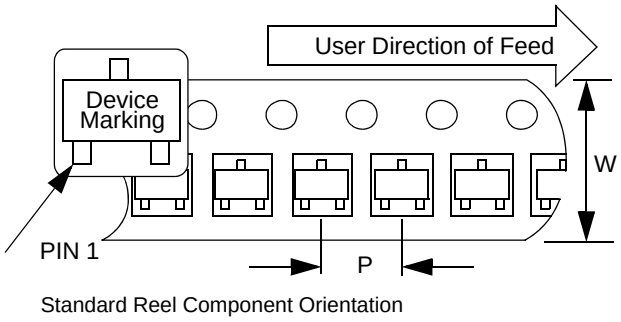
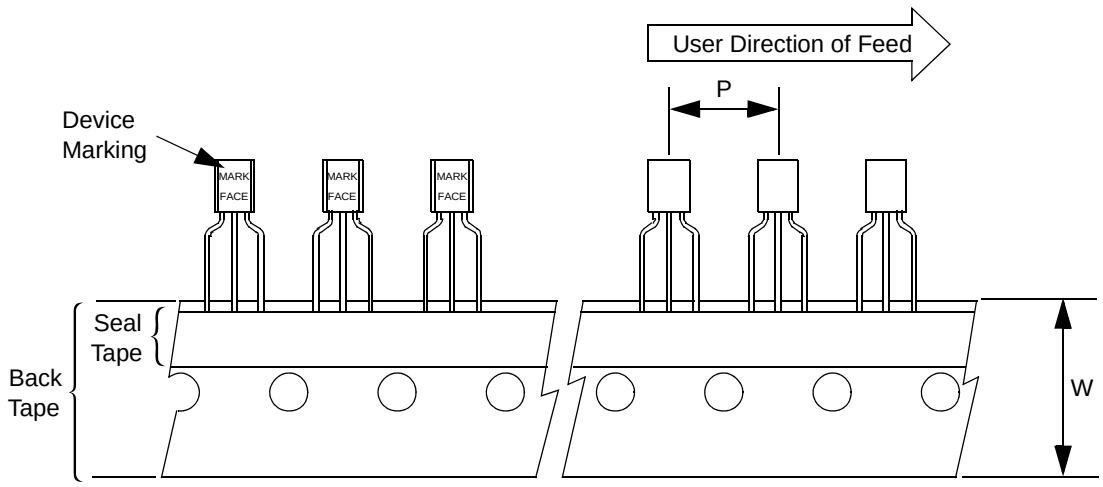



***FIGURE 5-2:*** *3-Lead SOT-23/SC70 Device Tape and Reel Specifications.*




**Note:** Bent leads are for Tape and Reel only.

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

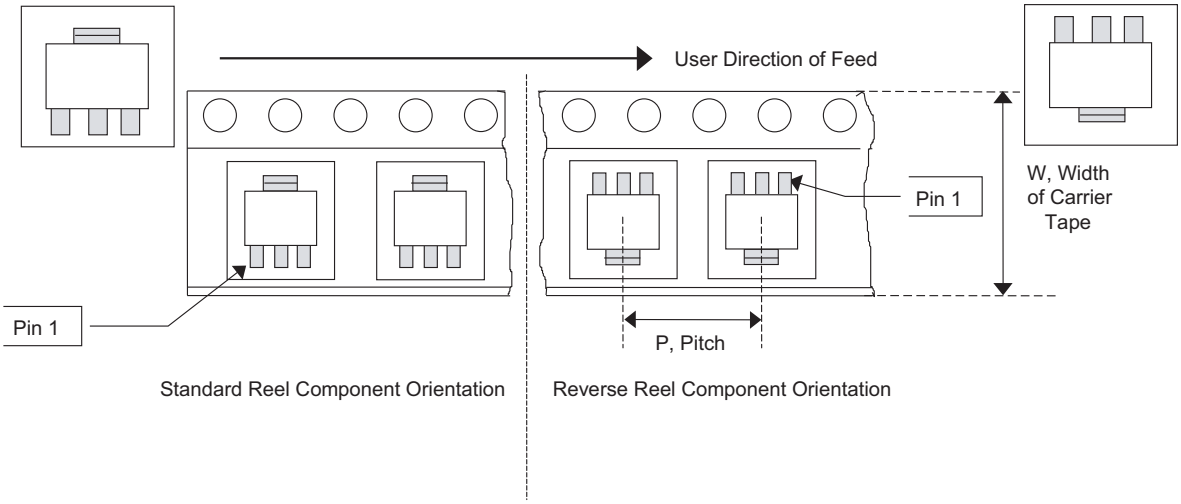



***FIGURE 5-4:*** *SOT-89 Devices.*

**NOTES:**

# APPENDIX A: REVISION HISTORY

## Revision F (July 2016)

The following is the list of modifications:

1. Updated Table 3-1.
2. Updated **Section 5.0 "Packaging information"**.
3. Minor typographical corrections.

## Revision E (January 2013)

- Added a note to each package outline drawing.

## Revision D (June 2005)

1. Added SOT-89-3 package information throughout.

## Revision C (March 2005)

The following is the list of modifications:

1. Added **Section 4.4 "Using in PIC® Microcontroller ICSP™ Applications (MCP111 only)"** on using the MCP111 in PIC microcontroller ICSP applications.
2. Added $V_{ODH}$ specifications in **Section 1.0 "Electrical Characteristics"** (for ICSP applications).
3. Added Figure 2-28.
4. Added devices features table to page 1.
5. Updated SC-70 package markings and added Pb-free marking information to **Section 5.0 "Packaging information"**.
6. Added **Appendix A: "Revision History"**.

## Revision B (August 2004)

1. Corrected package marking information in **Section 5.0 "Packaging information"**.

## Revision A (May 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: | MCP111: MicroPower Voltage Detector, open-drain<br>MCP111T: MicroPower Voltage Detector, open-drain (Tape and Reel)<br>MCP112: MicroPower Voltage Detector, push-pull<br>MCP112T: MicroPower Voltage Detector, push-pull (Tape and Reel) |
| Monitoring Options: | 195 = 1.90V<br>240 = 2.32V<br>270 = 2.63V<br>290 = 2.90V<br>300 = 2.93V<br>315 = 3.08V<br>450 = 4.38V<br>475 = 4.63V |
| Temperature Range: | I = -40°C to +85°C (MCP11X-195 only)<br>E = -40°C to +125°C (Except MCP11X-195 only) |
| Package: | LB = SC-70, 3-lead<br>MB = SOT-89, 3-lead<br>TO = TO-92, 3-lead<br>TT = SOT-23B, 3-lead |

**Examples:**

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.

**NOTES:**

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